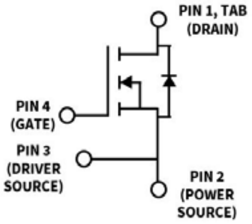
C3M0016120K

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



Features

- 3rd generation 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

Ordering Part Number	Package	Marking
C3M0016120K	TO 247-4	C3M0016120K

Typical Applications

- Solar inverters
- EV motor drive
- High voltage DC/DC converters
- Switched mode power supplies
- Load switch

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}			1200	v	$T_C = 25°C$	
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			115	A	$V_{GS} = 15$ V, $T_C = 25$ °C, $T_J \leq 175$ °C	Fig. 19 Note 2
				85		$V_{GS} = 15$ V, $T_C = 100$ °C, $T_J \leq 175$ °C	
Pulsed Drain Current	I_{DM}			250		t_{Pmax} limited by T_{jmax} $V_{GS} = 15$V, $T_C = 25$ °C	Fig. 22
Power Dissipation	P_D			556	W	$T_C = 25$ °C, $T_J = 175$ °C	Fig. 20
Operating Junction and Storage Temperature	T_J, T_{stg}			-40 to +175	°C		
Solder Temperature	T_L			260		According to JEDEC J-STD-020	
Mounting Torque	M_D			1 8.8	Nm Ibf-in	M3 or 6-32 screw	

Note (1): Recommended turn-on gate voltage is 15V with ±5% regulation tolerance, see Application Note PRD-04814 for additional details
Note (2): Verified by design

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	$V_{GS(th)}$	1.8	2.5	3.6		V_{DS} = $V_{GS,}$ I_D = 23 mA	Fig. 11
		—	2.0	—		V_{DS} = $V_{GS,}$ I_D = 23 mA, T_J = 175°C	
Zero Gate Voltage Drain Current	I_{DSS}	—	1	50	µA	V_{DS} = 1200 V, V_{GS} = 0 V	
Gate-Source Leakage Current	I_{GSS}	—	10	250	nA	V_{GS} = 15 V, V_{DS} = 0 V	
Drain-Source On-State Resistance	$R_{DS(on)}$	—	16	22.3	mΩ	V_{GS} = 15 V, I_D = 75 A	Fig. 4, 5, 6
		—	28.8	—		V_{GS} = 15 V, I_D = 75 A, T_J = 175°C	
Transconductance	g_{fs}	—	53	—	S	V_{DS} = 20 V, I_{DS} = 75 A	Fig. 7
			47			V_{DS} = 20 V, I_{DS} = 75 A, T_J = 175°C	
Input Capacitance	C_{iss}	—	6085	—	pF	V_{GS} = 0 V, V_{DS} = 1000 V ƒ = 100 khz V_{AC} = 25 mV	Fig. 17, 18
Output Capacitance	C_{oss}	—	230	—			
Reverse Transfer Capacitance	C_{rss}	—	13	—			
C_{oss} Stored Energy	E_{oss}	—	130	—	µJ		Fig. 16
Turn-On Switching Energy (SiC Diode FWD)	E_{on}	—	1.1	—	mJ	V_{DS} = 800 V, V_{GS} = -4 V/+15 V, I_D = 75 A, $R_{G(ext)}$ = 2.5 Ω, L= 65.7 µH, T_J = 175°C	Fig. 26
Turn Off Switching Energy (SiC Diode FWD)	E_{off}	—	0.8	—			
Turn-On Switching Energy (Body Diode FWD)	E_{on}	—	2.3	—			
Turn Off Switching Energy (Body Diode FWD)	E_{off}	-	0.6	—			
Turn-On Delay Time	$t_{d(on)}$	—	34	—	ns	V_{DD} = 800 V, V_{GS} = -4 V/15 V $R_{G(ext)}$ = 2.5 Ω, I_D = 75 A, L = 65.7 µH, Timing relative to V_{DS}, Inductive load	Fig. 27
Rise Time	t_r	—	33	—			
Turn-Off Delay Time	$t_{d(off)}$	—	65	—			
Fall Time	t_f	—	13	—			
Internal Gate Resistance	$R_{G(int)}$	—	2.6	—	Ω	ƒ = 1 MHz, V_{AC} = 25 mV	
Gate to Source Charge	Q_{gs}	—	67	—	nC	V_{DS} = 800 V, V_{GS} = -4 V/15 V I_D = 75 A Per IEC60747-8-4 pg 21	Fig. 12
Gate to Drain Charge	Q_{gd}	—	61	—			
Total Gate Charge	Q_g	—	211	—			

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

Parameter	Symbol	Typ.	Max.	Unit	Test Conditions	Notes
Diode Forward Voltage	V_{SD}	4.6	—	V	V_{GS} = -4 V, I_{SD} = 37.5 A, T_J = 25°C	Fig. 8, 9, 10
		4.2	—		V_{GS} = -4 V, I_{SD} = 37.5 A, T_J = 175°C	
Continuous Diode Forward Current[1]	I_S	—	112	A	V_{GS} = -4 V, T_C = 25°C	Note 3
Diode Pulse Current	I_{SM}	—	250		V_{GS} = -4 V, pulse width t_P limited by $T_{j\,max}$	Note 3
Reverse Recovery Time	t_{rr}	30	—	ns	V_{GS} = -4 V, I_{SD} = 75 A, V_R = 800 V di_F/dt = 4000 A/µs T_J = 175°C	Note 3
Reverse Recovery Charge	Q_{rr}	1238	—	nC		
Peak Reverse Recovery Current	I_{RRM}	64	—	A		
Reverse Recovery Time	t_{rr}	27	—	ns	V_{GS} = -4 V, I_{SD} = 75 A, V_R = 800 V di_F/dt = 5500 A/µs T_J = 175°C	Note 3
Reverse Recovery Charge	Q_{rr}	1261	—	nC		
Peak Reverse Recovery Current	I_{RRM}	77	—	A		

Note:

[3] When using MOSFET Body Diode $V_{GS\,max}$ = -4V/+19V

Thermal Characteristics

Parameter	Symbol	Typ.	Unit	Test Conditions	Notes
Thermal Resistance from Junction to Case	$R_{\theta JC}$	0.27	°C/W		Fig. 21
Thermal Resistance from Junction to Ambient	$R_{\theta JA}$	40			

Typical Performance

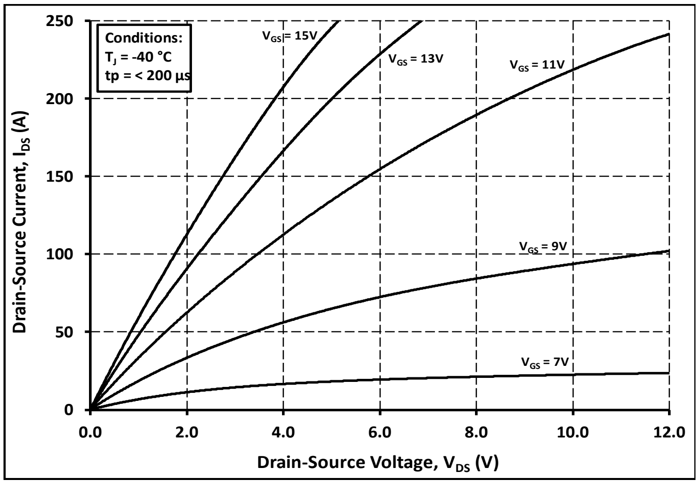


Figure 1. Output Characteristics T_J = -40°C

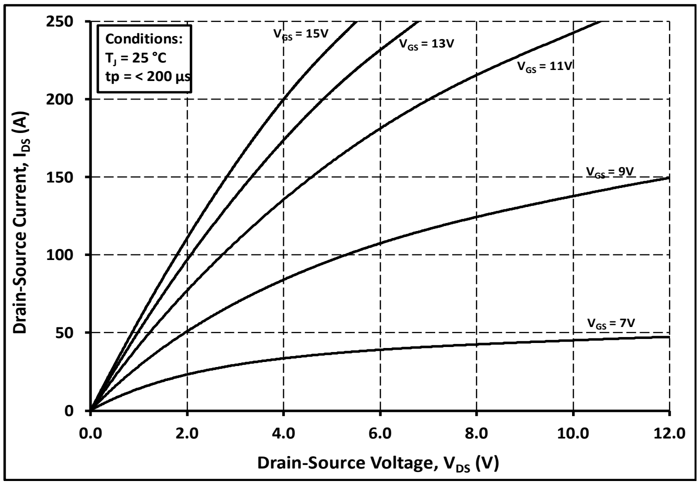


Figure 2. Output Characteristics T_J = 25°C

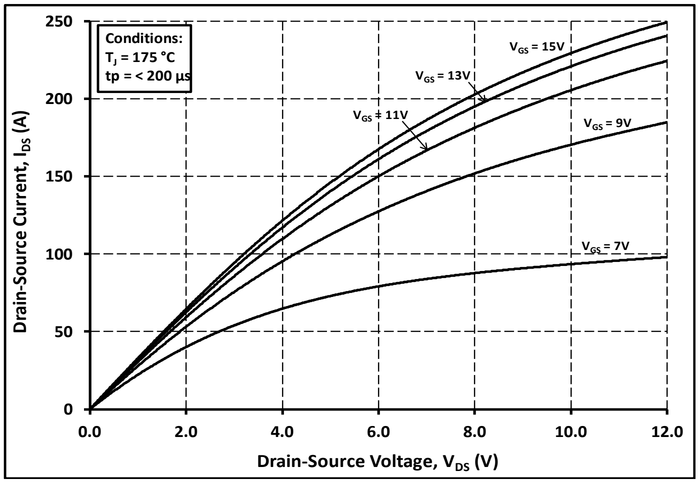


Figure 3. Output Characteristics T_J = 175°C

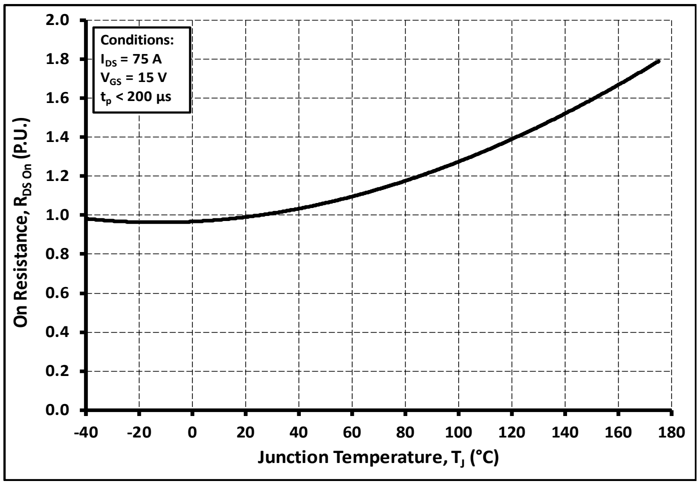


Figure 4. Normalized On-Resistance vs. Temperature

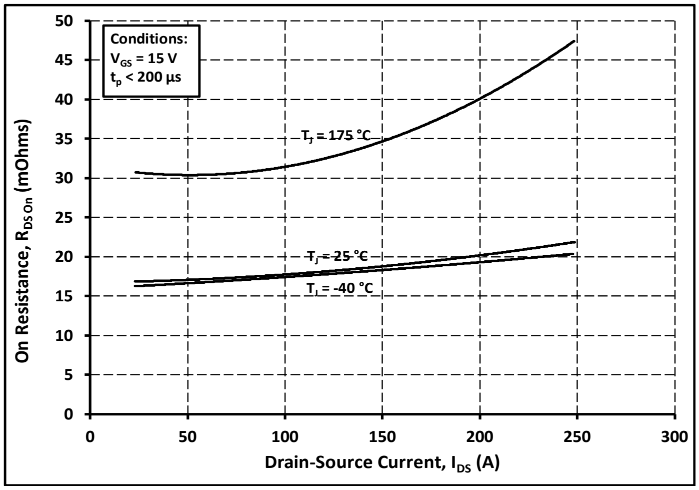


Figure 5. On-Resistance vs. Drain Current For Various Temperatures

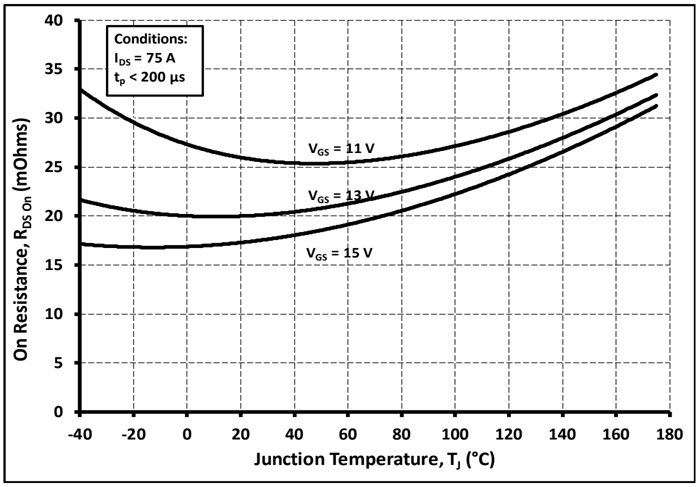


Figure 6. On-Resistance vs. Temperature For Various Gate Voltage

Typical Performance

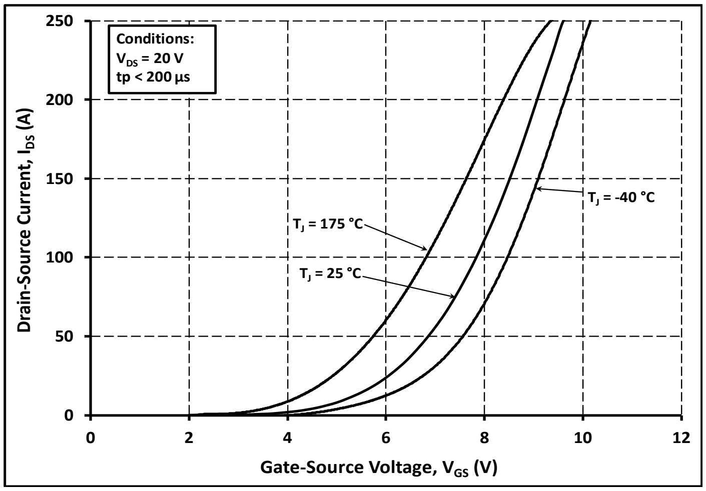


Figure 7. Transfer Characteristic for Various Junction Temperatures

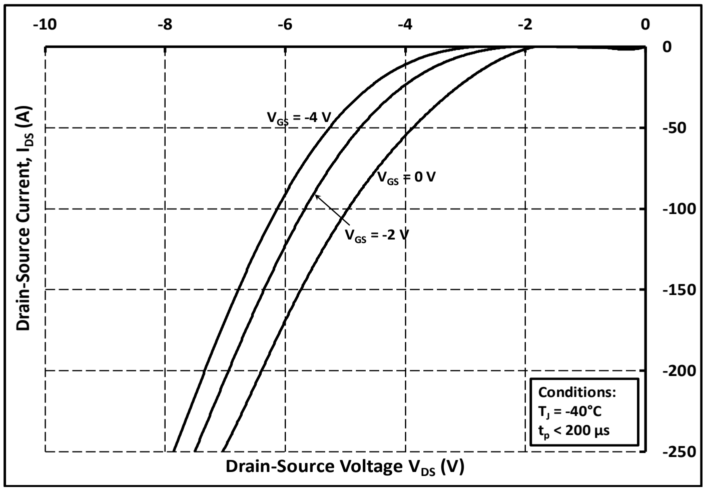


Figure 8. Body Diode Characteristic at -40°C

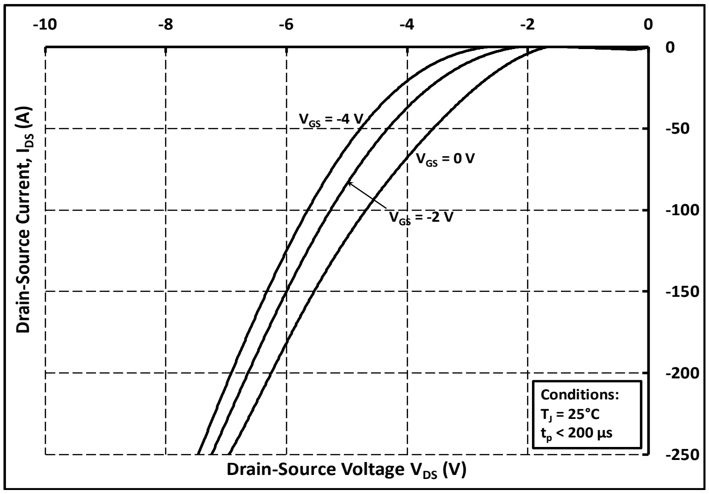


Figure 9. Body Diode Characteristic at 25°C

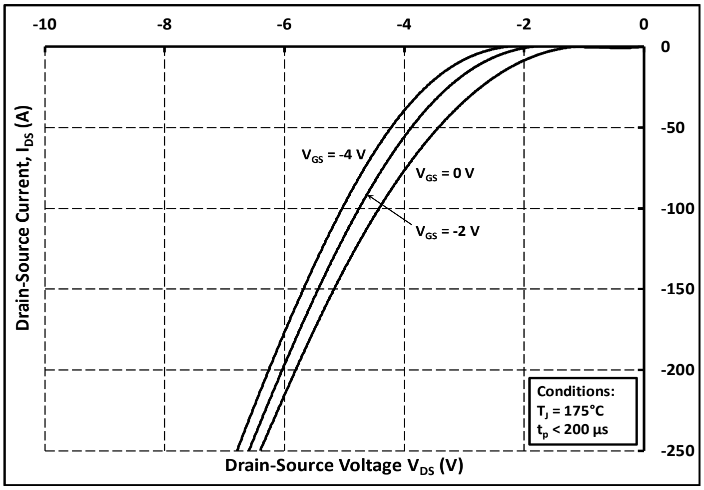


Figure 10. Body Diode Characteristic at 175°C

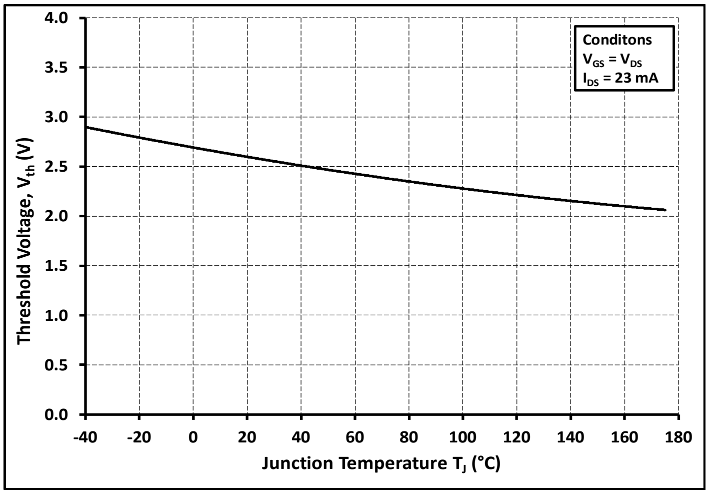


Figure 11. Threshold Voltage vs. Temperature

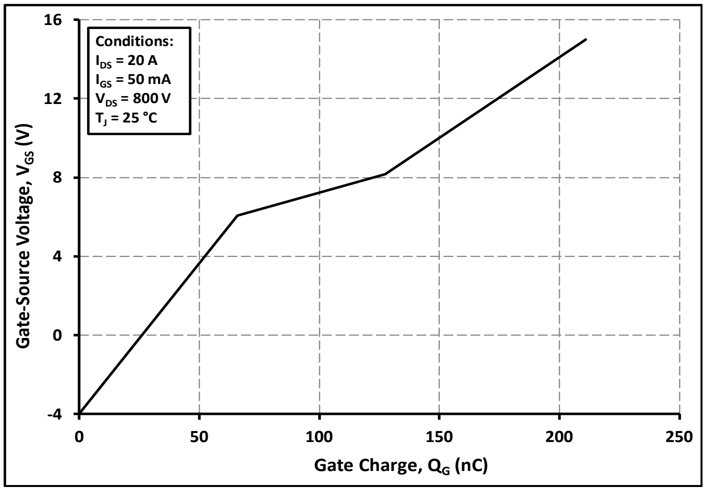


Figure 12. Gate Charge Characteristics

Typical Performance

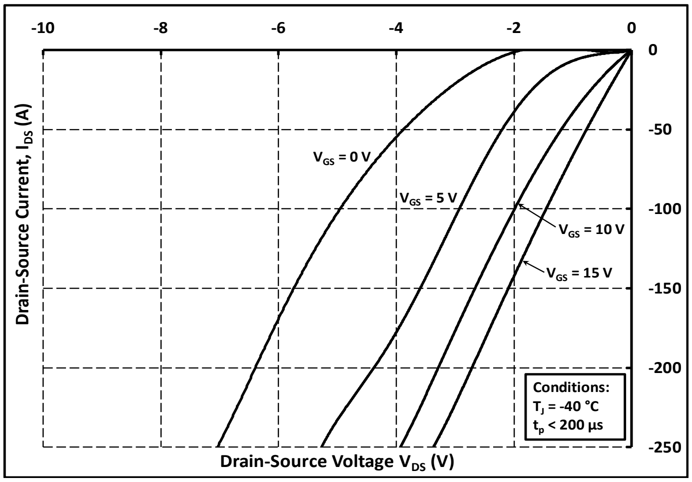


Figure 13. 3rd Quadrant Characteristic at -40°C

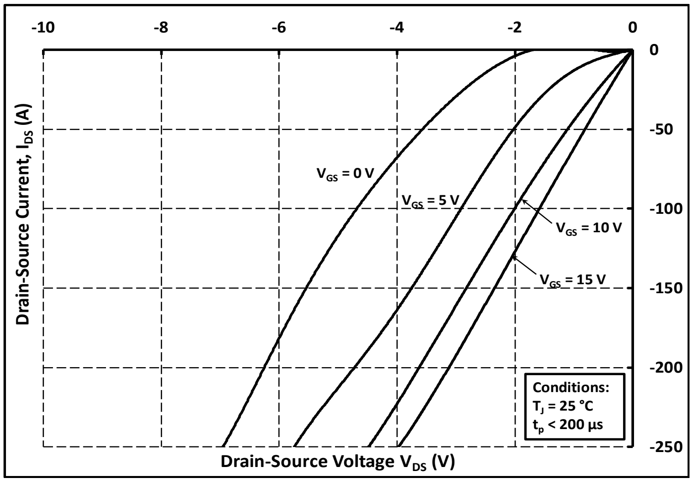


Figure 14. 3rd Quadrant Characteristic at 25°C

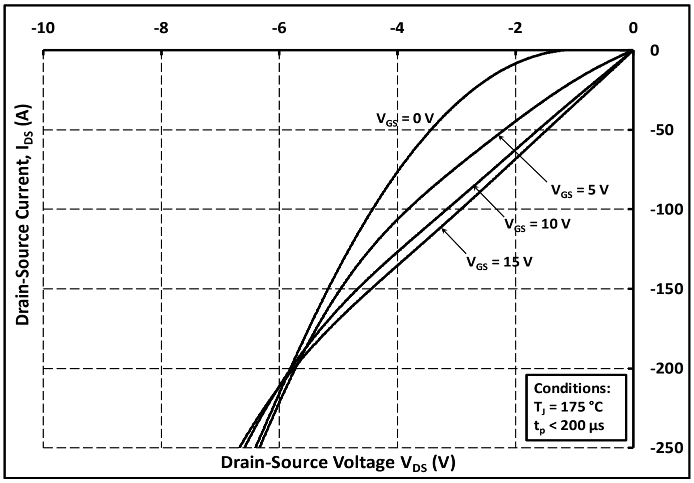


Figure 15. 3rd Quadrant Characteristic at 175°C

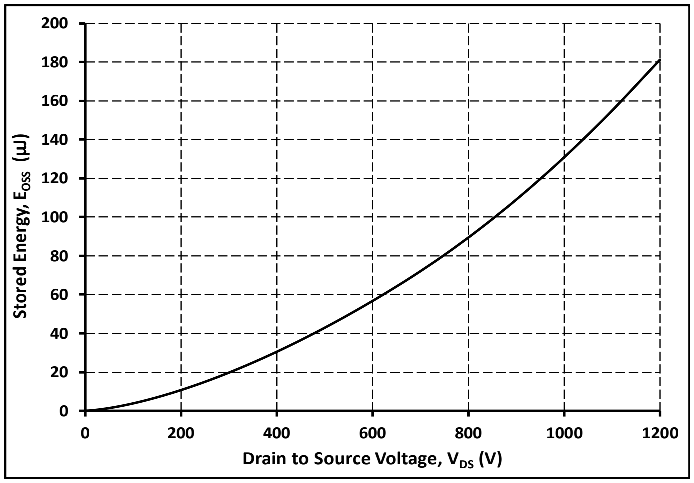


Figure 16. Output Capacitor Stored Energy

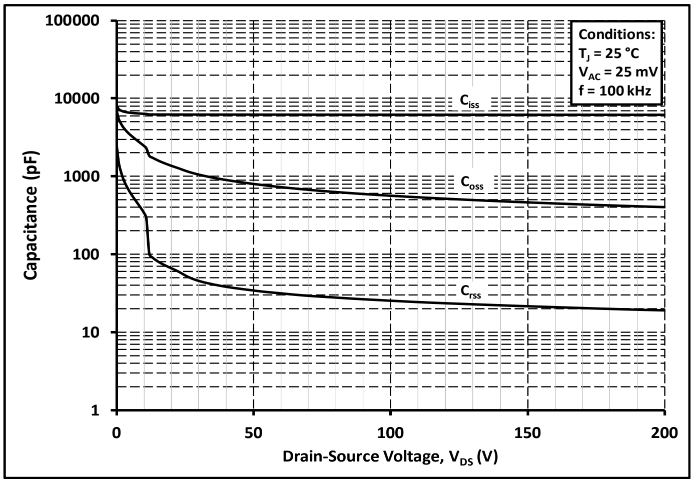


Figure 17. Capacitances vs. Drain-Source Voltage (0 - 200V)

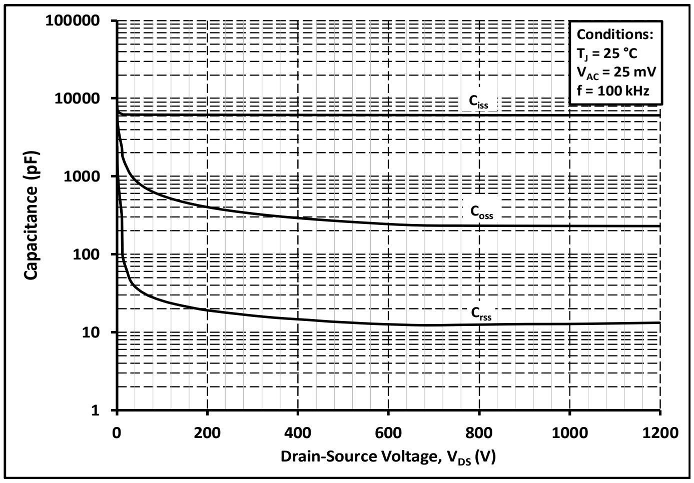


Figure 18. Capacitances vs. Drain-Source Voltage (0 - 1200V)

Typical Performance

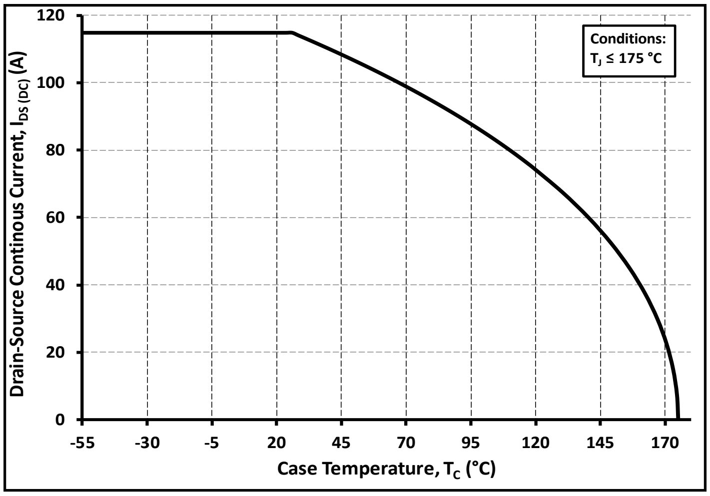


Figure 19. Continuous Drain Current Derating vs. Case Temperature

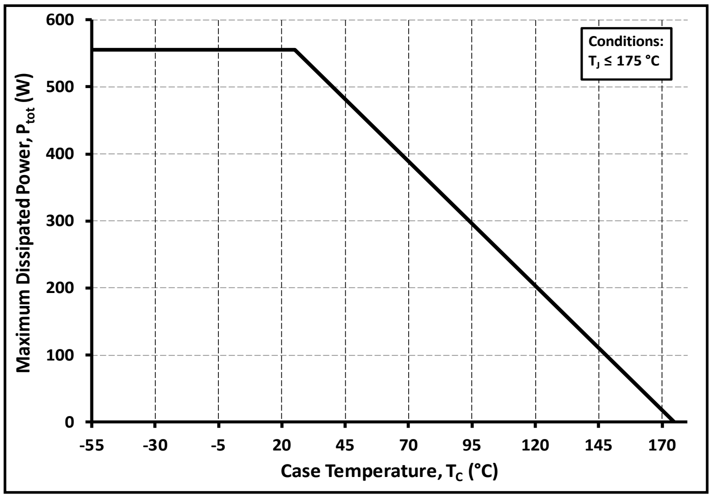


Figure 20. Maximum Power Dissipation Derating vs. Case Temperature

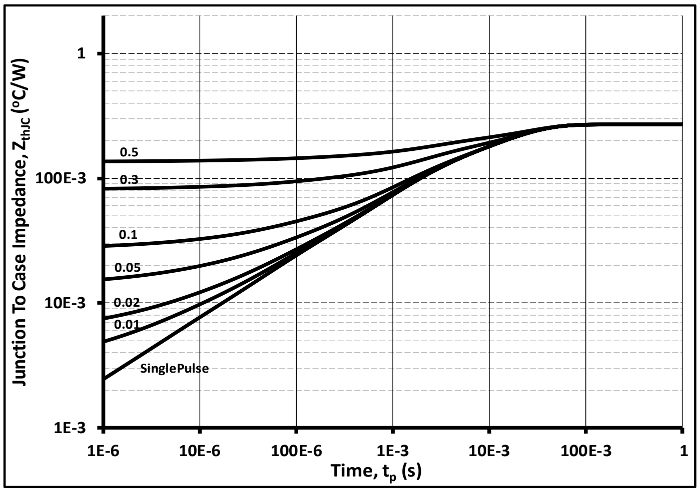


Figure 21. Transient Thermal Impedance (Junction - Case)

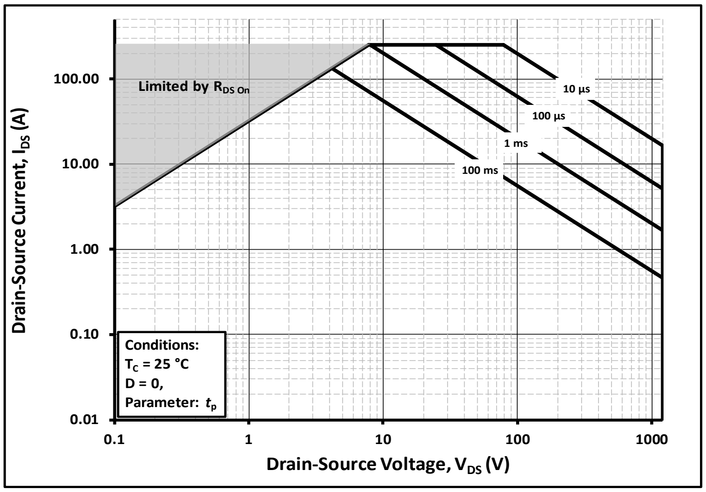


Figure 22. Safe Operating Area

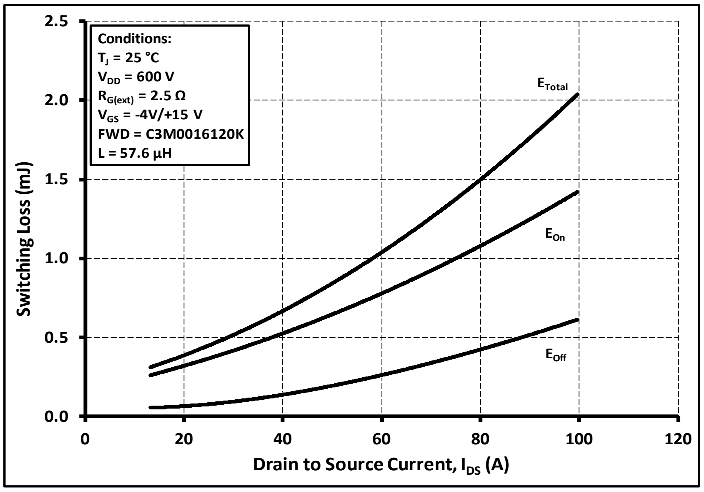


Figure 23. Clamped Inductive Switching Energy vs. Drain Current (V_{DD} = 600 V)

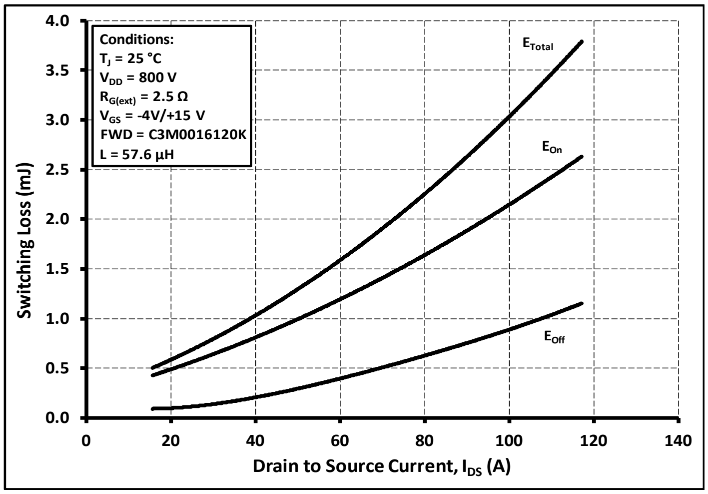


Figure 24. Clamped Inductive Switching Energy vs. Drain Current (V_{DD} = 800 V)

Typical Performance

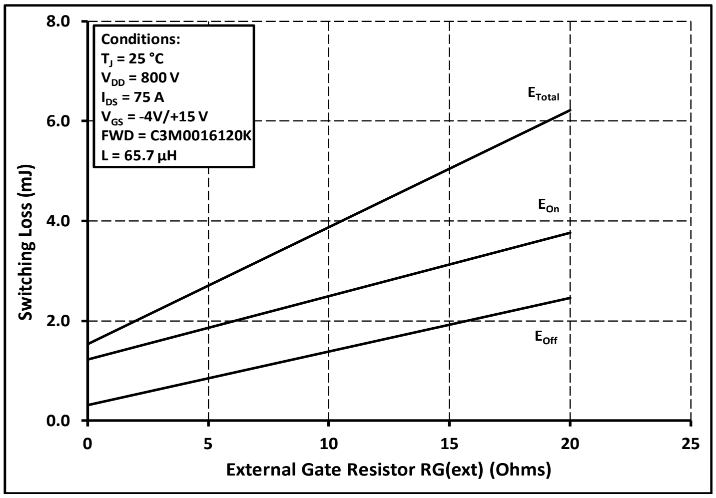


Figure 25. Clamped Inductive Switching Energy vs. $R_{G(ext)}$

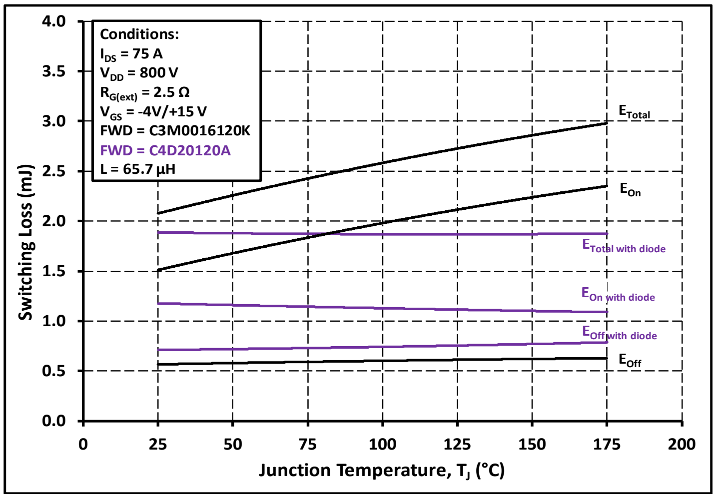


Figure 26. Clamped Inductive Switching Energy vs. Temperature

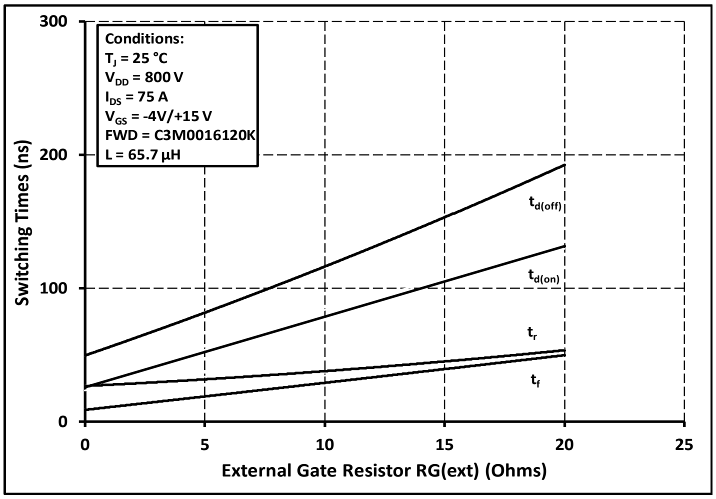


Figure 27. Switching Times vs. $R_{G(ext)}$

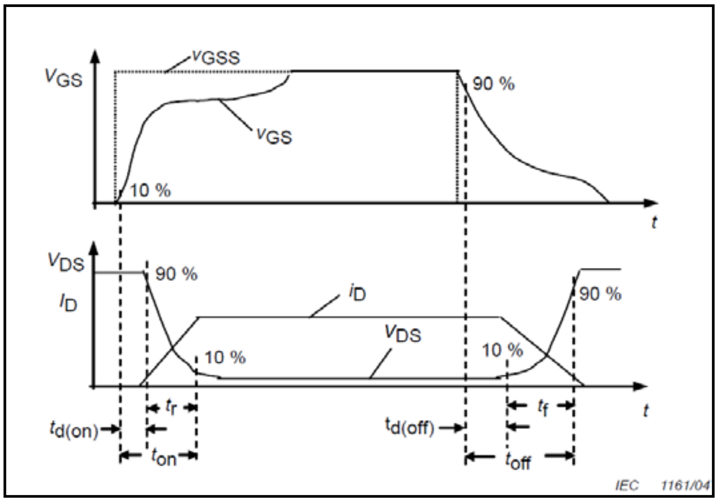


Figure 28. Switching Times Definition

Test Circuit Schematic[1]

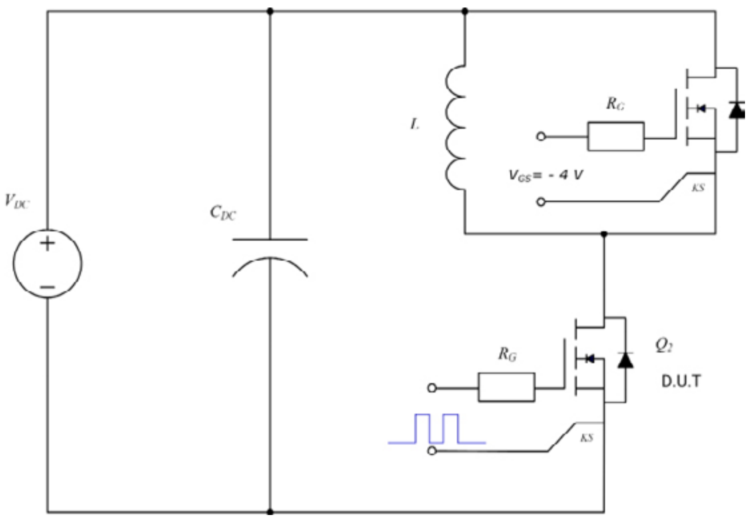
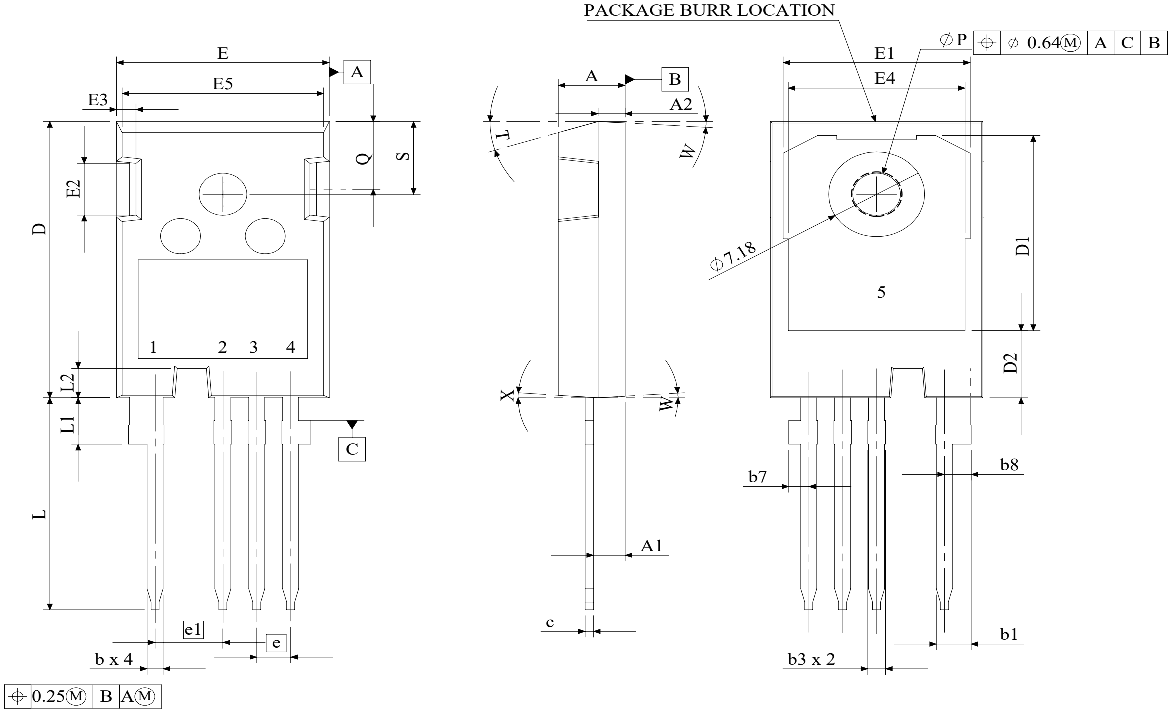


Figure 29. Clamped Inductive Switching Waveform Test Circuit

Note:

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

Package Dimensions – Package TO-247-4L



SYMBOL	MIN (mm)	MAX (mm)
A	4.83	5.21
A1	2.23	2.54
A2	1.91	2.16
b	1.07	1.33
b1	2.39	2.94
b3	1.07	1.60
b7	1.30	1.70
b8	1.80	2.20
c	0.55	0.68
D	23.30	23.63
D1	16.25	17.65
D2	5.55	5.95
E	15.75	16.13
E1	13.1	14.15
E2	3.68	5.10
E3	1.00	1.90
E4	12.38	13.43
E5	14.65	15.05
e1	5.08 BSC	
L	17.31	17.82
L1	3.97	4.37
L2	2.35	2.65
∅P	3.51	3.65
Q	5.49	6.00
S	6.04	6.30
T	17.5° REF.	
W	3.5° REF.	
X	4° REF.	

1	DRAIN
2	SOURCE
3	DRIVER SOURCE
4	GATE
5	DRAIN

NOTE:
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-247-4L

Date: 3/4/24

REVISION NO. 02

A4

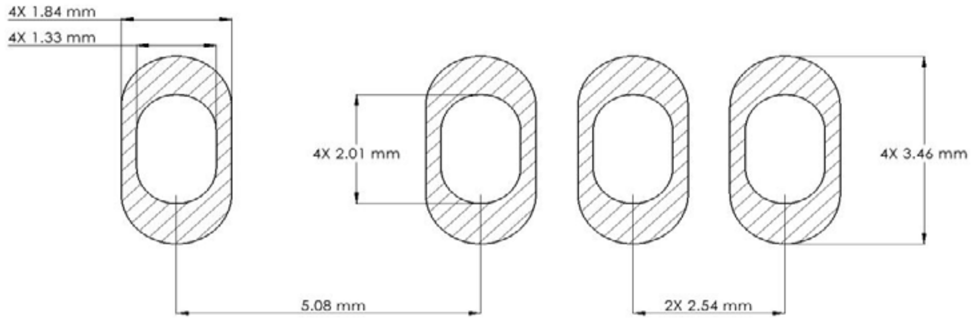
PRD 05966

SCALE:1:1

SHEET 1 OF 1

Recommended Solder Pad Layout

Primary dimensions shown in mm



Revision history

Document Version	Date of release	Description of changes
-	April-2019	Initial datasheet
2	December-2023	Update Package Drawing, package image, solder pad layout, added revision history table, Table 1 layout revised
3	March-2024	RDSON LSL Removed
4	September - 2024	Legal Disclaimer, POD, Diode Pulse Current Symbol

Notes & Disclaimer

WOLFSPEED PROVIDES TECHNICAL AND RELIABILITY DATA, DESIGN RESOURCES, APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, AND OTHER RESOURCES "AS IS" AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, WITH RESPECT THERETO, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, SUITABILITY, FITNESS FOR A PARTICULAR PURPOSE, OR NON-INFRINGEMENT OF THIRD-PARTY INTELLECTUAL PROPERTY RIGHTS.

This document and the information contained herein are subject to change without notice. Any such change shall be evidenced by the publication of an updated version of this document by Wolfspeed. No communication from any employee or agent of Wolfspeed or any third party shall effect an amendment or modification of this document. No responsibility is assumed by Wolfspeed for any infringement of patents or other rights of third parties which may result from use of the information contained herein. No license is granted by implication or otherwise under any patent or patent rights of Wolfspeed.

The information contained in this document (excluding examples, as well as figures or values that are labeled as "typical") constitutes Wolfspeed's sole published specifications for the subject product. "Typical" parameters are the average values expected by Wolfspeed in large quantities and are provided for informational purposes only. Any examples provided herein have not been produced under conditions intended to replicate any specific end use. Product performance can and does vary due to a number of factors.

This product has not been designed or tested for use in, and is not intended for use in, any application in which failure of the product would reasonably be expected to cause death, personal injury, or property damage. For purposes of (but without limiting) the foregoing, this product is not designed, intended, or authorized for use as a critical component in equipment implanted into the human body, life-support machines, cardiac defibrillators, and similar emergency medical equipment; air traffic control systems; or equipment used in the planning, construction, maintenance, or operation of nuclear facilities. Notwithstanding any application-specific information, guidance, assistance, or support that Wolfspeed may provide, the buyer of this product is solely responsible for determining the suitability of this product for the buyer's purposes, including without limitation (1) selecting the appropriate Wolfspeed products for the buyer's application, (2) designing, validating, and testing the buyer's application, and (3) ensuring the buyer's application meets applicable standards and any other legal, regulatory, and safety-related requirements.

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.

Contact info:

4600 Silicon Drive
Durham, NC 27703 USA
Tel: +1.919.313.5300
www.wolfspeed.com/power

Rev. 4, September 2024