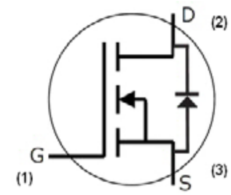
C2M0280120D

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

Features

- C2M™ 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

1 2 3



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Part Number	Package
C2M0280120D	TO 247-3

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

Maximum Ratings (T_C = 25°C unless otherwise specified)

Parameter	Symbol	Value	Unit	Test Conditions	Note
Drain-Source Voltage	$V_{DS\,max}$	1200	V	V_{GS} = 0 V, I_D = 100 μA	
Gate-Source Voltage (dynamic)[1]	$V_{GS\,max}$	-10/+25		Absolute maximum values	
Gate-Source Voltage (static)[2]	V_{GSop}	-5/+20		Recommended operational values	
Continuous Drain Current	I_D	11	A	V_{GS} = 20 V, T_C = 25°C	Fig. 19
		7.5		V_{GS} = 20 V, T_C = 100°C	
Pulsed Drain Current	$I_{D(pulse)}$	20		Pulse width t_P limited by $T_{j\,max}$	Fig. 22
Power Dissipation	P_D	69.4	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	
Mounting Torque	M_d	1 8.8	Nm lbf-in	M3 or 6-32 screw	

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Electrical Characteristics (T_C = 25℃ unless otherwise specified)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test Conditions	Note
Drain-Source Breakdown Voltage	$V_{(BR)DSS}$	1200	—	—	V	V_{GS} = 0 V, I_D = 100 μA	
Gate Threshold Voltage	$V_{GS(th)}$	2.0	3.1	4	V	V_{DS} = V_{GS}, I_D = 1.25 mA	Fig. 11
		—	2.7	—		V_{DS} = V_{GS}, I_D = 1.25 mA, T_J = 150℃	
Zero Gate Voltage Drain Current	I_{DSS}	—	1	100	μA	V_{DS} = 1200 V, V_{GS} = 0 V	
Gate-Source Leakage Current	I_{GSS}	—		250	nA	V_{GS} = 20 V, V_{DS} = 0 V	
Drain-Source On-State Resistance	$R_{DS(on)}$	—	320	370	mΩ	V_{GS} = 20 V, I_D = 6 A	Fig. 4, 5, 6
		—	540	—		V_{GS} = 20 V, I_D = 6 A, T_J = 150°C	
Transconductance	g_{fs}	—	2.6	—	S	V_{DS} = 20 V, I_{DS} = 6 A	Fig. 7
			2.5			V_{DS} = 20 V, I_{DS} = 6 A, T_J = 150°C	
Input Capacitance	C_{iss}	—	267	—	pF	V_{GS} = 0 V, V_{DS} = 1000 V, f = 1 Mhz, V_{AC} = 25 mV	Fig. 17, 18
Output Capacitance	C_{oss}	—	31	—			
Reverse Transfer Capacitance	C_{rss}	—	4	—			
Output Capacitance Stored Energy	E_{oss}	—	17	—	μJ		Fig. 16
Turn-On Switching Energy (Body Diode)	E_{on}	—	111	—		V_{DS} = 800 V, V_{GS} = -5/20 V, I_D = 6 A, $R_{G(ext)}$ = 2.5 Ω, L= 404 μH, FWD = Internal Body Diode of MOSFET	Fig. 25
Turn Off Switching Energy (Body Diode)	E_{off}	—	10	—			
Turn-On Switching Energy (External Diode)	E_{on}	—	95	—		V_{DS} = 800 V, V_{GS} = -5/20 V, I_D = 6 A, $R_{G(ext)}$ = 2.5 Ω, L= 404 μH, FWD = External SiC Diode	
Turn Off Switching Energy (External Diode)	E_{off}	—	9.8	—			
Turn-On Delay Time	$t_{d(on)}$	—	6	—	ns	V_{DS} = 800 V, V_{GS} = -5/20 V, I_D = 6 A, $R_{G(ext)}$ = 2.5 Ω, Inductive Load, Timing relative to V_{DS}, Per IEC60747-8-4 pg 21	Fig. 27
Rise Time	t_r	—	19	—			
Turn-Off Delay Time	$t_{d(off)}$	—	10	—			
Fall Time	t_f	—	16	—			
Internal Gate Resistance	$R_{G(int)}$	—	10	—	Ω	f = 1 MHz, V_{AC} = 25 mV , ESR of C_{ISS}	
Gate to Source Charge	Q_{gs}	—	6	—	nC	V_{DS} = 800 V, V_{GS} = -5/20 V, I_D = 6 A, Per IEC60747-8-4 pg 21	Fig. 12
Gate to Drain Charge	Q_{gd}	—	7	—			
Total Gate Charge	Q_g	—	19	—			

Reverse Diode Characteristics (T_C = 25˚C unless otherwise specified)

Parameter	Symbol	Typ.	Max.	Unit	Test Conditions	Note
Diode Forward Voltage	V_{SD}	4.3	—	V	V_{GS} = -5 V, I_{SD} = 3 A	Fig. 8, 9, 10
		3.8	—		V_{GS} = -5 V, I_{SD} = 3 A, T_J = 150°C	
Continuous Diode Forward Current	I_S	—	12	A	V_{GS} = -5 V, T_C = 25°C	Note 1
Diode Pulse Current	$I_{S, pulsed}$	—	20	—	V_{GS} = -5 V, pulse width t_P limited by $T_{j\,max}$	
Reverse Recover Time	t_{rr}	17	—	nS	V_{GS} = -5 V, I_{SD} = 6 A, V_R = 800 V dif/dt = 2985 A/µs	Note 1
Reverse Recovery Charge	Q_{rr}	48	—	nC		
Peak Reverse Recovery Current	I_{rrm}	5	—	A		
Reverse Recovery time	t_{rr}	25	—	nS	V_{GS} = -5 V, I_{SD} = 6 A, V_R = 800 V dif/dt = 1000 A/µs	Note 1
Reverse Recovery Charge	Q_{rr}	45	—	nC		
Peak Reverse Recovery Current	I_{rrm}	4	—	A		

Note:
[1] When using SiC Body Diode the maximum recommended V_{GS} = -5V

Thermal Characteristics

Parameter	Symbol	Typ.	Max.	Unit	Note
Thermal Resistance from Junction to Case	$R_{\theta JC}$	1.53	1.8	°C/W	Fig. 21
Thermal Resistance from Junction to Ambient			40		

Typical Performance

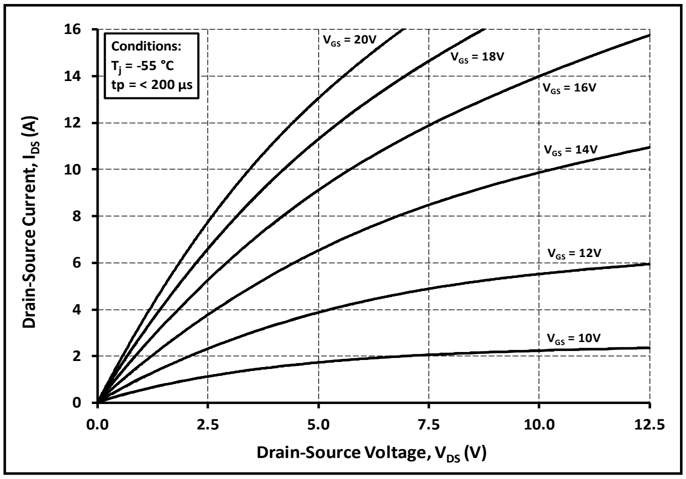


Figure 1. Output Characteristics T_J = -55°C

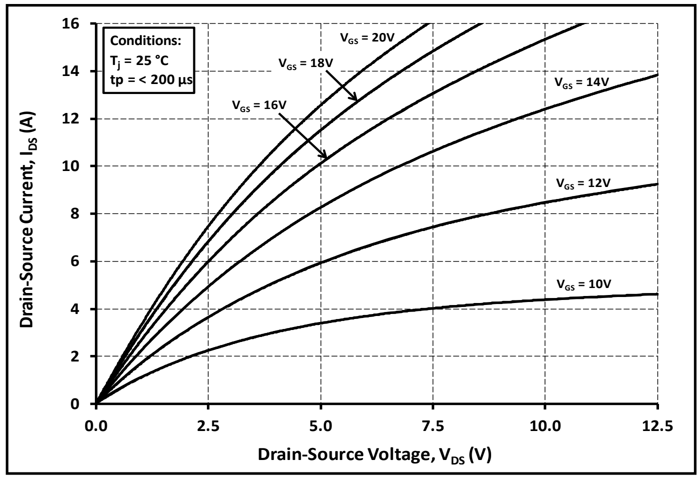


Figure 2. Output Characteristics T_J = 25°C

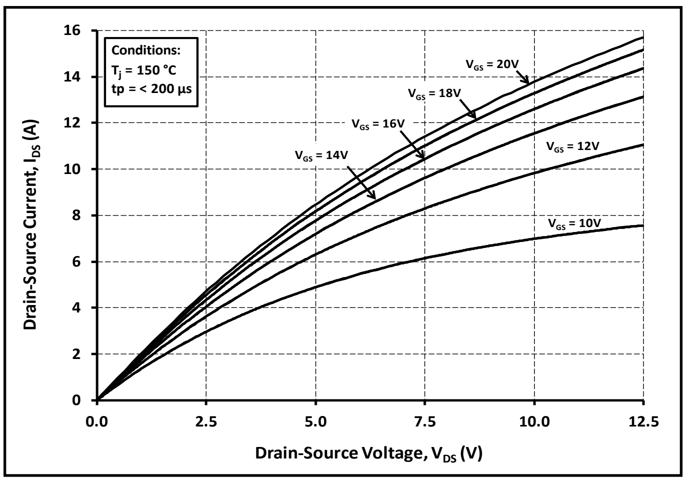


Figure 3. Output Characteristics T_J = 150°C

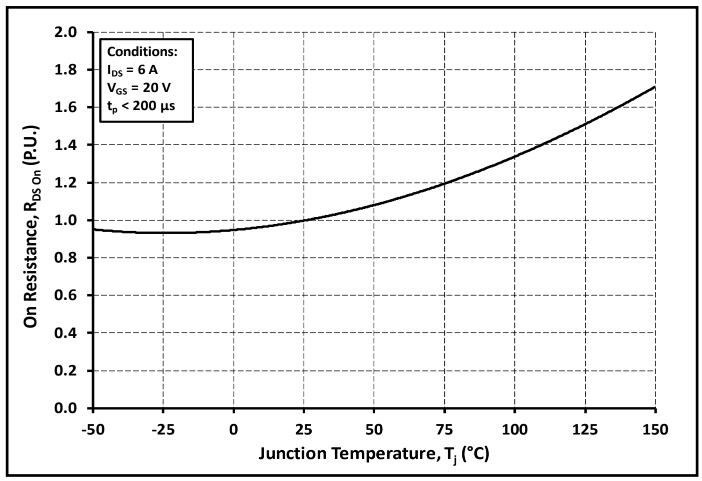


Figure 4. Normalized On-Resistance vs. Temperature

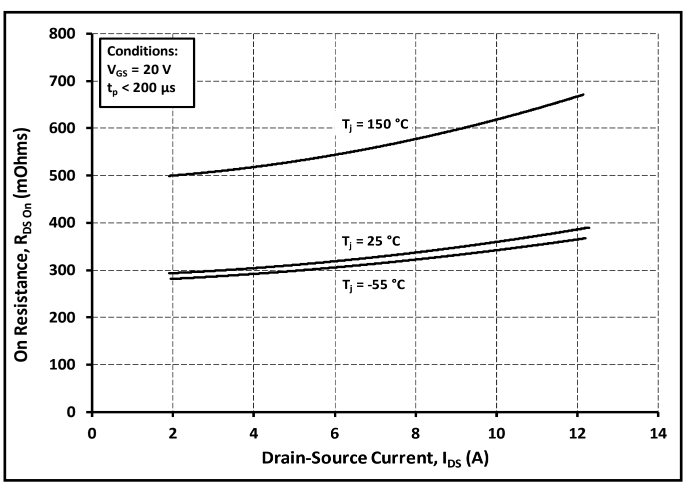


Figure 5. On-Resistance vs. Drain Current
For Various Temperatures

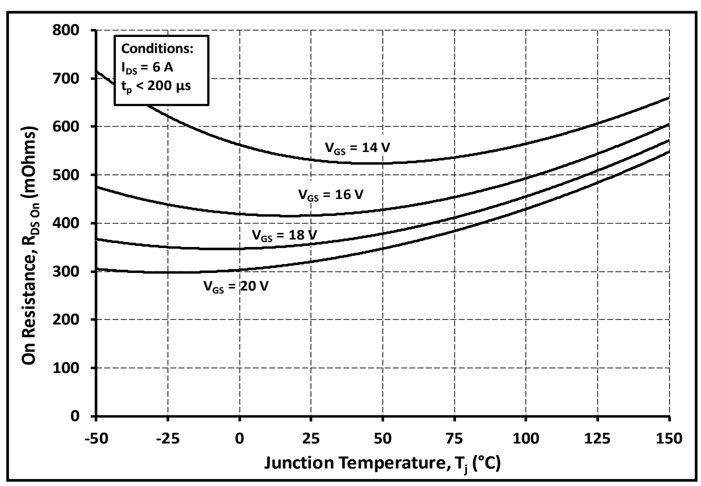


Figure 6. On-Resistance vs. Temperature
For Various Gate Voltage

Typical Performance

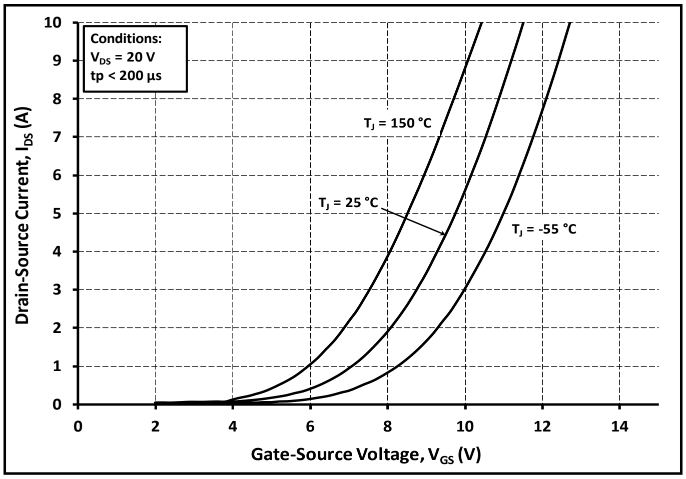


Figure 7. Transfer Characteristic for Various Junction Temperatures

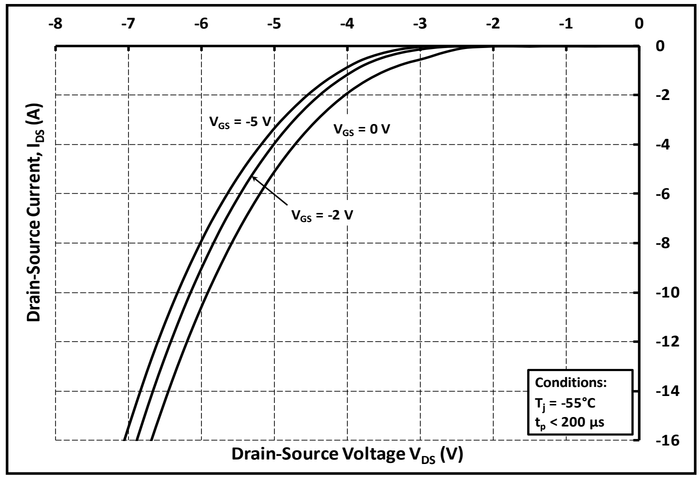


Figure 8. Body Diode Characteristic at -40°C

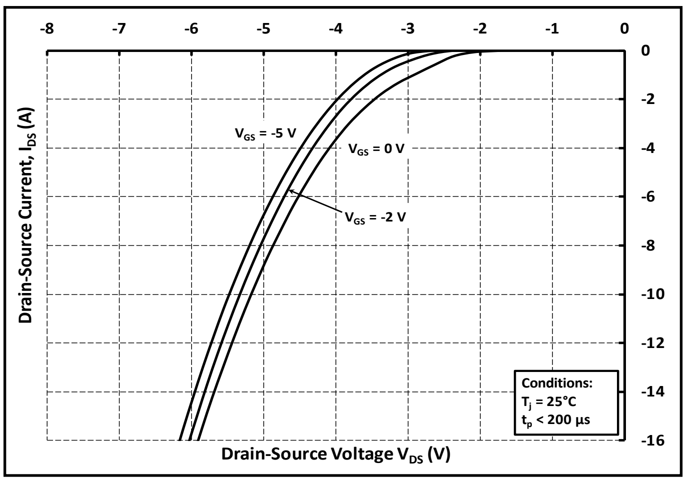


Figure 9. Body Diode Characteristic at 25°C

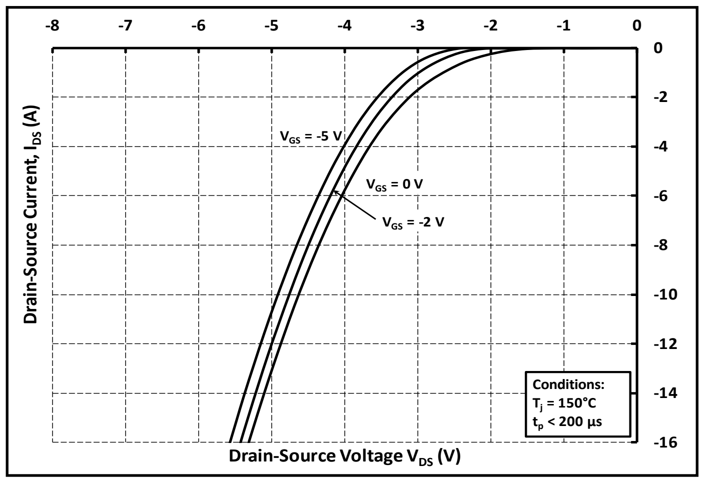


Figure 10. Body Diode Characteristic at 150°C

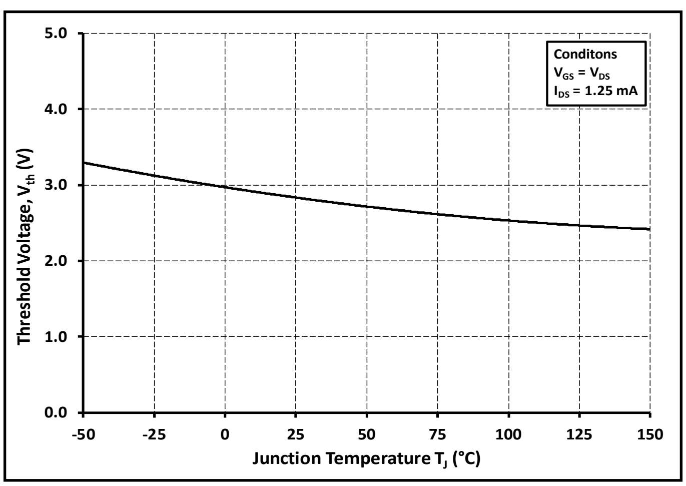


Figure 11. Threshold Voltage vs. Temperature

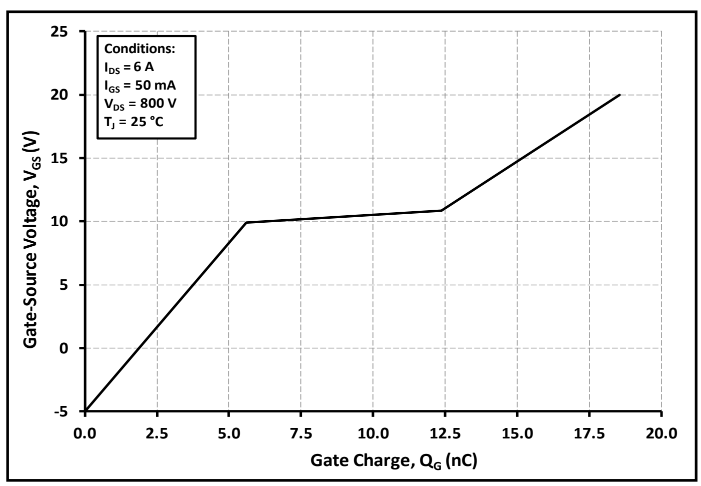


Figure 12. Gate Charge Characteristics

Typical Performance

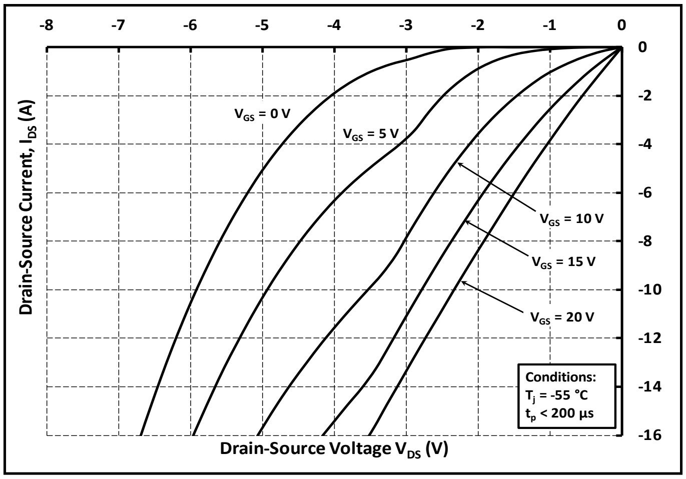


Figure 13. 3rd Quadrant Characteristic at -55°C

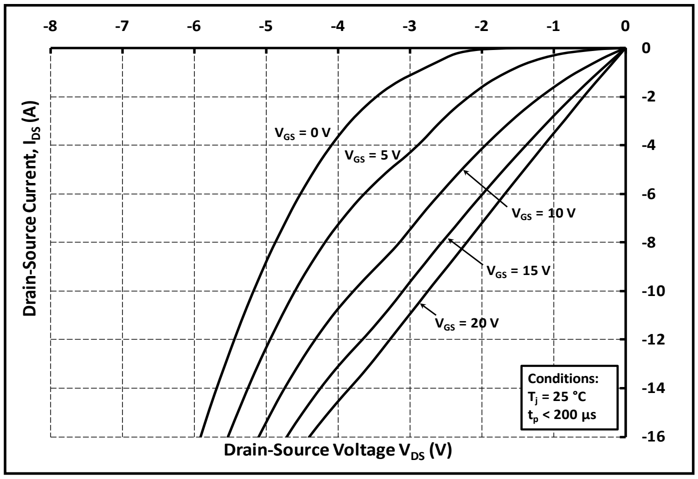


Figure 14. 3rd Quadrant Characteristic at 25°C

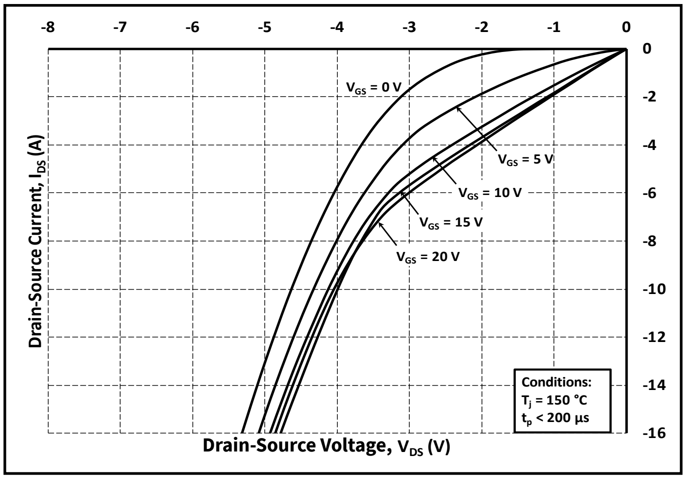


Figure 15. 3rd Quadrant Characteristic at 150°C

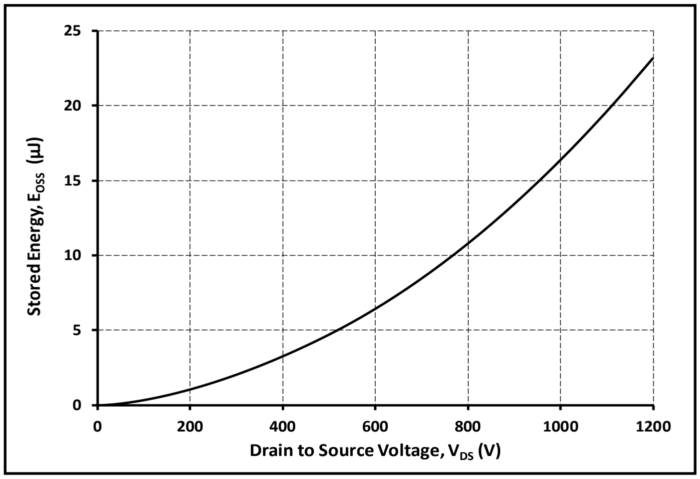


Figure 16. Output Capacitor Stored Energy

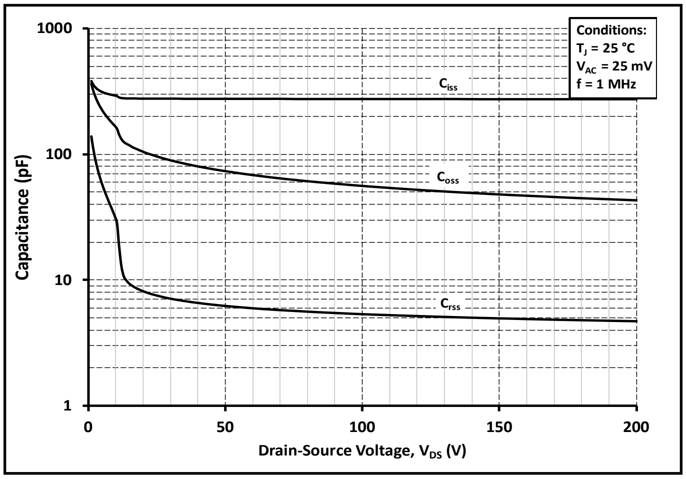


Figure 17. Capacitances vs. Drain-Source Voltage (0 - 200 V)

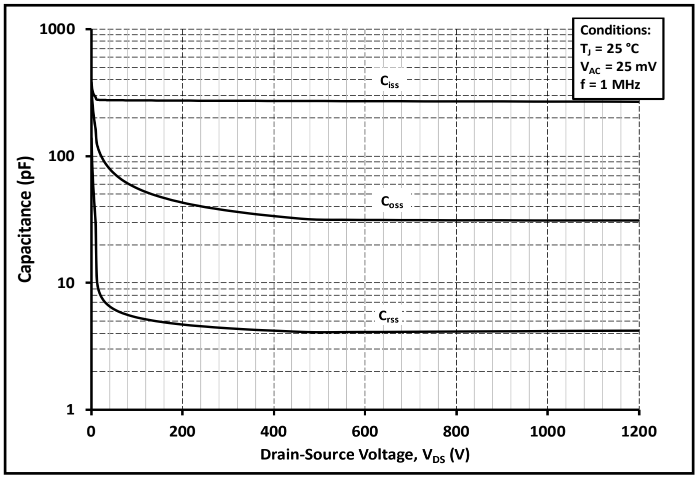


Figure 18. Capacitances vs. Drain-Source Voltage (0 - 1200 V)

Typical Performance

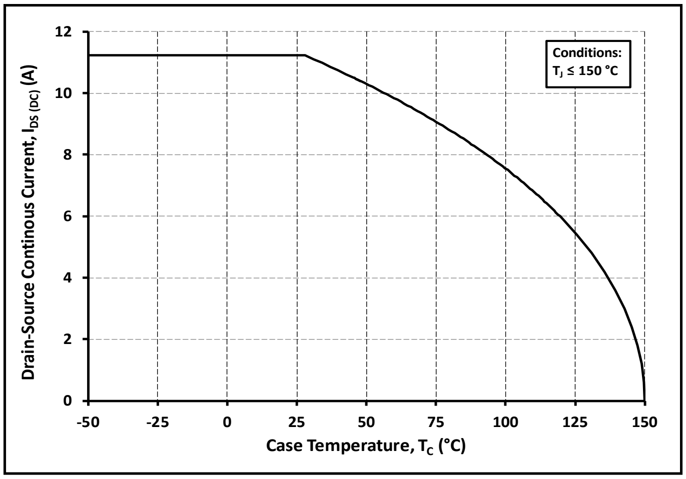


Figure 19. Continuous Drain Current Derating vs. Case Temperature

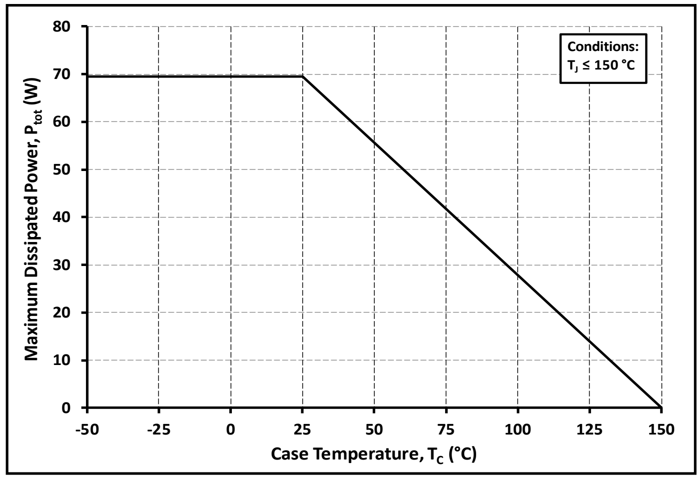


Figure 20. Maximum Power Dissipation Derating vs. Case Temperature

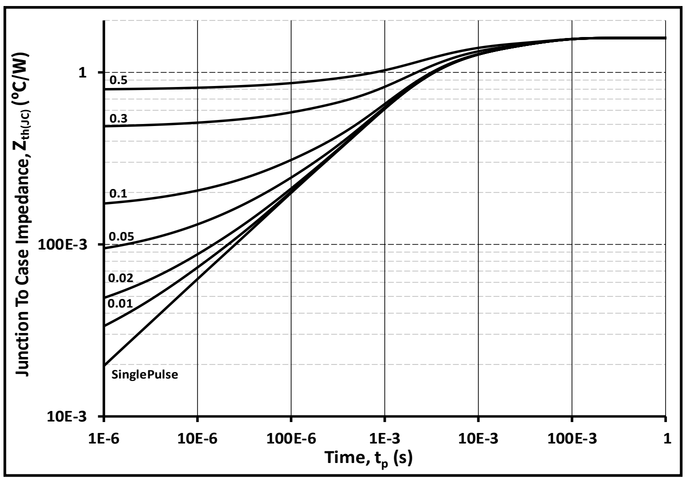


Figure 21. Transient Thermal Impedance (Junction - Case)

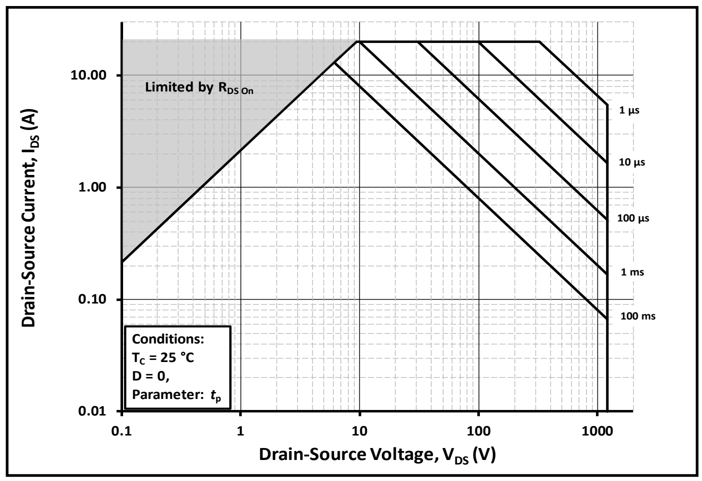


Figure 22. Safe Operating Area

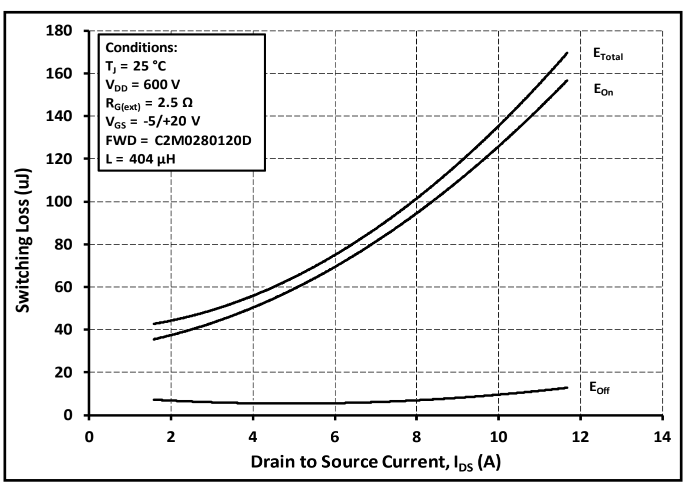


Figure 23. Clamped Inductive Switching Energy vs. Drain Current (V_{DD} = 600 V)

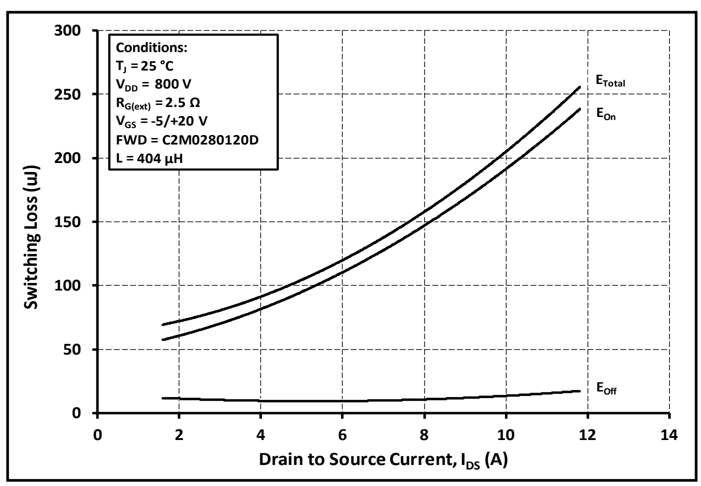


Figure 24. Clamped Inductive Switching Energy vs. Drain Current (V_{DD} = 800 V)

Typical Performance

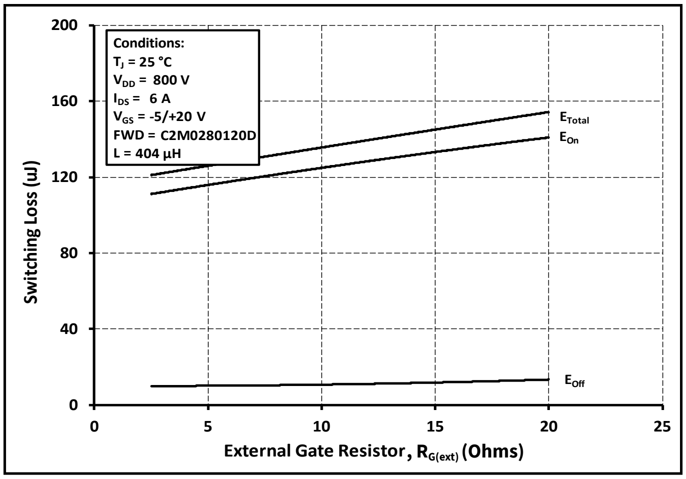


Figure 25. Clamped Inductive Switching Energy vs. $R_{G(ext)}$

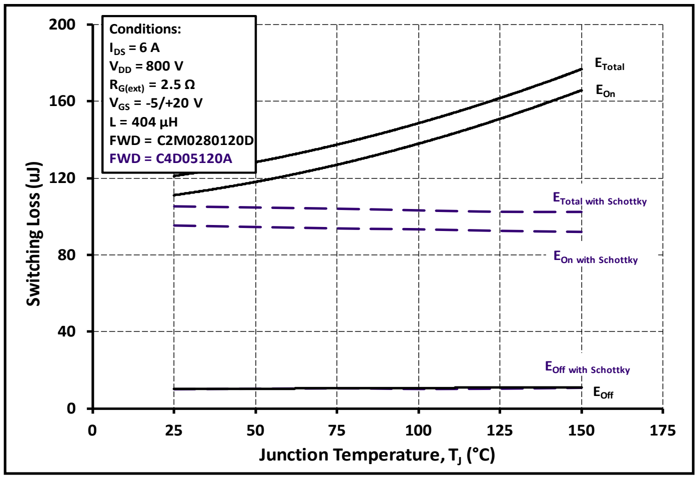


Figure 26. Clamped Inductive Switching Energy vs. Temperature

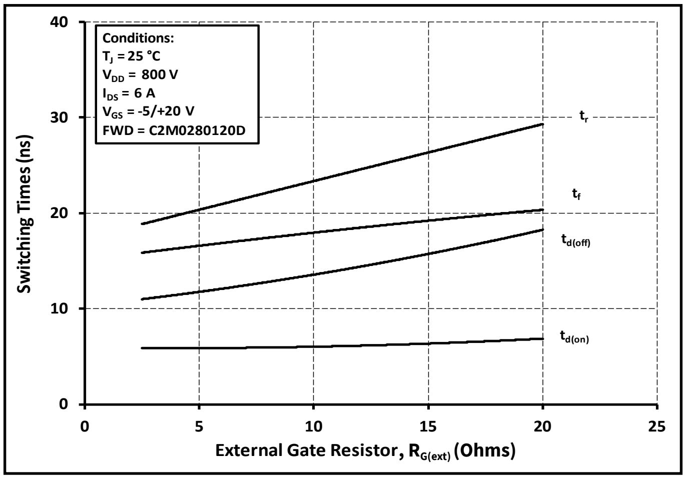


Figure 27. Switching Times vs. $R_{G(ext)}$

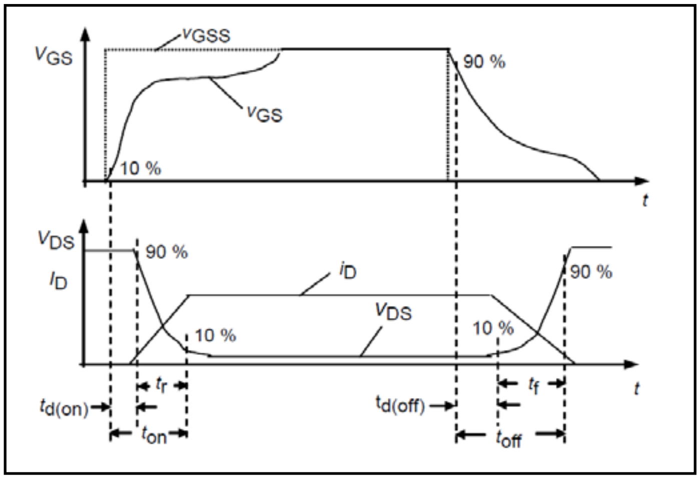


Figure 28. Switching Times Definition

Test Circuit Schematic

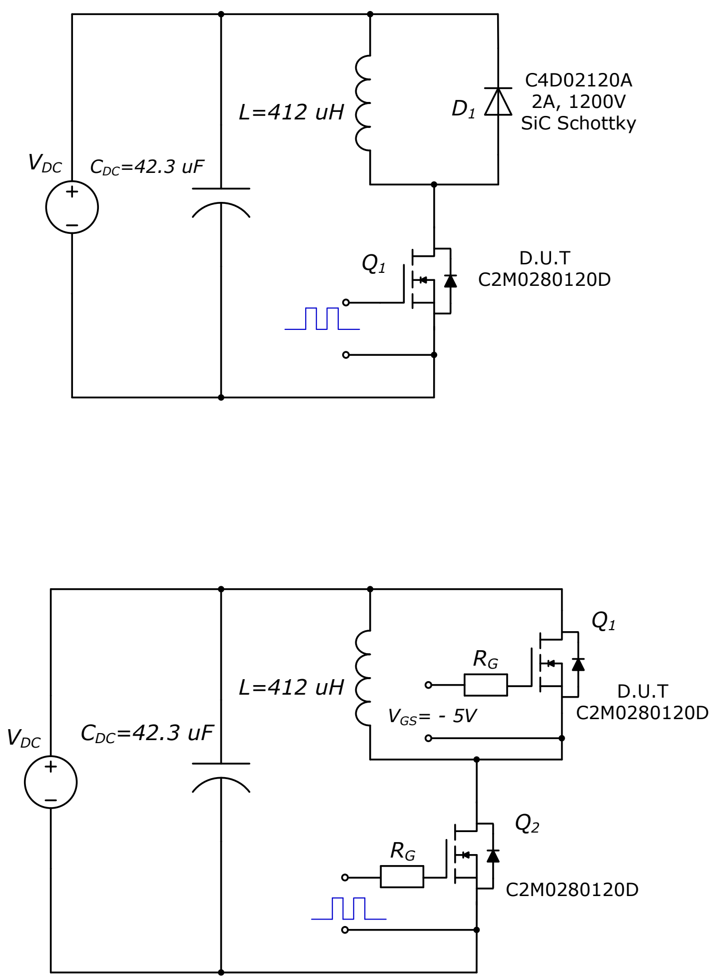
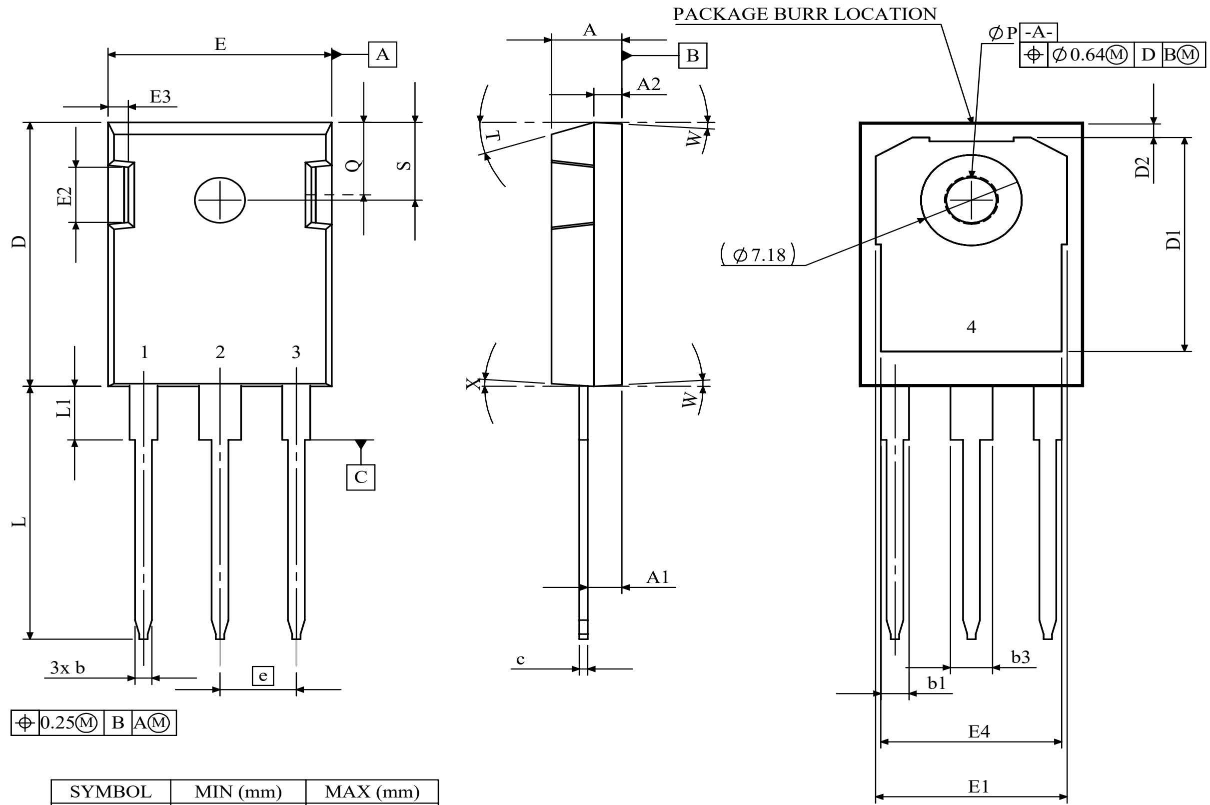


Figure 29. Clamped Inductive Switching Waveform Test Circuit

ESD Ratings

ESD Test	Resulting Classification
ESD-HBM	1A (250V - 500 V)
ESD-CDM	C3 (>1000 V)

Package Dimensions – TO-247-4L



SYMBOL	MIN (mm)	MAX (mm)
A	4.83	5.21
A1	2.29	2.54
A2	1.91	2.16
b	1.07	1.33
b1	1.91	2.41
b3	2.87	3.38
c	0.55	0.68
D	20.8	21.1
D1	16.25	17.65
D2	0.95	1.25
E	15.75	16.13
E1	13.1	14.15
E2	3.68	5.1
E3	1	1.9
E4	12.38	13.43
e	5.44 BSC	
L	19.81	20.32
L1	4.1	4.4
ØP	3.51	3.65
Q	5.49	6
S	6.04	6.3
T	17.5° REF.	
W	3.5° REF.	
X	4° REF.	

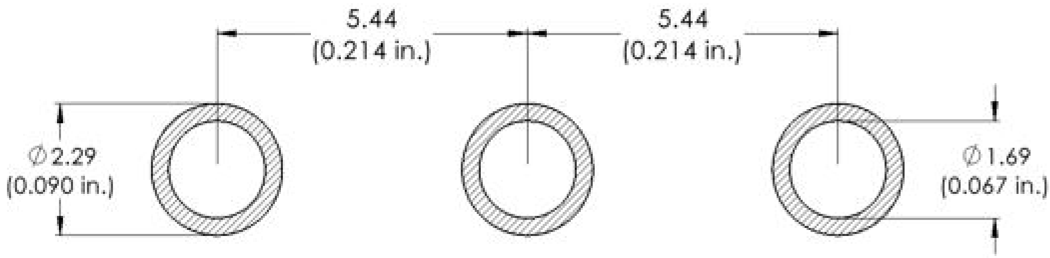
1	GATE
2	DRAIN
3	SOURCE
4	DRAIN

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

Wolfspeed	TITLE: PACKAGE OUTLINE DRAWING: TO-247-3L(MOSFET)
Date: 04/13/22	REVISION NO. 01 — A4
	SCALE:1:1 — SHEET 1 OF 1

Recommended Solder Pad Layout



Revision History

Current Revision	Date of Release	Description of Changes
3	February-2021	N/A
4	November-2023	Updated Wolfspeed branding, package drawing, package image, and solder pad layout, added Revision History Table

Related Links

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

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This product has not been designed or tested for use in, and is not intended for use in, applications in which failure of the product would reasonably be expected to cause death, personal injury, or property damage, including but not limited to equipment implanted into the human body, life-support machines, cardiac defibrillators, and similar emergency medical equipment, aircraft navigation, communication, and control systems, aircraft power and propulsion systems, air traffic control systems, and equipment used in the planning, construction, maintenance, or operation of nuclear facilities.

The Silicon Carbide MOSFET module switches at speeds beyond what is customarily associated with IGBT-based modules. Therefore, special precautions are required to realize optimal performance. The interconnection between the gate driver and module housing needs to be as short as possible. This will afford optimal switching time and avoid the potential for device oscillation. Also, great care is required to insure minimum inductance between the module and DC link capacitors to avoid excessive VDS overshoot.

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.

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.

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