Highly insulated module with Trench/Fieldstop IGBT3 and emitter controlled 3 diode

Features

- Electrical features
  - V_{CES} = 4500 V
  - $I_{C\ nom}$ = 1000 A / I_{CRM} = 2000 A
  - High DC stability
  - High dynamic robustness
  - High short-circuit capability
  - Low $V_{CE,sat}$
  - Trench IGBT 3
  - $V_{CE,sat}$ with positive temperature coefficient
- Mechanical features
  - AlSiC base plate for increased thermal cycling capability
  - High creepage and clearance distances
  - Isolated base plate
  - Package with CTI > 600
  - Package with enhanced insulation of 10.4 kV AC 60 s

Potential applications

- Motor drives
- Traction drives
- Multi-level inverter
- High-power converters
- Medium-voltage converters

Product validation

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

Description

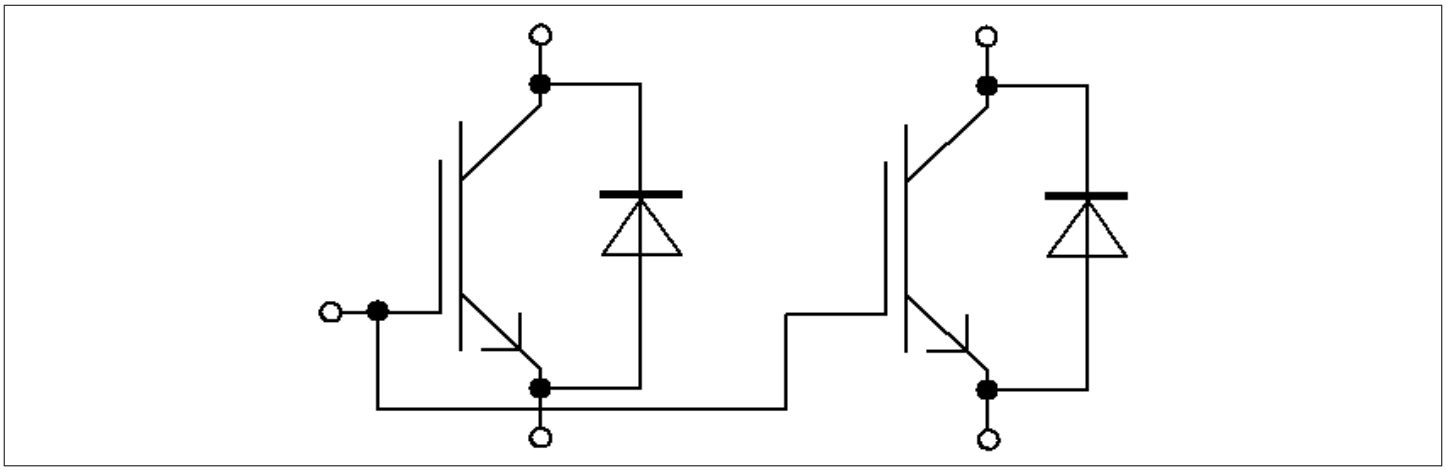


Table of contents

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	10.4	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	3000	V
Material of module baseplate			AlSiC	
Internal isolation		basic insulation (class 1, IEC 61140)	AlN	
Creepage distance	d_{Creep}	terminal to heatsink	64.0	mm
Creepage distance	d_{Creep}	terminal to terminal	56.0	mm
Clearance	d_{Clear}	terminal to heatsink	40.0	mm
Clearance	d_{Clear}	terminal to terminal	26.0	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}				20		nH
Module lead resistance, terminals - chip	$R_{CC'+EE'}$	T_C=25°C, per switch			0.18		mΩ
Storage temperature	T_{stg}			-55		125	°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*				1000		g

Note: The maximum allowed dv/dt measured between 0,6 and 1×Vce is 1400V/µs.

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} = 25 °C	4500	
			T_{vj} = 125 °C	4500	

(table continues...)

Table 3 (continued) Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
Continuous DC collector current	I_{CDC}	$T_{vj\,max}$ = 150 °C	T_C = 80 °C	1000	A
Repetitive peak collector current	I_{CRM}	t_p limited by $T_{vj\,op}$		2000	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 = 1000 A, V_{GE} = 15 V	T_{vj} = 25 °C		2.70	3.05	V
			T_{vj} = 125 °C		3.25	3.85	
Gate threshold voltage	V_{GEth}	I_C = 70.5 mA, V_{CE} = V_{GE}, T_{vj} = 25 °C		5.40	6	6.60	V
Gate charge	Q_G	V_{GE} = ±15 V, V_{CC} = 2800 V			26.5		µC
Internal gate resistor	R_{Gint}	T_{vj} = 25 °C			1.1		Ω
Input capacitance	C_{ies}	f = 1000 kHz, T_{vj} = 25 °C, V_{CE} = 25 V, V_{GE} = 0 V			185		nF
Reverse transfer capacitance	C_{res}	f = 1000 kHz, T_{vj} = 25 °C, V_{CE} = 25 V, V_{GE} = 0 V			3.1		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 = 1000 A, V_{CC} = 2800 V, V_{GE} = ±15 V, R_{Gon} = 1 Ω	T_{vj} = 25 °C		0.910		µs
			T_{vj} = 125 °C		0.960		
Rise time (inductive load)	t_r	I_C = 1000 A, V_{CC} = 2800 V, V_{GE} = ±15 V, R_{Gon} = 1 Ω	T_{vj} = 25 °C		0.210		µs
			T_{vj} = 125 °C		0.230		
Turn-off delay time (inductive load)	t_{doff}	I_C = 1000 A, V_{CC} = 2800 V, V_{GE} = ±15 V, R_{Goff} = 9.1 Ω	T_{vj} = 25 °C		7.150		µs
			T_{vj} = 125 °C		7.530		
Fall time (inductive load)	t_f	I_C = 1000 A, V_{CC} = 2800 V, V_{GE} = ±15 V, R_{Goff} = 9.1 Ω	T_{vj} = 25 °C		1.100		µs
			T_{vj} = 125 °C		2.120		
Turn-on time (resistive load)	t_{on_R}	I_C = 500 A, V_{CC} = 2000 V, V_{GE} = ±15 V, R_{Gon} = 1 Ω	T_{vj} = 25 °C	1.80			µs
Turn-on energy loss per pulse	E_{on}	I_C = 1000 A, V_{CC} = 2800 V, L_σ = 95 nH, V_{GE} = ±15 V, R_{Gon} = 1 Ω, di/dt = 3500 A/µs (T_{vj} = 125 °C)	T_{vj} = 25 °C		3700		mJ
			T_{vj} = 125 °C		5400		

(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 = 1000 A, V_{CC} = 2800 V, L_σ = 95 nH, V_{GE} = ±15 V, R_{Goff} = 9.1 Ω, dv/dt = 1300 V/µs (T_{vj} = 125 °C)	T_{vj} = 25 °C		3800		mJ
			T_{vj} = 125 °C		5000		
SC data	I_{SC}	V_{GE} ≤ 15 V, V_{CC} = 2800 V, V_{CEmax}=V_{CES}-L_{sCE}*di/dt	t_P ≤ 10 µs, T_{vj} ≤ 125 °C		4600		A
Thermal resistance, junction to case	R_{thJC}	per IGBT				11.1	K/kW
Thermal resistance, case to heat sink	R_{thCH}	per IGBT, λ_{grease} = 1 W/(m·K)			13.5		K/kW
Temperature under switching conditions	$T_{vj\,op}$			-50		125	°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} = 25 °C	4500	
			T_{vj} = 125 °C	4500	
Continuous DC forward current	I_F			1000	A
Repetitive peak forward current	I_{FRM}	t_P = 1 ms		2000	A
I^2t - value	I^2t	t_P = 10 ms, V_R = 0 V	T_{vj} = 125 °C	255	kA^2s
Maximum power dissipation	P_{RQM}		T_{vj} = 125 °C	1600	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 = 1000 A, V_{GE} = 0 V	T_{vj} = 25 °C		2.80	3.40	V
			T_{vj} = 125 °C		2.70	3.20	
Peak reverse recovery current	I_{RM}	V_{CC} = 2800 V, I_F = 1000 A, V_{GE} = -15 V, -di$_F$/dt = 3500 A/µs (T_{vj} = 125 °C)	T_{vj} = 25 °C		1030		A
			T_{vj} = 125 °C		1100		

(table continues...)

Table 6 (continued) Characteristic values

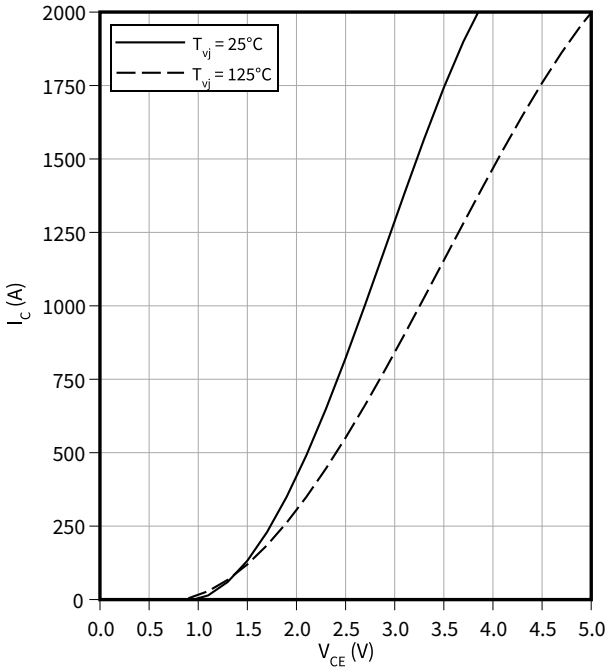
Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Recovered charge	Q_r	V_{CC} = 2800 V, I_F = 1000 A, V_{GE} = -15 V, -di$_F$/dt = 3500 A/µs (T_{vj} = 125 °C)	T_{vj} = 25 °C		860		µC
			T_{vj} = 125 °C		1700		
Reverse recovery energy	E_{rec}	V_{CC} = 2800 V, I_F = 1000 A, V_{GE} = -15 V, -di$_F$/dt = 3500 A/µs (T_{vj} = 125 °C)	T_{vj} = 25 °C		1300		mJ
			T_{vj} = 125 °C		2800		
Thermal resistance, junction to case	R_{thJC}	per diode				25.5	K/kW
Thermal resistance, case to heat sink	R_{thCH}	per diode, λ_{grease} = 1 W/(m·K)			21.0		K/kW
Temperature under switching conditions	$T_{vj\,op}$			-50		125	°C

4 Characteristics diagrams

Output characteristic (typical), IGBT, Inverter

$I_C = f(V_{CE})$

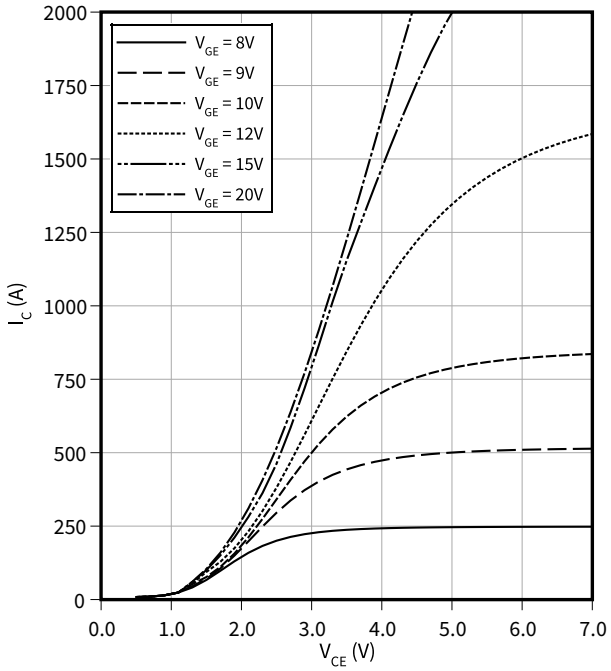
V_{GE} = 15 V



Output characteristic field (typical), IGBT, Inverter

$I_C = f(V_{CE})$

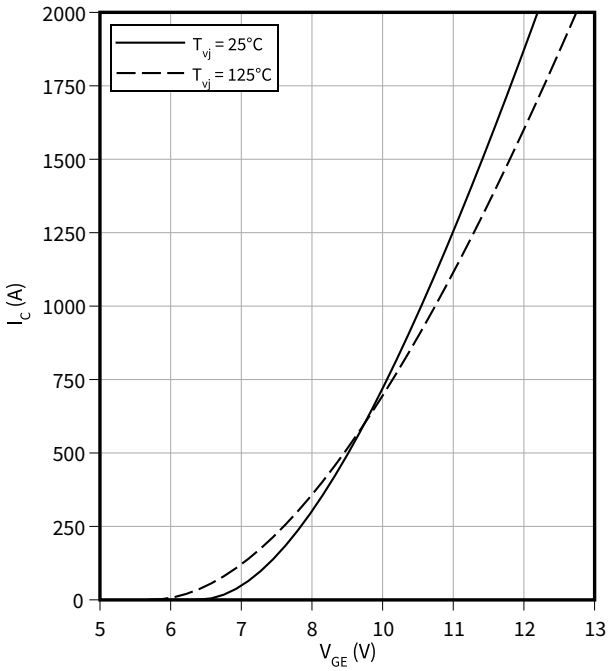
T_{vj} = 125 °C



Transfer characteristic (typical), IGBT, Inverter

$I_C = f(V_{GE})$

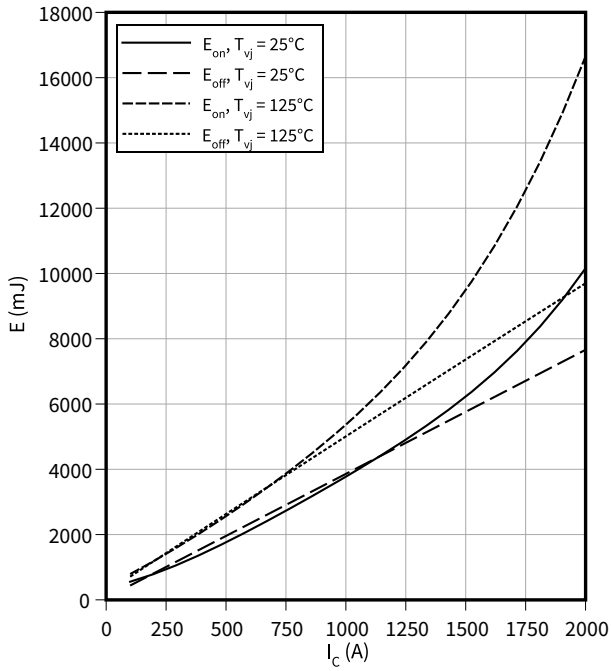
V_{CE} = 20 V



Switching losses (typical), IGBT, Inverter

$E = f(I_C)$

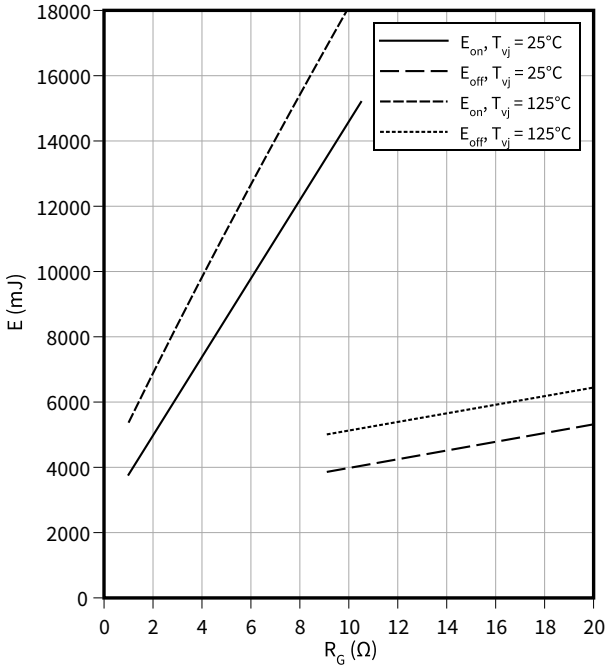
R_{Goff} = 9,1 Ω, R_{Gon} = 1 Ω, V_{CC} = 2800 V, V_{GE} = ± 15 V



Switching losses (typical), IGBT, Inverter

$E = f(R_G)$

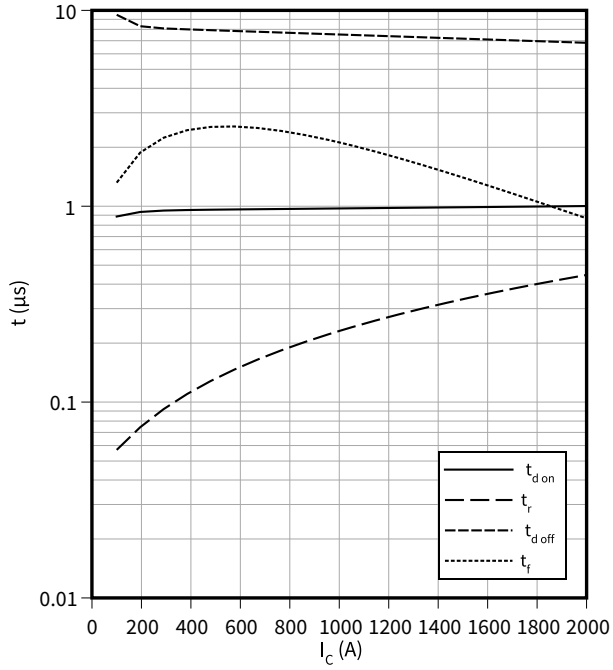
$I_C = 1000\ A$, $V_{CC} = 2800\ V$, $V_{GE} = \pm 15\ V$



Switching times (typical), IGBT, Inverter

$t = f(I_C)$

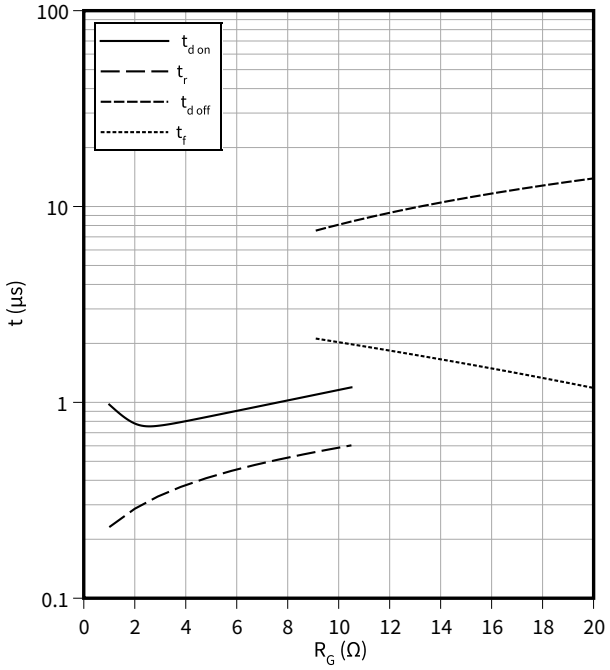
$R_{Goff} = 9.1\ \Omega$, $R_{Gon} = 1\ \Omega$, $V_{GE} = \pm 15\ V$, $V_{CC} = 2800\ V$, $T_{vj} = 125\ °C$



Switching times (typical), IGBT, Inverter

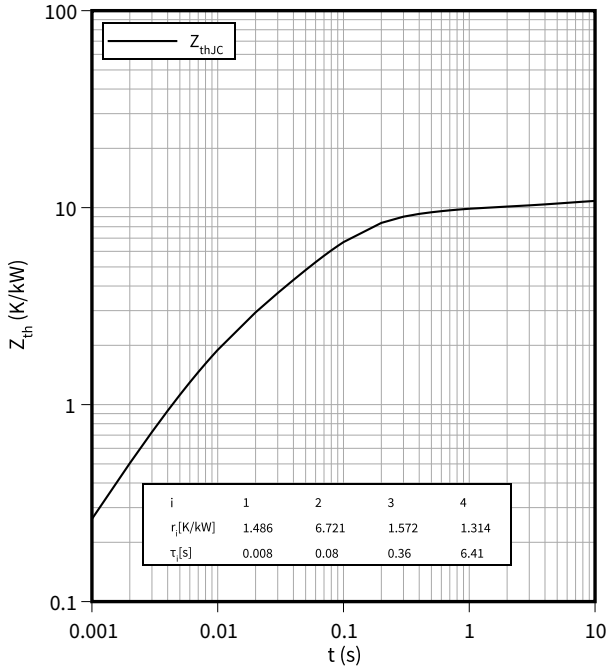
$t = f(R_G)$

$V_{GE} = \pm 15\ V$, $I_C = 1000\ A$, $V_{CC} = 2800\ V$, $T_{vj} = 125\ °C$



Transient thermal impedance , IGBT, Inverter

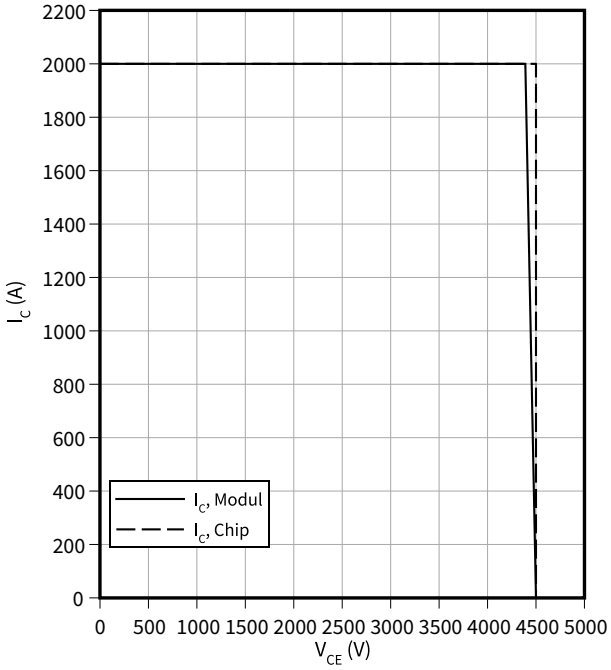
$Z_{th} = f(t)$



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

$I_C = f(V_{CE})$

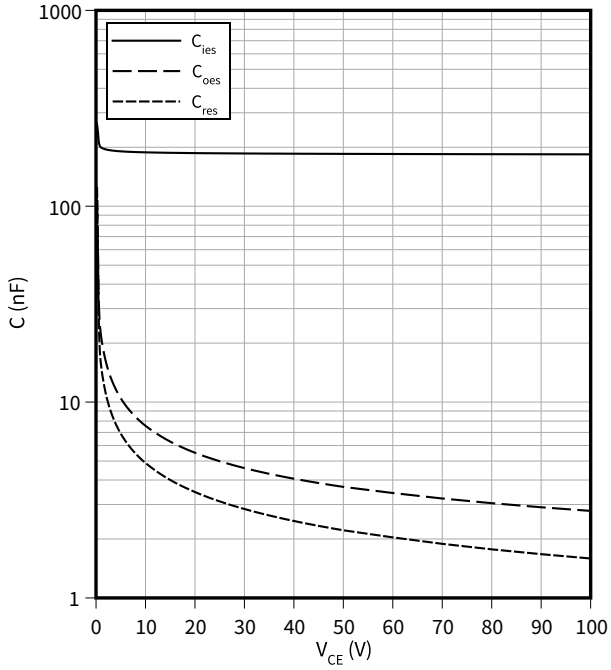
$R_{Goff} = 9.1\ \Omega$, $V_{GE} = \pm 15$ V, $T_{vj} = 125$ °C



Capacity characteristic (typical), IGBT, Inverter

$C = f(V_{CE})$

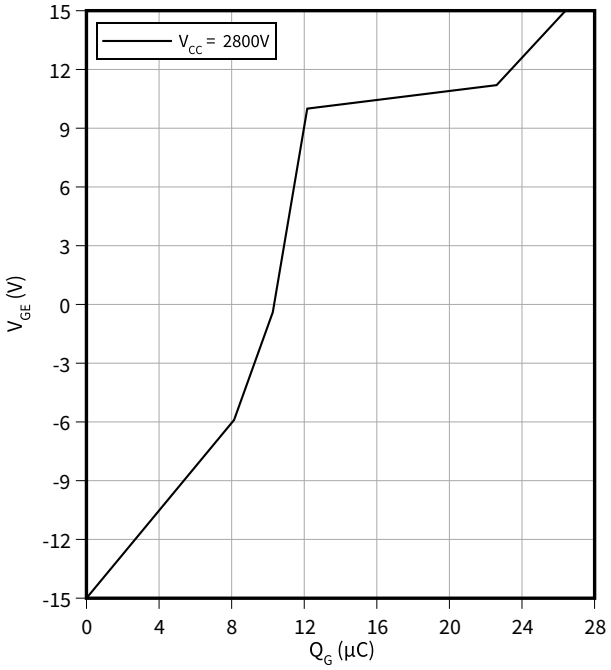
$f = 1000$ kHz, $V_{GE} = 0$ V, $T_{vj} = 25$ °C



Gate charge characteristic (typical), IGBT, Inverter

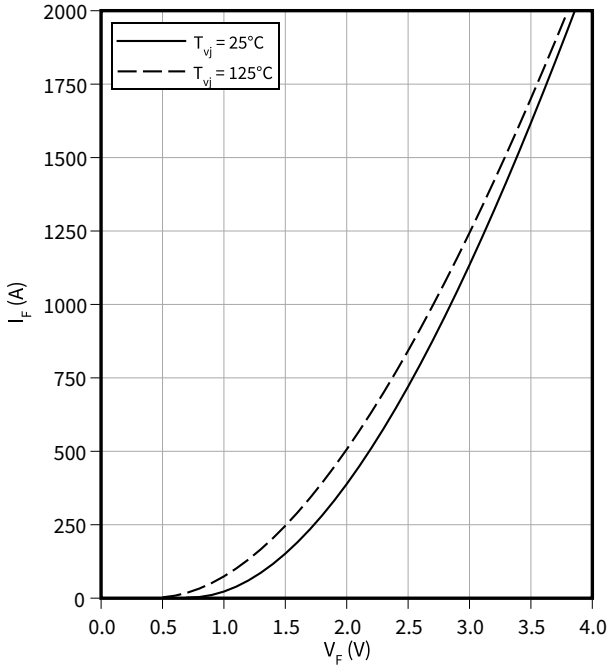
$V_{GE} = f(Q_G)$

$I_C = 1000$ A, $T_{vj} = 25$ °C



Forward characteristic (typical), Diode, Inverter

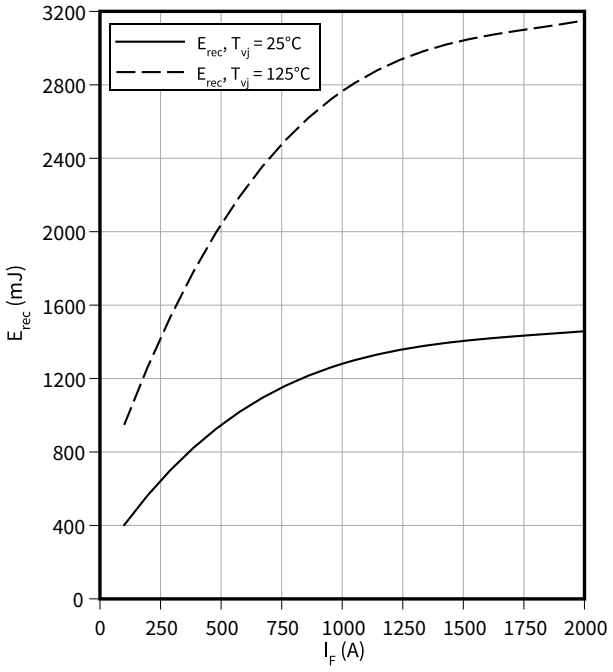
$I_F = f(V_F)$



Switching losses (typical), Diode, Inverter

$E_{rec} = f(I_F)$

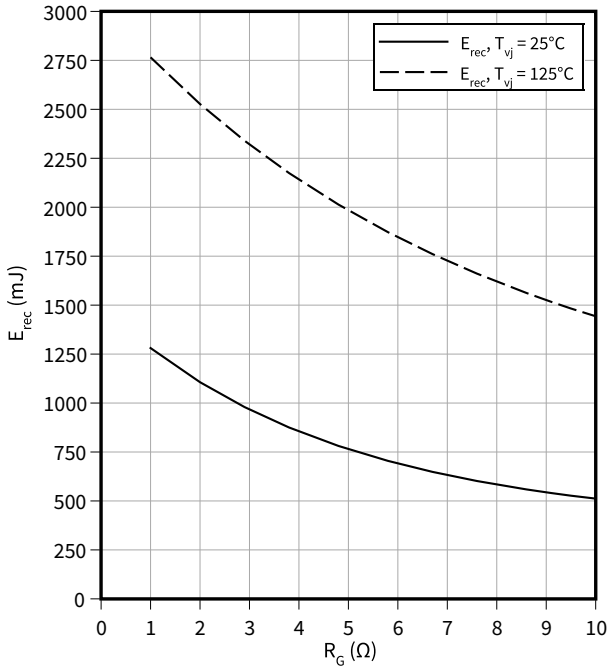
$R_{Gon} = R_{Gon}(IGBT)$, $V_{CC} = 2800$ V



Switching losses (typical), Diode, Inverter

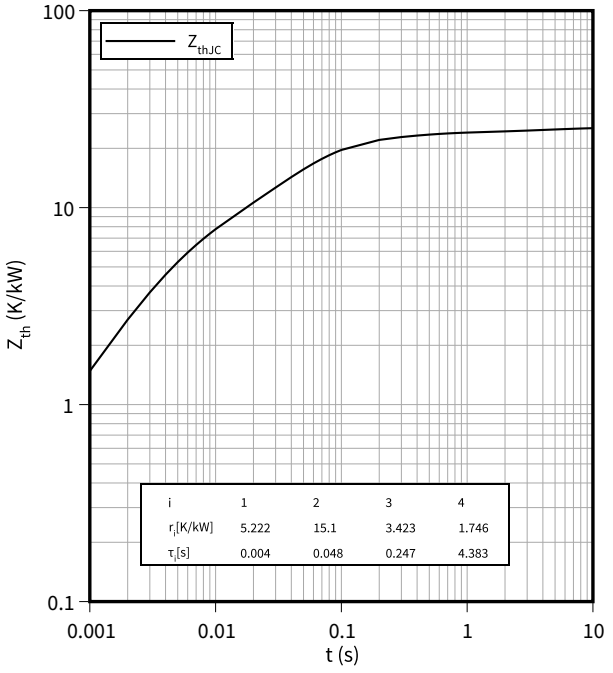
$E_{rec} = f(R_G)$

$I_F = 1000$ A, $V_{CC} = 2800$ V



Transient thermal impedance, Diode, Inverter

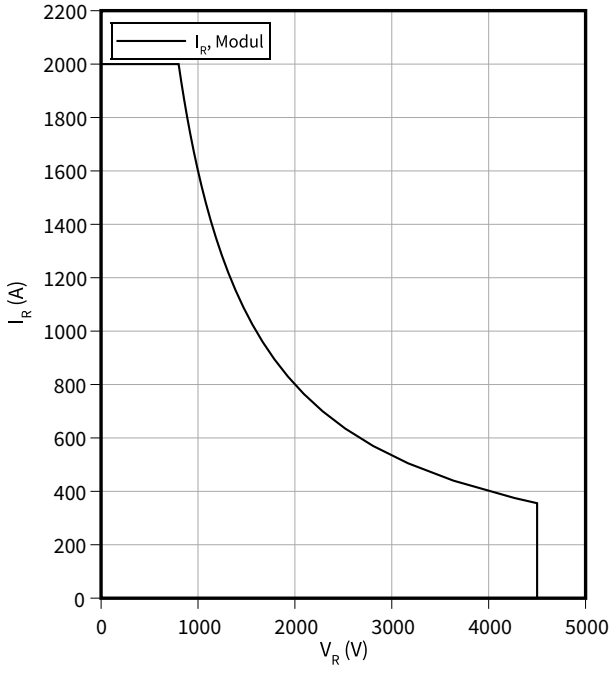
$Z_{th} = f(t)$



Safe operating area (SOA), Diode, Inverter

$I_R = f(V_R)$

$T_{vj} = 125$ °C



5 Circuit diagram

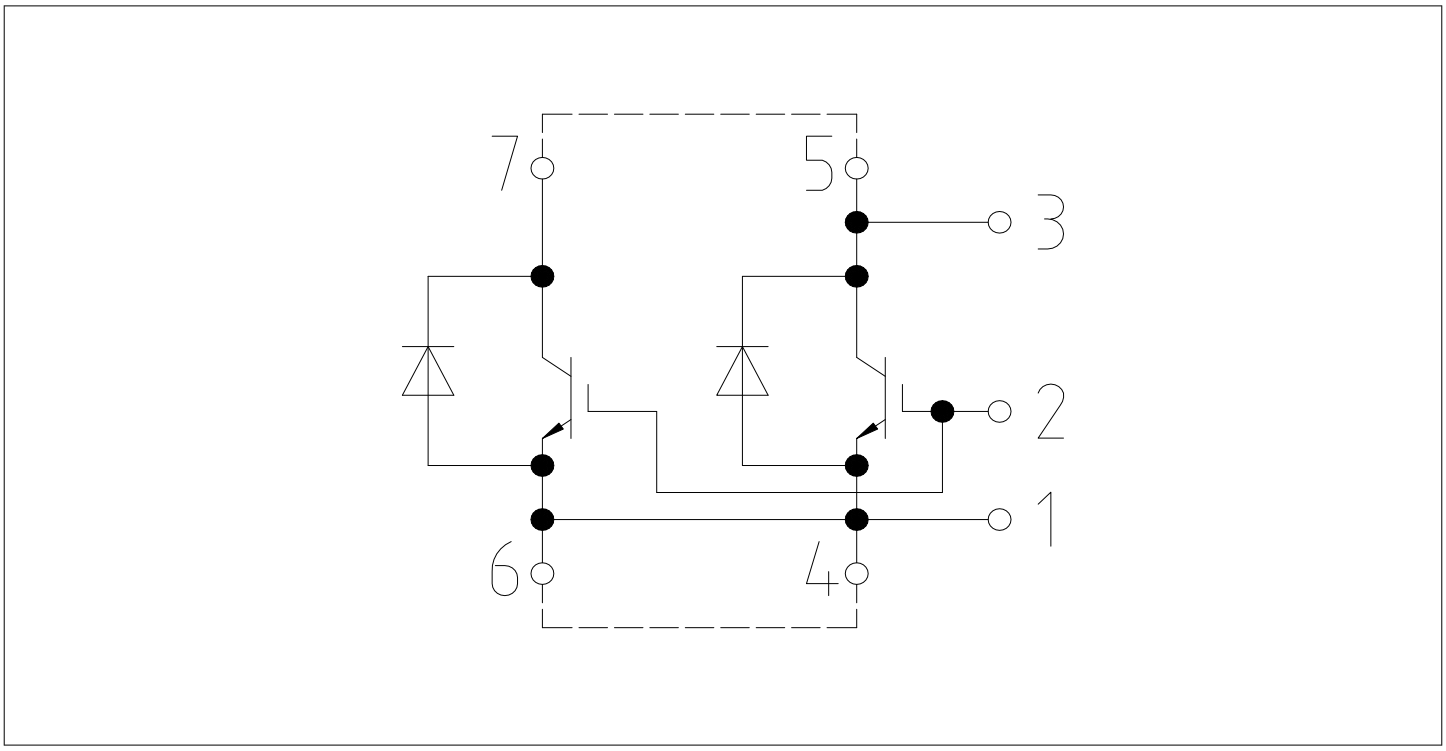


Figure 1

6 Package outlines

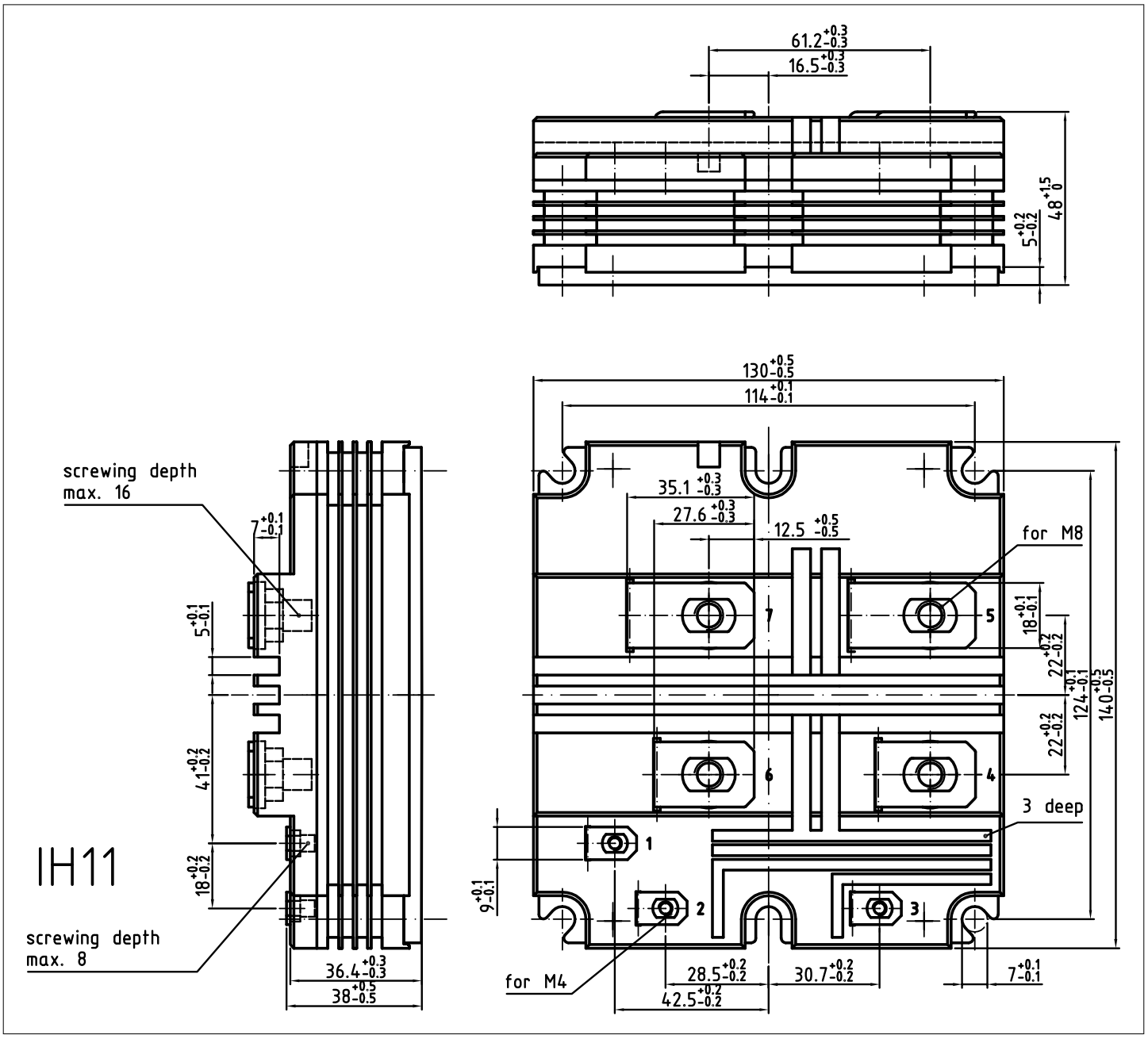


Figure 2

7 Module label code

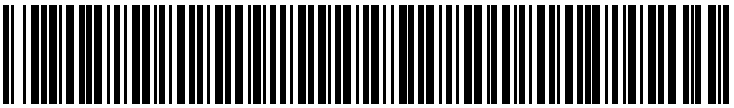
Module label code			
Code format	Data Matrix		Barcode Code128
Encoding	ASCII text		Code Set A
Symbol size	16x16		23 digits
Standard	IEC24720 and IEC16022		IEC8859-1
Code content	*Content* Module serial number Module material number Production order number Date code (production year) Date code (production week)	*Digit* 1 – 5 6 - 11 12 - 19 20 – 21 22 – 23	*Example* 71549 142846 55054991 15 30
Example	 7154914284655054991530	 7154914284655054991530	

Figure 3

Revision history

Document revision	Date of release	Description of changes
0.10	2021-09-15	Initial version
0.20	2022-02-24	Target datasheet
0.30	2022-05-16	Preliminary datasheet
1.00	2022-08-15	Final datasheet

AbN
automation

Trademarks

All referenced product or service names and trademarks are the property of their respective owners.

Edition 2022-08-15

Published by

Infineon Technologies AG

81726 Munich, Germany

© 2022 Infineon Technologies AG

All Rights Reserved.

Do you have a question about any aspect of this document?

Email: erratum@infineon.com

Document reference
IFX-ABA154-004

Important notice

The information given in this document shall in no event be regarded as a guarantee of conditions or characteristics ("Beschaffenheitsgarantie").

With respect to any examples, hints or any typical values stated herein and/or any information regarding the application of the product, Infineon Technologies hereby disclaims any and all warranties and liabilities of any kind, including without limitation warranties of non-infringement of intellectual property rights of any third party.

In addition, any information given in this document is subject to customer's compliance with its obligations stated in this document and any applicable legal requirements, norms and standards concerning customer's products and any use of the product of Infineon Technologies in customer's applications.

The data contained in this document is exclusively intended for technically trained staff. It is the responsibility of customer's technical departments to evaluate the suitability of the product for the intended application and the completeness of the product information given in this document with respect to such application.

Please note that this product is not qualified according to the AEC Q100 or AEC Q101 documents of the Automotive Electronics Council.

Warnings

Due to technical requirements products may contain dangerous substances. For information on the types in question please contact your nearest Infineon Technologies office.

Except as otherwise explicitly approved by Infineon Technologies in a written document signed by authorized representatives of Infineon Technologies, Infineon Technologies' products may not be used in any applications where a failure of the product or any consequences of the use thereof can reasonably be expected to result in personal injury.