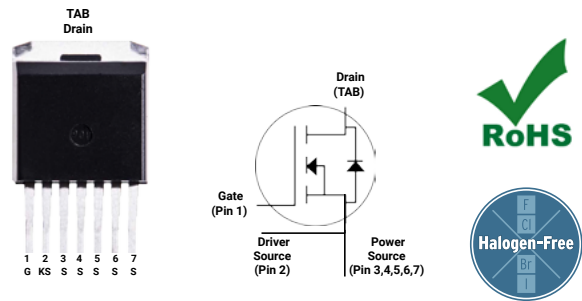# C3M0120090J

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

Features

- New C3M SiC MOSFET technology
- High blocking voltage with low On-resistance
- High speed switching with low capacitances
- New low impedance package with driver source
- Fast intrinsic diode with low reverse recovery (Q_{rr})
- Halogen free, RoHS compliant
- Wide creepage (~7mm) between drain and source

Part Number	Package
C3M0120090J	TO-263-7

Wolfspeed, Inc. is in the process of rebranding its products and related materials pursuant to the entity name change from Cree, Inc. to Wolfspeed, Inc. During this transition period, products received may be marked with either the Cree name and/or logo or the Wolfspeed name and/or logo.

Applications

- Renewable energy
- Lighting
- High voltage DC/DC converters
- Telecom Power Supplies
- Induction Heating

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}			900	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			22	A	$V_{GS} = 15\ V, T_C = 25\ °C, T_J \leq 150\ °C$	Fig. 19 Note 2
				14		$V_{GS} = 15\ V, T_C = 100\ °C, T_J \leq 150\ °C$	
Pulsed Drain Current	I_{DM}			50		t_{Pmax} limited by T_{jmax} $V_{GS} = 15V, T_C = 25\ °C$	Fig. 22
Power Dissipation	P_D			83	W	$T_C = 25\ °C, T_J = 150\ °C$	Fig. 20
Operating Junction and Storage Temperature	T_J, T_{stg}			-55 to +150	°C		
Solder Temperature	T_L			260		According to JEDEC J-STD-020	

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$_{(BR)DSS}$	900	—	—	V	V$_{GS}$ = 0 V, I$_D$ = 100 µA	
Gate Threshold Voltage	V$_{GS(th)}$	1.8	2.1	3.5	V	V$_{DS}$ = V$_{GS}$, I$_D$ = 3 mA	Fig. 11
		—	1.6	—		V$_{DS}$ = V$_{GS,}$ I$_D$ = 3 mA, T$_J$ = 150℃	
Zero Gate Voltage Drain Current	I$_{DSS}$	—	1	100	µA	V$_{DS}$ = 900 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$_{DS(on)}$	—	120	155	mΩ	V$_{GS}$ = 15 V, I$_D$ = 15 A	Fig. 4, 5, 6
		—	170	—		V$_{GS}$ = 15 V, I$_D$ = 15 A, T$_J$ = 150℃	
Transconductance	g$_{fs}$	—	8.9		S	V$_{DS}$ = 15 V, I$_{DS}$ = 15 A	Fig. 7
			7.1	—		V$_{DS}$ = 15 V, I$_{DS}$ = 15 A, T$_J$ = 150℃	
Input Capacitance	C$_{iss}$	—	414	—	pF	V$_{GS}$ = 0 V, V$_{DS}$ = 600 V f = 1 Mhz V$_{AC}$ = 25 mV	Fig. 17, 18
Output Capacitance	C$_{oss}$	—	48	—			
Reverse Transfer Capacitance	C$_{rss}$	—	3	—			
C$_{oss}$ Stored Energy	E$_{oss}$	—	10.6	—	µJ		Fig. 16
Turn-On Switching Energy	E$_{on}$	—	32	—		V$_{DS}$ = 400 V, V$_{GS}$ = -4 V/15 V, I$_D$ = 15 A, R$_{G(ext)}$ = 2.5 Ω, L= 99 µH, T$_J$ = 150℃	Fig. 26, 29
Turn Off Switching Energy	E$_{off}$	—	8	—			
Turn-On Delay Time	t$_{d(on)}$	—	5	—	ns	V$_{DD}$ = 400 V, V$_{GS}$ = -4 V/15 V I$_D$ = 15 A, R$_{G(ext)}$ = 2.5 Ω, Timing relative to V$_{DS}$ Inductive load	Fig. 27, 29
Rise Time	t$_r$	—	8	—			
Turn-Off Delay Time	t$_{d(off)}$	—	13	—			
Fall Time	t$_f$	—	4	—			
Internal Gate Resistance	R$_{G(int)}$	—	13	—	Ω	f = 1 MHz, V$_{AC}$ = 25 mV	
Gate to Source Charge	Q$_{gs}$	—	6	—	nC	V$_{DS}$ = 400 V, V$_{GS}$ = -4 V/15 V I$_D$ = 15 A Per IEC60747-8-4 pg 21	Fig. 12
Gate to Drain Charge	Q$_{gd}$	—	5	—			
Total Gate Charge	Q$_g$	—	18	—			

Reverse Diode Characteristics (T$_C$ = 25℃ unless otherwise specified)

Parameter	Symbol	Typ.	Max.	Unit	Test Conditions	Note
Diode Forward Voltage	V$_{SD}$	4.8	—	V	V$_{GS}$ = -4 V, I$_{SD}$ = 7.5 A	Fig. 8, 9, 10
		4.4	—		V$_{GS}$ = -4 V, I$_{SD}$ = 7.5 A, T$_J$ = 150℃	
Continuous Diode Forward Current	I$_S$	—	15	A	V$_{GS}$ = -4 V	
Diode Pulse Current	I$_{S, pulsed}$	—	50		V$_{GS}$ = -4 V, pulse width t$_P$ limited by T$_{j max}$	
Reverse Recover Time	t$_{rr}$	10	—	nS	V$_{GS}$ = -4 V, I$_{SD}$ = 15 A, V$_R$ = 400 V dif/dt = 900 A/µs, T$_J$ = 150℃	
Reverse Recovery Charge	Q$_{rr}$	72	—	nC		
Peak Reverse Recovery Current	I$_{rrm}$	23	—	A		

Thermal Characteristics

Parameter	Symbol	Max	Unit	Note
Thermal Resistance from Junction to Case	R$_{θJC}$	1.5	℃/W	Fig. 21
Thermal Resistance From Junction to Ambient	R$_{θJA}$	40		

Typical Performance

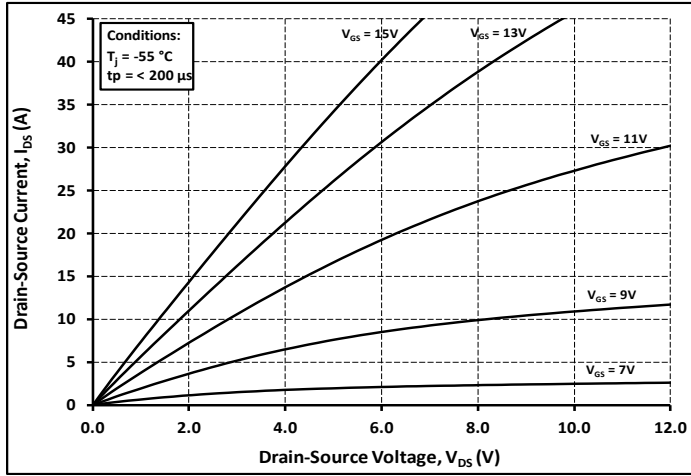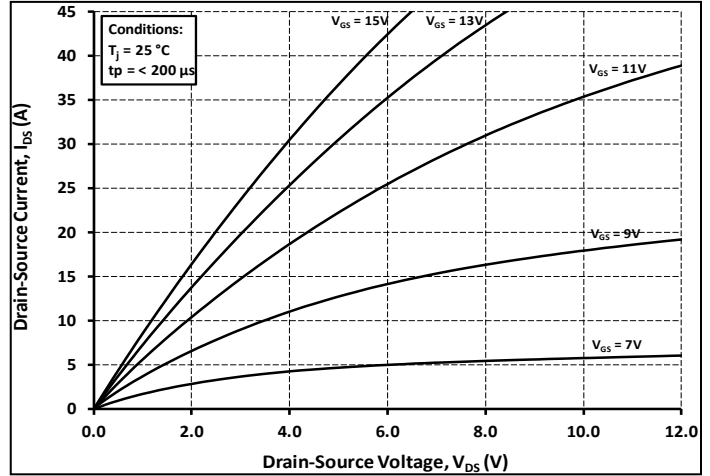**Figure 1.** Output Characteristics T_J = -55°C

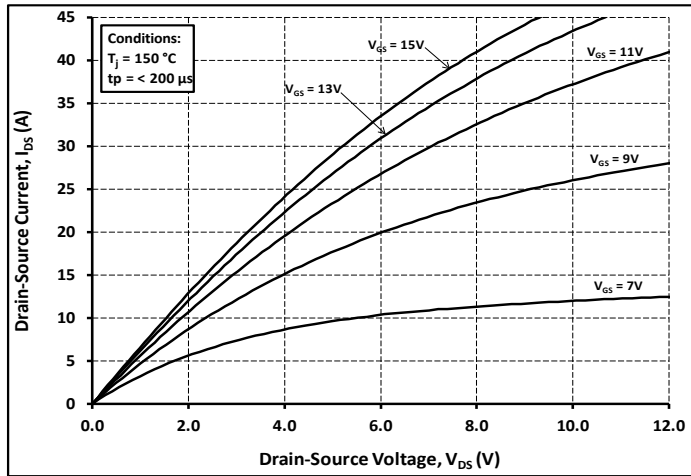**Figure 2.** Output Characteristics T_J = 25°C

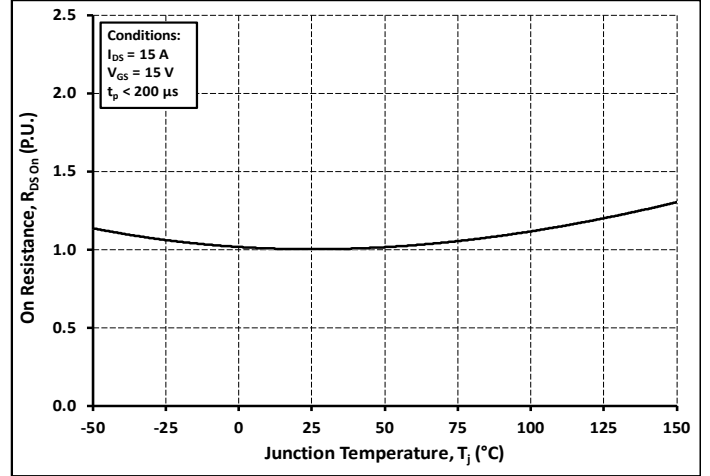**Figure 3.** Output Characteristics T_J = 150°C

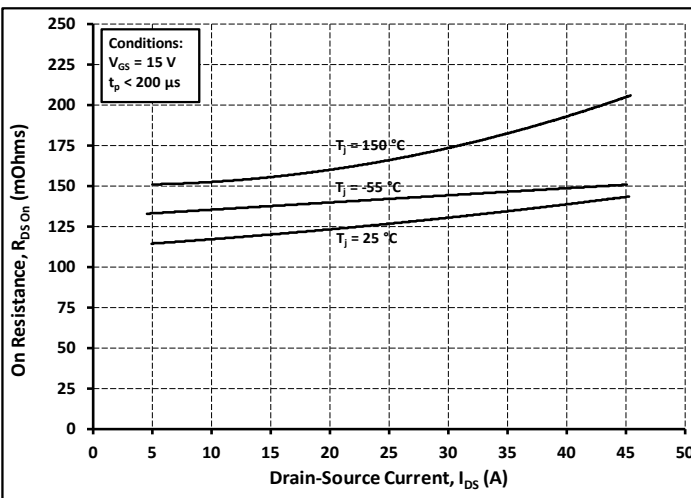**Figure 4.** Normalized On-Resistance vs. Temperature

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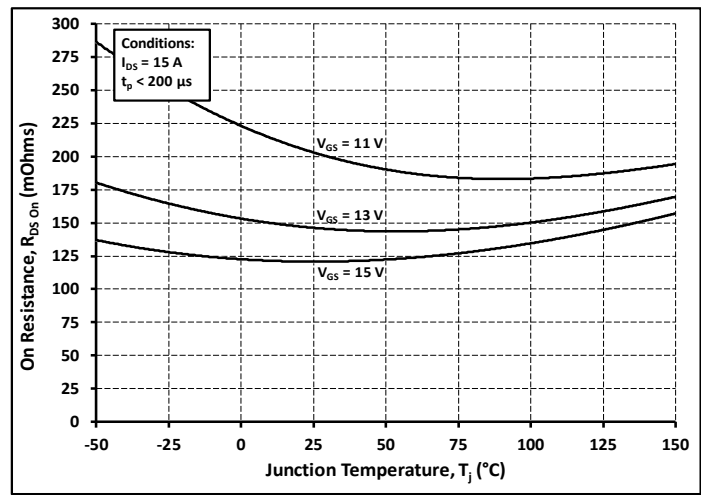For Various Temperatures

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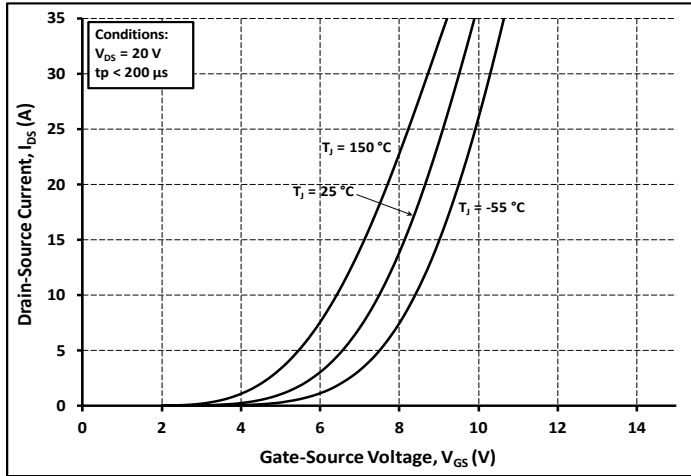For Various Gate Voltage

Typical Performance

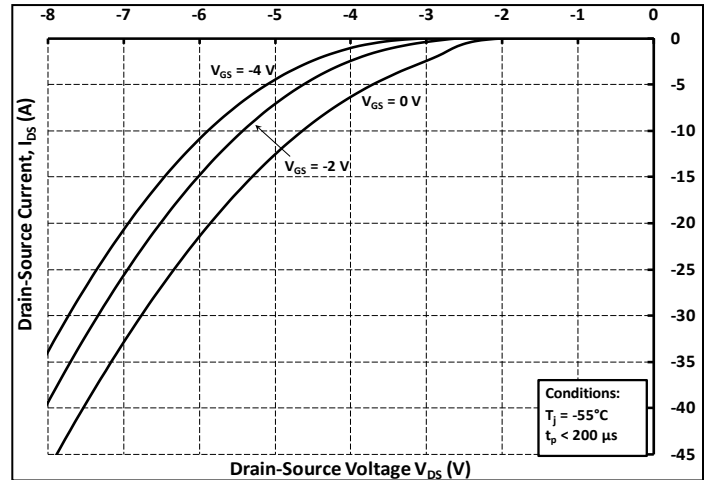**Figure 7.** Transfer Characteristic for Various Junction Temperatures

Figure 8. Body Diode Characteristic at -55°C
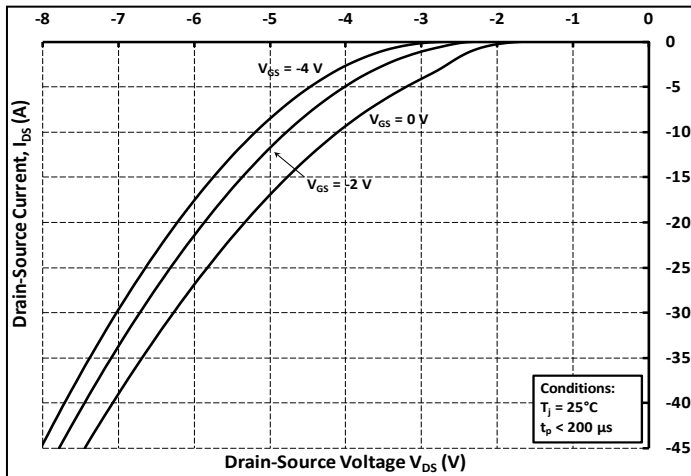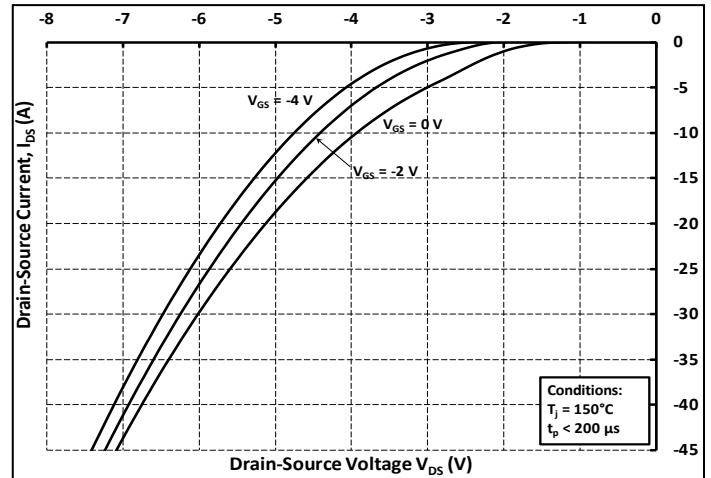

Figure 9. Body Diode Characteristic at 25°C

Figure 10. Body Diode Characteristic at 150°C
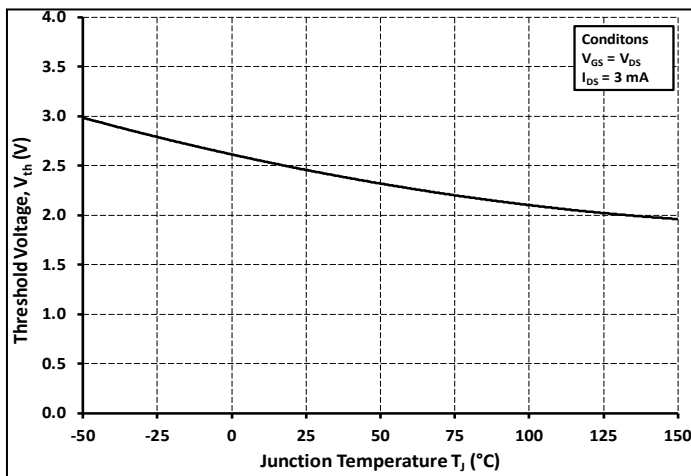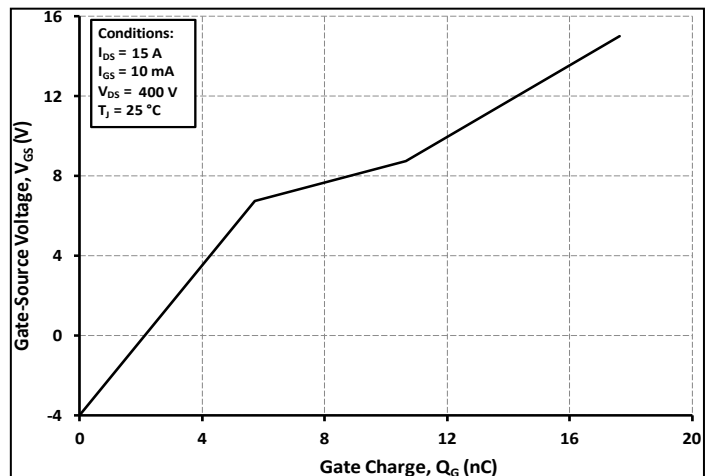

Figure 11. Threshold Voltage vs. Temperature

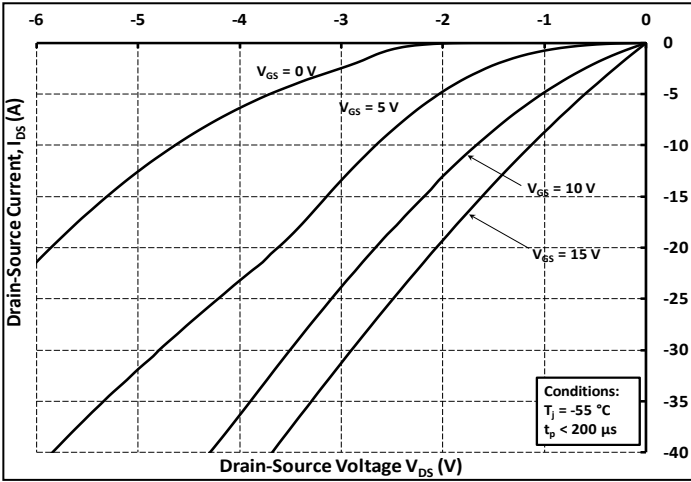**Figure 12.** Gate Charge Characteristics

Typical Performance
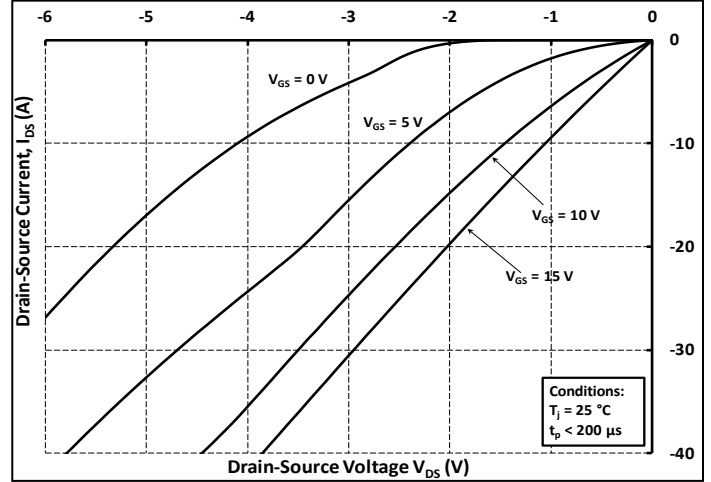

Figure 13. 3rd Quadrant Characteristic at -55°C
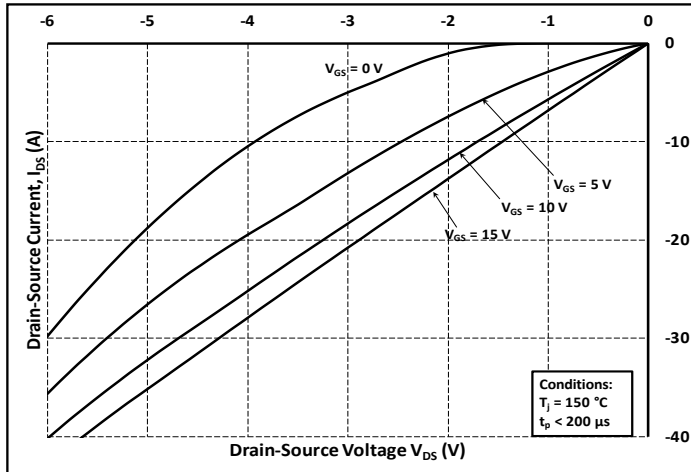

Figure 14. 3rd Quadrant Characteristic at 25°C

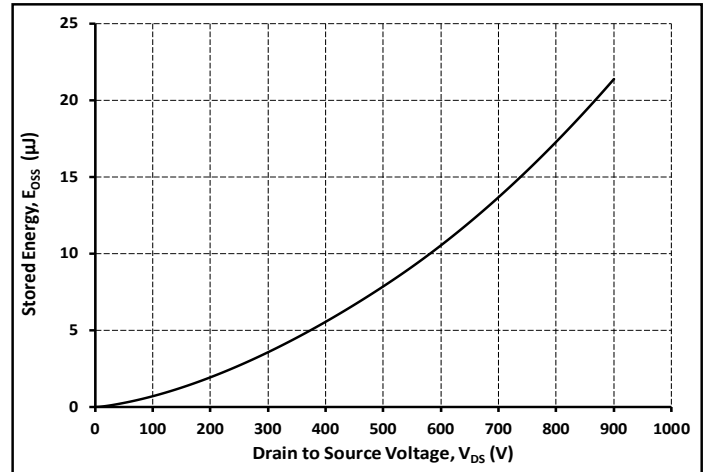**Figure 15.** 3rd Quadrant Characteristic at 150°C

Figure 16. Output Capacitor Stored Energy
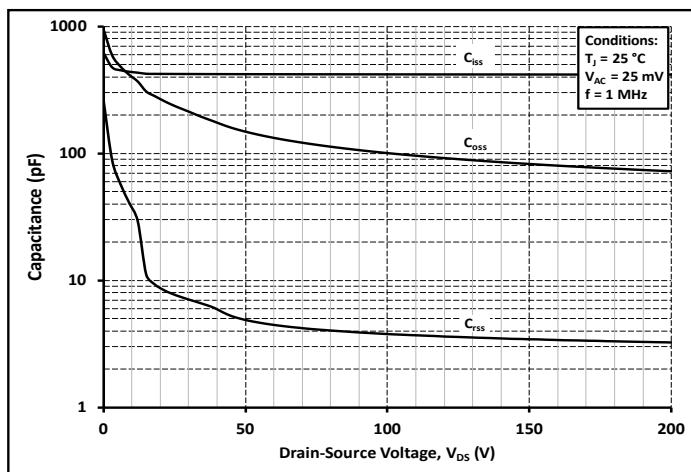

Figure 17. Capacitances vs. Drain-Source
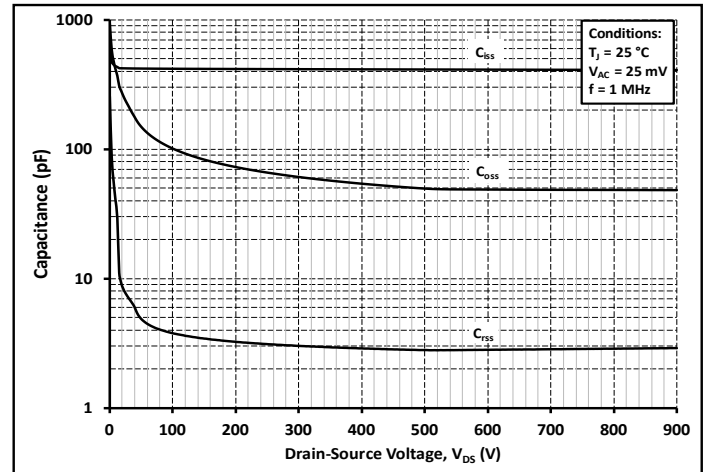Voltage (0 - 200 V)

Figure 18. Capacitances vs. Drain-Source
Voltage (0 - 900 V)

Typical Performance

Figure 19. Continuous Drain Current Derating vs.
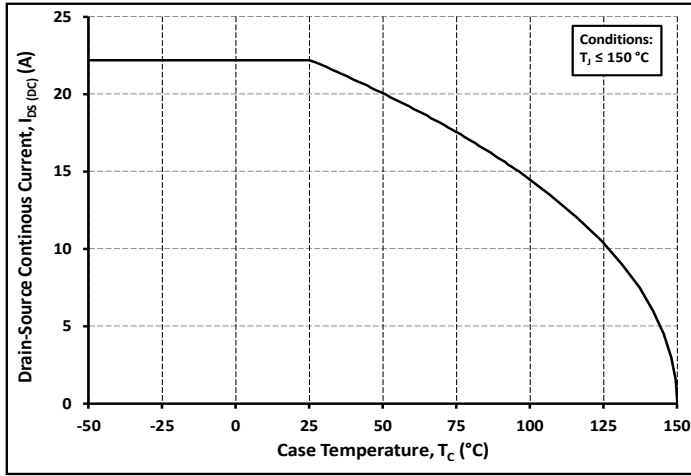Case Temperature

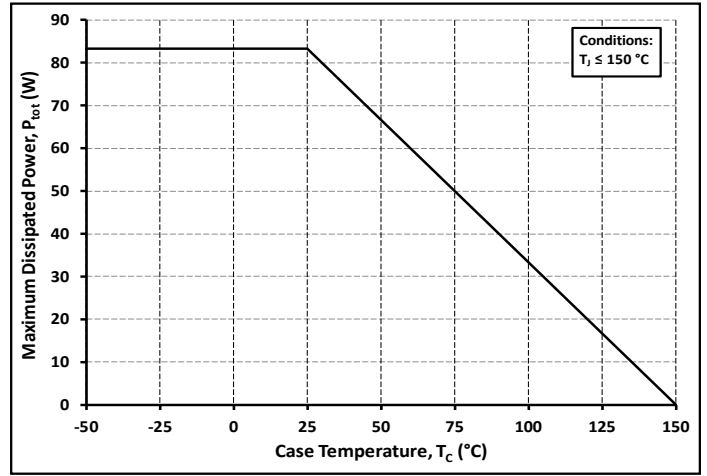**Figure 20.** Maximum Power Dissipation Derating vs.
Case Temperature
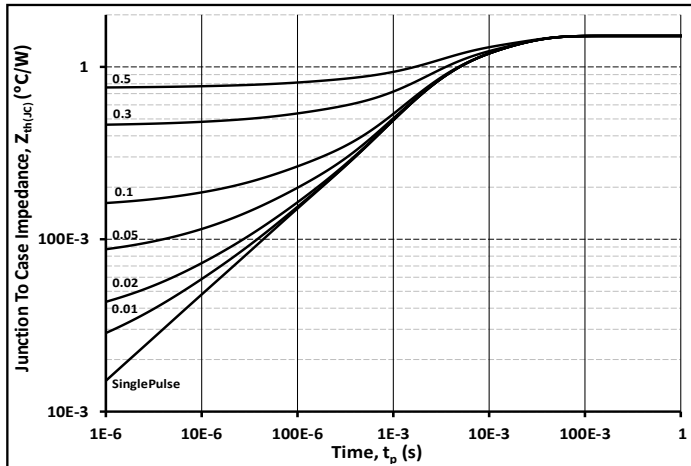
Figure 21. Transient Thermal Impedance
(Junction - Case)
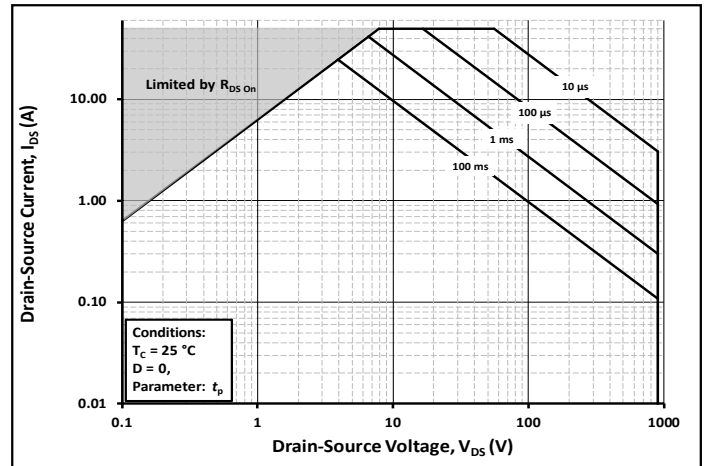
Figure 22. Safe Operating Area
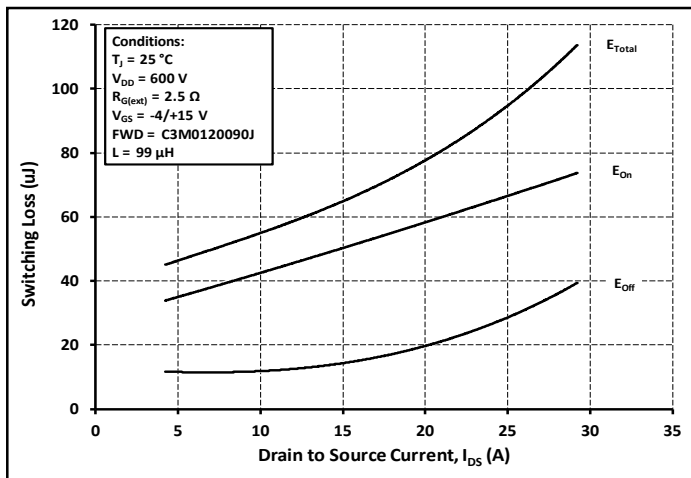
Figure 23. Clamped Inductive Switching Energy vs.
Drain Current (V_{DD} = 600 V)
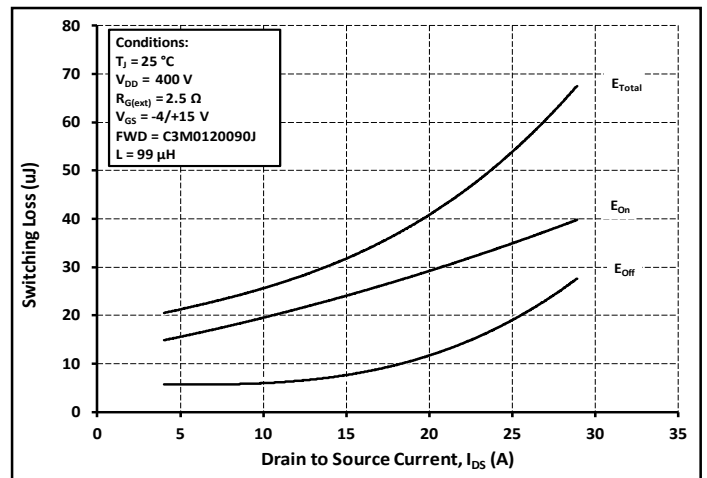
Figure 24. Clamped Inductive Switching Energy vs.
Drain Current (V_{DD} = 400 V)

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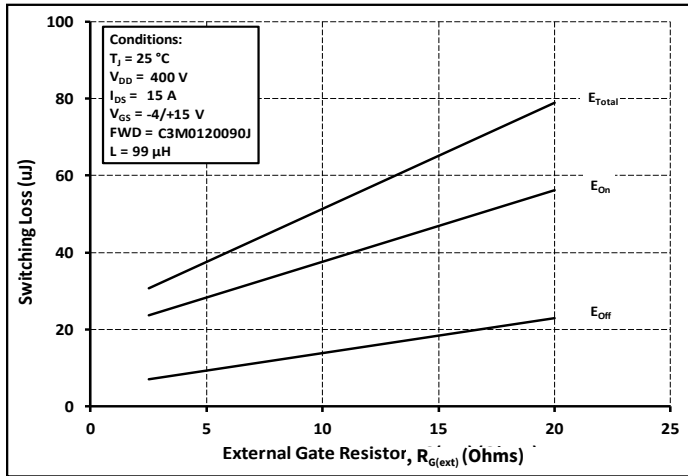
Figure 25. Clamped Inductive Switching Energy vs. $R_{G(ext)}$

Figure 26. Clamped Inductive Switching Energy vs. Temperature

Figure 27. Switching Times vs. $R_{G(ext)}$
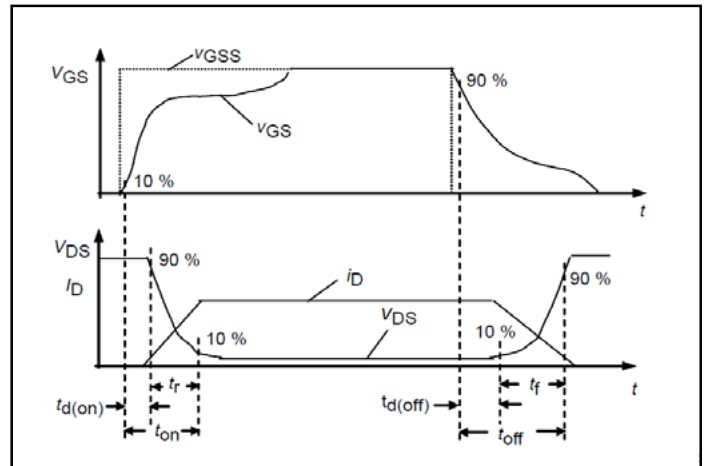
Figure 28. Switching Times Definition

Test Circuit Schematic
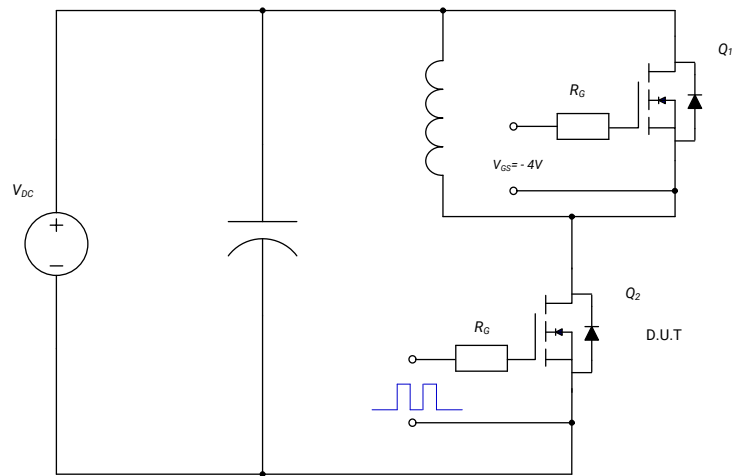
Figure 29. Clamped Inductive Switching Test Circuit

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

Package Dimensions – Package TO-263-7

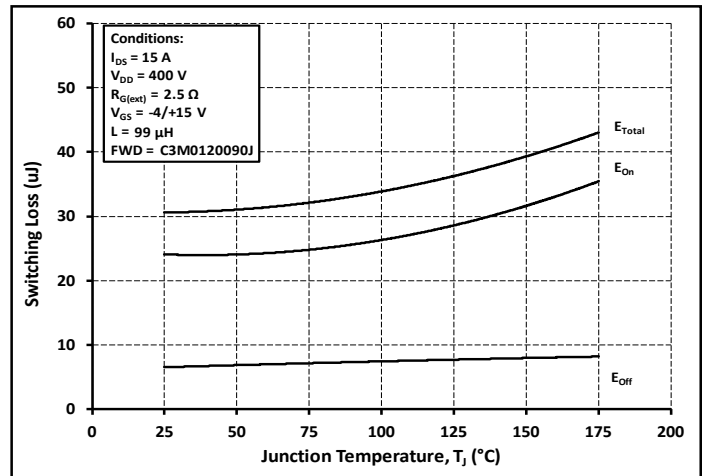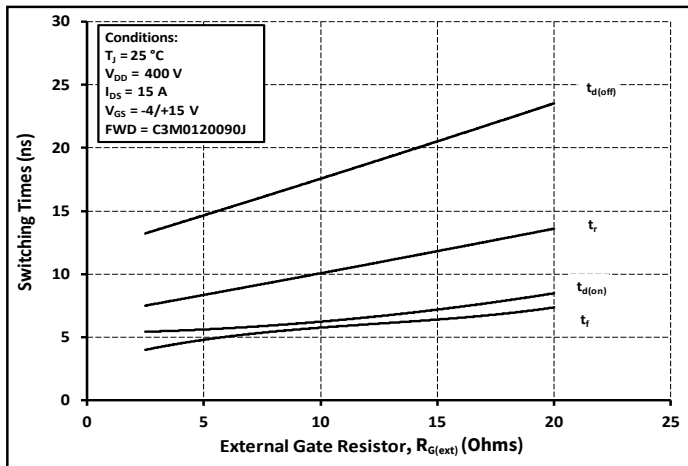| SYMBOL	MIN (mm)	MAX (mm)
A	4.30	4.57
A1	0.00	0.25
b	0.50	0.70
b2	0.60	1.00
c	0.33	0.65
C2	1.17	1.40
D	9.025	9.125
D1	4.70	4.90
D2	7.170 REF	
D3	4.000 REF	
D4	7.000 REF	
A2	2.595 REF	
E	10.13	10.23
E1	6.50	8.60
E2	6.778	7.665
e	1.27 TYP	
H	15.043	17.313
L	2.324	2.700
L1	0.968	1.868
R	0.506 REF	
R1	0.500 REF	
θ	0°	8°
θ1	4.5°	5.5°
θ2	4°	6°
θ3	4°	6°

1	GATE
2	KELVIN
3	
4	
5	SOURCE
6	
7	
8	DRAIN

NOTE
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. PACKAGE BURR FLASH SIZE (0.5 mm) IS NOT INCLUDED IN THE DIMENSIONS

Wolfspeed.

TITLE:
PACKAGE OUTLINE DRAWING:
TO 263-7L J

REVISION NO. 01

A4

Date: 04/13/22

SCALE:1:1

SHEET 1 OF 1

Recommended Solder Pad Layout
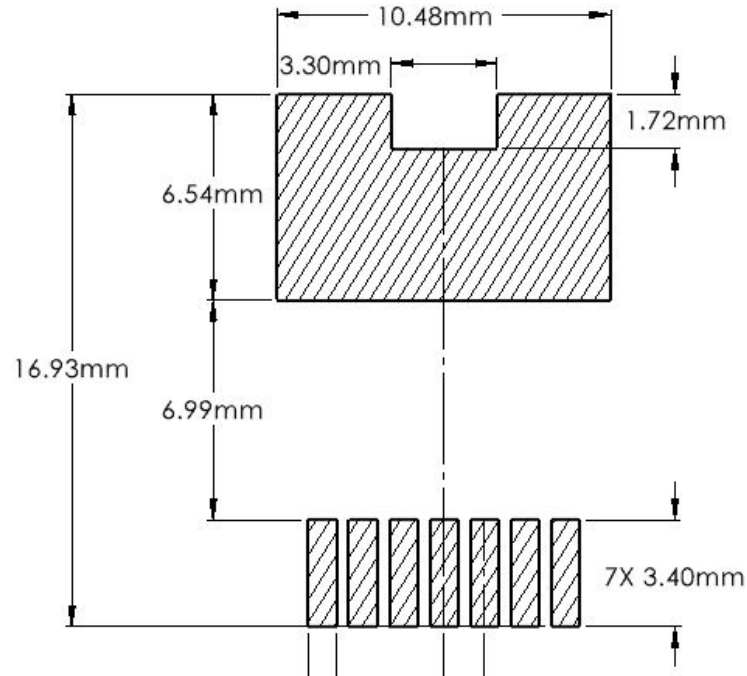
Revision History

Current Revision	Date of Release	Description of Changes
2	October-2020	N/A
3	January-2024	Updated Wolfspeed branding, package drawing, package image, solder pad layout, added Rev history, Table 1 layout revised

Related Links

- [SiC MOSFET Isolated Gate Driver reference design](#)
- [SiC MOSFET Evaluation Board](#)

Notes & Disclaimer

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The Silicon Carbide MOSFET module switches at speeds beyond what is customarily associated with IGBT-based modules. Therefore, special precautions are required to realize optimal performance. The interconnection between the gate driver and module housing needs to be as short as possible. This will afford optimal switching time and avoid the potential for device oscillation. Also, great care is required to insure minimum inductance between the module and DC link capacitors to avoid excessive VDS overshoot.

RoHS Compliance

The levels of RoHS restricted materials in this product are below the maximum concentration values (also referred to as the threshold limits) permitted for such substances, or are used in an exempted application, in accordance with EU Directive 2011/65/EC (RoHS2), as implemented January 2, 2013. RoHS Declarations for this product can be obtained from your Wolfspeed representative or from the Product Documentation sections of www.wolfspeed.com.

REACh Compliance

REACh substances of high concern (SVHCs) information is available for this product. Since the European Chemical Agency (ECHA) has published notice of their intent to frequently revise the SVHC listing for the foreseeable future, please contact your Wolfspeed representative to ensure you get the most up-to-date REACh SVHC Declaration. REACh banned substance information (REACh Article 67) is also available upon request.

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