HD13447

Voice Coil Motor Driver

Description

The HA13447 is a voice coil motor driver for hand disk drives (HDD).

Features

- Large output current (4 A peak)
- No cross-over distortion
- Thermally conductive package

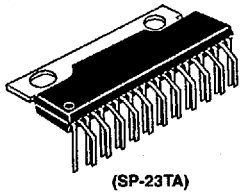
Functions

- Input amplifier
- Voltage regulator
- Bridge output amplifier
- Current sense amplifier
- Chip enable
- Low voltage inhibitor (LVI)
- Over temperature sensing device (OTSD)

Ordering Information

Type No.	Package
HA13447	SP-23TA

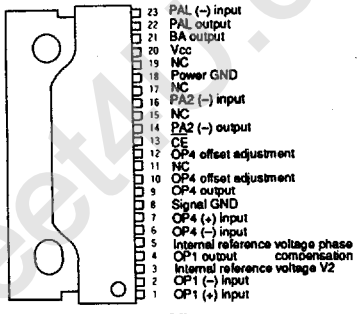
HA13447



(SP-23TA)

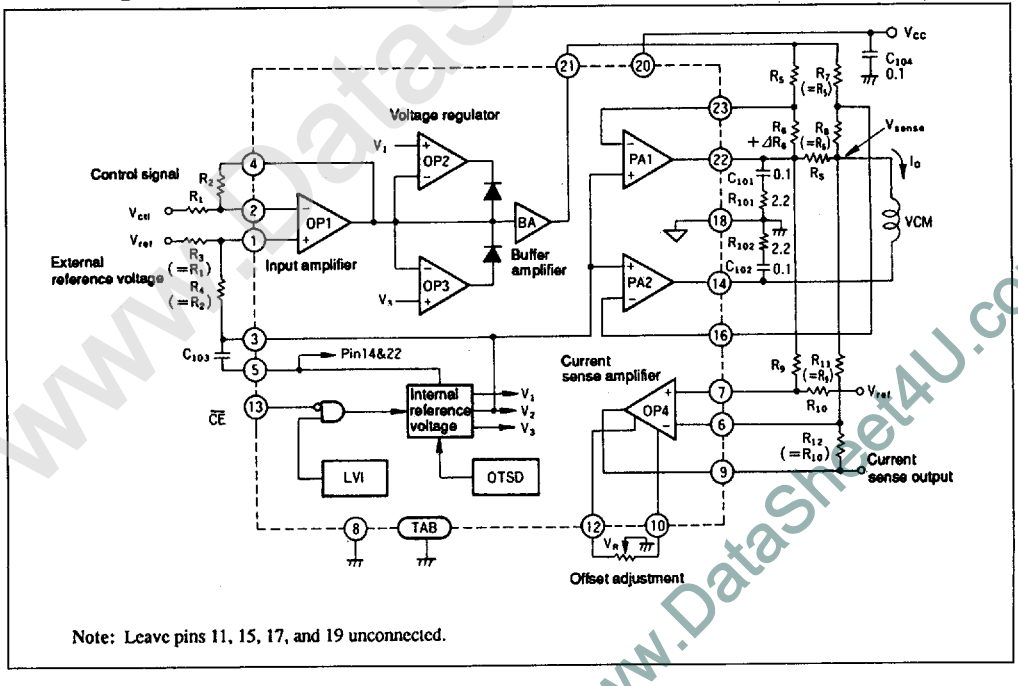
Pin Arrangement

•SP-23TA



Top View

Block Diagram



Note: Leave pins 11, 15, 17, and 19 unconnected.

HA13447

Absolute Maximum Ratings (Ta = 25°C)

Parameter	Symbol	Rating	Unit	Notes
Power supply voltage	V_{CC}	15	V	1
Input voltage	V_{IN}	V_{CC}	V	
Peak output current	I_{Opeak}	4	A	2
Normal output current	I_O	2.8	A	
Power dissipation	P_t	10	W	3
Junction temperature	T_j	150	°C	4
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.

Notes:

1. The recommended operating voltage range is V_{CC} = 12 V± 15% (10.2 V-13.8 V).
2. t ≤ 20 ms.
3. For Tc = 120°C, thermal resistance is as follows:
   $\theta_{j-o} \leq 3°C/W$
   $\theta_{j-a} \leq 40°C/W$
4. Recommended operating temperature range is T_{jop} = 0 to +125°C.

Electrical Characteristics (Ta = 25°C, V_{CC} = 12 V, V_{ref} = 6 V)

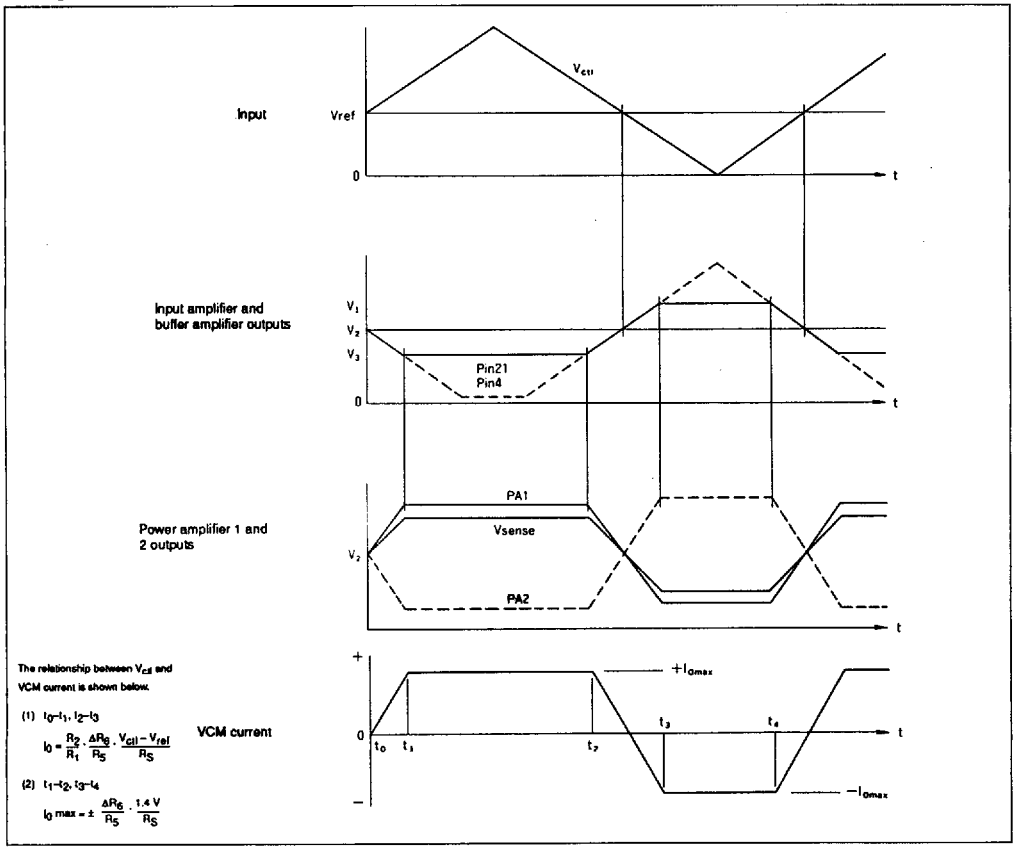
Parameter		Symbol	Min	Typ	Max	Unit	Test Conditions	Pin	Notes
Current consumption		I_{CCO}	—	—	10	mA	CE = H	20	
		I_{CC}	—	—	50	mA	CE = L, V_{ctl} = 6V	20	
Chip enable	Input voltage	V_{IL}	—	—	0.8	V		13	
		V_{IH}	2.0	—	—	V		13	
	Input current	I_{ce}	—	—	±10	μA	CE = 0 to 12 V	13	
Input amplifier	Common mode voltage	V_{OP1}	4	—	8	V		1, 2	
	Input current	I_{OP1}	—	—	±10		μA		1, 2
	Input offset voltage	ΔV_{OP1}	—	—	±10		mV		1, 2
	Output voltage amplitude	Vo1 +	9	—	—	V		4	
		Vo1 −	—	—	2	V		4	
	Open-loop gain	G_{OP1}	—	60	—	dB	f = 1 kHz	4	
	Gain bandwidth	B_{OP1}	—	1000	—	kHz	Gop1 = 0 dB	4	
Voltage limiter and buffer amplifier	Offset voltage	ΔV_{BA}	—	—	±25	mV		21	
		ΔV 1	1.1	1.3	1.5	V		21	1
	Limit voltage	ΔV 3	−1.5	−1.3	−1.1	V		21	2
	Output resistance	R_{BA}	—	—	500	Ω	f = 1 kHz	21	
Output amplifier	Input current	I_{PA}	—	—	±2	μA		16, 23	
	Input offset voltage	ΔV_{PA}	—	—	±20	mV		16, 23	
	Output leakage current	I_{CER}	—	—	1.0	mA	V_{CE} = 15V	14, 22	
	Output saturation voltage	V_{sat}	—	1.4	2.8	V	I_O = 0.6A	14, 22	3
			—	2.0	2.8	V	I_O = 2.8A	14, 22	3
	Open-loop gain	G_{PA}	—	60	—	dB	f = 1 kHz	14, 22	
	Gain bandwidth	B_{PA}	—	1000	—	kHz	G_{PA} = 1 dB	14, 22	

Electrical Characteristics (cont)

Parameter		Symbol	Min	Typ	Max	Unit	Test Conditions	Pin	Notes
Output amplifier	Total harmonic distortion	THD	—	—	3.5	%	f = 1 kHz 50 mA_{rms}	14 22	
			—	—	2.0	%	R_L = 2.5Ω 250 mA_{rms}	14, 22	
Internal reference voltage	Reference voltage	V2	5.4	6.0	6.6	V		3	
	V2 operating range	V2 max	8	—	—	V		3	
		V2 min	—	—	4.0	V		3	
	V2 output resistance	R_{V2}	—	—	100	Ω	f = 1 kHz	3	
Current sense amplifier	Common mode voltage	V_{OP4}	4	—	8	V		6, 7	
	Input current	I_{OP4}	—	—	±2	μA		6, 7	
	Input offset voltage	ΔV_{OP4}	—	—	±10	mV		6, 7	
	Output voltage amplitude	$V_{O}4+$	9	—	—	V		9	
		$V_{O}4-$	—	—	2	V		9	
	Open-loop gain	G_{OP4}	—	60	—	dB	f = 1 kHz	9	
	Bandwidth	B_{OP4}	—	1000	—	kHz	G_{OP4} = 0 dB	9	
LVI	Operating voltage	V_{sd}	8	—	10	V		20	
	Hysteresis	V_{hys}	0.7	—	1.5	V		20	
OTSD	Operating temperature	T_{sd}	—	150	—	°C	ΔV1 = 0.7V	—	

Notes: 1. △ V1=V1-V2 2. △ V3=V3-V2 3. Sum of the upper and lower saturation voltages.

Timing Chart



External Components

Symbol	Recommended Value	Purpose	Notes
R_1, R_2, R_3, R_4	10–56 kΩ	Set input amplifier gain	1
R_5, R_6, R_7, R_8, ΔR_6	10–56 kΩ	Set power amplifier gain	2
R_9, R_{10}, R_{11}, R_{12}	10– 56 kΩ	Set current sense amplifier gain	3
R_{101}, R_{102}	2.2 Ω	Stability	
R_S	≥ 0. 5 Ω	Current detection	4
V_R	10–47 kΩ	Offset adjustment	
C_{101}, C_{102}	0.1 μF	Stability	5
C_{103}	0.1 μF	Phase compensation	
C_{104}	0.1 μF	Power supply filter	

Notes:

1. When $R_1 = R_3$ and $R_2 = R_4$, the input/output characteristics of the input amplifier are given by the following equation. V2 is the internal reference voltage.

$$V_{PIN4} = -\frac{R_2}{R_1}(V_{ctl} - V_{ref}) + V2 \qquad (V_{ctl} - V_{ref}) + V2$$

Ensure that R_1, R_3, R_2, and R_4 are exactly (+/–0.5%) equal to minimize offset voltage.

2. When $R_5 = R_7$ and $R_6 = R_8$, the relationship between $V_{PIN}21$ and the output current I_O (current through R_S) is given by the following equation:

$$I_0 = \frac{\Delta R_6}{R}\frac{V_{PIN}21 - V2}{R_5}$$

Note that R_5 and R_6 must satisfy the following equation when setting the power amplifier gain.

$$\frac{\Delta R_6}{2R_5}\left(\frac{R_L}{R_S} - 1\right) - \left|\frac{\Delta R_6}{6R_5}\left(\frac{R_L}{R_S} + 1\right)\right| \le \frac{R_6}{R_5} \le \frac{\Delta R_6}{2R_5}\left(\frac{R_L}{R_S} - 1\right) + \left|\frac{\Delta R_6}{6R_5}\left(\frac{R_L}{R_S} + 1\right)\right|$$

Where $\frac{R_6}{R_5} \ge 2$

3. When $R_9 = R_{11}$ and $R_{10} = R_{12}$, the relationship between the output current (Io) and $V_{PIN}9$ is as follows:

$$V_{PIN9} = \frac{R_{10}}{R_9} \cdot I_O \cdot R_S + Vref$$

Be sure that R_9, R_{11}, R_{10}, and R_{12} are exactly (±0.5%) equal to minimize offset voltage.

4. Use non-inductive type.

5. Use parts with good high-frequency characteristics and no secondary resonance.