

# S1P02R120HBG-C (Preliminary)



## 1200V / 800A All-Silicon Carbide MOSFET Half-Bridge Module

### Features

- Electrical features
  - $V_{DSS} = 1200V$
  - $I_{D, nom} = 800A$
- High-speed Switching Possible
- High Power Density
- High Frequency Operation
- Ultra-low Losses



### Applications

- Motor drives
- High power converters
- Photovoltaics, wind power generation
- Induction heating equipment
- Electrified vehicle traction inverter

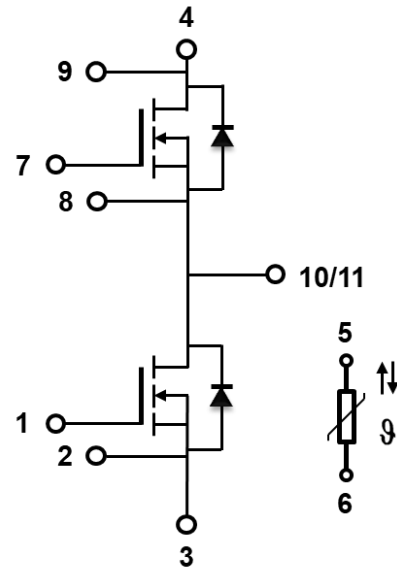


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### 1、Maximum ratings

Table 1 Maximum rating ( $T_c = 25^\circ\text{C}$  unless otherwise specified)

Symbol	Parameter	Value	Unit	Test Conditions	Note
$V_{DS,max}$	Drain source voltage	1200	V	$V_{GS} = 0V, I_D = 100 \mu A$	
$V_{GS,max}$	Gate source voltage	-8 /+22	V	Absolute maximum values	
$V_{GSop}$	Gate source voltage	-4 /+18	V	Recommended operational values	
$I_D$	Continuous drain current	800	A	$V_{GS} = 18V, T_C = 100^\circ\text{C}$	
$I_{D(pulse)}$	Pulsed drain current	1600	A	Pulse width $t_p$ limited by $T_{j,max}$	
$T_J, T_{stg}$	Operating Junction and storage temperature	-55 to +175	$^\circ\text{C}$		

## 2、Packaging characteristics

Table 2 Package Characteristics

Symbol	Description	Value	Unit	Note
$R_{HS}$	High-side Resistance	1.7	m $\Omega$	
$R_{LS}$	Low-side Resistance	1.7		
$L_s$	Stray inductance	18	nH	
$V_{ISO}$	Isolation Test Voltage RMS, f=50Hz, t=1min	3.4	kV	
Distance	Terminal to Heatsink Creepage Distance	14.5	mm	
	Terminal to Terminal Creepage Distance	13.0	mm	
	Terminal to Heatsink Clearance	12.5	mm	
	Terminal to Terminal Clearance	10.0	mm	
$R_{thJC}$	Average Thermal Resistance of Per Upper Switch	0.106	$^{\circ}\text{C}/\text{W}$	Figure 12
	Average Thermal Resistance of Per Lower Switch	0.101	$^{\circ}\text{C}/\text{W}$	Figure 12
$T_{jmax}$	Maximum Junction Temperature	175	$^{\circ}\text{C}$	
$T_{jop}$	Operation Junction Temperature	-40 to +175	$^{\circ}\text{C}$	
$T_{STG}$	Storage Temperature Range	-40 to +175	$^{\circ}\text{C}$	
W	Weight	380	g	
Ms	Maximum Mounting Torque	6.0	N·m	

### 3、Electrical characteristics

**Table 4 SiC MOSFET characteristics** (Tc = 25°C unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions	Note
$V_{(BR)DSS}$	Drain-source breakdown voltage	1200	-	-	V	$V_{GS} = 0V, I_D = 600\mu A$	
$V_{GS(th)}$	Gate threshold voltage	2.3	2.8	4.0	V	$V_{DS} = V_{GS}, I_D = 224mA$	
		-	2.0	-	V	$V_{DS} = V_{GS}, I_D = 224mA,$ $T_J = 175^\circ C$	
$I_{DSS}$	Zero gate voltage drain current	-	8	80	$\mu A$	$V_{DS} = 1200V, V_{GS} = 0V$	
$I_{GSS}$	Gate source leakage current	-	-	800	nA	$V_{GS} = 18V, V_{DS} = 0V$	
$R_{DS(on)}$	Current drain-source on-state resistance	-	1.75	4.0	m $\Omega$	$V_{GS} = 18V, I_D = 800A$	Figure 4
		-	2.6	-		$V_{GS} = 18V, I_D = 800A,$ $T_J = 175^\circ C$	
$g_{fs}$	Transconductance	-	424	-	S	$V_{DS} = 20V, I_D = 800A$	Figure 3
		-	412	-		$V_{DS} = 20V, I_D = 800A,$ $T_J = 175^\circ C$	
$R_{g,int}$	Internal gate resistance	-	1.8	-	$\Omega$	$V_{AC} = 25mV, f = 1MHz,$ open drain	
$C_{iss}$	Input capacitance	-	39.6	-	nF	$V_{DS} = 1000V, V_{GS} = 0V$ $T_J = 25^\circ C, V_{AC} = 25mV$ $f = 100KHz$	Figure 6
$C_{oss}$	Output capacitance	-	2.0	-			
$C_{rss}$	Reverse capacitance	-	0.13	-			
$Q_{gs}$	Gate source charge	-	462	-	nC	$V_{DS} = 800V,$ $V_{GS} = -4/+18V$ $I_D = 800A$	
$Q_{gd}$	Gate drain charge	-	968	-			
$Q_g$	Gate charge	-	1893	-			
$E_{on}$	Turn on switching energy	-	TBD	-	mJ	$V_{DS} = 800V, V_{GS} = -4/+18V$ $I_D = 800A, R_g = 5.2\Omega,$ $L = 20\mu H$	Figure9
$E_{off}$	Turn off switching energy	-	TBD	-			

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**Table 5** Body diode characteristics (Tc = 25°C unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions	Note
V <sub>SD</sub>	Diode forward voltage	-	3.5	-	V	V <sub>GS</sub> = -4V, I <sub>SD</sub> = 400A	Figure 7
		-	3.0	-	V	V <sub>GS</sub> = -4V, I <sub>SD</sub> = 400A T <sub>J</sub> = 175°C	
I <sub>S</sub>	Continuous diode forward current	-	640	-	A	V <sub>GS</sub> = -4V, Tc = 25°C	
t <sub>rr</sub>	Reverse recovery time	-	TBD	-	ns	V <sub>R</sub> = 800V, V <sub>GS</sub> = -4V I <sub>D</sub> = 800A di/dt=3000A/μs	
Q <sub>rr</sub>	Reverse recovery charge	-	TBD	-	μ C		
I <sub>rrm</sub>	Peak reverse recovery current	-	TBD	-	A		

**Table 6** NTC-Thermistor Characteristic

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions	Note
R <sub>25</sub>	Rate Resistance	-	5	-	kΩ	Tc=25°C	
ΔR/R	Deviation of R <sub>100</sub>	-5	-	5	%	Tc=100°C, R <sub>100</sub> =489Ω	
P <sub>25</sub>	Power Dissipation	-	-	60.0	mW	Tc=25°C	
B <sub>25/50</sub>	B-value	-	3380	3414	K	R <sub>2</sub> =R <sub>25</sub> exp[B <sub>25/50</sub> (1/T <sub>2</sub> - 1/T <sub>1</sub> )]	

### 4、Electrical characteristic diagram

Figure 1. Output Characteristic,  $T_{vj}=25^{\circ}\text{C}$

Figure 2. Output Characteristic,  $T_{vj}=175^{\circ}\text{C}$

Figure 3. Transfer Characteristic

Figure 4. On-resistance VS. Junction Temperature

Figure 5. On-resistance VS. Drain to Source Current

Figure 6. Capacitance VS.  $V_{DS}$

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Figure 7. 3<sup>rd</sup> Quadrant Characteristic

Figure 8. MOSFET Switching Energy vs. External Gate Resistance

Figure 9. MOSFET Switching Energy vs. Drain to Source Current

Figure 10. MOSFET Switching Energy vs. External Gate Resistance,  $T_{vj}=125^{\circ}\text{C}$

Figure 11. MOSFET Switching Energy vs. Drain to Source Current,  $T_{vj}=125^{\circ}\text{C}$

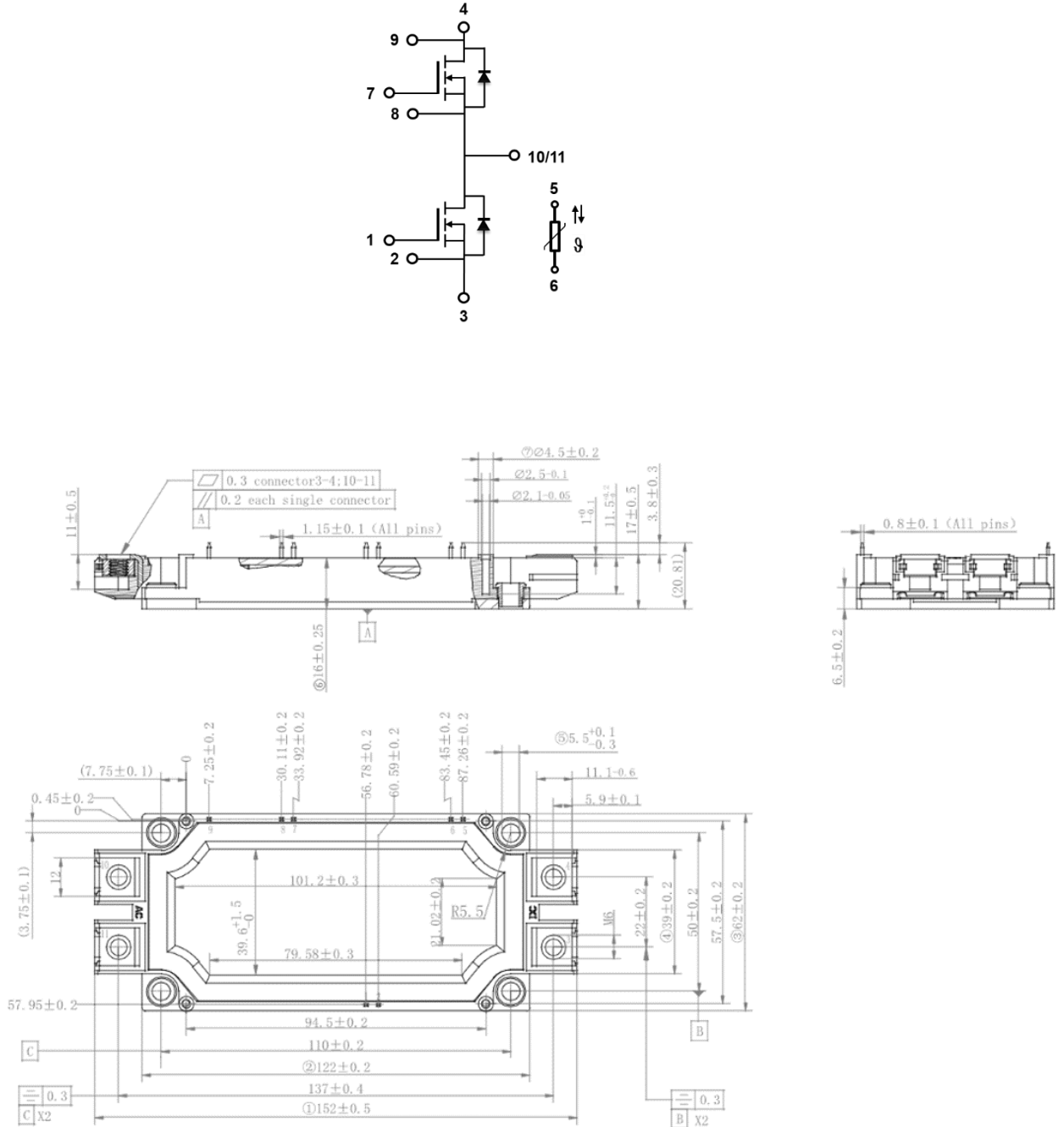
Figure 12. Transient Thermal Impedance (junction to case)

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### 5、 Package drawing



### 6、 Test conditions

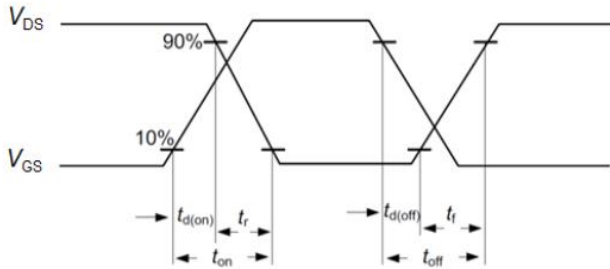


Figure A. Definition of switching times

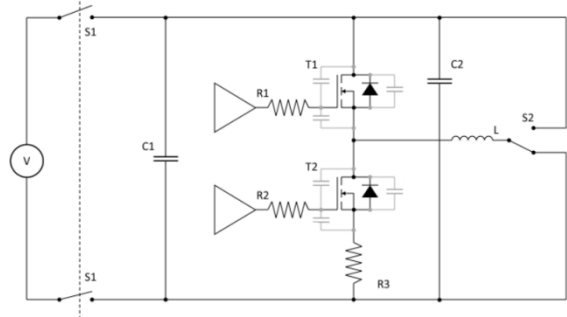


Figure B. Dynamic test circuit

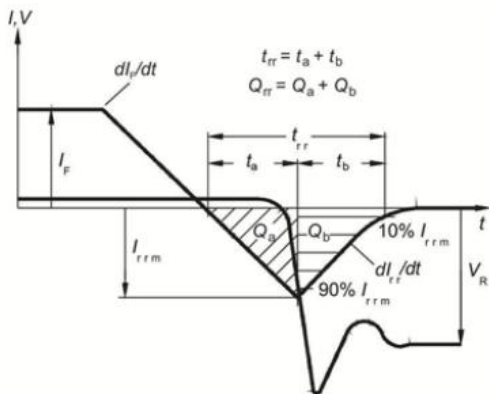


Figure C. Definition of diode switching characteristics

Figure C. Definition of body diode switching characteristics

### Revision history

Document version	Date of release	Description of changes	
V01_00	2025-07-03	—	

### Attention

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#### 1. 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 January 2, 2013.

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