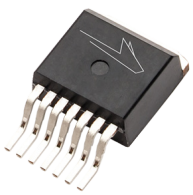
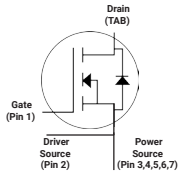
E3M0120090J

Silicon Carbide Power MOSFET
E-Series Automotive
N-Channel Enhancement Mode



TO-263-7



Package Types: TO-263-7
PN's: E3M0120090J

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.

Features

- 3rd generation of 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
- Wide creepage (~7 mm) between drain and source
- Automotive qualified (AEC-Q101) and PPAP capable

Applications

- EV charging
- DC/DC converters
- SMPS
- UPS
- Solar PV inverters

Benefits

- Reduce switching losses and minimize gate ringing
- High system efficiency
- Increased power density
- Increased system switching frequency

Maximum Ratings (T_C = 25 °C Unless Otherwise Specified)

Parameter	Symbol	Value	Unit	Test Conditions	Note
Drain-Source Voltage	V_{DSmax}	900	V	V_{GS} = 0 V, I_D = 100 µA	
Gate-Source Voltage	V_{GSmax}	-8/+19		Absolute Maximum Values	
Gate-Source Voltage	V_{GSop}	-4/+15		Recommended Operational Values	Note: 1
Continuous Drain Current	I_D	22	A	V_{GS} = 15 V, T_C = 25 °C	Fig. 19
		14		V_{GS} = 15 V, T_C = 100 °C	
Pulsed Drain Current	$I_{D\ (pulse)}$	50		Pulse Width t_P Limited by T_{jmax}	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): MOSFET can also safely operate at 0/+15 V.

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Electrical Characteristics (T_C = 25 °C Unless Otherwise Specified)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test Conditions	Note
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 °C	
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 °C	
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 °C	
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 (External Diode)	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 °C	Fig. 26, 29
Turn- Off Switching Energy (External Diode)	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 °C 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 °C	
Continuous Diode Forward Current	I_S		15	A	V_{GS} = -4 V	
Diode Pulse Current	$I_{S,\ pulse}$		50		V_{GS} = -4 V, Pulse Width t_P Limited by T_{jmax}	
Reverse Recovery 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 °C	
Reverse Recovery Charge	Q_{rr}	72		nC		
Peak Reverse Recovery Current	I_{rrm}	12		A		

Note (2): When using SiC body diode the maximum recommended V_{GS} = -4 V

Thermal Characteristics

Parameter	Symbol	Max.	Unit	Test Conditions	Note
Thermal Resistance from Junction to Case	$R_{\theta JC}$	1.5	°C/W		Fig. 21
Thermal Resistance From Junction to Ambient	$R_{\theta JA}$	40			

Typical Performance

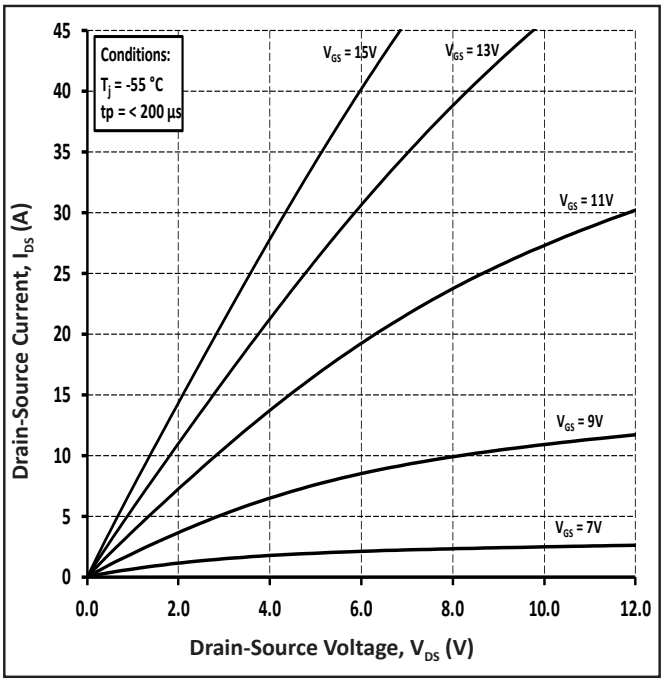


Figure 1. Output Characteristics T_J = -55 °C

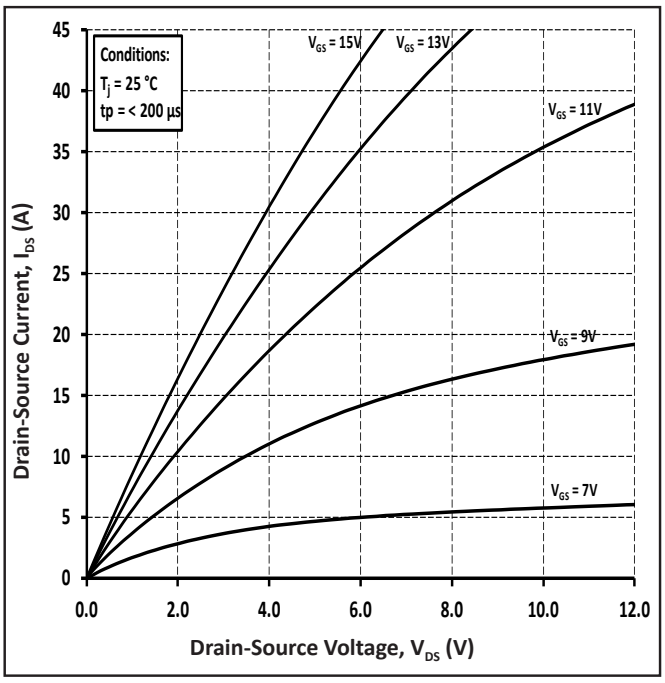


Figure 2. Output Characteristics T_J = 25 °C

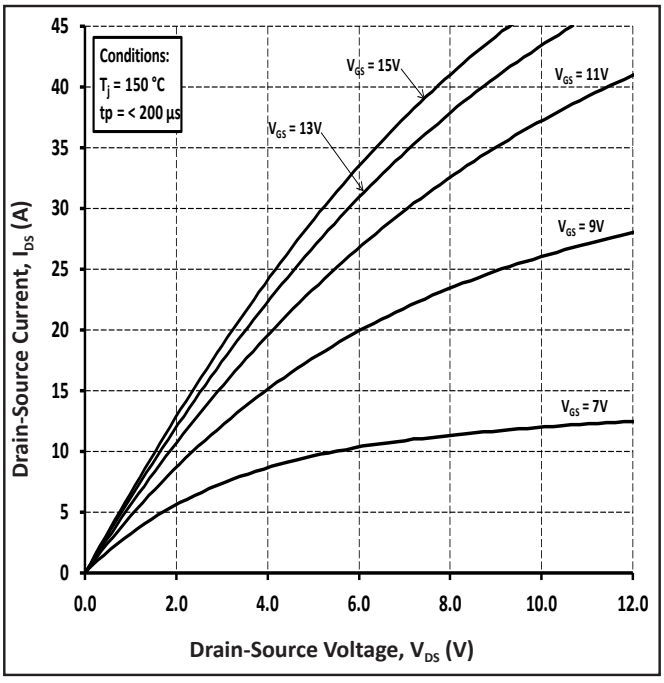


Figure 3. Output Characteristics T_J = 150 °C

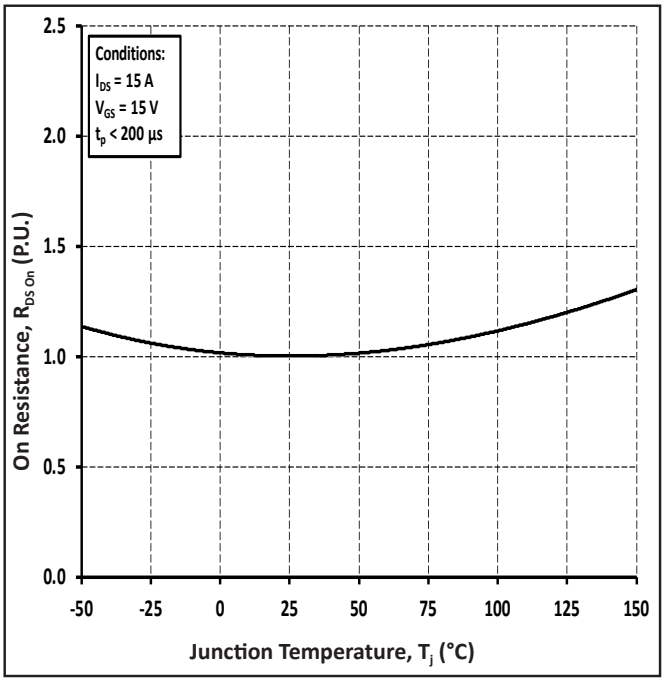


Figure 4. Normalized On-Resistance vs Temperature

Typical Performance

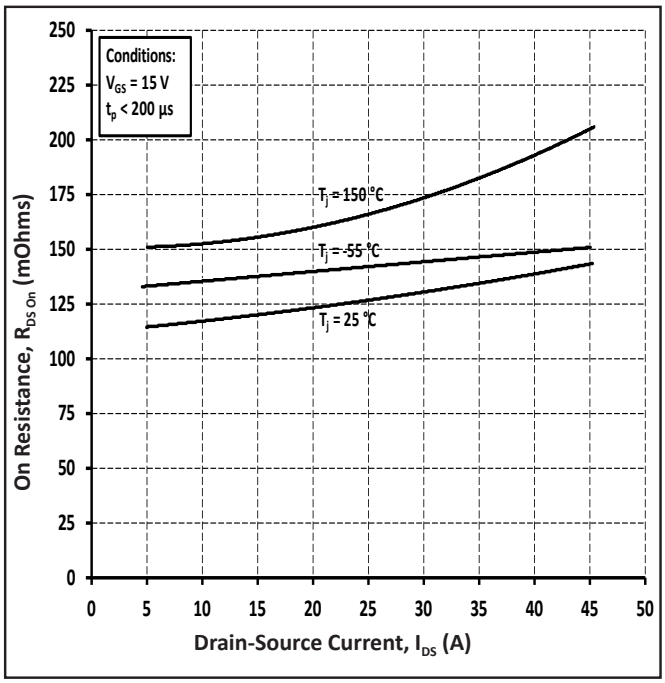


Figure 5. On-Resistance vs Drain Current for Various Temperatures

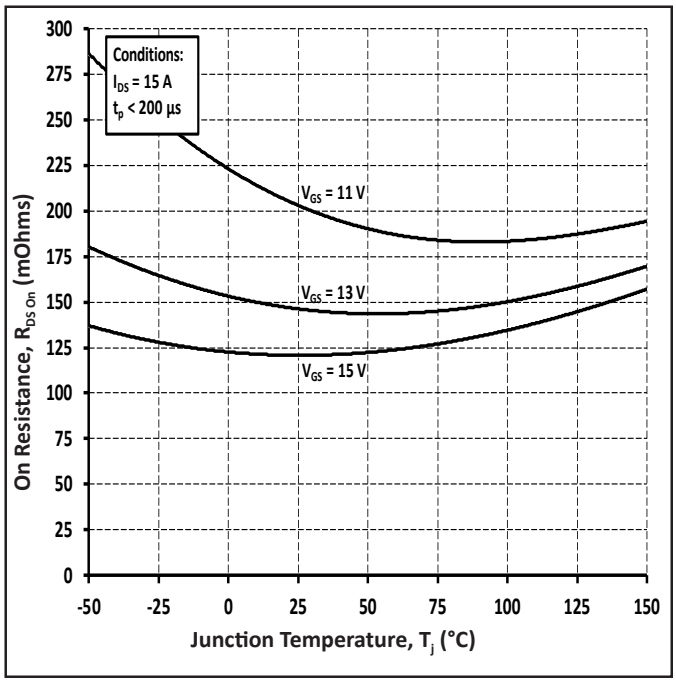


Figure 6. On-Resistance vs Temperature for Various Gate Voltage

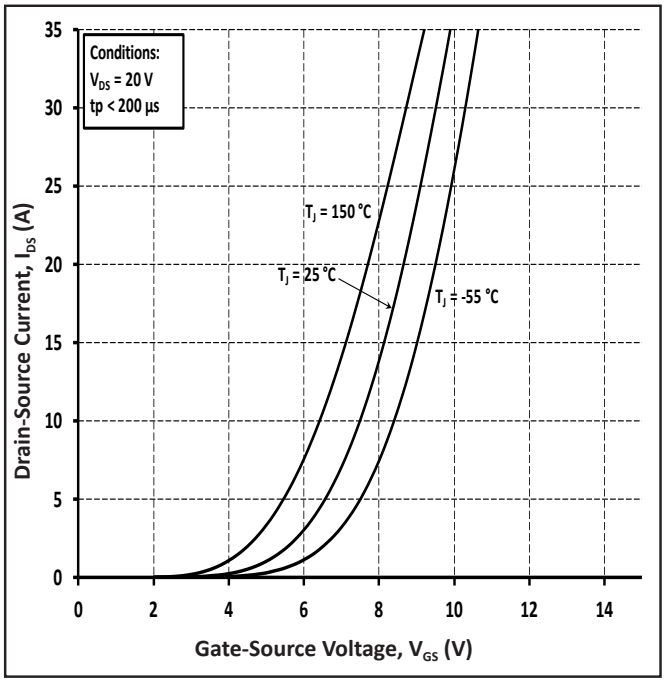


Figure 7. Transfer Characteristic for Various Junction Temperatures

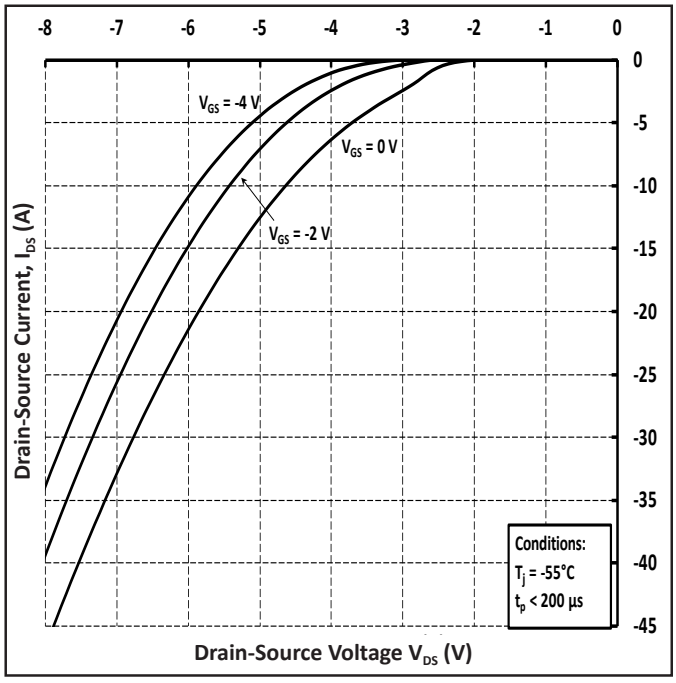


Figure 8. Body Diode Characteristic at -55 °C

Typical Performance

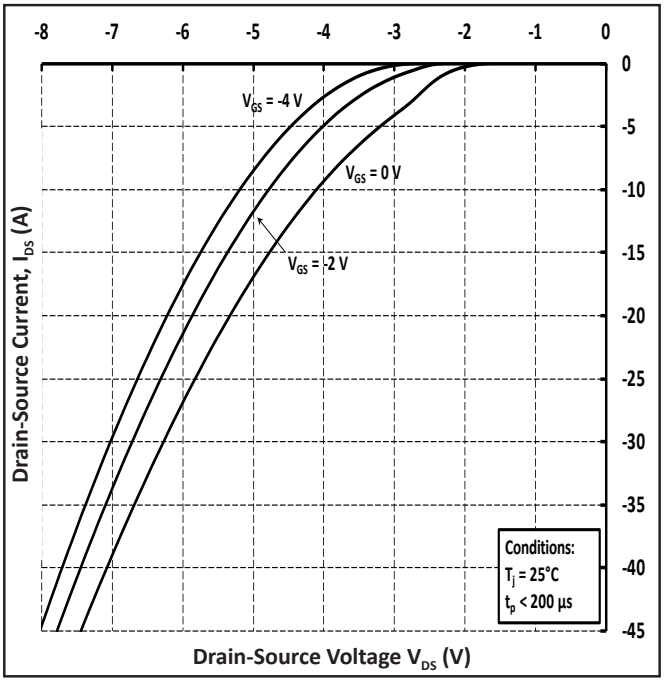


Figure 9. Body Diode Characteristic at 25 °C

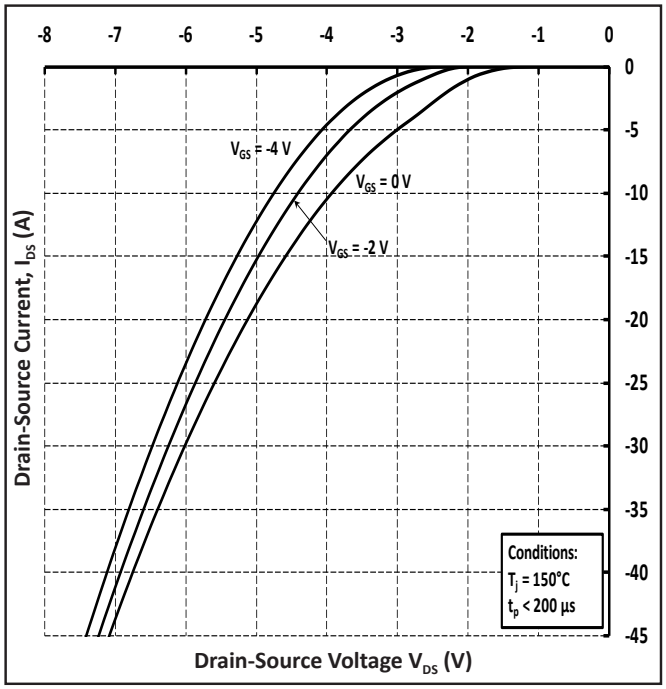


Figure 10. Body Diode Characteristic at 150 °C

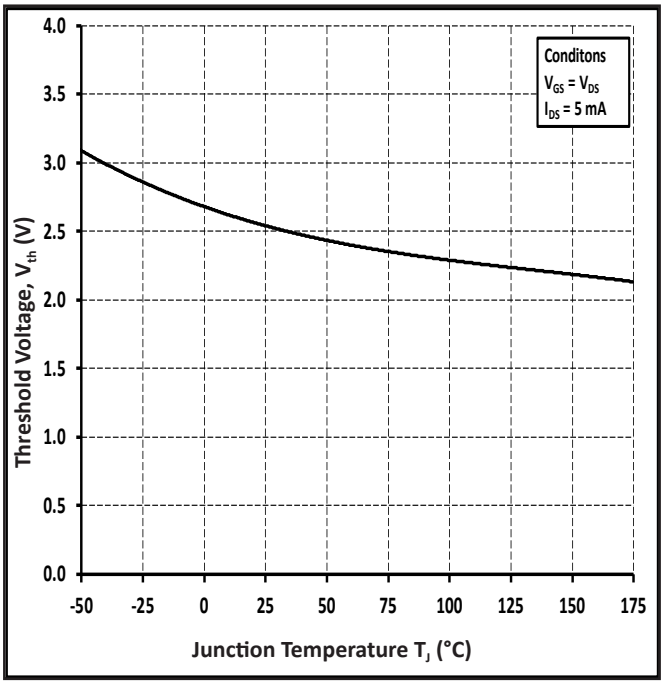


Figure 11. Threshold Voltage vs Temperature

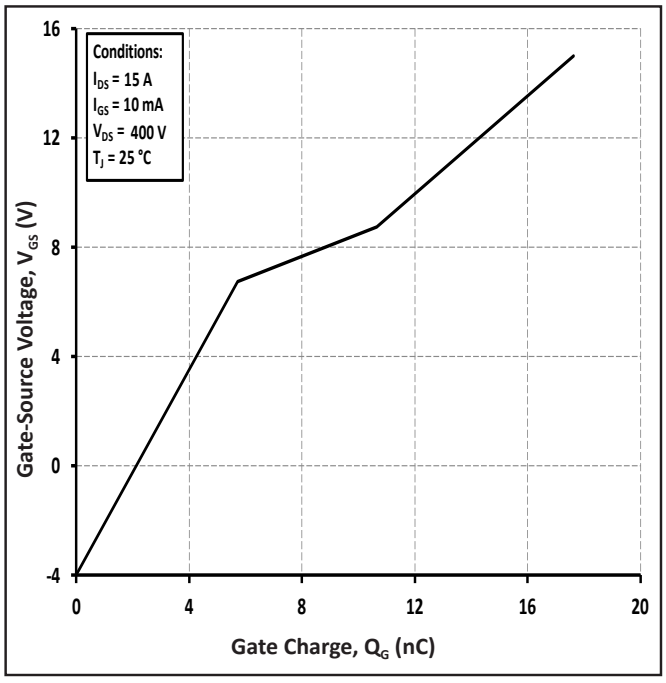


Figure 12. Gate Charge Characteristic

Typical Performance

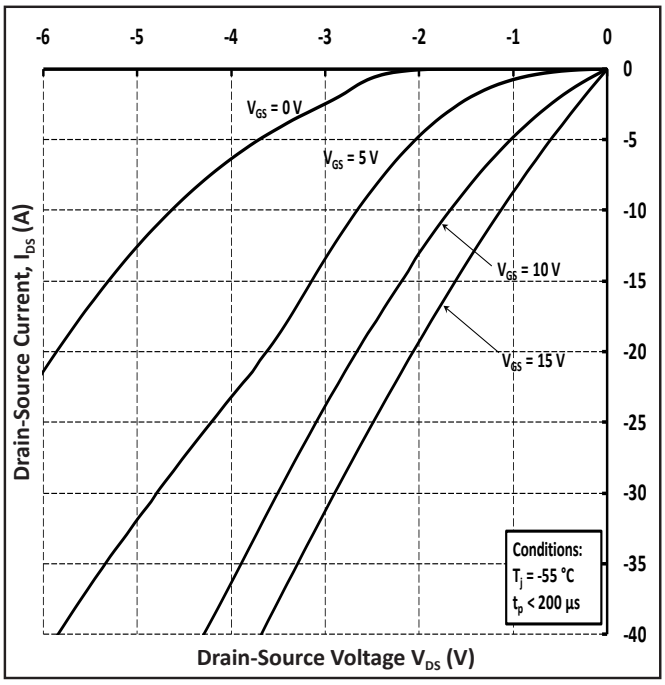


Figure 13. 3rd Quadrant Characteristic at -55 °C

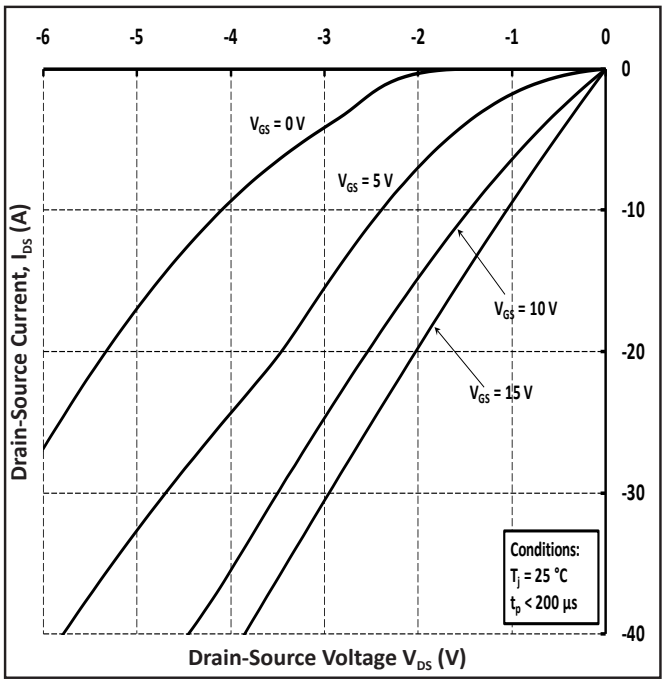


Figure 14. 3rd Quadrant Characteristic at 25 °C

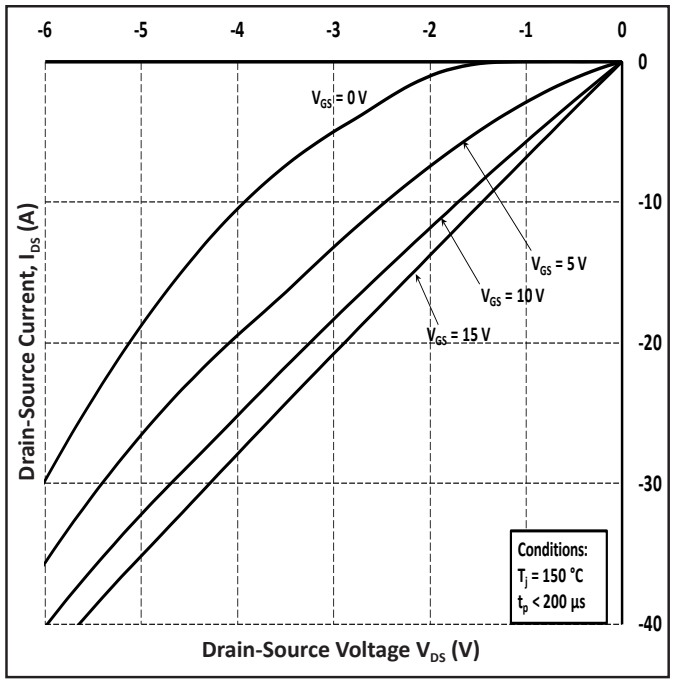


Figure 15. 3rd Quadrant Characteristic at 150 °C

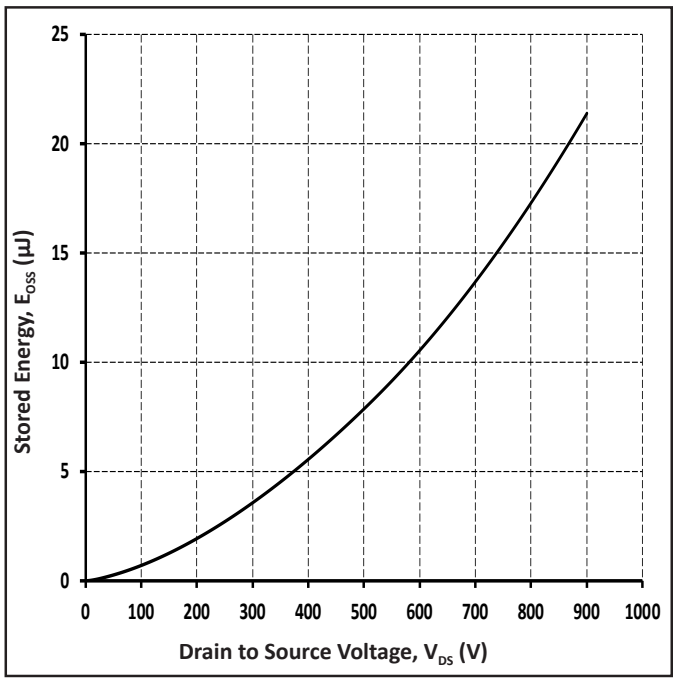


Figure 16. Output Capacitor Stored Energy

Typical Performance

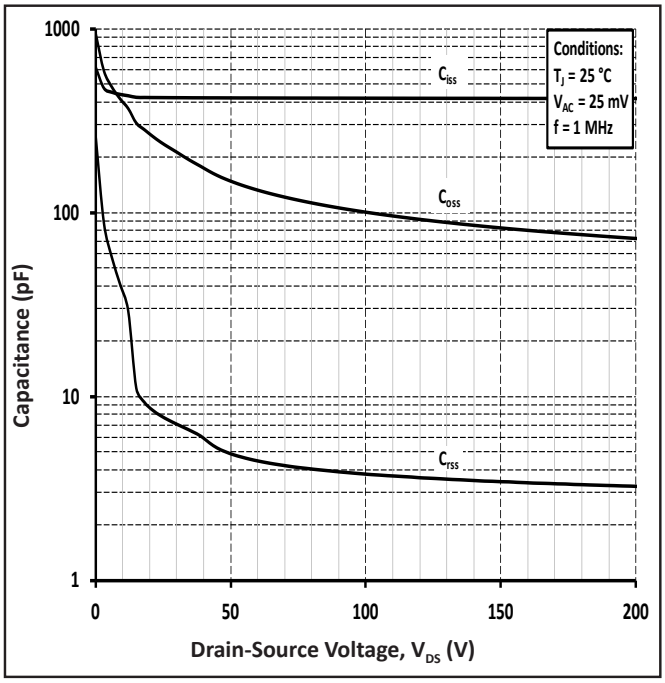


Figure 17. Capacitances vs Drain-Source Voltage (0-200 V)

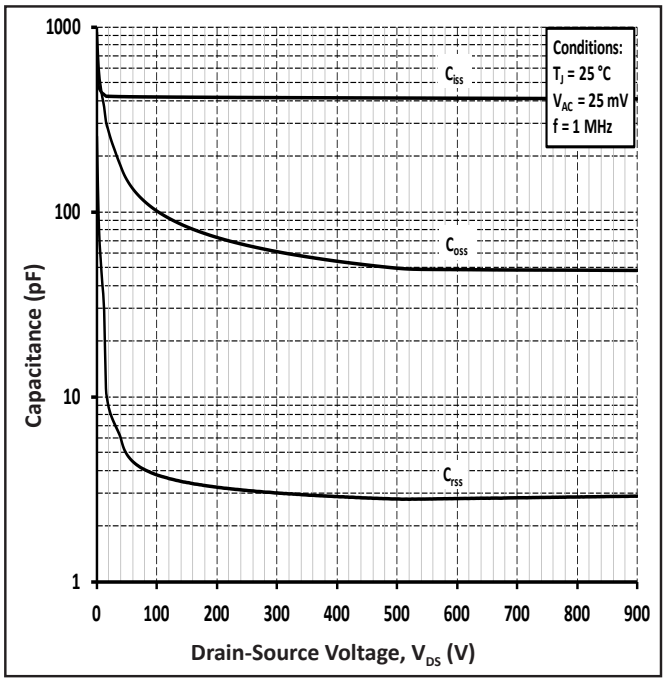


Figure 18. Capacitances vs Drain-Source Voltage (0-900 V)

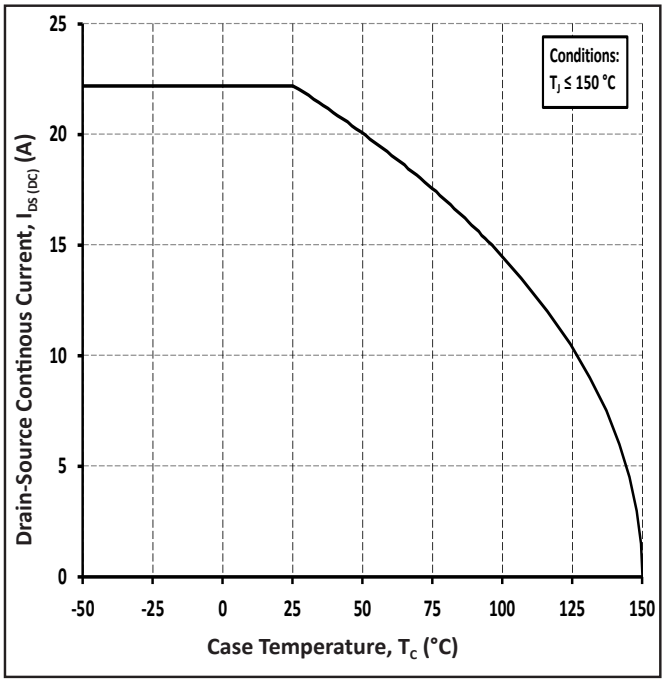


Figure 19. Continuous Drain Current Derating vs Case Temperature

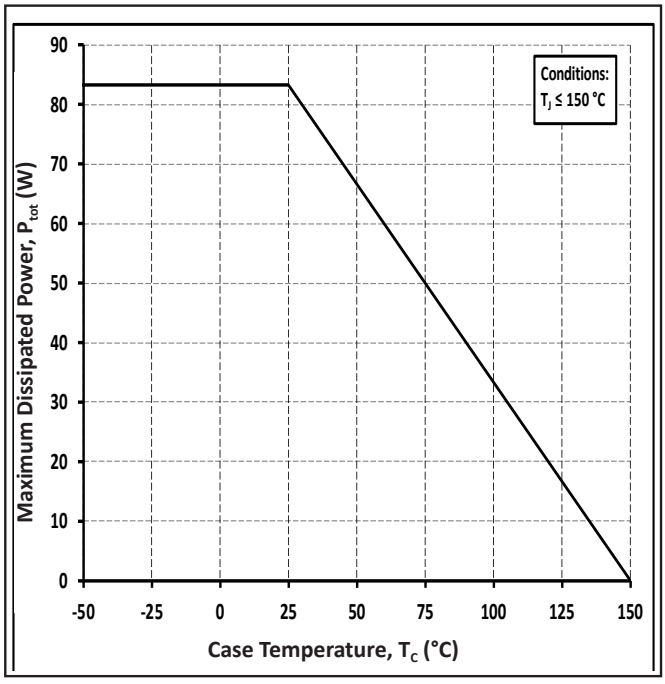


Figure 20. Maximum Power Dissipation Derating vs Case Temperature

Typical Performance

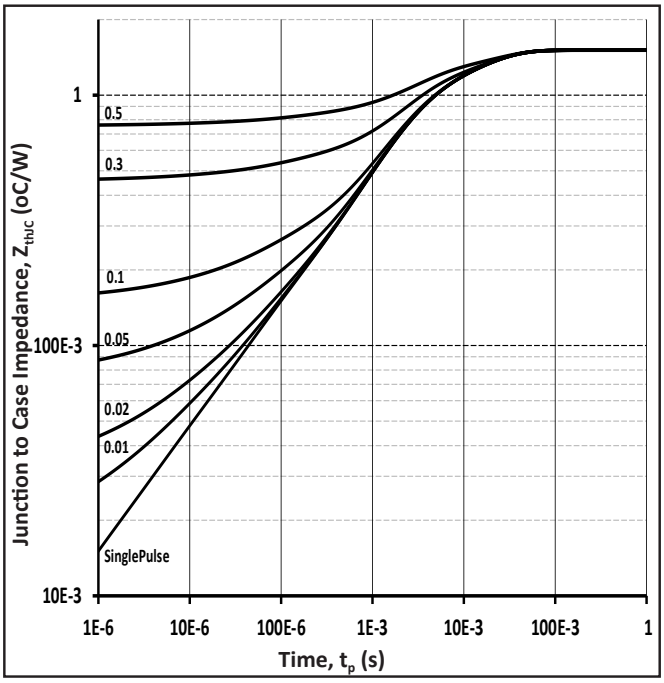


Figure 21. Transient Thermal Impedance (Junction - Case)

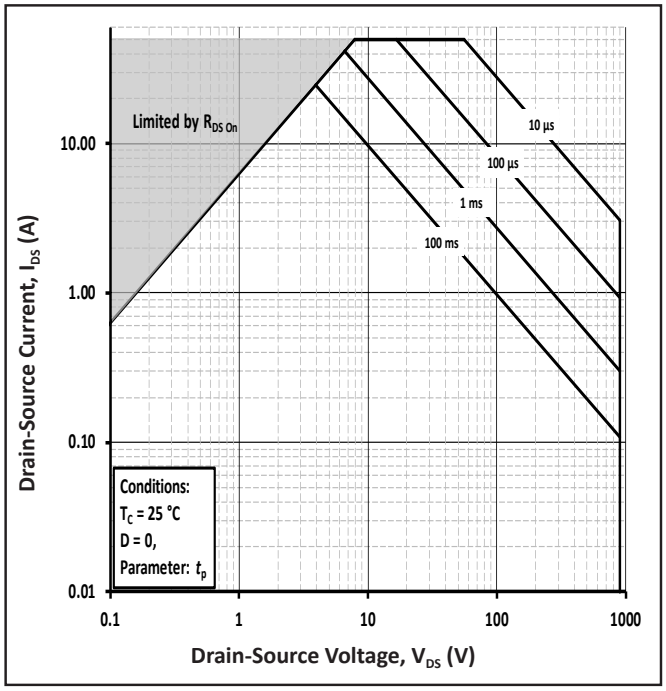


Figure 22. Safe Operating Area

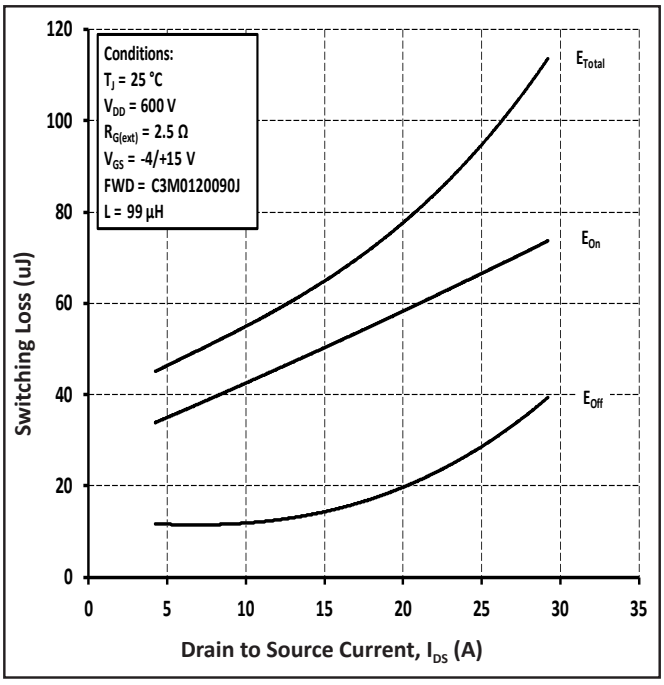


Figure 23. Clamped Inductive Switching Energy vs Drain Current (V_{DD} = 600 V)

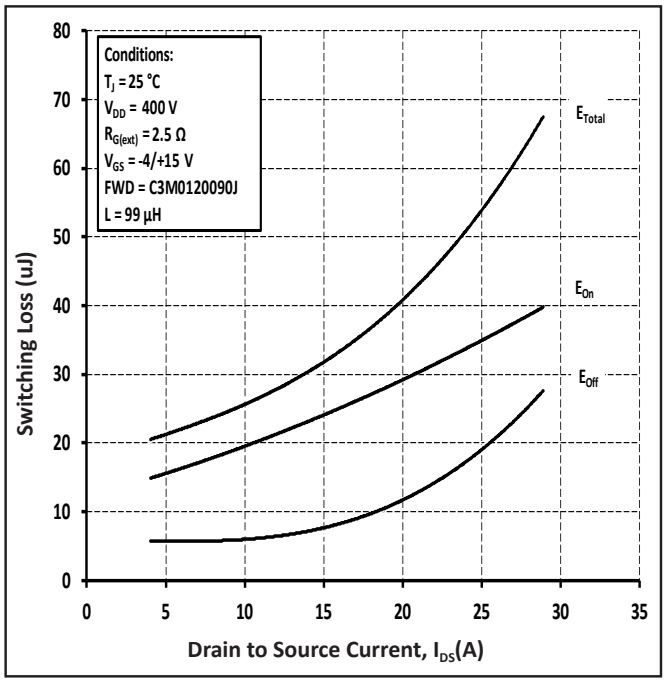


Figure 24. Clamped Inductive Switching Energy vs Drain Current (V_{DD} = 800 V)

Typical Performance

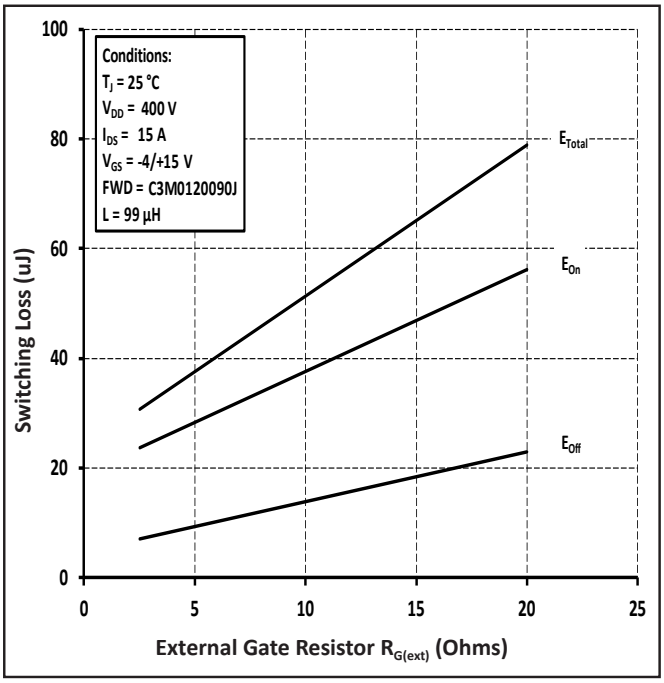


Figure 25. Clamped Inductive Switching Energy vs $R_{G(ext)}$

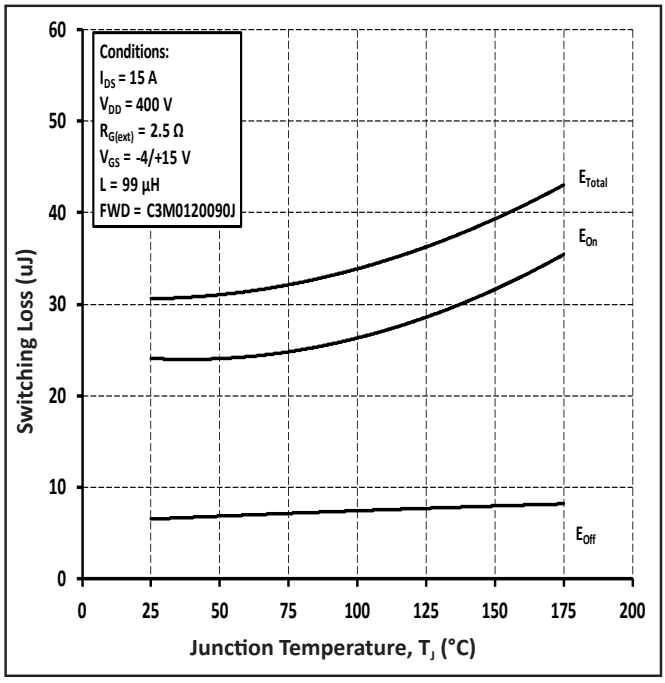


Figure 26. Clamped Inductive Switching Energy vs Temperature

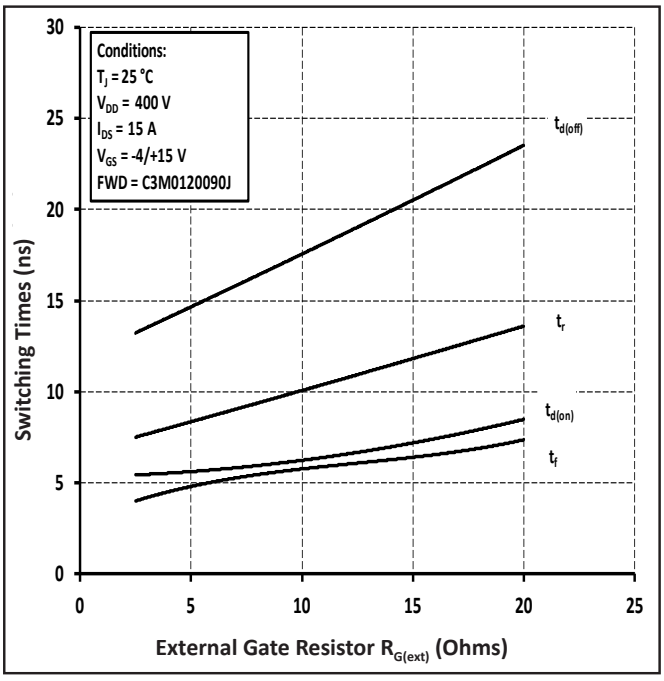


Figure 27. Switching Times vs $R_{G(ext)}$

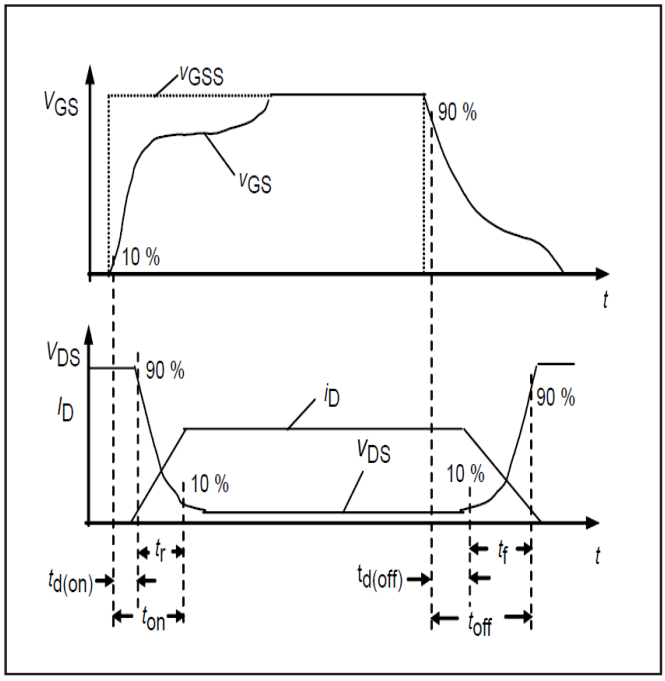


Figure 28. Switching Times Definition

Test Circuit Schematic

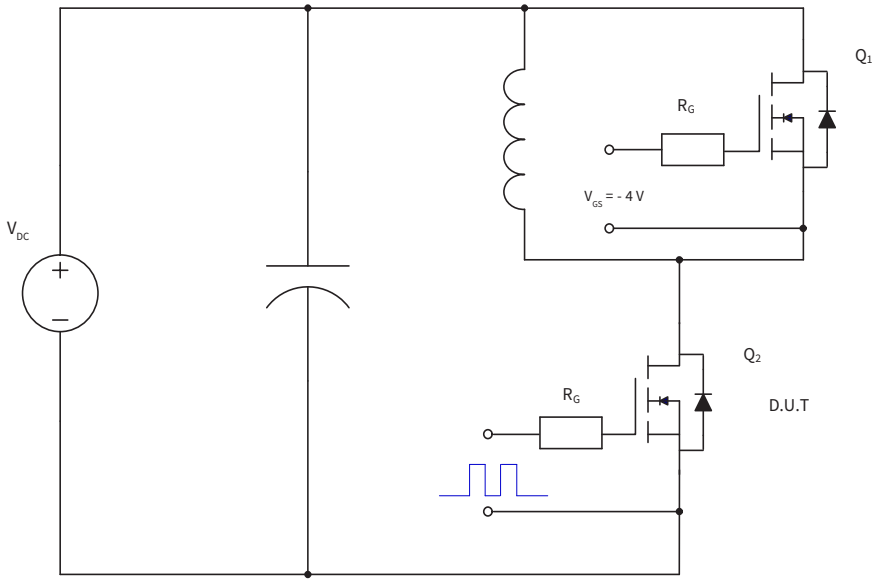
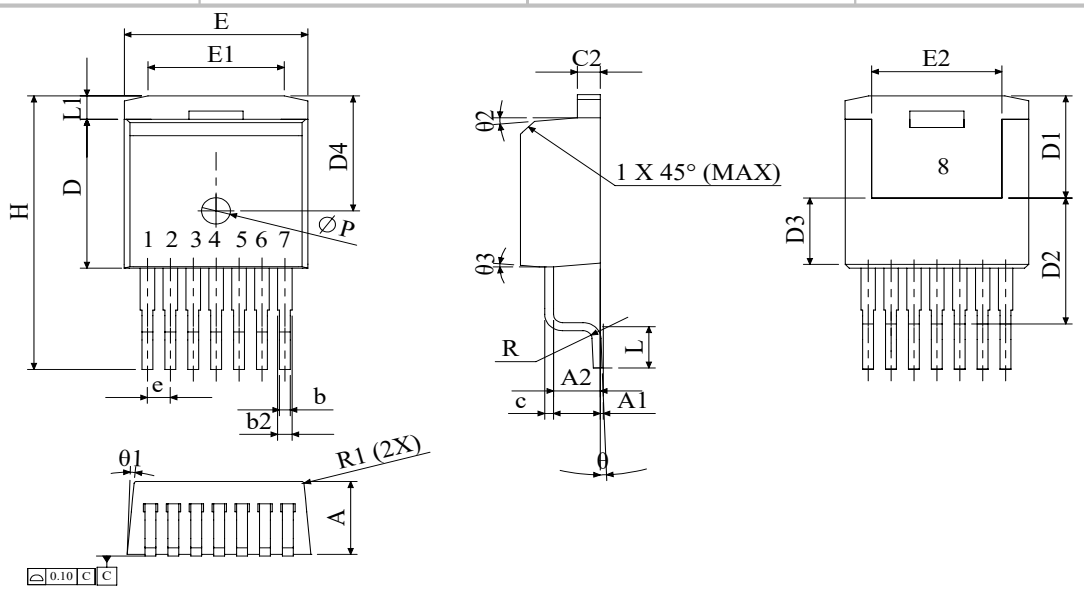


Figure 29. Clamped Inductive Switching Waveform Test Circuit

Note (3): 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	SOURCE
4	
5	
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

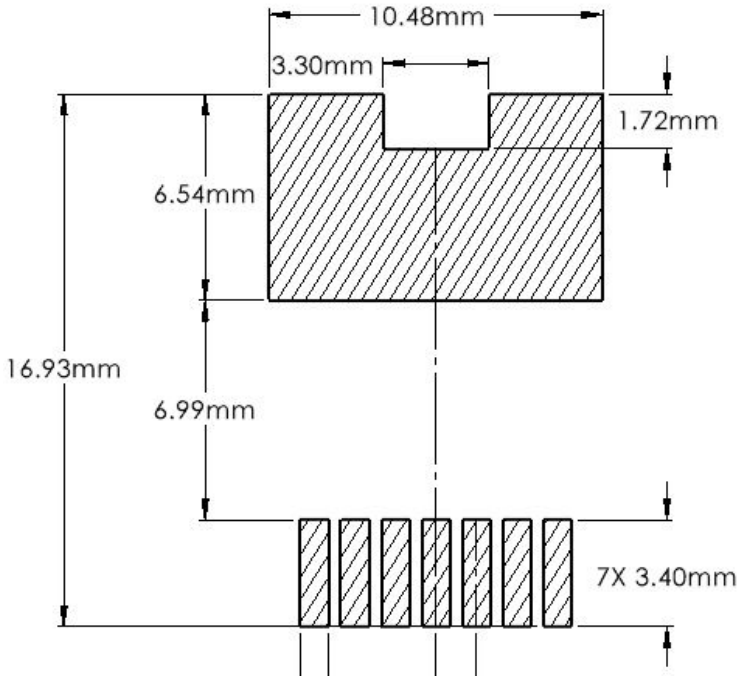
Wolfspeed

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
1	November-2020	N/A
2	December-2023	Updated Wolfspeed branding, package drawing, package image, solder pad layout, added Rev history
3	January - 2025	Legal Disclaimer Updated

Related Links

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

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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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