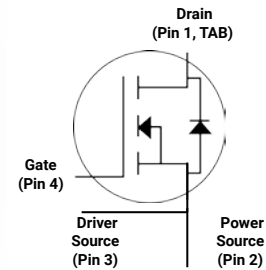
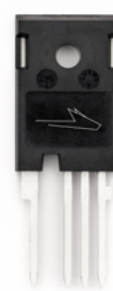


C3M0120065K

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

Features

- C3M™ 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
- Fast intrinsic diode with low reverse recovery (Q_{rr})
- Halogen free, RoHS compliant



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Ordering Part Number	Package	Marking
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C3M0120065K	TO-247-4	C3M0120065K
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Typical Applications

- Solar inverters
- DC/DC converters
- Switch Mode Power Supplies
- EV battery chargers
- UPS

Benefits

- Reduce switching losses and minimize gate ringing
- 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}			650	V	$T_c = 25^\circ\text{C}$	
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	$V_{GS} = 15\text{ V}, T_c = 25^\circ\text{C}, T_J \leq 175^\circ\text{C}$	Fig. 19
				16		$V_{GS} = 15\text{ V}, T_c = 100^\circ\text{C}, T_J \leq 175^\circ\text{C}$	Note 2
Pulsed Drain Current	I_{DM}			51		t_{Pmax} limited by T_{Jmax} $V_{GS} = 15\text{ V}, T_c = 25^\circ\text{C}$	Fig. 22
Power Dissipation	P_D			98	W	$T_c = 25^\circ\text{C}, T_J = 175^\circ\text{C}$	Fig. 20
Operating Junction and Storage Temperature	T_J, T_{stg}			-40 to +175	$^\circ\text{C}$		
Solder Temperature	T_L			260		According to JEDEC J-STD-020	
Mounting Torque	M_D			1 8.8	Nm lbf-in	M3 or 6-32 screw	

Note (1): Recommended turn-on gate voltage is 15V 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	$V_{(BR)DSS}$	650	—	—		$V_{DS} = 0\text{ V}, I_D = 100\mu\text{A}$	
Gate Threshold Voltage	$V_{GS(th)}$	1.8	2.3	3.6	V	$V_{DS} = V_{GS}, I_D = 1.86\text{ mA}$	Fig. 11
		—	1.9	—		$V_{DS} = V_{GS}, I_D = 1.86\text{ mA}, T_J = 175^\circ\text{C}$	
Zero Gate Voltage Drain Current	I_{DSS}	—	1	50	μA	$V_{DS} = 650\text{ V}, V_{GS} = 0\text{ V}$	
Gate-Source Leakage Current	I_{GSS}	—	10	250	nA	$V_{GS} = 15\text{ V}, V_{DS} = 0\text{ V}$	
Drain-Source On-State Resistance	$R_{DS(on)}$	—	120	157	m Ω	$V_{GS} = 15\text{ V}, I_D = 6.76$	Fig. 4, 5, 6
		—	168	—		$V_{GS} = 15\text{ V}, I_D = 6.76, T_J = 175^\circ\text{C}$	
Transconductance	g_{fs}	—	5.0	—	S	$V_{DS} = 20\text{ V}, I_{DS} = 6.76\text{ A}$	Fig. 7
			4.9			$V_{DS} = 20\text{ V}, I_{DS} = 6.76\text{ A}, T_J = 175^\circ\text{C}$	
Input Capacitance	C_{iss}	—	640	—	pF	$V_{GS} = 0\text{ V}, V_{DS} = 0\text{ V to } 400\text{ V}$ $f = 1\text{ Mhz}$ $V_{AC} = 25\text{ mV}$	Fig. 17, 18
Output Capacitance	C_{oss}	—	45	—			
Reverse Transfer Capacitance	C_{rss}	—	2.3	—			
Effective Output Capacitance (Energy Related)	$C_{o(er)}$	—	57	—			
Effective Output Capacitance (Time Related)	$C_{o(tr)}$	—	79	—		$V_{GS} = 0\text{ V}, V_{DS} = 0\text{ V to } 400\text{ V}$	Note 3
C_{oss} Stored Energy	E_{oss}	—	4.3	—		$V_{DS} = 400\text{ V}, f = 1\text{ Mhz}$	Fig. 16
Turn-On Switching Energy (Body Diode)	E_{on}	—	34	—	μJ	$V_{DS} = 400\text{ V}, V_{GS} = -4\text{ V/15 V}, I_D = 6.76\text{ A},$ $R_{G(ext)} = 10\text{ }\Omega, L = 237\text{ }\mu\text{H}, T_J = 175^\circ\text{C}$ FWD = Internal Body Diode of MOSFET	Fig. 25
Turn Off Switching Energy (Body Diode)	E_{off}	—	7	—			
Turn-On Switching Energy (External Diode)	E_{on}	—	27	—			
Turn Off Switching Energy (External Diode)	E_{off}	—	7	—			
Turn-On Delay Time	$t_{d(on)}$	—	8	—	ns	$V_{DD} = 400\text{ V}, V_{GS} = -4\text{ V/15 V}$ $I_D = 6.76\text{ A}, R_{G(ext)} = 10\text{ }\Omega$ Timing relative to V_{DS} Inductive load	Fig. 26
Rise Time	t_r	—	11	—			
Turn-Off Delay Time	$t_{d(off)}$	—	19	—			
Fall Time	t_f	—	11	—			
Internal Gate Resistance	$R_{G(int)}$	—	6	—	Ω	$f = 1\text{ MHz}, V_{AC} = 25\text{ mV}$	
Gate to Source Charge	Q_{gs}	—	8	—	nC	$V_{DS} = 400\text{ V}, V_{GS} = -4\text{ V/15 V}$ $I_D = 6.76\text{ A}$ Per IEC60747-8-4 pg 21	Fig. 12
Gate to Drain Charge	Q_{gd}	—	10	—			
Total Gate Charge	Q_g	—	28	—			

Note:

³ $C_{o(er)}$, a lumped capacitance that gives same stored energy as C_{oss} while V_{DS} is rising from 0 to 400V

$C_{o(tr)}$, a lumped capacitance that gives same charging time as C_{oss} while V_{DS} is rising from 0 to 400V



Reverse Diode Characteristics ($T_c = 25^\circ\text{C}$ unless otherwise specified)

Parameter	Symbol	Typ.	Max.	Unit	Test Conditions	Notes
Diode Forward Voltage	V _{SD}	4.5	—	V	V _{GS} = -4 V, I _{SD} = 3.4 A, T _J = 25°C	Fig. 8, 9, 10
		4.0	—		V _{GS} = -4 V, I _{SD} = 3.4 A, T _J = 175°C	
Continuous Diode Forward Current	I _S	—	16	A	V _{GS} = -4 V, T _C = 25°C	
Diode pulse Current	I _{SM}	—	51		V _{GS} = -4 V, pulse width t _p limited by T _{jmax}	
Reverse Recover Time	t _{rr}	8	—	ns	V _{GS} = -4 V, I _{SD} = 6.76 A, V _R = 400 V dif/dt = 6245 A/μs, T _J = 175°C	
Reverse Recovery Charge	Q _{rr}	119	—			
Peak Reverse Recovery Current	I _{RRM}	22	—	nC		
Reverse Recover Time	t _{rr}	15	—			
Reverse Recovery Charge	Q _{rr}	89	—	A	V _{GS} = -4 V, I _{SD} = 6.76 A, V _R = 400 V dif/dt = 1845 A/μs, T _J = 175°C	
Peak Reverse Recovery Current	I _{RRM}	10	—			

Thermal Characteristics

Parameter	Symbol	Typ.	Unit	Note
Thermal Resistance from Junction to Case	$R_{\theta JC}$	1.53	$^\circ\text{C}/\text{W}$	Fig. 21
Thermal Resistance From Junction to Ambient	$R_{\theta JA}$	40		



Typical Performance

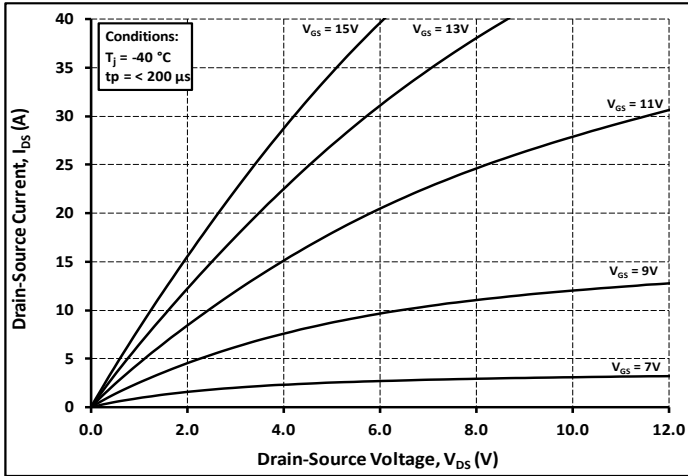


Figure 1. Output Characteristics $T_j = -40^\circ\text{C}$

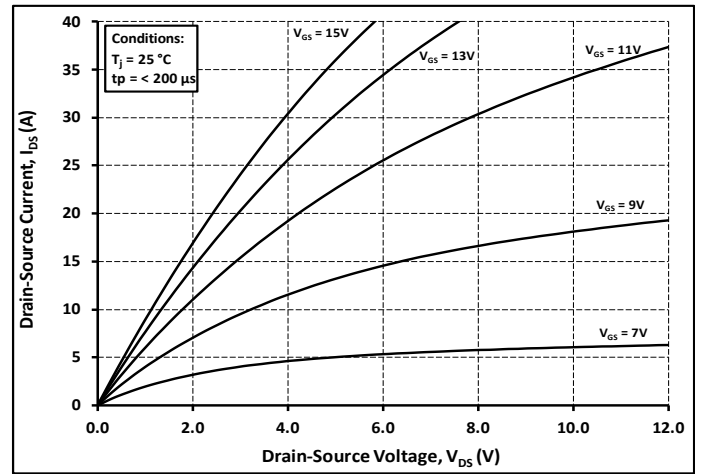


Figure 2. Output Characteristics $T_j = 25^\circ\text{C}$

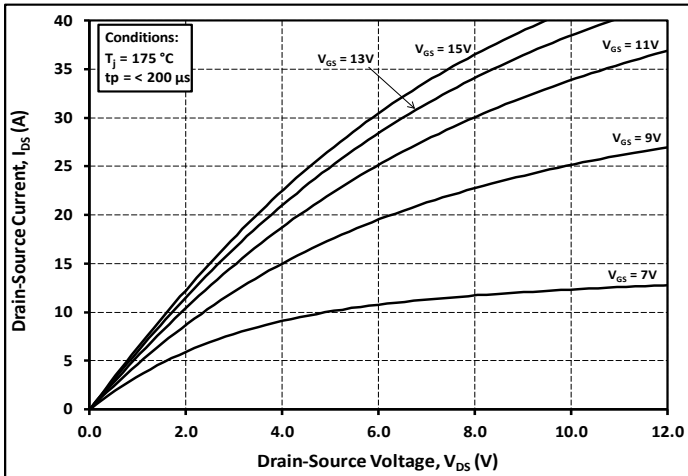


Figure 3. Output Characteristics $T_j = 175^\circ\text{C}$

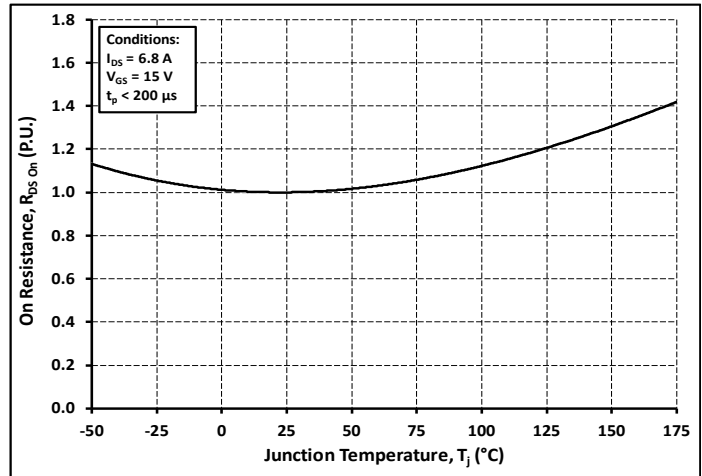


Figure 4. Normalized On-Resistance vs. Temperature

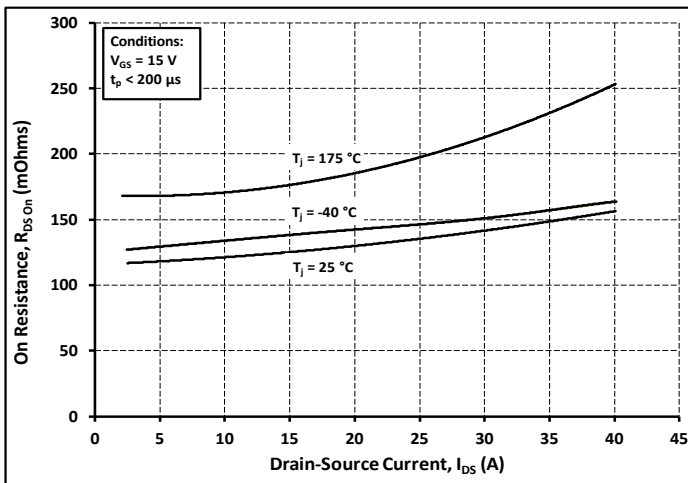


Figure 5. On-Resistance vs. Drain Current For Various Temperatures

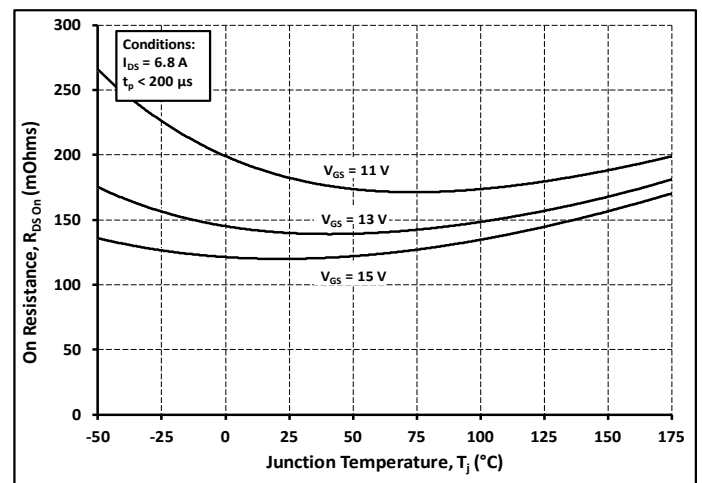


Figure 6. On-Resistance vs. Temperature For Various Gate Voltage

Typical Performance

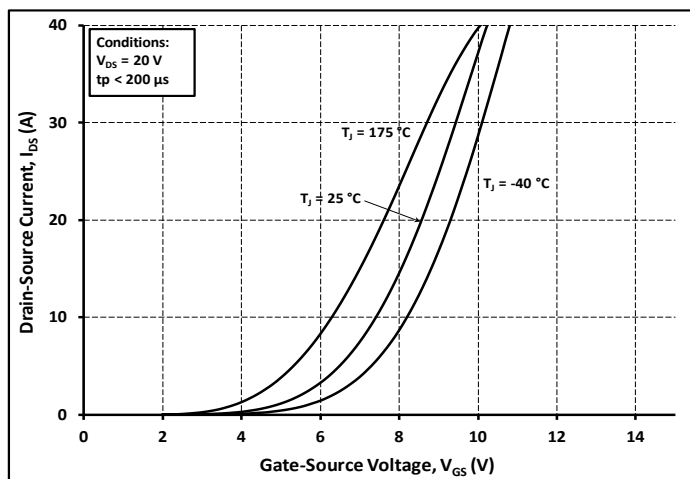


Figure 7. Transfer Characteristic for Various Junction Temperatures

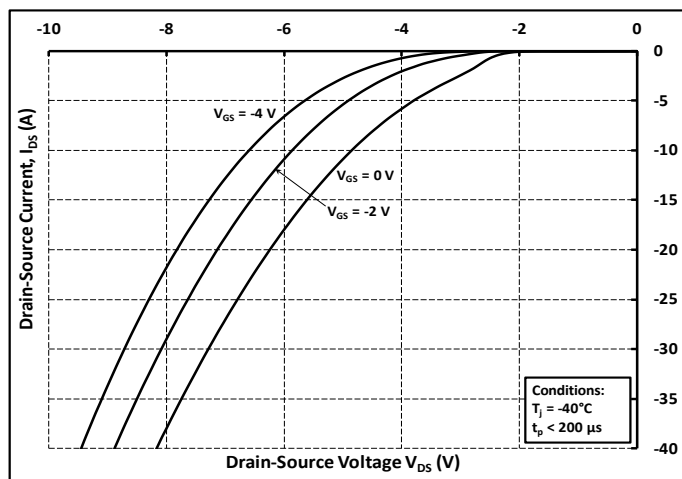


Figure 8. Body Diode Characteristic at -40°C

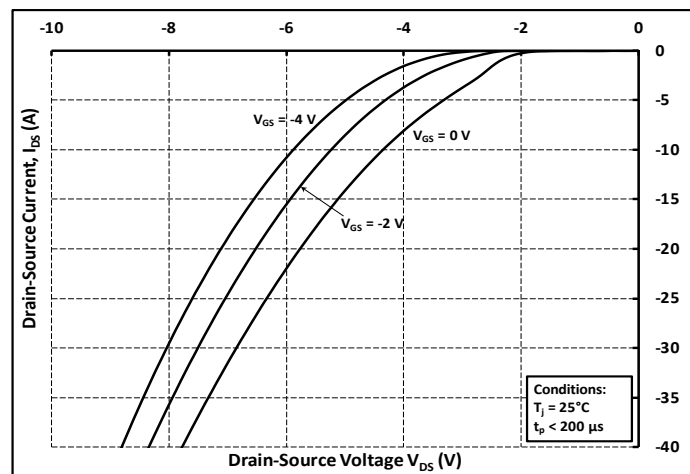


Figure 9. Body Diode Characteristic at 25°C

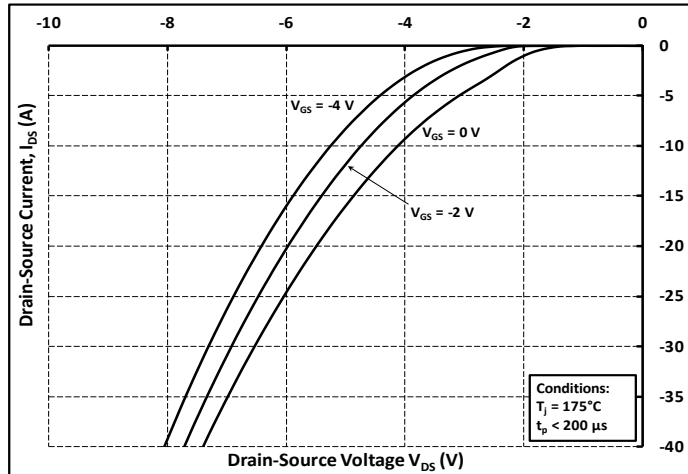


Figure 10. Body Diode Characteristic at 175°C

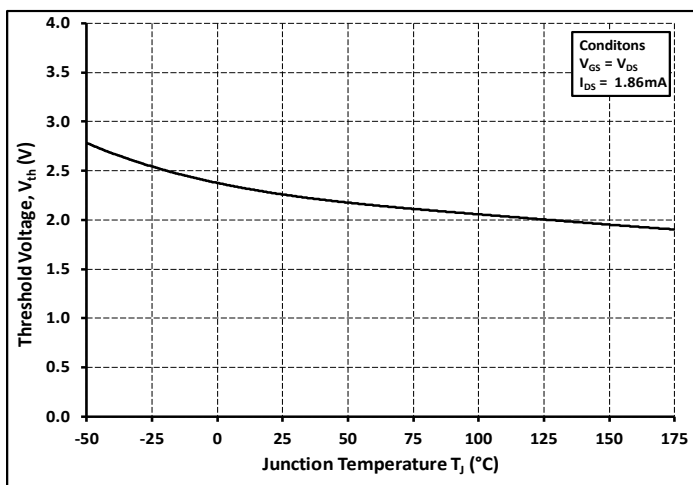


Figure 11. Threshold Voltage vs. Temperature

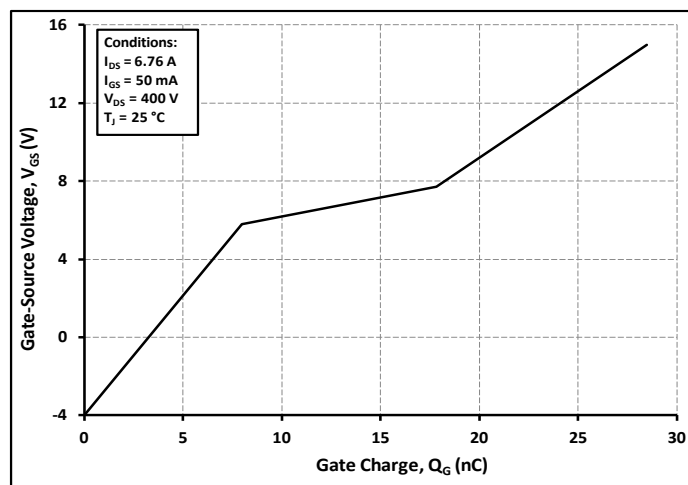


Figure 12. Gate Charge Characteristics

Typical Performance

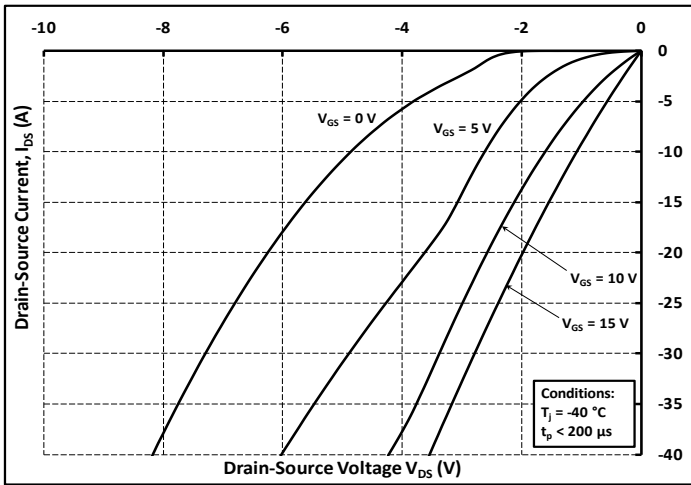


Figure 13. 3rd Quadrant Characteristic at -40°C

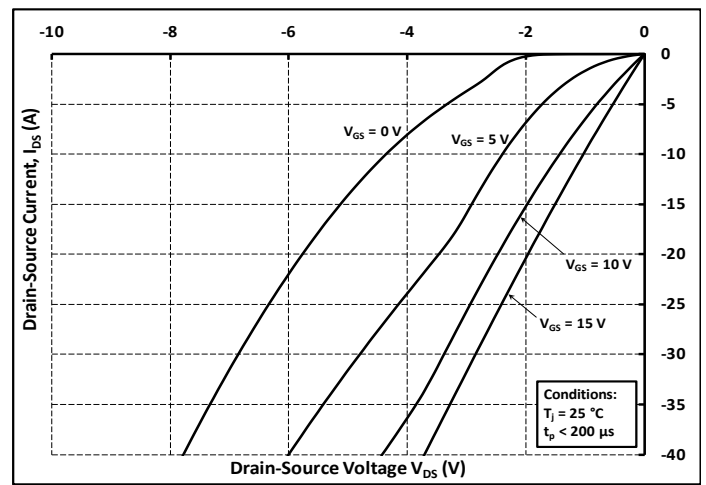


Figure 14. 3rd Quadrant Characteristic at 25°C

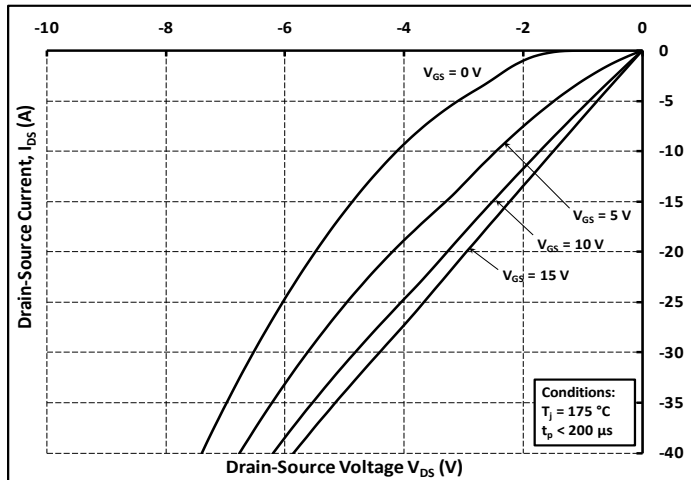


Figure 15. 3rd Quadrant Characteristic at 175°C

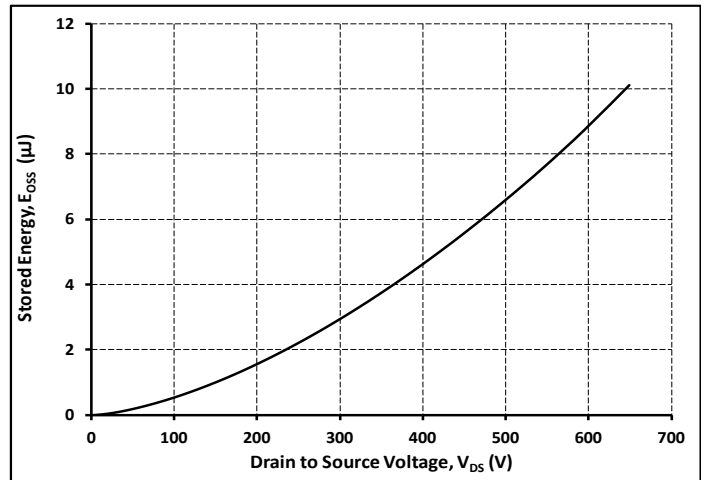


Figure 16. Output Capacitor Stored Energy

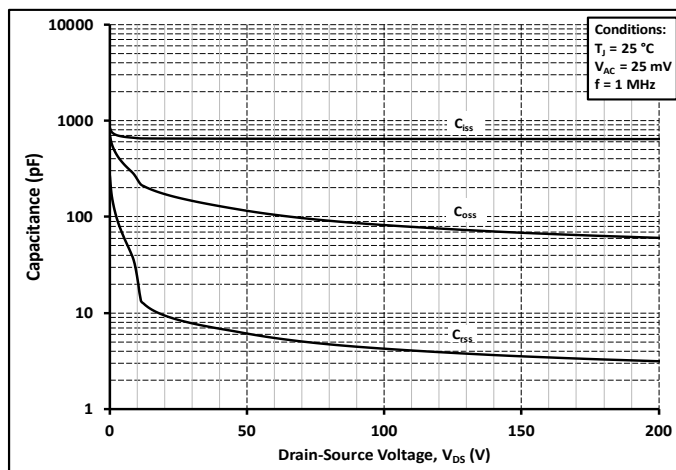


Figure 17. Capacitances vs. Drain-Source Voltage (0 - 200V)

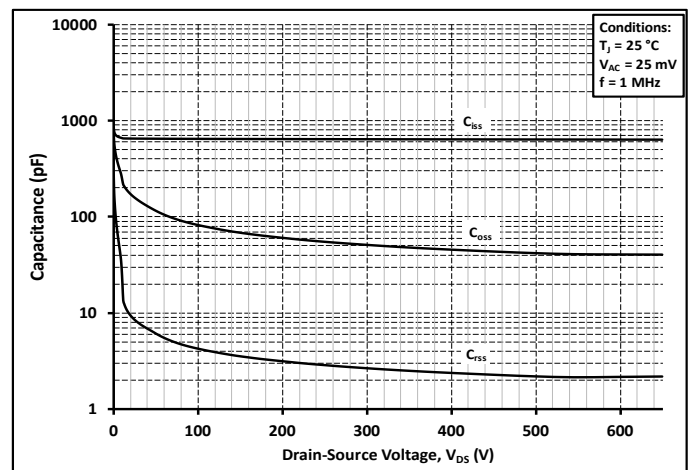


Figure 18. Capacitances vs. Drain-Source Voltage (0 - 650V)

Typical Performance

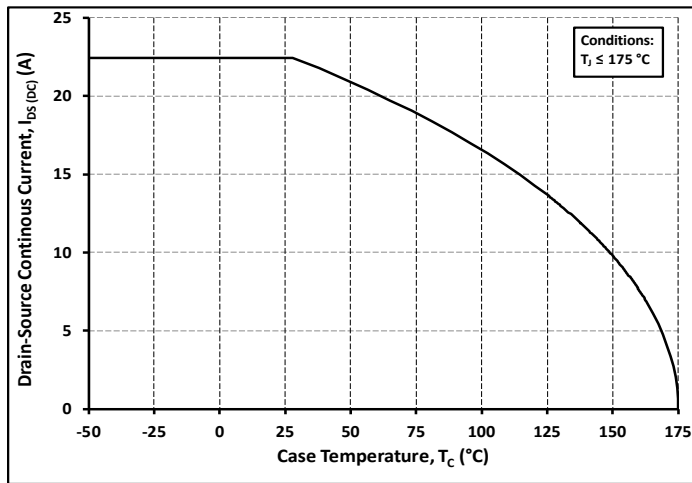


Figure 19. Continuous Drain Current Derating vs. Case Temperature

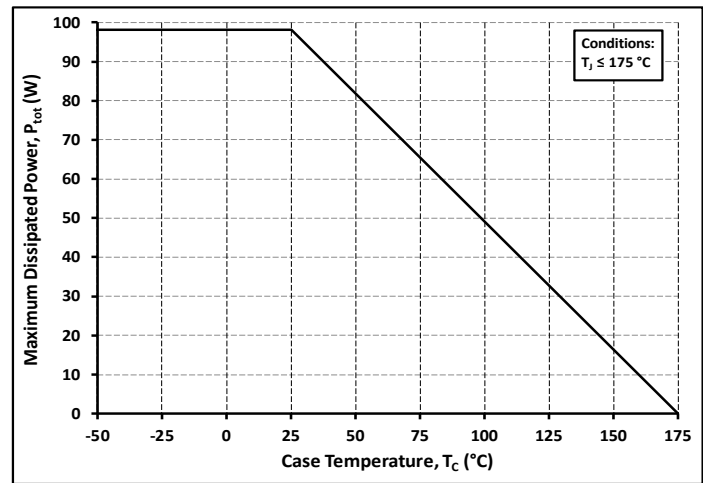


Figure 20. Maximum Power Dissipation Derating vs. Case Temperature

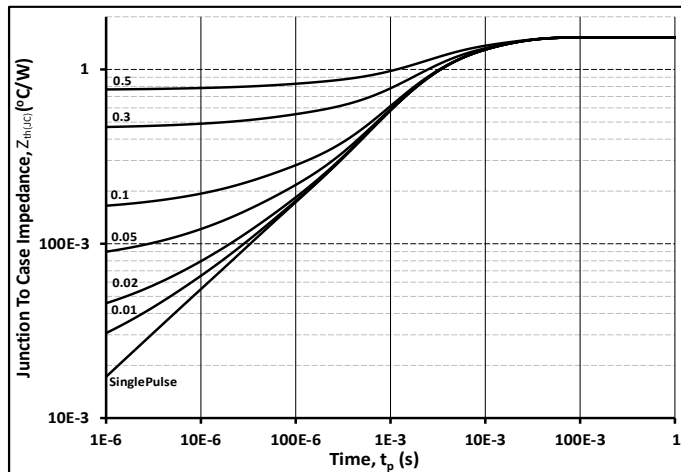


Figure 21. Transient Thermal Impedance (Junction - Case)

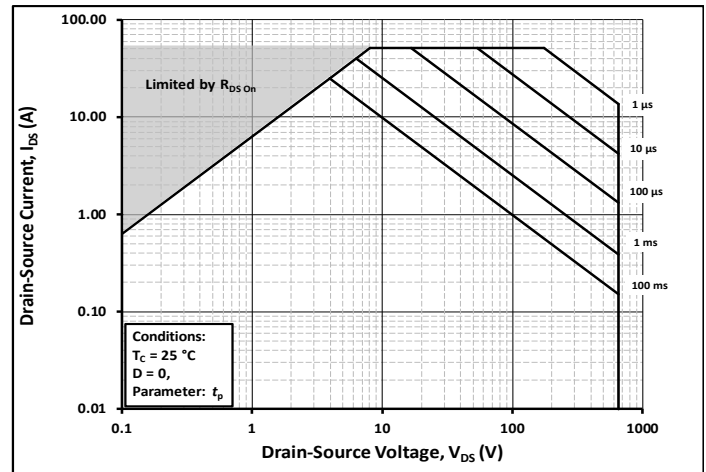


Figure 22. Safe Operating Area

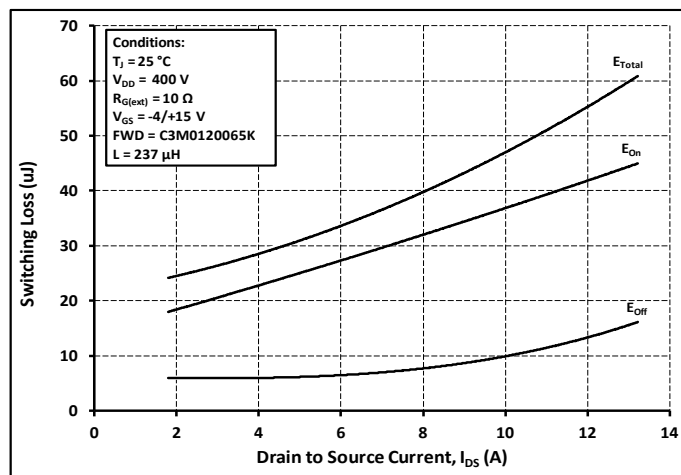


Figure 23. Clamped Inductive Switching Energy vs. Drain Current ($V_{DD} = 400V$)

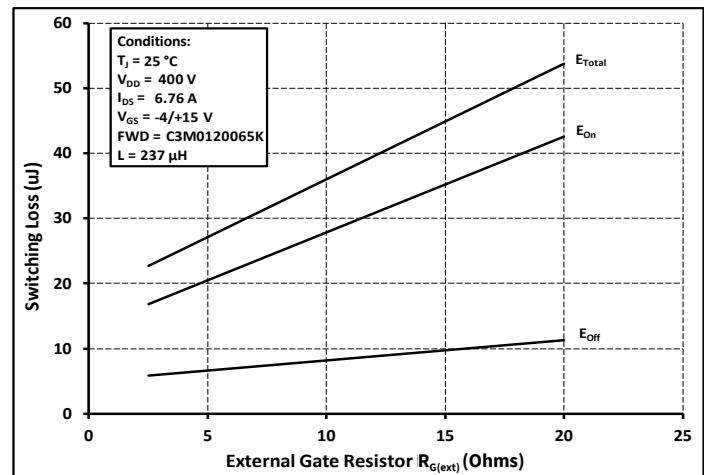


Figure 24. Clamped Inductive Switching Energy vs. $R_{G(ext)}$



Typical Performance

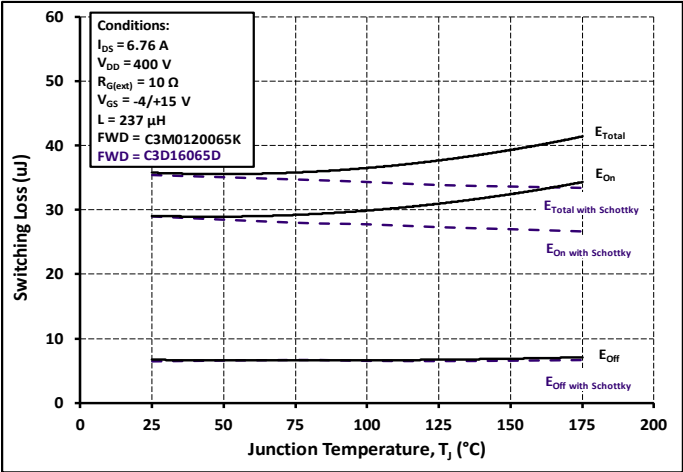


Figure 25. Clamped Inductive Switching Energy vs. Temperature

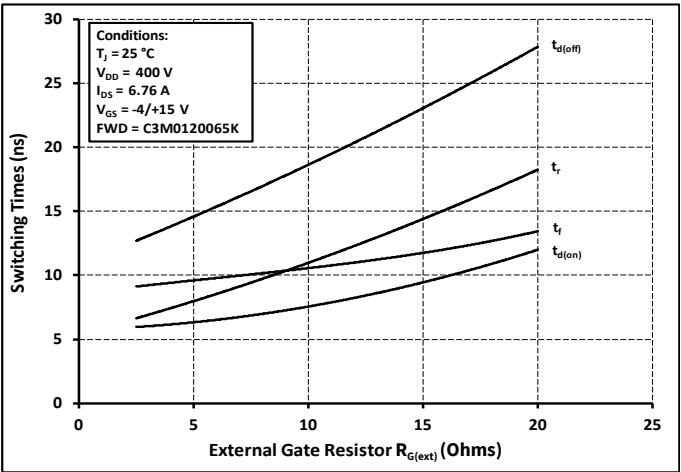


Figure 26. Switching Times vs. $R_{G(ext)}$

Test Circuit Schematic

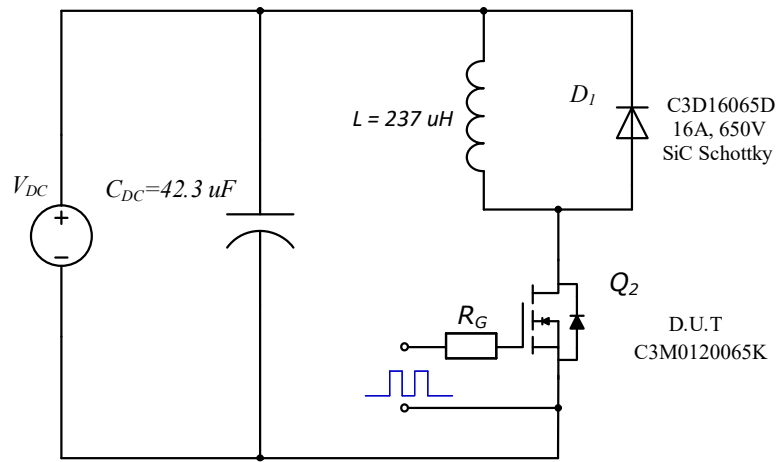


Figure 27. Clamped Inductive Switching Waveform Test Circuit

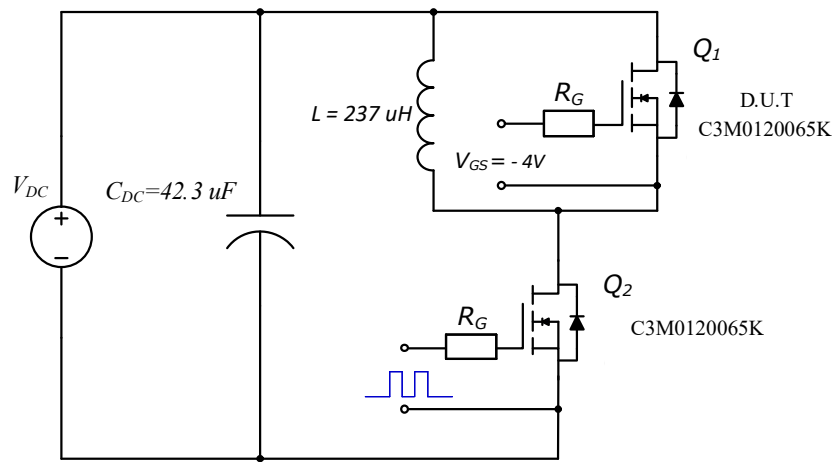
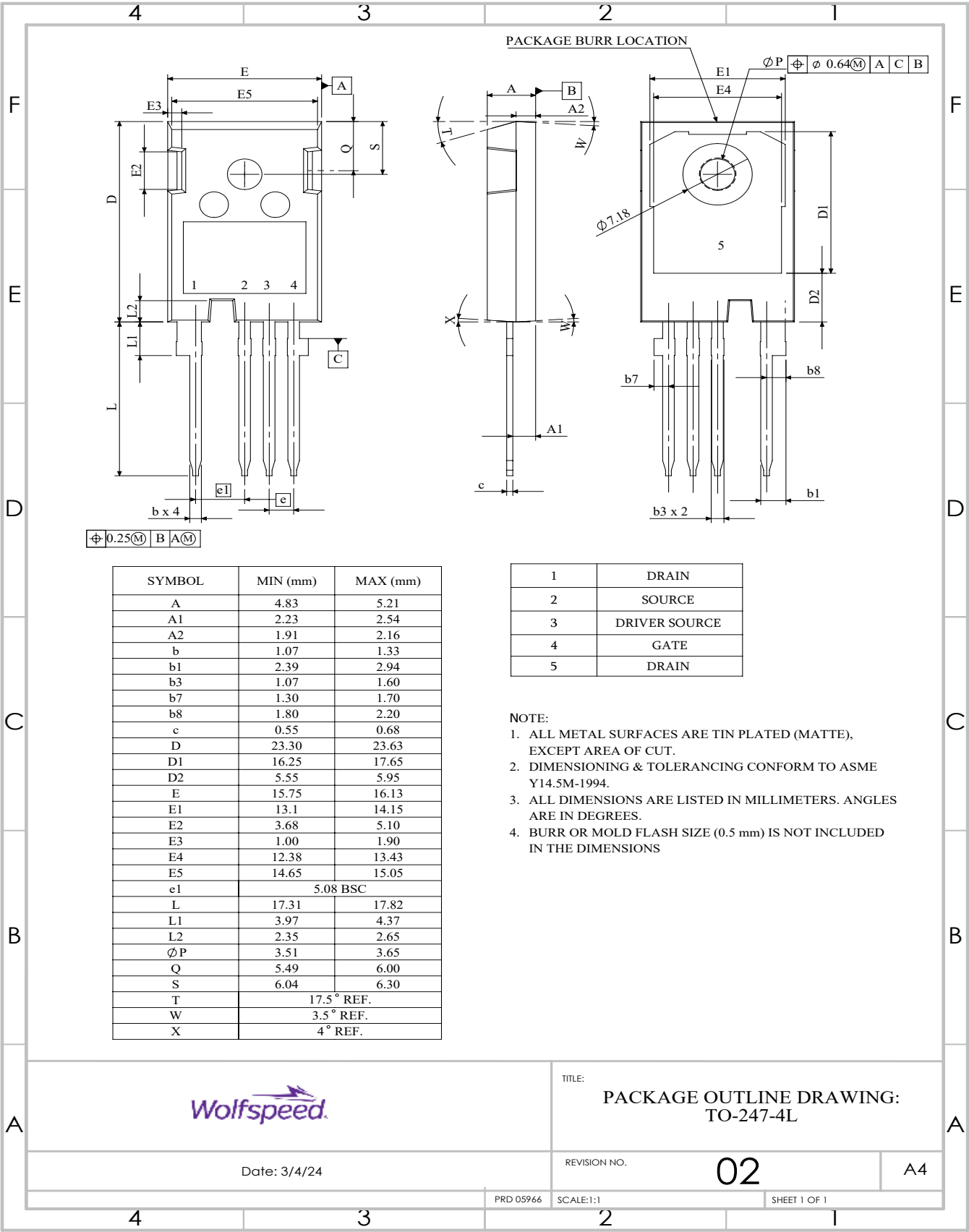
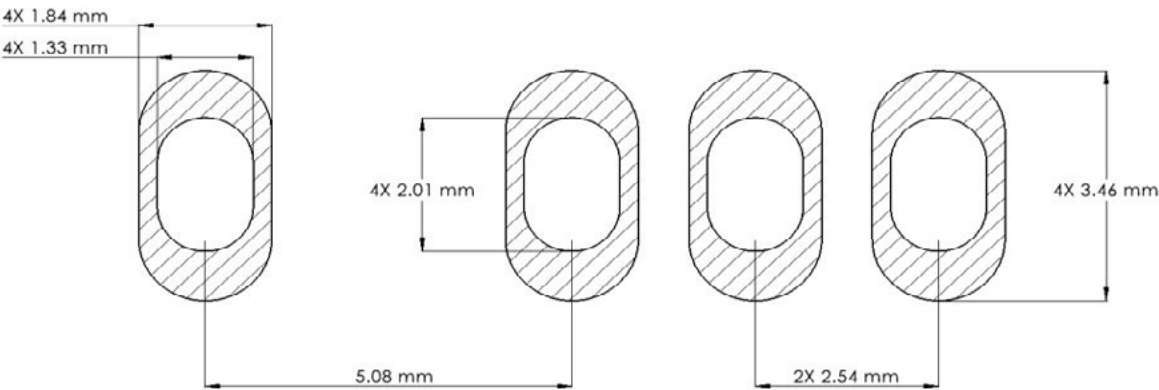


Figure 28. Body Diode Recovery Test Circuit

Package Dimensions – Package TO-247-4L



Recommended Solder Pad Layout



Revision History

Current Revision	Date of Release	Description of Changes
1	January-2021	N/A
2	December-2023	Updated Wolfspeed branding, package drawing, package image, and solder pad layout, added Revision History Table, Table 1 layout revised
3	September - 2024	Legal Disclaimer, POD, Diode Pulse Current Symbol

Related Links

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



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