CCS050M12CM2

1.2kV, 50A Silicon Carbide Six-Pack (Three Phase) Module

Z-FET™ MOSFET and Z-Rec™ Diode

V_{DS}		1.2 kV
I_D (T_C = 100˚C)		50 A
$R_{DS(on)}$	(T_J = 25˚C)	25 mΩ
E_{OFF}	(T_J = 150˚C)	0.6 mJ

Features

- Ultra Low Loss
- Zero Reverse Recovery Current
- Zero Turn-off Tail Current
- High-Frequency Operation
- Positive Temperature Coefficient on V_F and V_{DS}(on)
- Cu Baseplate, AIN DBC

System Benefits

- Enables Compact and Lightweight Systems
- High Efficiency Operation
- Ease of Transistor Gate Control
- Reduced Cooling Requirements
- Reduced System Cost

Applications

- Solar Inverters
- UPS and SMPS
- Induction Heating
- Regen Drives
- 3-Phase PFC
- Motor Drives

Package

Part Number	Package	Marking
CCS050M12CM2	Six-Pack	CCS050M12CM2

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

Symbol	Parameter	Value	Unit	Test Conditions	Notes
V_{DS}	Drain - Source Voltage	1.2	kV		
V_{GS}	Gate - Source Voltage	+25/-10	V		
I_D	Continuous Drain Current	87	A	V_{GS} = 20V, T_C=25˚C	Fig. 21
		50		V_{GS} = 20V, T_C=100˚C	
$I_{D(pulse)}$	Pulsed Drain Current	250	A	Pulse width t_P = 50 μA Rate limited by T_{jmax},T_C = 25˚C	
T_J	Junction Temperature	150	˚C		
T_C ,T_{STG}	Case and Storage Temperature Range	-40 to +150	˚C		
V_{isol}	Case Isolation Voltage	2.5	kV	DC, t=1min	
L_{Stray}	Stray Inductance	30	nH	Measured from pins 20 to 21	
M	Mounting Torque	5.0	Nm		
G	Weight	180	g		
P_D	Power Dissipation	337	W	T_C = 25ºC, T_J < 150ºC	

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	1.2			kV	$V_{GS,}$ = 0V, I_D = 100 uA	
$V_{GS(th)}$	Gate Threshold Voltage		2.3		V	V_{DS} = 10 V, I_D = 2.5 mA	
			1.6			V_{DS} = 10 V, I_D = 2.5 mA, T_J = 150ºC	
I_{DSS}	Zero Gate Voltage Drain Current		2	100	μA	V_{DS} = 1.2 kV, V_{GS} = 0V	
I_{GSS}	Gate-Source Leakage Current			0.5	μA	$V_{GS,}$ = 20 V, V_{DS} = 0V	
$R_{DS(on)}$	On State Resistance		25	34	mΩ	V_{GS} = 20 V, I_D = 50 A	Fig. 4 5,6,7
			43	63		V_{GS} = 20 V, I_D = 50 A, T_J = 150ºC	
g_{fs}	Transconductance		22		S	V_{DS} = 20 V, I_D = 50 A	Fig. 8
			21			V_{DS} = 20 V, I_D = 50 A, T_J = 150ºC	
C_{iss}	Input Capacitance		2.810		nF	V_{DS} = 800V, V_{GS} = 0V f = 1MHz, V_{AC} = 25mV	Fig. 16,17
C_{oss}	Output Capacitance		0.393				
C_{rss}	Reverse Transfer Capacitance		0.014				
E_{ON}	Turn-On Switching Energy		1.1		mJ	V_{DD} = 600V, V_{GS} = +20V/-5V I_D = 50A, R_G = 20Ω Inductive Load = 200 μH Note: IEC 60747-8-4 Definitions	Fig. 18
E_{Off}	Turn-Off Switching Energy		0.6		mJ		
R_G	Internal Gate Resistance		1.5		Ω	f = 1MHz, V_{AC} = 25mV	
Q_G	Gate Charge		180		nC	V_{DD}= 800V, I_D= 50A	Fig. 15
Resistive Switching							
$t_{d(on)}$	Turn-on delay time		21		ns	V_{DD} = 800V, R_{LOAD} = 8 Ω V_{GS} = +20/-2V, R_G = 3.8 Ω Note: IEC 60747-8-4 Definitions	
$t_{r(on)}$	V_{SD} fall time 90% to 10%		30		ns		
$t_{d(off)}$	Turn-off delay time		50		ns		
$t_{f(off)}$	V_{SD} rise time 10% to 90%		19		ns		

Module Application Note: The SiC MOSFET module switches at speeds beyond what is customarily associated with IGBT based modules. Therefore, special precautions are required to realize the best performance. The interconnection between the gate driver and module housing needs to be as short as possible. This will afford the best switching time and avoid the potential for device oscillation. Also, great care is required to insure minimum inductance between the module and link capacitors to avoid excessive V_{DS} overshoots.

Free-Wheeling SiC Schottky Diode Characteristics

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions	Note
V_{SD}	Diode Forward Voltage		1.6	1.85	V	I_F = 50A, V_{GS} = 0	
			2.2			I_F = 50A, T_J = 150ºC	
Q_C	Total Capacitive Charge		280		µC	I_F = 25A, V_R = 1000V di_F/dt = 500 A/µs, T_J = 25ºC	
t_{RR}	Reverse Recovery Time		TBD		ns		
E_{RR}	Reverse Recovery Energy		TBD		mJ		
C	Total Capacitance		3.42		nF	V_R=0V, f = 1MHz, T_J = 25ºC	
			0.23			V_R=400V, f = 1MHz, T_J = 25ºC	
			0.18			V_R=800V, f = 1MHz, T_J = 25ºC	
I_F	Continuous Forward Current		50		A	V_{GS} = -5V, T_{case} = 100ºC	

Thermal Characteristics

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions	Note
R_{thJCM}	Thermal Resistance Juction-to-Case for MOSFET		0.37	0.49	°C/W		
R_{thJCD}	Thermal Resistance Juction-to-Case for Diode		0.42	0.48			

Typical Performance

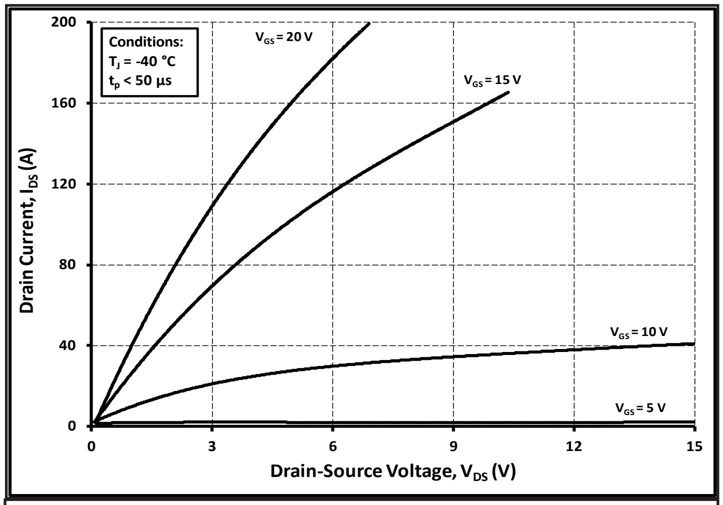


Figure 1. Typical Output Characteristics T_J = -40ºC

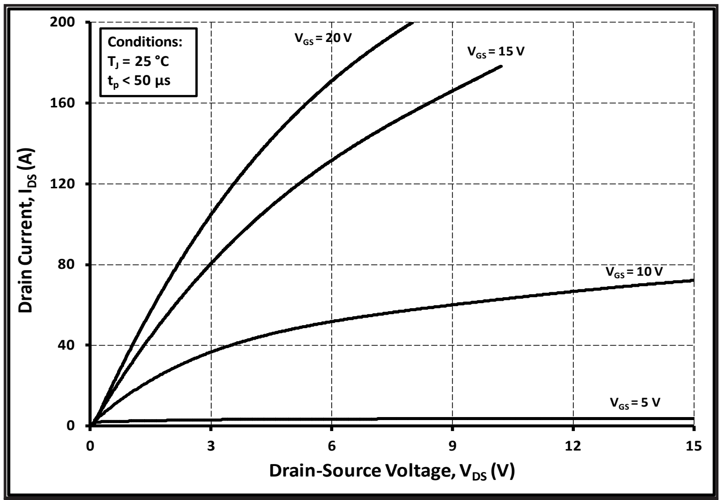


Figure 2. Typical Output Characteristics T_J = 25ºC

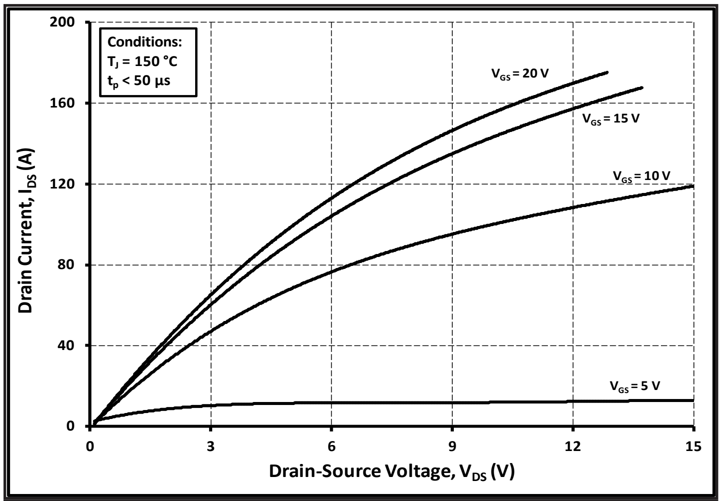


Figure 3. Typical Output Characteristics T_J = 150ºC

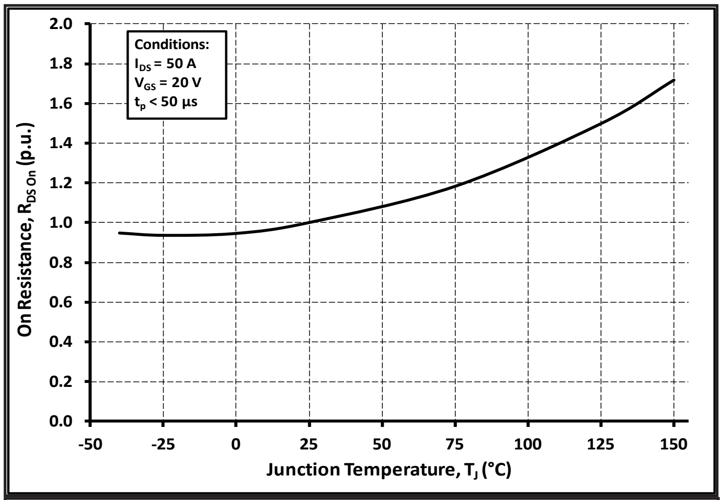


Figure 4. Normalized On-Resistance vs. Temperature

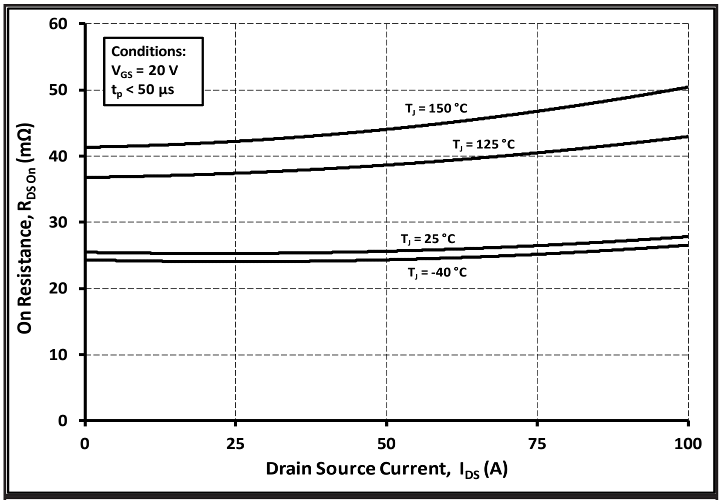


Figure 5. Normalized On-Resistance vs. Drain Current For Various Temperatures

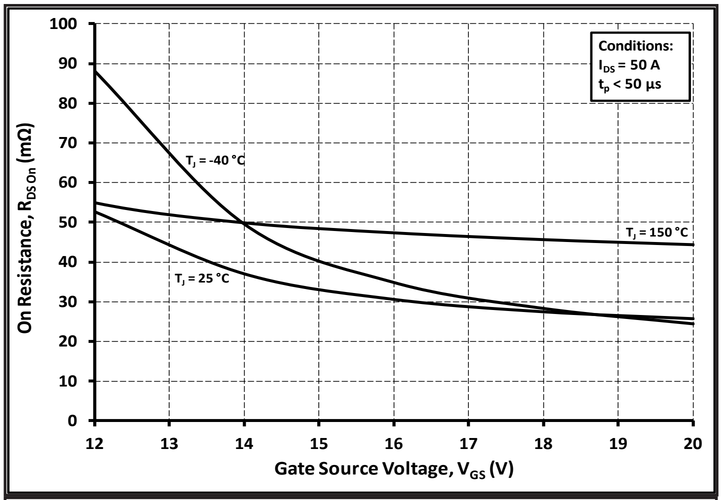


Figure 6. Normalized On-Resistance vs. Gate-Source Voltage for Various Temperatures

Typical Performance

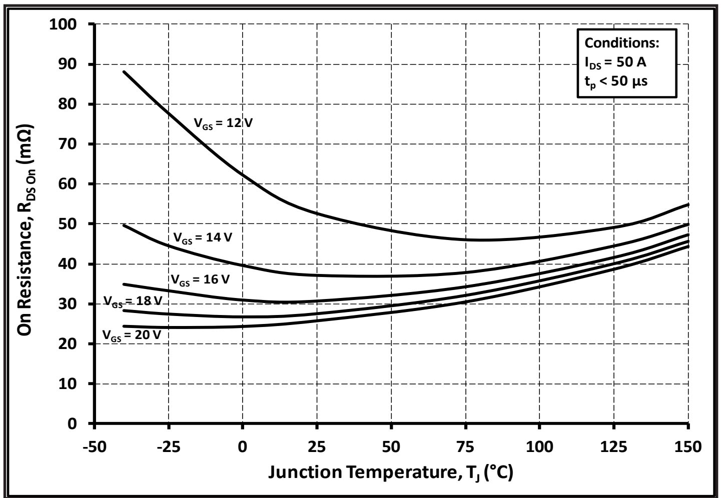


Figure 7. On-Resistance vs. Temperature for Various Gate-Source Voltages

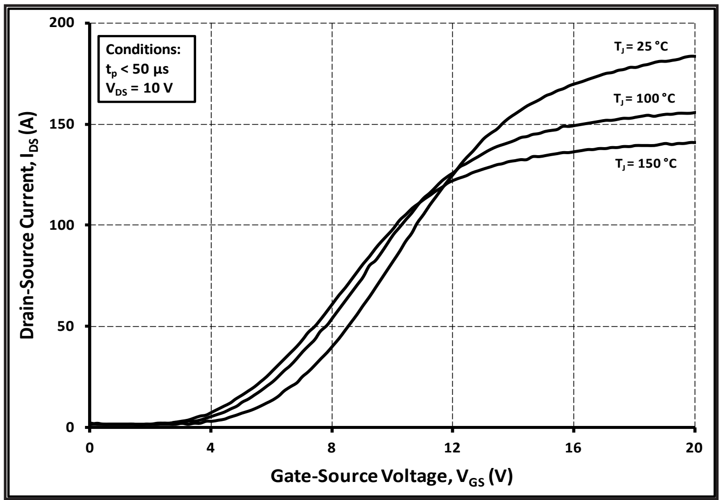


Figure 8. Transfer Characteristic for Various Junction Temperatures

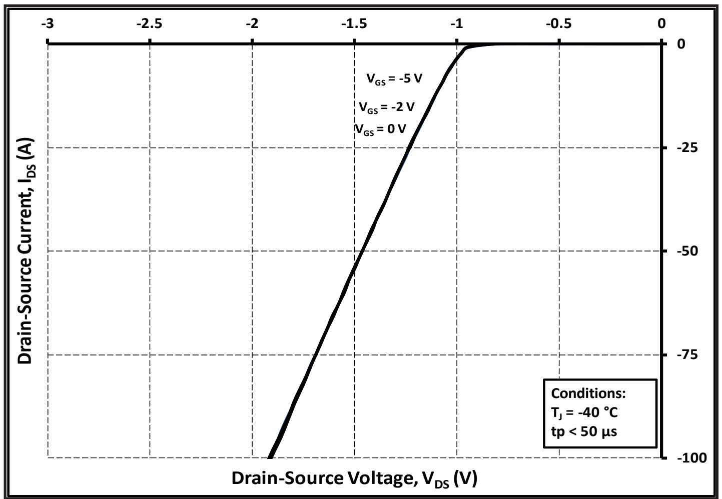


Figure 9. Diode Characteristic at -40ºC

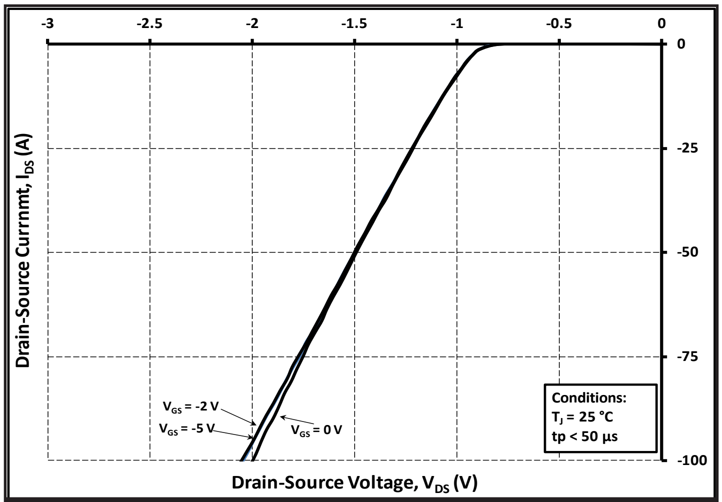


Figure 10. Diode Characteristic at 25ºC

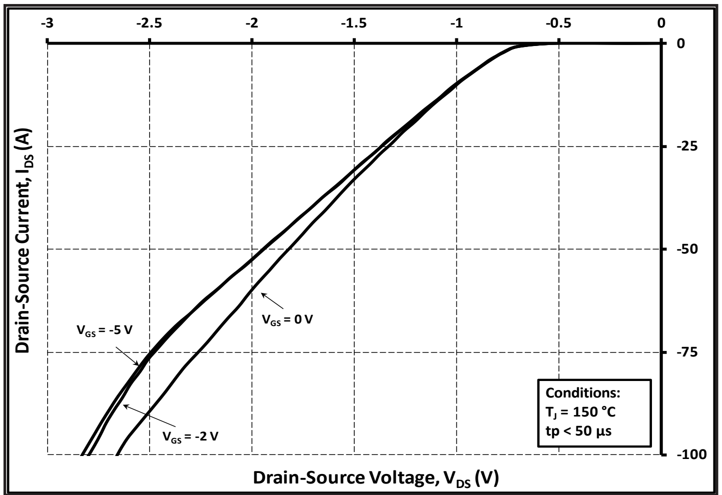


Figure 11. Diode Characteristic at 150ºC

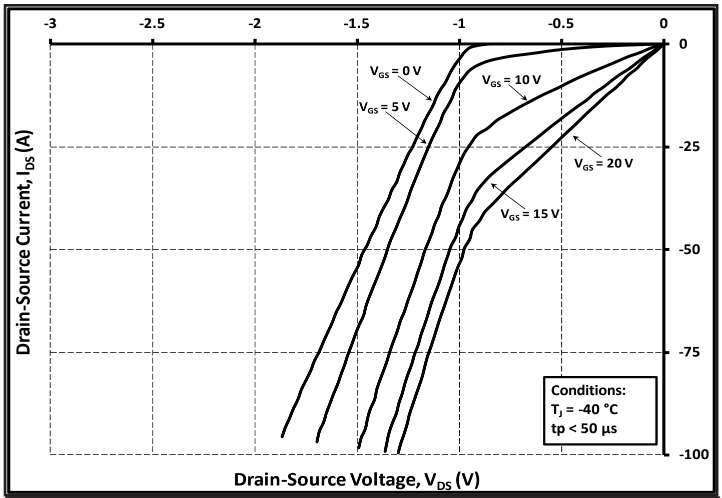


Figure 12. 3rd Quadrant Characteristic at -40ºC

Typical Performance

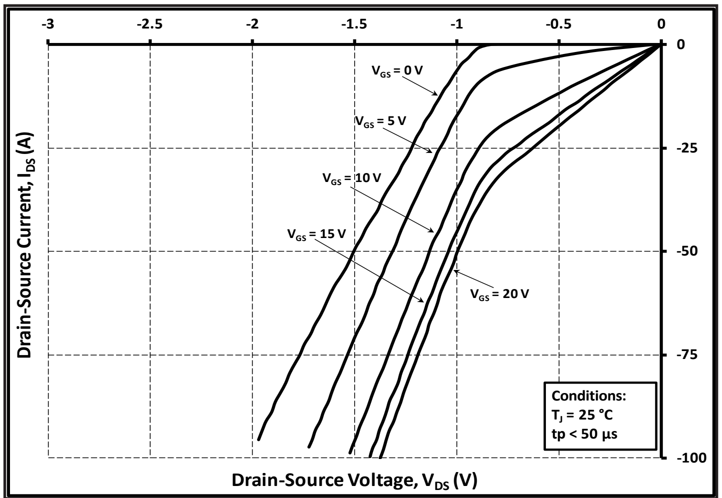


Figure 13. 3rd Quadrant Characteristic at 25ºC

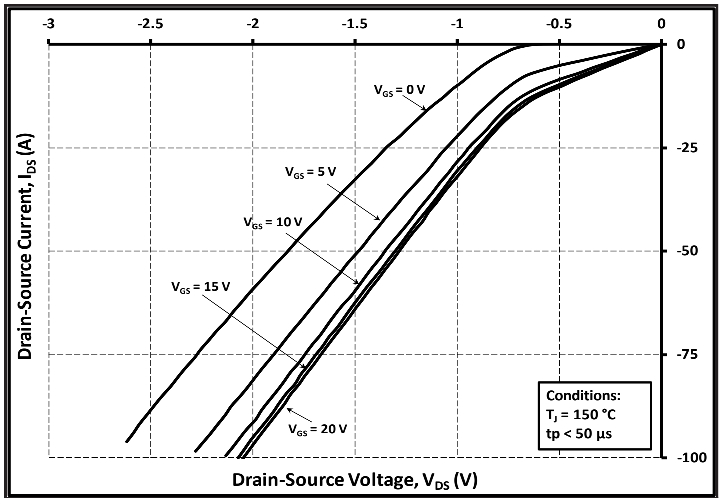


Figure 14. 3rd Quadrant Characteristic at 150ºC

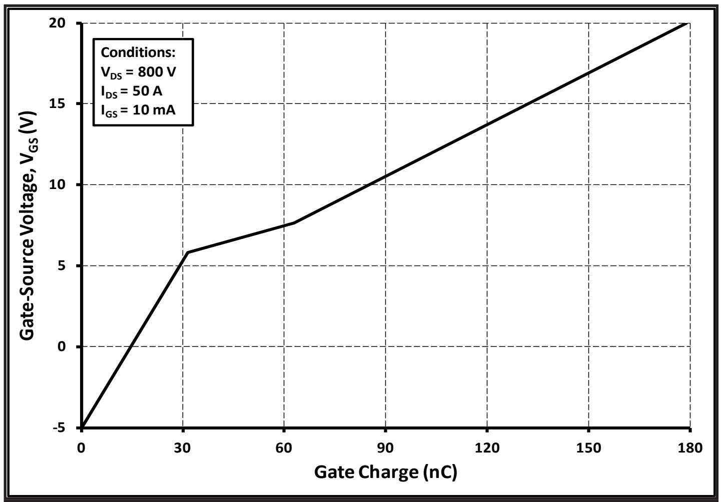


Figure 15. Typical Gate Charge Characteristics

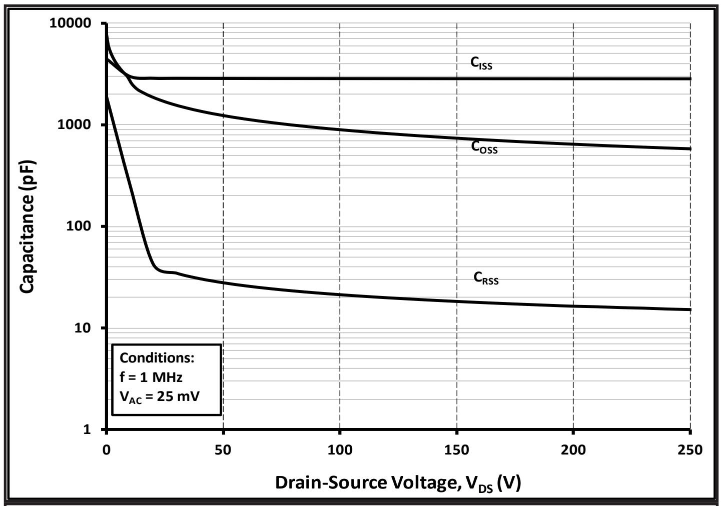


Figure 16. Typical Capacitances vs. Drain-Source Voltage (0 - 250V)

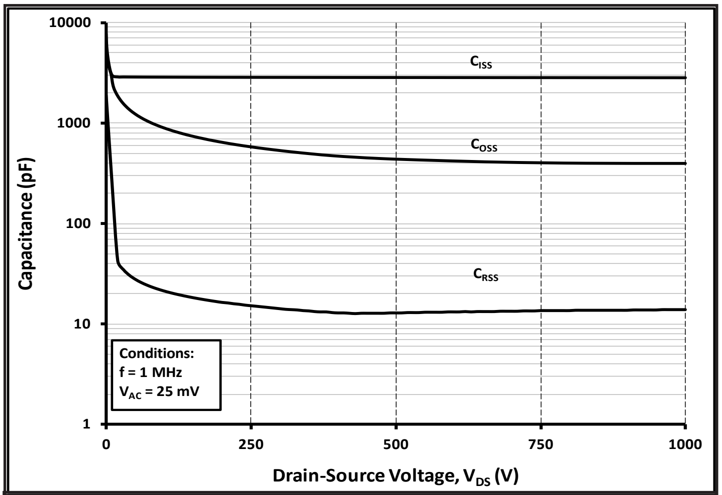


Figure 17. Typical Capacitances vs. Drain-Source Voltage (0 - 1000V)

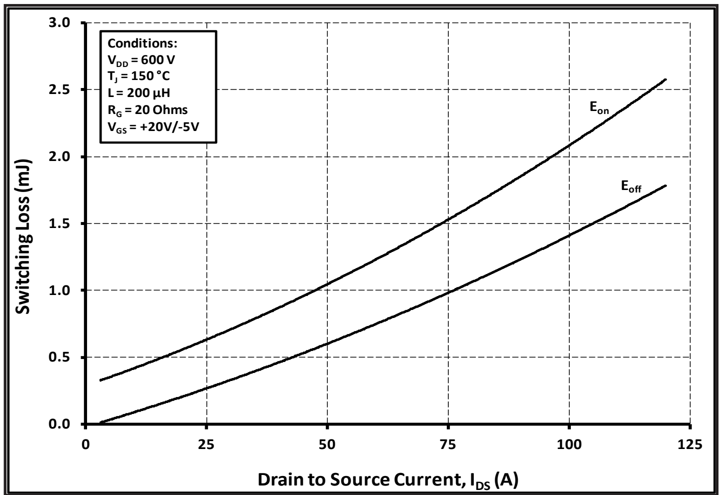


Figure 18. Inductive Switching Energy vs. Drain Current For V_{DS} = 600V, R_G = 20 Ω

Typical Performance

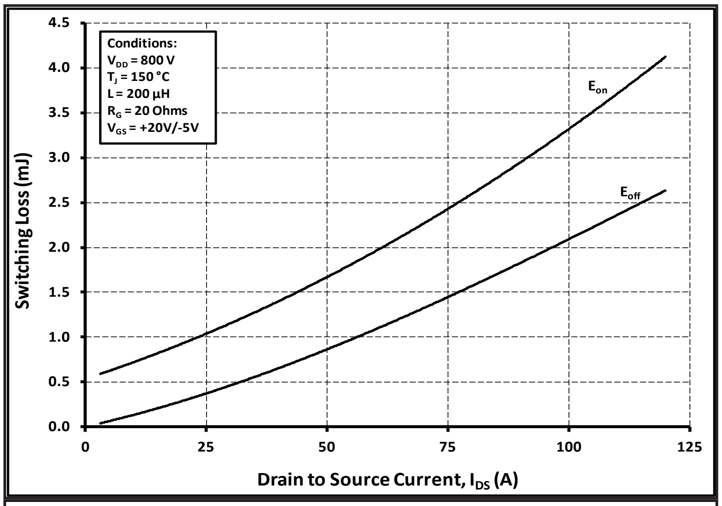


Figure 19. Inductive Switching Energy vs. Drain Current For V_{DS} = 800V, R_G = 20 Ω

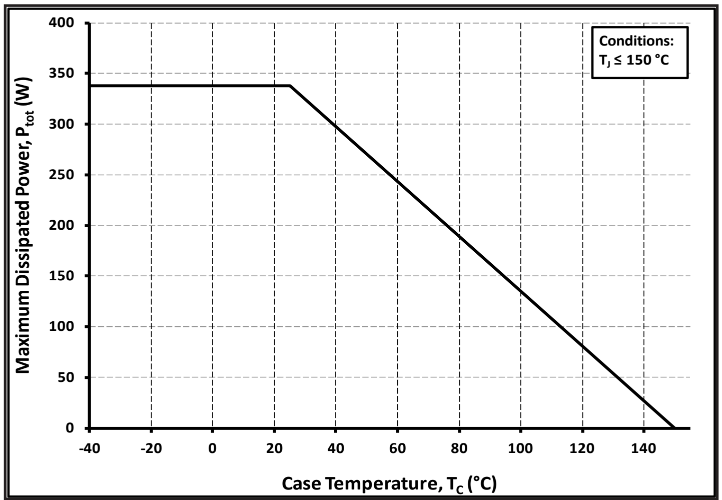


Figure 20. Power Dissipation Derating Curve

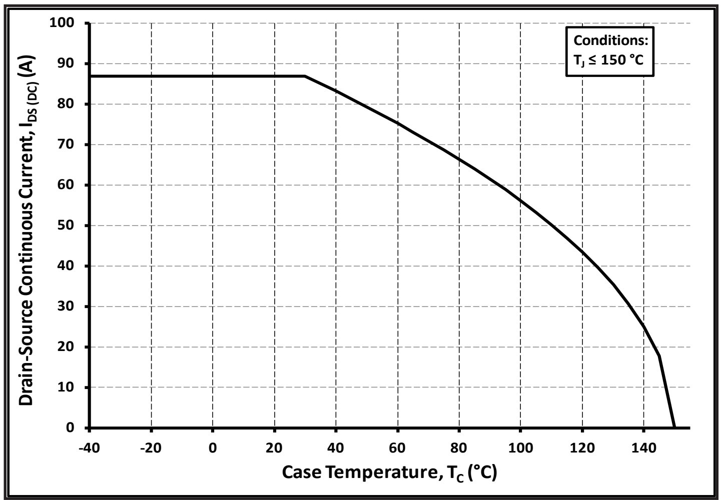
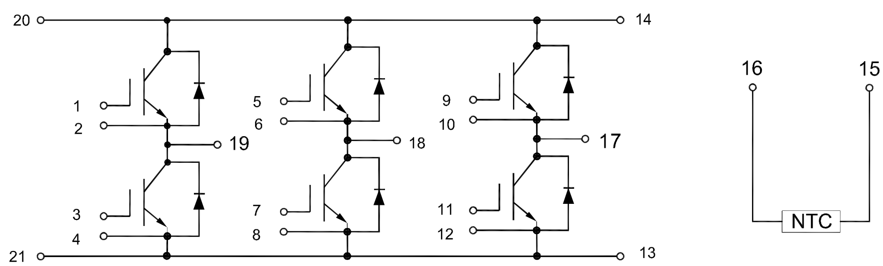
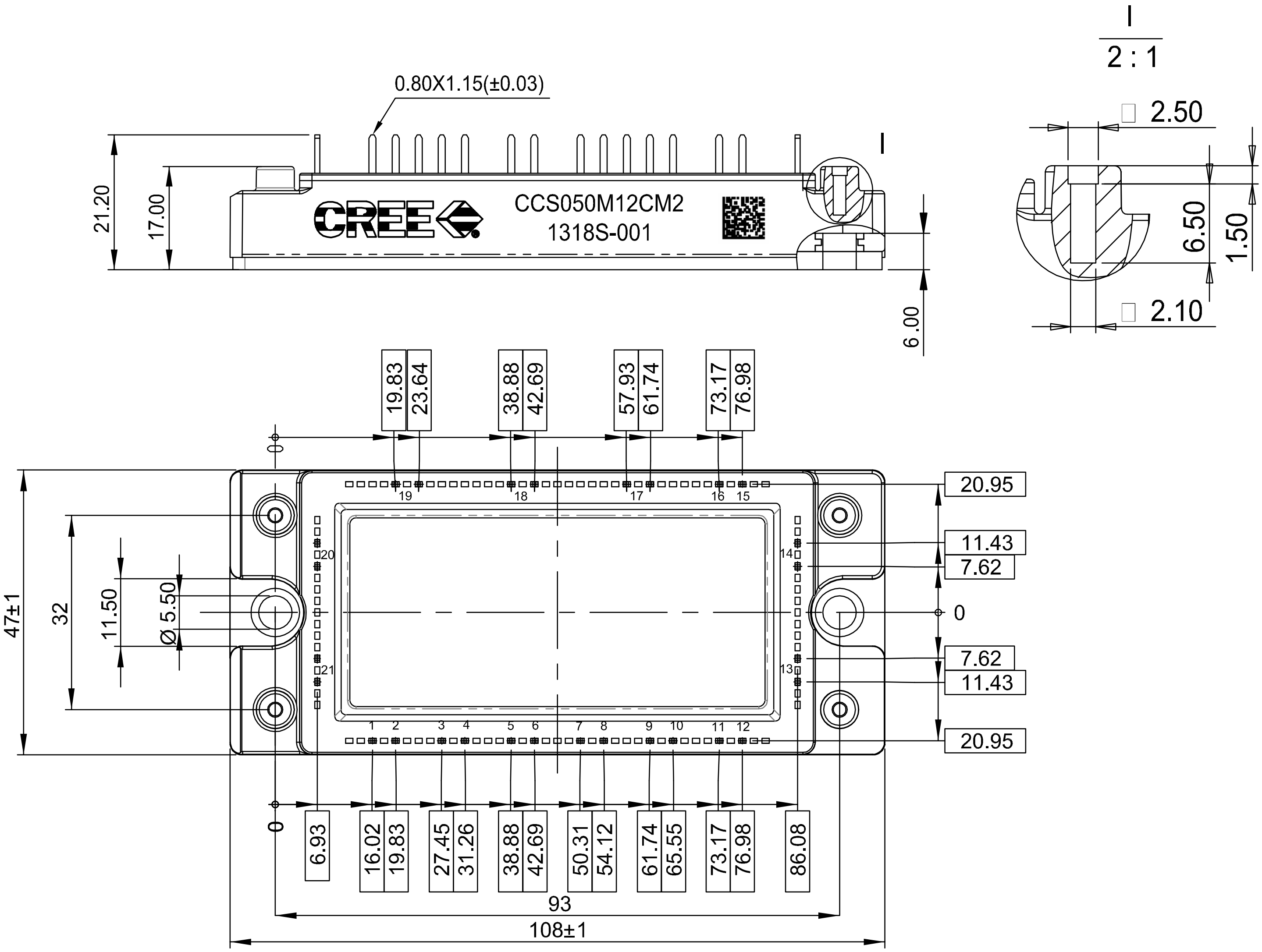


Figure 21. Continuous Current Derating Curve

Package Dimensions (mm)





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