HA166024FP/025FP —— Under Development

Read/Write IC for Hard Disk Drive

Description

The HA166024FP/025FP are 2 and 4-channel read and write circuit with very low noise amplifier for small hard disk drives.

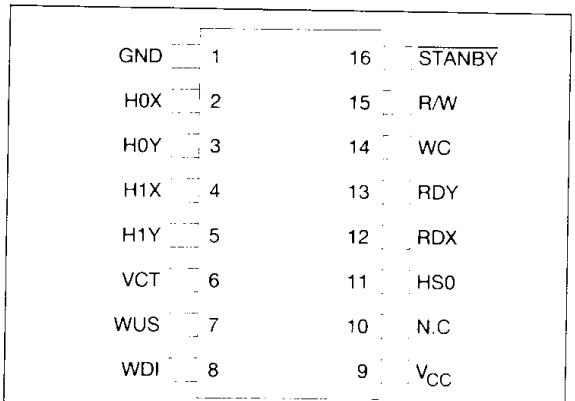
Functions

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

Features

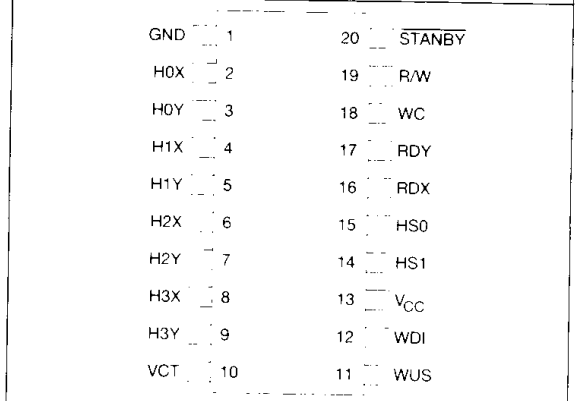
- Single power supply +5V
- Low noise $\leq$ 1 nv/$\sqrt{Hz}$
- The HA166024FP/025FP incorporates a standby function and realizes low power consumption in the idle mode (3.5mW typ).
- Read amplifier has high differential voltage gain of 200 typ.
- Emitter follower read amplifier outputs
- Adjustable 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



(Top View)

HA166024FP



(Top View)

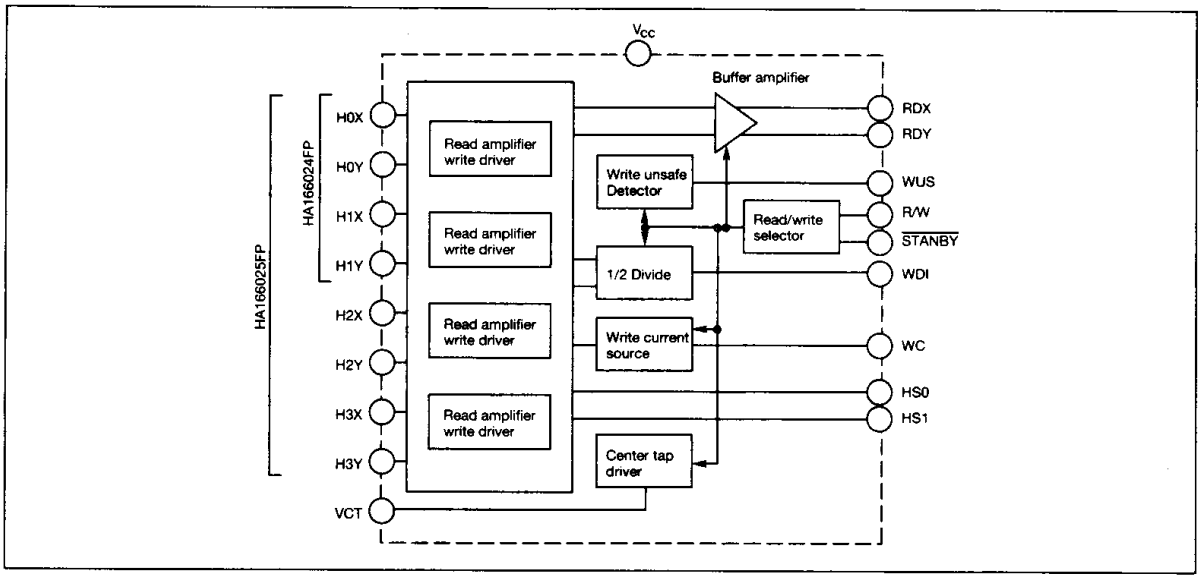
HA166025FP

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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.
$\overline{\text{STANBY}}$	Standby	Circuits go into the standby state and low power consumption state when this pin set to low.
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.
H2X, H2Y	Head 2X, 2Y	There pins are connected to the R/W head coil of channel 2.
H3X, H3Y	Head 3X, 3Y	There pins are connected to the R/W head coil of channel 3.
WC	Write current setting	Write current setting pin. The write current is defined as the equation (1) by connecting the external resistance Rwc between this pin and GND. WRITE CURRENT = K/RWC [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 shown 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
Vcc	5V	5V Power supply
GND	Ground	GND pins

Block Diagram



Absolute Maximum Ratings (Ta = 25°C)

Item	Symbol	Rating	Unit	Application terminal
Supply voltage	V_5	−0.3 to 6.0	V	Vcc
Write current	Iw	60	mA	
Interface input voltage	V_{in}	−0.3 to V_5 + 0.3	V	HS0, HS1, WD1, R/W, $\overline{\text{STANBY}}$
WUS voltage	V_{WUS}	14.0	V	WUS
WUS output current	I_{WUS}	12	mA	WUS
Center tap output current	I_{co}	−60	mA	VCT
Read data output current	I_{ro}	−10	mA	RDX, RDY
Head voltage swing	V_h	6.0	V_{P-P}	Note:
Operating temperature	T_{opr}	0 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: The HA166024FP has H0X, H0Y to H1X, H1Y.
The HA166025FP has H0X, H0Y to H3X, H3Y.

Power Supply (Ta = 25°C)

Item	Symbol	Min.	Typ.	Max.	Unit	Test Conditions	Note
Supply voltage range	Vcc	4.5	5.0	5.5	V		
+5V Supply current	I_5	—	26	35	mA	Read mode Vcc = 5.5V	1
			33 + Iw	48 + Iw		Write mode Vcc = 5.5V	
			0.7	1.2		Standby mode Vcc = 5.5V	
			27	36		Read mode Vcc = 5.5V	2
			35 + Iw	50 + Iw		Write mode Vcc = 5.5V	
			0.7	1.2		Idle mode Vcc = 5.5V	

Notes: 1. Apply for the HA166024FP. 2. Apply for the HA166025FP.

Electrical Characteristics (V_{CC} = 5V, T_a = 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} = 0.8V, (WDI in apply)
		-100				V_{il} = 0.8V, (HS0. HS1, $\overline{\text{STANBY}}$, R/W in apply)
High level input voltage	V_{ih}	2.0		V_{CC} + 0.3	V	
High level input current	I_{ih}			100	V_{ih} = 2.0V	μA
Read/Write transition time	T_{rw}		—			R/W to 90% VCT write voltage
Write/Read transition time	T_{wr}	—		600	ns	R/W to 90% VCT read voltage
Head select switching delay time	T_{hs}					Read or write mode
Chip disable transition	T_{irw}					R/W to idle or idle to R/W

Write Faults Detection

Item	Symbol	Min.	Typ.	Max.	Unit	Test Conditions
Low level US voltage	V_{ol}			0.5		V_{Lol} = 8mA
High level US current	I_{oh}	—	—	100		μA V_{oh} = 5.0V
Unsafe to safe delay time	T_{d2}			1.0	μs	
Safe to unsafe delay time	T_{d1}	1.6		8.0		

Head Select

HS1	Hs0	Head Select
L	L	0
	H	1
H	L	2
	H	3

Mode Select

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

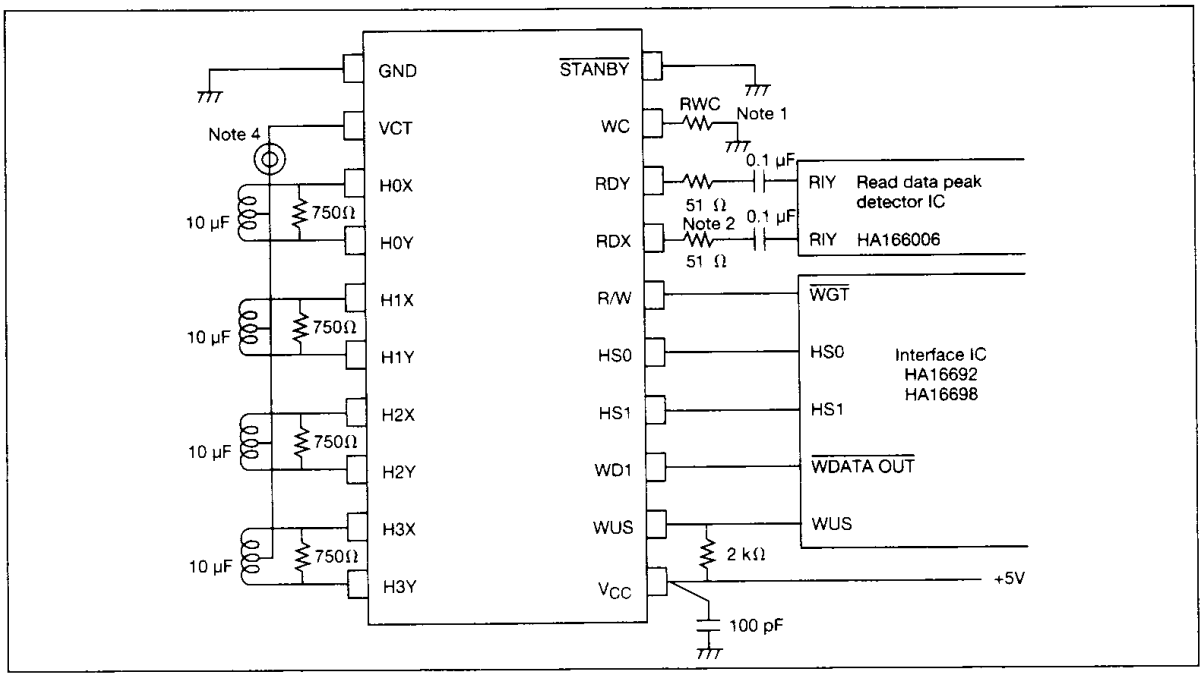
Read Amplifier

Item	Symbol	Min.	Typ.	Max.	Unit	Test Conditions
Differential voltage gain	Avd	170	200	230	V/V	f = 300 kHz
Band width (–3 dB)	Bw	40	—	—	MHz	
Input noise voltage	Vn	—		1.0	nV/√Hz	f ≤ 15 MHz, Input short
Input bias current	Ib		55	120	μA	Read mode
Common mode rejection	CMRR	50	—	—	dB	$V_{in(cm)}$ = VCT + 100mVPP, 0.0 VDC, f = 5 MHz
Power supply rejection ratio	PSRR	45				VCC ± 100mVPP, f = 5 MHz
Channel separation	Sep	60	80			Vin = 100mVPP, f = 5 MHz on unselected channels and Vin = 0mVPP on selected channels
Output offset voltage	Vo	–600	—	600	mV	Input short
Differential input impedance	Rin	—	2.3	—	kΩ	f = 300kHz
			1.3			f = 5MHz
Common mode output voltage	Vocm	2.5	3.0	3.5	V	
Output source current		—	–10	—	mA	
Output sink current	Ios	2.0	2.5			

Write Driver

Item	Symbol	Min.	Typ.	Max.	Unit	Test Conditions
Write current setting range	Iw	10	—	50	mA	Iw • Lhead > 200mA • μH
Head current rise time	Thcx	—	—	20	ns	Lh = 0μH, Rh = 0Ω, 10% to 90% point
Head current switching delay time	Td3			25		Rh = 0Ω, Lh = 0μH, from 50% point
Head current switching symmetry	Td4			2		WDI duty = 50%, rise/fall time = 1ns
WDI minimum input frequency	Fw	125		—	kHz	WUS = LOW
Head current gain	Ih/IWC	—	40			Head current/Iwc
VCT output voltage	VCT	1.8	2.1	2.4	V	Read mode Ib = –120 μA
		4.3	4.6	4.9		Write mode Iwc = –45mA
Write current accuracy 1	Ih1	9.3	10	10.7	mA	Rwc1 = 2.7kΩ
Write current accuracy 2	Ih2	27.9	30.0	32.1		Rwc2 = 0.85kΩ
Write current accuracy 3	Ih3	46.5	50.0	53.5		Rwc3 = 0.49Ω

An Example of Application Circuit



Notes: 1. External resistance value, RWC is determined by the following equation:

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

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

2. To avoid 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.