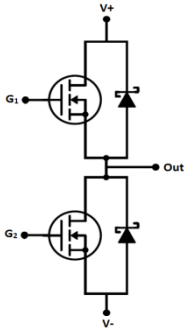
High-Temperature Silicon Carbide (SiC) Half-Bridge Power Module

N-Channel MOSFET Version

1200 V / 225 A / 13.5 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**
- **Enables high system efficiency**
- **Low profile, small form factor**



APPLICATIONS

- **High-efficiency converters / inverters**
- **Motor drives**
- **Aerospace: Military & Commercial**
- **Smart grid/grid-tie distributed generation**
- **Industrial and automotive traction drives**

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		1200	V
V_{GSS}	Gate-source voltage		-5 to 20	V
I_D	Continuous drain current	T_C = 25 °C	225	A
		T_C = 100 °C	175	
		T_C = 200 °C	80	
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	

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

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} = 0 V, I_D = 1 mA	1200	-	-	V
$V_{GS(th)}$	Gate-source threshold voltage	V_{DS} = V_{GS}, I_D = 1 mA	-	2.1	-	V
		V_{DS} = V_{GS}, I_D = 1 mA, T_j = 205 °C	-	1.1	-	
I_{DSS}	Drain-source leakage current	V_{GS} = - 5 V, V_{DS} = 1200 V	-	-	200	µA
		V_{GS} = - 5 V, V_{DS} = 1200 V, T_j = 205 °C	-	-	2000	
I_{GSS}	Gate-source leakage current	V_{GS} = 20 V, V_{DS} = 0 V	-	-	250	nA
$R_{DS(on)}$	Drain-source turn-on resistance	V_{GS} = 20 V, I_D = 75 A	-	13.5	-	mΩ
		V_{GS} = 20 V, I_D = 75 A, T_j = 225 °C	-	26.6	-	
C_{iss}	Input capacitance	V_{GS} = 0 V V_{DS} = 800 V f = 1 MHz	-	11,490	-	pF
C_{oss}	Output capacitance		-	720	-	
C_{rss}	Reverse transfer capacitance		-	78	-	
$t_{d(on)}$	Turn-on delay time	V_{DD} = 600 V, V_{GS} = - 4 to 20 V I_D = 120 A $R_{G(ext)}$ = 0 Ω, R_L = 60 Ω	-	36	-	ns
t_{rv}	Rise time		-	20	-	
$t_{d(off)}$	Turn-off delay time		-	68	-	
t_{fv}	Fall time		-	25	-	

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} = 800 V, V_{GS} = - 4 to 20 V I_D = 120 A	-	143	-	nC
Q_{gd}	Gate to drain charge		-	260	-	
Q_g	Gate charge total		-	545	-	

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 = 60 A	-	1.65	-	V
		I_F = 60 A, T_J = 200 °C	-	2.5	-	
I_R	Reverse current	V_R = 1200 V	-	TBD	-	µA
		V_R = 1200 V, T_J = 200 °C	-	TBD	-	
Q_C	Capacitive charge	V_R = 1200 V, I_F = 120 A, di/dt = 7500 A/µs	-	780	-	nC

Thermal Characteristics (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						
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

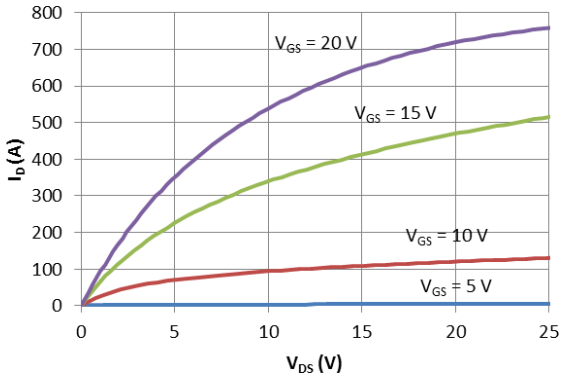


Fig. 1 - Typical Output Characteristics, T_J = 25°C

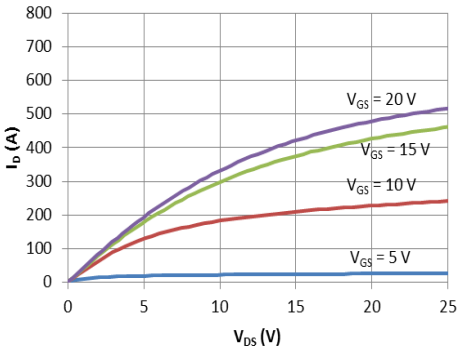


Fig. 2 - Typical Output Characteristics, T_J = 205°C

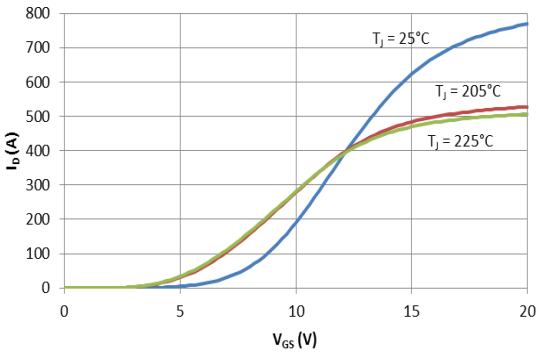


Fig. 3 - Transconductance

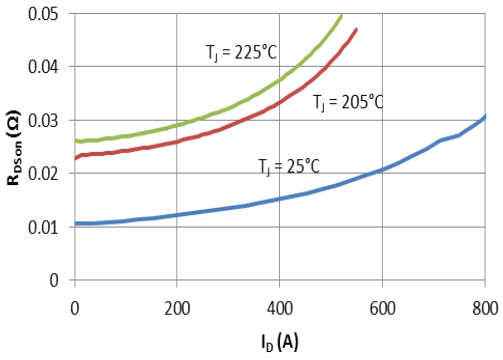


Fig. 4 - Typical On Resistance, V_{GS} = 20 V

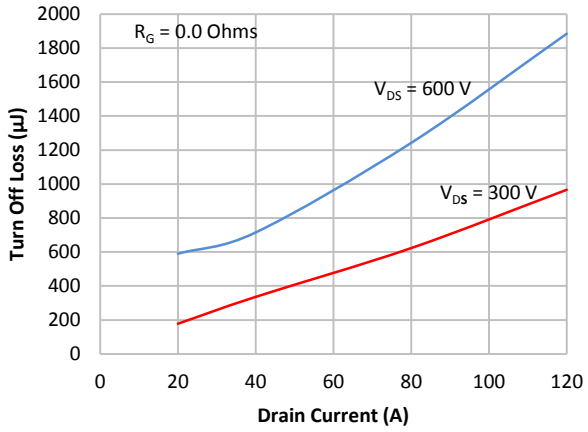


Fig. 5 – Turn off loss versus drain current

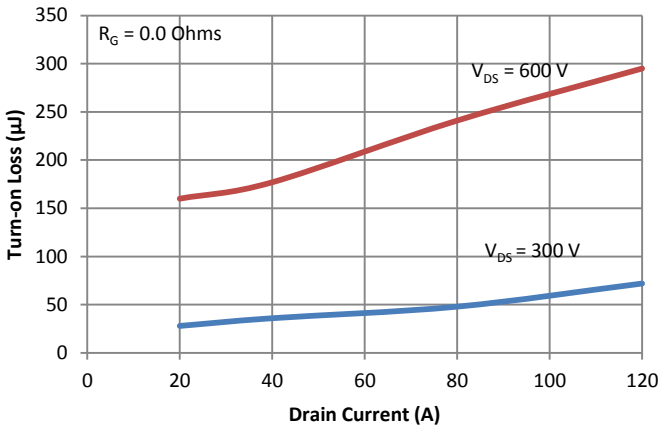


Fig. 6 – Turn on loss versus drain current

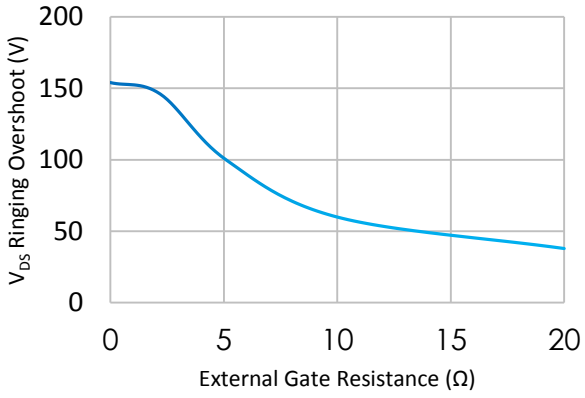


Fig. 7 – Ringing voltage overshoot versus external gate resistance

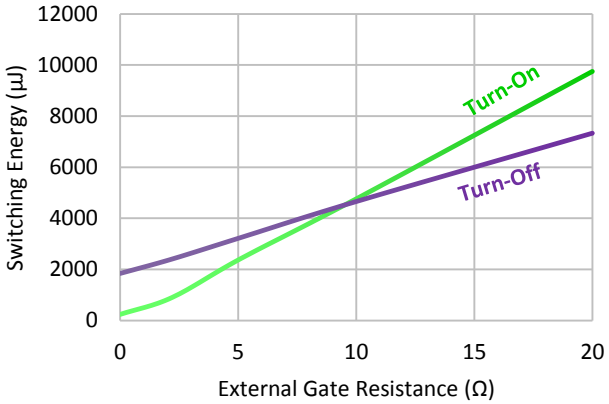


Fig. 8 – Switching energy versus external gate resistan

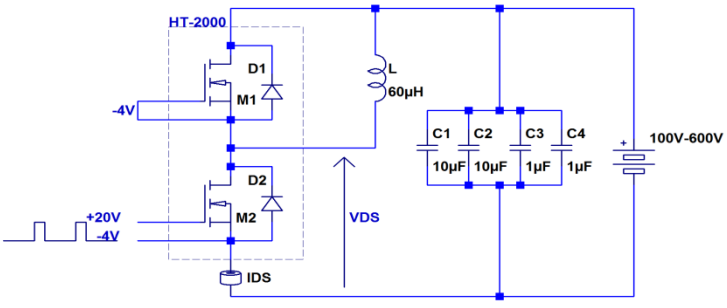
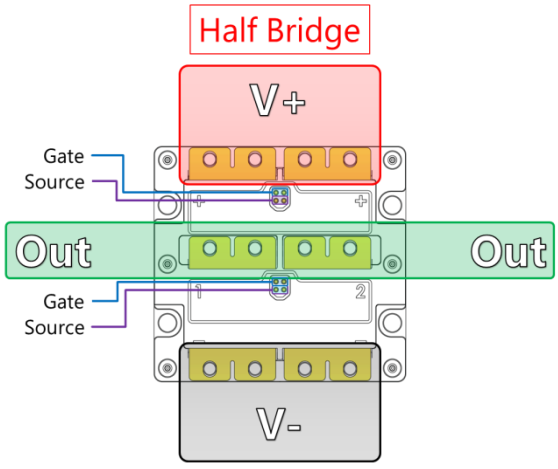


Fig. 9 - Energy values obtained using companion gate driver (T_{amb} = 25 °C).



Half Bridge Connection

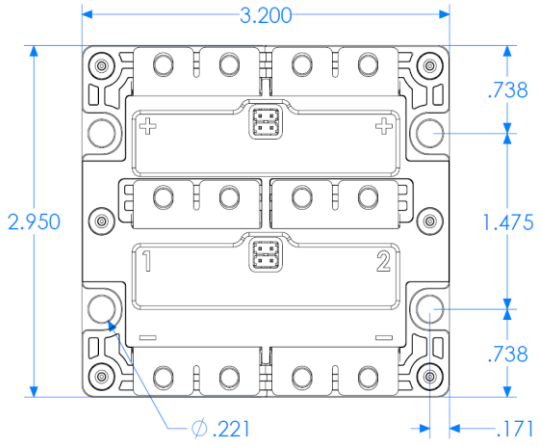
MOUNTING DIMENSIONS

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



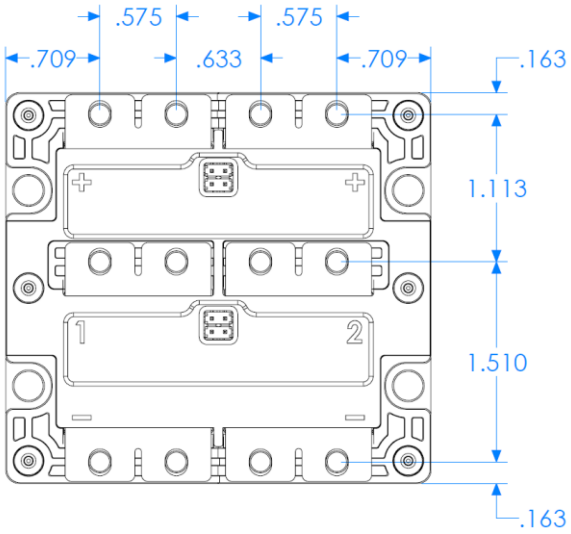
POWER CONTACT DIMENSIONS

All dimensions are listed in inches

#6-32 bolts required for the power contacts

A torque of 40 in·lb is recommended

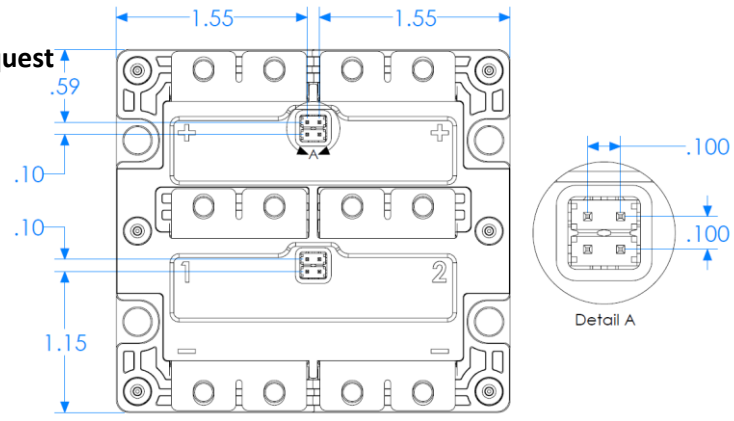
CAD models are available upon request



GATE DRIVE CONNECTIONS

All dimensions are listed in inches

CAD models are available upon request



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