Final datasheet
XHP™2 module with CoolSiC™ Trench MOSFET

Features

- Electrical features
  - V_{DSS} = 2300 V
  - I_{DN} = 2000 A / I_{DRM} = 4000 A
  - High current density
  - Low inductive design
  - Low switching losses
  - $T_{vj,op}$ = 175°C
- Mechanical features
  - AlN substrate with low thermal resistance
  - AlSiC base plate for increased thermal cycling capability
  - High creepage and clearance distances
  - High power density
  - Package with CTI > 600

Potential applications

- Traction
- High-power converters
- High-frequency switching application

Product validation

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

Description

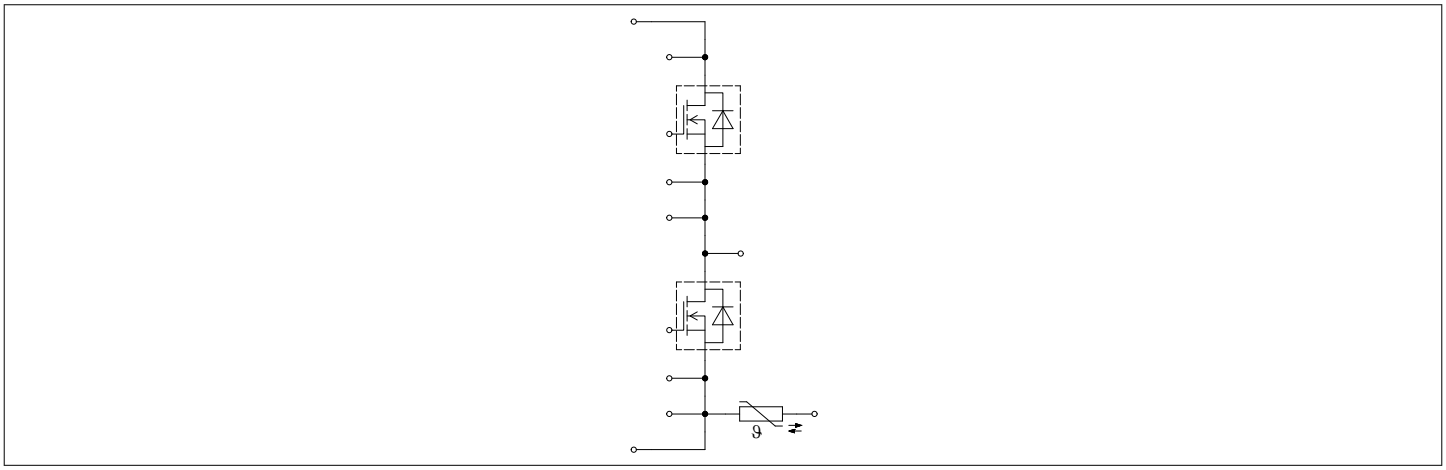


Table of contents

1 Package

Table 1 Insulation coordination

Parameter	Symbol	Note or test condition	Values	Unit
Isolation test voltage	V_{ISOL}	RMS, f = 50 Hz, t = 1 min	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	1500	V
Material of module baseplate			AlSiC	
Creepage distance	$d_{Creep\ nom}$	terminal to baseplate, nom.	40.0	mm
Creepage distance	$d_{Creep\ nom}$	terminal to terminal, nom.	34.0	mm
Clearance	$d_{Clear\ nom}$	terminal to baseplate, nom.	31.0	mm
Clearance	$d_{Clear\ nom}$	terminal to terminal, nom.	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	$R_{CC'+EE'}$	T_C = 25 °C, per switch			0.43		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	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				720		g

2 MOSFET Inverter

Table 3 Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
Drain-source voltage	V_{DSS}		T_{vj} = 25 °C	2300	V
Implemented drain current	I_{DN}			2000	A
Continuous DC drain current	I_{DDC}	T_{vj} = 175 °C, V_{GS} = 15 V	T_C = 25 °C	1335	A

(table continues...)

Table 3 (continued) Maximum rated values

Parameter	Symbol	Note or test condition	Values	Unit
Repetitive peak drain current	I_{DRM}	verified by design, t_p limited by T_{vjmax}	4000	A
Gate-source voltage, max. transient voltage	V_{GS}	$D < 0.01$	-10/23	V
Gate-source voltage, max. static voltage	V_{GS}		-7/20	V

Table 4 Recommended values

Parameter	Symbol	Note or test condition	Values	Unit
On-state gate voltage	$V_{GS(on)}$		15...18	V
Off-state gate voltage	$V_{GS(off)}$		-5	V

Table 5 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Drain-source on-resistance	$R_{DS(on)}$	I_D = 2000 A	V_{GS} = 15 V, T_{vj} = 25 °C		0.95	1.19	mΩ
			V_{GS} = 15 V, T_{vj} = 125 °C		1.7	2.13	
			V_{GS} = 15 V, T_{vj} = 175 °C		2.3	2.88	
Gate threshold voltage	$V_{GS(th)}$	I_D = 900 mA, V_{DS} = V_{GS}, T_{vj} = 25 °C, (tested after 1ms pulse at V_{GS} = +20 V)		3.45	4.2	5.15	V
Total gate charge	Q_G	V_{DD}=1500 V, V_{GS} = -5/15 V, T_{vj} = 25 °C			5.3		µC
Internal gate resistor	R_{Gint}	T_{vj} = 25 °C			1.1		Ω
Input capacitance	C_{ISS}	f = 100 kHz, V_{DS} = 1500 V, V_{GS} = 0 V	T_{vj} = 25 °C		190		nF
Output capacitance	C_{OSS}	f = 100 kHz, V_{DS} = 1500 V, V_{GS} = 0 V	T_{vj} = 25 °C		4.1		nF
Reverse transfer capacitance	C_{rss}	f = 100 kHz, V_{DS} = 1500 V, V_{GS} = 0 V	T_{vj} = 25 °C		0.2		nF
C_{OSS} stored energy	E_{OSS}	V_{DS} = 1500 V, V_{GS} = -5/15 V, T_{vj} = 25 °C			5.8		mJ
Drain-source leakage current	I_{DSS}	V_{DS} = 2300 V, V_{GS} = -5 V	T_{vj} = 25 °C			930	µA
Gate-source leakage current	I_{GSS}	V_{DS} = 0 V, T_{vj} = 25 °C	V_{GS} = 20 V			3200	nA

(table continues...)

Table 5 (continued) Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Turn-on delay time (inductive load)	$t_{d\,on}$	I_D = 2000 A, R_{Gon} = 0.81 Ω, V_{DD} = 1500 V, V_{GS} = -5/15 V, t_{dead} = 1500 ns, 0.1 V_{GS} to 0.1 I_D	T_{vj} = 25 °C		340		ns
			T_{vj} = 125 °C		315		
			T_{vj} = 175 °C		310		
Rise time (inductive load)	t_r	I_D = 2000 A, R_{Gon} = 0.81 Ω, V_{DD} = 1500 V, V_{GS} = -5/15 V, t_{dead} = 1500 ns, 0.1 I_D to 0.9 I_D	T_{vj} = 25 °C		240		ns
			T_{vj} = 125 °C		240		
			T_{vj} = 175 °C		240		
Turn-off delay time (inductive load)	$t_{d\,off}$	I_D = 2000 A, R_{Goff} = 1.41 Ω, V_{DD} = 1500 V, V_{GS} = -5/15 V, 0.9 V_{GS} to 0.9 I_D	T_{vj} = 25 °C		485		ns
			T_{vj} = 125 °C		535		
			T_{vj} = 175 °C		560		
Fall time (inductive load)	t_f	I_D = 2000 A, R_{Goff} = 1.41 Ω, V_{DD} = 1500 V, V_{GS} = -5/15 V, 0.9 I_D to 0.1 I_D	T_{vj} = 25 °C		200		ns
			T_{vj} = 125 °C		230		
			T_{vj} = 175 °C		250		
Turn-on time (resistive load)	t_{on_R}	I_D = 500 A, V_{DD} = 2000 V, V_{GS} = -5/15 V, R_{Gon} = 0.81 Ω	T_{vj} = 25 °C	0.26			µs
Turn-on energy loss per pulse	E_{on}	I_D = 2000 A, V_{DD} = 1500 V, L_σ = 14 nH, V_{GS} = -5/15 V, R_{Gon} = 0.81 Ω, di/dt = 6.1 kA/µs (T_{vj} = 175 °C), t_{dead} = 1500 ns	T_{vj} = 25 °C		970		mJ
			T_{vj} = 125 °C		990		
			T_{vj} = 175 °C		1080		
Turn-on energy loss per pulse, optimized	$E_{on,o}$	I_D = 2000 A, V_{DD} = 1500 V, L_σ = 14 nH, V_{GS} = -5/15 V, $R_{Gon,o}$ = 0.3 Ω, di/dt = 14.9 kA/µs (T_{vj} = 175 °C), t_{dead} = 400 ns	T_{vj} = 25 °C		785		mJ
			T_{vj} = 125 °C		750		
			T_{vj} = 175 °C		750		
Turn-off energy loss per pulse	E_{off}	I_D = 2000 A, V_{DD} = 1500 V, L_σ = 14 nH, V_{GS} = -5/15 V, R_{Goff} = 1.41 Ω, dv/dt = 9.2 kV/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		445		mJ
			T_{vj} = 125 °C		510		
			T_{vj} = 175 °C		550		
SC data	I_{SC}	V_{GS} = -5/15 V, V_{DD} = 1500 V, V_{DSmax} = V_{DSS}-L_{sDS}*di/dt	$t_P \leq$ 3 µs, T_{vj} = 175 °C		10100		A

(table continues...)

Table 5 (continued) Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Thermal resistance, junction to case	R_{thJC}	per MOSFET			29.3	K/kW
Thermal resistance, case to heat sink	R_{thCH}	per MOSFET, λ_{grease}= 5 W/(m*K)		8.30		K/kW
Temperature under switching conditions	$T_{vj\ op}$		-40		175	°C

3 Body diode (MOSFET Inverter)

Table 6 Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
DC body diode forward current	I_{SD}	T_{vj} = 175 °C, V_{GS} = -5 V	T_C = 25 °C	970	A
I^2t - value	I^2t	V_{DS} = 0 V, V_{GS} = -5 V, t_P = 10 ms	T_{vj} = 125 °C	600	kA^2s
			T_{vj} = 175 °C	500	

Table 7 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Forward voltage	V_{SD}	I_{SD} = 2000 A, V_{GS} = -5 V	T_{vj} = 25 °C		5	6.25	V
			T_{vj} = 125 °C		4.4	5.5	
			T_{vj} = 175 °C		4.2	5.25	
Reverse recovery energy	E_{rec}	I_{SD} = 2000 A, di_s/dt = 6.1 kA/µs (T_{vj} = 175 °C), V_{DD} = 1500 V, V_{GS} = -5/15 V, t_{dead} = 1500 ns	T_{vj} = 25 °C		30		mJ
			T_{vj} = 125 °C		48		
			T_{vj} = 175 °C		70		
Reverse recovery energy, optimized	$E_{rec,o}$	I_{SD} = 2000 A, di_s/dt = 14.9 kA/µs (T_{vj} = 175 °C), V_{DD} = 1500 V, V_{GS} = -5/15 V, t_{dead} = 400 ns	T_{vj} = 25 °C		25		mJ
			T_{vj} = 125 °C		28		
			T_{vj} = 175 °C		33		

4 NTC-Thermistor

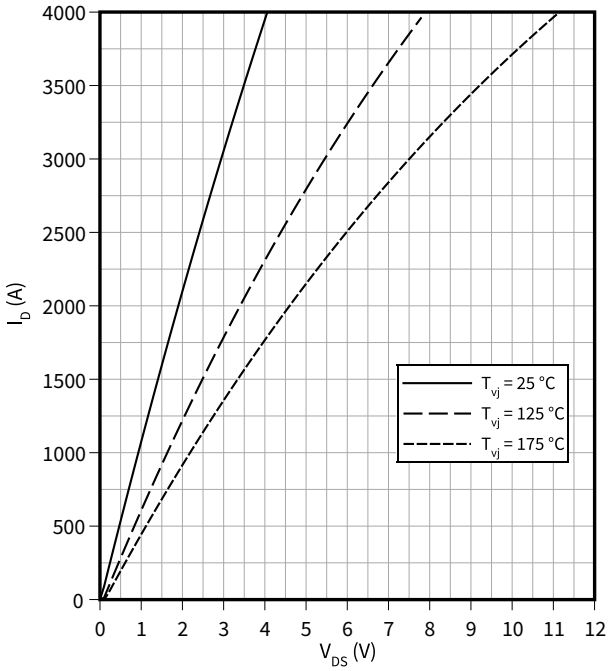
Table 8 Characteristic values

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

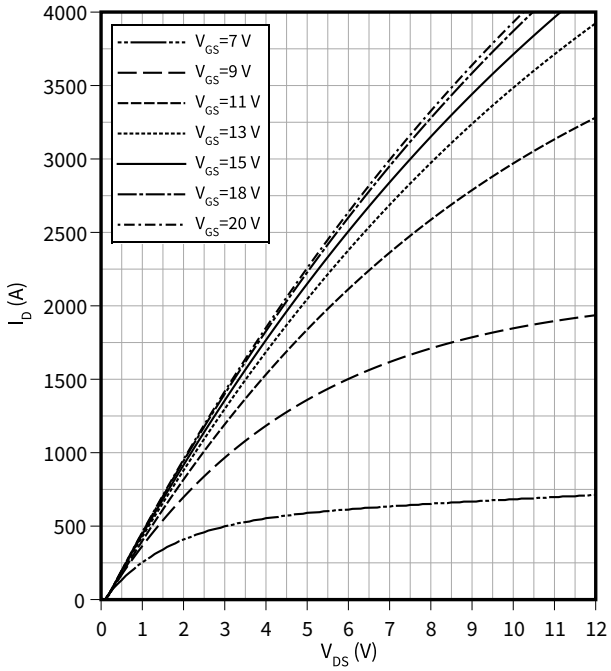
***Note**: For an analytical description of the NTC characteristics please refer to AN2009-10, chapter 4*

5 Characteristics diagrams

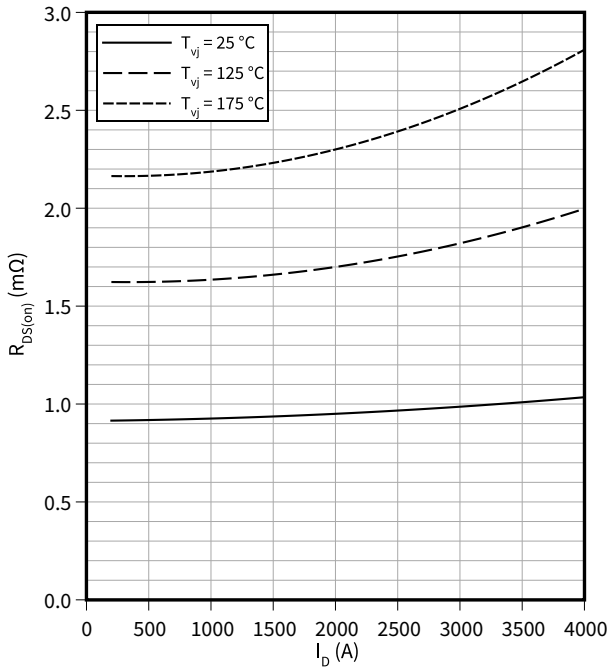
Output characteristic (typical), MOSFET Inverter
$I_D = f(V_{DS})$
V_{GS} = 15 V



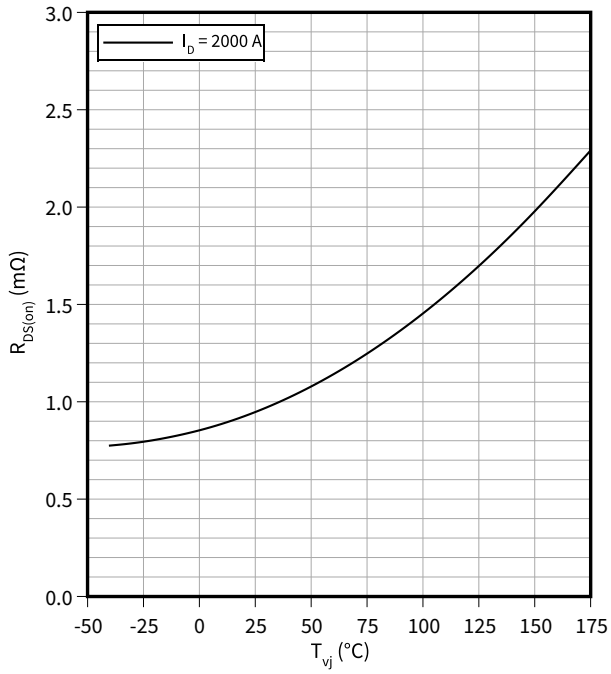
Output characteristic field (typical), MOSFET Inverter
$I_D = f(V_{DS})$
T_{vj} = 175 °C



Drain source on-resistance (typical), MOSFET Inverter
$R_{DS(on)} = f(I_D)$
V_{GS} = 15 V

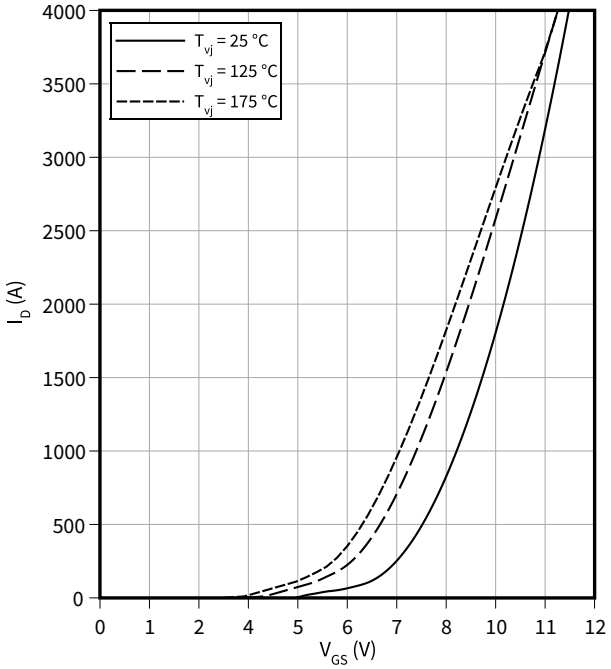


Drain source on-resistance (typical), MOSFET Inverter
$R_{DS(on)} = f(T_{vj})$
V_{GS} = 15 V



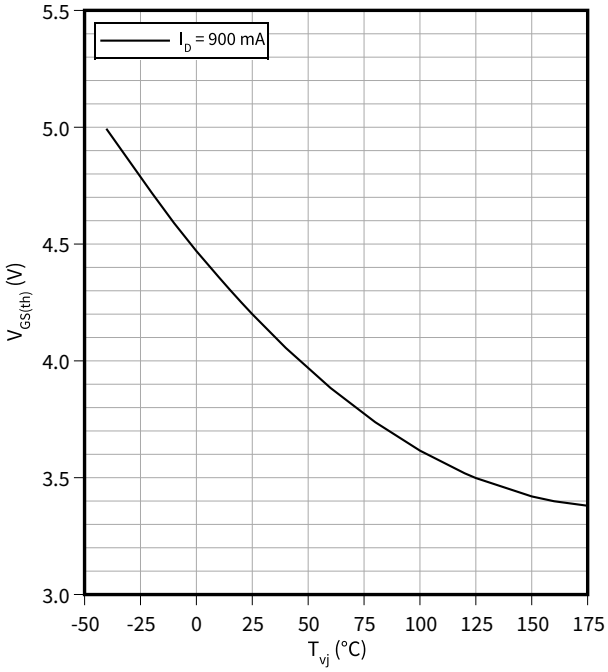
Transfer characteristic (typical), MOSFET Inverter

$I_D = f(V_{GS})$
$V_{DS} = 20$ V



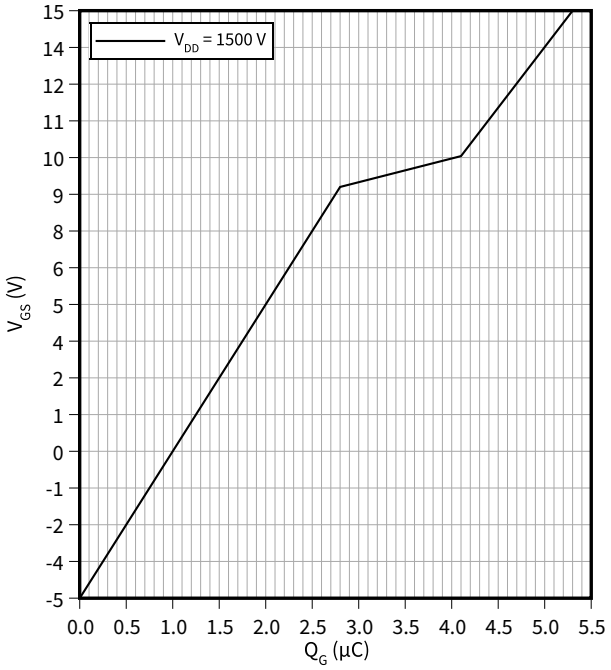
Gate-source threshold voltage (typical), MOSFET Inverter

$V_{GS(th)} = f(T_{vj})$
$V_{GS} = V_{DS}$



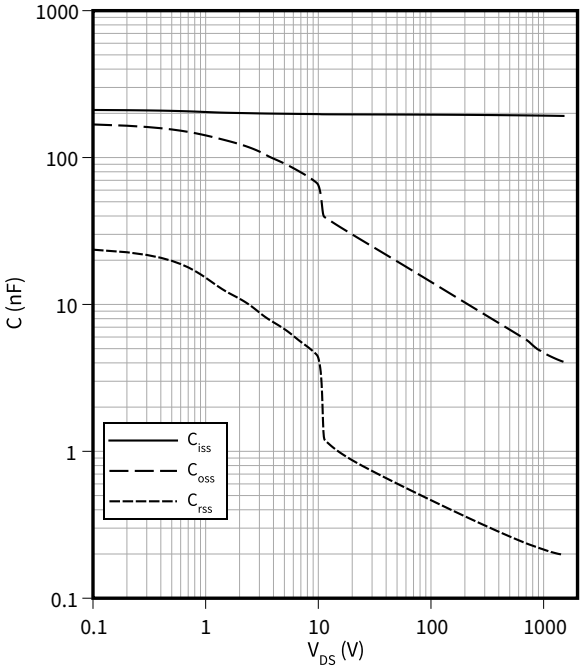
Gate charge characteristic (typical), MOSFET Inverter

$V_{GS} = f(Q_G)$
$I_D = 2000$ A, $T_{vj} = 25$ °C



Capacity characteristic (typical), MOSFET Inverter

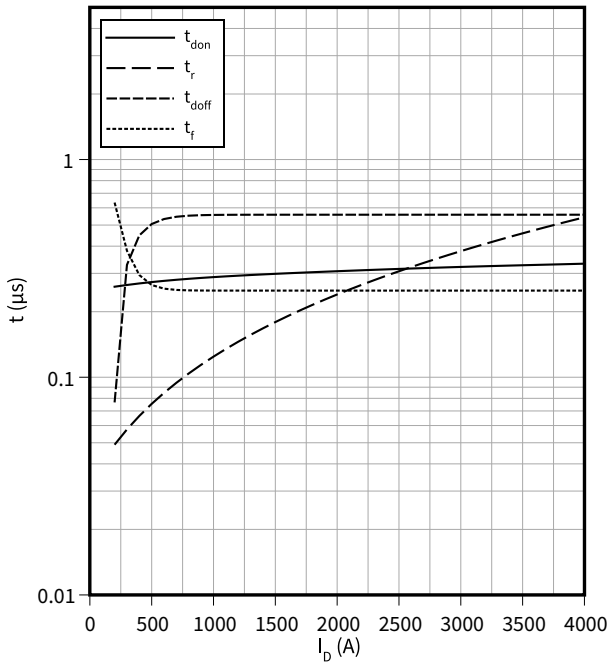
$C = f(V_{DS})$
$f = 100$ kHz, $T_{vj} = 25$ °C, $V_{GS} = 0$ V



Switching times (typical), MOSFET Inverter

$t = f(I_D)$

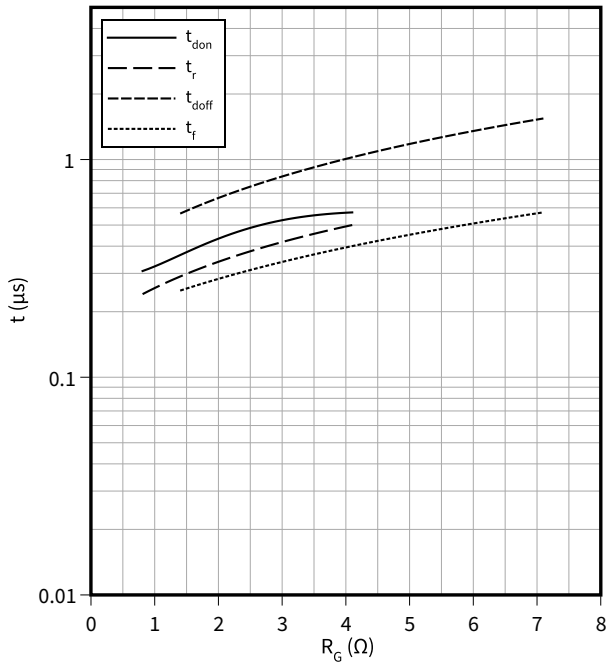
R_{Goff} = 1.41 Ω, R_{Gon} = 0.81 Ω, V_{DD} = 1500 V, T_{vj} = 175 °C, V_{GS} = -5/15 V



Switching times (typical), MOSFET Inverter

$t = f(R_G)$

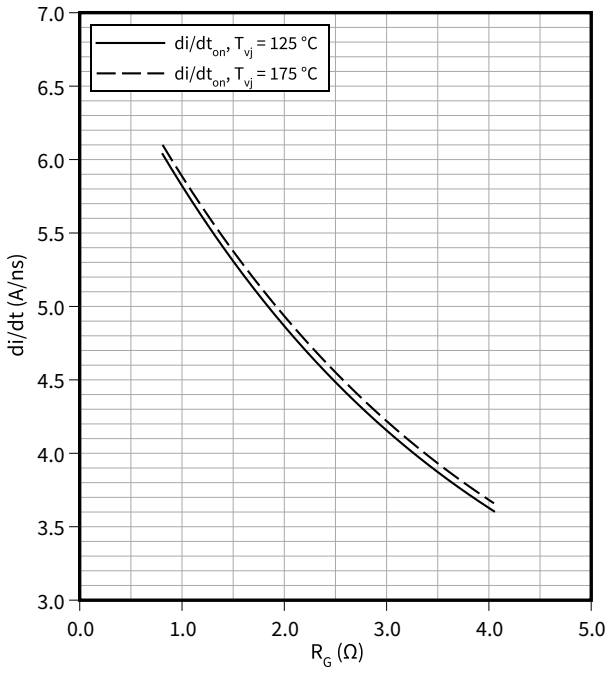
V_{DD} = 1500 V, I_D = 2000 A, T_{vj} = 175 °C, V_{GS} = -5/15 V



Current slope (typical), MOSFET Inverter

$di/dt = f(R_G)$

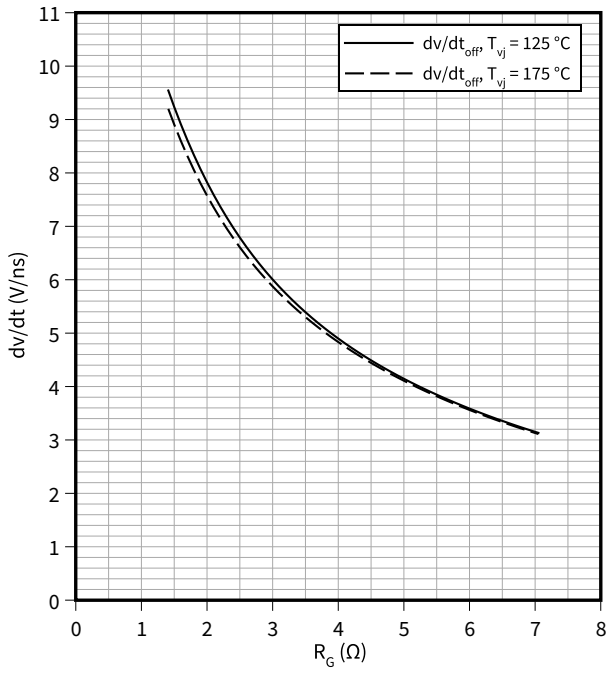
V_{DD} = 1500 V, t_{dead} = 1500 ns, I_D = 2000 A, V_{GS} = -5/15 V



Voltage slope (typical), MOSFET Inverter

$dv/dt = f(R_G)$

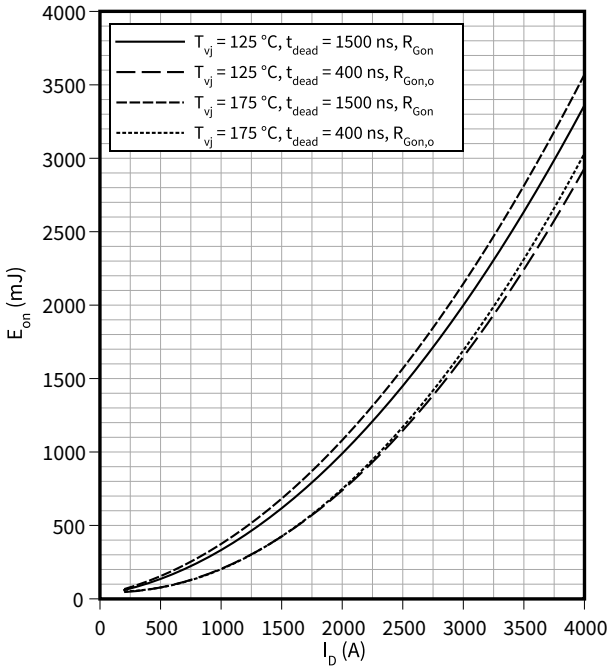
V_{DD} = 1500 V, I_D = 2000 A, V_{GS} = -5/15 V



Switching losses (typical), MOSFET Inverter

$E_{on} = f(I_D)$

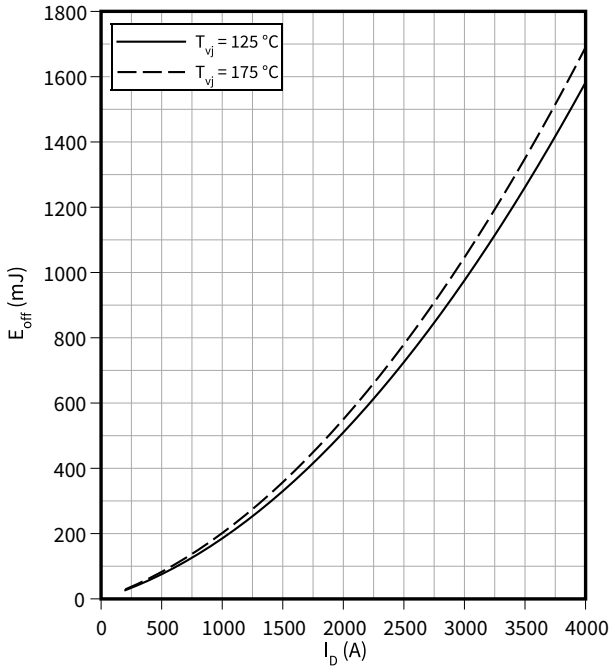
$R_{Gon} = 0.81\ \Omega$, $V_{DD} = 1500$ V, $R_{Gon,o} = 0.3\ \Omega$, $V_{GS} = 15/-5$ V



Switching losses (typical), MOSFET Inverter

$E_{off} = f(I_D)$

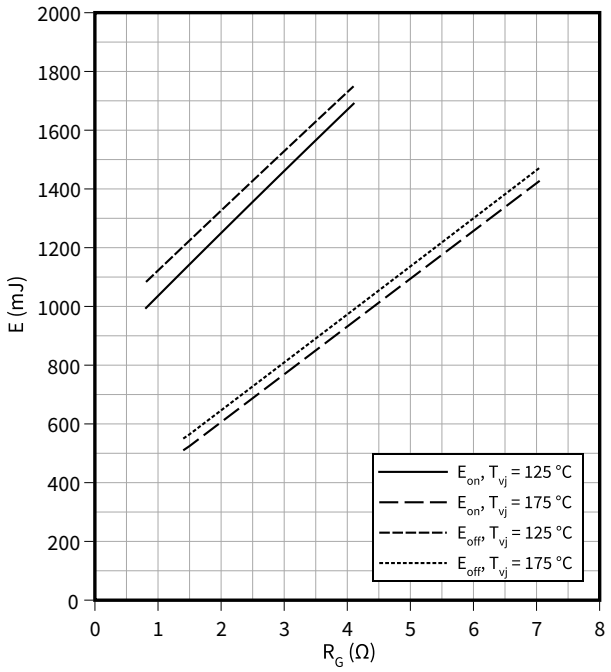
$R_{Goff} = 1.41\ \Omega$, $V_{DD} = 1500$ V, $V_{GS} = -5/15$ V



Switching losses (typical), MOSFET Inverter

$E = f(R_G)$

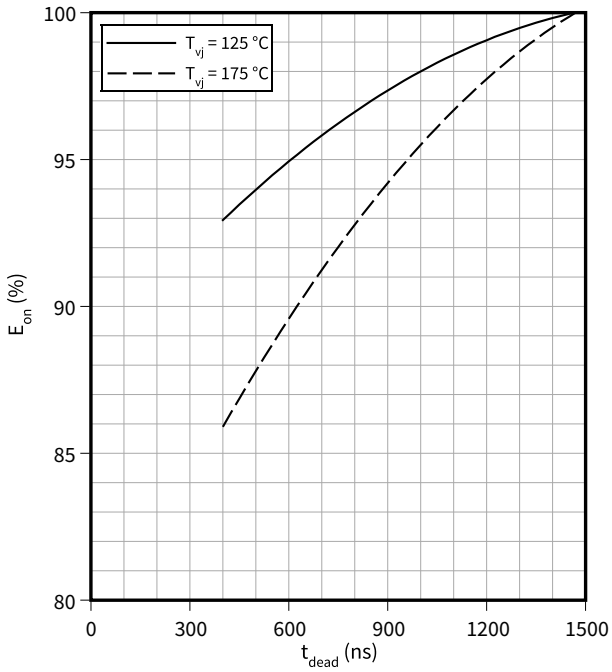
$V_{DD} = 1500$ V, $t_{dead} = 1500$ ns, $I_D = 2000$ A, $V_{GS} = -5/15$ V



Switching losses (typical), MOSFET Inverter

$E_{on} = f(t_{dead})$

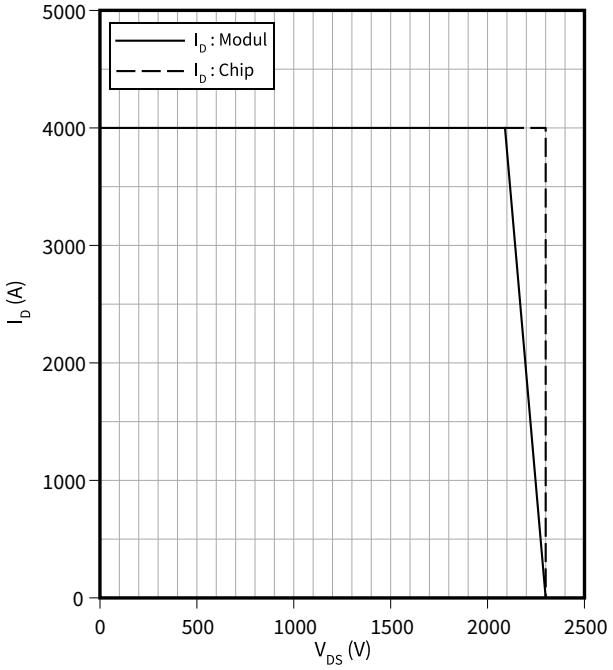
$R_{Gon} = 0.81\ \Omega$, $I_D = 2000$ A, $V_{DD} = 1500$ V, $V_{GS} = -5/15$ V



Reverse bias safe operating area (RBSOA), MOSFET Inverter

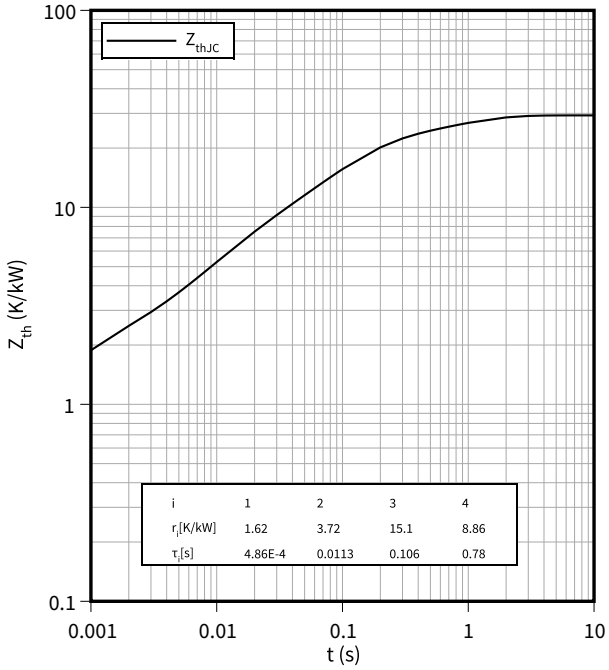
$I_D = f(V_{DS})$

$R_{Goff} = 1.41\ \Omega$, $T_{vj} = 175\ °C$, $V_{GS} = -5/15\ V$



Transient thermal impedance, MOSFET Inverter

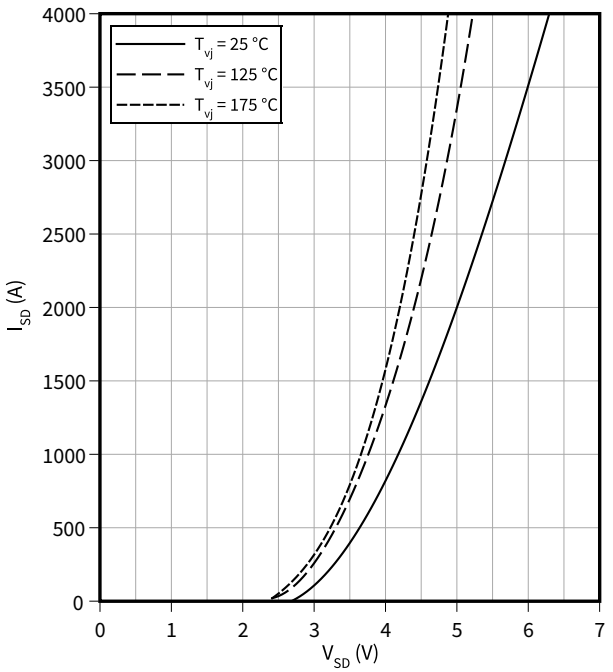
$Z_{th} = f(t)$



Forward characteristic body diode (typical), MOSFET Inverter

$I_{SD} = f(V_{SD})$

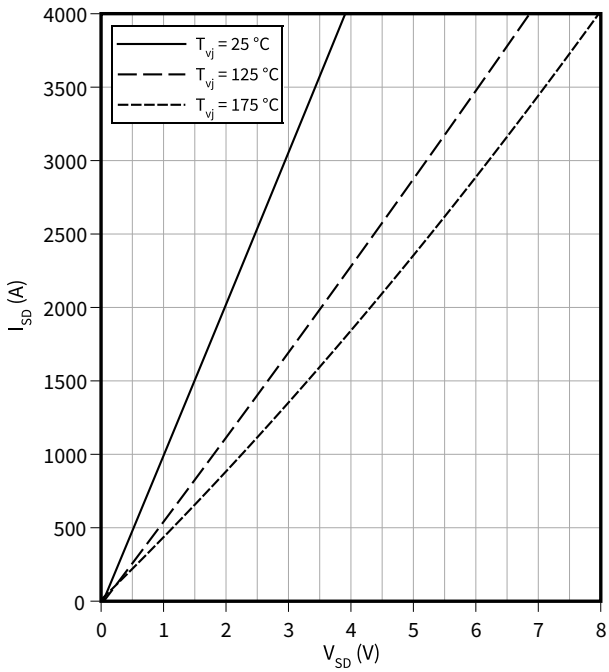
$V_{GS} = -5\ V$



Forward characteristic body diode (typical), MOSFET Inverter

$I_{SD} = f(V_{SD})$

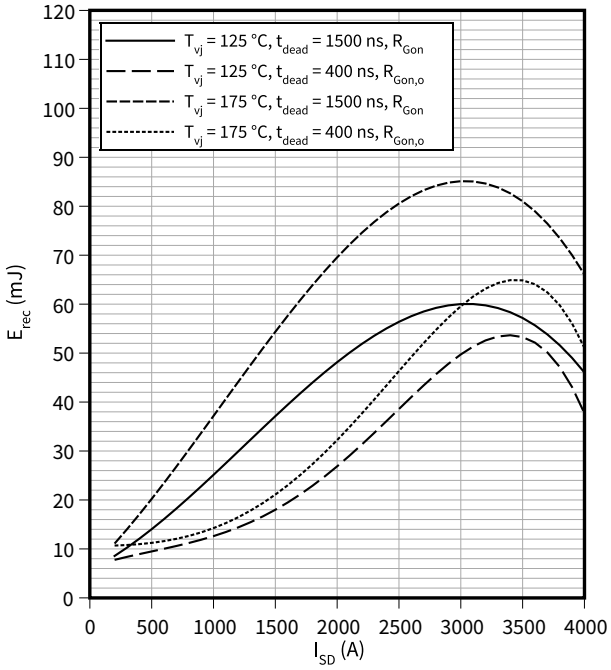
$V_{GS} = 15\ V$



Switching losses body diode (typical), MOSFET Inverter

$E_{rec} = f(I_{SD})$

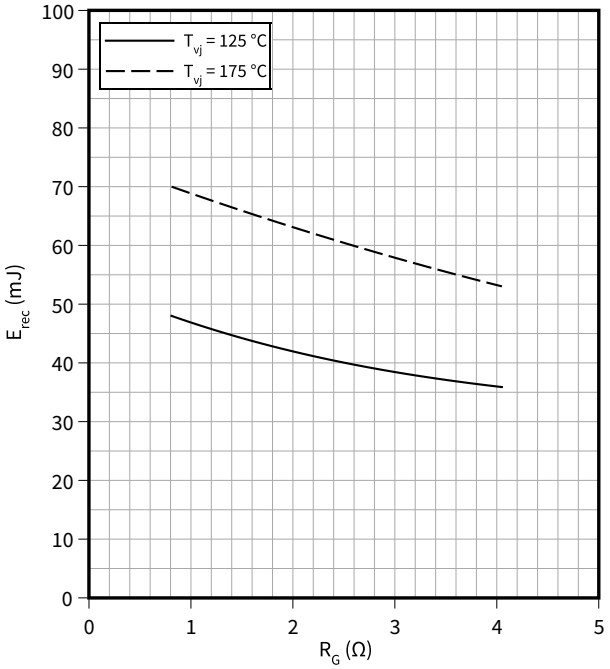
$R_{Gon} = 0.81\ \Omega$, $R_{Gon,o} = 0.3\ \Omega$, $V_{DD} = 1500$ V



Switching losses body diode (typical), MOSFET Inverter

$E_{rec} = f(R_G)$

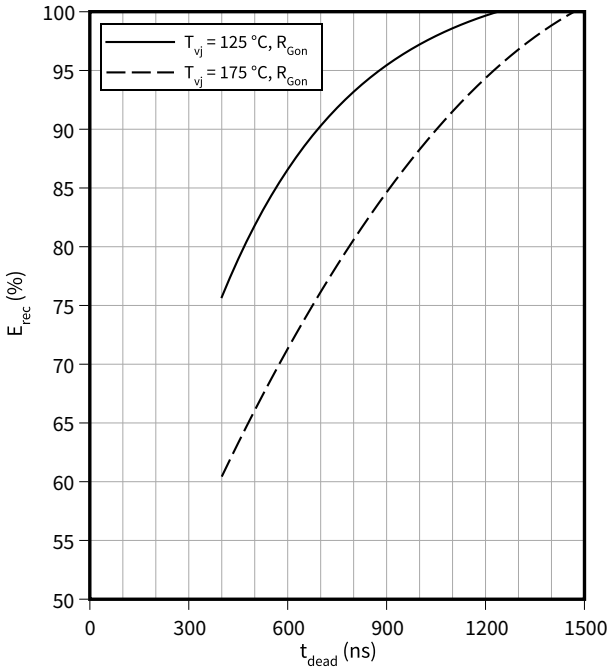
$t_{dead} = 1500$ ns, $I_{SD} = 2000$ A, $V_{DD} = 1500$ V



Switching losses body diode (typical), MOSFET Inverter

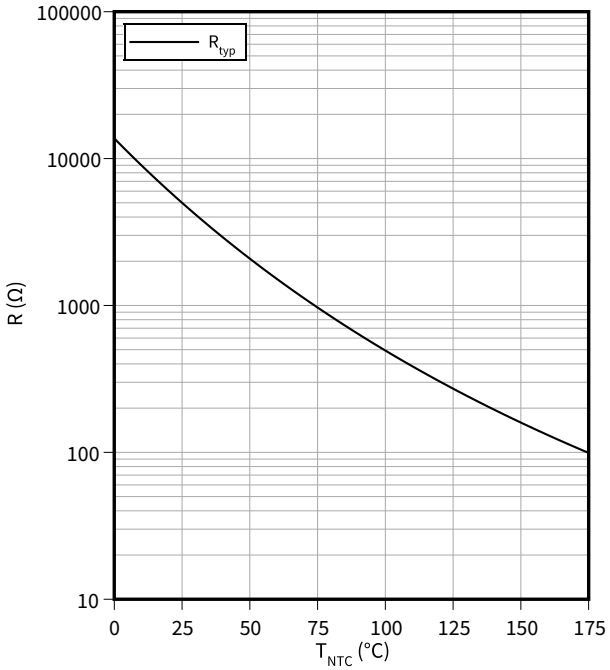
$E_{rec} = f(t_{dead})$

$R_{Gon} = 0.81\ \Omega$, $I_D = 2000$ A, $R_{Gon,o} = 0.3\ \Omega$, $V_{DD} = 1500$ V, $V_{GS} = 15/-5$ V



Temperature characteristic (typical), NTC-Thermistor

$R = f(T_{NTC})$



6 Circuit diagram

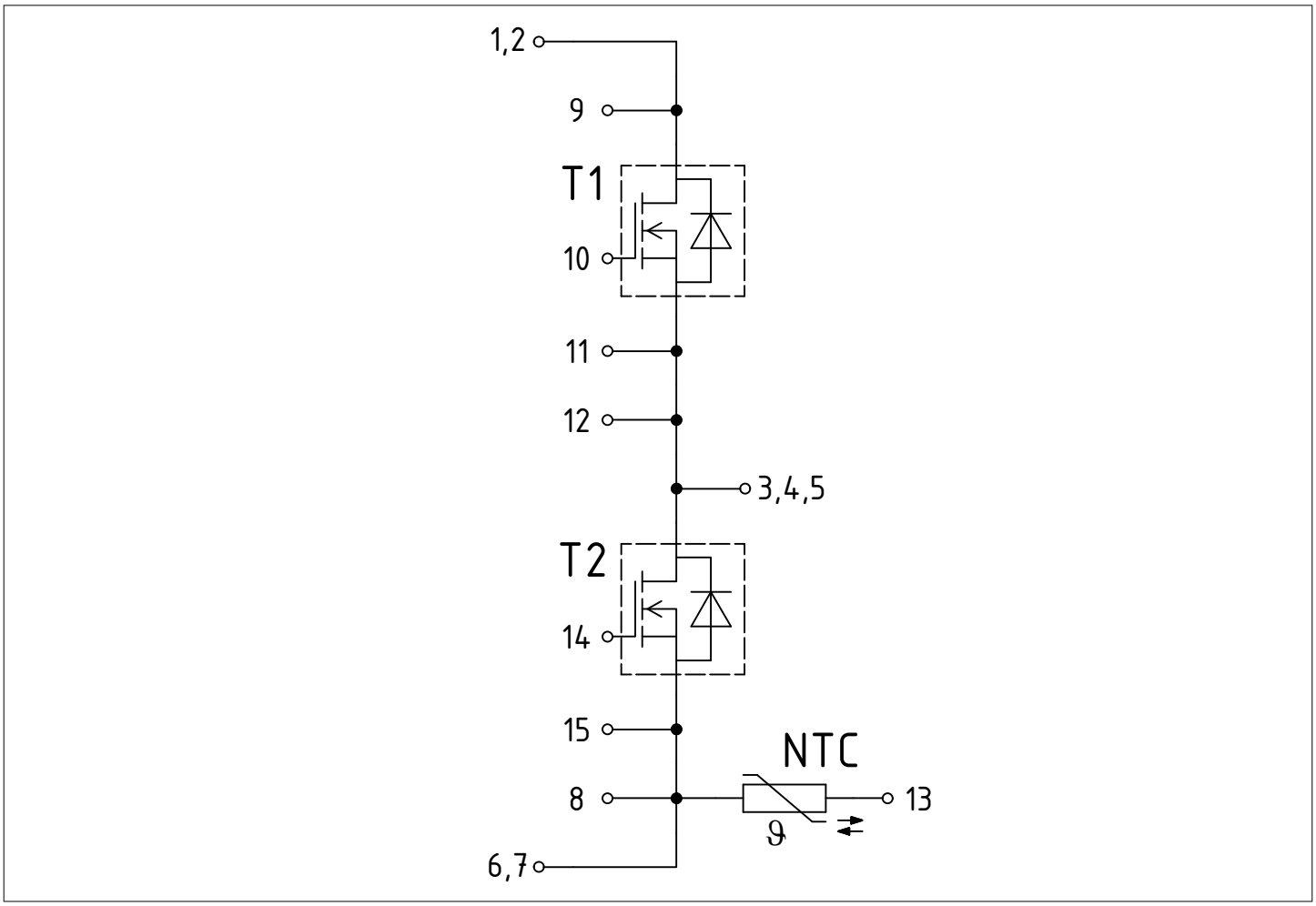


Figure 1

7 Package outlines

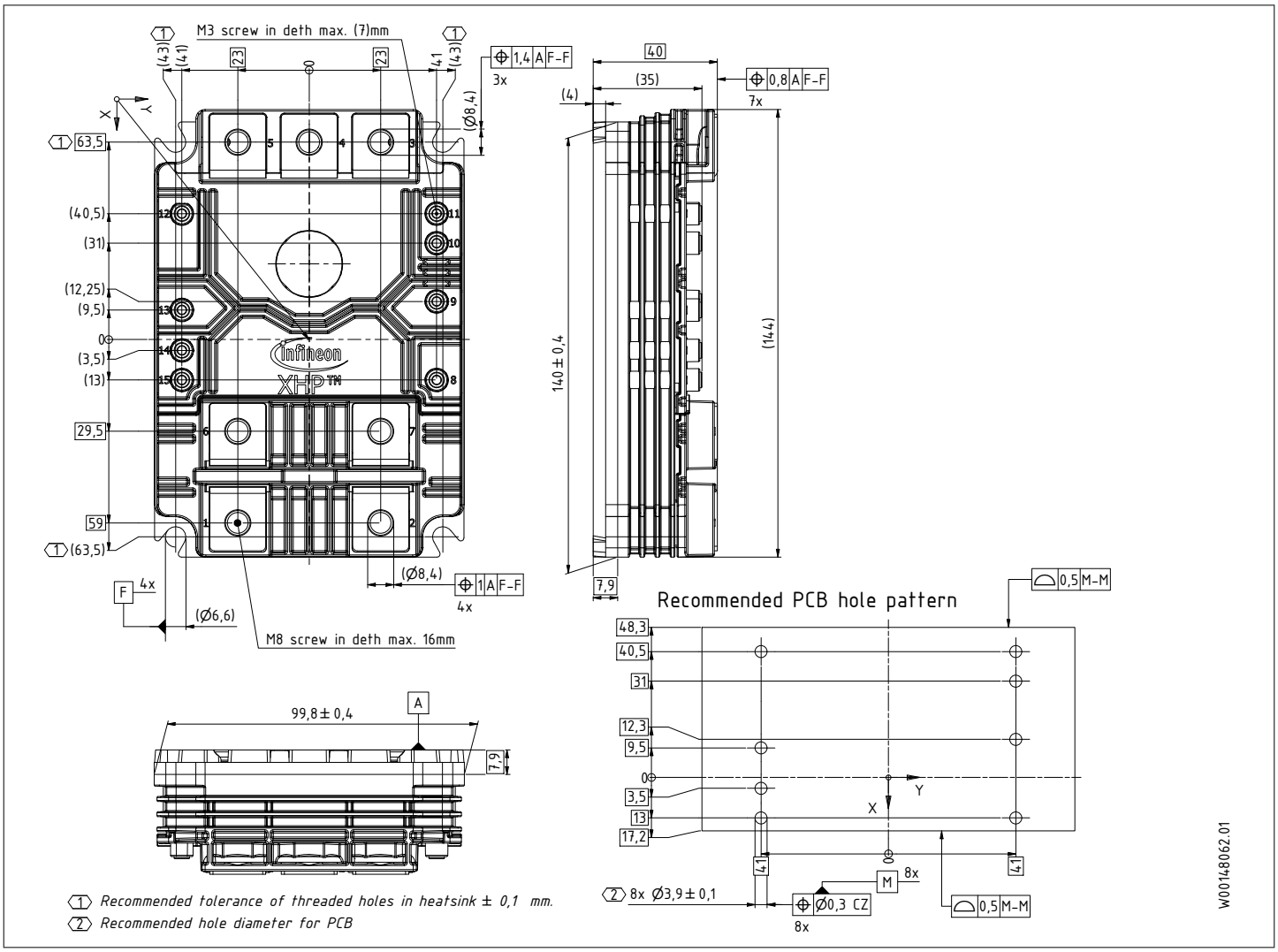


Figure 2

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	*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	2024-06-04	Initial version
0.20	2025-02-13	Preliminary datasheet
1.00	2025-04-08	Final datasheet

Trademarks

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

Edition 2025-04-08

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-ABK573-003

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.

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.