



1200V Half-Bridge Silicon Carbide Power Module

GE12160CEA3

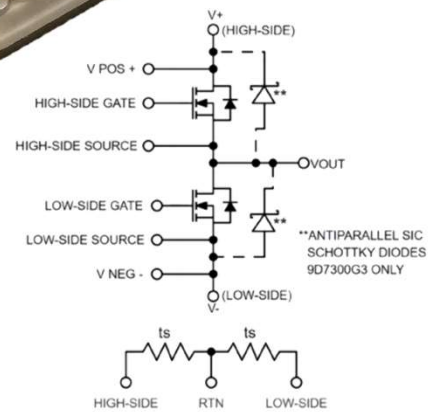
V_{DS} : 1200 V I_{DS} : 1425 A

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
- Integrated temperature sensing
- Dedicated DESAT Pin and Source-Kelvin Pin
- AlSiC Baseplate and Si_3N_4 AMB Substrate



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

Symbols	Parameters	Min.	Typ.	Max.	Unit	Test Conditions	Notes
I_{DS}	Continuous Drain Current			1425		$V_{GS} = 20\text{ V}, T_c = 25^\circ\text{C}$	Per Switch
				999	A	$V_{GS} = 20\text{ V}, T_c = 100^\circ\text{C}$	
				816		$V_{GS} = 20\text{ V}, T_c = 125^\circ\text{C}$	
$I_{DS,pulse}$	Pulsed Drain Current			2850	A	$T_c = 25^\circ\text{C}, t_p = 1\text{ ms}$	
V_{DSmax}	Drain - Source Breakdown Voltage	1200			V	$V_{GS} = 0\text{ V}, I_{DS} = 100\ \mu\text{A}$	
V_{GSmax}	Maximum Gate - Source Voltage			-15/+23	V	$V_{DS} = 0\text{ V}$	
V_{GSop}	Recommended Gate - Source Voltage		-5/+20		V		
T_{Jmax}	Junction Temperature			175	$^\circ\text{C}$		
T_c	Case Temperature Range	-55		150	$^\circ\text{C}$		
T_{STG}	Storage Temperature Range	-55		150	$^\circ\text{C}$		
P_D	Power Dissipation			3750	W	$T_c = 25^\circ\text{C}$	Per Switch



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

Symbols	Parameters	Min.	Typ.	Max.	Unit	Test Conditions	Notes
I_{DS}	Continuous Drain Current			1425	A	$V_{GS} = 20\text{ V}, T_c = 25^\circ\text{C}$	Per Switch
$V_{GS(th)}$	Gate Threshold Voltage	2.5	2.8	4.5	V	$V_{GS} = V_{DS}, I_{DS} = 480\text{ mA}$	
I_{DSS}	Drain Leakage Current			0.3 4.8	mA	$V_{DS} = 1200\text{ V}, V_{GS} = 0\text{ V}, T_J = 25^\circ\text{C}$ $T_J = 200^\circ\text{C}$	
I_{GSS}	Gate-Source Leakage Current			480	nA	$V_{GS} = -15/+23\text{ V}$	
$R_{DS(on)}$	On State Resistance (Device Only)		1.0 1.9	1.5 2.3	m Ω	$V_{GS} = 20\text{ V}, I_{DS} = 475\text{ A}, T_J = 25^\circ\text{C}$ $T_J = 175^\circ\text{C}$	Per Switch
$R_{G(int)}$	Gate-Source series resistance		0.90		Ω	$V_{GS} = 0\text{ V}, f = 100\text{ kHz}, T_c = 25^\circ\text{C}$	

MOSFET Dynamic Characteristics per switch @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

Symbols	Parameters	Min.	Typ.	Max.	Unit	Test Conditions	Notes
C_{iss}	Input Capacitance		90		nF		
C_{oss}	Output Capacitance		8.5		nF	$V_{GS} = 0\text{ V}$ $V_{DS} = 600\text{ V}$	
C_{rss}	Reverse Transfer Capacitance		0.25		nF	$f = 100\text{ kHz}$	
E_{on}	Turn-On Switching Energy		82		mJ	$V_{GS} = 0\text{ V to } +20\text{ V}$	
E_{off}	Turn-Off Switching Energy		85		mJ	$V_{DS} = 600\text{ V}$ $I_{DS} = 1600\text{ A}$	
t_r	Rise Time		195		ns	$R_{Gon} = 2.2\ \Omega$	
t_f	Fall Time		78		ns	$R_{Goff} = 1.5\ \Omega$	
Q_G	Total Gate Charge		3744		nC	$V_{GS} = 0\text{ to } 18\text{ V}$	
Q_{GD}	Gate-Drain Charge		1608		nC	$V_{DS} = 900\text{ V}$	
Q_{GS}	Gate-Source Charge		528		nC	$I_{DS} = 720\text{ A}$	

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

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

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	$^\circ\text{C/W}$	JESD51-14	Per Switch



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	3			kV	AC 50 Hz, 1 min, 25°C	
CTI	Comparative Tracking Index		600				
M_s	Mounting Torque			4.0	N-m	Power Terminals	
				2.5		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				



Typical performance: **GE12160CEA3**

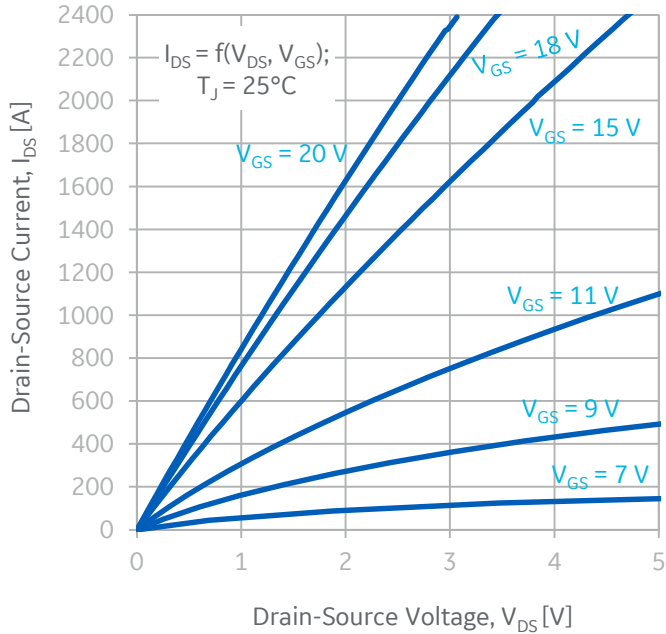


Figure 1: Output Characteristics (25°C)

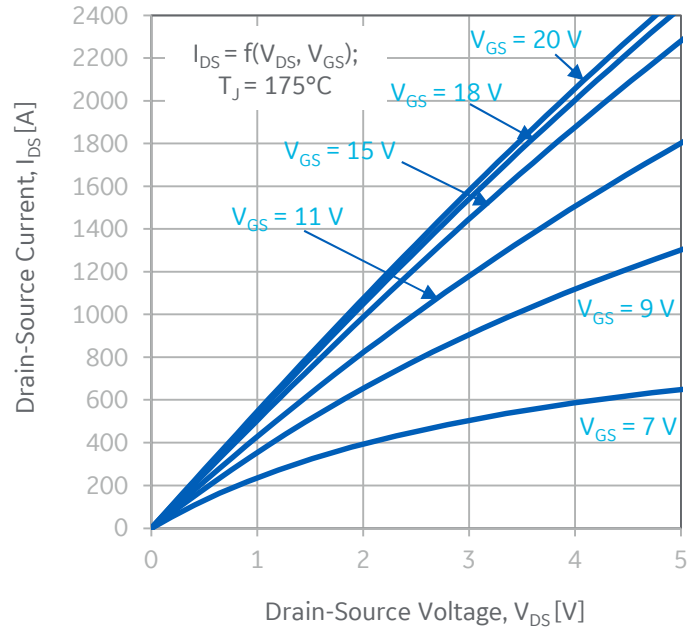


Figure 2: Output Characteristics (175°C)

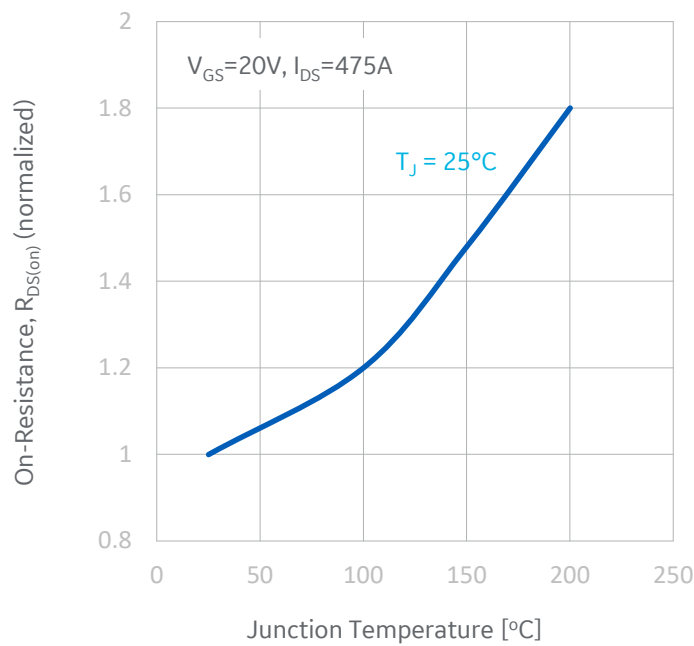


Figure 3: Normalized On-state Resistance vs. Temperature

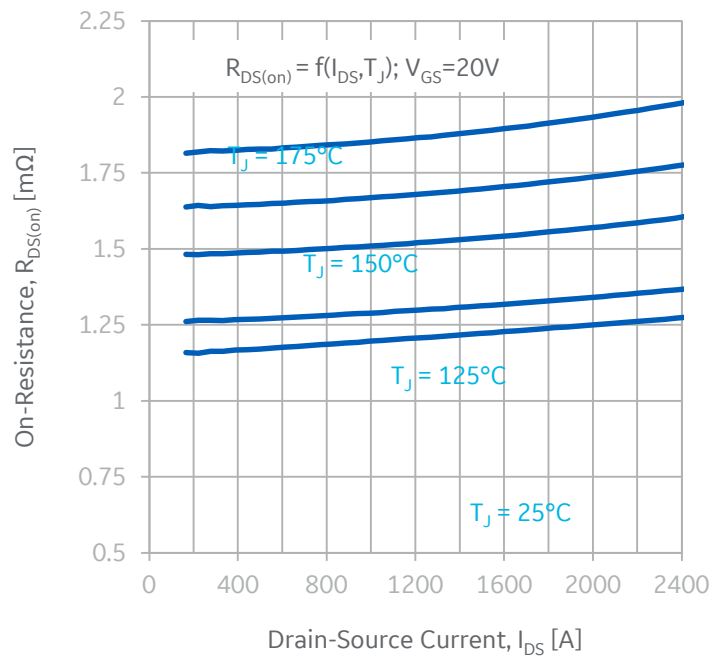


Figure 4: Module Drain-Source On-state Resistance



Typical performance: **GE12160CEA3**

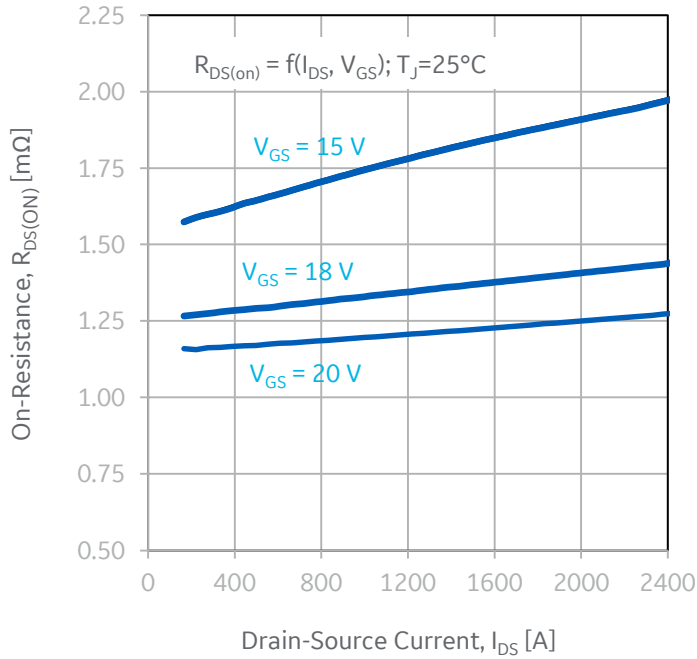


Figure 5: Module Drain-Source On-state Resistance

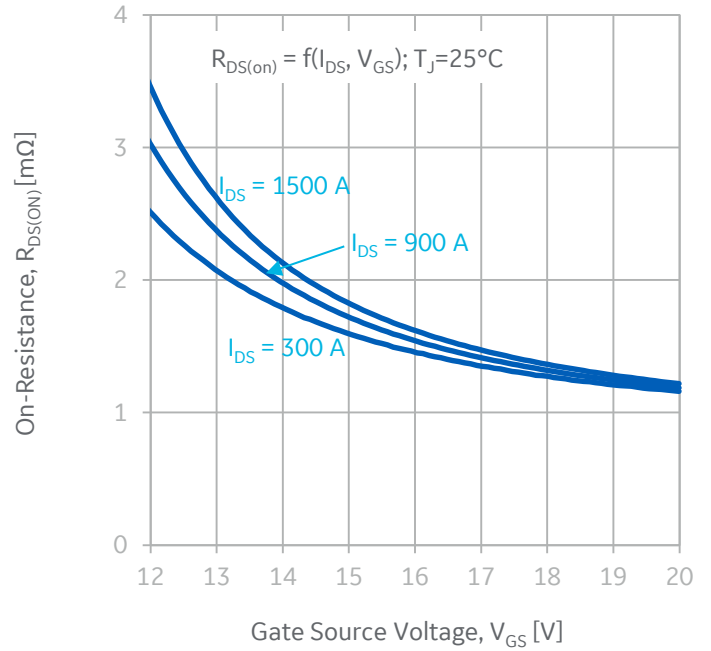


Figure 6: Drain-Source On-state Resistance vs. Gate Voltage

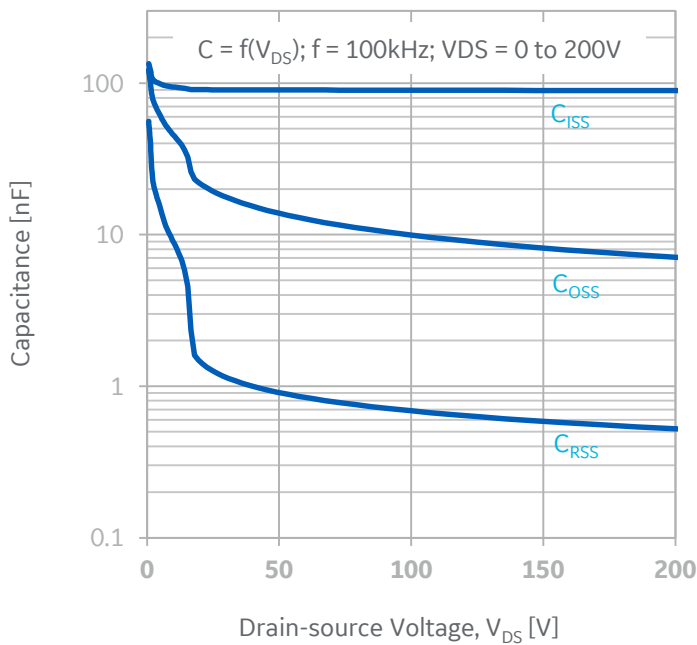


Figure 7: Junction Capacitances to 200 V

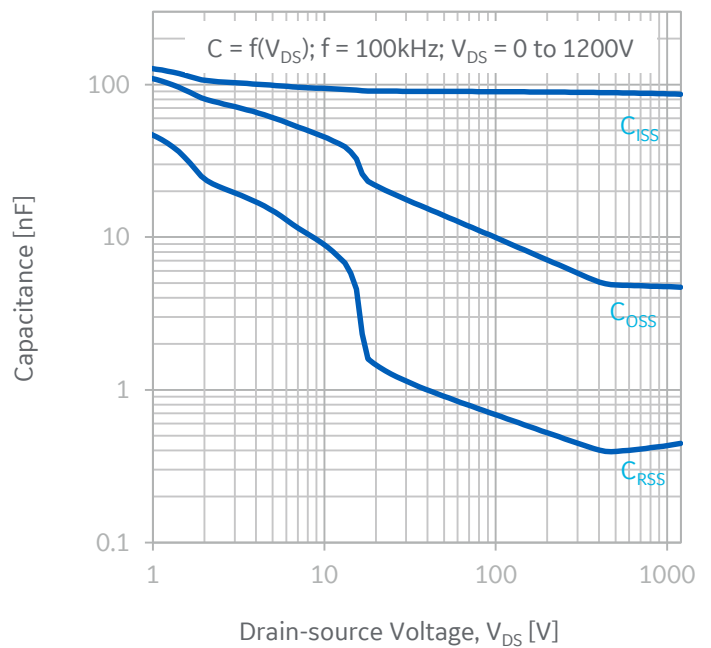


Figure 8: Junction Capacitances to 1200 V



Typical performance: **GE12160CEA3**

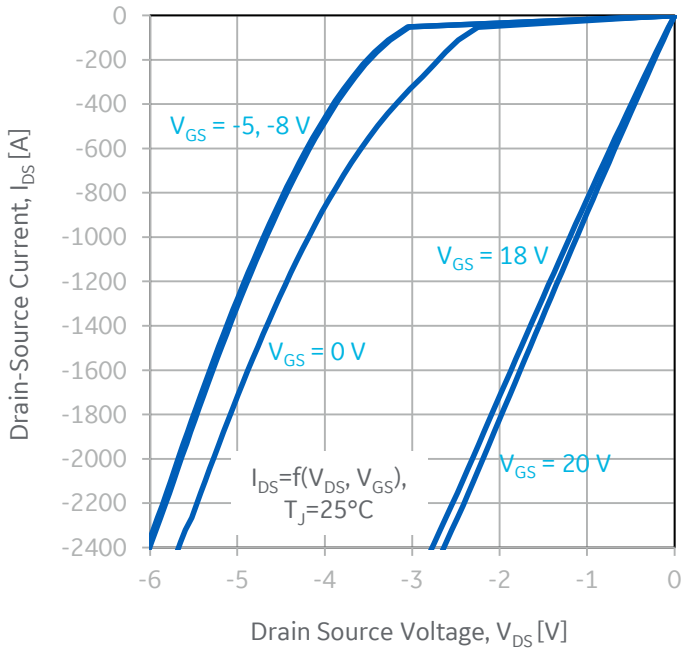


Figure 9: 3rd Quadrant Characteristics (25°C)

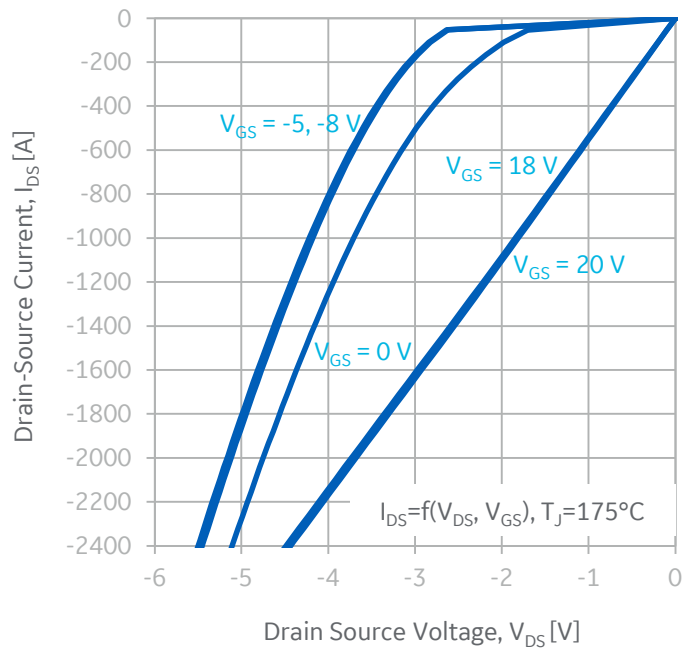


Figure 10: 3rd Quadrant Characteristics (175°C)

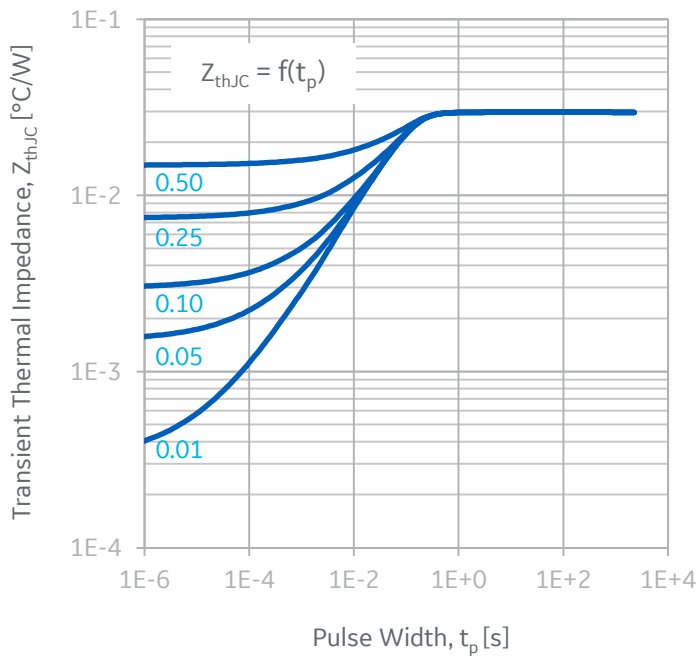


Figure 11: Transient Thermal Impedance

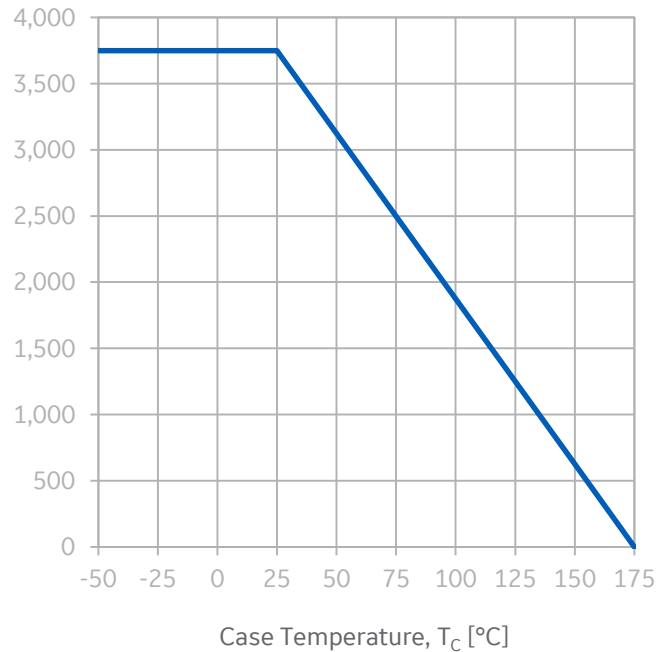
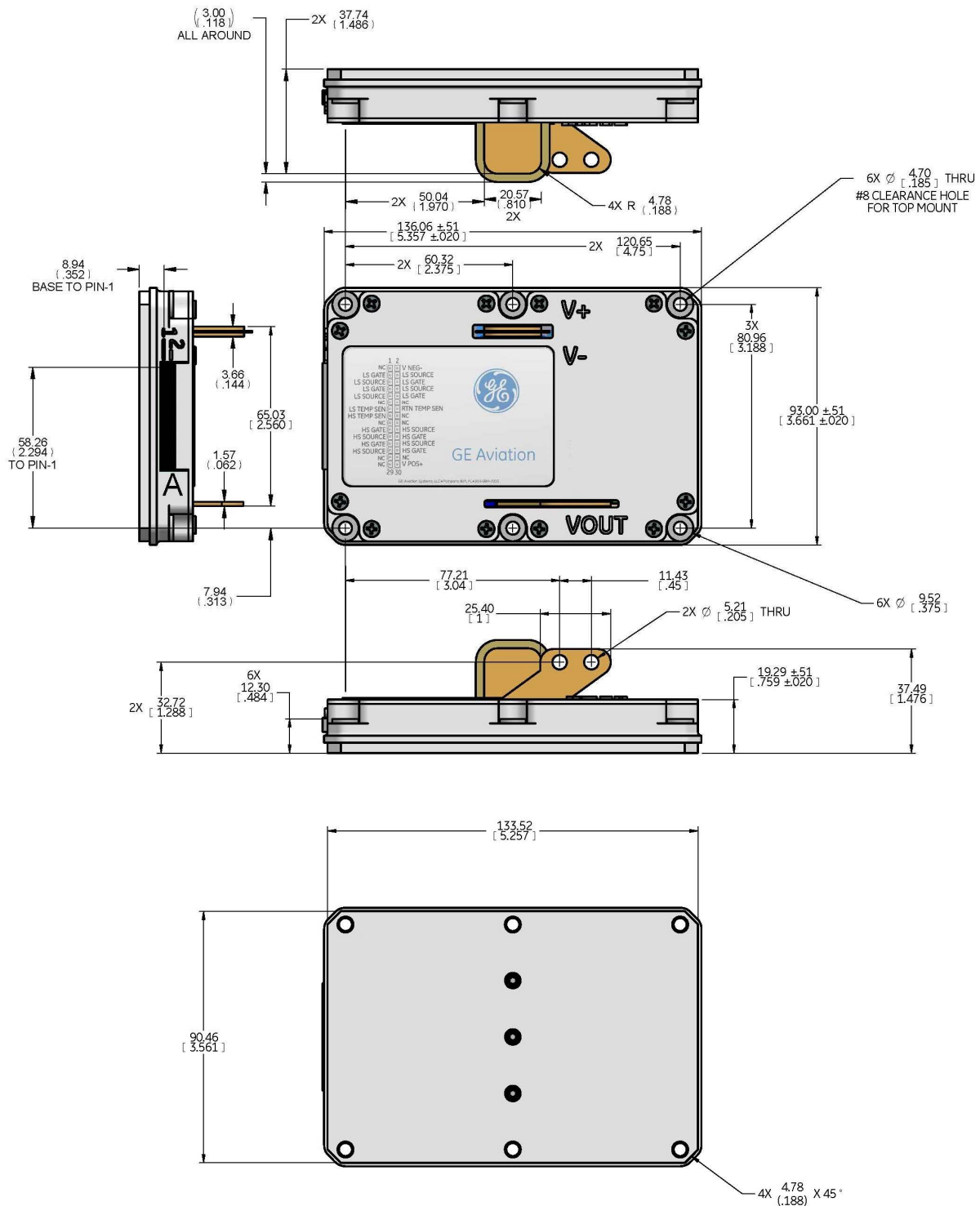


Figure 12: Maximum Power Dissipation vs. Case Temperature

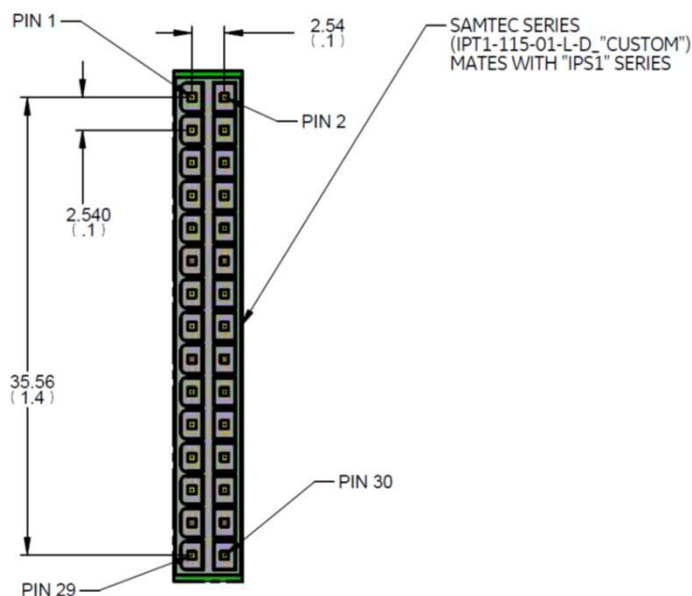


Module dimensions (millimeters)





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	LOW-SIDE TEMP SENSE
14	RTN TEMP SENSE
15	HIGH-SIDE TEMP SENSE
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 Connection

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

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Document revisions

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