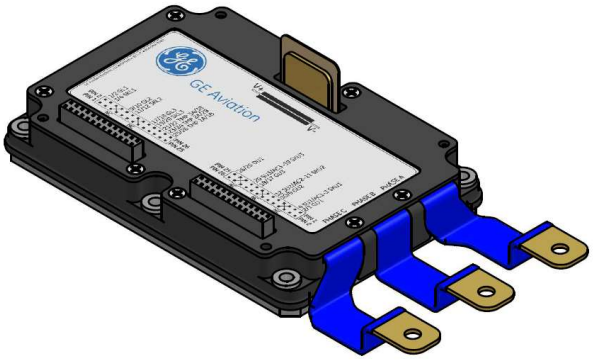
PRELIMINARY

1200V 6-Pack (3 Phase) Silicon Carbide
Power Module

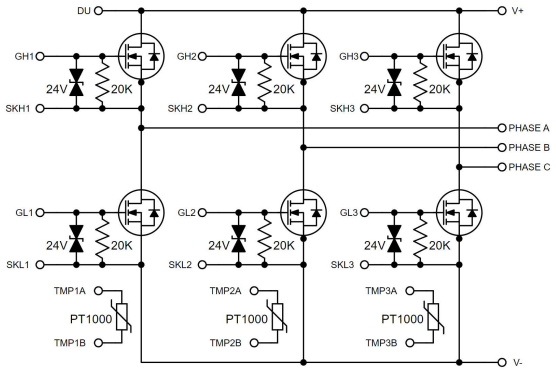
GE12050EEA3
V_{DS}: 1200 V I_{DS}: 475 A

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 $R_{DS(ON)}$ (3.1 mΩ) (device only)
- Low stray inductance
- 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˚C (unless otherwise specified)

Symbols	Parameters	Min.	Typ.	Max.	Unit	Test Conditions	Notes
I_{DS}	Continuous Drain Current			475	A	V_{GS} = 20 V, T_c = 25˚C	Per Switch
				333		V_{GS} = 20 V, T_c = 100˚C	
				272		V_{GS} = 20 V, T_c = 125˚C	
$I_{DS,pulse}$	Pulsed Drain Current			950	A	T_c = 25 ˚C, t_p = 1 ms	
V_{DSmax}	Drain - Source Breakdown Voltage	1200			V	V_{GS} = 0 V, I_{DS} = 100 µA	
V_{GSmax}	Maximum Gate - Source Voltage			-15/+23	V	V_{DS} = 0 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˚C	Per Switch

(Continued) **MOSFET DC Characteristics @ T_J = 25˚C** (unless otherwise specified)

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

MOSFET Dynamic Characteristics per switch @ T_J = 25˚C (unless otherwise specified)

Symbols	Parameters	Min.	Typ.	Max.	Unit	Test Conditions	Notes
C_{iss}	Input Capacitance		29.3		nF	V_{GS} = 0 V V_{DS} = 600 V f = 100 kHz	
C_{oss}	Output Capacitance		1.60		nF		
C_{rss}	Reverse Transfer Capacitance		0.13		nF		
E_{on}	Turn-On Switching Energy		4.3		mJ	V_{GS} = -5 V to +20 V V_{DS} = 600 V I_{DS} = 475 A R_{Gon} = R_{Goff} = 2.0 Ω	
E_{off}	Turn-Off Switching Energy		5.7		mJ		
t_r	Rise Time		21.9		ns		
t_f	Fall Time		38.9		ns		
Q_G	Total Gate Charge		1248		nC	V_{GS} = 0 to 18 V V_{DS} = 900 V I_{DS} = 240 A	
Q_{GD}	Gate-Drain Charge		536		nC		
Q_{GS}	Gate-Source Charge		176		nC		

Body Diode Characteristics per switch @ T_J = 25˚C (unless otherwise specified)

Symbols	Parameters	Min.	Typ.	Max.	Unit	Test Conditions	Notes
I_{SD}	Pulsed body diode current			720	A	V_{GS} = 0 V	1.
V_{SD}	Diode Forward Voltage		4.69		V	V_{GS} = 0 V, I_{SD} = 475 A, T_J = 25˚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	˚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	N-m	Power Terminals	
				4.0		Baseplate	
$L_{V+/V-}$	Loop Inductance		4.0		nH		
	Module Mass		0.54		Kg		
	Clearance Distance		19		mm	Phase A to Phase B	
			19		mm	Phase B to Phase C	
			7		mm	V+ to V-	
			111		mm	V- to Phase A	
			36		mm	Phase B to Baseplate	
			25		mm	V+ to Baseplate	
	Creepage Distance		107		mm	Phase A to Phase B	
			113		mm	Phase B to Phase C	
			7		mm	V+ to V-	
			116		mm	V- to Phase A	
			70		mm	Phase B to Baseplate	
			31		mm	V+ to Baseplate	
M_{BP}	Base Plate Material		AlSiC				

Typical performance: **GE12050EEA3**

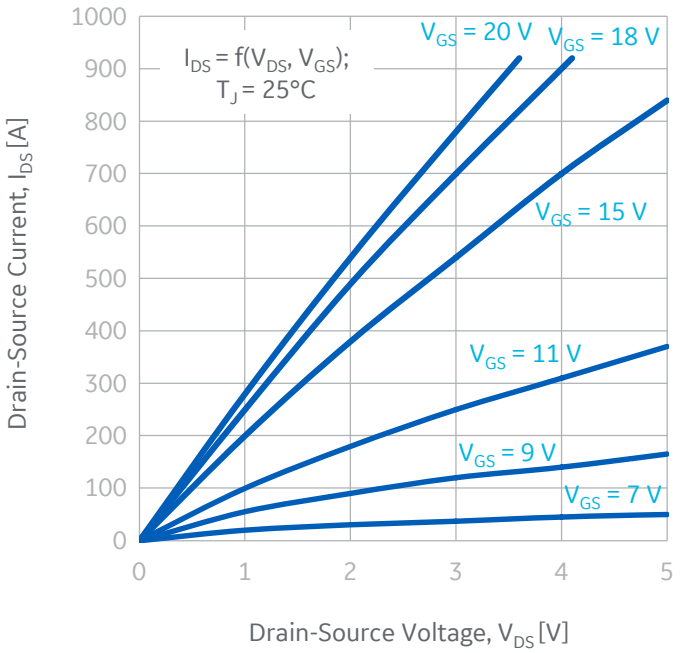


Figure 1: Output Characteristics (25°C)

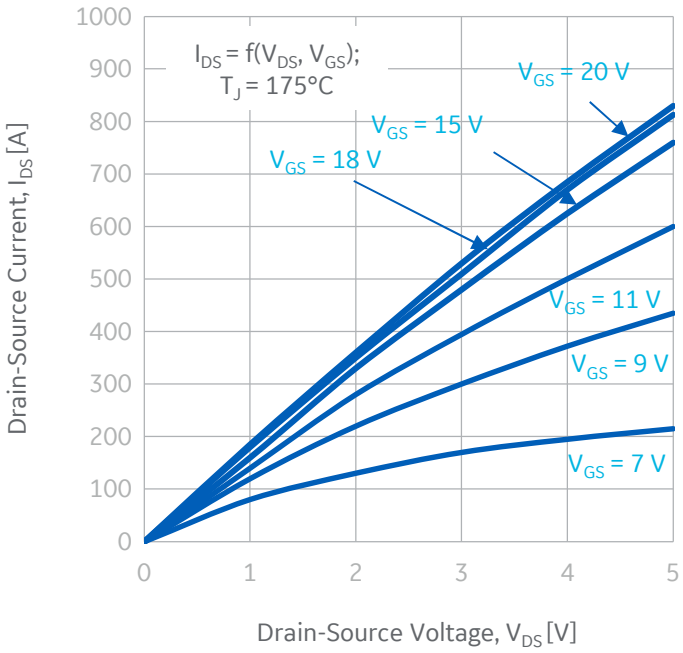


Figure 2: Output Characteristics (175°C)

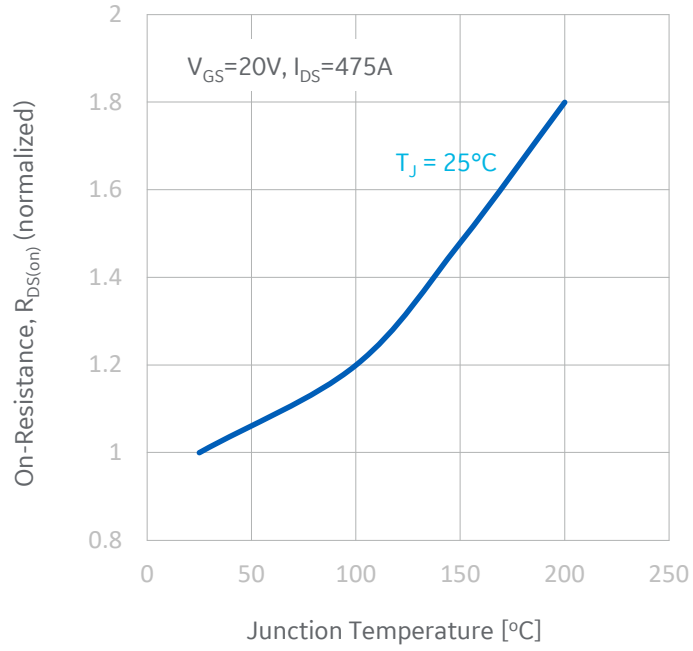


Figure 3: Normalized On-state Resistance vs. Temperature

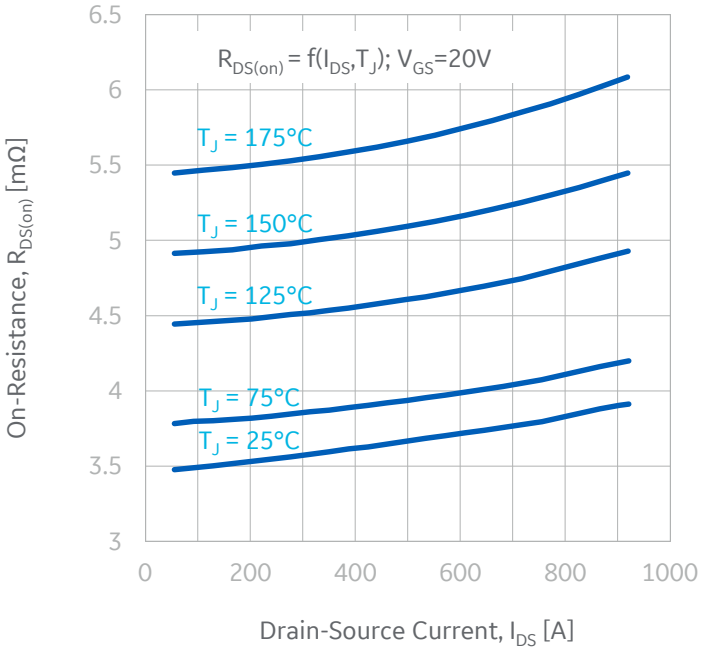


Figure 4: Module Drain-Source On-state Resistance

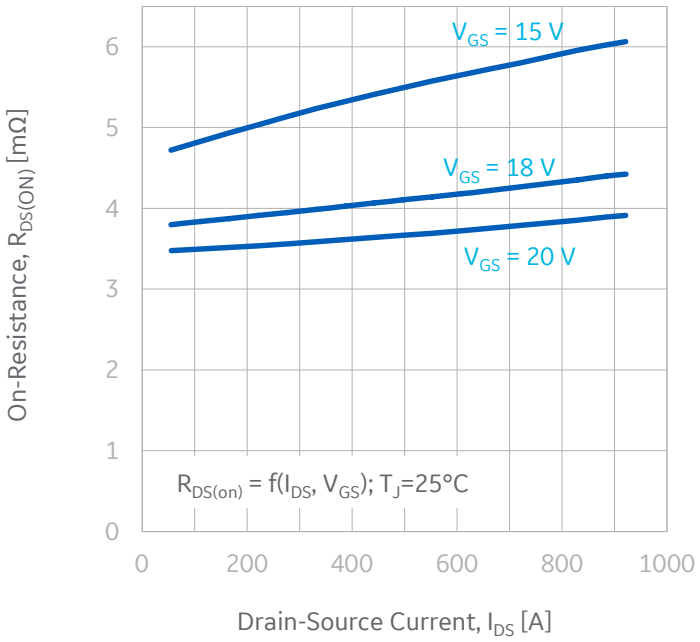


Figure 5: Module Drain-Source On-state Resistance

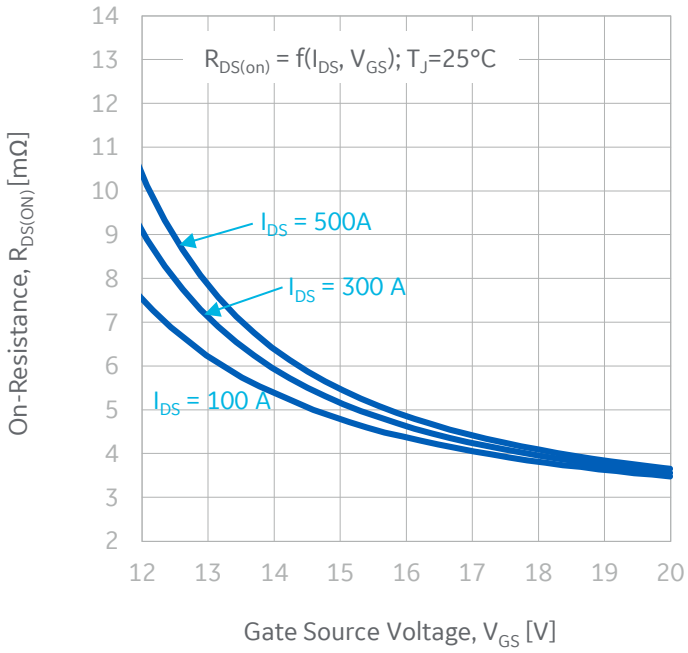


Figure 6: Drain-Source On-state Resistance vs. Gate Voltage

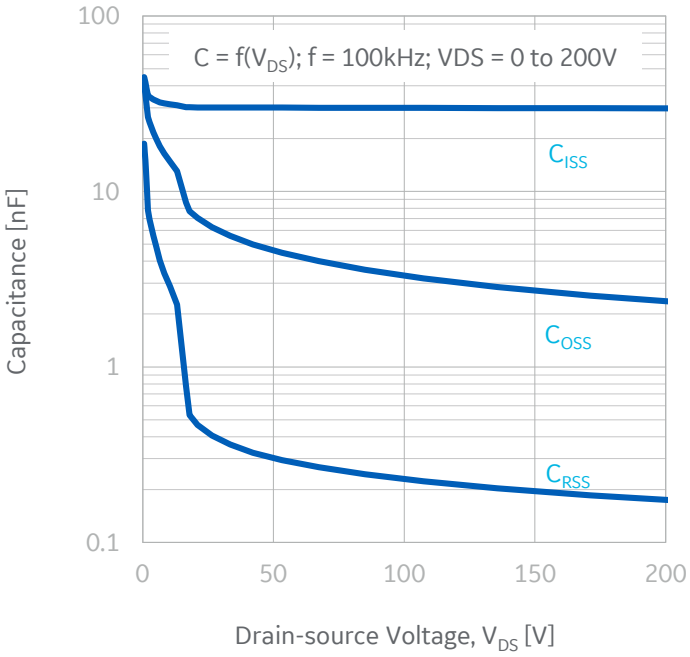


Figure 7: Junction Capacitances to 200 V

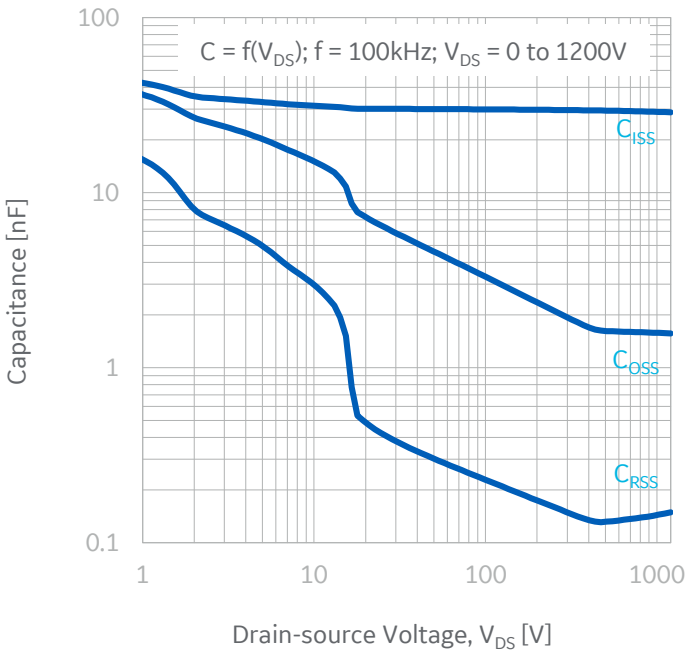


Figure 8: Junction Capacitances to 1200 V

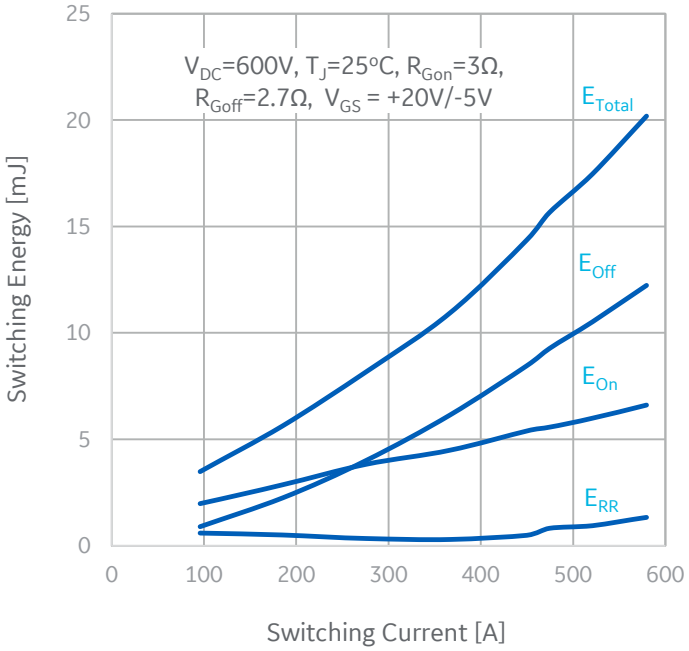


Figure 9: Switching Energy vs. Drain Current (600 V)

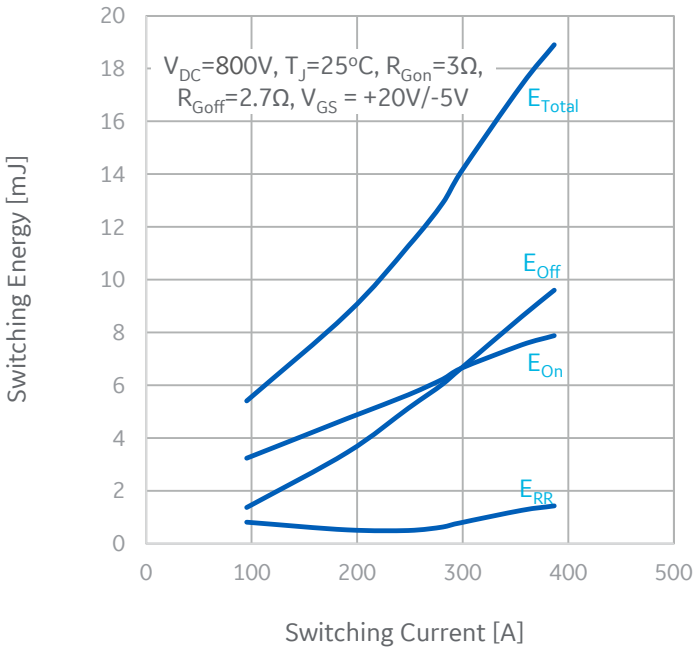


Figure 10: Switching Energy vs. Drain Current (800 V)

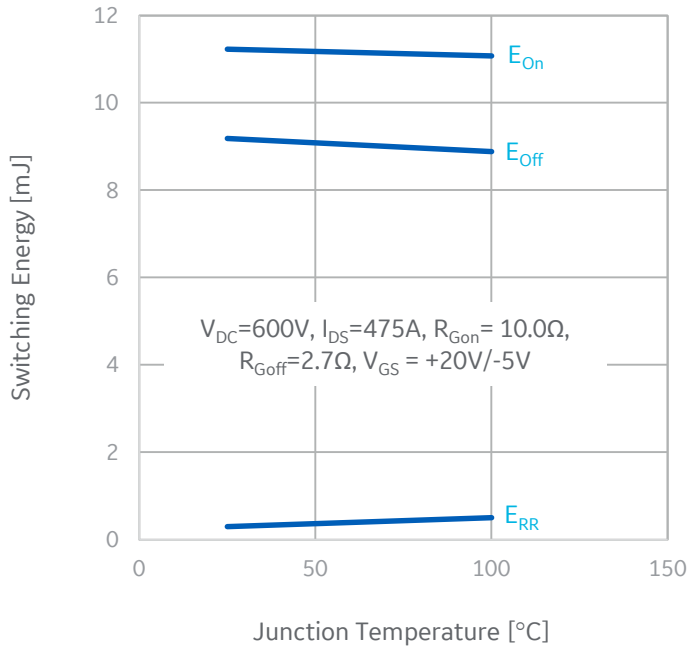


Figure 11: Switching Energy vs. Junction Temperature

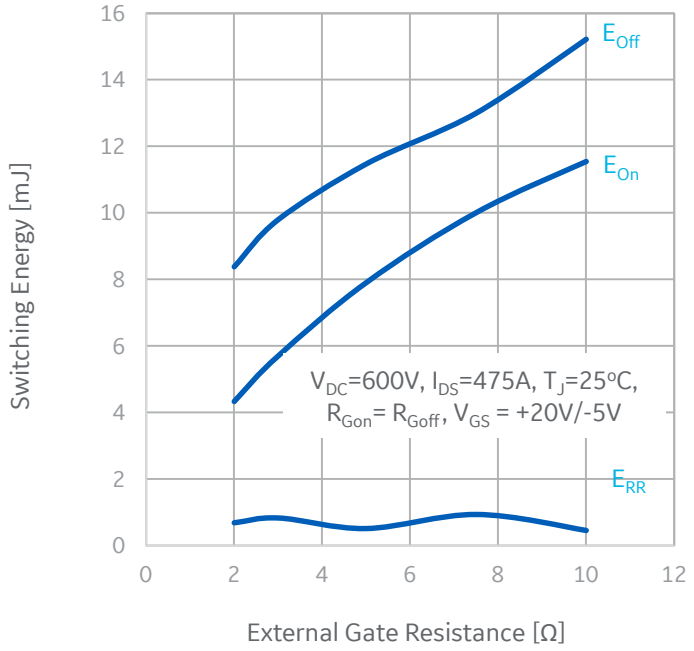


Figure 12: Switching Energy vs. Gate Resistance

Typical performance: **GE12050EEA3**

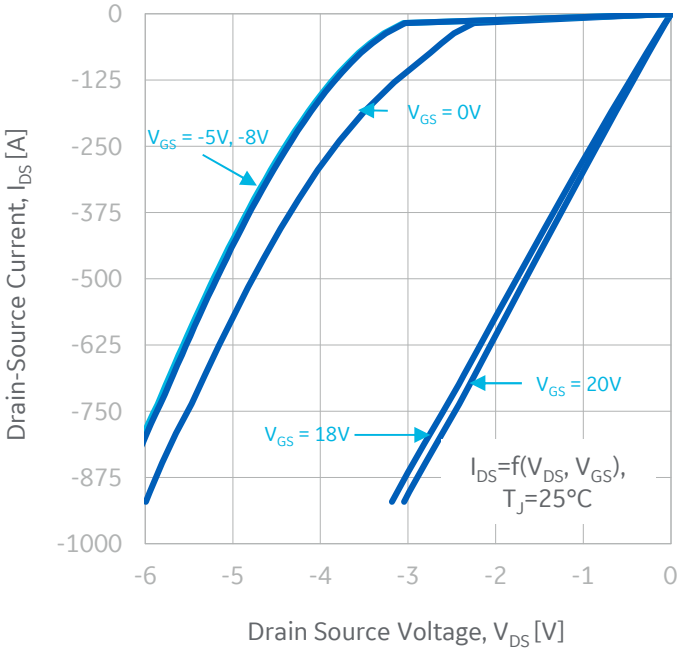


Figure 13: 3rd Quadrant Characteristics (25°C)

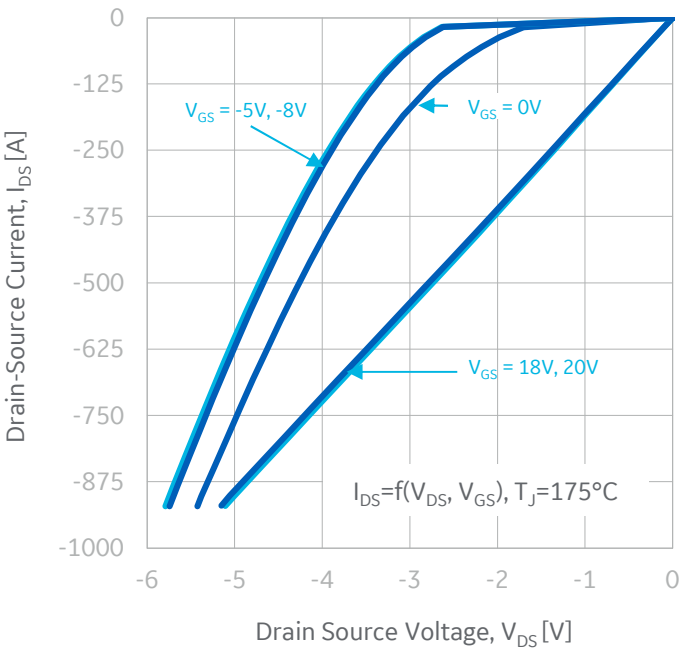


Figure 14: 3rd Quadrant Characteristics (175°C)

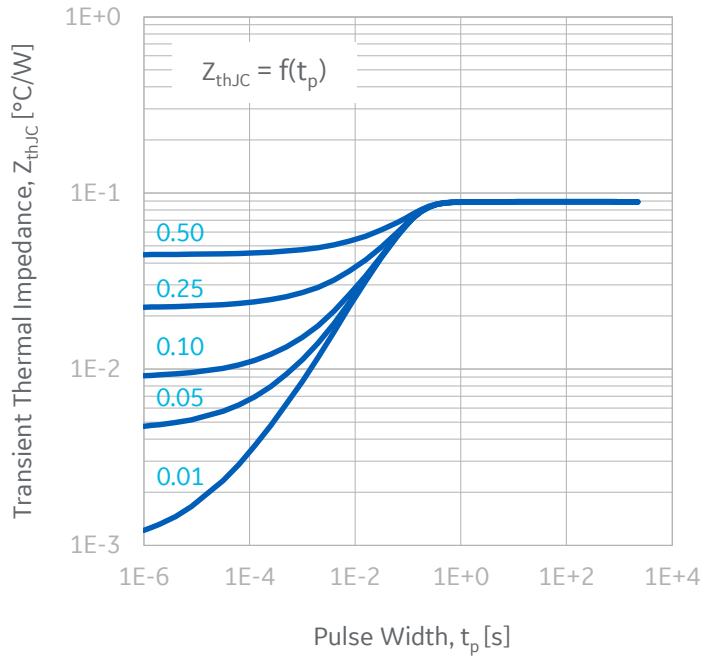


Figure 15: Transient Thermal Impedance

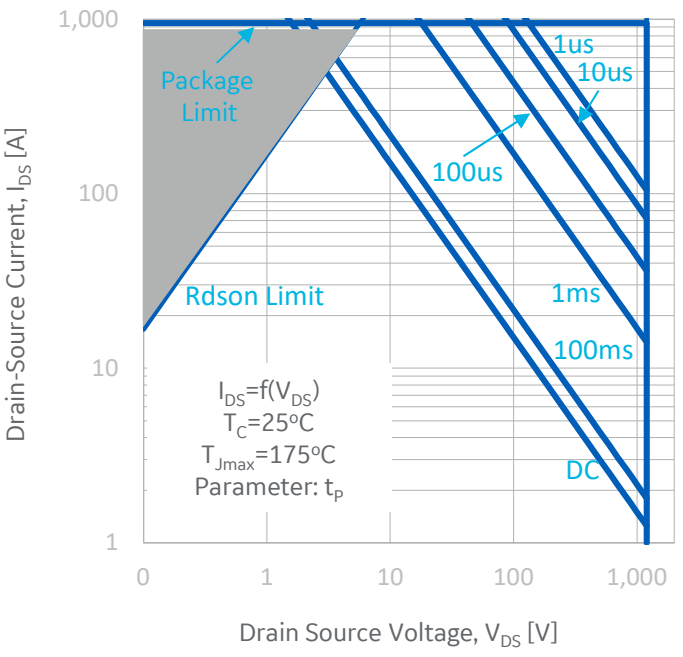


Figure 16: Forward-Bias Safe Operating Area

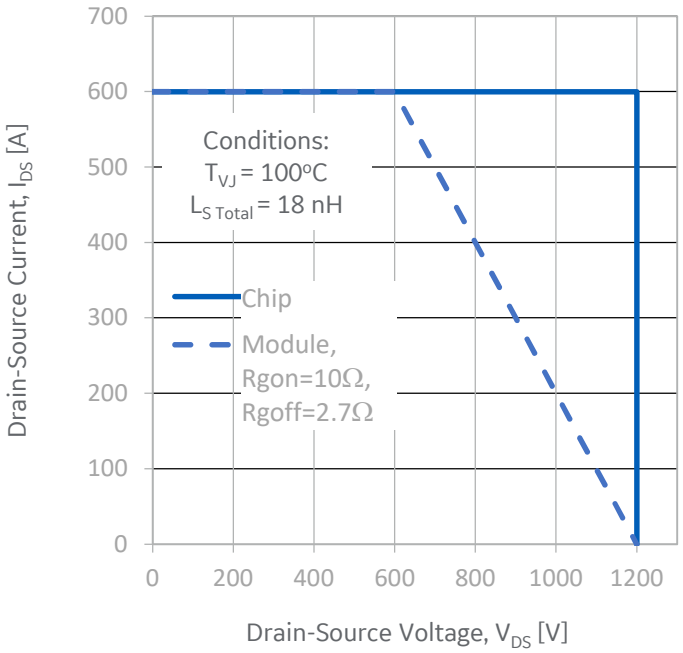


Figure 17: Reverse-Bias Safe Operating Area

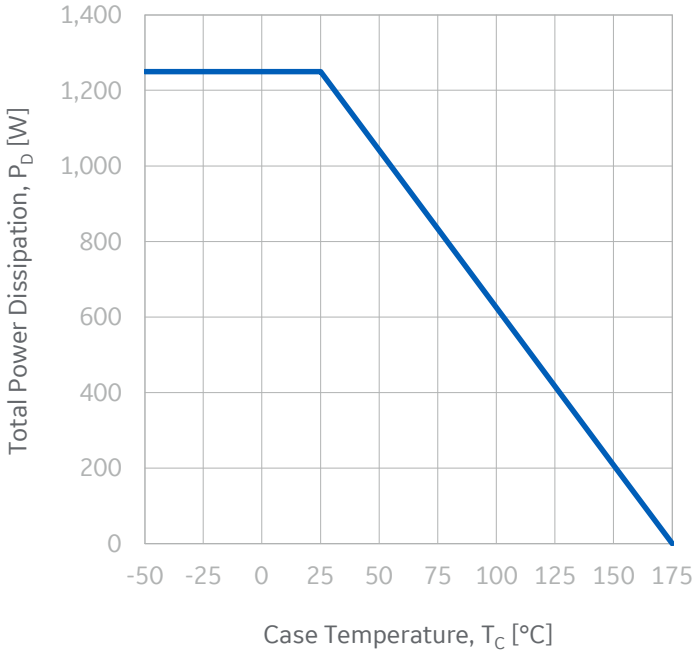
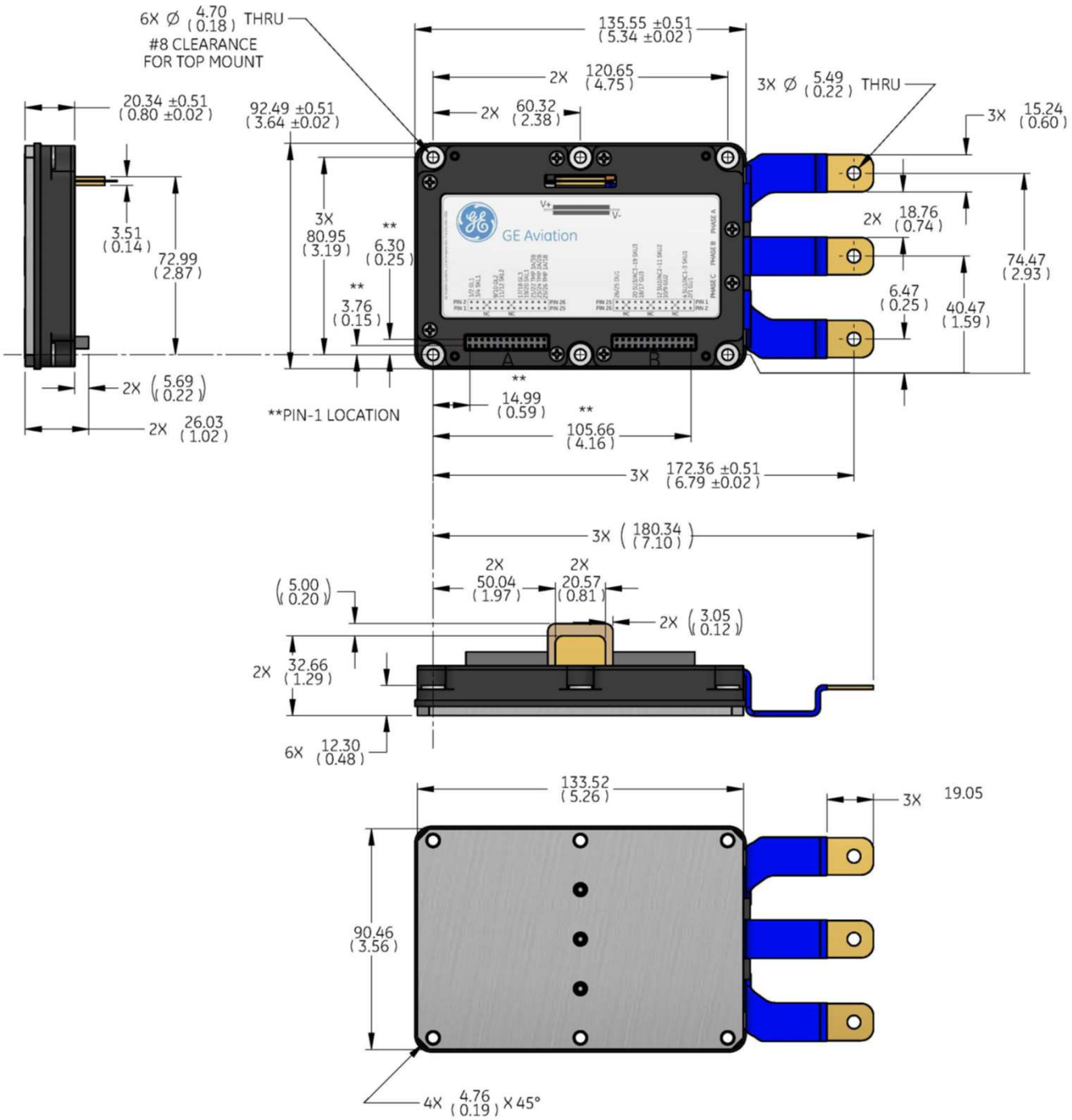


Figure 18: Maximum Power Dissipation vs. Case Temperature

Module dimensions (millimeters)



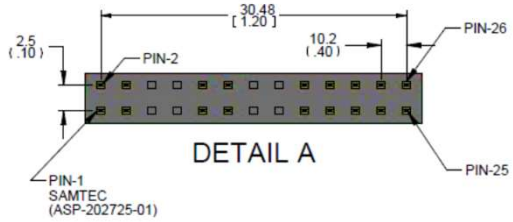
Electrical interface outline drawing

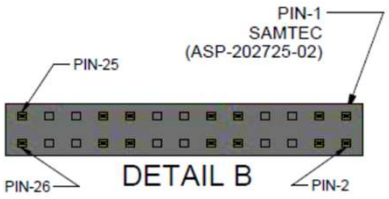
Lower Switch Interconnect	
1	GL1
2	GL1
3	SKL1
4	SKL1
5	**
6	**
7	**
8	**
9	GL2
10	GL2
11	SKL2
12	SKL2
13	**
14	**
15	**
16	**
17	GL3
18	GL3
19	SKL3
20	SKL3
21	TMP3A
22	TMP3B
23	TMP2A
24	TMP2B
25	TMP1A
26	TMP1B

** = No Connection

Upper Switch Interconnect	
1	GU1
2	GU1
3	SKU1
4	SKU1
5	**
6	**
7	**
8	**
9	GU2
10	GU2
11	SKU2
12	SKU2
13	**
14	**
15	**
16	**
17	GU3
18	GU3
19	SKU3
20	SKU3
21	**
22	**
23	**
24	**
25	DU
26	DU

** = No Connection





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Document revisions
Rev 1.3 – Public Release – March 2023