HA166008MP, HA166009MP, HA166010MP — Preliminary

Read/Write Circuit

Description

The HA166008MP/009MP/010MP are 4,6 and 8-channel read and write circuit with very low noise amplifier for small hard disk drives.

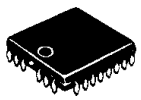
Functions

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

Features

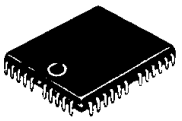
- Single polarity power supplies +5V, +12V
- Low noise ≤ $1nV/\sqrt{Hz}$
- Read amplifier has a high differential voltage gain of 200typ.
- Emitter followed read amplifier outputs
- Adjustable write current with an external resistor
- Supply voltage monitor circuit (+5V, +12V) inhibit miss writing at the lower supply voltage.
- TTL compatible interface
- Small surface mount package
- I/O pin separated pin arrangement.

HA166008MP



(MP-28)

HA166010MP



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Ordering Information

Type No.	Channel	Package
HA166008MP	4	MP-28
HA166009MP	6	MP-28
HA166010MP	8	MP-44

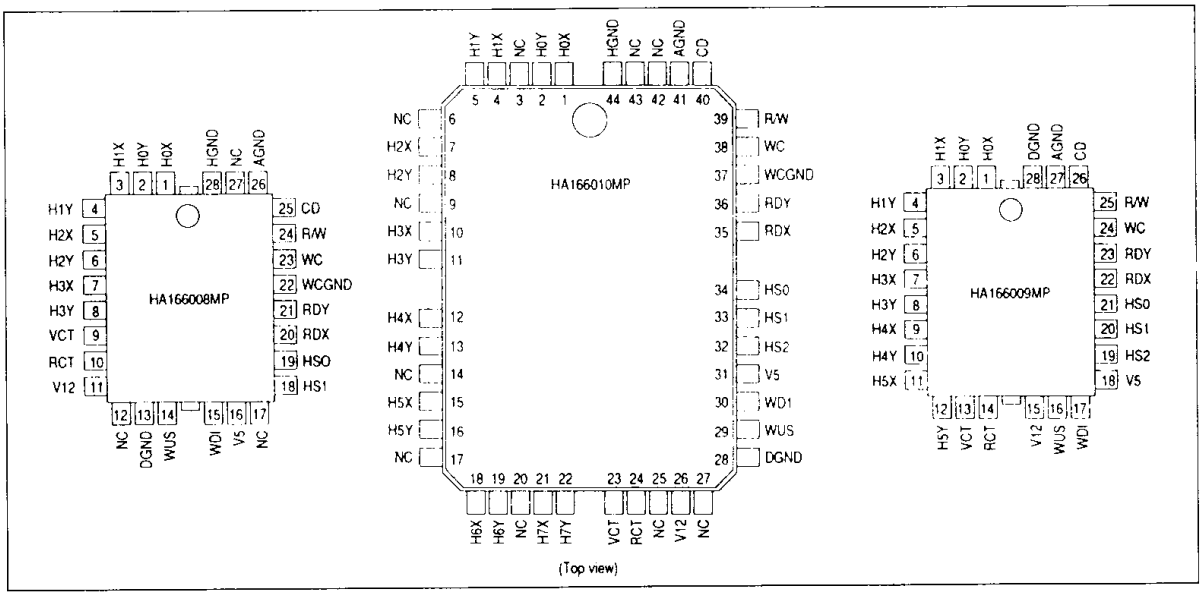
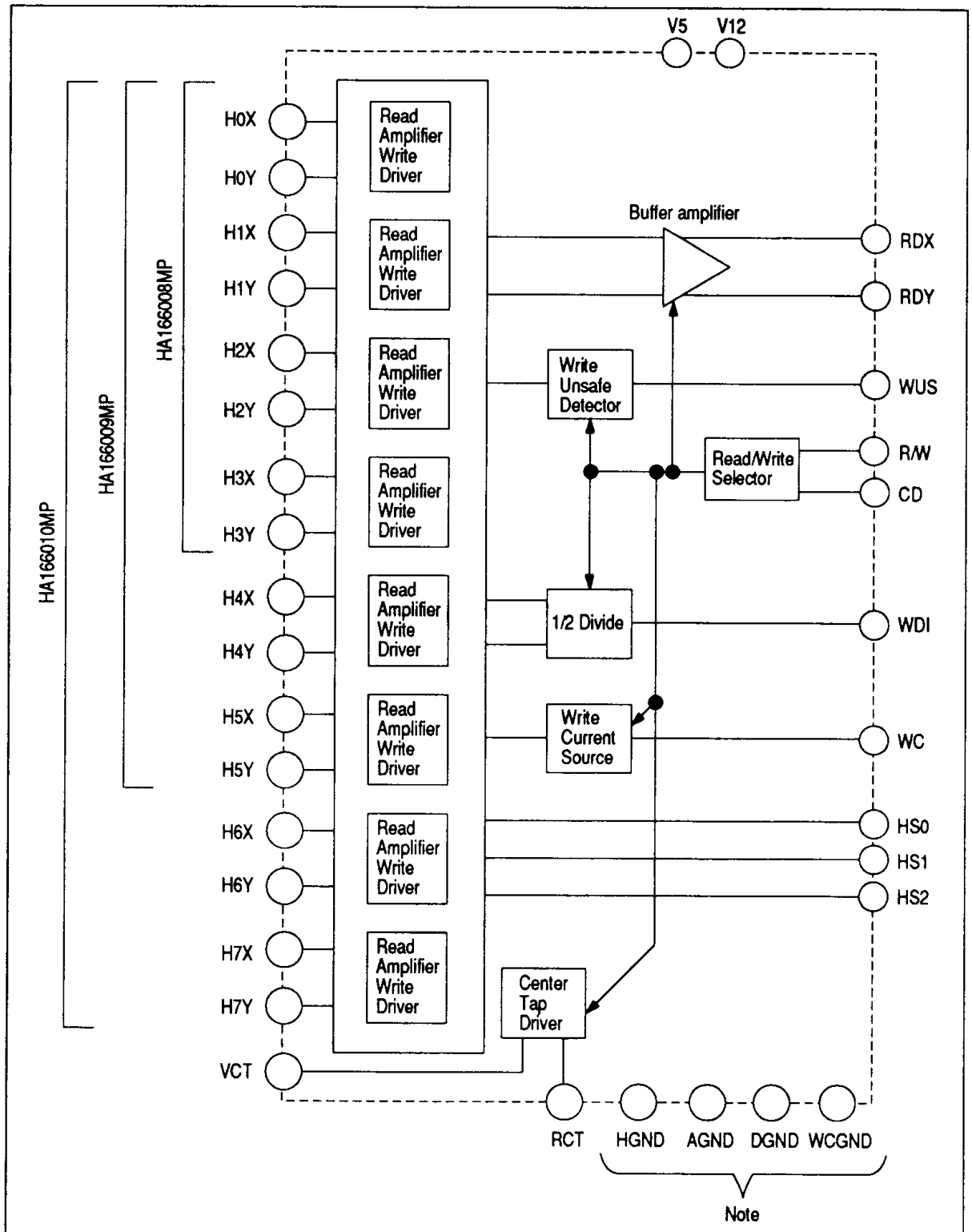


Figure 1 Pin Arrangements



Note: The HA166009MP has two GND pins(AGND and DGND).
The HA166008MP and HA166010MP have four GND pins(AGND, HGND, WCGND, DGND).

Figure 2 Block Diagram

Table 1 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.
CD	Chip disable	Chip select pin. This pin enables more chips to be used for multi channel systems. When selecting a chip, set this pin "Low".
VCT	Center tap voltage output	Center tap voltage output pin for the head coil Current corresponding to the wirte current flows out from this pin in the write mode.
RCT	Power supply for center tap	The chip power dissipation is reduced by pulling up this pin to the +12V supply with 1/2W and a 130Ω resistor. When the power dissipation has no problem, RCT pin can be pulled up to V_{12} voltage directly.
HS0 HS1 HS2	Head select 0 Head select 1 Head select 2	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	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.
H4X, H4Y	Head 4X, 4Y	These pins are connected to the R/W head coil of channel 4.
H5X, H5Y	Head 5X, 5Y	These pins are connected to the R/W head coil of channel 5.
H6X, H6Y	Head 6X, 6Y	These pins are connected to the R/W head coil of channel 6.

Pin Description (cont)

H7X, H7Y	Head 7X, 7Y	These pins are connected to the R/W head coil of channel 7.
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 currnet flow 6. All the combinations of the above conditions 7. In the read mode 8. Chip unselected
V5	5V	5V power supply
V12	12V	12V power supply
HGND	Head ground	These are all GND pins.
AGND	Analogue ground	
DGND	Digital ground	
WCGND	WC ground	

Table 2 Absolute Maximum Ratings (Ta=25 °C)

Item	Symbol	Rating	Unit	Application Terminal
Supply Voltage	V5	–0.3 to 6.0	V	V5
Supply Voltage	V12	–0.3 to 14.0	V	V12
Write Current	Iw	60	mA	
Interface Input Voltage	Vin	–0.3 to V5+0.3	V	HS0, HS1, HS2, WDI, R/W, CD

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

WUS voltage	Vwus	14.0	V	WUS
WUS output current	Iwus	12	mA	WUS
Center tap output current	Ico	–60	mA	VCT
Read data output current	Iro	–10	mA	RDX, RDY
Head voltage	Vh	–0.3 to 10.0	V	Note
Operating temperature	Topr	0 to +70	°C	
Storage temperature	Tstg	–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 HA166008MP has H0X, H0Y to H3X, H3Y.
The HA166009MP has H0X, H0Y to H5X, H5Y.
The HA166010MP has H0X, H0Y to H7X, H7Y.

Table 3 Power Supply (Ta=25 °C)

Item	Symbol	Min	Typ	Max	Unit	Test Conditions	Note
Supply voltage range	V5	4.5	5.0	5.5	V		1
Supply voltage range	V12	10.8	12	13.2	V		↓
+5V supply current	I5	—	15	25	mA	Read mode V12=13.2V V5=5.5V	↓
+5V supply current	I5	—	20	30	mA	Write mode V12=13.2V V5=5.5V	↓
+5V supply current	I5	—	8	13	mA	Idle mode V12=13.2V V5=5.5V	↓
+12V supply current	I12	—	38	55	mA	Read mode V12=13.2V V5=5.5V	2
+12V supply current	I12	—	15+Iw	25+Iw	mA	Write mode V12=13.2V V5=5.5V	↓

Power Supply (Ta=25 °C) (cont)

+12V supply current	I12	—	16	25	mA	Idle mode V12=13.2V V5=5.5V	↓
+12V supply current	I12	—	40	60	mA	Read mode V12=13.2V V5=5.5V	3
+12V supply current	I12	—	18+Iw	30+Iw	mA	Write mode V12=13.2V V5=5.5V	↓
+12V supply current	I12	—	19	30	mA	Idle mode V12=13.2V V5=5.5V	↓

Notes: 1. These specifications apply for the HA166008MP/009MP/010MP.
2. Apply for the HA166008MP.
3. Apply for the HA166009MP/010MP.

Table 4 Electrical Characteristics (HA166008MP/009MP/010MP)
(V12=12V, V5=5V, 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}	–400	—	—	µA	V_{IL}=0.8V, (WDI in apply)
Low level input current	I_{IL}	–100	—	—	µA	V_{IL}=0.8V, (HS0, HS1, HS2, CD, R/W in apply)
High level input voltage	V_{IH}	2.0	—	V5+0.3	V	
High level input current	I_{IH}	—	—	100	µs	V_{IH}=2.0V
Read/write transition time	trw	—	—	600	ns	R/W to 90% VCT write voltage
Write/read transition time	twr	—	—	600	ns	R/W to 90% VCT read voltage
Head select switching delay time	ths	—	—	600	ns	Read or write mode
Chip disable transition time	tirw	—	—	600	ns	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	I_{OL}=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	µs	

Head Select • Table

HS2	HS1	HS0	Head Select
L	L	L	0
L	L	H	1
L	H	L	2
L	H	H	3
H	L	L	4
H	L	H	5
H	H	L	6
H	H	H	7

Mode Select • Table

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

Read Amplifier

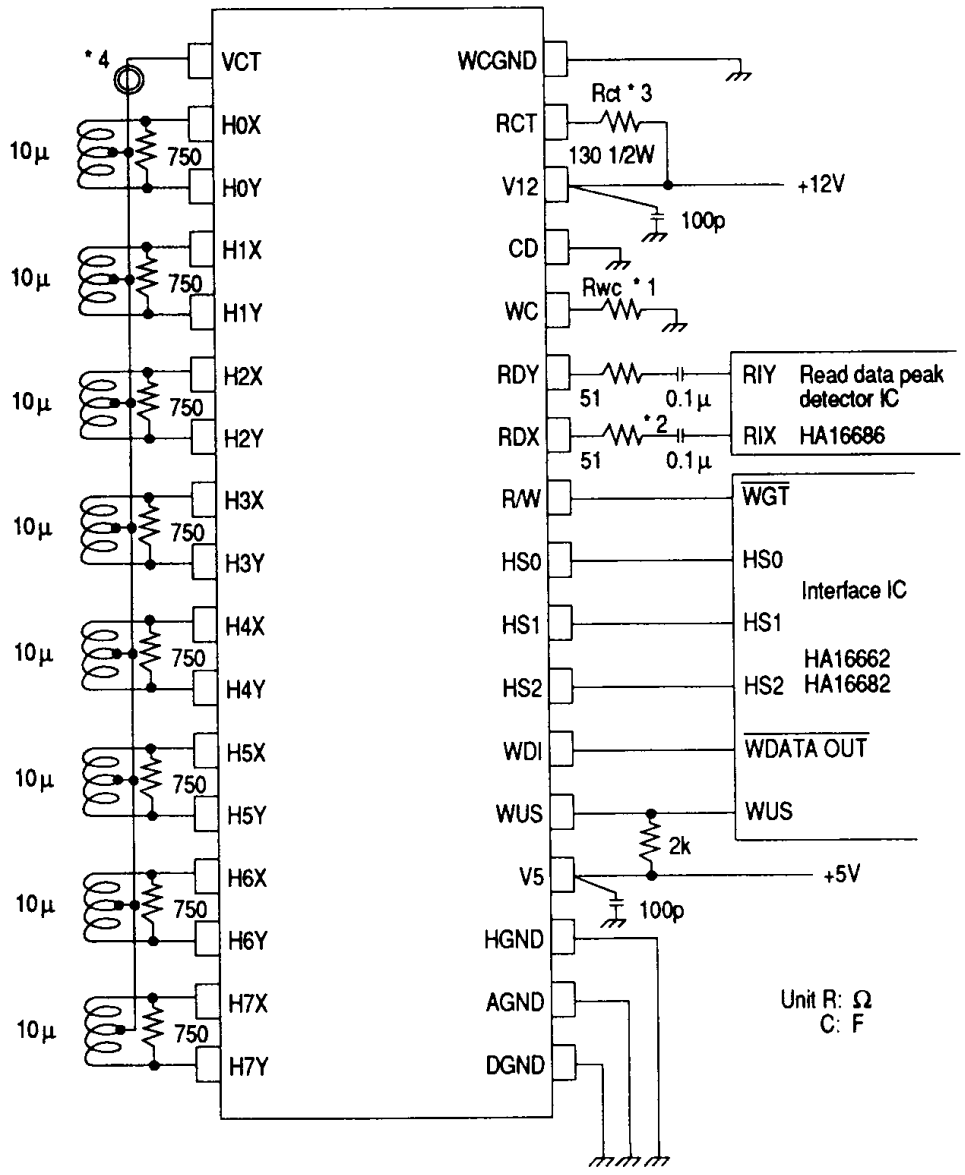
Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Differential voltage gain	Avd	170	200	230	V/V	f=300kHz
Band width (–3dB)	BW	40	—	—	MHz	
Input noise voltage	Vn	—	—	1.0	nV/√Hz	f≤15MHz, Input short
Input bias current	I_B	—	60	120	µA	Read mode (per side)
Common mode rejection ratio	CMRR	50	—	—	dB	Vin(cm)=V_{CT} +100mVpp, 0.0VDC, f=5MHz

Read Amplifier (cont)

Power supply rejection ratio	PSRR	45	—	—	dB	V5, V12±100mVpp, f=5MHz
Channel separation	Sep	45	—	—	dB	Vin=100mVpp, f=5MHz on unselected channels and Vin=0mVpp on selected channels
Output offset voltage	Vo	–600	—	600	mV	Input short
Differential input impedance	Rin	—	2.0	—	kΩ	f=300MHz
Differential input impedance	Rin	—	1.3	—	kΩ	f=5MHz
Common mode output voltage	Vocm	5.0	6.0	7.0	V	
Output source current		—	–10	—	mA	
Output sink current	Ios	2.0	2.5	—	mA	

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	ns	Rh=0Ω, Lh=0µH, from 50% point
Head current switching symmetry	td4	—	—	2	ns	WDI Duty=50%, rise/fall time=1ns
WDI minimum input frequency	fw	125	—	—	kHz	WUS=LOW
Head current gain	Ih/Iwc	—	20	—		Head current/Iwc
VCT output voltage	VCT	3.8	4.3	4.8	V	Read mode Ib=–120µA
	VCT	5.0	6.0	6.6	V	Write mode Iwc=–45mA
Write current accuracy	Ih1	9.3	10.0	10.7	mA	Rwc=9.38kΩ
	Ih2	27.9	30.0	32.1	mA	Rwc=3.00kΩ
	Ih3	46.5	50.0	53.5	mA	Rwc=1.73kΩ
K is calculated by the following equation	K=95.51-0.176•Ih (mA)					



Notes: *1. External resistance value, Rwc is determined by following equation.

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

To damp the ringings 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. External resistance R_{CT} restricts the power dissipation in an IC chip.

*4. Ferrite beads (or LR filter) control overshoot of write current, ringing and so on.

Figure 3 Circuit Example