CMF10120D-Silicon Carbide Power MOSFET

Z-FET™ MOSFET

N-Channel Enhancement Mode

V_{DS}	= 1200 V
$I_{D(MAX)}$	= 24 A
$R_{DS(on)}$	= 160mΩ

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

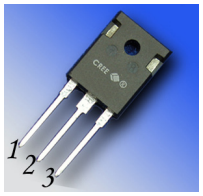
Benefits

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

Applications

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

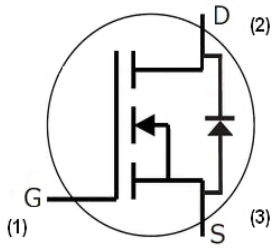
Package



TO-247-3

Halogen-Free

RoHS COMPLIANT



Part Number	Package
CMF10120D	TO-247-3

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

Symbol	Parameter	Value	Unit	Test Conditions	Note
I_D	Continuous Drain Current	24	A	V_{GS}@20V, T_C = 25°C	Fig. 10
		13		V_{GS}@20V, T_C = 100°C	
I_{Dpulse}	Pulsed Drain Current	49	A	Pulse width t_P limited by T_{jmax} T_C = 25°C	
E_{AS}	Single Pulse Avalanche Energy	1.2	J	I_D = 10A, V_{DD} = 50 V, L = 20 mH t_{AR} limited by T_{jmax}	Fig. 15
E_{AR}	Repetitive Avalanche Energy	0.8	J		
I_{AR}	Repetitive Avalanche Current	10	A	I_D = 10A, V_{DD} = 50 V, L = 15 mH t_{AR} limited by T_{jmax}	
V_{GS}	Gate Source Voltage	-5/+25	V		
P_{tot}	Power Dissipation	134	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 = 50μA	
$V_{GS(th)}$	Gate Threshold Voltage		2.4	3.5	V	V_{DS} = V_{GS}, I_D = 0.5 mA	Fig. 11
			3.1	4.1		V_{DS} = V_{GS}, I_D = 1.0 mA	
			1.8		V	V_{DS} = V_{GS}, I_D = 0.5 mA, T_J = 135ºC	
			2.3		V	V_{DS} = V_{GS}, I_D = 1.0 mA, T_J = 135ºC	
I_{DSS}	Zero Gate Voltage Drain Current		0.5	50	μA	V_{DS} = 1200V, V_{GS} = 0V	
			5	150		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		160	200	mΩ	V_{GS} = 20V, I_D = 10A	Fig. 3
			190	240		V_{GS} = 20V, I_D = 10A, T_J = 135ºC	
g_{fs}	Transconductance		4.2		S	V_{DS}= 20V, I_{DS}= 10A	Fig. 6
			3.9			V_{DS}= 20V, I_{DS}= 10A, T_J = 135ºC	
C_{iss}	Input Capacitance		928		pF	V_{GS} = 0V V_{DS} = 800V f = 1MHz V_{AC} = 25mV	Fig. 13
C_{oss}	Output Capacitance		63				
C_{rss}	Reverse Transfer Capacitance		7.5				
E_{oss}	C_{oss} Stored Energy		32		μJ		Fig 14
$t_{d(on)v}$	Turn-On Delay Time		8.8		ns	V_{DD} = 800V, V_{GS} = 0/20V I_D = 10A $R_{G(ext)}$ = 2.5Ω, R_L = 40Ω Timing relative to V_{DS}	fig. 17
t_{fv}	Fall Time		21				
$t_{d(off)V}$	Turn-Off Delay Time		38				
t_{rV}	Rise Time		34				
R_G	Internal Gate Resistance		13.6		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=5A, T_J = 25ºC	
		3.1			V_{GS} = -2V, I_F=5A, T_J = 25ºC	
t_{rr}	Reverse Recovery Time	138		ns	V_{GS} = -5V, I_F=10A, T_J = 25ºC V_R = 800V, di_F/dt= 100A/μs	Fig. 22
Q_{rr}	Reverse Recovery Charge	94		nC		
I_{rrm}	Peak Reverse Recovery Current	1.57		A		

Thermal Characteristics

Symbol	Parameter	Typ.	Max.	Unit	Test Conditions	Note
$R_{\theta JC}$	Thermal Resistance from Junction to Case	0.66	0.82	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	11.8		nC	V_{DD} = 800V, V_{GS} = 0/20V I_D =10A Per JEDEC24 pg 27	Fig.12
Q_{gd}	Gate to Drain Charge	21.5				
Q_g	Gate Charge Total	47.1				

Typical Performance

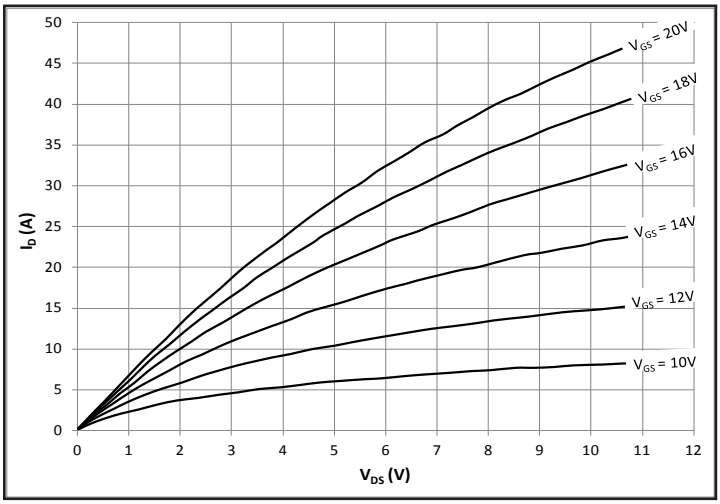


Figure 1. Typical Output Characteristics T_J = 25ºC

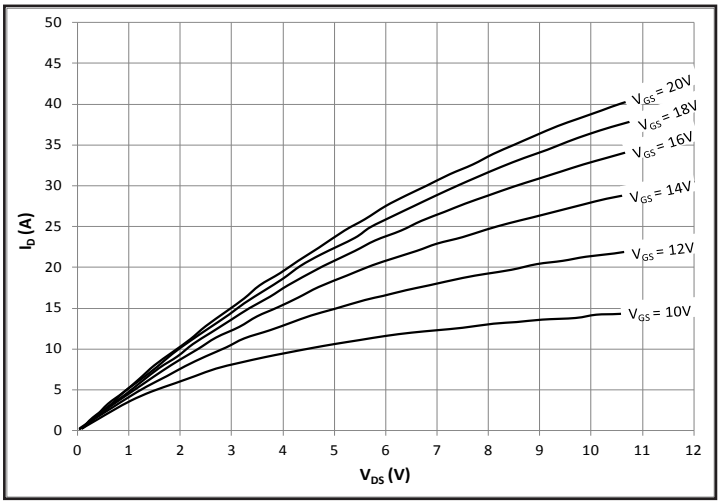


Figure 2. Typical Output Characteristics T_J = 135ºC

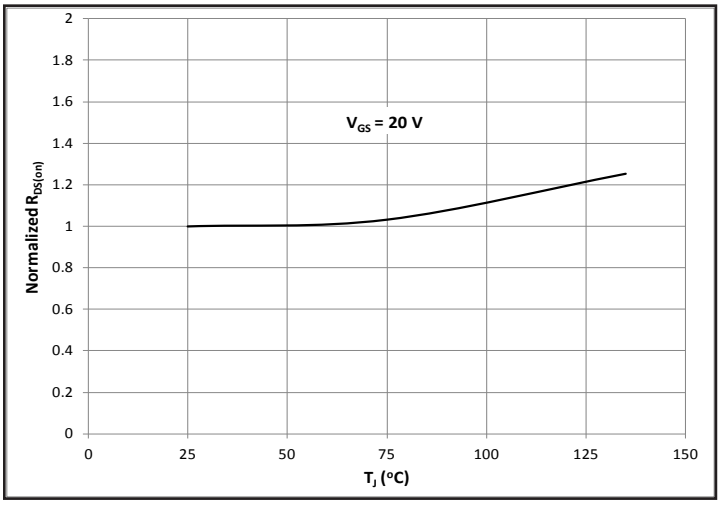


Figure 3. Normalized On-Resistance vs. Temperature

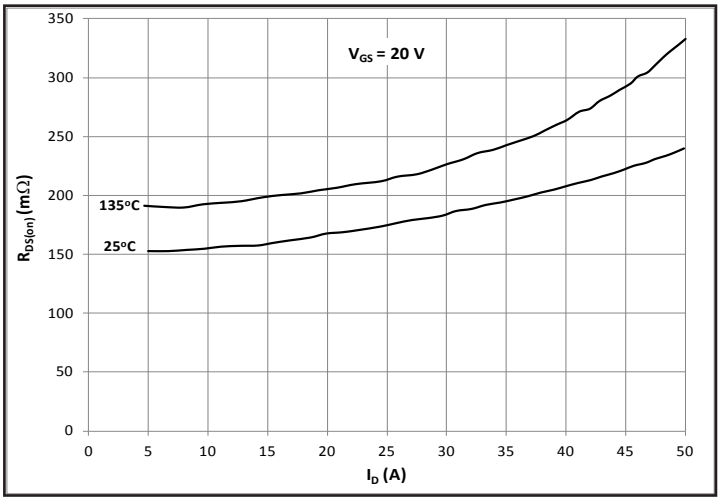


Figure 4. On-Resistance vs. Drain Current

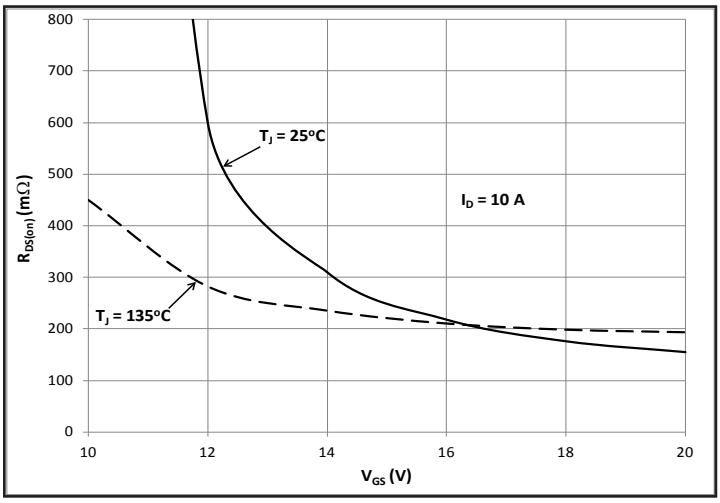


Figure 5. On-Resistance vs. Gate Voltage

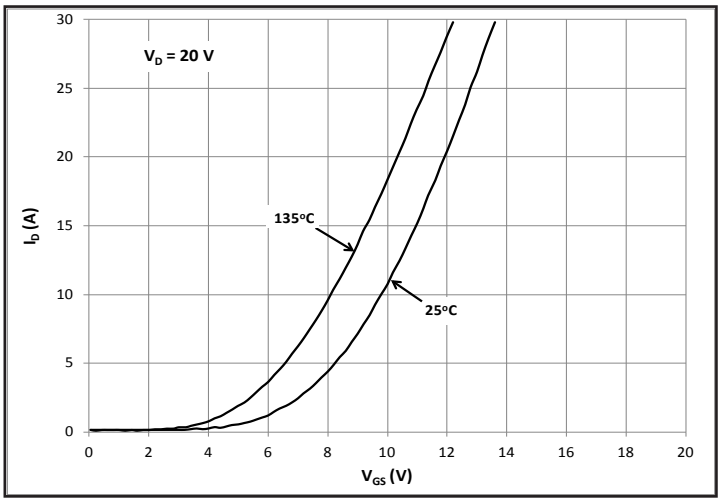


Figure 6. Typical Transfer Characteristics

Typical Performance

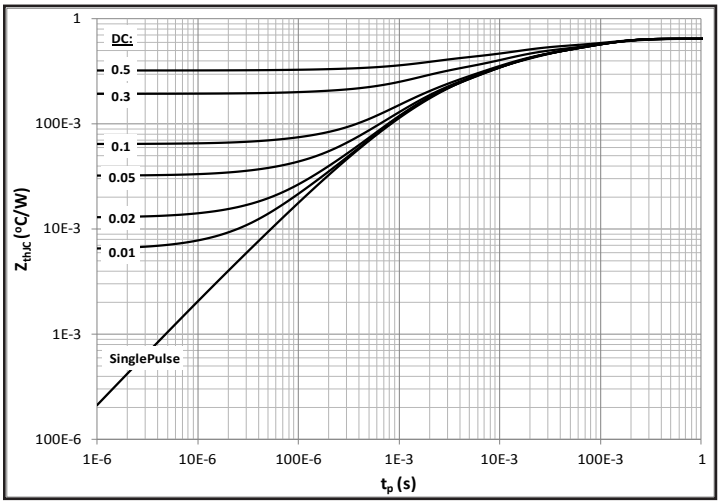


Figure 7. Transient Thermal Impedance (Junction - Case) with Duty Cycle

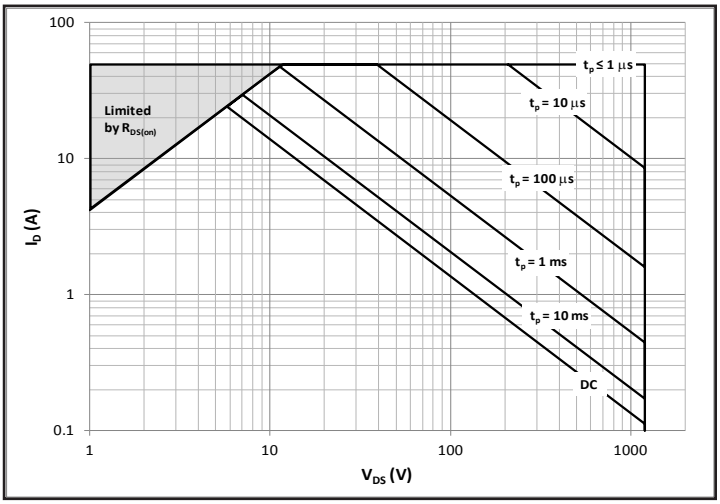


Figure 8. Safe Operating Area

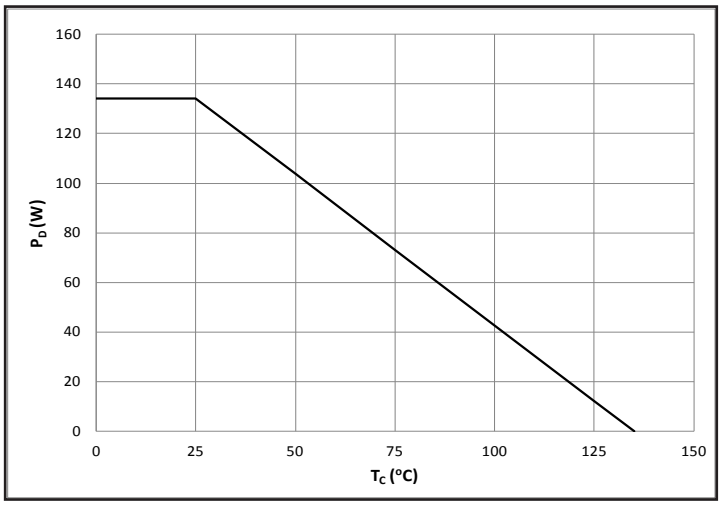


Figure 9. Power Dissipation Derating Curve

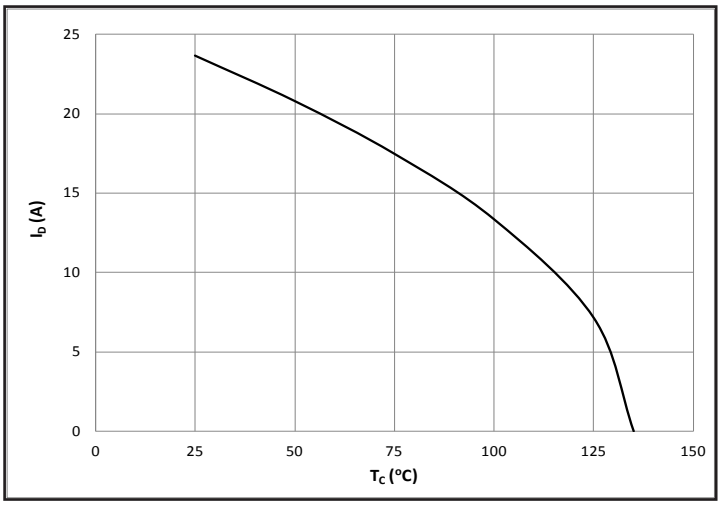


Figure 10. Continuous Current Derating Curve

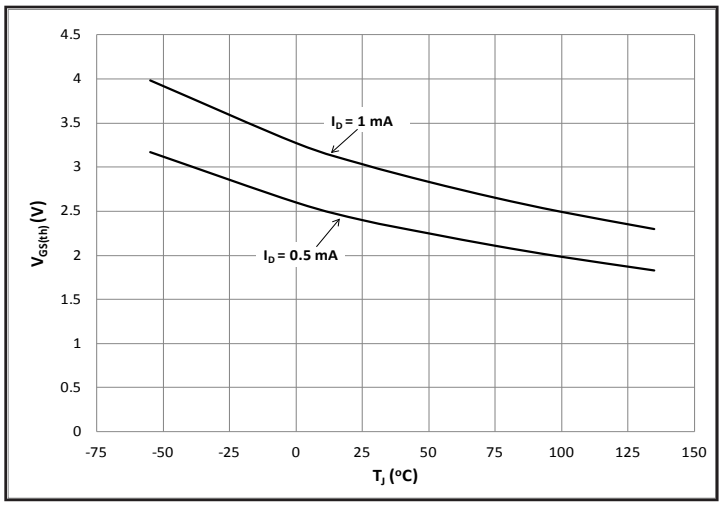


Figure 11. Gate Threshold Voltage vs. Temperature

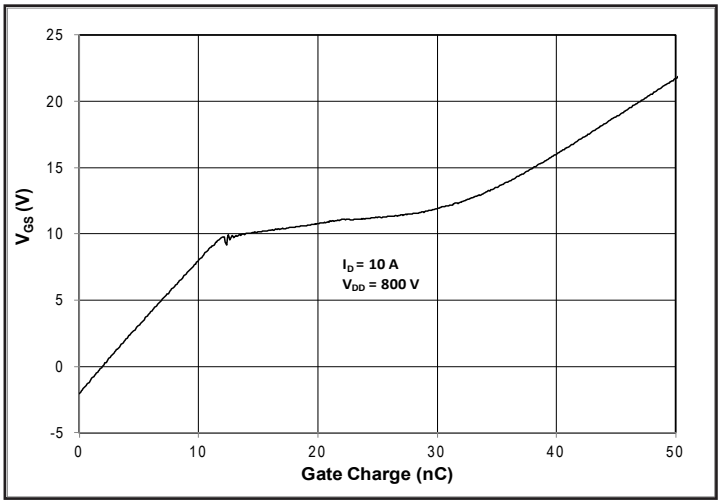
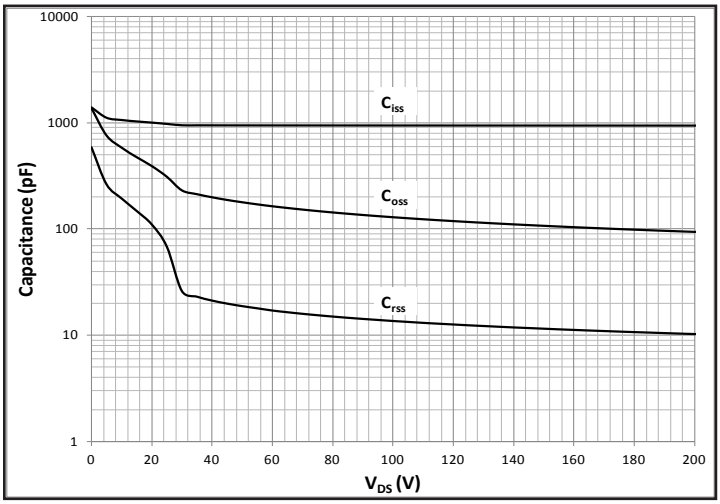


Figure 12. Typical Gate Charge Characteristics (25°C)

Typical Performance



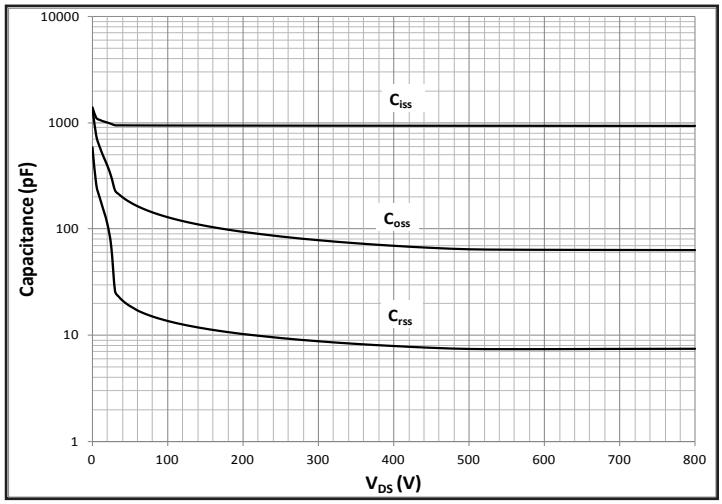


Figure 13A and 13B. Typical Capacitances vs. Drain Voltage at V_{GS} = 0V and f = 1 MHz

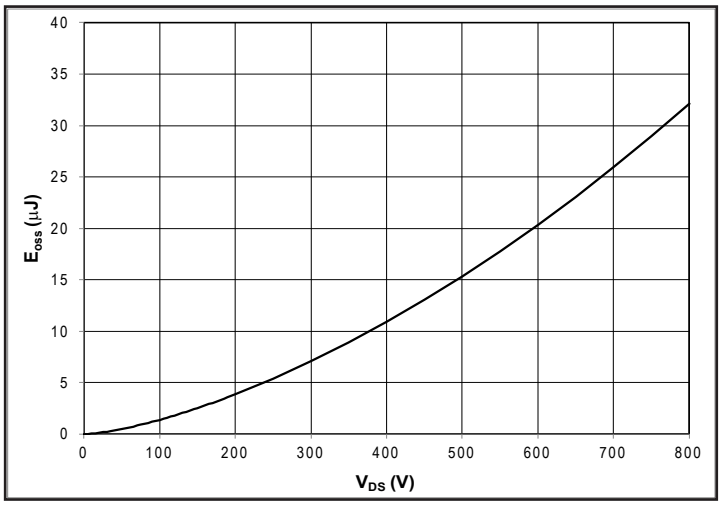


Figure 14. Typical C_{OSS} Stored Energy

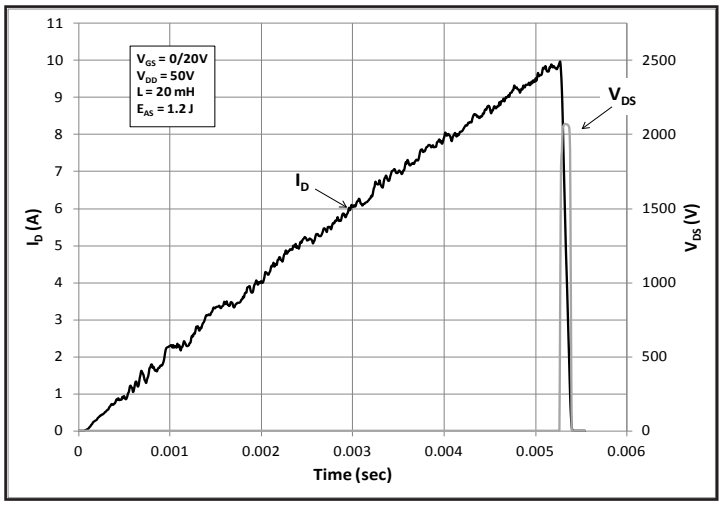


Figure 15. Typical Unclamped Inductive Switching Waveforms Showing Avalanche Capability

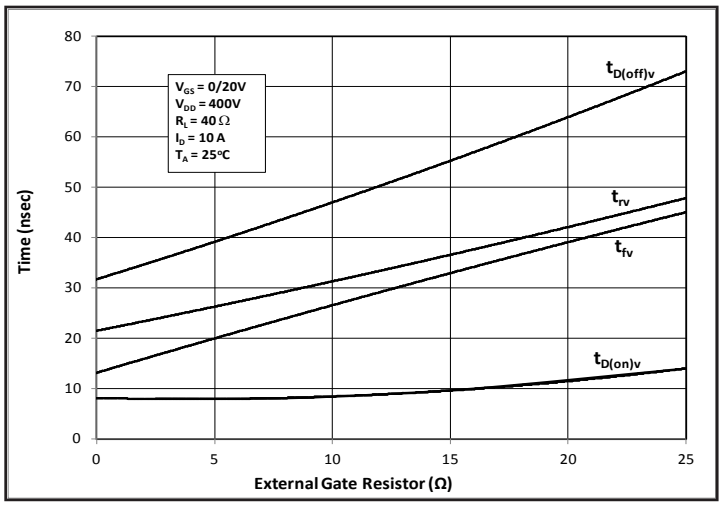


Figure 16. Resistive Switching Times vs. External R_G at V_{DD} = 400V, I_D = 10A

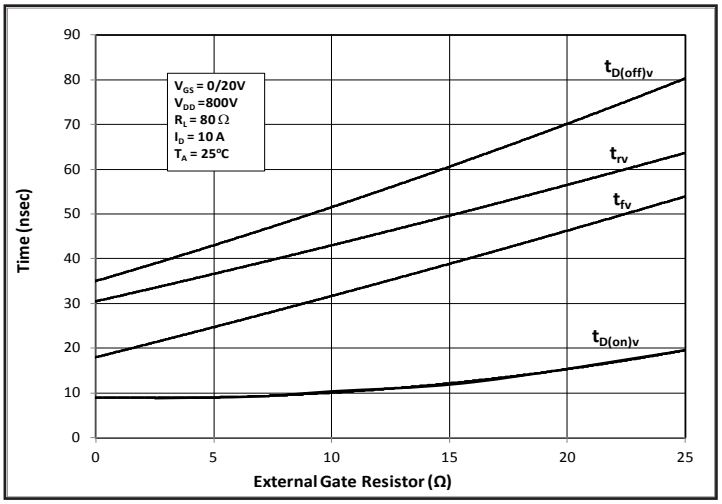


Figure 17. Resistive Switching Times vs. External R_G at V_{DD} = 800V, I_D = 10A

Typical Performance

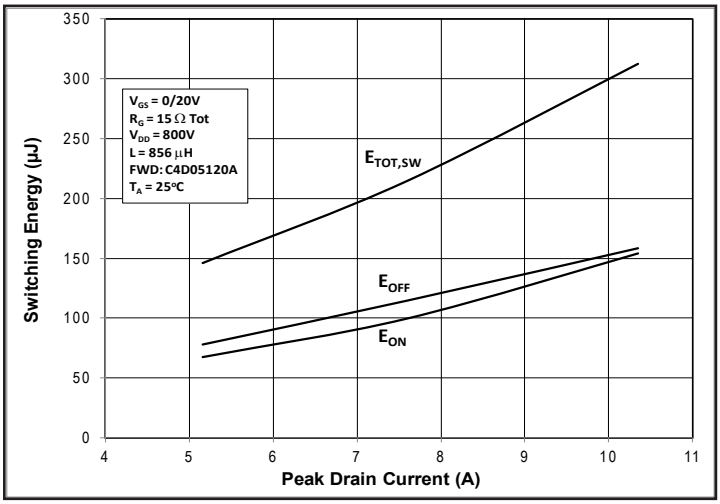


Figure 18. Clamped Inductive Switching Energy vs. Drain Current (Fig. 20)

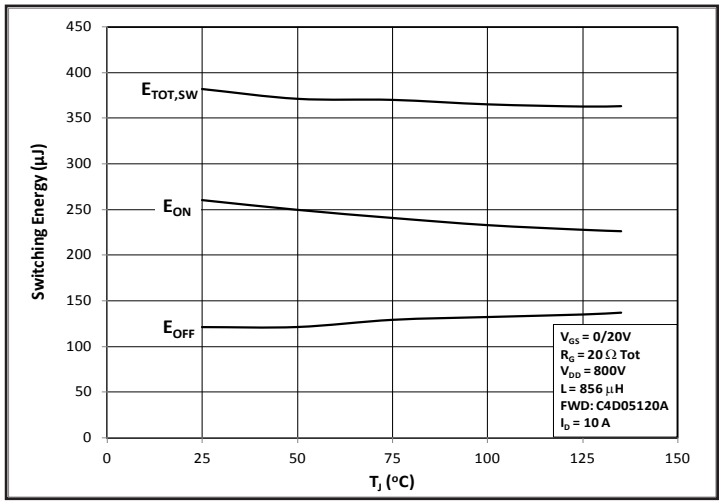


Figure 19. Clamped Inductive Switching Energy vs. Junction Temperature (Fig 20)

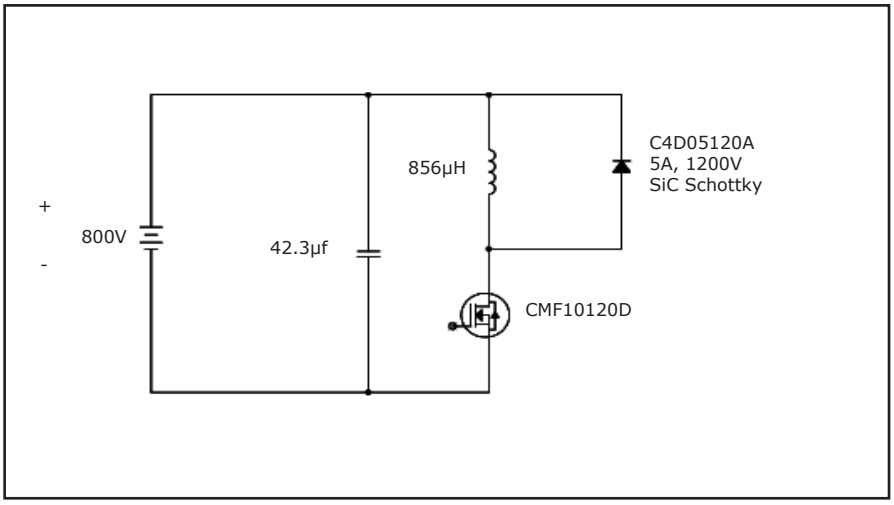


Figure 20. Clamped Inductive Switching Waveform Test Circuit

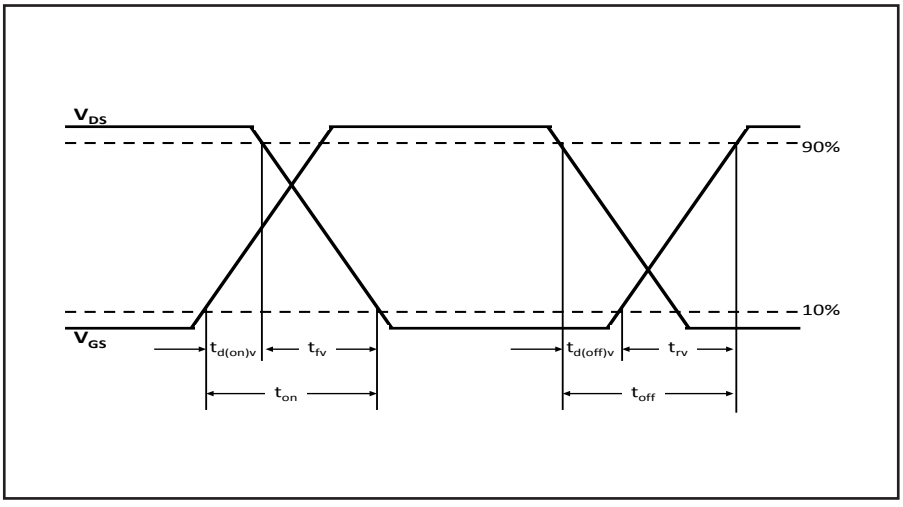


Figure 21. Switching Test Waveforms for Transition times

Test Circuit Diagrams and Waveforms

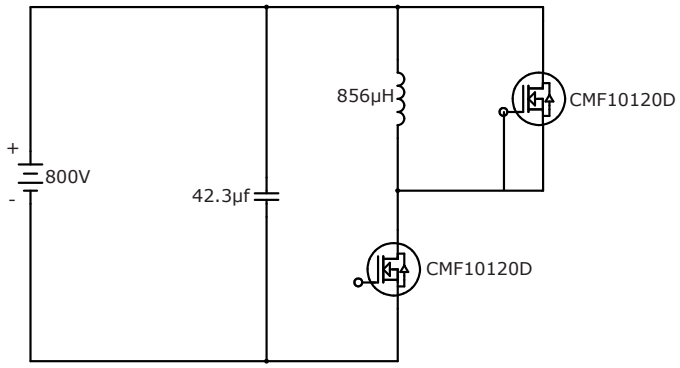


Fig 22. Body Diode Recovery Test

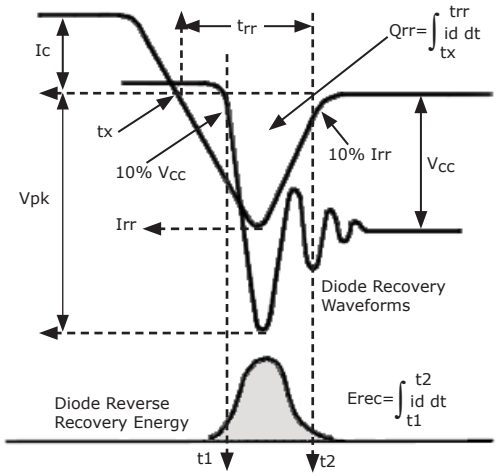


Fig 23. Body Diode Recovery Waveform

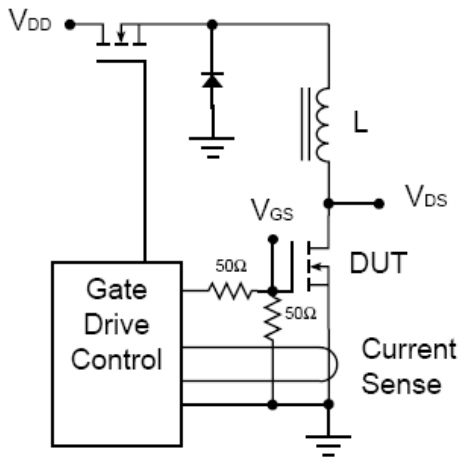
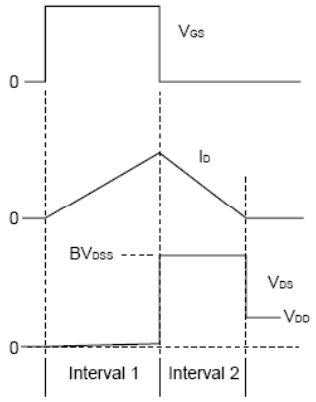


Fig 24. Unclamped Inductive Switching Test Circuit



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

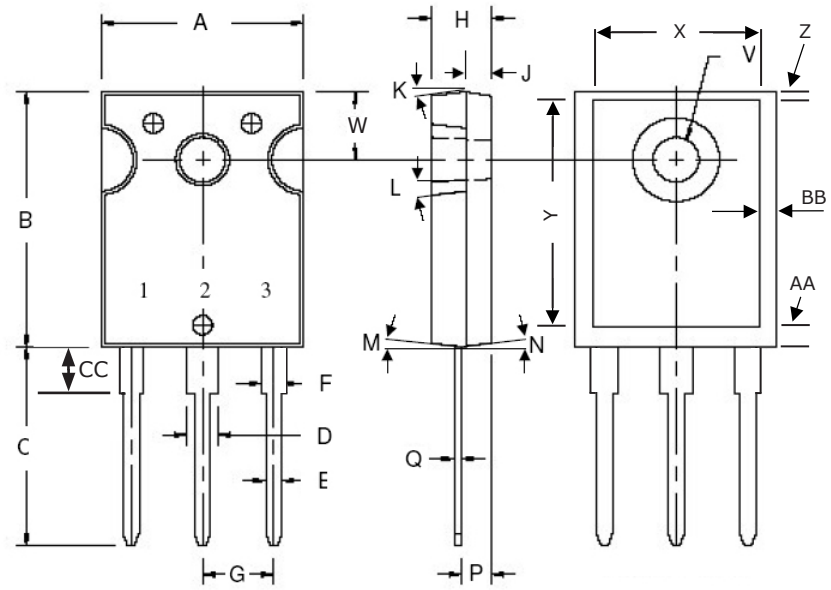
Fig 25. Unclamped Inductive Switching waveform for Avalanche Energy

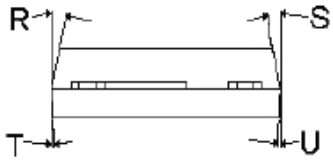
ESD Ratings

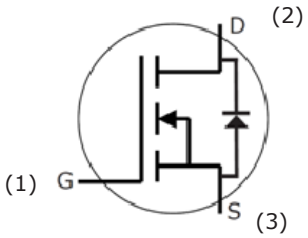
ESD Test	Total Devices Sampled	Resulting Classification
ESD-HBM	All Devices Passed 1000V	2 (>2000V)
ESD-MM	All Devices Passed 400V	C (>400V)
ESD-CDM	All Devices Passed 1000V	IV (>1000V)

Package Dimensions

Package TO-247-3

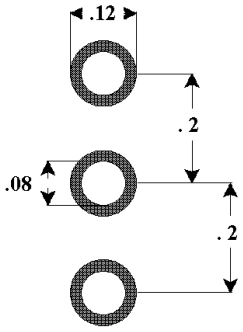






POS	Inches		Millimeters	
	Min	Max	Min	Max
A	.605	.635	15.367	16.130
B	.800	.831	20.320	21.10
C	.780	.800	19.810	20.320
D	.095	.133	2.413	3.380
E	.046	.052	1.168	1.321
F	.060	.095	1.524	2.410
G	.215 TYP		5.460 TYP	
H	.175	.205	4.450	5.210
J	.075	.085	1.910	2.160
K	6°	21°	6°	21°
L	4°	6°	4°	6°
M	2°	4°	2°	4°
N	2°	4°	2°	4°
P	.090	.100	2.286	2.540
Q	.020	.030	.508	.762
R	9°	11°	9°	11°
S	9°	11°	9°	11°
T	2°	8°	2°	8°
U	2°	8°	2°	8°
V	.137	.144	3.487	3.658
W	.210	.248	5.334	6.300
X	.502	.557	12.751	14.150
Y	.637	.695	16.180	17.653
Z	.038	.052	0.964	1.321
AA	.110	.140	2.794	3.556
BB	.030	.046	0.766	1.168
CC	.161	.176	4.100	4.472

Recommended Solder Pad Layout



TO-247-3

Part Number	Package	Marking
CMF10120D	TO-247-3	CMF10120

"The levels of environmentally sensitive, persistent biologically toxic (PBT), persistent organic pollutants (POP), or otherwise 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 2002/95/EC on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS), as amended through April 21, 2006.

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