



1200V Half-Bridge Silicon Carbide Power Module

GE12160CEA3

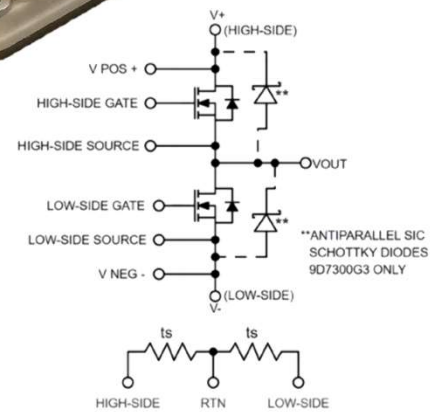
V_{DS} : 1200 V I_{DS} : 1425 A

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**

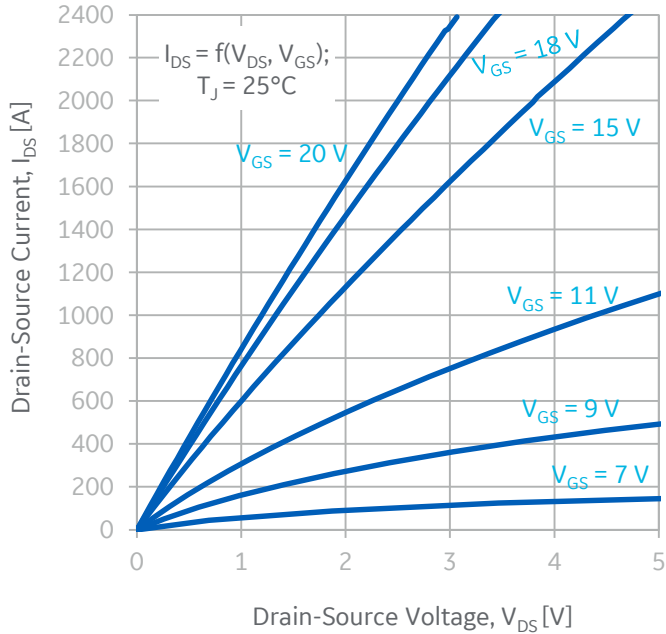


Figure 1: Output Characteristics (25°C)

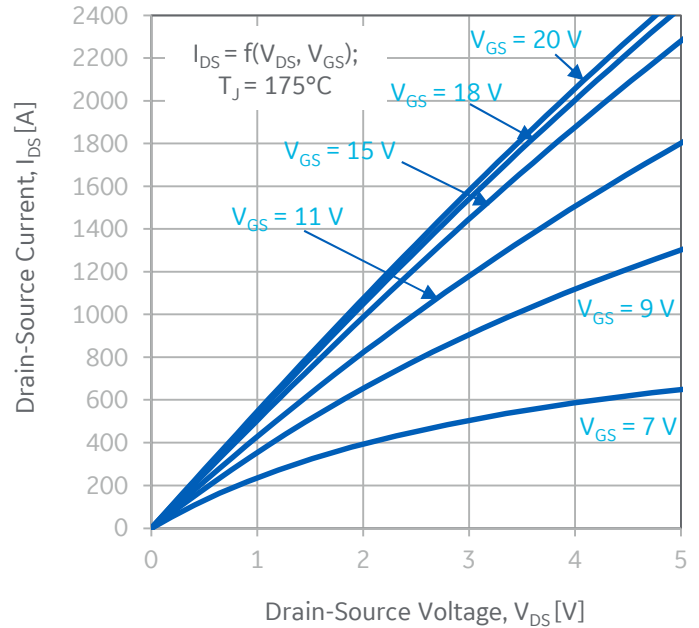


Figure 2: Output Characteristics (175°C)

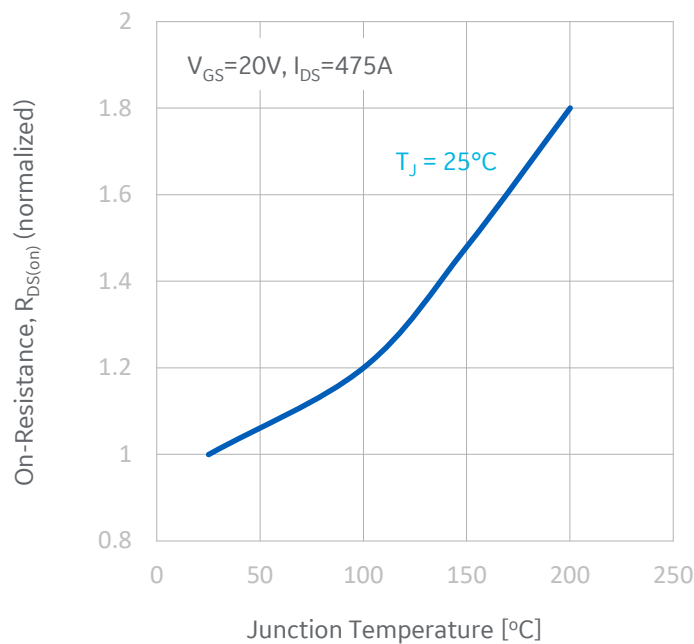


Figure 3: Normalized On-state Resistance vs. Temperature

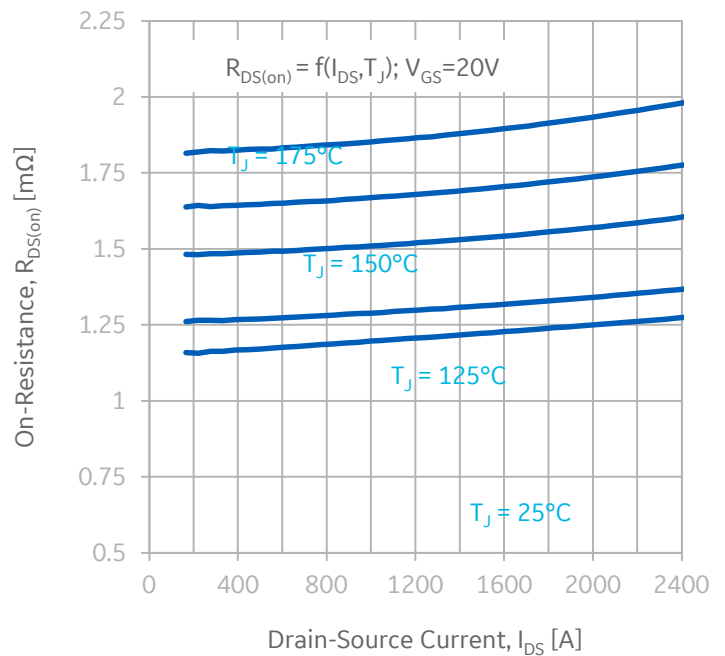


Figure 4: Module Drain-Source On-state Resistance



Typical performance: **GE12160CEA3**

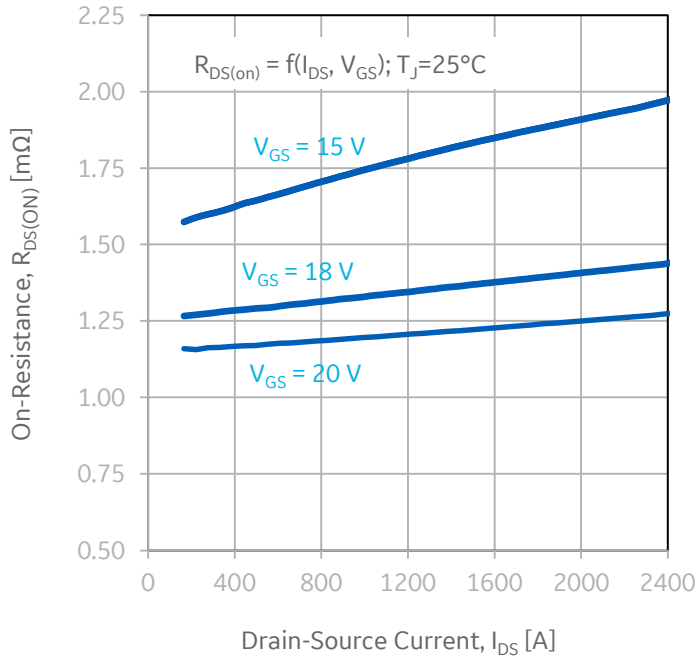


Figure 5: Module Drain-Source On-state Resistance

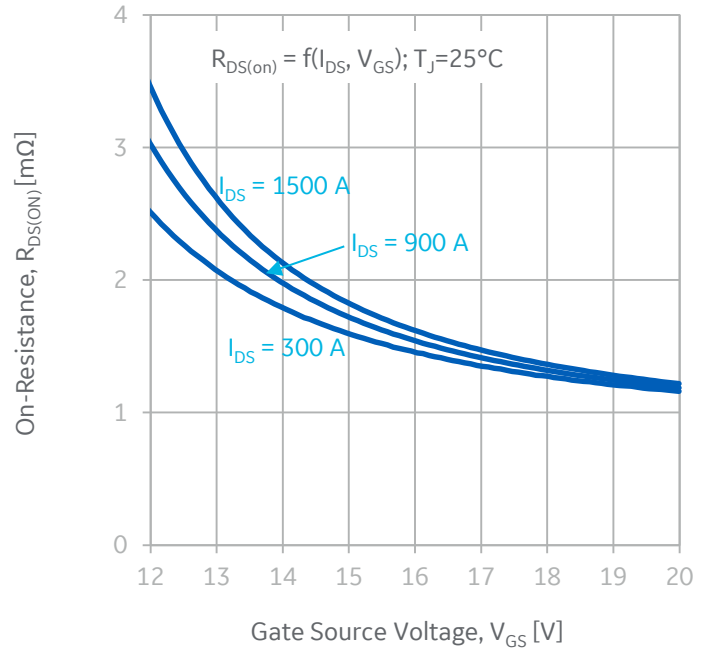


Figure 6: Drain-Source On-state Resistance vs. Gate Voltage

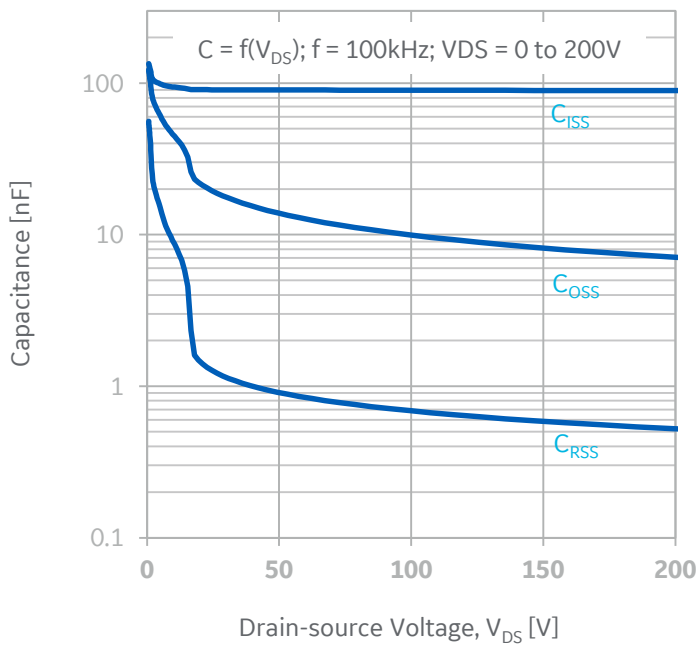


Figure 7: Junction Capacitances to 200 V

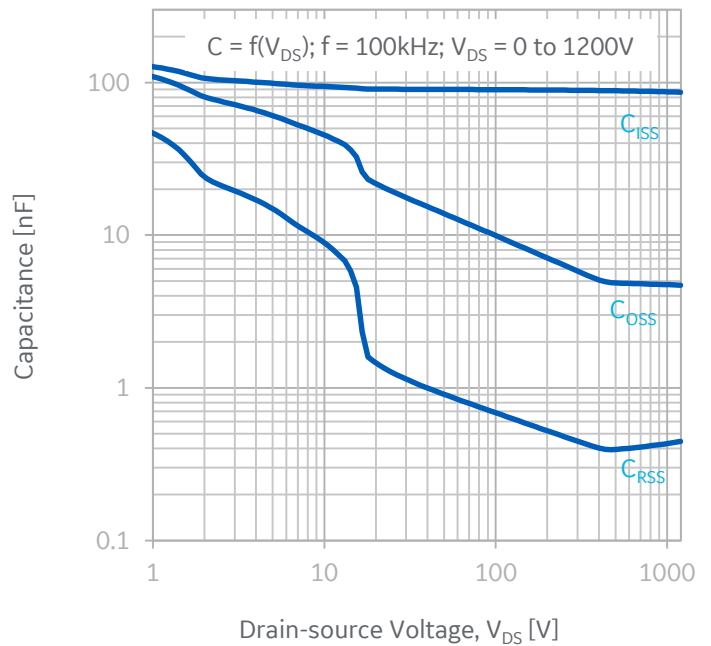


Figure 8: Junction Capacitances to 1200 V



Typical performance: **GE12160CEA3**

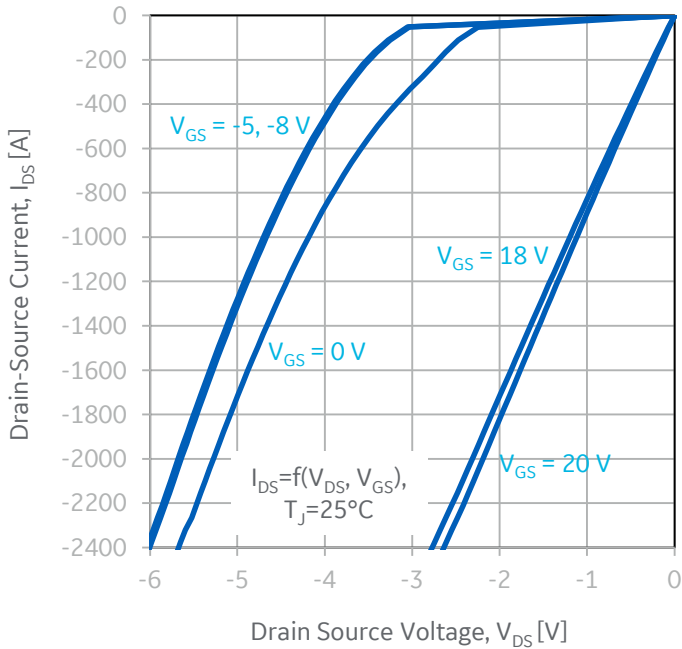


Figure 9: 3rd Quadrant Characteristics (25°C)

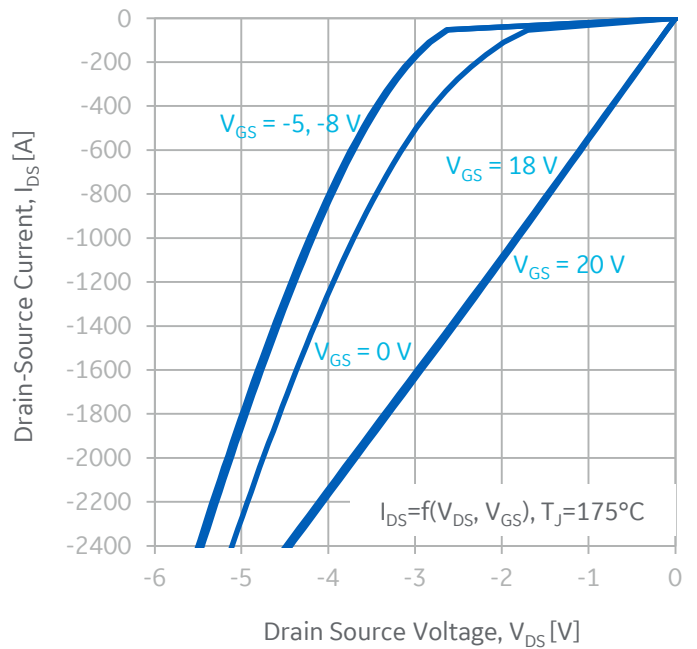


Figure 10: 3rd Quadrant Characteristics (175°C)

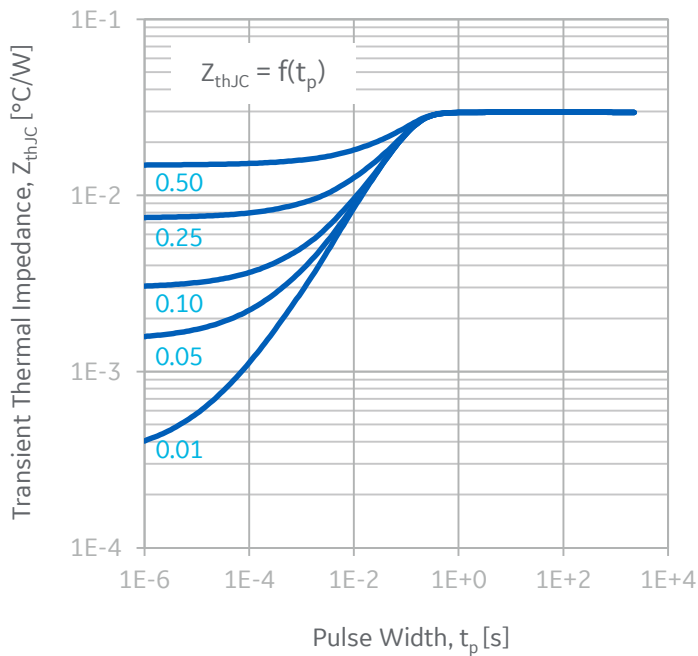


Figure 11: Transient Thermal Impedance

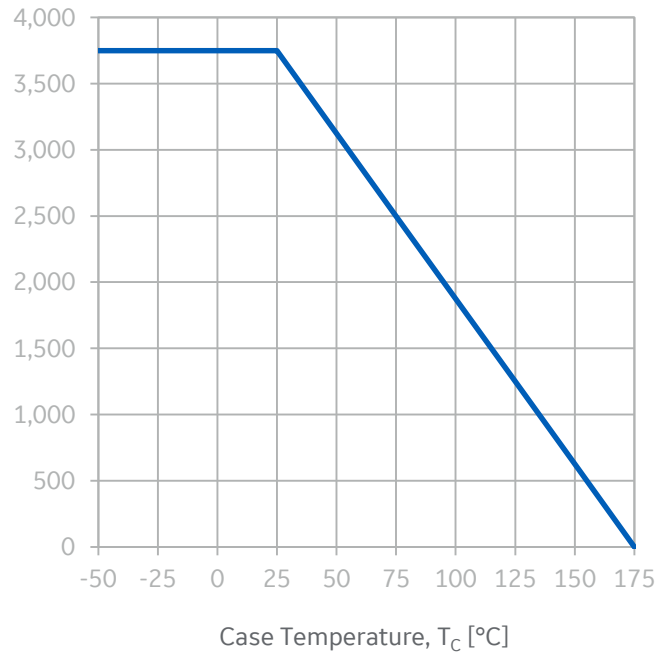
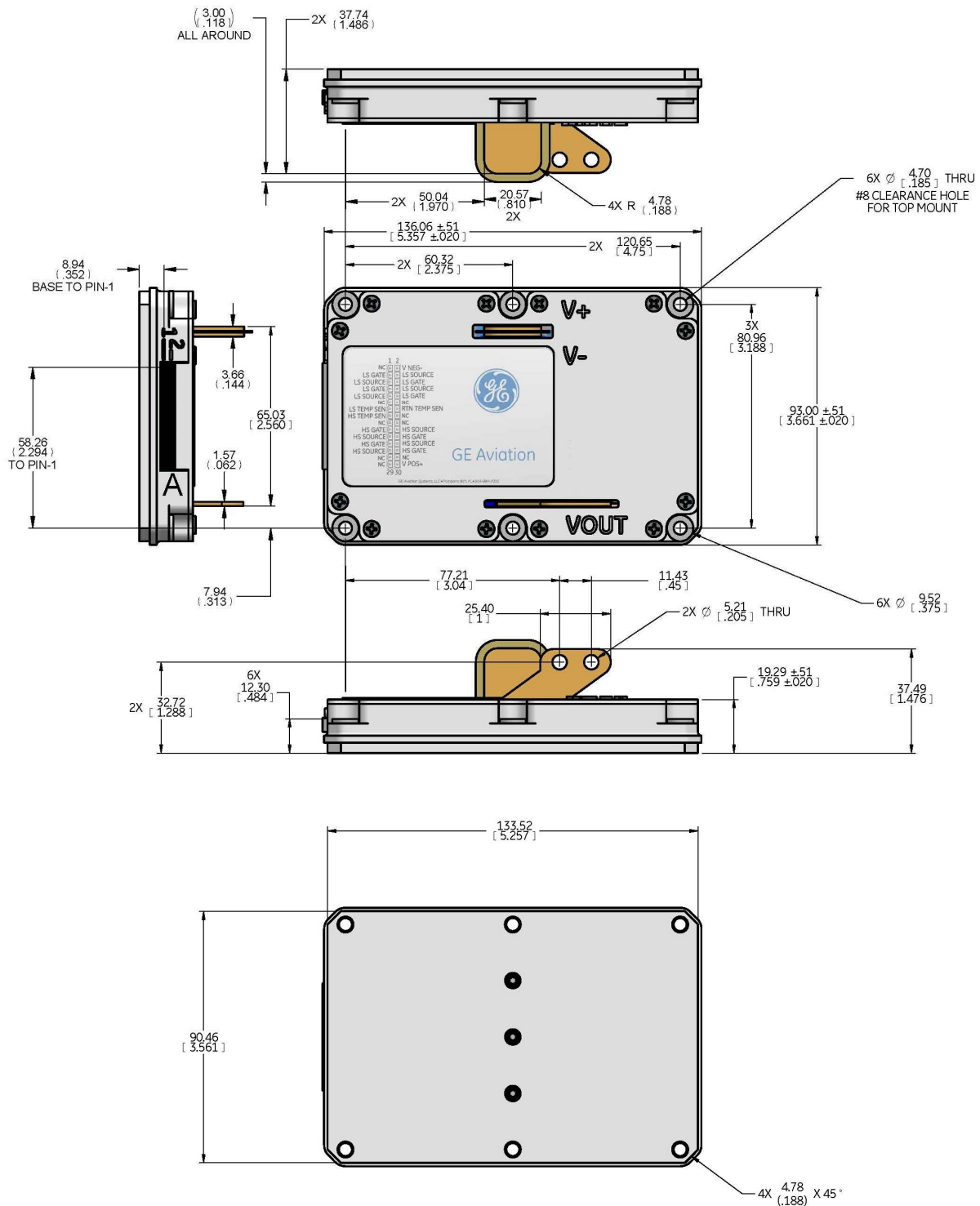


Figure 12: Maximum Power Dissipation vs. Case Temperature

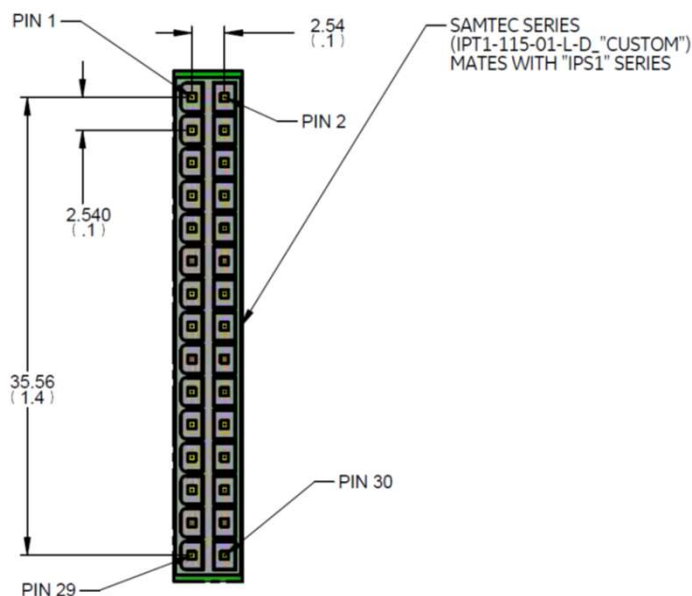


Module dimensions (millimeters)





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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