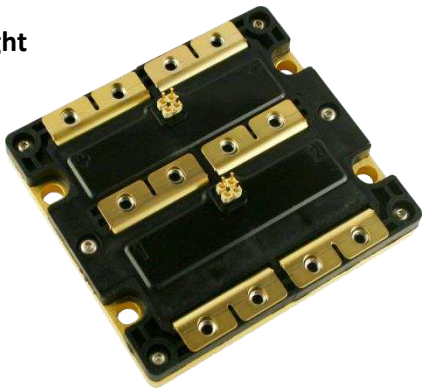
High-Temperature Silicon Carbide (SiC) Half-Bridge Power Module

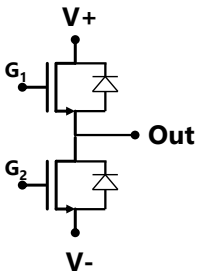
TMOS Version

600 V / 1000 A / 1.4 mΩ

FEATURES

- High temperature: $T_{c(max)}$ = 225 °C
  $T_{j(max)}$ = 225 °C
- AS9100:Rev. C-certified manufacturing, traceable throughout value chain
- Ultra-fast switching (<30 ns), low inductance
- High system efficiency
- Flux-free, void-free packaging
- Low profile, small form factor, extremely lightweight
- High reliability





APPLICATIONS

- High-efficiency converters / inverters
- Motor drives
- Aerospace: Military & Commercial
- Smart grid/grid-tie distributed generation

DESCRIPTION

The APE HT-2201 Silicon Carbide (SiC) half-bridge power module was designed specifically to address the growing demand for higher power densities, higher temperatures, and higher switching frequencies.

COMPANION PARTS

Maximum performance may be obtained through use of the companion high-temperature gate driver, part number APE MTGD2-2011, designed especially for driving the Silicon Carbide module.

Power Module Absolute Maximum Ratings (T_c = 25 °C unless otherwise specified)				
Symbol	**Parameter**	**Condition(s)**	**Value**	**Units**
V_{DSS}	Drain-source voltage		600	V
V_{GSS}	Gate-source voltage		-5 to 20	V
I_D	Continuous drain current	T_c = 25 °C	1000	A
		T_c = 100 °C	TBD	
		T_c = 225 °C	TBD	
I_{DM}	Peak pulsed drain current	Pulse width ≤ 10 µs, duty cycle ≤ 2%	TBD	A
P_D	Maximum power dissipated		1600	W
$T_{c(max)}$	Maximum case temperature[1]		225	°C
$T_{j(min)}$	Minimum operating junction temperature		- 50	°C
$T_{j(max)}$	Maximum operating junction temperature		225	
T_{stg}	Storage temperature		- 50 to 225	°C
V_{isol}	Insulation test voltage	AC, 1 min.	TBD	V
		AC, 1 s.	TBD	

Power Module Switch Position Electrical Characteristics (T_c = 25 °C unless otherwise specified)						
Symbols	**Parameter**	**Condition(s)**	**Values**			**Units**
			Min.	**Typical**	**Max.**	
$V_{(BR)DSS}$	Drain-source breakdown voltage	V_{GS} = -2 V, I_D = 1 mA	600	-	-	V
$V_{GS(th)}$	Gate-source threshold voltage	V_{DS} = 10 V, I_D = 1 mA	1.0	-	3.0	V
		V_{DS} = V_{GS}, I_D = 1 mA, T_j = 200 °C	TBD	-	TBD	
I_{DSS}	Drain-source leakage current	V_{GS} = - 2 V, V_{DS} = 600 V	-	-	200	µA
		V_{GS} = 2 V, V_{DS} = 600 V, T_j = 200 °C	-	-	TBD	
I_{GSS}	Gate-source leakage current	V_{GS} = 20 V, V_{DS} = 0 V	-	-	40	µA
$R_{DS(on)}$	Drain-source turn-on resistance	V_{GS} = 20 V, I_D = 1000 A	-	1.4	1.6	mΩ
		V_{GS} = 20 V, I_D = 1000 A, T_j = 150 °C	-	TBD	TBD	
C_{iss}	Input capacitance	V_{GS} = 0 V V_{DS} = 600 V f = 1 MHz	-	TBD	-	pF
C_{oss}	Output capacitance		-	TBD	-	
C_{rss}	Reverse transfer capacitance		-	TBD	-	
$t_{d(on)}$	Turn-on delay time	V_{DD} = 200 V, V_{GS} = - 4 to 20 V I_D = 500 A $R_{G(ext)}$ = 1.0 Ω, R_L = 43 µH	-	TBD	-	ns
t_{rv}	Rise time		-	45	-	
$t_{d(off)}$	Turn-off delay time		-	TBD	-	
t_{fv}	Fall time		-	35	-	

[1]The packaging materials have been qualified at this temperature.

Power Module Switch Position Gate Charge Electrical Characteristics (T_c = 25 °C unless otherwise specified)						
Symbols	**Parameter**	**Condition(s)**	**Values**			**Units**
			Min.	**Typical**	**Max.**	
Q_{gs}	Gate to source charge	V_{DD} = 400 V, V_{GS} = - 4 to 20 V	TBD	-	-	nC
Q_{gd}	Gate to drain charge	I_D = 1000 A	TBD	-	-	
Q_g	Gate charge total	$R_{G(ext)}$ = xx Ω, R_L = xx Ω	TBD	-	-	

Power Module Diode Position Electrical Characteristics (T_c = 25 °C unless otherwise specified)						
Symbols	**Parameter**	**Condition(s)**	**Values**			**Units**
			Min.	**Typical**	**Max.**	
V_{FM}	Forward voltage	I_F = 50 A	-	3.4	-	V
		I_F = 300 A, T_j = 25 °C	-	5.3	-	
I_R	Reverse current	V_R = 600V	-	TBD	-	µA
		V_R = 600 V, T_j = 150 °C	-	TBD	-	
Q_C	Capacitive charge	V_R = 600 V, I_F = 450 A, di/dt = 22900 A/µs	-	TBD	-	nC

Power Module Thermal Characteristics[2] (T_j = 25 °C unless otherwise specified)						
Symbols	**Parameter**	**Condition(s)**	**Values**			**Units**
			Min.	**Typical**	**Max.**	
$R_{\theta(j-c)}$	FET thermal resistance junction-case			0.125		°C/W

Power Module Mechanical Characteristics (T_j = 25 °C unless otherwise specified)						
Symbols	**Parameter**	**Condition(s)**	**Values**			**Units**
			Min.	**Typical**	**Max.**	
w	Weight			140		g
M_s	Lead frame mounting torque	6-32 steel screw for lead frame, 10-32 steel screw for baseplate		40		in·lb

TYPICAL PERFORMANCE CURVES

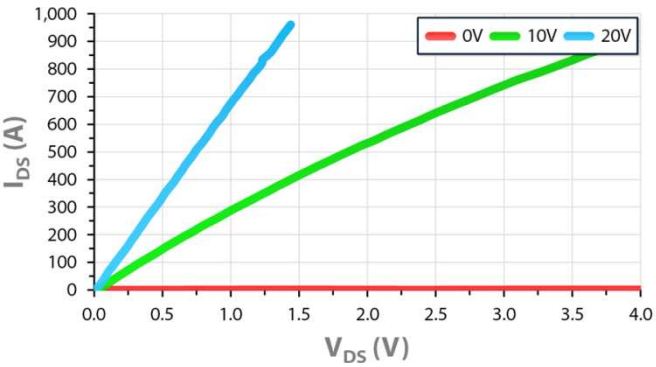
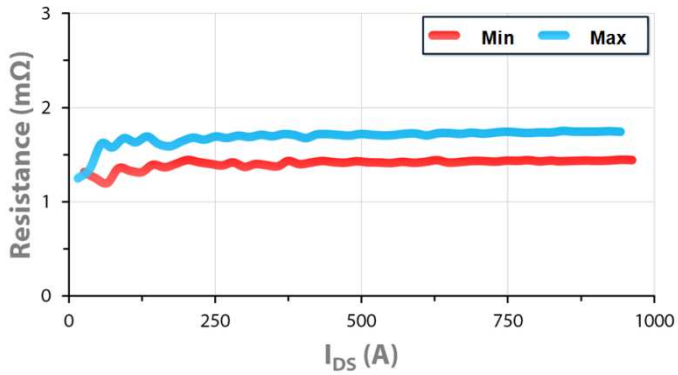


Fig. 1 - Die Junction @ 25 °C

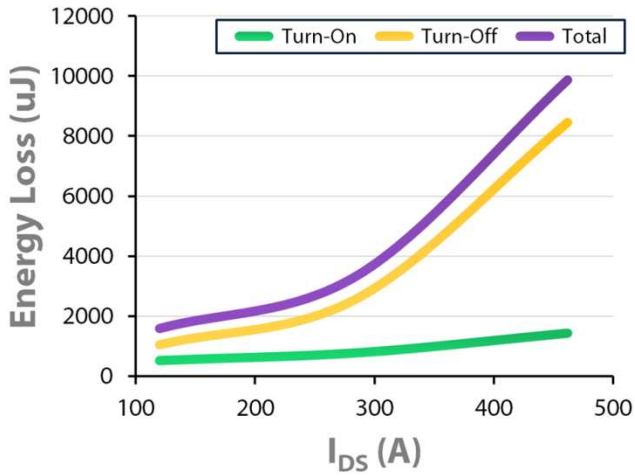
[2] FET thermal resistance junction-case is calculated measured with a 105 °C coldplate and full power distributed through the FETs. The thermal properties typically improve at lower temperatures.

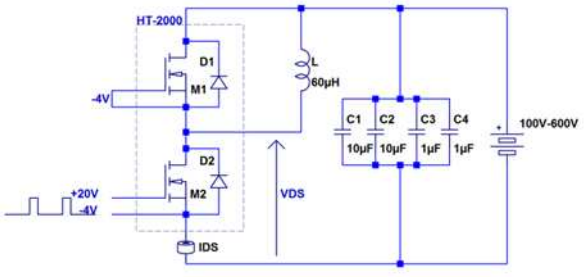
Typical Normalized On Resistance

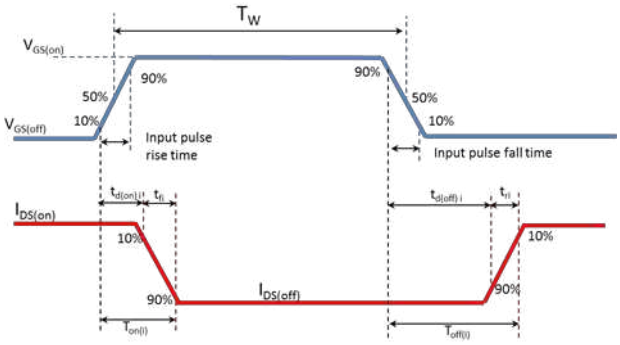
Normalized to an on resistance value of 1.4 mΩ (I_D = 1000 A, T_j =25 °C)



Typical Switching Losses

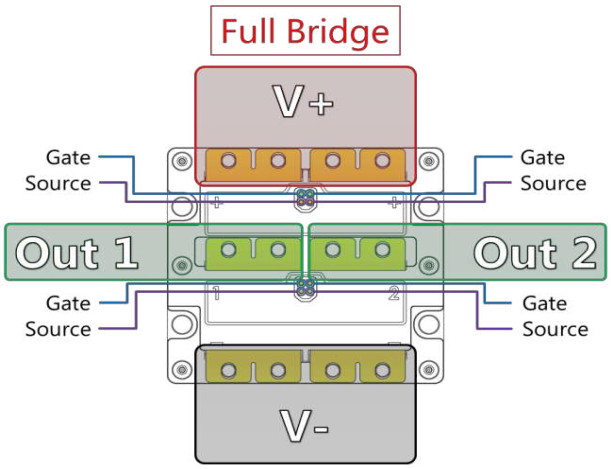


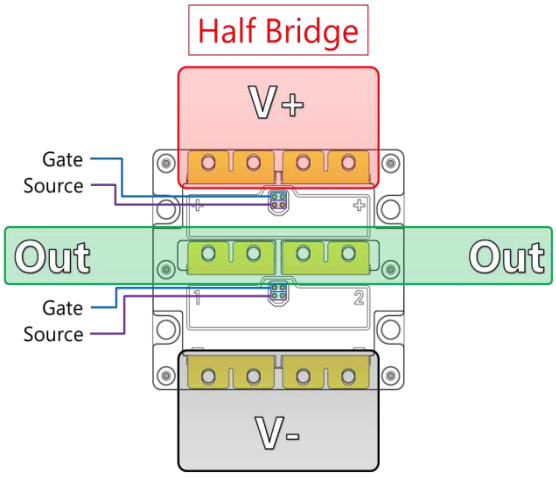


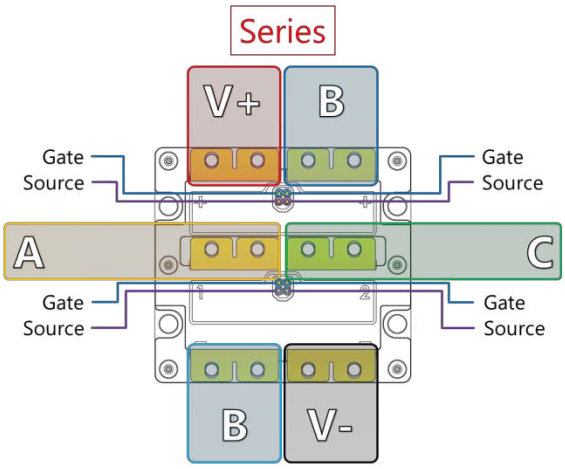


Energy values obtained using companion gate driver (T_{amb} = 25 °C).

HALF- AND FULL-BRIDGE CONNECTIONS







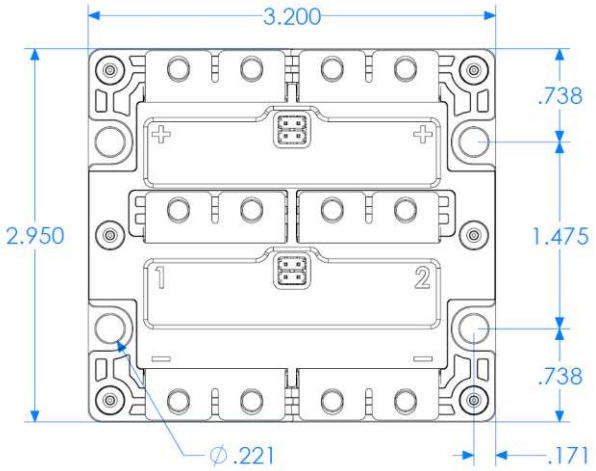
MOUNTING DIMENSIONS

All dimensions are listed in inches

#10-32 bolts are recommended for mounting

A torque of 40 in·lb is recommended

CAD models are available upon request



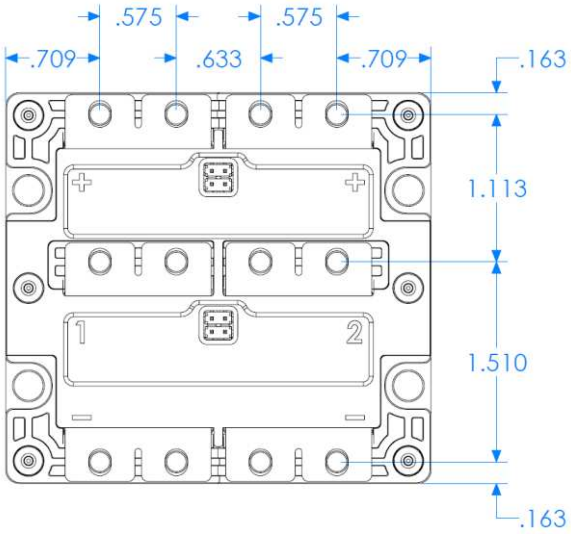
POWER CONTACT DIMENSIONS

All dimensions are listed in inches

#6-32 bolts required for the power contacts

A torque of 40 in·lb is recommended

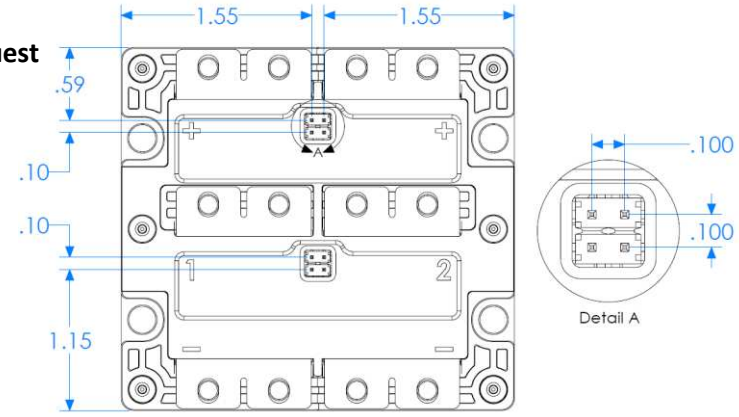
CAD models are available upon request



GATE DRIVE CONNECTIONS

All dimensions are listed in inches

CAD models are available upon request



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