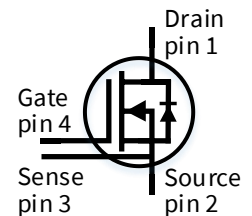


IMZ120R140M1H

CoolSiC™ 1200V SiC Trench MOSFET Silicon Carbide MOSFET

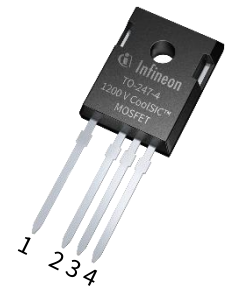
Features

- Very low switching losses
- Threshold-free on state characteristic
- Benchmark gate threshold voltage, $V_{GS(th)} = 4.5V$
- 0V turn-off gate voltage for easy and simple gate drive
- Fully controllable dV/dt
- Robust body diode for hard commutation
- Temperature independent turn-off switching losses
- Sense pin for optimized switching performance



Benefits

- Efficiency improvement
- Enabling higher frequency
- Increased power density
- Cooling effort reduction
- Reduction of system complexity and cost



Potential applications

- Energy generation
 - Solar string inverter and solar optimizer
- Industrial power supplies
 - Industrial UPS
 - Industrial SMPS
- Infrastructure – Charge
 - Charger



Product validation

Qualified for industrial applications according to the relevant tests of JEDEC 47/20/22

Note: *the source and sense pins are not exchangeable, their exchange might lead to malfunction*

Table 1 Key Performance and Package Parameters

Type	V_{DS}	I_D <small>$T_C = 25^\circ C, R_{th(j-c,max)}$</small>	$R_{DS(on)}$ <small>$T_{vj} = 25^\circ C, I_D = 6A, V_{GS} = 18V$</small>	$T_{j,max}$	Marking	Package
IMZ120R140M1H	1200V	19A	140m Ω	175 $^\circ C$	12M1H140	PG-TO247-4

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Maximum ratings

1 Maximum ratings

For optimum lifetime and reliability, Infineon recommends operating conditions that do not exceed 80% of the maximum ratings stated in this datasheet.

Table 2 Maximum ratings

Parameter	Symbol	Value	Unit
Drain-source voltage, $T_{vj} \geq 25^\circ\text{C}$	V_{DSS}	1200	V
DC drain current for $R_{th(j-c,max)}$, limited by T_{vjmax} , $V_{GS} = 18\text{V}$, $T_C = 25^\circ\text{C}$	I_D	19	A
$T_C = 100^\circ\text{C}$		13	
Pulsed drain current, t_p limited by T_{vjmax} , $V_{GS} = 18\text{V}$	$I_{D,pulse}^1$		A
DC body diode forward current for $R_{th(j-c,max)}$, limited by T_{vjmax} , $V_{GS} = 0\text{V}$	I_{SD}	21	A
$T_C = 100^\circ\text{C}$		12	
Pulsed body diode current, t_p limited by T_{vjmax}	$I_{SD,pulse}^1$	32	A
Gate-source voltage ²			
Max transient voltage, < 1% duty cycle	V_{GS}	-7... 23	V
Recommend turn-on gate voltage	$V_{GS,on}$	15... 18	
Recommend turn-off gate voltage	$V_{GS,off}$	0	
Power dissipation, limited by T_{vjmax}	P_{tot}	94	W
$T_C = 100^\circ\text{C}$		47	
Virtual junction temperature	T_{vj}	-55... 175	$^\circ\text{C}$
Storage temperature	T_{stg}	-55... 150	$^\circ\text{C}$
Soldering temperature, wavesoldering only allowed at leads, 1.6mm (0.063 in.) from case for 10 s	T_{sold}	260	$^\circ\text{C}$
Mounting torque, M3 screw Maximum of mounting processes: 3	M	0.6	Nm

¹ verified by design

² **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.

2 Thermal resistances

Table 3

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
MOSFET/body diode thermal resistance, junction – case	$R_{th(j-c)}$		-	1.2	1.6	K/W
Thermal resistance, junction – ambient	$R_{th(j-a)}$	leaded	-	-	62	K/W

Electrical Characteristics

3 Electrical Characteristics

3.1 Static characteristics

Table 4 Static characteristics (at $T_{vj} = 25^\circ\text{C}$, unless otherwise specified)

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
Drain-source on-state resistance	$R_{DS(on)}$	$V_{GS} = 18\text{V}, I_D = 6\text{A},$ $T_{vj} = 25^\circ\text{C}$	-	140	182	m Ω
		$T_{vj} = 100^\circ\text{C}$	-	178	-	
		$T_{vj} = 175^\circ\text{C}$	-	265	-	
		$V_{GS} = 15\text{V}, I_D = 6\text{A},$ $T_{vj} = 25^\circ\text{C}$	-	185	241	
Body diode forward voltage	V_{SD}	$V_{GS} = 0\text{V}, I_{SD} = 6\text{A}$ $T_{vj} = 25^\circ\text{C}$	-	4.1	5.2	V
		$T_{vj} = 100^\circ\text{C}$	-	4.0	-	
		$T_{vj} = 175^\circ\text{C}$	-	3.9	-	
Gate-source threshold voltage	$V_{GS(th)}$	<i>(tested after 1 ms pulse at</i> $V_{GS} = 20\text{V})$ $I_D = 2.5\text{mA}, V_{DS} = V_{GS}$ $T_{vj} = 25^\circ\text{C}$	3.5	4.5	5.7	V
		$T_{vj} = 175^\circ\text{C}$	-	3.6	-	
Zero gate voltage drain current	I_{DSS}	$V_{GS} = 0\text{V}, V_{DS} = 1200\text{V}$ $T_{vj} = 25^\circ\text{C}$	-	tbd	tbd	μA
		$T_{vj} = 175^\circ\text{C}$	-	tbd	-	
Gate-source leakage current	I_{GSS}	$V_{GS} = 23\text{V}, V_{DS} = 0\text{V}$	-	-	tbd	nA
		$V_{GS} = -7\text{V}, V_{DS} = 0\text{V}$	-	-	tbd	nA
Transconductance	g_{fs}	$V_{DS} = 20\text{V}, I_D = 6\text{A}$	-	3	-	S
Internal gate resistance	$R_{G,int}$	$f = 1\text{MHz}, V_{AC} = 25\text{mV}$	-	14	-	Ω

Electrical Characteristics

3.2 Dynamic characteristics

Table 5 Dynamic characteristics (at $T_{vj} = 25^{\circ}\text{C}$, unless otherwise specified)

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
Input capacitance	C_{iss}	$V_{DD} = 800\text{V}, V_{GS} = 0\text{V},$ $f = 1\text{MHz}, V_{AC} = 25\text{mV}$	-	454	-	pF
Output capacitance	C_{oss}		-	25	-	
Reverse capacitance	C_{rss}		-	3	-	
C_{oss} stored energy	E_{oss}		-	9	-	μJ
Total gate charge	Q_G	$V_{DD} = 800\text{V}, I_D = 6\text{A},$ $V_{GS} = 0/18\text{V}, \text{turn-on pulse}$	-	13	-	nC
Gate to source charge	$Q_{GS,pl}$		-	4	-	
Gate to drain charge	Q_{GD}		-	3	-	
Short-circuit withstand time ³	t_{SC}	$V_{DD} = 800\text{V}, L_{\sigma} = 80\text{nH},$ $R_{G,ext} = 80\text{ohm}, T_{vj} = 175^{\circ}\text{C}$ $V_{GS,on} = 15\text{V}$	-	3	-	μs

³ Verified by design for single short circuit event at $V_{GS,on} = 15\text{V}$.

Electrical Characteristics

3.3 Switching characteristics

Table 6 Switching characteristics, Inductive load ⁴

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
MOSFET Characteristics, $T_{vj} = 25^{\circ}\text{C}$						
Turn-on delay time	$t_{d(on)}$	$V_{DD} = 800\text{V}, I_D = 6\text{A},$ $V_{GS} = 0/18\text{V}, R_{G,ext} = 2\Omega,$ $L_{\sigma} = 40\text{nH},$ diode: body diode at $V_{GS} = 0\text{V}$ see Fig. E	-	tbd	-	ns
Rise time	t_r		-	tbd	-	
Turn-off delay time	$t_{d(off)}$		-	tbd	-	
Fall time	t_f		-	tbd	-	
Turn-on energy	E_{on}		-	62	-	μJ
Turn-off energy	E_{off}		-	12	-	
Total switching energy	E_{tot}		-	74	-	
Body Diode Characteristics, $T_{vj} = 25^{\circ}\text{C}$						
Diode reverse recovery charge	Q_{rr}	$V_{DD} = 800\text{V}, I_{SD} = 6\text{A},$ V_{GS} at diode = $0\text{V},$ $di_f/dt = 1000\text{A}/\mu\text{s},$ Q_{rr} includes also $Q_C,$ see Fig. C	-	100	-	μC
Diode peak reverse recovery current	I_{rrm}		-	2	-	A

MOSFET Characteristics, $T_{vj} = 175^{\circ}\text{C}$

Turn-on delay time	$t_{d(on)}$	$V_{DD} = 800\text{V}, I_D = 6\text{A},$ $V_{GS} = 0/18\text{V}, R_{G,ext} = 2\Omega,$ $L_{\sigma} = 40\text{nH},$ diode: body diode at $V_{GS} = 0\text{V}$ see Fig. E	-	tbd	-	ns
Rise time	t_r		-	tbd	-	
Turn-off delay time	$t_{d(off)}$		-	tbd	-	
Fall time	t_f		-	tbd	-	
Turn-on energy	E_{on}		-	88	-	μJ
Turn-off energy	E_{off}		-	13.5	-	
Total switching energy	E_{tot}		-	101.5	-	

Body Diode Characteristics, $T_{vj} = 175^{\circ}\text{C}$

Diode reverse recovery charge	Q_{rr}	$V_{DD} = 800\text{V}, I_{SD} = 6\text{A},$ V_{GS} at diode = $0\text{V},$ $di_f/dt = 1000\text{A}/\mu\text{s},$ Q_{rr} includes also $Q_C,$ see Fig. C	-	125	-	μC
Diode peak reverse recovery current	I_{rrm}		-	3	-	A

⁴ The chip technology was characterized up to 200 kV/ μs . The measured dV/dt was limited by measurement test setup and package.

4 Electrical characteristic diagrams

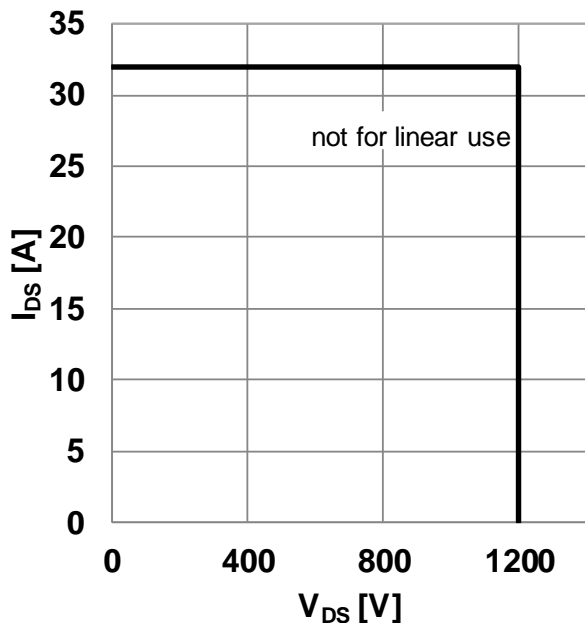


Figure 1 Safe operating area (SOA)
($V_{GS} = 0/18V$, $T_c = 25^\circ C$, $T_j < 175^\circ C$)

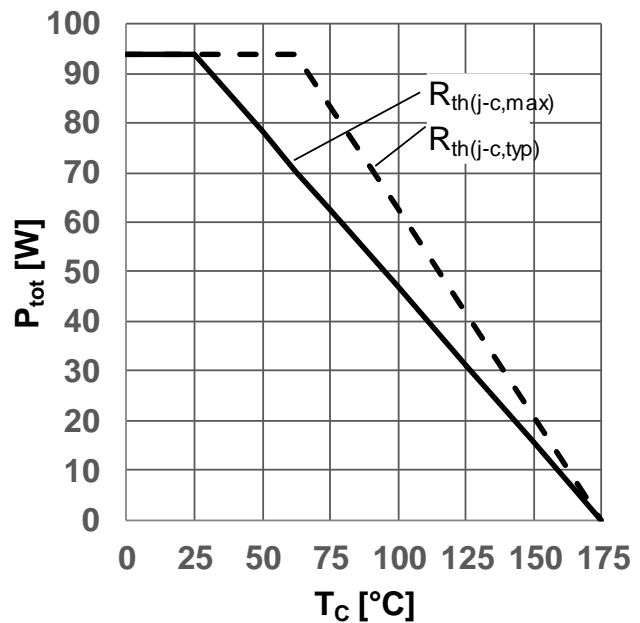


Figure 2 Power dissipation as a function of case temperature limited by bond wire
($P_{tot} = f(T_c)$)

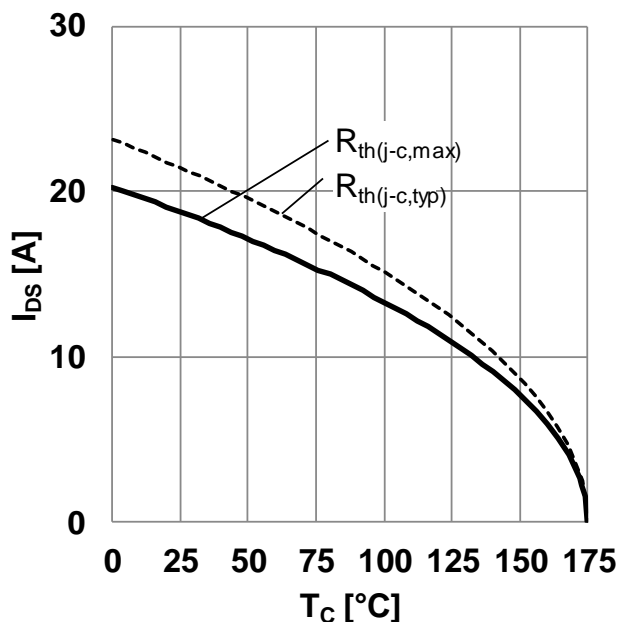


Figure 3 Maximum DC drain to source current as a function of case temperature limited by bond wire ($I_{DS} = f(T_c)$)

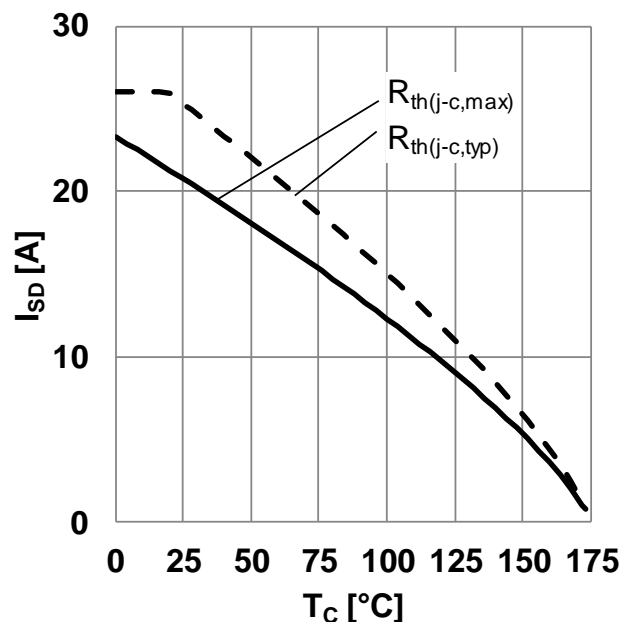


Figure 4 Maximum source to drain current as a function of case temperature limited by bond wire ($I_{SD} = f(T_c)$, $V_{GS} = 0V$)

Electrical characteristic diagrams

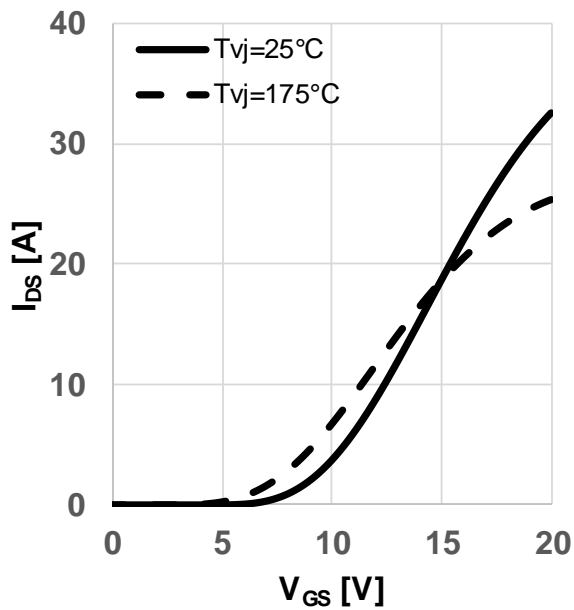


Figure 5 Typical transfer characteristic
 ($I_{DS} = f(V_{GS})$, $V_{DS} = 20\text{V}$, $t_P = 20\mu\text{s}$)

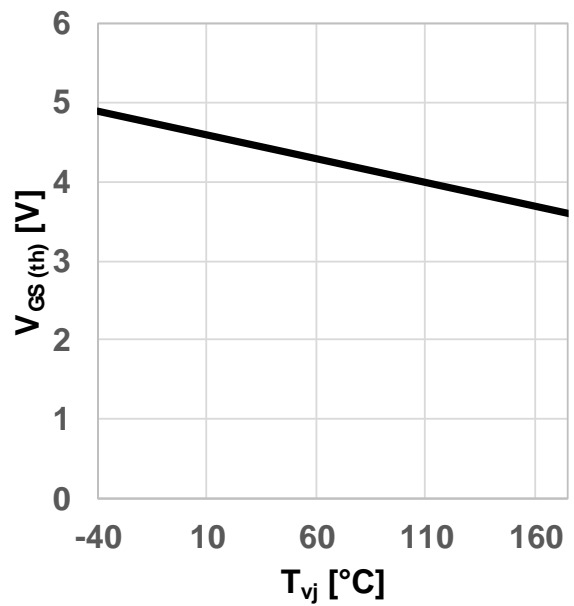


Figure 6 Typical gate-source threshold voltage as a function of junction temperature
 ($V_{GS(th)} = f(T_{vj})$, $I_{DS} = 2.5\text{mA}$, $V_{GS} = V_{DS}$)

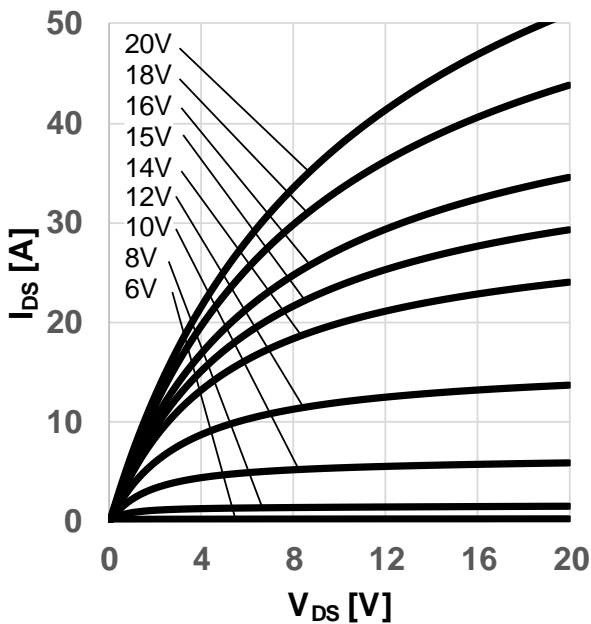


Figure 7 Typical output characteristic, V_{GS} as parameter
 ($I_{DS} = f(V_{DS})$, $T_{vj}=25^{\circ}\text{C}$, $t_P = 20\mu\text{s}$)

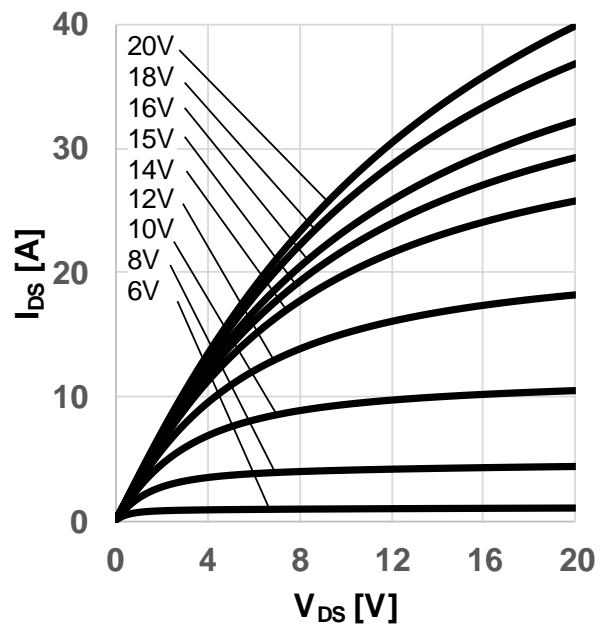


Figure 8 Typical output characteristic, V_{GS} as parameter
 ($I_{DS} = f(V_{DS})$, $T_{vj}=175^{\circ}\text{C}$, $t_P = 20\mu\text{s}$)

Electrical characteristic diagrams

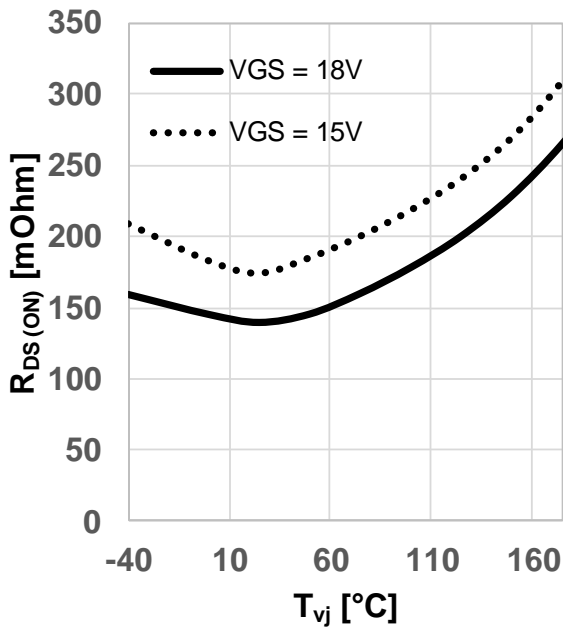


Figure 9 Typical on-resistance as a function of junction temperature
($R_{DS(on)} = f(T_{vj})$, $I_{DS} = 6A$)

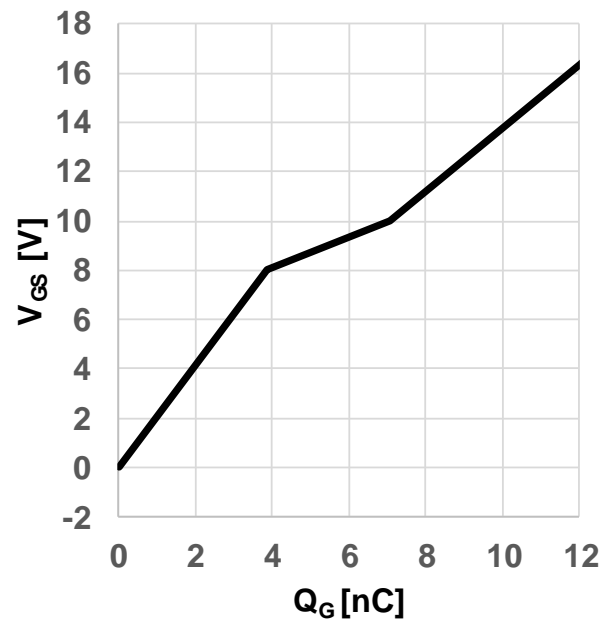


Figure 10 Typical gate charge
($V_{GS} = f(Q_G)$, $I_{DS} = 6A$, $V_{DS} = 800V$, turn-on pulse)

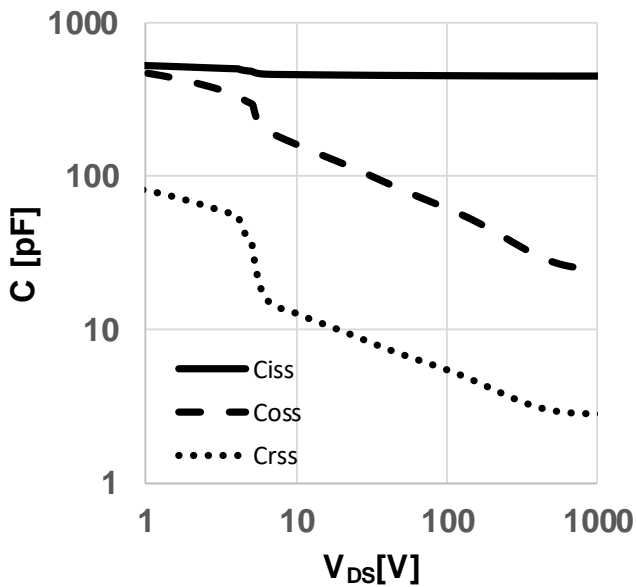


Figure 11 Typical capacitance as a function of drain-source voltage
($C = f(V_{DS})$, $V_{GS} = 0V$, $f = 1MHz$)

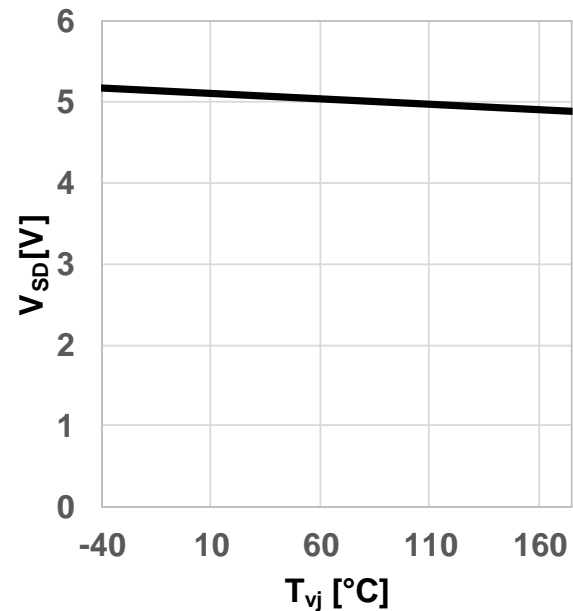


Figure 12 Typical body diode forward voltage as function of junction temperature
($V_{SD} = f(T_{vj})$, $V_{GS} = 0V$, $I_{SD} = 6A$)

Electrical characteristic diagrams

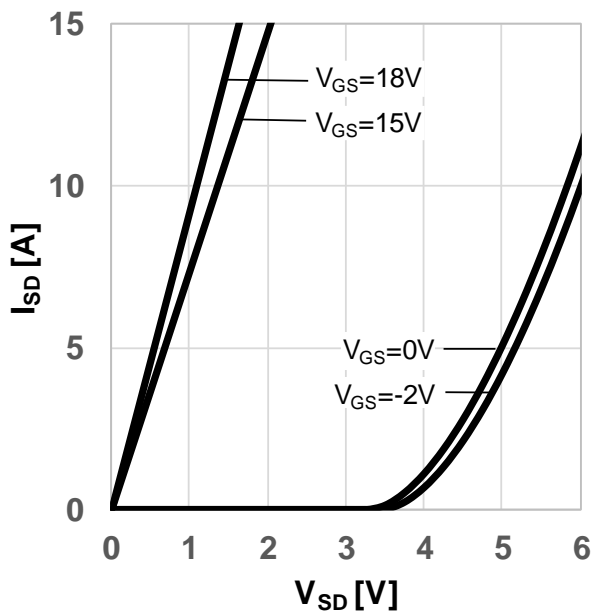


Figure 13 Typical body diode forward current as function of forward voltage, V_{SD} as parameter
 $(I_{SD} = f(V_{SD}), T_{vj} = 25^{\circ}\text{C}, t_P = 20\mu\text{s})$

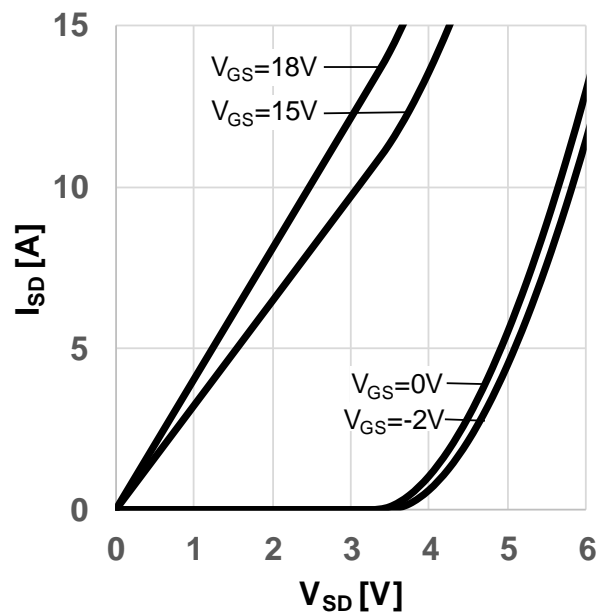


Figure 14 Typical body diode forward current as function of forward voltage, V_{SD} as parameter
 $(I_{SD} = f(V_{SD}), T_{vj} = 175^{\circ}\text{C}, t_P = 20\mu\text{s})$

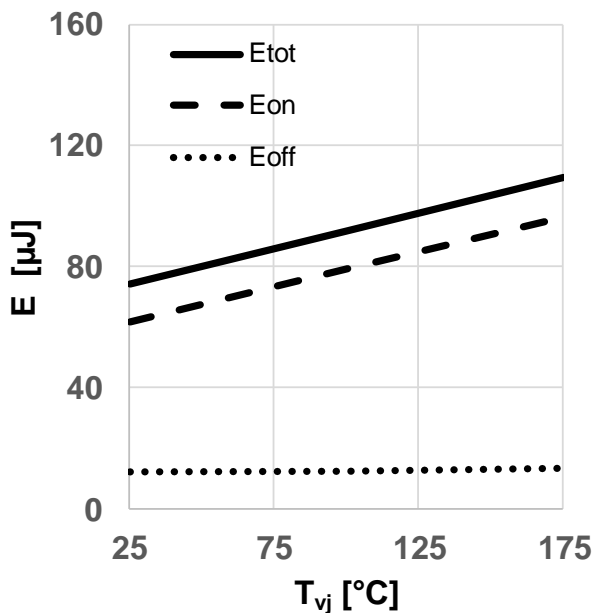


Figure 15 Typical switching energy losses as a function of junction temperature
 $(E = f(T_{vj}), V_{DD} = 800\text{V}, V_{GS} = 0\text{V}/18\text{V}, R_{G,ext} = 2\Omega, I_D = 6\text{A}, \text{ind. load, test circuit in Fig. E, diode: body diode at } V_{GS} = 0\text{V})$

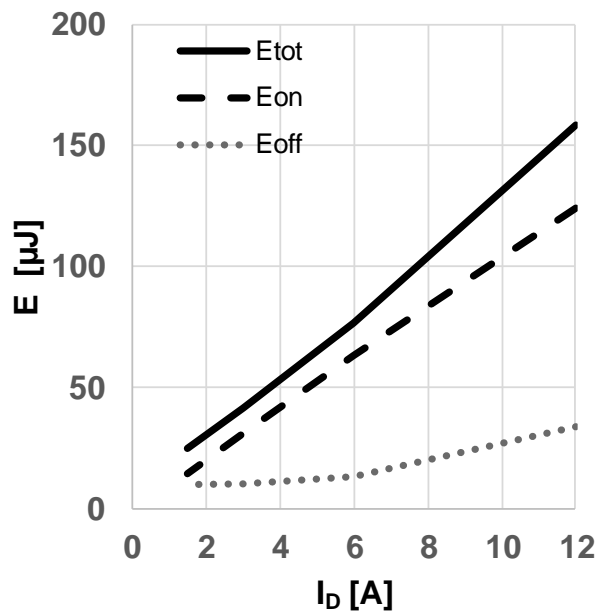


Figure 16 Typical switching energy losses as a function of drain-source current
 $(E = f(I_{DS}), V_{DD} = 800\text{V}, V_{GS} = 0\text{V}/18\text{V}, R_{G,ext} = 2\Omega, T_{vj} = 175^{\circ}\text{C}, \text{ind. load, test circuit in Fig. E, diode: body diode at } V_{GS} = 0\text{V})$

Electrical characteristic diagrams

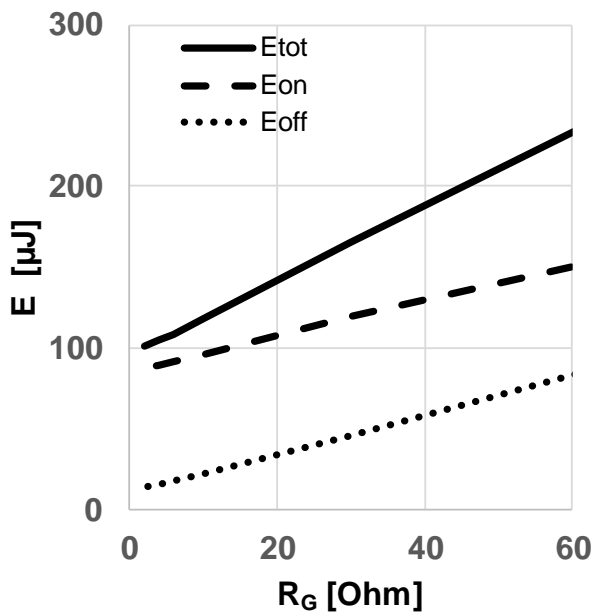


Figure 17 Typical switching energy losses as a function of gate resistance
 $(E = f(R_{G,ext}), V_{DD} = 800V, V_{GS} = 0V/18V,$
 $I_D = 6A, T_{vj} = 175^\circ C, \text{ind. load, test circuit in}$
 Fig. E, diode: body diode at $V_{GS} = 0V)$

tbd

Figure 18 Typical switching times as a function of gate resistor

$(t = f(R_{G,ext}), V_{DD} = 800V, V_{GS} = 0V/18V,$
 $I_D = 6A, T_{vj} = 175^\circ C, \text{ind. load, test circuit in}$
 Fig. E, diode: body diode at $V_{GS} = 0V)$

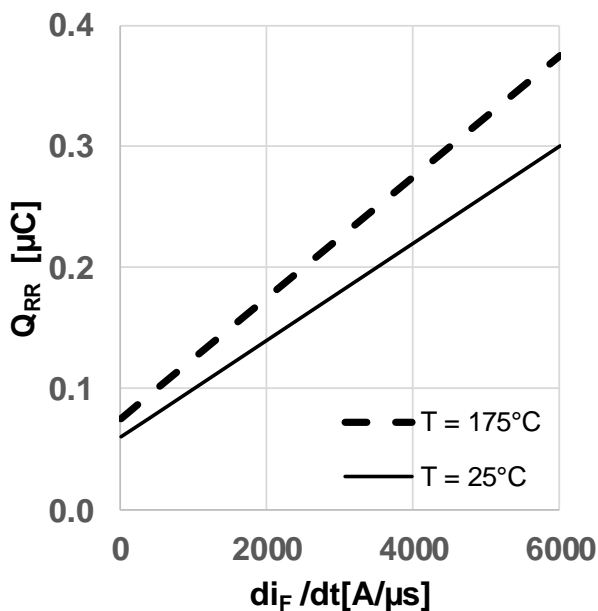


Figure 19 Typical reverse recovery charge as a function of diode current slope
 $(Q_{rr} = f(di_i/dt), V_{DD} = 800V, V_{GS} = 0V/18V,$
 $I_D = 6A, \text{ind. load, test circuit in Fig.E, body}$
 diode at $V_{GS} = 0V)$

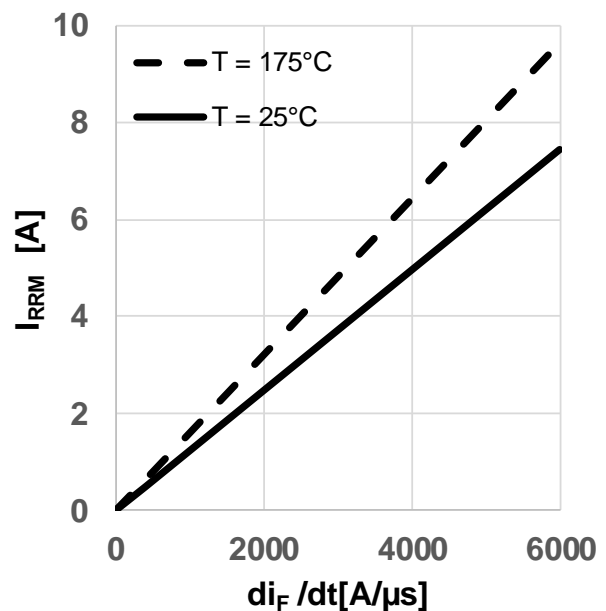


Figure 20 Typical reverse recovery current as a function of diode current slope
 $(I_{rrm} = f(di_i/dt), V_{DD} = 800V, V_{GS} = 0V/18V,$
 $I_D = 6A, \text{ind. load, test circuit in Fig.E,}$
 body diode at $V_{GS} = 0V)$

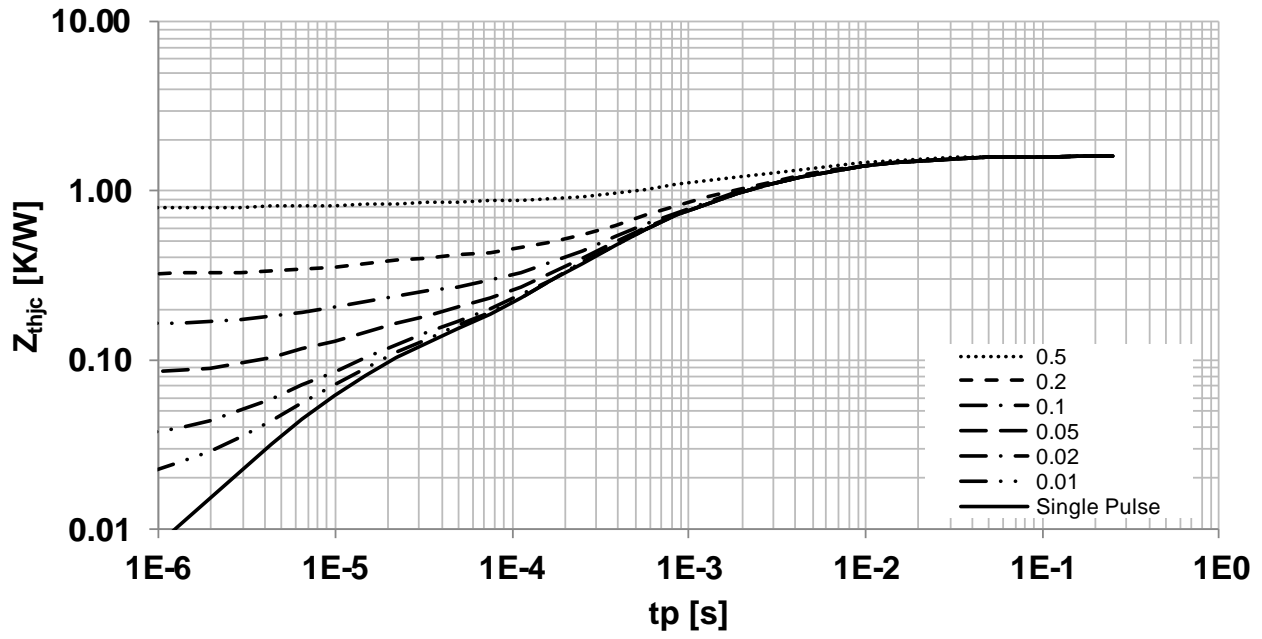


Figure 21 Max. transient thermal resistance (MOSFET/diode)
 $(Z_{th(j-c,max)} = f(t_p))$, parameter $D = t_p/T$, thermal equivalent circuit in Fig. D)

5 Package drawing

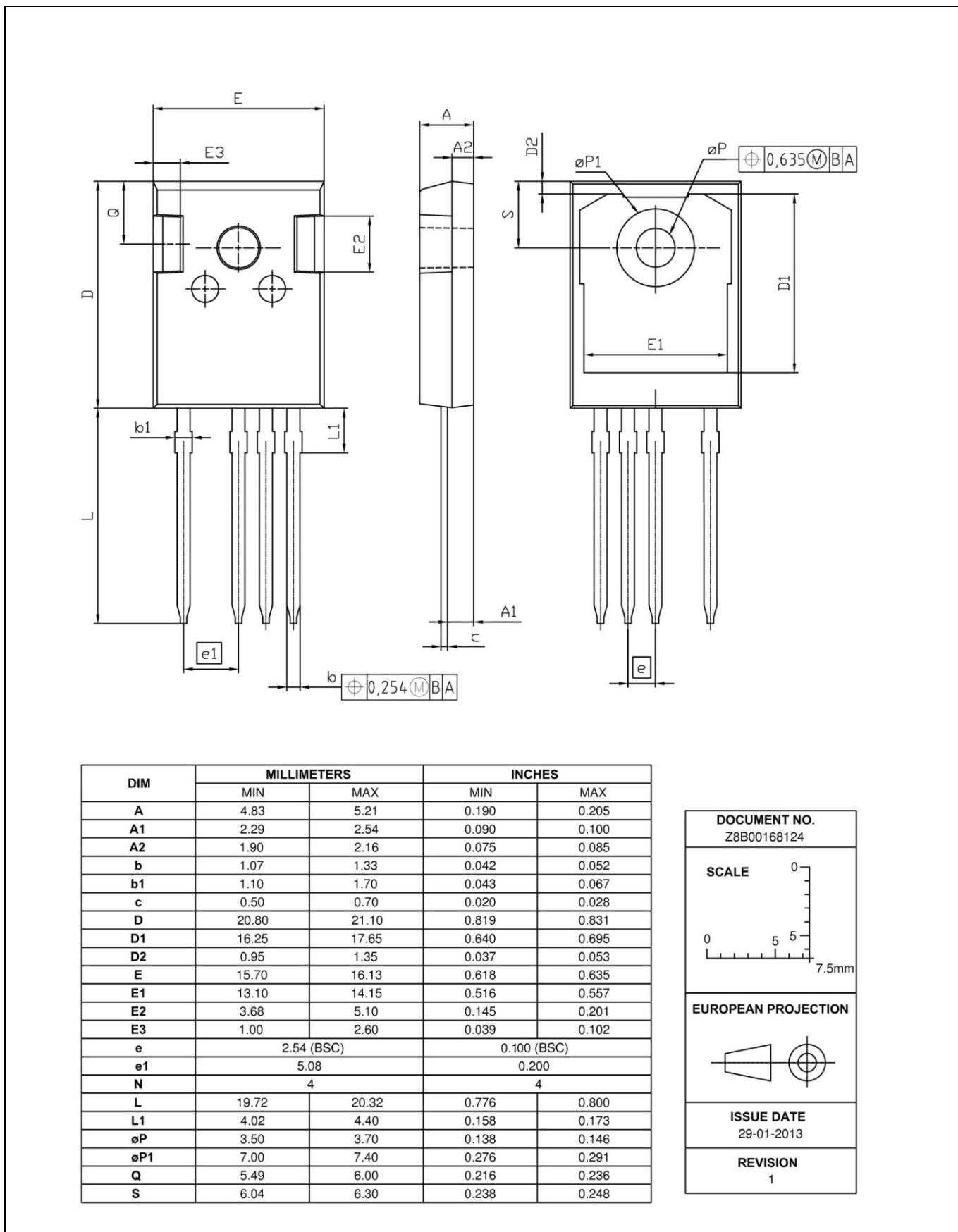


Figure 22 Package drawing

Test conditions

6 Test conditions

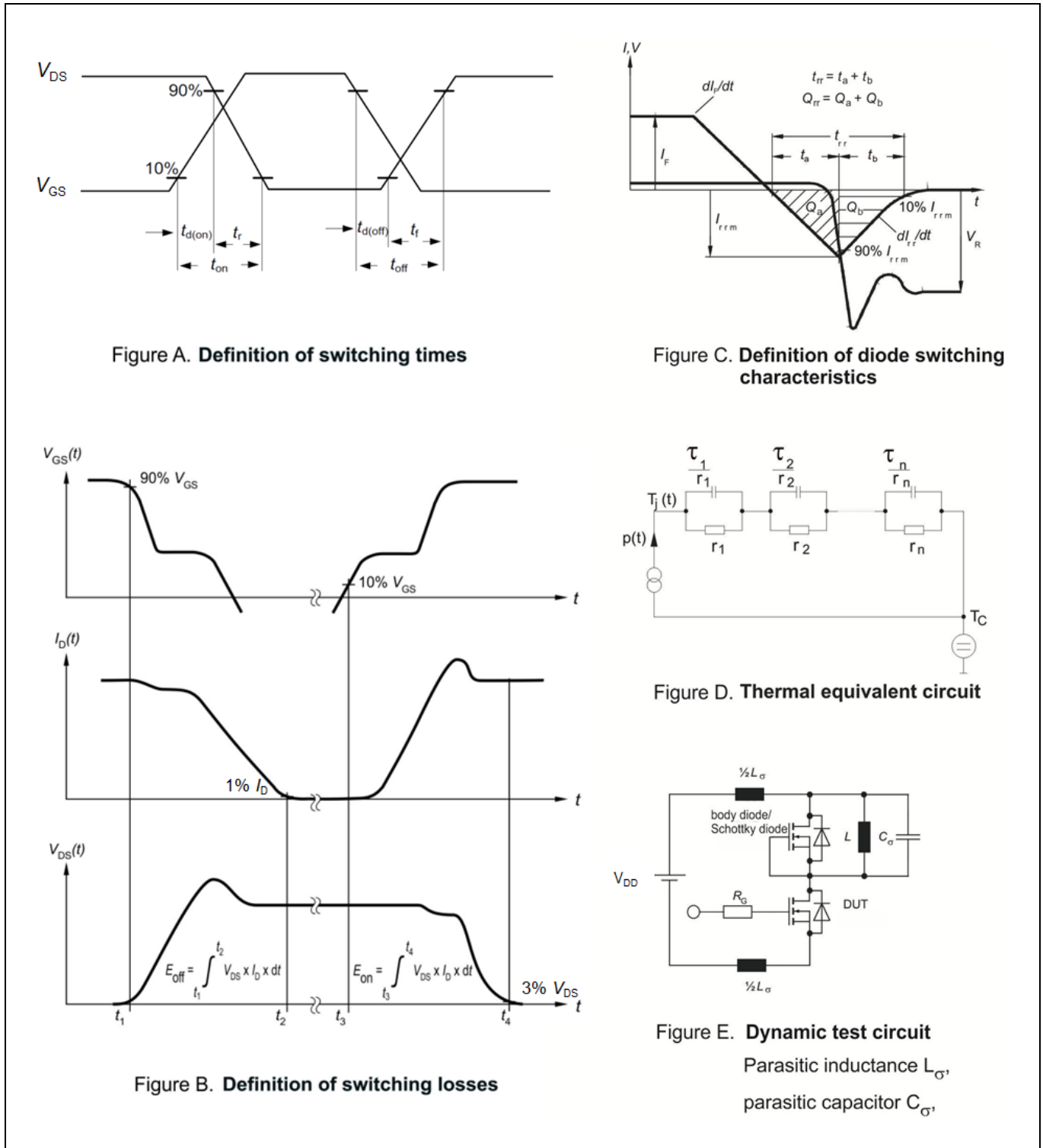


Figure 23 Test conditions

Revision history

Revision history

Document version	Date of release	Description of changes
0.9	2019-01-24	Initial version

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