

IHM-B module with Trench/Fieldstop IGBT3 and emitter controlled 3 diode

Features

- Electrical features
 - $V_{CES} = 4500\text{ V}$
 - $I_{C\text{ nom}} = 1200\text{ A} / I_{CRM} = 2400\text{ A}$
 - High DC stability
 - High short-circuit capability
 - High dynamic robustness
 - Low $V_{CE,sat}$
 - Trench IGBT 3
 - $V_{CE,sat}$ with positive temperature coefficient
- Mechanical features
 - ALSiC base plate for increased thermal cycling capability
 - Package with CTI > 600
 - IHM B housing
 - Isolated base plate
 - Standard housing



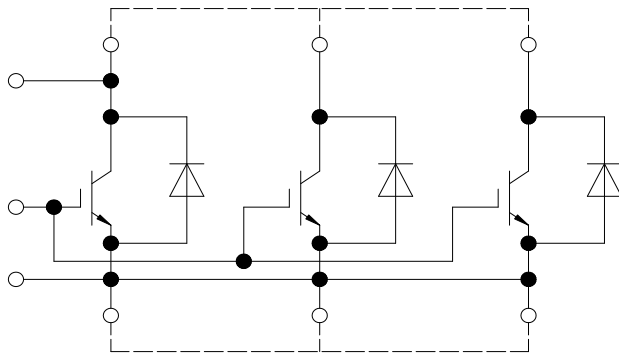
Potential applications

- High-power converters
- Medium-voltage converters
- Power transmission and distribution

Product validation

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

Description



external connection
(to be done)

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
	Revision history	14
	Disclaimer	15

1 Package

Table 1 Insulation coordination

Parameter	Symbol	Note or test condition	Values	Unit
Isolation test voltage	V_{ISOL}	RMS, $f = 50 \text{ Hz}$, $t = 1 \text{ min}$	6.0	kV
Partial discharge extinction voltage	V_{isol}	RMS, $f = 50 \text{ Hz}$, $Q_{PD} \leq 10 \text{ pC}$	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		mΩ
Module lead resistance, terminals - chip	$R_{CC'+EE'}$	$T_C=25^{\circ}\text{C}$, 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}		$T_{vj} = -40^{\circ}\text{C}$	4500	V
			$T_{vj} = 150^{\circ}\text{C}$	4500	
Continuous DC collector current	I_{CDC}	$T_{vj \text{ max}} = 150^{\circ}\text{C}$	$T_C = 95^{\circ}\text{C}$	1200	A
Repetitive peak collector current	I_{CRM}	$t_p = 1 \text{ ms}$		2400	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	$V_{CE\ sat}$	$I_C = 1200\ A, V_{GE} = 15\ V$	$T_{vj} = 25\ ^\circ C$		2.35	2.80	V
			$T_{vj} = 125\ ^\circ C$		2.90	3.45	
			$T_{vj} = 150\ ^\circ C$		3.00	3.55	
Gate threshold voltage	V_{GEth}	$I_C = 105\ mA, V_{CE} = V_{GE}, T_{vj} = 25\ ^\circ C$		5.5	6	6.5	V
Gate charge	Q_G	$V_{GE} = \pm 15\ V, V_{CE} = 2800\ V$			33.5		μC
Internal gate resistor	R_{Gint}	$T_{vj} = 25\ ^\circ C$			0.42		Ω
Input capacitance	C_{ies}	$f = 1000\ kHz, T_{vj} = 25\ ^\circ C, V_{CE} = 25\ V, V_{GE} = 0\ V$			280		nF
Reverse transfer capacitance	C_{res}	$f = 1000\ kHz, T_{vj} = 25\ ^\circ C, V_{CE} = 25\ V, V_{GE} = 0\ V$			4.7		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}	$I_C = 1200\ A, V_{CE} = 2800\ V, V_{GE} = \pm 15\ V, R_{Gon} = 1.3\ \Omega$	$T_{vj} = 25\ ^\circ C$		0.370		μs
			$T_{vj} = 125\ ^\circ C$		0.390		
			$T_{vj} = 150\ ^\circ C$		0.400		
Rise time (inductive load)	t_r	$I_C = 1200\ A, V_{CE} = 2800\ V, V_{GE} = \pm 15\ V, R_{Gon} = 1.3\ \Omega$	$T_{vj} = 25\ ^\circ C$		0.230		μs
			$T_{vj} = 125\ ^\circ C$		0.250		
			$T_{vj} = 150\ ^\circ C$		0.260		
Turn-off delay time (inductive load)	t_{doff}	$I_C = 1200\ A, V_{CE} = 2800\ V, V_{GE} = \pm 15\ V, R_{Goff} = 5.1\ \Omega$	$T_{vj} = 25\ ^\circ C$		5.700		μs
			$T_{vj} = 125\ ^\circ C$		6.000		
			$T_{vj} = 150\ ^\circ C$		6.100		
Fall time (inductive load)	t_f	$I_C = 1200\ A, V_{CE} = 2800\ V, V_{GE} = \pm 15\ V, R_{Goff} = 5.1\ \Omega$	$T_{vj} = 25\ ^\circ C$		0.340		μs
			$T_{vj} = 125\ ^\circ C$		0.500		
			$T_{vj} = 150\ ^\circ C$		0.570		
Turn-on time (resistive load)	t_{on_R}	$I_C = 500\ A, V_{CE} = 2000\ V, V_{GE} = \pm 15\ V, R_{Gon} = 1.3\ \Omega$	$T_{vj} = 25\ ^\circ C$	1.27			μs
Turn-on energy loss per pulse	E_{on}	$I_C = 1200\ A, V_{CE} = 2800\ V, L_\sigma = 150\ nH, V_{GE} = \pm 15\ V, R_{Gon} = 1.3\ \Omega, di/dt = 4800\ A/\mu s (T_{vj} = 150\ ^\circ C)$	$T_{vj} = 25\ ^\circ C$		4000		mJ
			$T_{vj} = 125\ ^\circ C$		5300		
			$T_{vj} = 150\ ^\circ C$		6000		
Turn-off energy loss per pulse	E_{off}	$I_C = 1200\ A, V_{CE} = 2800\ V, L_\sigma = 150\ nH, V_{GE} = \pm 15\ V, R_{Goff} = 5.1\ \Omega, dv/dt = 2000\ V/\mu s (T_{vj} = 150\ ^\circ C)$	$T_{vj} = 25\ ^\circ C$		4100		mJ
			$T_{vj} = 125\ ^\circ C$		5300		
			$T_{vj} = 150\ ^\circ C$		5700		
SC data	I_{SC}	$V_{GE} \leq 15\ V, V_{CC} = 2800\ V, V_{CEmax} = V_{CES} - L_{sCE} \cdot di/dt$	$t_p \leq 10\ \mu s, T_{vj} = 150\ ^\circ C$		6900		A

(table continues...)

Table 4 (continued) Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Thermal resistance, junction to case	R_{thJC}	per IGBT			8.20	K/kW
Thermal resistance, case to heat sink	R_{thCH}	per IGBT, $\lambda_{grease} = 1 \text{ W/(m}^2\text{K)}$		10.0		K/kW
Temperature under switching conditions	$T_{vj \text{ op}}$		-40		150	°C

Note: The maximum allowed dv/dt measured between 0.6 and $1 \times V_{ce}$ is 2400V/ μs .

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			1200	A
Repetitive peak forward current	I_{FRM}	$t_p = 1 \text{ ms}$		2400	A
I^2t - value	I^2t	$t_p = 10 \text{ ms}, V_R = 0 \text{ V}$	$T_{vj} = 125 \text{ }^{\circ}\text{C}$	510	kA^2s
			$T_{vj} = 150 \text{ }^{\circ}\text{C}$	460	
Maximum power dissipation	P_{RQM}	$T_{vj} = 150 \text{ }^{\circ}\text{C}$		2400	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	$I_F = 1200 \text{ A}, V_{GE} = 0 \text{ V}$	$T_{vj} = 25 \text{ }^{\circ}\text{C}$		2.50	V
			$T_{vj} = 125 \text{ }^{\circ}\text{C}$		2.50	
			$T_{vj} = 150 \text{ }^{\circ}\text{C}$		2.45	
Peak reverse recovery current	I_{RM}	$V_R = 2800 \text{ V}, I_F = 1200 \text{ A}, V_{GE} = -15 \text{ V}, -di_F/dt = 4800 \text{ A}/\mu\text{s} (T_{vj} = 150 \text{ }^{\circ}\text{C})$	$T_{vj} = 25 \text{ }^{\circ}\text{C}$		1600	A
			$T_{vj} = 125 \text{ }^{\circ}\text{C}$		1800	
			$T_{vj} = 150 \text{ }^{\circ}\text{C}$		1800	

(table continues...)

Table 6 (continued) **Characteristic values**

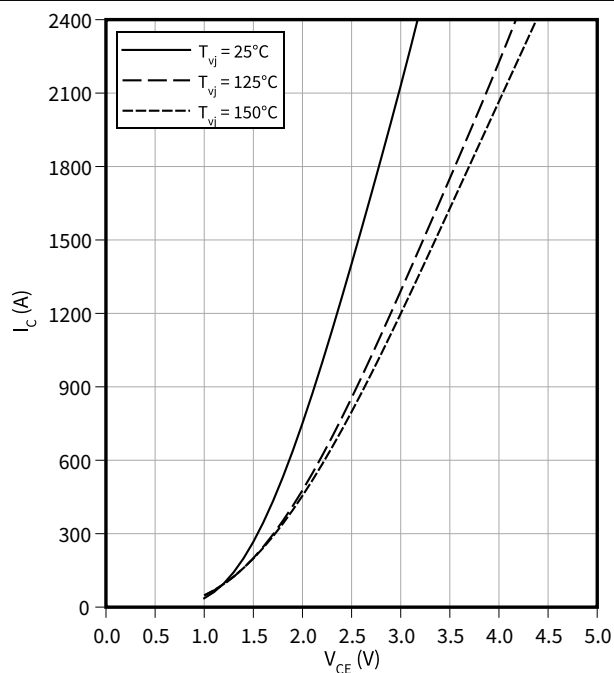
Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Recovered charge	Q_r	$V_R = 2800 \text{ V}$, $I_F = 1200 \text{ A}$, $V_{GE} = -15 \text{ V}$, $-di_F/dt = 4800 \text{ A}/\mu\text{s}$ ($T_{vj} = 150 \text{ }^\circ\text{C}$)	$T_{vj} = 25 \text{ }^\circ\text{C}$	1200		μC
			$T_{vj} = 125 \text{ }^\circ\text{C}$	2000		
			$T_{vj} = 150 \text{ }^\circ\text{C}$	2300		
Reverse recovery energy	E_{rec}	$V_R = 2800 \text{ V}$, $I_F = 1200 \text{ A}$, $V_{GE} = -15 \text{ V}$, $-di_F/dt = 4800 \text{ A}/\mu\text{s}$ ($T_{vj} = 150 \text{ }^\circ\text{C}$)	$T_{vj} = 25 \text{ }^\circ\text{C}$	1700		mJ
			$T_{vj} = 125 \text{ }^\circ\text{C}$	3200		
			$T_{vj} = 150 \text{ }^\circ\text{C}$	3800		
Thermal resistance, junction to case	R_{thJC}	per diode			13.8	K/kW
Thermal resistance, case to heat sink	R_{thCH}	per diode, $\lambda_{grease} = 1 \text{ W}/(\text{m}^\circ\text{K})$		10.5		K/kW
Temperature under switching conditions	$T_{vj op}$		-40		150	$^\circ\text{C}$

4 Characteristics diagrams

output characteristic (typical), IGBT, Inverter

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

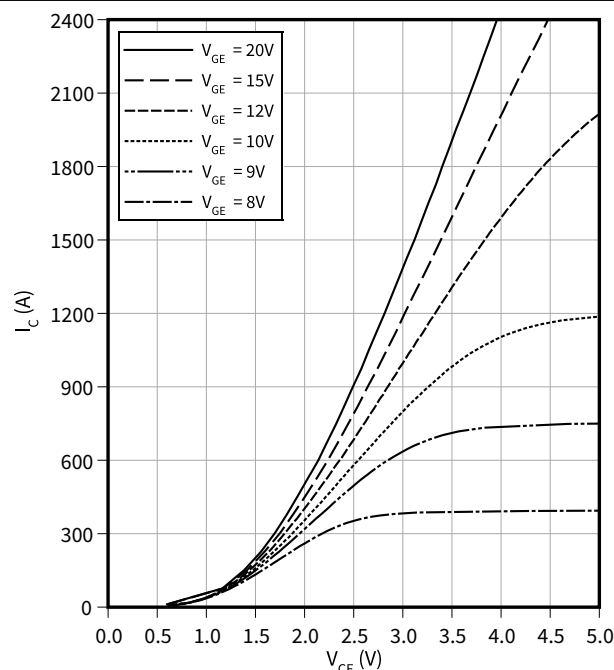
$$V_{GE} = 15 \text{ V}$$



output characteristic (typical), IGBT, Inverter

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

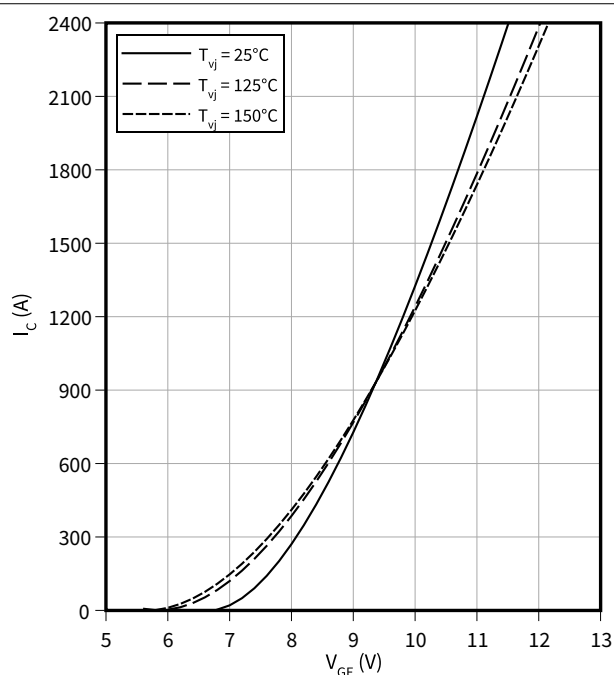
$$T_{vj} = 150 \text{ °C}$$



transfer characteristic (typical), IGBT, Inverter

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

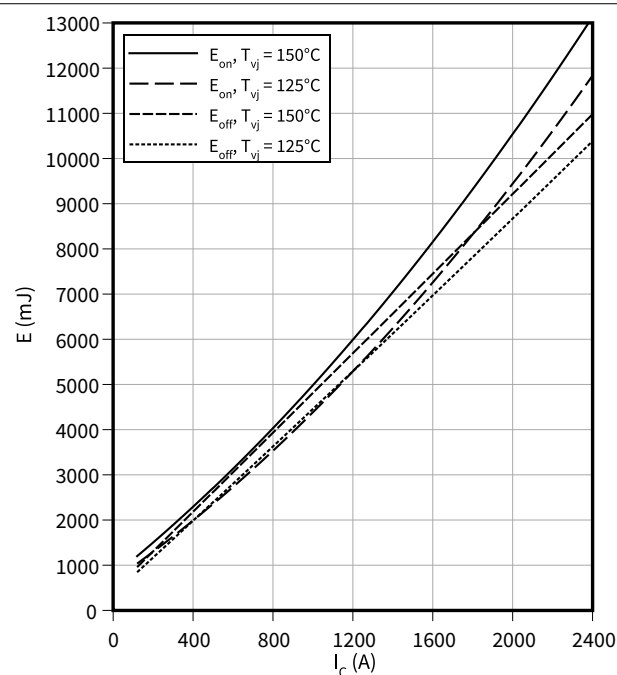
$$V_{CE} = 20 \text{ V}$$



switching losses (typical), IGBT, Inverter

$$E = f(I_C)$$

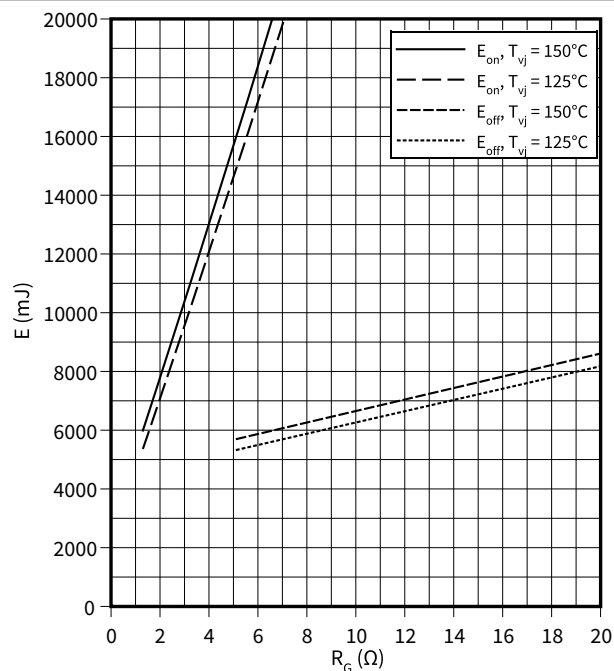
$$R_{Goff} = 5.1 \text{ } \Omega, R_{Gon} = 1.3 \text{ } \Omega, V_{CE} = 2800 \text{ V}, V_{GE} = -15 / 15 \text{ V}$$



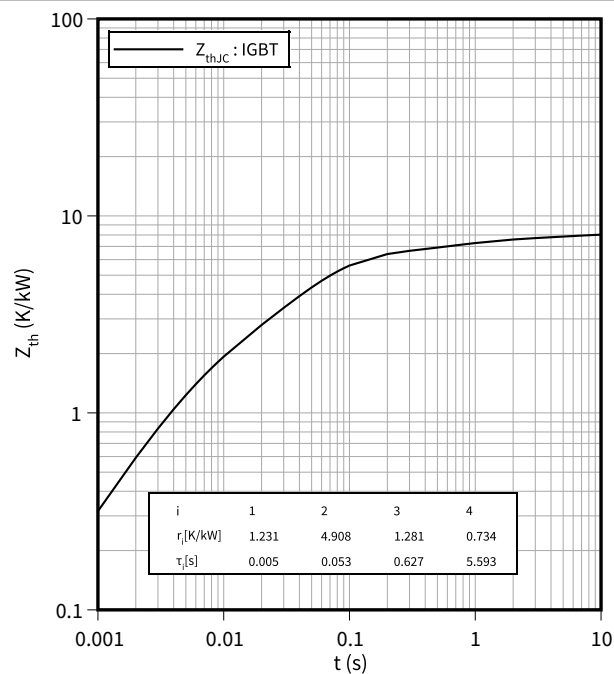
switching losses (typical), IGBT, Inverter

$$E = f(R_G)$$

$$I_C = 1200 \text{ A}, V_{CE} = 2800 \text{ V}, V_{GE} = -15 / 15 \text{ V}$$

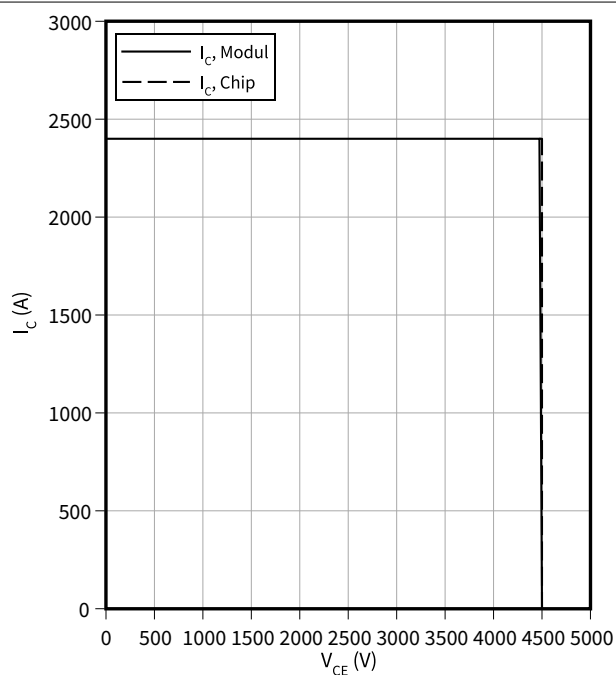
**transient thermal impedance, IGBT, Inverter**

$$Z_{th} = f(t)$$

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

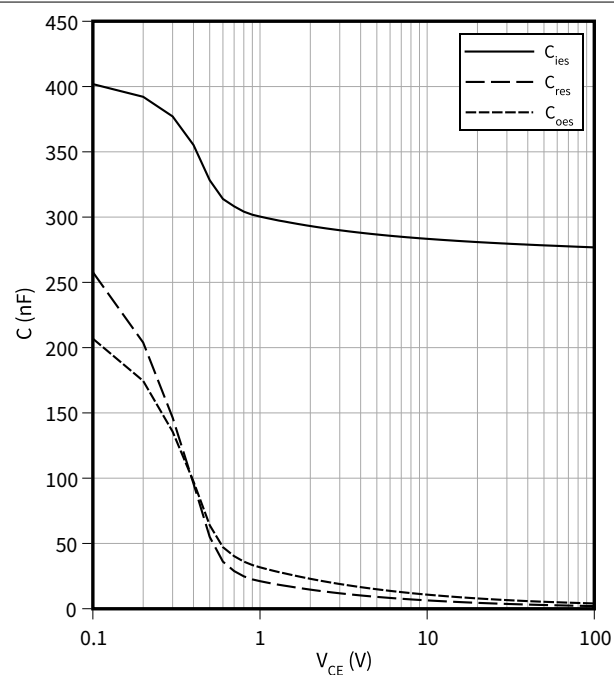
$$I_C = f(V_{CE})$$

$$R_{Goff} = 5.1 \Omega, V_{GE} = \pm 15 \text{ V}, T_{vj} = 150 \text{ }^\circ\text{C}$$

**capacity characteristic (typical), IGBT, Inverter**

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

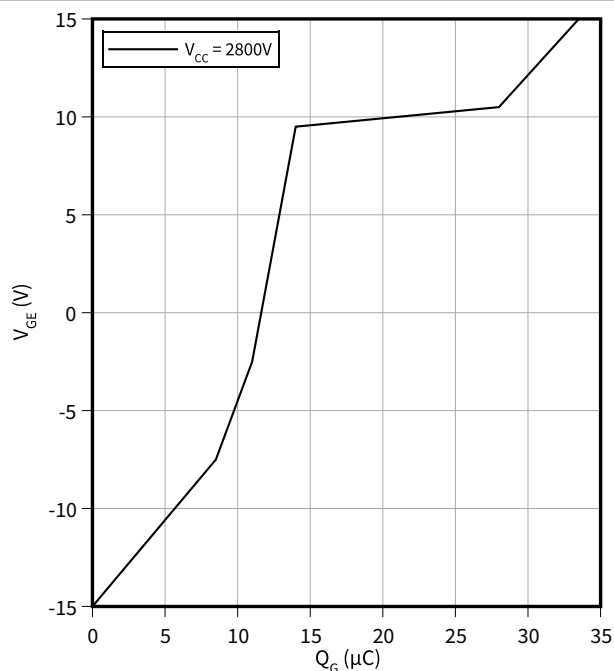
$$f = 100 \text{ kHz}, V_{GE} = 0 \text{ V}, T_{vj} = 25 \text{ }^\circ\text{C}$$



gate charge characteristic (typical), IGBT, Inverter

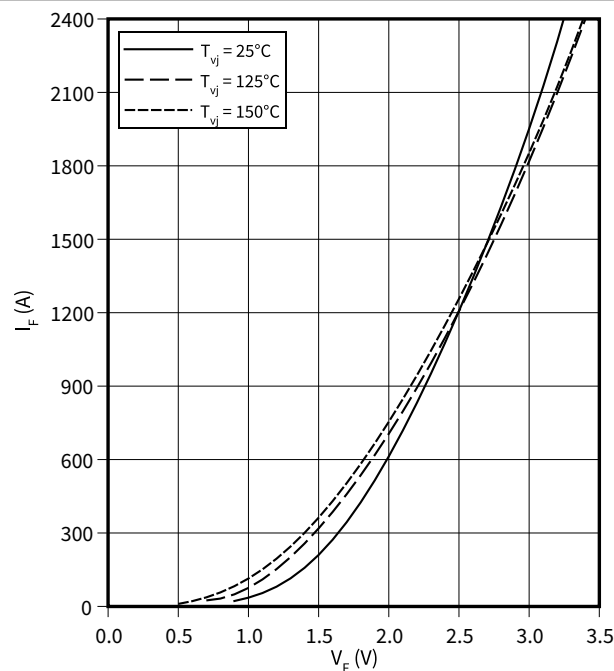
$$V_{GE} = f(Q_G)$$

$$I_C = 1200 \text{ A}, T_{vj} = 25^\circ\text{C}$$



forward characteristic (typical), Diode, Inverter

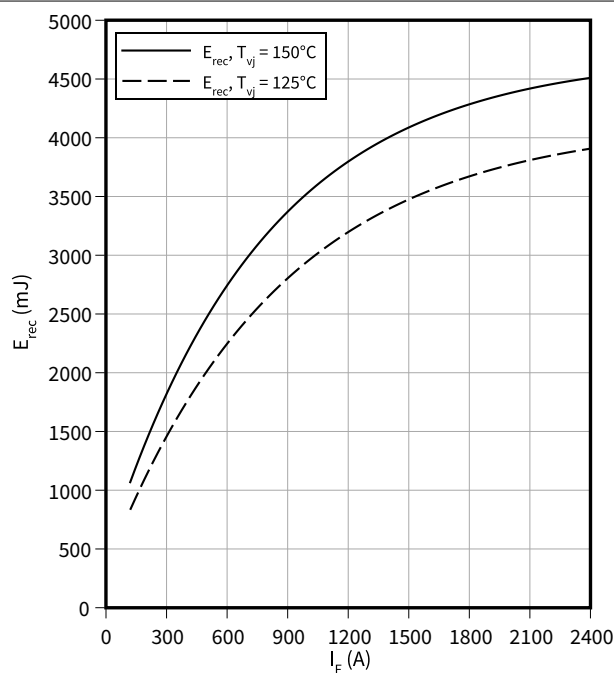
$$I_F = f(V_F)$$



switching losses (typical), Diode, Inverter

$$E_{rec} = f(I_F)$$

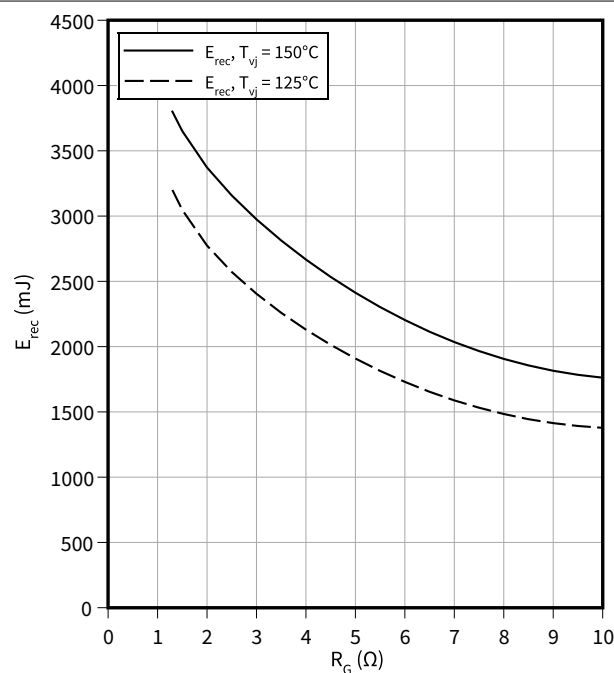
$$V_{CE} = 2800 \text{ V}, R_{Gon} = R_{Gon}(\text{IGBT})$$



switching losses (typical), Diode, Inverter

$$E_{rec} = f(R_G)$$

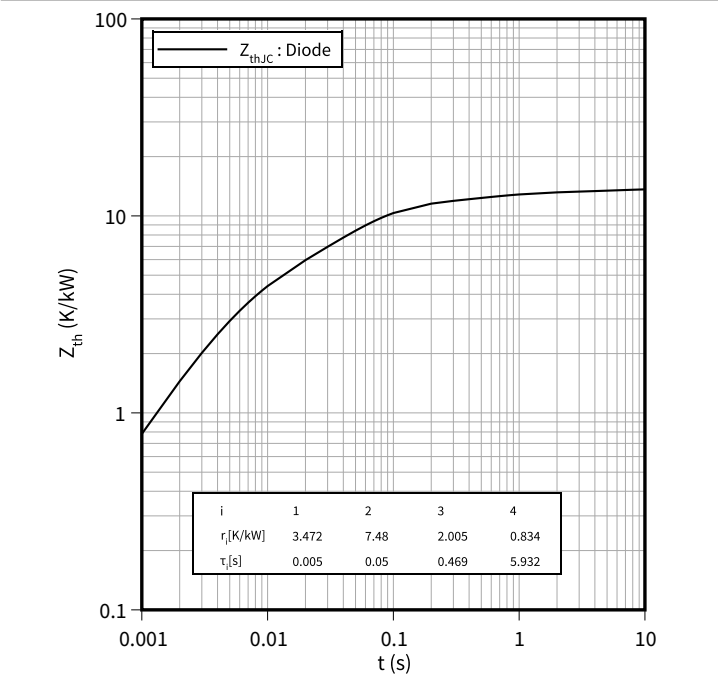
$$V_{CE} = 2800 \text{ V}, I_F = 1200 \text{ A}$$



4 Characteristics diagrams

transient thermal impedance , Diode, Inverter

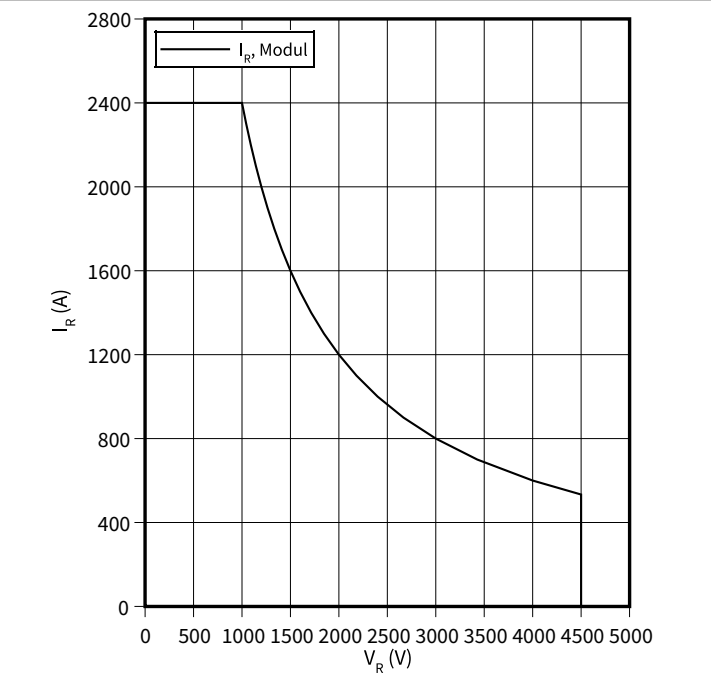
$Z_{th} = f(t)$



safe operation area (SOA), Diode, Inverter

$I_R = f(V_R)$

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



5 **Circuit diagram**

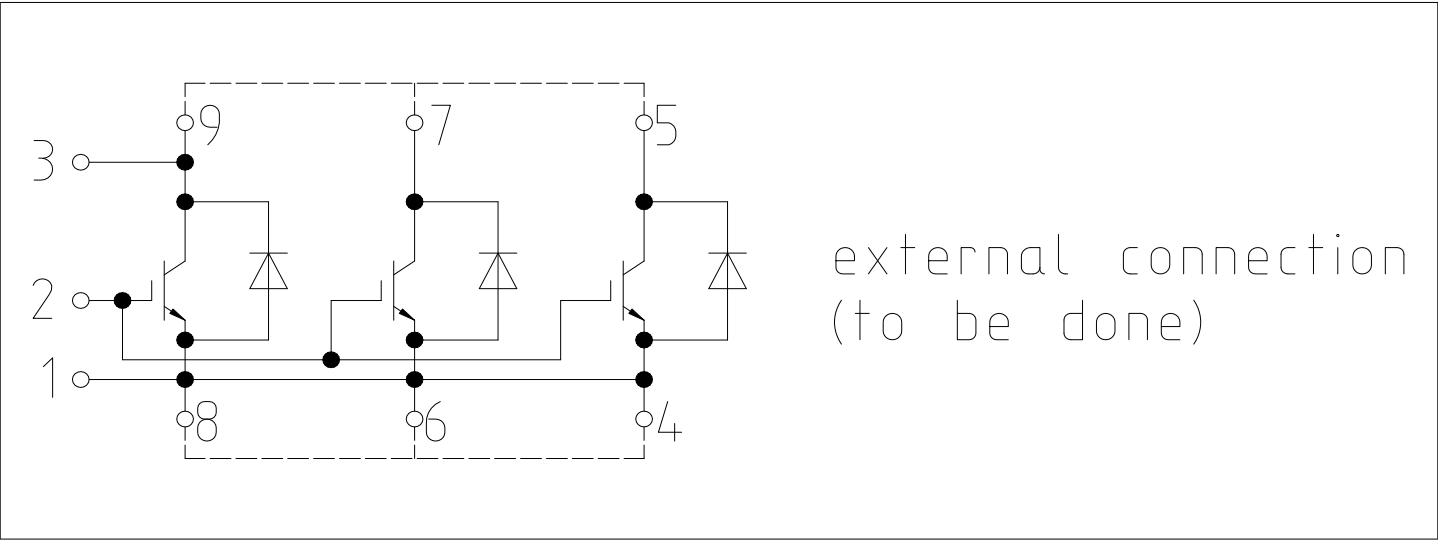


Figure 1

6 Package outlines

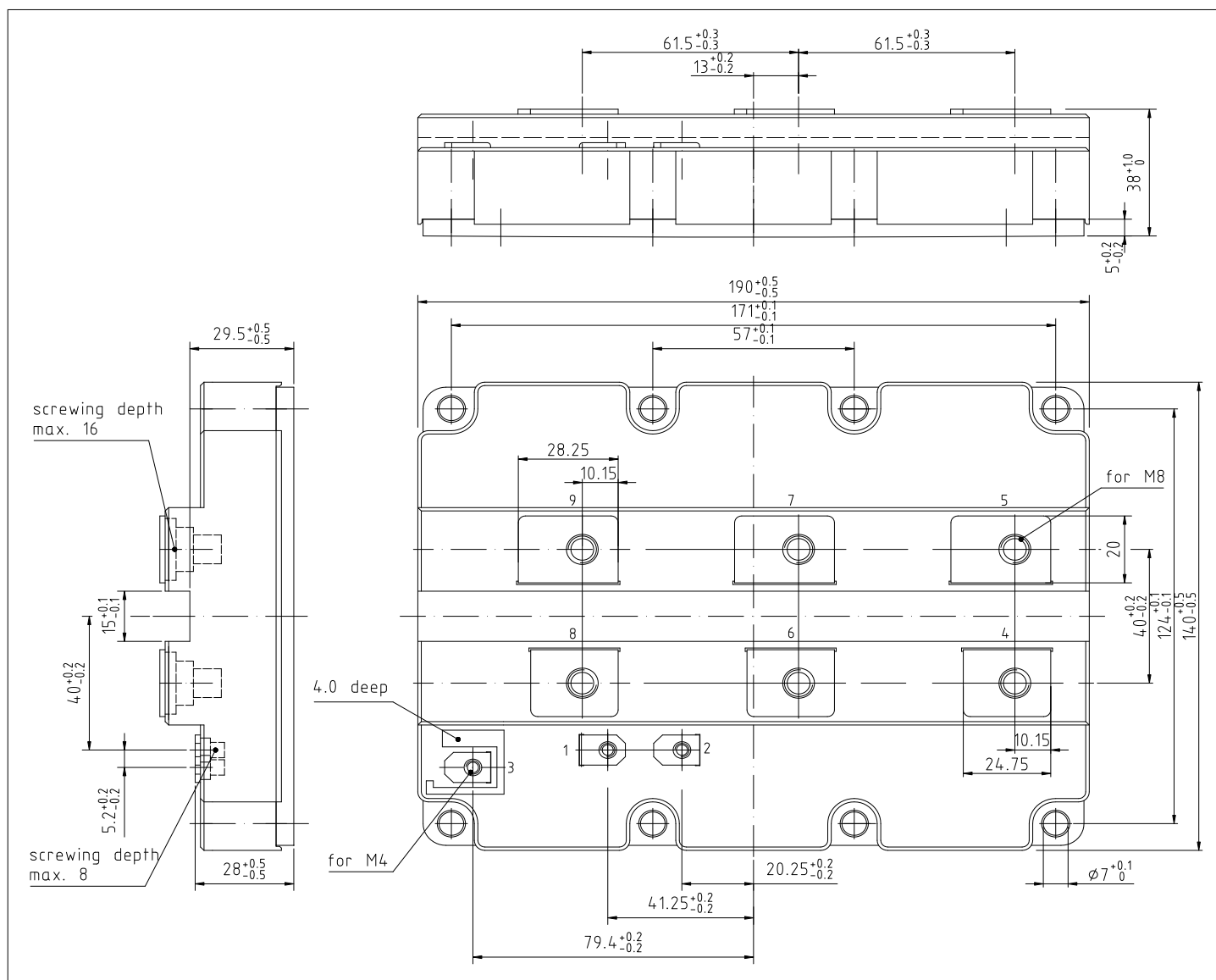


Figure 2

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
V1.0	2011-05-17	Target datasheet
V1.1	2013-06-07	Target datasheet
V2.0	2014-03-27	Preliminary datasheet
V3.0	2014-06-10	Final datasheet
V3.1	2014-08-19	Final datasheet
V3.2	2018-02-19	Final datasheet
V3.3	2019-08-23	Final datasheet
n/a	2020-09-01	Datasheet migrated to a new system with a new layout and new revision number schema: target or preliminary datasheet = 0.xy; final datasheet = 1.xy
1.10	2021-11-02	Final datasheet

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Edition 2021-11-02

Published by

Infineon Technologies AG
81726 Munich, Germany

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Document reference
IFX-AAW888-008

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