HA166152FP4
Pre Amplifier for
Hard Disk Drive

HITACHI

Rev. 0
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The HA166152FP4 is read/write amplifier designed for use with thin film recording heads. They have the following functions and features.

Functions

- Read amplifier circuit
- Write driver circuit
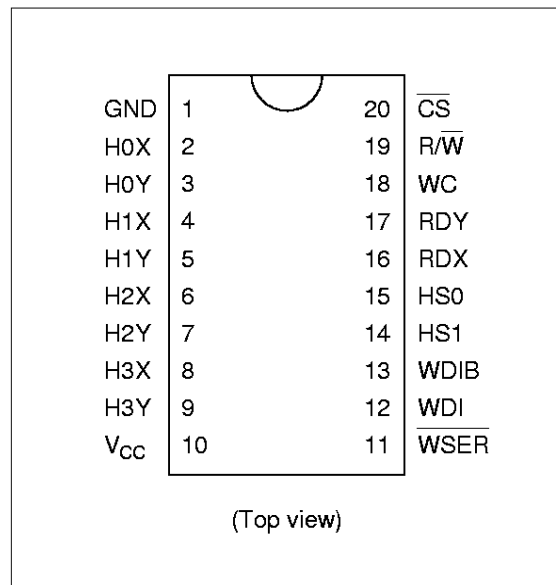- Constant write current setup circuit
- 4 channel servo write

Features

- Single power supply +5 V
- Low power
  Read: 195 mW (Typ)
  Idle: 35 mW (Typ)
- Low Noise: 0.5 nV/√Hz (Typ)
- Read amplifier has high differential voltage gain
  : 345 V/V (Typ)
- Built-in current and voltage monitors
- ECL compatible interface
- Emitter-follower read amplifier outputs
- Input capacitance: 10 pF (Typ)
- Write current range: 5 to 30 mA

Ordering Information

Type	Channel	Package
HA166152FP4	4	FP-20DA

Pin Arrangement

GND	1		20	$\overline{CS}$
H0X	2		19	$R/\overline{W}$
H0Y	3		18	WC
H1X	4		17	RDY
H1Y	5		16	RDX
H2X	6		15	HS0
H2Y	7		14	HS1
H3X	8		13	WDIB
H3Y	9		12	WDI
V_{CC}	10		11	$\overline{WSER}$

(Top view)

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Pin Description

Pin No.	Symbol	Pin Name	Description
1	GND	Ground	Ground pins
2, 3	H0X, H0Y	Head 0X, 0Y	These pins are connected to the R/$\overline{\text{W}}$ head coil of channel 0.
4, 5	H1X, H1Y	Head 1X, 1Y	These pins are connected to the R/$\overline{\text{W}}$ head coil of channel 1.
6, 7	H2X, H2Y	Head 2X, 2Y	These pins are connected to the R/$\overline{\text{W}}$ head coil of channel 2.
8, 9	H3X, H3Y	Head 3X, 3Y	These pins are connected to the R/$\overline{\text{W}}$ head coil of channel 3.
10	V_{CC}	5 V	5 V power supply
11	$\overline{\text{WSER}}$	Servo write switch	When R/$\overline{\text{W}}$ and $\overline{\text{WSER}}$ are set low, all write drivers are selected. Refer to the Mode Select Table.
12, 13	WDI, WDIB	Write data input	Write data input pin. The signal is devided in the IC, and drives the write driver.
14	HS1	Head select 1	Input pins for head select signals. The combination of these signals selects one head from head 0 to head 3. Refer to the head select table.
15	HS0	Head select 0	
16, 17	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.
18	WC	Write current setting	Write current setting pin. The write current is defined by the equation below by connecting the external resistance R_{WC} between this pin and GND. Write current [mA] = K/R_{WC} [kΩ]
19	R/$\overline{\text{W}}$	R/$\overline{\text{W}}$ 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.
20	$\overline{\text{CS}}$	Chip select	When this line is set high, the circuit goes into the idle state, a low power state. When this line is low, the chip is active.

Block Diagram
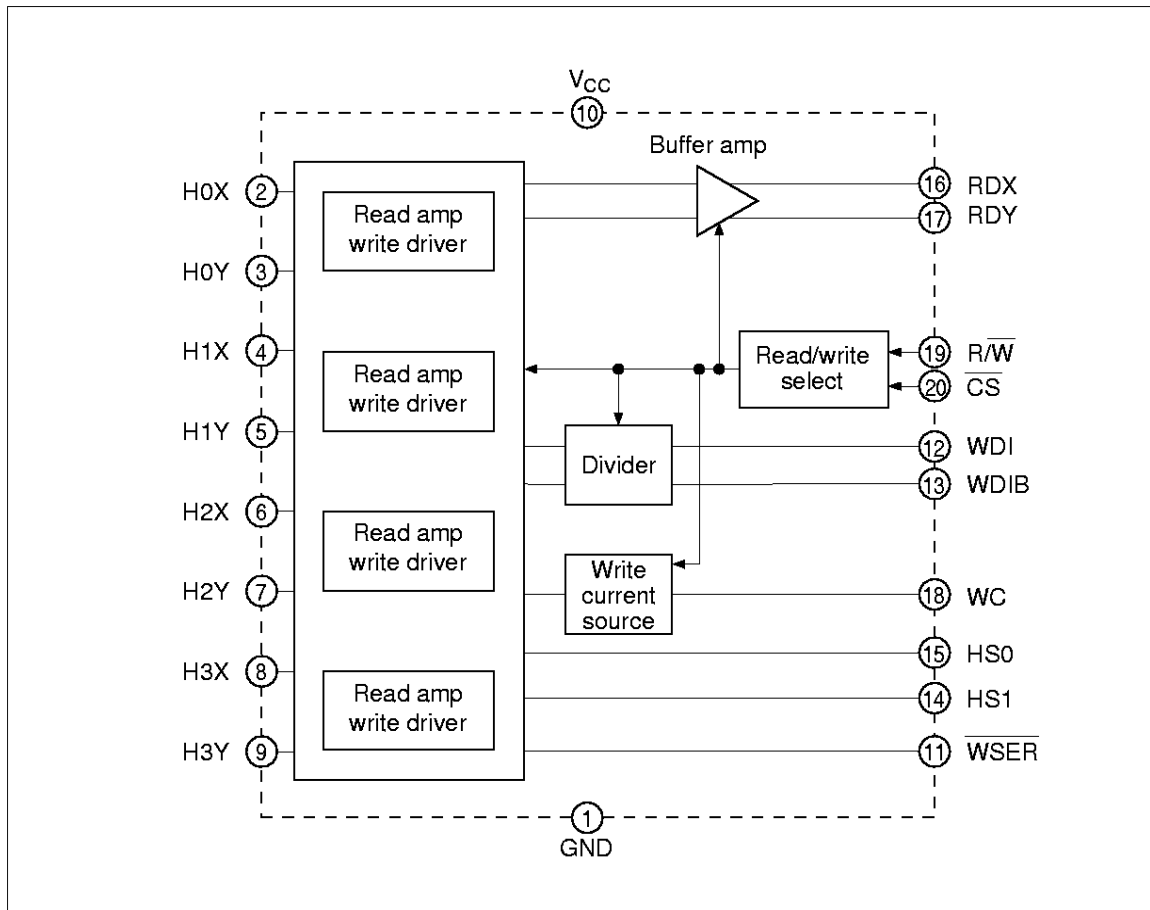
Absolute Maximum Ratings (Ta = 25°C)

Item	Symbol	Rating	Unit	Applicable Terminal
Supply voltage	V_{CC}	−0.3 to +6.0	V	V_{CC}
Write current	I_W	35	mA	
Interface input voltage	V_{IN}	−0.3 to V_{CC} +0.3	V	HS0, HS1, WDI, WDIB $\overline{\text{WSER}}$, R/$\overline{\text{W}}$, $\overline{\text{CS}}$
Read data output current	I_{RO}	−10	mA	RDX, RDY
Operating temperature	Topr	0 to +70	°C	
Storage temperature	Tstg	−55 to +150	°C	
Head voltage swing	V_{HSW}	4.0	Vpp	
Power dissipation	P_T	550	mW	

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Power Supply (Ta = 25°C)

Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Supply voltage range	V_{CC}	4.5	—	5.5	V	
+5.5 V supply current	I_{CC}	—	39	52	mA	Read mode
		—	$35 + I_W$	$43 + I_W$		Write mode
		—	7	11		Idle mode

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 voltage1	V_{IL1}	−0.3	—	0.8	V	
Low level input current1	I_{IL1}	−100	—	—	μA	V_{IL} = 0.4 V
High level input voltage1	V_{IH1}	2.0	—	V_{CC} + 0.3	V	
High level input current1	I_{IH1}	—	—	20	μA	V_{IH} = 2.0 V
Low level input voltage2	V_{IL2}	V_{CC} − 2	—	V_{CC} − 1.65	V	(WDI, WDIB)
Low level input current2	I_{IL2}	—	—	0.75	mA	V_{IL} = 3.2 V (WDI, WDIB)
High level input voltage2	V_{IH2}	V_{CC} − 1	—	V_{CC} + 0.3	V	(WDI, WDIB)
High level input current2	I_{IH2}	—	—	0.95	mA	V_{IH} = 4.2 V (WDI, WDIB)
Read/write transition time	t_{RW}	—	—	150	ns	
Write/read transition time	t_{WR}	—	—	500	ns	
Head select switching delay time	t_{HS}	—	—	1000	ns	Read mode
Chip disable transition time	t_{IRW}	—	—	1000	ns	Idle to read

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Head Select Table

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

Mode Select Table

R/$\overline{W}$	$\overline{WSER}$	Mode
L	L	Servo Write*1
	H	Write
H	L	Prohibition
	H	Read

Note: 1. When R/$\overline{W}$ and $\overline{WSER}$ are set from high to low, R/$\overline{W}$ and $\overline{WSER}$ must be switched at same timing and HS0, HS1 must be set high level.

Read Amplifier

Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Differential voltage gain	Avd	300	345	390	V/V	f = 300 kHz
Bandwidth	B_W	(90)*1	(150)*1	—	MHz	−3 dB
Input noise voltage	Vn	—	(0.5)*1	(0.6)*1	nV/$\sqrt{\text{Hz}}$	f ≤ 15 MHz, Inputs shorted
Common mode rejection ratio	CMRR	60	80	—	dB	
Power supply stability	PSRR	45	60	—		V_{CC} ±100 mVp-p, f = 5 MHz
Channel separation	Sep	60	80	—		Vin = 100 mVp-p on unselected channels and Vin = 0 mVp-p on selected channels, f = 5 MHz
Output offset voltage	Vo	−300	—	300	mV	Inputs shorted
Differential input impedance	Rin	—	0.72	—	kΩ	f = 300 kHz
			0.70			f = 5 MHz
Common mode output voltage	Vcom	2.0	2.5	3.0	V	
Output source current	I_{OSO}	—	−10	—	mA	
Output sink current	I_{OSI}	1.5	2.0	—		
Input capasitance	C_{IN}	—	(10)*1	(15)*1	pF	

Note: 1. These values are only for design purpose.

Write Driver

Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Write current setting range	I_W	5	—	30	mA	
Head current rise time	t_{hex}	—	4	15	ns	Lh = 0 µH, Rh = 0 Ω, 10% to 90% point
Head current switching delay time	t_{d3}	—	—	30		Rh = 0 Ω, Lh = 0 µH, from 50% point
Head current switching symmetry	t_{d4}	—	—	(1)*1		WDI duty cycle = 50%, rise/fall time = 1 ns
Head current gain	I_H/I_{WC}	—	19	—	A/A	Head current/I_{WC}
WC output voltage	V_{WC}	—	2.8	—	V	
Write current accuracy1	I_{H1}	9.45	10.5	11.55	mA	R_{WC} = 5 kΩ
Write current accuracy2	I_{H2}	18.0	20.0	22.0	mA	R_{WC} = 2.5 kΩ
Write current accuracy3	I_{H3}	27.0	30.0	33.0	mA	R_{WC} = 1.6 kΩ

Note: 1. These values are only for design purpose.
    2. Write current constant : K is determined by the following equation.
       $K = 54.8 - 0.23\ I_W\ $ (mA)
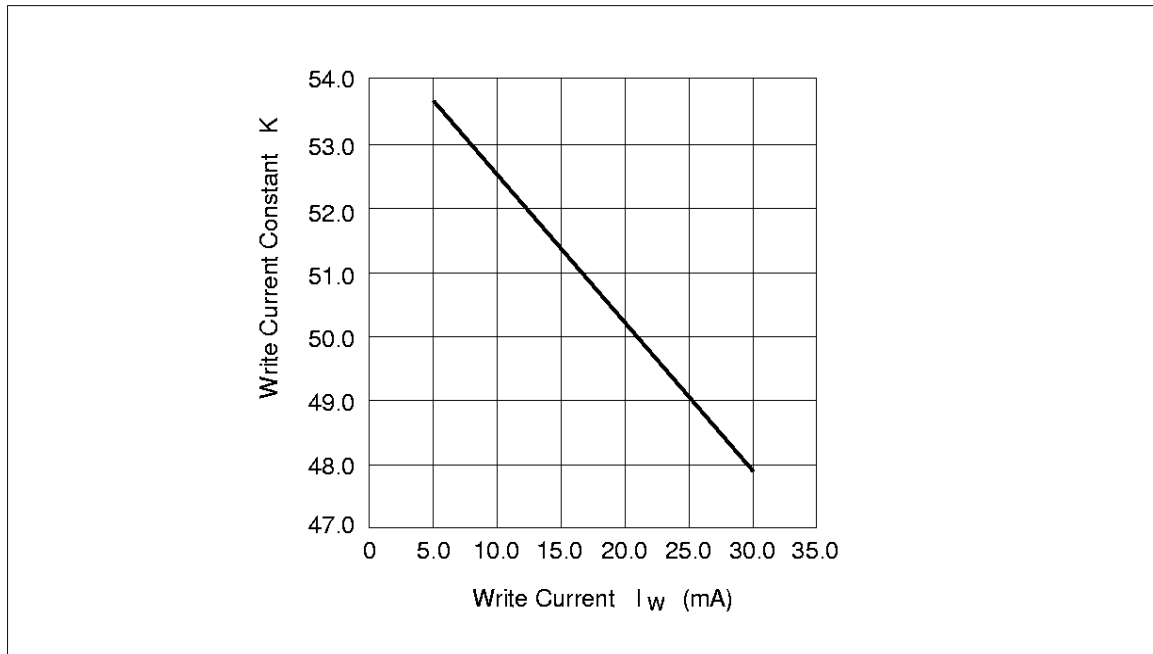
Figure.1 The relation between K and I_W

Timing Waveforms

WDI

R/$\overline{\text{W}}$ 50% 50%

$\overline{\text{CS}}$ 50%

t_{RW}

I_{WX}
I_{WY} 90% 90% 10%

t_{WR} t_{IRW}

RDX
RDY 90% 90%

WDI 50% 50%

t_{d3}

I_{WX}
I_{WY} 50% 90% 90% 10% 10%

t_{hex} t_{hex}

R/$\overline{\text{W}}$ 1.4 V

$\overline{\text{WSER}}$ 1.4 V

Time Lag must be under 10ns
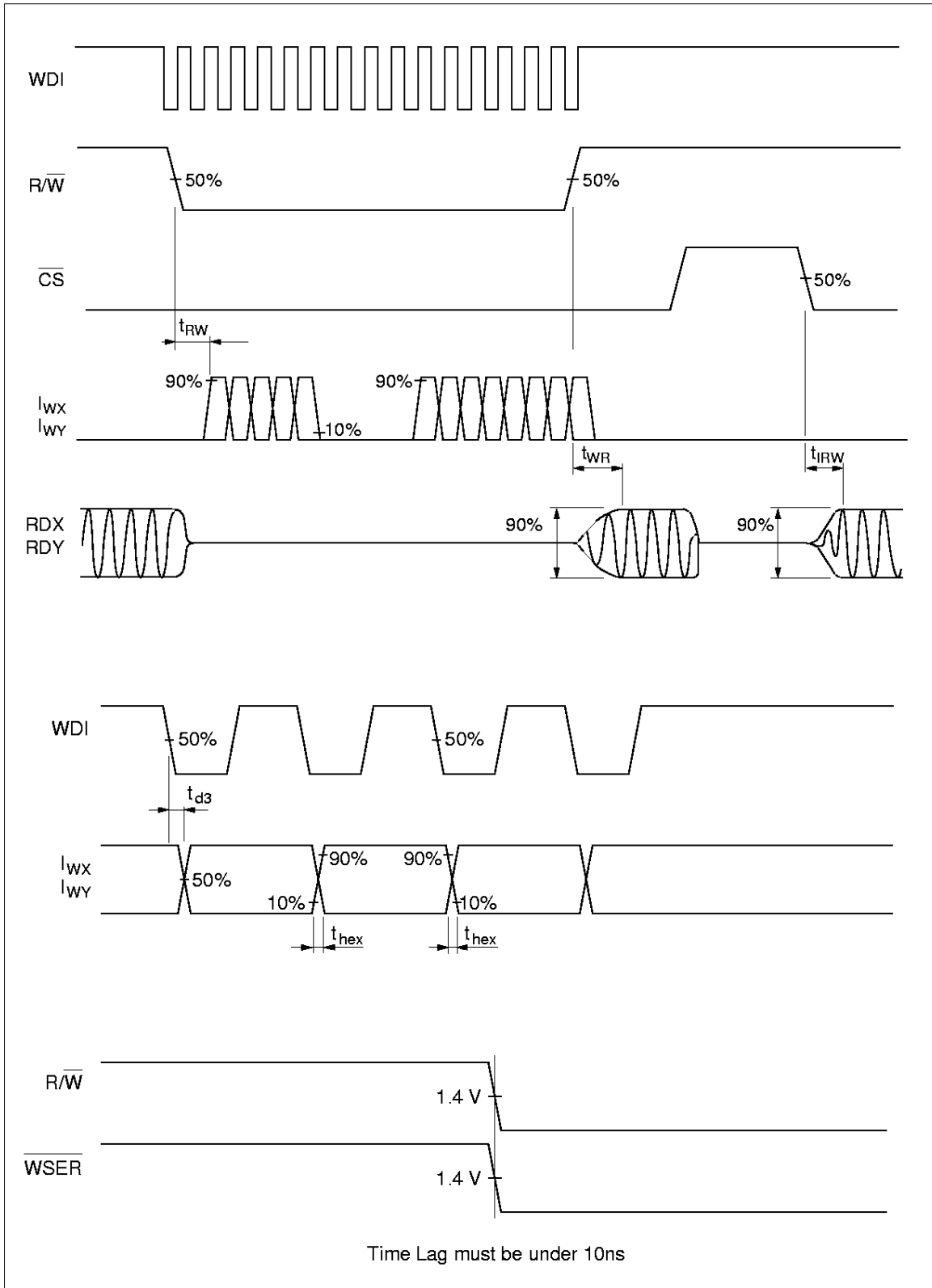
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Application Circuit Example
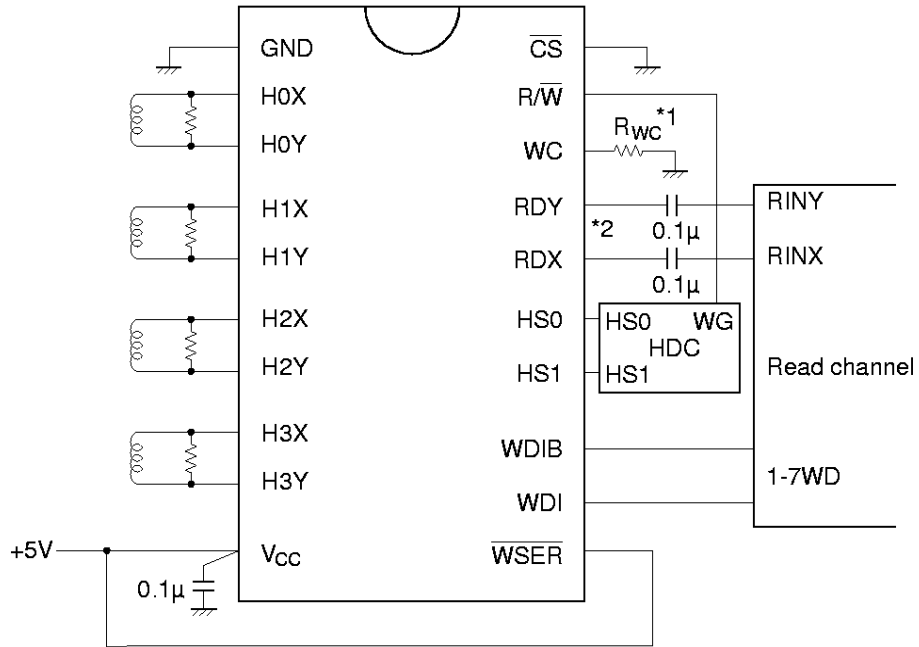
Unit R:
       C: F

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

$$R_{WC} [k\Omega] = \frac{K}{\text{Write current [mA]}}$$

Also, write current ringing on changeover between read and write can be suppressed by locating the resistor R_{WC} as close as possible to the WC pin.

2. When the length of the wiring pattern increases, the RDX and RDY outputs might have some oscillation. This oscillation can be eliminated by inserting series resistors on these outputs as close to the pins as possible.

Package Dimensions

Unit: mm

7.62 (300 mil) Type

Hitachi code	FP-20DA
JEDEC code	–
EIAJ code	–

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