

# HA166132FP, HA166134FP HA166132T, HA166134T Read/Write Amplifier for Hard Disk Drive



Preliminary  
Rev. 1  
Nov. 1991

The HA166132FP, HA166134FP, HA166132T and HA166134T are read/write amplifiers designed for use with thin film heads. They have the following functions and features.

## Functions

- Read amplifier circuit
- Write driver circuit
- Write error detection circuit
- Constant write current setup circuit

## Features

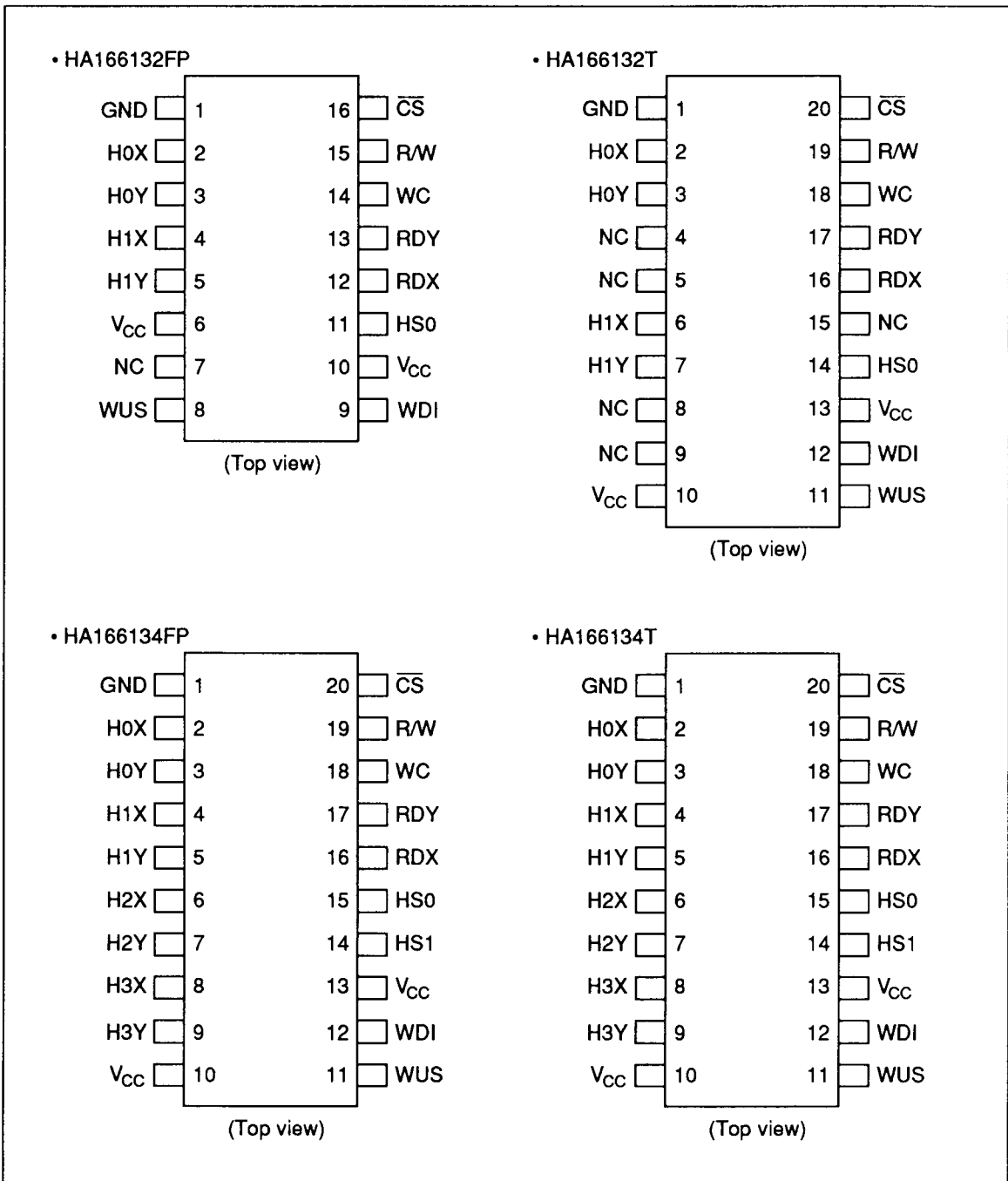
- Single power supply +5 V
- Low power
  - read: 150 mW (typ)
  - idle: 5 mW (typ)
- Low Noise: 0.7 nV/ $\sqrt{\text{Hz}}$  (typ)
- Read amplifier has high differential voltage gain
  - : 250 V/V (typ)
- Built-in current and voltage monitors
- TTL compatible interface
- Emitter-follower read amplifier outputs
- Input capacitance: 22 pF (typ)
- Write current range: 10 to 30 mA

## Ordering Information

Type	Channel	Package
HA166132FP	2	FP-16DA
HA166134FP	4	FP-20DA
HA166132T	2	TTP-20DA
HA166134T	4	TTP-20DA

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## Pin Arrangements



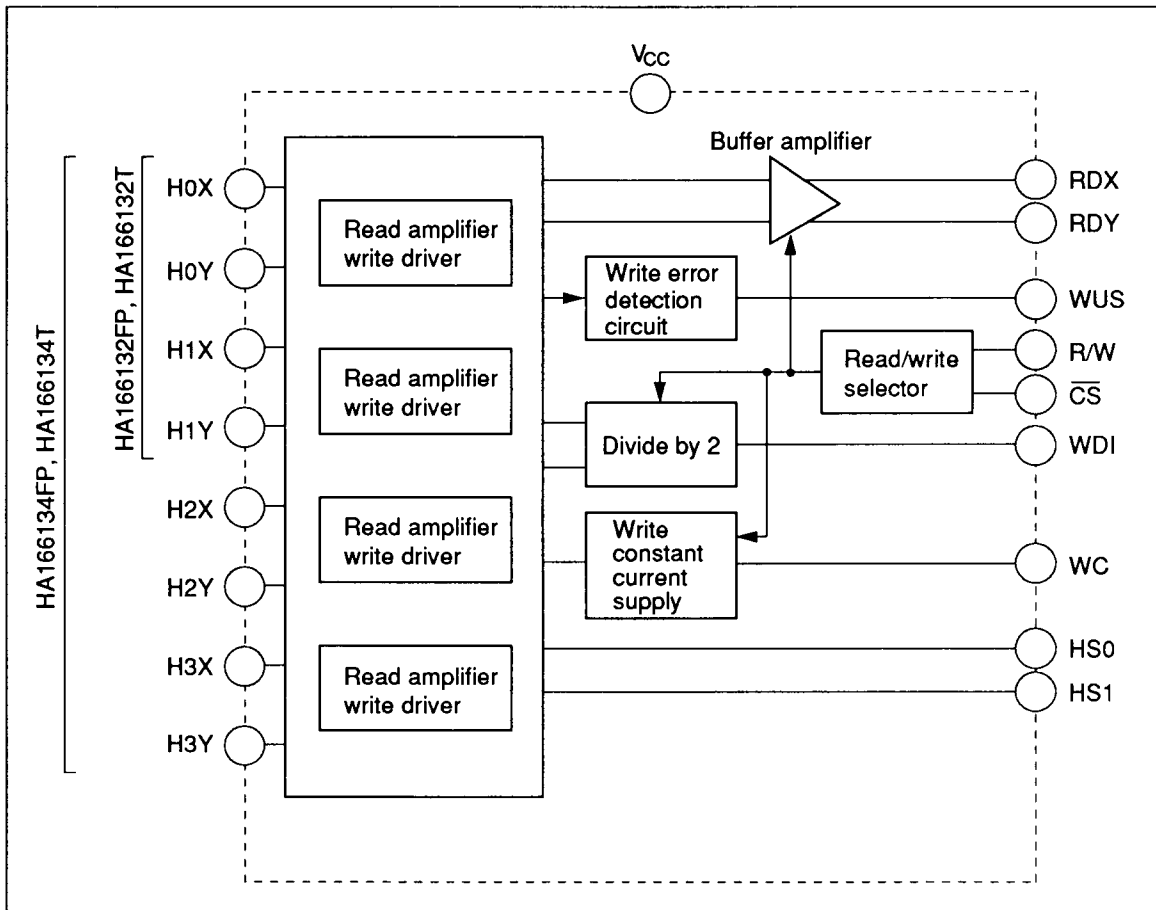
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### Pin Description

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.
$\overline{CS}$	Chip select	When this line is set high, the circuit goes into the standby state, a low power state. When this line is low, the chip is active.
HS0 HS1	Head select 0 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.
H0X, H0Y	Head 0X, 0Y	These pins are connected to the R/W head coil of channel 0.
H1X, H1Y	Head 1X, 1Y	These pins are connected to the R/W head coil of channel 1.
H2X, H2Y	Head 2X, 2Y	These pins are connected to the R/W head coil of channel 2.
H3X, H3Y	Head 3X, 3Y	These 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 by the equation below by connecting the external resistance $R_{WC}$ between this pin and GND.  $\text{Write current [mA]} = K/R_{WC} \text{ [k}\Omega\text{]}$
WDI	Write data input	Write data input pin. The signal is divided in the IC, and drives the write driver.
WUS	Write error detection circuit	A high level output indicates the write error detection conditions. WUS is high under the following conditions: <ol style="list-style-type: none"> <li>1. Head open</li> <li>2. Head short</li> <li>3. Write current too small.</li> <li>4. WDI input frequency too low.</li> </ol>
$V_{CC}$	5 V	5 V power supply
GND	Ground	Ground pins

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## Block Diagram



## Absolute Maximum Ratings (Ta = 25°C)

Item	Symbol	Rating	Unit	Applicable Terminal
Supply voltage	V <sub>S</sub>	-0.3 to +6.0	V	V <sub>CC</sub>
Write current	I <sub>W</sub>	35	mA	
Interface input voltage	V <sub>IN</sub>	-0.3 to V <sub>S</sub> +0.3	V	HS0, HS1, WDI, R/W, CS-bar
WUS voltage	V <sub>WUS</sub>	6.0	V	WUS
WUS output current	I <sub>WUS</sub>	12	mA	WUS
Read data output current	I <sub>RO</sub>	-10	mA	RDX, RDY
Operating temperature	T <sub>opr</sub>	0 to +70	°C	
Storage temperature	T <sub>stg</sub>	-55 to +125	°C	

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### Power Supply (Ta = 25°C)

Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Supply voltage range	V <sub>CC</sub>	4.75	5.0	5.25	V	
+5 V supply current	I <sub>S</sub>	—	33	45	mA	Read mode V <sub>CC</sub> = 5.25 V
			21 + I <sub>W</sub>	30 + I <sub>W</sub>		Write mode V <sub>CC</sub> = 5.25 V
			1.1	3		Idle mode V <sub>CC</sub> = 5.25 V

### Electrical Characteristics (V<sub>CC</sub> = 5 V, Ta = 25°C unless otherwise specified)

#### Digital Input

Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Low level input voltage	V <sub>IL</sub>	-0.3	—	0.8	V	
Low level input current	I <sub>IL</sub>	-100		—	μA	V <sub>IL</sub> = 0.8 V
High level input voltage	V <sub>IH</sub>	2.0		V <sub>CC</sub> + 0.3	V	
High level input current	I <sub>IH</sub>	—		100	μA	V <sub>IH</sub> = 2.0 V
Read/write transition time	t <sub>RW</sub>			1000	ns	
Write/read transition time	t <sub>WR</sub>			1500	ns	
Head select switching delay time	t <sub>HS</sub>			1500	ns	Read or write mode
Chip disable transition time	t <sub>IRW</sub>			12	μs	R/W to Idle or Idle to R/W

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## Write Fault Detection

Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Low level US voltage	$V_{OL}$	—	—	0.5	V	$I_{OL} = 8 \text{ mA}$
High level US current	$I_{OH}$	—	—	100	$\mu\text{A}$	$V_{OH} = 5.0 \text{ V}$
Unsafe to safe delay time	$td_2$	—	—	1.0	$\mu\text{s}$	
Safe to unsafe delay time	$td_1$	0.8	—	6.0		

## Head Select Table

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

## Mode Select Table

$\overline{\text{CS}}$	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	$A_{vd}$	220	250	280	V/V	$f = 300 \text{ kHz}$
Bandwidth	$V_w$	40	70	—	MHz	-3 dB
Input noise voltage	$V_n$	—	0.7	0.85	$\text{nV}/\sqrt{\text{Hz}}$	$f \leq 15 \text{ MHz}$ , Inputs shorted
Common mode rejection ratio	CMRR	60	80	—	dB	
Power supply stability	PSRR	45	60	—		$V_{CC} \pm 100 \text{ mVpp}$ , $f = 5 \text{ MHz}$
Channel separation	Sep	60	80	—		$V_{in} = 100 \text{ mVpp}$ on unselected channels and $V_{in} = 0 \text{ mVpp}$ on selected channels, $f = 5 \text{ MHz}$
Output offset voltage	$V_o$	-300	—	300	mV	Inputs shorted
Differential input impedance	$R_{in}$	—	1.1 0.85	—	$\text{k}\Omega$	$f = 300 \text{ kHz}$ $f = 5 \text{ MHz}$
Common mode output voltage	$V_{ocm}$	2.0	2.5	3.0	V	
Output source current	$I_{ODR}$	—	-10	—	mA	
Output sink current	$I_{OSDR}$	1.7	2.2	—		

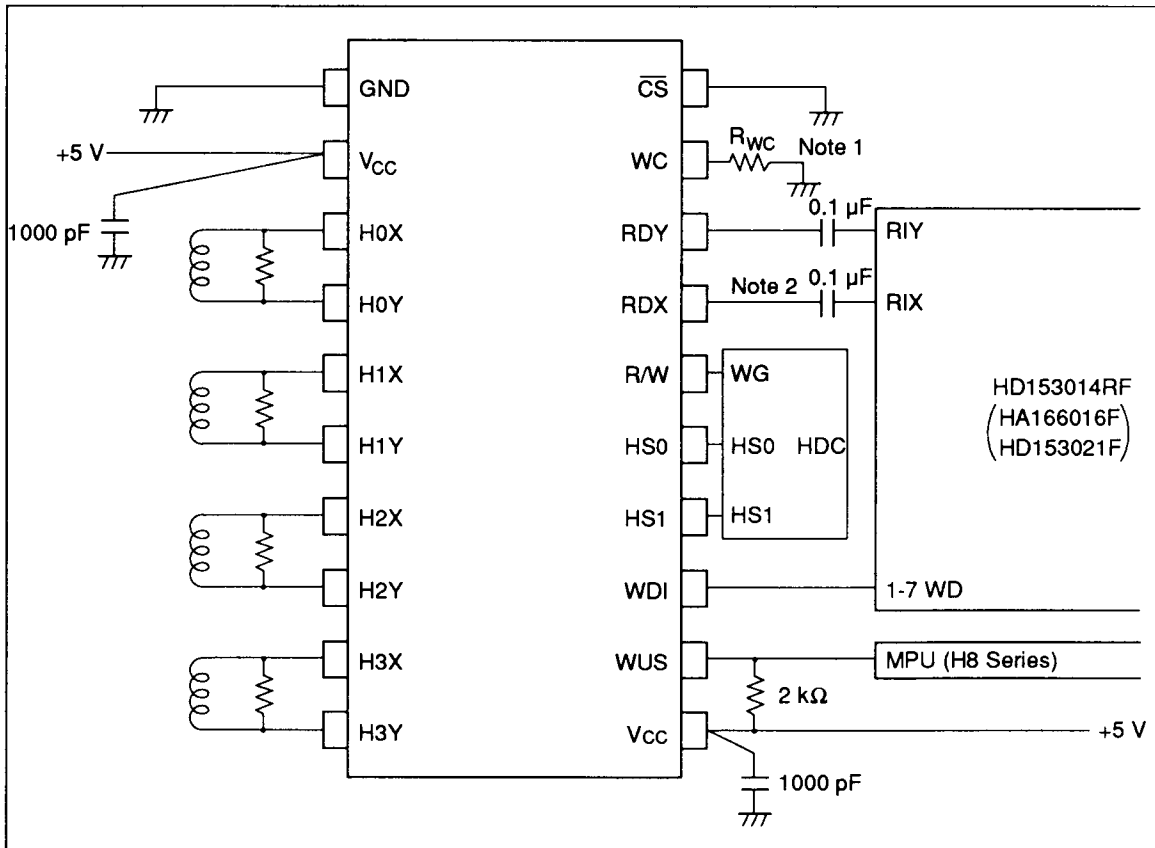
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### Write Driver

Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Write current setting range	$I_W$	10	—	30	mA	
Head current rise time	$t_{hex}$	—	6	20	ns	$L_h = 0 \mu H$ , $R_h = 0 \Omega$ , 10% to 90% point
Head current switching delay time	$t_{d3}$	—	12	35		$R_h = 0 \Omega$ , $L_h = 0 \mu H$ , from 50% point
Head current switching symmetry	$t_{d4}$	—	—	1		WDI duty cycle = 50%, rise/fall time = 1 ns
WDI minimum input frequency	$f_w$	1.8	—	—	MHz	WUS = low
Head current gain	$I_h/I_{WC}$	—	20	—	—	Head current/ $I_{WC}$
WC output voltage	$V_{WC}$	—	1.35	—	V	
Write current determination coefficient	K	24.8	27	29.2	—	

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## Application Circuit Example



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

$$R_{WC} [k\Omega] = \frac{27 \text{ (typ)}}{\text{Write current [mA]}}$$

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.

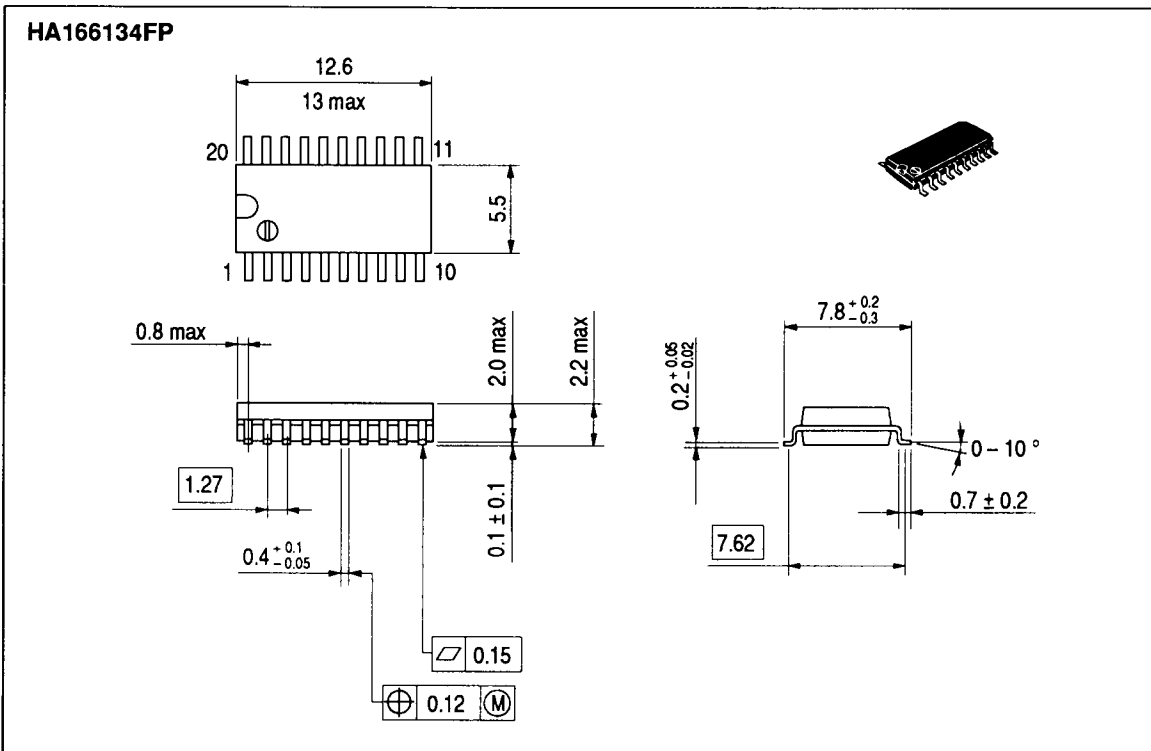
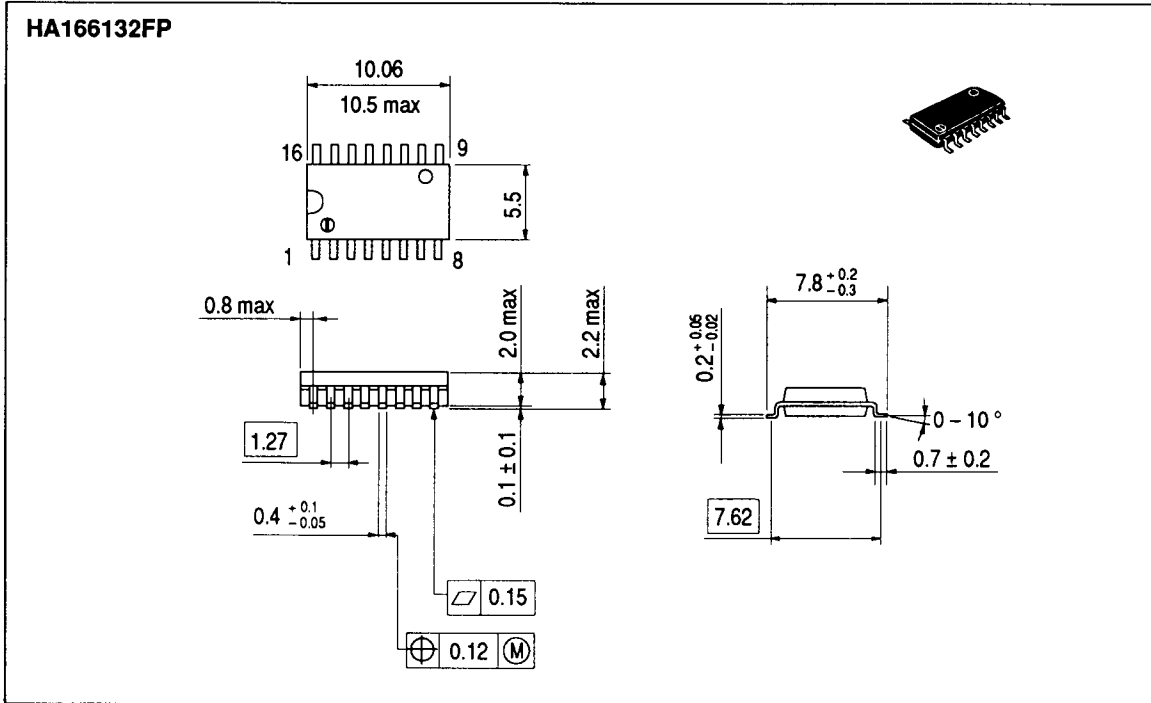
- When the length of the wiring pattern increases, the RDX and RDY outputs might have some oscillation. This oscillation can be eliminated by inserting series resistors on these outputs as close to the pins as possible.



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## Package Dimensions

Unit: mm

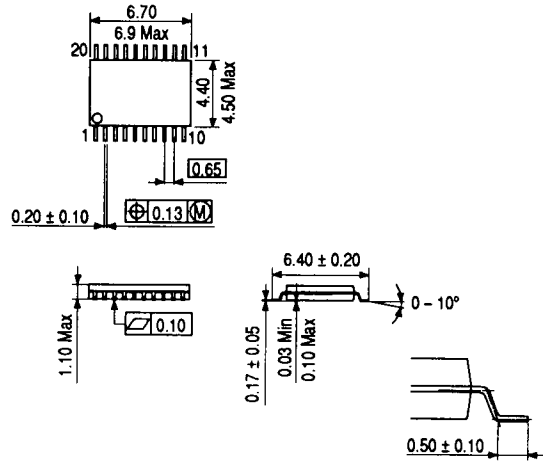


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## Package Dimensions (cont)

Unit: mm

- HA166132T
- HA166134T



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### Hitachi, Ltd.

Semiconductor & IC Div.  
Karukozaka MN Bldg., 2-1, Ageba-cho, Shinjuku-ku, Tokyo 162, Japan  
Tel: Tokyo (03) 3266-9376  
Fax: (03) 3235-2375

#### For further information write to:

Hitachi America, Ltd.  
Semiconductor & IC Div.  
2000 Sierra Point Parkway  
Brisbane, CA. 94005-1819  
U S A  
Tel: 415-589-8300  
Fax: 415-583-4207

Hitachi Europe GmbH  
Electronic Components Div.  
Central Europe Headquarters  
Hans-Pinsel-Straße 10A  
8013 Haar bei München  
F. R. Germany  
Tel: 089-46140  
Fax: 089-463068

Hitachi Europe Ltd.  
Electronic Components Div.  
Northern Europe Headquarters  
Whitebrook Park  
Lower Cookham Road  
Maidenhead  
Berkshire SL6 8YA  
United Kingdom  
Tel: 0628-585000  
Fax: 0628-778322

Hitachi Asia (Hong Kong) Ltd.  
Unit 706, North Tower,  
World Finance Centre,  
Harbour City, Canton Road  
Tsimshatsui, Kowloon  
Hong Kong  
Tel: 852-7359218  
Fax: 852-7306071