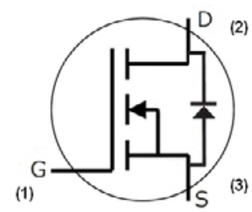
C2M0040120D

Silicon Carbide Power MOSFET
C2M^{TM} 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
- 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
C2M0040120D	TO-247-3	C2M0040120

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	$T_C = 25°C$	
Maximum Gate - Source Voltage	$V_{GS(max)}$	-10		+25	V	Transient	
Operational Gate-Source Voltage	$V_{GS\ op}$		-5/20		V	Static	Note 1
DC Continuous Drain Current	I_D			55	A	$V_{GS} = 20$ V, $T_C = 25$ °C, $T_J \leq 150$ °C	Fig. 19 Note 2
				36	A	$V_{GS} = 20$ V, $T_C = 100$ °C, $T_J \leq 150$ °C	
Pulsed Drain Current	I_{DM}			160	A	t_{Pmax} limited by T_{jmax} $V_{GS} = 20V$, $T_C = 25$ °C	Fig. 22
Power Dissipation	P_D			278	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	°C	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 20V with ±5% regulation tolerance, see Application Note PRD-04814 for additional details
Note (2): Verified by design

Electrical Characteristics (T_C = 25˚C unless otherwise specified)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test Conditions	Note
Drain-Source Breakdown Voltage	$V_{(BR)DSS}$	1200	—	—	V	V_{GS} = 0 V, I_D = 100 μA	
Gate Threshold Voltage	$V_{GS(th)}$	2.0	3.2	4	V	V_{DS} = $V_{GS,}$ I_D = 10 mA	Fig. 11
		—	2.4	—		V_{DS} = $V_{GS,}$ I_D = 10 mA, T_J = 150°C	
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	$R_{DS(on)}$	—	44	52	mΩ	V_{GS} = 20 V, I_D = 40 A	Fig. 4, 5, 6
		—	82	—		V_{GS} = 15 V, I_D = 40 A, T_J = 150°C	
Transconductance	g_{fs}	—	18.2	—	S	V_{DS} = 20 V, I_{DS} = 40 A	Fig. 7
			17.2			V_{DS} = 20 V, I_{DS} = 40 A, T_J = 150°C	
Input Capacitance	C_{iss}	—	2440	—	pF	V_{GS} = 0 V V_{DS} = 1000 V ƒ = 1 Mhz V_{AC} = 25 mV	Fig. 17, 18
Output Capacitance	C_{oss}	—	171	—			
Reverse Transfer Capacitance	C_{rss}	—	11	—			
C_{oss} Stored Energy	E_{oss}	—	89	—	μJ		Fig. 16
Turn-On Switching Energy (Body Diode)	E_{on}	—	1.7	—	mJ	V_{DS} = 800 V, V_{GS} = -5/+20 V I_D = 40 A, $R_{G(ext)}$ = 2.5 Ω, L= 99 μH	Fig. 26
Turn Off Switching Energy ((Body Diode)	E_{off}	—	0.4	—			
Turn-On Switching Energy (External SiC Diode)	E_{on}	—	1.3	—			
Turn Off Switching Energy (External SiC Diode)	E_{off}	-	0.4	—			
Turn-On Delay Time	$t_{d(on)}$	—	13	—	ns	V_{DD} = 800 V, V_{GS} = -5/20 V, I_D = 40 A, $R_{G(ext)}$ = 2.5 Ω, R_L = 20 Ω Timing relative to V_{DS} Per IEC60747-8-4 pg 83	Fig. 27
Rise Time	t_r	—	61	—			
Turn-Off Delay Time	$t_{d(off)}$	—	25	—			
Fall Time	t_f	—	13	—			
Internal Gate Resistance	$R_{G(int)}$	—	1.8	—	Ω	ƒ = 1 MHz, V_{AC} = 25 mV	
Gate to Source Charge	Q_{gs}	—	34	—	nC	V_{DS} = 800 V, V_{GS} = -5/20 V I_D = 40 A Per IEC60747-8-4 pg 21	Fig. 12
Gate to Drain Charge	Q_{gd}	—	42	—			
Total Gate Charge	Q_g	—	120	—			

Reverse Diode Characteristics

Parameter	Symbol	Typ.	Max.	Unit	Test Conditions	Notes
Diode Forward Voltage	V_{SD}	4.0	—	V	V_{GS} = -5 V, I_{SD} = 20 A, T_J = 25°C	Fig. 8, 9, 10
		3.6	—		V_{GS} = -5 V, I_{SD} = 20 A, T_J = 150°C	
Continuous Diode Forward Current[1]	I_S	—	60	A	T_C = 25°C	Note 1
Diode Pulse Current	I_{SM}	—	160		V_{GS} = -5 V, pulse width t_P limited by $T_{j\,max}$	
Reverse Recovery Time[1]	t_{rr}	54	—	ns	V_{GS} = -5 V, I_{SD} = 40 A, T_J = 25°C V_R = 800 V di_F/dt = 1000 A/µs	Note 1
Reverse Recovery Charge[1]	Q_{rr}	283	—	nC		
Peak Reverse Recovery Current[1]	I_{RRM}	15	—	A		

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

Thermal Characteristics

Parameter	Symbol	Typ.	Max.	Unit	Test Conditions	Notes
Thermal Resistance from Junction to Case	$R_{\theta JC}$	0.33	0.45	°C/W		Fig. 21
Thermal Resistance from Junction to Ambient	$R_{\theta JA}$		40			

Typical Performance

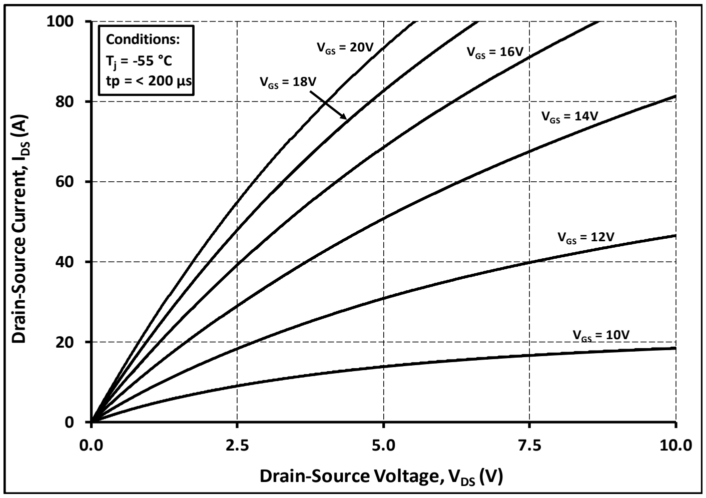


Figure 1. Output Characteristics T_J = -55°C

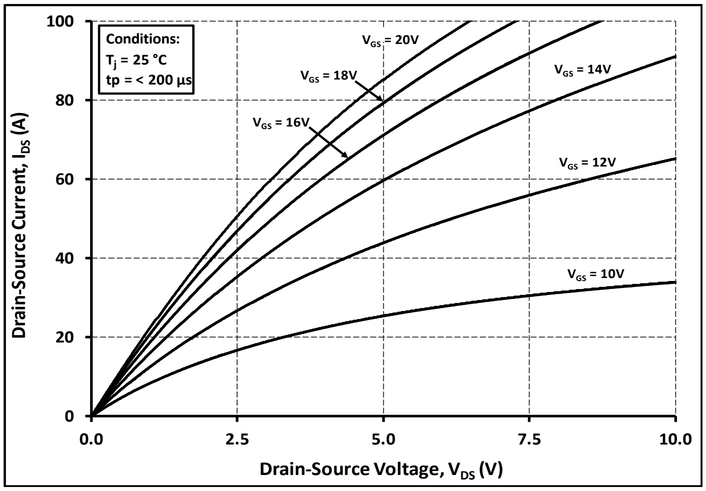


Figure 2. Output Characteristics T_J = 25°C

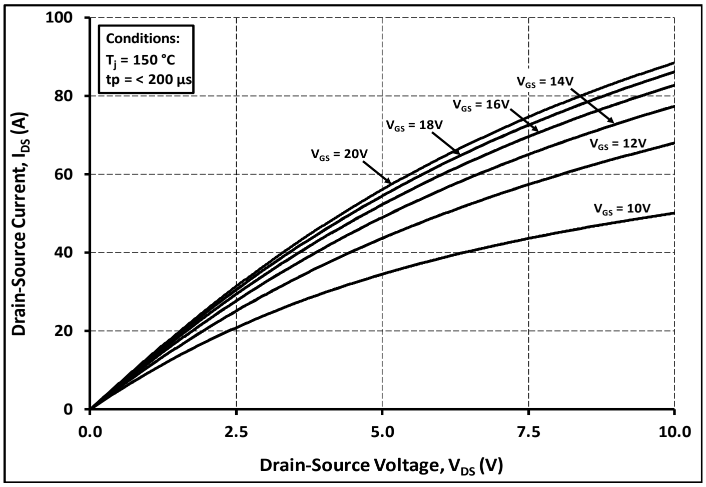


Figure 3. Output Characteristics T_J = 150°C

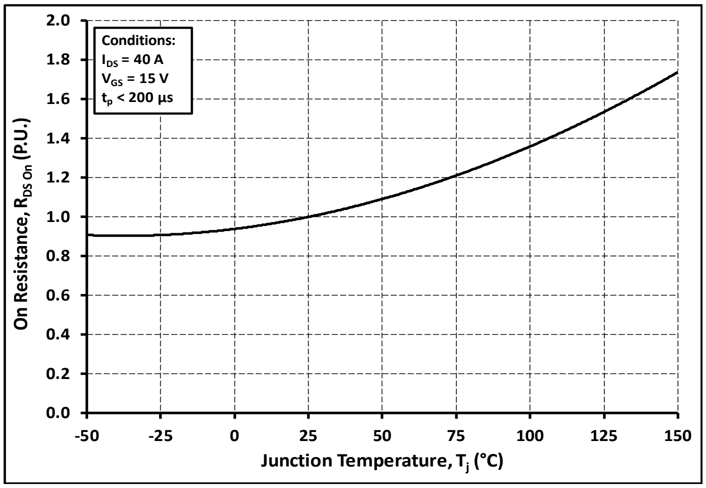


Figure 4. Normalized On-Resistance vs. Temperature

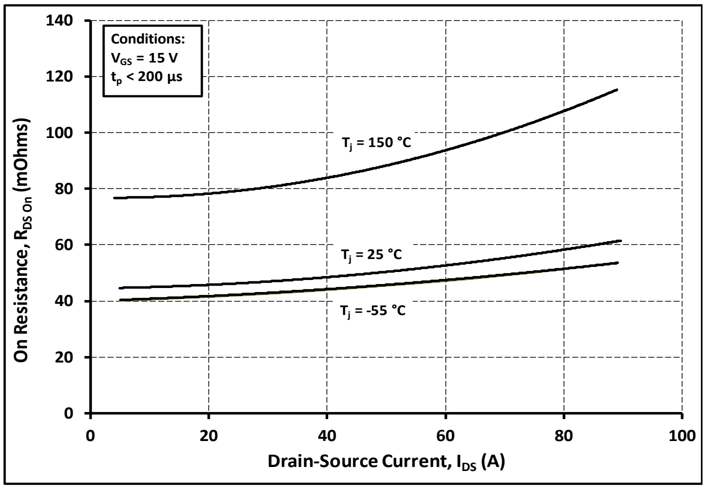


Figure 5. On-Resistance vs. Drain Current
For Various Temperatures

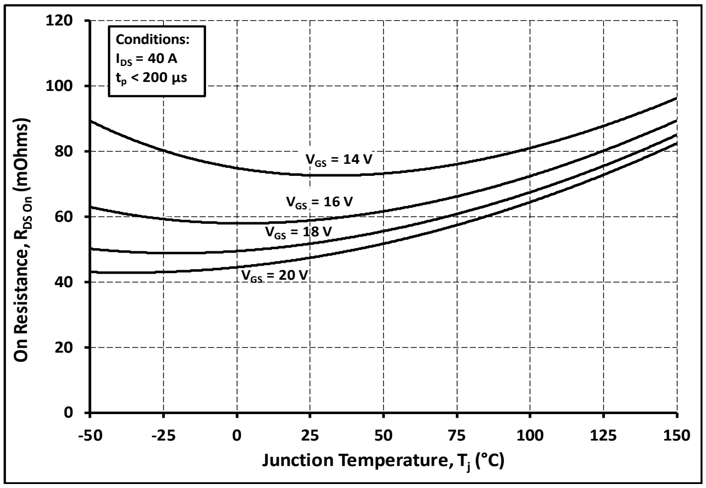


Figure 6. On-Resistance vs. Temperature
For Various Gate Voltage

Typical Performance

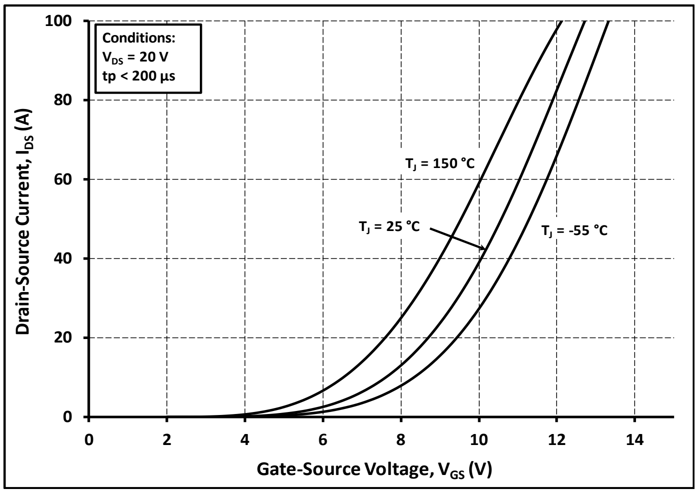


Figure 7. Transfer Characteristic for Various Junction Temperatures

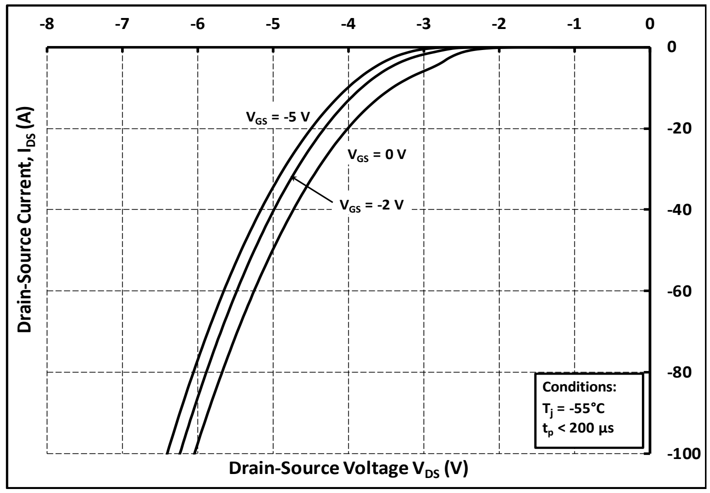


Figure 8. Body Diode Characteristic at -55°C

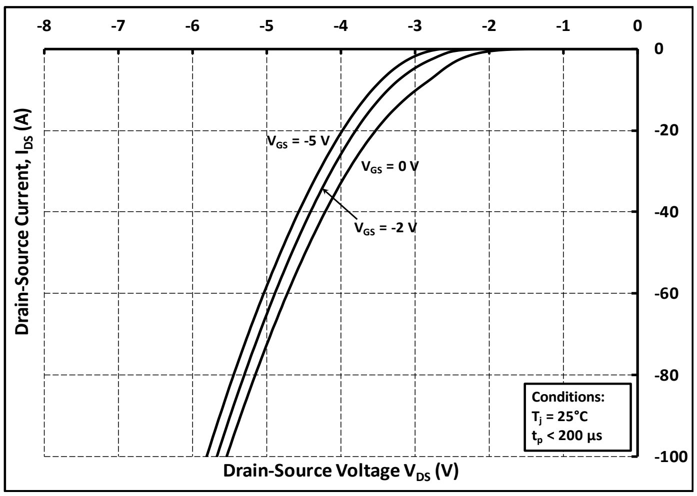


Figure 9. Body Diode Characteristic at 25°C

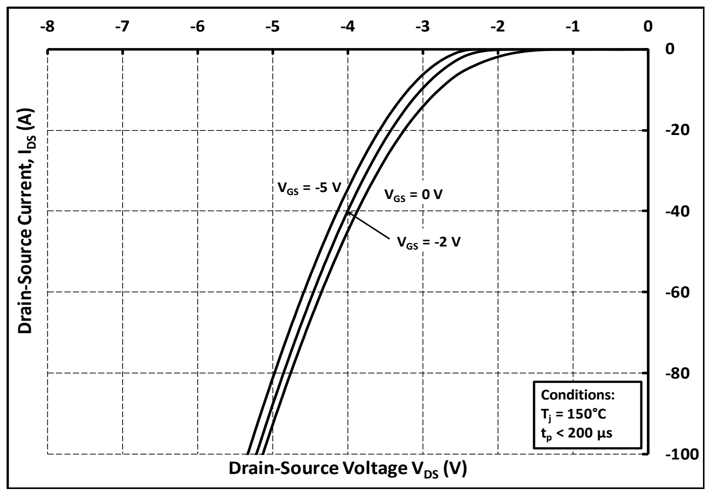


Figure 10. Body Diode Characteristic at 150°C

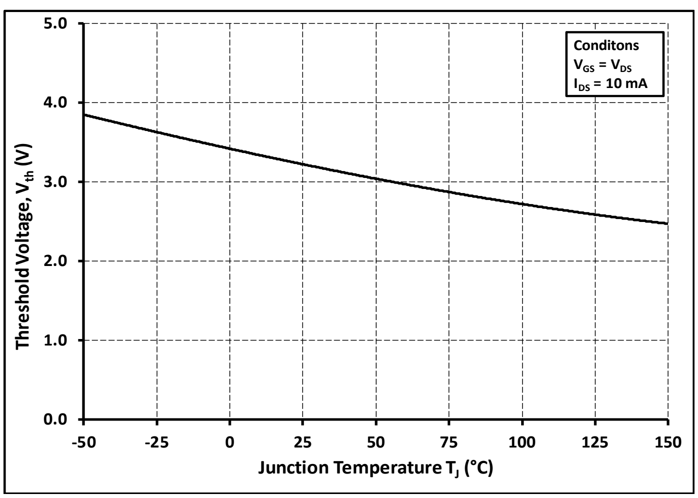


Figure 11. Threshold Voltage vs. Temperature

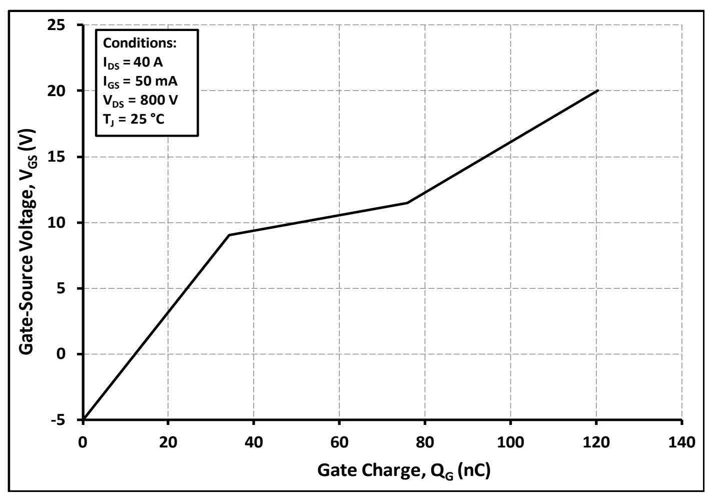


Figure 12. Gate Charge Characteristics

Typical Performance

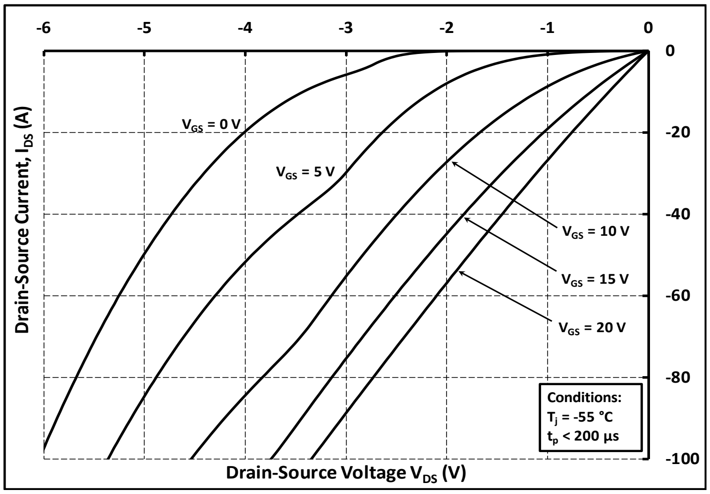


Figure 13. 3rd Quadrant Characteristic at -55°C

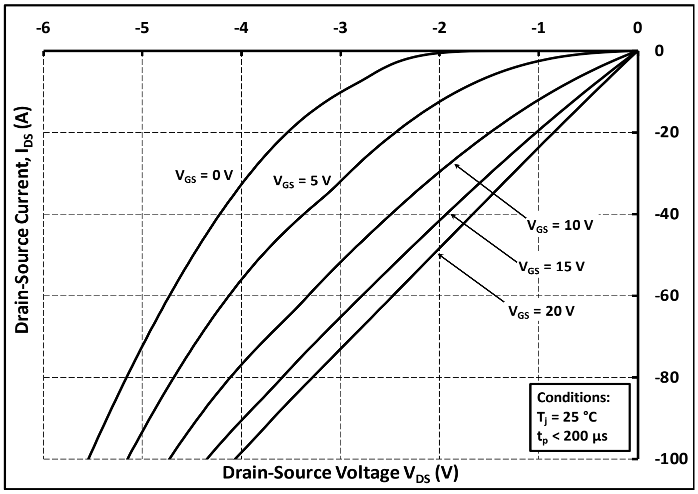


Figure 14. 3rd Quadrant Characteristic at 25°C

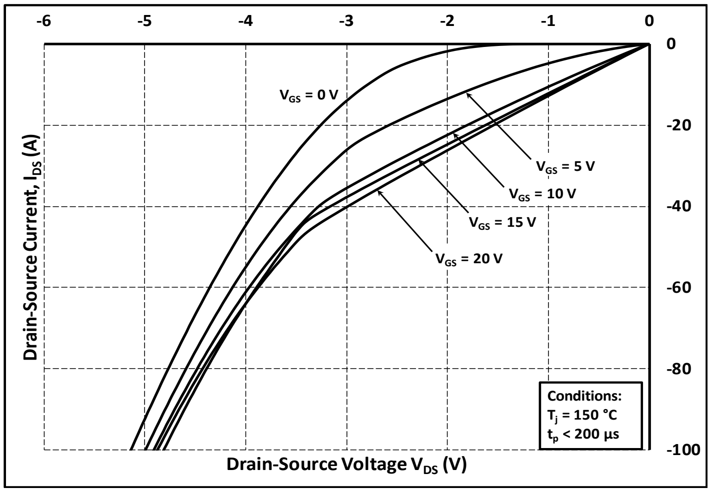


Figure 15. 3rd Quadrant Characteristic at 150°C

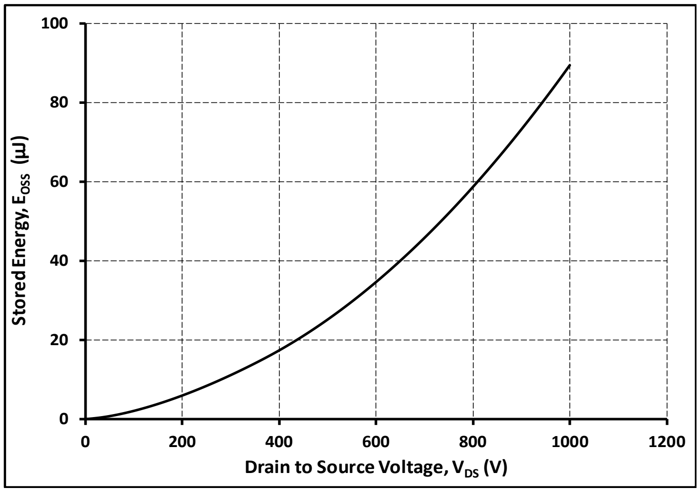


Figure 16. Output Capacitor Stored Energy

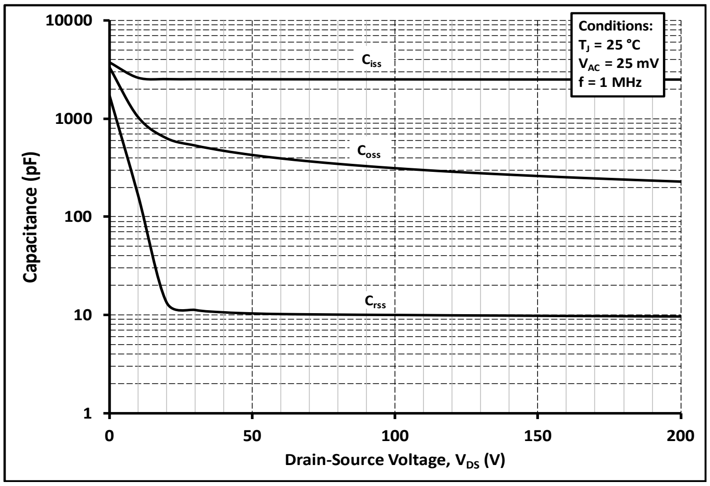


Figure 17. Capacitances vs. Drain-Source Voltage (0 - 200 V)

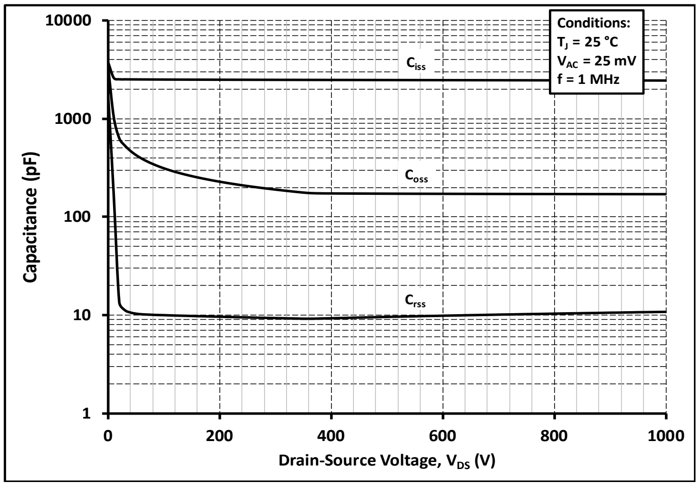


Figure 18. Capacitances vs. Drain-Source Voltage (0 - 1000 V)

Typical Performance

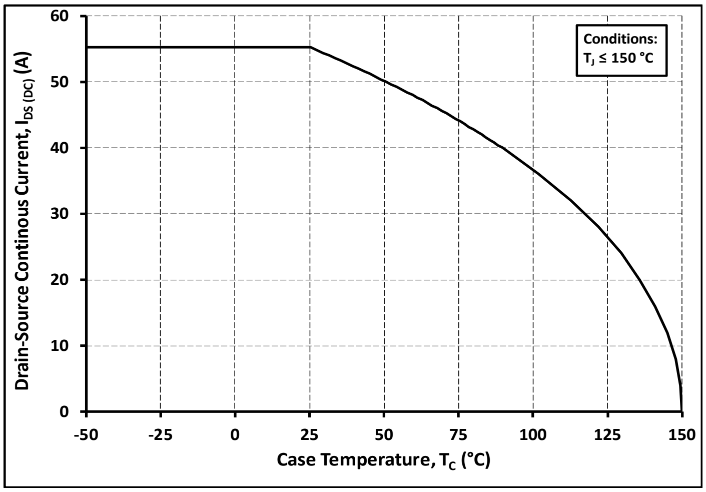


Figure 19. Continuous Drain Current Derating vs. Case Temperature

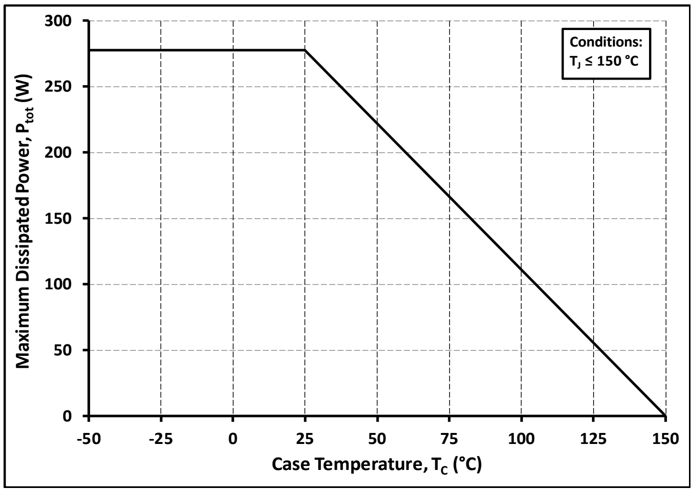


Figure 20. Maximum Power Dissipation Derating vs. Case Temperature

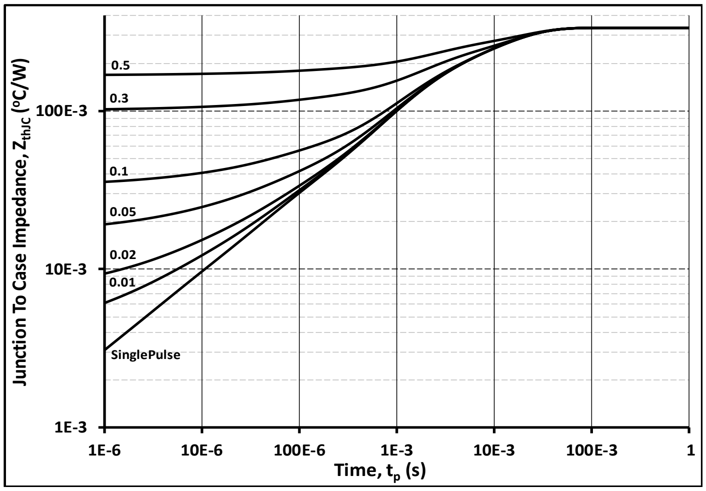


Figure 21. Transient Thermal Impedance (Junction - Case)

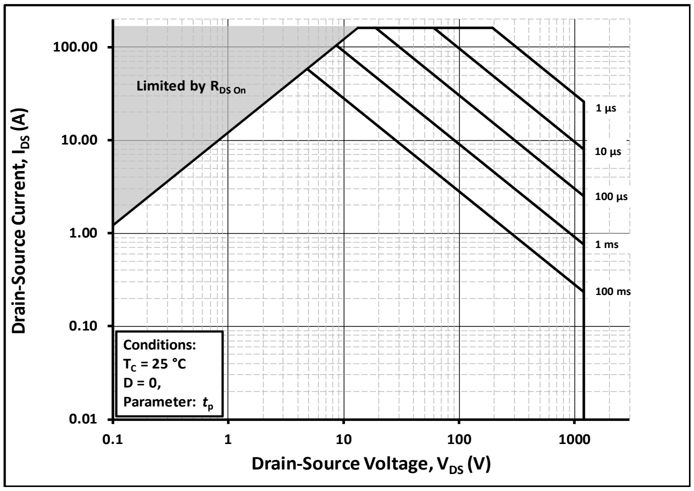


Figure 22. Safe Operating Area

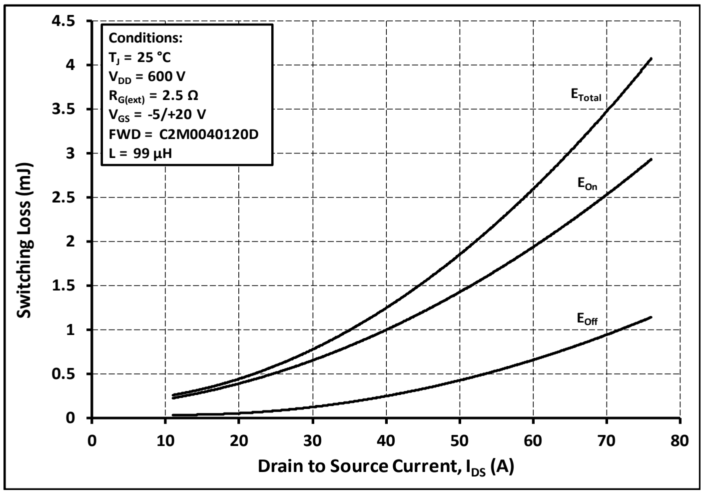


Figure 23. Clamped Inductive Switching Energy vs. Drain Current (V_{DD} = 600 V)

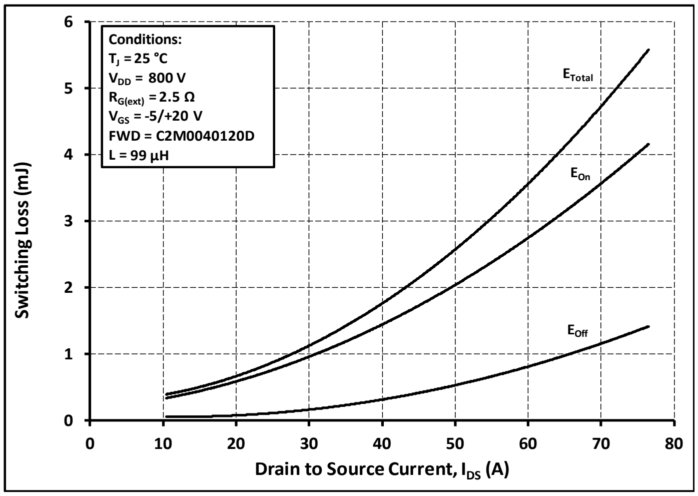


Figure 24. Clamped Inductive Switching Energy vs. Drain Current (V_{DD} = 800 V)

Typical Performance

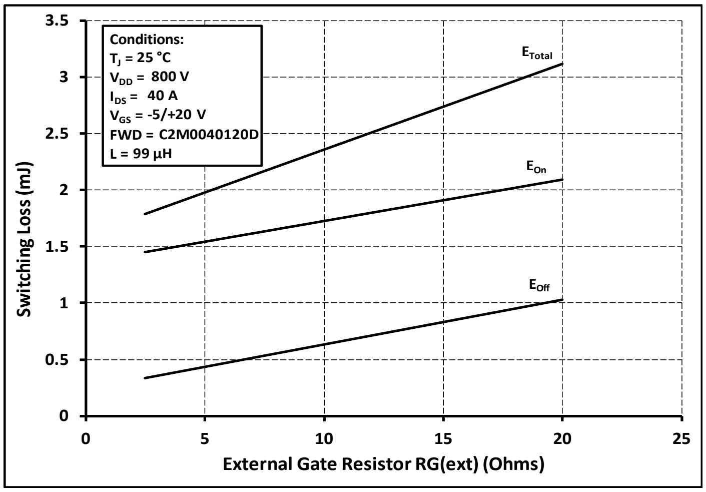


Figure 25. Clamped Inductive Switching Energy vs. $R_{G(ext)}$

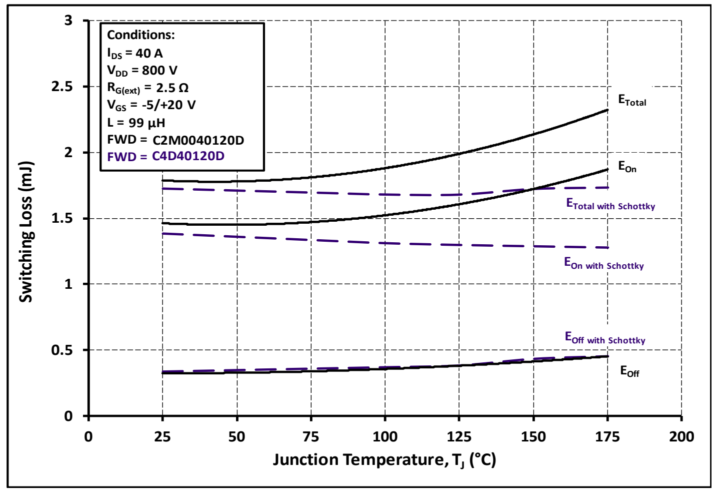


Figure 26. Clamped Inductive Switching Energy vs. Temperature

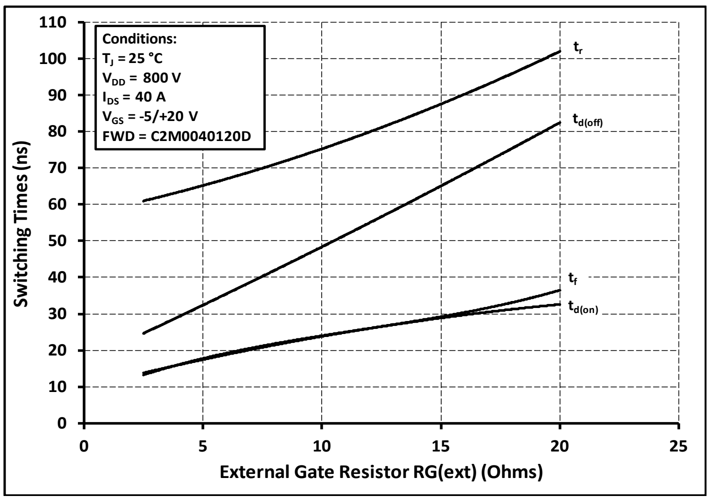


Figure 27. Switching Times vs. $R_{G(ext)}$

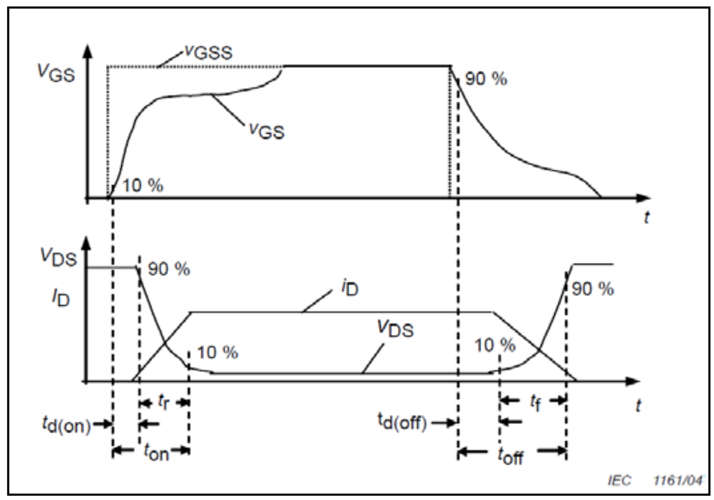


Figure 28. Switching Times Definition

Test Circuit Schematic[1]

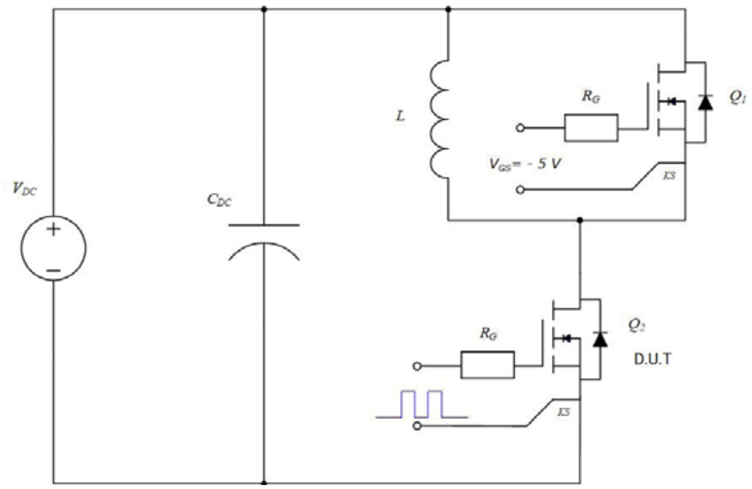
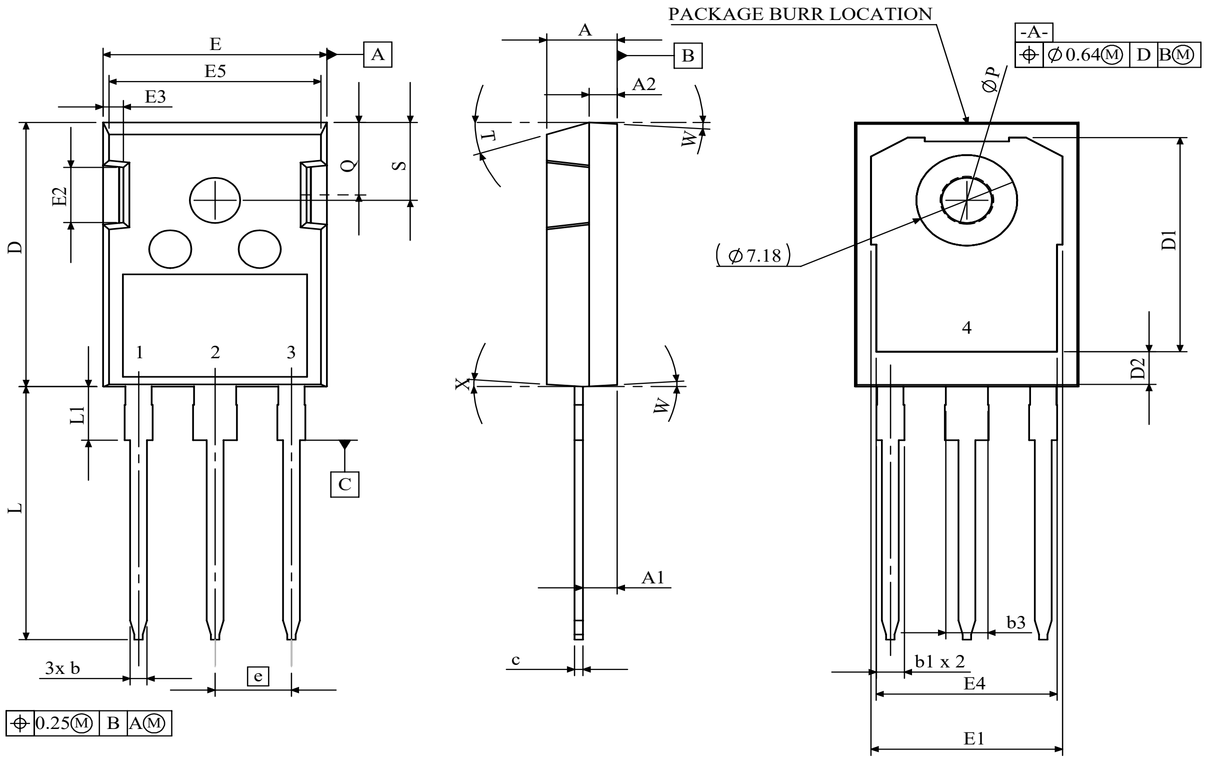


Figure 29. Clamped Inductive Switching Waveform Test Circuit

Note:
[1] Turn-off and Turn-on switching energy and timing values measured using SiC MOSFET Body Diode as shown above.

Package Dimensions – TO-247-3L



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
∅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)

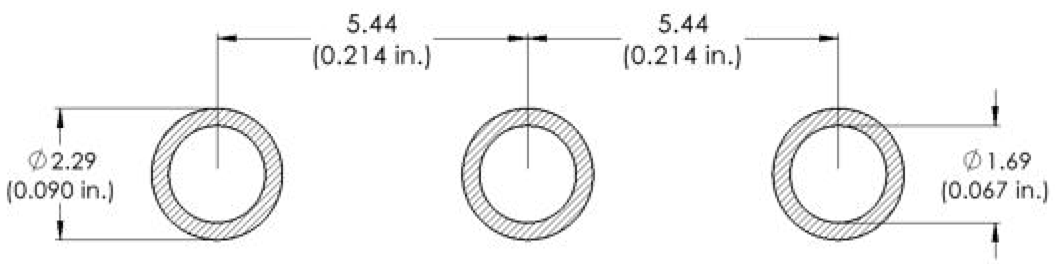
Date: 3/4/24

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
3	April-2021	N/A
4	November-2023	Updated Wolfspeed branding, package drawing, package image, and solder pad layout, added Revision History Table
5	October - 2024	Legal Disclaimer, POD, Table 1 Layout, Diode Pulse Current Symbol

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

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