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} = 1500 A / I_{DRM} = 3000 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

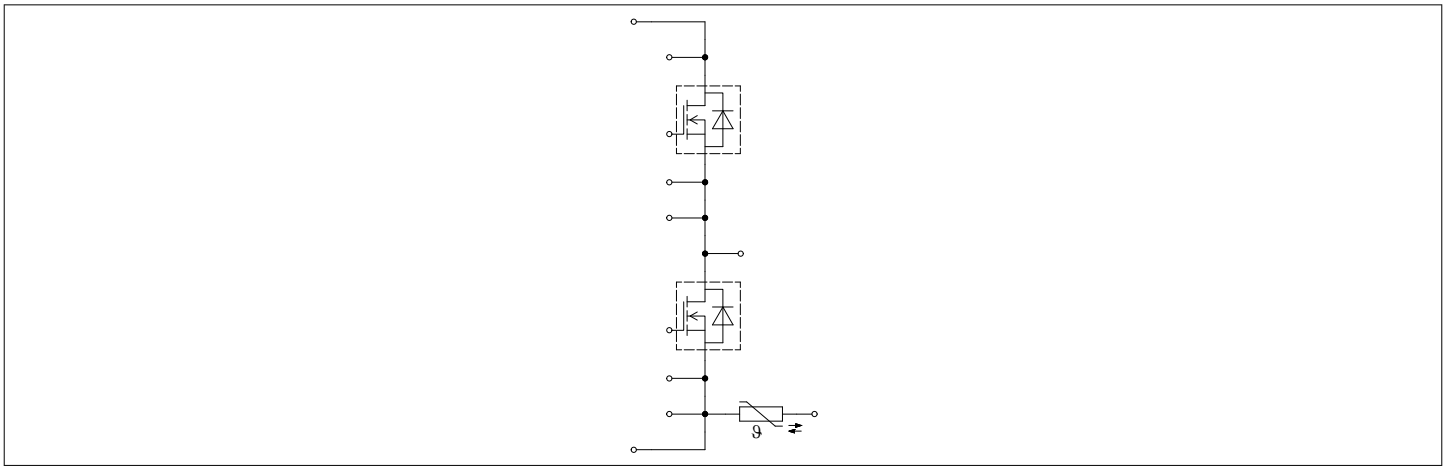


Table of contents

Description . . . 1
Features . . . 1
Potential applications . . . 1
Product validation . . . 1
Table of contents . . . 2
1 Package . . . 3
2 MOSFET Inverter . . . 3
3 Body diode (MOSFET Inverter) . . . 5
4 NTC-Thermistor . . . 6
5 Characteristics diagrams . . . 7
6 Circuit diagram . . . 13
7 Package outlines . . . 14
8 Module label code . . . 15
Revision history . . . 16
Disclaimer . . . 17

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}			1500	A
Continuous DC drain current	I_{DDC}	T_{vj} = 175 °C, V_{GS} = 15 V	T_H = 45 °C	1000	A
Repetitive peak drain current	I_{DRM}	verified by design, t_p limited by T_{vjmax}		3000	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 = 1500 A	V_{GS} = 15 V, T_{vj} = 25 °C		1.27	1.59	mΩ
			V_{GS} = 15 V, T_{vj} = 125 °C		2.27	2.84	
			V_{GS} = 15 V, T_{vj} = 175 °C		3.07	3.84	
Gate threshold voltage	$V_{GS(th)}$	I_D = 675 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			3.98		µC
Internal gate resistor	R_{Gint}	T_{vj} = 25 °C			1.5		Ω
Input capacitance	C_{ISS}	f = 100 kHz, V_{DS} = 1500 V, V_{GS} = 0 V	T_{vj} = 25 °C		143		nF
Output capacitance	C_{OSS}	f = 100 kHz, V_{DS} = 1500 V, V_{GS} = 0 V	T_{vj} = 25 °C		3.08		nF
Reverse transfer capacitance	C_{rss}	f = 100 kHz, V_{DS} = 1500 V, V_{GS} = 0 V	T_{vj} = 25 °C		0.15		nF
C_{OSS} stored energy	E_{OSS}	V_{DS} = 1500 V, V_{GS} = -5/15 V, T_{vj} = 25 °C			4.35		mJ
Drain-source leakage current	I_{DSS}	V_{DS} = 2300 V, V_{GS} = -5 V	T_{vj} = 25 °C			786	µA
Gate-source leakage current	I_{GSS}	V_{DS} = 0 V, T_{vj} = 25 °C	V_{GS} = 20 V			2400	nA
Turn-on delay time (inductive load)	$t_{d\,on}$	I_D = 1500 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		210		ns
			T_{vj} = 125 °C		200		
			T_{vj} = 175 °C		200		
Rise time (inductive load)	t_r	I_D = 1500 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		95		ns
			T_{vj} = 125 °C		95		
			T_{vj} = 175 °C		100		

(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 = 1500 A, R_{Goff} = 1.4 Ω, V_{DD} = 1500 V, V_{GS} = -5/15 V, 0.9 V_{GS} to 0.9 I_D	T_{vj} = 25 °C		380		ns
			T_{vj} = 125 °C		420		
			T_{vj} = 175 °C		445		
Fall time (inductive load)	t_f	I_D = 1500 A, R_{Goff} = 1.4 Ω, V_{DD} = 1500 V, V_{GS} = -5/15 V, 0.9 I_D to 0.1 I_D	T_{vj} = 25 °C		85		ns
			T_{vj} = 125 °C		115		
			T_{vj} = 175 °C		135		
Turn-on time (resistive load)	t_{on_R}	I_D = 500 A, V_{DD} = 1500 V, V_{GS} = -5/15 V, R_{Gon} = 0.1 Ω	T_{vj} = 25 °C	605.00			ns
Turn-on energy loss per pulse	E_{on}	I_D = 1500 A, V_{DD} = 1500 V, L_σ = 14 nH, V_{GS} = -5/15 V, R_{Gon} = 0.1 Ω, di/dt = 12.7 kA/µs (T_{vj} = 175 °C), t_{dead} = 3000 ns	T_{vj} = 25 °C		305		mJ
			T_{vj} = 125 °C		390		
			T_{vj} = 175 °C		470		
Turn-on energy loss per pulse, optimized	$E_{on,o}$	I_D = 1500 A, V_{DD} = 1500 V, L_σ = 14 nH, V_{GS} = -5/15 V, $R_{Gon,o}$ = 0.1 Ω, di/dt = 13 kA/µs (T_{vj} = 175 °C), t_{dead} = 500 ns	T_{vj} = 25 °C		300		mJ
			T_{vj} = 125 °C		305		
			T_{vj} = 175 °C		330		
Turn-off energy loss per pulse	E_{off}	I_D = 1500 A, V_{DD} = 1500 V, L_σ = 14 nH, V_{GS} = -5/15 V, R_{Goff} = 1.4 Ω, dv/dt = 11 kV/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		220		mJ
			T_{vj} = 125 °C		250		
			T_{vj} = 175 °C		270		
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		9000		A
Thermal resistance, junction to heat sink	R_{thJH}	per MOSFET, Valid with IFX pre-applied Thermal Interface Material				34.1	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	870	A
I^2t - value	I^2t	V_{DS} = 0 V, V_{GS} = -5 V, t_P = 10 ms	T_{vj} = 125 °C	340	kA^2s
			T_{vj} = 175 °C	280	

Table 7 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Forward voltage	V_{SD}	I_{SD} = 1500 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} = 1500 A, di_s/dt = 12.7 kA/µs (T_{vj} = 175 °C), V_{DD} = 1500 V, V_{GS} = -5/15 V, t_{dead} = 3000 ns	T_{vj} = 25 °C		4.35		mJ
			T_{vj} = 125 °C		31		
			T_{vj} = 175 °C		47		
Reverse recovery energy, optimized	$E_{rec,o}$	I_{SD} = 1500 A, di_s/dt = 13 kA/µs (T_{vj} = 175 °C), V_{DD} = 1500 V, V_{GS} = -5/15 V, t_{dead} = 500 ns	T_{vj} = 25 °C		4.35		mJ
			T_{vj} = 125 °C		7.5		
			T_{vj} = 175 °C		13		

4 NTC-Thermistor

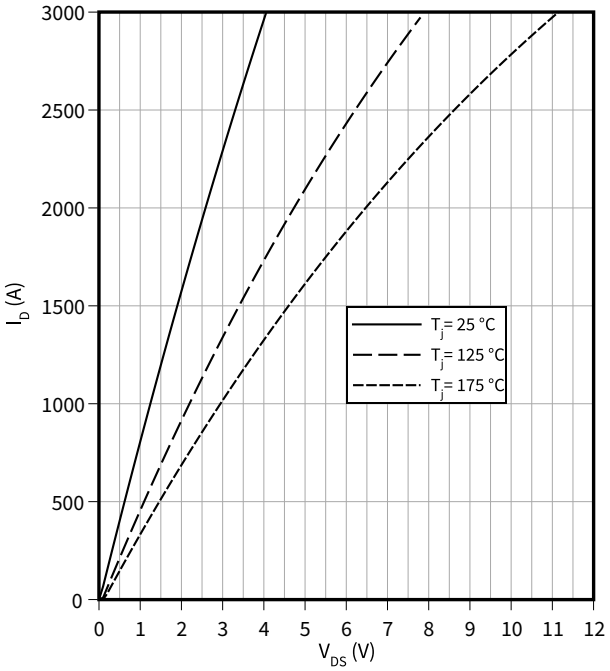
Table 8 Characteristic values

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

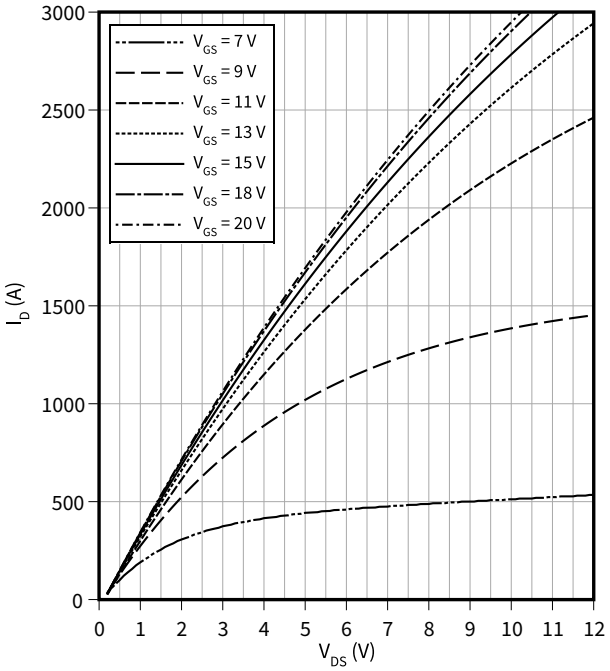
***Note**: For an analytical description of the NTC characteristics please refer to AN2009-10, chapter 4*

5 Characteristics diagrams

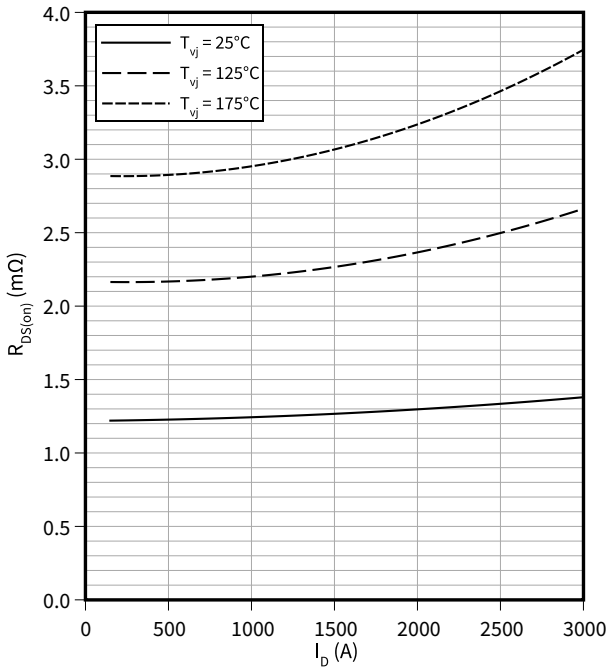
Output characteristic (typical), MOSFET Inverter
$I_D = f(V_{DS})$
V_{GS} = 15 V



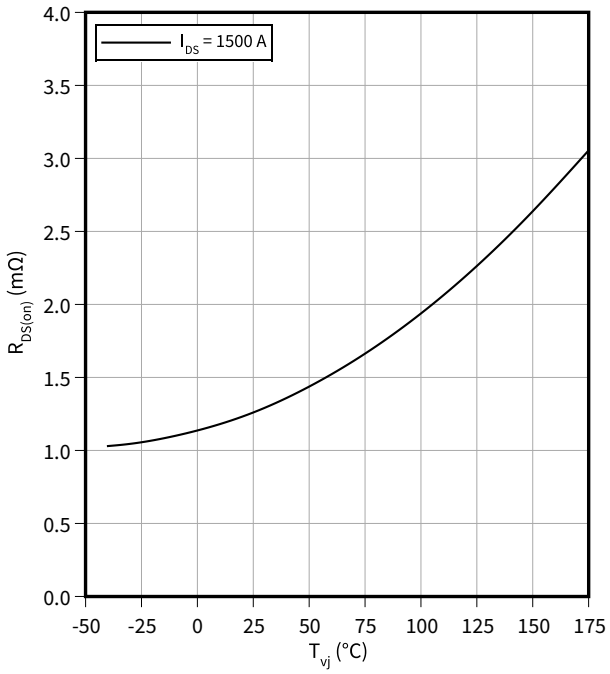
Output characteristic field (typical), MOSFET Inverter
$I_D = f(V_{DS})$
T_{vj} = 175 °C



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

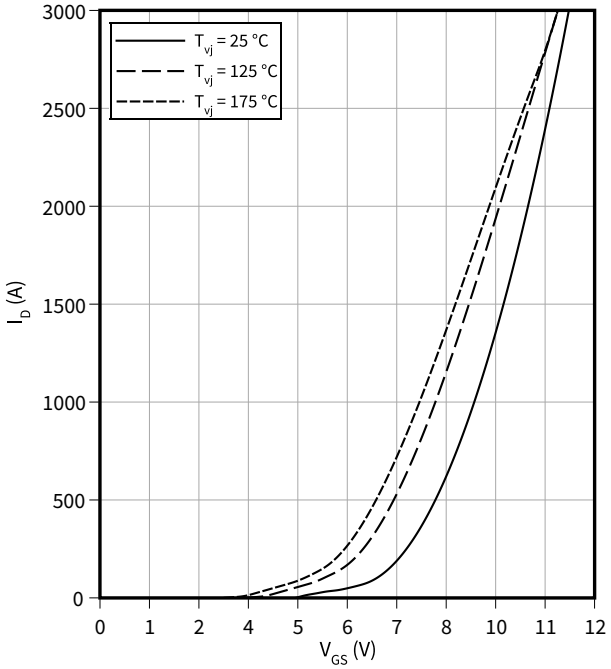


Drain source on-resistance (typical), MOSFET Inverter
$R_{DS(on)} = f(T_{vj})$
V_{GS} = 15 V



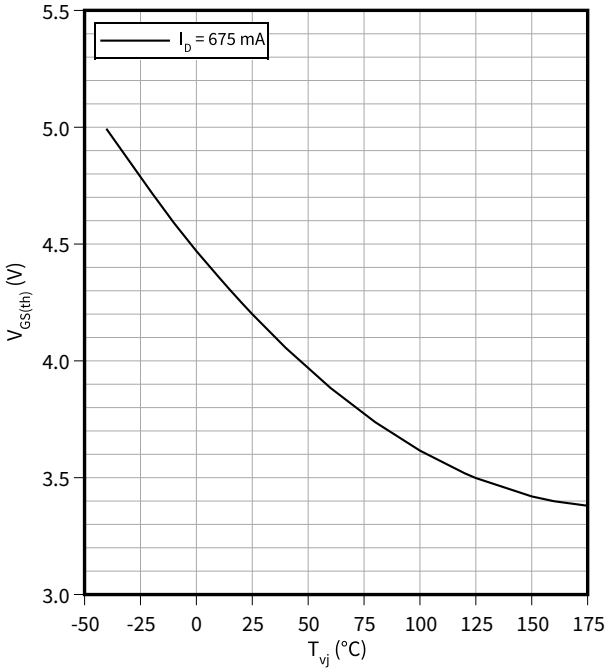
Transfer characteristic (typical), MOSFET Inverter

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



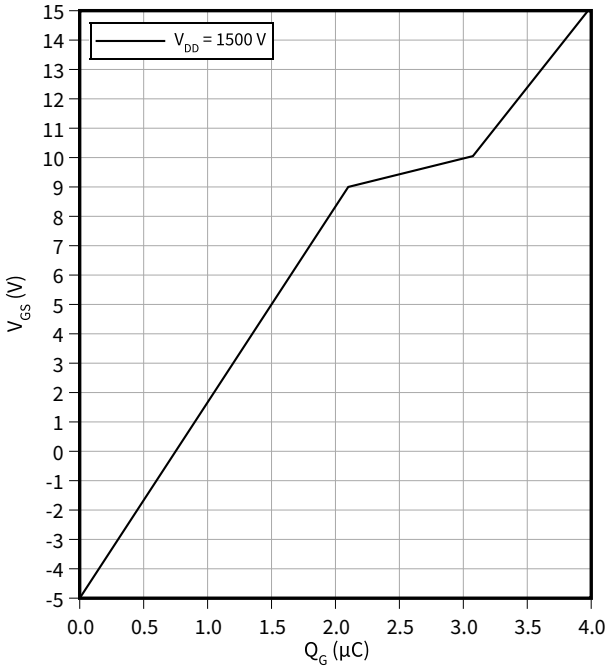
Gate-source threshold voltage (typical), MOSFET Inverter

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



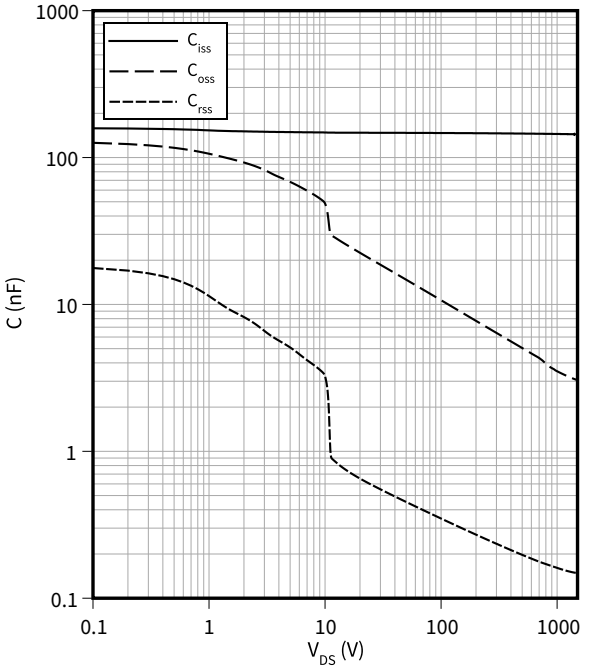
Gate charge characteristic (typical), MOSFET Inverter

$V_{GS} = f(Q_G)$
$I_D = 1500$ A, $T_{vj} = 25$ °C



Capacity characteristic (typical), MOSFET Inverter

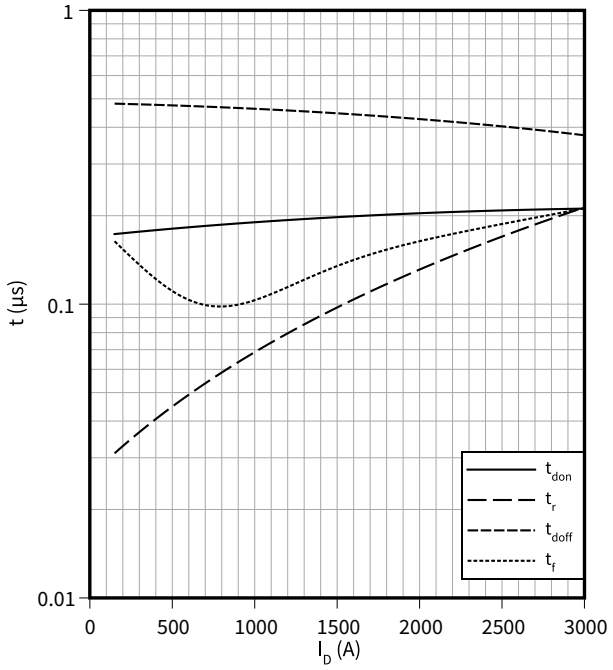
$C = f(V_{DS})$
$f = 100$ kHz, $T_{vj} = 25$ °C, $V_{GS} = 0$ V



Switching times (typical), MOSFET Inverter

$t = f(I_D)$

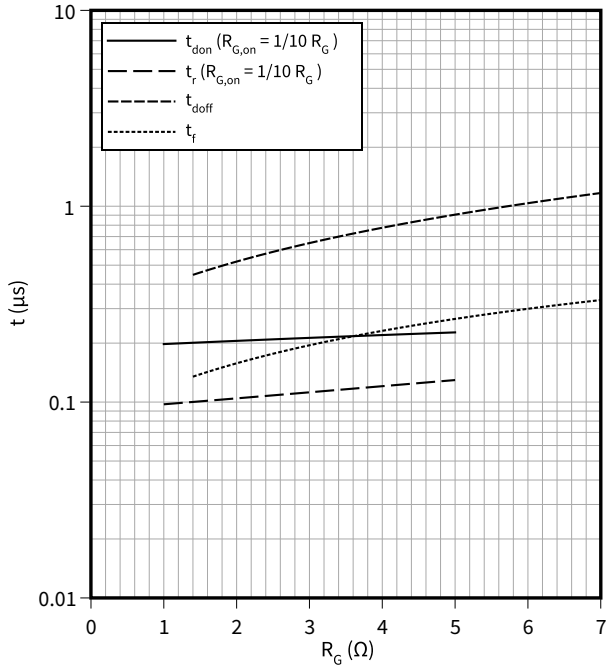
R_{Goff} = 1.4 Ω, R_{Gon} = 0.1 Ω, V_{DD} = 1500 V, T_{vj} = 175 °C, V_{GS} = -5/15 V



Switching times (typical), MOSFET Inverter

$t = f(R_G)$

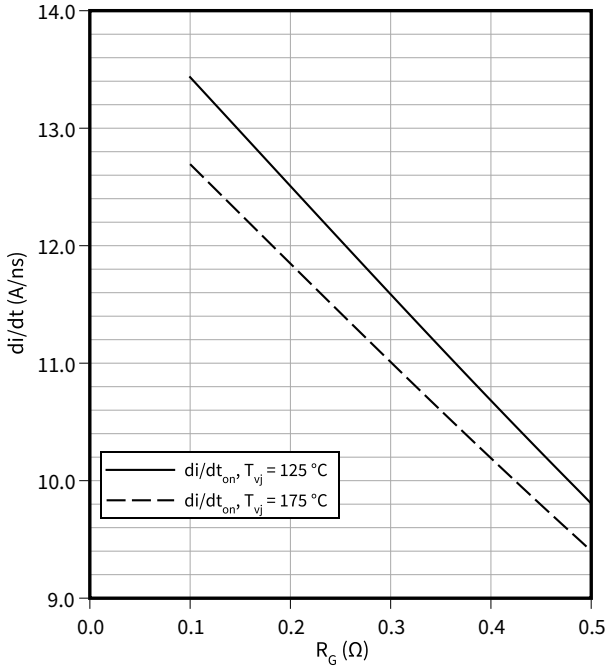
V_{DD} = 1500 V, I_D = 1500 A, T_{vj} = 175 °C, V_{GS} = -5/15 V



Current slope (typical), MOSFET Inverter

$di/dt = f(R_G)$

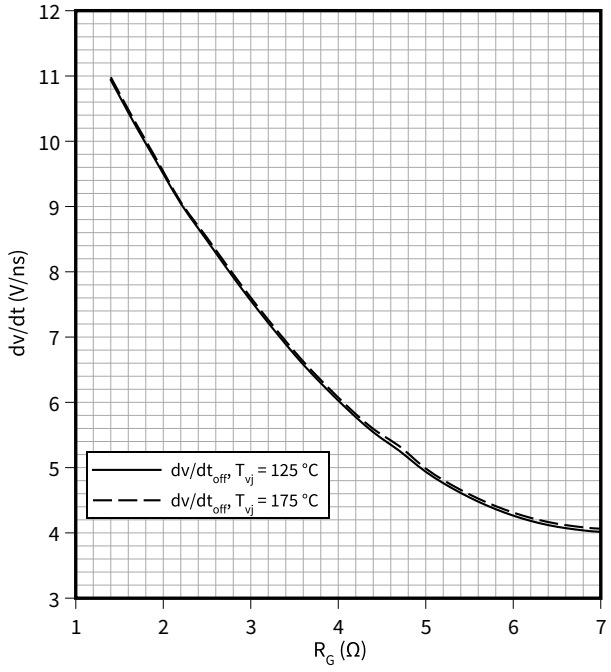
V_{DD} = 1500 V, t_{dead} = 3000 ns, I_D = 1500 A, V_{GS} = -5/15 V



Voltage slope (typical), MOSFET Inverter

$dv/dt = f(R_G)$

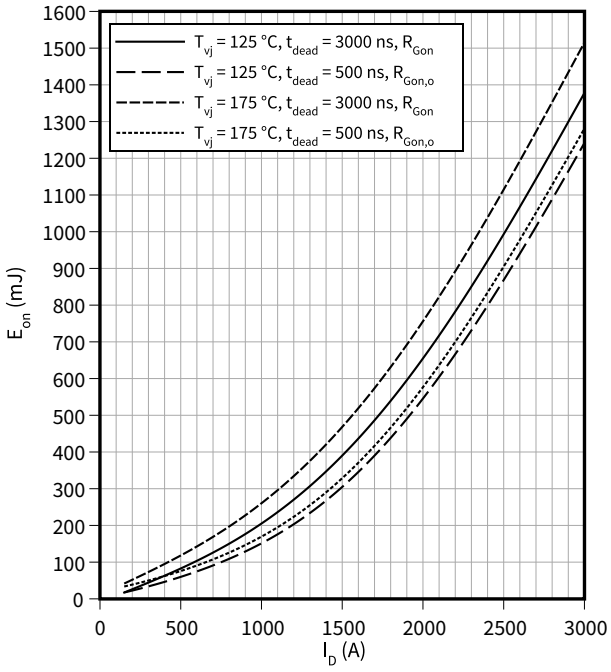
V_{DD} = 1500 V, I_D = 1500 A, V_{GS} = -5/15 V



Switching losses (typical), MOSFET Inverter

$E_{on} = f(I_D)$

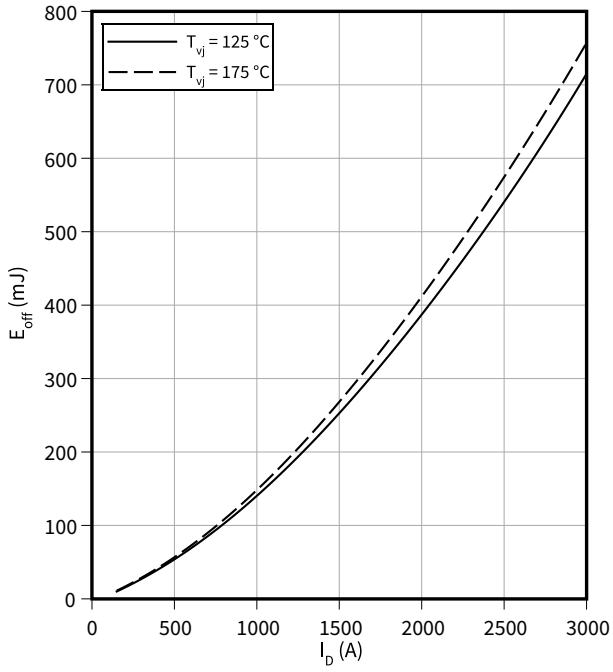
V_{DD} = 1500 V, R_{Gon} = 0.1 Ω, $R_{Gon,o}$ = 0.1 Ω, V_{GS} = -5/15 V



Switching losses (typical), MOSFET Inverter

$E_{off} = f(I_D)$

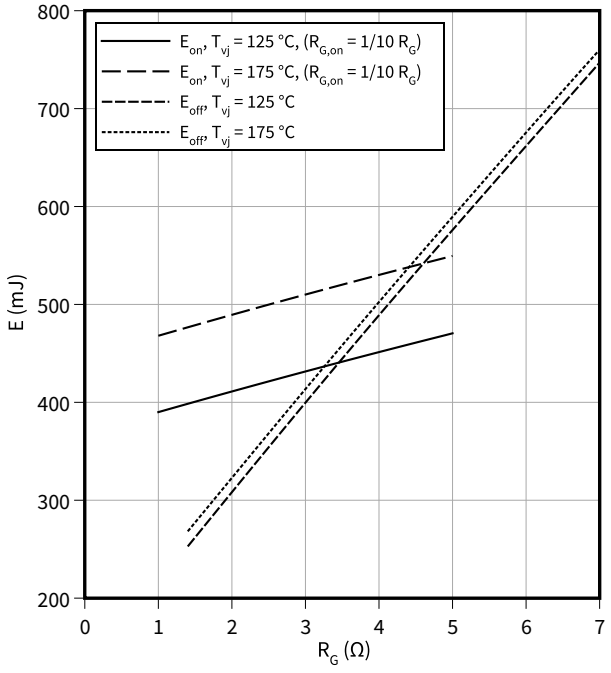
R_{Goff} = 1.4 Ω, V_{DD} = 1500 V, V_{GS} = -5/15 V



Switching losses (typical), MOSFET Inverter

$E = f(R_G)$

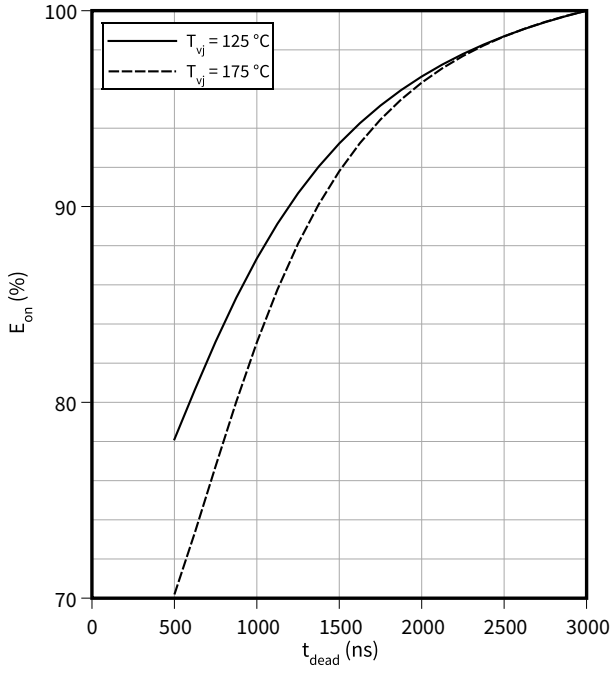
V_{DD} = 1500 V, t_{dead} = 3000 ns, I_D = 1500 A, V_{GS} = -5/15 V



Switching losses (typical), MOSFET Inverter

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

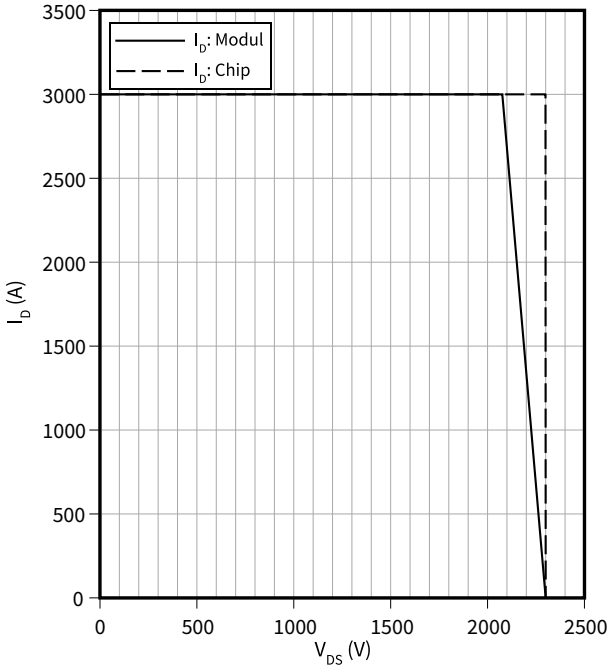
R_{Gon} = 0.1 Ω, I_D = 1500 A, V_{DD} = 1500 V, V_{GS} = -5/15 V



Reverse bias safe operating area (RBSOA), MOSFET Inverter

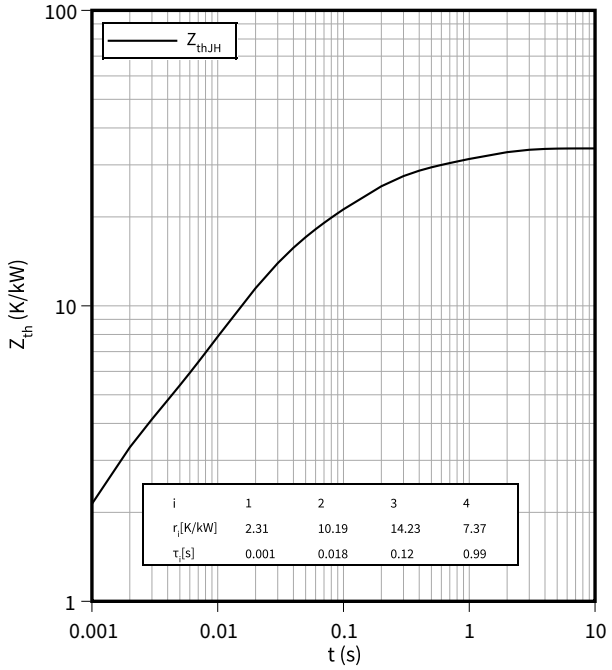
$I_D = f(V_{DS})$

R_{Goff} = 1.4 Ω, T_{vj} = 175 °C, V_{GS} = -5/15 V



Transient thermal impedance, MOSFET Inverter

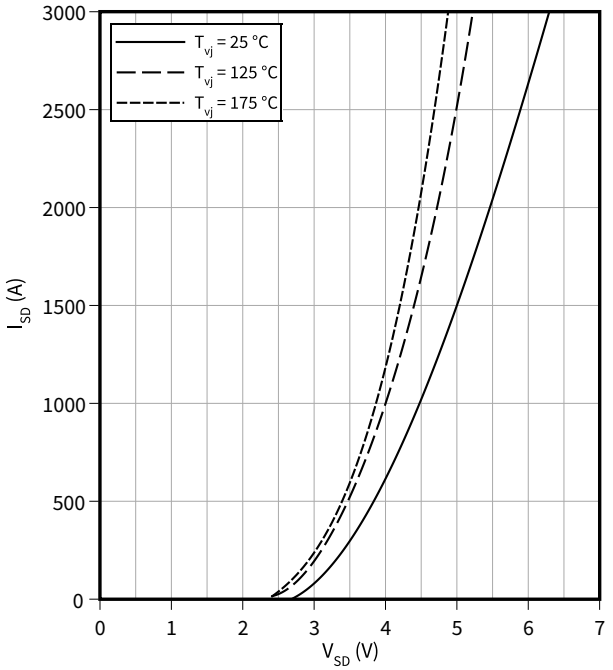
$Z_{th} = f(t)$



Forward characteristic body diode (typical), MOSFET Inverter

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

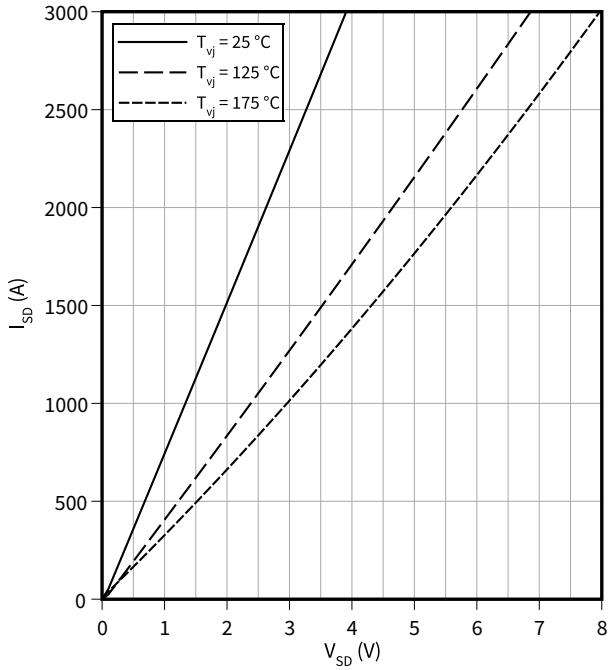
V_{GS} = -5 V



Forward characteristic body diode (typical), MOSFET Inverter

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

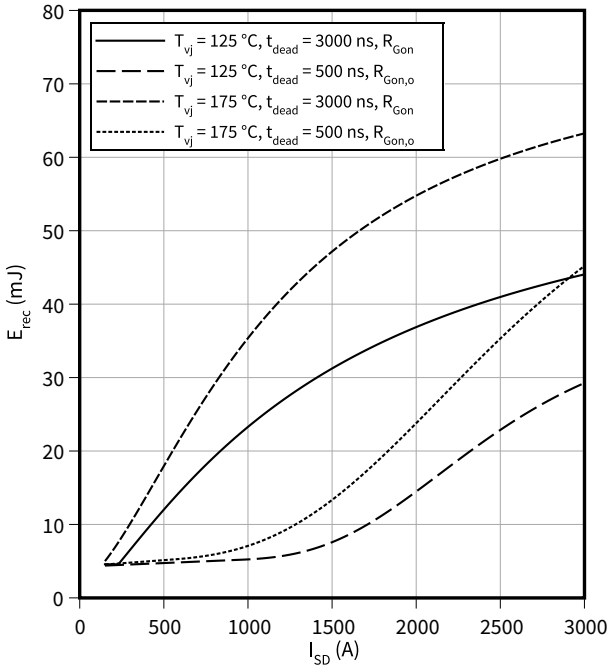
V_{GS} = 15 V



Switching losses body diode (typical), MOSFET Inverter

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

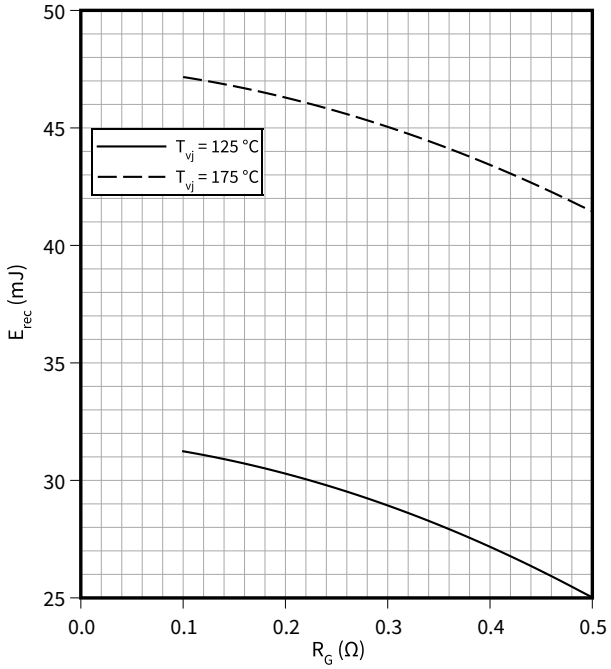
$R_{Gon} = 0.1\ \Omega$, $R_{Gon,o} = 0.1\ \Omega$, $V_{DD} = 1500$ V



Switching losses body diode (typical), MOSFET Inverter

$E_{rec} = f(R_G)$

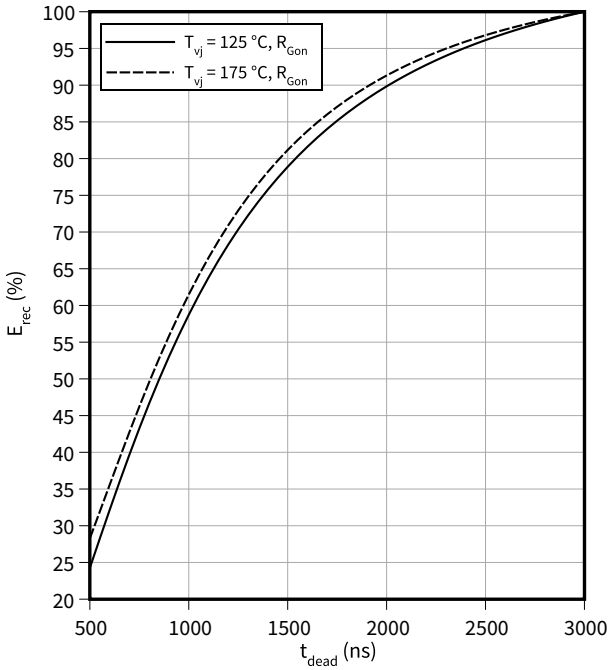
$t_{dead} = 3000$ ns, $I_{SD} = 1500$ A, $V_{DD} = 1500$ V



Switching losses body diode (typical), MOSFET Inverter

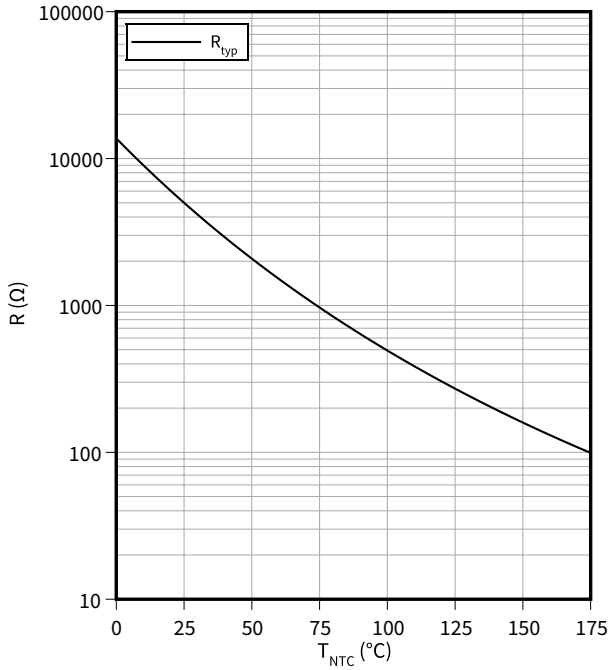
$E_{rec} = f(t_{dead})$

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



Temperature characteristic (typical), NTC-Thermistor

$R = f(T_{NTC})$



6 Circuit diagram

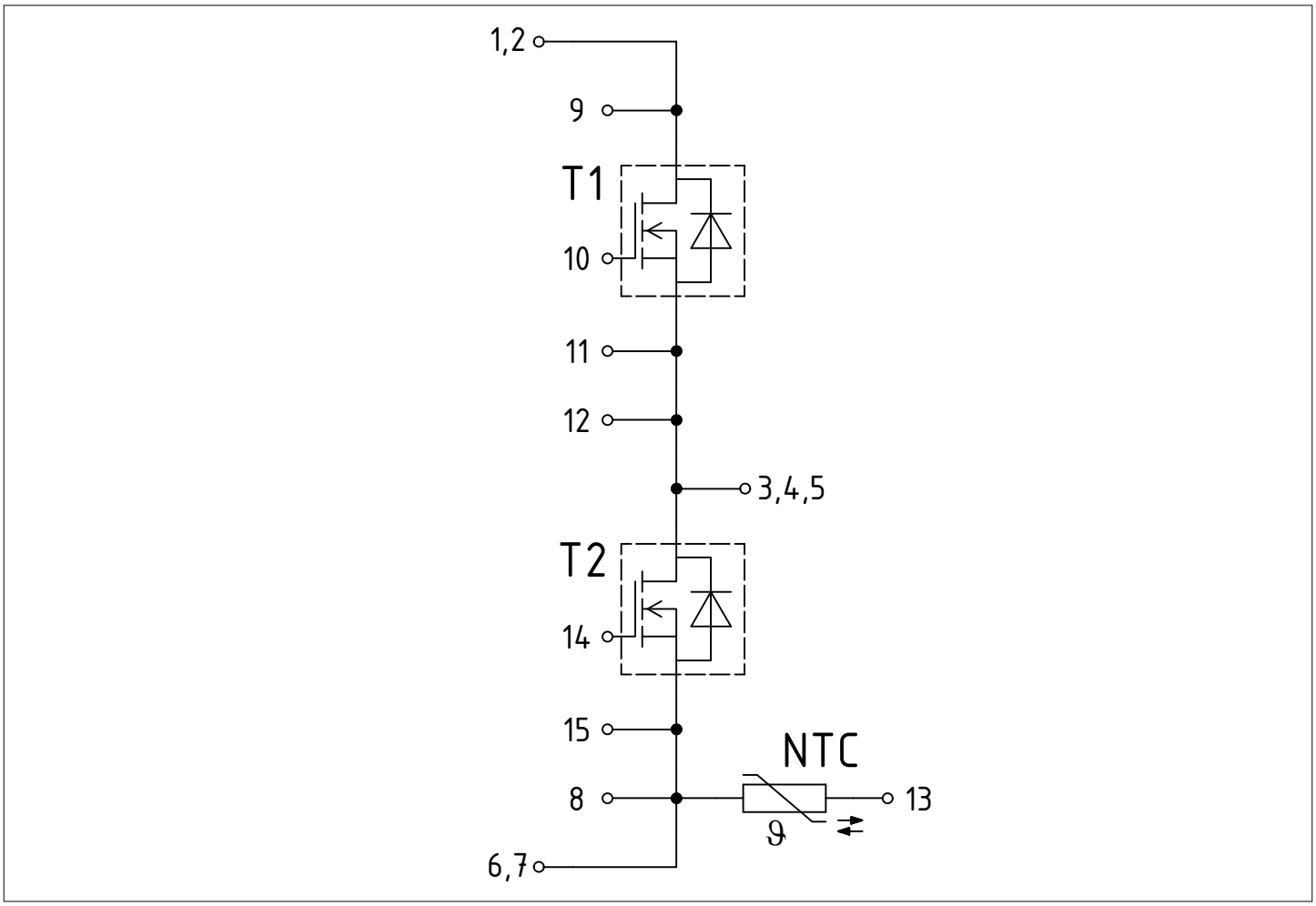


Figure 1

7 Package outlines

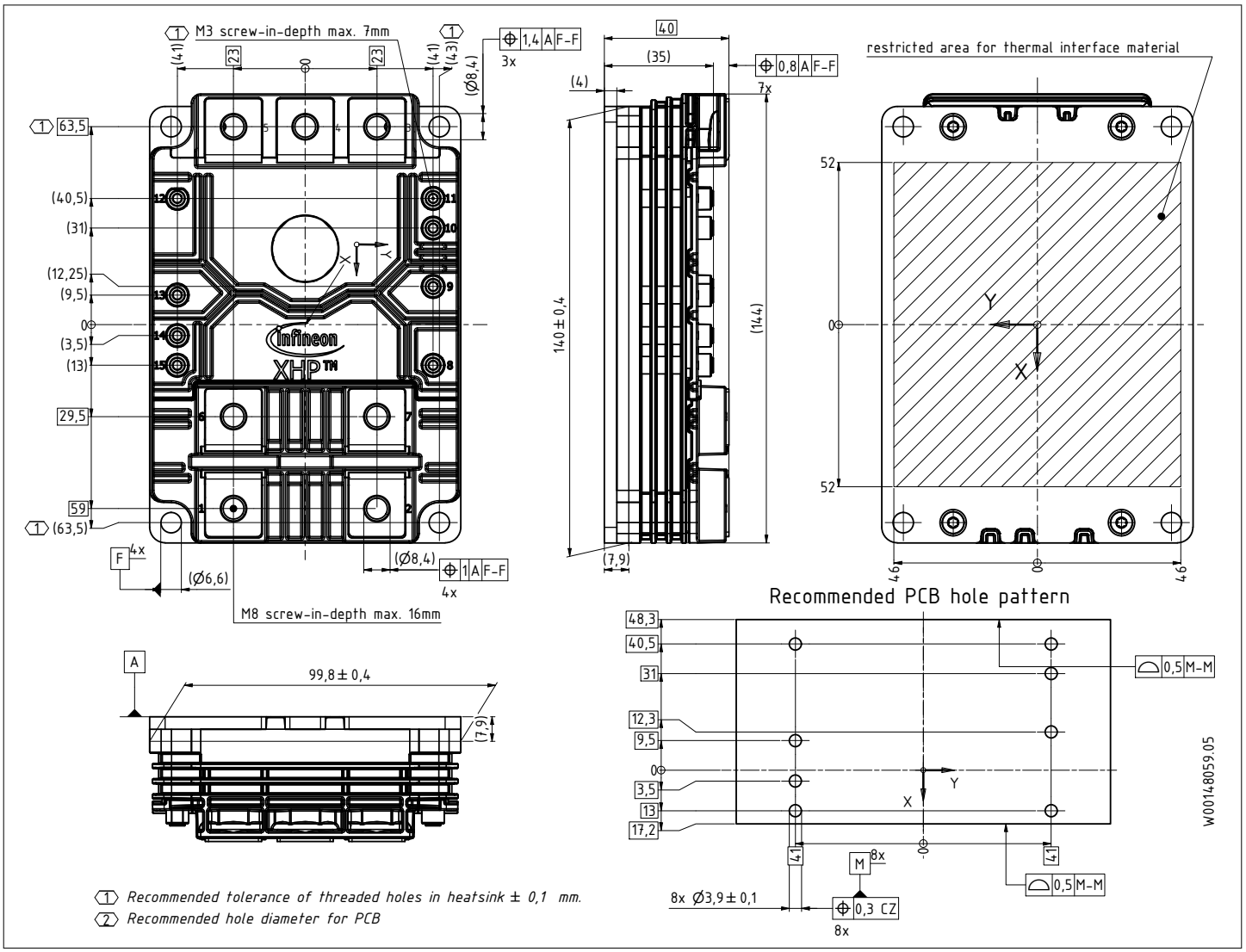


Figure 2

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	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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