

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

N-Channel MOSFET Version

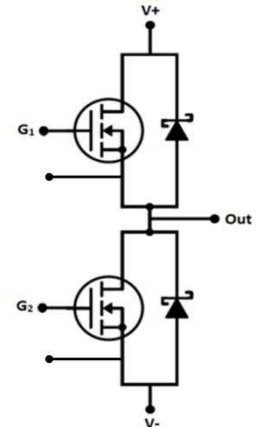
FEATURES

- Industry standard footprint
- High temperature: $T_{c(max)} = 225\text{ }^{\circ}\text{C}$
 $T_{j(max)} = 225\text{ }^{\circ}\text{C}$
- 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

1200 V / 3.6 mΩ

APPLICATIONS

- High-efficiency converters / inverters
- Motor drives
- Smart grid/grid-tie distributed generation
- Industrial and automotive traction drives



DESCRIPTION

The HT-3201 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 MTGD2-3011, designed especially for driving the SiC module.

Power Module Absolute Maximum Ratings ($T_c = 25\text{ }^{\circ}\text{C}$ unless otherwise specified)

Symbol	Parameter	Condition(s)	Value	Units
V_{DSS}	Drain-source voltage		1200	V
V_{GSS}	Gate-source voltage		-10 to 25	V
I_D	Continuous drain current	$T_c = 25\text{ }^{\circ}\text{C}, T_j = 200\text{ }^{\circ}\text{C}$	433	A
		$T_c = 175\text{ }^{\circ}\text{C}, T_j = 200\text{ }^{\circ}\text{C}$	170	
I_{DM}	Peak pulsed drain current	Pulse width $\leq 10\text{ }\mu\text{s}$, duty cycle $\leq 2\%$	TBD	A
P_D	Maximum power dissipated	$T_j = 225\text{ }^{\circ}\text{C}$	2000	W
$T_{C(max)}$	Maximum case temperature ¹		225	$^{\circ}\text{C}$
$T_{J(min)}$	Minimum operating junction temperature		- 50	$^{\circ}\text{C}$
$T_{J(max)}$	Maximum operating junction temperature		225	
T_{stg}	Storage temperature		- 50 to 225	$^{\circ}\text{C}$
V_{isol}	Insulation test voltage	AC, 1 min.	TBD	V
		AC, 1 s.	TBD	

¹The 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} = 10 V, I _D = 1 mA	-	5.25	-	V
		V _{DS} = 10 V, I _D = 1 mA, T _J = 200 °C	-	4.5	-	
I _{DSS}	Drain-source leakage current	V _{GS} = - 5 V, V _{DS} = 1200 V	-	720	-	μA
		V _{GS} = - 5 V, V _{DS} = 1200 V, T _J = 200 °C	-	-	-	
I _{GSS}	Gate-source leakage current	V _{GS} = 20 V, V _{DS} = 0 V	-	-	3.5	μA
R _{DS(on)}	Drain-source turn-on resistance	V _{GS} = 20 V, I _D = 400 A	-	3.6	-	mΩ
		V _{GS} = 20 V, I _D = 400 A, T _J = 200 °C	-	9.4	-	
C _{iss}	Input capacitance	V _{GS} = 0 V, V _{DS} = 1000 V	-	20,860	-	pF
C _{oss}	Output capacitance	f = 1 MHz, V _{AC} = 25 mV	-	1,540	-	
C _{rss}	Reverse transfer capacitance	MOSFETs only	-	161	-	
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	-	-	-	ns
t _{rv}	Rise time		-	50	-	
t _{d(off)}	Turn-off delay time		-	-	-	
t _{fv}	Fall time		-	70	-	

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} = 0/20 V I _D = 140 A	-	224	-	nC
Q _{gd}	Gate to drain charge		-	441	-	
Q _g	Gate charge total		-	1,253	-	

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 = 350 A	1.6	1.8	-	V
		I _F = 350 A, T _J = 200 °C	2.05	2.3	-	
I _R	Reverse current	V _R = 1200 V	-	700	-	μA
		V _R = 1200 V, T _J = 200 °C	-	TBD	-	
Q _C	Capacitive charge	V _R = 400 V	1,020	-	-	nC

Thermal Characteristics (T_J = 25 °C unless otherwise specified)						
Symbols	Parameter	Condition(s)	Values			Units
			Min.	Typical	Max.	
R _{θ(j-c)}	MOSFET thermal resistance junction-case		0.085	0.1	-	°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	M4 bolts	-	1.13	-	N·m

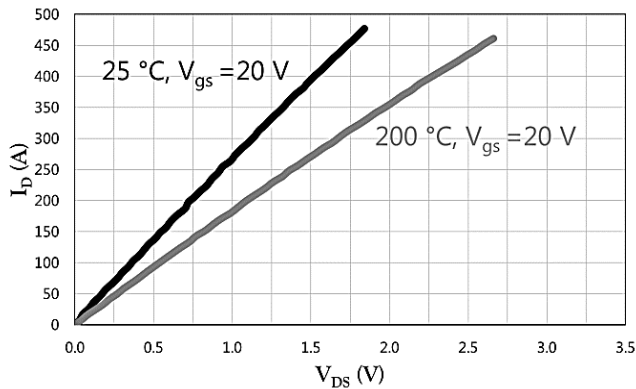
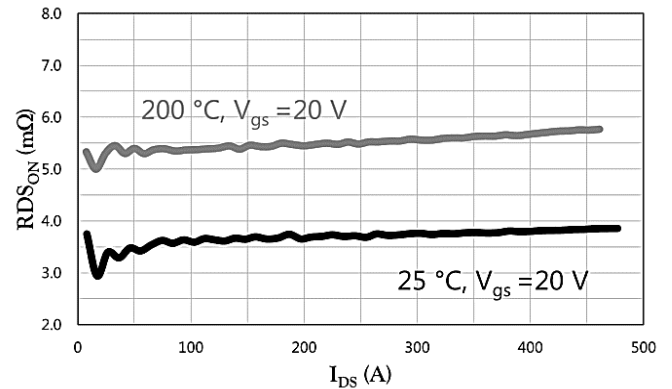
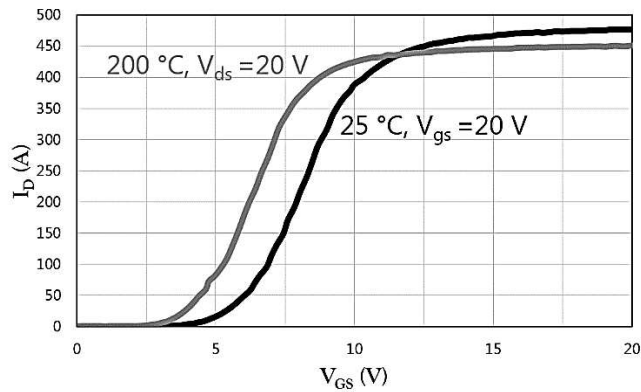
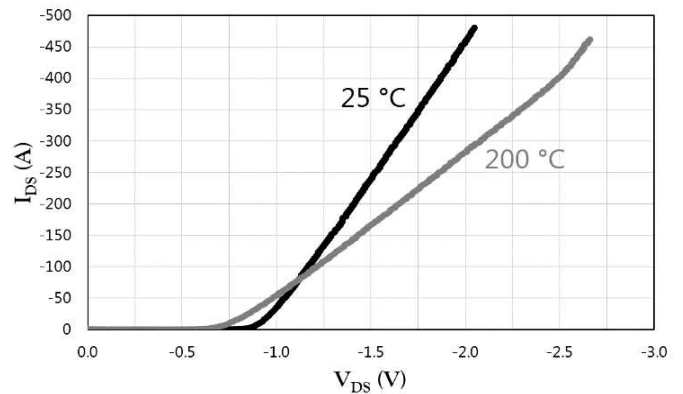
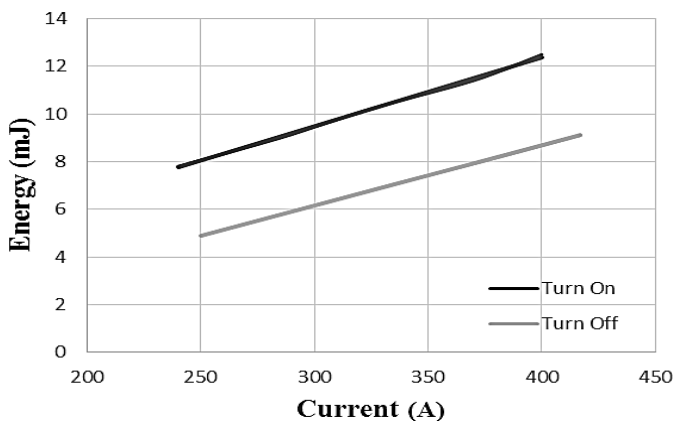
TYPICAL PERFORMANCE CURVES

 Fig. 1. Output characteristics at $V_{gs} = 20$ V at 25 °C & 200 °C.

 Fig. 2. On-resistance at $V_{gs} = 20$ V at 25 °C & 200 °C.

 Fig. 3. Transconductance with $V_{ds} = 20$ V at 25 °C & 200 °C.


Fig. 4. Reverse diode characteristics at 25 °C & 200 °C.

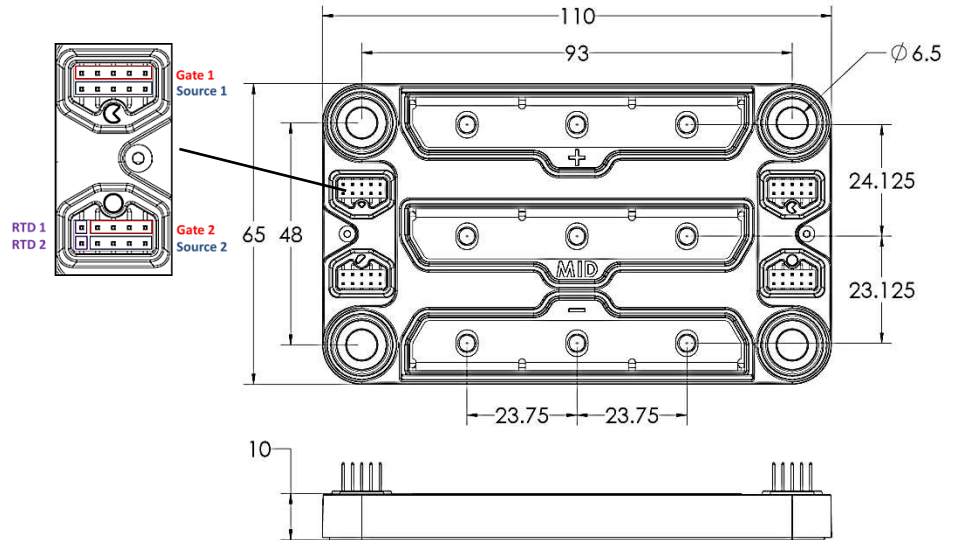

 Fig. 5. Switching Energy with $R_g = 5$ Ω & $V_{bus} = 600$ V

DIMENSIONS

All dimensions are listed in millimeters.

Bolts - Lead frame: M4
Base plate: M6

CAD models are available upon request.


ORDERING INSTRUCTIONS

An order for one or more parts can be initiated by issuing a purchase order to APEI. Please e-mail or fax your purchase order to sales@apei.net or +1.866.515.6604, respectively.

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