

# Reversible motor driver

## BA6919FS/BA6919FP-Y

The BA6919FS and BA6919FP-Y are reversible-motor drivers for use in compact DC motors requiring high supply voltage. Two logic inputs allow four output modes : forward, reverse, stop (standby), and brake. The built-in power save circuit turns off all the circuits during the motor stop mode to suppress current consumption. With a high maximum operating supply voltage of 34V, the ICs can be used in OA equipment and industrial devices.

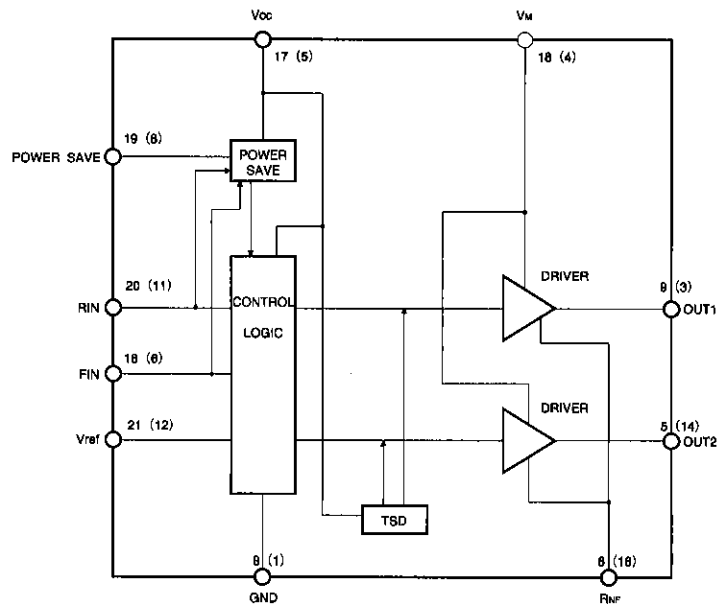
### ●Applications

VCRs, audio systems, OA equipment, and industrial devices

### ●Features

- 1) Wide range of operating voltage. (6.5 ~ 34V)
- 2) Interface with TTL and CMOS devices.
- 3) Power save circuit suppresses current consumption when motor is in stop mode; suitable for battery-driven equipment.
- 4) Output voltage can be set arbitrarily with the  $V_{REF}$  pin.
- 5) Surge absorption diode.
- 6) Thermal shutdown circuit turns off all output circuits to protect the IC from heat.
- 7) Logic and driver sections have separate ground pins; this allows the IC to drive speed-variable, reversible motors by connecting an electronic governor circuit.

### ●Block diagram



Pins 1-4, 7, 10-15, and 22-25 are not used  
 (Pins 2, 7, 9, 10, 13, and 15 are not used)  
 Descriptions in parentheses apply to the BA6919FS  
 Note: Be sure to connect the radiation fins to the ground

## ● Absolute maximum ratings (Ta=25°C)

Parameter	Symbol	Limits	Unit
Applied voltage	V <sub>CC</sub>	36	V
Power dissipation	BA6919FS	800* <sup>1</sup>	mW
	BA6919FP-Y	1450* <sup>2</sup>	
Operating temperature	T <sub>opr</sub>	-20~+75	°C
Storage temperature	T <sub>stg</sub>	-55~+150	°C
Output current	I <sub>OUT</sub>	1000* <sup>3</sup>	mA

\*1 Reduce power by 6.4 mW for each degree above 25°C.

\*2 Reduce power by 11.6 mW for each degree above 25°C.

\*3 Should not exceed Pd- or ASO-value

## ● Recommended operating conditions (Ta=25°C)

Parameter	Symbol	Min.	Typ.	Max.	Unit
Power supply voltage	V <sub>CC</sub>	6.5	—	34	V
Motor power supply voltage	V <sub>M</sub>	6.5	—	34	V

● Electrical characteristics (unless otherwise noted, Ta=25°C, V<sub>CC</sub>=12V, and V<sub>M</sub>=12V)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Circuit current 1	I <sub>CC1</sub>	6.1	12.2	18.3	mA	Forward or reverse mode
Circuit current 2	I <sub>CC2</sub>	4.3	8.6	12.9	mA	Brake mode
Circuit current 3	I <sub>CC3</sub>	—	—	15	μA	Standby mode
High level input voltage	V <sub>IH</sub>	2.0	—	—	V	
Low level input voltage	V <sub>IL</sub>	—	—	0.8	V	
High level input current	I <sub>IH</sub>	60	120	180	μA	V <sub>IN</sub> =2.0V
Output saturation voltage	V <sub>CE</sub>	1.1	2.2	3.3	V	I <sub>O</sub> = 200 mA; sum of the high- and low-side output transistor C-E voltages
Power save OFF voltage	V <sub>PS OFF</sub>	—	—	0.8	V	Operating mode
Power save ON voltage	V <sub>PS ON</sub>	2.0	—	—	V	Standby mode
REF bias current	I <sub>REF</sub>	10	20	30	μA	V <sub>REF</sub> =6V, I <sub>O</sub> =200mA

## ● Pin description

## BA6919FP-Y

Pin No.	Pin name	Function
1	N.C.	
2	N.C.	
3	N.C.	
4	N.C.	
5	OUT2	Motor output pin
6	RNF	Output ground pin; resistor connection pin for output current sensing
7	N.C.	
8	GND	GND
9	OUT1	Motor output pin
10	N.C.	
11	N.C.	
12	N.C.	
13	N.C.	
14	N.C.	
15	N.C.	
16	V <sub>M</sub>	Motor power supply
17	V <sub>CC</sub>	Power supply pin
18	F <sub>IN</sub>	Logic input pin
19	POWER SAVE	Power save switch; operation mode when 0.8 V or less, standby mode when 2.0 V or more
20	R <sub>IN</sub>	Logic input pin
21	V <sub>REF</sub>	High level output voltage setting pin
22	N.C.	
23	N.C.	
24	N.C.	
25	N.C.	
FIN	FIN	Be sure to connect the radiation fins to the ground

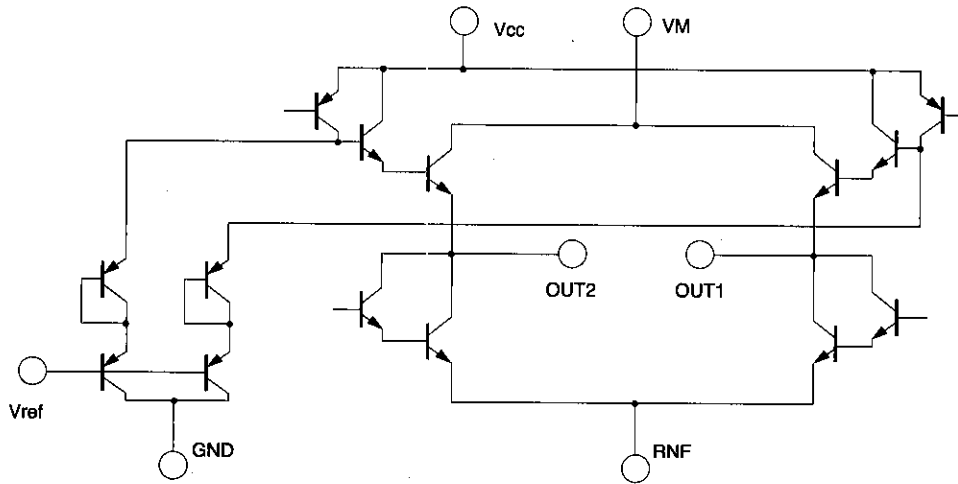
## BA6919FS

Pin No.	Pin name	Function
1	GND	GND
2	NC*	
3	OUT1	Motor output pin
4	V <sub>M</sub>	Motor power supply
5	V <sub>CC</sub>	Power supply pin
6	F <sub>IN</sub>	Logic input pin
7	NC*	
8	POWER SAVE	Power save switch; operation mode when 0.8 V or less, standby mode when 2.0 V or more
9	NC*	
10	NC*	
11	R <sub>IN</sub>	Logic input pin
12	V <sub>REF</sub>	High level output voltage setting pin
13	NC*	
14	OUT2	Motor output pin
15	NC*	
16	RNF	Output ground pin; resistor connection pin for output current sensing

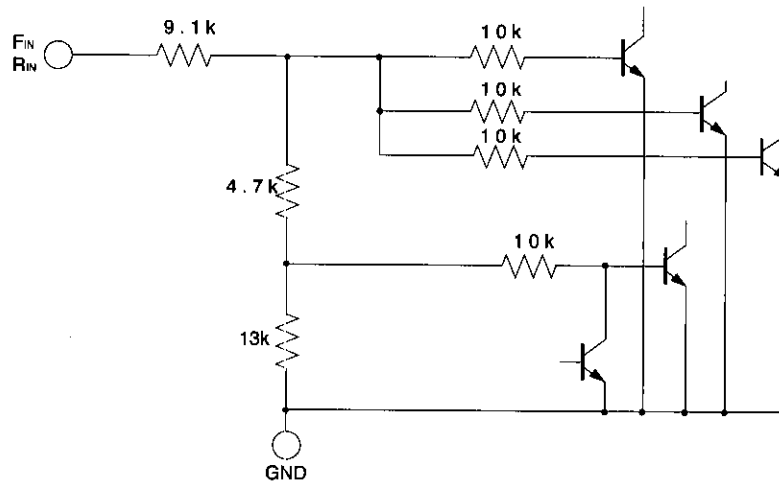
\*NC pins are not connected to the IC internals

● Input/output circuits

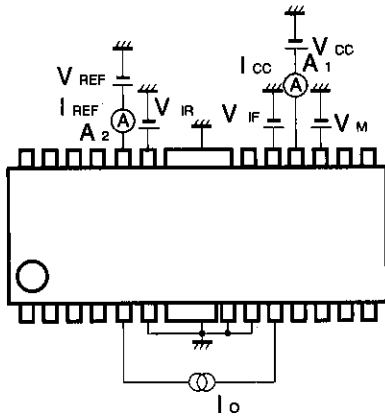
Output circuit



Input circuit (FIN, RIN)



● Measurement circuits

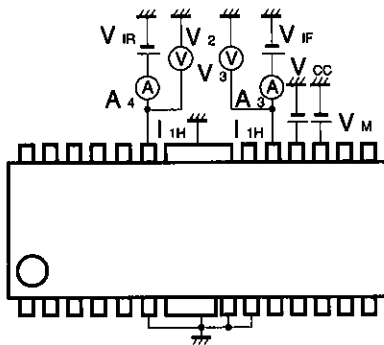


Circuit current ( $I_{CC}$ ) :  $A_1$  value  
 REF bias current ( $I_{REF}$ ) :  $A_2$  value

$I_o$  flows from HIGH to LOW level output pins

\* Refer to the Input/output truth table for output mode

Fig.1 Circuit for measuring circuit current and REF bias current

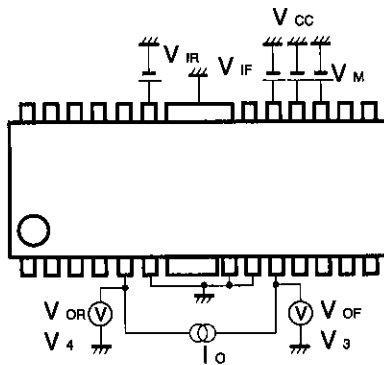


HIGH and LOW level input voltages  
 : values of  $V_1$  and  $V_2$  (output states are switched)

HIGH level input current  
 : sum of  $A_3$  and  $A_4$  currents when  $V_{IF}$  or  $V_{IR}$  is 2V

\* Refer to the Input/output truth table for output mode

Fig.2 Circuit for measuring HIGH level input voltage, LOW level input voltage, and HIGH level input current

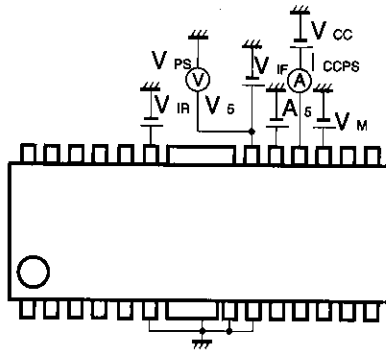


Output saturation voltage ( $V_{CE}$ ) : sum of the high- and low-side output transistor C-E voltages

$I_o$  flows from HIGH to LOW level output pins

Fig.3 Circuit for measuring output saturation voltage

● Measurement circuit



Power save ON voltage ( $V_{PS\ ON}$ )  
: VPS value when  $I_{CCPS} \leq 15 \mu A$

Power save OFF voltage ( $V_{PS\ OFF}$ )  
: VPS value when  $I_{CCPS} > 15 \mu A$

Fig.4 Power save ON voltage, Power save OFF voltage measurement circuit

● Circuit operation

(1) Input section ( $F_{IN}$ ,  $R_{IN}$ )

Control signals are input from these pins. The input circuit accepts TTL or higher logic input voltages.

Current flows from OUT1 to OUT2 (forward mode) when  $F_{IN}$  is HIGH and  $R_{IN}$  is LOW, and from OUT2 to OUT1 (reverse mode) when  $R_{IN}$  is HIGH and  $F_{IN}$  is LOW. Putting  $F_{IN}$  and  $R_{IN}$  both HIGH results in the brake mode in which the high-side output transistor is turned off and the motor driving current is shut down, so that a brake is put on the motor by absorbing the counter-electromotive force of the motor. When  $F_{IN}$  and  $R_{IN}$  are both LOW, both OUT1 and OUT2 are left open and the motor stops. The power saving circuit is activated during the stop mode, so that current consumption is suppressed by turning off all circuits in the IC.

● Truth table

$F_{IN}$	$R_{IN}$	OUT1	OUT2	Mode
H	L	H	L	Forward
L	H	L	H	Reverse
H	H	L	L	Brake
L	L	OPEN	OPEN	Standby

(2) Output section (OUT1, OUT2)

Two logic inputs control the motor by changing the status of the bridging transistors.

(3) HIGH level output voltage setting pin ( $V_{REF}$ )

Output voltage can be changed by controlling the  $V_{REF}$  voltage.

$$V_{OH} \doteq V_{REF}$$

$$\text{Except } V_{REF} \leq V_{CC} - [V_{sat} (\text{PNP}) + 2V_{BE} (\text{NPN})]$$

$$V_{OL} = V_{sat} (\text{NPN}) + V_{BE} (\text{NPN})$$

where  $V_{sat}$  and  $V_{BE}$  are functions of the output current. Leave the  $V_{REF}$  pin open when it is not used.

(4) Power supply section ( $V_{CC}$ ,  $V_M$ )

The  $V_{CC}$  pin supplies voltage to the logic section, and the  $V_M$  pin supplies voltage to the motor section.

(5) Thermal shutdown circuit

Regardless of the input mode, the thermal shutdown circuit turns off the outputs when the chip temperature rises due to such an event as motor locking. When the circuit is deactivated, the outputs revert to the status determined by the input mode. The circuit is activated when the chip temperature exceeds 175°C (typical), and deactivated when the chip temperature drops to 160°C (typical).

(6) Power saving circuit

All circuits are turned off to reduce current consumption when the  $F_{IN}$  and  $R_{IN}$  pins are both set to LOW or the POWER SAVE pin is put to the standby mode.

(7) Output ground pin or resistor connection pin for detecting output current (RNF)

The motor current can be sensed by connecting a current-detecting resistor to this pin. A constant-speed, reversible motor driver can be configured by connecting an external electronic governor circuit that controls the  $V_{REF}$  voltage.

● Operation notes

(1) Input circuit ( $F_{IN}$ ,  $R_{IN}$ )

To improve the reliability of operation, make sure to go through the open mode when reversing the motor rotational direction.

(2) Input pins ( $F_{IN}$ ,  $R_{IN}$ , POWER SAVE)

Voltage should never be applied to the  $F_{IN}$ ,  $R_{IN}$ , or POWER SAVE pin when the  $V_{CC}$  voltage is not applied to the IC. Similarly, the voltage on each input pin should not exceed any applied  $V_{CC}$  voltage.

(3) Temperature dependence of input pins ( $F_{IN}$ ,  $R_{IN}$ , POWER SAVE)

The  $F_{IN}$ ,  $R_{IN}$ , and POWER SAVE pins have temperature-dependent characteristics. Take the temperature effect into consideration when using the IC.

(4) HIGH level output voltage setting pin ( $V_{REF}$ )

Ensure that the voltage applied to the  $V_{REF}$  pin does not exceed the  $V_M$  or  $V_{CC}$  voltage.

(5) Ground pin

Be sure to keep the GND potential lower than the potentials of the other pins.

(6) PCB arrangement

When changing the rotational direction of a motor, a large current of up to a few hundred milliamperes can flow between the motor power supply and RNF. Depending on the application, this large output current may flow back to input pins, resulting in output oscillation or other malfunctions. Make sure that your design does not allow a common impedance between the large current output lines and the input section. Suppress the power supply impedance to low levels, otherwise output oscillation may occur.

(7) Package power dissipation

The power dissipated by the IC varies widely with the supply voltage and the output current. Give full consideration to the package power dissipation rating when setting the supply voltage and the output current.

(8) ASO

Make sure that the output current and supply voltage will not exceed the ASO values.

(9) Motor power supply pin ( $V_M$ )

A resistor connected to the motor power supply pin limits the large current that flows at motor startup, and serves for reducing the power dissipated within the IC. Use a resistor of a few ohms.

(10) Motor noise

To eliminate motor noise, connect a capacitor between OUT1 and GND and between OUT2 and GND. Alternatively, connect a capacitor between OUT1 and OUT2, and also a diode between OUT1 and GND and between OUT2 and GND (see Fig. 5).

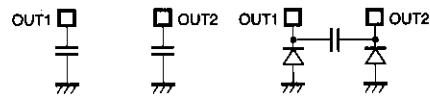


Fig.5

● Electrical characteristic curves

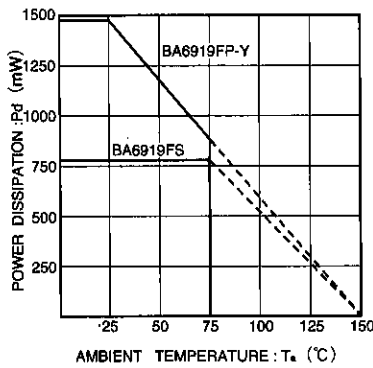


Fig.6 Heat reduction curve

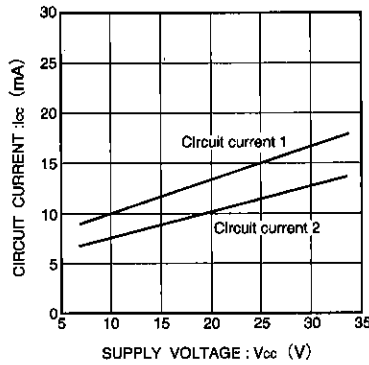


Fig.7 Circuit current vs. power supply voltage

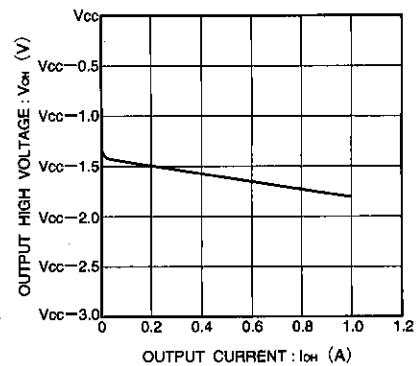


Fig.8 HIGH level output voltage vs. output current

● Electrical characteristic curves

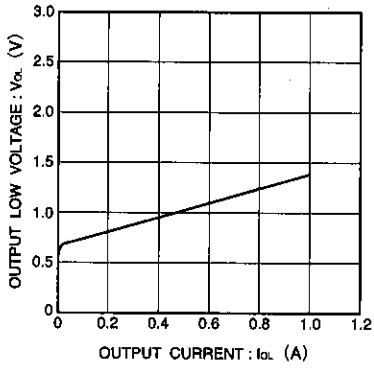
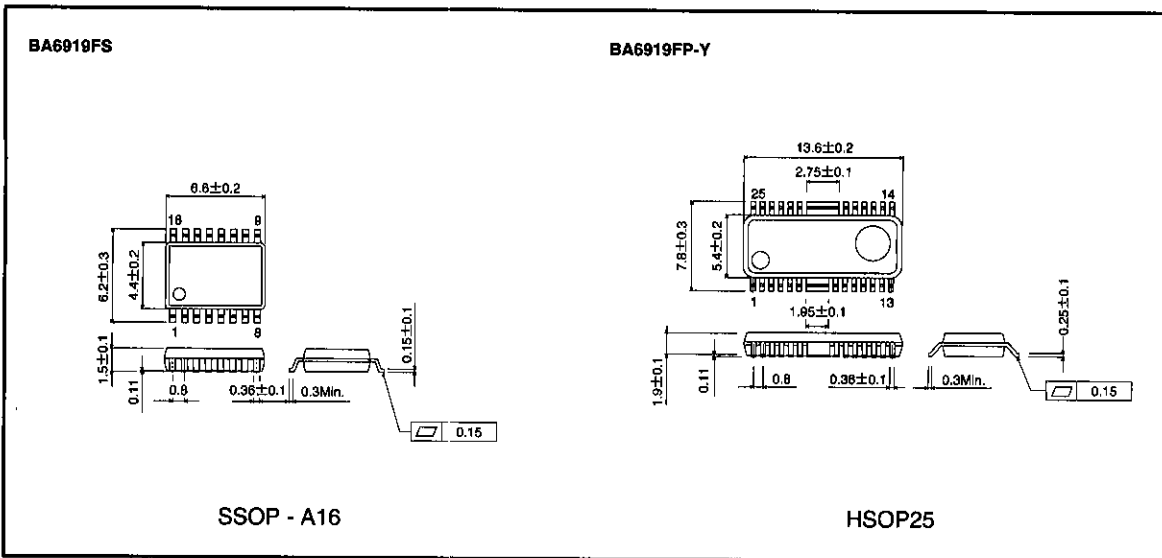


Fig.9 LOW level output voltage vs. output current

● External dimensions (Units: mm)





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