

## Preliminary datasheet

### EasyDUAL module with CoolSiC™ Trench MOSFET and PressFIT / NTC

#### Features

- Electrical features
  - $V_{DSS} = 1200\text{ V}$
  - $I_{DN} = 150\text{ A} / I_{DRM} = 300\text{ A}$
  - Low switching losses
  - Low inductive design
  - High current density
- Mechanical features
  - Rugged mounting due to integrated mounting clamps
  - PressFIT contact technology
  - Integrated NTC temperature sensor



Typical appearance

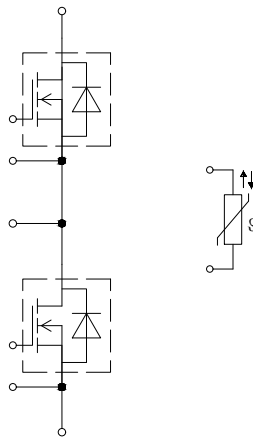
#### Potential applications

- UPS systems
- High-frequency switching application
- DC/DC converter
- Solar applications

#### 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)	$Al_2O_3$	
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	$L_{sCE}$			8		nH
Module lead resistance, terminals - chip	$R_{CC'+EE'}$	$T_H = 25 \text{ °C}$ , per switch		1.4		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
Implemented drain current	$I_{DN}$		150	A
Continuous DC drain current	$I_{DDC}$	$T_{vj} = 175 \text{ °C}$ , $V_{GS} = 18 \text{ V}$ $T_H = 65 \text{ °C}$	145	A
Repetitive peak drain current	$I_{DRM}$	verified by design, $t_p$ limited by $T_{vjmax}$	300	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

(table continues...)

**Table 4 (continued) Recommended values**

Parameter	Symbol	Note or test condition	Values	Unit
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	$R_{DS(on)}$	$I_D = 150\text{ A}$	$V_{GS} = 18\text{ V}$ , $T_{vj} = 25\text{ °C}$		5.4		mΩ
			$V_{GS} = 18\text{ V}$ , $T_{vj} = 125\text{ °C}$		8.7		
			$V_{GS} = 18\text{ V}$ , $T_{vj} = 175\text{ °C}$		11.6		
			$V_{GS} = 15\text{ V}$ , $T_{vj} = 25\text{ °C}$		6.5		
Gate threshold voltage	$V_{GS(th)}$	$I_D = 60\text{ mA}$ , $V_{DS} = V_{GS}$ , $T_{vj} = 25\text{ °C}$ , (tested after 1ms pulse at $V_{GS} = +20\text{ V}$ )	3.45	4.3	5.15	V	
Total gate charge	$Q_G$	$V_{DD} = 800\text{ V}$ , $V_{GS} = -3/18\text{ V}$		0.446		μC	
Internal gate resistor	$R_{Gint}$	$T_{vj} = 25\text{ °C}$		1.4		Ω	
Input capacitance	$C_{ISS}$	$f = 100\text{ kHz}$ , $V_{DS} = 800\text{ V}$ , $V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ °C}$	13.2		nF	
Output capacitance	$C_{OSS}$	$f = 100\text{ kHz}$ , $V_{DS} = 800\text{ V}$ , $V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ °C}$	0.63		nF	
Reverse transfer capacitance	$C_{rSS}$	$f = 100\text{ kHz}$ , $V_{DS} = 800\text{ V}$ , $V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ °C}$	0.042		nF	
$C_{OSS}$ stored energy	$E_{OSS}$	$V_{DS} = 800\text{ V}$ , $V_{GS} = -3/18\text{ V}$ , $T_{vj} = 25\text{ °C}$		258		μJ	
Drain-source leakage current	$I_{DSS}$	$V_{DS} = 1200\text{ V}$ , $V_{GS} = -3\text{ V}$	$T_{vj} = 25\text{ °C}$	0.09	530	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)	$t_{d\ on}$	$I_D = 150\text{ A}$ , $R_{Gon} = 2.4\text{ Ω}$ , $V_{DD} = 600\text{ V}$ , $V_{GS} = -3/18\text{ V}$	$T_{vj} = 25\text{ °C}$	38		ns	
			$T_{vj} = 125\text{ °C}$		37		
			$T_{vj} = 175\text{ °C}$		37		
Rise time (inductive load)	$t_r$	$I_D = 150\text{ A}$ , $R_{Gon} = 2.4\text{ Ω}$ , $V_{DD} = 600\text{ V}$ , $V_{GS} = -3/18\text{ V}$	$T_{vj} = 25\text{ °C}$	39		ns	
			$T_{vj} = 125\text{ °C}$		38		
			$T_{vj} = 175\text{ °C}$		38		
Turn-off delay time (inductive load)	$t_{d\ off}$	$I_D = 150\text{ A}$ , $R_{Goff} = 1.3\text{ Ω}$ , $V_{DD} = 600\text{ V}$ , $V_{GS} = -3/18\text{ V}$	$T_{vj} = 25\text{ °C}$	69		ns	
			$T_{vj} = 125\text{ °C}$		74		
			$T_{vj} = 175\text{ °C}$		77		

**(table continues...)**

**Table 5** (continued) **Characteristic values**

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Fall time (inductive load)	$t_f$	$I_D = 150\text{ A}$ , $R_{Goff} = 1.3\ \Omega$ , $V_{DD} = 600\text{ V}$ , $V_{GS} = -3/18\text{ V}$	$T_{vj} = 25\text{ }^\circ\text{C}$		15	ns
			$T_{vj} = 125\text{ }^\circ\text{C}$		15	
			$T_{vj} = 175\text{ }^\circ\text{C}$		15	
Turn-on energy loss per pulse	$E_{on}$	$I_D = 150\text{ A}$ , $V_{DD} = 600\text{ V}$ , $L_\sigma = 7\text{ nH}$ , $V_{GS} = -3/18\text{ V}$ , $R_{Gon} = 2.4\ \Omega$ , $di/dt = 8.1\text{ kA}/\mu\text{s}$ ( $T_{vj} = 175\text{ }^\circ\text{C}$ )	$T_{vj} = 25\text{ }^\circ\text{C}$		1.69	mJ
			$T_{vj} = 125\text{ }^\circ\text{C}$		2.14	
			$T_{vj} = 175\text{ }^\circ\text{C}$		2.43	
Turn-off energy loss per pulse	$E_{off}$	$I_D = 150\text{ A}$ , $V_{DD} = 600\text{ V}$ , $L_\sigma = 7\text{ nH}$ , $V_{GS} = -3/18\text{ V}$ , $R_{Goff} = 1.3\ \Omega$ , $dv/dt = 32\text{ kV}/\mu\text{s}$ ( $T_{vj} = 175\text{ }^\circ\text{C}$ )	$T_{vj} = 25\text{ }^\circ\text{C}$		0.98	mJ
			$T_{vj} = 125\text{ }^\circ\text{C}$		0.99	
			$T_{vj} = 175\text{ }^\circ\text{C}$		1.02	
SC data	$I_{SC}$	$V_{GS} = -5/15\text{ V}$ , $V_{DD} = 800\text{ V}$ , $V_{DSmax} = V_{DSS} - L_{sDS} * di/dt$ , $R_G = 10\ \Omega$	$t_p = 2\ \mu\text{s}$ , $T_{vj} = 25\text{ }^\circ\text{C}$		1260	A
			$t_p = 2\ \mu\text{s}$ , $T_{vj} = 150\text{ }^\circ\text{C}$		1230	
Thermal resistance, junction to heat sink	$R_{thJH}$	per MOSFET, $\lambda_{grease} = 1\text{ W}/(\text{m}\cdot\text{K})$			0.346	K/W
Temperature under switching conditions	$T_{vj\ op}$		-40		175	$^\circ\text{C}$

*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 Notes AN 2018-09 and AN 2021-13 must be considered to ensure sound operation of the device over the planned lifetime.

$T_{vj,op} > 150\text{ }^\circ\text{C}$  is allowed for operation at overload conditions for MOSFET and body diode. For detailed specifications, please refer to AN 2021-13.

### 3 Body diode (MOSFET)

**Table 6** **Maximum rated values**

Parameter	Symbol	Note or test condition	Values	Unit
DC body diode forward current	$I_{SD}$	$T_{vj} = 175\text{ }^\circ\text{C}$ , $V_{GS} = -3\text{ V}$ $T_H = 65\text{ }^\circ\text{C}$	75	A

**Table 7** Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit	
			Min.	Typ.	Max.		
Forward voltage	$V_{SD}$	$I_{SD} = 150 \text{ A}, V_{GS} = -3 \text{ V}$	$T_{vj} = 25 \text{ °C}$		4.2	5.35	V
			$T_{vj} = 125 \text{ °C}$		3.9		
			$T_{vj} = 175 \text{ °C}$		3.8		

## 4 NTC-Thermistor

**Table 8** Characteristic values

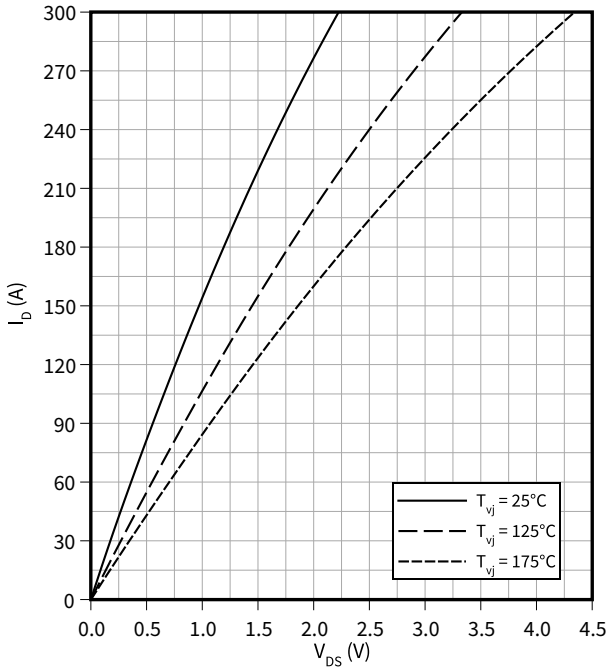
Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Rated resistance	$R_{25}$	$T_{NTC} = 25 \text{ °C}$		5		kΩ
Deviation of $R_{100}$	$\Delta R/R$	$T_{NTC} = 100 \text{ °C}, R_{100} = 493 \text{ Ω}$	-5		5	%
Power dissipation	$P_{25}$	$T_{NTC} = 25 \text{ °C}$			20	mW
B-value	$B_{25/50}$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

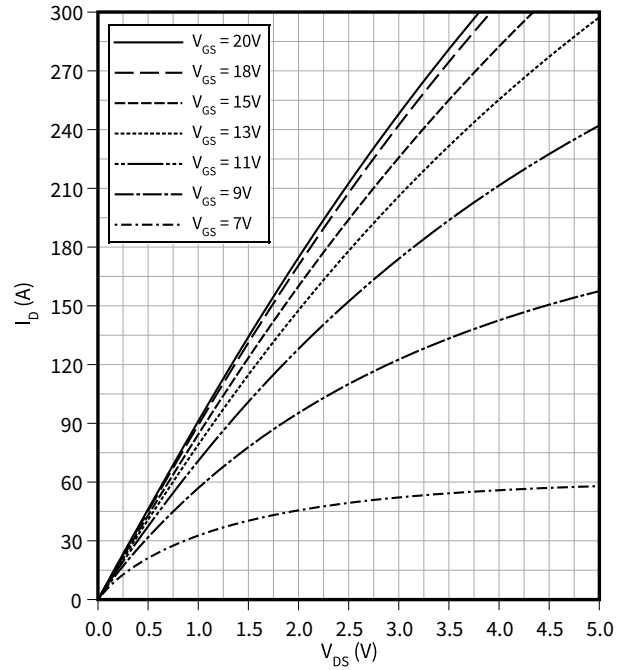
**Output characteristic (typical), MOSFET**

$I_D = f(V_{DS})$   
 $V_{GS} = 15\text{ V}$



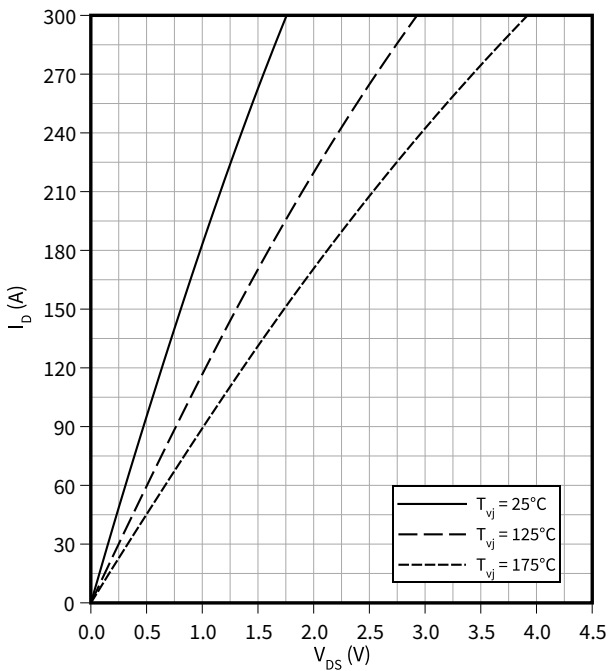
**Output characteristic (typical), MOSFET**

$I_D = f(V_{DS})$   
 $T_{vj} = 175\text{ °C}$



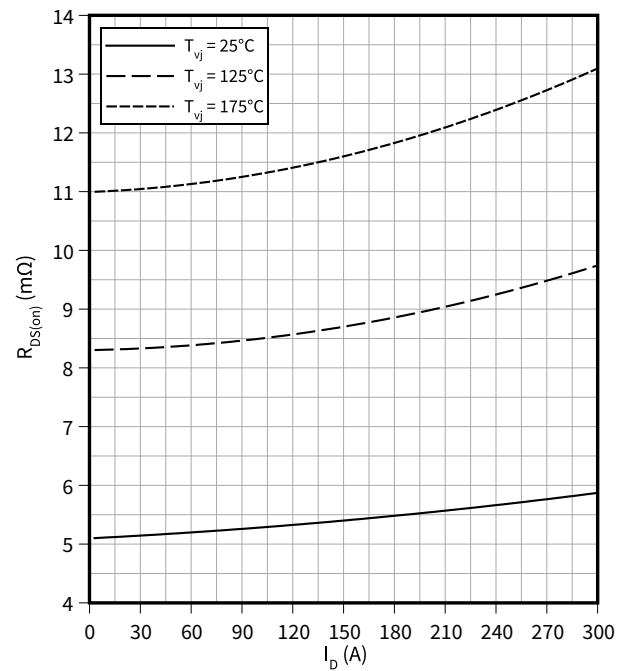
**Output characteristic (typical), MOSFET**

$I_D = f(V_{DS})$   
 $V_{GS} = 18\text{ V}$



**Drain source on-resistance (typical), MOSFET**

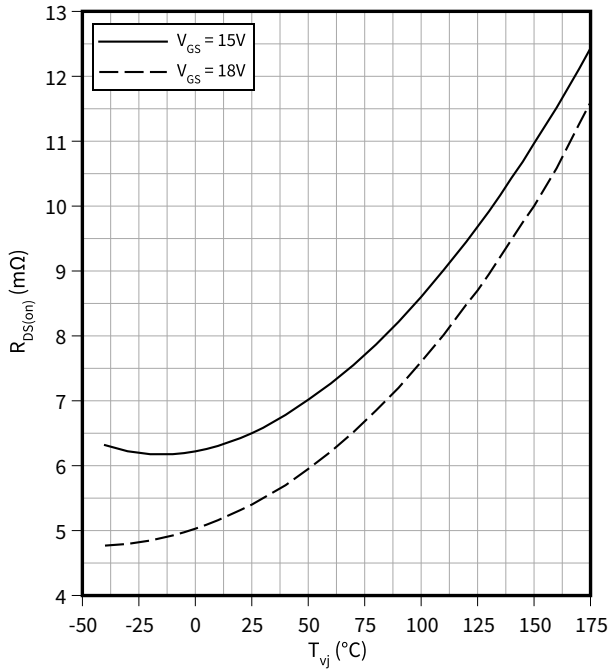
$R_{DS(on)} = f(I_D)$   
 $V_{GS} = 18\text{ V}$



5 Characteristics diagrams

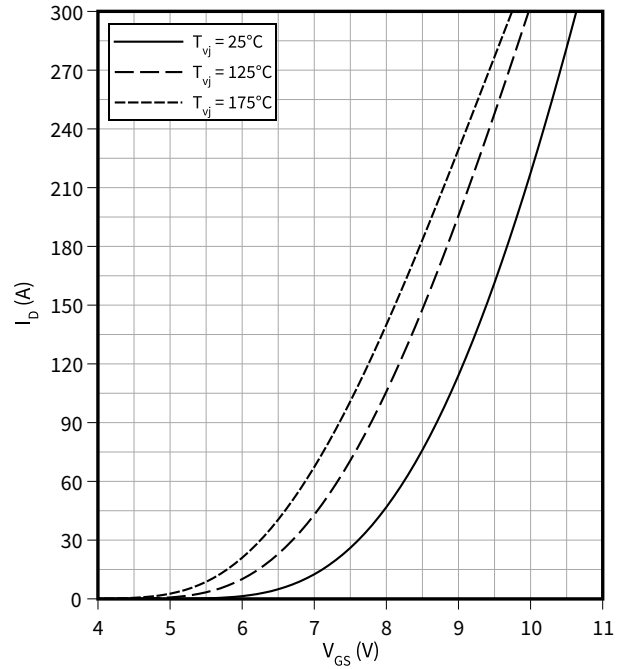
**Drain source on-resistance (typical), MOSFET**

$R_{DS(on)} = f(T_{vj})$   
 $I_D = 150 \text{ A}$



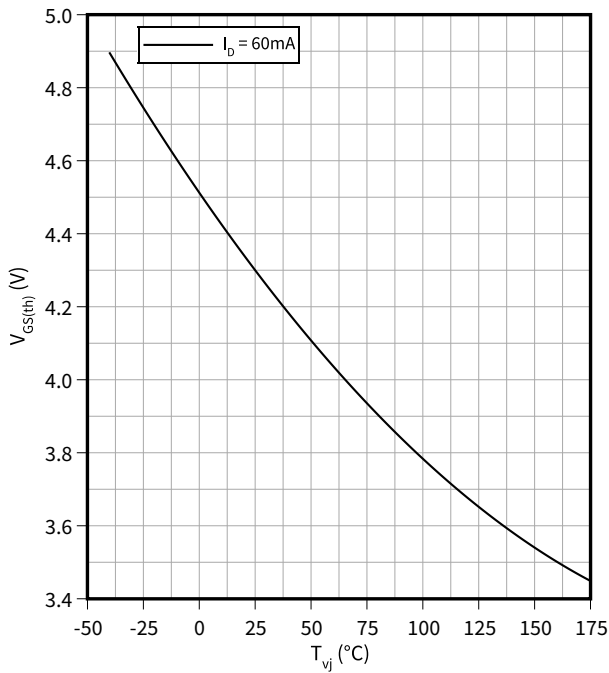
**Transfer characteristic (typical), MOSFET**

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



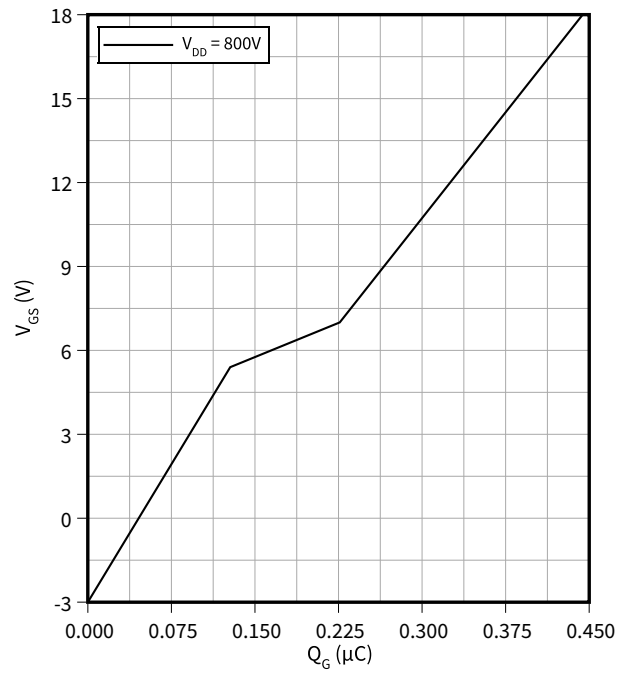
**Gate-source threshold voltage (typical), MOSFET**

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



**Gate charge characteristic (typical), MOSFET**

$V_{GS} = f(Q_G)$   
 $I_D = 150 \text{ A}, T_{vj} = 25 \text{ }^\circ C$

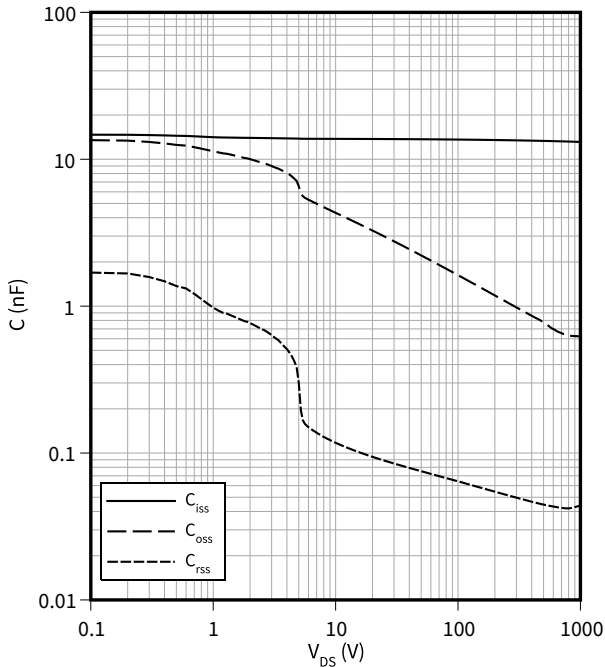




5 Characteristics diagrams

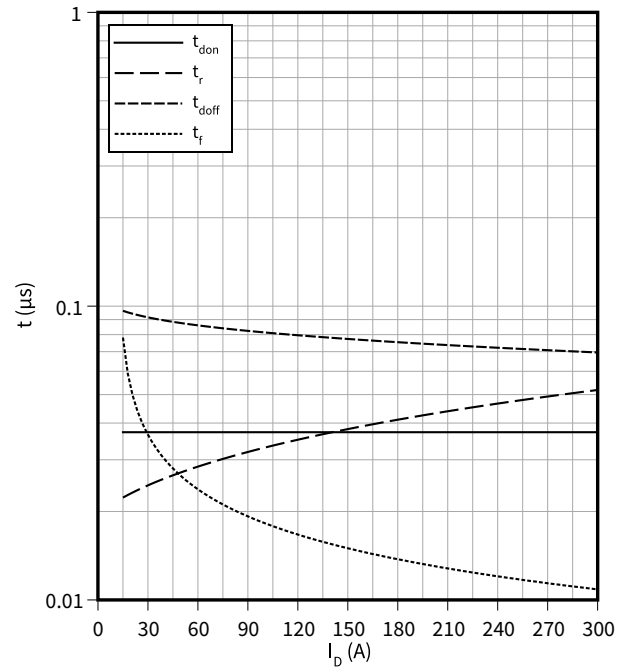
**Capacity characteristic (typical), MOSFET**

$C = f(V_{DS})$   
 $f = 100 \text{ kHz}, T_{vj} = 25 \text{ }^\circ\text{C}, V_{GS} = 0 \text{ V}$



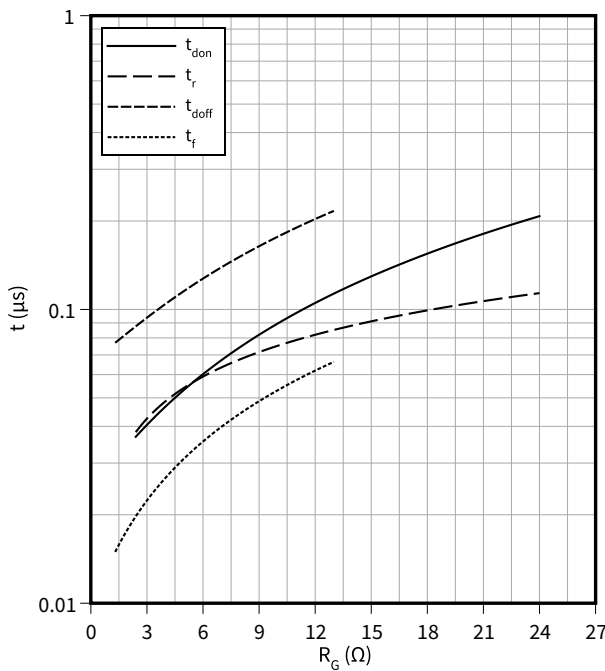
**Switching times (typical), MOSFET**

$t = f(I_D)$   
 $R_{Goff} = 1.3 \text{ } \Omega, R_{Gon} = 2.4 \text{ } \Omega, V_{DD} = 600 \text{ V}, T_{vj} = 175 \text{ }^\circ\text{C}, V_{GS} = -3/18 \text{ V}$



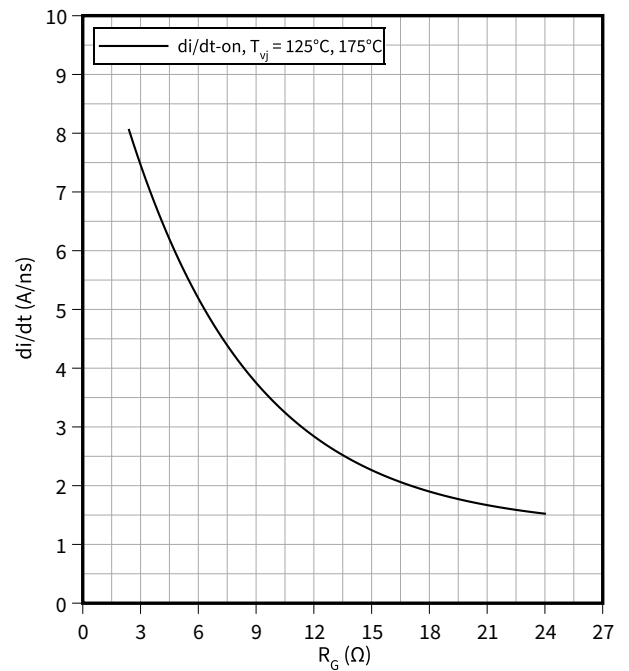
**Switching times (typical), MOSFET**

$t = f(R_G)$   
 $V_{DD} = 600 \text{ V}, I_D = 150 \text{ A}, T_{vj} = 175 \text{ }^\circ\text{C}, V_{GS} = -3/18 \text{ V}$



**Current slope (typical), MOSFET**

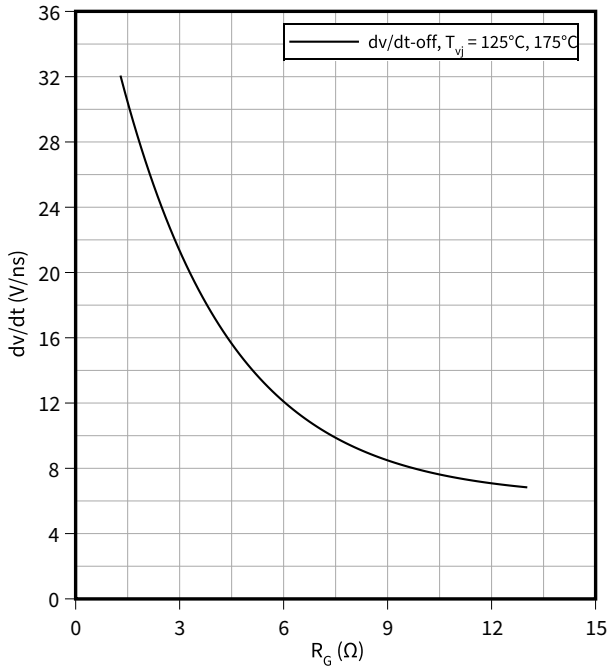
$di/dt = f(R_G)$   
 $V_{DD} = 600 \text{ V}, I_D = 150 \text{ A}, V_{GS} = -3/18 \text{ V}$



**Voltage slope (typical), MOSFET**

$dv/dt = f(R_G)$

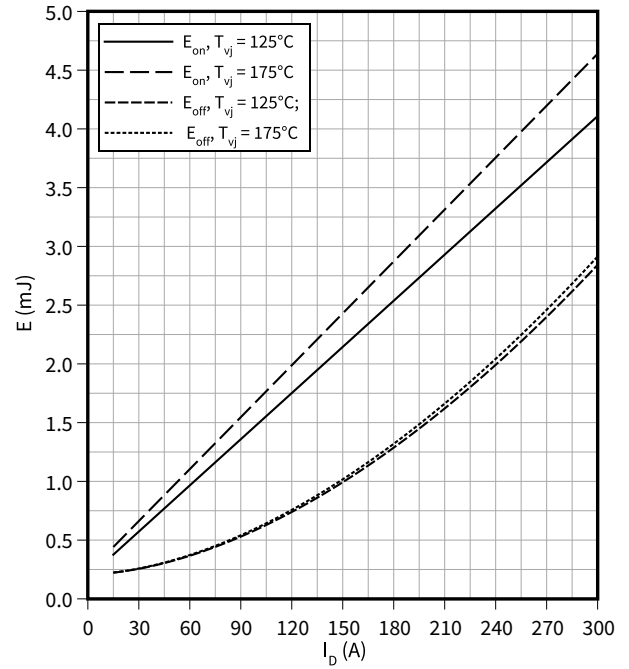
$V_{DD} = 600\text{ V}$ ,  $I_D = 150\text{ A}$ ,  $V_{GS} = -3/18\text{ V}$



**Switching losses (typical), MOSFET**

$E = f(I_D)$

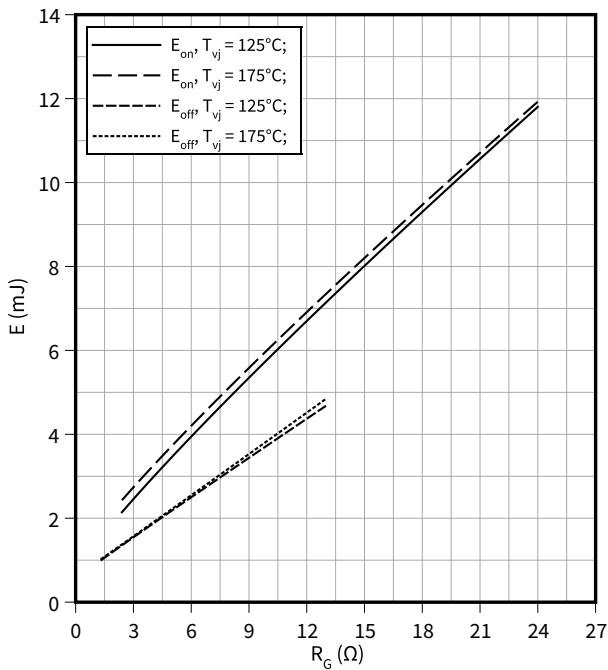
$R_{Goff} = 1.3\ \Omega$ ,  $R_{Gon} = 2.4\ \Omega$ ,  $V_{DD} = 600\text{ V}$ ,  $V_{GS} = -3/18\text{ V}$



**Switching losses (typical), MOSFET**

$E = f(R_G)$

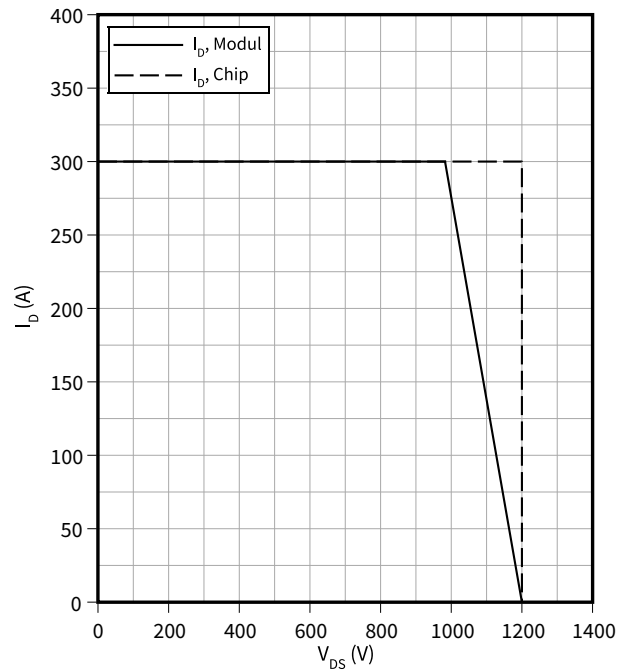
$V_{DD} = 600\text{ V}$ ,  $I_D = 150\text{ A}$ ,  $V_{GS} = -3/18\text{ V}$



**Reverse bias safe operating area (RBSOA), MOSFET**

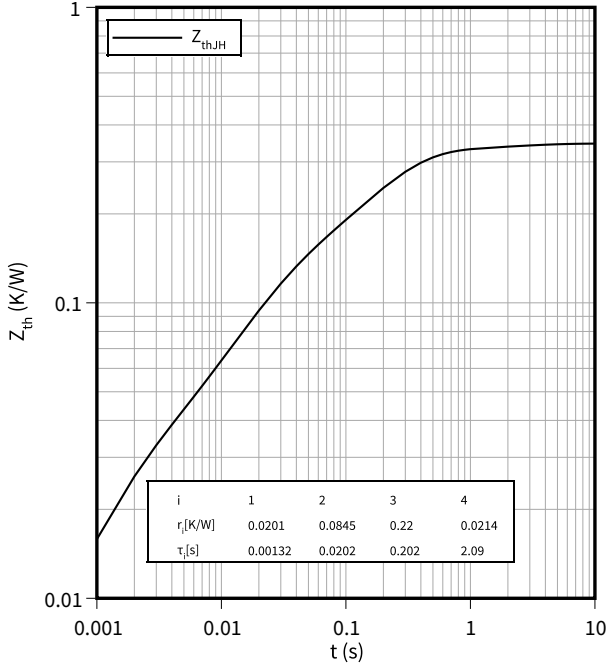
$I_D = f(V_{DS})$

$R_{Goff} = 1.3\ \Omega$ ,  $T_{vj} = 175\text{ °C}$ ,  $V_{GS} = -3/18\text{ V}$



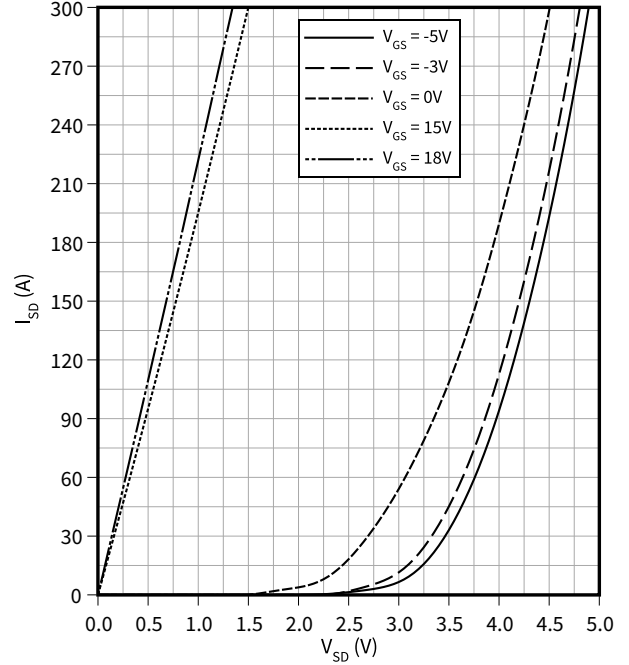
**Transient thermal impedance, MOSFET**

$Z_{th} = f(t)$



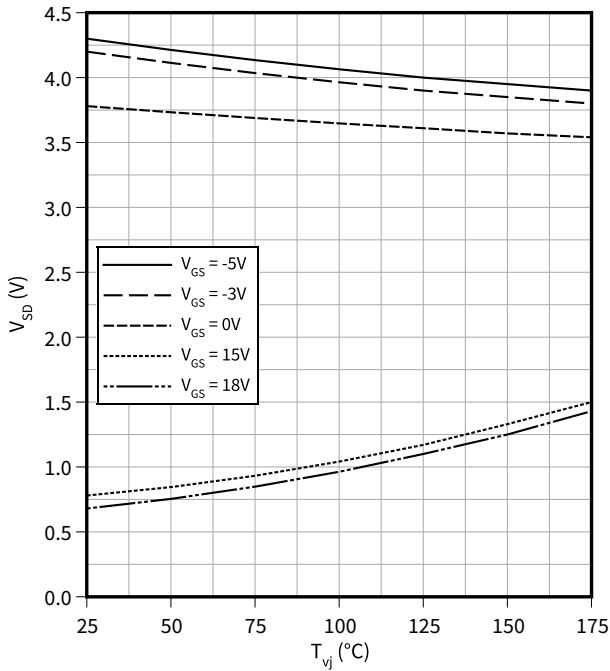
**Forward characteristic body diode (typical), MOSFET**

$I_{SD} = f(V_{SD})$   
 $T_{vj} = 25\text{ }^\circ\text{C}$



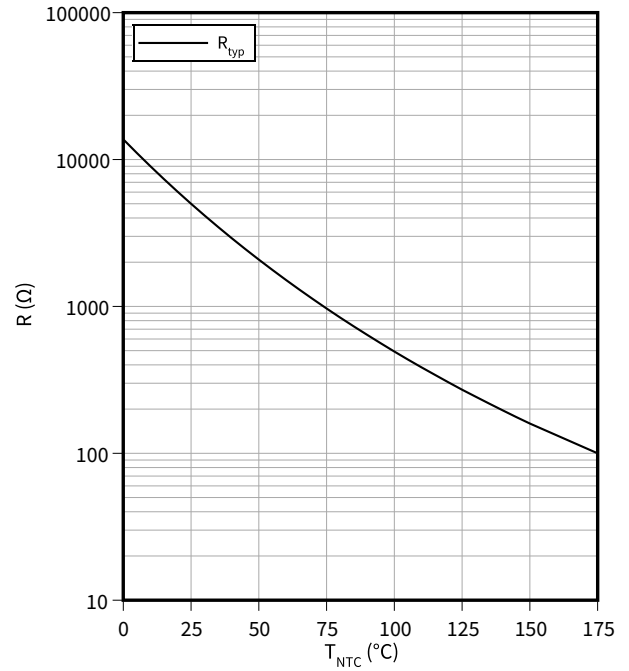
**Forward voltage of body diode (typical), MOSFET**

$V_{SD} = f(T_{vj})$   
 $I_{SD} = 150\text{ A}$



**Temperature characteristic (typical), NTC-Thermistor**

$R = f(T_{NTC})$



## 6 Circuit diagram

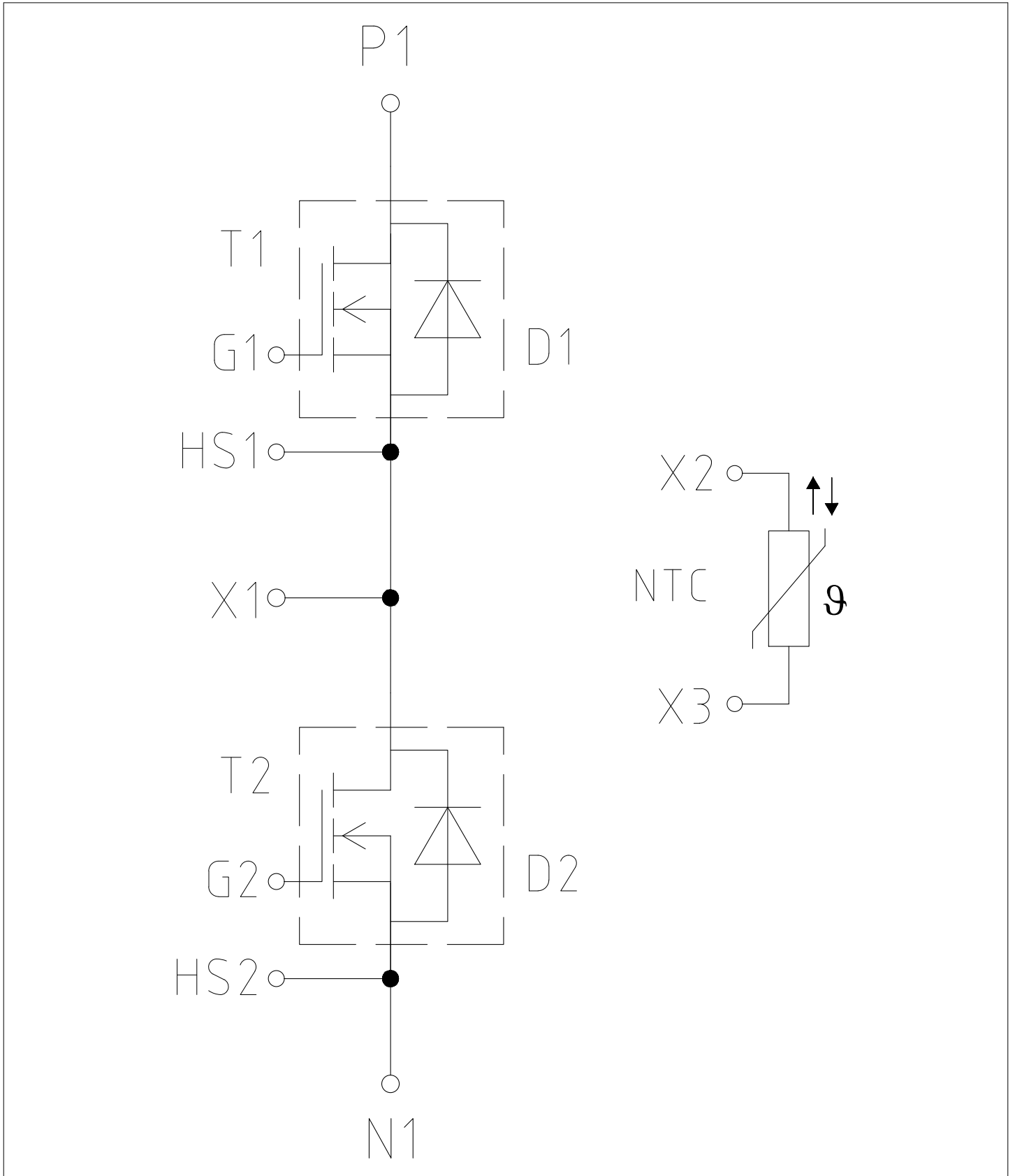


Figure 1

7 Package outlines

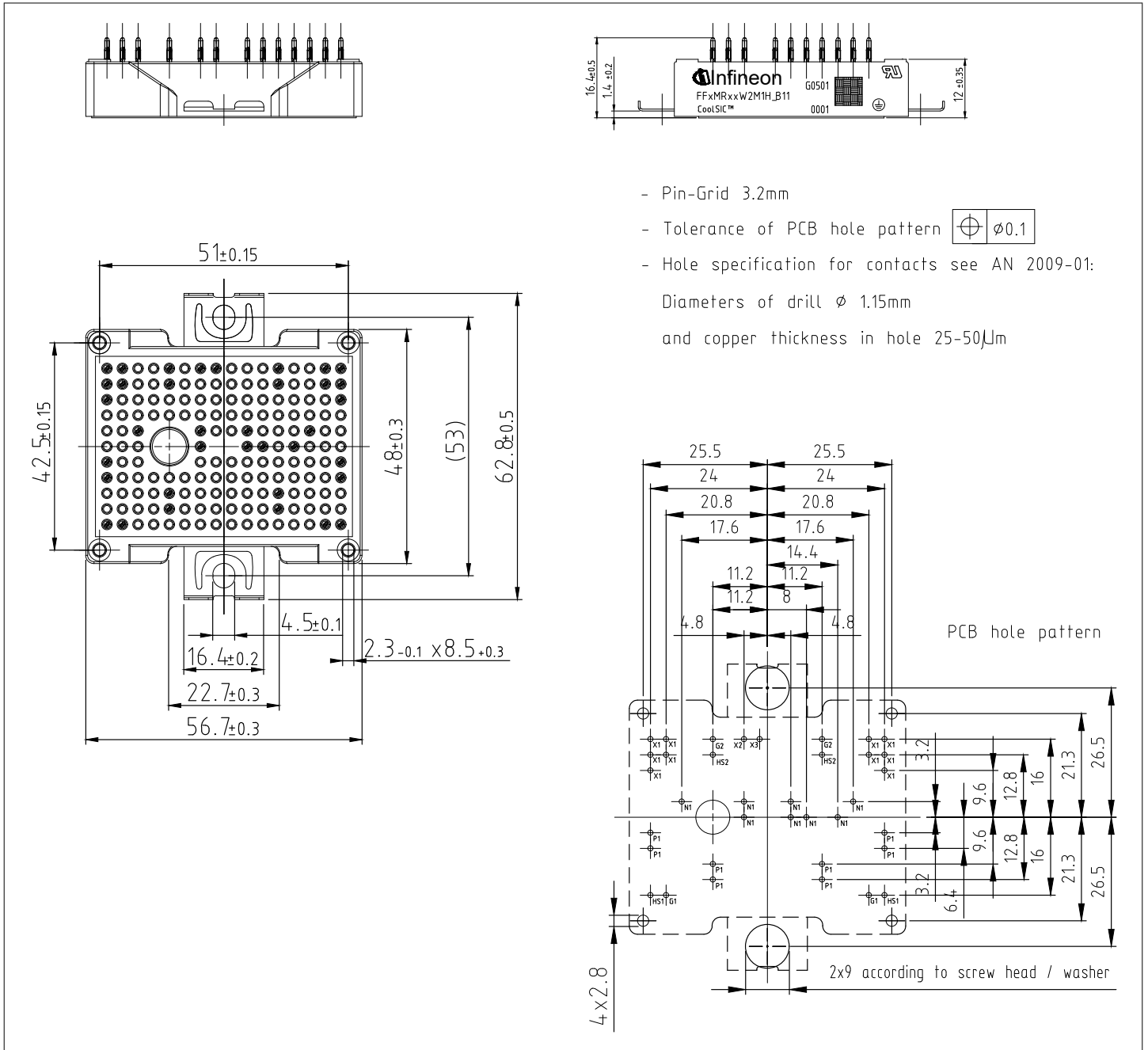

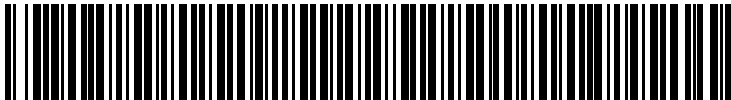


Figure 2

## 8 Module label code

<b>Module label code</b>			
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	 		<p>71549142846550549911530</p> <p>71549142846550549911530</p>

**Figure 3**