

Final datasheet

XHP™2 module with Trench/Fieldstop IGBT5, emitter controlled 5 diode and NTC

Features

- Electrical features
 - $V_{CES} = 1700 \text{ V}$
 - $I_{C\text{ nom}} = 1200 \text{ A} / I_{CRM} = 2400 \text{ A}$
 - Extended operating temperature $T_{v,j\text{ op}}$
 - High current density
 - Low switching losses
 - Low $V_{CE,\text{sat}}$
 - $T_{v,j\text{ op}} = 175^\circ\text{C}$
 - Mechanical features
 - High creepage and clearance distances
 - High power and thermal cycling capability
 - High power density
 - Package with CTI > 600



Potential applications

- High-power converters
 - Motor drives
 - Traction drives
 - Wind turbines

Product validation

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

Description

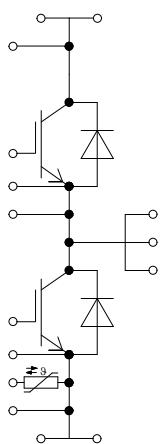


Table of contents

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 NTC-Thermistor	6
5 Characteristics diagrams	7
6 Circuit diagram	12
7 Package outlines	13
8 Module label code	14
Revision history	15
Disclaimer	16

1 Package

1 Package

Table 1 Insulation coordination

Parameter	Symbol	Note or test condition	Values	Unit
Isolation test voltage	V_{ISOL}	RMS, $f = 50$ Hz	4.0	kV
Material of module baseplate			Cu	
Creepage distance	d_{Creep}	terminal to heatsink	40.0	mm
Creepage distance	d_{Creep}	terminal to terminal	34.0	mm
Clearance	d_{Clear}	terminal to heatsink	31.0	mm
Clearance	d_{Clear}	terminal to terminal	8.0	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}			10		nH
Module lead resistance, terminals - chip	$R_{AA'+CC'}$	$T_C = 25$ °C, per switch		0.3		mΩ
Module lead resistance, terminals - chip	$R_{CC'+EE'}$	$T_C = 25$ °C, per switch		0.35		mΩ
Storage temperature	T_{stg}		-40		150	°C
Maximum baseplate operation temperature	T_{BPmax}				150	°C
Mounting torque for module mounting	M	- Mounting according to valid application note	M6, Screw	3	6	Nm
Terminal connection torque	M	- Mounting according to valid application note	M3, Screw	0.9	1.1	Nm
			M8, Screw	8	10	
Weight	G			1020		g

2 IGBT, Inverter

Table 3 Maximum rated values

Parameter	Symbol	Note or test condition	Values	Unit
Collector-emitter voltage	V_{CES}	$T_{vj} = 25$ °C	1700	V
Implemented collector current	I_{CN}		1200	A
Continuous DC collector current	I_{CDC}	$T_{vj\ max} = 175$ °C	$T_C = 75$ °C	A

(table continues...)

Table 3 (continued) Maximum rated values

Parameter	Symbol	Note or test condition	Values		Unit
Repetitive peak collector current	I_{CRM}	t_p limited by $T_{vj\ op}$	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	$V_{CE\ sat}$	$I_C = 1200 \text{ A}, V_{GE} = 15 \text{ V}$	$T_{vj} = 25^\circ\text{C}$		1.80	2.25
			$T_{vj} = 125^\circ\text{C}$		2.20	2.75
			$T_{vj} = 175^\circ\text{C}$		2.40	3.00
Gate threshold voltage	$V_{GE\ th}$	$I_C = 43 \text{ mA}, V_{CE} = V_{GE}, T_{vj} = 25^\circ\text{C}$	5.35	5.80	6.25	V
Gate charge	Q_G	$V_{GE} = \pm 15 \text{ V}, V_{CC} = 900 \text{ V}$		5.5		μC
Internal gate resistor	R_{Gint}	$T_{vj} = 25^\circ\text{C}$		0.75		Ω
Input capacitance	C_{ies}	$f = 100 \text{ kHz}, T_{vj} = 25^\circ\text{C}, V_{CE} = 25 \text{ V}, V_{GE} = 0 \text{ V}$		56		nF
Reverse transfer capacitance	C_{res}	$f = 100 \text{ kHz}, T_{vj} = 25^\circ\text{C}, V_{CE} = 25 \text{ V}, V_{GE} = 0 \text{ V}$		2		nF
Collector-emitter cut-off current	I_{CES}	$V_{CE} = 1700 \text{ V}, V_{GE} = 0 \text{ V}$	$T_{vj} = 125^\circ\text{C}$		10	mA
Gate-emitter leakage current	I_{GES}	$V_{CE} = 0 \text{ V}, V_{GE} = 20 \text{ V}, T_{vj} = 25^\circ\text{C}$			400	nA
Turn-on delay time (inductive load)	t_{don}	$I_C = 1200 \text{ A}, V_{CC} = 900 \text{ V}, V_{GE} = \pm 15 \text{ V}, R_{Gon} = 0.5 \Omega$	$T_{vj} = 25^\circ\text{C}$		0.173	
			$T_{vj} = 125^\circ\text{C}$		0.180	
			$T_{vj} = 175^\circ\text{C}$		0.183	
Rise time (inductive load)	t_r	$I_C = 1200 \text{ A}, V_{CC} = 900 \text{ V}, V_{GE} = \pm 15 \text{ V}, R_{Gon} = 0.5 \Omega$	$T_{vj} = 25^\circ\text{C}$		0.090	
			$T_{vj} = 125^\circ\text{C}$		0.095	
			$T_{vj} = 175^\circ\text{C}$		0.105	
Turn-off delay time (inductive load)	t_{doff}	$I_C = 1200 \text{ A}, V_{CC} = 900 \text{ V}, V_{GE} = \pm 15 \text{ V}, R_{Goff} = 4.5 \Omega$	$T_{vj} = 25^\circ\text{C}$		1.050	
			$T_{vj} = 125^\circ\text{C}$		1.150	
			$T_{vj} = 175^\circ\text{C}$		1.210	
Fall time (inductive load)	t_f	$I_C = 1200 \text{ A}, V_{CC} = 900 \text{ V}, V_{GE} = \pm 15 \text{ V}, R_{Goff} = 4.5 \Omega$	$T_{vj} = 25^\circ\text{C}$		0.180	
			$T_{vj} = 125^\circ\text{C}$		0.410	
			$T_{vj} = 175^\circ\text{C}$		0.560	
Turn-on energy loss per pulse	E_{on}	$I_C = 1200 \text{ A}, V_{CC} = 900 \text{ V}, L_\sigma = 20 \text{ nH}, V_{GE} = \pm 15 \text{ V}, R_{Gon} = 0.5 \Omega, di/dt = 12700 \text{ A}/\mu\text{s}$ ($T_{vj} = 175^\circ\text{C}$)	$T_{vj} = 25^\circ\text{C}$		220	
			$T_{vj} = 125^\circ\text{C}$		340	
			$T_{vj} = 175^\circ\text{C}$		420	

(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}	$I_C = 1200 \text{ A}$, $V_{CC} = 900 \text{ V}$, $L_\sigma = 20 \text{ nH}$, $V_{GE} = \pm 15 \text{ V}$, $R_{Goff} = 4.5 \Omega$, $dv/dt = 1800 \text{ V}/\mu\text{s}$ ($T_{vj} = 175 \text{ }^\circ\text{C}$)	$T_{vj} = 25 \text{ }^\circ\text{C}$		355	mJ
			$T_{vj} = 125 \text{ }^\circ\text{C}$		465	
			$T_{vj} = 175 \text{ }^\circ\text{C}$		535	
SC data	I_{SC}	$V_{GE} \leq 15 \text{ V}$, $V_{CC} = 1000 \text{ V}$, $V_{CEmax} = V_{CES} - L_{SCE} * di/dt$	$t_P \leq 10 \mu\text{s}$, $T_{vj} = 175 \text{ }^\circ\text{C}$		4600	A
Thermal resistance, junction to case	R_{thJC}	per IGBT			26.8	K/kW
Thermal resistance, case to heat sink	R_{thCH}	per IGBT, $\lambda_{grease} = 1 \text{ W}/(\text{m}\cdot\text{K})$			20.1	K/kW
Temperature under switching conditions	$T_{vj op}$		-40		175	${}^\circ\text{C}$

3 Diode, Inverter

Table 5 Maximum rated values

Parameter	Symbol	Note or test condition		Values		Unit
Repetitive peak reverse voltage	V_{RRM}		$T_{vj} = 25 \text{ }^\circ\text{C}$	1700		V
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	$t_P = 10 \text{ ms}$, $V_R = 0 \text{ V}$	$T_{vj} = 125 \text{ }^\circ\text{C}$	338		kA^2s
			$T_{vj} = 175 \text{ }^\circ\text{C}$	276		
Maximum power dissipation	P_{RQM}		$T_{vj} = 175 \text{ }^\circ\text{C}$	1200		kW

Table 6 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Forward voltage	V_F	$I_F = 1200 \text{ A}$, $V_{GE} = 0 \text{ V}$	$T_{vj} = 25 \text{ }^\circ\text{C}$		1.75	V
			$T_{vj} = 125 \text{ }^\circ\text{C}$		1.70	
			$T_{vj} = 175 \text{ }^\circ\text{C}$		1.70	
Peak reverse recovery current	I_{RM}	$V_{CC} = 900 \text{ V}$, $I_F = 1200 \text{ A}$, $V_{GE} = -15 \text{ V}$, $-di_F/dt = 12700 \text{ A}/\mu\text{s}$ ($T_{vj} = 175 \text{ }^\circ\text{C}$)	$T_{vj} = 25 \text{ }^\circ\text{C}$		1300	A
			$T_{vj} = 125 \text{ }^\circ\text{C}$		1500	
			$T_{vj} = 175 \text{ }^\circ\text{C}$		1600	

(table continues...)

Table 6 (continued) Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Recovered charge	Q_r	$V_{CC} = 900 \text{ V}$, $I_F = 1200 \text{ A}$, $V_{GE} = -15 \text{ V}$, $-\text{di}_F/\text{dt} = 12700 \text{ A}/\mu\text{s}$ ($T_{vj} = 175 \text{ }^\circ\text{C}$)	$T_{vj} = 25 \text{ }^\circ\text{C}$		240	μC
			$T_{vj} = 125 \text{ }^\circ\text{C}$		455	
			$T_{vj} = 175 \text{ }^\circ\text{C}$		585	
Reverse recovery energy	E_{rec}	$V_{CC} = 900 \text{ V}$, $I_F = 1200 \text{ A}$, $V_{GE} = -15 \text{ V}$, $-\text{di}_F/\text{dt} = 12700 \text{ A}/\mu\text{s}$ ($T_{vj} = 175 \text{ }^\circ\text{C}$)	$T_{vj} = 25 \text{ }^\circ\text{C}$		150	mJ
			$T_{vj} = 125 \text{ }^\circ\text{C}$		290	
			$T_{vj} = 175 \text{ }^\circ\text{C}$		365	
Thermal resistance, junction to case	R_{thJC}	per diode			51.4	K/kW
Thermal resistance, case to heat sink	R_{thCH}	per diode, $\lambda_{grease} = 1 \text{ W}/(\text{m}\cdot\text{K})$		27.1		K/kW
Temperature under switching conditions	$T_{vj op}$		-40		175	${}^\circ\text{C}$

4 NTC-Thermistor

Table 7 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Rated resistance	R_{25}	$T_{NTC} = 25 \text{ }^\circ\text{C}$		5		$\text{k}\Omega$
Deviation of R_{100}	$\Delta R/R$	$T_{NTC} = 100 \text{ }^\circ\text{C}$, $R_{100} = 493 \Omega$	-5		5	%
Power dissipation	P_{25}	$T_{NTC} = 25 \text{ }^\circ\text{C}$			20	mW
B-value	$B_{25/50}$	$R_2 = R_{25} \exp[B_{25/50}(1/T_2 - 1/(298,15 \text{ K}))]$		3375		K
B-value	$B_{25/80}$	$R_2 = R_{25} \exp[B_{25/80}(1/T_2 - 1/(298,15 \text{ K}))]$		3411		K
B-value	$B_{25/100}$	$R_2 = R_{25} \exp[B_{25/100}(1/T_2 - 1/(298,15 \text{ K}))]$		3433		K

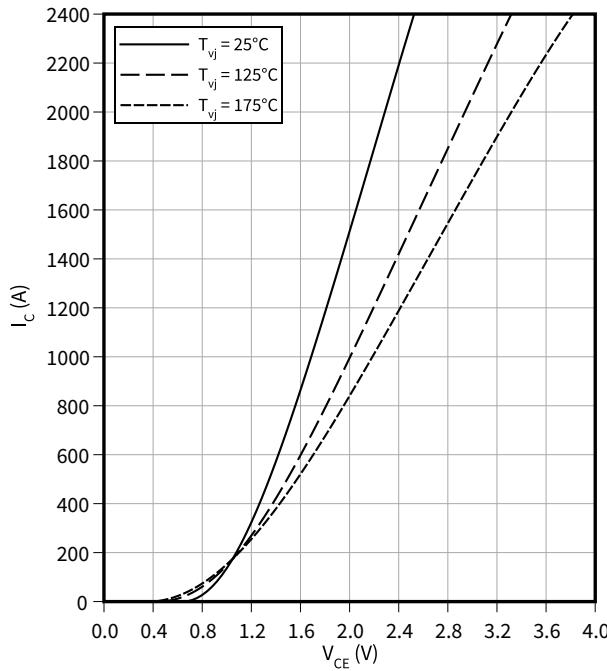
Note: For an analytical description of the NTC characteristics please refer to AN2009-10, chapter 4

5 Characteristics diagrams

Output characteristic (typical), IGBT, Inverter

$I_C = f(V_{CE})$

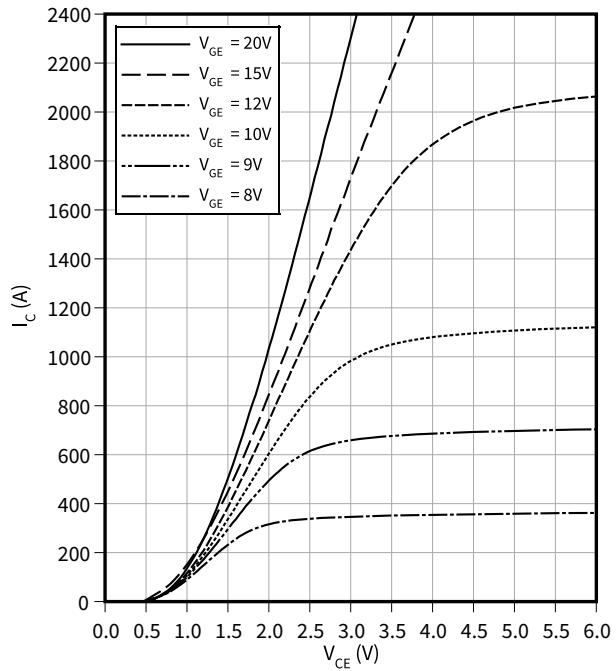
$V_{GE} = 15 \text{ V}$



Output characteristic field (typical), IGBT, Inverter

$I_C = f(V_{CE})$

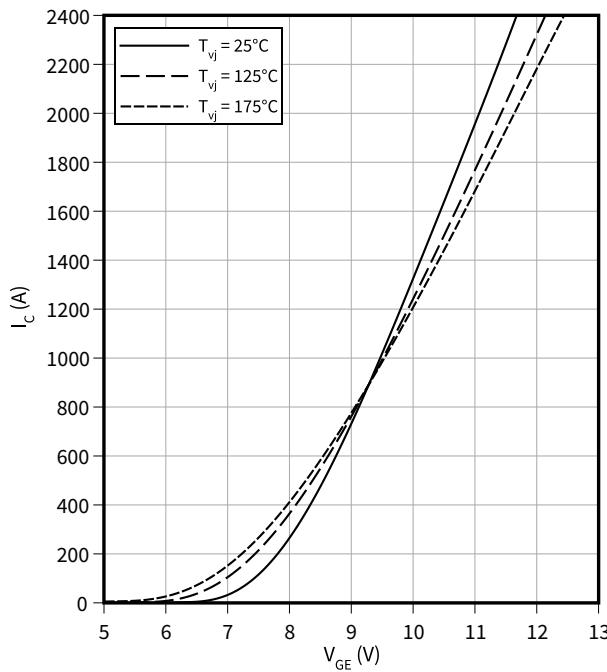
$T_{vj} = 175 \text{ }^\circ\text{C}$



Transfer characteristic (typical), IGBT, Inverter

$I_C = f(V_{GE})$

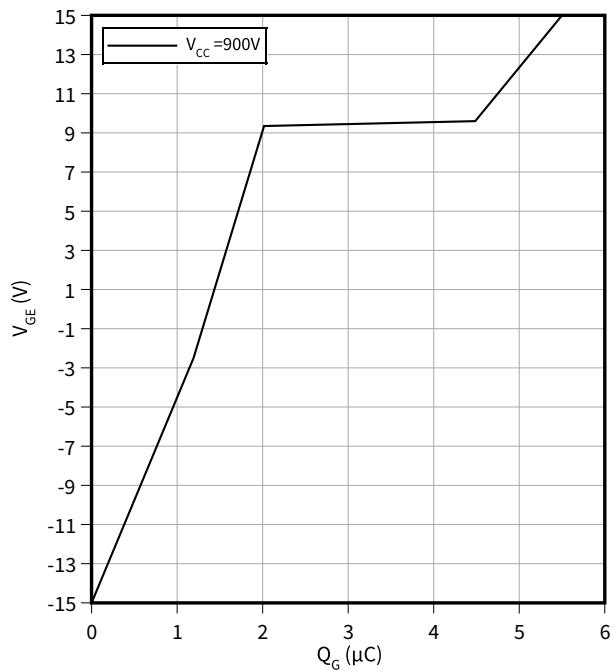
$V_{CE} = 20 \text{ V}$



Gate charge characteristic (typical), IGBT, Inverter

$V_{GE} = f(Q_G)$

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

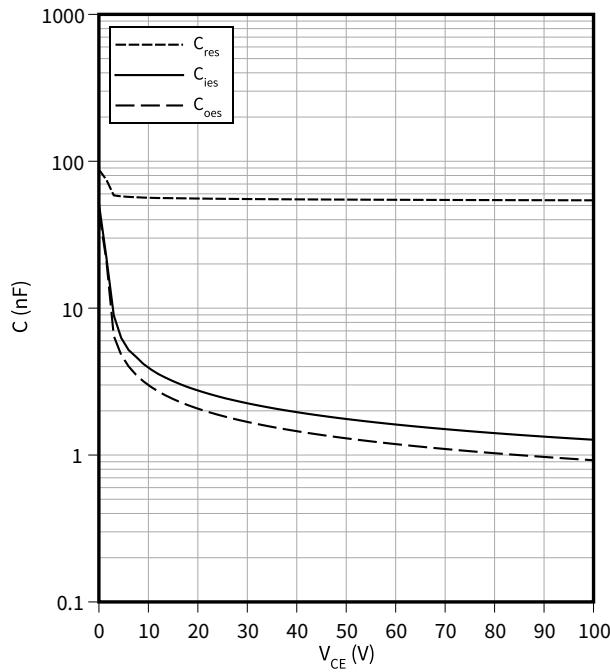


5 Characteristics diagrams

Capacity characteristic (typical), IGBT, Inverter

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

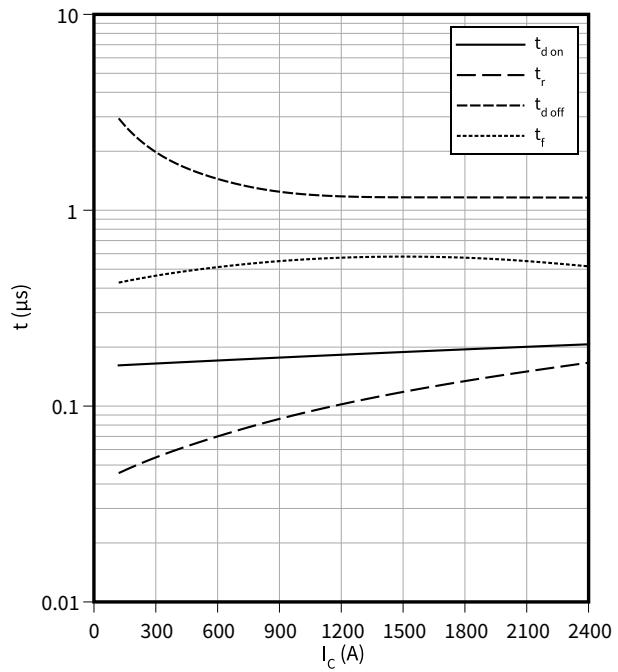
$$f = 100 \text{ kHz}, V_{GE} = 0 \text{ V}, T_{vj} = 25^\circ\text{C}$$



Switching times (typical), IGBT, Inverter

$$t = f(I_C)$$

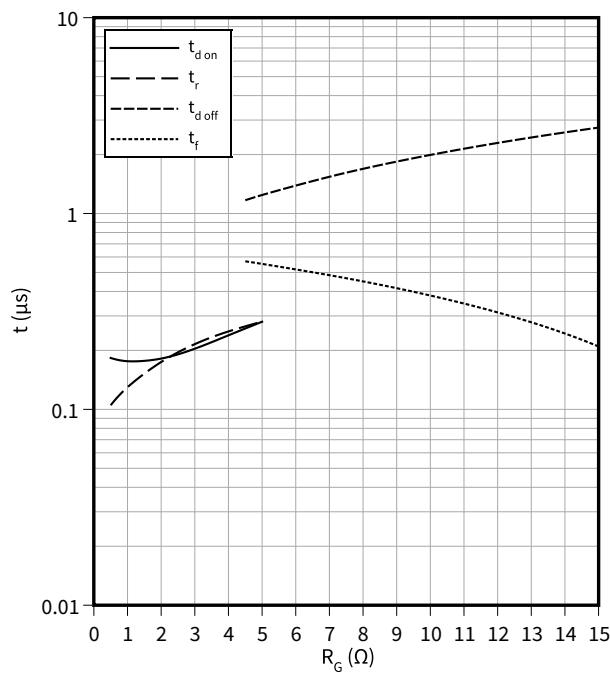
$$R_{Goff} = 4.5 \Omega, R_{Gon} = 0.5 \Omega, V_{GE} = \pm 15 \text{ V}, V_{CC} = 900 \text{ V}, T_{vj} = 175^\circ\text{C}$$



Switching times (typical), IGBT, Inverter

$$t = f(R_G)$$

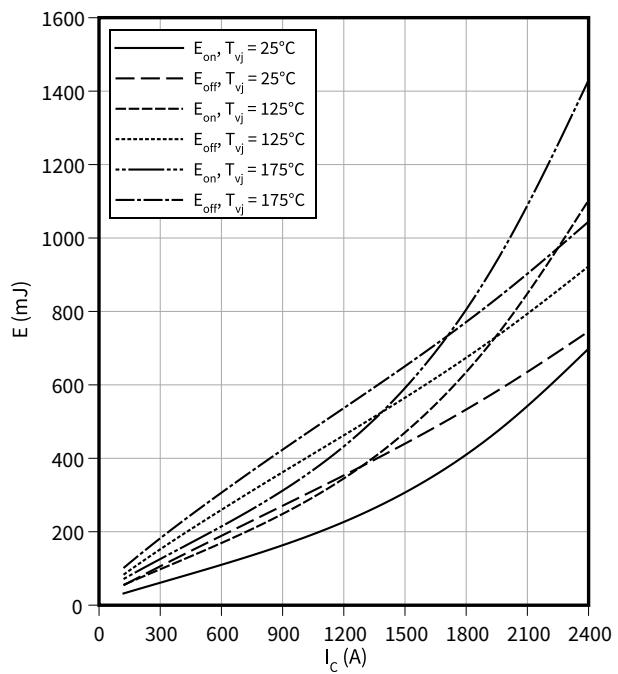
$$V_{GE} = \pm 15 \text{ V}, I_C = 1200 \text{ A}, V_{CC} = 900 \text{ V}, T_{vj} = 175^\circ\text{C}$$



Switching losses (typical), IGBT, Inverter

$$E = f(I_C)$$

$$R_{Goff} = 4.5 \Omega, R_{Gon} = 0.5 \Omega, V_{CC} = 900 \text{ V}, V_{GE} = \pm 15 \text{ V}$$

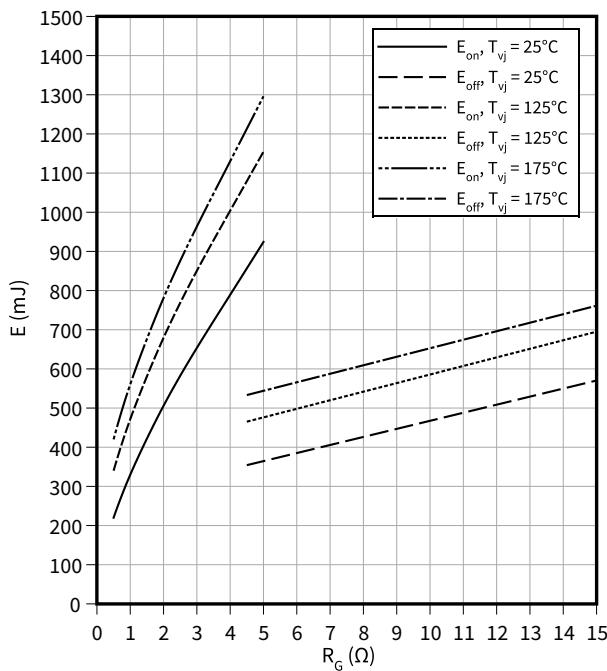


5 Characteristics diagrams

Switching losses (typical), IGBT, Inverter

$$E = f(R_G)$$

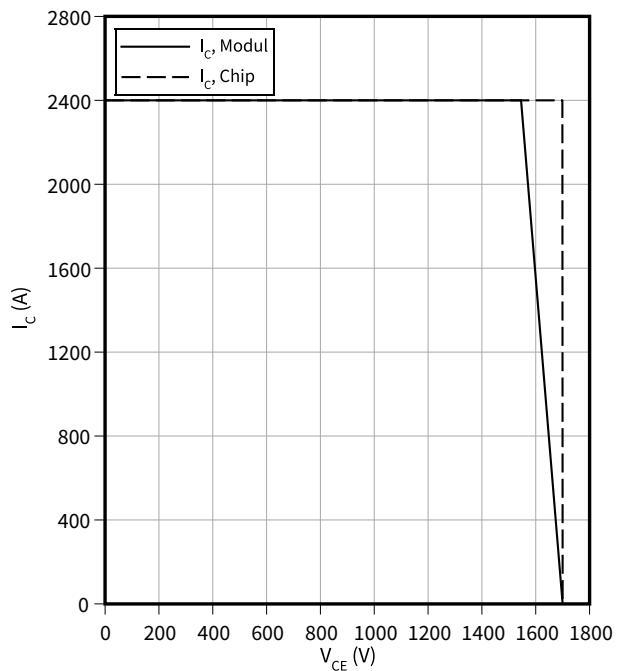
$$I_C = 1200 \text{ A}, V_{CC} = 900 \text{ V}, V_{GE} = \pm 15 \text{ V}$$



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

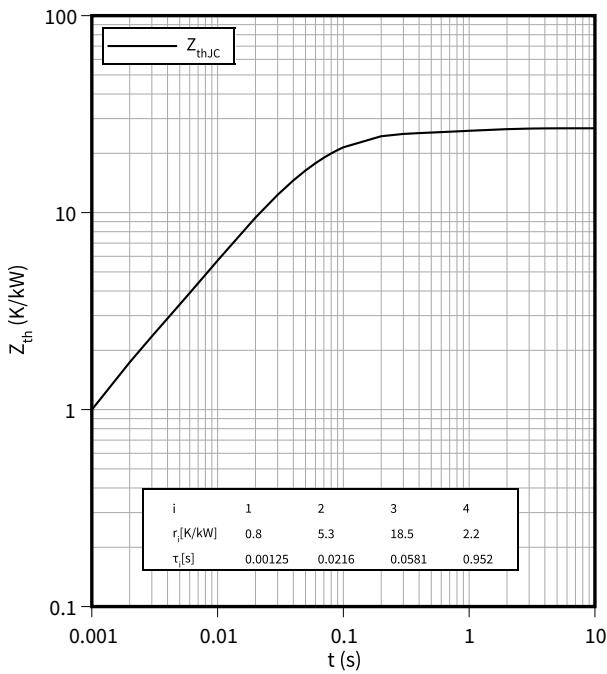
$$I_C = f(V_{CE})$$

$$R_{Goff} \geq 4.5 \Omega, V_{GE} = \pm 15 \text{ V}, T_{vj} = 175^\circ\text{C}$$



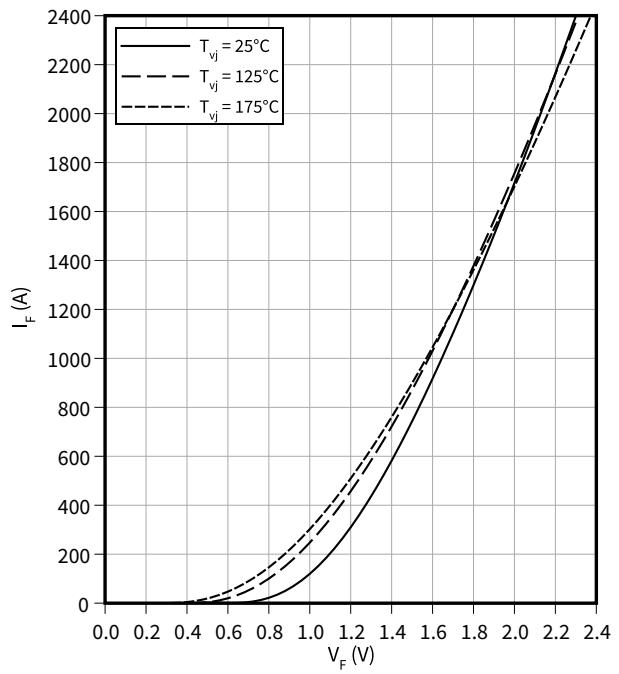
Transient thermal impedance, IGBT, Inverter

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



Forward characteristic (typical), Diode, Inverter

$$I_F = f(V_F)$$

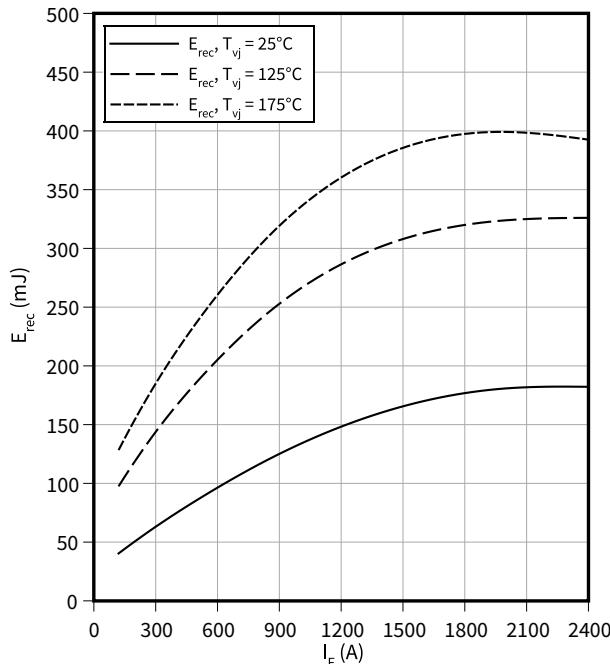


5 Characteristics diagrams

Switching losses (typical), Diode, Inverter

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

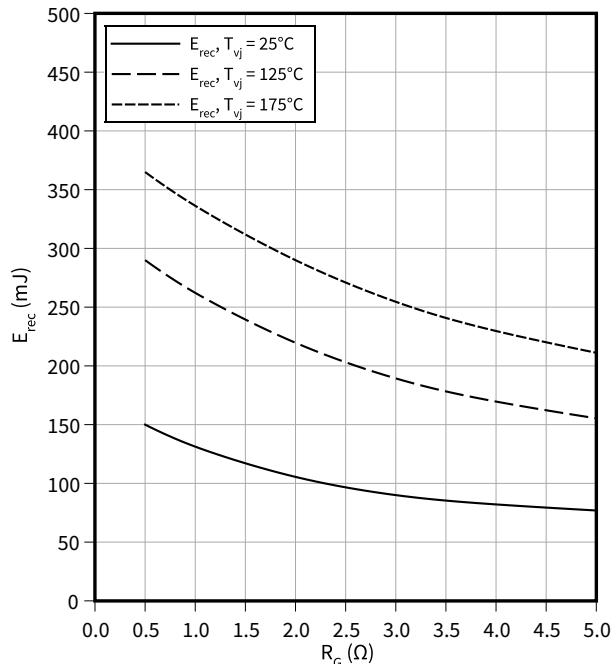
$$V_{CE} = 900 \text{ V}, R_{Gon} = R_{Gon}(IGBT)$$



Switching losses (typical), Diode, Inverter

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

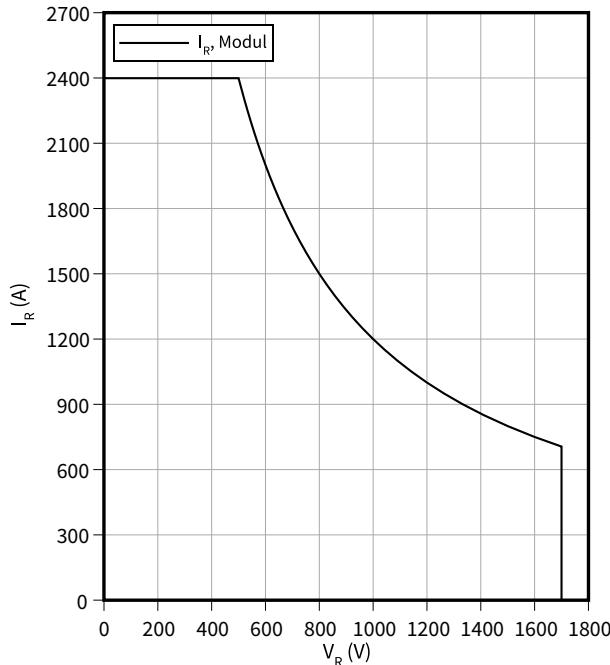
$$V_{CE} = 900 \text{ V}, I_F = 1200 \text{ A}$$



Safe operating area (SOA), Diode, Inverter

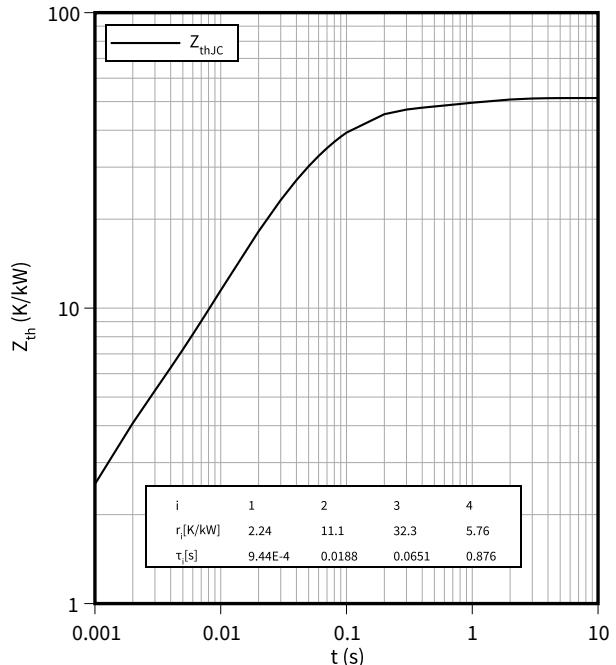
$$I_R = f(V_R)$$

$$T_{vj} = 175 \text{ }^{\circ}\text{C}$$



Transient thermal impedance, Diode, Inverter

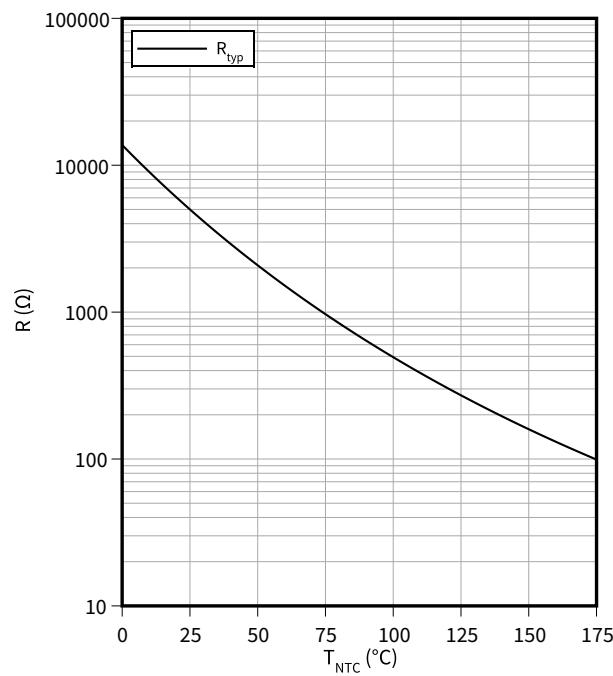
$$Z_{th} = f(t)$$



5 Characteristics diagrams

Temperature characteristic (typical), NTC-Thermistor

$$R = f(T_{NTC})$$



6 Circuit diagram

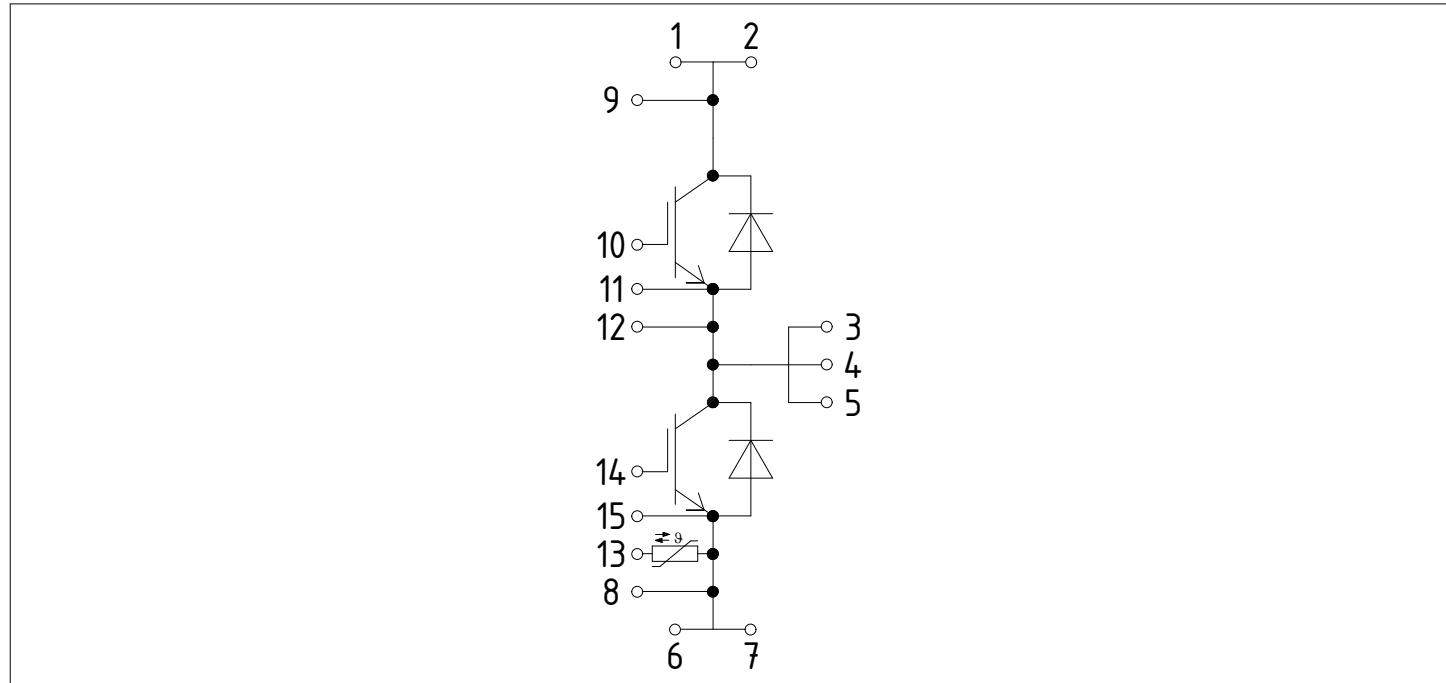


Figure 1

7

Package outlines

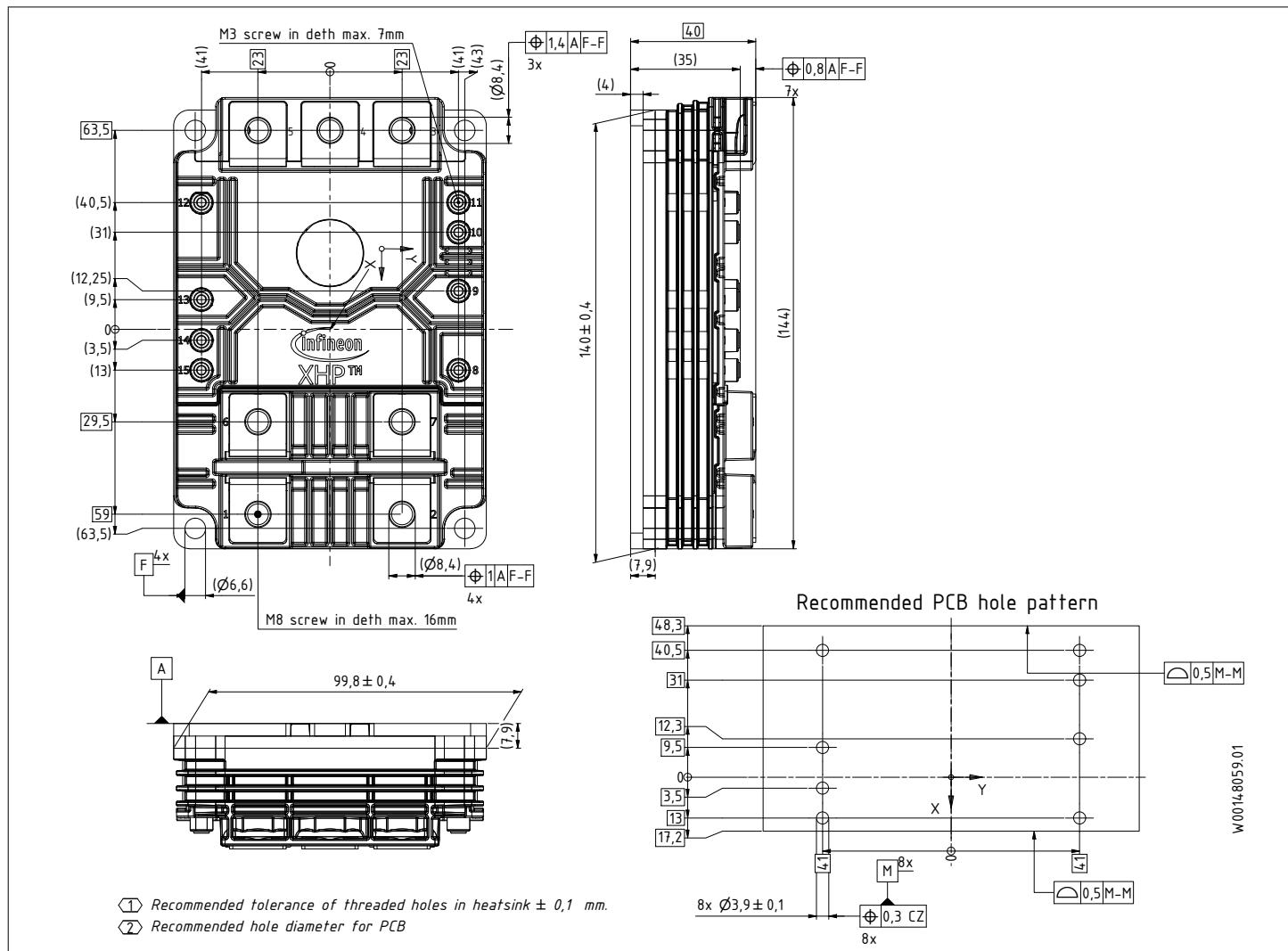


Figure 2

8 Module label code

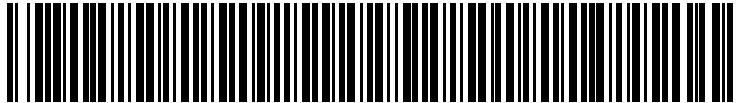
Module label code			
Code format	Data Matrix		Barcode Code128
Encoding	ASCII text		Code Set A
Symbol size	16x16		23 digits
Standard	IEC24720 and IEC16022		IEC8859-1
Code content	<i>Content</i> Module serial number Module material number Production order number Date code (production year) Date code (production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

Figure 3

Revision history

Revision history

Document revision	Date of release	Description of changes
V1.0	2019-02-06	Target datasheet
V1.1	2020-04-02	Target 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
0.10	2021-05-04	Target datasheet
0.20	2022-11-03	Preliminary datasheet
1.00	2023-10-30	Final datasheet

Trademarks

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

Edition 2023-10-30

Published by

**Infineon Technologies AG
81726 Munich, Germany**

**© 2023 Infineon Technologies AG
All Rights Reserved.**

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

Email: erratum@infineon.com

**Document reference
IFX-AAY150-005**

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.