

Final datasheet

EconoDUAL™3 module with CoolSiC™ Trench MOSFET and PressFIT / NTC

Features

- Electrical features
 - $V_{DS} = 1200\text{ V}$
 - $I_{DN} = 500\text{ A}$ / $I_{DRM} = 1000\text{ A}$
 - Integrated temperature sensor
 - Suitable Infineon gate drivers can be found under <https://www.infineon.com/gdfinder>
- Mechanical features
 - Standard housing
 - PressFIT contact technology
 - Isolated base plate
 - High power density



Potential applications

- Construction, commercial, and agriculture vehicles
- Wind turbines
- Motor drives
- UPS systems
- Solar applications

Product validation

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

Description

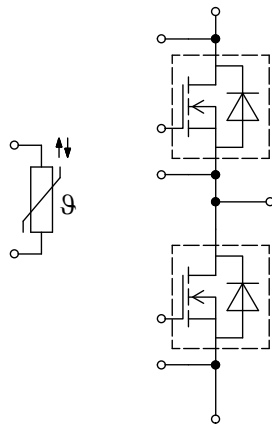


Table of contents

	Description	1
	Features	1
	Potential applications	1
	Product validation	1
	Table of contents	2
1	Package	3
2	MOSFET, T1 / T2	4
3	Body diode (MOSFET, T1 / T2)	6
4	NTC-Thermistor	6
5	Characteristics diagrams	8
6	Circuit diagram	15
7	Package outlines	16
8	Module label code	17
	Revision history	18
	Disclaimer	19

1 Package

1 Package

Table 1 Insulation coordination

Parameter	Symbol	Note or test condition	Values	Unit
Isolation test voltage	V_{ISOL}	RMS, $f = 50 \text{ Hz}$, $t = 1 \text{ min}$	3.4	kV
Isolation test voltage NTC	$V_{ISOL(NTC)}$	RMS, $f = 50 \text{ Hz}$, $t = 1 \text{ min}$	3.4	kV
Material of module baseplate			Cu	
Internal isolation		basic insulation (class 1, IEC 61140)	Al_2O_3	
Creepage distance	$d_{Creep \text{ nom}}$	terminal to baseplate, nom., (PD2, IEC 60664-1, Ed. 3.0)	> 15	mm
Creepage distance	$d_{Creep \text{ min}}$	terminal to baseplate, min., (PD2, IEC 60664-1, Ed. 3.0)	14.7	mm
Creepage distance	$d_{Creep \text{ nom}}$	terminal to terminal, nom., (PD2, IEC 60664-1, Ed. 3.0)	12.1	mm
Creepage distance	$d_{Creep \text{ min}}$	terminal to terminal, min., (PD2, IEC 60664-1, Ed. 3.0)	11.5	mm
Clearance	$d_{Clear \text{ nom}}$	terminal to baseplate, nom.	> 12.5	mm
Clearance	$d_{Clear \text{ min}}$	terminal to baseplate, min.	12.5	mm
Clearance	$d_{Clear \text{ nom}}$	terminal to terminal, nom.	10.0	mm
Clearance	$d_{Clear \text{ min}}$	terminal to terminal, min.	9.6	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}			20		nH
Module lead resistance, terminals - chip	$R_{CC'+EE'}$	$T_C = 25 \text{ °C}$, per switch		0.8		mΩ
Storage temperature	T_{stg}		-40		125	°C
Mounting torque for module mounting	M	- Mounting according to valid application note	M5, Screw	3	6	Nm
Terminal connection torque	M	- Mounting according to valid application note	M6, Screw	3	6	Nm
Weight	G			345		g

2 MOSFET, T1 / T2

Table 3 Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
Drain-source voltage	V_{DS}		$T_{vj} = 25\text{ °C}$	1200	V
Implemented drain current	I_{DN}			500	A
Continuous DC drain current	I_{DDC}	$T_{vj} = 175\text{ °C}$, $V_{GS} = 18\text{ V}$	$T_C = 115\text{ °C}$	420	A
Repetitive peak drain current	I_{DRM}	verified by design, t_p limited by T_{vjmax}		1000	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	$R_{DS(on)}$	$I_D = 500\text{ A}$	$V_{GS} = 15\text{ V}$, $T_{vj} = 25\text{ °C}$		1.75		mΩ
			$V_{GS} = 18\text{ V}$, $T_{vj} = 25\text{ °C}$		1.46	1.91	
			$V_{GS} = 18\text{ V}$, $T_{vj} = 125\text{ °C}$		2.36		
			$V_{GS} = 18\text{ V}$, $T_{vj} = 175\text{ °C}$		3.13		
Gate threshold voltage	$V_{GS(th)}$	$I_D = 224\text{ mA}$, $V_{DS} = V_{GS}$, $T_{vj} = 25\text{ °C}$, (tested after 1ms pulse at $V_{GS} = +20\text{ V}$)		3.45	4.3	5.15	V
Total gate charge	Q_G	$V_{DD} = 800\text{ V}$, $V_{GS} = -3/18\text{ V}$, $T_{vj} = 25\text{ °C}$			1.6		μC
Internal gate resistor	R_{Gint}	$T_{vj} = 25\text{ °C}$			0.9		Ω
Input capacitance	C_{ISS}	$f = 100\text{ kHz}$, $V_{DS} = 800\text{ V}$, $V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ °C}$		48.4		nF
Output capacitance	C_{OSS}	$f = 100\text{ kHz}$, $V_{DS} = 800\text{ V}$, $V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ °C}$		2.4		nF
Reverse transfer capacitance	C_{rss}	$f = 100\text{ kHz}$, $V_{DS} = 800\text{ V}$, $V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ °C}$		0.158		nF

(table continues...)

Table 5 (continued) **Characteristic values**

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
C _{OSS} stored energy	E _{OSS}	V _{DS} = 800 V, V _{GS} = -3/18 V, T _{vj} = 25 °C		945		μJ
Drain-source leakage current	I _{DSS}	V _{DS} = 1200 V, V _{GS} = -3 V, T _{vj} = 25 °C		0.32	660	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 = 500 A, R _{Gon} = 6.8 Ω, V _{DD} = 600 V, V _{GS} = -3/18 V, t _{dead} = 1000 ns	T _{vj} = 25 °C	156		ns
			T _{vj} = 125 °C	172		
			T _{vj} = 175 °C	182		
Rise time (inductive load)	t _r	I _D = 500 A, R _{Gon} = 6.8 Ω, V _{DD} = 600 V, V _{GS} = -3/18 V, t _{dead} = 1000 ns	T _{vj} = 25 °C	261		ns
			T _{vj} = 125 °C	243		
			T _{vj} = 175 °C	238		
Turn-off delay time (inductive load)	t _{d off}	I _D = 500 A, R _{Goff} = 3.9 Ω, V _{DD} = 600 V, V _{GS} = -3/18 V	T _{vj} = 25 °C	276		ns
			T _{vj} = 125 °C	305		
			T _{vj} = 175 °C	319		
Fall time (inductive load)	t _f	I _D = 500 A, R _{Goff} = 3.9 Ω, V _{DD} = 600 V, V _{GS} = -3/18 V	T _{vj} = 25 °C	74		ns
			T _{vj} = 125 °C	76		
			T _{vj} = 175 °C	77		
Turn-on energy loss per pulse	E _{on}	I _D = 500 A, V _{DD} = 600 V, L _σ = 8 nH, V _{GS} = -3/18 V, R _{Gon} = 6.8 Ω, di/dt = 4.7 kA/μs (T _{vj} = 175 °C), t _{dead} = 1000 ns	T _{vj} = 25 °C	40.2		mJ
			T _{vj} = 125 °C	38.3		
			T _{vj} = 175 °C	39		
Turn-on energy loss per pulse, optimized	E _{on,o}	I _D = 500 A, V _{DD} = 600 V, L _σ = 8 nH, V _{GS} = -3/18 V, R _{Gon,o} = 2.4 Ω, di/dt = 9.3 kA/μs (T _{vj} = 175 °C), t _{dead} = 200 ns	T _{vj} = 25 °C	16.8		mJ
			T _{vj} = 125 °C	17.1		
			T _{vj} = 175 °C	18.1		
Turn-off energy loss per pulse	E _{off}	I _D = 500 A, V _{DD} = 600 V, L _σ = 8 nH, V _{GS} = -3/18 V, R _{Goff} = 3.9 Ω, dv/dt = 6.2 kV/μs (T _{vj} = 175 °C)	T _{vj} = 25 °C	20.4		mJ
			T _{vj} = 125 °C	21.6		
			T _{vj} = 175 °C	22.2		
Thermal resistance, junction to case	R _{thJC}	per MOSFET			0.0820	K/W
Thermal resistance, case to heat sink	R _{thCH}	per MOSFET, λ _{grease} = 1 W / (m*K)		0.0300		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.

$T_{vj\ op} > 150^{\circ}\text{C}$ 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, T1 / T2)

Table 6 Maximum rated values

Parameter	Symbol	Note or test condition	Values	Unit
DC body diode forward current	I_{SD}	$T_{vj} = 175^{\circ}\text{C}$, $V_{GS} = -3\text{ V}$ $T_C = 115^{\circ}\text{C}$	200	A

Table 7 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Forward voltage	V_{SD}	$I_{SD} = 500\text{ A}$, $V_{GS} = -3\text{ V}$	$T_{vj} = 25^{\circ}\text{C}$	4.14	5.2	V
			$T_{vj} = 125^{\circ}\text{C}$	3.88		
			$T_{vj} = 175^{\circ}\text{C}$	3.78		
Peak reverse recovery current	I_{rrm}	$I_{SD} = 500\text{ A}$, $di_s/dt = 4.7\text{ kA}/\mu\text{s}$, $V_{DD} = 600\text{ V}$, $V_{GS} = -3\text{ V}$, $t_{dead} = 1000\text{ ns}$	$T_{vj} = 25^{\circ}\text{C}$	76		A
			$T_{vj} = 125^{\circ}\text{C}$	114		
			$T_{vj} = 175^{\circ}\text{C}$	148		
Recovered charge	Q_{rr}	$I_{SD} = 500\text{ A}$, $di_s/dt = 4.7\text{ kA}/\mu\text{s}$, $V_{DD} = 600\text{ V}$, $V_{GS} = -3\text{ V}$, $t_{dead} = 1000\text{ ns}$	$T_{vj} = 25^{\circ}\text{C}$	3.7		μC
			$T_{vj} = 125^{\circ}\text{C}$	4.9		
			$T_{vj} = 175^{\circ}\text{C}$	7		
Reverse recovery energy	E_{rec}	$I_{SD} = 500\text{ A}$, $di_s/dt = 4.7\text{ kA}/\mu\text{s}$ ($T_{vj} = 175^{\circ}\text{C}$), $V_{DD} = 600\text{ V}$, $V_{GS} = -3\text{ V}$, $t_{dead} = 1000\text{ ns}$	$T_{vj} = 25^{\circ}\text{C}$	0.12		mJ
			$T_{vj} = 125^{\circ}\text{C}$	0.37		
			$T_{vj} = 175^{\circ}\text{C}$	0.67		
Reverse recovery energy, optimized	$E_{rec,0}$	$I_{SD} = 500\text{ A}$, $di_s/dt = 9.3\text{ kA}/\mu\text{s}$ ($T_{vj} = 175^{\circ}\text{C}$), $V_{DD} = 600\text{ V}$, $V_{GS} = -3\text{ V}$, $t_{dead} = 200\text{ ns}$	$T_{vj} = 25^{\circ}\text{C}$	1.3		mJ
			$T_{vj} = 125^{\circ}\text{C}$	3.8		
			$T_{vj} = 175^{\circ}\text{C}$	5.3		

4 NTC-Thermistor

Table 8 Characteristic values

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

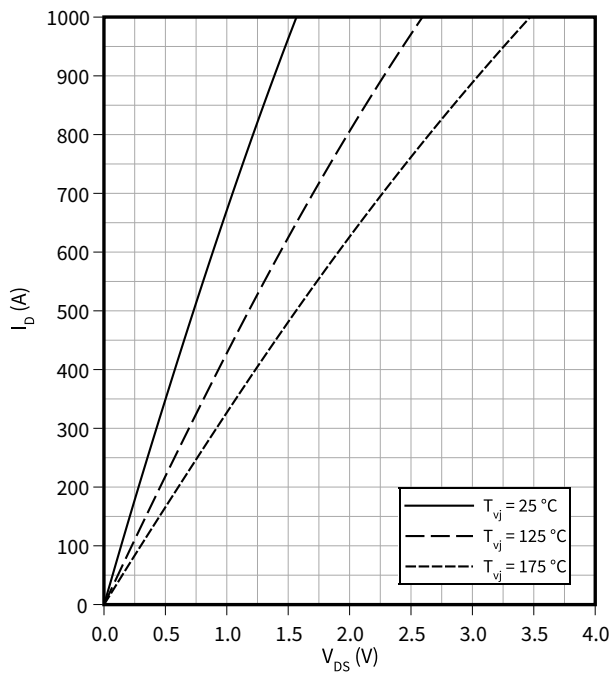
Note: For an analytical description of the NTC characteristics please refer to AN2009-10, chapter 4.

5 Characteristics diagrams

Output characteristic (typical), MOSFET, T1 / T2

$I_D = f(V_{DS})$

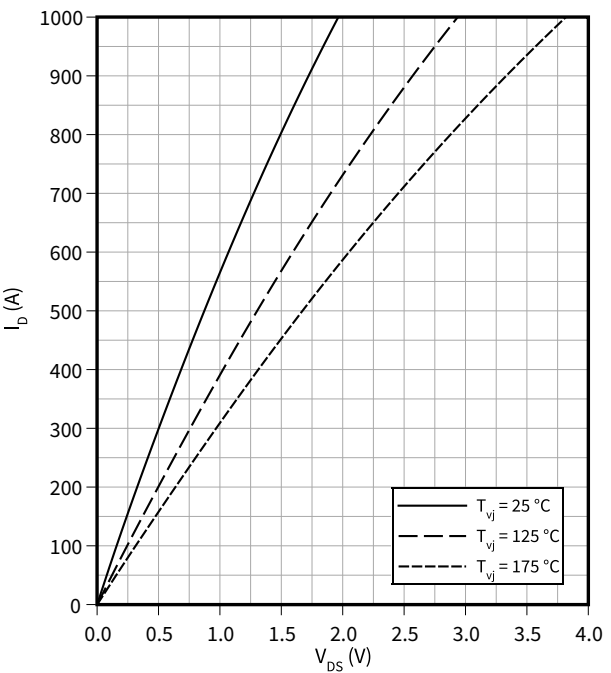
$V_{GS} = 18\text{ V}$



Output characteristic (typical), MOSFET, T1 / T2

$I_D = f(V_{DS})$

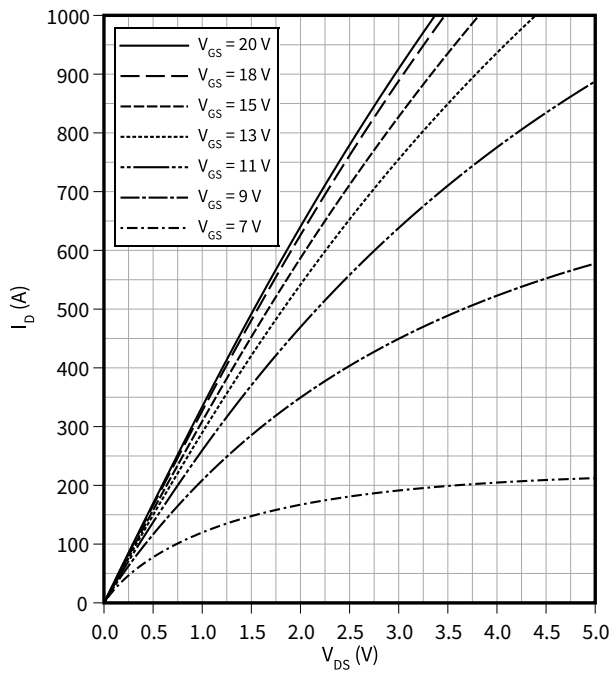
$V_{GS} = 15\text{ V}$



Output characteristic field (typical), MOSFET, T1 / T2

$I_D = f(V_{DS})$

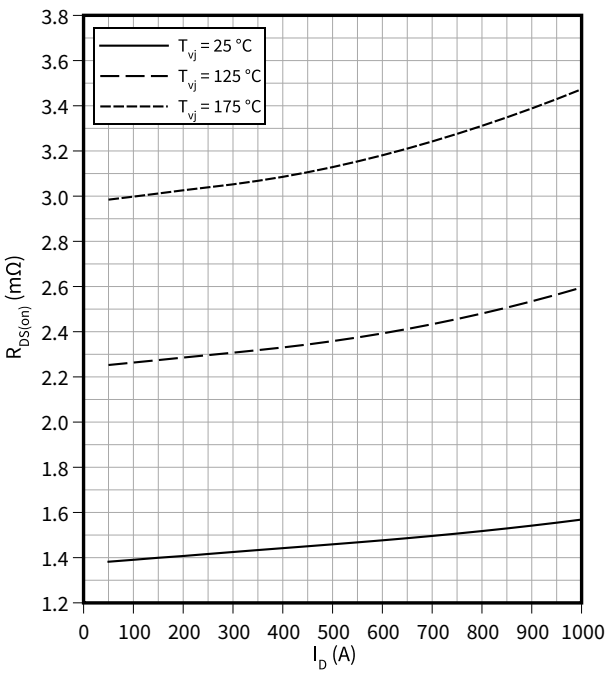
$T_{vj} = 175\text{ °C}$



Drain source on-resistance (typical), MOSFET, T1 / T2

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

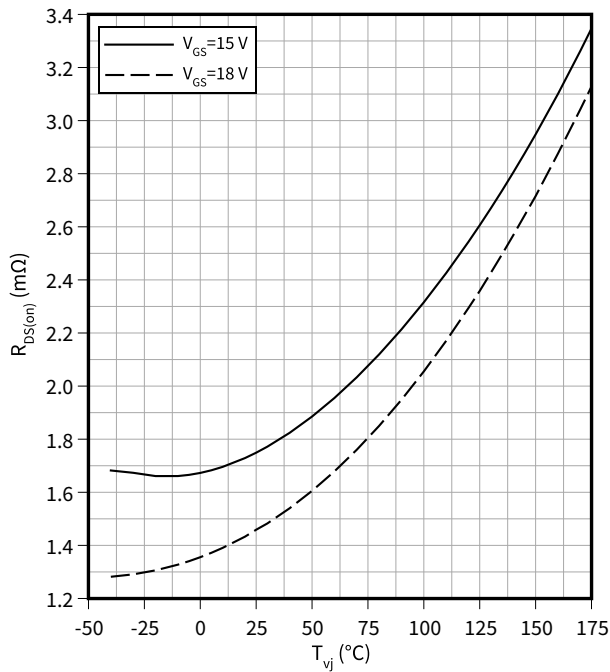
$V_{GS} = 18\text{ V}$



5 Characteristics diagrams

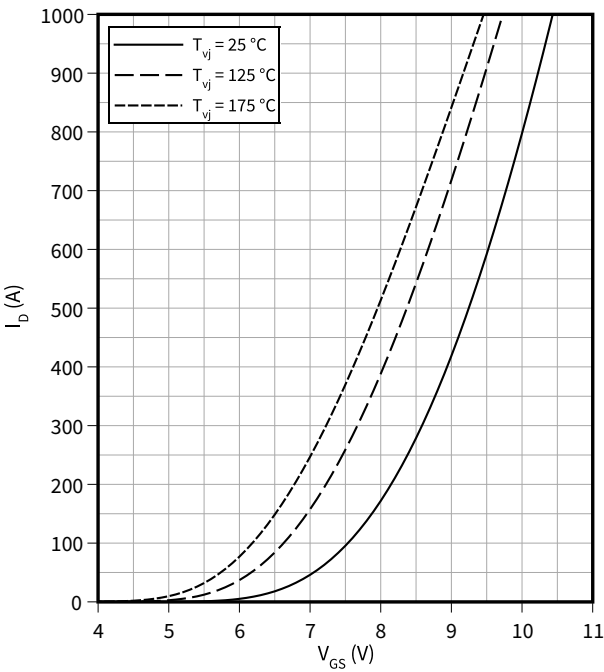
Drain source on-resistance (typical), MOSFET, T1 / T2

$R_{DS(on)} = f(T_{vj})$
 $I_D = 500 \text{ A}$



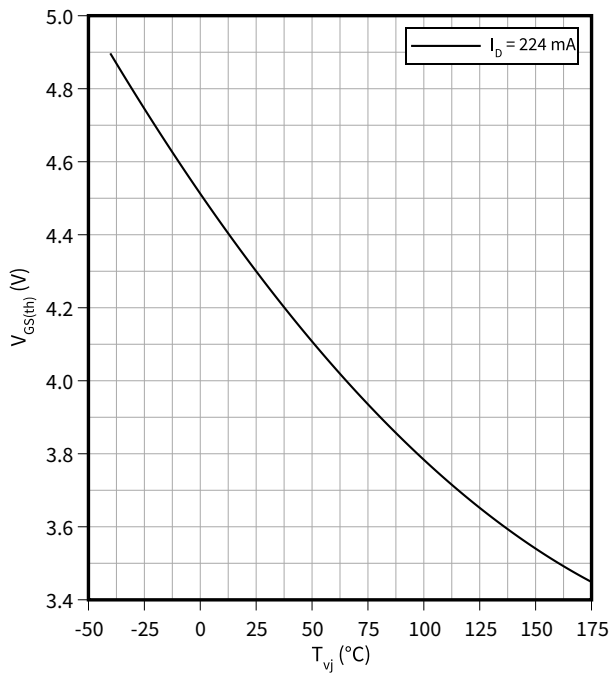
Transfer characteristic (typical), MOSFET, T1 / T2

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



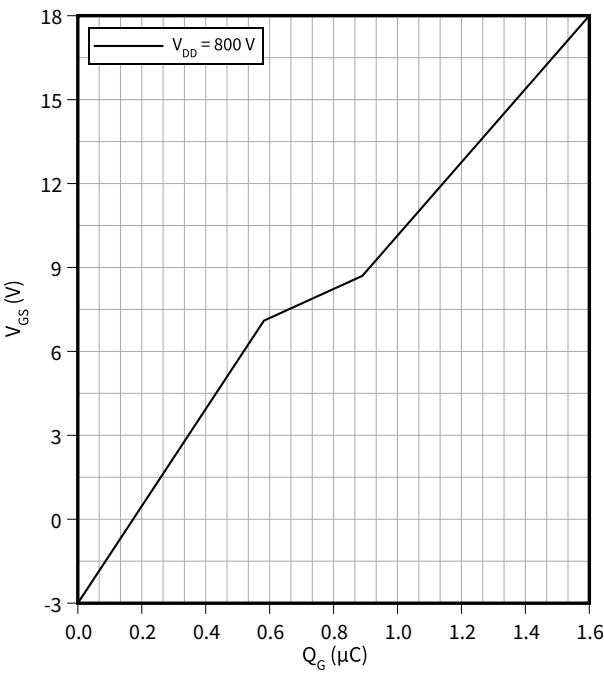
Gate-source threshold voltage (typical), MOSFET, T1 / T2

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



Gate charge characteristic (typical), MOSFET, T1 / T2

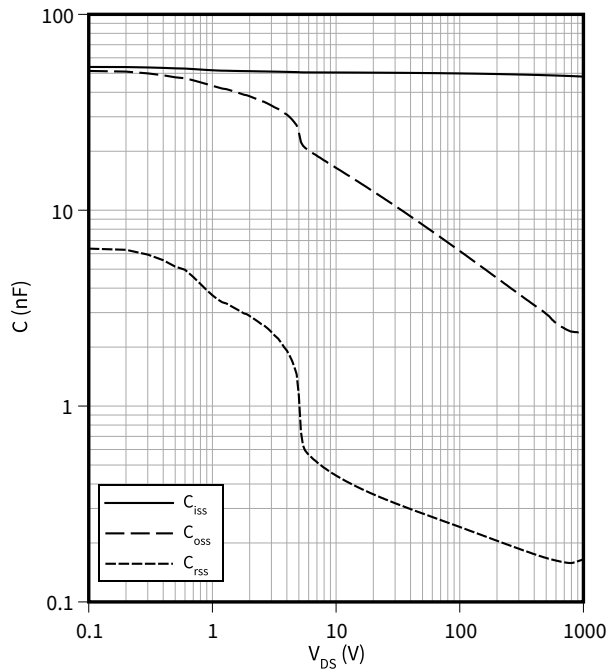
$V_{GS} = f(Q_G)$
 $I_D = 500 \text{ A}, T_{vj} = 25 \text{ }^\circ\text{C}$



5 Characteristics diagrams

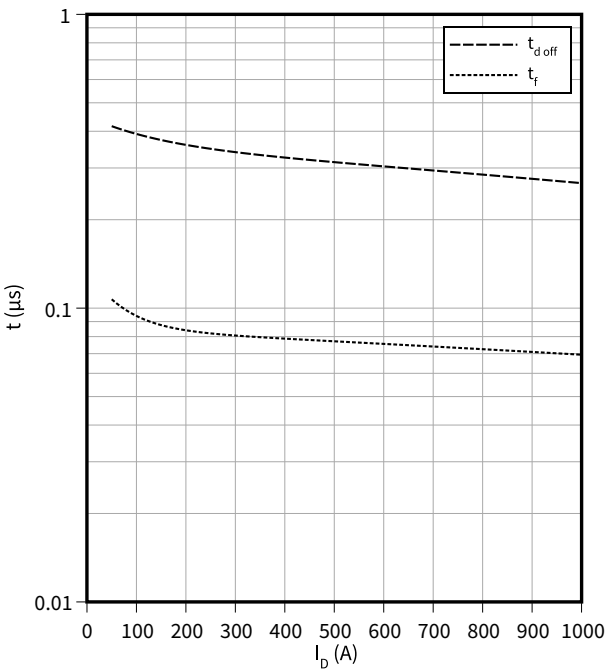
Capacity characteristic (typical), MOSFET, T1 / T2

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



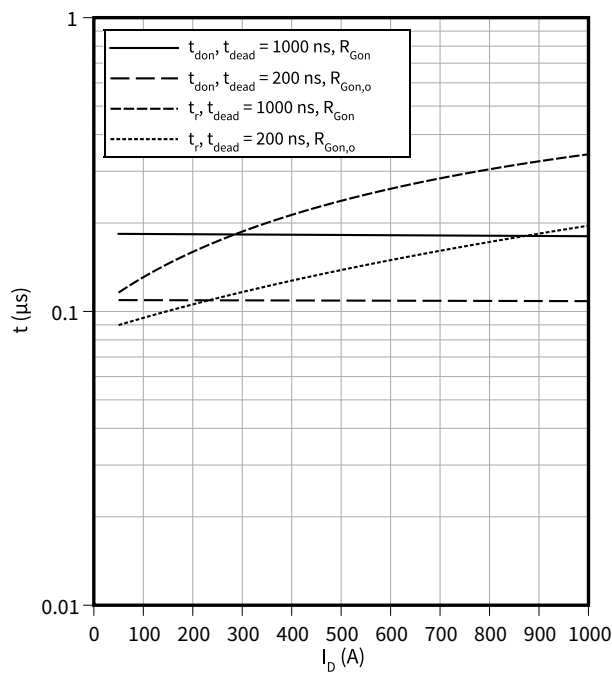
Switching times (typical), MOSFET, T1 / T2

$t = f(I_D)$
 $R_{Goff} = 3.9\text{ }\Omega$, $V_{DD} = 600\text{ V}$, $T_{vj} = 175\text{ °C}$, $V_{GS} = -3/18\text{ V}$



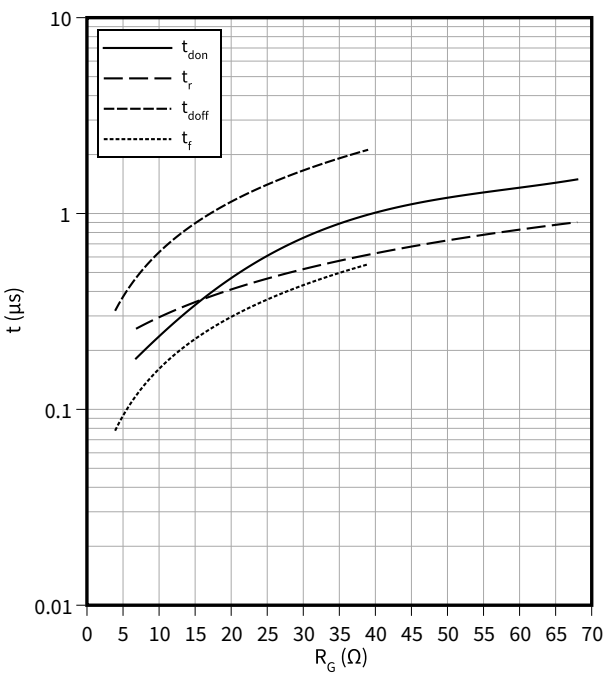
Switching times (typical), MOSFET, T1 / T2

$t = f(I_D)$
 $V_{DD} = 600\text{ V}$, $R_{Gon} = 6.8\text{ }\Omega$, $R_{Gon,o} = 2.4\text{ }\Omega$, $T_{vj} = 175\text{ °C}$, $V_{GS} = -3/18\text{ V}$



Switching times (typical), MOSFET, T1 / T2

$t = f(R_G)$
 $V_{DD} = 600\text{ V}$, $t_{dead} = 1000\text{ ns}$, $I_D = 500\text{ A}$, $T_{vj} = 175\text{ °C}$, $V_{GS} = -3/18\text{ V}$

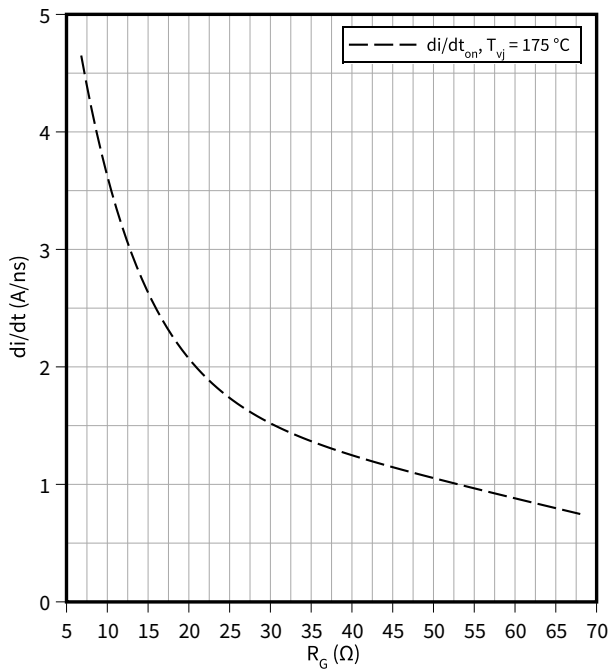


5 Characteristics diagrams

Current slope (typical), MOSFET, T1 / T2

$di/dt = f(R_G)$

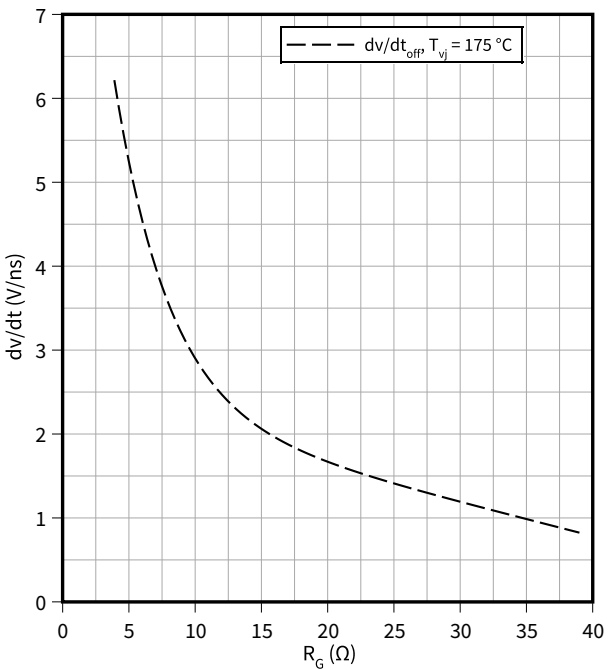
$V_{DD} = 600\text{ V}$, $I_D = 500\text{ A}$, $V_{GS} = -3/18\text{ V}$



Voltage slope (typical), MOSFET, T1 / T2

$dv/dt = f(R_G)$

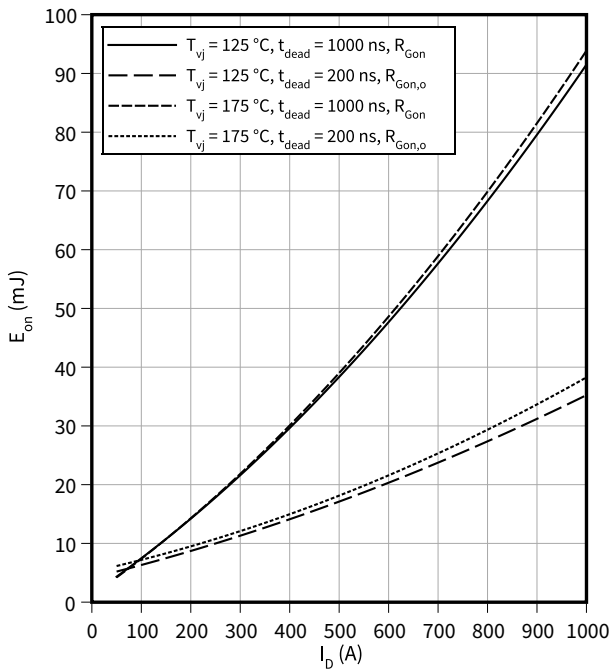
$V_{DD} = 600\text{ V}$, $I_D = 500\text{ A}$, $V_{GS} = -3/18\text{ V}$



Switching losses (typical), MOSFET, T1 / T2

$E_{on} = f(I_D)$

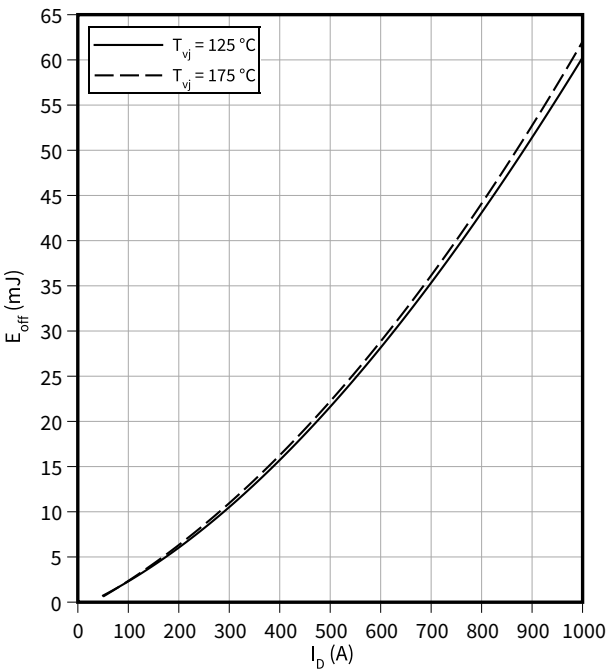
$V_{DD} = 600\text{ V}$, $R_{Gon} = 6.8\text{ Ω}$, $R_{Gon,o} = 2.4\text{ Ω}$, $V_{GS} = -3/18\text{ V}$



Switching losses (typical), MOSFET, T1 / T2

$E_{off} = f(I_D)$

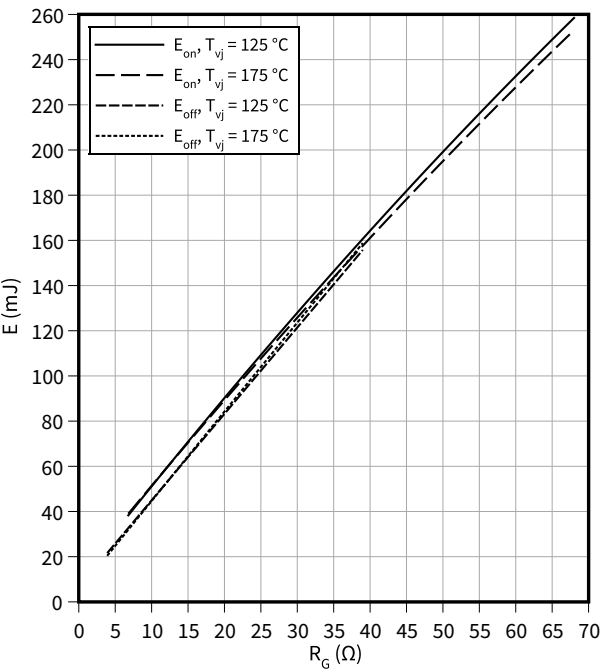
$R_{Goff} = 3.9\text{ Ω}$, $V_{DD} = 600\text{ V}$, $V_{GS} = -3/18\text{ V}$



5 Characteristics diagrams

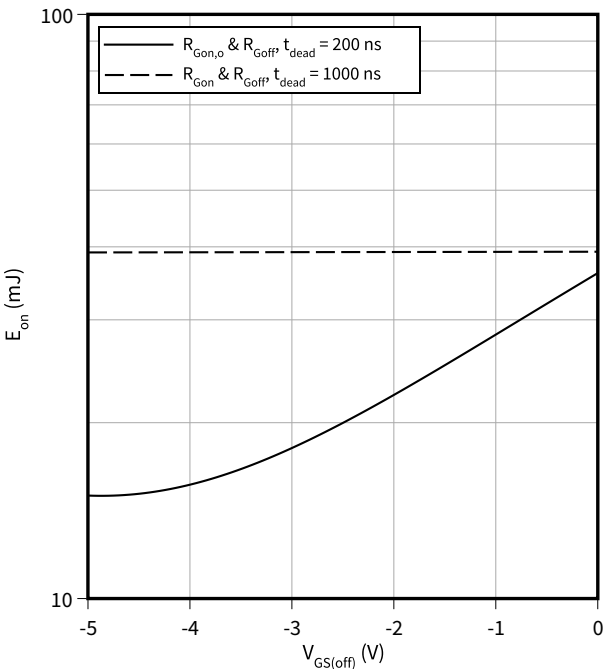
Switching losses (typical), MOSFET, T1 / T2

$E = f(R_G)$
 $V_{DD} = 600\text{ V}$, $t_{dead} = 1000\text{ ns}$, $I_D = 500\text{ A}$, $V_{GS} = -3/18\text{ V}$



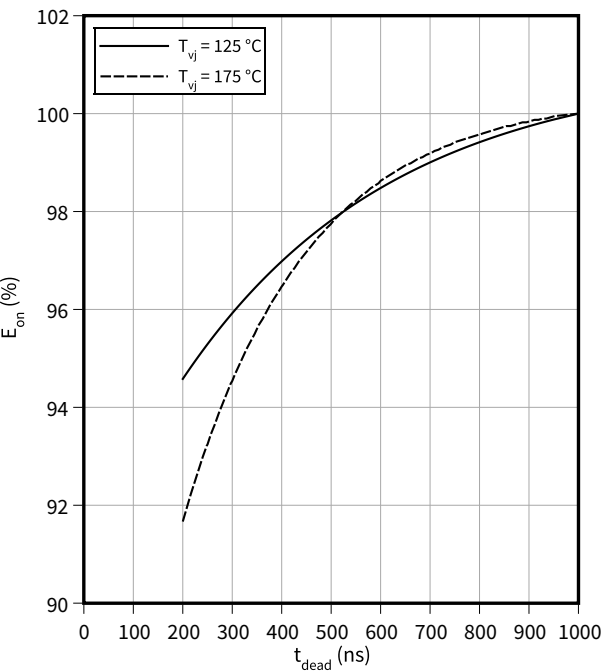
Switching losses (typical), MOSFET, T1 / T2

$E_{on} = f(V_{GS(off)})$
 $R_{Goff} = 3.9\text{ }\Omega$, $V_{DD} = 600\text{ V}$, $R_{Gon} = 6.8\text{ }\Omega$, $V_{GS(on)} = 18\text{ V}$, $I_D = 500\text{ A}$, $R_{Gon,o} = 2.4\text{ }\Omega$, $T_{vj} = 175\text{ }^\circ\text{C}$



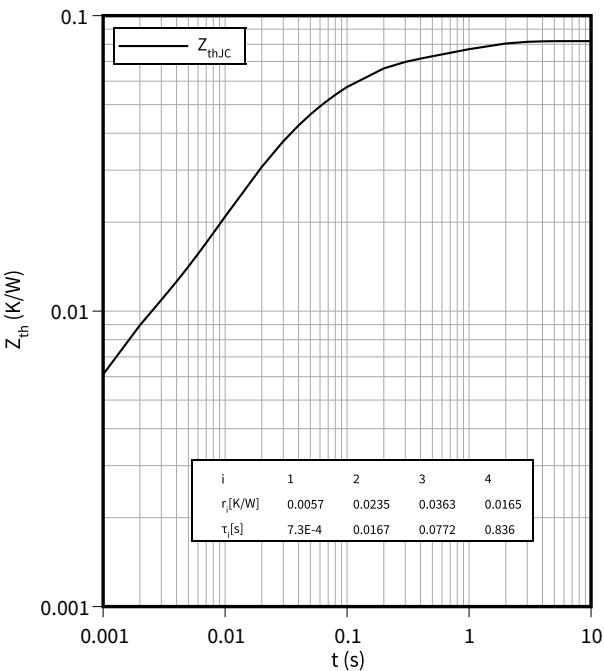
Switching losses (typical), MOSFET, T1 / T2

$E_{on} = f(t_{dead})$
 $R_{Gon} = 6.8\text{ }\Omega$, $I_D = 500\text{ A}$, $V_{DD} = 600\text{ V}$, $V_{GS} = -3/18\text{ V}$



Transient thermal impedance, MOSFET, T1 / T2

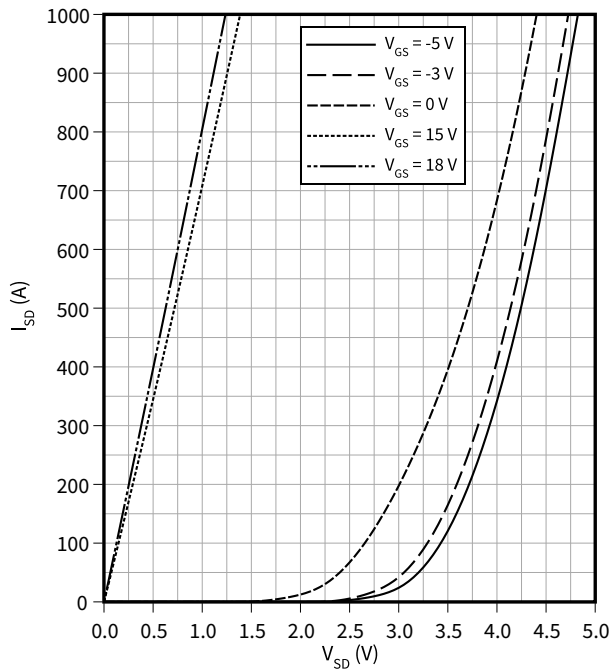
$Z_{th} = f(t)$



5 Characteristics diagrams

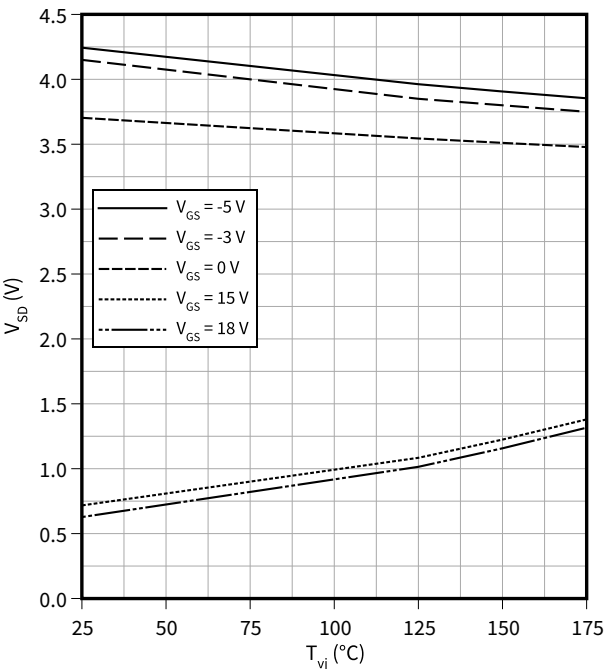
Forward characteristic body diode (typical), MOSFET, T1 / T2

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



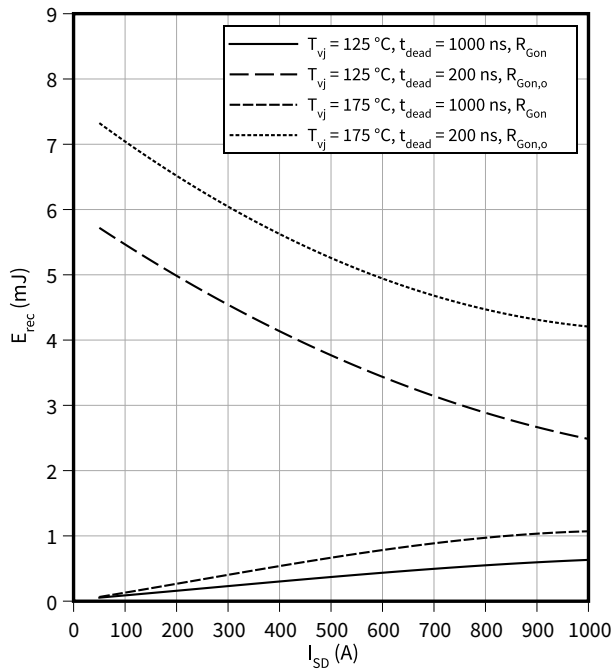
Forward voltage of body diode (typical), MOSFET, T1 / T2

$V_{SD} = f(T_{vj})$
 $I_{SD} = 500\text{ A}$



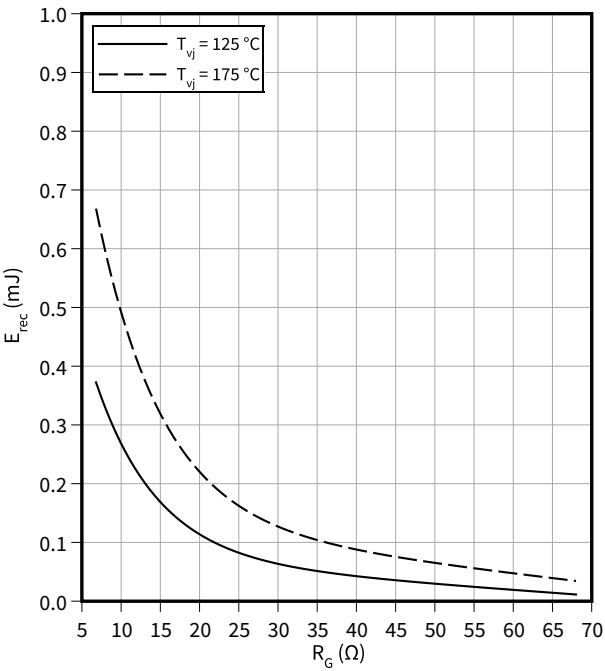
Switching losses body diode (typical), MOSFET, T1 / T2

$E_{rec} = f(I_{SD})$
 $R_{Gon} = 6.8\text{ }\Omega$, $R_{Gon,o} = 2.4\text{ }\Omega$, $V_{DD} = 600\text{ V}$



Switching losses body diode (typical), MOSFET, T1 / T2

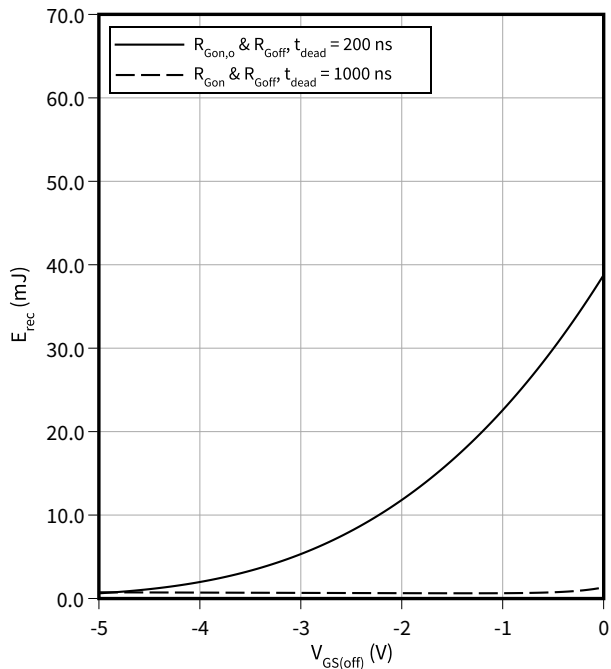
$E_{rec} = f(R_G)$
 $t_{dead} = 1000\text{ ns}$, $I_{SD} = 500\text{ A}$, $V_{DD} = 600\text{ V}$



5 Characteristics diagrams

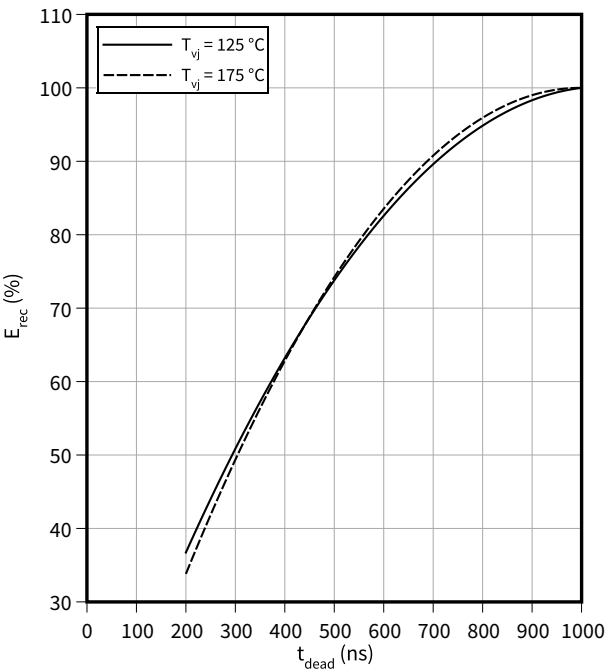
Switching losses body diode (typical), MOSFET, T1 / T2

$E_{rec} = f(V_{GS(off)})$
 $R_{Goff} = 3.9 \, \Omega$, $R_{Gon} = 6.8 \, \Omega$, $V_{GS(on)} = 18 \, V$, $I_{SD} = 500 \, A$, $R_{Gon,o} = 2.4 \, \Omega$, $V_{DD} = 600 \, V$, $T_{vj} = 175 \, ^\circ C$



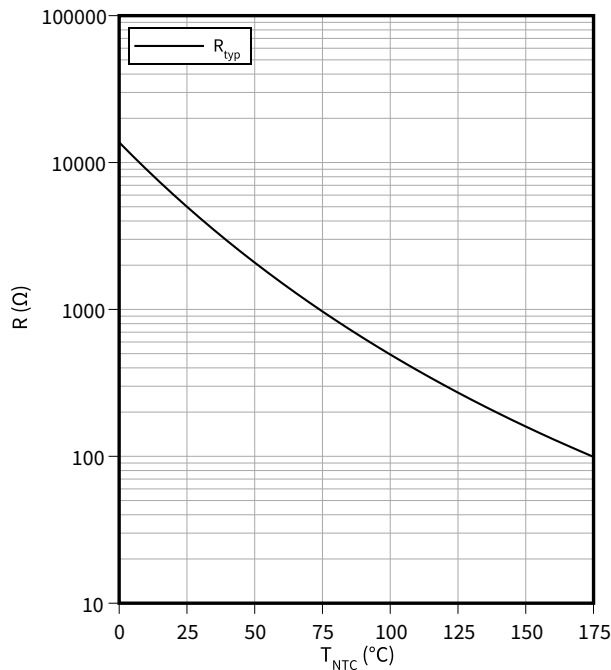
Switching losses body diode (typical), MOSFET, T1 / T2

$E_{rec} = f(t_{dead})$
 $R_{Gon} = 6.8 \, \Omega$, $I_D = 500 \, A$, $V_{DD} = 600 \, V$, $V_{GS} = -3/18 \, V$



Temperature characteristic (typical), NTC-Thermistor

$R = f(T_{NTC})$



6 Circuit diagram

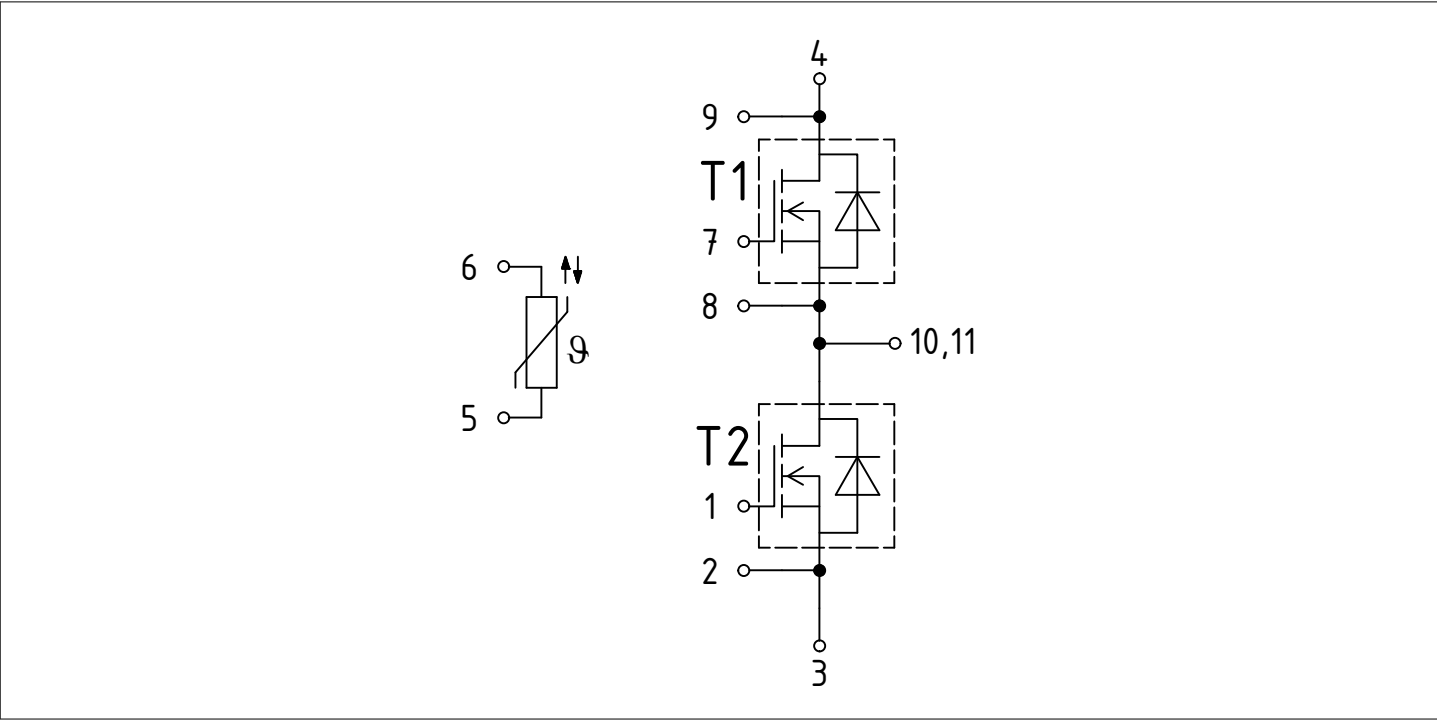


Figure 1

7 Package outlines

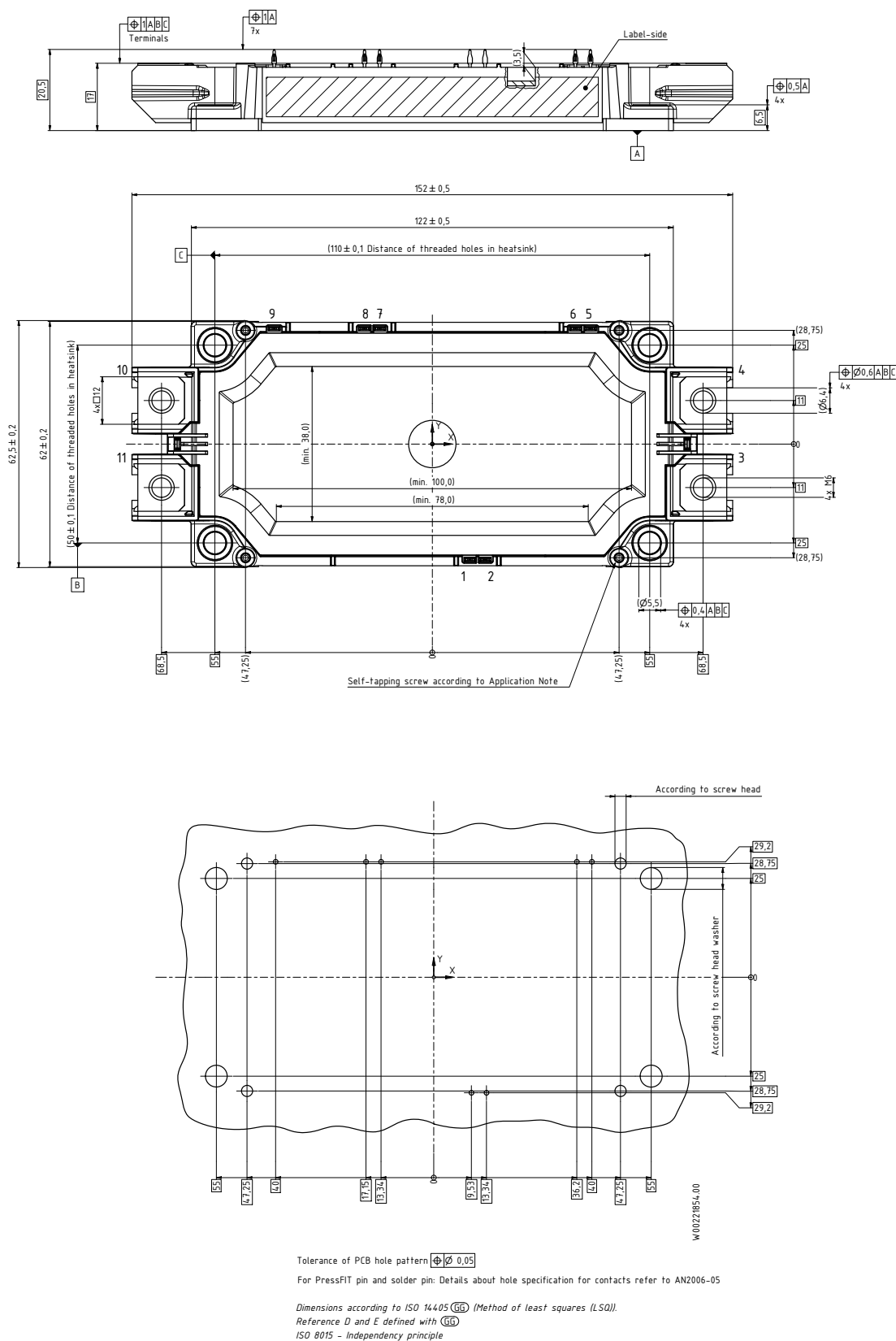


Figure 2

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	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

Revision history

Document revision	Date of release	Description of changes
0.10	2024-03-20	Initial version
0.20	2024-08-28	Target datasheet
1.00	2024-11-11	Final datasheet
1.01	2024-12-10	General update

Trademarks

All referenced product or service names and trademarks are the property of their respective owners.

Edition 2024-12-10

Published by

Infineon Technologies AG
81726 Munich, Germany

© 2024 Infineon Technologies AG
All Rights Reserved.

Do you have a question about any
aspect of this document?

Email: erratum@infineon.com

Document reference
IFX-ABI714-004

Important notice

The information given in this document shall in no event be regarded as a guarantee of conditions or characteristics ("Beschaffenhheitsgarantie").

With respect to any examples, hints or any typical values stated herein and/or any information regarding the application of the product, Infineon Technologies hereby disclaims any and all warranties and liabilities of any kind, including without limitation warranties of non-infringement of intellectual property rights of any third party.

In addition, any information given in this document is subject to customer's compliance with its obligations stated in this document and any applicable legal requirements, norms and standards concerning customer's products and any use of the product of Infineon Technologies in customer's applications.

The data contained in this document is exclusively intended for technically trained staff. It is the responsibility of customer's technical departments to evaluate the suitability of the product for the intended application and the completeness of the product information given in this document with respect to such application.

Warnings

Due to technical requirements products may contain dangerous substances. For information on the types in question please contact your nearest Infineon Technologies office.

Except as otherwise explicitly approved by Infineon Technologies in a written document signed by authorized representatives of Infineon Technologies, Infineon Technologies' products may not be used in any applications where a failure of the product or any consequences of the use thereof can reasonably be expected to result in personal injury.