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

Features

- Electrical features
  - V_{CES} = 4500 V
  - $I_{C\,nom}$ = 1800 A / I_{CRM} = 3600 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

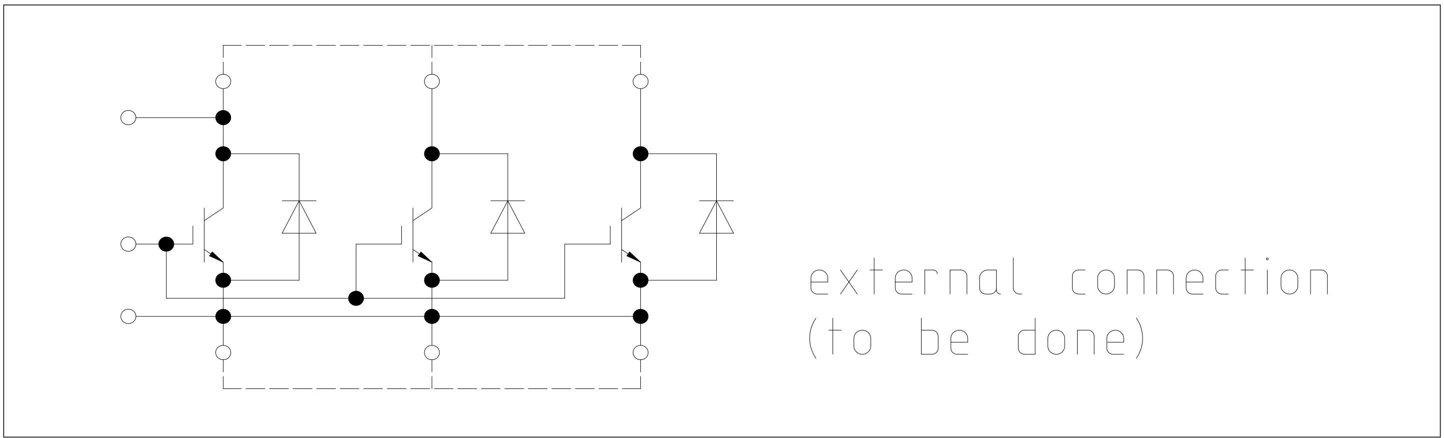


Table of contents

	Description	1
	Features	1
	Potential applications	1
	Product validation	1
	Table of contents	2
1	**Package**	3
2	**IGBT, Inverter**	3
3	**Diode, Inverter**	5
4	**Characteristics diagrams**	7
5	**Circuit diagram**	11
6	**Package outlines**	12
7	**Module label code**	13
	Disclaimer	14

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} ≤ 10 pC	3.5	kV
DC stability	$V_{CE(D)}$	T_{vj}=25°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°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 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 °C	4500	V
			T_{vj} = 150 °C	4500	
Continous DC collector current	I_{CDC}	$T_{vj\,max}$ = 150 °C	T_C = 105 °C	1800	A
Repetitive peak collector current	I_{CRM}	t_P = 1 ms		3600	A
Gate-emitter peak voltage	V_{GES}			-20/+25	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} = 25 V	T_{vj} = 25 °C		2.15	2.60	V
			T_{vj} = 125 °C		2.50	3.05	
			T_{vj} = 150 °C		2.60	3.15	
Gate threshold voltage	V_{GEth}	I_C = 149 mA, V_{CE} = V_{GE}, T_{vj} = 25 °C		5.5	6	6.5	V
Gate charge	Q_G	V_{GE} = ±15 V, V_{CE} = 2800 V			47		µC
Internal gate resistor	R_{Gint}	T_{vj} = 25 °C			0.29		Ω
Input capacitance	C_{ies}	f = 100 kHz, T_{vj} = 25 °C, V_{CE} = 25 V, V_{GE} = 0 V			297		nF
Reverse transfer capacitance	C_{res}	f = 100 kHz, T_{vj} = 25 °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 °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 = 1800 A, V_{CE} = 2800 V, V_{GE} = ±15 V, R_{Gon} = 0.75 Ω	T_{vj} = 25 °C		0.260		µs
			T_{vj} = 125 °C		0.290		
			T_{vj} = 150 °C		0.310		
Rise time (inductive load)	t_r	I_C = 1800 A, V_{CE} = 2800 V, V_{GE} = ±15 V, R_{Gon} = 0.75 Ω	T_{vj} = 25 °C		0.210		µs
			T_{vj} = 125 °C		0.230		
			T_{vj} = 150 °C		0.230		
Turn-off delay time (inductive load)	t_{doff}	I_C = 1800 A, V_{CE} = 2800 V, V_{GE} = ±15 V, R_{Goff} = 4.7 Ω	T_{vj} = 25 °C		6.930		µs
			T_{vj} = 125 °C		7.320		
			T_{vj} = 150 °C		7.410		
Fall time (inductive load)	t_f	I_C = 1800 A, V_{CE} = 2800 V, V_{GE} = ±15 V, R_{Goff} = 4.7 Ω	T_{vj} = 25 °C		1.130		µs
			T_{vj} = 125 °C		2.630		
			T_{vj} = 150 °C		2.850		
Turn-on energy loss per pulse	E_{on}	I_C = 1800 A, V_{CE} = 2800 V, L_σ = 110 nH, V_{GE} = ±15 V, R_{Gon} = 0.75 Ω, di/dt = 6500 A/µs (T_{vj} = 150 °C)	T_{vj} = 25 °C		5800		mJ
			T_{vj} = 125 °C		8100		
			T_{vj} = 150 °C		9100		
Turn-off energy loss per pulse	E_{off}	I_C = 1800 A, V_{CE} = 2800 V, L_σ = 110 nH, V_{GE} = ±15 V, R_{Goff} = 4.7 Ω, dv/dt = 1250 V/µs (T_{vj} = 150 °C)	T_{vj} = 25 °C		7050		mJ
			T_{vj} = 125 °C		9000		
			T_{vj} = 150 °C		9700		
SC data	I_{SC}	V_{GE} = 15 V, V_{CC} = 3000 V, V_{CEmax}=V_{CES}-L_{sCE}*di/dt	t_P ≤ 10 µs, T_{vj} = 150 °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, λ_{grease}= 1 W/(m*K)		3.60		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	4500	V
			T_{vj} = 150 °C	4500	
Continous DC forward current	I_F			1800	A
Repetitive peak forward current	I_{FRM}	t_P = 1 ms		3600	A
I^2t - value	I^2t	t_P = 10 ms, V_R = 0 V	T_{vj} = 125 °C	850	kA^2s
			T_{vj} = 150 °C	930	
Maximum power dissipation	P_{RQM}	T_{vj} = 150 °C		4000	kW
Minimum turn-on time	t_{onmin}			10	µs

Table 6 Characteristic values

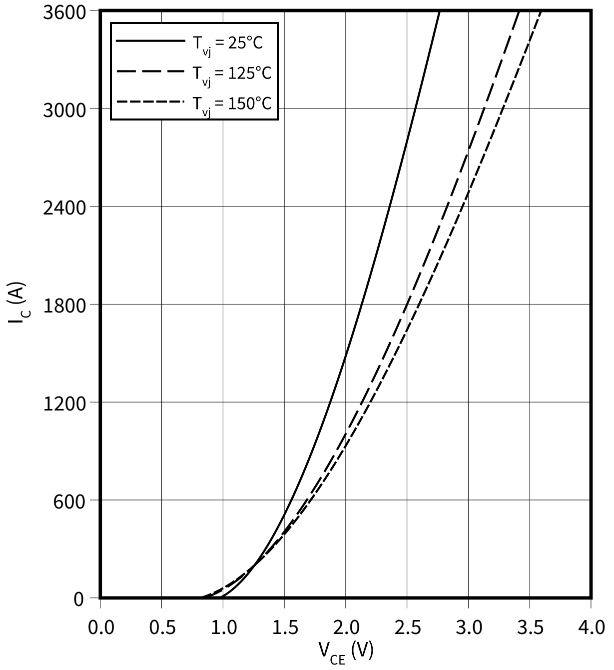
Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Forward voltage	V_F	I_F = 1800 A, V_{GE} = 0 V	T_{vj} = 25 °C		2.60	3.05	V
			T_{vj} = 125 °C		2.50	2.95	
			T_{vj} = 150 °C		2.45	2.90	
Peak reverse recovery current	I_{RM}	V_R = 2800 V, I_F = 1800 A, V_{GE} = -15 V, -di_F/dt = 6500 A/µs (T_{vj} = 150 °C)	T_{vj} = 25 °C		2360		A
			T_{vj} = 125 °C		2600		
			T_{vj} = 150 °C		2630		
Recovered charge	Q_r	V_R = 2800 V, I_F = 1800 A, V_{GE} = -15 V, -di_F/dt = 6500 A/µs (T_{vj} = 150 °C)	T_{vj} = 25 °C		1560		µC
			T_{vj} = 125 °C		3060		
			T_{vj} = 150 °C		3560		
Reverse recovery energy	E_{rec}	V_R = 2800 V, I_F = 1800 A, V_{GE} = -15 V, -di_F/dt = 6500 A/µs (T_{vj} = 150 °C)	T_{vj} = 25 °C		2340		mJ
			T_{vj} = 125 °C		5200		
			T_{vj} = 150 °C		6100		

Table 6 Characteristic values (continued)

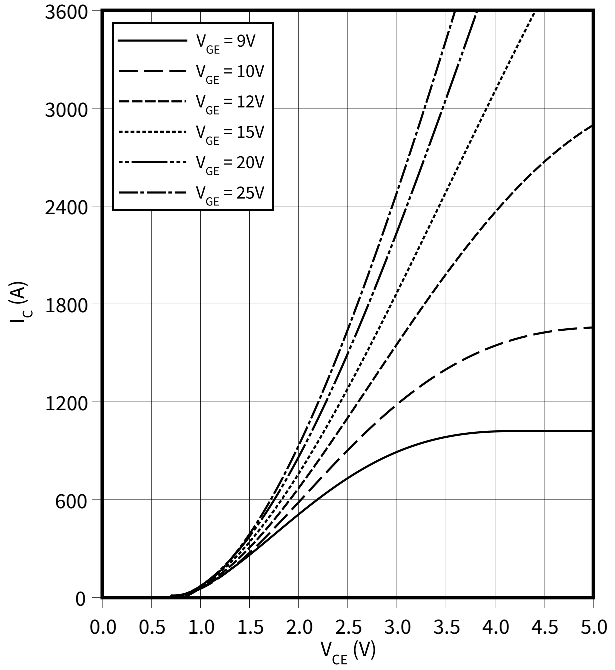
Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Thermal resistance, junction to case	R_{thJC}	per diode			12.7	K/kW
Thermal resistance, case to heatsink	R_{thCH}	per diode, λ_{grease}= 1 W/(m*K)		5.30		K/kW
Temperature under switching conditions	$T_{vj\ op}$		-40		150	°C

4 Characteristics diagrams

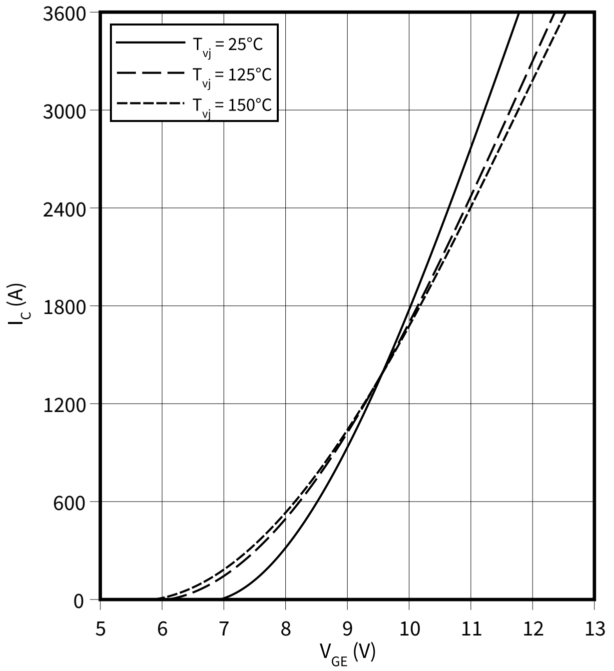
output characteristic (typical), IGBT, Inverter
$I_C = f(V_{CE})$
$V_{GE} = 25$ V



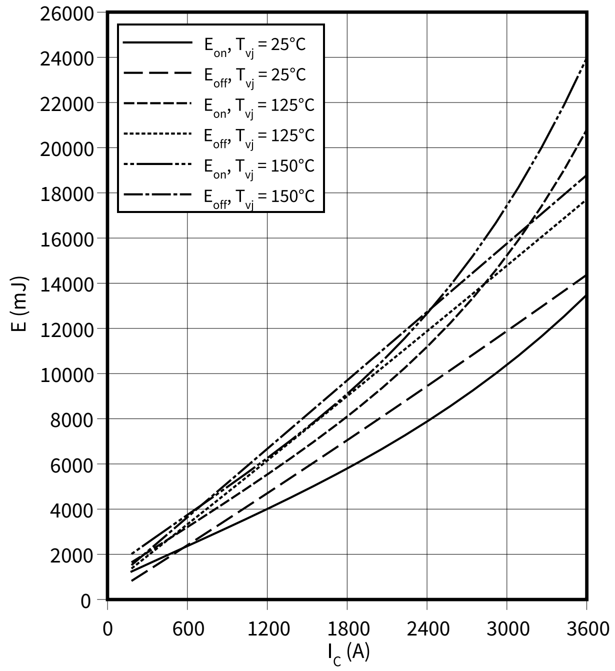
output characteristic (typical), IGBT, Inverter
$I_C = f(V_{CE})$
$T_{vj} = 150$ °C



transfer characteristic (typical), IGBT, Inverter
$I_C = f(V_{GE})$
$V_{CE} = 20$ V



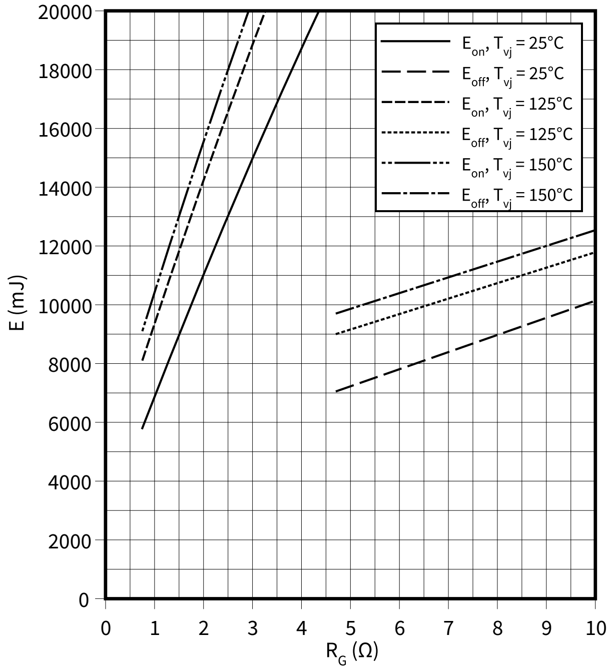
switching losses (typical), IGBT, Inverter
$E = f(I_C)$
$R_{Goff} = 4.7\ \Omega$, $R_{Gon} = 0.75\ \Omega$, $V_{GE} = \pm 15$ V, $V_{CE} = 2800$ V



switching losses (typical), IGBT, Inverter

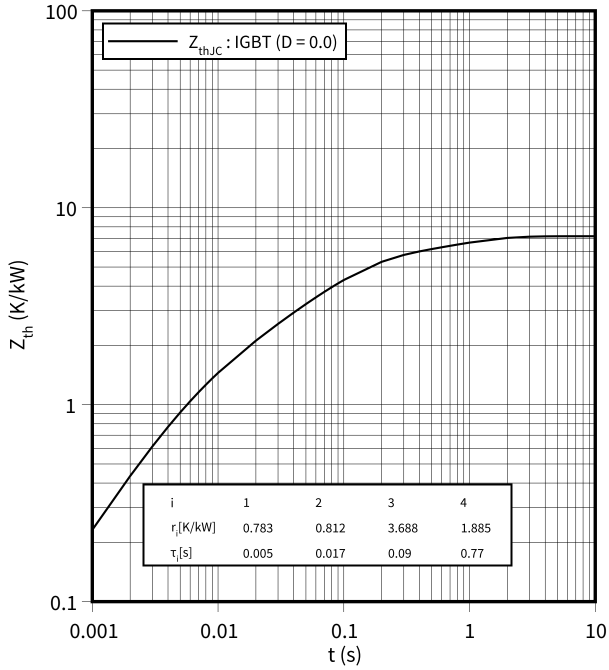
$E = f(R_G)$

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



transient thermal impedance , IGBT, Inverter

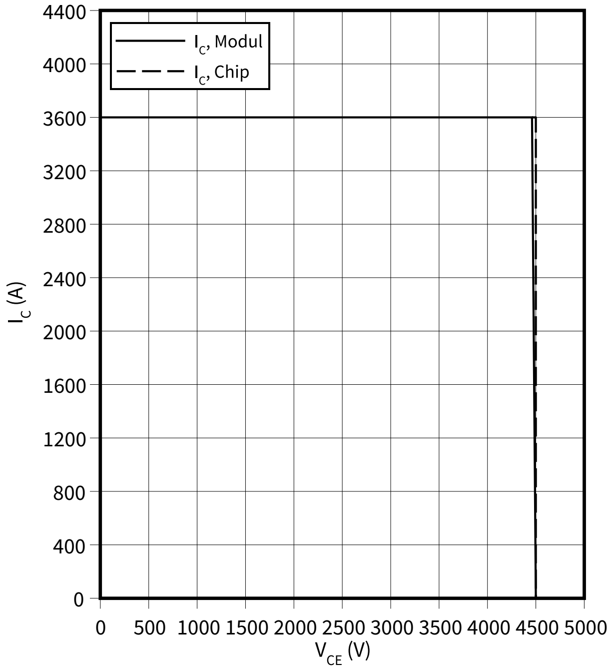
$Z_{th} = f(t)$



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

$I_C = f(V_{CE})$

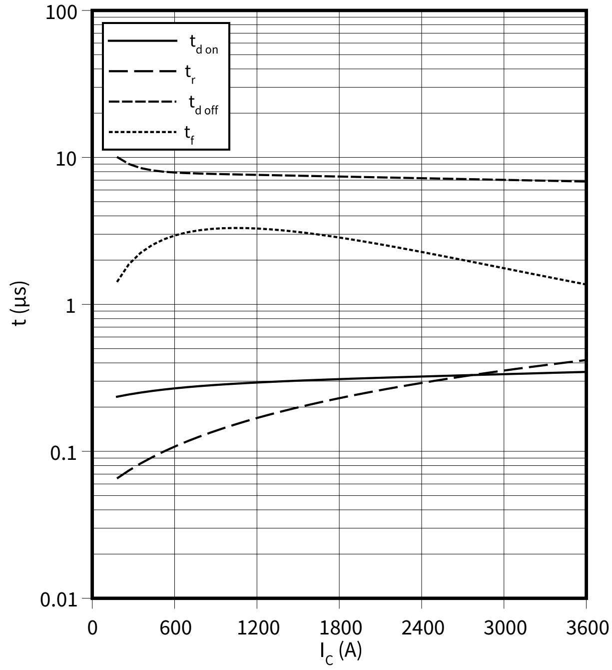
$V_{CC} \leq 3200$ V, $T_{vj} = 150$ °C, $R_{Goff} = 4.7\ \Omega$, $V_{GE} = \pm 15$ V



Switching times (typical), IGBT, Inverter

$t = f(I_C)$

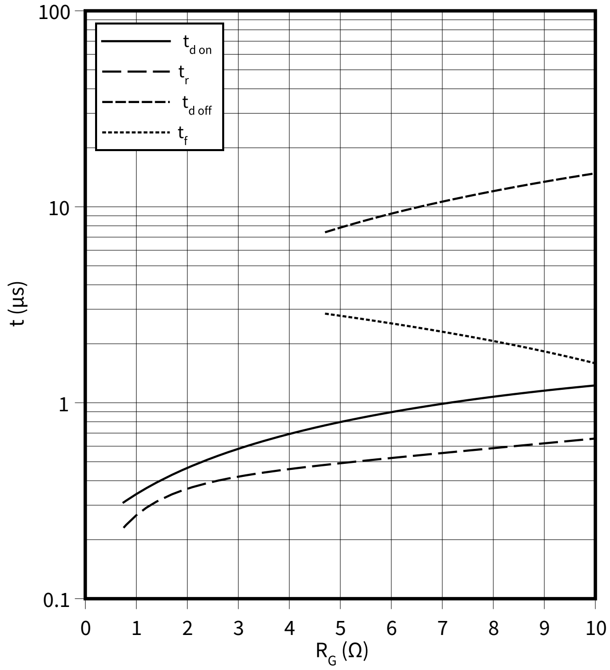
$R_{Goff} = 4.7\ \Omega$, $R_{Gon} = 0.75\ \Omega$, $V_{GE} = \pm 15$ V, $V_{CE} = 2800$ V, $T_{vj} =$ 150 °C



Switching times (typical), IGBT, Inverter

$t = f(R_G)$

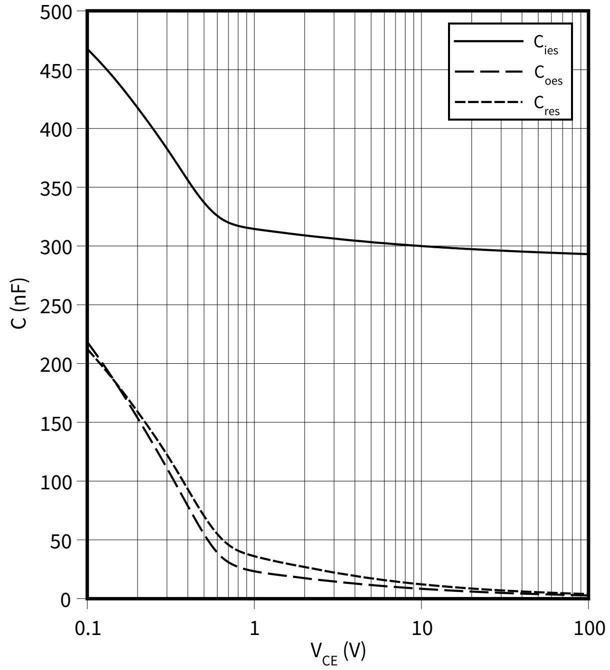
$V_{GE} = \pm 15$ V, $I_C = 1800$ A, $V_{CE} = 2800$ V, $T_{vj} = 150$ °C



capacity characteristic (typical), IGBT, Inverter

$C = f(V_{CE})$

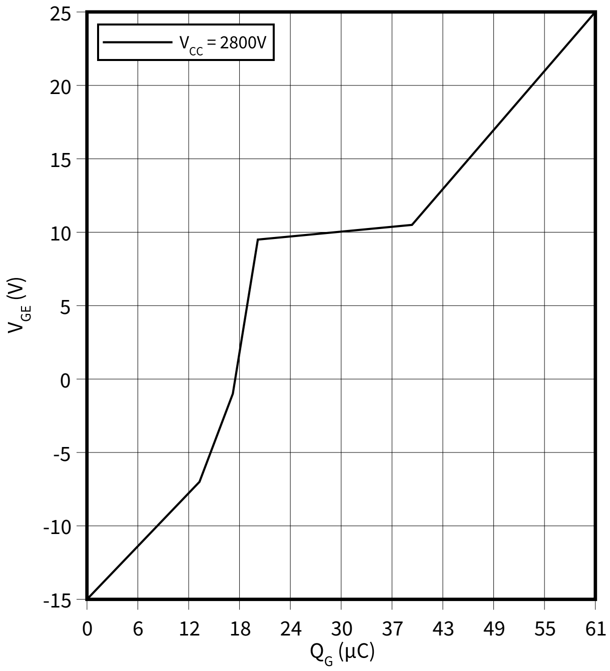
$f = 100$ kHz, $V_{GE} = 0$ V, $T_{vj} = 25$ °C



gate charge characteristic (typical), IGBT, Inverter

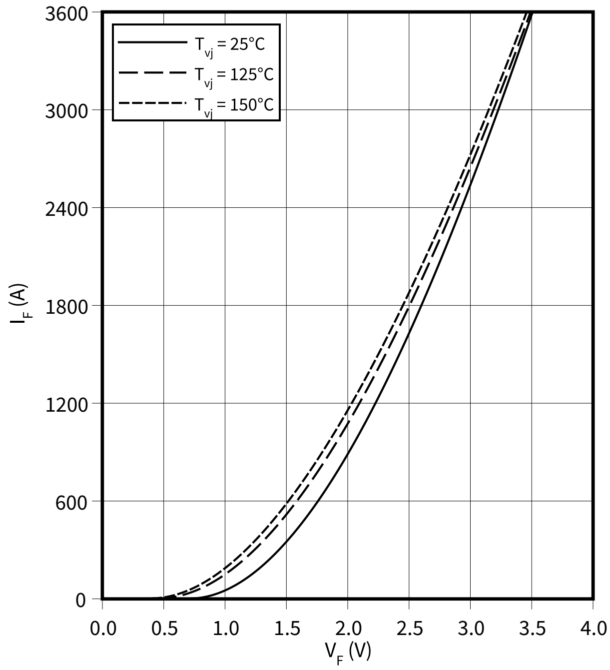
$V_{GE} = f(Q_G)$

$I_C = 1800$ A, $T_{vj} = 25$ °C



forward characteristic (typical), Diode, Inverter

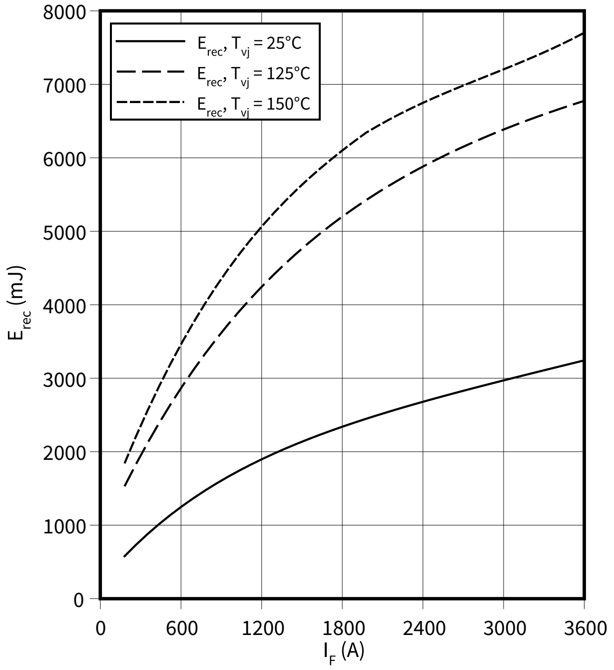
$I_F = f(V_F)$



switching losses (typical), Diode, Inverter

$E_{rec} = f(I_F)$

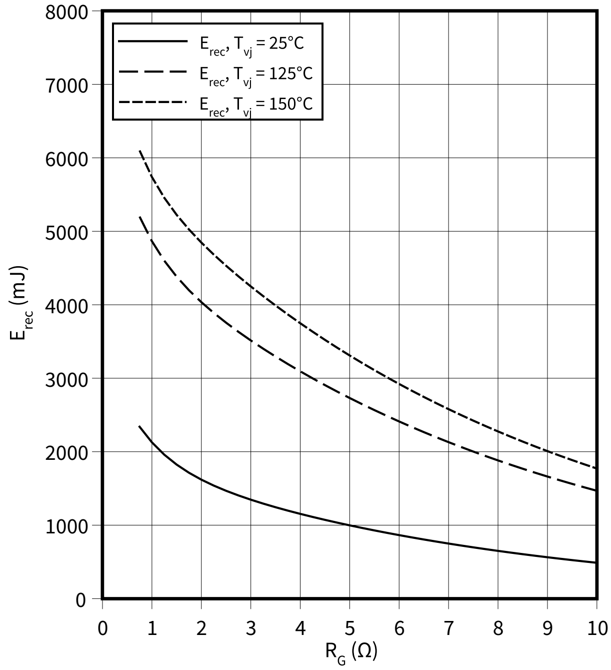
$R_{Gon} = R_{Gon}(IGBT)$, $V_{CE} = 2800$ V



switching losses (typical), Diode, Inverter

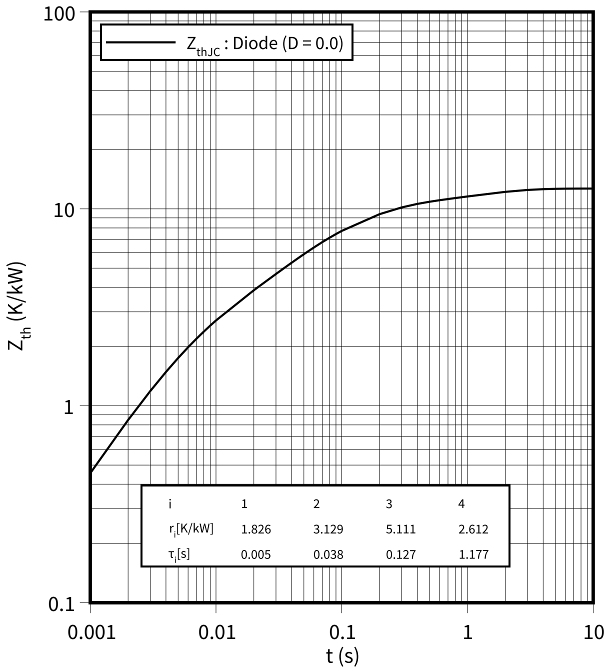
$E_{rec} = f(R_G)$

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



transient thermal impedance , Diode, Inverter

$Z_{th} = f(t)$

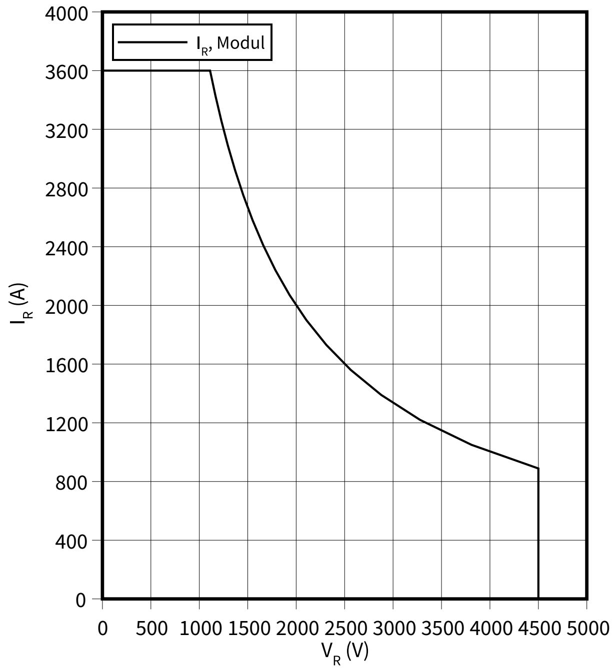


i	1	2	3	4
r_i[K/kW]	1.826	3.129	5.111	2.612
τ_i[s]	0.005	0.038	0.127	1.177

safe operation area (SOA), Diode, Inverter

$I_R = f(V_R)$

$T_{vj} = 150$ °C



5 Circuit diagram

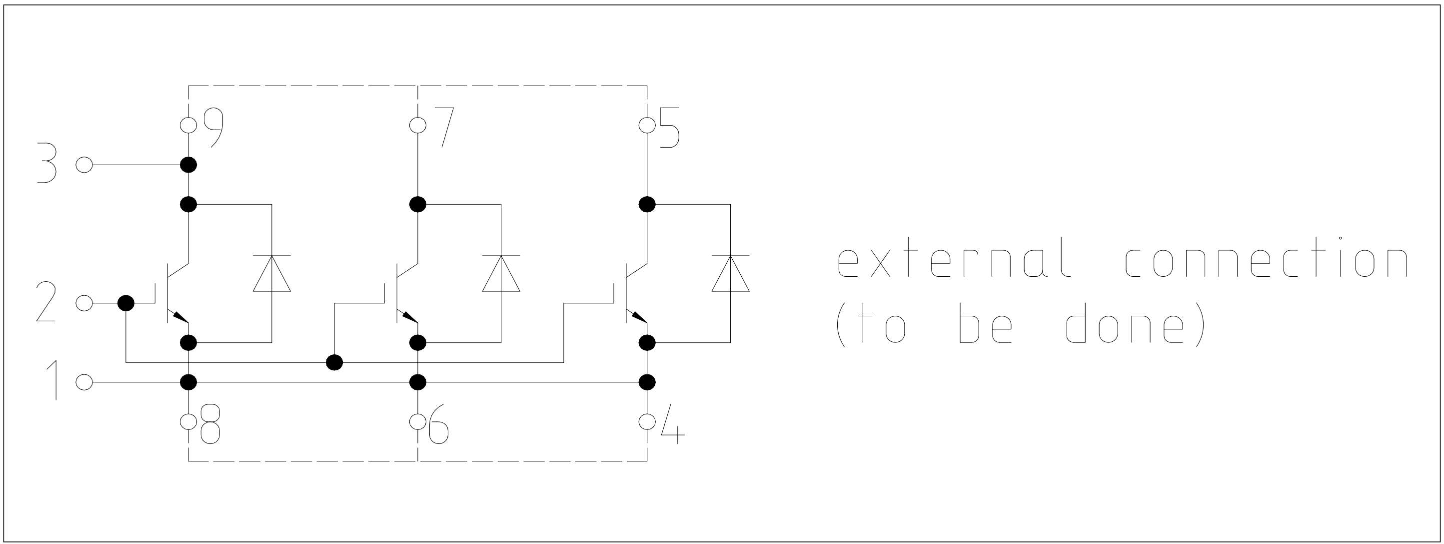


Figure 2

6 Package outlines

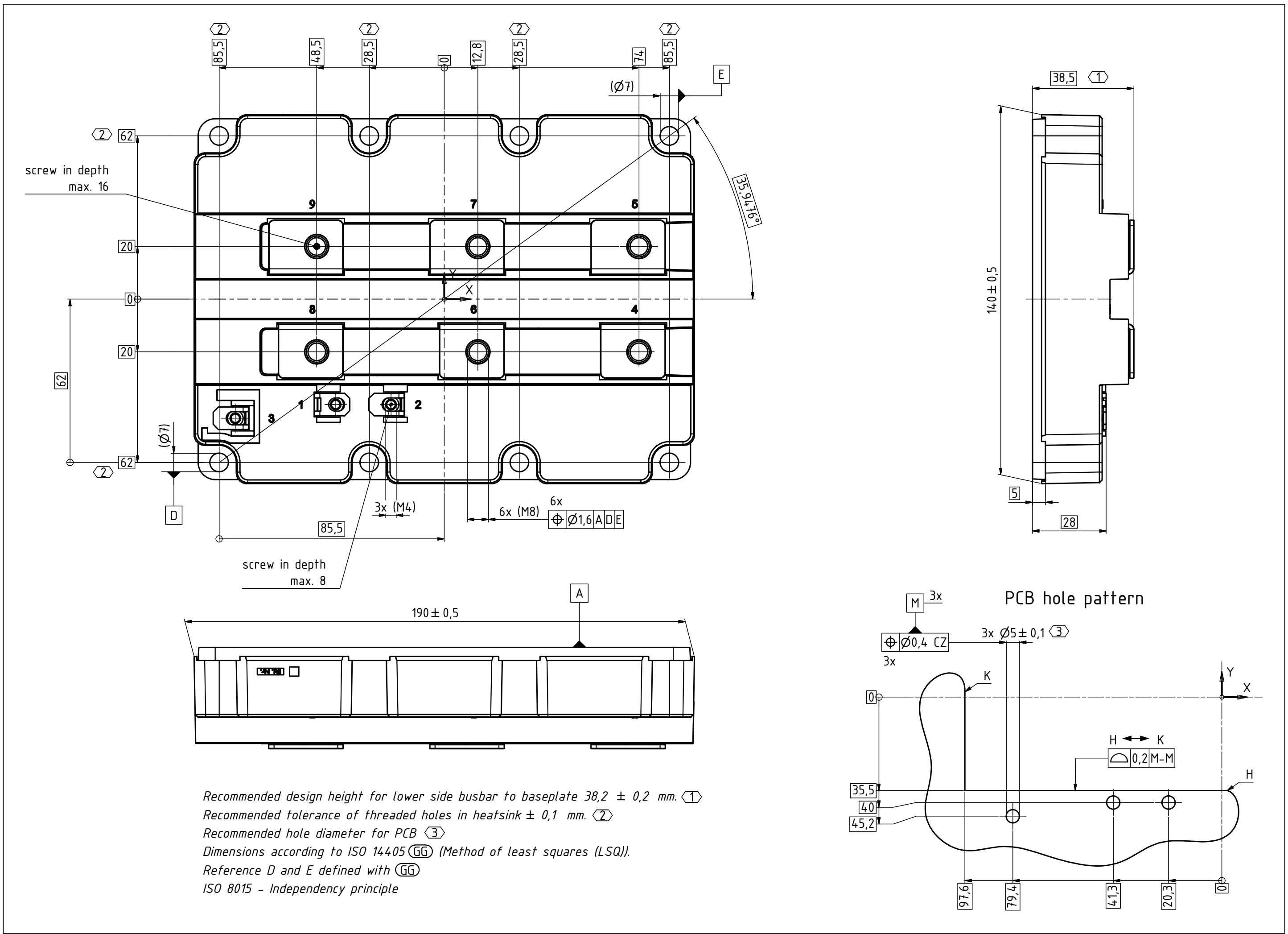


Figure 3

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	Data Matrix	Barcode Code128
	71549142846550549911530	71549142846550549911530

Figure 4

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