HA166024FP

Pre Amplifier for Hard Disk Drive

The HA166024FP is a 2-channel read and write circuit with very low noise amplifier for small hard disk drives.

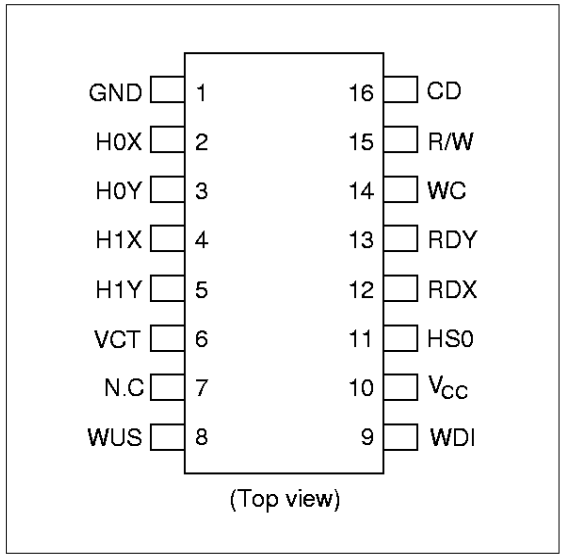
Functions

- Read amplifier circuit
- Write driver circuit
- Write unsafe detection circuit
- Write current source circuit

Features

- Single power supply +5 V
- Low Noise ≤ 1 nV/$\sqrt{\text{Hz}}$
- The HA166024FP incorporates a standby function and realizes low power consumption in the idle mode (5.5 mW typ).
- Read amplifier has high differential voltage gain of 200 typ.
- Emitter followered read amplifier outputs
- Adjustable write current with an external resistor
- Supply voltage monitor circuit inhibit miss writing at the lower supply voltage.
- TTL compatible interface
- I/O pin separated pin arrangement

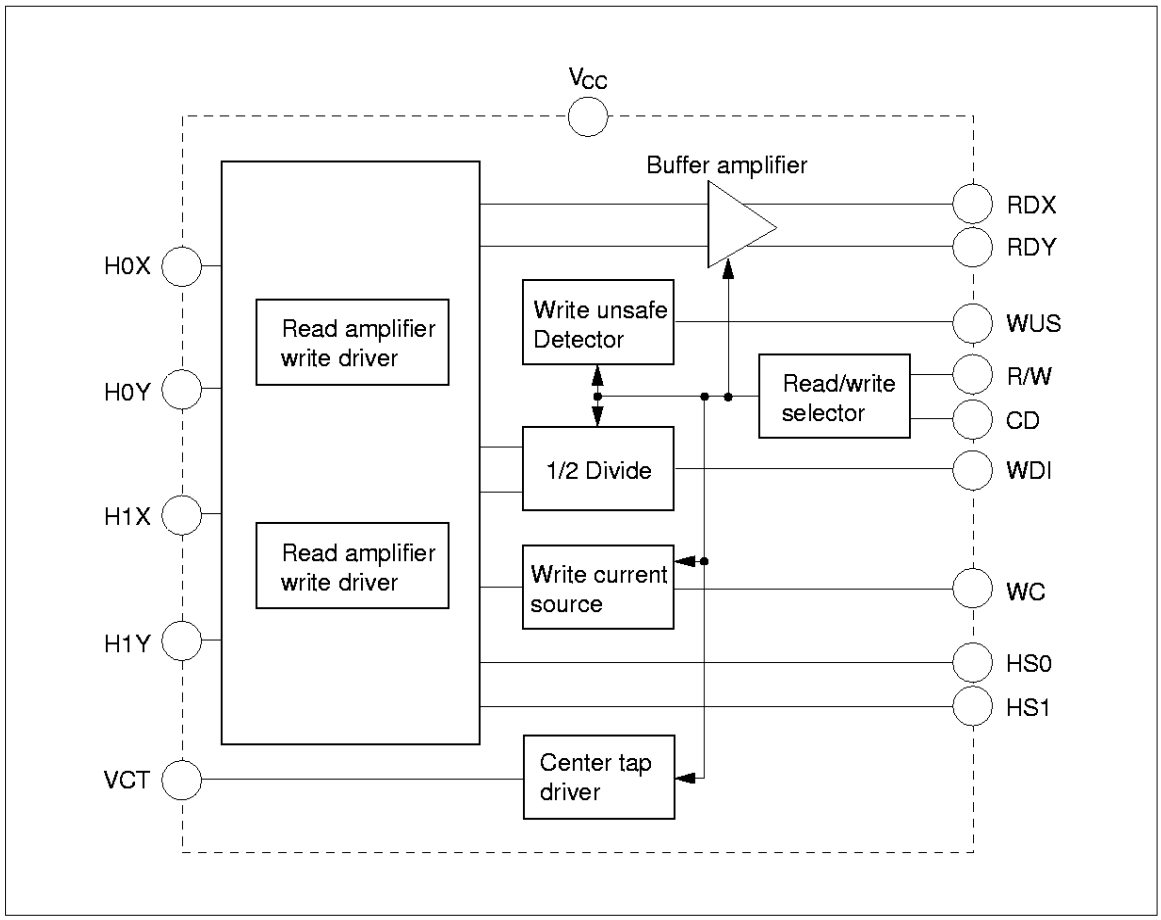
Pin Arrangement



Pin Description

Symbol	Name	Description
RDX RDY	Read amplifier output	Differential output pins for the read amp The signal read out from the head coil is amplified and provided on these pins.
R/W	R/W switch	Mode select switch for changing over the bias condition of the head coil A low level selects the write mode, while a high level selects the read mode.
CD	Chip disable	Circuits go into the standby state and low power consumption state when this pin set to high.
VCT	Center tap voltage output	Center tap voltage output pin for the head coil Current corresponding to the write current flows out from this pin in the write mode.
HS0 HS1	Head select 0 Head select 1	Input pins for head select signals. The combination of these signals selects each one head. Compare with head select table.
H0X, H0Y	Head 0X, 0Y	There pins are connected to the R/W head coil of channel 0.
H1X, H1Y	Head 1X, 1Y	There pins are connected to the R/W head coil of channel 1.
WC	Write Current setting	Write current setting pin. The write current is defined as the equation (1) by connecting the external resistance R_{WC} between this pin and GND. WRITE CURRENT = K/R_{WC} [A] ... (1)
WDI	Write data input	Write data input pin. The signal is divided through the F/F circuit in the IC, and drives the write driver.
WUS	Write unsafe detection output	A high level output indicates the unsafe writing conditions. Unsafe conditions are show as follows, at head pins 1. Short circuit to ground 2. Open Others 3. Center tap open 4. Extremely low WDI input frequency 5. No write current flow 6. All the combinations of the above conditions 7. In the read mode 8. Chip unselected
V_{CC}	5 V	5 V Power supply
GND	Ground	GND pins

Block Diagram



Absolute Maximum Ratings (Ta = 25°C)

Item	Symbol	Rating	Unit	Application terminal
Supply voltage	V5	–0.3 to 6.0	V	V_{CC}
Write current	I_W	60	mA	
Interface input voltage	Vin	–0.3 to V5 +0.3	V	HS0, HS1, WDI, R/W, CD
WUS voltage	V_{WUS}	7.0	V	WUS
WUS Output current	I_{WUS}	12	mA	WUS
Center tap ouput current	Ico	-60	mA	VCT
Read data output current	Iro	–10	mA	RDX, RDY
Head voltage swing	Vh	5.6	V_{p-p}	Note:
Operating temperature	Topr	0 to +70	°C	
Storage temperature	Tstg	–55 to +125	°C	

Note: H0X, H0Y to H1X, H1Y.

Power Supply (Ta = 25°C)

Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Supply voltage range	V_{CC}	4.75	5.0	5.25	V	
+5 V Supply current	I5	—	30	37	mA	Read mode V_{CC} = 5.25 V
			33 + I_W	43 + I_W		Write mode V_{CC} = 5.25 V
			1.0	1.4		Standby mode V_{CC} = 5.25 V

Electrical Characteristics (V_{CC} = 5 V, Ta = 25°C Unless otherwise specified)

Digital Input

Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Low level input voltage	V_{IL}	–0.3	—	0.8	V	
Low level input current	I_{IL}	–400		—	µA	V_{IL} = 0.8 V, (WDI in apply)
		–100				V_{IL} = 0.8 V, (HS0, HS1, CD, R/W in apply)
High level input voltage	V_{IH}	2.0		V_{CC} + 0.3	V	
High level input current	I_{IH}	—		100	µA	V_{IH} = 2.0 V
Read/Write transition time	Trw			600	ns	R/W to 90% VCT write voltage
Write/Read transition time	Twr			1	µs	R/W to 90% VCT read voltage
Head select switching delay time	Ths			600	ns	Read or write mode
Chip disable transition	Tirw			15	µs	R/W to Idle or Idle to R/W (VCT)

Write Faults Detection

Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Low level US voltage	V_{OL}	—	—	0.5	V	I_{OL} = 8 mA
High level US current	I_{OH}			100	µA	V_{OH}= 5.0 V
Unsafe to safe delay time	Td_2			1.0	µs	
Safe to unsafe delay time	Td_1	1.0	—	8.0		

Head Select • Table

HS1	HS0	Head Select
L	L	0
	H	1
H	L	2
	H	3

Mode Select • Table

CD	R/W	Mode
L	L	Write
	H	Read
H	L	Standby
	H	

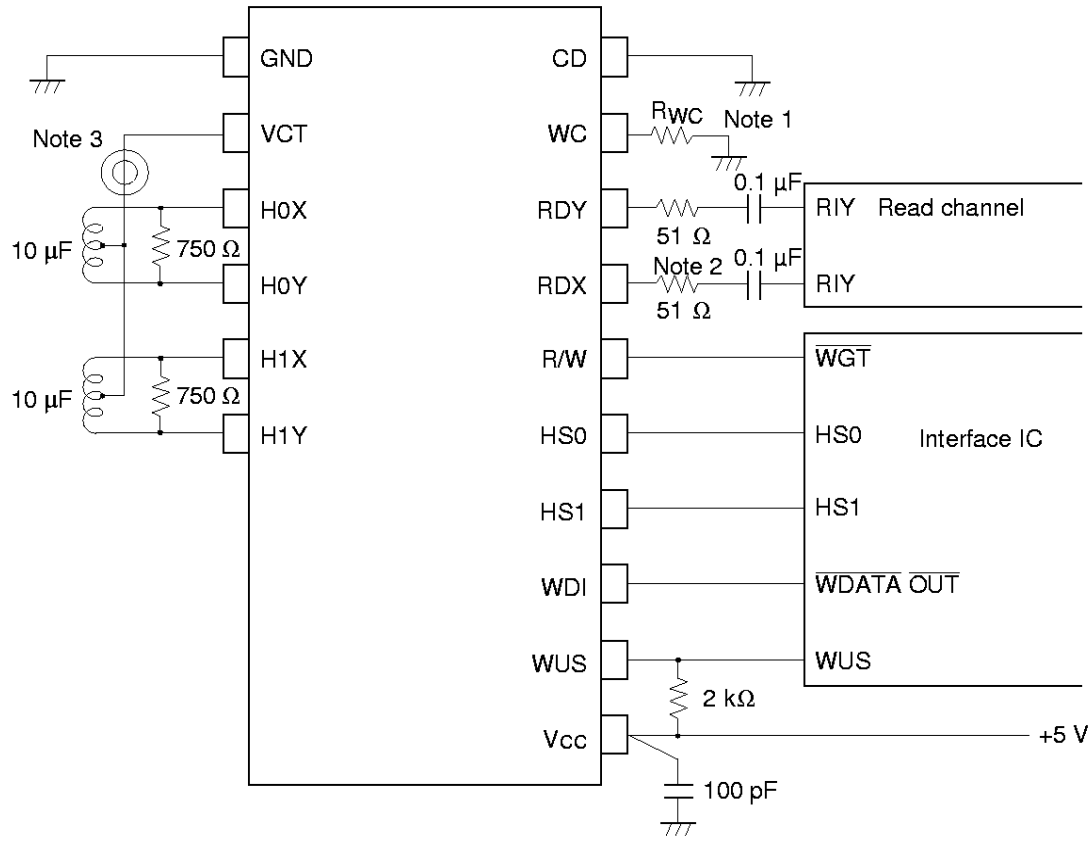
Read Amplifier

Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Differential voltage gain	Avd	170	200	230	V/V	f = 300 kHz
Band width (-3 dB)	B_W	40	—	—	MHz	
Input noise voltage	Vn	—		1.0	nV/√Hz	f ≤ 15 MHz, Input short
Input bias current	Ib		36	80	µA	Read mode
Common mode rejection	CMRR	50	—	—	dB	Vin(cm) = VCT + 100 mVpp, 0.0 VDC, f = 5 MHz
Power supply rejection ratio	PSRR	45				V_{CC} ±100 mVpp, f = 5 MHz
Channel separation	Sep	55				Vin = 100 mVpp, f = 5 MHz on unselected channels and Vin = 0 mVpp on selected channels
Output offset voltage	Vo	–300	—	300	mV	Input short
Differential input impedance	Rin	—	2.3	—	kΩ	f = 300 kHz
			1.3			f = 5 MHz
Common mode output voltage	Vocm	3.15	3.45	3.75	V	
Output source current		—	–5	—	mA	
Output sink current	I_{OS}	1.9	2.5			

Write Driver

Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Write current setting range	I_W	10	—	50	mA	I_W •Lhead > 200 mA •µH
Head current rise time	Thcx	—		20	ns	Lh = 0 µH, Rh = 0 Ω, 10% to 90% point
Head current switching delay time	Td_3			25		Rh = 0 Ω, Lh = 0 µH, From 50% point
Head current switching symmetry	Td_4			2		WDI duty = 50%, rise/fall time = 1 ns
WDI minimum input frequency	Fw	1		—	MHz	WUS = LOW
Head current gain	Ih/I_{WC}	—	25			Head current/Iwc
VCT output voltage	VCT	1.85	2.1	2.4	V	Read mode Ib = –80 µA
		4.3	4.6	4.97		Write mode Iwc = –45 mA
Write current accuracy 1	Ih1	9.3	10	10.7	mA	Rwc1 = 2.7 kΩ
Write current accuracy 2	Ih2	27.9	30.0	32.1		Rwc2 = 0.85 kΩ
Write current accuracy 3	Ih3	46.5	50.0	53.5		Rwc3 = 0.49 kΩ

An Example of Application Circuit



Notes: 1. External resistance value, R_{WC} is determined by following equation.

$$R_{WC}\ [k\Omega] = \frac{26\ (typ)}{\text{Write current [mA]}}$$

To damp the ringing of write current at the transient period of read to write, put R_{WC} just near the WC pin.

2. To aboid abnormal oscillation of RD outputs, shorten the pattern length or put series resistor as shown.

3. Ferrite beads (or LR filter) control overshoot of write current, ringing and so on.