

## System Motor Driver ICs for CD/DVD Players

# 1ch Spindle Motor Driver ICs



BA6859AFP-Y, BA6664FM, BD6671FM

No.10011EAT03

## ●Description

ROHM's spindle motor drivers incorporate the 3-phase full-wave pseudo-linear drive system (BA6859AFP-Y, BA6664FM) and 180° electrifying direct PWM drive system (BD6671FM). Smooth rotation characteristic performance is ensured. Besides, high torque is provided in a wide output range because the output stage incorporates low-saturation voltage NPN transistors (BA6859AFP-Y, BA6664FM) and low-power consumption MOSFET (BD6671FM).

## ●Features

- 1) 3-phase full-wave pseudo-linear system (BA6859AFP-Y, BA6664FM)
- 2) 180° electrifying direct drive PWM system (BD6671FM)
- 3) Power saving, TSD (thermal shutdown) functions built in
- 4) Current limiting, Hall bias circuit built in
- 5) FG output built in
- 6) 3-phase component FG output built in (BA6664FM, BD6671FM)
- 7) Circuit direction detection function built in (BA6859AFP-Y, BA6664FM)
- 8) Reverse rotation prevention circuit built in
- 9) Short brake pin built in (BA6859AFP-Y, BA6664FM)
- 10) Brake mode selection pin built in (BA6859AFP-Y, BD6671FM)
- 11) Supports DSP 3.3 V

## ●Applications

Used for car, CD and DVD players incorporating changer function

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

| Parameter             | Symbol            | Ratings            |                    |                    | Unit |
|-----------------------|-------------------|--------------------|--------------------|--------------------|------|
|                       |                   | BA6859AFP-Y        | BA6664FM           | BD6671FM           |      |
| Applied voltage       | V <sub>CC</sub>   | 7                  | 7                  | 7                  | V    |
| Applied voltage       | V <sub>M</sub>    | 15                 | 15                 | 15                 | V    |
| Applied voltage       | V <sub>G</sub>    | -                  | -                  | 20                 | V    |
| Power dissipation     | P <sub>d</sub>    | 1450 <sup>*1</sup> | 2200 <sup>*2</sup> | 2200 <sup>*2</sup> | mW   |
| Operating temperature | T <sub>opr</sub>  | -40~+85            | -40~+85            | -40~+85            | °C   |
| Storage temperature   | T <sub>stg</sub>  | -55~+150           | -55~+150           | -55~+150           | °C   |
| Output current        | I <sub>out</sub>  | 1300               | 1300               | 2500               | mA   |
| Junction temperature  | T <sub>jmax</sub> | 150                | 150                | 150                | °C   |

\*1 Reduced by 11.6 mW/°C over 25°C, when mounted on a glass epoxy board (70 mm x 70 mm x 1.6 mm).

\*2 Reduced by 17.6 mW/°C over 25°C, when mounted on a glass epoxy board (70 mm x 70 mm x 1.6 mm).

## ●Line up matrix

| Parameter            | Symbol          | Ratings     |          |          | Unit |
|----------------------|-----------------|-------------|----------|----------|------|
|                      |                 | BA6859AFP-Y | BA6664FM | BD6671FM |      |
| Power supply voltage | V <sub>CC</sub> | 4.5~5.5     | 4.5~5.5  | 4.5~5.5  | V    |
|                      | V <sub>M</sub>  | 3.0~14      | 3.0~14   | 4.0~13.2 | V    |
| VG pin voltage       | V <sub>G</sub>  | -           | -        | 8.5~19   | V    |

# ●Electrical characteristics

 1) BA6859AFP-Y (Unless otherwise specified,  $T_a=25^{\circ}\text{C}$ ,  $V_{CC}=5.0\text{V}$ ,  $V_M=12\text{V}$ )

| Parameter                            | Symbol                           | Limits |      |      | Unit | Conditions                                |
|--------------------------------------|----------------------------------|--------|------|------|------|-------------------------------------------|
|                                      |                                  | Min.   | Typ. | Max. |      |                                           |
| <Total device>                       |                                  |        |      |      |      |                                           |
| Circuit current 1                    | I <sub>CC1</sub>                 | —      | 0    | 0.2  | mA   | PS=L                                      |
| Circuit current 2                    | I <sub>CC2</sub>                 | —      | 5.0  | 7.5  | mA   | PS=H                                      |
| <Power-saving >                      |                                  |        |      |      |      |                                           |
| ON voltage range                     | V <sub>PSON</sub>                | —      | —    | 1.0  | V    | Internal circuit OFF                      |
| OFF voltage range                    | V <sub>PSOFF</sub>               | 2.5    | —    | —    | V    | Internal circuit ON                       |
| <Hall bias>                          |                                  |        |      |      |      |                                           |
| Hall bias voltage                    | V <sub>HB</sub>                  | 0.5    | 0.9  | 1.5  | V    | I <sub>HB</sub> =10mA                     |
| <Hall amp>                           |                                  |        |      |      |      |                                           |
| Input bias current                   | I <sub>HA</sub>                  | —      | 0.7  | 3.0  | μA   |                                           |
| Same phase input voltage range       | V <sub>HAR</sub>                 | 1.0    | —    | 4.0  | V    |                                           |
| Mini. input level                    | V <sub>INH</sub>                 | 50     | —    | —    | mVpp | One side input level                      |
| H3 hysteresis level                  | V <sub>HYS</sub>                 | 5      | 20   | 40   | mV   |                                           |
| <Torque Command >                    |                                  |        |      |      |      |                                           |
| Input voltage range                  | E <sub>C</sub> , E <sub>CR</sub> | 0      | —    | 5    | V    | Linear range:0.5~3.3V                     |
| Offset voltage -                     | E <sub>COFF-</sub>               | -80    | -50  | -20  | mV   | E <sub>CR</sub> =1.9V                     |
| Offset voltage +                     | E <sub>COFF+</sub>               | 20     | 50   | 80   | mV   | E <sub>CR</sub> =1.9V                     |
| Input bias current                   | E <sub>CIN</sub>                 | -3     | —    | 3    | μA   | E <sub>C</sub> =E <sub>CR</sub>           |
| I/O gain                             | G <sub>EC</sub>                  | 0.56   | 0.70 | 0.84 | A/V  | E <sub>C</sub> =1.2, 1.7V                 |
| <FG>                                 |                                  |        |      |      |      |                                           |
| FG output high-level voltage         | V <sub>FGH</sub>                 | 4.5    | 4.8  | —    | V    | I <sub>FG</sub> =-20μA                    |
| FG output low-level voltage          | V <sub>FGL</sub>                 | —      | 0.25 | 0.4  | V    | I <sub>FG</sub> =3.0mA                    |
| Duty (reference values)              | D <sub>U</sub>                   | —      | 50   | —    | %    |                                           |
| <Rotation Detection>                 |                                  |        |      |      |      |                                           |
| FR output high-level voltage         | V <sub>FRH</sub>                 | 4.1    | 4.4  | —    | V    | I <sub>FR</sub> =-20μA                    |
| FR output low-level voltage          | V <sub>FRL</sub>                 | —      | 0.25 | 0.4  | V    | I <sub>FR</sub> =3.0mA                    |
| <Output>                             |                                  |        |      |      |      |                                           |
| Output saturation high level voltage | V <sub>OH</sub>                  | —      | 1.0  | 1.4  | V    | I <sub>O</sub> =-600mA                    |
| Output saturation low level voltage  | V <sub>OL</sub>                  | —      | 0.4  | 0.7  | V    | I <sub>O</sub> =600mA                     |
| Pre-drive current                    | I <sub>VML</sub>                 | —      | 35   | 70   | mA   | E <sub>C</sub> =0V output open            |
| Output limit current                 | I <sub>TL</sub>                  | 560    | 700  | 840  | mA   |                                           |
| <Short brake >                       |                                  |        |      |      |      |                                           |
| ON voltage range                     | V <sub>SBON</sub>                | 2.5    | —    | —    | V    | BR=0V                                     |
| OFF voltage range                    | V <sub>SBOFF</sub>               | —      | —    | 1.0  | V    | BR=0V                                     |
| <Brake mode >                        |                                  |        |      |      |      |                                           |
| ON voltage range                     | V <sub>BRON</sub>                | 2.5    | —    | —    | V    | E <sub>C</sub> >E <sub>CR</sub> , SB=Open |
| OFF voltage range                    | V <sub>BROFF</sub>               | —      | —    | 1.0  | V    | E <sub>C</sub> >E <sub>CR</sub> , SB=Open |

# ●Reference: Data

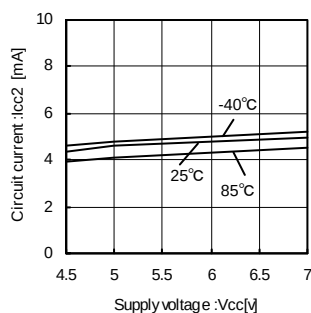


Fig.1 Circuit Current 2

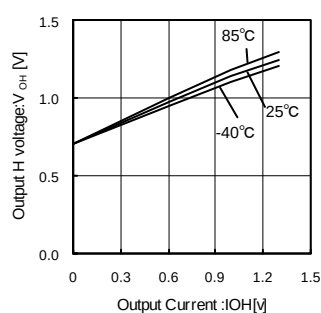


Fig.2 Output Saturation Voltage at High Level

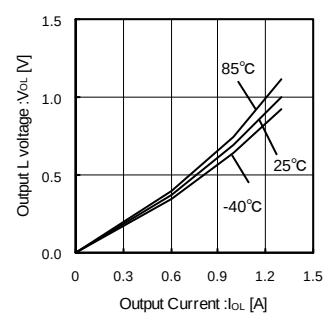


Fig.3 Output Saturation Voltage at Low Level

2) BA6664FM(Unless otherwise specified, Ta=25°C, V<sub>CC</sub>=5.0V, V<sub>M</sub>=12V)

| Parameter                            | Symbol                           | Limits |      |      | Unit | Conditions                                |
|--------------------------------------|----------------------------------|--------|------|------|------|-------------------------------------------|
|                                      |                                  | Min.   | Typ. | Max. |      |                                           |
| <Total device>                       |                                  |        |      |      |      |                                           |
| Circuit current 1                    | I <sub>CC1</sub>                 | —      | 0    | 0.2  | mA   | PS=L, GSW=Open                            |
| Circuit current 2                    | I <sub>CC2</sub>                 | —      | 6.2  | 9.1  | mA   | PS=H, GSW=Open                            |
| <Power-saving >                      |                                  |        |      |      |      |                                           |
| ON voltage range                     | V <sub>PSON</sub>                | —      | —    | 1.0  | V    | Internal current circuit OFF              |
| OFF voltage range                    | V <sub>PSOFF</sub>               | 2.5    | —    | —    | V    | Internal current circuit ON               |
| <Hall bias>                          |                                  |        |      |      |      |                                           |
| Hall bias voltage                    | V <sub>HB</sub>                  | 0.5    | 0.9  | 1.5  | V    | I <sub>HB</sub> =10mA                     |
| <Hall amp>                           |                                  |        |      |      |      |                                           |
| Input bias current                   | I <sub>HA</sub>                  | —      | 0.7  | 3.0  | μA   |                                           |
| Same phase input voltage range       | V <sub>HAR</sub>                 | 1.0    | —    | 4.0  | V    |                                           |
| Mini. input level                    | V <sub>INH</sub>                 | 50     | —    | —    | mVpp | One side input level                      |
| H3 hysteresis level                  | V <sub>HYS</sub>                 | 5      | 20   | 40   | mV   |                                           |
| <Torque Command >                    |                                  |        |      |      |      |                                           |
| Input voltage range                  | E <sub>C</sub> , E <sub>CR</sub> | 0      | —    | 5    | V    | Linear range:0.5~3.3V                     |
| Offset voltage -                     | E <sub>COFF-</sub>               | -75    | -45  | -15  | mV   | E <sub>CR</sub> =1.65V, GSW=L             |
| Offset voltage +                     | E <sub>COFF+</sub>               | 15     | 45   | 75   | mV   | E <sub>CR</sub> =1.65V, GSW=L             |
| Input bias current                   | E <sub>CIN</sub>                 | -3     | —    | 3    | μA   | E <sub>C</sub> =E <sub>CR</sub>           |
| I/O gain low-level                   | G <sub>ECL</sub>                 | 0.52   | 0.65 | 0.78 | A/V  | GSW=L,RNF=0.5 Ω                           |
| I/O gain medium-level                | G <sub>ECM</sub>                 | 1.04   | 1.3  | 1.56 | A/V  | GSW=OPEN,RNF=0.5 Ω                        |
| I/O gain high-level                  | G <sub>ECH</sub>                 | 2.24   | 2.8  | 3.36 | A/V  | GSW=H,RNF=0.5 Ω                           |
| <FG>                                 |                                  |        |      |      |      |                                           |
| FG output high-level voltage         | V <sub>FGH</sub>                 | 4.5    | 4.8  | —    | V    | I <sub>FG</sub> =-20μA                    |
| FG output low-level voltage          | V <sub>FGL</sub>                 | —      | 0.2  | 0.4  | V    | I <sub>FG</sub> =3.0mA                    |
| <FG2>                                |                                  |        |      |      |      |                                           |
| FG output high-level voltage         | V <sub>FG2H</sub>                | 4.6    | 4.9  | —    | V    | I <sub>FG2</sub> =-20μA                   |
| FG output low-level voltage          | V <sub>FG2L</sub>                | —      | 0.2  | 0.4  | V    | I <sub>FG2</sub> =3mA                     |
| <Rotation Detection>                 |                                  |        |      |      |      |                                           |
| FR output high-level voltage         | V <sub>FRH</sub>                 | 4.1    | 4.4  | —    | V    | I <sub>FR</sub> =-20μA                    |
| FR output low-level voltage          | V <sub>FRL</sub>                 | —      | 0.2  | 0.4  | V    | I <sub>FR</sub> =3.0mA                    |
| <Output>                             |                                  |        |      |      |      |                                           |
| Output saturation high-level voltage | V <sub>OH</sub>                  | —      | 1.0  | 1.35 | V    | I <sub>OUT</sub> =-600mA                  |
| Output saturation low-level voltage  | V <sub>OL</sub>                  | —      | 0.4  | 0.65 | V    | I <sub>OUT</sub> =600mA                   |
| Pre-drive current                    | I <sub>VML</sub>                 | —      | 35   | 70   | mA   | E <sub>C</sub> =0V output open            |
| Output limit current                 | I <sub>TL</sub>                  | 560    | 700  | 840  | mA   |                                           |
| <Short brake >                       |                                  |        |      |      |      |                                           |
| ON voltage range                     | V <sub>SBON</sub>                | 2.5    | —    | —    | V    | BR=0V                                     |
| OFF voltage range                    | V <sub>SBOFF</sub>               | —      | —    | 1.0  | V    | BR=0V                                     |
| <Brake mode >                        |                                  |        |      |      |      |                                           |
| ON voltage range                     | V <sub>BRON</sub>                | 2.5    | —    | —    | V    | E <sub>C</sub> >E <sub>CR</sub> , SB=Open |
| OFF voltage range                    | V <sub>BROFF</sub>               | —      | —    | 1.0  | V    | E <sub>C</sub> >E <sub>CR</sub> , SB=Open |
| <Gain switching >                    |                                  |        |      |      |      |                                           |
| Low voltage range                    | V <sub>GSWL</sub>                | —      | —    | 1.0  | V    |                                           |
| High voltage range                   | V <sub>GSWH</sub>                | 3.0    | —    | —    | V    |                                           |
| OPEN voltage                         | V <sub>GSWOP</sub>               | —      | 2.0  | —    | V    |                                           |

3) BD6671FM (Unless otherwise specified, Ta=25°C, V<sub>CC</sub>=5.0V, V<sub>M</sub>=12V)

| Parameter                         | Symbol                           | Limits |      |      | Unit | Conditions                                                |
|-----------------------------------|----------------------------------|--------|------|------|------|-----------------------------------------------------------|
|                                   |                                  | Min.   | Typ. | Max. |      |                                                           |
| <Total device>                    |                                  |        |      |      |      |                                                           |
| Circuit current 1                 | I <sub>CC1</sub>                 | —      | 100  | 200  | μA   | PS=L, GSW=Open                                            |
| Circuit current 2                 | I <sub>CC2</sub>                 | 8      | 14   | 20   | mA   | PS=H, GSW=Open                                            |
| <Power-saving >                   |                                  |        |      |      |      |                                                           |
| ON voltage range                  | V <sub>PSON</sub>                | —      | —    | 1.0  | V    | Internal current circuit OFF                              |
| OFF voltage range                 | V <sub>PSOFF</sub>               | 2.5    | —    | —    | V    | Internal current circuit ON                               |
| <Hall bias>                       |                                  |        |      |      |      |                                                           |
| Hall bias voltage                 | V <sub>HB</sub>                  | 0.7    | 1.0  | 1.3  | V    | I <sub>HB</sub> =10mA                                     |
| <Hall amp>                        |                                  |        |      |      |      |                                                           |
| Same phase input voltage range    | V <sub>HAR</sub>                 | 1.4    | —    | 3.6  | V    |                                                           |
| Mini. input level                 | V <sub>INH</sub>                 | 100    | —    | —    | mVpp | Both side input level                                     |
| Hall hysteresis level +           | V <sub>HYS+</sub>                | 5      | 20   | 40   | mV   |                                                           |
| Hall hysteresis level -           | V <sub>HYS-</sub>                | -40    | -20  | -5   | mV   |                                                           |
| <Gain switching >                 |                                  |        |      |      |      |                                                           |
| Low voltage range                 | V <sub>GSWL</sub>                | —      | —    | 0.6  | V    |                                                           |
| High voltage range                | V <sub>GSWH</sub>                | 2.0    | —    | —    | V    |                                                           |
| OPEN voltage range                | V <sub>GSWOP</sub>               | —      | 1.3  | —    | V    |                                                           |
| <Torque Command >                 |                                  |        |      |      |      |                                                           |
| Input voltage range               | E <sub>C</sub> , E <sub>CR</sub> | 0      | —    | 5    | V    | Linear range: 0.5~3.0V                                    |
| Offset voltage +                  | E <sub>COFF+</sub>               | 5      | 50   | 100  | mV   | GSW=M                                                     |
| Offset voltage -                  | E <sub>COFF-</sub>               | -100   | -50  | 5    | mV   | GSW=M                                                     |
| Input current                     | E <sub>CIN</sub>                 | -11    | -2.5 | 0    | μA   | E <sub>C</sub> =E <sub>CR</sub> =1.65V                    |
| I/O gain low-level                | G <sub>ECL</sub>                 | 0.28   | 0.35 | 0.42 | A/V  | GSW=L                                                     |
| I/O gain medium-level             | G <sub>ECM</sub>                 | 0.56   | 0.70 | 0.84 | A/V  | GSW=M                                                     |
| I/O gain high-level               | G <sub>ECH</sub>                 | 1.12   | 1.40 | 1.68 | A/V  | GSW=H                                                     |
| <Output>                          |                                  |        |      |      |      |                                                           |
| Output ON resistance              | R <sub>ON</sub>                  | —      | 1.0  | 1.35 | Ω    | I <sub>OUT</sub> =±600mA<br>(upper + lower side)          |
| Output limit current low-level    | I <sub>TLL</sub>                 | 340    | 400  | 460  | mA   | GSW=L                                                     |
| Output limit current medium-level | I <sub>TLM</sub>                 | 680    | 800  | 920  | mA   | GSW=M                                                     |
| Output limit current high-level   | I <sub>TLH</sub>                 | 1020   | 1200 | 1380 | mA   | GSW=H                                                     |
| <FG/FG3 output >                  |                                  |        |      |      |      |                                                           |
| High level voltage                | V <sub>FGH</sub>                 | 4.6    | —    | —    | V    | I <sub>FG</sub> =-100μA                                   |
| Low level voltage                 | V <sub>FGL</sub>                 | —      | —    | 0.4  | V    | I <sub>FG</sub> =+100μA                                   |
| <Booster voltage >                |                                  |        |      |      |      |                                                           |
| Charge pump output voltage        | V <sub>PUMP</sub>                | 12.5   | 17   | 19   | V    | V <sub>CC</sub> = 5V,V <sub>M</sub> =12V<br>CP1=CP2=0.1μF |
| <CP1 output >                     |                                  |        |      |      |      |                                                           |
| Upper side saturation voltage     | V <sub>CP1H</sub>                | 0.25   | 0.45 | 0.65 | V    | I <sub>CP1</sub> =-4mA                                    |
| Lower side saturation voltage     | V <sub>CP1L</sub>                | 0.2    | 0.4  | 0.6  | V    | I <sub>CP1</sub> =+4mA                                    |
| <CP2 output >                     |                                  |        |      |      |      |                                                           |
| Upper side saturation voltage     | V <sub>CP2H</sub>                | 0.4    | 0.6  | 0.8  | V    | I <sub>CP2</sub> =-4mA                                    |
| Lower side saturation voltage     | V <sub>CP2L</sub>                | 0.15   | 0.35 | 0.55 | V    | I <sub>CP2</sub> =+4mA                                    |

●Block Diagram, application Circuit Diagram and Pin Function

1)BA6859AFP-Y

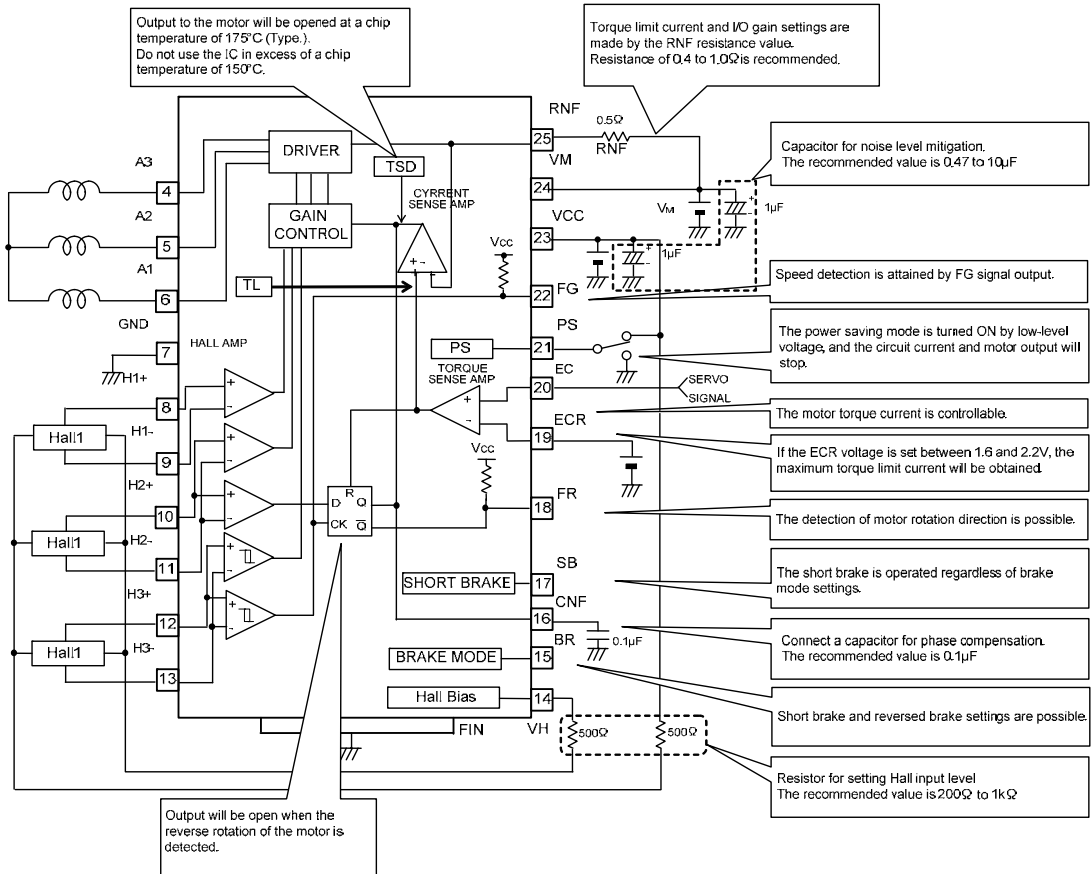


Fig.4 BA6859AFP-Y Block Diagram

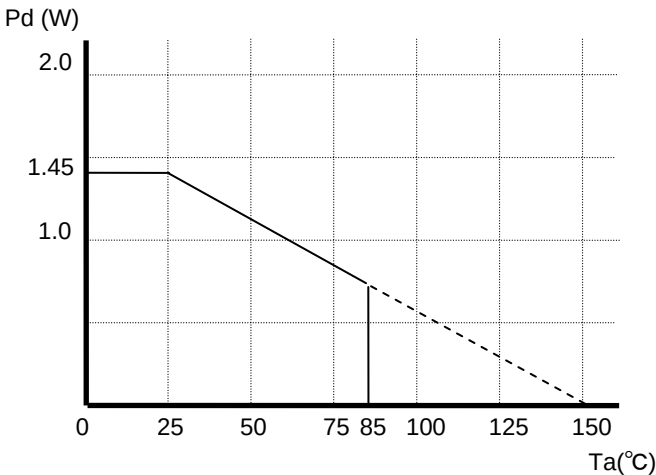


Fig.5 Power Dissipation Reduction (BA6859AFP-Y)

\* Reduced by 11.6 mW/°C over 25°C, when mounted on a glass epoxy board (70 mm x 70 mm x 1.6 mm).

BA6859AFP-Y Pin Function Table

| Pin No. | Pin name | Function                                               |
|---------|----------|--------------------------------------------------------|
| 1       | N.C.     | N.C.                                                   |
| 2       | N.C.     | N.C.                                                   |
| 3       | N.C.     | N.C.                                                   |
| 4       | A3       | Output pin                                             |
| 5       | A2       | Output pin                                             |
| 6       | A1       | Output pin                                             |
| 7       | GND      | GND pin                                                |
| 8       | H1+      | Hall signal input pin                                  |
| 9       | H1-      | Hall signal input pin                                  |
| 10      | H2+      | Hall signal input pin                                  |
| 11      | H2-      | Hall signal input pin                                  |
| 12      | H3+      | Hall signal input pin                                  |
| 13      | H3-      | Hall signal input pin                                  |
| 14      | VH       | Hall bias input pin                                    |
| 15      | BR       | Brake mode selection pin                               |
| 16      | CNF      | Capacitor connection pin for phase compensation        |
| 17      | SB       | Short brake pin                                        |
| 18      | FR       | Rotation detection pin                                 |
| 19      | ECR      | Output voltage control reference pin                   |
| 20      | EC       | Output voltage control pin                             |
| 21      | PS       | Power-saving pin                                       |
| 22      | FG       | FG signal output pin                                   |
| 23      | VCC      | Power supply pin                                       |
| 24      | VM       | Motor power supply pin                                 |
| 25      | RNF      | Resistance connection pin for output current detection |
| FIN     | FIN      | GND                                                    |

2)BA6664FM

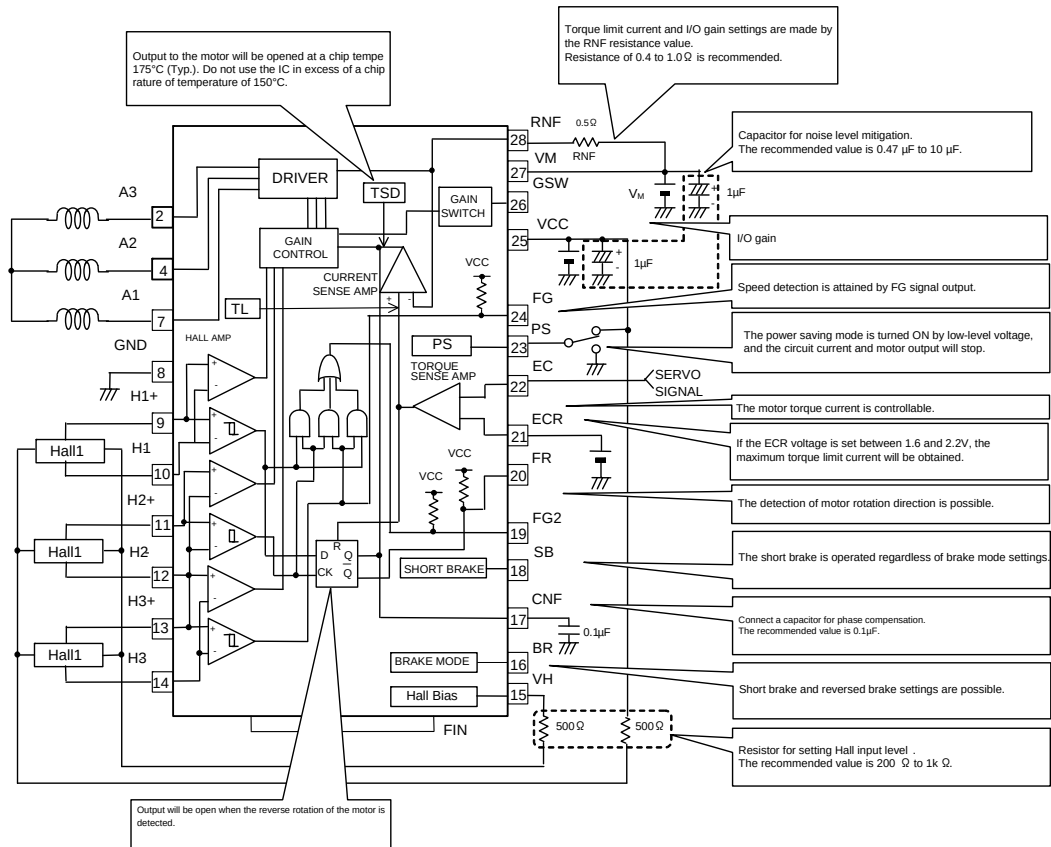


Fig.6 BA6664FM Block Diagram

BA6664FM Pin Function Table

| Pin No. | Pin name | Function                                               |
|---------|----------|--------------------------------------------------------|
| 1       | N.C.     | N.C.                                                   |
| 2       | A3       | Output pin                                             |
| 3       | N.C.     | N.C.                                                   |
| 4       | A2       | Output pin                                             |
| 5       | N.C.     | N.C.                                                   |
| 6       | N.C.     | N.C.                                                   |
| 7       | A1       | Output pin                                             |
| 8       | GND      | GND pin                                                |
| 9       | H1+      | Hall signal input pin                                  |
| 10      | H1-      | Hall signal input pin                                  |
| 11      | H2+      | Hall signal input pin                                  |
| 12      | H2-      | Hall signal input pin                                  |
| 13      | H3+      | Hall signal input pin                                  |
| 14      | H3-      | Hall signal input pin                                  |
| 15      | VH       | Hall bias input pin                                    |
| 16      | BR       | Brake mode pin                                         |
| 17      | CNF      | Capacitor connection pin for phase compensation        |
| 18      | SB       | Short brake pin                                        |
| 19      | FG2      | FG 3-phase component output pin                        |
| 20      | FR       | Rotation detection pin                                 |
| 21      | ECR      | Output voltage control reference pin                   |
| 22      | EC       | Output voltage control pin                             |
| 23      | PS       | Power-saving pin                                       |
| 24      | FG       | FG signal output pin                                   |
| 25      | VCC      | Power supply pin                                       |
| 26      | GSW      | Gain switching pin                                     |
| 27      | VM       | Motor power supply pin                                 |
| 28      | RNF      | Resistance connection pin for output current detection |
| FIN     | FIN      | GND                                                    |

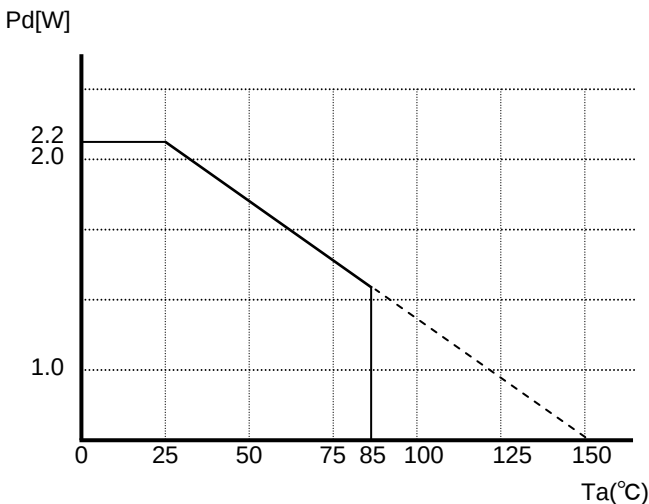


Fig.7 Power Dissipation Reduction (BA6664FM, BD6671FM)

\*Reduced by 11.6 mW/°C over 25°C, when mounted on a glass epoxy board (70 mm x 70 mm x 1.6 mm).

## 3)BD6671FM

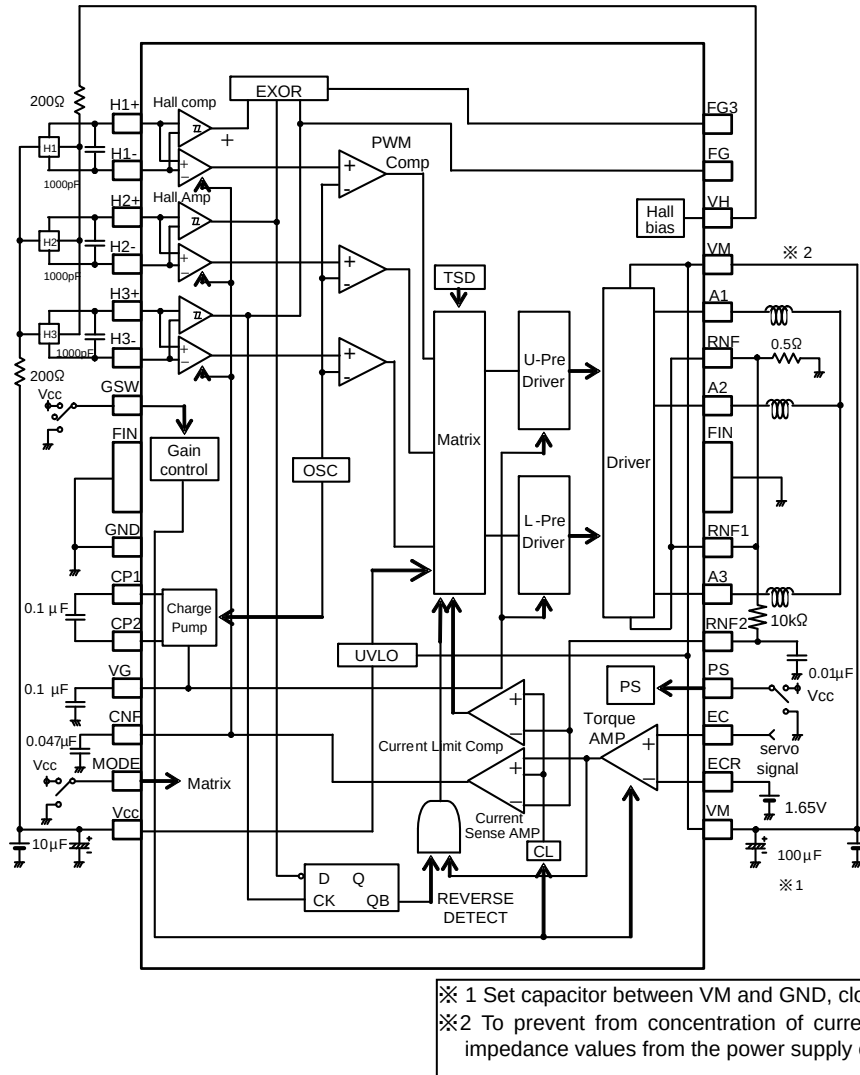


Fig.8 BD6671FM Block Diagram

## BD6671FM Pin Function

| Pin No | Pin name | Function                                        | Pin No | Pin name | Function                                               |
|--------|----------|-------------------------------------------------|--------|----------|--------------------------------------------------------|
| 1      | H1+      | Hall signal input pin                           | 15     | VM       | Motor power supply pin                                 |
| 2      | H1-      | Hall signal input pin                           | 16     | ECR      | Output voltage control reference pin                   |
| 3      | H2+      | Hall signal input pin                           | 17     | EC       | Output voltage control pin                             |
| 4      | H2-      | Hall signal input pin                           | 18     | PS       | Power-saving pin                                       |
| 5      | H3+      | Hall signal input pin                           | 19     | RNF2     | Resistance connection pin for output current detection |
| 6      | H3-      | Hall signal input pin                           | 20     | A3       | Output pin                                             |
| 7      | GSW      | Gain switching pin                              | 21     | RNF1     | Resistance connection pin for output current detection |
| 8      | GND      | GND                                             | 22     | A2       | Output pin                                             |
| 9      | CP1      | Charge pump capacity connection pin 1           | 23     | RNF1     | Resistance connection for output current               |
| 10     | CP2      | Charge pump capacity connection pin 2           | 24     | A1       | Output pin                                             |
| 11     | VG       | Charge pump output pin                          | 25     | VM       | Motor power supply pin                                 |
| 12     | CNF      | Capacitor connection pin for phase compensation | 26     | VH       | Hall bias pin                                          |
| 13     | MODE     | Brake mode switching pin                        | 27     | FG       | FG Output pin                                          |
| 14     | VCC      | Power supply pin                                | 28     | FG3      | FG3 Output pin                                         |
|        |          |                                                 | FIN    | FIN      | GND                                                    |

\*Heat radiation FIN: GND

## ● I/O logic

## 1) BA6859AFP-Y

| Input conditions |         |         |         |         |         |         | Output conditions |    |    |                  |    |    |
|------------------|---------|---------|---------|---------|---------|---------|-------------------|----|----|------------------|----|----|
|                  |         |         |         |         |         |         | Forward rotation  |    |    | Reverse rotation |    |    |
| Pin. No          | 8       | 9       | 10      | 11      | 12      | 13      | 6                 | 5  | 4  | 6                | 5  | 4  |
|                  | H1<br>+ | H1<br>- | H2<br>+ | H2<br>- | H3<br>+ | H3<br>- | A1                | A2 | A3 | A1               | A2 | A3 |
| 1                | L       | M       | H       | M       | M       | M       | H                 | L  | L  | L                | H  | H  |
| 2                | H       | M       | L       | M       | M       | M       | L                 | H  | H  | H                | L  | L  |
| 3                | M       | M       | L       | M       | H       | M       | L                 | H  | L  | H                | L  | H  |
| 4                | M       | M       | H       | M       | L       | M       | H                 | L  | H  | L                | H  | L  |
| 5                | H       | M       | M       | M       | L       | M       | L                 | L  | H  | H                | H  | L  |
| 6                | L       | M       | M       | M       | H       | M       | H                 | H  | L  | L                | L  | H  |

Input voltage  
Hi=2.6V  
Mid=2.5V  
Low=2.4V

Note: Forward rotation EC<ECR  
Reverse rotation EC>ECR

## 2) BA6664FM

| Input conditions |         |         |         |         |         |         | Output conditions |    |    |                  |    |    |
|------------------|---------|---------|---------|---------|---------|---------|-------------------|----|----|------------------|----|----|
|                  |         |         |         |         |         |         | Forward rotation  |    |    | Reverse rotation |    |    |
| Pin. No          | 9       | 10      | 11      | 12      | 13      | 14      | 7                 | 4  | 2  | 7                | 4  | 2  |
|                  | H1<br>+ | H1<br>- | H2<br>+ | H2<br>- | H3<br>+ | H3<br>- | A1                | A2 | A3 | A1               | A2 | A3 |
| 1                | L       | M       | H       | M       | M       | M       | H                 | L  | L  | L                | H  | H  |
| 2                | H       | M       | L       | M       | M       | M       | L                 | H  | H  | H                | L  | L  |
| 3                | M       | M       | L       | M       | H       | M       | L                 | H  | L  | H                | L  | H  |
| 4                | M       | M       | H       | M       | L       | M       | H                 | L  | H  | L                | H  | L  |
| 5                | H       | M       | M       | M       | L       | M       | L                 | L  | H  | H                | H  | L  |
| 6                | L       | M       | M       | M       | H       | M       | H                 | H  | L  | L                | L  | H  |

Input voltage  
Hi=2.6V  
Mid=2.5V  
Low=2.4V

Note: Forward rotation EC<ECR  
Reverse rotation EC>ECR

## 3) BD6671FM

| Input conditions |         |         |         |         |         |         | Output conditions |    |    |                           |    |    |                           |    |    |
|------------------|---------|---------|---------|---------|---------|---------|-------------------|----|----|---------------------------|----|----|---------------------------|----|----|
|                  |         |         |         |         |         |         | Forward rotation  |    |    | Reverse rotation (MODE=L) |    |    | Reverse rotation (MODE=H) |    |    |
| Pin. No          | 1       | 2       | 3       | 4       | 5       | 6       | 24                | 22 | 20 | 24                        | 22 | 20 | 24                        | 22 | 20 |
|                  | H1<br>+ | H1<br>- | H2<br>+ | H2<br>- | H3<br>+ | H3<br>- | A1                | A2 | A3 | A1                        | A2 | A3 | A1                        | A2 | A3 |
| 1                | L       | M       | H       | M       | M       | M       | H                 | L  | L  | L                         | H  | H  | L                         | L  | L  |
| 2                | H       | M       | L       | M       | M       | M       | L                 | H  | H  | H                         | L  | L  | L                         | L  | L  |
| 3                | M       | M       | L       | M       | H       | M       | L                 | H  | L  | H                         | L  | H  | L                         | L  | L  |
| 4                | M       | M       | H       | M       | L       | M       | H                 | L  | H  | L                         | H  | L  | L                         | L  | L  |
| 5                | H       | M       | M       | M       | L       | M       | L                 | L  | H  | H                         | H  | L  | L                         | L  | L  |
| 6                | L       | M       | M       | M       | H       | M       | H                 | H  | L  | L                         | L  | H  | L                         | L  | L  |

Input voltage  
Hi=2.6V  
Mid=2.5V  
Low=2.4V

Note: Forward rotation EC<ECR  
Reverse rotation EC>ECR



● I/O Timing Chart

1) BA6859AFP-Y, BA6664FM

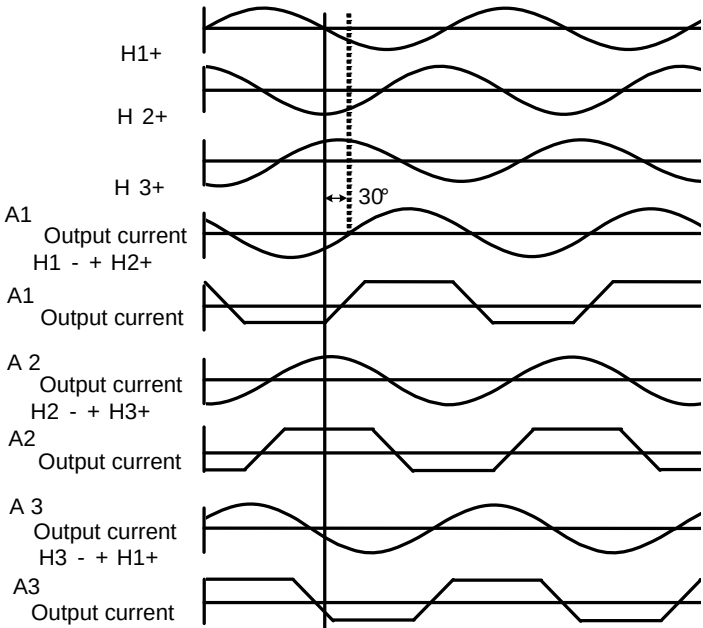


Fig. 9

2) BD6671FM

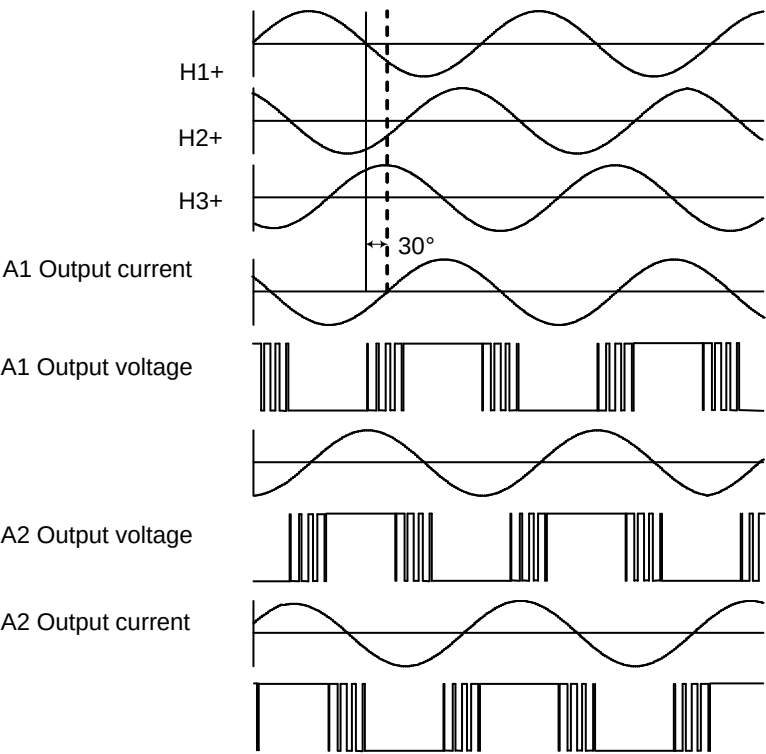
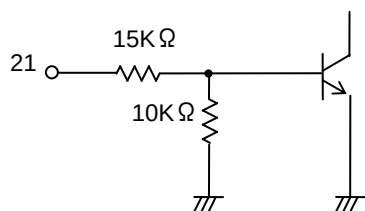


Fig. 10

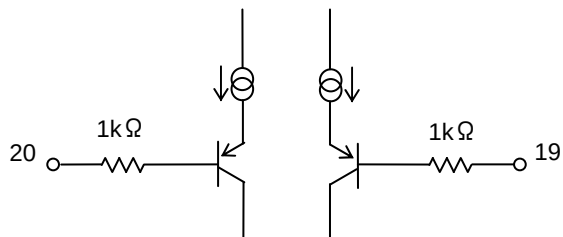
## ● I/O Circuit

## 1) BA6859AFP-Y

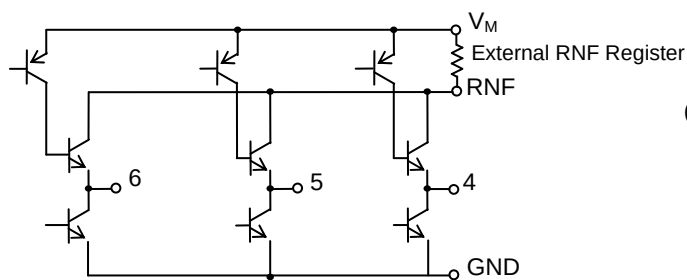
## (1) Power saving (pin 21)



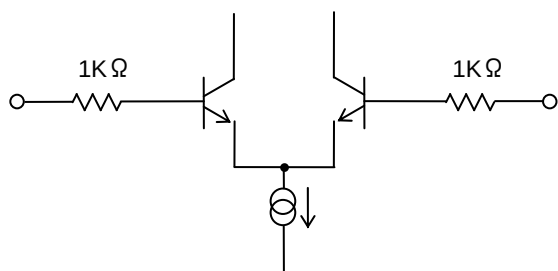
## (2) Torque command input (pin 19, pin 20)



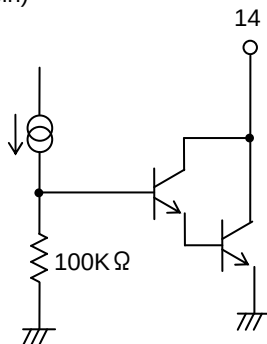
## (3) Coil output (A1: pin 6, A2: pin 5, A3: pin 4)



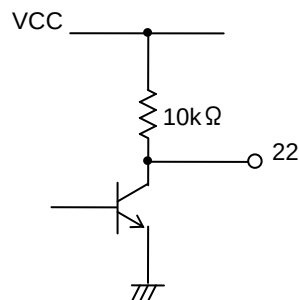
## (4) Hall input (H1+ : 8 pin, H1- : 9 pin, H2+ : 10 pin, H2- : 11 pin, H3+ : 12 pin, H3- : 13 pin)



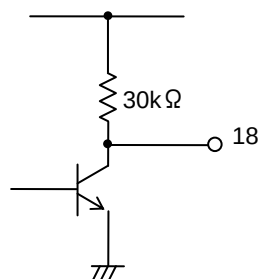
## (5) Hall bias (14 pin)



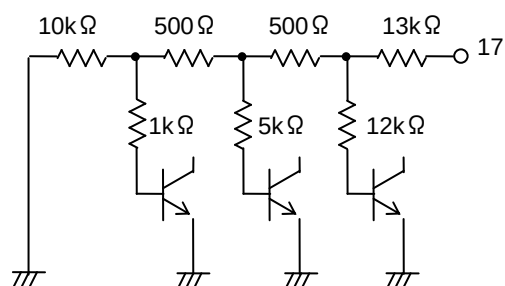
## (6) FG output (pin 22)



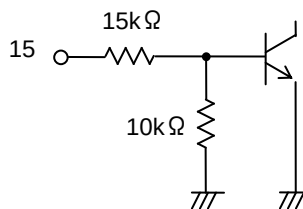
## (7) FR output (pin 18)



## (8) Short brake (17 pin)

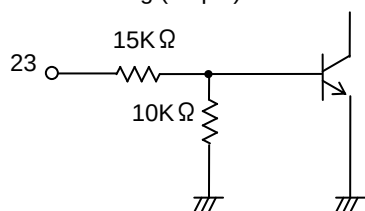


## (9) Brake mode (15 pin)

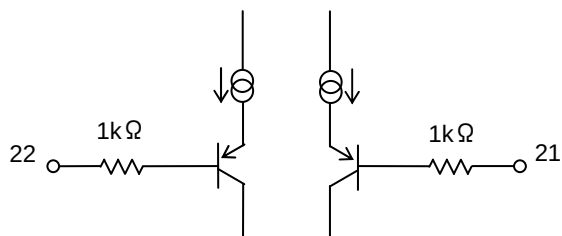


## 2) BA6664FM

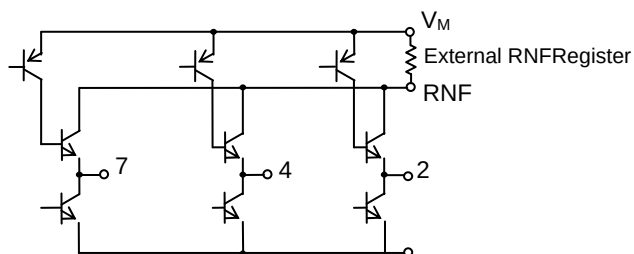
## (1) Power saving (23 pin)



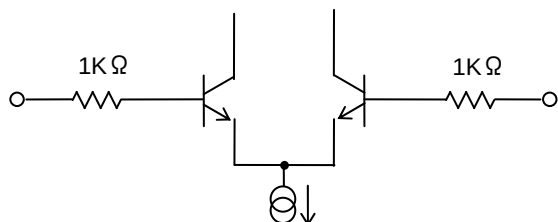
## (2) Torque command input (21 pin, 22 pin)



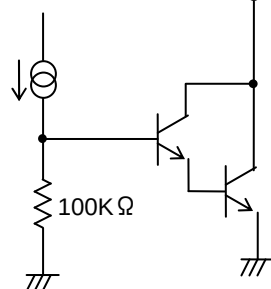
## (3) Coil output (A1 : 7 pin, A2 : 4 pin, A3 : 2 pin)



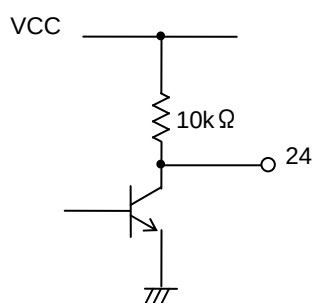
## (4) Hall input (H1+ : 9 pin, H1- : 10 pin, H2+ : 11 pin, H2- : 12 pin, H3+ : 13 pin, H3- : 14 pin)



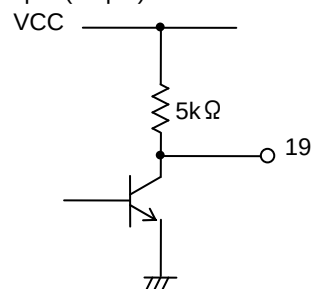
## (5) Hall bias (15 pin)



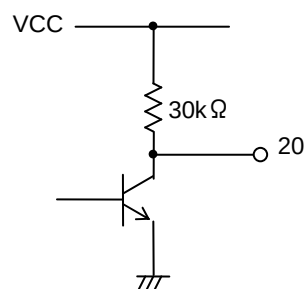
## (6) FG output (24 pin)



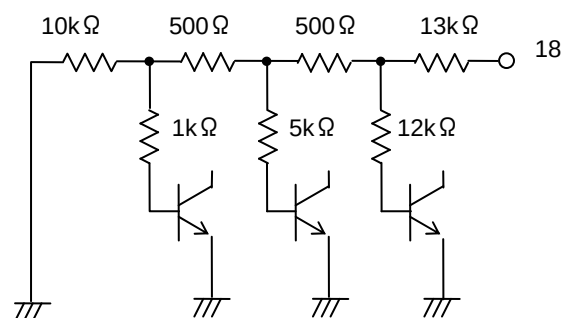
## (7) FG output (19 pin)



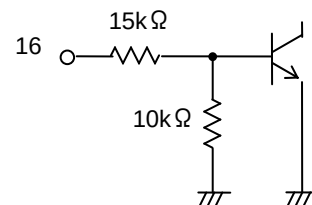
## (8) FR output (20 pin)



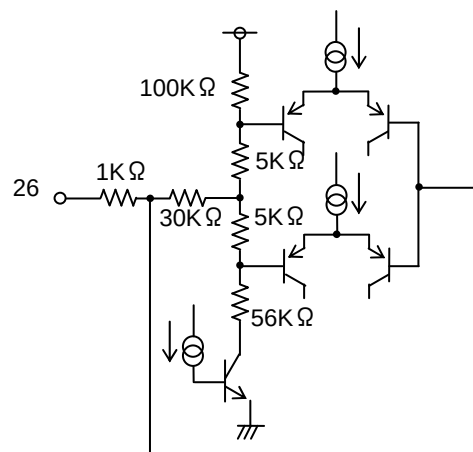
## (9) Short Brake mode (18 pin)



## (10) Brake mode (16 pin)

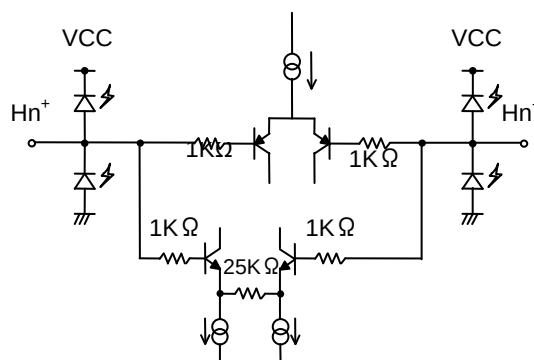


## (11) Gain switch (26 pin)

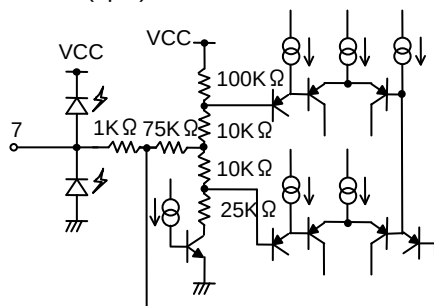


## 3) BD6671FM

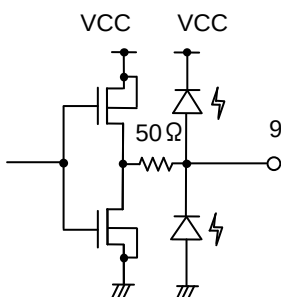
(1) Hall input (H1 : 1 pin, H1- : 2 pin, H2+ : 3 pin, H2- : 4 pin, H3+ : 5 pin, H3- : 6 pin)



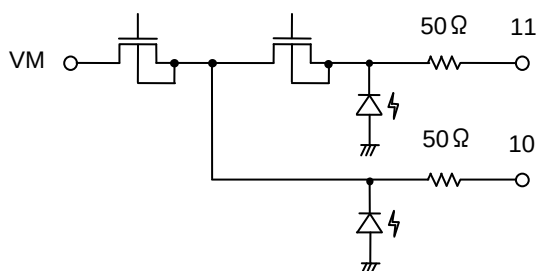
(2) Gain switch (7pin)



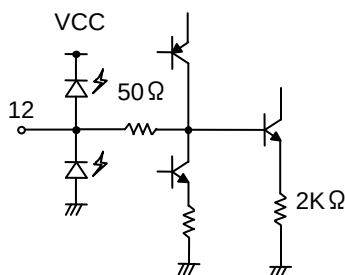
(3) CP1 output (9pin)



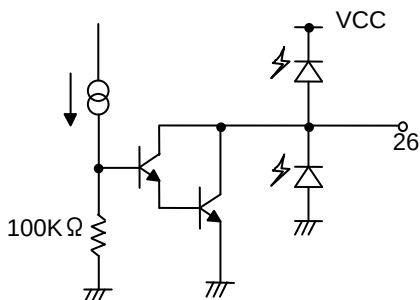
(4) CP2 / VG output (CP2 : 10 pin, VG : 11 pin)



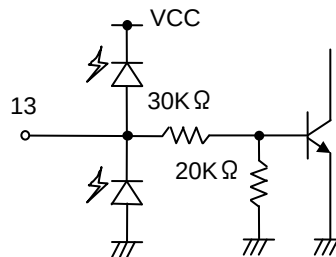
(5) CNF pin (12 pin)



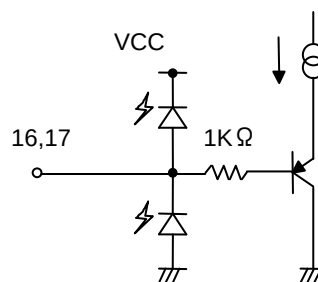
(11) Hall bias (26 pin)



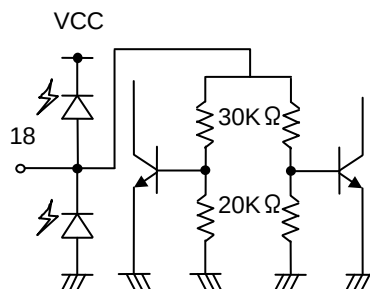
(6) Brake mode selection pin (13 pin)



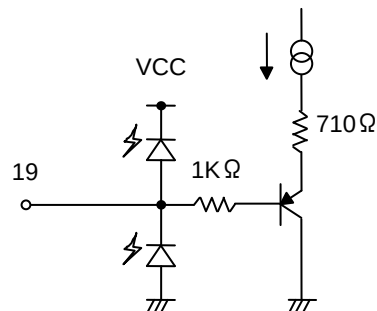
(7) Torque amp (ECR : 16 pin, EC : 17 pin)



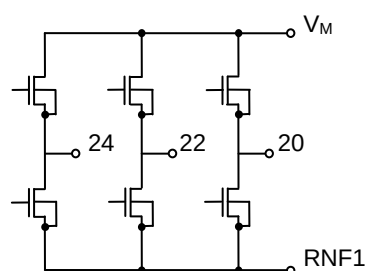
(8) Power saving (18 pin)



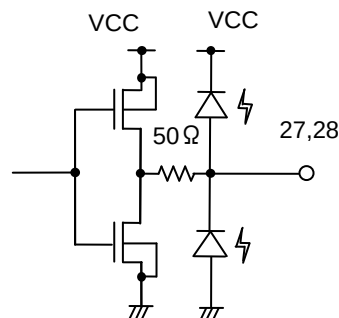
(9) RNF2 (19 pin)



(10) Output pin (A1 : 24 pin, A2 : 22 pin, A3 : 20 pin)



(12) FG / FG3 output (FG : 27 pin, FG3 : 28 pin)



●Operation Explanation  
●Torque Command

|        | Rotation direction |
|--------|--------------------|
| EC<ECR | Forward            |
| EC>ECR | Reverse*           |

\*Stops after detecting reverse rotation

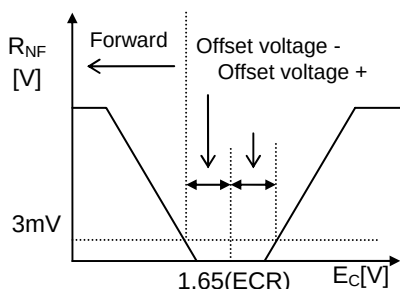


Fig.11

The I/O gain  $G_{EC}$  from the EC pin to the RNF pin (output current) is determined by the RNF detection resistor.

①(BA6859AFP-Y)

$$G_{EC} = 0.35/RNF [A/V] \dots\dots(1)$$

②(BA6664FM)

$$G_{ECL} = 0.325/RNF [A/V] (GSW=L)$$

$$G_{ECM} = 0.60/RNF [A/V] (GSW=OPEN)$$

$$G_{ECH} = 1.4/RNF [A/V] (GSW=H)$$

③(BD6671FM)

$$G_{ECL} = 0.175/RNF [A/V] (GSW=L)$$

$$G_{ECM} = 0.35/RNF [A/V] (GSW=M)$$

$$G_{ECH} = 0.70/RNF [A/V] (GSW=H)$$

④The following torque limit current ITL is obtained (BA6859AFP-Y, BA6664FM)

$$I_{TL} = 0.35/RNF [A] \dots\dots\dots(2)$$

⑤(BD6671FM)

$$I_{TLL} = 0.2/RNF [A] (GSW=L)$$

$$I_{TLM} = 0.4/RNF [A] (GSW=M)$$

$$I_{TLH} = 0.6/RNF [A] (GSW=H)$$

The value will become smaller than the computed value due to the wiring capacity and other factors, if the RNF resistance is  $0.5\Omega$  or below.

●Set-up of Motor Rotation Direction and Voltage Range of Torque Control Reference Terminal.

The motor rotation direction determined by the torque control terminal voltage EC and the torque control reference terminal voltage ECR

| Torque control input voltage | Rotation direction |
|------------------------------|--------------------|
| EC<ECR                       | Forward torque     |
| EC>ECR                       | Reverse torque     |

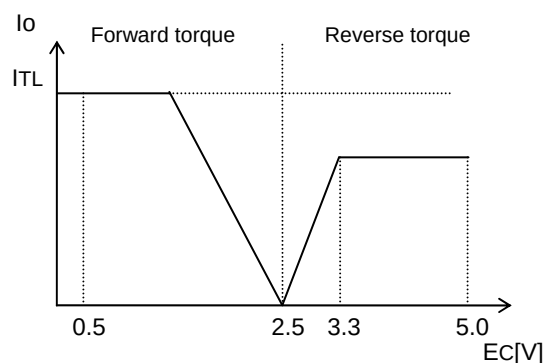


Fig.12

The relation between the input gain and torque limit current expressed as (1) and (2) discussed previously is only valid when EC and ECR are within a range from 0.5V to 3.3V. Depending on how the torque control reference terminal voltage, ECR is specified, there may be a case when the output current for the motor does not go up to the torque limit value. Please be aware of this voltage range when specifying the ECR voltage.

For BA6859AFP-Y, BA6664FM and BD6671FM, 1.6V~2.2V is recommended.

If above conditions are understood, the voltage input range to the EC and ECR terminals can be from 0V to VCC.

●Power Saving

The input circuit specified in I/O circuit 1) BA6859AFP-Y (1) is used for power saving input.

The power saving pin has a temperature characteristic of approximately  $-5\text{ mV}/^\circ\text{C}$  and also the built-in resistors has a dispersion of 30%. Keep the input voltage range in mind.

### ●Reverse Rotation Detection Function

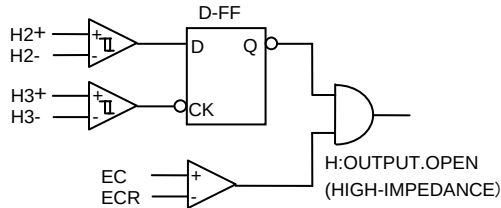


Fig.13

Fig. 13 shows the construction of the reverse rotation detection circuit.

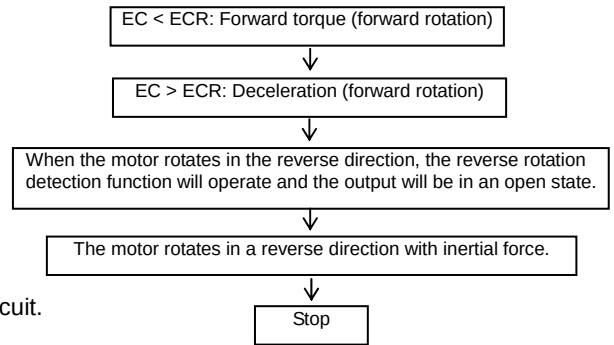
- Forward rotation ( $EC < ECR$ )

Fig. 9 shows the phase relation of the H2+ and H3+ Hall input signals, in which case the reverse rotation detection circuit will not work.

- Reverse rotation ( $EC > ECR$ )

The phase relation of the H2+ and H3+ signals are opposite to that when the motor is rotating in the forward direction. Therefore, the reverse rotation detection circuit operates, and the output is turned off and open.

#### Actual motor rotation at reverse detection



### ●FR Signal Output (BA6859AFP-Y, BA6664FM)

FR output signal pin outputs the FR signal of low(L) or high(H) after detecting the motor rotation direction.

| Motor rotation direction | FR signal output |
|--------------------------|------------------|
| Forward                  | "H"              |
| Reverse                  | "L"              |

### ●Brake Mode Change (BA6664FM, BD6671FM)

By applying high-level voltage to the BR pin, the brake mode for the following condition can be changed:  $EC > ECR$ .

|    |   | $EC < ECR$       | $EC > ECR$             |
|----|---|------------------|------------------------|
| BR | L | Forward rotation | Reverse rotation brake |
|    | H | Forward rotation | Short brake            |

When the BR pin is set to high level and used in short-brake mode, open the SB pin.

The BR pin has a temperature characteristics of approximately  $-5 \text{ mV}/^\circ\text{C}$ . Use the BR pin within the permissible input range.

### ●Short Brake (BA6859AFP-Y, BA6664FM)

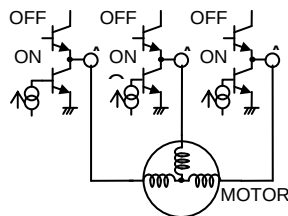


Fig.14

When the short-brake pin is set to high level, as shown in Fig.18, the output transistor (3-phase) on the high side will be turned off and the output transistor (3-phase) on the low side will be turned on. The short brake pin has a temperature characteristic of approximately  $-5 \text{ mV}/^\circ\text{C}$ . Keep the input voltage range (see Fig12) in mind.

### ●Hall Input

The Hall element allows both serial and parallel connections.

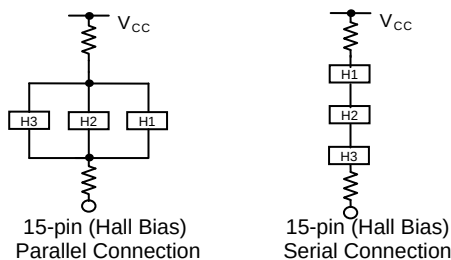


Fig.15

Set the Hall input voltage between 1.0 and 4.0 V. Compute the resistance between the VH and VCC pins in consideration of the flowing current of the Hall device.

### ●FG Signal Output / FG2 Signal Output

The FG signal output/FG2 signal output terminals are for detecting the motor rotation speed. The output frequency of FG2 signal is three times higher than the FG frequency signal output. So, it is suitable for the slow speed rotation detection. However, due to the Hall device variation and other reasons, the duty cycle may not reach 50% in some instances.

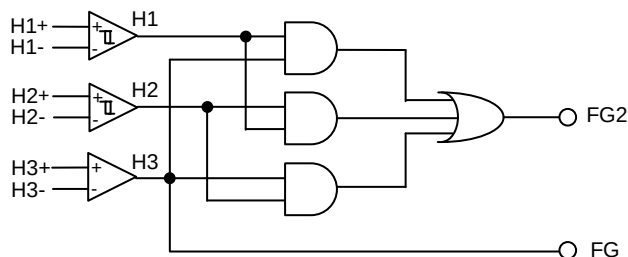


Fig. 16

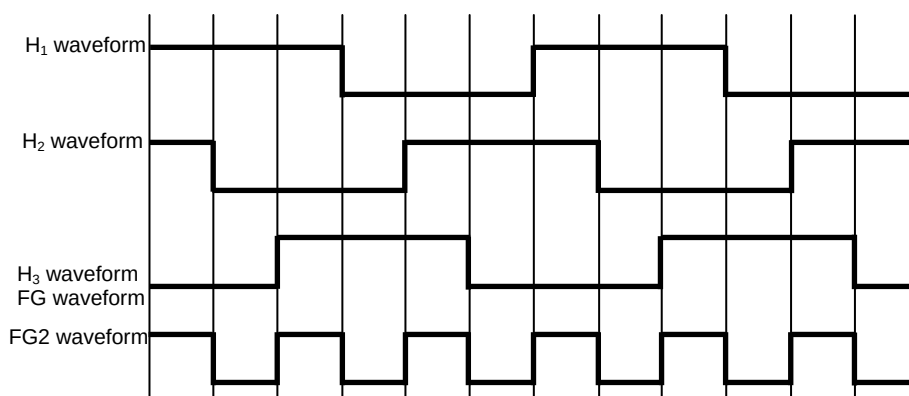


Fig. 17

### ●Notes for use

#### (1) Absolute maximum ratings

This product is subject to a strict quality management regime during its manufacture. However, damage may result if absolute maximum ratings such as applied voltage and operating temperature range are exceeded. Assumptions should not be made regarding the state of the IC (short mode or open mode) when such damage is suffered. A physical safety measure such as a fuse should be implemented when use of the IC in a special mode where the absolute maximum ratings may be exceeded is anticipated.

#### (2) Connecting the power supply connector backward

Connecting the power supply connector backwards may result in damage to the IC. Insert external diodes between the power supply and the IC's power supply pins as well as the motor coil to protect against damage from backward connections.

#### (3) Power supply lines

As return of current regenerated by back electromotive force of motor happens, take steps such as putting capacitor between power source and GND as an electric pathway for the regenerated current. Be sure that there is no problem with each property such as emptied capacity at lower temperature regarding electrolytic capacitor to decide capacity value. If the connected power supply does not have sufficient current absorption capacity, regenerative current will cause the voltage on the power supply line to rise, which combined with the product and its peripheral circuitry may exceed the absolute maximum ratings. It is recommended to implement a physical safety measure such as the insertion of a voltage clamp diode between the power supply and GND pins.

#### (4) GND potential

Ensure a minimum GND pin potential in all operating conditions.

#### (5) Setting of heat

Take the power dissipation Pd into account for practical application and make thermal design with sufficiently margined.

#### (6) Pin short and mistake fitting

Use caution when orienting and positioning the IC for mounting on printed circuit boards. Improper mounting may result in damage to the IC. Shorts between output pins or between output pins and the power supply and GND pins caused by the presence of a foreign object may result in damage to the IC.

#### (7) Actions in strong magnetic field

Use caution when using the IC in the presence of a strong magnetic field as doing so may cause the IC to malfunction.

## (8) ASO

When using the IC, set the output transistor so that it does not exceed absolute maximum ratings or ASO.

## (9) Thermal shutdown circuit (TSD)

This IC incorporates a TSD circuit. If the chip becomes the following temperature, coil output to the motor will be open. The TSD circuit is designed only to shut the IC off to prevent runaway thermal operation. It is not designed to protect the IC or guarantee its operation. Do not continue to use the IC after operating this circuit or use the IC in an environment where the operation of the TSD circuit is assumed.

|             | TSD ON temperature [°C] (typ.) | Hysteresis temperature [°C] (typ.) |
|-------------|--------------------------------|------------------------------------|
| BA6859AFP-Y | 175                            | 25                                 |
| BA6664FM    | 175                            | 15                                 |
| BD6671FM    | 170                            | 25                                 |

## (10) Regarding input pin of the IC

This monolithic IC contains P+ isolation and P substrate layers between adjacent elements in order to keep them isolated. P/N junctions are formed at the intersection of these P layers with the N layers of other elements to create a variety of parasitic elements.

For example, when the resistors and transistors are connected to the pins as shown in Fig. 18,

○The P/N junction functions as a parasitic diode

when GND > (Pin A) for the resistor or GND > (Pin B) for the transistor (NPN).

○Similarly, when GND > (Pin B) for the transistor (NPN), the parasitic diode described above combines

with the N layer of other adjacent elements to operate as a parasitic NPN transistor.

The formation of parasitic elements as a result of the relationships of the potentials of different pins is an inevitable result of the IC's architecture. The operation of parasitic elements can cause interference with circuit operation as well as IC malfunction and damage. For these reasons, it is necessary to use caution so that the IC is not used in a way that will trigger the operation of parasitic elements, such as by the application of voltages lower than the GND (P substrate) voltage to input pins.

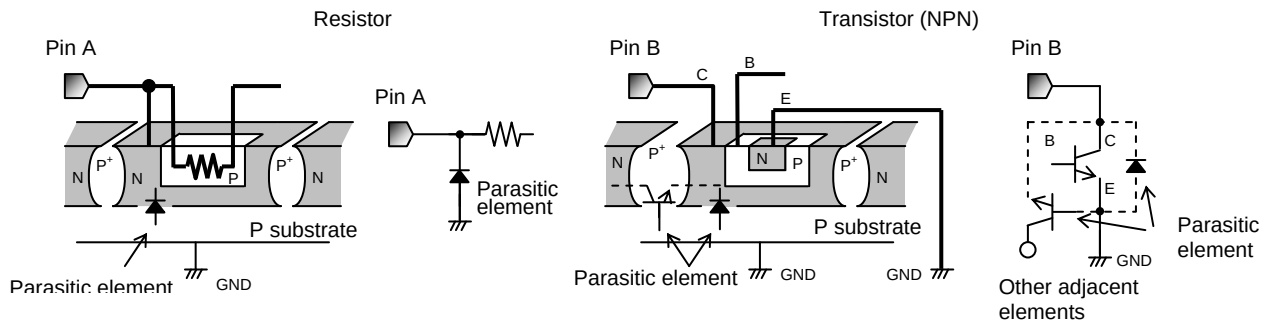


Fig.18 Example of IC structure

## (11) Testing on application boards

When testing the IC on an application board, connecting a capacitor to a pin with low impedance subjects the IC to stress. Always discharge capacitors after each process or step. Ground the IC during assembly steps as an antistatic measure, and use similar caution when transporting or storing the IC. Always turn the IC's power supply off before connecting it to or removing it from a jig or fixture during the inspection process.

## (12) Ground Wiring Pattern

When using both small signal and large current GND patterns, it is recommended to isolate the two ground patterns, placing a single ground point at the application's reference point so that the pattern wiring resistance and voltage variations caused by large currents do not cause variations in the small signal ground voltage. Be careful not to change the GND wiring pattern of any external parts, either.



|                |   |                                   |   |   |   |                                           |   |                                                                   |   |   |
|----------------|---|-----------------------------------|---|---|---|-------------------------------------------|---|-------------------------------------------------------------------|---|---|
| B              | A | 6                                 | 6 | 6 | 4 | F                                         | M | -                                                                 | E | 2 |
| Part No.<br>BA |   | Part No.<br>6859A<br>6664<br>6671 |   |   |   | Package<br>FP-Y : HSOP25<br>FM : HSOP-M28 |   | Packaging and forming specification<br>E2: Embossed tape and reel |   |   |
| BD             |   |                                   |   |   |   |                                           |   |                                                                   |   |   |

|                   |                                                                                                                                                     |
|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| Tape              | Embossed carrier tape                                                                                                                               |
| Quantity          | 2000pcs                                                                                                                                             |
| Direction of feed | E2<br>( The direction is the 1pin of product is at the upper left when you hold reel on the left hand and you pull out the tape on the right hand ) |

The diagram illustrates the physical layout of the embossed carrier tape. It shows a horizontal strip with eight rectangular components mounted on it. Each component has a wavy line representing a circuit trace and a black dot indicating a specific pin. Above each component is a small circle, likely a mounting hole. An arrow labeled "Reel" points to the left end of the tape, indicating the starting point of the feed. Another arrow labeled "Direction of feed" points to the right, showing the direction of travel. A label "1pin" with an arrow points to the first pin of the first component, which is located at the upper left corner of the component's footprint.

1pin

Direction of feed

\*Order quantity needs to be multiple of the minimum quantity

18.5±0.2  
(MAX 18.85 include BURR)

28 15

9.9±0.3

7.5±0.2

1.25

1

5.15±0.1

14

4°+6°  
-4°

0.5±0.2

1.2±0.15

0.27<sup>+0.1</sup><sub>-0.05</sub>

2.2±0.1

0.11

0.8

0.37±0.1

0.1

S

(Unit : mm)

|                   |                                                                                                                                                     |
|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| Tape              | Embossed carrier tape                                                                                                                               |
| Quantity          | 1500pcs                                                                                                                                             |
| Direction of feed | E2<br>( The direction is the 1pin of product is at the upper left when you hold reel on the left hand and you pull out the tape on the right hand ) |

The diagram illustrates the feed direction for the embossed carrier tape. It shows a horizontal strip of tape with eight components. Each component is a rectangular package with a wavy line representing a pin. An arrow labeled "1pin" points to the top-left pin of the fourth component. Another arrow labeled "Direction of feed" points to the right, indicating the direction of travel. A label "Reel" with an arrow points to the left side of the tape, indicating the starting point of the feed.

\*Order quantity needs to be multiple of the minimum quantity

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| JAPAN     | USA       | EU         | CHINA     |
|-----------|-----------|------------|-----------|
| CLASS III | CLASS III | CLASS II b | CLASS III |
| CLASS IV  |           | CLASS III  |           |

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  - Use of our Products outdoors or in places where the Products are exposed to direct sunlight or dust
  - Use of our Products in places where the Products are exposed to sea wind or corrosive gases, including Cl<sub>2</sub>, H<sub>2</sub>S, NH<sub>3</sub>, SO<sub>2</sub>, and NO<sub>2</sub>
  - Use of our Products in places where the Products are exposed to static electricity or electromagnetic waves
  - Use of our Products in proximity to heat-producing components, plastic cords, or other flammable items
  - Sealing or coating our Products with resin or other coating materials
  - Use of our Products without cleaning residue of flux (even if you use no-clean type fluxes, cleaning residue of flux is recommended); or Washing our Products by using water or water-soluble cleaning agents for cleaning residue after soldering
  - Use of the Products in places subject to dew condensation
- The Products are not subject to radiation-proof design.
- Please verify and confirm characteristics of the final or mounted products in using the Products.
- In particular, if a transient load (a large amount of load applied in a short period of time, such as pulse. is applied, confirmation of performance characteristics after on-board mounting is strongly recommended. Avoid applying power exceeding normal rated power; exceeding the power rating under steady-state loading condition may negatively affect product performance and reliability.
- De-rate Power Dissipation (Pd) depending on Ambient temperature (Ta). When used in sealed area, confirm the actual ambient temperature.
- Confirm that operation temperature is within the specified range described in the product specification.
- ROHM shall not be in any way responsible or liable for failure induced under deviant condition from what is defined in this document.

## Precaution for Mounting / Circuit board design

- When a highly active halogenous (chlorine, bromine, etc.) flux is used, the residue of flux may negatively affect product performance and reliability.
- In principle, the reflow soldering method must be used; if flow soldering method is preferred, please consult with the ROHM representative in advance.

For details, please refer to ROHM Mounting specification

## Precautions Regarding Application Examples and External Circuits

1. If change is made to the constant of an external circuit, please allow a sufficient margin considering variations of the characteristics of the Products and external components, including transient characteristics, as well as static characteristics.
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## Precaution for Electrostatic

This Product is electrostatic sensitive product, which may be damaged due to electrostatic discharge. Please take proper caution in your manufacturing process and storage so that voltage exceeding the Products maximum rating will not be applied to Products. Please take special care under dry condition (e.g. Grounding of human body / equipment / solder iron, isolation from charged objects, setting of ionizer, friction prevention and temperature / humidity control).

## Precaution for Storage / Transportation

1. Product performance and soldered connections may deteriorate if the Products are stored in the places where:
  - [a] the Products are exposed to sea winds or corrosive gases, including Cl<sub>2</sub>, H<sub>2</sub>S, NH<sub>3</sub>, SO<sub>2</sub>, and NO<sub>2</sub>
  - [b] the temperature or humidity exceeds those recommended by ROHM
  - [c] the Products are exposed to direct sunshine or condensation
  - [d] the Products are exposed to high Electrostatic
2. Even under ROHM recommended storage condition, solderability of products out of recommended storage time period may be degraded. It is strongly recommended to confirm solderability before using Products of which storage time is exceeding the recommended storage time period.
3. Store / transport cartons in the correct direction, which is indicated on a carton with a symbol. Otherwise bent leads may occur due to excessive stress applied when dropping of a carton.
4. Use Products within the specified time after opening a humidity barrier bag. Baking is required before using Products of which storage time is exceeding the recommended storage time period.

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QR code printed on ROHM Products label is for ROHM's internal use only.

## Precaution for Disposition

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