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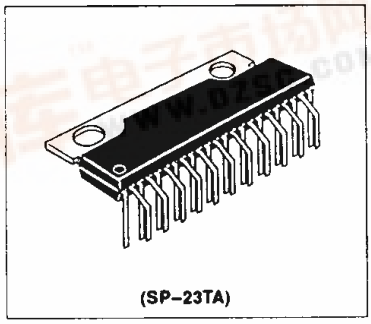
HA13412

Three-Phase Brushless Motor Driver


(SP-23TA)

Description

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

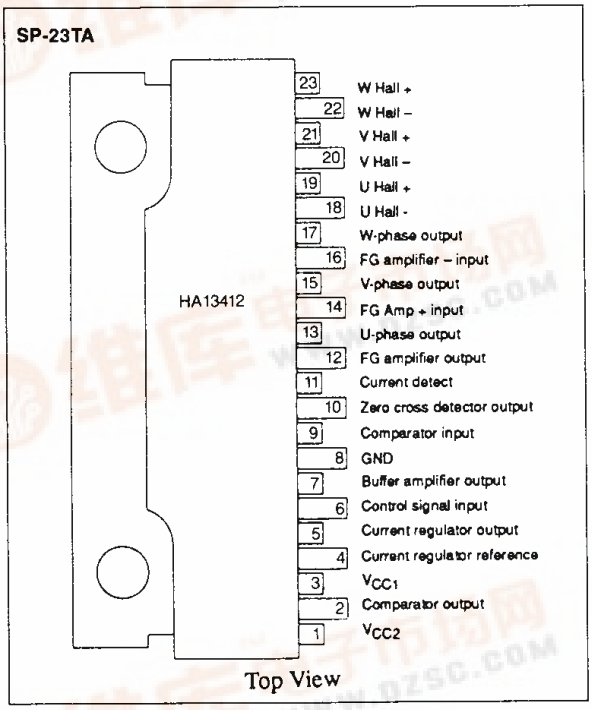
With a maximum output current of 1 A/phase and power supply voltage of 35 V, this device is ideal as a driver for printer positioning motors, etc.

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

SP-23TA



Top View

Ordering Information

Type No.	Package
HA13412	SP-23TA

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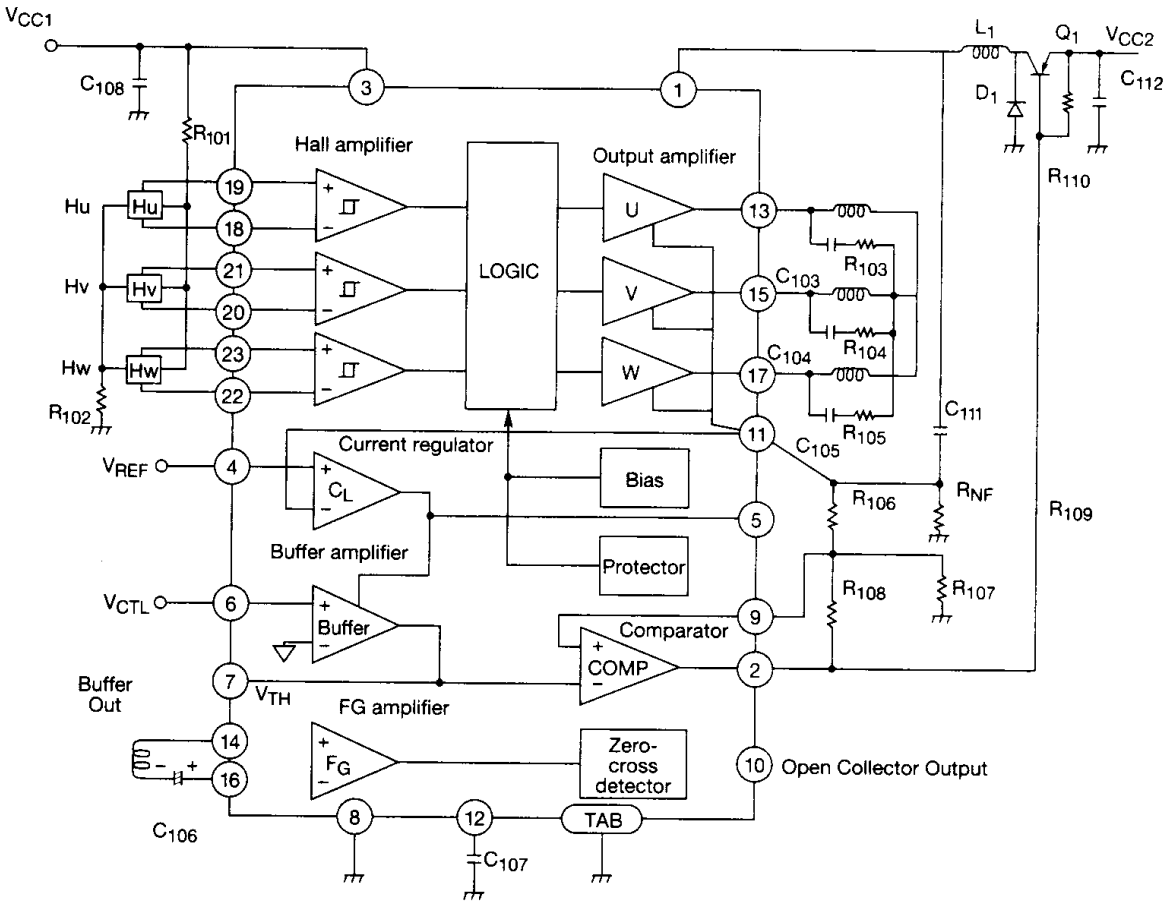
Block Diagram



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	$\theta_{j\text{-}c}$	4	°C/W	
Junction to air	$\theta_{j\text{-}a}$	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 V
   V_{CC2} = 5–30 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
		—	2.0	2.7	V		I_O = 0.6 A		
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	
		–100	—	12	µA	V_{CTL} = 0.4 V			
	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	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 comparater 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:

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

Keep hys in the 20–50 mV range.

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. Vref is the voltage at pin 4.

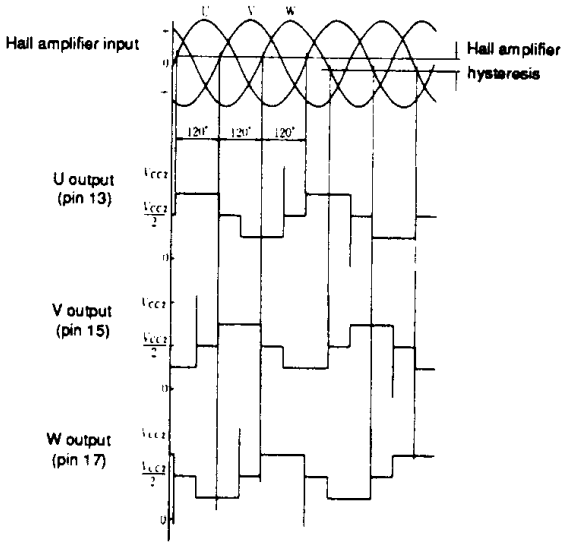
$$I_{o\,max} = \frac{V_{ref}}{R_{NF}}$$

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

$$fc = \frac{R_{NF}}{4L1}\,\frac{R_{108}}{R_{106}}$$

Timing Chart

• Hall Amplifier and Output Voltages



• FG Amplifier and Zero-Cross Detector Voltages