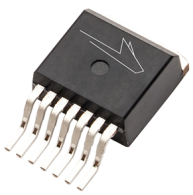
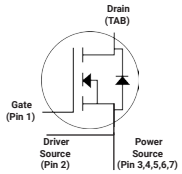
E3M0120090J

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



TO-263-7



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

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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				

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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			

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Typical Performance

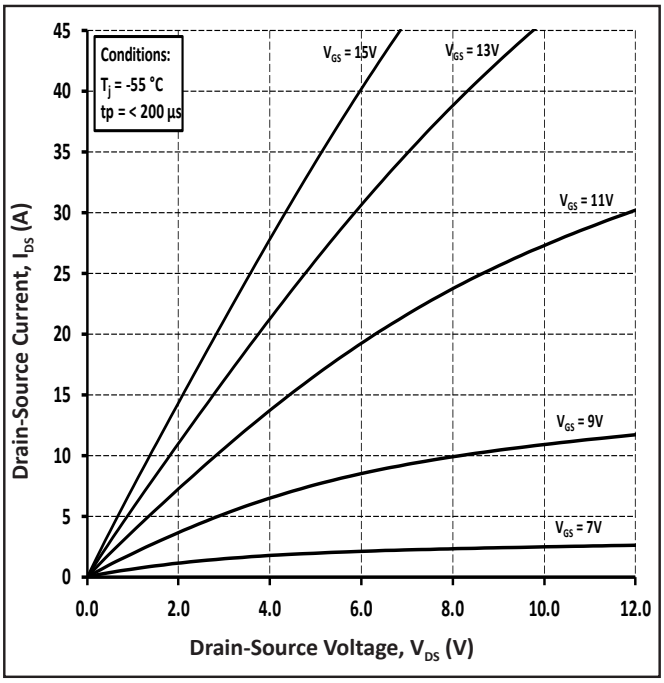


Figure 1. Output Characteristics T_J = -55 °C

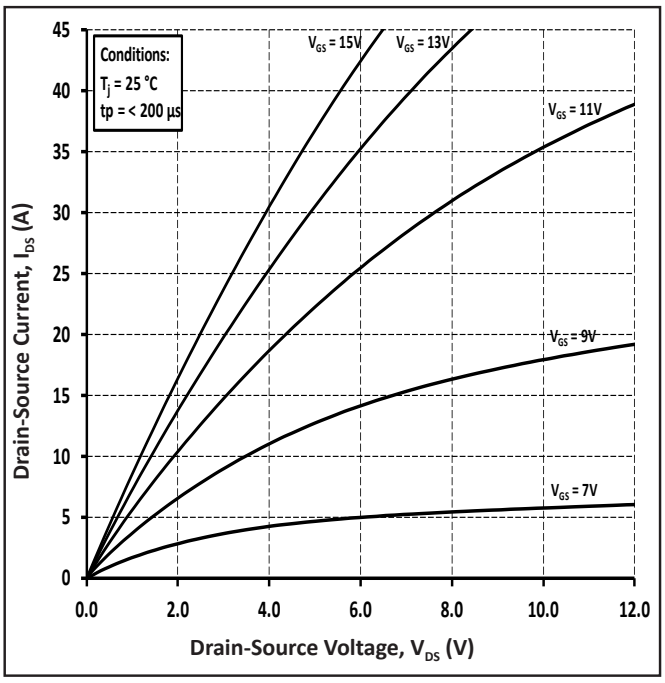


Figure 2. Output Characteristics T_J = 25 °C

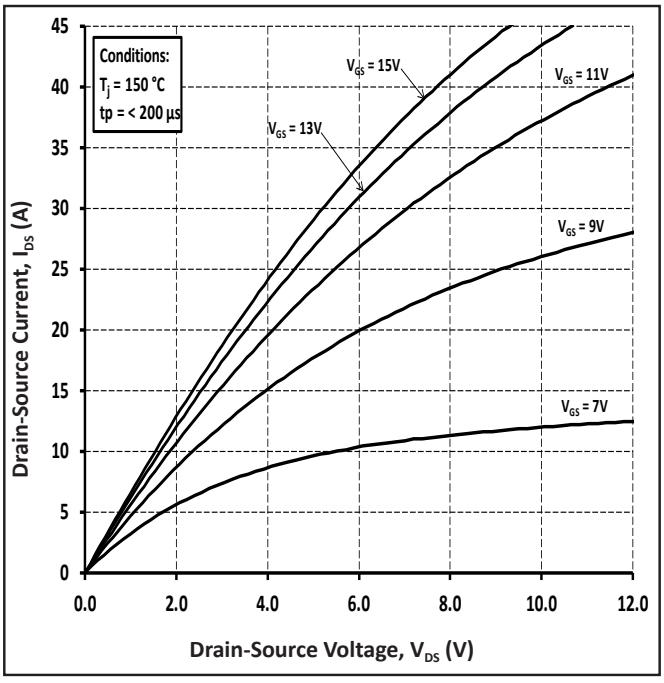


Figure 3. Output Characteristics T_J = 150 °C

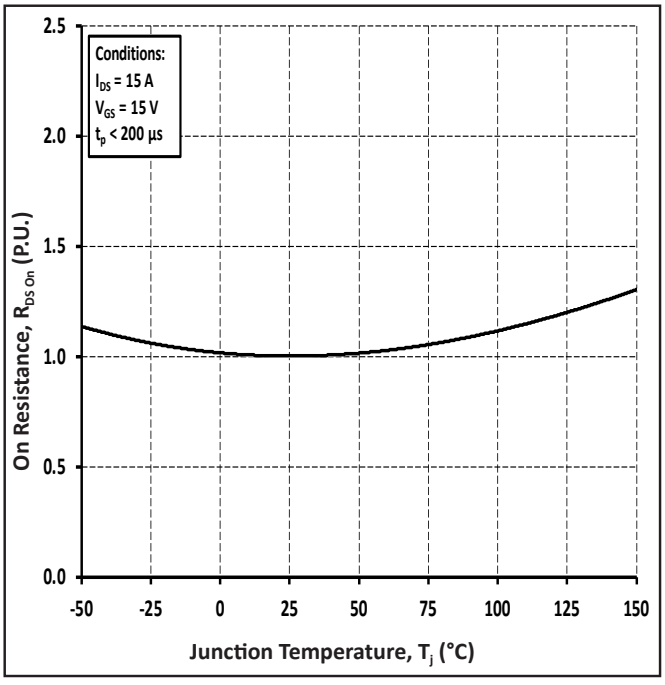


Figure 4. Normalized On-Resistance vs Temperature

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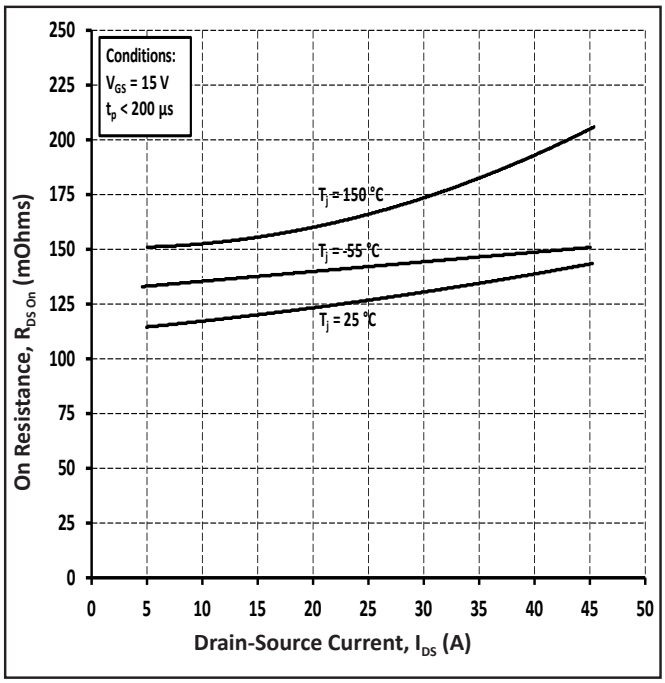


Figure 5. On-Resistance vs Drain Current for Various Temperatures

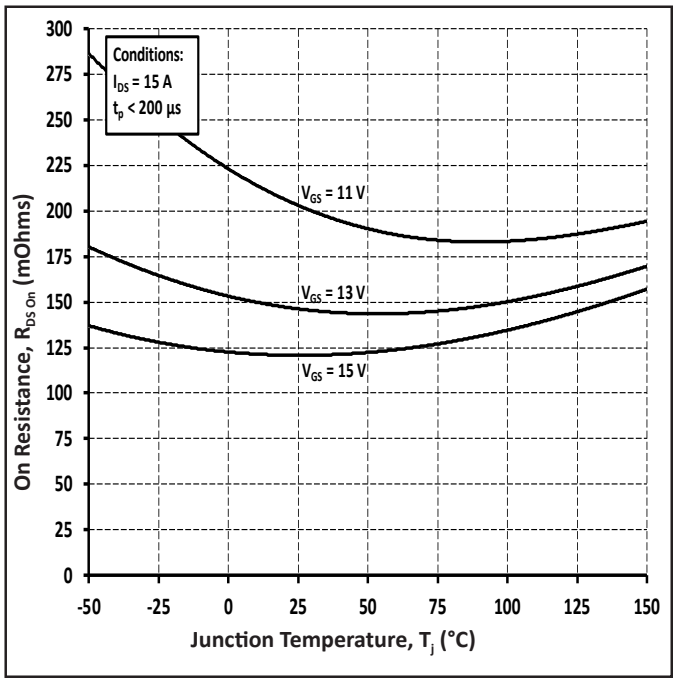


Figure 6. On-Resistance vs Temperature for Various Gate Voltage

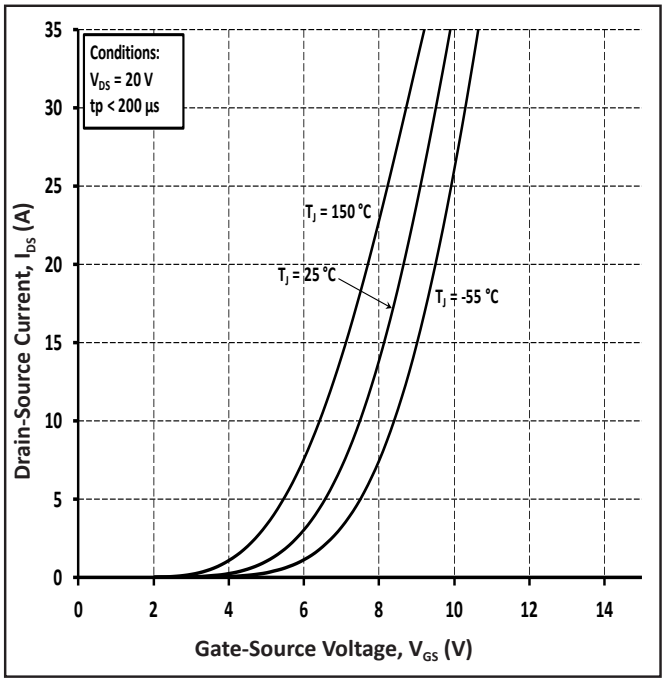


Figure 7. Transfer Characteristic for Various Junction Temperatures

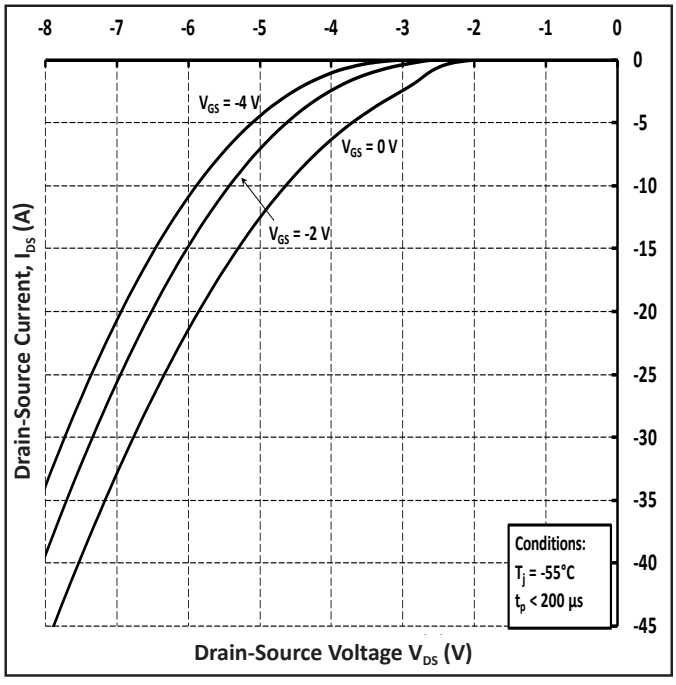


Figure 8. Body Diode Characteristic at -55 °C

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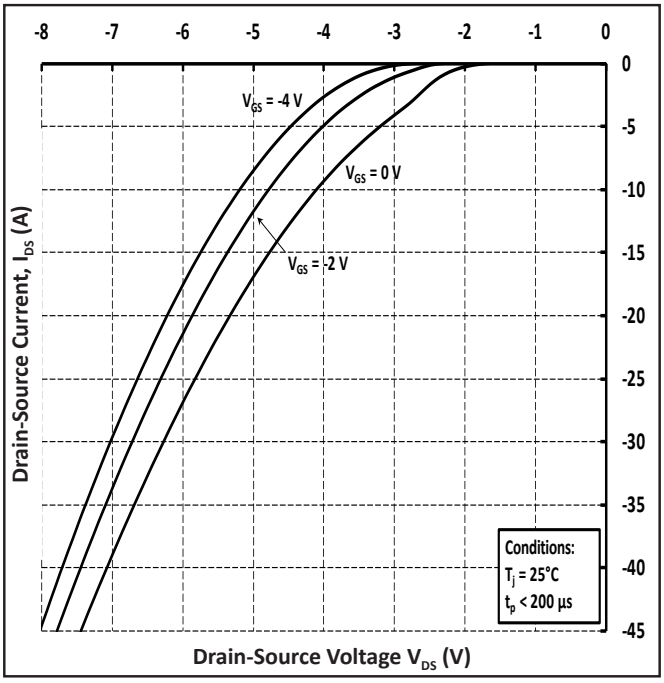


Figure 9. Body Diode Characteristic at 25 °C

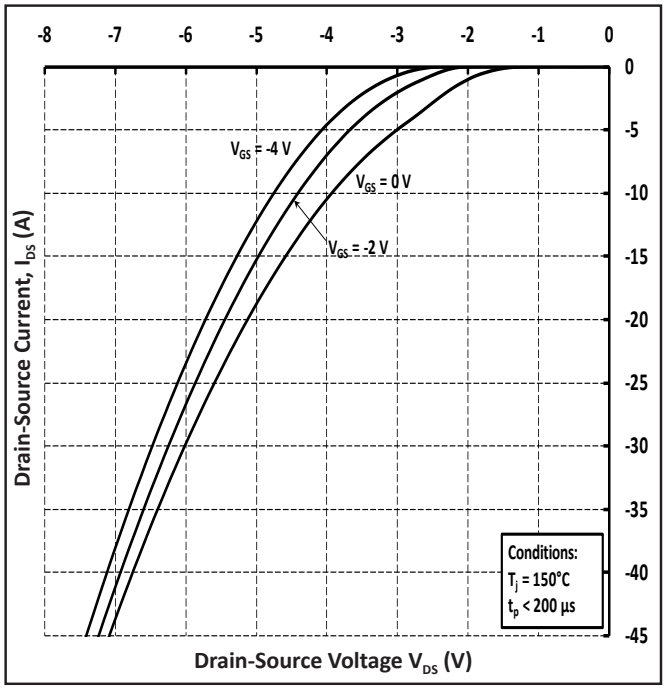


Figure 10. Body Diode Characteristic at 150 °C

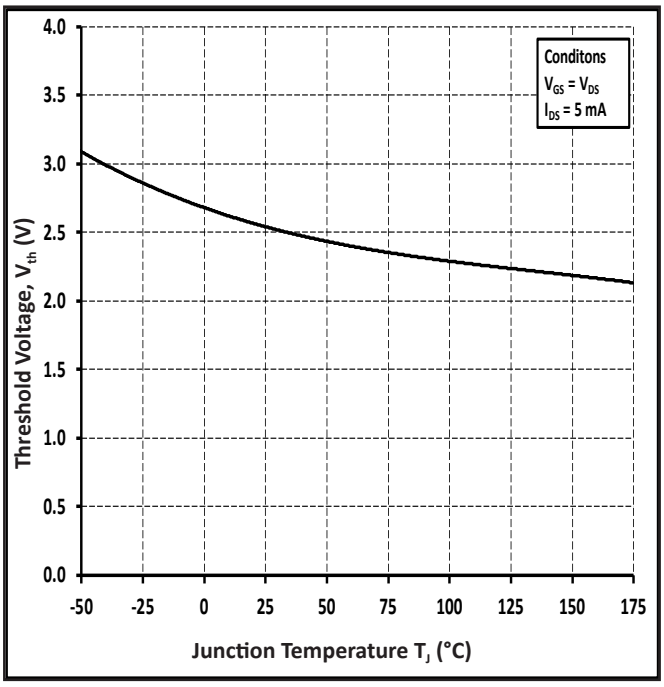


Figure 11. Threshold Voltage vs Temperature

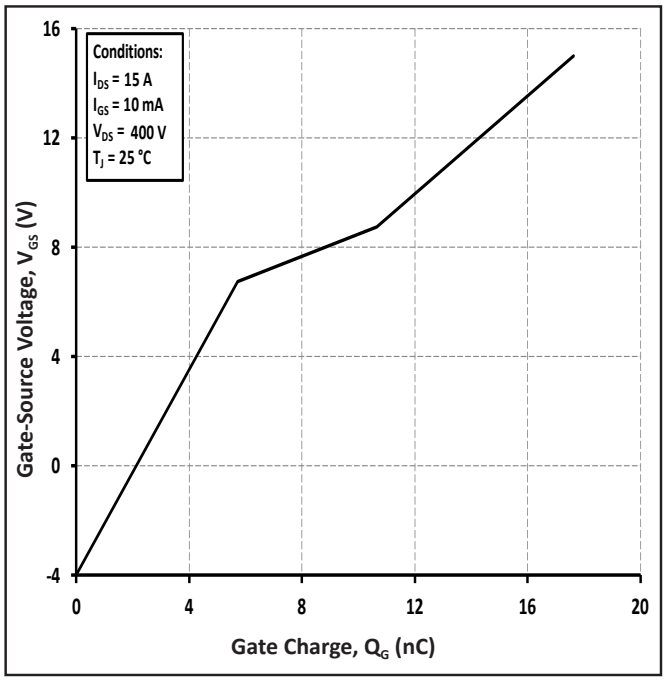


Figure 12. Gate Charge Characteristic

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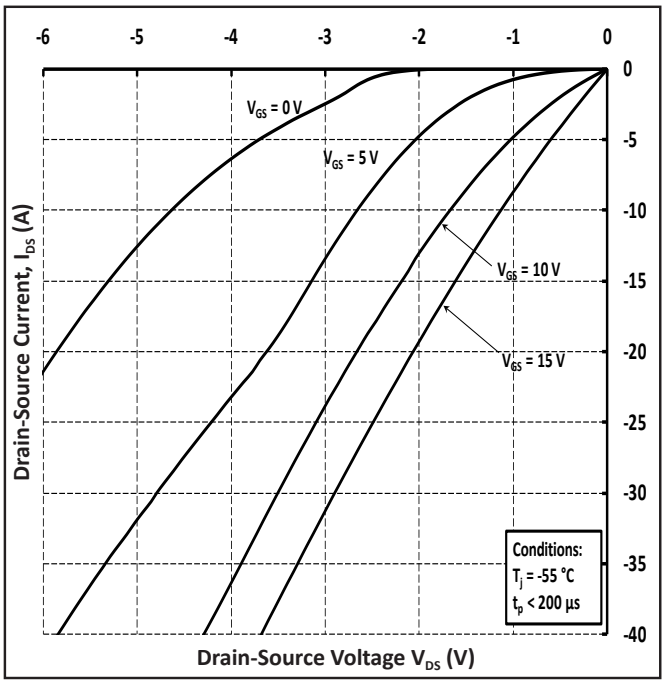


Figure 13. 3rd Quadrant Characteristic at -55 °C

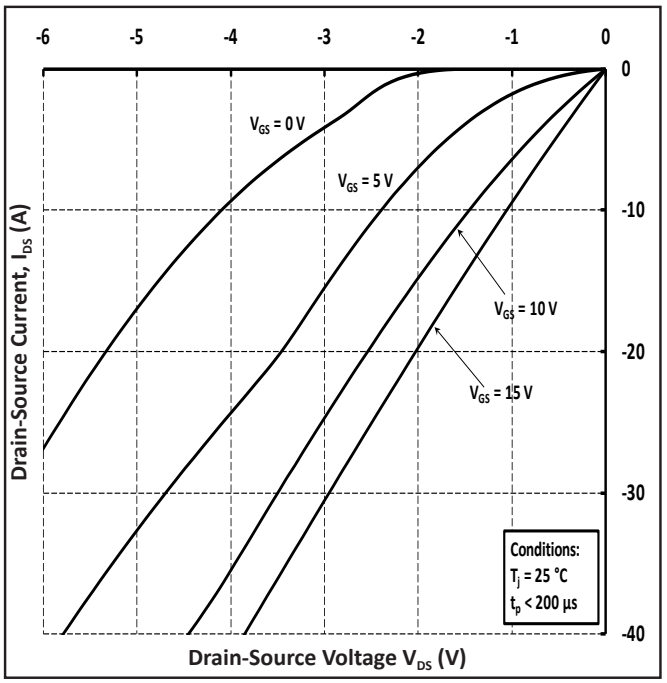


Figure 14. 3rd Quadrant Characteristic at 25 °C

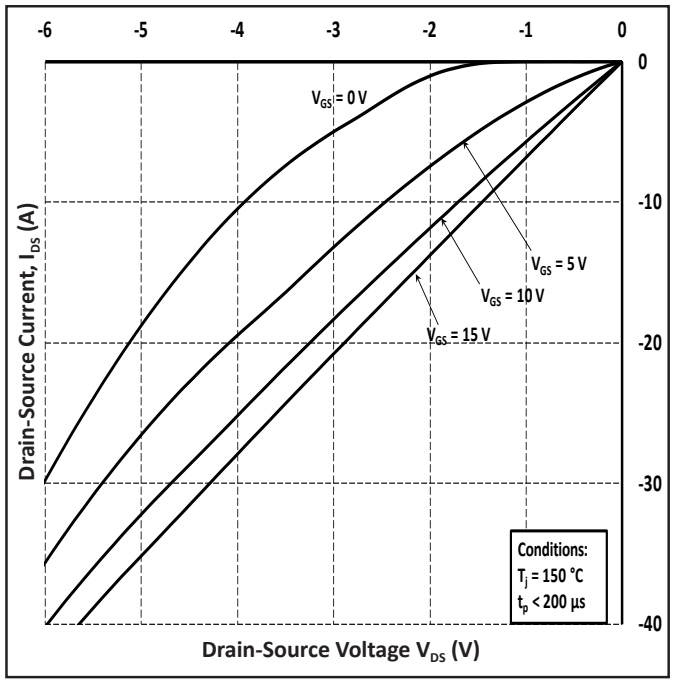


Figure 15. 3rd Quadrant Characteristic at 150 °C

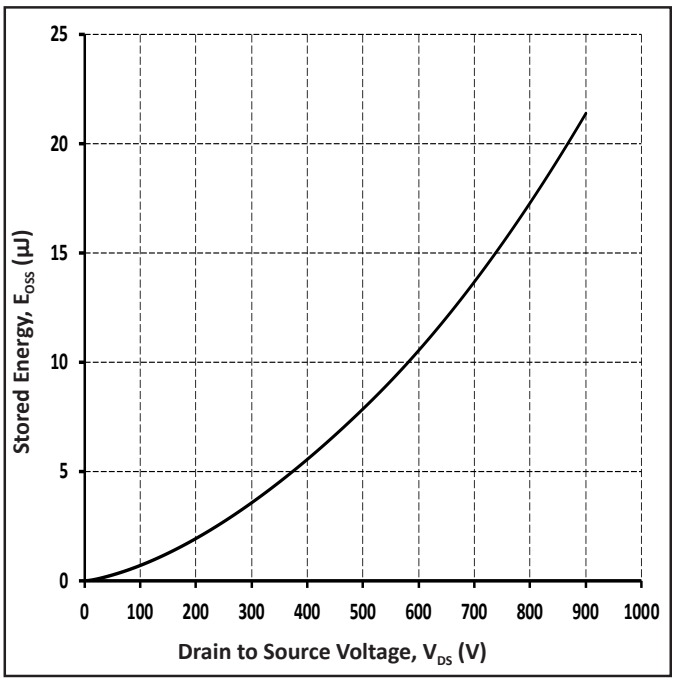


Figure 16. Output Capacitor Stored Energy

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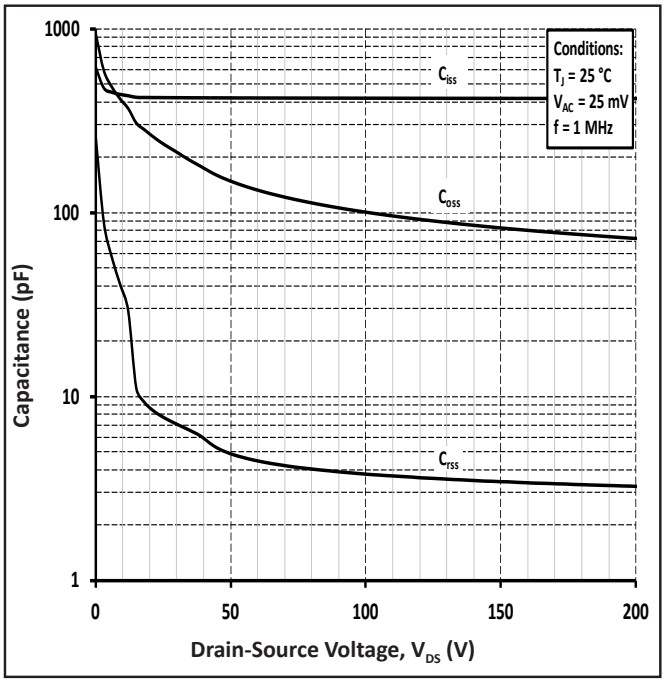


Figure 17. Capacitances vs Drain-Source Voltage (0-200 V)

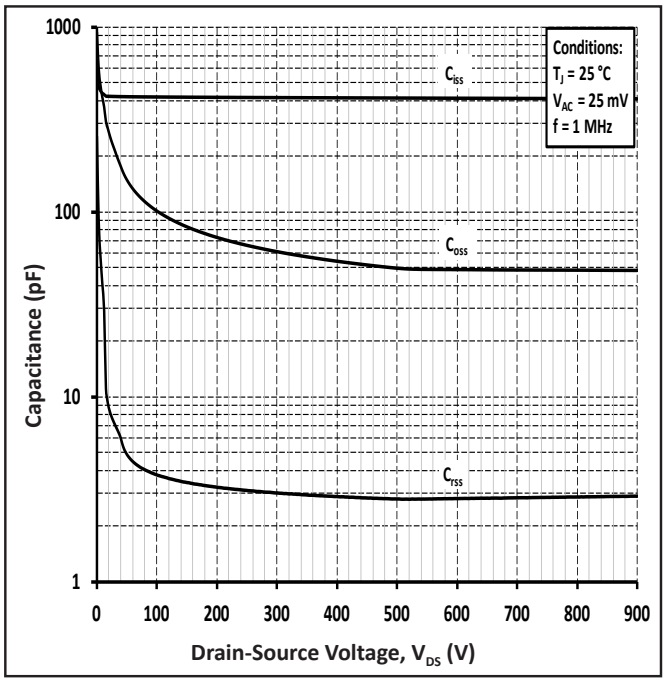


Figure 18. Capacitances vs Drain-Source Voltage (0-900 V)

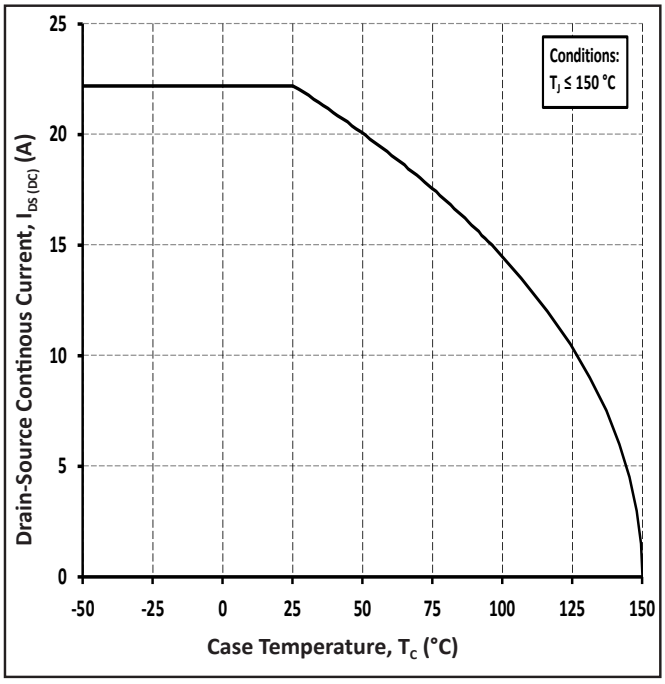


Figure 19. Continuous Drain Current Derating vs Case Temperature

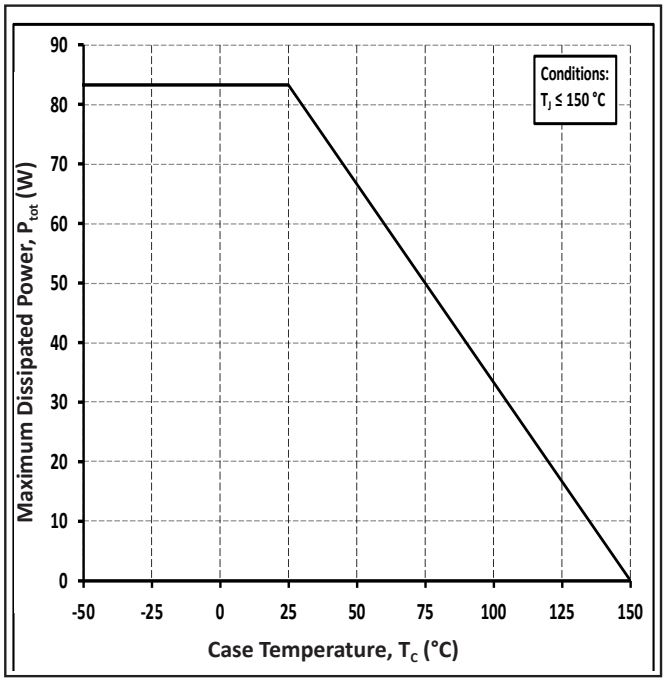


Figure 20. Maximum Power Dissipation Derating vs Case Temperature

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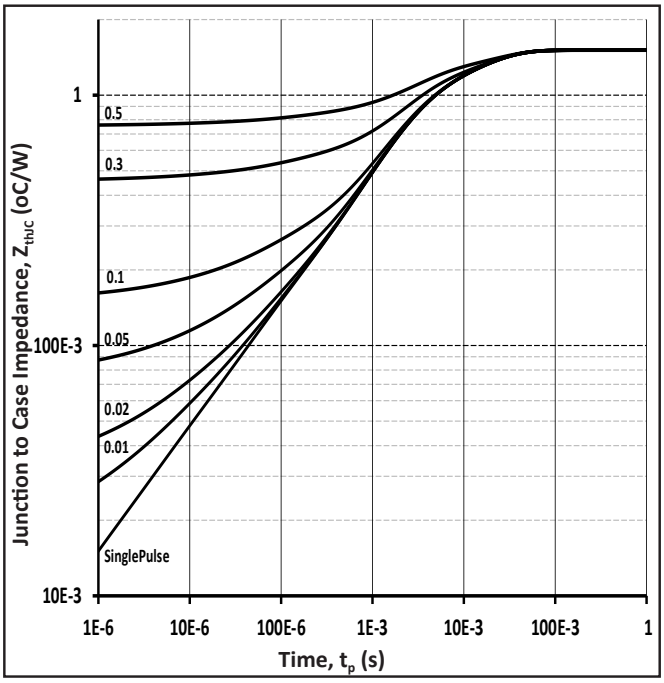


Figure 21. Transient Thermal Impedance (Junction - Case)

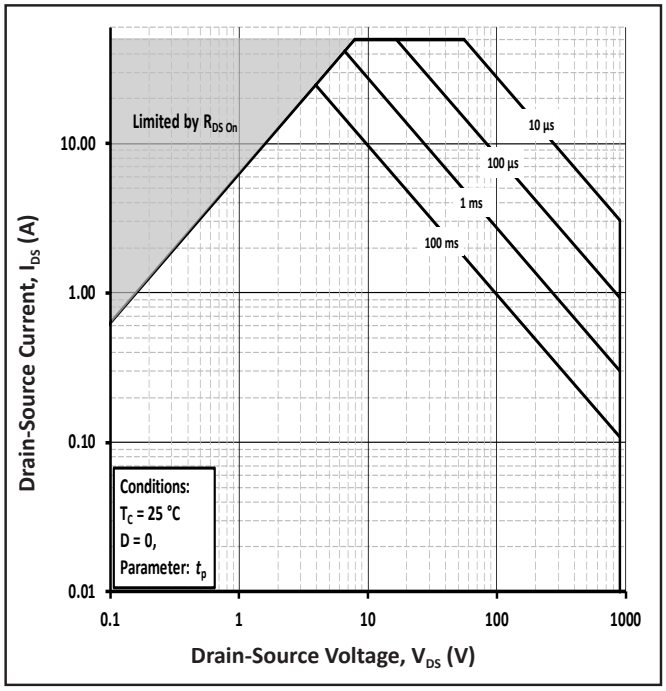


Figure 22. Safe Operating Area

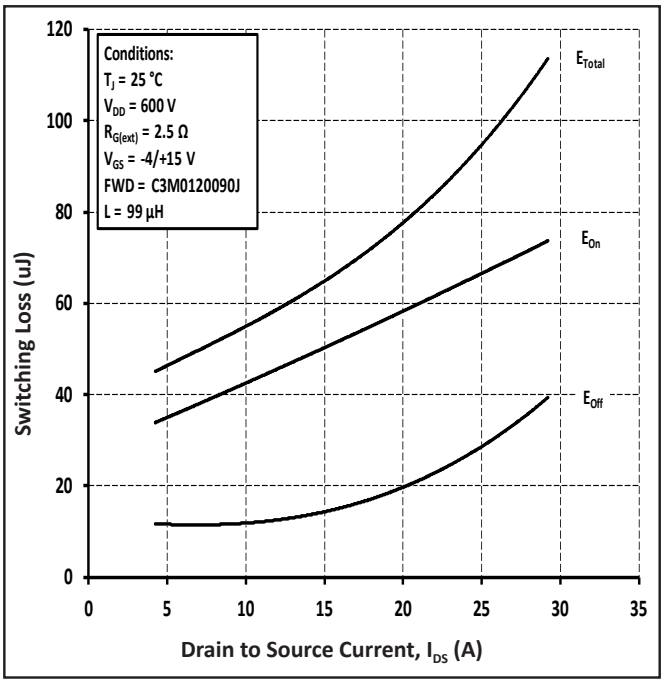


Figure 23. Clamped Inductive Switching Energy vs Drain Current (V_{DD} = 600 V)

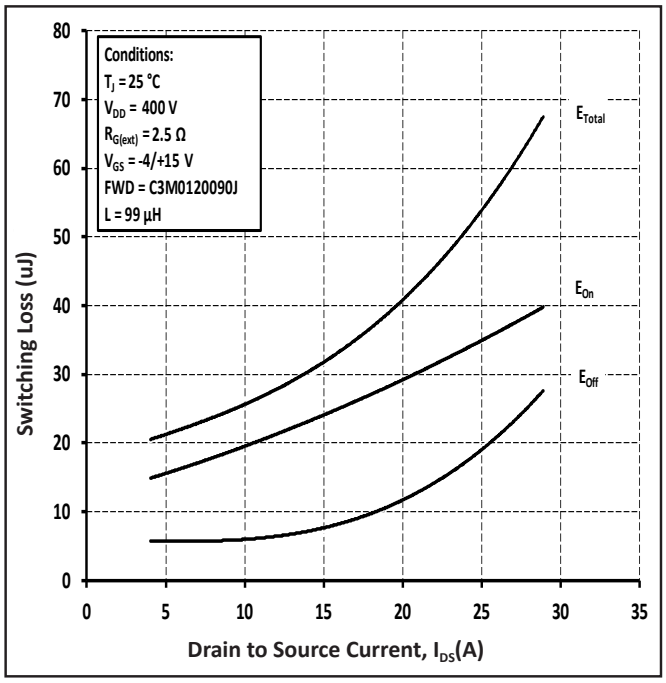


Figure 24. Clamped Inductive Switching Energy vs Drain Current (V_{DD} = 800 V)

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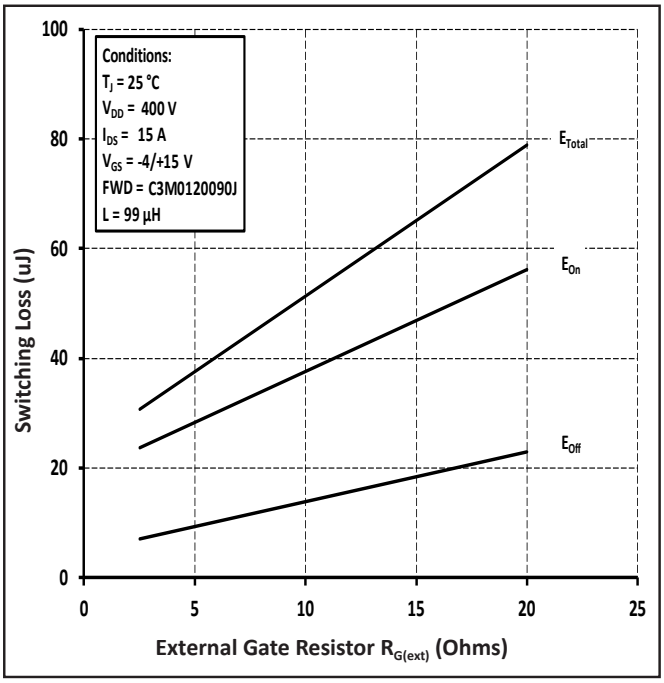


Figure 25. Clamped Inductive Switching Energy vs $R_{G(ext)}$

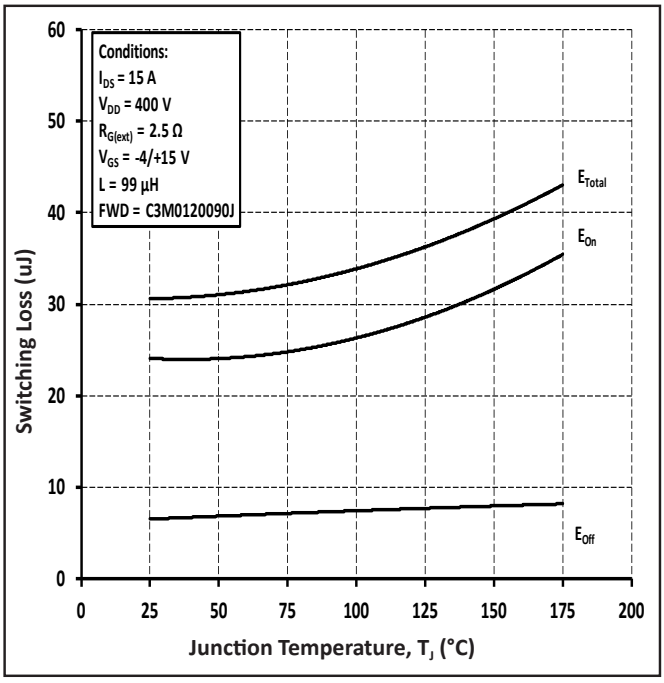


Figure 26. Clamped Inductive Switching Energy vs Temperature

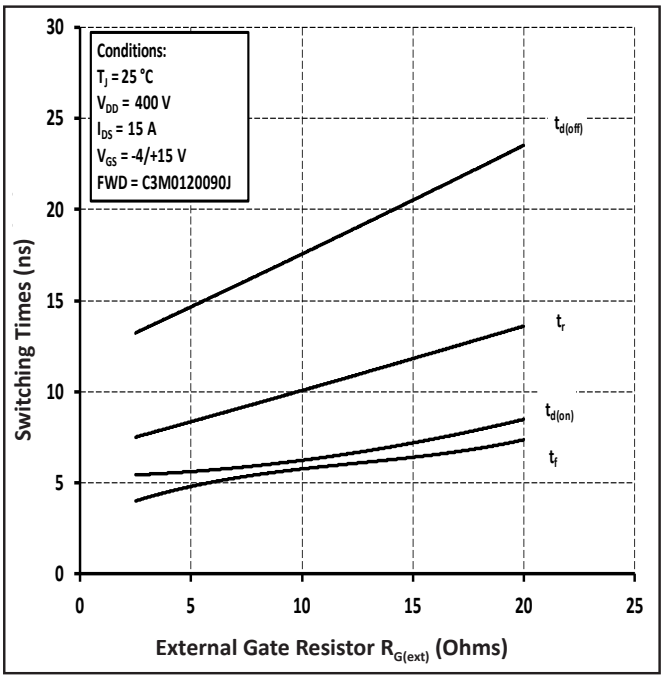


Figure 27. Switching Times vs $R_{G(ext)}$

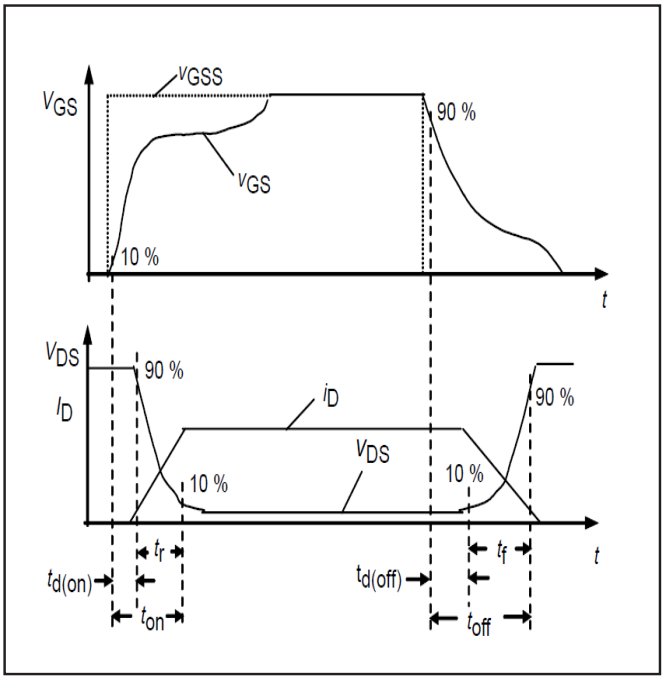


Figure 28. Switching Times Definition

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Test Circuit Schematic

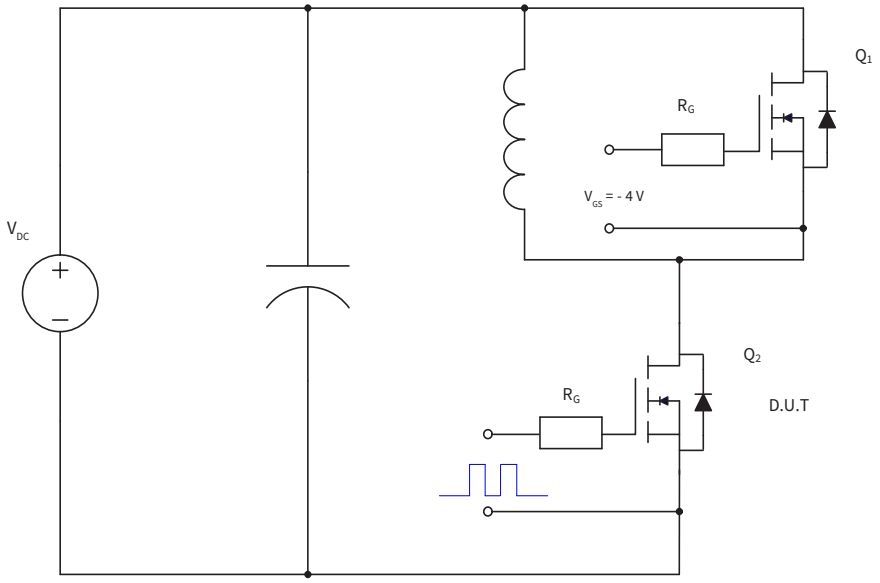


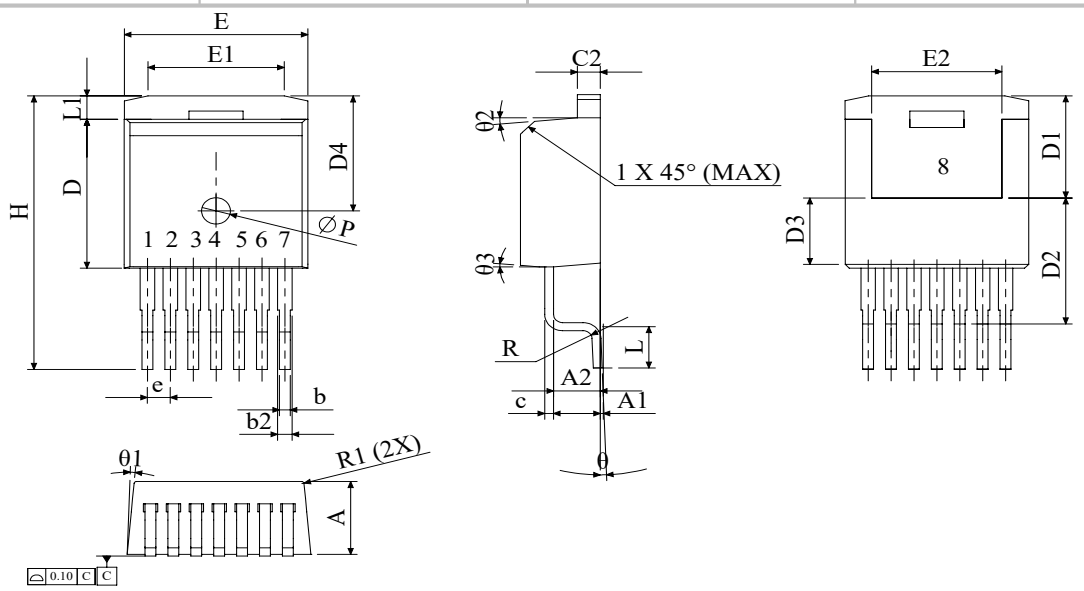
Figure 29. Clamped Inductive Switching Waveform Test Circuit

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-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

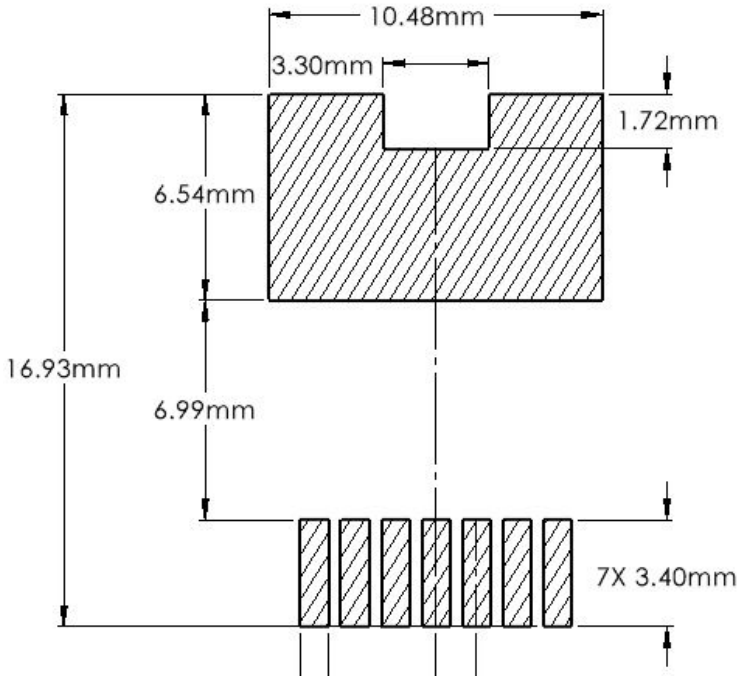
TITLE: PACKAGE OUTLINE DRAWING: TO 263-7L J

REVISION NO. 01 | A4

Date: 04/13/22 | SCALE:1:1 | SHEET 1 OF 1

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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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