



# 1700V Dual Silicon Carbide Power Module

## GE17042BCA3

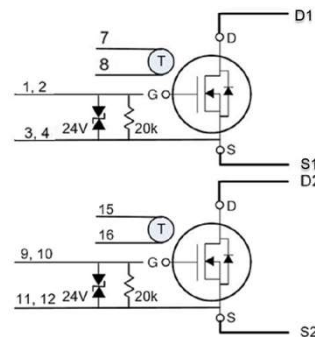
$V_{DS}$ : 1700 V  $I_{DS}$ : 425 A

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



## Features

- Highly reliable GE SiC MOSFET devices
- Low  $R_{DS(ON)}$  (3.75 m $\Omega$ ) (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
- Integrated temperature sensing
- AlSiC Baseplate and Si<sub>3</sub>N<sub>4</sub> 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          |      |        | 425     |                  | $V_{GS} = 20\text{ V}, T_c = 25^\circ\text{C}$   | Per Switch |
|                |                                   |      |        | 300     | A                | $V_{GS} = 20\text{ V}, T_c = 100^\circ\text{C}$  |            |
|                |                                   |      |        | 245     |                  | $V_{GS} = 20\text{ V}, T_c = 125^\circ\text{C}$  |            |
| $I_{DS,pulse}$ | Pulsed Drain Current              |      |        | 850     | A                | $T_c = 25^\circ\text{C}, t_p = 1\text{ ms}$      |            |
| $V_{DSmax}$    | Drain - Source Breakdown Voltage  | 1700 |        |         | 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                 |      |        | 1250    | W                | $T_c = 25^\circ\text{C}$                         |            |



(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          |      |              | 425          | A          | $V_{GS} = 20\text{ V}, T_c = 25^\circ\text{C}$   | Per Switch |
| $V_{GS(th)}$ | Gate Threshold Voltage            | 2.5  | 2.9          | 4.5          | V          | $V_{GS} = V_{DS}, I_{DS} = 160\text{ mA}$  |            |
| $I_{DSS}$    | Drain Leakage Current             |      |              | 0.10<br>1.6  | mA         | $V_{DS} = 1700\text{ V}, V_{GS} = 0\text{ V}, T_J = 25^\circ\text{C}$<br>$T_J = 175^\circ\text{C}$ |            |
| $I_{GSS}$    | Gate-Source Leakage Current       |      |              | 160          | nA         | $V_{GS} = -15/+23\text{ V}$  |            |
| $R_{DS(on)}$ | On State Resistance (Device Only) |      | 3.75<br>6.70 | 4.45<br>8.25 | m $\Omega$ | $V_{GS} = 20\text{ V}, I_{DS} = 425\text{ A}, T_J = 25^\circ\text{C}$<br>$T_J = 175^\circ\text{C}$ | Per Switch |
| $R_{G(int)}$ | Gate-Source Series Resistance     |      | 1.42         |              | $\Omega$   | $V_{GS} = 0\text{ V}, f = 100\text{ kHz}, T_c = 25^\circ\text{C}$                                  |            |

**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            |      | 29.10 |      | nF   | $V_{GS} = 0\text{ V}$<br>$V_{DS} = 900\text{ V}$<br>$f = 100\text{ kHz}$  |                                     |
| $C_{oss}$ | Output Capacitance           |      | 1.08  |      | nF   |   |                                     |
| $C_{rss}$ | Reverse Transfer Capacitance |      | 0.08  |      | nF   |   |                                     |
| $E_{on}$  | Turn-On Switching Energy     |      | 9.5   |      | mJ   | $V_{GS} = -8\text{ V to } +20\text{ V}$<br>$V_{DS} = 900\text{ V}$<br>$I_{DS} = 450\text{ A}$<br>$R_{Gon} = R_{Goff} = 1.0\ \Omega$ | Tested in half-bridge configuration |
| $E_{off}$ | Turn-Off Switching Energy    |      | 9.1   |      | mJ   |   |                                     |
| $t_r$     | Rise Time                    |      | 28.9  |      | ns   |   |                                     |
| $t_f$     | Fall Time                    |      | 35.7  |      | ns   |   |                                     |
| $Q_G$     | Total Gate Charge            |      | 1207  |      | nC   | $V_{GS} = 0\text{ to } 18\text{ V}$<br>$V_{DS} = 900\text{ V}$<br>$I_{DS} = 240\text{ A}$   |                                     |
| $Q_{GD}$  | Gate-Drain Charge            |      | 525   |      | nC   |   |                                     |
| $Q_{GS}$  | Gate-Source Charge           |      | 186   |      | nC   |   |                                     |

**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 |      |      | 720  | A    | $V_{GS} = 0\text{ V}$  | 1.    |
| $V_{SD}$ | Diode Forward Voltage     |      | 4.65 |      | V    | $V_{GS} = 0\text{ V}, I_{SD} = 425\text{ A}, T_J = 25^\circ\text{C}$ |       |

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 |      | 0.10 | 0.12 | $^\circ\text{C/W}$ | 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            |       |

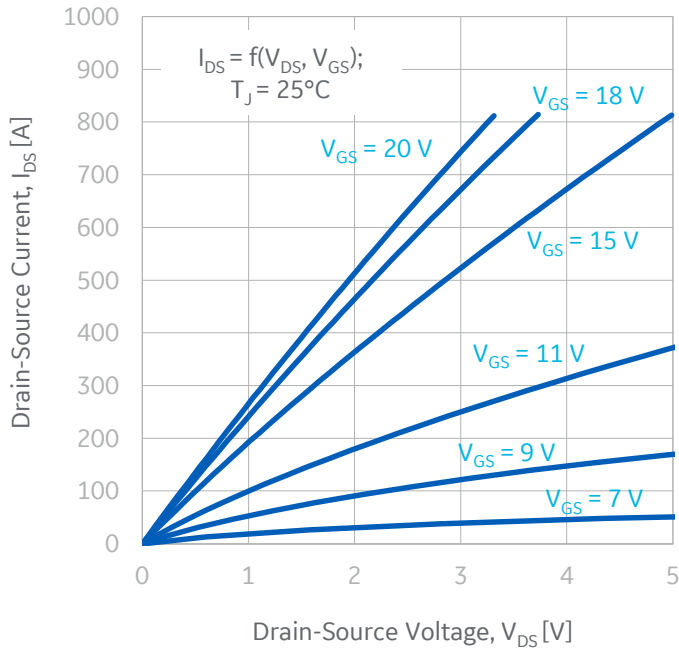
2. RTD is mounted directly over center-most die allowing direct reading of  $T_j$

## Module packaging data

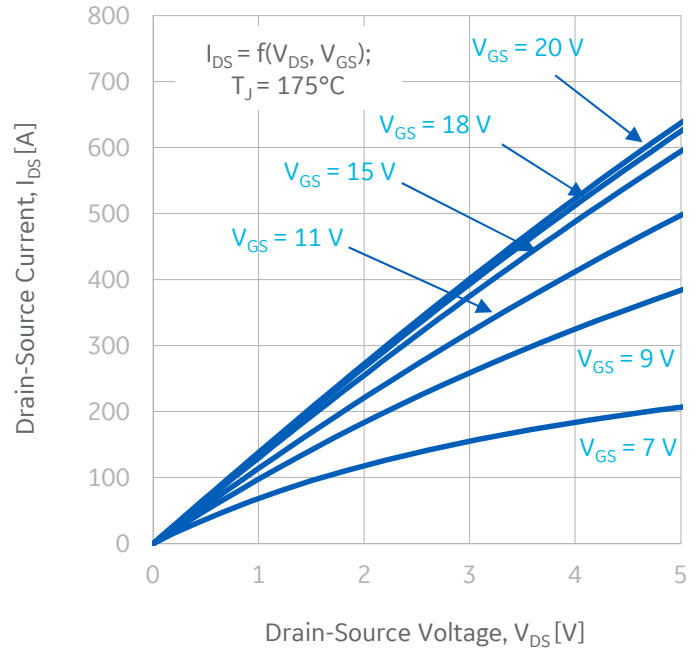
| Symbols    | Parameters                 | Min. | Typ.  | Max.       | Unit | Test Conditions              | Notes |
|------------|----------------------------|------|-------|------------|------|------------------------------|-------|
| $V_{Iso}$  | Case Isolation Voltage     | 4    |       |            | kV   | AC 50 Hz, 1 min, 25°C        |       |
| CTI        | Comparative Tracking Index |      | 600   |            |      |                              |       |
| $M_s$      | Mounting Torque            |      |       | 5.0<br>4.0 | N-m  | Power Terminals<br>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 |            |      |                              |       |



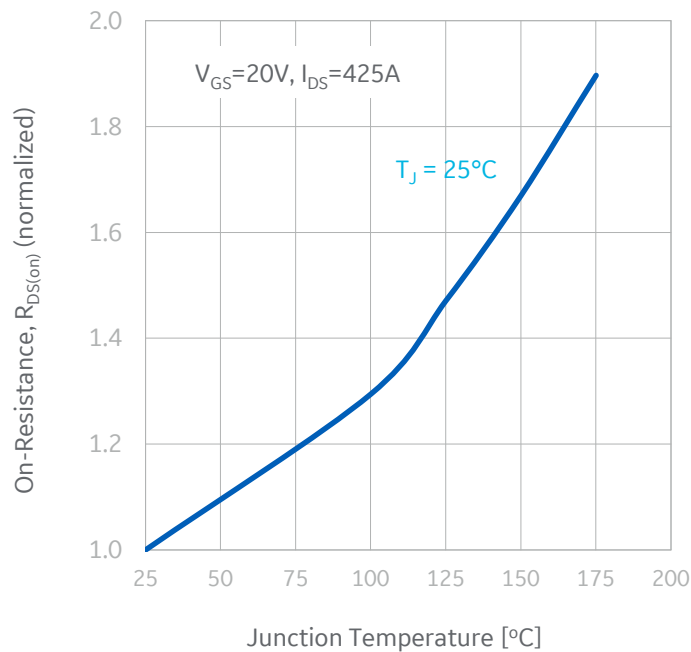
Typical performance: **GE17042CCA3**



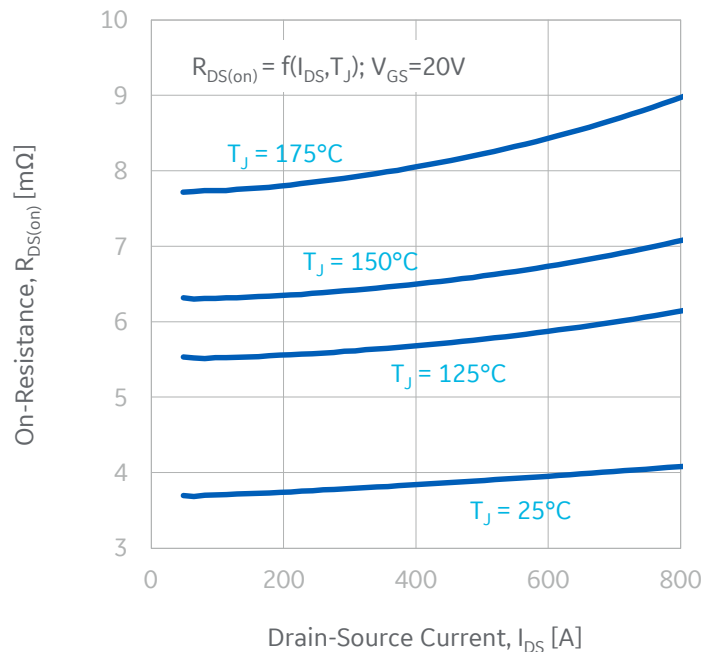
**Figure 1:** Output Characteristics (25°C)



**Figure 2:** Output Characteristics (175°C)



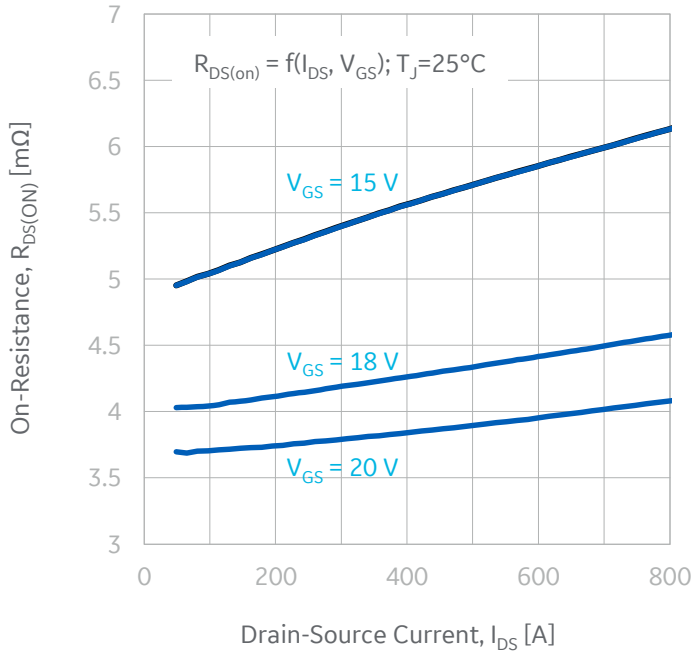
**Figure 3:** Normalized On-state Resistance vs. Temperature



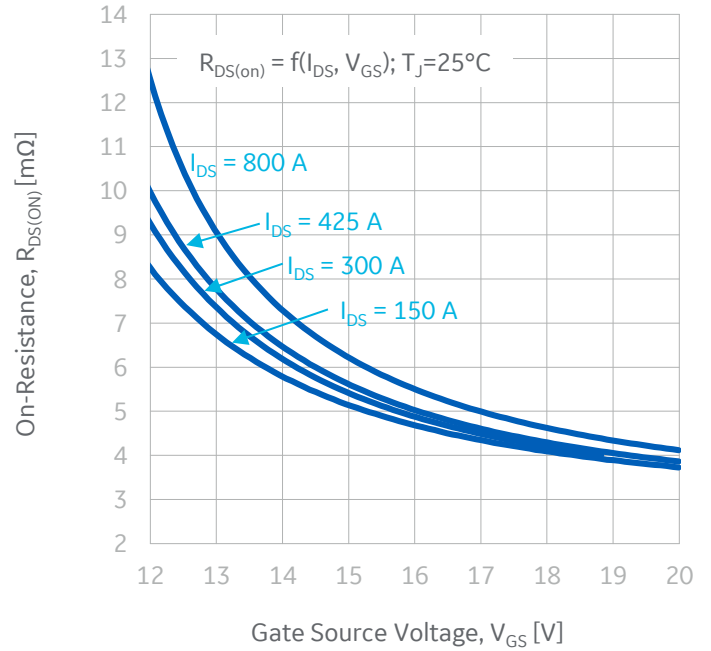
**Figure 4:** Module Drain-Source On-state Resistance



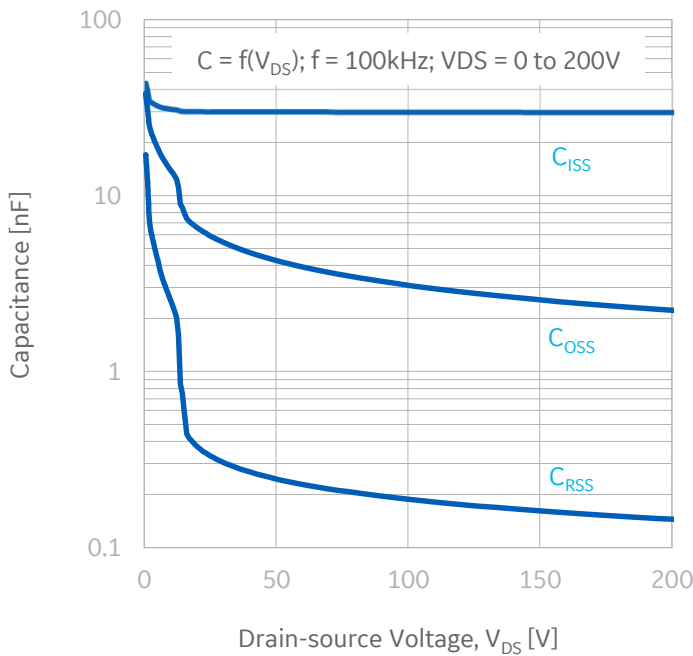
Typical performance: **GE17042CCA3**



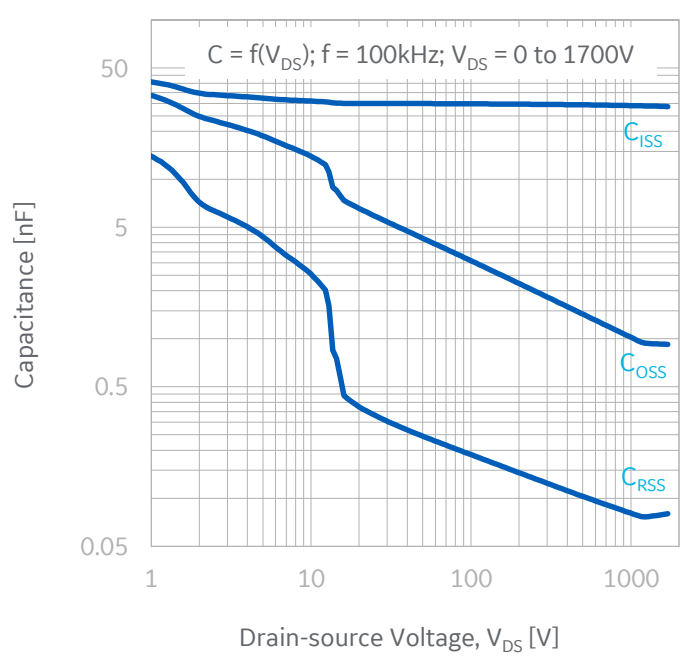
**Figure 5:** Module Drain-Source On-state Resistance



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



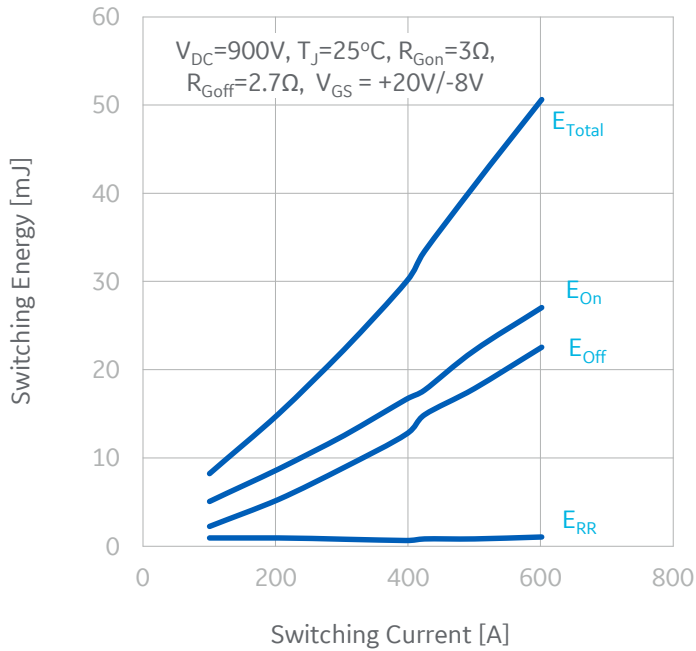
**Figure 7:** Junction Capacitances to 200 V



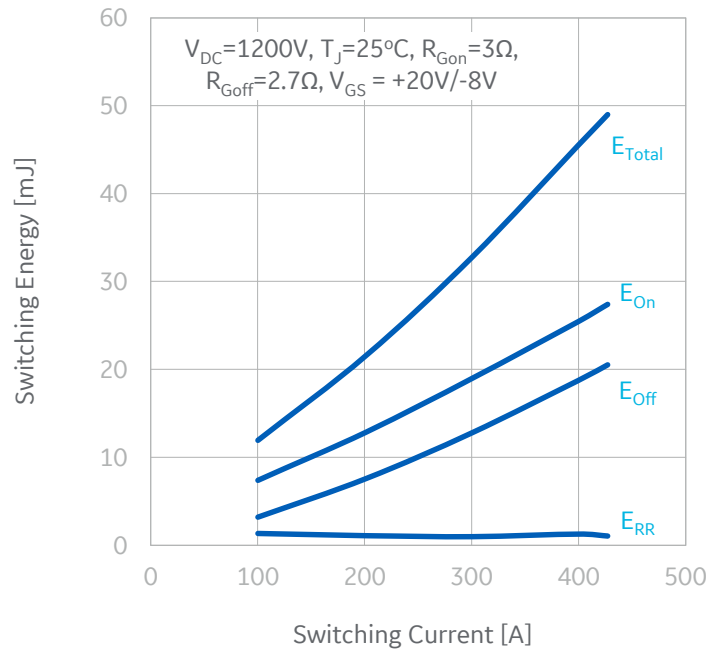
**Figure 8:** Junction Capacitances to 1700 V



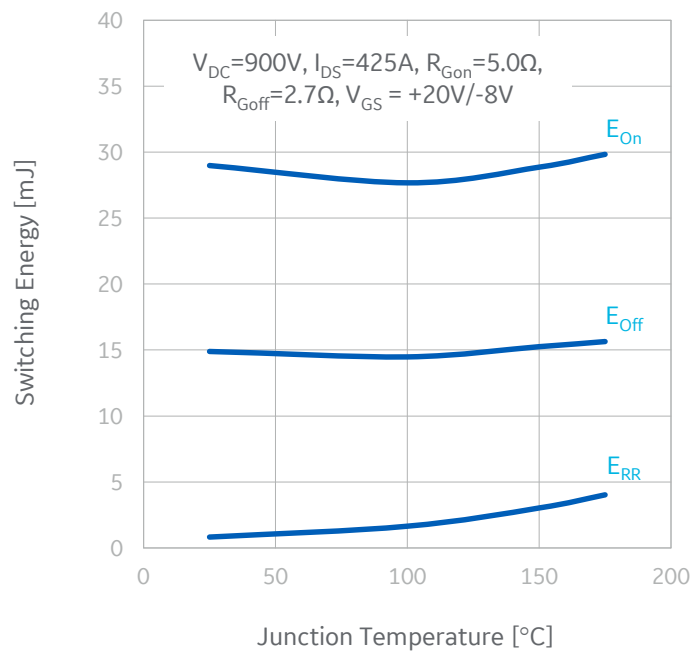
Typical performance: **GE17042CCA3**



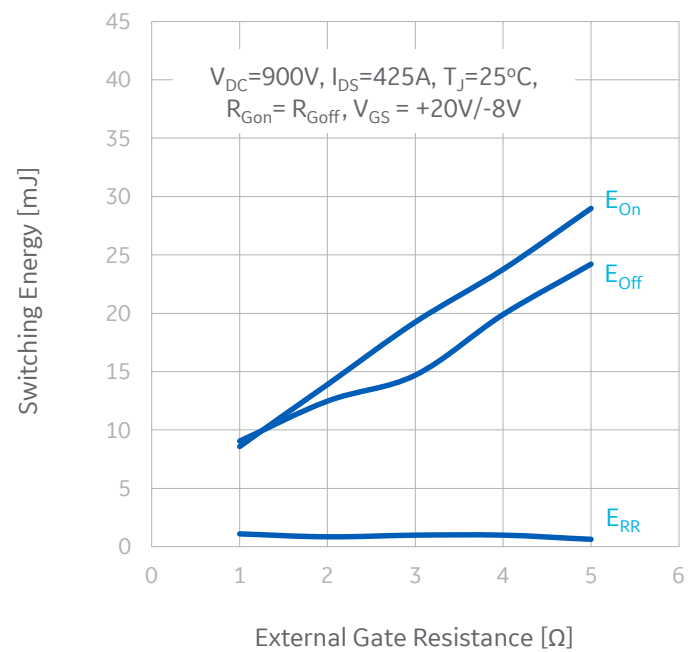
**Figure 9:** Switching Energy vs. Drain Current (900 V)



**Figure 10:** Switching Energy vs. Drain Current (1200 V)



**Figure 11:** Switching Energy vs. Junction Temperature



**Figure 12:** Switching Energy vs. Gate Resistance



Typical performance: GE17042CCA3

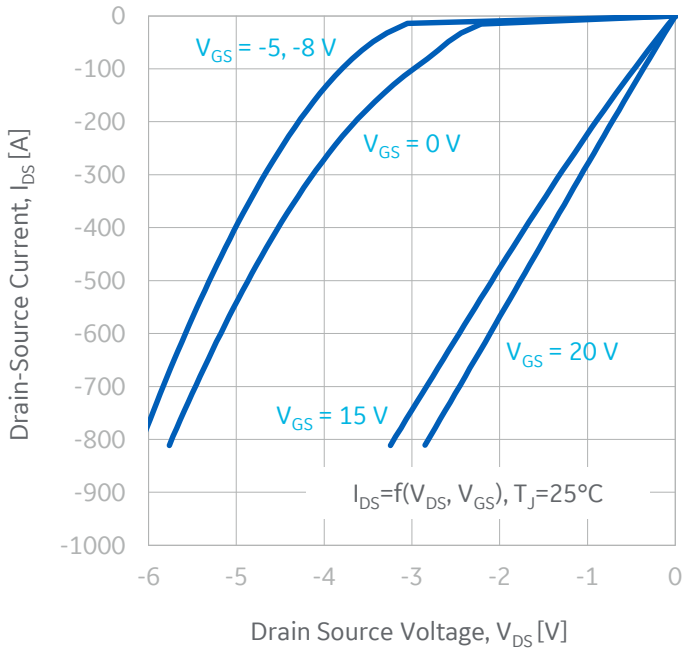


Figure 13: 3<sup>rd</sup> Quadrant Characteristics (25°C)

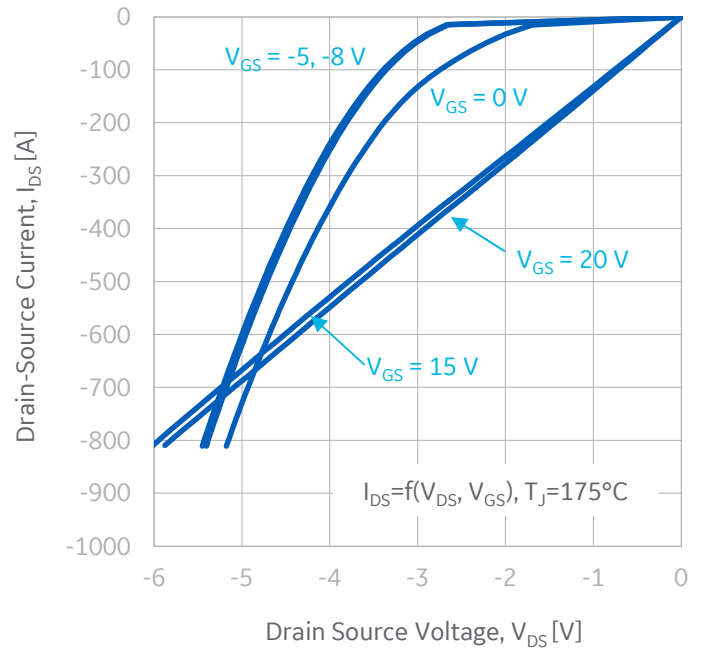


Figure 14: 3<sup>rd</sup> Quadrant Characteristics (175°C)

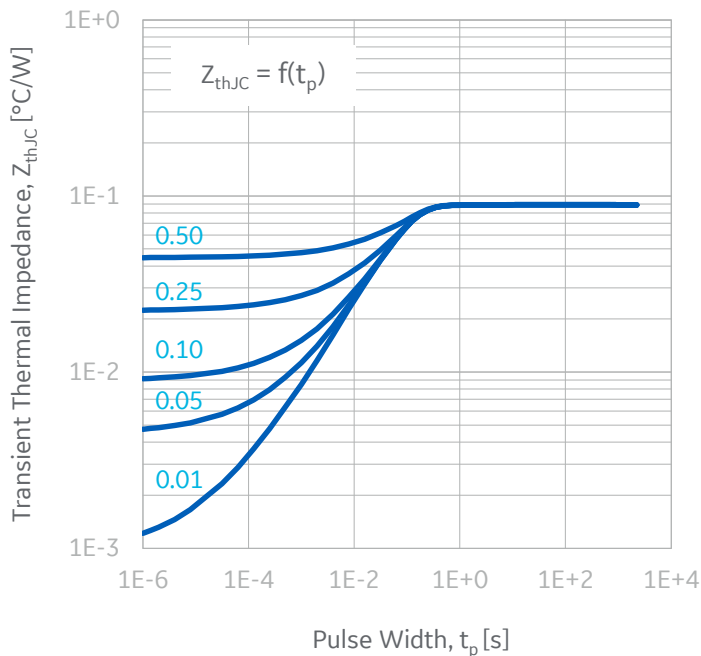


Figure 15: Transient Thermal Impedance

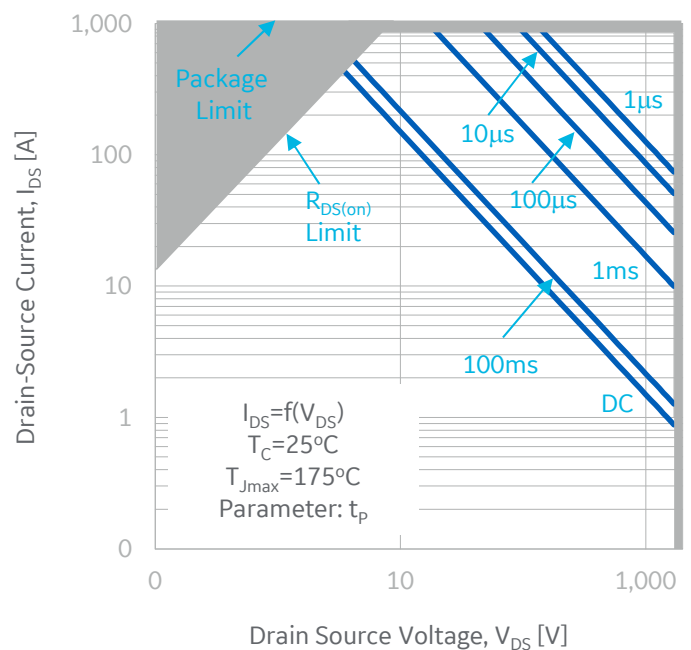
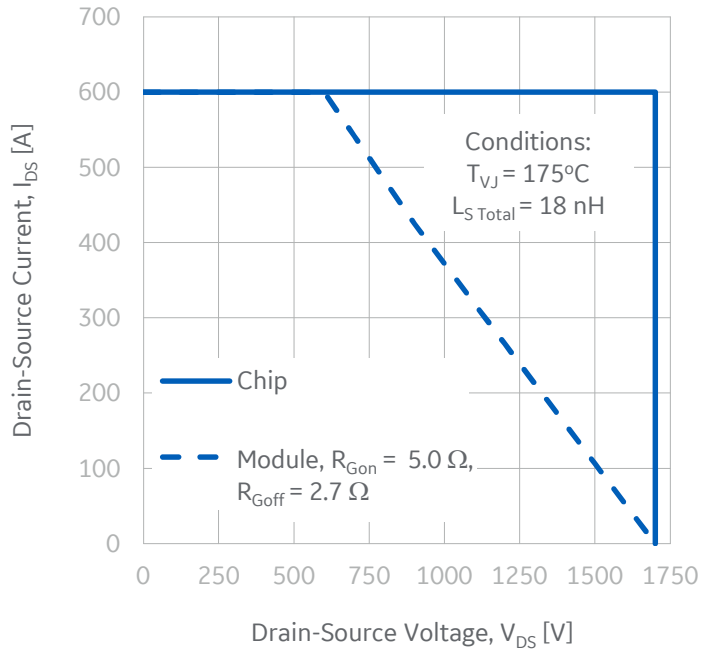


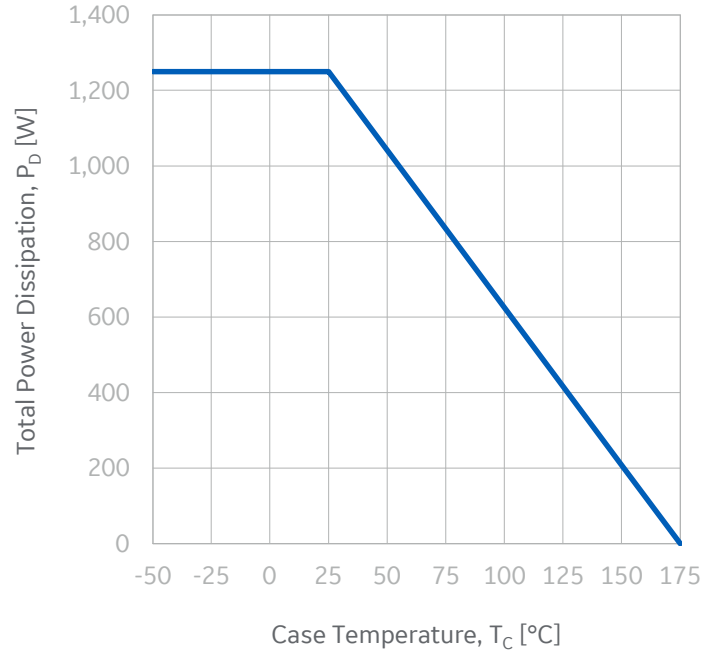
Figure 16: Forward-Bias Safe Operating Area



Typical performance: **GE17042CCA3**



**Figure 17:** Reverse-Bias Safe Operating Area

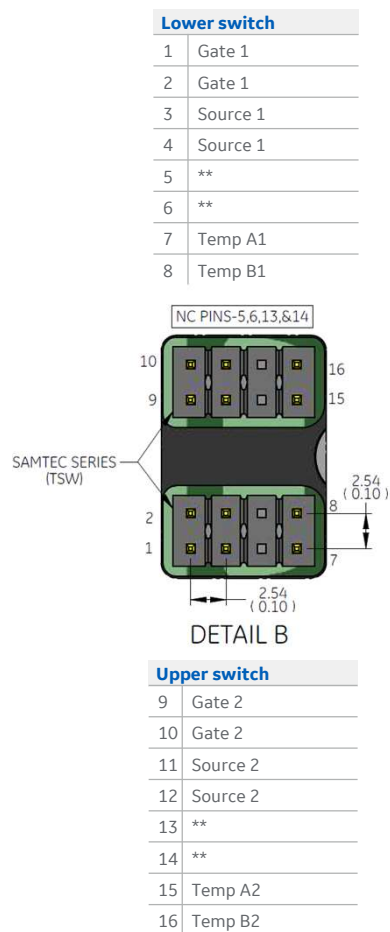


**Figure 18:** Maximum Power Dissipation vs. Case Temperature

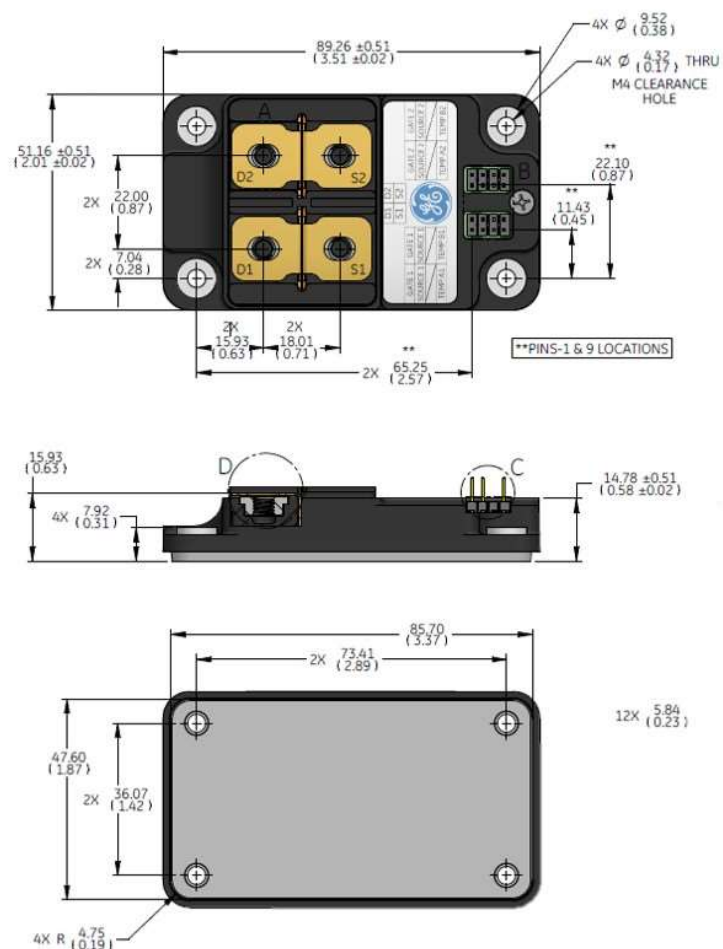




## Electrical interface outline drawing



## Module dimensions (millimeters)



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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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