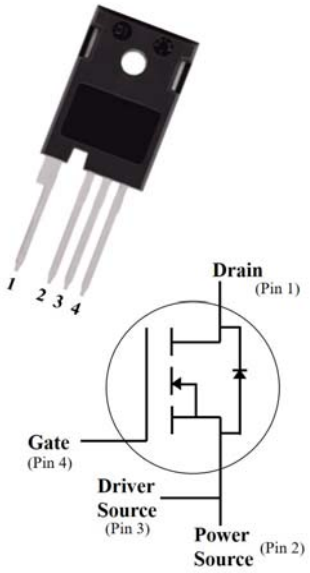
Silicon Carbide Power MOSFET （N-Channel Enhancement）

V_{DS}	1200V
$I_{D\ (25°C)}$	63A
$R_{DS(on)}$	40mΩ



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			D212040NCFG1		
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	-10/+22	Absolute maximum values	
Gate source voltage @ T_j=25°C	$V_{GS,op}$	V	-5/+18	Recommended operational values	Note1、2
Continuous drain current @ T_c=25°C	I_D	A	63	V_{GS}=18V, Tc=25℃	Fig.18
Continuous drain current @ T_c=100°C			41	V_{GS}=18V, Tc=100℃	
Pulsed drain current	$I_{D(pulsed)}$	A	160	Pulse width t_p limited by $T_{j,max}$	Fig.23
Power Dissipation	P_{TOT}	W	333	T_c=25°C , Tj = 175℃	Fig.17
Power Dissipation			144	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	2.0	2.5	4.0	V_{DS}=V_{GS}, I_D= 10mA	Fig.4, 11
				2.0		V_{DS}=V_{GS}, I_D= 10mA, 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		42	52	V_{GS}=20V, I_D=40A	Fig.5, 6, 7
				72		V_{GS}=18V, I_D=40A,Tj=175℃	
Internal gate resistance	Rg	Ω		1.8	5.0	f=1MHz	
Diode forward voltage	V_{SD}	V		4.0		V_{GS}=-5V, I_{SD}=20A	Fig.8
				3.4		V_{GS}=0V, I_{SD}=20A Tj=175℃	Fig.9
Transconductance	g_f	S		18		V_{DS}=20V,I_D=40A	Fig.4
				17		V_{DS}=20V,I_D=40A,Tj=175℃	

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

PARAMTETER	SYMBOL	UNIT	Min.	Typ.	Max.	Test Conditions	Note
Input capacitance	Ciss	pF		2225		V_{DS}=1000V, V_{GS}=0V, Tj=25℃, f=1MHz, V_{AC}= 25mV	Fig.13, 14
Output capacitance	Coss			141			
Reverse capacitance	Crss			15			
Coss stored energy	Eoss	uJ		78			Fig.15
Gate source charge	Qgs	nC		34		V_{DS}=800V, V_{GS}=-5/18V, I_D=40A	Fig.12
Gate drain charge	Qgd			42			
Gate charge	Qg			120			

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

PARAMTETER	SYMBOL	UNIT	Min.	Typ.	Max.	Test Conditions	Note
Turn on switching energy	E_{on}	mJ		1.5		V_{DD}=800V, V_{GS}=-5/+18V, I_D=40A, Rg=2.5Ω, L=99uH	Fig.21, 22
Turn off switching energy	E_{off}			0.3			
Turn on delay time	$t_{d(on)}$	ns		13			
Rise time	t_r			61			

Turn off delay time	$t_{d(off)}$	ns		25		V_{DD}=800V, V_{GS}=-5/+18V, I_D=40A, Rg=2.5Ω, L=99uH	Fig.21, 22
Fall time	t_f			13			

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

PARAMTETER	SYMBOL	UNIT	Min.	Typ.	Max.	Test Conditions	Note
Diode forward voltage	V_{SD}	V		4.0		V_{GS}=-5V,I_{SD}=20A	Fig.8
				3.4		V_{GS}=0V, I_{SD}=20A, Tj=175℃	Fig.9
Continuous diode forward current	I_S	A		60		Tc=25℃	Note1
Reverse recovery time	trr	nS		54		V_R=800V, V_{GS}=-5V, I_D=40A, di/dt=1000A/uS	
Reverse recovery charge	Qrr	nC		283			
Peak reverse recovery current	Irrm	A		15			

Note 1: When using SiC Body Diode the maximun recommended V_{GS} = -5V
Note 2: MOSFET can also safely operate at 0/20 V

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

PARAMETER	SYMBOL	UNIT	Max.
Thermal resistance	$R_{\theta J-C}$	°C /W	0.45

■Typical Characteristics

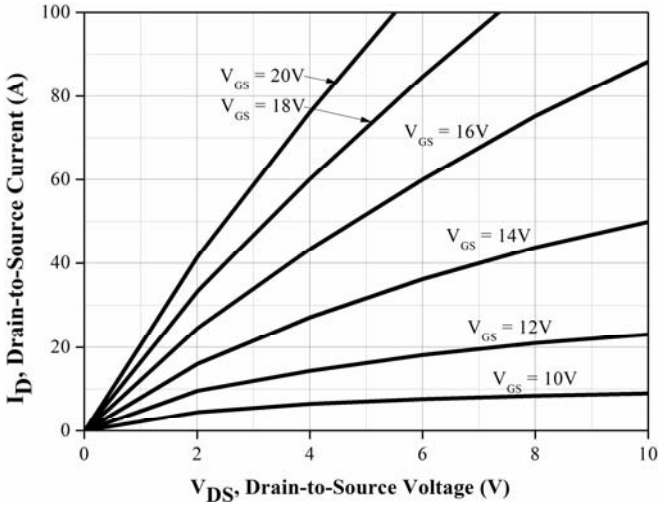


Figure 1. Output Characteristics Tj = -55℃

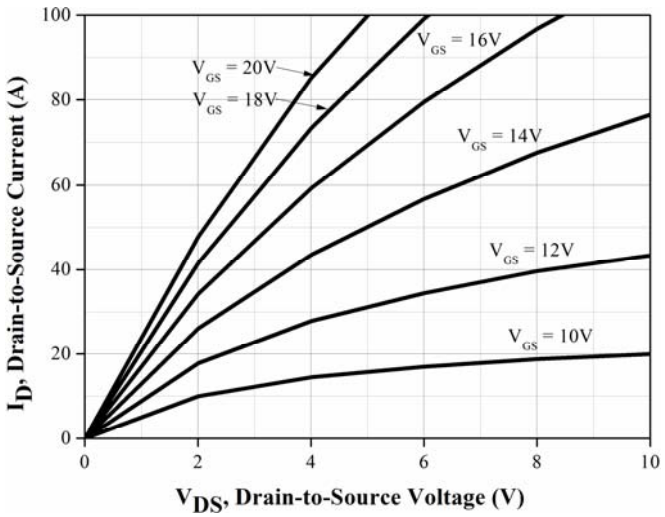


Figure2. Output Characteristics Tj = 25℃

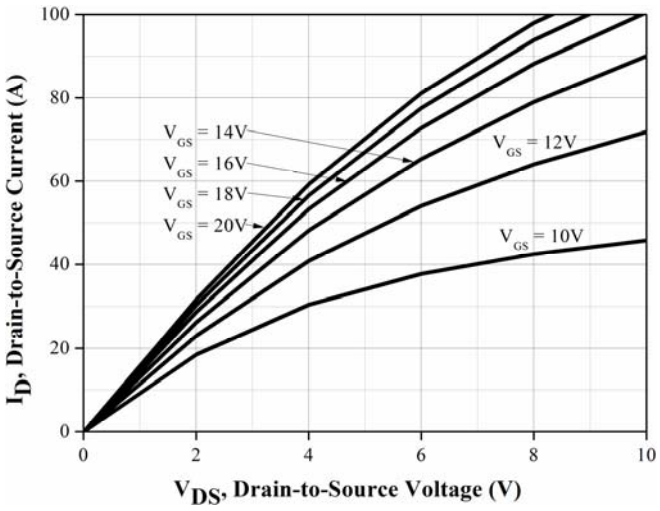


Figure 3. Output Characteristics Tj = 175℃

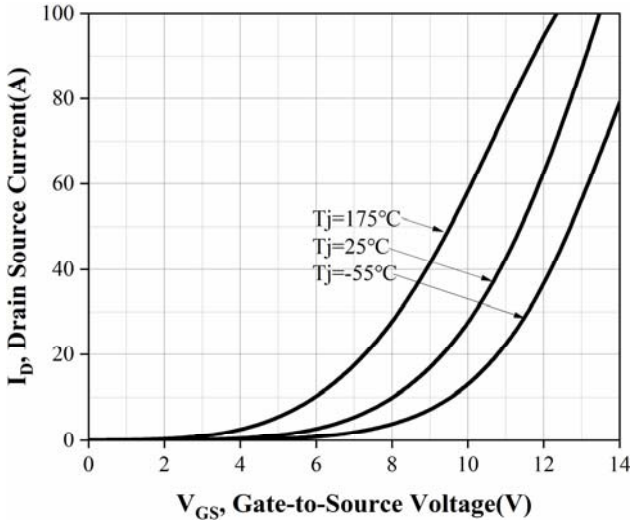


Figure 4. Transfer Characteristics for various junction temperature

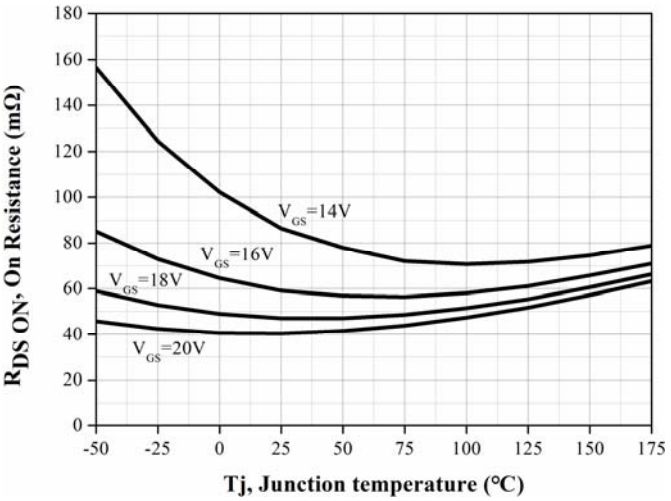


Figure 5. On-resistance vs.temperature for various gate voltage

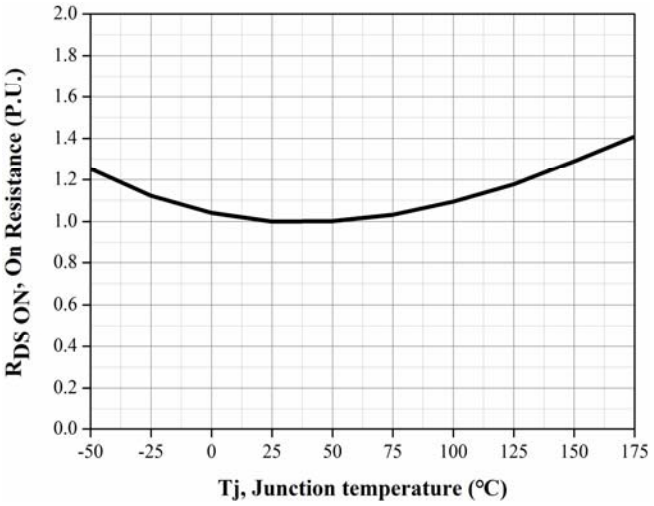


Figure 6. Normalized on-resistance vs.temperature

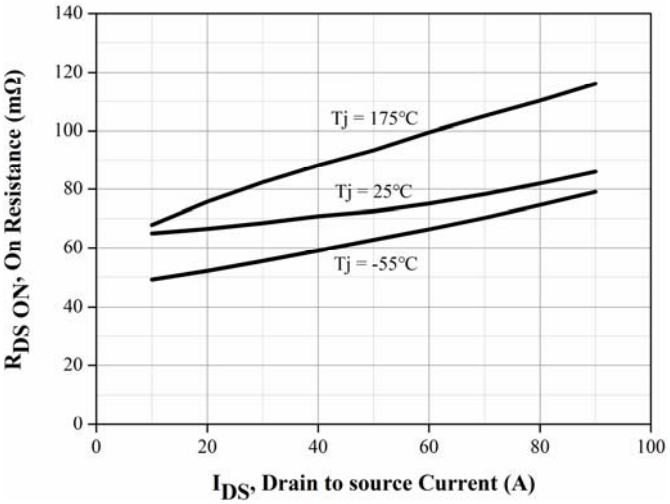


Figure 7. On-resistance vs. drain current

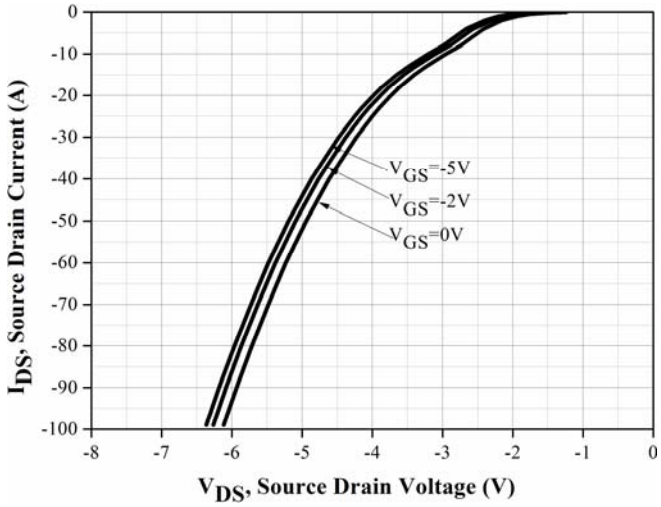


Figure 8. Body diode characteristic at Tj= 25 ℃

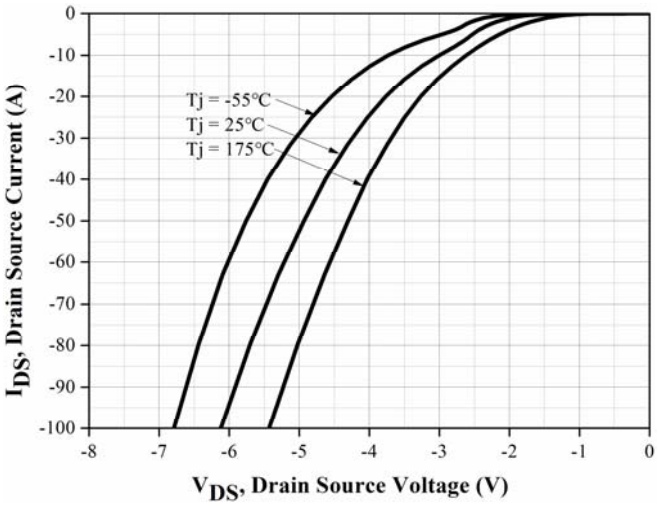


Figure 9. Body diode characteristic

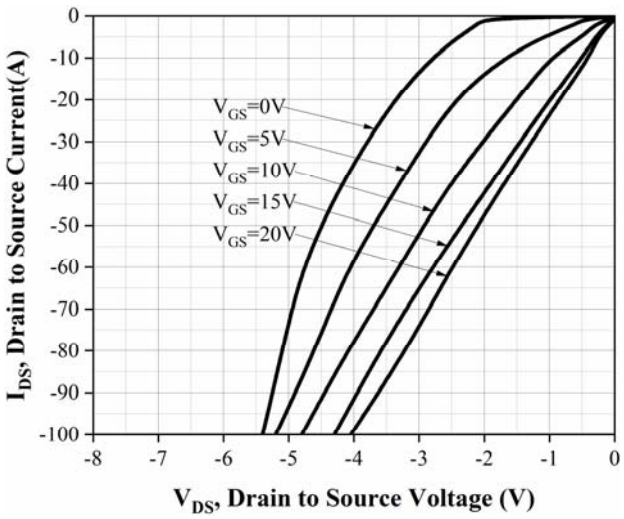


Figure 10. 3rd quadrant characteristic at Tj= 25 ℃

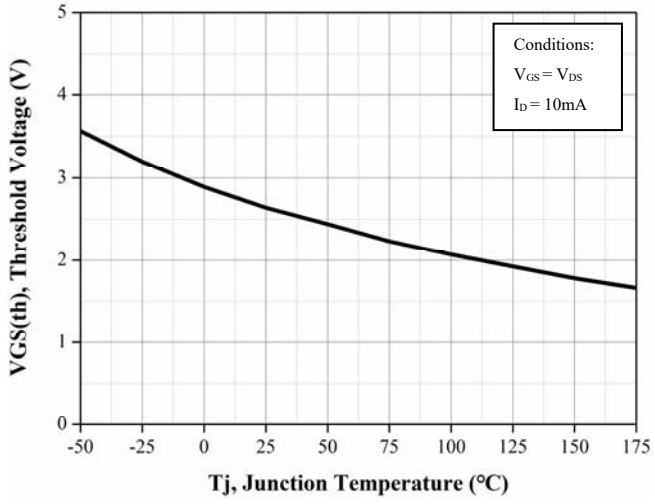


Figure 11. Threshold voltage vs.temperature

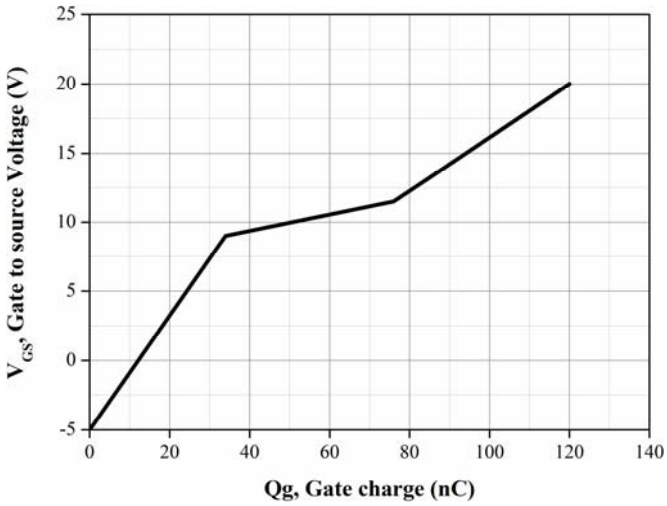


Figure 12. Gate charge characteristic

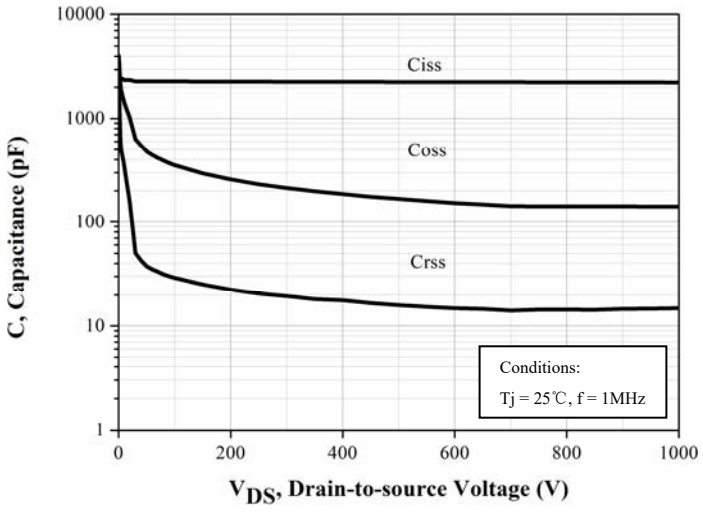


Figure 13. Capacitances vs.drain source voltage (0-1000V)

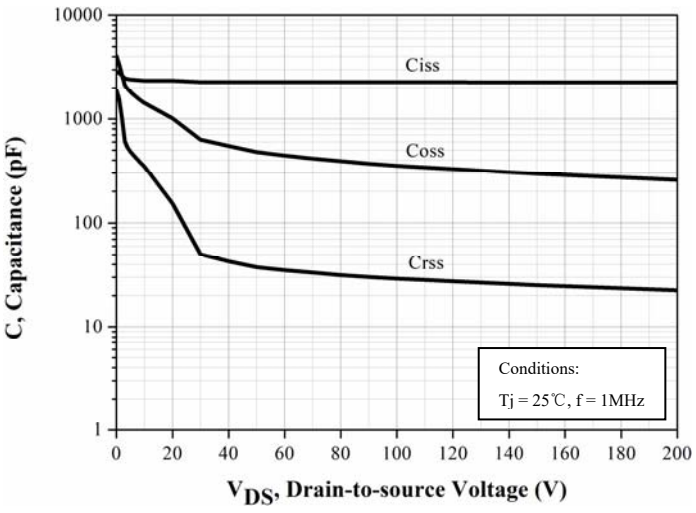


Figure 14. Capacitances vs.drain source voltage (0-200V)

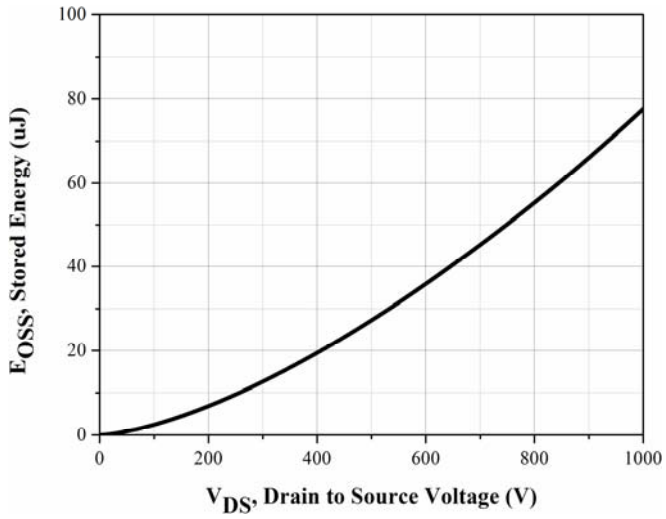


Figure 15. Output capacitor stored energy

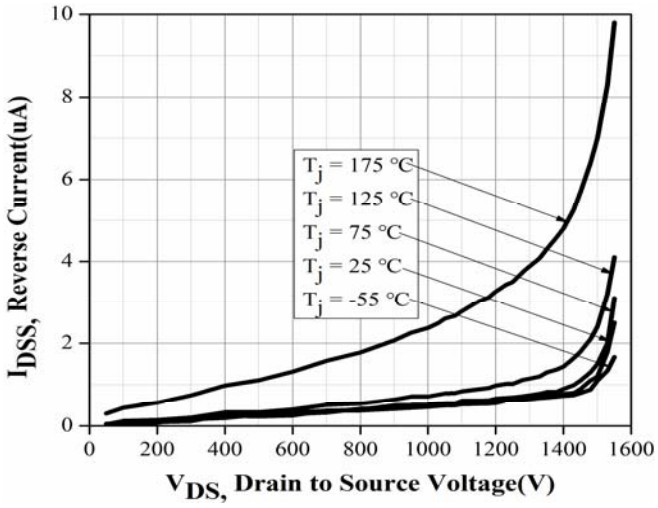


Figure 16. Reverse characteristics vs. Tj

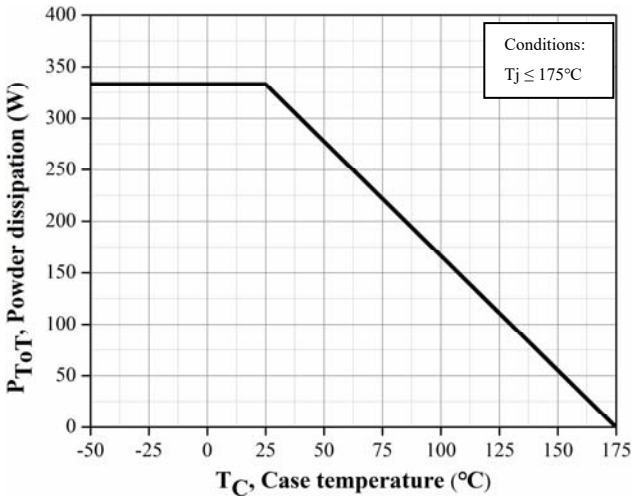


Figure 17. Maximun power dissipation derating vs. case temperatere

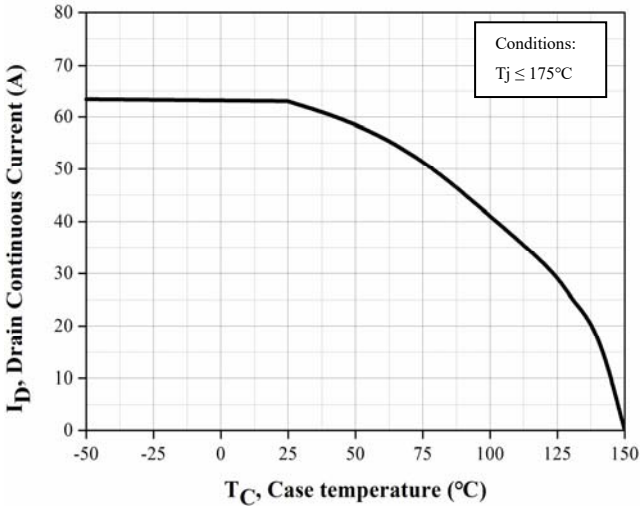


Figure 18. Coutinuous drain current derating vs. case temperatere

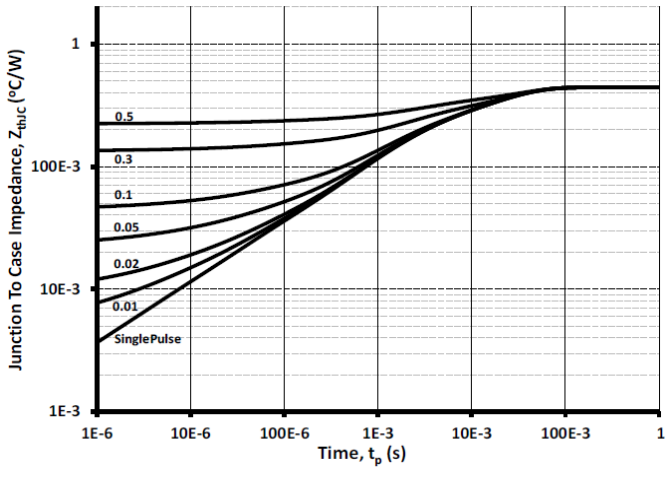


Figure 19. Transient thermal impedance (junction - case)

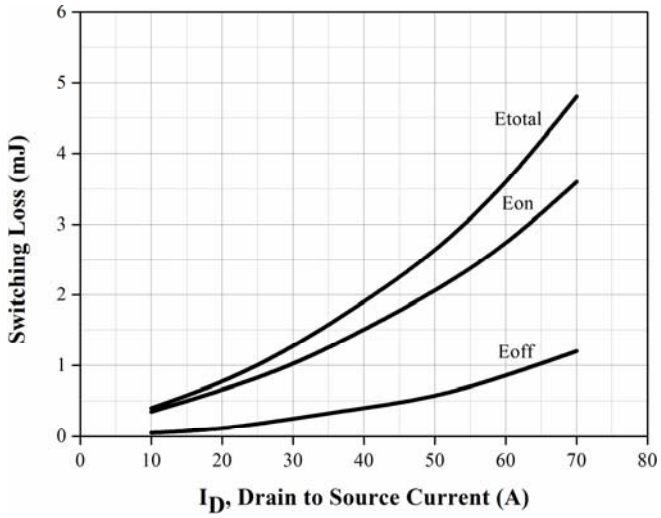


Figure 20. Clamped Inductive switching energy vs. darin current

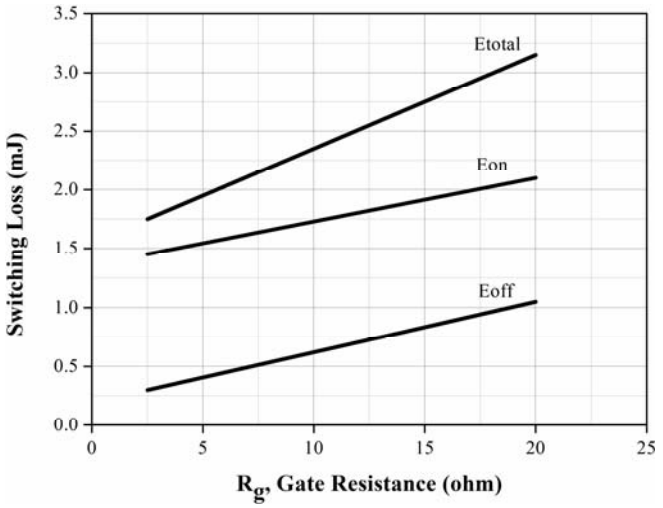


Figure 21. Clamped inductive switching energy vs. Rg

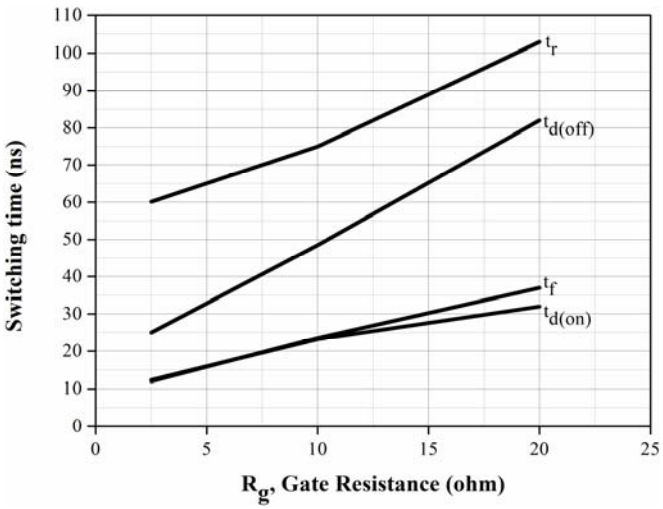


Figure 22. Switching times vs. Rg

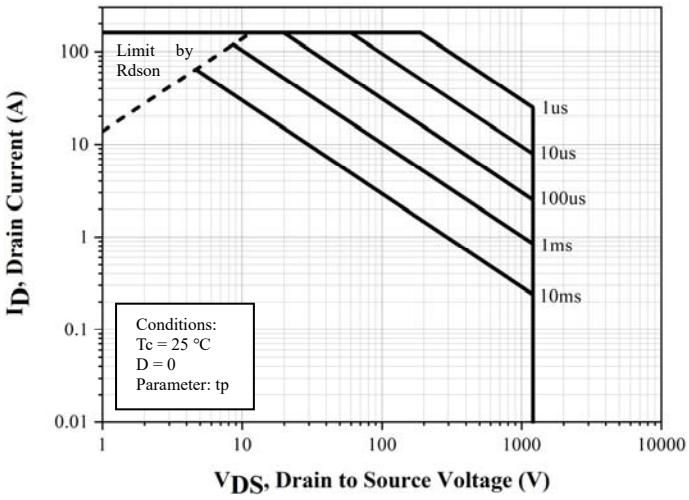


Figure 23. Safe Operating Area

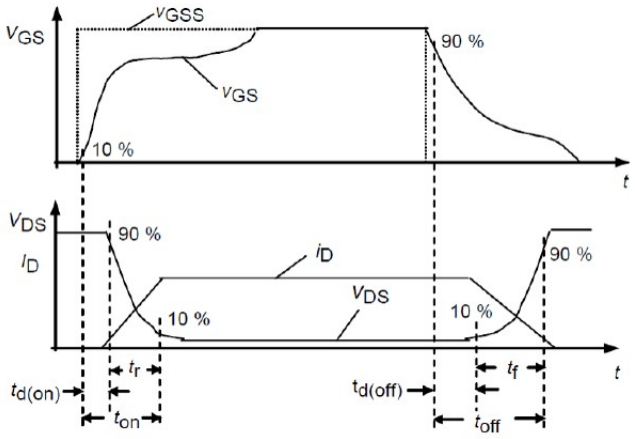


Figure 24. Switching Times Definition

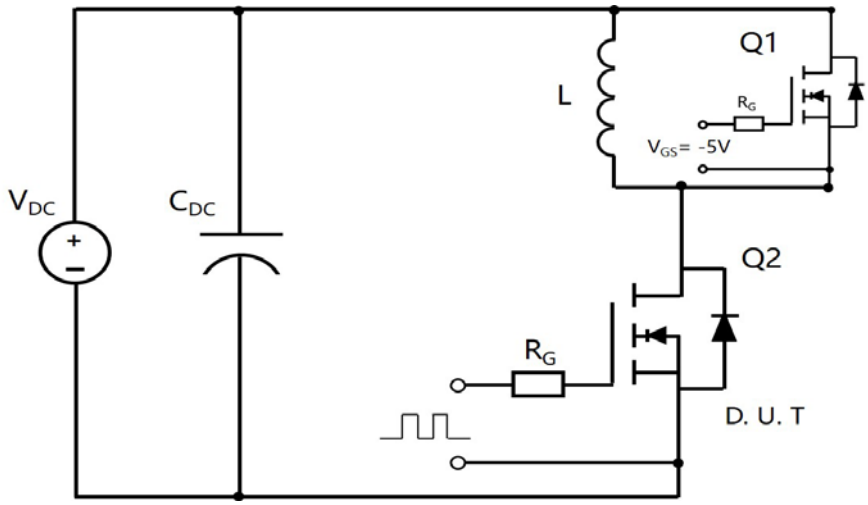
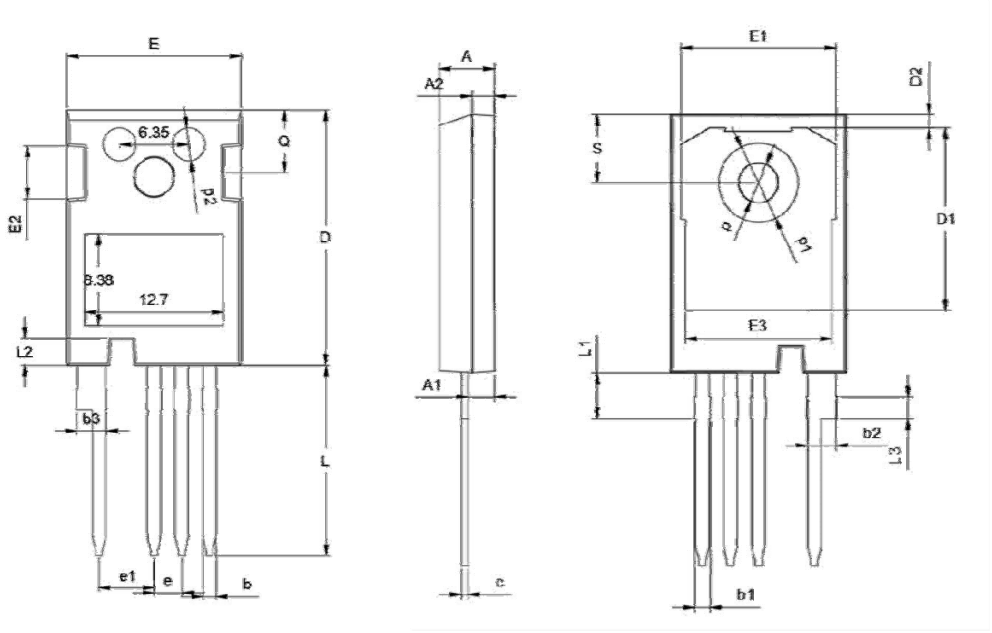


Figure 25. Clamped Inductive Switching Waveform Test Circuit

■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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