

# 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<br>(with 5V power supply) |            | V <sub>CC</sub>  | 7          | V    |
| Applied voltage<br>(motor power supply1)  |            | V <sub>M1</sub>  | 16         | V    |
| Applied voltage<br>(motor power supply2)  |            | V <sub>M2</sub>  | 16         | V    |
| Power<br>dissipation                      | BA6849FM   | P <sub>d</sub>   | 2200*1     | mW   |
|   | BA6849FP   |                  | 1700*2     | mW   |
|   | BA6849FP-Y |                  | 1450*3     | mW   |
|   | BA6849FS   |                  | 1000*4     | mW   |
| Operating temperature                     |            | T <sub>opr</sub> | -20~+75    | °C   |
| Storage temperature                       |            | T <sub>stg</sub> | -55~+150*5 | °C   |
| Output current                            |            | I <sub>OUT</sub> | 1300*6     | mA   |

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

\*2 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.

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

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

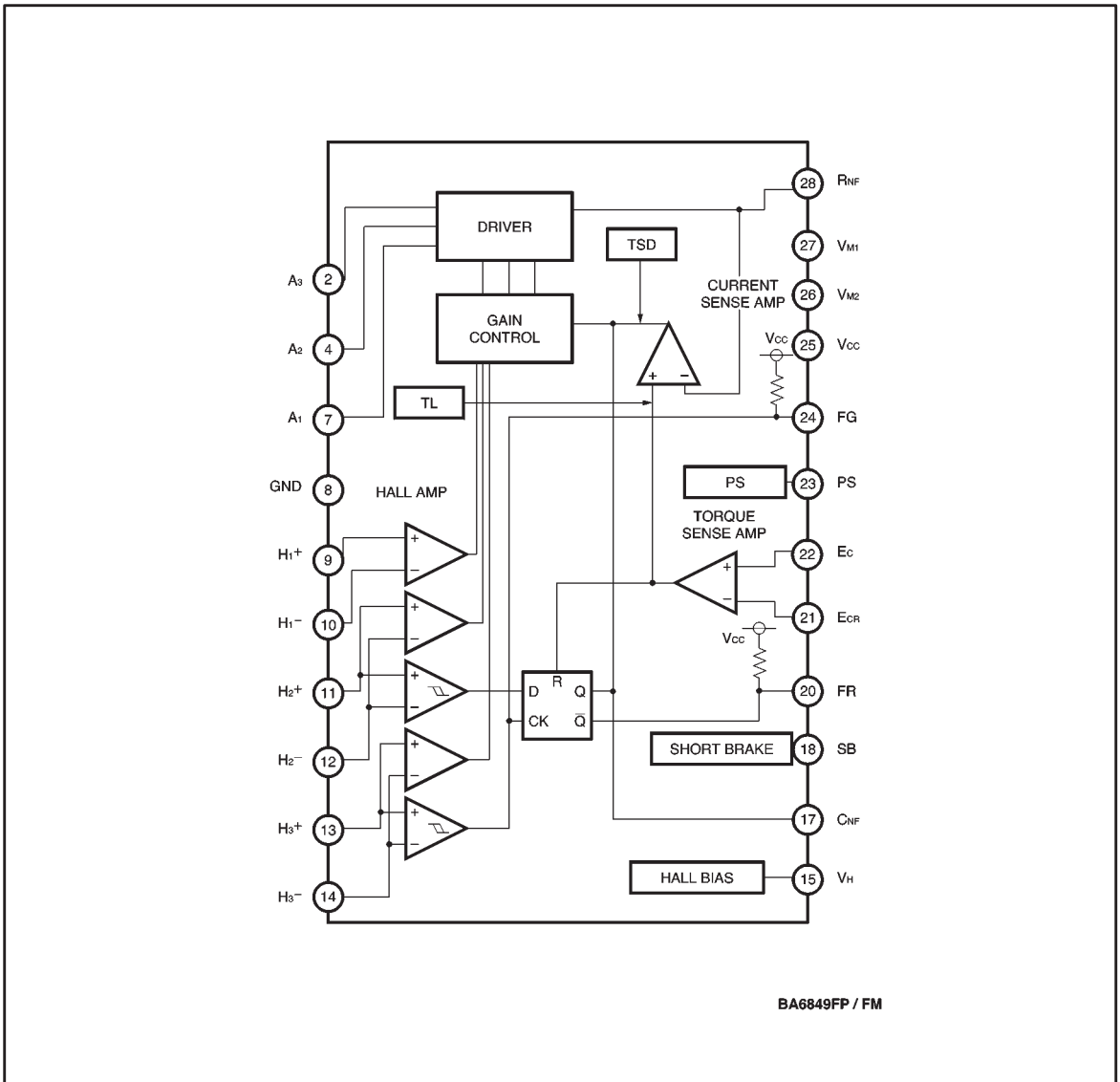
\*5 T<sub>j</sub> should not exceed 150°C.

\*6 Should not exceed P<sub>d</sub> or ASO values.

● Recommended operating conditions (Ta = 25°C)

| Parameter            | Symbol          | Limits   | Unit |
|----------------------|-----------------|----------|------|
| Power supply voltage | V <sub>CC</sub> | 4.25~5.5 | V    |
|                      | 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                    | Function  |
|---------|-----------------------------|---|
| 2       | A <sub>3</sub>              | Output  |
| 4       | A <sub>2</sub>              | Output  |
| 7       | A <sub>1</sub>              | Output  |
| 8       | GND                         | GND   |
| 9       | H <sub>1</sub> <sup>+</sup> | Hall signal input                                   |
| 10      | H <sub>1</sub> <sup>-</sup> | Hall signal input                                   |
| 11      | H <sub>2</sub> <sup>+</sup> | Hall signal input                                   |
| 12      | H <sub>2</sub> <sup>-</sup> | Hall signal input                                   |
| 13      | H <sub>3</sub> <sup>+</sup> | Hall signal input                                   |
| 14      | H <sub>3</sub> <sup>-</sup> | Hall signal input                                   |
| 15      | V <sub>H</sub>              | Hall bias   |
| 17      | C <sub>NF</sub>             | For connection of phase compensation capacitor      |
| 18      | SB                          | Short brake   |
| 20      | FR                          | Rotation direction detection                        |
| 21      | E <sub>CR</sub>             | Output voltage control reference                    |
| 22      | E <sub>C</sub>              | Output voltage control                              |
| 23      | PS                          | Power save  |
| 24      | FG                          | FG signal output                                    |
| 25      | V <sub>CC</sub>             | Power supply  |
| 26      | V <sub>M2</sub>             | Motor power supply 2                                |
| 27      | V <sub>M1</sub>             | Motor power supply 1                                |
| 28      | R <sub>NF</sub>             | For connection of output current detection resistor |
| FIN     | —                           | SUB GND   |

\* \* Missing pin numbers are N.C.

## BA6849FP-Y

| Pin No. | Pin name                    | Function  |
|---------|-----------------------------|---|
| 1       | —                           | SUB GND   |
| 2       | A <sub>3</sub>              | Output  |
| 3       | A <sub>2</sub>              | Output  |
| 5       | A <sub>1</sub>              | Output  |
| 6       | GND                         | GND   |
| 7       | H <sub>1</sub> <sup>+</sup> | Hall signal input                                   |
| 8       | H <sub>1</sub> <sup>-</sup> | Hall signal input                                   |
| 9       | H <sub>2</sub> <sup>+</sup> | Hall signal input                                   |
| 10      | H <sub>2</sub> <sup>-</sup> | Hall signal input                                   |
| 11      | H <sub>3</sub> <sup>+</sup> | Hall signal input                                   |
| 12      | H <sub>3</sub> <sup>-</sup> | Hall signal input                                   |
| 13      | V <sub>H</sub>              | Hall bias   |
| 15      | C <sub>NF</sub>             | For connection of phase compensation capacitor      |
| 16      | SB                          | Short brake   |
| 17      | FR                          | Rotation direction detection                        |
| 18      | E <sub>CR</sub>             | Torque control reference                            |
| 19      | E <sub>C</sub>              | Torque control                                      |
| 20      | PS                          | Power save  |
| 21      | FG                          | FG signal output                                    |
| 22      | V <sub>CC</sub>             | Power supply  |
| 23*     | V <sub>M2</sub>             | Motor power supply 2                                |
| 23*     | V <sub>M1</sub>             | Motor power supply 1                                |
| 24      | R <sub>NF</sub>             | For connection of output current detection resistor |

\* Connected within the IC.

Note) Missing pin numbers are N.C.

## MA6849FS

| Pin No. | Pin name                    | Function  |
|---------|-----------------------------|---|
| 1       | —                           | SUB GND   |
| 2       | A <sub>3</sub>              | Output  |
| 3       | A <sub>2</sub>              | Output  |
| 5       | A <sub>1</sub>              | Output  |
| 6       | GND                         | GND   |
| 7       | H <sub>1</sub> <sup>+</sup> | Hall signal input                                   |
| 8       | H <sub>1</sub> <sup>-</sup> | Hall signal input                                   |
| 9       | H <sub>2</sub> <sup>+</sup> | Hall signal input                                   |
| 10      | H <sub>2</sub> <sup>-</sup> | Hall signal input                                   |
| 11      | H <sub>3</sub> <sup>+</sup> | Hall signal input                                   |
| 12      | H <sub>3</sub> <sup>-</sup> | Hall signal input                                   |
| 13      | V <sub>H</sub>              | Hall bias   |
| 15      | C <sub>NF</sub>             | For connection of phase compensation capacitor      |
| 16      | SB                          | Short brake   |
| 17      | FR                          | Rotation direction detection                        |
| 18      | E <sub>CR</sub>             | Torque control reference                            |
| 19      | E <sub>C</sub>              | Torque control                                      |
| 20      | PS                          | Power save  |
| 21      | FG                          | FG signal output                                    |
| 22      | V <sub>CC</sub>             | Power supply  |
| 23*     | V <sub>M2</sub>             | Motor power supply 2                                |
| 23*     | V <sub>M1</sub>             | Motor power supply 1                                |
| 24      | R <sub>NF</sub>             | For connection of output current detection resistor |

\* Connected within the IC.

Note) Missing pin numbers are N.C.

● Input / output circuits

(1) Power save

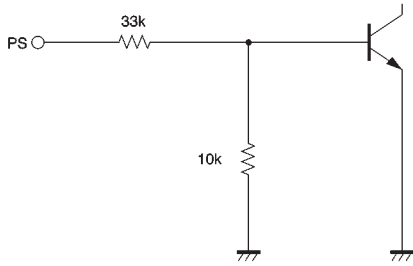


Fig.1

(2) Torque command input

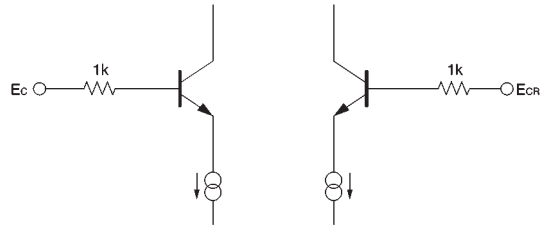


Fig.2

(3) Torque output ( $A_1$ ,  $A_2$ , and  $A_3$ )

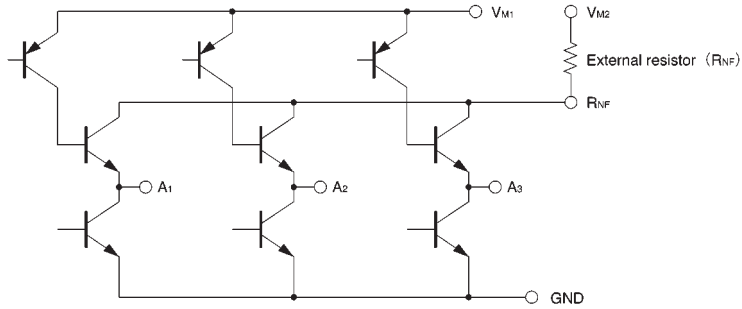


Fig.3

(4) Hall input ( $H_1^+$ ,  $H_1^-$ ,  $H_2^+$ ,  $H_2^-$ ,  $H_3^+$ ,  $H_3^-$ )

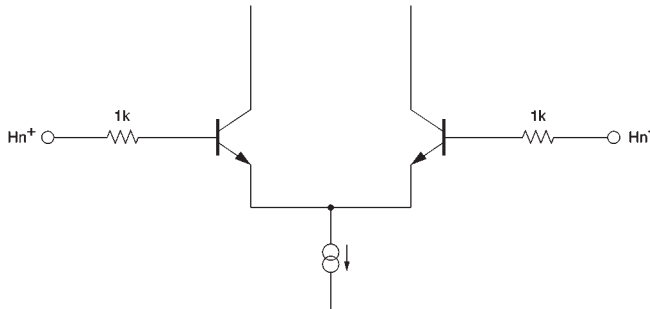


Fig.4

Note: Resistance values are typical values.

(5) Hall bias

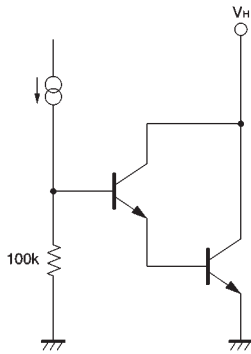


Fig.5

(7) FR Output

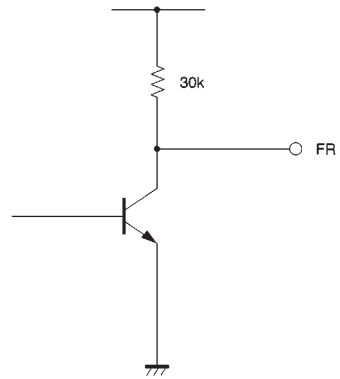


Fig.7

(6) FG output

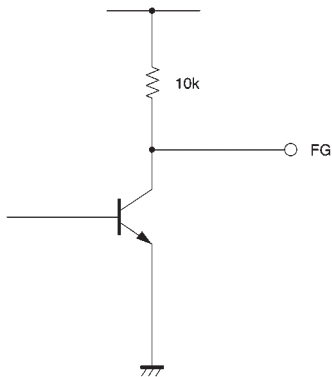


Fig.6

(8) Short brake

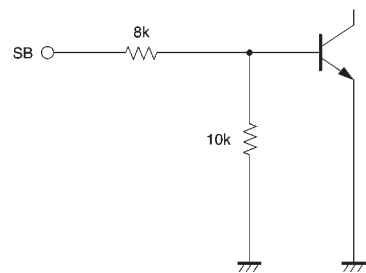


Fig.8

Note: Resistance values are typical values.

●Electrical characteristics (unless otherwise noted,  $T_a = 25^\circ\text{C}$ ,  $V_{CC} = 5\text{V}$ ,  $V_{M1} = 12\text{V}$ ,  $V_{M2} = 12\text{V}$ )

| Parameter                            | Symbol      | Min. | Typ. | Max. | Unit              | Coniditions                    |
|--------------------------------------|-------------|------|------|------|-------------------|--------------------------------|
| 〈Total device〉                       |             |      |      |      |                   |                                |
| Circuit current 1                    | $I_{CC1}$   | —    | 0    | 0.2  | mA                | In the power save ON state     |
| Circuit current 2                    | $I_{CC2}$   | —    | 4.1  | 6.5  | mA                | In the power save OFF state    |
| 〈Power save〉                         |             |      |      |      |                   |                                |
| ON voltage range                     | $V_{PSON}$  | —    | —    | 1.5  | V                 | —                              |
| OFF voltage range                    | $V_{PSOFF}$ | 3.5  | —    | —    | V                 | —                              |
| 〈Hall bias〉                          |             |      |      |      |                   |                                |
| Hall bias voltage                    | $V_{HB}$    | 0.5  | 0.9  | 1.5  | V                 | $I_{HB}=10\text{mA}$           |
| 〈Hall amplifier〉                     |             |      |      |      |                   |                                |
| Input bias current                   | $I_{HA}$    | —    | 0.7  | 3.0  | $\mu\text{A}$     | —                              |
| Same phase input voltage range       | $V_{HAR}$   | 1.5  | —    | 4.0  | V                 | —                              |
| Minimum input level                  | $V_{INH}$   | 50   | —    | —    | mV <sub>P-P</sub> | —                              |
| H3 hysteresis level                  | $V_{HYS}$   | 10   | 20   | 40   | mV                | —                              |
| 〈Torque command〉                     |             |      |      |      |                   |                                |
| Input voltage range                  | $E_C$       | 1.0  | —    | 4.0  | V                 | —                              |
| “—” offset voltage                   | $E_{COFF-}$ | -80  | -50  | -20  | mV                | $E_{CR}=2.5\text{V}$           |
| “+” offset voltage                   | $E_{COFF+}$ | 20   | 50   | 80   | mV                | $E_{CR}=2.5\text{V}$           |
| Input bias current                   | $E_{CIN}$   | —    | 0.5  | 2.0  | $\mu\text{A}$     | $E_C=E_{CR}$                   |
| I / O gain                           | $G_{EC}$    | 0.41 | 0.51 | 0.61 | A / V             | $E_C=1.5\text{V}, 2.0\text{V}$ |
| 〈FG〉                                 |             |      |      |      |                   |                                |
| FG output high level voltage         | $V_{FGH}$   | 4.5  | 4.8  | —    | V                 | $I_{FG}=-20\mu\text{A}$        |
| FG output low level voltage          | $V_{FGL}$   | 0    | 0.25 | 0.4  | V                 | $I_{FG}=3\text{mA}$            |
| DUTY (reference value)               | DU          | —    | 50   | —    | %                 | —                              |
| 〈Rotation detection〉                 |             |      |      |      |                   |                                |
| FR output high level voltage         | $V_{FRH}$   | 4.1  | 4.4  | —    | V                 | $I_{FR}=-20\mu\text{A}$        |
| FR output low level voltage          | $V_{FRL}$   | 0    | 0.25 | 0.4  | V                 | $I_{FR}=3\text{mA}$            |
| 〈Output〉                             |             |      |      |      |                   |                                |
| Output saturation high level voltage | $V_{OH}$    | —    | 1.0  | 1.5  | V                 | $I_o=-600\text{mA}$            |
| Output saturation low level voltage  | $V_{OL}$    | —    | 0.4  | 0.8  | V                 | $I_o=600\text{mA}$             |
| Pre-drive current                    | $I_{VML}$   | —    | 35   | 70   | mA                | $E_C=0\text{V}$ output open    |
| Output limit current                 | $I_{TL}$    | 560  | 700  | 840  | mA                | —                              |
| 〈Short brake〉                        |             |      |      |      |                   |                                |
| ON voltage range                     | $V_{SBON}$  | 3.5  | —    | —    | V                 | —                              |
| OFF voltage range                    | $V_{SBOFF}$ | —    | —    | 1.5  | V                 | —                              |

©Not designed for radiation 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.

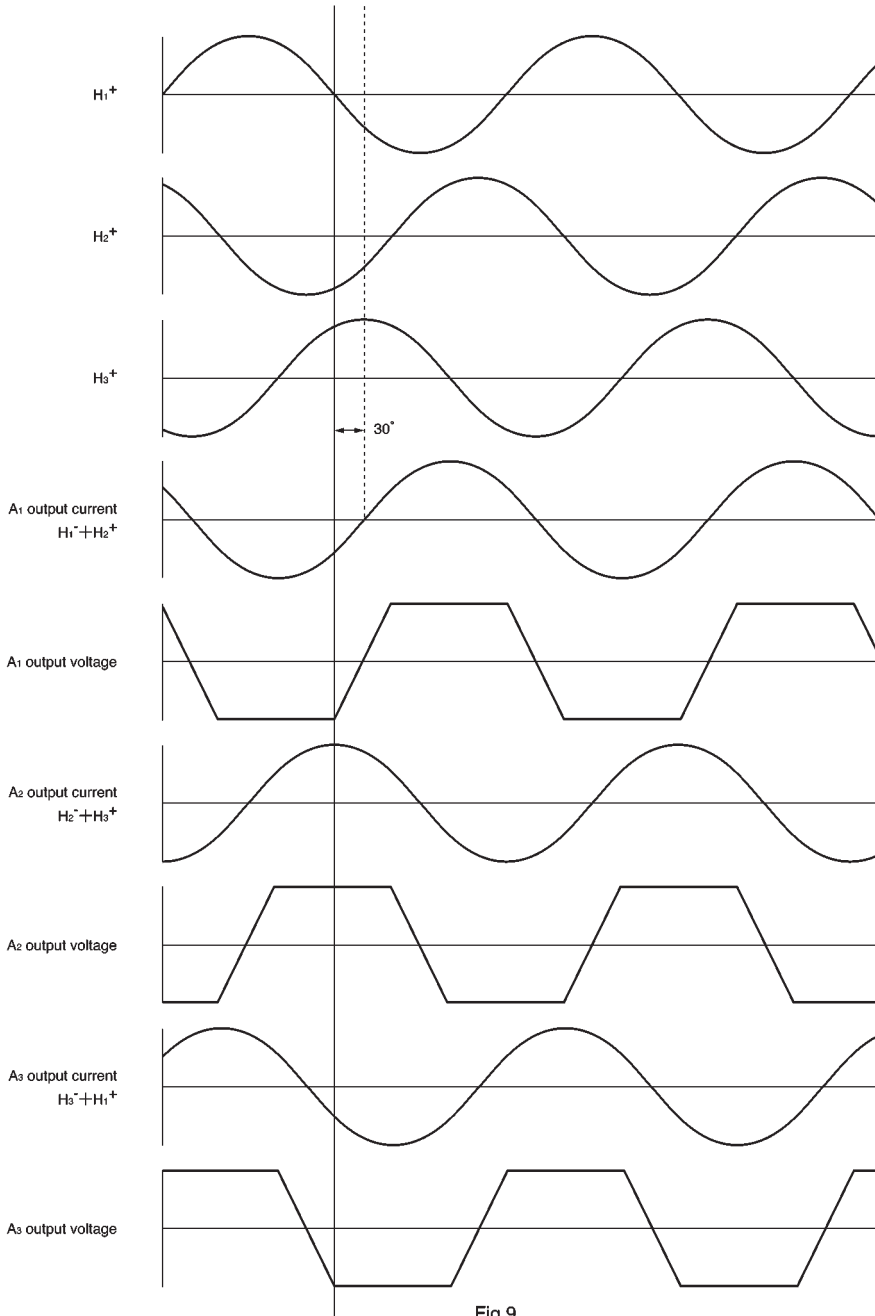


Fig.9

(2) Torque command

The  $R_{NF}$  pin voltage with respect to the torque command

( $E_c$ ) is as follows:

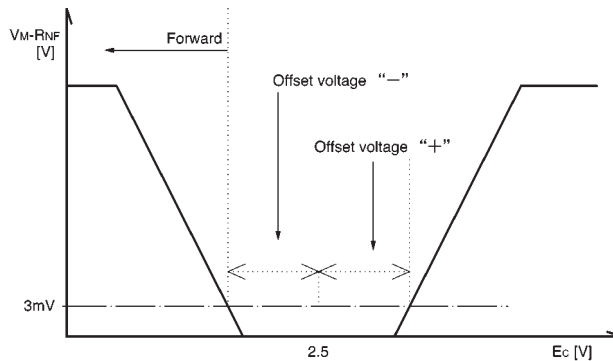


Fig.10

|                | Rotation direction |
|----------------|--------------------|
| $E_c < E_{CR}$ | Forward            |
| $E_c > E_{CR}$ | Reverse*           |

\* 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  $I_{TL}$  is given by:

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

(3) Reverse rotation detection function

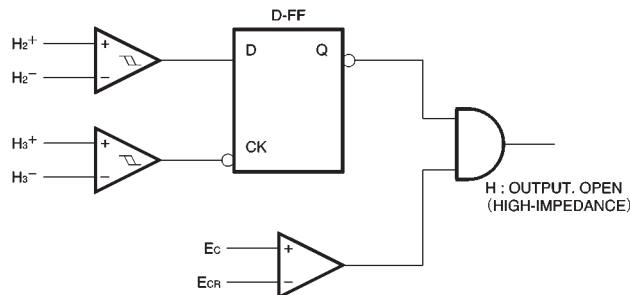


Fig.11

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

1) Forward ( $E_c < E_{CR}$ )

The phase relationship between the Hall input signals  $H_2^+$  and  $H_3^+$  becomes as shown in Fig.9, and the reverse rotation detection circuit does not operate.

2) Reverse ( $E_c > E_{CR}$ )

The phase relationship between the signals  $H_2^+$  and  $H_3^+$  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 | H                    |

(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.

(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.

●Application example

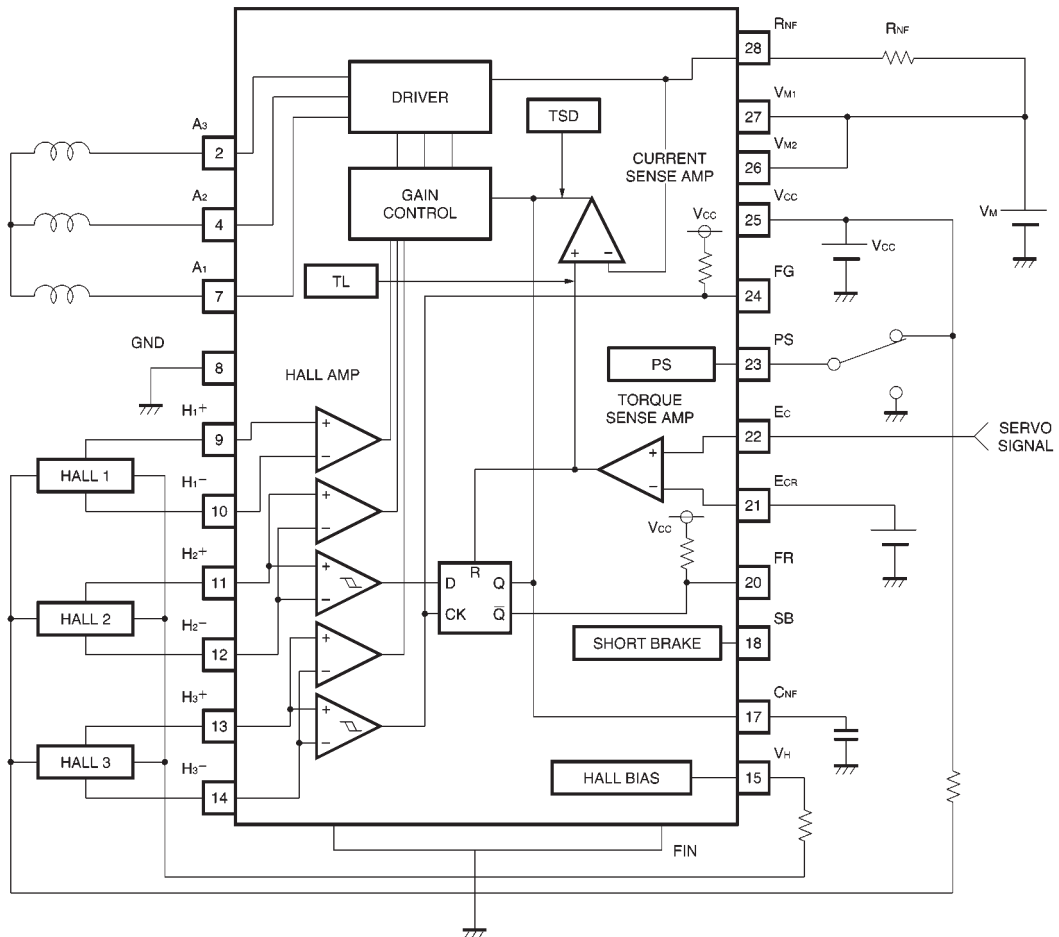


Fig.12

● 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  $-8\text{mV} / ^\circ\text{C}$ , and the resistance will fluctuate between  $\pm 30\%$  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.

(3) Thermal shutdown (TSD)

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

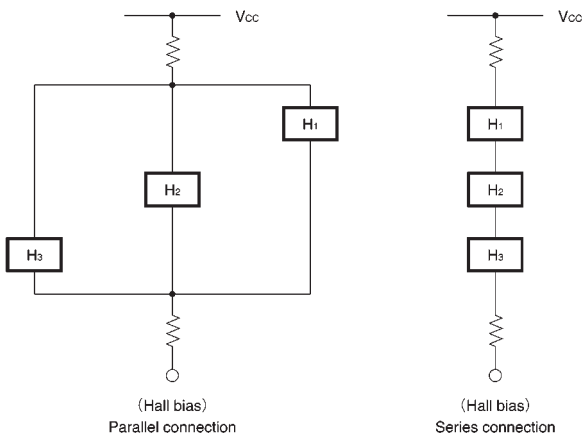


Fig.13

● Electrical characteristics curves

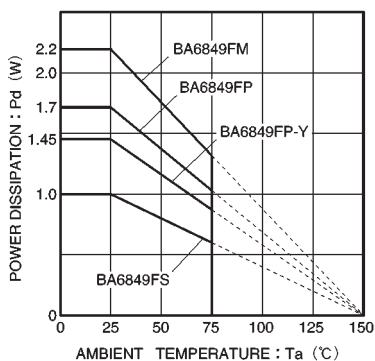


Fig.14 Package derating characteristics

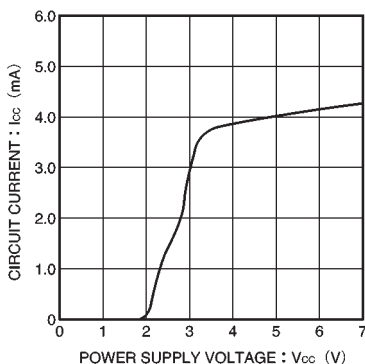


Fig.15 Power supply current vs. power supply voltage

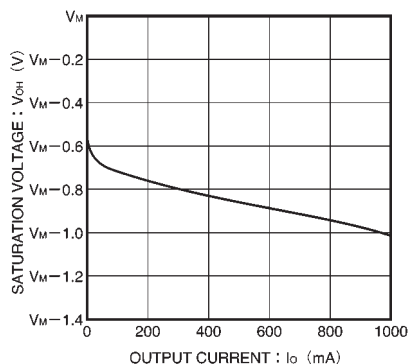


Fig.16 Upper-side output saturation voltage vs. output current

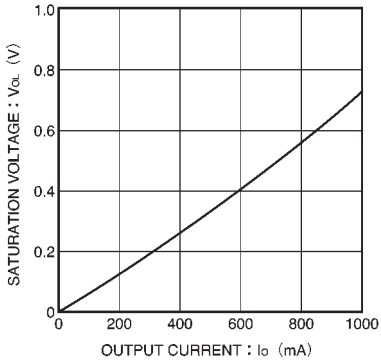
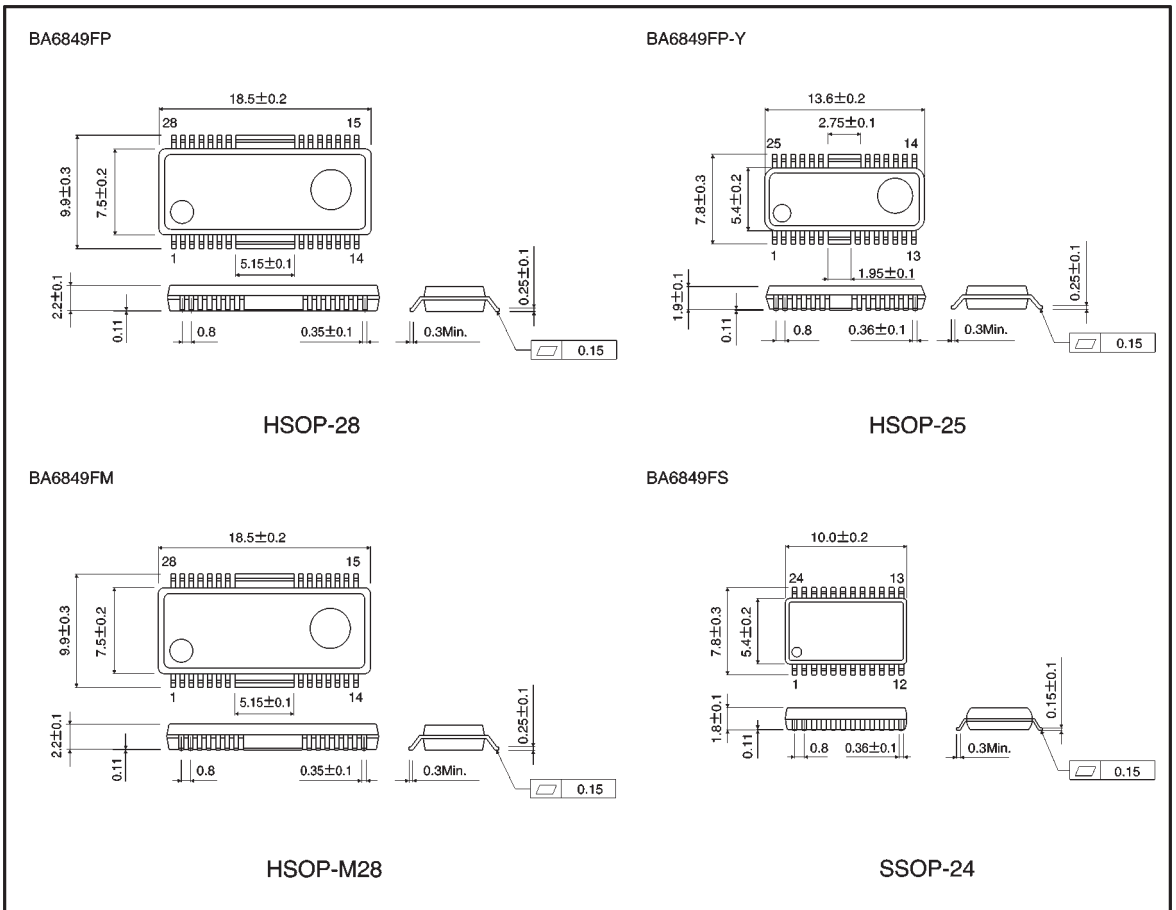


Fig.17 Lower-side output saturation voltage vs. output current

● External dimensions (Units: mm)



ROHM-logo

**Product Designation**

- **When ordering, specify the part number.**
- **Check each code against the tables shown below.**
- **Fill in from the left, leaving any extra boxes empty on the right.**

Product Designation

**Ordering information**

**Packing and forming information only required for SOP, and QFP parts that are required in tape and reel containers. For example, to order part BA4558F on paper tape type E2, order number is BA4558F-E2, when required in tube container, order number is BA4558F.**

| <input checked="" type="checkbox"/> Quick reference of packaging specifications |                |                              |
|---|----------------|------------------------------|
| Package   | Container type | Packaging specification code |
| DIP/SDIP  | Tube container |                              |
| SIP/HSIP/ZIP/SZIP/RSIP-A3   | Tube container |                              |
| SOP/SSOP/HSOP/WSOP-10/WSOP-L10  | Tube container |                              |
|   | Embossed tape  | E1, E2                       |

|                                     |                        |  |
|-------------------------------------|------------------------|--|
| <b>SSOP-A54</b>                     | <b>Embossed tape</b>   | <b>E2</b>  |
| <b>QFP/SQFP/VQFP/UQFP/TQFP/PBGA</b> | <b>Tray</b>            |  |
|                                     | <b>Tray (dry pack)</b> | <b>VP</b>  |
|                                     | <b>Embossed tape</b>   | <b>E1, E2</b>  |
| <b>TO220FP</b>                      | <b>Bulk</b>            |  |
|                                     | <b>Tube container</b>  |  |
| <b>SMP5</b>                         | <b>Embossed tape</b>   | <b>TL, TR</b>  |
| <b>TO252</b>                        | <b>Embossed tape</b>   | <b>E1, E2</b>  |
| <b>RSLP8</b>                        | <b>Embossed tape</b>   | <b>E2(Sprocket 1pin, Horizontal)</b>                               |
| <b>RSIP13</b>                       | <b>Embossed tape</b>   | <b>E2(Sprocket 1pin, Horizontal), E4 (Sprocket 1pin, Vertical)</b> |

**Note: SOP type can be delivered in tube, paper tape, or embossed tape.**

---

[BGA/CSP package](#) | [SIP/ZIP package](#)

[QFP package](#) | [Photo package](#)

[SOP package](#) | **Product Designation**

[DIP package](#) | [Packaging Specification](#)

---

[\[LSI Package Assemblies\]](#)

---

[\[HOME | Selection Guide\]](#)