

# 3-phase motor driver

## BA6840BFS / BA6840BFP-Y / BA6840BFP / BA6842BFS

The BA6840BFS, BA6840BFP-Y, BA6840BFP, and BA6842BFS are one-chip ICs designed for driving CD-ROM motors. They are high performance-ICs with a 3-phase, full-wave, pseudo-linear drive system.

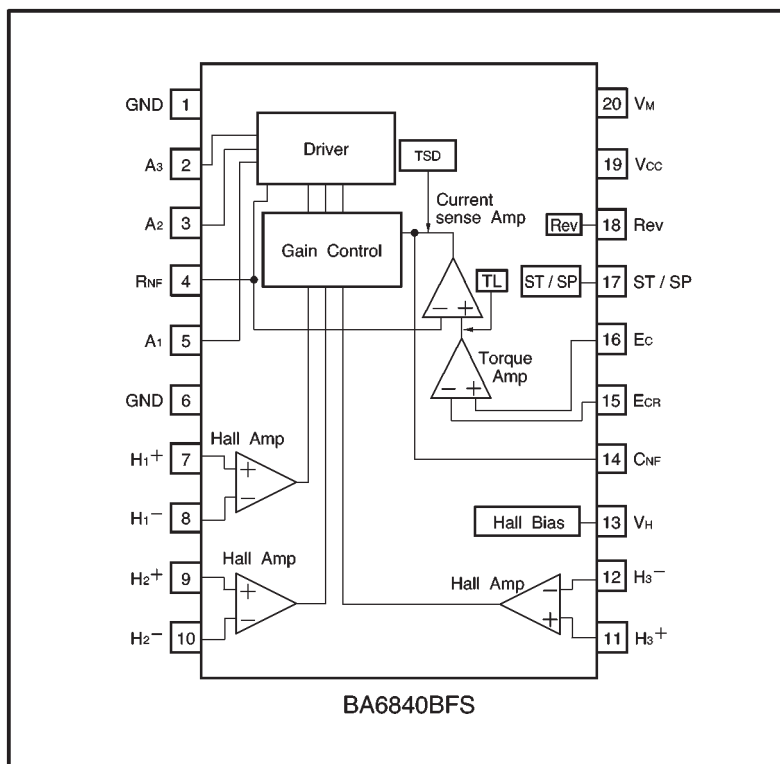
### ●Applications

CD-ROM/RW, DVD-ROM/PLAYER

### ●Features

- 1) 3-phase, full-wave, pseudo-linear drive system.
- 2) Start / stop pin; power saving during stop mode.
- 3) Internal current limit circuit.
- 4) Internal thermal shutdown circuit.
- 5) Internal hall bias circuit.

### ●Block diagram



●Absolute maximum ratings (Ta = 25°C)

| Parameter             |             | Symbol           | Limits   | Unit |
|-----------------------|-------------|------------------|----------|------|
| Power supply voltage  |             | V <sub>CC</sub>  | 7        | V    |
|                       |             | V <sub>M</sub>   | 16       |      |
| Power dissipation     | BA6840BFS   | Pd               | 930*1    | mW   |
|                       | BA6840BFP-Y |                  | 1450*2   |      |
|                       | BA6840BFP   |                  | 1700*3   |      |
|                       | BA6842BFS   |                  | 1000*4   |      |
| Operating temperature |             | T <sub>opr</sub> | −20~+75  | °C   |
| Storage temperature   |             | T <sub>stg</sub> | −55~+150 | °C   |
| Output current        |             | I <sub>out</sub> | 1300     | mA   |

\*1 Reduced by 7.5 mW for each increase in Ta of 1°C over 25°C.

\*2 Reduced by 11.6 mW for each increase in Ta of 1°C over 25°C.

\*3 Reduced by 13.6 mW for each increase in Ta of 1°C over 25°C.

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

\*1~4 When mounted on a 90×50×1.6 mm glass epoxy board.

Should not exceed Pd or ASO values.

●Recommended operating conditions

| Parameter                      | Symbol          | Min. | Typ. | Max. | Unit |
|--------------------------------|-----------------|------|------|------|------|
| Operating power supply voltage | V <sub>CC</sub> | 4.25 | —    | 5.50 | V    |
|                                | V <sub>M</sub>  | 3.0  | —    | 15   | V    |

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

| Parameter                            | Symbol             | Min. | Typ. | Max. | Unit              | Conditions                                                                                                                    |
|--------------------------------------|--------------------|------|------|------|-------------------|-------------------------------------------------------------------------------------------------------------------------------|
| 〈Overall〉                            |                    |      |      |      |                   |                                                                                                                               |
| Supply current 1                     | I <sub>CC1</sub>   | —    |      | 0.2  | mA                | Start / stop OFF                                                                                                              |
| Supply current 2                     | I <sub>CC2</sub>   | —    | 3.6  | 6.0  | mA                | Start / stop ON inputs : H, M and L                                                                                           |
| 〈Start / stop〉                       |                    |      |      |      |                   |                                                                                                                               |
| ON voltage                           | V <sub>PSON</sub>  | 3.5  | —    | —    | V                 |                                                                                                                               |
| OFF voltage                          | V <sub>PSOFF</sub> | —    | —    | 1.5  | V                 |                                                                                                                               |
| 〈Hall bias〉                          |                    |      |      |      |                   |                                                                                                                               |
| Hall bias voltage                    | V <sub>HB</sub>    | —    | 0.9  | 1.5  | V                 | I <sub>HB</sub> =10mA                                                                                                         |
| 〈Hall amplifier〉                     |                    |      |      |      |                   |                                                                                                                               |
| Input bias current                   | I <sub>HA</sub>    | —    | 0.25 | 1.0  | μA                |                                                                                                                               |
| Common-mode input voltage            | V <sub>HAR</sub>   | 1.5  | —    | 4.0  | V                 |                                                                                                                               |
| Minimum input level                  | V <sub>INH</sub>   | 50   | —    | —    | mV <sub>P-P</sub> |                                                                                                                               |
| 〈Torque control〉                     |                    |      |      |      |                   |                                                                                                                               |
| Input voltage                        | E <sub>C</sub>     | 1.0  | —    | 4.0  | V                 |                                                                                                                               |
| Offset voltage +                     | E <sub>cofs+</sub> | 20   | 50   | 80   | mV                | For E <sub>CR</sub> = 2.5 V                                                                                                   |
| Offset voltage —                     | E <sub>cofs—</sub> | —80  | —50  | —20  | mV                |                                                                                                                               |
| Input current                        | E <sub>CIN</sub>   | —    | 0.5  | 2.0  | μA                | E <sub>C</sub> = E <sub>CR</sub> = 2.5V                                                                                       |
| Input/output gain                    | G <sub>EC</sub>    | 0.41 | 0.51 | 0.61 | A/V               | R <sub>NF</sub> = 0.5 Ω, when measured at<br>E <sub>C</sub> =2points: 1.5V and 2.0V<br>E <sub>C</sub> =2points: 3.0V and 3.5V |
| 〈Output〉                             |                    |      |      |      |                   |                                                                                                                               |
| Output saturation high level voltage | V <sub>OH</sub>    | —    | 1.0  | 1.6  | V                 | I <sub>O</sub> = —600mA                                                                                                       |
| Output saturation low level voltage  | V <sub>OL</sub>    | —    | 0.4  | 0.9  | V                 | I <sub>O</sub> = 600mA                                                                                                        |
| Torque limit current                 | I <sub>TL</sub>    | 560  | 700  | 840  | mA                | R <sub>NF</sub> = 0.5 Ω                                                                                                       |

○Not designed for radiation resistance

## ●Electrical characteristic curves

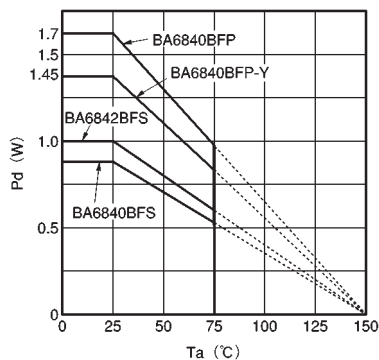


Fig.1 Power dissipation curves

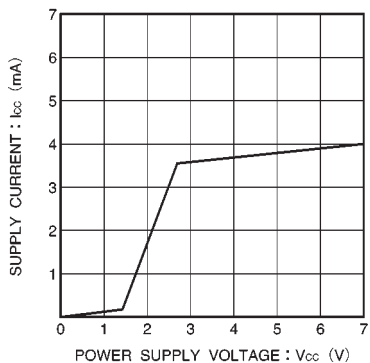


Fig.2 Supply current vs. power supply voltage

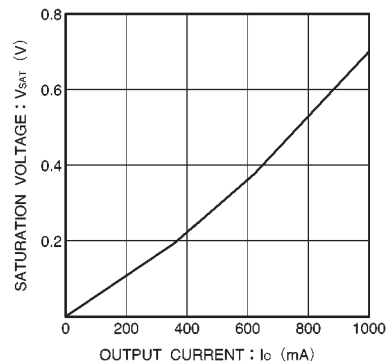


Fig.3 Low-level output saturation voltage vs. output current

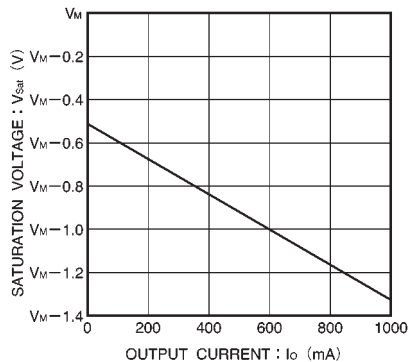


Fig.4 High-level output saturation voltage vs. output current

### ● Circuit operation

#### (1) Hall input ~ output

The 3-phase Hall signal is amplified in the hall amplifiers and sent to the matrix section, where the signal is further amplified and combined. After the signal is converted to a current in the amplitude control circuit, the current is supplied to the output driver, which then provides a motor drive current. The phases of the Hall input signal, output voltage, and output current are shown in Fig. 5.

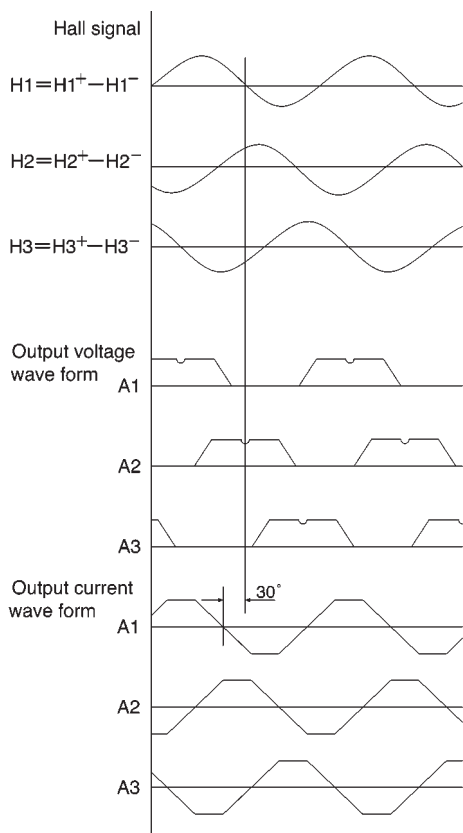


Fig. 5

#### (2) Torque control pin

The  $R_{NF}$ -pin current depends on the torque control input voltage ( $E_C$ ) as shown in Fig. 6.

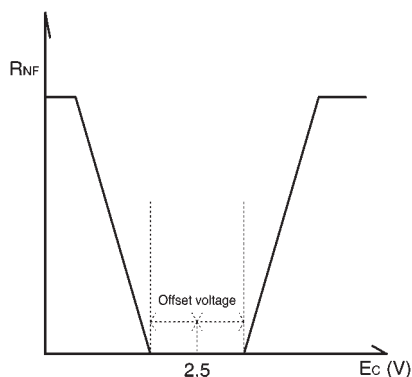


Fig. 6

|                | Reverse pin voltage |         |
|----------------|---------------------|---------|
|                | H                   | L       |
| $E_{CR} < E_C$ | Reverse             | Forward |
| $E_{CR} > E_C$ | Stop                | Reverse |

#### (3) Start / stop pin

The motor is in the run mode when the pin input voltage is 3.5V or more, and in the idle mode (all output transistors are off) when the voltage is 1.5V or less.

#### (4) Power ground pin ( $R_{NF}$ pin)

The  $R_{NF}$  pin is the output stage ground pin. Connect a resistor ( $0.5\Omega$  recommended) between this pin and the ground to monitor the output current.

#### (5) Phase compensation pin ( $C_{NF}$ pin)

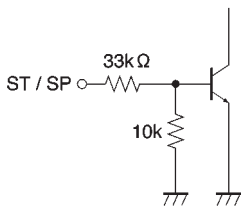
Connect and adjust a capacitor between this pin and the ground if the output tends to oscillate.

●Pin descriptions

| Pin name                    | BA6840BFS | BA6840BFP-Y | BA6840BFP | BA6842BFS        | Function                                    |
|-----------------------------|-----------|-------------|-----------|------------------|---------------------------------------------|
| GND                         | 1         | FIN         | FIN       | 8, 9, 23, 24, 25 | Ground                                      |
| A <sub>3</sub>              | 2         | 3           | 3         | 1                | Output                                      |
| A <sub>2</sub>              | 3         | 4           | 4         | 4                | Output                                      |
| R <sub>NF</sub>             | 4         | 6           | 5         | 5                | Current detector ouput                      |
| A <sub>1</sub>              | 5         | 7           | 6         | 7                | Output                                      |
| GND                         | 6         | 8           | 7         | 10               | Ground                                      |
| H <sub>1</sub> <sup>+</sup> | 7         | 9           | 9         | 11               | Hall signal input                           |
| H <sub>1</sub> <sup>-</sup> | 8         | 10          | 10        | 12               | Hall signal input                           |
| H <sub>2</sub> <sup>+</sup> | 9         | 11          | 13        | 13               | Hall signal input                           |
| H <sub>2</sub> <sup>-</sup> | 10        | 12          | 14        | 15               | Hall signal input                           |
| H <sub>3</sub> <sup>+</sup> | 11        | 13          | 15        | 16               | Hall signal input                           |
| H <sub>3</sub> <sup>-</sup> | 12        | 14          | 16        | 17               | Hall signal input                           |
| V <sub>H</sub>              | 13        | 15          | 17        | 18               | Hall bias                                   |
| C <sub>NF</sub>             | 14        | 17          | 20        | 21               | Capacitor for phase compensation connection |
| E <sub>CR</sub>             | 15        | 18          | 21        | 22               | Standard output current control             |
| E <sub>C</sub>              | 16        | 19          | 22        | 26               | Output current control                      |
| ST / SP                     | 17        | 20          | 23        | 27               | Start / stop switch                         |
| REV                         | 18        | 22          | 24        | 29               | Reverse                                     |
| V <sub>CC</sub>             | 19        | 23          | 25        | 30               | Power supply                                |
| V <sub>M</sub>              | 20        | 24          | 26        | 31               | Motor power supply                          |

●Input / output circuits

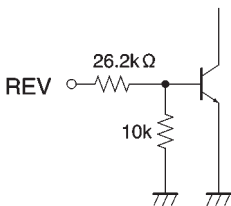
(1) Start / stop



(Resistances are typical values.)

Fig. 7

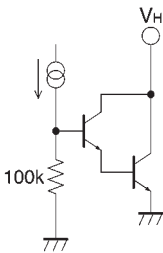
(2) Reversing pin



(Resistances are typical values.)

Fig. 8

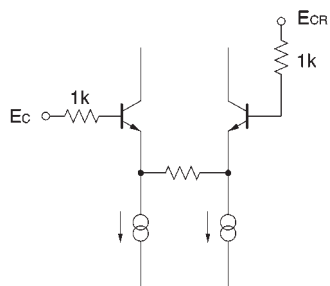
(3) Hall bias



(Resistances are typical values.)

Fig. 9

## (4) Torque control input



(Resistances are typical values.)

Fig. 10

## (5) Coil output

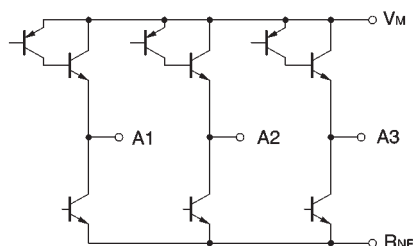
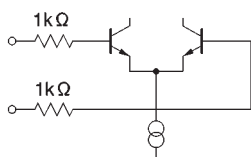


Fig. 11

(6) Hall input ( $H1^+$ ,  $H1^-$ ,  $H2^+$ ,  $H2^-$ ,  $H3^+$ ,  $H3^-$ )

(Resistances are typical values.)

Fig. 12

## ● Operation notes

## (1) Start / stop

The I / O equivalent circuit of the start / stop pin is shown in Fig. 7. The pin has a temperature dependence of  $-7\text{mV} / ^\circ\text{C}$ , and the resistance can vary  $\pm 30\%$ . Take the temperature effect into consideration when designing your application.

## (2) Hall input

The Hall input equivalent circuit is shown in Fig. 12. The Hall devices can be connected in either series or parallel.

## (3) Thermal shutdown circuit (TSD)

The circuit puts the coil outputs ( $A_1$ ,  $A_2$ , and  $A_3$ ) to the open state at the temperature of  $175^\circ\text{C}$  (typical). There is a temperature difference of about  $15^\circ\text{C}$  between the temperatures at which the circuit is activated and deactivated.

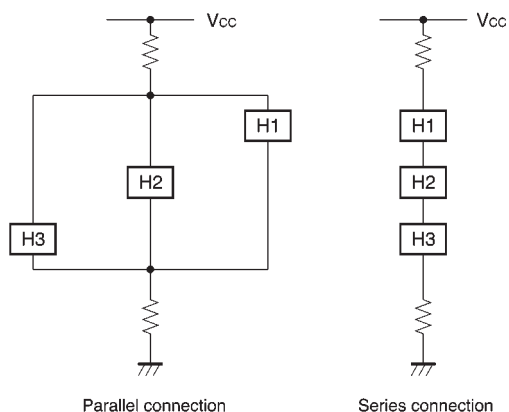


Fig. 13

## ●Application example

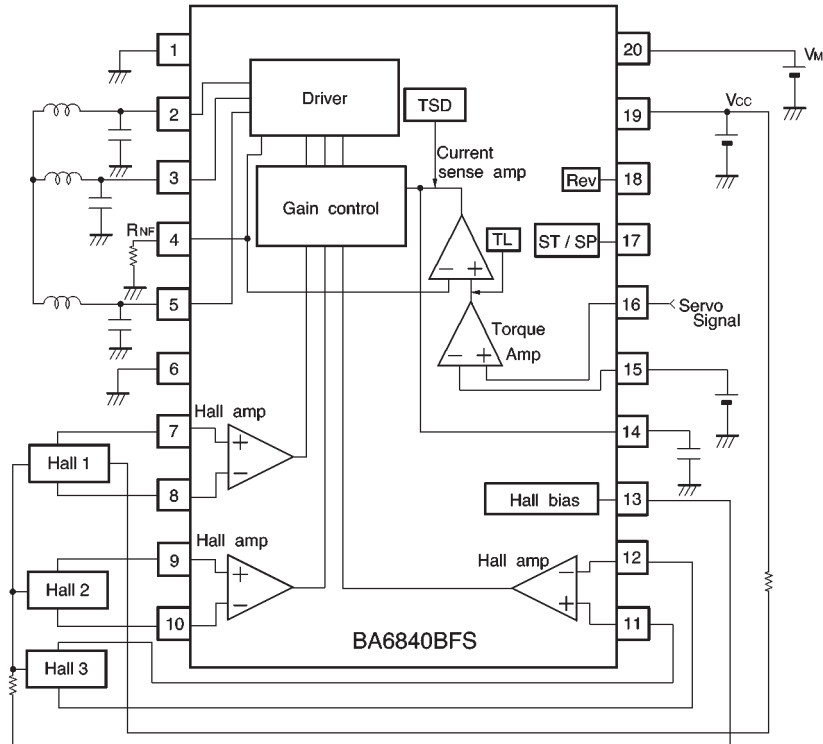
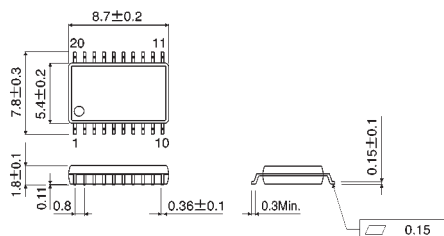


Fig.14

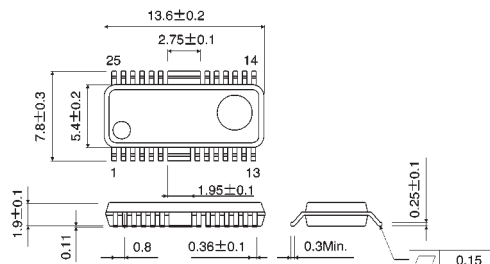
● External dimensions (Units: mm)

BA6840BFS



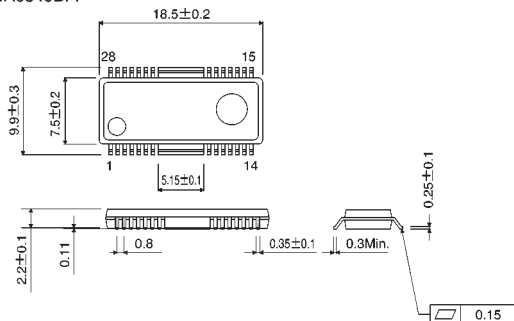
SSOP-A20

BA6840BFP-Y



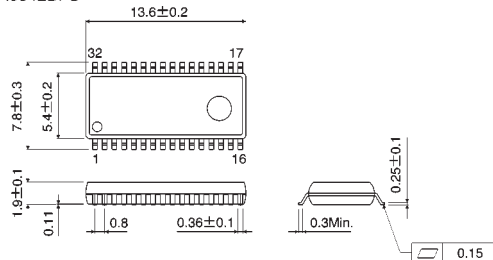
HSOP25

BA6840BFP



HSOP28

BA6842BFS



SSOP-P32