HA16689MP

Read/Write Circuit

Description

The HA16689MP is a low-noise, 8-channel read/write circuit for use with small hard disk drives, with a built-in head damping resistance.

Functions

- Read amplifier
- Write driver
- Write fault detector
- Fixed write current select

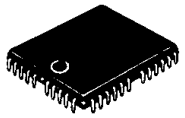
Features

- Two-power supply design (+5 V and +12 V)
- Easily extended for systems with more than 8 channels
- Low-noise read amplifier with differential gain of 200 (typ)
- Emitter follower fixed current read amplifier output
- Write current can be selected using an external resistor
- Built-in power supply monitor for both 5 V and 12 V prevents incorrect writes
- TTL-compatible interface
- Compact surface-mount package
- Symmetrical arrangement of head input/output and controller signal/pins
- Built-in head damping resistance (750 Ω typ)

Ordering Information

Type No.	Package
HA16689MP	MP-44

HA16689MP



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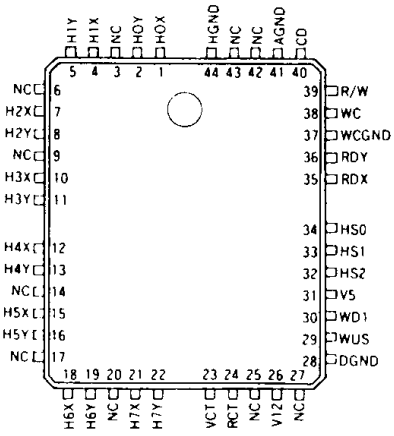
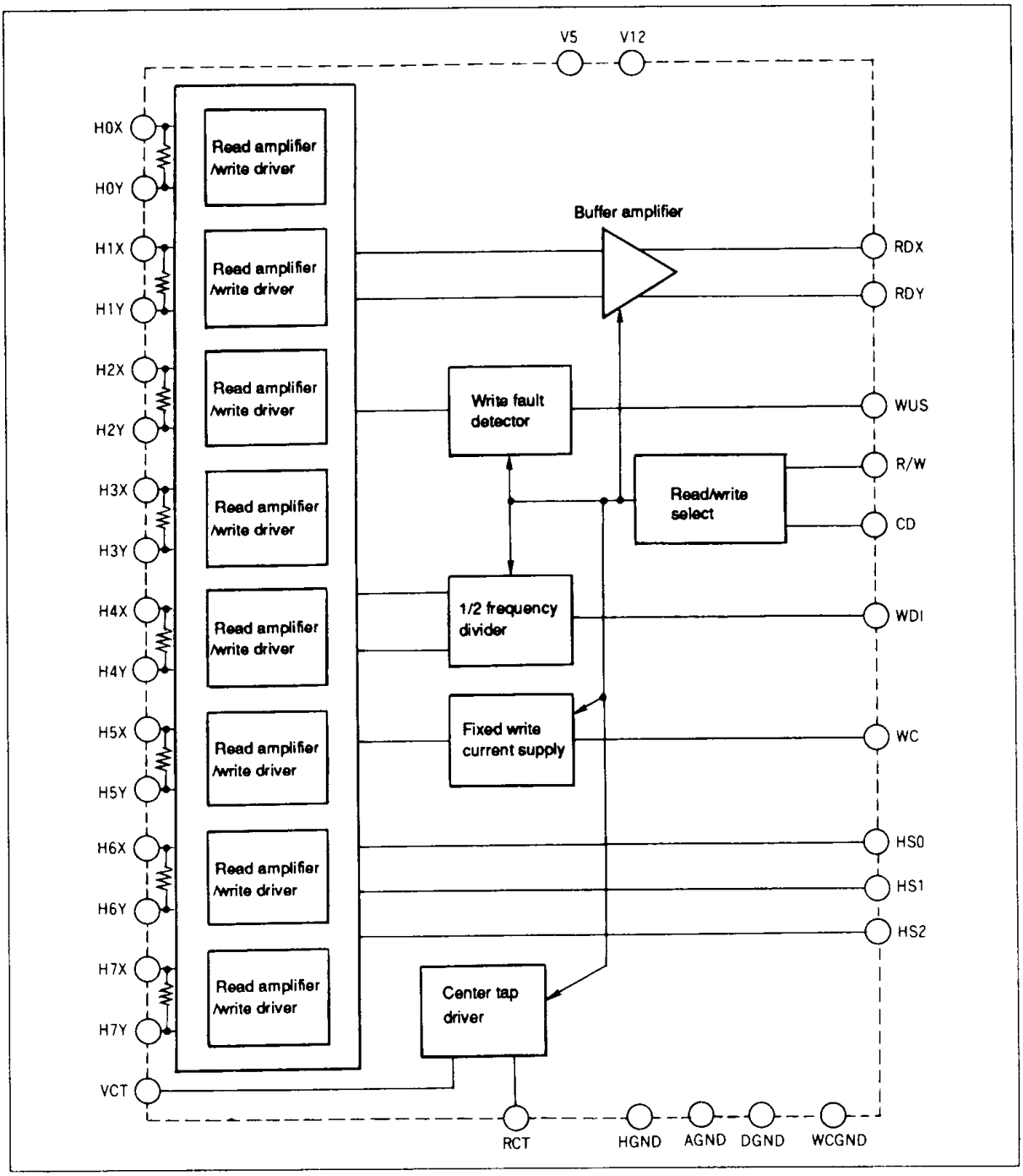
Pin Assignment



Top View

Block Diagram



Pin Descriptions

Symbol	Pin No.	Name	Function
RDX	35	Read amplifier output	Differential output for a pre-amplifier. Outputs amplified read signal from the head coil.
RDY	36		
R/W	39	R/W select	Selects head coil bias for read/write. When R/W is low, write mode is selected; when it is low, read mode is selected.
CD	40	Chip disable	CD input can be used as a chip select for systems requiring more than 8 channels. CD low selects the chip; CD high disables it.
VCT	23	Center tap voltage output	Head center tap voltage output. In write mode, outputs a current proportional to the write current.
RCT	24	Power supply for center tap	Power consumption can be reduced by connecting RCT to V12 through 130 Ω (1/2 W) resistor. When power consumption is not a concern, RCT can be tied directly to V12.
HS0	34	Head select 0	Head select signal inputs. Selects from head channels 0 to 7 (see table 1).
HS1	33	Head select 1	
HS2	32	Head select 2	
H0X, H0Y	1, 2	Head 0X, 0Y	Channel 0 head coil input/output.
H1X, H1Y	4, 5	Head 1X, 1Y	Channel 1 head coil input/output.
H2X, H2Y	7, 8	Head 2X, 2Y	Channel 2 head coil input/output.
H3X, H3Y	10, 11	Head 3X, 3Y	Channel 3 head coil input/output.
H4X, H4Y	12, 13	Head 4X, 4Y	Channel 4 head coil input/output.
H5X, H5Y	15, 16	Head 5X, 5Y	Channel 5 head coil input/output.
H6X, H6Y	18, 19	Head 6X, 6Y	Channel 6 head coil input/output.
H7X, H7Y	21, 22	Head 7X, 7Y	Channel 7 head coil input/output.
WC	38	Write current select	The write current can be selected by connecting resistor (R_{WC}) between this pin and GND as shown below. WRITE CURRENT = K/R_{WC} [A] (Equation 1)
WDi	30	Write data input	The write data signal is 1/2 frequency divided, then fed to a write driver.
WUS	29	Write fault detector output	WUS goes high when a write fault is detected. Any of the following will cause WUS to go high: 1. Head coil is shorted to ground or open-circuited 2. Center tap is open-circuited 3. WDi input frequency is too low 4. There is no write current 5. Chip is in read mode 6. Chip is not selected
V5	31	5 V power supply	Digital power supply.
V12	26	12 V power supply	Analog power supply.
HGND	44	Head ground	Ground for head coil input/outputs.
AGND	41	Analog ground	Analog ground.
DGND	28	Digital ground	Digital ground.
WCGND	37	WC ground	Ground for fixed write current source.

Absolute Maximum Ratings (Ta = 25°C)

Parameter	Symbol	Rating	Unit	Pins
Digital power supply voltage	V5	6.0	V	V5
Analog power supply voltage	V12	14.0	V	V12
Write current	I_W	60	mA	
Input voltage	V_{in}	−0.3 to V5 + 0.3	V	HS0, HS1, HS2, WDi, R/W, CD
WUS voltage	V_{WUS}	14.0	V	WUS
WUS output current	I_{WUS}	12	mA	WUS
Center tap output current	I_{co}	−60	mA	VCT
Read data output current	I_{ro}	−10	mA	RDX, RDY
Head voltage	V_h	−0.3 to 14	V	H0X, H0Y to H7X, H7Y
Operating temperature	T_{opr}	0 to +70	°C	
Storage temperature	T_{stg}	−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.

Electrical Characteristics (V12 = 12 V, V5 = 5 V, Ta = 25°C, unless otherwise specified)

Power Supply

Parameter	Symbol	Min	Typ	Max	Unit	Test Conditions
Power supply voltage	V5	4.5	5.0	5.5	V	
	V12	10.8	12.0	13.2	V	
+5 V power supply current	I 5	—	—	25	mA	Read mode
	I 5	—	—	30	mA	Write mode
	I 5	—	—	20	mA	Idle mode
+12 V power supply current	I 12	—	—	35	mA	Read mode
	I 12	—	—	20 + I_W	mA	Write mode
	I 12	—	—	20	mA	Idle mode

Digital Inputs

Parameter	Symbol	Min	Typ	Max	Unit	Test Conditions
Input low voltage	V_{IL}	−0.3	—	0.8	V	
Input low current	I_{IL}	−400	—	—	µA	V_{IL} = 0.8 V (applies to WDi)
	I_{IL}	−100	—	—	µA	V_{IL} = 0.8 V (applies to HS0, HS1, HS2, CD, and R/W)
Input high voltage	V_{IH}	2.0	—	V5 + 0.3	V	
Input high current	I_{IH}	—	—	100	µA	V_{IH} = 2.0 V
Read/write transition time	t_{rw}	—	—	600	ns	R/W to 90% VCT write voltage
Write/read transition time	t_{wr}	—	—	600	ns	R/W to 90% VCT read voltage
Head select delay	t_{hs}	—	—	600	ns	Read or write mode
Chip disable delay	t_{irw}	—	—	600	ns	R/W to Idle or Idle to R/W

Write Fault Detector

Parameter	Symbol	Min	Typ	Max	Unit	Test Conditions
US low voltage	V_{OL}	—	—	0.5	V	I_{OL} = 8 mA
US high current	I_{OH}	—	—	100	µA	V_{OH} = 5.0 V
Fault to no-fault delay	t_{d2}	—	—	1.0	µs	
No-fault to fault delay	t_{d1}	1.6	—	8.0	µs	

Read Amplifiers

Parameter	Symbol	Min	Typ	Max	Unit	Test Conditions
Differential voltage gain	A_{vd}	170	200	230	V/V	f = 300 kHz
Bandwidth (–3 dB)	B_W	—	20	—	MHz	
Input noise voltage	Vn	—	1.5	—	nV/√Hz	f ≤ 15 MHz, Input shorted
Input bias current	Ib	—	—	35	µA	Read mode
Common mode rejection ratio	CMRR	50	—	—	dB	Vin (Cm) = VCT + 100 mV_{p-p}, 0.0 VDC, f = 5 MHz
Supply voltage rejection ratio	PSRR	45	—	—	dB	V5, V12 ± 100 mV_{p-p}, f = 5 MHz
Channel separation	Sep	45	—	—	dB	Vin = 100 mV_{p-p} on unselected channels and Vin = 0 mV_{p-p} on selected channel f = 1 MHz
Output offset voltage	Vo	–600	—	600	mV	Input shorted
Differential input impedance	Rin	570	750	930	Ω	f = 300 kHz
	Rin	—	500	—	Ω	f = 5 MHz
Common mode output voltage	V_ocm	5.0	6.0	7.5	V	
Output source current	I_{ORD}	—	–10	—	mA	
Output sink current	I_{OSRD}	1.5	2.2	—	mA	

Write Drivers

Parameter	Symbol	Min	Typ	Max	Unit	Test Conditions
Write current select range	I_W	10	—	50	mA	I_W Lhead > 200 mA µH
Head current rise time	Thcx	—	—	20	ns	Lh = 0 µH, Rh = 0 Ω, 10% to 90% point
Head current switching delay time	Td_3	—	—	25	ns	Rh = 0 Ω, Lh = 0 µH, From 50% point
Head current switching symmetry	Td_4	—	—	2	ns	WDi duty cycle = 50% rise/fall time = 1 ns
WDi minimum input frequency	F_w	125	—	—	kHz	WUS = Low
Head current gain	Ih/IWC	—	20	—		Head current /I_{WC}
VCT output voltage	VCT	3.8	4.3	5.0	V	Read mode Ib = –35 µA
	VCT	5.0	6.0	6.6	V	Write mode I_{WC} = –45 mA
Write current select coefficient	K	131	140	149	V	

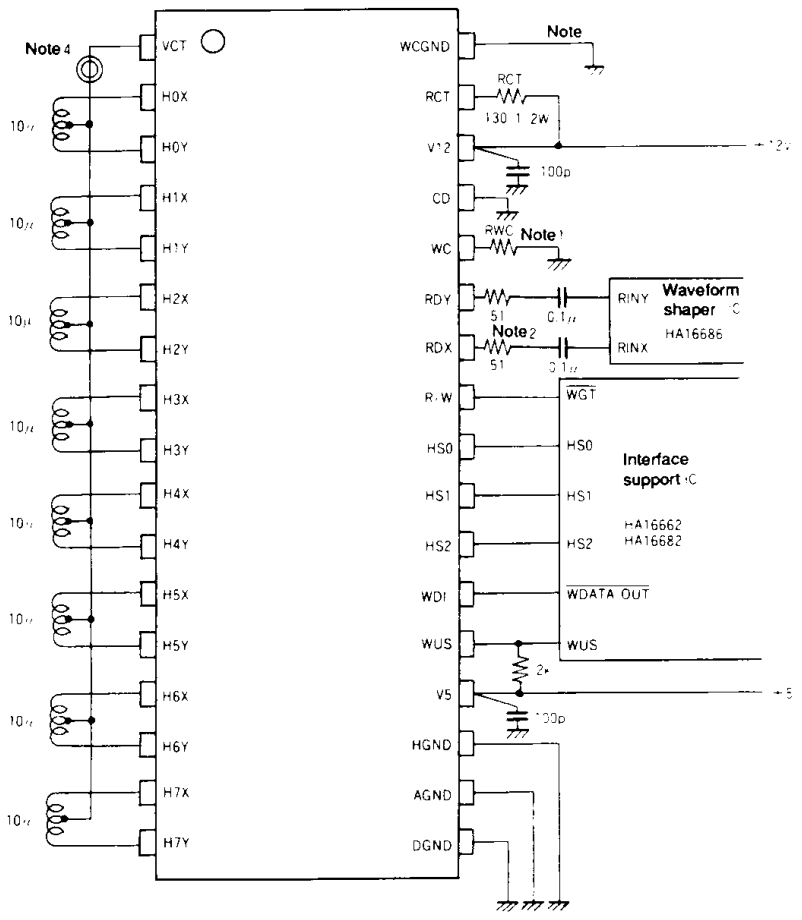
Table 1 Head Select

HS2	HS1	HS0	Head Select
Low	Low	Low	0
Low	Low	High	1
Low	High	Low	2
Low	High	High	3
High	Low	Low	4
High	Low	High	5
High	High	Low	6
High	High	High	7

Table 2 Mode Select

CD	R/W	Mode
Low	Low	Write
Low	High	Read
High	Low	Idle
High	High	Idle

Circuit Example



Notes:

1. The resistance of RWC is determined by

$$R_{WC}\ [k\Omega] = \frac{140\ (typ)}{\text{Write current [mA]}}$$

   Placing R_{WC} close to WC will reduce write current ringing when switching between reading and writing.
2. The longer these contacts are, the greater the tendency for RDX and RDY to oscillate. Oscillation can be reduced by inserting the series resistors right next to the RDX and RDY pins.
3. RCT reduces current consumption in write mode.
4. Ferrite leads (or a LR filter) reduce write current overshoot and ringing when the VCT contacts are long.