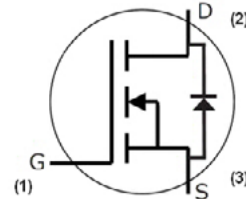


C3M0160120D

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

Features

- C3M™ Silicon Carbide (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



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Part Number	Package	Marking
C3M0160120D	TO 247-3	C3M0160120D

Typical Applications

- Renewable energy
- High voltage DC/DC converters
- Switch Mode Power Supplies
- UPS

Benefits

- Higher system efficiency
- Reduced cooling requirements
- Increased power density
- Increased 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	$V_{GS(max)}$	-8		+19		Transient	
Operational Gate-Source Voltage	$V_{GS op}$		-4/15			Static	Note 1
DC Continuous Drain Current	I_D			17	A	$V_{GS} = 15\text{ V}, T_c = 25^\circ\text{C}, T_J \leq 150^\circ\text{C}$	Fig. 19
				12		$V_{GS} = 15\text{ V}, T_c = 100^\circ\text{C}, T_J \leq 150^\circ\text{C}$	Note 2
Pulsed Drain Current	I_{DM}			34		t_{pmax} limited by T_{Jmax} $V_{GS} = 15\text{ V}, T_c = 25^\circ\text{C}$	Fig. 22
Power Dissipation	P_D			97	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	$^\circ\text{C}$		
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	$V_{(BR)DSS}$	1200	—	—	V	$V_{GS} = 0\text{ V}, I_D = 100\text{ }\mu\text{A}$	Fig. 11
Gate Threshold Voltage	$V_{GS(th)}$	1.8	2.8	3.6		$V_{DS} = V_{GS}, I_D = 2.33\text{ mA}$	
		—	2.2	—		$V_{DS} = V_{GS}, I_D = 2.33\text{ mA}, T_J = 150^\circ\text{C}$	
Zero Gate Voltage Drain Current	I_{DSS}	—	1	50	μA	$V_{DS} = 1200\text{ V}, V_{GS} = 0\text{ V}$	
Gate-Source Leakage Current	I_{GSS}	—	10	250	nA	$V_{GS} = 15\text{ V}, V_{DS} = 0\text{ V}$	
Drain-Source On-State Resistance	$R_{DS(on)}$	—	160	208	m Ω	$V_{GS} = 15\text{ V}, I_D = 8.5\text{ A}$	Fig. 4, 5, 6
		—	256	—		$V_{GS} = 15\text{ V}, I_D = 8.5\text{ A}, T_J = 150^\circ\text{C}$	
Transconductance	g_{fs}	—	5.2	—	S	$V_{DS} = 20\text{ V}, I_{DS} = 8.5\text{ A}$	Fig. 7
			4.9			$V_{DS} = 20\text{ V}, I_{DS} = 8.5\text{ A}, T_J = 150^\circ\text{C}$	
Input Capacitance	C_{iss}	—	632	—	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}	—	39	—			
Reverse Transfer Capacitance	C_{rss}	—	3	—			
Output Capacitance Stored Energy	E_{oss}	—	22.5	—	μJ	$V_{DS} = 800\text{ V}, V_{GS} = -4\text{ V}/15\text{ V}, I_D = 8.5\text{ A}, R_{G(ext)} = 2.5\text{ }\Omega, L = 336\text{ }\mu\text{H}, T_J = 150^\circ\text{C}$	Fig. 26, 29
Turn-On Switching Energy (SiC Diode FWD)	E_{on}	—	183	—			
Turn Off Switching Energy (SiC Diode FWD)	E_{off}	—	16	—			
Turn-On Switching Energy (Body Diode FWD)	E_{on}	—	294	—			
Turn Off Switching Energy (Body Diode FWD)	E_{off}	—	14	—	ns	$V_{DD} = 800\text{ V}, V_{GS} = -4\text{ V}/15\text{ V}$ $I_D = 8.5\text{ A}, R_{G(ext)} = 2.5\text{ }\Omega,$ Timing relative to V_{DS} Inductive load	Fig. 27, 28
Turn-On Delay Time	$t_{d(on)}$	—	30	—			
Rise Time	t_r	—	16	—			
Turn-Off Delay Time	$t_{d(off)}$	—	20	—			
Fall Time	t_f	—	13	—	Ω	$f = 1\text{ MHz}, V_{AC} = 25\text{ mV}$	Fig. 12
Internal Gate Resistance	$R_{G(int)}$	—	8	—			
Gate to Source Charge	Q_{gs}	—	9	—			
Gate to Drain Charge	Q_{gd}	—	12	—			
Total Gate Charge	Q_g	—	38	—	nC	$V_{DS} = 800\text{ V}, V_{GS} = -4\text{ V}/15\text{ V}$ $I_D = 8.5\text{ A}$ Per IEC60747-8-4 pg 21	

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

Parameter	Symbol	Typ.	Max.	Unit	Test Conditions	Note
Diode Forward Voltage	V_{SD}	4.5	—	V	$V_{GS} = -4\text{ V}, I_{SD} = 3\text{ A}$	Fig. 8, 9, 10
		4.0	—		$V_{GS} = -4\text{ V}, I_{SD} = 3\text{ A}, T_J = 150^\circ\text{C}$	
Continuous Diode Forward Current	I_S	—	17	A	$V_{GS} = -4\text{ V}, T_c = 25^\circ\text{C}$	
Diode Pulse Current	I_{SM}	—	34		$V_{GS} = -4\text{ V}, \text{pulse with limited by } T_{Jmax}$	
Reverse Recover Time	t_{rr}	34	—	nS	$V_{GS} = -4\text{ V}, I_{SD} = 8.5\text{ A}, V_R = 800\text{ V}$ $dif/dt = 844\text{ A}/\mu\text{s}, T_J = 150^\circ\text{C}$	
Reverse Recovery Charge	Q_{rr}	194	—	nC		
Peak Reverse Recovery Current	I_{rrm}	8	—	A		

Thermal Characteristics

Parameter	Symbol	Typ.	Unit	Note
Thermal Resistance from Junction to Case	$R_{\theta JC}$	1.29	$^\circ\text{C}/\text{W}$	Fig. 21

Typical Performance

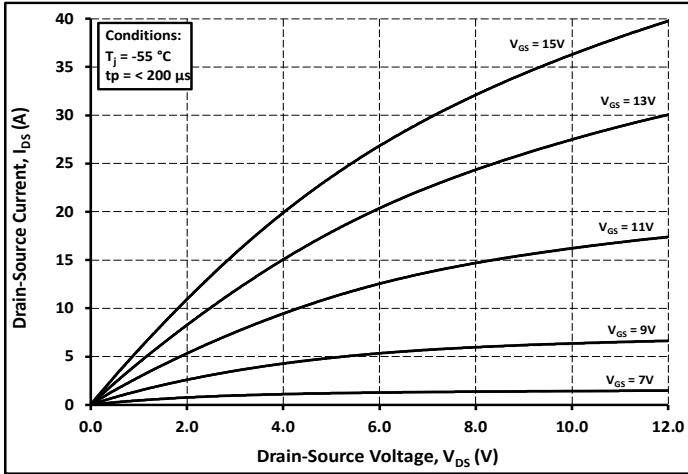


Figure 1. Output Characteristics $T_j = -55^\circ\text{C}$

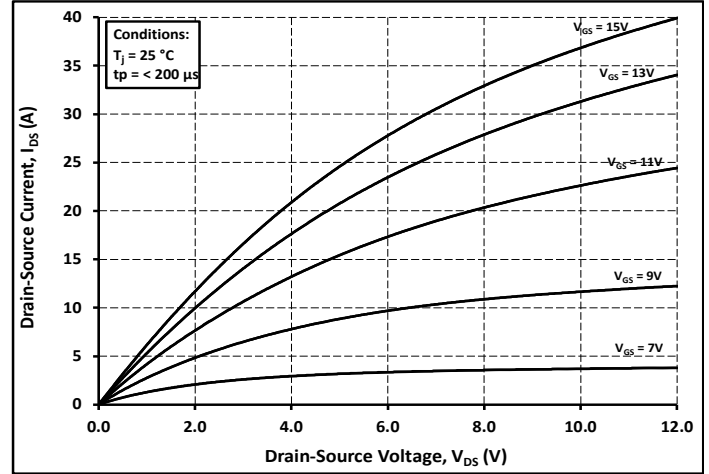


Figure 2. Output Characteristics $T_j = 25^\circ\text{C}$

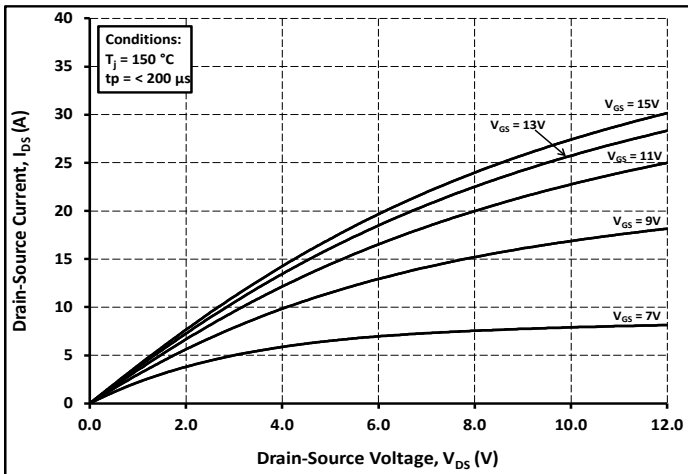


Figure 3. Output Characteristics $T_j = 150^\circ\text{C}$

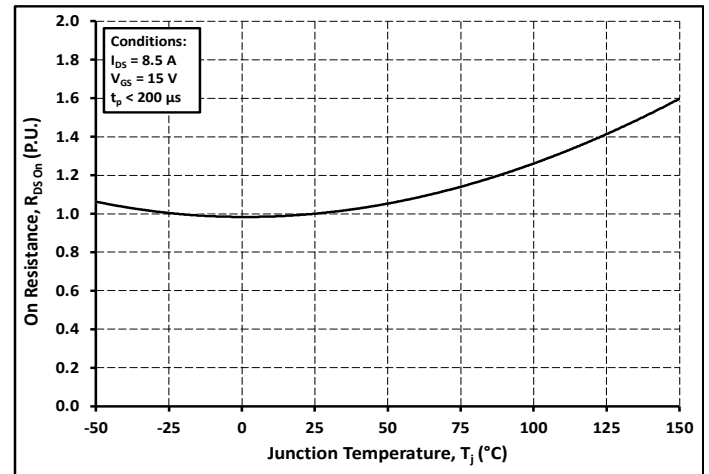


Figure 4. Normalized On-Resistance vs. Temperature

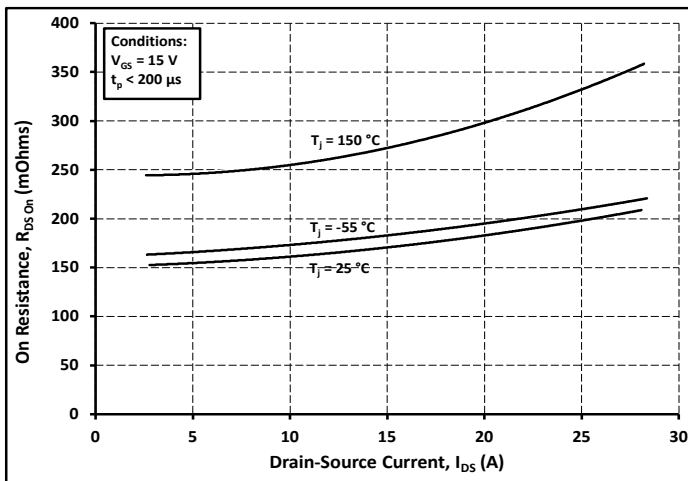


Figure 5. On-Resistance vs. Drain Current
For Various Temperatures

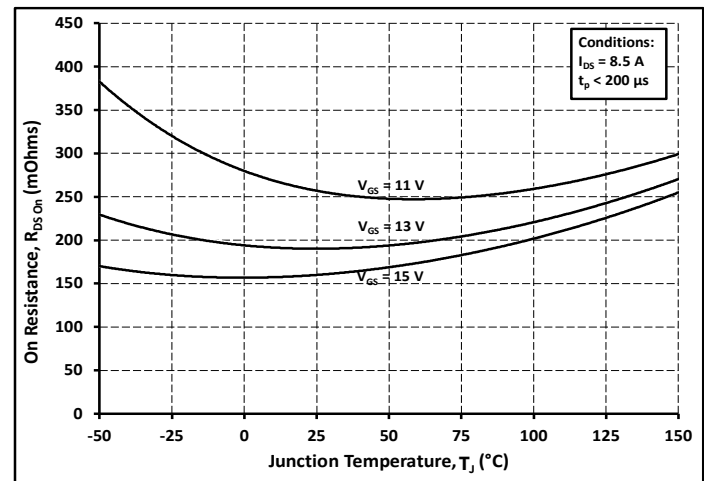


Figure 6. On-Resistance vs. Temperature
For Various Gate Voltage

Typical Performance

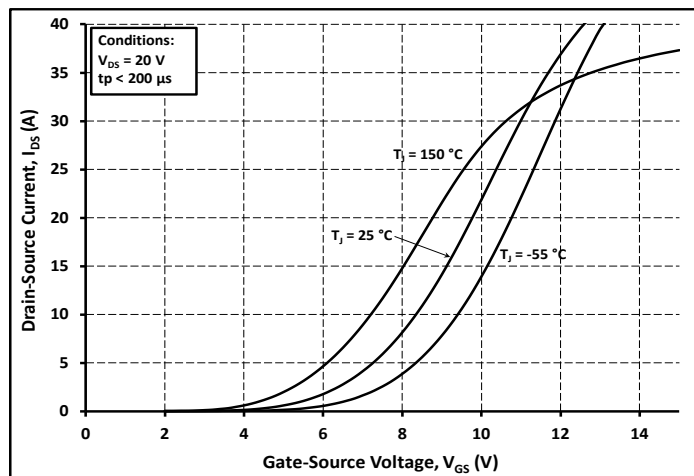


Figure 7. Transfer Characteristic for Various Junction Temperatures

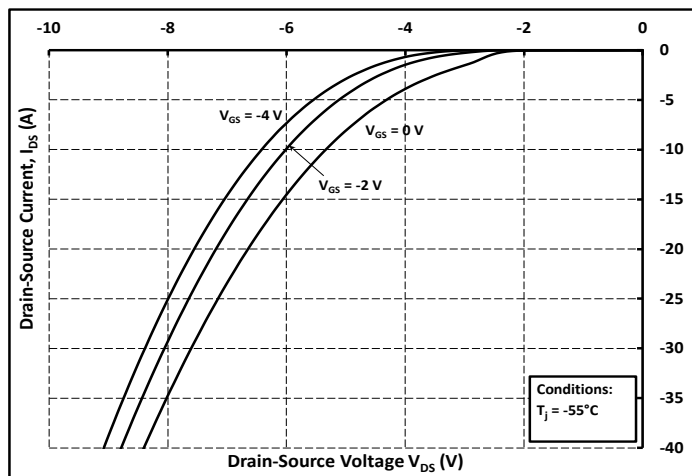


Figure 8. Body Diode Characteristic at -40°C

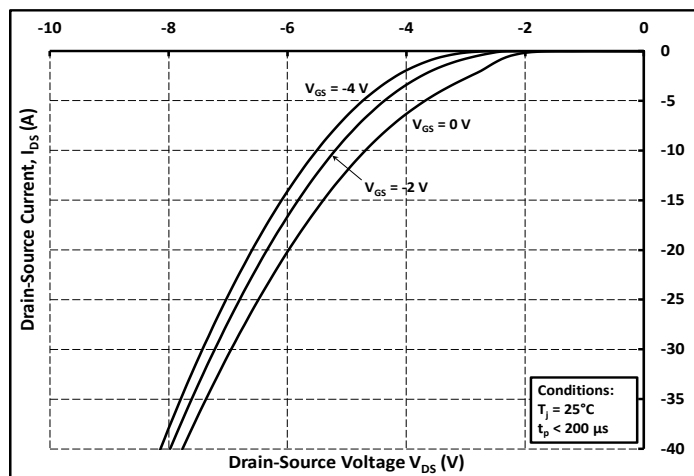


Figure 9. Body Diode Characteristic at 25°C

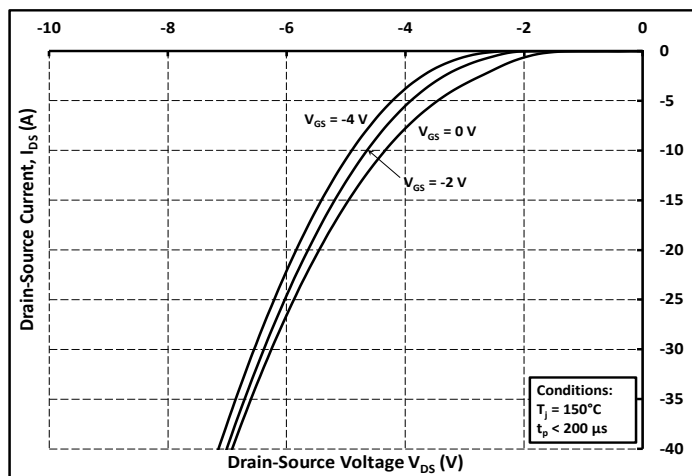


Figure 10. Body Diode Characteristic at 150°C

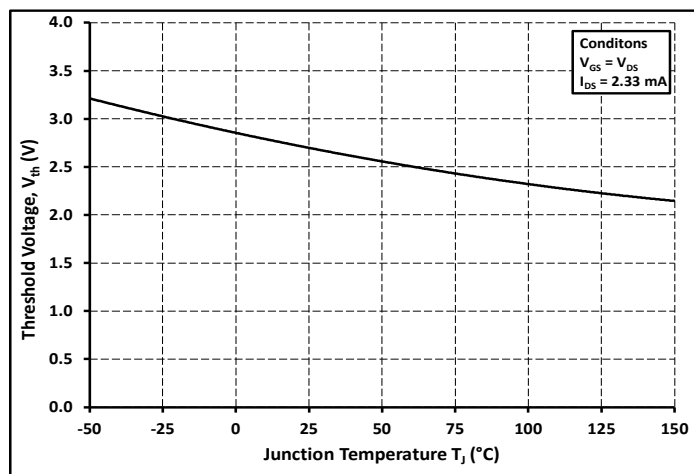


Figure 11. Threshold Voltage vs. Temperature

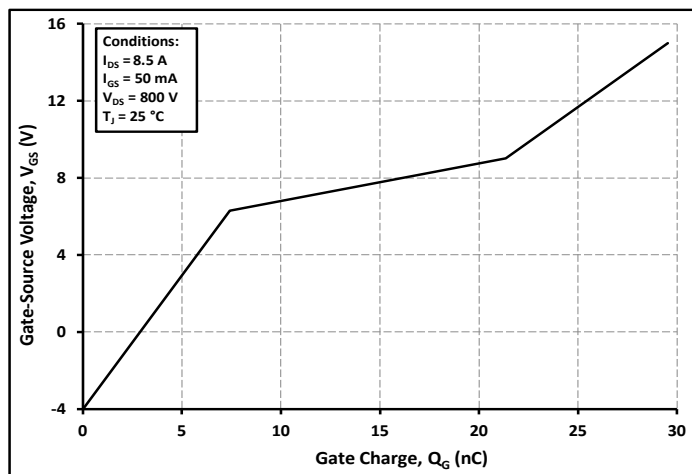


Figure 12. Gate Charge Characteristics

Typical Performance

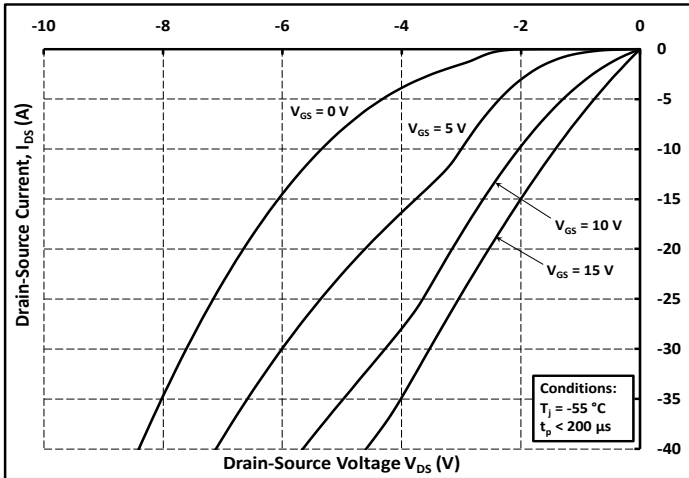


Figure 13. 3rd Quadrant Characteristic at -55°C

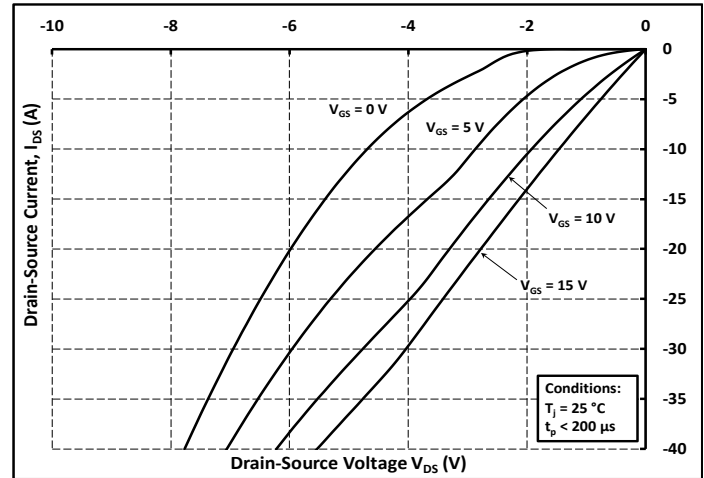


Figure 14. 3rd Quadrant Characteristic at 25°C

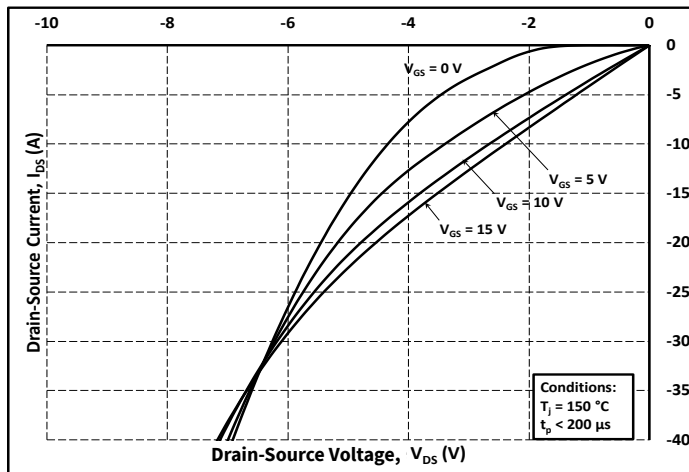


Figure 15. 3rd Quadrant Characteristic at 150°C

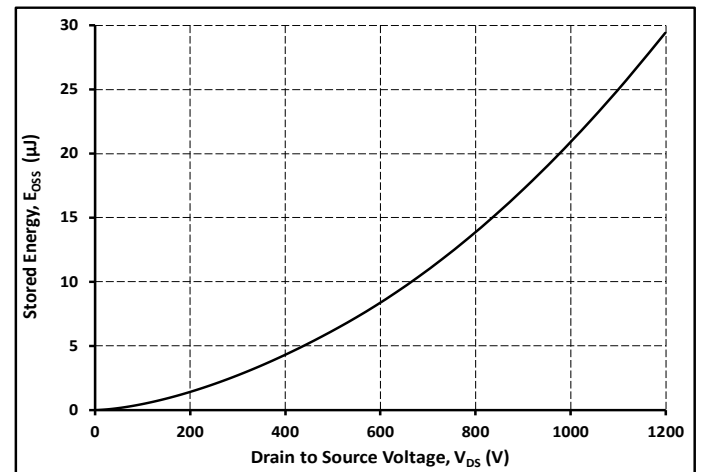


Figure 16. Output Capacitor Stored Energy

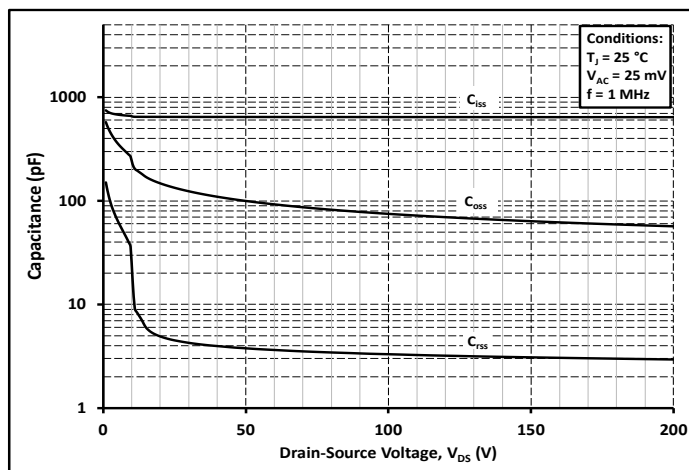


Figure 17. Capacitances vs. Drain-Source Voltage (0 - 200 V)

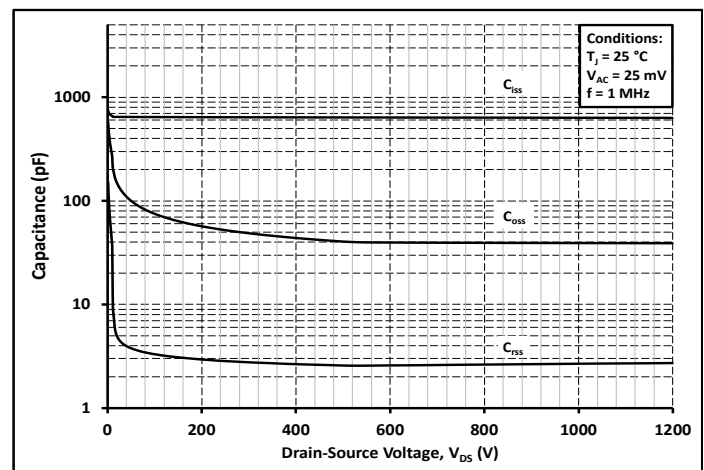


Figure 18. Capacitances vs. Drain-Source Voltage (0 - 1200 V)

Typical Performance

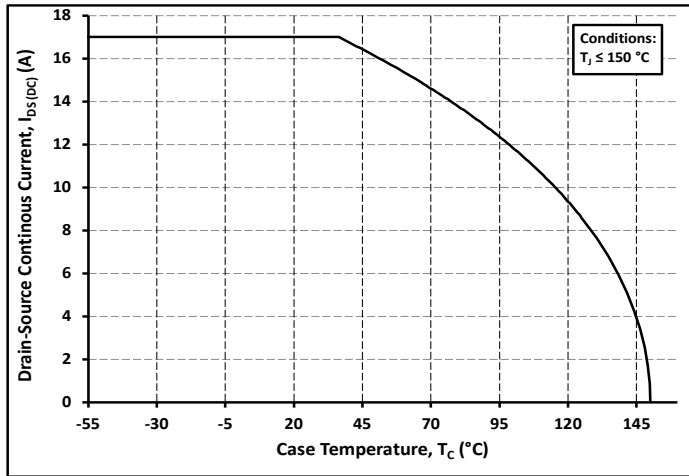


Figure 19. Continuous Drain Current Derating vs. Case Temperature

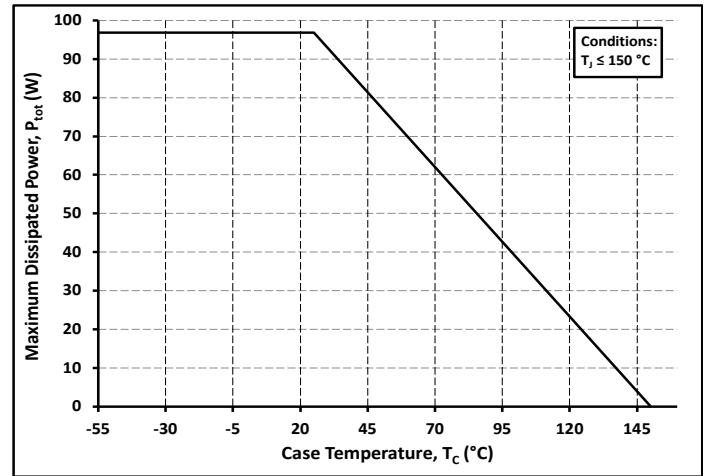


Figure 20. Maximum Power Dissipation Derating vs. Case Temperature

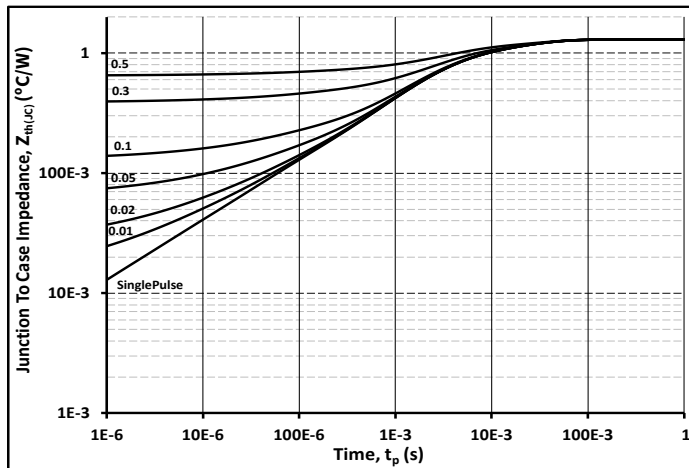


Figure 21. Transient Thermal Impedance (Junction - Case)

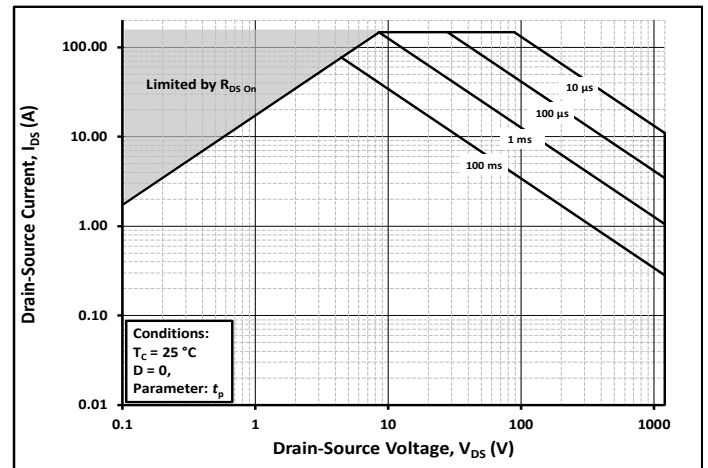


Figure 22. Safe Operating Area

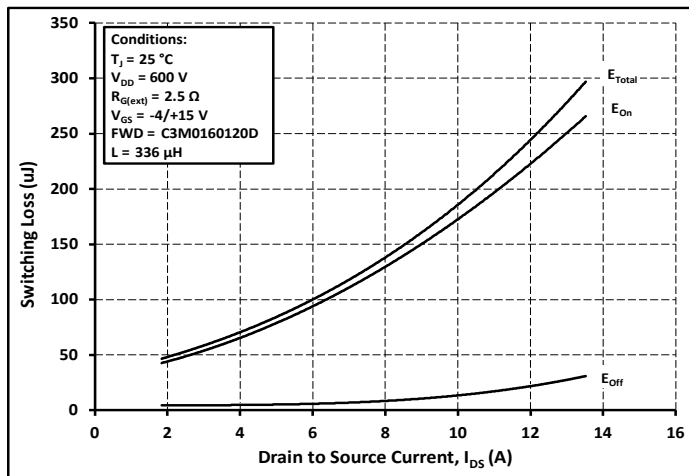


Figure 23. Clamped Inductive Switching Energy vs. Drain Current ($V_{DD} = 600 \text{ V}$)

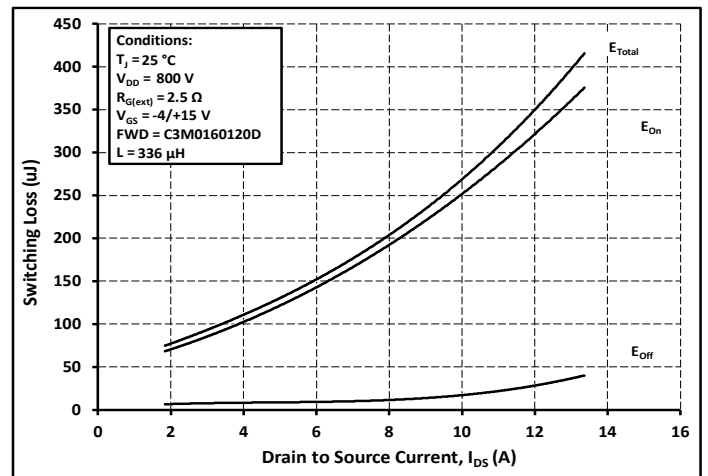


Figure 24. Clamped Inductive Switching Energy vs. Drain Current ($V_{DD} = 800 \text{ V}$)

Typical Performance

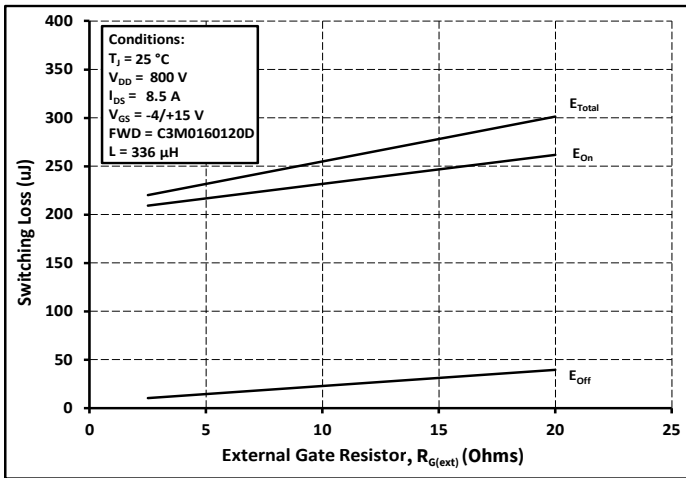


Figure 25. Clamped Inductive Switching Energy vs. $R_{G(\text{ext})}$

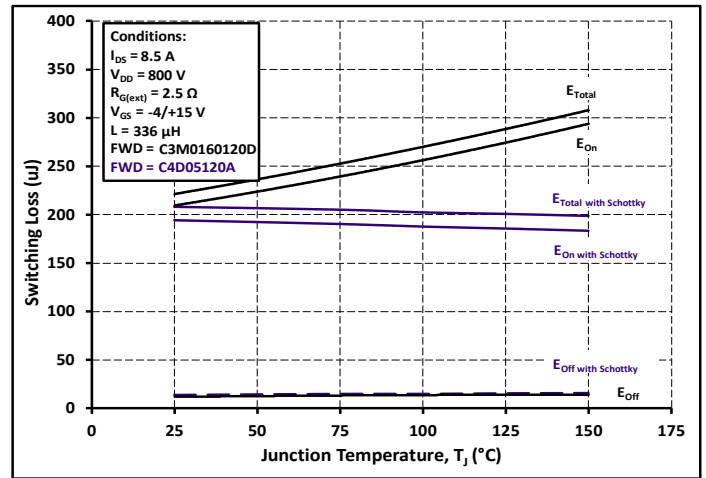


Figure 26. Clamped Inductive Switching Energy vs. Temperature

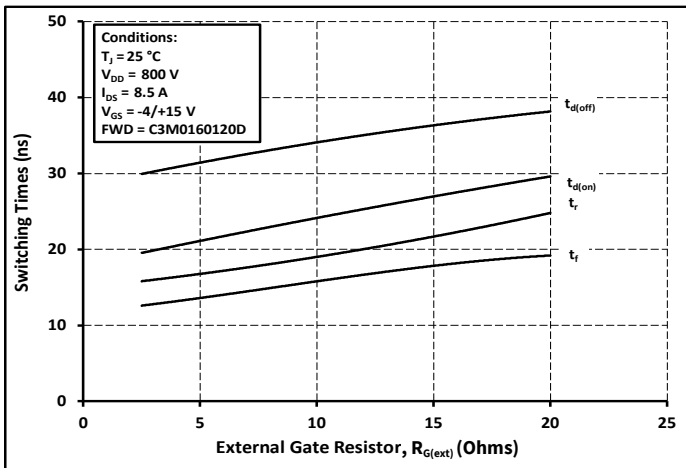


Figure 27. Switching Times vs. $R_{G(\text{ext})}$

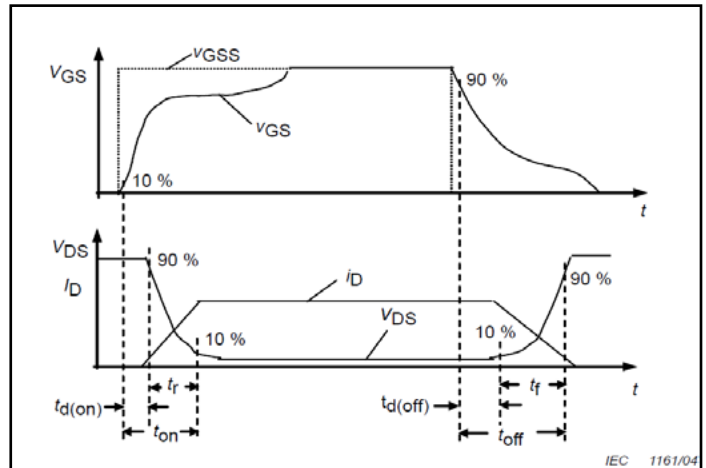


Figure 28. Switching Times Definition

Test Circuit Schematic

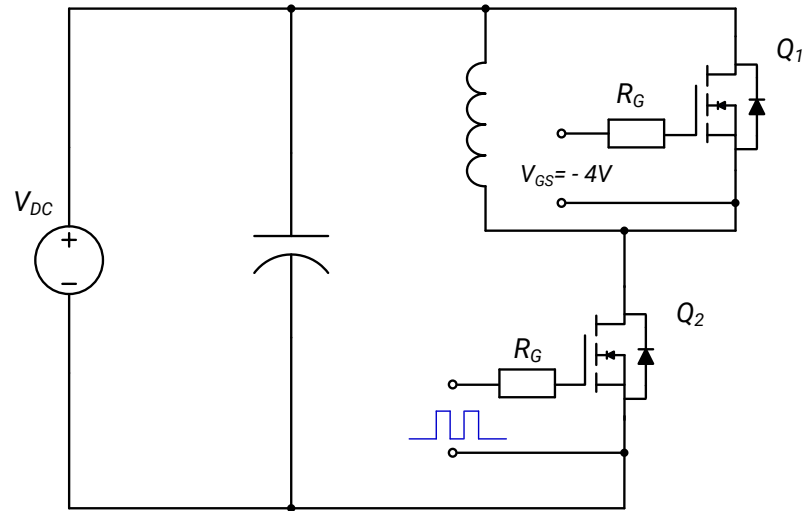
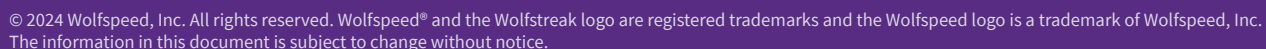


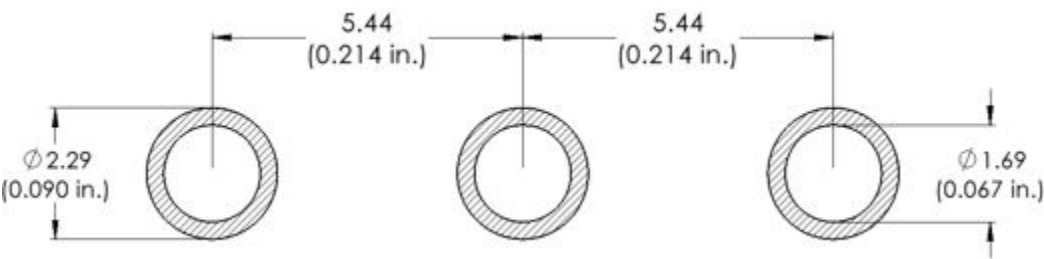
Figure 29. Clamped Inductive Switching Waveform Test Circuit

Note:

Turn-off and Turn-on switching energy and timing values measured using SiC MOSFET Body Diode as shown above.



Recommended Solder Pad Layout



Revision History

Current Revision	Date of Release	Description of Changes
A	April-2020	N/A
2	November-2023	Not Released
3	January-2024	Updated Wolfspeed branding, package drawing, package image, and solder pad layout, added Revision History Table, Table 1 layout revised
4	September - 2024	Legal Disclaimer, POD, 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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