

Final datasheet

EasyPACK™ module with CoolSiC™ Trench MOSFET and High Current Pin / NTC

Features

- Electrical features
 - $V_{DS} = 2000\text{ V}$
 - $I_{DN} = 400\text{ A}$ / $I_{DRM} = 640\text{ A}$
 - Low switching losses
 - High current density
 - Suitable Infineon gate drivers can be found under <https://www.infineon.com/gdfinder>
- Mechanical features
 - 3.2 kV AC 1 minute insulation
 - High current pin
 - PressFIT contact technology
 - Rugged mounting due to integrated mounting clamps
 - Integrated NTC temperature sensor



Potential applications

- Energy storage systems (ESS)
- EV charging
- UPS systems
- Solar applications

Product validation

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

Description

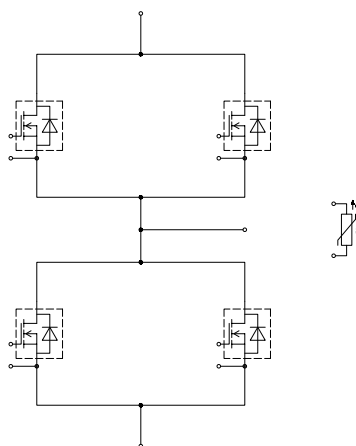


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1 Package

Table 1 Insulation coordination

Parameter	Symbol	Note or test condition	Values	Unit
Isolation test voltage	V_{ISOL}	RMS, $f = 50 \text{ Hz}$, $t = 1 \text{ min}$	3.2	kV
Isolation test voltage NTC	$V_{ISOL(NTC)}$	RMS, $f = 50 \text{ Hz}$, $t = 1 \text{ min}$	3.2	kV
Internal isolation		basic insulation (class 1, IEC 61140)	Al_2O_3	
Comparative tracking index	CTI		> 400	
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}			17		nH
Module lead resistance, terminals - chip	$R_{CC'+EE'}$	$T_H = 25 \text{ °C}$, per switch		1		mΩ
Storage temperature	T_{stg}		-40		125	°C
Mounting torque for module mounting	M	- Mounting according to valid application note	M5, Screw	1.3	1.5	Nm
Weight	G			78		g

Note: The current under continuous operation is limited to 50A rms per high current pin.

2 MOSFET, T1.1-T1.2 / T2.1-T2.2

Table 3 Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
Drain-source voltage	V_{DSS}		$T_{vj} = 25 \text{ °C}$	2000	V
Implemented drain current	I_{DN}			400	A
Continuous DC drain current	I_{DDC}	$T_{vj} = 175 \text{ °C}$, $V_{GS} = 18 \text{ V}$	$T_H = 65 \text{ °C}$	275	A
Repetitive peak drain current	I_{DRM}	verified by design, t_p limited by T_{vjmax}		640	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	$R_{DS(on)}$	$I_D = 320\text{ A}$	$V_{GS} = 18\text{ V}, T_{vj} = 25\text{ °C}$		2.6	4.1	mΩ
			$V_{GS} = 18\text{ V}, T_{vj} = 125\text{ °C}$		5.4		
			$V_{GS} = 18\text{ V}, T_{vj} = 175\text{ °C}$		7.7		
			$V_{GS} = 15\text{ V}, T_{vj} = 25\text{ °C}$		2.8		
Gate threshold voltage	$V_{GS(th)}$	$I_D = 224\text{ mA}, V_{DS} = V_{GS},$ (tested after 1ms pulse at $V_{GS} = +20\text{ V}$), $T_{vj} = 25\text{ °C}$		3.45	4.3	5.15	V
Total gate charge	Q_G	$V_{DD} = 1200\text{ V}, V_{GS} = -3/18\text{ V}, T_{vj} = 25\text{ °C}$			1.56		μC
Internal gate resistor	R_{Gint}	$T_{vj} = 25\text{ °C}$			0.9		Ω
Input capacitance	C_{ISS}	$f = 100\text{ kHz}, V_{DS} = 1500\text{ V}, V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ °C}$		47.9		nF
Output capacitance	C_{OSS}	$f = 100\text{ kHz}, V_{DS} = 1500\text{ V}, V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ °C}$		1.12		nF
Reverse transfer capacitance	C_{rSS}	$f = 100\text{ kHz}, V_{DS} = 1500\text{ V}, V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ °C}$		0.084		nF
C_{OSS} stored energy	E_{OSS}	$V_{DS} = 1500\text{ V}, V_{GS} = -3/18\text{ V}, T_{vj} = 25\text{ °C}$			1470		μJ
Drain-source leakage current	I_{DSS}	$V_{DS} = 2000\text{ V}, V_{GS} = -3\text{ V}$	$T_{vj} = 25\text{ °C}$		0.08	660	μA
Gate-source leakage current	I_{GSS}	$V_{DS} = 0\text{ V}, T_{vj} = 25\text{ °C}$	$V_{GS} = 20\text{ V}$			400	nA
Turn-on delay time (inductive load)	$t_{d\ on}$	$I_D = 320\text{ A}, R_{Gon} = 3\text{ Ω}, V_{DD} = 1500\text{ V}, V_{GS} = -3/18\text{ V}, t_{dead} = 1000\text{ ns}$	$T_{vj} = 25\text{ °C}$		86		ns
			$T_{vj} = 125\text{ °C}$		82		
			$T_{vj} = 175\text{ °C}$		81		
Rise time (inductive load)	t_r	$I_D = 320\text{ A}, R_{Gon} = 3\text{ Ω}, V_{DD} = 1500\text{ V}, V_{GS} = -3/18\text{ V}, t_{dead} = 1000\text{ ns}$	$T_{vj} = 25\text{ °C}$		44		ns
			$T_{vj} = 125\text{ °C}$		39		
			$T_{vj} = 175\text{ °C}$		39		

(table continues...)

Table 5 (continued) Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Turn-off delay time (inductive load)	$t_{d\ off}$	$I_D = 320\text{ A}$, $R_{Goff} = 1\ \Omega$, $V_{DD} = 1500\text{ V}$, $V_{GS} = -3/18\text{ V}$	$T_{vj} = 25\text{ °C}$	123		ns
			$T_{vj} = 125\text{ °C}$	136		
			$T_{vj} = 175\text{ °C}$	142		
Fall time (inductive load)	t_f	$I_D = 320\text{ A}$, $R_{Goff} = 1\ \Omega$, $V_{DD} = 1500\text{ V}$, $V_{GS} = -3/18\text{ V}$	$T_{vj} = 25\text{ °C}$	62		ns
			$T_{vj} = 125\text{ °C}$	65		
			$T_{vj} = 175\text{ °C}$	67		
Turn-on energy loss per pulse	E_{on}	$I_D = 320\text{ A}$, $V_{DD} = 1500\text{ V}$, $L_\sigma = 8\text{ nH}$, $V_{GS} = -3/18\text{ V}$, $R_{Gon} = 3\ \Omega$, $di/dt = 9$ $\text{kA}/\mu\text{s}$ ($T_{vj} = 175\text{ °C}$), $t_{dead} = 1000\text{ ns}$	$T_{vj} = 25\text{ °C}$	44.3		mJ
			$T_{vj} = 125\text{ °C}$	49.7		
			$T_{vj} = 175\text{ °C}$	56.5		
Turn-on energy loss per pulse, optimized	$E_{on,o}$	$I_D = 320\text{ A}$, $V_{DD} = 1500\text{ V}$, $L_\sigma = 8\text{ nH}$, $V_{GS} = -3/18\text{ V}$, $R_{Gon,o} = 1\ \Omega$, $di/dt =$ $17\text{ kA}/\mu\text{s}$ ($T_{vj} = 175\text{ °C}$), $t_{dead} = 100\text{ ns}$	$T_{vj} = 25\text{ °C}$	22.2		mJ
			$T_{vj} = 125\text{ °C}$	23.7		
			$T_{vj} = 175\text{ °C}$	26.6		
Turn-off energy loss per pulse	E_{off}	$I_D = 320\text{ A}$, $V_{DD} = 1500\text{ V}$, $L_\sigma = 8\text{ nH}$, $V_{GS} = -3/18\text{ V}$, $R_{Goff} = 1\ \Omega$, $dv/dt = 26.6$ $\text{kV}/\mu\text{s}$ ($T_{vj} = 175\text{ °C}$)	$T_{vj} = 25\text{ °C}$	12		mJ
			$T_{vj} = 125\text{ °C}$	13.5		
			$T_{vj} = 175\text{ °C}$	14		
Thermal resistance, junction to heat sink	R_{thJH}	per MOSFET, $\lambda_{grease} = 3.3\text{ W}/(\text{m}\cdot\text{K})$		0.12		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 detailed specifications, please refer to AN 2018-14.

3 Body diode (MOSFET, T1.1-T1.2 / T2.1-T2.2)

Table 6 Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
DC body diode forward current	I_{SD}	$T_{vj} = 175\text{ °C}$, $V_{GS} = -3\text{ V}$	$T_H = 65\text{ °C}$	210	A

Table 7 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Forward voltage	V_{SD}	$I_{SD} = 320 \text{ A}$, $V_{GS} = -3 \text{ V}$	$T_{vj} = 25 \text{ °C}$	4.4	5.95	V
			$T_{vj} = 125 \text{ °C}$	4		
			$T_{vj} = 175 \text{ °C}$	3.85		
Peak reverse recovery current	I_{rrm}	$I_{SD} = 320 \text{ A}$, $di_s/dt = 9 \text{ kA}/\mu\text{s}$, $V_{DD} = 1500 \text{ V}$, $V_{GS} = -3 \text{ V}$, $t_{dead} = 1000 \text{ ns}$	$T_{vj} = 25 \text{ °C}$	156		A
			$T_{vj} = 125 \text{ °C}$	229		
			$T_{vj} = 175 \text{ °C}$	292		
Recovered charge	Q_{rr}	$I_{SD} = 320 \text{ A}$, $di_s/dt = 9 \text{ kA}/\mu\text{s}$, $V_{DD} = 1500 \text{ V}$, $V_{GS} = -3 \text{ V}$, $t_{dead} = 1000 \text{ ns}$	$T_{vj} = 25 \text{ °C}$	9.2		μC
			$T_{vj} = 125 \text{ °C}$	14.8		
			$T_{vj} = 175 \text{ °C}$	19.7		
Reverse recovery energy	E_{rec}	$I_{SD} = 320 \text{ A}$, $di_s/dt = 9 \text{ kA}/\mu\text{s}$ ($T_{vj} = 175 \text{ °C}$), $V_{DD} = 1500 \text{ V}$, $V_{GS} = -3 \text{ V}$, $t_{dead} = 1000 \text{ ns}$	$T_{vj} = 25 \text{ °C}$	8.1		mJ
			$T_{vj} = 125 \text{ °C}$	10.2		
			$T_{vj} = 175 \text{ °C}$	11.9		
Reverse recovery energy, optimized	$E_{rec,o}$	$I_{SD} = 320 \text{ A}$, $di_s/dt = 17 \text{ kA}/\mu\text{s}$ ($T_{vj} = 175 \text{ °C}$), $V_{DD} = 1500 \text{ V}$, $V_{GS} = -3 \text{ V}$, $t_{dead} = 100 \text{ ns}$	$T_{vj} = 25 \text{ °C}$	10.8		mJ
			$T_{vj} = 125 \text{ °C}$	12.5		
			$T_{vj} = 175 \text{ °C}$	13		

4 NTC-Thermistor

Table 8 Characteristic values

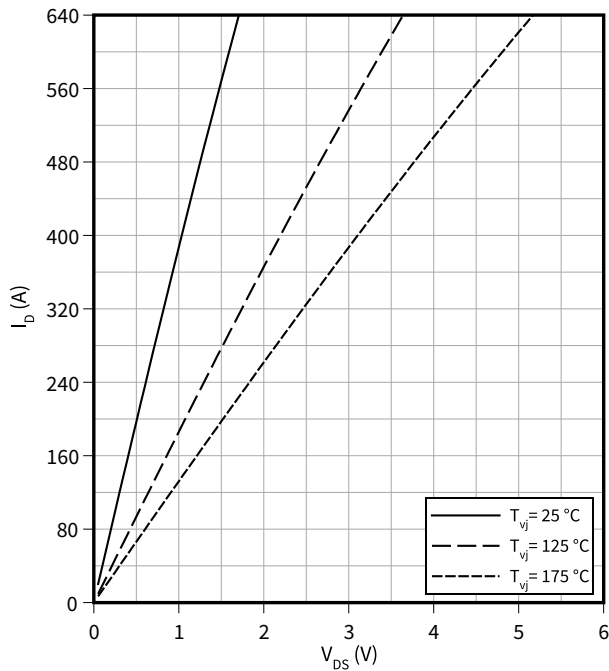
Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Rated resistance	R_{25}	$T_{NTC} = 25 \text{ °C}$		5		k Ω
Deviation of R_{100}	$\Delta R/R$	$T_{NTC} = 100 \text{ °C}$, $R_{100} = 493 \text{ }\Omega$	-5		5	%
Power dissipation	P_{25}	$T_{NTC} = 25 \text{ °C}$			20	mW
B-value	$B_{25/50}$	$R_2 = R_{25} \exp[B_{25/50}(1/T_2 - 1/(298,15 \text{ K}))]$		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: For an analytical description of the NTC characteristics please refer to AN2009-10, chapter 4

5 Characteristics diagrams

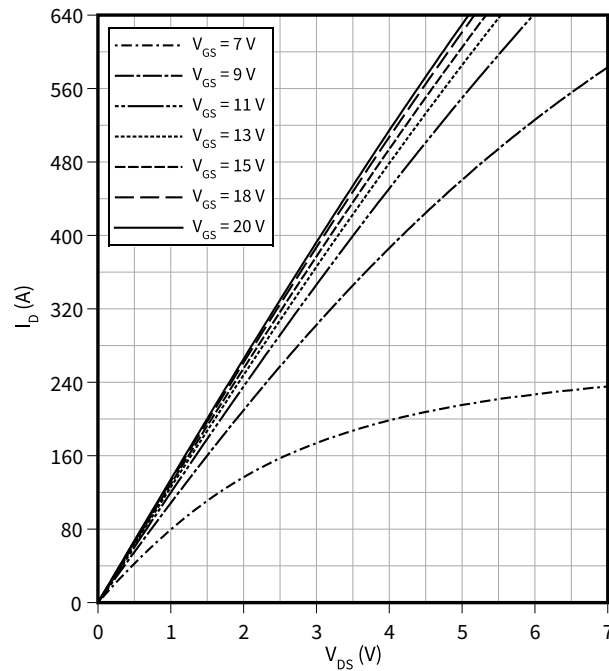
Output characteristic (typical), MOSFET, T1.1-T1.2 / T2.1-T2.2

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



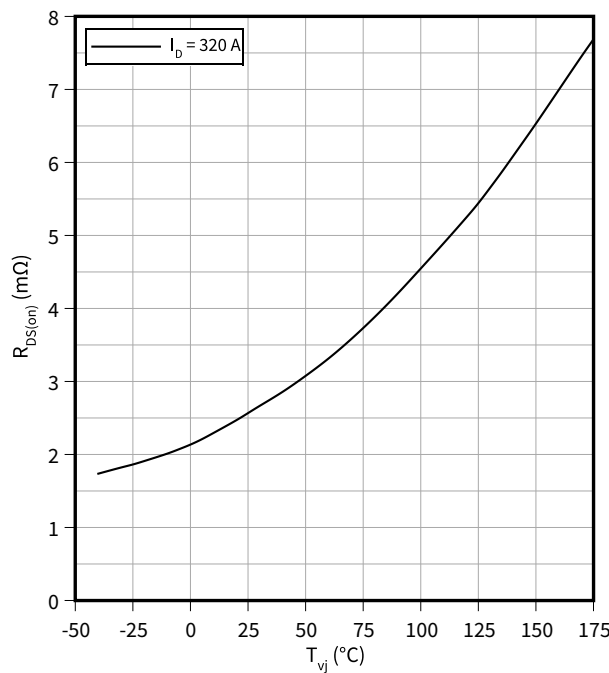
Output characteristic field (typical), MOSFET, T1.1-T1.2 / T2.1-T2.2

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



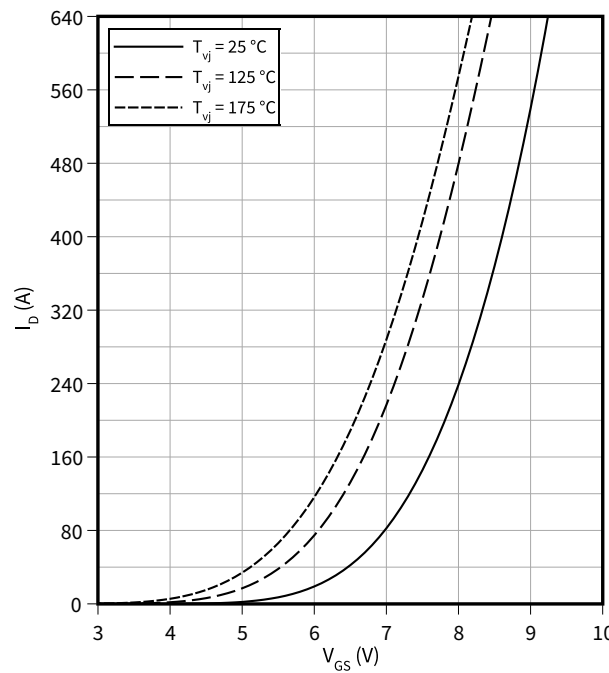
Drain source on-resistance (typical), MOSFET, T1.1-T1.2 / T2.1-T2.2

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



Transfer characteristic (typical), MOSFET, T1.1-T1.2 / T2.1-T2.2

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

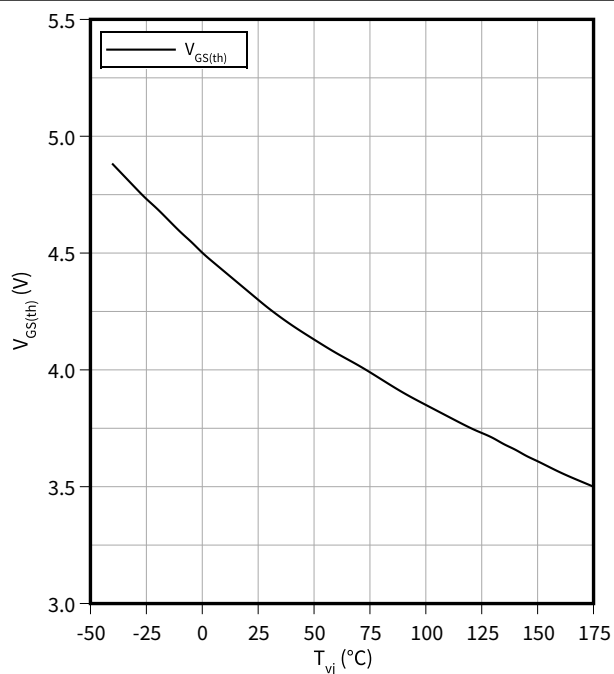


5 Characteristics diagrams

Gate-source threshold voltage (typical), MOSFET, T1.1-T1.2 / T2.1-T2.2

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

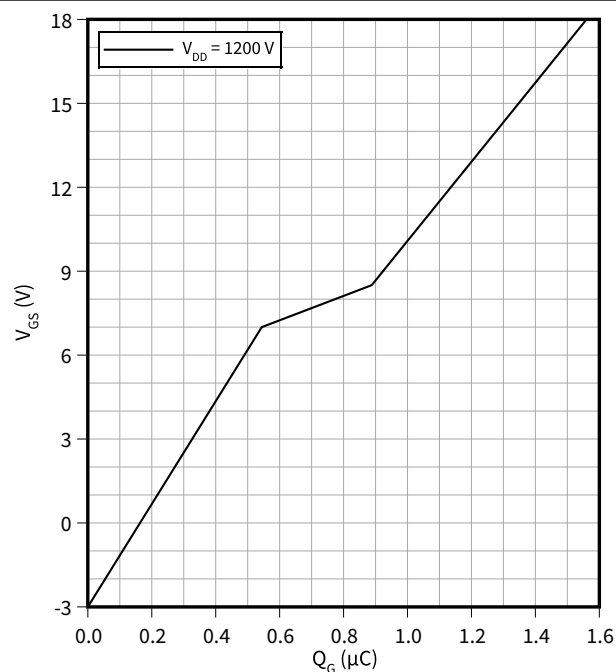
$$I_D = 224 \text{ mA}, V_{GS} = V_{DS}$$



Gate charge characteristic (typical), MOSFET, T1.1-T1.2 / T2.1-T2.2

$$V_{GS} = f(Q_G)$$

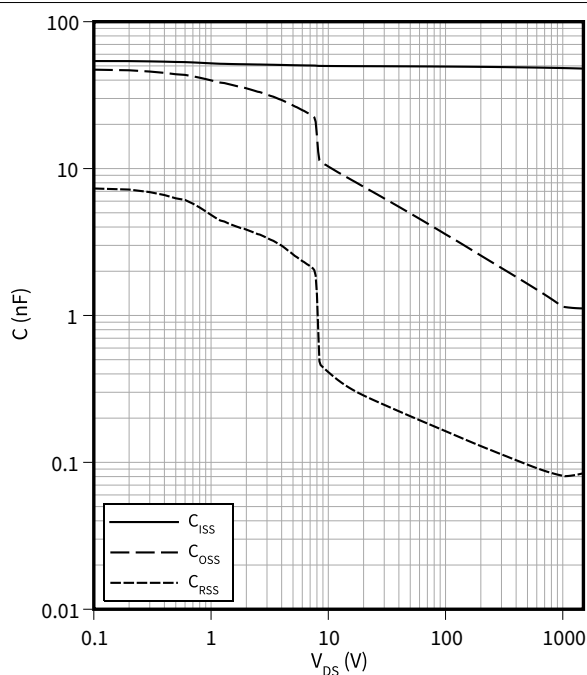
$$I_D = 320 \text{ A}, T_{vj} = 25 \text{ °C}$$



Capacity characteristic (typical), MOSFET, T1.1-T1.2 / T2.1-T2.2

$$C = f(V_{DS})$$

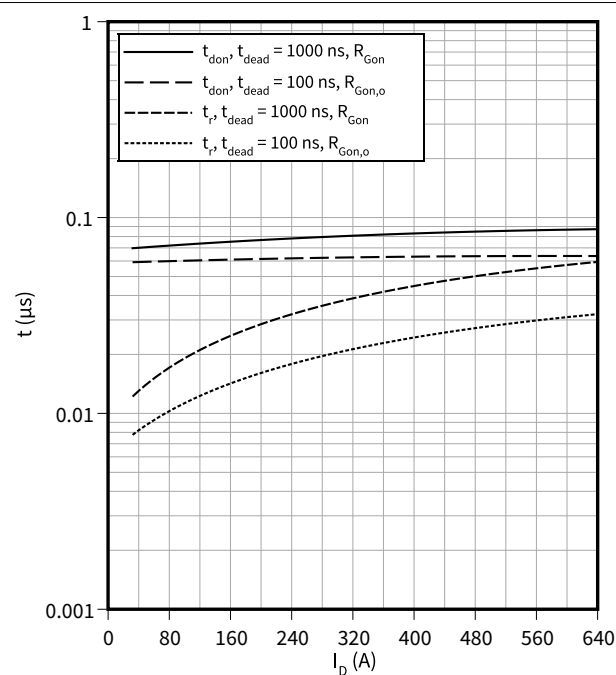
$$f = 100 \text{ kHz}, T_{vj} = 25 \text{ °C}, V_{GS} = 0 \text{ V}$$



Switching times (typical), MOSFET, T1.1-T1.2 / T2.1-T2.2

$$t = f(I_D)$$

$$V_{DD} = 1500 \text{ V}, R_{Gon} = 3 \text{ } \Omega, R_{Gon,o} = 1 \text{ } \Omega, T_{vj} = 175 \text{ °C}, V_{GS} = -3/18 \text{ V}$$

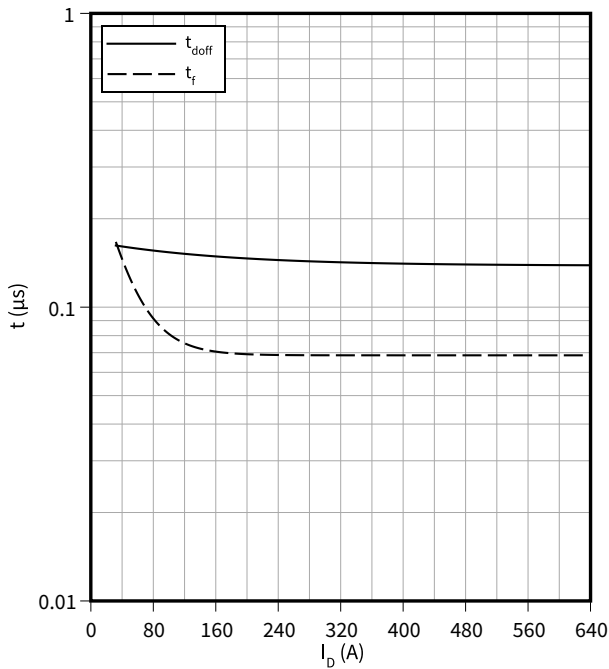


5 Characteristics diagrams

Switching times (typical), MOSFET, T1.1-T1.2 / T2.1-T2.2

$t = f(I_D)$

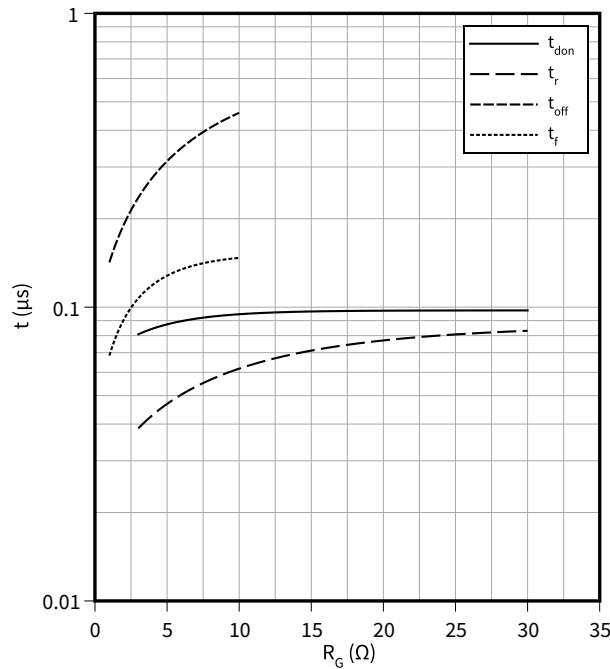
$R_{Goff} = 1 \Omega$, $V_{DD} = 1500 \text{ V}$, $T_{vj} = 175 \text{ }^\circ\text{C}$, $V_{GS} = -3/18 \text{ V}$



Switching times (typical), MOSFET, T1.1-T1.2 / T2.1-T2.2

$t = f(R_G)$

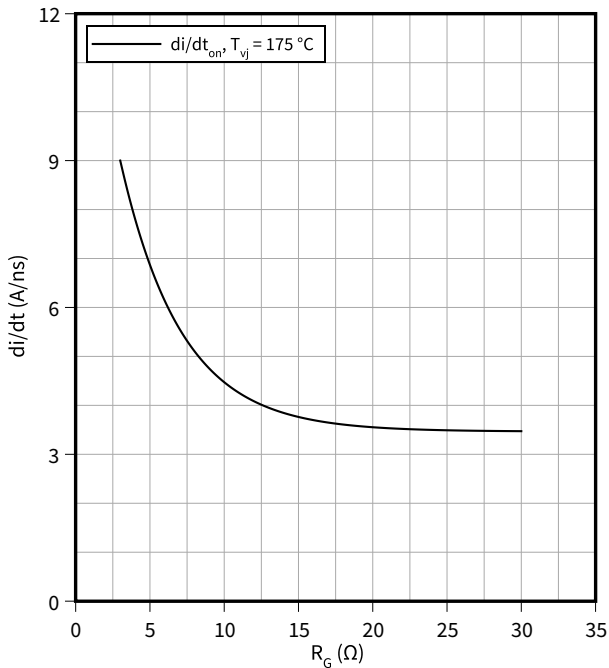
$V_{DD} = 1500 \text{ V}$, $t_{dead} = 1000 \text{ ns}$, $I_D = 320 \text{ A}$, $T_{vj} = 175 \text{ }^\circ\text{C}$, $V_{GS} = -3/18 \text{ V}$



Current slope (typical), MOSFET, T1.1-T1.2 / T2.1-T2.2

$di/dt = f(R_G)$

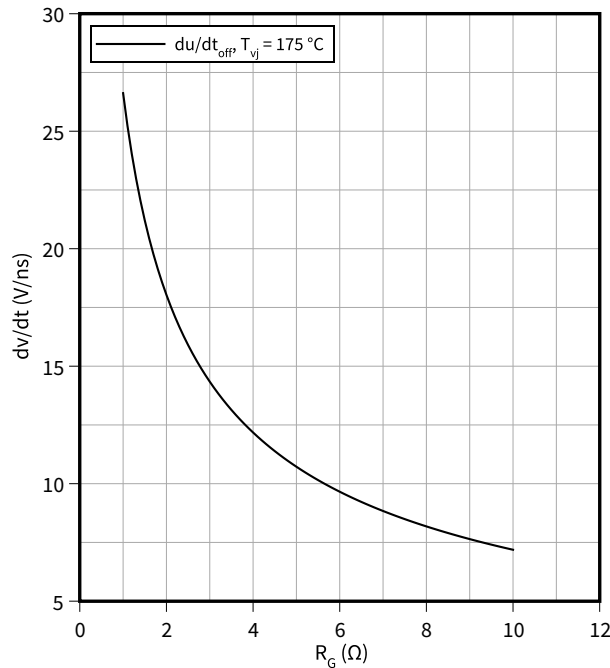
$V_{DD} = 1500 \text{ V}$, $I_D = 320 \text{ A}$, $V_{GS} = -3/18 \text{ V}$



Voltage slope (typical), MOSFET, T1.1-T1.2 / T2.1-T2.2

$dv/dt = f(R_G)$

$V_{DD} = 1500 \text{ V}$, $I_D = 320 \text{ A}$, $V_{GS} = -3/18 \text{ V}$

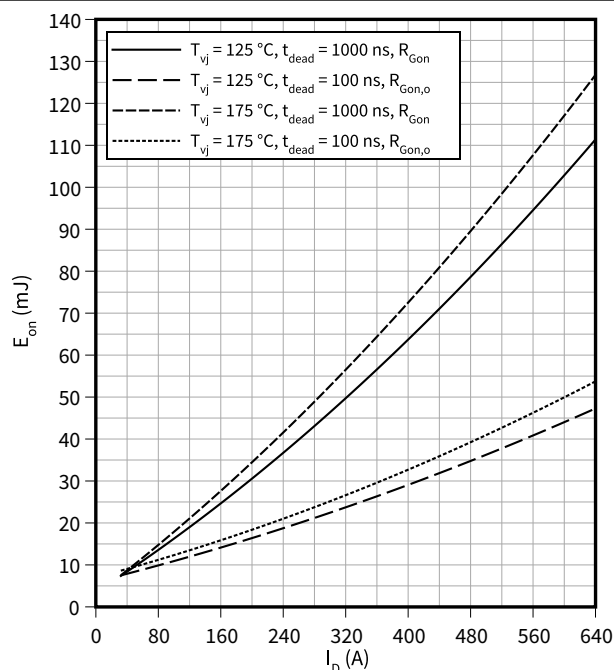


5 Characteristics diagrams

Switching losses (typical), MOSFET, T1.1-T1.2 / T2.1-T2.2

$$E_{on} = f(I_D)$$

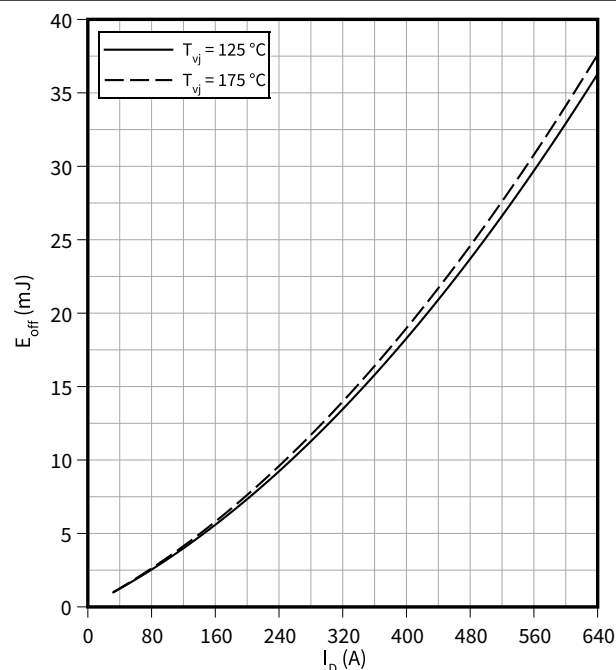
$V_{DD} = 1500 \text{ V}$, $R_{Gon} = 3 \Omega$, $R_{Gon,o} = 1 \Omega$, $V_{GS} = -3/18 \text{ V}$



Switching losses (typical), MOSFET, T1.1-T1.2 / T2.1-T2.2

$$E_{off} = f(I_D)$$

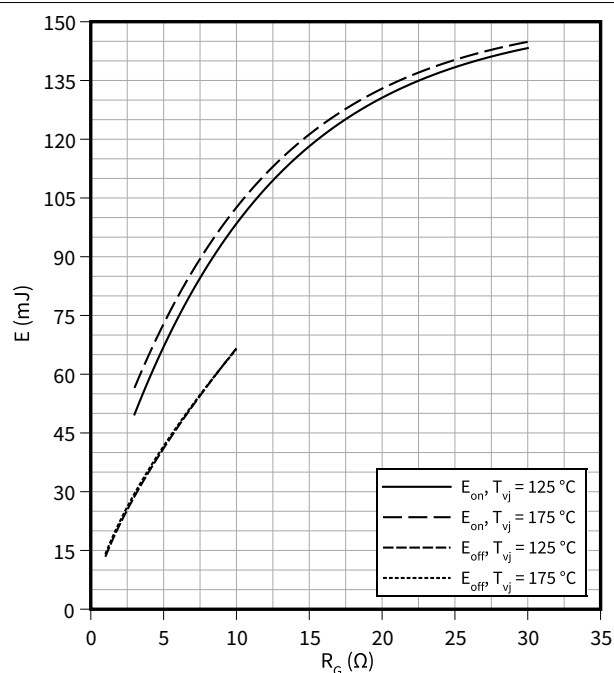
$R_{Goff} = 1 \Omega$, $V_{DD} = 1500 \text{ V}$, $V_{GS} = -3/18 \text{ V}$



Switching losses (typical), MOSFET, T1.1-T1.2 / T2.1-T2.2

$$E = f(R_G)$$

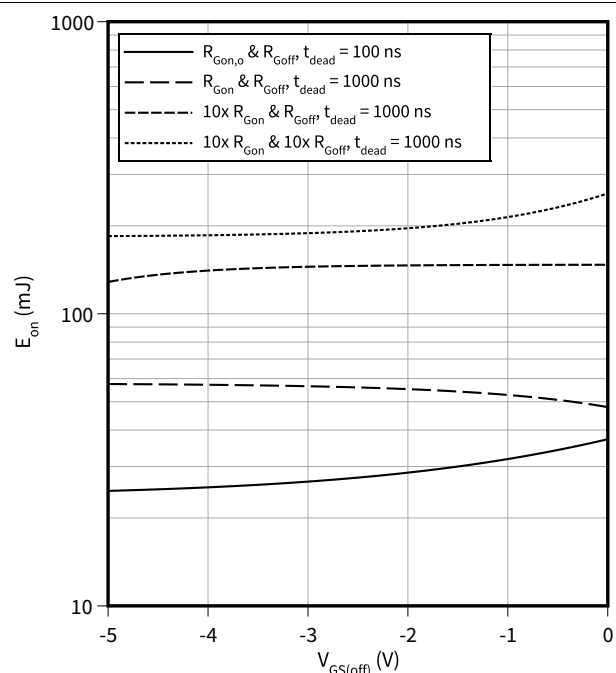
$V_{DD} = 1500 \text{ V}$, $t_{dead} = 1000 \text{ ns}$, $I_D = 320 \text{ A}$, $V_{GS} = -3/18 \text{ V}$



Switching losses (typical), MOSFET, T1.1-T1.2 / T2.1-T2.2

$$E_{on} = f(V_{GS(off)})$$

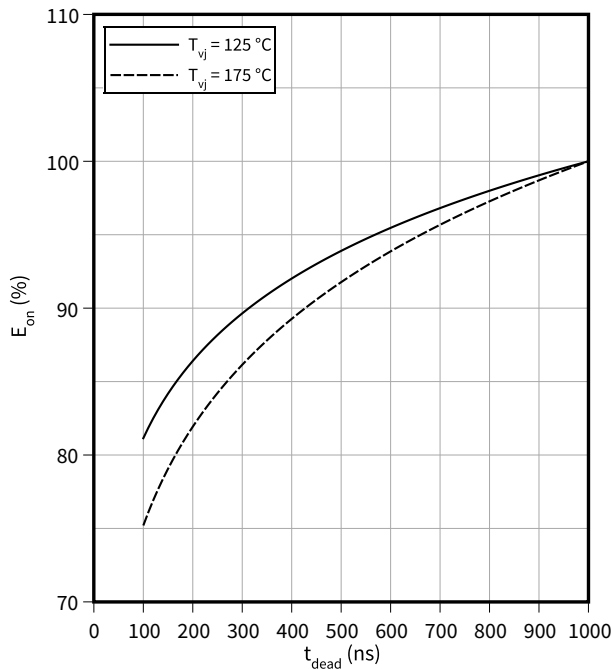
$R_{Goff} = 1 \Omega$, $V_{DD} = 1500 \text{ V}$, $R_{Gon} = 3 \Omega$, $V_{GS(on)} = 18 \text{ V}$, $I_D = 320 \text{ A}$, $R_{Gon,o} = 1 \Omega$, $T_{vj} = 175 \text{ °C}$



5 Characteristics diagrams

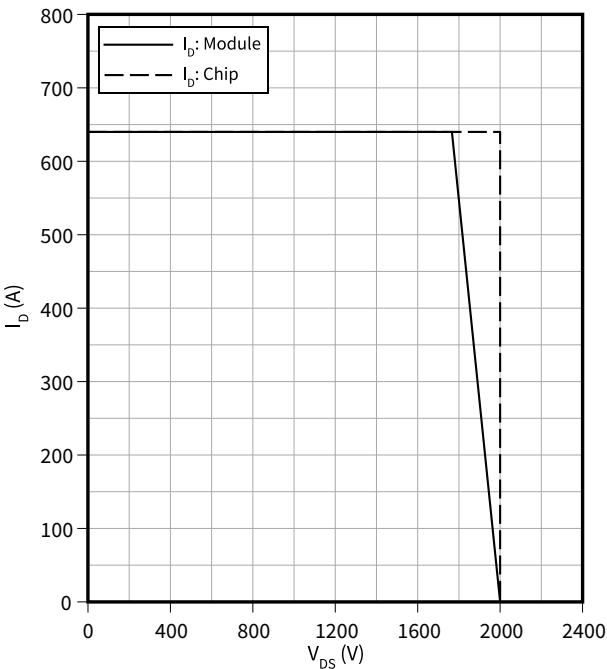
Switching losses (typical), MOSFET, T1.1-T1.2 / T2.1-T2.2

$E_{on} = f(t_{dead})$
 $R_{Gon} = 3 \Omega$, $I_D = 320 \text{ A}$, $V_{DD} = 1500 \text{ V}$, $V_{GS} = -3/18 \text{ V}$



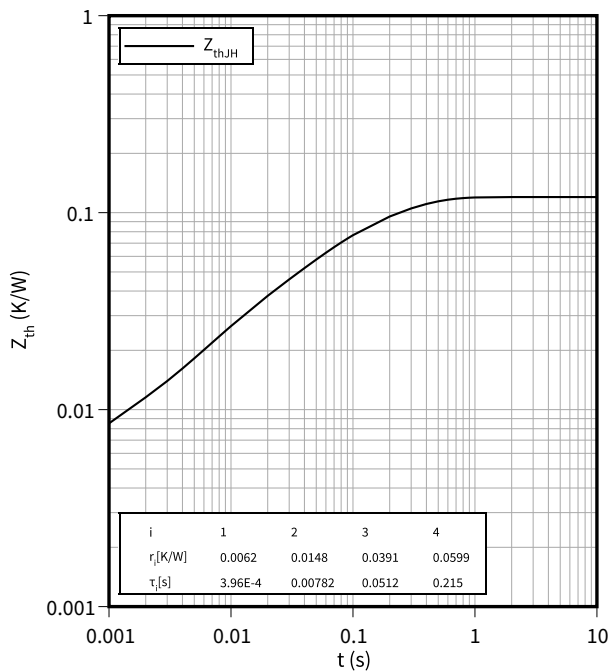
Reverse bias safe operating area (RBSOA), MOSFET, T1.1-T1.2 / T2.1-T2.2

$I_D = f(V_{DS})$
 $R_{Goff} = 1 \Omega$, $T_{vj} = 175 \text{ °C}$, $V_{GS} = -3/18 \text{ V}$



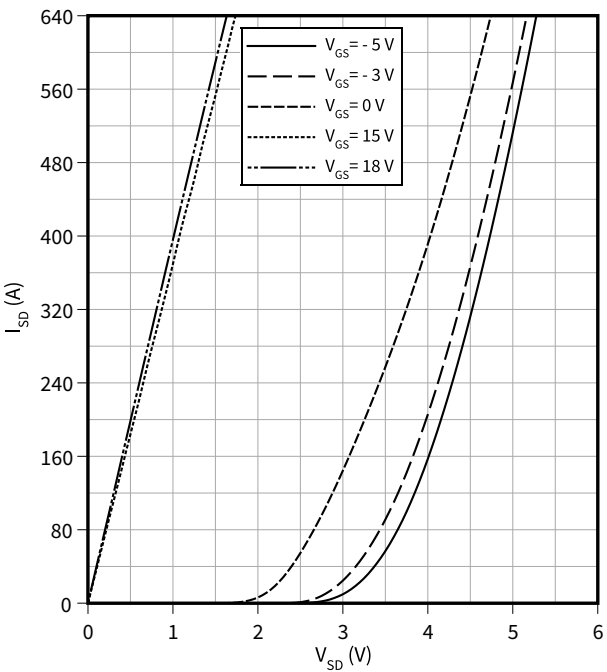
Transient thermal impedance, MOSFET, T1.1-T1.2 / T2.1-T2.2

$Z_{th} = f(t)$



Forward characteristic body diode (typical), MOSFET, T1.1-T1.2 / T2.1-T2.2

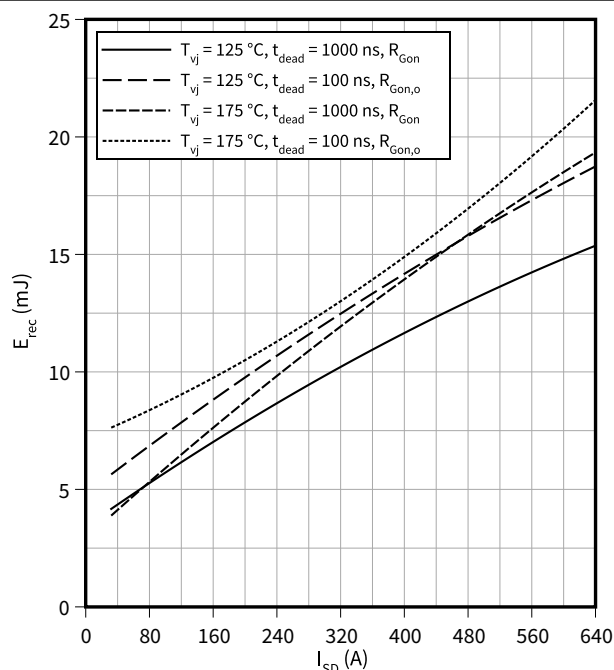
$I_{SD} = f(V_{SD})$
 $T_{vj} = 25 \text{ °C}$



Switching losses body diode (typical), MOSFET, T1.1-T1.2 / T2.1-T2.2

$$E_{\text{rec}} = f(I_{\text{SD}})$$

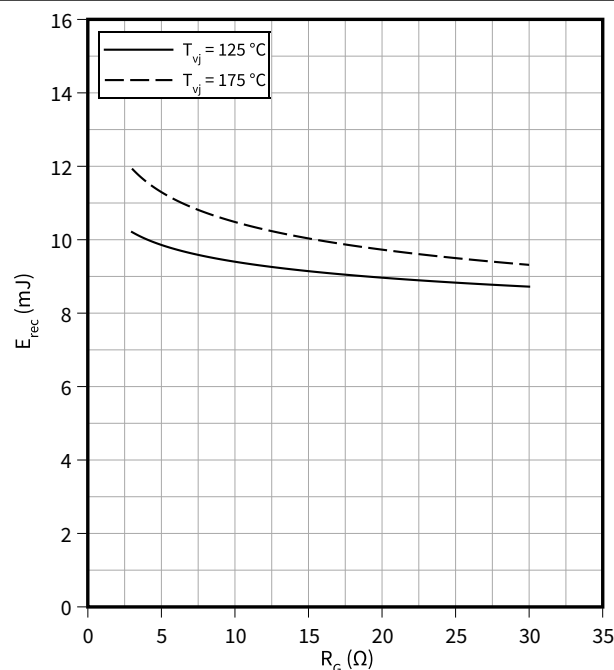
$R_{\text{Gon}} = 3 \Omega$, $R_{\text{Gon},0} = 1 \Omega$, $V_{\text{DD}} = 1500 \text{ V}$



Switching losses body diode (typical), MOSFET, T1.1-T1.2 / T2.1-T2.2

$$E_{\text{rec}} = f(R_{\text{G}})$$

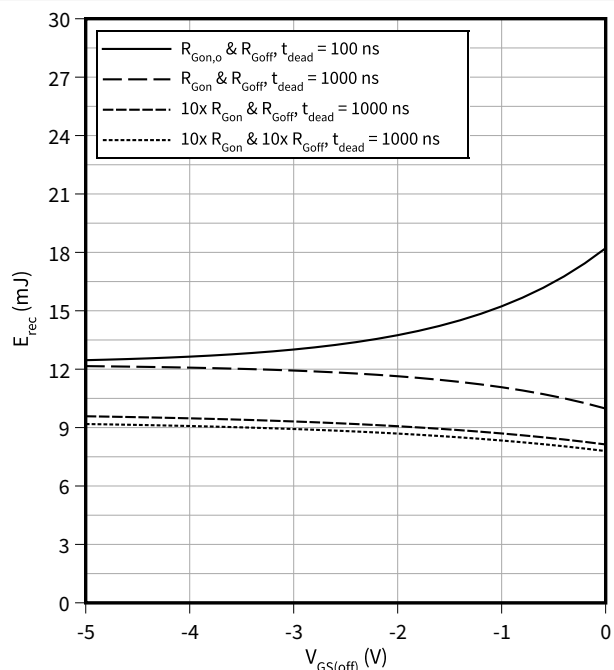
$t_{\text{dead}} = 1000 \text{ ns}$, $I_{\text{SD}} = 320 \text{ A}$, $V_{\text{DD}} = 1500 \text{ V}$



Switching losses body diode (typical), MOSFET, T1.1-T1.2 / T2.1-T2.2

$$E_{\text{rec}} = f(V_{\text{GS(off)}})$$

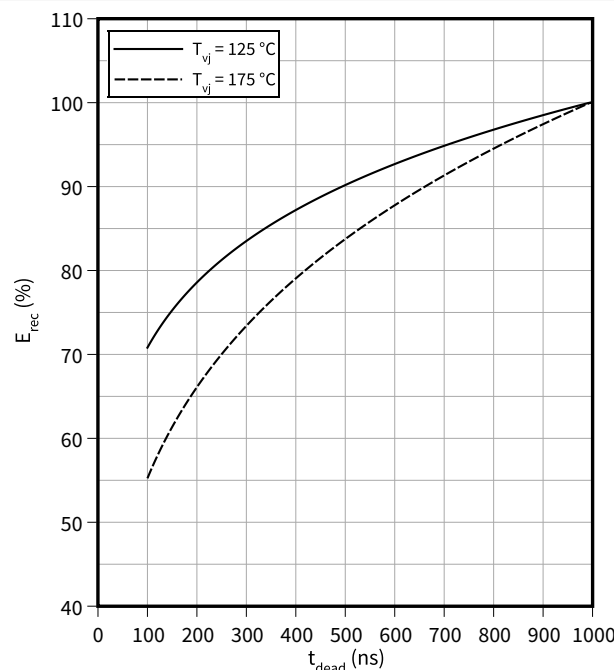
$R_{\text{Goff}} = 1 \Omega$, $R_{\text{Gon}} = 3 \Omega$, $V_{\text{GS(on)}} = 18 \text{ V}$, $I_{\text{SD}} = 320 \text{ A}$, $R_{\text{Gon},0} = 1 \Omega$, $V_{\text{DD}} = 1500 \text{ V}$, $T_{\text{vj}} = 175 \text{ °C}$



Switching losses body diode (typical), MOSFET, T1.1-T1.2 / T2.1-T2.2

$$E_{\text{rec}} = f(t_{\text{dead}})$$

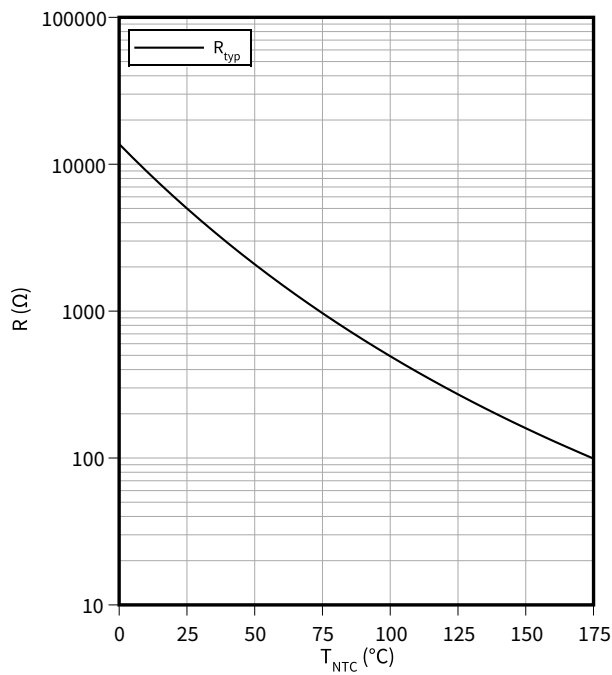
$R_{\text{Gon}} = 3 \Omega$, $I_{\text{D}} = 320 \text{ A}$, $V_{\text{DD}} = 1500 \text{ V}$, $V_{\text{GS}} = -3/18 \text{ V}$



5 Characteristics diagrams

Temperature characteristic (typical), NTC-Thermistor

$R = f(T_{NTC})$



6 Circuit diagram

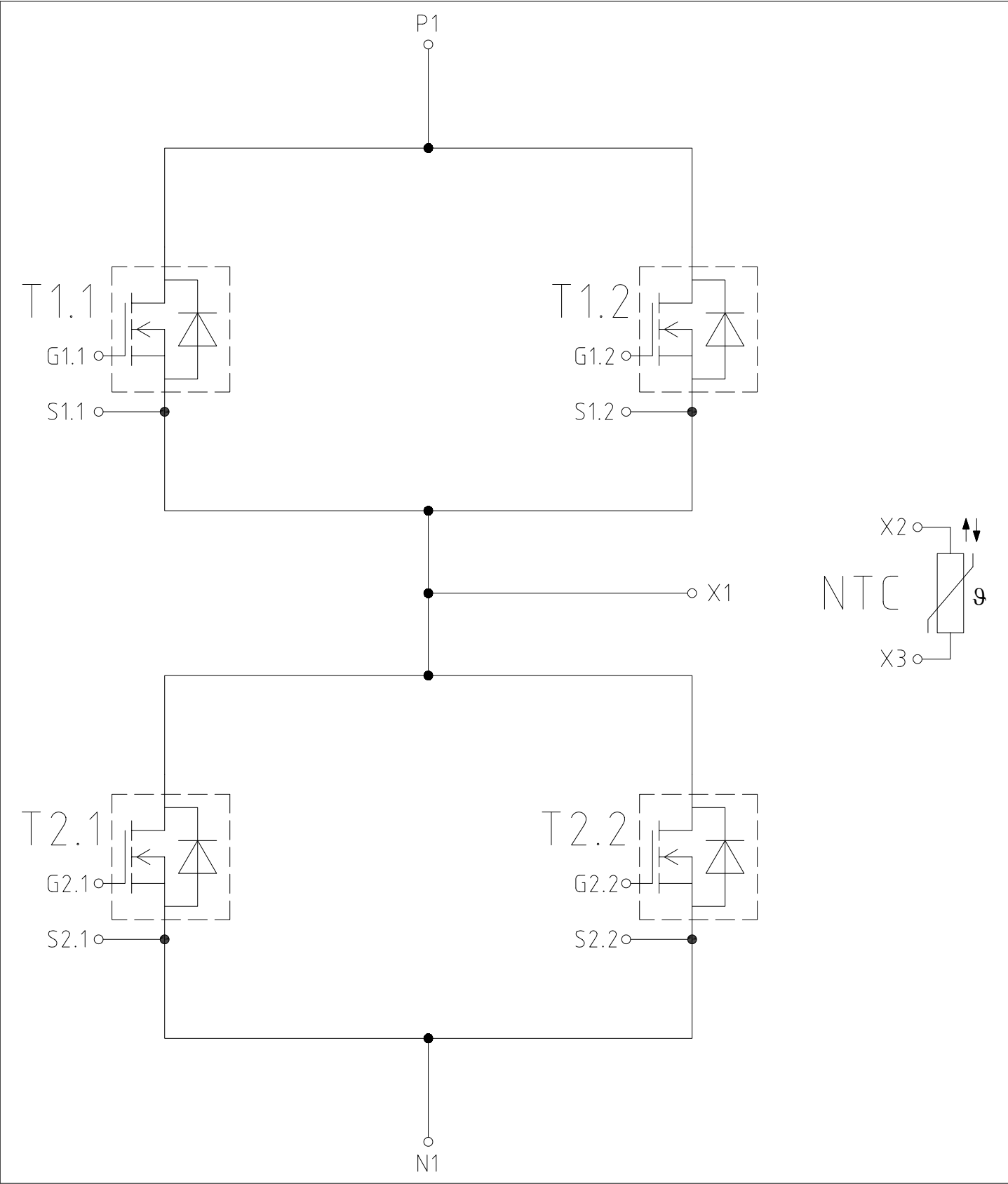


Figure 1

7 Package outlines

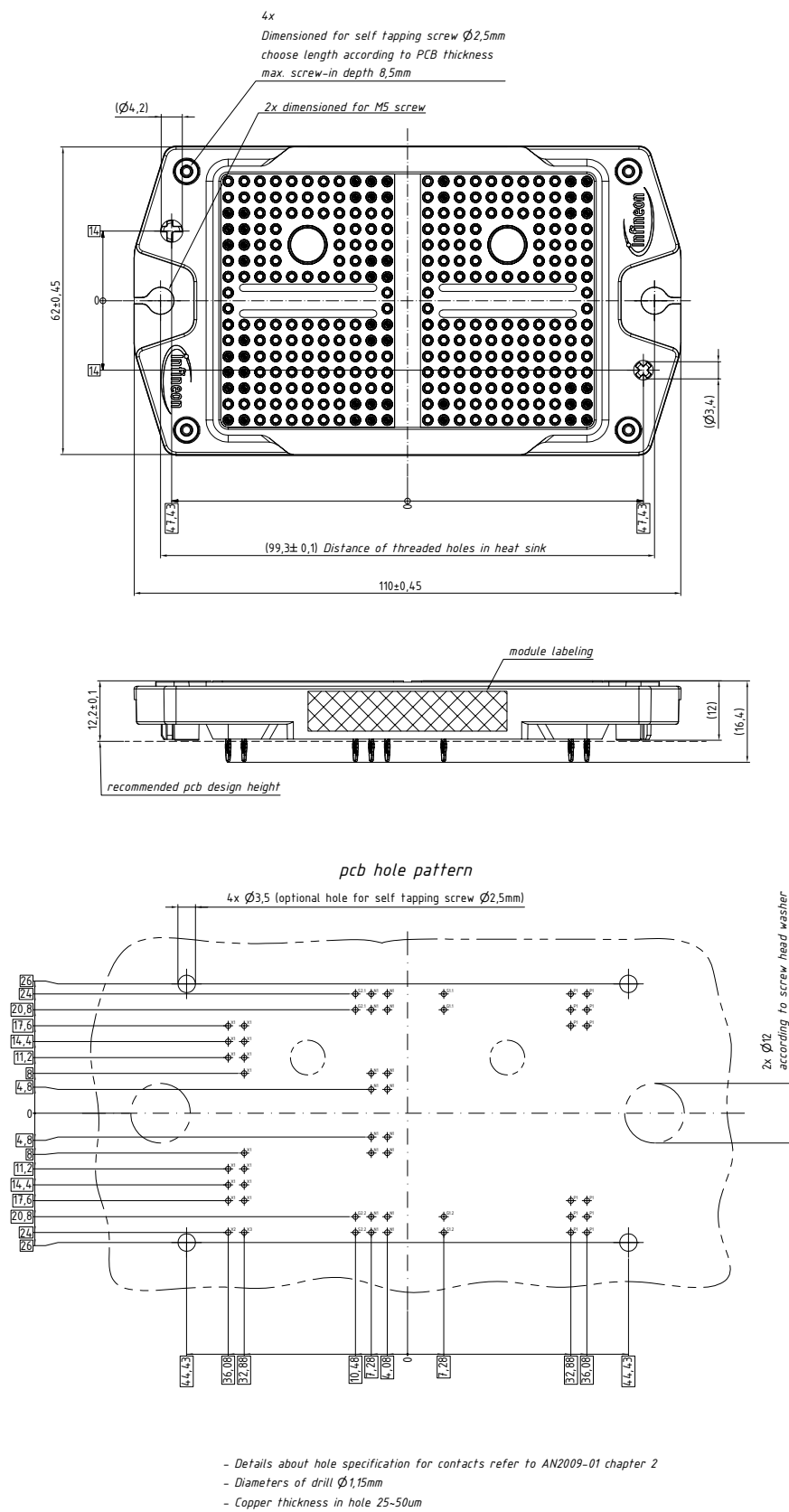


Figure 2

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 version	Date of release	Description of changes
0.10	2024-02-12	Initial version
1.00	2025-01-13	Final datasheet

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