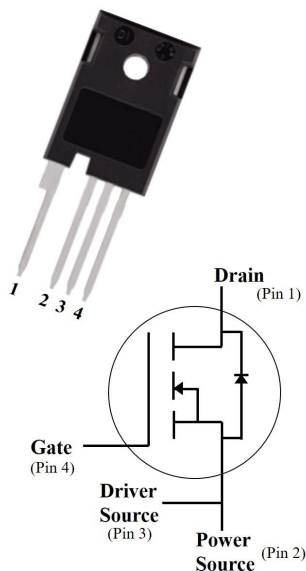


Silicon Carbide Power MOSFET (N-Channel Enhancement)

V_{DS}	650V
I_D (25°C)	60A
$R_{DS(on)}$	50mΩ



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

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 ($T_C=25^\circ\text{C}$ Unless otherwise specified)

PARAMETER	SYMBOL	UNIT	VALUE	TEST CONDITIONS	NOTE
Device marking code			D206550NCFGH		
Drain source voltage @ $T_J=25^\circ\text{C}$	$V_{DS,max}$	V	650	$V_{GS}=0\text{ V}$, $I_D=100\mu\text{A}$	
Gate source voltage @ $T_J=25^\circ\text{C}$	$V_{GS,max}$	V	-10/+25	Absolute maximum values (AC f > 1Hz, duty cycle < 1%)	Note1
Gate source voltage @ $T_J=25^\circ\text{C}$	$V_{GS,op}$	V	-5/+20	Recommended operational values	
Continuous drain current @ $T_C=25^\circ\text{C}$	I_D	A	60	$V_{GS}=20\text{V}$, $T_C=25^\circ\text{C}$	Fig.14
Continuous drain current @ $T_C=110^\circ\text{C}$			41	$V_{GS}=20\text{V}$, $T_C=110^\circ\text{C}$	
Pulse Drain Current	$I_{D,pulse}$	A	127	Limited by t_{pw}	Fig.15
Avalanche energy, Single Pulse	E_{AS}	mJ	1600	$V_{DD}=100\text{V}$, $I_D=14\text{A}$	
Power Dissipation	P_{TOT}	W	250	$T_C=25^\circ\text{C}$, $T_J = 175^\circ\text{C}$	Fig.13
Operating junction and Storage temperature range	T_J, T_{stg}	$^\circ\text{C}$	-55 to +175		
Soldering temperature	T_L	$^\circ\text{C}$	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)

PARAMETER	SYMBOL	UNIT	Min.	Typ.	Max.	Test Conditions	Note
Gate threshold voltage	$V_{GS(th)}$	V		2.6		$V_{DS}=V_{GS}$, $I_D=20mA$	Fig.4, 11
Drain source breakdown voltage	$V_{(BR)DSS}$	V	650			$V_{GS}=0$, $I_D=100\mu A$	
Zero gate voltage drain current	I_{DSS}	μA		<1	100	$V_{DS}=650V$, $V_{GS}=0V$	
				10	500	$V_{DS}=650V$, $V_{GS}=0V$, $T_J=175^\circ C$	
Gate source leakage current	I_{GSS}	nA			250	$V_{GS}=20V$, $V_{DS}=0V$	
Current drain source on-state resistance	$R_{DS(on)}$	m Ω		50	65	$V_{GS}=20V$, $I_D=20A$	Fig.3, 5, 6
				65		$V_{GS}=20V$, $I_D=20A$, $T_J=175^\circ C$	
Transconductance	g_f	S		13.2		$V_{DS}=15V$, $I_D=40A$	

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

PARAMETER	SYMBOL	UNIT	Min.	Typ.	Max.	Test Conditions	Note
Input capacitance	C_{iss}	pF		1850		$V_{DS}=400V$, $V_{GS}=0V$, $T_J=25^\circ C$, $f=1MHz$, $V_{AC}=25mV$	Fig.10
Output capacitance	C_{oss}			208			
Reverse capacitance	C_{rss}			33			
Coss stored energy	E_{oss}	μJ		24			Fig.12
Gate source charge	Q_{gs}	nC		30		$V_{DS}=400V$, $V_{GS}=-5/20V$, $I_D=30A$	Fig.16
Gate drain charge	Q_{gd}			43			
Gate charge	Q_g			121			
Internal Gate Resistance	$R_{G(int)}$	Ω		1.2		$f=1MHz$, $V_{AC}=25mV$	

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

PARAMETER	SYMBOL	UNIT	Min.	Typ.	Max.	Test Conditions	Note
Turn on delay time	$t_{d(on)}$	ns		16		$V_{DD}=400V$, $V_{GS}=-4/+20V$, $I_D=20A$, $R_L=20\Omega$, $R_{G(ext)}=2.7\Omega$	
Rise time	t_r			17			
Turn off delay time	$t_{d(off)}$			20			
Fall time	t_f			10			
Turn on switching energy	E_{on}	μJ		21		$V_{DD}=400V$, $V_{GS}=0/+20V$, $I_D=50A$, $R_{G(ext)}=2.7\Omega$	Fig.17, 18
Turn off switching energy	E_{off}			28			

**■Body diode characteristics** ($T_c=25^\circ\text{C}$ unless otherwise specified)

PARAMETER	SYMBOL	UNIT	Min.	Typ.	Max.	Test Conditions	Note
Diode forward voltage	V_{SD}	V		3.0		$V_{GS}=0V, I_{SD}=5A$	Fig.8
Continuous diode forward current	I_S	A		42.5		$V_{GS}=0V, T_c=25^\circ\text{C}$	
Reverse recovery time	t_{rr}	nS		58		$V_{DS}=400V, V_{GS}=0V, I_{SD}=30A, di/dt=300A/\mu S$	
Reverse recovery charge	Q_{rr}	nC		122			
Peak reverse recovery current	I_{rrm}	A		3.75			

Note 1: When using SiC Body Diode the maximum recommended $V_{GS} = -5V$

■Thermal Characteristics ($T_a=25^\circ\text{C}$ Unless otherwise specified)

PARAMETER	SYMBOL	UNIT	Value
Thermal resistance	$R_{\theta J-C}$	$^\circ\text{C/W}$	0.6

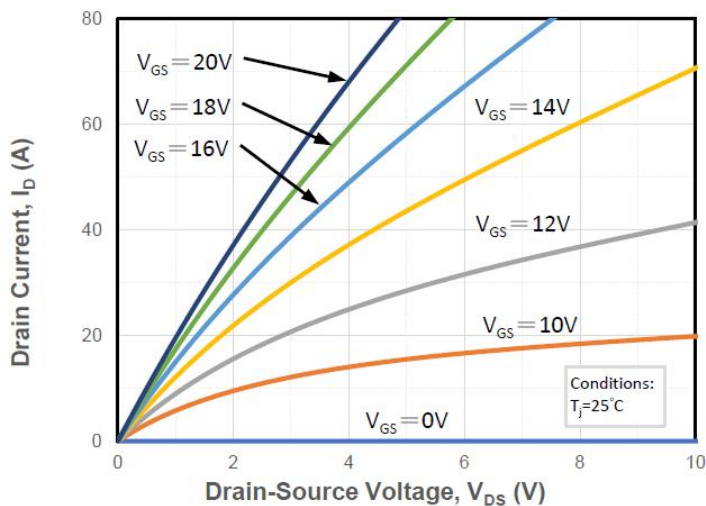
■Typical Characteristics

Figure 1. Output Characteristics $T_j = 25^\circ\text{C}$

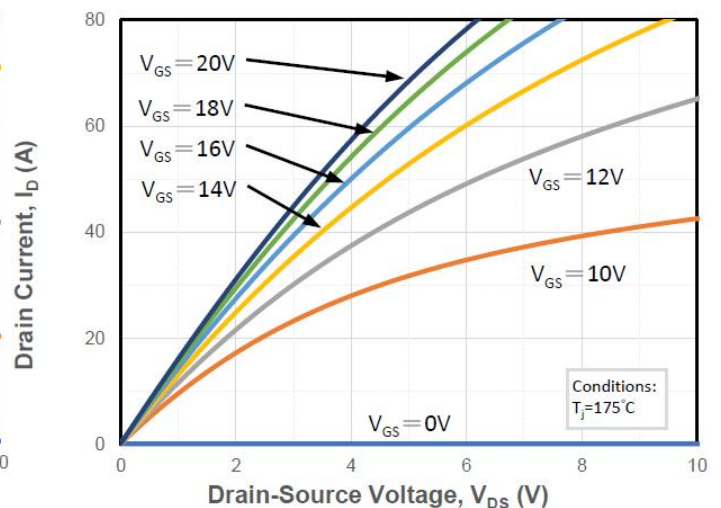


Figure2. Output Characteristics $T_j = 175^\circ\text{C}$

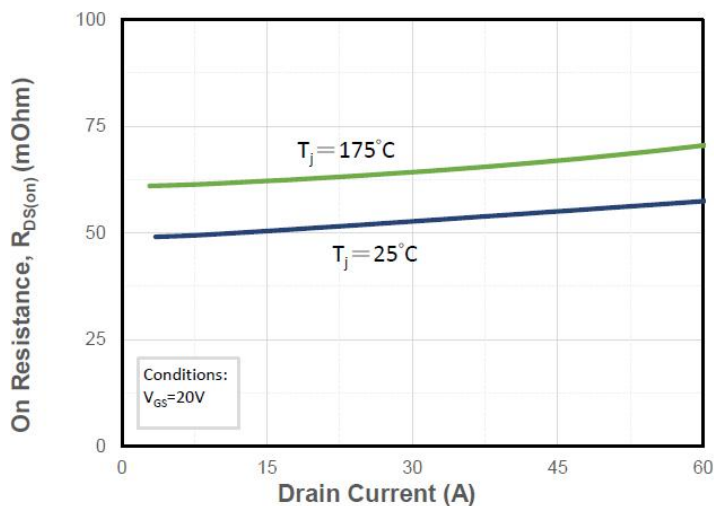


Figure 3. On-resistance vs. drain current

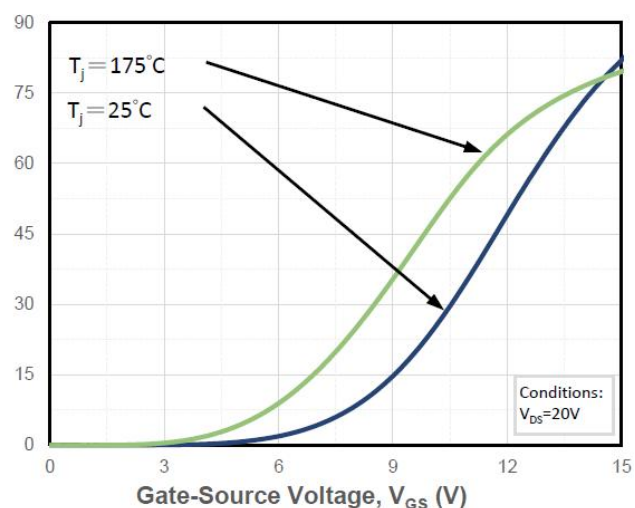


Figure 4. Transfer Characteristics for various T_J

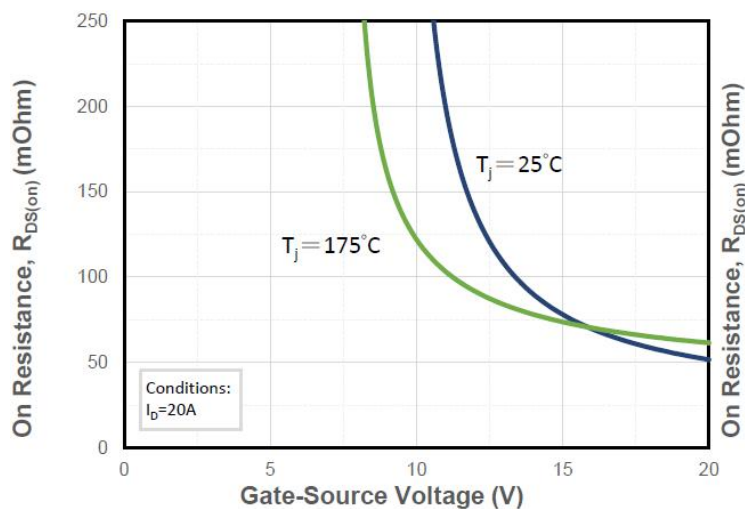


Figure 5. On-resistance vs. gate voltage for various T_J

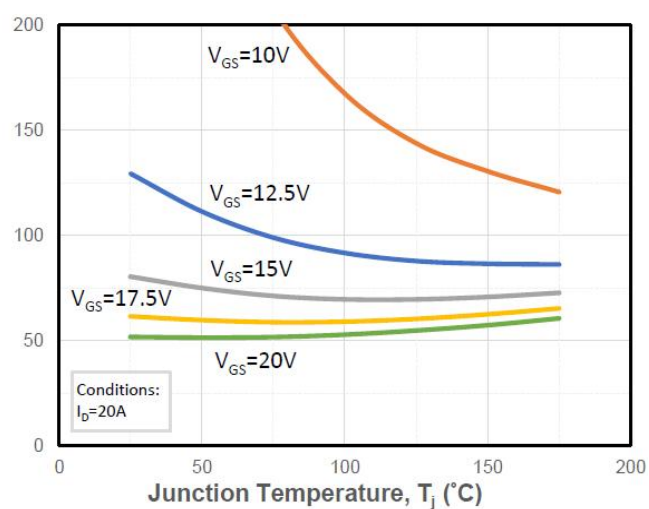


Figure 6. On-resistance vs. Temperature for various Gate voltage

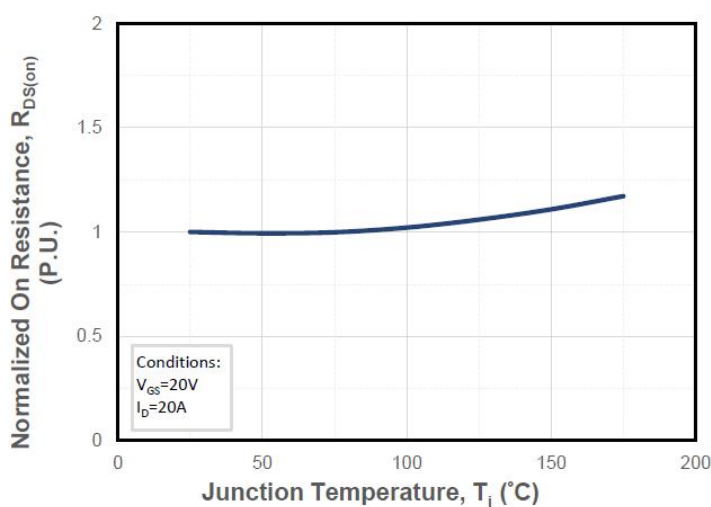


Figure 7. Normalized On-Resistance vs. Temperature

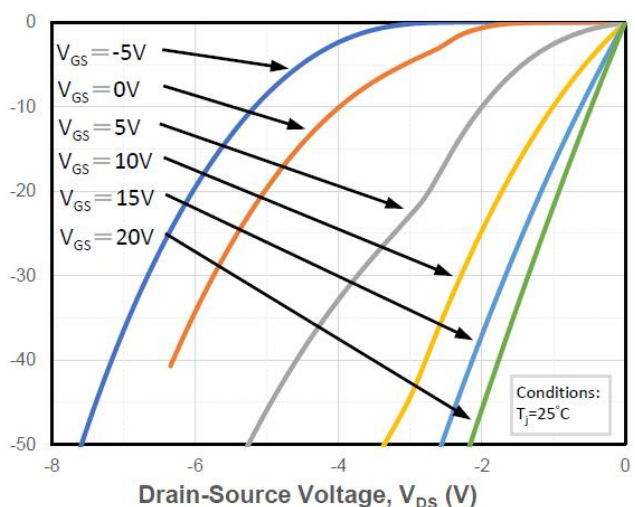


Figure 8. Reverse Output Characteristics at $T_J = 25^\circ\text{C}$

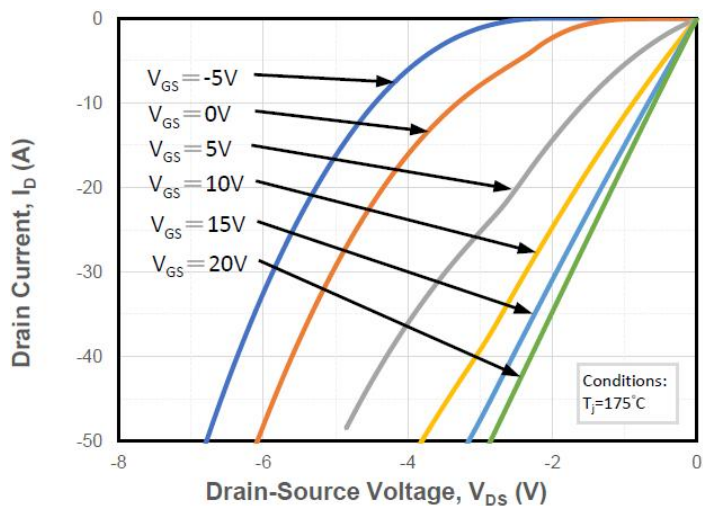


Figure 9. Reverse Output Characteristics at $T_j = 175^\circ\text{C}$

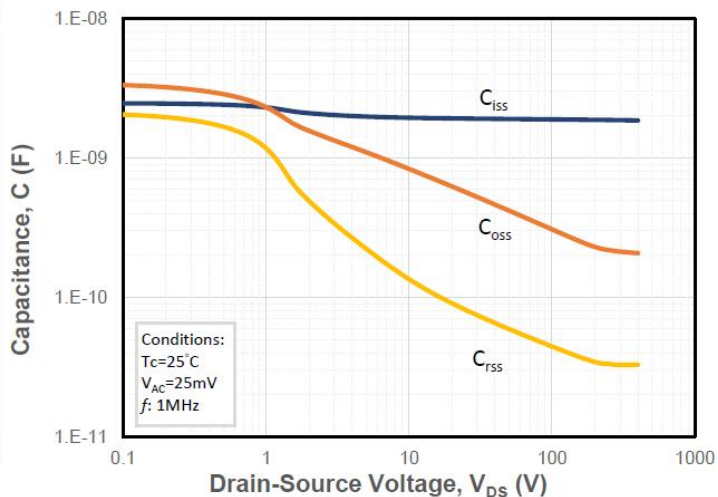


Figure 10. Capacitances vs. Drain to Source Voltage

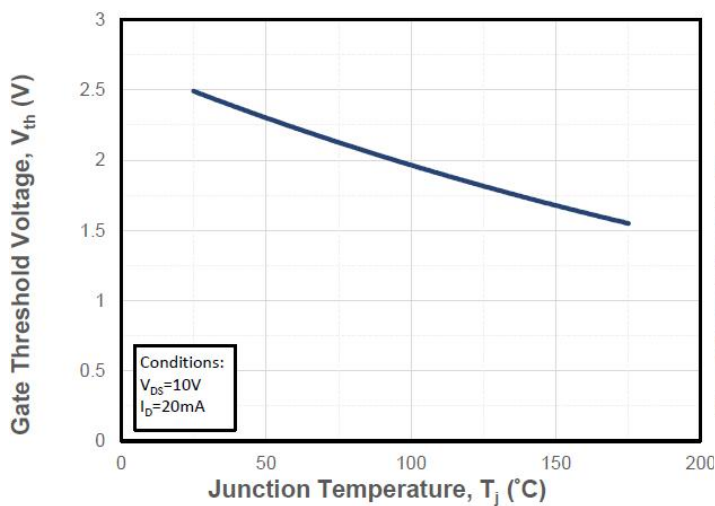


Figure 11. Threshold voltage vs. temperature

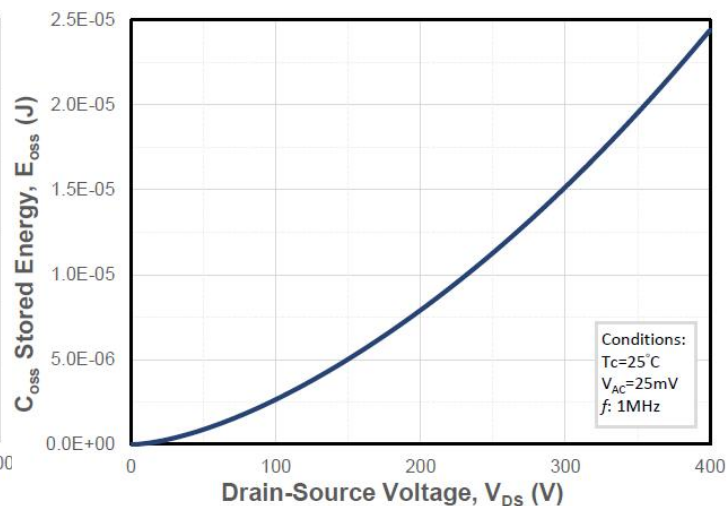


Figure 12. Output Capacitor Stored Energy

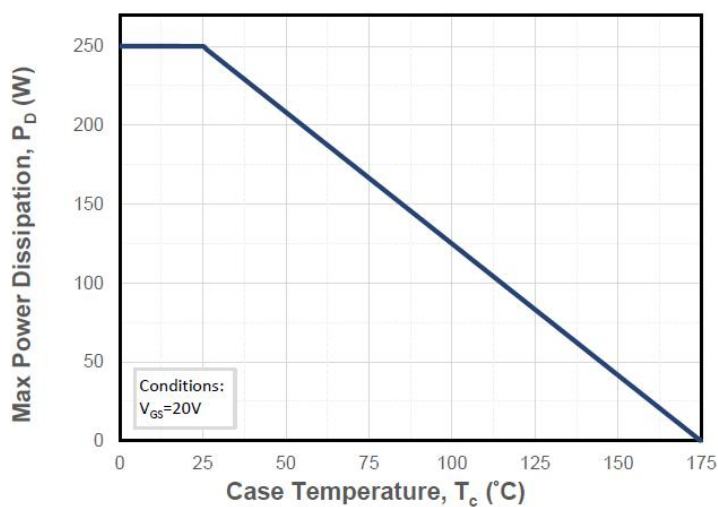


Figure 13. Maximum Power Dissipation Derating vs. Case Temperature

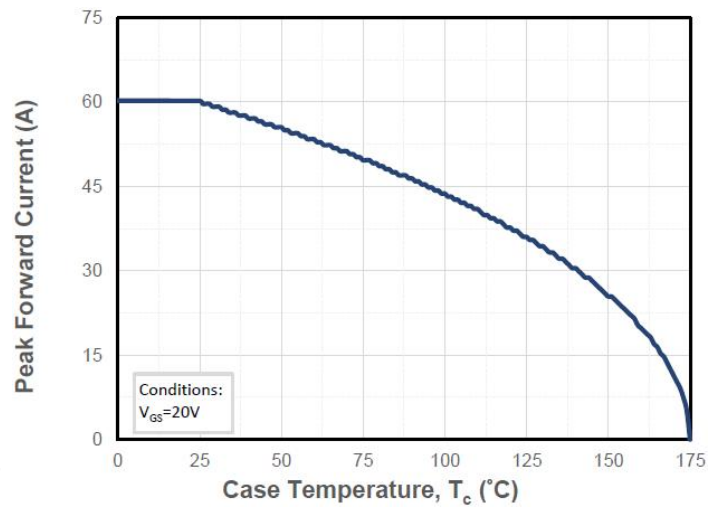


Figure 14. Drain Current Derating vs. Case Temperature

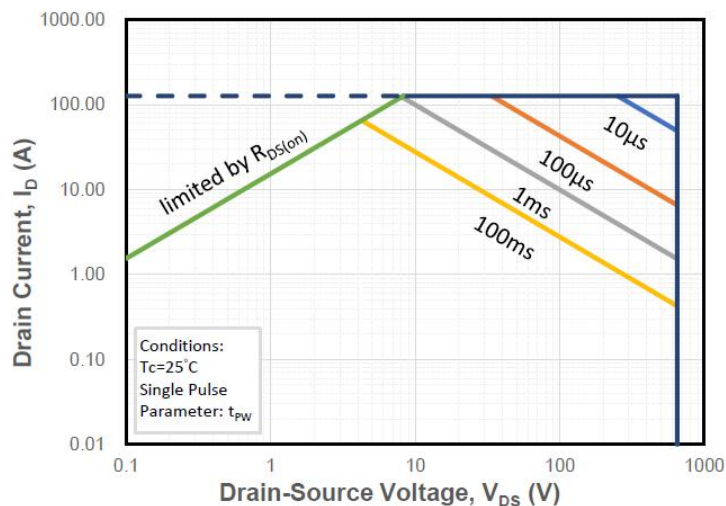


Figure 15. Safe Operating Area

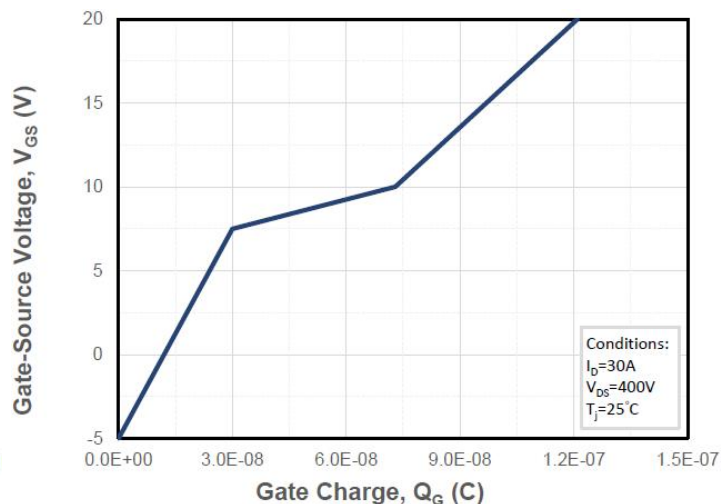


Figure 16. Gate Charge Characteristics

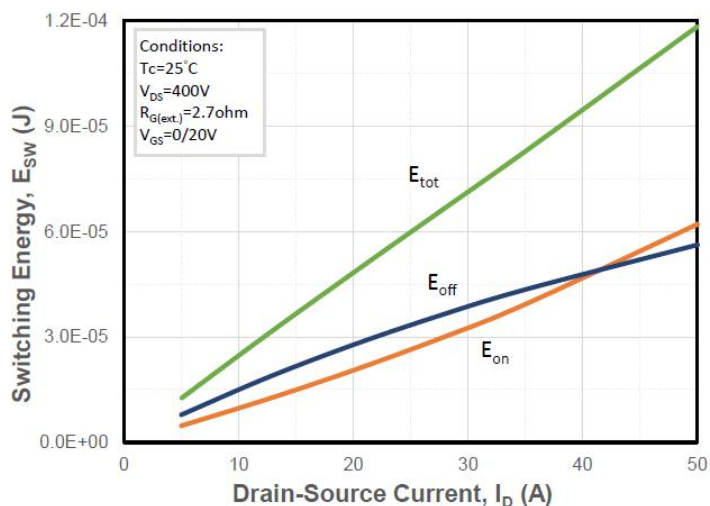


Figure 17. Clamped Inductive Switching Energy vs. Drain Current

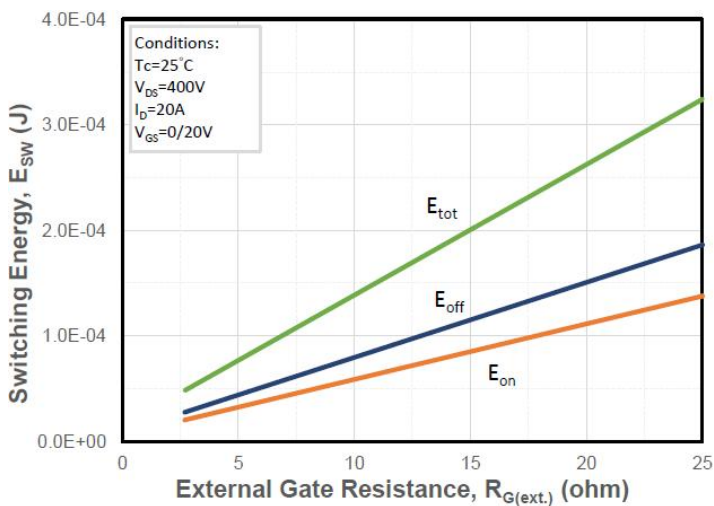


Figure 18. Clamped Inductive Switching Energy vs. External Gate Resistor ($R_{G(ext.)}$)

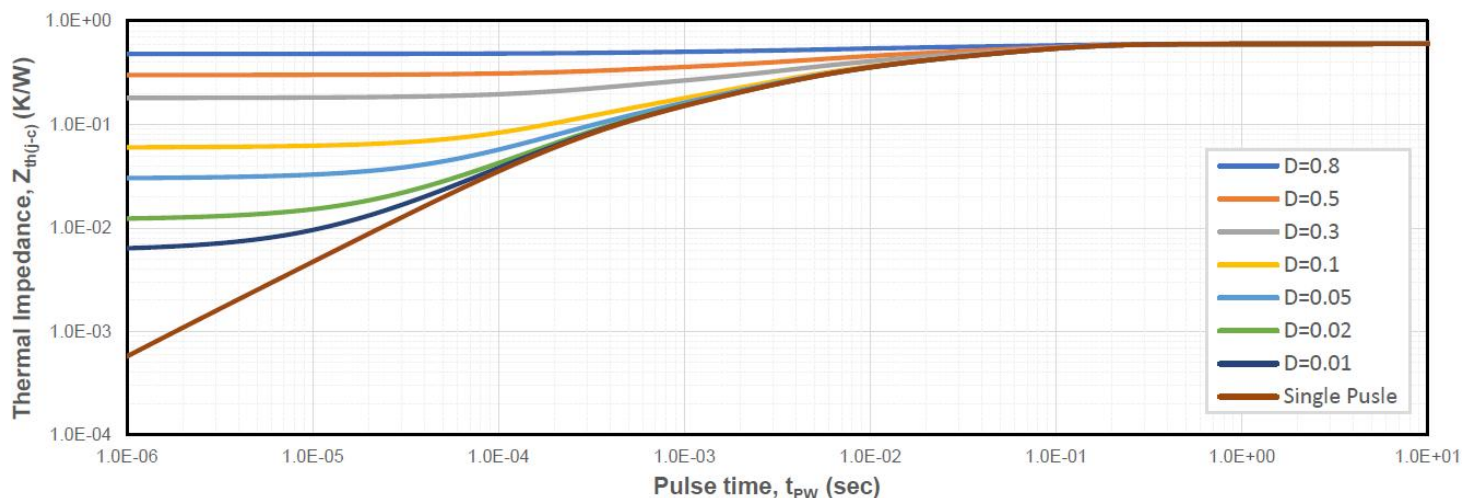


Figure 19. Transient Junction to Case Thermal Impedance

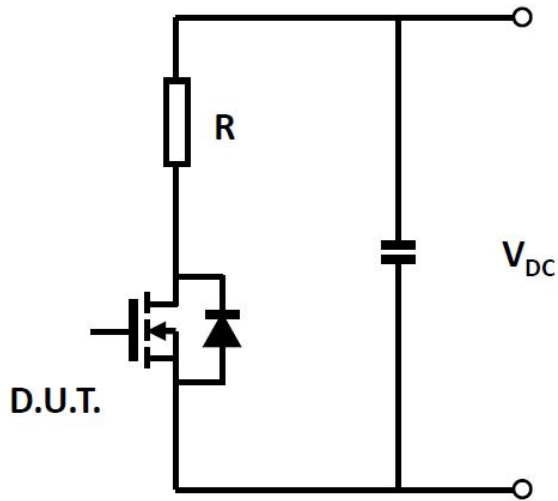


Figure 20. Schematic of Resistive Switching

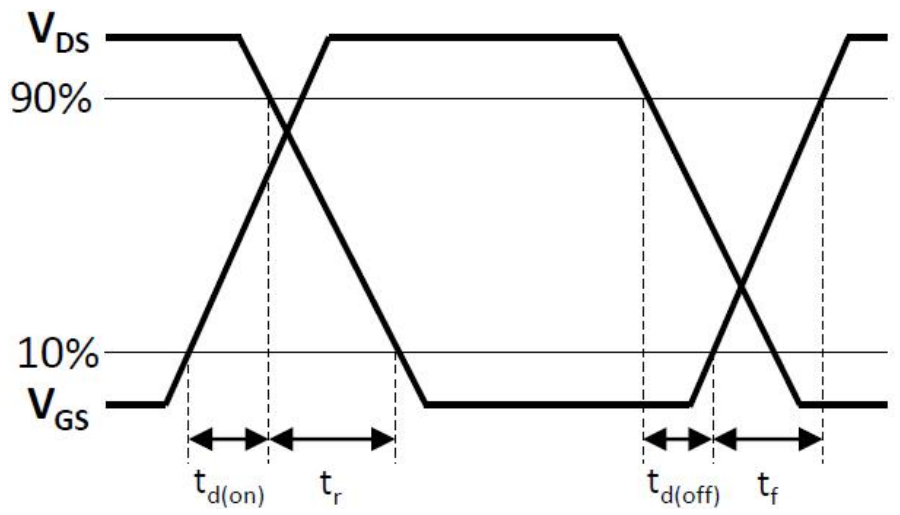
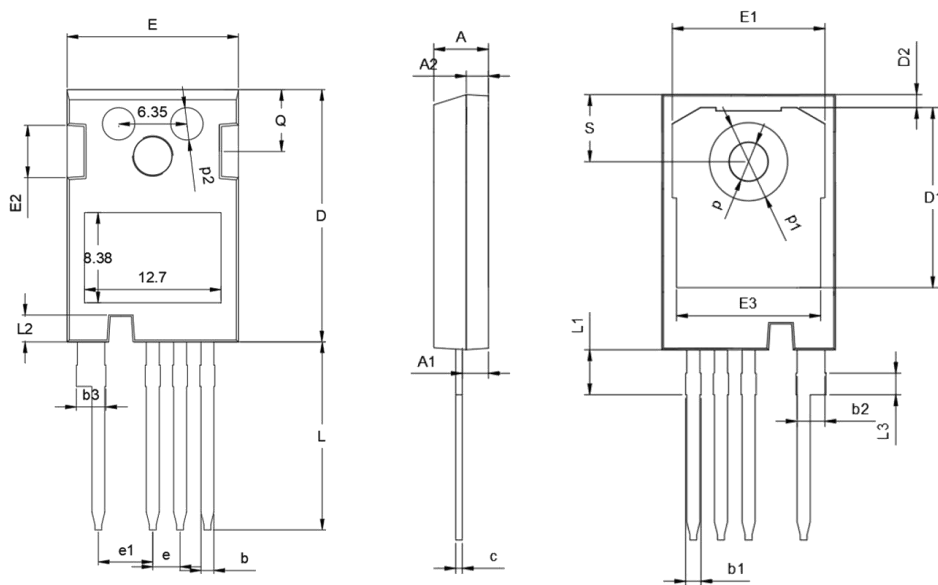


Figure 21. Switching Times Definition

■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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