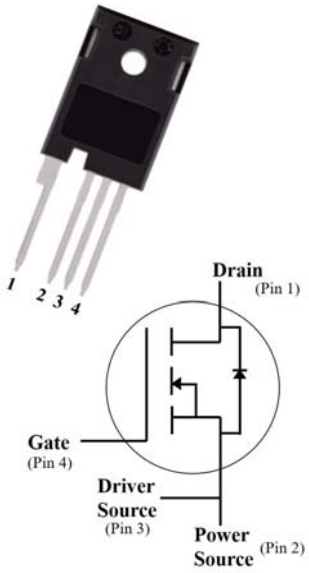
Silicon Carbide Power MOSFET （N-Channel Enhancement）

V_{DS}	1200V
$I_{D\ (25°C)}$	39A
$R_{DS(on)}$	80mΩ



Features

- High speed switching
- Essentially no switching losses
- Reduction of heat sink requirements
- Maximum working temperature at 175 °C
- High blocking voltage
- Fast Intrinsic diode with low recovery current
- High-frequency operation
- Halogen free, RoHS compliant
- AEC-Q101 qualified

Typical Applications

Typical applications are in power factor correction(PFC), solar inverter, uninterruptible power supply, motor drives, photovoltaic inverter, electric car and charger.

Mechanical Data

- **Package**: TO247-4L
- **Terminals**: Tin plated leads
- **Polarity**: As marked

■Maximum Ratings (T_C=25℃ Unless otherwise specified）

PARAMTETER	SYMBOL	UNIT	VALUE	TEST CONDITIONS	NOTE
Device marking code			D212080NCFG1Q		
Drain source voltage @ T_j=25°C	$V_{DS,max}$	V	1200	V_{GS}=0 V, I_D=100uA	
Gate source voltage @ T_j=25°C	$V_{GS,max}$	V	-8/+22	Absolute maximum values	Note1
Gate source voltage @ T_j=25°C	$V_{GS,op}$	V	-4/+18	Recommended operational values	Note2
Continuous drain current @ T_c=25°C	I_D	A	39	V_{GS}=18V, Tc=25℃	Fig.18
Continuous drain current @ T_c=100°C			28	V_{GS}=18V, Tc=100℃	
Pulsed drain current	$I_{D(pulsed)}$	A	80	Pulse width t_p limited by $T_{j,max}$	Fig.23
Power Dissipation	P_{TOT}	W	223	T_c=25°C , Tj = 175℃	Fig.17
Power Dissipation			97	T_c=110°C, Tj = 175℃	
Operating junction and Storage temperature range	Tj ,Tstg	°C	-55 to +175		
Soldering temperature	T_L	°C	260	1.6mm (0.063") from case for 10s	
Mounting torque	T_M	Nm	0.6	M3 screw Maximum of mounting process: 3	

■Static Electrical Characteristics（Tc=25℃ unless otherwise specified ）

PARAMTETER	SYMBOL	UNIT	Min.	Typ.	Max.	Test Conditions	Note
Gate threshold voltage	$V_{GS(th)}$	V	2.3	2.9	3.6	V_{DS}=V_{GS}, I_D= 5mA	Fig.4, 11
				2.2		V_{DS}=V_{GS}, I_D= 5mA, Tj=175℃	
Drain source breakdown voltage	$V_{(BR)DSS}$	V	1200			V_{GS}=0, I_D=100uA	
Zero gate voltage drain current	I_{DSS}	uA		1	10	V_{DS}=1200V, V_{GS}= 0V	Fig.16
Gate source leakage current	I_{GSS}	nA			100	V_{GS}= 18V, V_{DS}=0V	
Current drain source on-state resistance	$R_{DS\ ON}$	mΩ		77	85	V_{GS}=18V, I_D=20A	Fig.5, 6, 7
				122		V_{GS}=18V, I_D=20A,Tj=175℃	
Internal gate resistance	Rg	Ω		3.1		f=1MHz	
Diode forward voltage	V_{SD}	V		3.9		V_{GS}=-4V, I_{SD}=10A	Fig.8
				3.2		V_{GS}=0V, I_{SD}=10A Tj=175℃	Fig.9
Transconductance	g_f	S		10		V_{DS}=16V,I_D=20A	Fig.4
				9.2		V_{DS}=16V,I_D=20A,Tj=175℃	

■Dynamic Electrical Characteristics（Tc=25℃ unless otherwise specified ）

PARAMTETER	SYMBOL	UNIT	Min.	Typ.	Max.	Test Conditions	Note
Input capacitance	Ciss	pF		890		V_{DS}=1000V, V_{GS}=0V, Tj=25℃, f=1MHz, V_{AC}= 25mV	Fig.13, 14
Output capacitance	Coss			58			
Reverse capacitance	Crss			4			
Coss stored energy	Eoss	uJ		34			Fig.15
Gate source charge	Qgs	nC		12		V_{DS}=800V, V_{GS}=-4/18V, I_D=20A	Fig.12
Gate drain charge	Qgd			11			
Gate charge	Qg			41			

■Switching Characteristics（Tc=25℃ unless otherwise specified ）

PARAMTETER	SYMBOL	UNIT	Min.	Typ.	Max.	Test Conditions	Note
Turn on switching energy	E_{on}	uJ		235		V_{DD}=800V, V_{GS}=-4/+18V, I_D=20A, Rg=0Ω, L=220uH	Fig.21, 22
Turn off switching energy	E_{off}			419			
Turn on delay time	$t_{d(on)}$	ns		27.9			
Rise time	t_r			13.9			

Turn off delay time	$t_{d(off)}$	ns		29		V_{DD}=800V, V_{GS}=-4/+18V, I_D=20A, Rg=0Ω, L=220uH、	Fig.21, 22
Fall time	t_f			35.3			

■Body diode characteristics（Tc=25℃ unless otherwise specified ）

PARAMTETER	SYMBOL	UNIT	Min.	Typ.	Max.	Test Conditions	Note
Diode forward voltage	V_{SD}	V		3.9		V_{GS}=-4V,I_{SD}=10A	Fig.8
				3.2		V_{GS}=0V, I_{SD}=10A, Tj=175℃	Fig.9
Continuous diode forward current	I_S	A		39		Tc=25℃	Note1
Reverse recovery time	trr	nS		28.24		V_R=800V, V_{GS}=-4V, I_D=20A, di/dt=2095A/uS	
Reverse recovery charge	Qrr	nC		190			
Peak reverse recovery current	Irrm	A		30.08			

Note 1: When using SiC Body Diode the maximun recommended V_{GS} = -4V
Note 2: MOSFET can also safely operate at 0/18 V

■Thermal Characteristics （T_a=25℃ Unless otherwise specified）

PARAMETER	SYMBOL	UNIT	Value
Thermal resistance	$R_{\theta J-C}$	°C /W	0.67

■Typical Characteristics

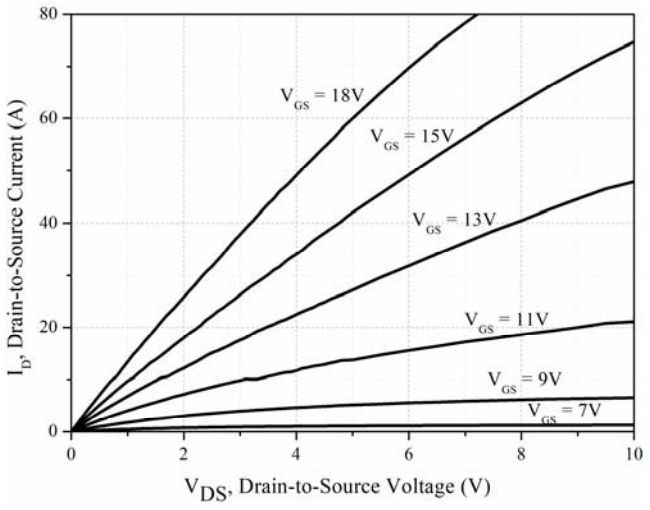


Figure 1. Output Characteristics Tj = -40℃

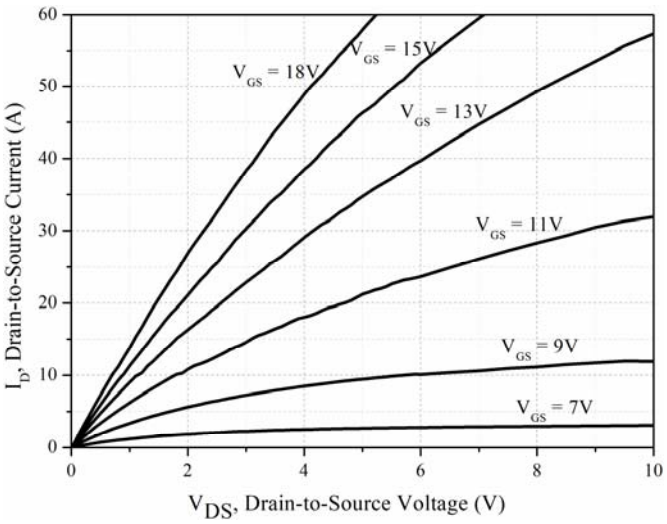


Figure2. Output Characteristics Tj = 25℃

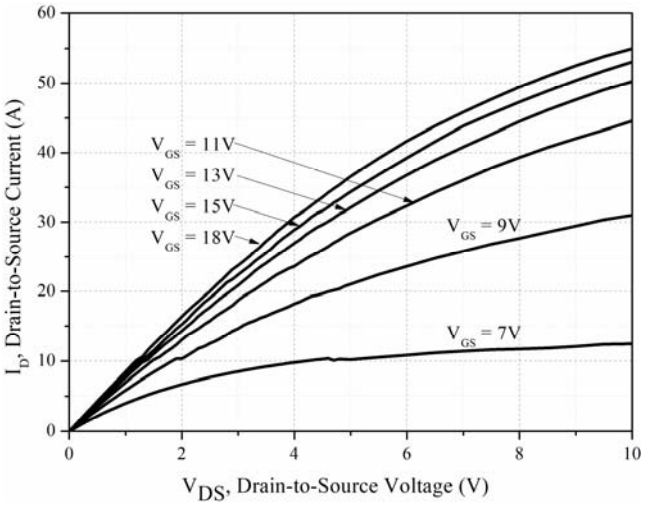


Figure 3. Output Characteristics Tj = 175℃

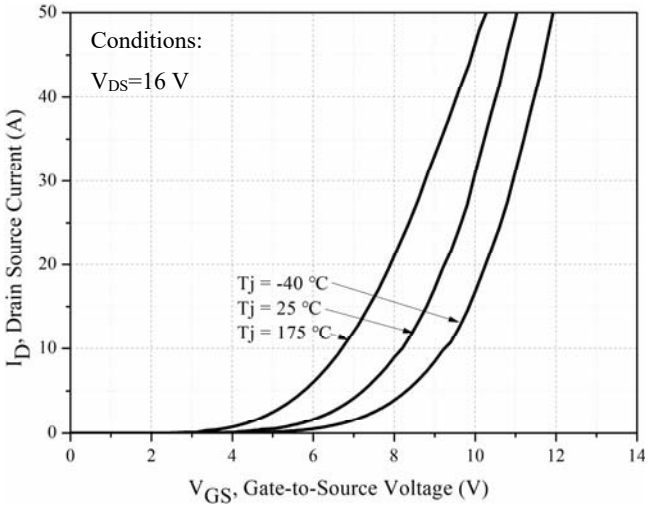


Figure 4. Transfer Characteristics for various junction temperature

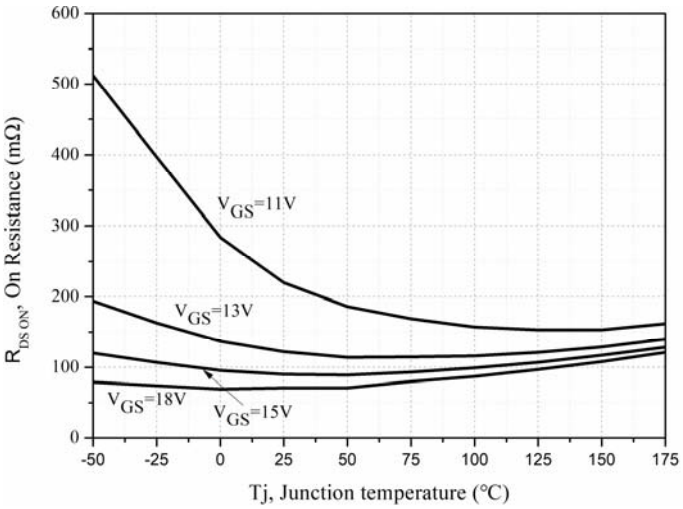


Figure 5. On-resistance vs.temperature for various gate voltage

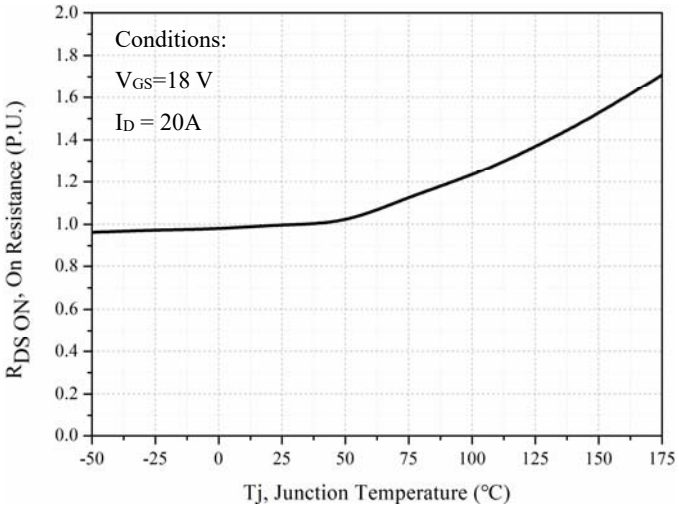


Figure 6. Normalized on-resistance vs.temperature

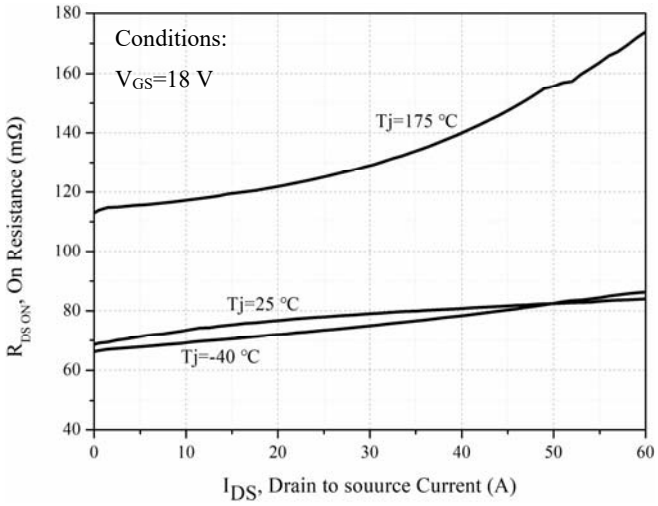


Figure 7. On-resistance vs. drain current

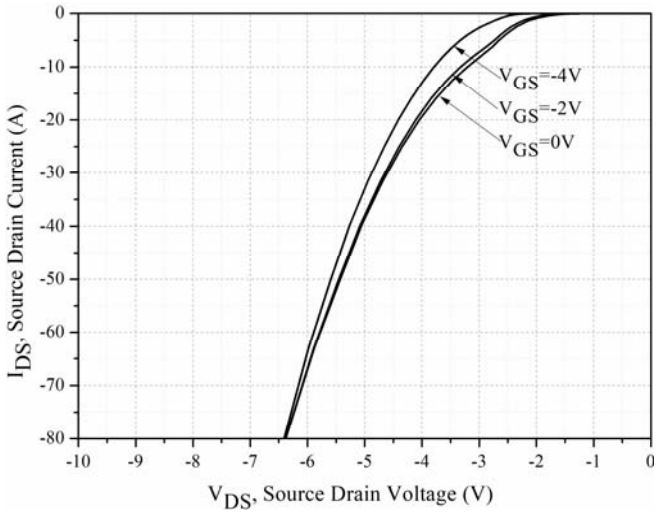


Figure 8. Body diode characteristic at Tj= 25 ℃

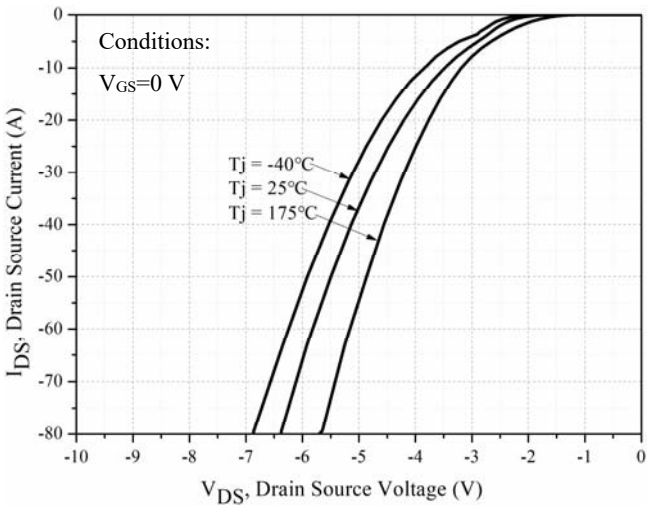


Figure 9. Body diode characteristic

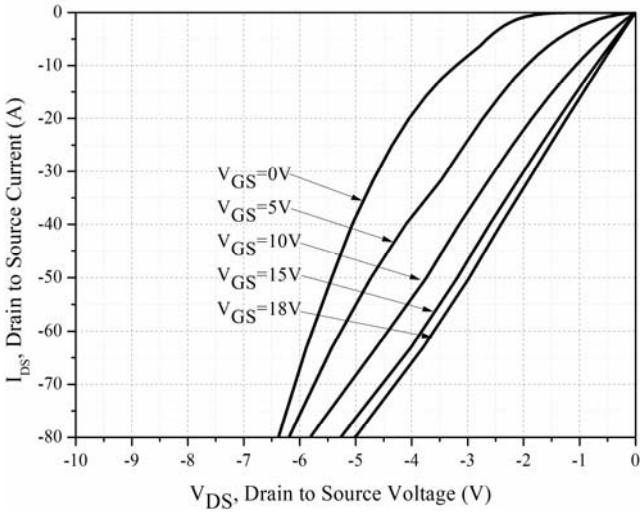


Figure 10. 3rd quadrant characteristic at Tj= 25 ℃

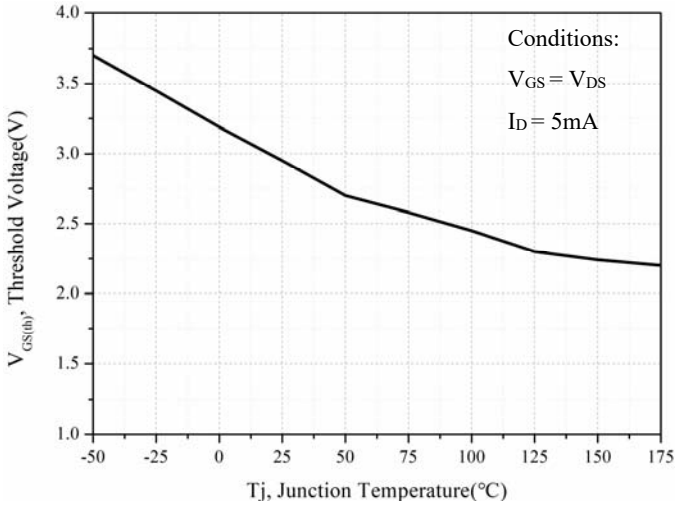


Figure 11. Threshold voltage vs.temperature

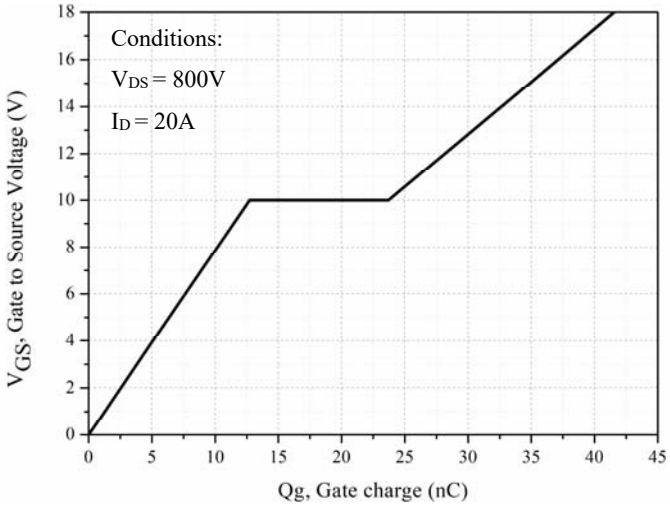


Figure 12. Gate charge characteristic

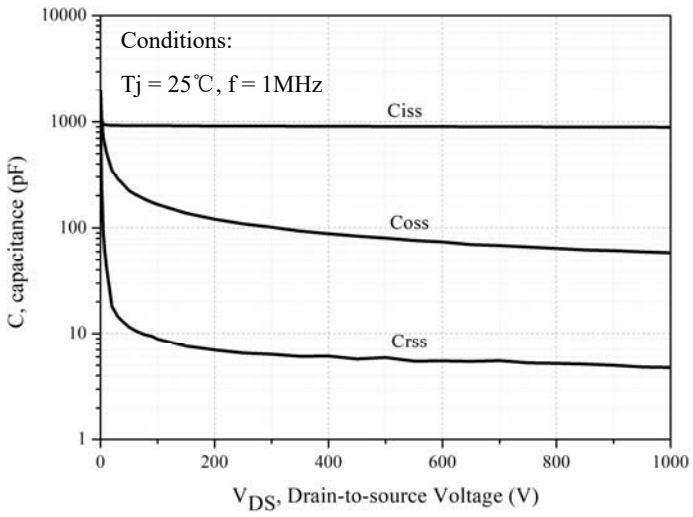


Figure 13. Capacitances vs.drain source voltage (0-1000V)

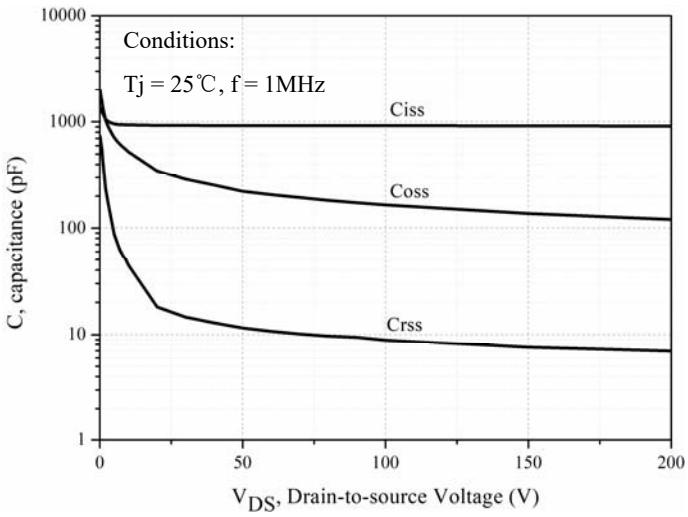


Figure 14. Capacitances vs.drain source voltage (0-200V)

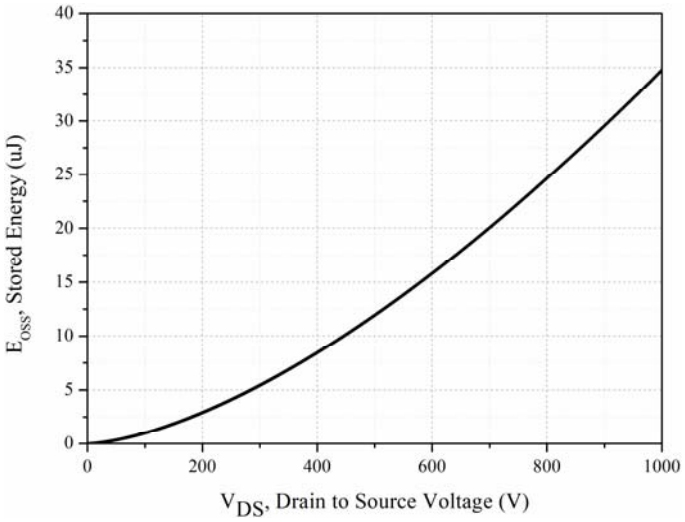


Figure 15. Output capacitor stored energy

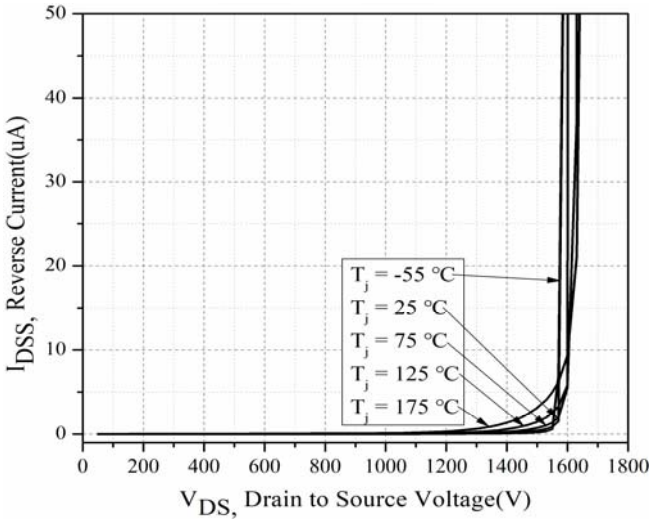


Figure 16. Reverse characteristics vs. Tj

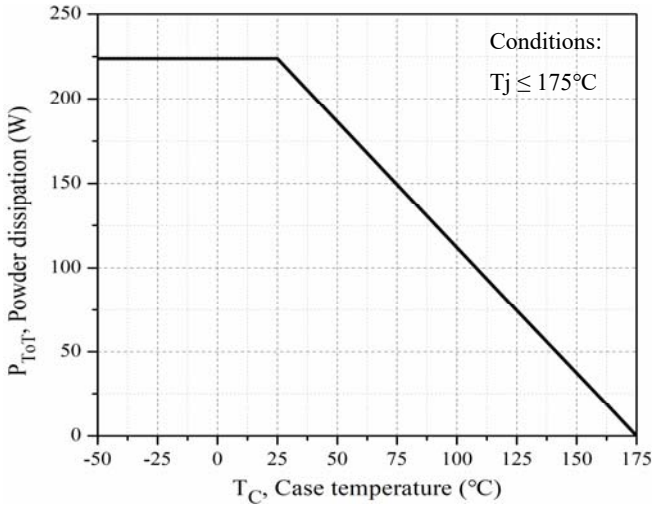


Figure 17. Maximun power dissipation derating vs. case temperatere

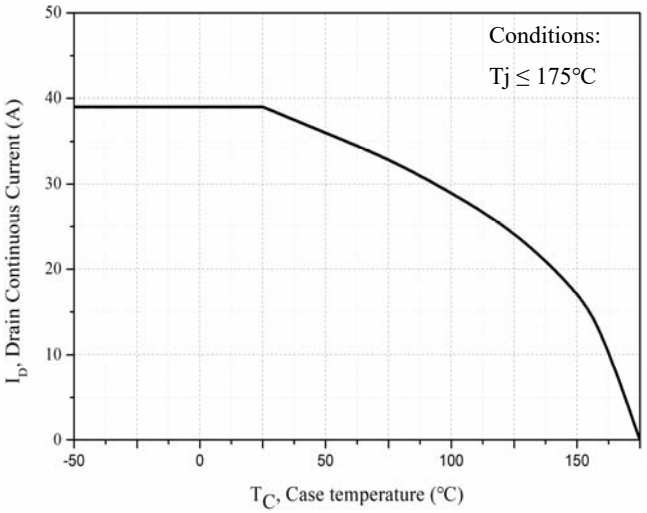


Figure 18. Coutinuous drain current derating vs. case temperatere

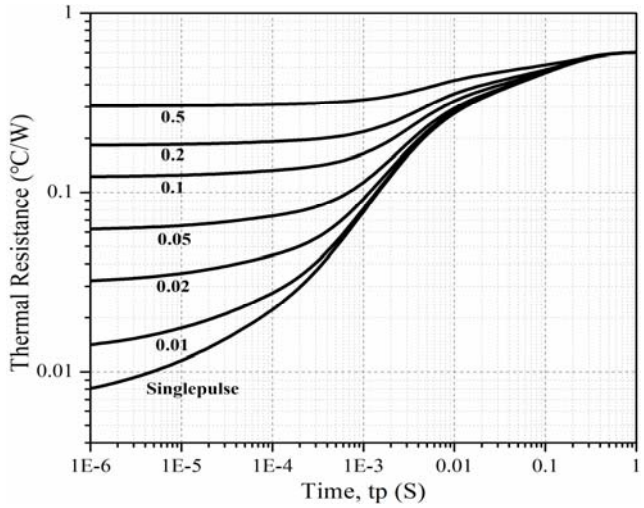


Figure 19. Transient thermal impedance (junction - case)

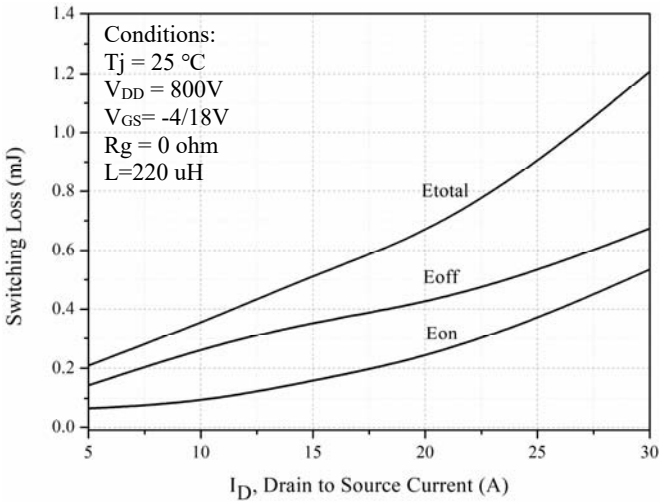


Figure 20. Clamped Inductive switching energy vs. darin current

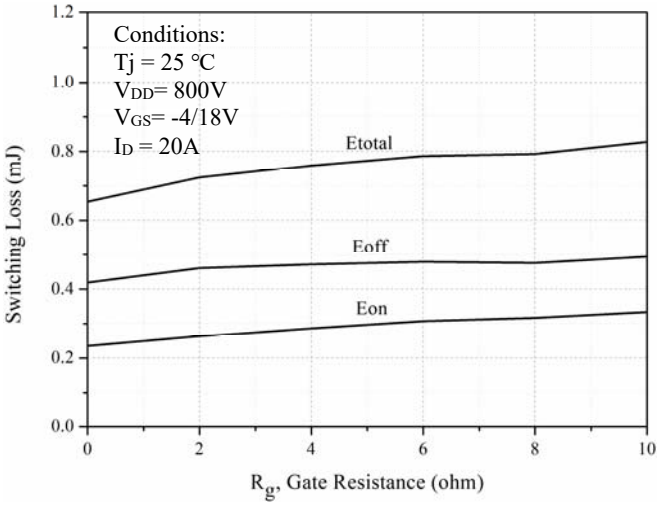


Figure 21. Clamped inductive switching energy vs. Rg

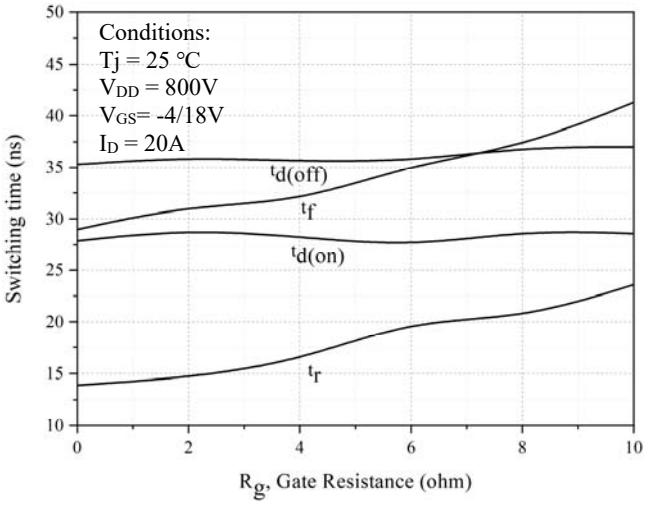


Figure 22. Switching times vs. Rg

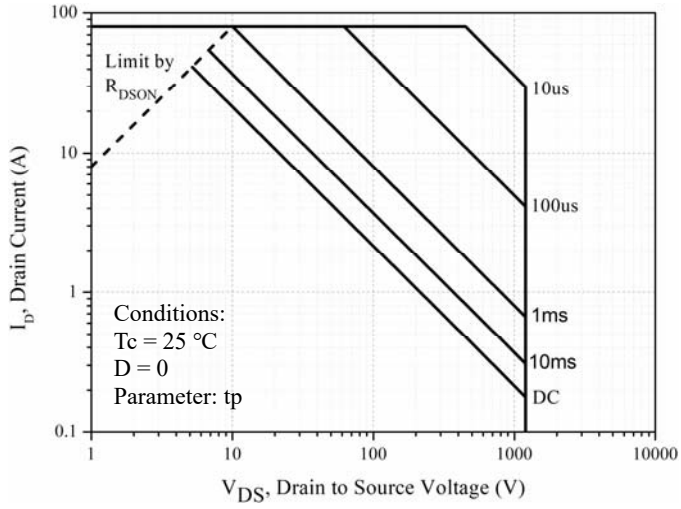


Figure 23. Safe operating area

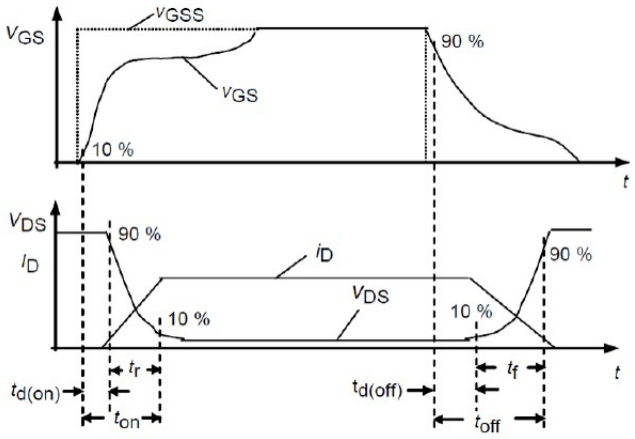


Figure 24. Switching Times Definition

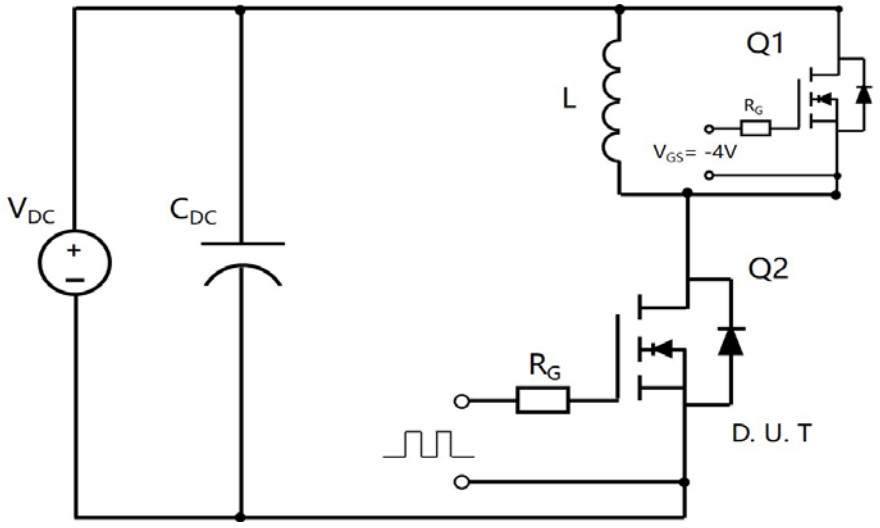
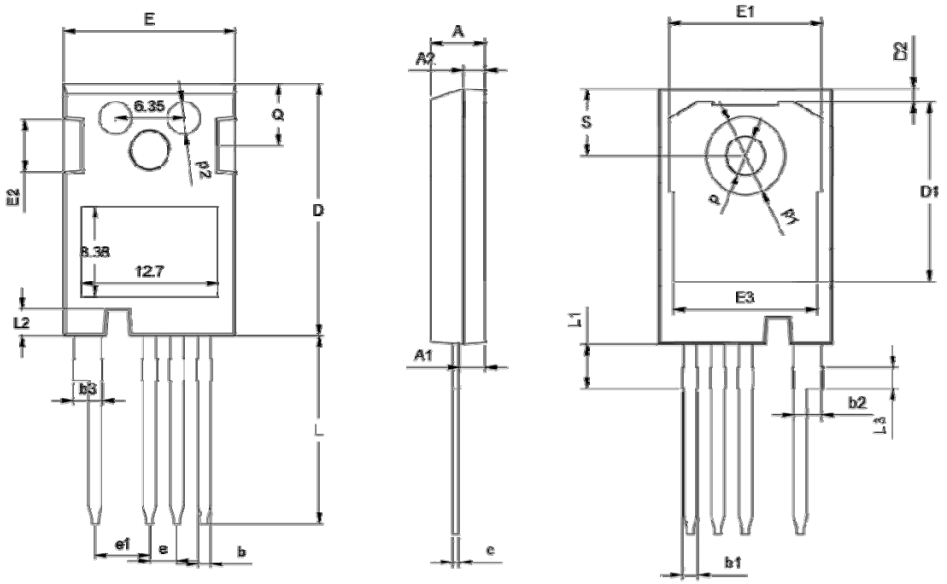


Figure 25. Clamped Inductive Switching Waveform Test Circuit

■Outline Dimensions



TO247-4L			
Dim	Min	Norm	Max
A	4.80	5.00	5.20
A1	2.30	2.40	2.50
A2	1.88	1.98	2.08
b	1.10	1.20	1.30
b1	1.20	/	1.50
b2	2.35	2.55	2.75
b3	2.45	/	2.85
c	0.55	0.60	0.65
D	23.3	23.45	23.6
D1	16.25	16.55	16.85
D2	1.00	/	1.30
e	TYP2.54		
e1	TYP5.06		
E	15.75	15.90	16.05
E1	13.80	/	14.20
E2	4.40	4.75	5.10
E3	13.00	/	13.45
L	17.34	17.49	17.64
L1	4.00	/	4.30
L2	2.35	/	2.65
L3	TYP1.98		
Q	5.60	5.80	6.00
S	6.05	/	6.30
p	TYP3.58		
p1	TYP7.18		
p2	TYP3.00		

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