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

Features

- Electrical features
  - V_{DSS} = 1200 V
  - I_{DN} = 150 A
  - New semiconductor material - silicon carbide
  - Blocking voltage 1200 V
  - Low $R_{DS,on}$
  - Low switching losses
  - Low Q_g and C_{rss}
  - Low inductive design
  - $T_{vj,op}$ = 150°C
- Mechanical features
  - 5.1 kV DC 1 second Insulation
  - Compact design
  - High power density
  - Integrated NTC temperature sensor
  - PressFIT contact technology
  - RoHS compliant

Potential applications

- Automotive applications
- Auxiliary inverters
- DC/DC converter
- (Hybrid) electrical vehicles (H)EV

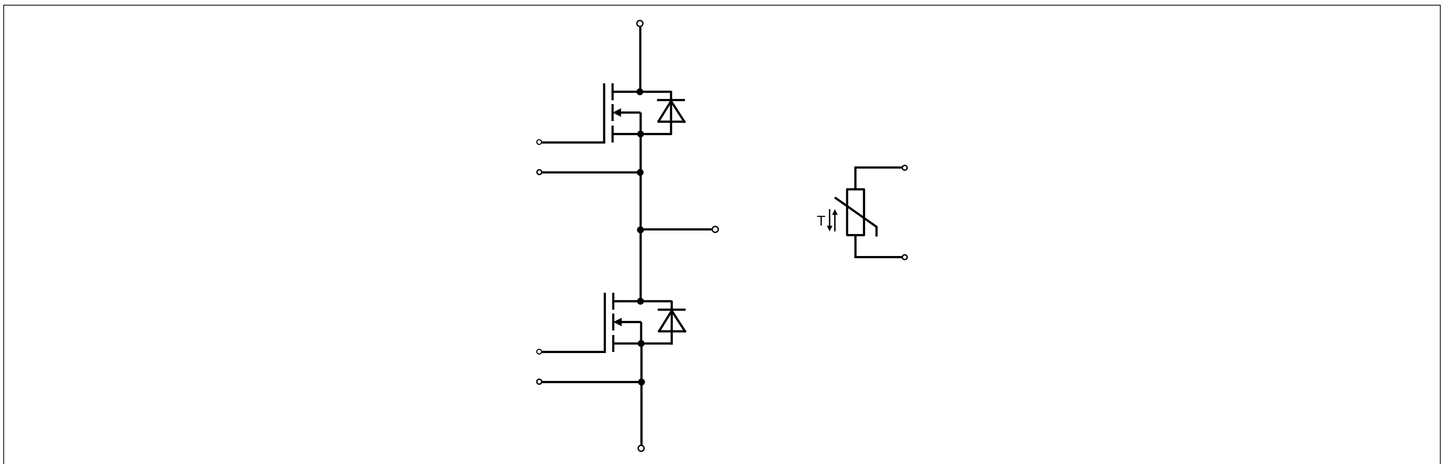
Product validation

- Qualified according to AQG 324, release no.: 02.1/2019

Description

The Automotive CoolSiC™ EasyPACK™1B is a half bridge module which combines the benefits of Infineon's robust silicon carbide technology with a very compact and flexible package for hybrid and (fuel cell) electric vehicles. The power module implements the new CoolSiC™ Automotive MOSFET 1200V Gen1, optimized for high voltage applications like DC/DC converter and Auxiliary inverter. The chipset offers benchmark current density, high block voltage and reduced switching losses, which allows compact designs and helps to improve system efficiency, as well as allows a reliable operation under harsh environmental conditions.

The Automotive CoolSiC™ EasyPACK™1B power module family comes with mechanical guiding elements and mounting clamps supporting easy assembly processes for customers. Furthermore, the press-fit pins for the signal terminals avoid additional time consuming selective solder processes, which provides cost savings on system level and increases system reliability. The Automotive CoolSiC™ EasyPACK™1B allows a flexible cooler and application construction.



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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 = 0 Hz, t = 1 sec	5.10	kV
Internal isolation		basic insulation (class 1, IEC 61140)	Al_2O_3	
Creepage distance	d_{creep}	terminal to heatsink	11.5	mm
Creepage distance	d_{creep}	terminal to terminal	8.0	mm
Clearance	d_{clear}	terminal to heatsink	10.0	mm
Clearance	d_{clear}	terminal to terminal	5.5	mm
Comparative tracking index	*CTI*		> 200	

Table 2 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Stray inductance module	$L_{s,CE}$			5.0		nH
Module lead resistance, terminals - chip	$R_{AA'+CC'}$	T_c = 25 °C, per switch		1.00		mΩ
Storage temperature	T_{stg}		-40		150	°C
Weight	*G*			24		g
Mounting force per clamp	*F*		20		50	N

2 MOSFET

Table 3 Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
Drain-source voltage	V_{DSS}		T_{vj} = 25 °C	1200	V
DC drain current	$I_{D,nom}$	V_{GS} = 15 V, T_h = 65 °C	$T_{vj,max}$ = 175 °C	150	A
Pulsed drain current	$I_{D,pulse}$	verified by design, t_p limited by T_{vjmax}		300	A
Gate-source voltage	V_{GSS}			-10/20	V

Table 4 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Drain-source on-resistance	$R_{DS,on}$	I_D = 150 A, V_{GS} = 15 V	T_{vj} = 25 °C		7.33	9.80	mΩ
			T_{vj} = 125 °C		10.60		
			T_{vj} = 150 °C		12.10		

(table continues...)

Table 4 **(continued) Characteristic values**

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Gate threshold voltage	$V_{GS,th}$	I_D = 90 mA, V_{GS} = V_{DS}, (tested after 1ms pulse at V_{GS} = +20 V)	T_{vj} = 25 °C	3.25	4.40	5.55	V
Total gate charge	Q_G	V_{DS} = 600 V, V_{GS} = -5/15 V			0.49		µC
Internal gate resistor	$R_{G,int}$		T_{vj} = 25 °C		0.6		Ω
Input capacitance	C_{iss}	f = 1 MHz, V_{DS} = 600 V, V_{GS} = 0 V	T_{vj} = 25 °C		16		nF
Output capacitance	C_{oss}	f = 1 MHz, V_{DS} = 600 V, V_{GS} = 0 V	T_{vj} = 25 °C		0.70		nF
Reverse transfer capacitance	C_{rss}	f = 1 MHz, V_{DS} = 600 V, V_{GS} = 0 V	T_{vj} = 25 °C		0.06		nF
C_{OSS} stored energy	E_{oss}	V_{DS} = 600 V, V_{GS} = -5/15 V	T_{vj} = 25 °C		164		µJ
Drain-source leakage current	I_{DSX}	V_{GS} = -5 V, V_{DSS} = 1200 V	T_{vj} = 25 °C			100	µA
Gate-source leakage current	I_{GSS}	V_{GS} = 20 V, V_{DS} = 0 V	T_{vj} = 25 °C			400	nA
Turn-on delay time, inductive load	$t_{d,on}$	I_D = 150 A, $R_{G,on}$ = 5.1 Ω, V_{GS} = -5/15 V, V_{DS} = 600 V	T_{vj} = 25 °C		53		ns
			T_{vj} = 125 °C		48		
			T_{vj} = 150 °C		46		
Rise time (inductive load)	t_r	I_D = 150 A, $R_{G,on}$ = 5.1 Ω, V_{GS} = -5/15 V	T_{vj} = 25 °C		35		ns
			T_{vj} = 125 °C		34		
			T_{vj} = 150 °C		33		
Turn-off delay time, inductive load	$t_{d,off}$	I_D = 150 A, $R_{G,off}$ = 5.1 Ω, V_{GS} = -5/15 V, V_{DS} = 600 V	T_{vj} = 25 °C		146		ns
			T_{vj} = 125 °C		148		
			T_{vj} = 150 °C		149		
Fall time (inductive load)	t_f	I_D = 150 A, $R_{G,off}$ = 5.1 Ω, V_{GS} = -5/15 V, V_{DS} = 600 V	T_{vj} = 25 °C		38		ns
			T_{vj} = 125 °C		38		
			T_{vj} = 150 °C		39		
Turn-on energy loss per pulse	E_{on}	I_D = 150 A, $R_{G,on}$ = 5.1 Ω, V_{GS} = -5/15 V, V_{DS} = 600 V, L_σ = 20 nH	T_{vj} = 25 °C		4.26		mJ
			T_{vj} = 125 °C		5.01		
			T_{vj} = 150 °C, di/dt = 4.9 kA/µs		5.29		
Turn-off energy loss per pulse	E_{off}	I_D = 150 A, $R_{G,off}$ = 5.1 Ω, V_{GS} = -5/15 V, V_{DS} = 600 V, L_σ = 20 nH	T_{vj} = 25 °C		2.67		mJ
			T_{vj} = 125 °C		2.73		
			T_{vj} = 150 °C, du/dt = 15.5 kV/µs		2.76		

(table continues...)

Table 4 **(continued) Characteristic values**

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Short circuit data	I_{SC}	V_{DD} = 800 V, V_{GS} = -5/15 V, R_G = 5.1 Ω, V_{DSmax} = V_{DSS}- L_{sDS}·di/dt	t_{SC} ≤ 3 µs, T_{vj} = 150 °C		2000		A
			t_{SC} ≤ 3 µs, T_{vj} = 25 °C		2200		
Thermal resistance, junction to heat sink	$R_{th,j-h}$	per MOSFET			0.46	0.55	K/W
Temperature under switching conditions	$T_{vj,op}$			-40		150	°C

3 Body diode

Table 5 **Maximum rated values**

Parameter	Symbol	Note or test condition		Values	Unit
DC body diode forward current	$I_{F,S}$	V_{GS} = -5 V	T_h = 65 °C	60	A
Pulsed body diode current	$I_{F,S,pulse}$	verified by design, t_p limited by T_{vjmax}		300	A

Table 6 **Characteristic values**

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Forward voltage	$V_{F,SD}$	$I_{F,S}$ = 150 A, V_{GS} = -5 V	T_{vj} = 25 °C		4.40	5.95	V
			T_{vj} = 125 °C		4.18		
			T_{vj} = 150 °C		4.12		
Peak reverse recovery current	I_{rrm}	$I_{F,S}$ = 150 A, V_{GS} = -5 V, $V_{R,DS}$ = 600 V	T_{vj} = 25 °C		75		A
			T_{vj} = 125 °C		135		
			-*di/dt* = 6.1 kA/µs, T_{vj} = 150 °C		158		
Recovered charge	Q_{rr}	$I_{F,S}$ = 150 A, V_{GS} = -5 V, $V_{R,DS}$ = 600 V	T_{vj} = 25 °C		2.58		µC
			T_{vj} = 125 °C		4.10		
			-*di/dt* = 6.1 kA/µs, T_{vj} = 150 °C		5.13		
Reverse recovery energy	E_{rec}	$I_{F,S}$ = 150 A, V_{GS} = -5 V, $V_{R,DS}$ = 600 V	T_{vj} = 25 °C		0.5		mJ
			T_{vj} = 125 °C		0.9		
			T_{vj} = 150 °C, -*di/dt* = 6.1 kA/µs		1.4		

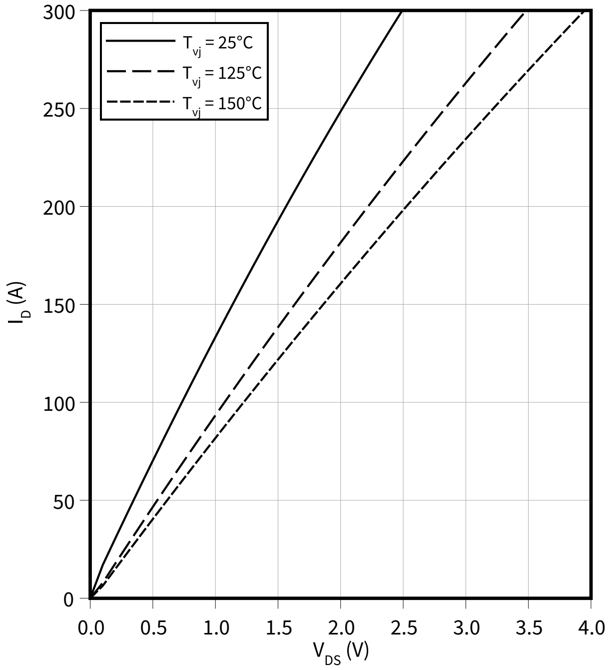
4 NTC-Thermistor

Table 7 Characteristic values

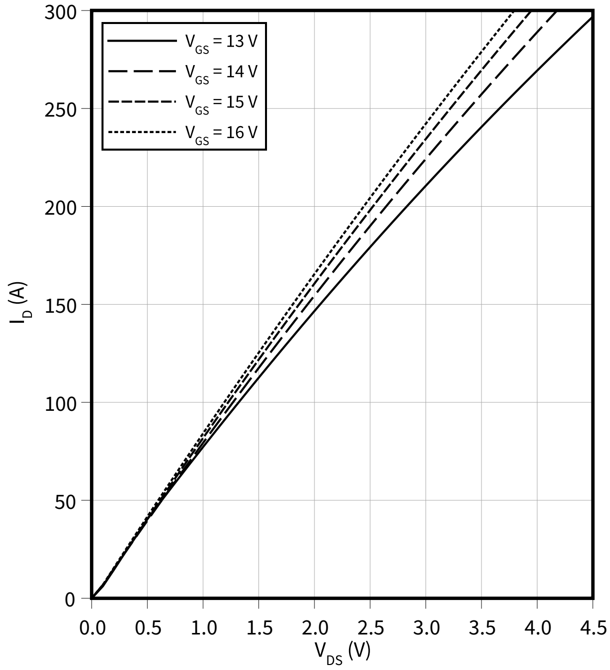
Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Rated resistance	R_{25}	T_{NTC} = 25 °C		5		kΩ
Deviation of R_{100}	$\Delta R/R$	T_{NTC} = 100 °C, R_{100} = 493 Ω	-5		5	%
Power dissipation	P_{25}	T_{NTC} = 25 °C			20	mW
B-value	$B_{25/50}$	$R_2 = R_{25} \exp[B_{25/50}(1/T_2 - 1/(298,15\ K))]$		3375		K
B-value	$B_{25/80}$	$R_2 = R_{25} \exp[B_{25/80}(1/T_2 - 1/(298,15\ K))]$		3411		K
B-value	$B_{25/100}$	$R_2 = R_{25} \exp[B_{25/100}(1/T_2 - 1/(298,15\ K))]$		3433		K

5 Characteristics diagrams

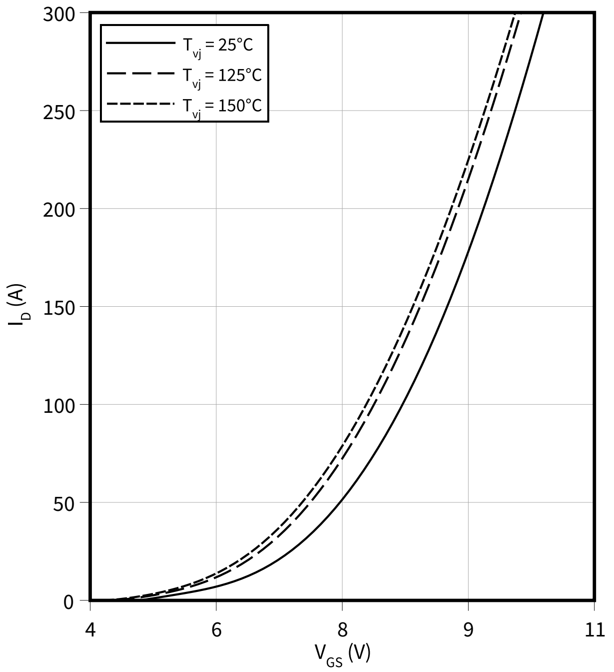
Output characteristic (typical), MOSFET
$I_D = f(V_{DS})$
$V_{GS} = 15\ V$



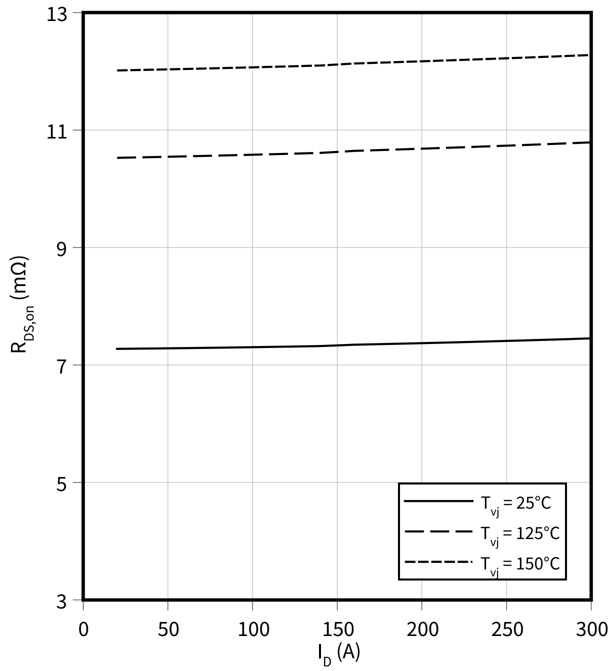
Output characteristic (typical), MOSFET
$I_D = f(V_{DS})$
$T_{vj} = 150\ °C$



Transfer characteristic (typical), MOSFET
$I_D = f(V_{GS})$
$V_{DS} = 20\ V$



Drain-source on-resistance (typical), MOSFET
$R_{DS,on} = f(I_D)$
$V_{GS} = 15\ V$

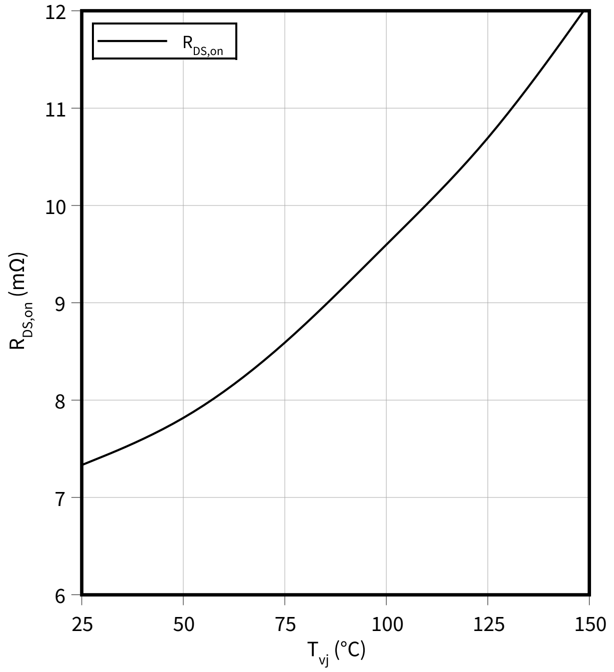


5 Characteristics diagrams

Drain-source on-resistance (typical), MOSFET

$R_{DS,on} = f(T_{vj})$

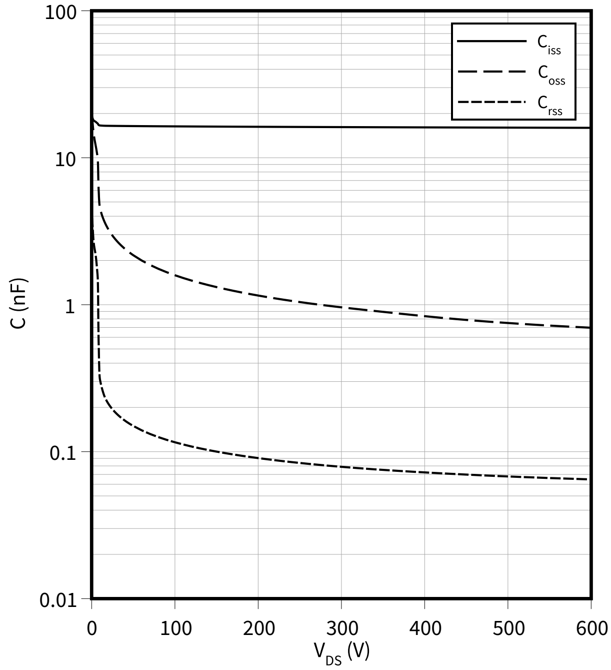
I_D = 150 A, V_{GS} = 15 V



Capacity characteristic (typical), MOSFET

$C = f(V_{DS})$

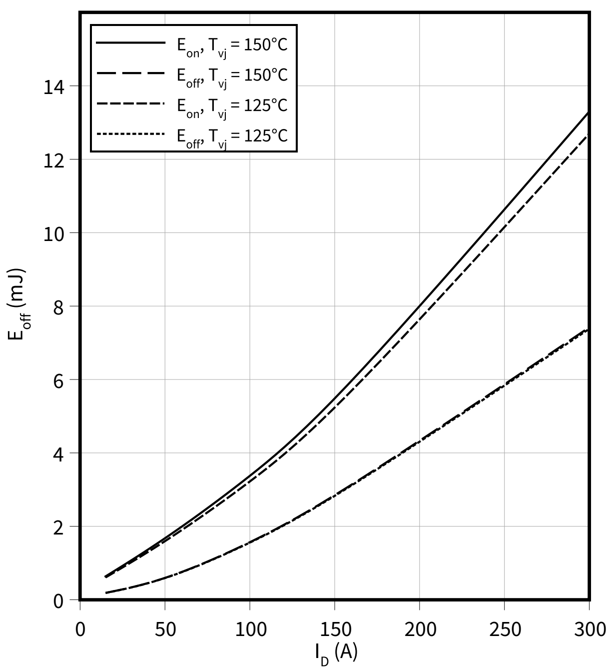
f = 100 kHz, V_{GS} = 0 V, T_{vj} = 25 °C



Switching losses (typical), MOSFET

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

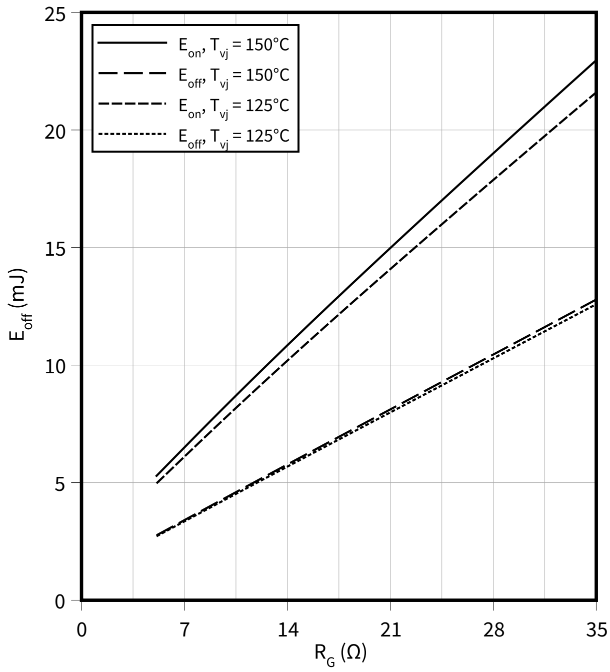
V_{DS} = 600 V, $R_{G,off}$ = 5.1 Ω, $R_{G,on}$ = 5.1 Ω, V_{GS} = ±15 V



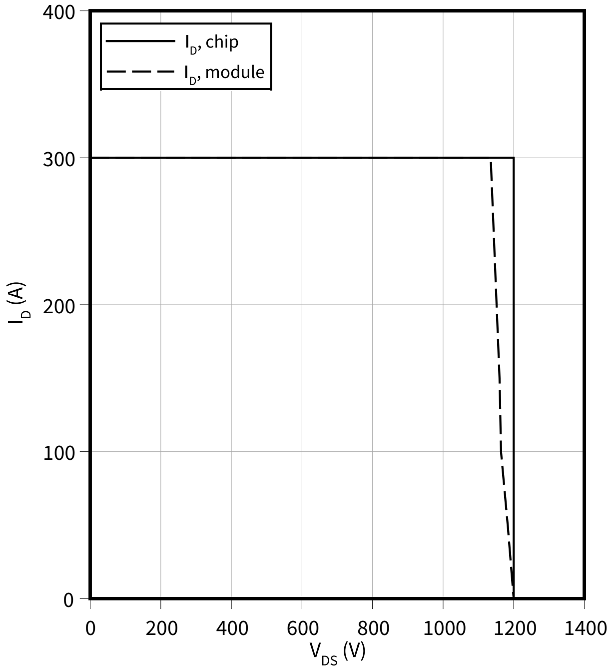
Switching losses (typical), MOSFET

$E_{off} = f(R_G)$, $E_{on} = f(R_G)$

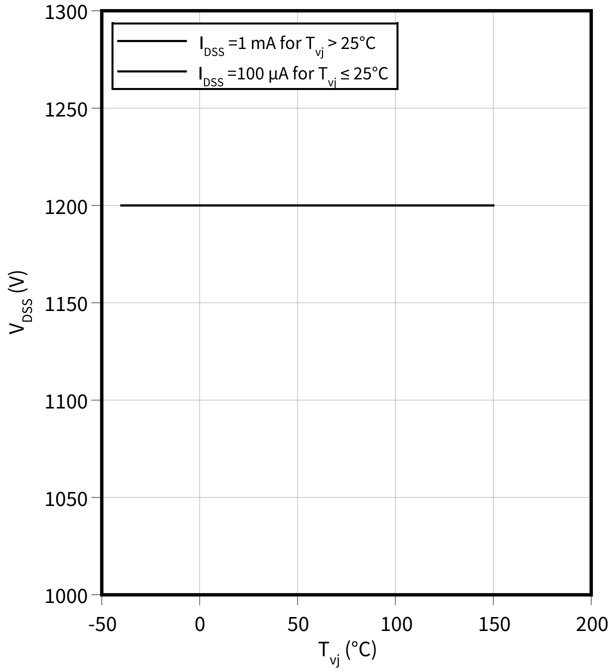
I_D = 150 A, V_{DS} = 600 V, V_{GS} = -5/15 V



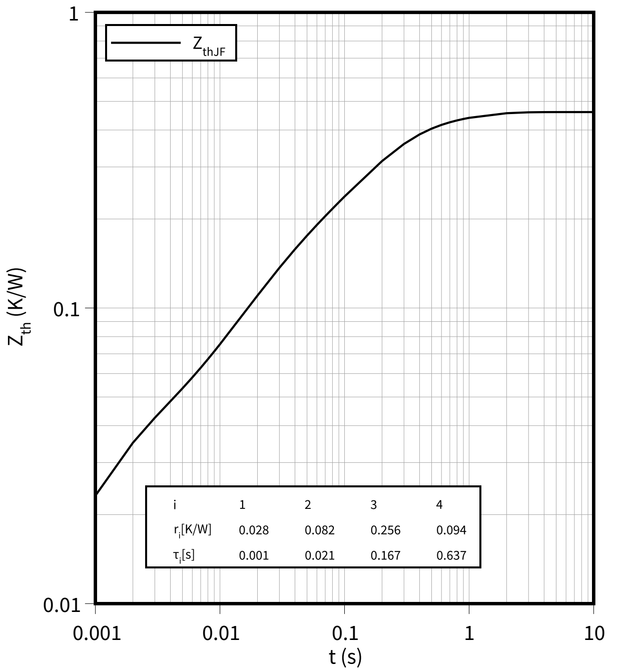
Reverse bias safe operating area (RBSOA), MOSFET
$I_D = f(V_{DS})$
V_{GS} = -5/15 V, T_{vj} = 150 °C



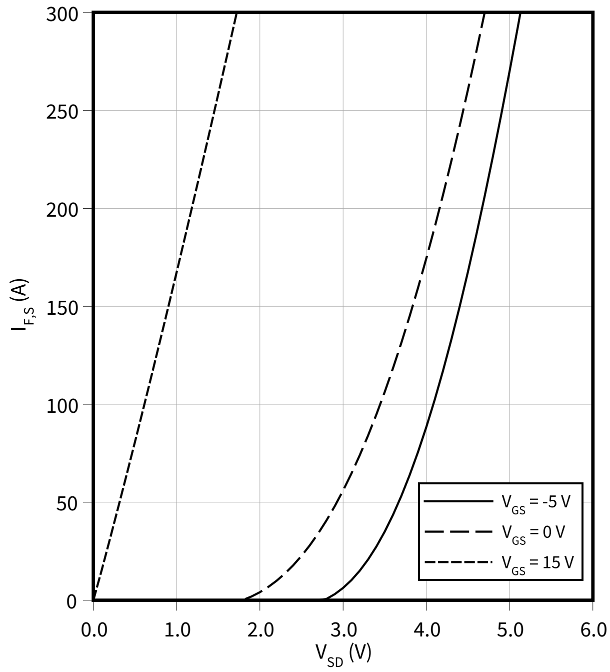
Maximum allowed drain-source voltage, MOSFET
$V_{DSS} = f(T_{vj})$
verified by characterization / design not by test

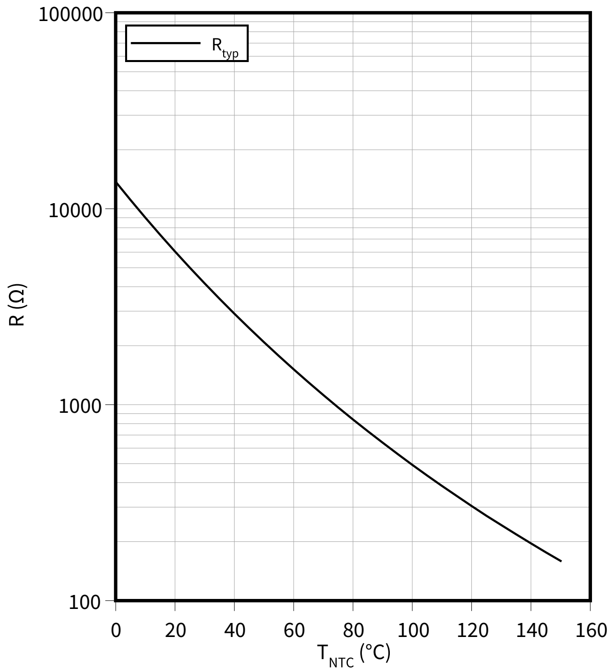


Transient thermal impedance , MOSFET
$Z_{th} = f(t)$



Forward characteristic body diode (typical), MOSFET
$I_{F,S} = f(V_{SD})$
T_{vj} = 25 °C



Temperature characteristic (typical), NTC-Thermistor $R = f(T_{NTC})$	
	

6 Circuit diagram

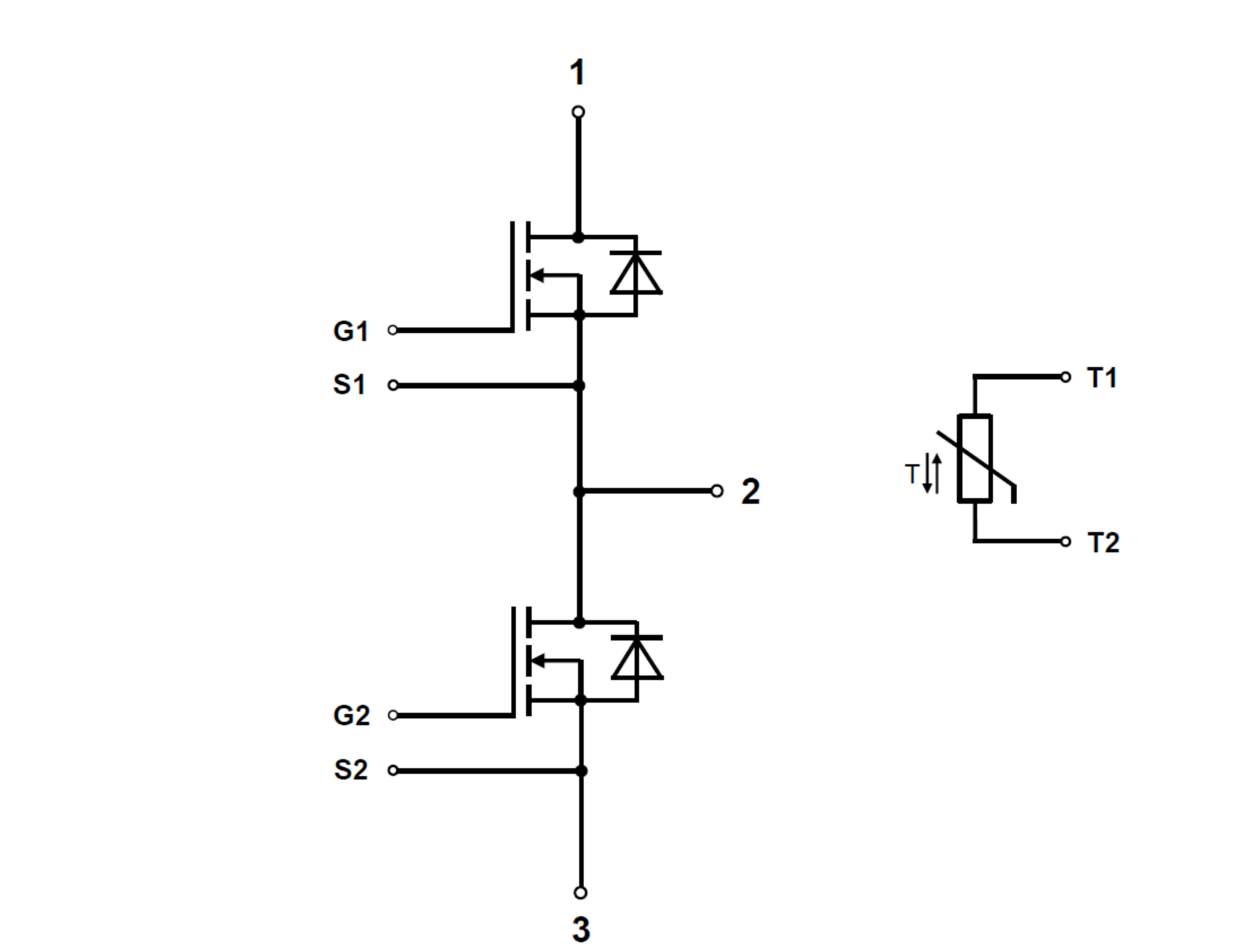


Figure 1

7 Package outlines

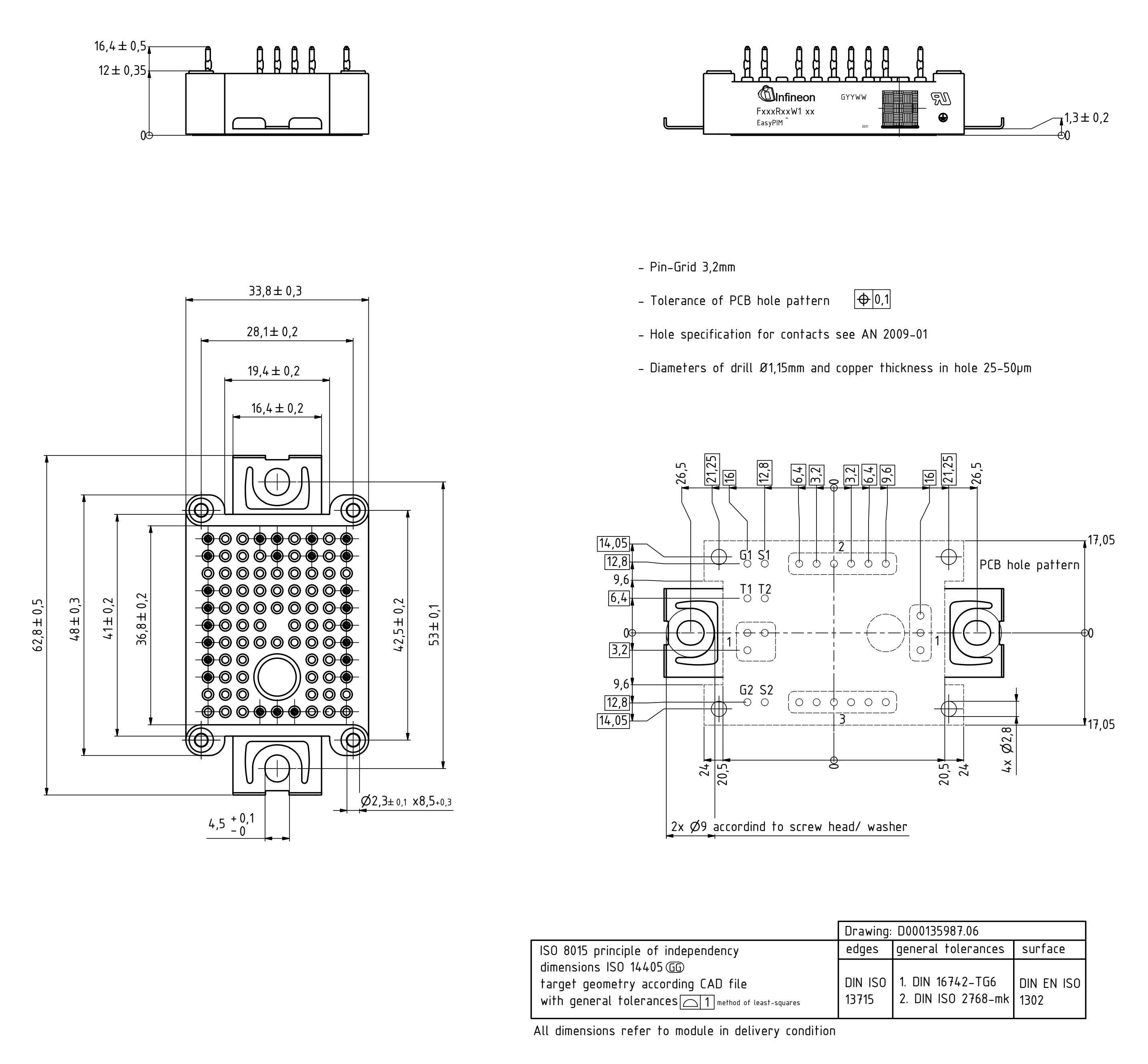


Figure 2

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

Packing label code

Code format	Barcode Code128
Encoding	Code Set A
Symbol size	34 digits
Standard	IEC8859-1

Code content	*Content*	*Identifier*	*Digit*	*Example*
	Module serial number	X	2 – 9	95056609
	Module material number	1T	12 – 19	2X0003E0
	Production order number	S	21 – 25	754389
	Date code (production year)	9D	28 – 31	1139
	Date code (production week)	Q	33 – 34	15

Example	X950566091T2X0003E0S754389D1139Q15

Figure 3

Revision history

Document revision	Date of release	Description of changes
V1.0	2018-11-21	Target datasheet
V1.1	2018-11-27	Correction of pin designation in circuit diagram
V2.0	2019-08-13	Target datasheet 1.1, New data for preliminary datasheet
V3.0	2020-03-25	Final datasheet
V3.1	2020-09-15	Correction of Erec energy and du/dt value
n/a	2020-10-05	Datasheet migrated to a new system with a new layout and new revision number schema: target or preliminary datasheet = 0.xy; final datasheet = 1.xy
1.11	2022-09-16	Fixed various typos

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