

Three-phase motor driver for CD-ROMs

BA6858AFP / BA6858AFM / BA6859AFP / BA6859AFP-Y / BA6859AFM / BA6859AFS

The BA6858A and BA6859A series are ICs developed for CD-ROM spindle motor drives. In addition to the functions of the BA6849 series, (short brake, reverse-rotation prevention circuit, rotation direction detector, and FG output), the BA6858A and BA6859A series have a built-in brake mode switching pin. With torque command input, these series are compatible with the DSP3.3V. In addition, the BA6858A series has an FG composite output.

● Applications

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

● Features

1) Three-phase, pseudo-linear drive system.	6) Built-in reverse rotation prevention circuit.
2) Built-in power save and thermal shutdown functions.	7) Built-in short brake pin.
3) Built-in current limiter and Hall bias circuits.	8) Built-in brake mode switching pin.
4) Built-in FG output.	9) DSP3.3V compatible.
5) Built-in rotation direction detector.	

● Absolute maximum ratings (Ta = 25°C)

Parameter	Symbol	Limits	Unit
Applied voltage (with 5V power supply)	V _{CC}	7	V
Applied voltage (motor power supply)	V _M	15	V
Power dissipation	P _d	2200* ³	mW
		1700* ¹	mW
		1450* ²	mW
		1000* ⁴	mW
Operating temperature	T _{opr}	-20~+75	°C
Storage temperature	T _{stg}	-55~+150* ⁵	°C
Output current	I _{out}	1300* ⁶	mA

* When mounted on a 70mm × 70mm × 1.6mm glass epoxy board.

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

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

*3 Reduced by 17.6mW 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.

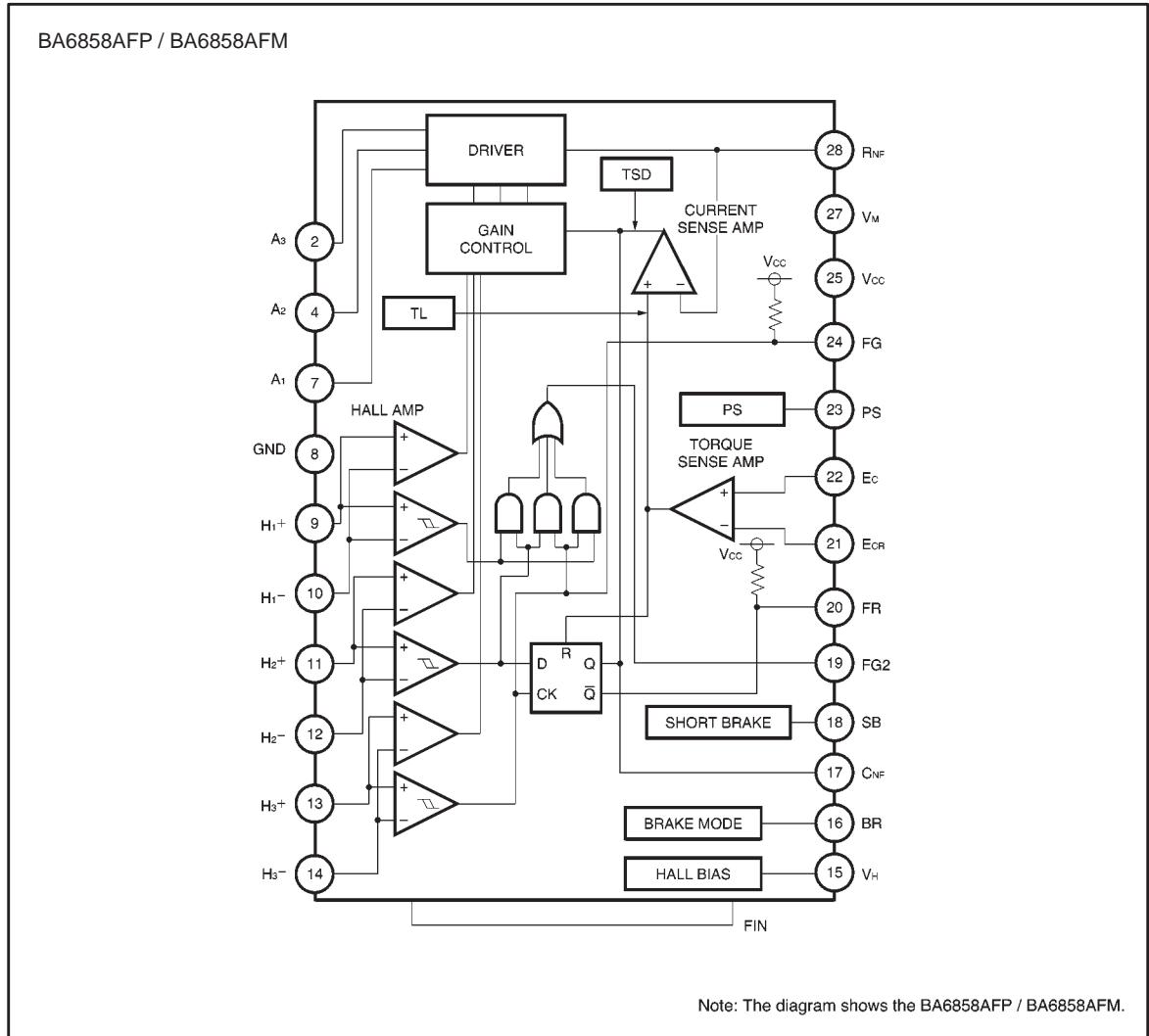
*5 Ta should not exceed 150°C.

*6 Should not exceed P_d or ASO values.

● Recommended operating conditions ($T_a = 25^\circ\text{C}$)

Parameter	Symbol	Limits	Unit
Power supply voltage	V_{cc}	4.5~5.5	V
	V_M	3.0~14	V

● Block diagram



●Pin descriptions

BA6858AFP/BA6858AFM

Pin No.	Pin name	Function
2	A ₃	Output
4	A ₂	Output
7	A ₁	Output
8	GND	GND
9	H ₁ +	Hall signal input
10	H ₁ -	Hall signal input
11	H ₂ +	Hall signal input
12	H ₂ -	Hall signal input
13	H ₃ +	Hall signal input
14	H ₃ -	Hall signal input
15	V _H	Hall bias
16	BR	Brake mode switch
17	C _{NF}	For connection of phase compensation capacitor
18	SB	Short brake
19	FG ₂	Three-phase composite FG signal output
20	FR	Rotation direction detection
21	E _{CR}	Torque control reference
22	E _C	Torque control
23	PS	Power save
24	FG	FG signal output
25	V _{CC}	Power supply
27	V _M	Motor power supply
28	R _{NF}	For connection of output current detection resistor
FIN	—	SUB GND

* Missing pin numbers are N.C.

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BA6859AFP/BA6859AFM

Pin No.	Pin name	Function
2	A ₃	Output
4	A ₂	Output
7	A ₁	Output
8	GND	GND
9	H ₁ +	Hall signal input
10	H ₁ -	Hall signal input
11	H ₂ +	Hall signal input
12	H ₂ -	Hall signal input
13	H ₃ +	Hall signal input
14	H ₃ -	Hall signal input
15	V _H	Hall bias
16	BR	Brake mode switch
17	C _{NF}	For connection of phase compensation capacitor
18	SB	Short brake
20	FR	Rotation direction detection
21	E _{CR}	Torque control reference
22	E _c	Torque control
23	PS	Power save
24	FG	FG signal output
25	V _{cc}	Power supply
27	V _M	Motor power supply
28	R _{NF}	For connection of output current detection resistor
FIN	—	SUB GND

* Missing pin numbers are N.C.

BA6859AFP-Y

Pin No.	Pin name	Function
4	A ₃	Output
5	A ₂	Output
6	A ₁	Output
7	GND	GND
8	H ₁ +	Hall signal input
9	H ₁ -	Hall signal input
10	H ₂ +	Hall signal input
11	H ₂ -	Hall signal input
12	H ₃ +	Hall signal input
13	H ₃ -	Hall signal input
14	V _H	Hall bias
15	BR	Brake mode switch
16	C _{NF}	For connection of phase compensation capacitor
17	SB	Short brake
18	FR	Rotation direction detection
19	E _{CR}	Torque control reference
20	E _c	Torque control
21	PS	Power save
22	FG	FG signal output
23	V _{cc}	Power supply
24	V _M	Motor power supply
25	R _{NF}	For connection of output current detection resistor
FIN	—	SUB GND

* Missing pin numbers are N.C.

Optical disc ICs

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BA6859AFS

Pin No.	Pin name	Function
1	—	SUB GND
2	A ₃	Output
3	A ₂	Output
5	A ₁	Output
6	GND	GND
7	H ₁ +	Hall signal input
8	H ₁ -	Hall signal input
9	H ₂ +	Hall signal input
10	H ₂ -	Hall signal input
11	H ₃ +	Hall signal input
12	H ₃ -	Hall signal input
13	V _H	Hall bias
14	BR	Brake mode switch
15	C _{NF}	For connection of phase compensation capacitor
16	SB	Short brake
17	FR	Rotation direction detection
18	E _{CR}	Torque control reference
19	E _C	Torque control
20	PS	Power save
21	FG	FG signal output
22	V _{CC}	Power supply
23	V _M	Motor power supply
24	R _{NF}	For connection of output current detection resistor

* Missing pin numbers are N.C.

Optical disc ICs

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● Input / output circuits

(1) Power save

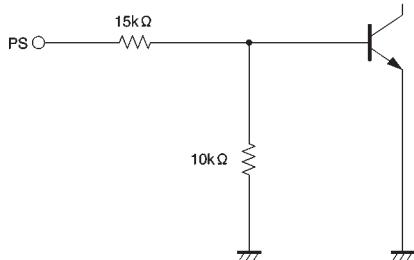


Fig. 1

(2) Torque command input

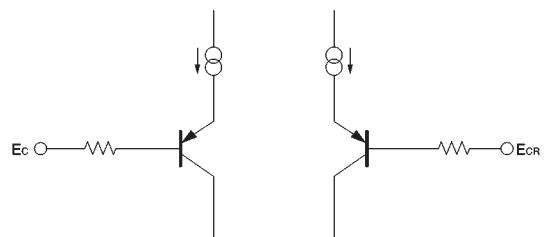


Fig.2

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

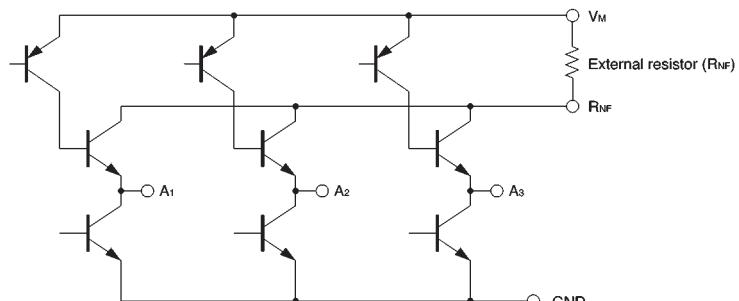


Fig.3

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

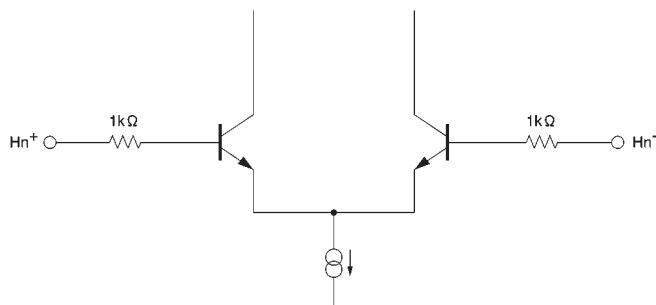


Fig.4

(5) Hall bias

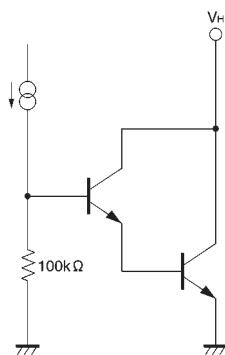


Fig.5

(7) FG_2 Output

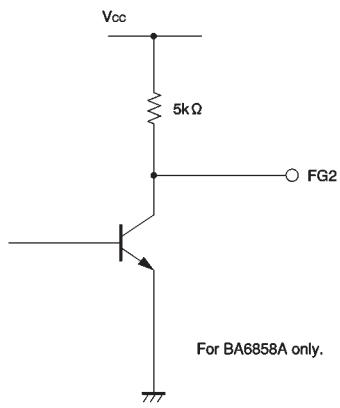


Fig.7

(6) FG output

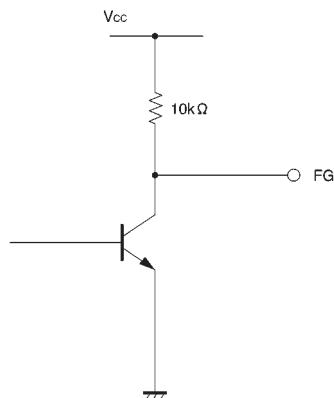


Fig.6

(8) FR output

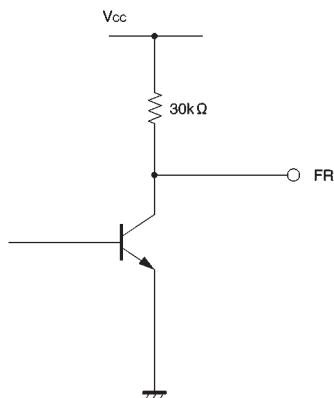


Fig.8

(9) Short brake

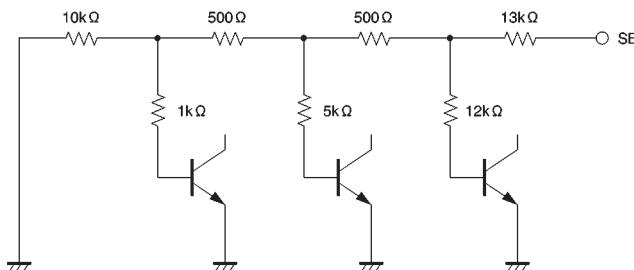


Fig.9

(10) Brake mode

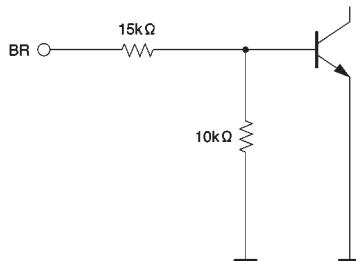


Fig.10

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

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
<Total device>						
Circuit current 1	I_{cc1}	—	0	0.2	mA	In the power save ON state
Circuit current 2	I_{cc2}	—	5.8 5.0	8.5 (58A) 7.5 (59A)	mA	In the power save OFF state
<Power save>						
ON voltage range	V_{PSON}	—	—	1.0	V	—
OFF voltage range	V_{PSOFF}	2.5	—	—	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	μA	—
Same phase input voltage range	V_{HAR}	1.0	—	4.0	V	—
Minimum input level	V_{INH}	50	—	—	$\text{mV}_{\text{P-P}}$	—
H3 hysteresis level	V_{HYS}	5	20	40	mV	—
<Torque command>						
Input voltage range	E_c, E_{CR}	0.5	—	3.3	V	Can operate from 0 to V_{cc} .
"—" offset voltage	E_{COFF}^-	-80	-50	-20	mV	$E_{CR}=1.9\text{V}$
"+" offset voltage	E_{COFF}^+	20	50	80	mV	$E_{CR}=1.9\text{V}$
Input bias current	E_{CIN}	-3	—	3	μA	$E_c=E_{CR}$
I / O gain	G_{EC}	0.56	0.7	0.84	A / V	$E_c=1.2\text{V}, 1.7\text{V}$
<FG>						
FG output "H" voltage	V_{FGH}	4.5	4.8	—	V	$I_{FG}=-20\ \mu\text{A}$
FG output "L" voltage	V_{FGL}	—	0.25	0.4	V	$I_{FG}=3\text{mA}$
<FG2> (BA6858A only)						
FG2 output high level voltage	V_{FG2H}	4.6	4.9	—	V	$I_{FG2}=-20\ \mu\text{A}$
FG2 output low level voltage	V_{FG2L}	—	0.25	0.4	V	$I_{FG2}=3\text{mA}$
DUTY (reference value)	D_U	—	50	—	%	—

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
⟨Rotation detection⟩						
FR output high level voltage	V_{FRH}	4.1	4.4	—	V	$I_{FR} = -20 \mu A$
FR output low level voltage	V_{FRL}	—	0.25	0.4	V	$I_{FR} = 3mA$
⟨Output⟩						
Output saturation high level voltage	V_{OH}	—	1.0	1.4	V	$I_o = -600mA$
Output saturation low level voltage	V_{OL}	—	0.4	0.7	V	$I_o = 600mA$
Pre-drive current	I_{VML}	—	35	70	mA	$E_c = 0V$ output open
Output limit current	I_{TL}	560	700	840	mA	—
⟨Short brake⟩						
ON voltage range	V_{SBON}	2.5	—	—	V	$BR = 0V$
OFF voltage range	V_{SBOFF}	—	—	1.0	V	$BR = 0V$
⟨Brake mode⟩						
ON voltage range	V_{BRON}	2.5	—	—	V	$E_c > E_{CR}$ SB open
OFF voltage range	V_{BROFF}	—	—	1.0	V	$E_c > E_{CR}$ SB open

©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.11. 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.

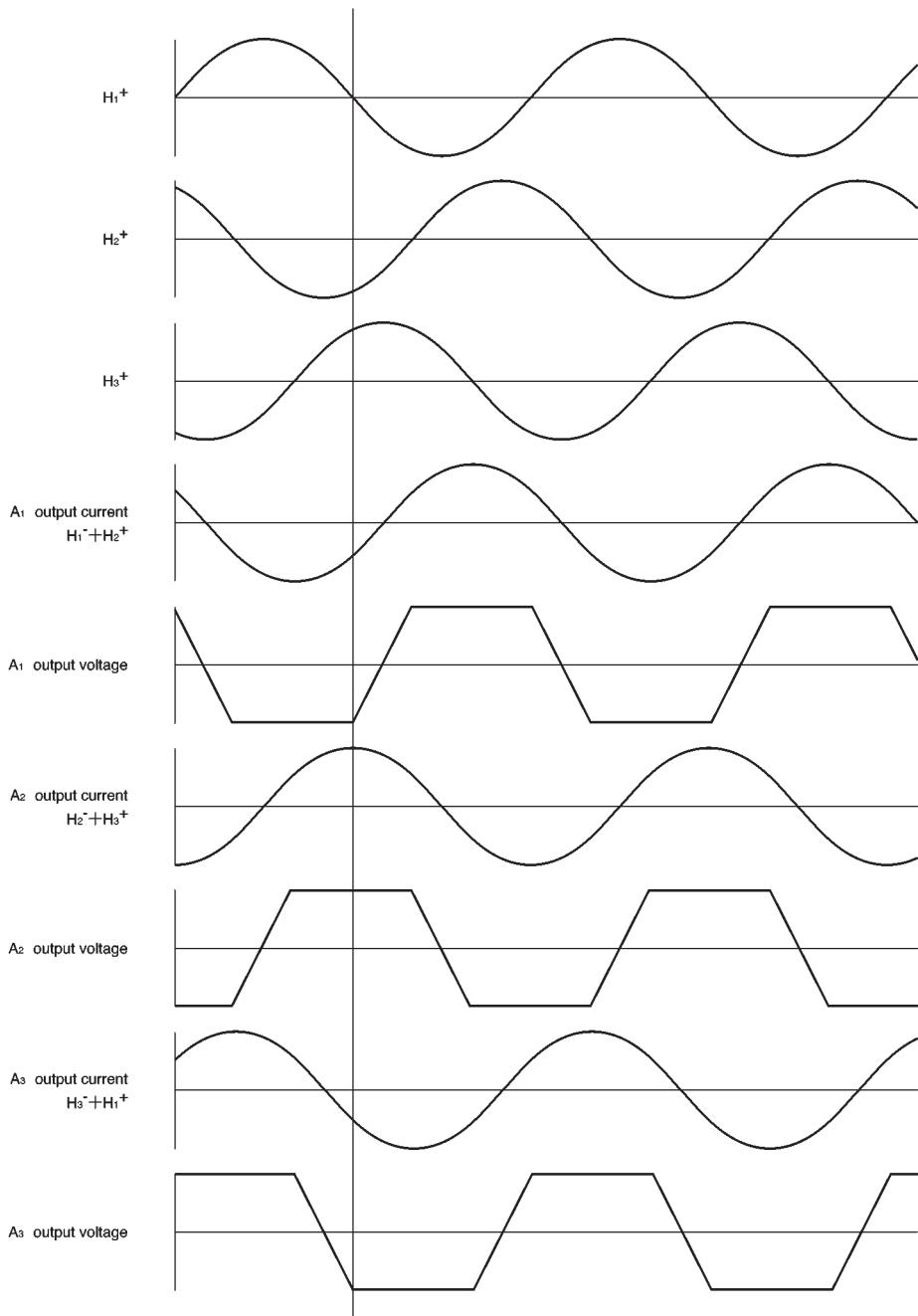


Fig.11

(2) Torque command

The R_{NF} pin voltage with respect to the torque command (E_c) is as follows:

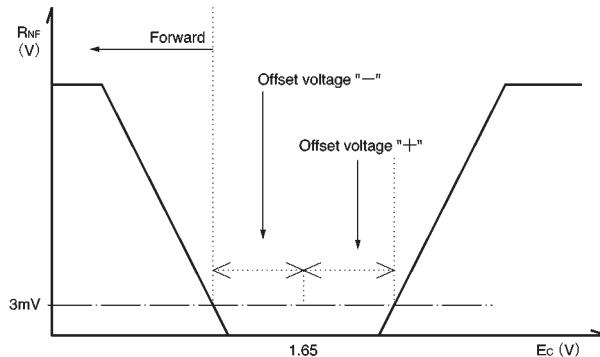


Fig.12

	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.

$$G_{EC} = 0.35 / R_{NF} \text{ (A/V)}$$

The torque limit current ITL is given by:

$$ITL = 0.35 / R_{NF} \text{ (A)}$$

(3) Reverse rotation detection function

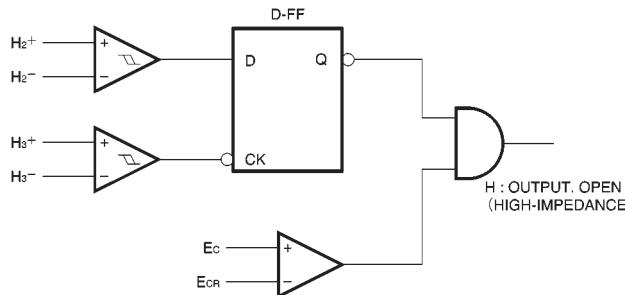


Fig.13

The reverse detection circuit construction is shown in Fig.13.

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

The phase relationship between the Hall input signals H_2^+ and H_3^+ becomes as shown in Fig.11, 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 2.5V or more is applied to the short brake pin, the top-side output transistors of all phases go off, and the bottom-side output transistors go on. This applies braking to the motor. Short braking operates regardless of the torque command signal.

(5) Brake mode switching

When 2.5V or more is applied to the BR pin, the brake mode for when $E_c > E_{CR}$ can be changed.

	$E_c < E_{CR}$	$E_c > E_{CR}$
BR	1.0 or less	Forward
	2.5 or more	Reverse brake

● Application example

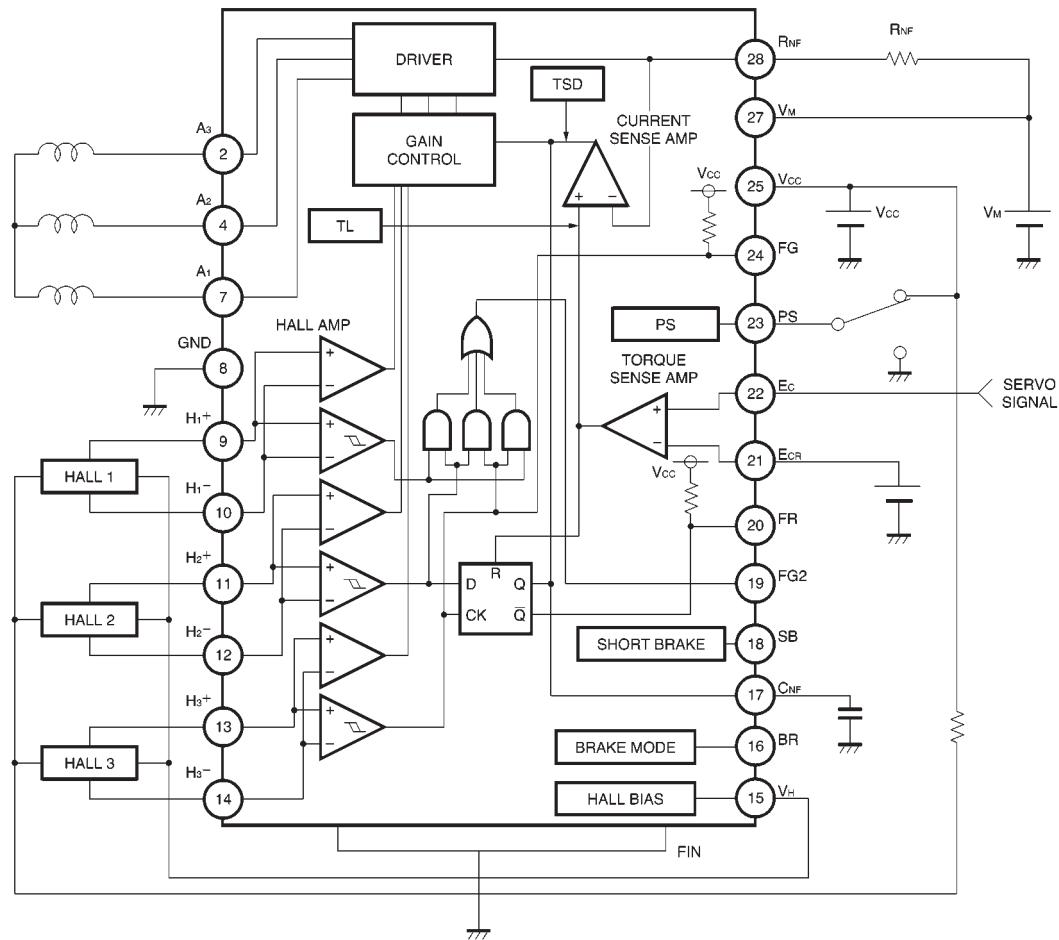


Fig.14

● Operation notes

(1) Torque command

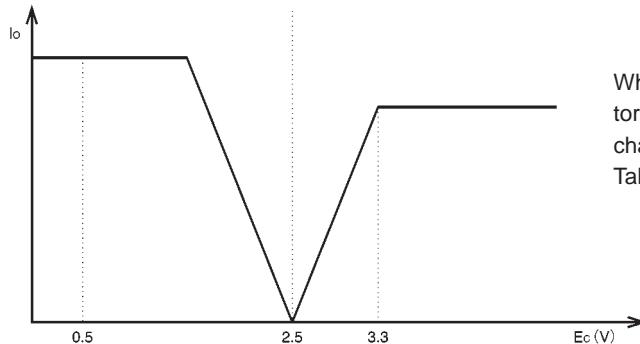


Fig.15

When operating with $E_{CR} = 2.5V$, the voltage range for the torque command input is 0.5V to 3.3V, and therefore, the characteristic will be unbalanced as shown in Fig.15. Take due care.

(2) Switches

The switches have a temperature characteristic of approximately $-5mV / ^\circ C$. Take care with regard to the input voltage range.

(3) Hall input

The input circuit shown in Fig.4 is used for the Hall inputs.

The Hall elements can be connected either in series or in parallel.

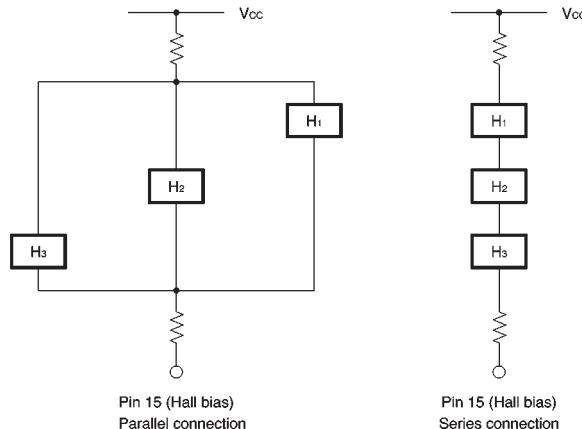


Fig.16

Set the Hall input voltage in the range 1.0V to 4.0V.

Set the resistance values between V_H and V_{CC} pins and the Hall elements after calculating the current to flow in Hall elements.

If there will not be a resistor connected between the Hall elements and the V_H pin, we recommend that $I_{VH} = 5mA$ or more.

(4) Thermal shutdown (TSD)

When the junction temperature reaches $175^\circ C$ (Typ.), the A_1 , A_2 , and A_3 coil outputs go open circuit.

The thermal shutdown has approximately $15^\circ C$ (Typ.) of hysteresis.

Optical disc ICs

● Electrical characteristics curves

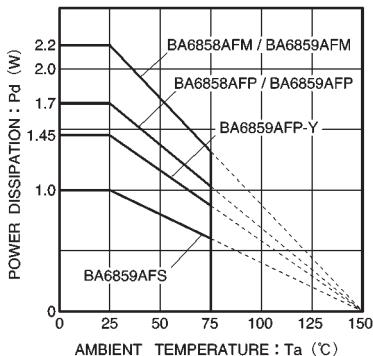


Fig.17 Package derating curves

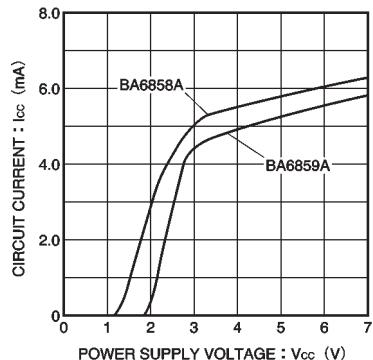


Fig.18 Power supply current vs.
power supply voltage

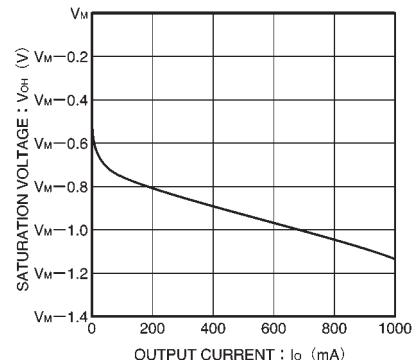


Fig.19 Upper-side output saturation
voltage vs. output current

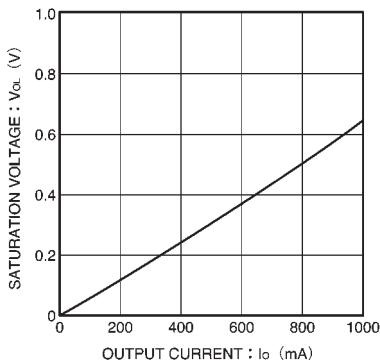


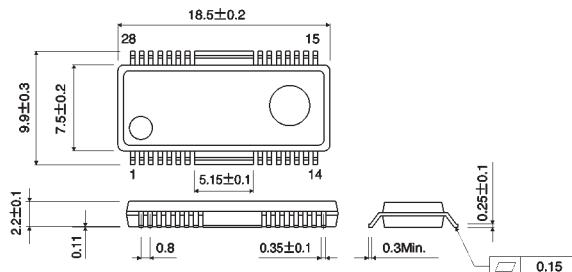
Fig.20 Lower-side output saturation
voltage vs. output current

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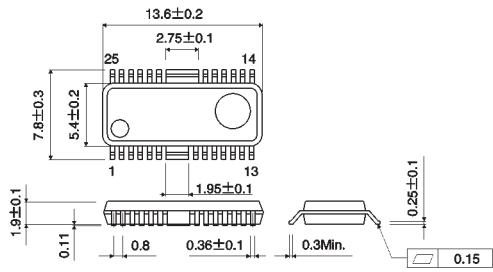
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● External dimensions (Units: mm)

BA6858AFP / BA6859AFP



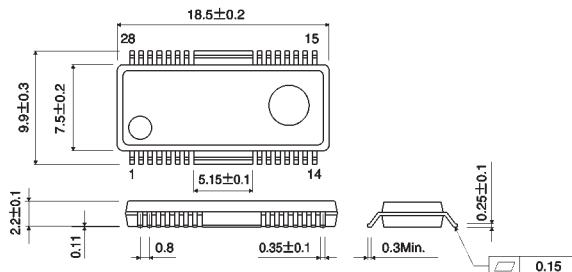
BA6859AFP-Y



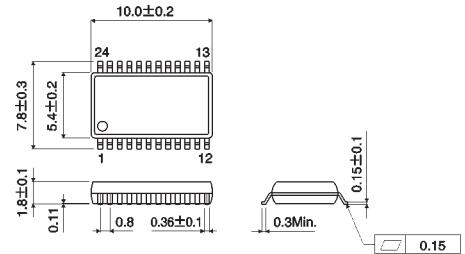
HSOP28

HSOP25

BA6858AFM / BA6859AFM



BA6859AFS



HSOP-M28

SSOP-A24