



# 1200V half-bridge Silicon Carbide

Power module

**GE12047CCA3**

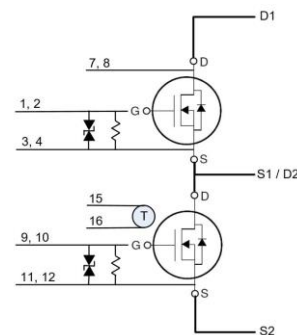
**$V_{DS}$ : 1200V  $I_{DS}$ : 475A**

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



## Features

- Highly reliable GE SiC MOSFET devices
- Low  $R_{DS(ON)}$  (3.1 m $\Omega$ ) (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 @ $T_j = 25\text{ °C}$ (unless otherwise specified)

Symbols	Parameters	Min.	Typ.	Max.	Unit	Test Conditions	Notes
$I_D$	Continuous Drain Current			475	A	$V_{GS}=20\text{ V}, T_c=25\text{ °C}$	Per Switch
				333		$V_{GS}=20\text{ V}, T_c=100\text{ °C}$	
				272		$V_{GS}=20\text{ V}, T_c=125\text{ °C}$	
$I_{D,pulse}$	Pulsed Drain Current			950	A	$T_c=25\text{ °C}, t_p=1\text{ ms}$	
$V_{DSmax}$	Drain - Source Breakdown Voltage	1200			V	$V_{GS}=0\text{ V}, I_{DS}=100\text{ }\mu\text{A}$	
$V_{GSmax}$	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	°C		
$T_c$	Case Temperature Range	-55		150	°C		
$T_{STG}$	Storage Temperature Range	-55		150	°C		
$P_D$	Power Dissipation			1250	W	$T_c=25\text{ °C}$	



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

Symbols	Parameters	Min.	Typ.	Max.	Unit	Test Conditions	Notes
$I_D$	Continuous Drain Current			475	A	$V_{GS}=20\text{ V}, T_c=25\text{ }^\circ\text{C}$	Per Switch
$V_{GS(th)}$	Gate Threshold Voltage	2.5	2.8	4.5	V	$V_{GS}=V_{DS}, I_{DS}=160\text{mA}$	
$I_{DSS}$	Drain Leakage Current			0.10	mA	$V_{DS}=1200\text{ V}, V_{GS}=0\text{V}, T_J=25\text{ }^\circ\text{C}$	
				1.6		$T_J=200\text{ }^\circ\text{C}$	
$I_{GSS}$	Gate-Source Leakage Current			160	nA	$V_{GS}= -15/+23\text{V}$	
$R_{DS(on)}$	On State Resistance (Device Only)		3.1	4.4	m $\Omega$	$V_{GS}=20\text{V}, I_{DS}=475\text{A}, T_J=25\text{ }^\circ\text{C}$	Per Switch
			5.6	6.8		$T_J=175\text{ }^\circ\text{C}$	
$R_{G(int)}$	Gate-Source series resistance		0.90		$\Omega$	$V_{GS}=0\text{ V}, f=100\text{ kHz}, T_c=25\text{ }^\circ\text{C}$	

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

Symbols	Parameters	Min.	Typ.	Max.	Unit	Test Conditions	Notes
$C_{iss}$	Input Capacitance		29.3		nF		
$C_{oss}$	Output Capacitance		1.60		nF	$V_{GS}=0\text{ V}$	
						$V_{DS}=600\text{V}$	
$C_{rss}$	Reverse Transfer Capacitance		0.13		nF	$f=100\text{ kHz}$	
$E_{on}$	Turn-On Switching Energy		7.72		mJ	$V_{GS}=0\text{V to }+20\text{ V}$	
$E_{off}$	Turn-Off Switching Energy		3.79		mJ	$V_{DS}=800\text{ V}$	
$t_r$	Rise Time		21.9		ns	$I_{DS}=350\text{ A}$	
$t_f$	Fall Time		38.9		ns	$R_{G(ext)}=0\text{ }\Omega$	
$Q_G$	Total Gate Charge		1248		nC	$V_{GS}=0\text{ to }18\text{ V}$	
$Q_{GD}$	Gate-Drain Charge		536		nC	$V_{DS}=900\text{ V}$	
$Q_{GS}$	Gate-Source Charge		176		nC	$I_{DS}=240\text{A}$	

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

Symbols	Parameters	Min.	Typ.	Max.	Unit	Test Conditions	Notes
$I_{SD}$	Pulsed body diode current			720	A	$V_{GS}=0\text{ V}$	Pulse duration up to 1 $\mu\text{s}$
$V_{SD}$	Diode Forward Voltage		4.69		V	$V_{GS}=0\text{ V}, I_{SD}=475\text{ A}, T_J=25\text{ }^\circ\text{C}$	

**Thermal Characteristics**

Symbols	Parameters	Min.	Typ.	Max.	Unit	Test Conditions	Notes
$R_{th}$	Thermal Resistance Junction-to-Case		0.10	0.12	$^\circ\text{C/W}$	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		
	Temperature Coefficient		3850		ppm/K		
	Operating Temperature	-70		+500	°C		
	Insulation Resistance		100		Mohm	20 °C	
			2		Mohm	500 °C	

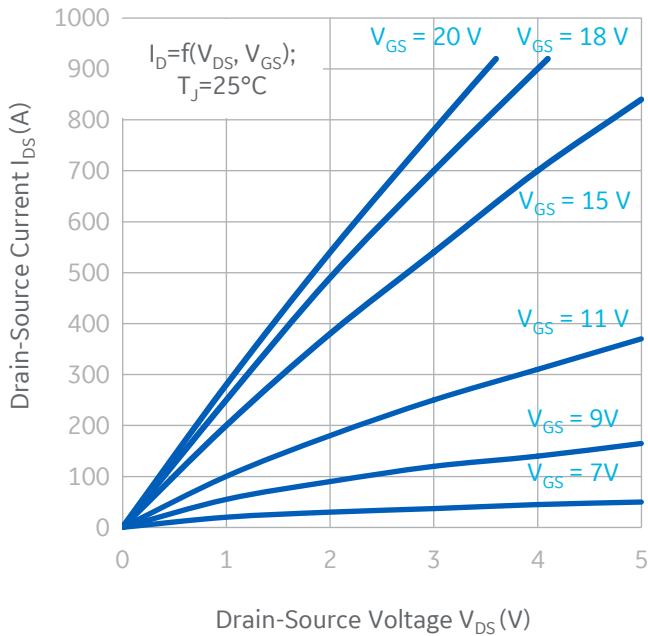
1. RTD is mounted directly over center-most die allowing direct reading of  $T_J$

## Module packing data

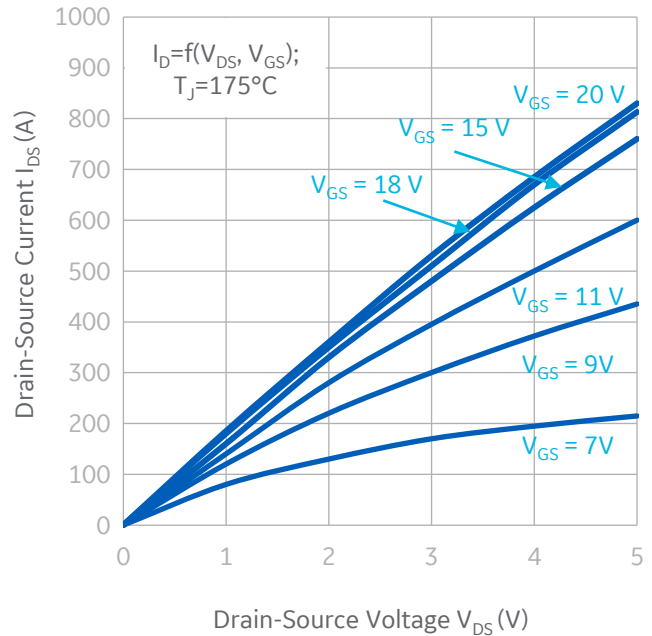
Symbols	Parameters	Min.	Typ.	Max.	Unit	Test Conditions	Notes
$V_{Iso}$	Case Isolation Voltage	4			kV	AC 50Hz, 1min, 25 °C	
CTI	Comparative Tracking Index		600				
$M_s$	Mounting Torque			5.0	N-m	Power Terminals	
				4.0		Baseplate	
$L_{D1S2}$	Loop Inductance		6		nH		
	Module Mass		0.12		Kg		
	Clearance 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)	



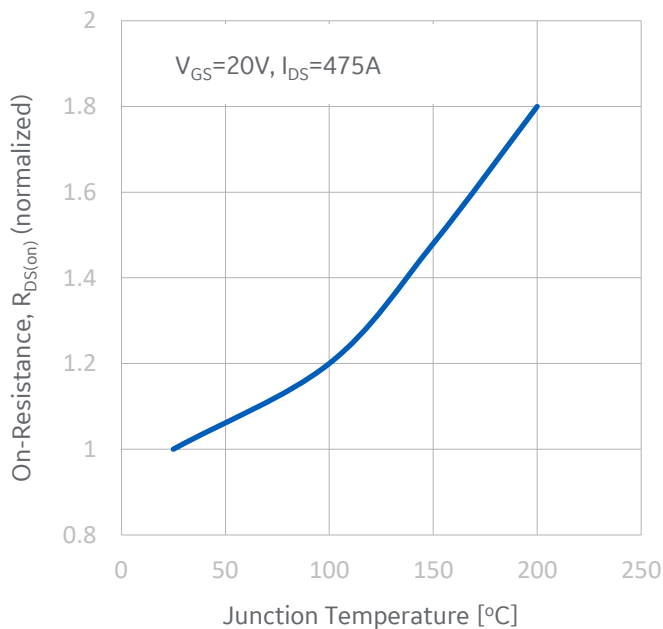
Typical performance: **GE12047CCA3**



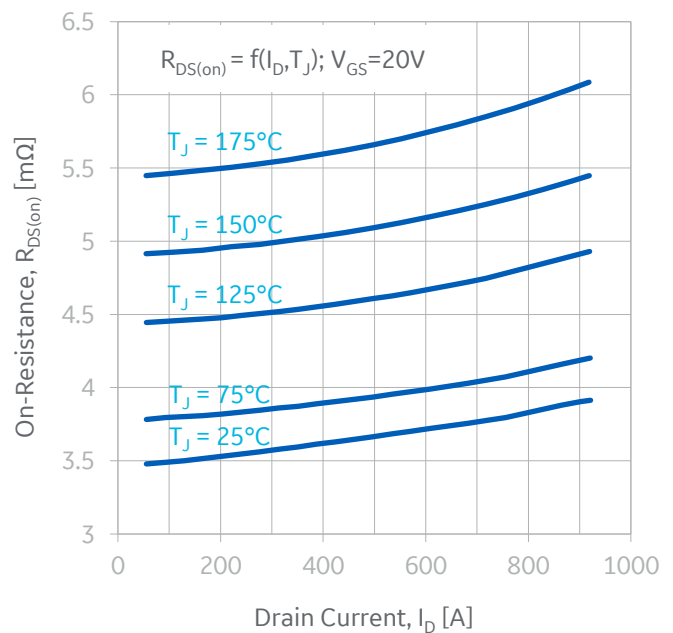
**Figure 1:** Output characteristics (25 °C)



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



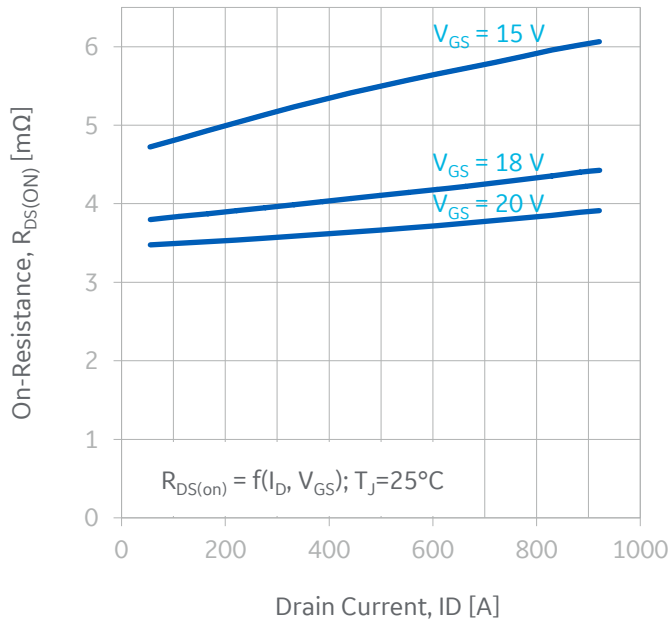
**Figure 3:** Normalized on-state resistance vs Temperature



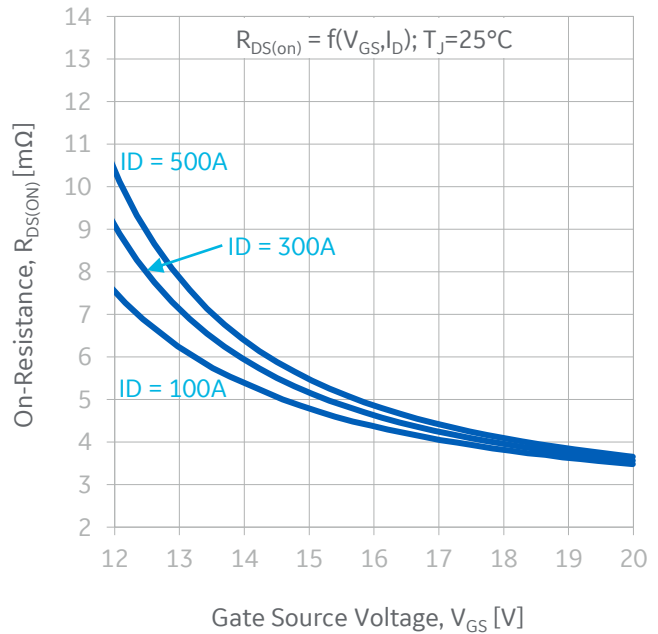
**Figure 4:** Module Drain-Source on-state resistance



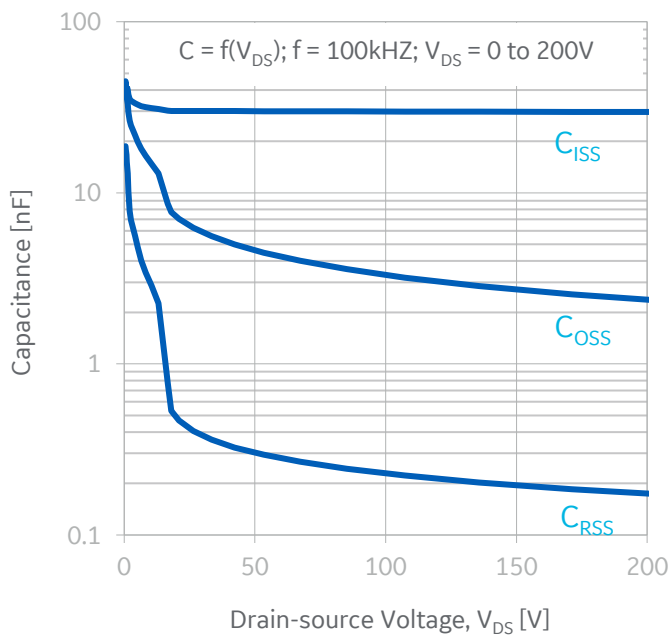
Typical performance: **GE12047CCA3**



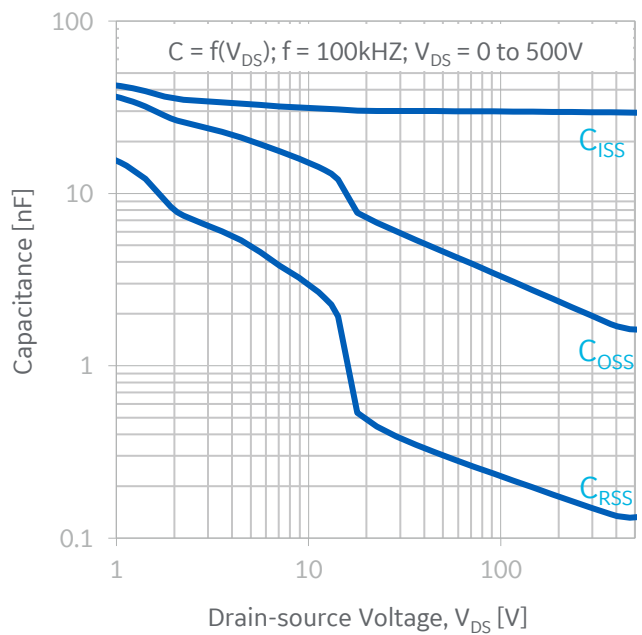
**Figure 5:** Module Drain-Source on-state resistance



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



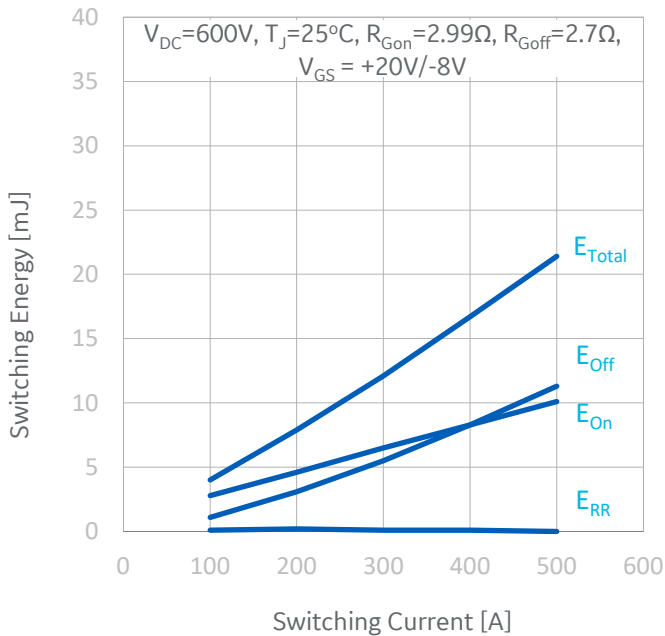
**Figure 7:** Input Capacitance to 200V



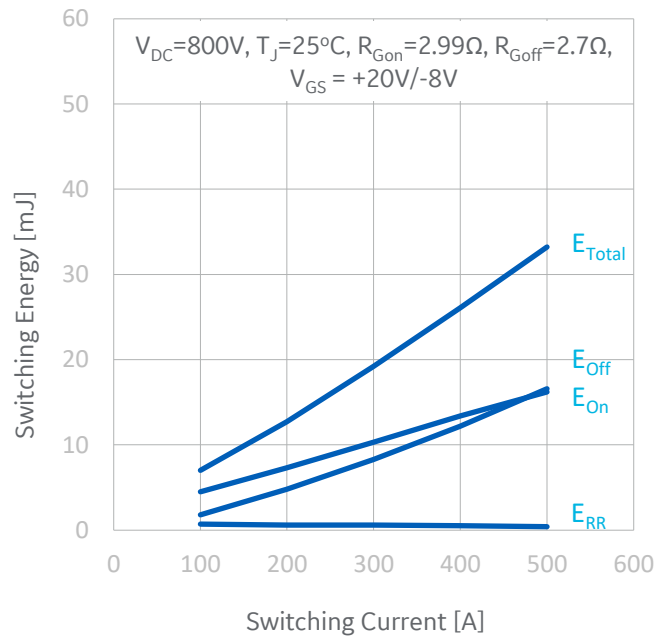
**Figure 8:** Input Capacitance to 500V



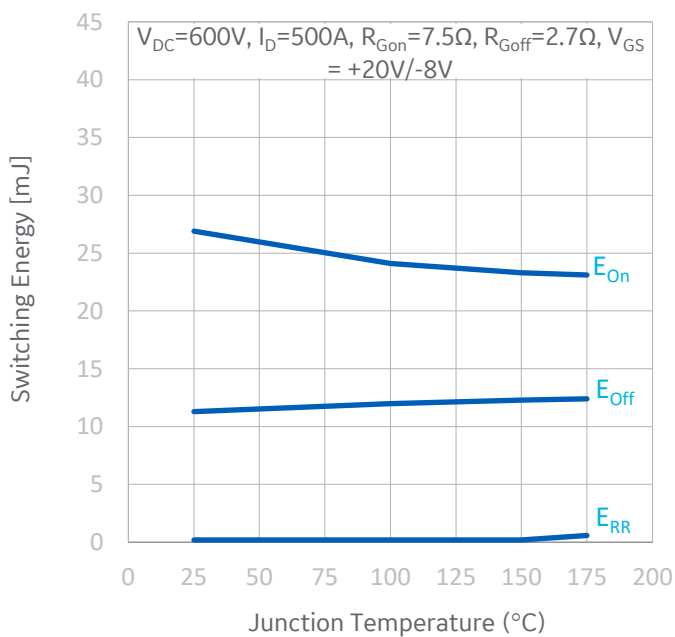
Typical performance: **GE12047CCA3**



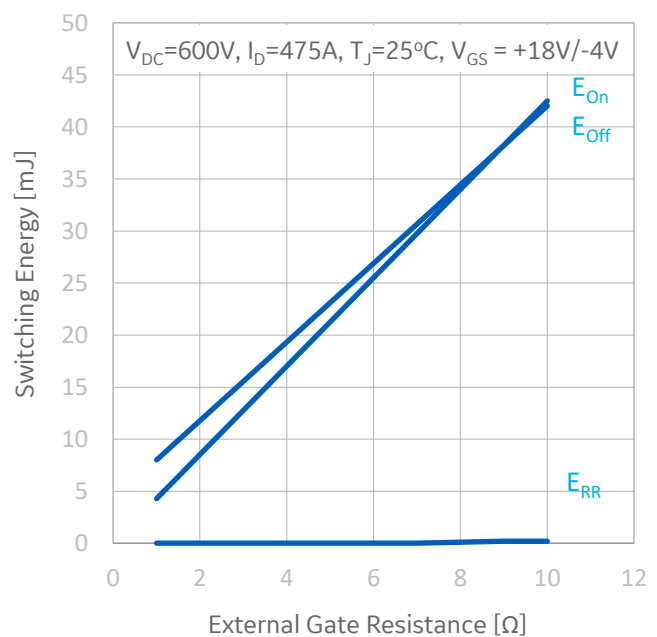
**Figure 9:** Switching Energy Vs Drain Current (600V)



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



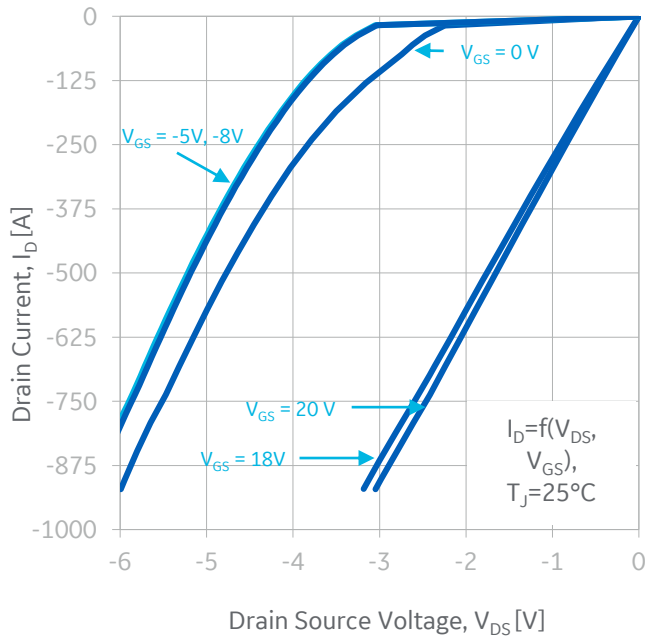
**Figure 11:** Switching Energy Vs Junction Temperature



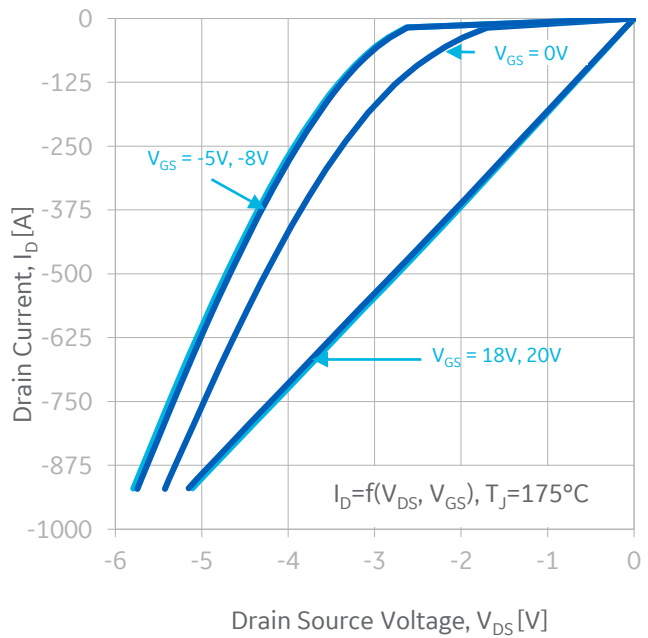
**Figure 12:** Switching Energy Vs Gate Resistance



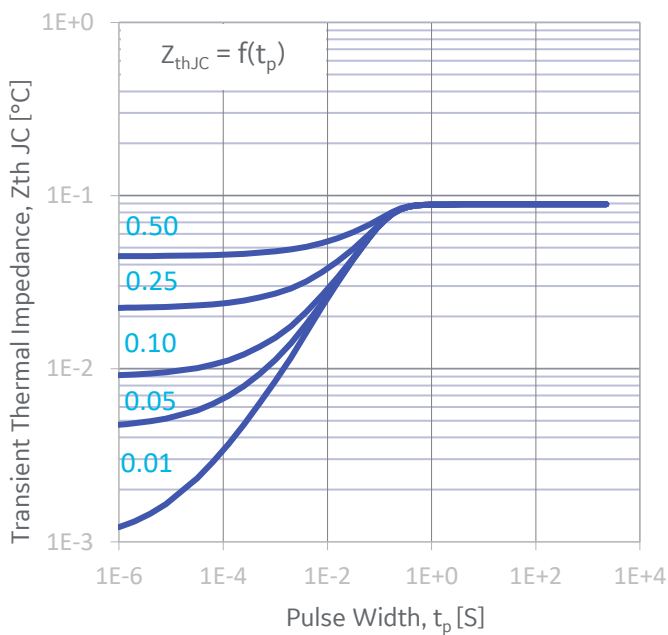
Typical performance: **GE12047CCA3**



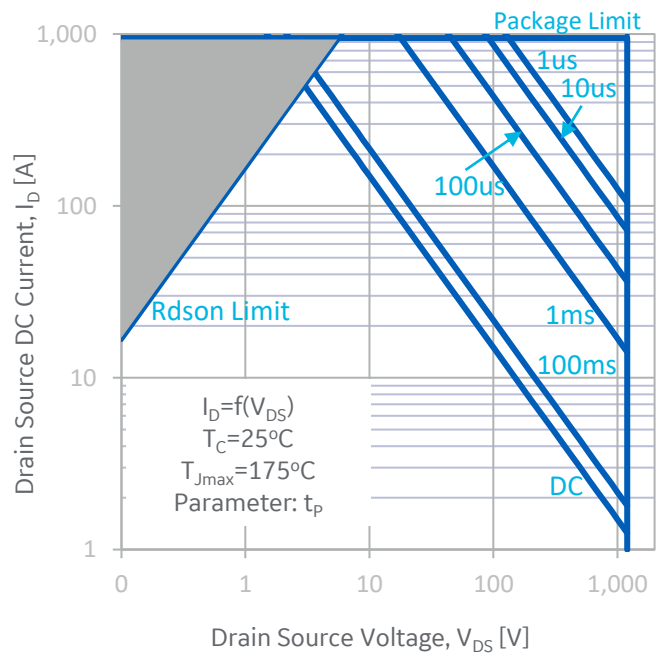
**Figure 13:** 3<sup>rd</sup> Quadrant Characteristics (25°C)



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



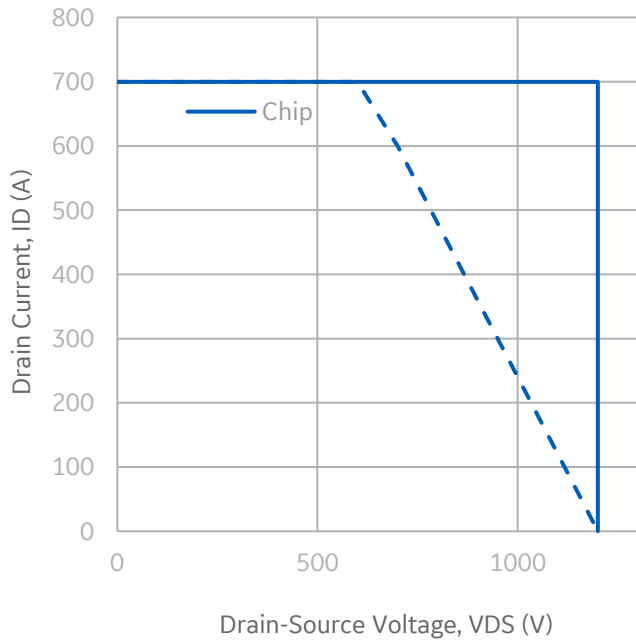
**Figure 15:** Transient Thermal Impedance



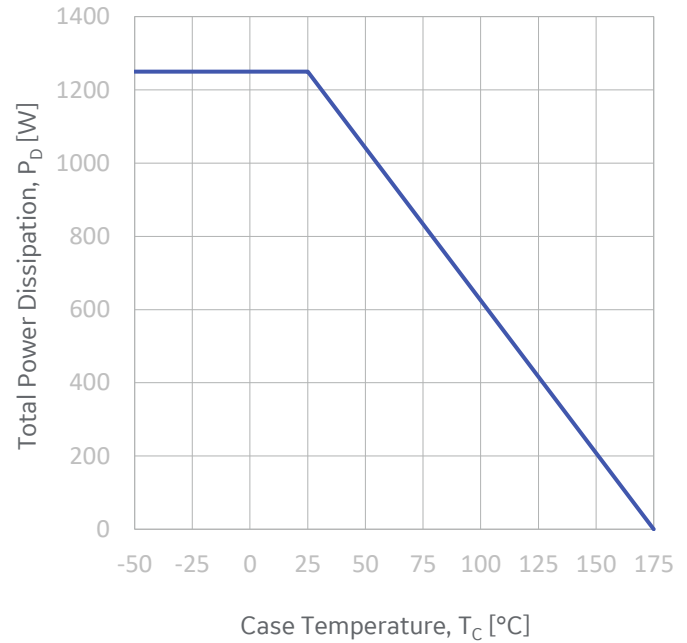
**Figure 16:** Forward-Bias Safe Operating Area



Typical performance: **GE12047CCA3**



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

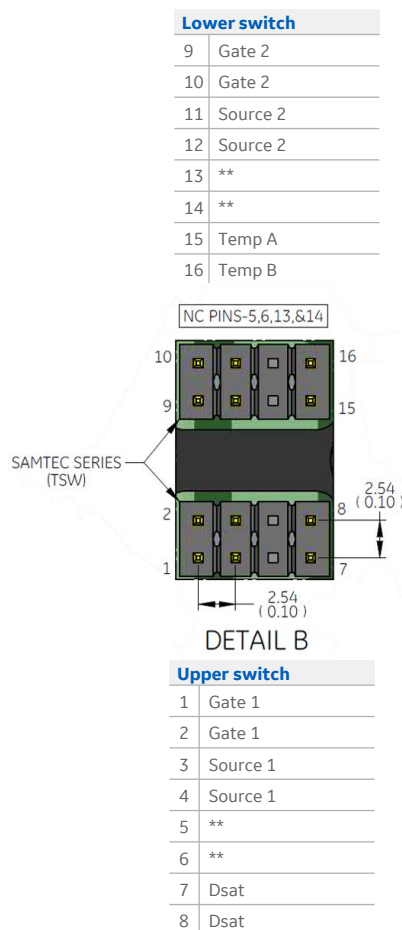


**Figure 18:** Maximum Power Dissipation Vs Case Temperature

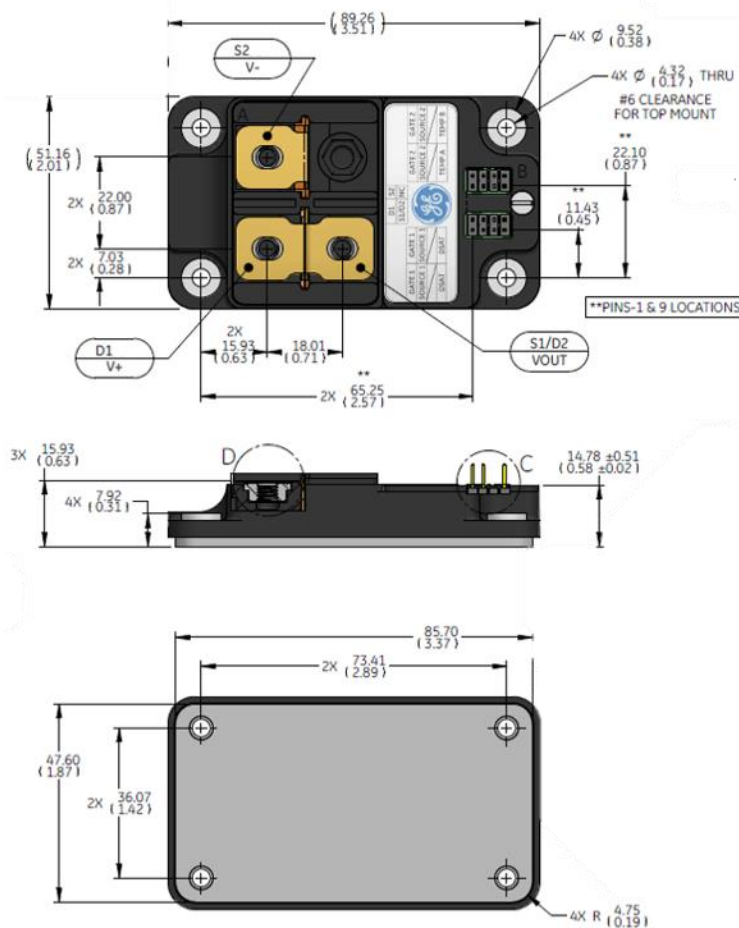




## Electrical interface outline drawing



## Module dimensions (millimeters)



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### Document revisions

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