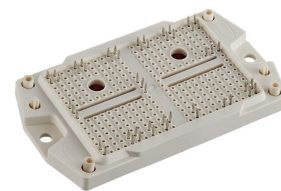


EasyPACK™ module with CoolSiC™ Trench MOSFET and PressFIT / NTC

Features

- Electrical features
 - $V_{DS} = 2000\text{ V}$
 - $I_{DN} = 60\text{ A}$ / $I_{DRM} = 120\text{ A}$
 - High current density
 - Low inductive design
- Mechanical features
 - Rugged mounting due to integrated mounting clamps
 - PressFIT contact technology
 - Integrated NTC temperature sensor



Potential applications

- Solar applications

Product validation

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

Description

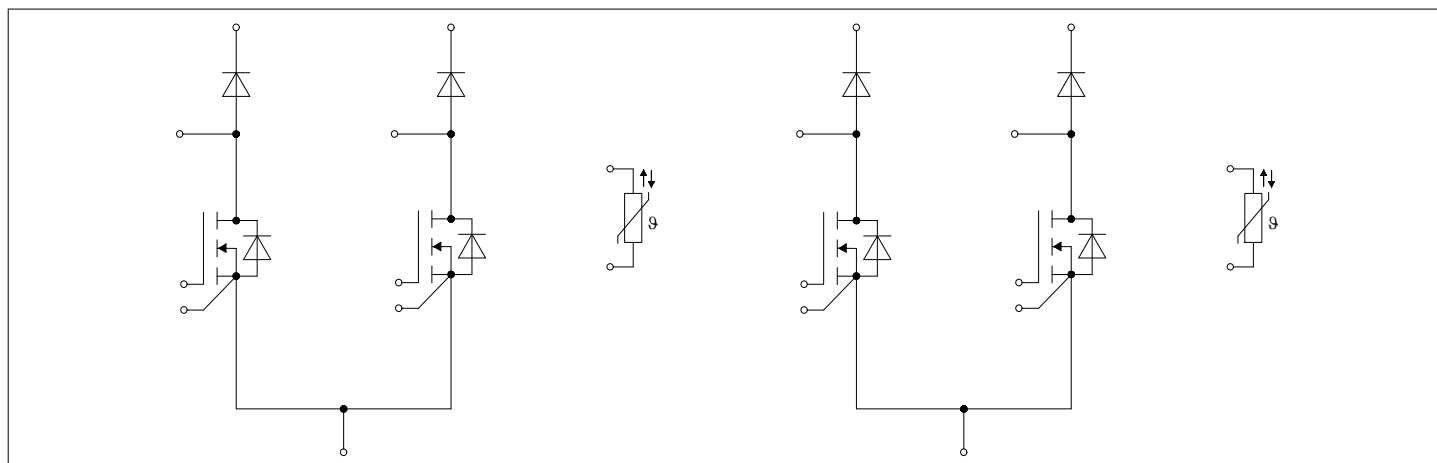


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1 Package

Table 1 Insulation coordination

Parameter	Symbol	Note or test condition	Values	Unit
Isolation test voltage	V_{ISOL}	RMS, $f = 50 \text{ Hz}$, $t = 1 \text{ min}$	3.2	kV
Internal isolation		basic insulation (class 1, IEC 61140)	Al_2O_3	
Creepage distance	d_{Creep}	terminal to heatsink	10.4	mm
Creepage distance	d_{Creep}	terminal to terminal	10.2	mm
Clearance	d_{Clear}	terminal to heatsink	10.1	mm
Clearance	d_{Clear}	terminal to terminal	9.4	mm
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}			14		nH
Storage temperature	T_{stg}		-40		125	°C
Mounting torque for module mounting	M	- Mounting according to valid application note	1.3		1.5	Nm
Weight	G			78		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}	$T_{vj} = 25 \text{ °C}$	2000	V
Implemented drain current	I_{DN}		60	A
Continuous DC drain current	I_{DDC}	$T_{vj} = 175 \text{ °C}$, $V_{GS} = 18 \text{ V}$ $T_H = 65 \text{ °C}$	50	A
Repetitive peak drain current	I_{DRM}	verified by design, t_p limited by T_{vjmax}	120	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	$V_{GS(on)}$		18	V
Off-state gate voltage	$V_{GS(off)}$		-3	V

Table 5 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Drain-source on-resistance	$R_{DS(on)}$	$I_D = 60\text{ A}$	$V_{GS} = 18\text{ V}, T_{vj} = 25\text{ }^{\circ}\text{C}$		17.2	26.5	mΩ
			$V_{GS} = 18\text{ V}, T_{vj} = 125\text{ }^{\circ}\text{C}$		36.6		
			$V_{GS} = 18\text{ V}, T_{vj} = 175\text{ }^{\circ}\text{C}$		51.7		
Gate threshold voltage	$V_{GS(th)}$	$I_D = 34\text{ mA}, V_{DS} = V_{GS}, T_{vj} = 25\text{ }^{\circ}\text{C},$ (tested after 1ms pulse at $V_{GS} = +20\text{ V}$)		3.45	4.3	5.15	V
Total gate charge	Q_G	$V_{DD} = 1200\text{ V}, V_{GS} = -3/18\text{ V}$			0.234		μC
Internal gate resistor	R_{Gint}	$T_{vj} = 25\text{ }^{\circ}\text{C}$			3.8		Ω
Input capacitance	C_{ISS}	$f = 100\text{ kHz}, V_{DS} = 1200\text{ V}, V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ }^{\circ}\text{C}$		7.24		nF
Output capacitance	C_{OSS}	$f = 100\text{ kHz}, V_{DS} = 1200\text{ V}, V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ }^{\circ}\text{C}$		0.169		nF
Reverse transfer capacitance	C_{rss}	$f = 100\text{ kHz}, V_{DS} = 1200\text{ V}, V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ }^{\circ}\text{C}$		0.012		nF
C_{OSS} stored energy	E_{OSS}	$V_{DS} = 1200\text{ V}, V_{GS} = -3/18\text{ V}, T_{vj} = 25\text{ }^{\circ}\text{C}$			154		μJ
Drain-source leakage current	I_{DSS}	$V_{DS} = 2000\text{ V}, V_{GS} = -3\text{ V}$	$T_{vj} = 25\text{ }^{\circ}\text{C}$		0.012	205	μA
Gate-source leakage current	I_{GSS}	$V_{DS} = 0\text{ V}, T_{vj} = 25\text{ }^{\circ}\text{C}$	$V_{GS} = 20\text{ V}$			400	nA
Turn-on delay time (inductive load)	$t_{d\text{ on}}$	$I_D = 60\text{ A}, R_{Gon} = 1.6\text{ }\Omega, V_{DD} = 1200\text{ V}, V_{GS} = -3/18\text{ V}$	$T_{vj} = 25\text{ }^{\circ}\text{C}$		38.1		ns
			$T_{vj} = 125\text{ }^{\circ}\text{C}$		38.1		
			$T_{vj} = 175\text{ }^{\circ}\text{C}$		38.1		
Rise time (inductive load)	t_r	$I_D = 60\text{ A}, R_{Gon} = 1.6\text{ }\Omega, V_{DD} = 1200\text{ V}, V_{GS} = -3/18\text{ V}$	$T_{vj} = 25\text{ }^{\circ}\text{C}$		26		ns
			$T_{vj} = 125\text{ }^{\circ}\text{C}$		26		
			$T_{vj} = 175\text{ }^{\circ}\text{C}$		26		
Turn-off delay time (inductive load)	$t_{d\text{ off}}$	$I_D = 60\text{ A}, R_{Goff} = 2\text{ }\Omega, V_{DD} = 1200\text{ V}, V_{GS} = -3/18\text{ V}$	$T_{vj} = 25\text{ }^{\circ}\text{C}$		74.4		ns
			$T_{vj} = 125\text{ }^{\circ}\text{C}$		81.5		
			$T_{vj} = 175\text{ }^{\circ}\text{C}$		83.9		

(table continues...)

Table 5 (continued) **Characteristic values**

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Fall time (inductive load)	t_f	$I_D = 60\text{ A}$, $R_{Goff} = 2\ \Omega$, $V_{DD} = 1200\text{ V}$, $V_{GS} = -3/18\text{ V}$	$T_{vj} = 25\text{ °C}$	16		ns
			$T_{vj} = 125\text{ °C}$	16.1		
			$T_{vj} = 175\text{ °C}$	17.1		
Turn-on energy loss per pulse	E_{on}	$I_D = 60\text{ A}$, $V_{DD} = 1200\text{ V}$, $L_\sigma = 35\text{ nH}$, $V_{GS} = -3/18\text{ V}$, $R_{Gon} = 1.6\ \Omega$, $di/dt = 5\text{ kA}/\mu\text{s}$ ($T_{vj} = 175\text{ °C}$)	$T_{vj} = 25\text{ °C}$	1.5		mJ
			$T_{vj} = 125\text{ °C}$	1.5		
			$T_{vj} = 175\text{ °C}$	1.5		
Turn-off energy loss per pulse	E_{off}	$I_D = 60\text{ A}$, $V_{DD} = 1200\text{ V}$, $L_\sigma = 35\text{ nH}$, $V_{GS} = -3/18\text{ V}$, $R_{Goff} = 2\ \Omega$, $dv/dt = 56.14\text{ kV}/\mu\text{s}$ ($T_{vj} = 175\text{ °C}$)	$T_{vj} = 25\text{ °C}$	0.435		mJ
			$T_{vj} = 125\text{ °C}$	0.481		
			$T_{vj} = 175\text{ °C}$	0.529		
Thermal resistance, junction to heat sink	R_{thJH}	per MOSFET		0.515		K/W
Temperature under switching conditions	$T_{vj\ op}$		-40		175	°C

Note: The body diode of CoolSiC™ Trench MOSFET cannot be used for polarity protection. An external diode is needed for this purpose.

The selection of positive and negative gate-source voltages impacts 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 MOSFET and body diode. For detailed specifications, please refer to AN 2021-13

3 Body diode

Table 6 **Characteristic values**

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Forward voltage	V_{SD}	$I_{SD} = 60\text{ A}$, $V_{GS} = -3\text{ V}$	$T_{vj} = 25\text{ °C}$	4.6	6.15	V
			$T_{vj} = 125\text{ °C}$	4.15		
			$T_{vj} = 175\text{ °C}$	4		

4 Diode, Boost

Table 7 Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
Repetitive peak reverse voltage	V_{RRM}		$T_{vj} = 25\text{ °C}$	2000	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	$t_P = 10\text{ ms}, V_R = 0\text{ V}$	$T_{vj} = 125\text{ °C}$	90	A^2s
			$T_{vj} = 175\text{ °C}$	70	

Table 8 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Forward voltage	V_F	$I_F = 40\text{ A}$	$T_{vj} = 25\text{ °C}$		1.50	1.85	V
			$T_{vj} = 125\text{ °C}$		2.17		
			$T_{vj} = 175\text{ °C}$		2.67		
Thermal resistance, junction to heat sink	R_{thJH}	per diode			0.685		K/W
Temperature under switching conditions	$T_{vj\text{ op}}$			-40		175	°C

Note: $T_{vj\text{ op}} > 150\text{ °C}$ is allowed for operation at overload conditions for booster diode. For detailed specifications, please refer to AN 2021-13

5 NTC-Thermistor

Table 9 Characteristic values

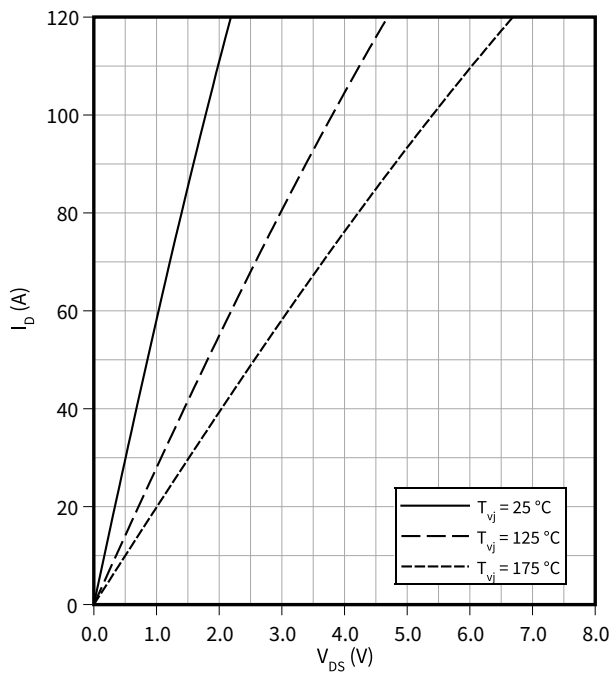
Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Rated resistance	R_{25}	$T_{NTC} = 25\text{ °C}$		5		kΩ
Deviation of R_{100}	$\Delta R/R$	$T_{NTC} = 100\text{ °C}, R_{100} = 493\text{ Ω}$	-5		5	%
Power dissipation	P_{25}	$T_{NTC} = 25\text{ °C}$			20	mW
B-value	$B_{25/50}$	$R_2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

6 Characteristics diagrams

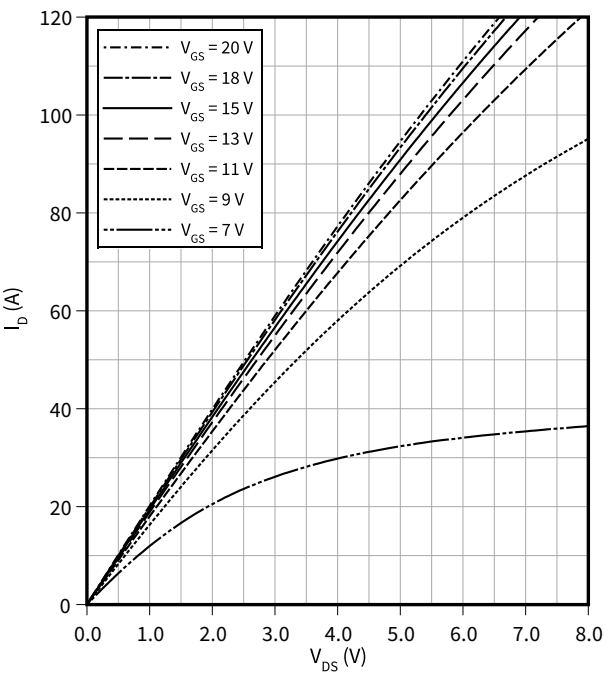
Output characteristic (typical), MOSFET

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



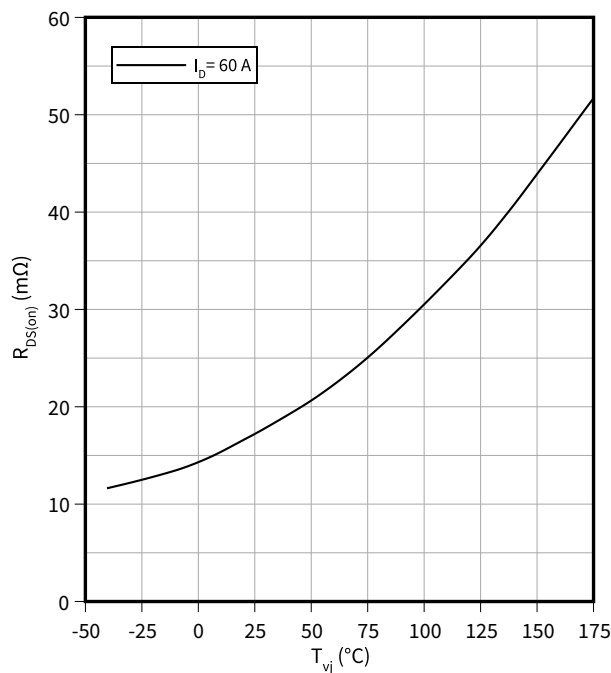
Output characteristic field (typical), MOSFET

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



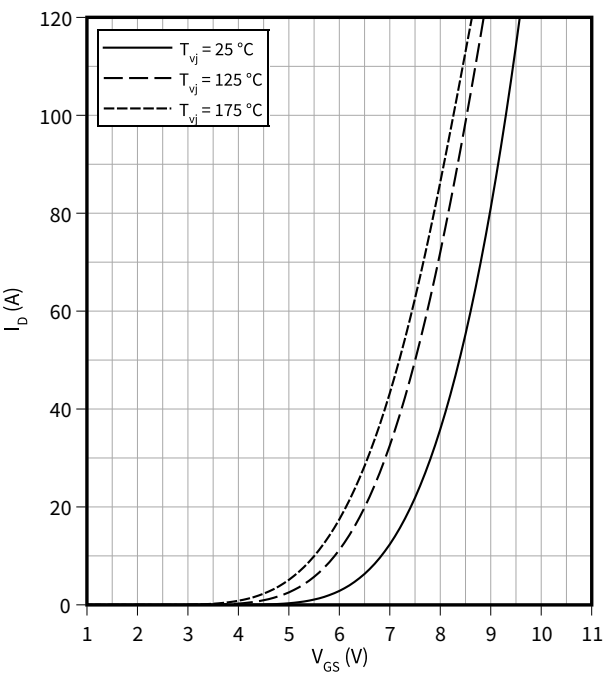
Drain source on-resistance (typical), MOSFET

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



Transfer characteristic (typical), MOSFET

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

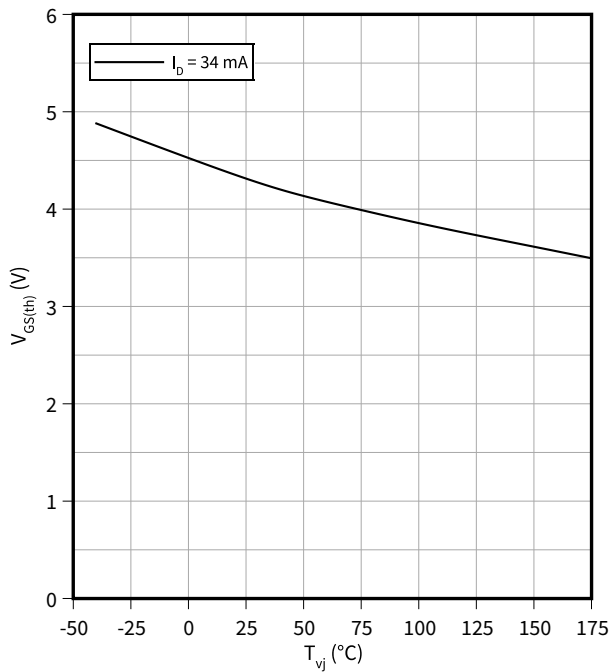


6 Characteristics diagrams

Gate-source threshold voltage (typical), MOSFET

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

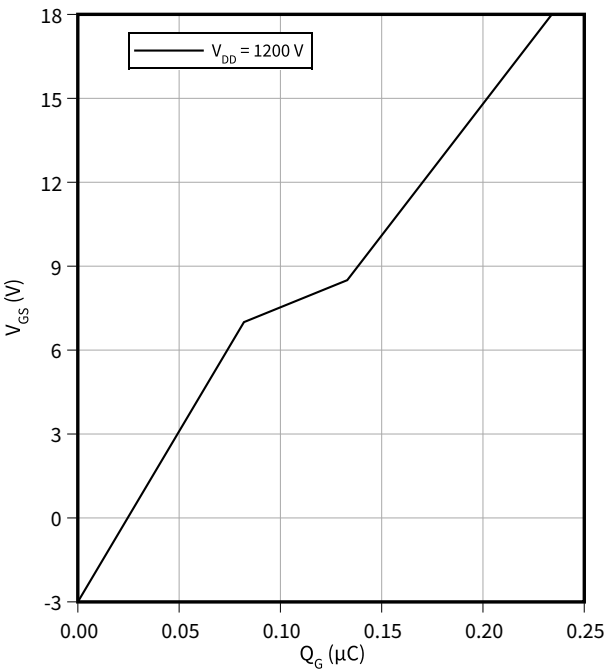
$V_{GS} = V_{DS}$



Gate charge characteristic (typical), MOSFET

$V_{GS} = f(Q_G)$

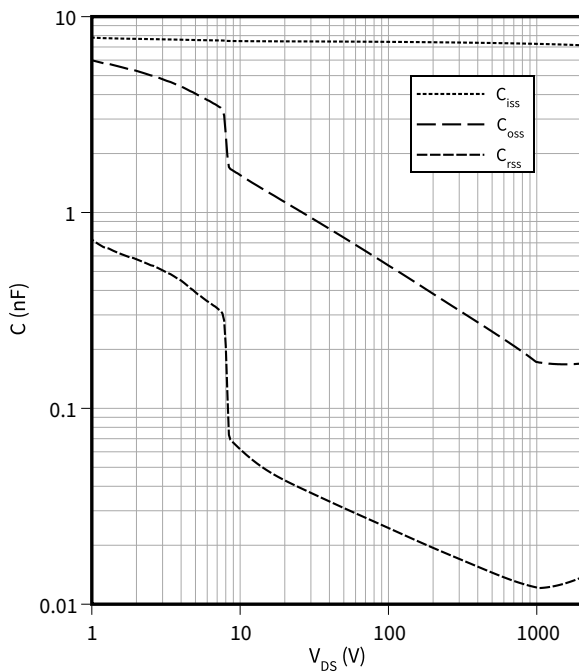
$I_D = 60 \text{ A}, T_{vj} = 25 \text{ °C}$



Capacity characteristic (typical), MOSFET

$C = f(V_{DS})$

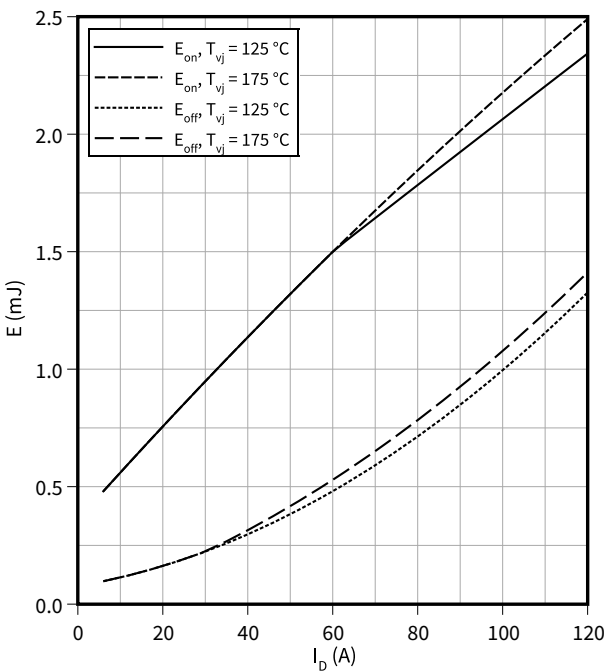
$f = 100 \text{ kHz}, T_{vj} = 25 \text{ °C}, V_{GS} = 0 \text{ V}$



Switching losses (typical), MOSFET

$E = f(I_D)$

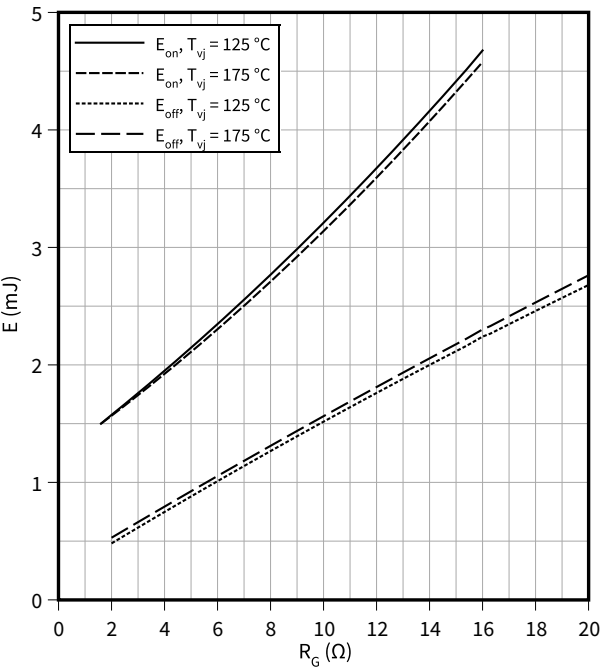
$R_{Goff} = 2 \text{ } \Omega, R_{Gon} = 1.6 \text{ } \Omega, V_{DD} = 1200 \text{ V}, V_{GS} = -3/18 \text{ V}$



6 Characteristics diagrams

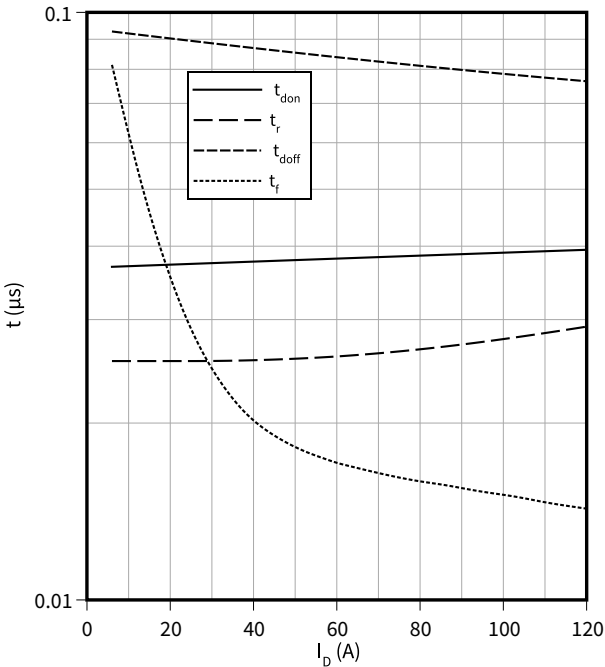
Switching losses (typical), MOSFET

$E = f(R_G)$
 $V_{DD} = 1200\text{ V}$, $I_D = 60\text{ A}$, $V_{GS} = -3/18\text{ V}$



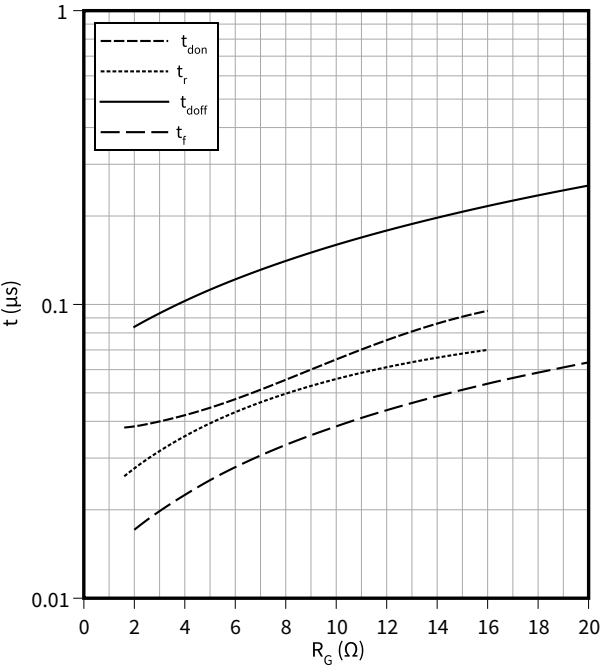
Switching times (typical), MOSFET

$t = f(I_D)$
 $R_{Goff} = 2.0\text{ }\Omega$, $R_{Gon} = 1.6\text{ }\Omega$, $V_{DD} = 1200\text{ V}$, $T_{vj} = 175\text{ }^\circ\text{C}$, $V_{GS} = -3/18\text{ V}$



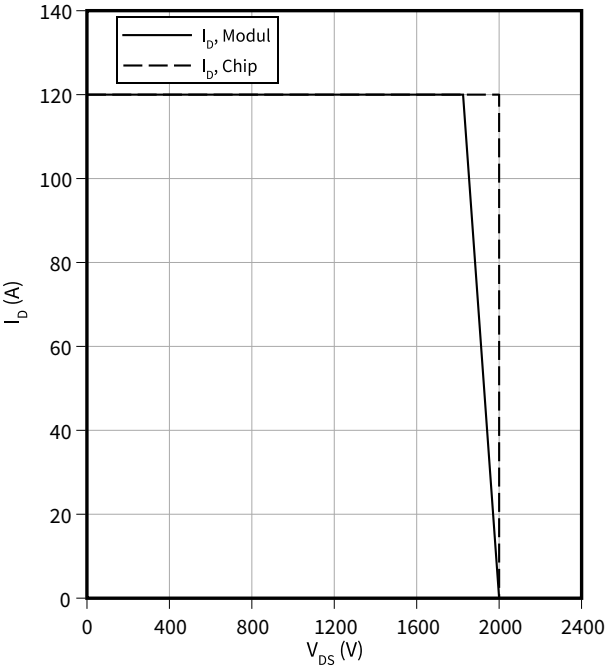
Switching times (typical), MOSFET

$t = f(R_G)$
 $V_{DD} = 1200\text{ V}$, $I_D = 60\text{ A}$, $T_{vj} = 175\text{ }^\circ\text{C}$, $V_{GS} = -3/18\text{ V}$



Reverse bias safe operating area (RBSOA), MOSFET

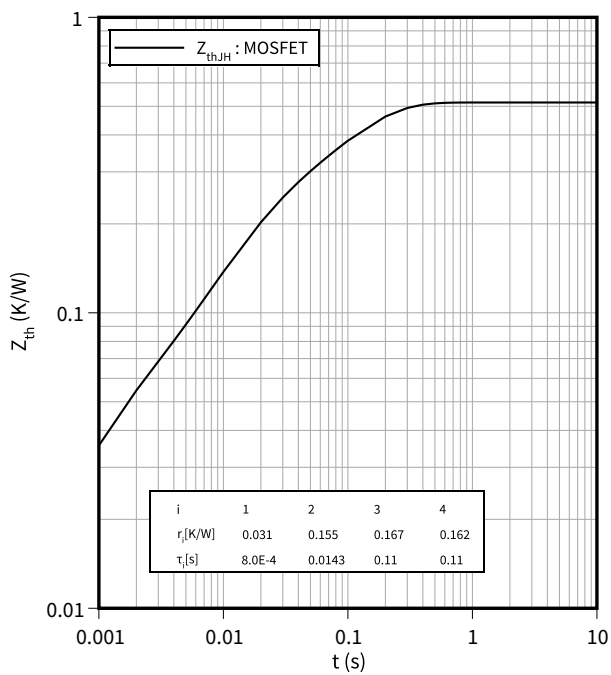
$I_D = f(V_{DS})$
 $R_{Goff} = 2\text{ }\Omega$, $T_{vj} = 175\text{ }^\circ\text{C}$, $V_{GS} = -3/18\text{ V}$



6 Characteristics diagrams

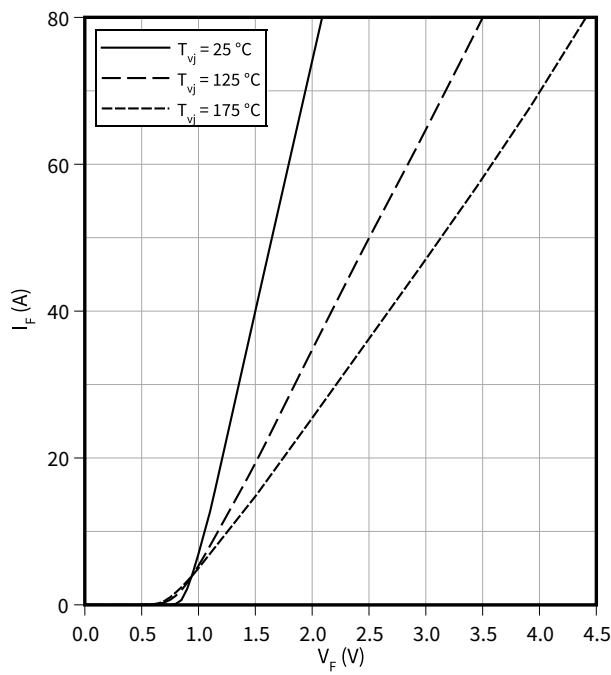
Transient thermal impedance , MOSFET

$Z_{th} = f(t)$



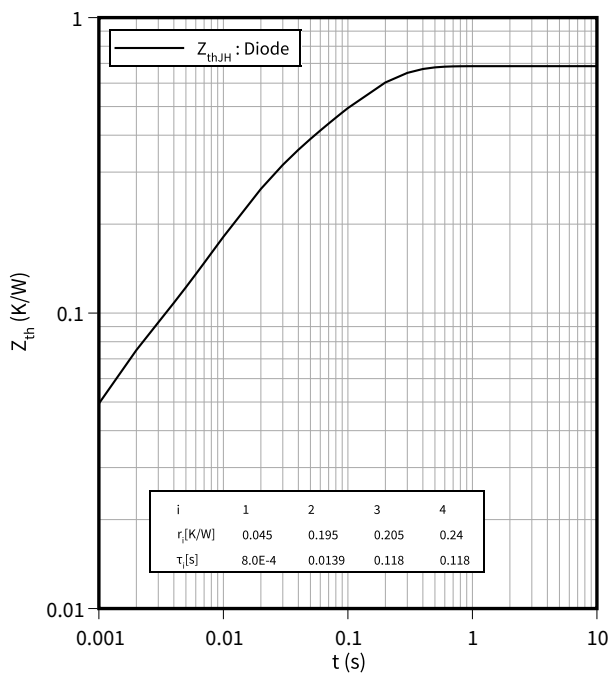
Forward characteristic (typical), Diode, Boost

$I_F = f(V_F)$



Transient thermal impedance, Diode, Boost

$Z_{th} = f(t)$



Temperature characteristic (typical), NTC-Thermistor

$R = f(T_{NTC})$

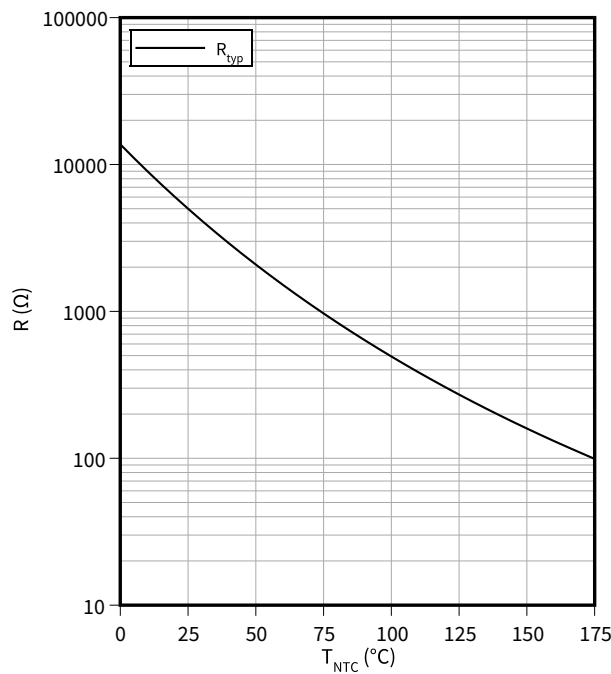


Figure 1

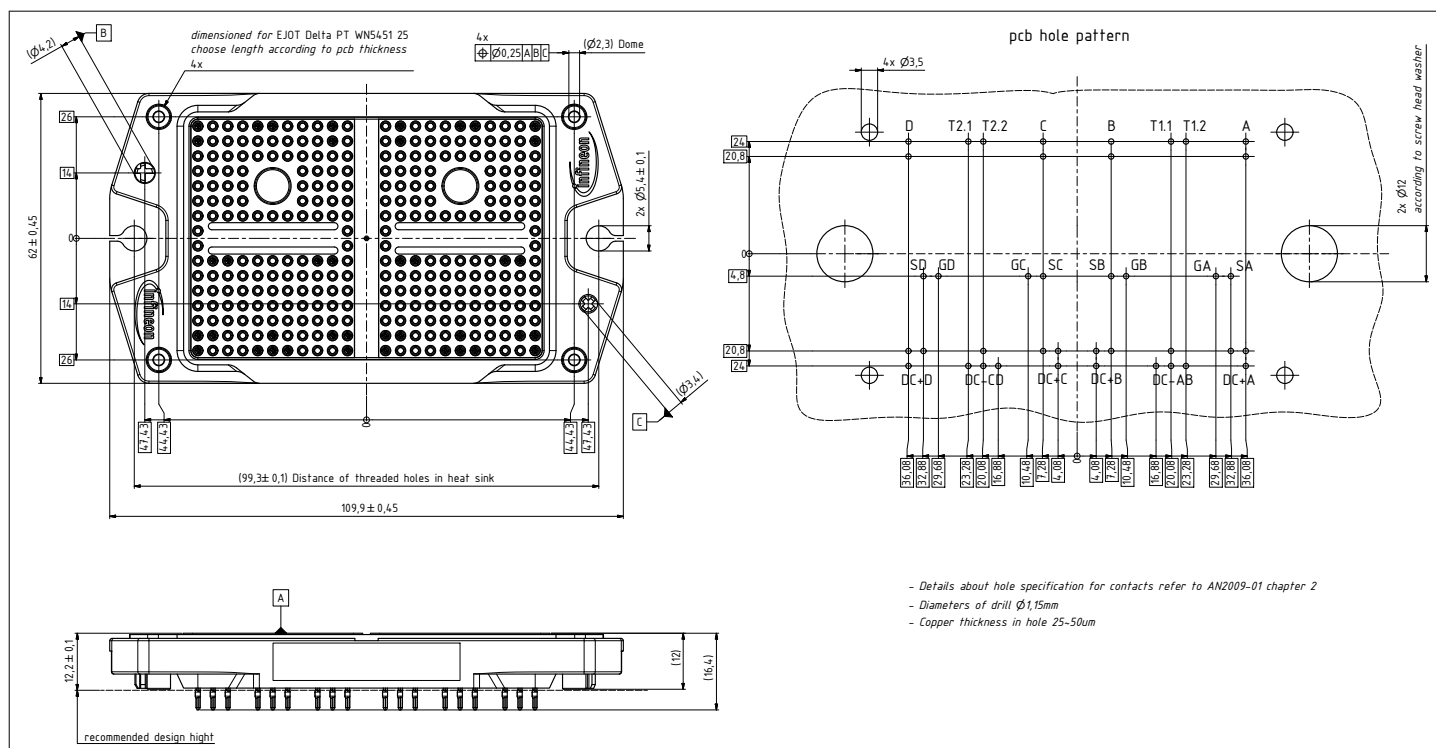


Figure 2

9 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 revision	Date of release	Description of changes
0.10	2022-07-05	Initial version
1.00	2022-07-15	Final datasheet

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