CREE

V_{DS}	1200 V
$I_{D \, @ \, 25°C}$	115 A
$R_{DS(on)}$	16 mΩ

C3M0016120K

Silicon Carbide Power MOSFET
C3M™ 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})
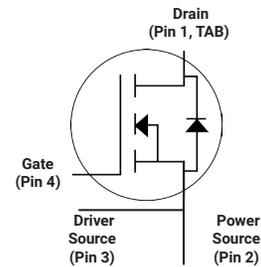- Halogen free, RoHS compliant

Benefits

- Reduce switching losses and minimize gate ringing
- Higher system efficiency
- Reduce cooling requirements
- Increase power density
- Increase system switching frequency

Applications

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

Package

Part Number	Package	Marking
C3M0016120K	TO 247-4	C3M0016120K

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

Symbol	Parameter	Value	Unit	Test Conditions	Note
V_{DSmax}	Drain - Source Voltage	1200	V	V_{GS} = 0 V, I_D = 100 µA	
V_{GSmax}	Gate - Source Voltage (dynamic)	-8/+19	V	AC (f >1 Hz)	Note 1
V_{GSop}	Gate - Source Voltage (static)	-4/+15	V	Static	Note 2
I_D	Continuous Drain Current	115	A	V_{GS} = 15 V, T_C = 25°C	Fig. 19
		85		V_{GS} = 15 V, T_C = 100°C	
$I_{D(pulse)}$	Pulsed Drain Current	250	A	Pulse width t_P limited by T_{jmax}	
P_D	Power Dissipation	556	W	T_C=25°C, T_J = 175 °C	Fig. 20
T_J , T_{stg}	Operating Junction and Storage Temperature	-40 to +175	°C		
T_L	Solder Temperature	260	°C	1.6mm (0.063") from case for 10s	

Note (1): When using MOSFET Body Diode V_{GSmax} = -4V/+19V
Note (2): MOSFET can also safely operate at 0/+15 V

Electrical Characteristics $(T_C = 25°C$ unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions	Note
$V_{(BR)DSS}$	Drain-Source Breakdown Voltage	1200			V	$V_{GS} = 0$ V, $I_D = 100$ µA	
$V_{GS(th)}$	Gate Threshold Voltage	1.8	2.5	3.6	V	$V_{DS} = V_{GS}$, $I_D = 23$ mA	Fig. 11
			2.0		V	$V_{DS} = V_{GS}$, $I_D = 23$ mA, $T_J = 175°C$	
I_{DSS}	Zero Gate Voltage Drain Current		1	50	µA	$V_{DS} = 1200$ V, $V_{GS} = 0$ V	
I_{GSS}	Gate-Source Leakage Current		10	250	nA	$V_{GS} = 15$ V, $V_{DS} = 0$ V	
$R_{DS(on)}$	Drain-Source On-State Resistance	11.2	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, $T_J = 175°C$	
g_{fs}	Transconductance		53		S	$V_{DS} = 20$ V, $I_{DS} = 75$ A	Fig. 7
			47			$V_{DS} = 20$ V, $I_{DS} = 75$ A, $T_J = 175°C$	
C_{iss}	Input Capacitance		6085		pF	$V_{GS} = 0$ V, $V_{DS} = 1000$ V f = 1 MHz $V_{AC} = 25$ mV	Fig. 17, 18
C_{oss}	Output Capacitance		230				
C_{rss}	Reverse Transfer Capacitance		13				
E_{oss}	C_{oss} Stored Energy		130		µJ		Fig. 16
E_{ON}	Turn-On Switching Energy (SiC Diode FWD)		1.1		mJ	$V_{DS} = 800$ V, $V_{GS} = -4$ V/+15 V, $I_D = 75$ A, $R_{G(ext)} = 2.5Ω$, L= 65.7 µH, Tj = 175°C	Fig. 26
E_{OFF}	Turn Off Switching Energy (SiC Diode FWD)		0.8				
E_{ON}	Turn-On Switching Energy (Body Diode FWD)		2.3		mJ	$V_{DS} = 800$ V, $V_{GS} = -4$ V/+15 V, $I_D = 75$ A, $R_{G(ext)} = 2.5Ω$, L= 65.7 µH, Tj = 175°C	Fig. 26
E_{OFF}	Turn Off Switching Energy (Body Diode FWD)		0.6				
$t_{d(on)}$	Turn-On Delay Time		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 Timing relative to V_{DS}, Inductive load	Fig. 27
t_r	Rise Time		33				
$t_{d(off)}$	Turn-Off Delay Time		65				
t_f	Fall Time		13				
$R_{G(int)}$	Internal Gate Resistance		2.6		Ω	f = 1 MHz, $V_{AC} = 25$ mV	
Q_{gs}	Gate to Source Charge		67		nC	$V_{DS} = 800$ V, $V_{GS} = -4$ V/15 V $I_D = 75$ A Per IEC60747-8-4 pg 21	Fig. 12
Q_{gd}	Gate to Drain Charge		61				
Q_g	Total Gate Charge		211				

![CREE logo]

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

Symbol	Parameter	Typ.	Max.	Unit	Test Conditions	Note
V_{SD}	Diode Forward Voltage	4.6		V	V_{GS} = -4 V, I_{SD} = 37.5 A, T_J = 25 °C	Fig. 8, 9, 10
		4.2		V	V_{GS} = -4 V, I_{SD} = 37.5 A, T_J = 175 °C	
I_S	Continuous Diode Forward Current		112	A	V_{GS} = -4 V, T_C = 25˚C	Note 1
$I_{S, pulse}$	Diode pulse Current		250	A	V_{GS} = -4 V, pulse width t_P limited by T_{jmax}	Note 1
t_{rr}	Reverse Recover time	30		ns	V_{GS} = -4 V, I_{SD} = 75 A, V_R = 800 V dif/dt = 4000 A/µs, T_J = 175 °C	Note 1
Q_{rr}	Reverse Recovery Charge	1238		nC		
I_{rrm}	Peak Reverse Recovery Current	64		A		
t_{rr}	Reverse Recover time	27		ns	V_{GS} = -4 V, I_{SD} = 75 A, V_R = 800 V dif/dt = 5500 A/µs, T_J = 175 °C	Note 1
Q_{rr}	Reverse Recovery Charge	1261		nC		
I_{rrm}	Peak Reverse Recovery Current	77		A		

Thermal Characteristics

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

Typical Performance
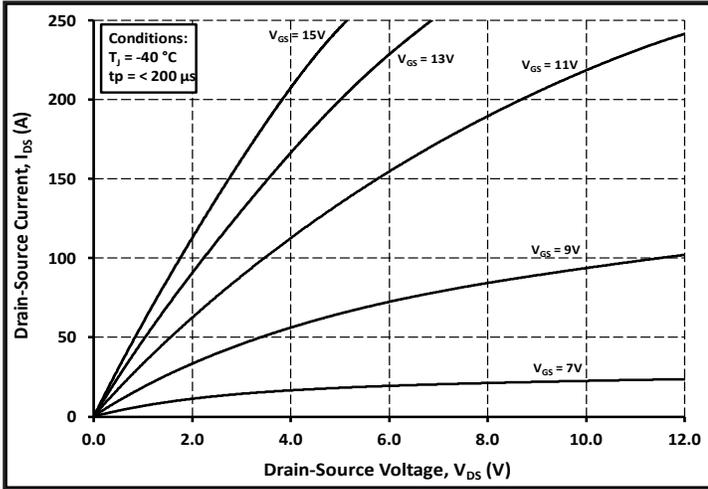
Figure 1. Output Characteristics T_J = -40 °C
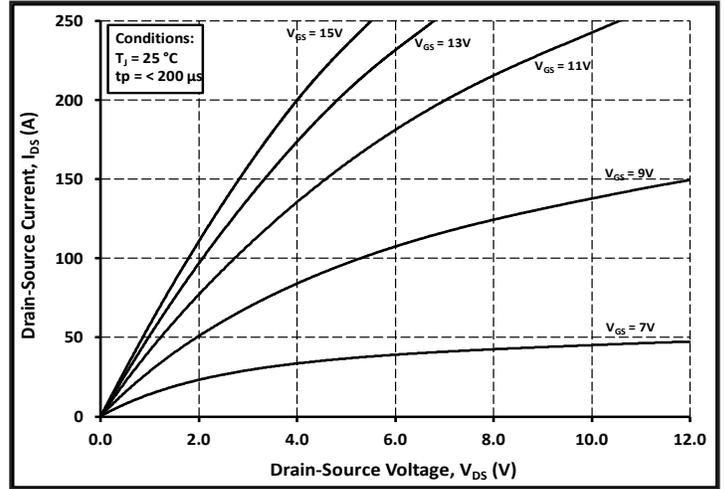
Figure 2. Output Characteristics T_J = 25 °C
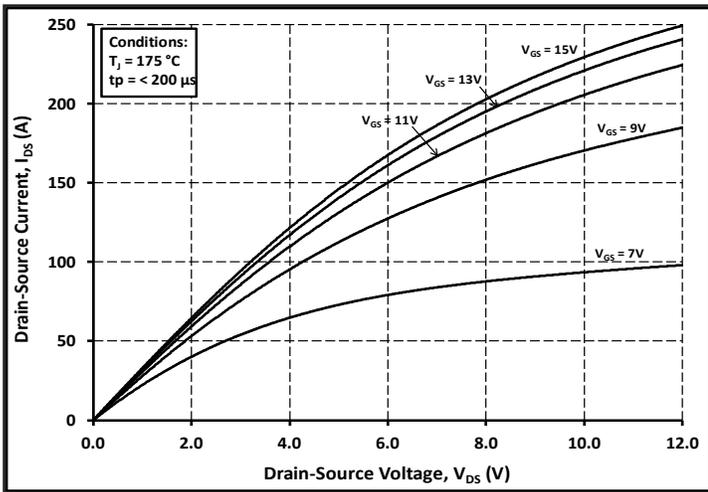
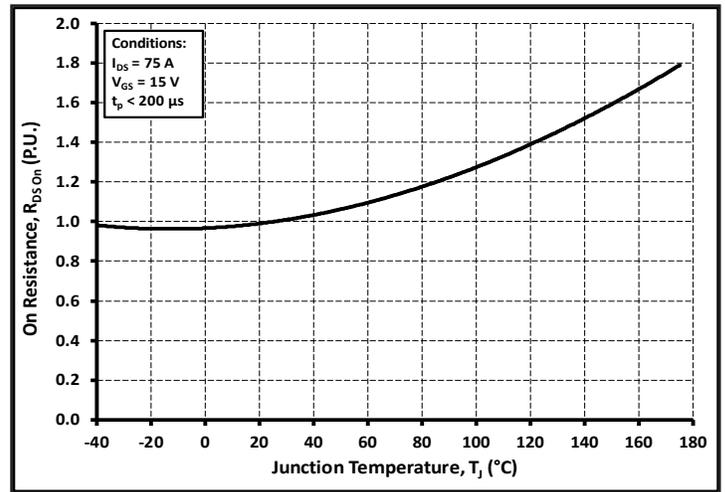Figure 3. Output Characteristics T_J = 175 °C

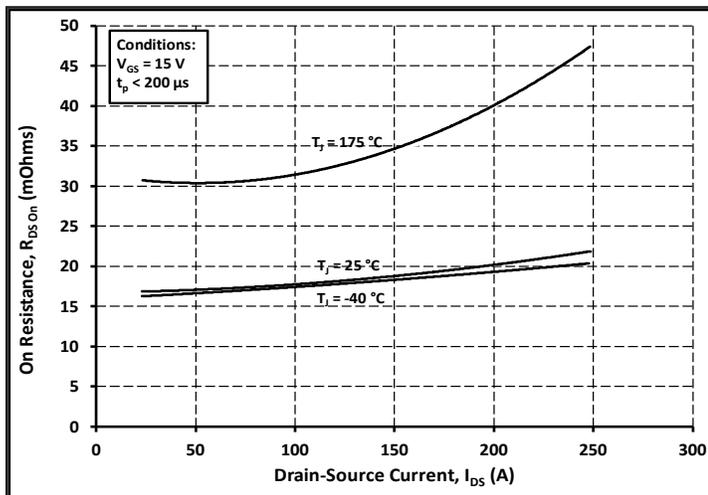Figure 4. Normalized On-Resistance vs. Temperature

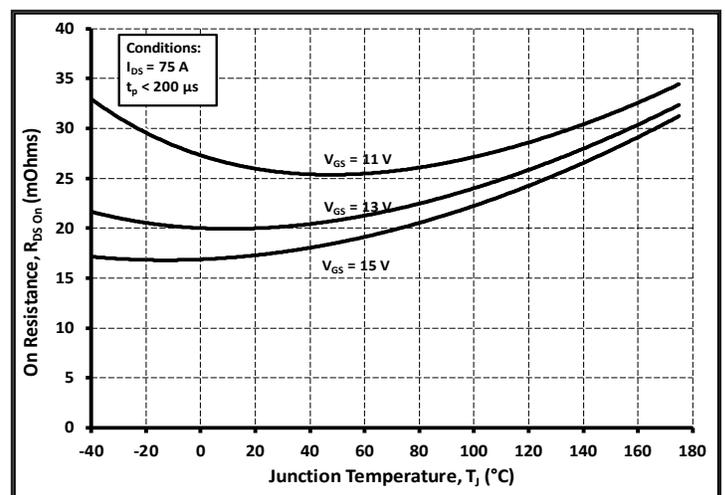Figure 5. On-Resistance vs. Drain Current
For Various Temperatures

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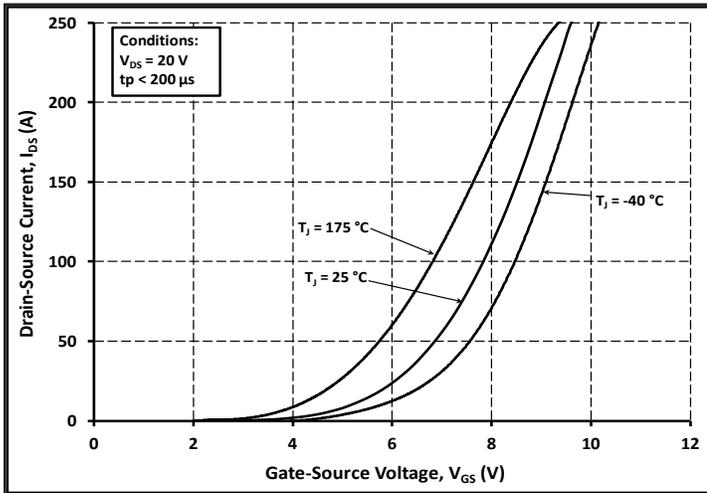For Various Gate Voltage

Typical Performance

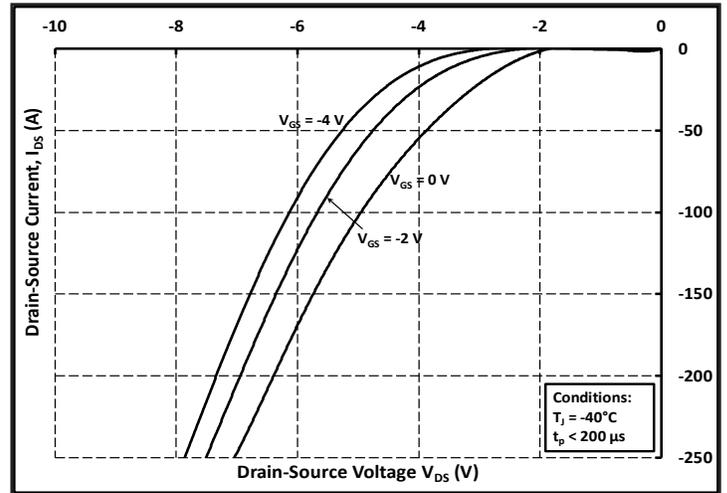Figure 7. Transfer Characteristic for
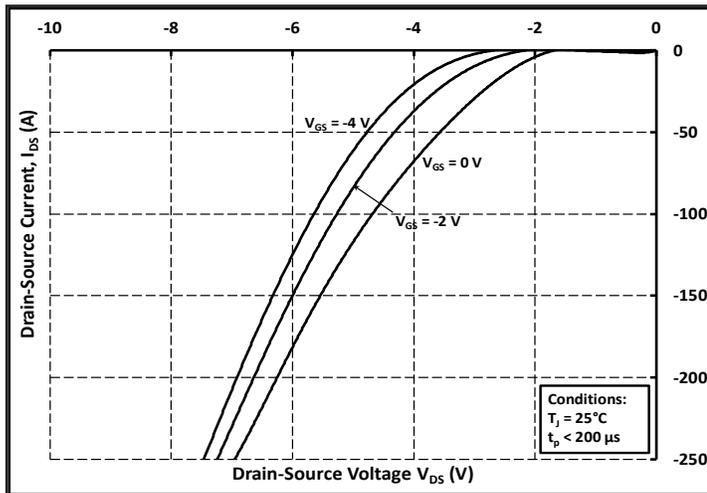Various Junction Temperatures

Figure 8. Body Diode Characteristic at -40 ºC

Figure 9. Body Diode Characteristic at 25 ºC
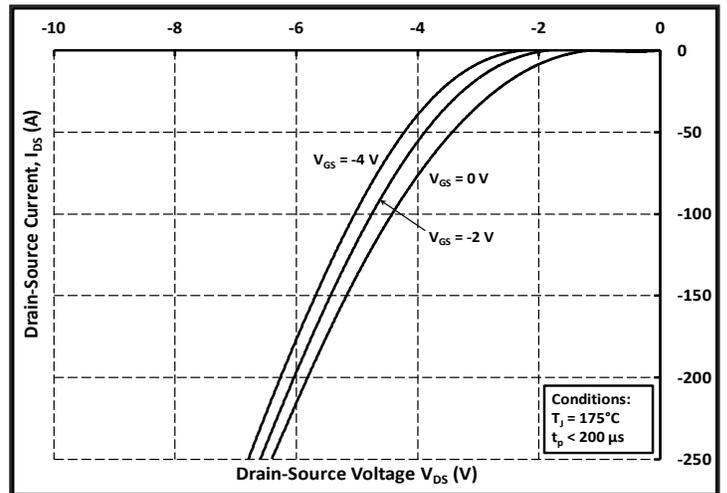
Figure 10. Body Diode Characteristic at 175 ºC
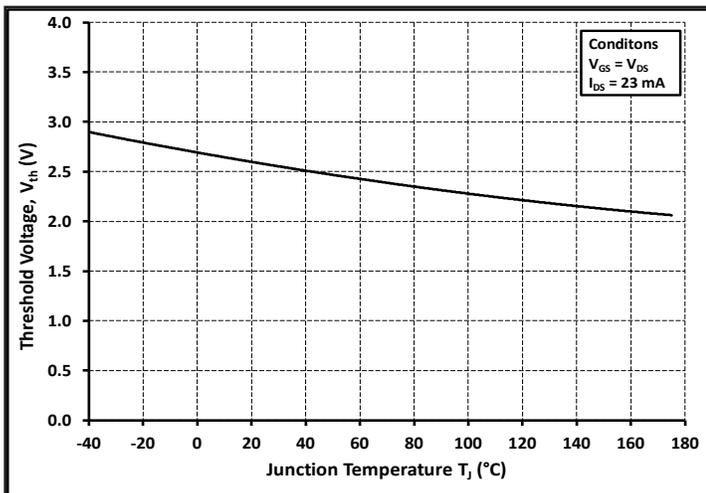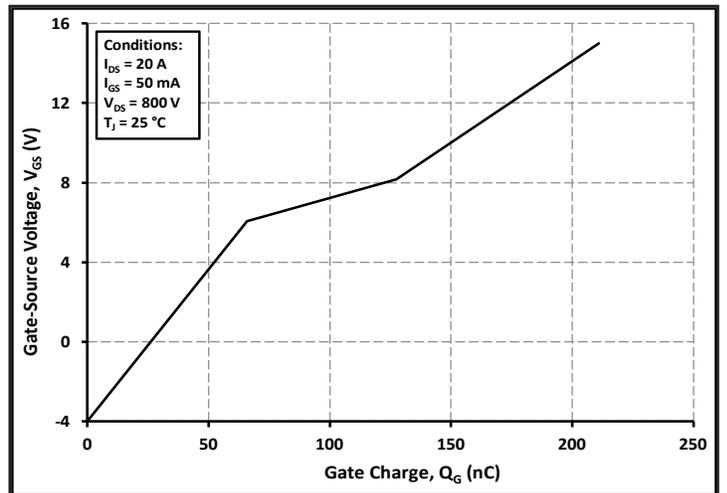

Figure 11. Threshold Voltage vs. Temperature

Figure 12. Gate Charge Characteristics
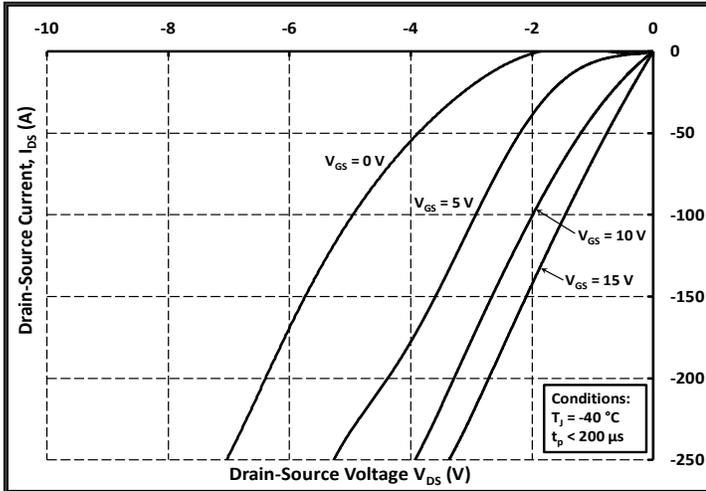
Typical Performance
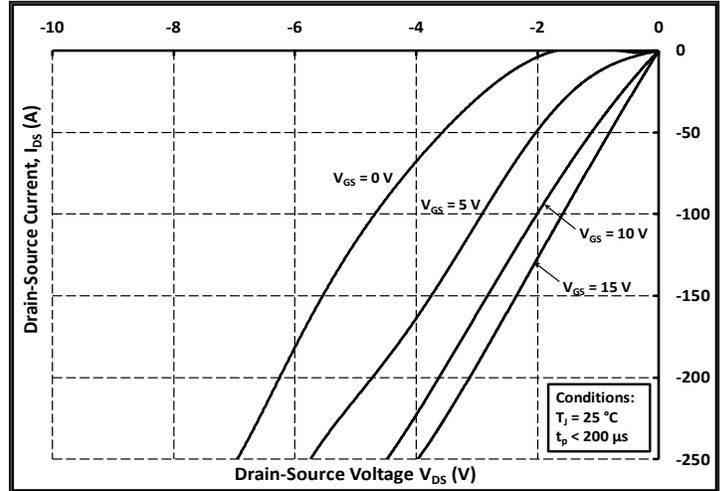

Figure 13. 3rd Quadrant Characteristic at -40 ºC

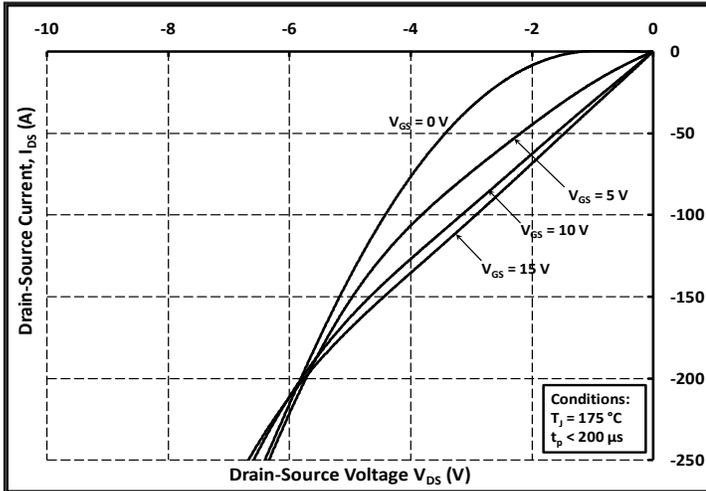Figure 14. 3rd Quadrant Characteristic at 25 ºC

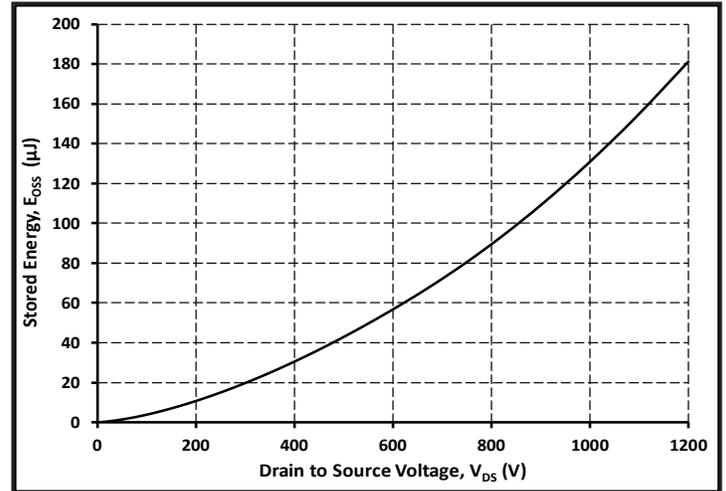Figure 15. 3rd Quadrant Characteristic at 175 ºC

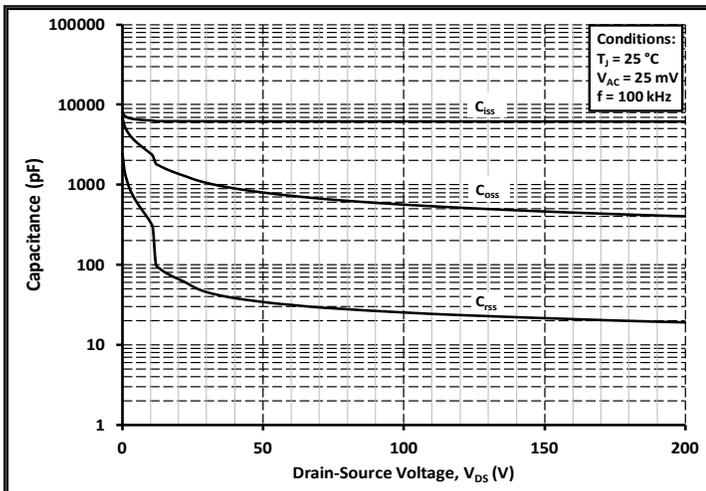Figure 16. Output Capacitor Stored Energy

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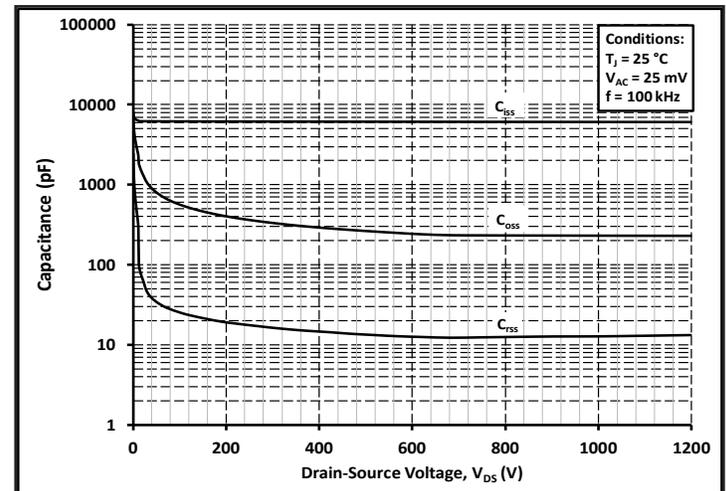Voltage (0 - 200V)

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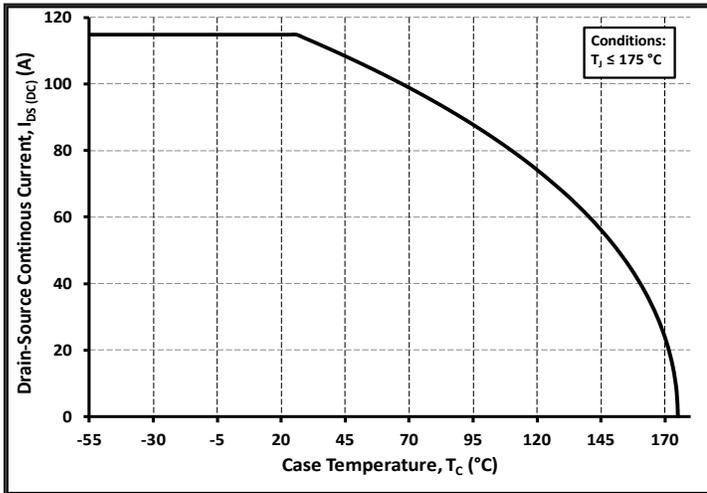
Typical Performance

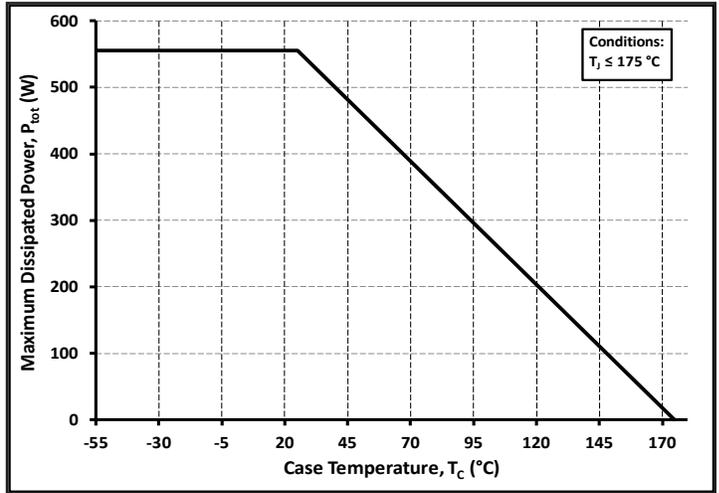Figure 19. Continuous Drain Current Derating vs. Case Temperature

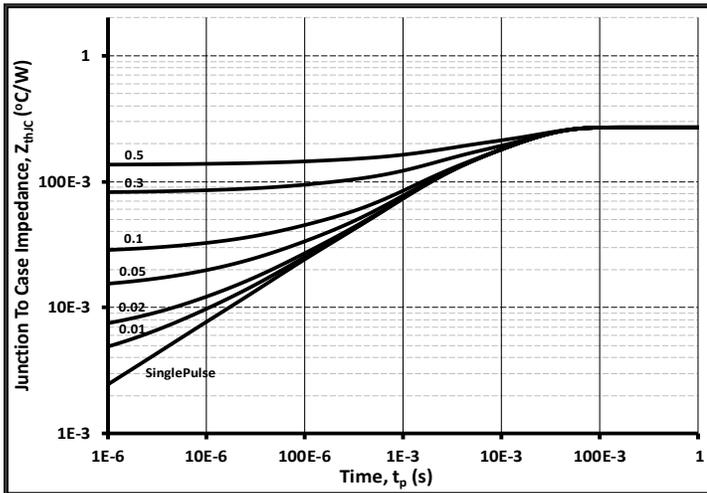Figure 20. Maximum Power Dissipation Derating vs. Case Temperature

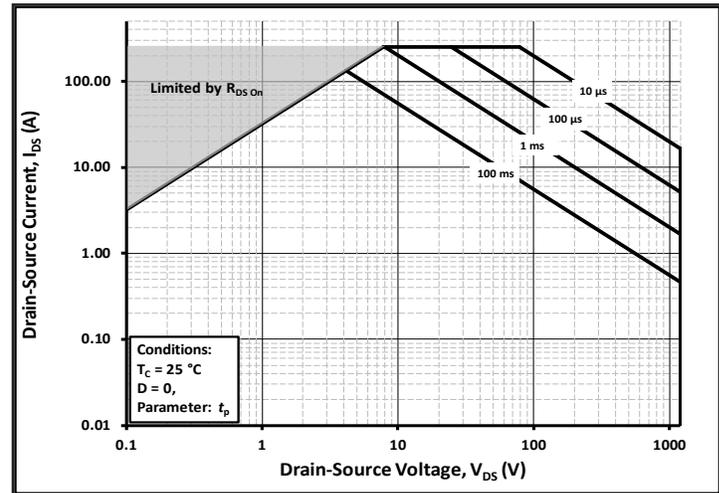Figure 21. Transient Thermal Impedance (Junction - Case)
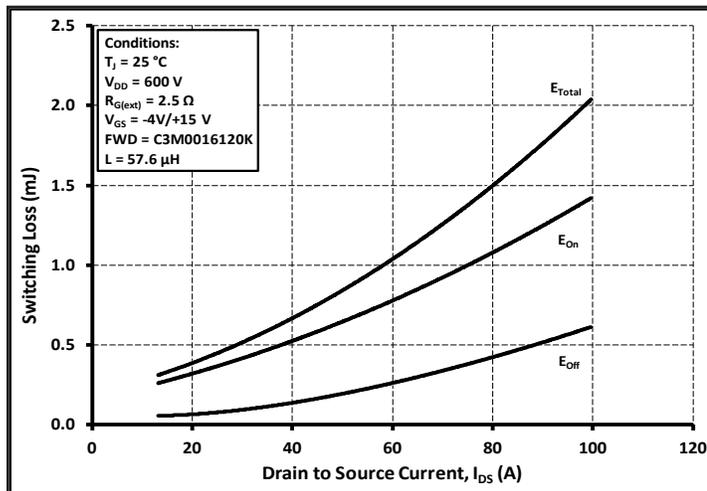

Figure 22. Safe Operating Area

Figure 23. Clamped Inductive Switching Energy vs. Drain Current (V_{DD} = 600V)
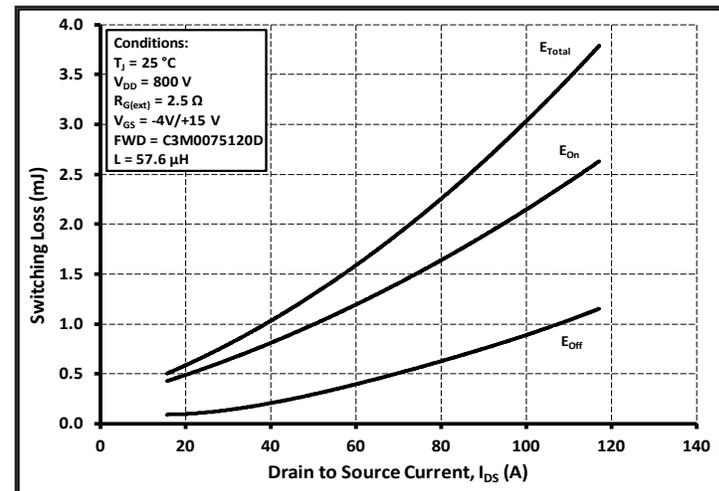
Figure 24. Clamped Inductive Switching Energy vs. Drain Current (V_{DD} = 800V)

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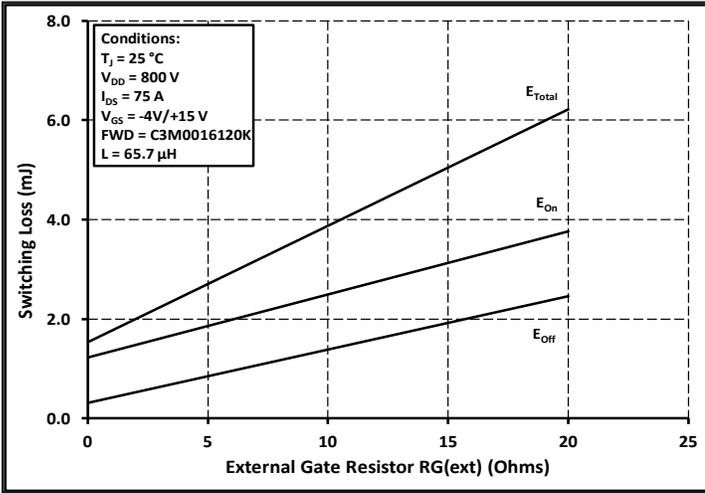
Figure 25. Clamped Inductive Switching Energy vs. $R_{G(ext)}$

Conditions:
T_J = 25 °C
V_{DD} = 800 V
I_{DS} = 75 A
V_{GS} = -4V/+15 V
FWD = C3M0016120K
L = 65.7 μH
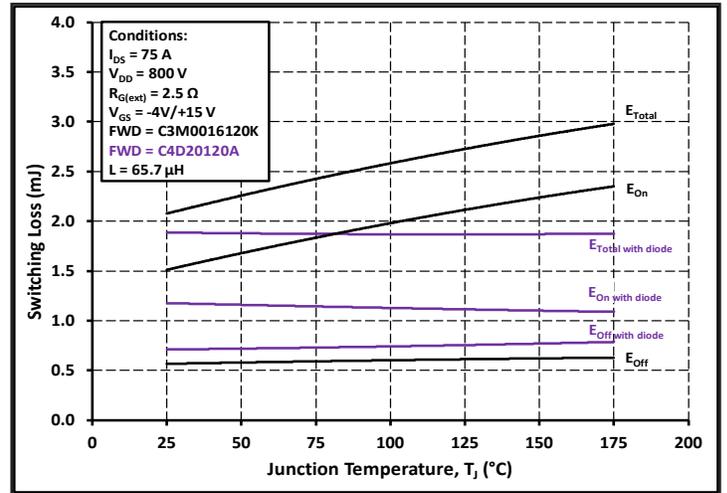
Figure 26. Clamped Inductive Switching Energy vs. Temperature

Conditions:
I_{DS} = 75 A
V_{DD} = 800 V
$R_{G(ext)}$ = 2.5 Ω
V_{GS} = -4V/+15 V
FWD = C4D20120A
L = 65.7 μH
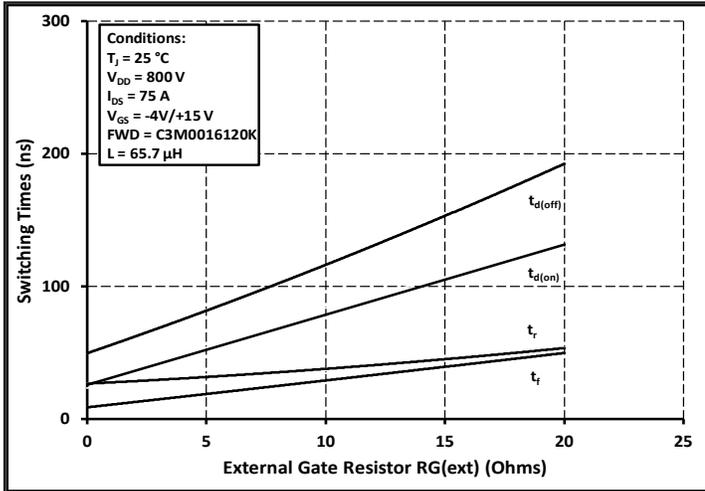
Figure 27. Switching Times vs. $R_{G(ext)}$

Conditions:
T_J = 25 °C
V_{DD} = 800 V
I_{DS} = 75 A
V_{GS} = -4V/+15 V
FWD = C3M0016120K
L = 65.7 μH
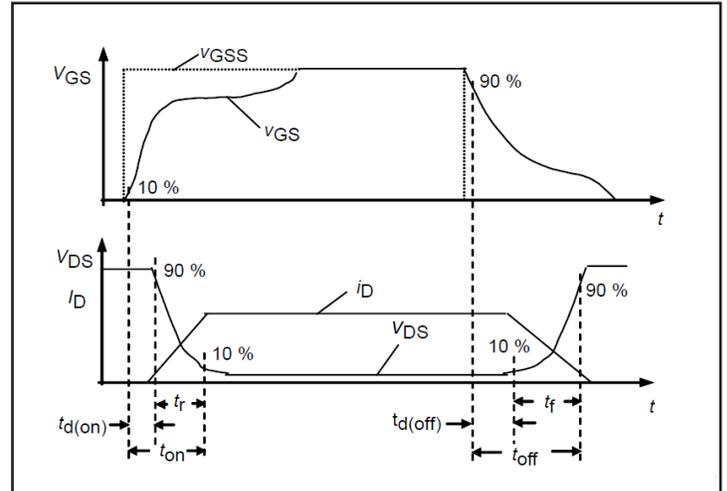
Figure 28. Switching Times Definition

Test Circuit Schematic
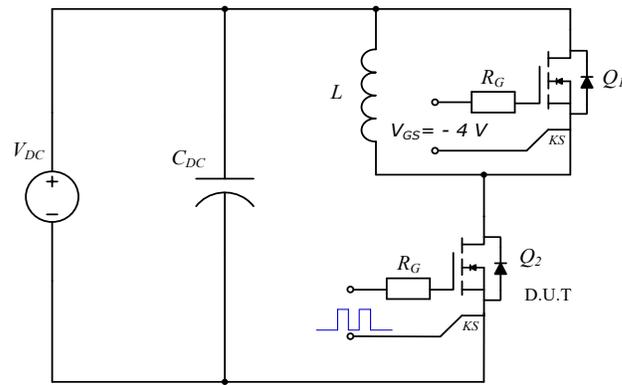
Figure 29. Clamped Inductive Switching
Waveform Test Circuit

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

E
(12.7)
E3
(6.35)
A
⬥ A
Q
S
E2
(ø3)
D
(8.38)
L2
F   F
⬥ C
POLISH
L1
G   G
L
e1
e
3x b
⊕ 0.25 Ⓜ B A Ⓜ

A
⬥ B
A2
W
T
T
W
A1
c

øP   —A—
⊕ ø0.64 Ⓜ D B Ⓜ
E1
E4
D2
D1
ø7.18
b5
H   H
b3   b1

b',b2,b4,b6
BASE METAL
c   c'
PLATING   b,b1,b3,b5

SECTION "F-F", "G-G" AND "H-H"
SCALE: NONE

CREE
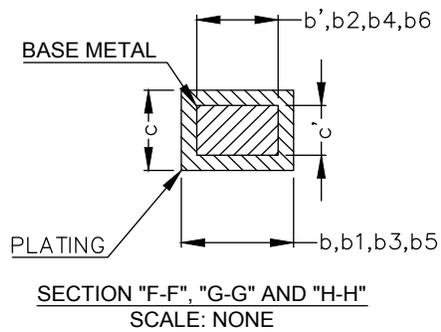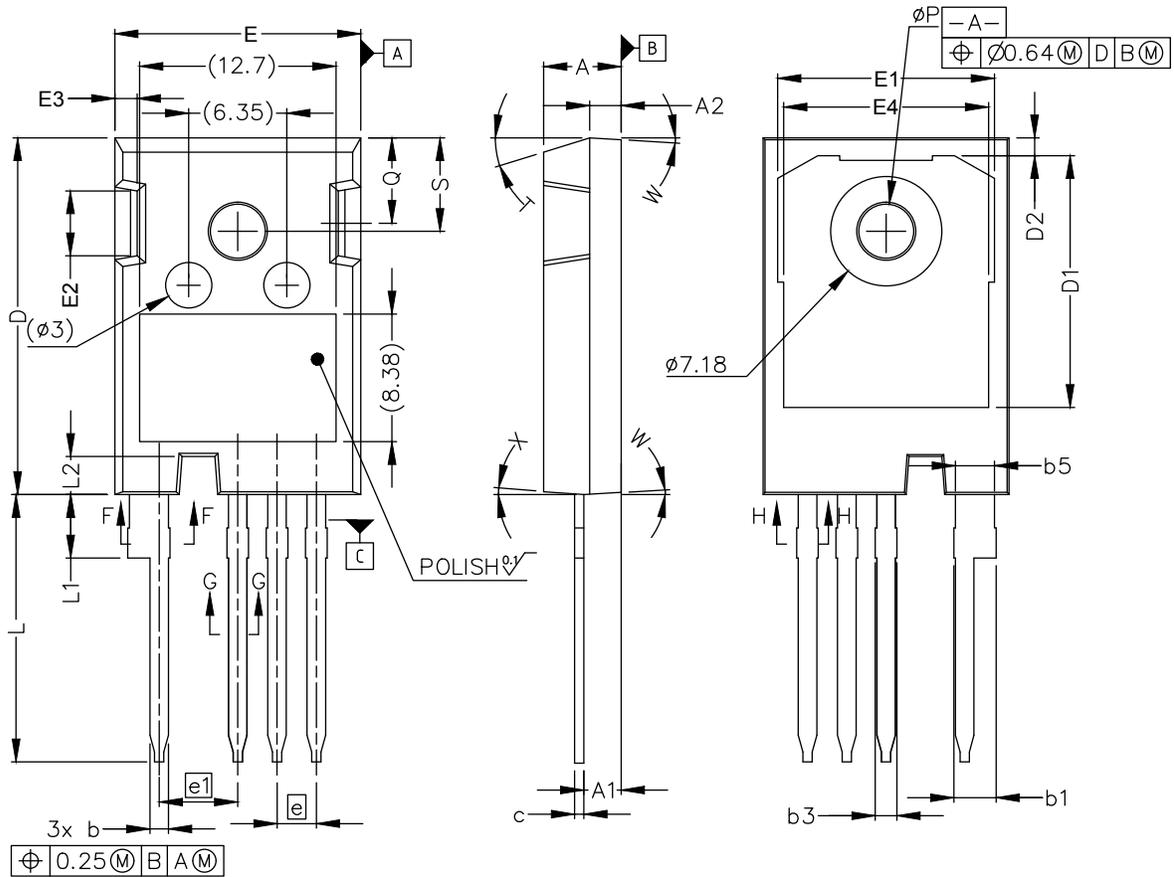
Package Dimensions

Package TO-247-4L

NOTE ;
1. ALL METAL SURFACES: TIN PLATED,EXCEPT AREA OF CUT
2. DIMENSIONING & TOLERANCEING CONFIRM TO
   ASME Y14.5M-1994.
3. ALL DIMENSIONS ARE IN MILLIMETERS.
   ANGLES ARE IN DEGREES.

| SYM	MILLIMETERS MIN	MILLIMETERS MAX	SYM	MILLIMETERS MIN	MILLIMETERS MAX
A	4.83	5.21	E1	13.10	14.15
A1	2.29	2.54	E2	3.68	5.10
A2	1.91	2.16	E3	1.00	1.90
b'	1.07	1.28	E4	12.38	13.43
b	1.07	1.33	e	2.54 BSC	
b1	2.39	2.94	e1	5.08 BSC	
b2	2.39	2.84	N	4	
b3	1.07	1.60	L	17.31	17.82
b4	1.07	1.50	L1	3.97	4.37
b5	2.39	2.69	L2	2.35	2.65
b6	2.39	2.64	øP	3.51	3.65
c'	0.55	0.65	Q	5.49	6.00
c	0.55	0.68	S	6.04	6.30
D	23.30	23.60	T	17.5° REF.	
D1	16.25	17.65	W	3.5 ° REF.	
D2	0.95	1.25	X	4° REF.	
E	15.75	16.13			

Recommended Solder Pad Layout

2.24 [ø0.09"]

1.7 [ø0.07"]

2.54 [0.10"]

2.54 [0.10"]

5.08 [0.20"]

C3M0016120K Rev. -, 04-2019
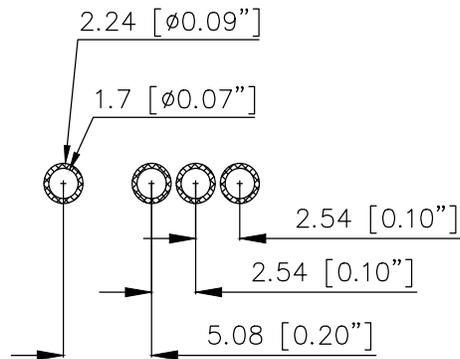
Notes

- **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 Cree representative or from the Product Documentation sections of www.cree.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 a Cree representative to insure you get the most up-to-date REACh SVHC Declaration. REACh banned substance information (REACh Article 67) is also available upon request.

- This product has not been designed or tested for use in, and is not intended for use in, applications implanted into the human body nor in applications in which failure of the product could lead to death, personal injury or property damage, including but not limited to equipment used in the operation of nuclear facilities, life-support machines, cardiac defibrillators or similar emergency medical equipment, aircraft navigation or communication or control systems, air traffic control systems.

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**