CAS100H12AM1

1.2 kV, 100A Silicon Carbide Half-Bridge Module

Z-FET™ MOSFET and Z-Rec™ Diode

V_{DS}	1.2 kV
$R_{DS(on)}$ (T_J = 25˚C)	16 mΩ
E_{OFF} (T_J = 125˚C)	1.8 mJ

Features

- Ultra Low Loss
- Zero Turn-off Tail Current from MOSFET
- Zero Reverse Recovery Current from Diode
- High-Frequency Operation
- Positive Temperature Coefficient on V_F and $V_{DS(on)}$
- AlSiC Baseplate, AMB Si_3N_4 Substrate

System Benefits

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

Applications

- High Power Converters
- Motor Drives
- Solar Inverters
- UPS and SMPS
- Induction Heating

Package

Part Number	Package	Marking
CAS100H12AM1	Half-Bridge Module	CAS100H12AM1

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	-5/+20	V		
I_D	Continuous Drain Current	168	A	V_{GS} = 20V, T_C=25˚C	Fig. 25
		117		V_{GS} = 20V, T_C=90˚C	
$I_{D(pulse)}$	Pulsed Drain Current	400	A	Pulse width Limited by T_{jmax}, T_C = 25˚C	
T_J	Junction Temperature	150	˚C		
T_C , T_{STG}	Case and Storage Temperature Range	-55 to +125	˚C		
V_{isol}	Case Isolation Voltage	6	kV	AC, t=1min	
L_{Stray}	Stray Inductance	20	nH	Measured from D1 to S2	
M	Mounting Torque	2.94	Nm		
G	Weight	150	g	Measured without fasteners	
	Clearance Distance	12.2	mm	Terminal to terminal	
	Creepage Distance	17.3	mm	Terminal to terminal	
		20.2	mm	Terminal to base plate	
Pd	Power Dissipation	568	W		Fig 24

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 = 100uA	
$V_{GS(th)}$	Gate Threshold Voltage	2.0	2.5		V	V_{DS} = $V_{GS,}$ I_D = 5mA	Fig. 9
		2.6	3.1			V_{DS} = $V_{GS,}$ I_D = 50mA	
			1.8			V_{DS} = $V_{GS,}$ I_D = 5mA, T_J = 150ºC	
			2.4			V_{DS} = $V_{GS,}$ I_D = 50mA, T_J = 150ºC	
I_{DSS}	Zero Gate Voltage Drain Current		5	500	µA	V_{DS} = 1200V, V_{GS} = 0V	
			50	1250		V_{DS} = 1200V, V_{GS} = 0V, T_J = 150ºC	
I_{GSS}	Gate-Source Leakage Current			0.25	µA	$V_{GS,}$ = 20V, V_{DS} = 0V	
$R_{DS(on)}$	On State Resistance		16	20	mΩ	V_{GS} = 20V, I_D = 100A	Fig. 7
			20	24		V_{GS} = 20V, I_D = 100A, T_J = 150ºC	
g_{fs}	Transconductance		31		S	V_{DS} = 20V, I_D = 100A	Fig. 8
			32			V_{DS} = 20V, I_D = 100A, T_J = 150ºC	
C_{iss}	Input Capacitance		10.7		nF	V_{DS} = 600V, V_{GS} = 0V f = 1MHz, V_{AC} = 25mV	Fig. 16,17
C_{oss}	Output Capacitance		0.970				
C_{rss}	Reverse Transfer Capacitance		0.037				
E_{ON}	Turn-On Switching Energy (25ºC) (125ºC)		4.6 3.9		mJ	V_{DD} = 800V, V_{GS} = +20V/-5V I_D = 100A, R_G = 5.1Ω Inductive Load = 200 µH Note: IEC 60747-8-4 Definitions	Fig. 21
E_{Off}	Turn-Off Switching Energy (25ºC) (125ºC)		1.7 1.8		mJ		
R_G	Internal Gate Resistance		1.25		Ω	f = 1MHz, V_{AC} = 25mV	
Q_G	Gate Charge		490		nC	V_{DD}= 600V, I_D= 100A	Fig. 18
Resistive Switching							
$t_{d(on)}$	Turn-on delay time		58		ns	V_{DD} = 800V, R_{LOAD} = 8Ω V_{GS} = +20/-5V RG = 5.1Ω Note: IEC 60747-8-4 Definitions	Fig. 19, 20
$t_{r(on)}$	$V_{S1/D2}$ fall time 90% to 10%		76		ns		
$t_{d(off)}$	Turn-off delay time		82		ns		
$t_{f(off)}$	$V_{S1/D2}$ rise time 10% to 90%		46		ns		

Free-Wheeling SiC Schottky Diode Characteristics

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions	Note
V_{SD}	Diode Forward Voltage		1.8	2.2	V	I_F = 100A, V_{GS} = 0	Fig. 11
			2.5			I_F = 100A, T_J = 150ºC	Fig. 12
Q_C	Total Capacitive Charge		1.6		µC	I_F = 100A, V_R = 600V di_F/dt = 2200A/µs, T_J = 25ºC	
t_{RR}	Reverse Recovery Time		47		ns		
E_{RR}	Reverse Recovery Energy		0.5		mJ		

Thermal Characteristics

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions	Note
R_{thJCM}	Thermal Resistance Juction-to-Case for MOSFET		0.22	0.24	°C/W		
R_{thJCD}	Thermal Resistance Juction-to-Case for Diode		0.35	0.37			

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.

Please Refer to application note: [CPWR-AN12] Design Considerations when using Cree SiC Modules.

Typical Performance

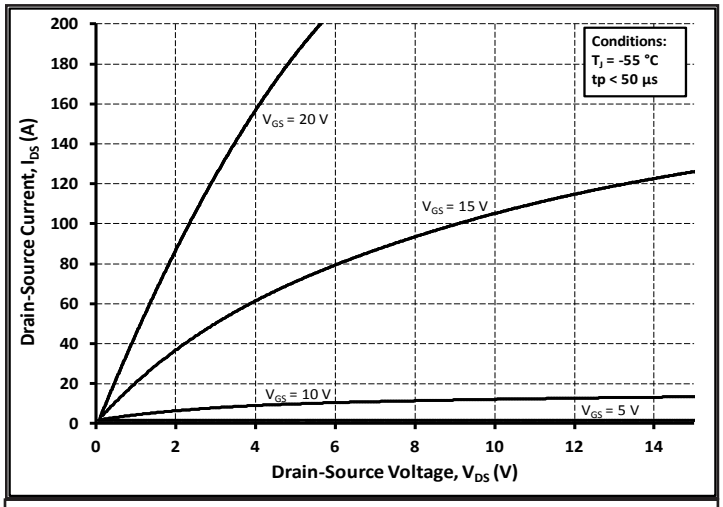


Figure 1. Typical Output Characteristics T_J = -55ºC

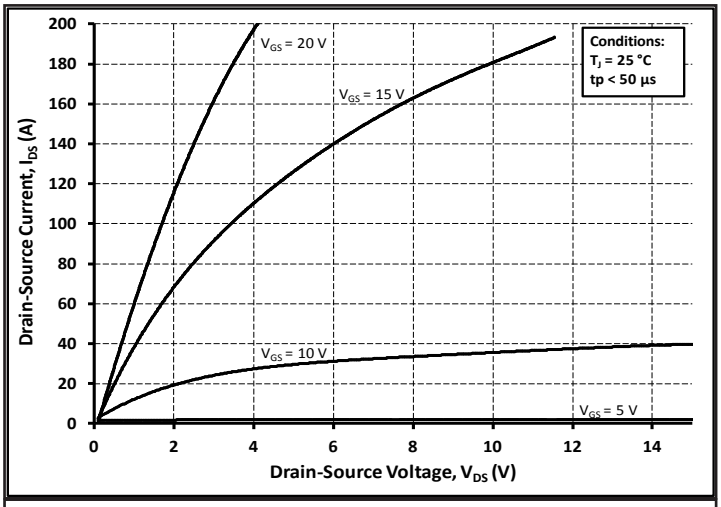


Figure 2. Typical Output Characteristics T_J = 25ºC

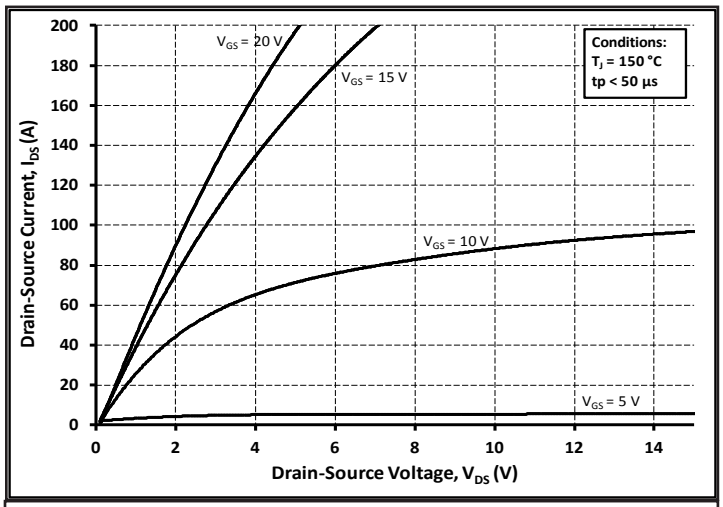


Figure 3. Typical Output Characteristics T_J = 150ºC

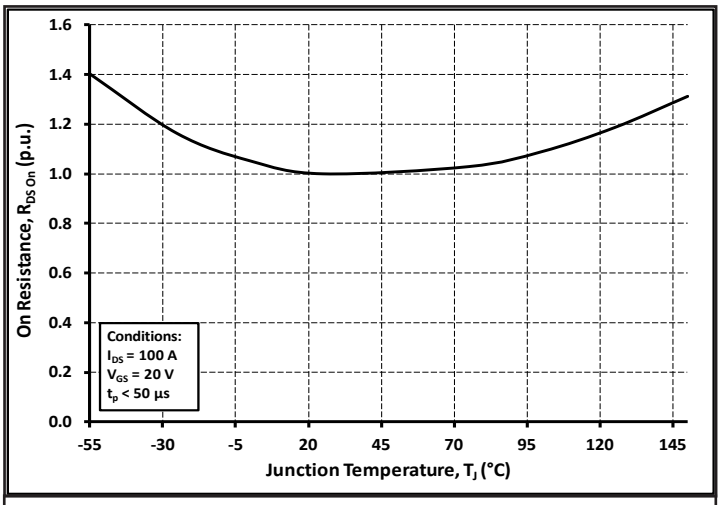


Figure 4. Normalized On-Resistance vs. Temperature

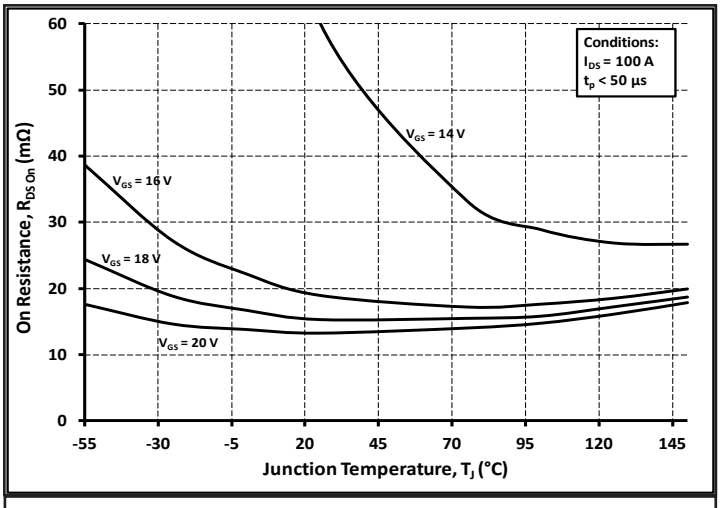


Figure 5. On-Resistance vs. Temperature for Various Gate-Source Voltages

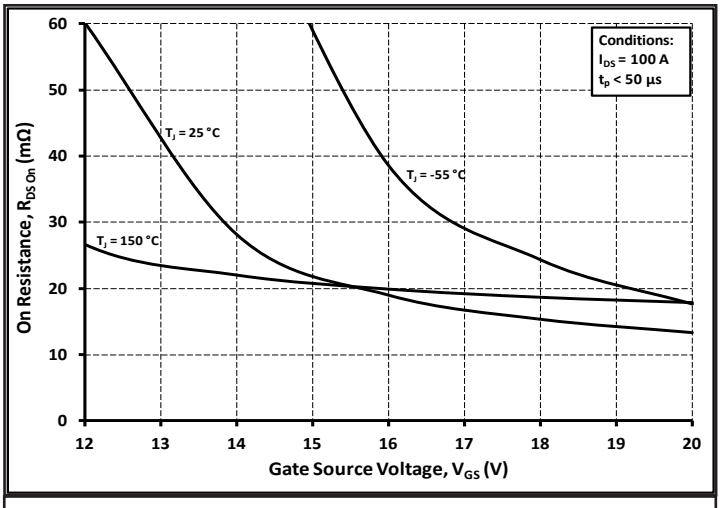


Figure 6. On-Resistance vs. Gate Source Voltage for Various Temperature

Typical Performance

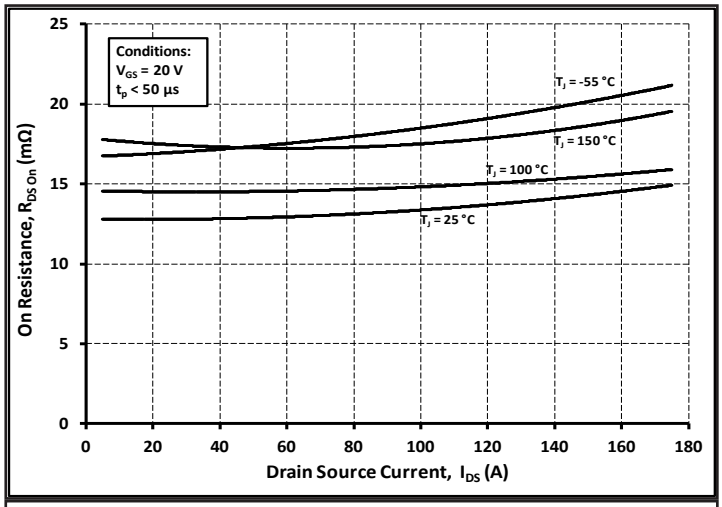


Figure 7. On-Resistance vs. Drain Current for Various Temperatures

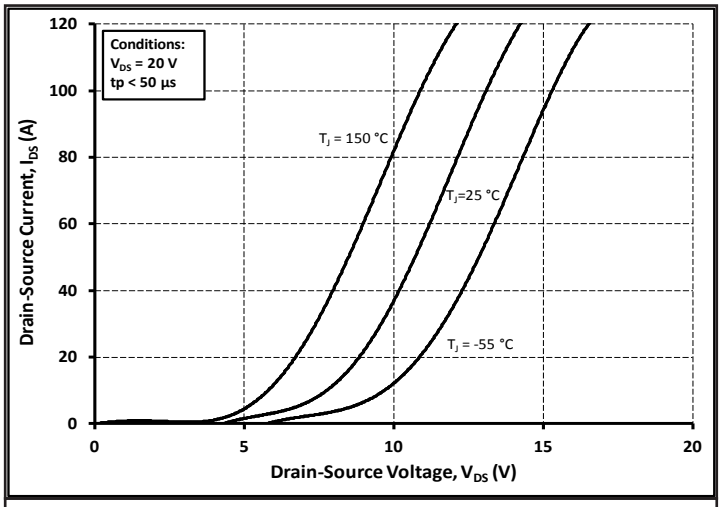


Figure 8. Transfer Characteristics for Various Junction Temperatures

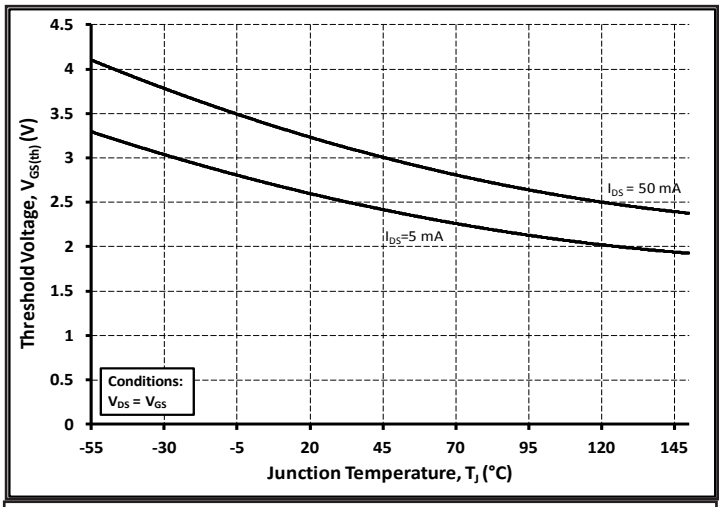


Figure 9. Threshold Voltage vs Junction Temperature

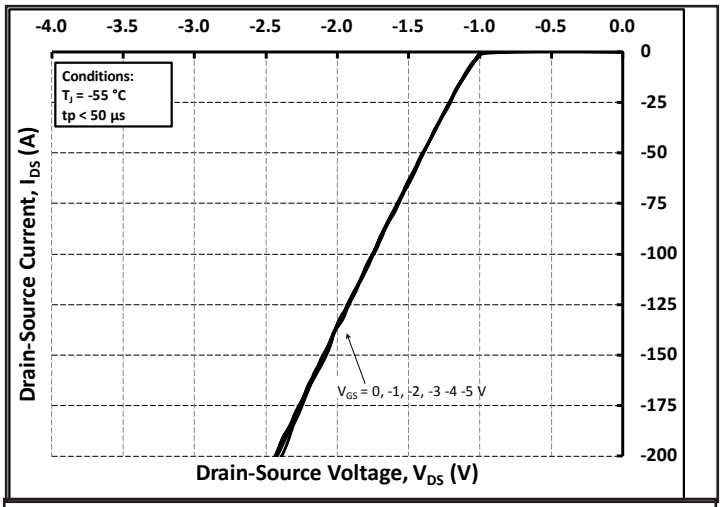


Figure 10. Typical Diode Characteristics T_J = -55ºC

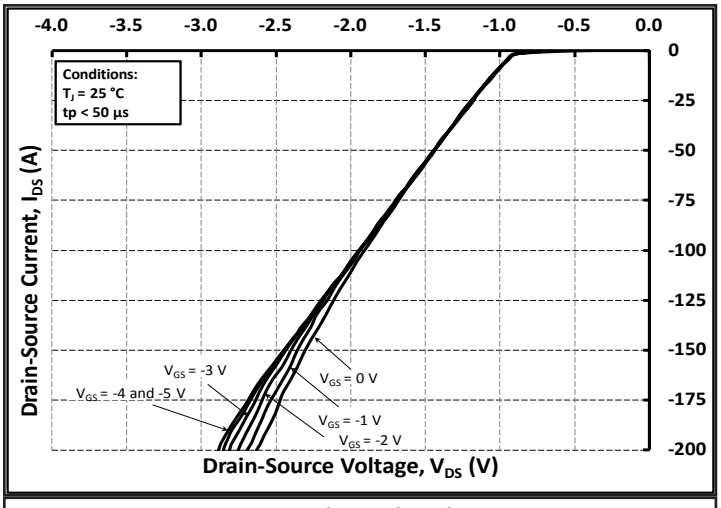


Figure 11. Typical Diode Characteristics T_J = 25ºC

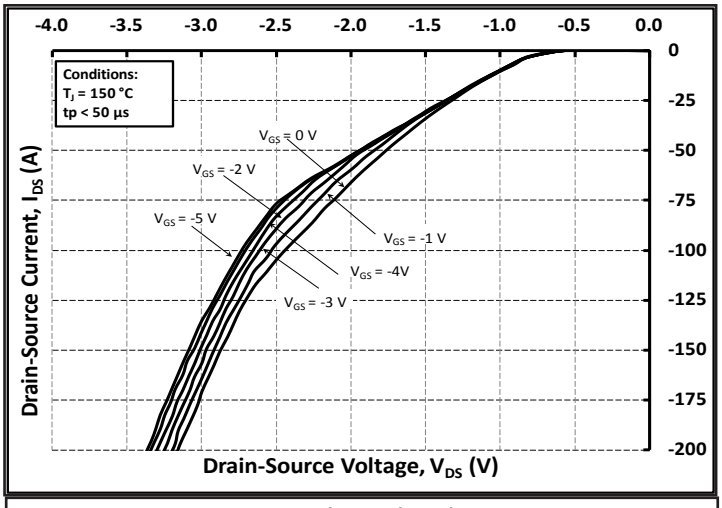


Figure 12. Typical Diode Characteristics T_J = 150ºC

Typical Performance

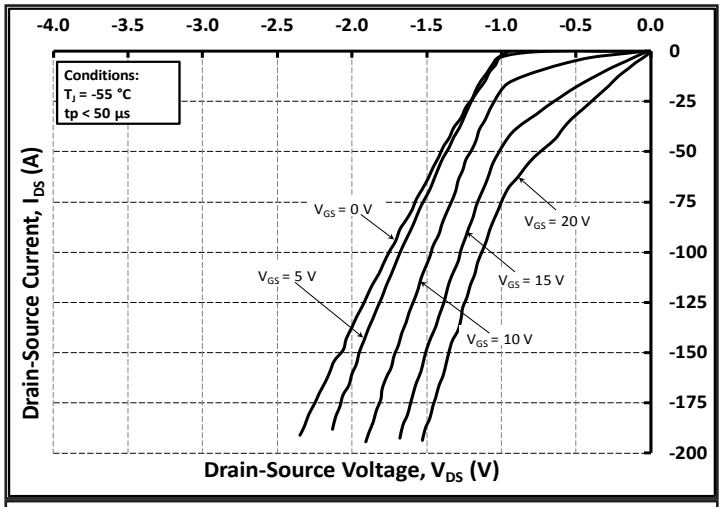


Figure 13. Typical 3rd Quadrant Characteristics T_J = -55 ºC

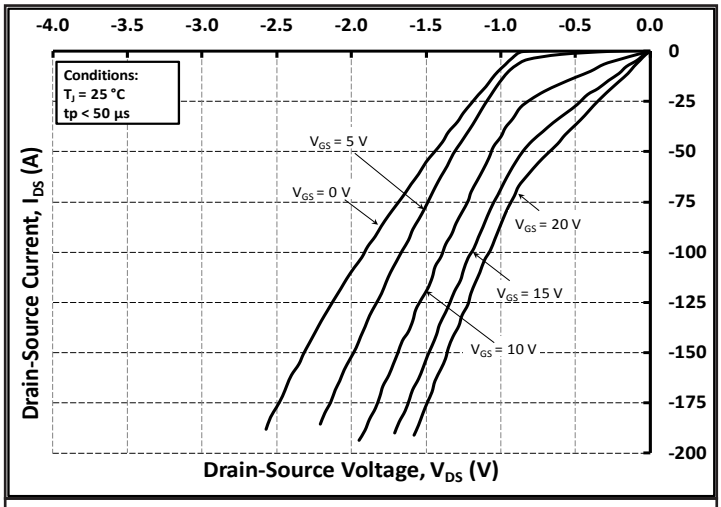


Figure 14. Typical 3rd Quadrant Characteristics T_J = 25 ºC

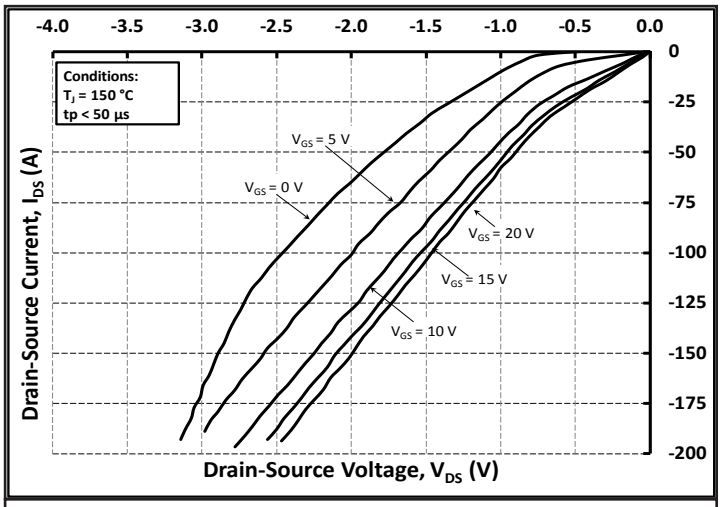


Figure 15. Typical 3rd Quadrant Characteristics T_J = 150 ºC

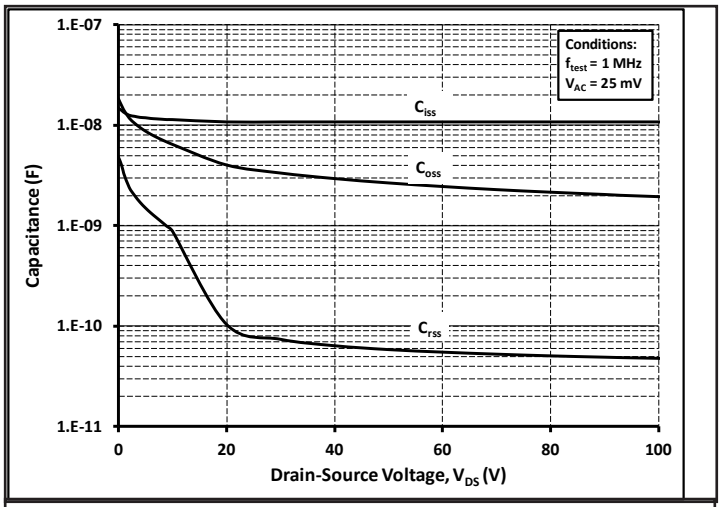


Figure 16. Typical Capacitances vs. Drain-Source Voltage (0 - 100V)

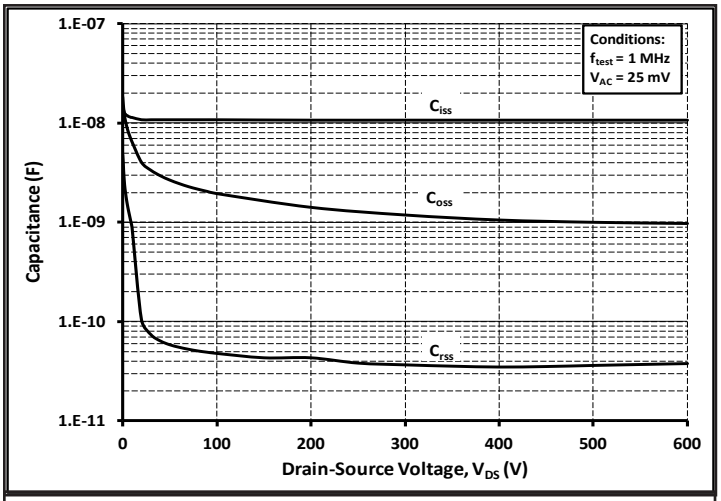


Figure 17. Typical Capacitances vs. Drain-Source Voltage (0 - 600V)

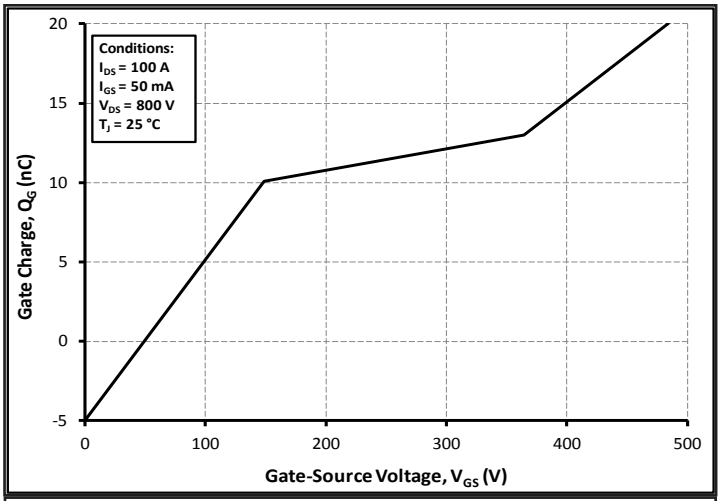


Figure 18. Typical Gate Charge Characteristic

Typical Performance

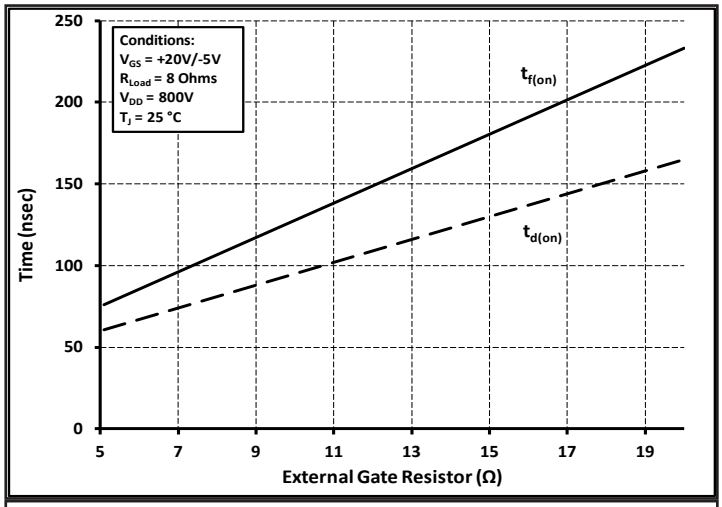


Figure 19. Resistive Switching Times vs. R_G (Turn on)

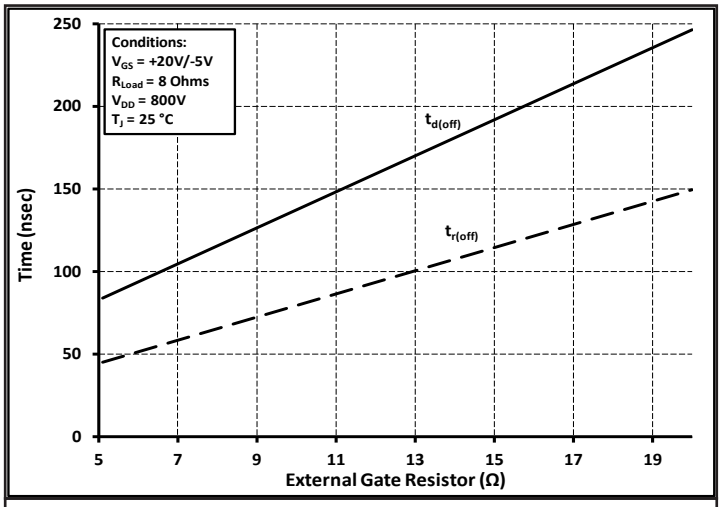


Figure 20. Resistive Switching Times vs. R_G (Turn off)

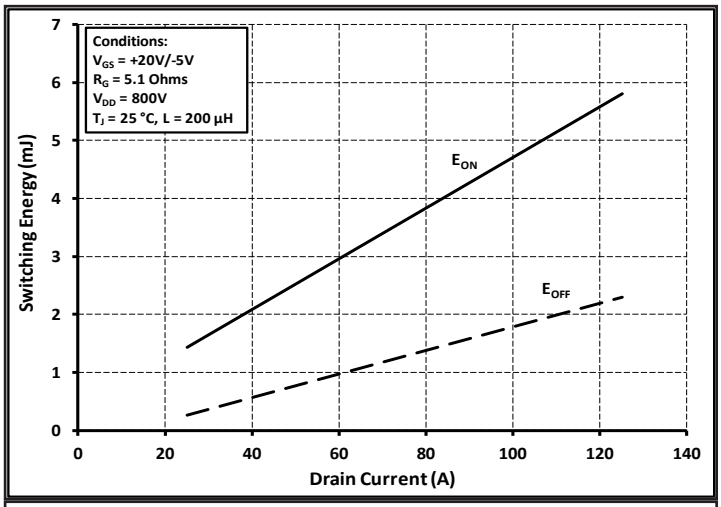


Figure 21. Clamped Inductive Switching Energy vs. Drain Current

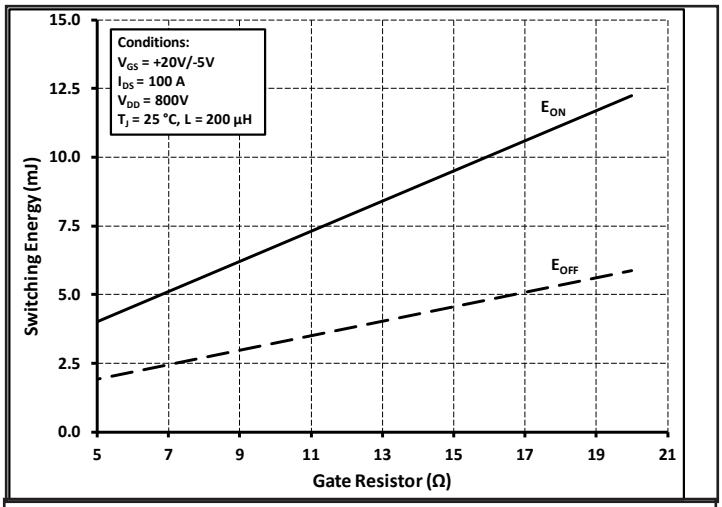


Figure 22. Clamped Inductive Switching Energy vs. Gate Resistance

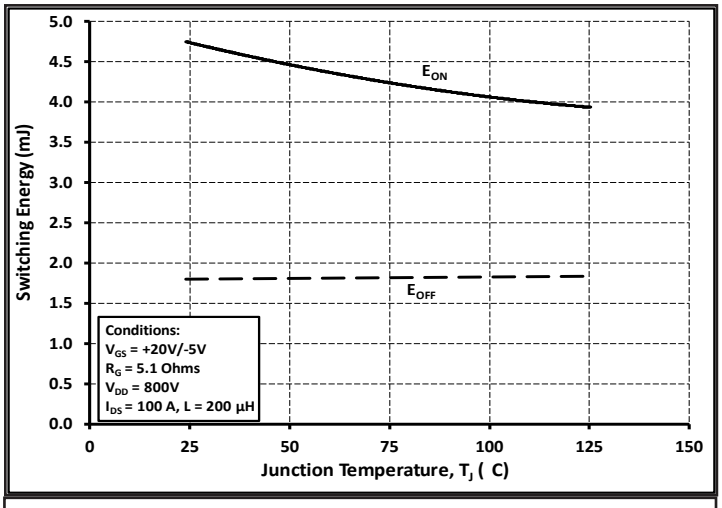


Figure 23. Clamped Inductive Switching Energy vs. Temperature

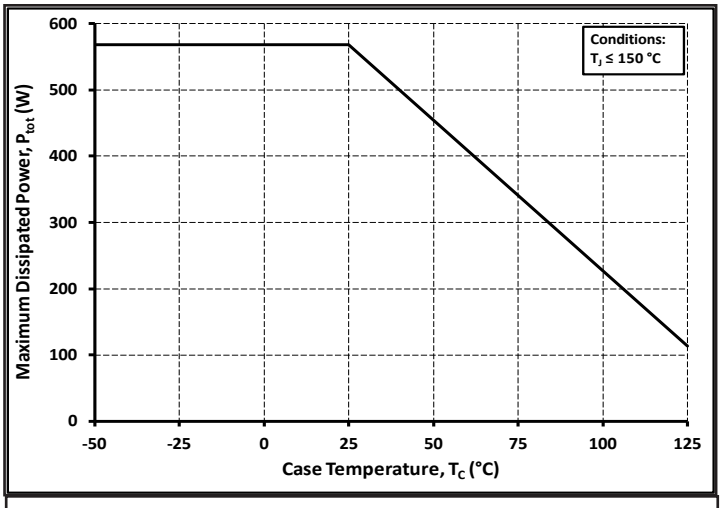


Figure 24. Power Dissipation Derating Curve

Typical Performance

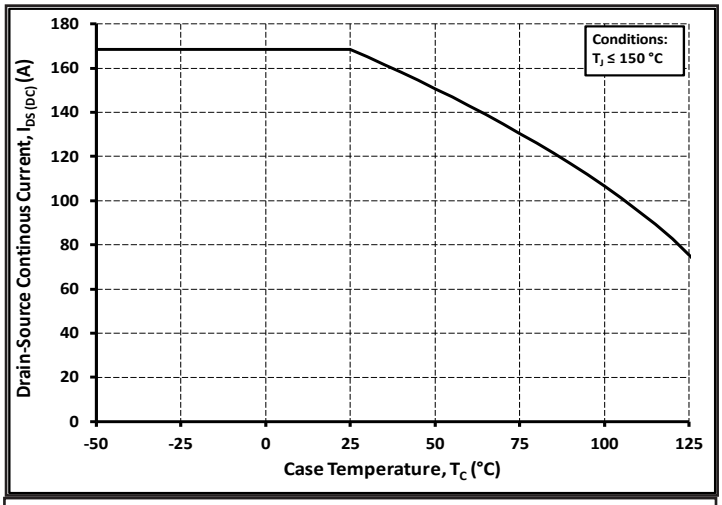


Figure 25. Continuous Current Derating Curve

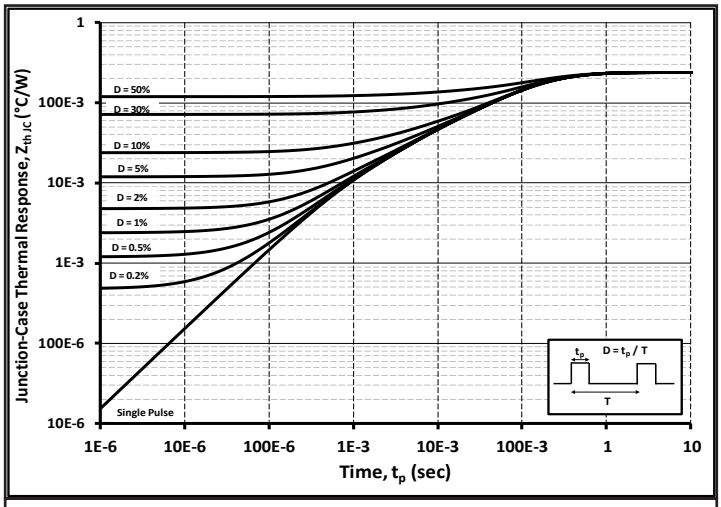


Figure 26. Transient Thermal Impedance - MOSFET

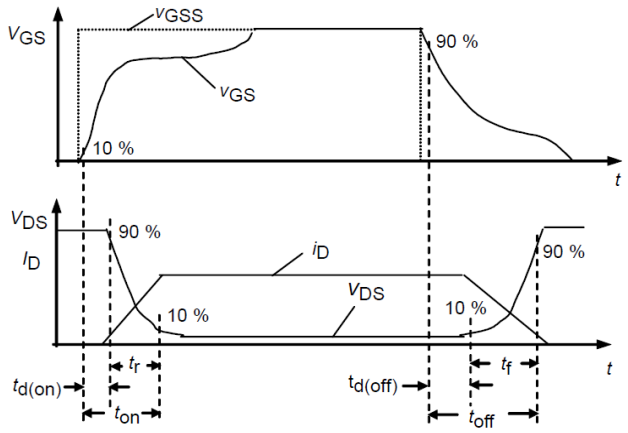
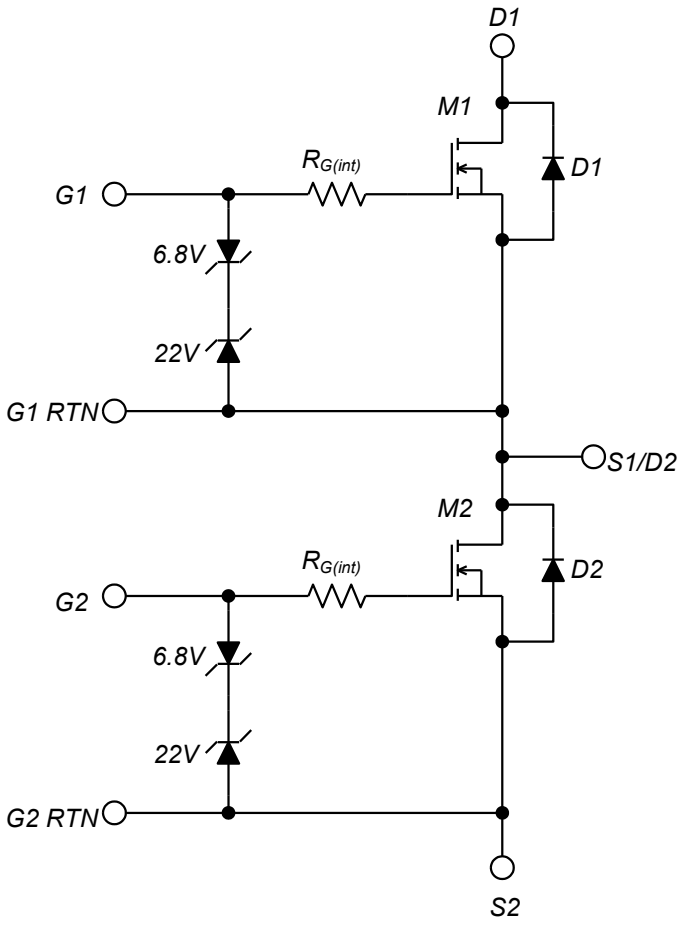
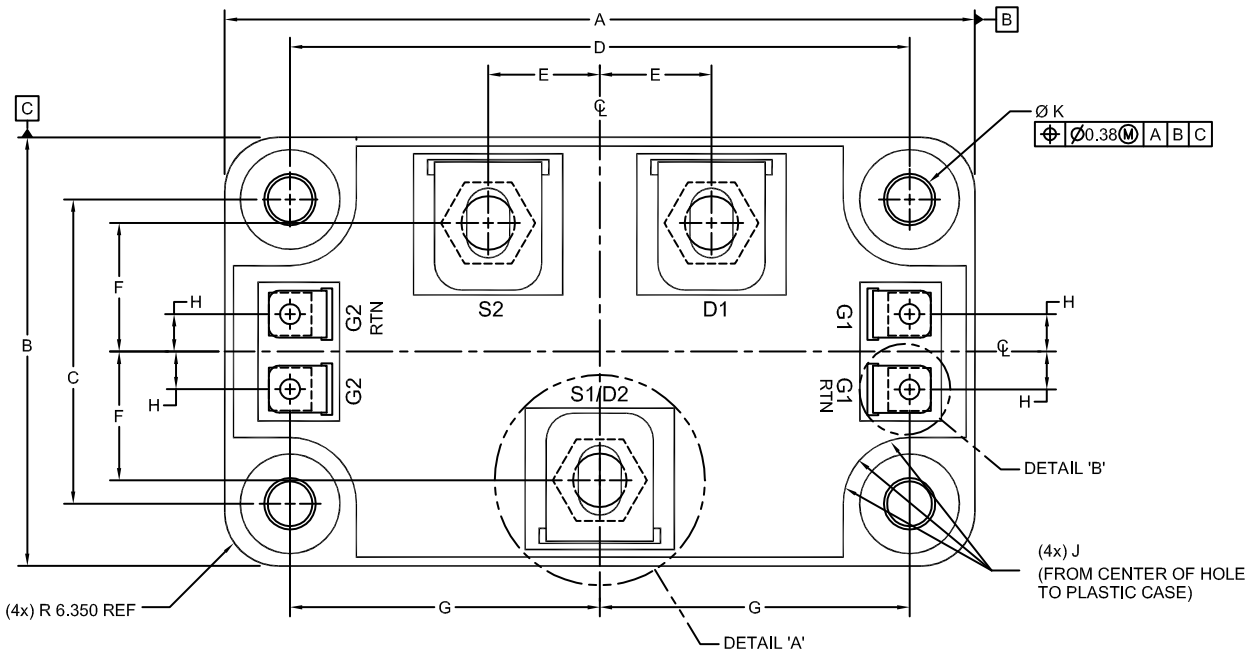


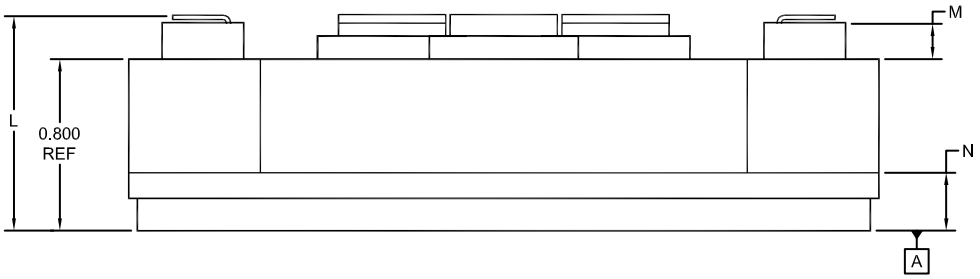
Figure 27. Resistive Switching Time Description

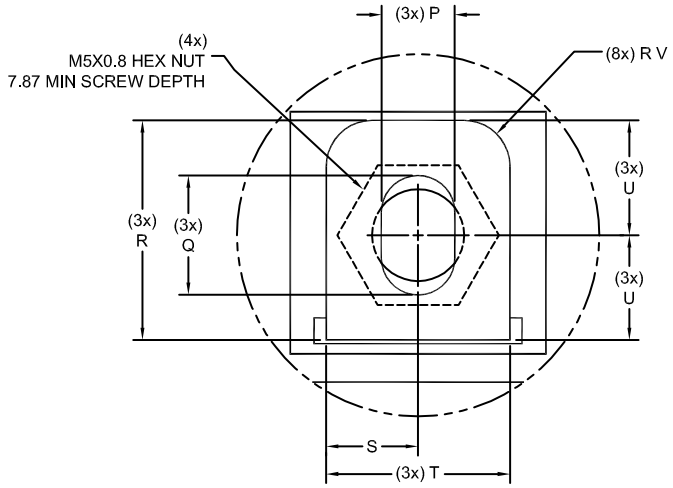
Circuit Diagram



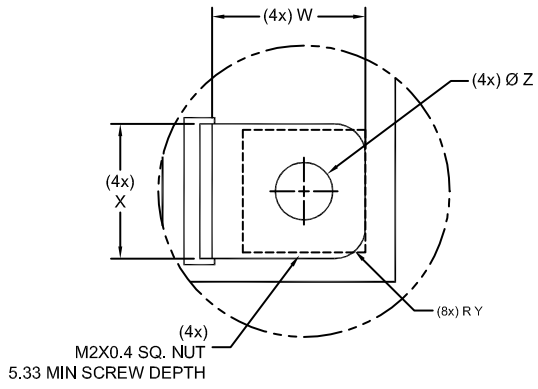
Package Dimensions (mm)





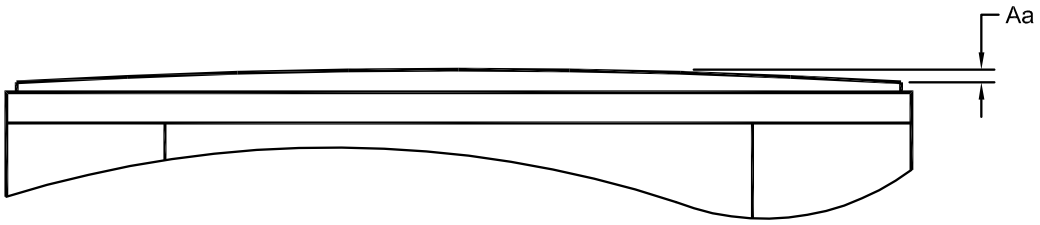


DETAIL 'A'
SCALE 3:1



DETAIL 'B'
SCALE 5:1

Package Dimensions (mm)



POWER MODULE (SIDE VIEW)
(EXAGGERATED DOME)
(NOT TO SCALE)

Package Dimensions (mm)

REF	MIN	MAX
A	88.14	89.15
B	50.04	51.05
C	35.81	36.32
D	73.15	73.66
E	12.60	13.87
F	14.61	15.88
G	36.07	37.34
H	3.810	5.080
J	6.096	———
K	5.283	5.715
L	25.02	25.78
M	2.286	———
N	6.477	7.239
P	4.953	5.842
Q	7.874	8.636
R	12.70	17.78
S	5.080	7.620
T	12.70	13.97
U	———	10.16
V	2.540	———
W	———	6.350
X	———	5.588
Y	1.270	———
Z	2.286	2.794
Aa	0.000	0.178

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