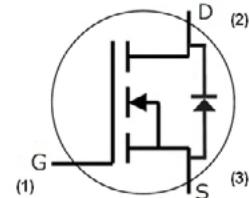


# C2M0025120D

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

## Features

- High Blocking Voltage with Low On-Resistance
- High Speed Switching with Low Capacitances
- Easy to Parallel and Simple to Drive
- Avalanche Ruggedness
- Resistant to Latch-Up
- Halogen Free, RoHS Compliant



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.

Ordering Part Number	Package	Marking
C2M0025120D	TO-247-3	C2M0025120

## Typical Applications

- Solar inverters
- Switch Mode Power Supplies
- High Voltage DC/DC converters
- Battery Chargers
- Motor Drive
- Pulsed Power Applications

## Benefits

- Higher system efficiency
- Reduce cooling requirements
- Increase power density
- Increase system switching frequency

## Key Parameters

Parameter	Symbol	Min.	Typ.	Max	Unit	Conditions	Note
Drain - Source Voltage	$V_{DS}$			1200	v	$T_c = 25^\circ\text{C}$	
Maximum Gate - Source Voltage	$V_{GS(max)}$	-10		+25		Transient	
Operational Gate-Source Voltage	$V_{GSop}$		-5/20			Static	Note 1
DC Continuous Drain Current	$I_D$			63	A	$V_{GS} = 20\text{ V}, T_c = 25^\circ\text{C}, T_J \leq 150^\circ\text{C}$	Fig. 19
				39		$V_{GS} = 20\text{ V}, T_c = 100^\circ\text{C}, T_J \leq 150^\circ\text{C}$	Note 2
Pulsed Drain Current	$I_{DM}$			250		$t_{pmax}$ limited by $T_{Jmax}$ $V_{GS} = 20\text{ V}, T_c = 25^\circ\text{C}$	Fig. 22
Power Dissipation	$P_D$			378	W	$T_c = 25^\circ\text{C}, T_J = 150^\circ\text{C}$	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	
Mounting Torque	$M_D$			1	Nm lbf-in	M3 or 6-32 screw	
				8.8			

Note (1): Recommended turn-on gate voltage is 20V with  $\pm 5\%$  regulation tolerance, see Application Note PRD-04814 for additional details

Note (2): Verified by design


**Electrical Characteristics** ( $T_C = 25^\circ\text{C}$  unless otherwise specified)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test Conditions	Note
Drain-Source Breakdown Voltage	$V_{(BR)DSS}$	1200	—	—	V	$V_{GS} = 0\text{ V}, I_D = 100\ \mu\text{A}$	Fig. 11
Gate Threshold Voltage	$V_{GS(th)}$	2.0	2.6	4		$V_{DS} = V_{GS}, I_D = 15\ \text{mA}$	
		—	2.3	—		$V_{DS} = V_{GS}, I_D = 25\ \text{mA}, T_J = 150^\circ\text{C}$	
Zero Gate Voltage Drain Current	$I_{DSS}$	—	2	100	$\mu\text{A}$	$V_{DS} = 1200\ \text{V}, V_{GS} = 0\ \text{V}$	
Gate-Source Leakage Current	$I_{GSS}$	—	—	250	nA	$V_{GS} = 20\ \text{V}, V_{DS} = 0\ \text{V}$	
Drain-Source On-State Resistance	$R_{DS(on)}$	—	25	34	m $\Omega$	$V_{GS} = 20\ \text{V}, I_D = 50\ \text{A}$	Fig. 4, 5, 6
		—	41	—		$V_{GS} = 20\ \text{V}, I_D = 50\ \text{A}, T_J = 150^\circ\text{C}$	
Transconductance	$g_{fs}$	—	24.6	—	S	$V_{DS} = 20\ \text{V}, I_{DS} = 50\ \text{A}$	Fig. 7
			24			$V_{DS} = 20\ \text{V}, I_{DS} = 50\ \text{A}, T_J = 150^\circ\text{C}$	
Input Capacitance	$C_{iss}$	—	3140	—	pF	$V_{GS} = 0\ \text{V}, V_{DS} = 1000\ \text{V}$ $f = 1\ \text{MHz}$ $V_{AC} = 25\ \text{mV}$	Fig. 17, 18
Output Capacitance	$C_{oss}$	—	224	—			
Reverse Transfer Capacitance	$C_{rss}$	—	9	—			
$C_{oss}$ Stored Energy	$E_{oss}$	—	128	—			
Turn-On Switching Energy (Body Diode)	$E_{on}$	—	2.18	—	mJ	$V_{DS} = 800\ \text{V}, V_{GS} = -5\ \text{V}/+20\ \text{V}, I_D = 50\ \text{A},$ $R_{G(ext)} = 2.5\ \Omega, L = 99\ \mu\text{H}$ FWD = Internal Body Diode of MOSFET	Fig. 26
Turn Off Switching Energy ((Body Diode)	$E_{off}$	—	0.68	—			
Turn-On Switching Energy (External SiC Diode)	$E_{on}$	—	1.14	—			
Turn Off Switching Energy (External SiC Diode)	$E_{off}$	—	0.8	—			
Turn-On Delay Time	$t_{d(on)}$	—	15	—	ns	$V_{DD} = 800\ \text{V}, V_{GS} = -5\ \text{V}/20\ \text{V}, I_D = 50\ \text{A},$ $R_{G(ext)} = 2.5\ \Omega,$ Inductive Load Timing relative to $V_{DS}$ Per IEC60747-8-4 pg 83	Fig. 27
Rise Time	$t_r$	—	58	—			
Turn-Off Delay Time	$t_{d(off)}$	—	33	—			
Fall Time	$t_f$	—	17	—			
Internal Gate Resistance	$R_{G(int)}$	—	1.0	—	$\Omega$	$f = 1\ \text{MHz}, V_{AC} = 25\ \text{mV}, \text{ESR of } C_{iss}$	
Gate to Source Charge	$Q_{gs}$	—	46	—	nC	$V_{DS} = 800\ \text{V}, V_{GS} = -5\ \text{V}/20\ \text{V}$ $I_D = 50\ \text{A}$ Per IEC60747-8-4 pg 21	Fig. 12
Gate to Drain Charge	$Q_{gd}$	—	71.5	—			
Total Gate Charge	$Q_g$	—	194	—			



## Reverse Diode Characteristics

Parameter	Symbol	Typ.	Max.	Unit	Test Conditions	Notes
Diode Forward Voltage	$V_{SD}$	4.1	—	V	$V_{GS} = -5\text{ V}, I_{SD} = 25\text{ A}$	Fig. 8, 9, 10
		3.5	—		$V_{GS} = -5\text{ V}, I_{SD} = 25\text{ A}, T_J = 150^\circ\text{C}$	
Continuous Diode Forward Current <sup>2</sup>	$I_S$	—	63		$V_{GS} = -5\text{ V}, T_C = 25^\circ\text{C}$	Note 2
Diode Pulse Current	$I_{SM}$	—	250		$V_{GS} = -5\text{ V}$ , pulse width $t_P$ limited by $T_{Jmax}$	
Reverse Recovery Time <sup>2</sup>	$t_{rr}$	33	—	ns	$V_{GS} = -5\text{ V}, I_{SD} = 50\text{ A}, T_J = 25^\circ\text{C}$ $V_R = 800\text{ V}$ $di_f/dt = 2180\text{ A}/\mu\text{s}$	Note 2
Reverse Recovery Charge <sup>2</sup>	$Q_{rr}$	487	—	nC		
Peak Reverse Recovery Current <sup>2</sup>	$I_{RRM}$	24	—	A		
Reverse Recovery Time <sup>2</sup>	$t_{rr}$	67	—	ns	$V_{GS} = -5\text{ V}, I_{SD} = 50\text{ A}, T_J = 25^\circ\text{C}$ $V_R = 800\text{ V}$ $di_f/dt = 1320\text{ A}/\mu\text{s}$	Note 2
Reverse Recovery Charge <sup>2</sup>	$Q_{rr}$	386	—	nC		
Peak Reverse Recovery Current <sup>2</sup>	$I_{RRM}$	15	—	A		

Note:

<sup>2</sup>When using SiC Body Diode the maximum recommended  $V_{GS} = -5\text{V}$

## Thermal Characteristics

Parameter	Symbol	Typ.	Max.	Unit	Test Conditions	Notes
Thermal Resistance from Junction to Case	$R_{\theta JC}$	0.24	0.33	°C/W		Fig. 21
Thermal Resistance from Junction to Ambient	$R_{\theta JA}$		40			



Typical Performance

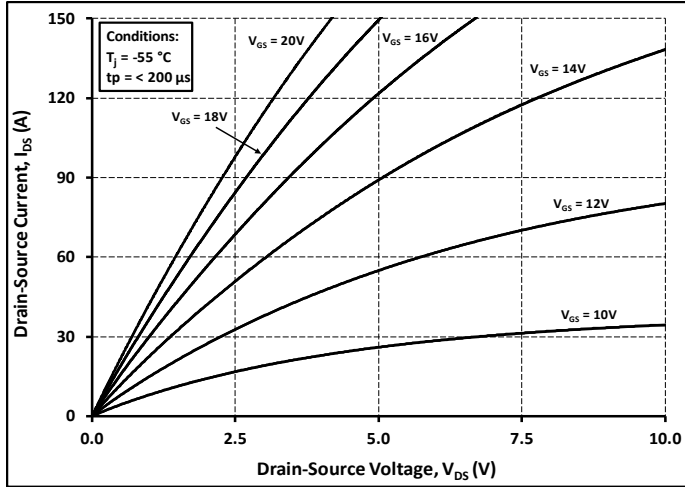


Figure 1. Output Characteristics  $T_j = -55^\circ\text{C}$

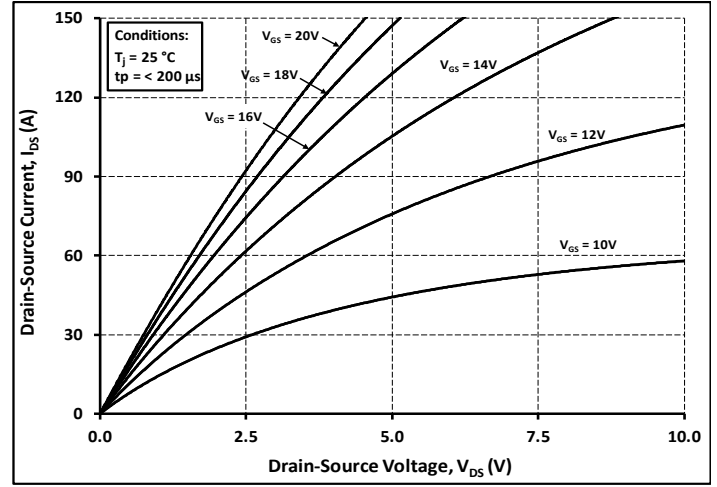


Figure 2. Output Characteristics  $T_j = 25^\circ\text{C}$

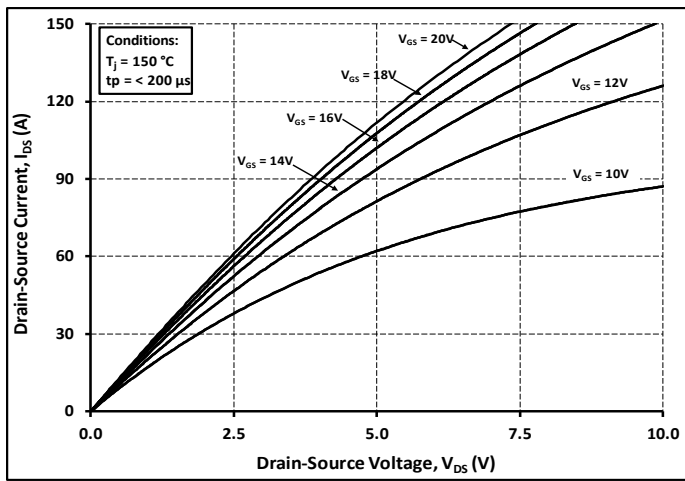


Figure 3. Output Characteristics  $T_j = 150^\circ\text{C}$

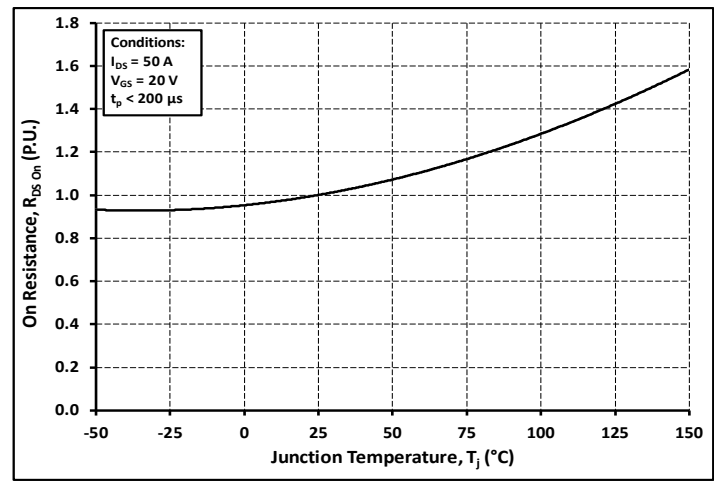


Figure 4. Normalized On-Resistance vs. Temperature

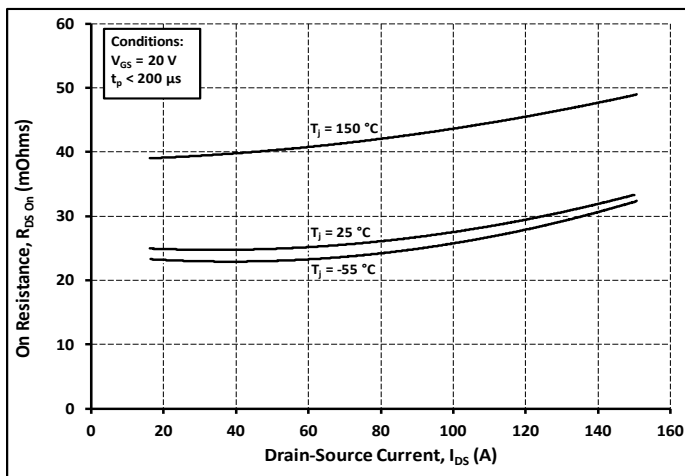


Figure 5. On-Resistance vs. Drain Current For Various Temperatures

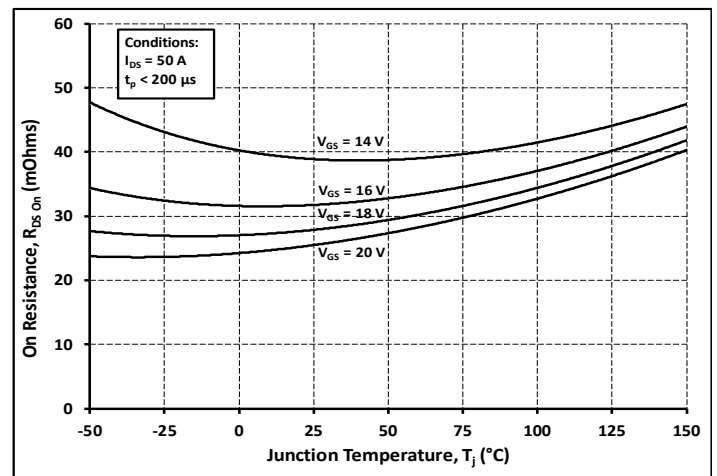


Figure 6. On-Resistance vs. Temperature For Various Gate Voltage



Typical Performance

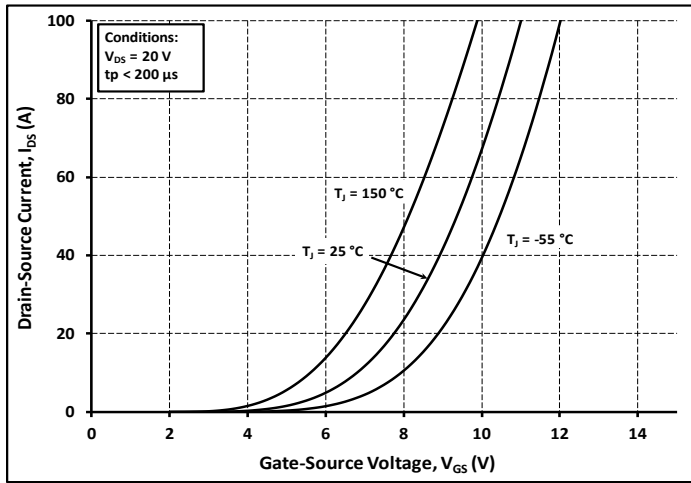


Figure 7. Transfer Characteristic for

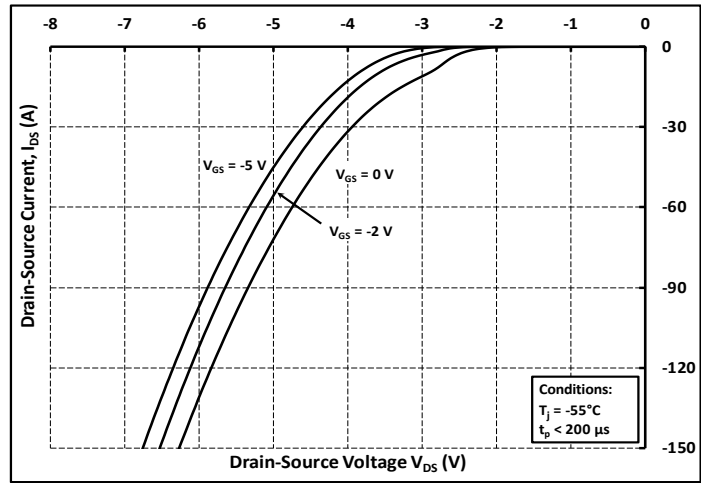


Figure 8. Body Diode Characteristic at -55°C

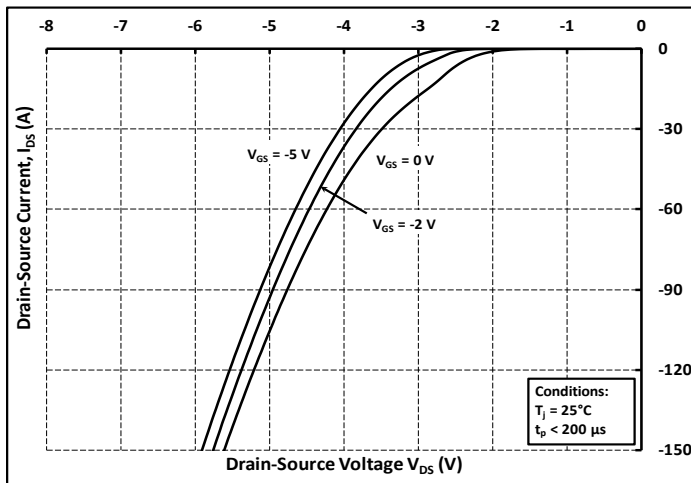


Figure 9. Body Diode Characteristic at 25°C

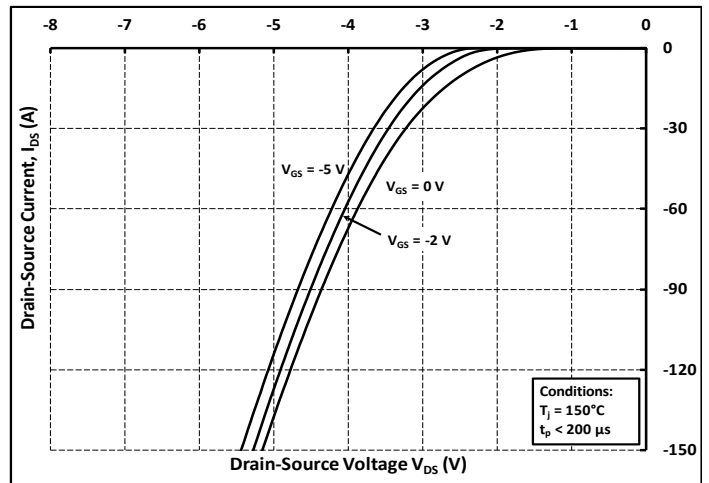


Figure 10. Body Diode Characteristic at 150°C

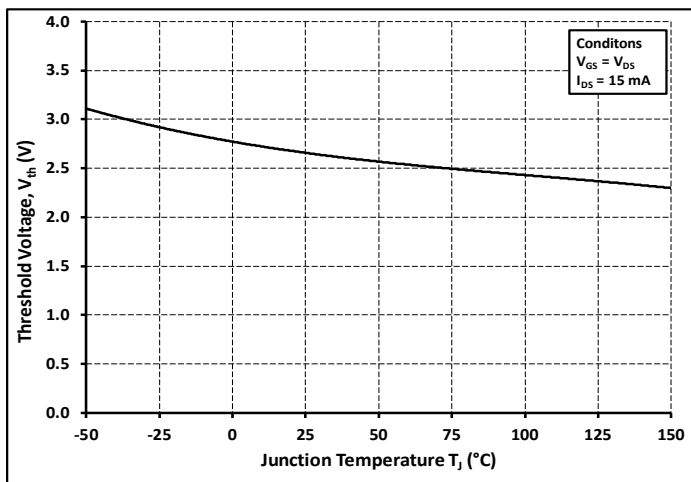


Figure 11. Threshold Voltage vs. Temperature

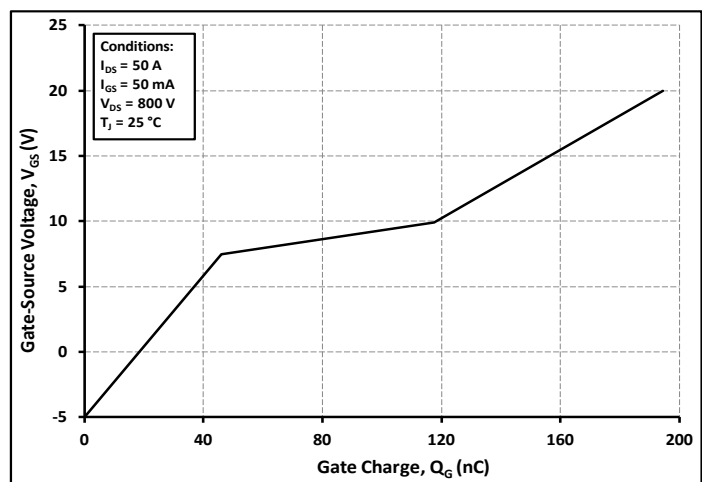


Figure 12. Gate Charge Characteristics



Typical Performance

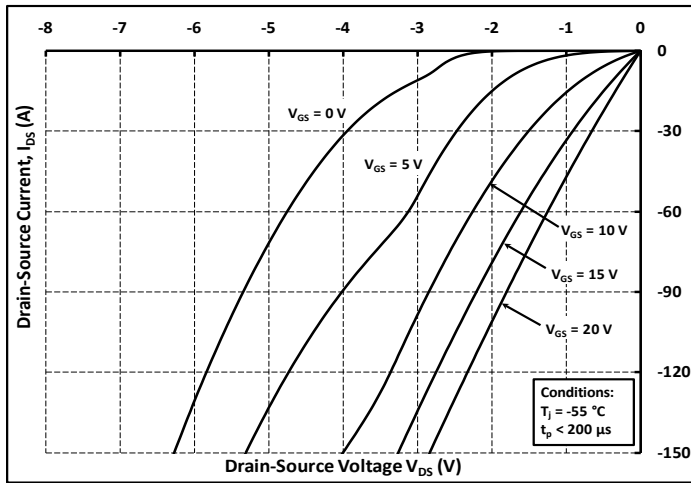


Figure 13. 3rd Quadrant Characteristic at  $-55^\circ\text{C}$

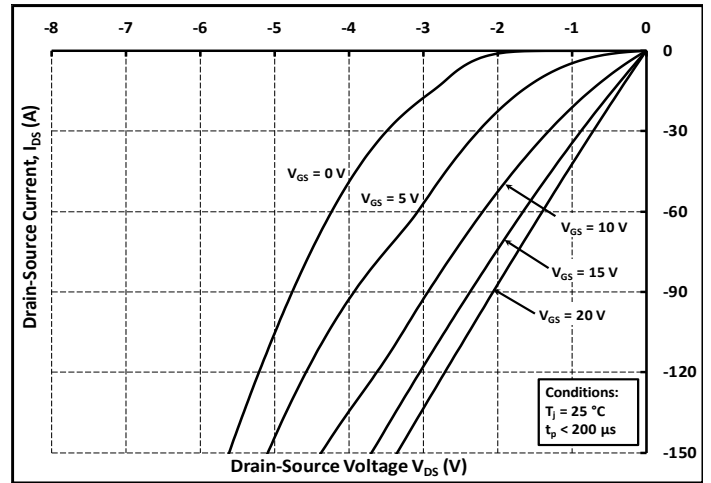


Figure 14. 3rd Quadrant Characteristic at  $25^\circ\text{C}$

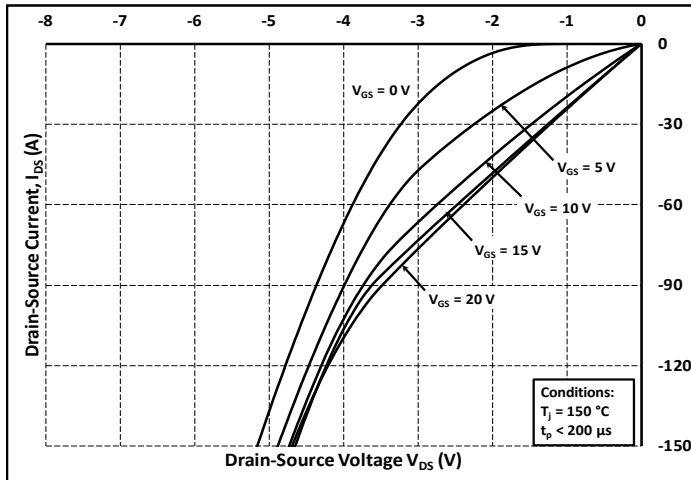


Figure 15. 3rd Quadrant Characteristic at  $150^\circ\text{C}$

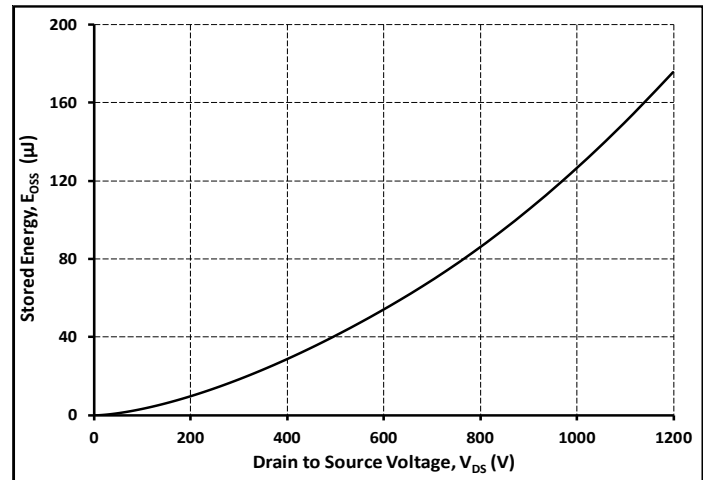


Figure 16. Output Capacitor Stored Energy

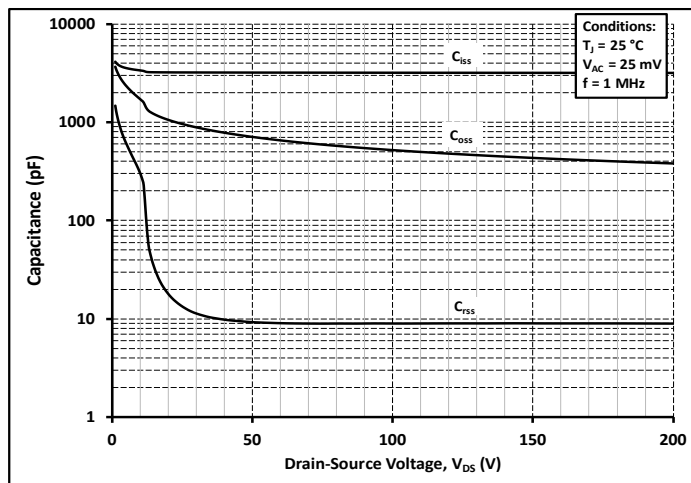


Figure 17. Capacitances vs. Drain-Source

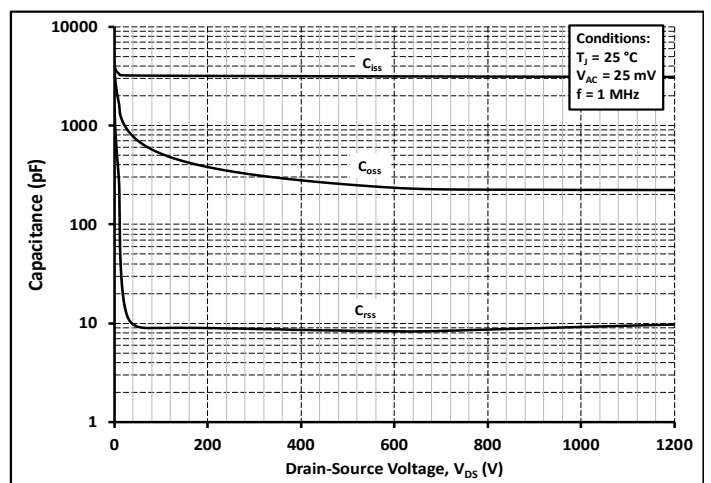


Figure 18. Capacitances vs. Drain-Source



Typical Performance

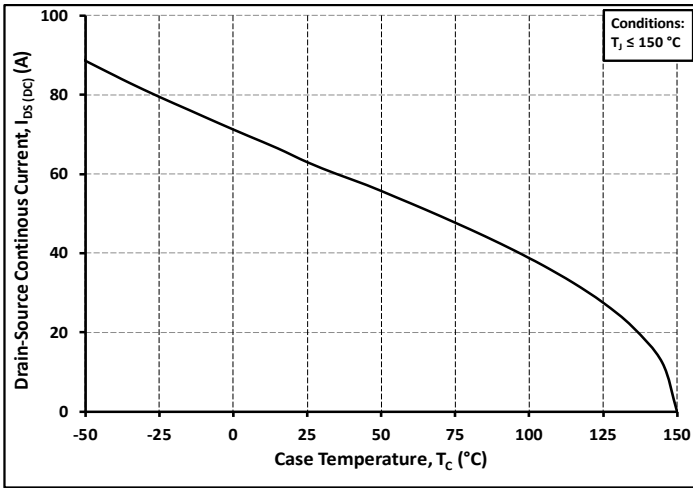


Figure 19. Continuous Drain Current Derating vs. Case Temperature

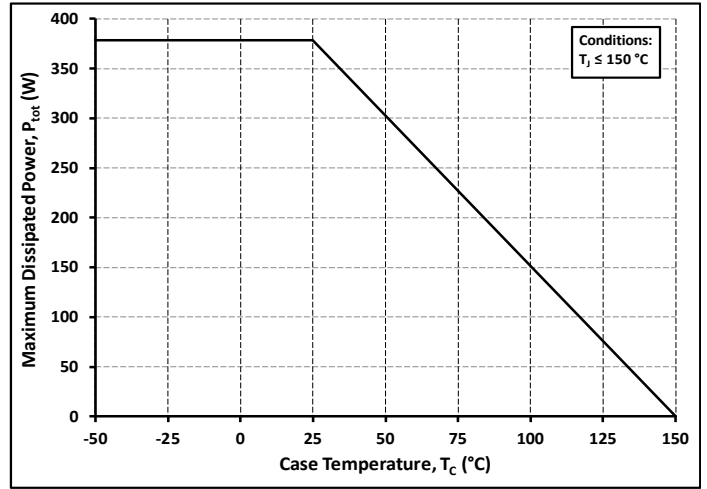


Figure 20. Maximum Power Dissipation Derating vs. Case Temperature

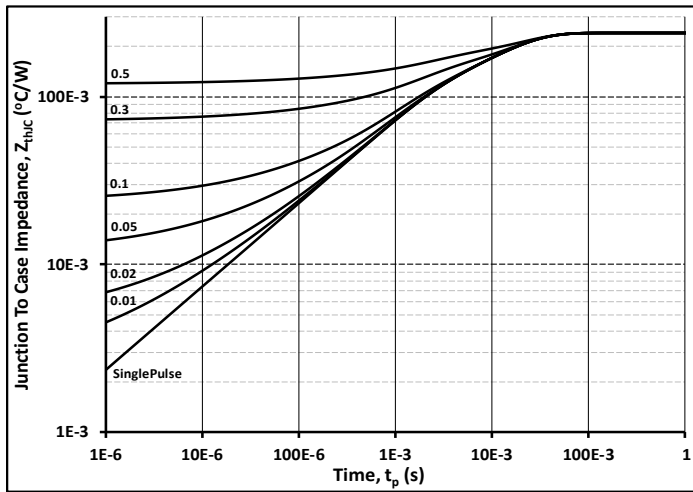


Figure 21. Transient Thermal Impedance

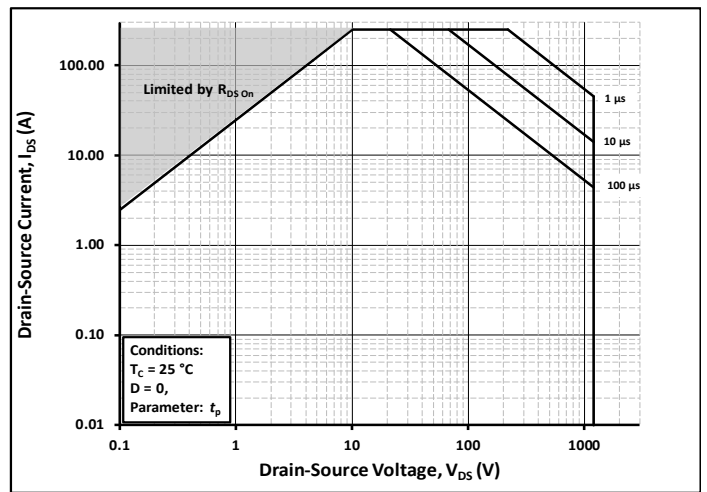


Figure 22. Safe Operating Area

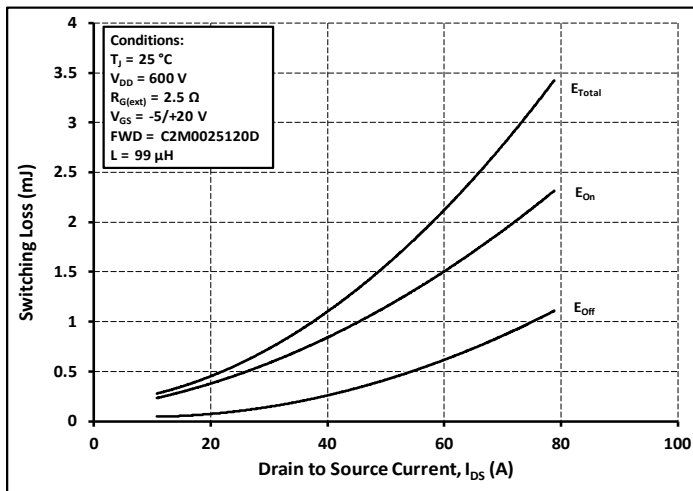


Figure 23. Clamped Inductive Switching Energy

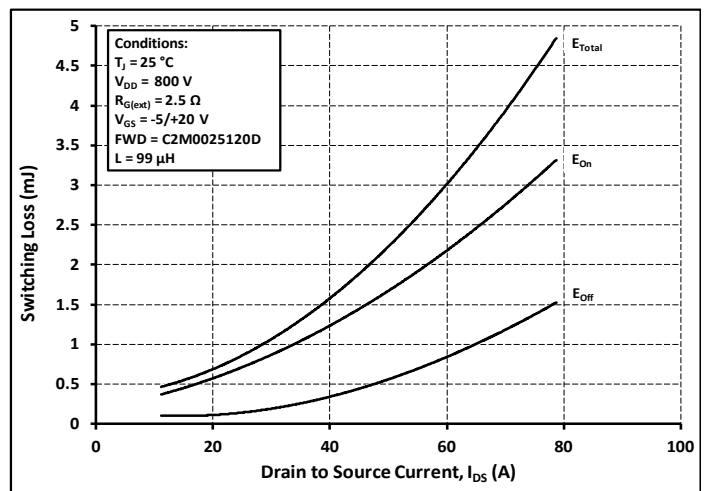


Figure 24. Clamped Inductive Switching Energy



Typical Performance

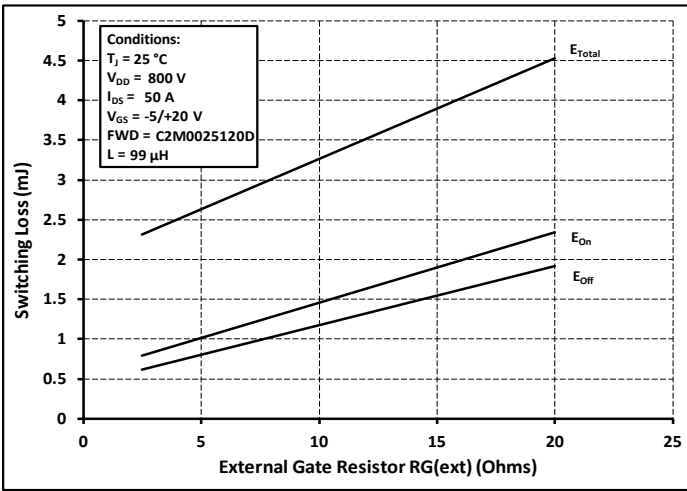


Figure 25. Clamped Inductive Switching Energy vs.  $R_{G(ext)}$

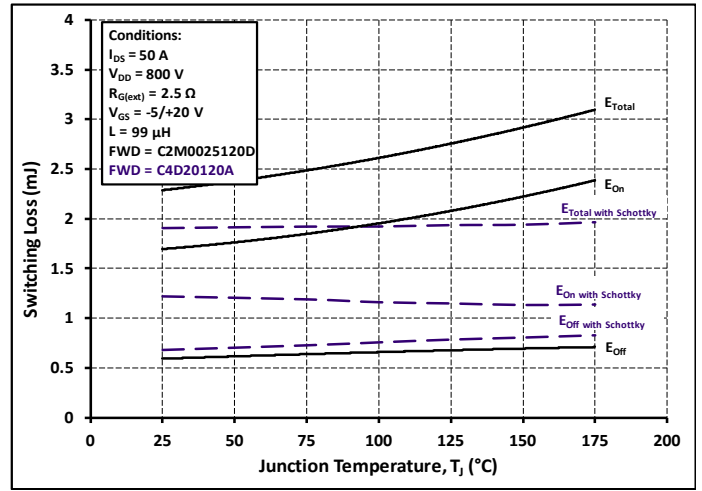


Figure 26. Clamped Inductive Switching Energy

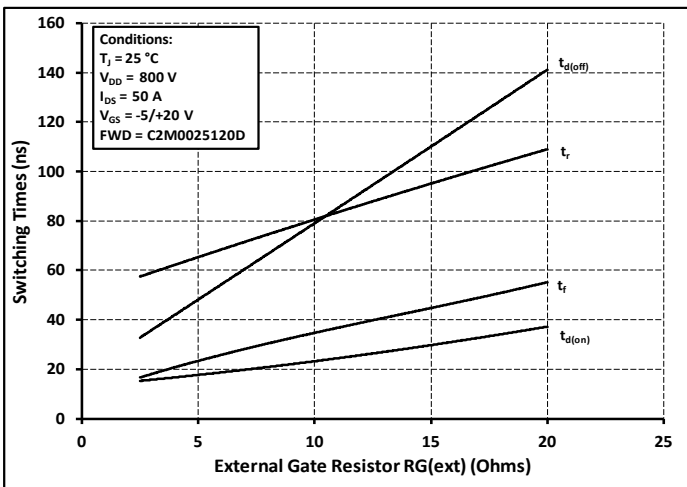


Figure 27. Switching Times vs.  $R_{G(ext)}$

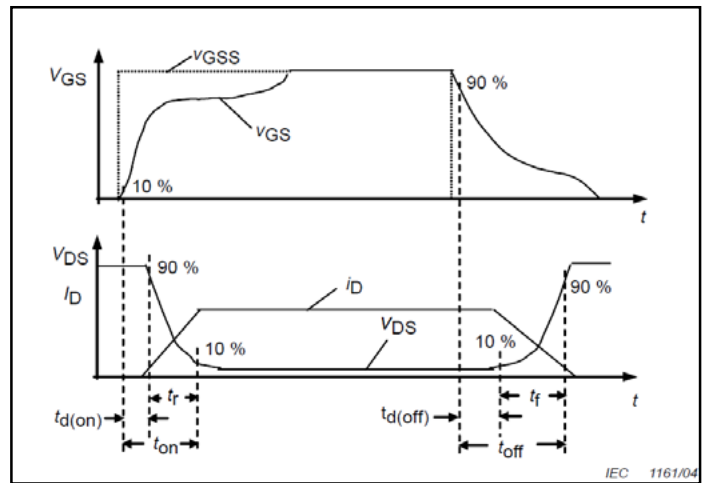
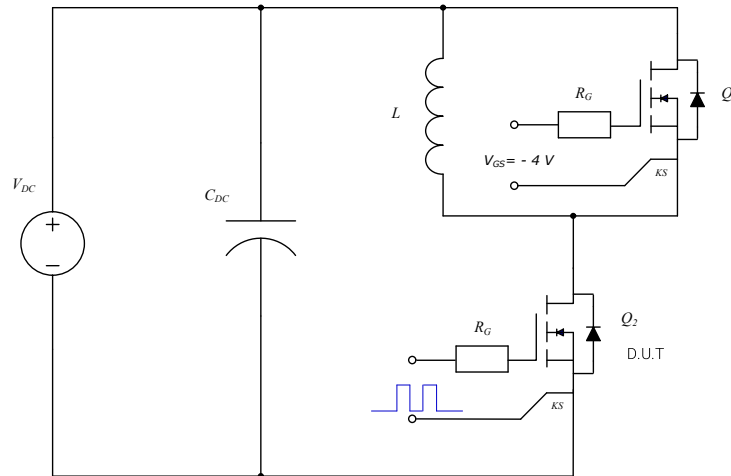


Figure 28. Switching Times Definition



## Test Circuit Schematic<sup>1</sup>

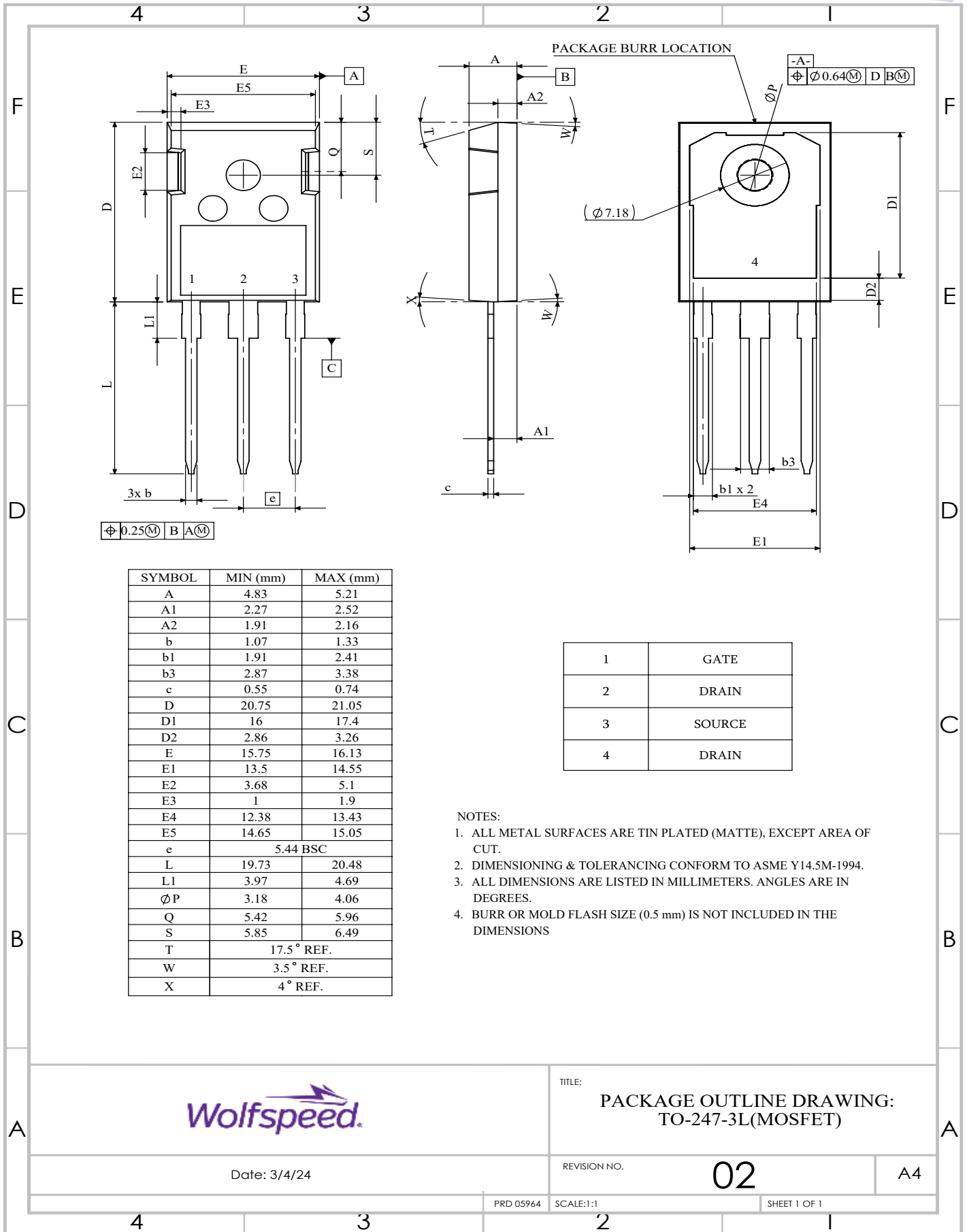


**Figure 29.** Clamped Inductive Switching

**Note:**

<sup>1</sup> Turn-off and Turn-on switching energy and timing values measured using SiC MOSFET Body Diode as shown above.

Package Dimensions - TO-247-3L



$\phi 0.25(M)$  B (A)

-A-  
 $\phi 0.64(M)$  D (B)

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
$\phi P$	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



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

Date: 3/4/24

REVISION NO.

02

A4

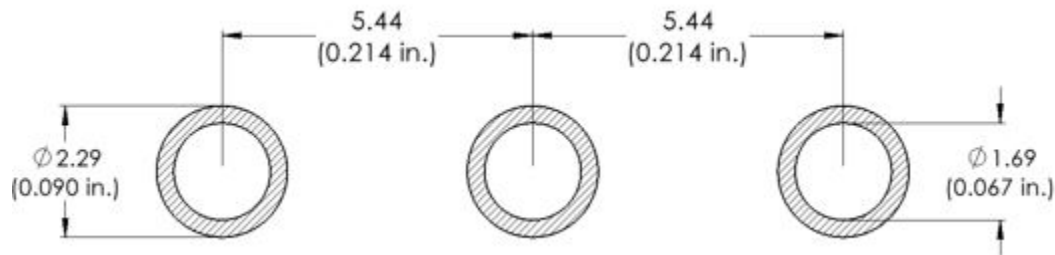
PRD 05964

SCALE:1:1

SHEET 1 OF 1



## Recommended Solder Pad Layout



## Revision History

Current Revision	Date of Release	Description of Changes
5	April-2021	N/A
6	November-2023	Updated Wolfspeed branding, package drawing, package image, and solder pad layout, added Revision History Table
7	September - 2024	Legal Disclaimer, POD, Table 1 layout, Diode Pulse Current symbol

## Related Links

- [SPICE Models: http://wolfspeed.com/power/tools-and-support](http://wolfspeed.com/power/tools-and-support)
- [SiC MOSFET Isolated Gate Driver Reference Design: http://wolfspeed.com/power/tools-and-support](http://wolfspeed.com/power/tools-and-support)
- [SiC MOSFET Evaluation Board: http://wolfspeed.com/power/tools-and-support](http://wolfspeed.com/power/tools-and-support)



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### **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](http://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. SVHC Declaration. REACH banned substance information (REACH Article 67) is also available upon request.

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