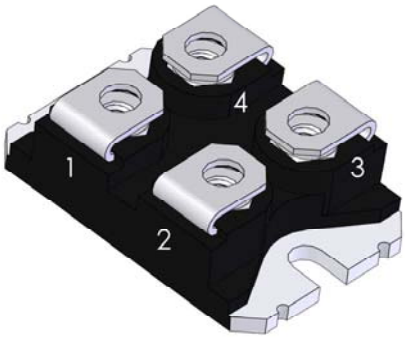
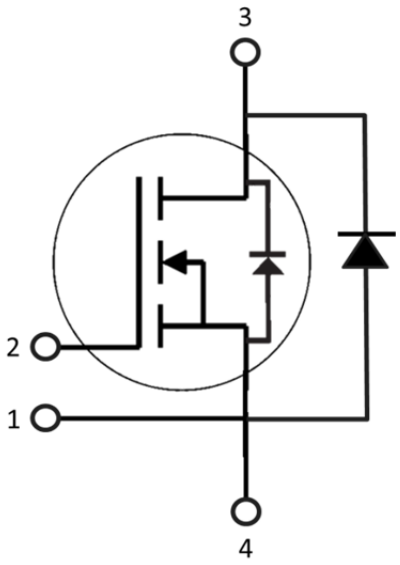
COPACK (SiC MOSFETs and SBDs)
SOT-227 Power Module

V_{CES} =1200V
I_D = 80A @T_C= 100^{0}C
R_{DS_ON}= 20mohm @ T_J= 25^{0}C





Features

- **High speed switching SiC MOSFETs**
- Freewheeling diode with zero reverse recovery SiC SBDs
- **Low R_{DS_ON}**
- Simple to drive
- Kelvin reference for stable gate driving
- High junction temperature operation
- Positive temperature coefficient for easy to parallel mounting

Applications

- Photo Voltaic Inverter
- Aerospace actuators
- Server Power supplies
- High voltage AC/DC Converter
- Motor Drivers

RoHS

Benefits

- Outstanding power conversion efficiency at high switching frequency operation
- Low switching losses and Low EMI noises
- Very rugged and easy mount
- Direct mounting to heatsink (isolated package)
- Low junction to case thermal resistance
- Easy paralleling due to positive T_C of V_F
- RoHS Compliant

Absolute Maximum Ratings (T_j=25^{o}C unless otherwise specified)

Parameters	Symbol	Conditions	Specifications	Units
SiC MOSFETs				
Maximum Drain-Source Voltage	V_{DSS}	T_j = 25 ^{0}C~150 ^{0}C	1200	V
Continuous Drain Current	$I_{D\ (DC)}$	T_j = 25 ^{0}C, V_{GS}=20V	120	A
		T_j = 150 ^{0}C, V_{GS}=20V	80	A
Pulse Drain Current	$I_{D(Pulse)}$	Pulse width t_P limited by T_{jmax}, T_C=25 ^{0}C	160	A
Gate-Source Voltage	V_{GSMAX}	AC (freq. > 1 kHz)	-10/+25	V
	V_{GSOP}	Static	-5/+20	V
SiC SBDs				
Maximum Reverse Voltage	V_{RRM}		1200	V
Continuous Forward Current	I_F	T_C = 25 ^{0}C, T_j = 175 ^{0}C	111	A
		T_C = 121 ^{0}C, T_j = 175 ^{0}C	60	A
		T_C = 150 ^{0}C, T_j = 175 ^{0}C	37	A
Surge Non-repetitive Forward Current Sine Halfwave	I_{FSM}	T_C=25 ^{0}C, T_j = 25 ^{0}C, T_p = 8.3ms	270	A
COPACK Modules Thermal Properties				
Maximum Power Dissipation	P_D	T_C = 25 ^{0}C	640	W
		T_C = 100 ^{0}C	250	W
Operating Junction Temperature	T_j	MOSFET	-40 ~ 150	^{0}C
		SBD	-40 ~ 175	^{0}C
Storage Temperature	T_{STG}		-40 ~ 150	^{0}C

Electrical Characteristics (T_j=25^{o}C unless otherwise specified)

Parameters	Symbol	Conditions	Min	Typ	Max	Units
SiC MOSFETs						
Drain-Source Breakdown Voltage	$V_{(BR)DSS}$	V_{GS}=0V, I_D=100μA	1200	--	--	V
Gate Threshold Voltage	$V_{GS(TH)}$	V_{DS}= 10V, I_D=20mA, T_j = 25 ^{0}C	2.0	2.6	4	V
		V_{DS}= 10V, I_D=20mA, T_j = 150 ^{0}C		2.1		V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS}=1200V, V_{GS}=0V, T_j = 25 ^{0}C	--	2	200	μA
Gate Source Leakage Current	I_{GSS}	V_{GS}=20V, V_{DS}=0V	--	--	500	nA
Internal Gate Resistance	R_G	f = 1MHz, V_{AC} = 25mV, per die		0.9		Ω
Drain-Source On-state Resistance	$R_{DS(ON)}$	V_{GS}= 20V, I_D=80A, T_j = 25 ^{0}C	--	20	26	mΩ
		V_{GS}= 20V, I_D=80A, T_j = 150 ^{0}C	--	42	50	mΩ
Trans-conductance	g_{fs}	V_{DS}= 20V, I_D=80A, T_j = 25 ^{0}C		15		S
		V_{DS}= 20V, I_D=80A, T_j = 150 ^{0}C		13		

Input Capacitance	C_{ISS}	V_{GS} = 0V, V_{DS} = 1000V, freq = 1MHz, V_{AC} = 25mV	--	3.8	--	nF
Output Capacitance	C_{OSS}		--	300	--	pF
Reverse transfer Capacitance	C_{RES}		--	20	--	pF
Turn-on Delay Time	$t_{d(on)}$	V_{DS} = 800V, V_{GS} = -5/20V I_D = 80A, $R_{G(ext)}$ = 2.5Ω, L = 856µH. Refer to definition	--	15	--	ns
Rise Time	t_r		--	53	--	ns
Turn-off Delay Time	$t_{d(off)}$		--	27	--	ns
Fall Time	t_f		--	35	--	ns
Turn-on Switching Loss	E_{ON}			3.0		mJ
Turn-off Switching Loss	E_{OFF}			1.2		mJ
Total Gate Charge	Q_g	V_{DS}=800 V, V_{GS} = -5/20V, I_D=80A	--	230	--	nC
SiC SBDs						
Maximum peak repetitive reverse voltage	V_{RRM}		1200	--	--	V
Reverse Leakage Current	I_{RM}	V_R = 1200V, T_j = 25 ^{0}C	--	4	120	µA
		V_R = 1200V, T_j = 175 ^{0}C	--	138	--	µA
Diode Forward Voltage	V_F	I_F = 60A, T_j = 25 ^{0}C	--	1.54	1.70	V
		I_F = 60A, T_j = 175 ^{0}C	--	2.23	2.70	V
Total Capacitive Charge	Q_C	V_R=800 V, T_j = 25 ^{0}C	--	316	--	nC
Total Capacitance	C	V_R = 1V, f = 1 MHz	--	3524	--	pF
		V_R = 400V, f = 1 MHz	--	300	--	pF
		V_R = 800V, f = 1 MHz	--	216	--	pF

Thermal and Package Characteristics (T_j=25^{o}C unless otherwise specified)

Parameters	Symbol	Conditions	Min	Typ	Max	Units
Junction to Case Thermal Resistance	R_{THJC}	MOSFET	--	0.26	0.34	^{0}C /W
		SBD	--	0.32	0.40	^{0}C /W
Mounting Torque	M_d		1.1	1.3	1.5	N-m
Terminal Connection Torque	M_{dt}			1.1	1.3	N-m
Package Weight	W_t			32		g
Isolation Voltage	V_{ISOL}	I_{ISOL} < 1mA, 50/60Hz, t=1 min	2500			V

Typical MOSFET Performance

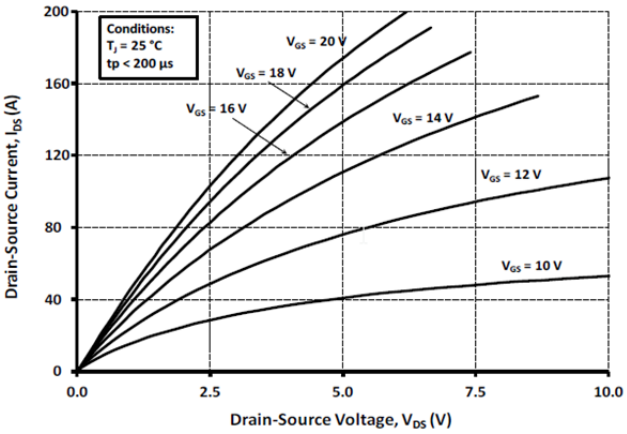


Figure 1. Typical Forward Characteristics T_j=25 °C

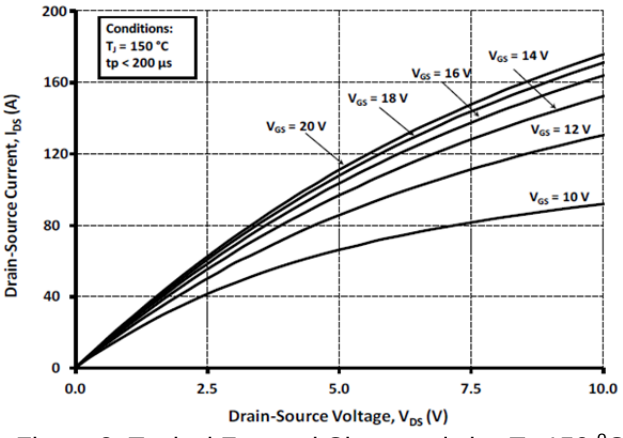


Figure 2. Typical Forward Characteristics T_j=150 °C

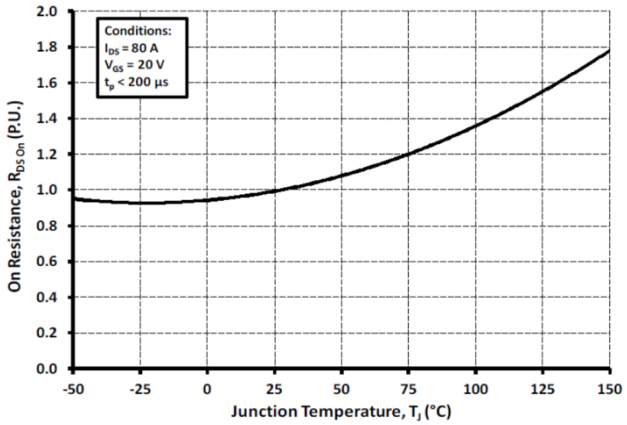


Figure 3. Normalized $R_{DS\ ON}$ vs. Temperature

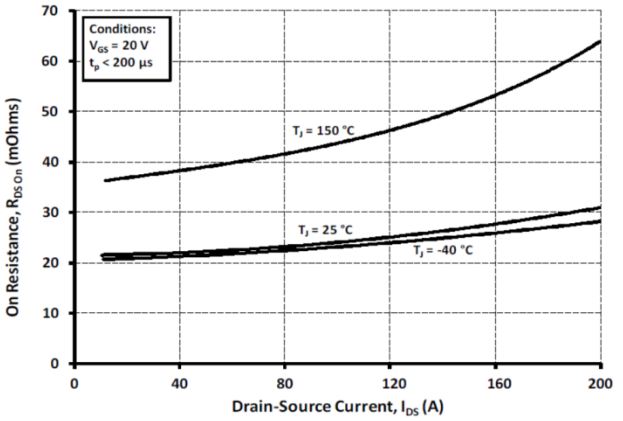


Figure 4. $R_{DS\ ON}$ vs. Drain Current

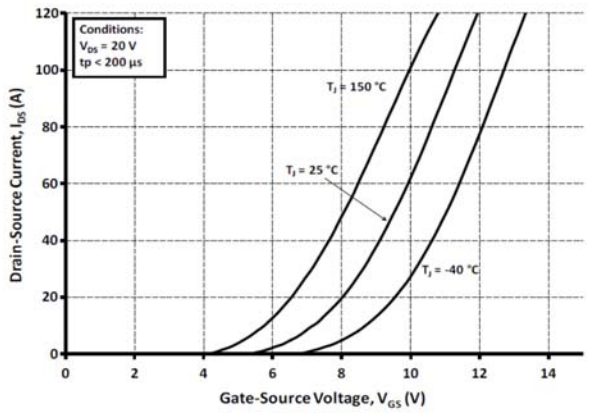


Figure 5. Transfer Characteristic for Various Junction Temperatures

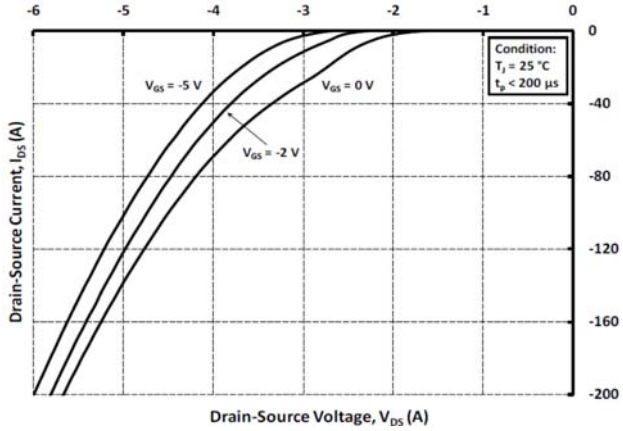


Figure 6. Body Diode Characteristic at 25 ºC

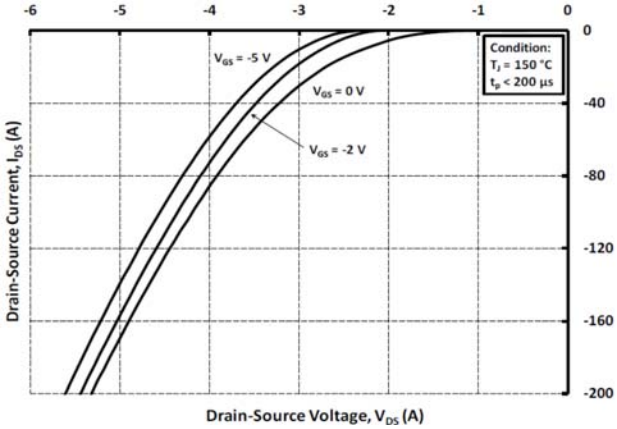


Figure 7. Body Diode Characteristic at 150 ºC

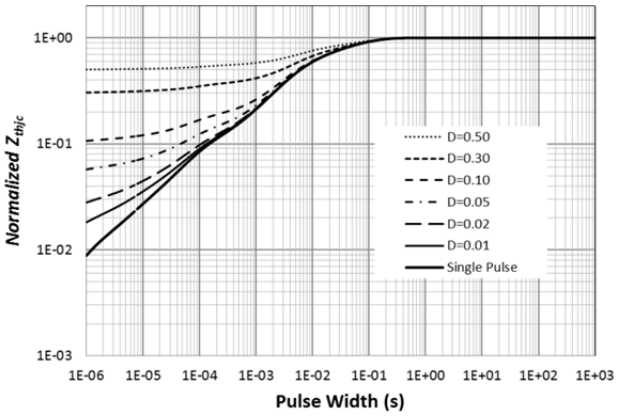


Figure 8. Transient Thermal Impedance (Junction to Case)

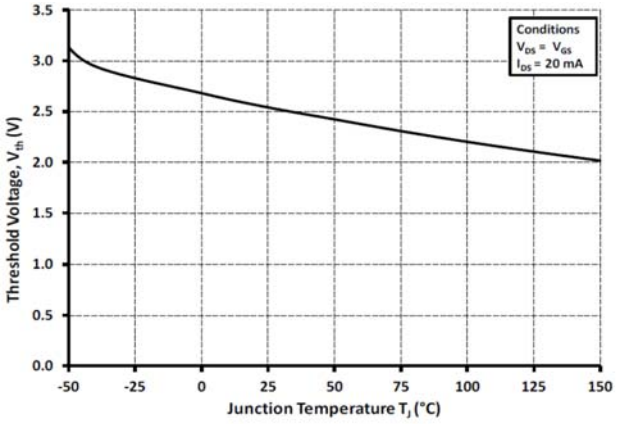


Figure 9. Gate Threshold Voltage vs. Temperature

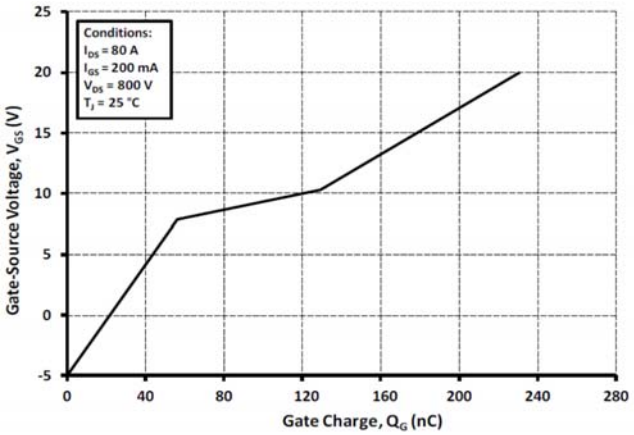


Figure 10. Gate Charge Characteristics

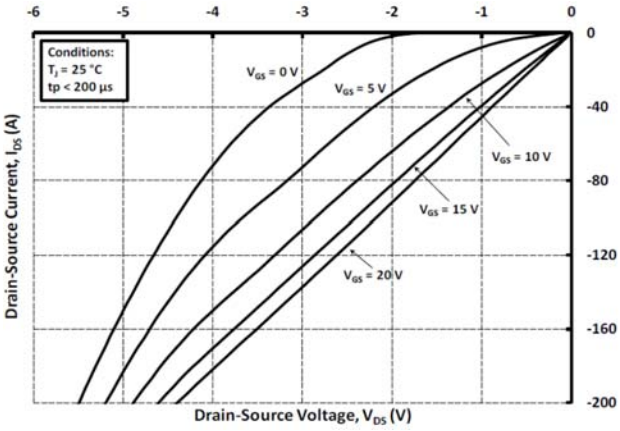


Figure 11. 3rd Quadrant Characteristic at 25 ºC

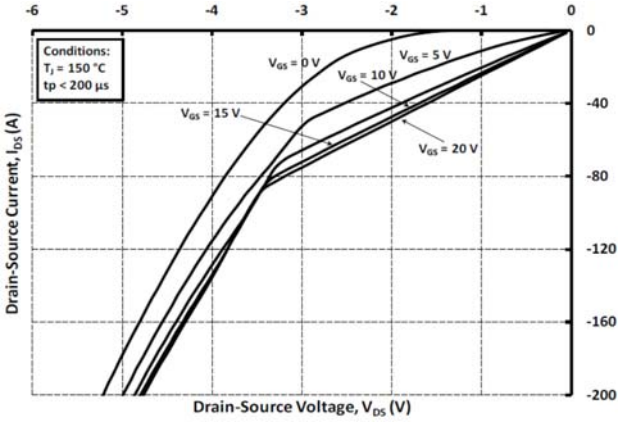


Figure 12. 3rd Quadrant Characteristic at 150 ºC

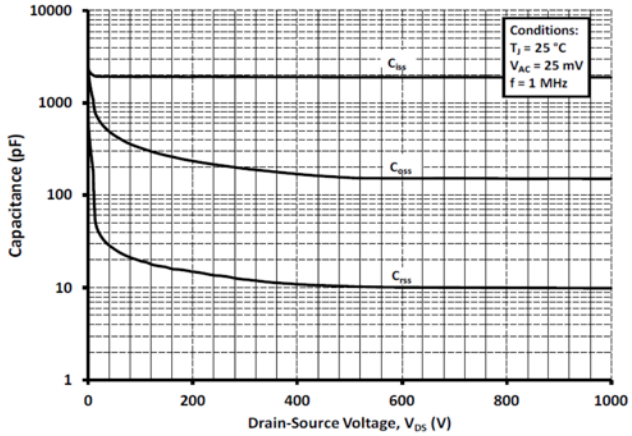


Figure 13. Capacitances vs. Drain-Source Voltage for a MOSFET die (Module includes 2 MOSFETs)

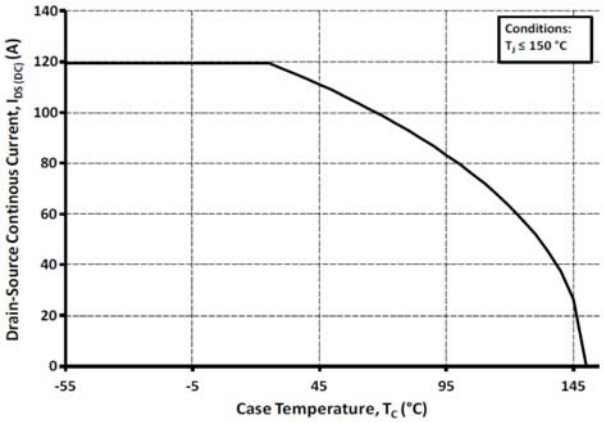


Figure 14. Continuous Drain Current Derating vs. Case Temperature

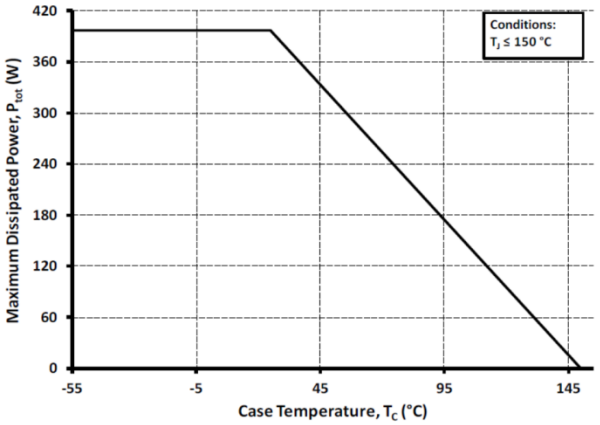


Figure 15. Maximum Power Dissipation Derating vs. Case Temperature

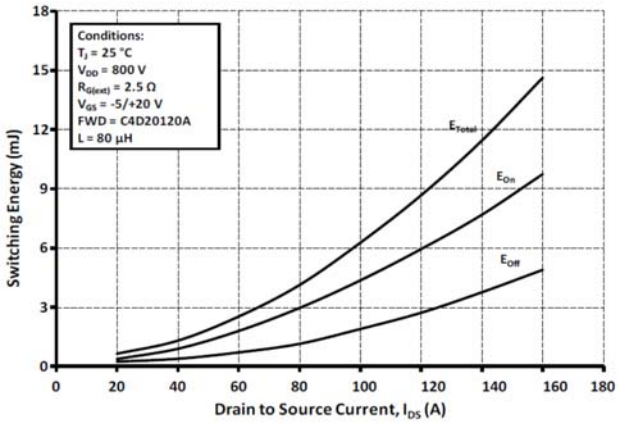


Figure 16. Clamped Inductive Switching Energy vs. Drain Current

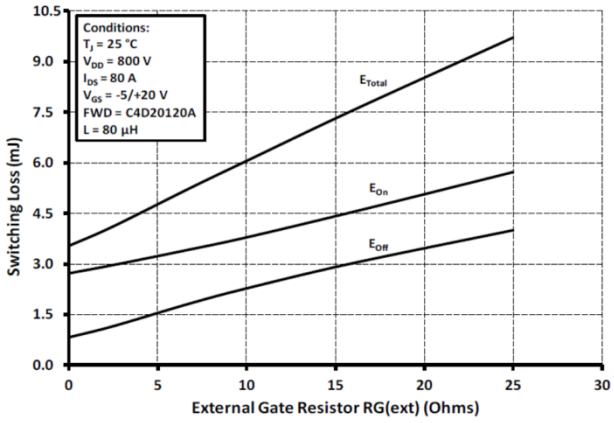


Figure 17. Clamped Inductive Switching Energy vs. $R_{G(ext)}$

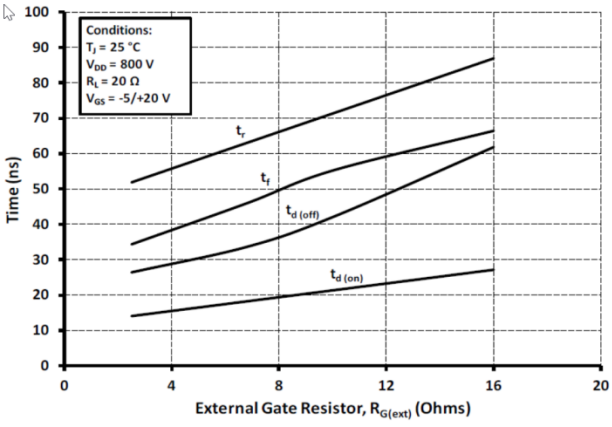


Figure 18. Switching Times vs. $R_{G(ext)}$

Typical SBD Performance

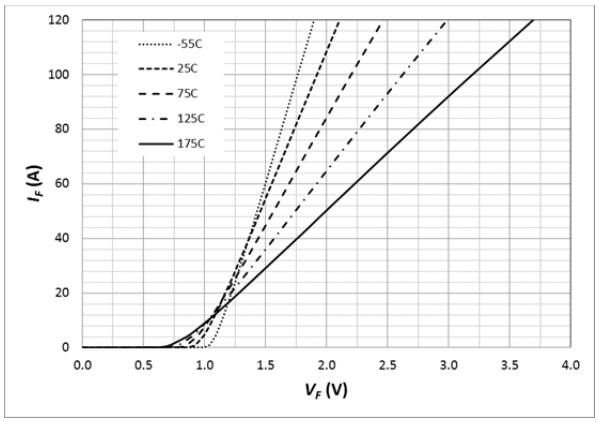


Figure 19. Forward Characteristics of SBD (parameterized on Tj)

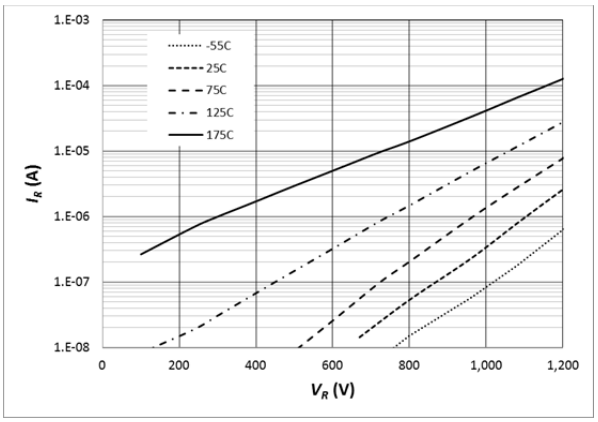


Figure 20. Reverse Characteristics of SBD (parameterized on Tj)

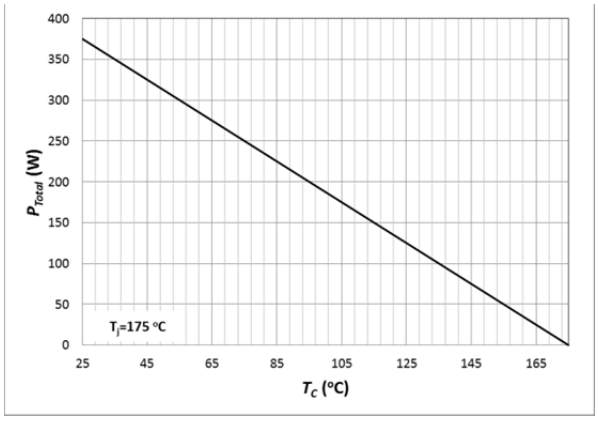


Figure 21. Power Derating of SBD

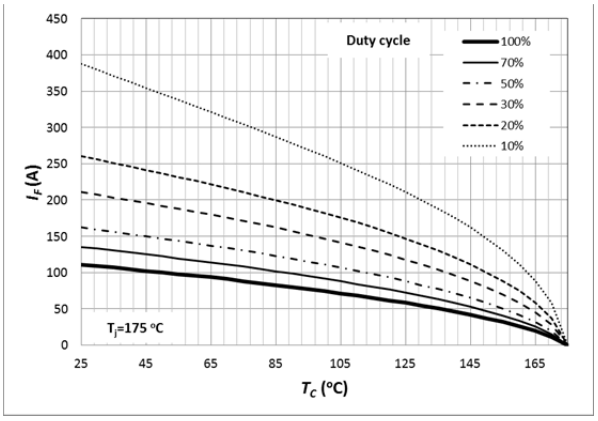


Figure 22. Current Derating of SBD

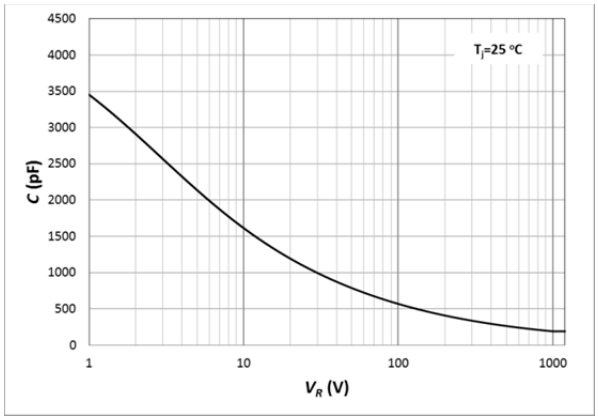


Figure 23. Capacitance Curve of SBD

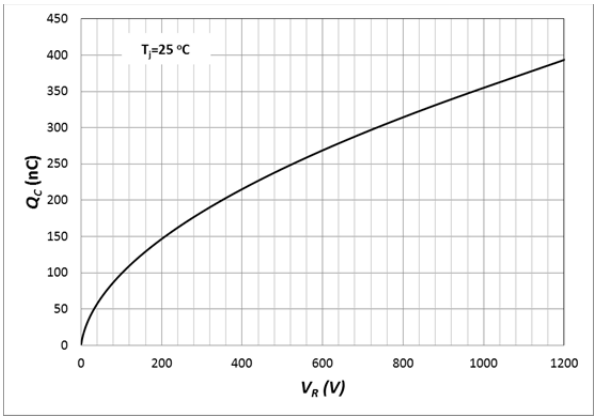


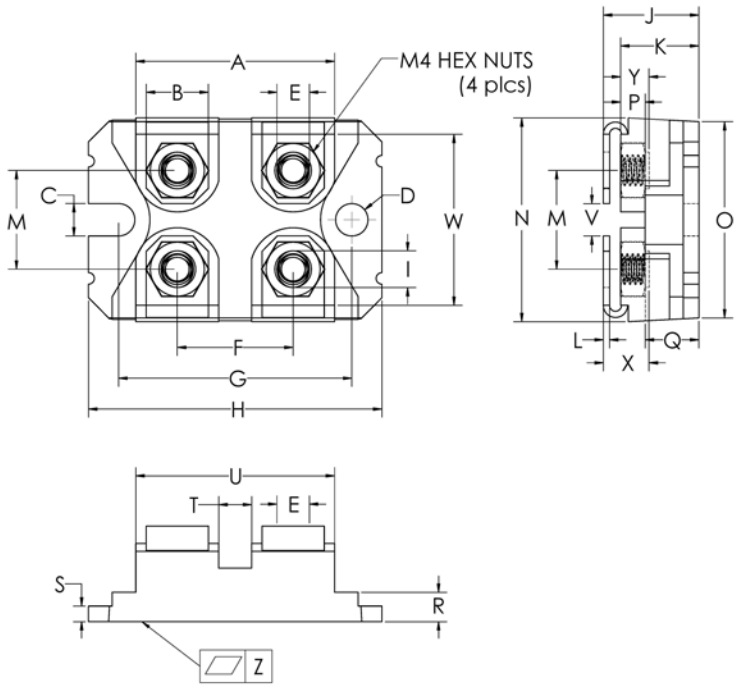
Figure 24. Capacitive Charge of SBD

Part Number and Pin assignment

Part Number	Rating	Pin 1*	Pin 2	Pin 3	Pin 4*
GCMS020A120S1-E1	1200V, R_{ds_ON}=20 mohm	Source	Gate	Drain	Source

* pin 1 could be used as a kelvin reference terminal, and pin 4 is assigned for main source power terminal.

SOT-227 Package Outline and Dimension



Sym	Millimeters		Inches	
	Min	Max	Min	Max
A	31.67	31.90	1.247	1.256
B	7.95	8.18	0.313	0.322
C	4.14	4.24	0.163	0.167
D	4.14	4.24	0.163	0.167
E	4.14	4.24	0.163	0.167
F	14.94	15.09	0.588	0.594
G	30.15	30.25	1.187	1.191
H	38.00	38.10	1.496	1.500
I	4.75	4.83	0.187	0.190
J	11.68	12.19	0.460	0.480
K	9.45	9.60	0.372	0.378
L	0.76	0.84	0.030	0.033
M	12.62	12.88	0.497	0.507
N	25.15	25.30	0.990	0.996
O	24.79	25.04	0.976	0.986
P	3.02	3.15	0.119	0.124
Q	6.71	6.96	0.264	0.274
R	4.17	4.42	0.164	0.174
S	2.08	2.13	0.082	0.084
T	3.28	3.63	0.129	0.143
U	26.75	26.90	1.053	1.059
V	3.86	4.24	0.152	0.167
W	20.55	26.90	0.809	0.814
X	5.45	5.85	0.215	0.230
Y	3.15	3.66	0.124	0.144
Z	0.00	0.13	0.000	0.005

Revision History

Date	Revision	Notes
02/04/2016	0.1	Initial release
05/29/2018	0.2	Update the measured data
01/03/2020	0.3	Applied company name change
04/22/2020	0.4	Update the characteristics
05/27/2020	0.5	Updated mechanical drawing

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 March, 2013. RoHS Declarations for this product can be obtained from the Product Documentation sections of www.SemiQ.com.

REACh Compliance

REACh substances of high concern (SVHC) information is available for this product. Since the European Chemicals Agency (ECHA) has published notice of their intent to frequently revise the SVHC listing for the foreseeable future,please contact our office at SemiQ Headquarters in Lake Forest, California to insure you get the most up-to-date REACh SVHC Declaration. REACh banned substance information (REACh Article 67) is also available upon request.

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