Final datasheet

CoolSiC™ 1200 V SiC Trench MOSFET : Silicon Carbide MOSFET with .XT interconnection technology

Features

- V_{DSS} = 1200 V at T_{vj} = 25°C
- I_{DDC} = 98 A at T_C = 25°C
- $R_{DS(on)}$ = 19 mΩ at V_{GS} = 18 V, T_{vj} = 25°C
- Very low switching losses
- Short circuit withstand time 3 µs
- Benchmark gate threshold voltage, $V_{GS(th)}$ = 4.2 V
- Robust against parasitic turn on, 0 V turn-off gate voltage can be applied
- Robust body diode for hard commutation
- .XT interconnection technology for best-in-class thermal performance

Halogen-free

Green

Lead-free

RoHS

Potential applications

- General purpose drives (GPD)
- EV Charging
- Online UPS/Industrial UPS
- String inverter
- Solar power optimizer

Product validation

- Qualified for industrial applications according to the relevant tests of JEDEC47/20/22

Description

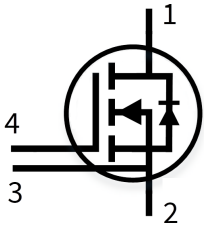
1 – Drain

2 – Source

3 – Kelvin sense contact

4 – Gate

Note: the source and sense pins are not exchangeable, their exchange might lead to malfunction (only for 4pin, TO263-7L)



Type	Package	Marking
IMZA120R020M1H	PG-TO247-4-U02	12M1H020

Table of contents

1 Package

Table 1 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Storage temperature	T_{stg}		-55		150	°C
Soldering temperature	T_{sold}	wave soldering 1.6 mm (0.063 in.) from case for 10 s			260	°C
Mounting torque	M	M3 screw, Maximum of mounting processes: 3			0.6	Nm
Thermal resistance, junction-ambient	$R_{th(j-a)}$				62	K/W
MOSFET/body diode thermal resistance, junction-case	$R_{th(j-c)}$			0.31	0.4	K/W

2 MOSFET

Table 2 Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
Drain-source voltage	V_{DSS}	$T_{vj} \geq 25$ °C		1200	V
Continuous DC drain current for $R_{th(j-c,max)}$, limited by $T_{vj(max)}$	I_{DDC}	$V_{GS} = 18$ V	$T_c = 25$ °C	98	A
			$T_c = 100$ °C	71	
Peak drain current, t_p limited by $T_{vj(max)}$	I_{DM}	$V_{GS} = 18$ V		213	A
Gate-source voltage, max. transient voltage[1)]	V_{GS}	$t_p \leq 0.5$ µs, $D < 0.01$		-10/23	V
Gate-source voltage, max. static voltage	V_{GS}			-7/20	V
Avalanche energy, single pulse	E_{AS}	$I_D = 40.1$ A, $V_{DD} = 50$ V, $L = 0.9$ mH		721	mJ
Avalanche energy, repetitive	E_{AR}	$I_D = 40.1$ A, $V_{DD} = 50$ V, $L = 4.5$ µH		3.58	mJ
Short-circuit withstand time	t_{SC}	$V_{DD} \leq 800$ V, $V_{DS,peak} < 1200$ V, $V_{GS(on)} = 15$ V, $T_{vj(start)} = 25$ °C		3	µs
Power dissipation, limited by $T_{vj(max)}$	P_{tot}		$T_c = 25$ °C	375	W
			$T_c = 100$ °C	188	

1) Important note: The selection of positive and negative gate-source voltages impacts the long-term behavior of the device. The design guidelines described in Application Note AN2018-09 must be considered to ensure sound operation of the device over the planned lifetime.

Table 3 Recommended values

Parameter	Symbol	Note or test condition	Values	Unit
Recommended turn-on gate voltage	$V_{GS(on)}$		15...18	V
Recommended turn-off gate voltage	$V_{GS(off)}$		-5...0	V

Table 4 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Drain-source on-state resistance	$R_{DS(on)}$	I_D = 41 A	T_{vj} = 25 °C, $V_{GS(on)}$ = 18 V		19	26.9	mΩ
			T_{vj} = 100 °C, $V_{GS(on)}$ = 18 V		25		
			T_{vj} = 175 °C, $V_{GS(on)}$ = 18 V		36		
			T_{vj} = 25 °C, $V_{GS(on)}$ = 15 V		23.7	30	
Gate-source threshold voltage	$V_{GS(th)}$	I_D = 17.6 mA, V_{DS} = V_{GS} (tested after 1 ms pulse at V_{GS} = 20 V)	T_{vj} = 25 °C	3.5	4.2	5.2	V
			T_{vj} = 175 °C		3.6		
Zero gate-voltage drain current	I_{DSS}	V_{DS} = 1200 V, V_{GS} = 0 V	T_{vj} = 25 °C			320	µA
			T_{vj} = 175 °C		5.4		
Gate leakage current	I_{GSS}	V_{DS} = 0 V	V_{GS} = 23 V			100	nA
			V_{GS} = -10 V			-100	
Forward transconductance	g_{fs}	I_D = 41 A, V_{DS} = 20 V			20.9		S
Internal gate resistance	$R_{G,int}$	f = 1 MHz, V_{AC} = 25 mV			1.8		Ω
Input capacitance	C_{iss}	V_{DS} = 800 V, V_{GS} = 0 V, f = 100 kHz, V_{AC} = 25 mV			3460		pF
Output capacitance	C_{oss}	V_{DS} = 800 V, V_{GS} = 0 V, f = 100 kHz, V_{AC} = 25 mV			159		pF
Reverse transfer capacitance	C_{rss}	V_{DS} = 800 V, V_{GS} = 0 V, f = 100 kHz, V_{AC} = 25 mV			23		pF
C_{oss} stored energy	E_{oss}	V_{DS} = 800 V, V_{GS} = 0 V, f = 100 kHz, V_{AC} = 25 mV			65		µJ
Total gate charge	Q_G	V_{DD} = 800 V, I_D = 41 A, V_{GS} = -2/18 V, turn-on pulse			109		nC
Plateau gate charge	$Q_{GS(pl)}$	V_{DD} = 800 V, I_D = 41 A, V_{GS} = -2/18 V, turn-on pulse			27.1		nC
Gate-to-drain charge	Q_{GD}	V_{DD} = 800 V, I_D = 41 A, V_{GS} = -2/18 V, turn-on pulse			21.8		nC

(table continues...)

Table 4 (continued) Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Turn-on delay time	$t_{d(on)}$	V_{DD} = 800 V, I_D = 41 A, V_{GS} = 0/18 V, $R_{GS(on)}$ = 1 Ω, $R_{GS(off)}$ = 1 Ω, L_σ = 15 nH, diode: body diode at V_{GS} = 0 V	T_{vj} = 25 °C		36		ns
			T_{vj} = 175 °C		34		
Rise time	t_r	V_{DD} = 800 V, I_D = 41 A, V_{GS} = 0/18 V, $R_{GS(on)}$ = 1 Ω, $R_{GS(off)}$ = 1 Ω, L_σ = 15 nH, diode: body diode at V_{GS} = 0 V	T_{vj} = 25 °C		13.7		ns
			T_{vj} = 175 °C		15.5		
Turn-off delay time	$t_{d(off)}$	V_{DD} = 800 V, I_D = 41 A, V_{GS} = 0/18 V, $R_{GS(on)}$ = 1 Ω, $R_{GS(off)}$ = 1 Ω, L_σ = 15 nH, diode: body diode at V_{GS} = 0 V	T_{vj} = 25 °C		43.8		ns
			T_{vj} = 175 °C		46		
Fall time	t_f	V_{DD} = 800 V, I_D = 41 A, V_{GS} = 0/18 V, $R_{GS(on)}$ = 1 Ω, $R_{GS(off)}$ = 1 Ω, L_σ = 15 nH, diode: body diode at V_{GS} = 0 V	T_{vj} = 25 °C		14.8		ns
			T_{vj} = 175 °C		14.7		
Turn-on energy	E_{on}	V_{DD} = 800 V, I_D = 41 A, V_{GS} = 0/18 V, $R_{GS(on)}$ = 1 Ω, $R_{GS(off)}$ = 1 Ω, L_σ = 15 nH, diode: body diode at V_{GS} = 0 V	T_{vj} = 25 °C		400		µJ
			T_{vj} = 175 °C		650		
Turn-off energy	E_{off}	V_{DD} = 800 V, I_D = 41 A, V_{GS} = 0/18 V, $R_{GS(on)}$ = 1 Ω, $R_{GS(off)}$ = 1 Ω, L_σ = 15 nH, diode: body diode at V_{GS} = 0 V	T_{vj} = 25 °C		108		µJ
			T_{vj} = 175 °C		115		
Total switching energy	E_{tot}	V_{DD} = 800 V, I_D = 41 A, V_{GS} = 0/18 V, $R_{GS(on)}$ = 1 Ω, $R_{GS(off)}$ = 1 Ω, L_σ = 15 nH, diode: body diode at V_{GS} = 0 V	T_{vj} = 25 °C		570		µJ
			T_{vj} = 175 °C		1020		

(table continues...)

Table 4 (continued) Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Virtual junction temperature	T_{vj}		-55		175	°C

***Note**: For optimum lifetime and reliability, Infineon recommends operating conditions that do not exceed 80% of the maximum ratings stated in this datasheet.*

The chip technology was characterized up to 200 kV/µs. The measured dV/dt was limited by measurement test setup and package.

Dynamic test circuit see Fig. F.

3 Body diode (MOSFET)

Table 5 Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
Drain-source voltage	V_{DSS}	$T_{vj} \geq 25$ °C		1200	V
Continuous reverse drain current for $R_{th(j\text{-}c,max)}$, limited by $T_{vj(max)}$	I_{SDC}	$V_{GS} = 0$ V	$T_c = 25$ °C	94	A
			$T_c = 100$ °C	58	
Peak reverse drain current, t_p limited by $T_{vj(max)}$	I_{SM}	$V_{GS} = 0$ V		213	A

Table 6 Characteristic values

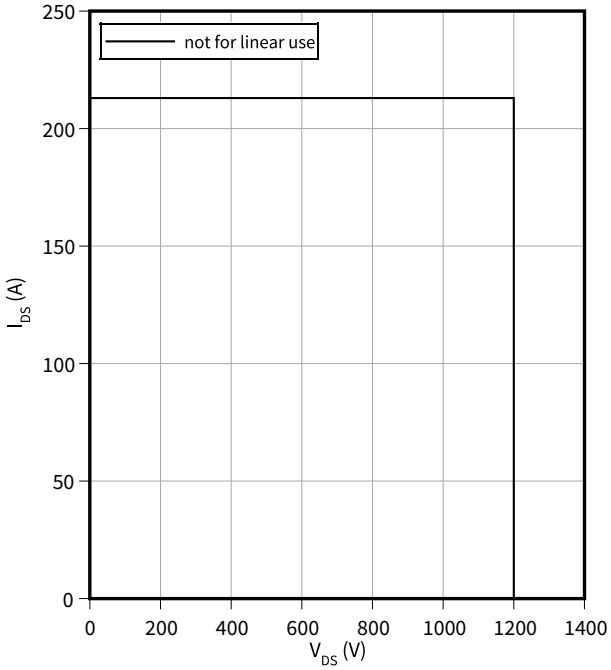
Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Drain-source reverse voltage	V_{SD}	$I_{SD} = 41$ A, $V_{GS} = 0$ V	$T_{vj} = 25$ °C		3.8	5	V
			$T_{vj} = 100$ °C		3.7		
			$T_{vj} = 175$ °C		3.6		
MOSFET forward recovery charge	Q_{fr}	$V_{DD} = 800$ V, $I_{SD} = 41$ A, $V_{GS} = 0$ V, $-di_{SD}/dt = 3000$ A/µs, Q_{fr} includes also Q_C	$T_{vj} = 25$ °C		340		nC
			$T_{vj} = 175$ °C		622		
MOSFET peak forward recovery current	I_{frm}	$V_{DD} = 800$ V, $I_{SD} = 41$ A, $V_{GS} = 0$ V, $-di_{SD}/dt = 3000$ A/µs, Q_{fr} includes also Q_C	$T_{vj} = 25$ °C		14		A
			$T_{vj} = 175$ °C		23		
MOSFET forward recovery energy	E_{fr}	$V_{DD} = 800$ V, $I_{SD} = 41$ A, $V_{GS} = 0$ V, $-di_{SD}/dt = 3000$ A/µs, Q_{fr} includes also Q_C	$T_{vj} = 25$ °C		63		µJ
			$T_{vj} = 175$ °C		254		
Virtual junction temperature	T_{vj}			-55		175	°C

4 Characteristics diagrams

Reverse bias safe operating area (RBSOA)

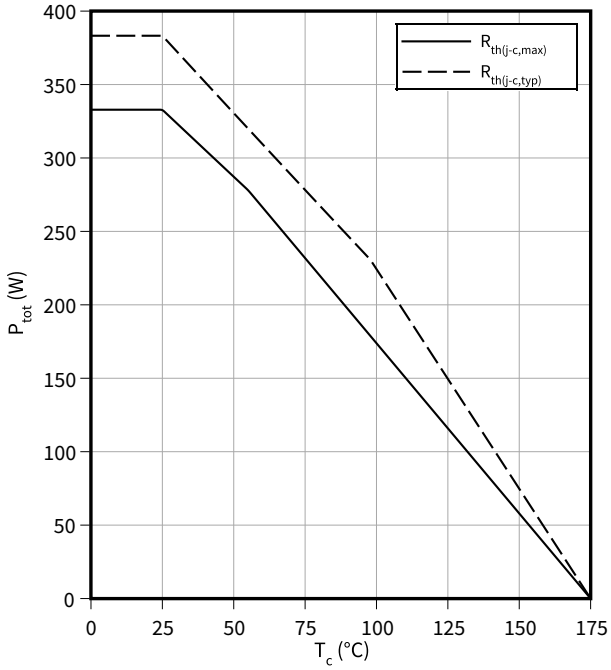
$I_{DS} = f(V_{DS})$

$T_{vj} \leq 175$ °C, $V_{GS} = 0/18$ V, $T_c = 25$ °C



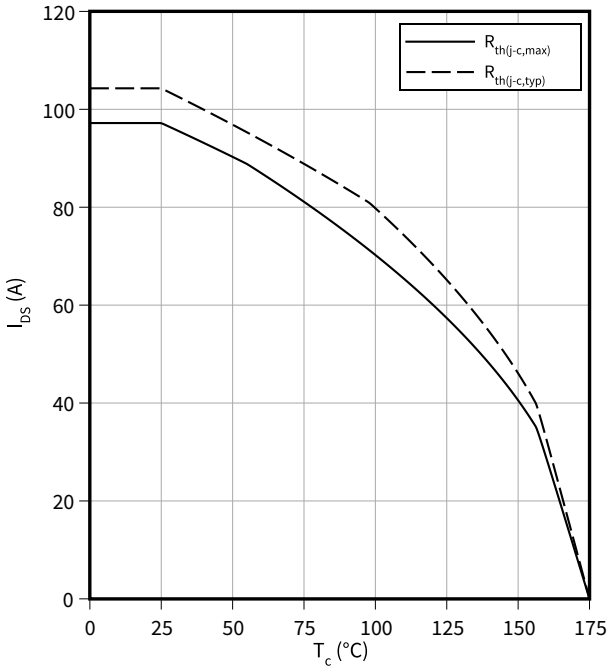
Power dissipation as a function of case temperature limited by bond wire

$P_{tot} = f(T_c)$



Maximum DC drain to source current as a function of case temperature limited by bond wire

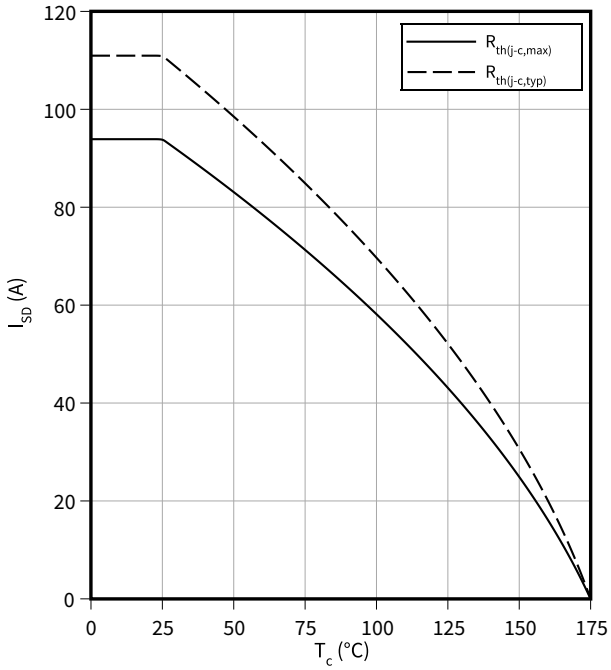
$I_{DS} = f(T_c)$



Maximum source to drain current as a function of case temperature limited by bond wire

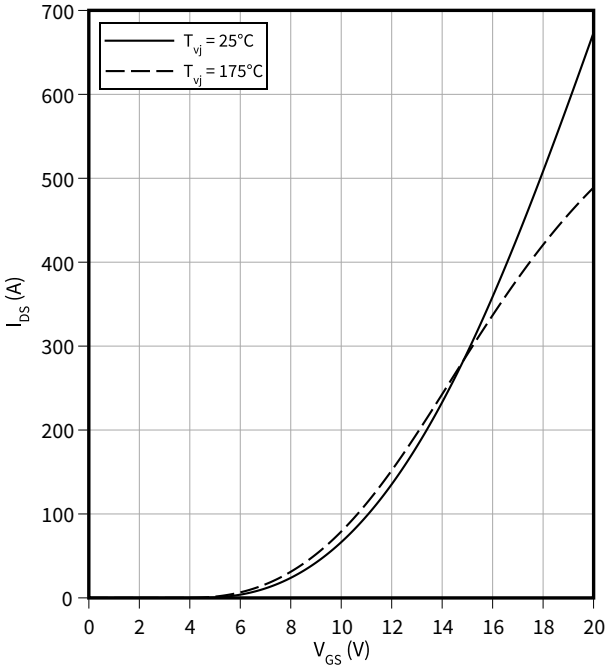
$I_{SD} = f(T_c)$

$V_{GS} = 0$ V



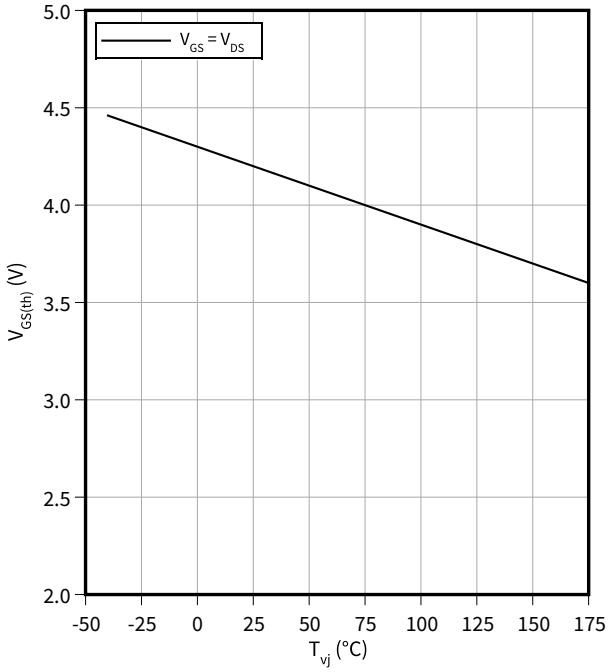
Typical transfer characteristic

$I_{DS} = f(V_{GS})$
V_{DS} = 20 V, t_p = 20 µs



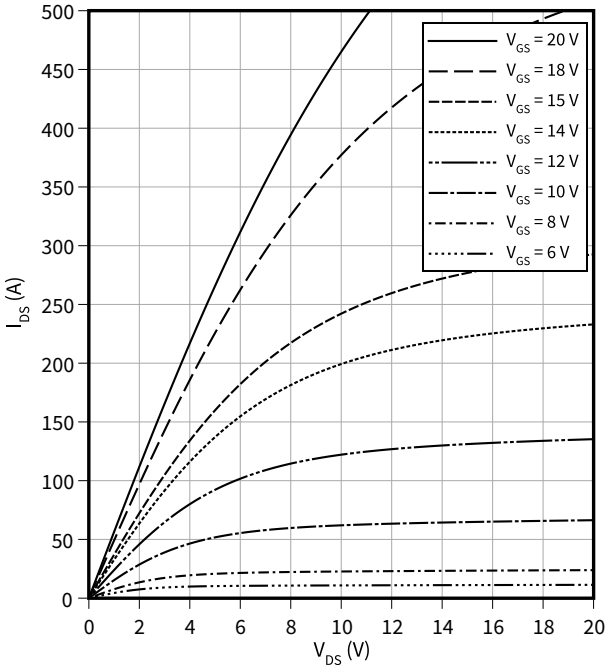
Typical gate-source threshold voltage as a function of junction temperature

$V_{GS(th)} = f(T_{vj})$
I_D = 17.6 mA



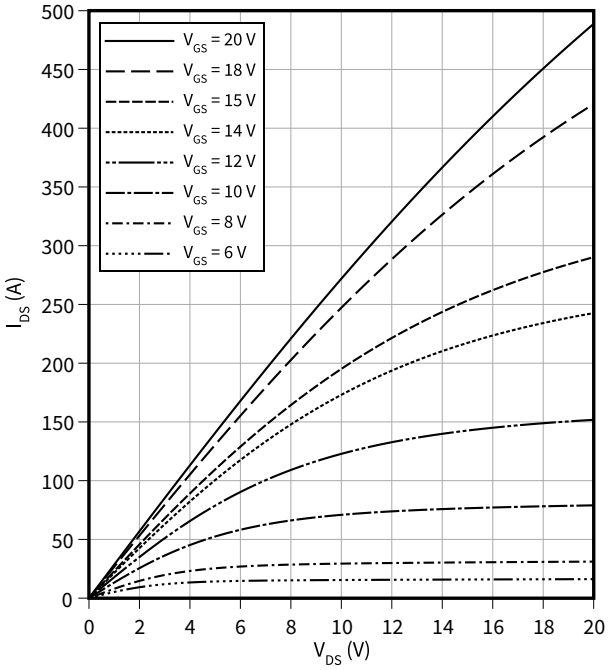
Typical output characteristic, V_{GS} as parameter

$I_{DS} = f(V_{DS})$
T_{vj} = 25 °C, t_p = 20 µs



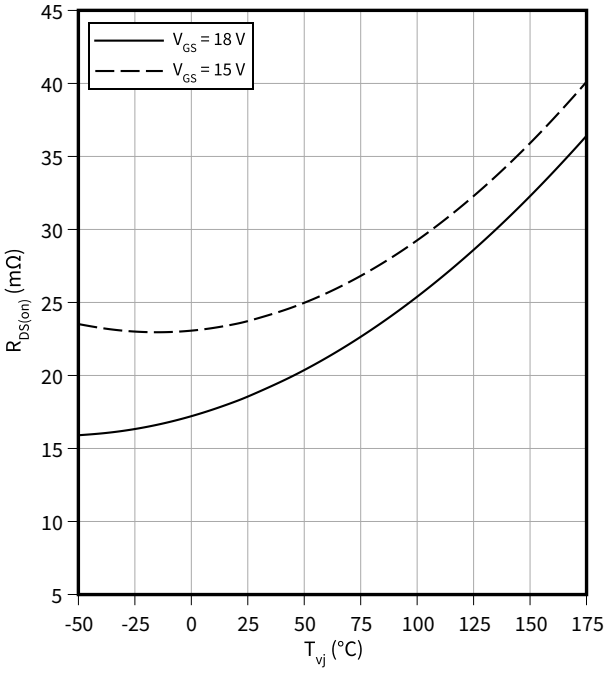
Typical output characteristic, V_{GS} as parameter

$I_{DS} = f(V_{DS})$
T_{vj} = 175 °C, t_p = 20 µs



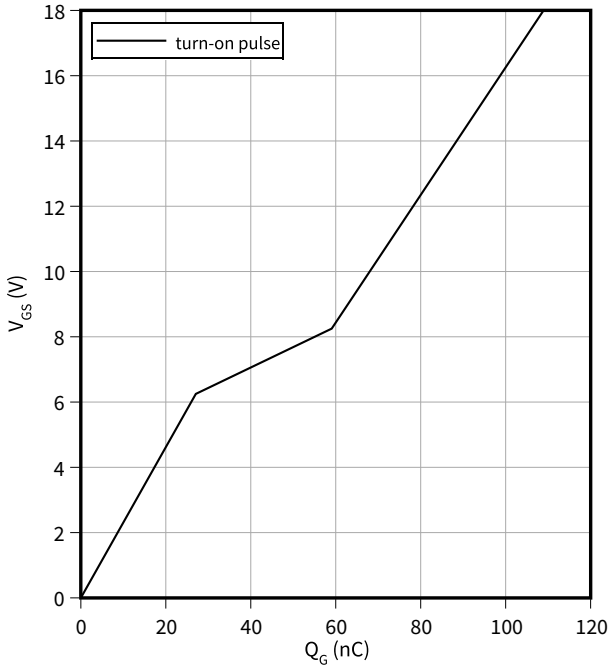
Typical on-state resistance as a function of junction temperature

$R_{DS(on)} = f(T_{vj})$
$I_D = 41$ A



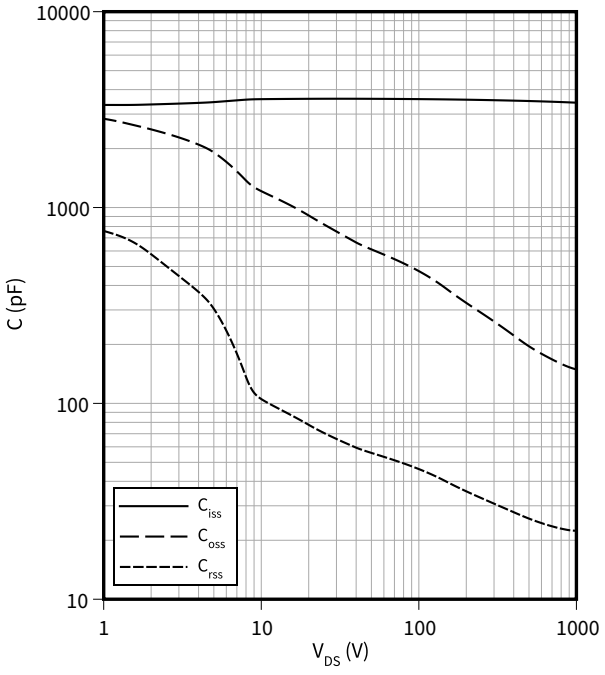
Typical gate charge

$V_{GS} = f(Q_G)$
$I_D = 41$ A, $V_{DS} = 800$ V



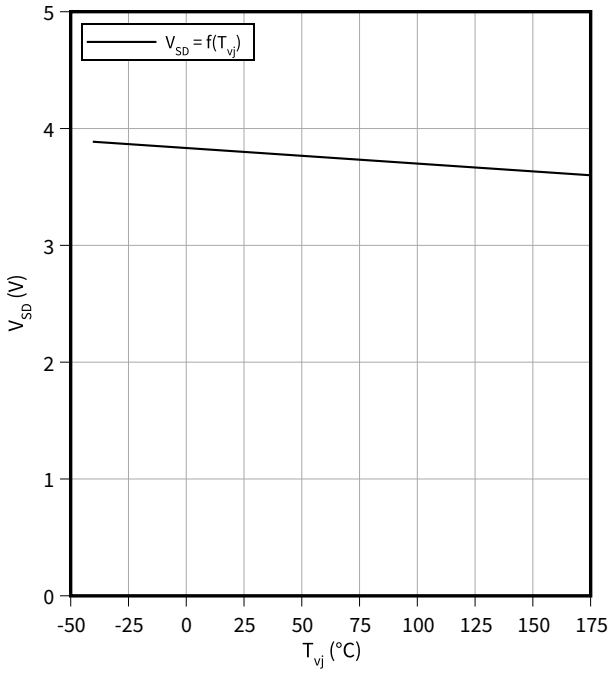
Typical capacitance as a function of drain-source voltage

$C = f(V_{DS})$
$f = 100$ kHz, $V_{GS} = 0$ V



Typical reverse drain voltage as function of junction temperature

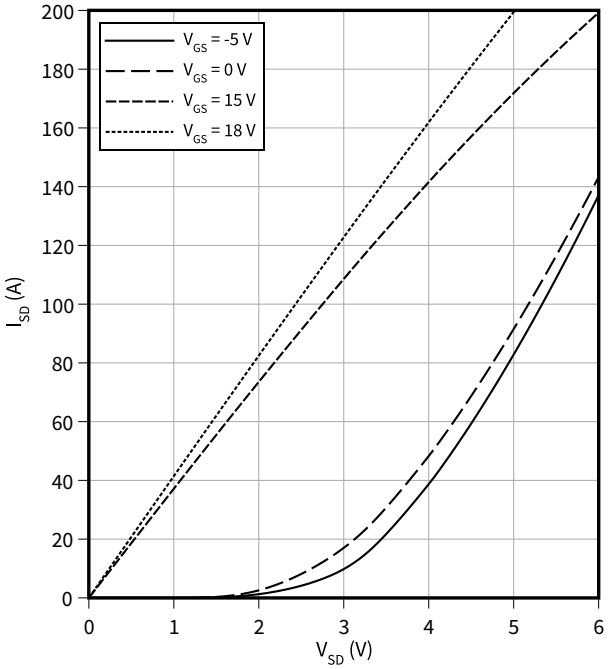
$V_{SD} = f(T_{vj})$
$I_{SD} = 41$ A, $V_{GS} = 0$ V



Typical reverse drain current as function of reverse drain voltage, V_{GS} as parameter

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

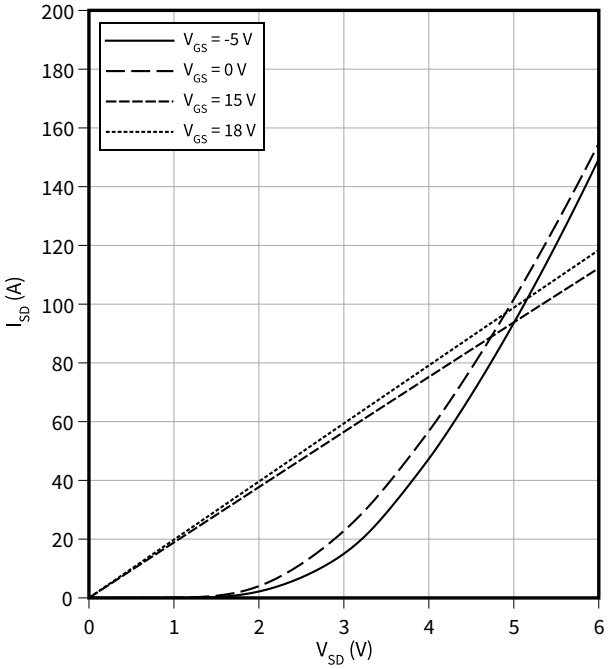
$T_{vj} = 25\ °C$, $t_p = 20\ µs$



Typical reverse drain current as function of reverse drain voltage, V_{GS} as parameter

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

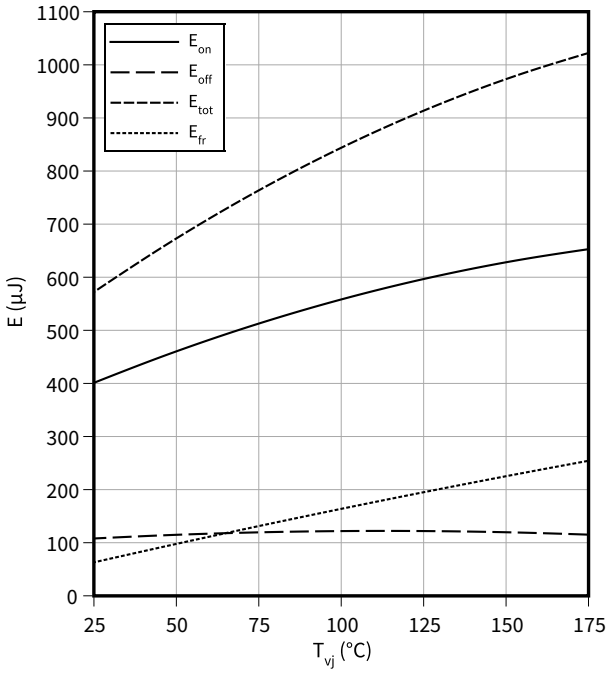
$T_{vj} = 175\ °C$, $t_p = 20\ µs$



Typical switching energy as a function of junction temperature, test circuit in Fig. F, 2nd device own body diode: $V_{GS} = 0\ V$

$E = f(T_{vj})$

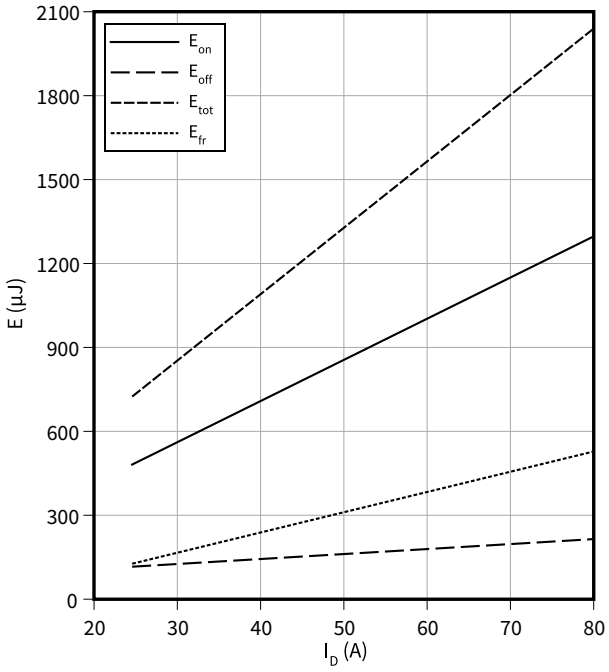
$V_{GS} = 0/18\ V$, $I_D = 41\ A$, $R_{G,ext} = 1\ Ω$, $V_{DD} = 800\ V$



Typical switching energy as a function of drain current, test circuit in Fig. F, 2nd device own body diode: $V_{GS} = 0\ V$

$E = f(I_D)$

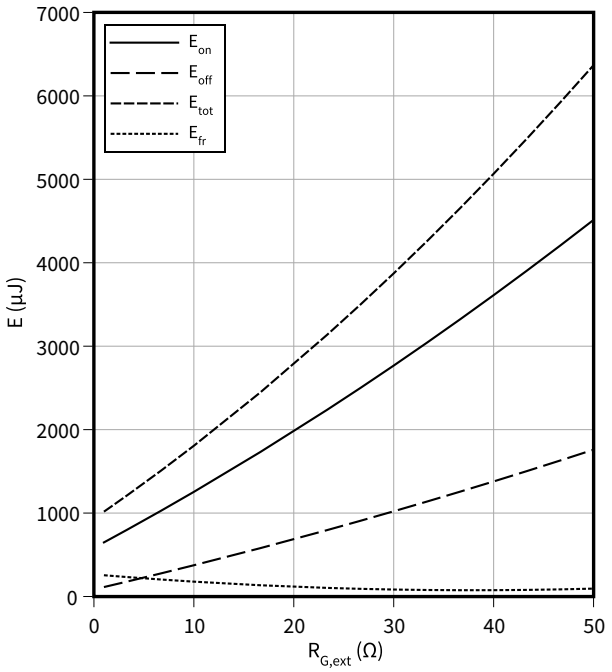
$V_{GS} = 0/18\ V$, $T_{vj} = 175\ °C$, $R_{G,ext} = 1\ Ω$, $V_{DD} = 800\ V$



Typical switching energy losses as a function of gate resistance, test circuit in Fig. F, 2nd device own body diode: V_{GS} = 0 V

$E = f(R_{G,ext})$

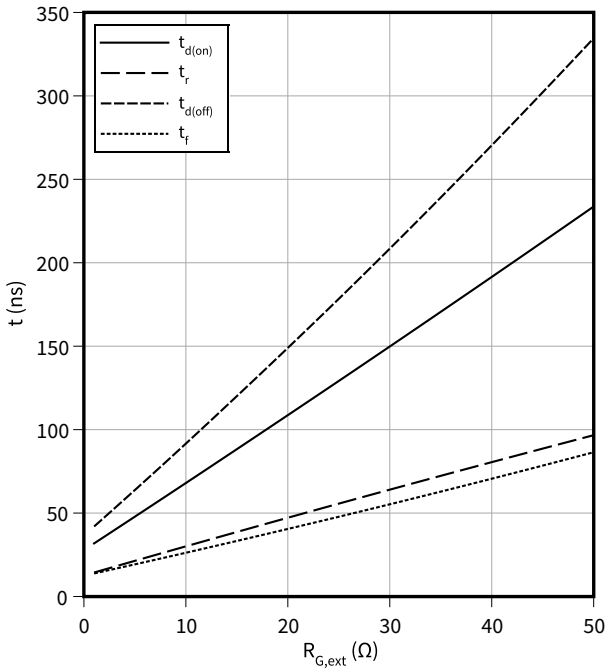
V_{GS} = 0/18 V, I_D = 41 A, T_{vj} = 175 °C, V_{DD} = 800 V



Typical switching times as a function of gate resistance, test circuit in Fig. F, 2nd device own body diode: V_{GS} = 0 V

$t = f(R_{G,ext})$

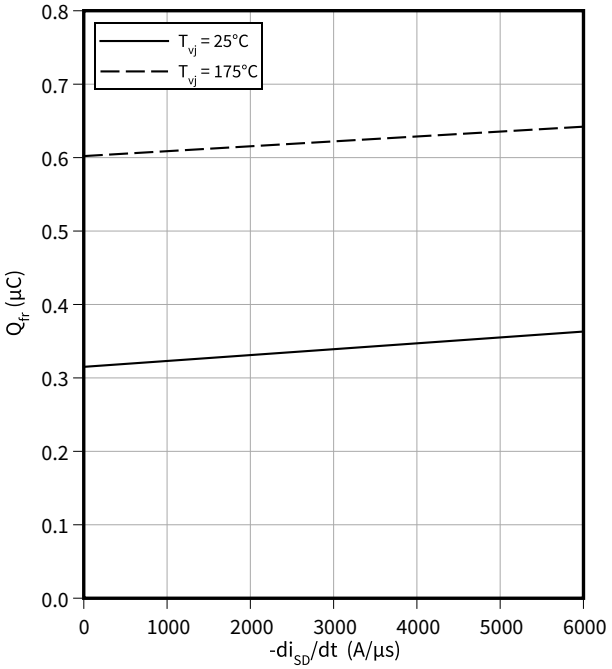
V_{GS} = 0/18 V, I_D = 41 A, T_{vj} = 175 °C, V_{DD} = 800 V



Typical reverse recovery charge as a function of reverse drain current slope, test circuit in Fig. F, 2nd device own body diode: V_{GS} = 0 V

$Q_{fr} = f(-di_{SD}/dt)$

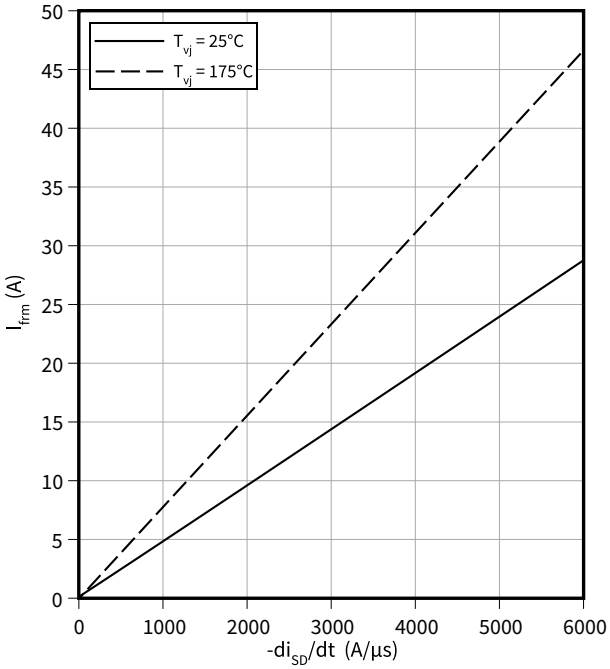
V_{GS} = 0/18 V, I_{SD} = 41 A, V_{DD} = 800 V



Typical reverse recovery current as a function of reverse drain current slope, test circuit in Fig. F, 2nd device own body diode: V_{GS} = 0 V

$I_{frm} = f(-di_{SD}/dt)$

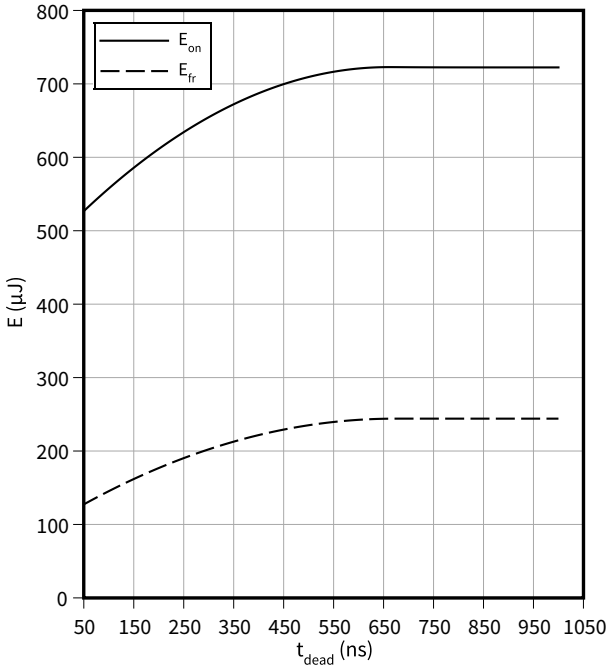
V_{GS} = 0/18 V, I_{SD} = 41 A, V_{DD} = 800 V



Typical switching energy losses as a function of dead time / blanking time, test circuit in Fig. F, 2nd device own body diode: V_{GS} = -5 V

$E = f(t_{dead})$

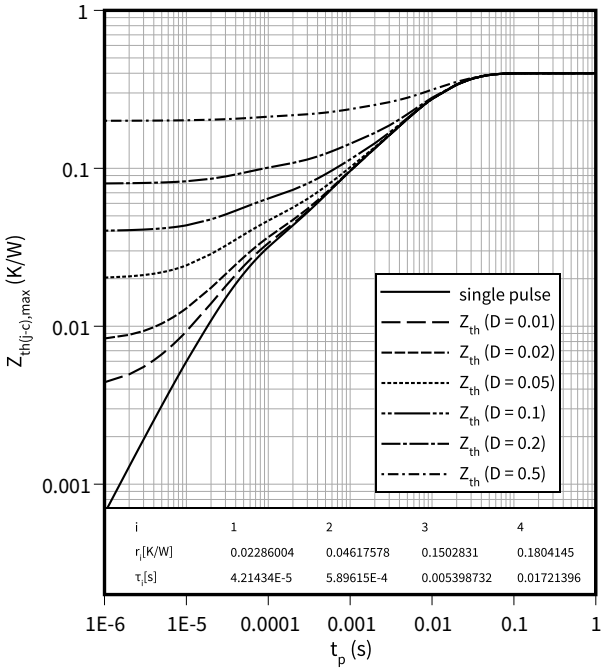
I_D = 41 A, T_{vj} = 175 °C, V_{GS} = -5/18 V, V_{DD} = 800 V



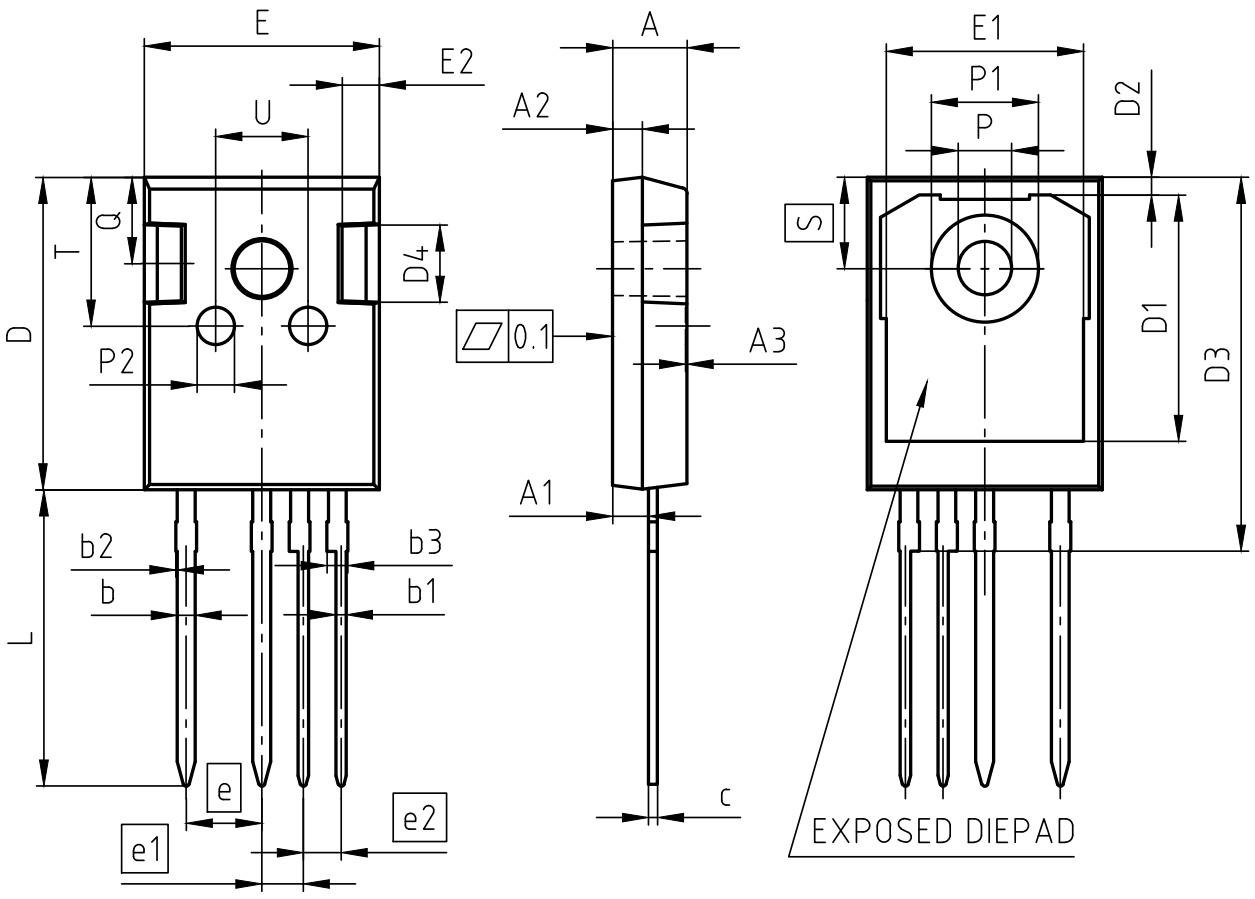
Max. transient thermal impedance (MOSFET/diode)

$Z_{th(j-c),max} = f(t_p)$

$D = t_p/T$



5 Package outlines



NOTES:
ALL DIMENSIONS DO NOT INCLUDE MOLD FLASH
OR PROTRUSIONS.

PACKAGE - GROUP NUMBER:	PG-TO247-4-U02				
DIMENSIONS	**MILLIMETERS**		**DIMENSIONS**	**MILLIMETERS**	
	MIN.	MAX.		MIN.	MAX.
A	4.90	5.10	**E**	15.70	15.90
A1	2.31	2.51	**E1**	13.10	13.50
A2	1.90	2.10	**E2**	2.40	2.60
A3	0.05	0.25	**e**	5.08	
b	1.10	1.30	**e1**	2.79	
b1	0.65	0.79	**e2**	2.54	
b2	---	0.20	**N**	4	
b3	1.34	1.44	**L**	19.80	20.10
c	0.58	0.66	**øP**	3.50	3.70
D	20.90	21.10	**øP1**	7.00	7.40
D1	16.25	16.85	**øP2**	2.40	2.60
D2	1.05	1.35	**Q**	5.60	6.00
D3	24.97	25.27	**S**	6.15	
D4	4.90	5.10	**T**	9.80	10.20
			U	6.00	6.40

Figure 1

6 Testing conditions

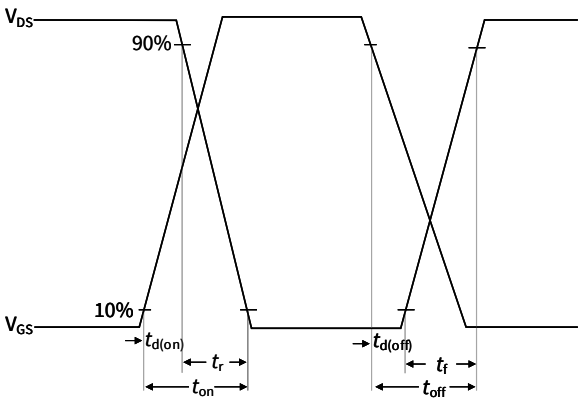


Figure A. **Definition of switching times**

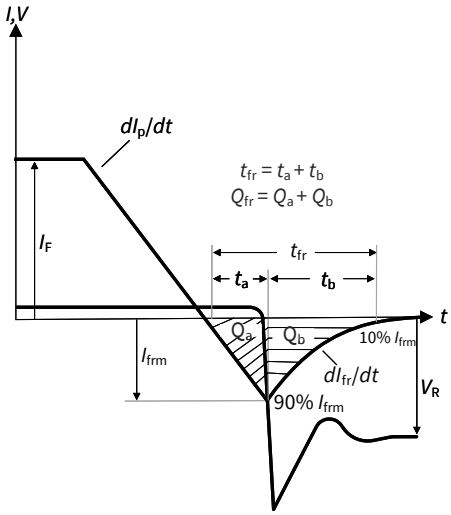


Figure B. **Definition of diode switching characteristics**

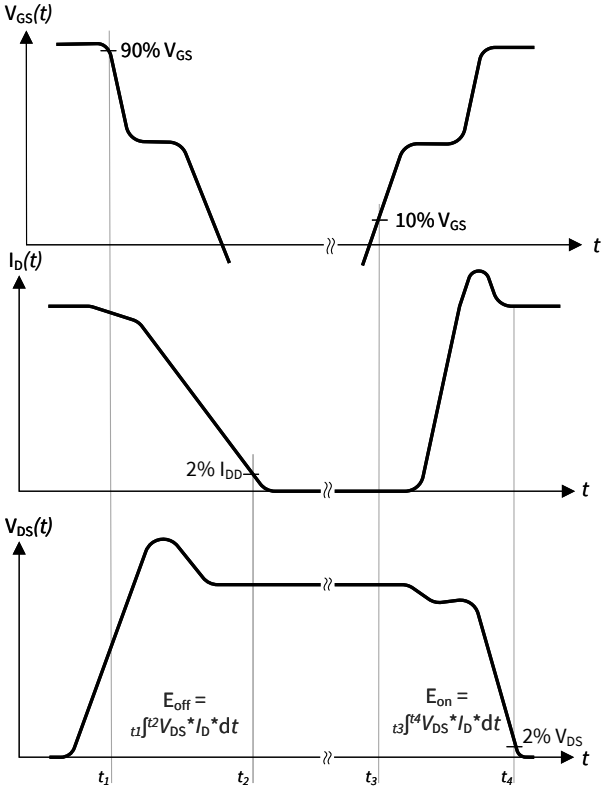


Figure C. **Definition of switching losses**

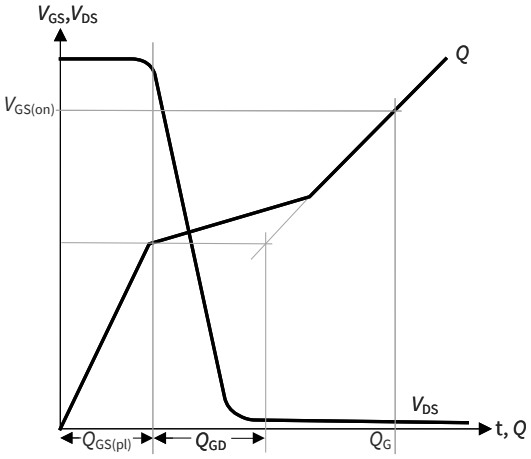


Figure D. **Definition of QGD**

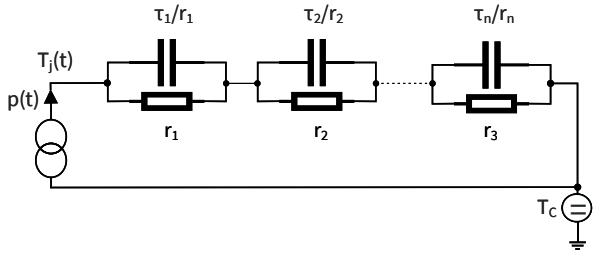


Figure E. **Thermal equivalent circuit**

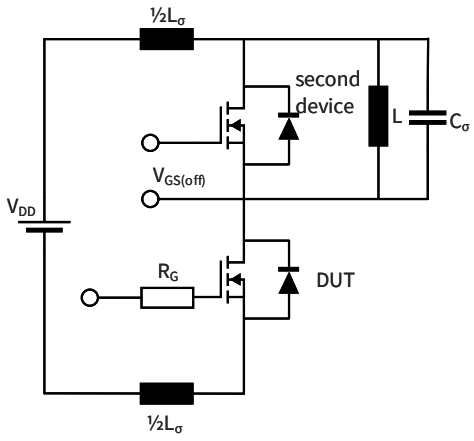


Figure F. **Dynamic test circuit**
Parasitic inductance L_σ,
Parasitic capacitor C_σ,

Figure 2

Revision history

Document revision	Date of release	Description of changes
1.00	2022-02-03	Final datasheet
1.10	2022-08-10	Change of test condition of dynamic capacitances in Table 4, “Characteristic values” (C_{iss}, C_{oss}, C_{rss}): V_{DD}= 25 V to V_{DD}= 800 V Correction of unit of “Input capacitance” C_{iss} from nF to pF Change of V_{GS} “Gate-source voltage, max. static voltage” in Table 2, “Maximum rated values” from -5/20 V to -7/20 V Editorial changes in “Features” on page 1 Editorial changes in “Package” on page 1 Correction of unit of x-axis at diagram “Max. transient thermal impedance (MOSFET/diode)” from µs to s, on page 13 Correction of diagram “Max. transient thermal impedance (MOSFET/diode)”, on page 13
1.20	2023-05-08	Correction of gate charge values in Table 4 Editorial changes
1.30	2024-11-15	Updated package name Corrected forward transconductance g_{fs} in Table 4 Corrected switching energies in Table 4 Corrected diagram “Typical output characteristic, V_{GS} as parameter" Corrected diagram “Typical transfer characteristic” Editorial changes

Trademarks

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

Edition 2024-11-15

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-ABC754-004

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.

Please note that this product is not qualified according to the AEC Q100 or AEC Q101 documents of the Automotive Electronics Council.

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.