GE Aerospace

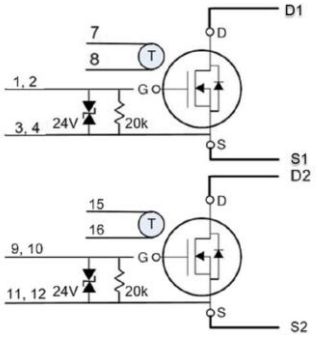
1200V Dual Silicon Carbide
Power Module

GE12047BCA3
V_{DS}: 1200 V I_{DS}: 475 A

Superior performance for high power, high frequency applications needing best-in-class power density

Features

- Highly reliable GE SiC MOSFET devices AEC-Q101 qualified to 200°C
- Low $R_{DS(ON)}$ (3.1 mΩ) (device only)
- Low stray inductance (1 nH)
- Ultra-low switching losses over entire operating range
- GE Power Overlay wire-bondless technology
- Body diode with minimal reverse recovery
- Direct above die temperature sensor
- AlSiC Baseplate and Si_3N_4 AMB Substrate



MOSFET DC Characteristics @ T_J = 25˚C (unless otherwise specified)

Symbols	Parameters	Min.	Typ.	Max.	Unit	Test Conditions	Notes
I_{DS}	Continuous Drain Current			475	A	V_{GS} = 20 V, T_c = 25˚C	Per Switch
				333		V_{GS} = 20 V, T_c = 100˚C	
				272		V_{GS} = 20 V, T_c = 125˚C	
$I_{DS,pulse}$	Pulsed Drain Current			950	A	T_c = 25 ˚C, t_p = 1 ms	
V_{DSmax}	Drain - Source Breakdown Voltage	1200			V	V_{GS} = 0 V, I_{DS} = 1 µA	
V_{GSmax}	Maximum Gate - Source Voltage			-15/+23	V	V_{DS} = 0 V	
V_{GSop}	Recommended Gate - Source Voltage		-5/+20		V		
T_{Jmax}	Junction Temperature			175	˚C		
T_C	Case Temperature Range	-55		150	˚C		
T_{STG}	Storage Temperature Range	-55		150	˚C		
P_D	Power Dissipation			1250	W	T_c = 25˚C	Per Switch

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(Continued) **MOSFET DC Characteristics @ T_J = 25˚C** (unless otherwise specified)

Symbols	Parameters	Min.	Typ.	Max.	Unit	Test Conditions	Notes
I_{DS}	Continuous Drain Current			475	A	V_{GS} = 20 V, T_c = 25˚C	Per Switch
$V_{GS(th)}$	Gate Threshold Voltage	2.5	2.8	4.5	V	V_{GS} = V_{DS}, I_{DS} = 480 mA	
I_{DSS}	Drain Leakage Current			0.1	mA	V_{DS} = 1200 V, V_{GS} = 0 V, T_J = 25˚C	
				1.6		T_J = 200˚C	
I_{GSS}	Gate-Source Leakage Current			160	nA	V_{GS} = -15/+23 V	
$R_{DS(on)}$	On State Resistance (Device Only)		3.1	4.4	mΩ	V_{GS} = 20 V, I_{DS} = 475 A, T_J = 25˚C	Per Switch
			5.6	6.8		T_J = 175˚C	
$R_{G(int)}$	Gate-Source series resistance		0.90		Ω	V_{GS} = 0 V, f = 100 kHz, T_c = 25˚C	

MOSFET Dynamic Characteristics per switch @ T_J = 25˚C (unless otherwise specified)

Symbols	Parameters	Min.	Typ.	Max.	Unit	Test Conditions	Notes
C_{iss}	Input Capacitance		29.3		nF	V_{GS} = 0 V V_{DS} = 600 V f = 100 kHz	
C_{oss}	Output Capacitance		1.6		nF		
C_{rss}	Reverse Transfer Capacitance		0.13		nF		
E_{on}	Turn-On Switching Energy		7.72		mJ	V_{GS} = -8 V to +20 V V_{DS} = 800 V I_{DS} = 350 A $R_{G(ext)}$ = 0 Ω	Tested in half-bridge configuration
E_{off}	Turn-Off Switching Energy		3.79		mJ		
t_r	Rise Time		21.9		ns		
t_f	Fall Time		38.9		ns		
Q_G	Total Gate Charge		1248		nC	V_{GS} = 0 to 18 V V_{DS} = 900 V I_{DS} = 720 A	
Q_{GD}	Gate-Drain Charge		536		nC		
Q_{GS}	Gate-Source Charge		176		nC		

Body Diode Characteristics per switch @ T_J = 25˚C (unless otherwise specified)

Symbols	Parameters	Min.	Typ.	Max.	Unit	Test Conditions	Notes
I_{SD}	Pulsed body diode current			720	A	V_{GS} = 0 V	1.
V_{SD}	Diode Forward Voltage		4.69		V	V_{GS} = 0 V, I_{SD} = 475 A, T_J = 25˚C	

1. Use of body diode is recommended in pulse mode only, with pulse duration up to 1 µs

Thermal Characteristics

Symbols	Parameters	Min.	Typ.	Max.	Unit	Test Conditions	Notes
R_{th}	Thermal Resistance Junction-to-Case		0.10	0.12	˚C/W	JESD51-14	Per Switch

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Temperature Sensor Characteristics

Symbols	Parameters	Min.	Typ.	Max.	Unit	Test Conditions	Notes
R_{RTD}	Rated Resistance of RTD		1k		ohm		2.
	Tolerance of Resistance		0.12		%		
	Accuracy		0.3		°C		
	Measuring Current	100		300	µA		
TCR	Temperature Coefficient		3850		ppm/K		
	Operating Temperature	-70		+500	°C		
	Insulation Resistance	100			Mohm	20°C	

2. RTD is mounted directly over center-most die allowing direct reading of T_J

Module packaging data

Symbols	Parameters	Min.	Typ.	Max.	Unit	Test Conditions	Notes
V_{Iso}	Case Isolation Voltage	4			kV	AC 50 Hz, 1 min, 25˚C	
CTI	Comparative Tracking Index		600				
M_s	Mounting Torque			5.0	N-m	Power Terminals	
				4.0		Baseplate	
L_{D1S1}	Loop Inductance		1		nH		
L_{D2S2}	Loop Inductance		1		nH		
	Module Mass		0.12		Kg		
	Clearance Distance		9		mm	D1 to D2	
			4		mm	D1 to S1	
			23		mm	Pins 1, 2 to S1	
			25		mm	Pins 9, 10 to S1	
			9		mm	D1, S2 to Baseplate	
			12		mm	Pins 7, 8 to Baseplate	
	Creepage Distance		11		mm	D1 to D2	
			6		mm	D1 to S1	
			28		mm	Pins 1, 2 to S1	
			30		mm	Pins 9, 10 to S1	
			12		mm	D1, S2 to Baseplate	
			17		mm	Pins 7, 8 to Baseplate	
M_{BP}	Base Plate Material		AlSiC				

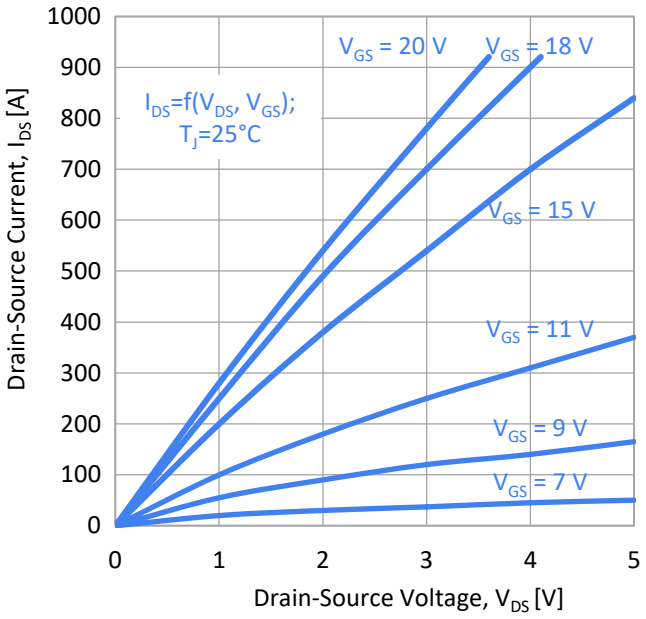

Figure 1: Output Characteristics (25°C)

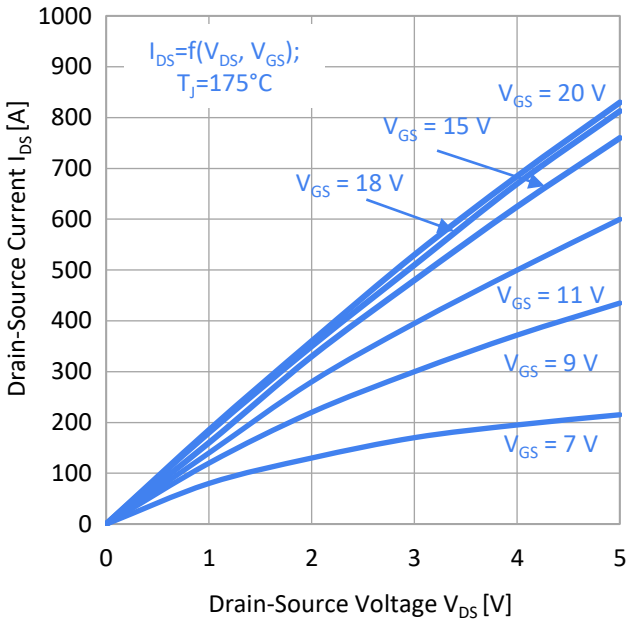

Figure 2: Output Characteristics (175°C)

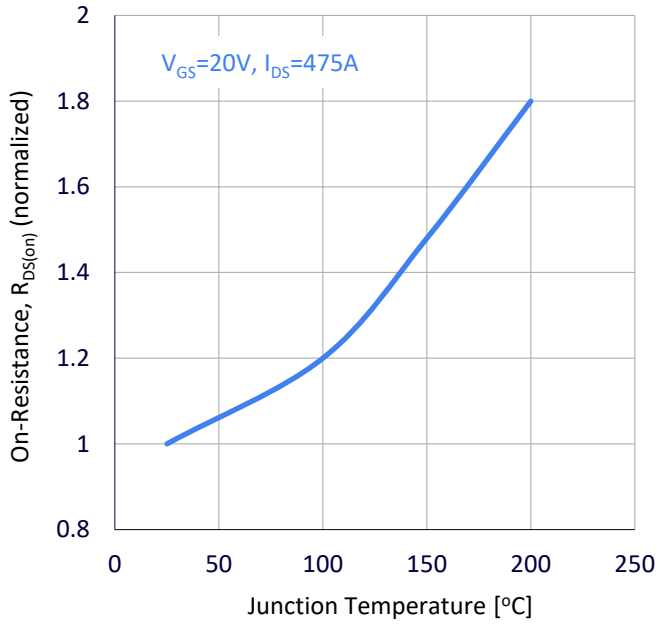

Figure 3: Normalized On-state Resistance vs. Temperature

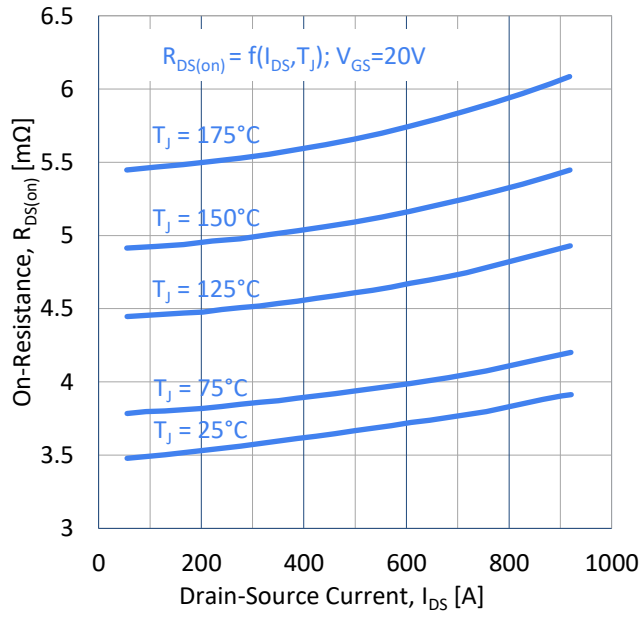

Figure 4: Module Drain-Source On-state Resistance

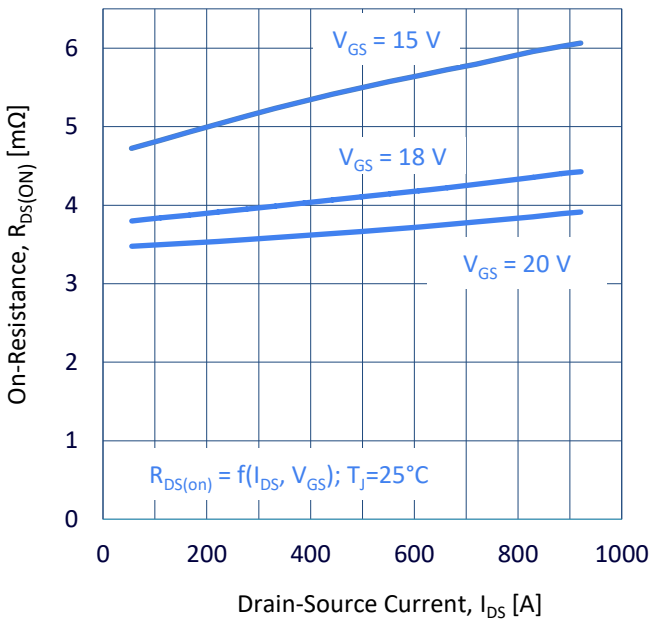

Figure 5: Module Drain-Source On-state Resistance

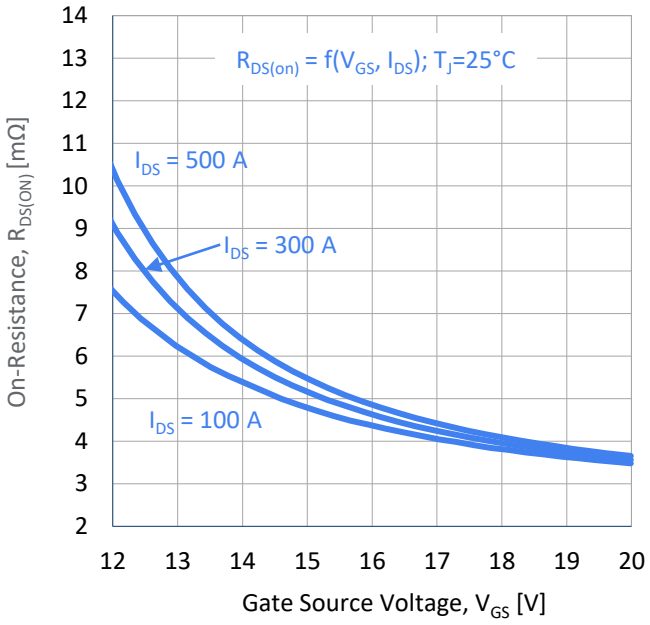

Figure 6: Drain-Source On-state Resistance vs. Gate Voltage

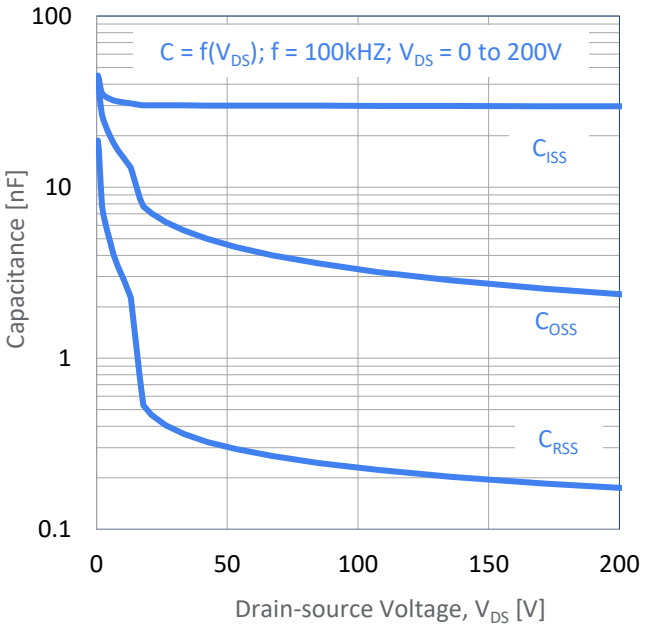

Figure 7: Junction Capacitances to 200 V

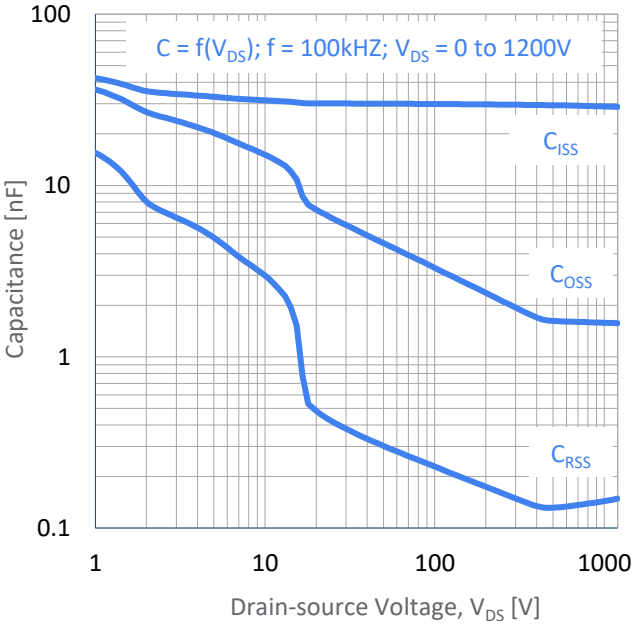

Figure 8: Junction Capacitances to 1200 V

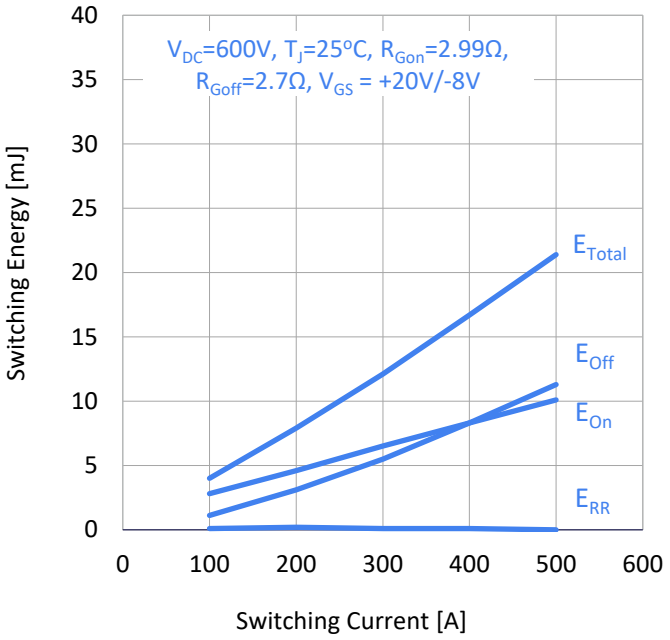

Figure 9: Switching Energy vs. Drain Current (600 V)

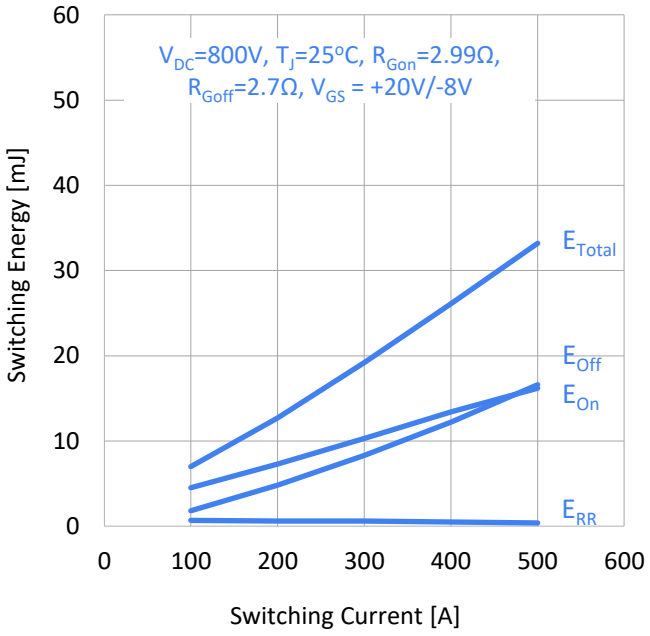

Figure 10: Switching Energy vs. Drain Current (800 V)

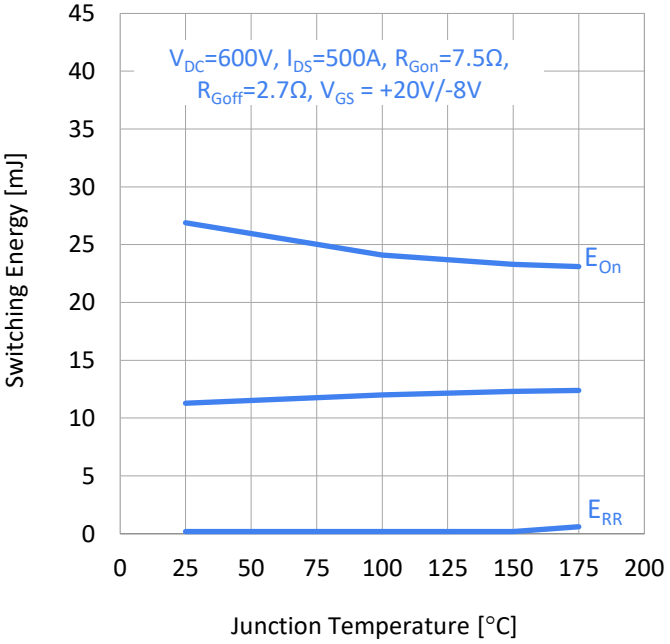

Figure 11: Switching Energy vs. Junction Temperature

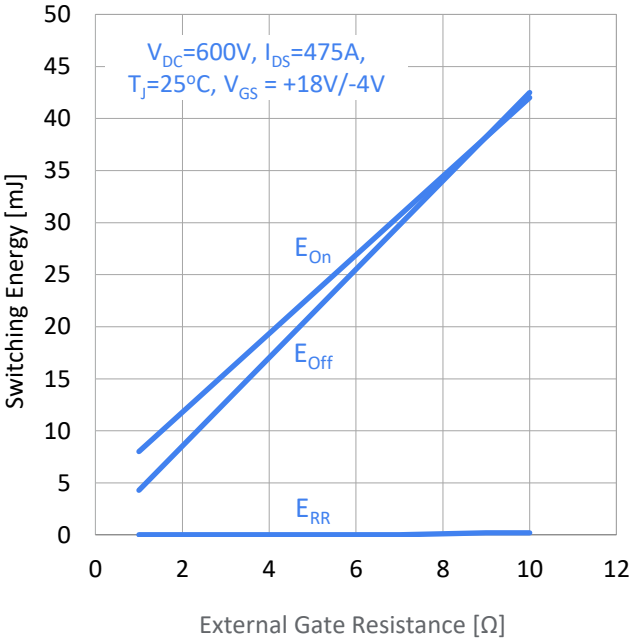

Figure 12: Switching Energy vs. Gate Resistance

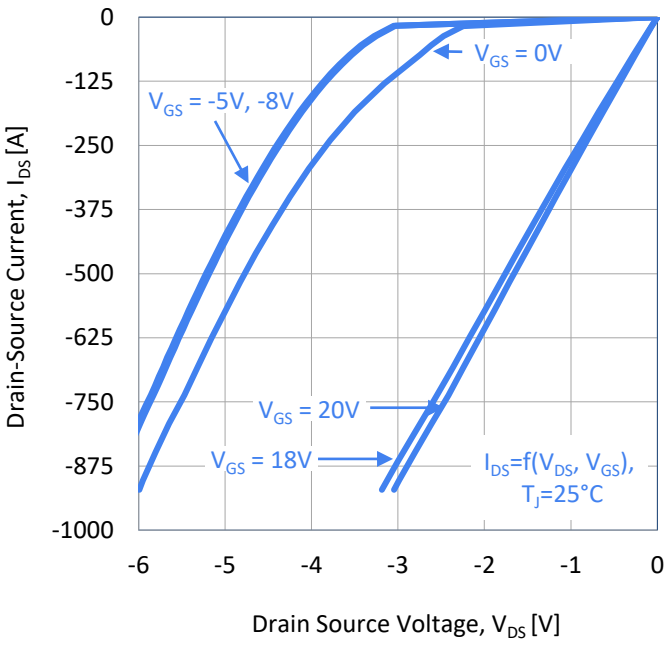

Figure 13: 3rd Quadrant Characteristics (25°C)

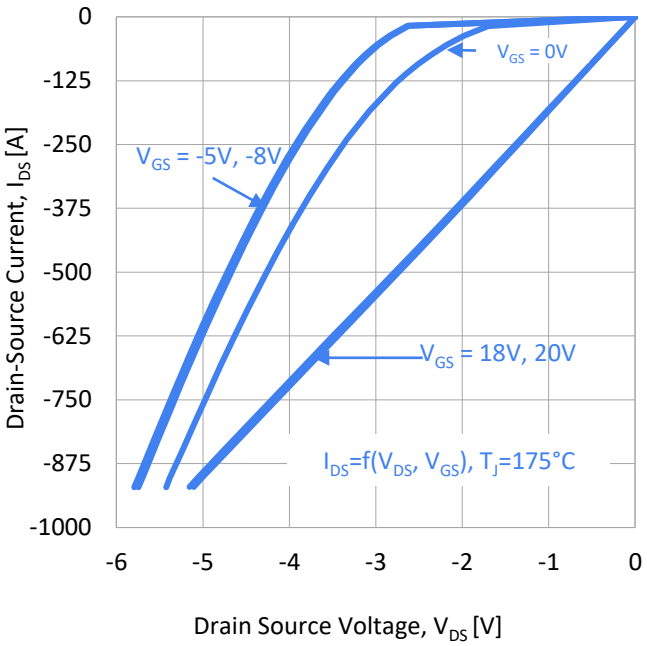

Figure 14: 3rd Quadrant Characteristics (175°C)

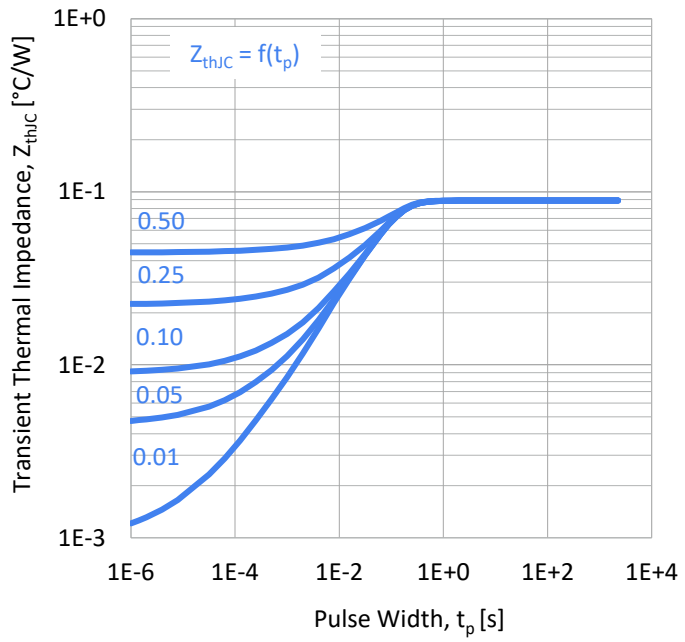

Figure 15: Transient Thermal Impedance

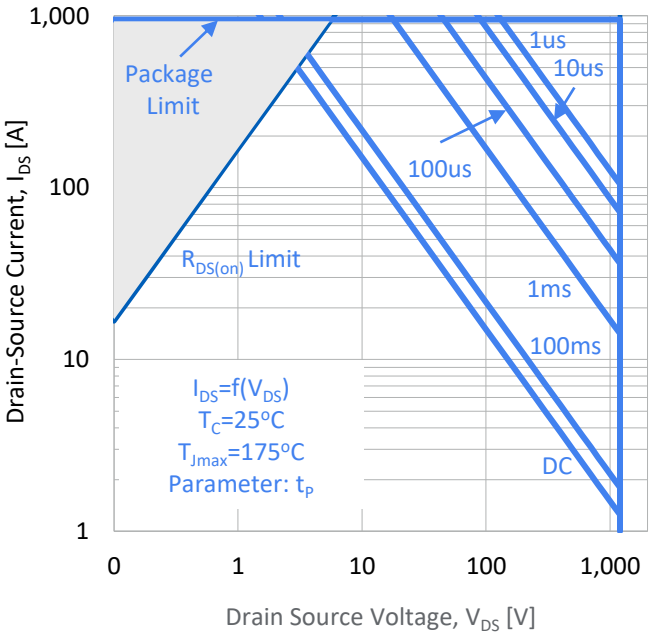

Figure 16: Forward-Bias Safe Operating Area

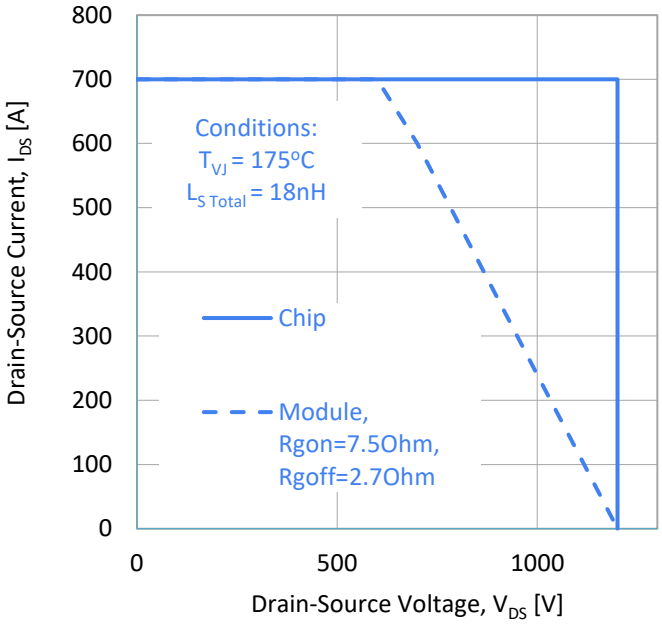

Figure 17: Reverse-Bias Safe Operating Area

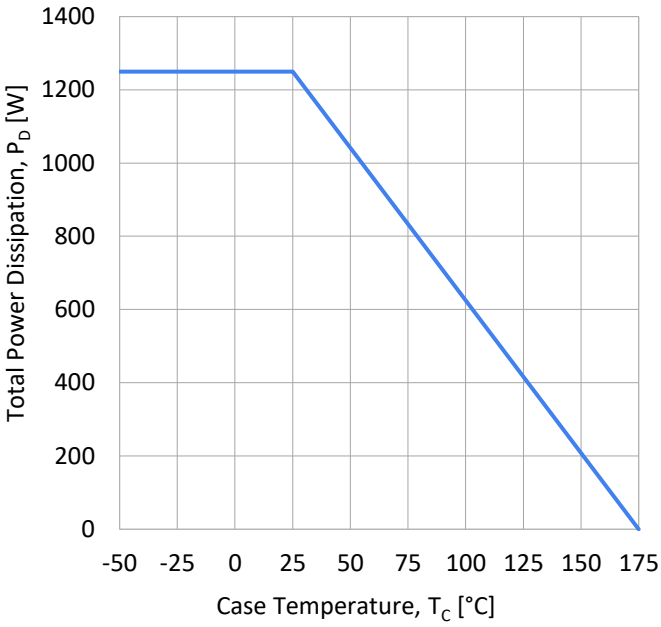

Figure 18: Maximum Power Dissipation vs. Case Temperature

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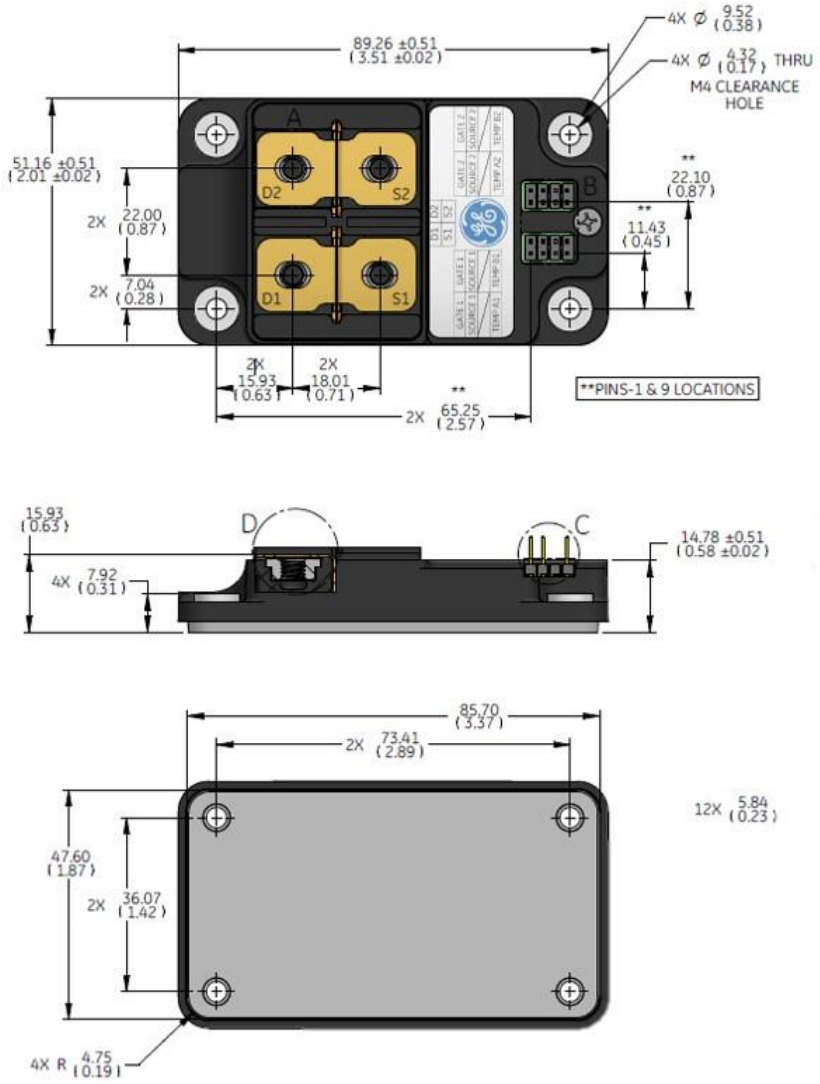
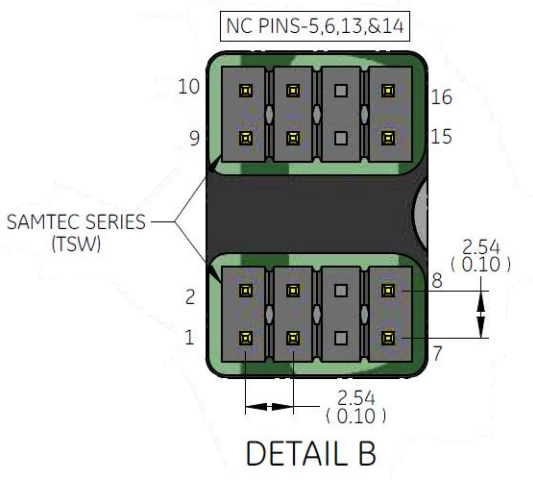
Module dimensions (millimeters)



Electrical interface outline drawing



Lower switch	
1	Gate 1
2	Gate 1
3	Source 1
4	Source 1
5	**
6	**
7	Temp A1
8	Temp B1

Upper switch	
9	Gate 2
10	Gate 2
11	Source 2
12	Source 2
13	**
14	**
15	Temp A2
16	Temp B2

Questions or need help designing in GE SiC Power modules? Please contact:

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Document revisions
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