FS55MR12W1M1H_B11

EasyPACK™ module

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

Features

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

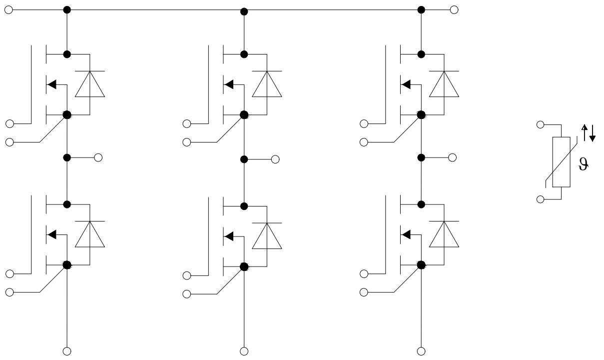
Potential applications

- 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 Hz, t = 1 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°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 °C	1200	V
Implemented drain current	I_{DN}			15	A
Continuous DC drain current	I_{DDC}	T_{vj} = 175 °C, V_{GS} = 18 V	T_H = 95 °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	$R_{DS(on)}$	$I_D = 15$ A	$V_{GS} = 18$ V, $T_{vj} = 25$ °C		52.9	79	mΩ
			$V_{GS} = 18$ V, $T_{vj} = 125$ °C		85.5		
			$V_{GS} = 18$ V, $T_{vj} = 175$ °C		114		
			$V_{GS} = 15$ V, $T_{vj} = 25$ °C		63.5		
Gate threshold voltage	$V_{GS(th)}$	$I_D = 6$ mA, $V_{DS} = V_{GS}$, $T_{vj} = 25$ °C, (tested after 1ms pulse at $V_{GS} = +20$ V)		3.45	4.3	5.15	V
Total gate charge	Q_G	$V_{DS} = 800$ V, $V_{GS} = -3/18$ V			0.045		µC
Internal gate resistor	R_{Gint}	$T_{vj} = 25$ °C			7.5		Ω
Input capacitance	C_{ISS}	$f = 100$ kHz, $V_{DS} = 800$ V, $V_{GS} = 0$ V	$T_{vj} = 25$ °C		1.35		nF
Output capacitance	C_{OSS}	$f = 100$ kHz, $V_{DS} = 800$ V, $V_{GS} = 0$ V	$T_{vj} = 25$ °C		0.064		nF
Reverse transfer capacitance	C_{rss}	$f = 100$ kHz, $V_{DS} = 800$ V, $V_{GS} = 0$ V	$T_{vj} = 25$ °C		0.004		nF
C_{OSS} stored energy	E_{OSS}	$V_{DS} = 800$ V, $V_{GS} = -3/18$ V, $T_{vj} = 25$ °C			26.2		µJ
Drain-source leakage current	I_{DSS}	$V_{DS} = 1200$ V, $V_{GS} = -3$ V	$T_{vj} = 25$ °C		0.01	110	µA
Gate-source leakage current	I_{GSS}	$V_{DS} = 0$ V, $T_{vj} = 25$ °C	$V_{GS} = 20$ V			400	nA
Turn-on delay time (inductive load)	$t_{d\,on}$	$I_D = 15$ A, $R_{Gon} = 3.9$ Ω, $V_{DS} = 600$ V, $V_{GS} = -3/18$ V	$T_{vj} = 25$ °C		23.1		ns
			$T_{vj} = 125$ °C		23.1		
			$T_{vj} = 175$ °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 A, R_{Gon} = 3.9 Ω, V_{DS} = 600 V, V_{GS} = -3/18 V	T_{vj} = 25 °C		19.7		ns
			T_{vj} = 125 °C		20.5		
			T_{vj} = 175 °C		21.1		
Turn-off delay time (inductive load)	$t_{d\ off}$	I_D = 15 A, R_{Goff} = 3.3 Ω, V_{DS} = 600 V, V_{GS} = -3/18 V	T_{vj} = 25 °C		43.7		ns
			T_{vj} = 125 °C		48.4		
			T_{vj} = 175 °C		51.1		
Fall time (inductive load)	t_f	I_D = 15 A, R_{Goff} = 3.3 Ω, V_{DS} = 600 V, V_{GS} = -3/18 V	T_{vj} = 25 °C		17.3		ns
			T_{vj} = 125 °C		17.3		
			T_{vj} = 175 °C		17.3		
Turn-on energy loss per pulse	E_{on}	I_D = 15 A, V_{DS} = 600 V, L_σ = 6 nH, V_{GS} = -3/18 V, R_{Gon} = 3.9 Ω, di/dt = 1.8 kA/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		0.235		mJ
			T_{vj} = 125 °C		0.297		
			T_{vj} = 175 °C		0.334		
Turn-off energy loss per pulse	E_{off}	I_D = 15 A, V_{DS} = 600 V, L_σ = 6 nH, V_{GS} = -3/18 V, R_{Goff} = 3.3 Ω, dv/dt = 27.7 kV/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		0.037		mJ
			T_{vj} = 125 °C		0.041		
			T_{vj} = 175 °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°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 °C, V_{GS} = -3 V	T_H = 105 °C	7	A

Table 7 **Characteristic values**

Parameter	**Symbol**	**Note or test condition**		**Values**			**Unit**
				Min.	**Typ.**	**Max.**	
Forward voltage	V_{SD}	$I_{SD} = 15$ A, $V_{GS} = -3$ V	$T_{vj} = 25$ °C		4.2	5.35	V
			$T_{vj} = 125$ °C		3.9		
			$T_{vj} = 175$ °C		3.8		

4 NTC-Thermistor

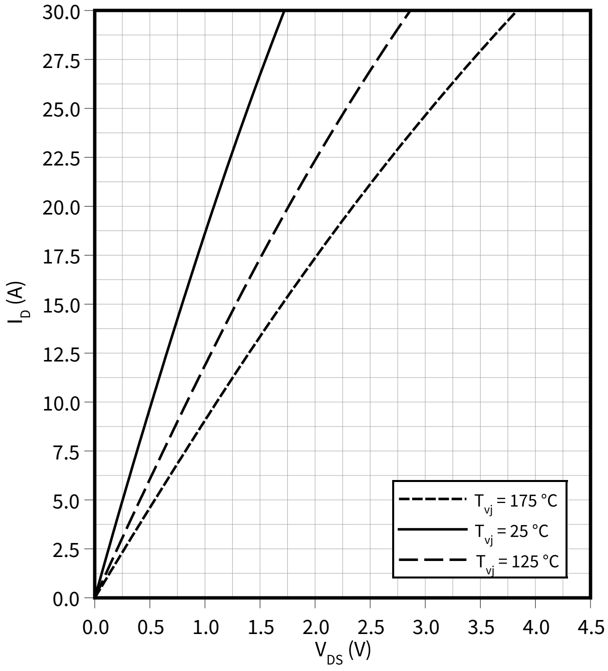
Table 8 **Characteristic values**

Parameter	**Symbol**	**Note or test condition**	**Values**			**Unit**
			Min.	**Typ.**	**Max.**	
Rated resistance	R_{25}	$T_{NTC} = 25$ °C		5		kΩ
Deviation of R_{100}	$\Delta R/R$	$T_{NTC} = 100$ °C, $R_{100} = 493\ \Omega$	-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

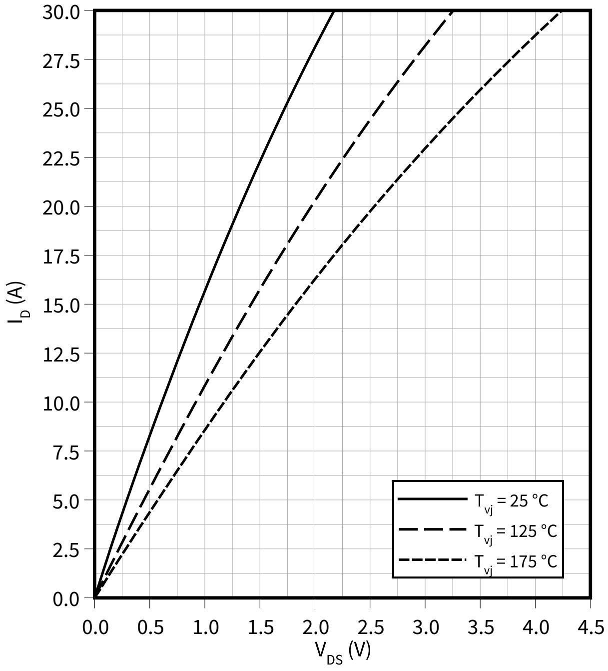
Note: *Specification according to the valid application note.*

5 Characteristics diagrams

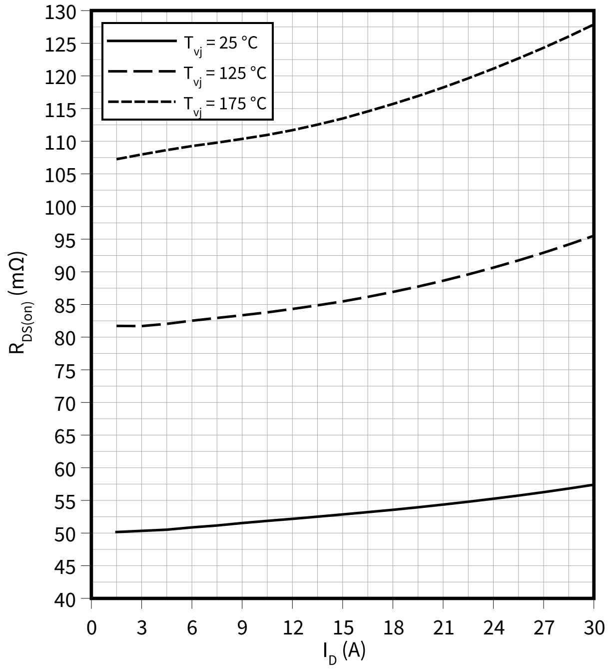
Output characteristic (typical), MOSFET
$I_D = f(V_{DS})$
$V_{GS} = 18$ V



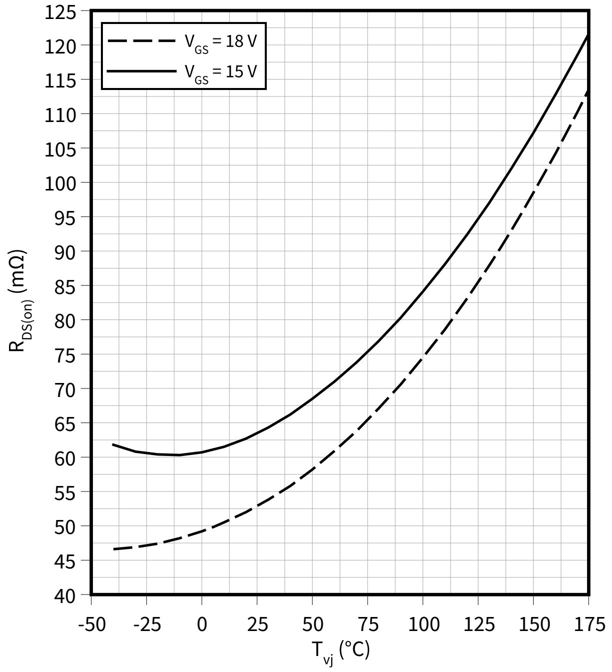
Output characteristic (typical), MOSFET
$I_D = f(V_{DS})$
$V_{GS} = 15$ V



Drain source on-resistance (typical), MOSFET
$R_{DS(on)} = f(I_D)$
$V_{GS} = 18$ V

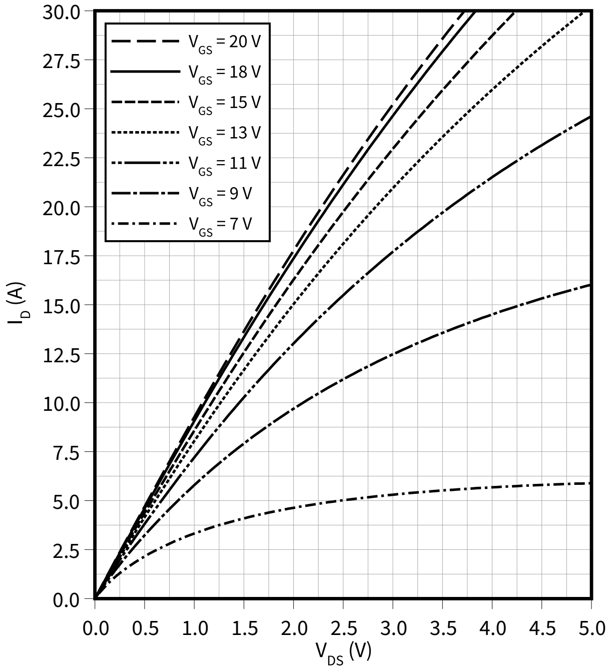


Drain source on-resistance (typical), MOSFET
$R_{DS(on)} = f(T_{vj})$
$I_D = 15$ A



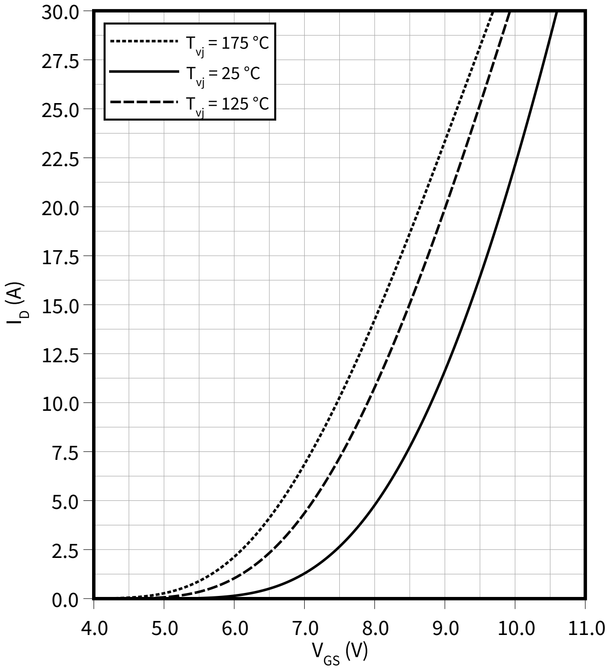
Output characteristic field (typical), MOSFET

$I_D = f(V_{DS})$
$T_{vj} = 175\ °C$



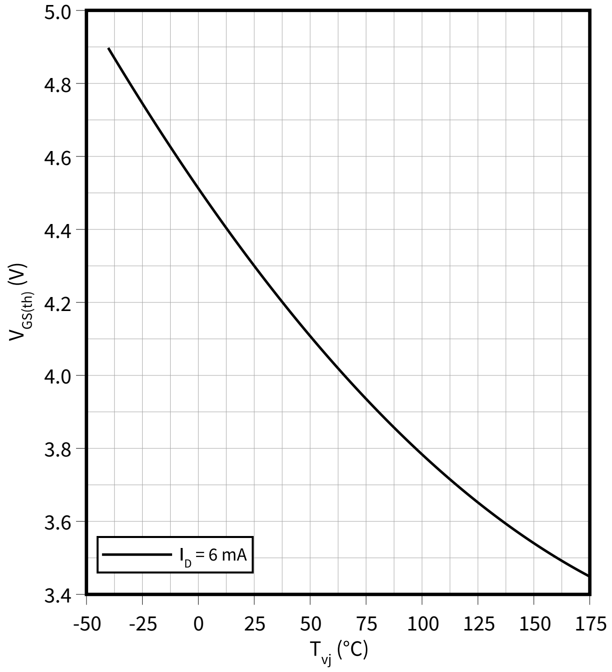
Transfer characteristic (typical), MOSFET

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



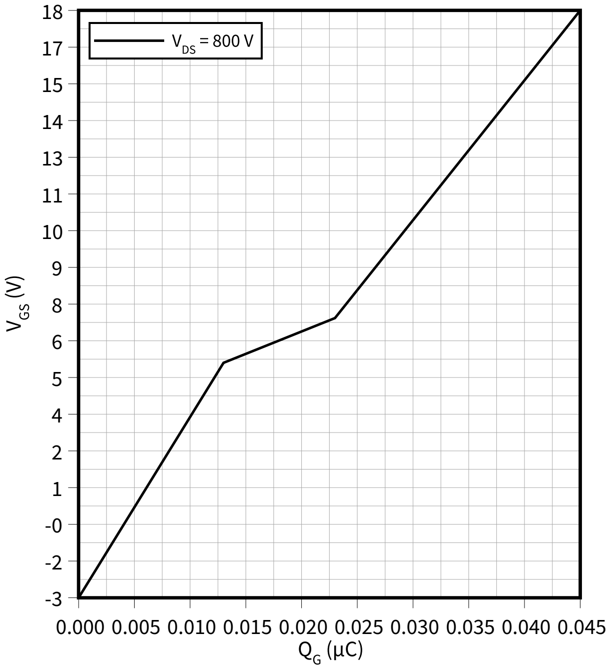
Gate-source threshold voltage (typical), MOSFET

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



Gate charge characteristic (typical), MOSFET

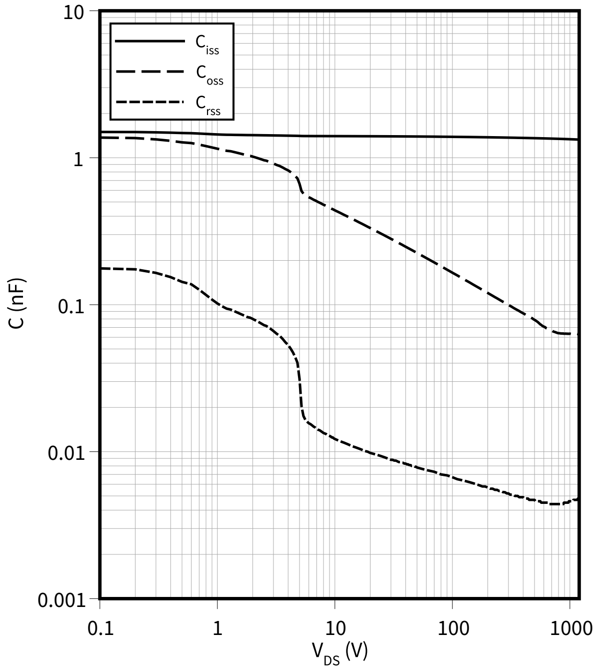
$V_{GS} = f(Q_G)$
$I_D = 15\ A,\ T_{vj} = 25\ °C$



Capacity characteristic (typical), MOSFET

$C = f(V_{DS})$

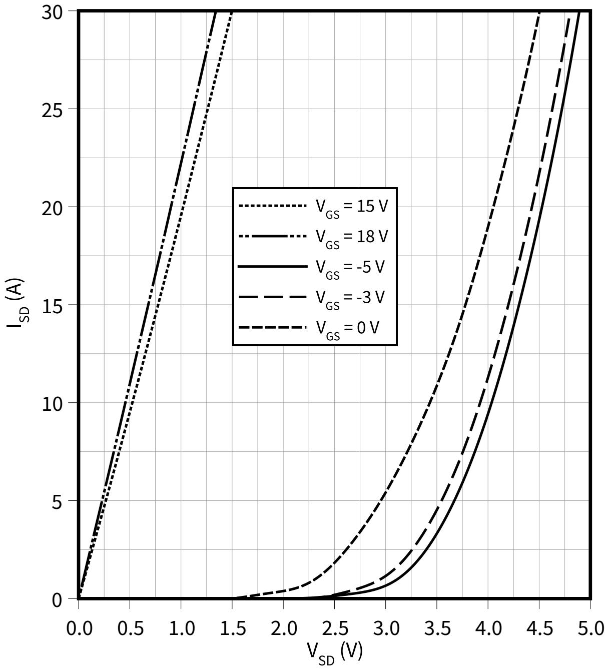
$f = 100\ \text{kHz}, T_{vj} = 25\ °C, V_{GS} = 0\ V$



Forward characteristic body diode (typical), MOSFET

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

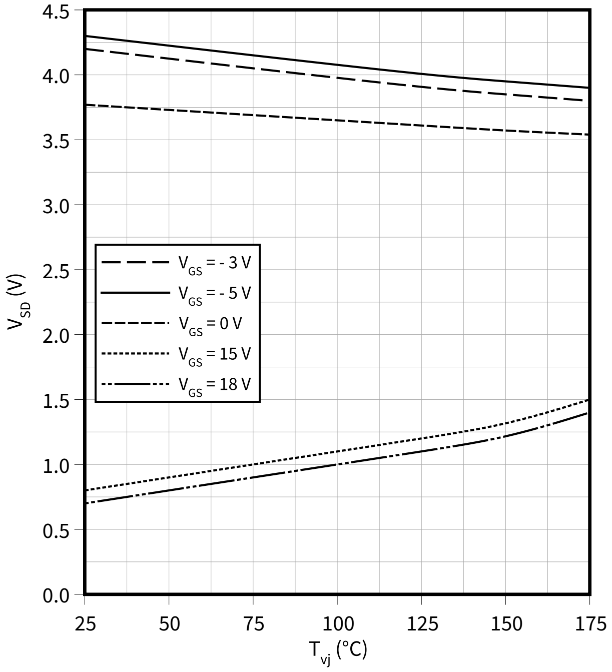
$T_{vj} = 25\ °C$



Forward voltage of body diode (typical), MOSFET

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

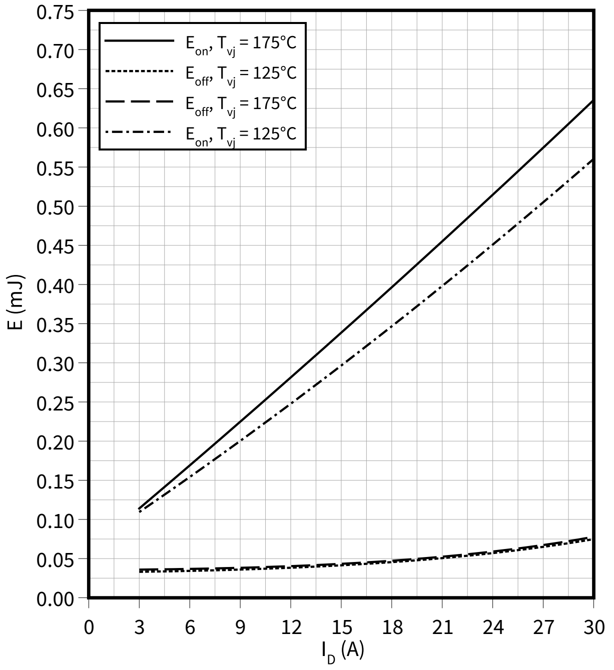
$I_{SD} = 15\ A$



Switching losses (typical), MOSFET

$E = f(I_D)$

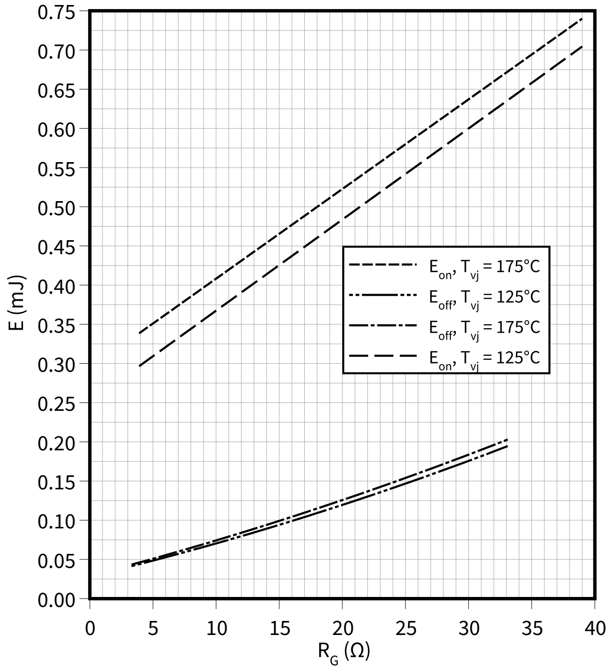
$R_{Goff} = 3.3\ \Omega, R_{Gon} = 3.9\ \Omega, V_{DS} = 600\ V, V_{GS} = -3/18\ V$



Switching losses (typical), MOSFET

$E = f(R_G)$

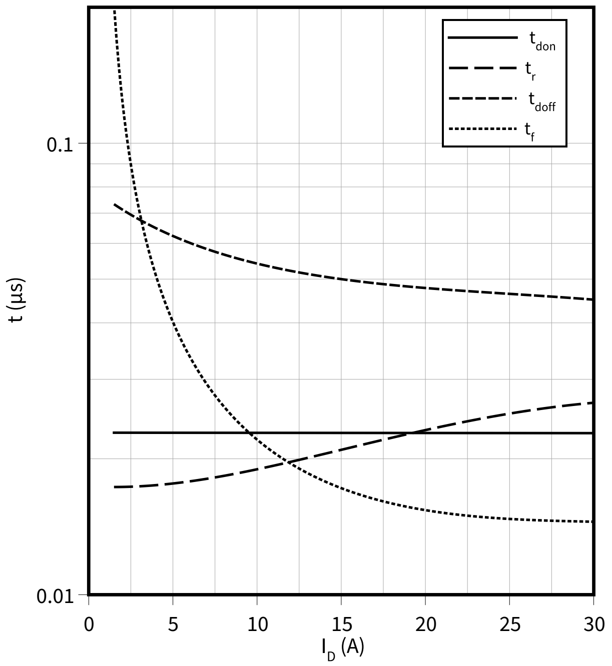
V_{DS} = 600 V, I_D = 15 A, V_{GS} = -3/18 V



Switching times (typical), MOSFET

$t = f(I_D)$

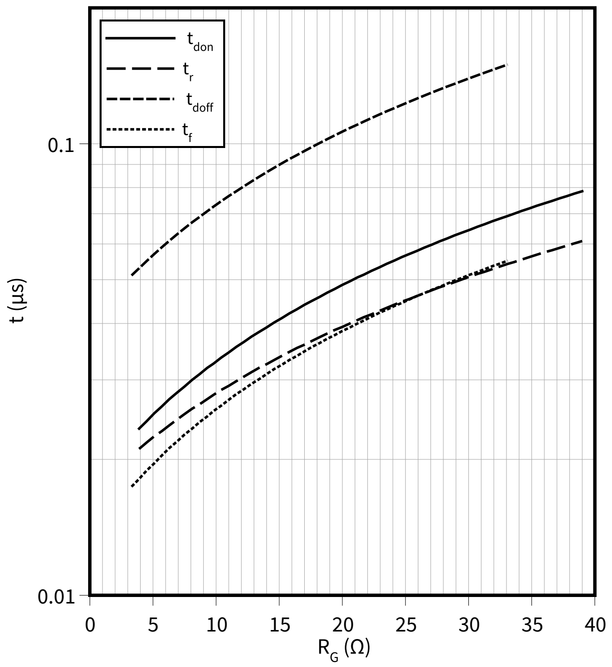
R_{Goff} = 3.3 Ω, R_{Gon} = 3.9 Ω, V_{DS} = 600 V, T_{vj} = 175 °C, V_{GS} = -3/18 V



Switching times (typical), MOSFET

$t = f(R_G)$

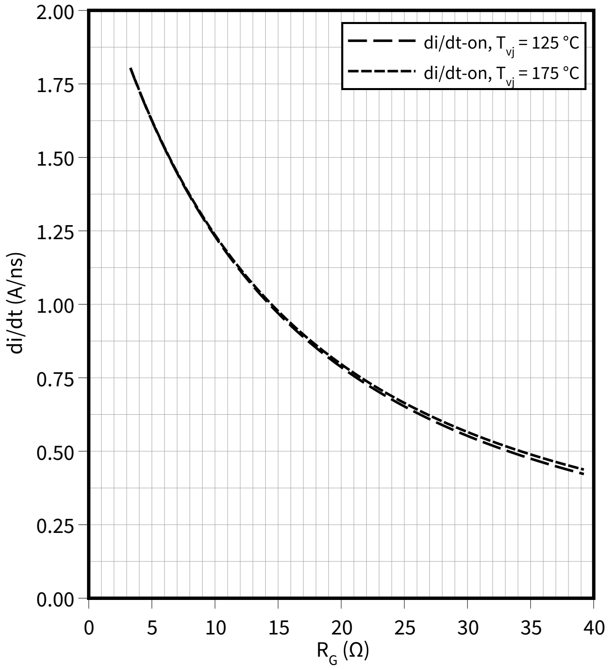
V_{DS} = 600 V, I_D = 15 A, T_{vj} = 175 °C, V_{GS} = -3/18 V



Current slope (typical), MOSFET

$di/dt = f(R_G)$

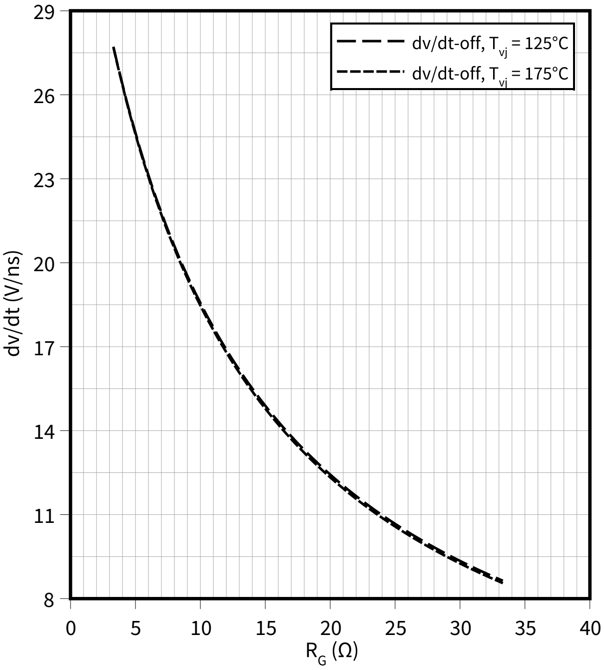
V_{DS} = 600 V, I_D = 15 A, V_{GS} = -3/18 V



Voltage slope (typical), MOSFET

$dv/dt = f(R_G)$

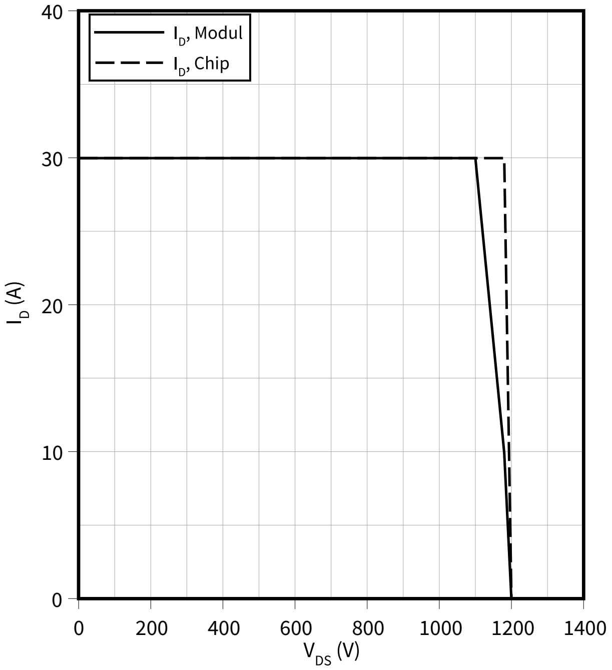
$V_{DS} = 600$ V, $I_D = 15$ A, $V_{GS} = -3/18$ V



Reverse bias safe operating area (RBSOA), MOSFET

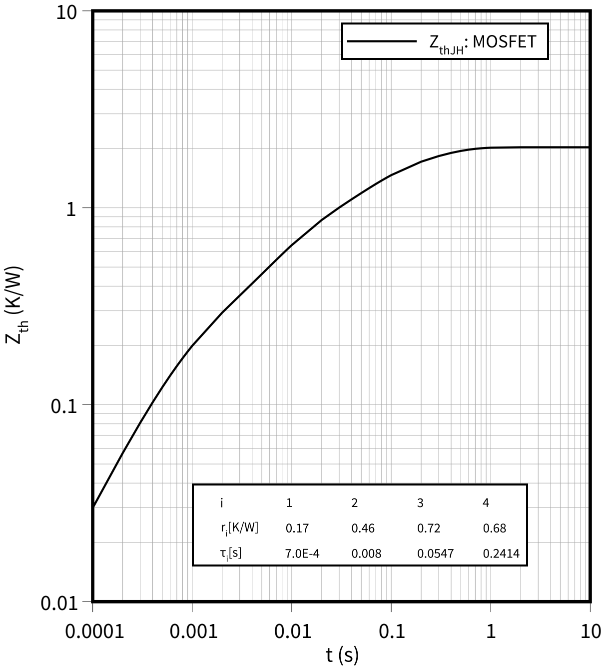
$I_D = f(V_{DS})$

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



Transient thermal impedance , MOSFET

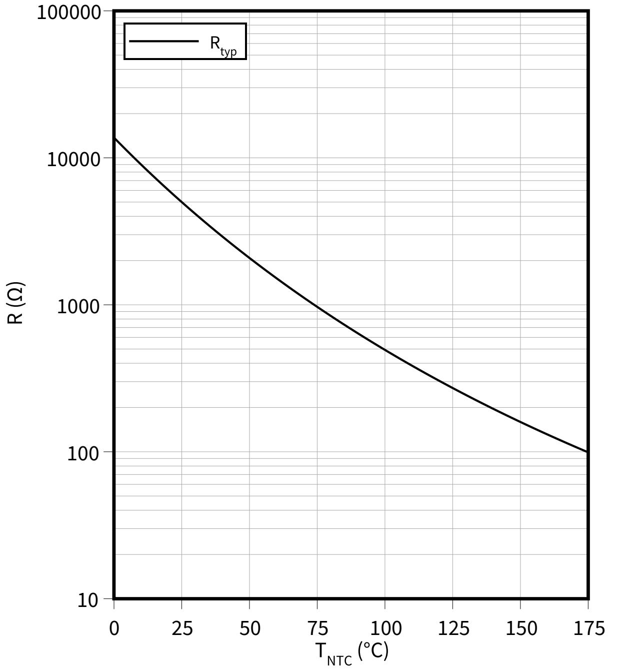
$Z_{th} = f(t)$



i	1	2	3	4
r_i[K/W]	0.17	0.46	0.72	0.68
$τ_i$[s]	7.0E-4	0.008	0.0547	0.2414

Temperature characteristic (typical), NTC-Thermistor

$R = f(T_{NTC})$



6 Circuit diagram

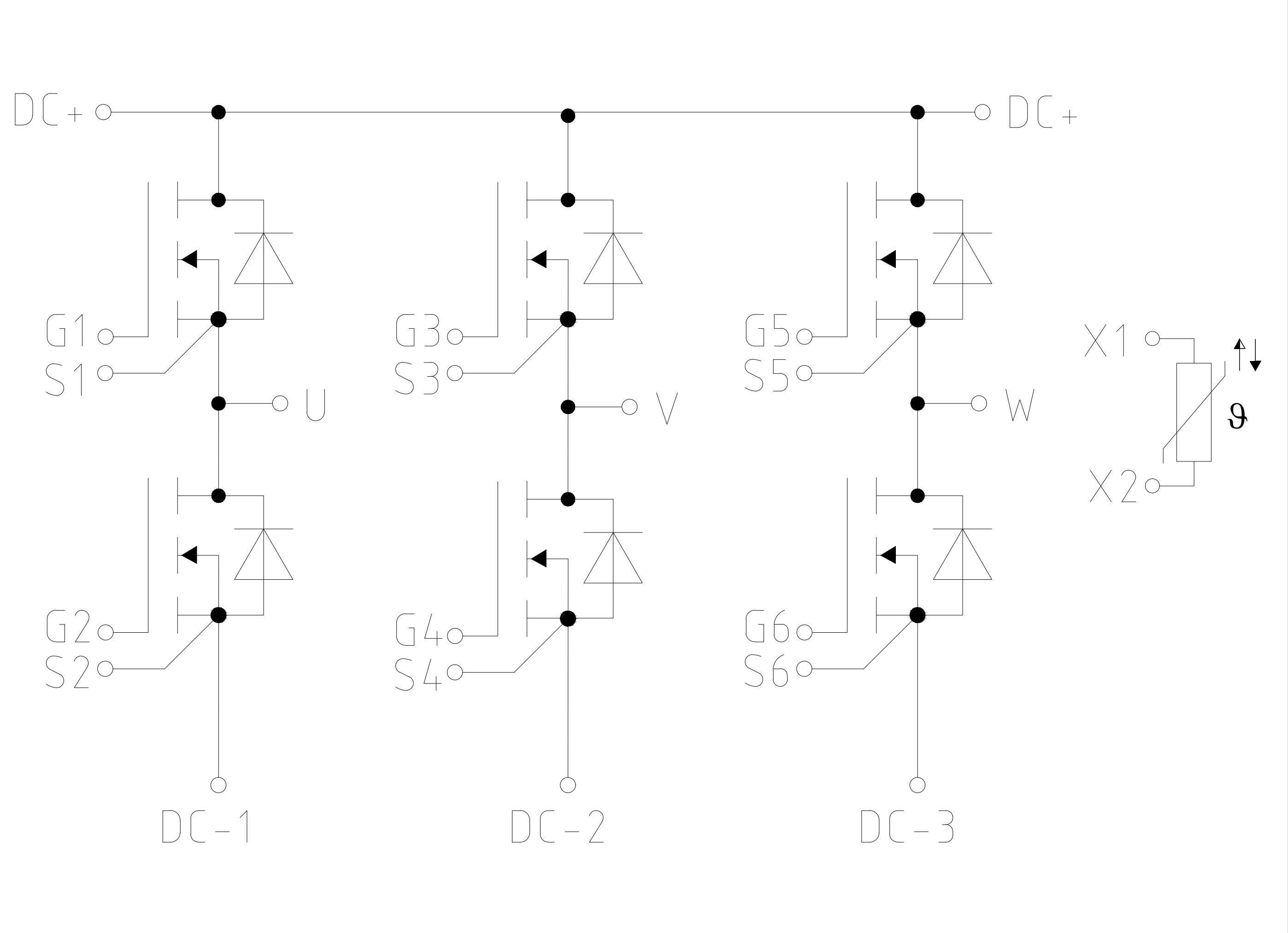
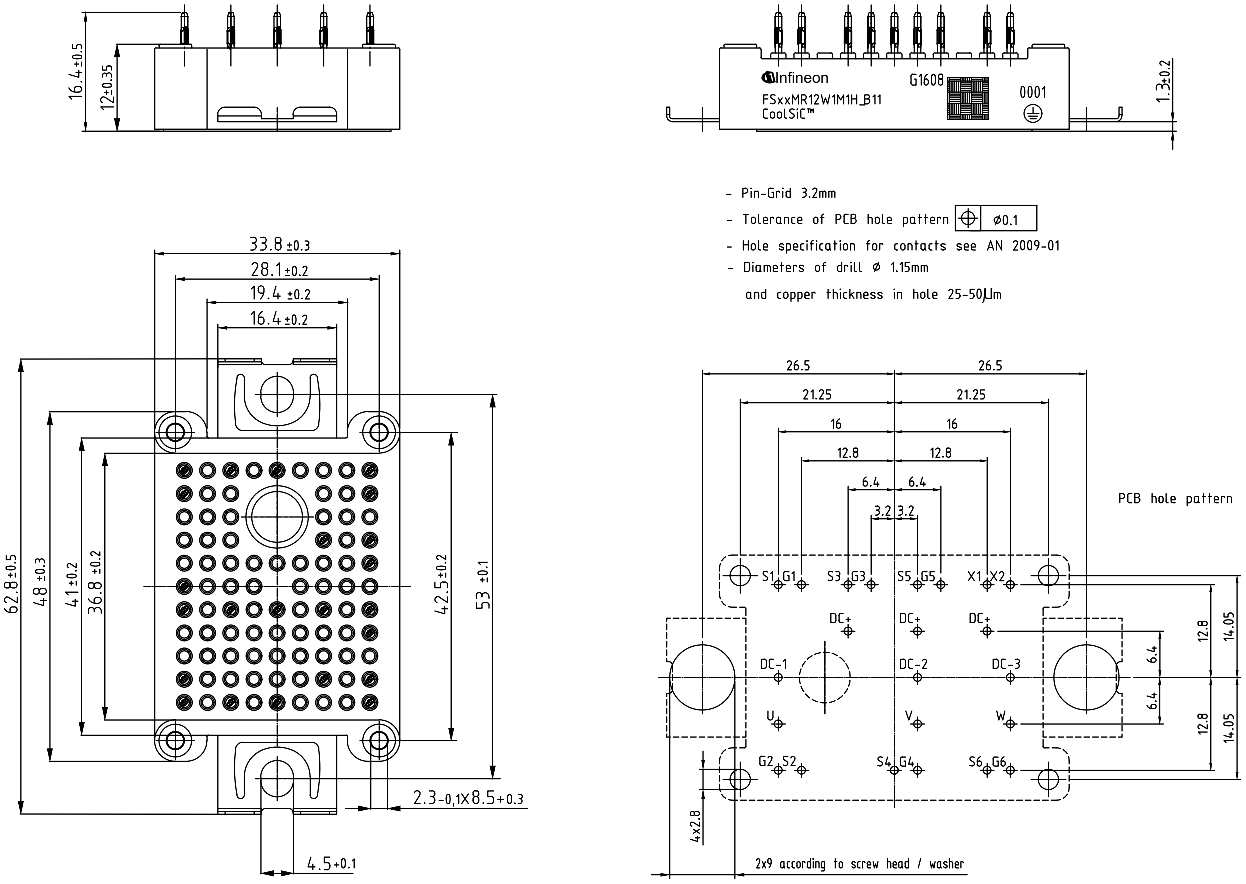


Figure 1

7 Package outlines



- Pin-Grid 3.2mm
- Tolerance of PCB hole pattern ⌖ ⌀0.1
- Hole specification for contacts see AN 2009-01
- Diameters of drill ⌀ 1.15mm

and copper thickness in hole 25-50µm

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	71549142846550549911530	71549142846550549911530	

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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