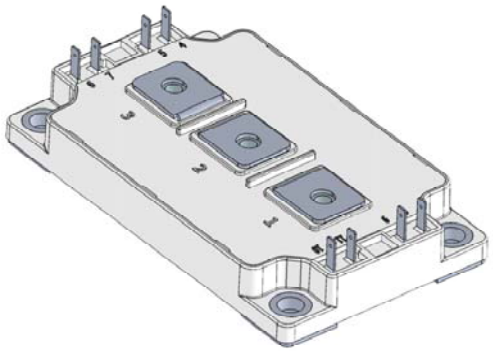
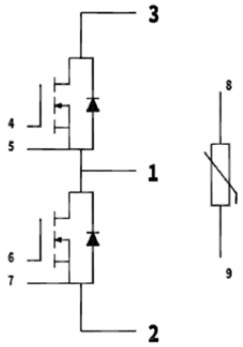
1200V 10 mΩ SiC MOSFETs Half Bridge Module



Package: 62mm x 106mm x 17mm



Features

- Ultra Low Loss with SiC MOSFETs
- Zero Reverse Recovery Current with SiC SBDs
- Zero Turn-off Tail Current
- High-Frequency Operation
- Positive Temperature Coefficient on VDS(on)
- Cu baseplate with Si_3N_4 AMB DBC substrate

Applications

- UPS and SMPS
- Fast DC/DC Converter
- Solar and Wind Inverter
- Induction Heating/Welding

RoHS

Benefits

- Outstanding performance at high frequency operation
- Low switching losses
- Better EMI noise with low parasitic inductance
- Direct mounting to heatsink (isolated package)
- Low junction to case thermal resistance
- Easy paralleling due to positive T_C of R_{DS_ON}
- RoHS Compliant

Absolute Maximum Ratings (T_j=25°C unless otherwise specified)

Parameter	Symbol	Conditions	Specifications	Units
Drain - Source Voltage	V_{DS}		1200	V
Continuous Drain Current	I_D	V_{GS}=20V, T_C = 25 °C	240	A
		V_{GS}=20V, T_C = 90 °C	160	A
Gate - Source Voltage	V_{GS}		+25/-10	V
Pulsed Drain Current	I_{DS}	Limited by Tj_max	640	A
Maximum Power Dissipation	P_D	T_C = 25 °C	500	W
		T_C = 100 °C	TBD	W
Operating Junction Temperature	T_j		-55 ~ 150	°C
Storage Temperature	T_{STG}		-55 ~ 125	°C
Solder Temperature	T_L	Max for 10 sec	260	°C

Electrical Characteristics of MOSFETs (T_j=25°C unless otherwise specified)

Parameter	Symbol	Conditions	Min	Typ	Max	Units
OFF						
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = 1200V, V_{GS} = 0V	--	--	500	μA
Gate-Source Leakage Current	I_{GSS}	V_{DS} = 0V, V_{GS} = 20V	--	--	±1	μA
ON						
Gate-Source Threshold Voltage	$V_{GS(TH)}$	V_{DS} = 10V, I_D = 12mA, T_j = 25 °C		2.25	--	V
		V_{DS} = 10V, I_D = 12mA, T_j = 125 °C		1.75		
On State Resistance	$R_{DS(ON)}$	V_{GS} = 20V, I_D = 160A, T_j = 25 °C	--	10	13	mΩ
		V_{GS} = 20V, I_D = 160A, T_j = 150 °C	--	21	--	mΩ
Transconductance	g_{fs}	V_{DS} = 20V, I_D = 160A, T_j = 25 °C		60		S
		V_{DS} = 20V, I_D = 160A, T_j = 150 °C		52		
DYNAMIC						
Input Capacitance	C_{ISS}	V_{DS} = 600V, V_{GS} = 0V, f = 1 MHz, V_{AC} = 25mV	--	7600	--	pF
Output Capacitance	C_{OSS}		--	1050	--	pF
Reverse Transfer Capacitance	C_{RSS}		--	44	--	pF
Internal Gate Resistance	$R_{G(INT)}$	f = 1 MHz, V_{AC} = 25mV		0.45		Ω
External Gate Resistance	$R_{G(EXT)}$			10		Ω
Module Stray Inductance	L_σ	Between terminal 2 and 3	--	8.2	--	nH
Module Lead Resistance	R_{mod}		--	TBD	--	mΩ
SWITCHING						
Turn-On Delay Time	$t_{d(on)}$	V_{DD}= 600V, I_D =160A R_G= 20Ω, V_{GS}= -5/20V Inductive Load, T_J=25 °C	--	165	--	ns
Rise Time	t_r		--	110	--	ns
Turn-Off Delay Time	$t_{d(off)}$		--	395	--	ns
Fall Time	t_f		--	175	--	ns
Turn-On Switching Energy Loss	E_{ON}		--	6.5	--	mJ
Turn-Off Switching Energy Loss	E_{OFF}		--	8.1	--	mJ
Turn-On Delay Time	$t_{d(on)}$	V_{DD}= 600V, I_D =160A R_G= 20Ω, V_{GS}=-5/20V Inductive Load, T_J=125 °C	--	150	--	ns
Rise Time	t_r		--	100	--	ns
Turn-Off Delay Time	$t_{d(off)}$		--	460	--	ns
Fall Time	t_f		--	170	--	ns
Turn-On Switching Energy Loss	E_{ON}		--	5.4	--	mJ
Turn-Off Switching Energy Loss	E_{OFF}		--	7.8	--	mJ
Total Gate Charge	Q_G	V_{DD}= 600V, I_D =160A V_{GS}= -5/20V	--	390	--	nC
Gate-Source Charge	Q_{GS}		--	120	--	nC
Gate-Drain Charge	Q_{GD}		--	148	--	nC

Maximum Rated Values of SiC Freewheeling SBDs (T_C=25℃ unless otherwise specified)

Parameter	Symbol	Conditions	Value	Unit
Repetitive Peak Reverse Voltage	V_{RRM}	T_j=25 °C	1200	V
Diode Continuous Forward Current	I_F	T_C=100 °C, T_j=150 °C	160	A
Surge Non-repetitive Forward Current	$I_{F,SM}$	T_C=100 °C, t_p=8.3 ms sine half wave	600	A

Electrical Characteristics of SiC SBD (T_C=25℃ unless otherwise specified)

Parameter	Symbol	Conditions		Min	Typ	Max	Unit
DC Blocking Voltage	V_R	I_R=100 uA		1200			V
Forward Voltage	V_F	I_F =160A	T_J = 25℃		1.8	2.0	V
			T_J = 150℃		2.3		
Total Capacitive Charge	Q_C	V_R=1200V	T_J = 25℃		518		nC

Thermal Characteristics (T_C=25℃ unless otherwise specified)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
MOSFET Thermal Resistance: Junction-To-Case	$R_{\theta JCM}$			0.08	0.11	℃/W
Diode Thermal Resistance: Junction-To-Case	$R_{\theta JCD}$			0.118	0.13	℃/W

Module Characteristics (T_j=25°C unless otherwise specified)

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Mounting Torque	M_d				5	N-m
Clearance		Terminal to terminal		12		mm
Package Weight	W_t			270		g
Isolation Voltage	V_{ISOL}	I_{ISOL} < 1mA, 50/60Hz, t=1 min	2500			V

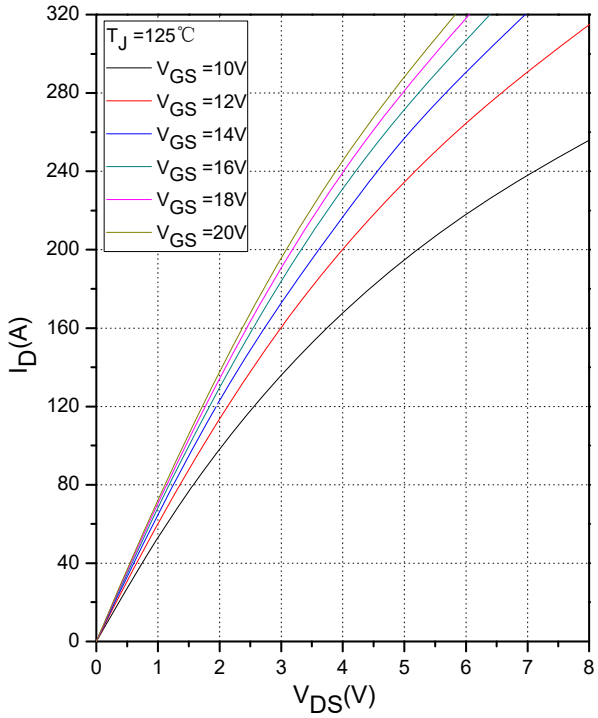


Fig.1 Typical Output Characteristics

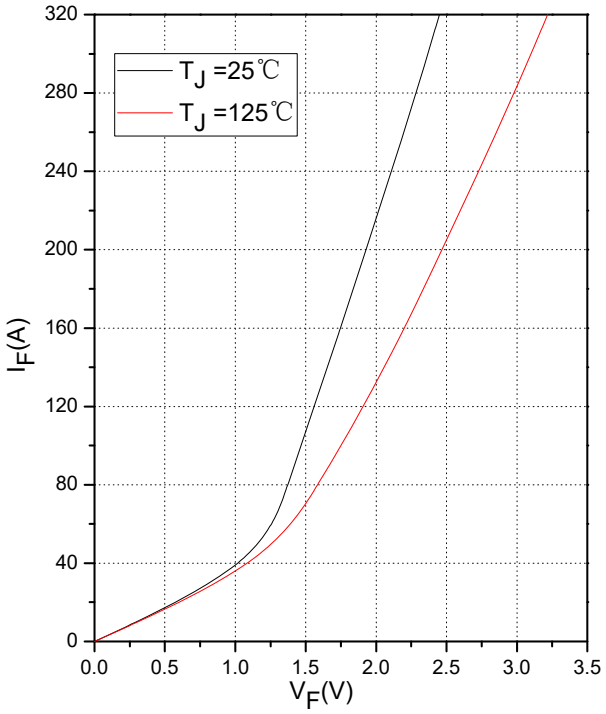


Fig.2 Forward Characteristics of Diode

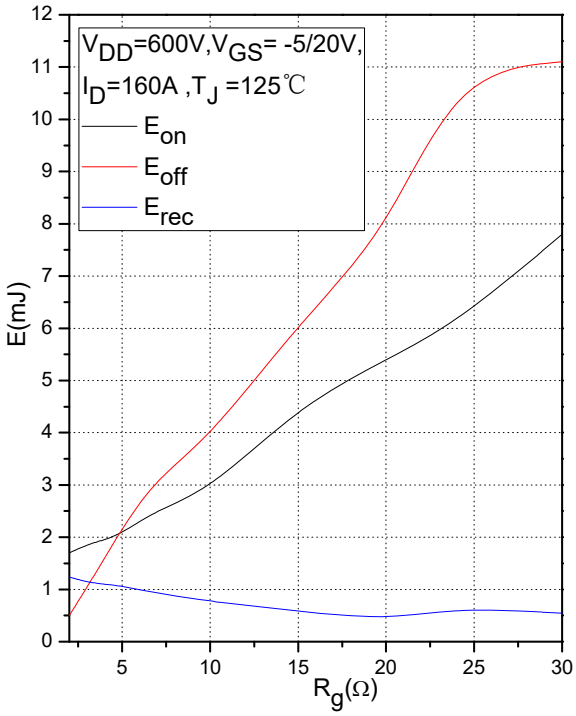


Fig.3 Typical Switching Loss vs. Gate Resistance

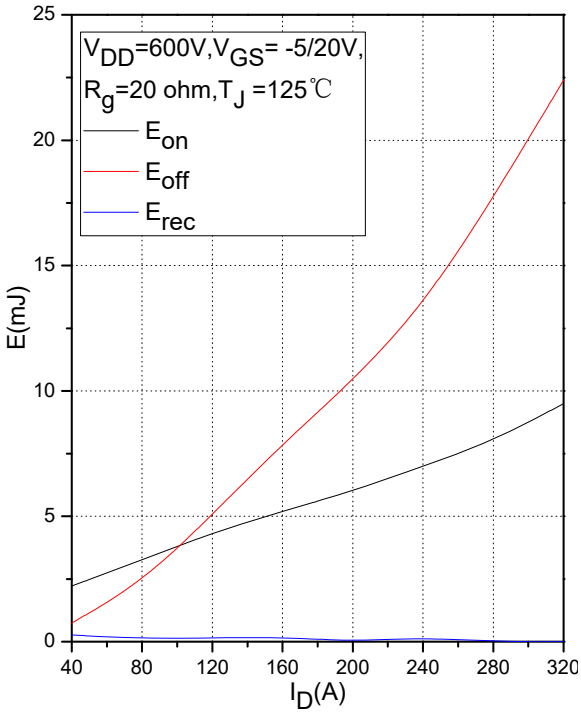
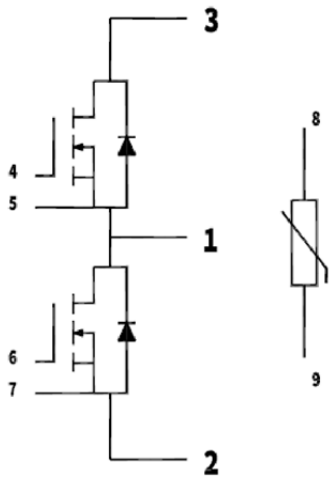
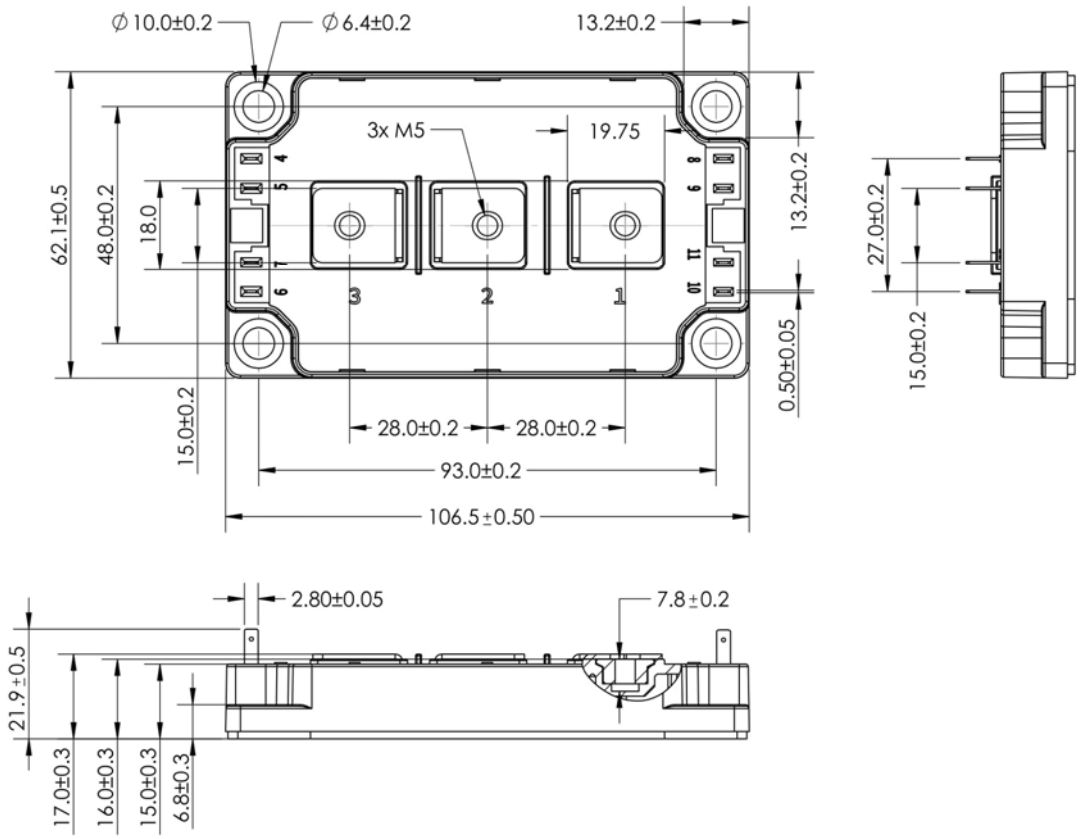


Fig.4 Typical Switching Loss vs. Drain Current

Internal Circuit:



Preliminary Package Outline (Unit: mm):



Revision History

Date	Revision	Notes
03/04/2016	0.1	Initial release
10/05/2016	0.2	Revised the substrate material and other electrical parameters
07/07/2017	0.3	Add the measured performance data
01/03/2020	0.4	Applied company name change
05/27/2020	0.5	Updated mechanical drawing

Notes

RoHS Compliance

The levels of RoHS restricted materials in this product are below the maximum concentration values (also referred to as the threshold limits) permitted for such substances, or are used in an exempted application, in accordance with EU Directive 2011/65/EC (RoHS2), as implemented March, 2013. RoHS Declarations for this product can be obtained from the Product Documentation sections of www.SemiQ.com.

REACh Compliance

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