



### Features

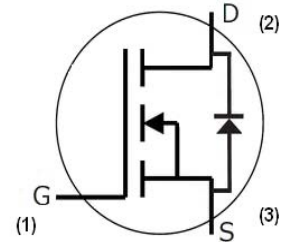
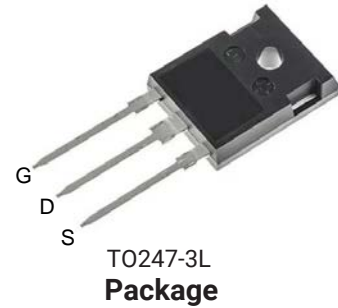
- 3<sup>rd</sup> Generation SiC MOSFET technology
- High blocking voltage with low on-resistance
- High speed switching with low capacitances
- Fast intrinsic diode with low reverse recovery (Qrr)
- Halogen free, RoHS compliant

### Benefits

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

### Applications

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



Part Number	Package	Marking
HC3M0032120D	TO247-3L	HC3M0032120D

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

Symbol	Parameter	Value	Unit	Test Conditions	Note
$V_{DSmax}$	Drain - Source Voltage	1200	V	$V_{GS} = 0\text{ V}, I_b = 100\text{ }\mu\text{A}$	
$V_{GSmax}$	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	$V_{GS} = 15\text{ V}, T_c = 25\text{ }^\circ\text{C}$	Fig. 19
		48		$V_{GS} = 15\text{ V}, T_c = 100\text{ }^\circ\text{C}$	
$I_{D(pulse)}$	Pulsed Drain Current	120	A	Pulse width $t_p$ limited by $T_{jmax}$	
$P_D$	Power Dissipation	283	W	$T_c = 25\text{ }^\circ\text{C}, T_j = 175\text{ }^\circ\text{C}$	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	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	$V_{DS} = V_{GS}, I_D = 11.5\ \text{mA}$	Fig. 11
			2.0		V	$V_{DS} = V_{GS}, I_D = 11.5\ \text{mA}, T_J = 175^\circ\text{C}$	
$I_{DSS}$	Zero Gate Voltage Drain Current		1	50	$\mu\text{A}$	$V_{DS} = 1200\ \text{V}, V_{GS} = 0\ \text{V}$	
$I_{GSS}$	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	23	32	43	m $\Omega$	$V_{GS} = 15\ \text{V}, I_D = 40\ \text{A}$	Fig. 4, 5, 6
			57.6			$V_{GS} = 15\ \text{V}, I_D = 40\ \text{A}, T_J = 175^\circ\text{C}$	
$g_{fs}$	Transconductance		27		S	$V_{DS} = 20\ \text{V}, I_{DS} = 40\ \text{A}$	Fig. 7
			22			$V_{DS} = 20\ \text{V}, I_{DS} = 40\ \text{A}, T_J = 175^\circ\text{C}$	
$C_{iss}$	Input Capacitance		3357		pF	$V_{GS} = 0\ \text{V}, V_{DS} = 1000\ \text{V}$ $f = 100\ \text{kHz}$ $V_{AC} = 25\ \text{mV}$	Fig. 17, 18
$C_{oss}$	Output Capacitance		129				
$C_{riss}$	Reverse Transfer Capacitance		8				
$E_{oss}$	$C_{oss}$ Stored Energy		76				$\mu\text{J}$
$E_{ON}$	Turn-On Switching Energy (SiC Diode FWD)		1.94		mJ	$V_{DS} = 800\ \text{V}, V_{GS} = -4\ \text{V}/+15\ \text{V}, I_D = 40\ \text{A},$ $R_{G(ext)} = 5\ \Omega, L = 157\ \mu\text{H}, T_J = 175^\circ\text{C}$	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	$V_{DS} = 800\ \text{V}, V_{GS} = -4\ \text{V}/+15\ \text{V}, I_D = 40\ \text{A},$ $R_{G(ext)} = 5\ \Omega, L = 157\ \mu\text{H}, T_J = 175^\circ\text{C}$	Fig. 26
$E_{OFF}$	Turn Off Switching Energy (Body Diode FWD)		0.72				
$t_{d(on)}$	Turn-On Delay Time		107		ns	$V_{DD} = 800\ \text{V}, V_{GS} = -4\ \text{V}/15\ \text{V}$ $R_{G(ext)} = 5\ \Omega, I_D = 40\ \text{A}, L = 157$ 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		$\Omega$	$f = 1\ \text{MHz}, V_{AC} = 25\ \text{mV}$	
$Q_{gs}$	Gate to Source Charge		35		nC	$V_{DS} = 800\ \text{V}, V_{GS} = -4\ \text{V}/15\ \text{V}$ $I_D = 40\ \text{A}$ Per IEC60747-8-4 pg 21	Fig. 12
$Q_{gd}$	Gate to Drain Charge		40				
$Q_g$	Total Gate Charge		114				

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

Symbol	Parameter	Typ.	Max.	Unit	Test Conditions	Note
$V_{SD}$	Diode Forward Voltage	4.6		V	$V_{GS} = -4\ \text{V}, I_{SD} = 20\ \text{A}, T_J = 25^\circ\text{C}$	Fig. 8, 9, 10
		4.2		V	$V_{GS} = -4\ \text{V}, I_{SD} = 20\ \text{A}, T_J = 175^\circ\text{C}$	
$I_S$	Continuous Diode Forward Current		62	A	$V_{GS} = -4\ \text{V}, T_c = 25^\circ\text{C}$	Note 1
$I_{S,pulse}$	Diode pulse Current		120	A	$V_{GS} = -4\ \text{V}$ , pulse width $t_p$ limited by $T_{jmax}$	Note 1
$t_{rr}$	Reverse Recover time	69		ns	$V_{GS} = -4\ \text{V}, I_{SD} = 40\ \text{A}, V_R = 800\ \text{V}$ $dif/dt = 1500\ \text{A}/\mu\text{s}, T_J = 175^\circ\text{C}$	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
$R_{\theta JC}$	Thermal Resistance from Junction to Case	0.45	$^\circ\text{C}/\text{W}$		Fig. 21
$R_{\theta JA}$	Thermal Resistance From Junction to Ambient	40			



### Typical Performance

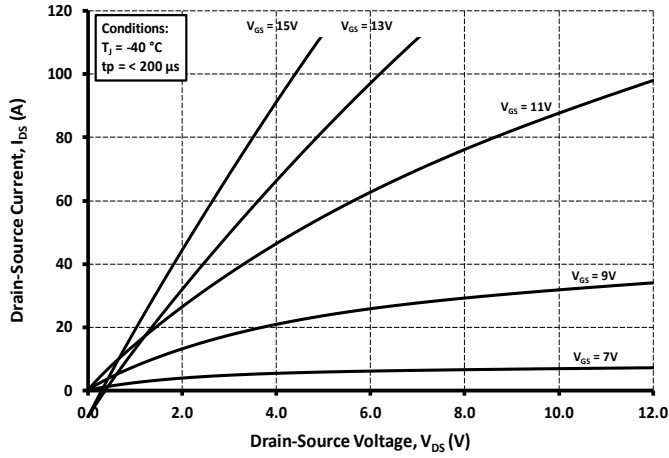


Figure 1. Output Characteristics  $T_J = -40\text{ }^\circ\text{C}$

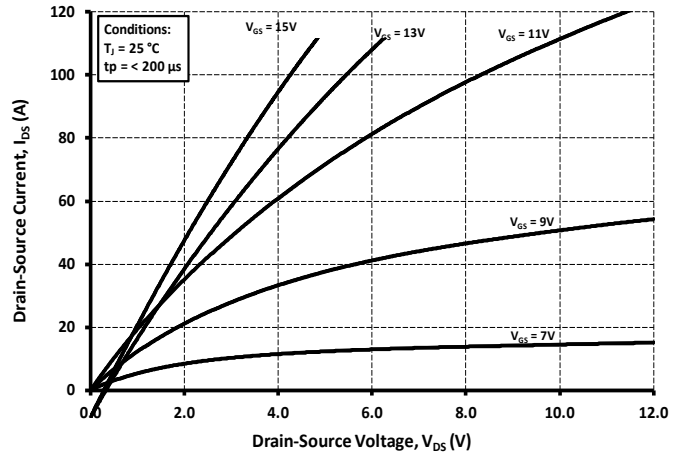


Figure 2. Output Characteristics  $T_J = 25\text{ }^\circ\text{C}$

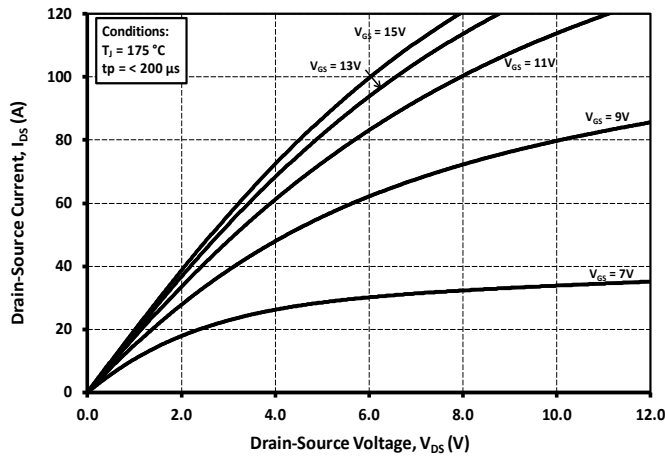


Figure 3. Output Characteristics  $T_J = 175\text{ }^\circ\text{C}$

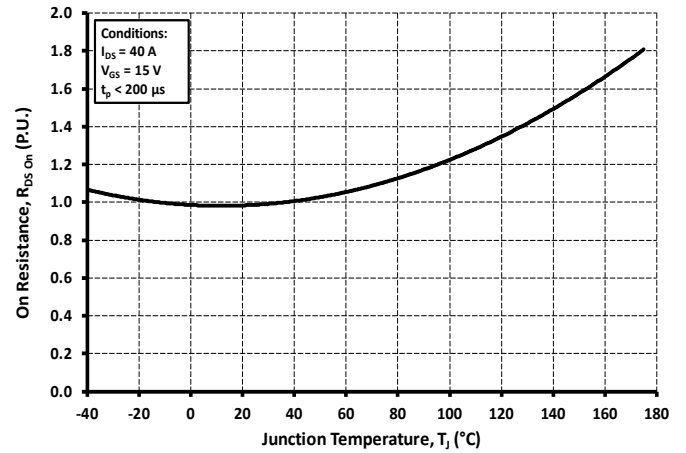


Figure 4. Normalized On-Resistance vs. Temperature

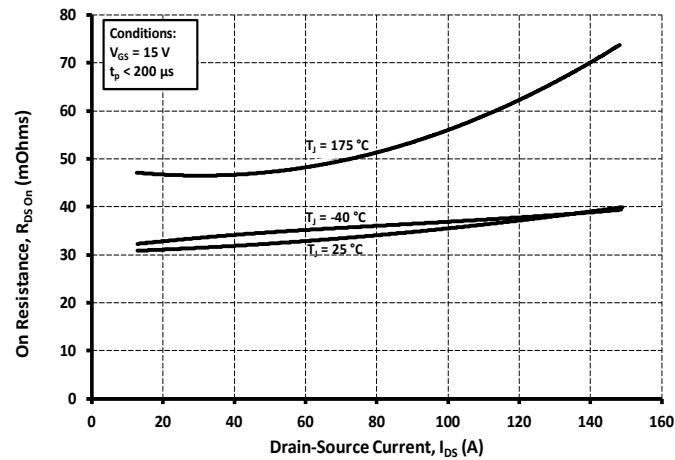


Figure 5. On-Resistance vs. Drain Current For Various Temperatures

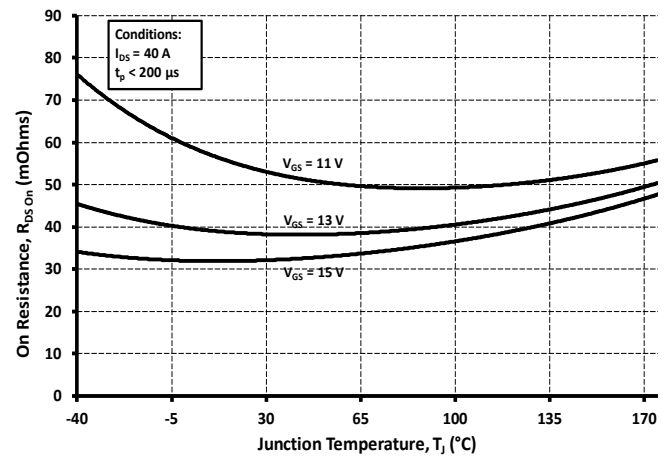


Figure 6. On-Resistance vs. Temperature For Various Gate Voltage



### Typical Performance

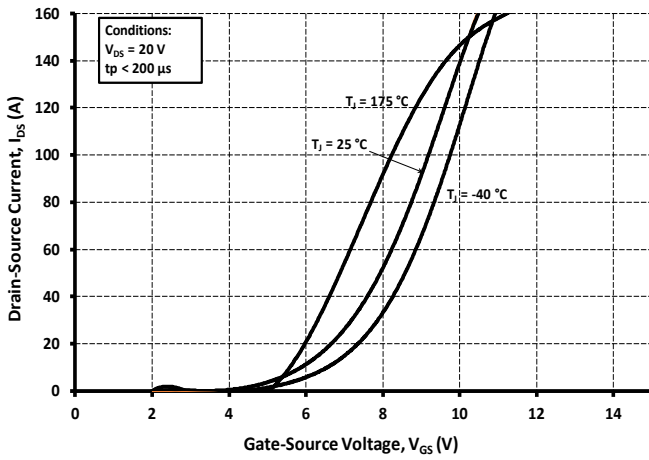


Figure 7. Transfer Characteristic for Various Junction Temperatures

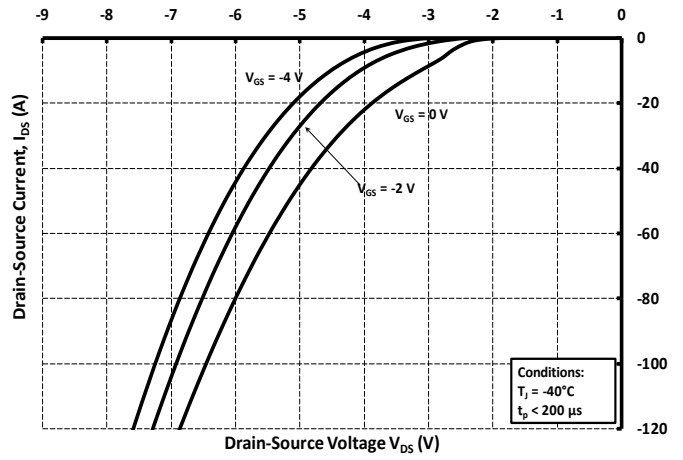


Figure 8. Body Diode Characteristic at -40 °C

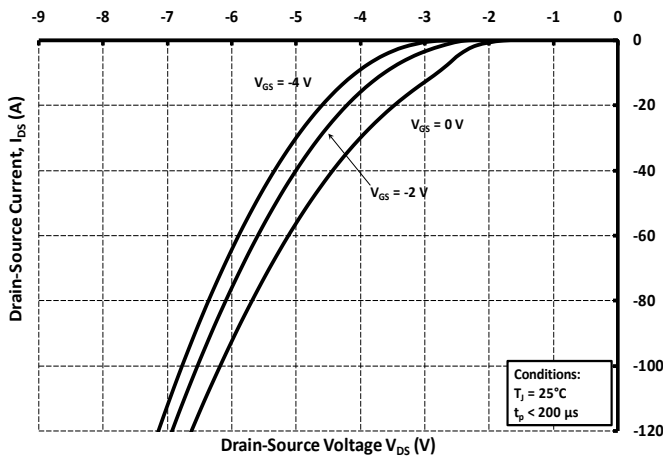


Figure 9. Body Diode Characteristic at 25 °C

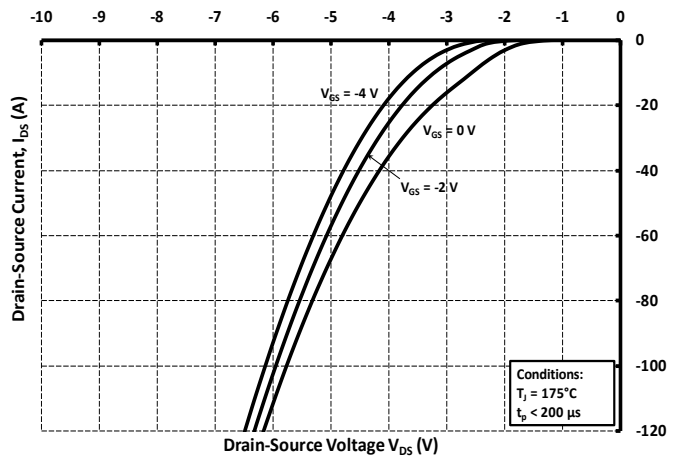


Figure 10. Body Diode Characteristic at 175 °C

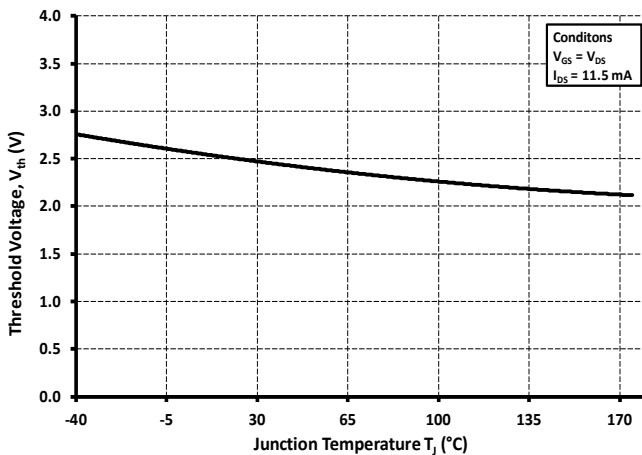


Figure 11. Threshold Voltage vs. Temperature

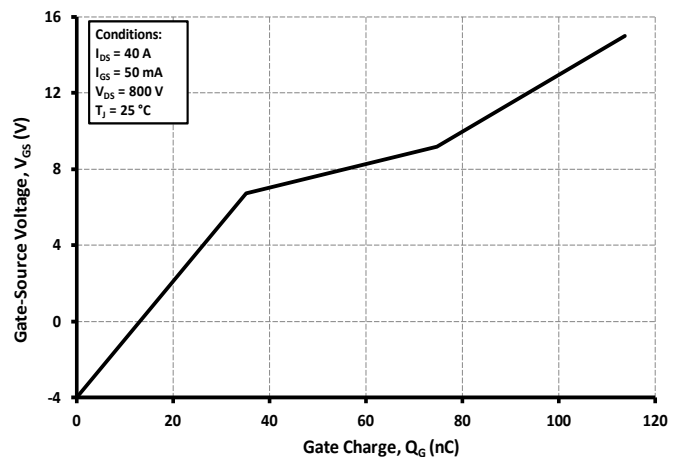


Figure 12. Gate Charge Characteristics



### Typical Performance

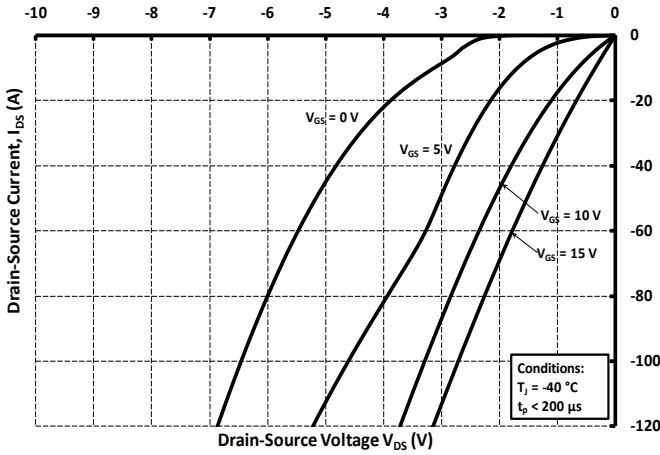


Figure 13. 3rd Quadrant Characteristic at  $-40\text{ }^\circ\text{C}$

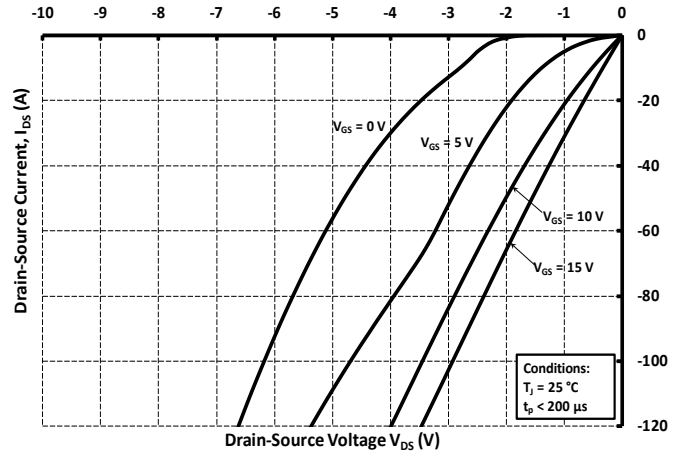


Figure 14. 3rd Quadrant Characteristic at  $25\text{ }^\circ\text{C}$

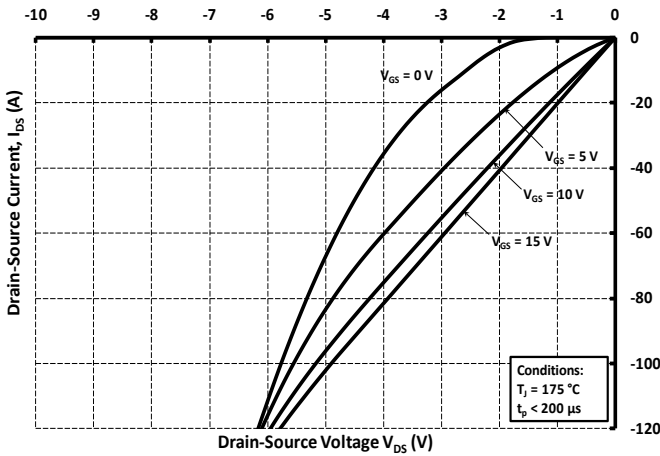


Figure 15. 3rd Quadrant Characteristic at  $175\text{ }^\circ\text{C}$

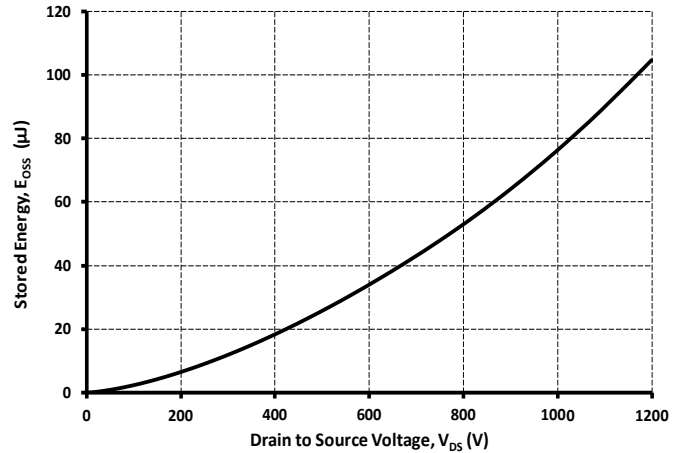


Figure 16. Output Capacitor Stored Energy

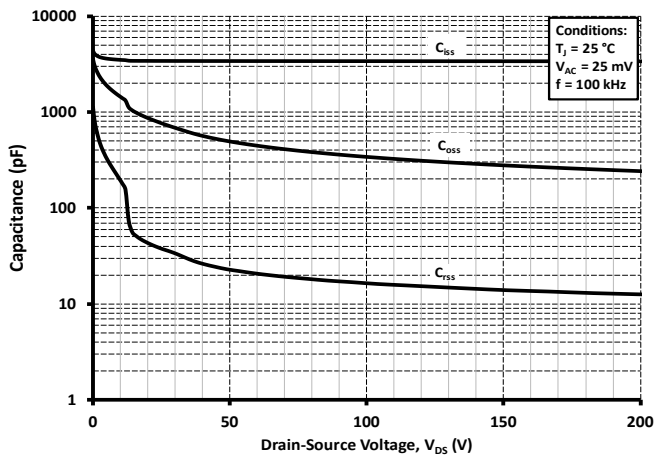


Figure 17. Capacitances vs. Drain-Source Voltage (0 - 200V)

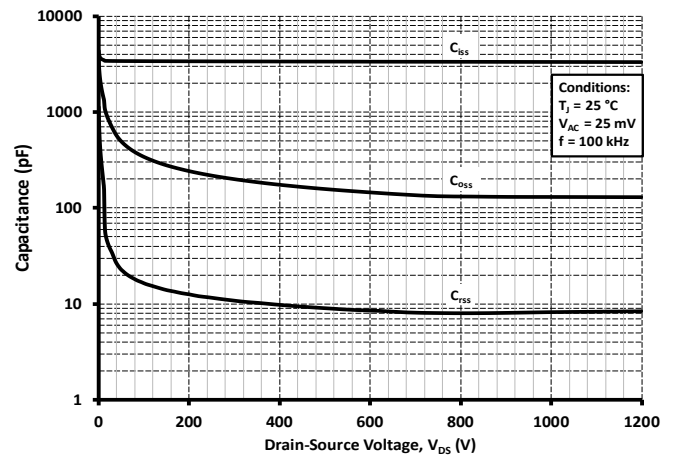


Figure 18. Capacitances vs. Drain-Source Voltage (0 - 1200V)



Typical Performance

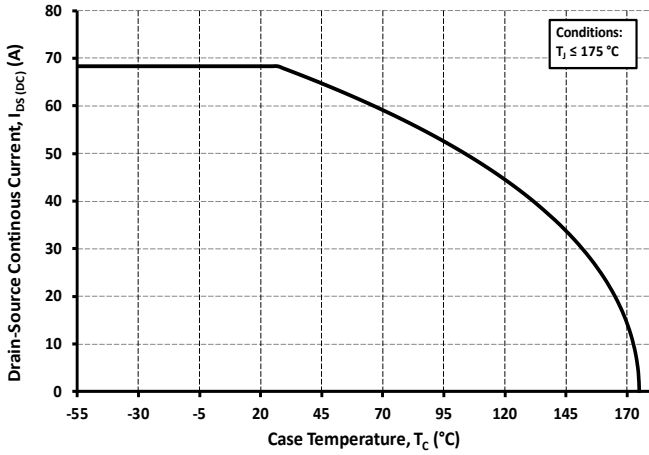


Figure 19. Continuous Drain Current Derating vs. Case Temperature

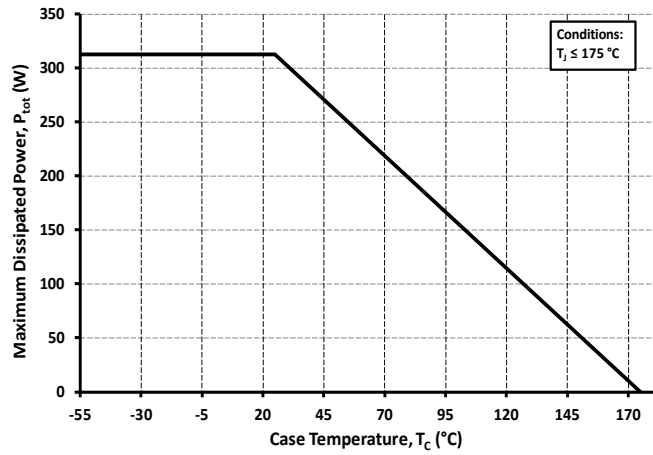


Figure 20. Maximum Power Dissipation Derating vs. Case Temperature

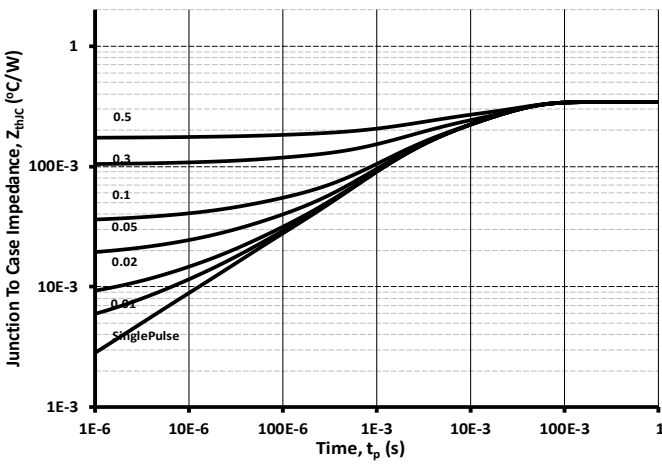


Figure 21. Transient Thermal Impedance (Junction - Case)

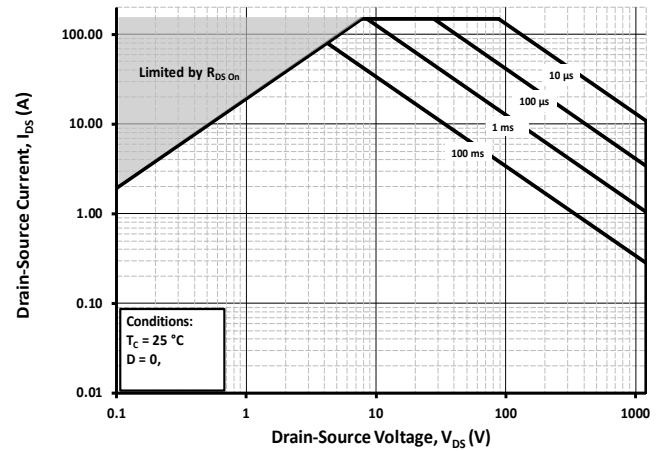


Figure 22. Safe Operating Area

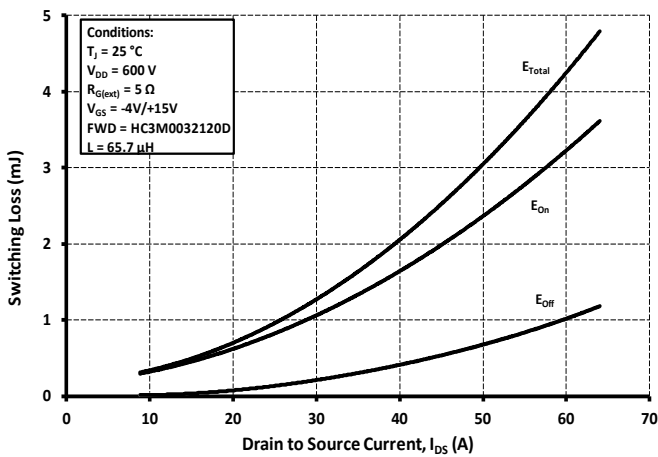


Figure 23. Clamped Inductive Switching Energy vs. Drain Current ( $V_{DD} = 600V$ )

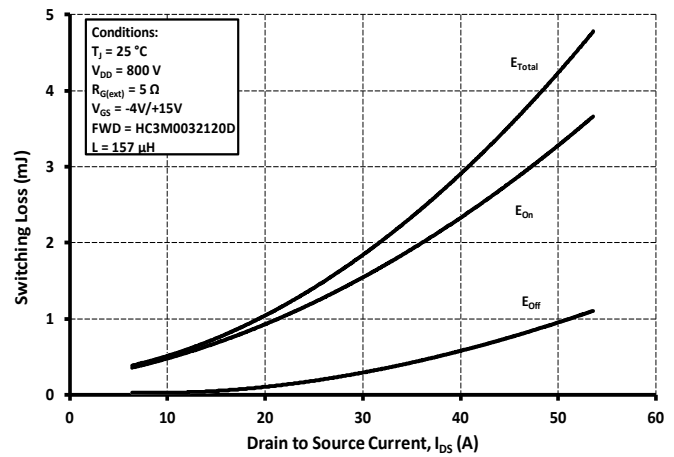


Figure 24. Clamped Inductive Switching Energy vs. Drain Current ( $V_{DD} = 800V$ )



### Typical Performance

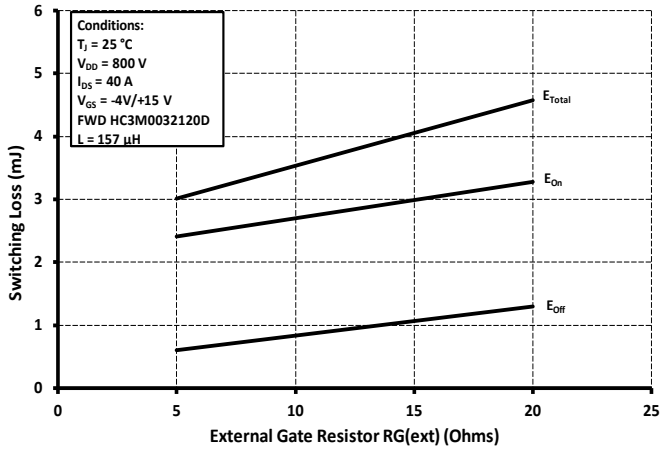


Figure 25. Clamped Inductive Switching Energy vs.  $R_{G(ext)}$

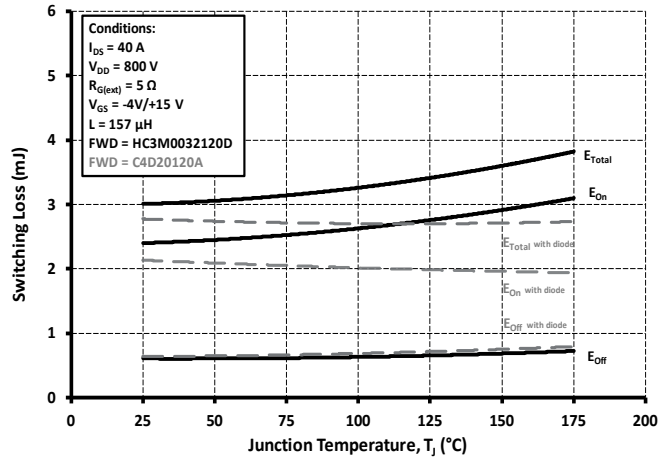


Figure 26. Clamped Inductive Switching Energy vs. Temperature

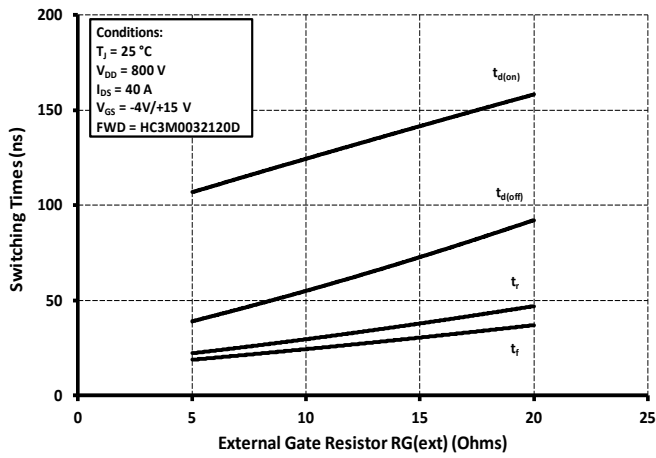


Figure 27. Switching Times vs.  $R_{G(ext)}$

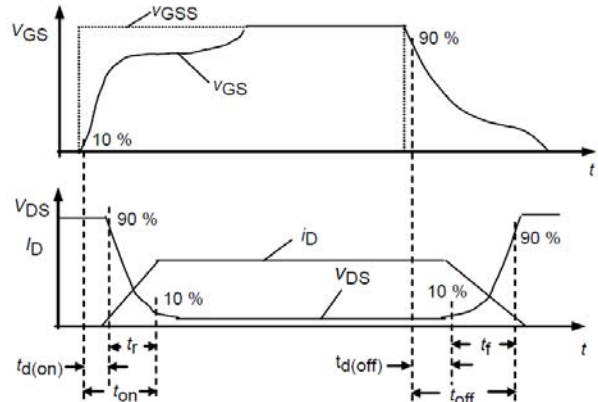


Figure 28. Switching Times Definition

IEC 1161/04



### Test Circuit Schematic

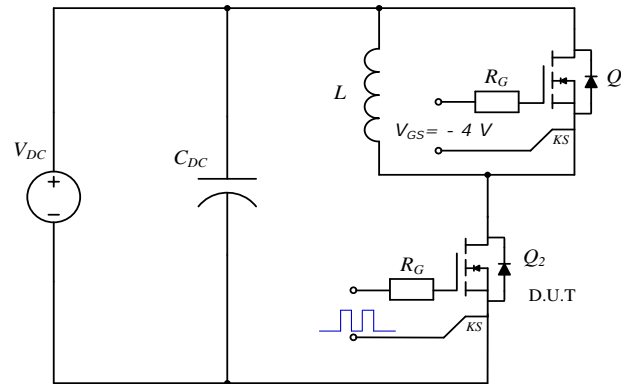


Figure 29. Clamped Inductive Switching  
Waveform Test Circuit

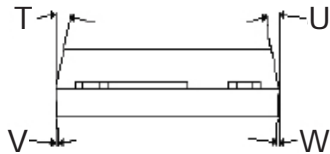
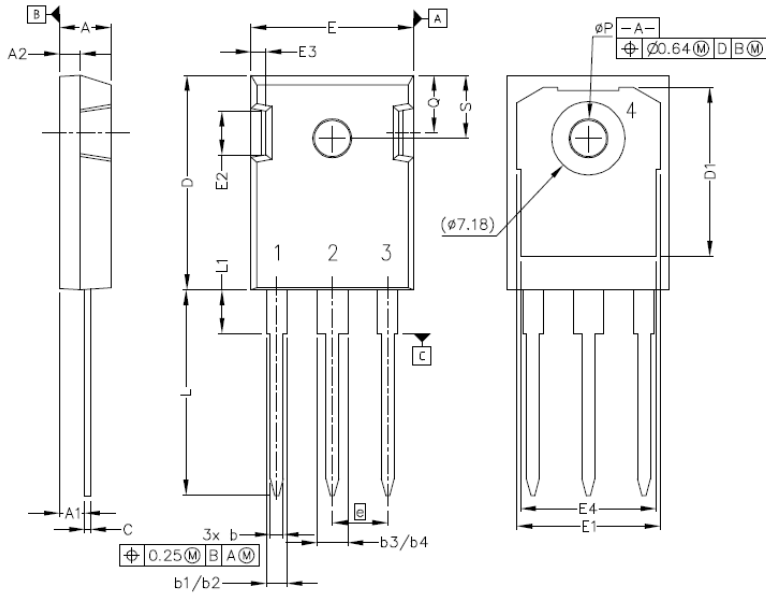
Note (3): Turn-off and Turn-on switching energy and timing values measured using SiC MOSFET Body Diode as shown above.





## Package Dimensions

### Package T0247-3L

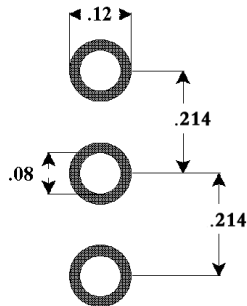


#### Pinout Information:

- 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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