

CoolSiC™ 1200 V SiC Trench MOSFET : Silicon Carbide MOSFET

Features

- $V_{DSS} = 1200\text{ V}$ at $T_{vj} = 25^\circ\text{C}$
- $I_{DC} = 98\text{ A}$ at $T_c = 25^\circ\text{C}$
- $R_{DS(on)} = 19\text{ m}\Omega$ at $V_{GS} = 18\text{ V}$, $T_{vj} = 25^\circ\text{C}$
- Very low switching losses
- Short circuit withstand time $3\ \mu\text{s}$
- 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 power optimizer

Product validation

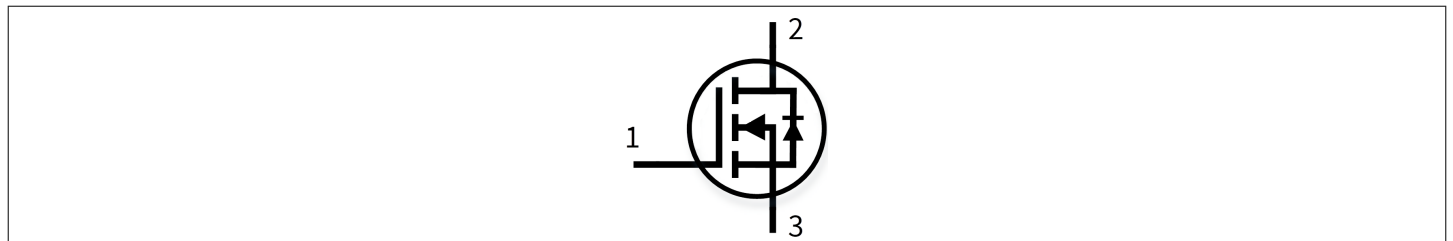
- Qualified for industrial applications according to the relevant tests of JEDEC47/20/22
- Please also note the application note AN2019-05 for power and thermal cycling

Description

- 1 – gate
- 2 – drain
- 3 – source



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



Type	Package	Marking
IMW120R020M1H	PG-TO247-3-STD-NN2.5	12M1H020

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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	$R_{th(j-c)}$			0.31	0.40	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}	$V_{GS} = 18\text{ V}$	$T_c = 25\text{ °C}$	98	A
			$T_c = 100\text{ °C}$	71	
Peak drain current, t_p limited by $T_{vj(max)}$	I_{DM}	$V_{GS} = 18\text{ V}$	213	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}	$I_D = 40.1\text{ A}$, $V_{DD} = 50\text{ V}$, $L = 0.9\text{ mH}$	721	mJ	
Avalanche energy, repetitive	E_{AR}	$I_D = 40.1\text{ A}$, $V_{DD} = 50\text{ V}$, $L = 4.5\text{ }\mu\text{H}$	3.58	mJ	
Short-circuit withstand time	t_{SC}	$V_{DD} \leq 800\text{ V}$, $V_{DS,peak} < 1200\text{ V}$, $V_{GS(on)} = 15\text{ V}$, $T_{vj(start)} = 25\text{ °C}$	3	μs	
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}		$T_c = 25\text{ °C}$	375	W
			$T_c = 100\text{ °C}$	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	$R_{DS(on)}$	$I_D = 41\text{ A}$	$T_{vj} = 25\text{ °C}$, $V_{GS(on)} = 18\text{ V}$		19	26.9	mΩ
			$T_{vj} = 100\text{ °C}$, $V_{GS(on)} = 18\text{ V}$		25		
			$T_{vj} = 175\text{ °C}$, $V_{GS(on)} = 18\text{ V}$		36		
			$T_{vj} = 25\text{ °C}$, $V_{GS(on)} = 15\text{ V}$		23.7	30	
Gate-source threshold voltage	$V_{GS(th)}$	$I_D = 17.6\text{ mA}$, $V_{DS} = V_{GS}$ (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}	$V_{DS} = 1200\text{ V}$, $V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ °C}$			320	μA
			$T_{vj} = 175\text{ °C}$		5.4		
Gate leakage current	I_{GSS}	$V_{DS} = 0\text{ V}$	$V_{GS} = 23\text{ V}$			100	nA
			$V_{GS} = -10\text{ V}$			-100	
Forward transconductance	g_{fs}	$I_D = 41\text{ A}$, $V_{DS} = 20\text{ V}$		27.4		S	
Internal gate resistance	$R_{G,int}$	$f = 1\text{ MHz}$, $V_{AC} = 25\text{ mV}$		1.8		Ω	
Input capacitance	C_{iss}	$V_{DD} = 800\text{ V}$, $V_{GS} = 0\text{ V}$, $f = 100\text{ kHz}$, $V_{AC} = 25\text{ mV}$		3460		pF	
Output capacitance	C_{oss}	$V_{DD} = 800\text{ V}$, $V_{GS} = 0\text{ V}$, $f = 100\text{ kHz}$, $V_{AC} = 25\text{ mV}$		159		pF	
Reverse transfer capacitance	C_{rss}	$V_{DD} = 800\text{ V}$, $V_{GS} = 0\text{ V}$, $f = 100\text{ kHz}$, $V_{AC} = 25\text{ mV}$		23		pF	
C_{oss} stored energy	E_{oss}	$V_{DD} = 800\text{ V}$, $V_{GS} = 0\text{ V}$, $f = 100\text{ kHz}$, $V_{AC} = 25\text{ mV}$		65		μJ	
Total gate charge	Q_G	$V_{DD} = 800\text{ V}$, $I_D = 41\text{ A}$, $V_{GS} = 0/18\text{ V}$, turn-on pulse		109		nC	
Plateau gate charge	$Q_{GS(pl)}$	$V_{DD} = 800\text{ V}$, $I_D = 41\text{ A}$, $V_{GS} = 0/18\text{ V}$, turn-on pulse		27.1		nC	
Gate-to-drain charge	Q_{GD}	$V_{DD} = 800\text{ V}$, $I_D = 41\text{ A}$, $V_{GS} = 0/18\text{ V}$, 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	$t_{d(on)}$	$V_{DD} = 800\text{ V}, I_D = 41\text{ A},$ $V_{GS} = 0/18\text{ V},$ $R_{GS(on)} = 2\ \Omega,$ $R_{GS(off)} = 2\ \Omega, L_\sigma = 15\text{ nH},$ diode: body diode at $V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ }^\circ\text{C}$		23	ns
			$T_{vj} = 175\text{ }^\circ\text{C}$		21	
Rise time	t_r	$V_{DD} = 800\text{ V}, I_D = 41\text{ A},$ $V_{GS} = 0/18\text{ V},$ $R_{GS(on)} = 2\ \Omega,$ $R_{GS(off)} = 2\ \Omega, L_\sigma = 15\text{ nH},$ diode: body diode at $V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ }^\circ\text{C}$		21.9	ns
			$T_{vj} = 175\text{ }^\circ\text{C}$		28.2	
Turn-off delay time	$t_{d(off)}$	$V_{DD} = 800\text{ V}, I_D = 41\text{ A},$ $V_{GS} = 0/18\text{ V},$ $R_{GS(on)} = 2\ \Omega,$ $R_{GS(off)} = 2\ \Omega, L_\sigma = 15\text{ nH},$ diode: body diode at $V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ }^\circ\text{C}$		29	ns
			$T_{vj} = 175\text{ }^\circ\text{C}$		32	
Fall time	t_f	$V_{DD} = 800\text{ V}, I_D = 41\text{ A},$ $V_{GS} = 0/18\text{ V},$ $R_{GS(on)} = 2\ \Omega,$ $R_{GS(off)} = 2\ \Omega, L_\sigma = 15\text{ nH},$ diode: body diode at $V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ }^\circ\text{C}$		16.5	ns
			$T_{vj} = 175\text{ }^\circ\text{C}$		16.4	
Turn-on energy	E_{on}	$V_{DD} = 800\text{ V}, I_D = 41\text{ A},$ $V_{GS} = 0/18\text{ V},$ $R_{GS(on)} = 2\ \Omega,$ $R_{GS(off)} = 2\ \Omega, L_\sigma = 15\text{ nH},$ diode: body diode at $V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ }^\circ\text{C}$		1050	μJ
			$T_{vj} = 175\text{ }^\circ\text{C}$		1273	
Turn-off energy	E_{off}	$V_{DD} = 800\text{ V}, I_D = 41\text{ A},$ $V_{GS} = 0/18\text{ V},$ $R_{GS(on)} = 2\ \Omega,$ $R_{GS(off)} = 2\ \Omega, L_\sigma = 15\text{ nH},$ diode: body diode at $V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ }^\circ\text{C}$		400	μJ
			$T_{vj} = 175\text{ }^\circ\text{C}$		444	
Total switching energy	E_{tot}	$V_{DD} = 800\text{ V}, I_D = 41\text{ A},$ $V_{GS} = 0/18\text{ V},$ $R_{GS(on)} = 2\ \Omega,$ $R_{GS(off)} = 2\ \Omega, L_\sigma = 15\text{ nH},$ diode: body diode at $V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ }^\circ\text{C}$		1627	μJ
			$T_{vj} = 175\text{ }^\circ\text{C}$		2194	
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}	$V_{GS} = 0\text{ V}$	$T_c = 25\text{ °C}$	94	A
			$T_c = 100\text{ °C}$	58	
Peak reverse drain current, t_p limited by $T_{vj(max)}$	I_{SM}	$V_{GS} = 0\text{ V}$	213	A	

Table 6 Characteristic values

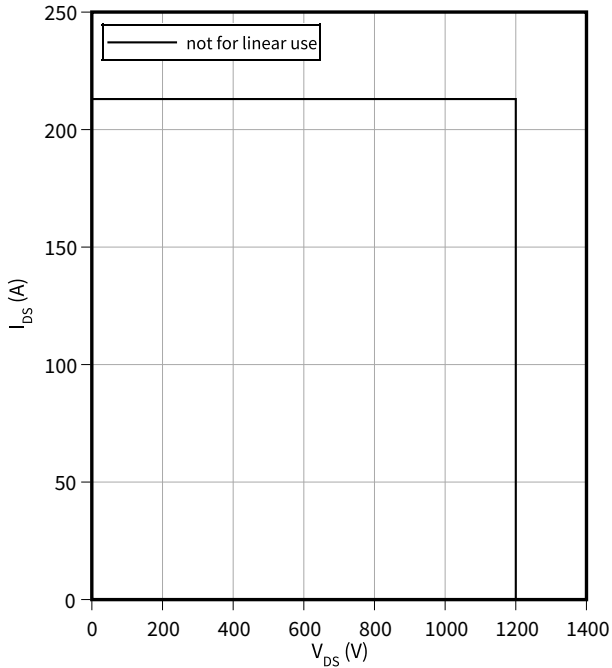
Parameter	Symbol	Note or test condition	Values			Unit	
			Min.	Typ.	Max.		
Drain-source reverse voltage	V_{SD}	$I_{SD} = 41\text{ A}, V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ °C}$		3.8	5	V
			$T_{vj} = 100\text{ °C}$		3.7		
			$T_{vj} = 175\text{ °C}$		3.6		
MOSFET forward recovery charge	Q_{fr}	$V_{DD} = 800\text{ V}, I_{SD} = 41\text{ A}, V_{GS} = 0\text{ V}, di_{SD}/dt = 3000\text{ A}/\mu\text{s}, Q_{fr}$ includes also Q_C	$T_{vj} = 25\text{ °C}$		340		nC
			$T_{vj} = 175\text{ °C}$		622		
MOSFET peak forward recovery current	I_{frm}	$V_{DD} = 800\text{ V}, I_{SD} = 41\text{ A}, V_{GS} = 0\text{ V}, di_{SD}/dt = 3000\text{ A}/\mu\text{s}, Q_{fr}$ includes also Q_C	$T_{vj} = 25\text{ °C}$		17		A
			$T_{vj} = 175\text{ °C}$		21		
MOSFET forward recovery energy	E_{fr}	$V_{DD} = 800\text{ V}, I_{SD} = 41\text{ A}, V_{GS} = 0\text{ V}, di_{SD}/dt = 3000\text{ A}/\mu\text{s}, Q_{fr}$ includes also Q_C	$T_{vj} = 25\text{ °C}$		177		μJ
			$T_{vj} = 175\text{ °C}$		477		
Virtual junction temperature	T_{vj}		-55		175	°C	

4 Characteristics diagrams

Reverse bias safe operating area (RBSOA)

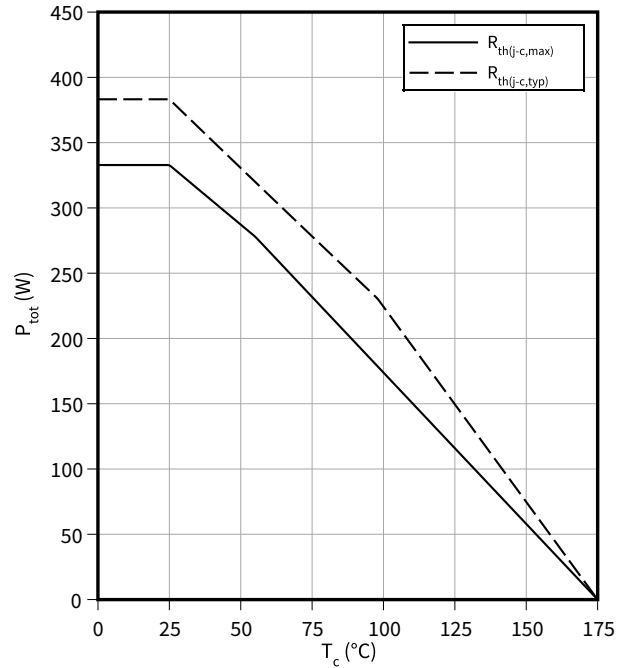
$$I_{DS} = f(V_{DS})$$

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



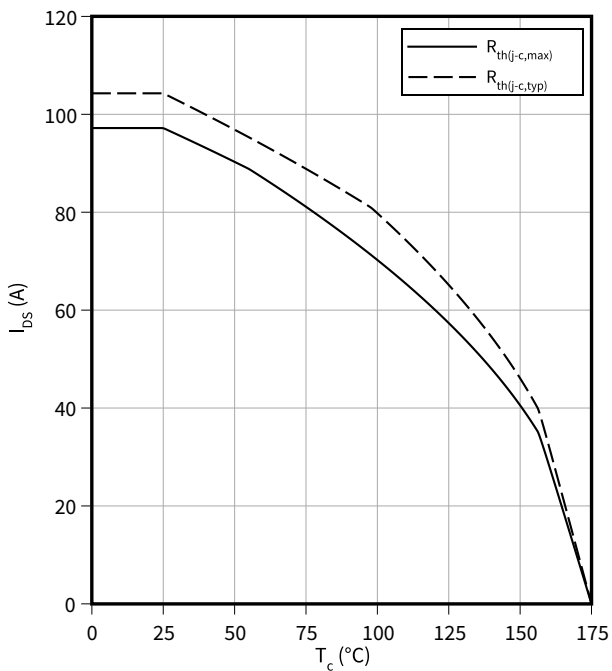
Power dissipation as a function of case temperature limited by bond wire

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



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

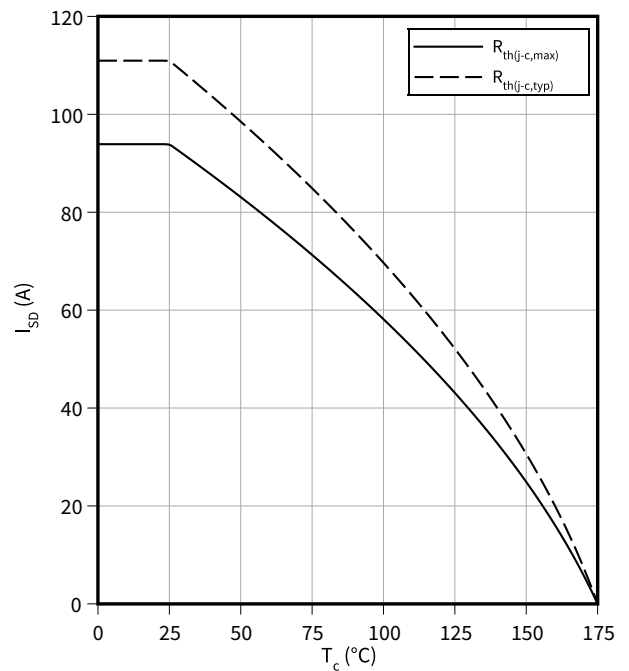
$$I_{DS} = f(T_c)$$



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

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

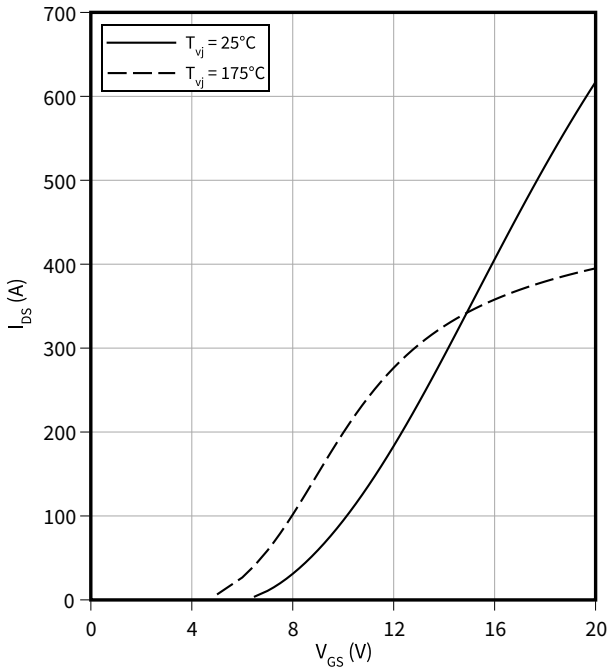
$$V_{GS} = 0\text{ V}$$



4 Characteristics diagrams

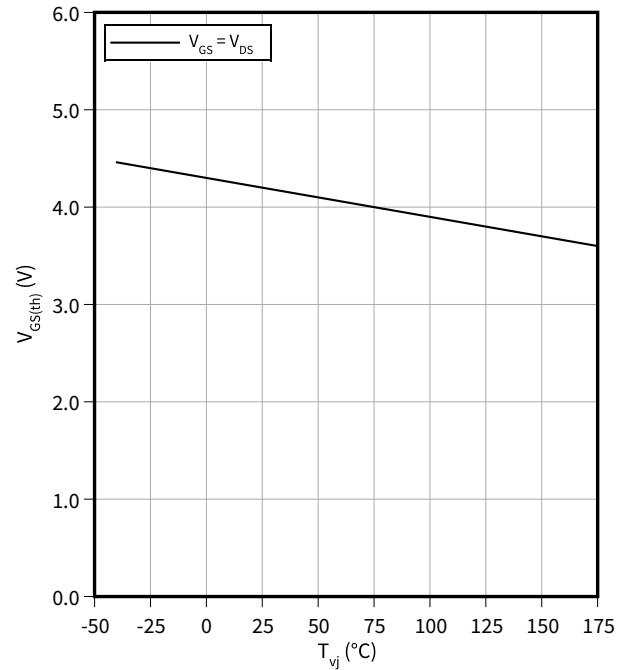
Typical transfer characteristic

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



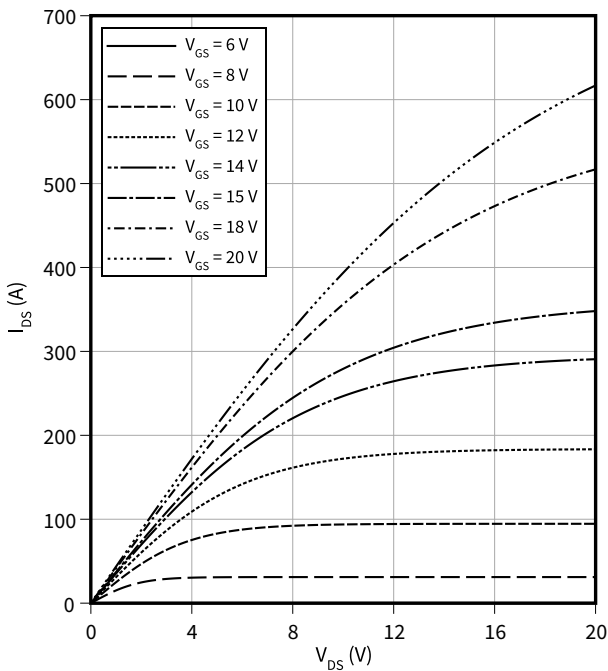
Typical gate-source threshold voltage as a function of junction temperature

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



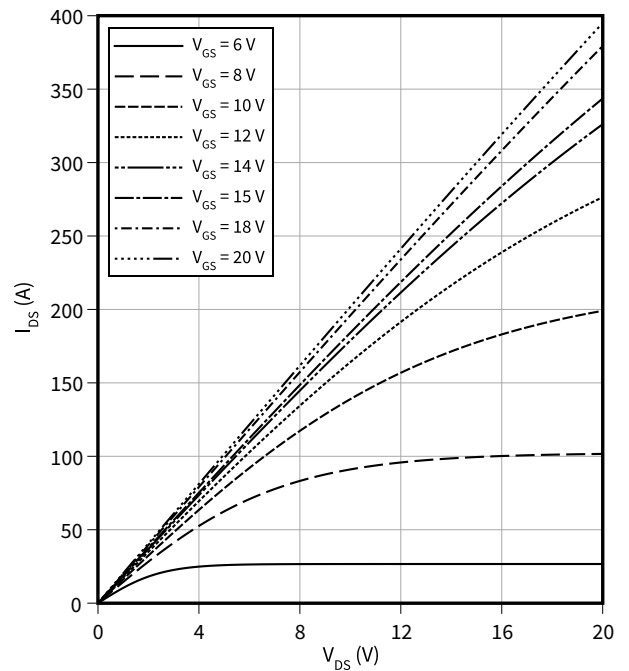
Typical output characteristic, V_{GS} as parameter

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



Typical output characteristic, V_{GS} as parameter

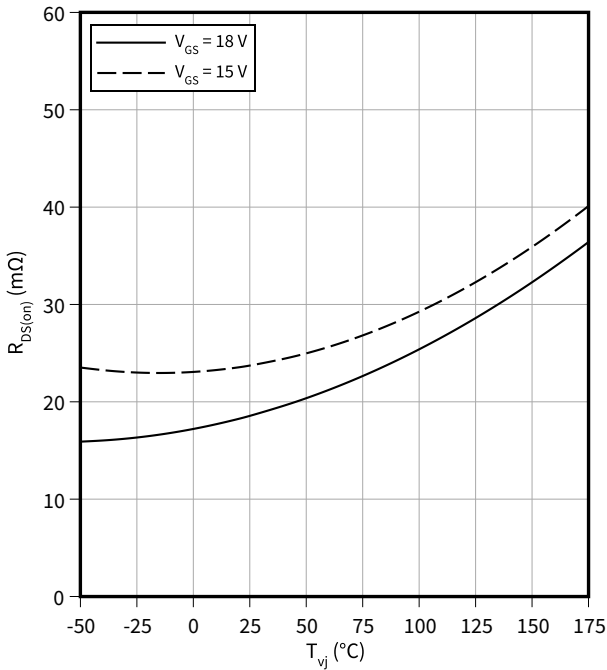
$I_{DS} = f(V_{DS})$
 $T_{vj} = 175^\circ\text{C}, t_p = 20 \mu\text{s}$



4 Characteristics diagrams

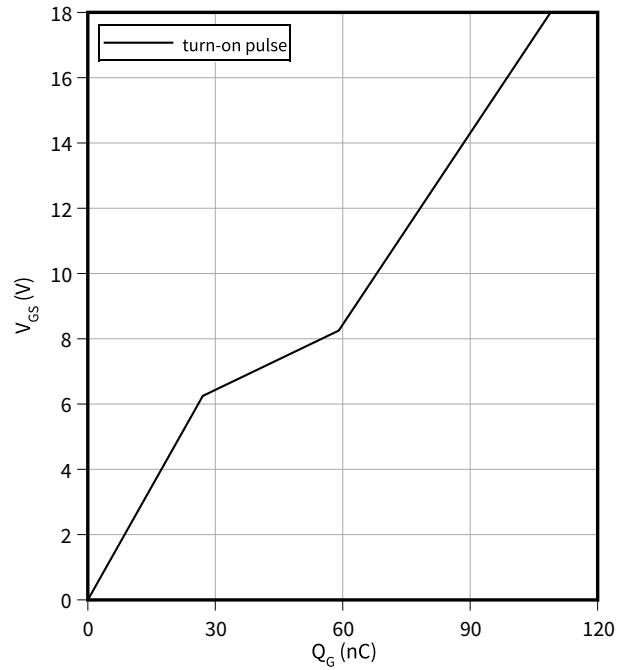
Typical on-state resistance as a function of junction temperature

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



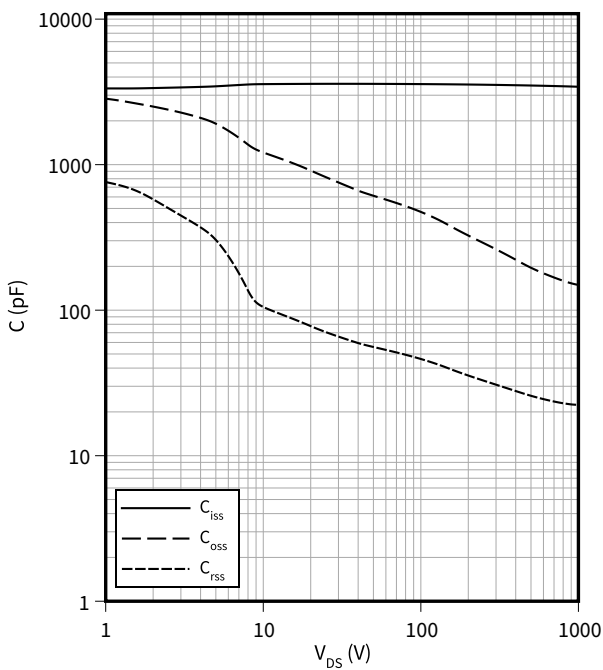
Typical gate charge

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



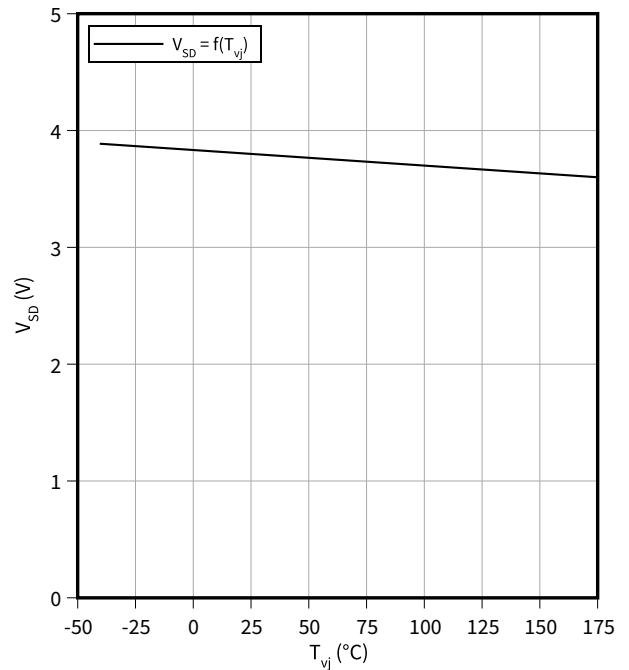
Typical capacitance as a function of drain-source voltage

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



Typical reverse drain voltage as function of junction temperature

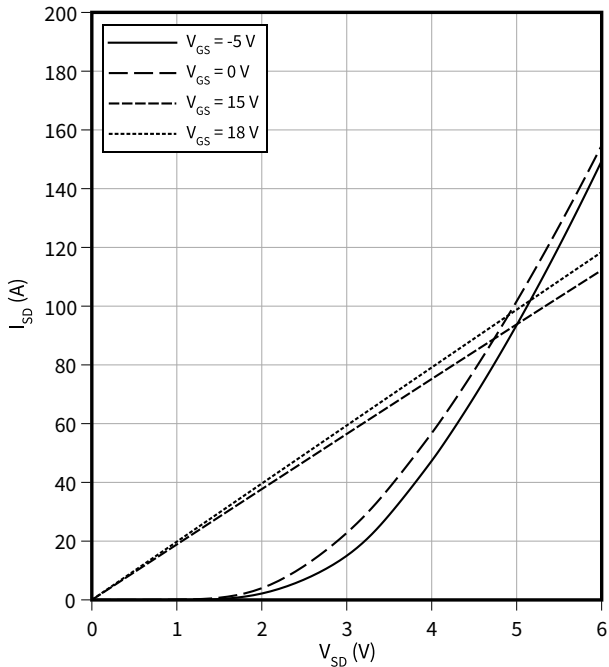
$V_{SD} = f(T_{vj})$
 $I_{SD} = 41\text{ A}, V_{GS} = 0\text{ V}$



4 Characteristics diagrams

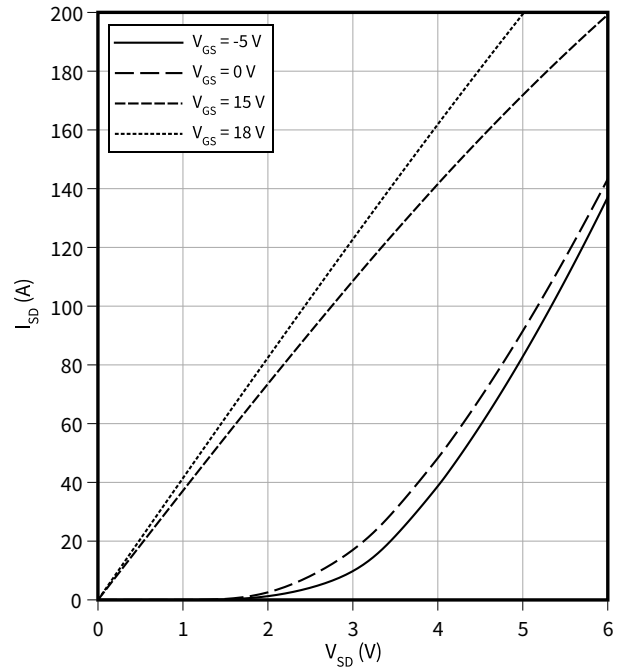
Typical reverse drain current as function of reverse drain voltage, V_{GS} as parameter

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



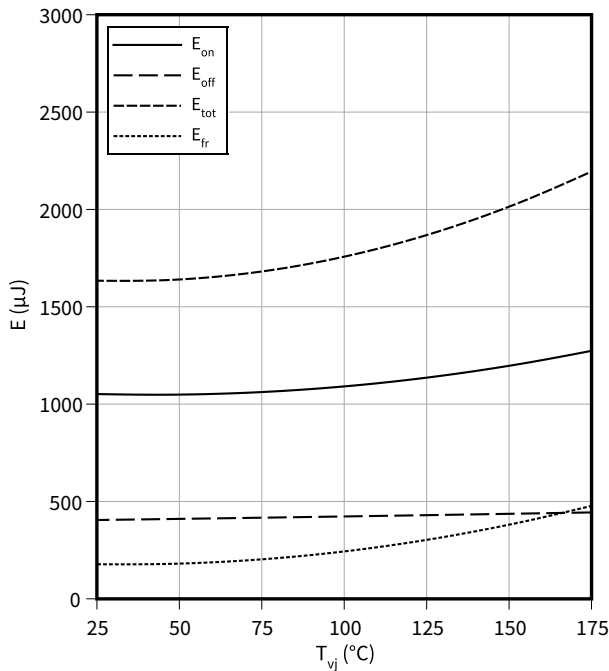
Typical reverse drain current as function of reverse drain voltage, V_{GS} as parameter

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



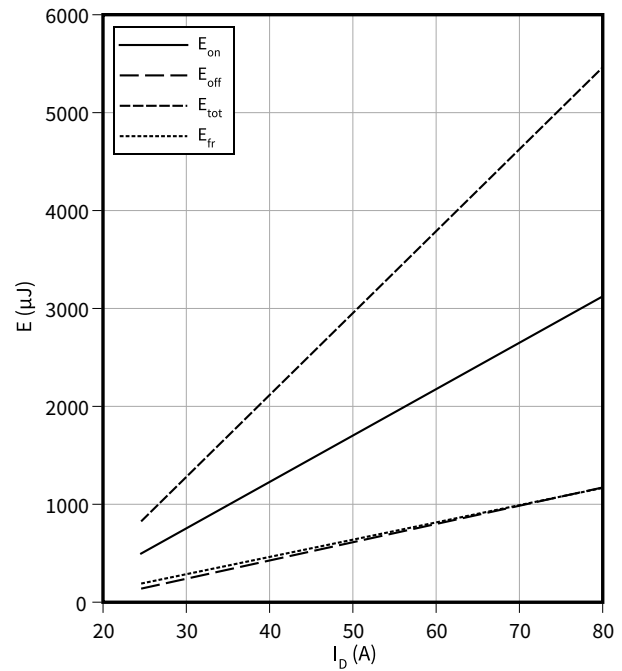
Typical switching energy as a function of junction temperature, test circuit in Fig. F, 2nd device own body diode: $V_{GS} = 0\text{ V}$

$E = f(T_{vj})$
 $V_{GS} = 0/18\text{ V}$, $I_D = 41\text{ A}$, $R_{G,ext} = 2\text{ }\Omega$, $V_{DD} = 800\text{ V}$



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

$E = f(I_D)$
 $V_{GS} = 0/18\text{ V}$, $T_{vj} = 175\text{ °C}$, $R_{G,ext} = 2\text{ }\Omega$, $V_{DD} = 800\text{ V}$

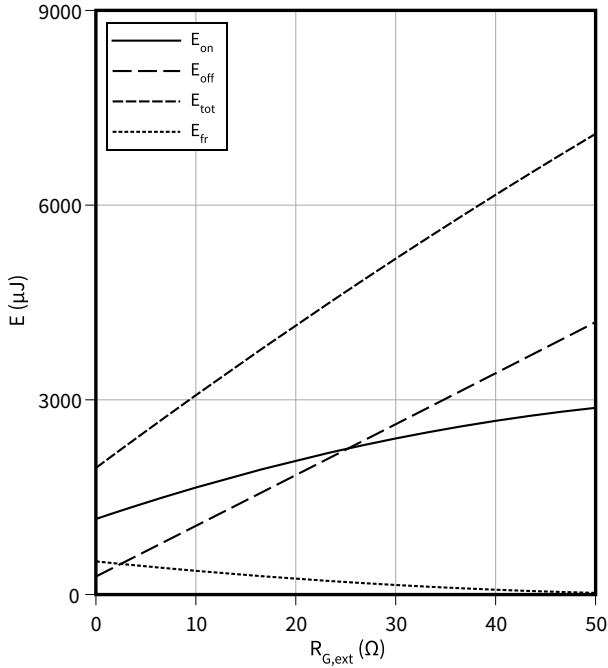


4 Characteristics diagrams

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

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

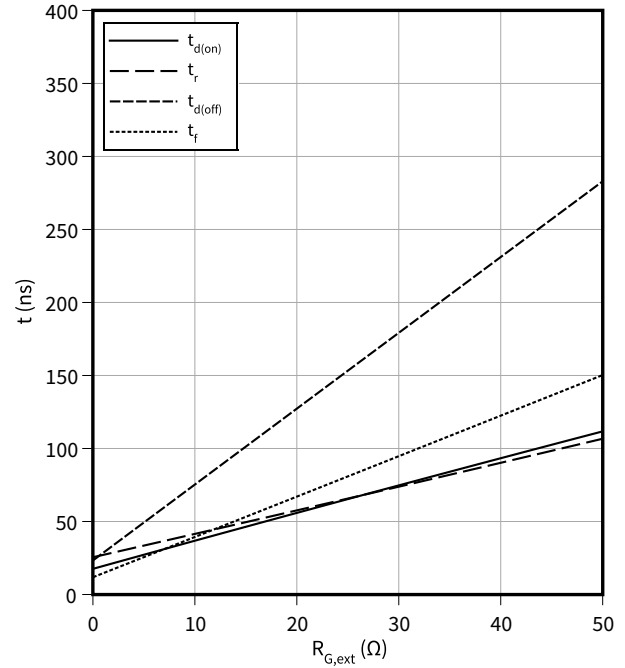
$V_{GS} = 0/18\text{ V}$, $I_D = 41\text{ A}$, $T_{vj} = \text{ }^\circ\text{C}$, $V_{DD} = 800\text{ V}$



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

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

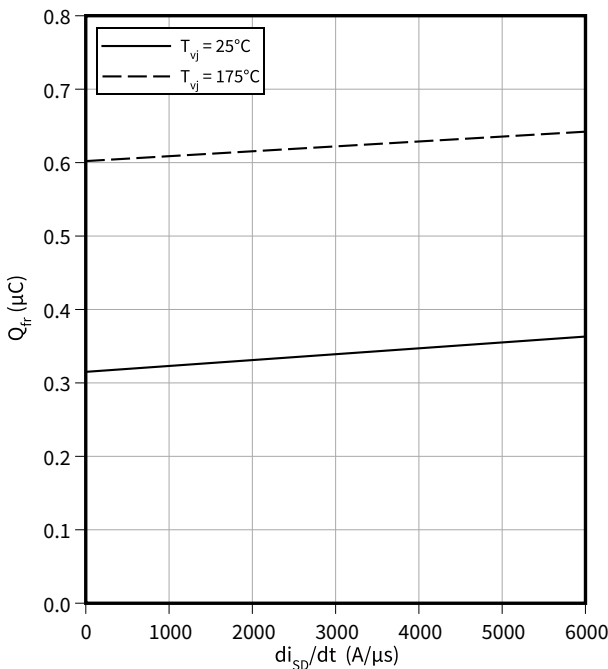
$V_{GS} = 0/18\text{ V}$, $I_D = 41\text{ A}$, $T_{vj} = 175\text{ }^\circ\text{C}$, $V_{DD} = 800\text{ V}$



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

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

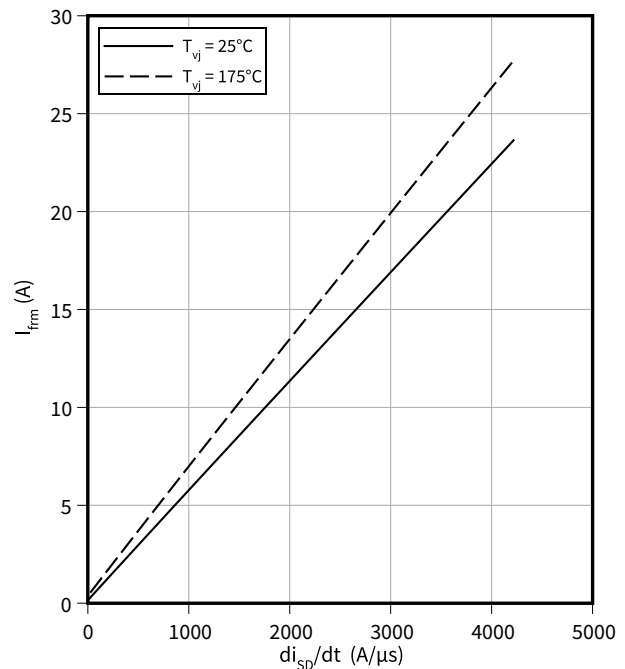
$V_{GS} = 0/18\text{ V}$, $I_{SD} = 41\text{ A}$, $V_{DD} = 800\text{ V}$



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

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

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

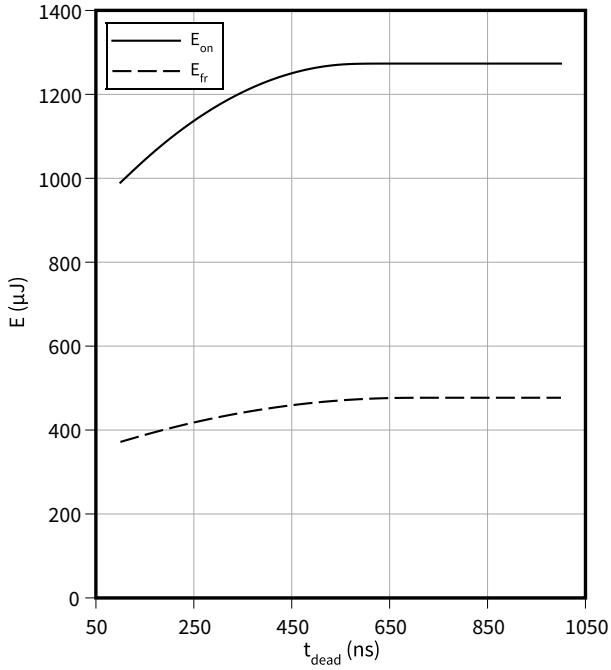


4 Characteristics diagrams

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

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

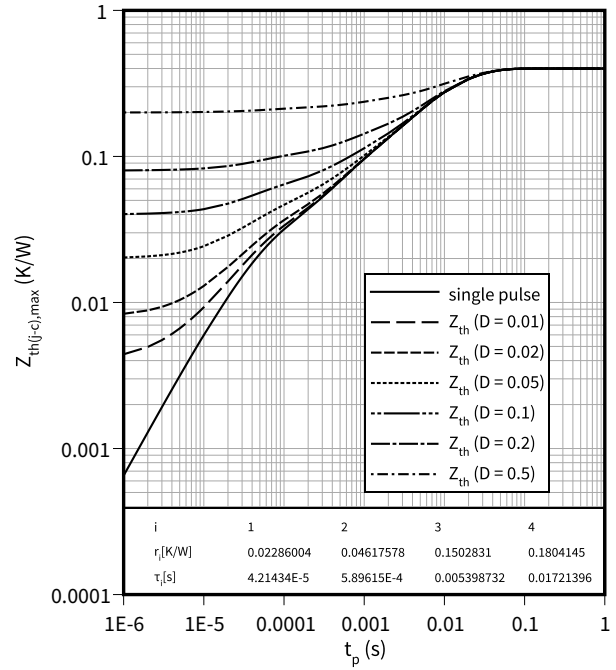
$V_{GS} = -5/18$ V, $I_D = 41$ A, $T_{vj} = 175$ °C, $V_{DD} = 800$ V



Max. transient thermal impedance (MOSFET/diode)

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

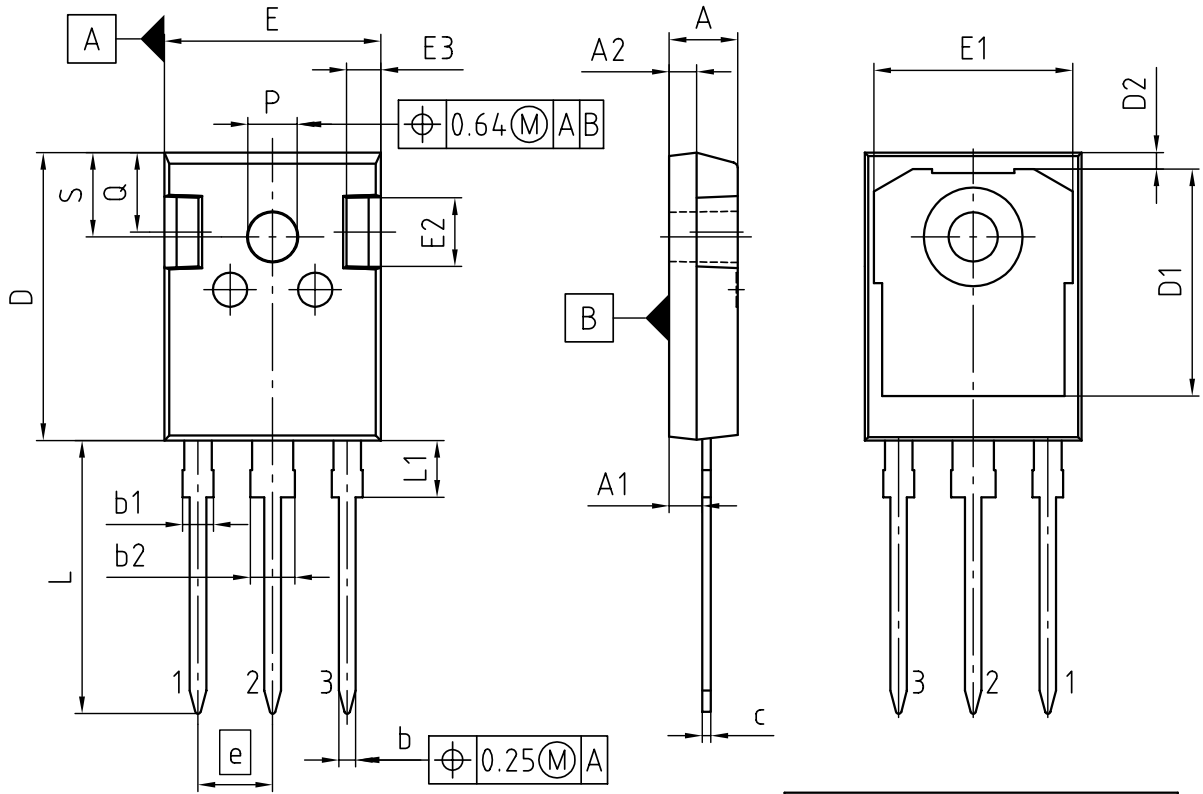
$$D = t_p/T$$



i	1	2	3	4
r_f [K/W]	0.02286004	0.04617578	0.1502831	0.1804145
τ_f [s]	4.21434E-5	5.89615E-4	0.005398732	0.01721396

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

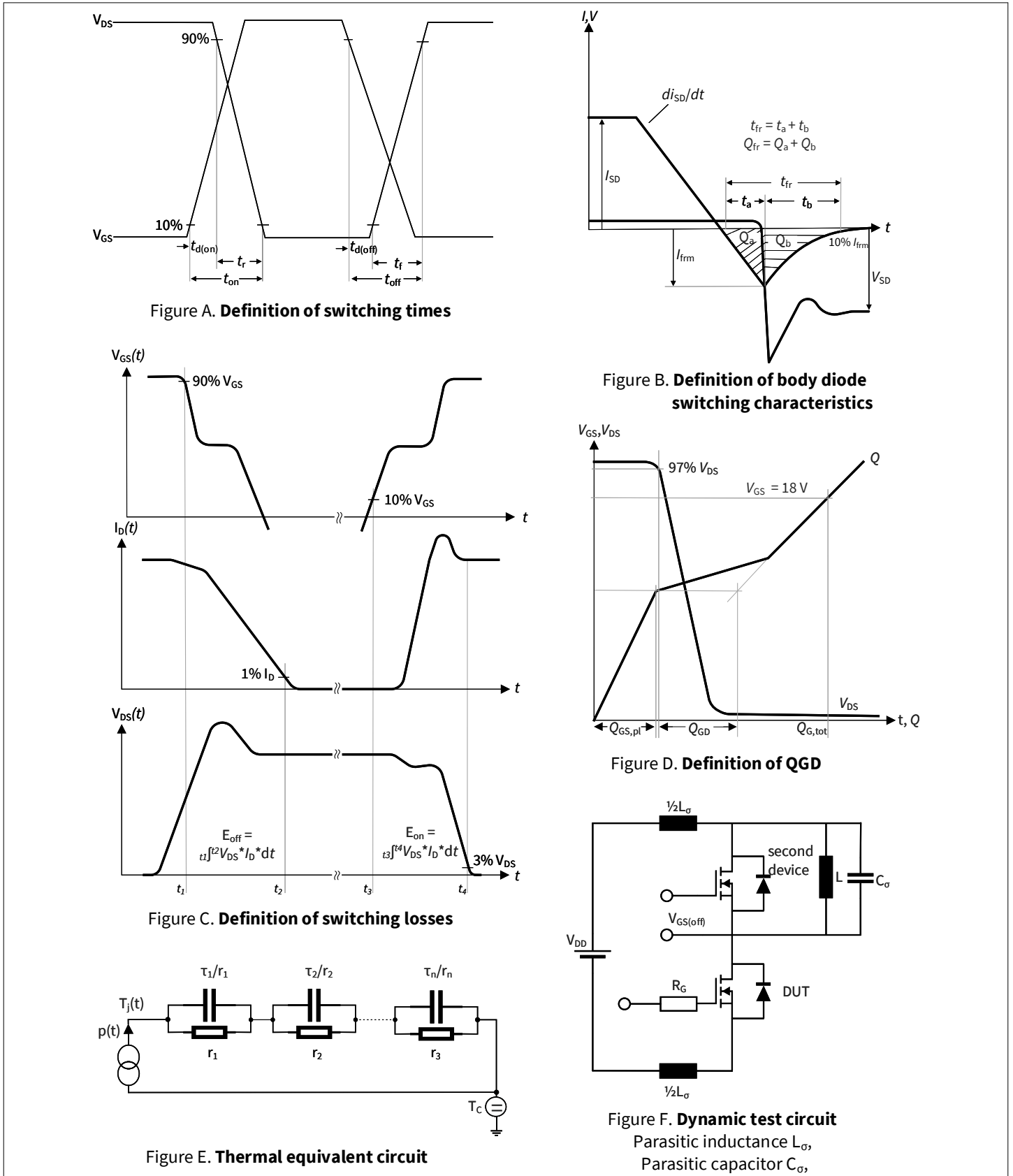


Figure 2

Revision history

Document revision	Date of release	Description of changes
1.00	2022-02-02	Final datasheet
1.10	2022-08-12	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 Correction of diagram "Typical reverse drain current as a function of reverse drain voltage, V_{GS} as parameter", on page 11
1.20	2023-02-20	Correction of I_{DSS} in table 4 on page 4 Editorial changes
1.30	2023-05-08	Correction of gate charge values in Table 4

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