Final datasheet

XHP™2 module with CoolSiC™ Trench MOSFET and NTC / pre-applied thermal interface material

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
  - Substrate for low thermal resistance
  - Copper base plate
  - High creepage and clearance distances
  - High power density
  - Package with CTI > 600
  - Pre-applied thermal interface material

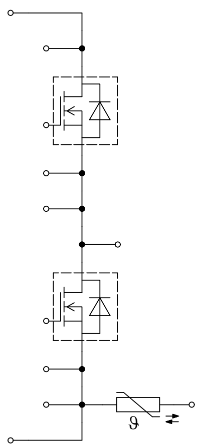
Potential applications

- Central inverter
- Wind power generation
- Energy storage systems
- Industrial drives
- Traction drives
- DC/DC converter
- 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



Please read the sections "Important notice" and "Warnings" at the end of this document

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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	4.0	kV
Material of module baseplate			Cu	
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_H = 25 °C, per switch			0.4		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 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_H = 45 °C	1185	A
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		Min.	Typ.	Max.	Unit
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
Turn-on delay time (inductive load)	$t_{d\ on}$	I_D = 2000 A, R_{Gon} = 0.1 Ω, V_{DD} = 1500 V, V_{GS} = -5/15 V, t_{dead} = 3000 ns, 0.1 V_{GS} to 0.1 I_D	T_{vj} = 25 °C		225		ns
			T_{vj} = 125 °C		215		
			T_{vj} = 175 °C		215		
Rise time (inductive load)	t_r	I_D = 2000 A, R_{Gon} = 0.1 Ω, V_{DD} = 1500 V, V_{GS} = -5/15 V, t_{dead} = 3000 ns, 0.1 I_D to 0.9 I_D	T_{vj} = 25 °C		100		ns
			T_{vj} = 125 °C		100		
			T_{vj} = 175 °C		105		

(table continues...)

Table 5 **(continued) Characteristic values**

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Turn-off delay time (inductive load)	$t_{d\,off}$	I_D = 2000 A, R_{Goff} = 1 Ω, V_{DD} = 1500 V, V_{GS} = -5/15 V, 0.9 V_{GS} to 0.9 I_D	T_{vj} = 25 °C		375		ns
			T_{vj} = 125 °C		420		
			T_{vj} = 175 °C		450		
Fall time (inductive load)	t_f	I_D = 2000 A, R_{Goff} = 1 Ω, V_{DD} = 1500 V, V_{GS} = -5/15 V, 0.9 I_D to 0.1 I_D	T_{vj} = 25 °C		105		ns
			T_{vj} = 125 °C		130		
			T_{vj} = 175 °C		145		
Turn-on time (resistive load)	t_{on_R}	I_D = 500 A, V_{DD} = 2000 V, V_{GS} = -5/15 V, R_{Gon} = 0.1 Ω	T_{vj} = 25 °C	625.00			ns
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} = 0.1 Ω, di/dt = 16.3 kA/µs (T_{vj} = 175 °C), t_{dead} = 3000 ns	T_{vj} = 25 °C		410		mJ
			T_{vj} = 125 °C		540		
			T_{vj} = 175 °C		640		
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, $R_{Gon,o}$ = 0.1 Ω, di/dt = 15.2 kA/µs (T_{vj} = 175 °C), t_{dead} = 500 ns	T_{vj} = 25 °C		390		mJ
			T_{vj} = 125 °C		410		
			T_{vj} = 175 °C		470		
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 Ω, dv/dt = 10.8 kV/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		330		mJ
			T_{vj} = 125 °C		370		
			T_{vj} = 175 °C		400		
SC data	I_{SC}	V_{GS} = -5/15 V, V_{DD} = 1500 V, V_{DSmax} = V_{DSS}-L_{sDS}*di/dt	t_P ≤ 3 µs, T_{vj} = 175 °C		12000		A
Thermal resistance, junction to heat sink	R_{thJH}	per MOSFET, Valid with IFX pre-applied Thermal Interface Material				33	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_H = 45 °C	975	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 = 16.3 kA/µs (T_{vj} = 175 °C), V_{DD} = 1500 V, V_{GS} = -5/15 V, t_{dead} = 3000 ns	T_{vj} = 25 °C		5.8		mJ
			T_{vj} = 125 °C		39.2		
			T_{vj} = 175 °C		64.1		
Reverse recovery energy, optimized	$E_{rec,o}$	I_{SD} = 2000 A, di_s/dt = 15.2 kA/µs (T_{vj} = 175 °C), V_{DD} = 1500 V, V_{GS} = -5/15 V, t_{dead} = 500 ns	T_{vj} = 25 °C		5.8		mJ
			T_{vj} = 125 °C		11.8		
			T_{vj} = 175 °C		19.6		

4 NTC-Thermistor

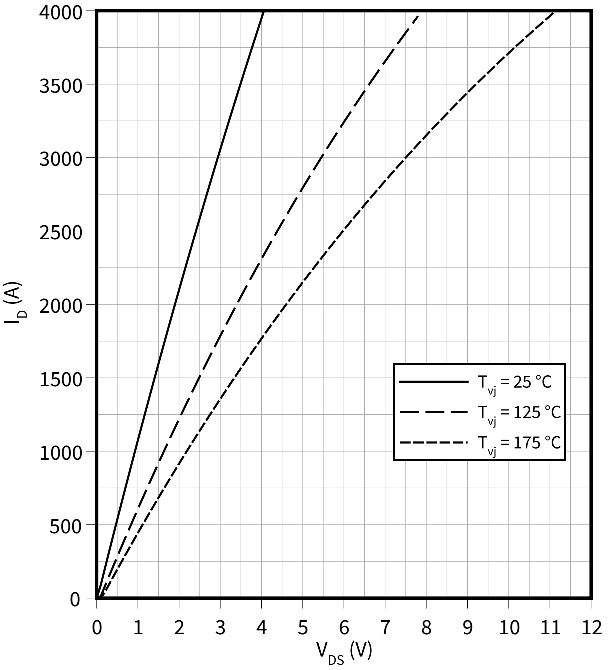
Table 8 **Characteristic values**

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

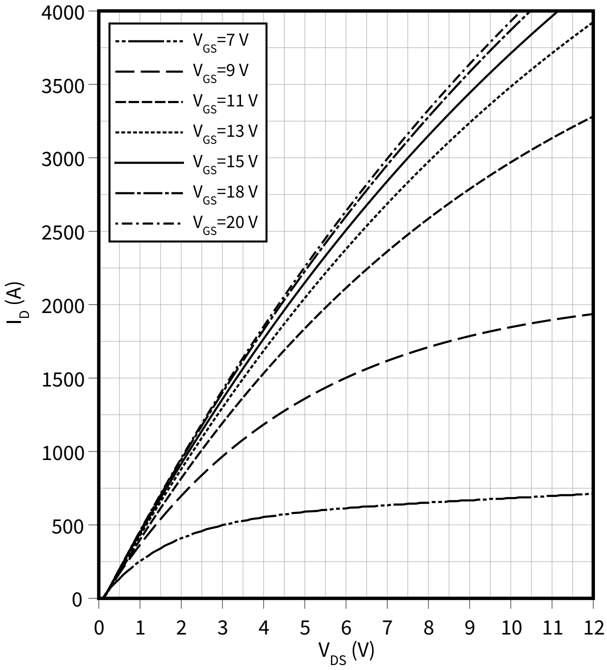
Note: *For an analytical description of the NTC characteristics please refer to AN2009-10, chapter 4*

5 Characteristics diagrams

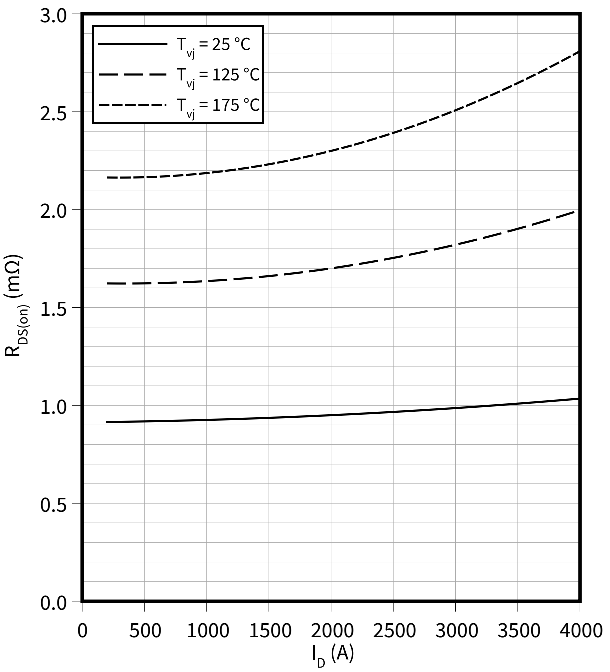
Output characteristic (typical), MOSFET Inverter
$I_D = f(V_{DS})$
$V_{GS} = 15$ V



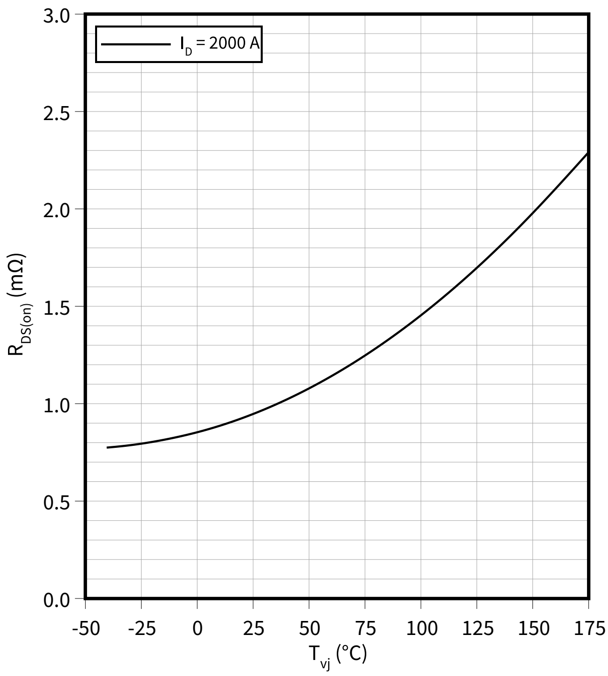
Output characteristic field (typical), MOSFET Inverter
$I_D = f(V_{DS})$
$T_{vj} = 175$ °C



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



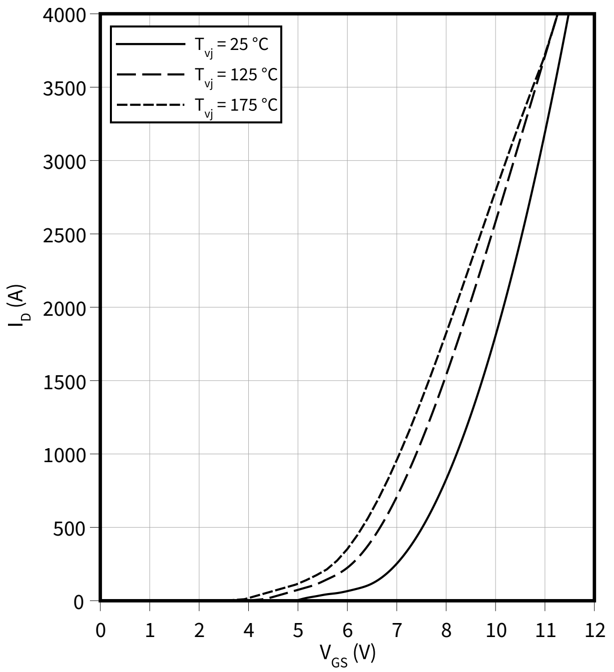
Drain source on-resistance (typical), MOSFET Inverter
$R_{DS(on)} = f(T_{vj})$
$V_{GS} = 15$ V



Transfer characteristic (typical), MOSFET Inverter

$I_D = f(V_{GS})$

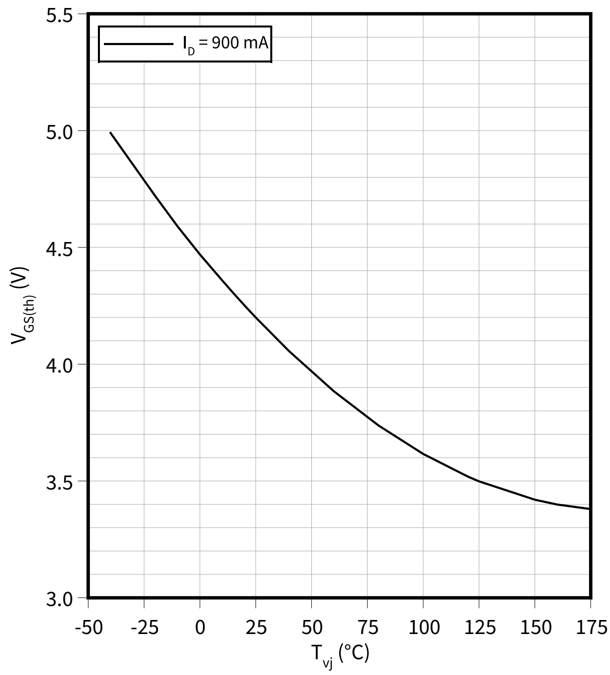
$V_{DS} = 20$ V



Gate-source threshold voltage (typical), MOSFET Inverter

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

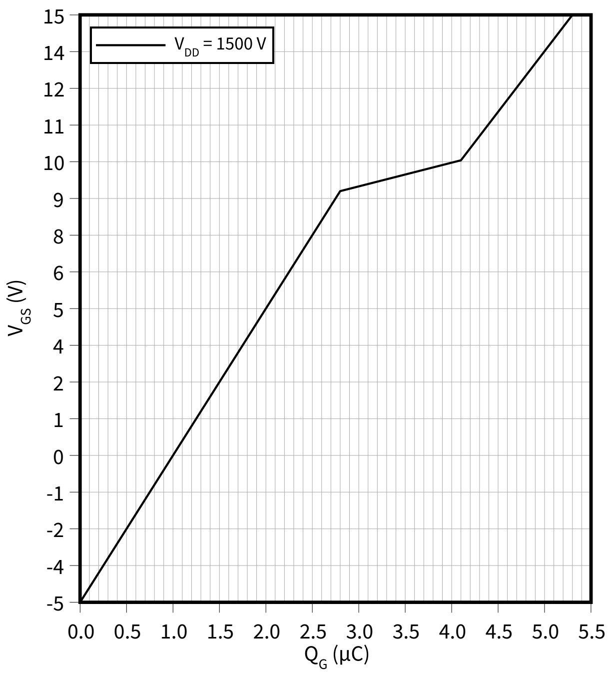
$V_{GS} = V_{DS}$



Gate charge characteristic (typical), MOSFET Inverter

$V_{GS} = f(Q_G)$

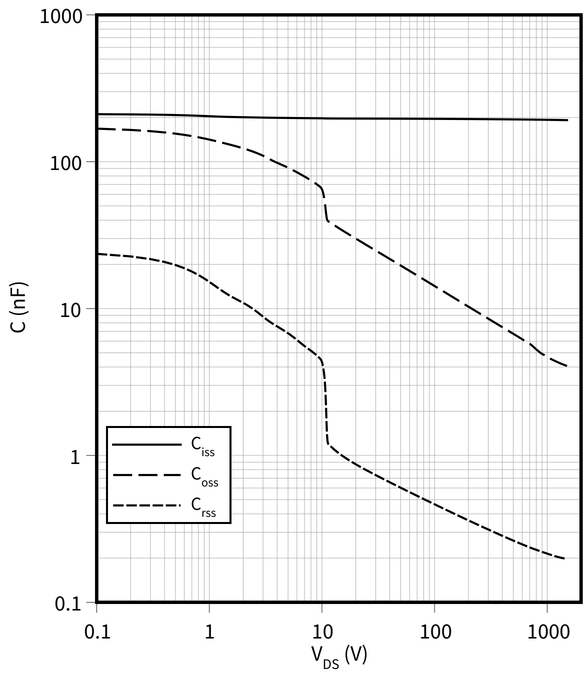
$I_D = 2000$ A, $T_{vj} = 25$ °C



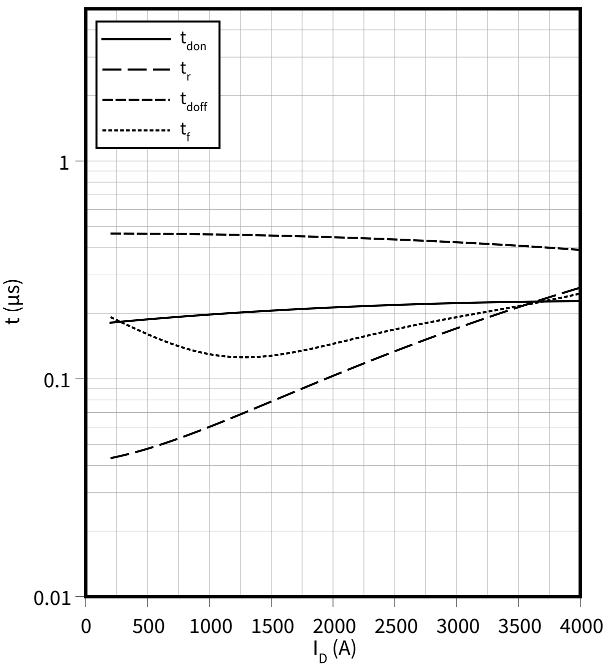
Capacity characteristic (typical), MOSFET Inverter

$C = f(V_{DS})$

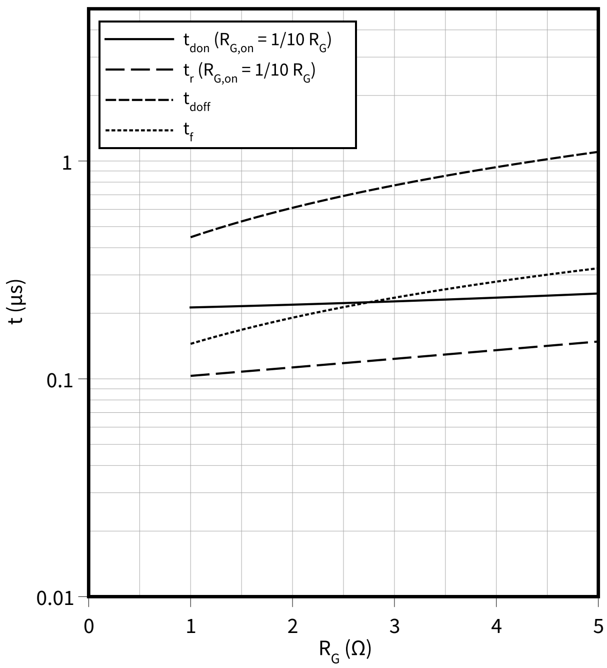
f = 100 kHz, $T_{vj} = 25$ °C, $V_{GS} = 0$ V



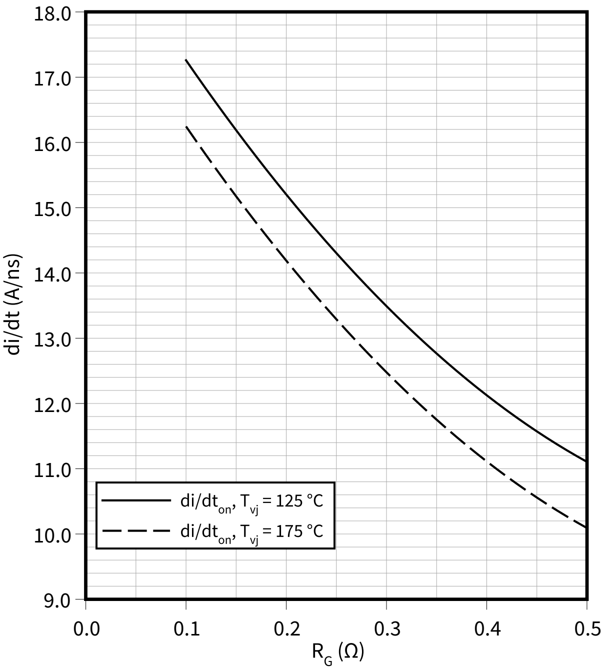
Switching times (typical), MOSFET Inverter
$t = f(I_D)$
$R_{Goff} = 1\ \Omega$, $R_{Gon} = 0.1\ \Omega$, $V_{DD} = 1500$ V, $T_{vj} = 175$ °C, $V_{GS} = -5/15$ V



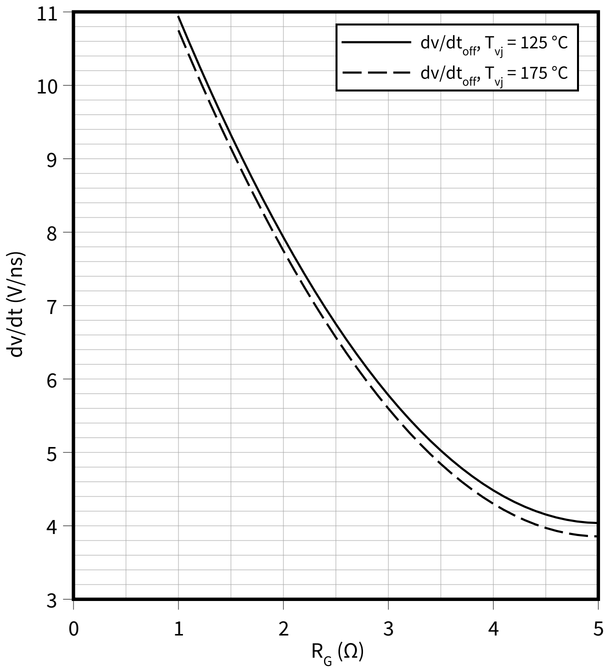
Switching times (typical), MOSFET Inverter
$t = f(R_G)$
$V_{DD} = 1500$ V, $I_D = 2000$ A, $T_{vj} = 175$ °C, $V_{GS} = -5/15$ V



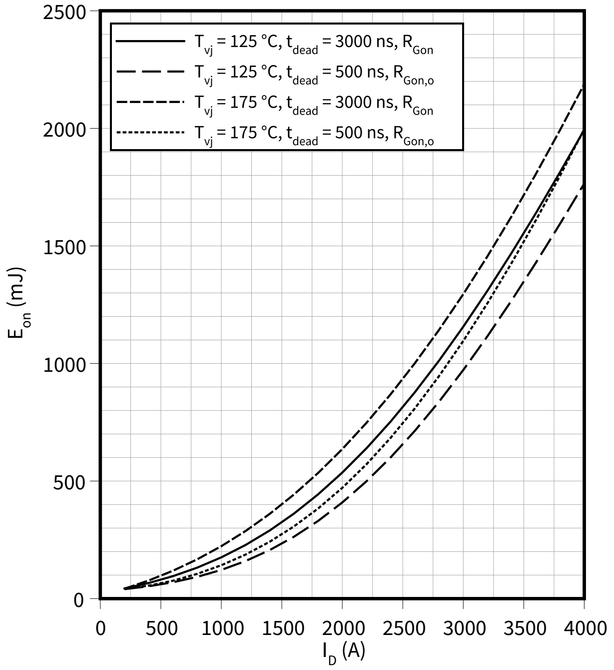
Current slope (typical), MOSFET Inverter
$di/dt = f(R_G)$
$V_{DD} = 1500$ V, $t_{dead} = 3000$ ns, $I_D = 2000$ A, $V_{GS} = -5/15$ V



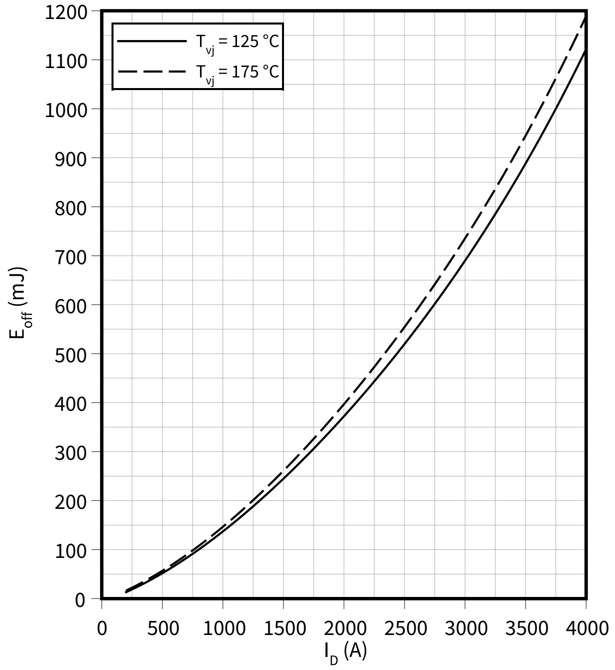
Voltage slope (typical), MOSFET Inverter
$dv/dt = f(R_G)$
$V_{DD} = 1500$ V, $I_D = 2000$ A, $V_{GS} = -5/15$ V



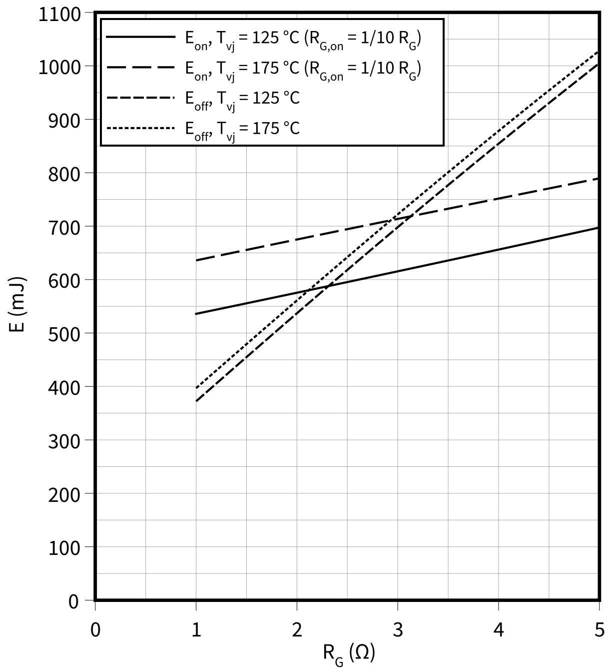
Switching losses (typical), MOSFET Inverter
$E_{on} = f(I_D)$
$R_{Gon} = 0.1\ \Omega$, $V_{DD} = 1500$ V, $R_{Gon,o} = 0.1\ \Omega$, $V_{GS} = 15/-5$ V



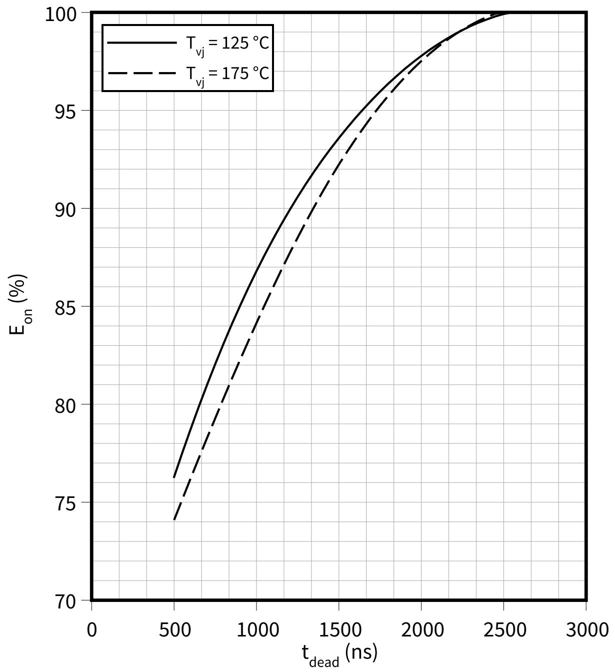
Switching losses (typical), MOSFET Inverter
$E_{off} = f(I_D)$
$R_{Goff} = 1\ \Omega$, $V_{DD} = 1500$ V, $V_{GS} = -5/15$ V



Switching losses (typical), MOSFET Inverter
$E = f(R_G)$
$V_{DD} = 1500$ V, $t_{dead} = 3000$ ns, $I_D = 2000$ A, $V_{GS} = -5/15$ V



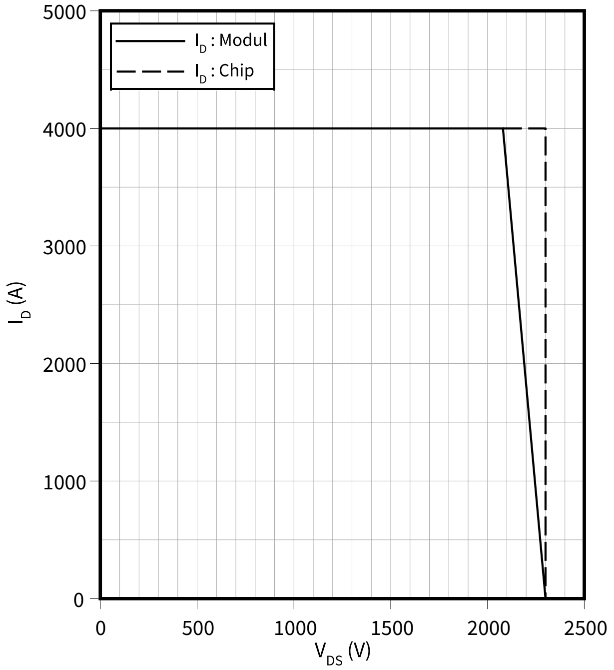
Switching losses (typical), MOSFET Inverter
$E_{on} = f(t_{dead})$
$R_{Gon} = 0.1\ \Omega$, $I_D = 2000$ A, $V_{DD} = 1500$ V, $V_{GS} = -5/15$ V



Reverse bias safe operating area (RBSOA), MOSFET Inverter

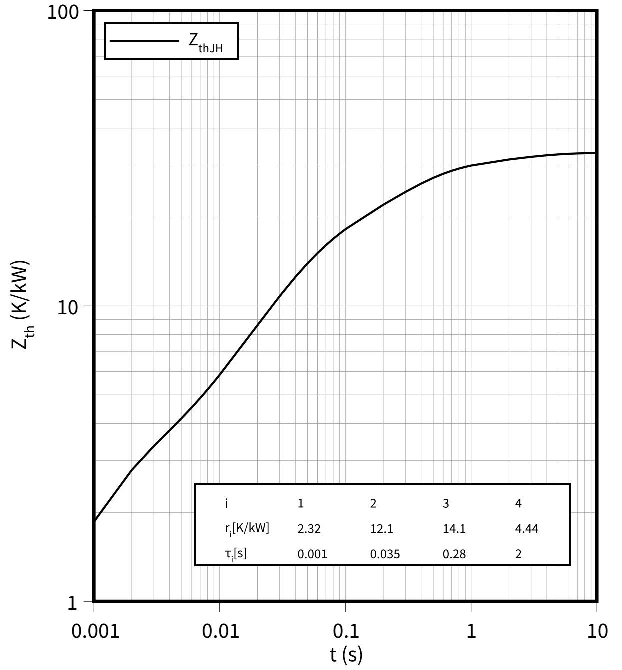
$I_D = f(V_{DS})$

$R_{Goff} = 1\ \Omega$, $T_{vj} = 175\ °C$, $V_{GS} = -5/15\ V$



Transient thermal impedance, MOSFET Inverter

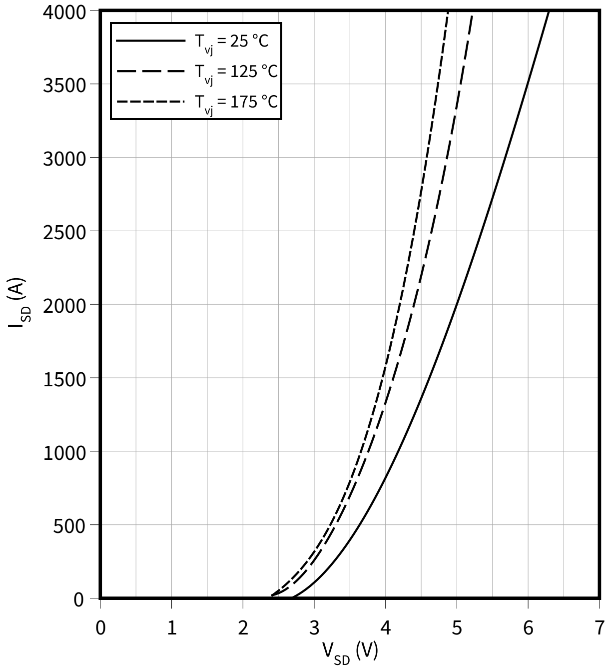
$Z_{th} = f(t)$



Forward characteristic body diode (typical), MOSFET Inverter

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

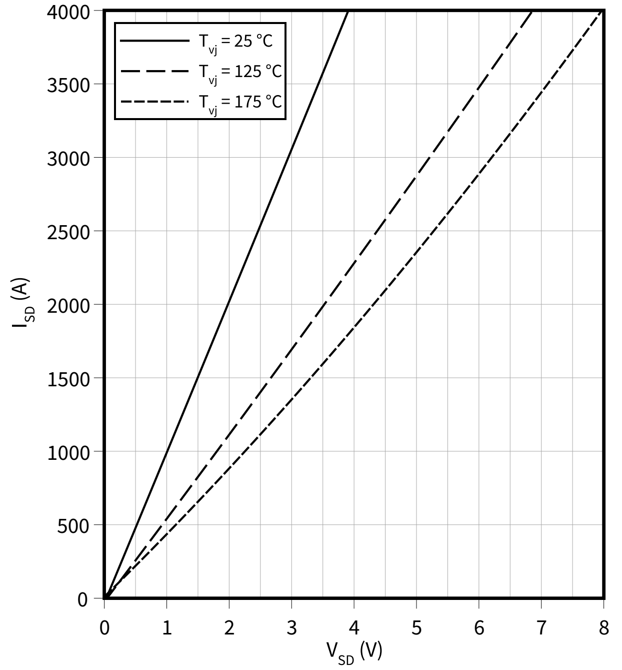
$V_{GS} = -5\ V$



Forward characteristic body diode (typical), MOSFET Inverter

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

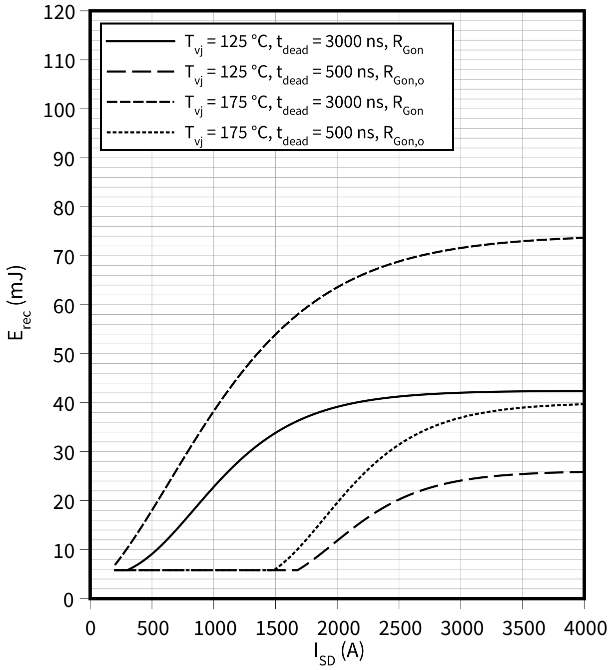
$V_{GS} = 15\ V$



Switching losses body diode (typical), MOSFET Inverter

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

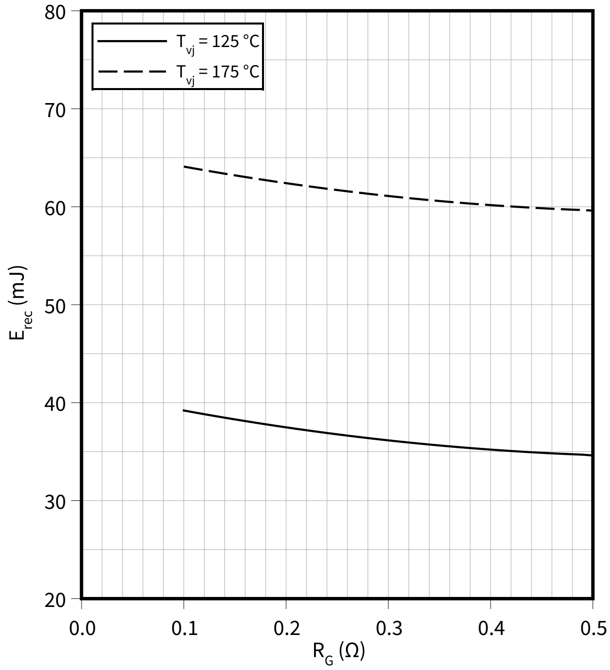
$R_{Gon} = 0.1\ \Omega$, $R_{Gon,o} = 0.1\ \Omega$, $V_{DD} = 1500\ V$



Switching losses body diode (typical), MOSFET Inverter

$E_{rec} = f(R_G)$

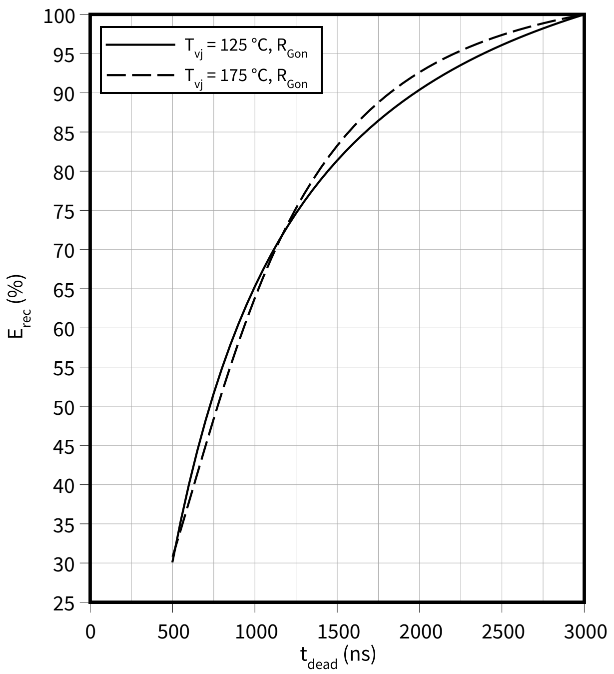
$t_{dead} = 3000\ ns$, $I_{SD} = 2000\ A$, $V_{DD} = 1500\ V$



Switching losses body diode (typical), MOSFET Inverter

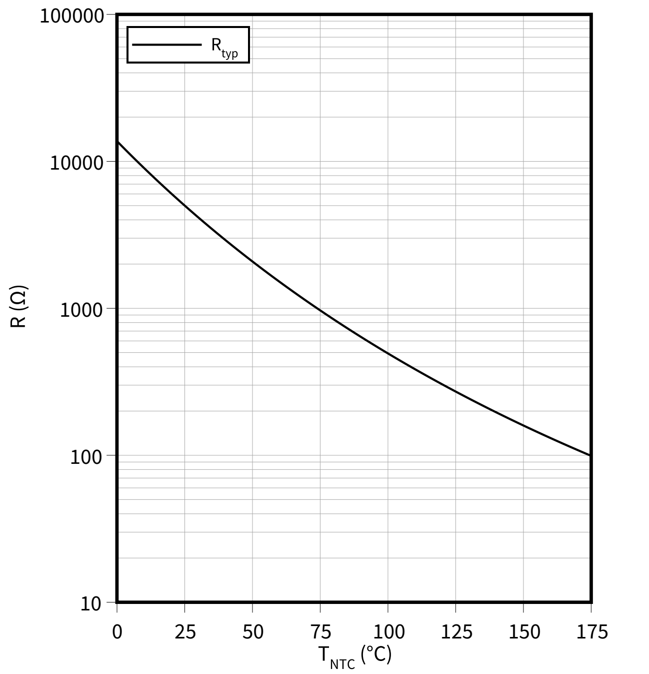
$E_{rec} = f(t_{dead})$

$R_{Gon} = 0.1\ \Omega$, $I_D = 2000\ A$, $R_{Gon,o} = 0.1\ \Omega$, $V_{DD} = 1500\ V$, $V_{GS} = 15/-5\ V$



Temperature characteristic (typical), NTC-Thermistor

$R = f(T_{NTC})$



6 Circuit diagram

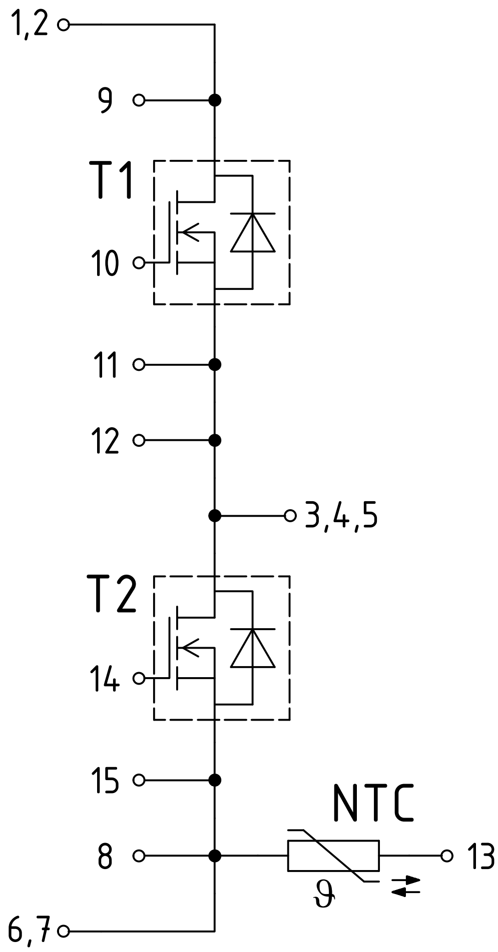


Figure 1

7 Package outlines

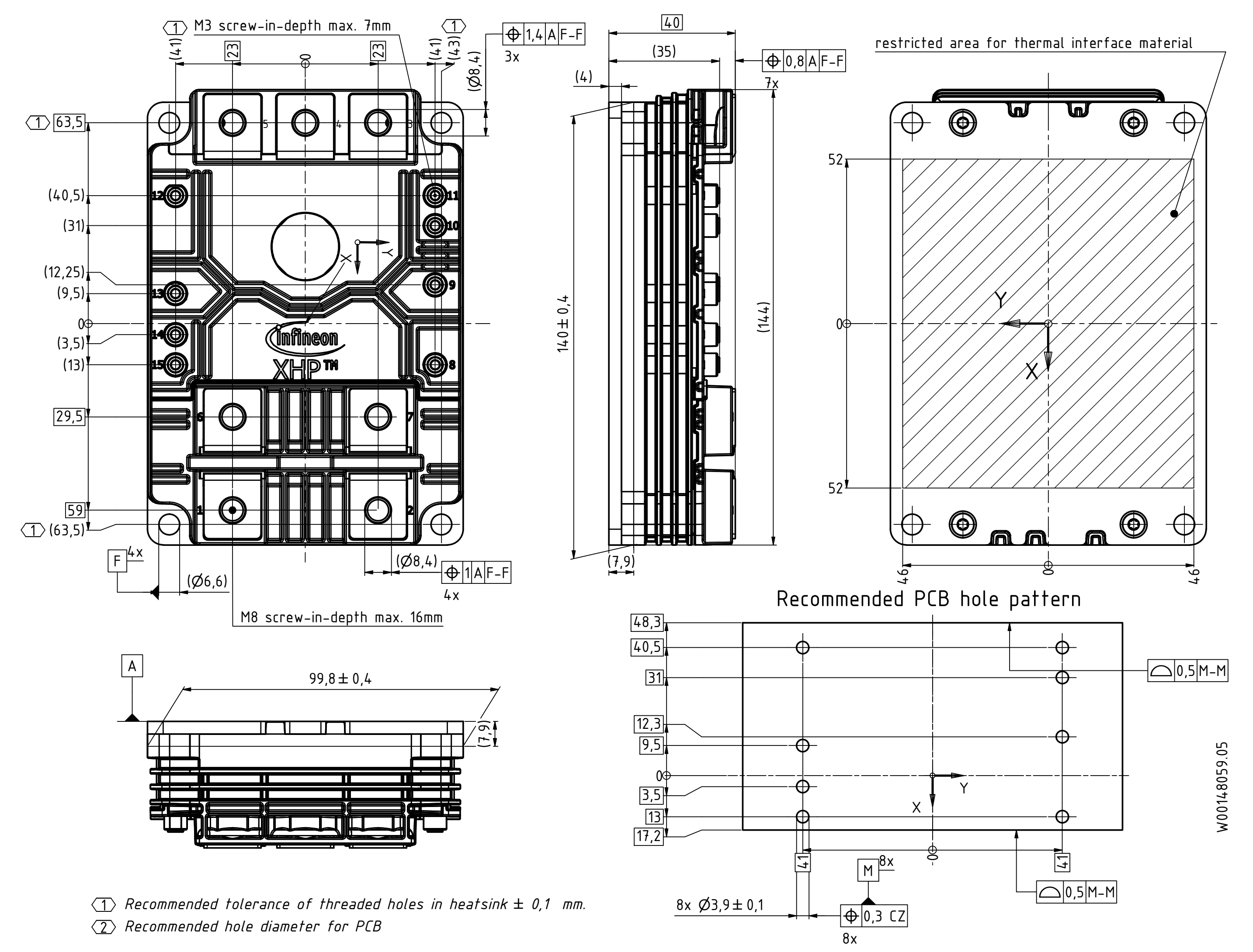


Figure 2

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*	*Digit*	*Example*
	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	Data Matrix	Barcode Code128
	71549142846550549911530	71549142846550549911530

Figure 3

Revision history

Document revision	Date of release	Description of changes
0.10	2025-06-08	Preliminary datasheet
1.00	2025-07-07	Final datasheet

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Edition 2025-07-07

Published by

Infineon Technologies AG

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Document reference
IFX-ABO307-002