

Preliminary datasheet

EasyPACK™ module with CoolSiC™ Trench MOSFET and PressFIT / NTC

Features

- Electrical features
 - $V_{DS} = 1200\text{ V}$
 - $I_{DN} = 100\text{ A}$ / $I_{DRM} = 200\text{ A}$
 - Low inductive design
 - Low switching losses
 - High current density
- Mechanical features
 - PressFIT contact technology
 - Integrated NTC temperature sensor
 - Rugged mounting due to integrated mounting clamps
 - AlN substrate with low thermal resistance



Typical appearance

Potential applications

- High-frequency switching application
- DC/DC converter
- UPS systems
- DC charger for EV

Product validation

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

Description

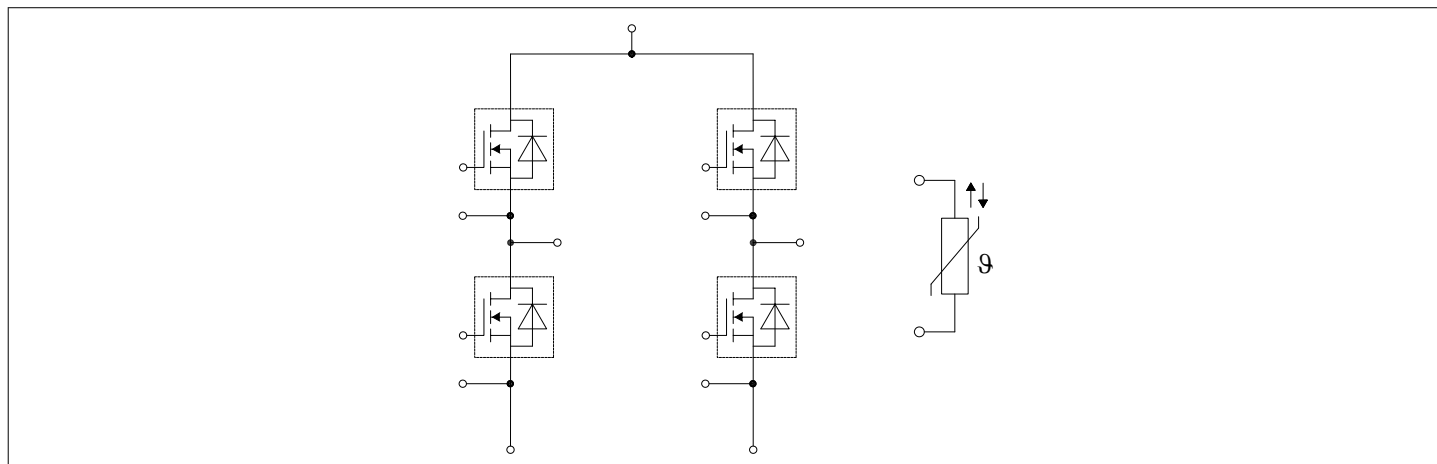


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1 Package

Table 1 Insulation coordination

Parameter	Symbol	Note or test condition	Values	Unit
Isolation test voltage	V_{ISOL}	RMS, $f = 50 \text{ Hz}$, $t = 1 \text{ min}$	3.0	kV
Internal isolation		basic insulation (class 1, IEC 61140)	AIN	
Comparative tracking index	CTI		> 200	
Relative thermal index (electrical)	RTI	housing	140	°C

Table 2 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Stray inductance module	L_{sCE}			9		nH
Module lead resistance, terminals - chip	$R_{CC'+EE'}$	$T_H = 25 \text{ °C}$, per switch		2.1		mΩ
Storage temperature	T_{stg}		-40		125	°C
Mounting force per clamp	F		40		80	N
Weight	G			39		g

Note: The current under continuous operation is limited to 25 A rms per connector pin.

2 MOSFET

Table 3 Maximum rated values

Parameter	Symbol	Note or test condition	Values	Unit
Drain-source voltage	V_{DSS}	$T_{vj} = 25 \text{ °C}$	1200	V
Continuous DC drain current	I_{DDC}	$T_{vj} = 175 \text{ °C}$, $V_{GS} = 18 \text{ V}$ $T_H = 80 \text{ °C}$	100	A
Repetitive peak drain current	I_{DRM}	verified by design, t_p limited by T_{vjmax}	200	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...0	V

Table 5 **Characteristic values**

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Drain-source on-resistance	$R_{DS(on)}$	$I_D = 100 \text{ A}$	$V_{GS}=18 \text{ V}, T_{vj}=25 \text{ °C}$		8.1		mΩ
			$V_{GS}=18 \text{ V}, T_{vj}=125 \text{ °C}$		13.1		
			$V_{GS}=18 \text{ V}, T_{vj}=150 \text{ °C}$		15.1		
			$V_{GS} = 15 \text{ V}, T_{vj} = 25 \text{ °C}$		9.7		
Gate threshold voltage	$V_{GS(th)}$	$I_D = 40 \text{ mA}, V_{DS} = V_{GS}, T_{vj} = 25 \text{ °C},$ (tested after 1ms pulse at $V_{GS} = +20 \text{ V}$)		3.45	4.3	5.15	V
Total gate charge	Q_G	$V_{DD}=800 \text{ V}, V_{GS} = -3/18 \text{ V}$			0.297		μC
Internal gate resistor	R_{Gint}	$T_{vj}=25 \text{ °C}$			2.1		Ω
Input capacitance	C_{ISS}	$f = 100 \text{ kHz}, V_{DS}=800 \text{ V}, V_{GS}=0 \text{ V}$	$T_{vj}=25 \text{ °C}$		8.8		nF
Output capacitance	C_{OSS}	$f = 100 \text{ kHz}, V_{DS}=800 \text{ V}, V_{GS}=0 \text{ V}$	$T_{vj}=25 \text{ °C}$		0.42		nF
Reverse transfer capacitance	C_{rss}	$f = 100 \text{ kHz}, V_{DS}=800 \text{ V}, V_{GS}=0 \text{ V}$	$T_{vj}=25 \text{ °C}$		0.028		nF
C_{OSS} stored energy	E_{OSS}	$V_{DS}=800 \text{ V}, V_{GS} = -3/18 \text{ V}, T_{vj} = 25 \text{ °C}$			172		μJ
Drain-source leakage current	I_{DSS}	$V_{DS} = 1200 \text{ V}, V_{GS} = -3 \text{ V}$	$T_{vj} = 25 \text{ °C}$		0.06	380	μA
Gate-source leakage current	I_{GSS}	$V_{DS} = 0 \text{ V}, T_{vj} = 25 \text{ °C}$	$V_{GS}=20 \text{ V}$			400	nA
Turn-on delay time (inductive load)	$t_{d on}$	$I_D = 100 \text{ A}, R_{Gon} = 8.2 \text{ Ω}, V_{DD} = 600 \text{ V}, V_{GS} = -3/18 \text{ V}$	$T_{vj} = 25 \text{ °C}$		42		ns
			$T_{vj} = 125 \text{ °C}$		42		
			$T_{vj} = 150 \text{ °C}$		42		
Rise time (inductive load)	t_r	$I_D = 100 \text{ A}, R_{Gon} = 8.2 \text{ Ω}, V_{DD} = 600 \text{ V}, V_{GS} = -3/18 \text{ V}$	$T_{vj} = 25 \text{ °C}$		63		ns
			$T_{vj} = 125 \text{ °C}$		63		
			$T_{vj} = 150 \text{ °C}$		63		
Turn-off delay time (inductive load)	$t_{d off}$	$I_D = 100 \text{ A}, R_{Goff} = 5.6 \text{ Ω}, V_{DD} = 600 \text{ V}, V_{GS} = -3/18 \text{ V}$	$T_{vj} = 25 \text{ °C}$		72		ns
			$T_{vj} = 125 \text{ °C}$		80		
			$T_{vj} = 150 \text{ °C}$		82		
Fall time (inductive load)	t_f	$I_D = 100 \text{ A}, R_{Goff} = 5.6 \text{ Ω}, V_{DD} = 600 \text{ V}, V_{GS} = -3/18 \text{ V}$	$T_{vj} = 25 \text{ °C}$		24		ns
			$T_{vj} = 125 \text{ °C}$		24		
			$T_{vj} = 150 \text{ °C}$		24		

(table continues...)

Table 5 (continued) Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Turn-on energy loss per pulse	E_{on}	$I_D = 100\text{ A}$, $V_{DD} = 600\text{ V}$, $L_\sigma = 3\text{ nH}$, $V_{GS} = -3/18\text{ V}$, $R_{Gon} = 8.2\text{ }\Omega$, $di/dt = 3.83\text{ kA}/\mu\text{s}$ ($T_{vj} = 150\text{ }^\circ\text{C}$)	$T_{vj} = 25\text{ }^\circ\text{C}$	2.23		mJ
			$T_{vj} = 125\text{ }^\circ\text{C}$	2.44		
			$T_{vj} = 150\text{ }^\circ\text{C}$	2.5		
Turn-off energy loss per pulse	E_{off}	$I_D = 100\text{ A}$, $V_{DD} = 600\text{ V}$, $L_\sigma = 3\text{ nH}$, $V_{GS} = -3/18\text{ V}$, $R_{Goff} = 5.6\text{ }\Omega$, $dv/dt = 20\text{ kV}/\mu\text{s}$ ($T_{vj} = 150\text{ }^\circ\text{C}$)	$T_{vj} = 25\text{ }^\circ\text{C}$	0.949		mJ
			$T_{vj} = 125\text{ }^\circ\text{C}$	1.01		
			$T_{vj} = 150\text{ }^\circ\text{C}$	1.04		
Thermal resistance, junction to heat sink	R_{thJH}	per MOSFET, $\lambda_{grease} = 1\text{ W}/(\text{m}\cdot\text{K})$		0.402		K/W
Temperature under switching conditions	$T_{vj\text{ op}}$		-40		150	$^\circ\text{C}$

Note: The selection of positive and negative gate-source voltages impacts losses and the long-term behavior of the MOSFET and body diode. The design guidelines described in Application Note AN 2018-09 and AN 2021-13 must be considered to ensure sound operation of the device over the planned lifetime.

3 Body diode (MOSFET)

Table 6 Maximum rated values

Parameter	Symbol	Note or test condition	Values	Unit
DC body diode forward current	I_{SD}	$T_{vj} = 175\text{ }^\circ\text{C}$, $V_{GS} = -3\text{ V}$ $T_H = 80\text{ }^\circ\text{C}$	55	A

Table 7 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Forward voltage	V_{SD}	$I_{SD} = 100\text{ A}$, $V_{GS} = -3\text{ V}$	$T_{vj} = 25\text{ }^\circ\text{C}$	4.2	5.35	V
			$T_{vj} = 125\text{ }^\circ\text{C}$	3.9		
			$T_{vj} = 150\text{ }^\circ\text{C}$	3.85		

4 NTC-Thermistor

Table 8 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Rated resistance	R_{25}	$T_{NTC} = 25\text{ }^\circ\text{C}$		5		k Ω
Deviation of R_{100}	$\Delta R/R$	$T_{NTC} = 100\text{ }^\circ\text{C}$, $R_{100} = 493\text{ }\Omega$	-5		5	%

(table continues...)

Table 8 (continued) Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Power dissipation	P_{25}	$T_{NTC} = 25\text{ °C}$			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

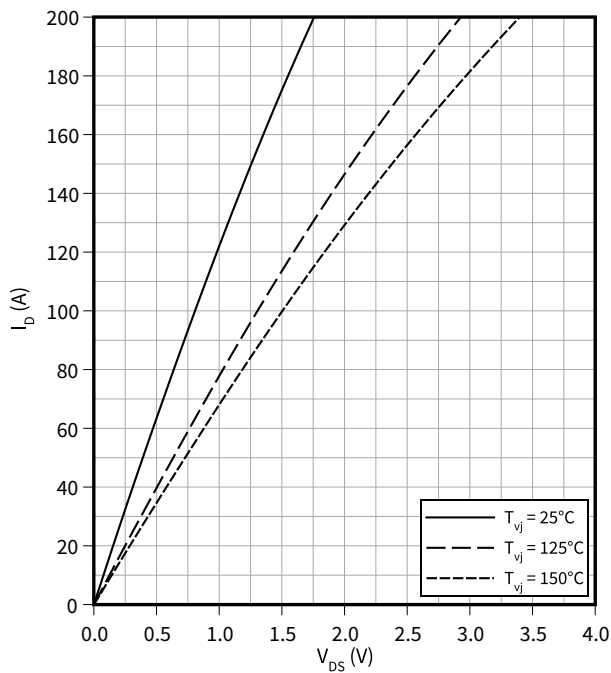
Note: For an analytical description of the NTC characteristics please refer to AN2009-10, chapter 4.

5 Characteristics diagrams

Output characteristic (typical), MOSFET

$I_D = f(V_{DS})$

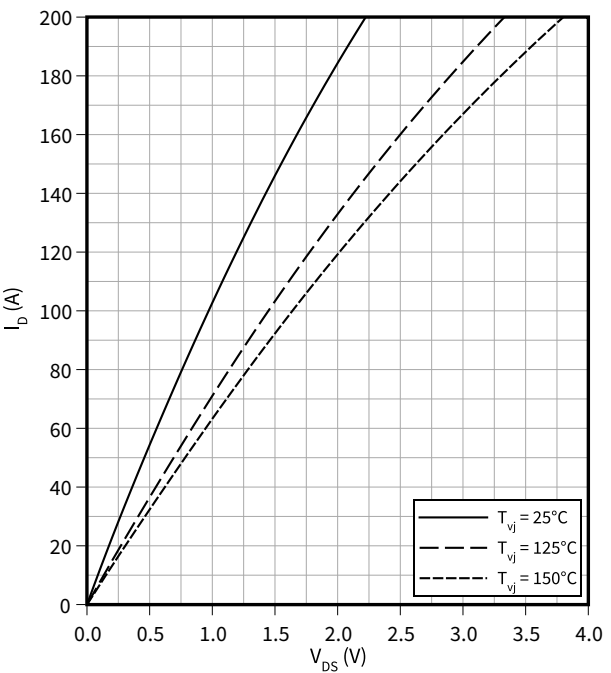
$V_{GS} = 18\text{ V}$



Output characteristic (typical), MOSFET

$I_D = f(V_{DS})$

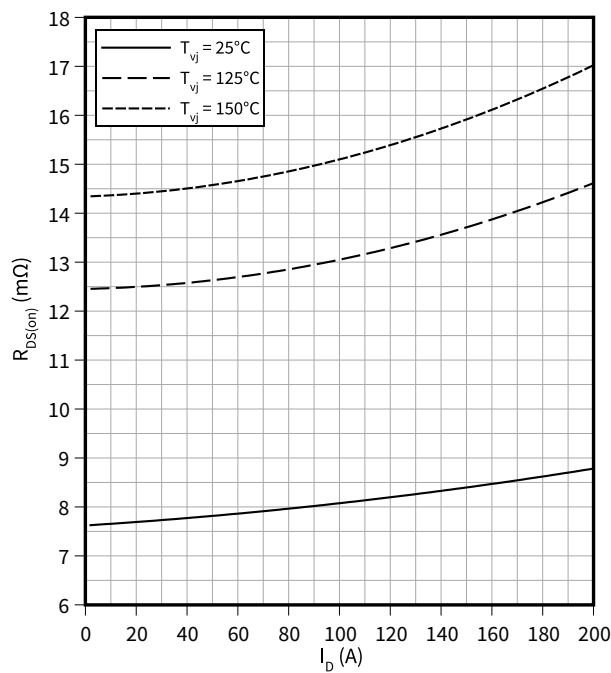
$V_{GS} = 15\text{ V}$



Drain source on-resistance (typical), MOSFET

$R_{DS(on)} = f(I_D)$

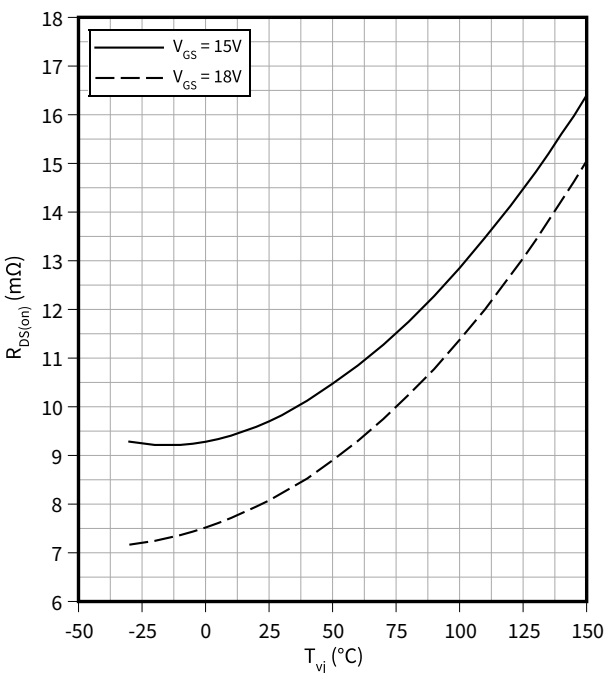
$V_{GS} = 18\text{ V}$



Drain source on-resistance (typical), MOSFET

$R_{DS(on)} = f(T_{vj})$

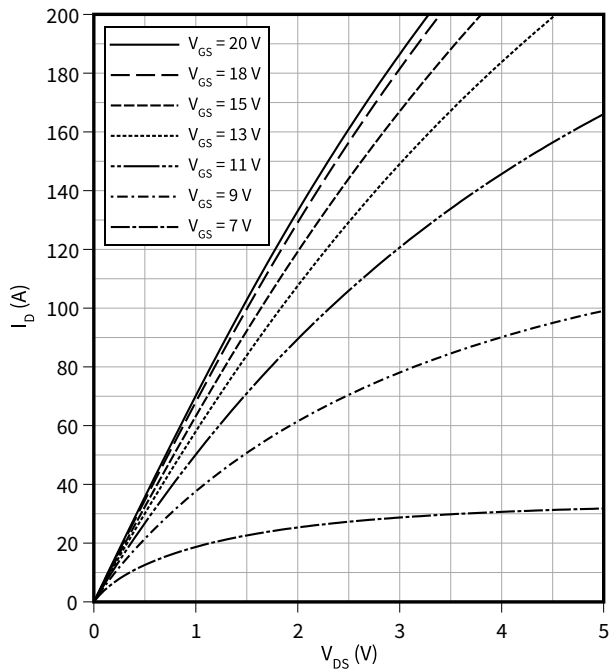
$I_D = 100\text{ A}$



5 Characteristics diagrams

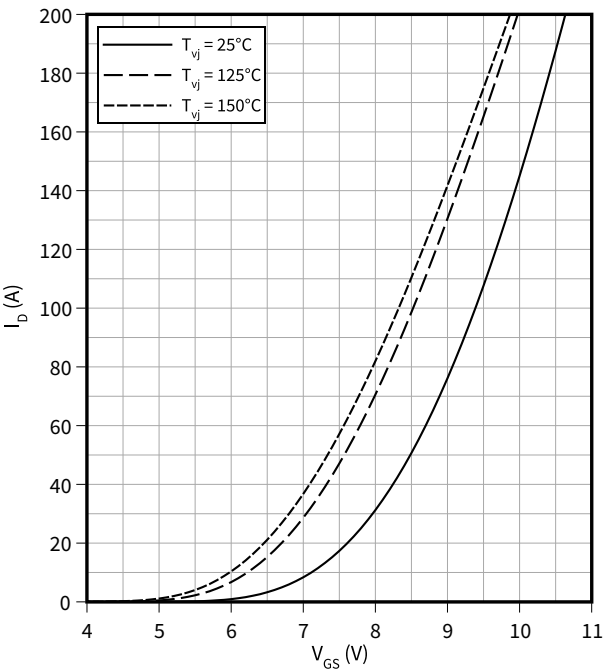
Output characteristic field (typical), MOSFET

$I_D = f(V_{DS})$
 $T_{vj} = 150\text{ °C}$



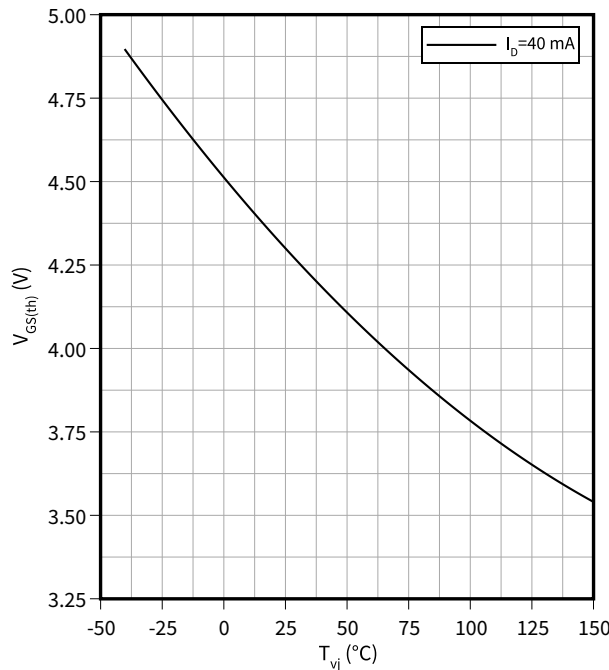
Transfer characteristic (typical), MOSFET

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



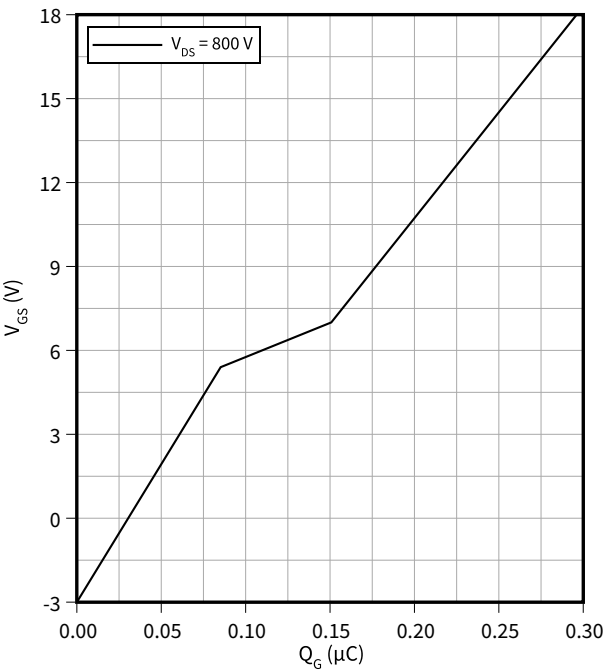
Gate-source threshold voltage (typical), MOSFET

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



Gate charge characteristic (typical), MOSFET

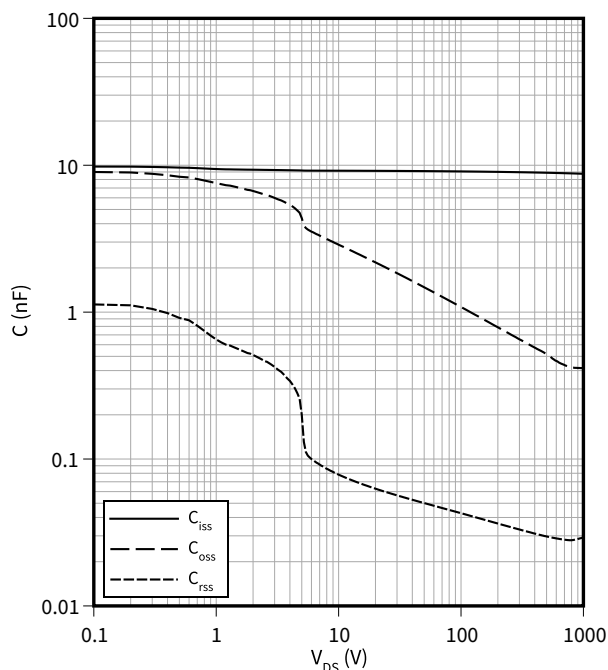
$V_{GS} = f(Q_G)$
 $I_D = 100\text{ A}, T_{vj} = 25\text{ °C}$



Capacity characteristic (typical), MOSFET

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

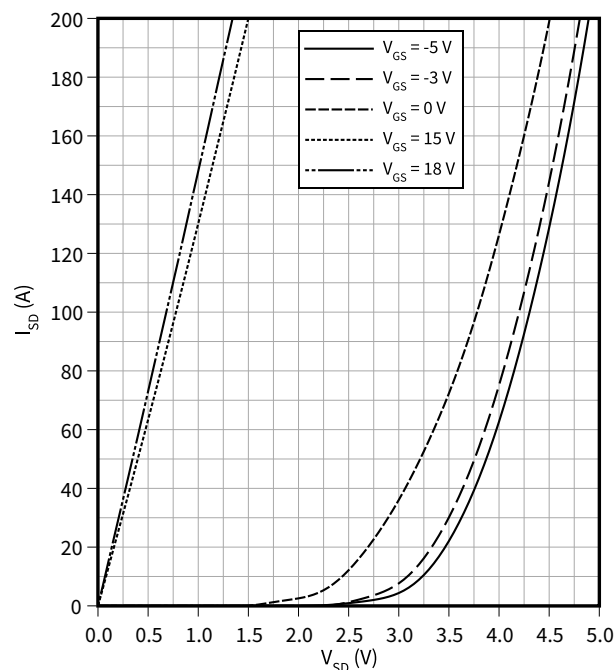
$f = 100 \text{ kHz}$, $T_{vj} = 25 \text{ °C}$, $V_{GS} = 0 \text{ V}$



Forward characteristic body diode (typical), MOSFET

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

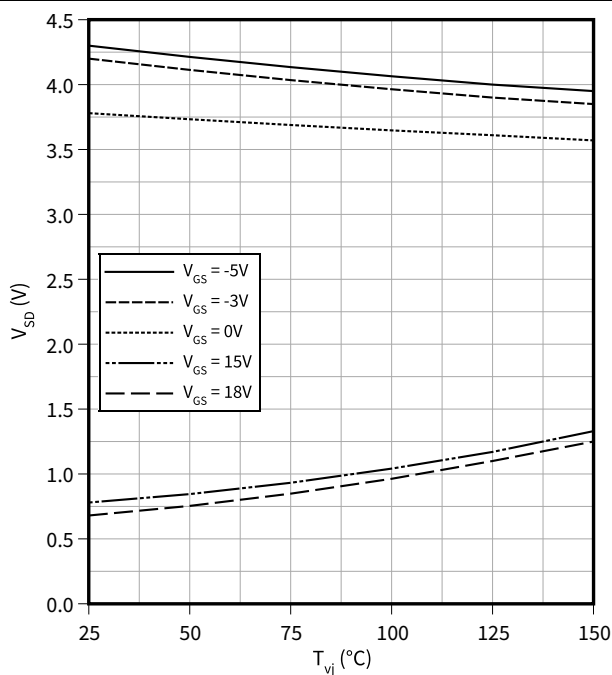
$T_{vj} = 25 \text{ °C}$



Forward voltage of body diode (typical), MOSFET

$$V_{SD} = f(T_{vj})$$

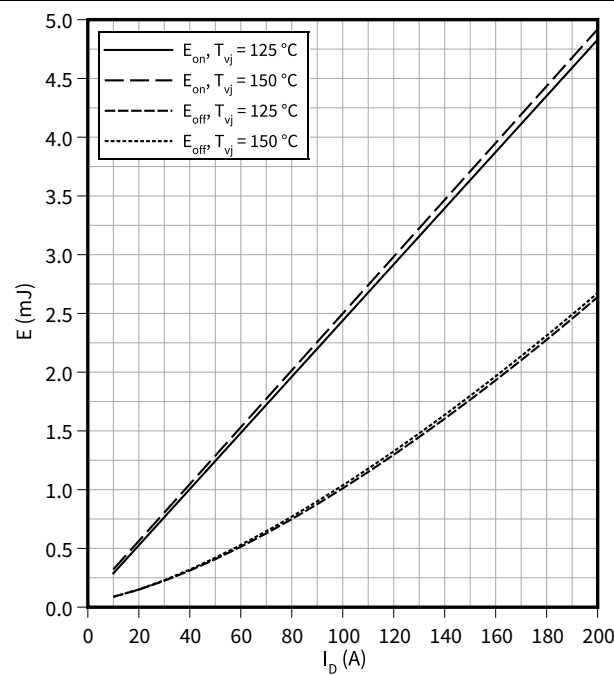
$I_{SD} = 100 \text{ A}$



Switching losses (typical), MOSFET

$$E = f(I_D)$$

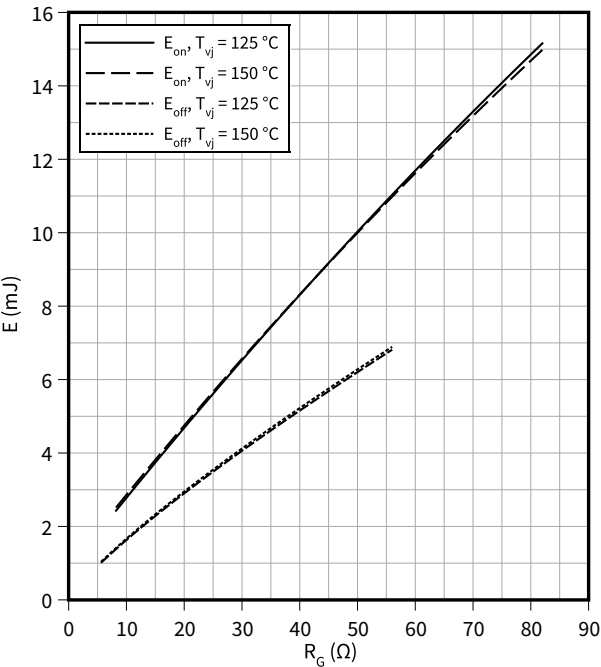
$R_{Goff} = 5.6 \text{ } \Omega$, $R_{Gon} = 8.2 \text{ } \Omega$, $V_{DD} = 600 \text{ V}$, $V_{GS} = -3/18 \text{ V}$



5 Characteristics diagrams

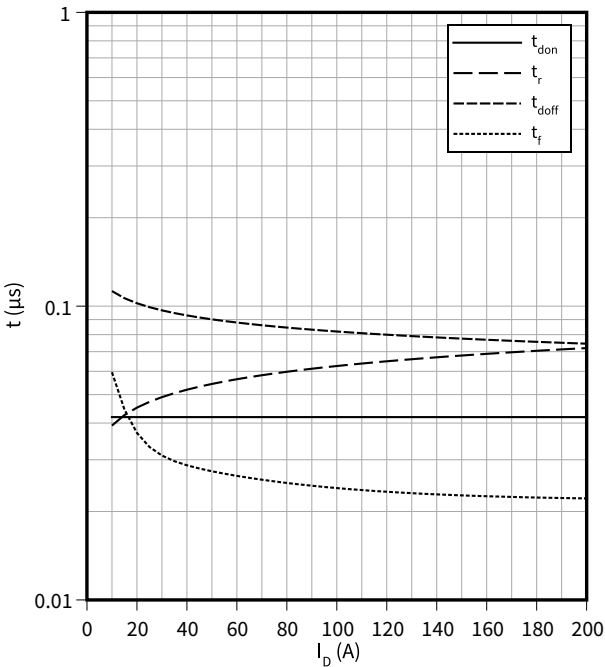
Switching losses (typical), MOSFET

$E = f(R_G)$
 $V_{DD} = 600\text{ V}, I_D = 100\text{ A}, V_{GS} = -3/18\text{ V}$



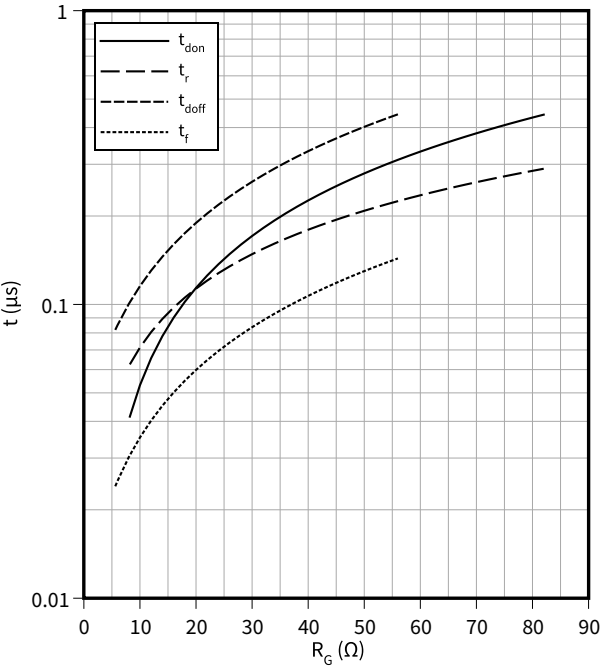
Switching times (typical), MOSFET

$t = f(I_D)$
 $R_{Goff} = 5.6\text{ }\Omega, R_{Gon} = 8.2\text{ }\Omega, V_{DD} = 600\text{ V}, T_{vj} = 150\text{ }^\circ\text{C}, V_{GS} = -3/18\text{ V}$



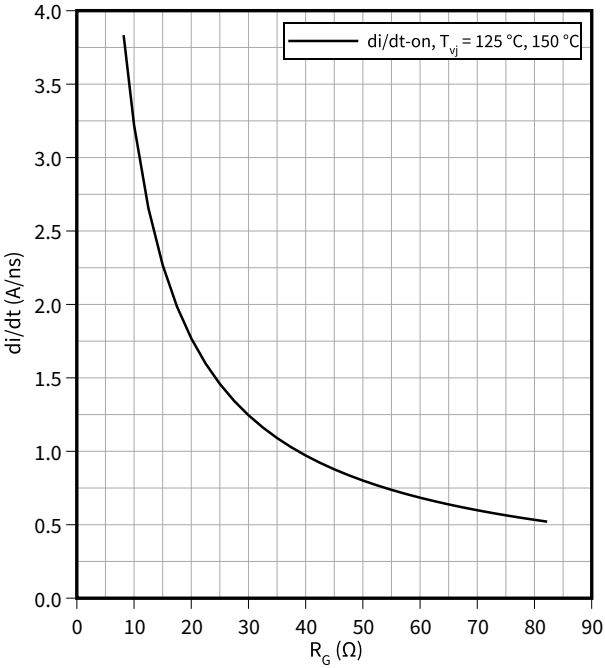
Switching times (typical), MOSFET

$t = f(R_G)$
 $V_{DD} = 600\text{ V}, I_D = 100\text{ A}, T_{vj} = 150\text{ }^\circ\text{C}, V_{GS} = -3/18\text{ V}$



Current slope (typical), MOSFET

$di/dt = f(R_G)$
 $V_{DD} = 600\text{ V}, I_D = 100\text{ A}, V_{GS} = -3/18\text{ V}$

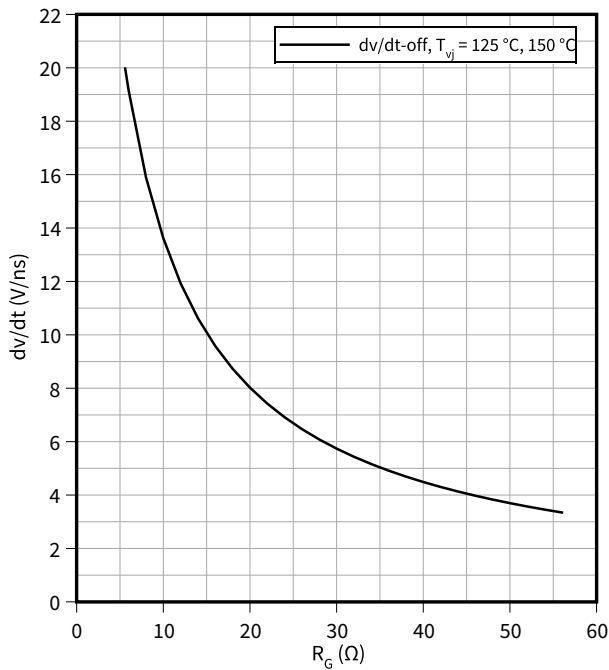


5 Characteristics diagrams

Voltage slope (typical), MOSFET

$dv/dt = f(R_G)$

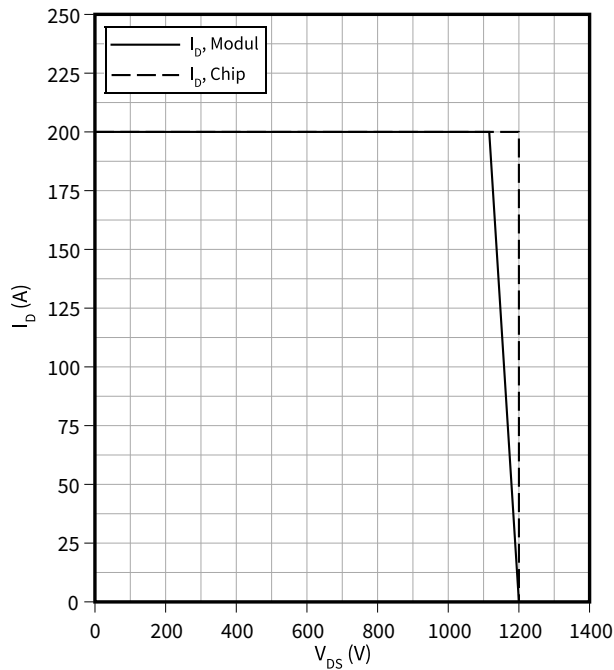
$V_{DD} = 600\text{ V}$, $I_D = 100\text{ A}$, $V_{GS} = -3/18\text{ V}$



Reverse bias safe operating area (RBSOA), MOSFET

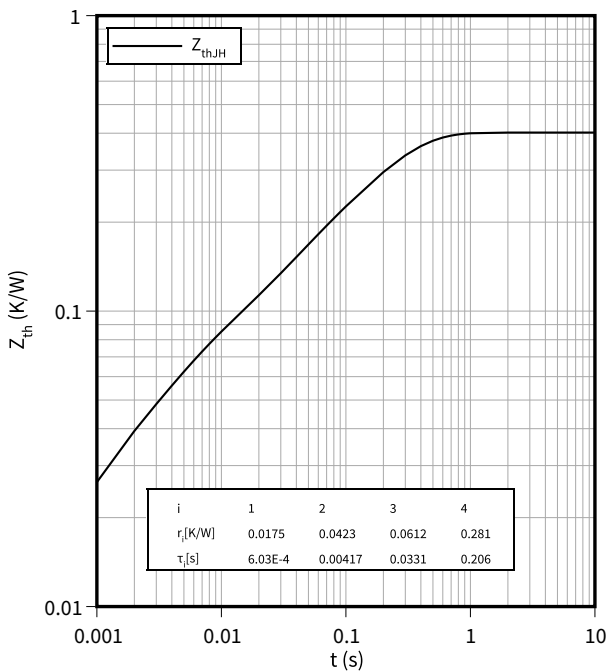
$I_D = f(V_{DS})$

$R_{Goff} = 5.6\ \Omega$, $T_{vj} = 150^\circ\text{C}$, $V_{GS} = -3/18\text{ V}$



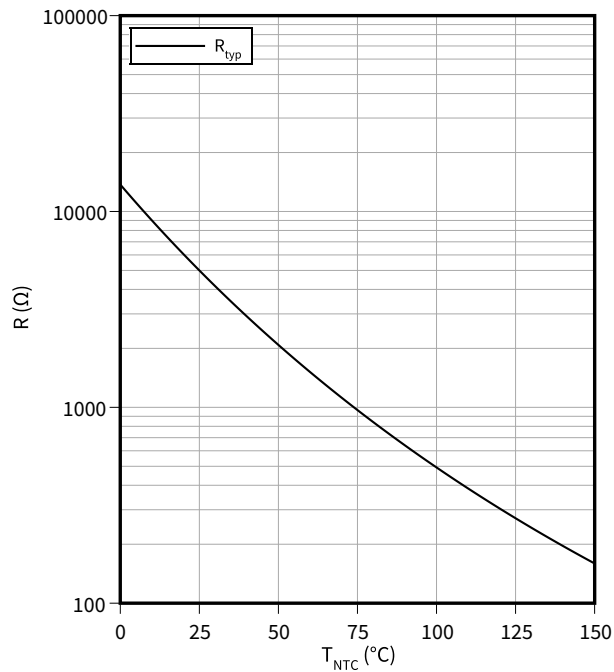
Transient thermal impedance, MOSFET

$Z_{th} = f(t)$



Temperature characteristic (typical), NTC-Thermistor

$R = f(T_{NTC})$



6 Circuit diagram

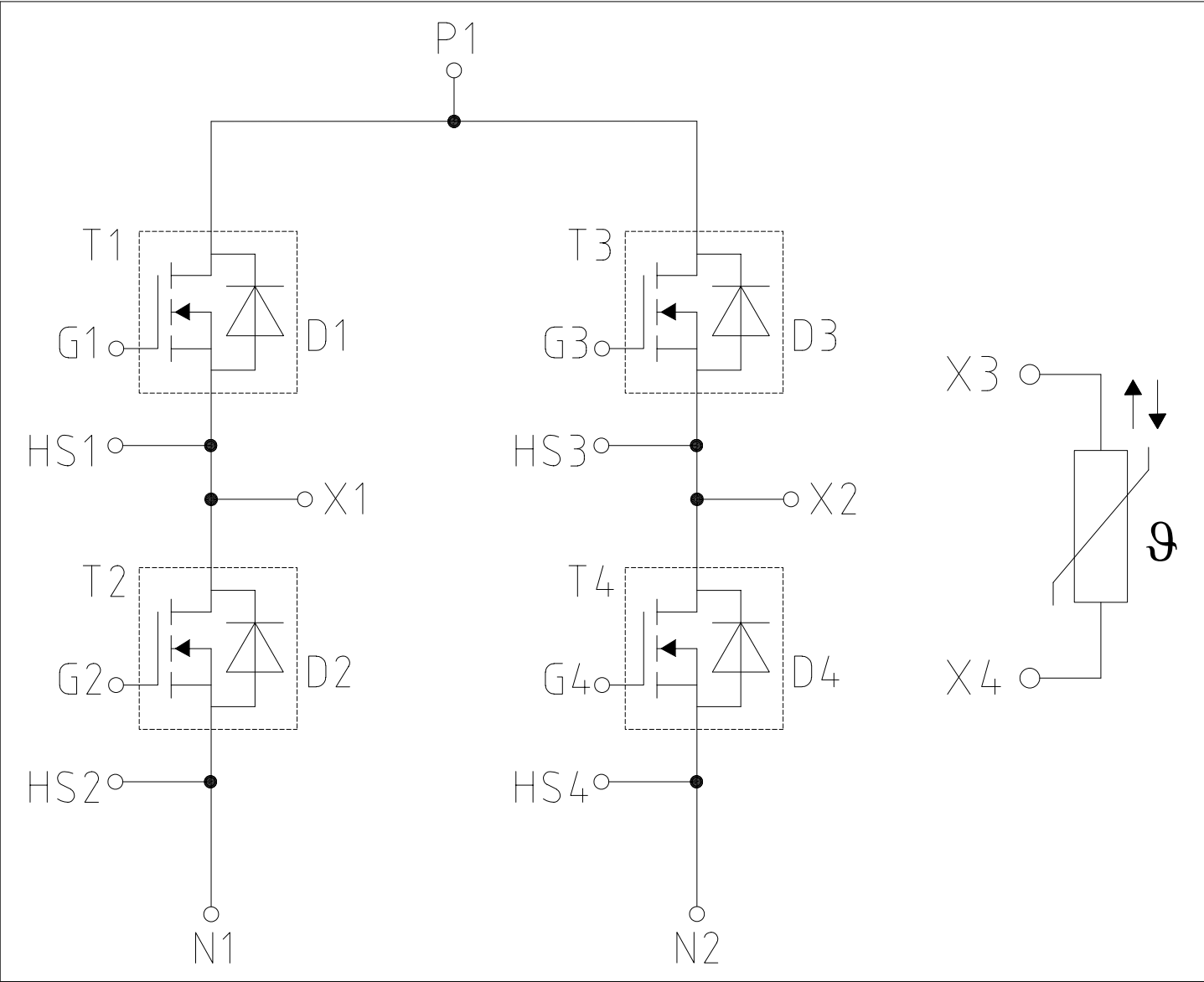


Figure 1

7 Package outlines

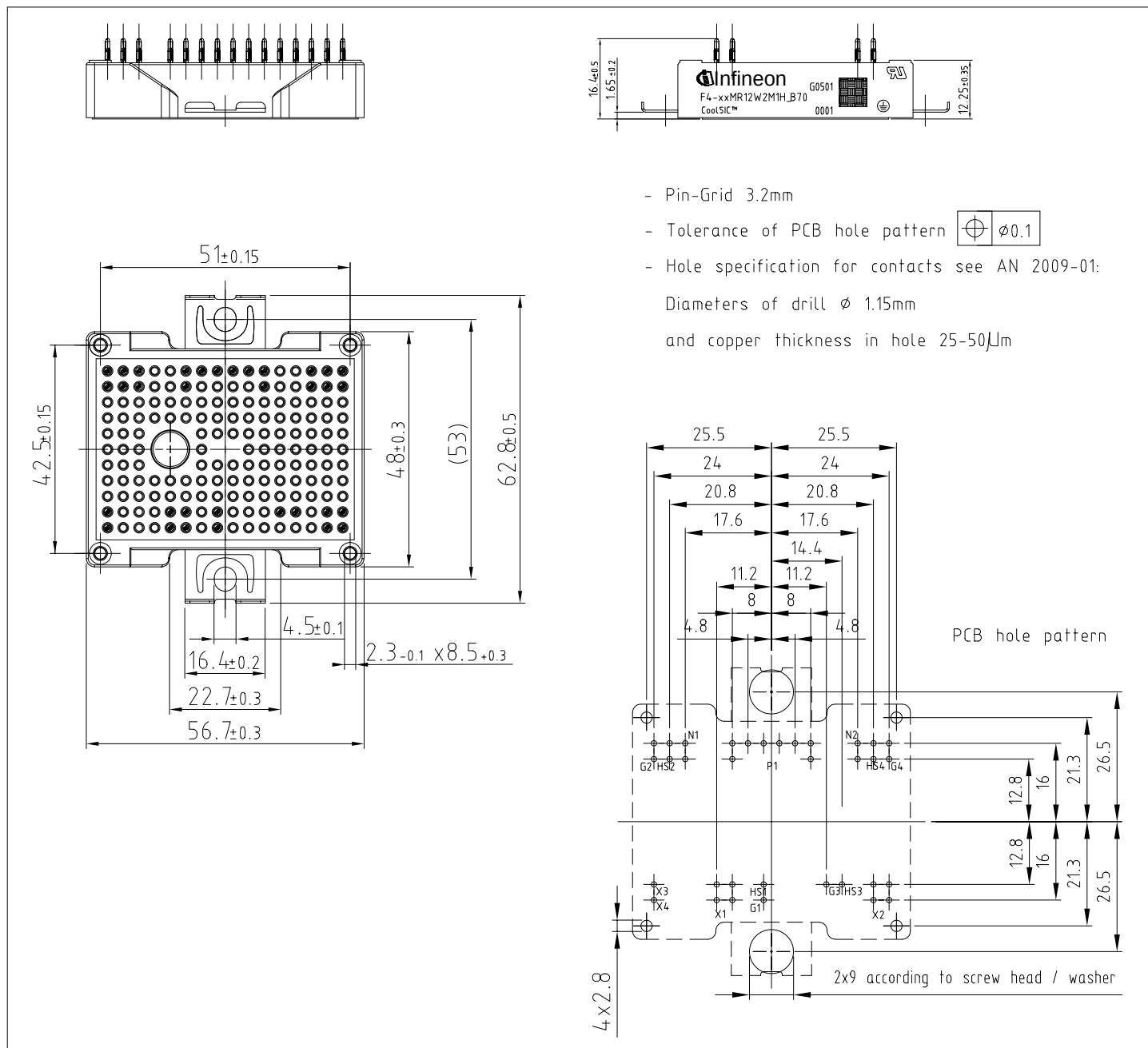


Figure 2

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>	<i>Digit</i>	<i>Example</i>
	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			
			
71549142846550549911530		71549142846550549911530	

Figure 3

Revision history

Document revision	Date of release	Description of changes
0.10	2022-08-03	Initial version
0.20	2023-06-09	Preliminary datasheet

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