

CoolSiC™ 1200 V SiC Trench MOSFET : Silicon Carbide MOSFET

Features

- $V_{DS} = 1200\text{ V}$ at $T_{vj} = 25^\circ\text{C}$
- $I_{DC} = 225\text{ A}$ at $T_c = 25^\circ\text{C}$
- $R_{DS(on)} = 7\text{ m}\Omega$ at $V_{GS} = 18\text{ V}$, $T_{vj} = 25^\circ\text{C}$
- Very low switching losses
- Benchmark gate threshold voltage, $V_{GS(th)} = 4.2\text{ V}$
- 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

Potential applications

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

Product validation

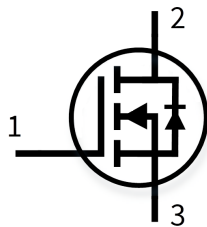
- Qualified for industrial applications according to the relevant tests of JEDEC47/20/22
- Please also note the application note AN2019-05 for power and thermal cycling

Description

- 1 – gate
- 2 – drain
- 3 – source



- Halogen-free
- Green
- Lead-free
- RoHS



Type	Package	Marking
IMW120R007M1H	PG-TO247-3-STD-NN2.5	12M1H007

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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	$R_{th(j-c)}$			0.15	0.20	K/W

2 MOSFET

Table 2 Maximum rated values

Parameter	Symbol	Note or test condition	Values	Unit	
Drain-source voltage	V_{DSS}	$T_{vj} \geq 25 \text{ °C}$	1200	V	
Continuous DC drain current for $R_{th(j-c,max)}$, limited by $T_{vj(max)}$	I_{DDC}	$V_{GS} = 18 \text{ V}$	$T_c = 25 \text{ °C}$	225	A
			$T_c = 100 \text{ °C}$	168	
Peak drain current, t_p limited by $T_{vj(max)}$	I_{DM}	$V_{GS} = 18 \text{ V}$	504	A	
Gate-source voltage, max. transient voltage ¹⁾	V_{GS}	$t_p \leq 0.5 \text{ }\mu\text{s}$, $D < 0.001$	-10/23	V	
Gate-source voltage, max. static voltage	V_{GS}		-7/20	V	
Avalanche energy, single pulse	E_{AS}	$I_D = 35 \text{ A}$, $V_{DD} = 50 \text{ V}$, $L = 1 \text{ mH}$	638	mJ	
Avalanche energy, repetitive	E_{AR}	$I_D = 35 \text{ A}$, $V_{DD} = 50 \text{ V}$, $L = 5.2 \text{ }\mu\text{H}$	3.2	mJ	
MOSFET dv/dt robustness	dv/dt	$V_{DS} = 0 \dots 800 \text{ V}$	150	V/ns	
Power dissipation, limited by $T_{vj(max)}$	P_{tot}		$T_c = 25 \text{ °C}$	750	W
			$T_c = 100 \text{ °C}$	375	

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	$R_{DS(on)}$	$I_D = 108\text{ A}$	$T_{vj} = 25\text{ °C}$, $V_{GS(on)} = 18\text{ V}$		7	9.9	mΩ
			$T_{vj} = 100\text{ °C}$, $V_{GS(on)} = 18\text{ V}$		10		
			$T_{vj} = 175\text{ °C}$, $V_{GS(on)} = 18\text{ V}$		14		
			$T_{vj} = 25\text{ °C}$, $V_{GS(on)} = 15\text{ V}$		8.9	11.1	
Gate-source threshold voltage	$V_{GS(th)}$	$I_D = 47\text{ mA}$, $V_{DS} = V_{GS}$ (tested after 1 ms pulse at $V_{GS} = 20\text{ V}$)	$T_{vj} = 25\text{ °C}$	3.5	4.2	5.2	V
			$T_{vj} = 175\text{ °C}$		3.6		
Zero gate-voltage drain current	I_{DSS}	$V_{DS} = 1200\text{ V}$, $V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ °C}$			860	μA
			$T_{vj} = 175\text{ °C}$		15		
Gate leakage current	I_{GSS}	$V_{DS} = 0\text{ V}$	$V_{GS} = 23\text{ V}$			300	nA
			$V_{GS} = -10\text{ V}$			-300	
Forward transconductance	g_{fs}	$I_D = 108\text{ A}$, $V_{DS} = 20\text{ V}$		72.6			S
Internal gate resistance	$R_{G,int}$	$f = 1\text{ MHz}$, $V_{AC} = 25\text{ mV}$		1.8			Ω
Input capacitance	C_{iss}	$V_{DD} = 800\text{ V}$, $V_{GS} = 0\text{ V}$, $f = 100\text{ kHz}$, $V_{AC} = 25\text{ mV}$		9170			pF
Output capacitance	C_{oss}	$V_{DD} = 800\text{ V}$, $V_{GS} = 0\text{ V}$, $f = 100\text{ kHz}$, $V_{AC} = 25\text{ mV}$		420			pF
Reverse transfer capacitance	C_{rss}	$V_{DD} = 800\text{ V}$, $V_{GS} = 0\text{ V}$, $f = 100\text{ kHz}$, $V_{AC} = 25\text{ mV}$		61			pF
C_{oss} stored energy	E_{oss}	$V_{DD} = 800\text{ V}$, $V_{GS} = 0\text{ V}$, $f = 100\text{ kHz}$, $V_{AC} = 25\text{ mV}$		172			μJ
Total gate charge	Q_G	$V_{DD} = 800\text{ V}$, $I_D = 108\text{ A}$, $V_{GS} = 0/18\text{ V}$, turn-on pulse		289			nC
Plateau gate charge	$Q_{GS(pl)}$	$V_{DD} = 800\text{ V}$, $I_D = 108\text{ A}$, $V_{GS} = 0/18\text{ V}$, turn-on pulse		71.8			nC
Gate-to-drain charge	Q_{GD}	$V_{DD} = 800\text{ V}$, $I_D = 108\text{ A}$, $V_{GS} = 0/18\text{ V}$, turn-on pulse		57.7			nC

(table continues...)

Table 4 (continued) Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Turn-on delay time	$t_{d(on)}$	$V_{DD} = 800\text{ V}, I_D = 108\text{ A},$ $V_{GS} = 0/18\text{ V},$ $R_{GS(on)} = 1\ \Omega,$ $R_{GS(off)} = 1\ \Omega, L_\sigma = 15\text{ nH},$ diode: body diode at $V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ }^\circ\text{C}$		62	ns
			$T_{vj} = 175\text{ }^\circ\text{C}$		55	
Rise time	t_r	$V_{DD} = 800\text{ V}, I_D = 108\text{ A},$ $V_{GS} = 0/18\text{ V},$ $R_{GS(on)} = 1\ \Omega,$ $R_{GS(off)} = 1\ \Omega, L_\sigma = 15\text{ nH},$ diode: body diode at $V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ }^\circ\text{C}$		58	ns
			$T_{vj} = 175\text{ }^\circ\text{C}$		75	
Turn-off delay time	$t_{d(off)}$	$V_{DD} = 800\text{ V}, I_D = 108\text{ A},$ $V_{GS} = 0/18\text{ V},$ $R_{GS(on)} = 1\ \Omega,$ $R_{GS(off)} = 1\ \Omega, L_\sigma = 15\text{ nH},$ diode: body diode at $V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ }^\circ\text{C}$		77	ns
			$T_{vj} = 175\text{ }^\circ\text{C}$		85	
Fall time	t_f	$V_{DD} = 800\text{ V}, I_D = 108\text{ A},$ $V_{GS} = 0/18\text{ V},$ $R_{GS(on)} = 1\ \Omega,$ $R_{GS(off)} = 1\ \Omega, L_\sigma = 15\text{ nH},$ diode: body diode at $V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ }^\circ\text{C}$		44	ns
			$T_{vj} = 175\text{ }^\circ\text{C}$		44	
Turn-on energy	E_{on}	$V_{DD} = 800\text{ V}, I_D = 108\text{ A},$ $V_{GS} = 0/18\text{ V},$ $R_{GS(on)} = 1\ \Omega,$ $R_{GS(off)} = 1\ \Omega, L_\sigma = 15\text{ nH},$ diode: body diode at $V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ }^\circ\text{C}$		2900	μJ
			$T_{vj} = 175\text{ }^\circ\text{C}$		3470	
Turn-off energy	E_{off}	$V_{DD} = 800\text{ V}, I_D = 108\text{ A},$ $V_{GS} = 0/18\text{ V},$ $R_{GS(on)} = 1\ \Omega,$ $R_{GS(off)} = 1\ \Omega, L_\sigma = 15\text{ nH},$ diode: body diode at $V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ }^\circ\text{C}$		1200	μJ
			$T_{vj} = 175\text{ }^\circ\text{C}$		1320	
Total switching energy	E_{tot}	$V_{DD} = 800\text{ V}, I_D = 108\text{ A},$ $V_{GS} = 0/18\text{ V},$ $R_{GS(on)} = 1\ \Omega,$ $R_{GS(off)} = 1\ \Omega, L_\sigma = 15\text{ nH},$ diode: body diode at $V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ }^\circ\text{C}$		4561	μJ
			$T_{vj} = 175\text{ }^\circ\text{C}$		6028	
Virtual junction temperature	T_{vj}			-55	175	$^\circ\text{C}$

3 Body diode (MOSFET)

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}	$T_{vj} \geq 25\text{ °C}$	1200	V	
Continuous reverse drain current for $R_{th(j-c,max)}$, limited by $T_{vj(max)}$	I_{SDC}	$V_{GS} = 0\text{ V}$	$T_c = 25\text{ °C}$	205	A
			$T_c = 100\text{ °C}$	125	
Peak reverse drain current, t_p limited by $T_{vj(max)}$	I_{SM}	$V_{GS} = 0\text{ V}$	504	A	

Table 6 Characteristic values

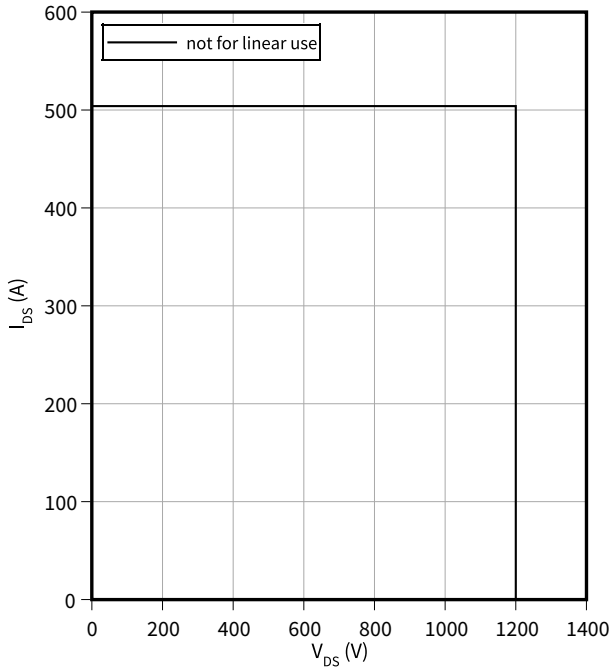
Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Drain-source reverse voltage	V_{SD}	$I_{SD} = 108\text{ A}, V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ °C}$	3.8	5	V
			$T_{vj} = 100\text{ °C}$	3.7		
			$T_{vj} = 175\text{ °C}$	3.6		
MOSFET forward recovery charge	Q_{fr}	$V_{DD} = 800\text{ V}, I_{SD} = 108\text{ A}, V_{GS} = 0\text{ V}, di_{SD}/dt = 3000\text{ A}/\mu\text{s}, Q_{fr}$ includes also Q_C	$T_{vj} = 25\text{ °C}$	900		nC
			$T_{vj} = 175\text{ °C}$	1651		
MOSFET peak forward recovery current	I_{frm}	$V_{DD} = 800\text{ V}, I_{SD} = 108\text{ A}, V_{GS} = 0\text{ V}, di_{SD}/dt = 3000\text{ A}/\mu\text{s}, Q_{fr}$ includes also Q_C	$T_{vj} = 25\text{ °C}$	7		A
			$T_{vj} = 175\text{ °C}$	8		
MOSFET forward recovery energy	E_{fr}	$V_{DD} = 800\text{ V}, I_{SD} = 108\text{ A}, V_{GS} = 0\text{ V}, di_{SD}/dt = 3000\text{ A}/\mu\text{s}, Q_{fr}$ includes also Q_C	$T_{vj} = 25\text{ °C}$	461		μJ
			$T_{vj} = 175\text{ °C}$	1238		
Virtual junction temperature	T_{vj}		-55		175	°C

4 Characteristics diagrams

Reverse bias safe operating area (RBSOA)

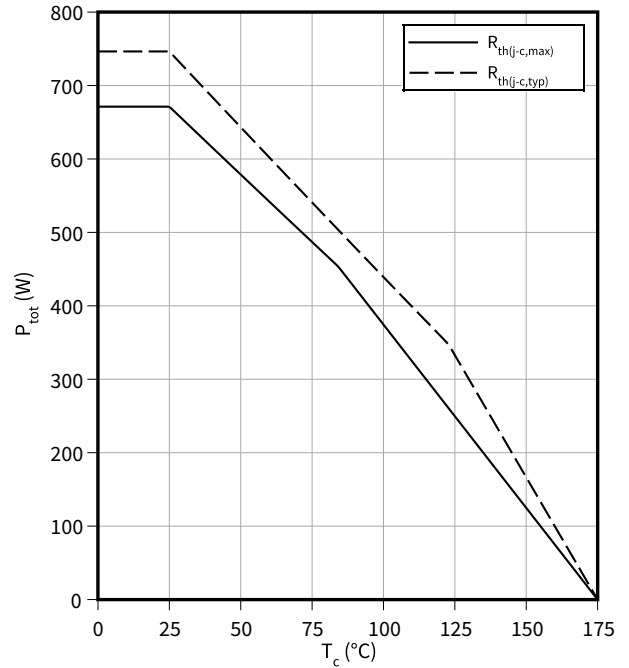
$$I_{DS} = f(V_{DS})$$

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



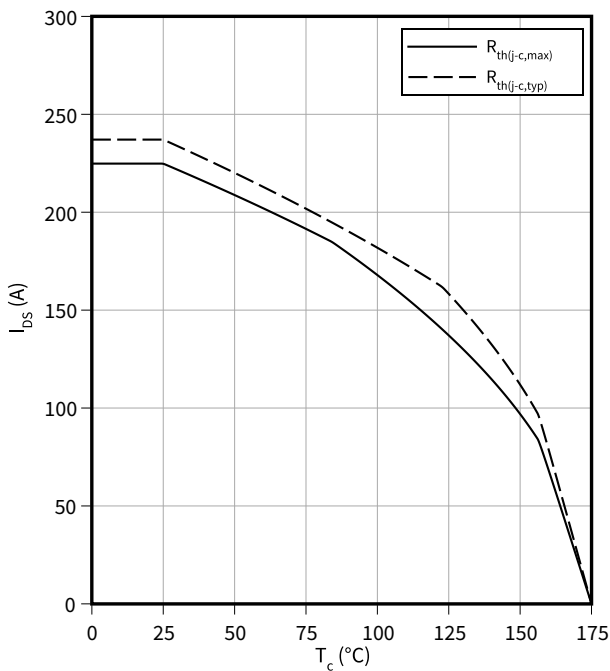
Power dissipation as a function of case temperature limited by bond wire

$$P_{tot} = f(T_c)$$



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

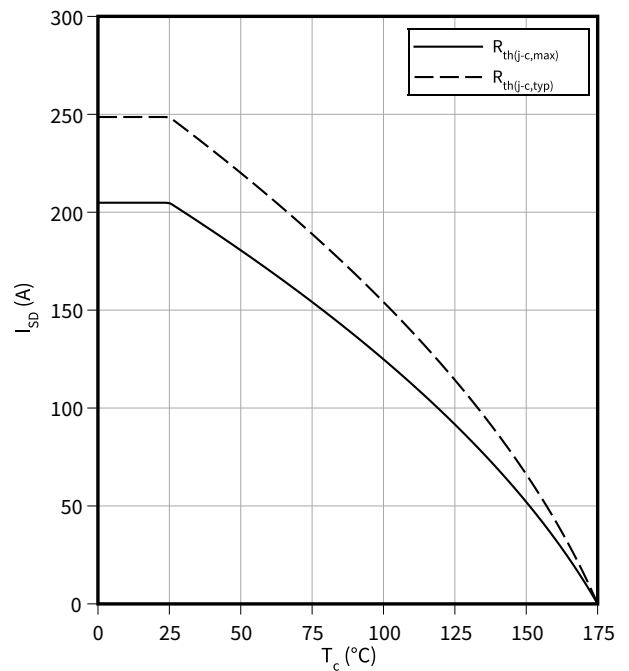
$$I_{DS} = f(T_c)$$



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

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

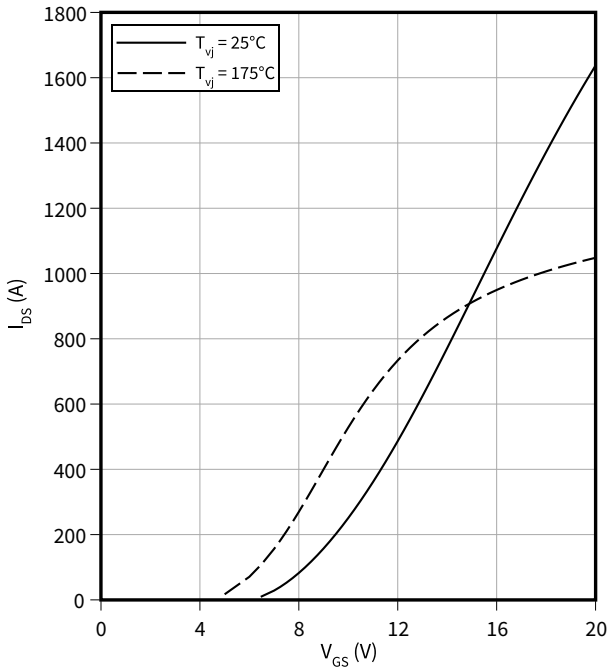
$$V_{GS} = 0\text{ V}$$



4 Characteristics diagrams

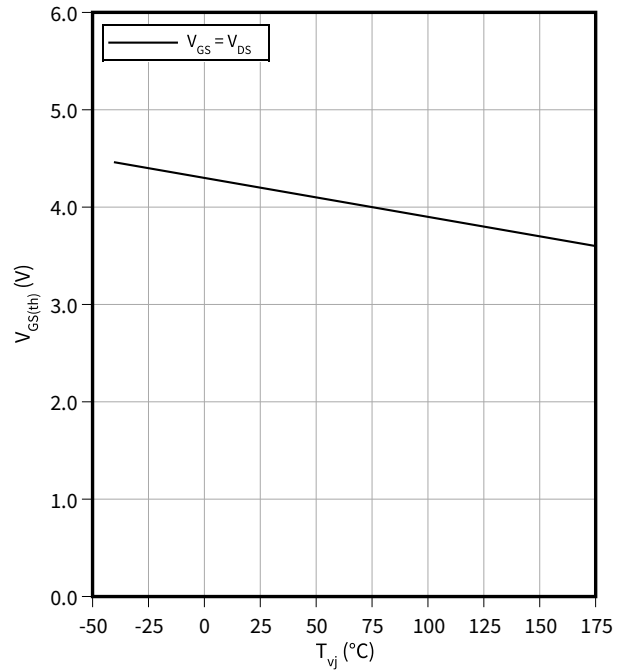
Typical transfer characteristic

$I_{DS} = f(V_{GS})$
 $V_{DS} = 20\text{ V}$, $t_p = 20\ \mu\text{s}$



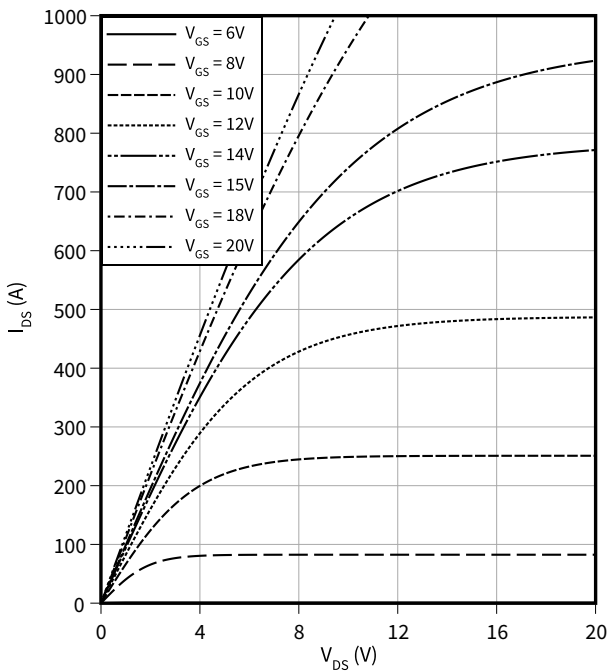
Typical gate-source threshold voltage as a function of junction temperature

$V_{GS(th)} = f(T_{vj})$
 $I_D = 47\text{ mA}$



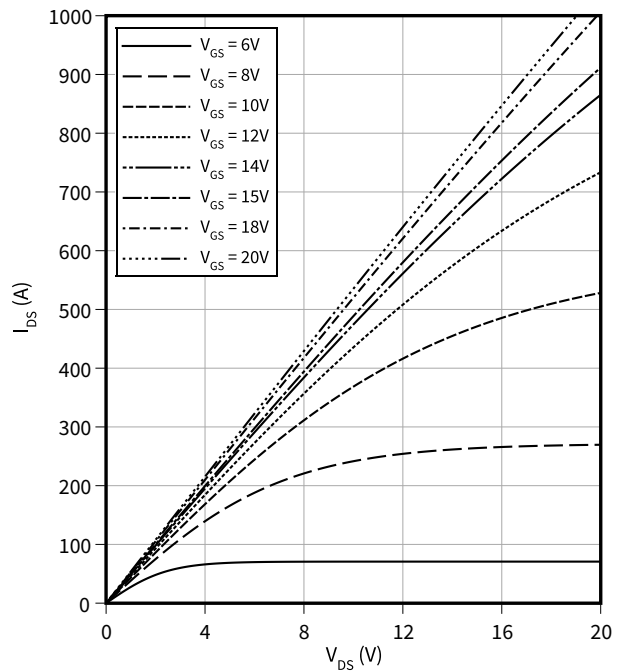
Typical output characteristic, V_{GS} as parameter

$I_{DS} = f(V_{DS})$
 $T_{vj} = 25\ ^\circ\text{C}$, $t_p = 20\ \mu\text{s}$



Typical output characteristic, V_{GS} as parameter

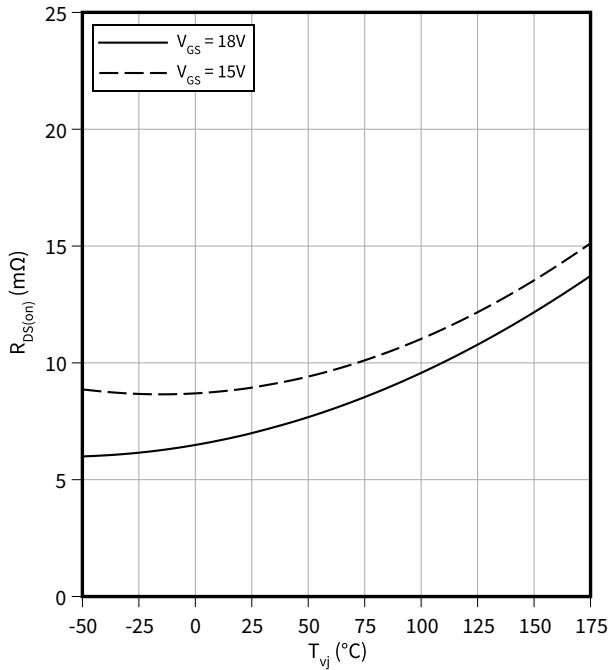
$I_{DS} = f(V_{DS})$
 $T_{vj} = 175\ ^\circ\text{C}$, $t_p = 20\ \mu\text{s}$



4 Characteristics diagrams

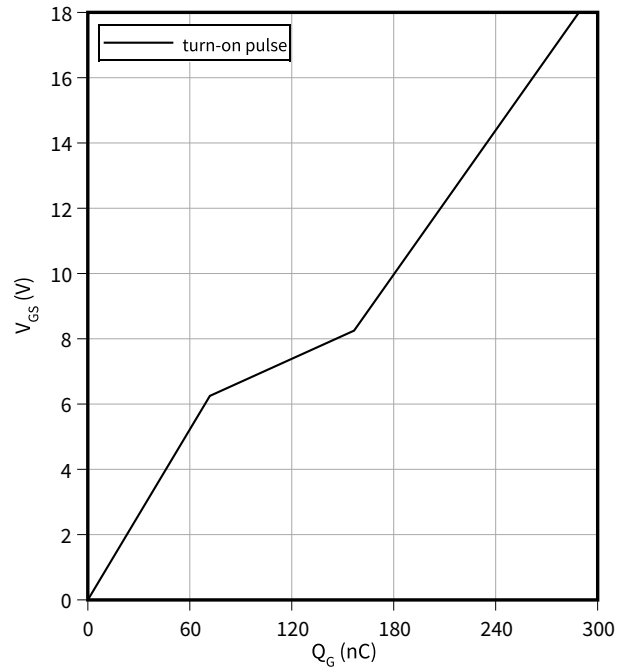
Typical on-state resistance as a function of junction temperature

$R_{DS(on)} = f(T_{vj})$
 $I_D = 108 \text{ A}$



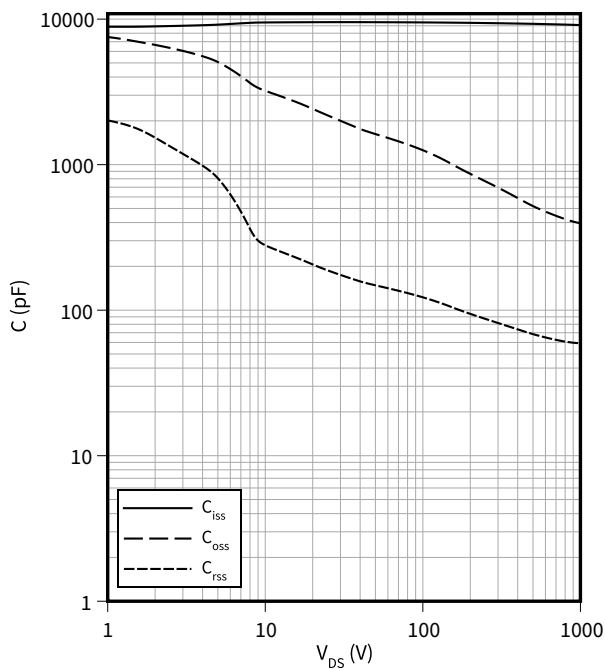
Typical gate charge

$V_{GS} = f(Q_G)$
 $I_D = 108 \text{ A}, V_{DS} = 800 \text{ V}$



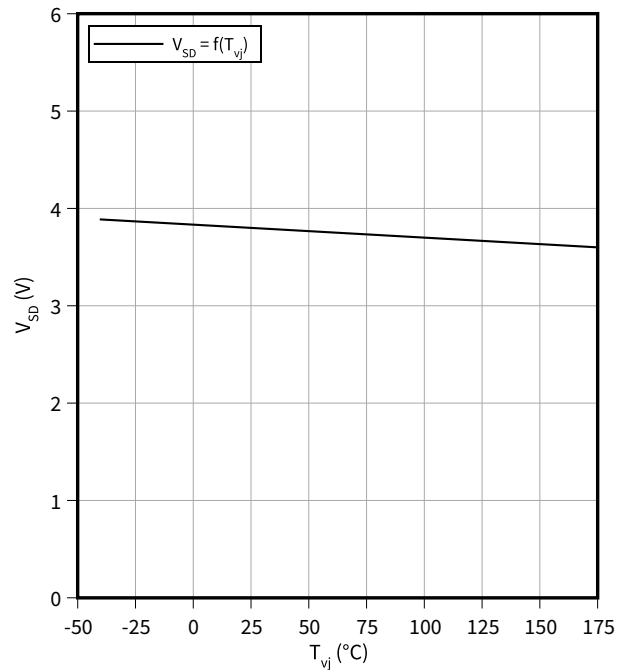
Typical capacitance as a function of drain-source voltage

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



Typical reverse drain voltage as function of junction temperature

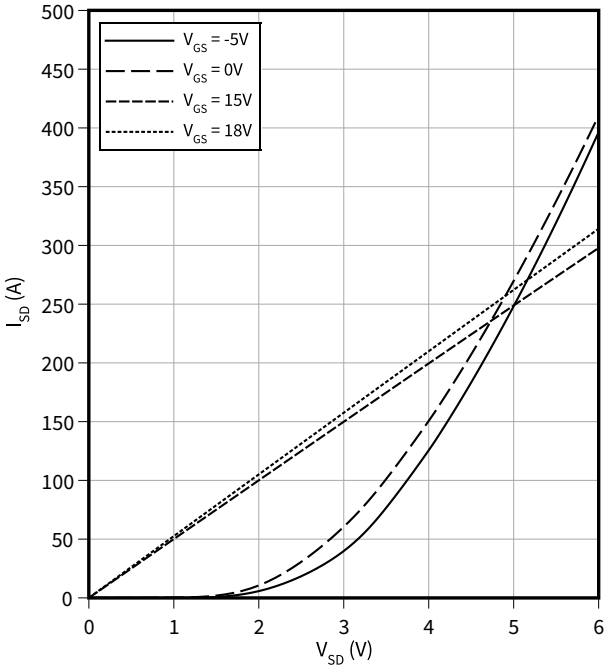
$V_{SD} = f(T_{vj})$
 $I_{SD} = 108 \text{ A}, V_{GS} = 0 \text{ V}$



4 Characteristics diagrams

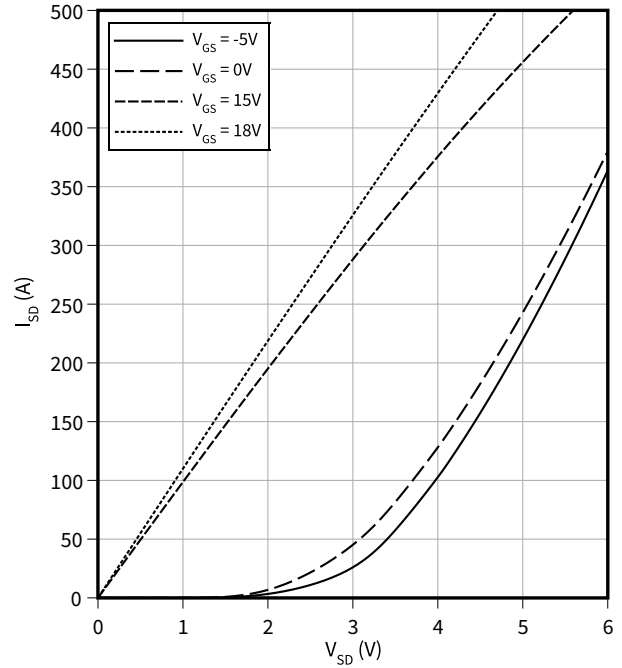
Typical reverse drain current as function of reverse drain voltage, V_{GS} as parameter

$I_{SD} = f(V_{SD})$
 $T_{vj} = 175\text{ °C}$, $t_p = 20\text{ }\mu\text{s}$



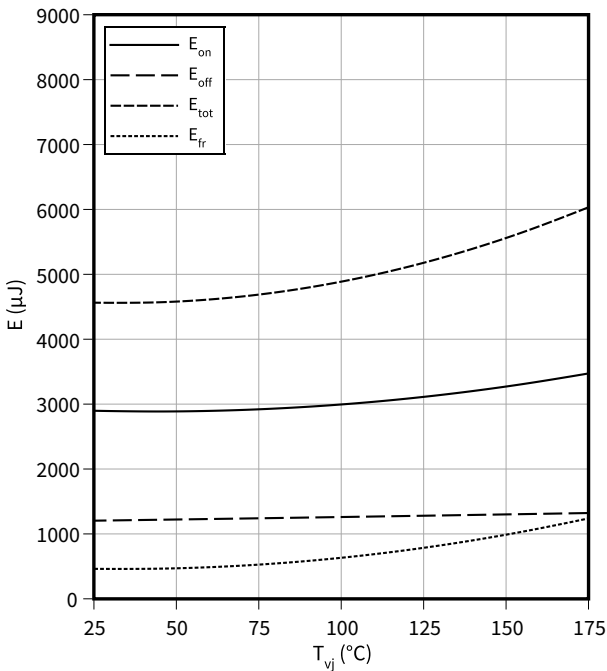
Typical reverse drain current as function of reverse drain voltage, V_{GS} as parameter

$I_{SD} = f(V_{SD})$
 $T_{vj} = 25\text{ °C}$, $t_p = 20\text{ }\mu\text{s}$



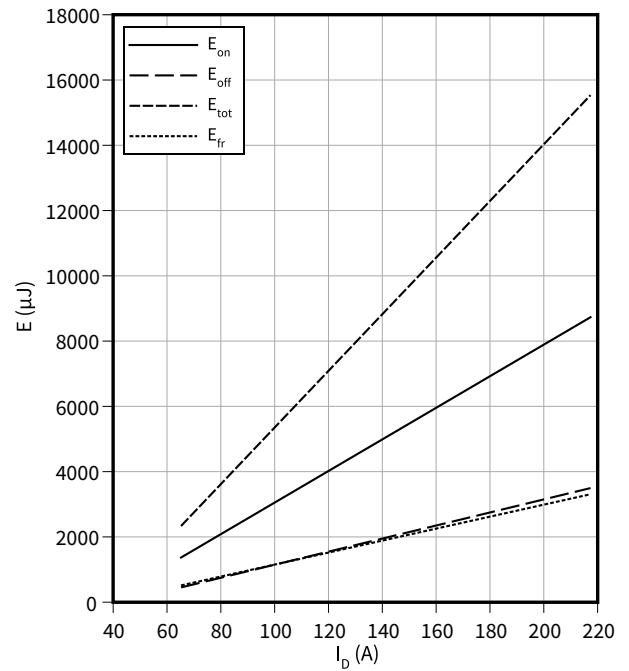
Typical switching energy as a function of junction temperature, test circuit in Fig. F, 2nd device own body diode: $V_{GS} = 0\text{ V}$

$E = f(T_{vj})$
 $V_{GS} = 0/18\text{ V}$, $I_D = 108\text{ A}$, $R_{G,ext} = 1\text{ }\Omega$, $V_{DD} = 800\text{ V}$



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

$E = f(I_D)$
 $T_{vj} = 175\text{ °C}$, $R_{G,ext} = 1\text{ }\Omega$, $V_{DD} = 800\text{ V}$, $V_{GS} = 0/18\text{ V}$

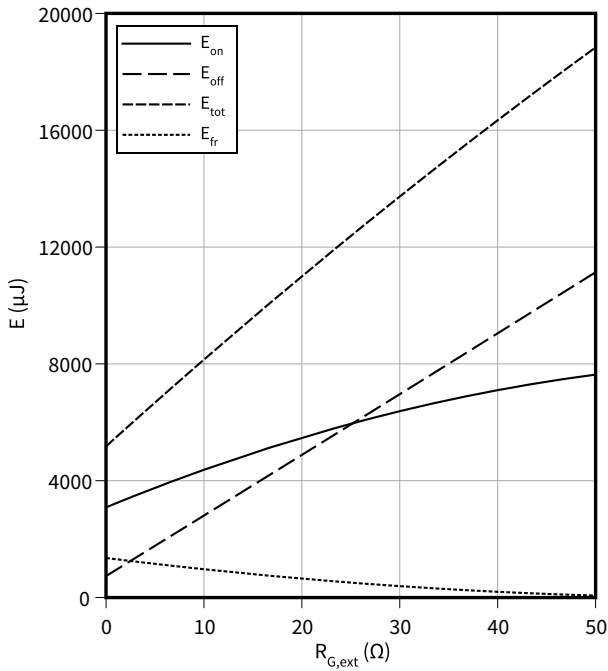


4 Characteristics diagrams

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

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

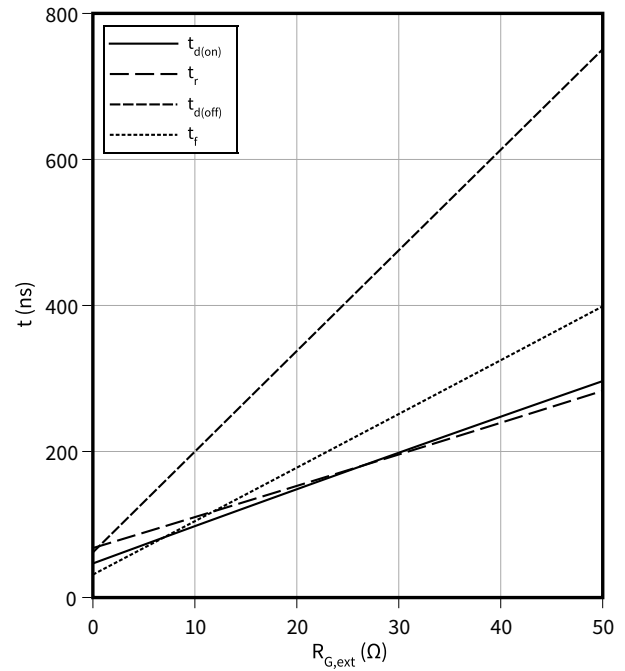
$V_{GS} = 0/18\text{ V}$, $I_D = 108\text{ A}$, $T_{vj} = \text{°C}$, $V_{DD} = 800\text{ V}$



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

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

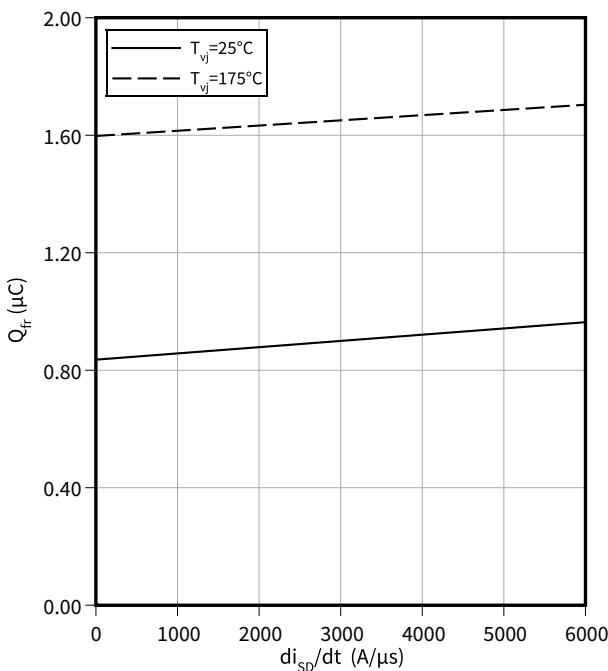
$V_{GS} = 0/18\text{ V}$, $I_D = 108\text{ A}$, $T_{vj} = 175\text{ °C}$, $V_{DD} = 800\text{ V}$



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

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

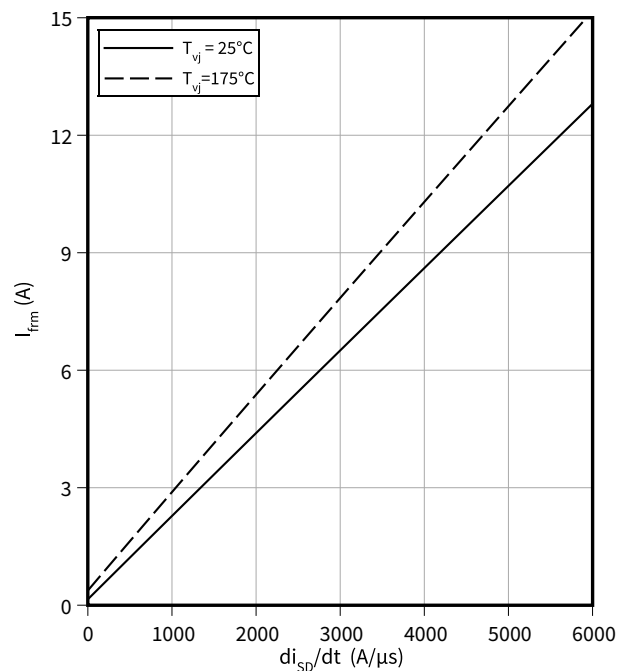
$V_{GS} = 0/18\text{ V}$, $I_{SD} = 108\text{ A}$, $V_{DD} = 800\text{ V}$



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

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

$V_{GS} = 0/18\text{ V}$, $I_{SD} = 108\text{ A}$, $V_{DD} = 800\text{ V}$

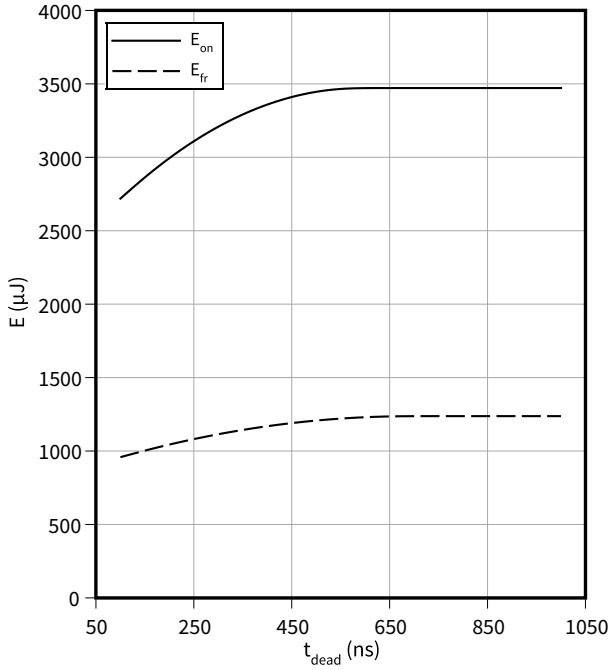


4 Characteristics diagrams

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

$$E = f(t_{\text{dead}})$$

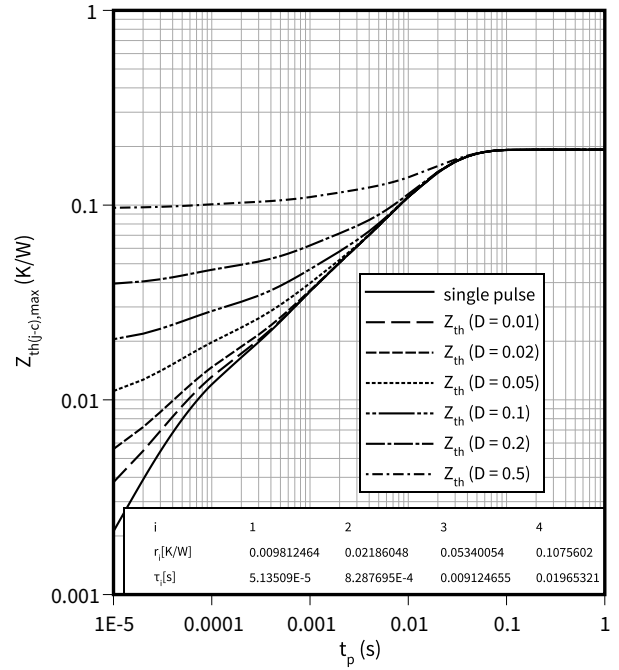
$V_{GS} = -5/18\text{ V}$, $I_D = 108\text{ A}$, $T_{vj} = 175\text{ °C}$, $V_{DD} = 800\text{ V}$



Max. transient thermal impedance (MOSFET/diode)

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

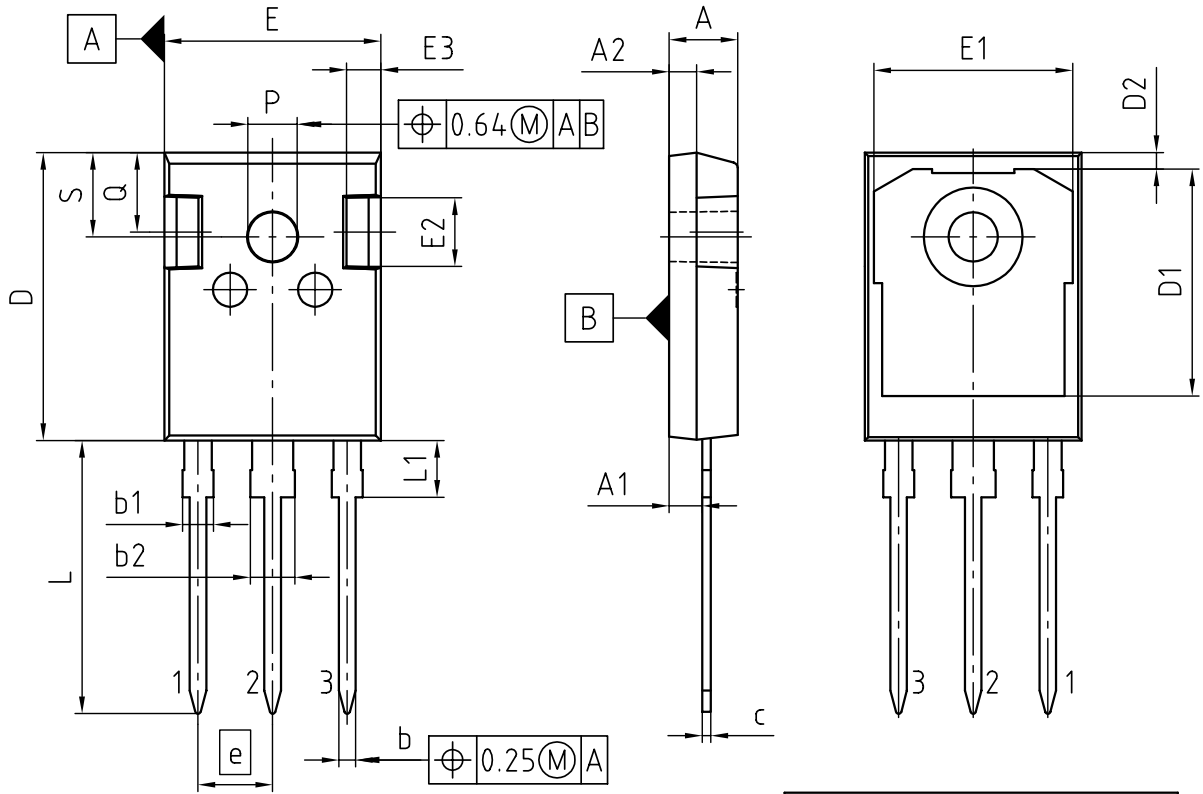
$$D = t_p/T$$



i	1	2	3	4
$r_i\text{ [K/W]}$	0.009812464	0.02186048	0.05340054	0.1075602
$\tau_i\text{ [s]}$	5.13509E-5	8.287695E-4	0.009124655	0.01965321

5 Package outlines

PG-TO247-3-STD-NN2.5



PACKAGE - GROUP NUMBER: PG-TO247-3-U06		
DIMENSIONS	MILLIMETERS	
	MIN.	MAX.
A	4.83	5.21
A1	2.27	2.54
A2	1.85	2.16
b	1.07	1.33
b1	1.90	2.41
b2	2.87	3.38
c	0.55	0.68
D	20.80	21.10
D1	16.25	17.65
D2	0.95	1.35
E	15.70	16.13
E1	13.10	14.15
E2	3.68	5.10
E3	1.00	2.60
e	5.44	
N	3	
L	19.80	20.32
L1	4.10	4.47
øP	3.50	3.70
Q	5.49	6.00
S	6.04	6.30

NOTE:
DIMENSIONS DO NOT INCLUDE MOLDFLASH; PROTRUSION OR GATE BURRS

Figure 1

6 Testing conditions

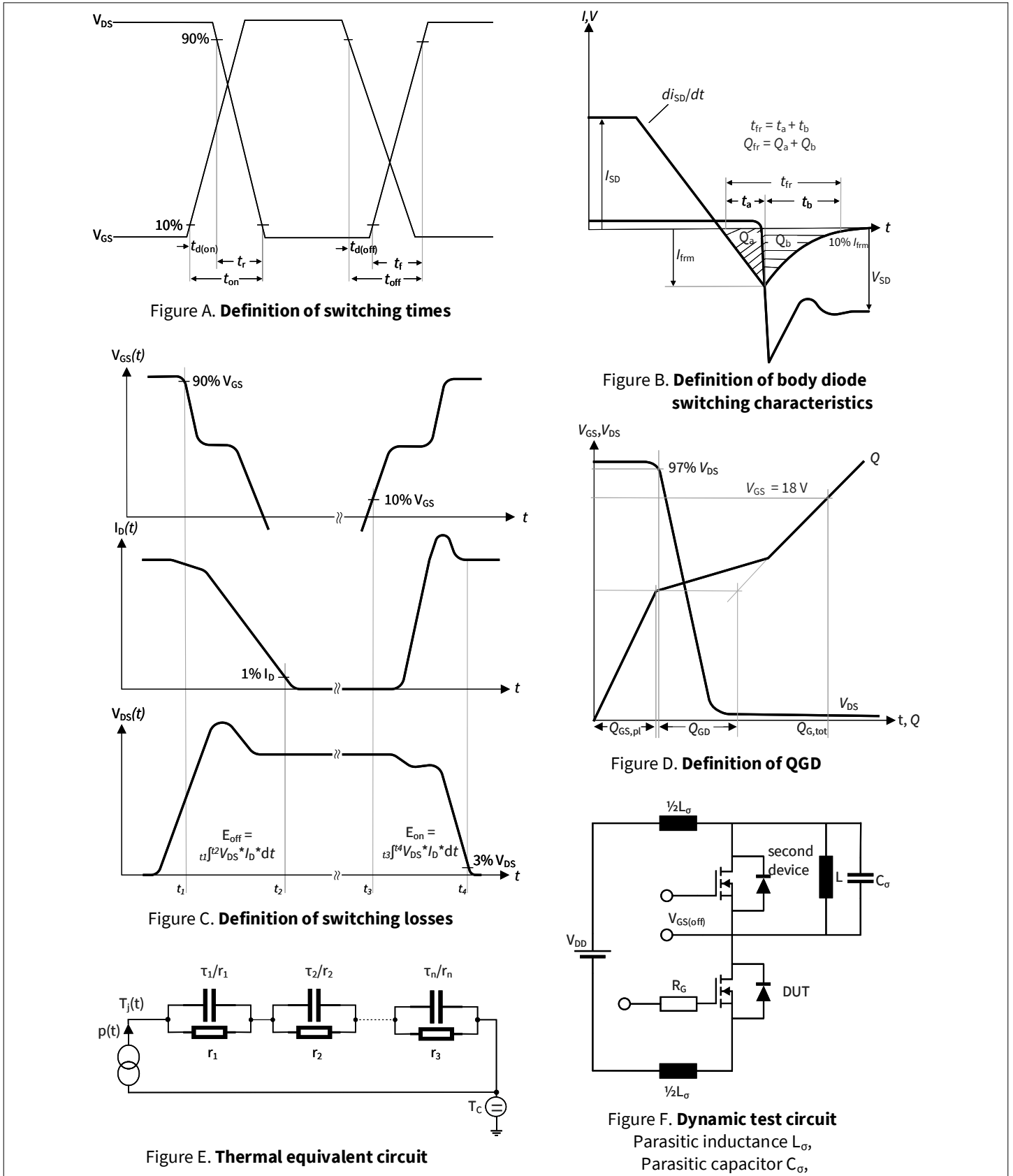


Figure 2

Revision history

Document revision	Date of release	Description of changes
1.00	2022-02-02	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}): $V_{DD}= 25\text{ V}$ to $V_{DD}= 800\text{ V}$ 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
1.20	2023-05-08	Correction of gate charge values in Table 4 Editorial changes

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