XHP™3 module with Trench/Fieldstop IGBT3 and Emitter Controlled 3 diode

Features

- Electrical features
  - High dynamic robustness
  - Low V_{CEsat}
  - Trench IGBT 3
- Mechanical features
  - Package with CTI > 600
  - Package with enhanced insulation of 10.4kV AC 10s
  - AlSiC base plate for increased thermal cycling capability
  - Extended storage temperature down to T_{stg} = -55°C
  - High creepage and clearance distances
  - Housing material compliant with the classification R23 (HL3) of the EN45545-2 “Fire protection of railway vehicles”

Potential applications

- Traction drives
- Medium voltage converters

Product validation

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

Description

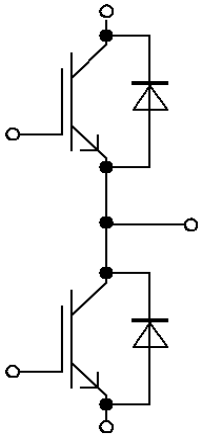


Table of contents

1 Package

Table 1 Insulation Coordination

Parameter	Symbol	Note or test condition	Values	Unit
Isolation test voltage	V_{ISOL}	RMS, f = 50 Hz, t = 10 s	10.4	kV
Partial discharge extinction voltage	V_{isol}	RMS, f = 50 Hz, Q_{PD} typ. 10 pC	5.1	kV
DC stability	$V_{CE(D)}$	T_{vj}=25°C, 100 Fit	3800	V
Material of module baseplate			AlSiC	
Creepage distance	d_{Creep}	terminal to heatsink	53.0	mm
Clearance	d_{Clear}	terminal to heatsink	26.0	mm
Comperative tracking index	*CTI*		> 600	

Table 2 Characteristic Values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Stray inductance module	L_{sCE}				25		nH
Module lead resistance, terminals - chip	$R_{AA'+CC'}$	T_C=25°C, per switch			0.33		mΩ
Module lead resistance, terminals - chip	$R_{CC'+EE'}$	T_C=25°C, per switch			0.42		mΩ
Storage temperature	T_{stg}			-55		125	°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	M3, Screw	0.9		1.1	Nm
			M8, Screw	8		10	
Weight	G				700		g

2 IGBT, Inverter

Table 3 Maximum Rated Values

Parameter	Symbol	Note or test condition		Values	Unit
Collector-emitter voltage	V_{CES}		T_{vj} = -50 °C	5900	V
			T_{vj} = 125 °C	6500	
Continous DC collector current	I_{CDC}	$T_{vj\,max}$ = 125 °C	T_C = 80 °C	225	A

Table 3 Maximum Rated Values (continued)

Parameter	Symbol	Note or test condition	Values	Unit
Repetitive peak collector current	I_{CRM}	t_P = 1 ms	450	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 = 225 A, V_{GE} = 15 V	T_{vj} = 25 °C		3.00	3.40	V
			T_{vj} = 125 °C		3.70	4.20	
Gate threshold voltage	V_{GEth}	I_C = 33 mA, V_{CE} = V_{GE}, T_{vj} = 25 °C		5.40	6	6.60	V
Gate charge	Q_G	V_{GE} = ±15 V, V_{CE} = 3600 V			10.5		µC
Internal gate resistor	R_{Gint}	T_{vj} = 25 °C			0.67		Ω
Input capacitance	C_{ies}	f = 100 kHz, T_{vj} = 25 °C, V_{CE} = 25 V, V_{GE} = 0 V			65.6		nF
Reverse transfer capacitance	C_{res}	f = 100 kHz, T_{vj} = 25 °C, V_{CE} = 25 V, V_{GE} = 0 V			1		nF
Collector-emitter cut-off current	I_{CES}	V_{CE} = 6500 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 = 225 A, V_{CE} = 3600 V, V_{GE} = ±15 V, R_{Gon} = 4.7 Ω	T_{vj} = 25 °C		0.240		µs
			T_{vj} = 125 °C		0.240		
Rise time (inductive load)	t_r	I_C = 225 A, V_{CE} = 3600 V, V_{GE} = ±15 V, R_{Gon} = 4.7 Ω	T_{vj} = 25 °C		0.070		µs
			T_{vj} = 125 °C		0.080		

Table 4 Characteristic Values (continued)

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Turn-off delay time (inductive load)	t_{doff}	I_C = 225 A, V_{CE} = 3600 V, V_{GE} = ±15 V, R_{Goff} = 22 Ω	T_{vj} = 25 °C T_{vj} = 125 °C		6.000 6.400		µs
Fall time (inductive load)	t_f	I_C = 225 A, V_{CE} = 3600 V, V_{GE} = ±15 V, R_{Goff} = 22 Ω	T_{vj} = 25 °C T_{vj} = 125 °C		0.950 2.000		µs
Turn-on energy loss per pulse	E_{on}	I_C = 225 A, V_{CE} = 3600 V, L_σ = 85 nH, V_{GE} = ±15 V, R_{Gon} = 4.7 Ω, di/dt = 2200 A/µs (T_{vj} = 125 °C)	T_{vj} = 25 °C T_{vj} = 125 °C		1230 1710		mJ
Turn-off energy loss per pulse	E_{off}	I_C = 225 A, V_{CE} = 3600 V, L_σ = 85 nH, V_{GE} = ±15 V, R_{Goff} = 22 Ω, dv/dt = 2100 V/µs (T_{vj} = 125 °C)	T_{vj} = 25 °C T_{vj} = 125 °C		875 1170		mJ
SC data	I_{SC}	$V_{GE} \leq$ 15 V, V_{CC} = 4500 V, $V_{CEmax}=V_{CES}-L_{sCE}*di/dt$	$t_P \leq$ 10 µs, T_{vj} = 125 °C		1300		A
Thermal resistance, junction to case	R_{thJC}	per IGBT				0.0291	K/W
Thermal resistance, case to heatsink	R_{thCH}	per IGBT, λ_{Paste}= 1 W /(m*K) / λ_{grease}= 1 W/(m*K)			0.0213		K/W
Temperature under switching conditions	$T_{vj\,op}$			-50		125	°C

3 Diode, Inverter

Table 5 Maximum Rated Values

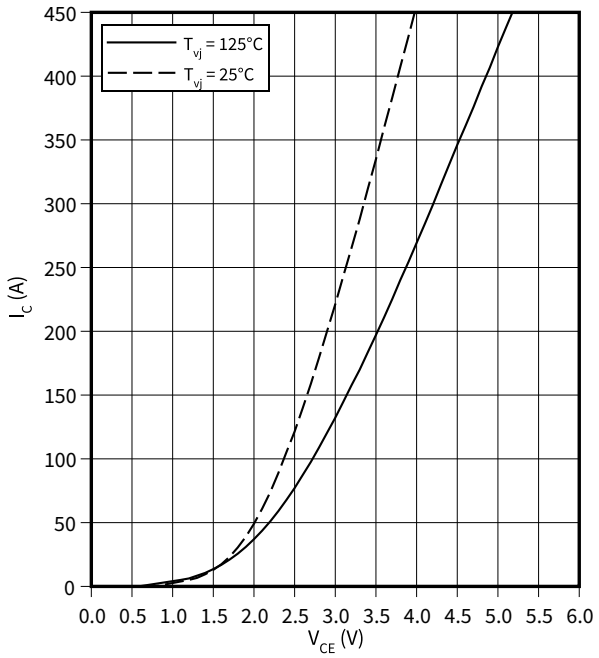
Parameter	Symbol	Note or test condition		Values	Unit
Repetitive peak reverse voltage	V_{RRM}		T_{vj} = -50 °C	5900	V
			T_{vj} = 125 °C	6500	
Continous DC forward current	I_F			225	A
Repetitive peak forward current	I_{FRM}	t_P = 1 ms		450	A
I^2t - value	I^2t	t_P = 10 ms, V_R = 0 V	T_{vj} = 125 °C	45.2	kA^2s
Maximum power dissipation	P_{RQM}	T_{vj} = 125 °C		1000	kW
Minimum turn-on time	t_{onmin}			10	µs

Table 6 Characteristic Values

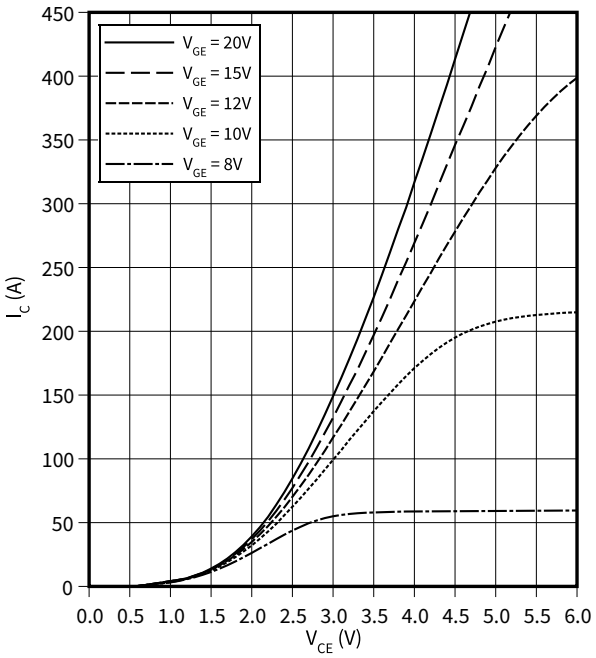
Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Forward voltage	V_F	I_F = 225 A, V_{GE} = 0 V	T_{vj} = 25 °C		3.10	3.55	V
			T_{vj} = 125 °C		2.85	3.25	
Peak reverse recovery current	I_{RM}	V_R = 3600 V, I_F = 225 A, V_{GE} = -15 V, -di$_F$/dt = 2200 A/µs (T_{vj} = 125 °C)	T_{vj} = 25 °C		405		A
			T_{vj} = 125 °C		365		
Recovered charge	Q_r	V_R = 3600 V, I_F = 225 A, V_{GE} = -15 V, -di$_F$/dt = 2200 A/µs (T_{vj} = 125 °C)	T_{vj} = 25 °C		255		µC
			T_{vj} = 125 °C		505		
Reverse recovery energy	E_{rec}	V_R = 3600 V, I_F = 225 A, V_{GE} = -15 V, -di$_F$/dt = 2200 A/µs (T_{vj} = 125 °C)	T_{vj} = 25 °C		450		mJ
			T_{vj} = 125 °C		1070		
Thermal resistance, junction to case	R_{thJC}	per diode				0.0513	K/W
Thermal resistance, case to heatsink	R_{thCH}	per diode, λ_{Paste}= 1 W /(m*K) / λ_{grease}= 1 W/(m*K)			0.0242		K/W
Temperature under switching conditions	$T_{vj\,op}$			-50		125	°C

4 Characteristics diagrams

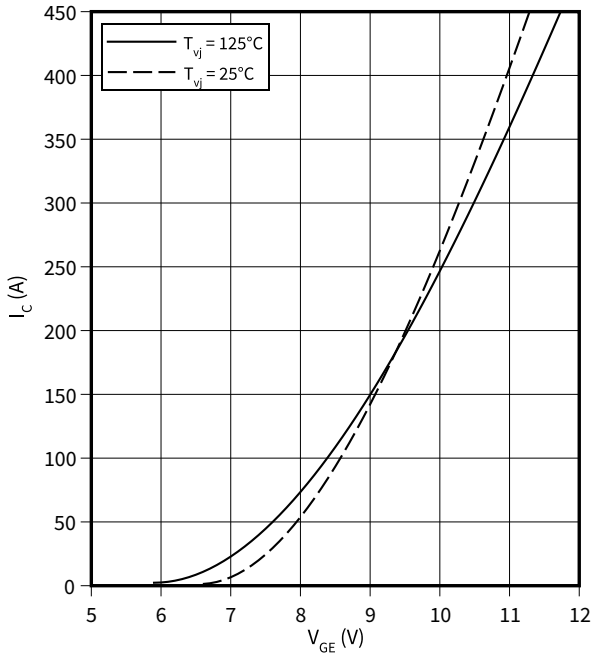
output characteristic (typical), IGBT, Inverter
$I_C = f(V_{CE})$
V_{GE} = 15 V



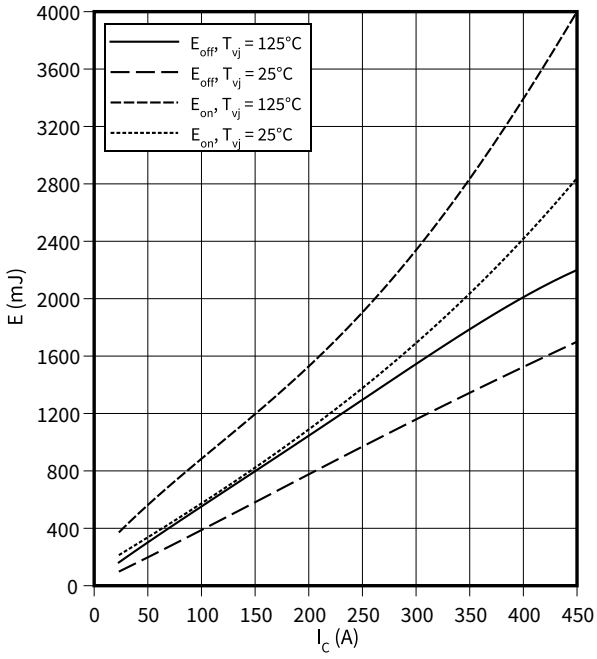
output characteristic (typical), IGBT, Inverter
$I_C = f(V_{CE})$
T_{vj} = 125 °C



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



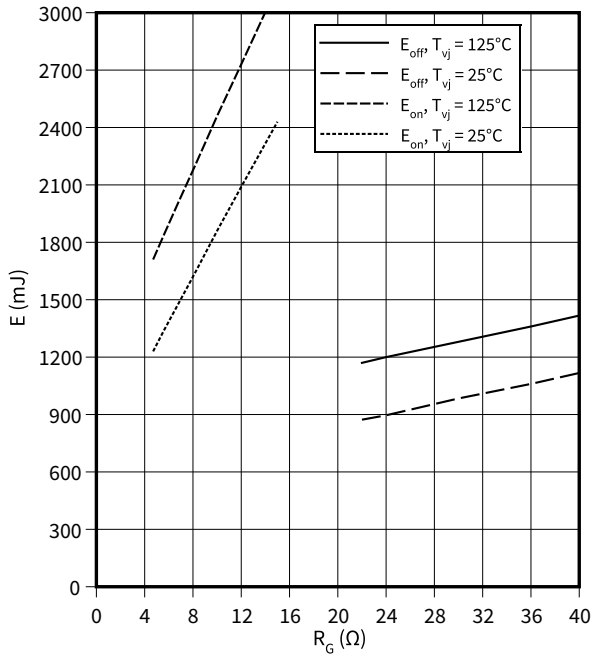
switching losses (typical), IGBT, Inverter
$E = f(I_C)$
R_{Goff} = 22 Ω, R_{Gon} = 4.7 Ω, V_{CE} = 3600 V, V_{GE} = ± 15 V



switching losses (typical), IGBT, Inverter

$E = f(R_G)$

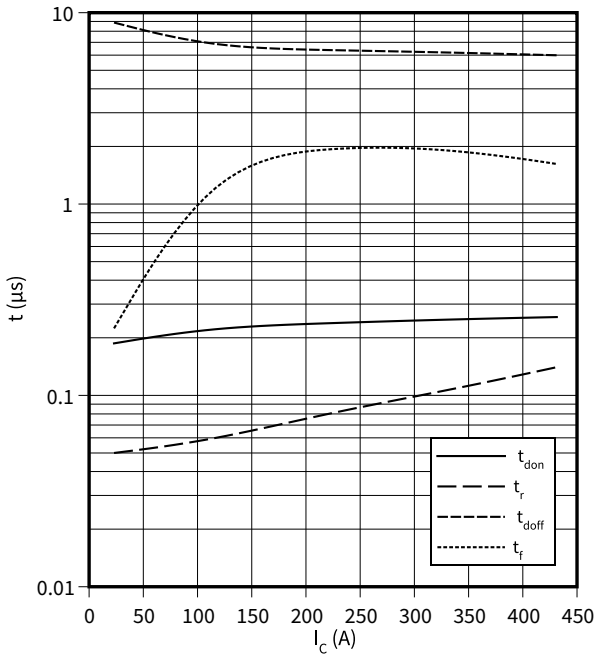
$I_C = 225\ A$, $V_{CE} = 3600\ V$, $V_{GE} = \pm 15\ V$



switching times (typical), IGBT, Inverter

$t = f(I_C)$

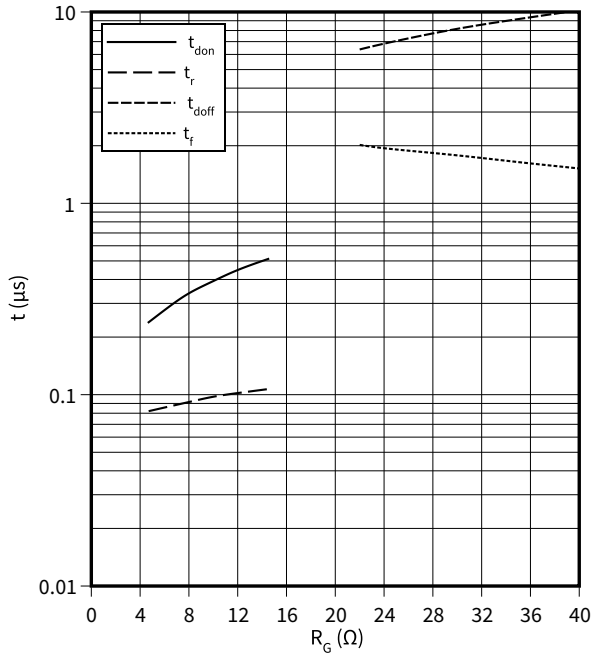
$R_{Goff} = 22\ \Omega$, $R_{Gon} = 4.7\ \Omega$, $V_{CE} = 3600\ V$, $V_{GE} = \pm 15\ V$, $T_{vj} = 125\ °C$



switching times (typical), IGBT, Inverter

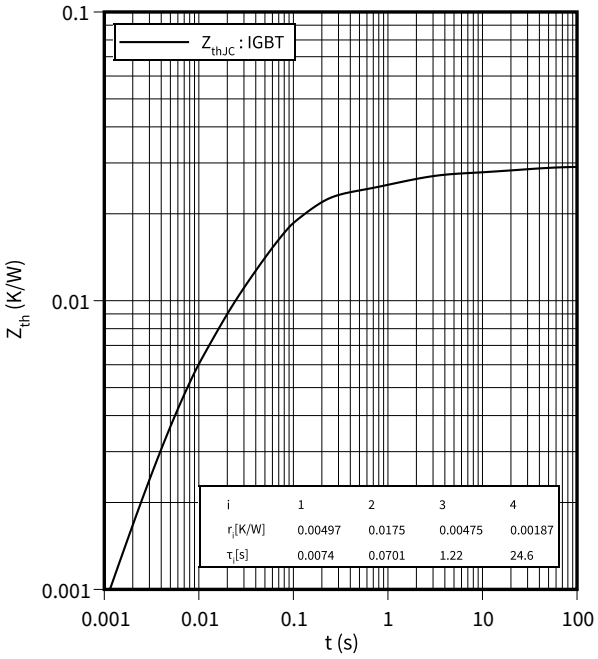
$t = f(R_G)$

$I_C = 225\ A$, $V_{CE} = 3600\ V$, $V_{GE} = \pm 15\ V$, $T_{vj} = 125\ °C$



transient thermal impedance, IGBT, Inverter

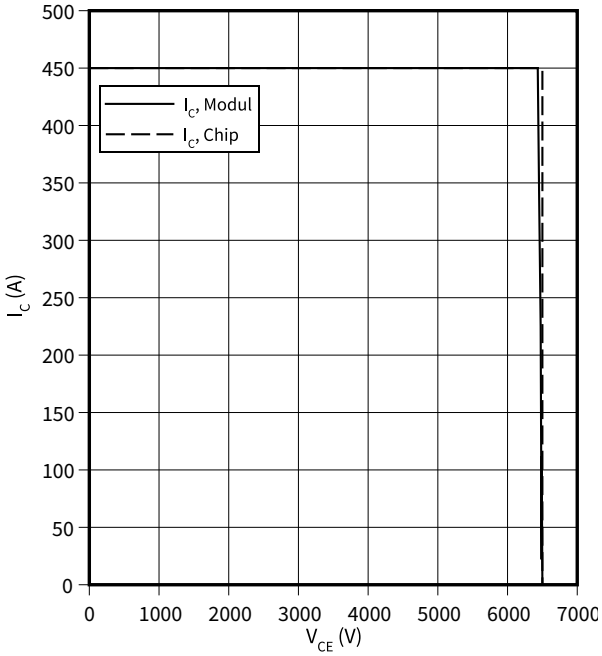
$Z_{th} = f(t)$



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

$I_C = f(V_{CE})$

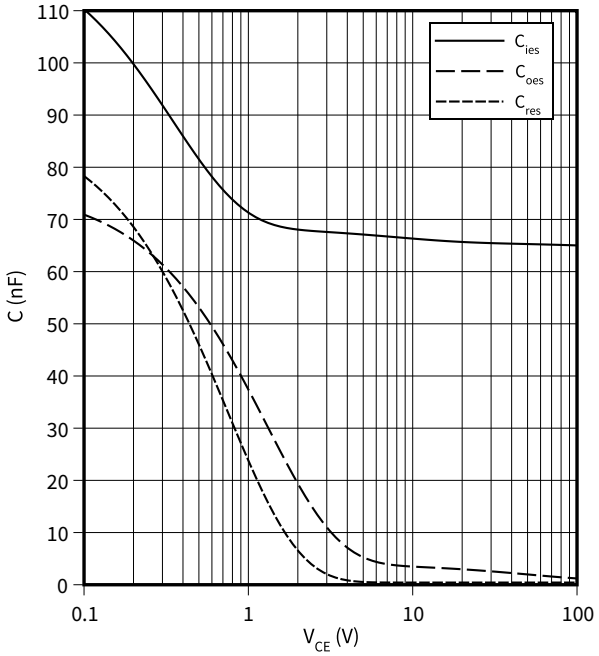
$R_{Goff} = 22\ \Omega$, $V_{GE} = \pm 15$ V, $T_{vj} = 125$ °C



capacity characteristic (typical), IGBT, Inverter

$C = f(V_{CE})$

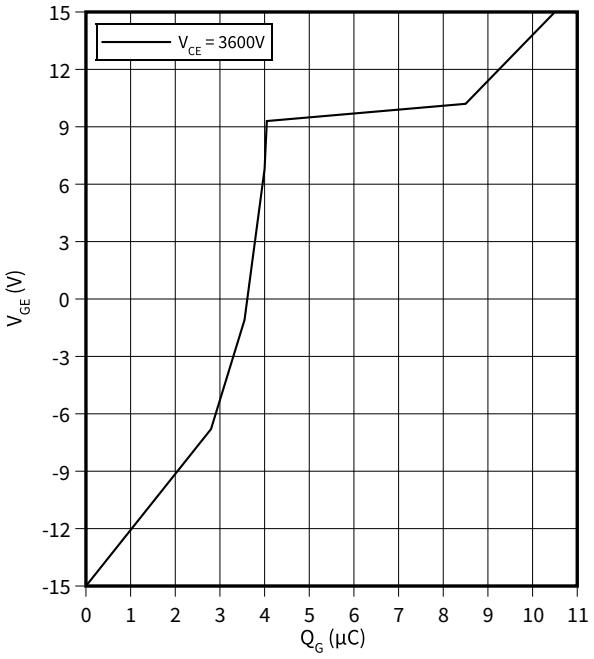
$f = 100$ kHz, $V_{GE} = 0$ V, $T_{vj} = 25$ °C



gate charge characteristic (typical), IGBT, Inverter

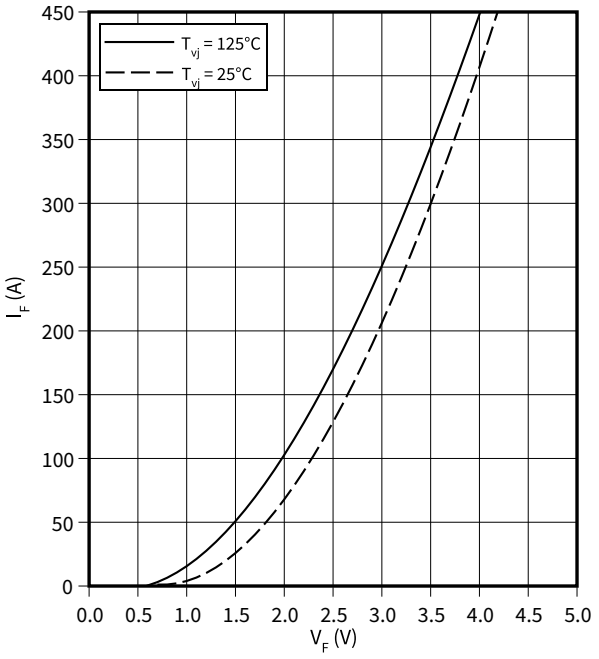
$V_{GE} = f(Q_G)$

$I_C = 225$ A, $T_{vj} = 25$ °C



forward characteristic (typical), Diode, Inverter

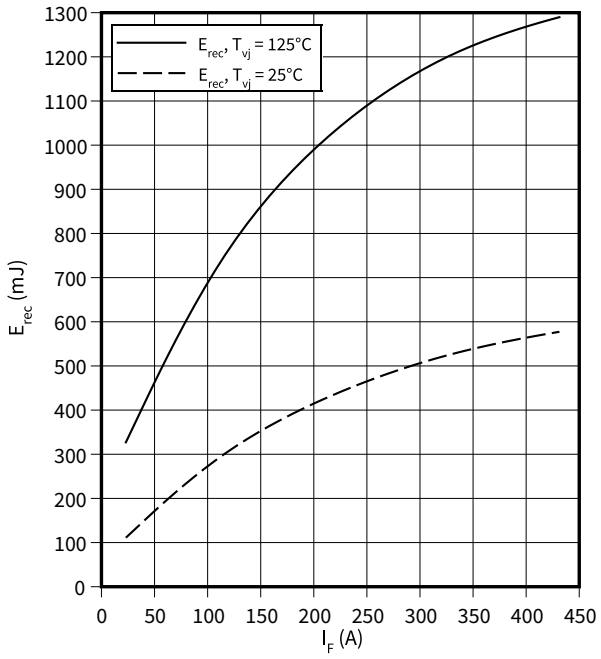
$I_F = f(V_F)$



switching losses (typical), Diode, Inverter

$E_{rec} = f(I_F)$

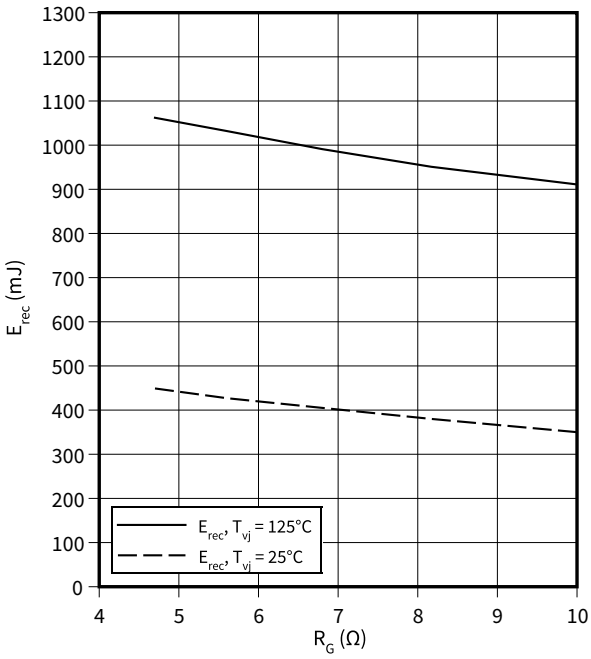
$R_{Gon} = 4.7\ \Omega$, $V_{CE} = 3600$ V



switching losses (typical), Diode, Inverter

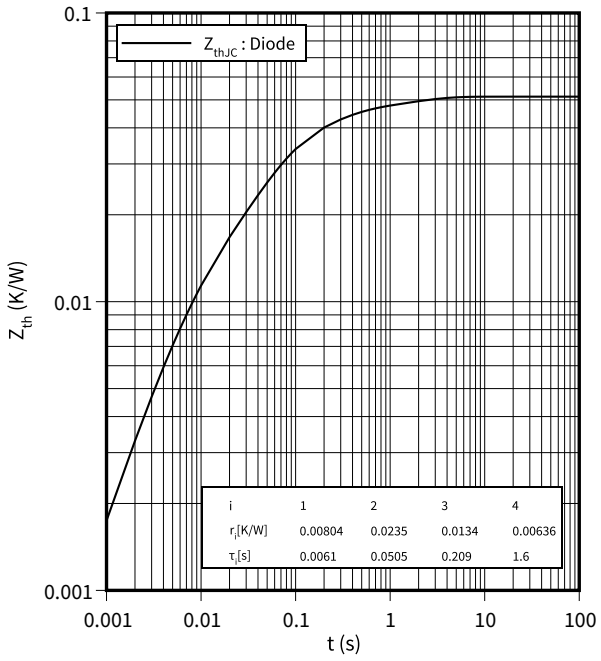
$E_{rec} = f(R_G)$

$V_{CE} = 3600$ V, $I_F = 225$ A



transient thermal impedance , Diode, Inverter

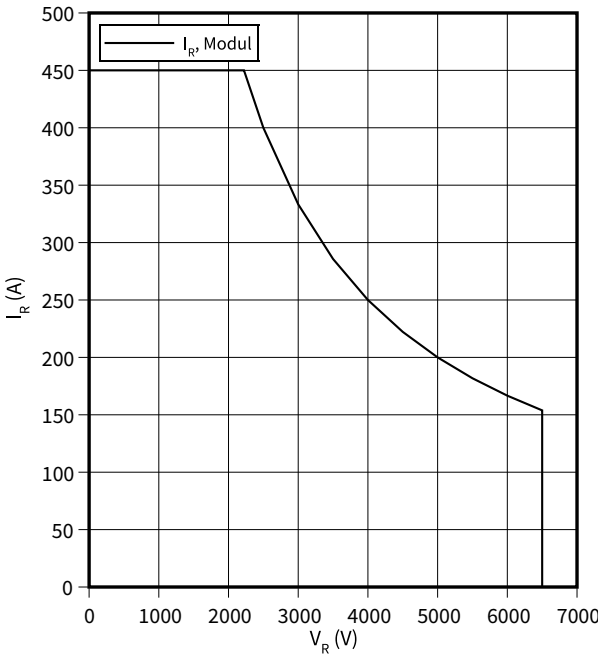
$Z_{th} = f(t)$



safe operation area (SOA), Diode, Inverter

$I_R = f(V_R)$

$T_{vj} = 125$ °C



5 Circuit diagram

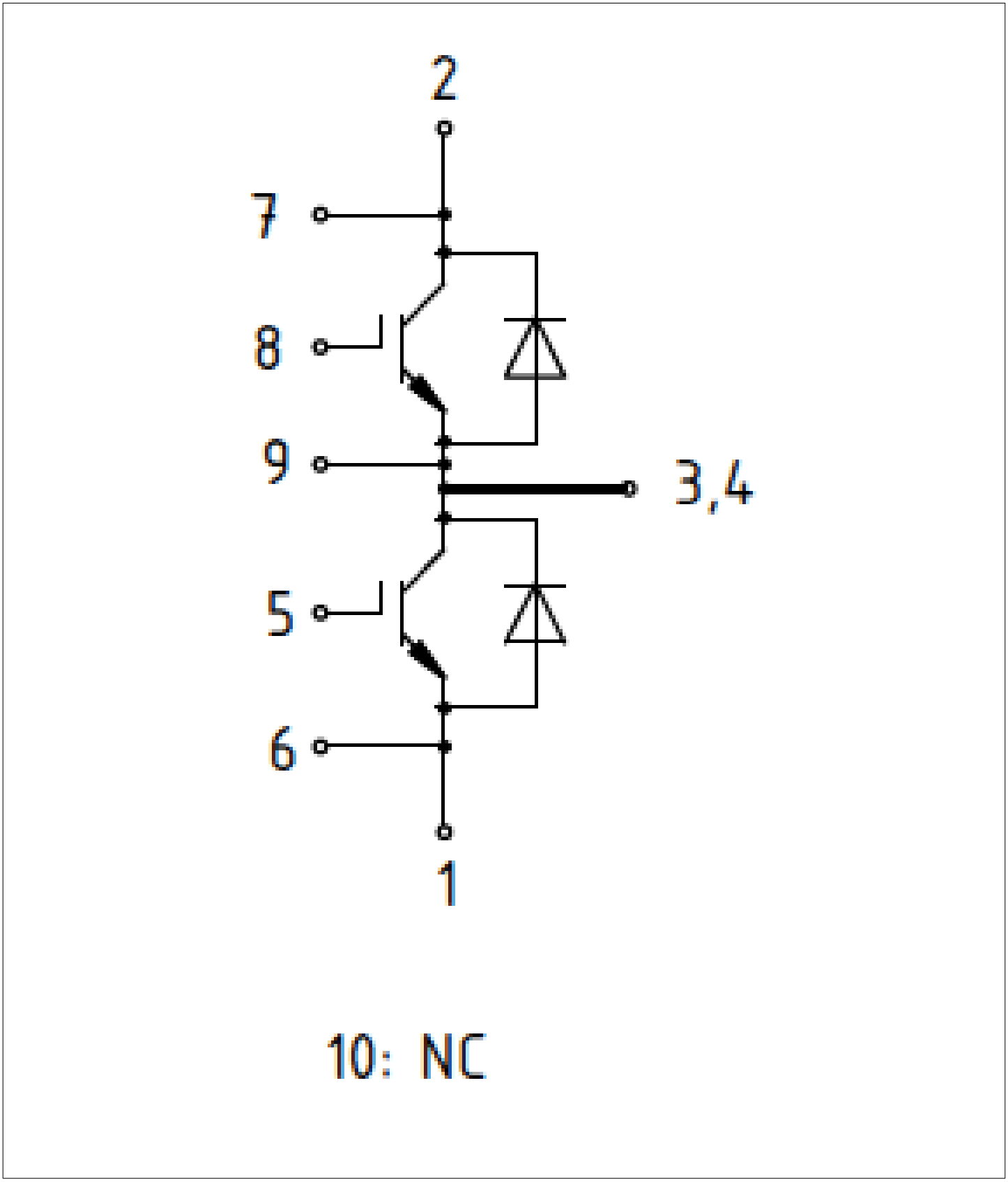


Figure 2

6 Package outlines

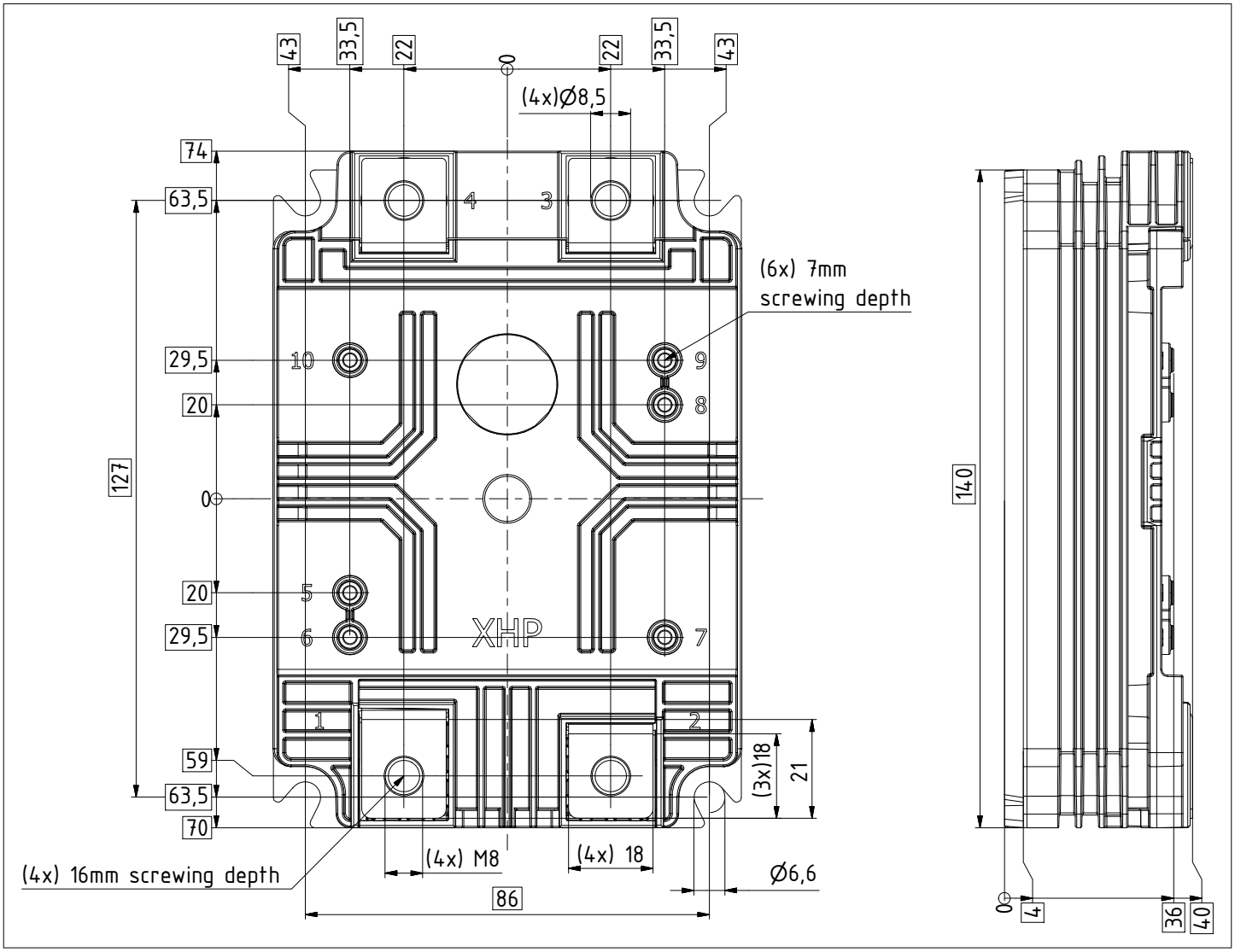


Figure 3

7 Module label code

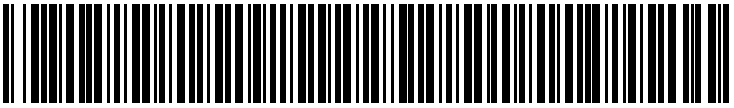
Module label code			
Code format	Data Matrix		Barcode Code128
Encoding	ASCII text		Code Set A
Symbol size	16x16		23 digits
Standard	IEC24720 and IEC16022		IEC8859-1
Code content	*Content* Module serial number Module material number Production order number Date code (production year) Date code (production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

Figure 4

Trademarks

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

Edition 2020-12-11

Published by

Infineon Technologies AG

81726 Munich, Germany

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

Email: erratum@infineon.com

Document reference
IFX-

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.