2-phase motor driver for VCR cylinder motors

BA6970FS

The BA6970FS is a direct-drive motor driver suitable for 2-phase, full-wave linear motors. The IC consists of a Hall amplifier control circuit, driver circuits, FG/PG signal amplifiers, and hysteresis amplifiers.

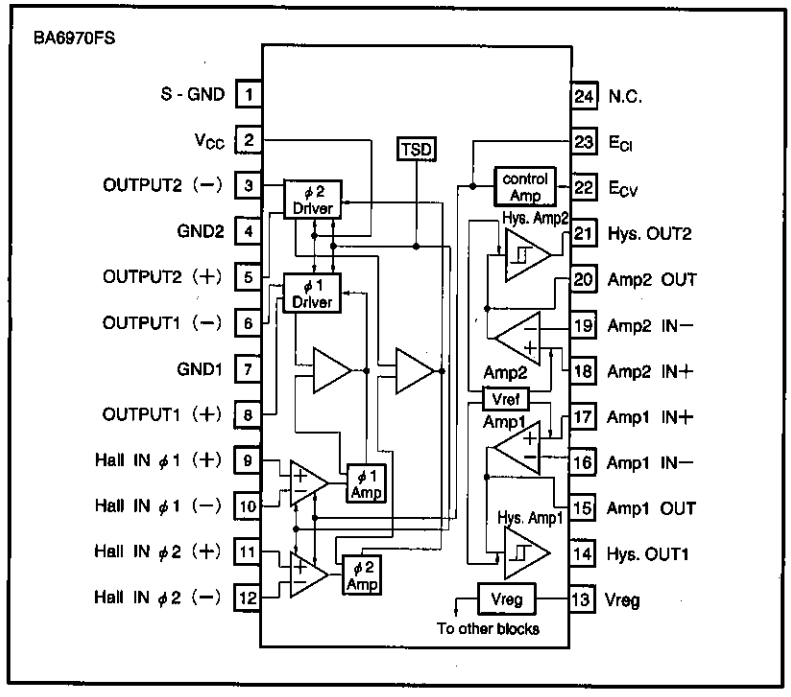
●Applications

VCR cylinder motors

●Features

1) Linear drive system provides low switching noise.
2) Output current can be controlled by either current or voltage input.
3) Two amplifiers and two hysteresis amplifiers.
4) Constant supply voltage pin for Hall devices.
5) High ratio of output current and control current. (4000 typically)
6) Available in a compact surface-mount package.

●Block diagram



●Absolute maximum ratings (Ta=25℃)

Parameter	Symbol	Limits	Unit
Applied voltage	Vcc	18	V
Power dissipation	Pd	1000*1	mW
Operating temperature	Topr	−25~75	℃
Storage temperature	Tstg	−55~150	℃
Output current	$I_{OMax.}$	1200*2	mA
Input current	$I_{ECIMax.}$	5	mA

*1 Mounted on a glass epoxy PCB (90 X 50 X 1.6 mm).
Reduce power by 8 mW for each degree above 25℃.

*2 Should not exceed Pd- or ASO value (for the current of one phase).

●Recommended operating conditions (Ta=25℃)

Parameter	Symbol	Limits	Unit
Operating power supply voltage	Vcc	8.0~16.0	V

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

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Circuit current	I_{CC}	—	5.8	13.0	mA	
Constant output voltage	V_{reg}	4.6	5.0	5.4	V	
MDA						
Hall device minimum input voltage	V_{INH}	50	—	—	mV_{P-P}	
Hall input bias current	I_{BH}	—	0.25	2.0	μA	I_{cont}=100 μA
HIGH level output saturation voltage	V_{OH}	10.45	10.79	—	V	I_{OUT}=800mA
LOW level output saturation voltage	V_{OL}	—	1.33	2.16	V	I_{OUT}=800mA
ECV (voltage control)						
Torque control input voltage	E_{CV}	0	—	V_{reg}	V	
Torque control voltage offset	E_{CVOFS}	−150	0	150	mV	For 0.48 X V_{reg}
Torque control input current	I_{ECVIN}	—	1.0	6	μA	E_{CV}=2.5V
Output standby current	$I_{ECVidle}$	—	0	5	mA	E_{CV}=2.5V
I/O gain	G_{ECV}	0.38	0.55	0.64	A/V	Measured at E_{CV} = 2.8 V, 3.3 V; ΔV$_{IN}$ = 100 mV
E_{CI} (current control)						
Ratio of pin-23 current and output current	I_{OUT} / I_{cont}	3300	4000	4700	—	ΔV$_{IN}$ = 100 mV; measured at I_{cont} = 30 μA, 50 μA
Output current differential	ΔI_{out}	−30	0	30	mA	I_{cont}=30 μA
Amp1, Amp2						
Input sink current	I_{INA}	—	0.2	2.0	μA	V_{IN}=2.5V
Open loop gain	G_A	65	70	—	dB	f_{IN}=500Hz
DC bias voltage variation	ΔV$_{BA}$	−10	0	10	%	Variation from V_{reg}
HIGH level output voltage	$V_{OH\,A}$	V_{reg} −1.48	V_{reg} −0.72	—	V	$I_{OH\,A}$=0.5mA
LOW level output voltage	$V_{OL\,A}$	—	0.85	1.45	V	$I_{OL\,A}$=0.5mA
Input voltage of Amplifiers 1 and 2	V_{AB}	1.2	—	4.0	V	
Hys. Amp1, 2						
Hysteresis width	V_{hys}	±142	±180	±218	mV	
LOW level output voltage	V_{OLhys}	—	0.12	0.32	V	I_{OLhysA}=2mA
LOW level output voltage	V_{Bhys}	7.0	10.0	13.0	kΩ	

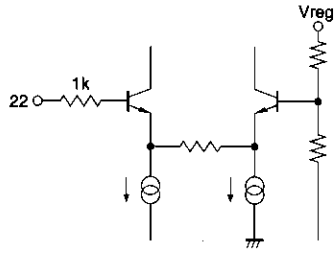
©Not designed for radiation resistance.

●Pin description

Pin No.	Pin name	Function
1	S−GND	Signal ground pin
2	Vcc	Output current control pin
3	OUTPUT2 (−)	Output pin
4	GND2	OUTPUT2 GND
5	OUTPUT2 (+)	Output pin
6	OUTPUT1 (−)	Output pin
7	GND1	OUTPUT1 GND
8	OUTPUT1 (+)	Output pin
9	Hall IN ϕ_1 (+)	Hall signal input pin
10	Hall IN ϕ_1 (−)	Hall signal input pin
11	Hall IN ϕ_2 (+)	Hall signal input pin
12	Hall IN ϕ_2 (−)	Hall signal input pin
13	Vreg	Constant voltage output pin
14	Hys.OUT1	Hysteresis amplifier 1 output pin
15	Amp1OUT	Amplifier 1 output pin; hysteresis amplifier 1 input pin
16	Amp1IN−	Amplifier 1 input pin, inverted
17	Amp1IN+	Amplifier 1 input pin, non-inverted
18	Amp2IN+	Amplifier 2 input pin, non-inverted
19	Amp2IN−	Amplifier 2 input pin, inverted
20	Amp2OUT	Amplifier 2 output pin; hysteresis amplifier 2 input pin
21	Hys.OUT2	Hysteresis amplifier 2 output pin
22	Ecv	Output current control pin (voltage control)
23	Eci	Output current control pin (current control)
24	S−GND	Signal ground pin

●Input/output circuits

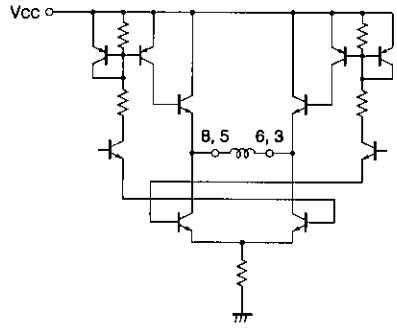
(1) Ecv (22 pin)



(All resistances, in Ω, are typical values)

Fig.1

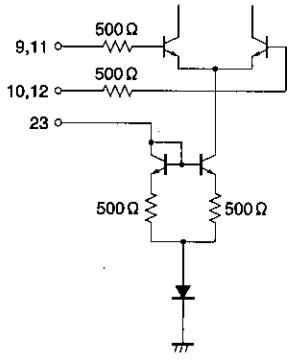
(2) Motor output (8, 6, 5, 3 pin)



(All resistances, in Ω, are typical values)

Fig.2

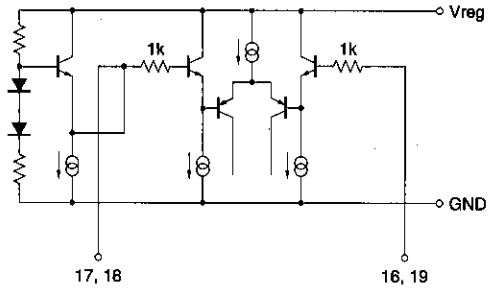
(3) Hall inputs (9, 10, 11, 12 pin), Eci input

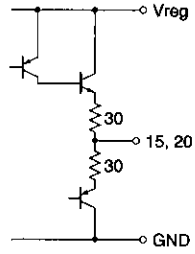


(All resistances, in Ω, are typical values)

Fig.3

(4) I/O of amplifiers 1 and 2

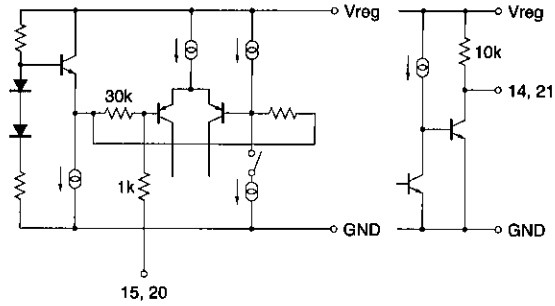




(All resistances, in Ω, are typical values)

Fig.4

(5) I/O of hysteresis amplifiers



(All resistances, in Ω, are typical values)

Fig.5

* Note that the resistance values can vary ±30%

●Circuit operation

(1) The signal from the Hall device is amplified by the Hall amplifier and then supplied to the driver circuit. The driver gain, which is constant, is regulated by changing the Hall amplifier gain with the E_{CI} input current or the E_{CV} input voltage (E_{CI} and E_{CV} are output current control pins). The motor rotational speed is sensed by the FG, and the output from which is F/I-converted and supplied to the E_{CI} pin or F/V-converted and supplied to the E_{CV} pin as a feedback signal, so that a constant rotational speed is maintained as follows (Fig. 6) :

1) The motor speed decreases.
2) The speed control IC outputs a feedback signal
3) The Hall amplifier gain increases.
4) The output current increases.
5) The motor speed increases.

(2) When the voltage on Hall IN ϕ_1 (+) is higher than the voltage on Hall IN ϕ_1 (−), an output current flows from OUT1 (+) to OUT1 (−) according to the voltage differential. When the voltage on Hall IN ϕ_1 (−) is higher, on the other hand, an output current flows from OUT1 (−) to OUT1 (+).
Similarly, when the voltage on Hall IN ϕ_2 (+) is higher than the voltage on Hall IN ϕ_2 (−), an output current flows from OUT2 (+) to OUT2 (−) according to the voltage differential. When the voltage on Hall IN ϕ_2 (−) is higher, on the other hand, an output current flows from OUT2 (−) to OUT2 (+).

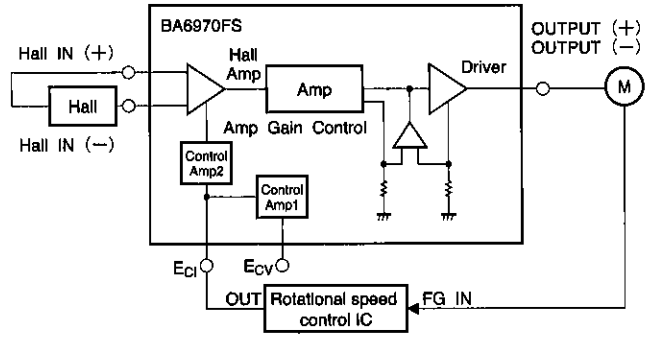


Fig.6

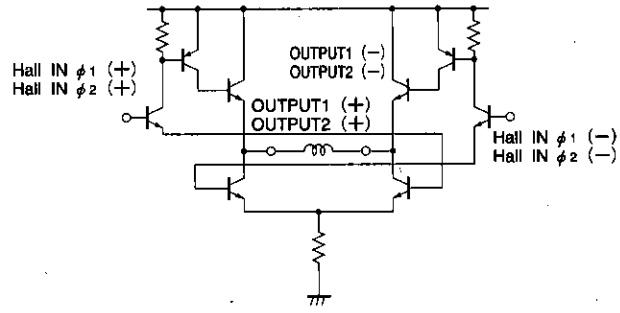


Fig.7

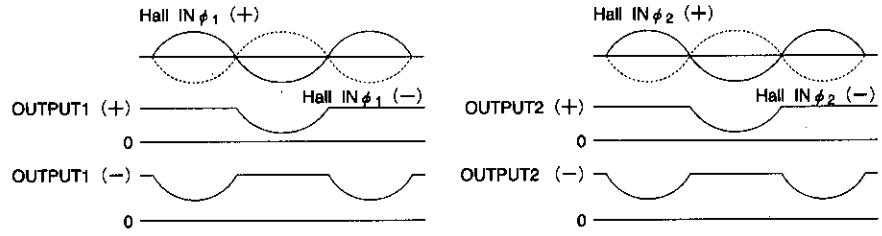


Fig.8

(3) Output waveforms are shown in Fig. 9. Because of the amplifier offset, the output is left OPEN when the output signal switches from positive to negative. The output waveform is determined by the external circuit because the IC impedance increases during this transition period. Since inductive loads are usually provided, a capacitor should be connected to suppress backlash voltages.

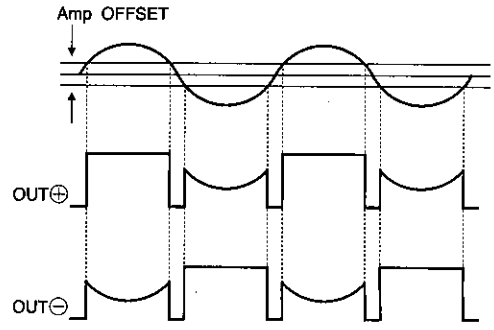


Fig.9

●Operation notes

1. Ecv input (pin 22)
   The Ecv input is plotted against the output current in Fig. 10.

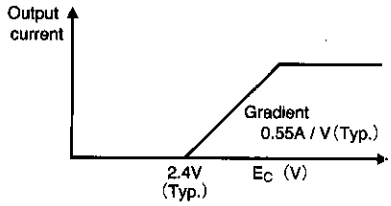


Fig.10

2. Hall input
   Hall input signals of 50mV (peak to peak) or greater should be applied between pins 9 and 10 and between pins 11 and 12. The DC input range is 2V to (Vreg−1.5V). There will be no problem if the input is centered around Vreg/2.
   Because the Hall input impedance is 1MΩ or grater, any type of Hall device can be connected. No current flows when the transistor is off because pins 9 and 10 as well as pins 11 and 12 are differential inputs.
   Because the IC is a linear driver, any DC offset in the Hall device will be amplified and appear in the output. Use Hall devices having a minimum offset. Hall devices can be connected in either series or parallel.

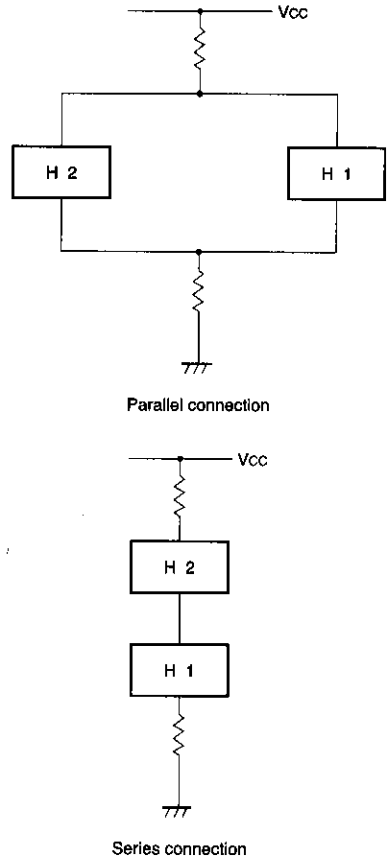


Fig.11

3. E_{CI} input
   The ECI input circuit has $2V_F$ and a 500Ω resistor connected in series. Current is limited only by the 500Ω resistor.
4. Amplifiers 1 and 2
   An input range of 0.6V to (V_{CC} − 1.2V) is recommended. Unpredictable outputs may occur when the input is outside this range.
5. Hysteresis amplifier
   An input range of 0.6V to (V_{CC} − 1.2V) is recommended. Unpredictable outputs may occur when the input is outside this range.
6. Thermal shutdown circuit
   The thermal shutdown circuit puts the driver outputs (8, 6, 5, 3 pin) to the open state at the temperature of 175℃ (typical). The circuit is deactivated when the temperature drops to about 155℃.
7. Signal ground pin
   Pins 1 and 24 are signal ground pins. Be noted that unpredictable outputs may occur if your application causes a large current between pins 1 and 24 via the bonding wire IC chip.

●Application example

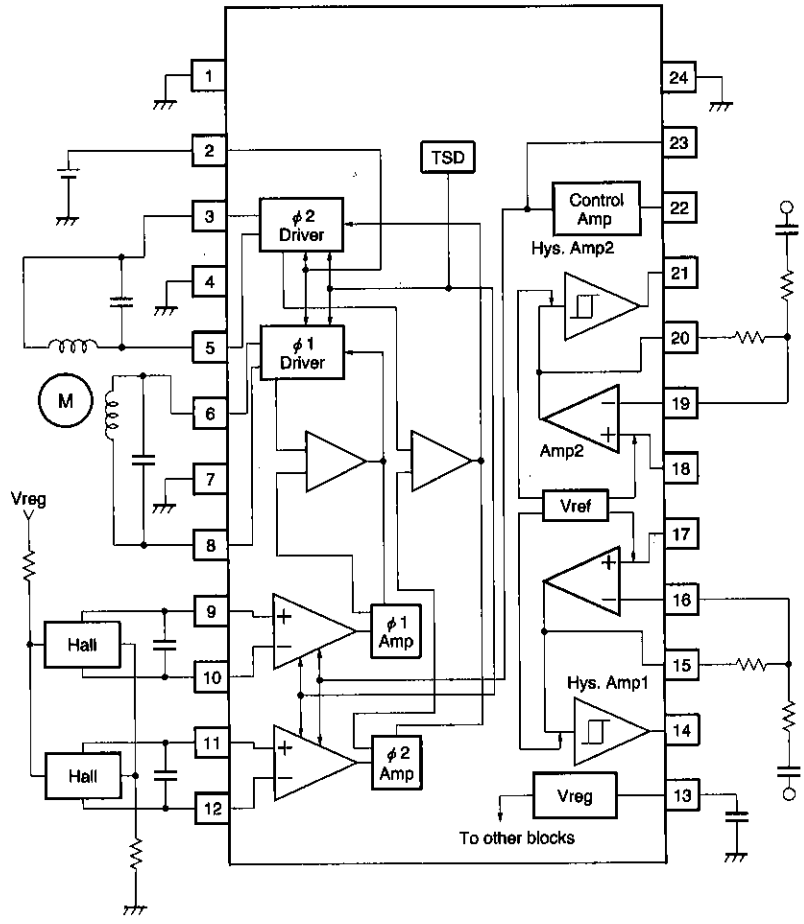


Fig.12

●Electrical characteristic curves

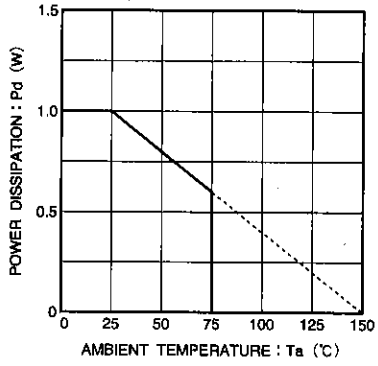


Fig.13 Temperature dependence of power dissipation curve

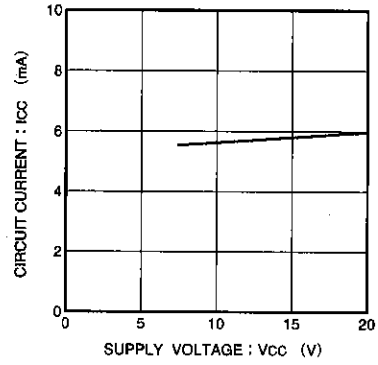


Fig.14 Circuit current vs. supply voltage

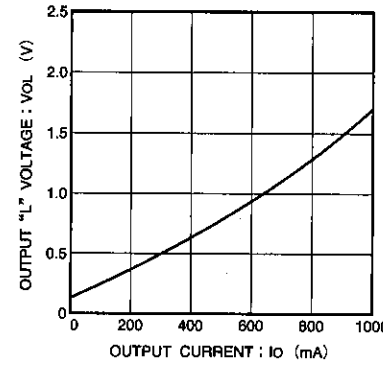


Fig.15 HIGH level output voltage vs. output current

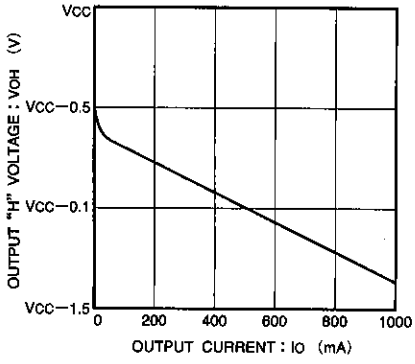
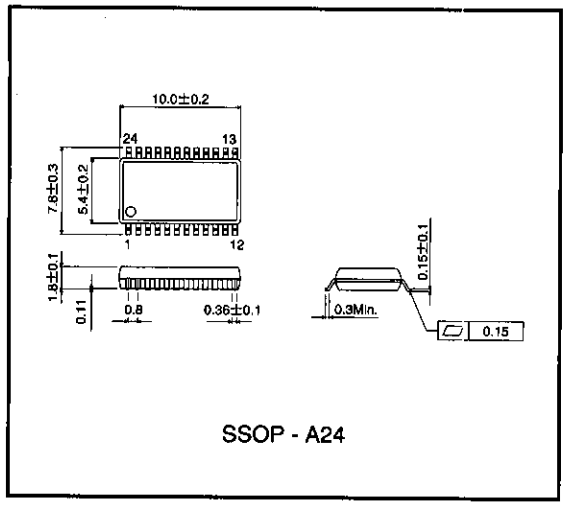


Fig.16 HIGH level output voltage vs. output current

●External dimensions (Units: mm)



SSOP - A24

Notes

- The contents described in this catalogue are correct as of March 1997.
- No unauthorized transmission or reproduction of this book, either in whole or in part, is permitted.
- The contents of this book are subject to change without notice. Always verify before use that the contents are the latest specifications. If, by any chance, a defect should arise in the equipment as a result of use without verification of the specifications, ROHM CO., LTD., can bear no responsibility whatsoever.
- Application circuit diagrams and circuit constants contained in this data book are shown as examples of standard use and operation. When designing for mass production, please pay careful attention to peripheral conditions.
- Any and all data, including, but not limited to application circuit diagrams, information, and various data, described in this catalogue are intended only as illustrations of such devices and not as the specifications for such devices. ROHM CO., LTD., disclaims any warranty that any use of such device shall be free from infringement of any third party's intellectual property rights or other proprietary rights, and further, assumes absolutely no liability in the event of any such infringement, or arising from or connected with or related to the use of such devices.
- Upon the sale of any such devices; other than for the buyer's right to use such devices itself, resell or otherwise dispose of the same; no express or implied right or license to practice or commercially exploit any intellectual property rights or other proprietary rights owned or controlled by ROHM CO., LTD., is granted to any such buyer.
- The products in this manual are manufactured with silicon as the main material.
- The products in this manual are not of radiation resistant design.

The products listed in this catalogue are 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 these products 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, or other safety devices) please be sure to consult with our sales representatives in advance.

- Notes when exporting
  - It is essential to obtain export permission when exporting any of the above products when it falls under the category of strategic material (or labor) as determined by foreign exchange or foreign trade control laws.
  - Please be sure to consult with our sales representatives to ascertain whether any product is classified as a strategic material.