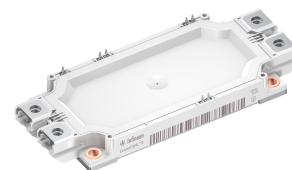


Final datasheet

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

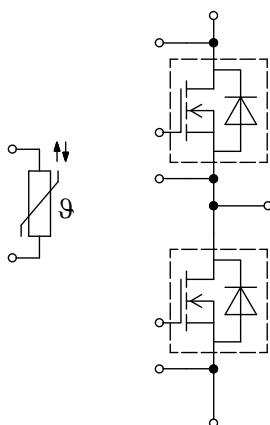


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1 Package

Table 1 Insulation coordination

Parameter	Symbol	Note or test condition	Values	Unit
Isolation test voltage	V_{ISOL}	RMS, $f = 50 \text{ Hz}$, $t = 1 \text{ min}$	3.4	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/(m²K)		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	$E_{rec,o}$	$I_{SD} = 500\text{ A}$, $di_s/dt = 9.3\text{ kA}/\mu\text{s}$ ($T_{vj} = 175^\circ\text{C}$), $V_{DD} = 600\text{ V}$, $V_{GS} = -3\text{ V}$, $t_{dead} = 200\text{ ns}$	$T_{vj} = 25^\circ\text{C}$	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

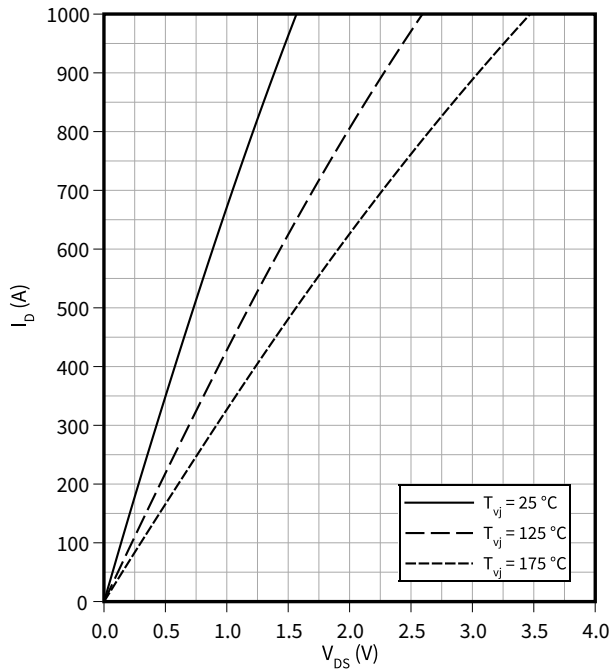
Note: For an analytical description of the NTC characteristics please refer to AN2009-10, chapter 4.

5 Characteristics diagrams

Output characteristic (typical), MOSFET, T1 / T2

$I_D = f(V_{DS})$

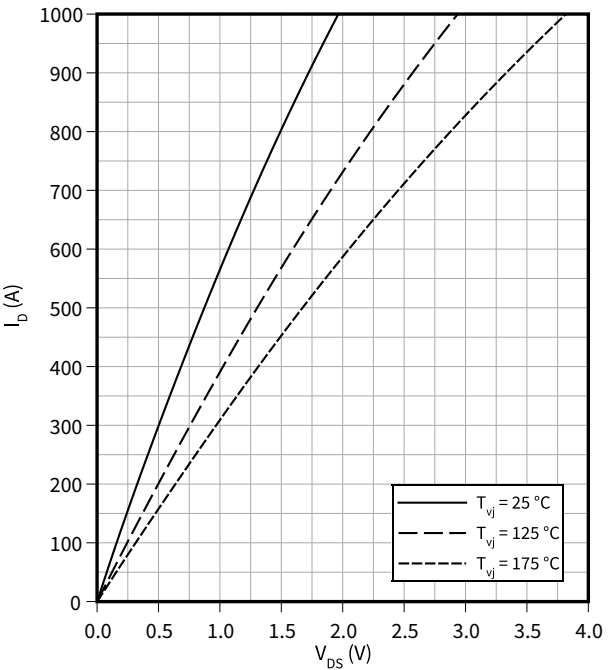
$V_{GS} = 18\text{ V}$



Output characteristic (typical), MOSFET, T1 / T2

$I_D = f(V_{DS})$

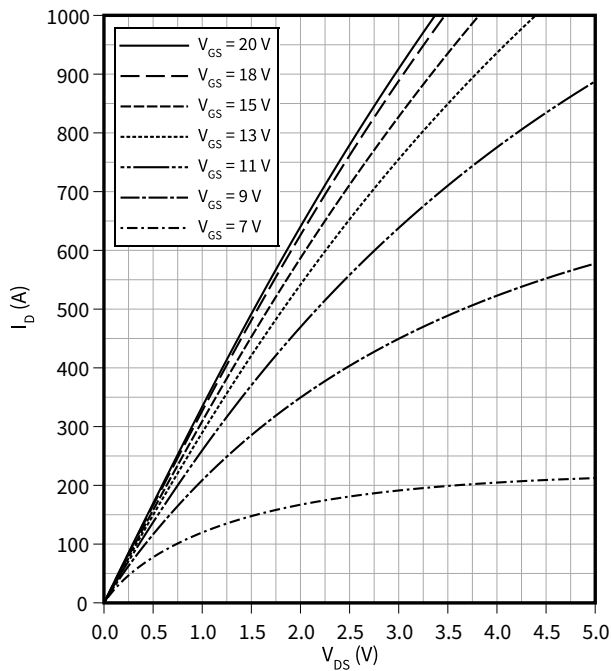
$V_{GS} = 15\text{ V}$



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

$I_D = f(V_{DS})$

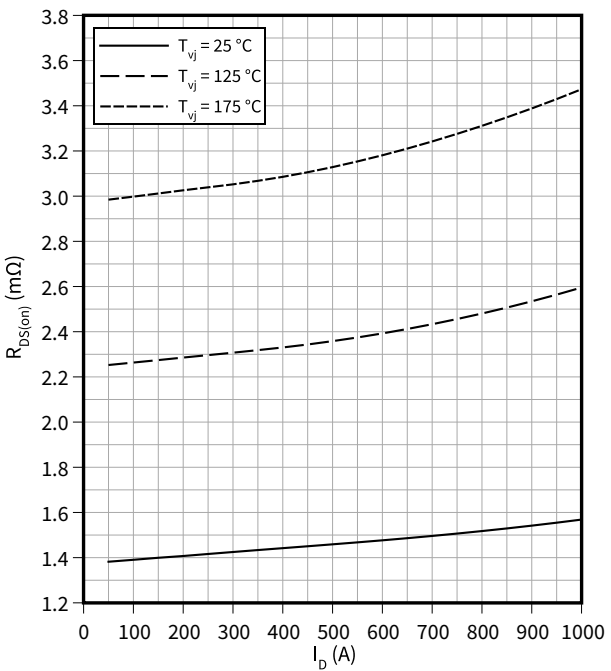
$T_{vj} = 175\text{ °C}$



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

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

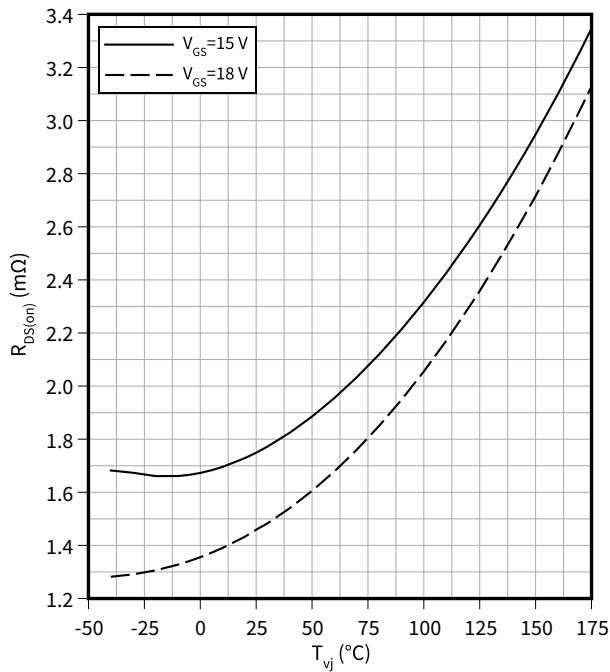
$V_{GS} = 18\text{ V}$



5 Characteristics diagrams

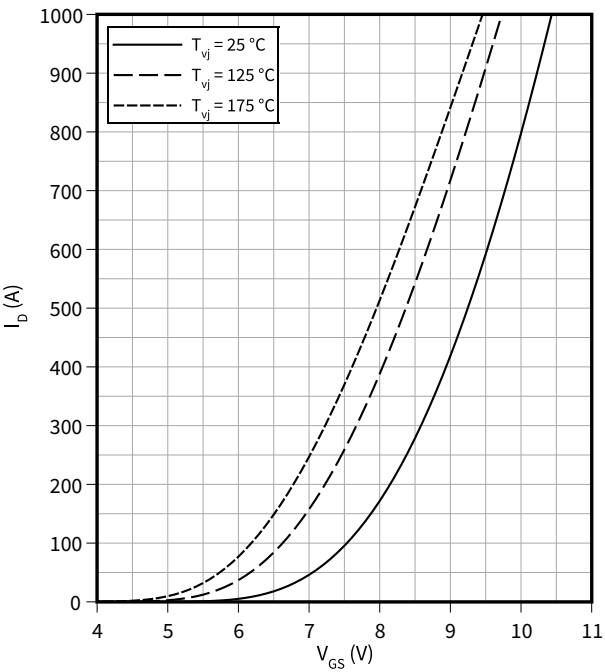
Drain source on-resistance (typical), MOSFET, T1 / T2

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



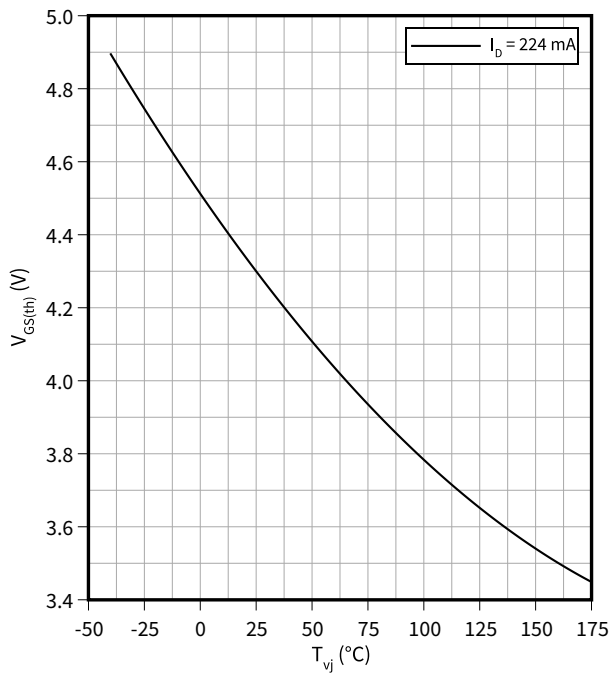
Transfer characteristic (typical), MOSFET, T1 / T2

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



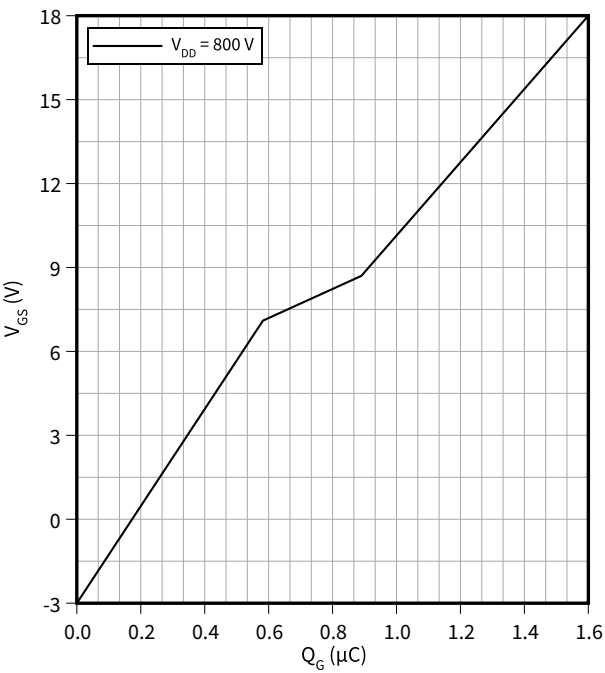
Gate-source threshold voltage (typical), MOSFET, T1 / T2

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



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

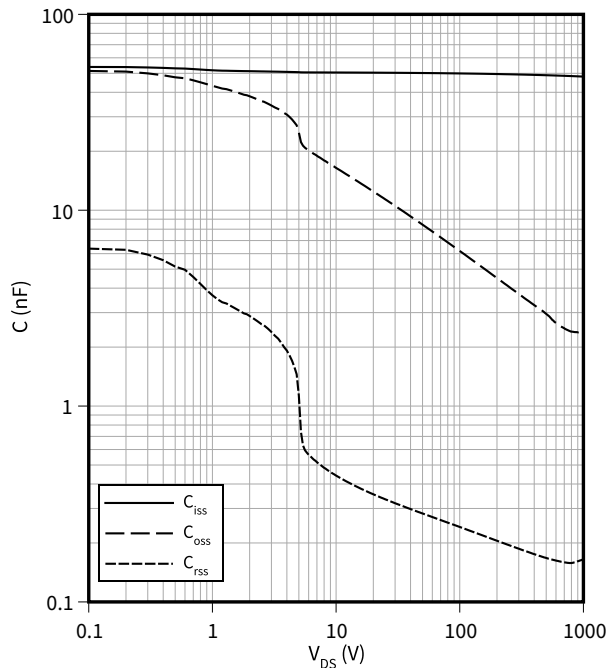
$V_{GS} = f(Q_G)$
 $I_D = 500\text{ A}, T_{vj} = 25\text{ °C}$



5 Characteristics diagrams

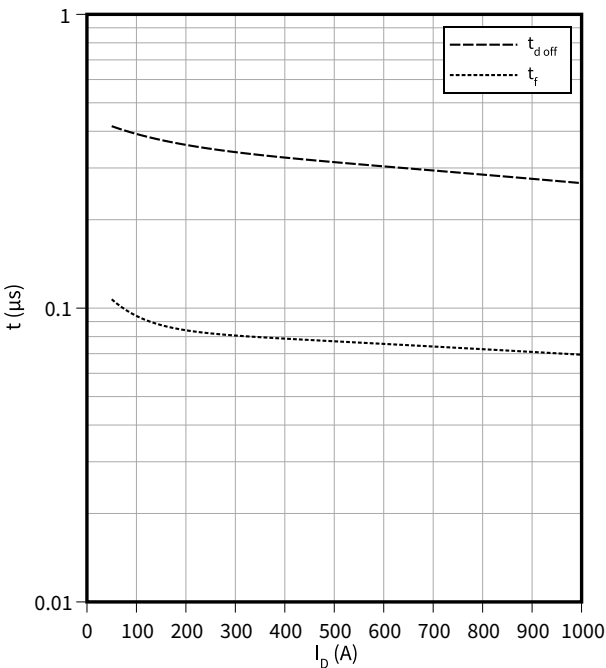
Capacity characteristic (typical), MOSFET, T1 / T2

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



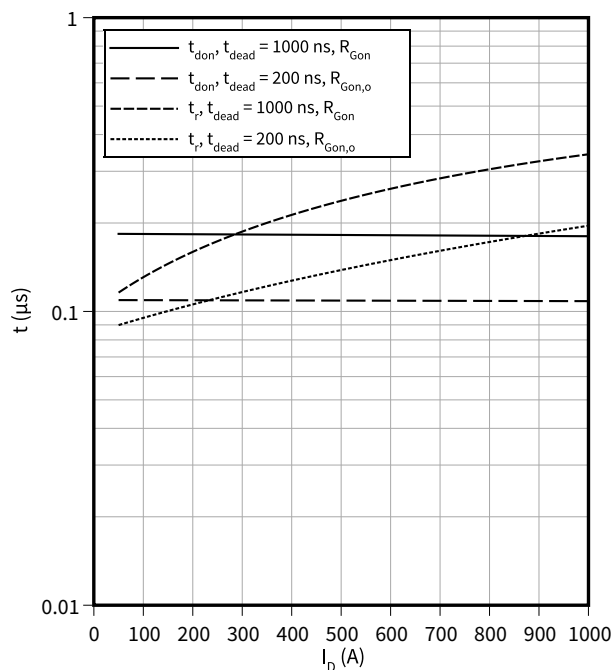
Switching times (typical), MOSFET, T1 / T2

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



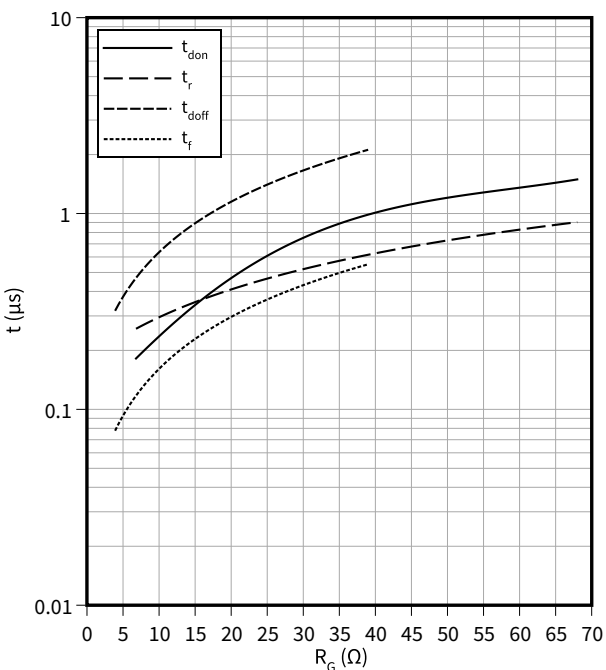
Switching times (typical), MOSFET, T1 / T2

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



Switching times (typical), MOSFET, T1 / T2

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

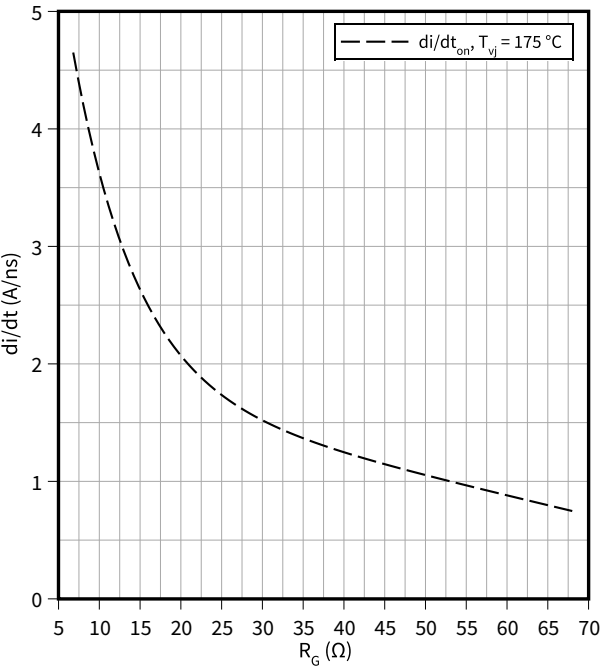


5 Characteristics diagrams

Current slope (typical), MOSFET, T1 / T2

$di/dt = f(R_G)$

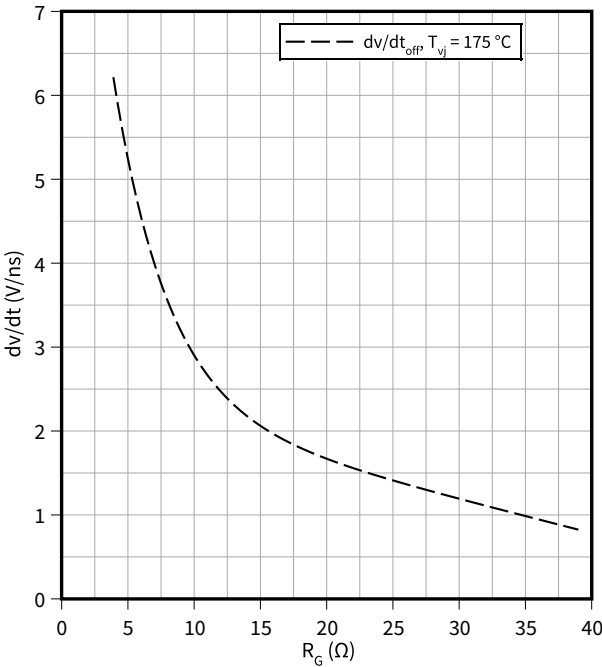
$V_{DD} = 600\text{ V}$, $I_D = 500\text{ A}$, $V_{GS} = -3/18\text{ V}$



Voltage slope (typical), MOSFET, T1 / T2

$dv/dt = f(R_G)$

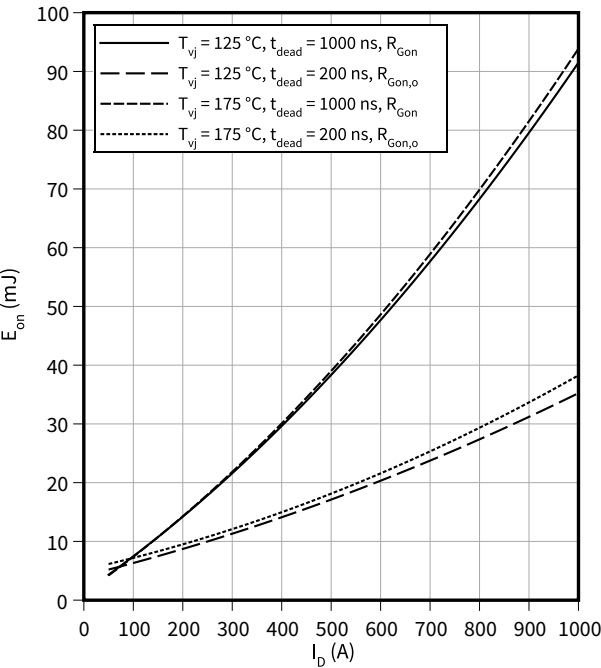
$V_{DD} = 600\text{ V}$, $I_D = 500\text{ A}$, $V_{GS} = -3/18\text{ V}$



Switching losses (typical), MOSFET, T1 / T2

$E_{on} = f(I_D)$

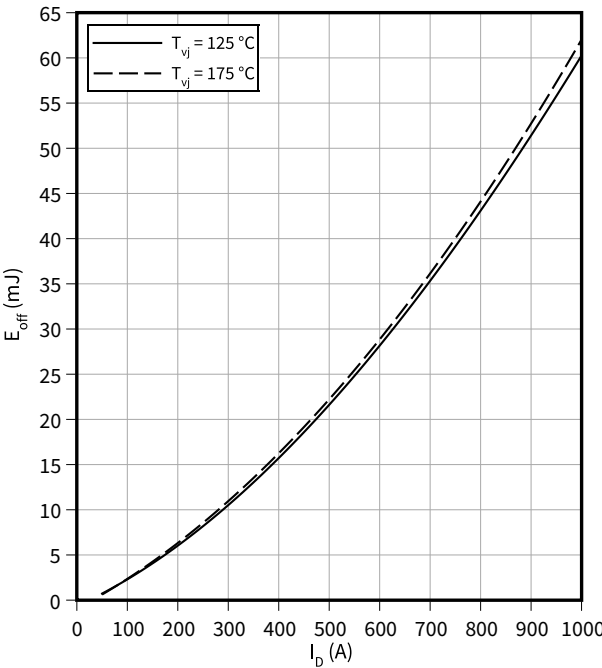
$V_{DD} = 600\text{ V}$, $R_{Gon} = 6.8\text{ }\Omega$, $R_{Gon,o} = 2.4\text{ }\Omega$, $V_{GS} = -3/18\text{ V}$



Switching losses (typical), MOSFET, T1 / T2

$E_{off} = f(I_D)$

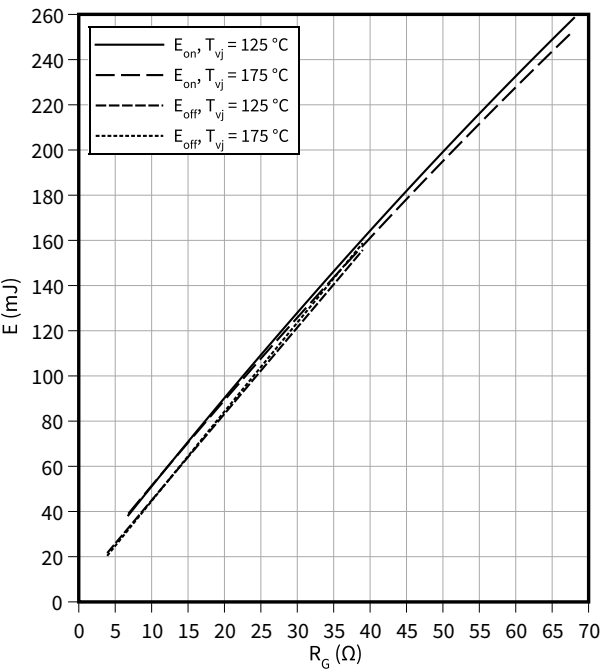
$R_{Goff} = 3.9\text{ }\Omega$, $V_{DD} = 600\text{ V}$, $V_{GS} = -3/18\text{ V}$



5 Characteristics diagrams

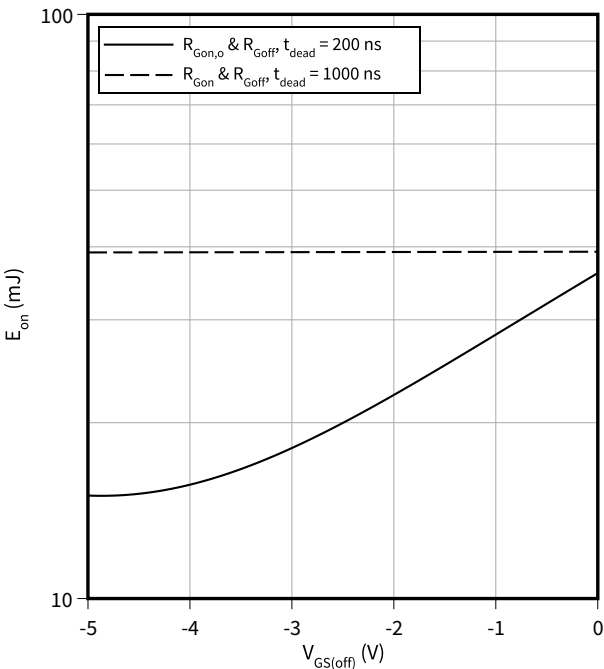
Switching losses (typical), MOSFET, T1 / T2

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



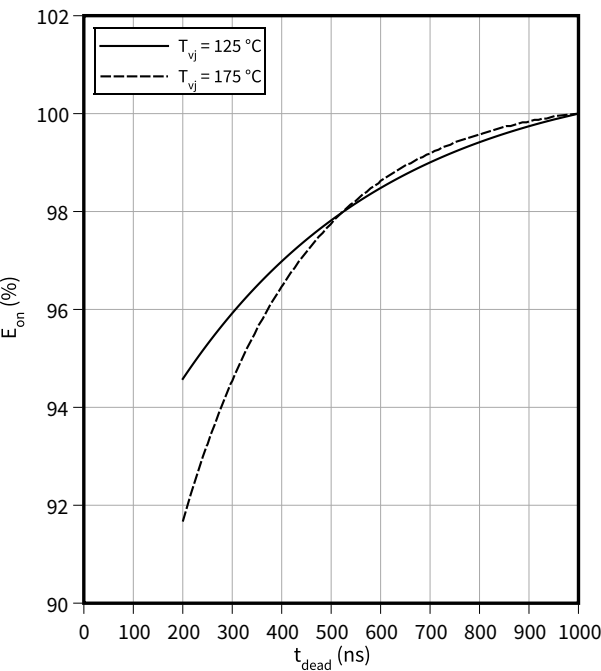
Switching losses (typical), MOSFET, T1 / T2

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



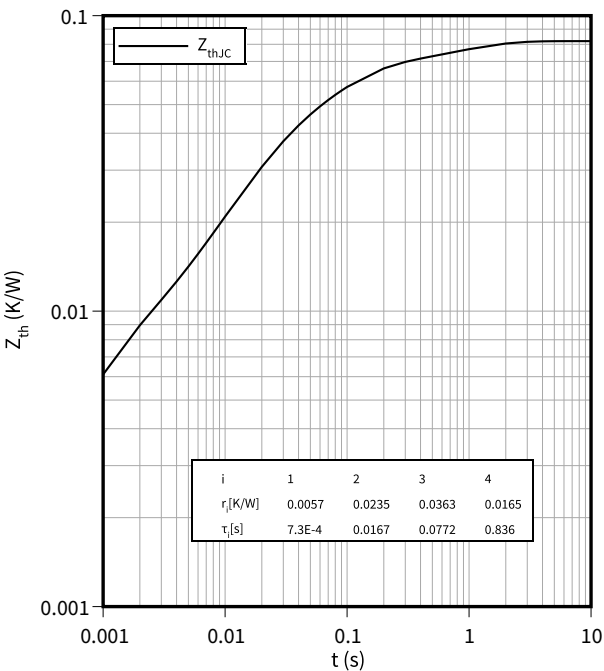
Switching losses (typical), MOSFET, T1 / T2

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



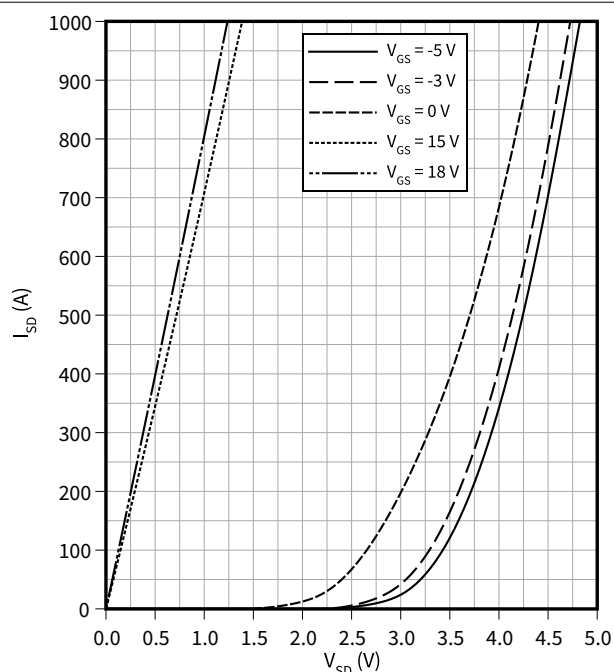
Transient thermal impedance, MOSFET, T1 / T2

$Z_{th} = f(t)$



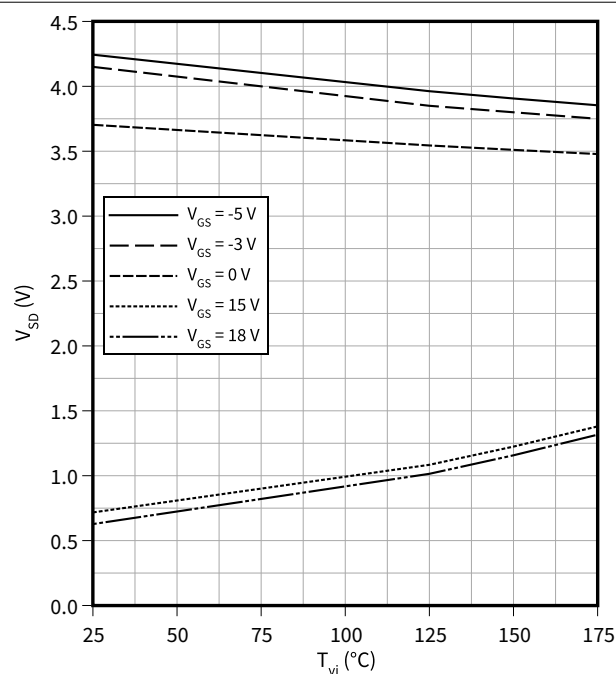
Forward characteristic body diode (typical), MOSFET, T1 / T2

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



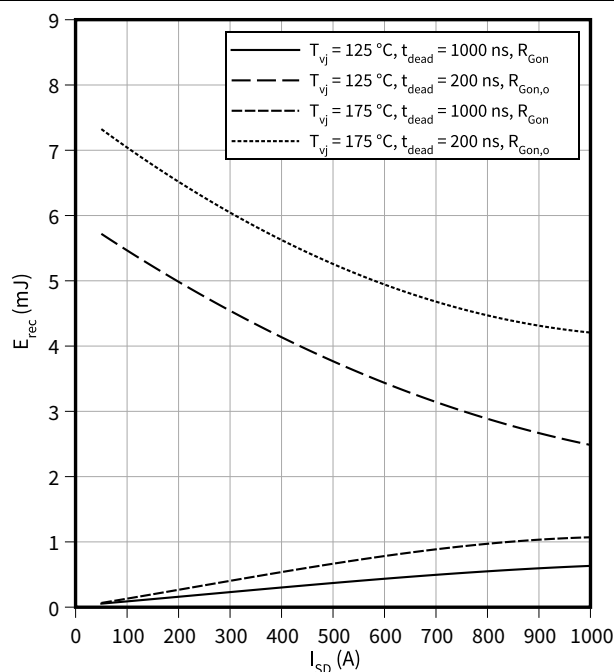
Forward voltage of body diode (typical), MOSFET, T1 / T2

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



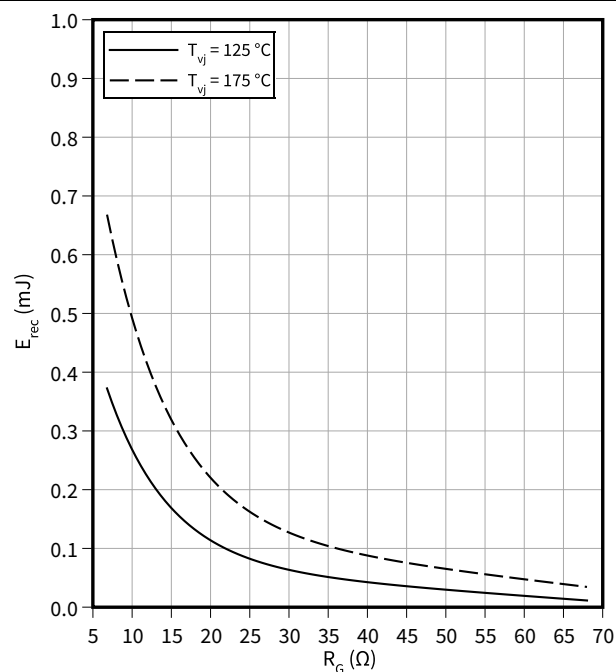
Switching losses body diode (typical), MOSFET, T1 / T2

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



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

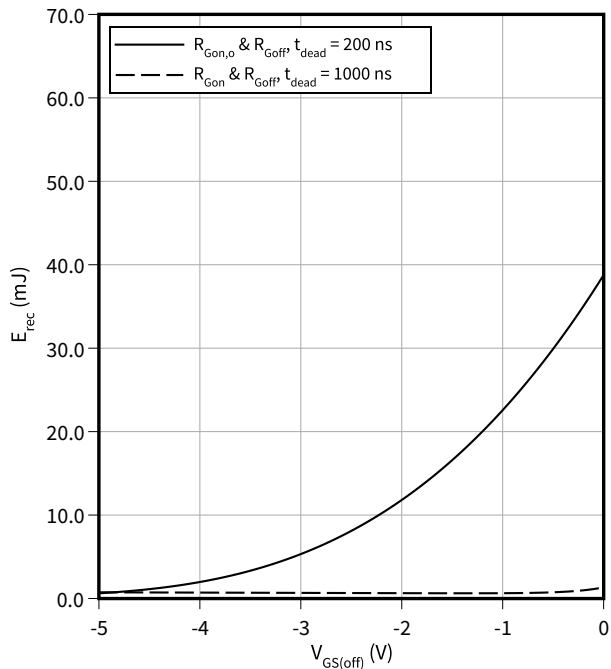
$E_{rec} = f(R_G)$
 $t_{dead} = 1000\text{ ns}$, $I_{SD} = 500\text{ A}$, $V_{DD} = 600\text{ V}$



5 Characteristics diagrams

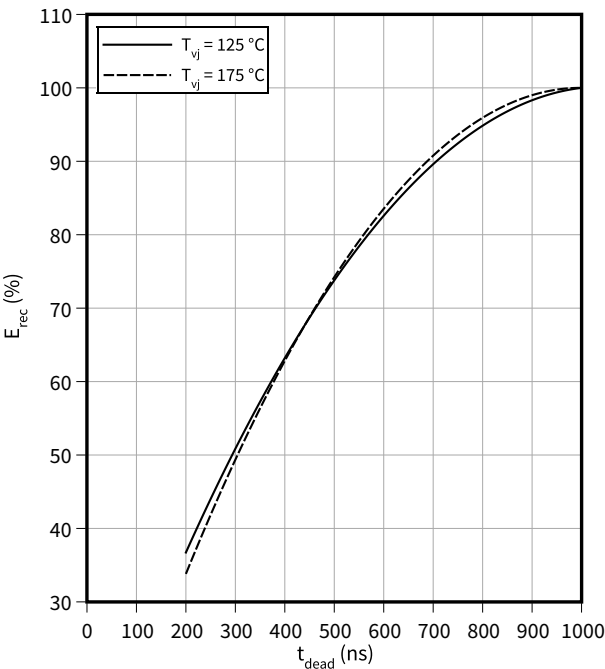
Switching losses body diode (typical), MOSFET, T1 / T2

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



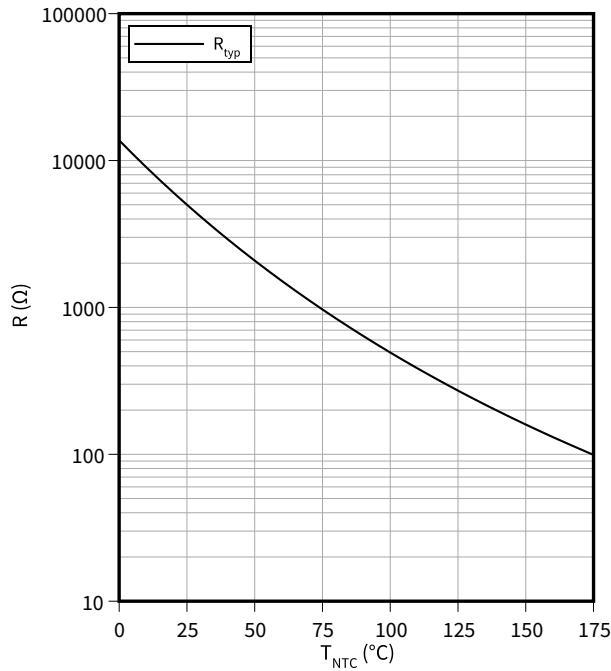
Switching losses body diode (typical), MOSFET, T1 / T2

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



Temperature characteristic (typical), NTC-Thermistor

$R = f(T_{NTC})$



6 Circuit diagram

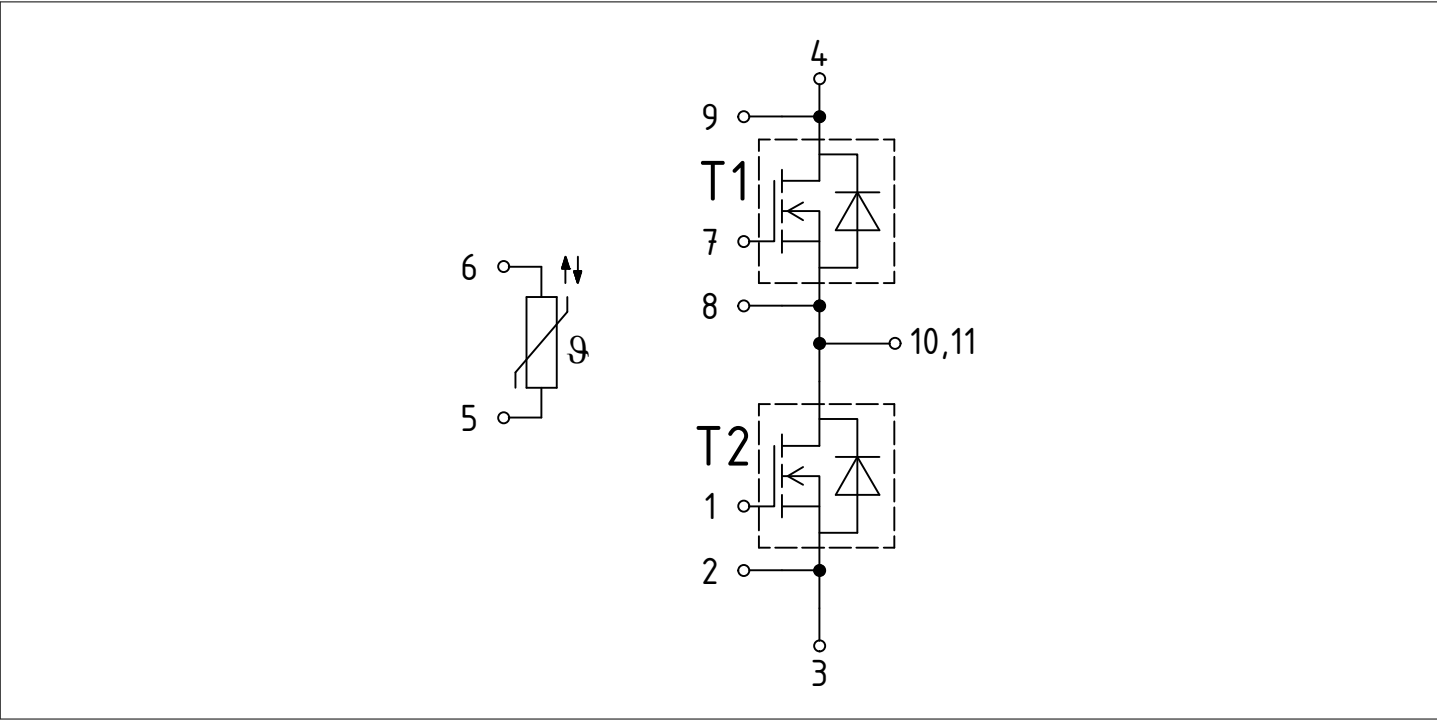


Figure 1

7 Package outlines

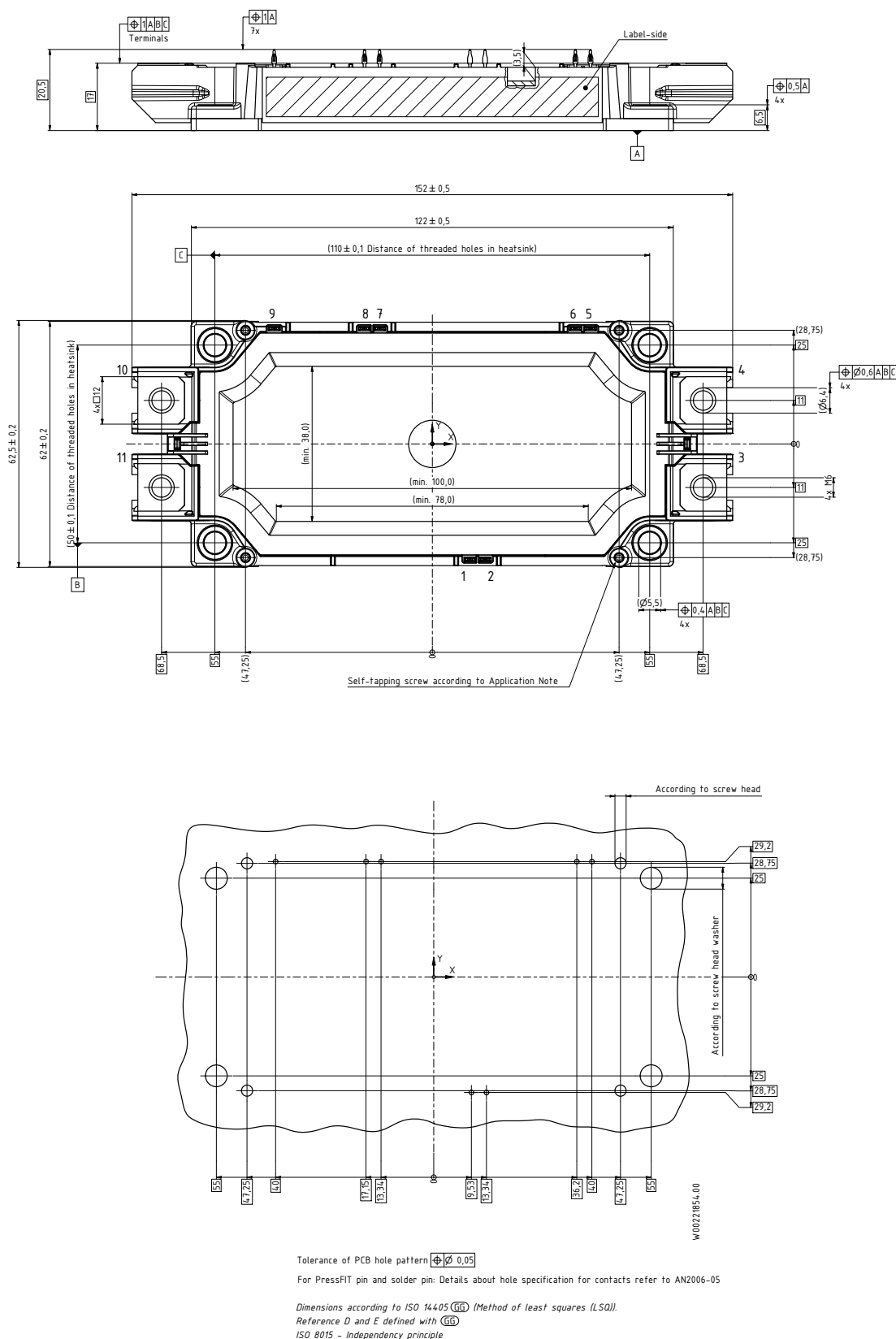


Figure 2

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	<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

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

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