

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

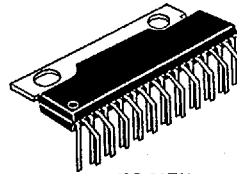
Functions

- 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

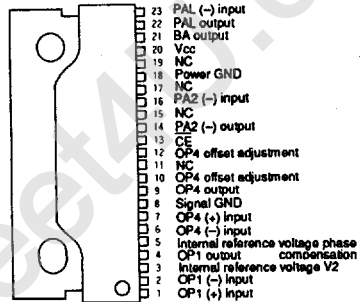
HA13447



(SP-23TA)

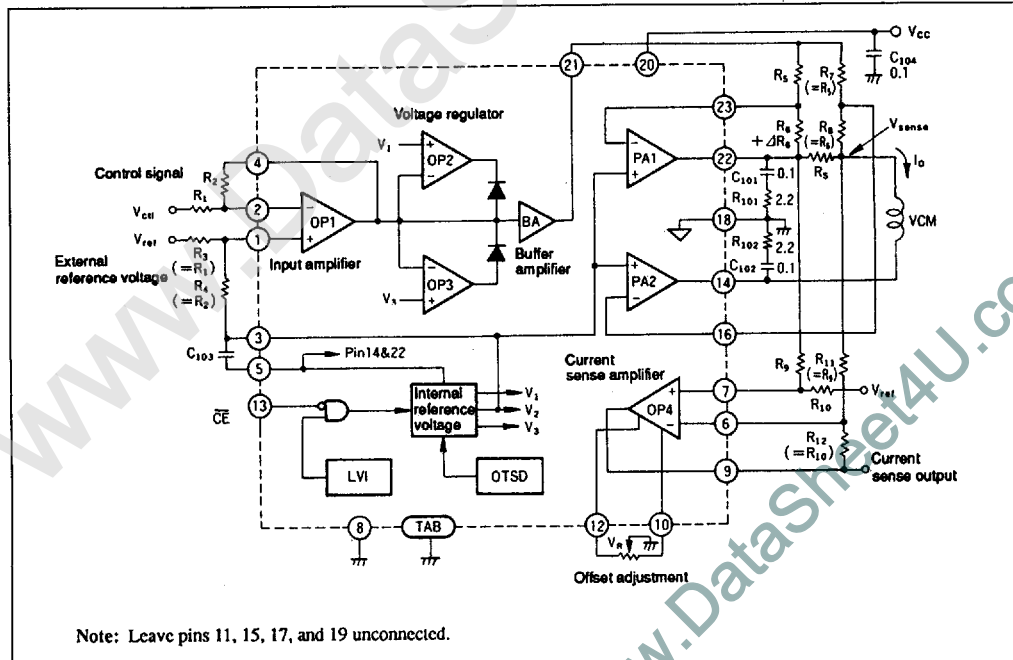
Pin Arrangement

•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:

- The recommended operating voltage range is V_{CC} = 12 V ± 15% (10.2 V-13.8 V).
- t ≤ 20 ms.
- For Tc = 120°C, thermal resistance is as follows:
 $\theta_{j-o} \leq 3^\circ\text{C/W}$
 $\theta_{j-a} \leq 40^\circ\text{C/W}$
- 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 _{clt} = 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	V _{o1+}	9	—	—	V		4	
		V _{o1-}	—	—	2	V		4	
	Open-loop gain	G _{OP1}	—	60	—	dB	f = 1 kHz	4	
Gain bandwidth	B _{OP1}	—	1000	—	kHz	G _{op1} = 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		

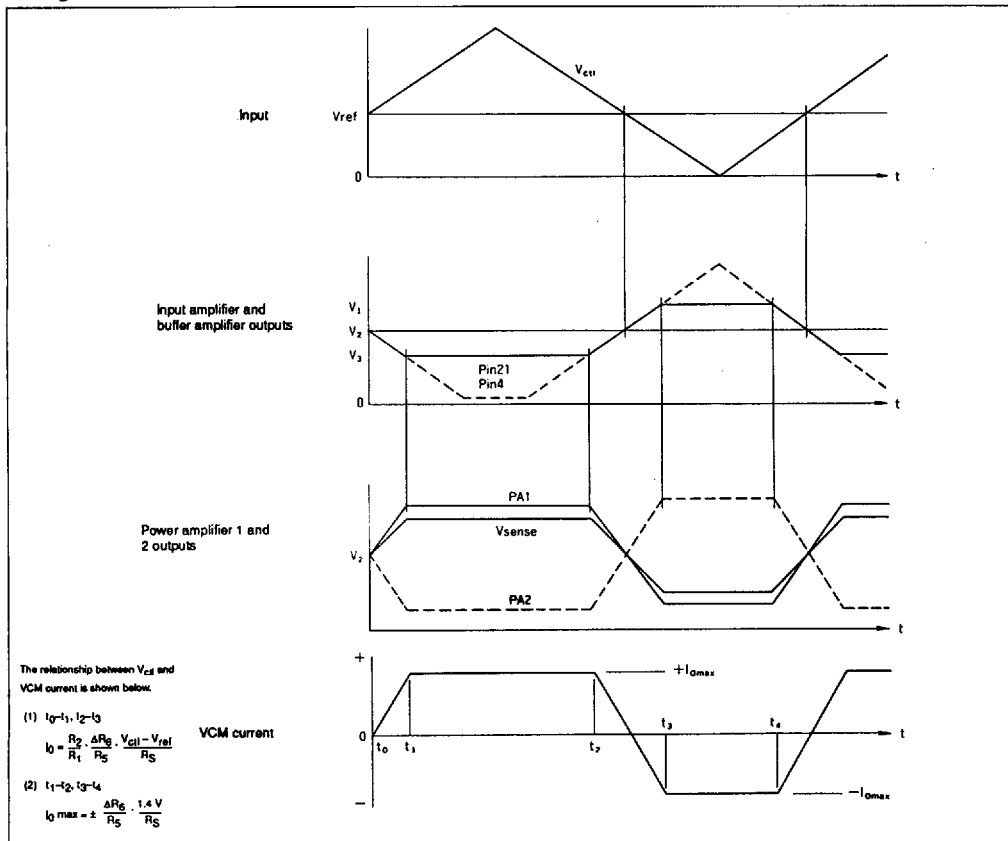
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Electrical Characteristics (cont)

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 _{O4+}	9	—	—	V		9	
			V _{O4-}	—	—	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. ΔV1 = V1 - V2 2. ΔV3 = 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:

- When R₁ = R₃ and R₂ = R₄, the input/output characteristics of the input amplifier are given by the following equation. V₂ is the internal reference voltage.

$$V_{PIN4} = -\frac{R_2}{R_1} (V_{cd} - V_{ref}) + V_2 \quad (V_{cd} - V_{ref}) + V_2$$

Ensure that R₁, R₃, R₂, and R₄ are exactly (+/-0.5%) equal to minimize offset voltage.

- When R₅ = R₇ and R₆ = R₈, the relationship between V_{PIN21} and the output current I_O (current through R_S) is given by the following equation:

$$I_0 = \frac{\Delta R_6}{R} \frac{V_{PIN21} - V_2}{R_5}$$

Note that R₅ and R₆ must satisfy the following equation when setting the power amplifier gain.

$$\frac{\Delta R_6}{2R_5} \left(\frac{R_L}{R_S} - 1 \right) - \left| \frac{\Delta R_8}{8R_5} \left(\frac{R_L}{R_S} + 1 \right) \right| \leq \frac{R_6}{R_5} \leq \frac{\Delta R_8}{2R_5} \left(\frac{R_L}{R_S} - 1 \right) + \left| \frac{\Delta R_8}{8R_5} \left(\frac{R_L}{R_S} + 1 \right) \right|$$

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

- When R₉ = R₁₁ and R₁₀ = R₁₂, the relationship between the output current (I_O) and V_{PIN9} is as follows:

$$V_{PIN9} = \frac{R_{10}}{R_9} \cdot I_0 \cdot R_S + V_{ref}$$

Be sure that R₉, R₁₁, R₁₀, and R₁₂ are exactly (±0.5%) equal to minimize offset voltage.

- Use non-inductive type.
- Use parts with good high-frequency characteristics and no secondary resonance.

