

### Final datasheet

### CoolSiC™ 1700 V SiC Trench MOSFET : Silicon Carbide MOSFET

#### Features

- $V_{DSS} = 1700\text{ V}$  at  $T_{vj} = 25^\circ\text{C}$
- $I_{DC} = 10\text{ A}$  at  $T_C = 25^\circ\text{C}$
- $R_{DS(on)} = 450\text{ m}\Omega$  at  $V_{GS} = 12\text{ V}$ ,  $T_{vj} = 25^\circ\text{C}$
- Optimized for fly-back topologies
- 12 V / 0 V gate-source voltage compatible with most fly-back controllers
- Very low switching losses
- Benchmark gate threshold voltage,  $V_{GS(th)} = 4.5\text{ V}$
- Fully controllable dv/dt for EMI optimization
- .XT interconnection technology for best-in-class thermal performance

#### Potential applications

- General purpose drives (GPD)
- EV-Charging
- Energy Storage Systems (ESS)
- String inverter
- Uninterruptible power supplies

#### Product validation

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

#### Description

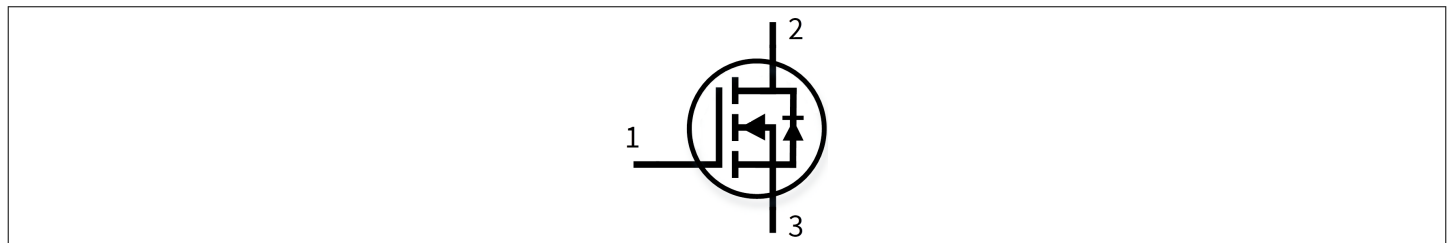
1 – gate

2 – drain

3 – source



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



Type	Package	Marking
IMWH170R450M1	PG-TO247-3-STD-NN4.8	170M1450

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1 Package

## 1 Package

**Table 1** Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Internal source inductance measured 5 mm (0.197 in.) from case	$L_S$			13		nH
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	$R_{th(j-c)}$			1.04	1.35	K/W

## 2 MOSFET

**Table 2** Maximum rated values

Parameter	Symbol	Note or test condition	Values	Unit	
Drain-source voltage	$V_{DSS}$	$T_{vj} \geq 25 \text{ °C}$	1700	V	
Continuous DC drain current for $R_{th(j-c,max)}$ , limited by $T_{vj(max)}$	$I_{DDC}$	$V_{GS} = 12 \text{ V}$	$T_c = 25 \text{ °C}$	10	A
			$T_c = 100 \text{ °C}$	7.1	
Peak drain current, $t_p$ limited by $T_{vj(max)}$	$I_{DM}$	$V_{GS} = 12 \text{ V}$	25.6	A	
Gate-source voltage, max. transient voltage <sup>1)</sup>	$V_{GS}$	$t_p \leq 0.5 \text{ }\mu\text{s}$ , $D < 0.01$	-10/20	V	
Power dissipation, limited by $T_{vj(max)}$	$P_{tot}$		$T_c = 25 \text{ °C}$	111	W
			$T_c = 100 \text{ °C}$	55	

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	$V_{GS(on)}$		12...15	V
Recommended turn-off gate voltage	$V_{GS(off)}$		0	V

**Table 4** Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit	
			Min.	Typ.	Max.		
Drain-source on-state resistance	$R_{DS(on)}$	$I_D = 2\text{ A}$	$T_{vj} = 25\text{ °C}$ , $V_{GS(on)} = 12\text{ V}$		450		mΩ
			$T_{vj} = 100\text{ °C}$ , $V_{GS(on)} = 12\text{ V}$		638		
			$T_{vj} = 175\text{ °C}$ , $V_{GS(on)} = 12\text{ V}$		917		
			$T_{vj} = 25\text{ °C}$ , $V_{GS(on)} = 15\text{ V}$		364	390	
Gate-source threshold voltage	$V_{GS(th)}$	$I_D = 2.6\text{ mA}$ , $V_{DS} = V_{GS}$ (tested after 1 ms pulse at $V_{GS} = 20\text{ V}$ )	$T_{vj} = 25\text{ °C}$	3.5	4.5	5.7	V
			$T_{vj} = 175\text{ °C}$		3.6		
Zero gate-voltage drain current	$I_{DSS}$	$V_{DS} = 1700\text{ V}$ , $V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ °C}$		0.9	11	μA
			$T_{vj} = 175\text{ °C}$		10		
Gate leakage current	$I_{GSS}$	$V_{DS} = 0\text{ V}$	$V_{GS} = 20\text{ V}$			100	nA
			$V_{GS} = -10\text{ V}$			-100	
Forward transconductance	$g_{fs}$	$I_D = 2\text{ A}$ , $V_{DS} = 20\text{ V}$		0.9			S
Internal gate resistance	$R_{G,int}$	$f = 1\text{ MHz}$ , $V_{AC} = 25\text{ mV}$		20			Ω
Input capacitance	$C_{iss}$	$V_{DD} = 1000\text{ V}$ , $V_{GS} = 0\text{ V}$ , $f = 100\text{ kHz}$ , $V_{AC} = 25\text{ mV}$		506			pF
Output capacitance	$C_{oss}$	$V_{DD} = 1000\text{ V}$ , $V_{GS} = 0\text{ V}$ , $f = 100\text{ kHz}$ , $V_{AC} = 25\text{ mV}$		19.4			pF
Reverse transfer capacitance	$C_{rss}$	$V_{DD} = 1000\text{ V}$ , $V_{GS} = 0\text{ V}$ , $f = 100\text{ kHz}$ , $V_{AC} = 25\text{ mV}$		1.2			pF
$C_{oss}$ stored energy	$E_{oss}$	$V_{DD} = 1000\text{ V}$ , $V_{GS} = 0\text{ V}$ , $f = 100\text{ kHz}$ , $V_{AC} = 25\text{ mV}$		3.5			μJ
Total gate charge	$Q_G$	$V_{DD} = 1000\text{ V}$ , $I_D = 2\text{ A}$ , $V_{GS} = 0/12\text{ V}$ , turn-on pulse		11.7			nC
Plateau gate charge	$Q_{GS(pl)}$	$V_{DD} = 1000\text{ V}$ , $I_D = 2\text{ A}$ , $V_{GS} = 0/12\text{ V}$ , turn-on pulse		4			nC
Gate-to-drain charge	$Q_{GD}$	$V_{DD} = 1000\text{ V}$ , $I_D = 2\text{ A}$ , $V_{GS} = 0/12\text{ V}$ , turn-on pulse		2.9			nC
Turn-on delay time	$t_{d(on)}$	$V_{DD} = 1000\text{ V}$ , $I_D = 2\text{ A}$ , $V_{GS} = 0/12\text{ V}$ , $R_{G,ext} = 6.9\text{ Ω}$ , $L_G = 40\text{ nH}$ , diode: body diode at $V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ °C}$		21		ns
			$T_{vj} = 175\text{ °C}$		18		

(table continues...)

**Table 4 (continued) Characteristic values**

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Rise time	$t_r$	$V_{DD} = 1000\text{ V}$ , $I_D = 2\text{ A}$ , $V_{GS} = 0/12\text{ V}$ , $R_{G,ext} = 6.9\ \Omega$ , $L_\sigma = 40\text{ nH}$ , diode: body diode at $V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ }^\circ\text{C}$		12	ns
			$T_{vj} = 175\text{ }^\circ\text{C}$		10	
Turn-off delay time	$t_{d(off)}$	$V_{DD} = 1000\text{ V}$ , $I_D = 2\text{ A}$ , $V_{GS} = 0/12\text{ V}$ , $R_{G,ext} = 6.9\ \Omega$ , $L_\sigma = 40\text{ nH}$ , diode: body diode at $V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ }^\circ\text{C}$		26	ns
			$T_{vj} = 175\text{ }^\circ\text{C}$		29	
Fall time	$t_f$	$V_{DD} = 1000\text{ V}$ , $I_D = 2\text{ A}$ , $V_{GS} = 0/12\text{ V}$ , $R_{G,ext} = 6.9\ \Omega$ , $L_\sigma = 40\text{ nH}$ , diode: body diode at $V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ }^\circ\text{C}$		23	ns
			$T_{vj} = 175\text{ }^\circ\text{C}$		23	
Turn-on energy	$E_{on}$	$V_{DD} = 1000\text{ V}$ , $I_D = 2\text{ A}$ , $V_{GS} = 0/12\text{ V}$ , $R_{G,ext} = 6.9\ \Omega$ , $L_\sigma = 40\text{ nH}$ , diode: body diode at $V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ }^\circ\text{C}$		114	$\mu\text{J}$
			$T_{vj} = 175\text{ }^\circ\text{C}$		118	
Turn-off energy	$E_{off}$	$V_{DD} = 1000\text{ V}$ , $I_D = 2\text{ A}$ , $V_{GS} = 0/12\text{ V}$ , $R_{G,ext} = 6.9\ \Omega$ , $L_\sigma = 40\text{ nH}$ , diode: body diode at $V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ }^\circ\text{C}$		26	$\mu\text{J}$
			$T_{vj} = 175\text{ }^\circ\text{C}$		29	
Total switching energy	$E_{tot}$	$V_{DD} = 1000\text{ V}$ , $I_D = 2\text{ A}$ , $V_{GS} = 0/12\text{ V}$ , $R_{G,ext} = 6.9\ \Omega$ , $L_\sigma = 40\text{ nH}$ , diode: body diode at $V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ }^\circ\text{C}$		140	$\mu\text{J}$
			$T_{vj} = 175\text{ }^\circ\text{C}$		147	
Virtual junction temperature	$T_{vj}$			-55	175	$^\circ\text{C}$

**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/ $\mu\text{s}$ . The measured  $dV/dt$  was limited by measurement test setup and package.

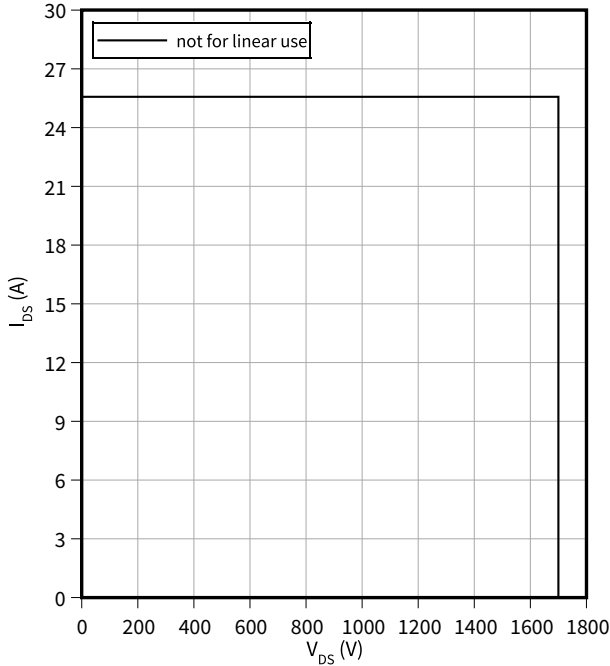
Dynamic test circuit see Fig. F.

### 3 Characteristics diagrams

**Reverse bias safe operating area (RBSOA)**

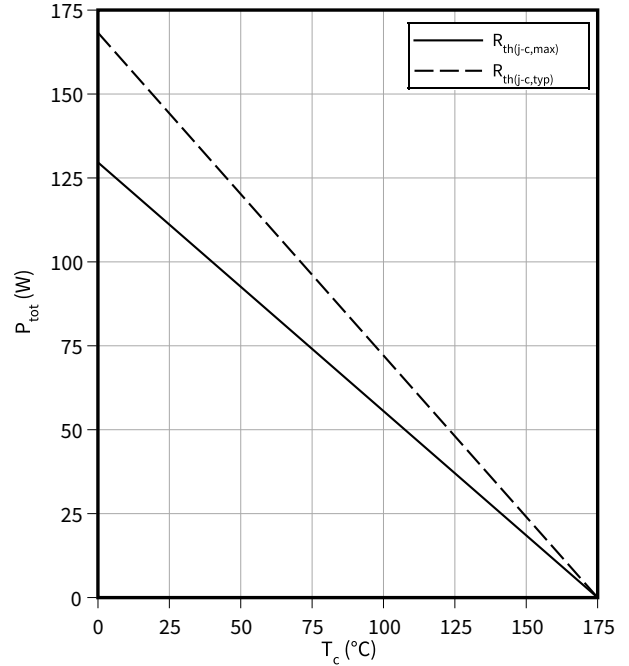
$$I_{DS} = f(V_{DS})$$

$$T_{vj} \leq 175\text{ °C}, V_{GS} = 0/12\text{ V}, T_c = 25\text{ °C}$$



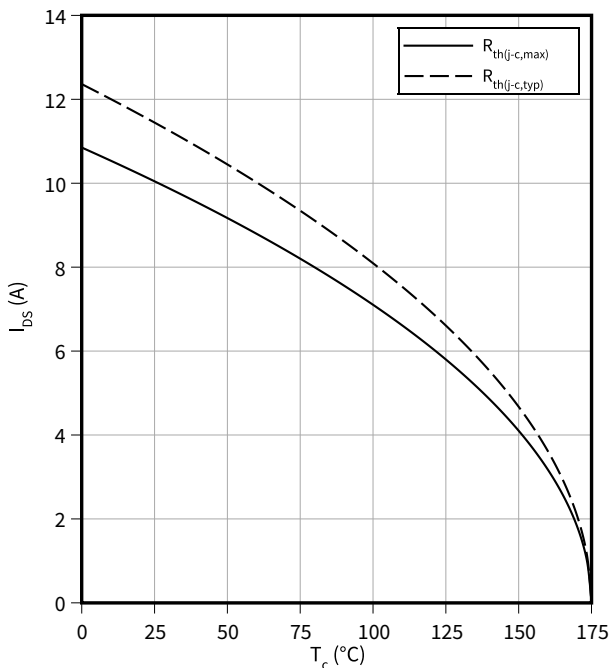
**Power dissipation as a function of case temperature limited by bond wire**

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



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

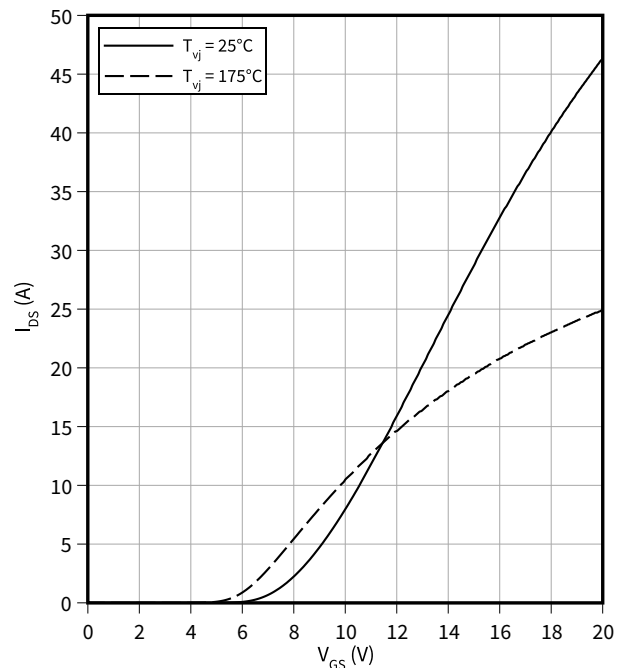
$$I_{DS} = f(T_c)$$



**Typical transfer characteristic**

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

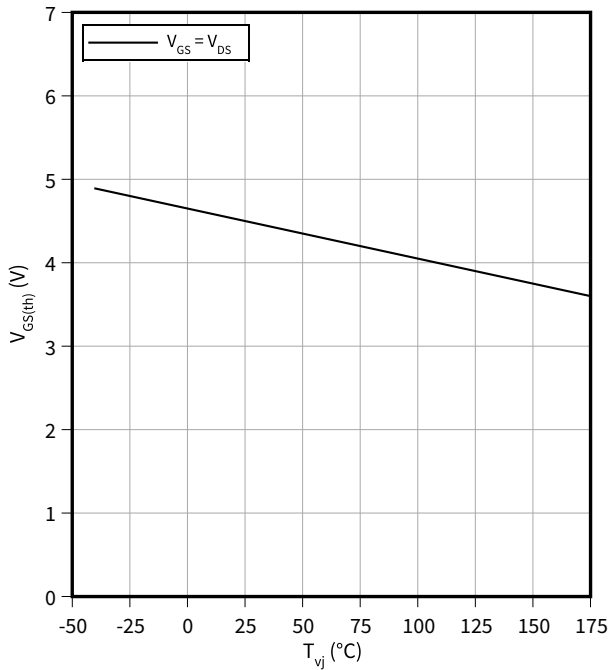
$$V_{DS} = 20\text{ V}, t_p = 20\text{ }\mu\text{s}$$



3 Characteristics diagrams

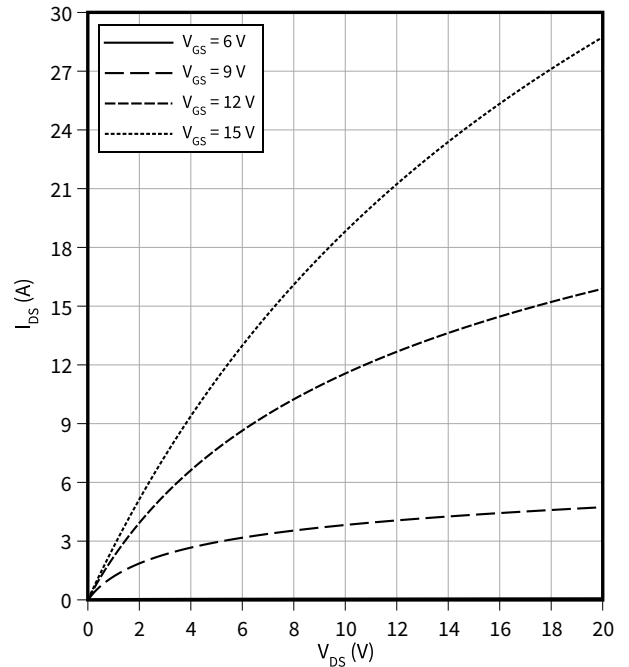
**Typical gate-source threshold voltage as a function of junction temperature**

$V_{GS(th)} = f(T_{vj})$   
 $I_D = 2.6 \text{ mA}$



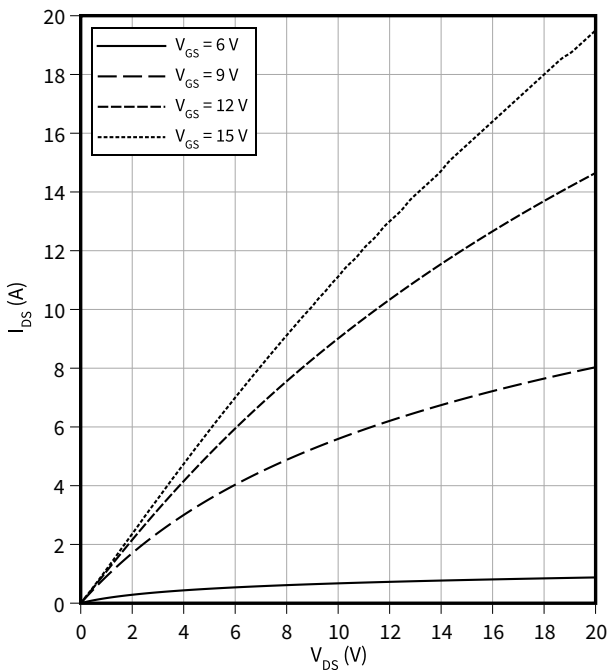
**Typical output characteristic,  $V_{GS}$  as parameter**

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



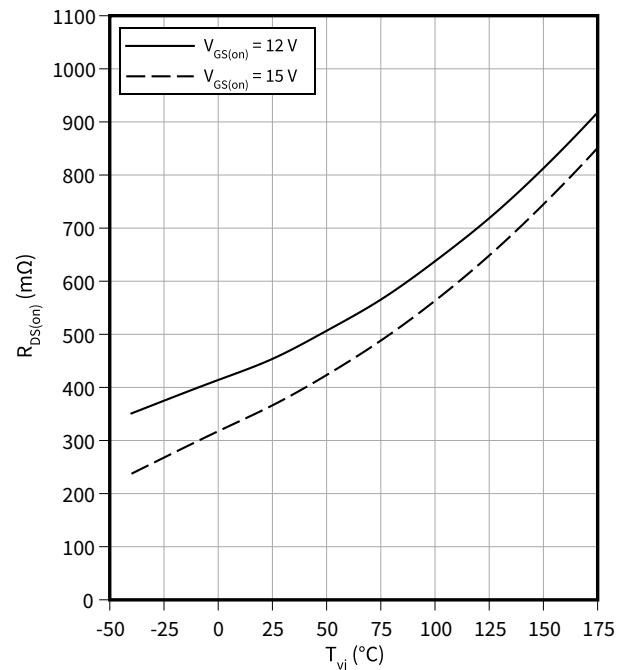
**Typical output characteristic,  $V_{GS}$  as parameter**

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



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

$R_{DS(on)} = f(T_{vj})$   
 $I_D = 2 \text{ A}$

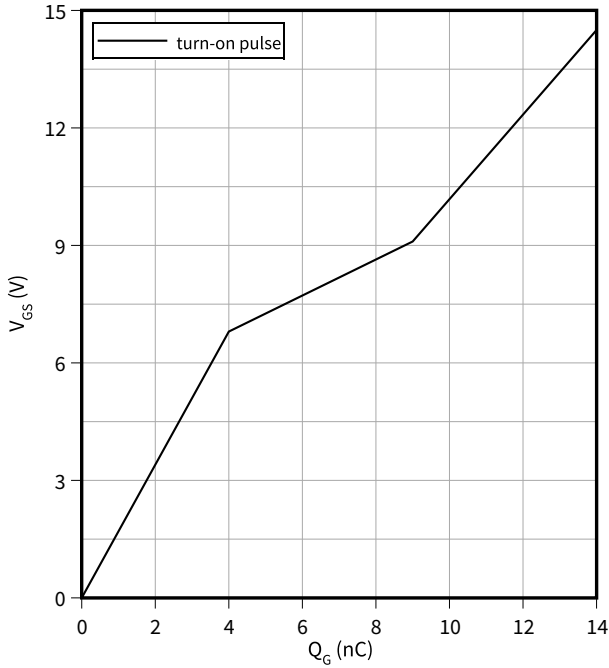


3 Characteristics diagrams

**Typical gate charge**

$V_{GS} = f(Q_G)$

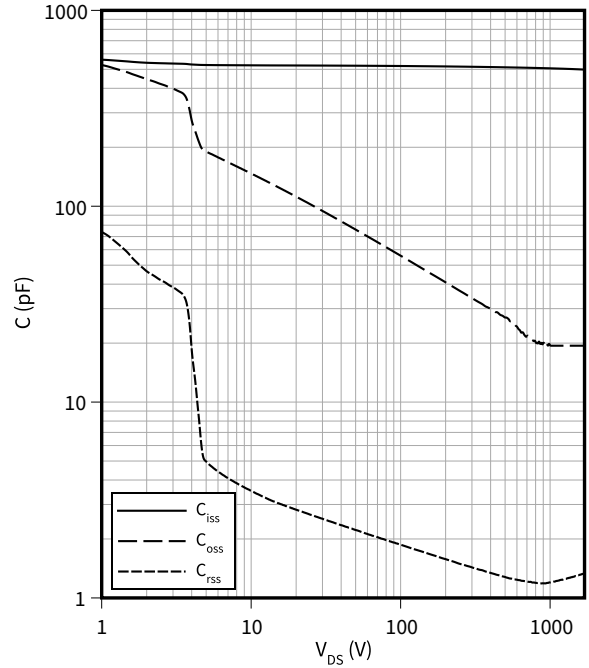
$I_D = 2 \text{ A}, V_{DS} = 1000 \text{ V}$



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

$C = f(V_{DS})$

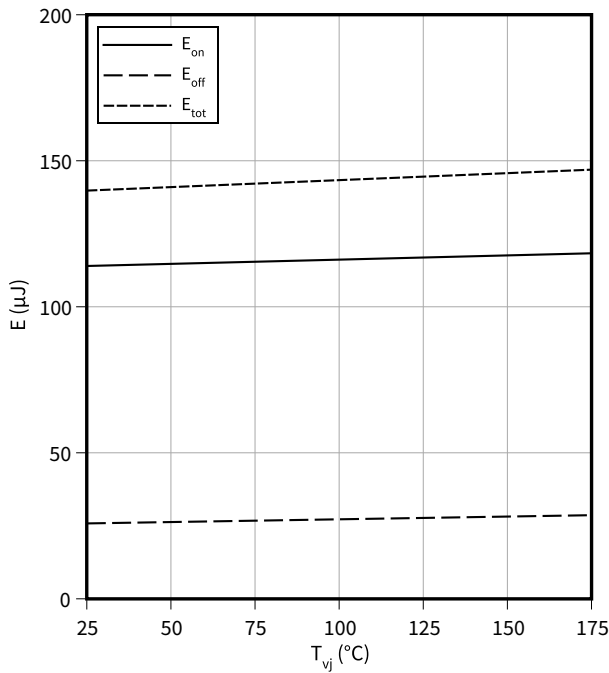
$f = 100 \text{ kHz}, V_{GS} = 0 \text{ V}$



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

$E = f(T_{vj})$

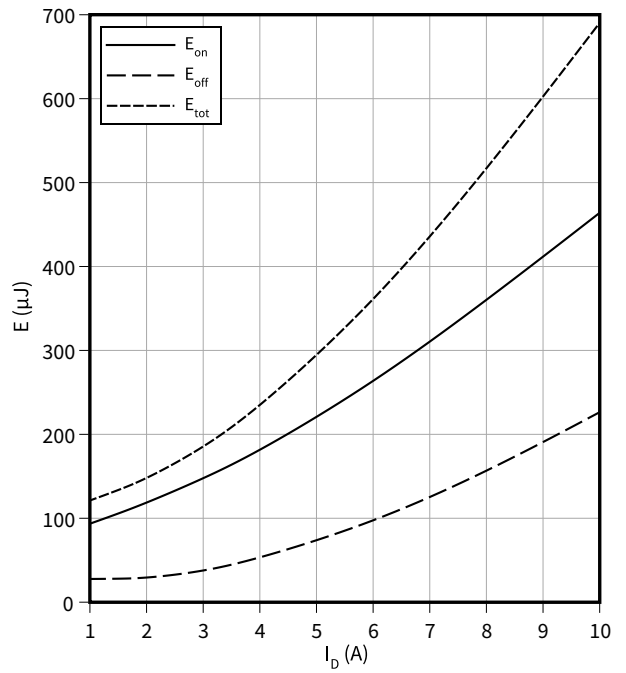
$V_{GS} = 0/12 \text{ V}, I_D = 2 \text{ A}, R_{G,ext} = 6.9 \Omega, V_{DD} = 1000 \text{ V}$



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

$E = f(I_D)$

$V_{GS} = 0/12 \text{ V}, T_{vj} = 175 \text{ °C}, R_{G,ext} = 6.9 \Omega, V_{DD} = 1000 \text{ V}$



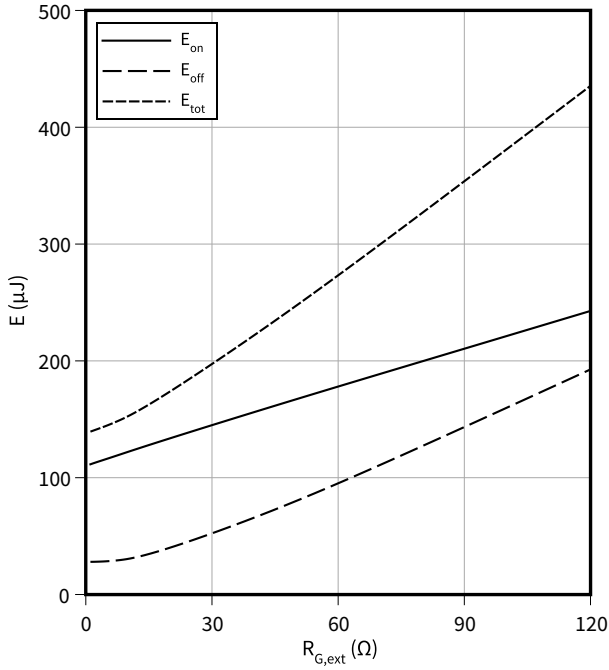


3 Characteristics diagrams

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

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

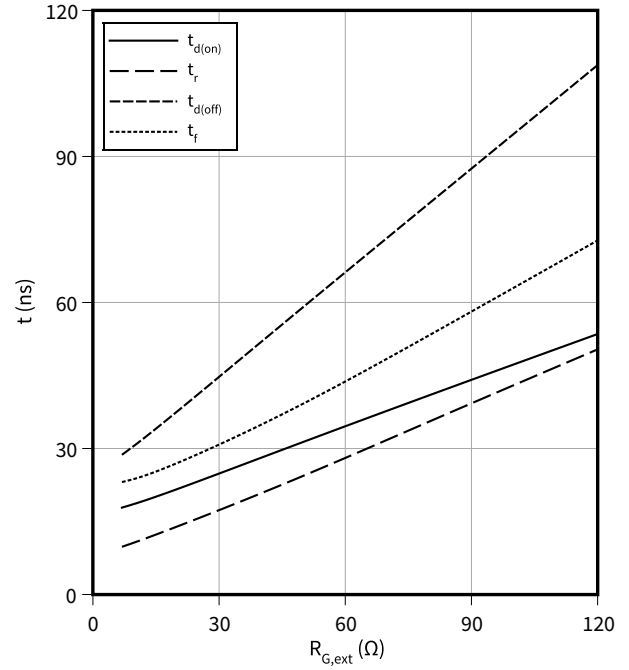
$V_{GS} = 0/12\text{ V}$ ,  $I_D = 2\text{ A}$ ,  $T_{vj} = 175\text{ °C}$ ,  $V_{DD} = 1000\text{ V}$



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

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

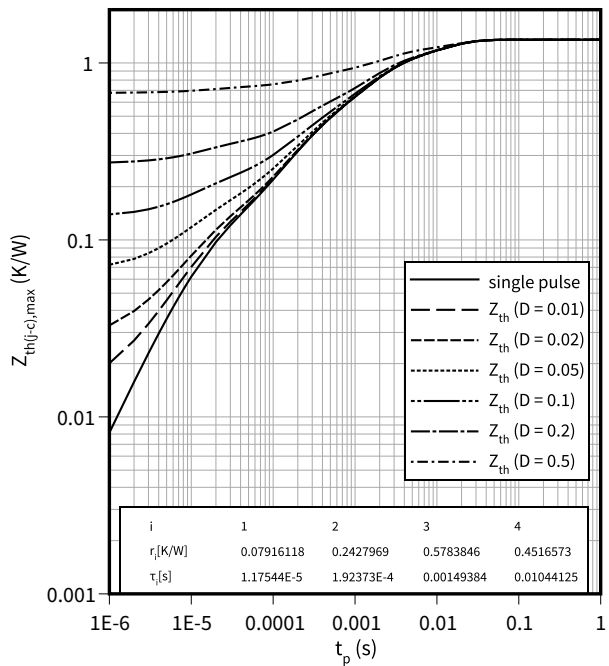
$V_{GS} = 0/12\text{ V}$ ,  $I_D = 2\text{ A}$ ,  $T_{vj} = 175\text{ °C}$ ,  $V_{DD} = 1000\text{ V}$



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

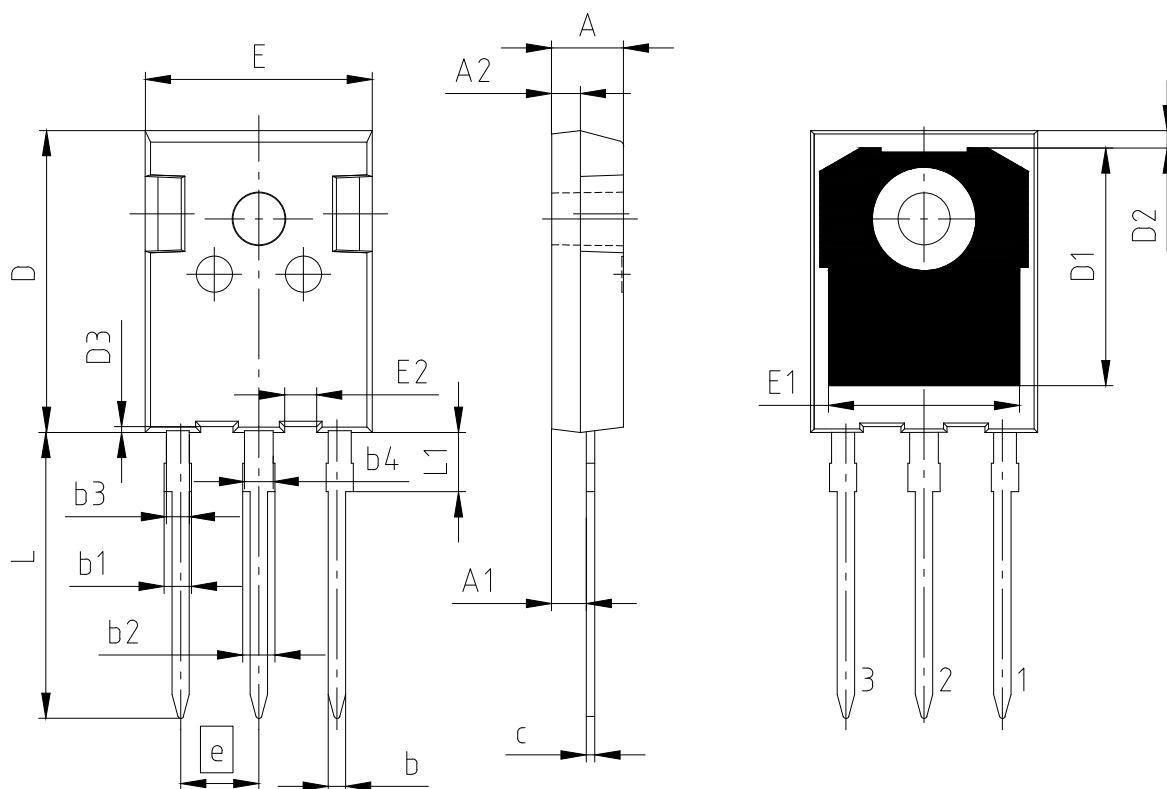
$$Z_{th(j-c),max} = f(t_p)$$

$$D = t_p/T$$



## 4 Package outlines

PG-TO247-3-STD-NN4.8



PACKAGE - GROUP NUMBER:		PG-TO247-3-U04	
DIMENSIONS	MILLIMETERS		
	MIN.	MAX.	
A	4.90	5.10	
A1	2.31	2.51	
A2	1.90	2.10	
b	1.16	1.26	
b1		1.90	
b2		2.30	
b3	1.55	1.65	
b4	1.96	2.06	
c	0.59	0.66	
D	20.90	21.10	
D1	16.25	16.85	
D2	1.05	1.35	
D3	0.55	0.65	
E	15.70	15.90	
E1	13.10	13.50	
E2	2.14	2.34	
e	5.44		
N	3		
L	19.80	20.10	
L1	3.95	4.30	

Figure 1

## 5 Testing conditions

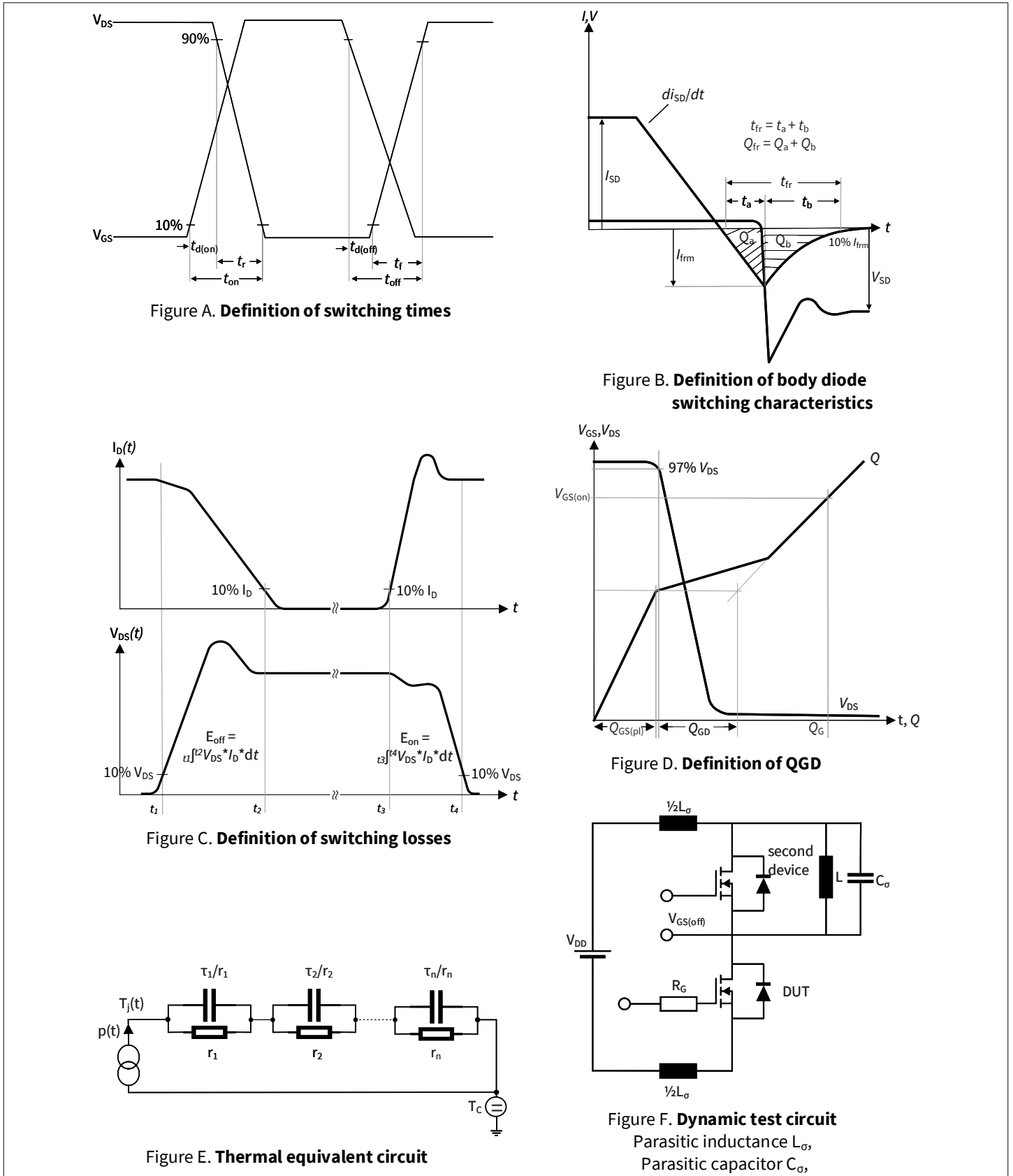


Figure 2

Revision history

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**Revision history**

<b>Document revision</b>	<b>Date of release</b>	<b>Description of changes</b>
1.00	2024-03-25	Final datasheet

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**Email: [erratum@infineon.com](mailto:erratum@infineon.com)**

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