HA13456A/AMP

Three-Phase Brushless DC Motor Driver

Description

The HA13456/AMP three-phase brushless DC motor driver can provide an output current of 1.0 A per phase. It is intended for use as a floppy disk drive spindle motor driver.

Features

- Single-chip motor driver
- Digital control eliminates need for calibration
- Low current consumption

Functions

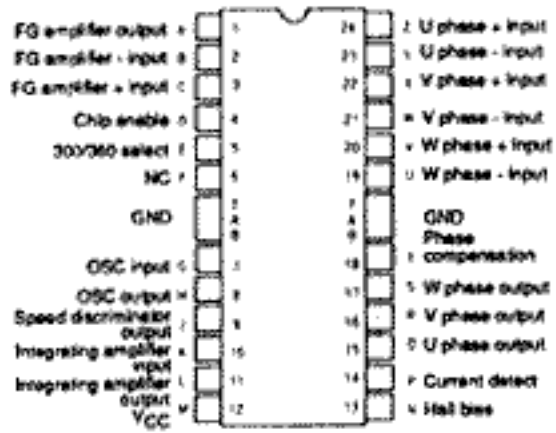
- 1.0-A three-phase output circuit
- Hall amplifier matrix
- Control amplifier (current control)
- FG amplifier, zero-cross detector
- Oscillator circuit
- High-speed discriminator
- 300 or 360 rpm
- Integrating amplifier
- Current limiter
- Overtemperature shutdown (OTSD)
- Chip enable

Product Line-up

Name	Package
HA13456A	DP-24TS
HA13456AMP	MP-28T

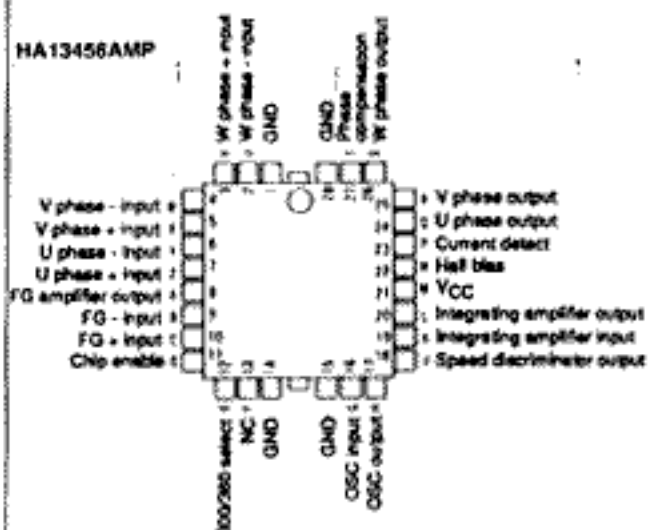
Pin Arrangement

HA13456A



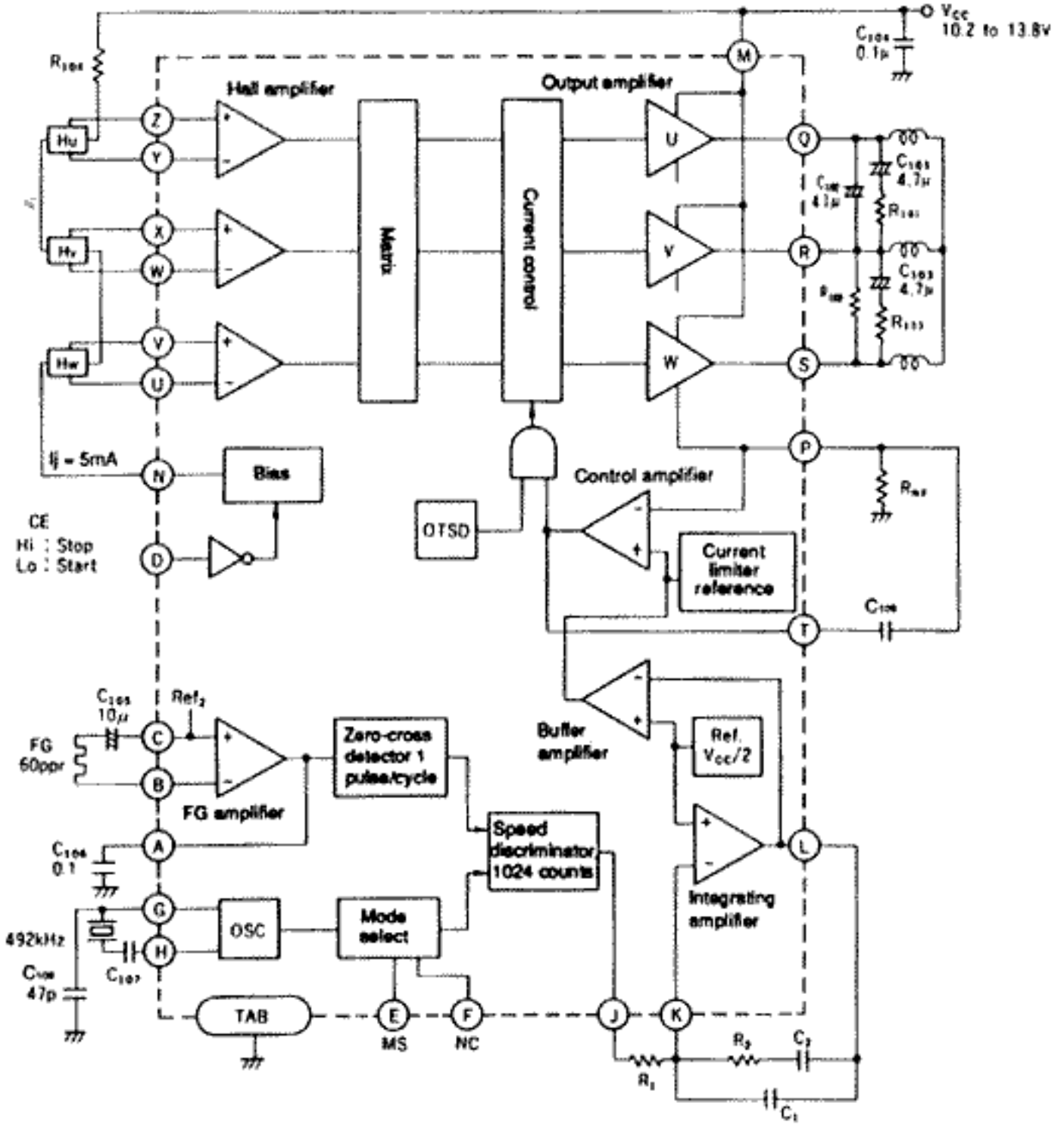
(Top View)

HA13456AMP



(Top View)

Block Diagram



Truth Table

Chip Enable	Hall amplifier input						Output		
CE	U+	U−	V+	V−	W+	W−	U	V	W
L	H	L	L	H	H	L	H	L	Open
	H	L	L	H	L	H	H	Open	L
	H	L	H	L	L	H	Open	H	L
	L	H	H	L	L	H	L	H	Open
	L	H	H	L	H	L	L	Open	H
	L	H	L	H	H	L	Open	L	H
H	X	X	X	X	X	X	Open	Open	Open

Absolute Maximum Ratings (Ta = 25°C)

Item	Symbol	Rating	Unit	Notes
Power supply voltage	V_{CC}	+15	V	1
Peak output current	I_{op}	1.0	A	2
Normal output current	I_o	0.7	A	
Input voltage	V_{in}	−0.5 to V_{CC}	V	3
Power dissipation	P_t	2	W	4
Junction temperature	T_j	150	°C	5
Storage temperature	T_{stg}	−55 to +125	°C	

Notes:

1. The operating voltage range (V_{CC}) is 10.2 to 13.8 V.
2. $t \leq 0.5$ seconds
3. Applies to chip enable CE and mode select MS pins.
4. For Tc=100°C. Thermal resistance is as follows.
   $\theta_j - c \leq 20°C/W$
   $\theta_j - a \leq 60°C/W$ (when using glass epoxy baseplate)
5. Operating junction temperature (Tjopr) range is 0 to 125°C.

Electrical Characteristics (Ta = 25°C, V_{CC} = 12V)

Item		Symbol	Min	Typ	Max	Unit	Test Conditions	Pins DP-24TS	Pins MP-28T	Notes
Quiescent current		I_{Q1}	—	0.45	1.0	mA	CE = 2 V	12	21	1
		I_{Q2}	—	15	23	mA	CE = 0.8 V, R_L = OPEN			
Input low voltage		V_{IL}	—	—	0.8	V		4, 5	11, 12	
Input high voltage		V_{IH}	2.0	—	V_{CC}	V				
Input low current		I_{IL}	—	—	±20	µA	V_{IL} = 0 V			
Input high current		I_{IH}	50	—	200	µA	V_{IH} = 2 V	4	11	
			—	—	±10	µA		5	12	
Hall amplifier	Input current	I_{HB}	—	—	±10	µA	V_H = 2 V	19 – 24	2 – 7	
	Input common mode voltage range	V_H	1.5	—	V_{CC} −1.0	V				
	Differential input voltage range	U_H	75	—	—	mVpp				
Hall bias	Output voltage	V_{HB}	1.2	1.6	2.0	V	CE = 0.8 V, I_O = 5 mA	13	22	
	Leakage current	I_H off	—	—	±10	µA	CE = 2 V, V_{CE} = 15 V			
Output amplifier	Leakage current	I_{CER}	—	—	±1	mA	CE = 2 V, V_{CE} = 15 V	15,	24,	
	Saturation voltage	Vsat	—	1.5	2.2	V	I_O = 0.7 A	16,	25,	2
			—	1.2	1.6	V	I_O = 0.35 A	17	26	
Current limiter reference voltage		Vref1	370	410	450	V		14	23	
Control amplifier	Voltage gain	G_{CTL}	−2	0	+2	V		14	23	
	Phase deviation	ΔG_{CTL}	—	—	±1.0	dB				
Integrating amplifier	Reference voltage	Vref2	—	6.3	—	dB		10	19	
	Input current	I_{B1}	—	—	±50	nA				
	Output voltage amplitude	A +	—	0.7	—	V	I_g = −0.5 mA	11	20	3
		A −	—	−1.3	—	V	I_g = 0.5 mA			
	Gain bandwidth	BW_D	—	300	—	kHz	G_V = 0 dB			
Speed discriminator	Output high voltage	V_{DOH}	V_{CC} −0.3	—	—	V	I_{10} = 0.5 mA	9	18	
	Output low voltage	V_{DOL}	—	—	0.3	V	I_{10} = −0.5 mA			
	Output cutoff current	I_D off	—	—	±50	nA	V = 2.5 V			
	Operating frequency	f_D	—	—	1000	kHz				
	Number of counts	N_D	—	1024	—	—				
OSC	Frequency range	f_{OSC}	—	—	1000	kHz		8	17	
	Frequency error	Δf_{OSC}	—	—	±0.2	%	492 kHz			
FG amplifier	Voltage gain	G_{FG}	38	40	42	dB	f = 300 Hz	1	8	
	Undistorted maximum output voltage	V_O	0.4	—	—	Vrms				
	Input voltage	V_I	2	—	—	mVpp		2, 3	9,10	
OTSD	Operating temperature	Tsd	12.5	—	—	°C				4

Notes.

1. Not including Hall bias current.
2. Sum of upper and lower saturation voltages.
3. Based on V_{ref2}.
4. For reference only; not tested before delivery.

External Components

Part No.	Reference Value 12 V, 5.25" FDD	Purpose	Notes
R_{101}, R_{102}, R_{103}	4.7 Ω	Stability	
R_{104}	1.8 kΩ	Hall amplifier bias	
R_1	56 kΩ	Integration constant	
R_2	56 kΩ	Integration constant	
R_{NF}	0.39 Ω	Current detect	1
C_{101}, C_{102}, C_{103}	4.7 µF	Stability	2
C_{104}	0.1 µF	Power supply bypass	3
C_{105}	10 µF	AC connection to FG amplifier	
C_{106}	0.1 µF	Bandwidth setting for FG amplifier	
C_{107}	47 pF	AC connection to oscillator	
C_{108}	47 pF	Stability	
C_{109}	0.1 µF	Control amplifier phase compensation	
C_1	0.04 µF	Integration constant	4
C_2	0.47 µF	Integration constant	4
X'tal	492 kHz	Oscillator	5

Notes:

1. The current limiter operates according to the following equation.

$$I_{O\,max} = \frac{V_{ref\,1}}{R_{NF}}$$

2. Use non-polar capacitors.
3. Place as close as possible to the IC.
4. Use non-polar capacitor with low leakage current.
5. The relationship between the oscillator frequency fosc(Hz) and the FG frequency f_{FG}(Hz) is as follows.
   a. When MS = high:

$$f_{OSC} = \frac{8 \times 1024 \times f_{FG}}{6}$$

   b. When MS = low:

$$8 \times 1024 \times f_{FG}$$