

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

### Features

- Electrical features
  - $V_{DSS} = 1200\text{ V}$
  - $I_{DN} = 15\text{ A} / I_{DRM} = 30\text{ A}$
  - Low inductive design
  - Low switching losses
- Mechanical features
  - Rugged mounting due to integrated mounting clamps
  - PressFIT contact technology
  - Integrated NTC temperature sensor



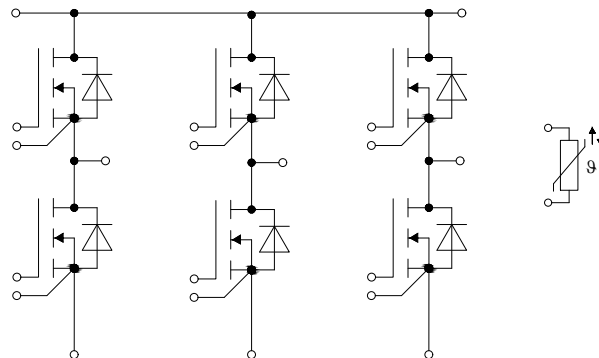
### Potential applications

- High-frequency switching application
- DC/DC converter
- Motor drives
- UPS systems

### 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)	$Al_2O_3$	
Creepage distance	$d_{Creep}$	terminal to heatsink	11.5	mm
Creepage distance	$d_{Creep}$	terminal to terminal	6.3	mm
Clearance	$d_{Clear}$	terminal to heatsink	10.0	mm
Clearance	$d_{Clear}$	terminal to terminal	5.0	mm
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	$L_{SCE}$			14		nH
Module lead resistance, terminals - chip	$R_{CC'+EE'}$	$T_H = 25^\circ\text{C}$ , per switch		3		mΩ
Storage temperature	$T_{stg}$		-40		125	°C
Mounting force per clamp	$F$		20		50	N
Weight	$G$			24		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	$V_{DSS}$	$T_{vj} = 25^\circ\text{C}$	1200	V
Implemented drain current	$I_{DN}$		15	A
Continuous DC drain current	$I_{DDC}$	$T_{vj} = 175^\circ\text{C}$ , $V_{GS} = 18 \text{ V}$ $T_H = 95^\circ\text{C}$	15	A
Repetitive peak drain current	$I_{DRM}$	verified by design, $t_p$ limited by $T_{vjmax}$	30	A
Gate-source voltage, max. transient voltage	$V_{GS}$	$D < 0.01$	-10/23	V

(table continues...)

**Table 3 (continued) Maximum rated values**

Parameter	Symbol	Note or test condition	Values	Unit
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	$R_{DS(on)}$	$I_D = 15\text{ A}$	$V_{GS} = 18\text{ V}$ , $T_{vj} = 25\text{ °C}$		52.9	79	mΩ
			$V_{GS} = 18\text{ V}$ , $T_{vj} = 125\text{ °C}$		85.5		
			$V_{GS} = 18\text{ V}$ , $T_{vj} = 175\text{ °C}$		114		
			$V_{GS} = 15\text{ V}$ , $T_{vj} = 25\text{ °C}$		63.5		
Gate threshold voltage	$V_{GS(th)}$	$I_D = 6\text{ mA}$ , $V_{DS} = V_{GS}$ , $T_{vj} = 25\text{ °C}$ , (tested after 1ms pulse at $V_{GS} = +20\text{ V}$ )	3.45	4.3	5.15	V	
Total gate charge	$Q_G$	$V_{DS} = 800\text{ V}$ , $V_{GS} = -3/18\text{ V}$		0.045		μC	
Internal gate resistor	$R_{Gint}$	$T_{vj} = 25\text{ °C}$		7.5		Ω	
Input capacitance	$C_{ISS}$	$f = 100\text{ kHz}$ , $V_{DS} = 800\text{ V}$ , $V_{GS} = 0\text{ V}$		1.35		nF	
Output capacitance	$C_{OSS}$	$f = 100\text{ kHz}$ , $V_{DS} = 800\text{ V}$ , $V_{GS} = 0\text{ V}$		0.064		nF	
Reverse transfer capacitance	$C_{rSS}$	$f = 100\text{ kHz}$ , $V_{DS} = 800\text{ V}$ , $V_{GS} = 0\text{ V}$		0.004		nF	
$C_{OSS}$ stored energy	$E_{OSS}$	$V_{DS} = 800\text{ V}$ , $V_{GS} = -3/18\text{ V}$ , $T_{vj} = 25\text{ °C}$		26.2		μJ	
Drain-source leakage current	$I_{DSS}$	$V_{DS} = 1200\text{ V}$ , $V_{GS} = -3\text{ V}$		0.01	110	μA	
Gate-source leakage current	$I_{GSS}$	$V_{DS} = 0\text{ V}$ , $T_{vj} = 25\text{ °C}$			400	nA	
Turn-on delay time (inductive load)	$t_{d\ on}$	$I_D = 15\text{ A}$ , $R_{Gon} = 3.9\text{ Ω}$ , $V_{DS} = 600\text{ V}$ , $V_{GS} = -3/18\text{ V}$	$T_{vj} = 25\text{ °C}$		23.1	ns	
			$T_{vj} = 125\text{ °C}$		23.1		
			$T_{vj} = 175\text{ °C}$		23.1		

**(table continues...)**

**Table 5 (continued) Characteristic values**

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Rise time (inductive load)	$t_r$	$I_D = 15\text{ A}, R_{Gon} = 3.9\ \Omega,$ $V_{DS} = 600\text{ V}, V_{GS} = -3/18\text{ V}$	$T_{vj} = 25\text{ °C}$	19.7		ns
			$T_{vj} = 125\text{ °C}$	20.5		
			$T_{vj} = 175\text{ °C}$	21.1		
Turn-off delay time (inductive load)	$t_{d\ off}$	$I_D = 15\text{ A}, R_{Goff} = 3.3\ \Omega,$ $V_{DS} = 600\text{ V}, V_{GS} = -3/18\text{ V}$	$T_{vj} = 25\text{ °C}$	43.7		ns
			$T_{vj} = 125\text{ °C}$	48.4		
			$T_{vj} = 175\text{ °C}$	51.1		
Fall time (inductive load)	$t_f$	$I_D = 15\text{ A}, R_{Goff} = 3.3\ \Omega,$ $V_{DS} = 600\text{ V}, V_{GS} = -3/18\text{ V}$	$T_{vj} = 25\text{ °C}$	17.3		ns
			$T_{vj} = 125\text{ °C}$	17.3		
			$T_{vj} = 175\text{ °C}$	17.3		
Turn-on energy loss per pulse	$E_{on}$	$I_D = 15\text{ A}, V_{DS} = 600\text{ V},$ $L_\sigma = 6\text{ nH}, V_{GS} = -3/18\text{ V},$ $R_{Gon} = 3.9\ \Omega, di/dt = 1.8$ $\text{kA}/\mu\text{s} (T_{vj} = 175\text{ °C})$	$T_{vj} = 25\text{ °C}$	0.235		mJ
			$T_{vj} = 125\text{ °C}$	0.297		
			$T_{vj} = 175\text{ °C}$	0.334		
Turn-off energy loss per pulse	$E_{off}$	$I_D = 15\text{ A}, V_{DS} = 600\text{ V},$ $L_\sigma = 6\text{ nH}, V_{GS} = -3/18\text{ V},$ $R_{Goff} = 3.3\ \Omega, dv/dt = 27.7$ $\text{kV}/\mu\text{s} (T_{vj} = 175\text{ °C})$	$T_{vj} = 25\text{ °C}$	0.037		mJ
			$T_{vj} = 125\text{ °C}$	0.041		
			$T_{vj} = 175\text{ °C}$	0.043		
Thermal resistance, junction to heat sink	$R_{thJH}$	per MOSFET		2.03		K/W
Temperature under switching conditions	$T_{vj\ op}$		-40		175	°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.*

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

### 3 Body diode

**Table 6 Maximum rated values**

Parameter	Symbol	Note or test condition	Values	Unit
DC body diode forward current	$I_{SD}$	$T_{vj} = 175\text{ °C}, V_{GS} = -3\text{ V}$ $T_H = 105\text{ °C}$	7	A

**Table 7** Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit	
			Min.	Typ.	Max.		
Forward voltage	$V_{SD}$	$I_{SD} = 15 \text{ A}, V_{GS} = -3 \text{ V}$	$T_{vj} = 25 \text{ °C}$		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

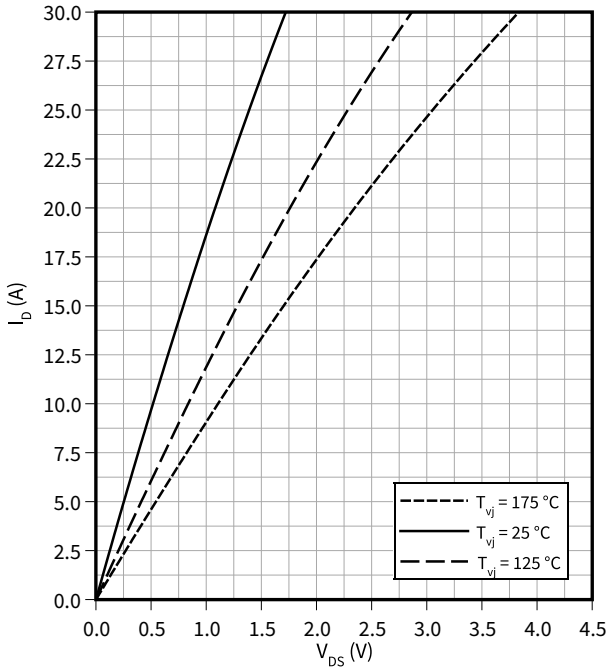
Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Rated resistance	$R_{25}$	$T_{NTC} = 25 \text{ °C}$		5		kΩ
Deviation of $R_{100}$	$\Delta R/R$	$T_{NTC} = 100 \text{ °C}, R_{100} = 493 \text{ } \Omega$	-5		5	%
Power dissipation	$P_{25}$	$T_{NTC} = 25 \text{ °C}$			20	mW
B-value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

## 5 Characteristics diagrams

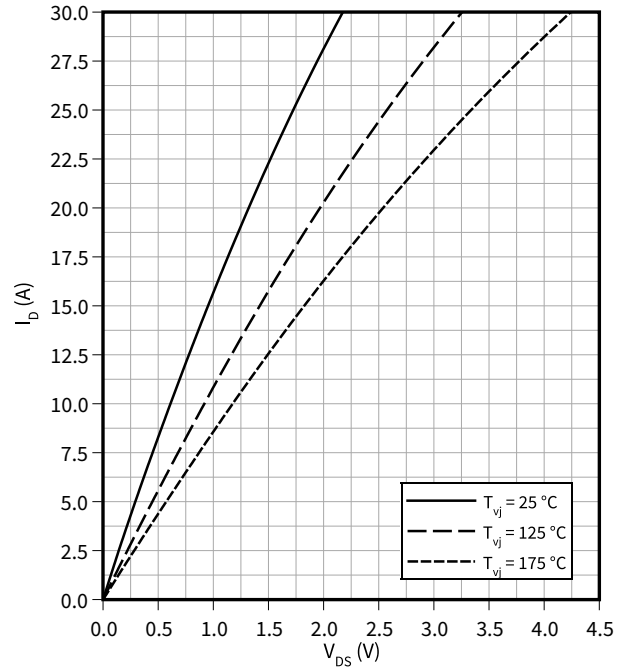
**Output characteristic (typical), MOSFET**

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



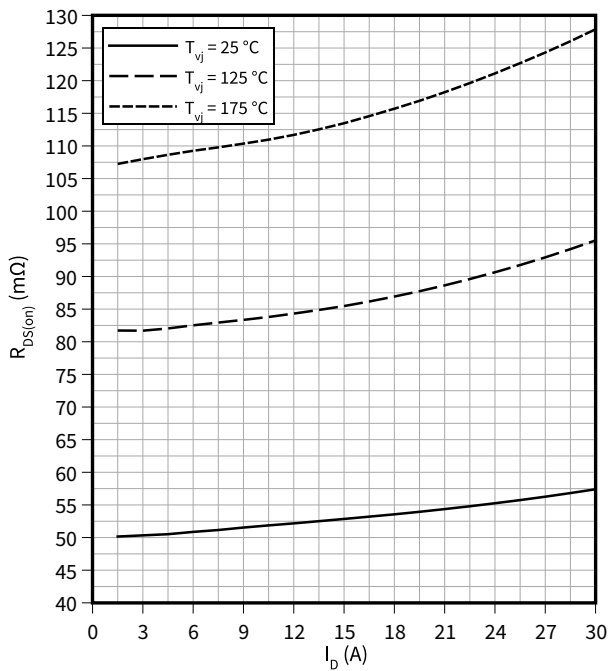
**Output characteristic (typical), MOSFET**

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



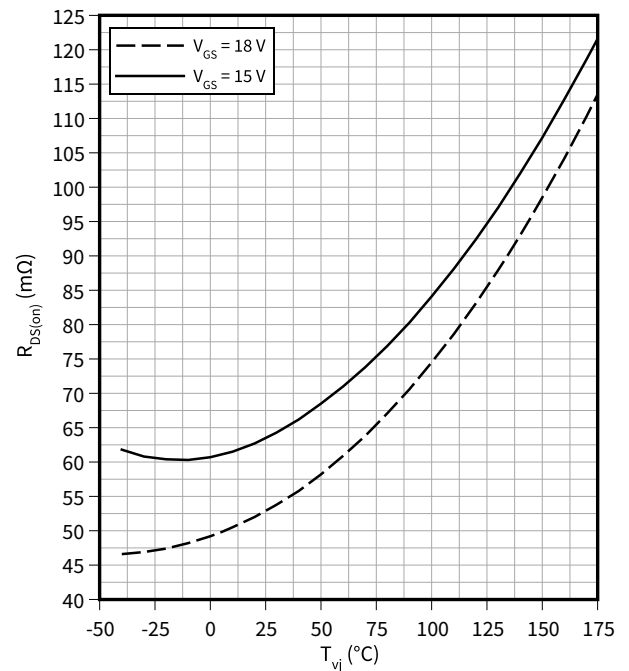
**Drain source on-resistance (typical), MOSFET**

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



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

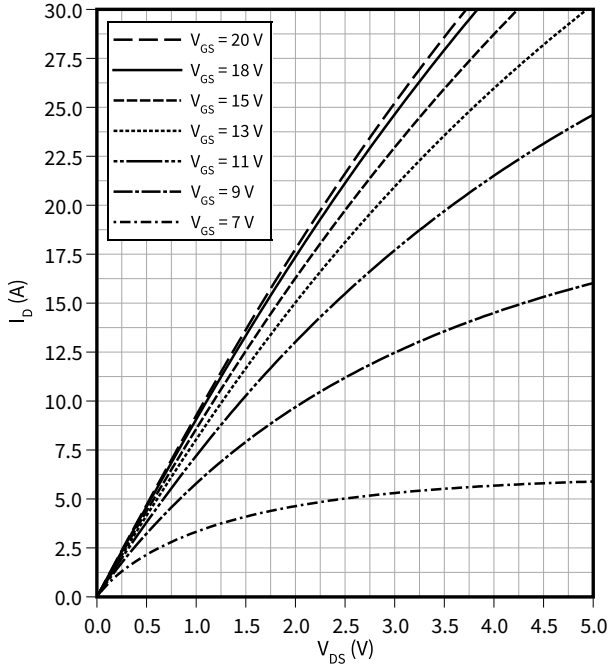
$R_{DS(on)} = f(T_{vj})$   
 $I_D = 15\text{ A}$



5 Characteristics diagrams

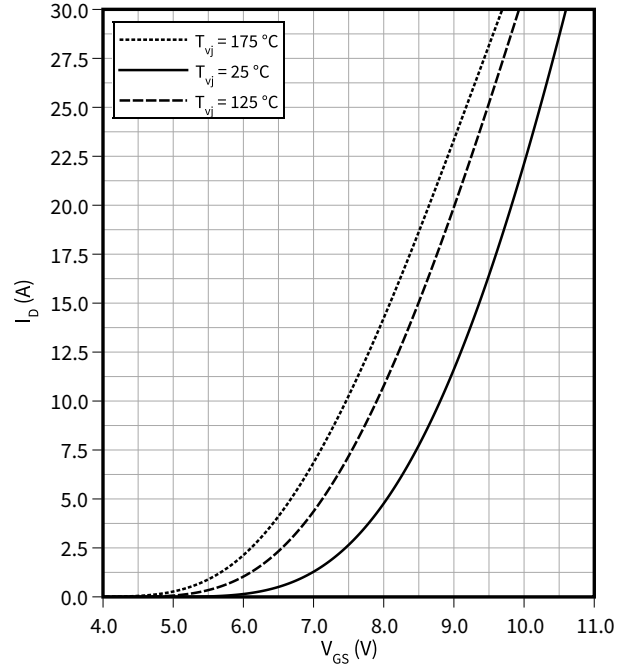
**Output characteristic field (typical), MOSFET**

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



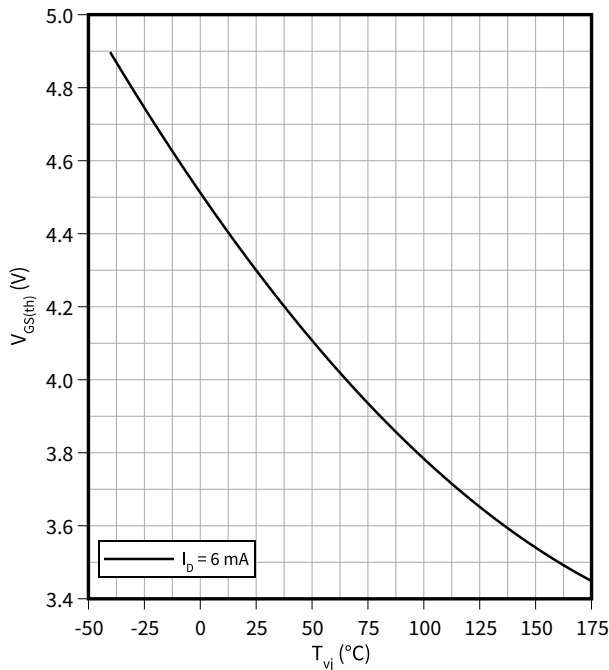
**Transfer characteristic (typical), MOSFET**

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



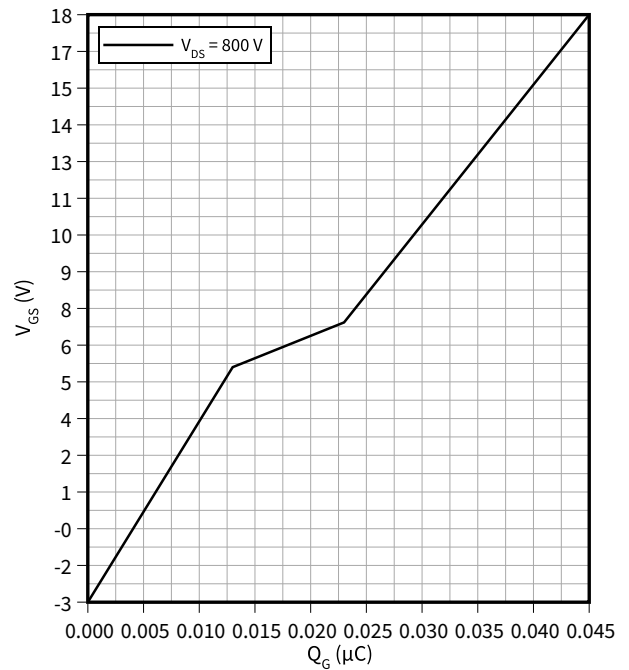
**Gate-source threshold voltage (typical), MOSFET**

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



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

$V_{GS} = f(Q_G)$   
 $I_D = 15\text{ A}, T_{vj} = 25\text{ °C}$

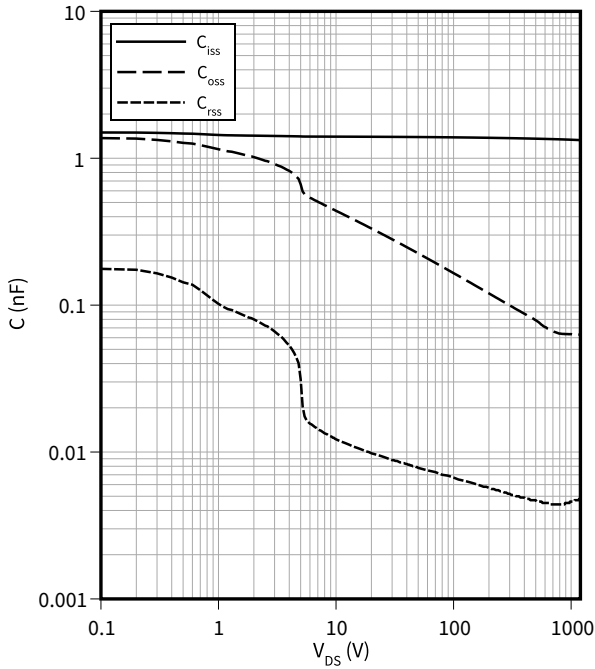




5 Characteristics diagrams

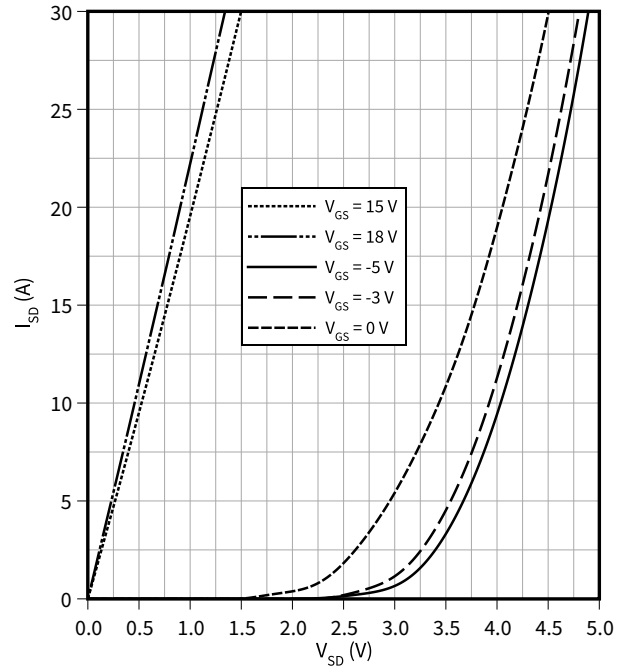
**Capacity characteristic (typical), MOSFET**

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



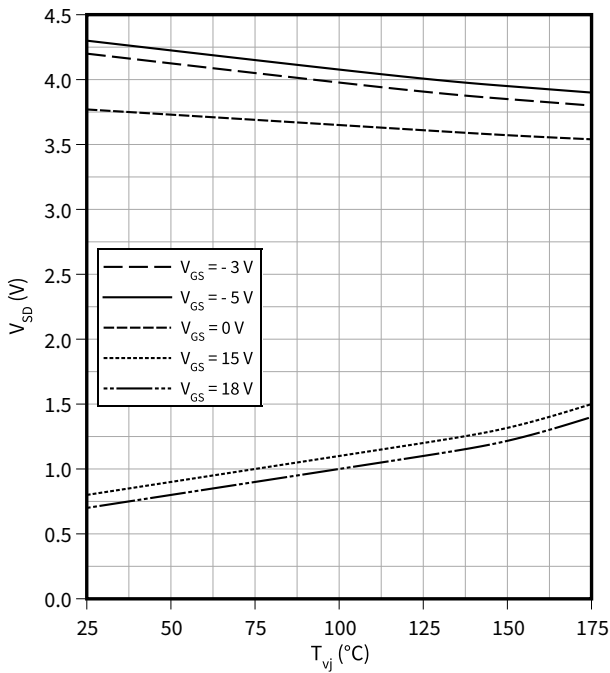
**Forward characteristic body diode (typical), MOSFET**

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



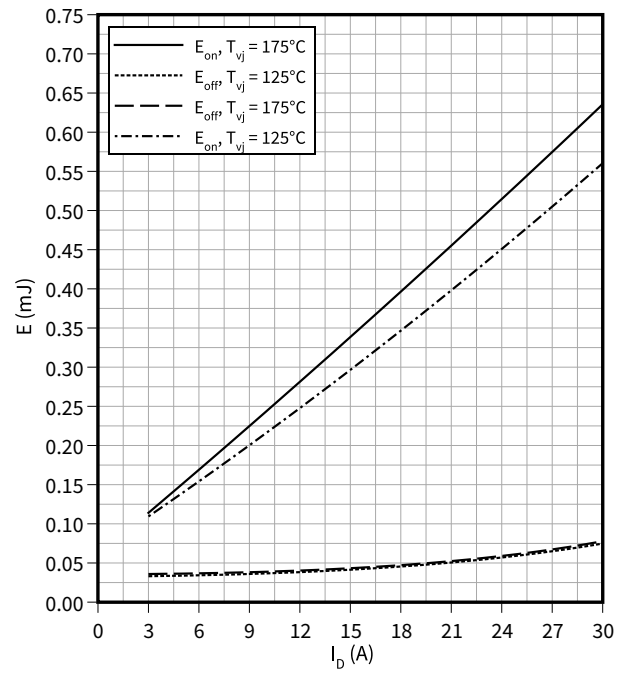
**Forward voltage of body diode (typical), MOSFET**

$V_{SD} = f(T_{vj})$   
 $I_{SD} = 15 \text{ A}$



**Switching losses (typical), MOSFET**

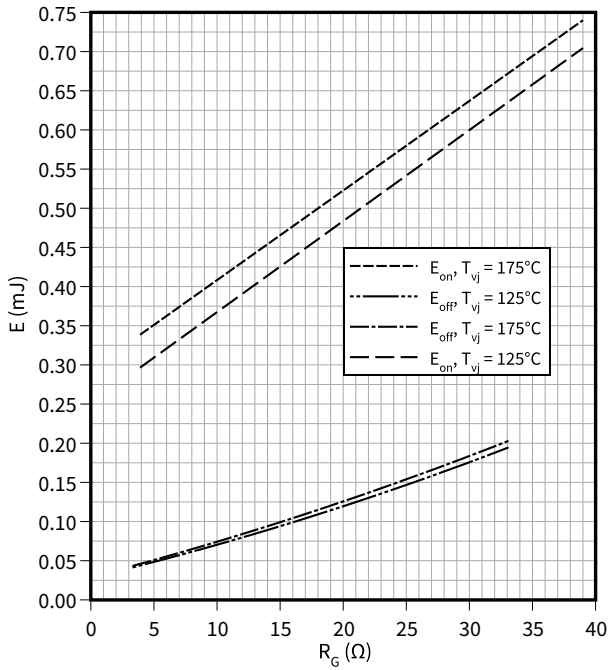
$E = f(I_D)$   
 $R_{Goff} = 3.3 \text{ } \Omega, R_{Gon} = 3.9 \text{ } \Omega, V_{DS} = 600 \text{ V}, V_{GS} = -3/18 \text{ V}$



**Switching losses (typical), MOSFET**

$E = f(R_G)$

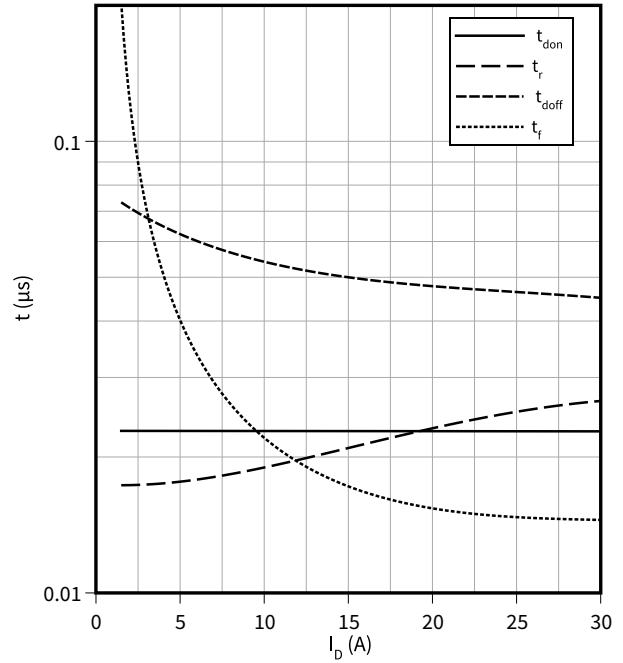
$V_{DS} = 600\text{ V}$ ,  $I_D = 15\text{ A}$ ,  $V_{GS} = -3/18\text{ V}$



**Switching times (typical), MOSFET**

$t = f(I_D)$

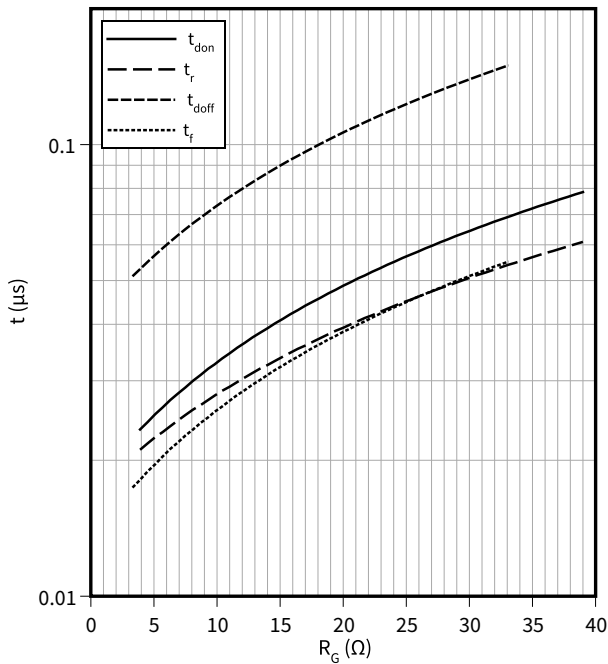
$R_{Goff} = 3.3\ \Omega$ ,  $R_{Gon} = 3.9\ \Omega$ ,  $V_{DS} = 600\text{ V}$ ,  $T_{vj} = 175\text{ °C}$ ,  $V_{GS} = -3/18\text{ V}$



**Switching times (typical), MOSFET**

$t = f(R_G)$

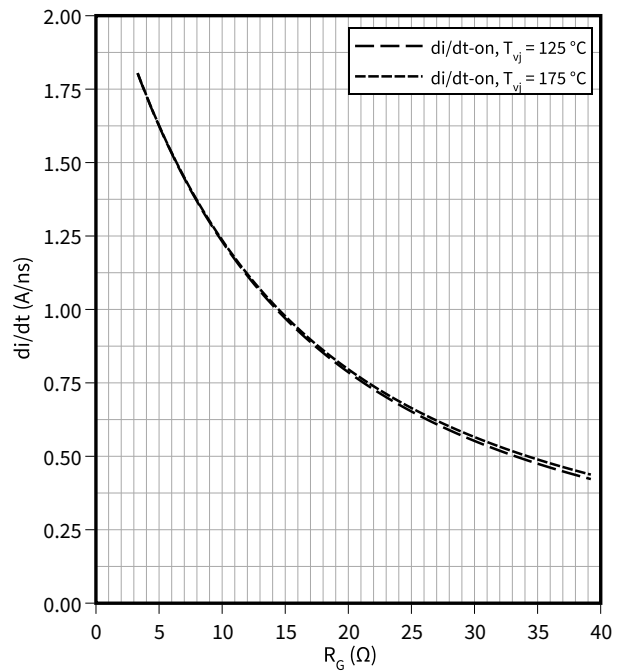
$V_{DS} = 600\text{ V}$ ,  $I_D = 15\text{ A}$ ,  $T_{vj} = 175\text{ °C}$ ,  $V_{GS} = -3/18\text{ V}$



**Current slope (typical), MOSFET**

$di/dt = f(R_G)$

$V_{DS} = 600\text{ V}$ ,  $I_D = 15\text{ A}$ ,  $V_{GS} = -3/18\text{ V}$

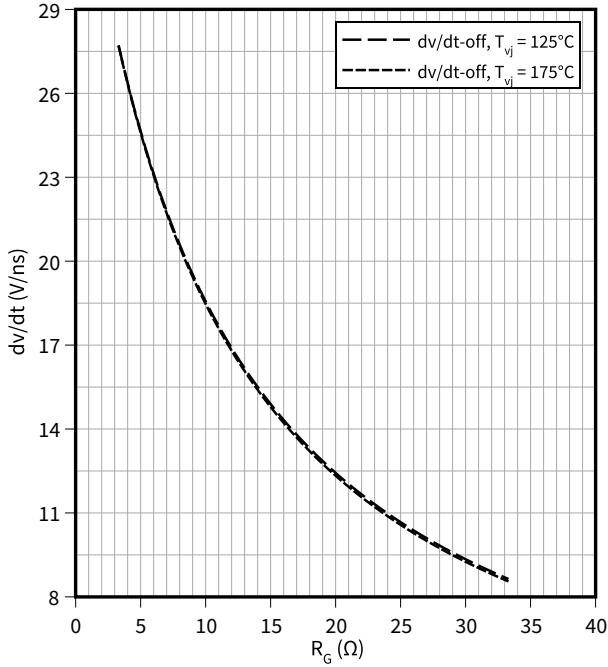


5 Characteristics diagrams

**Voltage slope (typical), MOSFET**

$dv/dt = f(R_G)$

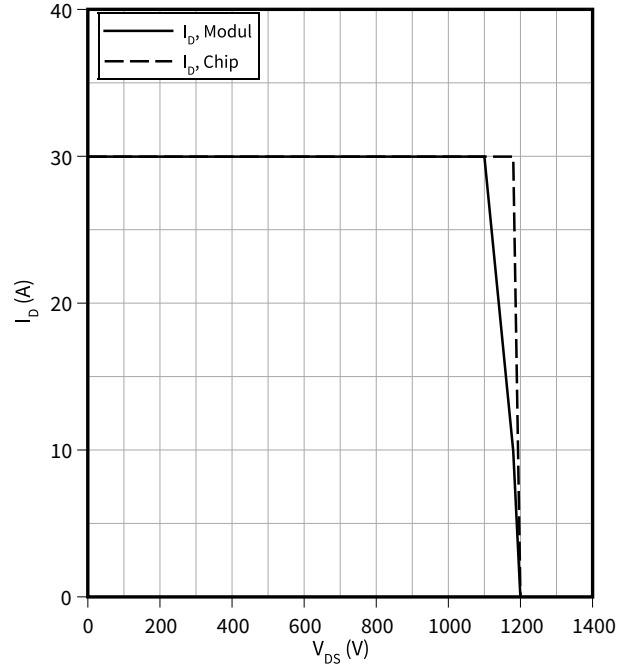
$V_{DS} = 600\text{ V}$ ,  $I_D = 15\text{ A}$ ,  $V_{GS} = -3/18\text{ V}$



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

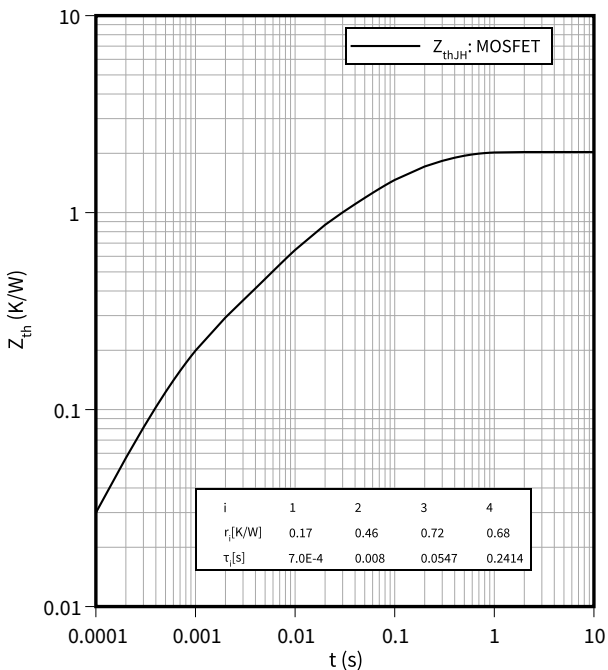
$I_D = f(V_{DS})$

$R_{Goff} = 3.3\ \Omega$ ,  $T_{vj} = 175\text{ °C}$ ,  $V_{GS} = -3/18\text{ V}$



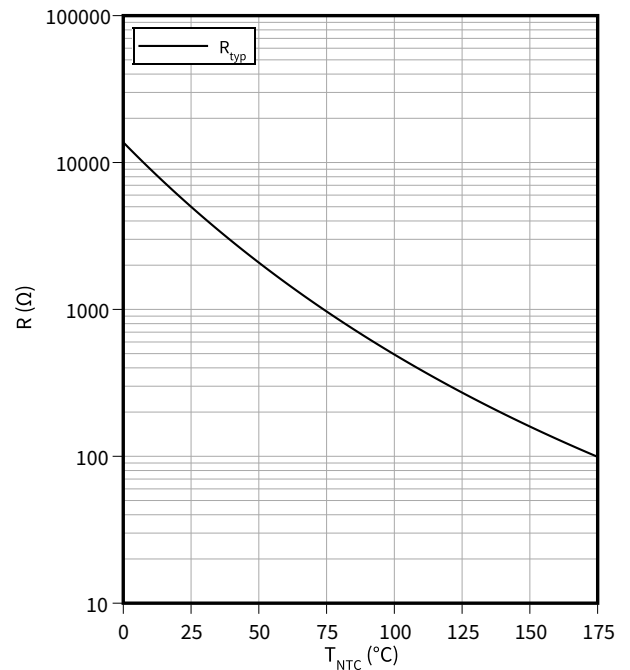
**Transient thermal impedance, MOSFET**

$Z_{th} = f(t)$



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

$R = f(T_{NTC})$



## 6 Circuit diagram

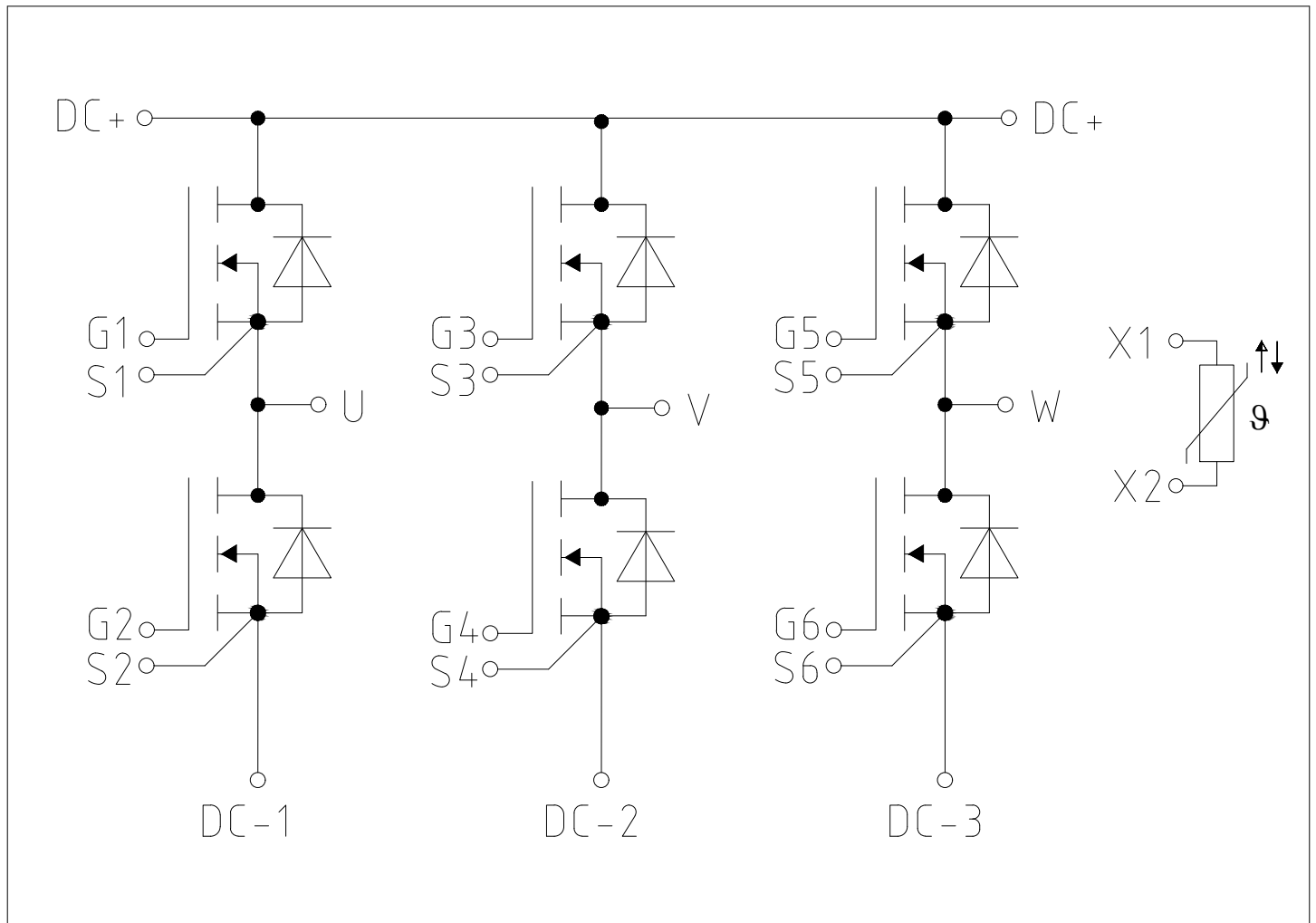


Figure 1

## 7 Package outlines

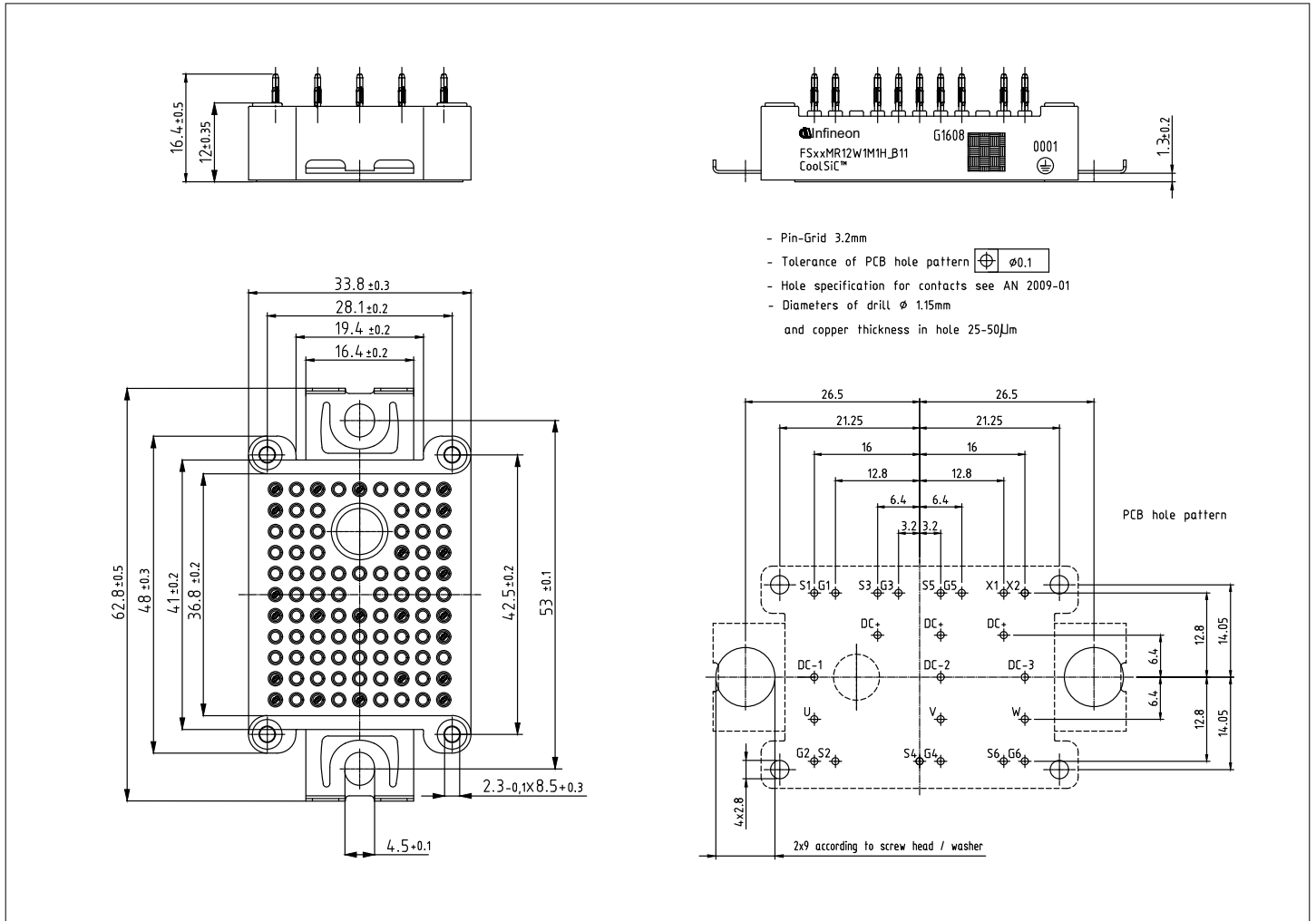


Figure 2

## 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> 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	<div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">               71549142846550549911530         </div> <div style="text-align: center;">               71549142846550549911530         </div> </div>		

**Figure 3**

## Revision history

Document revision	Date of release	Description of changes
0.10	2021-05-10	Target datasheet
1.00	2022-03-03	Final datasheet
1.10	2022-04-13	Add of missing dv/dt and di/dt in table for dynamic parameters

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