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

Features

- Electrical features
  - V_{CES} = 3300 V
  - $I_{C\ nom}$ = 2400 A / I_{CRM} = 4800 A
  - High current density
  - High DC stability
  - High short-circuit capability
  - Low switching losses
  - Low $V_{CE,sat}$
  - $T_{vj,op}$ = 150°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

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

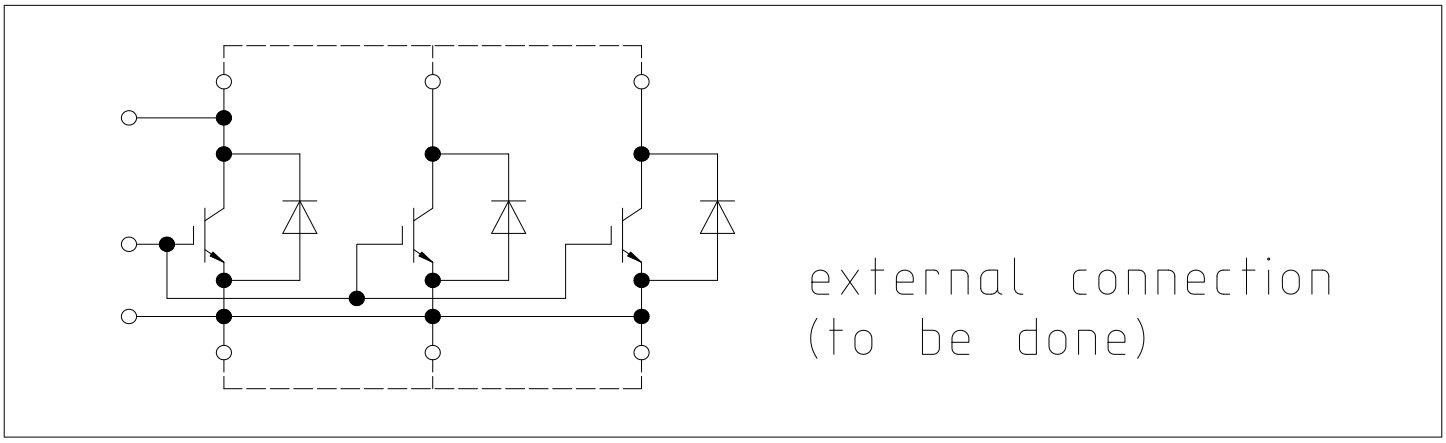


Table of contents

1 Package

Table 1 Insulation coordination

Parameter	Symbol	Note or test condition	Values	Unit
Isolation test voltage	V_{ISOL}	RMS, f = 50 Hz	6.0	kV
Partial discharge extinction voltage	V_{isol}	RMS, f = 50 Hz, Q_{PD} ≤ 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 = 105 °C	2400	A
Repetitive peak collector current	I_{CRM}	t_p limited by $T_{vj\,op}$		4800	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 = 2400 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 = 94 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_{CC} = 1800 V			40		µC
Internal gate resistor	R_{Gint}	T_{vj} = 25 °C			0.5		Ω
Input capacitance	C_{ies}	f = 1000 kHz, T_{vj} = 25 °C, V_{CE} = 25 V, V_{GE} = 0 V			280		nF
Reverse transfer capacitance	C_{res}	f = 1000 kHz, T_{vj} = 25 °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 °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 = 2400 A, V_{CC} = 1800 V, V_{GE} = ±15 V, R_{Gon} = 0.5 Ω	T_{vj} = 25 °C		0.560		µs
			T_{vj} = 125 °C		0.660		
			T_{vj} = 150 °C		0.670		
Rise time (inductive load)	t_r	I_C = 2400 A, V_{CC} = 1800 V, V_{GE} = ±15 V, R_{Gon} = 0.5 Ω	T_{vj} = 25 °C		0.250		µs
			T_{vj} = 125 °C		0.270		
			T_{vj} = 150 °C		0.290		
Turn-off delay time (inductive load)	t_{doff}	I_C = 2400 A, V_{CC} = 1800 V, V_{GE} = ±15 V, R_{Goff} = 3.3 Ω	T_{vj} = 25 °C		4.000		µs
			T_{vj} = 125 °C		4.300		
			T_{vj} = 150 °C		4.300		
Fall time (inductive load)	t_f	I_C = 2400 A, V_{CC} = 1800 V, V_{GE} = ±15 V, R_{Goff} = 3.3 Ω	T_{vj} = 25 °C		0.540		µs
			T_{vj} = 125 °C		1.180		
			T_{vj} = 150 °C		1.400		
Turn-on time (resistive load)	t_{on_R}	I_C = 500 A, V_{CC} = 2000 V, V_{GE} = ±15 V, R_{Gon} = 0.5 Ω	T_{vj} = 25 °C	1.19			µs
Turn-on energy loss per pulse	E_{on}	I_C = 2400 A, V_{CC} = 1800 V, L_σ = 85 nH, V_{GE} = ±15 V, R_{Gon} = 0.5 Ω, di/dt = 7600 A/µs (T_{vj} = 150 °C)	T_{vj} = 25 °C		2000		mJ
			T_{vj} = 125 °C		3400		
			T_{vj} = 150 °C		3900		

(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 = 2400 A, V_{CC} = 1800 V, L_σ = 85 nH, V_{GE} = ±15 V, R_{Goff} = 3.3 Ω, dv/dt = 1500 V/µs (T_{vj} = 150 °C)	T_{vj} = 25 °C		3500		mJ
			T_{vj} = 125 °C		4600		
			T_{vj} = 150 °C		4950		
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		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	$T_{vj\,op}$			-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	
Continuous DC forward current	I_F			2400	A
Repetitive peak forward current	I_{FRM}	t_P = 1 ms		4800	A
I^2t - value	I^2t	t_P = 10 ms, V_R = 0 V	T_{vj} = 125 °C	1230	kA^2s
			T_{vj} = 150 °C	1110	
Maximum power dissipation	P_{RQM}		T_{vj} = 150 °C	5400	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 = 2400 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	

(table continues...)

Table 6 (continued) Characteristic values

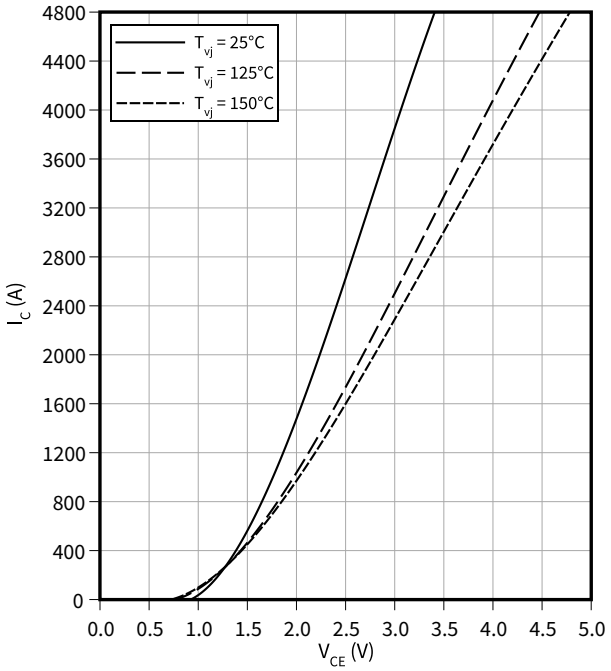
Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Peak reverse recovery current	I_{RM}	V_{CC} = 1800 V, I_F = 2400 A, V_{GE} = -15 V, -di$_F$/dt = 7600 A/µs (T_{vj} = 150 °C)	T_{vj} = 25 °C		2440		A
			T_{vj} = 125 °C		2820		
			T_{vj} = 150 °C		2880		
Recovered charge	Q_r	V_{CC} = 1800 V, I_F = 2400 A, V_{GE} = -15 V, -di$_F$/dt = 7600 A/µs (T_{vj} = 150 °C)	T_{vj} = 25 °C		1100		µC
			T_{vj} = 125 °C		2100		
			T_{vj} = 150 °C		2500		
Reverse recovery energy	E_{rec}	V_{CC} = 1800 V, I_F = 2400 A, V_{GE} = -15 V, -di$_F$/dt = 7600 A/µs (T_{vj} = 150 °C)	T_{vj} = 25 °C		1480		mJ
			T_{vj} = 125 °C		2750		
			T_{vj} = 150 °C		3200		
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	$T_{vj\,op}$			-40		150	°C

4 Characteristics diagrams

Output characteristic (typical), IGBT, Inverter

$I_C = f(V_{CE})$

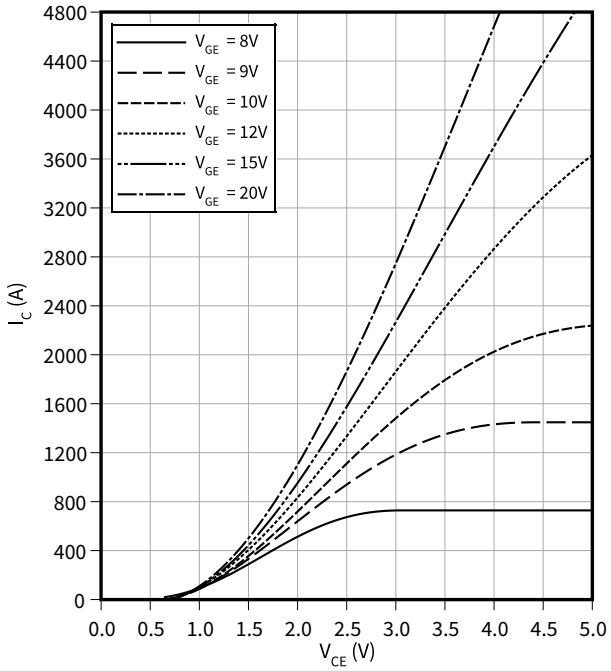
V_{GE} = 15 V



Output characteristic field (typical), IGBT, Inverter

$I_C = f(V_{CE})$

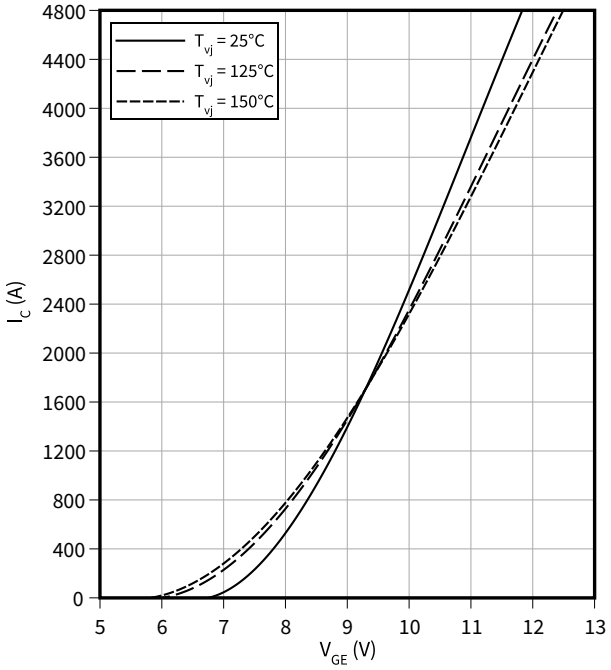
T_{vj} = 150 °C



Transfer characteristic (typical), IGBT, Inverter

$I_C = f(V_{GE})$

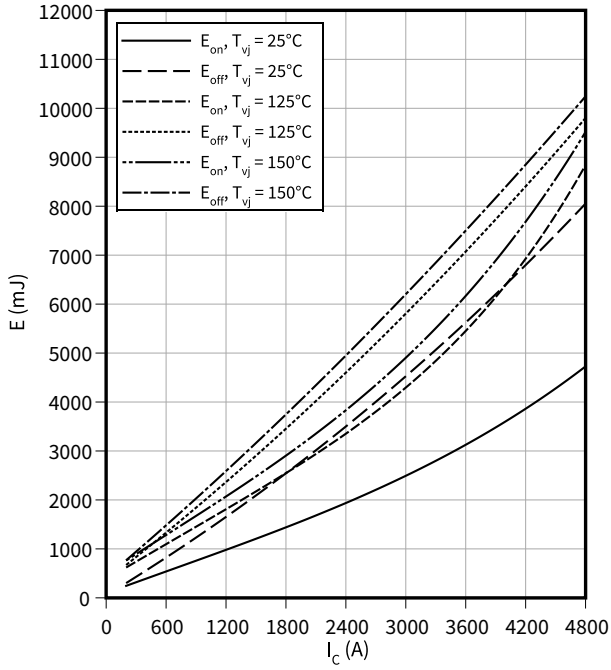
V_{CE} = 20 V



Switching losses (typical), IGBT, Inverter

$E = f(I_C)$

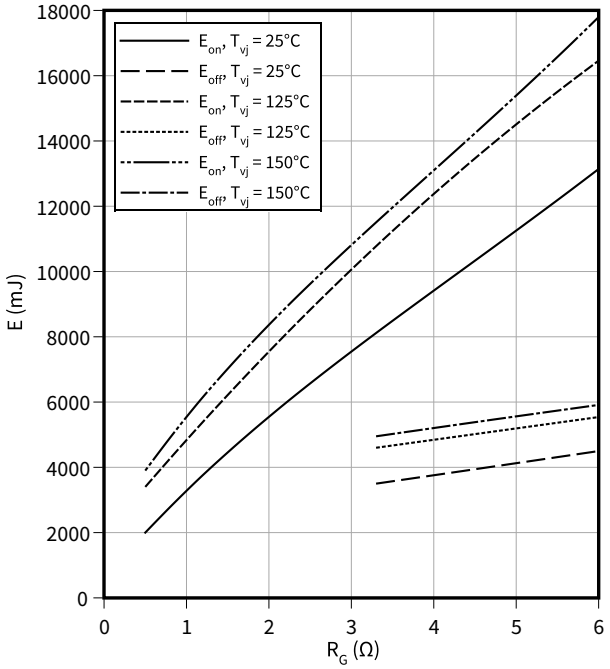
R_{Goff} = 3.3 Ω, R_{Gon} = 0.5 Ω, V_{CC} = 1800 V, V_{GE} = ± 15 V



Switching losses (typical), IGBT, Inverter

$E = f(R_G)$

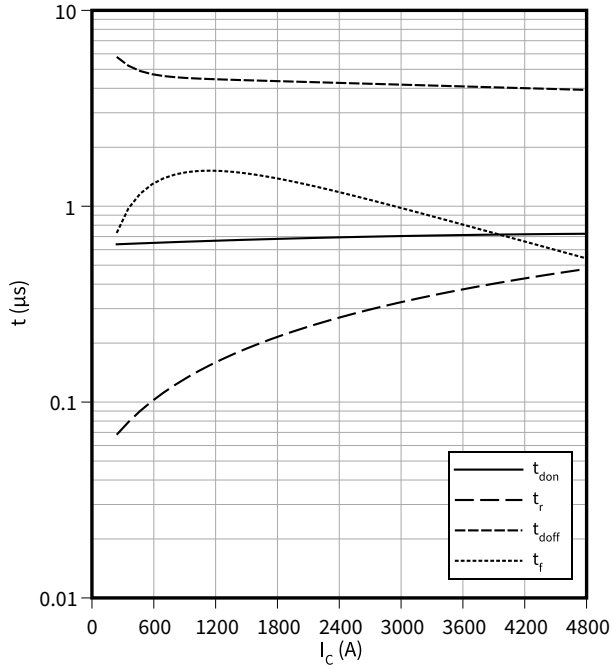
$I_C = 2400$ A, $V_{CC} = 1800$ V, $V_{GE} = \pm 15$ V



Switching times (typical), IGBT, Inverter

$t = f(I_C)$

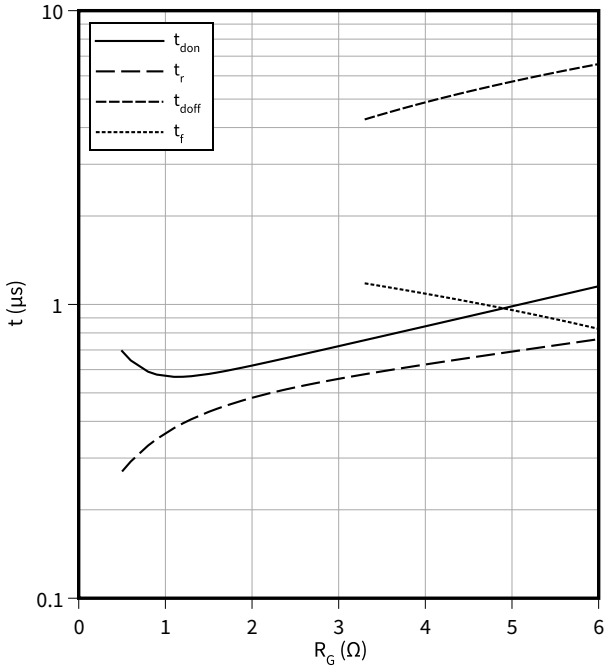
$R_{Goff} = 3.3\ \Omega$, $R_{Gon} = 0.5\ \Omega$, $V_{CC} = 1800$ V, $V_{GE} = \pm 15$ V, $T_{vj} = 125$ °C



Switching times (typical), IGBT, Inverter

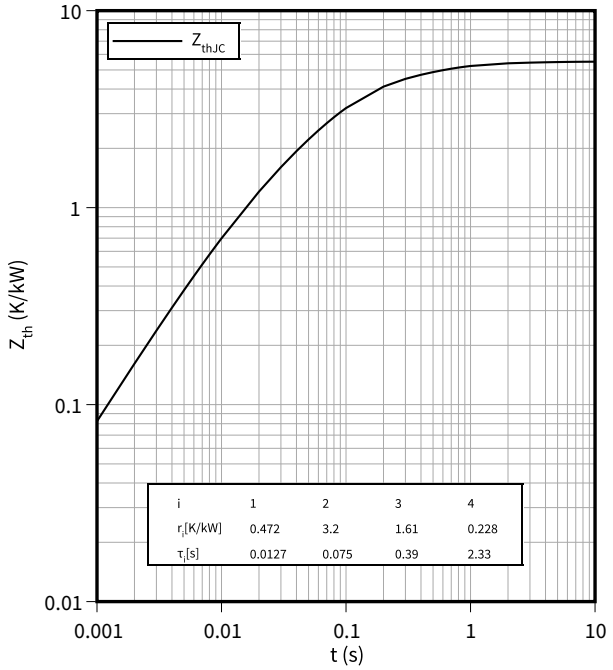
$t = f(R_G)$

$I_C = 2400$ A, $V_{CC} = 1800$ V, $V_{GE} = \pm 15$ V, $T_{vj} = 125$ °C



Transient thermal impedance , IGBT, Inverter

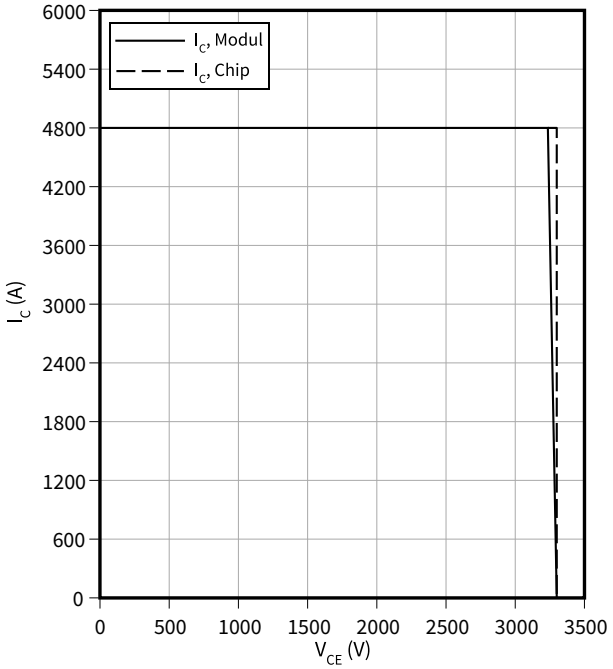
$Z_{th} = f(t)$



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

$I_C = f(V_{CE})$

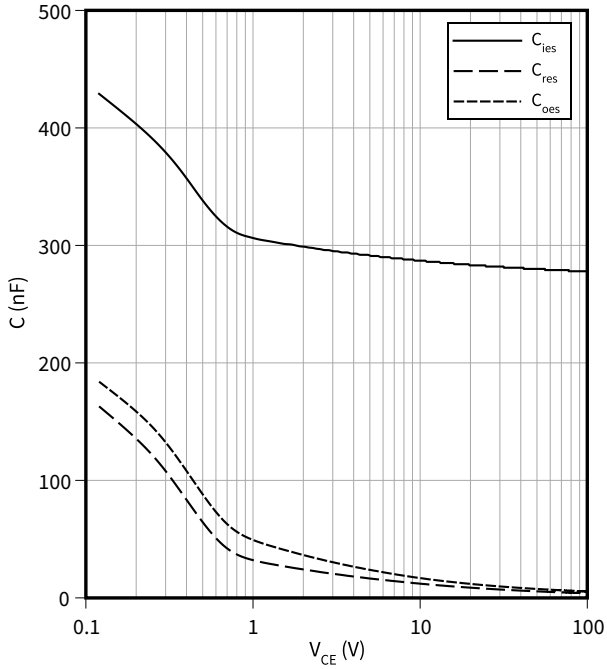
$R_{Goff} = 3.3\ \Omega$, $V_{GE} = 15$ V, $T_{vj} = 150$ °C



Capacity characteristic (typical), IGBT, Inverter

$C = f(V_{CE})$

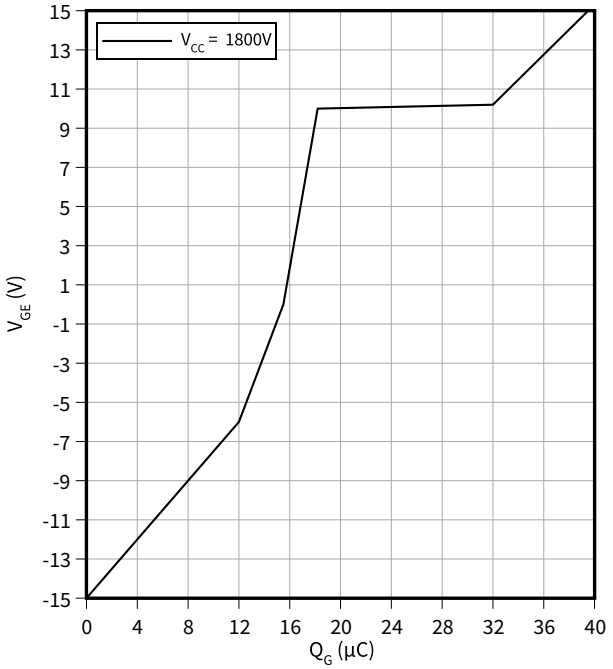
$f = 100$ kHz, $V_{GE} = 0$ V, $T_{vj} = 25$ °C



Gate charge characteristic (typical), IGBT, Inverter

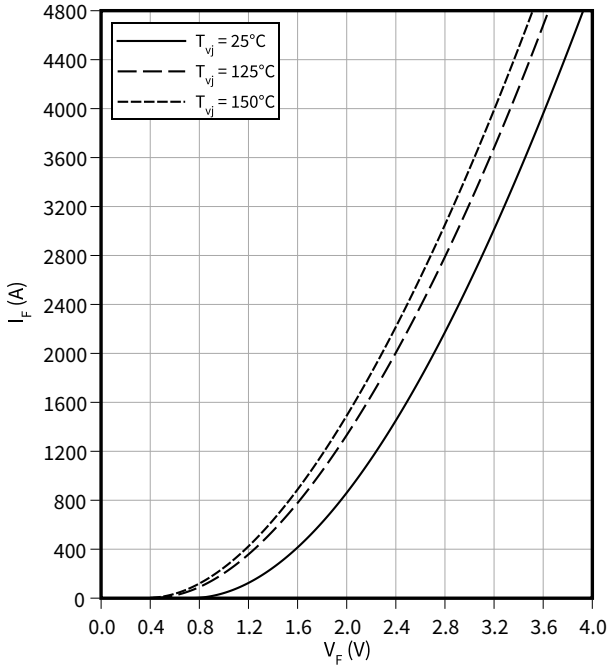
$V_{GE} = f(Q_G)$

$I_C = 2400$ A, $T_{vj} = 25$ °C



Forward characteristic (typical), Diode, Inverter

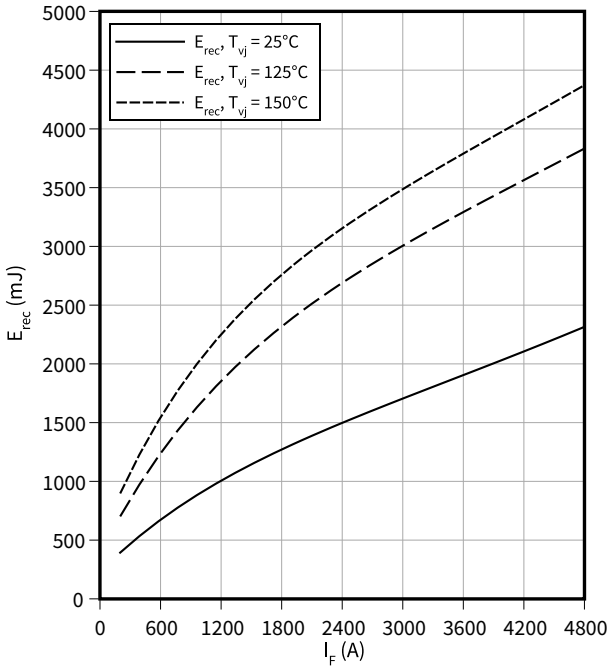
$I_F = f(V_F)$



Switching losses (typical), Diode, Inverter

$E_{rec} = f(I_F)$

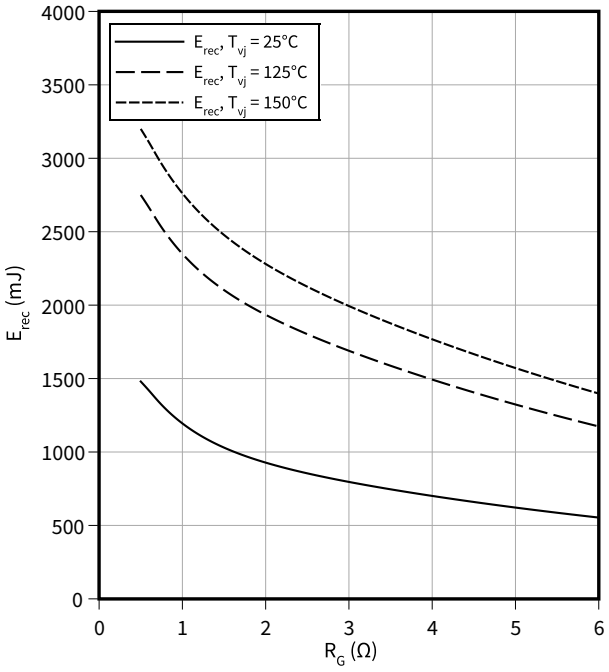
V_{CE} = 1800 V, $R_{Gon} = R_{Gon}$(IGBT)



Switching losses (typical), Diode, Inverter

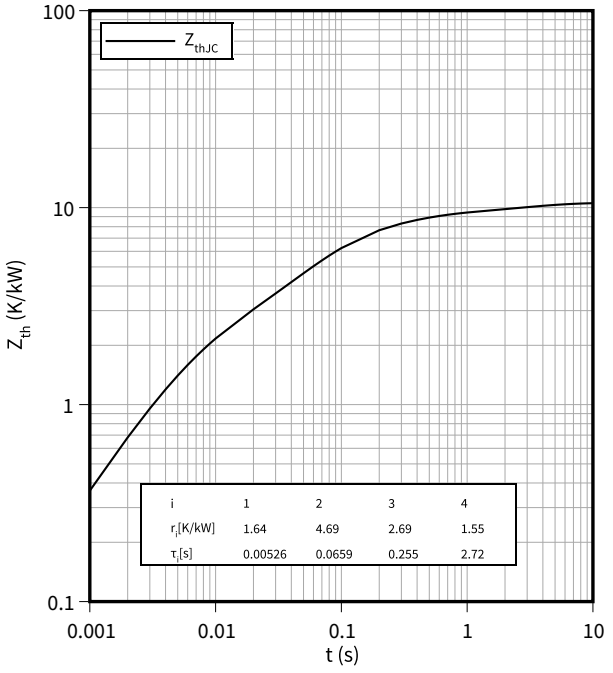
$E_{rec} = f(R_G)$

V_{CE} = 1800 V, I_F = 2400 A



Transient thermal impedance, Diode, Inverter

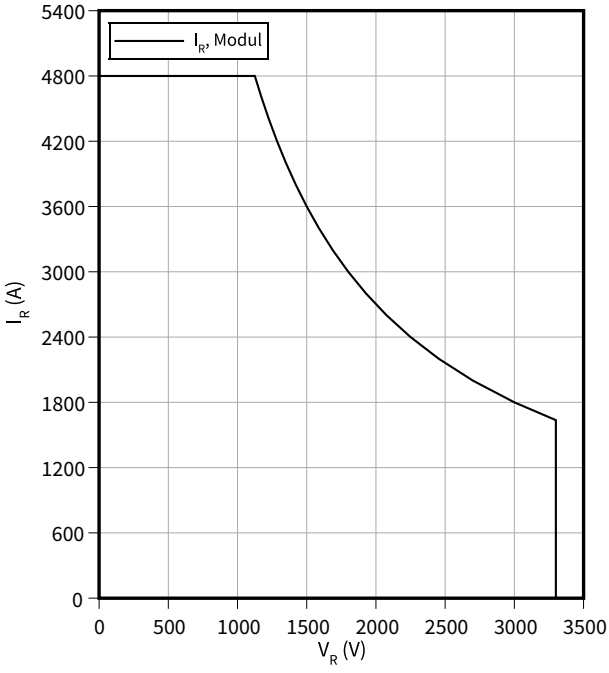
$Z_{th} = f(t)$



Safe operating area (SOA), Diode, Inverter

$I_R = f(V_R)$

T_{vj} = 150 °C



5 Circuit diagram

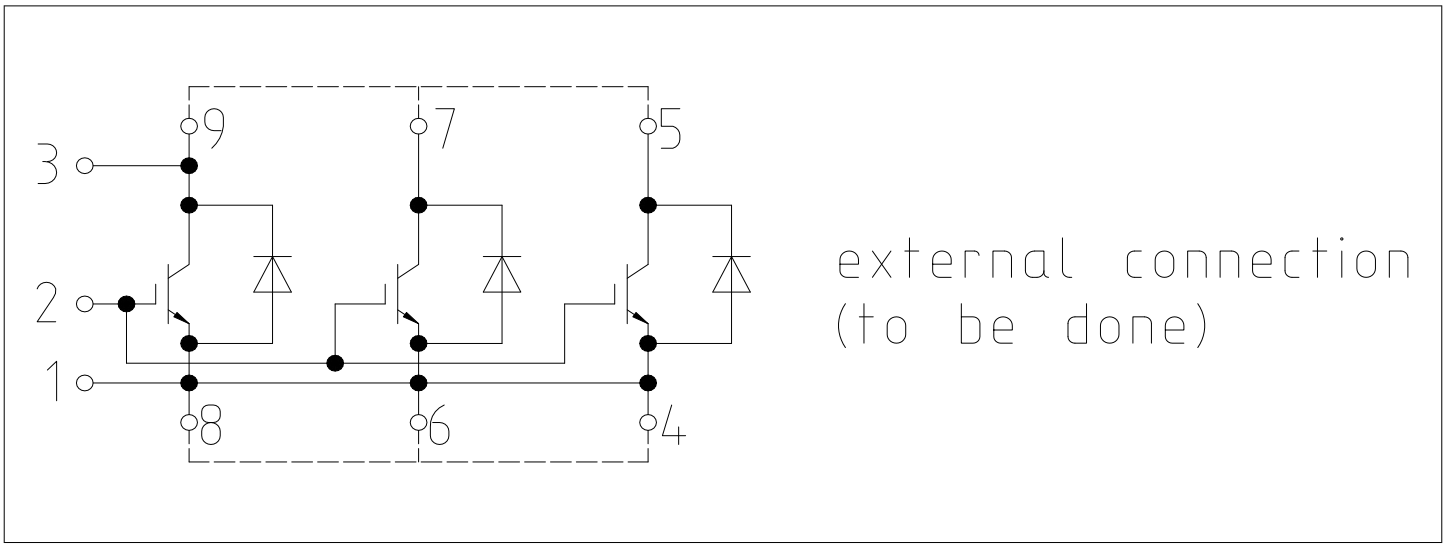


Figure 1

6 Package outlines

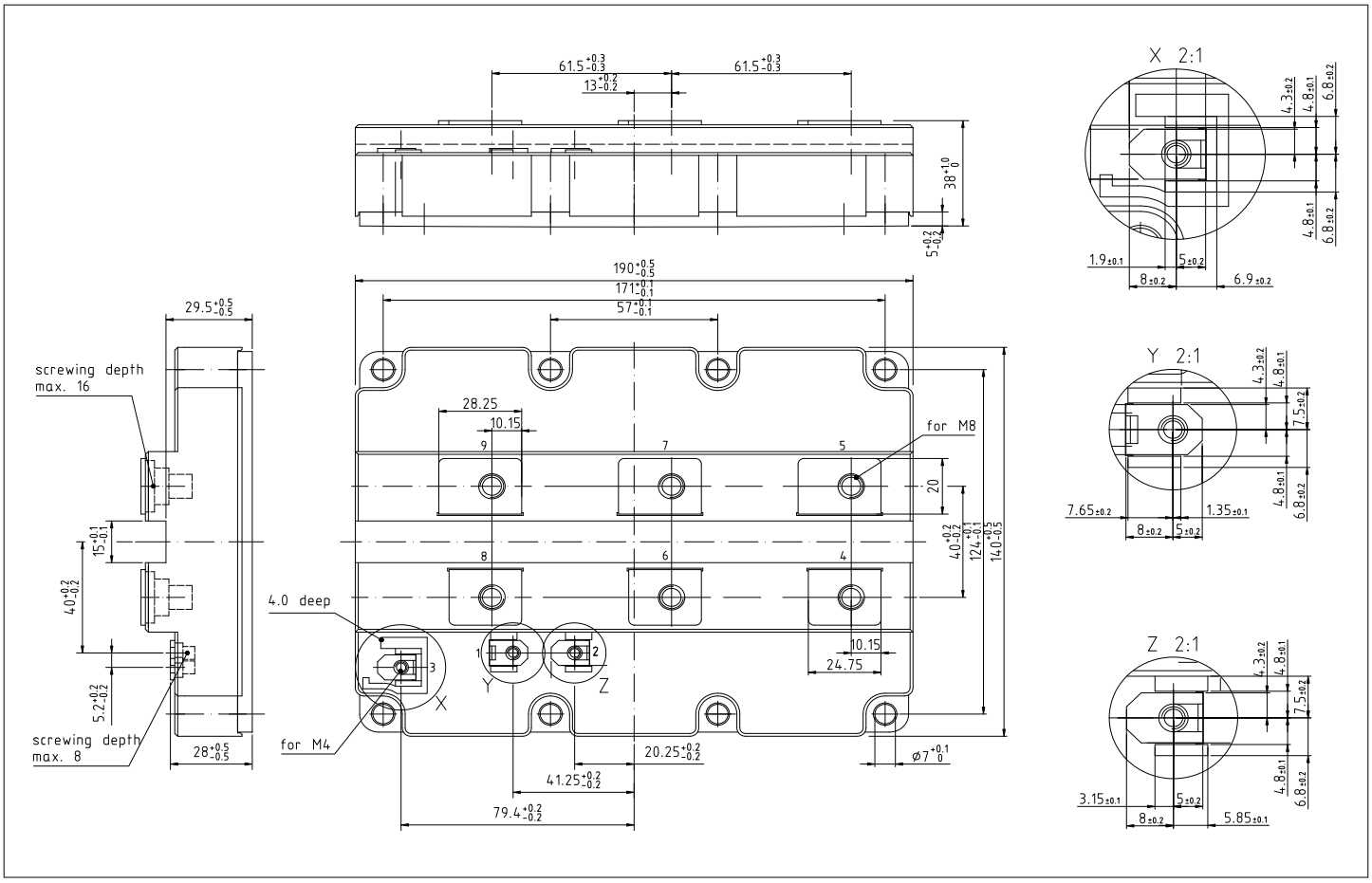


Figure 2

7 Module label code

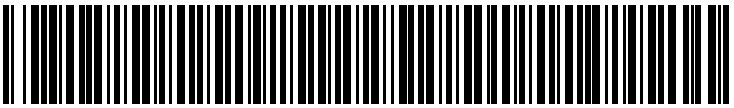
Module label code			
Code format	Data Matrix		Barcode Code128
Encoding	ASCII text		Code Set A
Symbol size	16x16		23 digits
Standard	IEC24720 and IEC16022		IEC8859-1
Code content	*Content* Module serial number Module material number Production order number Date code (production year) Date code (production week)	*Digit* 1 – 5 6 - 11 12 - 19 20 – 21 22 – 23	*Example* 71549 142846 55054991 15 30
Example	 71549142846550549911530	 71549142846550549911530	

Figure 3

Revision history

Document revision	Date of release	Description of changes
1.00	2021-03-25	
1.10	2021-10-15	Final datasheet
1.20	2022-04-27	Final datasheet
1.30	2022-11-22	Final datasheet

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