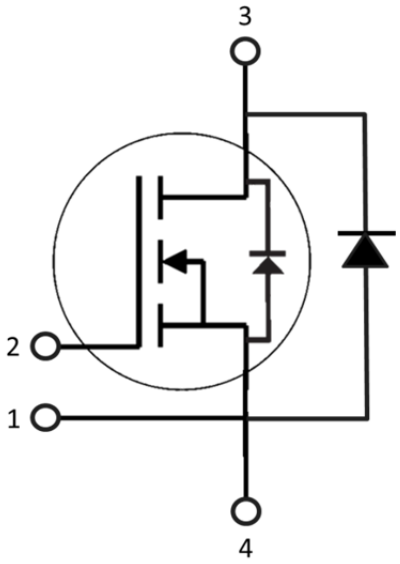
1200V/40 mΩ SiC MOSFET in SOT-227 Package

V_{CES} = 1200V
I_D = 40A @T_C= 80^{0}C
R_{DS_ON}= 40 mohm @ T_J= 25^{0}C



RoHS

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

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°C unless otherwise specified)

Parameters	Symbol	Conditions	Specifications	Units
SiC MOSFETs				
Maximum Drain-Source Voltage	V_{DSS}	T_j = 25 °C~150 °C	1200	V
Continuous Drain Current	$I_{D\ (DC)}$	T_j = 25 °C, V_{GS}=20V	60	A
		T_j = 150 °C, V_{GS}=20V	40	A
Pulse Drain Current	$I_{D(Pulse)}$	Pulse width t_P limited by T_{jmax}, T_C=25 °C	160	A
Gate-Source Voltage	V_{GS}	Absolute max value	-10/+25	V
SiC SBDs				
Maximum Reverse Voltage	V_{RRM}		1200	V
Average Forward Current	I_{DAV}	T_j = 25 °C	30	A
		T_j = 150 °C	15	A
Non-repetitive Forward Surge Current	I_{FSM}	Pulse width t_P limited by T_{jmax}	60	A
SOT-227 Modules Thermal Properties				
Maximum Power Dissipation	P_D	T_C = 25 °C	TBD	W
		T_C = 100 °C	TBD	W
Operating Junction Temperature	T_j		-40 ~ 150	°C
Storage Temperature	T_{STG}		-40 ~ 150	°C

Electrical Characteristics (T_j=25°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=10mA, T_j = 25 °C	2.4	2.8	--	V
		V_{DS}= 10V, I_D=10mA, T_j = 150 °C	1.8	2.0	--	V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS}=1200V, V_{GS}=0V, T_j = 25 °C	--	1	100	μA
		V_{DS}=1200V, V_{GS}=0V, T_j = 150 °C	--	TBD	TBD	μA
Gate Source Leakage Current	I_{GSS}	V_{GS}=20V, V_{DS}=0V	--	--	250	nA
Internal Gate Resistance	R_G	f = 1MHz, V_{AC} = 25mV, per die		1.8		Ω
Drain-Source On-state Resistance	$R_{DS(ON)}$	V_{GS}= 20V, I_D=40A, T_j = 25 °C	--	40	52	mΩ
		V_{GS}= 20V, I_D=40A, T_j = 150 °C	--	84	100	mΩ
Trans-conductance	g_{fs}	V_{DS}= 20V, I_D=40A, T_j = 25 °C		15		S
		V_{DS}= 20V, I_D=40A, T_j = 150 °C		13		
Input Capacitance	C_{ISS}	V_{GS} = 0V, V_{DS} = 1000V, freq = 1MHz, V_{AC} = 25mV	--	1.9	--	nF
Output Capacitance	C_{OSS}		--	150	--	pF

Reverse transfer Capacitance	C_{RES}		--	10	--	pF
Turn-on Delay Time	$t_{d(on)}$	V_{DS} = 800V, V_{GS} = -5/20V I_D = 40A, $R_{G(ext)}$ = 2.5Ω, L = 85µH. 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}			1.0		mJ
Turn-off Switching Loss	E_{OFF}			0.4		mJ
Total Gate Charge	Q_g	V_{DS}=800 V, V_{GS} = -5/20V I_D = 40A	--	115	--	nC
SiC SBDs						
Maximum peak repetitive reverse voltage	V_{RRM}		1200	--	--	V
Maximum Reverse Leakage Current	I_{RM}	V_R = 1200V, T_j = 25 ^{0}C	--	4.1	100	µA
		V_R = 1200V, T_j = 150 ^{0}C	--	606	--	µA
Diode Forward Voltage	V_F	I_F = 15A, T_j = 25 ^{0}C	--	1.5	1.7	V
		I_F = 15A, T_j = 150 ^{0}C	--	2.3	--	V
Total Capacitive Charge	Q_C	V_R=1200 V, I_F<$I_{F,max}$	--	52	--	nC
Switching Time	t_C	dI_F/dt = 500 A/µs, T_j = 25 ^{0}C	--	--	10	ns
Total Capacitance	C	V_R = 1V, f = 1 MHz	--	895	--	pF
		V_R = 600V, f = 1 MHz	--	52	--	pF
		V_R = 1200V, f = 1 MHz	--	43	--	pF

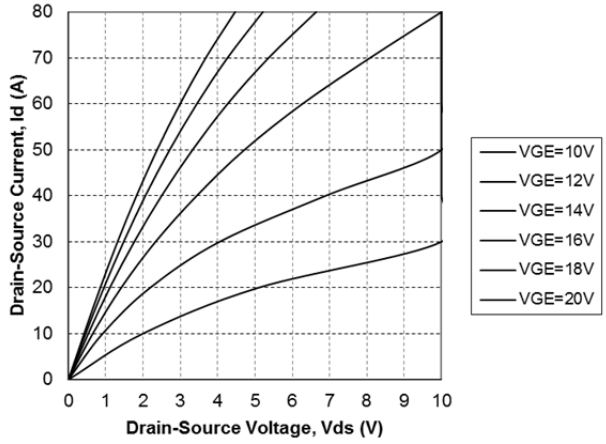
Thermal and Package Characteristics (T_j=25^{o}C unless otherwise specified)

Parameters	Symbol	Conditions	Min	Typ	Max	Units
Junction to Case Thermal Resistance	R_{THJC}	MOSFET	--	--	0.6	^{0}C /W
		SBD	--	--	0.65	^{0}C /W
Junction to Ambient Thermal Resistance	R_{THJA}	MOSFET	--	--	TBD	^{0}C /W
		SBD	--	--	TBD	^{0}C /W
Mounting Torque	M_d				1.5	N-m
Terminal Connection Torque	M_{dt}		1.3	--	1.5	N-m
Package Weight	W_t			32		g
Isolation Voltage	V_{ISOL}	I_{ISOL} < 1mA, 50/60Hz, t=1 min	2500			V

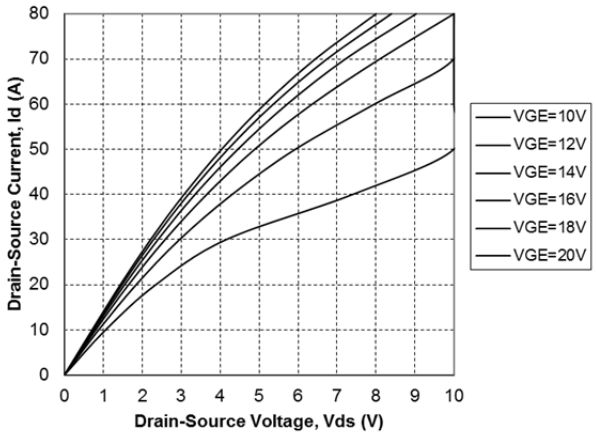
Part Number and Pin assignment

Part Number	Rating	Pin 1*	Pin 2	Pin 3	Pin 4*
GCMS040A120S1-E1	1200V, R_{ds_ON}=40 mohm, I_{d_SBD}=15A	Source	Gate	Drain	Source

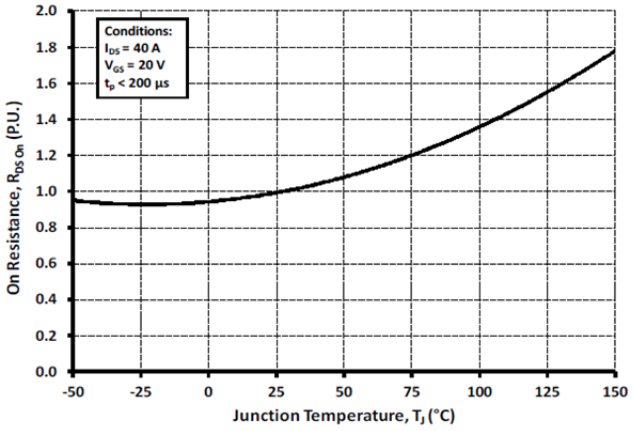
* pin 1 could be used as a kelvin reference terminal, and pin 4 is assigned for main source power terminal.



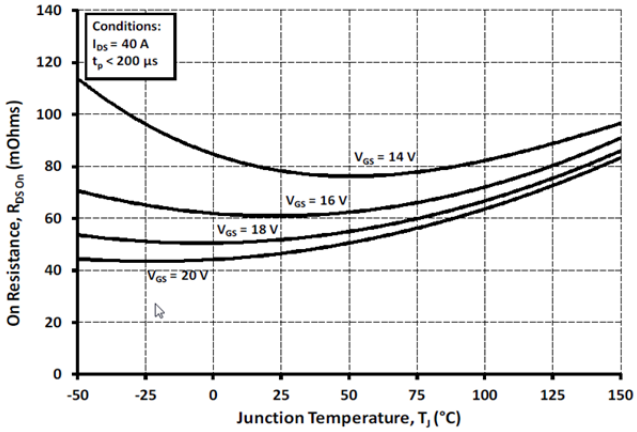
Typical Forward Characteristics T_j=25 °C



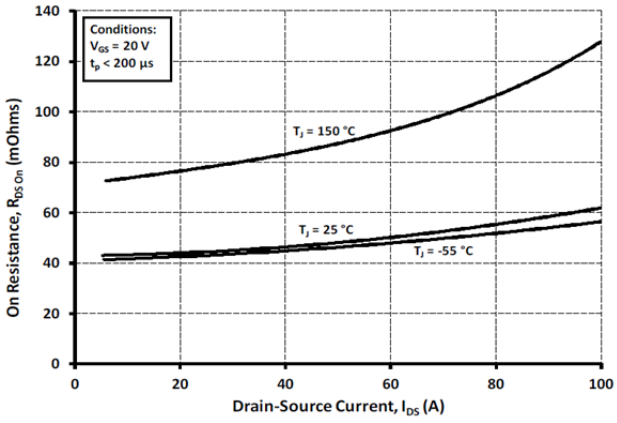
Typical Forward Characteristics T_j=150 °C



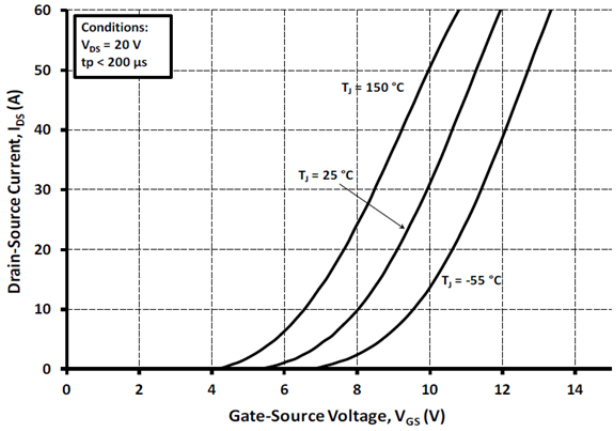
Normalized R_{DS_ON} vs. Temperature



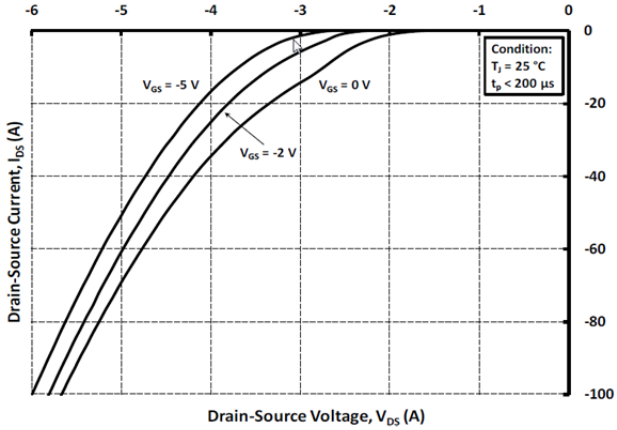
R_{DS_ON} vs. Junction Temperature



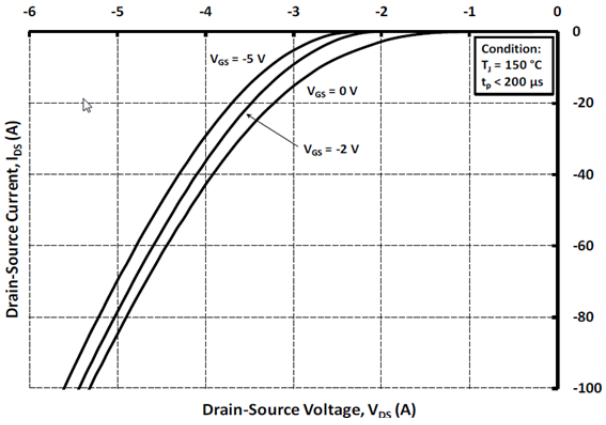
R_{DS_ON} vs. Drain Current



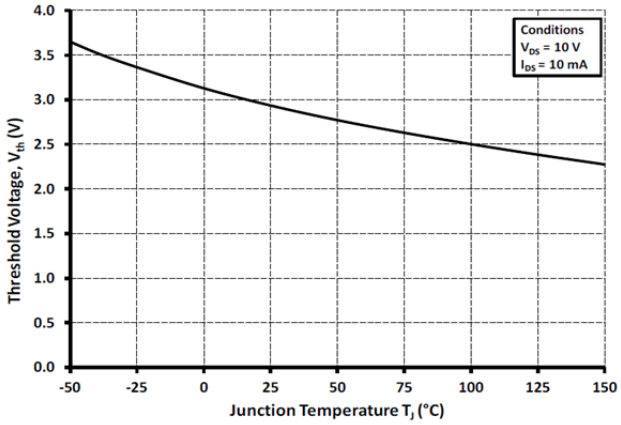
Transfer Characteristics



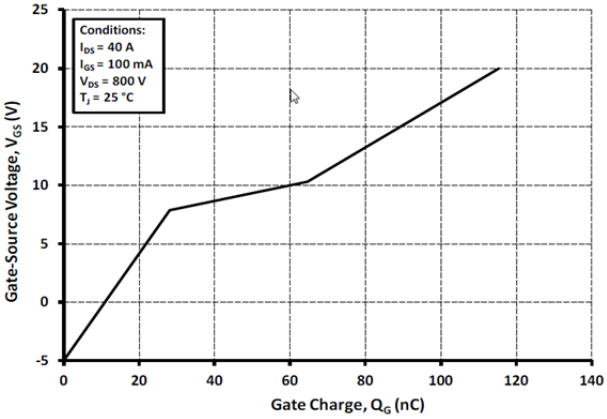
Body Diode Characteristics T_j=25 °C



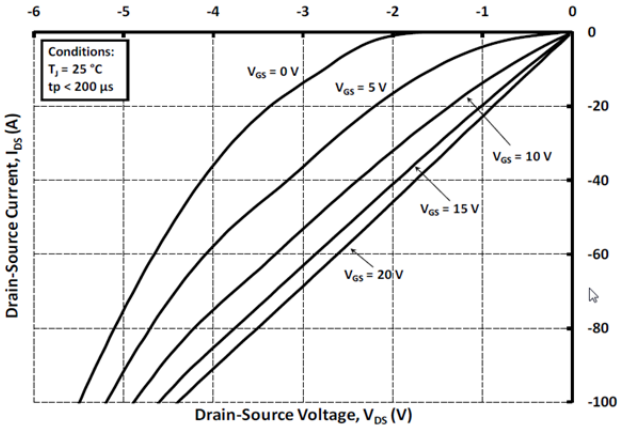
Body Diode Characteristics T_j=150 °C



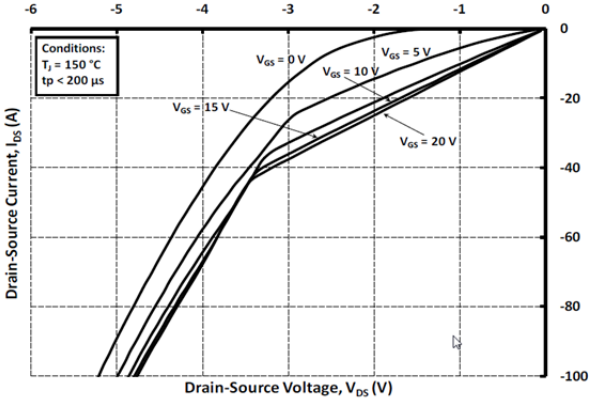
Threshold Voltage vs. Temperature



Gate Charge Characteristics



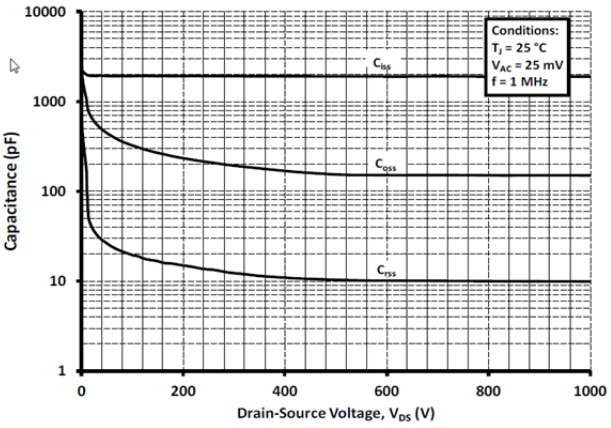
3rd Quadrant Characteristics T_j=25 °C



3rd Quadrant Characteristics T_j=150 °C

TBD

Switching Loss vs. Drain Current



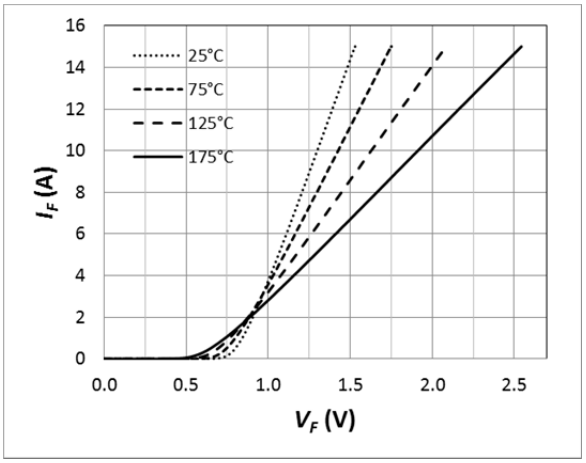
Capacitances vs. Drain-Source Voltage (0~1k V)

TBD

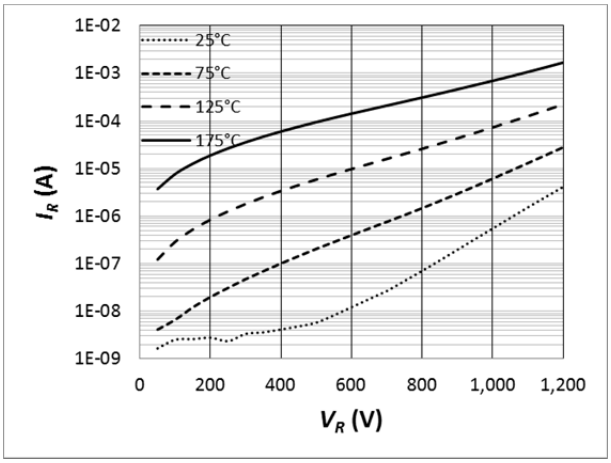
Clamped Inductive Switching Energy vs. $R_{G(ext)}$

TBD

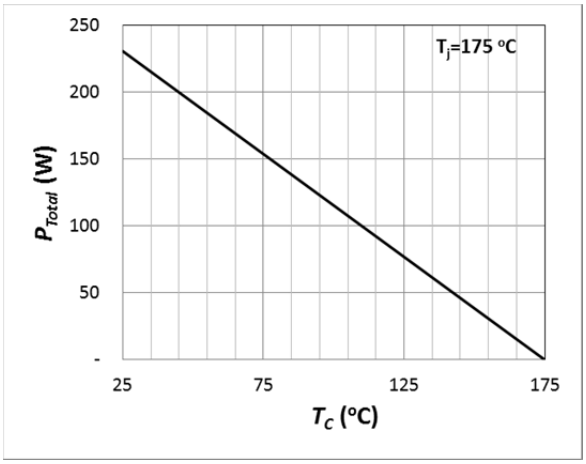
Clamped Inductive Switching Energy vs. Temperature



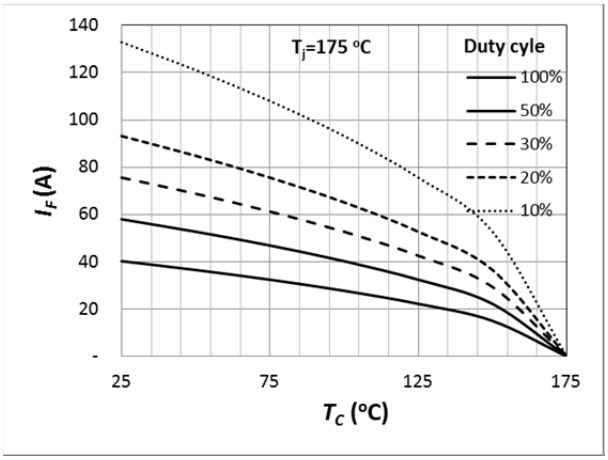
Forward Characteristics (parameterized on Tj)



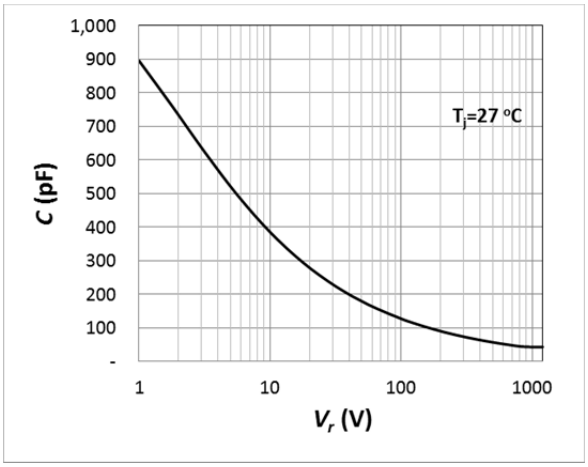
Reverse Characteristics (parameterized on Tj)



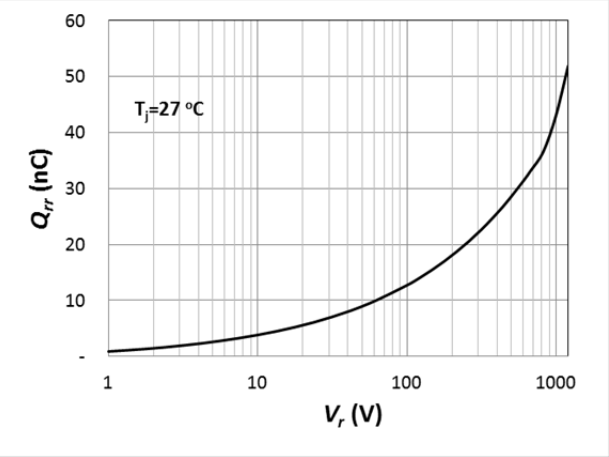
Power Derating



Current Derating

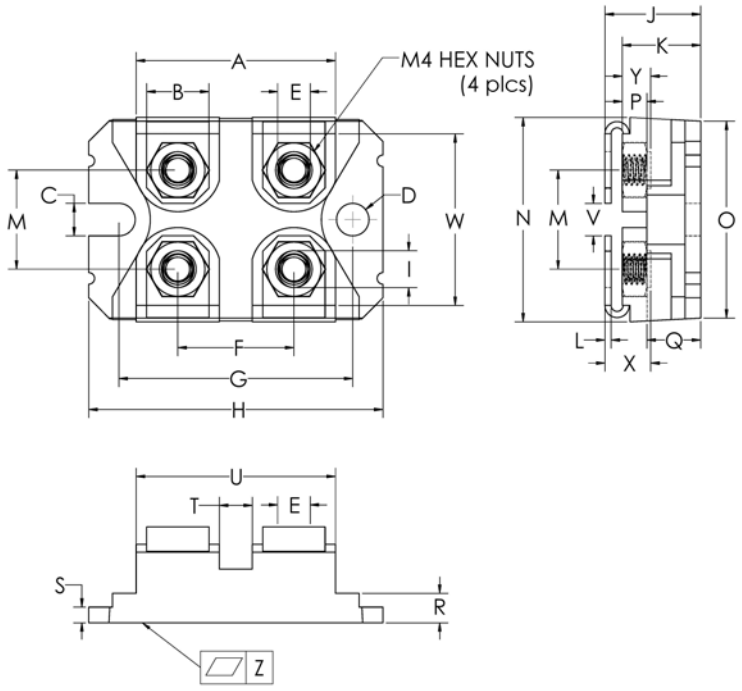


Capacitance Curve



Recovery Charge

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
04/14/2016	0.1	Initial release
01/03/2020	0.2	Applied company name change
05/27/2020	0.3	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.

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