

HMM35N120T

Silicon Carbide Power MOSFET

N-Channel Enhancement Mode

V_{DS}	1200 V
$I_D @ 25^\circ\text{C}$	32 A
$R_{DS(on)}$	75 m Ω

Package

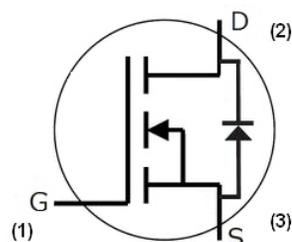


Features

- SiC MOSFET technology
- High blocking voltage with low On-resistance
- High speed switching with low capacitances
- Fast intrinsic diode with low reverse recovery (Qrr)
- Halogen free, RoHS compliant

Benefits

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



Applications

- Renewable energy
- EV battery chargers
- High voltage DC/DC converters
- Switch Mode Power Supplies

Ordering Part Number	Package	Marking	T_J, T_{stg} Range
HMM35N120T	TO 247-3	HMM35N120T XXXX	-55 - 150 °C
HMM35N120T-A	TO 247-3	HMM35N120T-A XXXX	-40 - 175 °C

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	$V_{GS} = 0\text{ V}, I_D = 100\ \mu\text{A}$	
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	32	A	$V_{GS} = 15\text{ V}, T_C = 25^\circ\text{C}$	Fig. 19
		23		$V_{GS} = 15\text{ V}, T_C = 100^\circ\text{C}$	
$I_{D(pulse)}$	Pulsed Drain Current	80	A	Pulse width t_p limited by T_{jmax}	Fig. 22
P_D	Power Dissipation	136	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	°C		
T_L	Solder Temperature	260	°C	1.6mm (0.063") from case for 10s	
M_d	Mounting Torque	1	Nm lbf-in	M3 or 6-32 screw	
		8.8			

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

Note (2): MOSFET can also safely operate at $0/+15\text{V}$

Electrical Characteristics ($T_C = 25^\circ\text{C}$ unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions	Note
$V_{(BR)DSS}$	Drain-Source Breakdown Voltage	1200			V	$V_{GS} = 0\text{ V}, I_D = 100\ \mu\text{A}$	
$V_{GS(th)}$	Gate Threshold Voltage	1.8	2.5	3.6	V	$V_{DS} = V_{GS}, I_D = 5\ \text{mA}$	Fig. 11
			2.2		V	$V_{DS} = V_{GS}, I_D = 5\ \text{mA}, T_J = 175^\circ\text{C}$	
I_{DSS}	Zero Gate Voltage Drain Current		1	100	μA	$V_{DS} = 1200\ \text{V}, V_{GS} = 0\ \text{V}$	
I_{GSS}	Gate-Source Leakage Current		10	250	nA	$V_{GS} = 15\ \text{V}, V_{DS} = 0\ \text{V}$	
$R_{DS(on)}$	Drain-Source On-State Resistance		75	90	m Ω	$V_{GS} = 15\ \text{V}, I_D = 20\ \text{A}$	Fig. 4, 5, 6
			120			$V_{GS} = 15\ \text{V}, I_D = 20\ \text{A}, T_J = 175^\circ\text{C}$	
g_{fs}	Transconductance		12		S	$V_{DS} = 20\ \text{V}, I_{DS} = 20\ \text{A}$	Fig. 7
			13			$V_{DS} = 20\ \text{V}, I_{DS} = 20\ \text{A}, T_J = 175^\circ\text{C}$	
C_{iss}	Input Capacitance		1390		pF	$V_{GS} = 0\ \text{V}, V_{DS} = 1000\ \text{V}$ $f = 1\ \text{MHz}$ $V_{AC} = 25\ \text{mV}$	Fig. 17, 18
C_{oss}	Output Capacitance		58				
C_{rss}	Reverse Transfer Capacitance		2				
E_{oss}	C_{oss} Stored Energy		33				μJ
E_{ON}	Turn-On Switching Energy (SiC Diode FWD)		564		μJ	$V_{DS} = 800\ \text{V}, V_{GS} = -4\ \text{V}/15\ \text{V}, I_D = 20\ \text{A},$ $R_{G(ext)} = 0\ \Omega, L = 157\ \mu\text{H}, T_J = 150^\circ\text{C}$	Fig. 26, 29
E_{OFF}	Turn Off Switching Energy (SiC Diode FWD)		186				
E_{ON}	Turn-On Switching Energy (Body Diode FWD)		924		μJ	$V_{DS} = 800\ \text{V}, V_{GS} = -4\ \text{V}/15\ \text{V}, I_D = 20\ \text{A},$ $R_{G(ext)} = 0\ \Omega, L = 157\ \mu\text{H}, T_J = 150^\circ\text{C}$	Fig. 26, 29
E_{OFF}	Turn Off Switching Energy (Body Diode FWD)		162				
$t_{d(on)}$	Turn-On Delay Time		56		ns	$V_{DD} = 800\ \text{V}, V_{GS} = -4\ \text{V}/15\ \text{V}$ $I_D = 20\ \text{A}, R_{G(ext)} = 0\ \Omega,$ Timing relative to V_{DS} Inductive load	Fig. 27, 28
t_r	Rise Time		17				
$t_{d(off)}$	Turn-Off Delay Time		32				
t_f	Fall Time		13				
$R_{G(int)}$	Internal Gate Resistance		9.0		Ω	$f = 1\ \text{MHz}, V_{AC} = 25\ \text{mV}$	
Q_{gs}	Gate to Source Charge		17		nC	$V_{DS} = 800\ \text{V}, V_{GS} = -4\ \text{V}/15\ \text{V}$ $I_D = 20\ \text{A}$ Per IEC60747-8-4 pg 21	Fig. 12
Q_{gd}	Gate to Drain Charge		20				
Q_g	Total Gate Charge		54				

Reverse Diode Characteristics ($T_C = 25^\circ\text{C}$ unless otherwise specified)

Symbol	Parameter	Typ.	Max.	Unit	Test Conditions	Note
V_{SD}	Diode Forward Voltage	4.5		V	$V_{GS} = -4\ \text{V}, I_{SD} = 10\ \text{A}$	Fig. 8, 9, 10
		4.0		V	$V_{GS} = -4\ \text{V}, I_{SD} = 10\ \text{A}, T_J = 175^\circ\text{C}$	
I_S	Continuous Diode Forward Current		26	A	$V_{GS} = -4\ \text{V}, T_J = 25^\circ\text{C}$	Note 1
$I_{S, pulse}$	Diode pulse Current	80		A	$V_{GS} = -4\ \text{V},$ pulse width t_p limited by T_{Jmax}	Note 1
t_{rr}	Reverse Recover time	48		ns	$V_{GS} = -4\ \text{V}, I_{SD} = 20\ \text{A}, V_R = 800\ \text{V}$ $\text{diff}/\text{dt} = 2800\ \text{A}/\mu\text{s}, T_J = 150^\circ\text{C}$	Note 1
Q_{rr}	Reverse Recovery Charge	279		nC		
I_{rrm}	Peak Reverse Recovery Current	9		A		

Thermal Characteristics

Symbol	Parameter	Typ.	Max.	Unit	Test Conditions	Note
$R_{\theta JC}$	Thermal Resistance from Junction to Case	0.97	1.1	$^\circ\text{C}/\text{W}$		Fig. 21
$R_{\theta JA}$	Thermal Resistance From Junction to Ambient		40			

Typical Performance

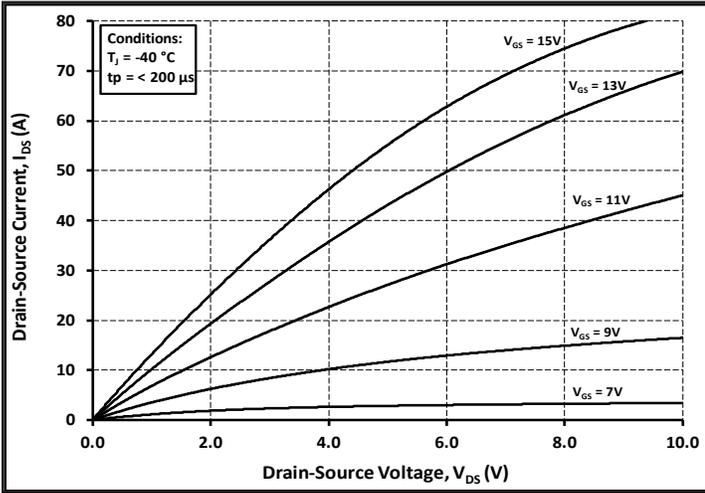


Figure 1. Output Characteristics $T_J = -40\text{ }^\circ\text{C}$

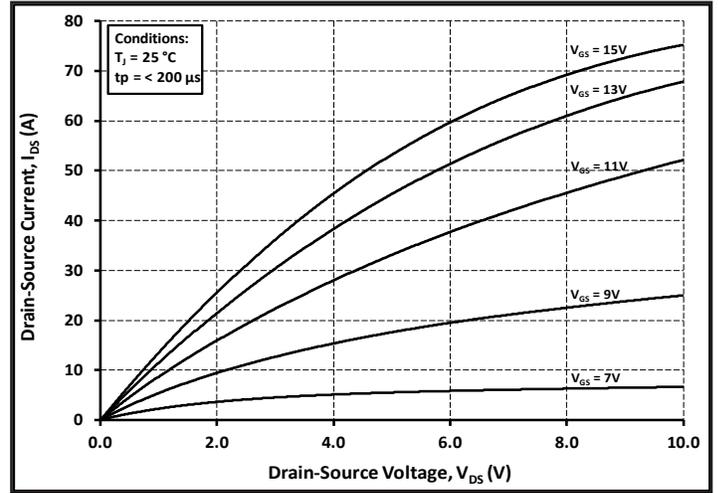


Figure 2. Output Characteristics $T_J = 25\text{ }^\circ\text{C}$

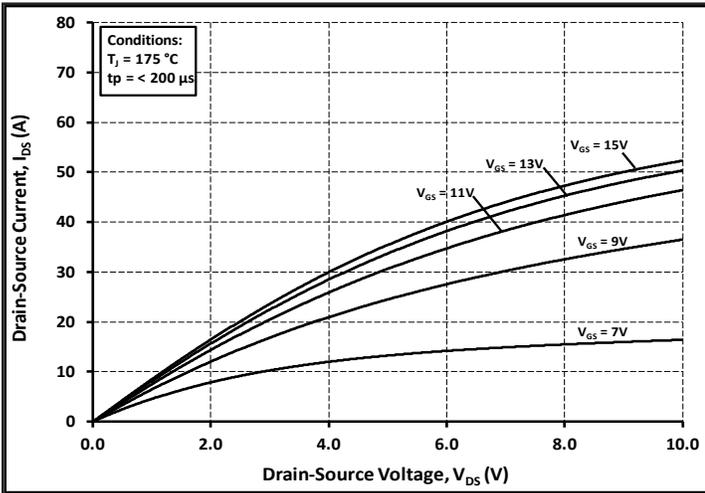


Figure 3. Output Characteristics $T_J = 175\text{ }^\circ\text{C}$

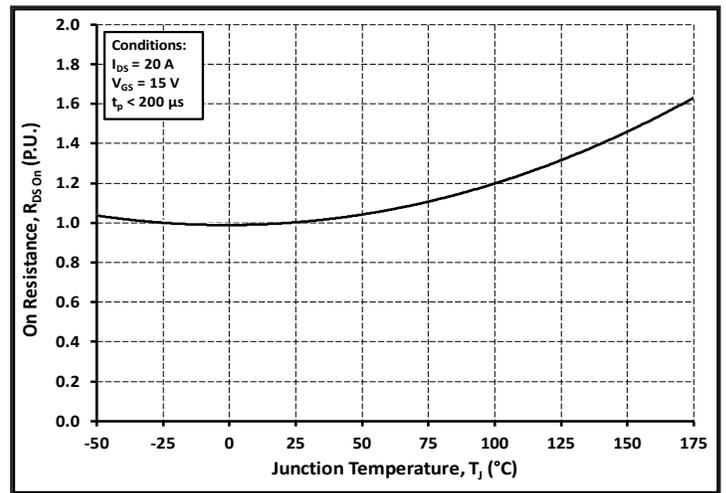


Figure 4. Normalized On-Resistance vs. Temperature

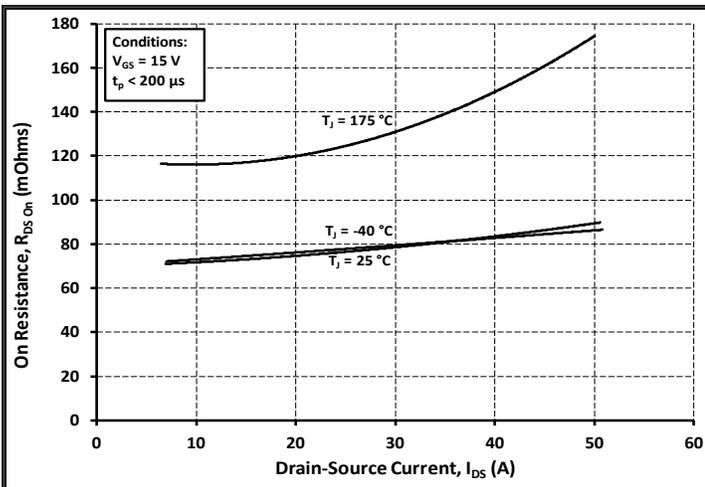


Figure 5. On-Resistance vs. Drain Current For Various Temperatures

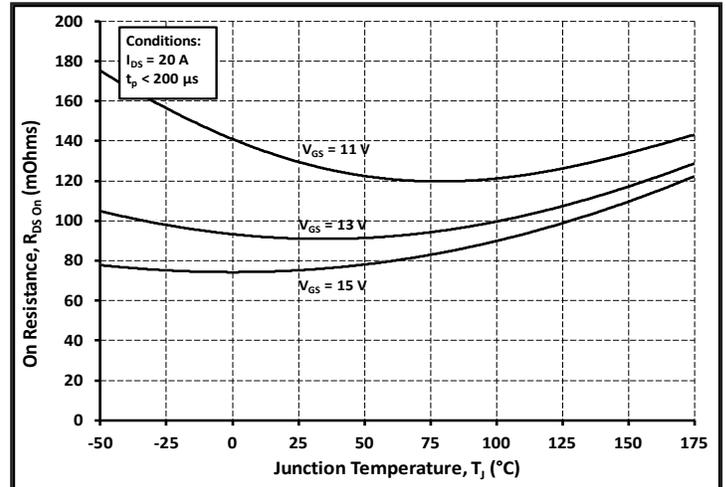


Figure 6. On-Resistance vs. Temperature For Various Gate Voltage

Typical Performance

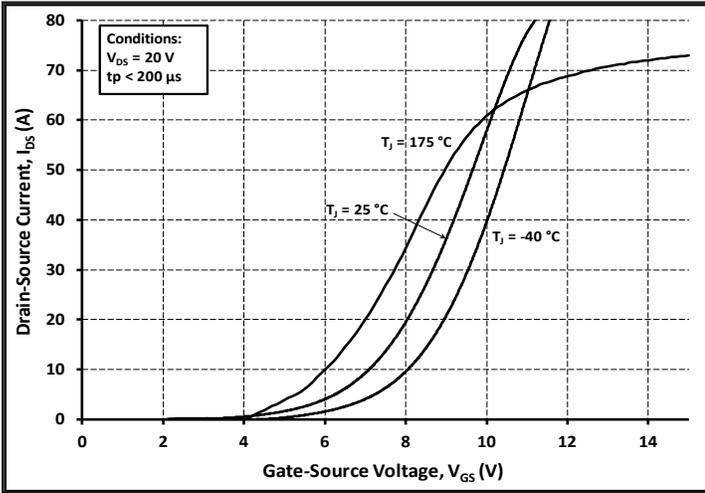


Figure 7. Transfer Characteristic for Various Junction Temperatures

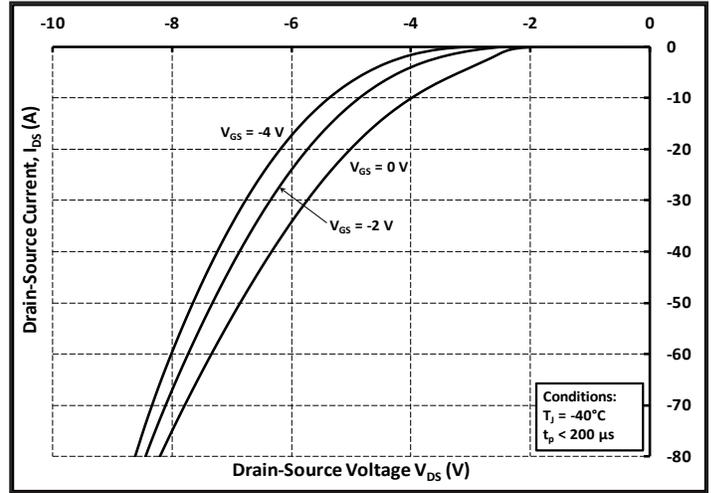


Figure 8. Body Diode Characteristic at -40 °C

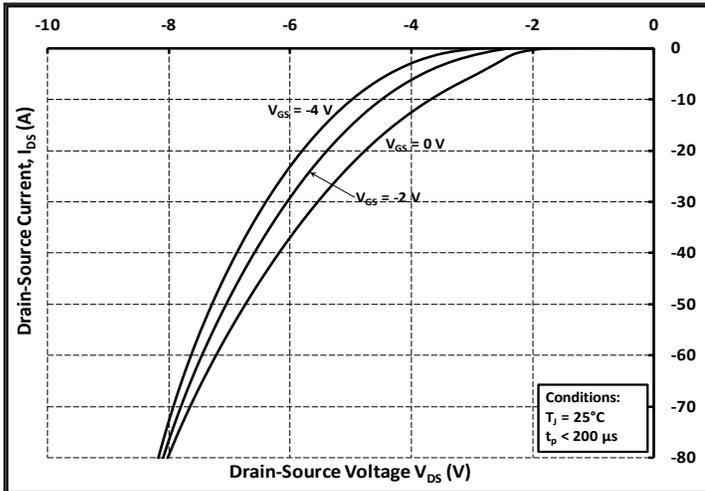


Figure 9. Body Diode Characteristic at 25 °C

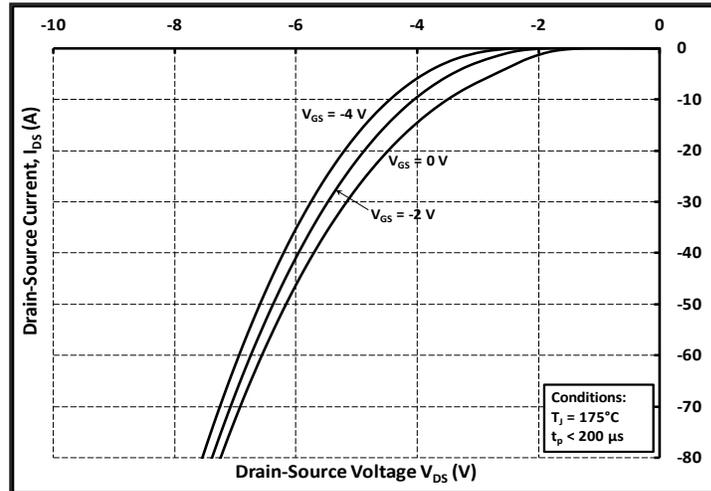


Figure 10. Body Diode Characteristic at 175 °C

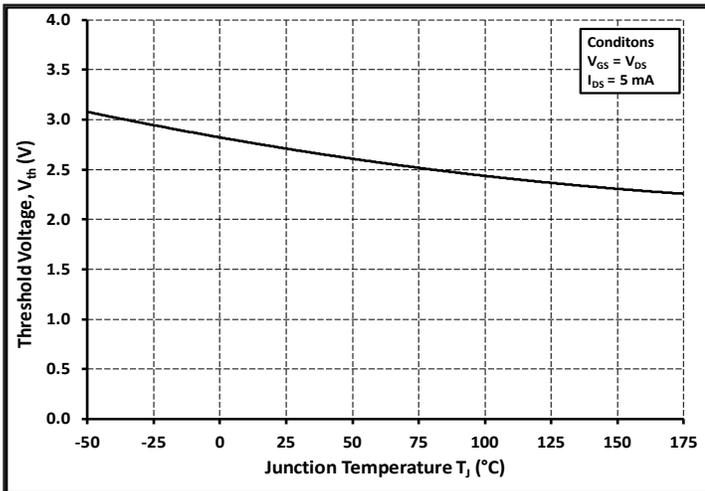


Figure 11. Threshold Voltage vs. Temperature

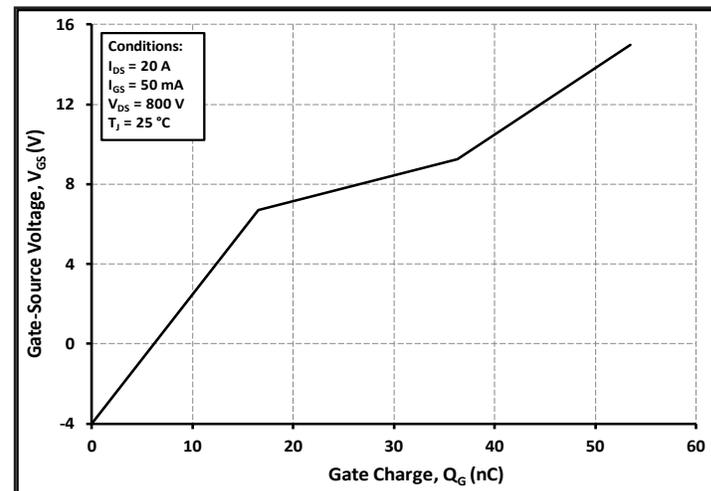


Figure 12. Gate Charge Characteristics

Typical Performance

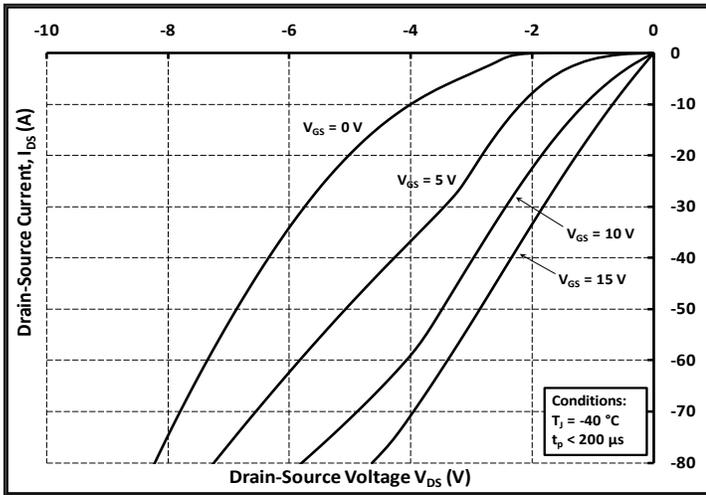


Figure 13. 3rd Quadrant Characteristic at -40 °C

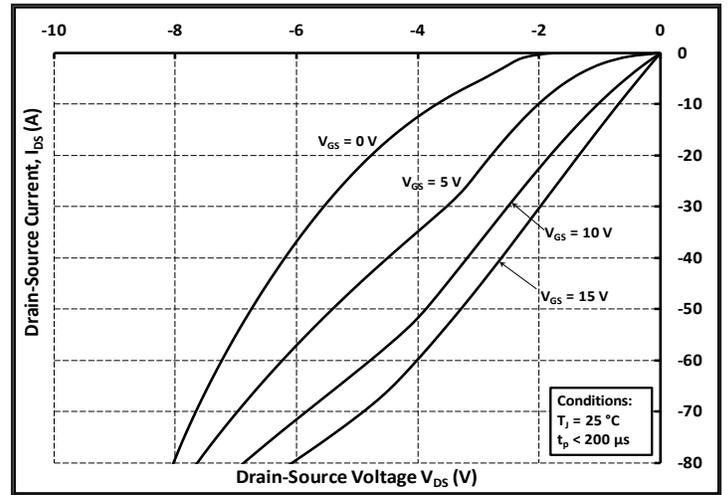


Figure 14. 3rd Quadrant Characteristic at 25 °C

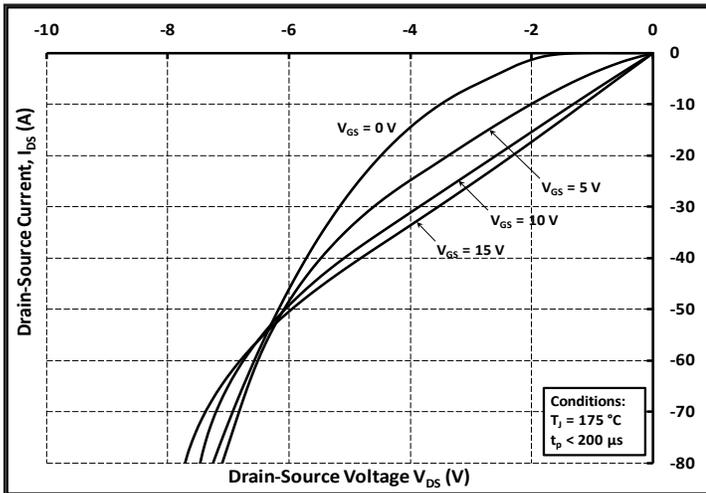


Figure 15. 3rd Quadrant Characteristic at 175 °C

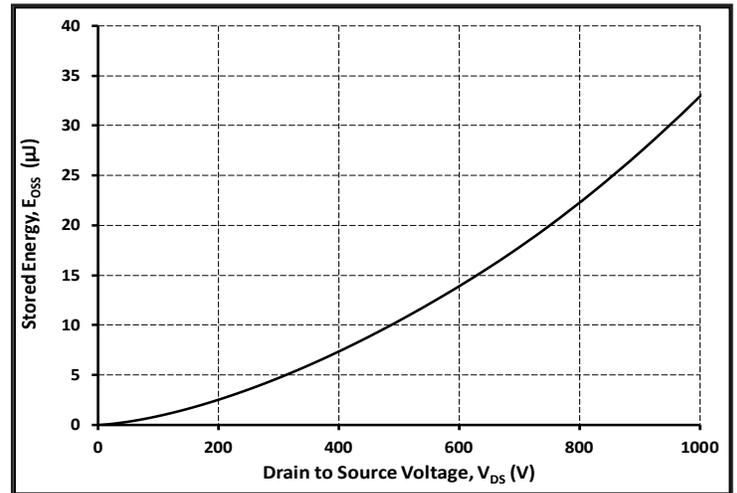


Figure 16. Output Capacitor Stored Energy

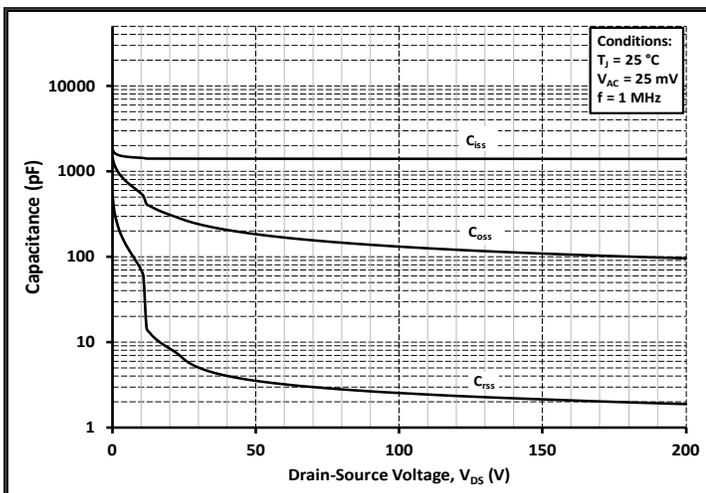


Figure 17. Capacitances vs. Drain-Source Voltage (0 - 200V)

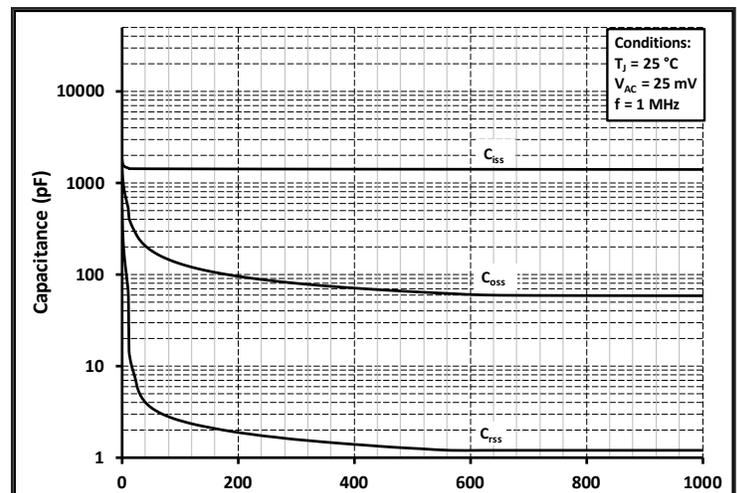


Figure 18. Capacitances vs. Drain-Source Voltage (0 - 1000V)

Typical Performance

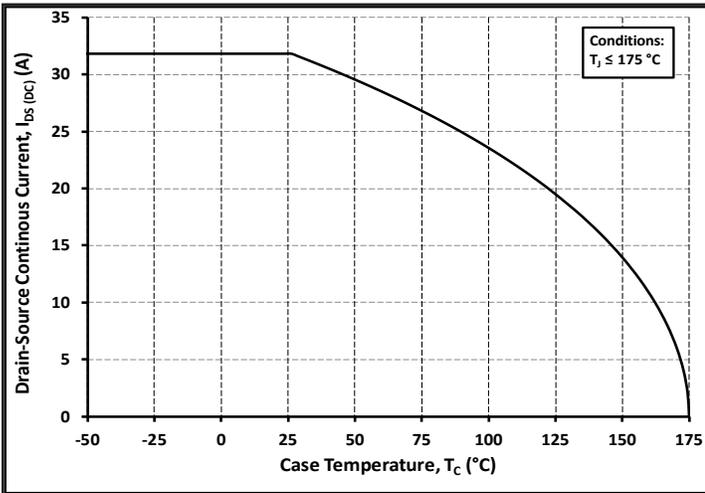


Figure 19. Continuous Drain Current Derating vs. Case Temperature

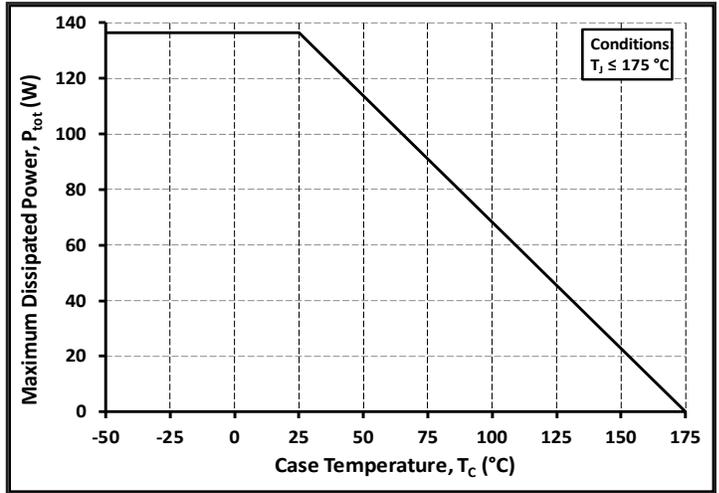


Figure 20. Maximum Power Dissipation Derating vs. Case Temperature

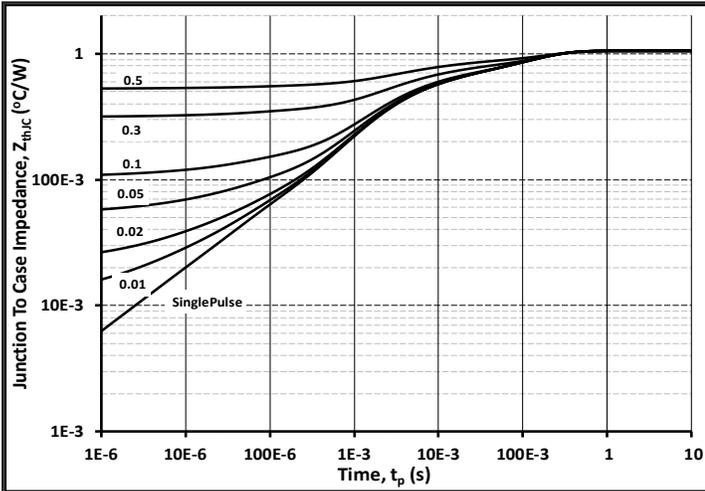


Figure 21. Transient Thermal Impedance (Junction - Case)

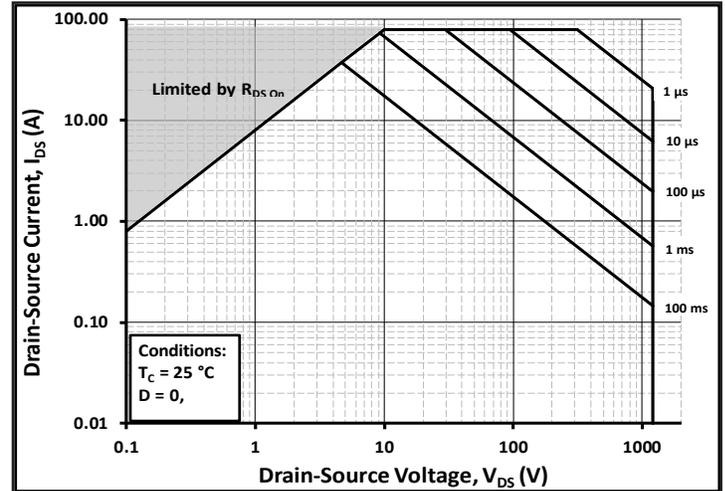


Figure 22. Safe Operating Area

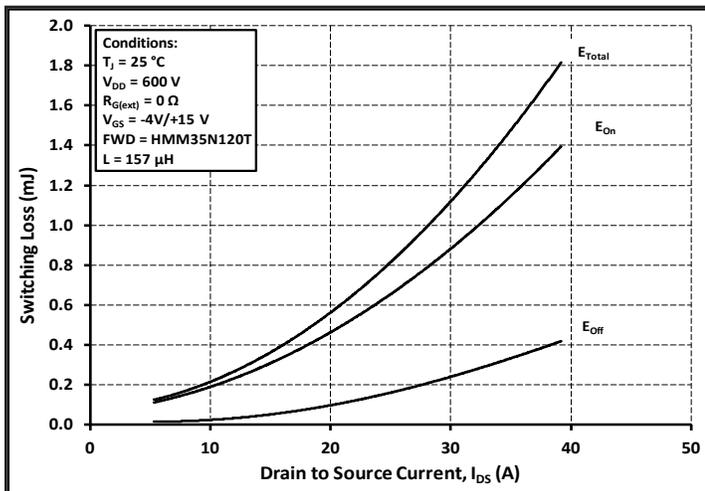


Figure 23. Clamped Inductive Switching Energy vs. Drain Current ($V_{DD} = 600V$)

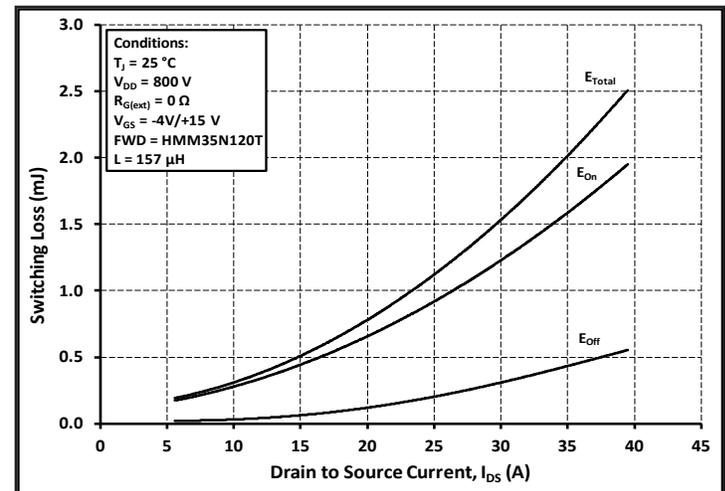


Figure 24. Clamped Inductive Switching Energy vs. Drain Current ($V_{DD} = 800V$)

Typical Performance

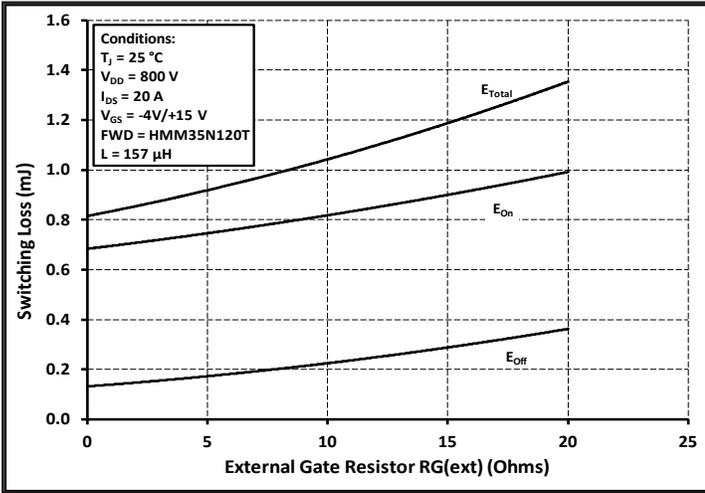


Figure 25. Clamped Inductive Switching Energy vs. $R_{G(ext)}$

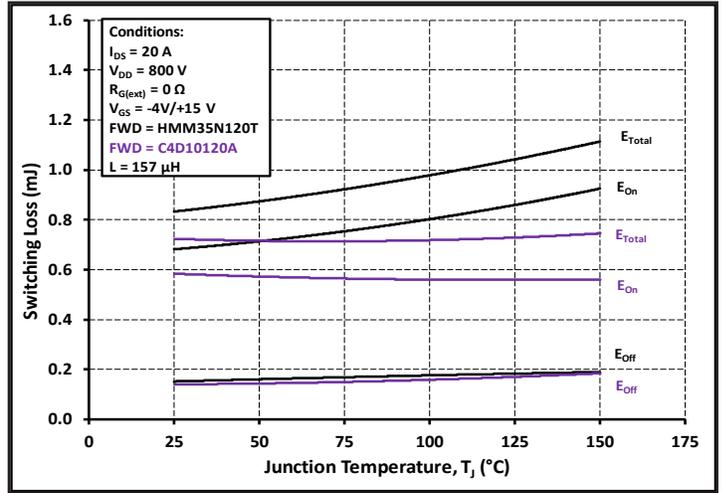


Figure 26. Clamped Inductive Switching Energy vs. Temperature

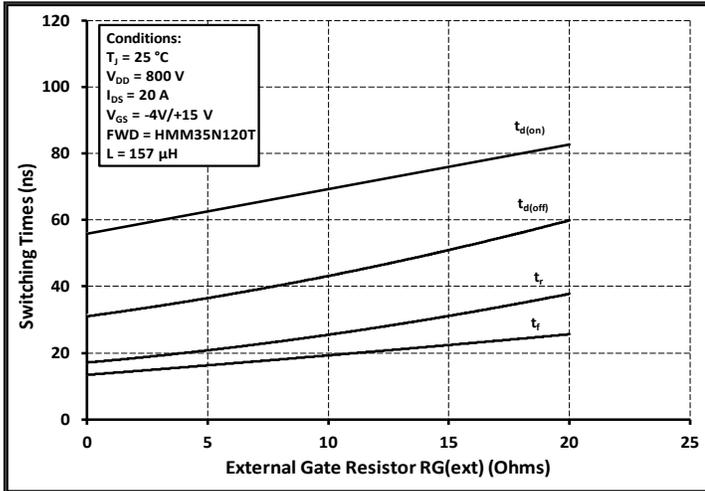


Figure 27. Switching Times vs. $R_{G(ext)}$

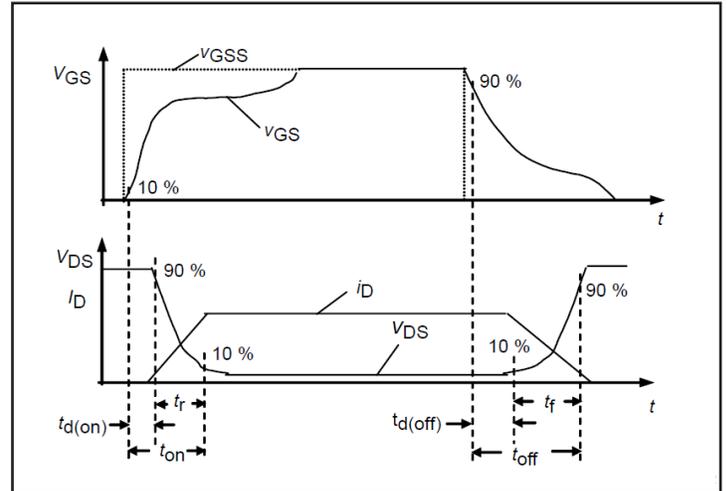


Figure 28. Switching Times Definition

Test Circuit Schematic

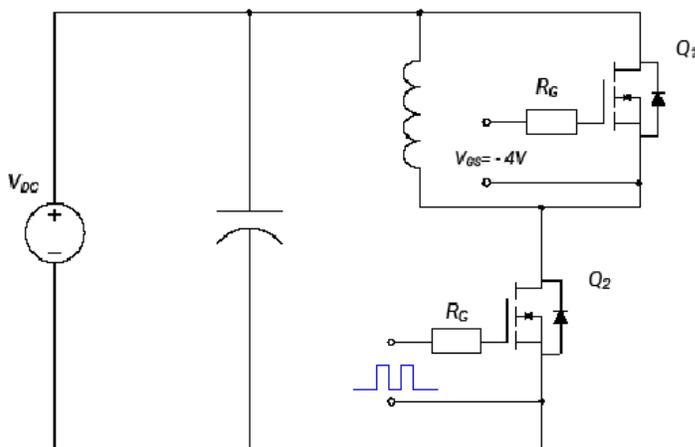
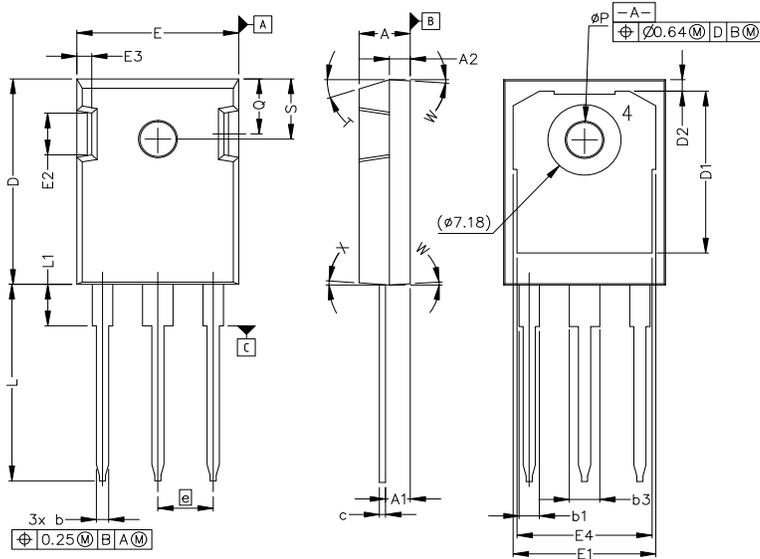


Figure 29. Clamped Inductive Switching
Waveform Test Circuit

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-247-3

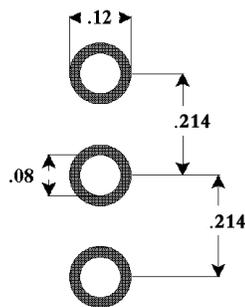


Pinout Information:

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

SYM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.83	5.21	.190	.205
A1	2.29	2.54	.090	.100
A2	1.91	2.16	.075	.085
b	1.07	1.33	.042	.052
b1	1.91	2.41	.075	.095
b3	2.87	3.38	.113	.133
c	0.55	0.68	.022	.027
D	20.80	21.10	.819	.831
D1	16.25	17.65	.640	.695
D2	0.95	1.25	.037	.049
E	15.75	16.13	.620	.635
E1	13.10	14.15	.516	.557
E2	3.68	5.10	.145	.201
E3	1.00	1.90	.039	.075
E4	12.38	13.43	.487	.529
e	5.44 BSC		.214 BSC	
N	3		3	
L	19.81	20.32	.780	.800
L1	4.10	4.40	.161	.173
φP	3.51	3.65	.138	.144
Q	5.49	6.00	.216	.236
S	6.04	6.30	.238	.248
T	17.5° REF.			
W	3.5° REF.			
X	4° REF.			

Recommended Solder Pad Layout



TO-247-3