

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

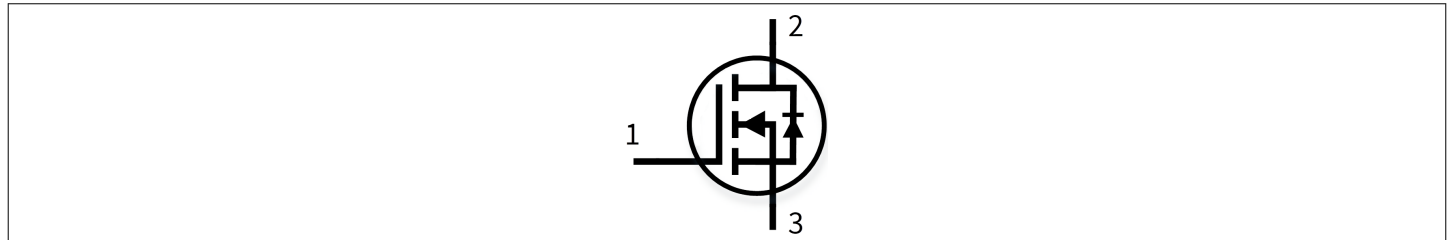
- Qualified for industrial applications according to the relevant tests of JEDEC47/20/22

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 ¹⁾	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	$V_{DD} = 1000 \text{ V}$, $I_D = 2 \text{ A}$, $V_{GS} = 0/12 \text{ V}$, $R_{G,ext} = 6.9 \text{ } \Omega$, $L_\sigma = 40 \text{ nH}$, 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	$t_{d(off)}$	$V_{DD} = 1000 \text{ V}$, $I_D = 2 \text{ A}$, $V_{GS} = 0/12 \text{ V}$, $R_{G,ext} = 6.9 \text{ } \Omega$, $L_\sigma = 40 \text{ nH}$, 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	$V_{DD} = 1000 \text{ V}$, $I_D = 2 \text{ A}$, $V_{GS} = 0/12 \text{ V}$, $R_{G,ext} = 6.9 \text{ } \Omega$, $L_\sigma = 40 \text{ nH}$, 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}	$V_{DD} = 1000 \text{ V}$, $I_D = 2 \text{ A}$, $V_{GS} = 0/12 \text{ V}$, $R_{G,ext} = 6.9 \text{ } \Omega$, $L_\sigma = 40 \text{ nH}$, diode: body diode at $V_{GS} = 0 \text{ V}$	$T_{vj} = 25 \text{ }^\circ\text{C}$		114	μJ
			$T_{vj} = 175 \text{ }^\circ\text{C}$		118	
Turn-off energy	E_{off}	$V_{DD} = 1000 \text{ V}$, $I_D = 2 \text{ A}$, $V_{GS} = 0/12 \text{ V}$, $R_{G,ext} = 6.9 \text{ } \Omega$, $L_\sigma = 40 \text{ nH}$, diode: body diode at $V_{GS} = 0 \text{ V}$	$T_{vj} = 25 \text{ }^\circ\text{C}$		26	μJ
			$T_{vj} = 175 \text{ }^\circ\text{C}$		29	
Total switching energy	E_{tot}	$V_{DD} = 1000 \text{ V}$, $I_D = 2 \text{ A}$, $V_{GS} = 0/12 \text{ V}$, $R_{G,ext} = 6.9 \text{ } \Omega$, $L_\sigma = 40 \text{ nH}$, diode: body diode at $V_{GS} = 0 \text{ V}$	$T_{vj} = 25 \text{ }^\circ\text{C}$		140	μJ
			$T_{vj} = 175 \text{ }^\circ\text{C}$		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/ μs . The measured dV/dt was limited by measurement test setup and package.

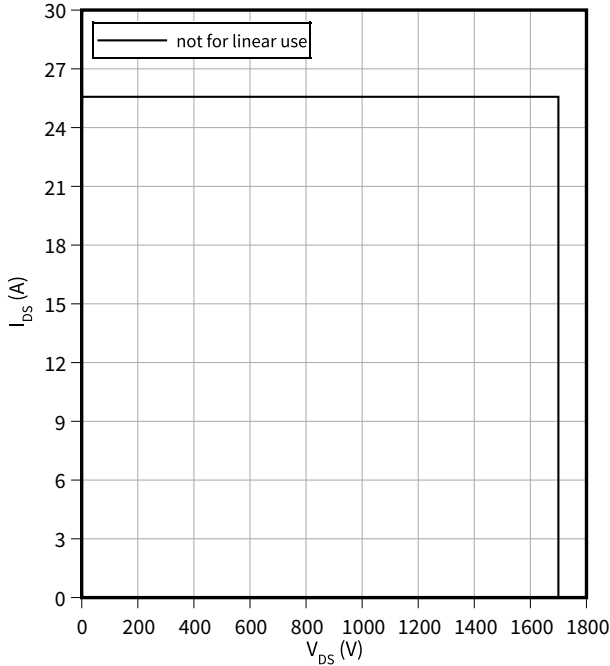
Dynamic test circuit see Fig. F.

3 Characteristics diagrams

Reverse bias safe operating area (RBSOA)

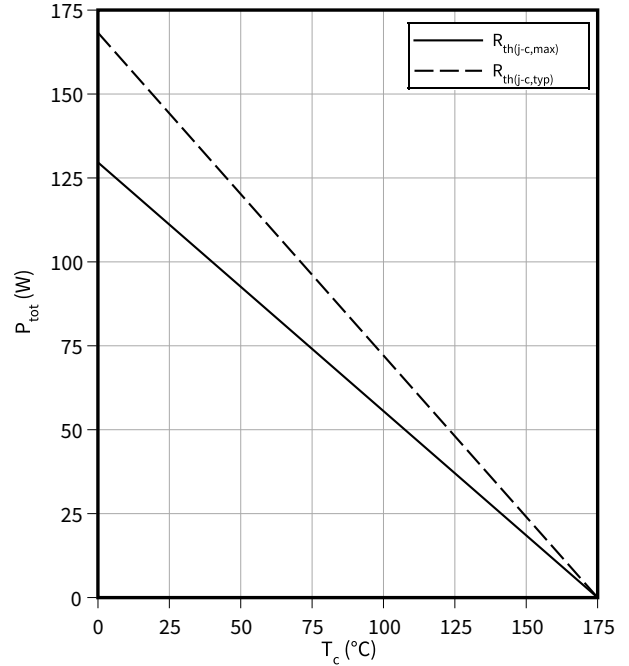
$$I_{DS} = f(V_{DS})$$

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



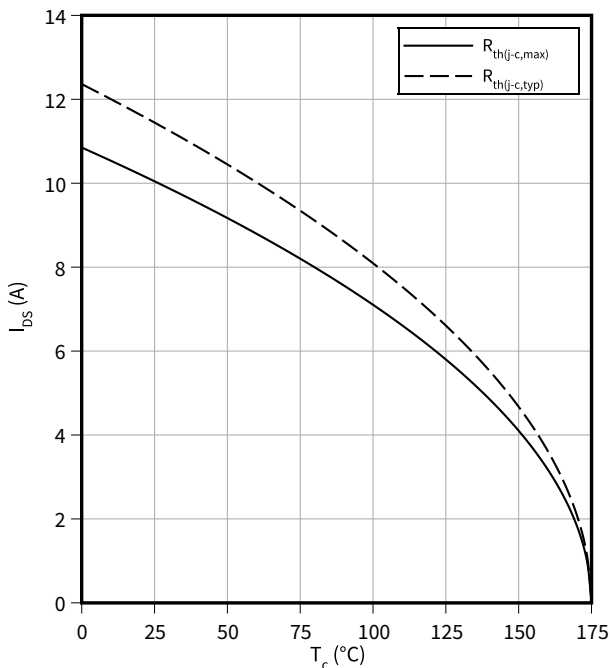
Power dissipation as a function of case temperature limited by bond wire

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



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

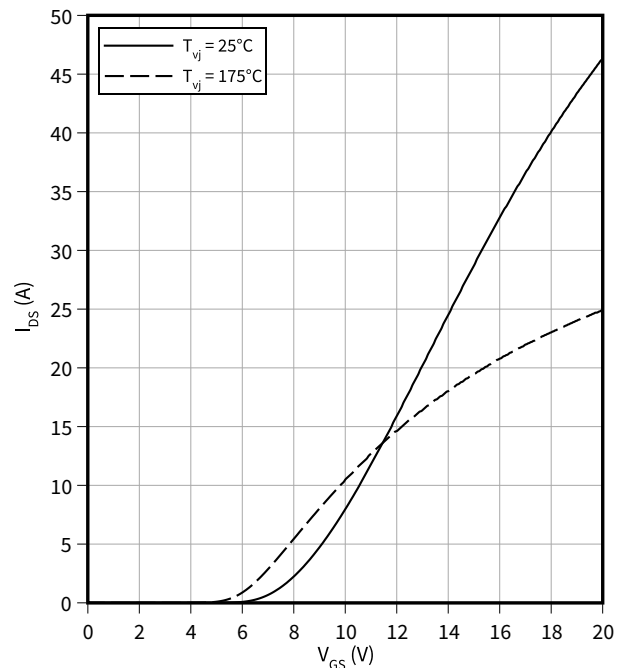
$$I_{DS} = f(T_c)$$



Typical transfer characteristic

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

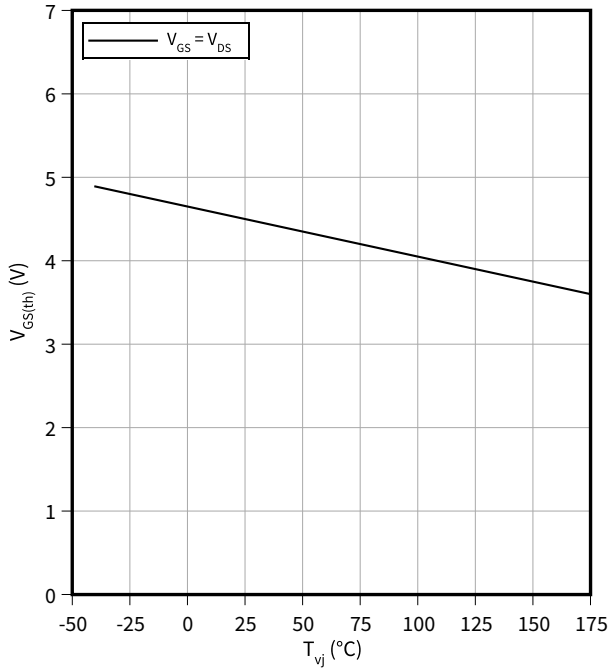
$$V_{DS} = 20\text{ V}, t_p = 20\text{ }\mu\text{s}$$



3 Characteristics diagrams

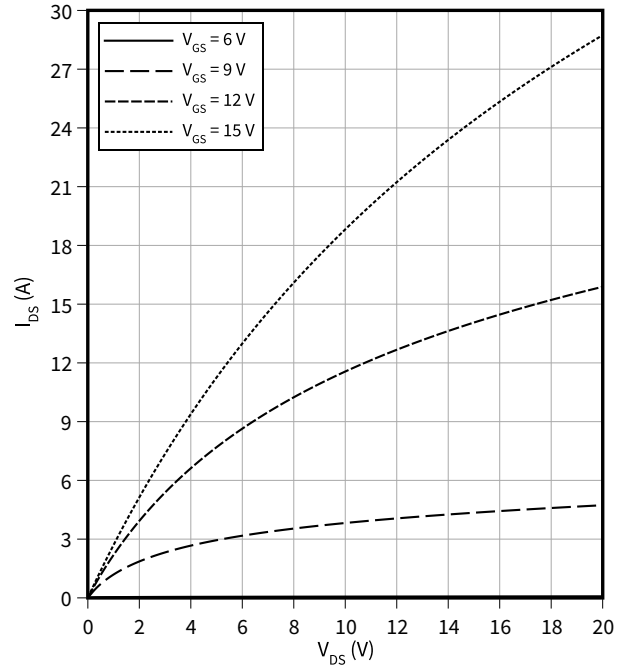
Typical gate-source threshold voltage as a function of junction temperature

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



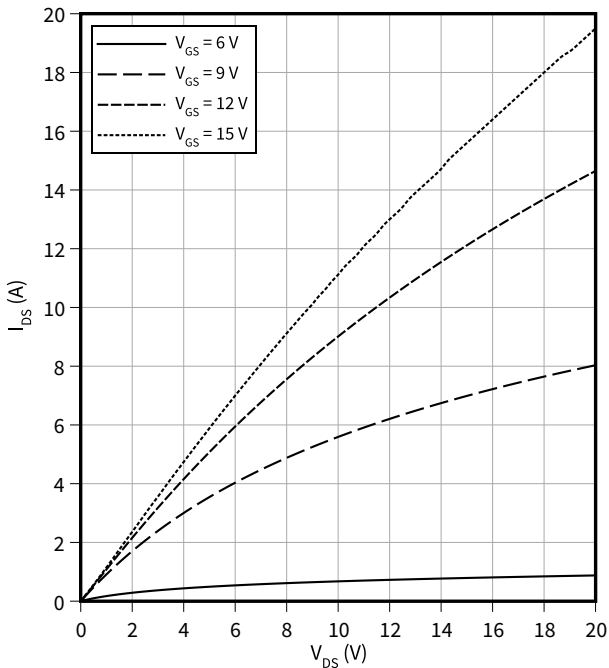
Typical output characteristic, V_{GS} as parameter

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



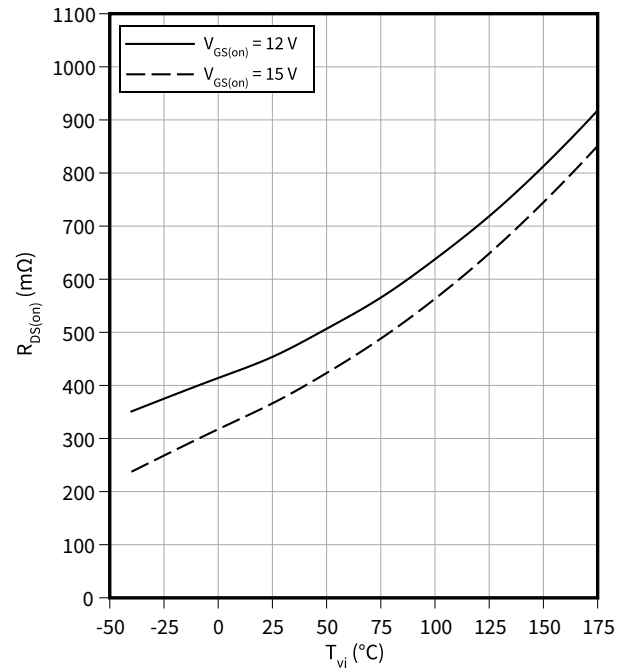
Typical output characteristic, V_{GS} as parameter

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



Typical on-state resistance as a function of junction temperature

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

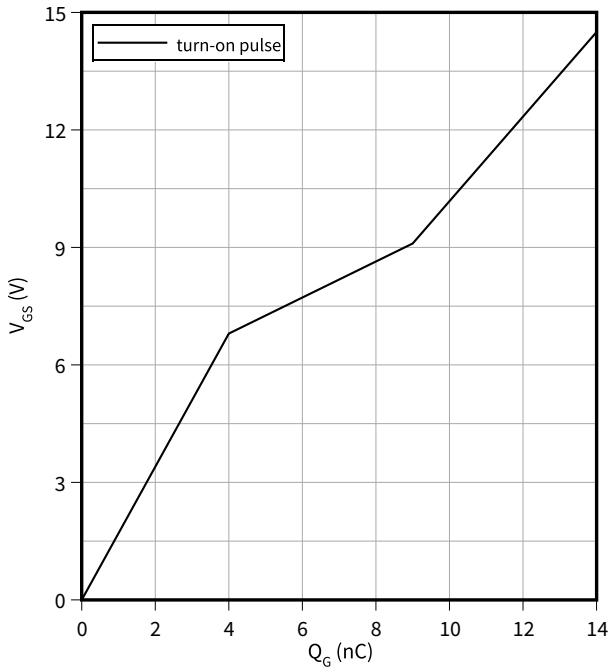


3 Characteristics diagrams

Typical gate charge

$V_{GS} = f(Q_G)$

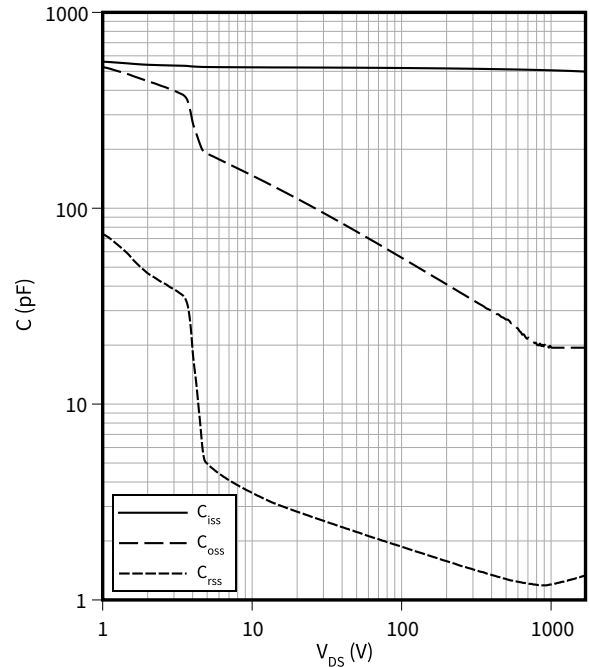
$I_D = 2 \text{ A}, V_{DS} = 1000 \text{ V}$



Typical capacitance as a function of drain-source voltage

$C = f(V_{DS})$

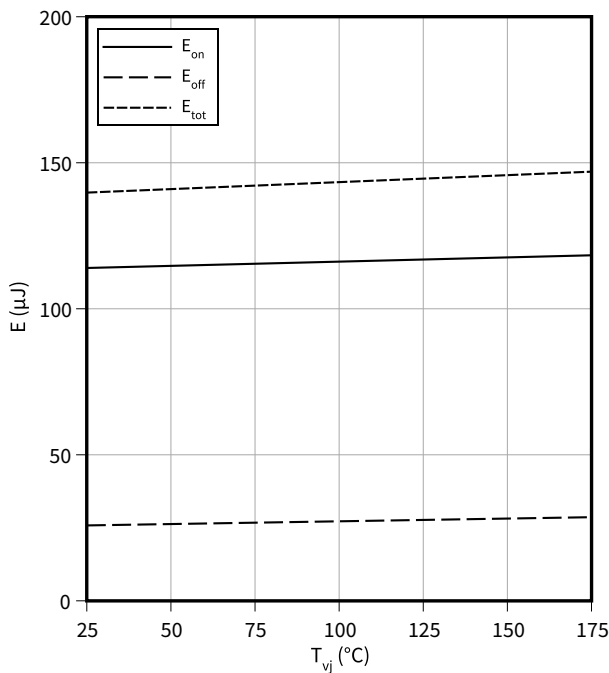
$f = 100 \text{ kHz}, V_{GS} = 0 \text{ V}$



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

$E = f(T_{vj})$

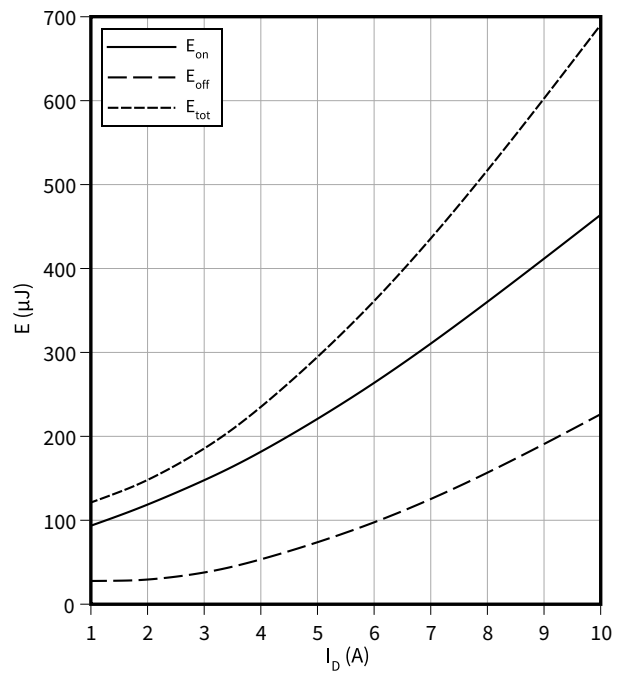
$V_{GS} = 0/12 \text{ V}, I_D = 2 \text{ A}, R_{G,ext} = 6.9 \Omega, V_{DD} = 1000 \text{ V}$



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

$E = f(I_D)$

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

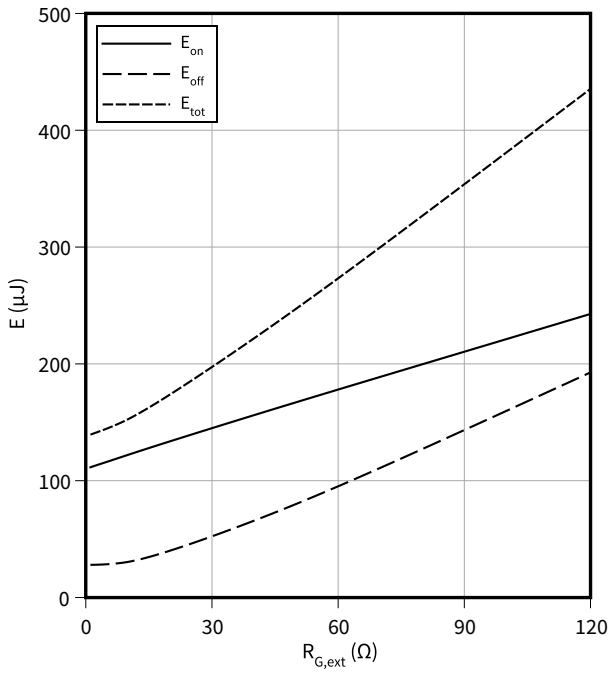


3 Characteristics diagrams

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

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

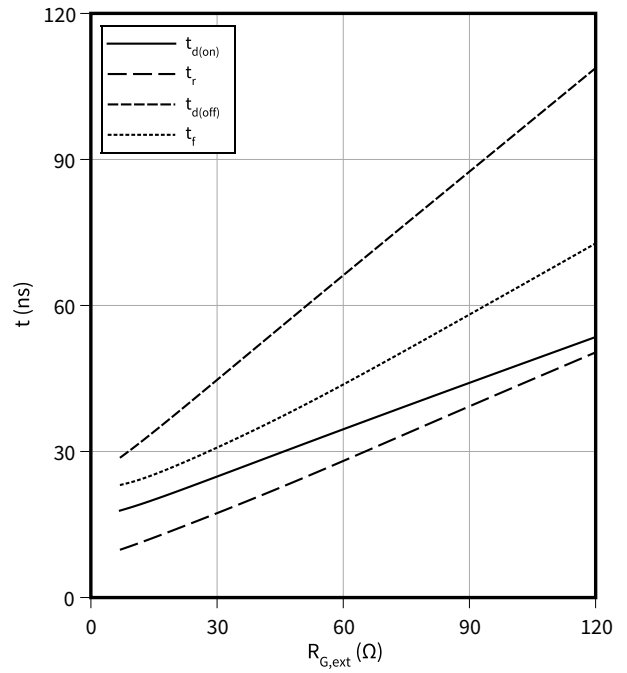
$V_{GS} = 0/12\text{ V}$, $I_D = 2\text{ A}$, $T_{vj} = 175\text{ °C}$, $V_{DD} = 1000\text{ V}$



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

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

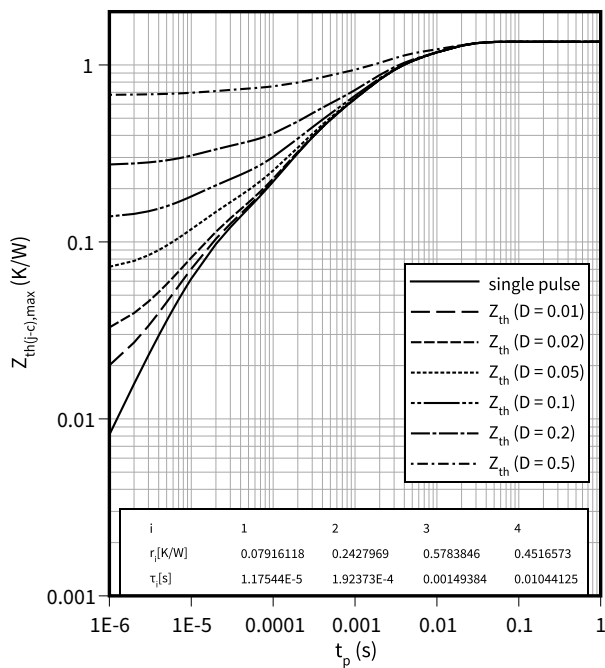
$V_{GS} = 0/12\text{ V}$, $I_D = 2\text{ A}$, $T_{vj} = 175\text{ °C}$, $V_{DD} = 1000\text{ V}$



Max. transient thermal impedance (MOSFET/diode)

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

$D = t_p/T$



4 Package outlines

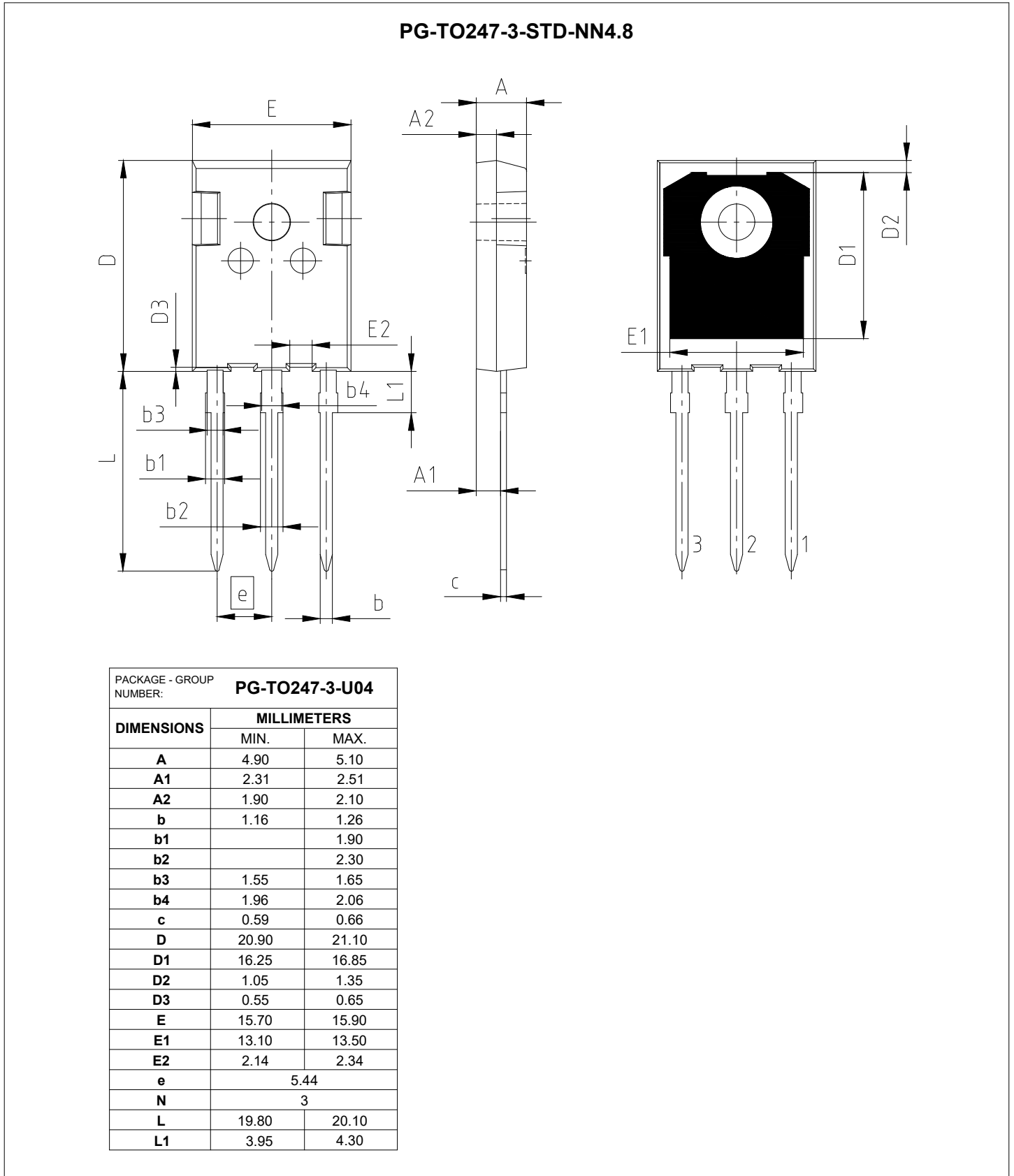


Figure 1

5 Testing conditions

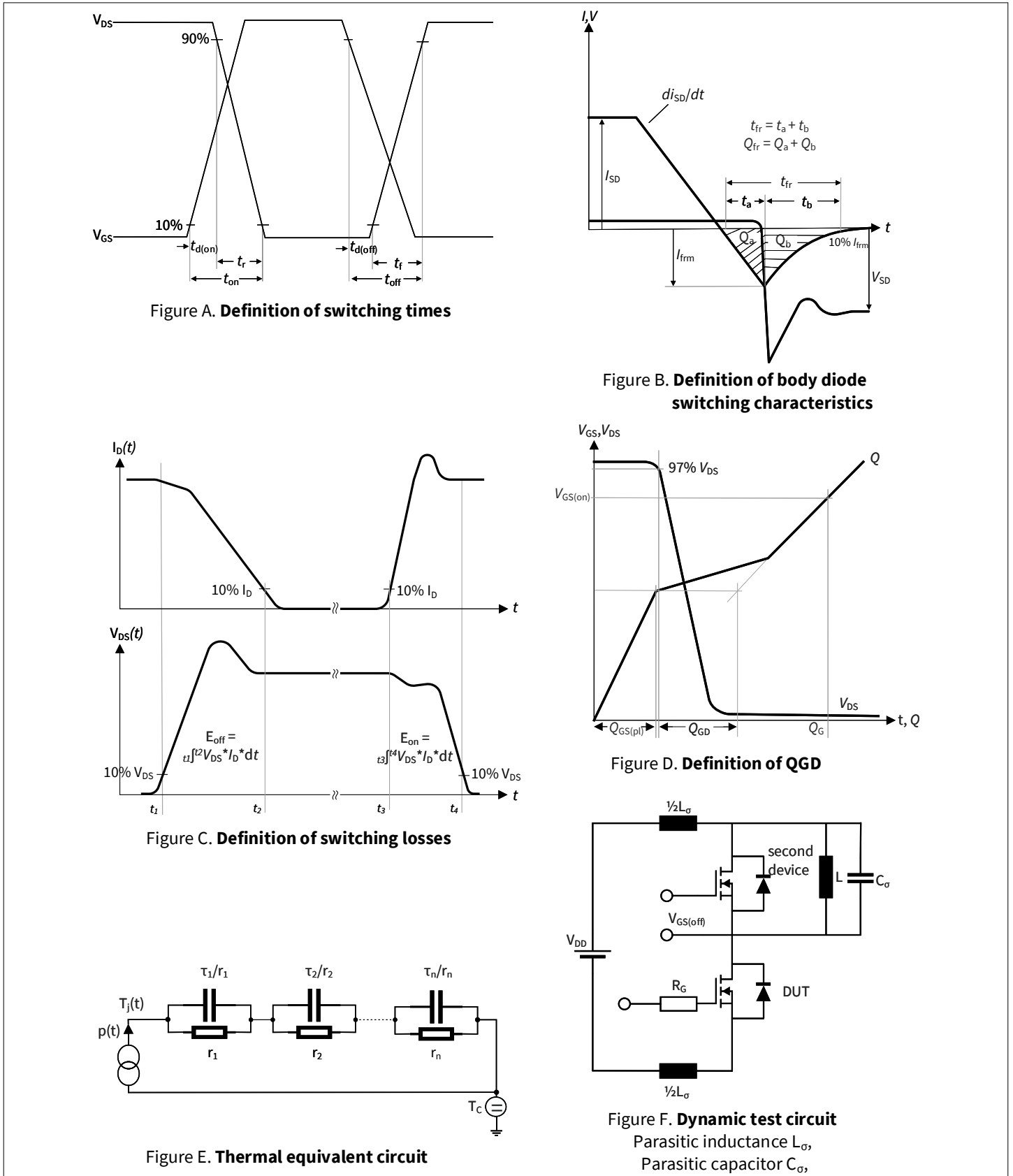


Figure 2

Revision history

Revision history

Document revision	Date of release	Description of changes
1.00	2024-03-25	Final datasheet

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[G3R40MT12J](#)