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HMM60N120T

Silicon Carbide Power MOSFET
N-channel Enhancement Mode

Features

- High Blocking Voltage with Low On-Resistance
- High Speed Switching with Low Capacitances
- Easy to Parallel and Simple to Drive
- Resistant to Latch-Up
- Halogen Free, RoHS Compliant

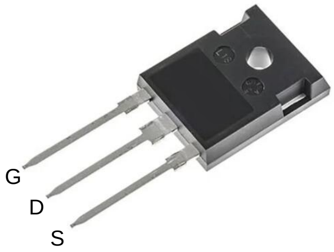
V_{DS}	1200 V
I_D @ 25˚C	55 A
$R_{DS(on)}$	40 mΩ

Benefits

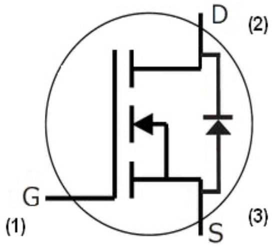
- Higher System Efficiency
- Reduced Cooling Requirements
- Increased Power Density
- Increased System Switching Frequency

Applications

- Solar Inverters
- Switch Mode Power Supplies
- High Voltage DC/DC converters
- Battery Chargers
- Motor Drives
- Pulsed Power Applications



TO-247-3
Package



Part Number	Package	Marking
HMM60N120T	TO-247-3	HMM60N120T XXXX

Maximum Ratings (T_C = 25 ˚C unless otherwise specified)

Symbol	Parameter	Value	Unit	Test Conditions	Note
V_{DSmax}	Drain - Source Voltage	1200	V	V_{GS} = 0 V, I_D = 100 μA	
V_{GSmax}	Gate - Source Voltage	-10/+25	V	Absolute maximum values	
V_{GSop}	Gate - Source Voltage	-5/+20	V	Recommended operational values	
I_D	Continuous Drain Current	55	A	V_{GS} = 20 V, T_C = 25˚C	Fig. 19
		36		V_{GS} = 20 V, T_C = 100˚C	
$I_{D(pulse)}$	Pulsed Drain Current	160	A	Pulse width t_P limited by T_{jmax}	Fig. 22
P_D	Power Dissipation	278	W	T_C=25˚C, T_J = 150 ˚C	Fig. 20
T_J , T_{stg}	Operating Junction and Storage Temperature	-55 to +150	˚C		
T_L	Solder Temperature	260	˚C	1.6mm (0.063”) from case for 10s	
M_d	Mounting Torque	1 8.8	Nm lbf-in	M3 or 6-32 screw	

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	2.0	3.2	4	V	V_{DS} = V_{GS} , I_D = 10mA	Fig. 11
			2.4		V	V_{DS} = V_{GS}, I_D = 10mA,T_J = 150 °C	
I_{DSS}	Zero Gate Voltage Drain Current		1	100	μA	V_{DS} = 1200 V, V_{GS} = 0 V	
I_{GSS}	Gate-Source Leakage Current			250	nA	V_{GS} = 20 V, V_{DS} = 0 V	
$R_{DS(on)}$	Drain-Source On-State Resistance		44	52	mΩ	V_{GS} = 20 V, I_D = 40 A	Fig. 4,5,6
			82			V_{GS} = 20 V, I_D = 40 A, T_J = 150 °C	
g_{fs}	Transconductance		18.2		S	V_{DS}= 20 V, I_{DS}= 40 A	Fig. 7
			17.2			V_{DS}= 20 V, I_{DS}= 40 A, T_J = 150 °C	
C_{iss}	Input Capacitance		2440		pF	V_{GS} = 0 V V_{DS} = 1000 V f = 1 MHz V_{AC} = 25 mV	Fig. 17,18
C_{oss}	Output Capacitance		171				
C_{rss}	Reverse Transfer Capacitance		11				
E_{oss}	C_{oss} Stored Energy		89		μJ		Fig 16
E_{ON}	Turn-On Switching Energy (Body Diode)		1.7		mJ	V_{DS} = 800 V, V_{GS} = -5/20 V I_D = 40A, $R_{G(ext)}$ = 2.5Ω, L= 99 μH	Fig. 25
E_{OFF}	Turn Off Switching Energy (Body Diode)		0.4				
E_{ON}	Turn-On Switching Energy (External SiC Diode)		1.3			V_{DS} = 800 V, V_{GS} = -5/20 V I_D = 40A, $R_{G(ext)}$ = 2.5Ω, L= 99 μH	
E_{OFF}	Turn Off Switching Energy (External SiC Diode)		0.4				
$t_{d(on)}$	Turn-On Delay Time		13		ns	V_{DD} = 800 V, V_{GS} = -5/20 V I_D = 40 A $R_{G(ext)}$ = 2.5 Ω, R_L = 20 Ω Timing relative to V_{DS} Per IEC60747-8-4 pg 83	Fig. 27
t_r	Rise Time		61				
$t_{d(off)}$	Turn-Off Delay Time		25				
t_f	Fall Time		13				
$R_{G(int)}$	Internal Gate Resistance		1.8		Ω	f = 1 MHz, V_{AC} = 25 mV	
Q_{gs}	Gate to Source Charge		34		nC	V_{DS} = 800 V, V_{GS} = -5/20 V I_D = 40 A Per IEC60747-8-4 pg 21	Fig. 12
Q_{gd}	Gate to Drain Charge		42				
Q_g	Total Gate Charge		120				

Reverse Diode Characteristics

Symbol	Parameter	Typ.	Max.	Unit	Test Conditions	Note
V_{SD}	Diode Forward Voltage	4.0		V	V_{GS} = - 5 V, I_{SD} = 20 A, T_J = 25 °C	Fig. 8, 9, 10
		3.6		V	V_{GS} = - 5 V, I_{SD} = 20 A, T_J = 150 °C	
I_S	Continuous Diode Forward Current		60	A	T_C= 25 °C	Note 1
$I_{S,\ pulse}$	Diode Pulse Current		160	A	V_{GS} = - 5 V, Pulse width t_P limited by T_{jmax}	
t_{rr}	Reverse Recovery Time	54		ns	V_{GS} = - 5 V, I_{SD} = 40 A T_J = 25 °C VR = 800 V dif/dt = 1000 A/μs	Note 1
Q_{rr}	Reverse Recovery Charge	283		nC		
I_{rrm}	Peak Reverse Recovery Current	15		A		

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

Thermal Characteristics

Symbol	Parameter	Typ.	Max.	Unit	Test Conditions	Note
$R_{\theta JC}$	Thermal Resistance from Junction to Case	0.33	0.45	°C/W		Fig. 21
$R_{\theta JC}$	Thermal Resistance from Junction to Ambient		40			

Typical Performance

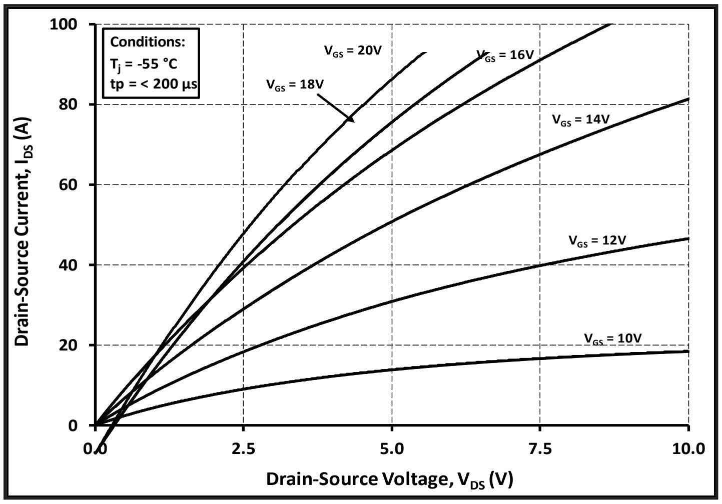


Figure 1. Output Characteristics T_J = -55 °C

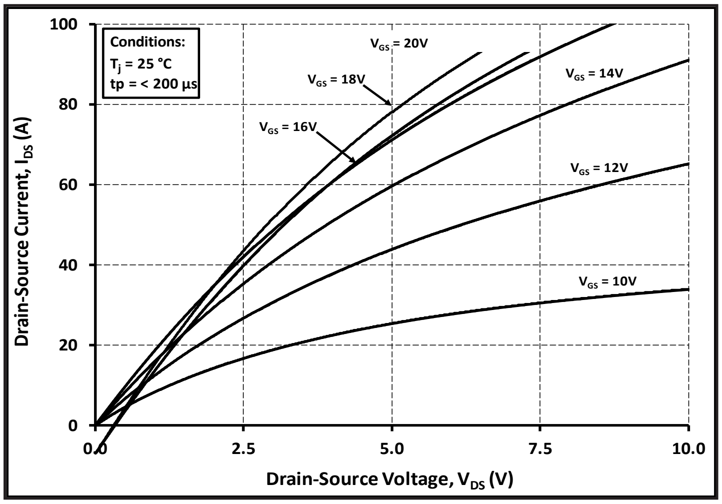


Figure 2. Output Characteristics T_J = 25 °C

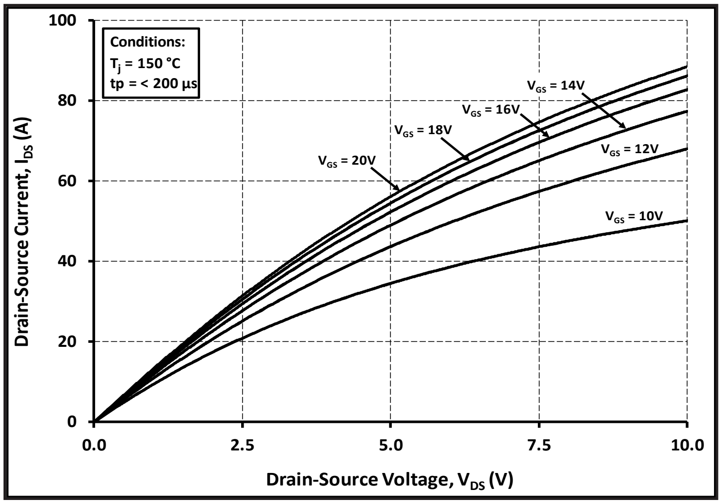


Figure 3. Output Characteristics T_J = 150 °C

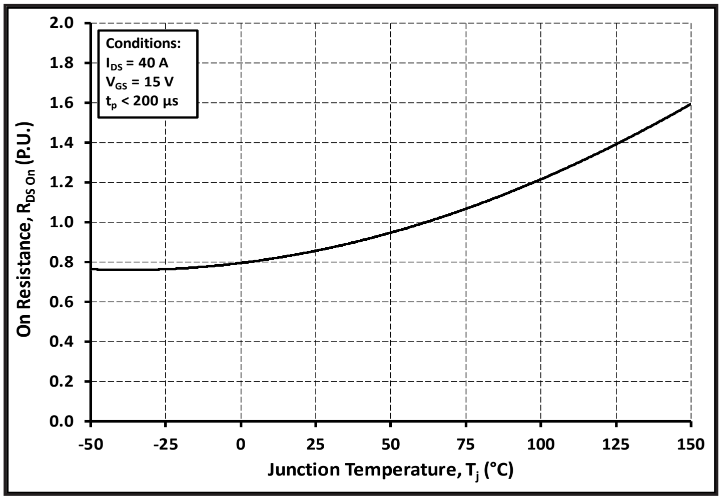


Figure 4. Normalized On-Resistance vs. Temperature

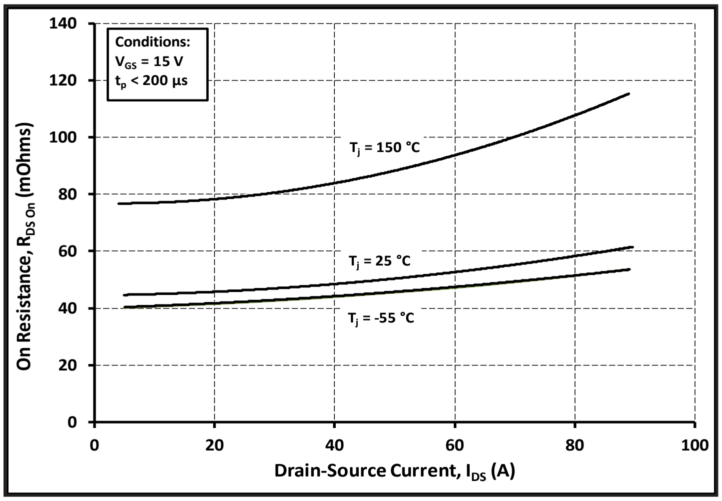


Figure 5. On-Resistance vs. Drain Current
For Various Temperatures

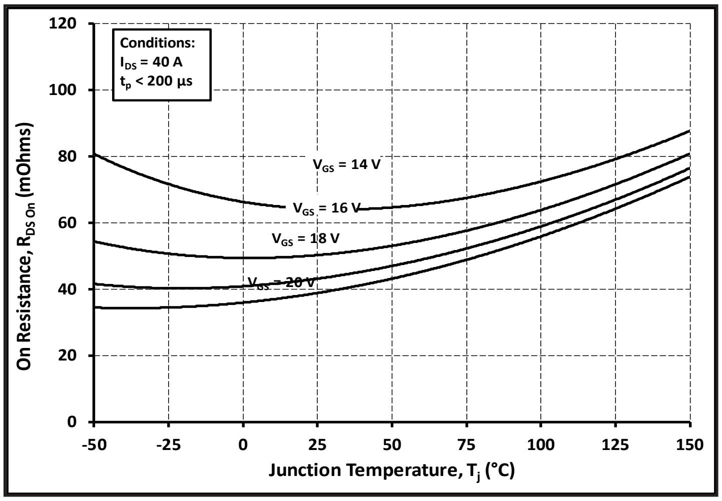


Figure 6. On-Resistance vs. Temperature
For Various Gate Voltage

Typical Performance

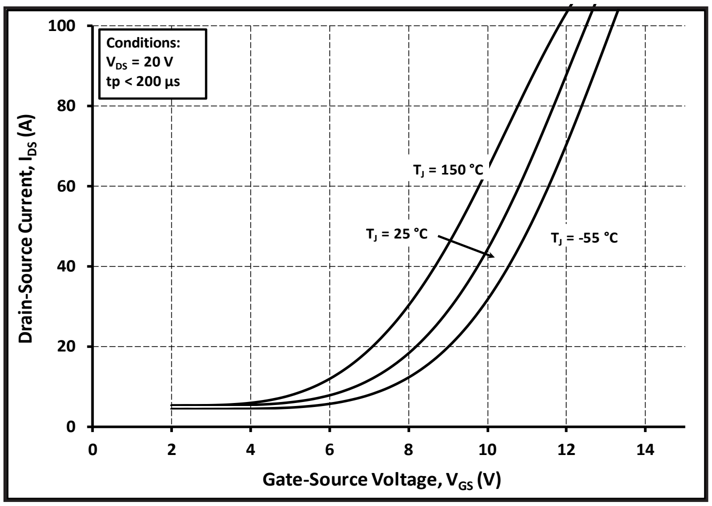


Figure 7. Transfer Characteristic for Various Junction Temperatures

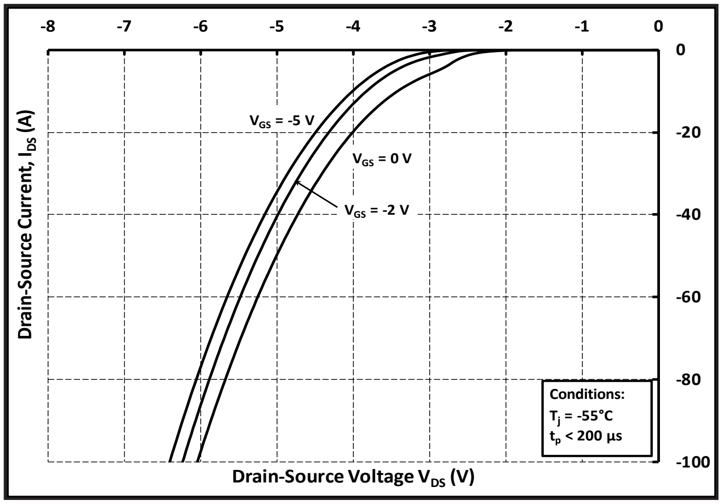


Figure 8. Body Diode Characteristic at -55 °C

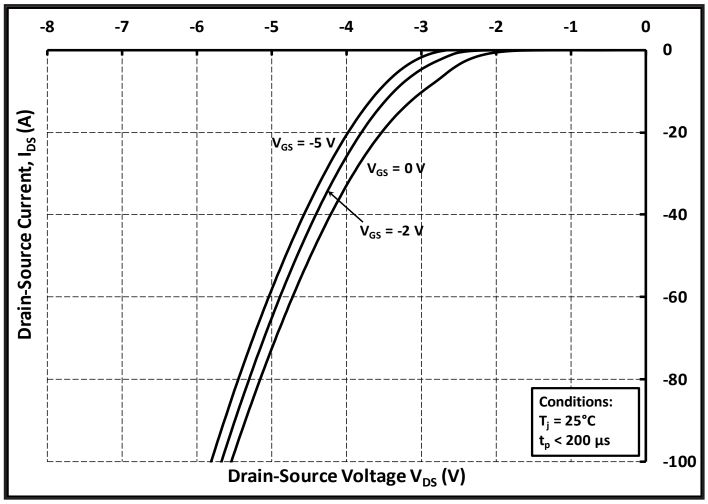


Figure 9. Body Diode Characteristic at 25 °C

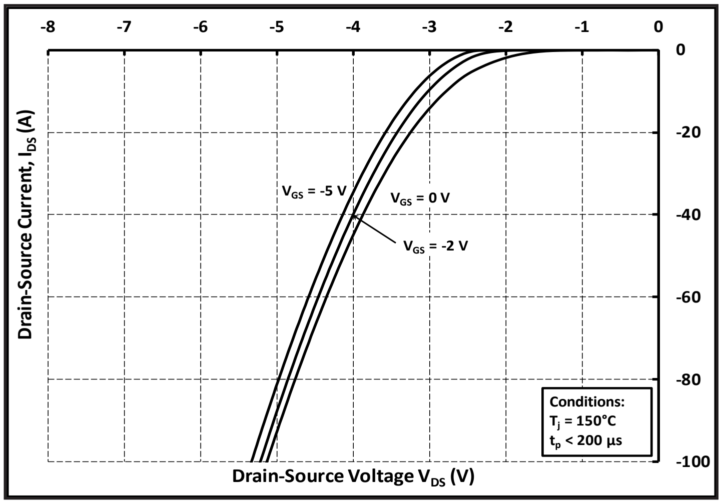


Figure 10. Body Diode Characteristic at 150 °C

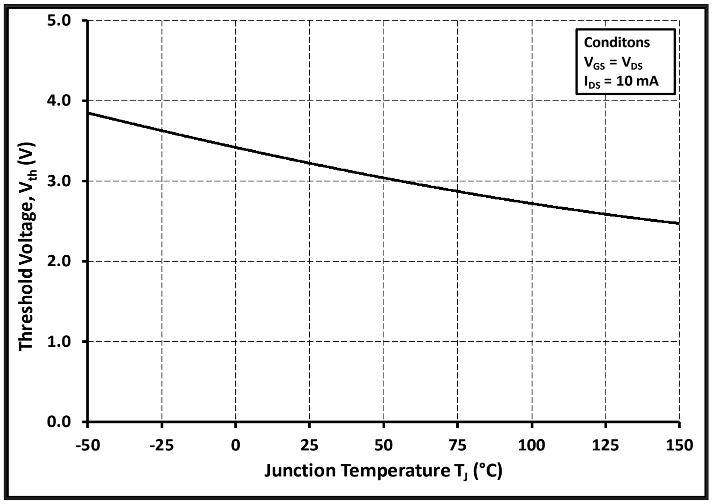


Figure 11. Threshold Voltage vs. Temperature

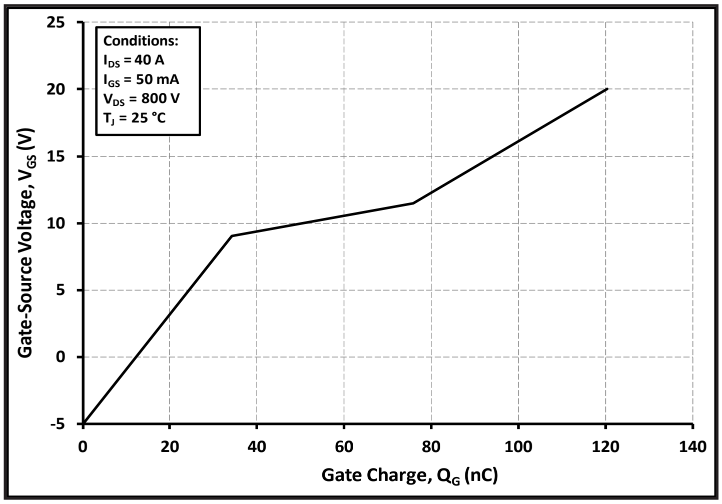


Figure 12. Gate Charge Characteristics

Typical Performance

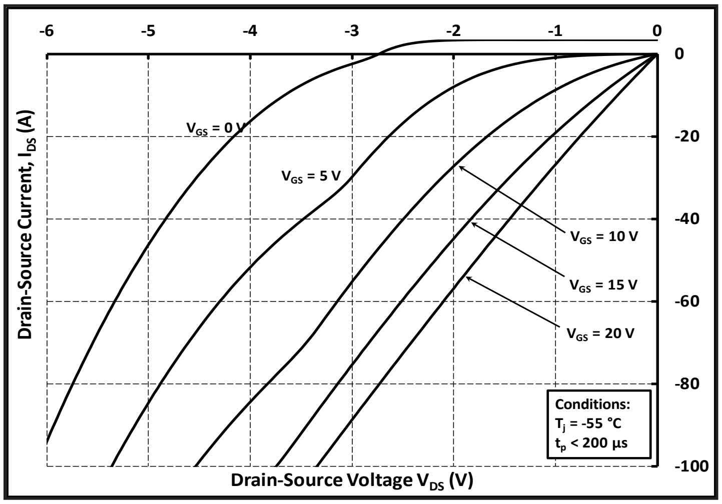


Figure 13. 3rd Quadrant Characteristic at -55 °C

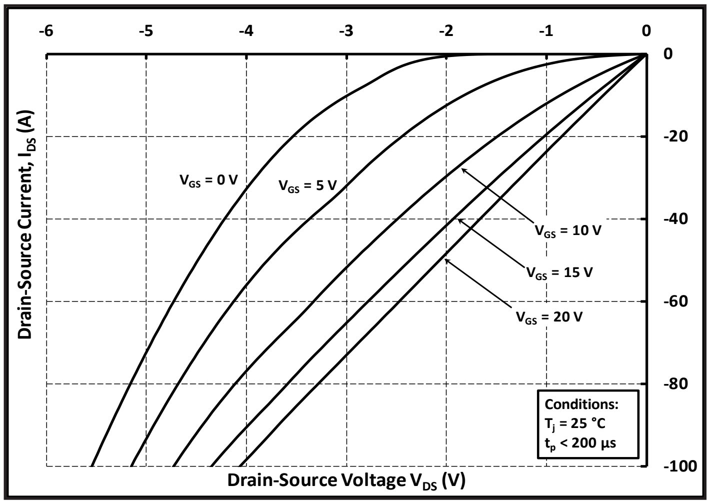


Figure 14. 3rd Quadrant Characteristic at 25 °C

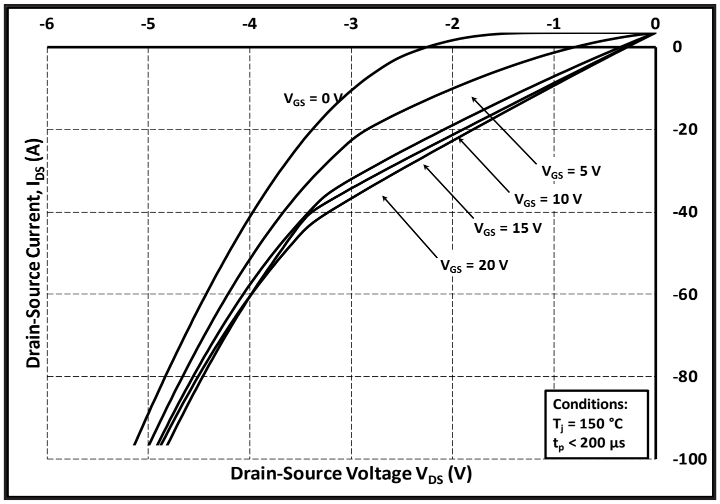


Figure 15. 3rd Quadrant Characteristic at 150 °C

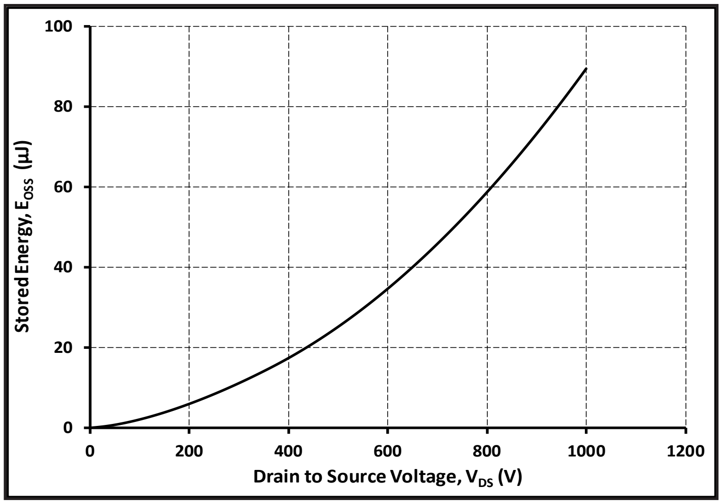


Figure 16. Output Capacitor Stored Energy

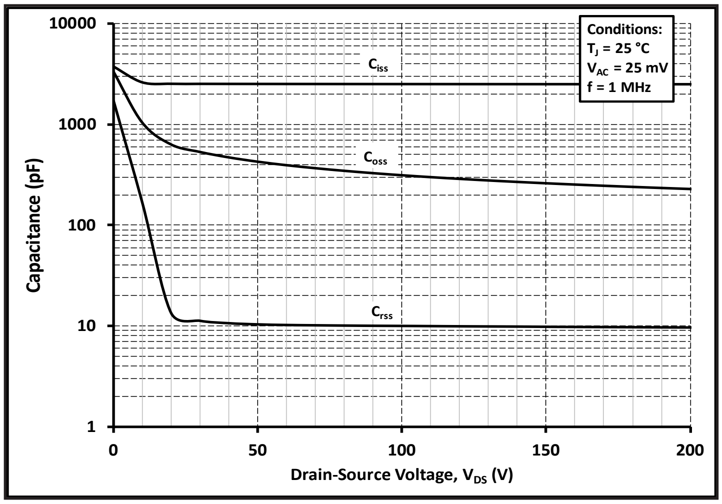


Figure 17. Capacitances vs. Drain-Source Voltage (0-200 V)

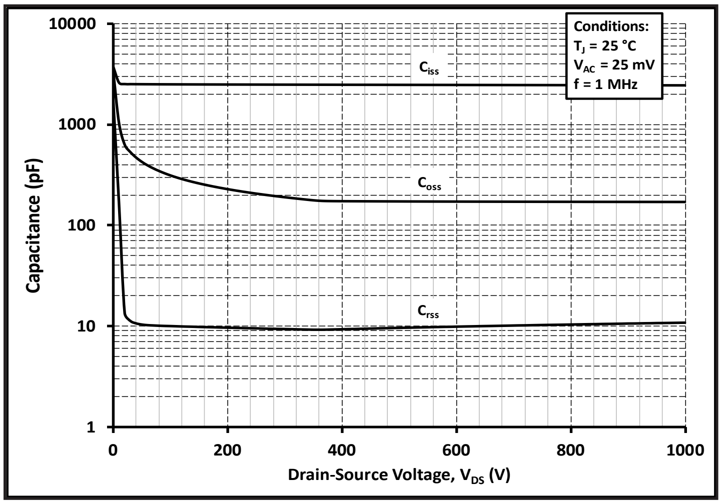


Figure 18. Capacitances vs. Drain-Source Voltage (0-1000 V)

Typical Performance

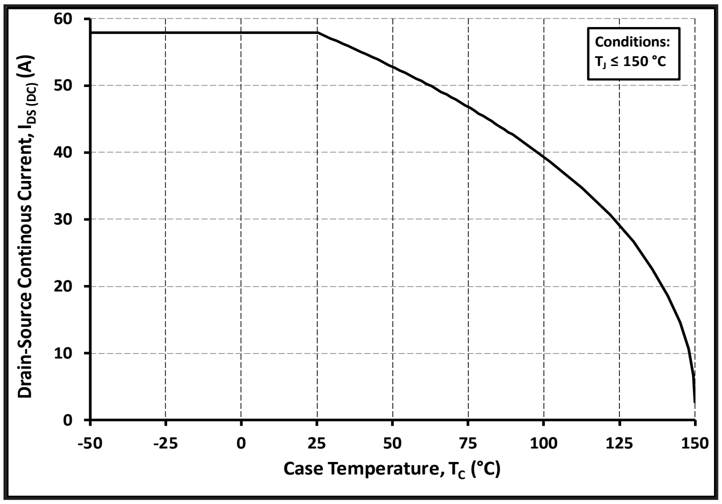


Figure 19. Continuous Drain Current Derating vs. Case Temperature

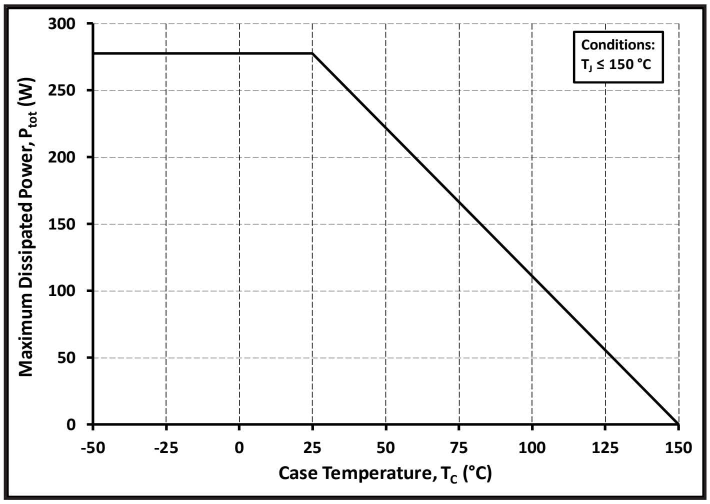


Figure 20. Maximum Power Dissipation Derating vs. Case Temperature

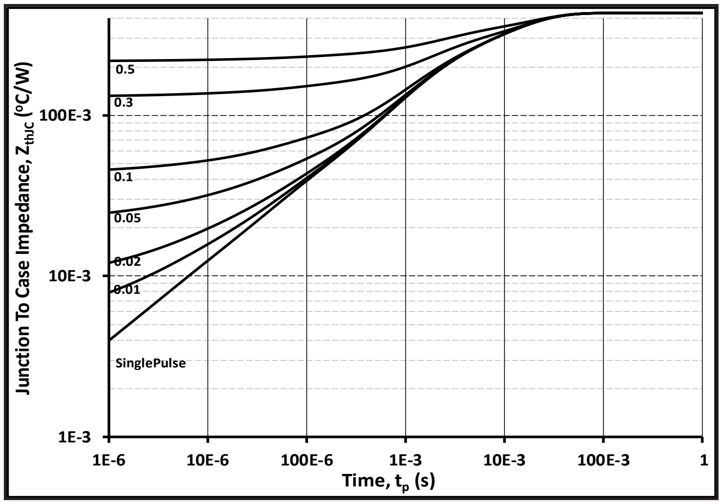


Figure 21. Transient Thermal Impedance (Junction - Case)

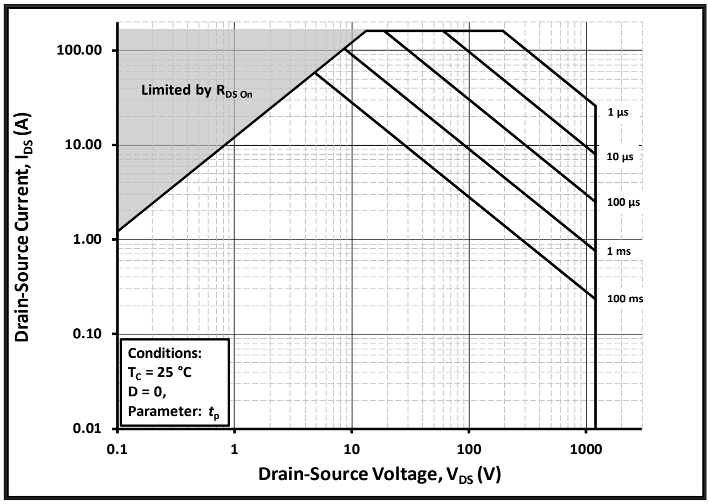


Figure 22. Safe Operating Area

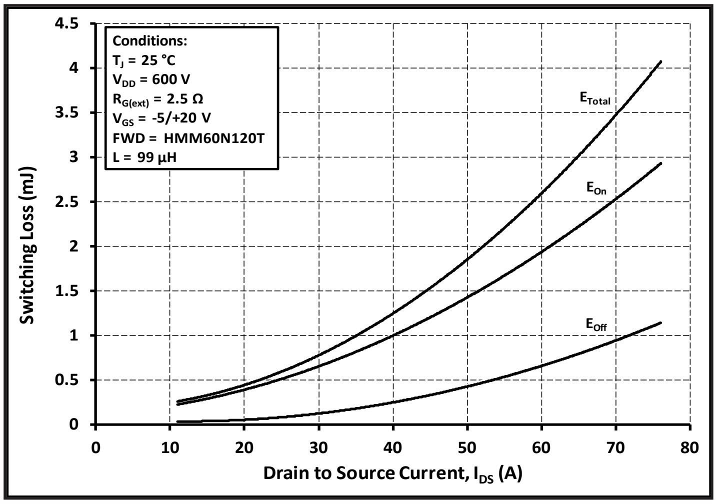


Figure 23. Clamped Inductive Switching Energy vs. Drain Current (V_{DD} = 600V)

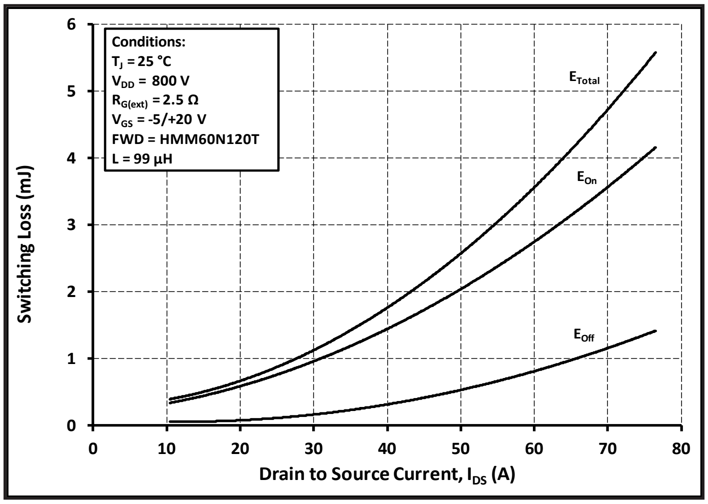


Figure 24. Clamped Inductive Switching Energy vs. Drain Current (V_{DD} = 800V)

Typical Performance

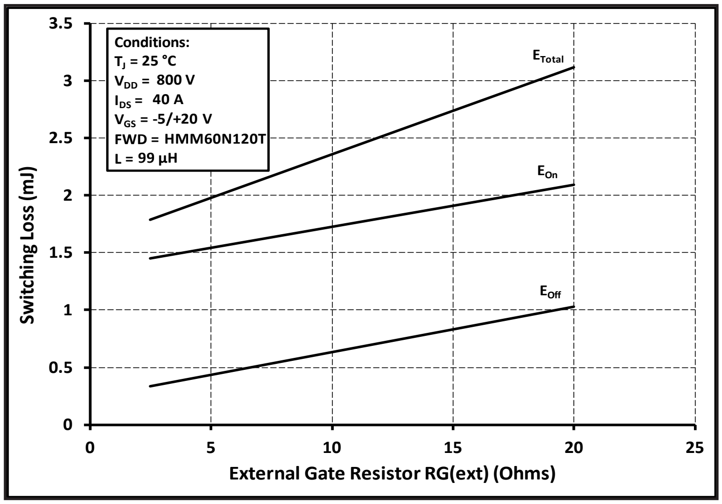


Figure 25. Clamped Inductive Switching Energy vs. $R_{G(ext)}$

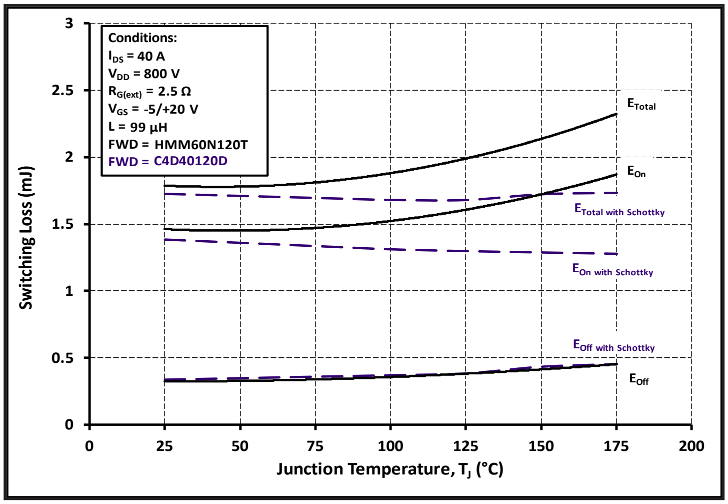


Figure 26. Clamped Inductive Switching Energy vs. Temperature

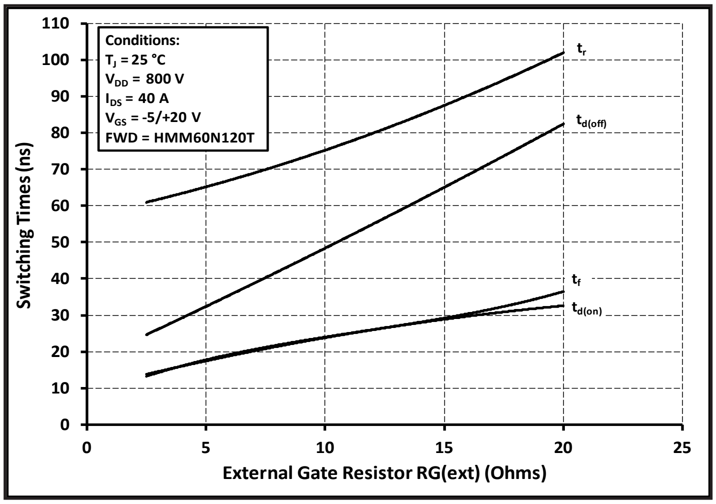


Figure 27. Switching Times vs. $R_{G(ext)}$

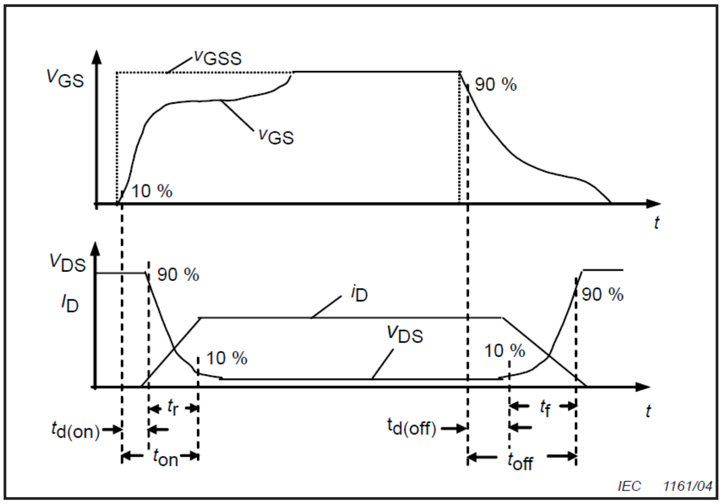


Figure 28. Switching Times Definition

Test Circuit Schematic

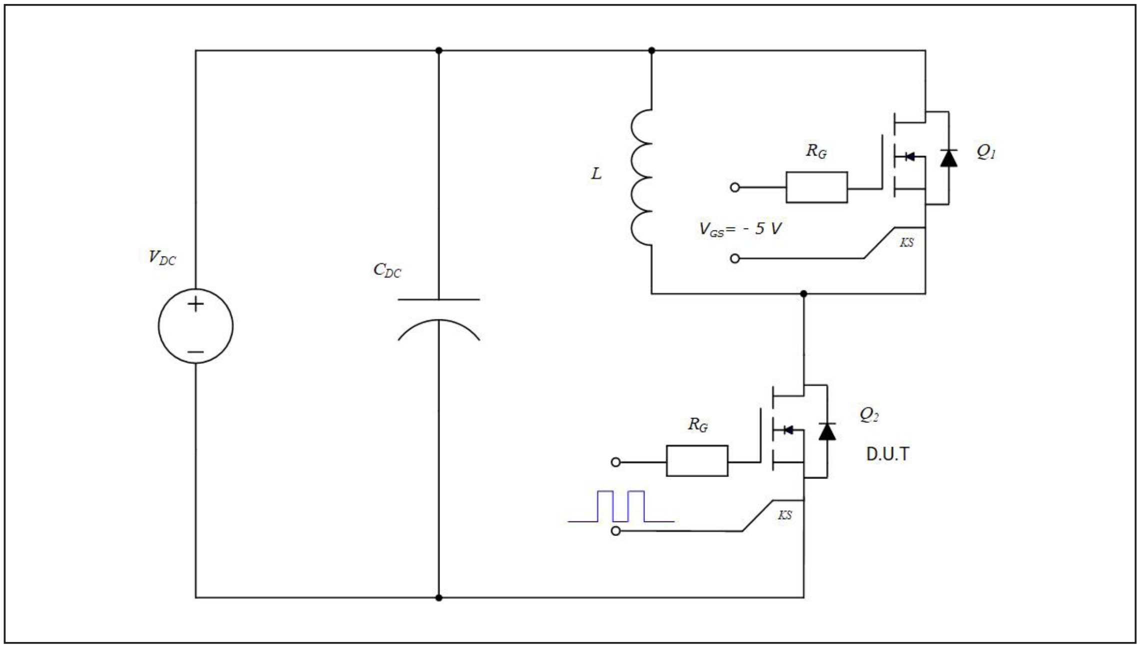


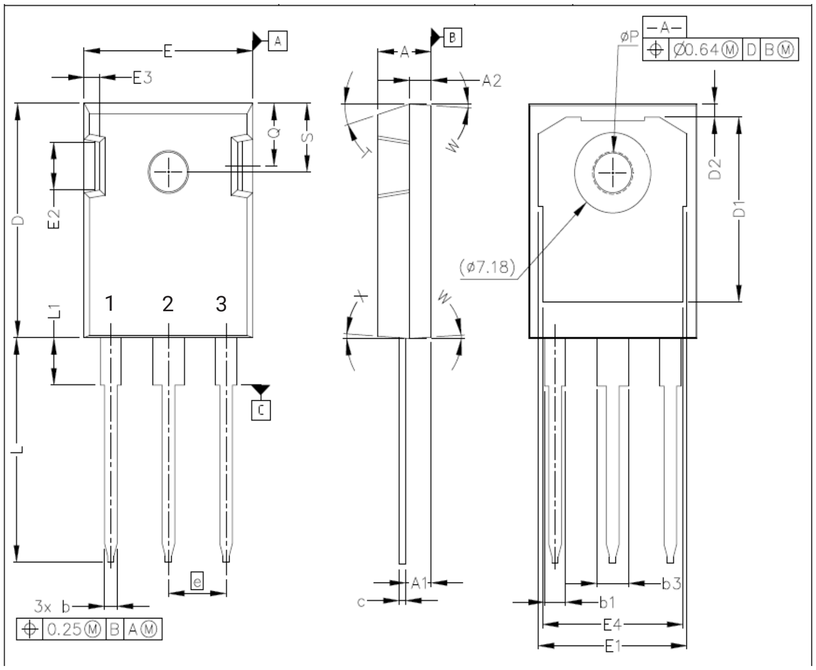
Figure 29. Clamped Inductive Switching
Waveform Test Circuit

ESD Ratings

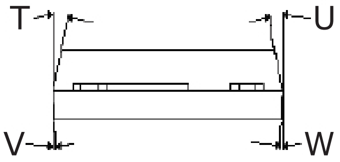
ESD Test	Resulting Classification
ESD-HBM	3A (4000V - 8000V)
ESD-CDM	C3 (>=1000V)

Package Dimensions

Package TO-247-3



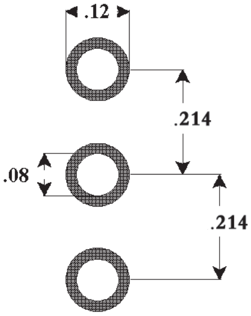
SYM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.83	5.21	.190	.205
A1	2.29	2.54	.090	.100
A2	1.91	2.16	.075	.085
b	1.07	1.33	.042	.052
b1	1.91	2.41	.075	.095
b3	2.87	3.38	.113	.133
c	0.55	0.68	.022	.027
D	20.80	21.10	.819	.831
D1	16.25	17.65	.640	.695
D2	0.95	1.25	.037	.049
E	15.75	16.13	.620	.635
E1	13.10	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
øP	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.			



Pinout Information:

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

Recommended Solder Pad Layout



TO-247-3