STRUCTURE Silicon Monolithic Integrated Circuit

PRODUCT SERIES Three phase brushless DC motor controller

TYPE **BD6201FS**

FEATURES
- Selectable 120° or 150° PWM commutation logic
- Phase control supported

O ABSOLUTE MAXIMUM RATINGS (Ta=25°C)

Parameter	Symbol	Ratings	Unit
Supply voltage	VCC	32*1	V
All others	$V_{I/O}$	-0.3 ~ 7.0	V
Driver outputs	$I_{OMAX(OUT)}$	±15*1	mA
FG/DIR outputs	$I_{OMAX(FG/DIR)}$	±5*1	mA
VREG output	$I_{OMAX(VREG)}$	-40*1	mA
Operating temperature	Topr	-40 ~ 100	°C
Storage temperature	Tstg	-55 ~ 150	°C
Power dissipation	Pd	0.95*2	W
Junction temperature	Tjmax	150	°C

*** Notes: All voltages are with respect to ground.

*1 Do not, however, exceed Pd or ASO.

*2 Mounted on a 70mm x 70mm x 1.6mm FR4 glass-epoxy board with less than 3% copper foil. Derated at 7.6mW/°C above 25°C.

O OPERATING CONDITIONS (Ta=25°C)

Parameter	Symbol	Limits	Unit
Supply voltage	VCC	7 ~ 20	V

This product is not designed for protection against radioactive rays.
The product described in this specification is a strategic product (and/or service) subject to COCOM regulations.
It should not be exported without authorization from the appropriate government.

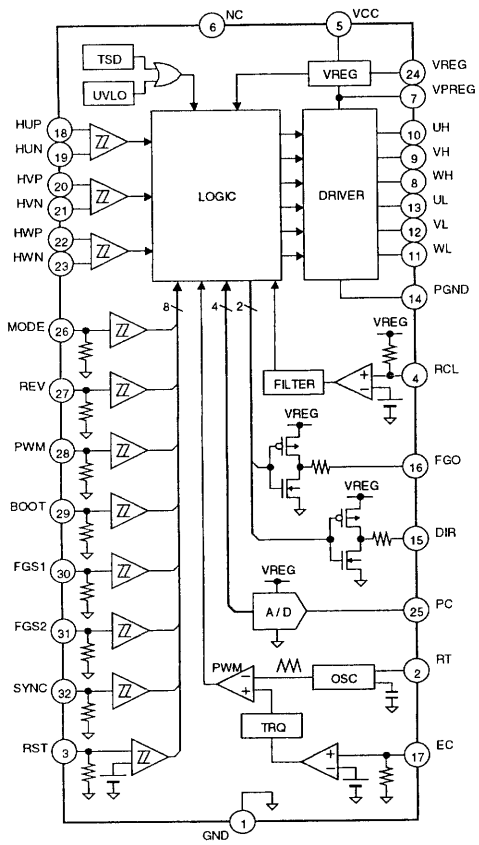
Status of this document
The Japanese version of this document is the formal specification.
A customer may use this translation version only for a reference to help reading the formal version.
If there are any differences in translation version of this document, formal version takes priority.

Application example
- **ROHM cannot provide adequate confirmation of patents.**
- **The product described in this specification is designed to be used with ordinary electronic equipment or devices (such as audio-visual equipment, office-automation equipment, communications devices, electrical appliances, and electronic toys).**
  Should you intend to use this product with equipment or devices which require an extremely high level of reliability and the malfunction of which would directly endanger human life (such as medical instruments, transportation equipment, aerospace machinery, nuclear-reactor controllers, fuel controllers and other safety devices), please be sure to consult with our sales representative in advance.
- **ROHM assumes no responsibility for use of any circuits described herein, conveys no license under any patent or other right, and makes no representations that the circuits are free from patent infringement.**

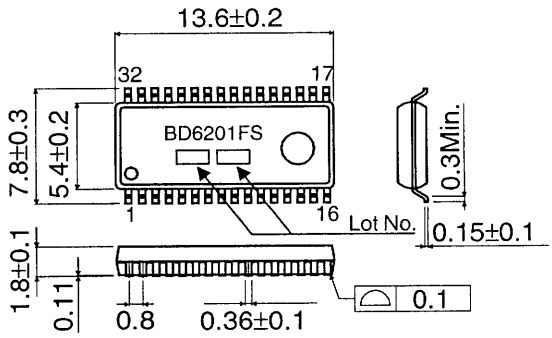
O ELECTRICAL CHARACTERISTICS (Unless otherwise specified, Ta=25°C and VCC=15V)

Parameter	Symbol	Limits			Unit	Conditions
		Min.	Typ.	Max.		
Power supply						
Supply current	I_{CC}	4.0	6.5	10	mA	
VREG voltage	V_{REG}	4.5	5.0	5.5	V	I_O=-30mA
VPREG voltage	V_{PREG}	4.5	5.0	5.5	V	I_O=-30mA
Driver outputs						
Output high voltage	V_{OH}	V_{PREG}-0.6	V_{PREG}-0.2	V_{PREG}	V	I_O=-5mA
Output low voltage	V_{OL}	0	0.2	0.6	V	I_O=5mA
Dead time	T_{OFF}	1.4	2.0	2.5	µs	
Minimum pulse width	T_{CAN}	0.8	1.0	1.5	µs	
Hall comparators						
Input bias current	I_{HALL}	-2.0	-0.1	2.0	µA	V_{IN}=0V
Common mode input	V_{HALLCM}	1.5	-	6.0	V	
Minimum input level	$V_{HALLMIN}$	50	-	-	mV_{p-p}	
Hysteresis voltage P	$V_{HALLHY+}$	7	15	25	mV	
Hysteresis voltage N	$V_{HALLHY-}$	-25	-15	-7	mV	
Torque control						
Input bias current	I_{EC}	15	25	35	µA	V_{IN}=5V
Refresh start-up voltage	V_{ECL}	0.6	1.0	1.4	V	BOOT=H, EC=V_{ECL} ~ V_{ECMIN}
Torque min. voltage	V_{ECMIN}	1.7	2.1	2.5	V	
Minimum output duty	D_{MIN}	1.6	2.0	3.0	%	F_{OSC}=20kHz, EC=V_{ECMIN}
Maximum output duty	D_{MAX}	90	-	95	%	F_{OSC}=20kHz, EC=V_{ECMAX}
Torque max. voltage	V_{ECMAX}	5.0	5.4	5.8	V	
REV, MODE, PWM, FGS1, FGS2, SYNC and BOOT						
Input bias current	I_{IN}	30	50	70	µA	V_{IN}=5V
Input high voltage	V_{INH}	3	-	7	V	
Input low voltage	V_{INL}	0	-	1	V	
Hysteresis voltage	V_{INHY}	0.2	0.5	0.8	V	
RST						
Input bias current	I_{RST}	30	50	70	µA	V_{IN}=5V
Input high voltage	V_{RSTH}	2.2	2.5	2.8	V	
Input low voltage	V_{RSTL}	1.95	2.25	2.55	V	
Hysteresis voltage	V_{RSTHY}	0.20	0.25	0.30	V	
FG and DIR						
Output high voltage	V_{FGOH}, V_{DIROH}	V_{REG}-0.6	V_{REG}-0.2	V_{REG}	V	I_O=-2mA
Output low voltage	V_{FGOL}, V_{DIROL}	0	0.2	0.6	V	I_O=2mA
Over current protection						
Input bias current	I_{RCL}	-32.0	-22.7	-10.0	µA	V_{IN}=0V
Input threshold voltage	V_{RCL}	0.45	0.50	0.55	V	
Masking time	T_{RCL}	1.5	2.0	2.6	µs	
Phase control						
Advance angle 1	P_0	-	0	2	deg	V_{PC}=0V
Advance angle 2	P_{30}	28	30	32	deg	V_{PC}=V_{REG}
Oscillator						
Carrier frequency	F_{OSC}	16	20	24	kHz	R_T=20kΩ
Under voltage lock out						
Release voltage	V_{UVH}	6.0	6.5	7.0	V	
Lock out voltage	V_{UVL}	5.5	6.0	6.5	V	
Hysteresis voltage	V_{UVHY}	0.35	0.50	0.65	V	

O BLOCK DIAGRAM



O PHYSICAL DIMENSIONS AND MARKING



SSOP-A32 (Unit: [mm])

O PIN DESCRIPTIONS

Pin	Name	Function	Pin	Name	Function
1	GND	Signal ground	17	EC	Torque control input pin
2	RT	Carrier frequency setting pin	18	HUP	Hall input pin phase U+
3	RST	External forced reset input pin	19	HUN	Hall input pin phase U-
4	RCL	Over current sense pin	20	HVP	Hall input pin phase V+
5	VCC	Power supply	21	HVN	Hall input pin phase V-
6	NC	No connection	22	HWP	Hall input pin phase W+
7	VPREG	Regulator for driver	23	HWN	Hall input pin phase W-
8	WH	High side driver output phase W	24	VREG	Regulator output
9	VH	High side driver output phase V	25	PC	Phase control input pin
10	UH	High side driver output phase U	26	MODE	Commutation mode setting pin
11	WL	Low side driver output phase W	27	REV	Rotation direction setting pin
12	VL	Low side driver output phase V	28	PWM	PWM switching arm setting pin
13	UL	Low side driver output phase U	29	BOOT	Bootstrap switch
14	PGND	Driver ground	30	FGS1	FG pulse number setting pin 1
15	DIR	Direction monitor output	31	FGS2	FG pulse number setting pin 2
16	FGO	FG signal output	32	SYNC	Synchronous rectification switch

O NOTES FOR USE

1) Absolute maximum ratings
Devices may be destroyed when supply voltage or operating temperature exceeds the absolute maximum rating. Because the cause of this damage cannot be identified as, for example, a short circuit or an open circuit, it is important to consider circuit protection measures – such as adding fuses – if any value in excess of absolute maximum ratings is to be implemented.

2) Electrical potential at GND
Keep the GND terminal potential to the minimum potential under any operating condition. In addition, check to determine whether there is any terminal that provides voltage below GND, including the voltage during transient phenomena. However, note that even if the voltage does not fall below GND in any other operating condition, it can still swing below GND potential when the motor generates back electromotive force at the RCL terminal. The chip layout in this product is designed to avoid this sort of electrical potential problem, but pulling excessive current may still result in malfunctions. Therefore, it is necessary to observe operation closely to conclusively confirm that there is no problem in actual operation.
If there are a small signal GND and a high current GND, it is recommended to separate the patterns for the high current GND and the small signal GND and provide a proper grounding to the reference point of the set not to affect the voltage at the small signal GND with the change in voltage due to resistance component of pattern wiring and high current. Also for GND wiring pattern of the component externally connected, pay special attention not to cause undesirable change to it.

3) Driver outputs
The high voltage semiconductor generally driven by this product is connected to the next stage via the controller. If any special mode in excess of absolute maximum ratings is to be implemented with this product or its application circuits, it is important to take physical safety measures, such as providing voltage clamping diodes or fuses.

4) Thermal design
Use a thermal design that allows for a sufficient margin in light of the power dissipation (Pd) in actual operating conditions.

5) Inter-pin shorts and mounting errors
Use caution when positioning the IC for mounting on printed circuit boards. The IC may be damaged if there is any connection error or if pins are shorted together. Also, connecting the power supply in reverse polarity can damage the IC. Take precautions against reverse polarity when connecting the power supply lines, such as establishing an external diode between the power supply and the IC power supply pin.

6) Operation in strong electromagnetic fields
Using this product in strong electromagnetic fields may cause IC malfunctions. Use extreme caution with electromagnetic fields.

7) ASO - Area of Safety Operation
When using the IC, set the output transistor so that it does not exceed absolute maximum ratings or ASO.

8) Capacitor between output and GND
In the event a large capacitor is connected between the output and GND, if VCC and VIN are short-circuited with 0V or GND for any reason, the current charged in the capacitor flows into the output and may destroy the IC. Use a capacitor smaller than 1μF between output and GND.

9) Built-in thermal shutdown circuit
This IC incorporates a built-in thermal shutdown circuit. The thermal shutdown circuit is designed only to shut the IC off to prevent thermal runaway. It is not designed to protect the IC or guarantee operation in the presence of extreme heat. Do not continue to use the IC after the thermal shutdown circuit is activated, and do not use the IC in an environment where activation of the circuit is assumed.

10) Testing on application boards
When testing the IC on an application board, connecting a capacitor to a low impedance pin subjects the IC to stress. Always discharge capacitors after each process or step. Always turn the IC's power supply off before connecting it to or removing it from a jig or fixture during the inspection process. Ground the IC during assembly steps as an antistatic measure. Use similar precaution when transporting or storing the IC.