



Features

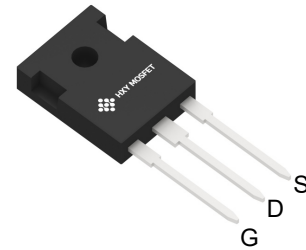
- High Blocking Voltage with Low On-Resistance
- High Speed Switching with Low Capacitances
- Easy to Parallel and Simple to Drive
- Resistant to Latch-Up
- Halogen Free, RoHS Compliant

Benefits

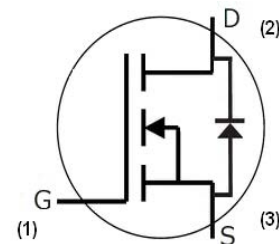
- Higher System Efficiency
- Reduced Cooling Requirements
- Increased Power Density
- Increased System Switching Frequency

Applications

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



TO-247



Part Number	Package	Qty(PCS)
NTHL040N120M3S	TO-247	30

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	-10/+25	V	Absolute maximum values	
V_{GSop}	Gate - Source Voltage	-5/+20	V	Recommended operational values	
I_D	Continuous Drain Current	55	A	$V_{GS} = 20\text{ V}$, $T_C = 25^\circ\text{C}$	Fig. 19
		36		$V_{GS} = 20\text{ V}$, $T_C = 100^\circ\text{C}$	
$I_{D(pulse)}$	Pulsed Drain Current	160	A	Pulse width t_p limited by T_{jmax}	Fig. 22
P_D	Power Dissipation	278	W	$T_C = 25^\circ\text{C}$, $T_J = 150^\circ\text{C}$	Fig. 20
T_J, T_{stg}	Operating Junction and Storage Temperature	-55 to +150	$^\circ\text{C}$		
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	



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	$V_{GS} = 0\text{ V}, I_D = 100\text{ }\mu\text{A}$	
$V_{GS(th)}$	Gate Threshold Voltage	2.0	3.2	4	V	$V_{DS} = V_{GS}, I_D = 10\text{mA}$	Fig. 11
			2.4		V	$V_{DS} = V_{GS}, I_D = 10\text{mA}, T_J = 150^\circ\text{C}$	
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			250	nA	$V_{GS} = 20\text{ V}, V_{DS} = 0\text{ V}$	
$R_{DS(on)}$	Drain-Source On-State Resistance		44	52	$\text{m}\Omega$	$V_{GS} = 20\text{ V}, I_D = 40\text{ A}$	Fig. 4,5,6
			82			$V_{GS} = 20\text{ V}, I_D = 40\text{ A}, T_J = 150^\circ\text{C}$	
g_{fs}	Transconductance		18.2		S	$V_{DS} = 20\text{ V}, I_{DS} = 40\text{ A}$	Fig. 7
			17.2			$V_{DS} = 20\text{ V}, I_{DS} = 40\text{ A}, T_J = 150^\circ\text{C}$	
C_{iss}	Input Capacitance		2440		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		171				
C_{rss}	Reverse Transfer Capacitance		11				Fig 16
E_{oss}	C_{oss} Stored Energy		89				
E_{ON}	Turn-On Switching Energy (Body Diode)		1.7		mJ	$V_{DS} = 800\text{ V}, V_{GS} = -5/20\text{ V}$ $I_D = 40\text{A}, R_{G(ext)} = 2.5\Omega, L = 99\text{ }\mu\text{H}$	Fig. 25
E_{OFF}	Turn Off Switching Energy (Body Diode)		0.4				
E_{ON}	Turn-On Switching Energy (External SiC Diode)		1.3			$V_{DS} = 800\text{ V}, V_{GS} = -5/20\text{ V}$ $I_D = 40\text{A}, R_{G(ext)} = 2.5\Omega, L = 99\text{ }\mu\text{H}$	
E_{OFF}	Turn Off Switching Energy (External SiC Diode)		0.4				
$t_{d(on)}$	Turn-On Delay Time		13		ns	$V_{DD} = 800\text{ V}, V_{GS} = -5/20\text{ V}$ $I_D = 40\text{ A}$ $R_{G(ext)} = 2.5\text{ }\Omega, R_L = 20\text{ }\Omega$ 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	$f = 1\text{ MHz}, V_{AC} = 25\text{ mV}$	
Q_{gs}	Gate to Source Charge		34		nC	$V_{DS} = 800\text{ V}, V_{GS} = -5/20\text{ V}$ $I_D = 40\text{ A}$ 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	$V_{GS} = -5\text{ V}, I_{SD} = 20\text{ A}, T_J = 25\text{ }^{\circ}\text{C}$	Fig. 8, 9, 10
		3.6		V	$V_{GS} = -5\text{ V}, I_{SD} = 20\text{ A}, T_J = 150\text{ }^{\circ}\text{C}$	
I_S	Continuous Diode Forward Current		60	A	$T_C = 25\text{ }^{\circ}\text{C}$	Note 1
$I_{S, \text{pulse}}$	Diode Pulse Current		160	A	$V_{GS} = -5\text{ V},$ Pulse width t_p limited by T_{jmax}	
t_{rr}	Reverse Recovery Time	54		ns	$V_{GS} = -5\text{ V}, I_{SD} = 40\text{ A}, T_J = 25\text{ }^{\circ}\text{C}$ $V_R = 800\text{ V}$ $di/dt = 1000\text{ A}/\mu\text{s}$	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 $V_{GS} = -5\text{V}$

Thermal Characteristics

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



Typical Performance

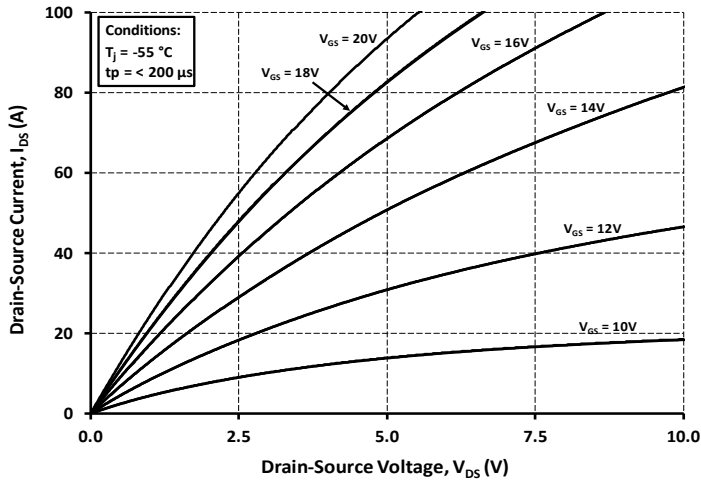


Figure 1. Output Characteristics $T_J = -55\text{ }^{\circ}\text{C}$

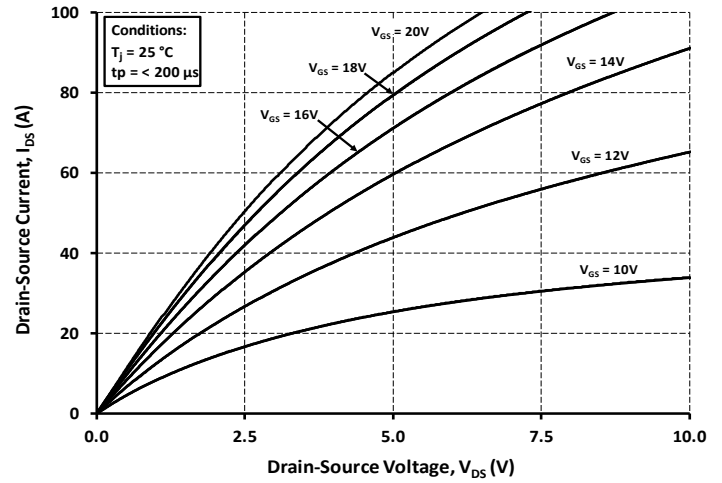


Figure 2. Output Characteristics $T_J = 25\text{ }^{\circ}\text{C}$

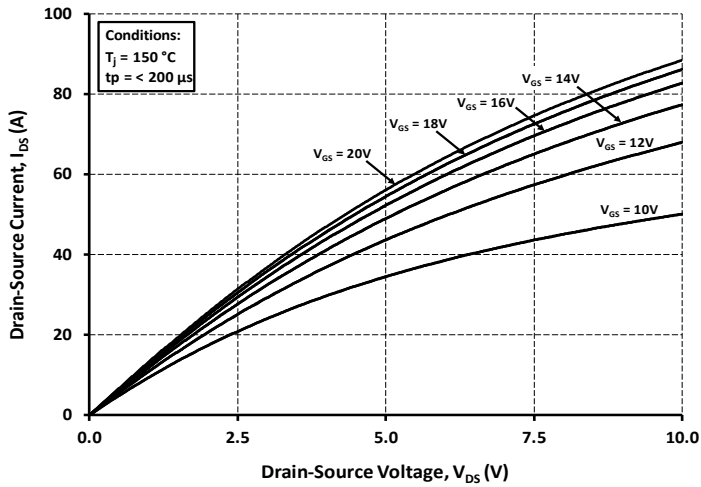


Figure 3. Output Characteristics $T_J = 150\text{ }^{\circ}\text{C}$

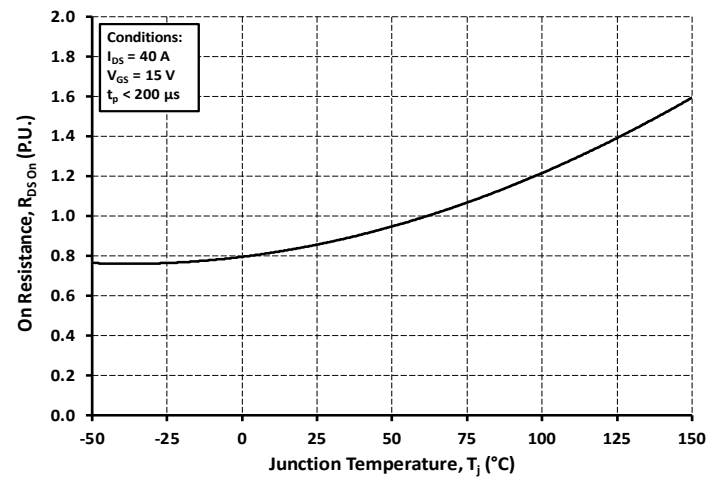


Figure 4. Normalized On-Resistance vs. Temperature

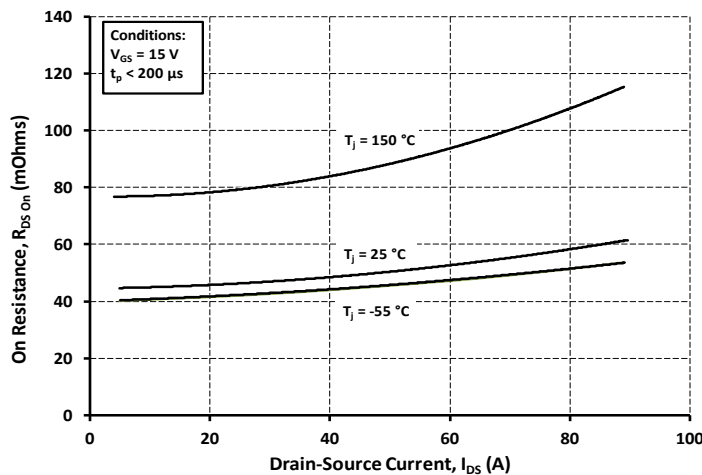


Figure 5. On-Resistance vs. Drain Current
For Various Temperatures

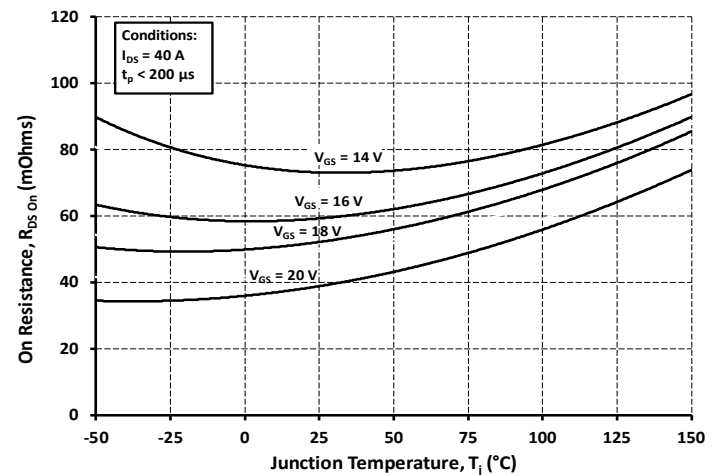


Figure 6. On-Resistance vs. Temperature
For Various Gate Voltage



Typical Performance

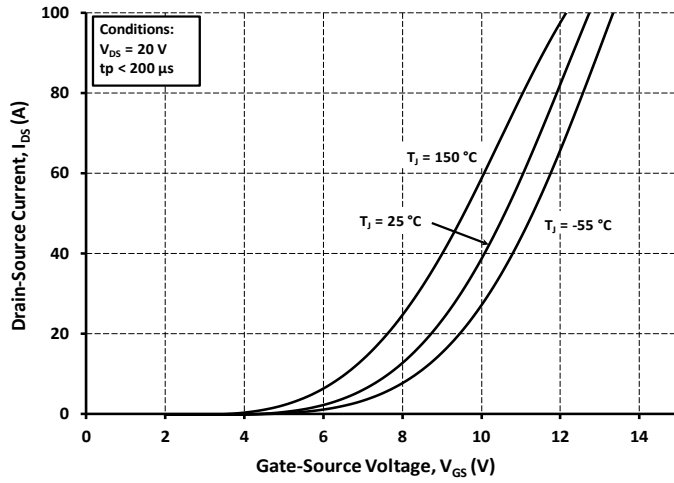


Figure 7. Transfer Characteristic for Various Junction Temperatures

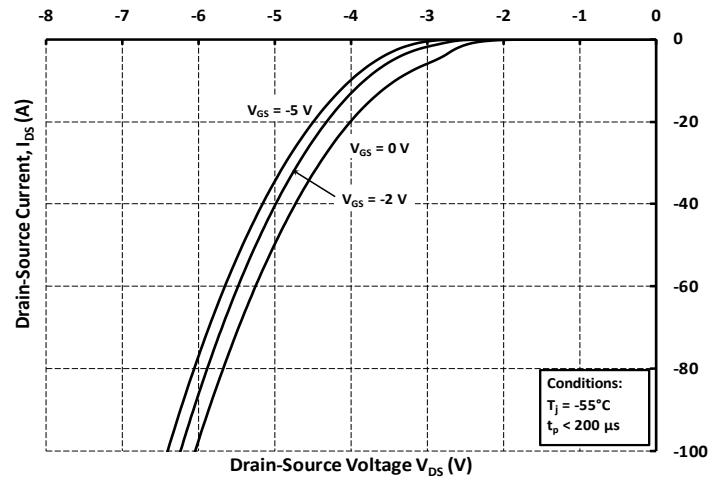


Figure 8. Body Diode Characteristic at -55 °C

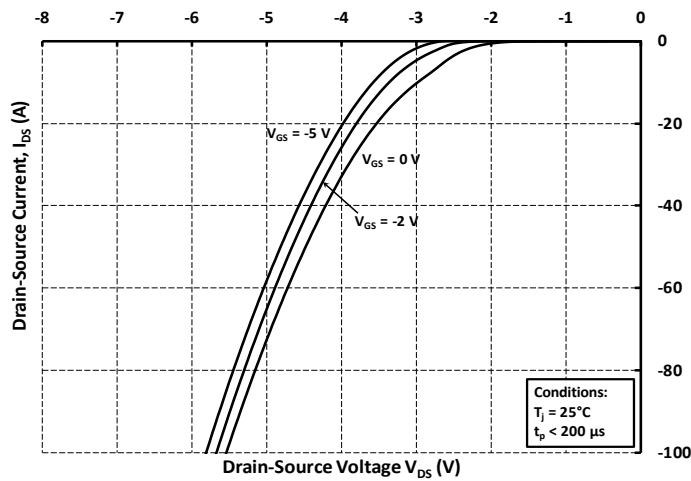


Figure 9. Body Diode Characteristic at 25 °C

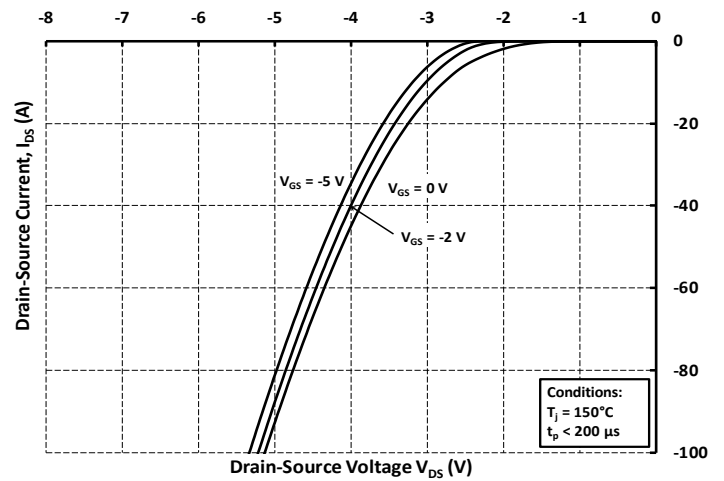


Figure 10. Body Diode Characteristic at 150 °C

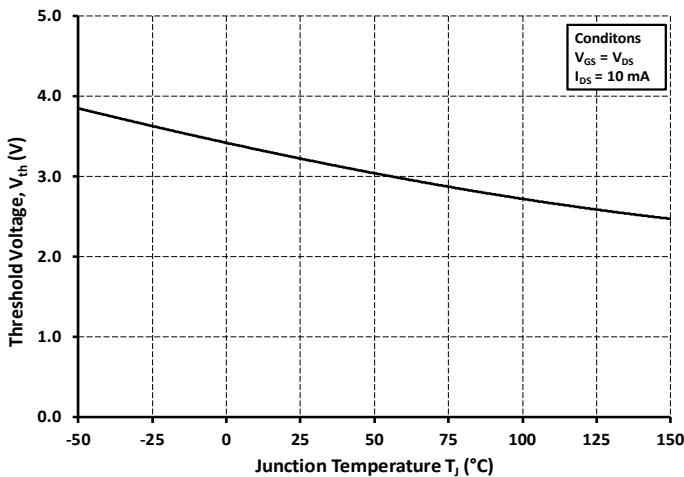


Figure 11. Threshold Voltage vs. Temperature

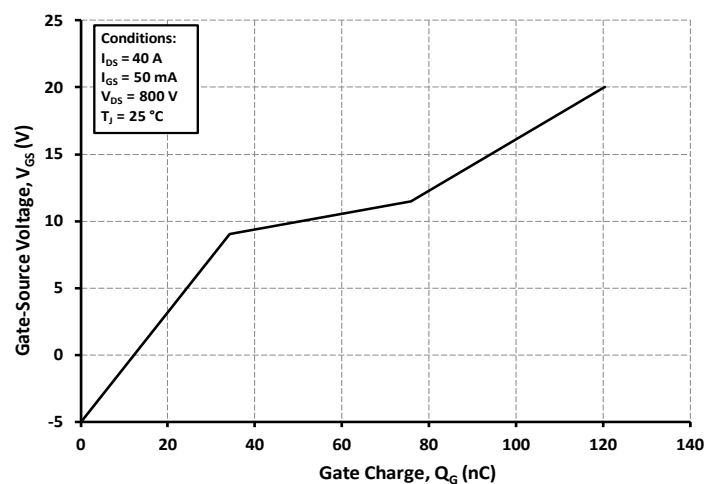


Figure 12. Gate Charge Characteristics



Typical Performance

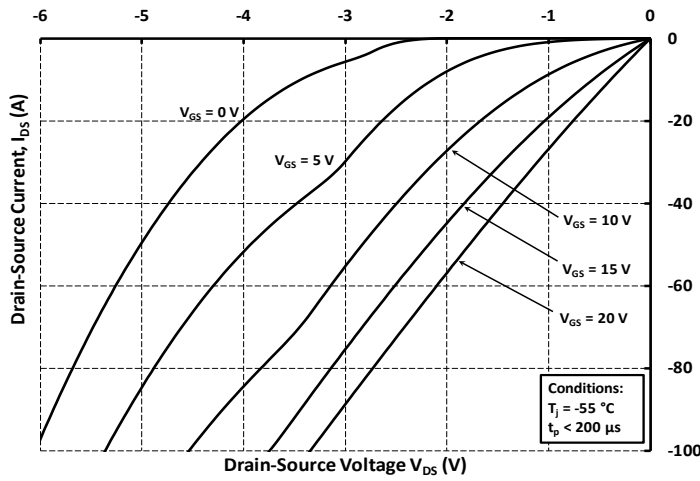


Figure 13. 3rd Quadrant Characteristic at -55 °C

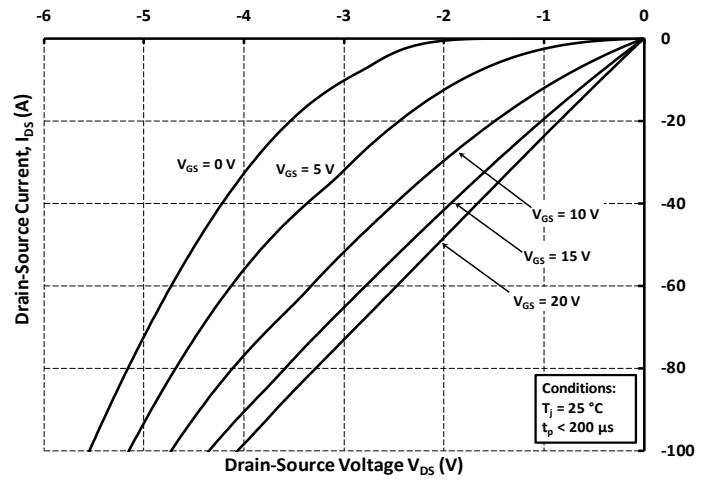


Figure 14. 3rd Quadrant Characteristic at 25 °C

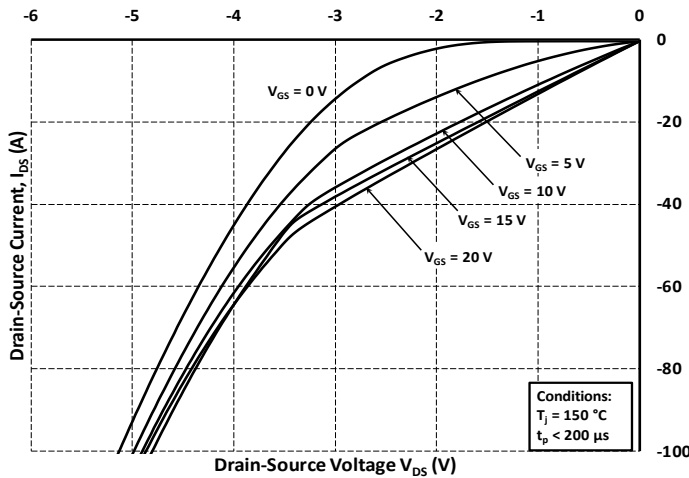


Figure 15. 3rd Quadrant Characteristic at 150 °C

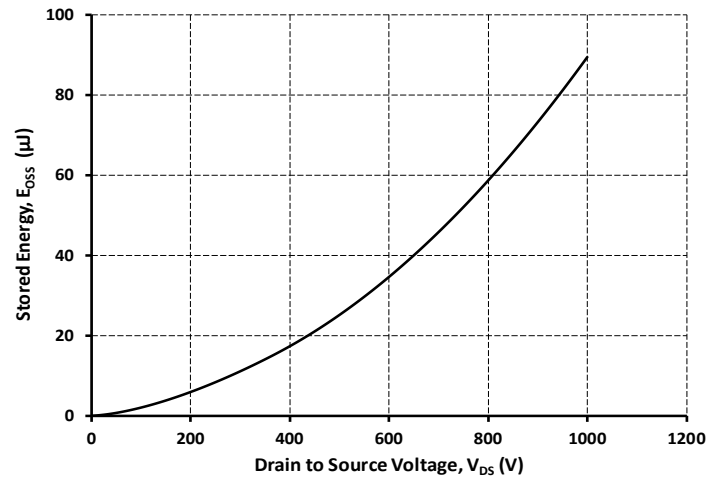


Figure 16. Output Capacitor Stored Energy

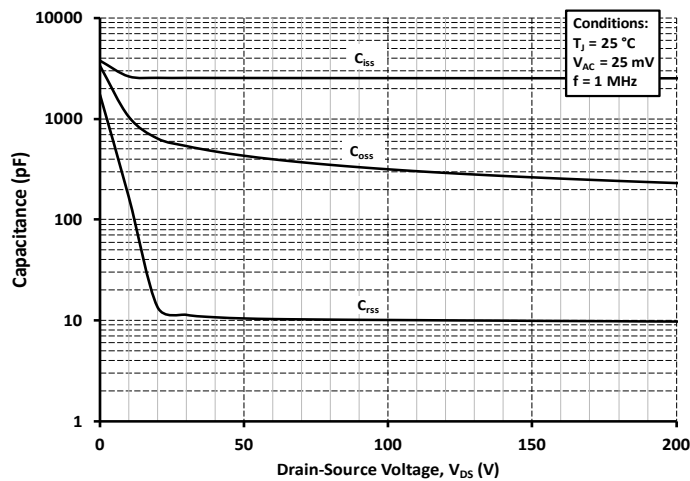


Figure 17. Capacitances vs. Drain-Source Voltage (0-200 V)

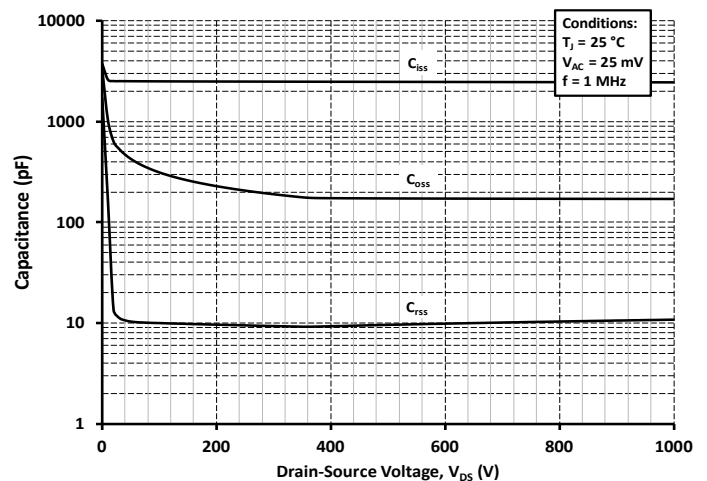


Figure 18. Capacitances vs. Drain-Source Voltage (0-1000 V)



Typical Performance

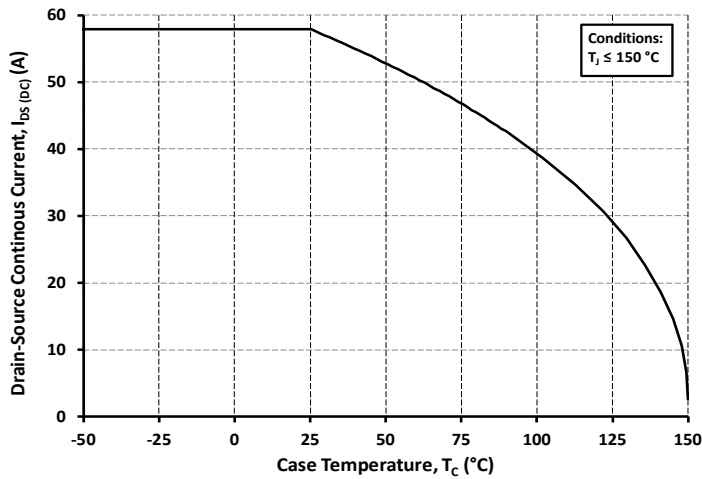


Figure 19. Continuous Drain Current Derating vs. Case Temperature

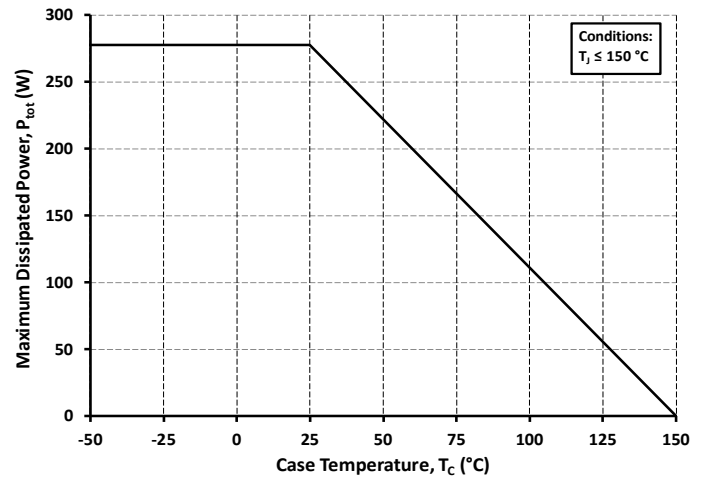


Figure 20. Maximum Power Dissipation Derating vs. Case Temperature

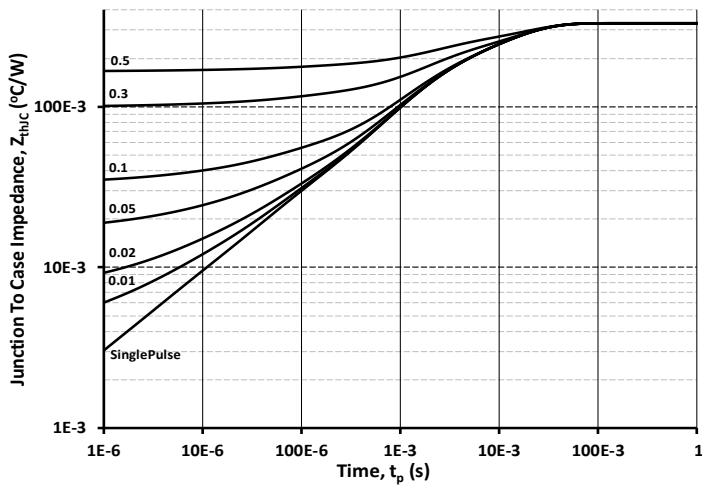


Figure 21. Transient Thermal Impedance (Junction - Case)

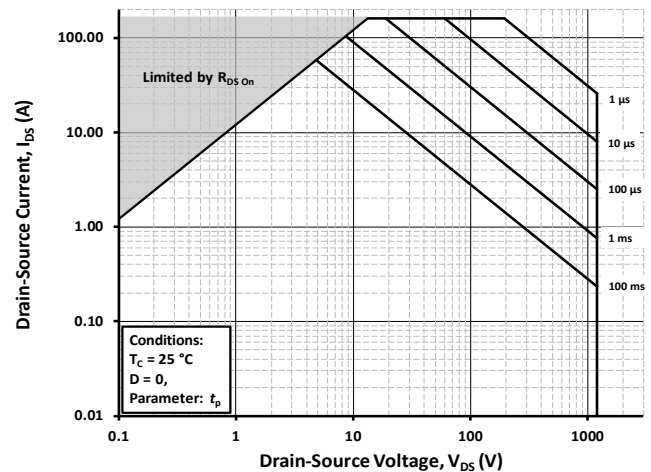


Figure 22. Safe Operating Area

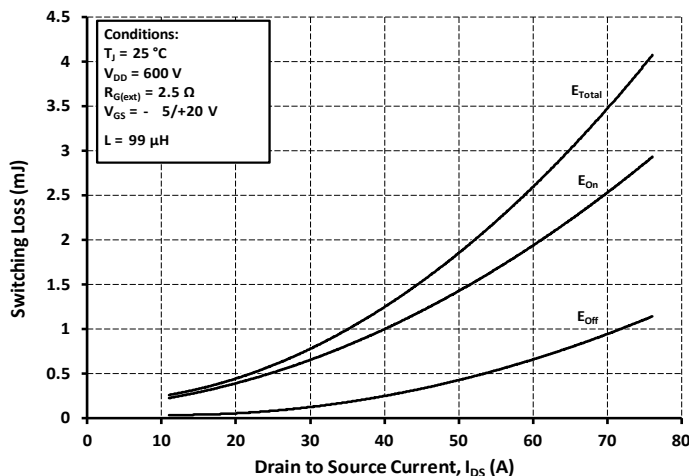


Figure 23. Clamped Inductive Switching Energy vs. Drain Current ($V_{DD} = 600V$)

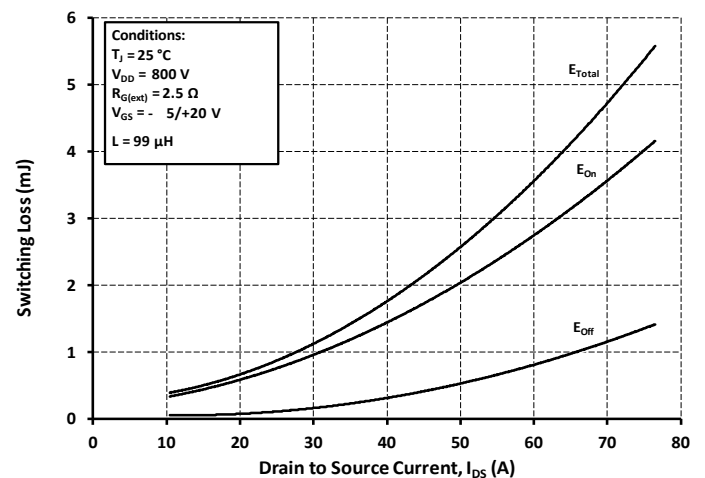


Figure 24. Clamped Inductive Switching Energy vs. Drain Current ($V_{DD} = 800V$)



Typical Performance

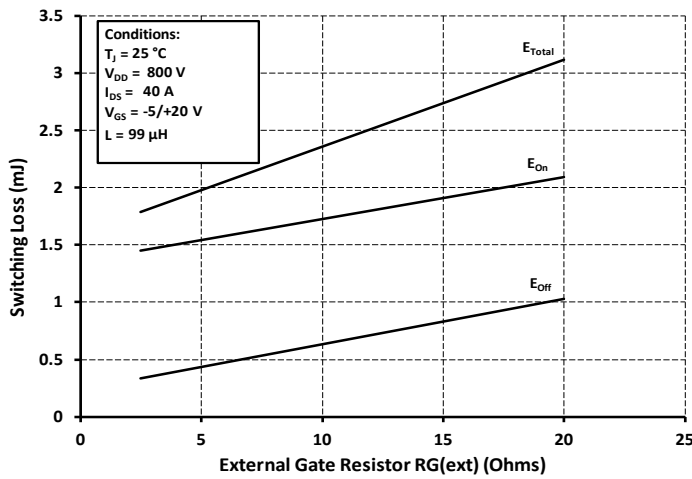


Figure 25. Clamped Inductive Switching Energy vs. $R_{G(ext)}$

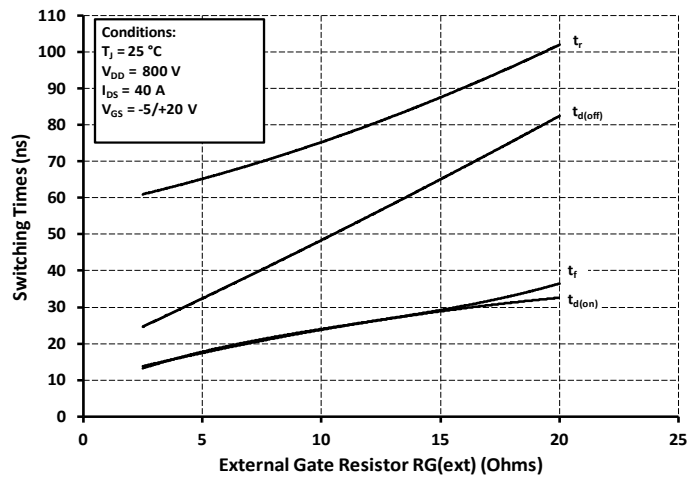


Figure 27. Switching Times vs. $R_{G(ext)}$

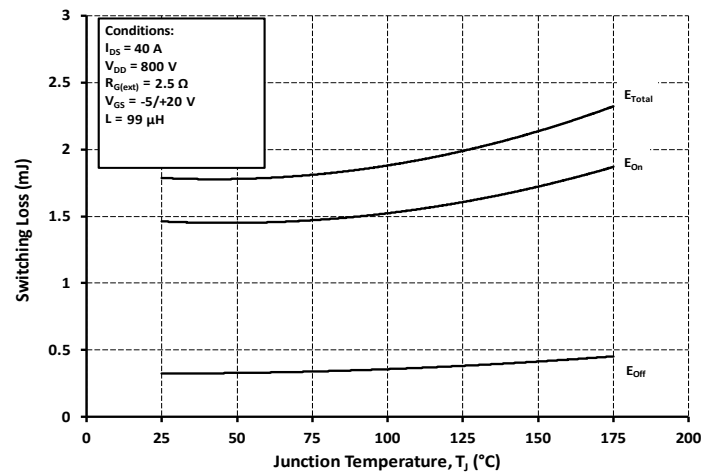


Figure 26. Clamped Inductive Switching Energy vs. Temperature

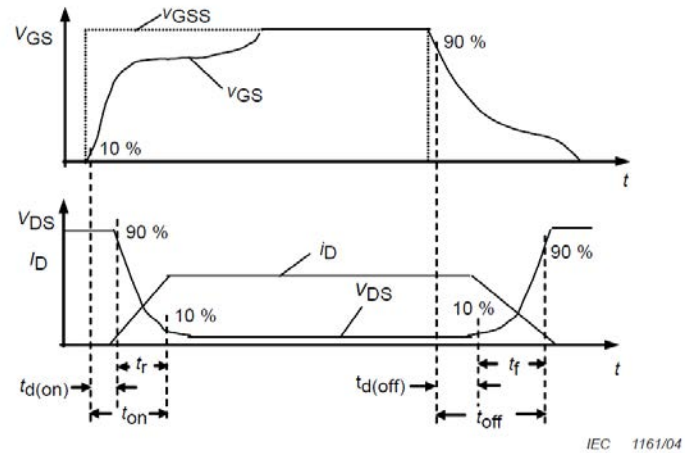


Figure 28. Switching Times Definition



Test Circuit Schematic

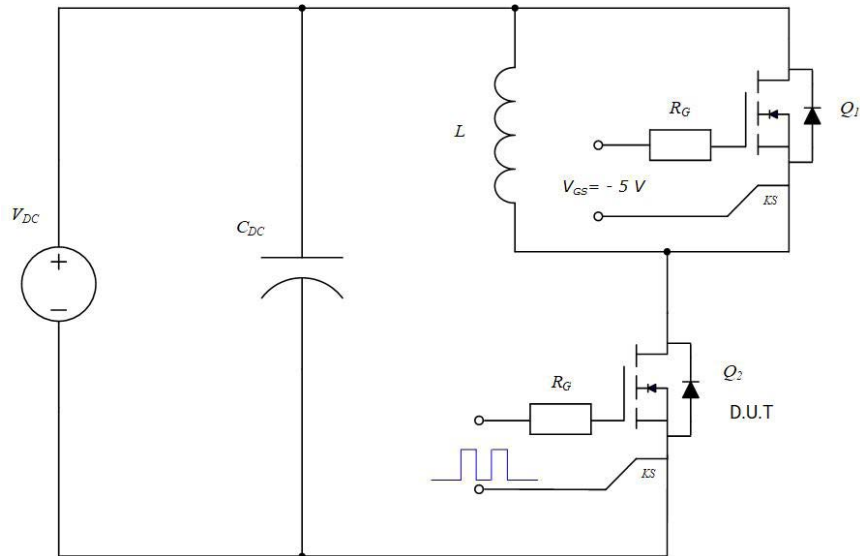


Figure 29. Clamped Inductive Switching
Waveform Test Circuit

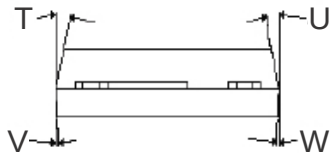
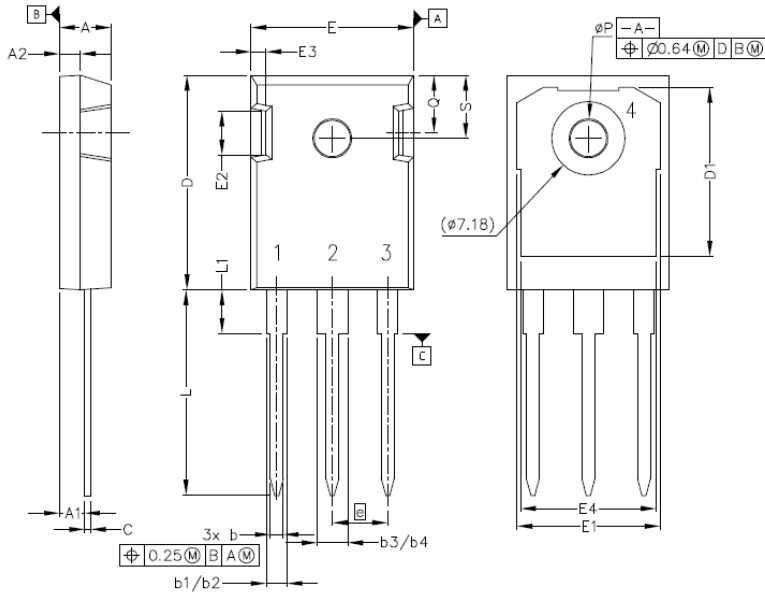
ESD Ratings

ESD Test	Resulting Classification
ESD-HBM	3A (4000V - 8000V)
ESD-CDM	C3 ($\geq 1000V$)



Package Dimensions

Package T0-247

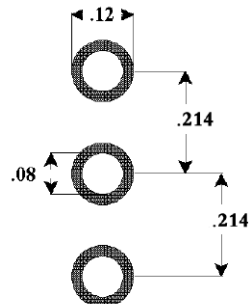


Pinout Information:

- 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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