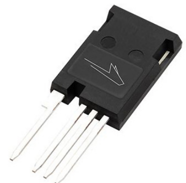
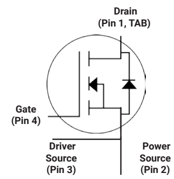
C2M0045170P

Silicon Carbide Power MOSFET
C2M™ MOSFET Technology
N-Channel Enhancement Mode



TO-247-4L Plus



Package Types: TO-247-4L Plus
PN's: C2M0045170P

Features

- 2nd generation SiC MOSFET technology
- Optimized package with separate driver source pin
- 8mm of creepage distance between drain and source
- High blocking voltage with low on-resistance
- High speed switching with low capacitances
- Resistant to latch-up
- Halogen free, RoHS compliant

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Typical Applications

- Solar inverters
- Switch mode power supplies
- High voltage DC/DC converters
- Motor drive
- Pulsed power applications

Benefits

- Reduce switching losses and minimize gate ringing
- Higher system efficiency
- Reduced cooling requirements
- 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}	1700	V	V_{GS} = 0 V, I_D = 100 μA	
Gate - Source Voltage	V_{GSmax}	-10/+25	V	Absolute Maximum Values, AC (f >1 Hz)	Note: 1
Gate - Source Voltage	V_{GSop}	-5/+20	V	Recommended Operational Values	Note: 2
Continuous Drain Current	I_D	75	A	V_{GS} = 20 V, T_C = 25 °C	Fig. 19
		48	A	V_{GS} = 20 V, T_C = 100 °C	
Pulsed Drain Current	$I_{D\,(pulse)}$	160	A	Pulse Width t_P Limited by T_{jmax}	Fig. 22
Power Dissipation	P_D	338	W	T_C = 25 °C, T_J = 150 °C	Fig. 20
Operating Junction and Storage Temperature	T_J, T_{stg}	-40 to +150	°C		
Solder Temperature	T_L	260	°C	According to JEDEC J-STD-020	

Note (1): When using MOSFET body diode V_{GSmax} = -5 V/+25 V.
Note (2): MOSFET can also safely operate at 0/+20 V.

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

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test Conditions	Note
Drain-Source Breakdown Voltage	$V_{(BR)DSS}$	1700			V	V_{GS} = 0 V, I_D = 100 µA	
Gate Threshold Voltage	$V_{GS(th)}$	2.0	3.0	4		$V_{DS} = V_{GS}$, I_D = 18 mA	Fig. 11
			2.5			$V_{DS} = V_{GS}$, I_D = 18 mA, T_J = 150 °C	
Zero Gate Voltage Drain Current	I_{DSS}		2	100	µA	V_{DS} = 1700 V, V_{GS} = 0 V	
Gate-Source Leakage Current	I_{GSS}			600	nA	V_{GS} = 20 V, V_{DS} = 0 V	
Drain-Source On-State Resistance	$R_{DS(on)}$		40	70	mΩ	V_{GS} = 20 V, I_D = 50 A	Fig. 4,5,6
			80			V_{GS} = 20 V, I_D = 50 A, T_J = 150 °C	
Transconductance	g_{fs}		24.7		S	V_{DS} = 20 V, I_{DS} = 50 A	Fig. 7
			23.4			V_{DS} = 20 V, I_{DS} = 50 A, T_J = 150 °C	
Input Capacitance	C_{iss}		3455		pF	V_{GS} = 0 V V_{DS} = 1200 V f = 1 MHz V_{AC} = 25 mV	Fig. 17,18
Output Capacitance	C_{oss}		171				
Reverse Transfer Capacitance	C_{rss}		6.7				
C_{oss} Stored Energy	E_{oss}		139		µJ		Fig. 16
Effective Output Capacitance (Energy Related)	$C_{o(er)}$		188		pF	V_{GS} = 0 V, V_{DS} = 0... 1200 V	Note: 3
Effective Output Capacitance (Time Related)	$C_{o(tr)}$		255		pF		
Turn-On Switching Energy (SiC Diode FWD)	E_{ON}		0.52		mJ	V_{DS} = 1200 V, V_{GS} = -5/20 V, I_D = 50 A, $R_{G(ext)}$ = 2.5 Ω, L = 99 µH, T_J = 150 °C, Using SiC Diode as FWD	Fig. 26, 29b Note 2
Turn Off Switching Energy (SiC Diode FWD)	E_{OFF}		0.43				
Turn-On Switching Energy (Body Diode FWD)	E_{ON}		2.0		mJ	V_{DS} = 1200 V, V_{GS} = -5/20 V, I_D = 50 A, $R_{G(ext)}$ = 2.5 Ω, L = 99 µH, T_J = 150 °C, Using MOSFET as FWD	Fig. 26, 29a Note 2
Turn Off Switching Energy (Body Diode FWD)	E_{OFF}		0.31				
Turn-On Delay Time	$t_{d(on)}$		15		ns	V_{DD} = 1200 V, V_{GS} = -5/20 V I_D = 50 A, $R_{G(ext)}$ = 2.5 Ω, Timing Relative to V_{DS} Inductive Load	Fig. 27, 29 Note 2
Rise Time	t_r		18				
Turn-Off Delay Time	$t_{d(off)}$		34				
Fall Time	t_f		12				
Internal Gate Resistance	$R_{G(int)}$		1.3		Ω	f = 1 MHz, V_{AC} = 25 mV	
Gate to Source Charge	Q_{gs}		46		nC	V_{DS} = 1200 V, V_{GS} = -5/20 V I_D = 50 A Per IEC60747-8-4 pg 21	Fig. 12
Gate to Drain Charge	Q_{gd}		71				
Total Gate Charge	Q_g		204				

Note (3): $C_{o(er)}$, a lumped capacitance that gives same stored energy as coss while V_{DS} is rising from 0 to 1200 V.
$C_{o(tr)}$, a lumped capacitance that gives same charging time as coss while V_{DS} is rising from 0 to 1200 V.

Reverse Diode Characteristics

Parameter	Symbol	Typ.	Max.	Unit	Test Conditions	Note
Diode Forward Voltage	V_{SD}	3.8		V	V_{GS} = -5 V, I_{SD} = 25 A	Fig. 8, 9, 10 Note 1
		3.4			V_{GS} = -5 V, I_{SD} = 25 A, T_J = 150 °C	
Continuous Diode Forward Current	I_S		76	A	V_{GS} = -5 V, T_C = 25 °C	Note 1
Diode Pulse Current	$I_{S, pulse}$		160		V_{GS} = -5 V, Pulse Width t_P Limited by T_{jmax}	Note 1
Reverse Recovery Time	t_{rr}	44		ns	V_{GS} = -5 V, I_{SD} = 50 A , V_R = 1200 V dif/dt = 4030 A/µs, T_J = 150 °C	
Reverse Recovery Charge	Q_{rr}	1.9		µC		
Peak Reverse Recovery Current	I_{rrm}	64		A		
Reverse Recovery Time	t_{rr}	25		ns	V_{GS} = -5 V, I_{SD} = 50 A , V_R = 1200 V dif/dt = 13450 A/µs, T_J = 150 °C	
Reverse Recovery Charge	Q_{rr}	2.4		µC		
Peak Reverse Recovery Current	I_{rrm}	166		A		

Thermal Characteristics

Parameter	Symbol	Typ.	Max	Unit	Test Conditions	Note
Thermal Resistance from Junction to Case	$R_{\theta JC}$	0.22	0.37	°C/W		Fig. 21
Thermal Resistance from Junction to Ambient	$R_{\theta JC}$		40			

Typical Performance

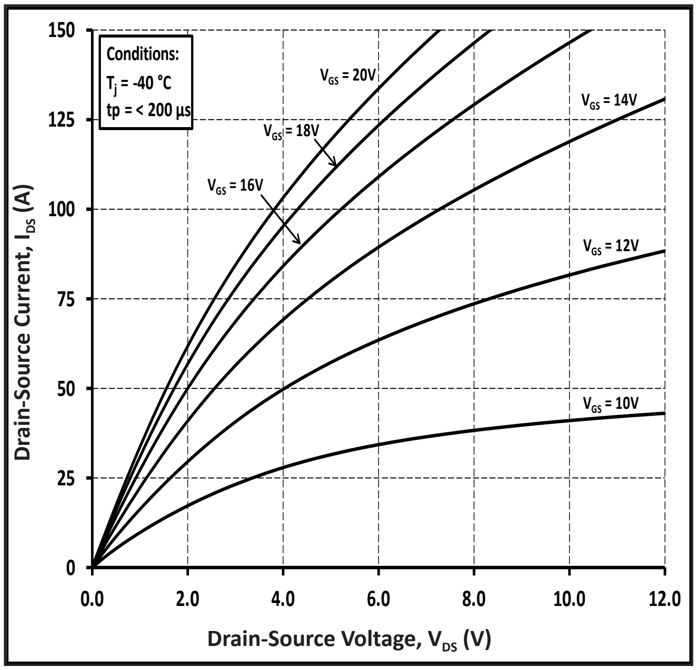

Figure 1. Output Characteristics T_J = -40 °C

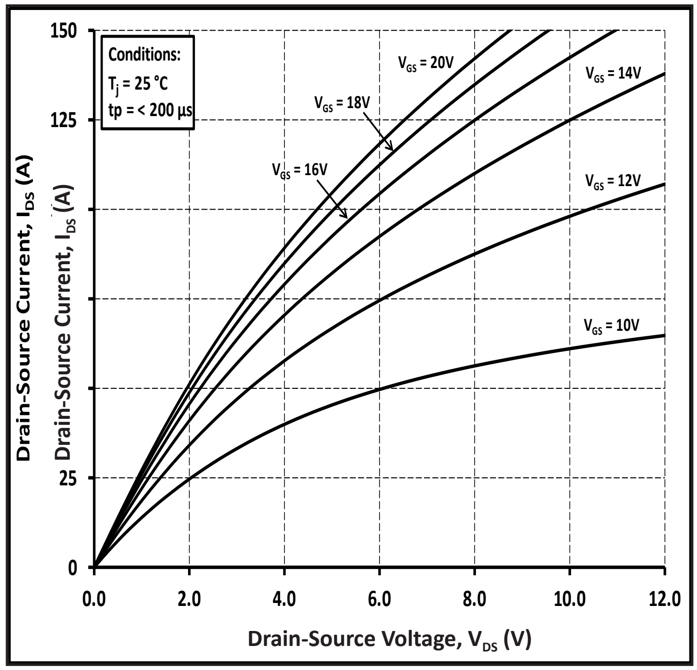

Figure 2. Output Characteristics T_J = 25 °C

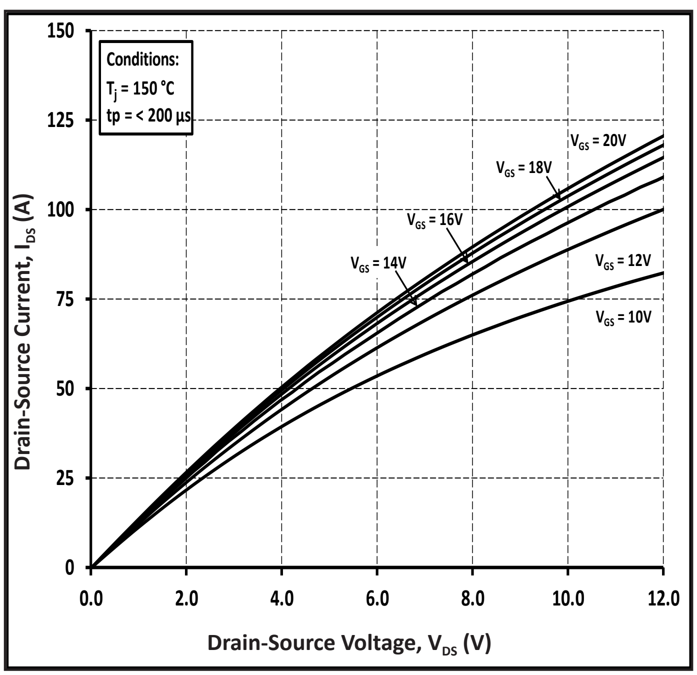

Figure 3. Output Characteristics T_J = 150 °C

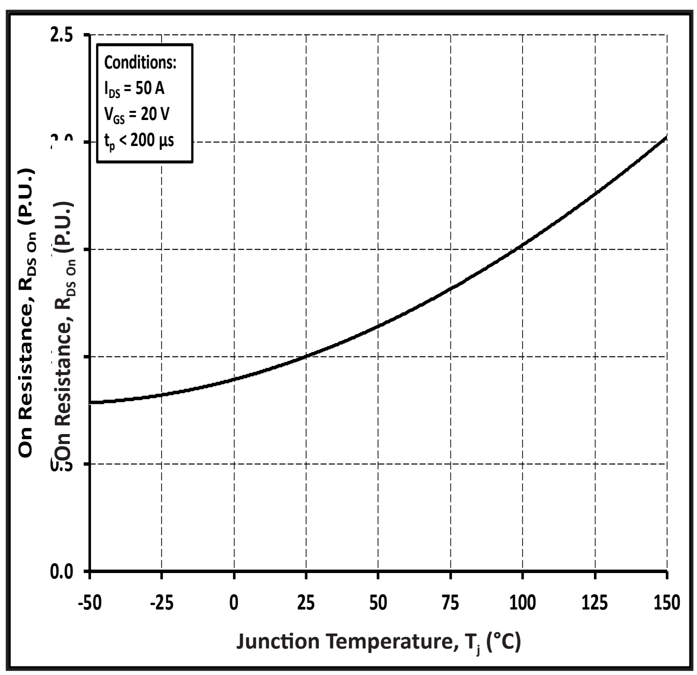

Figure 4. Normalized On-Resistance vs Temperature

Typical Performance

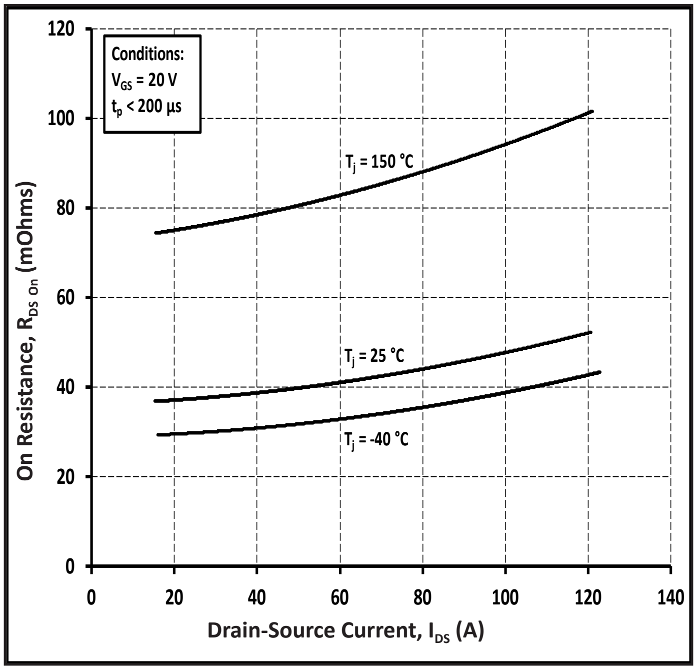

Figure 5. On-Resistance vs Drain Current for Various Temperatures

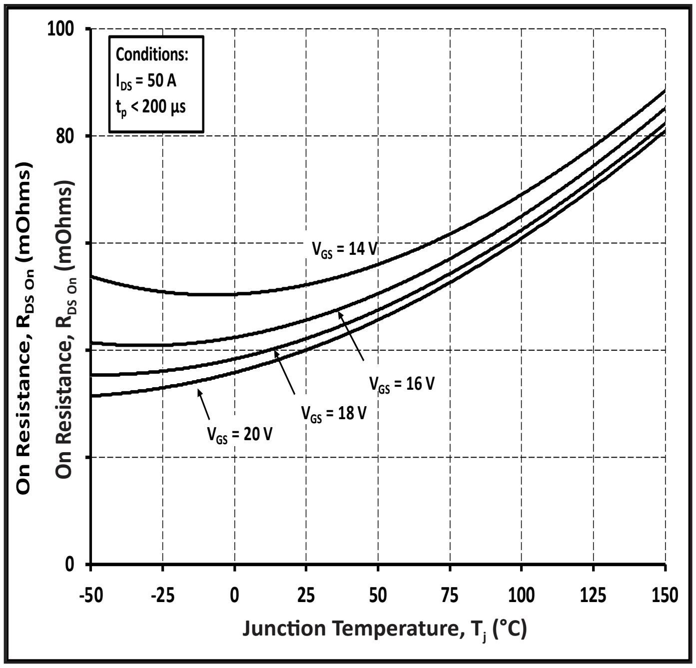

Figure 6. On-Resistance vs Temperature for Various Gate Voltage

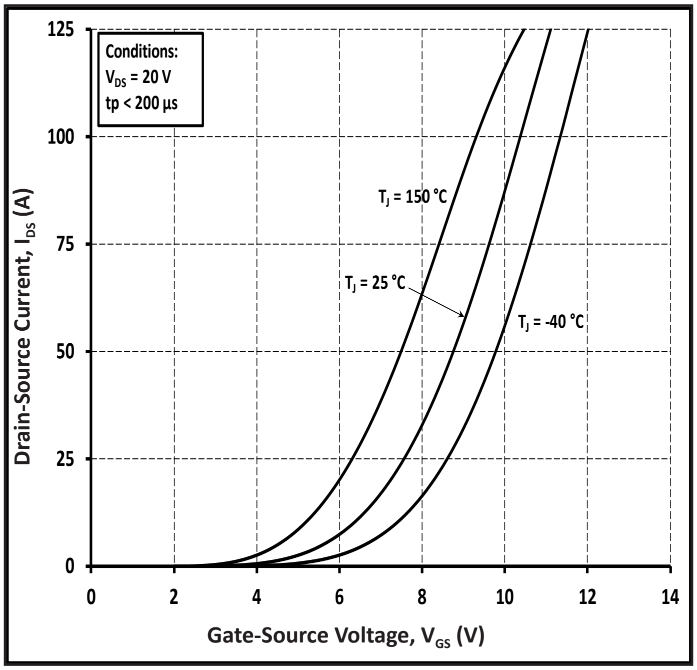

Figure 7. Transfer Characteristic for Various Junction Temperatures

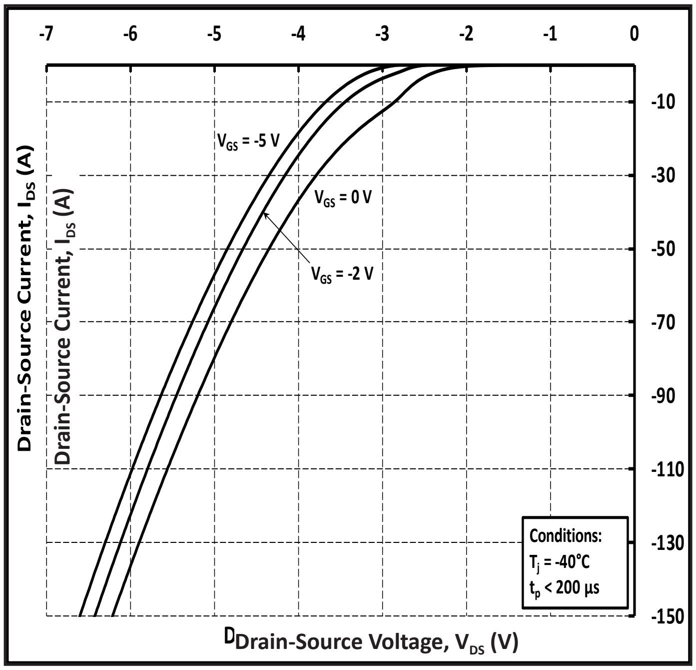

Figure 8. Body Diode Characteristic at -40 °C

Typical Performance

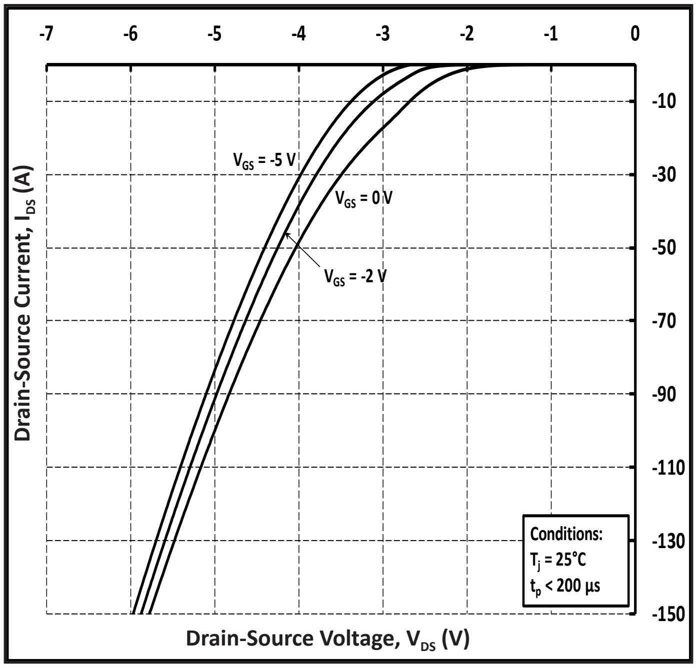

Figure 9. Body Diode Characteristic at 25 °C

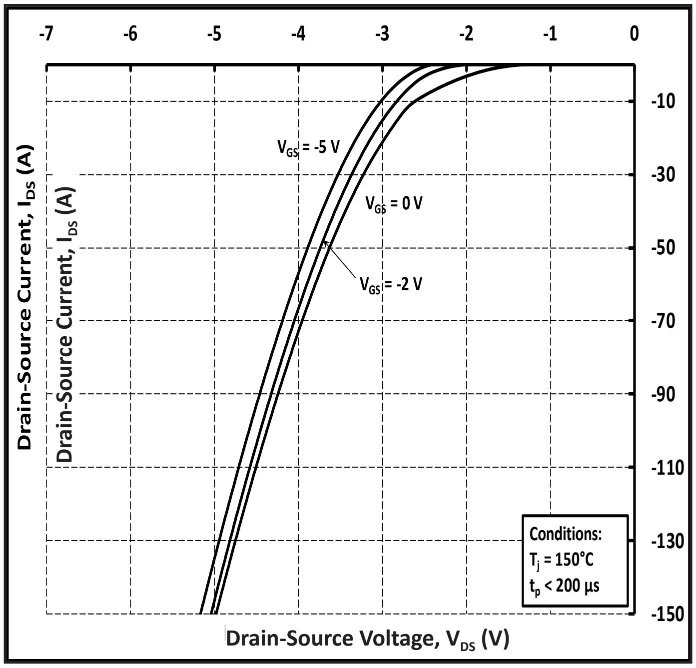

Figure 10. Body Diode Characteristic at 150 °C

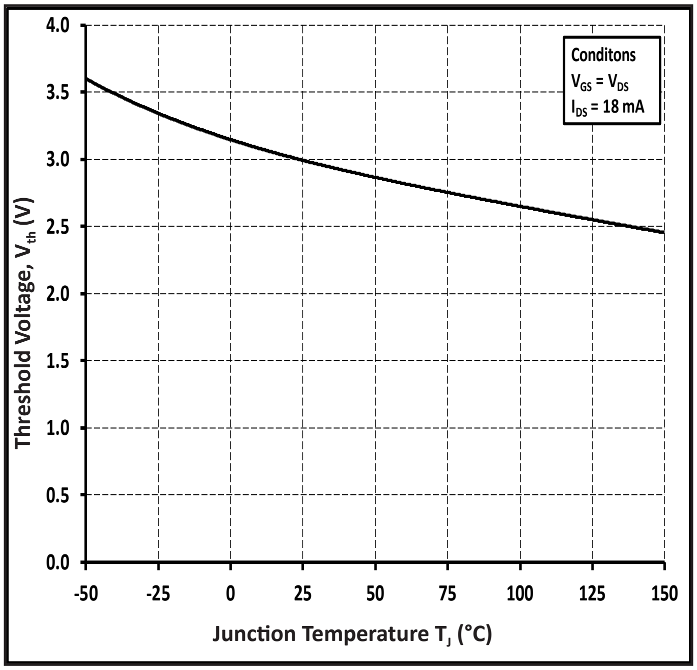

Figure 11. Threshold Voltage vs Temperature

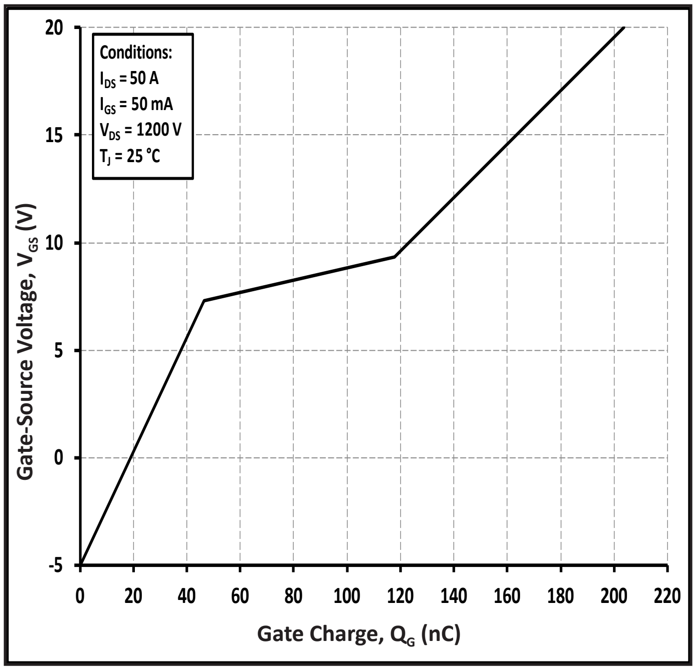

Figure 12. Gate Charge Characteristic

Typical Performance

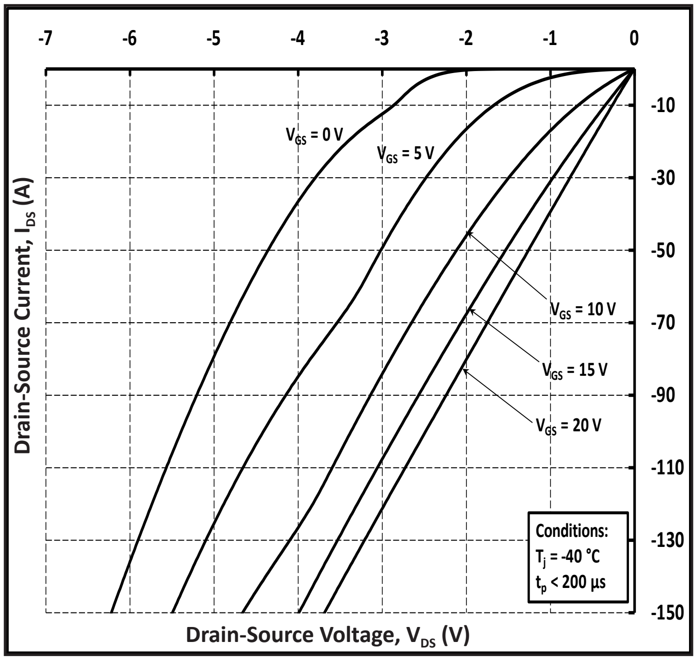

Figure 13. 3rd Quadrant Characteristic at -40 °C

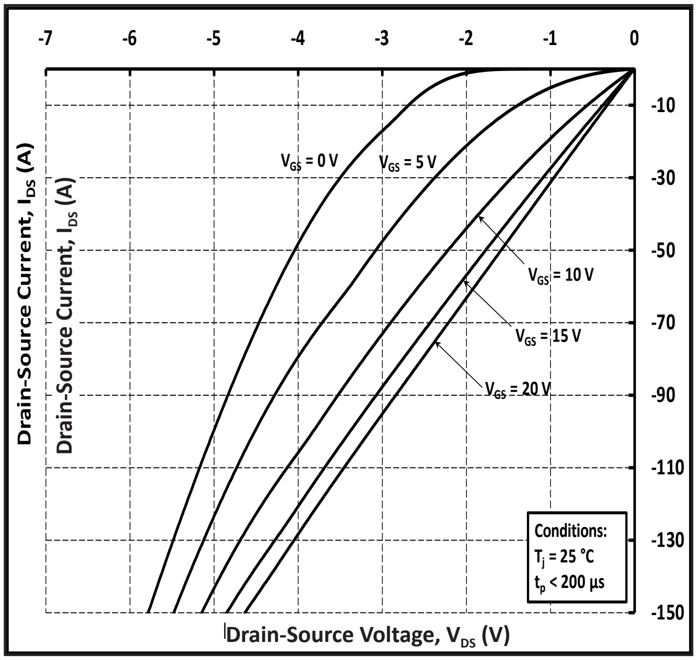

Figure 14. 3rd Quadrant Characteristic at 25 °C

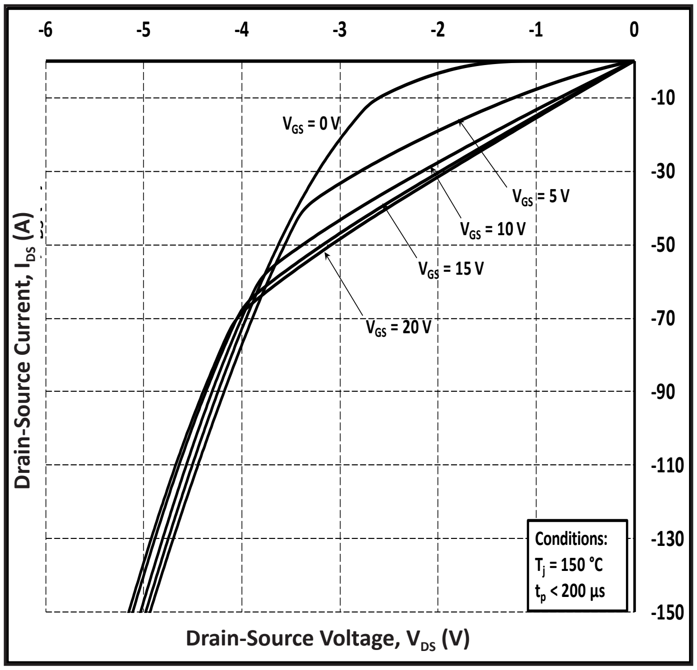

Figure 15. 3rd Quadrant Characteristic at 150 °C

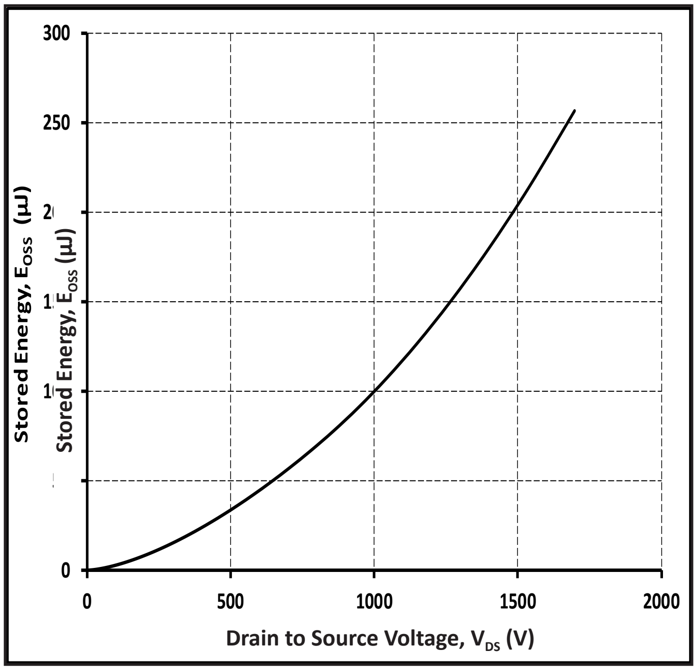

Figure 16. Output Capacitor Stored Energy

Typical Performance

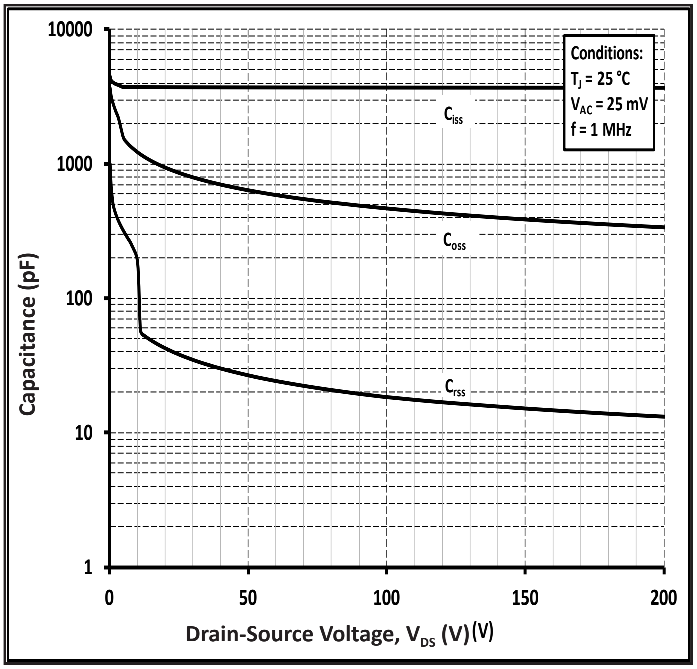

Figure 17. Capacitances vs Drain-Source Voltage (0-200 V)

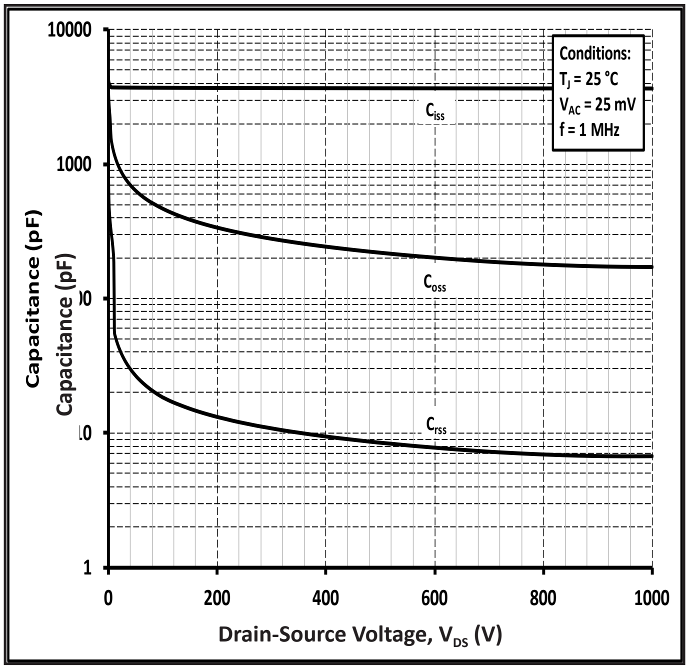

Figure 18. Capacitances vs Drain-Source Voltage (0-1000 V)

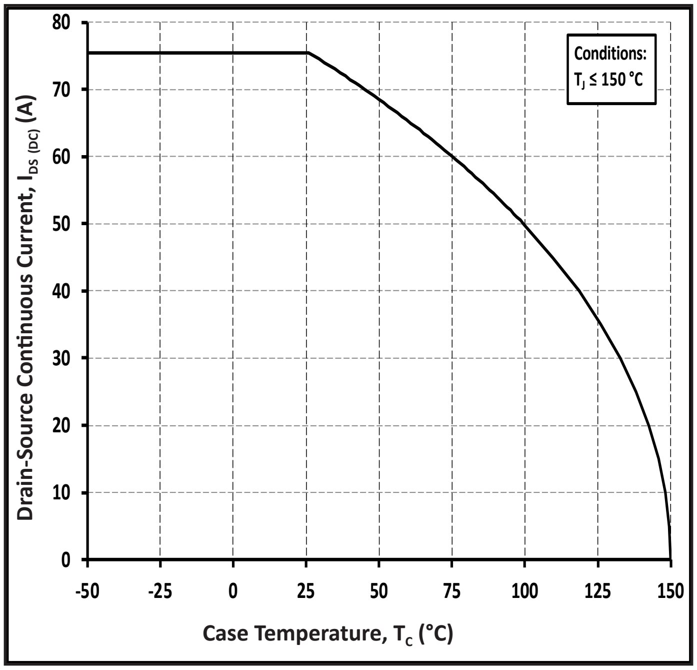

Figure 19. Continuous Drain Current Derating vs Case Temperature

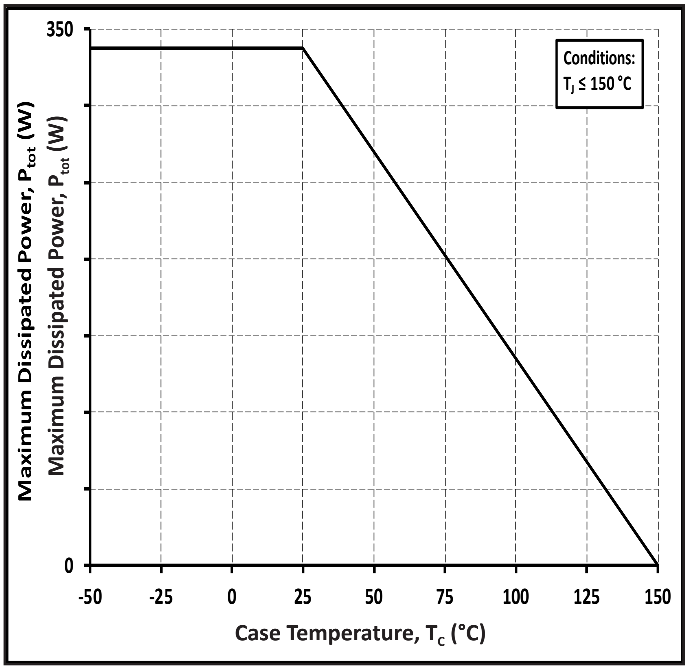

Figure 20. Maximum Power Dissipation Derating vs Case Temperature

Typical Performance

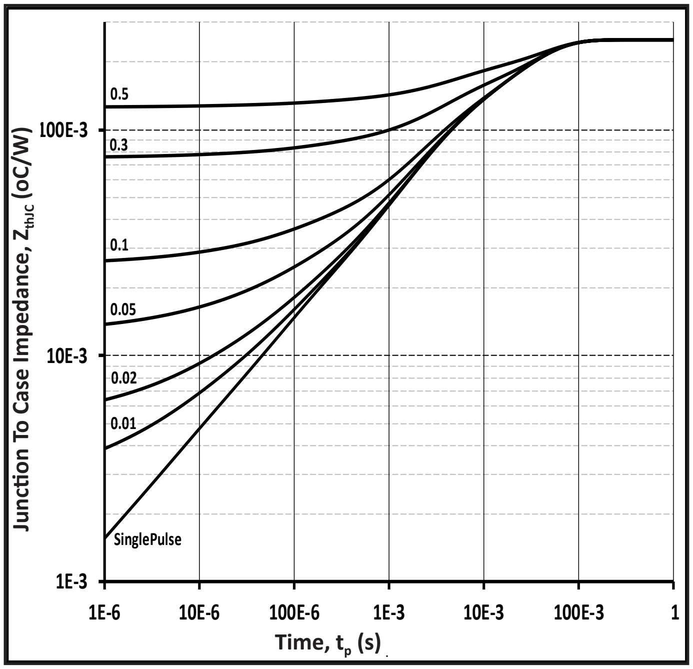

Figure 21. Transient Thermal Impedance (Junction - Case)

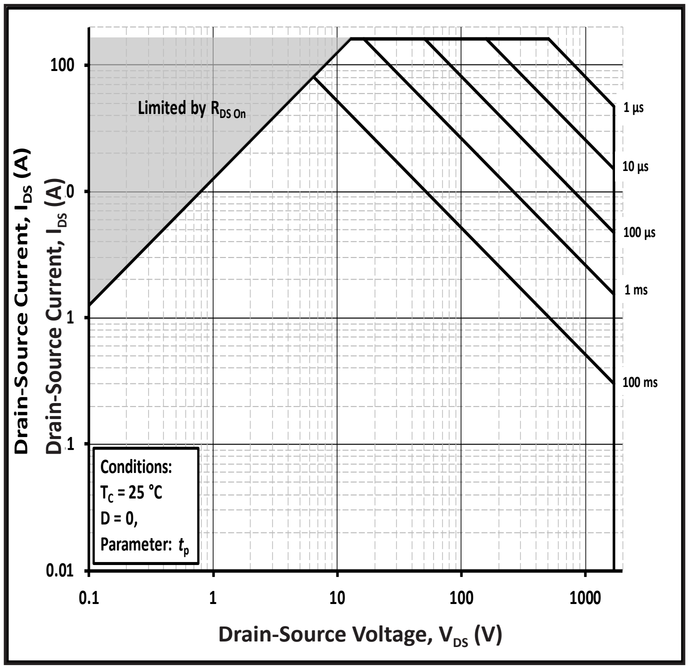

Figure 22. Safe Operating Area

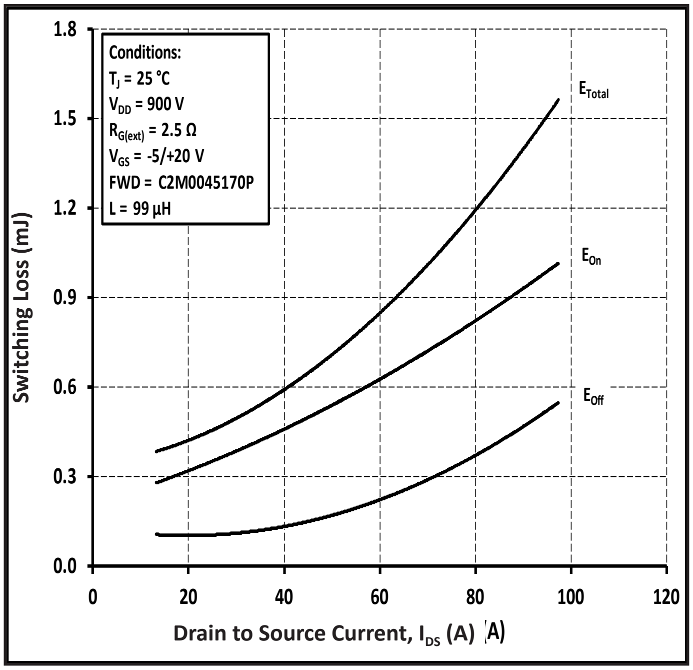

Figure 23. Clamped Inductive Switching Energy vs Drain Current (V_{DD} = 900 V)

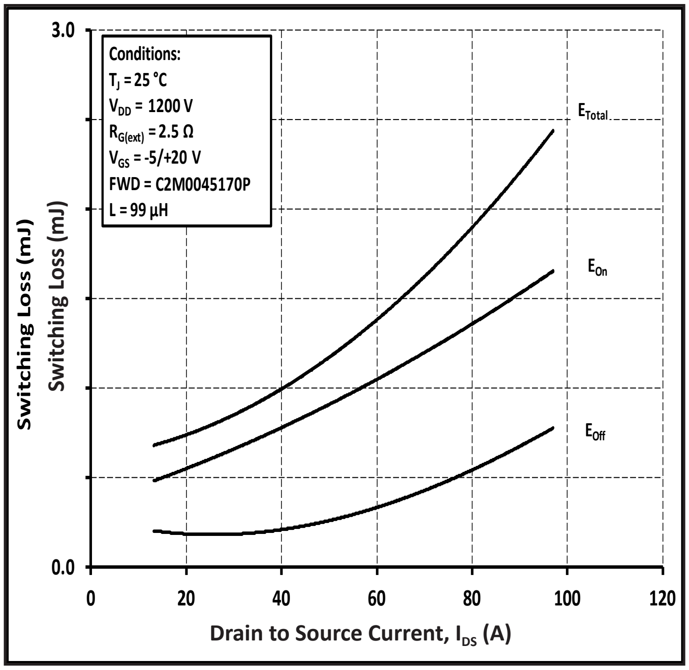

Figure 24. Clamped Inductive Switching Energy vs Drain Current (V_{DD} = 1200 V)

Typical Performance

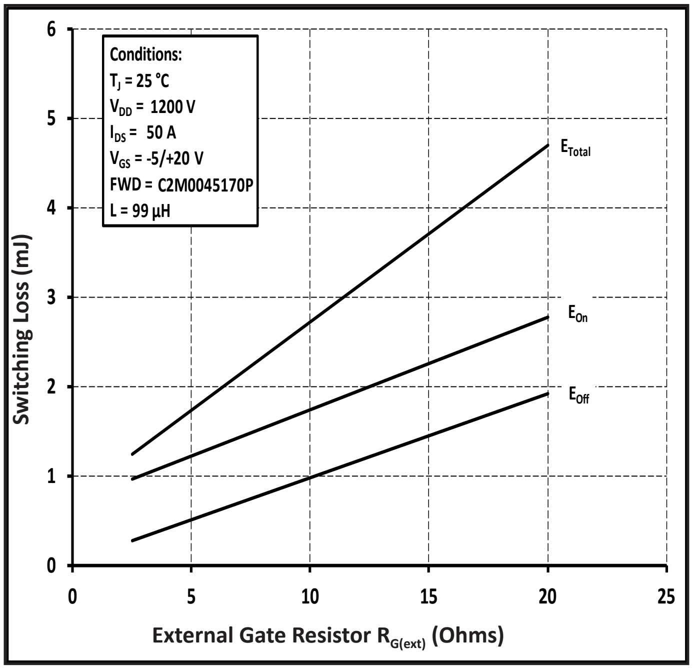

Figure 25. Clamped Inductive Switching Energy vs $R_{G(ext)}$

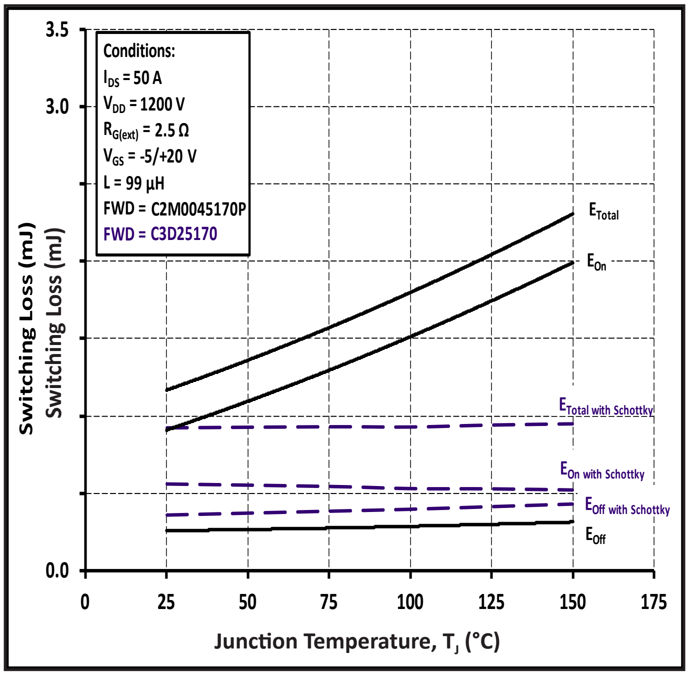

Figure 26. Clamped Inductive Switching Energy vs Temperature

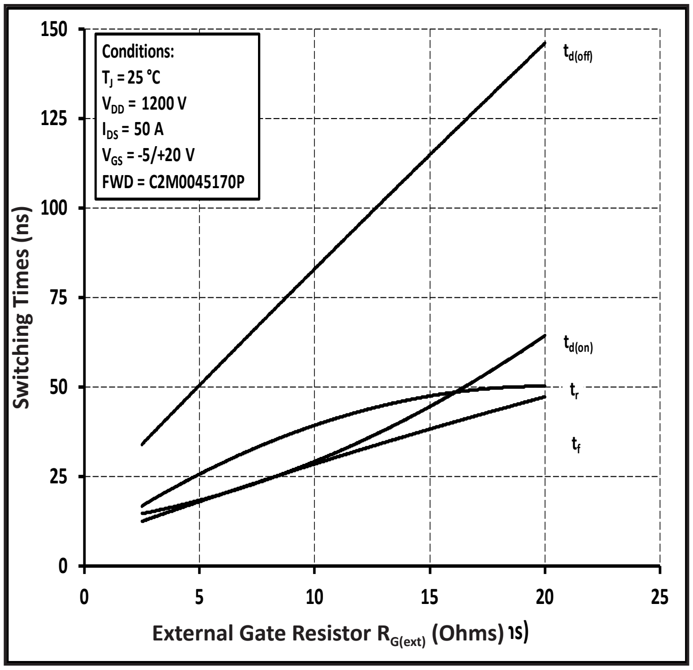

Figure 27. Switching Times vs $R_{G(ext)}$

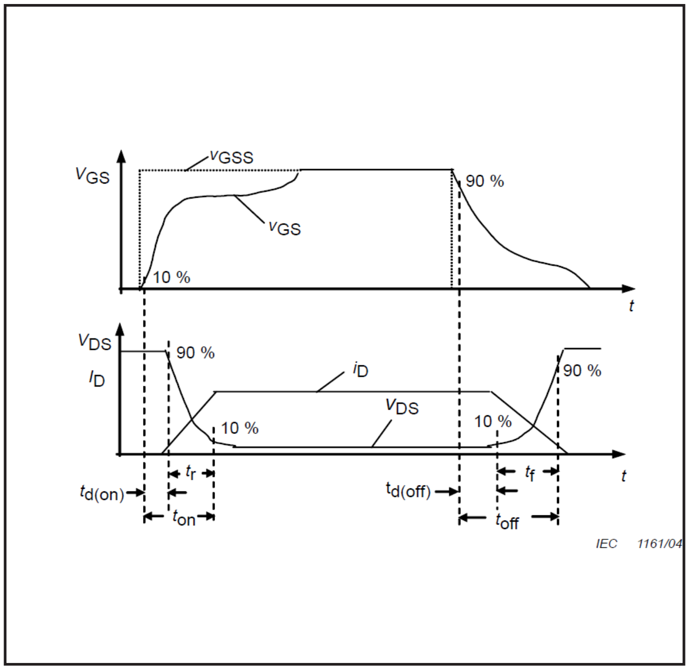

Figure 28. Switching Times Definition

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Test Circuit Schematic

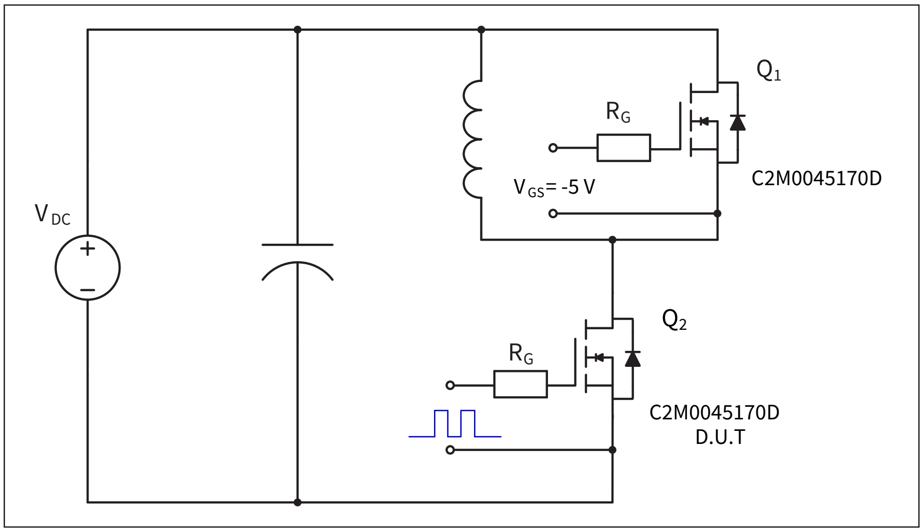


Figure 29a. Clamped Inductive Switching Test Circuit Using MOSFET Intristic Body Diode

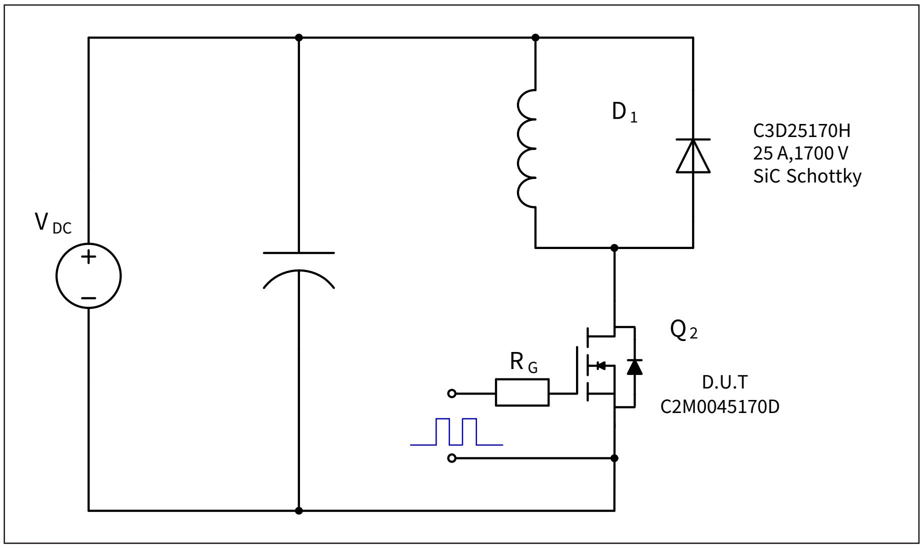
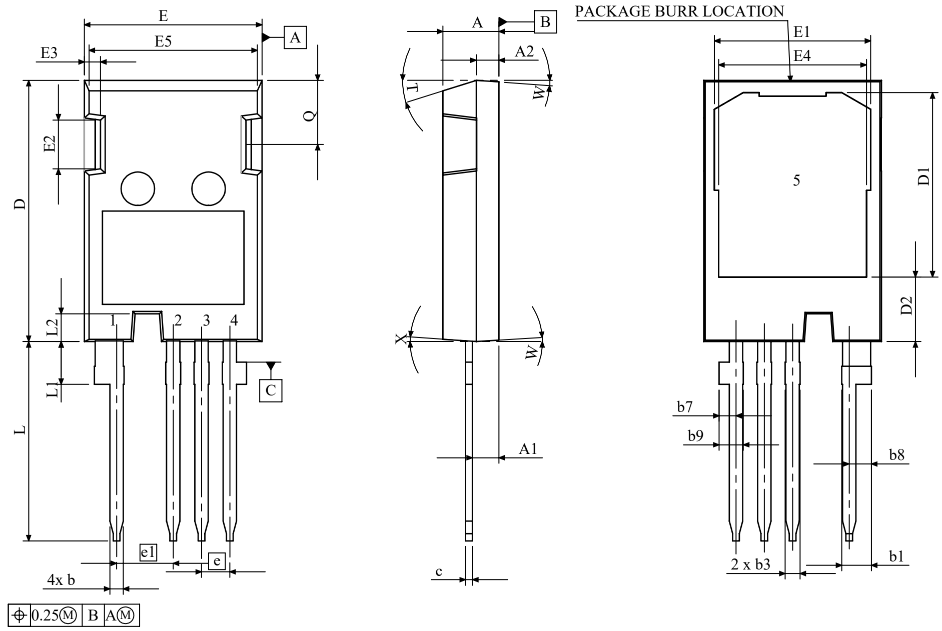


Figure 29b. Clamped Inductive Switching Test Circuit Using SiC Schottky Diode

Package Dimensions

Package: TO-247-4L



SYMBOL	MIN (mm)	MAX (mm)
A	4.83	5.21
A1	2.24	2.54
A2	1.91	2.16
b	1.07	1.33
b1	2.39	2.94
b3	1.07	1.60
b7	1.30	1.70
b8	1.80	2.20
b9	2.00	2.40
c	0.55	0.68
D	23.30	23.60
D1	16.25	17.65
D2	5.55	5.95
E	15.75	16.13
E1	13.1	14.15
E2	3.68	5.10
E3	1.00	1.90
E4	12.38	13.43
E5	14.65	15.05
e	2.54 BSC	
e1	5.08 BSC	
L	17.27	17.82
L1	3.97	4.37
L2	2.35	2.65
Q	5.49	6.00
T	17.5° REF.	
W	3.5° REF.	
X	4° REF.	

1	DRAIN
2	SOURCE
3	DRIVER SOURCE
4	GATE
5	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. BURR OR MOLD FLASH SIZE (0.5 mm) IS NOT INCLUDED IN THE DIMENSIONS

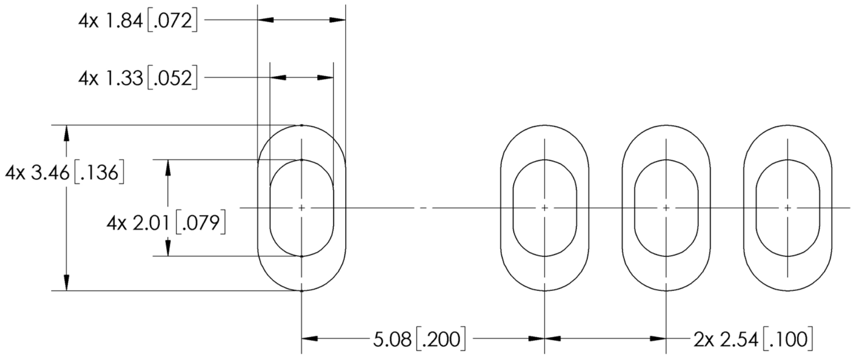
Wolfspeed

TITLE: PACKAGE OUTLINE DRAWING: TO-247-4L PLUS

Date: 05/10/24 | REVISION NO. 4 | A4

PRD-05969 | SCALE:1:1 | SHEET 1 OF 1

Recommended Solder Pad Layout



Part Number	Package	Marking
C2M0045170P	TO-247-4L	C2M0045170P

Revision History

Current Revision	Date of Release	Description of Changes
2	May-2022	Initial Release
3	October-2023	Wolfspeed branding, POD, Package image, Solder Temp conditions note changed to JEDEC standard
4	November-2023	Corrected POD A1, D2, and L
5	February-2024	Corrected Qrr units
6	October - 2024	Legal Statement, POD Updated

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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.SVHC Declaration. REACh banned substance information (REACh Article 67) is also available upon request.

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