GE Aerospace

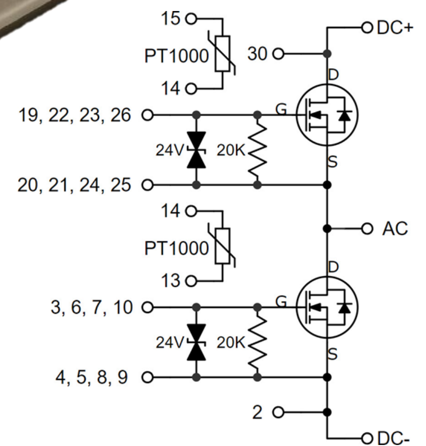
1200V Half-Bridge Silicon Carbide
Power Module

GE12160CEA3
V_{DS}: 1200 V I_{DS}: 1425 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 $R_{DS(ON)}$ (1.0 mΩ) (device only)
- Low stray inductance (3 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
- Dedicated DESAT Pin and Kelvin-Source Pin
- 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			1425	A	V_{GS} = 20 V, T_c = 25˚C	Per Switch
				999		V_{GS} = 20 V, T_c = 100˚C	
				816		V_{GS} = 20 V, T_c = 125˚C	
$I_{DS,pulse}$	Pulsed Drain Current			2850	A	T_c = 25 ˚C, t_p = 1 ms	
V_{DSmax}	Drain - Source Breakdown Voltage	1200			V	V_{GS} = 0 V, I_{DS} = 100 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			3750	W	T_c = 25˚C	Per Switch

(Continued) **MOSFET DC Characteristics @ $T_J = 25^{\circ}C$** (unless otherwise specified)

Symbols	Parameters	Min.	Typ.	Max.	Unit	Test Conditions	Notes
I_{DS}	Continuous Drain Current			1425	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			0.3	mA	V_{DS} = 1200 V, V_{GS} = 0 V, T_J = 25˚C	
				4.8		T_J = 200˚C	
I_{GSS}	Gate-Source Leakage Current			480	nA	V_{GS} = -15/+23 V	
$R_{DS(on)}$	On State Resistance (Device Only)		1.0	1.5	mΩ	V_{GS} = 20 V, I_{DS} = 475 A, T_J = 25˚C	Per Switch
			1.9	2.3		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 @ $T_J = 25^{\circ}C$ (unless otherwise specified)

Symbols	Parameters	Min.	Typ.	Max.	Unit	Test Conditions	Notes
C_{iss}	Input Capacitance		90		nF	V_{GS} = 0 V V_{DS} = 600 V f = 100 kHz	
C_{oss}	Output Capacitance		8.5		nF		
C_{rss}	Reverse Transfer Capacitance		0.25		nF		
E_{on}	Turn-On Switching Energy		104		mJ	V_{GS} = -8 V to +20 V V_{DS} = 600 V I_{DS} = 1550 A R_{Gon} = 2.26 Ω R_{Goff} = 2.26 Ω	
E_{off}	Turn-Off Switching Energy		103		mJ		
t_r	Rise Time		195		ns		
t_f	Fall Time		78		ns		
Q_G	Total Gate Charge		3744		nC	V_{GS} = 0 to 18 V V_{DS} = 900 V I_{DS} = 720 A	
Q_{GD}	Gate-Drain Charge		1608		nC		
Q_{GS}	Gate-Source Charge		528		nC		

Body Diode Characteristics per switch @ $T_J = 25^{\circ}C$ (unless otherwise specified)

Symbols	Parameters	Min.	Typ.	Max.	Unit	Test Conditions	Notes
I_{SD}	Pulsed body diode current			2160	A	V_{GS} = 0 V	1.
V_{SD}	Diode Forward Voltage		4.69		V	V_{GS} = 0 V, I_{SD} = 1425 A, T_J = 25˚C	

1. Use of body diode is recommended in pulse mode only

Thermal Characteristics

Symbols	Parameters	Min.	Typ.	Max.	Unit	Test Conditions	Notes
R_{th}	Thermal Resistance Junction-to-Case		0.03	0.04	˚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		ºC		
	Measuring Current	100		300	µA		
TCR	Temperature Coefficient		3850		ppm/K		
	Operating Temperature	-70		+500	°C		
	Insulation Resistance		100		Mohm	20ºC	

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	2			kV	AC 50 Hz, 1 min, 25˚C	3.
CTI	Comparative Tracking Index		600				
M_s	Mounting Torque			4.0	N-m	Power Terminals	
				2.5	N-m	Baseplate	
L_{D1S2}	Loop Inductance		3		nH		
	Module Mass		0.46		Kg		
	Clearance Distance		7		mm	V+ to V-	
			60		mm	V- to V_{OUT}	
			25		mm	V+ to Baseplate	
			25		mm	V_{OUT} to Baseplate	
	Creepage Distance		7		mm	V+ to V-	
			60		mm	V- to V_{OUT}	
			30		mm	V+ to Baseplate	
			30		mm	V_{OUT} to Baseplate	
M_{BP}	Base Plate Material		AlSiC				

3. Limited by Y-capacitor rating. Please contact GE Aerospace for 4kV modules.

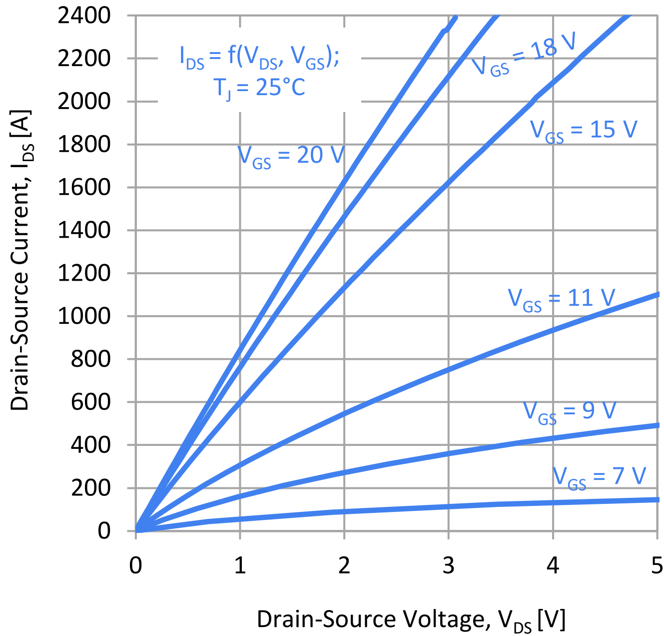

Figure 1: Output Characteristics (25°C)

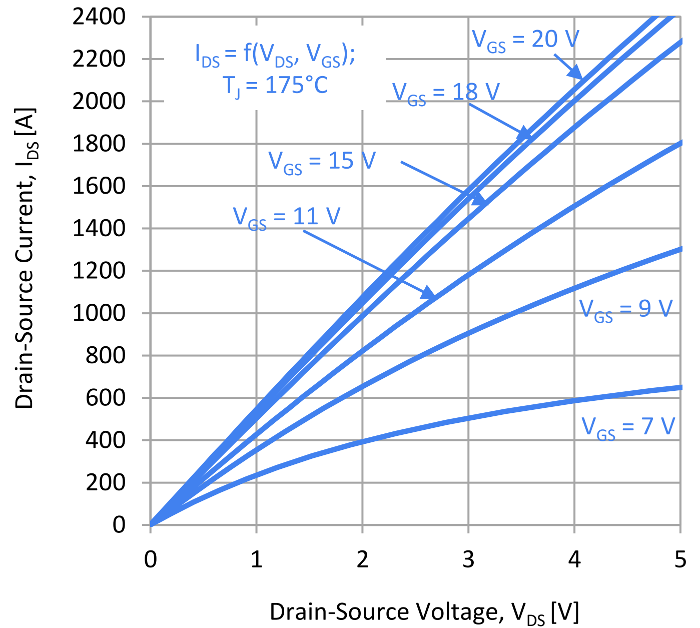

Figure 2: Output Characteristics (175°C)

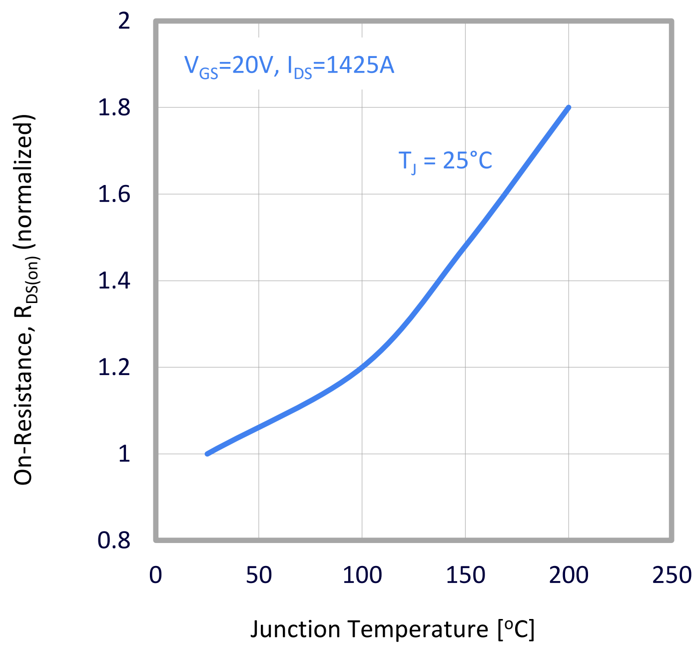

Figure 3: Normalized On-state Resistance vs. Temperature

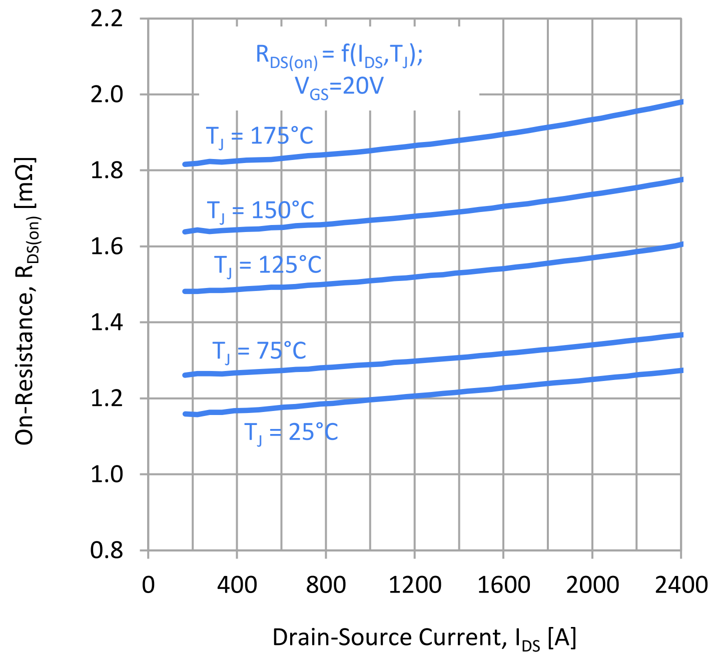

Figure 4: Module Drain-Source On-state Resistance

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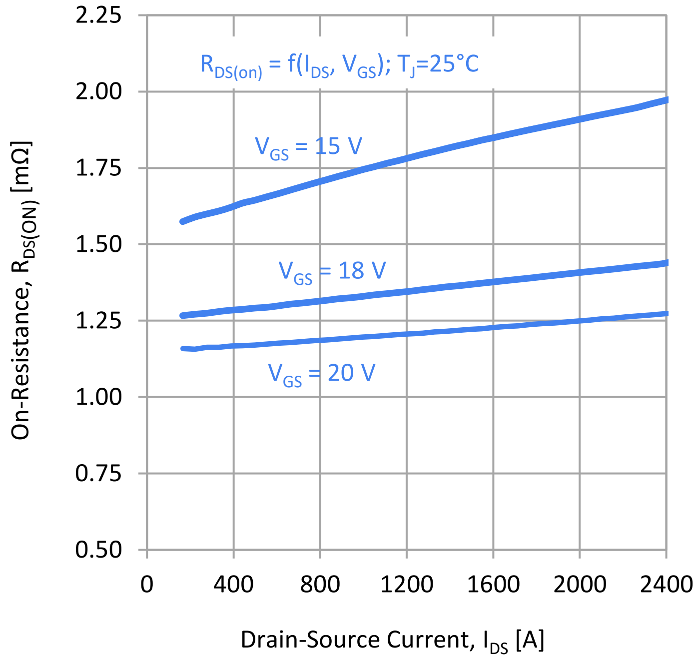

Figure 5: Module Drain-Source On-state Resistance

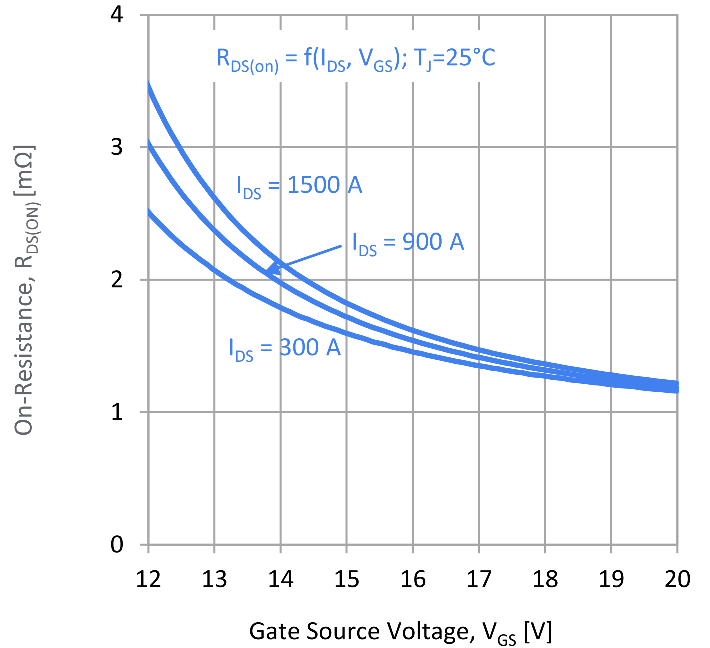

Figure 6: Drain-Source On-state Resistance vs. Gate Voltage

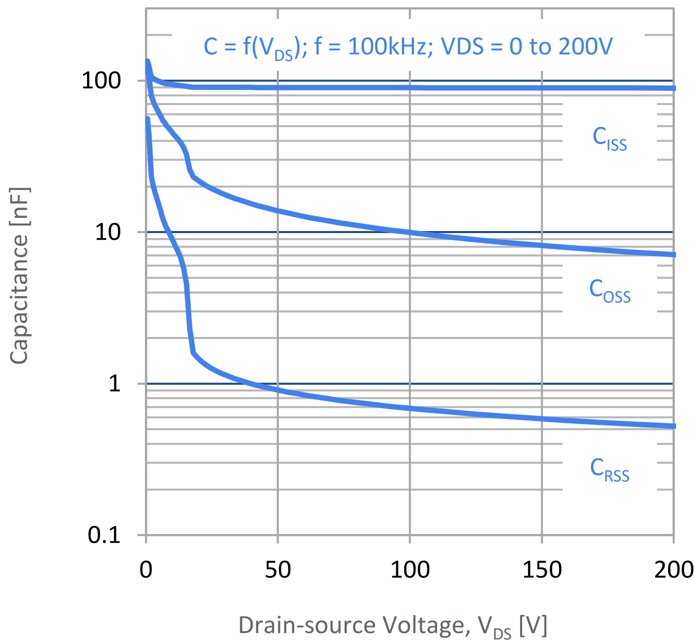

Figure 7: Junction Capacitances to 200 V

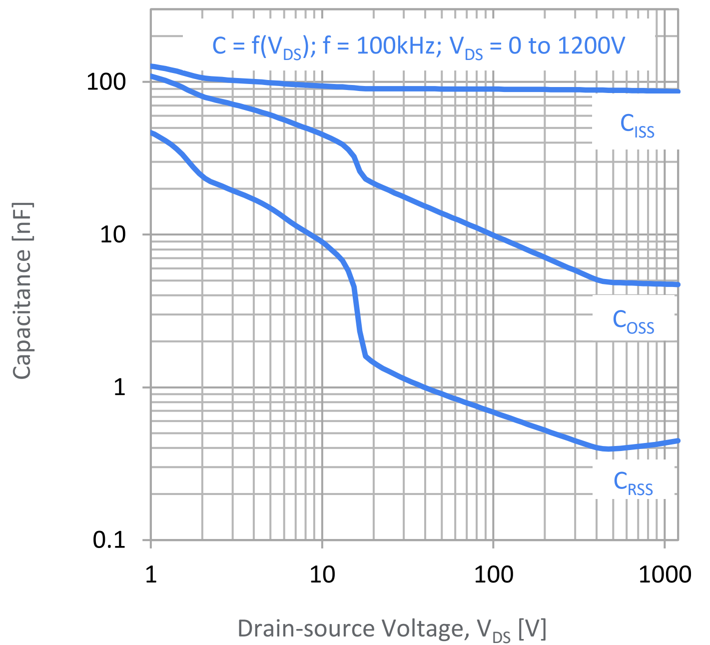

Figure 8: Junction Capacitances to 1200 V

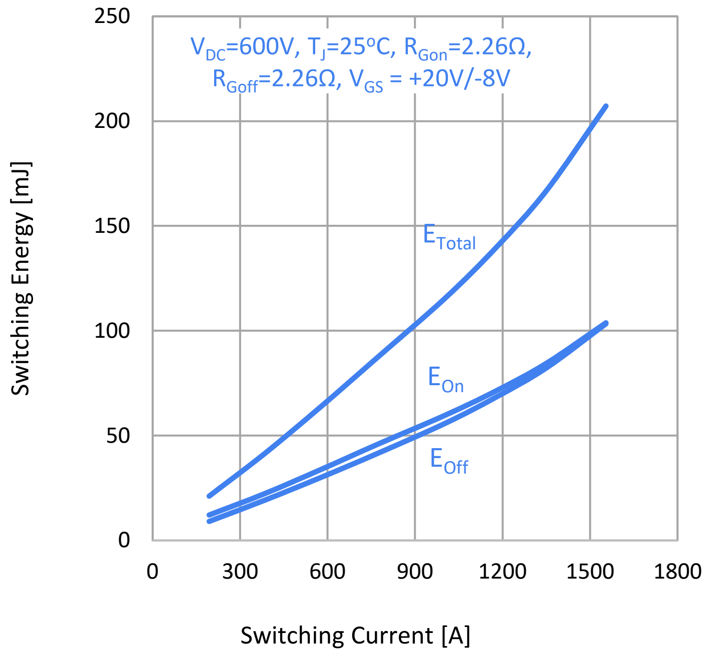

Figure 9: Switching Energy vs. Drain Current (600 V), 25°C

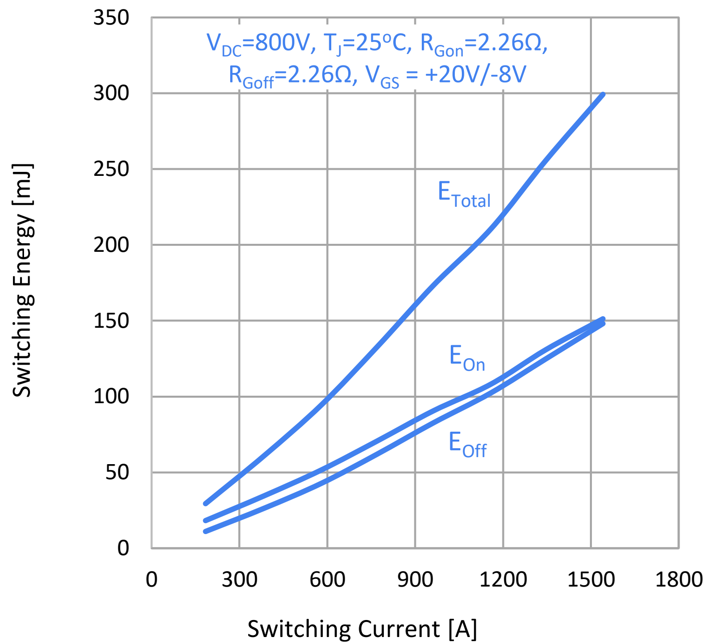

Figure 10: Switching Energy vs. Drain Current (800 V), 25°C

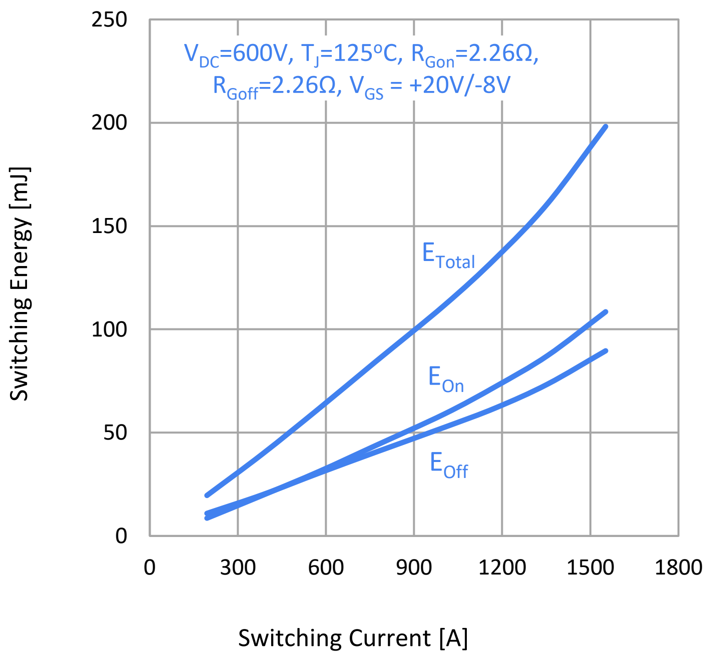

Figure 11: Switching Energy vs. Drain Current (600 V), 125°C

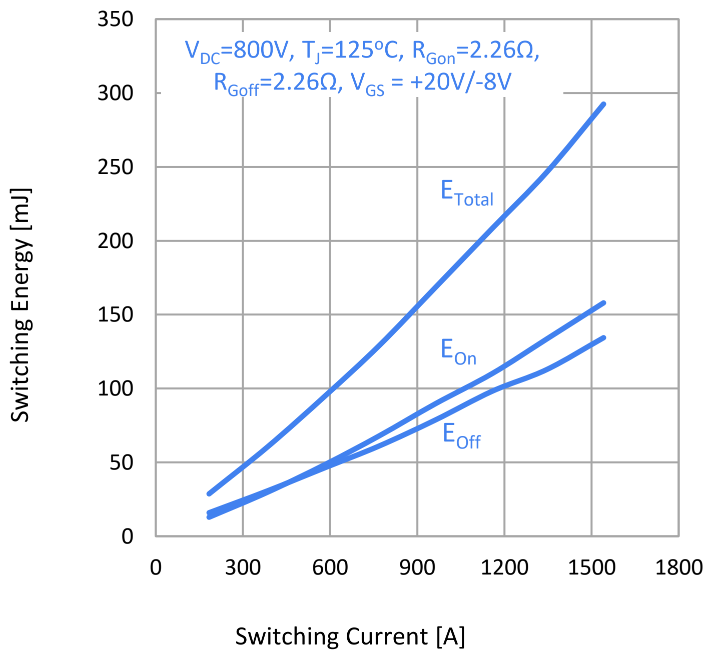

Figure 12: Switching Energy vs. External Gate Resistance

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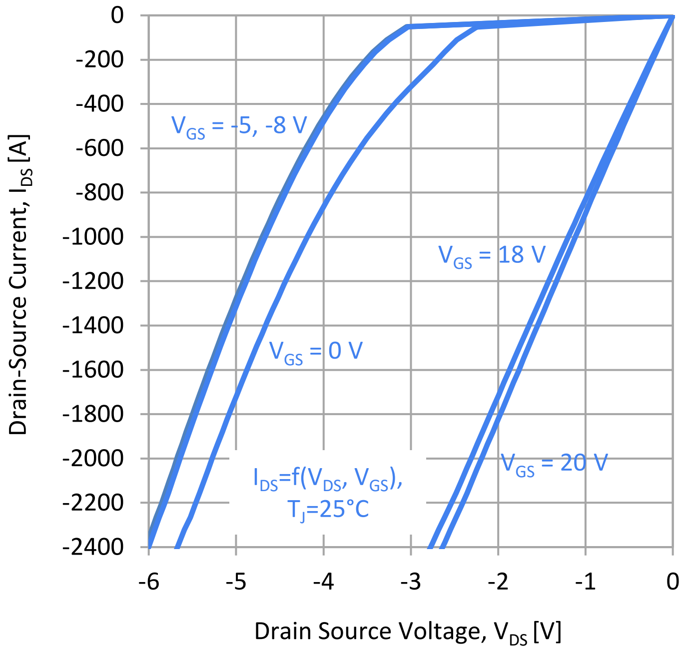

Figure 13: 3rd Quadrant Characteristics (25°C)

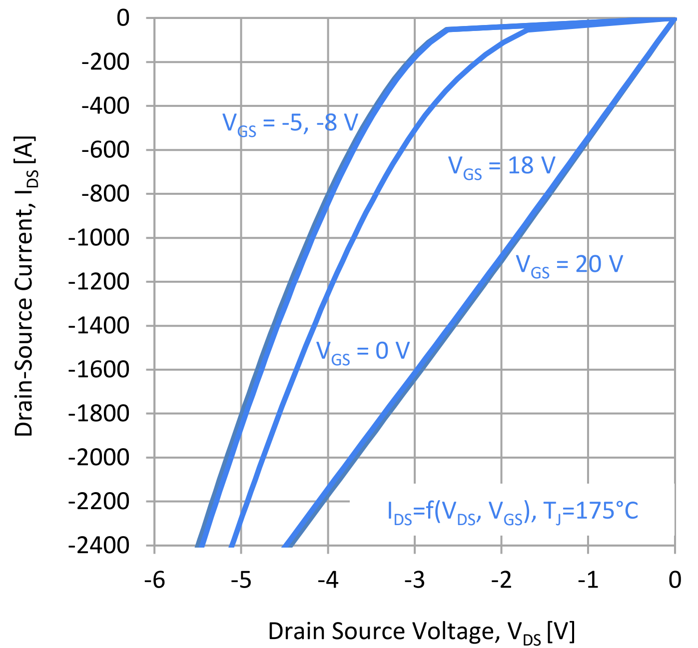

Figure 14: 3rd Quadrant Characteristics (175°C)

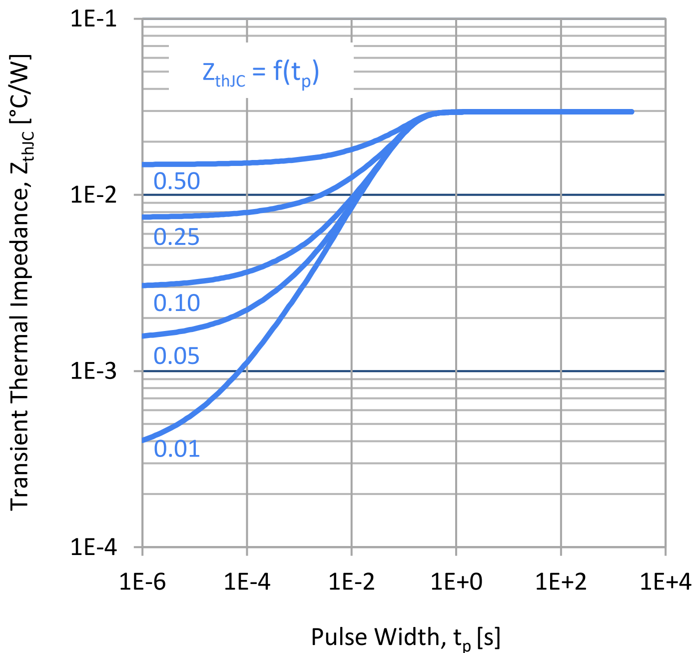

Figure 15: Transient Thermal Impedance

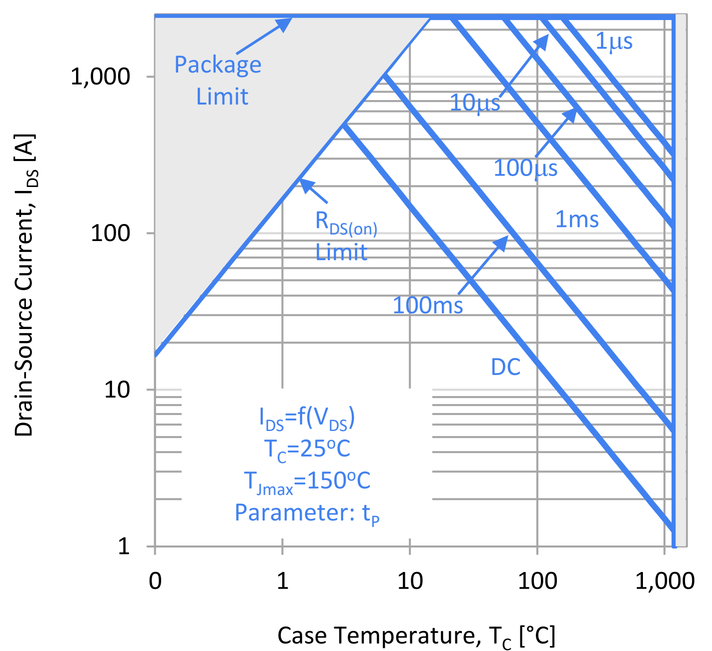

Figure 16: Maximum Power Dissipation vs. Case Temperature

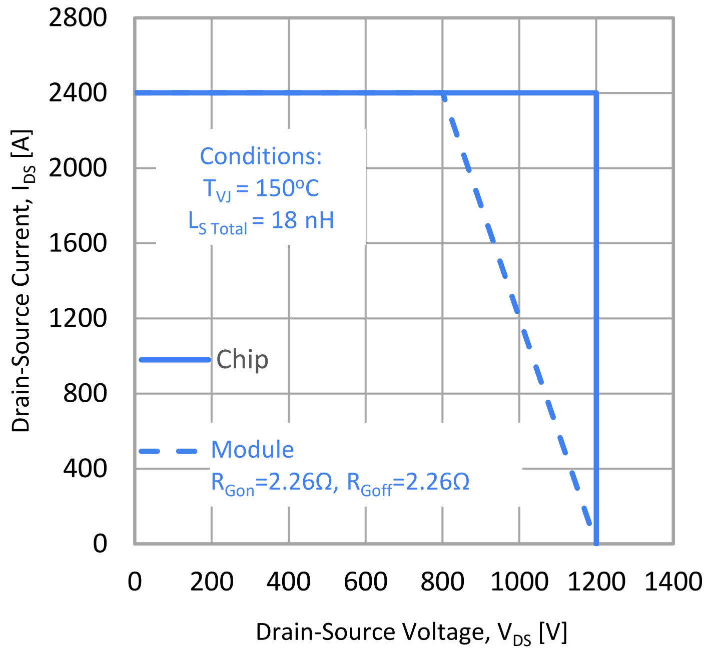

Figure 17: Reverse-Bias Safe Operating Area

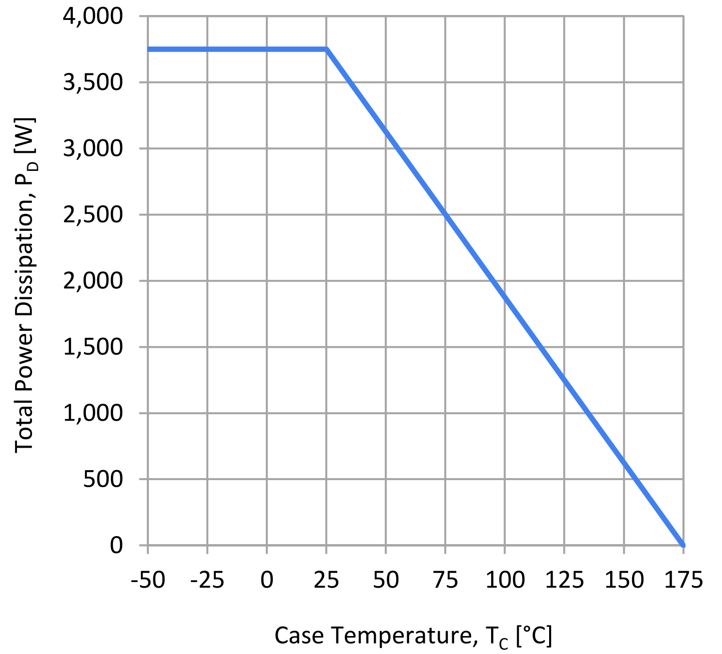

Figure 18: Maximum Power Dissipation vs. Case Temperature

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Module dimensions (millimeters)

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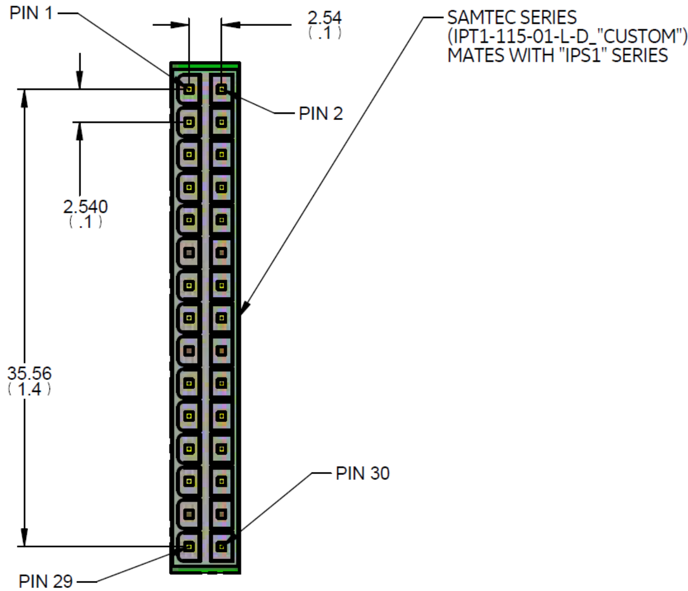
Electrical interface outline drawing



INTERCONNECT	
1	**
2	V NEG (-)
3	LOW-SIDE GATE
4	LOW-SIDE SOURCE
5	LOW-SIDE SOURCE
6	LOW-SIDE GATE
7	LOW-SIDE GATE
8	LOW-SIDE SOURCE
9	LOW-SIDE SOURCE
10	LOW-SIDE GATE
11	**
12	**
13	LS TEMP SEN
14	RTN TEMP SEN
15	HS TEMP SEN
16	**
17	**
18	**
19	HIGH-SIDE GATE
20	HIGH-SIDE SOURCE
21	HIGH-SIDE SOURCE
22	HIGH-SIDE GATE
23	HIGH-SIDE GATE
24	HIGH-SIDE SOURCE
25	HIGH-SIDE SOURCE
26	HIGH-SIDE GATE
27	**
28	**
29	**
30	V POS (+)

**NO CONNECT

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

SiC.Products@ge.com

GE Aerospace
2705 Gateway Dr.
Pompano Beach, FL 33069
(954) 984-2400

Document revisions
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