

HA13412

Three-Phase Brushless Motor Driver

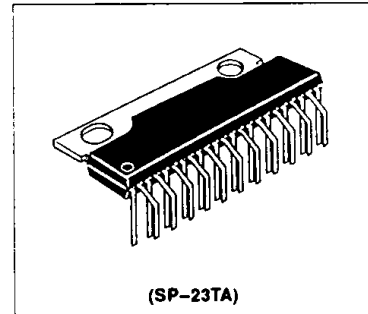
Description

The HA13412 is a monolithic power IC developed for use as a three-phase brushless DC motor driver.

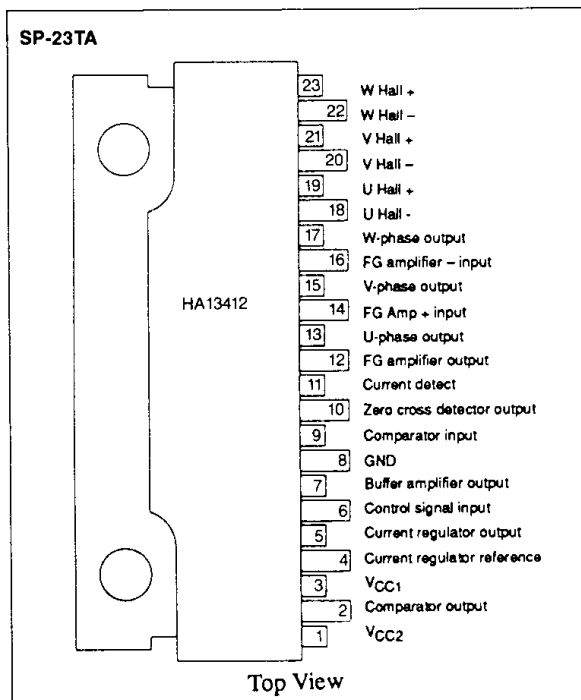
With a maximum output current of 1 A/phase and power supply voltage of 35 V, this device is ideal as a driver for printer positioning motors, etc.

Features

- Hysteresis-compensating Hall amplifier
- Current limiter
- FG signal zero-cross detector
- Protection circuit disables the output transistor if the Hall amplifier input is cut
- Separate power supplies permit the control and output blocks each to be used over a wide range of voltages
 - Control block: 6–15 V
 - Output block: 5–30 V
- Overtemperature shutdown (OTSD)



Pin Assignment



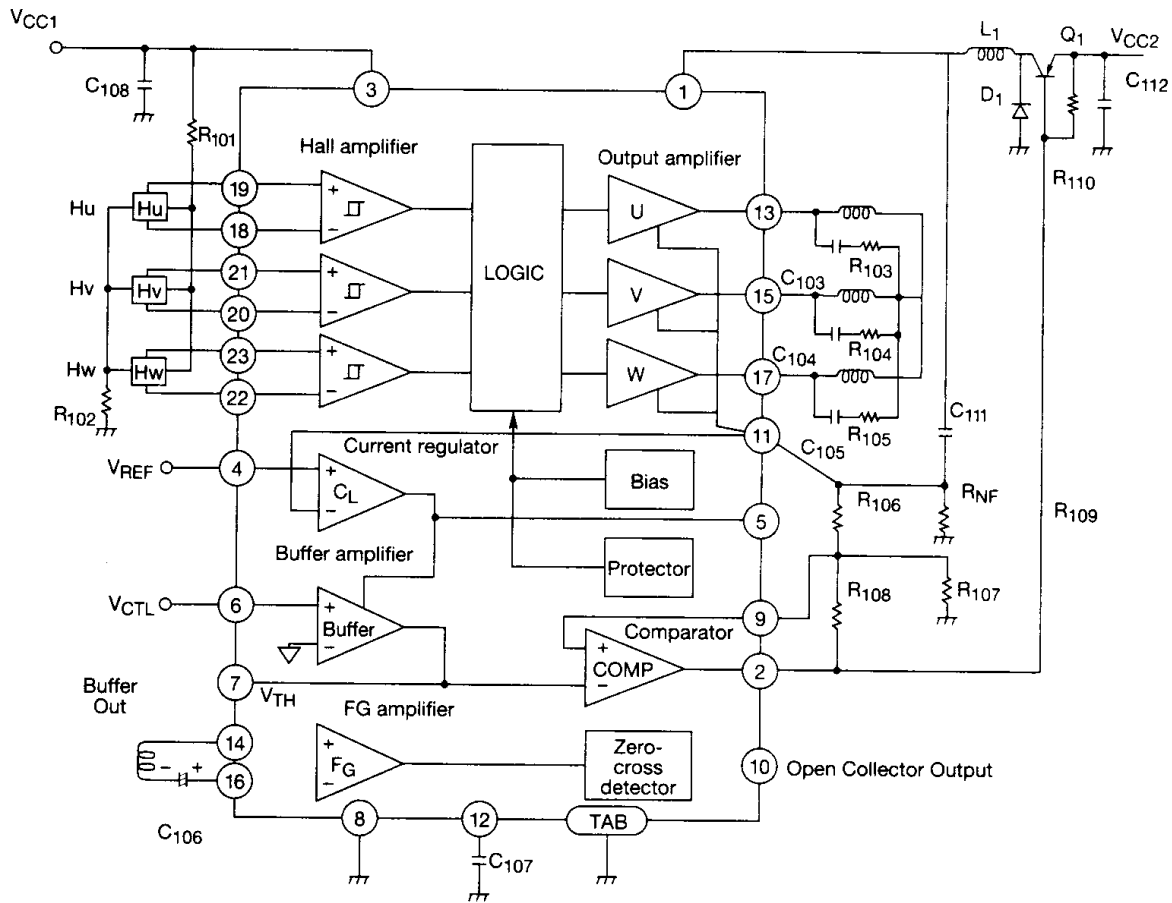
Ordering Information

Type No.	Package
HA13412	SP-23TA



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Block Diagram



Absolute Maximum Ratings (Ta = 25°C)

Parameter	Symbol	Rating	Unit	Note
Control block power supply voltage	V _{CC1}	15	V	1
Output block power supply voltage	V _{CC2}	35	V	1
Output current	I _O	1.0	A	
Power Dissipation	P _T	10	W	
Thermal resistance				
Junction to case	θ _{J-C}	4	°C/W	
Junction to air	θ _{J-a}	40		
Hall amplifier input voltage	V _H	0 to V _{CC1}	V	
Control voltage	V _{CTL}	0 to V _{CC1}	V	
Junction temperature	T _j	150	°C	
Operating temperature	T _{opr}	-20 to +70	°C	
Storage temperature	T _{stg}	-55 to +125	°C	

The absolute maximum ratings are limiting values, to be applied individually, beyond which the device may be permanently damaged. Functional operation under any of these conditions is not guaranteed. Exposing a circuit to its absolute maximum rating for extended periods of time may affect the device's reliability.

Note:

1. Recommended operating voltage range:

$$V_{CC1} = 6-15 \text{ V}$$

$$V_{CC2} = 5-30 \text{ V}$$



Electrical Characteristics (Ta = 25°C, V_{CC1} = 12 V, V_{CC2} = 12 V)

Parameter	Min	Typ	Max	Unit	Test Conditions	Pin	Notes	
Overall	Current consumption	—	18	25	mA	V _{CTL} = 0 V	V _{CC1} = 15 V	3
		—	27	36	mA		V _{CC2} = 35 V, V _{CC1} = 15 V	1
Hall amplifier	Input current	—	—	±50	μA			18–23
	In-phase voltage range		2.0	V _{CC1} – 1.25	V	V _{CC1} = 6–15 V		18–23
	Hysteresis	10	—	30	mV	R _g = 400 Ω		18–23
Output amplifier	Common-mode error voltage	35	—	—	V	I _o = 20 mA		13, 15, 17
	Leakage current	—	—	±1.0	mV	V _{CE} = 35 V		13, 15, 17
	Saturation voltage	—	3.0	4.3	V	V _{CTL} = V _{CC1}	I _O = 1.0 A	13, 15, 17 1
Buffer amplifier	Threshold voltage	0.9	1.0	1.1	V	I _O = 10 mA, V _{CC1} = 8–14 V		6
	Input current	—	0	±12	μA	V _{CTL} = V _{CC1}		6
	Voltage gain	–2	0	+2	dB	f = 500 Hz		6, 7
Comparator	Input offset voltage	—	100	—	mV			
	Output leakage current	—	—	±1.0	mA	V _{CE} = 42 V		
	Output saturation voltage	—	1.0	—	V	I _C = 10 mA		
Current limiter	Offset voltage	–25	—	+25	mV	V _{Ref} = 350 mV		11
FG zero-cross detector	Pulsewidth	—	90	—	μs	FG = 500 Hz/10 mVpp		10 2
detector	Output leakage current	—	—	±10	μA	V _{CE} = 15 V		10
	Output low voltage	—	0.5	1.0	V	I _C = 10 mA		10

Notes:

1. Sum of the upper and lower saturation voltages.
2. Change based on external constants.

External Components

Symbol	Recommended Value	Purpose	Notes
R ₁₀₁ , R ₁₀₂	—	Hall element bias	1
R ₁₀₃ , R ₁₀₄ , R ₁₀₅	10 Ω	Stability	2
R ₁₀₆ , R ₁₀₇	—	Setting of control gain	
R ₁₀₈	—	Setting of comparator hysteresis amplitude	3
R ₁₀₉	—	Comparator output current limiter	4
R ₁₁₀	—	Current leakage prevention	
R _{NF}	—	Output current detection	5
C ₁₀₃ , C ₁₀₄ , C ₁₀₅	0.1 μF	Stability	2
C ₁₀₆	100 μF	AC coupling for FG amplifier	
C ₁₀₇	0.1 μF	Setting of zero cross detector output pulsewidth	
C ₁₁₂ , C ₁₀₈	0.1 μF	Power supply filter	
C ₁₁₁ , L ₁	47 μF/1.0 mH	Lowpass filter	6
D ₁	—	Flywheel diode	

Notes:

1. Bias the Hall amplifiers so that the output voltage exceeds 50 mVpp.
2. Not necessary if there are no incidental oscillations observed in the output waveform.
3. The comparator's hysteresis amplitude (hys) is defined as follows:

$$hys = \frac{V_{CC2}}{\frac{R_{108} + R_{108}}{R_{106} + R_{107}}}$$

Keep hys in the 20–50 mV range



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4. Select R_{109} so that a value of 10 mA is not exceeded.
5. The maximum output current permitted by the current regulator is defined by the following equation. V_{ref} is the voltage at pin 4.

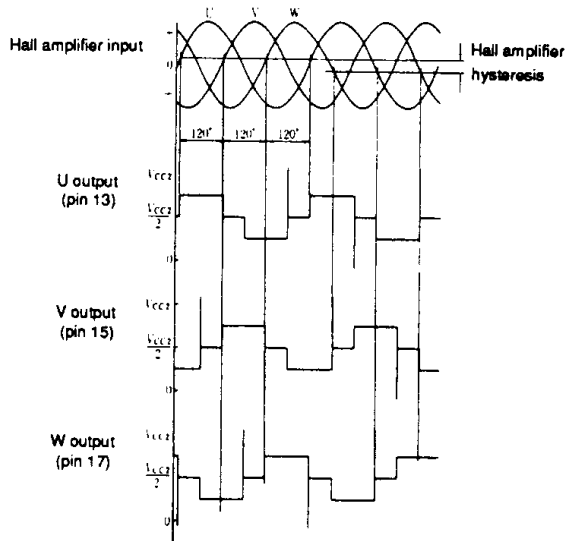
$$I_{max} = \frac{V_{ref}}{R_{NF}}$$

6. The Q_1 switching frequency (f_c) is defined by the following equation.

$$f_c = \frac{R_{NF}}{4L_1} \frac{R_{108}}{R_{106}}$$

Timing Chart

• Hall Amplifier and Output Voltages



• FG Amplifier and Zero-Cross Detector Voltages

