# 3-phase motor driver for CD-ROMs

# BA6849FP / BA6849FP-Y / BA6849FM / BA6849FS

The BA6849 series are ICs developed for CD-ROM spindle motor drives. These ICs possess a short brake and reverse-rotation brake for two types of brake functions, and also contain FG output and rotation direction detection (FR) circuits, making them high-functionality and high-performance ICs.

#### Applications

CD-ROM, CD-R, CD-RW, DVD-ROM, and DVD-RAM

#### Features

- 1) Three-phase, full-wave, pseudo-linear drive system.
- 2) Built-in power save and thermal shutdown functions.
- 3) Built-in current limiter and Hall bias circuits.
- 4) Built-in FG output.

- 5) Built-in rotation direction detector.
- 6) Built-in reverse rotation prevention circuit.
- 7) Built-in short brake pin.

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

Parameter		Symbol	Limits	Unit
Applied voltage (with 5V power supply)		Vcc	7	V
Applied voltage (motor power supply1)		V <sub>M1</sub>	16	V
Applied voltage (motor power supply2)		V <sub>M2</sub>	16	V
Power dissipation	BA6849FM	Pd	2200*1	mW
	BA6849FP		1700*2	mW
	BA6849FP-Y		1450*3	mW
	BA6849FS		1000*4	mW
Operating temperature		Topr	<b>−20</b> ~+75	Ĉ
Storage temperature		Tstg	<b>−55</b> ~+150*⁵	C
Output current		Іоит	1300*6	mA

<sup>\*1</sup> Reduced by 17.6mW for each increase in Ta of 1°C over 25°C.

<sup>\*2</sup> When mounted on a 70mm×70mm×1.6mm glass epoxy board. Reduced by 13.6mW for each increase in Ta of 1°C over 25°C.

<sup>\*3</sup> Reduced by 11.6mW for each increase in Ta of 1°C over 25°C.

<sup>\*4</sup> Reduced by 8.0mW for each increase in Ta of 1°C over 25°C.

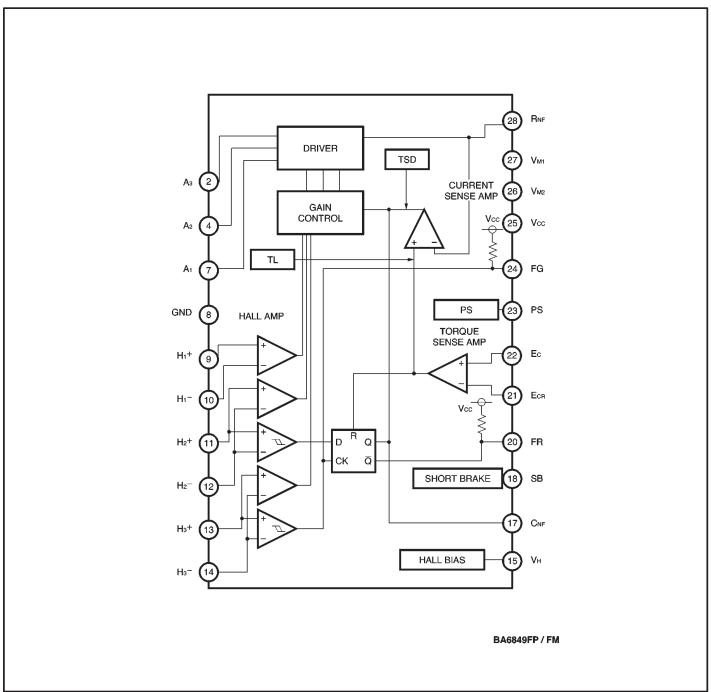
<sup>\*5</sup> Tj should not exceed 150℃.

<sup>\*6</sup> Should not exceed Pd or ASO values.

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

Parameter	Symbol	Limits	Unit
	Vcc	4.25~5.5	V
Power supply voltage	V <sub>M1</sub>	3.0~15	V
	V <sub>M2</sub>	3.0~15	V

# Block diagram



# ●Pin descriptions BA6849FP/BA6849FM

Pin No.	Pin Name	Functiom
2	Аз	Output
4	<b>A</b> 2	Output
7	<b>A</b> 1	Output
8	GND	GND
9	H <sub>1</sub> +	Hall signal input
10	H <sub>1</sub> -	Hall signal input
11	H <sub>2</sub> +	Hall signal input
12	H2 <sup>-</sup>	Hall signal input
13	<b>Н</b> з <sup>+</sup>	Hall signal input
14	H3 <sup></sup>	Hall signal input
15	Vн	Hall bias
17	Cnf	For connection of phase compensation capacitor
18	SB	Short brake
20	FR	Rotation direction detection
21	Ecr	Output voltage control reference
22	Ec	Output voltage control
23	PS	Power save
24	FG	FG signal output
25	Vcc	Power supply
26	V <sub>M2</sub>	Motor power supply 2
27	<b>V</b> м1	Motor power supply 1
28	Rnf	For connection of output current detection resistor
FIN	_	SUB GND

<sup>\* \*</sup> Missing pin numbers are N.C.

# BA6849FP-Y

Pin No.	Pin name	Function
1	_	SUB GND
2	Аз	Output
3	<b>A</b> 2	Output
5	A <sub>1</sub>	Output
6	GND	GND
7	H <sub>1</sub> +	Hall signal input
- 8	H <sub>1</sub> -	Hall signal input
9	H <sub>2</sub> +	Hall signal input
10	H2 <sup>-</sup>	Hall signal input
11	H <sub>3</sub> +	Hall signal input
12	H3 <sup>-</sup>	Hall signal input
13	Vн	Hall bias
15	CNF	For connection of phase compensation capacitor
16	SB	Short brake
17	FR	Rotation direction detection
18	Ecr	Torque control reference
19	Ec	Torque control
20	PS	Power save
21	FG	FG signal output
22	Vcc	Power supply
23*	<b>V</b> <sub>M2</sub>	Motor power supply 2
23*	<b>V</b> <sub>M1</sub>	Motor power supply 1
24	Rnf	For connection of output current detection resistor

<sup>\*</sup> Connected within the IC.

Note) Missing pin numbers are N.C.



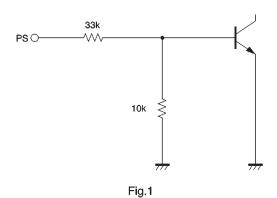
# MA6849FS

Pin No.	Pin name	Function
1	_	SUB GND
2	Аз	Output
3	A2	Output
5	A <sub>1</sub>	Output
6	GND	GND
7	H1 <sup>+</sup>	Hall signal input
8	H <sub>1</sub> -	Hall signal input
9	H <sub>2</sub> +	Hall signal input
10	H <sub>2</sub> -	Hall signal input
11	H <sub>3</sub> +	Hall signal input
12	H3 <sup>-</sup>	Hall signal input
13	Vн	Hall bias
15	Cnf	For connection of phase compensation capacitor
16	SB	Short brake
17	FR	Rotation direction detection
18	Ecr	Torque control reference
19	Ec	Torque control
20	PS	Power save
21	FG	FG signal output
22	Vcc	Power supply
23*	V <sub>M2</sub>	Motor power supply 2
23*	<b>V</b> м1	Motor power supply 1
24	Rnf	For connection of output current detection resistor

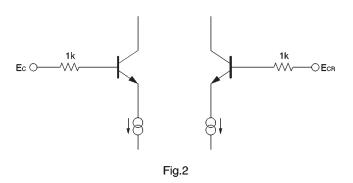
<sup>\*</sup> Connected within the IC.
Note) Missing pin numbers are N.C.

# •Input / output circuits

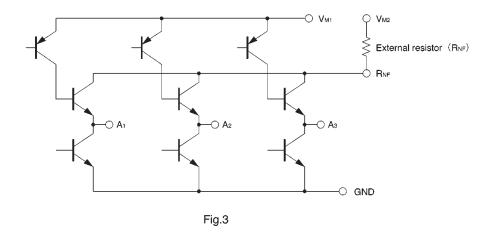
# (1) Power save



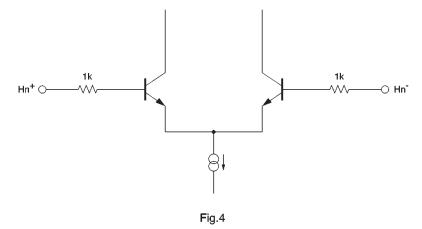
# (2) Torque command input



# (3) Torque output (A<sub>1</sub>, A<sub>2</sub>, and A<sub>3</sub>)

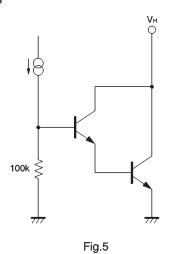


# (4) Hall input (H<sub>1</sub><sup>+</sup>, H<sub>1</sub><sup>-</sup>, H<sub>2</sub><sup>+</sup>, H<sub>2</sub><sup>-</sup>, H<sub>3</sub><sup>+</sup>, H<sub>3</sub><sup>-</sup>)

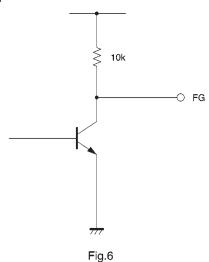


Note: Resistance values are typical values.

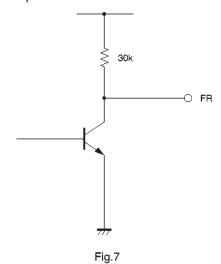
(5) Hall bias



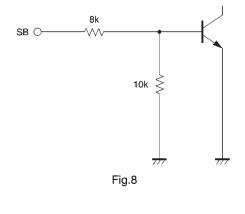
(6) FG output



(7) FR Output



(8) Short brake



Note: Resistance values are typical values.

●Electrical characteristics (unless otherwise noted, Ta = 25°C, Vcc = 5V, V<sub>M1</sub> = 12V, V<sub>M2</sub> = 12V)

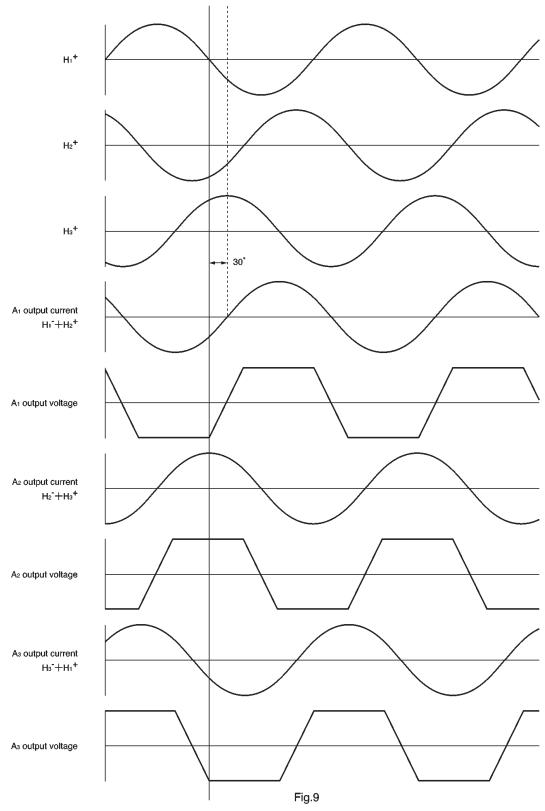
Parameter	Symbol	Min.	Тур.	Max.	Unit	Coniditions
⟨Total device⟩						
Circuit current 1	Icc <sub>1</sub>	_	0	0.2	mA	In the power save ON state
Circuit current 2	Icc2	_	4.1	6.5	mA	In the power save OFF state
〈Power save〉						
ON voltage range	V <sub>PSON</sub>	_	_	1.5	V	_
OFF voltage range	VPSOFF	3.5	_	_	V	_
〈Hall bias〉						
Hall bias voltage	Vнв	0.5	0.9	1.5	V	I <sub>HB</sub> =10mA
〈Hall amplifier〉						
Input bias current	Іна	_	0.7	3.0	μΑ	_
Same phase input voltage range	VHAR	1.5	_	4.0	V	_
Minimum input level	Vinh	50	_	_	mV <sub>P-P</sub>	_
H3 hysteresis level	V <sub>H</sub> ys	10	20	40	mV	_
⟨Torque command⟩						
Input voltage range	Ec	1.0	_	4.0	V	_
"—" offset voltage	Ecoff—	-80	-50	-20	mV	EcR=2.5V
"+" offset voltage	Ecoff+	20	50	80	mV	EcR=2.5V
Input bias current	Ecin	_	0.5	2.0	μA	Ec=Ecr
I / O gain	GEC	0.41	0.51	0.61	A/V	Ec=1.5V, 2.0V
⟨FG⟩						
FG output high level voltage	VFGH	4.5	4.8	_	V	I <sub>FG</sub> =-20 μ A
FG output low level voltage	VFGL	0	0.25	0.4	V	IFG=3mA
DUTY (reference value)	DU	_	50	_	%	_
⟨Rotation detection⟩						
FR output high level voltage	V <sub>FRH</sub>	4.1	4.4	_	V	I <sub>FR</sub> =-20 μ A
FR output low level voltage	VFRL	0	0.25	0.4	V	IFR=3mA
⟨Output⟩						
Output saturation high level voltage	Vон	_	1.0	1.5	V	lo=-600mA
Output saturation low level voltage	Vol	_	0.4	0.8	V	lo=600mA
Pre-drive current	IVML	_	35	70	mA	Ec=0V output open
Output limit current	l⊤∟	560	700	840	mA	_
〈Short brake〉						
ON voltage range	VsBon	3.5	<u> </u>	_	٧	_
OFF voltage range	Vsboff	_	_	1.5	V	_

ONot designed forradiation resistance.

#### Circuit operation

# (1) Hall input to coil output

The phase relationship between the Hall input signals and the output current and voltage is shown in Fig.9. The motor position data input via the Hall pins is amplified by the Hall amplifier, and formed into waveforms by the matrix block. These signals are input to the output driver that supplies the drive current to the motor coils.



#### (2) Torque command

The RNF pin voltage with respect to the torque command

#### (Ec) is as follows:

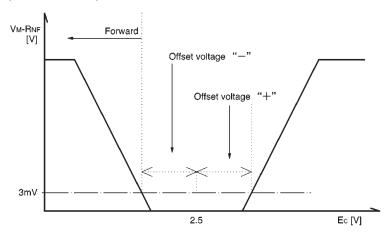


Fig.10

	Rotation direction
Ec < Ecr	Forward
Ec > Ecr	Reverse*

<sup>\*</sup> Stops after detecting reverse.

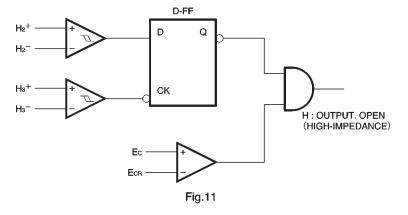
The I / O gain ( $G_{EC}$ ) from the  $E_C$  pin to the  $R_{NF}$  pin (output current) is determined by the  $R_{NF}$  detector resistor.

$$G_{EC} = 0.255 / R_{NF} [A / V]$$

The torque limit current I<sub>TL</sub> is given by:

$$I_{TL} = 0.35 / R_{NF} [A]$$

#### (3) Reverse rotation detection function



The reverse detection circuit construction is shown in Fig.11.

#### 1) Forward (Ec < Ecr)

The phase relationship between the Hall input signals H2<sup>+</sup> and H3<sup>+</sup> becomes as shown in Fig.9, and the reverse rotation detection circuit does not operate.

#### 2) Reverse (Ec > Ecr)

The phase relationship between the signals  ${\rm H_2}^+$  and  ${\rm H_3}^+$  is opposite that for forward operation, and the reverse rotation detection circuit operates. The output goes OFF, and becomes open circuit.

	FR signal output pin
Forward	L
Reverse	Н

#### (4) Short brake

When 3.5V or more is applied to the short brake pin, the upper-side output transistors of all go off, and the lower-side output transistors go on. Short braking operates regardless of the torque command signal.

# Application example

#### (5) Other circuits

When 3.5V or more is applied to the power save pin, all circuits are on. When 1.5V or less is applied, the IC enters power save mode. Also, the Hall bias pins turn on and off with the power save pin.

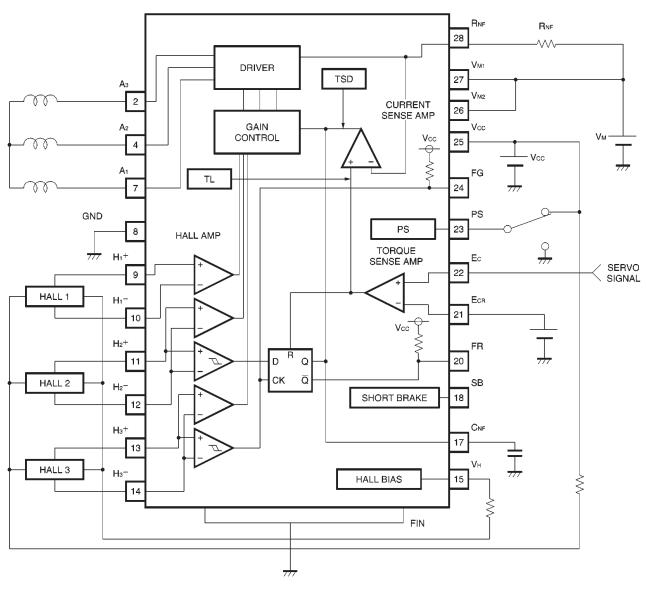


Fig.12

#### Operation notes

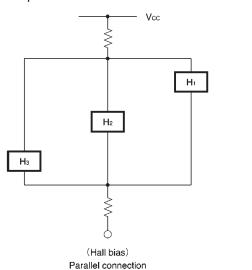
# (1) Power save

The power save input is an I/O circuit like the own shown in Fig.1.

The thermal derating characteristics of the power save pin is -8mV /  $^{\circ}\text{C}$ , and the resistance will fluctuate between  $\pm30\%$  so be careful of the input voltage range.

# (2) Hall input

The input circuit shown in Fig.4 is used for the Hall inputs. The Hall elements can be connected either in series or in parallel.



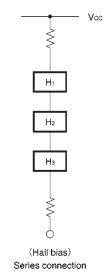
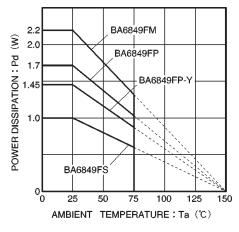


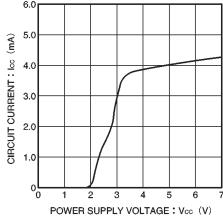
Fig.13

# (3) Thermal shutdown (TSD)

When the junction temperature reaches  $175^{\circ}C$ , the  $A_1$ ,  $A_2$ , and  $A_3$  coil outputs go open circuit. The thermal shutdown has approximately  $15^{\circ}C$  of hysteresis.

# Electrical characteristics curves





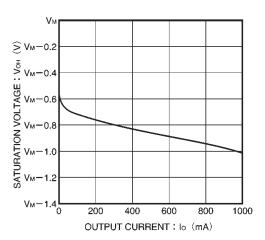


Fig.14 Package derating characteristics

Fig.15 Power supply current vs. power supply voltage

Fig.16 Upper-side output saturation voltage vs. output current

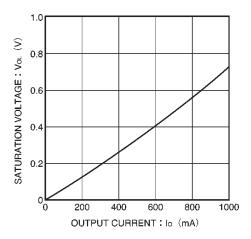


Fig.17 Lower-side output saturation voltage vs. output current

#### External dimensions (Units: mm)

