Reversible motor driver

BA6918/BA6918N

The BA6918 and BA6918N 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.

●Absolute maximum ratings (Ta=25℃)

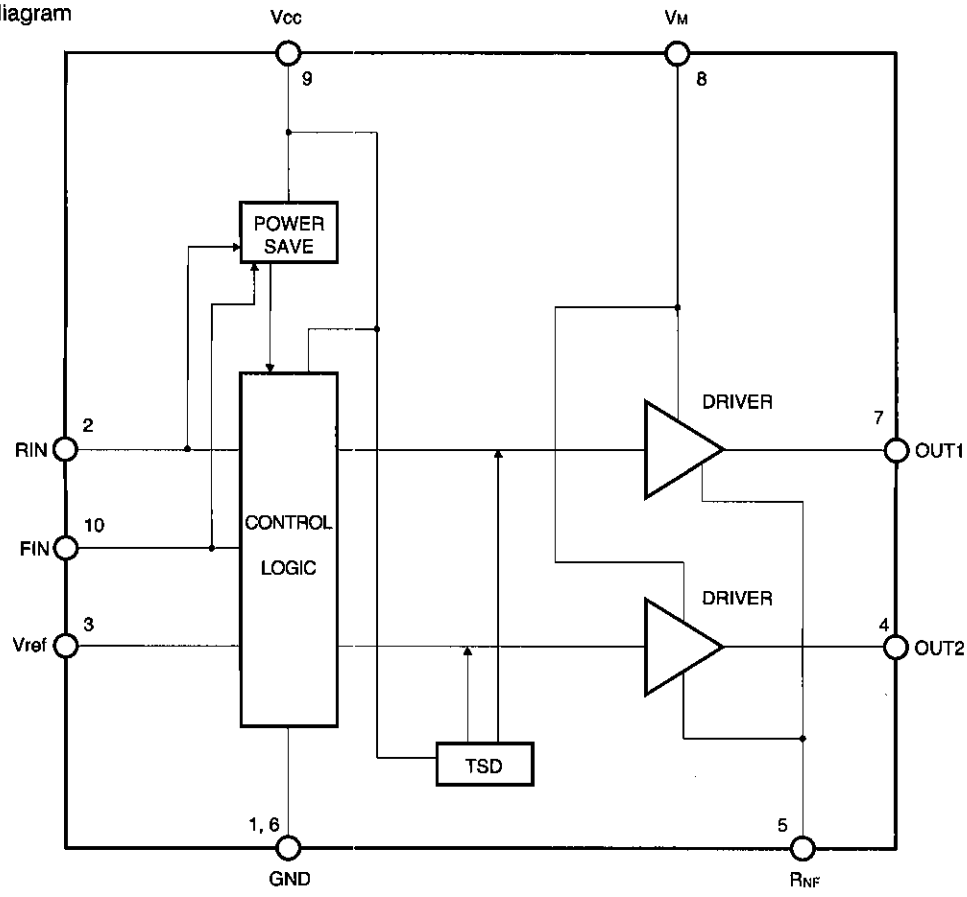
Parameter		Symbol	Limits	Unit
Power supply voltage		Vcc	36	V
Power dissipation	BA6918	Pd	2500*1	mW
	BA6918N		1100*2	
Operating temperature		Topr	−20~+75	℃
Storage temperature		Tstg	−55~+150	℃
Output current		IOUT	1000*3	mA

*1 Reduce power by 20 mW for each degree above 25℃.
*2 Reduce power by 8.8 mW for each degree above 25℃.
*3 Should not exceed Pd- or ASO-value

●Recommended operating conditions (Ta=25℃)

Parameter	Symbol	Min.	Typ.	Max.	Unit
Power supply voltage	Vcc	6.5	—	34	V
Motor power supply voltage	VM	6.5	—	34	V

●Block diagram

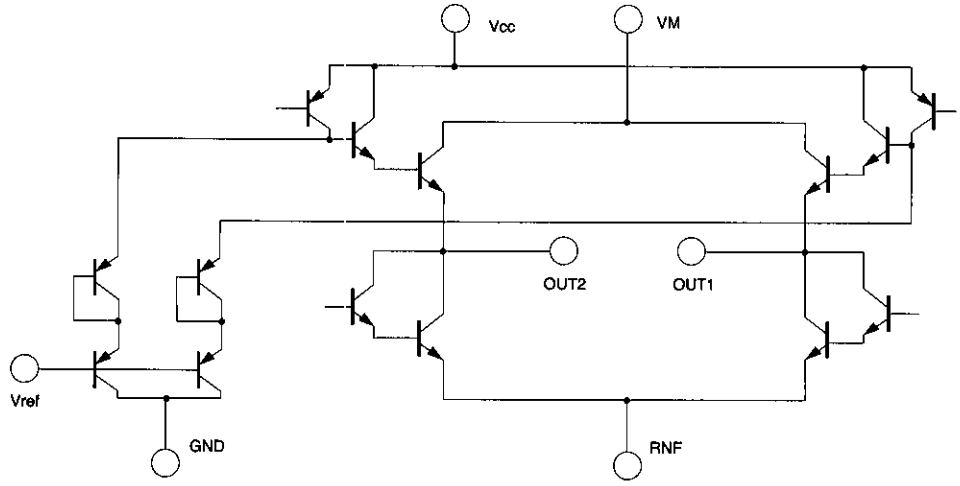


●Pin description

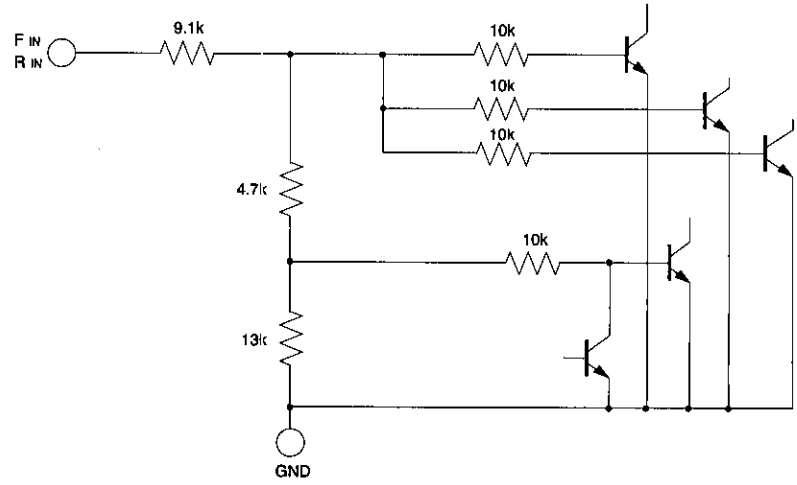
Pin No.	Pin name	Function
1	GND	
2	R_{IN}	Logic input pin
3	V_{REF}	High level output voltage setting pin
4	OUT2	Motor output pin
5	RNF	Output ground pin; resistor connection pin for output current sensing
6	GND	GND
7	OUT1	Motor output pin
8	V_M	Motor power supply
9	V_{CC}	Power supply pin
10	F_{IN}	Logic input pin

●Input/output circuits

Output circuit

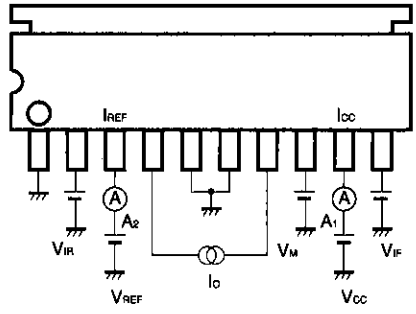


Input circuit (F_{IN}, R_{IN})



●Electrical characteristics (Unless otherwise noted, Ta=25℃, V_{CC}=12V, and V_M=12V)

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

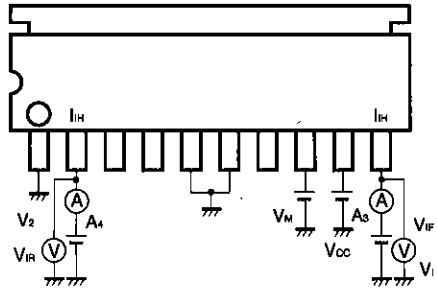


Circuit current (I_{CC}) : A_1 value
REF bias current (I_{REF}) : A_2 value

Io flows from HIGH to LOW level output pins

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

Fig.1 Measurement circuit for 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_{1F} or V_{1R} is 2V

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

Fig.2 Measurement circuit for HIGH level input voltage, LOW level input voltage, and HIGH level input current

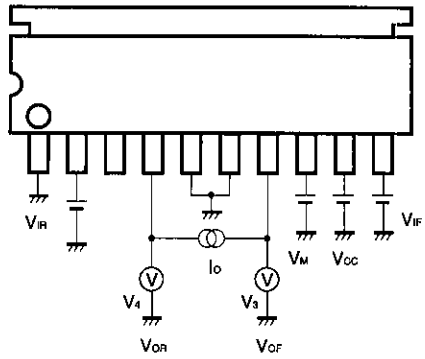


Fig.3 Measurement circuit for output saturation voltage

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

Io flows from HIGH to LOW level output pins

●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.

●Input/output 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.

$V_{OH} \fallingdotseq V_{REF}$

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

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

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℃ (typical), and deactivated when the chip temperature drops to 160℃ (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.

(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})

Voltage should never be applied to the F_{IN} or R_{IN} 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 (FIN, RIN)

The F_{IN} and R_{IN} 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. 4).

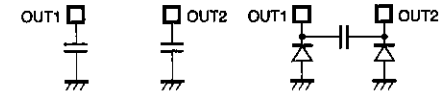


Fig.4

●Electrical characteristic curves

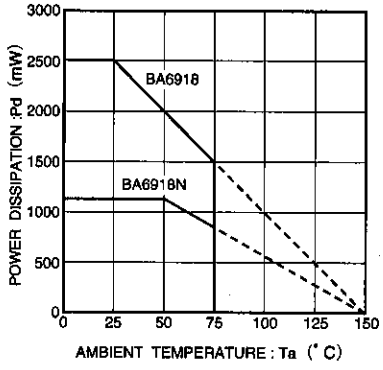


Fig.5 Power dissipation curve

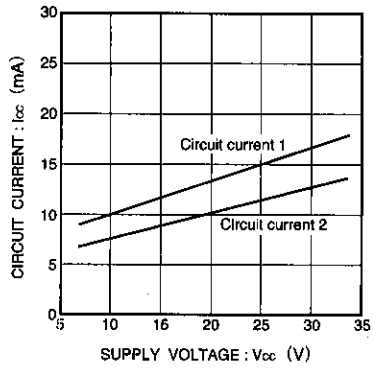


Fig.6 Circuit current vs. power supply voltage

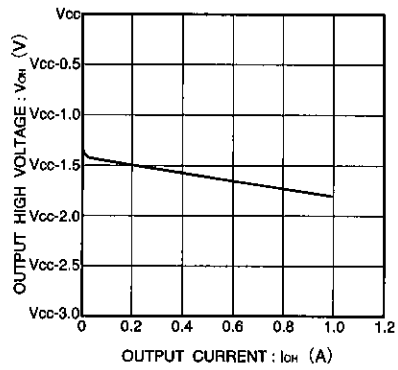


Fig.7 HIGH level output voltage vs. output current

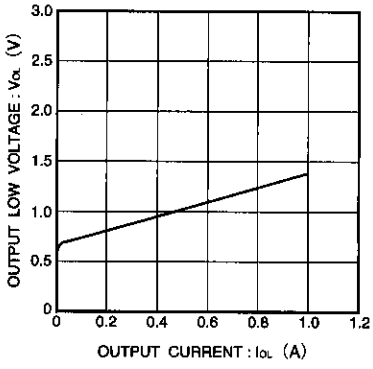
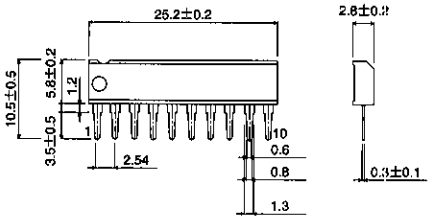


Fig.8 LOW level output voltage vs. output current

●External dimensions (Units: mm)

BA6918



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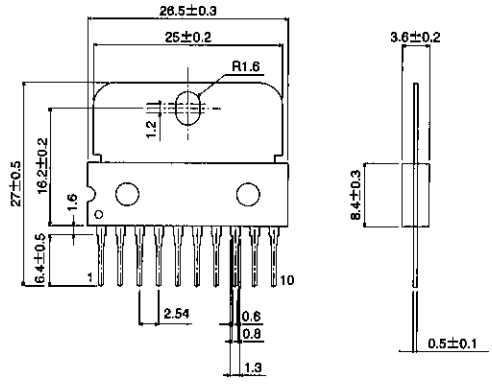

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