Easy 1B Module

CoolSiC™ Automotive MOSFET

FF08MR12W1MA1_B11A

Qualified for Automotive Applications. Product Validation according to AQG 324

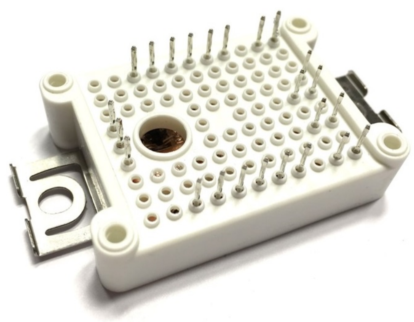
Final Data Sheet

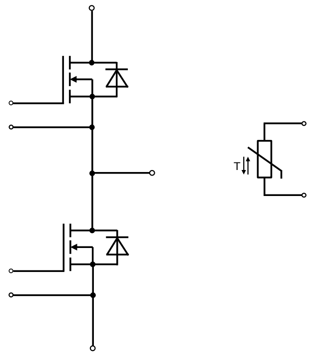
V3.1, 2020-09-15

Automotive High Power

1 Features / Description

EasyDUAL module with CoolSiC™ Automotive MOSFET and PressFIT / NTC





V_{DSS} = 1200 V
I_D = 150 A

Typical Applications

- Automotive Applications
- Auxiliary Inverters
- DC/DC converter
- Hybrid Electrical Vehicles (H)EV

Electrical Features

- New semiconductor material - Silicon Carbide
- Blocking voltage 1200V
- Low RDSon
- Low Switching Losses
- Low Qg and Crss
- Low Inductive Design
- $T_{vj\,op}$ = 150°C

Mechanical Features

- 5.1kV DC 1sec Insulation
- Compact design
- High Power Density
- Integrated NTC temperature sensor
- PressFIT Contact Technology
- RoHS compliant

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.

It is qualified for Automotive Applications and validated according to AQG 324.

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. Due to the high clearance & creepage distances, the module family is also well suited for increased system working voltages and supports modular approaches.

Product Name	Ordering Code
FF08MR12W1MA1_B11A	SP002314006

2 MOSFET

2.1 Maximum Rated Values

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

2.2 Characteristic Values

Parameter	Conditions		Symbol	min.	typ.	max.	Unit
Drain-source on resistance	$I_{D\,nom}$ = 150 A V_{GS} = 15 V	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	$R_{DS\,on}$		7.33 10.6 12.1	9.80	mΩ
Gate threshold voltage	I_D = 90.0 mA, V_{DS} = V_{GS} (tested after 1ms pulse at V_{GS} = +20 V)	T_{vj} = 25°C	$V_{GS(th)}$	3.25	4.40	5.55	V
Total gate charge	V_{GS} = -5/15 V, V_{DS} = 600 V		Q_G		0.495		µC
Internal gate resistor		T_{vj} = 25°C	R_{Gint}		0.6		Ω
Input capacitance	f = 1 MHz, V_{GS} = 0 V V_{DS} = 600 V	T_{vj} = 25°C	C_{iss}		16.0		nF
Output capacitance	f = 1 MHz, V_{GS} = 0 V V_{DS} = 600 V	T_{vj} = 25°C	C_{oss}		0.70		nF
Reverse transfer capacitance	f = 1 MHz, V_{GS} = 0 V V_{DS} = 600 V	T_{vj} = 25°C	C_{rss}		0.06		nF
C_{OSS} stored energy	V_{DS} = 600 V, V_{GS} = -5 / 15 V	T_{vj} = 25°C	E_{OSS}		164		µJ
Drain-source leakage current	V_{DSS} = 1200 V, V_{GS} = -5 V	T_{vj} = 25°C	I_{DSX}			100	µA
Gate-source leakage current	V_{DS} = 0 V, T_{vj} = 25°C	V_{GS} = 20 V	I_{GSS}			400	nA
Turn on delay time, inductive load	$I_{D\,nom}$ = 150 A, R_{Gon} = 5.10 Ω V_{DS} = 600 V V_{GS} = -5 / 15 V	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	$t_{d\,on}$		53.0 48.0 46.0		ns
Rise time, inductive load	$I_{D\,nom}$ = 150 A, R_{Gon} = 5.10 Ω V_{DS} = 600 V V_{GS} = -5 / 15 V	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	t_r		35.0 34.0 33.0		ns
Turn off delay time, inductive load	$I_{D\,nom}$ = 150 A, R_{Goff} = 5.10 Ω V_{DS} = 600 V V_{GS} = -5 / 15 V	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	$t_{d\,off}$		146 148 149		ns
Fall time, inductive load	$I_{D\,nom}$ = 150 A, R_{Goff} = 5.10 Ω V_{DS} = 600 V V_{GS} = -5 / 15 V	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	t_f		38.0 38.0 39.0		ns
Turn-on energy loss per pulse	$I_{D\,nom}$ = 150 A, V_{GS} = -5 / 15 V V_{DS} = 600 V, R_{Gon} = 5.10 Ω L_S = 20 nH di/dt = 4.92 kA/µs ($T_{vj\,op}$ = 150°C)	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	E_{on}		4.26 5.01 5.29		mJ
Turn-off energy loss per pulse	$I_{D\,nom}$ = 150 A, V_{GS} = -5 / 15 V V_{DS} = 600 V, R_{Goff} = 5.10 Ω L_S = 20 nH du/dt = 15.5 kV/µs ($T_{vj\,op}$ = 150°C)	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	E_{off}		2.67 2.73 2.76		mJ
SC data	V_{GS} = -5 / 15 V, R_G = 5.10 Ω V_{DD} = 800 V V_{DSmax} = V_{DSS} -L_{sDS} ·di/dt	$t_P \leq$ 3 µs, T_{vj} = 150°C $t_P \leq$ 3 µs, T_{vj} = 25°C	I_{SC}		2000 2200		A
Thermal resistance, junction to heatsink	per MOSFET		R_{thJH}		0.460	0.550	K/W
Temperature under switching conditions			$T_{vj\,op}$	-40		150	°C

3 Body diode

3.1 Maximum Rated Values

Parameter	Conditions		Symbol	Value	Unit
DC body diode forward current	T_{vj} = 175°C, V_{GS} = -5 V	T_H = 65°C	I_{SD}	60	A
Pulsed body diode current	verified by design, t_p limited by T_{vjmax}		$I_{SD\ pulse}$	300	A

3.2 Characteristic Values

Parameter	Conditions		Symbol	min.	typ.	max.	Unit
Forward voltage	I_{SD} = 150 A V_{GS} = -5 V	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	V_{DSR}		4.40 4.18 4.12	5.95	V
Peak reverse recovery current	I_{SD} = 150 A, V_{GS} = -5 V $-di_S/dt$ = 6.10 kA/µs V_R = 600 V	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	I_{rrm}		75.0 135 158		A
Recovered charge	I_{SD} = 150 A, V_{GS} = -5 V $-di_S/dt$ = 6.10 kA/µs V_R = 600 V	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	Q_{rr}		2.58 4.10 5.13		µC
Reverse recovery energy	I_{SD} = 150 A, V_{GS} = -5 V $-di_S/dt$ = 6.10 kA/µs V_R = 600 V	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	E_{rec}		0.48 0.95 1.35		mJ

4 NTC-Thermistor

Parameter	Conditions	Symbol	min.	typ.	max.	Unit
				Value		
Rated resistance	T_C = 25°C	R_{25}		5.00		kΩ
Deviation of R100	T_C = 100°C, R_{100} = 493 Ω	ΔR/R	-5		5	%
Power dissipation	T_C = 25°C	P_{25}			20.0	mW
B-value	$R_2 = R_{25}$ exp $[B_{25/50}(1/T_2$ - 1/(298,15 K))]	$B_{25/50}$		3375		K
B-value	$R_2 = R_{25}$ exp $[B_{25/80}(1/T_2$ - 1/(298,15 K))]	$B_{25/80}$		3411		K
B-value	$R_2 = R_{25}$ exp $[B_{25/100}(1/T_2$ - 1/(298,15 K))]	$B_{25/100}$		3433		K

Specification according to the valid application note.

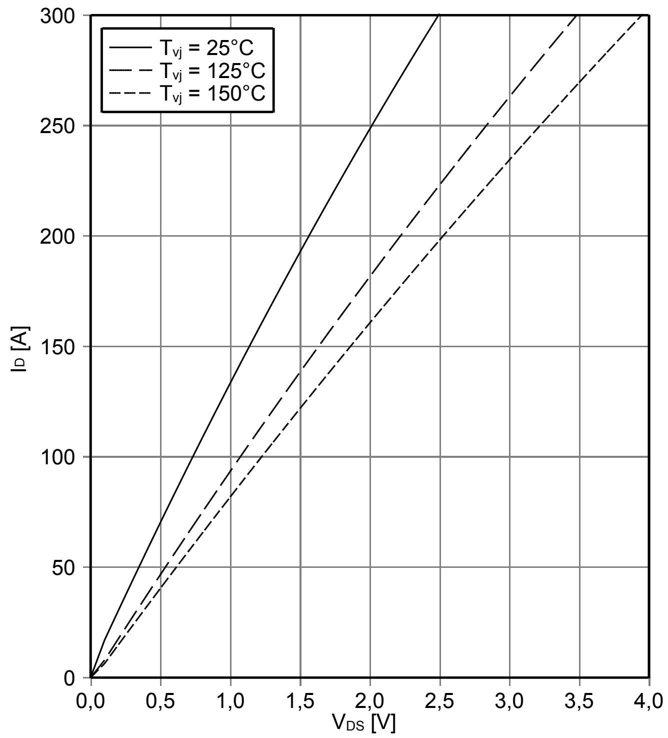
5 Module

Parameter	Conditions	Symbol	Value	Unit
Isolation test voltage	RMS, f = 0 Hz, t = 1sec	V_{ISOL}	5.1	kV
Internal isolation	basic insulation (class 1, IEC 61140)		Al_2O_3	
Creepage distance	terminal to heatsink terminal to terminal	d_{Creep}	11.5 8.0	mm
Clearance	terminal to heatsink terminal to terminal	d_{Clear}	10.0 5.5	mm
Comperative tracking index		CTI	> 200	

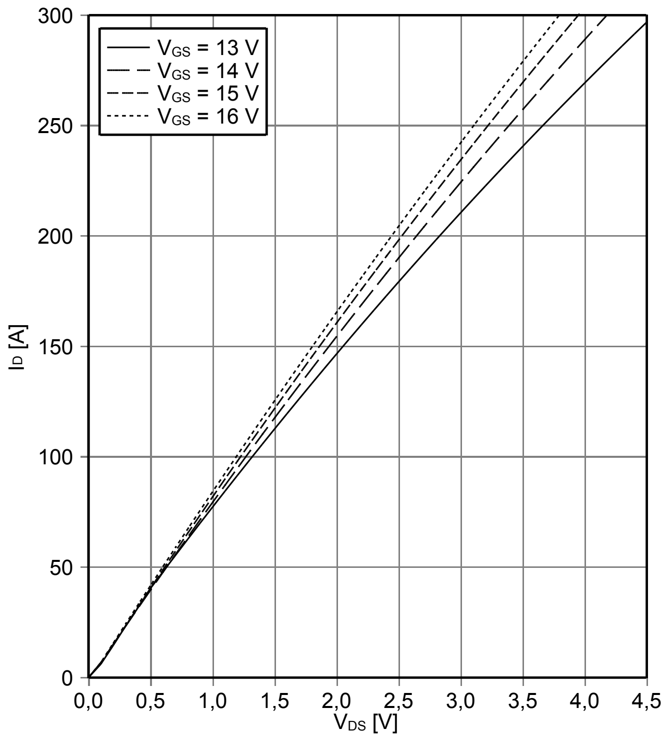
Parameter	Conditions	Symbol	min.	typ.	max.	Unit
Stray inductance module		L_{sCE}		5.0		nH
Module lead resistance, terminals - chip	T_C = 25 °C, per switch	$R_{AA'+CC'}$		1.00		mΩ
Storage temperature		T_{stg}	-40		150	°C
Mounting force per clamp		F	20	-	50	N
Weight		G		24		g

6 Characteristics Diagrams

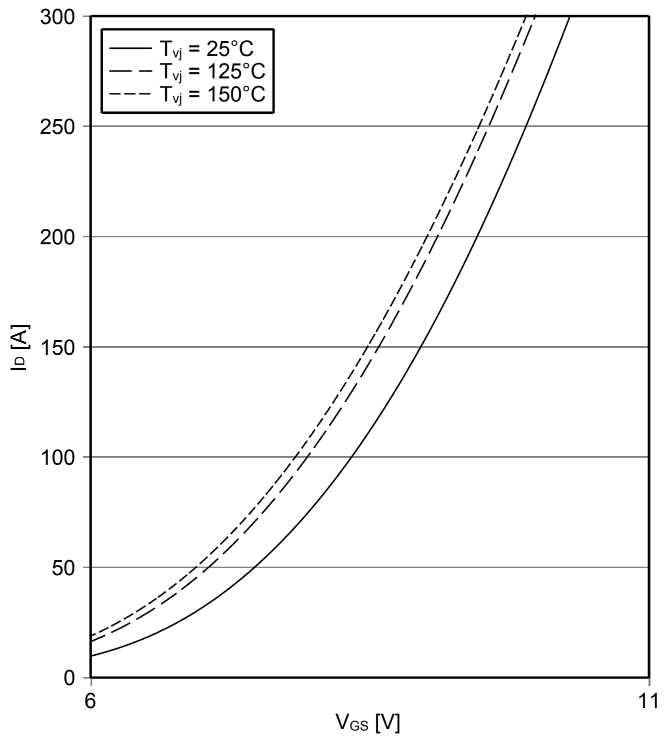
output characteristic MOSFET (typical)
$I_D = f(V_{DS})$
$V_{GS} = 15$ V



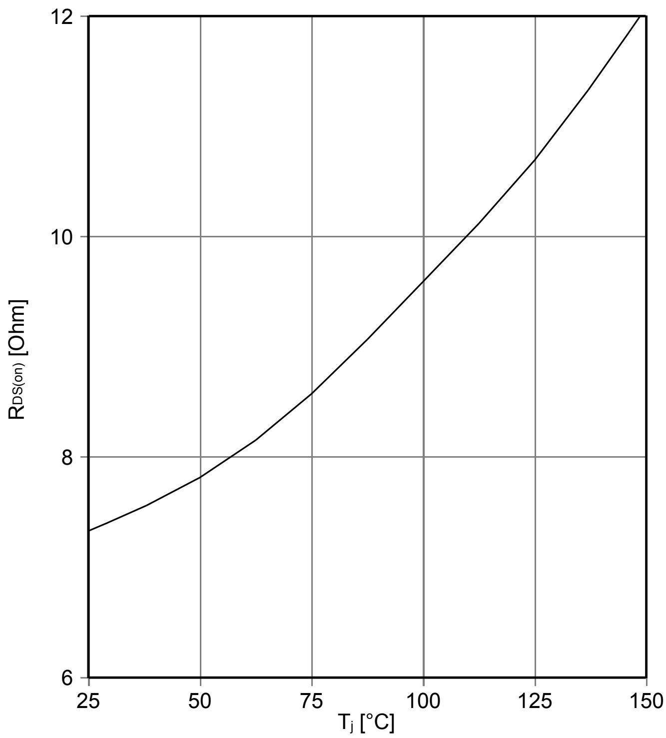
output characteristic MOSFET (typical)
$I_D = f(V_{DS})$
$T_{vj} = 150°C$



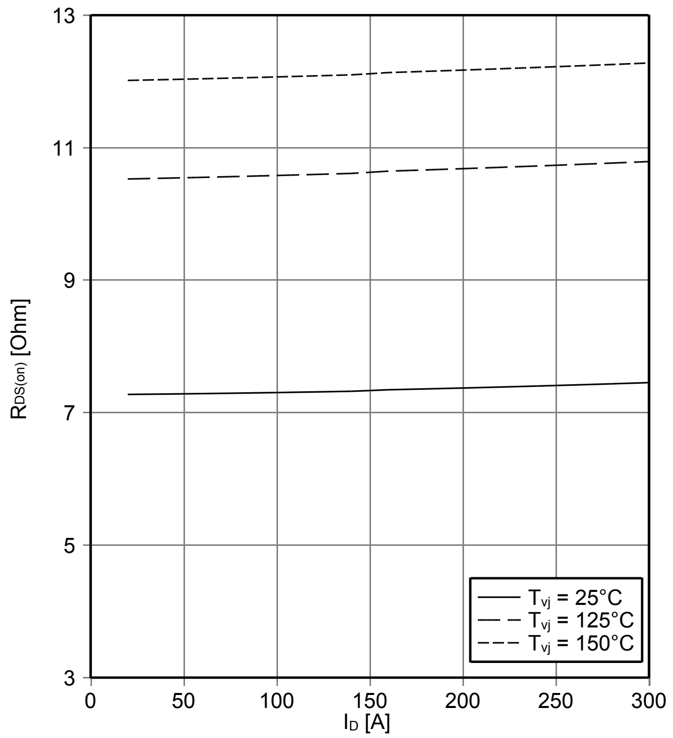
transfer characteristic MOSFET (typical)
$I_D = f(V_{GS})$
$V_{DS} = 20$ V



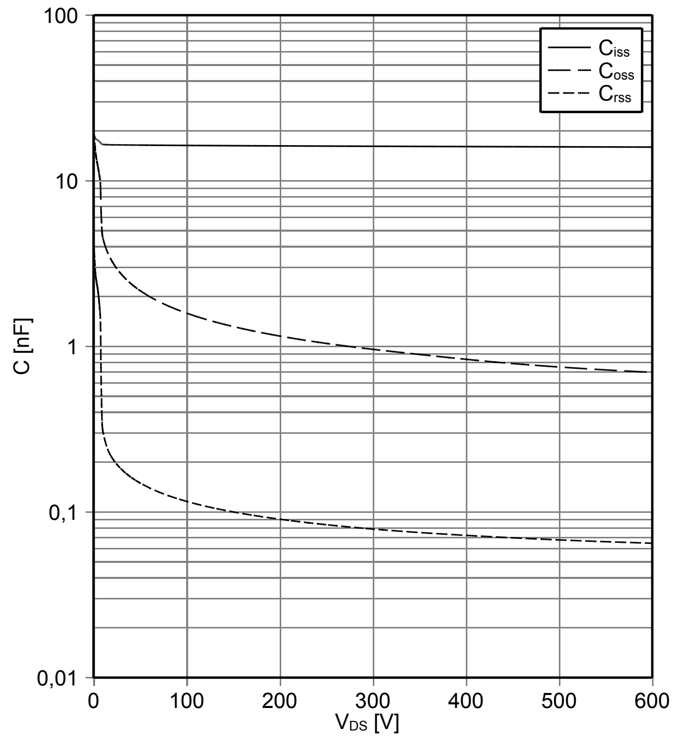
drain source on-resistance MOSFET (typical)
$R_{DS(on)} = f(T_j)$
$V_{GS} = 15$ V; $I_D = 150$ A



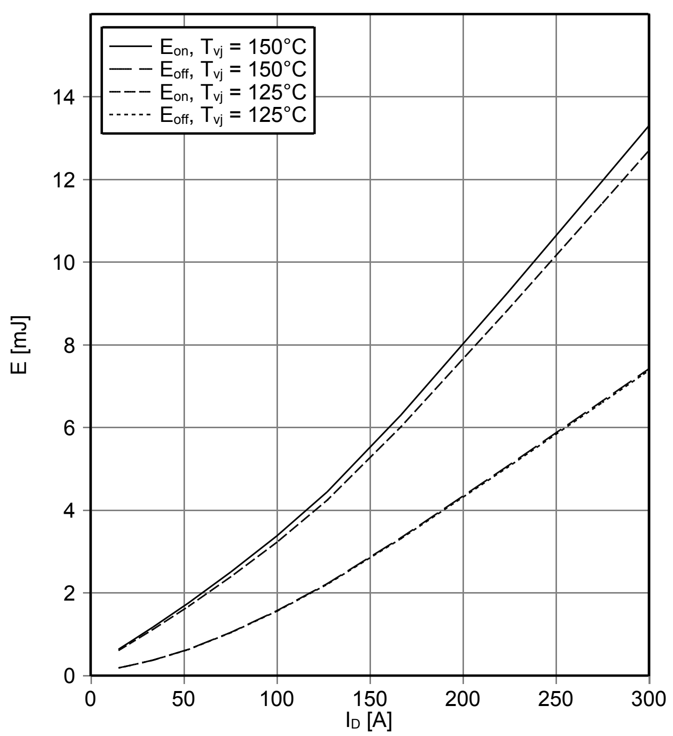
drain source on-resistance MOSFET (typical)
$R_{DS(on)} = f(T_j)$
$V_{GS} = 15$ V



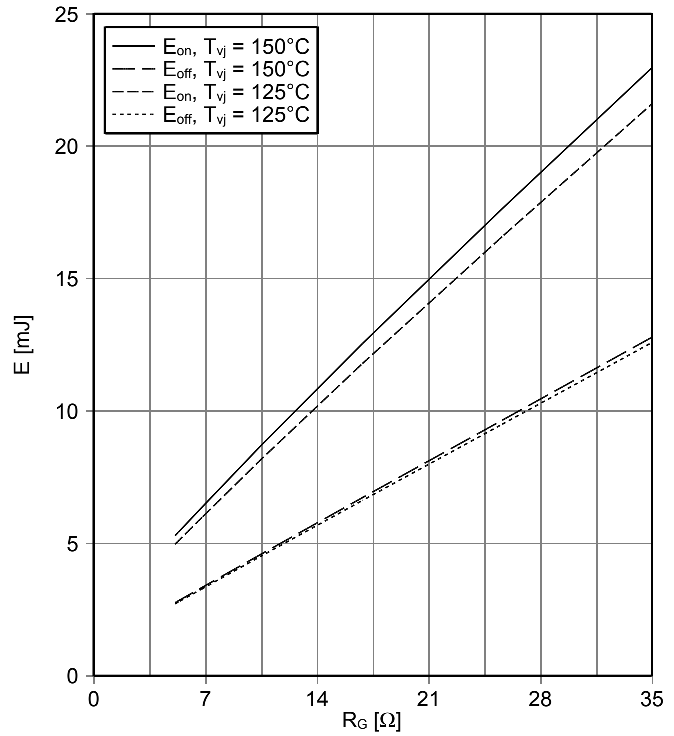
capacity characteristic MOSFET (typical)
$C = f(V_{DS})$
$V_{GS} = 0$ V, $T_{vj} = 25$°C, f = 100kHz



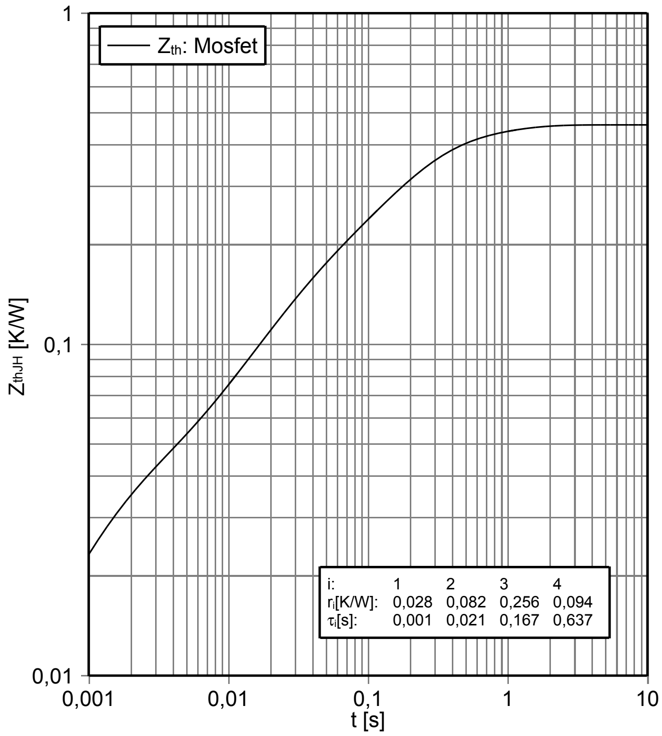
switching losses MOSFET (typical)
$E_{on} = f(I_D)$, $E_{off} = f(I_D)$
$V_{GS} = -5$ V / +15 V, $R_{Gon} = R_{Goff} = 5.1$ Ω, $V_{DS} = 600$ V



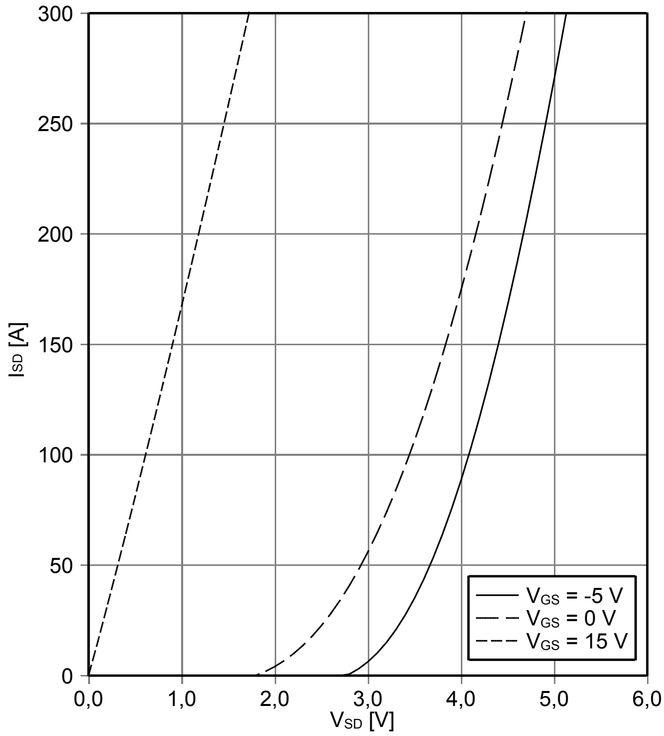
switching losses MOSFET (typical)
$E_{on} = f(R_G)$, $E_{off} = f(R_G)$
$V_{GS} = -5$ V / +15 V, $I_D = 150$ A, $V_{DS} = 600$ V



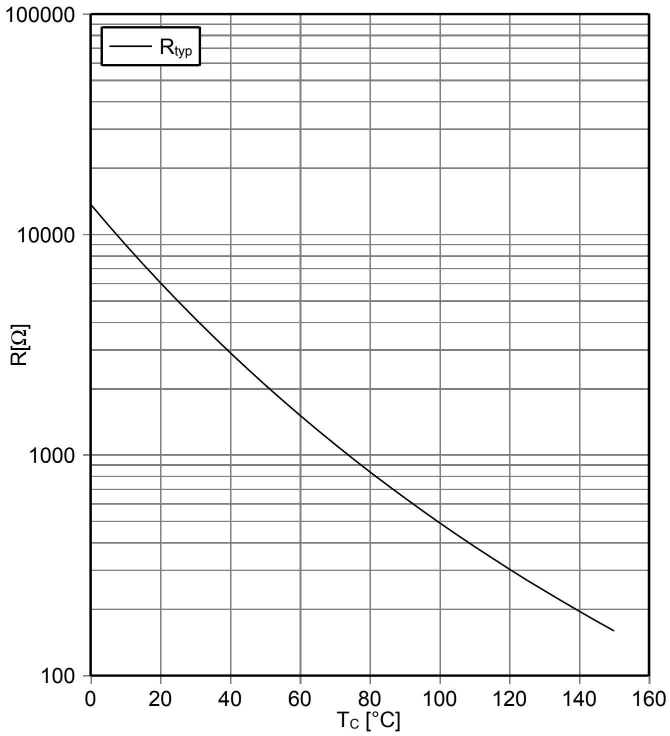
transient thermal impedance MOSFET
Z_{thJH} = f (t) (typical)



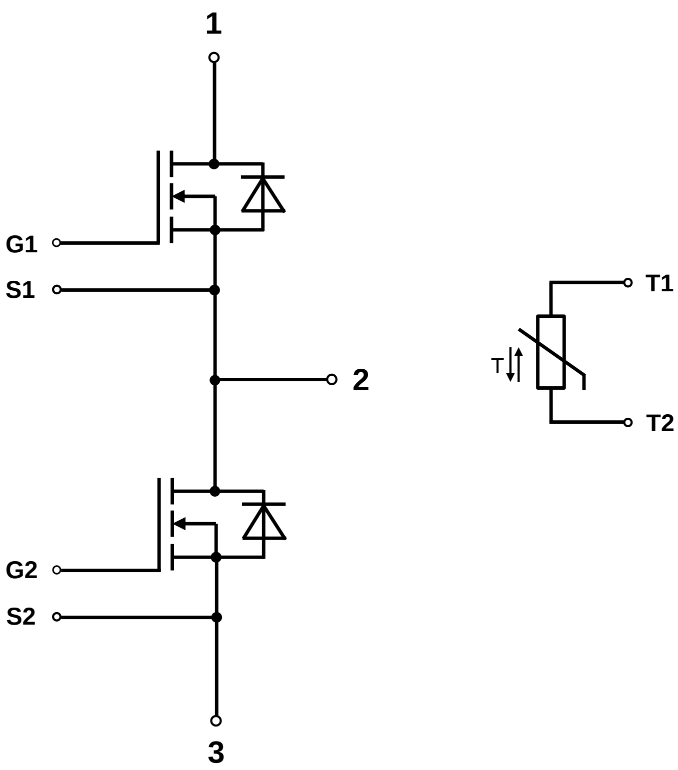
forward characteristic MOSFET body diode (typical)
I_{SD} = f(V_{SD})
T_j = 25°C



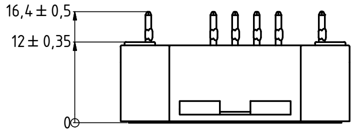
NTC-Thermistor-temperature characteristic (typical)
R = f (T)

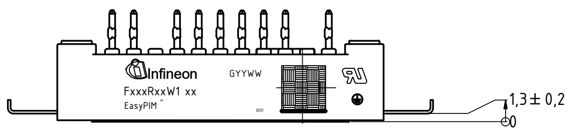


7 Circuit diagram

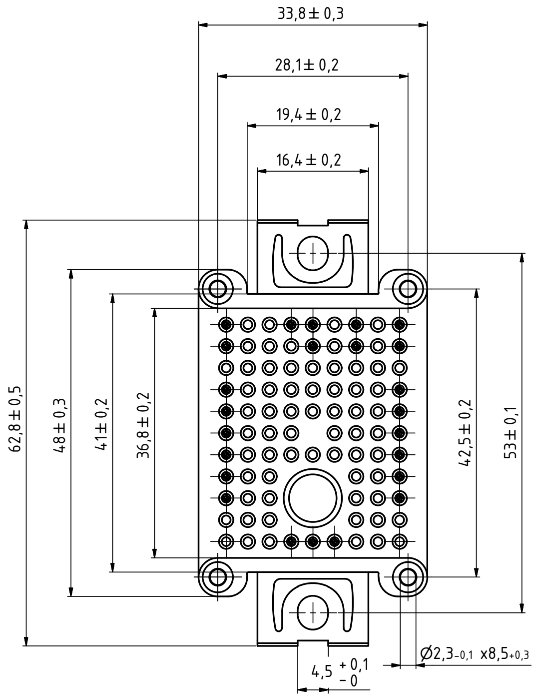


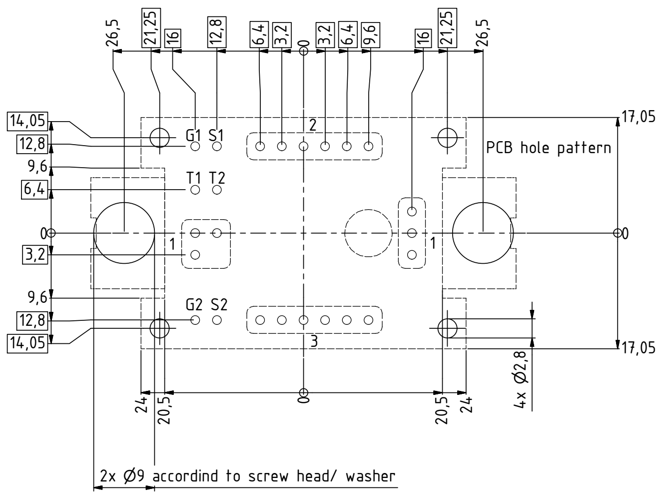
8 Package outlines





- Pin-Grid 3,2mm
- Tolerance of PCB hole pattern ⌖ 0,1
- Hole secificatin for contacts see AN 2009-01
- Diameters of drill Ø1,15mm and copper thickness in hole 25-50µm





	Drawing: D000135987.02		
	edges	general tolerances	surface
ISO 8015 principle of independency dimensions ISO 14405 (GG) target geometry according CAD file with general tolerances ⌓ 1 method of least-squares	DIN ISO 13715	1. DIN 16742-TG6 2. DIN ISO 2768-mk	DIN EN ISO 1302

All dimensions refer to module in delivery condition

9 Label Codes

9.1 Module Code

Code Format	Data Matrix		
Encoding	ASCII Text		
Symbol Size	16x16		
Standard	IEC24720 and IEC16022		
Code Content	Content Module Serial Number Module Material Number Production Order Number Datecode (Production Year) Datecode (Production Week)	Digit 1 - 5 6 - 11 12 - 19 20 - 21 22 - 23	Example (below) 71549 142846 55054991 15 30
Example	71549142846550549911530		

9.2 Packing Code

Code Format	Code128			
Encoding	Code Set A			
Symbol Size	34 digits			
Standard	IEC8859-1			
Code Content	Content Backend Construction Number Production Lot Number Serial Number Date Code Box Quantity	Identifier X 1T S 9D Q	Digit 2 - 9 12 - 19 21 - 25 28 - 31 33 - 34	Example (below) 95056609 2X0003E0 754389 1139 15
Example	X950566091T2X0003E0S754389D1139Q15			

Revision History

Major changes since previous revision

Revision History		
Reference	Date	Description
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

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