

HA166102FP, HA166104FP HA166102T, HA166104T

Read/Write Amplifier for Hard Disk Drive



Preliminary
Rev. 0
Nov. 1991

The HA166102FP, HA166104FP, HA166102T and HA166104T are read/write amplifiers designed for use with two-terminal recording 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

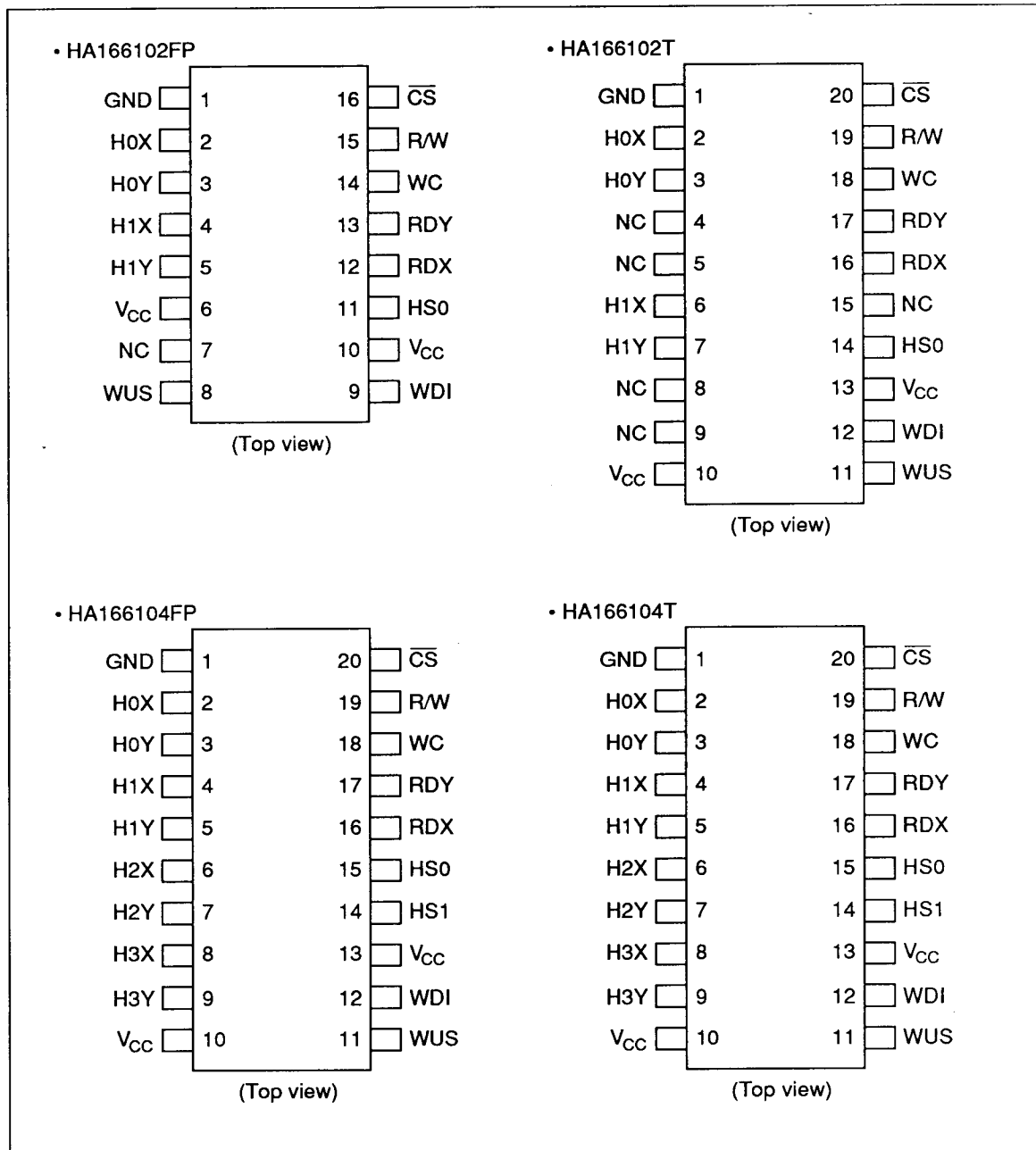
- Single power supply +5 V
- Low power
 - read: 150 mW (typ)
 - idle: 5 mW (typ)
- Low Noise: 0.7 nV/ $\sqrt{\text{Hz}}$ (typ)
- Read amplifier has high differential voltage gain : 250 V/V (typ)
- Built-in current and voltage monitors
- TTL compatible interface
- Emitter-follower read amplifier outputs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

Ordering Information

Type	Channel	Package
HA166102FP	2	FP-16DA
HA166104FP	4	FP-20DA
HA166102T	2	TTP-20DA
HA166104T	4	TTP-20DA

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Pin Arrangements



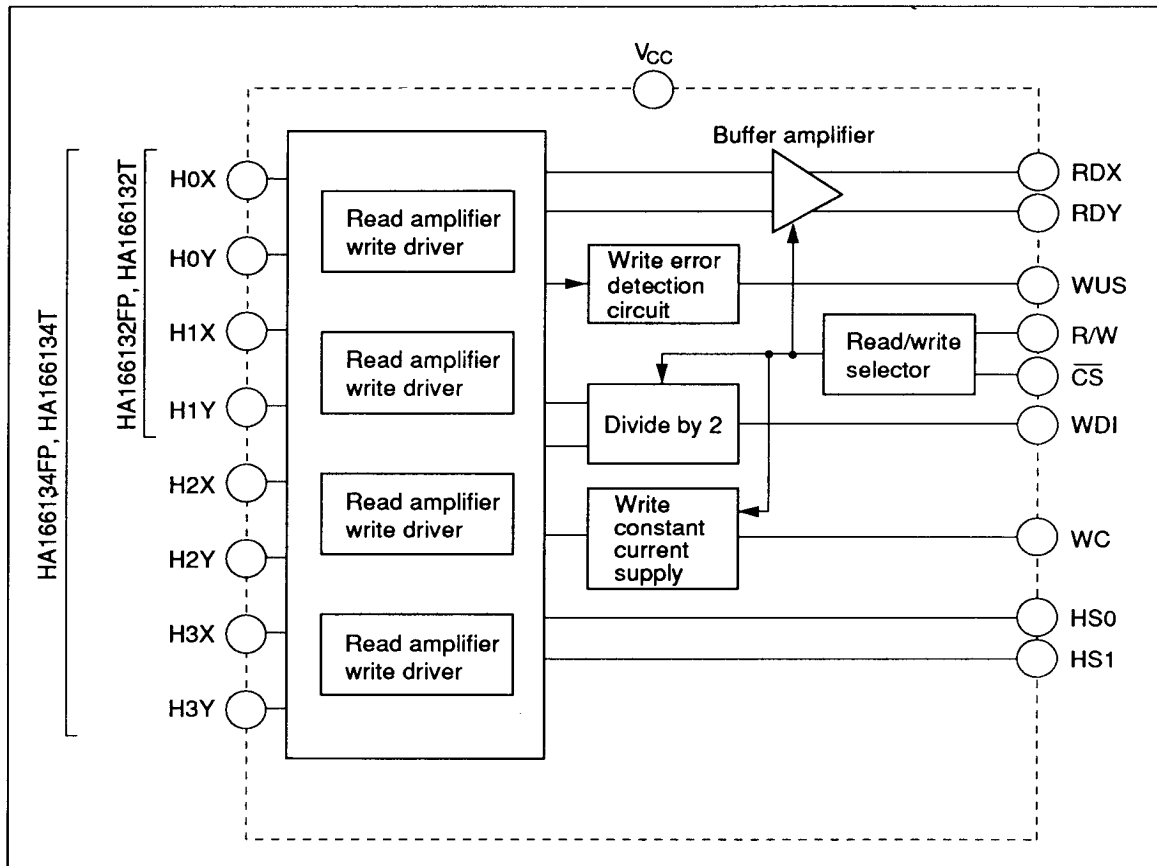
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Pin Description

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. $\text{Write current [mA]} = K/R_{WC} [\text{k}\Omega]$
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"> 1. Head short 2. Write current too small. 3. WDI input frequency too low.
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	V5	-0.3 to +6.0	V	V _{CC}
Write current	I _W	35	mA	
Interface input voltage	V _{IN}	-0.3 to V5 +0.3	V	HS0, HS1, WDI, R/W, CS-bar
WUS voltage	V _{WUS}	6.0	V	WUS
WUS output current	I _{WUS}	12	mA	WUS
Read data output current	I _{RO}	-10	mA	RDX, RDY
Operating temperature	T _{opr}	0 to +70	°C	
Storage temperature	T _{stg}	-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 _{CC}	4.75	5.0	5.25	V	
+5 V supply current	I _S	—	33	45	mA	Read mode V _{CC} = 5.25 V
			21 + I _W	30 + I _W		Write mode V _{CC} = 5.25 V
			1.1	3		Idle 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}	-100		—	μA	V _{IL} = 0.8 V
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	t _{RW}			1000	ns	
Write/read transition time	t _{WR}			1500	ns	
Head select switching delay time	t _{HS}			1500	ns	Read or write mode
Chip disable transition time	t _{IRW}			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	μA	$V_{OH} = 5.0 \text{ V}$
Unsafe to safe delay time	td_2	—	—	1.0	μs	
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	—		

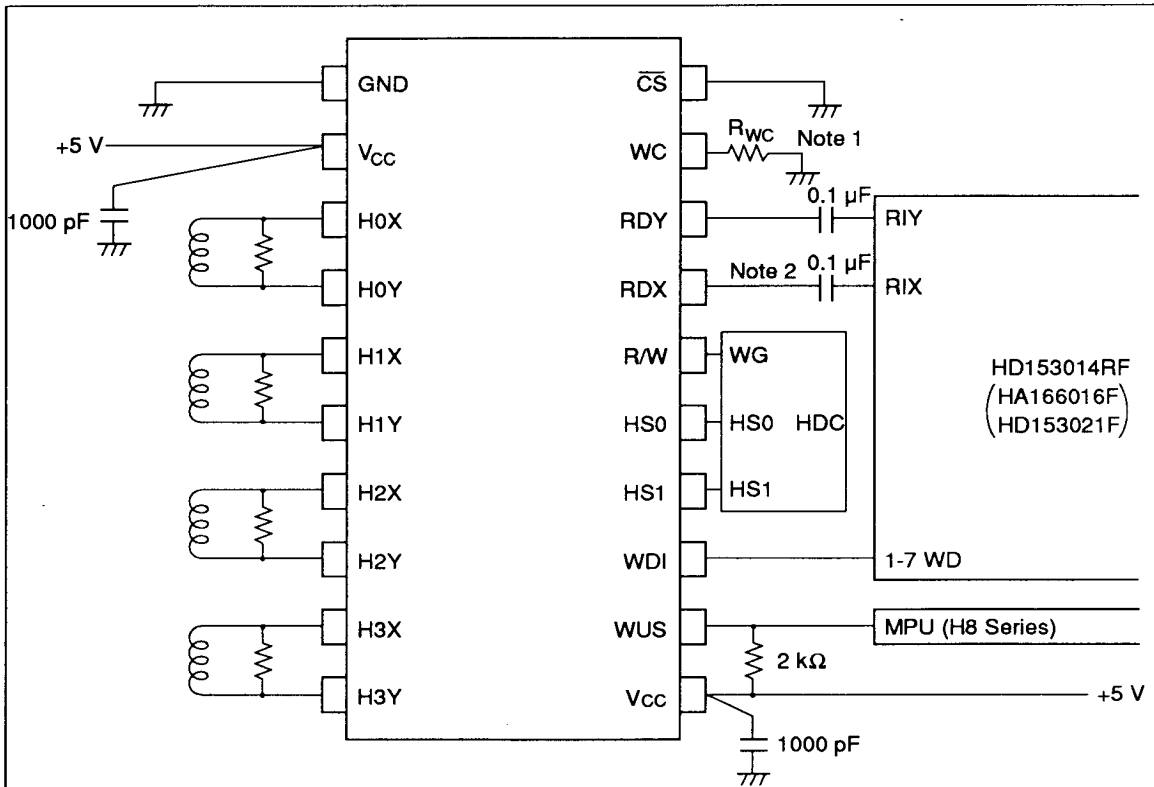
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Write Driver

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.

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

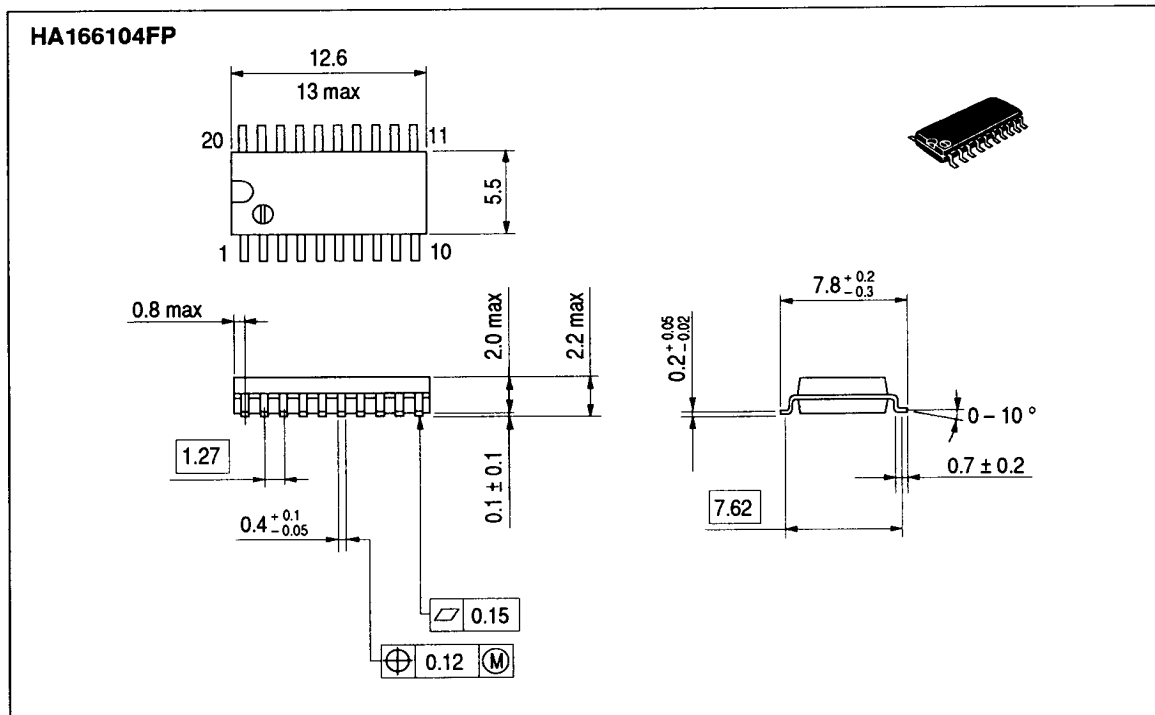
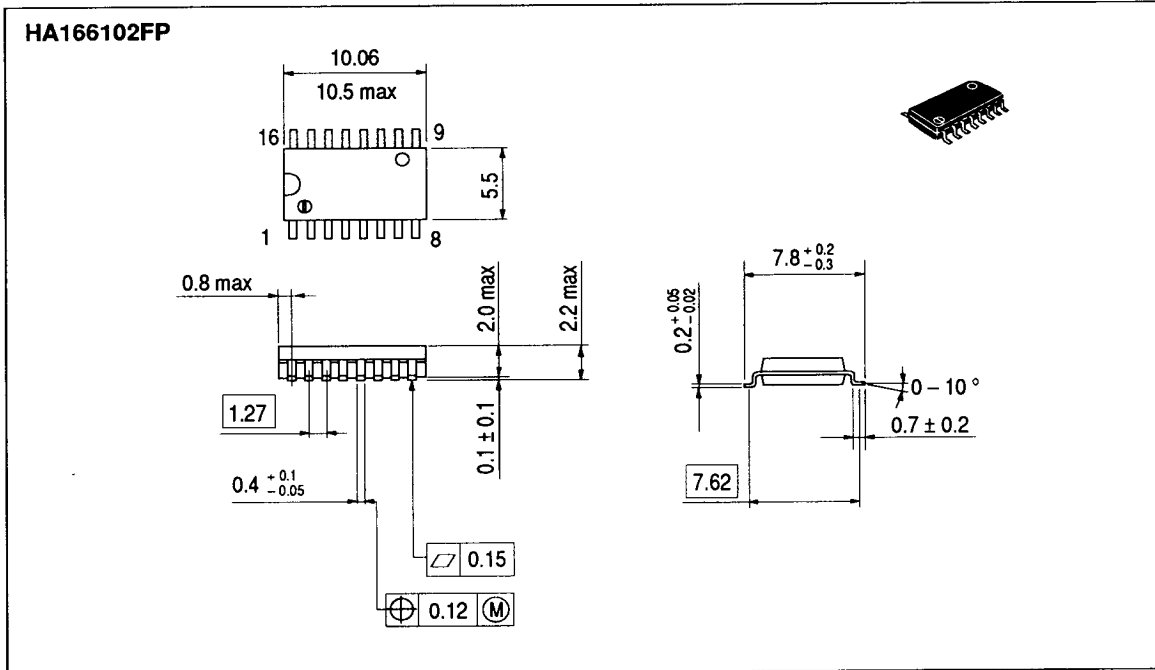
Also, write current ringing on changeover between read and write can be suppressed by locating the resistor R_{WC} as close as possible to the WC pin.

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.

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Package Dimensions

Unit: mm

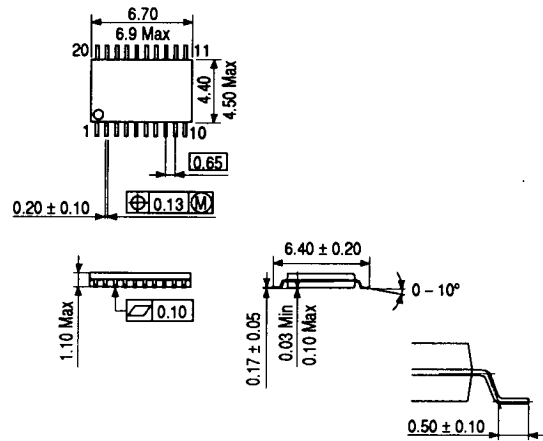


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Package Dimensions (cont)

Unit: mm

- HA166102T
- HA166104T



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SEP 05 1992

ADE-207-050 (H) Printed in Japan

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