BA6465FP-Y

3-phase, full-wave, pseudo-linear motor driver

The BA6465FP-Y is an IC that can be used to control and drive floppy disk drive spindle motors. This IC uses a three-phase, full-wave pseudo-linear drive system.

With a built-in power saving function, two amplifiers and a Schmidt amplifier, the IC can be used to amplify FG signals and thus reduces the number of components required in the floppy drive.

Features

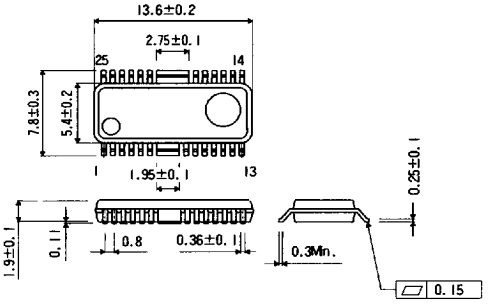
- available in HSOP25 package
- low output saturation voltage
- built-in Hall-effect element power switch
- built-in current limiter and thermal shutdown
- contains two amplifiers and a hysteresis amplifier

Applications

- floppy disk drive

Dimensions (Units : mm)

BA6465FP-Y (HSOP25)



Block diagram

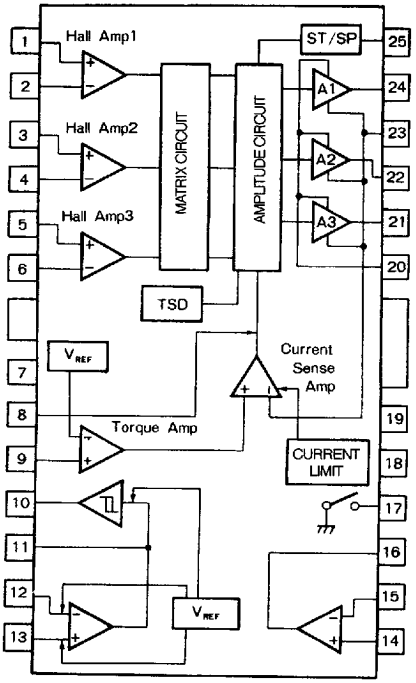


Table 1 Pin description (Sheet 1 of 2)

Pin no.	Pin name	Function
1	H1+	Hall signal input pin
2	H1–	
3	H2+	
4	H2–	
5	H3+	
6	H3–	
7	S-GND	Signal ground pin
8	C_{NF}	Connection point for external phase compensation capacitor
9	E_C	Output current control
10	Hys_{OUT1}	Hysteresis amplifier output
11	$Amp1_{OUT}$	Amplifier 1 output and hysteresis amplifier input
12	$Amp1_{IN-}$	Amplifier 1 inverting input
13	$Amp1_{IN+}$	Amplifier 1 non-inverting input

Table 1 Pin description (Sheet 2 of 2)

Pin no.	Pin name	Function
14	$Amp2_{IN}+$	Amplifier 2 non-inverting input
15	$Amp2_{IN}-$	Amplifier 2 inverting input
16	$Amp2_{OUT}$	Amplifier 2 output
17	H-GND	Hall element bias switch
18	N C	Not connected
19	V_{CC}	Power supply
20	V_M	Motor power supply
21	A_3	Output
22	A_2	Output
23	R_{NF}	Output current monitor
24	A_1	Output
25	ST / SP	Start/stop switching
FIN	FIN	Cooling fin. Note: The fin must be connected to ground.

Absolute maximum ratings (T_a = 25°C)

Parameter	Symbol	Limits	Unit	Conditions
Power supply voltage	V_{CC}	7	V	
	V_M	24	V	
Power dissipation	P_d	1450	mW	Mounted on 90 mm × 50 mm × 1.6 mm glass-epoxy PCB. Reduce power by 11.6 mW/°C for each degree above 25°C.
Output current	I_{OUT}	1300	mA	Output current must be such that max P_d or ASO is not exceeded.
Operating temperature	T_{opr}	−20 ~ +75	°C	
Storage temperature	T_{stg}	−55 ~ +150	°C	

Recommended operating conditions (T_a = 25°C)

Parameter	Symbol	Min	Typical	Max	Unit
Operating voltage	V_{CC}	4.25		5.50	V
	V_M	3.0		20	V

Electrical characteristics (unless otherwise noted, $T_a = 25°C$, $V_{CC} = 5$ V, $V_M = 12$ V)

Parameter	Symbol	Min	Typical	Max	Unit	Conditions
Supply current	I_{CC}		9.0	14.0	mA	ST/SP = 5 V
Standby supply current	I_{ST}		0	10.0	µA	ST/SP = 0 V
Pin 17 saturation voltage	V_{17}		0.8	1.2	V	At pin 17 with current of 10 mA
Motor drive output						
Hall input bias current	I_{BH}		0.5	5.0	µA	H+ = HIGH, H- = LOW or H+ = LOW, H- = HIGH
Hall input common mode, voltage	V_{HB}	1.5		4.0	V	
Hall element input level	V_{INH}	50			mV_{pk-pk}	
Torque command voltage input	E_C	0		5.0	V	
Torque command offset	E_{cofs}	−150	0	+150	mV	For $E_C = 2.3$ V.
Output idle voltage	E_{cidle}		0	10	mV	$E_C = 2$ V, $R_{NF} = 0.5$ Ω
Servo input current	E_{CIN}		1.0	5.0	µA	$E_C = 2.5$ V
Input / output gain	G_{EC}	0.420	0.510	0.600	A/V	$R_{NF} = 0.5$ Ω, Measured at two points: $E_C = 2.5$ V and $E_C = 2.8$ V
Min start / stop "on"	$V_{S/S}$ on	3.5			V	
Max start / stop "off"	$V_{S/S}$ off			1.2	V	
Output saturation voltage H	V_{OH}	10.4	11.1		V	$I_O = 600$ mA
Output saturation voltage L	V_{OL}		0.3	0.9	V	$I_O = 600$ mA
Output drive current	$I_{O(max)}$	800			mA	$R_{NF} = 0$Ω, $T_j = 25$ °C (chip internal junction temperature)
Current limiter voltage	V_{CL}	170	200	230	mV	R_{NF} pin voltage, $R_{NF} = 0.5$ Ω
Amplifier 1 and amplifier 2						
Amp1 input impedance	R_{BA}	14	20	26	kΩ	
Open loop gain	G_A	65	70		dB	f = 500 Hz
DC bias voltage	V_{BA}	2.25	2.50	2.75	V	
High level output voltage	V_{OHA}	3.6	4.0		V	$I_{OA} = 0.5$ mA
Low level output voltage	V_{OLA}		0.9	1.3	V	$I_{OA} = 0.5$ mA
Amp 1 input voltage	V_{AB1}	1.2		4.0	V	
Amp 2 input voltage	V_{AB2}	1.2		3.0	V	
Schmidt amplifier						
Hysteresis amplitude	V_{hys}	±112	±150	±188	mV	
Low level output voltage	V_{OLhys}		0.1	0.3	V	$I_{OLhys} = 2$ mA
Output pull-up resistance	R_{Bhys}	7.0	10.0	13.0	kΩ	

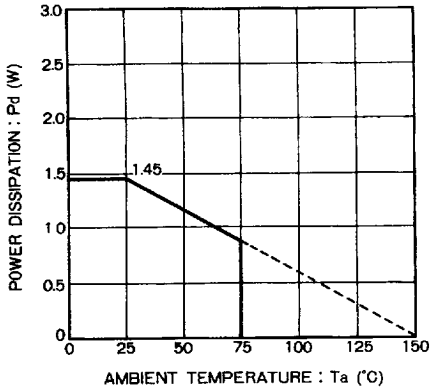


Figure 1

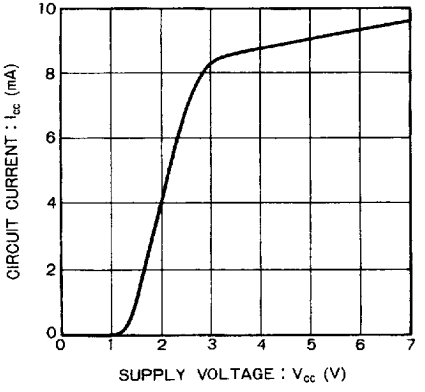


Figure 2

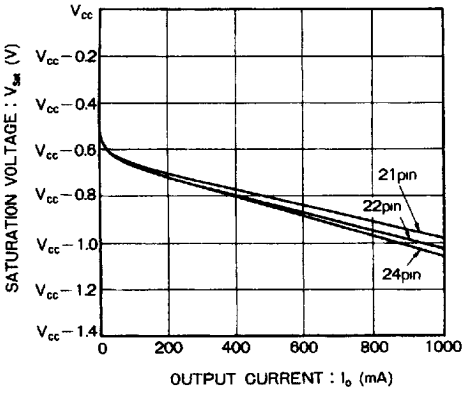


Figure 3

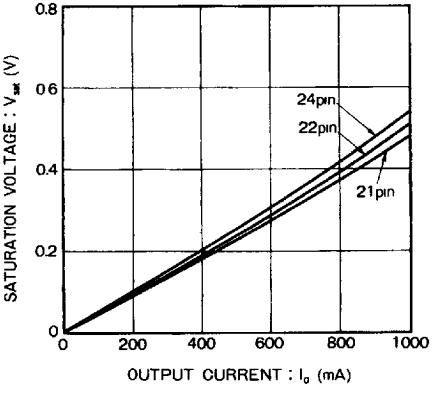


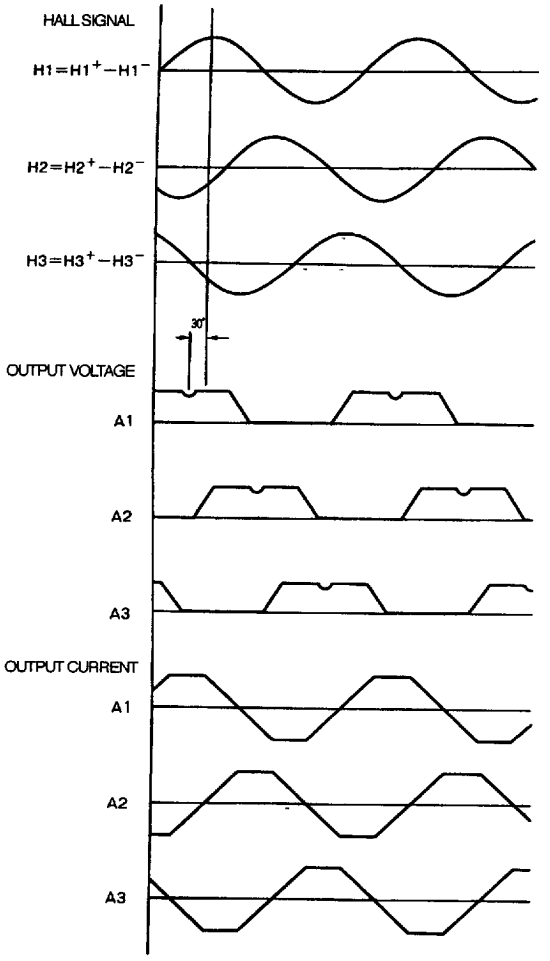
Figure 4

Operation

Hall inputs to driver outputs

Three Hall signals (for the three phases of the motor) are amplified in Hall amplifiers 1, 2, and 3, and applied to a matrix section, where they are further amplified and combined. After voltage-to-current conversion in the amplitude control circuit, the signals are fed to output drivers, which supply drive currents to the motor windings. Figure 5 shows the phase relationships between the Hall signal inputs and the current and voltage waveforms at the outputs of the drivers.

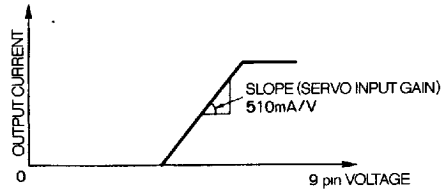
Figure 5 Hall input phase relationships



Torque control pin (E_C)

The output motor drive currents can be controlled by applying a voltage to the torque control pin (pin 9). The control characteristics are shown in Figure 6:

Figure 6 E_C torque control



Start/stop pin (ST/SP)

The ST/SP pin controls switching between "run" and "standby" modes. In the run mode, motor power is supplied. The run state is activated when a potential +3.5 V or more is applied to this pin. See Figure 7.

In the standby mode, all transistors are off and no motor drive current is supplied. The standby state is activated when the pin voltage falls below +1.2 V.

The start/stop pin has a –7 mV/°C temperature characteristic, and there can up to a ±30% variation in input resistance. It is quite important during design to pay close attention to these temperature characteristics.

Power ground pin (R_{NF})

This is the output stage ground connection. If a small resistor (0.5 Ω is recommended) is connected between this pin and ground, the output current can be monitored.

Phase compensation pin (C_{NF})

This pin is used to control any oscillation of the output. Connect a capacitor between this pin and V_{CC} to reduce the oscillations.

Amplifier 1 and amplifier 2

Amplifier 1 and amplifier 2 each have an open loop gain of typically 70 dB. The Amplifier 1 input pins (12 and 13) are biased internally to about 2.45 V. Amplifier 2 is not internally biased.

Be careful not to exceed the specified input range of these amplifiers. Unpredictable outputs can occur when the input ranges specified in the "Electrical characteristics" table are exceeded

Hysteresis amplifier

The hysteresis (Schmitt) amplifier has a hysteresis amplitude of ±150 mV (typical). The input pin (11) is biased internally.

Hall inputs

The equivalent circuit of the Hall amplifier input is shown in Figure 11. The Hall elements can connected in series or parallel as shown in Figure 15.

Thermal shutdown (TSD)

At a temperature of typically 175°C, the TSD circuit opens the A1, A2, and A3 outputs and the motor shuts down. The TSD circuit resets when the temperature falls below 155°C (typically).

Input and output equivalent circuits

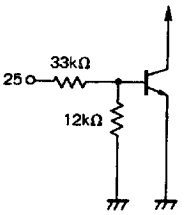


Figure 7 Start/stop (pin 25)

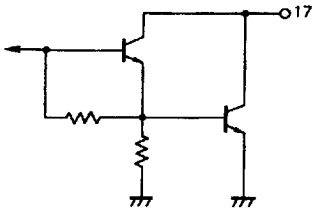


Figure 8 V_{17} (pin 17)

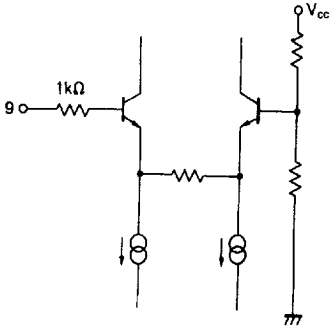


Figure 9 Torque command input (pin 9)

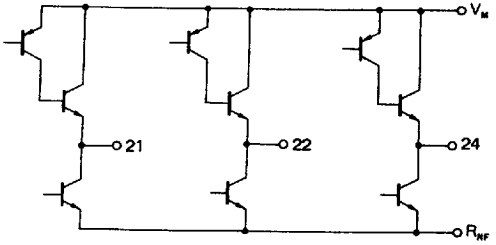


Figure 10 Motor winding output (A1: pin 24, A2: pin 22, A3: pin 21)

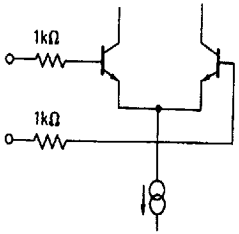


Figure 11 Hall input (H1+: pin 1, H1-: pin 2, H2+: pin 3, H2-: pin 4, H3+: pin 5, H3-: pin 6)

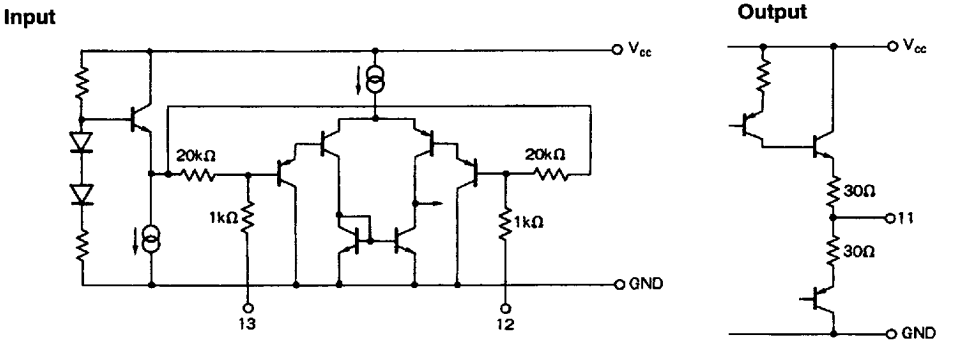


Figure 12 Amplifier 1 input & output

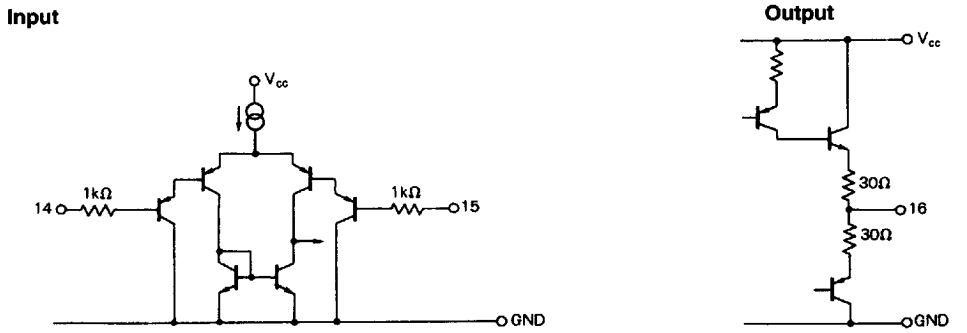


Figure 13 Amplifier 2 input & output

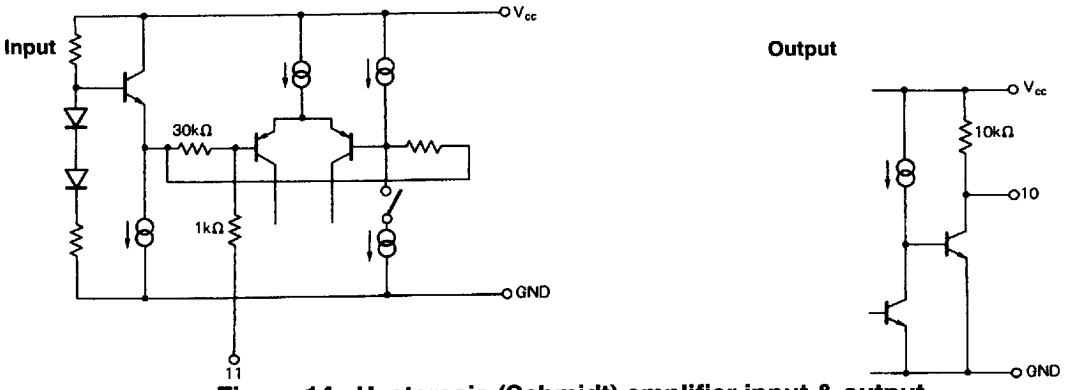


Figure 14 Hysteresis (Schmidt) amplifier input & output

Note: There can be a variation of as much as ±30% in the input and output circuit resistance values.

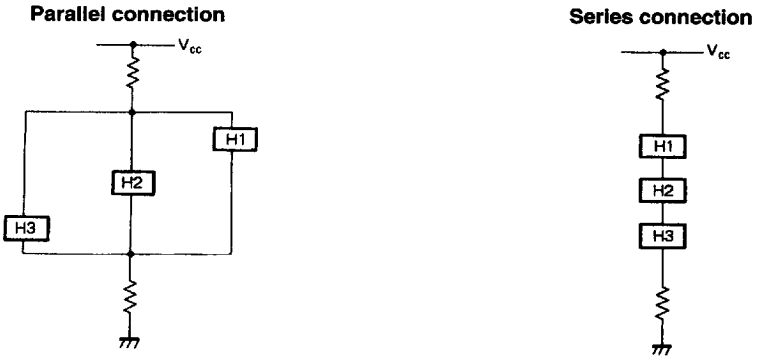


Figure 15 Connection of Hall amplifier inputs

Figure 16 Application example