

Preliminary datasheet

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

Features

- Electrical features
 - $V_{DS} = 1200\text{ V}$
 - $I_{DN} = 50\text{ A}$ / $I_{DRM} = 100\text{ A}$
 - Low inductive design
 - High current density
- Mechanical features
 - Integrated NTC temperature sensor
 - PressFIT contact technology
 - Rugged mounting due to integrated mounting clamps



Typical appearance

Potential applications

- Solar applications

Product validation

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

Description

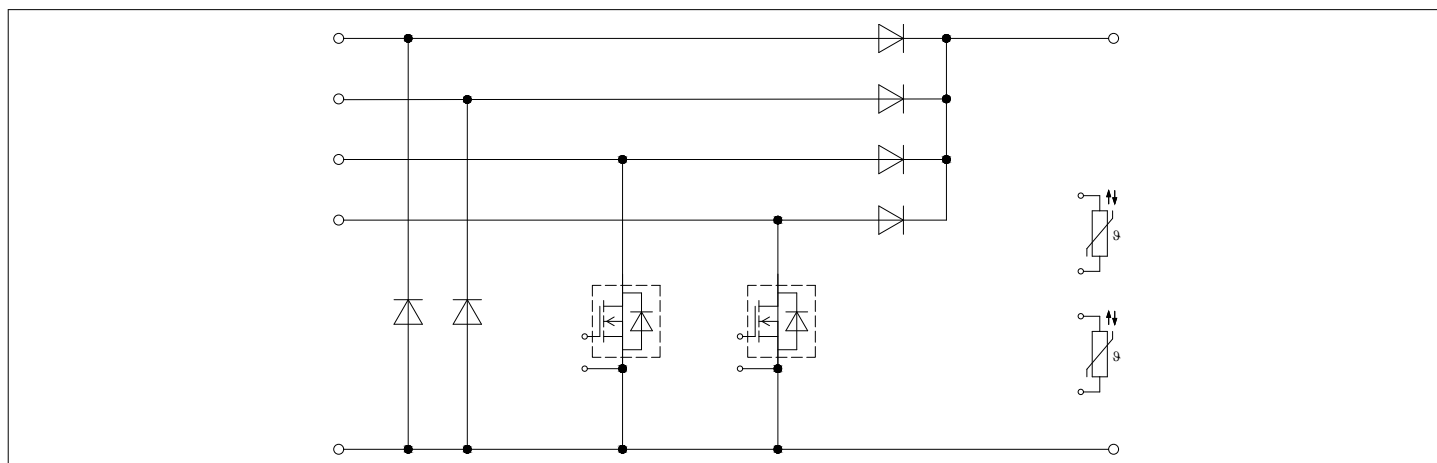


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1 Package

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}			10		nH
Module lead resistance, terminals - chip	$R_{AA'+CC'}$	$T_H = 25 \text{ °C}$, per switch		3		mΩ
Module lead resistance, terminals - chip	$R_{CC'+EE'}$	$T_H = 25 \text{ °C}$, per switch		2		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}		$T_{vj} = 25 \text{ °C}$	1200	V
Implemented drain current	I_{DN}			50	A
Continuous DC drain current	I_{DDC}	$T_{vj} = 175 \text{ °C}$, $V_{GS} = 18 \text{ V}$	$T_H = 65 \text{ °C}$	45	A
Repetitive peak drain current	I_{DRM}	verified by design, t_p limited by T_{vjmax}		100	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	$R_{DS(on)}$	$I_D = 50\text{ A}$		$V_{GS} = 18\text{ V}, T_{vj} = 25\text{ °C}$	16.2	mΩ
				$V_{GS} = 18\text{ V}, T_{vj} = 125\text{ °C}$	26.1	
				$V_{GS} = 18\text{ V}, T_{vj} = 175\text{ °C}$	34.7	
				$V_{GS} = 15\text{ V}, T_{vj} = 25\text{ °C}$	19.4	
Gate threshold voltage	$V_{GS(th)}$	$I_D = 20\text{ mA}, V_{DS} = V_{GS}, T_{vj} = 25\text{ °C},$ (tested after 1ms pulse at $V_{GS} = +20\text{ V}$)	3.45	4.3	5.15	V
Total gate charge	Q_G	$V_{DD} = 800\text{ V}, V_{GS} = -3/18\text{ V}$		0.149		μC
Internal gate resistor	R_{Gint}	$T_{vj} = 25\text{ °C}$		4.1		Ω
Input capacitance	C_{ISS}	$f = 100\text{ kHz}, V_{DS} = 800\text{ V}, V_{GS} = 0\text{ V}, T_{vj} = 25\text{ °C}$		4.4		nF
Output capacitance	C_{OSS}	$f = 100\text{ kHz}, V_{DS} = 800\text{ V}, V_{GS} = 0\text{ V}, T_{vj} = 25\text{ °C}$		0.21		nF
Reverse transfer capacitance	C_{RSS}	$f = 100\text{ kHz}, V_{DS} = 800\text{ V}, V_{GS} = 0\text{ V}, T_{vj} = 25\text{ °C}$		0.014		nF
C_{OSS} stored energy	E_{OSS}	$V_{DS} = 800\text{ V}, V_{GS} = -3/18\text{ V}, T_{vj} = 25\text{ °C}$		86		μJ
Drain-source leakage current	I_{DSS}	$V_{DS} = 1200\text{ V}, V_{GS} = -3\text{ V}, T_{vj} = 25\text{ °C}$		0.03	210	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)	$t_{d on}$	$I_D = 50\text{ A}, R_{Gon} = 3.3\text{ Ω}, V_{DD} = 600\text{ V}, V_{GS} = -3/18\text{ V}$	$T_{vj} = 25\text{ °C}$	32		ns
			$T_{vj} = 125\text{ °C}$	32		
			$T_{vj} = 175\text{ °C}$	32		
Rise time (inductive load)	t_r	$I_D = 50\text{ A}, R_{Gon} = 3.3\text{ Ω}, V_{DD} = 600\text{ V}, V_{GS} = -3/18\text{ V}$	$T_{vj} = 25\text{ °C}$	23.9		ns
			$T_{vj} = 125\text{ °C}$	23.9		
			$T_{vj} = 175\text{ °C}$	23.9		

(table continues...)

Table 5 (continued) Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Turn-off delay time (inductive load)	$t_{d\ off}$	$I_D = 50\ A, R_{Goff} = 2\ \Omega,$ $V_{DD} = 600\ V, V_{GS} = -3/18\ V$	$T_{vj} = 25\ ^\circ C$	60.7		ns
			$T_{vj} = 125\ ^\circ C$	60.7		
			$T_{vj} = 175\ ^\circ C$	60.7		
Fall time (inductive load)	t_f	$I_D = 50\ A, R_{Goff} = 2\ \Omega,$ $V_{DD} = 600\ V, V_{GS} = -3/18\ V$	$T_{vj} = 25\ ^\circ C$	10.5		ns
			$T_{vj} = 125\ ^\circ C$	10.5		
			$T_{vj} = 175\ ^\circ C$	10.5		
Turn-on energy loss per pulse	E_{on}	$I_D = 50\ A, V_{DD} = 600\ V,$ $L_\sigma = 35\ nH, V_{GS} = -3/18\ V,$ $R_{Gon} = 3.3\ \Omega, di/dt = 4.29\ kA/\mu s$ ($T_{vj} = 175\ ^\circ C$)	$T_{vj} = 25\ ^\circ C$	0.516		mJ
			$T_{vj} = 125\ ^\circ C$	0.516		
			$T_{vj} = 175\ ^\circ C$	0.516		
Turn-off energy loss per pulse	E_{off}	$I_D = 50\ A, V_{DD} = 600\ V,$ $L_\sigma = 35\ nH, V_{GS} = -3/18\ V,$ $R_{Goff} = 2\ \Omega, dv/dt = 45.7\ kV/\mu s$ ($T_{vj} = 175\ ^\circ C$)	$T_{vj} = 25\ ^\circ C$	0.133		mJ
			$T_{vj} = 125\ ^\circ C$	0.133		
			$T_{vj} = 175\ ^\circ C$	0.133		
Thermal resistance, junction to heat sink	R_{thJH}	per MOSFET		1.1		K/W
Temperature under switching conditions	$T_{vj\ op}$		-40		175	$^\circ C$

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.

$T_{vj,op} > 150^\circ C$ 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}	$T_{vj} = 175\ ^\circ C, V_{GS} = -3\ V$ $T_H = 65\ ^\circ C$	24	A

Table 7 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Forward voltage	V_{SD}	$I_{SD} = 50\ A, V_{GS} = -3\ V$	$T_{vj} = 25\ ^\circ C$	4.2	5.35	V
			$T_{vj} = 125\ ^\circ C$	3.9		
			$T_{vj} = 175\ ^\circ C$	3.8		

4 Diode, Boost

Table 8 Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
Repetitive peak reverse voltage	V_{RRM}		$T_{vj} = 25\text{ °C}$	1200	V
Continuous DC forward current	I_F			40	A
Repetitive peak forward current	I_{FRM}	$t_P = 1\text{ ms}$		80	A
I^2t - value	I^2t	$t_P = 10\text{ ms}, V_R = 0\text{ V}$	$T_{vj} = 125\text{ °C}$	320	A^2s
			$T_{vj} = 150\text{ °C}$	295	

Table 9 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Forward voltage	V_F	$I_F = 40\text{ A}, V_{GE} = 0\text{ V}$	$T_{vj} = 25\text{ °C}$	1.40	1.85	V
			$T_{vj} = 125\text{ °C}$	1.70		
			$T_{vj} = 150\text{ °C}$	1.85		
Peak reverse recovery current	I_{RM}	$V_{CC} = 600\text{ V}, I_F = 40\text{ A}, -di_F/dt = 3900\text{ A}/\mu s$ ($T_{vj} = 150\text{ °C}$)	$T_{vj} = 25\text{ °C}$	43		A
			$T_{vj} = 125\text{ °C}$	43		
			$T_{vj} = 150\text{ °C}$	43		
Recovered charge	Q_r	$V_{CC} = 600\text{ V}, I_F = 40\text{ A}, -di_F/dt = 3900\text{ A}/\mu s$ ($T_{vj} = 150\text{ °C}$)	$T_{vj} = 25\text{ °C}$	4.03		μC
			$T_{vj} = 125\text{ °C}$	4.03		
			$T_{vj} = 150\text{ °C}$	4.03		
Reverse recovery energy	E_{rec}	$V_{CC} = 600\text{ V}, I_F = 40\text{ A}, -di_F/dt = 3900\text{ A}/\mu s$ ($T_{vj} = 150\text{ °C}$)	$T_{vj} = 25\text{ °C}$	0.063		mJ
			$T_{vj} = 125\text{ °C}$	0.063		
			$T_{vj} = 150\text{ °C}$	0.063		
Thermal resistance, junction to heat sink	R_{thJH}	per diode		1.11		K/W
Temperature under switching conditions	$T_{vj\text{ op}}$			-40	150	°C

5 Bypass-diode

Table 10 Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
Repetitive peak reverse voltage	V_{RRM}		$T_{vj} = 25\text{ °C}$	1200	V

(table continues...)

Table 10 (continued) Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
Maximum RMS forward current per chip	I_{FRMSM}	$T_H = 80\text{ °C}$		50	A
Maximum RMS current at rectifier output	I_{RMSM}	$T_H = 80\text{ °C}$		50	A
Surge forward current	I_{FSM}	$t_P = 10\text{ ms}$	$T_{vj} = 25\text{ °C}$	450	A
			$T_{vj} = 150\text{ °C}$	360	
I^2t - value	I^2t	$t_P = 10\text{ ms}$	$T_{vj} = 25\text{ °C}$	1010	A ² s
			$T_{vj} = 150\text{ °C}$	648	

Table 11 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Forward voltage	V_F	$I_F = 30\text{ A}$	$T_{vj} = 150\text{ °C}$		0.95		V
Reverse current	I_r	$T_{vj} = 150\text{ °C}, V_R = 1200\text{ V}$			0.1		mA
Thermal resistance, junction to heat sink	R_{thJH}	per diode			1.29		K/W
Temperature under switching conditions	$T_{vj, op}$			-40		150	°C

6 Inverse-polarity protection diode

Table 12 Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
Repetitive peak reverse voltage	V_{RRM}		$T_{vj} = 25\text{ °C}$	1200	V
Maximum RMS forward current per chip	I_{FRMSM}	$T_H = 80\text{ °C}$		50	A
Maximum RMS current at rectifier output	I_{RMSM}	$T_H = 80\text{ °C}$		50	A
Surge forward current	I_{FSM}	$t_P = 10\text{ ms}$	$T_{vj} = 25\text{ °C}$	450	A
			$T_{vj} = 150\text{ °C}$	360	
I^2t - value	I^2t	$t_P = 10\text{ ms}$	$T_{vj} = 25\text{ °C}$	1010	A ² s
			$T_{vj} = 150\text{ °C}$	648	

Table 13 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Forward voltage	V_F	$I_F = 30 \text{ A}$	$T_{vj} = 150 \text{ °C}$		0.95		V
Reverse current	I_r	$T_{vj} = 150 \text{ °C}, V_R = 1200 \text{ V}$			0.1		mA
Thermal resistance, junction to heat sink	R_{thJH}	per diode			1.16		K/W
Temperature under switching conditions	$T_{vj, op}$			-40		150	°C

7 NTC-Thermistor

Table 14 Characteristic values

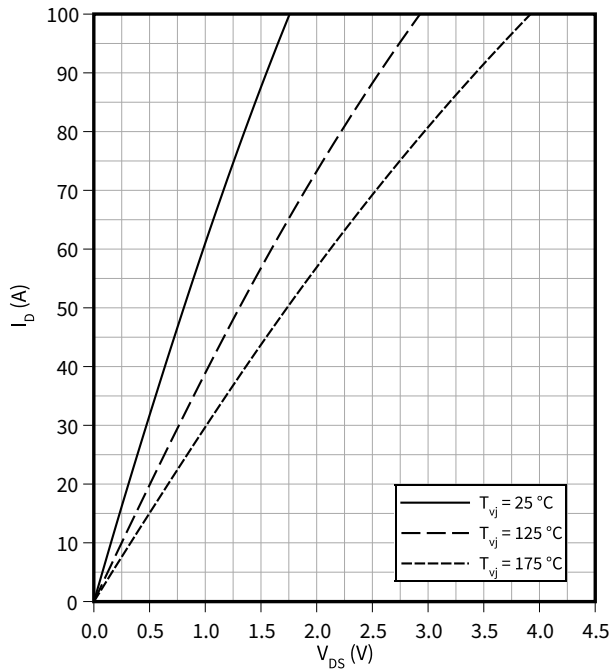
Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Rated resistance	R_{25}	$T_{NTC} = 25 \text{ °C}$			5		kΩ
Deviation of R_{100}	$\Delta R/R$	$T_{NTC} = 100 \text{ °C}, R_{100} = 493 \text{ Ω}$		-5		5	%
Power dissipation	P_{25}	$T_{NTC} = 25 \text{ °C}$				20	mW
B-value	$B_{25/50}$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

8 Characteristics diagrams

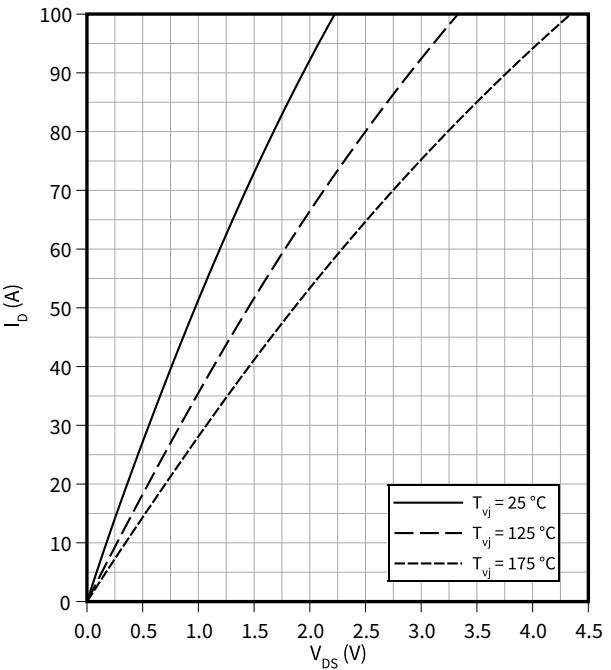
Output characteristic (typical), MOSFET

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



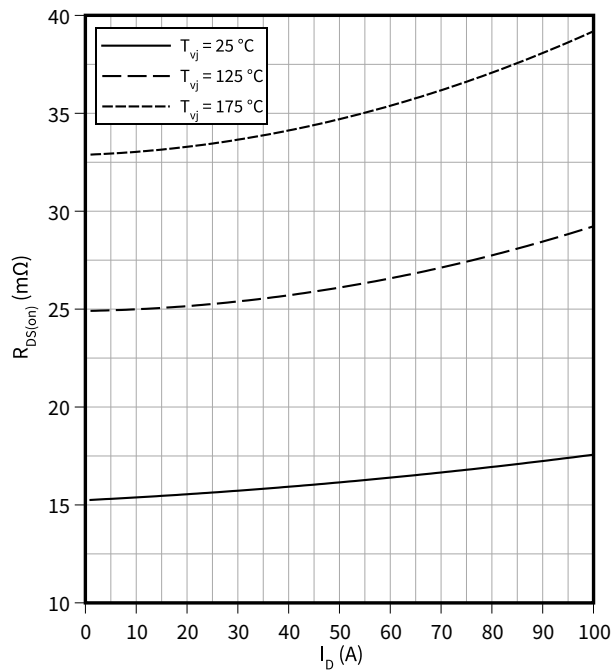
Output characteristic (typical), MOSFET

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



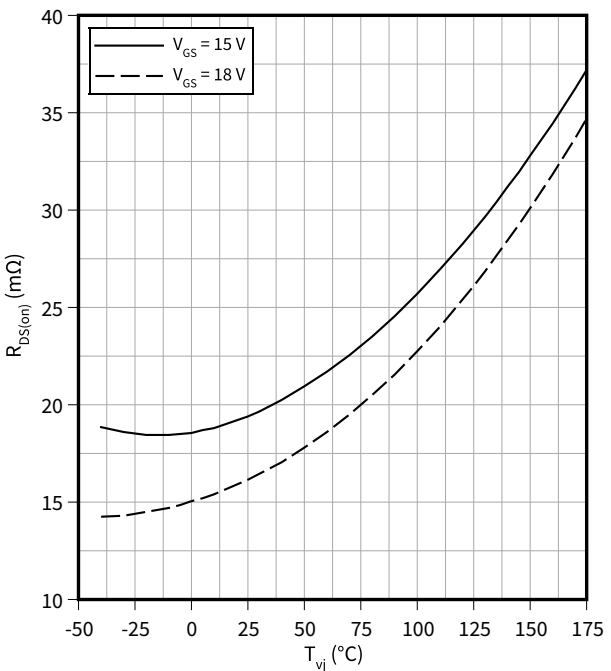
Drain source on-resistance (typical), MOSFET

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



Drain source on-resistance (typical), MOSFET

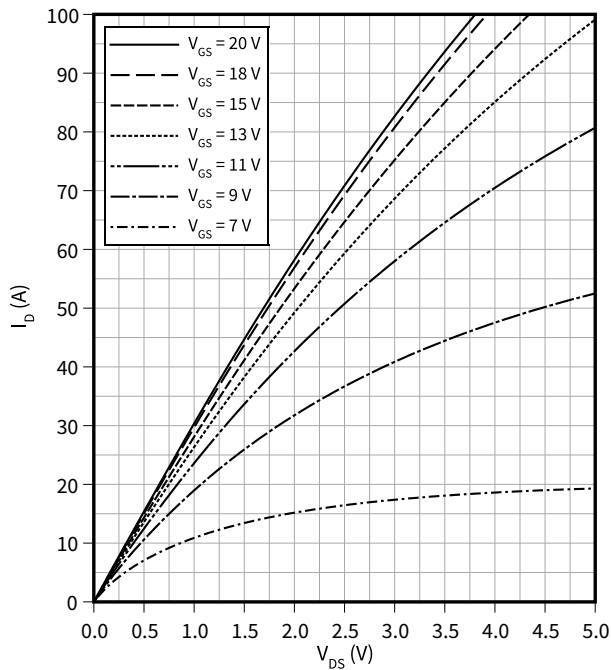
$R_{DS(on)} = f(T_{vj})$
 $I_D = 50\text{ A}$



8 Characteristics diagrams

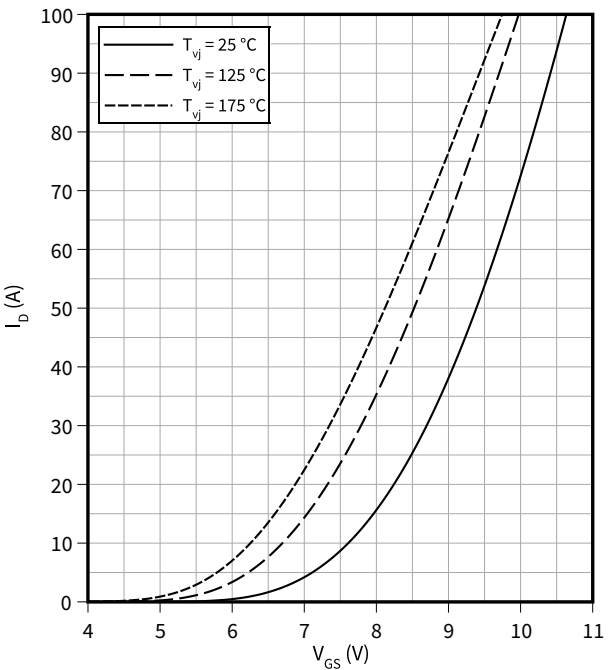
Output characteristic field (typical), MOSFET

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



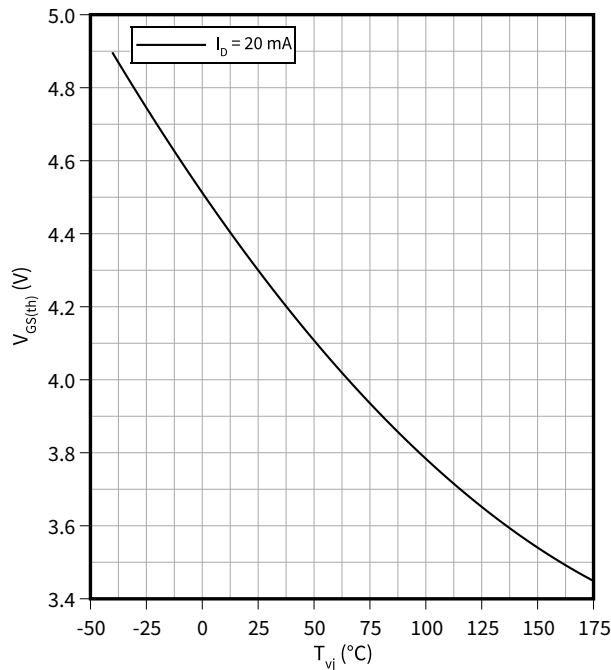
Transfer characteristic (typical), MOSFET

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



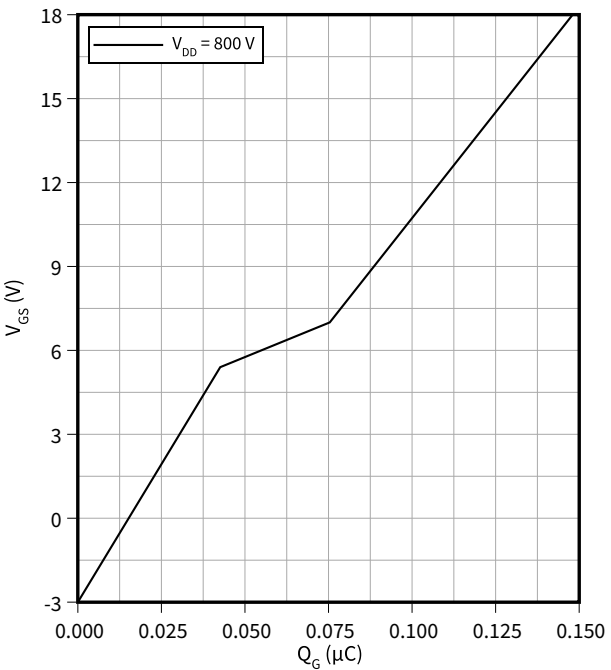
Gate-source threshold voltage (typical), MOSFET

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



Gate charge characteristic (typical), MOSFET

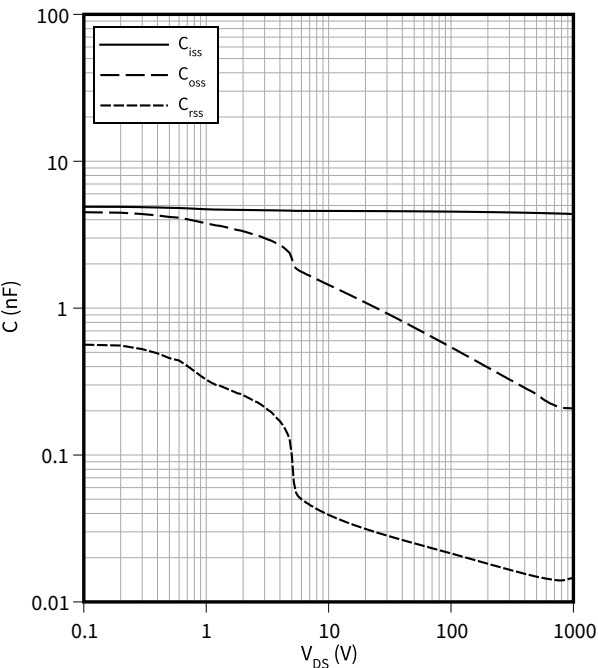
$V_{GS} = f(Q_G)$
 $I_D = 50\text{ A}, T_{vj} = 25\text{ °C}$



8 Characteristics diagrams

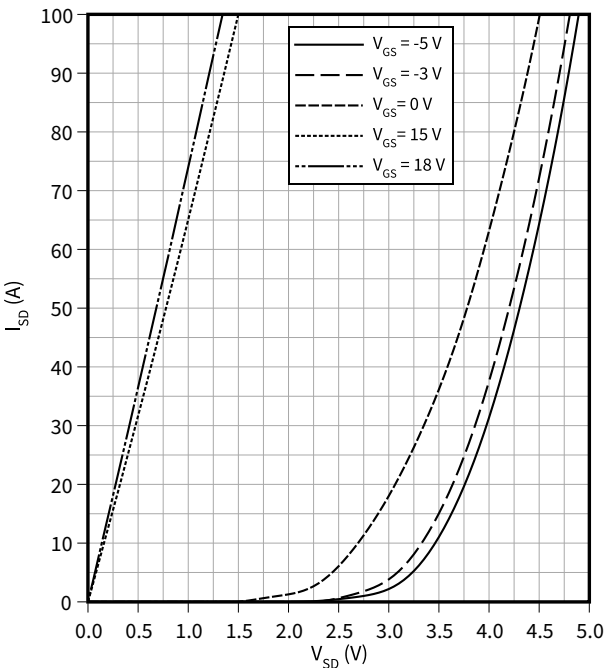
Capacity characteristic (typical), MOSFET

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



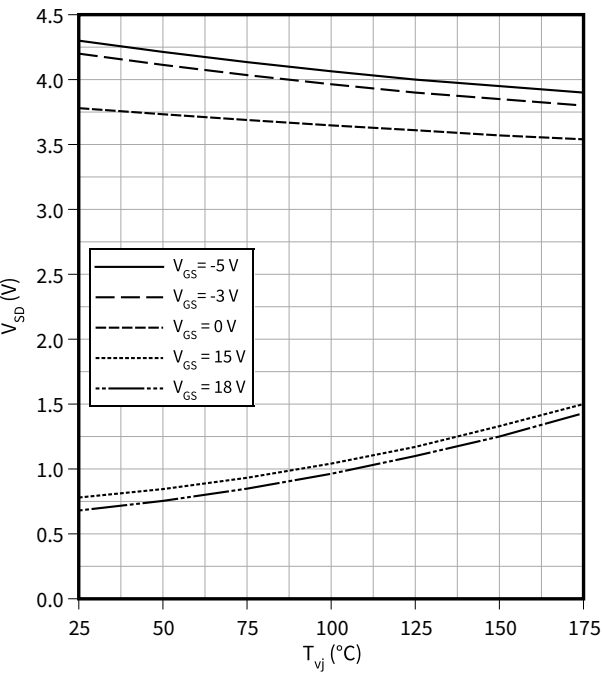
Forward characteristic body diode (typical), MOSFET

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



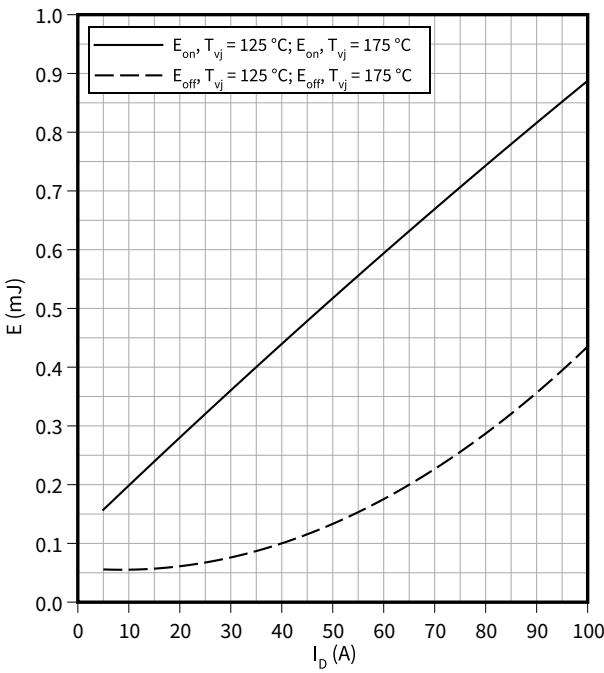
Forward characteristic body diode (typical), MOSFET

$V_{SD} = f(T_{vj})$
 $I_{SD} = 50 \text{ A}$



Switching losses (typical), MOSFET

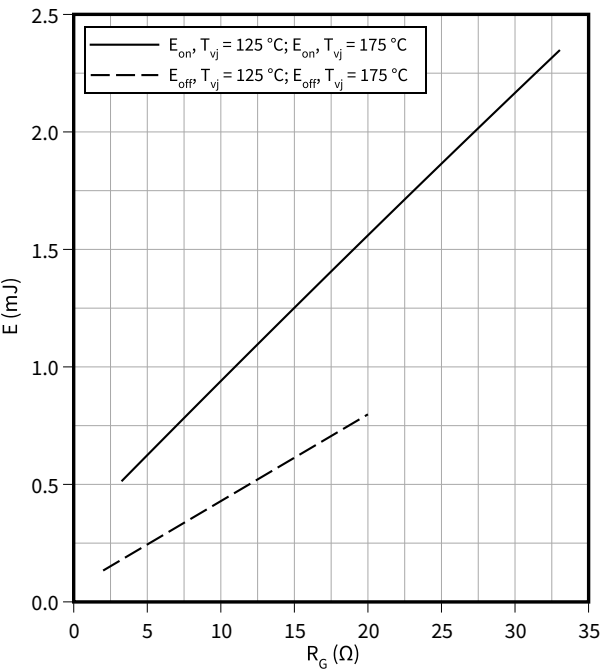
$E = f(I_D)$
 $R_{Goff} = 2 \text{ } \Omega$, $R_{Gon} = 3.3 \text{ } \Omega$, $V_{DD} = 600 \text{ V}$, $V_{GS} = -3/18 \text{ V}$



8 Characteristics diagrams

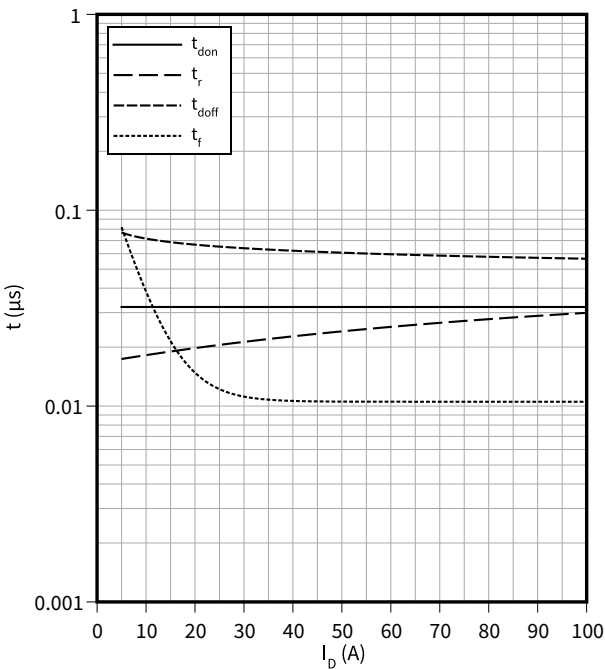
Switching losses (typical), MOSFET

$E = f(R_G)$
 $V_{DD} = 600\text{ V}$, $I_D = 50\text{ A}$, $V_{GS} = -3/18\text{ V}$



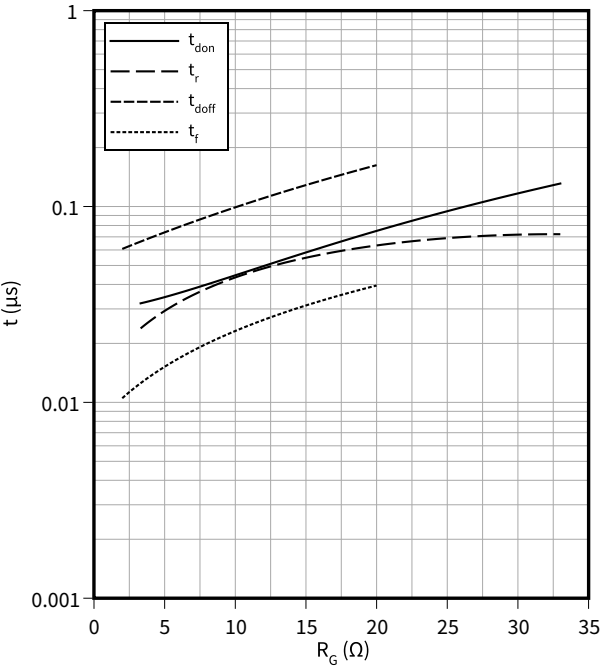
Switching times (typical), MOSFET

$t = f(I_D)$
 $R_{Goff} = 2\text{ }\Omega$, $R_{Gon} = 3.3\text{ }\Omega$, $V_{DD} = 600\text{ V}$, $T_{vj} = 175\text{ }^\circ\text{C}$, $V_{GS} = -3/18\text{ V}$



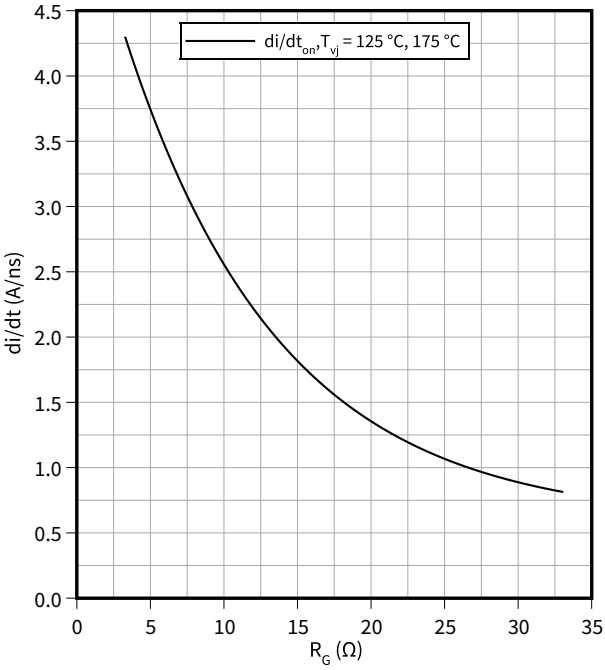
Switching times (typical), MOSFET

$t = f(R_G)$
 $V_{DD} = 600\text{ V}$, $I_D = 50\text{ A}$, $T_{vj} = 175\text{ }^\circ\text{C}$, $V_{GS} = -3/18\text{ V}$



Current slope (typical), MOSFET

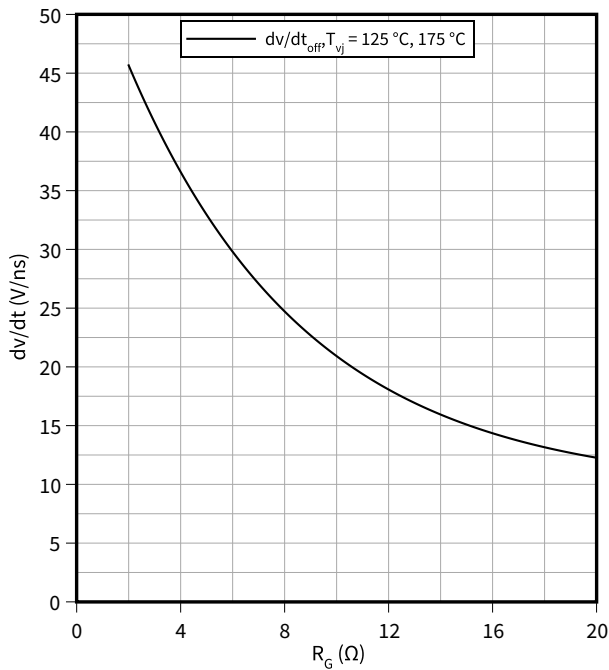
$di/dt = f(R_G)$
 $V_{DD} = 600\text{ V}$, $I_D = 50\text{ A}$, $V_{GS} = -3/18\text{ V}$



8 Characteristics diagrams

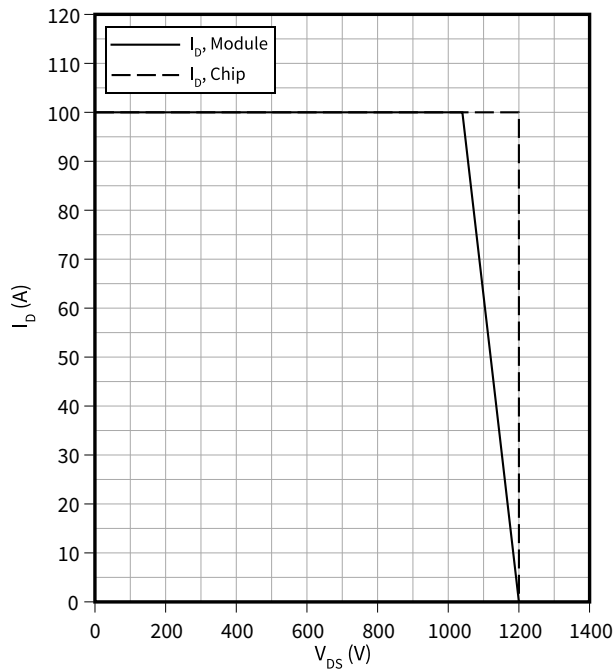
Voltage slope (typical), MOSFET

$dv/dt = f(R_G)$
 $V_{DD} = 600\text{ V}$, $I_D = 50\text{ A}$, $V_{GS} = -3/18\text{ V}$



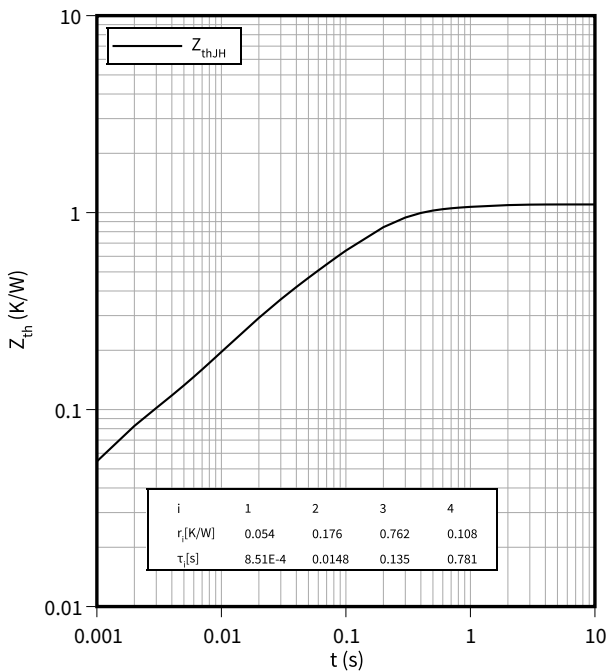
Reverse bias safe operating area (RBSOA), MOSFET

$I_D = f(V_{DS})$
 $R_{Goff} = 2\text{ }\Omega$, $T_{vj} = 175\text{ }^\circ\text{C}$, $V_{GS} = -3/18\text{ V}$



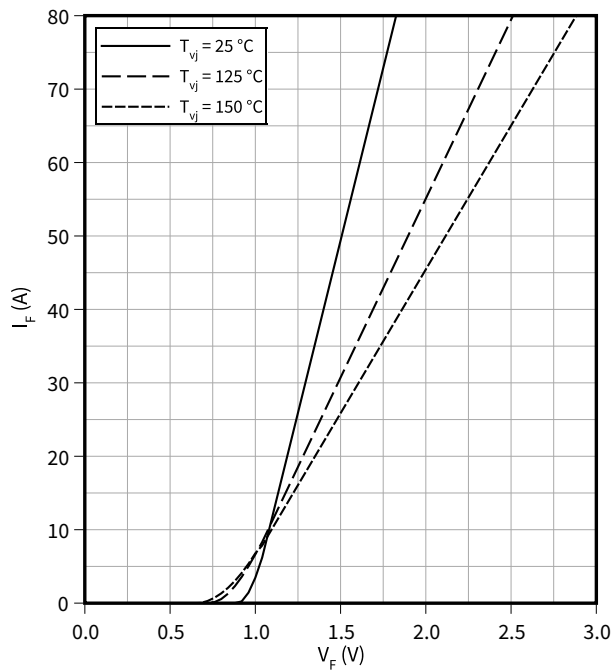
Transient thermal impedance , MOSFET

$Z_{th} = f(t)$



Forward characteristic (typical), Diode, Boost

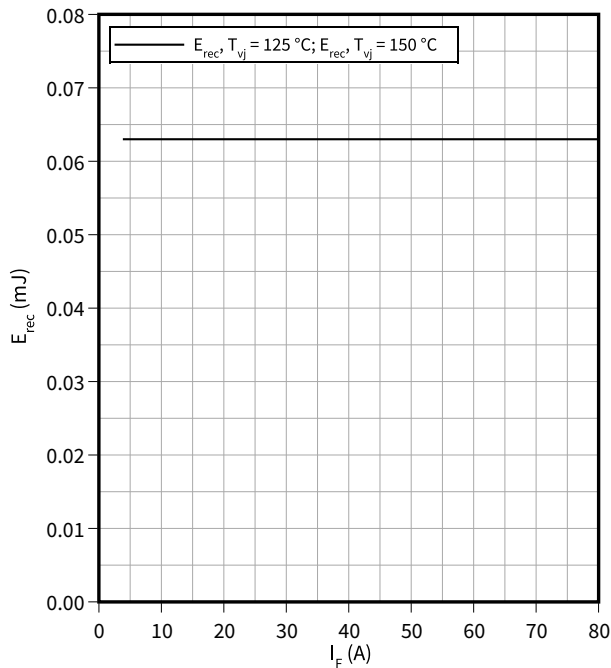
$I_F = f(V_F)$



8 Characteristics diagrams

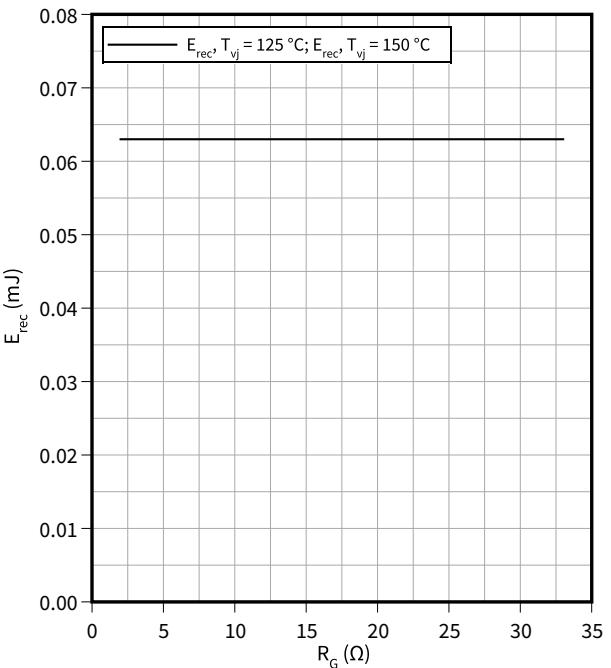
Switching losses (typical), Diode, Boost

$E_{rec} = f(I_F)$
 $R_{Gon} = 3.3 \Omega, V_{CC} = 600 V$



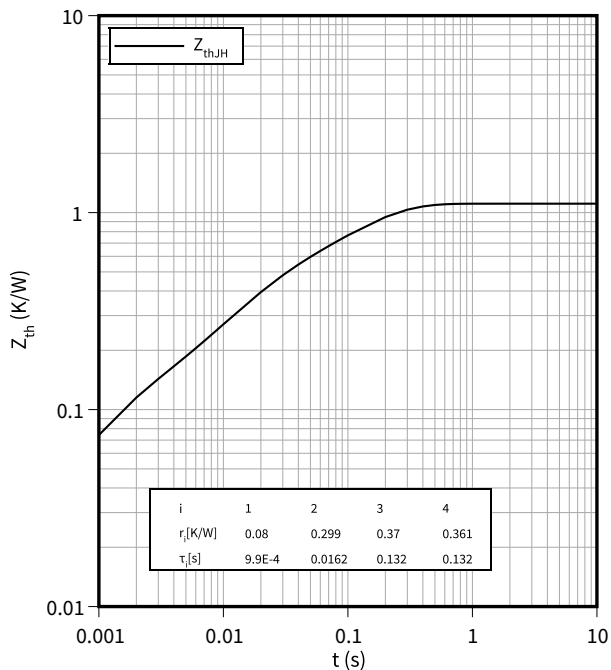
Switching losses (typical), Diode, Boost

$E_{rec} = f(R_G)$
 $I_F = 40 A, V_{CC} = 600 V$



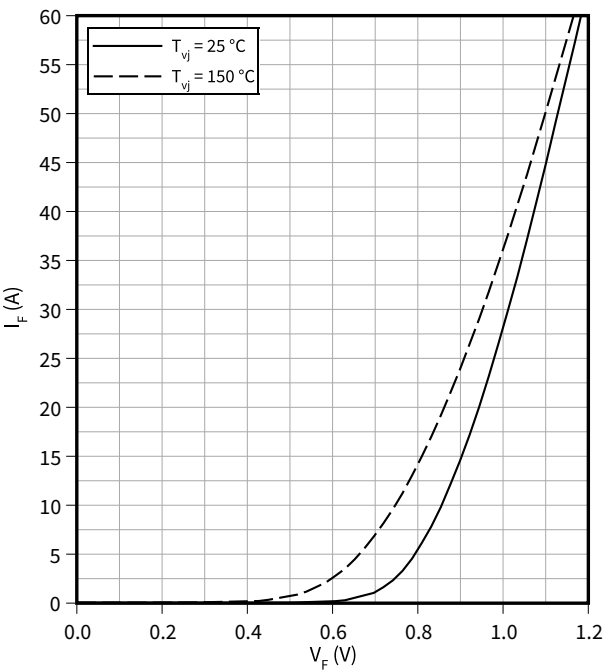
Transient thermal impedance, Diode, Boost

$Z_{th} = f(t)$



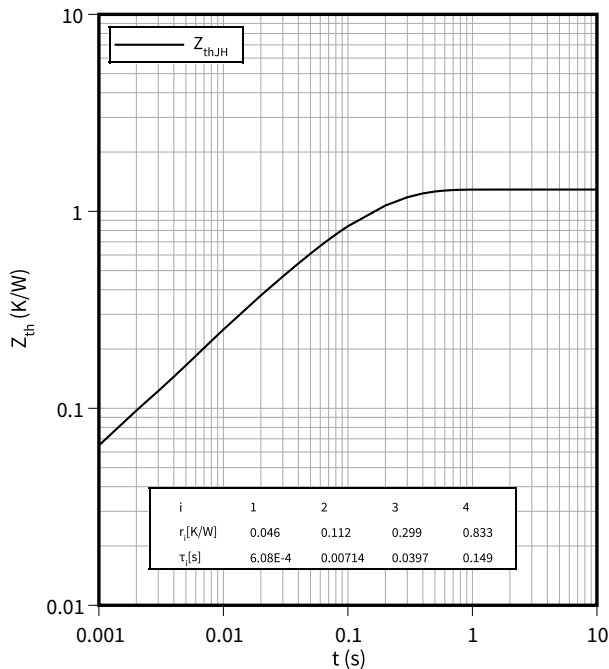
Forward characteristic (typical), Bypass-diode

$I_F = f(V_F)$



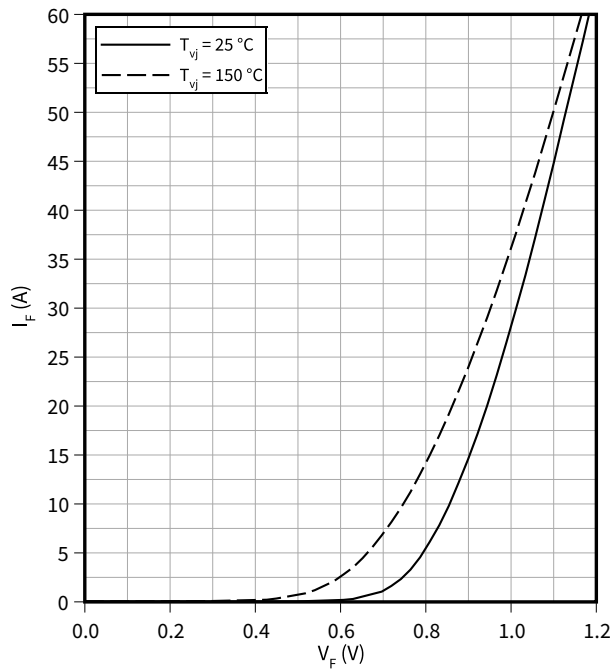
Transient thermal impedance, Bypass-diode

$Z_{th} = f(t)$



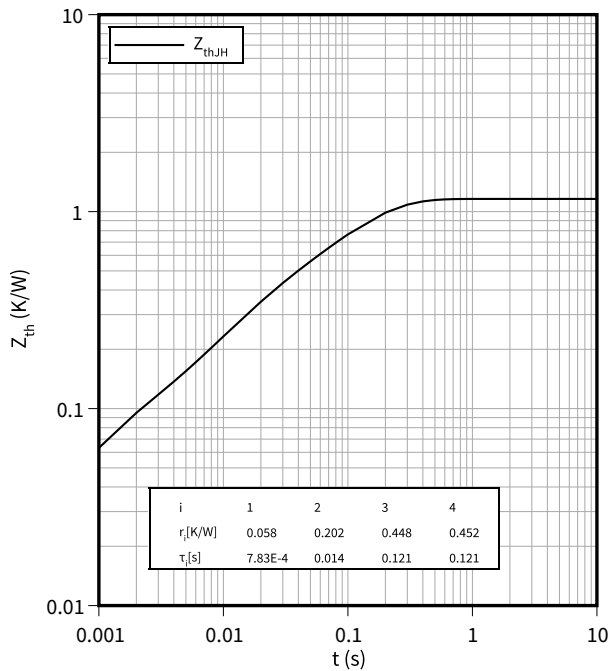
Forward characteristic (typical), Inverse-polarity protection diode

$I_F = f(V_F)$



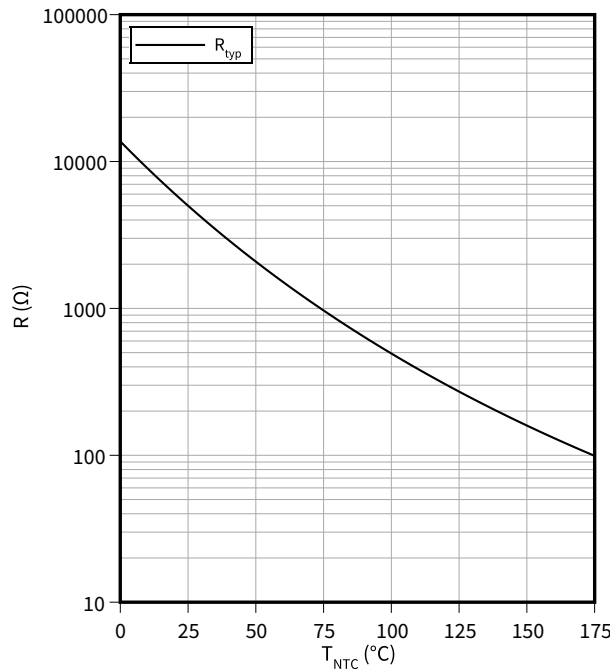
Transient thermal impedance, Inverse-polarity protection diode

$Z_{th} = f(t)$



Temperature characteristic (typical), NTC-Thermistor

$R = f(T_{NTC})$



9 Circuit diagram

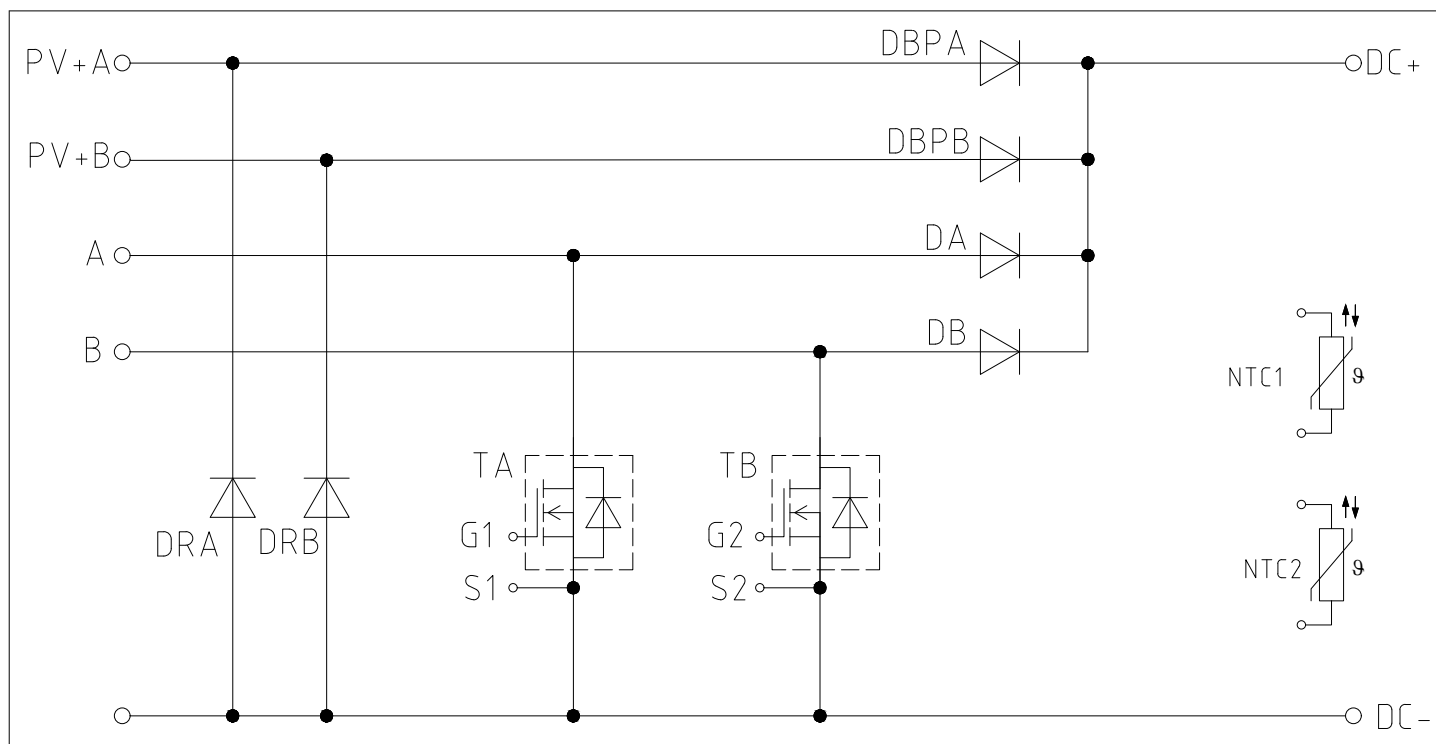


Figure 1

10 Package outlines

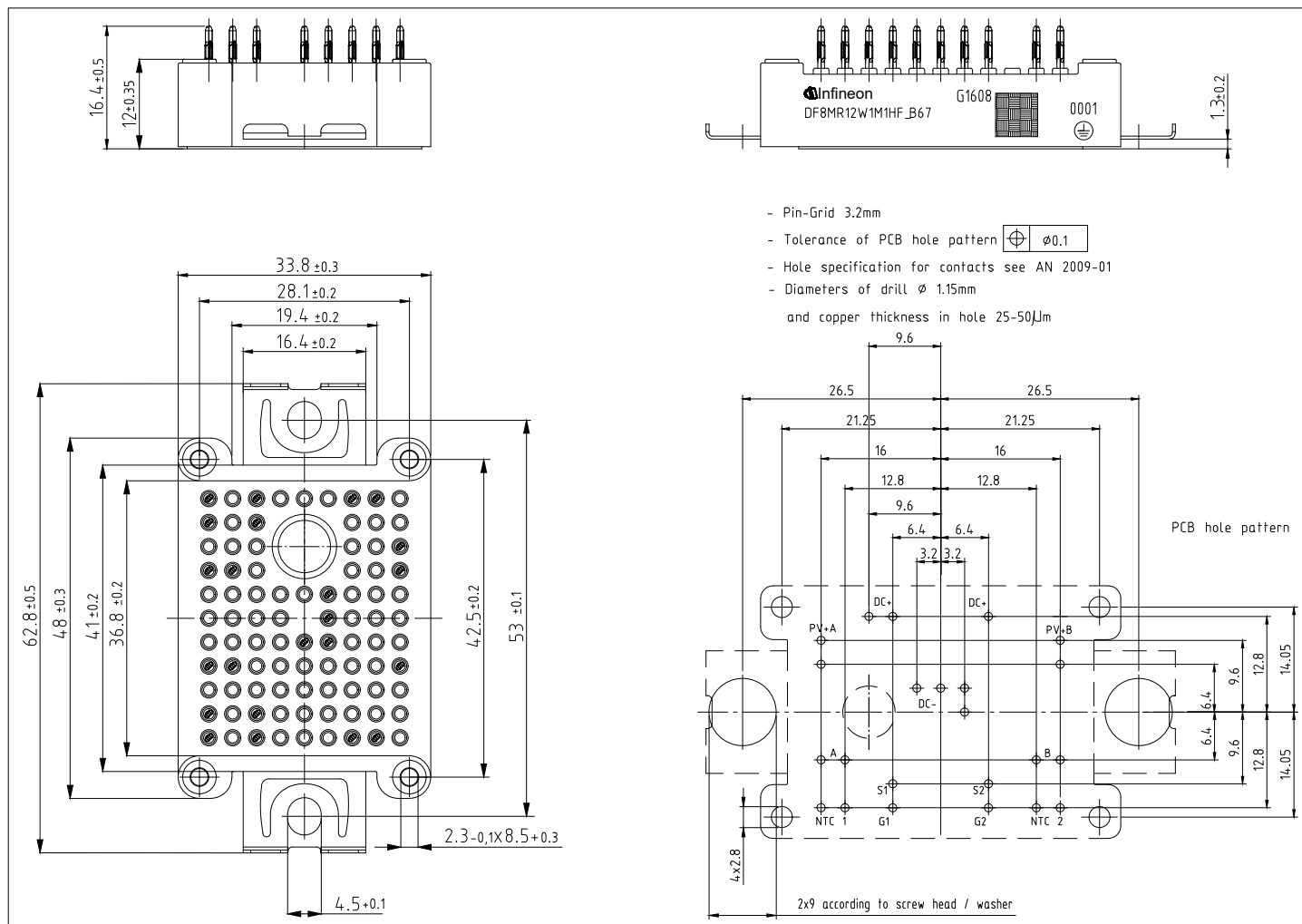


Figure 2

11 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 version	Date of release	Description of changes
0.10	2022-11-21	Initial version

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Edition 2022-11-21

Published by

Infineon Technologies AG
81726 Munich, Germany

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Document reference
IFX-ABE635-001

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