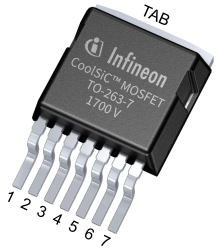
Final datasheet

CoolSiC™ 1700 V SiC Trench MOSFET : Silicon Carbide MOSFET

Features



- V_{DSS} = 1700 V at T_{vj} = 25°C
- I_{DDC} = 5.2 A at T_C = 25°C
- $R_{DS(on)}$ = 1000 mΩ at V_{GS} = 12 V, T_{vj} = 25°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 V
- Fully controllable dv/dt for EMI optimization
- Reduction of system complexity
- Directly drive from fly-back controller
- Efficiency improvement and cooling effort reduction
- Enabling higher frequency

Halogen-free
Green
Lead-free
RoHS

Potential applications

- Solar string inverter
- Solar central inverter
- Industrial UPS
- Industrial SMPS
- Charger

Product validation

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

Description

Pin definition:

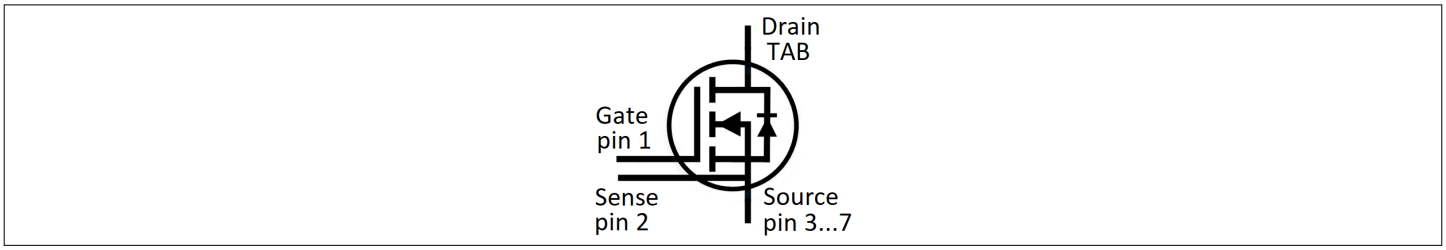
• Pin 1 – Gate

• Pin 2 – Kelvin sense contact

• Pin 3…7 – Source

• Tab – Drain

Note: the source and sense pins are not exchangeable, their exchange might lead to malfunction recommended for forward operation mode only



Type	Package	Marking
IMBF170R1K0M1	PG-TO263-7-U01	170M11K0

Table of contents

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}	reflow soldering (MSL1 according to JEDEC J-STD-020)			260	°C
Thermal resistance, junction-ambient[1)]	$R_{th(j-a)}$				62	K/W
MOSFET/body diode thermal resistance, junction-case	$R_{th(j-c)}$			1.7	2.2	K/W

1) leaded

2 MOSFET

Table 2 Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
Drain-source voltage	V_{DSS}	$T_{vj} \geq 25$ °C		1700	V
Continuous DC drain current for $R_{th(j-c,max)}$, limited by $T_{vj(max)}$	I_{DDC}	$V_{GS} = 12$ V	$T_c = 25$ °C	5.2	A
			$T_c = 100$ °C	3.7	
Peak drain current, t_p limited by $T_{vj(max)}$[1)]	I_{DM}	$V_{GS} = 12$ V		13.3	A
Gate-source voltage, max. transient voltage[2)]	V_{GS}	$t_p \leq 0.5$ µs, $D < 0.01$		-10...23	V
Gate-source voltage, max. static voltage	V_{GS}			-7...20	V
Power dissipation, limited by $T_{vj(max)}$	P_{tot}		$T_c = 25$ °C	68	W
			$T_c = 100$ °C	34	

1) verified by design.
2) **Important note:** The selection of positive and negative gate-source voltages impacts the long-term behavior of the device.

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 = 1 A	T_{vj} = 25 °C, $V_{GS(on)}$ = 12 V		1000		mΩ
			T_{vj} = 100 °C, $V_{GS(on)}$ = 12 V		1416		
			T_{vj} = 175 °C, $V_{GS(on)}$ = 12 V		2037		
			T_{vj} = 25 °C, $V_{GS(on)}$ = 15 V		809	880	
Gate-source threshold voltage	$V_{GS(th)}$	I_D = 1.1 mA, V_{DS} = V_{GS} (tested after 1 ms pulse at V_{GS} = 20 V)	T_{vj} = 25 °C	3.5	4.5	5.7	V
			T_{vj} = 175 °C		3.6		
Zero gate-voltage drain current	I_{DSS}	V_{DS} = 1700 V, V_{GS} = 0 V	T_{vj} = 25 °C		0.4	11	µA
			T_{vj} = 175 °C		6		
Gate leakage current	I_{GSS}	V_{DS} = 0 V	V_{GS} = 20 V			100	nA
			V_{GS} = -10 V			-100	
Forward transconductance	g_{fs}	I_D = 1 A, V_{DS} = 20 V			0.42		S
Internal gate resistance	$R_{G,int}$	f = 1 MHz, V_{AC} = 25 mV			35		Ω
Input capacitance	C_{iss}	V_{DS} = 1000 V, V_{GS} = 0 V, f = 1000 kHz, V_{AC} = 25 mV			275		pF
Output capacitance	C_{oss}	V_{DS} = 1000 V, V_{GS} = 0 V, f = 1000 kHz, V_{AC} = 25 mV			7.2		pF
Reverse transfer capacitance	C_{rss}	V_{DS} = 1000 V, V_{GS} = 0 V, f = 1000 kHz, V_{AC} = 25 mV			0.7		pF
C_{oss} stored energy	E_{oss}	V_{DS} = 1000 V, V_{GS} = 0 V, f = 1000 kHz, V_{AC} = 25 mV			1.3		µJ
Total gate charge	Q_G	V_{DD} = 1000 V, I_D = 1 A, V_{GS} = 0/12 V, turn-on pulse			5		nC
Plateau gate charge	$Q_{GS(pl)}$	V_{DD} = 1000 V, I_D = 1 A, V_{GS} = 0/12 V, turn-on pulse			1.5		nC
Gate-to-drain charge	Q_{GD}	V_{DD} = 1000 V, I_D = 1 A, V_{GS} = 0/12 V, turn-on pulse			1.6		nC
Turn-on delay time	$t_{d(on)}$	V_{DD} = 1000 V, I_D = 1 A, V_{GS} = 0/12 V, $R_{G,ext}$ = 22 Ω, L_σ = 40 nH, diode: body diode at V_{GS} = 0 V	T_{vj} = 25 °C		19		ns
			T_{vj} = 175 °C		16		

(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 V, I_D = 1 A, V_{GS} = 0/12 V, $R_{G,ext}$ = 22 Ω, L_σ = 40 nH, diode: body diode at V_{GS} = 0 V	T_{vj} = 25 °C		14		ns
			T_{vj} = 175 °C		11		
Turn-off delay time	$t_{d(off)}$	V_{DD} = 1000 V, I_D = 1 A, V_{GS} = 0/12 V, $R_{G,ext}$ = 22 Ω, L_σ = 40 nH, diode: body diode at V_{GS} = 0 V	T_{vj} = 25 °C		20		ns
			T_{vj} = 175 °C		23		
Fall time	t_f	V_{DD} = 1000 V, I_D = 1 A, V_{GS} = 0/12 V, $R_{G,ext}$ = 22 Ω, L_σ = 40 nH, diode: body diode at V_{GS} = 0 V	T_{vj} = 25 °C		22		ns
			T_{vj} = 175 °C		23		
Turn-on energy	E_{on}	V_{DD} = 1000 V, I_D = 1 A, V_{GS} = 0/12 V, $R_{G,ext}$ = 22 Ω, L_σ = 40 nH, diode: body diode at V_{GS} = 0 V	T_{vj} = 25 °C		31		µJ
			T_{vj} = 175 °C		33		
Turn-off energy	E_{off}	V_{DD} = 1000 V, I_D = 1 A, V_{GS} = 0/12 V, $R_{G,ext}$ = 22 Ω, L_σ = 40 nH, diode: body diode at V_{GS} = 0 V	T_{vj} = 25 °C		7		µJ
			T_{vj} = 175 °C		8		
Total switching energy	E_{tot}	V_{DD} = 1000 V, I_D = 1 A, V_{GS} = 0/12 V, $R_{G,ext}$ = 22 Ω, L_σ = 40 nH, diode: body diode at V_{GS} = 0 V	T_{vj} = 25 °C		37		µJ
			T_{vj} = 175 °C		41		
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.

Characteristics at T_{vj} = 25°C, unless otherwise specified.

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}	$T_{vj} \geq 25$ °C	1700	V
Peak reverse drain current, t_p limited by $T_{vj(max)}$	I_{SM}	$V_{GS} = 0$ V	13.3	A

Table 6 Characteristic values

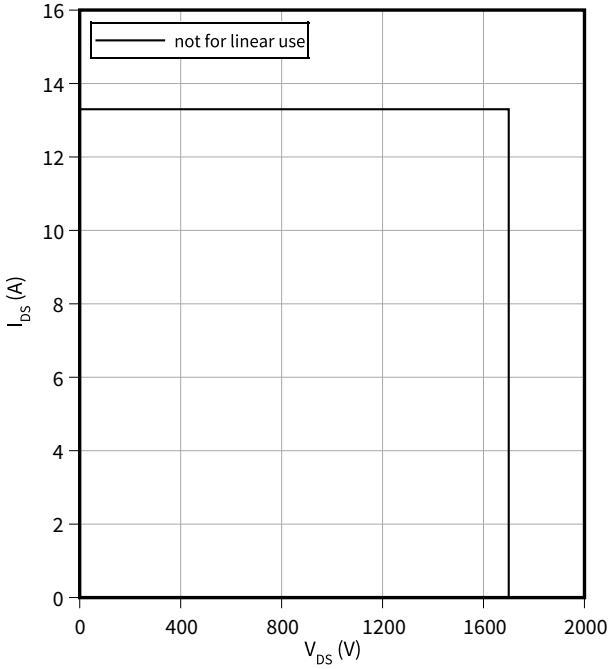
Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Drain-source reverse voltage	V_{SD}	$I_{SD} = 1$ A, $V_{GS} = 0$ V	$T_{vj} = 25$ °C		3.8		V
			$T_{vj} = 175$ °C		3.5		
MOSFET forward recovery charge	Q_{fr}	$V_{DD} = 1000$ V, $I_{SD} = 1$ A, $V_{GS} = 0$ V, $-di_{SD}/dt = 1000$ A/µs, Q_{fr} includes also Q_C	$T_{vj} = 25$ °C		45.1		nC
			$T_{vj} = 175$ °C		58.1		
MOSFET peak forward recovery current	I_{frm}	$V_{DD} = 1000$ V, $I_{SD} = 1$ A, $V_{GS} = 0$ V, $-di_{SD}/dt = 1000$ A/µs, Q_{fr} includes also Q_C	$T_{vj} = 25$ °C		3.6		A
			$T_{vj} = 175$ °C		4		
MOSFET forward recovery energy	E_{fr}	$V_{DD} = 1000$ V, $I_{SD} = 1$ A, $V_{GS} = 0$ V, $-di_{SD}/dt = 1000$ A/µs, Q_{fr} includes also Q_C	$T_{vj} = 25$ °C		0.11		µJ
			$T_{vj} = 175$ °C		0.21		
Virtual junction temperature	T_{vj}			-55		175	°C

4 Characteristics diagrams

Reverse bias safe operating area (RBSOA)

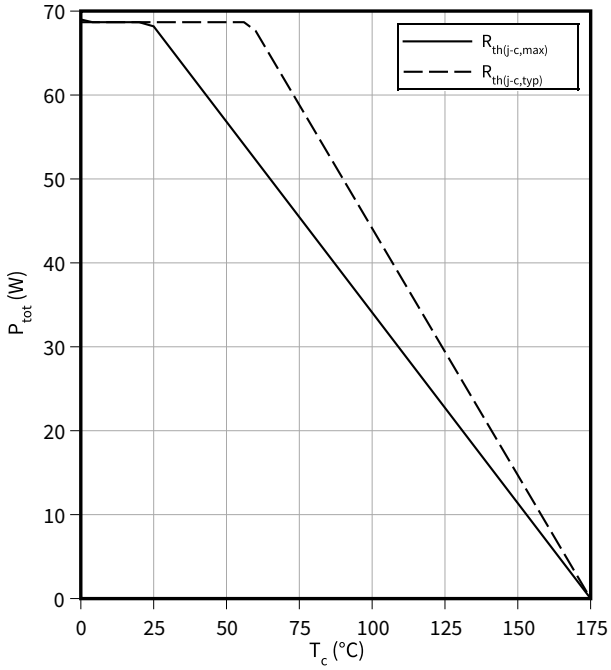
$I_{DS} = f(V_{DS})$

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



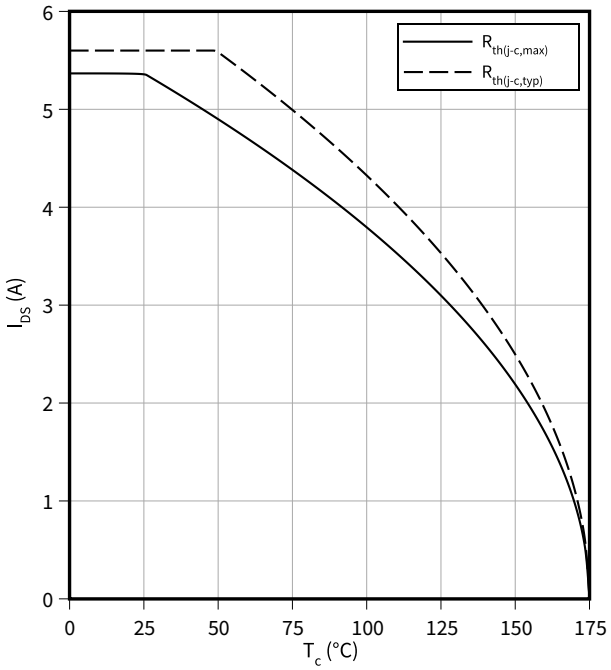
Power dissipation as a function of case temperature limited by bond wire

$P_{tot} = f(T_c)$



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

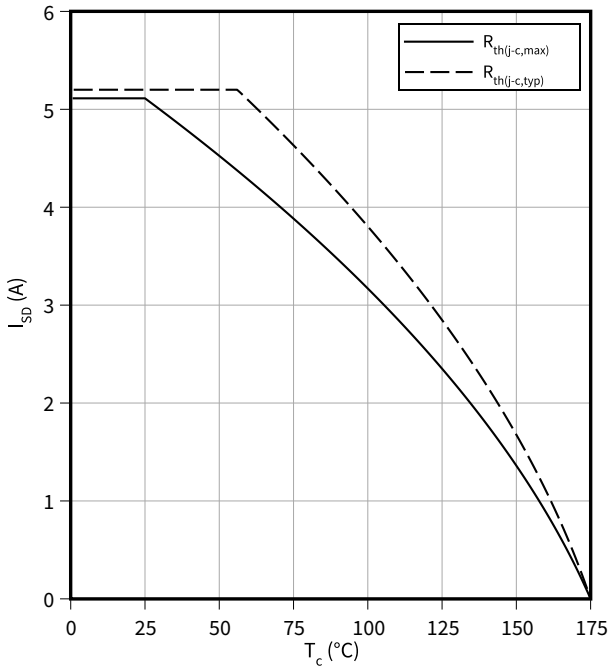
$I_{DS} = f(T_c)$



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

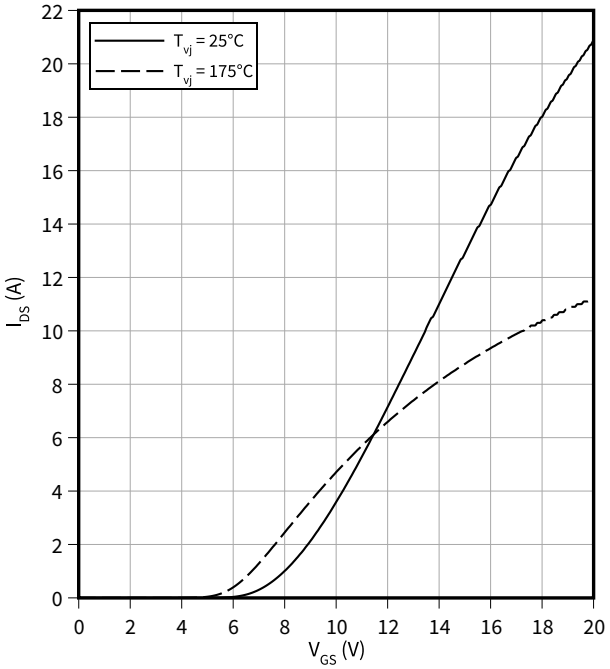
$I_{SD} = f(T_c)$

$V_{GS} = 0\ V$



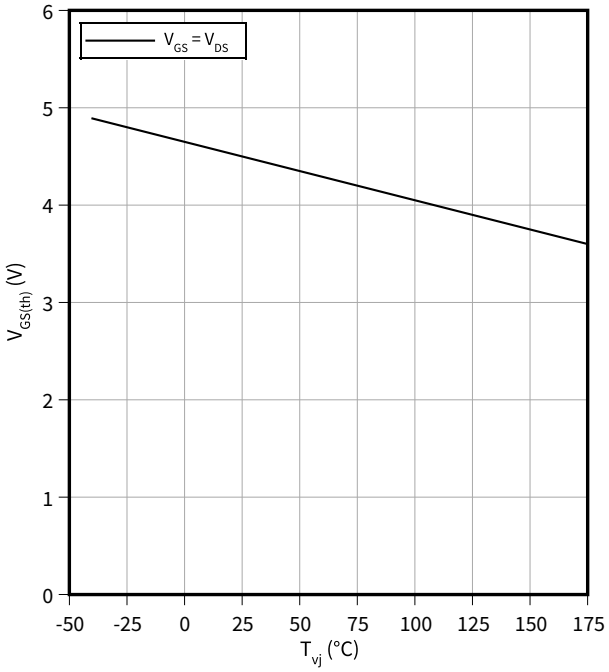
Typical transfer characteristic

$I_{DS} = f(V_{GS})$
V_{DS} = 20 V, t_p = 20 µs



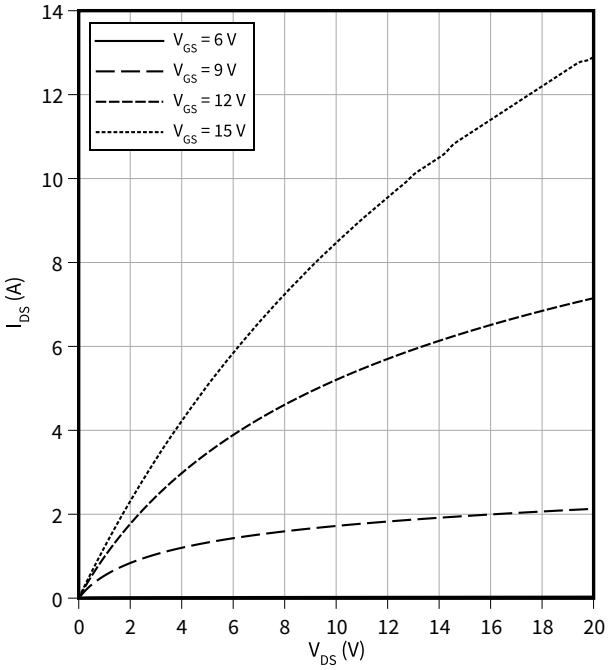
Typical gate-source threshold voltage as a function of junction temperature

$V_{GS(th)} = f(T_{vj})$
I_D = 1.1 mA



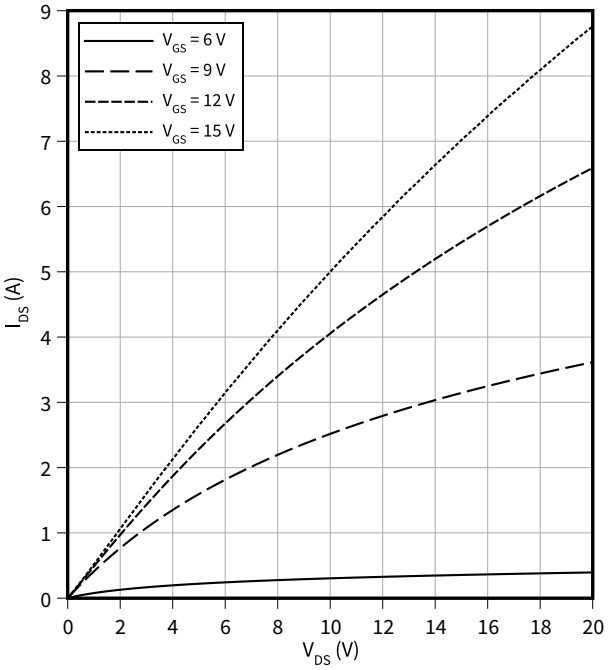
Typical output characteristic, V_{GS} as a parameter

$I_{DS} = f(V_{DS})$
T_{vj} = 25 °C, t_p = 20 µs



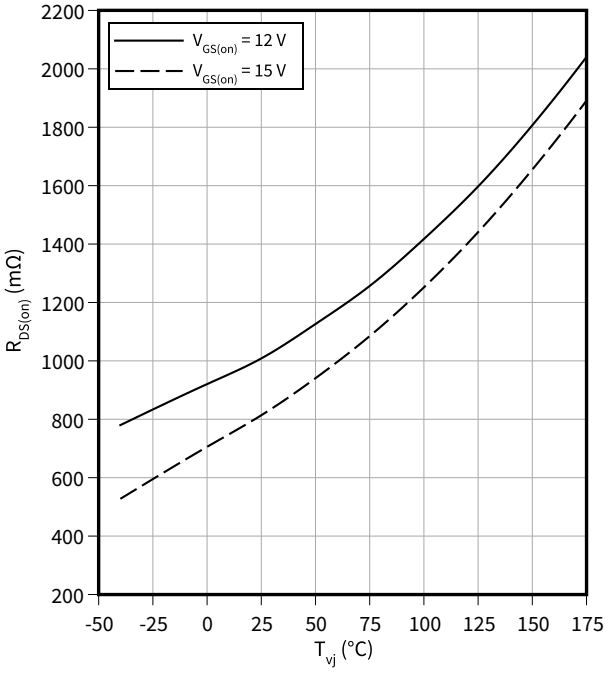
Typical output characteristic, V_{GS} as a parameter

$I_{DS} = f(V_{DS})$
T_{vj} = 175 °C, t_p = 20 µs



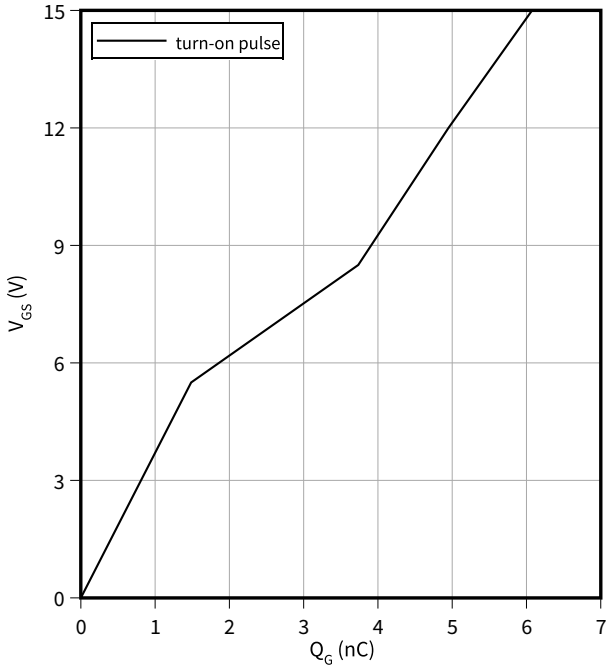
Typical on-state resistance as a function of junction temperature

$R_{DS(on)} = f(T_{vj})$
$I_D = 1$ A



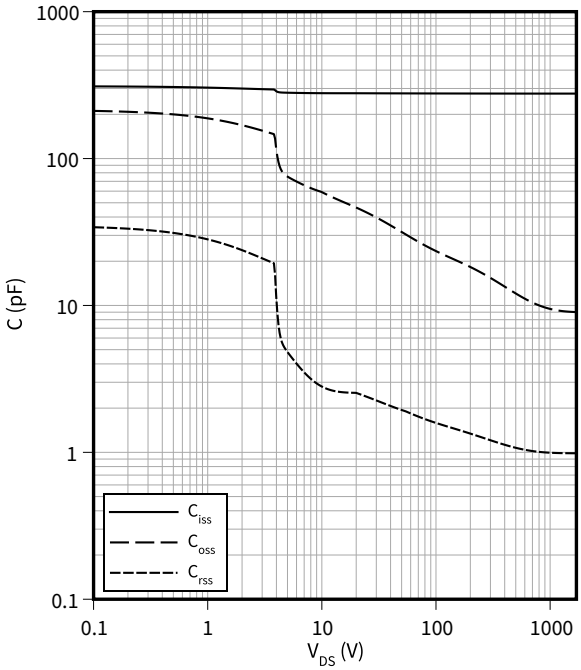
Typical gate charge

$V_{GS} = f(Q_G)$
$I_D = 1$ A, $V_{DS} = 1000$ V



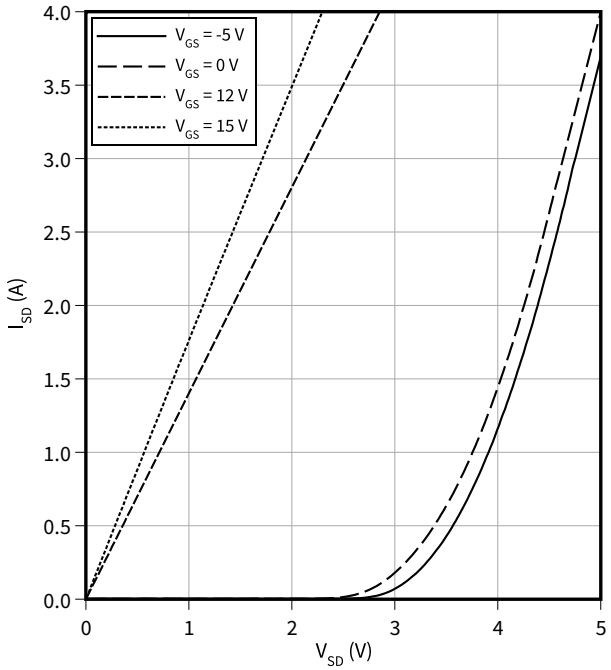
Typical capacitance as a function of drain-source voltage

$C = f(V_{DS})$
$f = 1000$ kHz, $V_{GS} = 0$ V



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

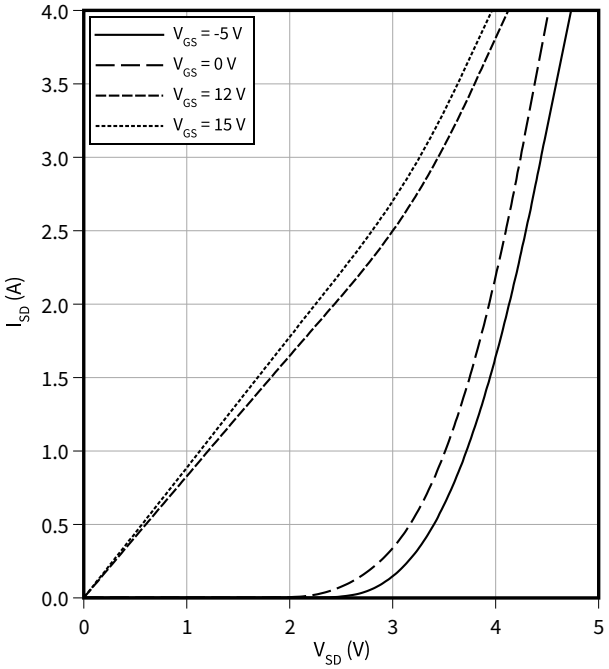
$I_{SD} = f(V_{SD})$
$T_{vj} = 25$ °C, $t_p = 20$ µs



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

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

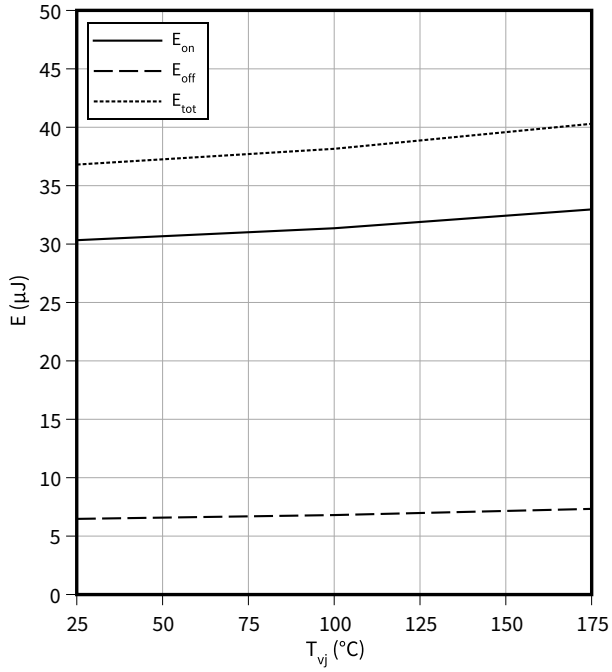
T_{vj} = 175 °C, t_p = 20 µs



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

$E = f(T_{vj})$

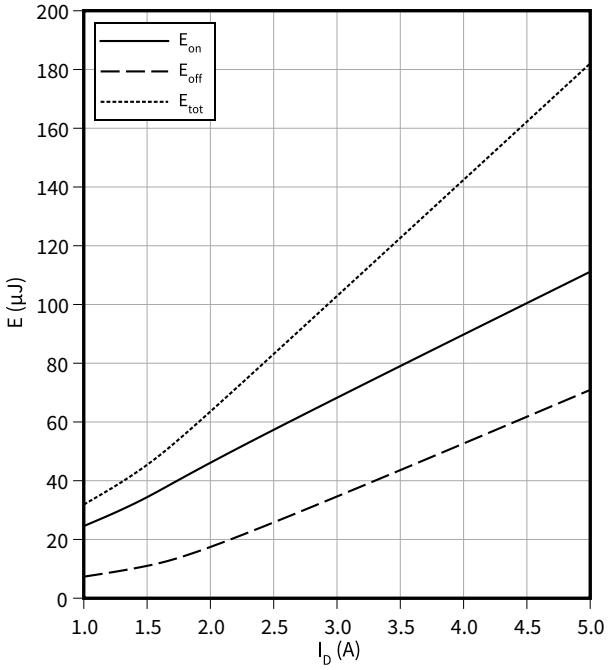
V_{GS} = 0/12 V, I_D = 1 A, $R_{G,ext}$ = 22 Ω, V_{DD} = 1000 V



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

$E = f(I_D)$

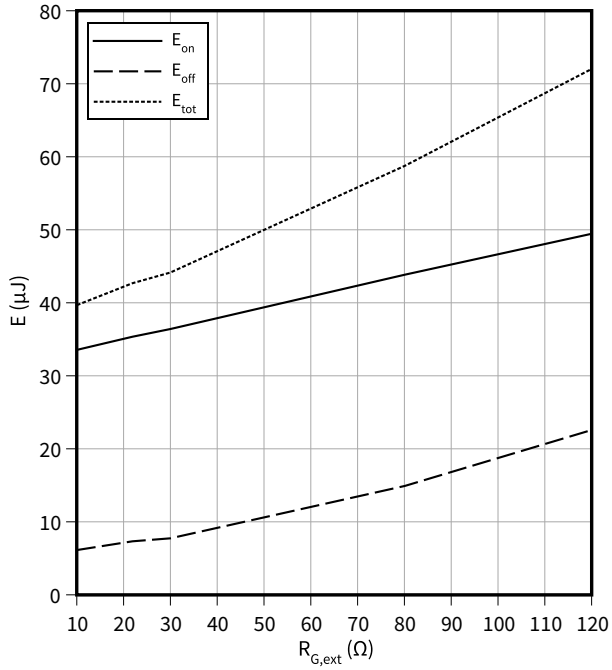
V_{GS} = 0/12 V, T_{vj} = 175 °C, $R_{G,ext}$ = 22 Ω, V_{DD} = 1000 V



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

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

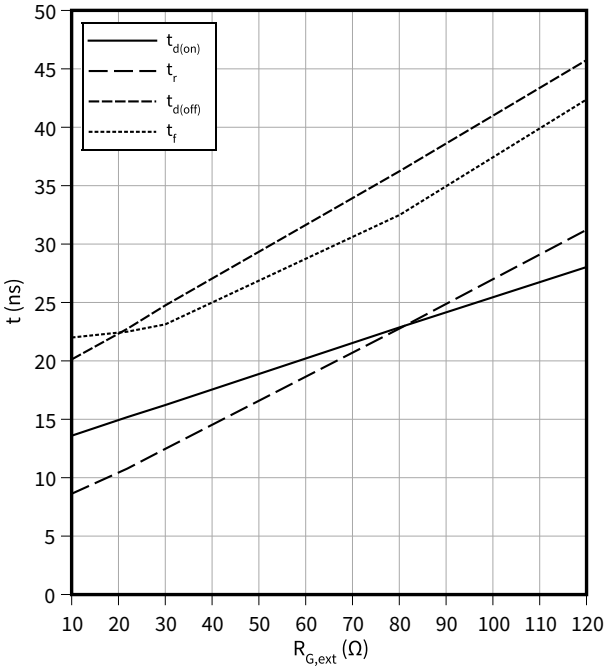
V_{GS} = 0/12 V, I_D = 1 A, T_{vj} = 175 °C, V_{DD} = 1000 V



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

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

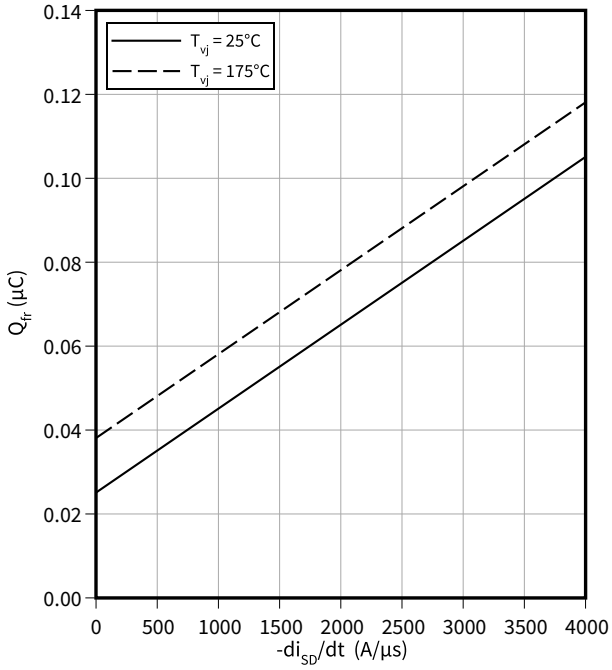
V_{GS} = 0/12 V, I_D = 1 A, T_{vj} = 175 °C, V_{DD} = 1000 V



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 V

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

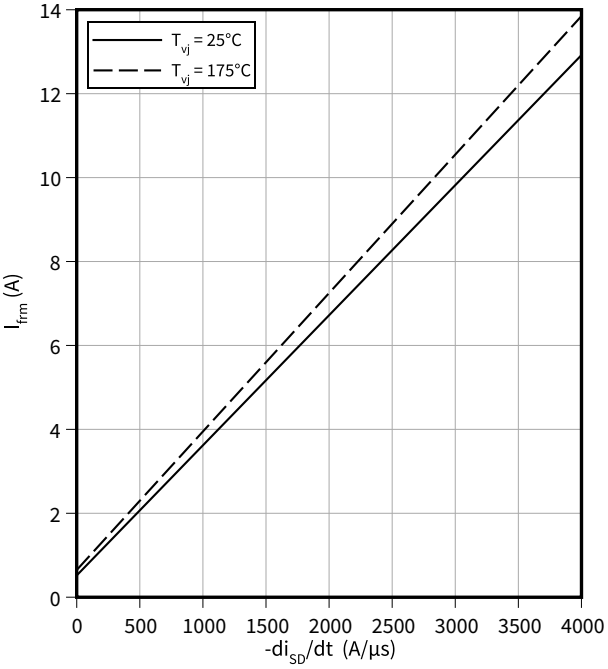
V_{GS} = 0 V, I_{SD} = 1 A, V_{DD} = 1000 V



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 V

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

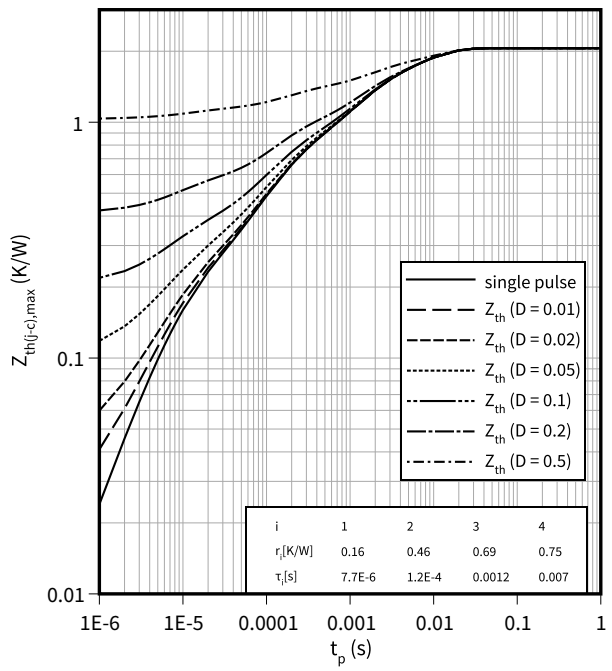
V_{GS} = 0 V, I_{SD} = 1 A, V_{DD} = 1000 V



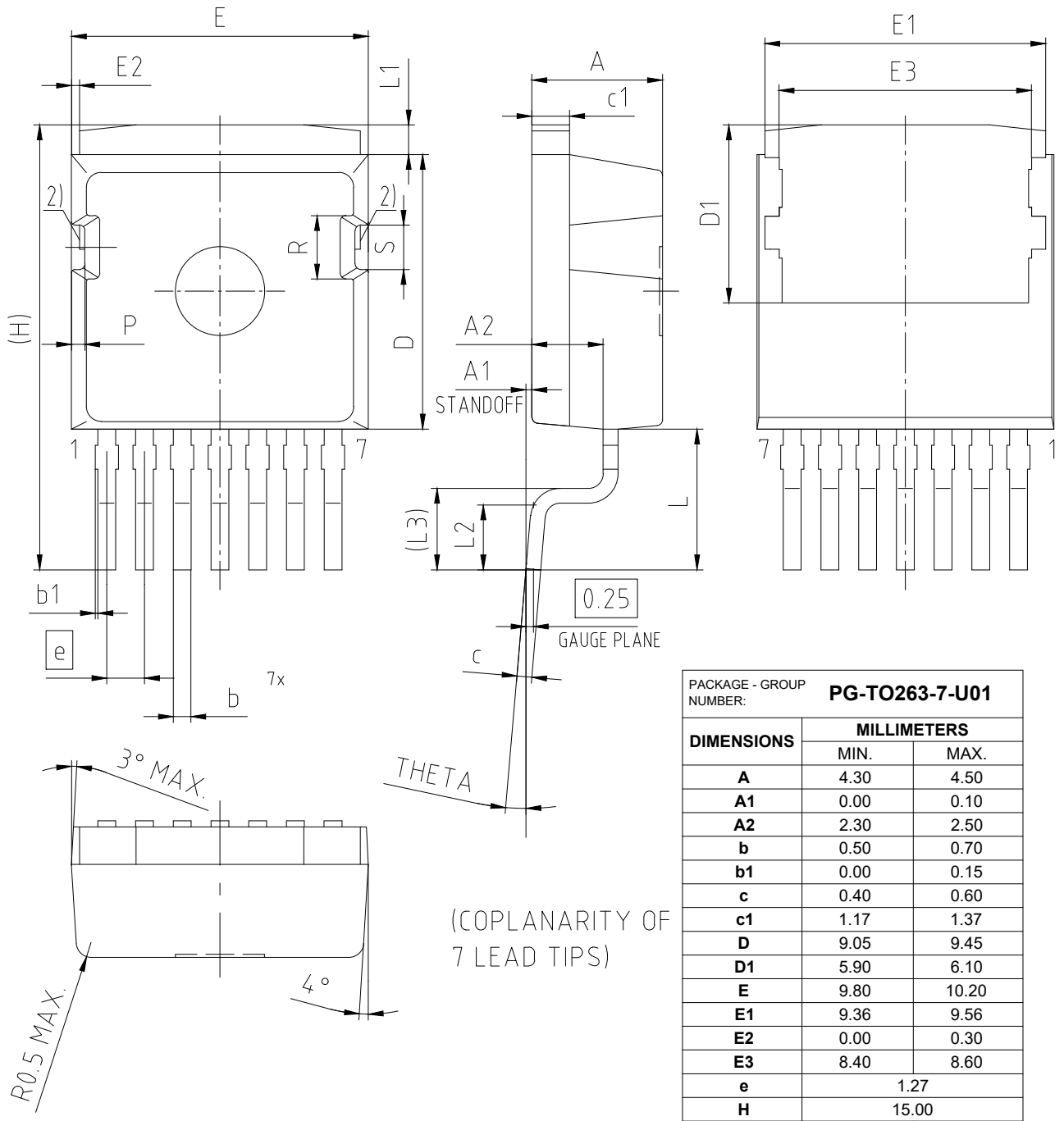
Max. transient thermal impedance (MOSFET/diode)

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

$D = t_p/T$



5 Package outlines



PACKAGE - GROUP NUMBER:	PG-TO263-7-U01	
DIMENSIONS	**MILLIMETERS**	
	MIN.	MAX.
A	4.30	4.50
A1	0.00	0.10
A2	2.30	2.50
b	0.50	0.70
b1	0.00	0.15
c	0.40	0.60
c1	1.17	1.37
D	9.05	9.45
D1	5.90	6.10
E	9.80	10.20
E1	9.36	9.56
E2	0.00	0.30
E3	8.40	8.60
e	1.27	
H	15.00	
L	4.20	5.20
L1	0.70	1.30
L2	1.70	2.30
L3	2.70	
P	0.35	0.55
R	2.03	2.23
S	1.40	1.60
THETA	0.00°	8.00°

NOTES:
1) ALL METAL SURFACES TIN PLATED EXCEPT AREA OF CUT
2) MOLD FILLING IS ACCEPTABLE AT THIS AREA

Figure 1

6 Testing conditions

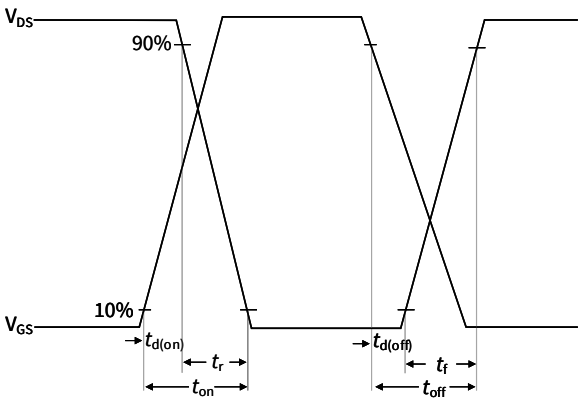


Figure A. **Definition of switching times**

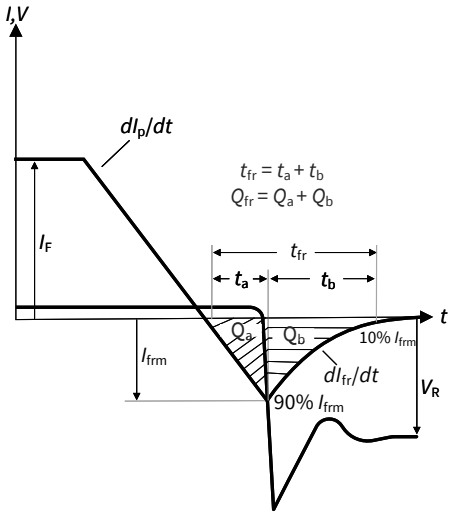


Figure B. **Definition of diode switching characteristics**

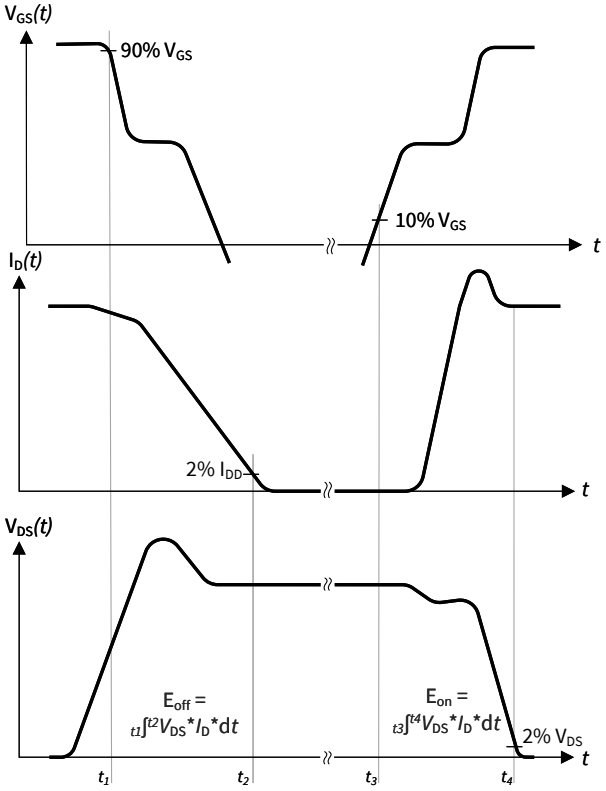


Figure C. **Definition of switching losses**

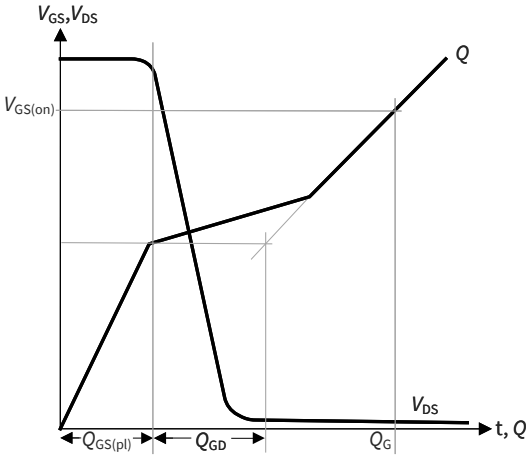


Figure D. **Definition of QGD**

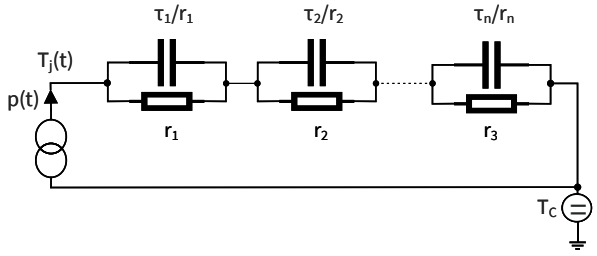


Figure E. **Thermal equivalent circuit**

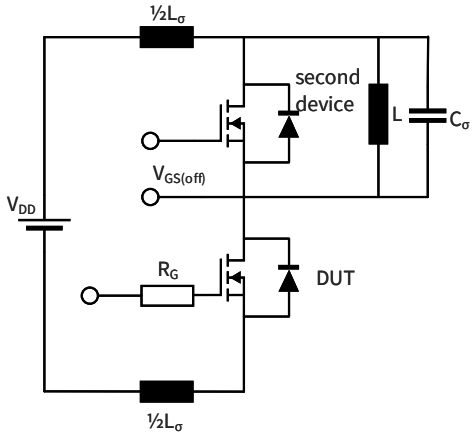


Figure F. **Dynamic test circuit**
Parasitic inductance L_σ,
Parasitic capacitor C_σ,

Figure 2

Revision history

Document revision	Date of release	Description of changes
1.00	2025-03-22	Changed package name Increased Gate-source voltage, max. transient voltage Added Gate-source voltage, max. static voltage Added diode characteristic parameters in Table 5 and Table 6 Added graphs $I_{SD} = f(V_{SD})$, $I_{SD} = f(T_c)$, $Q_{fr} = f(-di_{SD}/dt)$, $I_{frm} = f(-di_{SD}/dt)$ Corrected graph $I_{DS} = f(T_c)$ Editorial changes ***Legacy Revisions*** 2.1 2020-04-27 Final Datasheet 2.2 2020-12-11 Correction of circuit symbol on page 1 2.3 2021-04-12 Editorial changes

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