



Features

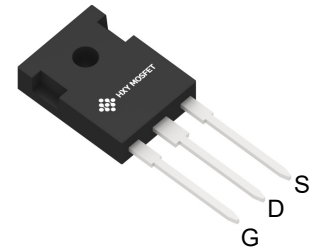
- High Blocking Voltage with Low On-Resistance
- High Speed Switching with Low Capacitances
- Easy to Parallel and Simple to Drive
- Resistant to Latch-Up
- Halogen Free, RoHS Compliant

Benefits

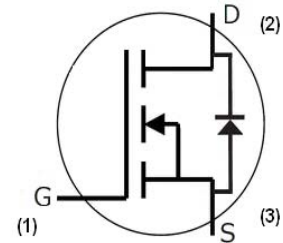
- Higher System Efficiency
- Reduced Cooling Requirements
- Increased Power Density
- Increased System Switching Frequency

Applications

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



TO-247
(TO-247-3)



Part Number	Package	Qty(PCS)
MSC040SMA120B	TO-247(TO-247-3)	30

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 ($T_C = 25^\circ\text{C}$ 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	$V_{GS} = -5\text{ V}, I_{SD} = 40\text{ A}, T_J = 25\text{ }^{\circ}\text{C}$ $VR = 800\text{ V}$ $dif/dt = 1000\text{ A}/\mu\text{s}$	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

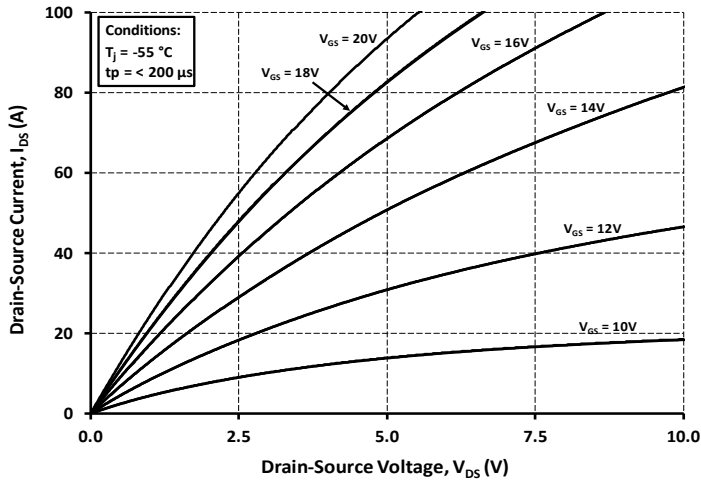


Figure 1. Output Characteristics $T_J = -55\text{ }^{\circ}\text{C}$

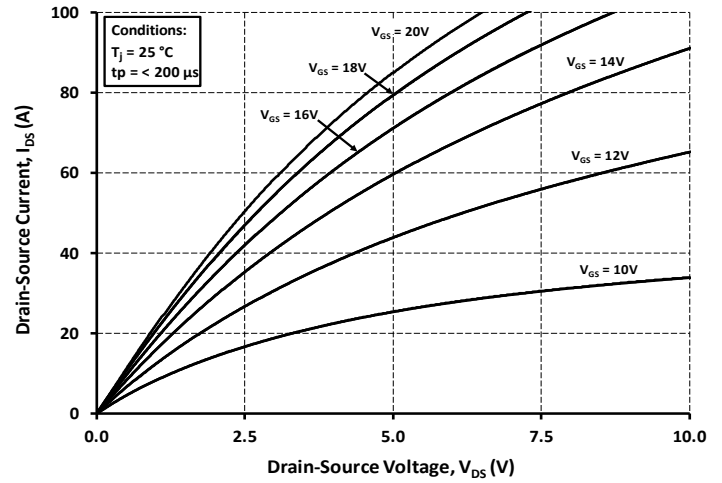


Figure 2. Output Characteristics $T_J = 25\text{ }^{\circ}\text{C}$

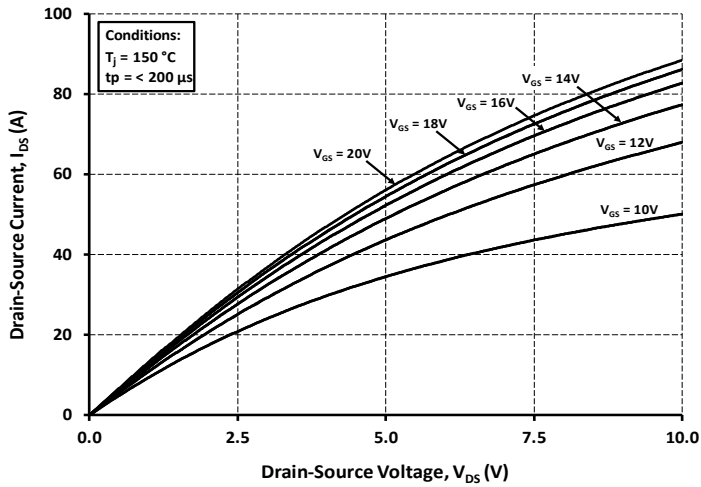


Figure 3. Output Characteristics $T_J = 150\text{ }^{\circ}\text{C}$

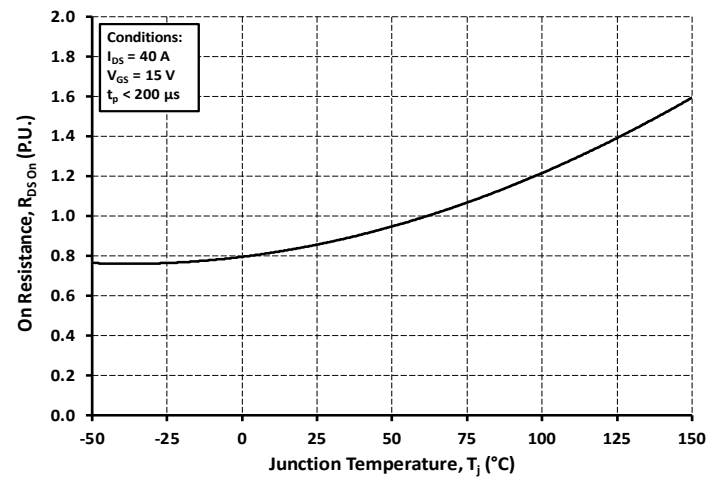


Figure 4. Normalized On-Resistance vs. Temperature

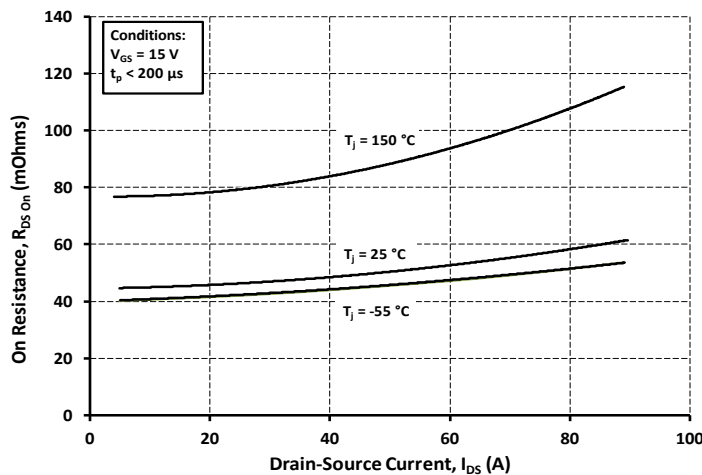


Figure 5. On-Resistance vs. Drain Current
For Various Temperatures

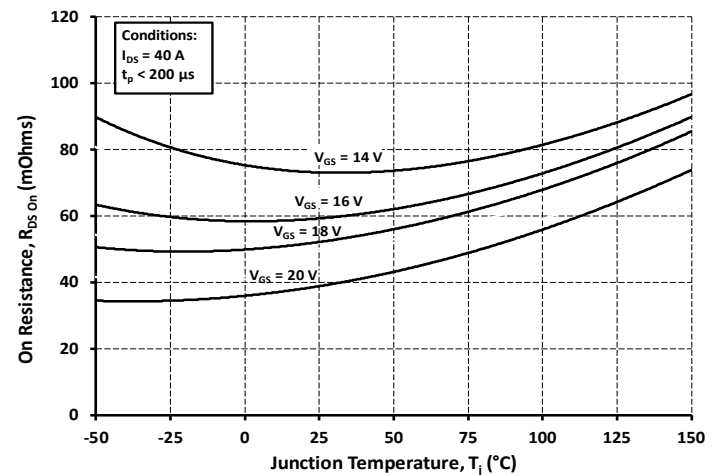


Figure 6. On-Resistance vs. Temperature
For Various Gate Voltage



Typical Performance

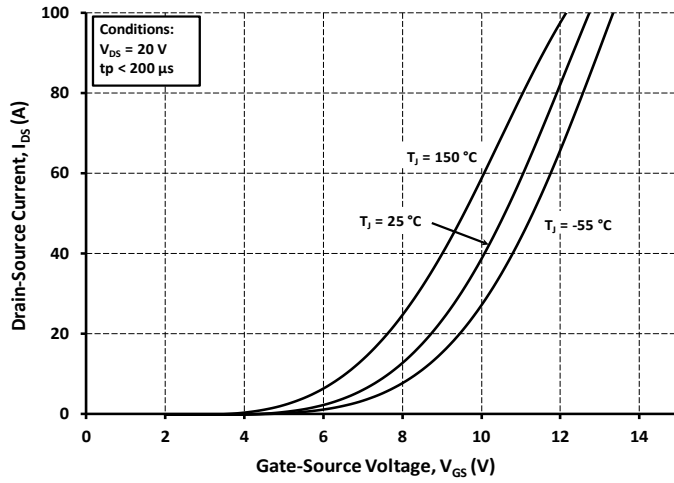


Figure 7. Transfer Characteristic for Various Junction Temperatures

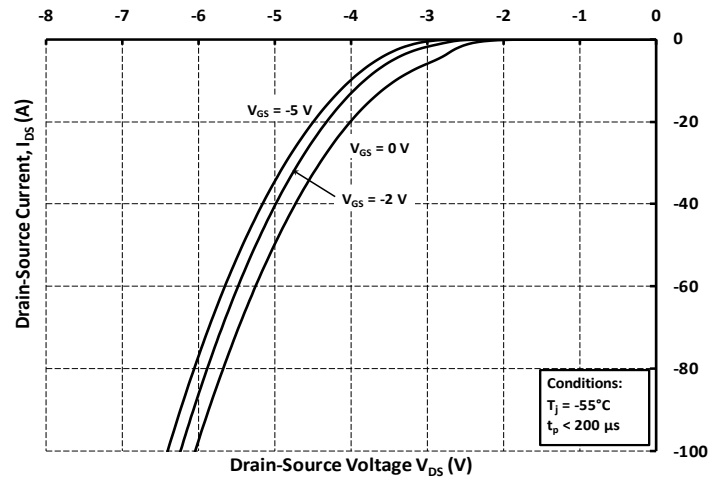


Figure 8. Body Diode Characteristic at -55 °C

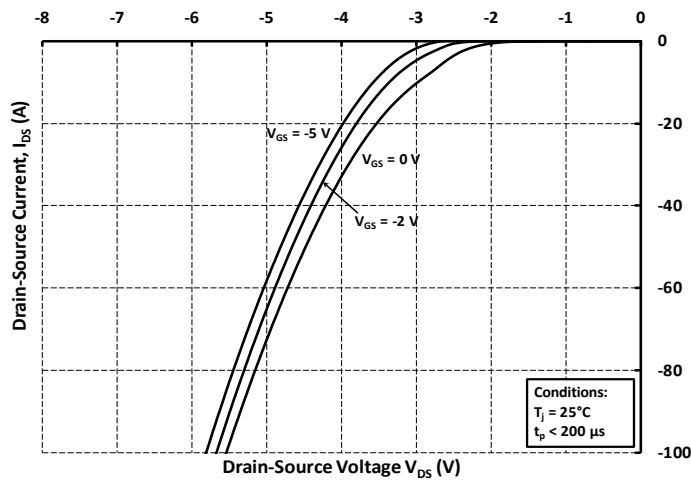


Figure 9. Body Diode Characteristic at 25 °C

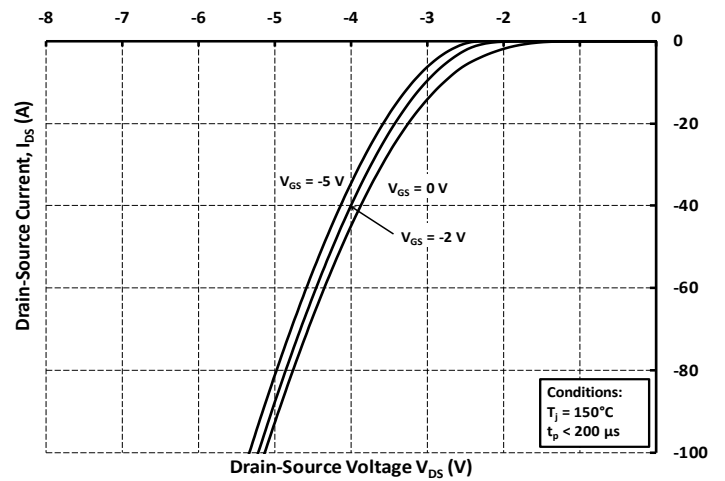


Figure 10. Body Diode Characteristic at 150 °C

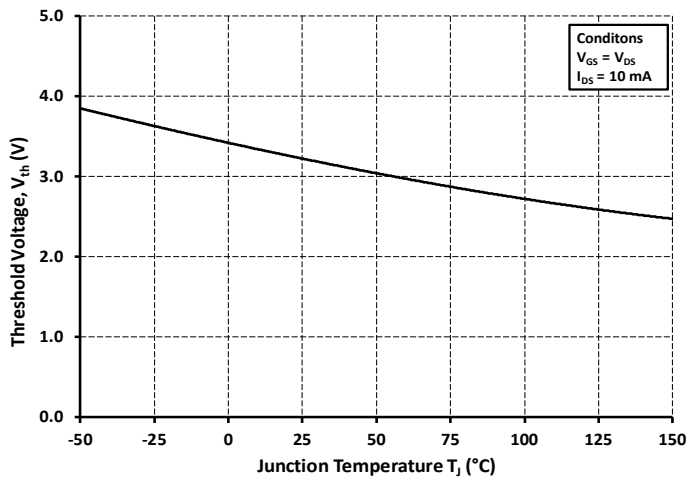


Figure 11. Threshold Voltage vs. Temperature

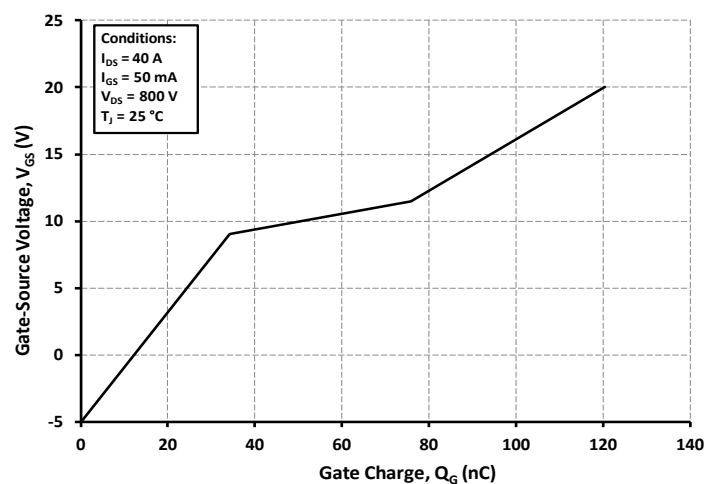


Figure 12. Gate Charge Characteristics



Typical Performance

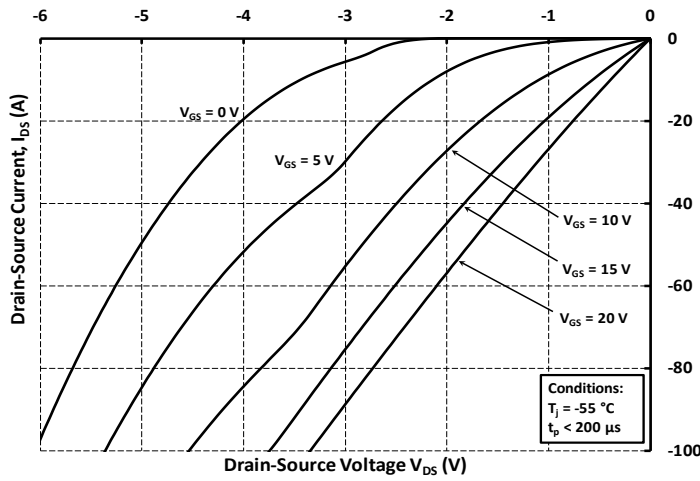


Figure 13. 3rd Quadrant Characteristic at -55 °C

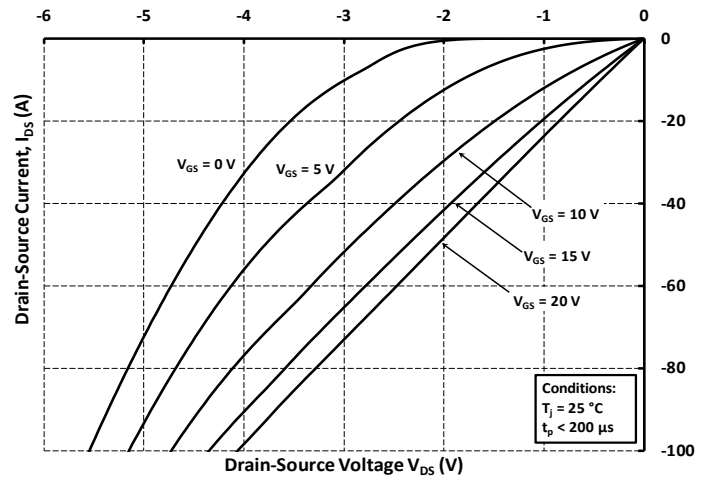


Figure 14. 3rd Quadrant Characteristic at 25 °C

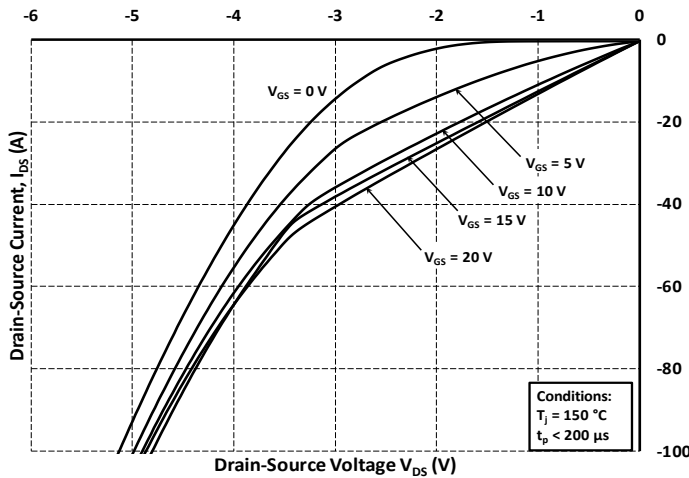


Figure 15. 3rd Quadrant Characteristic at 150 °C

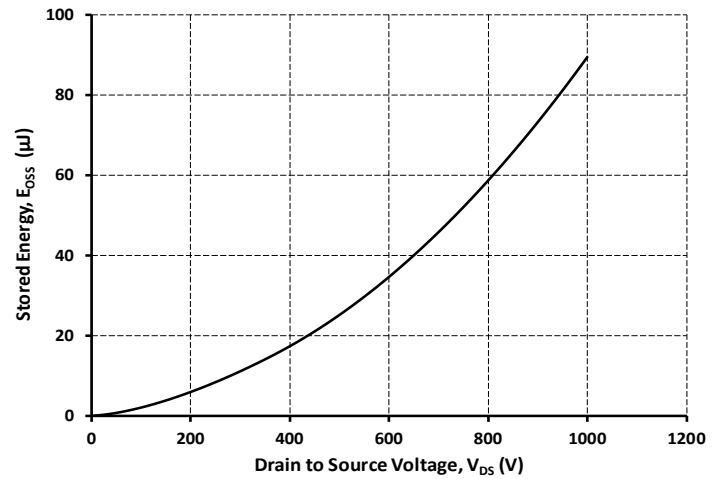


Figure 16. Output Capacitor Stored Energy

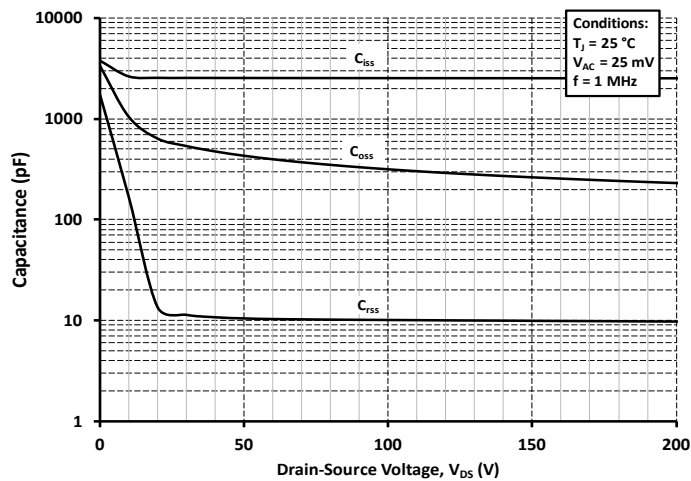


Figure 17. Capacitances vs. Drain-Source Voltage (0-200 V)

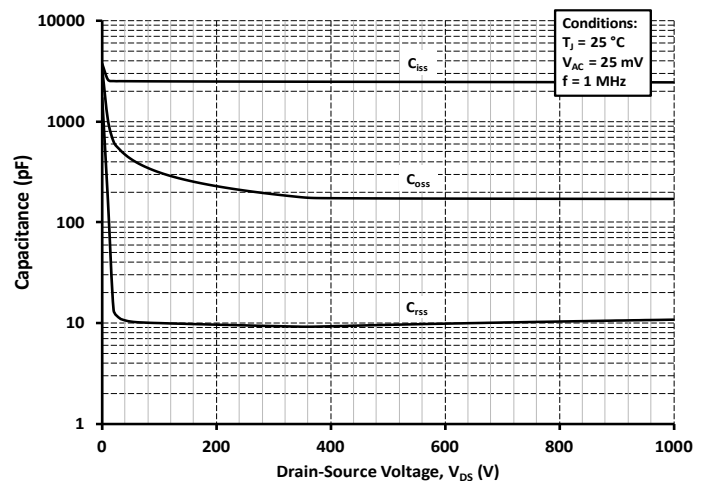


Figure 18. Capacitances vs. Drain-Source Voltage (0-1000 V)



Typical Performance

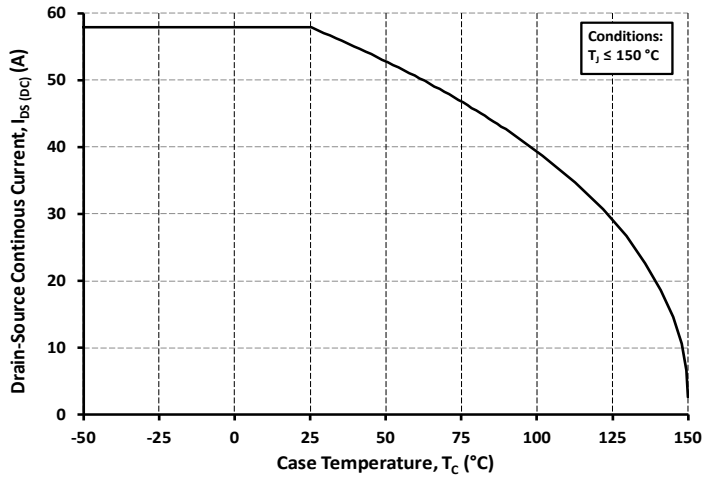


Figure 19. Continuous Drain Current Derating vs. Case Temperature

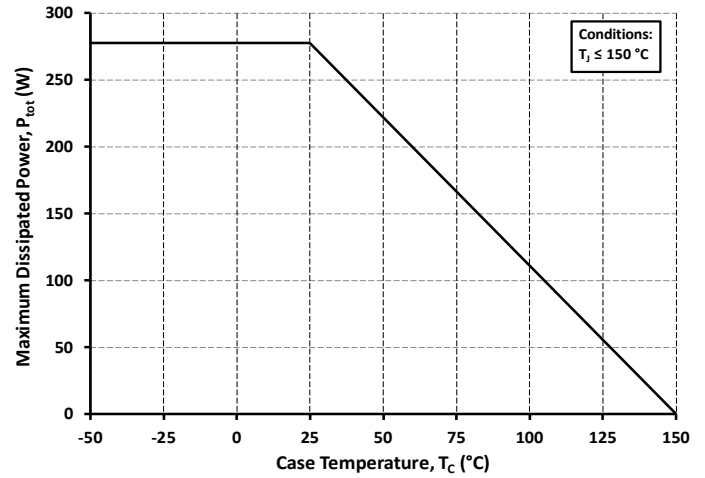


Figure 20. Maximum Power Dissipation Derating vs. Case Temperature

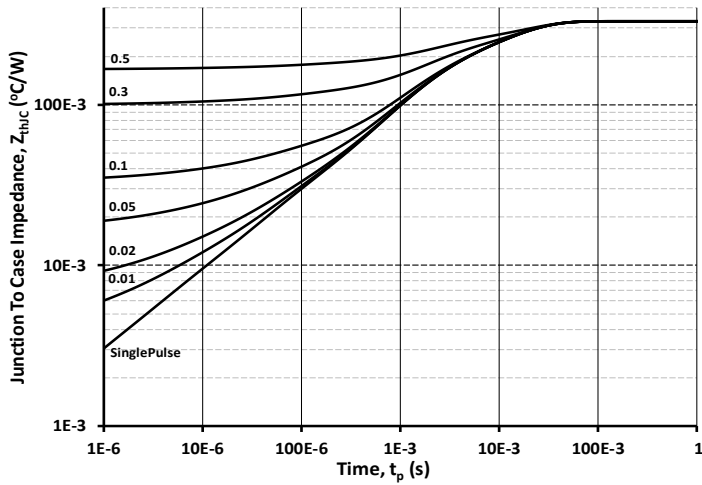


Figure 21. Transient Thermal Impedance (Junction - Case)

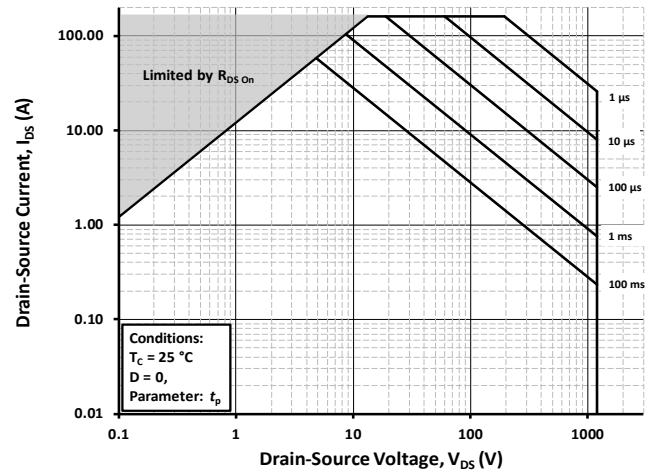


Figure 22. Safe Operating Area

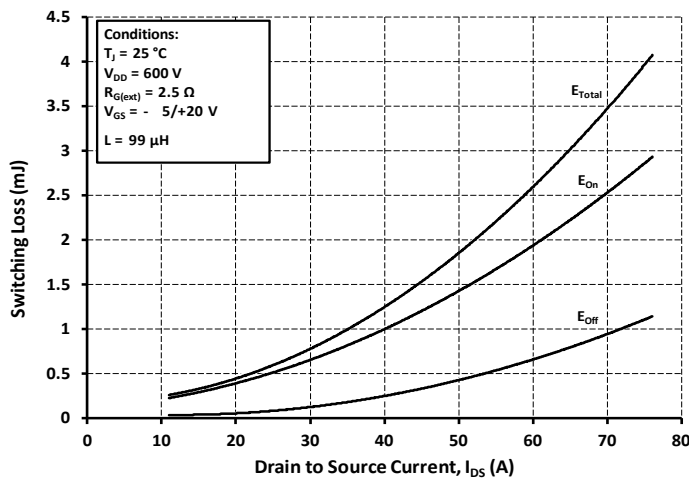


Figure 23. Clamped Inductive Switching Energy vs. Drain Current ($V_{DD} = 600V$)

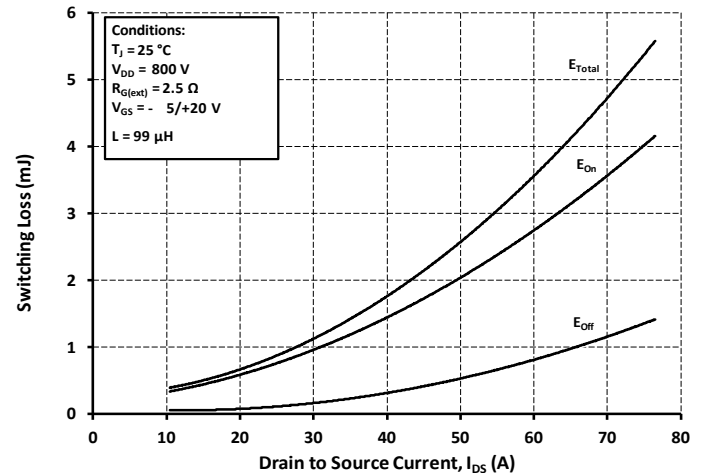


Figure 24. Clamped Inductive Switching Energy vs. Drain Current ($V_{DD} = 800V$)



Typical Performance

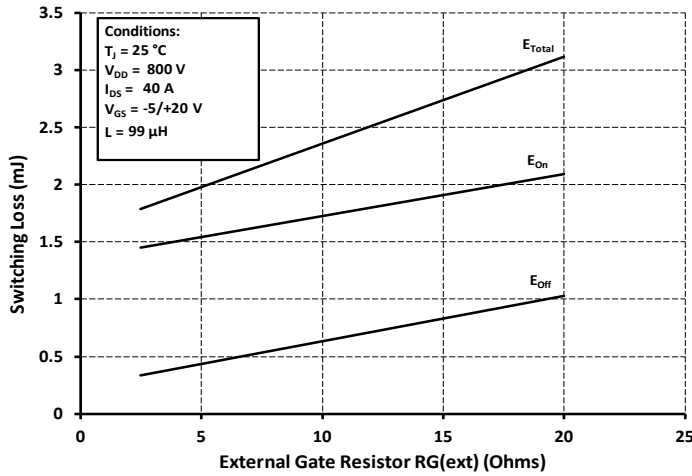


Figure 25. Clamped Inductive Switching Energy vs. $R_{G(ext)}$

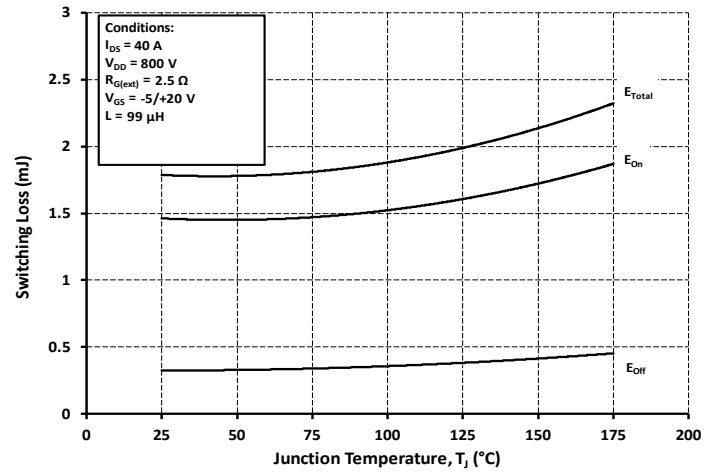


Figure 26. Clamped Inductive Switching Energy vs. Temperature

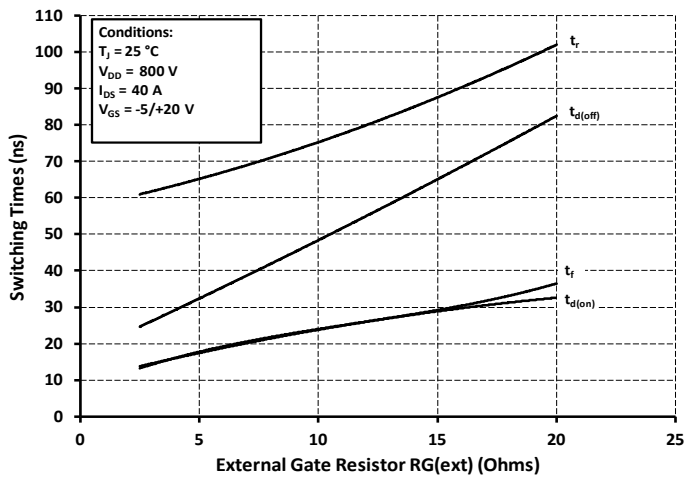


Figure 27. Switching Times vs. $R_{G(ext)}$

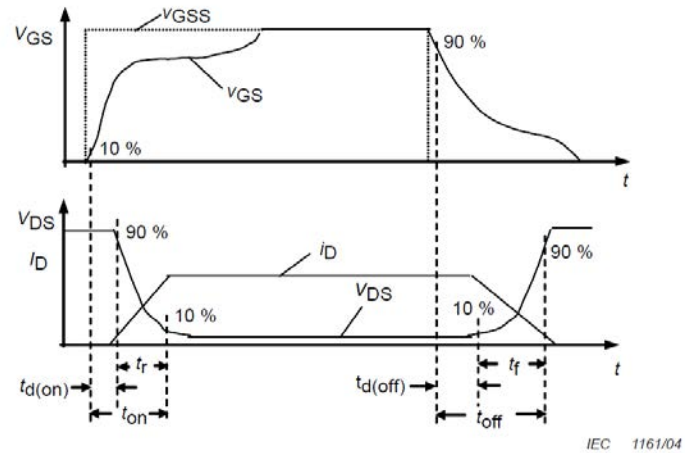


Figure 28. Switching Times Definition



Test Circuit Schematic

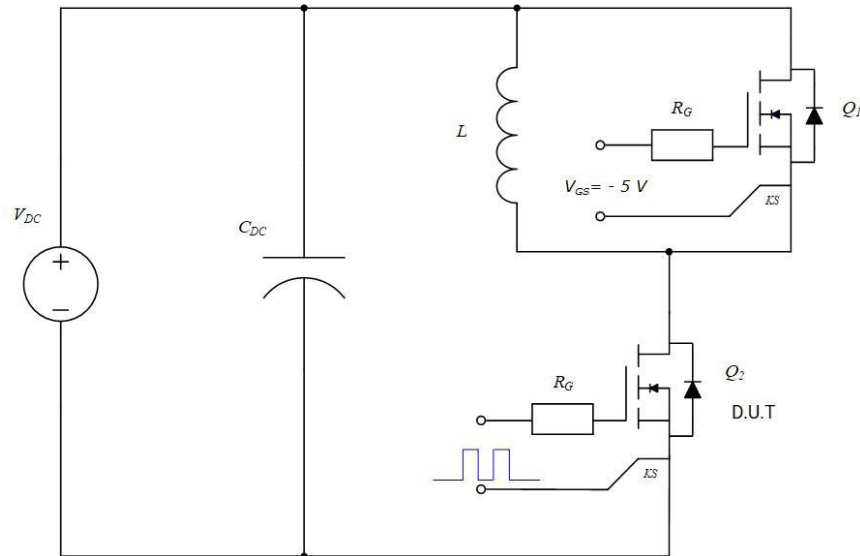


Figure 29. Clamped Inductive Switching
Waveform Test Circuit

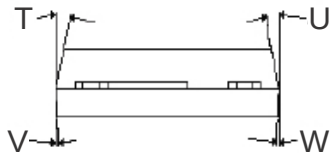
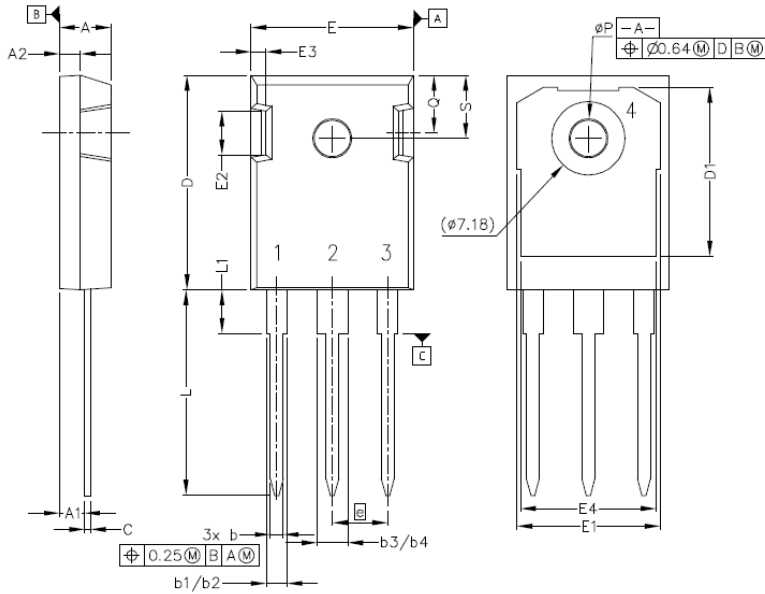
ESD Ratings

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



Package Dimensions

Package T0-247(T0-247-3)

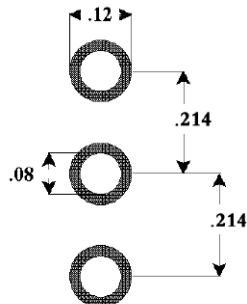


Pinout Information:

- 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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