

# 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

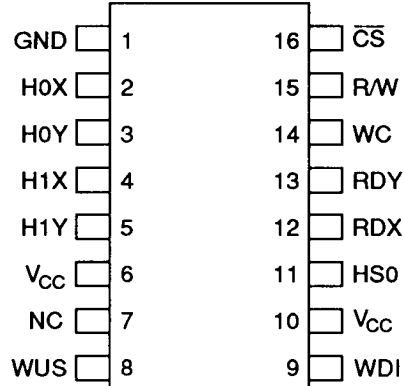
### Ordering Information

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

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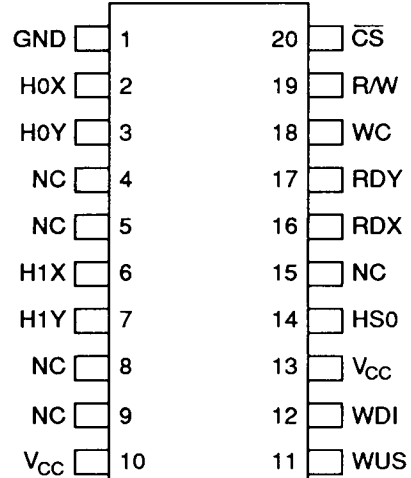
## Pin Arrangements

### • HA166132FP



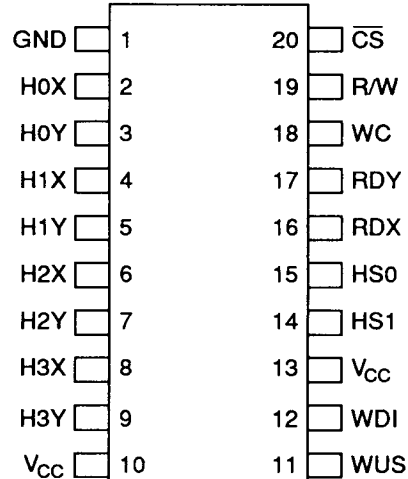
(Top view)

### • HA166132T



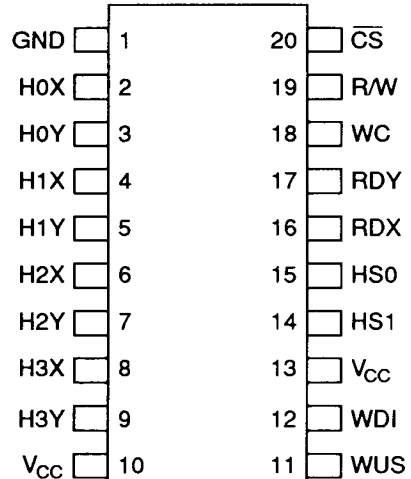
(Top view)

### • HA166134FP



(Top view)

### • HA166134T



(Top view)

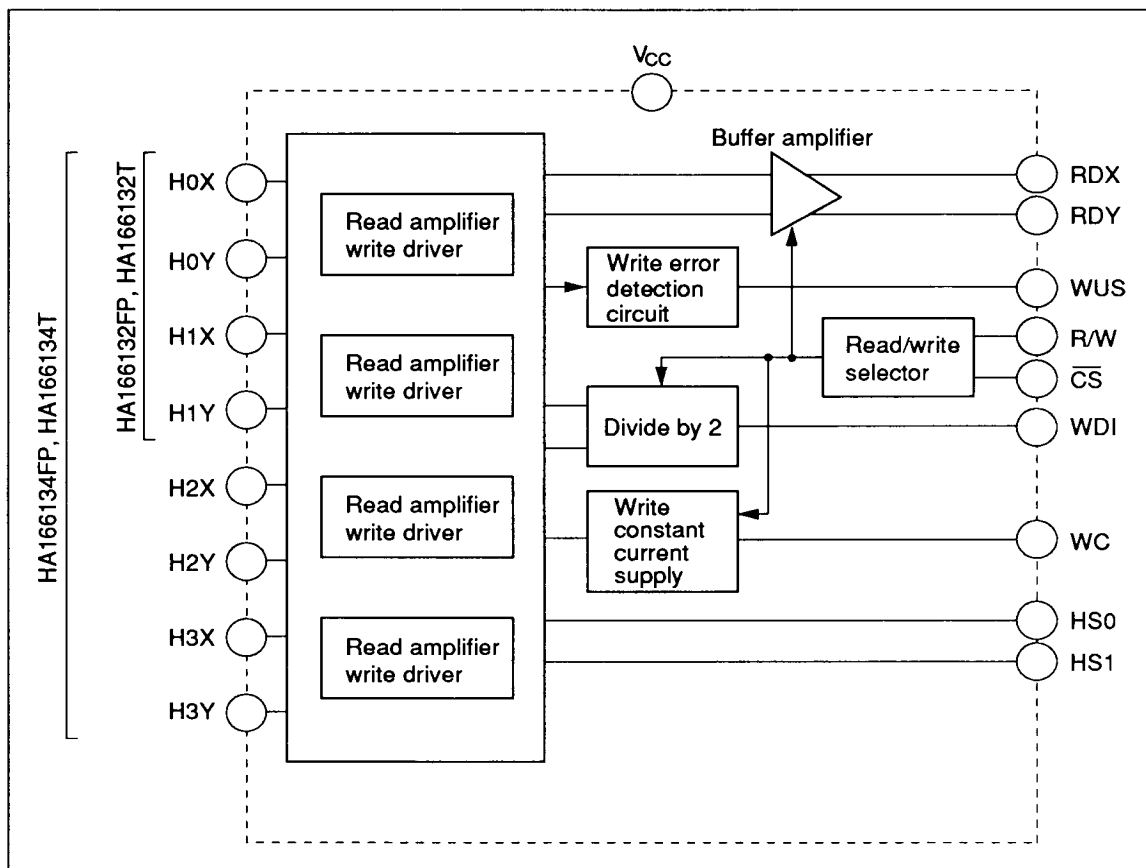
## HA166132FP, HA166134FP, HA166132T, HA166134T

### Pin Description

| Symbol          | Name                           | Description                                                                                                                                                                                                                                                                            |
|-----------------|--------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| RDX, RDY        | Read amplifier output          | Differential output pins for the read amp.<br>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<br><br>A low level selects the write mode, while a high level selects the read mode.                                                                                                                          |
| 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<br>HS1      | Head select 0<br>Head select 1 | Input pins for head select signals. The combination of these signals selects one head from head 0 to head 3.<br><br>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.<br><br>$\text{Write current [mA]} = K/R_{WC} \text{ [k}\Omega\text{]}$                                                          |
| 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.<br>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 <sub>CC</sub> | 5 V                            | 5 V power supply                                                                                                                                                                                                                                                                       |
| GND             | Ground                         | Ground pins                                                                                                                                                                                                                                                                            |

# HA166132FP, HA166134FP, HA166132T, HA166134T

## 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 |
| 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   |                        |

## HA166132FP, HA166134FP, HA166132T, HA166134T

### 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<br>V <sub>CC</sub> = 5.25 V  |
|                      |                 |      | 21 + I <sub>W</sub> | 30 + I <sub>W</sub> |      | Write mode<br>V <sub>CC</sub> = 5.25 V |
|                      |                 |      | 1.1                 | 3                   |      | Idle mode<br>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 |

# HA166132FP, HA166134FP, HA166132T, HA166134T

## 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 | $\text{nV}/\sqrt{\text{Hz}}$ | $f \leq 15 \text{ MHz}$ ,<br>Inputs shorted                                                                                         |
| Common mode rejection ratio  | CMRR       | 60   | 80          | —    | dB                           |                                                                                                                                     |
| Power supply stability       | PSRR       | 45   | 60          | —    |                              | $V_{CC} \pm 100 \text{ mVpp}$ ,<br>$f = 5 \text{ MHz}$                                                                              |
| Channel separation           | Sep        | 60   | 80          | —    |                              | $V_{in} = 100 \text{ mVpp}$ on<br>unselected channels and<br>$V_{in} = 0 \text{ mVpp}$ on selected<br>channels, $f = 5 \text{ MHz}$ |
| Output offset voltage        | $V_o$      | −300 | —           | 300  | mV                           | Inputs shorted                                                                                                                      |
| Differential input impedance | $R_{in}$   | —    | 1.1<br>0.85 | —    | $\text{k}\Omega$             | $f = 300 \text{ kHz}$<br>$f = 5 \text{ MHz}$                                                                                        |
| 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   | $L_h = 0 \mu H$ , $R_h = 0 \Omega$ ,<br>10% to 90% point |
| Head current switching delay time       | $td_3$       | —    | 12   | 35   |      | $R_h = 0 \Omega$ , $L_h = 0 \mu H$ ,<br>from 50% point   |
| Head current switching symmetry         | $td_4$       | —    | —    | 1    |      | WDI duty cycle = 50%,<br>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 | —    |                                                          |

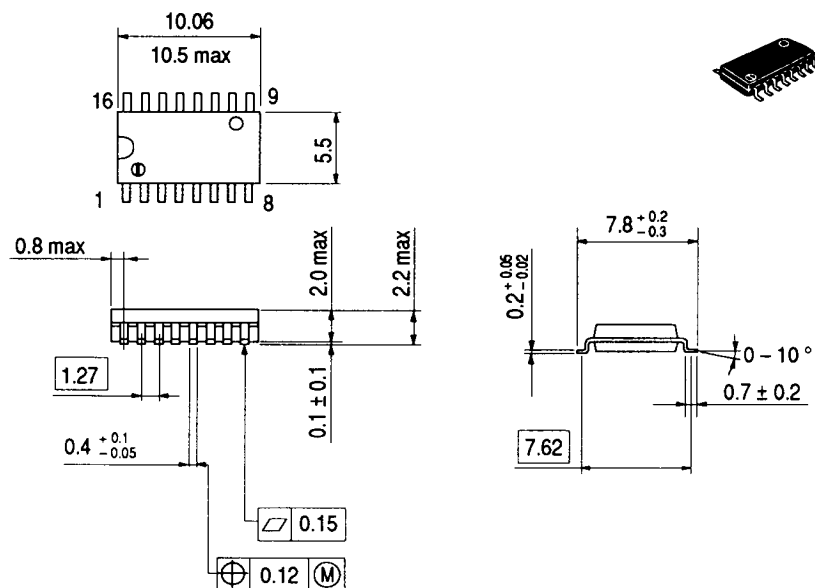


# HA166132FP, HA166134FP, HA166132T, HA166134T

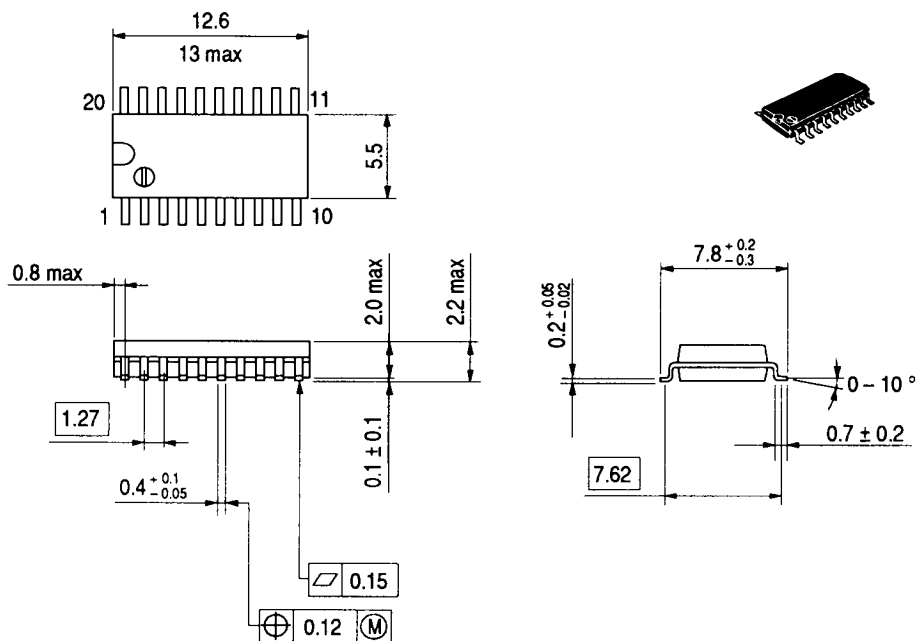
## Package Dimensions

Unit: mm

### HA166132FP



### HA166134FP

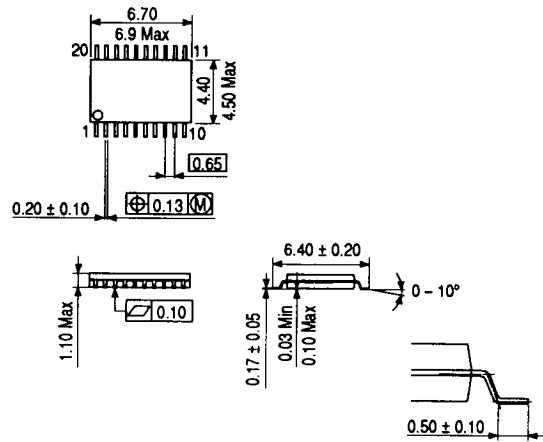


# HA166132FP, HA166134FP, HA166132T, HA166134T

## Package Dimensions (cont)

Unit: mm

- HA166132T
- HA166134T



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