



Features

- 3rd Generation SiC MOSFET technology
- High blocking voltage with low on-resistance
- High speed switching with low capacitances
- Fast intrinsic diode with low reverse recovery (Q_{rr})
- Halogen free, RoHS compliant

Benefits

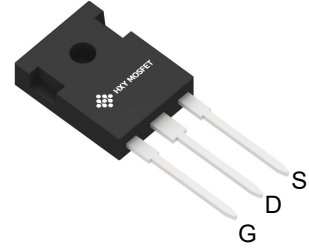
- Higher system efficiency
- Reduced cooling requirements
- Increased power density
- Increased system switching frequency

Applications

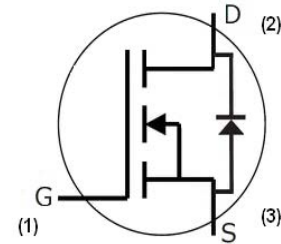
- Solar inverters
- EV motor drive
- High voltage DC/DC converters
- Switched mode power supplies



Part Number	Package	Qty(PCS)
SP50N120CTF	TO-247	30



TO-247



Maximum Ratings ($T_c = 25^\circ\text{C}$ unless otherwise specified)

Symbol	Parameter	Value	Unit	Test Conditions	Note
V_{DSmax}	Drain - Source Voltage	1200	V	$V_{GS} = 0\text{ V}$, $I_D = 100\text{ }\mu\text{A}$	
V_{GSmax}	Gate - Source Voltage (dynamic)	-8/+19	V	AC ($f > 1\text{ Hz}$)	Note 1
V_{GSop}	Gate - Source Voltage (static)	-4/+15	V	Static	Note 2
I_D	Continuous Drain Current	63	A	$V_{GS} = 15\text{ V}$, $T_c = 25^\circ\text{C}$	Fig. 19
		48		$V_{GS} = 15\text{ V}$, $T_c = 100^\circ\text{C}$	
$I_{D(pulse)}$	Pulsed Drain Current	120	A	Pulse width t_p limited by T_{jmax}	
P_D	Power Dissipation	283	W	$T_c = 25^\circ\text{C}$, $T_j = 175^\circ\text{C}$	Fig. 20
T_j, T_{stg}	Operating Junction and Storage Temperature	-40 to +175	$^\circ\text{C}$		
T_L	Solder Temperature	260	$^\circ\text{C}$	1.6mm (0.063") from case for 10s	
M_d	Mounting Torque	1 8.8	Nm lbf-in	M3 or 6-32 screw	

Note (1): When using MOSFET Body Diode $V_{GSmax} = -4\text{V}/+19\text{V}$

Note (2): MOSFET can also safely operate at 0/+15 V



Electrical Characteristics (T_c = 25°C unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions	Note
V _{(BR)DSS}	Drain-Source Breakdown Voltage	1200			V	V _{GS} = 0 V, I _D = 100 μA	
V _{GS(th)}	Gate Threshold Voltage	1.8	2.5	3.6	V	V _{DS} = V _{GS} , I _D = 11.5 mA	Fig. 11
			2.0		V	V _{DS} = V _{GS} , I _D = 11.5 mA, T _J = 175°C	
I _{DSS}	Zero Gate Voltage Drain Current		1	50	μA	V _{DS} = 1200 V, V _{GS} = 0 V	
I _{GSS}	Gate-Source Leakage Current		10	250	nA	V _{GS} = 15 V, V _{DS} = 0 V	
R _{DS(on)}	Drain-Source On-State Resistance	23	32	43	mΩ	V _{GS} = 15 V, I _D = 40 A	Fig. 4, 5, 6
			57.6			V _{GS} = 15 V, I _D = 40 A, T _J = 175°C	
g _{fs}	Transconductance		27		S	V _{DS} = 20 V, I _{DS} = 40 A	Fig. 7
			22			V _{DS} = 20 V, I _{DS} = 40 A, T _J = 175°C	
C _{iss}	Input Capacitance		3357		pF	V _{GS} = 0 V, V _{DS} = 1000 V f = 100 kHz V _{AC} = 25 mV	Fig. 17, 18
C _{oss}	Output Capacitance		129				
C _{rss}	Reverse Transfer Capacitance		8				
E _{oss}	C _{oss} Stored Energy		76				Fig. 16
E _{ON}	Turn-On Switching Energy (SiC Diode FWD)		1.94		mJ	V _{DS} = 800 V, V _{GS} = -4 V/+15 V, I _D = 40A, R _{G(ext)} = 5Ω, L = 157 μH, T _J = 175°C	Fig. 26
E _{OFF}	Turn Off Switching Energy (SiC Diode FWD)		0.79				
E _{ON}	Turn-On Switching Energy (Body Diode FWD)		3.10		mJ	V _{DS} = 800 V, V _{GS} = -4 V/+15 V, I _D = 40A, R _{G(ext)} = 5Ω, L = 157 μH, T _J = 175°C	Fig. 26
E _{OFF}	Turn Off Switching Energy (Body Diode FWD)		0.72				
t _{d(on)}	Turn-On Delay Time		107		ns	V _{DD} = 800 V, V _{GS} = -4 V/15 V R _{G(ext)} = 5 Ω, I _D = 40 A, L = 157 Timing relative to V _{DS} , Inductive load	Fig. 27
t _r	Rise Time		22				
t _{d(off)}	Turn-Off Delay Time		39				
t _f	Fall Time		19				
R _{G(int)}	Internal Gate Resistance		1.7		Ω	f = 1 MHz, V _{AC} = 25 mV	
Q _{gs}	Gate to Source Charge		35		nC	V _{DS} = 800 V, V _{GS} = -4 V/15 V I _D = 40 A Per IEC60747-8-4 pg 21	Fig. 12
Q _{gd}	Gate to Drain Charge		40				
Q _g	Total Gate Charge		114				

Reverse Diode Characteristics (T_c = 25°C unless otherwise specified)

Symbol	Parameter	Typ.	Max.	Unit	Test Conditions	Note
V _{SD}	Diode Forward Voltage	4.6		V	V _{GS} = -4 V, I _{SD} = 20 A, T _J = 25 °C	Fig. 8, 9, 10
		4.2		V	V _{GS} = -4 V, I _{SD} = 20 A, T _J = 175 °C	
I _S	Continuous Diode Forward Current		62	A	V _{GS} = -4 V, T _c = 25°C	Note 1
I _{S, pulse}	Diode pulse Current		120	A	V _{GS} = -4 V, pulse width t _p limited by T _{Jmax}	Note 1
t _{rr}	Reverse Recover time	69		ns	V _{GS} = -4 V, I _{SD} = 40 A, V _R = 800 V dif/dt = 1500 A/μs, T _J = 175 °C	Note 1
Q _{rr}	Reverse Recovery Charge	848		nC		
I _{rrm}	Peak Reverse Recovery Current	19		A		

Thermal Characteristics

Symbol	Parameter	Typ.	Unit	Test Conditions	Note
R _{θJC}	Thermal Resistance from Junction to Case	0.45	°C/W		Fig. 21
R _{θJA}	Thermal Resistance From Junction to Ambient	40			



Typical Performance

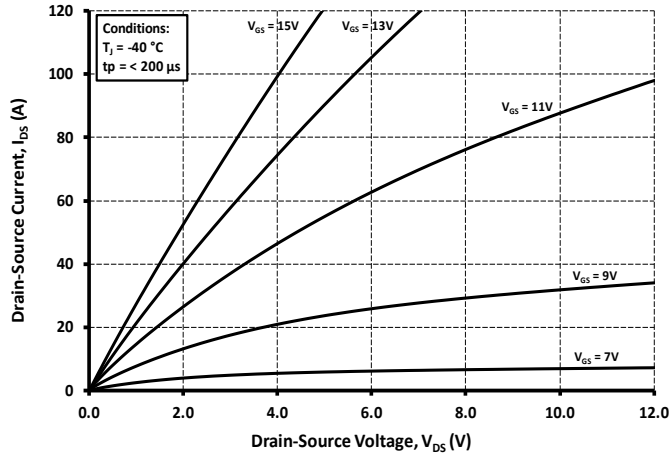


Figure 1. Output Characteristics $T_j = -40^\circ\text{C}$

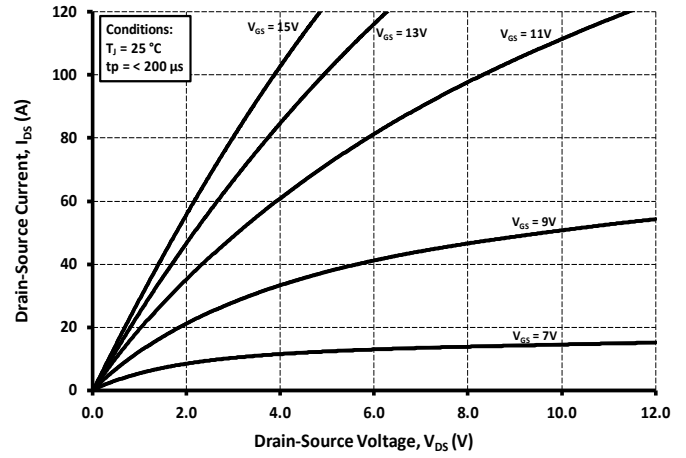


Figure 2. Output Characteristics $T_j = 25^\circ\text{C}$

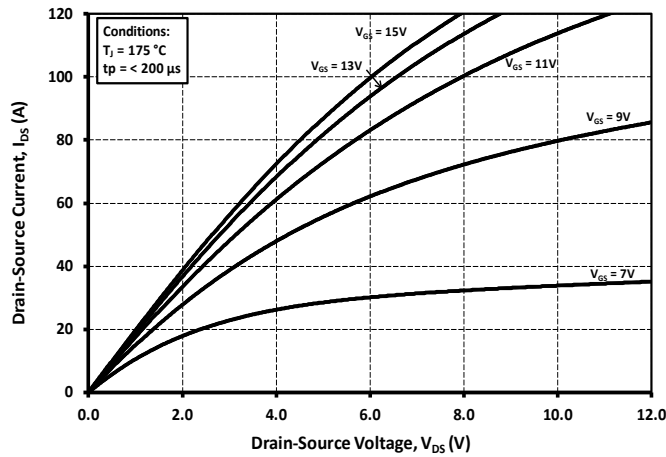


Figure 3. Output Characteristics $T_j = 175^\circ\text{C}$

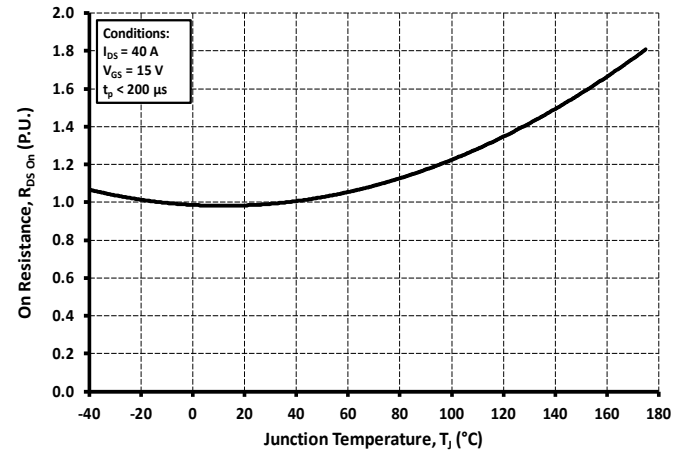


Figure 4. Normalized On-Resistance vs. Temperature

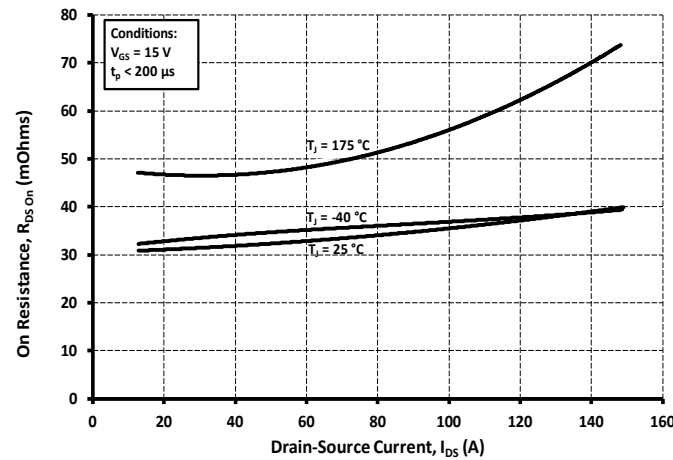


Figure 5. On-Resistance vs. Drain Current
For Various Temperatures

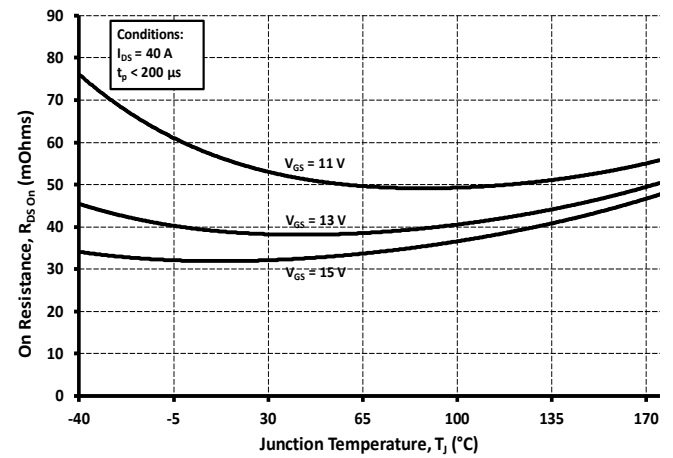


Figure 6. On-Resistance vs. Temperature
For Various Gate Voltage



Typical Performance

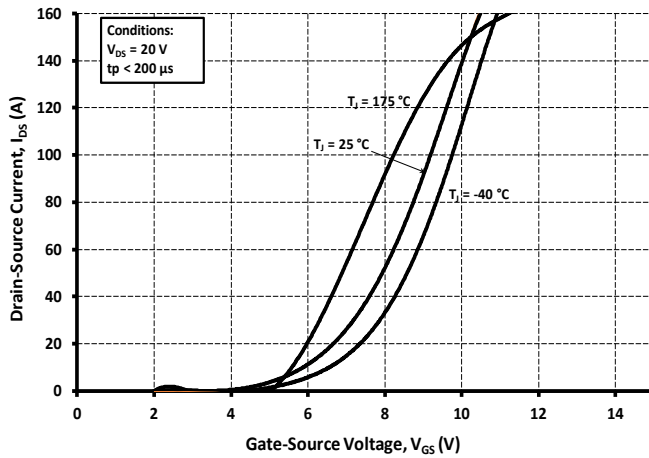


Figure 7. Transfer Characteristic for Various Junction Temperatures

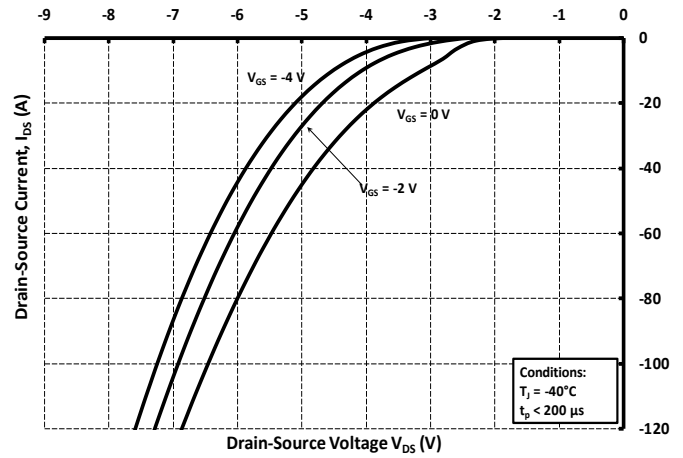


Figure 8. Body Diode Characteristic at -40°C

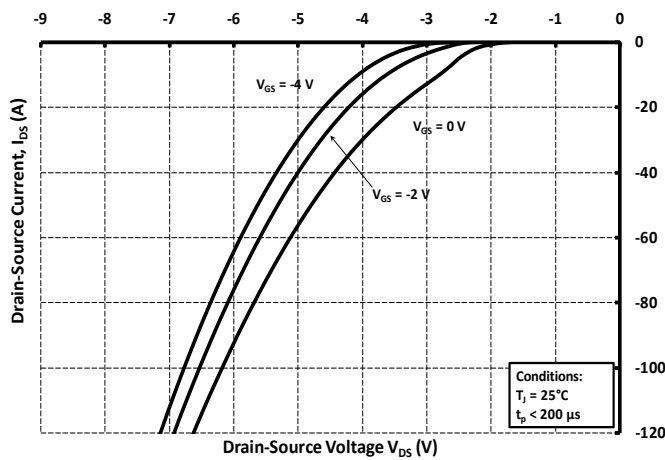


Figure 9. Body Diode Characteristic at 25°C

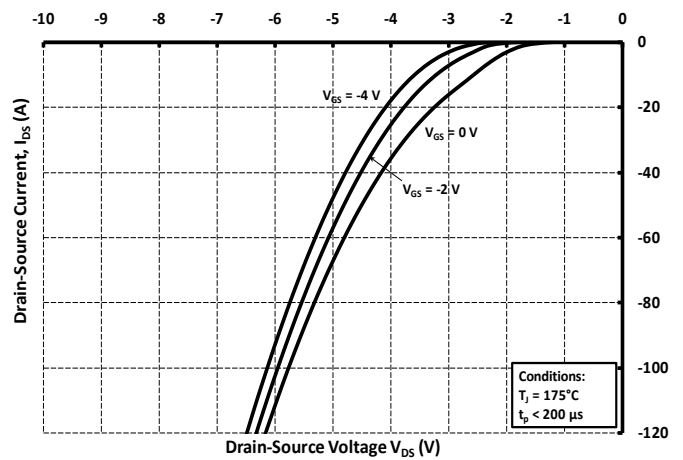


Figure 10. Body Diode Characteristic at 175°C

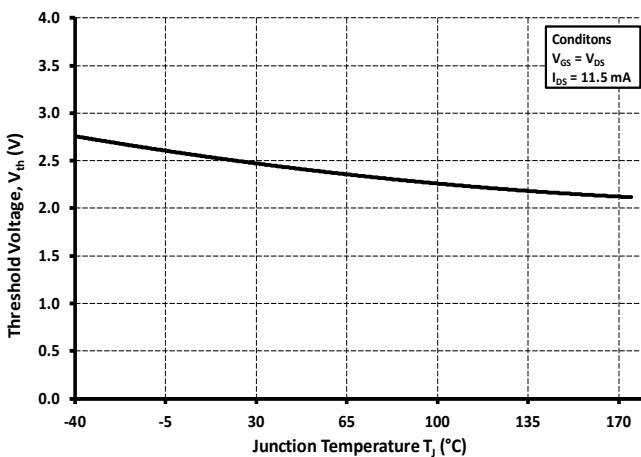


Figure 11. Threshold Voltage vs. Temperature

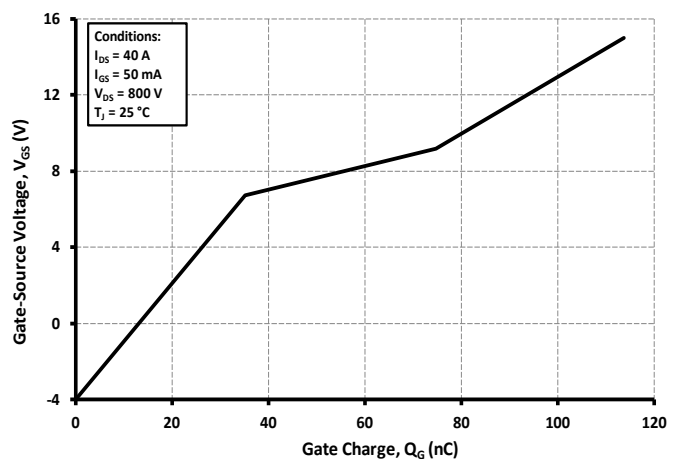


Figure 12. Gate Charge Characteristics



Typical Performance

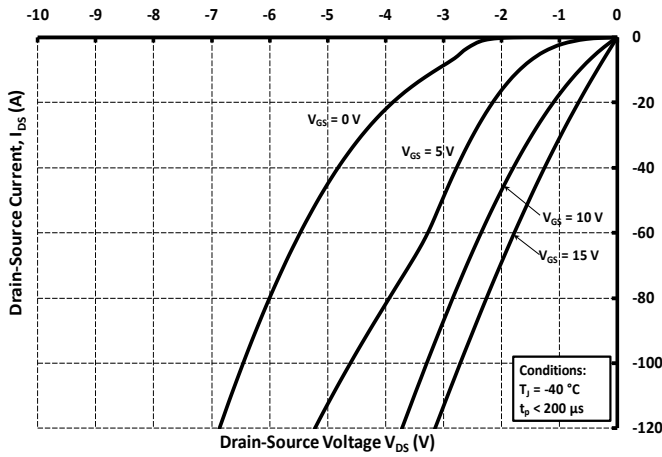


Figure 13. 3rd Quadrant Characteristic at -40 °C

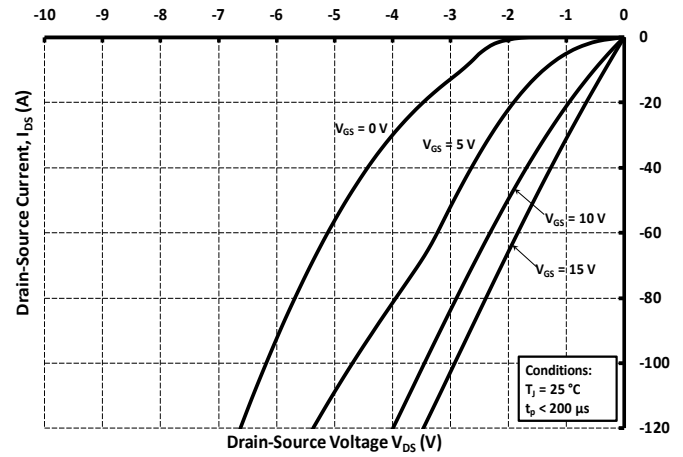


Figure 14. 3rd Quadrant Characteristic at 25 °C

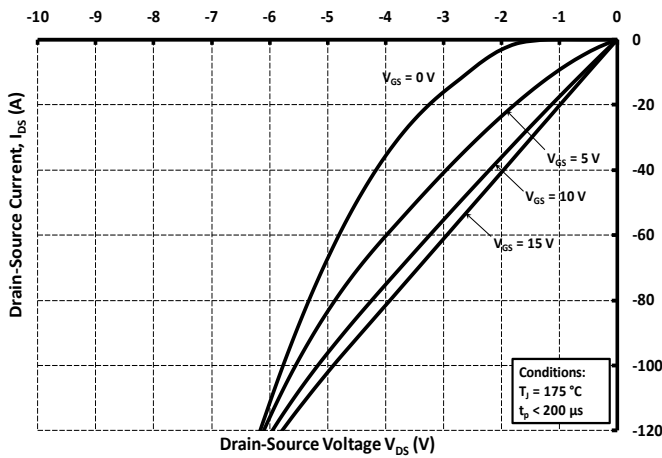


Figure 15. 3rd Quadrant Characteristic at 175 °C

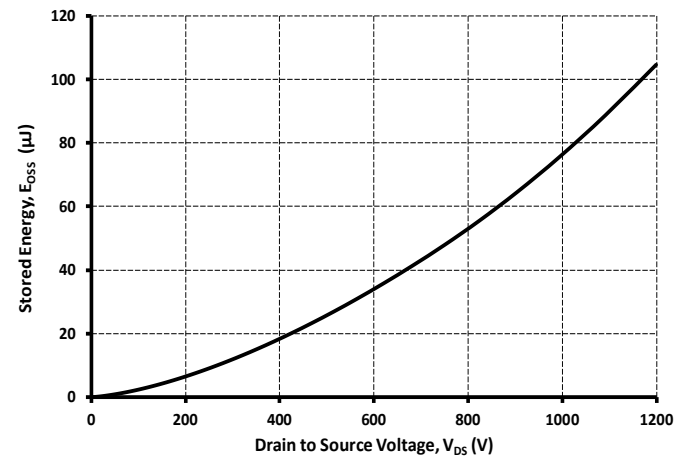


Figure 16. Output Capacitor Stored Energy

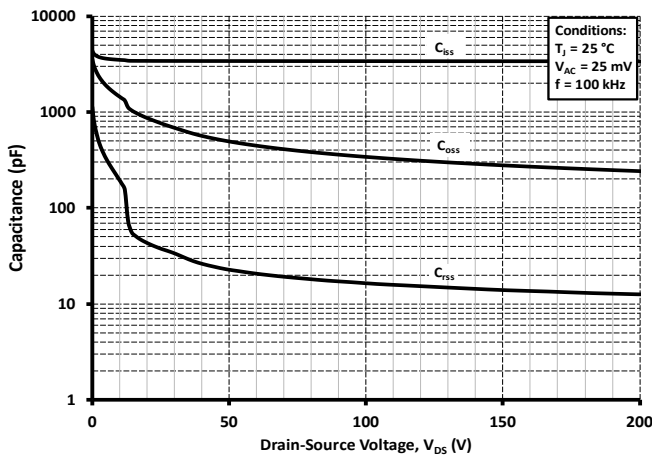


Figure 17. Capacitances vs. Drain-Source Voltage (0 - 200V)

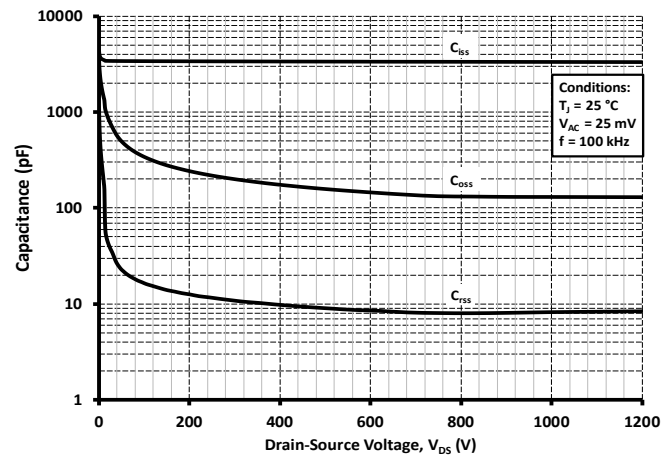


Figure 18. Capacitances vs. Drain-Source Voltage (0 - 1200V)



Typical Performance

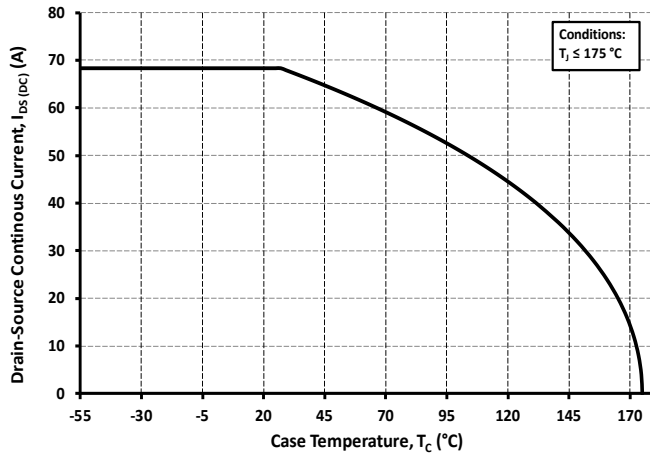


Figure 19. Continuous Drain Current Derating vs. Case Temperature

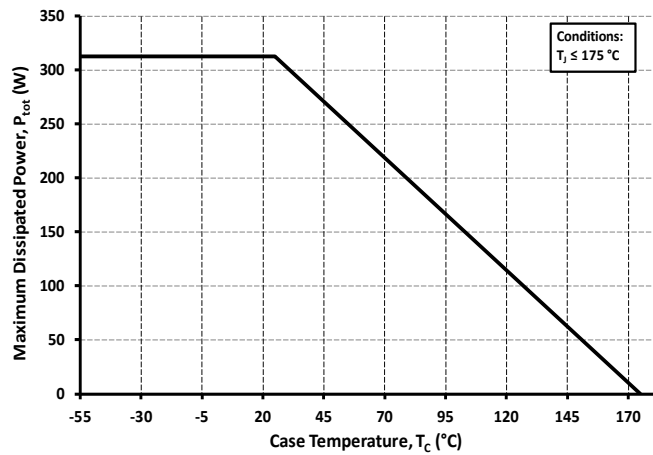


Figure 20. Maximum Power Dissipation Derating vs. Case Temperature

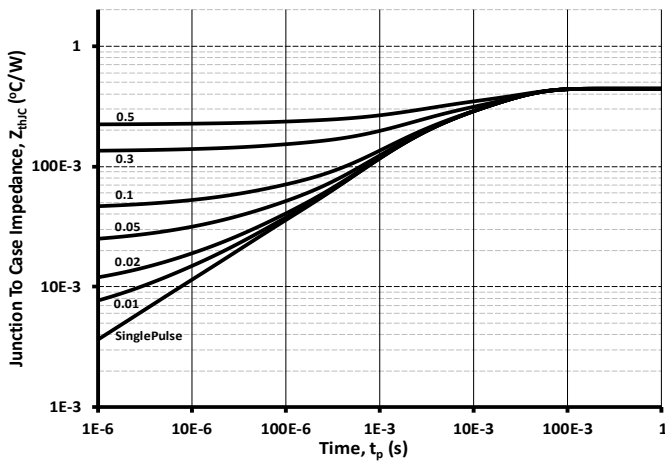


Figure 21. Transient Thermal Impedance (Junction - Case)

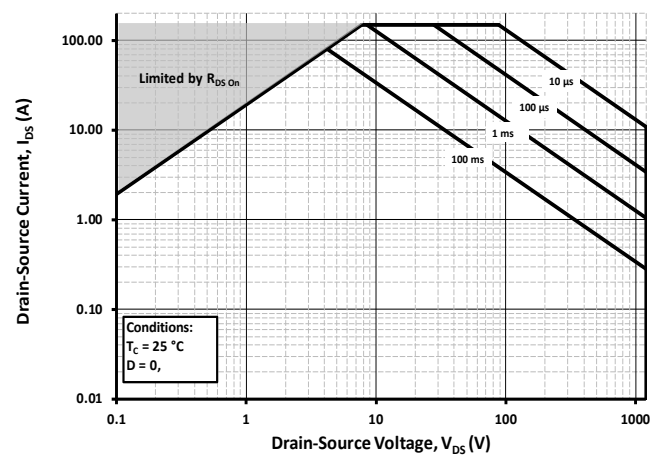


Figure 22. Safe Operating Area

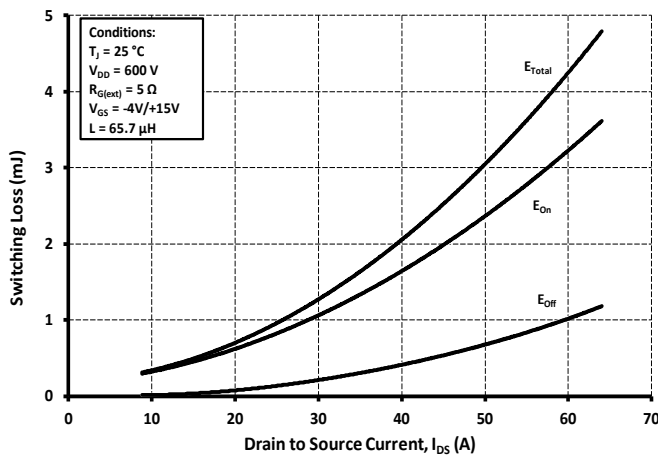


Figure 23. Clamped Inductive Switching Energy vs. Drain Current ($V_{DD} = 600V$)

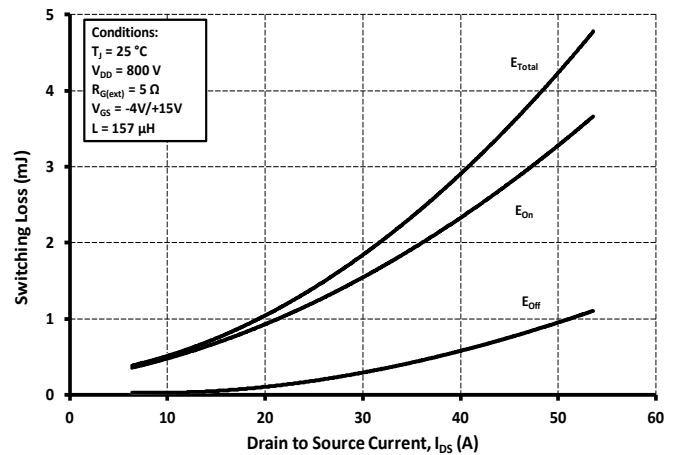


Figure 24. Clamped Inductive Switching Energy vs. Drain Current ($V_{DD} = 800V$)



Typical Performance

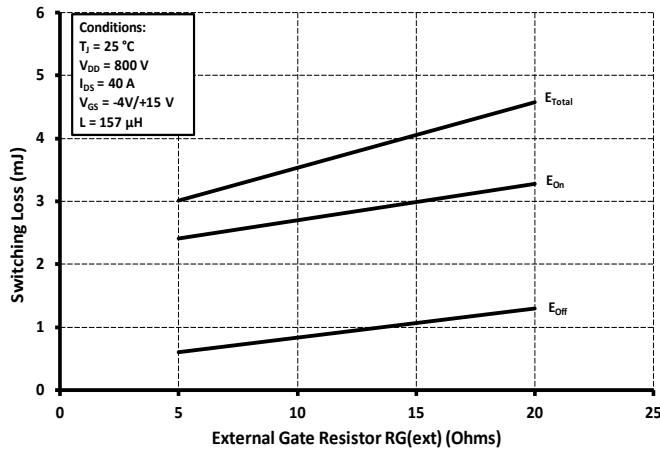


Figure 25. Clamped Inductive Switching Energy vs. $R_{G(ext)}$

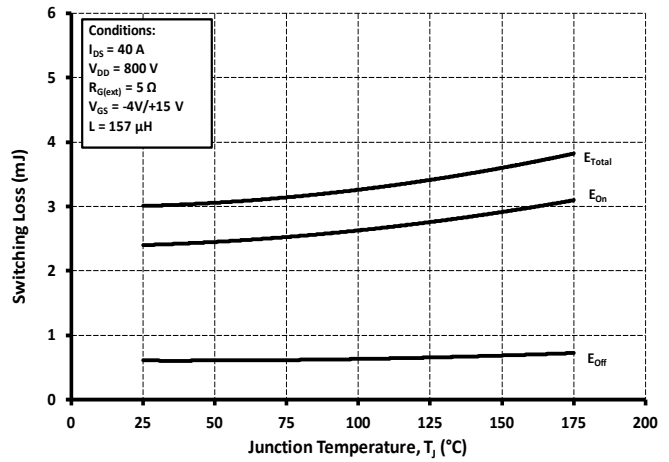


Figure 26. Clamped Inductive Switching Energy vs. Temperature

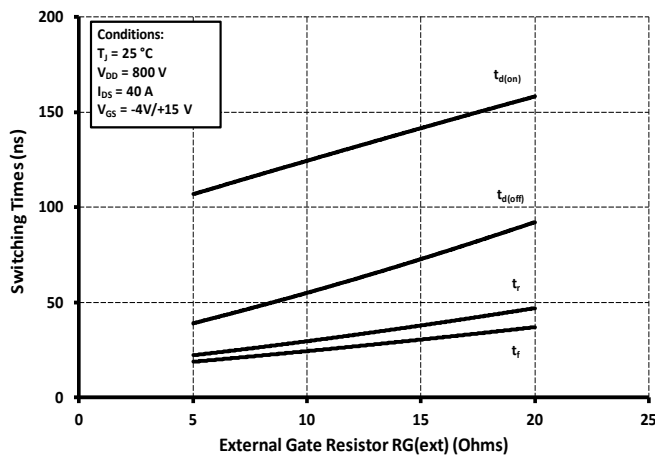
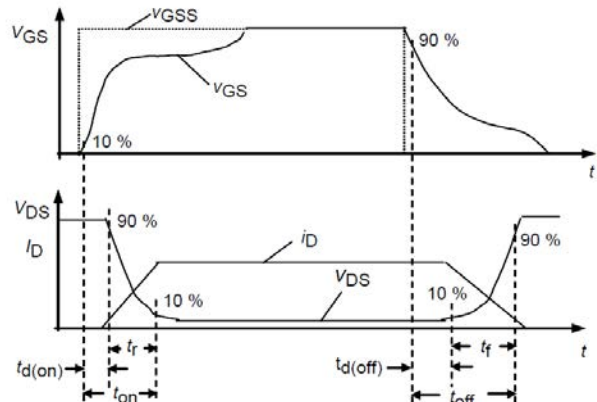


Figure 27. Switching Times vs. $R_{G(ext)}$



IEC 1161/04

Figure 28. Switching Times Definition



Test Circuit Schematic

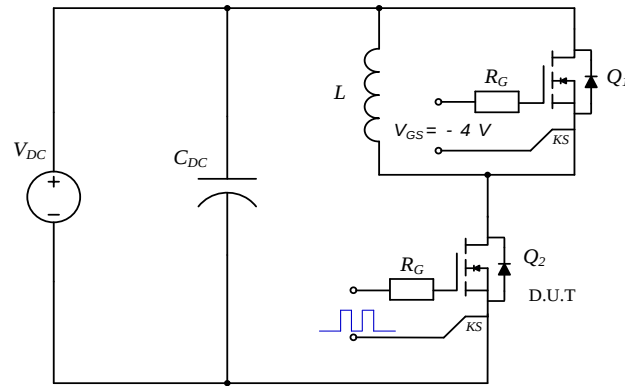


Figure 29. Clamped Inductive Switching
Waveform Test Circuit

Note (3): Turn-off and Turn-on switching energy and timing values measured using SiC MOSFET Body Diode as shown above.



Package Dimensions

Package TO-247

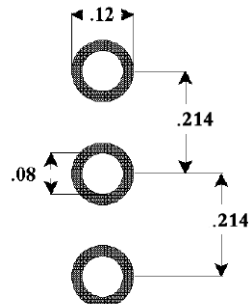


Pinout Information:

- Pin 1 = Gate
- Pin 2, 4 = Drain
- Pin 3 = Source

POS	Inches		Millimeters	
	Min	Max	Min	Max
A	.190	.205	4.83	5.21
A1	.090	.100	2.29	2.54
A2	.075	.085	1.91	2.16
b	.042	.052	1.07	1.33
b1	.075	.095	1.91	2.41
b2	.075	.085	1.91	2.16
b3	.113	.133	2.87	3.38
b4	.113	.123	2.87	3.13
c	.022	.027	0.55	0.68
D	.819	.831	20.80	21.10
D1	.640	.695	16.25	17.65
D2	.037	.049	0.95	1.25
E	.620	.635	15.75	16.13
E1	.516	.557	13.10	14.15
E2	.145	.201	3.68	5.10
E3	.039	.075	1.00	1.90
E4	.487	.529	12.38	13.43
e	.214 BSC		5.44 BSC	
N	3		3	
L	.780	.800	19.81	20.32
L1	.161	.173	4.10	4.40
ØP	.138	.144	3.51	3.65
Q	.216	.236	5.49	6.00
S	.238	.248	6.04	6.30
T	9°	11°	9°	11°
U	9°	11°	9°	11°
V	2°	8°	2°	8°
W	2°	8°	2°	8°

Recommended Solder Pad Layout



T0247-3L



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