

### Final datasheet

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

#### Features

- $V_{DSS} = 1200\text{ V}$  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 power optimizer

#### Product validation

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

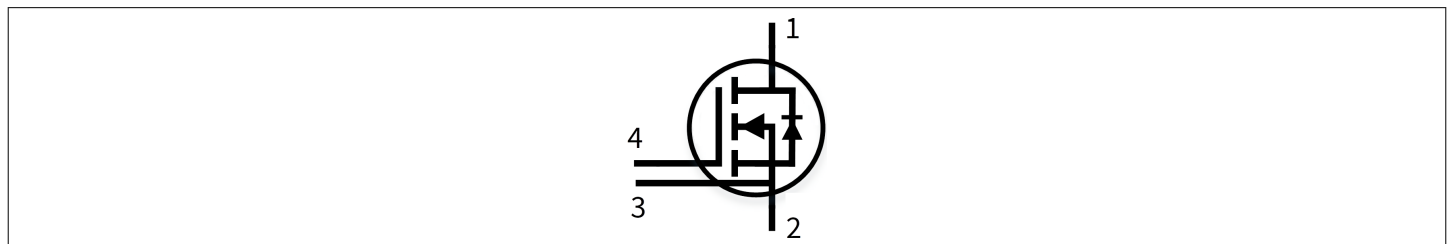


- Halogen-free
- Green
- Lead-free
- RoHS

#### 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
IMZA120R007M1H	PG-TO247-4-U02	12M1H007

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**1 Package**

## 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	0.2	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 <sup>1)</sup>	$V_{GS}$	$t_p \leq 0.5 \text{ }\mu\text{s}$ , $D < 0.01$	-10/23	V	
Gate-source voltage, max. static voltage	$V_{GS}$		-7/20	V	
Avalanche energy, single pulse	$E_{AS}$	$I_D = 35 \text{ A}$ , $V_{DD} = 50 \text{ V}$ , $L = 1 \text{ mH}$	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	
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
			$T_{vj} = 175\text{ °C}$		14.6		
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	$g_{fs}$	$I_D = 108\text{ A}$ , $V_{DS} = 20\text{ V}$		54.3		S	
Internal gate resistance	$R_{G,int}$	$f = 1\text{ MHz}$ , $V_{AC} = 25\text{ mV}$		1.8		Ω	
Input capacitance	$C_{iss}$	$V_{DS} = 800\text{ V}$ , $V_{GS} = 0\text{ V}$ , $f = 100\text{ kHz}$ , $V_{AC} = 25\text{ mV}$		9170		pF	
Output capacitance	$C_{oss}$	$V_{DS} = 800\text{ V}$ , $V_{GS} = 0\text{ V}$ , $f = 100\text{ kHz}$ , $V_{AC} = 25\text{ mV}$		420		pF	
Reverse transfer capacitance	$C_{rss}$	$V_{DS} = 800\text{ V}$ , $V_{GS} = 0\text{ V}$ , $f = 100\text{ kHz}$ , $V_{AC} = 25\text{ mV}$		61		pF	
$C_{oss}$ stored energy	$E_{oss}$	$V_{DS} = 800\text{ V}$ , $V_{GS} = 0\text{ V}$ , $f = 100\text{ kHz}$ , $V_{AC} = 25\text{ mV}$		172		μJ	
Total gate charge	$Q_G$	$V_{DD} = 800\text{ V}$ , $I_D = 108\text{ A}$ , $V_{GS} = -2/18\text{ V}$ , turn-on pulse		289		nC	
Plateau gate charge	$Q_{GS(pl)}$	$V_{DD} = 800\text{ V}$ , $I_D = 108\text{ A}$ , $V_{GS} = -2/18\text{ V}$ , turn-on pulse		71.8		nC	
Gate-to-drain charge	$Q_{GD}$	$V_{DD} = 800\text{ V}$ , $I_D = 108\text{ A}$ , $V_{GS} = -2/18\text{ V}$ , 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 $V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ }^\circ\text{C}$		97	ns
			$T_{vj} = 175\text{ }^\circ\text{C}$		92	
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 $V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ }^\circ\text{C}$		36	ns
			$T_{vj} = 175\text{ }^\circ\text{C}$		41	
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 $V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ }^\circ\text{C}$		116	ns
			$T_{vj} = 175\text{ }^\circ\text{C}$		121	
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 $V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ }^\circ\text{C}$		39	ns
			$T_{vj} = 175\text{ }^\circ\text{C}$		39	
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 $V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ }^\circ\text{C}$		1360	$\mu\text{J}$
			$T_{vj} = 175\text{ }^\circ\text{C}$		2040	
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 $V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ }^\circ\text{C}$		410	$\mu\text{J}$
			$T_{vj} = 175\text{ }^\circ\text{C}$		440	
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 $V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ }^\circ\text{C}$		1926	$\mu\text{J}$
			$T_{vj} = 175\text{ }^\circ\text{C}$		3110	

**(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	$V_{DSS}$	$T_{vj} \geq 25\text{ °C}$	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

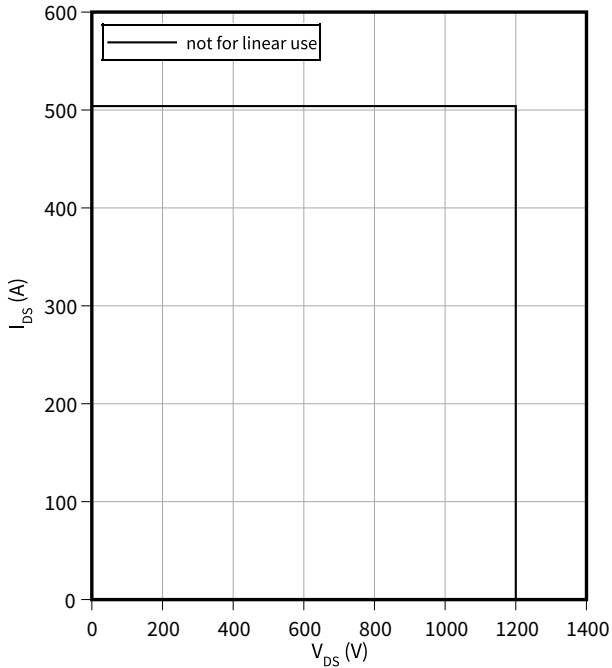
Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Drain-source reverse voltage	$V_{SD}$	$I_{SD} = 108\text{ A}, V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ °C}$	3.8	5	V
			$T_{vj} = 100\text{ °C}$	3.7		
			$T_{vj} = 175\text{ °C}$	3.6		
MOSFET forward recovery charge	$Q_{fr}$	$V_{DD} = 800\text{ V}, I_{SD} = 108\text{ A}, V_{GS} = 0\text{ V}, -di_{SD}/dt = 3000\text{ A}/\mu\text{s}, Q_{fr}$ includes also $Q_C$	$T_{vj} = 25\text{ °C}$	900		nC
			$T_{vj} = 175\text{ °C}$	1650		
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 $Q_C$	$T_{vj} = 25\text{ °C}$	5		A
			$T_{vj} = 175\text{ °C}$	9		
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 $Q_C$	$T_{vj} = 25\text{ °C}$	156		μJ
			$T_{vj} = 175\text{ °C}$	630		
Virtual junction temperature	$T_{vj}$		-55		175	°C

## 4 Characteristics diagrams

### Reverse bias safe operating area (RBSOA)

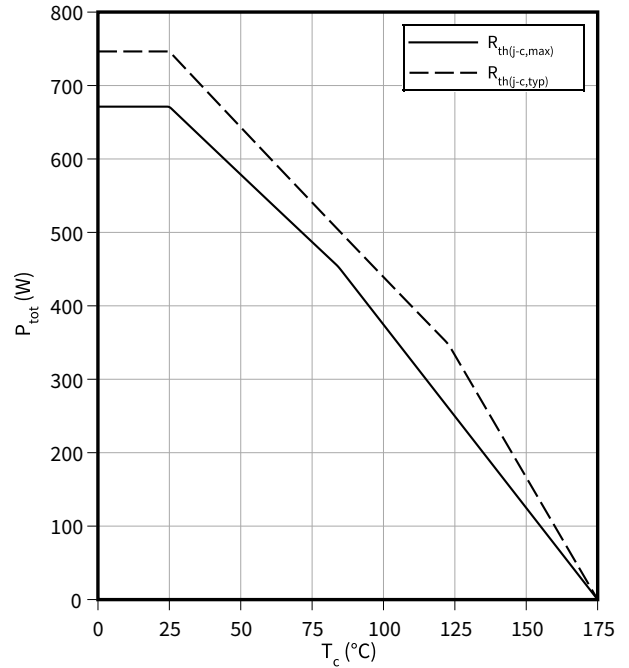
$$I_{DS} = f(V_{DS})$$

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



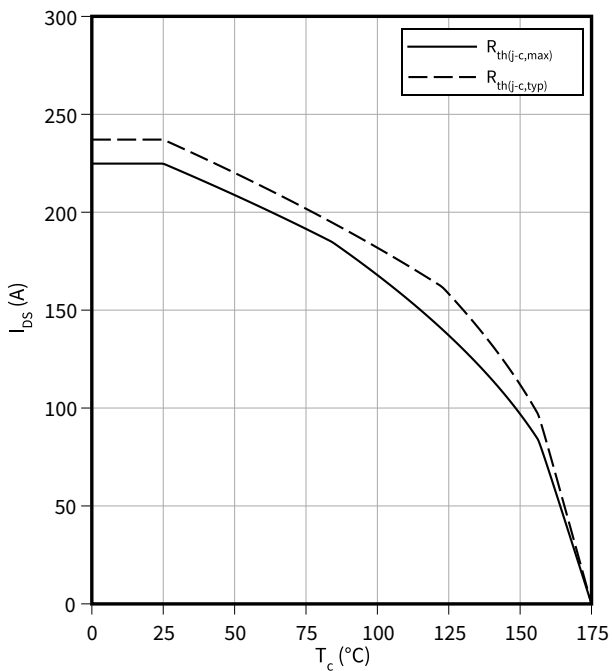
### Power dissipation as a function of case temperature limited by bond wire

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



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

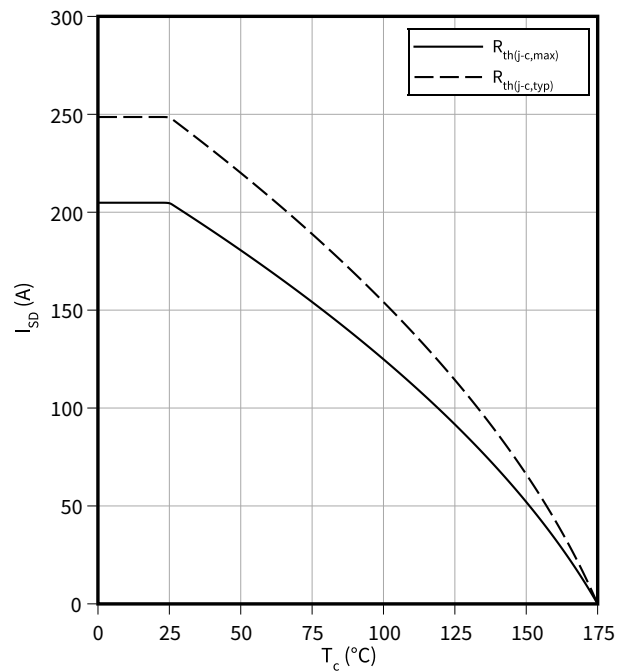
$$I_{DS} = f(T_c)$$



### Maximum source to drain current as a function of case temperature limited by bond wire, Body diode

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

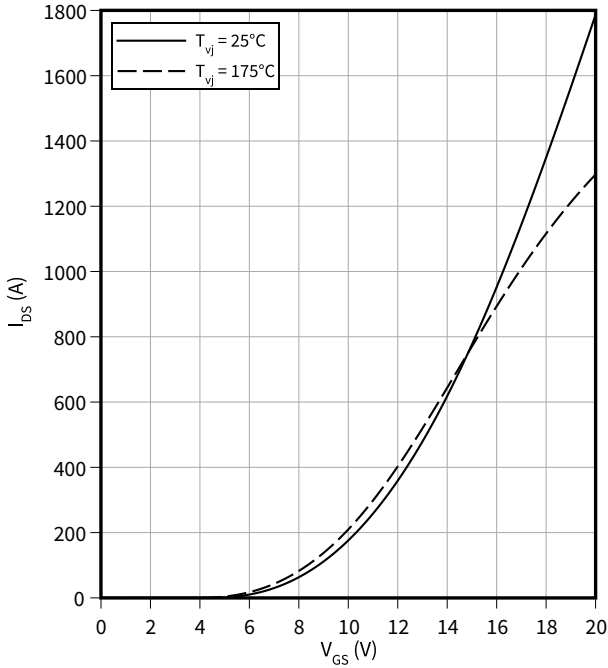
$$V_{GS} = 0\text{ V}$$



4 Characteristics diagrams

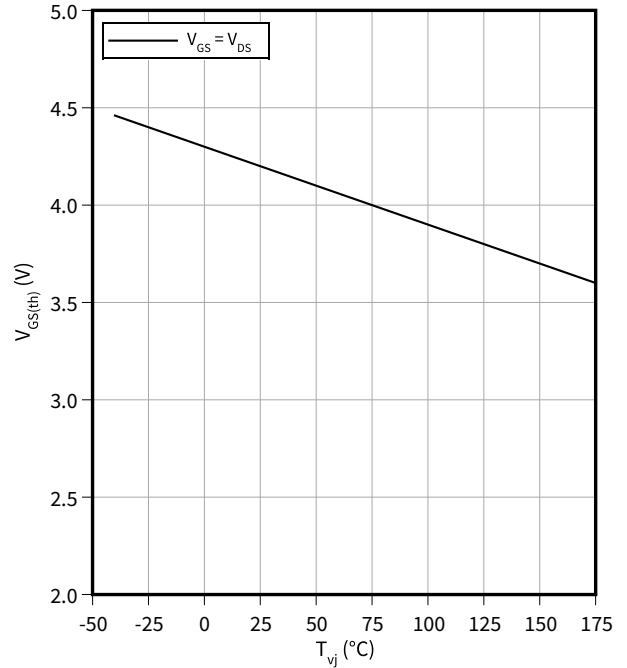
**Typical transfer characteristic**

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



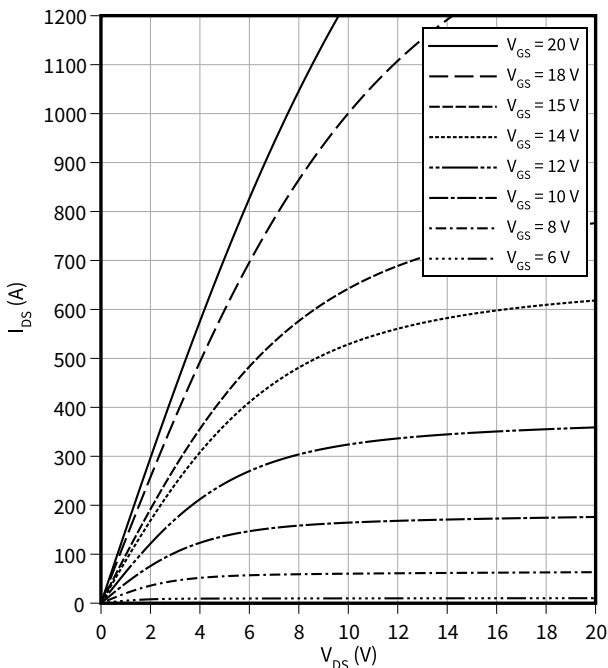
**Typical gate-source threshold voltage as a function of junction temperature**

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



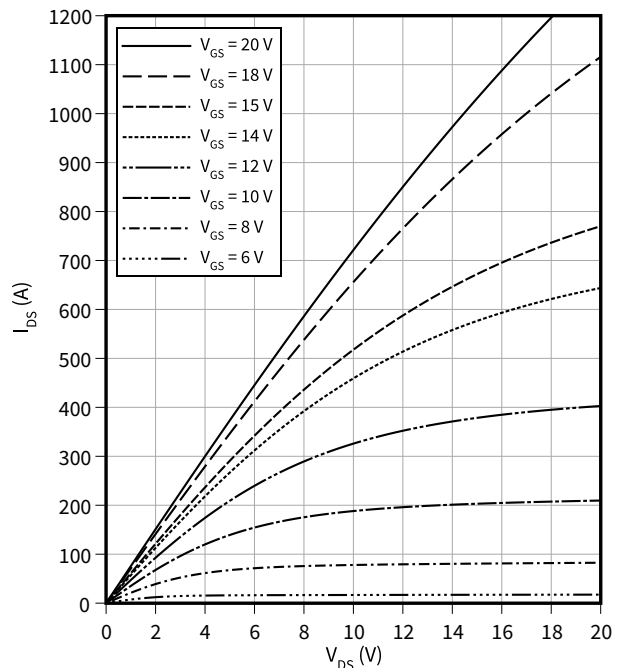
**Typical output characteristic,  $V_{GS}$  as parameter**

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



**Typical output characteristic,  $V_{GS}$  as parameter**

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

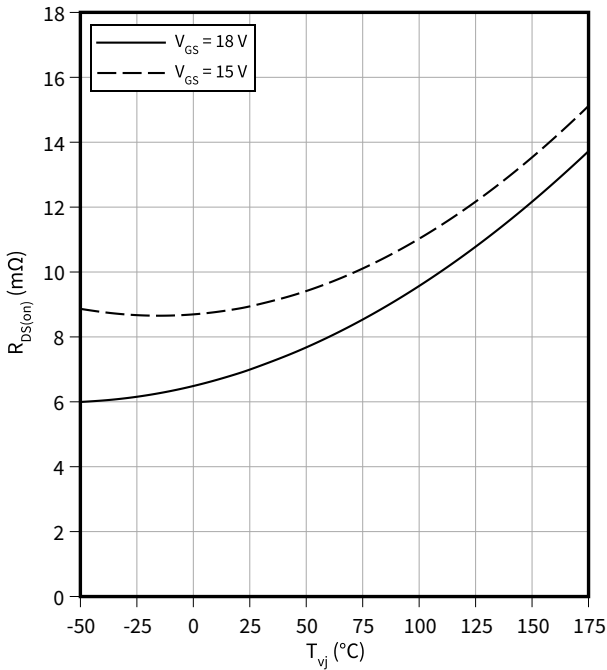




4 Characteristics diagrams

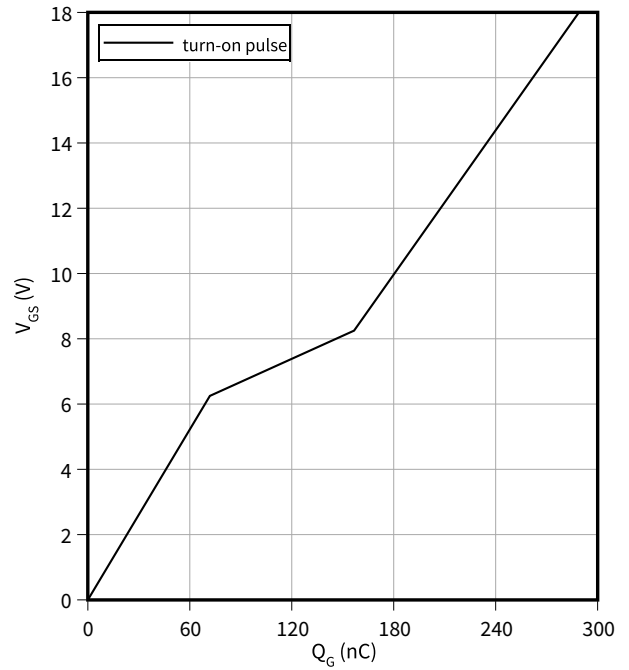
**Typical on-state resistance as a function of junction temperature**

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



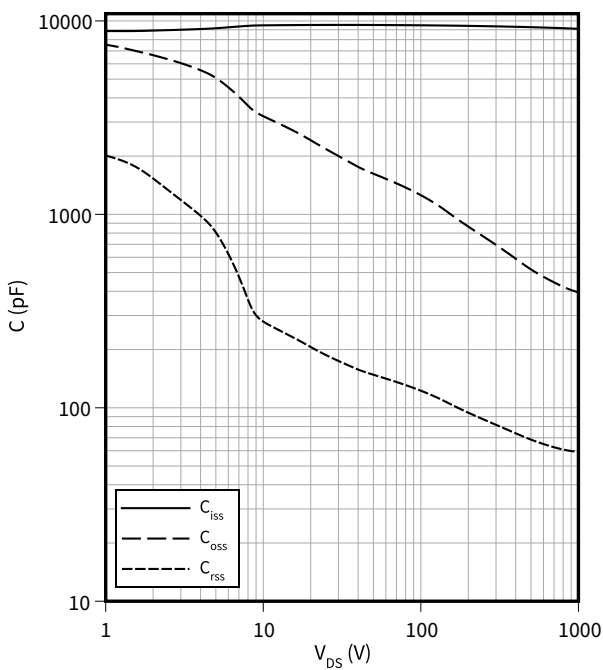
**Typical gate charge**

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



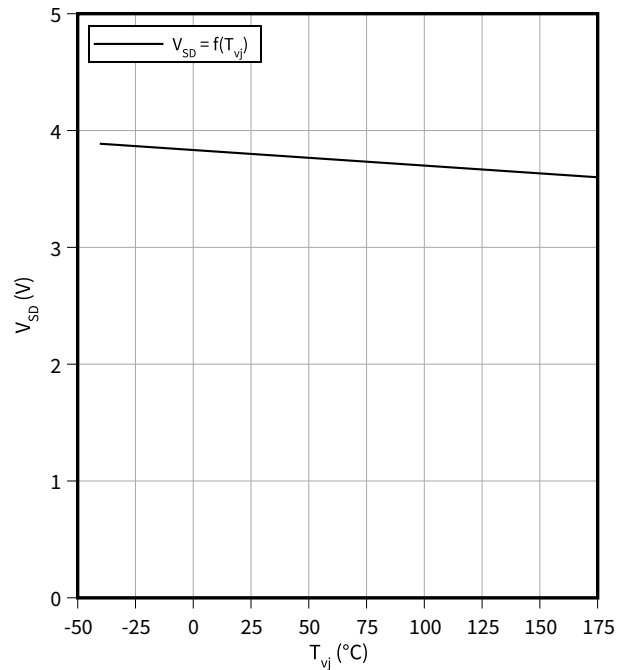
**Typical capacitance as a function of drain-source voltage**

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



**Typical reverse drain voltage as function of junction temperature**

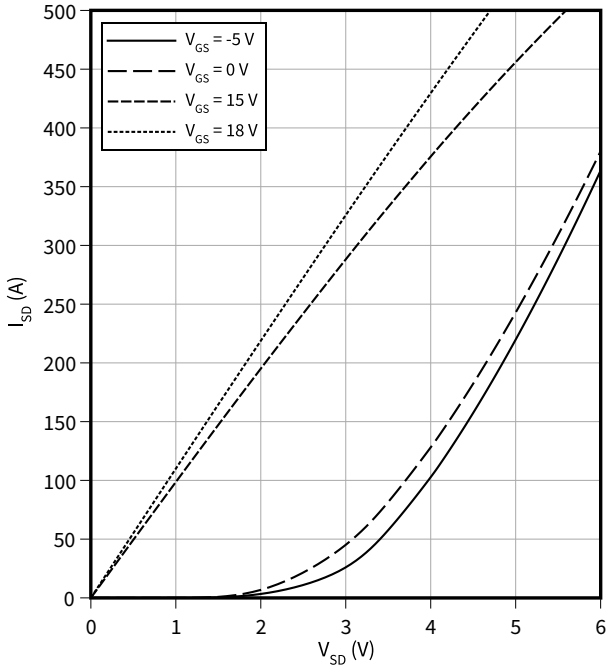
$V_{SD} = f(T_{vj})$   
 $I_{SD} = 108 \text{ A}, V_{GS} = 0 \text{ V}$



4 Characteristics diagrams

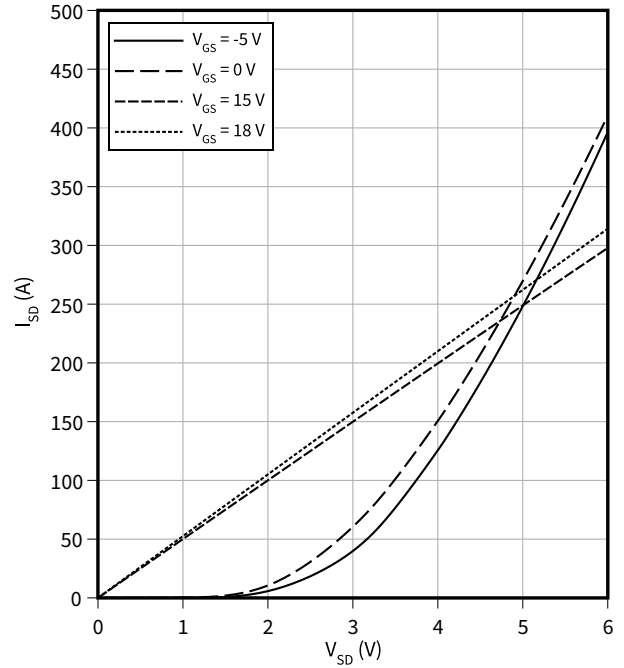
**Typical reverse drain current as function of reverse drain voltage,  $V_{GS}$  as parameter**

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



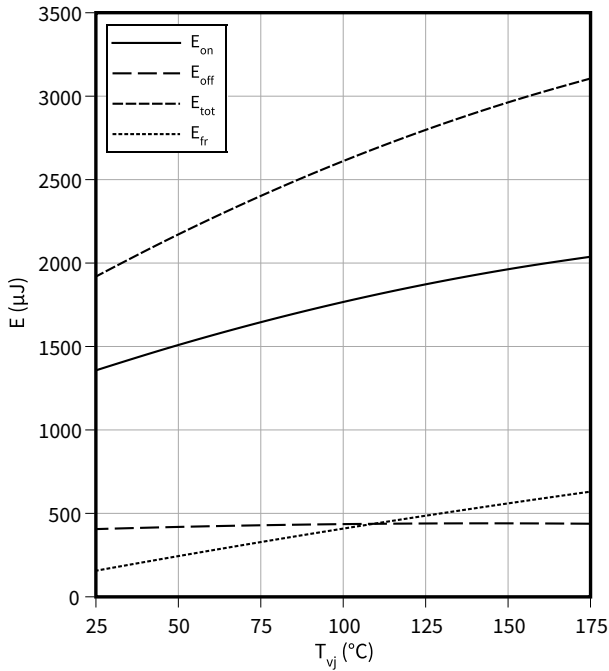
**Typical reverse drain current as function of reverse drain voltage,  $V_{GS}$  as parameter**

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



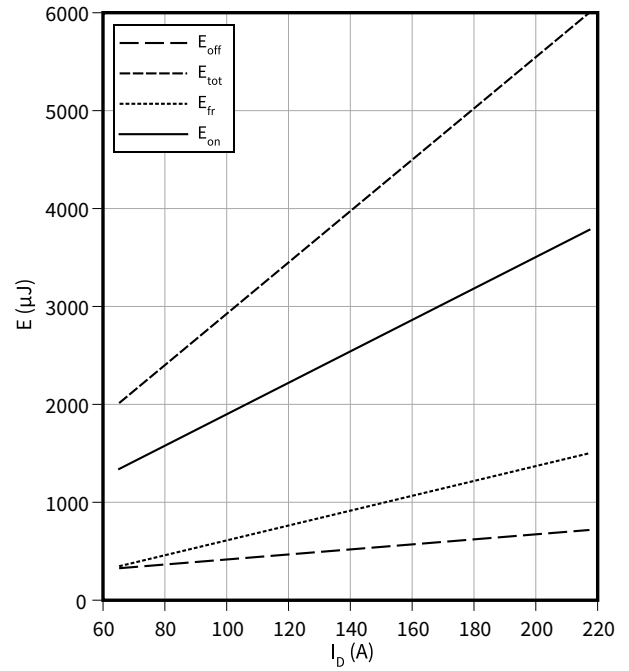
**Typical switching energy as a function of junction temperature, test circuit in Fig. F, 2nd device own body diode:  $V_{GS} = 0\text{ V}$**

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



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

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

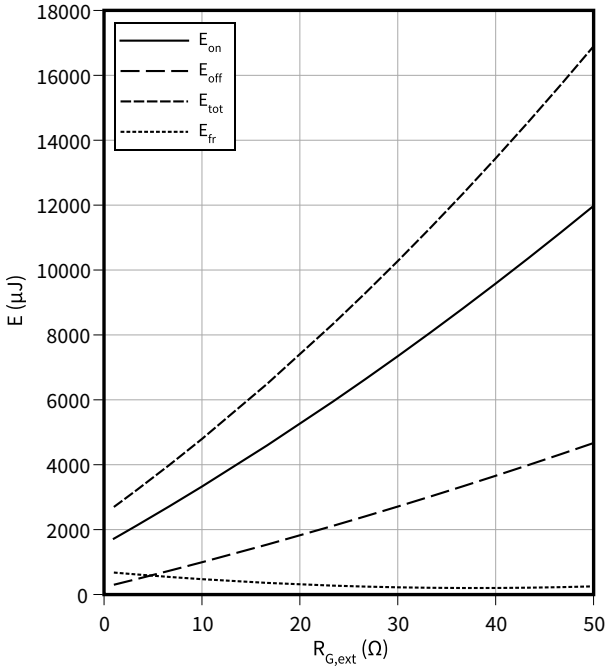


4 Characteristics diagrams

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

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

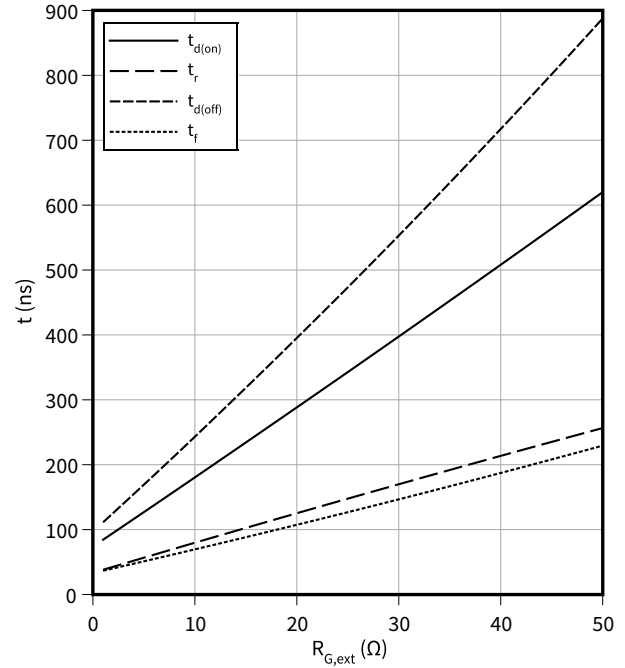
$V_{GS} = 0/18\text{ V}$ ,  $I_D = 108\text{ A}$ ,  $T_{vj} = 175\text{ °C}$ ,  $V_{DD} = 800\text{ V}$



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

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

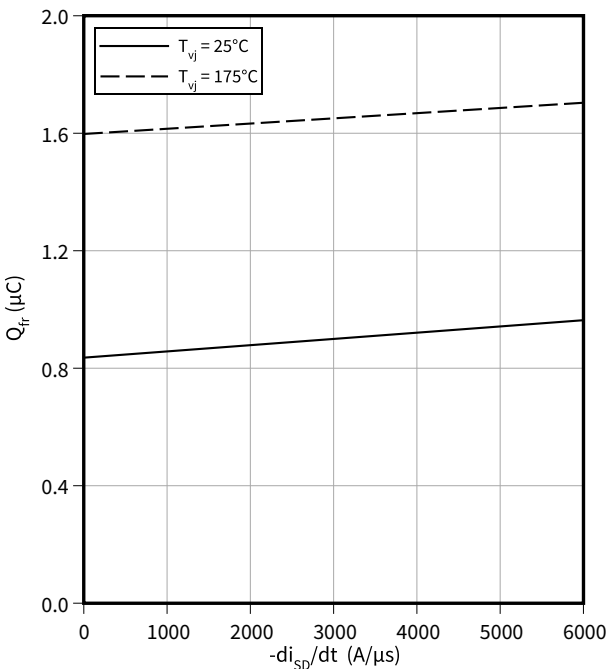
$V_{GS} = 0/18\text{ V}$ ,  $I_D = 108\text{ A}$ ,  $T_{vj} = 175\text{ °C}$ ,  $V_{DD} = 800\text{ V}$



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

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

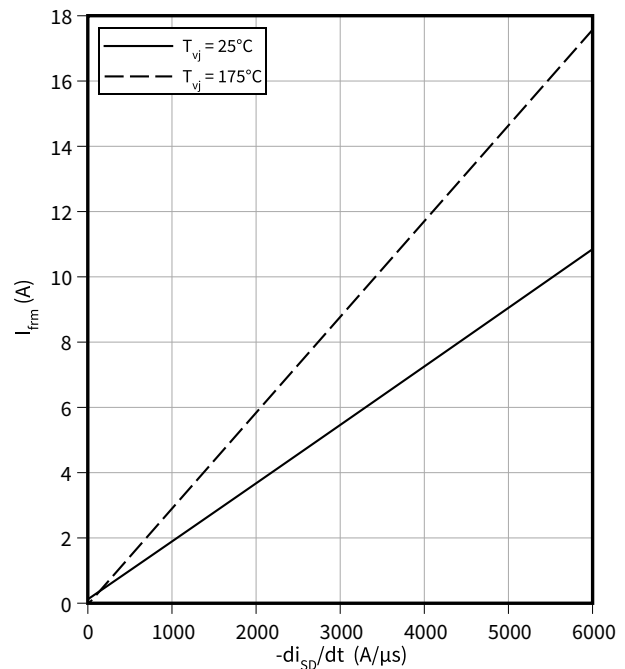
$V_{GS} = 0/18\text{ V}$ ,  $I_{SD} = 108\text{ A}$ ,  $V_{DD} = 800\text{ V}$



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

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

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

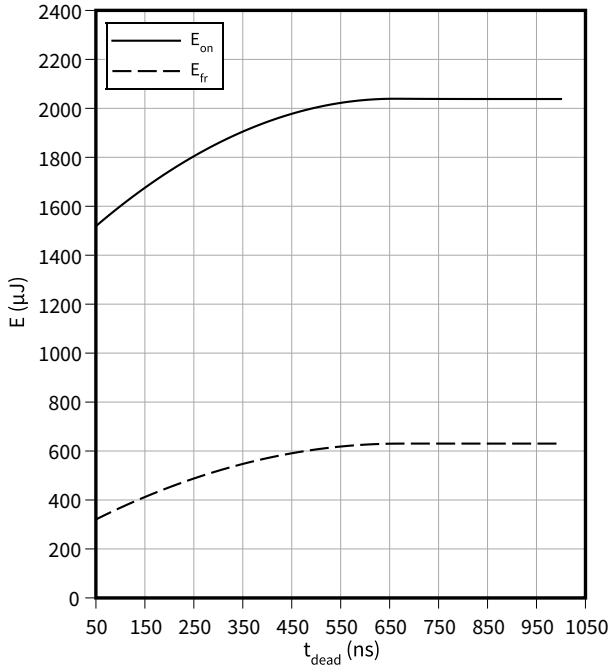


4 Characteristics diagrams

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

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

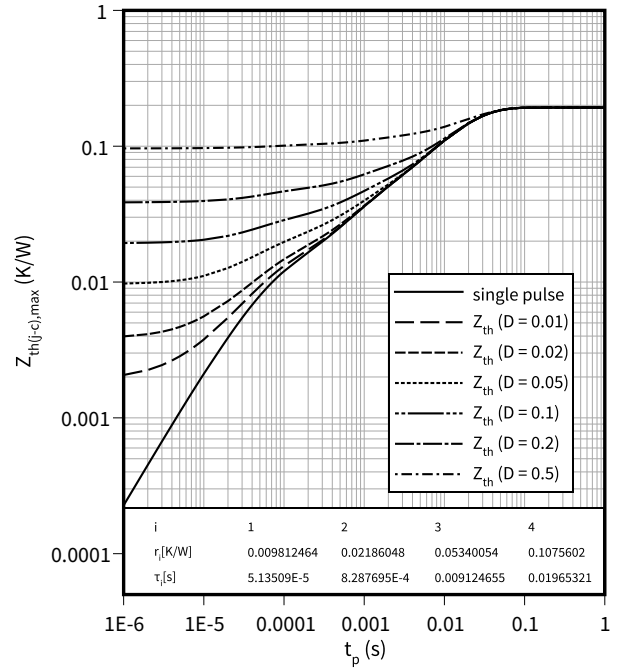
$V_{GS} = -5/18\text{ V}$ ,  $I_D = 108\text{ A}$ ,  $T_{vj} = 175\text{ °C}$ ,  $V_{DD} = 800\text{ V}$



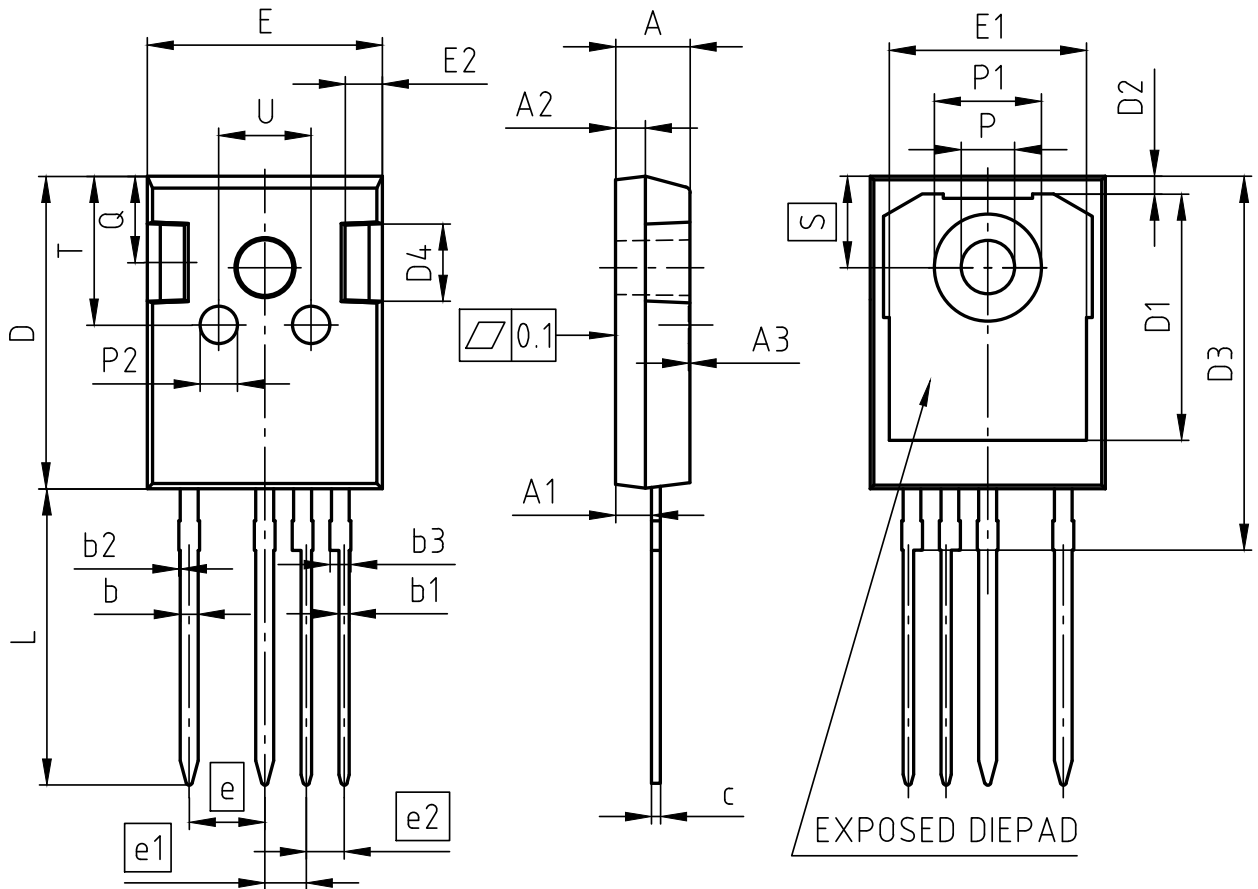
**Max. transient thermal impedance (MOSFET/diode)**

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

$$D = t_p/T$$



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

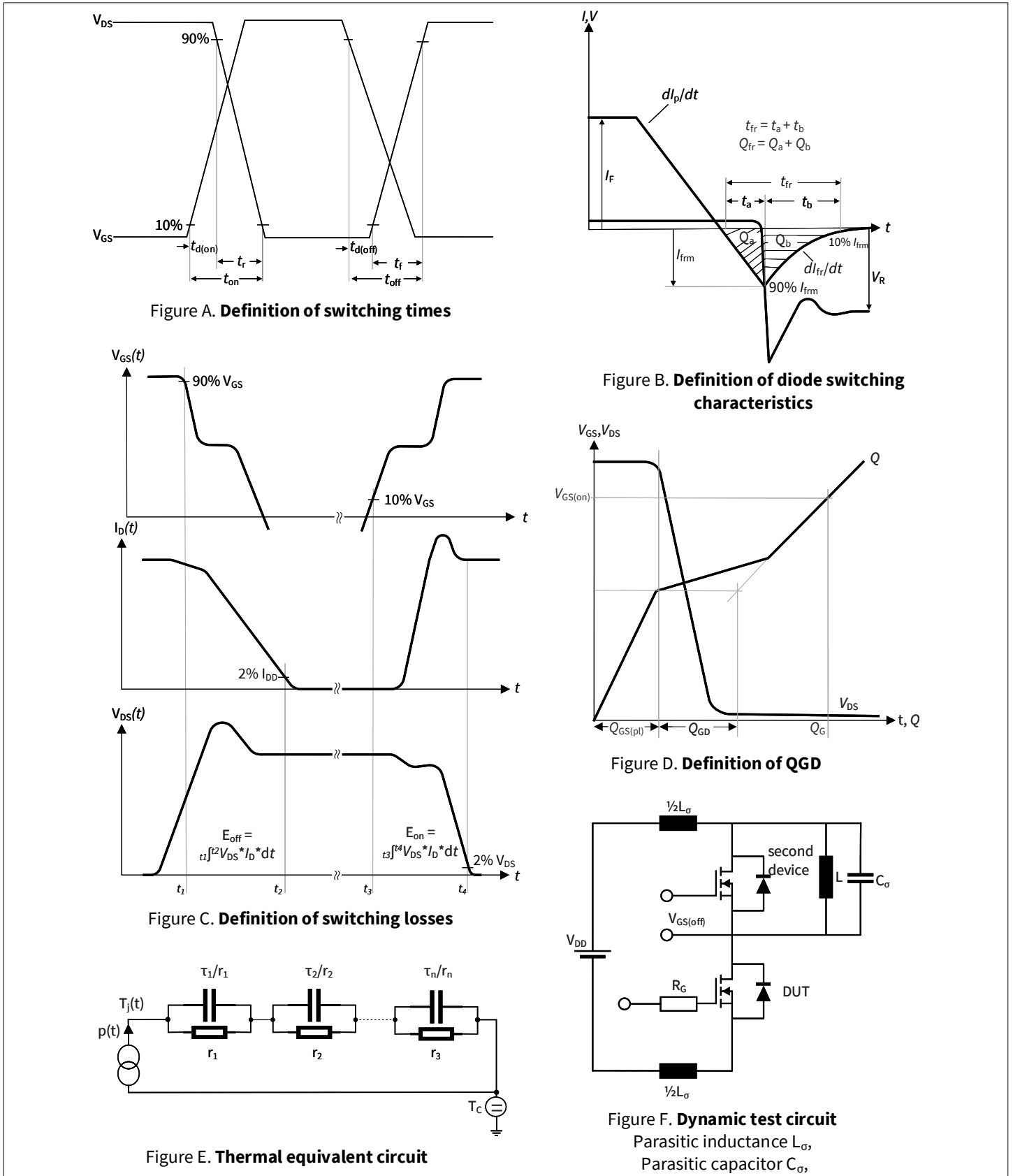


Figure 2

## Revision history

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

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