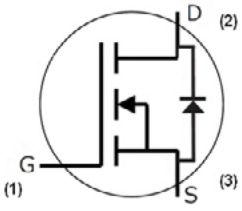
C3M0016120D

Silicon Carbide Power MOSFET C3M™ MOSFET Technology
N-Channel Enhancement Mode









Features

- C3M™ Silicon Carbide (SiC) MOSFET technology
- High blocking voltage with low On-resistance
- High speed switching with low capacitances
- Fast intrinsic diode with low reverse recovery (Q_{rr})
- Halogen free, RoHS compliant

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Part Number	Package	Marking
C3M0016120D	TO 247-3	C3M0016120D

Typical Applications

- Renewable energy
- High voltage DC/DC converters
- Switch Mode Power Supplies
- UPS

Benefits

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

Key Parameters

Parameter	Symbol	Min.	Typ.	Max	Unit	Conditions	Note
Drain - Source Voltage	V_{DS}			1200	V	T_C = 25°C	
Maximum Gate - Source Voltage	$V_{GS(max)}$	-8		+19		Transient	
Operational Gate-Source Voltage	$V_{GS\ op}$		-4/15			Static	Note 1
DC Continuous Drain Current	I_D			115	A	V_{GS} = 15 V, T_C = 25 °C, T_J ≤175 °C	Fig. 19 Note 2
				85		V_{GS} = 15 V, T_C = 100 °C, T_J ≤175 °C	
Pulsed Drain Current	I_{DM}			250		t_{Pmax} limited by T_{jmax} V_{GS} = 15V, T_C = 25 °C	Fig. 22
Power Dissipation	P_D			556	W	T_C = 25 °C, T_J = 175 °C	Fig. 20
Operating Junction and Storage Temperature	T_J, T_{stg}			-40 to +175	°C		
Solder Temperature	T_L			260		According to JEDEC J-STD-020	
Mounting Torque	M_D			1 8.8	Nm lbf-in	M3 or 6-32 screw	

Note (1): Recommended turn-on gate voltage is 15V with ±5% regulation tolerance, see Application Note PRD-04814 for additional details
Note (2): Verified by design

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Electrical Characteristics (T_C = 25℃ unless otherwise specified)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test Conditions	Note
Drain-Source Breakdown Voltage	$V_{(BR)DSS}$	1200	—	—	V	V_{GS} = 0 V, I_D = 100 µA	
Gate Threshold Voltage	$V_{GS(th)}$	1.8	2.5	3.6	V	V_{DS} = $V_{GS,}$ I_D = 23 mA	Fig. 11
		—	2.0	—		V_{DS} = $V_{GS,}$ I_D = 23 mA, T_J = 175℃	
Zero Gate Voltage Drain Current	I_{DSS}	—	1	50	µA	V_{DS} = 1200 V, V_{GS} = 0 V	
Gate-Source Leakage Current	I_{GSS}	—	10	250	nA	V_{GS} = 15 V, V_{DS} = 0 V	
Drain-Source On-State Resistance	$R_{DS(on)}$	11.2	16	22.3	mΩ	V_{GS} = 15 V, I_D = 75 A	Fig. 4, 5, 6
		—	28.8	—		V_{GS} = 15 V, I_D = 75 A, T_J = 175°C	
Transconductance	g_{fs}	—	53	—	S	V_{DS} = 20 V, I_{DS} = 75 A	Fig. 7
			47			V_{DS} = 20 V, I_{DS} = 75 A, T_J = 175°C	
Input Capacitance	C_{iss}	—	6085	—	pF	V_{GS} = 0 V, V_{DS} = 1000 V f = 100 khz V_{AC} = 25 mV	Fig. 17, 18
Output Capacitance	C_{oss}	—	230	—			
Reverse Transfer Capacitance	C_{rss}	—	13	—			
C_{oss} Stored Energy	E_{oss}	—	130	—	µJ		Fig. 16
Turn-On Switching Energy (Body Diode)	E_{on}	—	4.64	—	mJ	V_{DS} = 800 V, V_{GS} = -4/+15 V, I_D = 75 A, $R_{G(ext)}$ = 5Ω, L= 65.7 µH, T_J = 175°C	Fig. 25
Turn Off Switching Energy (Body Diode)	E_{off}	—	2.93	—			
Turn-On Switching Energy (External Diode)	E_{on}	—	7.79	—			
Turn Off Switching Energy (External Diode)	E_{off}	—	2.95	—			
Turn-On Delay Time	$t_{d(on)}$	—	174	—	ns	V_{DS} = 800 V, V_{GS} = -4/25 V $R_{G(ext)}$ = 5 Ω, I_D = 75 A, L= 65.7 µH Timing relative to V_{DS}, Inductive load	Fig. 27
Rise Time	t_r	—	28	—			
Turn-Off Delay Time	$t_{d(off)}$	—	84	—			
Fall Time	t_f	—	27	—			
Internal Gate Resistance	$R_{G(int)}$	—	2.6	—	Ω	f = 1 MHz, V_{AC} = 25 mV	
Gate to Source Charge	Q_{gs}	—	70	—	nC	V_{DS} = 800 V, V_{GS} = -4 V/25 V I_D = 75 A Per IEC60747-8-4 pg 21	Fig. 12
Gate to Drain Charge	Q_{gd}	—	60	—			
Total Gate Charge	Q_g	—	207	—			

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Reverse Diode Characteristics (T_C = 25℃ unless otherwise specified)

Parameter	Symbol	Typ.	Max.	Unit	Test Conditions	Note
Diode Forward Voltage	V_{SD}	4.6	—	V	V_{GS} = -4 V, I_{SD} = 37.5 A, T_J = 25°C	Fig. 8, 9, 10
		4.2	—		V_{GS} = -4 V, I_{SD} = 37.5 A, T_J = 175°C	
Continuous Diode Forward Current	I_S	—	112	A	V_{GS} = -4 V, T_C = 25°C	
Diode Pulse Current	I_{SM}	—	250		V_{GS} = -4 V, pulse width t_P limited by $T_{j\,max}$	
Reverse Recover Time	t_{rr}	96	—	nS	V_{GS} = -4 V, I_{SD} = 75 A, V_R = 800 V di_F/dt = 900, A/µs, T_J = 175°C	
Reverse Recovery Charge	Q_{rr}	604	—	nC		
Peak Reverse Recovery Current	I_{rrm}	15	—	A		
Reverse Recovery time	t_{rr}	58	—	nS	V_{GS} = -5 V, I_{SD} = 75 A, V_R = 800 V di_F/dt = 1400 A/µs, T_J = 175°C	
Reverse Recovery Charge	Q_{rr}	672	—	nC		
Peak Reverse Recovery Current	I_{rrm}	22	—	A		

Thermal Characteristics

Parameter	Symbol	Typ.	Unit	Note
Thermal Resistance from Junction to Case	$R_{\theta JC}$	0.27	°C/W	Fig. 21
Thermal Resistance from Junction to Ambient	$R_{\theta JA}$	40		

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Typical Performance

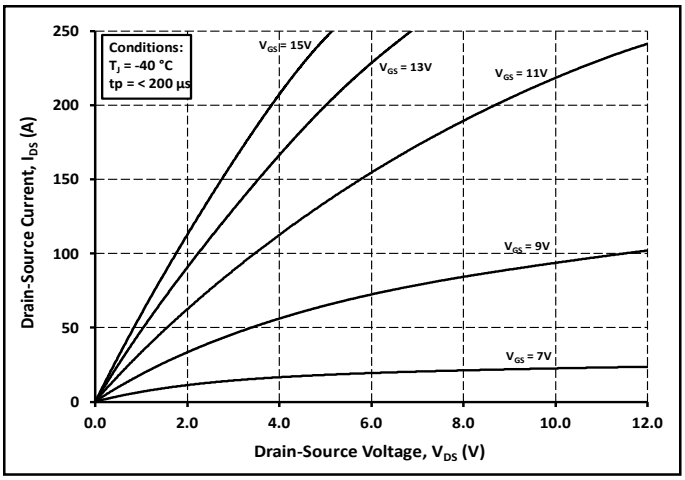

Figure 1. Output Characteristics T_J = -40°C

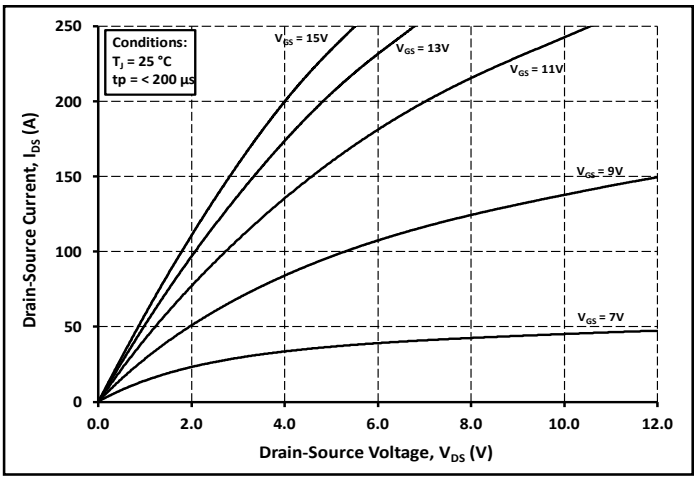

Figure 2. Output Characteristics T_J = 25°C

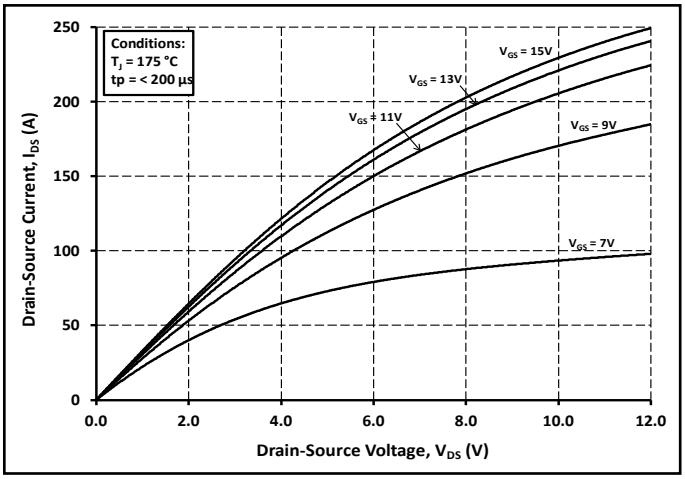

Figure 3. Output Characteristics T_J = 175°C

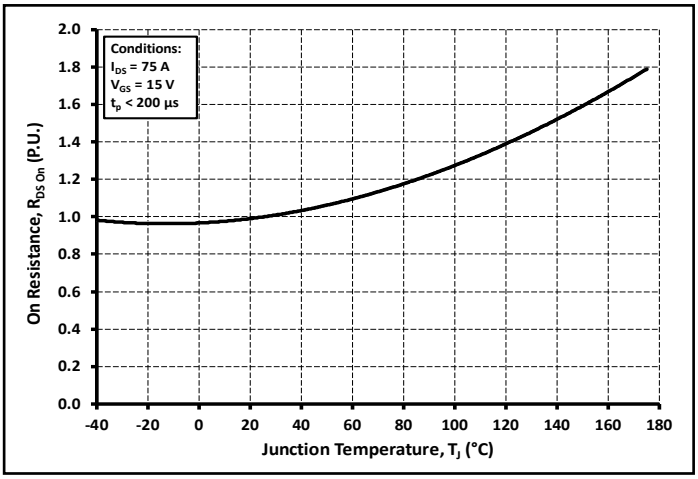

Figure 4. Normalized On-Resistance vs. Temperature

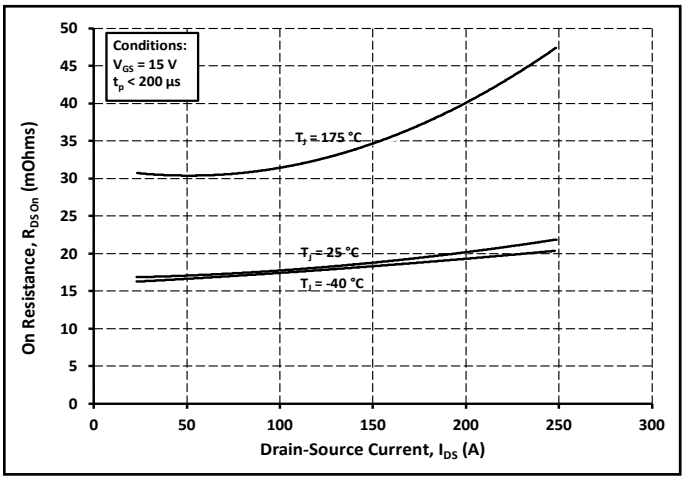

Figure 5. On-Resistance vs. Drain Current For Various Temperatures

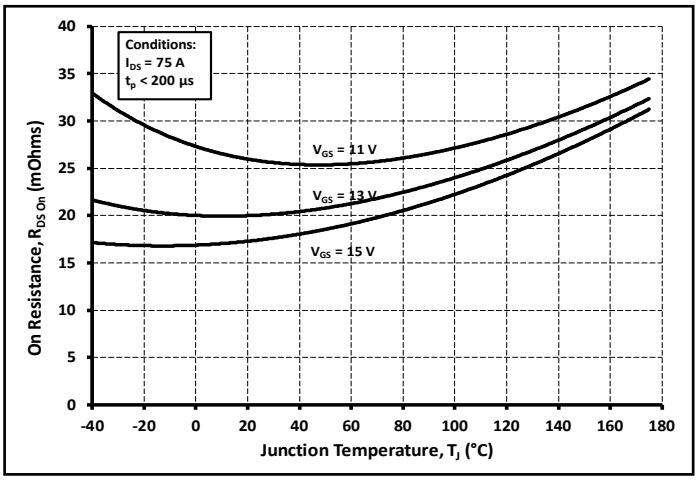

Figure 6. On-Resistance vs. Temperature For Various Gate Voltage

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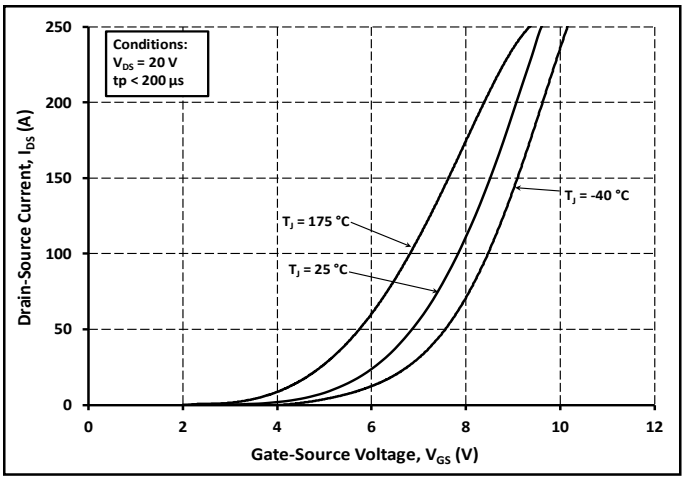

Figure 7. Transfer Characteristic for Various Junction Temperatures

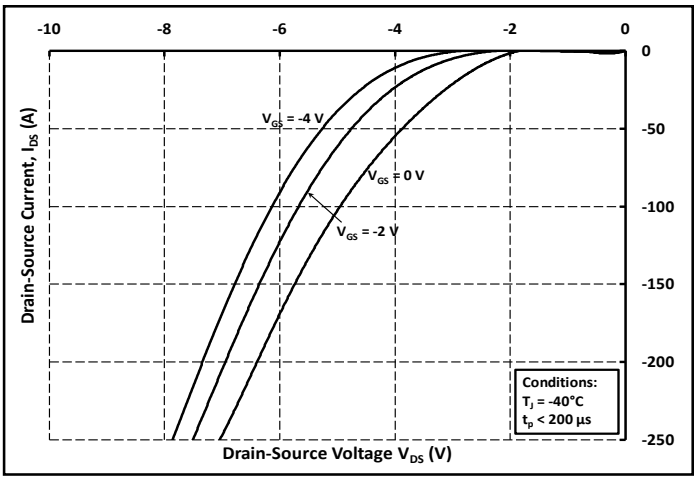

Figure 8. Body Diode Characteristic at -40°C

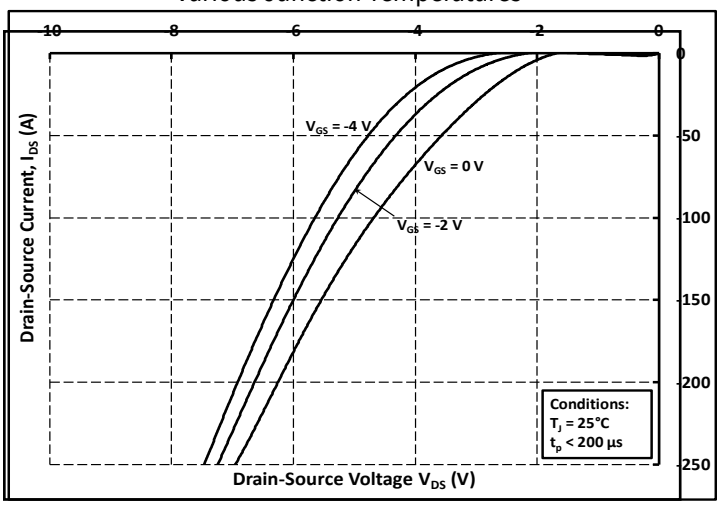

Figure 9. Body Diode Characteristic at 25°C

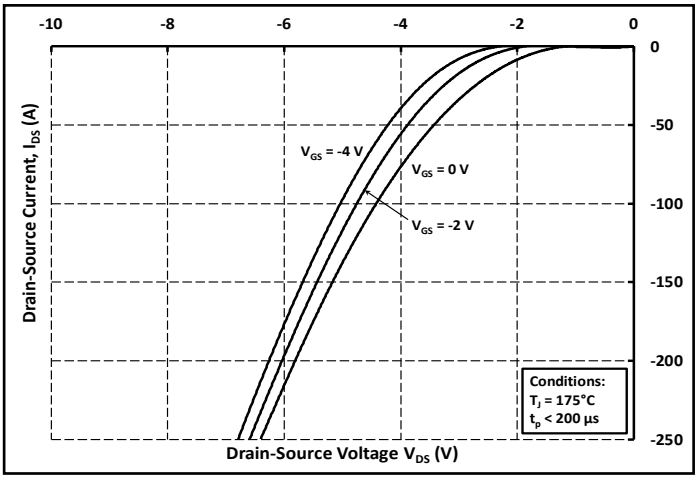

Figure 10. Body Diode Characteristic at 175°C

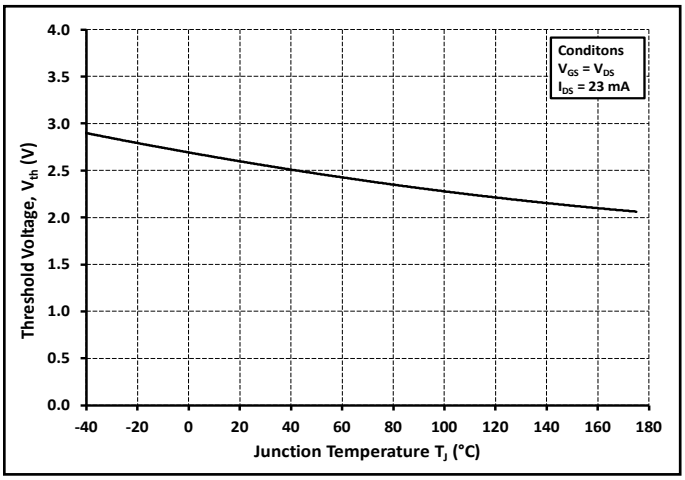

Figure 11. Threshold Voltage vs. Temperature

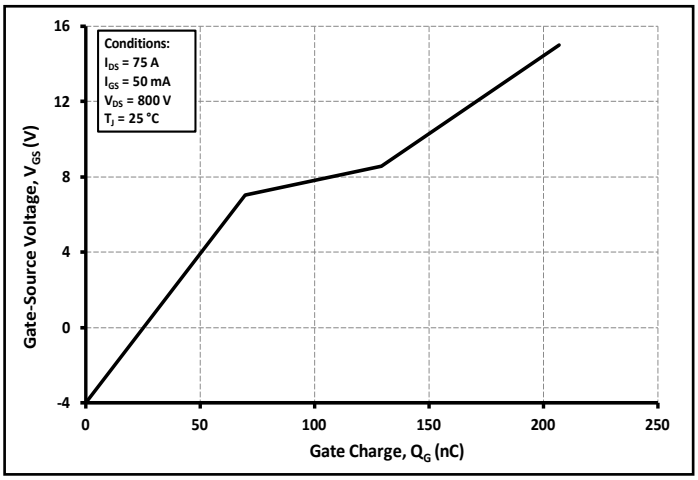

Figure 12. Gate Charge Characteristics

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Typical Performance

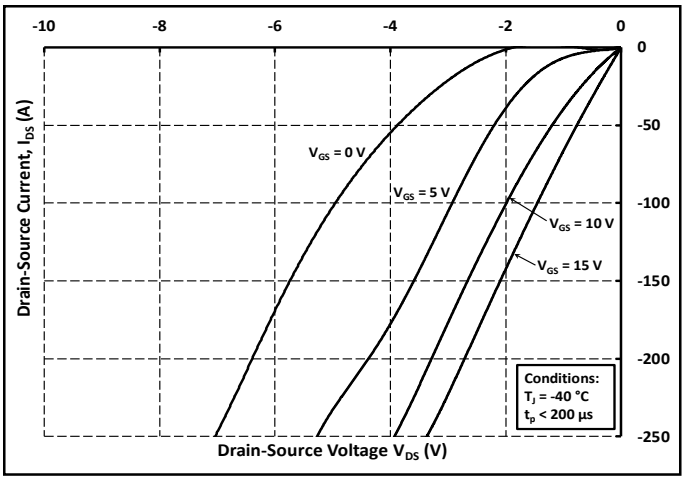

Figure 13. 3rd Quadrant Characteristic at -40°C

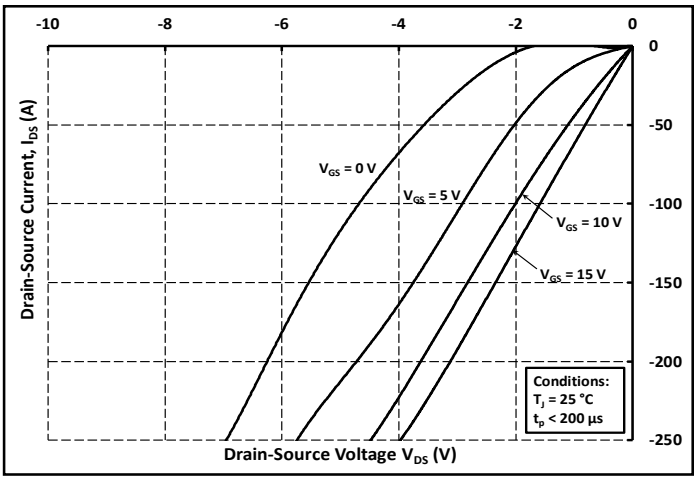

Figure 14. 3rd Quadrant Characteristic at 25°C

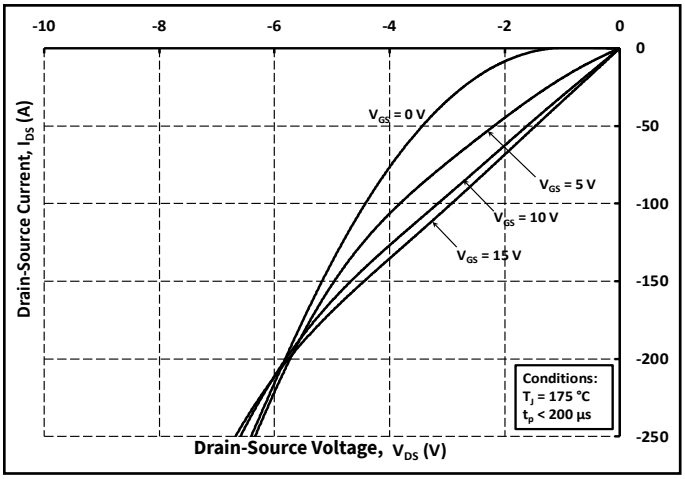

Figure 15. 3rd Quadrant Characteristic at 175°C

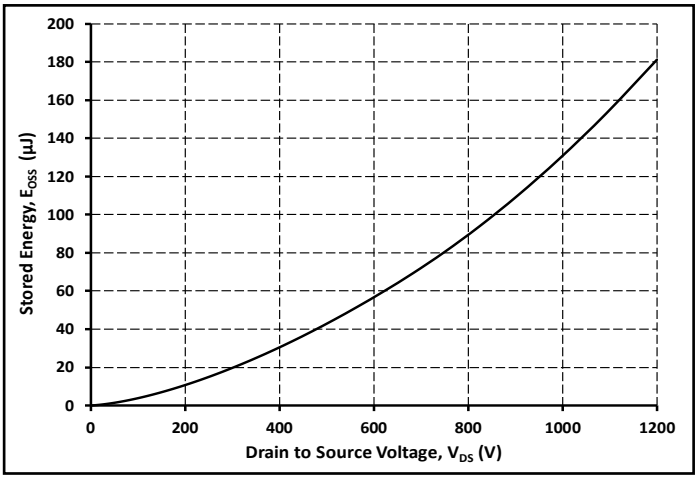

Figure 16. Output Capacitor Stored Energy

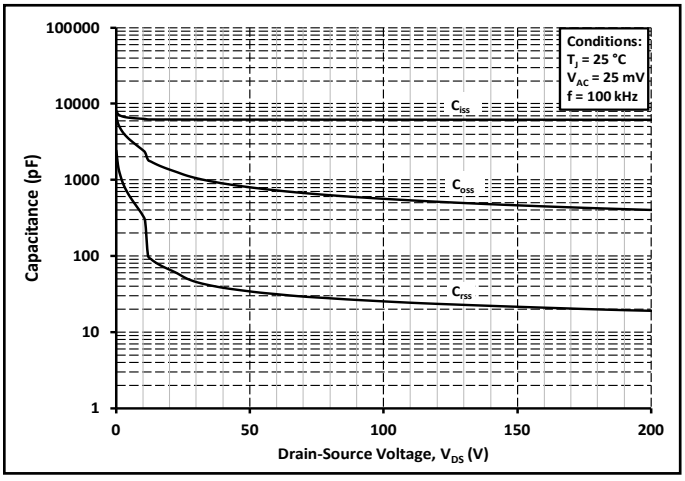

Figure 17. Capacitances vs. Drain-Source Voltage (0 - 200 V)

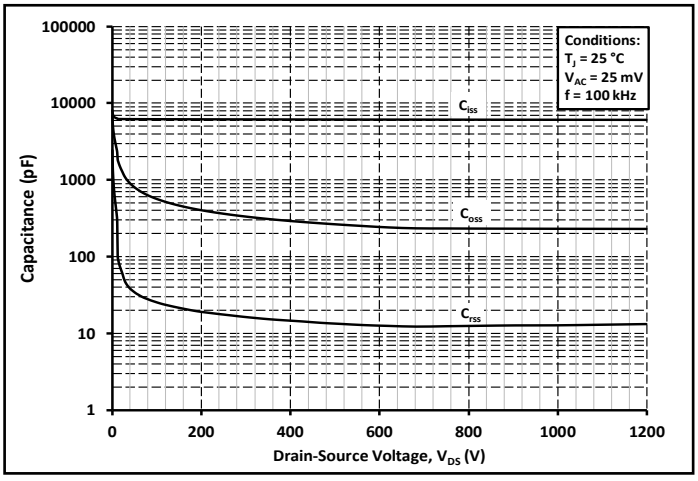

Figure 18. Capacitances vs. Drain-Source Voltage (0 - 1200 V)

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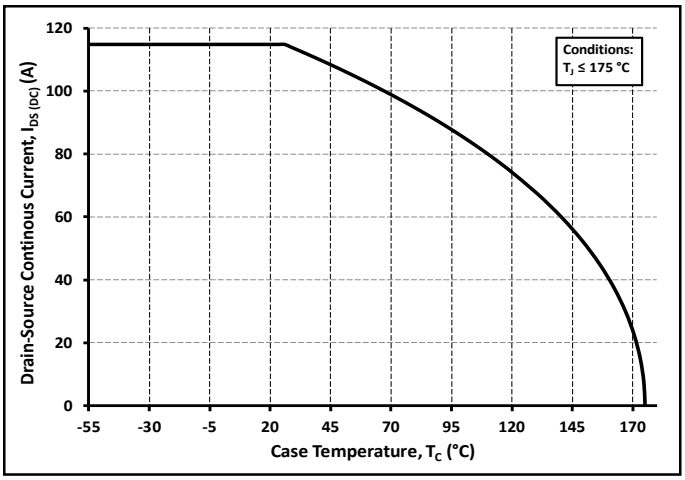

Figure 19. Continuous Drain Current Derating vs. Case Temperature

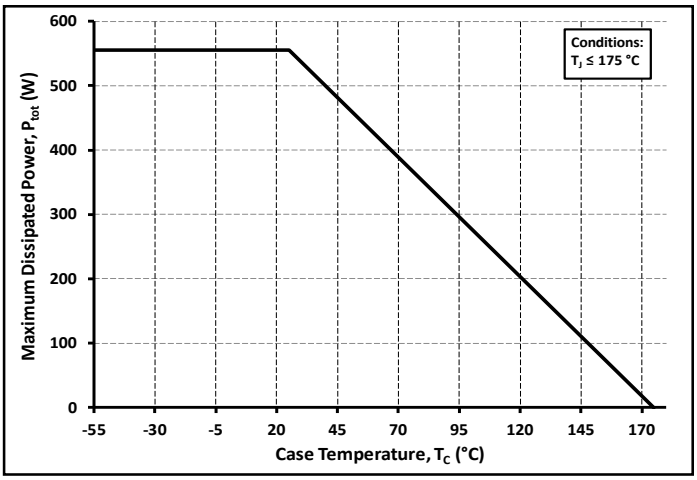

Figure 20. Maximum Power Dissipation Derating vs. Case Temperature

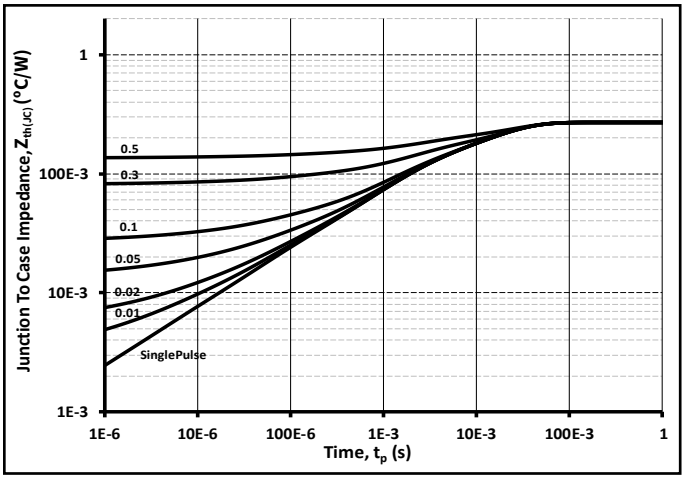

Figure 21. Transient Thermal Impedance (Junction - Case)

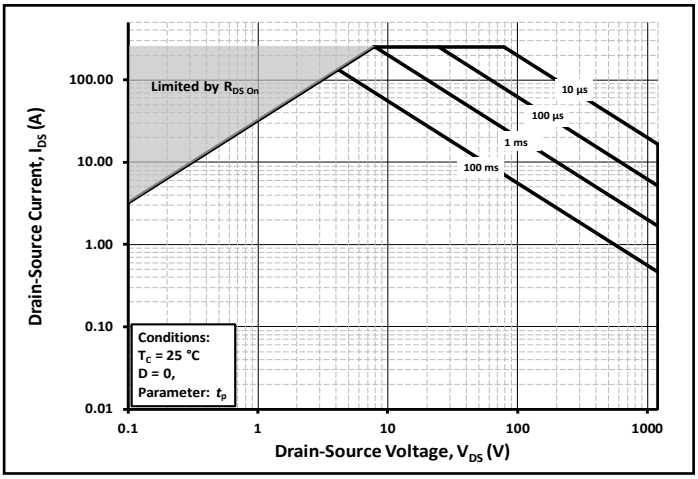

Figure 22. Safe Operating Area

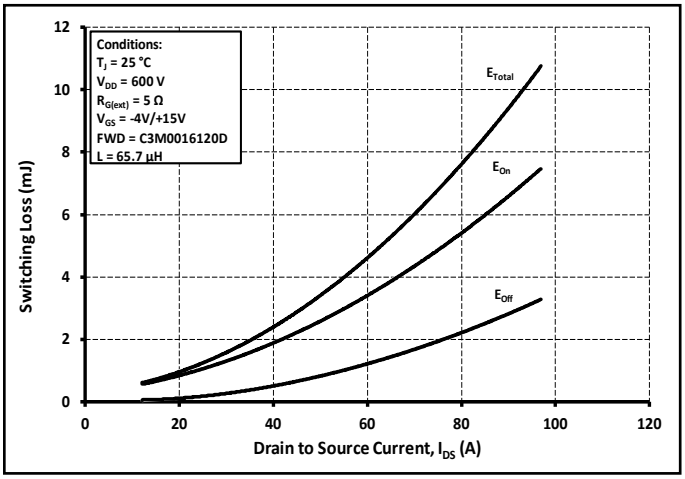

Figure 23. Clamped Inductive Switching Energy vs. Drain Current (V_{DD} = 600 V)

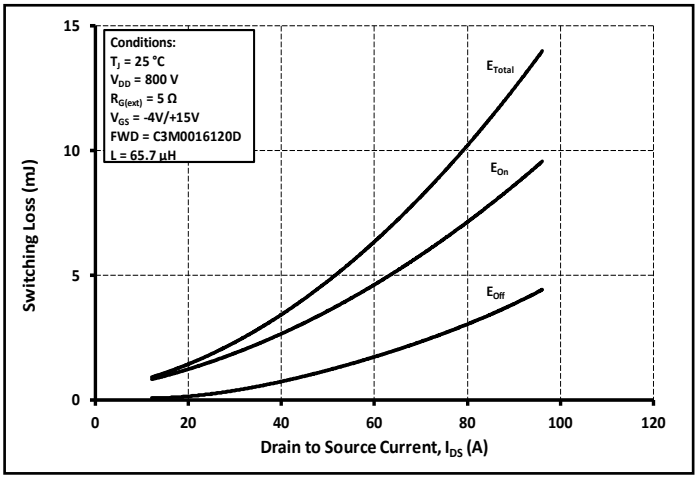

Figure 24. Clamped Inductive Switching Energy vs. Drain Current (V_{DD} = 800 V)

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Typical Performance

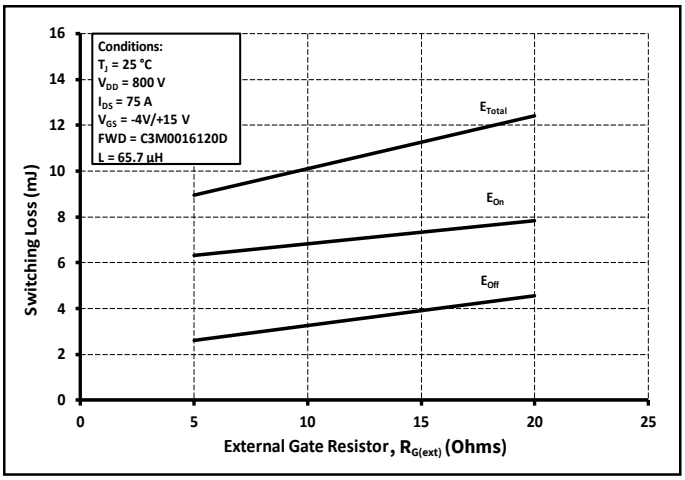

Figure 25. Clamped Inductive Switching Energy vs. $R_{G(ext)}$

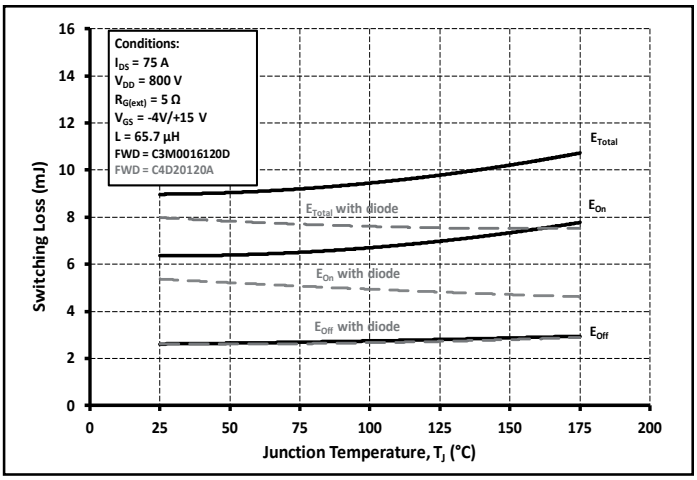

Figure 26. Clamped Inductive Switching Energy vs. Temperature

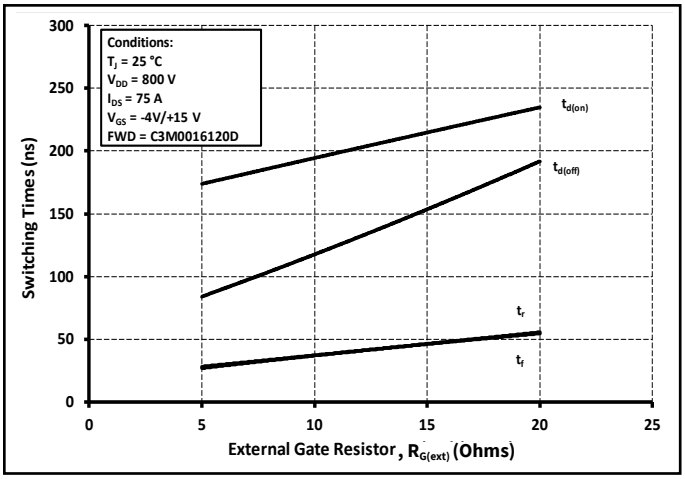

Figure 27. Switching Times vs. $R_{G(ext)}$

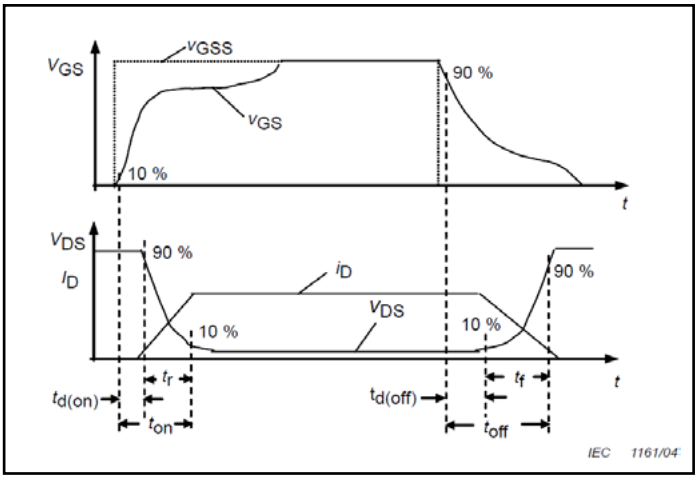

Figure 28. Switching Times Definition

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Test Circuit Schematic

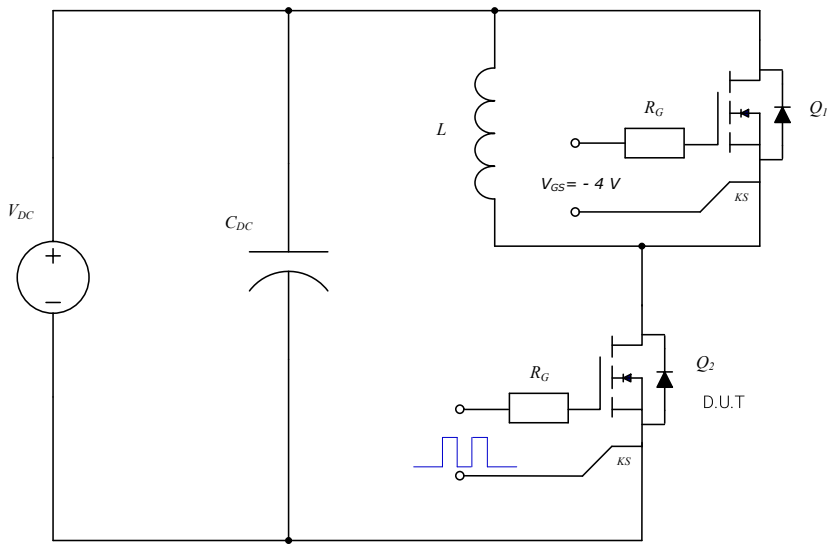

Figure 29. Clamped Inductive Switching Waveform Test Circuit

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

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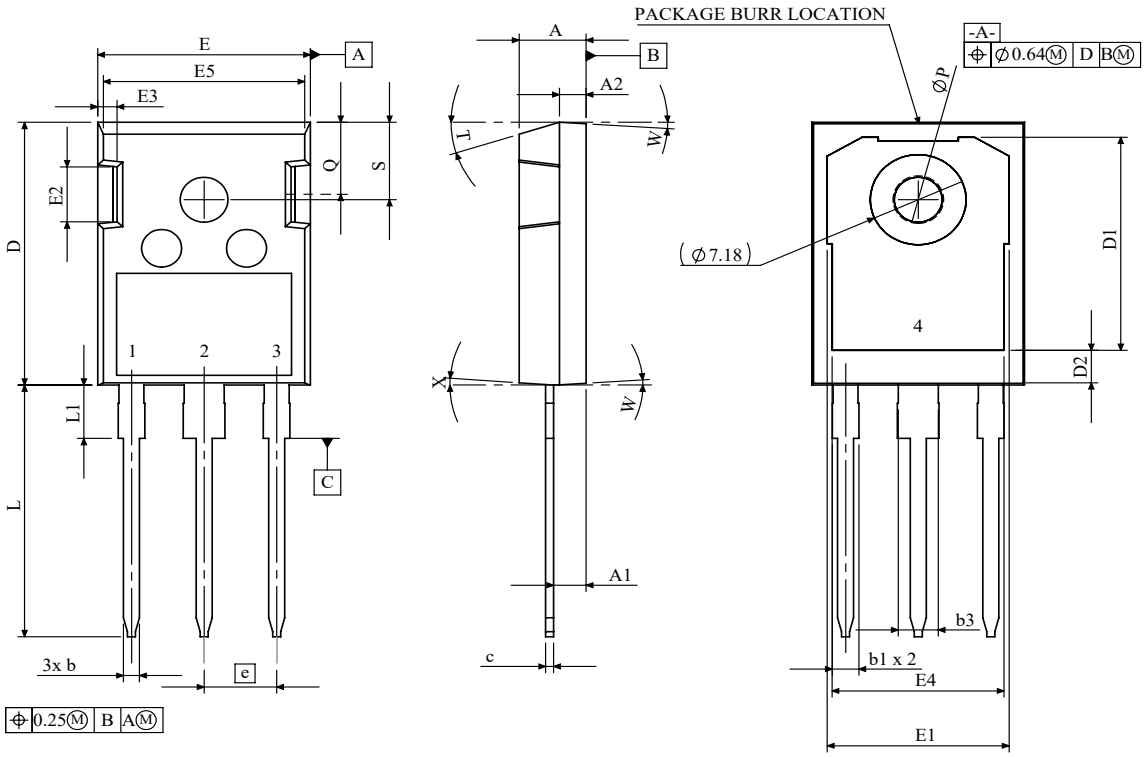
Package Dimensions – Package TO-247-3



SYMBOL	MIN (mm)	MAX (mm)
A	4.83	5.21
A1	2.27	2.52
A2	1.91	2.16
b	1.07	1.33
b1	1.91	2.41
b3	2.87	3.38
c	0.55	0.74
D	20.75	21.05
D1	16	17.4
D2	2.86	3.26
E	15.75	16.13
E1	13.5	14.55
E2	3.68	5.1
E3	1	1.9
E4	12.38	13.43
E5	14.65	15.05
e	5.44 BSC	
L	19.73	20.48
L1	3.97	4.69
ØP	3.18	4.06
Q	5.42	5.96
S	5.85	6.49
T	17.5° REF.	
W	3.5° REF.	
X	4° REF.	

1	GATE
2	DRAIN
3	SOURCE
4	DRAIN

NOTES:
1. ALL METAL SURFACES ARE TIN PLATED (MATTE), EXCEPT AREA OF CUT.
2. DIMENSIONING & TOLERANCING CONFORM TO ASME Y14.5M-1994.
3. ALL DIMENSIONS ARE LISTED IN MILLIMETERS. ANGLES ARE IN DEGREES.
4. BURR OR MOLD FLASH SIZE (0.5 mm) IS NOT INCLUDED IN THE DIMENSIONS

Wolfspeed

TITLE: PACKAGE OUTLINE DRAWING: TO-247-3L(MOSFET)

Date: 3/4/24

REVISION NO. 02

A4

PRD 05964 SCALE:1:1 SHEET 1 OF 1

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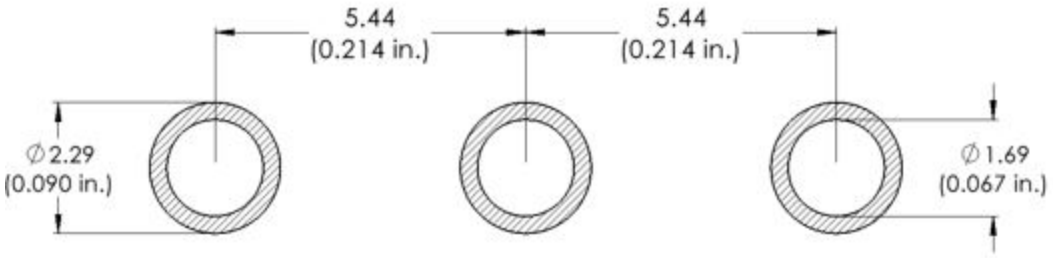
Recommended Solder Pad Layout



Revision History

Current Revision	Date of Release	Description of Changes
-	August-2019	N/A
1	January-2024	Updated Wolfspeed branding, package drawing, package image, and solder pad layout, added Revision History Table, Table 1 layout revised
2	September - 2024	Legal Disclaimer, POD, Diode Pulse Current Symbol

Related Links

- SPICE Models
- SiC MOSFET Isolated Gate Driver reference design
- SiC MOSFET Evaluation Board

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Contact info:

4600 Silicon Drive
Durham, NC 27703 USA
Tel: +1.919.313.5300
www.wolfspeed.com/power

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