1700V N-Channel Silicon Carbide Power MOSFET

1. Applications

Asymmetrical Bridge
Converter
Inverter
Single Switch Forward
Flyback

2. Features

Low drain-source on-resistance: RDS(ON)=22mΩ (typ.)
Easy to control Gate switching
Enhancement mode: Vth = 2.0 to 4.0 V

Table 1 Key Performance Parameters

Parameter	Value	Unit
V_{DS} @ $T_{j,max}$	1700	V
$R_{DS(on),max}$	35	mΩ
$Q_{g,typ}$	220.4	nC
$I_{D,pulse}$	226	A

3. Packaging and Internal Circuit

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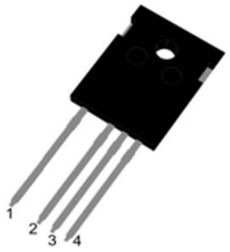

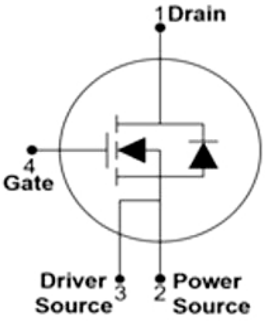

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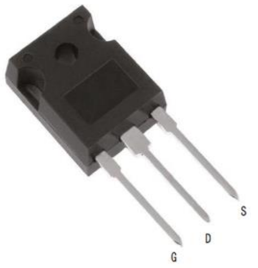
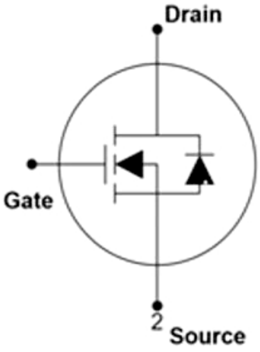




1 Maximum ratings

at T_j = 25°C, unless otherwise specified

Table 2 Maximum ratings

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Continuous drain current[1]	I_D	-	-	114	A	TC=25°C
		-	-	82	A	TC=100°C
Pulsed drain current[2]	$I_{D,pulse}$	-		226	A	T_C=25°C
Gate source voltage (dynamic)	V_{GS}	-10	-	25	V	Absolute maximum values
Gate source voltage (static)	V_{GS}	-5	-	20	V	Recommended operational values
Power dissipation	P_{tot}	-	-	750	W	TC=25°C
Storage temperature	T_{stg}	-55	-	175	°C	
Operating junction temperature	T_j	-55	-	175	°C	
Soldering Temperature Distance of 1.6mm from case for 10s	T_L			260	°C	
Transconductance	GFS	-	40.2	-	S	VDS=20V IDS=50A
			41			VDS=20V IDS=50A, Tj=175°C

[1] Limited by $T_{j,max}$. Maximum Duty Cycle D = 0.50
[2] Pulse width t_p limited by $T_{j,max}$
[3] Identical low side and high side switch with identical R_G

2 Thermal characteristics

Table 3 Thermal characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Thermal resistance, junction - case	R_{thJC}	-	0.2	-	°C/W	-
Thermal resistance, junction - ambient	R_{thJA}	-	25.1	-	°C/W	device on PCB, minimal footprint

3 Electrical characteristics

at T_j=25°C, unless otherwise specified

Table 4 Static characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Drain-source breakdown voltage	$V_{(BR)DSS}$	1700	-	-	V	V_{GS}=0V, I_D=100uA
Gate threshold voltage	$V_{(GS)th}$	2.0	2.5	4	V	V_{DS}=V_{GS}, I_D=18mA
Zero gate voltage drain current	I_{DSS}	-	-	100	uA	V_{DS}=1700V, V_{GS}=0V
Gate-source leakage current	I_{GSS+}	-	-	600	nA	V_{GS}=22V, V_{DS}=0V
Gate-source leakage current	I_{GSS-}	-	-	-600	nA	V_{GS}=-10V, V_{DS}=0V
Drain-source on-state resistance	$R_{DS(on)}$	-	22	35	mΩ	V_{GS}=20V, I_D=30A, T_j=25°C
Gate resistance (Intrinsic)	R_G	-	1.8	-	Ω	f=1MHz, open drain

Table 5 Dynamic characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Input capacitance	C_{iss}	-	3629	-	pF	*VGS=0V, VDS=1200V, f=1MHz*
Output capacitance	C_{oss}	-	127.9	-	pF	
Reverse transfer capacitance	C_{rss}	-	12.9	-	pF	
Turn-on delay time	$t_{d(on)}$	-	29	-	ns	V_{DD}=1200V, I_D=50A,R_G=2.5Ω; T_J =25℃ *VGS=-5/20V L=99uH*
Rise time	t_r	-	14.4	-	ns	
Turn-off delay time	$t_{d(off)}$	-	39.7	-	ns	
Fall time	t_f	-	12.2	-	ns	
Turn-on Switching Energy	*Eon*		1075		uJ	
Turn-off Switching Energy	*Eoff*		456		uJ	

Table 6 Gate charge characteristics

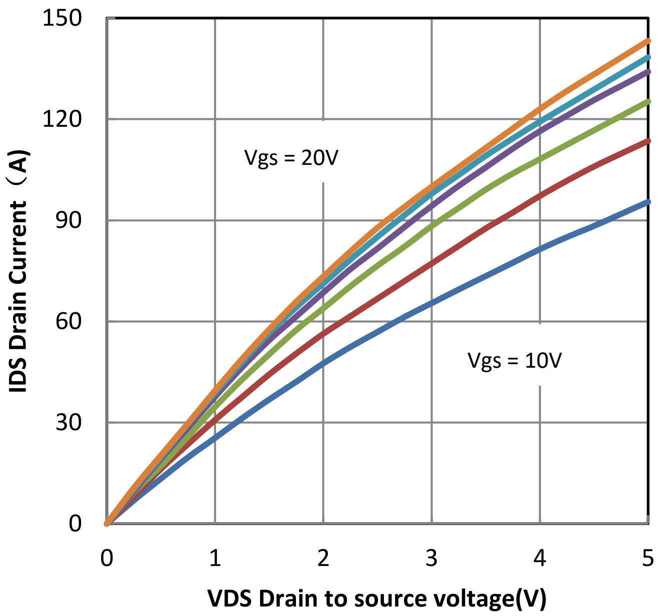
Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Gate to source charge	Q_{gs}	-	37.1	-	nC	V_{DD}=1200V, I_D=50A, V_{GS}=-5/20V
Gate to drain charge	Q_{gd}	-	45.6	-	nC	
Gate charge total	Q_g	-	220.4	-	nC	

Table 7 Reverse diode characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Continuous Source Current	I_{SD}	-	-	113	A	
Diode forward voltage	V_{SD}	-	3.9	-	V	I_S=25A, V_{GS} =-5V, T_j=25°C
Reverse recovery time	t_{rr}	-	43.1	-	ns	VGS = -5 V, ISD = 50 A, VR = 1200 V di/dt = 4030 A/μs
Reverse recovery charge	Q_{rr}	-	549	-	nC	
Peak reverse recovery current	I_{rrm}	-	22.7	-	A	

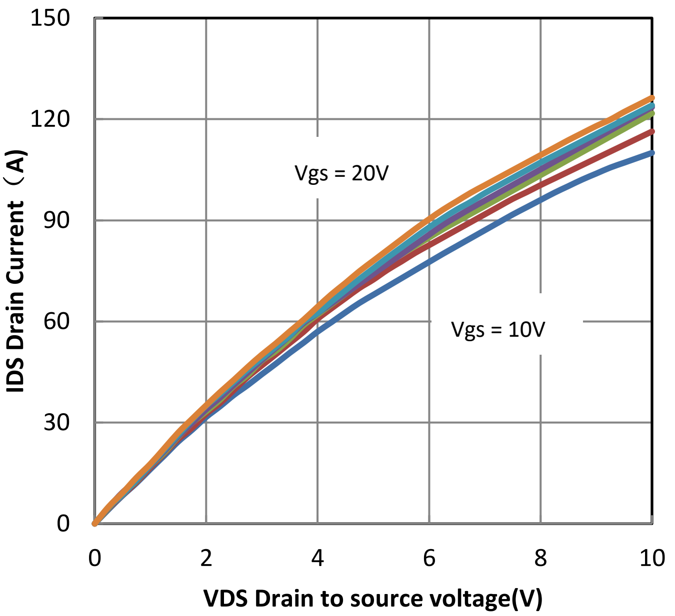
4 Electrical characteristics diagram

Diagram 1: Typ. output characteristics



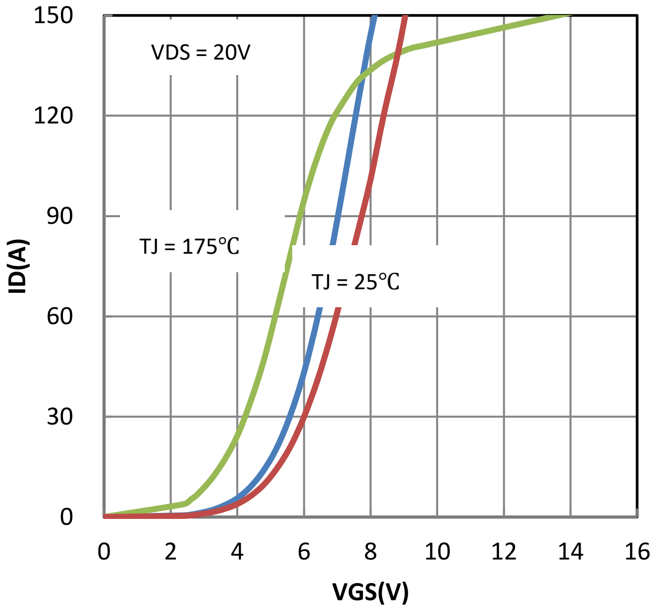
I_D=f(V_{DS});T_j=25 °C; parameter: $V_{GS;}$ VGS=10,12,14,16,18,20V

Diagram 2: Typ. output characteristics



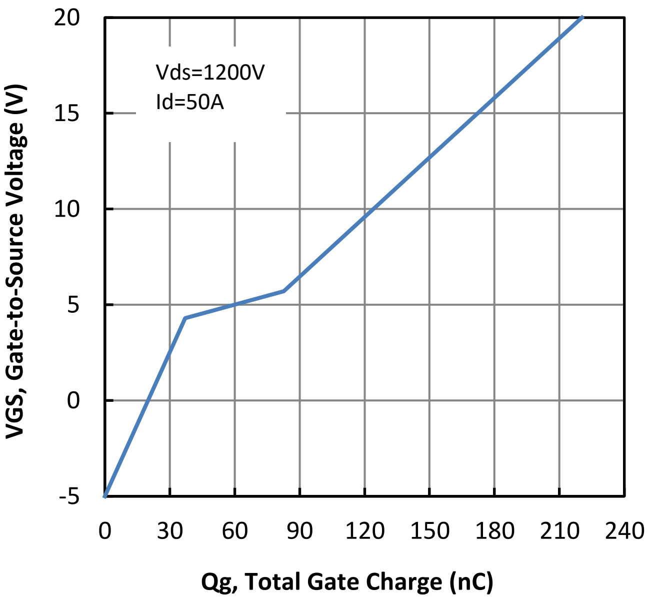
I_D=f(V_{DS});T_j=175 °C; parameter: $V_{GS;}$ VGS=10,12,14,16,18,20V

Diagram 3: Typ. transfer characteristics



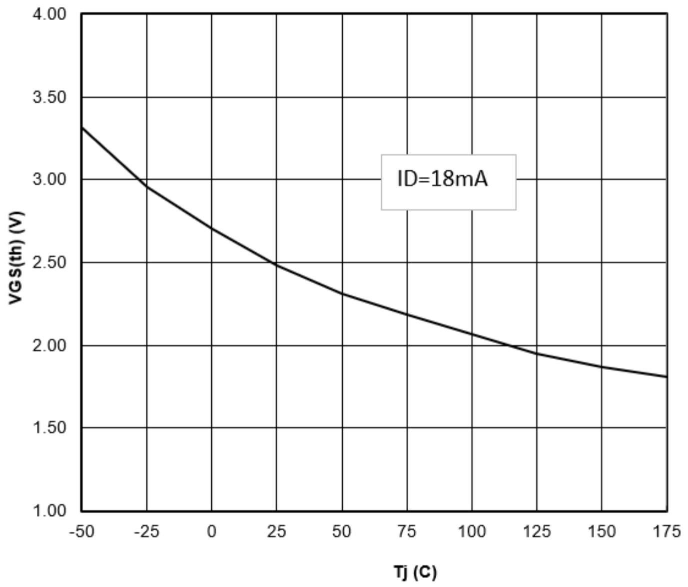
I_D=f(V_{GS}); V_{DS} =20V; parameter: T_j

Diagram 4: Typ. gate charge



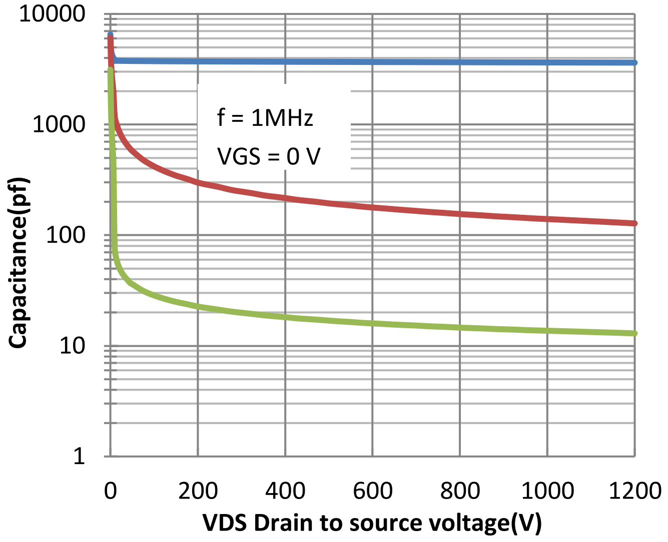
V_{GS}=f(Q_{gate});I_D=50A ; V_{DS} =1200V; turn-on pulse

Diagram 5: Typical gate-source threshold voltage as a function of junction temperature



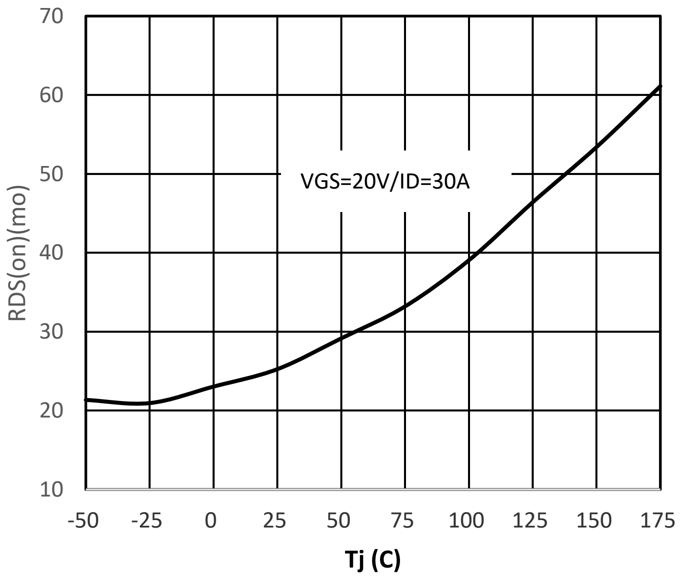
$V_{GS(th)}$=f(T_j); I_{DS}=18mA; V_{GS}=V_{DS}

Diagram 6: Typ. Capacitance as a function of drain-source voltage



C=f(V_{DS});V_{GS}=0V; f=1MHz

Diagram 7: Typical resistance vs. junction temperature



$R_{DS(ON)}$=f(T_j);I_{DS}=30A

Diagram 8: Typical body diodes Characteristics at 25C

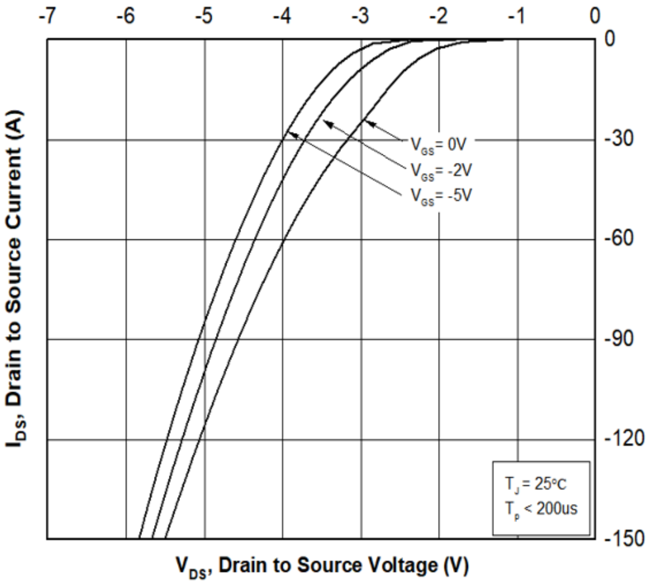
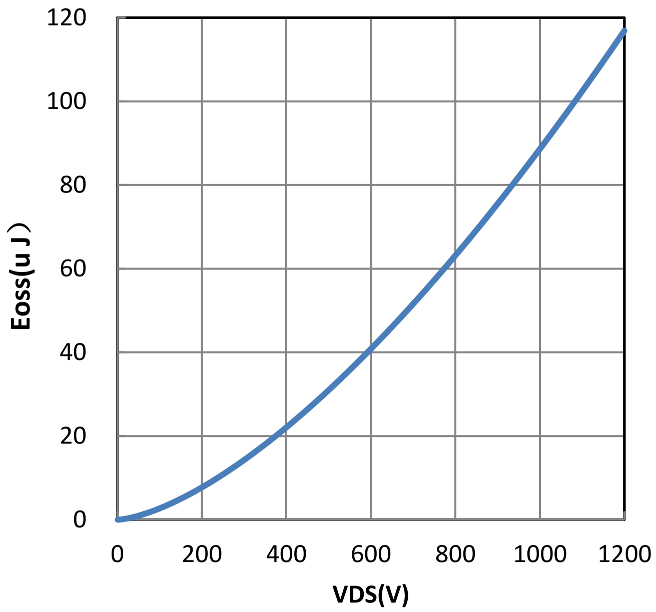
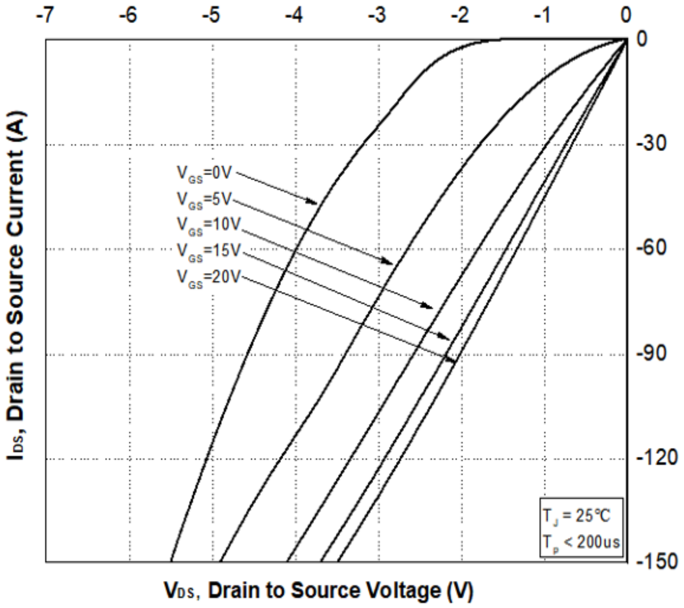


Diagram 9: Output Capacitor Stored Energy



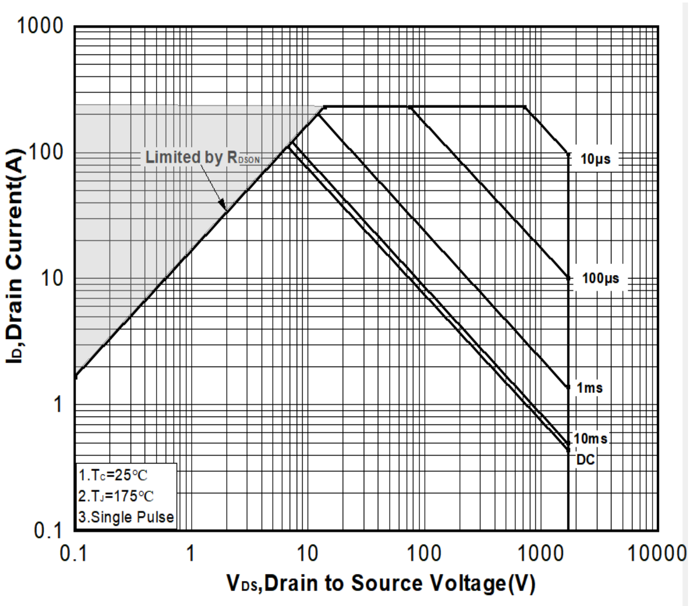
Eoss=f(VDS)

Diagram 10: 3rd Quadrant Characteristic at 25 °C



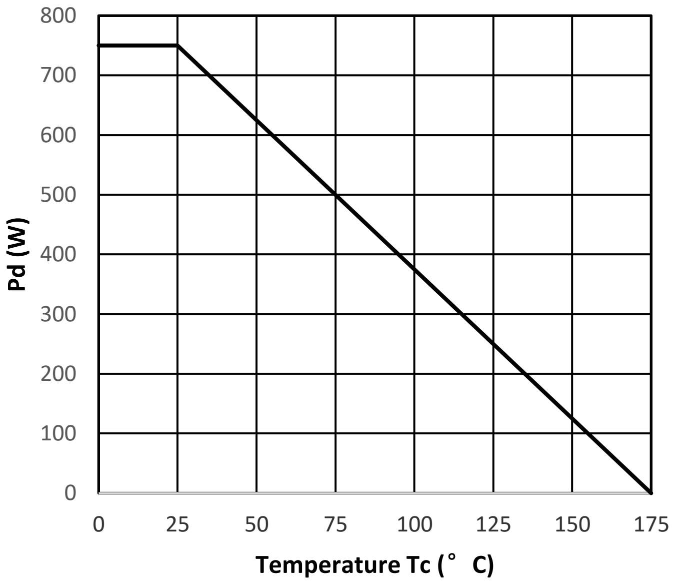
I_{SD}=f(V_{SD})

Diagram 11: Safe operating area(SOA)



V_{GS}=0/18V; T_C=25 °C; T_j<175 °C

Diagram 12: Power dissipation as a function of case temperature limited by bond wire



P_{tot}= f(T_C)

Diagram 13: Clamped Inductive Switching Energy vs. Drain Current (VDD = 800V)

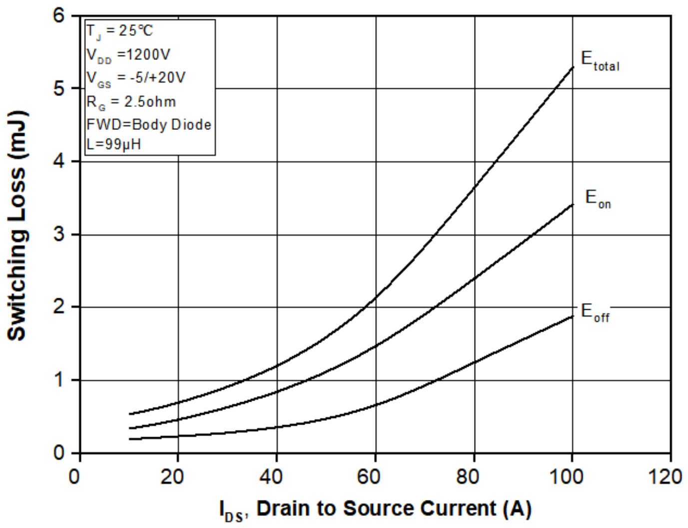


Diagram 14: Clamped Inductive Switching Energy vs. RG(ext)

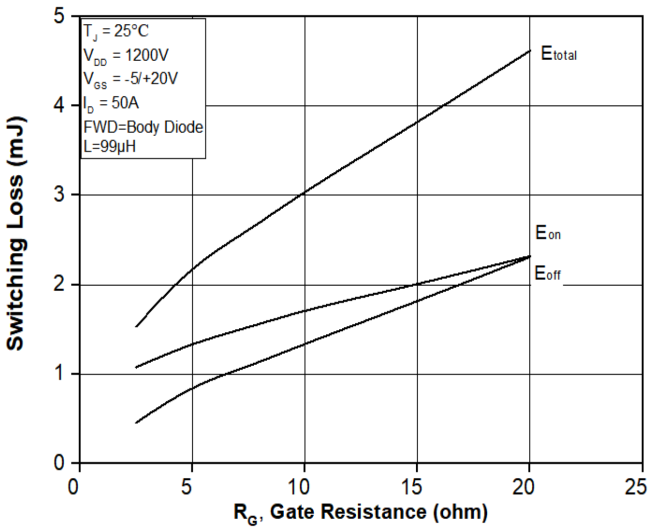


Diagram 15: Clamped Inductive Switching Energy vs. Temperature

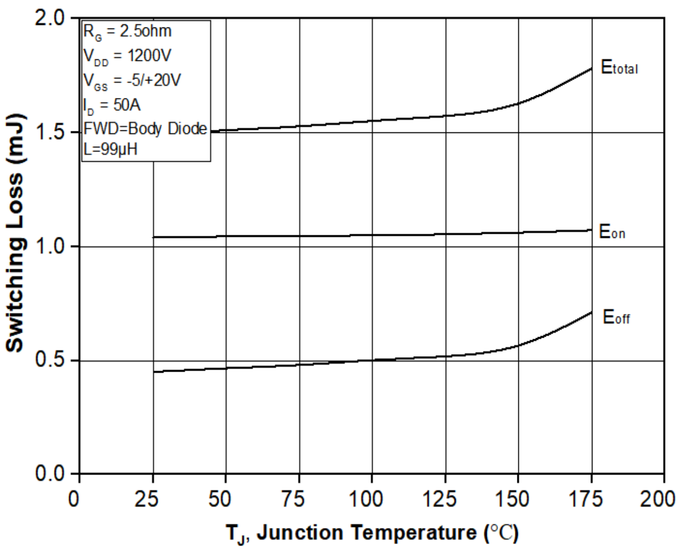
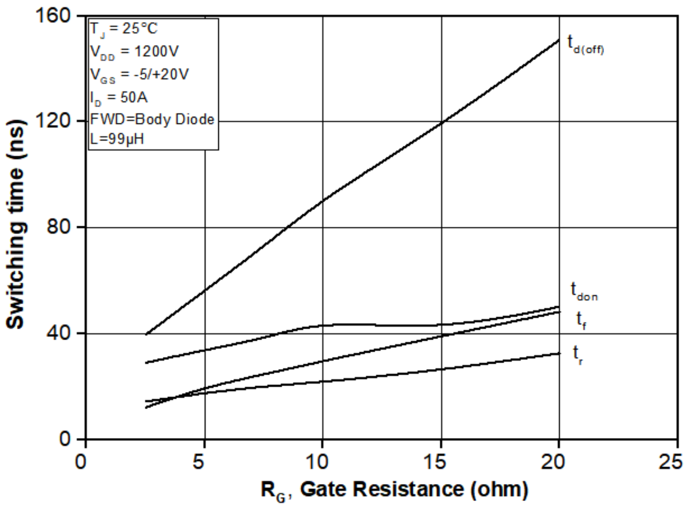


Diagram 16: Switching Times vs. RG(ext)



<table>
<tr><th>Diagram 17: Continuous Drian Current Derating vs. Case Temperature</th><th>Diagram 18: Max. transient thermal resistance (MOSFET/ diodes)</th></tr>
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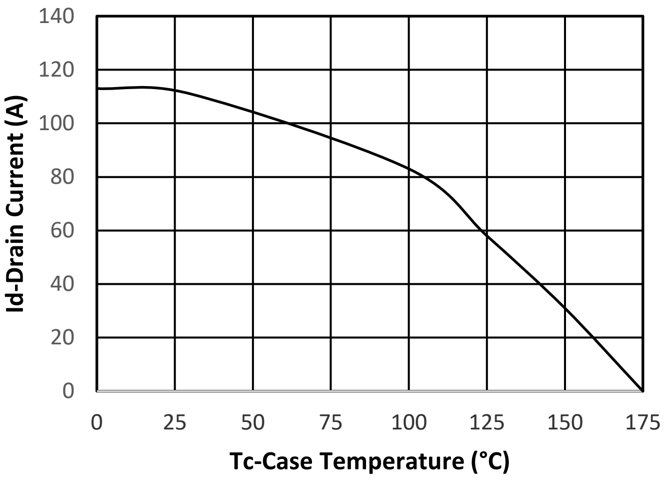

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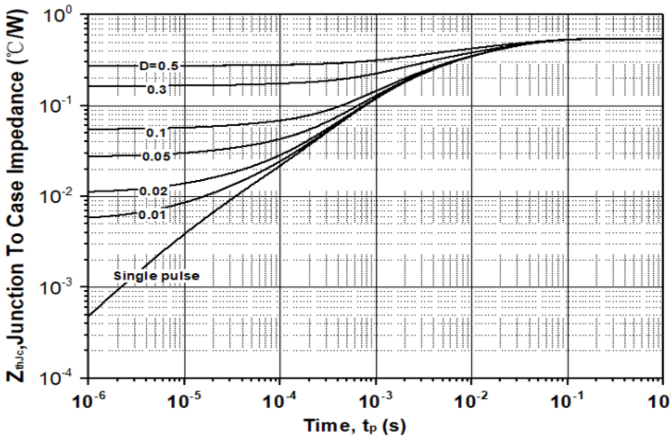

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<tr><td>I_{DS}= f(T_C)</td><td>$Z_{th(j\text{-}c,max)}$= f(t_p),parameter D= t_p/T</td></tr>
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5 Test Circuits

Table 8 Diode characteristics

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<tr><th>Test circuit for diode characteristics</th><th>Diode recovery waveform</th></tr>
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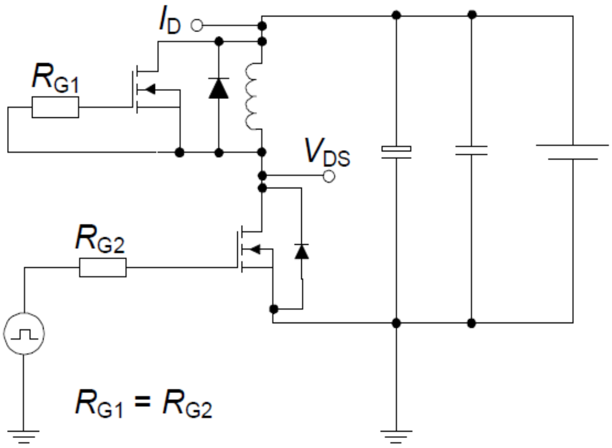

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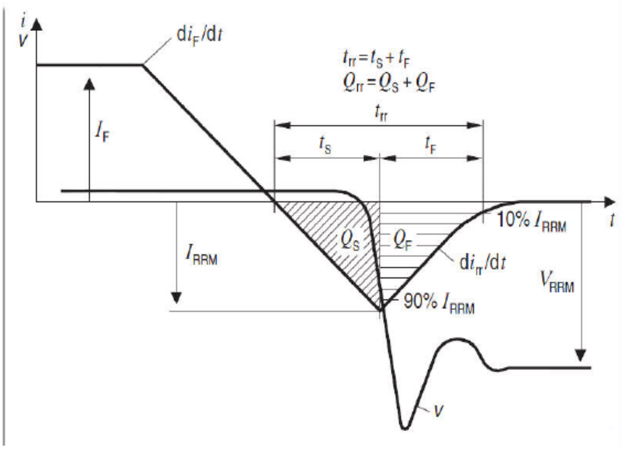

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Table 9 Switching times

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<tr><th>Switching times test circuit for inductive load</th><th>Switching times waveform</th></tr>
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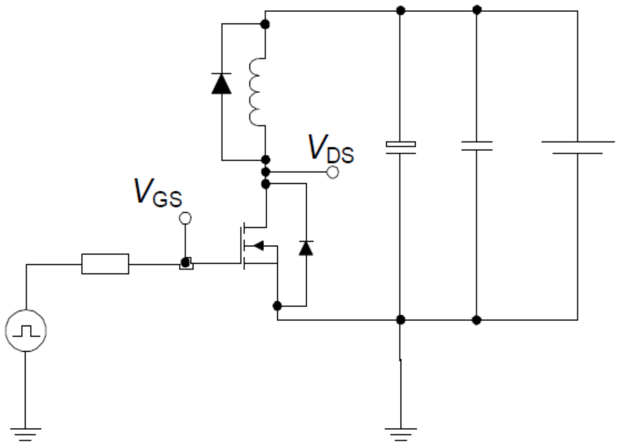

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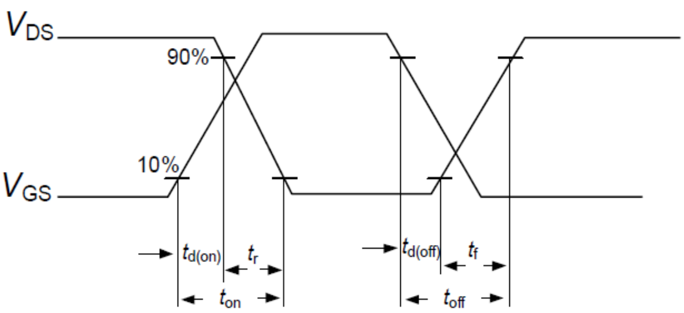

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6 Package Outlines

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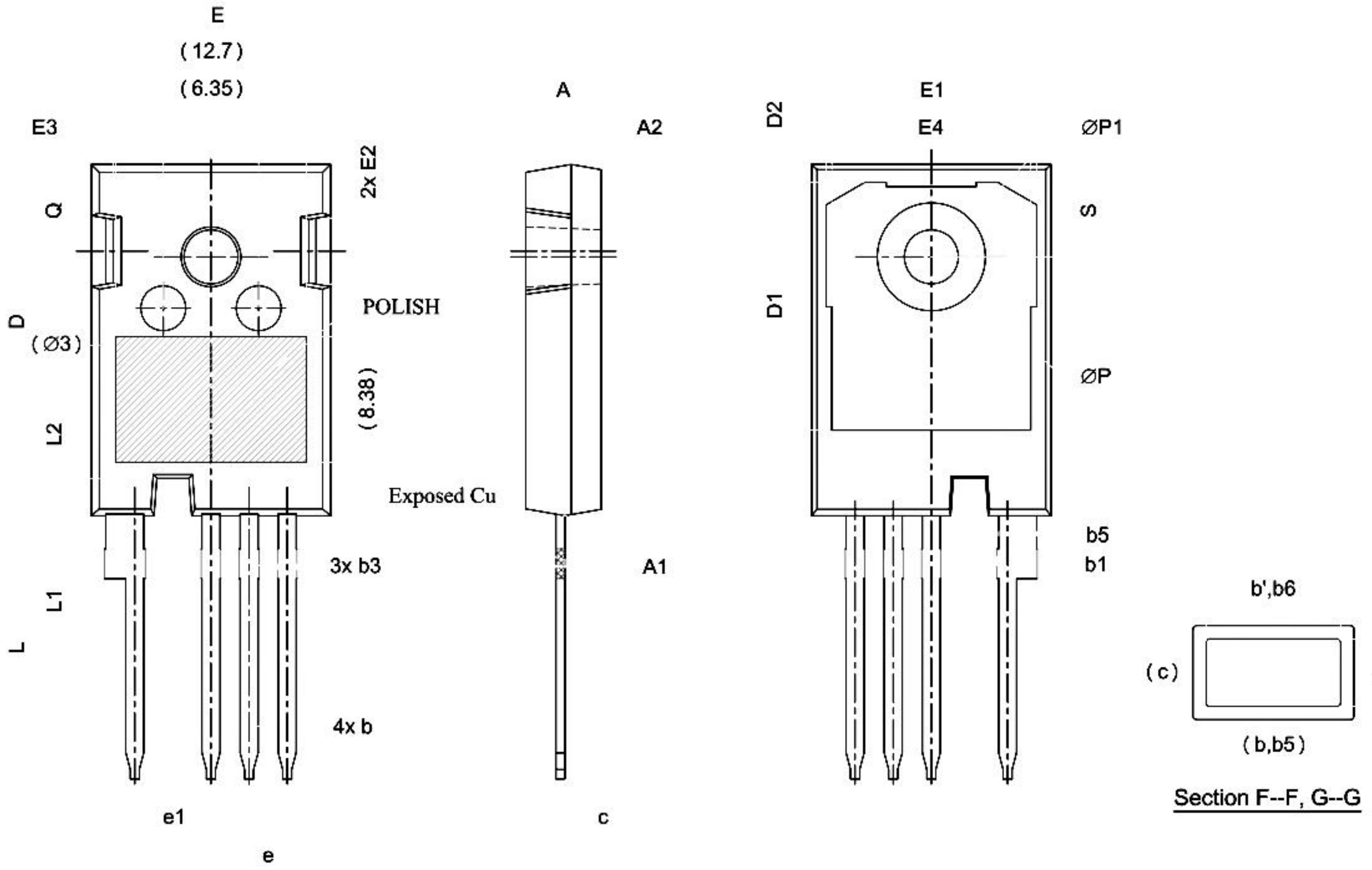

SYMBOL	DIMENSIONS		
	MIN.	NOM.	MAX.
A	4.83	5.02	5.21
A1	2.29	2.41	2.54
A2	1.91	2.00	2.16
b'	1.07	1.20	1.28
b	1.07	1.20	1.33
b1	2.39	2.67	2.94
b3	1.07	1.30	1.60
b5	2.39	2.53	2.69
b6	2.39	2.53	2.64
c	0.55	0.60	0.68
c1	0.55	0.60	0.65
D	23.30	23.45	23.60
D1	16.25	16.55	17.65
D2	0.95	1.19	1.25
E	15.75	15.94	16.13
E1	13.10	14.02	14.15
E2	3.68	4.40	5.10
E3	1.00	1.45	1.90
E4	12.38	13.26	13.43
e	2.54 BSC		
e1	5.08 BSC		
L	17.31	17.57	17.82
L1	3.97	4.19	4.37
L2	2.35	2.50	2.65
ØP	3.51	3.61	3.65
ØP1	7.19 REF.		
Q	5.49	5.79	6.00
S	6.04	6.17	6.30

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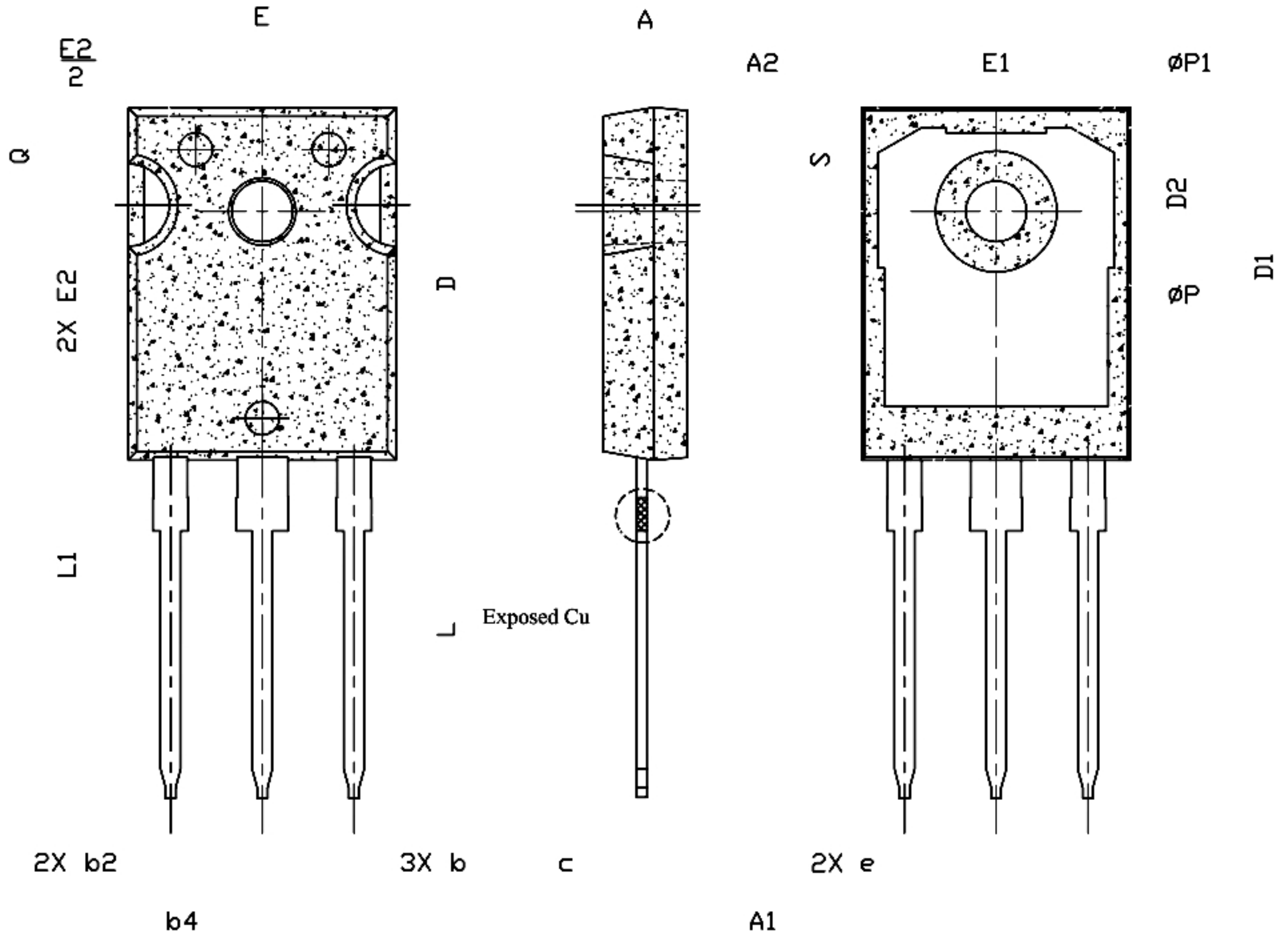

SYMBOL	DIMENSIONS			NOTES
	MIN.	NOM.	MAX.	
A	4.83	5.02	5.21	
A1	2.29	2.41	2.55	
A2	1.50	2.00	2.49	
b	1.12	1.20	1.33	
b1	1.12	1.20	1.28	
b2	1.91	2.00	2.39	6
b3	1.91	2.00	2.34	
b4	2.87	3.00	3.22	6, 8
b5	2.87	3.00	3.18	
c	0.55	0.60	0.69	6
c1	0.55	0.60	0.65	
D	20.80	20.95	21.10	4
D1	16.25	16.55	17.65	5
D2	0.51	1.19	1.35	
E	15.75	15.94	16.13	4
E1	13.46	14.02	14.16	5
E2	4.32	4.91	5.49	3
e		5.44BSC		
L	19.81	20.07	20.32	
L1	4.10	4.19	4.40	6
∅P	3.56	3.61	3.65	7
∅P1		7.19REF.		
Q	5.39	5.79	6.20	
S	6.04	6.17	6.30	

Revision History

Revision	Date	Subjects (major changes since last revision)
1.0	2024-06-09	Preliminary version