

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

Features

- Electrical features
 - $V_{CES} = 4500\text{ V}$
 - $I_{C\text{nom}} = 1800\text{ A} / I_{CRM} = 3600\text{ A}$
 - High DC stability
 - High dynamic robustness
 - High short-circuit capability
 - Low V_{CESat}
 - Trench IGBT 4
 - V_{CESat} with positive temperature coefficient
- Mechanical features
 - Package with CTI > 600
 - Standard housing
 - ALSiC base plate for increased thermal cycling capability
 - IHM B housing
 - Isolated base plate



Potential applications

- Wind turbines
- High power converters
- Medium voltage converters
- Motor drives
- UPS systems

Product validation

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

Description

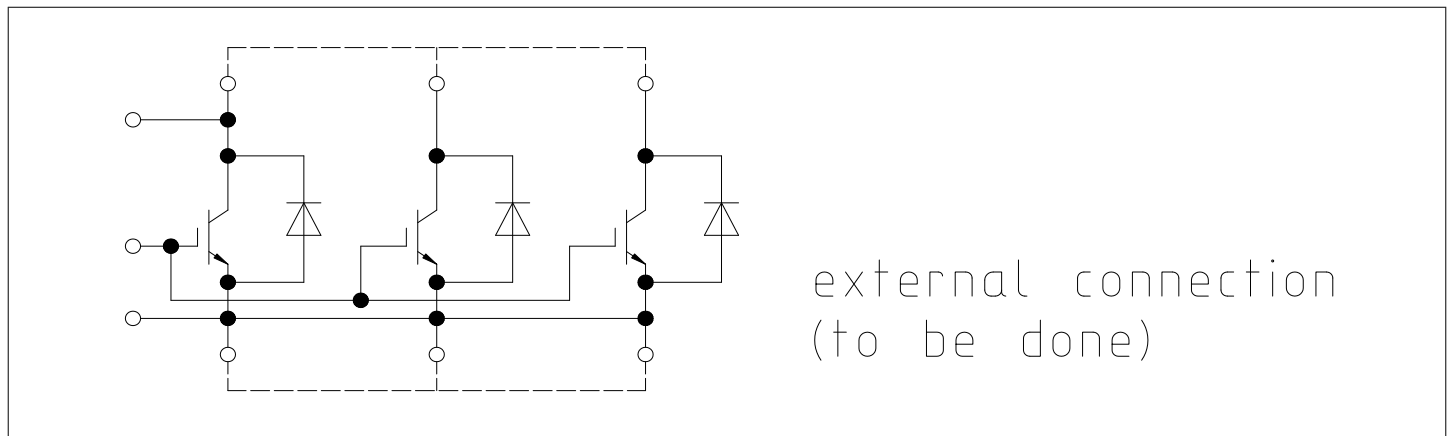


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1 Package

Table 1 Insulation coordination

Parameter	Symbol	Note or test condition	Values	Unit
Isolation test voltage	V_{ISOL}	RMS, $f = 50$ Hz, $t = 1$ min	6.0	kV
Partial discharge extinction voltage	V_{isol}	RMS, $f = 50$ Hz, $Q_{PD} \leq 10$ pC	3.5	kV
DC stability	$V_{CE(D)}$	$T_{vj} = 25^\circ\text{C}$, 100 Fit	2900	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	$R_{AA'+CC'}$	$T_C = 25^\circ\text{C}$, per switch		0.08		m Ω	
Module lead resistance, terminals - chip	$R_{CC'+EE'}$	$T_C = 25^\circ\text{C}$, per switch		0.095		m Ω	
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			1200		g	

2 IGBT, Inverter

Table 3 Maximum rated values

Parameter	Symbol	Note or test condition	Values	Unit	
Collector-emitter voltage	V_{CES}		$T_{vj} = -40^\circ\text{C}$	4500	V
			$T_{vj} = 150^\circ\text{C}$	4500	
Continuous DC collector current	I_{CDC}	$T_{vj\ max} = 150^\circ\text{C}$	$T_C = 100^\circ\text{C}$	1800	A
Repetitive peak collector current	I_{CRM}	$t_p = 1$ ms		3600	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	$V_{CE\ sat}$	$I_C = 1800\ A, V_{GE} = 15\ V$	$T_{vj} = 25\ ^\circ C$		2.35	2.80	V
			$T_{vj} = 125\ ^\circ C$		2.85	3.40	
			$T_{vj} = 150\ ^\circ C$		2.95	3.50	
Gate threshold voltage	V_{GEth}	$I_C = 149\ mA, V_{CE} = V_{GE}, T_{vj} = 25\ ^\circ C$	5.5	6	6.5	V	
Gate charge	Q_G	$V_{GE} = \pm 15\ V, V_{CE} = 2800\ V$		47		μC	
Internal gate resistor	R_{Gint}	$T_{vj} = 25\ ^\circ C$		0.29		Ω	
Input capacitance	C_{ies}	$f = 100\ kHz, T_{vj} = 25\ ^\circ C, V_{CE} = 25\ V, V_{GE} = 0\ V$		297		nF	
Reverse transfer capacitance	C_{res}	$f = 100\ kHz, T_{vj} = 25\ ^\circ C, V_{CE} = 25\ V, V_{GE} = 0\ V$		5.4		nF	
Collector-emitter cut-off current	I_{CES}	$V_{CE} = 4500\ V, V_{GE} = 0\ V$	$T_{vj} = 25\ ^\circ C$			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}	$I_C = 1800\ A, V_{CE} = 2800\ V, V_{GE} = \pm 15\ V, R_{Gon} = 0.75\ \Omega$	$T_{vj} = 25\ ^\circ C$	0.260			μs
			$T_{vj} = 125\ ^\circ C$	0.290			
			$T_{vj} = 150\ ^\circ C$	0.310			
Rise time (inductive load)	t_r	$I_C = 1800\ A, V_{CE} = 2800\ V, V_{GE} = \pm 15\ V, R_{Gon} = 0.75\ \Omega$	$T_{vj} = 25\ ^\circ C$	0.210			μs
			$T_{vj} = 125\ ^\circ C$	0.230			
			$T_{vj} = 150\ ^\circ C$	0.230			
Turn-off delay time (inductive load)	t_{doff}	$I_C = 1800\ A, V_{CE} = 2800\ V, V_{GE} = \pm 15\ V, R_{Goff} = 4.7\ \Omega$	$T_{vj} = 25\ ^\circ C$	6.930			μs
			$T_{vj} = 125\ ^\circ C$	7.320			
			$T_{vj} = 150\ ^\circ C$	7.410			
Fall time (inductive load)	t_f	$I_C = 1800\ A, V_{CE} = 2800\ V, V_{GE} = \pm 15\ V, R_{Goff} = 4.7\ \Omega$	$T_{vj} = 25\ ^\circ C$	1.130			μs
			$T_{vj} = 125\ ^\circ C$	2.630			
			$T_{vj} = 150\ ^\circ C$	2.850			
Turn-on energy loss per pulse	E_{on}	$I_C = 1800\ A, V_{CE} = 2800\ V, L_\sigma = 110\ nH, V_{GE} = \pm 15\ V, R_{Gon} = 0.75\ \Omega, di/dt = 6500\ A/\mu s (T_{vj} = 150\ ^\circ C)$	$T_{vj} = 25\ ^\circ C$	5800			mJ
			$T_{vj} = 125\ ^\circ C$	8100			
			$T_{vj} = 150\ ^\circ C$	9100			
Turn-off energy loss per pulse	E_{off}	$I_C = 1800\ A, V_{CE} = 2800\ V, L_\sigma = 110\ nH, V_{GE} = \pm 15\ V, R_{Goff} = 4.7\ \Omega, dv/dt = 1250\ V/\mu s (T_{vj} = 150\ ^\circ C)$	$T_{vj} = 25\ ^\circ C$	7050			mJ
			$T_{vj} = 125\ ^\circ C$	9000			
			$T_{vj} = 150\ ^\circ C$	9700			
SC data	I_{SC}	$V_{GE} = 15\ V, V_{CC} = 3000\ V, V_{CEmax} = V_{CES} - L_{sCE} * di/dt$	$t_p \leq 10\ \mu s, T_{vj} = 150\ ^\circ C$	8100			A
Thermal resistance, junction to case	R_{thJC}	per IGBT				7.20	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, $\lambda_{grease} = 1 \text{ W/(m}^2\text{K)}$		3.60		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}		$T_{vj} = -40 \text{ }^\circ\text{C}$	4500	V
			$T_{vj} = 150 \text{ }^\circ\text{C}$	4500	
Continuous DC forward current	I_F		1800	A	
Repetitive peak forward current	I_{FRM}	$t_p = 1 \text{ ms}$	3600	A	
I^2t - value	I^2t	$t_p = 10 \text{ ms}, V_R = 0 \text{ V}$	$T_{vj} = 125 \text{ }^\circ\text{C}$	850	kA ² s
			$T_{vj} = 150 \text{ }^\circ\text{C}$	930	
Maximum power dissipation	P_{RQM}	$T_{vj} = 150 \text{ }^\circ\text{C}$	4000	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	$I_F = 1800 \text{ A}, V_{GE} = 0 \text{ V}$	$T_{vj} = 25 \text{ }^\circ\text{C}$		2.60	3.05	V
			$T_{vj} = 125 \text{ }^\circ\text{C}$		2.50	2.95	
			$T_{vj} = 150 \text{ }^\circ\text{C}$		2.45	2.90	
Peak reverse recovery current	I_{RM}	$V_R = 2800 \text{ V}, I_F = 1800 \text{ A}, V_{GE} = -15 \text{ V}, -di_F/dt = 6500 \text{ A}/\mu\text{s} (T_{vj} = 150 \text{ }^\circ\text{C})$	$T_{vj} = 25 \text{ }^\circ\text{C}$		2360		A
			$T_{vj} = 125 \text{ }^\circ\text{C}$		2600		
			$T_{vj} = 150 \text{ }^\circ\text{C}$		2630		
Recovered charge	Q_r	$V_R = 2800 \text{ V}, I_F = 1800 \text{ A}, V_{GE} = -15 \text{ V}, -di_F/dt = 6500 \text{ A}/\mu\text{s} (T_{vj} = 150 \text{ }^\circ\text{C})$	$T_{vj} = 25 \text{ }^\circ\text{C}$		1560		μC
			$T_{vj} = 125 \text{ }^\circ\text{C}$		3060		
			$T_{vj} = 150 \text{ }^\circ\text{C}$		3560		
Reverse recovery energy	E_{rec}	$V_R = 2800 \text{ V}, I_F = 1800 \text{ A}, V_{GE} = -15 \text{ V}, -di_F/dt = 6500 \text{ A}/\mu\text{s} (T_{vj} = 150 \text{ }^\circ\text{C})$	$T_{vj} = 25 \text{ }^\circ\text{C}$		2340		mJ
			$T_{vj} = 125 \text{ }^\circ\text{C}$		5200		
			$T_{vj} = 150 \text{ }^\circ\text{C}$		6100		

Table 6 Characteristic values (continued)

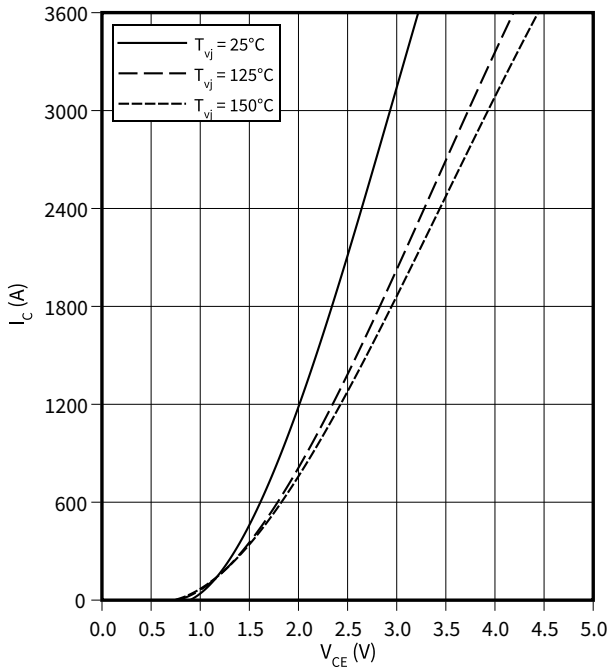
Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Thermal resistance, junction to case	R_{thJC}	per diode			12.7	K/kW
Thermal resistance, case to heatsink	R_{thCH}	per diode, $\lambda_{grease} = 1 \text{ W/(m}^2\text{K)}$		5.30		K/kW
Temperature under switching conditions	$T_{vj\ op}$		-40		150	°C

4 Characteristics diagrams

output characteristic (typical), IGBT, Inverter

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

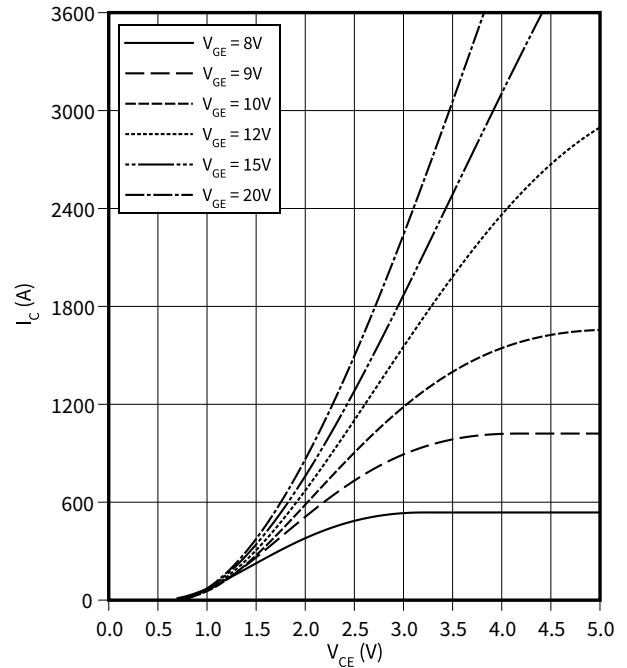
$$V_{GE} = 15 \text{ V}$$



output characteristic (typical), IGBT, Inverter

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

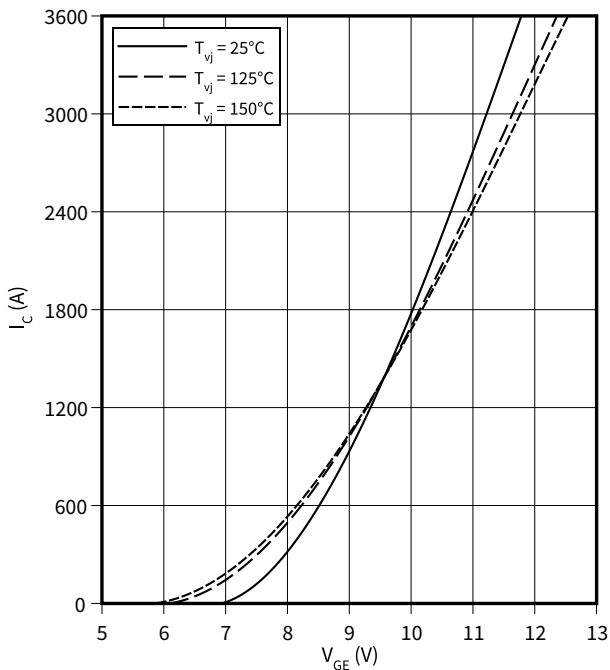
$$T_{vj} = 150 \text{ °C}$$



transfer characteristic (typical), IGBT, Inverter

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

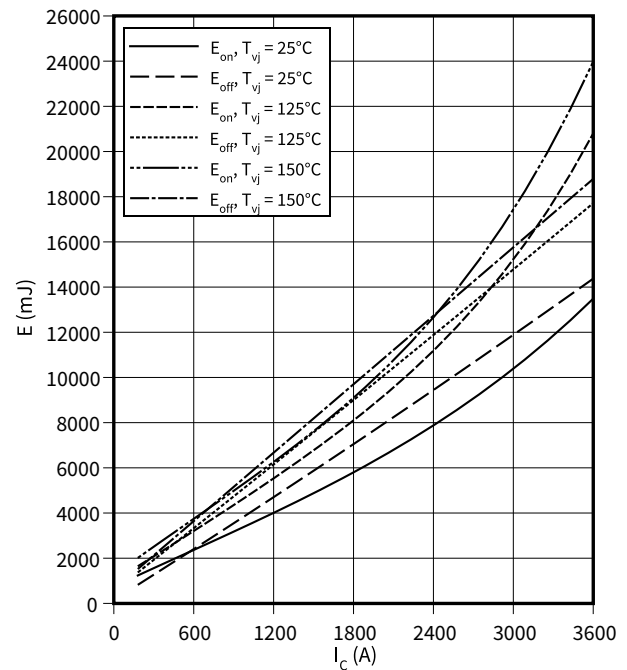
$$V_{CE} = 20 \text{ V}$$



switching losses (typical), IGBT, Inverter

$$E = f(I_C)$$

$$R_{Goff} = 4.7 \text{ } \Omega, R_{Gon} = 0.75 \text{ } \Omega, V_{GE} = \pm 15 \text{ V}, V_{CE} = 2800 \text{ V}$$

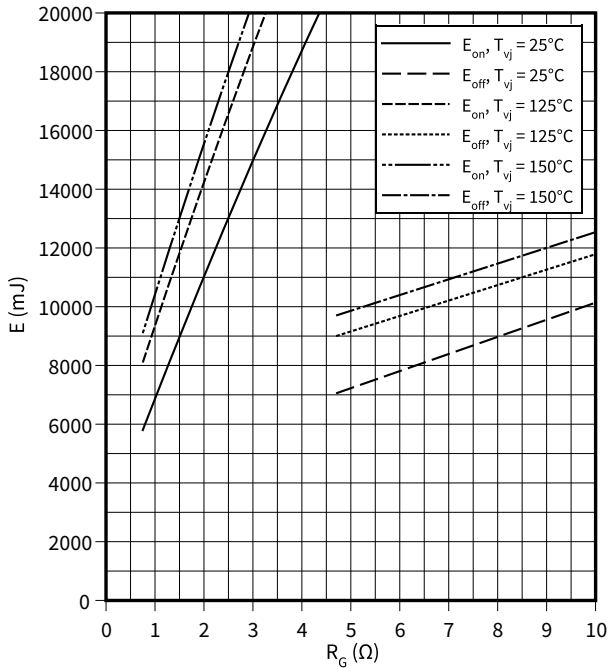


4 Characteristics diagrams

switching losses (typical), IGBT, Inverter

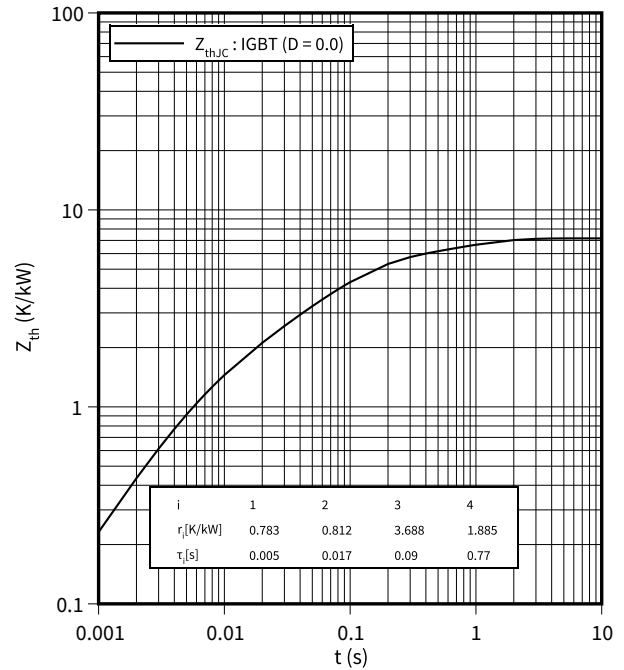
$E = f(R_G)$

$V_{GE} = \pm 15 \text{ V}$, $I_C = 1800 \text{ A}$, $V_{CE} = 2800 \text{ V}$



transient thermal impedance, IGBT, Inverter

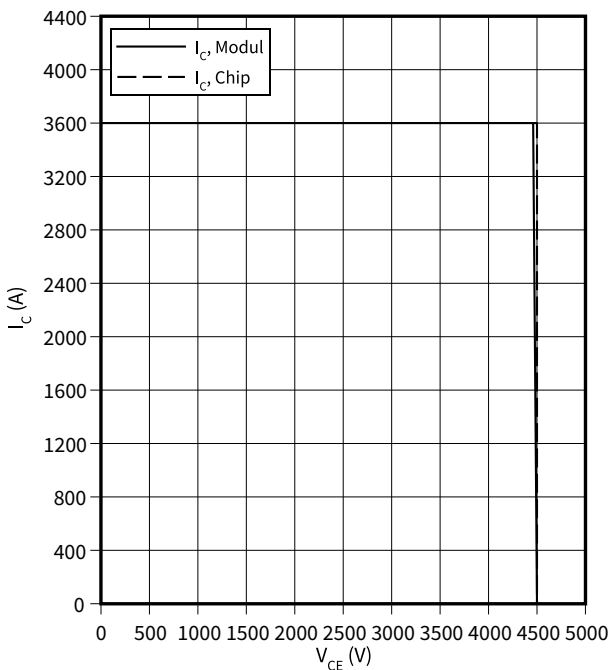
$Z_{th} = f(t)$



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

$I_C = f(V_{CE})$

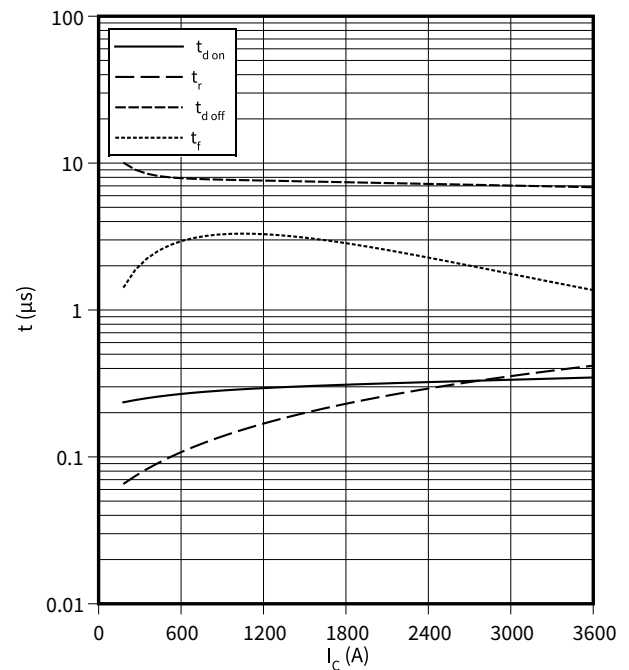
$R_{Goff} = 4.7 \Omega$, $V_{GE} = \pm 15 \text{ V}$, $V_{CC} \leq 3000 \text{ V}$, $T_{vj} = 150 \text{ }^\circ\text{C}$



Switching times (typical), IGBT, Inverter

$t = f(I_C)$

$V_{CE} = 2800 \text{ V}$, $T_{vj} = 150 \text{ }^\circ\text{C}$, $R_{Goff} = 4.7 \Omega$, $R_{Gon} = 0.75 \Omega$, $V_{GE} = \pm 15 \text{ V}$

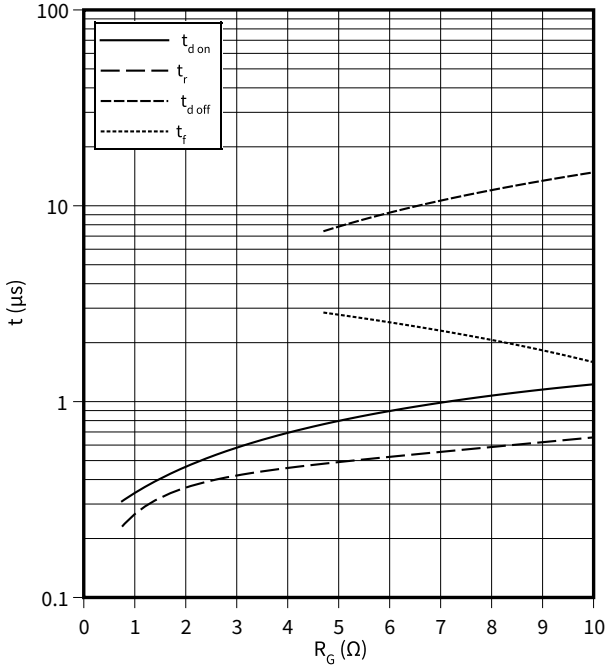


4 Characteristics diagrams

Switching times (typical), IGBT, Inverter

$t = f(R_G)$

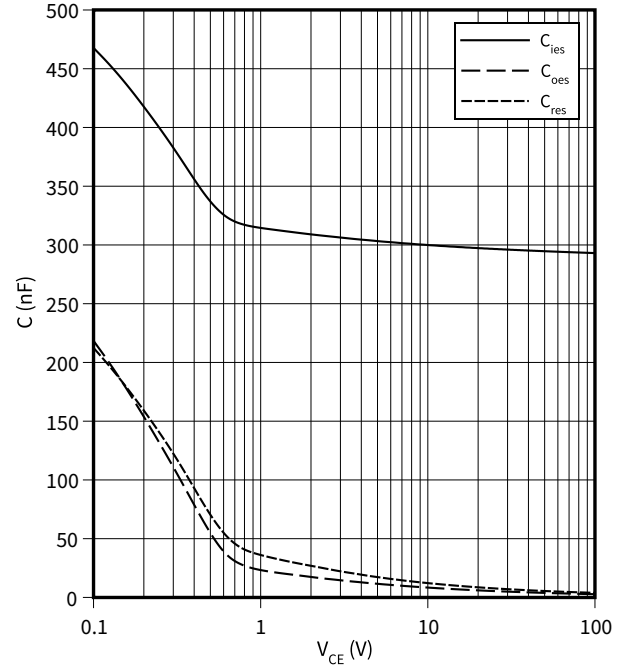
$V_{GE} = \pm 15 \text{ V}$, $I_C = 1800 \text{ A}$, $V_{CE} = 2800 \text{ V}$, $T_{vj} = 150 \text{ }^\circ\text{C}$



capacity characteristic (typical), IGBT, Inverter

$C = f(V_{CE})$

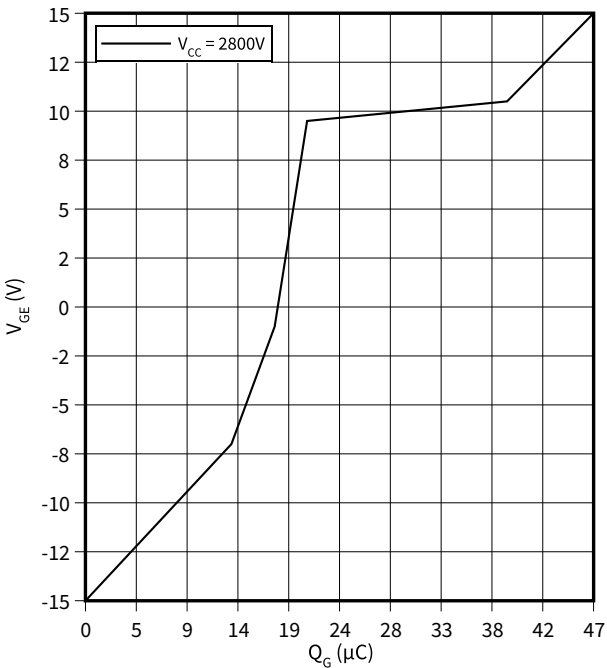
$f = 100 \text{ kHz}$, $V_{GE} = 0 \text{ V}$, $T_{vj} = 25 \text{ }^\circ\text{C}$



gate charge characteristic (typical), IGBT, Inverter

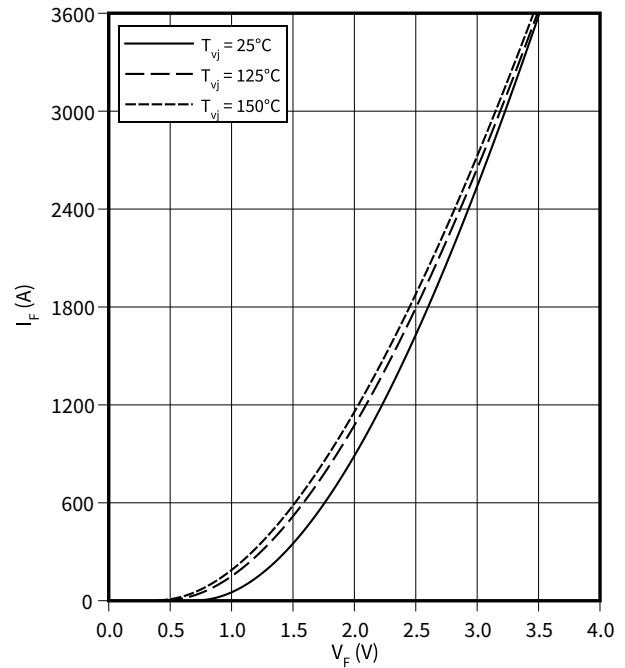
$V_{GE} = f(Q_G)$

$I_C = 1800 \text{ A}$, $T_{vj} = 25 \text{ }^\circ\text{C}$



forward characteristic (typical), Diode, Inverter

$I_F = f(V_F)$

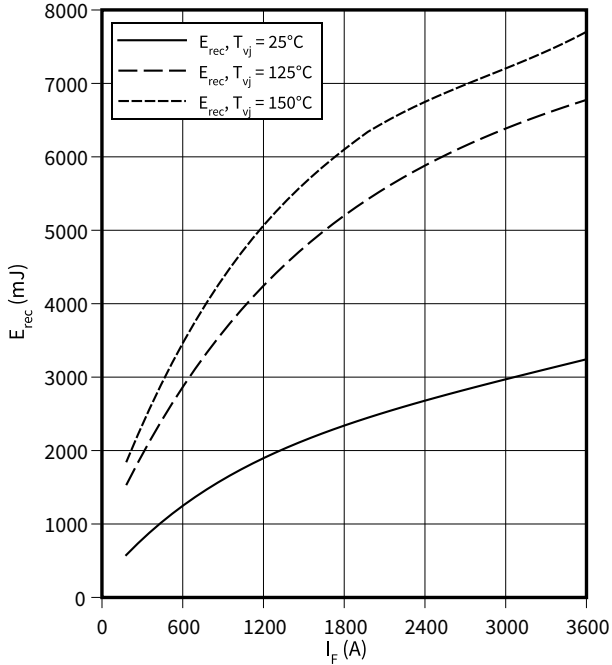


4 Characteristics diagrams

switching losses (typical), Diode, Inverter

$E_{rec} = f(I_F)$

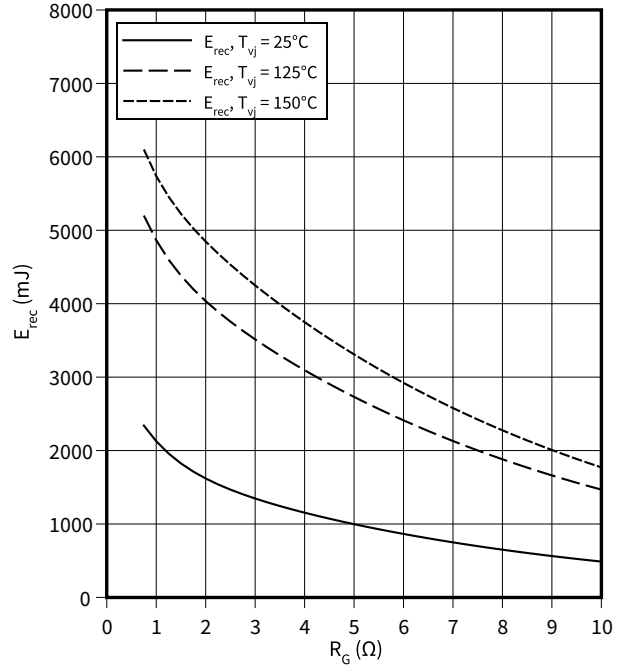
$V_{CE} = 2800\text{ V}, R_{Gon} = R_{Gon}(IGBT)$



switching losses (typical), Diode, Inverter

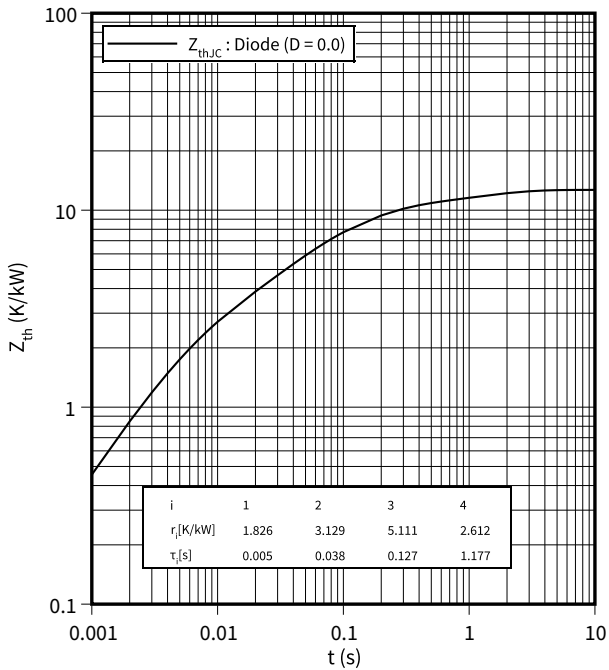
$E_{rec} = f(R_G)$

$V_{CE} = 2800\text{ V}, I_F = 1800\text{ A}$



transient thermal impedance , Diode, Inverter

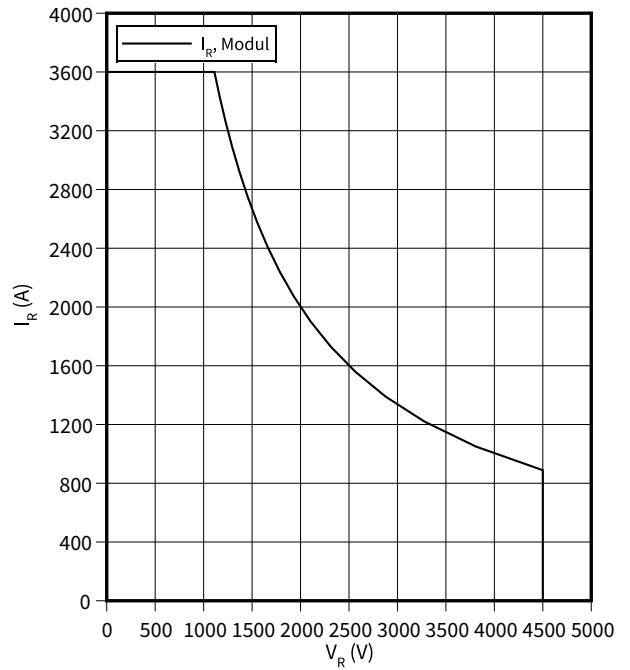
$Z_{th} = f(t)$



safe operation area (SOA), Diode, Inverter

$I_R = f(V_R)$

$T_{vj} = 150\text{ °C}$



5 Circuit diagram

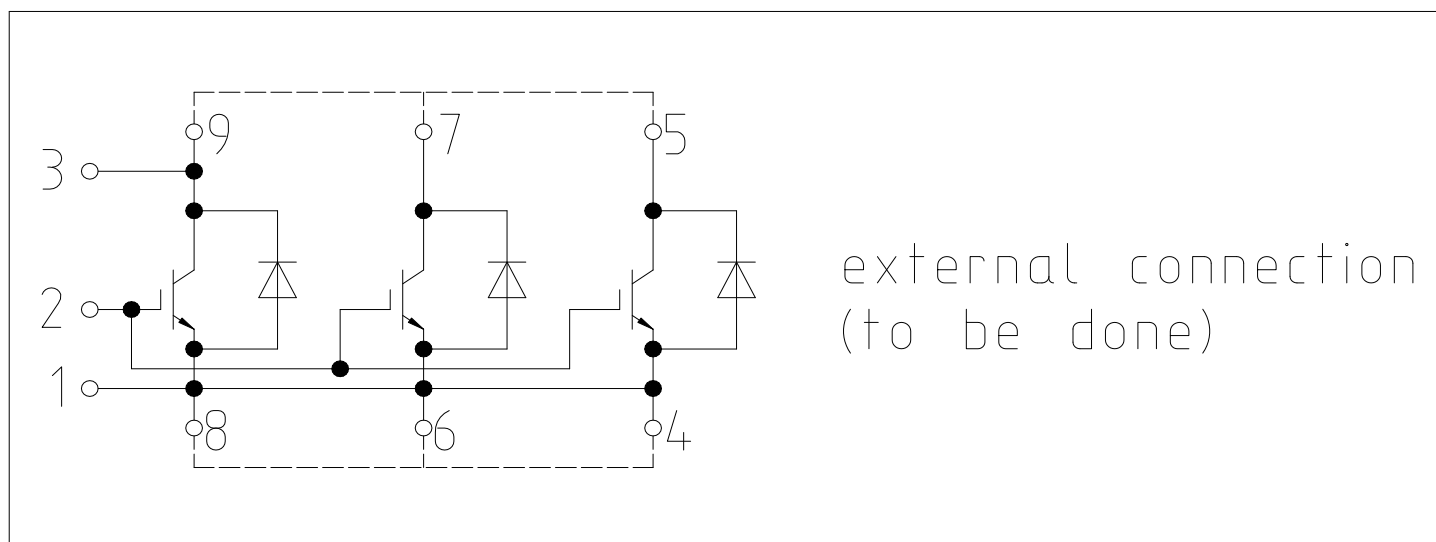


Figure 2

6 Package outlines

6 Package outlines

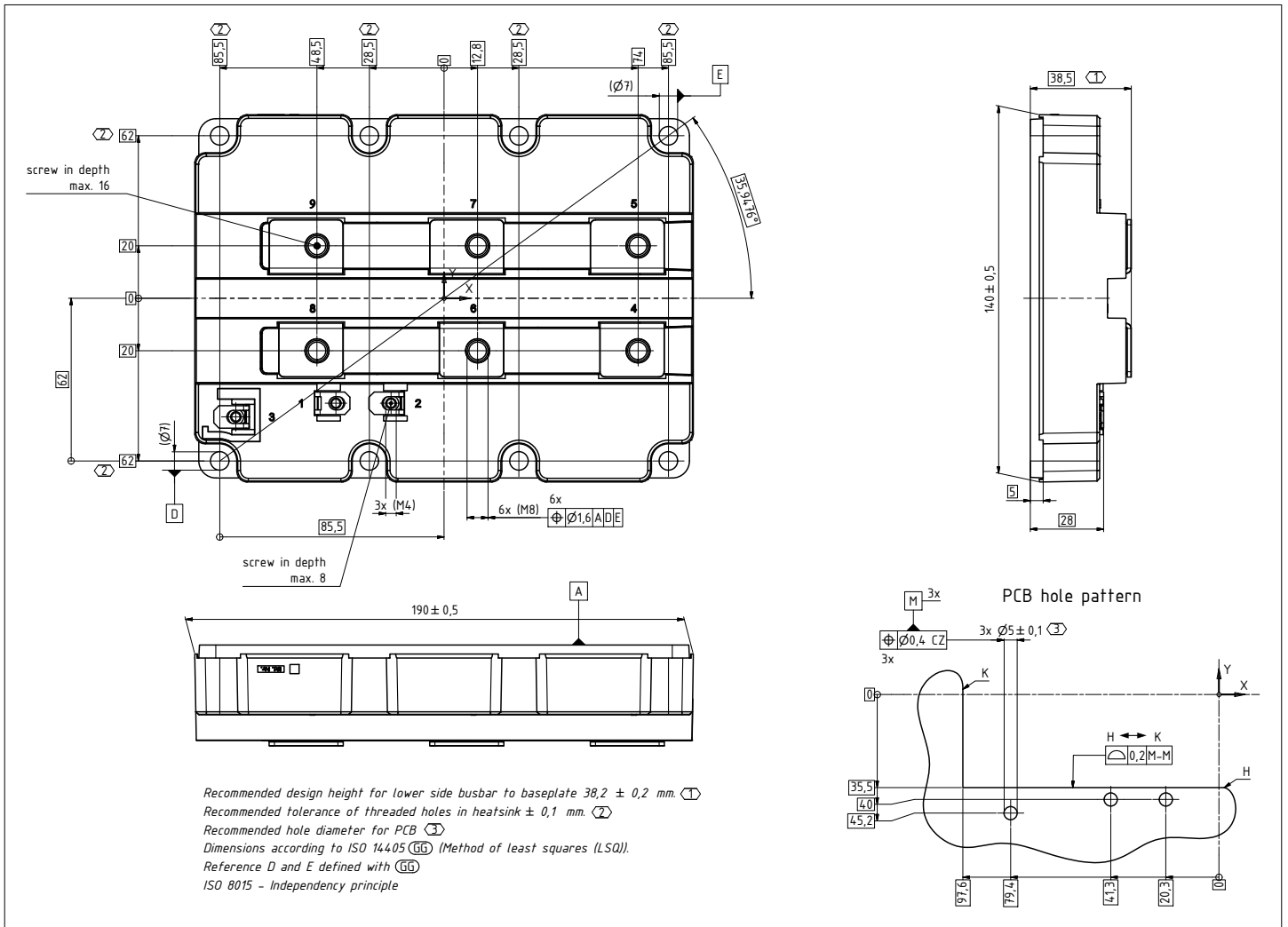


Figure 3

7 Module label code


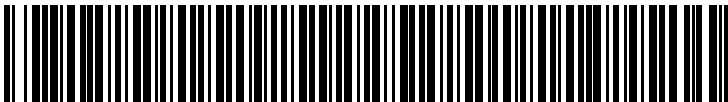
Module label code			
Code format	Data Matrix	Barcode Code128	
Encoding	ASCII text	Code Set A	
Symbol size	16x16	23 digits	
Standard	IEC24720 and IEC16022	IEC8859-1	
Code content	Content	Digit	Example
	Module serial number	1 - 5	71549
	Module material number	6 - 11	142846
	Production order number	12 - 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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