CMF20120D-Silicon Carbide Power MOSFET

Z-FET™ MOSFET

N-Channel Enhancement Mode

V_{DS}	1200 V
$I_{D(MAX)}$	42 A
$R_{DS(on)}$	80mΩ

Features

- High Speed Switching with Low Capacitances
- High Blocking Voltage with Low $R_{DS(on)}$
- Easy to Parallel and Simple to Drive
- Avalanche Ruggedness
- Resistant to Latch-Up
- Halogen Free, RoHS Compliant

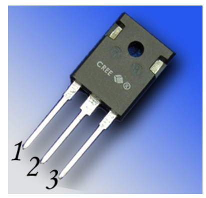
Benefits

- Higher System Efficiency
- Reduced Cooling Requirements
- Increased System Switching Frequency

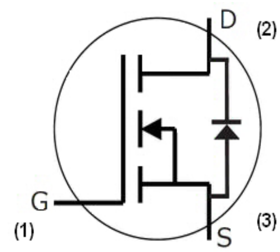
Applications

- Solar Inverters
- High Voltage DC/DC Converters
- Motor Drives
- Switch Mode Power Supplies
- UPS

Package



TO-247-3



Part Number	Package
CMF20120D	TO-247-3

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

Symbol	Parameter	Value	Unit	Test Conditions	Note
I_D	Continuous Drain Current	42	A	V_{GS}@20V, T_C = 25˚C	Fig. 10
		24		V_{GS}@20V, T_C = 100˚C	
I_{Dpulse}	Pulsed Drain Current	90	A	Pulse width t_P limited by T_{jmax} T_C = 25˚C	
E_{AS}	Single Pulse Avalanche Energy	2.2	J	I_D = 20A, V_{DD} = 50 V, L = 9.5 mH	Fig. 15
E_{AR}	Repetitive Avalanche Energy	1.5	J	t_{AR} limited by T_{jmax}	
I_{AR}	Repetitive Avalanche Current	20	A	I_D = 20A, V_{DD} = 50 V, L = 3 mH t_{AR} limited by T_{jmax}	
V_{GS}	Gate Source Voltage	-5/+25	V		
P_{tot}	Power Dissipation	215	W	T_C=25˚C	Fig. 9
T_J , T_{stg}	Operating Junction and Storage Temperature	-55 to +135	˚C		
T_L	Solder Temperature	260	˚C	1.6mm (0.063") from case for 10s	
M_d	Mounting Torque	1 8.8	Nm lbf-in	M3 or 6-32 screw	

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} = 0V, I_D = 100μA	
$V_{GS(th)}$	Gate Threshold Voltage		2.65	4	V	V_{DS} = V_{GS}, I_D = 1mA	Fig. 11
			3.2	4.8		V_{DS} = V_{GS}, I_D = 10mA	
			2.0		V	V_{DS} = V_{GS}, I_D = 1mA, T_J = 135ºC	
			2.45			V_{DS} = V_{GS}, I_D = 10mA, T_J = 135ºC	
I_{DSS}	Zero Gate Voltage Drain Current		1	100	μA	V_{DS} = 1200V, V_{GS} = 0V	
			10	250		V_{DS} = 1200V, V_{GS} = 0V, T_J = 135ºC	
I_{GSS}	Gate-Source Leakage Current			0.25	μA	V_{GS} = 20V, V_{DS} = 0V	
$R_{DS(on)}$	Drain-Source On-State Resistance		80	100	mΩ	V_{GS} = 20V, I_D = 20A	Fig. 3
			95	120		V_{GS} = 20V, I_D = 20A, T_J = 135ºC	
g_{fs}	Transconductance		7.9		S	V_{DS}= 20V, I_{DS}= 20A	Fig. 6
			7.4			V_{DS}= 20V, I_{DS}= 20A, T_J = 135ºC	
C_{iss}	Input Capacitance		1915		pF	V_{GS} = 0V V_{DS} = 800V f = 1MHz V_{AC} = 25mV	Fig. 13
C_{oss}	Output Capacitance		120				
C_{rss}	Reverse Transfer Capacitance		13				
E_{oss}	C_{oss} Stored Energy		62		μJ		Fig. 14
$t_{d(on)v}$	Turn-On Delay Time		13		ns	V_{DD} = 800V, V_{GS} = 0/20V I_D = 20A $R_{G(ext)}$ = 2.5Ω, R_L = 40Ω Timing relative to V_{DS}	Fig. 17
t_{fv}	Fall Time		24				
$t_{d(off)v}$	Turn-Off Delay Time		40				
t_{rv}	Rise Time		38				
R_G	Internal Gate Resistance		5		Ω	f = 1MHz, V_{AC} = 25mV	

Built-in SiC Body Diode Characteristics

Symbol	Parameter	Typ.	Max.	Unit	Test Conditions	Note
V_{SD}	Diode Forward Voltage	3.5		V	V_{GS} = -5V, I_F=10A, T_J = 25ºC	
		3.1			V_{GS} = -2V, I_F=10A, T_J = 25ºC	
t_{rr}	Reverse Recovery Time	220		ns	V_{GS} = -5V, I_F=20A, T_J = 25ºC V_R = 800V, di_F/dt= 100A/μs	Fig. 22
Q_{rr}	Reverse Recovery Charge	142		nC		
I_{rrm}	Peak Reverse Recovery Current	2.3		A		

Thermal Characteristics

Symbol	Parameter	Typ.	Max.	Unit	Test Conditions	Note
$R_{\theta JC}$	Thermal Resistance from Junction to Case	0.44	0.51	K/W		Fig. 7
$R_{\theta CS}$	Case to Sink, w/ Thermal Compound	0.25				
$R_{\theta JA}$	Thermal Resistance From Junction to Ambient		40			

Gate Charge Characteristics

Symbol	Parameter	Typ.	Max.	Unit	Test Conditions	Note
Q_{gs}	Gate to Source Charge	23.8		nC	V_{DD} = 800V, V_{GS} = 0/20V I_D =20A Per JEDEC24 pg 27	Fig. 12
Q_{gd}	Gate to Drain Charge	43.1				
Q_g	Gate Charge Total	90.8				

Typical Performance

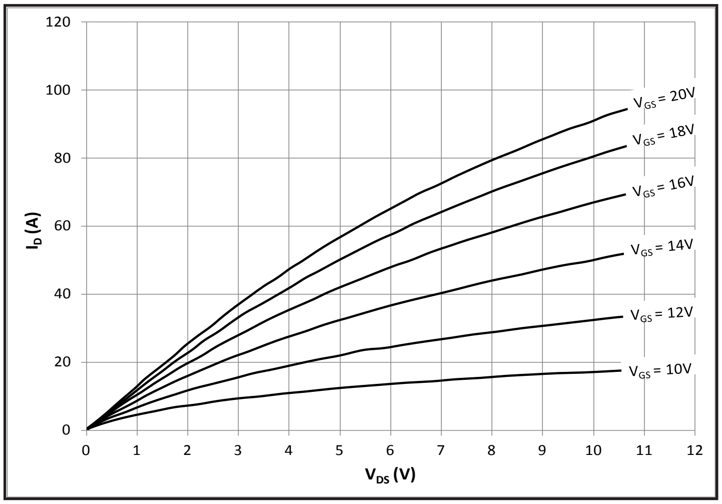


Figure 1. Typical Output Characteristics T_J = 25ºC

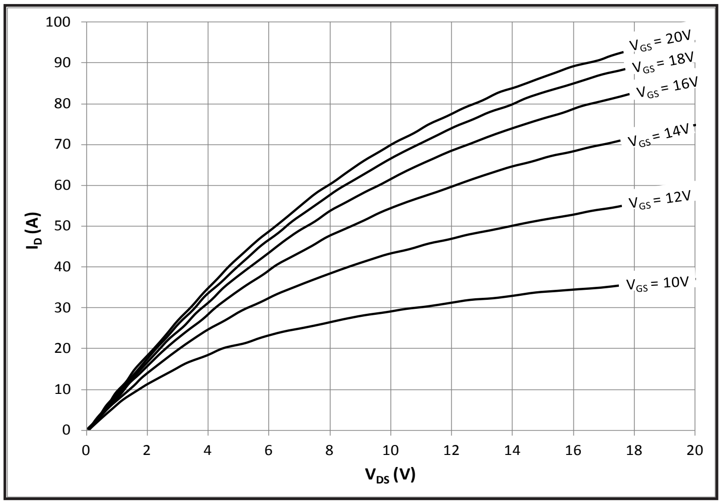


Figure 2. Typical Output Characteristics T_J = 135ºC

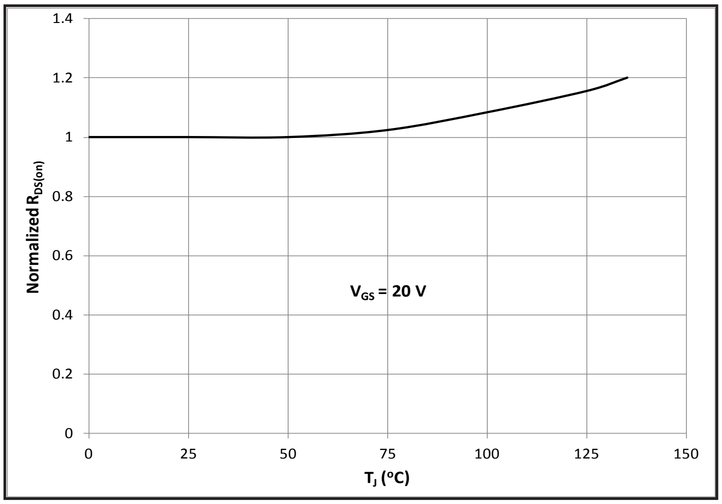


Figure 3. Normalized On-Resistance vs. Temperature

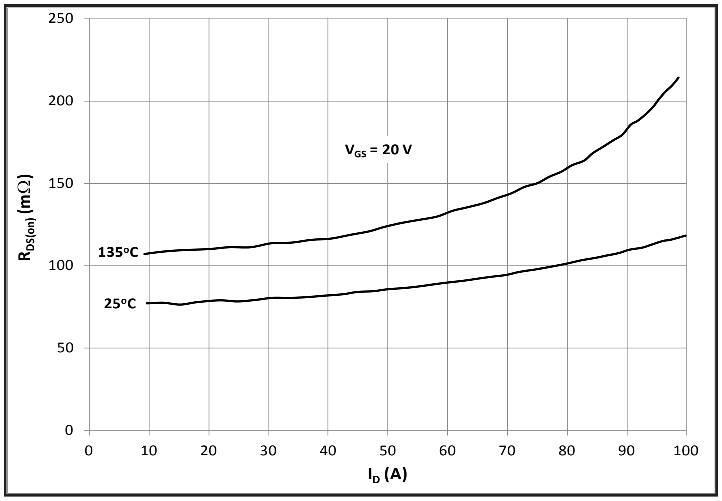


Figure 4. On-Resistance vs. Drain Current

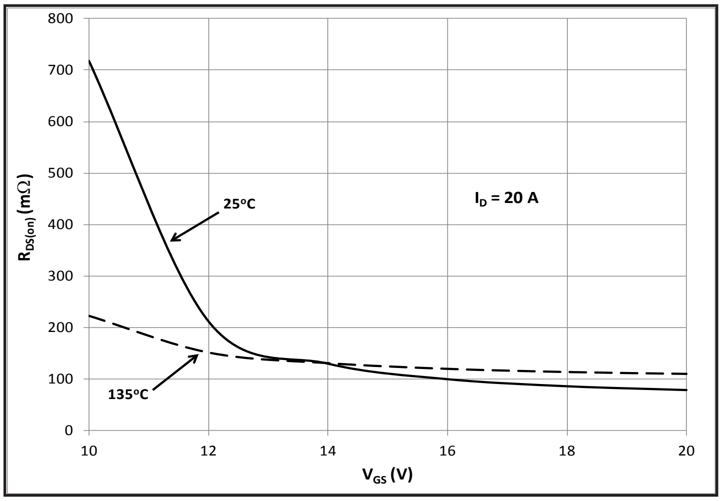


Figure 5. On-Resistance vs. Gate Voltage

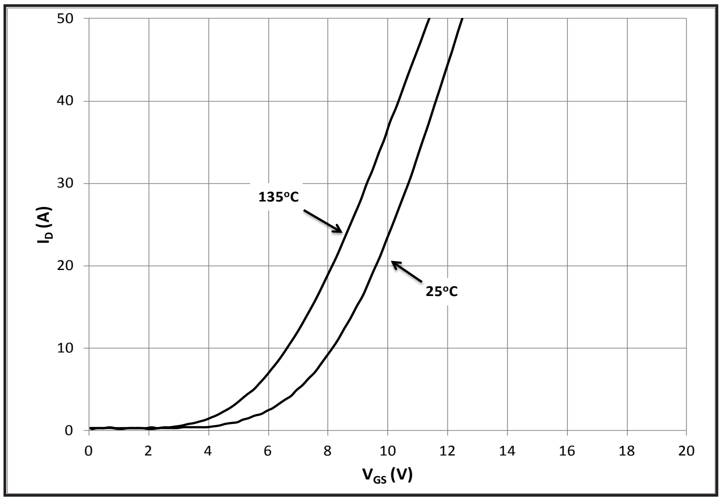


Figure 6. Typical Transfer Characteristics

Typical Performance

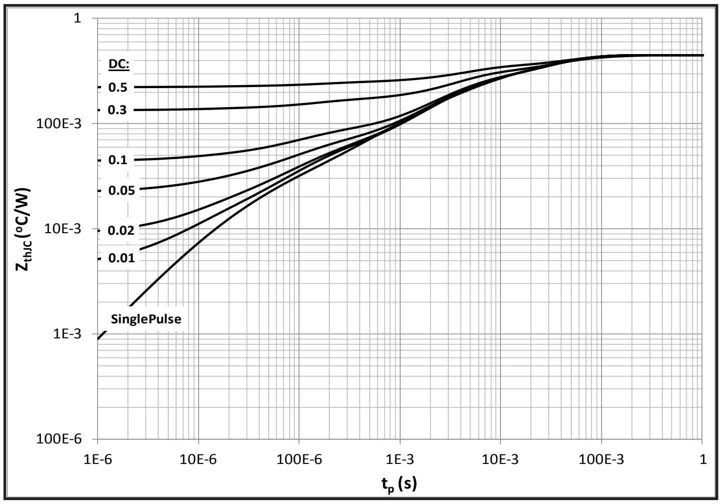


Figure 7. Transient Thermal Impedance (Junction - Case) with Duty Cycle

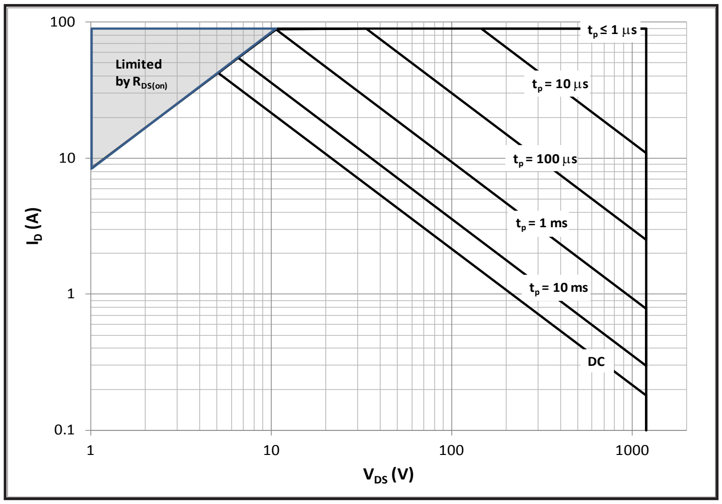


Figure 8. Safe Operating Area

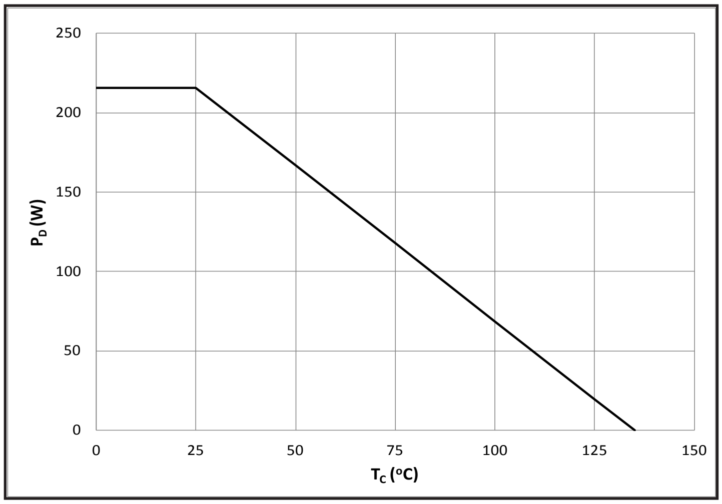


Figure 9. Power Dissipation Derating Curve

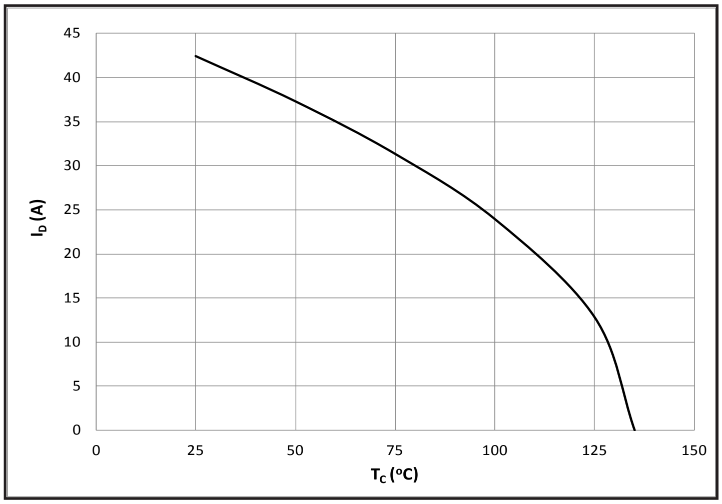


Figure 10. Continuous Current Derating Curve

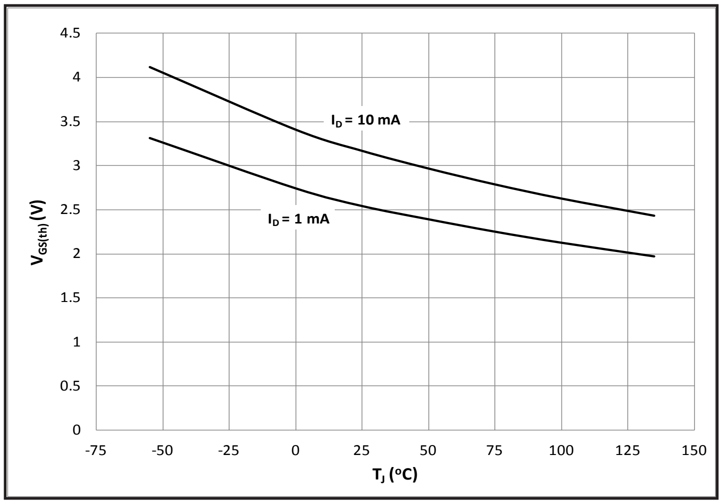


Figure 11. Gate Threshold Voltage vs. Temperature

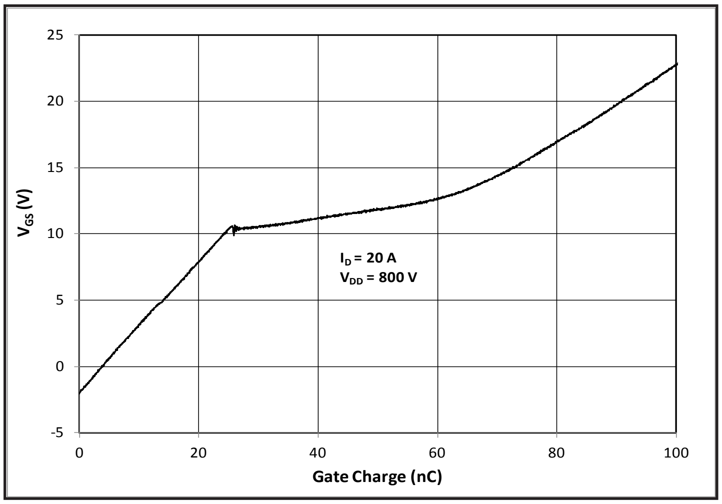
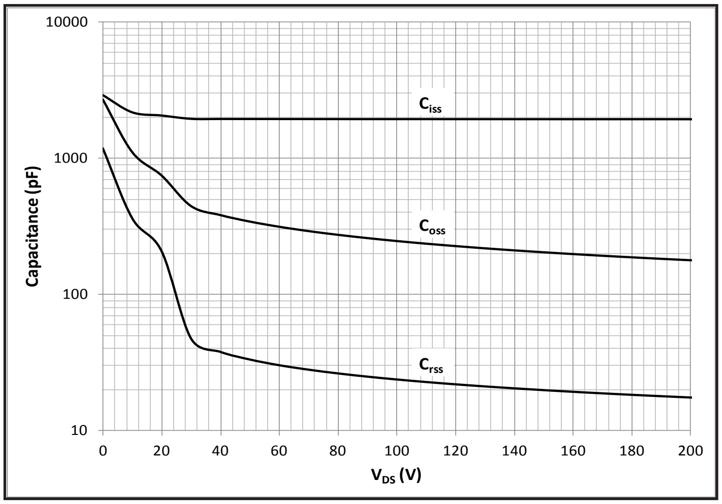


Figure 12. Typical Gate Charge Characteristics (25°C)

Typical Performance



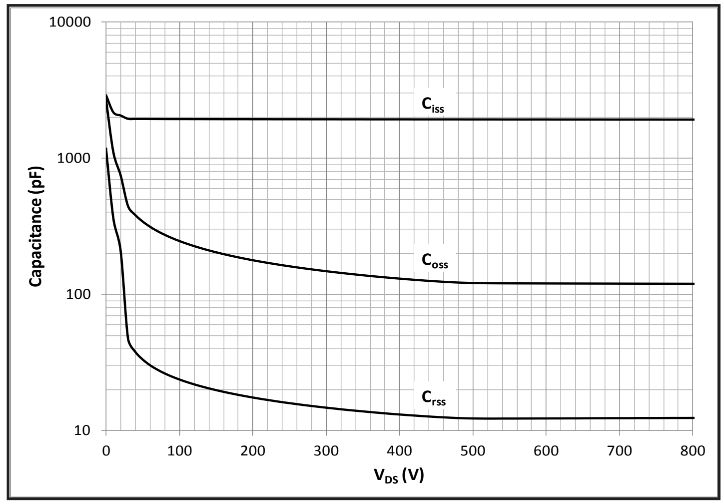


Figure 13A and 13B. Typical Capacitances vs. Drain Voltage at V_{GS} = 0V and f = 1 MHz

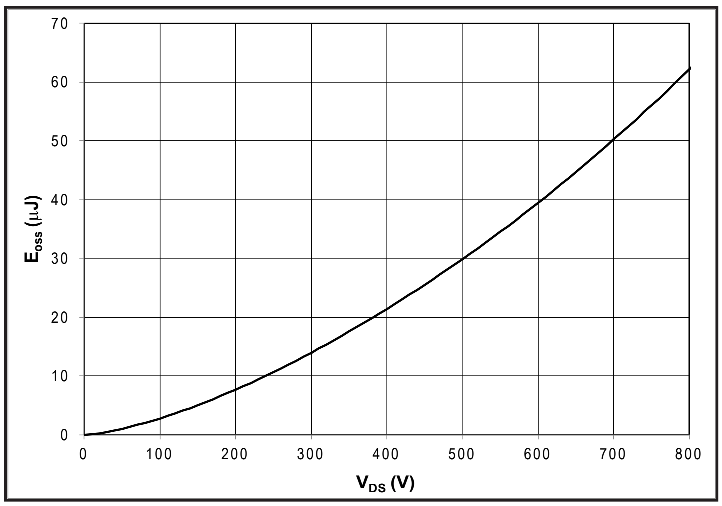


Figure 14. Typical C_{OSS} Stored Energy

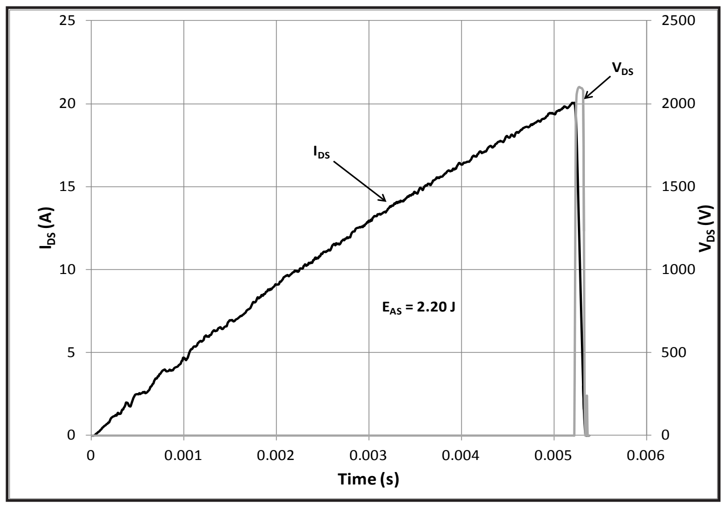


Figure 15. Typical Unclamped Inductive Switching Waveforms Showing Avalanche Capability

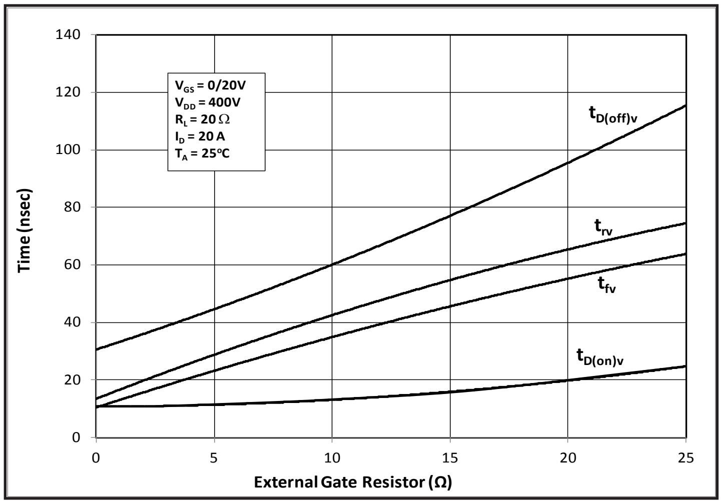


Figure 16. Resistive Switching Times vs. External R_G at V_{DD} = 400V, I_D = 20A

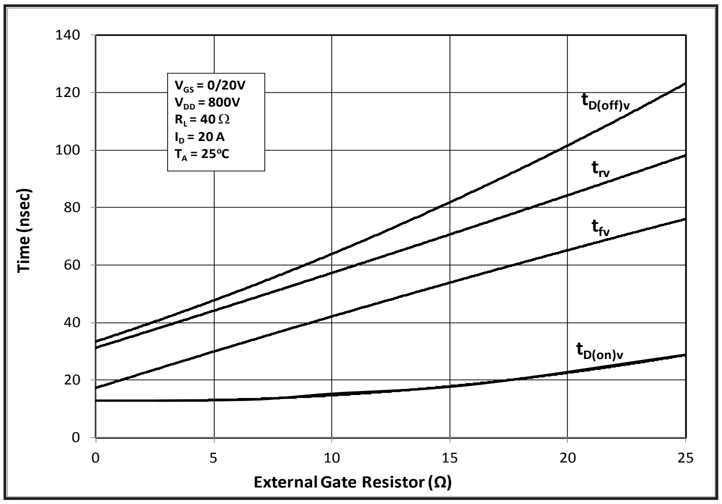


Figure 17. Resistive Switching Times vs. External R_G at V_{DD} = 800V, I_D = 20A

Typical Performance

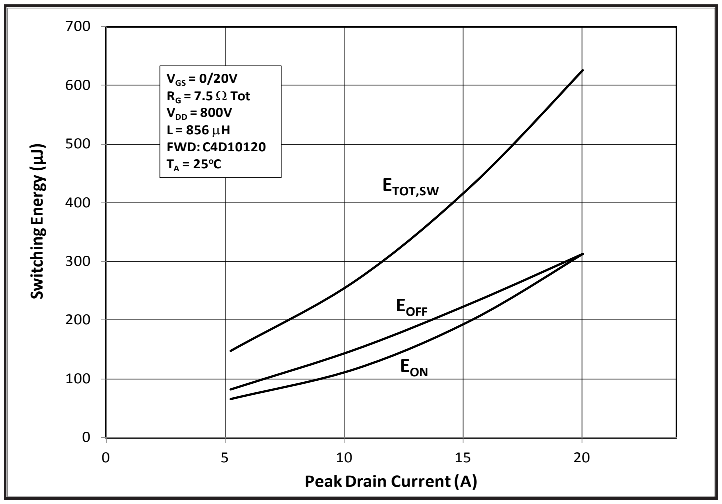


Figure 18. Clamped Inductive Switching Energy vs. Drain Current (Fig. 20)

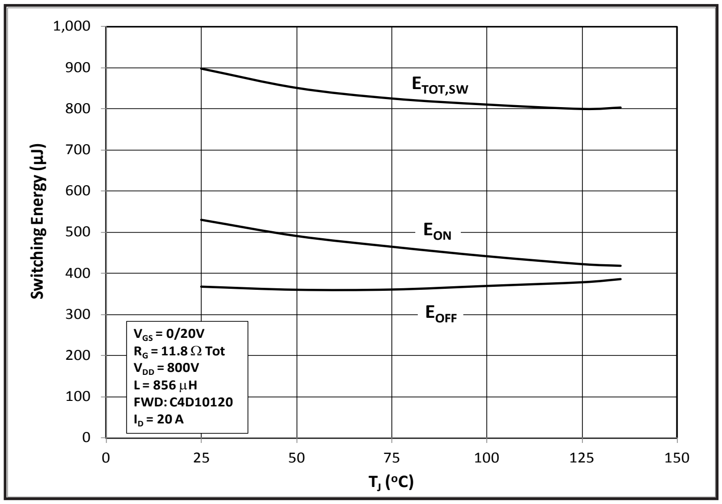


Figure 19. Clamped Inductive Switching Energy vs. Junction Temperature (Fig 20)

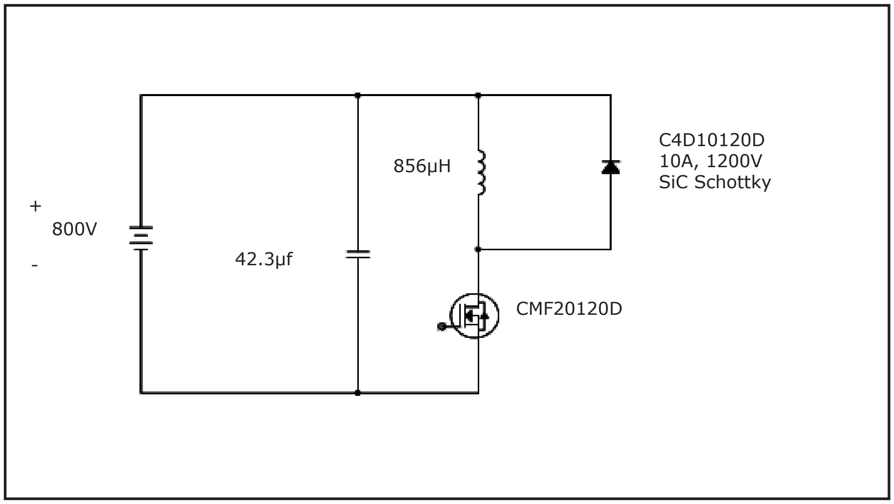


Figure 20. Clamped Inductive Switching Waveform Test Circuit

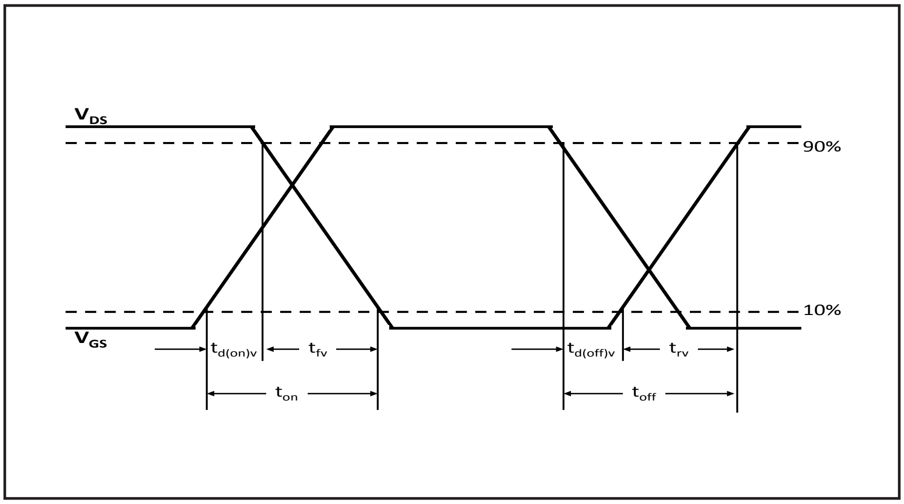


Figure 21. Switching Test Waveforms for Transition times

Test Circuit Diagrams and Waveforms

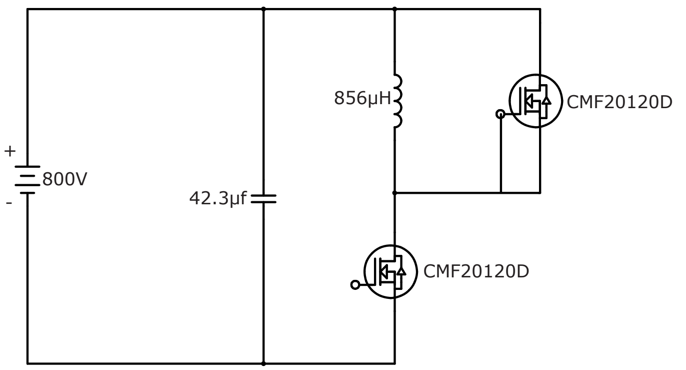


Fig 22. Body Diode Recovery Test

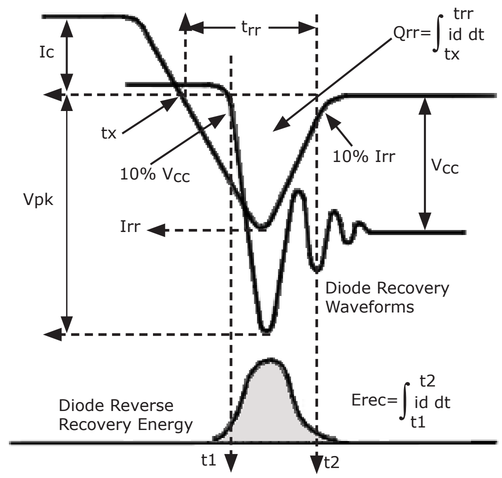


Fig 23. Body Diode Recovery Waveform

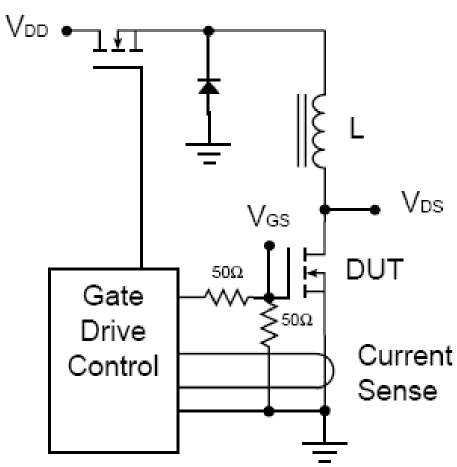
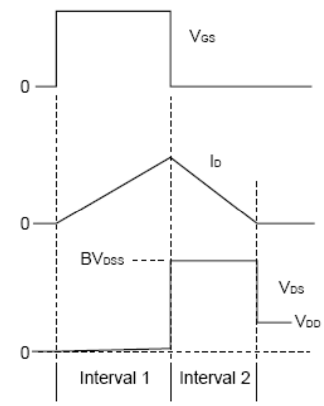


Fig 24. Unclamped Inductive Switching Test Circuit



$$E_A = 1/2L \times I_D^2$$

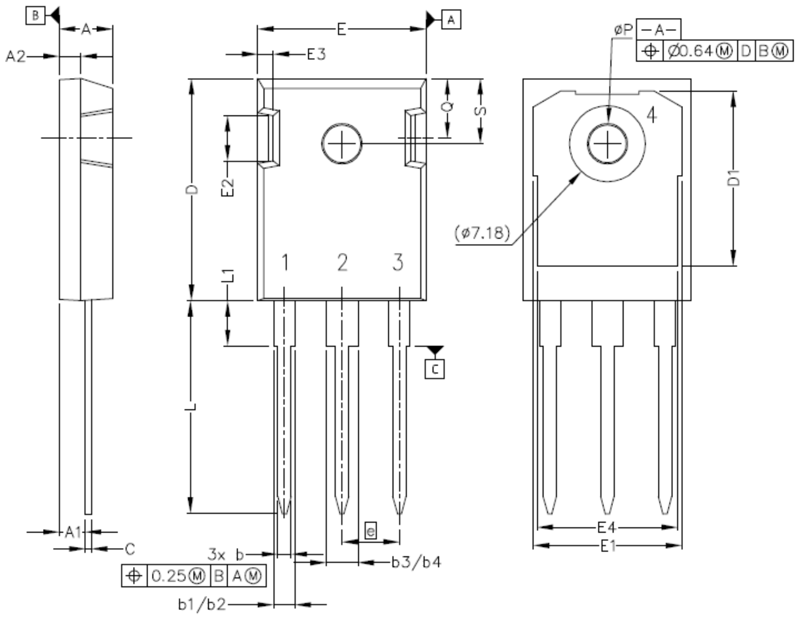
Fig 25. Unclamped Inductive Switching waveform for Avalanche Energy

ESD Ratings

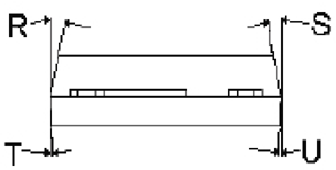
ESD Test	Total Devices Sampled	Resulting Classification
ESD-HBM	All Devices Passed 1000V	2 (>2000V)
ESD-MM	All Devices Passed 400V	C (>400V)
ESD-CDM	All Devices Passed 1000V	IV (>1000V)

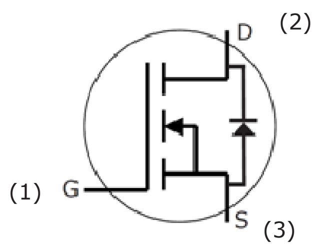
Package Dimensions

Package TO-247-3

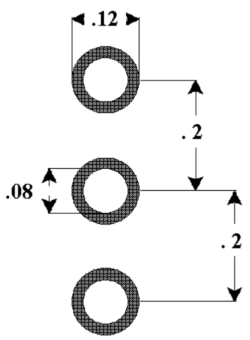


POS	Inches		Millimeters	
	Min	Max	Min	Max
A	.190	.205	4.83	5.21
A1	.090	.100	2.29	2.54
A2	.075	.085	1.91	2.16
b	.042	.052	1.07	1.33
b1	.075	.095	1.91	2.41
b2	.075	.085	1.91	2.16
b3	.113	.133	2.87	3.38
b4	.113	.123	2.87	3.13
c	.022	.027	0.55	0.68
D	.819	.831	20.80	21.10
D1	.640	.695	16.25	17.65
D2	.037	.049	0.95	1.25
E	.620	.635	15.75	16.13
E1	.516	.557	13.10	14.15
E2	.145	.201	3.68	5.10
E3	.039	.075	1.00	1.90
E4	.487	.529	12.38	13.43
e	.214 BSC		5.44 BSC	
N	3		3	
L	.780	.800	19.81	20.32
L1	.161	.173	4.10	4.40
ØP	.138	.144	3.51	3.65
Q	.216	.236	5.49	6.00
S	.238	.248	6.04	6.30





Recommended Solder Pad Layout



TO-247-3

Part Number	Package	Marking
CMF20120D	TO-247-3	CMF20120

Cree, Inc.
4600 Silicon Drive
Durham, NC 27703
USA Tel: +1.919.313.5300
Fax: +1.919.313.5451
www.cree.com/power