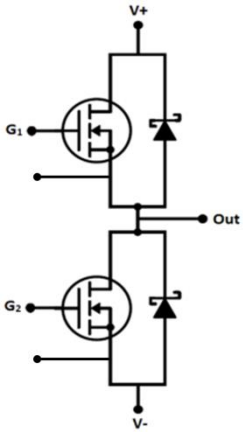
High-Temperature Silicon Carbide (SiC) Half-Bridge Power Module

N-Channel MOSFET Version

1200 V / 3.6 mΩ

FEATURES

- **Industry standard footprint**
- **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**
- **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 °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 °C, T_J = 200 °C	433	A
		T_C = 175 °C, T_J = 200 °C	170	
I_{DM}	Peak pulsed drain current	Pulse width ≤ 10 µs, duty cycle ≤ 2%	TBD	A
P_D	Maximum power dissipated	T_J = 225 °C	2000	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} = 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 f = 1 MHz, V_{AC} = 25 mV MOSFETs only	-	20,860	-	pF
C_{oss}	Output capacitance		-	1,540	-	
C_{rss}	Reverse transfer capacitance		-	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.**	
$R_{\theta(j-c)}$	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

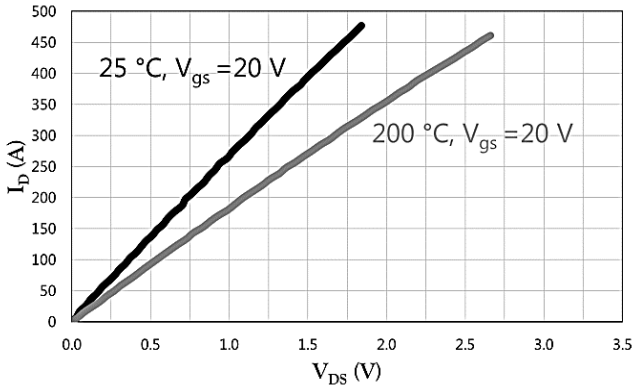


Fig. 1. Output characteristics at V_{gs} = 20 V at 25 °C & 200 °C.

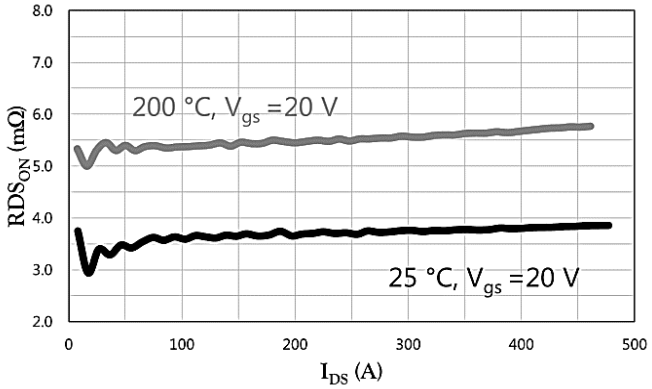


Fig. 2. On-resistance at V_{gs} = 20 V at 25 °C & 200 °C.

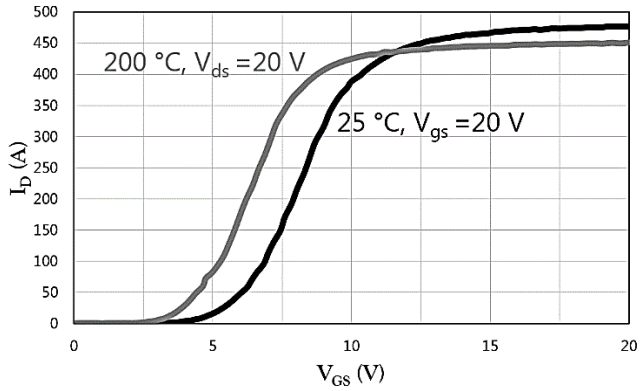


Fig. 3. Transconductance with V_{ds} = 20 V at 25 °C & 200 °C.

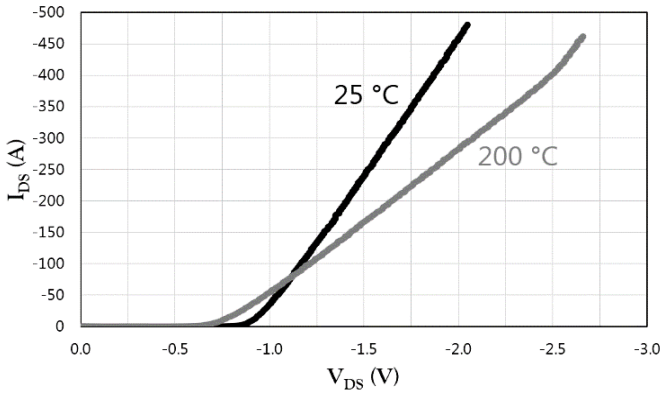


Fig. 4. Reverse diode characteristics at 25 °C & 200 °C.

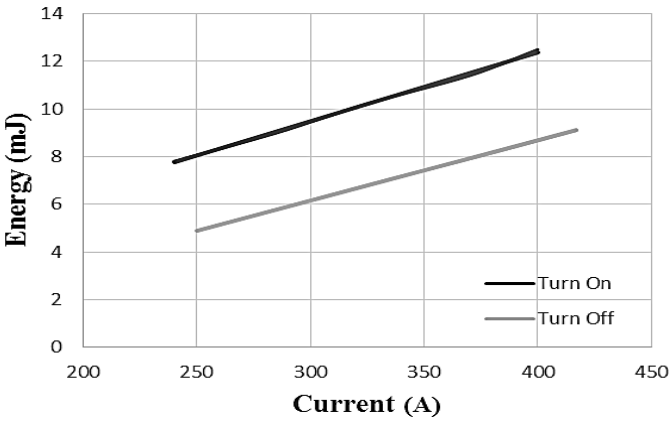


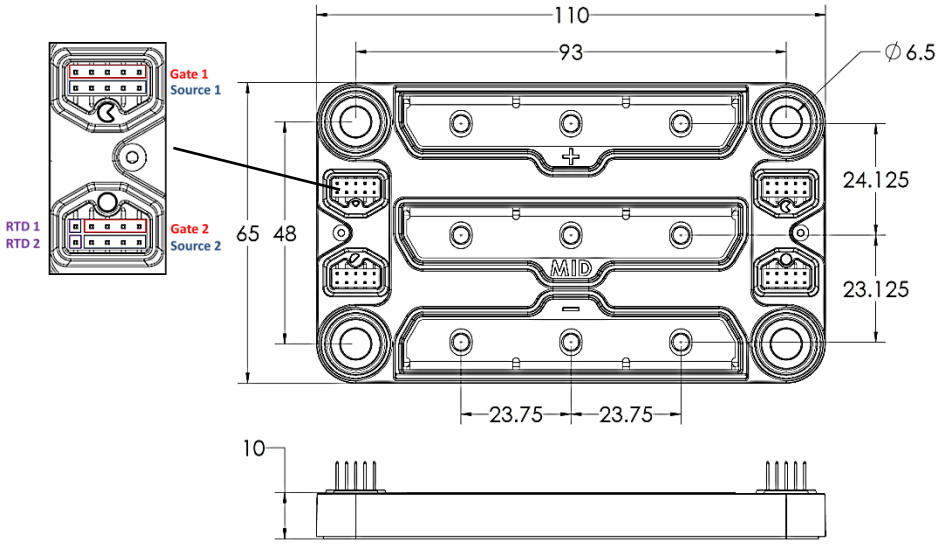
Fig. 5 Switching Energy with R_g = 5 Ω & V_{bus} = 600 V

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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