Final datasheet
62 mm C-Series module with CoolSiC™ Trench MOSFET

Features

- Electrical features
  - V_{DSS} = 2000 V
  - I_{DN} = 400 A / I_{DRM} = 800 A
  - Low switching losses
  - High current density
  - Suitable Infineon gate drivers can be found under https://www.infineon.com/gdfinder
- Mechanical features
  - 4 kV AC 1 min insulation

Potential applications

- UPS systems
- DC/DC converter
- High-frequency switching application
- Solar applications

Product validation

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

Description

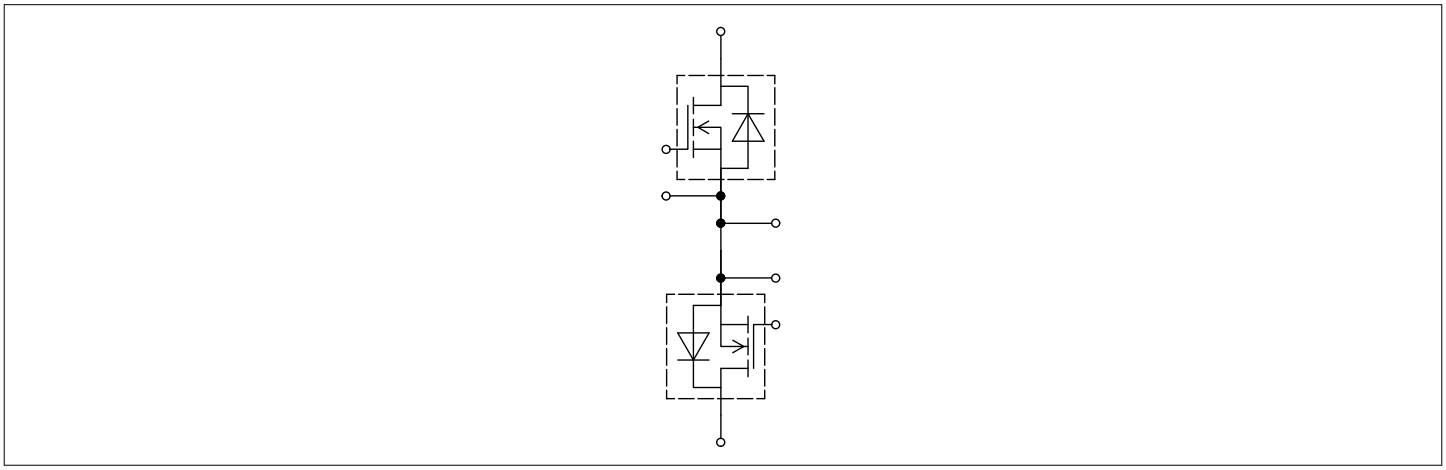


Table of contents

1 Package

Table 1 Insulation coordination

Parameter	Symbol	Note or test condition	Values	Unit
Isolation test voltage	V_{ISOL}	RMS, f = 50 Hz, *t* = 1 min	4.0	kV
Material of module baseplate			Cu	
Internal isolation		basic insulation (class 1, IEC 61140)	Al_2O_3	
Creepage distance	$d_{Creep\ nom}$	terminal to baseplate, nom.	29.0	mm
Creepage distance	$d_{Creep\ nom}$	terminal to terminal, nom.	23.0	mm
Clearance	$d_{Clear\ nom}$	terminal to baseplate, nom.	23.0	mm
Clearance	$d_{Clear\ nom}$	terminal to terminal, nom.	11.0	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}				20		nH
Module lead resistance, terminals - chip	$R_{CC'+EE'}$	T_C = 25 °C, per switch			0.385		mΩ
Storage temperature	T_{stg}			-40		125	°C
Mounting torque for module mounting	*M*	- Mounting according to valid application note	M6, Screw	3		6	Nm
Terminal connection torque	*M*	- Mounting according to valid application note	M6, Screw	2.5		5	Nm
Weight	*G*				340		g

***Note**: The electrical characterization was performed in NPC2 topology, which combines the modules FF3MR20KM1H and FF3MR20KM1H_S.*

It has to be considered, that the commutation in this configuration takes place between both modules.

2 MOSFET, T1 / T2

Table 3 Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
Drain-source voltage	V_{DSS}		T_{vj} = 25 °C	2000	V
Implemented drain current	I_{DN}			400	A

(table continues...)

Table 3 (continued) Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
Continuous DC drain current	I_{DDC}	T_{vj} = 175 °C, V_{GS} = 18 V	T_C = 25 °C	375	A
Repetitive peak drain current	I_{DRM}	verified by design, t_p limited by T_{vjmax}		800	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 = 400 A	V_{GS} = 18 V, T_{vj} = 25 °C		2.6	4	mΩ
			V_{GS} = 18 V, T_{vj} = 125 °C		5.5		
			V_{GS} = 18 V, T_{vj} = 175 °C		7.8		
Gate threshold voltage	$V_{GS(th)}$	I_D = 224 mA, V_{DS} = V_{GS}, T_{vj} = 25 °C, (tested after 1ms pulse at V_{GS} = +20 V)		3.45	4.3	5.15	V
Total gate charge	Q_G	V_{DD} = 1200 V, V_{GS} = -3/18 V, T_{vj} = 25 °C			1.56		µC
Internal gate resistor	R_{Gint}	T_{vj} = 25 °C			0.9		Ω
Input capacitance	C_{ISS}	f = 100 kHz, V_{DS} = 1200 V, V_{GS} = 0 V	T_{vj} = 25 °C		48.2		nF
Output capacitance	C_{OSS}	f = 100 kHz, V_{DS} = 1200 V, V_{GS} = 0 V	T_{vj} = 25 °C		1.13		nF
Reverse transfer capacitance	C_{rss}	f = 100 kHz, V_{DS} = 1200 V, V_{GS} = 0 V	T_{vj} = 25 °C		0.08		nF
C_{OSS} stored energy	E_{OSS}	V_{DS} = 1200 V, V_{GS} = -3/18 V, T_{vj} = 25 °C			2030		µJ
Drain-source leakage current	I_{DSS}	V_{DS} = 2000 V, V_{GS} = -3 V	T_{vj} = 25 °C		0.08	660	µA
Gate-source leakage current	I_{GSS}	V_{DS} = 0 V, T_{vj} = 25 °C	V_{GS} = 20 V			400	nA

(table continues...)

Table 5 (continued) Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Turn-on delay time (inductive load)	$t_{d\,on}$	I_D = 400 A, R_{Gon} = 9.1 Ω, V_{DD} = 1200 V, V_{GS} = -3/18 V	T_{vj} = 25 °C		341		ns
			T_{vj} = 125 °C		304		
			T_{vj} = 175 °C		285		
Rise time (inductive load)	t_r	I_D = 400 A, R_{Gon} = 9.1 Ω, V_{DD} = 1200 V, V_{GS} = -3/18 V	T_{vj} = 25 °C		246		ns
			T_{vj} = 125 °C		244		
			T_{vj} = 175 °C		244		
Turn-off delay time (inductive load)	$t_{d\,off}$	I_D = 400 A, R_{Goff} = 2.7 Ω, V_{DD} = 1200 V, V_{GS} = -3/18 V	T_{vj} = 25 °C		235		ns
			T_{vj} = 125 °C		256		
			T_{vj} = 175 °C		267		
Fall time (inductive load)	t_f	I_D = 400 A, R_{Goff} = 2.7 Ω, V_{DD} = 1200 V, V_{GS} = -3/18 V	T_{vj} = 25 °C		63.4		ns
			T_{vj} = 125 °C		66.1		
			T_{vj} = 175 °C		66.2		
Turn-on energy loss per pulse	E_{on}	I_D = 400 A, V_{DD} = 1200 V, L_σ = 40 nH, V_{GS} = -3/18 V, R_{Gon} = 9.1 Ω, di/dt = 2.86 kA/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		77.7		mJ
			T_{vj} = 125 °C		79.1		
			T_{vj} = 175 °C		84		
Turn-off energy loss per pulse	E_{off}	I_D = 400 A, V_{DD} = 1200 V, L_σ = 40 nH, V_{GS} = -3/18 V, R_{Goff} = 2.7 Ω, dv/dt = 14.5 kV/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		26.2		mJ
			T_{vj} = 125 °C		27.3		
			T_{vj} = 175 °C		27.9		
Thermal resistance, junction to case	R_{thJC}	per MOSFET				0.0880	K/W
Thermal resistance, case to heat sink	R_{thCH}	per MOSFET, λ_{grease}= 1 W /(m*K)			0.0330		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°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

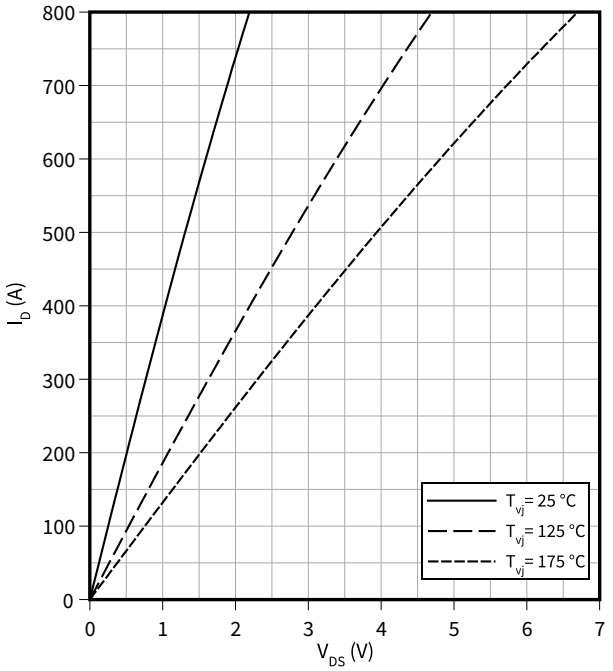
Parameter	Symbol	Note or test condition		Values	Unit
DC body diode forward current	I_{SD}	T_{vj} = 175 °C, V_{GS} = -3 V	T_C = 25 °C	315	A

Table 7 Characteristic values

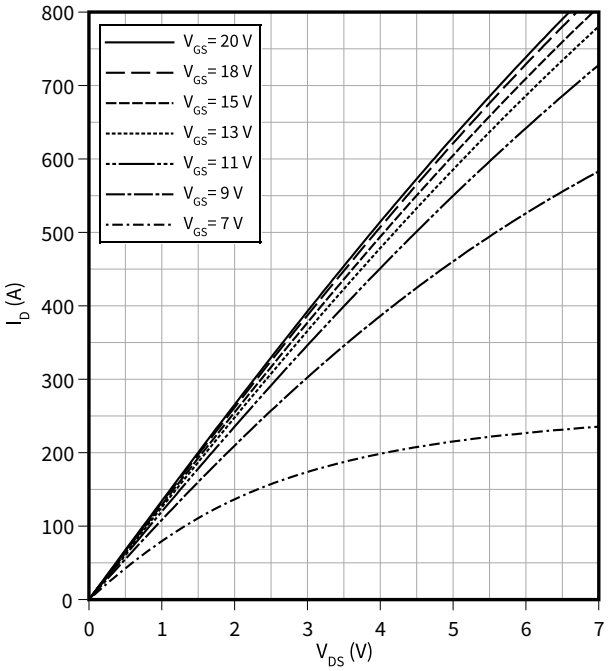
Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Forward voltage	V_{SD}	I_{SD} = 400 A, V_{GS} = -3 V	T_{vj} = 25 °C		4.6	6.15	V
			T_{vj} = 125 °C		4.15		
			T_{vj} = 175 °C		4		

4 Characteristics diagrams

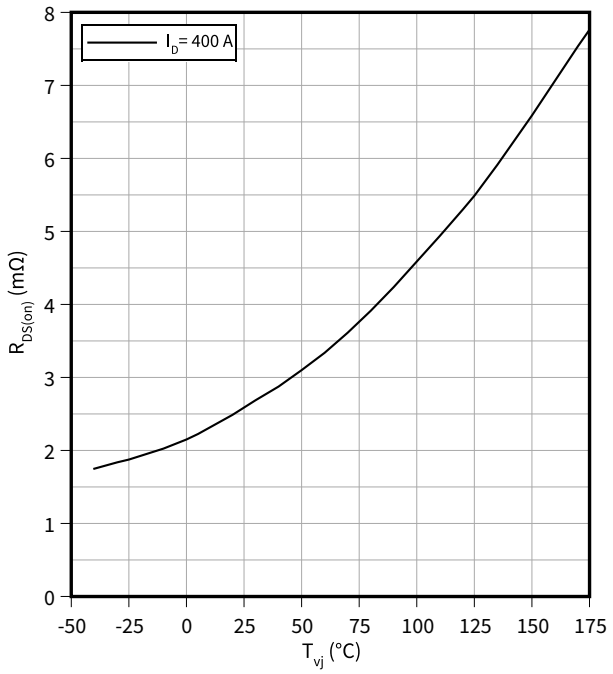
Output characteristic (typical), MOSFET, T1 / T2
$I_D = f(V_{DS})$
$V_{GS} = 18$ V



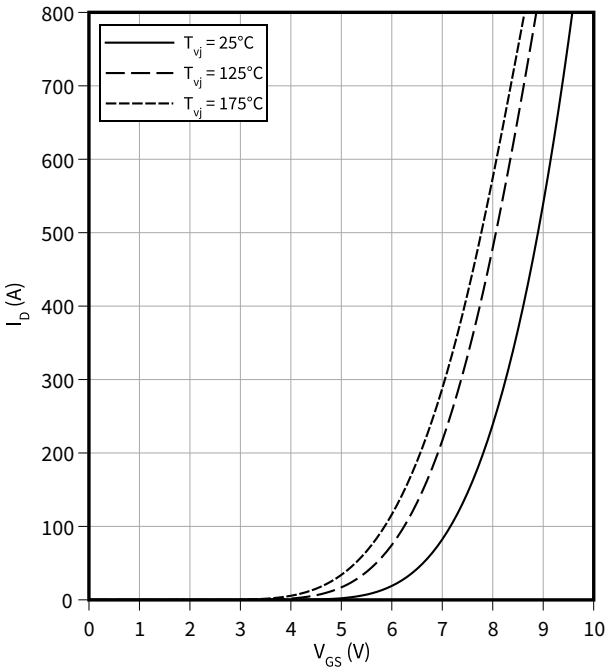
Output characteristic (typical), MOSFET, T1 / T2
$I_D = f(V_{DS})$
$T_{vj} = 175$ °C



Drain source on-resistance (typical), MOSFET, T1 / T2
$R_{DS(on)} = f(T_{vj})$
$V_{GS} = 18$ V

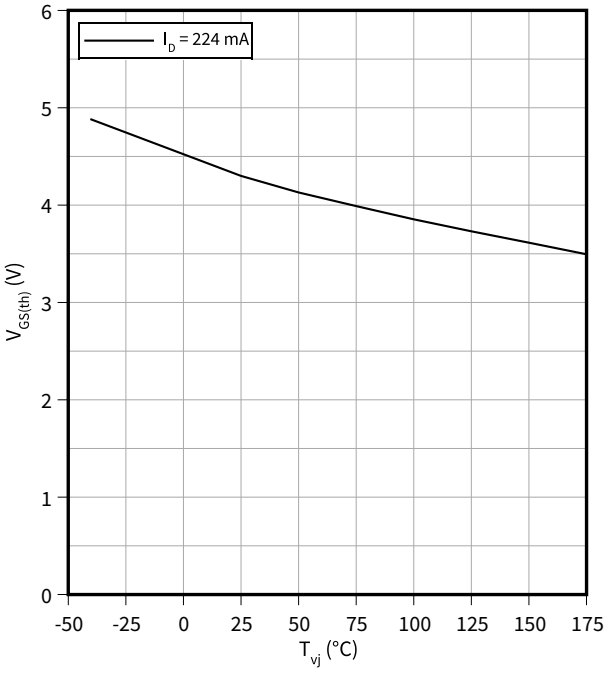


Transfer characteristic (typical), MOSFET, T1 / T2
$I_D = f(V_{GS})$
$V_{DS} = 20$ V



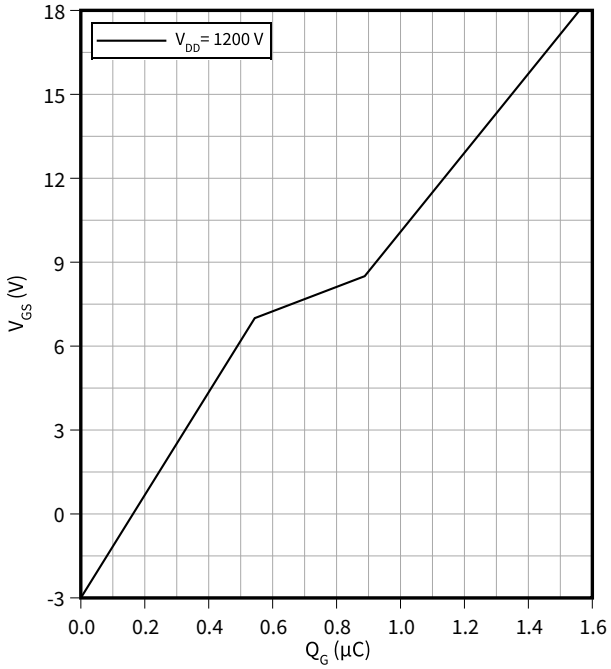
Gate-source threshold voltage (typical), MOSFET, T1 / T2

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



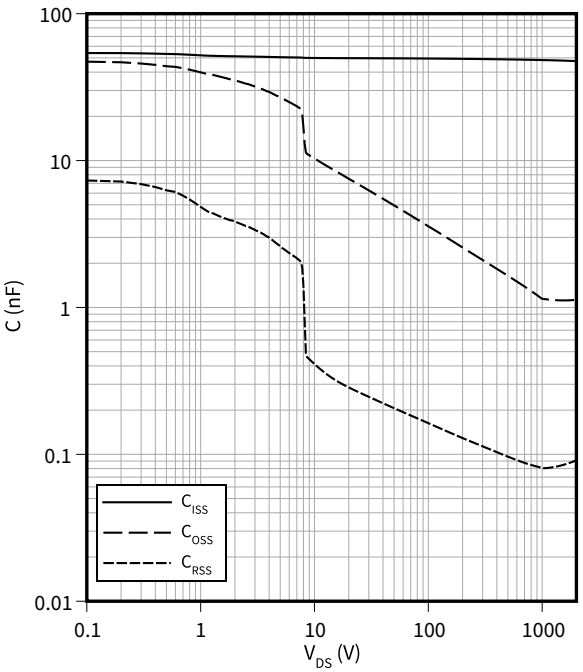
Gate charge characteristic (typical), MOSFET, T1 / T2

$V_{GS} = f(Q_G)$
I_D = 400 A, T_{vj} = 25 °C



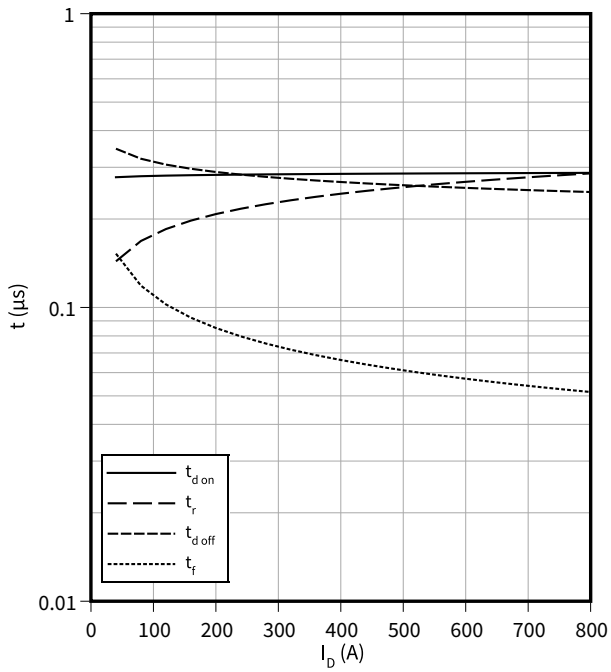
Capacity characteristic (typical), MOSFET, T1 / T2

$C = f(V_{DS})$
f = 100 kHz, T_{vj} = 25 °C, V_{GS} = -3 V



Switching times (typical), MOSFET, T1 / T2

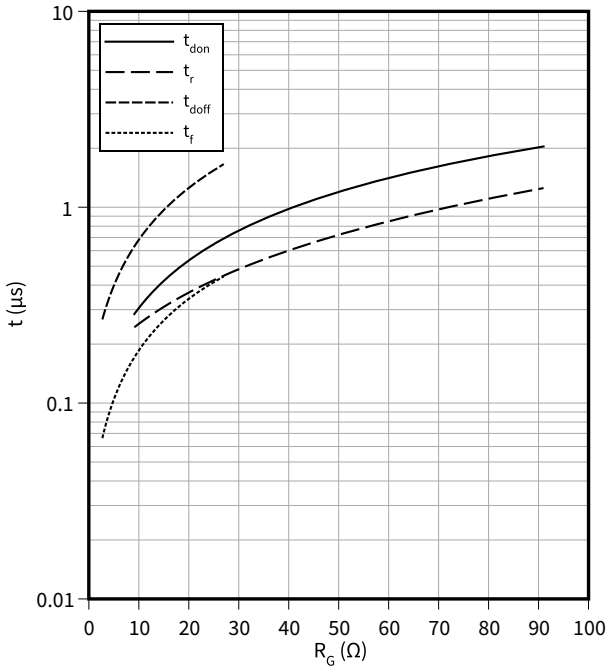
$t = f(I_D)$
R_{Goff} = 2.7 Ω, R_{Gon} = 9.1 Ω, V_{DD} = 1200 V, T_{vj} = 175 °C, V_{GS} = -3/18 V



Switching times (typical), MOSFET, T1 / T2

$t = f(R_G)$

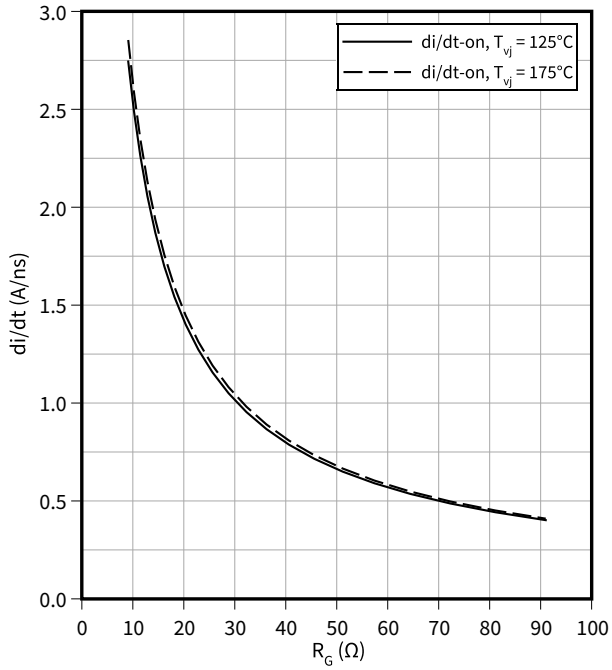
V_{DD} = 1200 V, I_D = 400 A, T_{vj} = 175 °C, V_{GS} = -3/18 V



Current slope (typical), MOSFET, T1 / T2

$di/dt = f(R_G)$

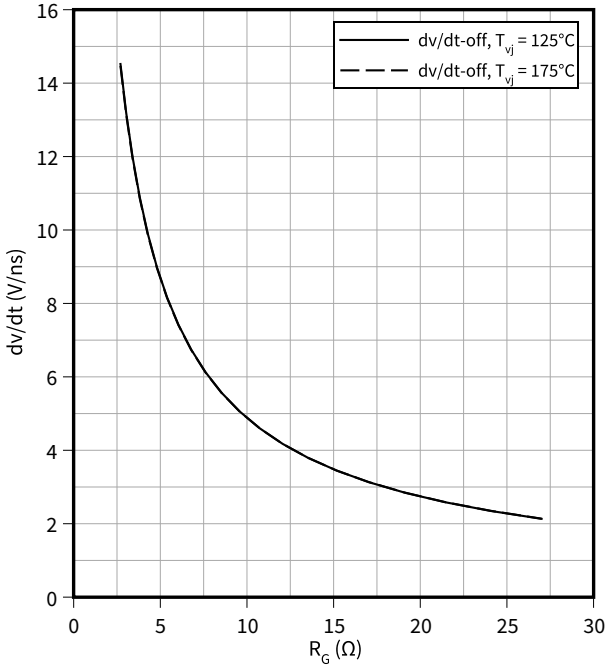
V_{DD} = 1200 V, I_D = 400 A, V_{GS} = -3/18 V



Voltage slope (typical), MOSFET, T1 / T2

$dv/dt = f(R_G)$

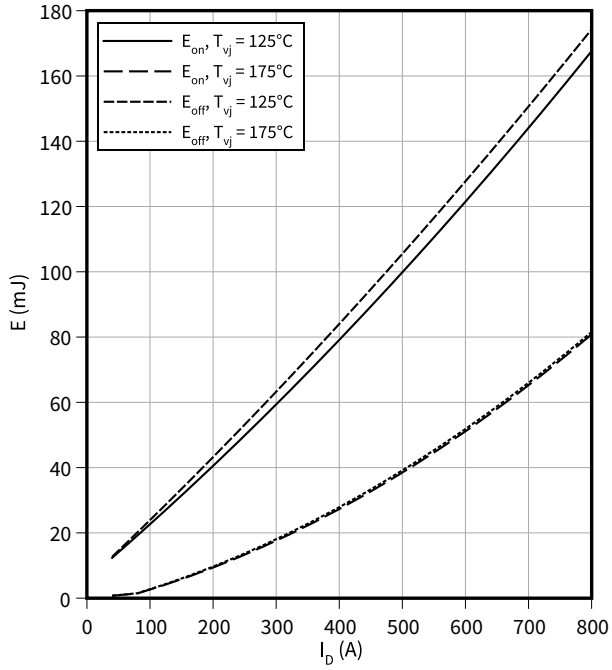
V_{DD} = 1200 V, I_D = 400 A, V_{GS} = -3/18 V



Switching losses (typical), MOSFET, T1 / T2

$E = f(I_D)$

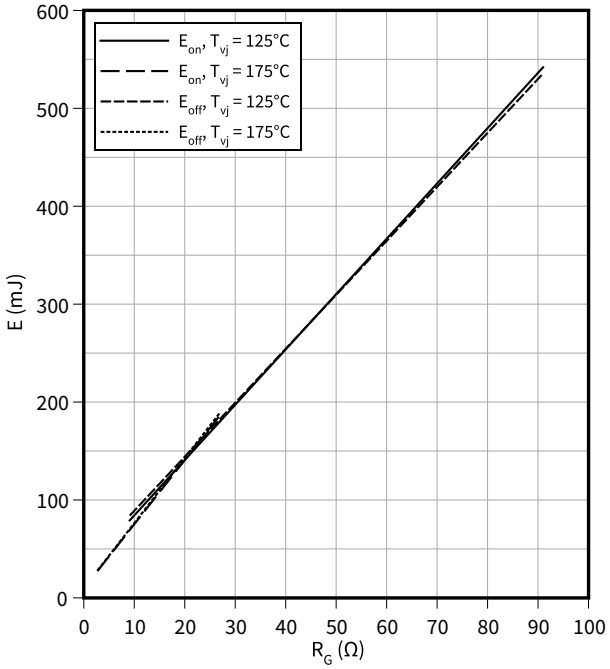
R_{Goff} = 2.7 Ω, R_{Gon} = 9.1 Ω, V_{DD} = 1200 V, V_{GS} = -3/18 V



Switching losses (typical), MOSFET, T1 / T2

$E = f(R_G)$

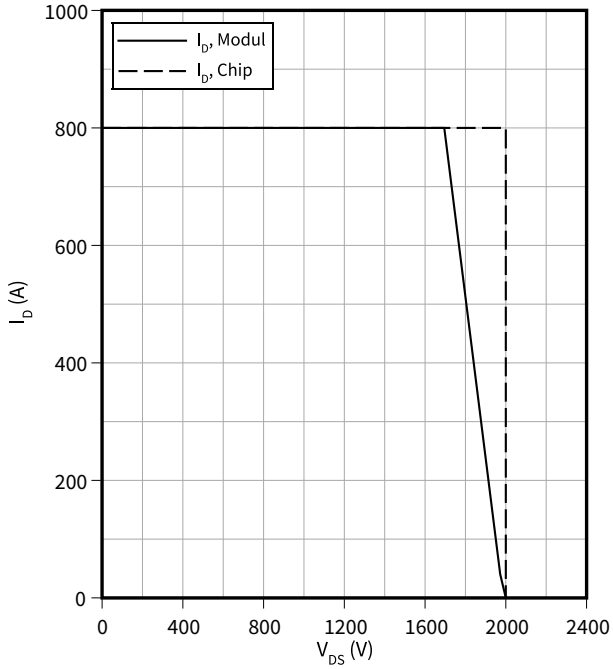
$V_{DD} = 1200$ V, $I_D = 400$ A, $V_{GS} = -3/18$ V



Reverse bias safe operating area (RBSOA), MOSFET, T1 / T2

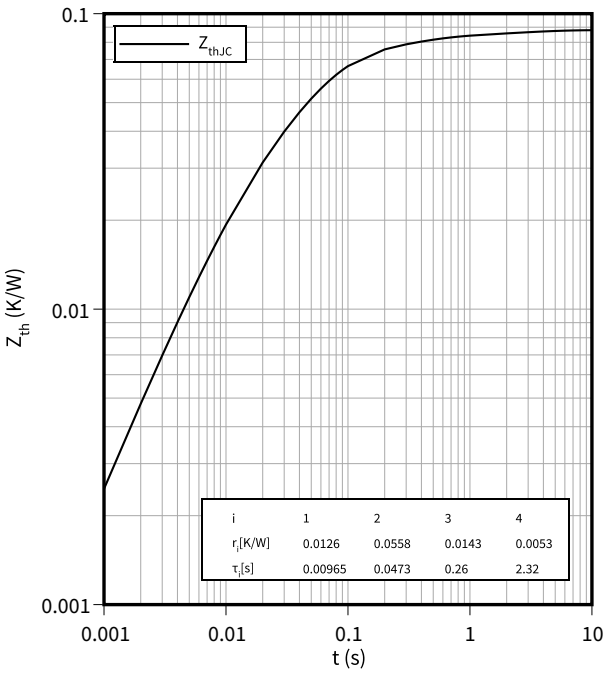
$I_D = f(V_{DS})$

$R_{Goff} = 2.7\ \Omega$, $T_{vj} = 175$ °C, $V_{GS} = -3/18$ V



Transient thermal impedance, MOSFET, T1 / T2

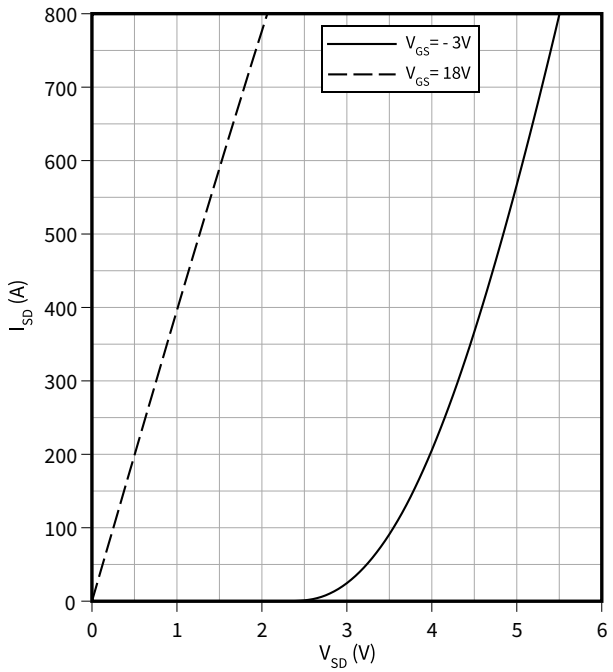
$Z_{th} = f(t)$



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

$I_{SD} = f(V_{SD})$

$T_{vj} = 25$ °C



5 Circuit diagram

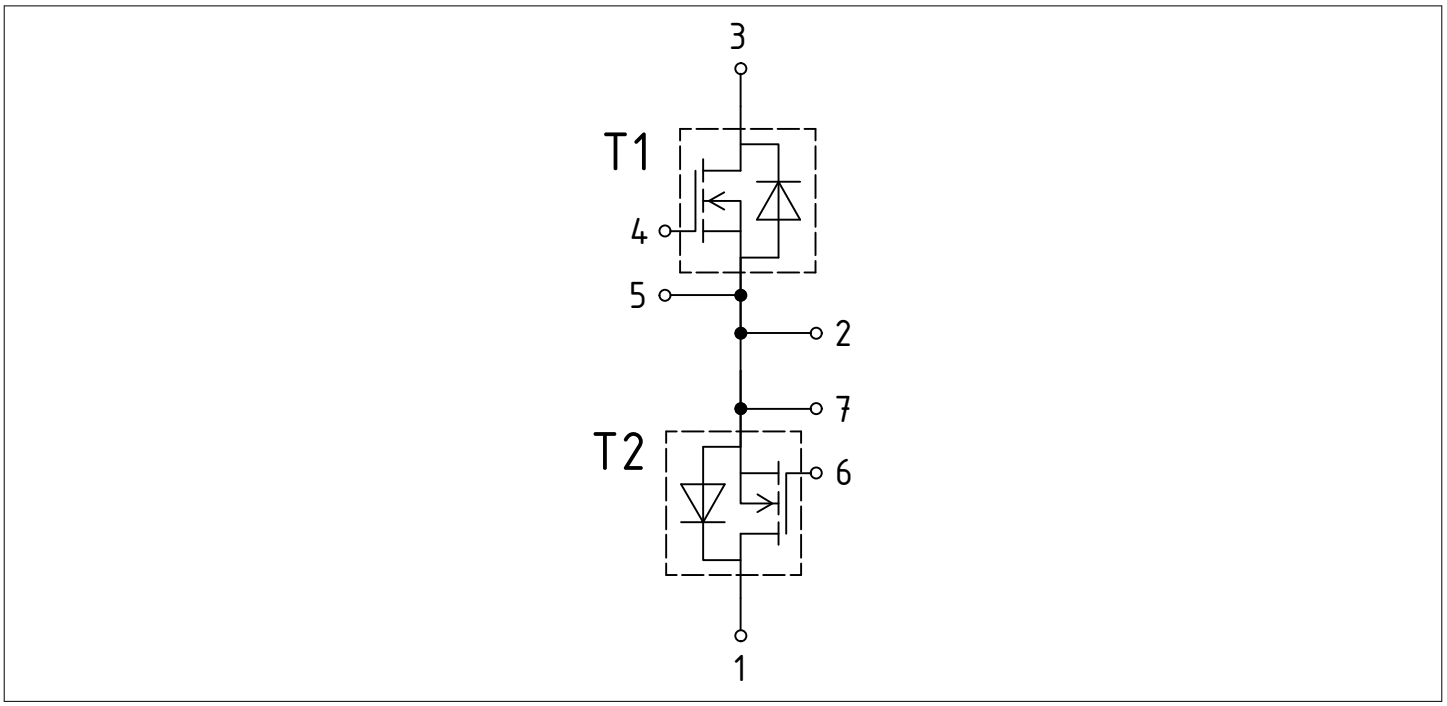


Figure 1

6 Package outlines

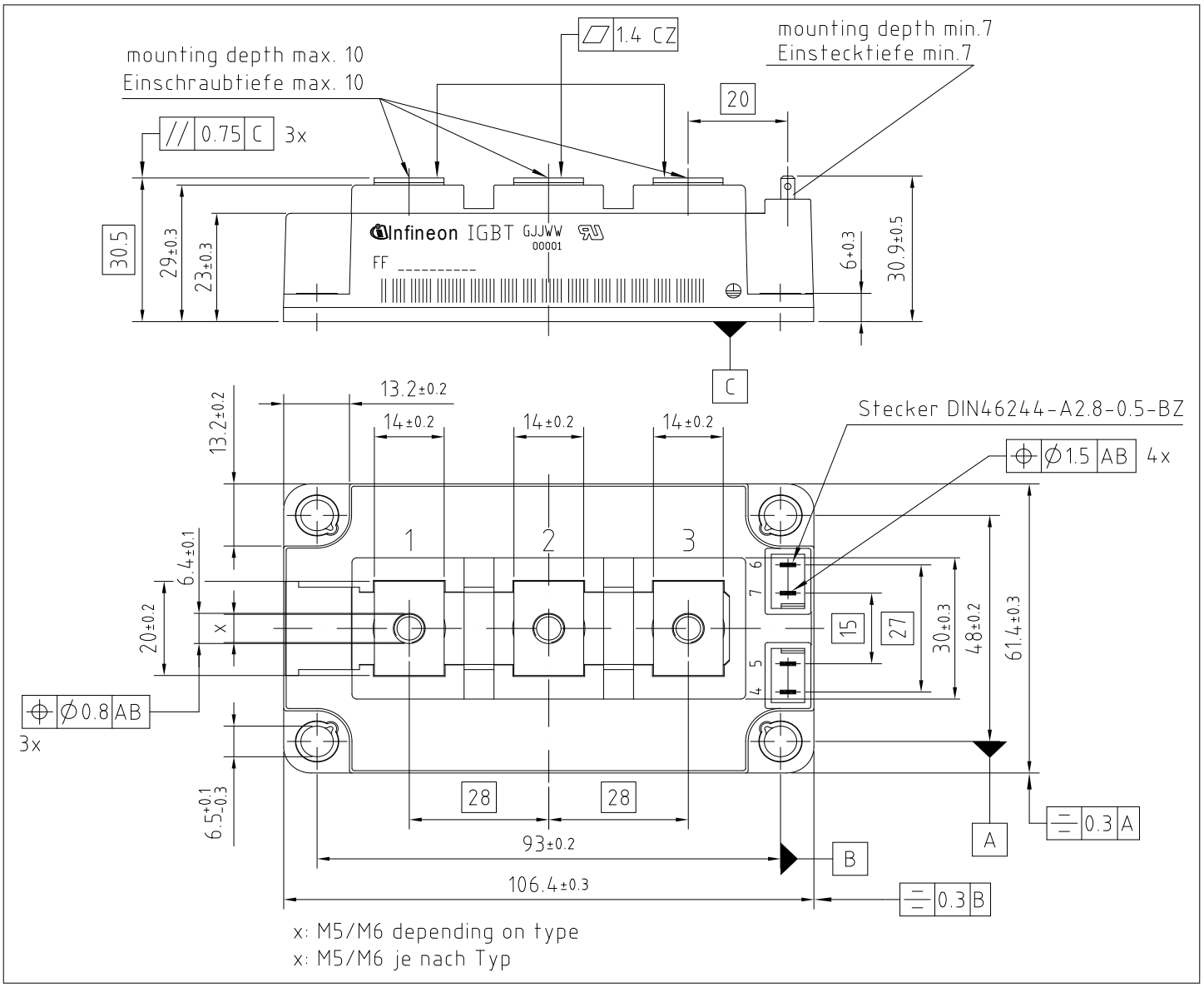


Figure 2

7 Module label code

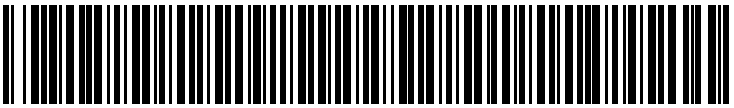
Module label code			
Code format	Data Matrix		Barcode Code128
Encoding	ASCII text		Code Set A
Symbol size	16x16		23 digits
Standard	IEC24720 and IEC16022		IEC8859-1
Code content	*Content* Module serial number Module material number Production order number Date code (production year) Date code (production week)	*Digit* 1 – 5 6 - 11 12 - 19 20 – 21 22 – 23	*Example* 71549 142846 55054991 15 30
Example	 7154914284655054991530	 7154914284655054991530	

Figure 3

Revision history

Document revision	Date of release	Description of changes
0.10	2023-02-02	Initial version
1.00	2024-09-05	Final datasheet

Trademarks

All referenced product or service names and trademarks are the property of their respective owners.

Edition 2024-09-05

Published by

Infineon Technologies AG

81726 Munich, Germany

Do you have a question about any aspect of this document?

Email: erratum@infineon.com

Document reference
IFX-ABG733-002

Important notice

The information given in this document shall in no event be regarded as a guarantee of conditions or characteristics ("Beschaffenheitsgarantie").

With respect to any examples, hints or any typical values stated herein and/or any information regarding the application of the product, Infineon Technologies hereby disclaims any and all warranties and liabilities of any kind, including without limitation warranties of non-infringement of intellectual property rights of any third party.

In addition, any information given in this document is subject to customer's compliance with its obligations stated in this document and any applicable legal requirements, norms and standards concerning customer's products and any use of the product of Infineon Technologies in customer's applications.

The data contained in this document is exclusively intended for technically trained staff. It is the responsibility of customer's technical departments to evaluate the suitability of the product for the intended application and the completeness of the product information given in this document with respect to such application.

Warnings

Due to technical requirements products may contain dangerous substances. For information on the types in question please contact your nearest Infineon Technologies office.

Except as otherwise explicitly approved by Infineon Technologies in a written document signed by authorized representatives of Infineon Technologies, Infineon Technologies' products may not be used in any applications where a failure of the product or any consequences of the use thereof can reasonably be expected to result in personal injury.