# SiC Power Module

BSM600D12P4G103

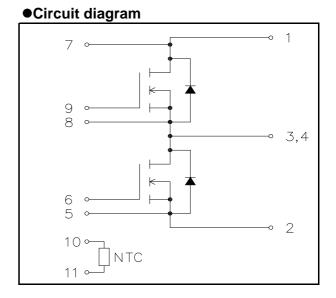
Datasheet

#### Application

- · Motor drive
- · Inverter, Converter
- · Photovoltaics, wind power generation.
- · Induction heating equipment.

#### Features

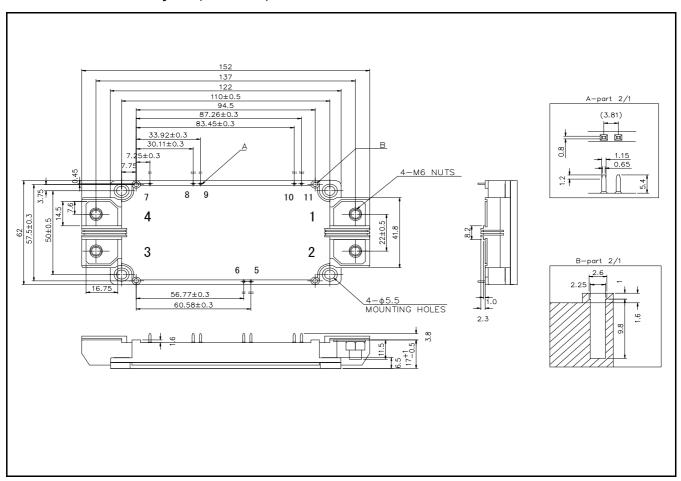
- 1) Low surge, low switching loss.
- 2) High-speed switching possible.
- 3) Reduced temperature dependence.



#### ●Construction

This product is a half bridge module consisting of SiC-UMOSFET from ROHM.

## ● Dimensions & Pin layout (Unit : mm)



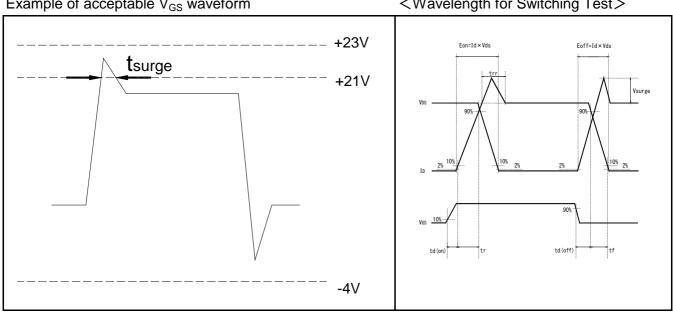
# ◆Absolute maximum ratings (T<sub>i</sub> = 25°C)

Parameter	Symbol	Conditions	Ratings	Unit	
Drain - Source Voltage	$V_{\rm DSS}$	G-S short	1200		
Gate - Source Voltage (+)	$V_{GSS}$	D-S short	21	V	
Gate - Source Voltage (-)	V <sub>GSS</sub>	D-S short	-4		
G - S Voltage (t <sub>surge</sub> <300nsec)	V <sub>GSSsurge</sub>	D-S short Note 1)	-4 to 23	1	
Droin Current	I <sub>D</sub>	DC(Tc=60°C) V <sub>GS</sub> =18V	567	A	
Drain Current Note 2)	I <sub>DRM</sub>	Pulse (Tc = $60^{\circ}$ C) 1ms V <sub>GS</sub> = $18V_{Note 3)}$	1200		
Source Current Note 2)	I <sub>S</sub>	DC(Tc=60°C) V <sub>GS</sub> =18V	567		
	I <sub>SRM</sub>	Pulse (Tc = $60^{\circ}$ C) 1ms V <sub>GS</sub> = $18V$ <sub>Note 3)</sub>	1200		
	I <sub>SRM</sub>	Pulse (Tc = $60^{\circ}$ C) 1.5µs V <sub>GS</sub> = $0$ V <sub>Note 3) 4)</sub>	1200		
Total Power Dissipation Note 5)	Ptot	Tc = 25°C	1780	W	
Max Junction Temperature	Tjmax		175		
Junction Temperature	Tjop		-40 to 150	°C	
Storage Temperature	age Temperature Tstg		-40 to 125		
Isolation Voltage	Visol	Terminals to baseplate f = 60Hz AC 1 min.	2500	Vrms	
Mounting Torque		Main Terminals : M6 screw	4.5	N - m	
Mounting Torque	-	Mounting to heat sink M5 screw	3.5	- N ⋅m	

- Please note especially when using driver source that  $V_{\mbox{\scriptsize GSSsurge}}$  must be in the range of Note 1) absolute maximum rating.
- Note 2) Case temperature (Tc) is defined on the surface of base plate just under the chips.
- Note 3) Repetition rate should be kept within the range where temperature rise if die should not exceed Tjmax.
- Note 4) Repititive pulse, PW $\leq$ 1.5  $\mu$  s, PW $\leq$ 5%
- Tj is less than 175°C. Note 5)

#### Example of acceptable V<sub>GS</sub> waveform

#### <Wavelength for Switching Test>



## ●Electrical characteristics (T<sub>i</sub>=25°C)

Parameter	Symbol	Conditions			Ratings		
i arameter	Symbol	Conditions		Min.	Тур.	Max.	Unit
On-state static	Vos(on)		Tj=25°C	_	1.6	2.0	V
Drain-Source		$I_D=600A, V_{GS}=18V$	Tj=125°C	_	2.4		
Voltage			Tj=150°C	_	2.7	3.3	
Drain Cutoff Current	IDSS	V <sub>DS</sub> =1200V, V <sub>GS</sub> =0V		_	_	1	mA
Souce-Drain Voltage	$V_{SD}$	Vgs=0V, Is=600A	Tj=25°C	_	4.3	_	V
			Tj=125°C	_	4.7	_	
			Tj=150°C	_	4.7	_	
			Tj=25°C	_	1.5	_	
		$V_{GS}$ =18V, $I_{S}$ =600A	Tj=125°C	_	2.4	_	
			Tj=150°C	_	2.7	_	
Gate-Source Threshold Voltage	Vgs(th)	V <sub>DS</sub> =10V, I <sub>D</sub> =291.2mA <sub>Note 6)</sub>		2.8	_	4.8	V
Gate-Source	lgss	$V_{GS}$ =21V, $V_{DS}$ =0V		_	_	0.5	
Leak Current		$V_{GS}$ =-4V, $V_{DS}$ =0V			_	_	μA
Switching Characteristics	td(on)	$V_{GS}(on)=18V, V_{GS}(off)=0V$			135	_	ns
	tr	V <sub>DS</sub> =600V			110	_	
	trr	I <sub>D</sub> =600A			35	_	
	td (off)	$R_G(on)=4.7$ ohm, $R_G(off)=2.7$ ohm		_	435	_	
	tf	Inductive load			90	_	
Input Capacitance	Ciss	V <sub>DS</sub> =10V, V <sub>GS</sub> =0V, 200kHz			59	-	nF
Gate Registance	RGint	Tj=25°C		_	0.13	_	Ω
NTC Rated Resistance	R25			_	5.0	_	kΩ
NTC B Value	B <sub>25/50</sub>			_	3370	_	K
Stray Inductance	Ls			_	14.1	_	nH
Creepage Distance	-	Terminal to heat sink		_	16.7	_	mm
		Terminal to terminal		_	16.7	_	mm
Clearance Distance	-	Terminal to heat sink		_	12.0	_	mm
		Terminal to terminal		_	11.0	_	mm
Junction-to -Case Thermal Resistance	Rth(j-c)	UMOSFET(1/2 module) Note 7)			_	84.1	°C/kW
Case-to -heat sink Thermal Resistance	Rth(c-f)	Case to heat sink, per 1 module. Thermal grease applied. Note 8)			15	_	

- Note 6) Tested after applying  $V_{GS} = 21V$  for 100ms.
- Note 7) Measurement of Tc is to be done at the point just under the chip.
- Note 8) Typical value is measured by using thermally conductive grease of  $\lambda=0.9W/(m\cdot K)$ .
- Note 9) SiC devices have lower short cuicuit withstand capability due to high current density. Please be advised to pay careful attention to short cuicuit accident and try to adjust protection time to shutdown them as short as possible.
- Note 10) If the Product is used beyond absolute maximum ratings defined in the Specifications, as its internal structure may be dameged, please replace such Product with a new one.

400

200

0

0

#### ●Electrical characteristic curves (Typical)

1200  $V_{GS}=14V$ 1000 V<sub>GS</sub>=16V Drain Current I<sub>D</sub> (A) 800 V<sub>GS</sub>=18V ′<sub>GS</sub>=12V 600  $V_{GS}=20V$ 

V<sub>GS</sub>=10V

Fig.1 Output characteristic 25°C (TYP)

Fig.2 Drain source voltage characteristic (TYP)

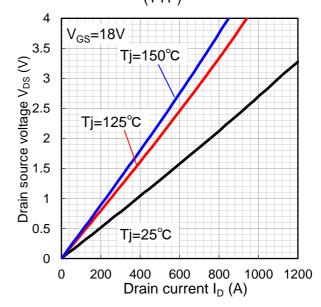


Fig.3 Drain source voltage characteristic 25°C (TYP)

2

Drain source voltage V<sub>DS</sub> (V)

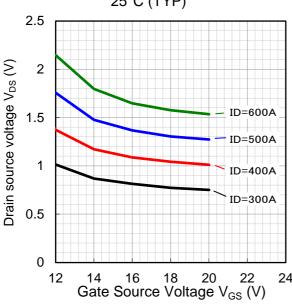


Fig.4 Ron vs Tj characteristic (TYP)

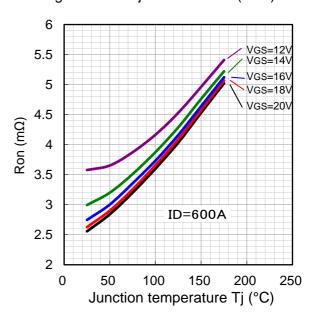


Fig.5 Forward characteristic of Diode (TYP)

1000  $V_{GS}=18V$   $V_{GS}=0V$   $V_{$ 

(TYP) 1200 Tj=25°C 1000 Source current Is (A) 800 V<sub>GS</sub>=18V 600 400 Tj=150°C  $V_{GS}=0V$ 200 Tj=125°C 0 5

Fig.6 Forward characteristic of Diode

Fig.7 Drain Current vs Gate Voltage (TYP)

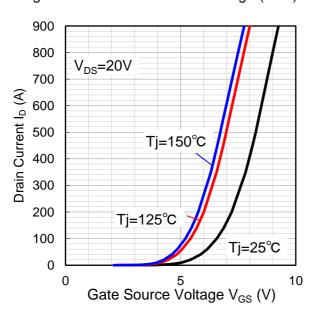


Fig.8 Drain Current vs Gate Voltage (TYP)

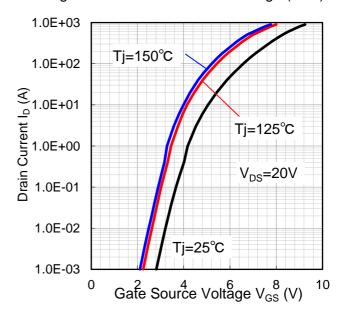


Fig.9 Switching time vs drain current at 25°C (TYP) td(off)

1000 Switching time (ns) td(on) 100  $Rg(on)=4.7\Omega$ VDS=600V  $RG(off)=2.7\Omega$ Vgs(on)=18V Vgs(off)=0V INDUCTIVE LOAD 10 400 600 800 1000 1200 1400 200 0

Fig.10 Switching time vs drain current at 125°C (TYP)

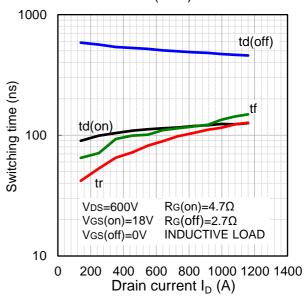


Fig.11 Switching time vs drain current at

Drain current I<sub>D</sub> (A)

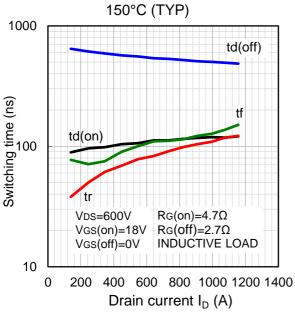


Fig.12 Switching loss vs drain current at 25°C (TYP)

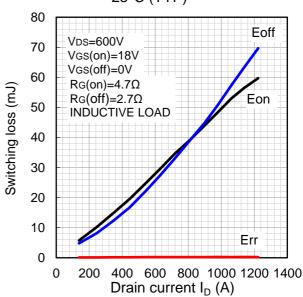


Fig.13 Switching loss vs drain current at 125°C (TYP)

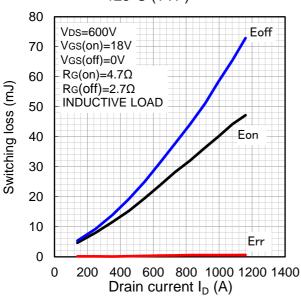


Fig.14 Switching loss vs drain current at 150°C (TYP)

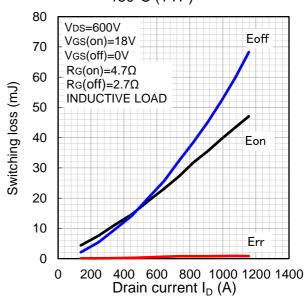


Fig.15 Recovery characteristic vs drain current at 25°C (TYP)

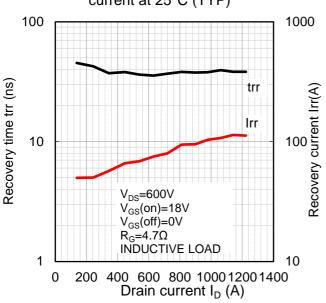


Fig.16 Recovery characteristic vs drain current at 125°C (TYP)

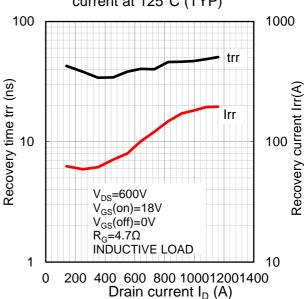


Fig.17 Recovery characteristic vs drain current at 150°C (TYP)

100

(SC)

LITY

100

(SC)

LITY

100

(SC)

LITY

100

VDS=600V

VGS(0n)=18V

VGS(0n)=18V

VGS(0f)=0V

RG=4.7Ω

INDUCTIVE LOAD

1

0 200 400 600 800 100012001400

Drain current ID (A)

at 25°C (TYP)

10000

V<sub>DS</sub>=600V
I<sub>D</sub>=600A
V<sub>GS</sub>(on)=18V
V<sub>GS</sub>(off)=0V
INDUCTIVE LOAD

td(on)

ttr

10

11

10

Fig.18 Switching time vs gate resistance

Fig.19 Switching time vs gate resistance at 125°C (TYP)

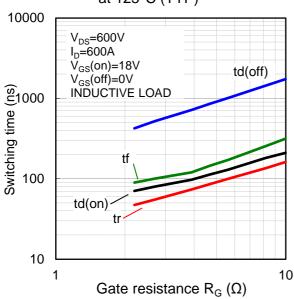


Fig.20 Switching time vs gate resistance at 150°C (TYP)

Gate resistance  $R_G(\Omega)$ 

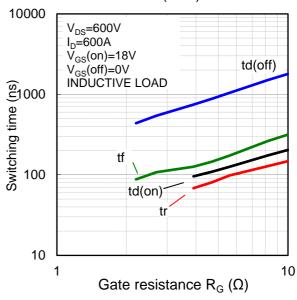


Fig.21 Switching loss vs gate resistance at 25°C (TYP)

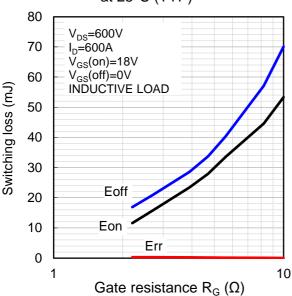


Fig.22 Switching loss vs gate resistance at 125°C (TYP)

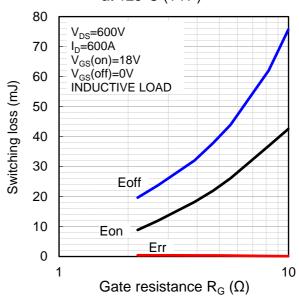


Fig.23 Switching loss vs gate resistance at 150°C (TYP)

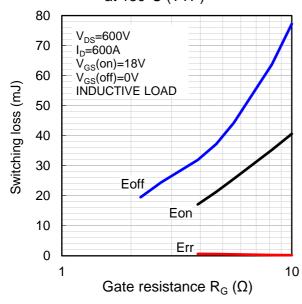
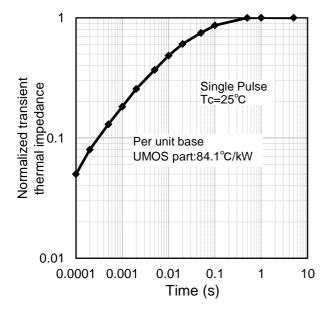


Fig.24 Capacitance vs Drain source voltage (TYP) 1.E-06 Ciss 1.E-07 Capacitance(F) 80-3.1 60-4 Tj=25°C Coss VGS=0V 200kHz 1.E-10 Crss 1.E-11 0.1 10 100 1000 Drain source voltage V<sub>DS</sub> (V)

Fig.25 Gate charge characteristic (TYP)

Fig.26 Transient thermal impedance (TYP)



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