



# 1200V half-bridge Silicon Carbide

Power module

**GE12047CCA3**

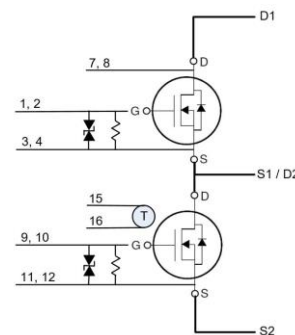
**V<sub>DS</sub>: 1200V I<sub>DS</sub>: 475A**

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



## Features

- Highly reliable GE SiC MOSFET devices
- Low R<sub>DS(ON)</sub> (3.1 mΩ) (device only)
- Low stray inductance (6 nH)
- SiC die qualified to +200 °C
- Ultra-low switching losses over entire operating range
- Body diode with minimal reverse recovery
- Integrated temperature sensing
- Dedicated DESAT Pin and Source-Kelvin Pin
- AlSiC Baseplate and Si<sub>3</sub>N<sub>4</sub> AMB Substrate



### MOSFET DC Characteristics @ T<sub>J</sub> = 25 °C (unless otherwise specified)

Symbols	Parameters	Min.	Typ.	Max.	Unit	Test Conditions	Notes
I <sub>D</sub>	Continuous Drain Current			475	A	V <sub>GS</sub> =20 V, T <sub>c</sub> =25 °C	Per Switch
				333		V <sub>GS</sub> =20 V, T <sub>c</sub> =100 °C	
				272		V <sub>GS</sub> =20 V, T <sub>c</sub> =125 °C	
I <sub>D,pulse</sub>	Pulsed Drain Current			950	A	T <sub>c</sub> =25 °C, t <sub>p</sub> =1 ms	
V <sub>DSmax</sub>	Drain - Source Breakdown Voltage	1200			V	V <sub>GS</sub> =0 V, I <sub>DS</sub> =100 μA	
V <sub>GSmax</sub>	Maximum Gate - Source Voltage			-15/+23	V	V <sub>DS</sub> =0 V	
V <sub>GSop</sub>	Recommended Gate - Source Voltage		-5/+20		V		
T <sub>Jmax</sub>	Junction Temperature			175	°C		
T <sub>C</sub>	Case Temperature Range	-55		150	°C		
T <sub>STG</sub>	Storage Temperature Range	-55		150	°C		
P <sub>D</sub>	Power Dissipation			1250	W	T <sub>c</sub> =25 °C	



(Continued) **MOSFET DC Characteristics @ T<sub>J</sub> = 25 °C** (unless otherwise specified)

Symbols	Parameters	Min.	Typ.	Max.	Unit	Test Conditions	Notes
I <sub>D</sub>	Continuous Drain Current			475	A	V <sub>GS</sub> =20 V, T <sub>c</sub> =25 °C	Per Switch
V <sub>GS(th)</sub>	Gate Threshold Voltage	2.5	2.8	4.5	V	V <sub>GS</sub> = V <sub>DS</sub> , I <sub>DS</sub> =160mA	
I <sub>DSS</sub>	Drain Leakage Current			0.10	mA	V <sub>DS</sub> =1200 V, V <sub>GS</sub> =0V, T <sub>J</sub> =25 °C	
				1.6			T <sub>J</sub> =200 °C
I <sub>GSS</sub>	Gate-Source Leakage Current			160	nA	V <sub>GS</sub> = -15/+23V	
R <sub>DS(on)</sub>	On State Resistance (Device Only)		3.1	4.4	mΩ	V <sub>GS</sub> =20V, I <sub>DS</sub> =475A, T <sub>J</sub> =25 °C	Per Switch
			5.6	6.8			
R <sub>G(int)</sub>	Gate-Source series resistance		0.90		Ω	V <sub>GS</sub> = 0 V, f = 100 kHz, T <sub>c</sub> =25 °C	

**MOSFET Dynamic Characteristics per switch @ T<sub>J</sub> = 25 °C** (unless otherwise specified)

Symbols	Parameters	Min.	Typ.	Max.	Unit	Test Conditions	Notes
C <sub>iss</sub>	Input Capacitance		29.3		nF	V <sub>GS</sub> =0 V V <sub>DS</sub> =600V f=100 kHz	
C <sub>oss</sub>	Output Capacitance		1.60		nF		
C <sub>rss</sub>	Reverse Transfer Capacitance		0.13		nF		
E <sub>on</sub>	Turn-On Switching Energy		7.72		mJ	V <sub>GS</sub> =0V to +20 V V <sub>DS</sub> =800 V I <sub>DS</sub> =350 A R <sub>G(ext)</sub> =0 Ω	
E <sub>off</sub>	Turn-Off Switching Energy		3.79		mJ		
t <sub>r</sub>	Rise Time		21.9		ns		
t <sub>f</sub>	Fall Time		38.9		ns		
Q <sub>G</sub>	Total Gate Charge		1248		nC	V <sub>GS</sub> =0 to 18 V V <sub>DS</sub> =900 V I <sub>DS</sub> =240A	
Q <sub>GD</sub>	Gate-Drain Charge		536		nC		
Q <sub>GS</sub>	Gate-Source Charge		176		nC		

**Body Diode Characteristics per switch @ T<sub>J</sub> = 25 °C** (unless otherwise specified)

Symbols	Parameters	Min.	Typ.	Max.	Unit	Test Conditions	Notes
I <sub>SD</sub>	Pulsed body diode current			720	A	V <sub>GS</sub> =0 V	Pulse duration up to 1μs
V <sub>SD</sub>	Diode Forward Voltage		4.69		V	V <sub>GS</sub> =0 V, I <sub>SD</sub> =475 A, T <sub>J</sub> =25 °C	

**Thermal Characteristics**

Symbols	Parameters	Min.	Typ.	Max.	Unit	Test Conditions	Notes
R <sub>th</sub>	Thermal Resistance Junction-to-Case		0.10	0.12	°C/W	JESD24-3	Per Switch



## Temperature Sensor Characteristics

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

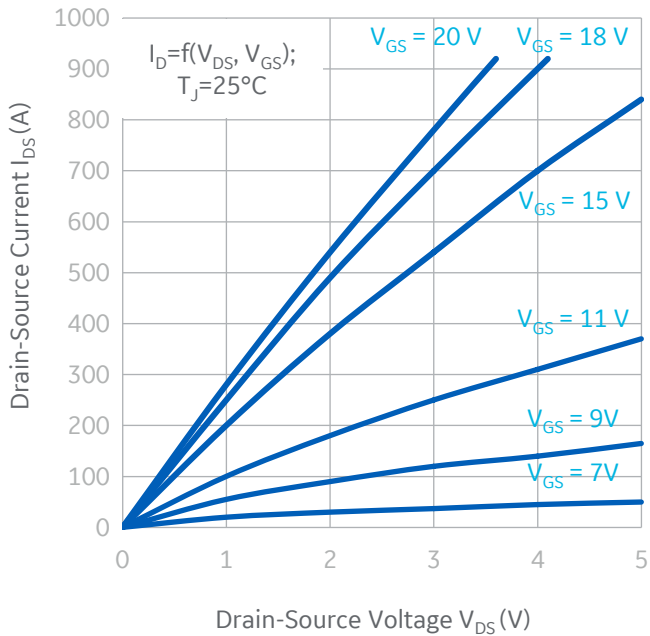
1. RTD is mounted directly over center-most die allowing direct reading of  $T_J$

## Module packing data

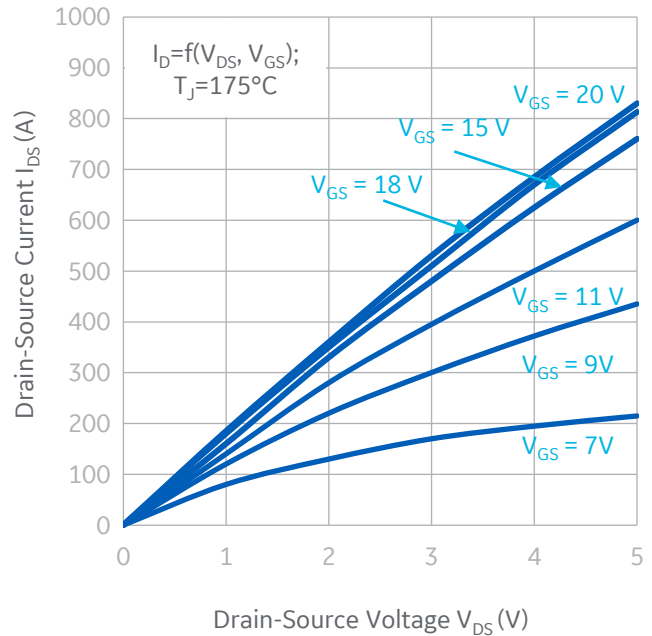
Symbols	Parameters	Min.	Typ.	Max.	Unit	Test Conditions	Notes
$V_{Iso}$	Case Isolation Voltage	4			kV	AC 50Hz, 1min, 25 °C	
CTI	Comparative Tracking Index		600				
$M_s$	Mounting Torque			5.0	N-m	Power Terminals	
				4.0		Baseplate	
$L_{D1S2}$	Loop Inductance		6		nH		
	Module Mass		0.12		Kg		
	Clearance Distance		9		mm	D1 to S2	
			4		mm	D1 to S1/D2	
			23		mm	Pins 1, 2 to S1/D2	
			25		mm	Pins 9, 10 to S1/D2	
			9		mm	D1, S2 to Baseplate	
			12		mm	Pins 7, 8 to Baseplate	
	Creepage Distance		11		mm	D1 to S2	
			6		mm	D1 to S1/D2	
			28		mm	Pins 1, 2 to S1/D2	
			30		mm	Pins 9, 10 to S1/D2	
			12		mm	D1, S2 to Baseplate	
			17		mm	Pins 7, 8 to Baseplate	
$M_{BP}$	Base Plate Material		AlSiC			(Cu available)	



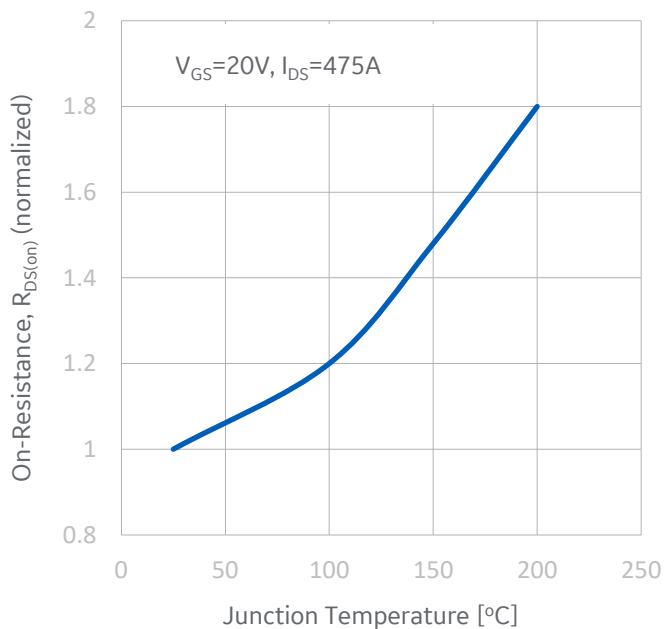
Typical performance: **GE12047CCA3**



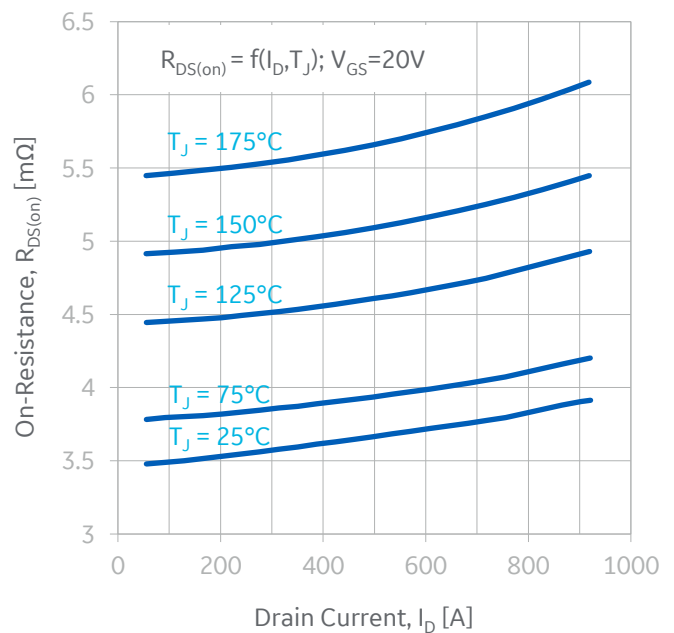
**Figure 1:** Output characteristics (25 °C)



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



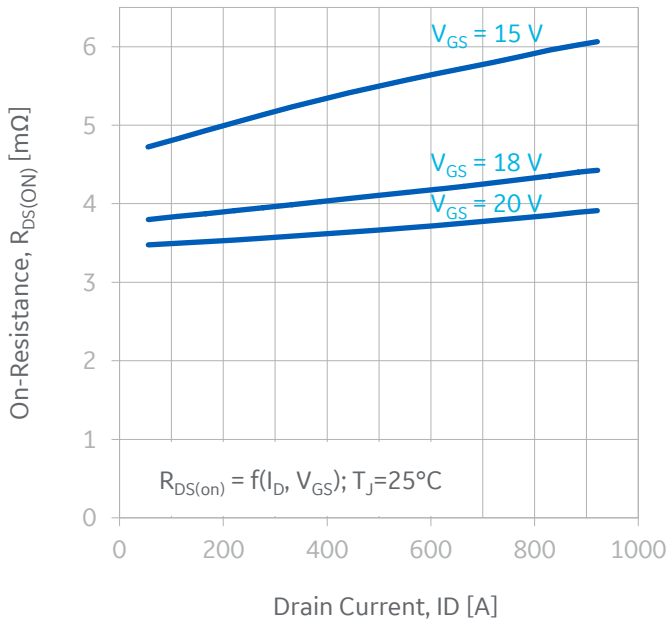
**Figure 3:** Normalized on-state resistance vs Temperature



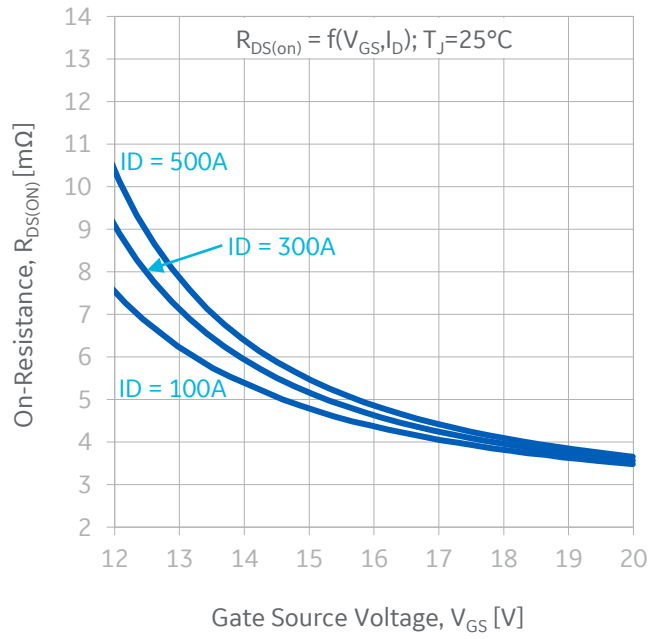
**Figure 4:** Module Drain-Source on-state resistance



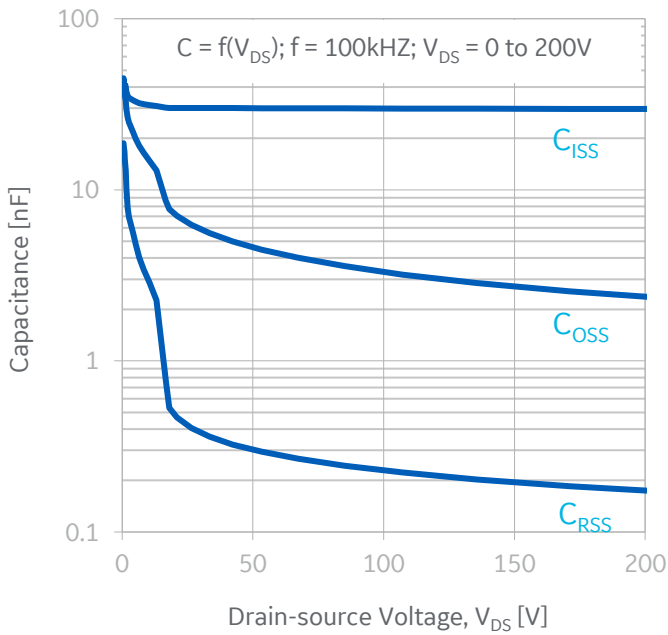
Typical performance: **GE12047CCA3**



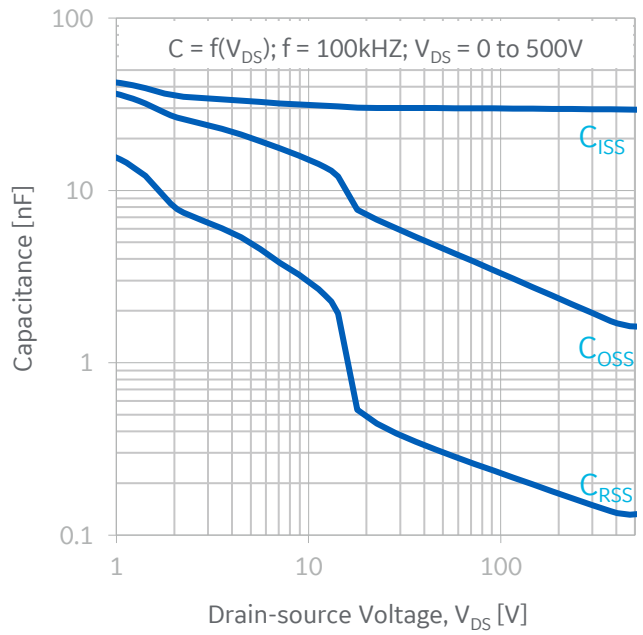
**Figure 5:** Module Drain-Source on-state resistance



**Figure 6:** Drain-Source on-state resistance vs. Gate-Source Voltage



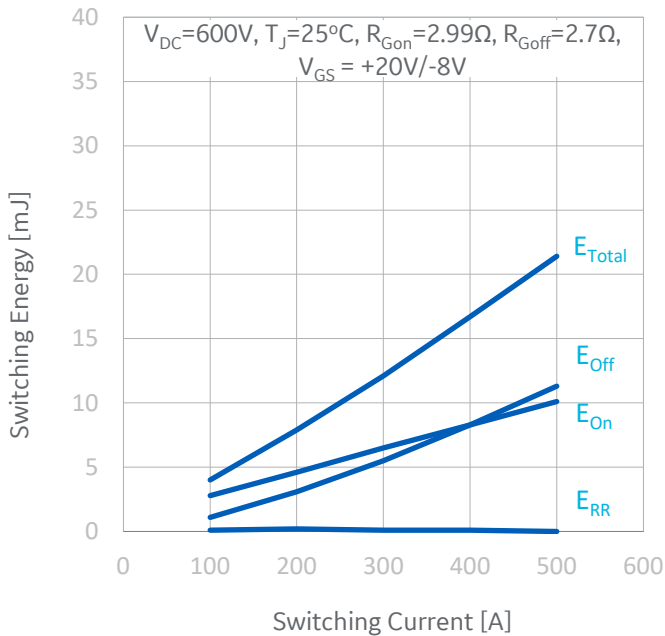
**Figure 7:** Input Capacitance to 200V



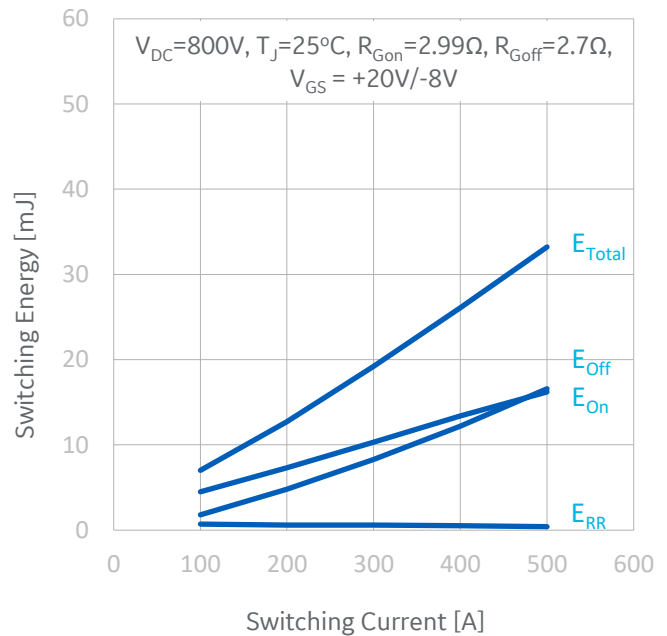
**Figure 8:** Input Capacitance to 500V



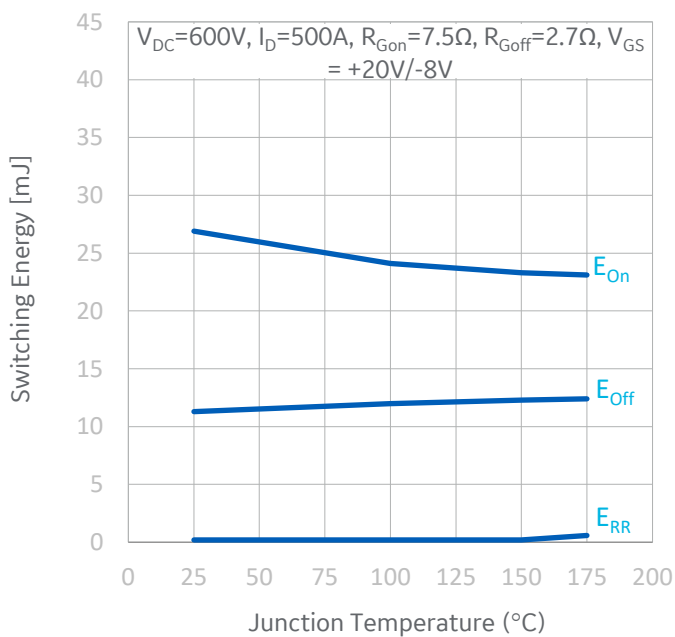
Typical performance: **GE12047CCA3**



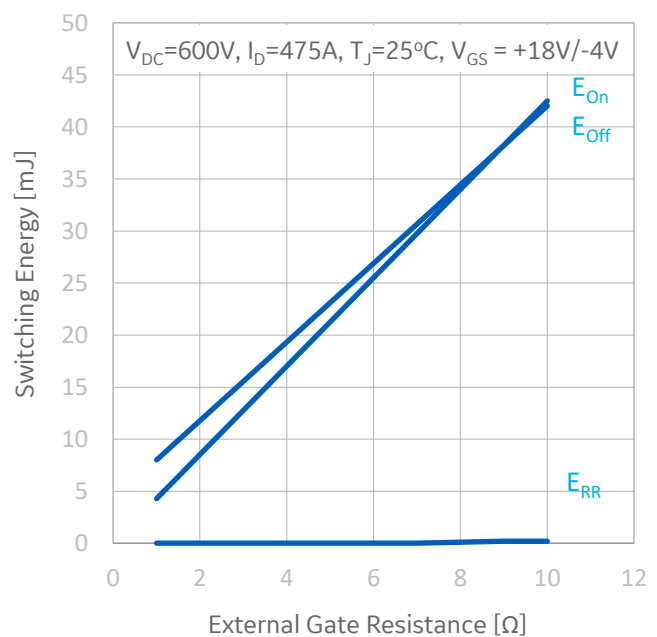
**Figure 9:** Switching Energy Vs Drain Current (600V)



**Figure 10:** Switching Energy Vs Drain Current (800V)



**Figure 11:** Switching Energy Vs Junction Temperature



**Figure 12:** Switching Energy Vs Gate Resistance



Typical performance: GE12047CCA3

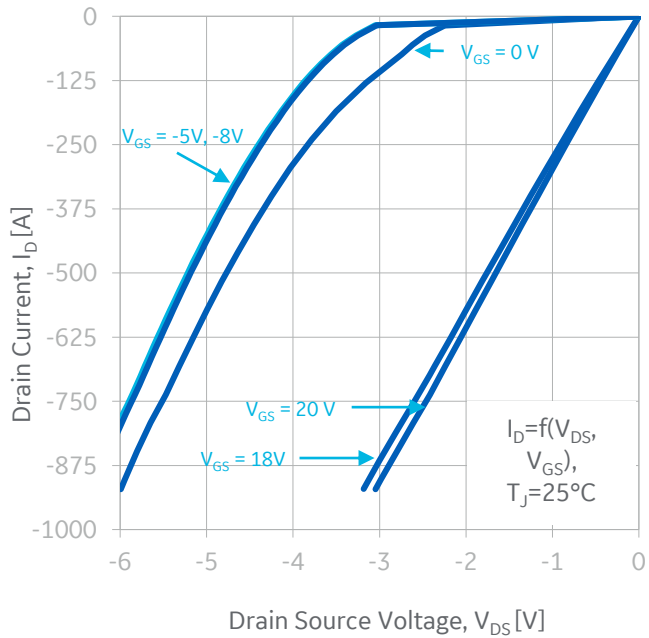


Figure 13: 3<sup>rd</sup> Quadrant Characteristics (25°C)

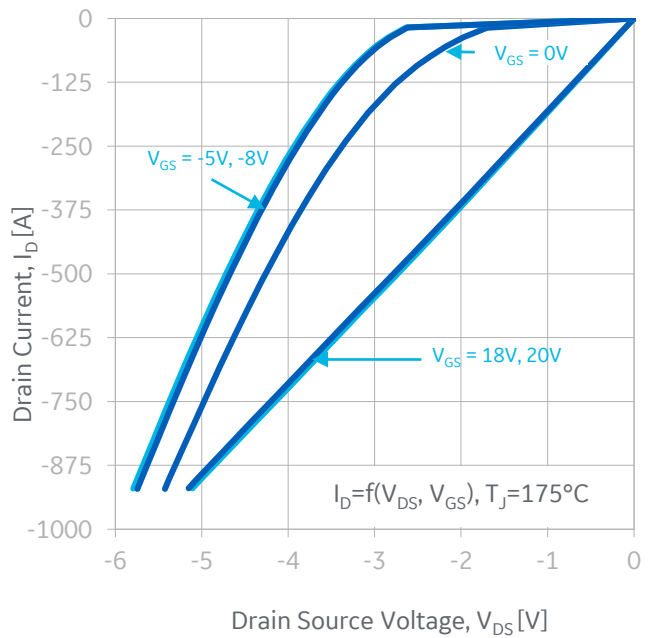


Figure 14: 3<sup>rd</sup> Quadrant Characteristics (175°C)

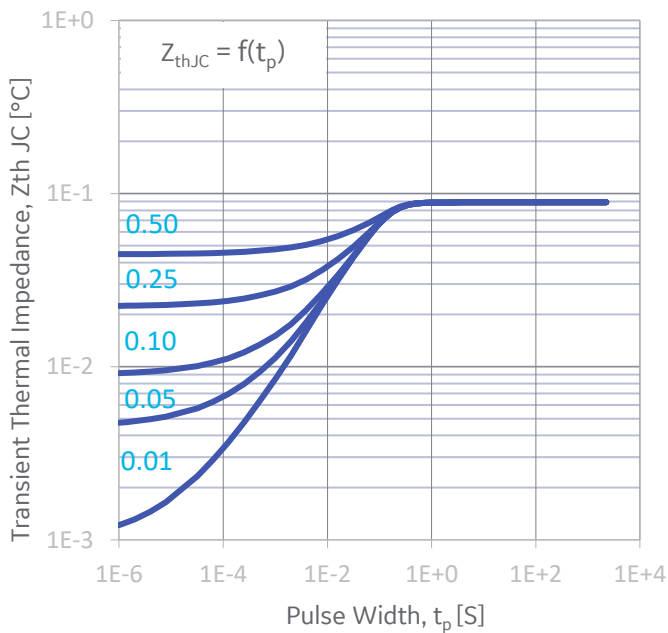


Figure 15: Transient Thermal Impedance

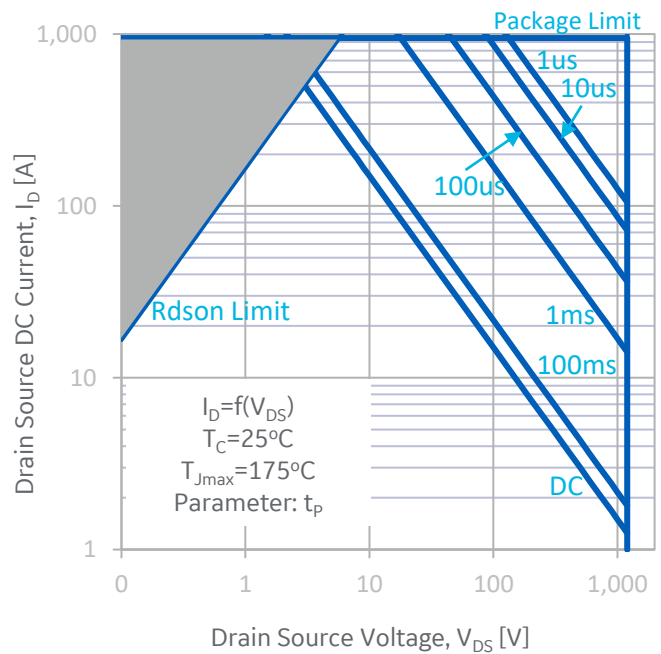
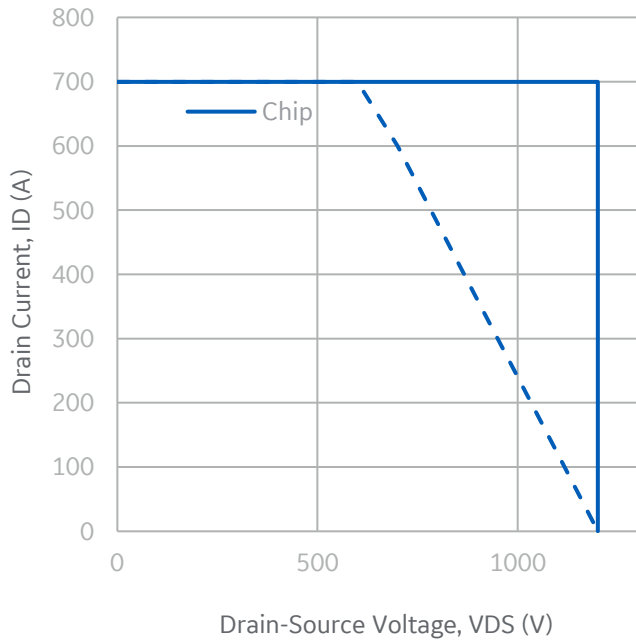


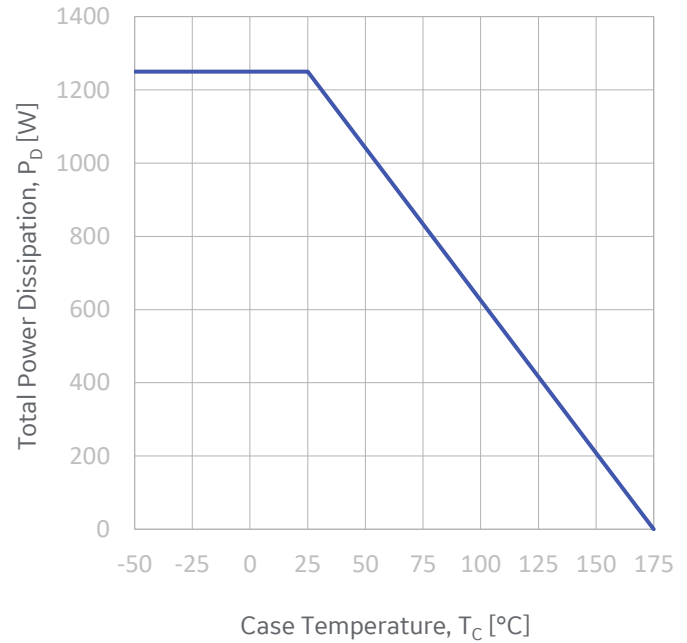
Figure 16: Forward-Bias Safe Operating Area



Typical performance: **GE12047CCA3**



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

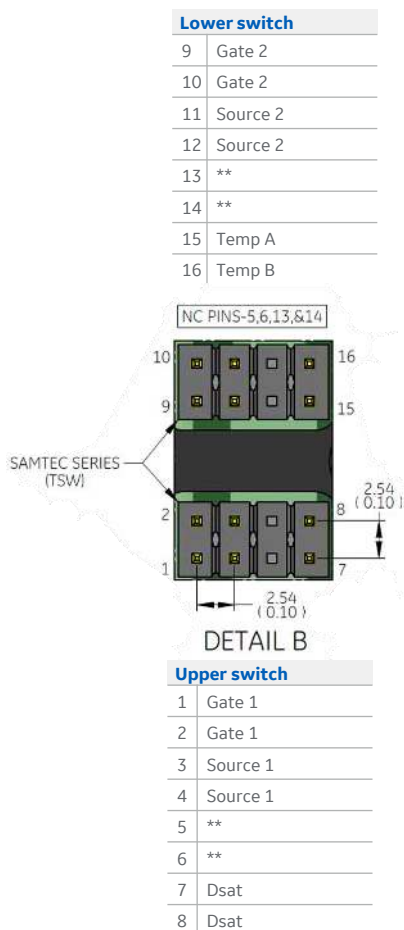


**Figure 18:** Maximum Power Dissipation Vs Case Temperature

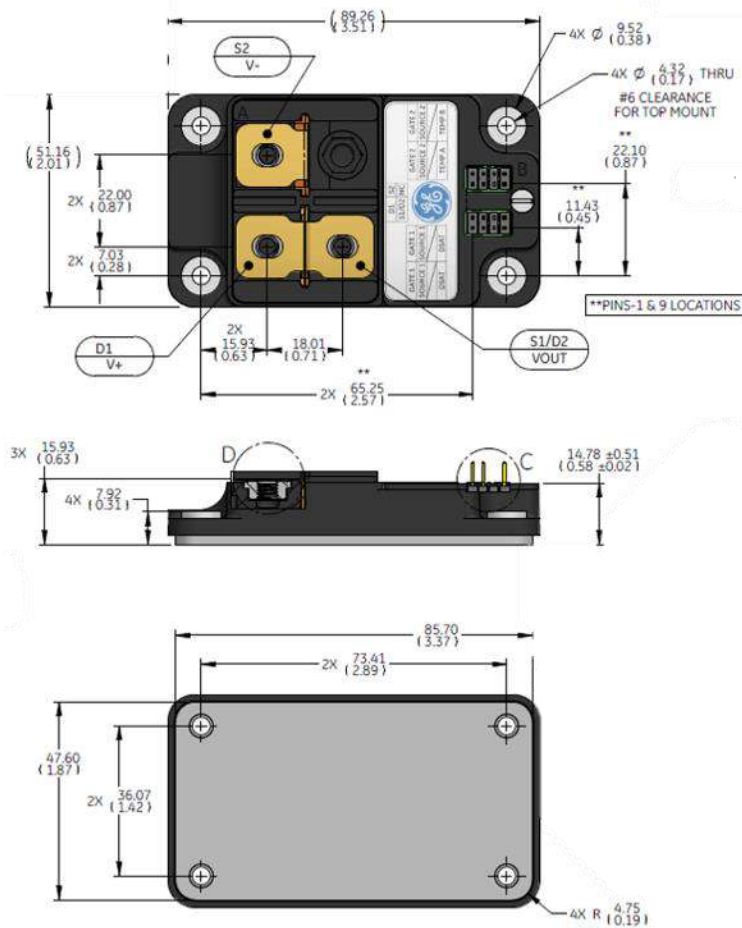




## Electrical interface outline drawing



## Module dimensions (millimeters)



### Disclaimer

The data presented in this document are for informational purposes only and shall in no event be regarded as a guarantee of conditions or characteristics. Any warranty or license for this product shall be specified and governed by the terms of a separate purchase agreement. General Electric Company does not assume any liability arising out of the application or use of this product; neither does it convey any license under its patent rights, nor the rights of others.

General Electric Company reserves the right to make changes in specifications and features shown herein to improve reliability, function, or design, or discontinue this product, at any time without notice or obligation. Contact your GE representative for the most current information.

### Warning

This product is not authorized for use (1) in life support systems or (2) for applications implanted into the human body, without the express written approval of General Electric Company.

### Document revisions

Rev. #: 1, Public Release – May 11, 2021