

# 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

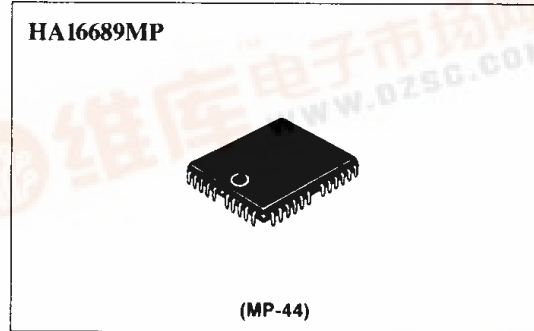
- Read amplifier
- Write driver
- Write fault detector
- Fixed write current select

### Features

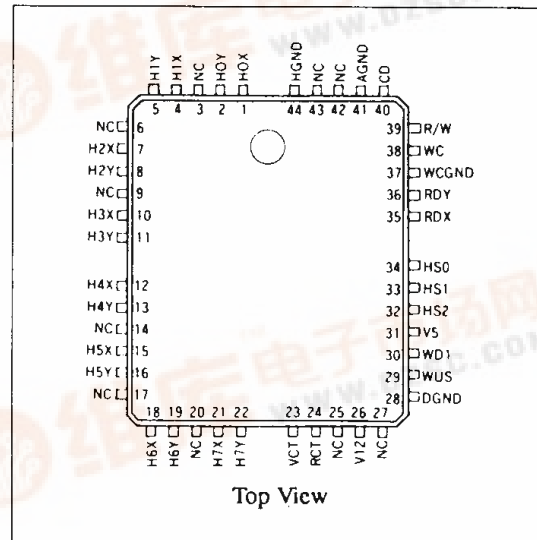
- Two-power supply design (+5 V and +12 V)
- Easily extended for systems with more than 8 channels
- Low-noise read amplifier with differential gain of 200 (typ)
- Emitter follower fixed current read amplifier output
- Write current can be selected using an external resistor
- Built-in power supply monitor 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  $\Omega$  typ)

### Ordering Information

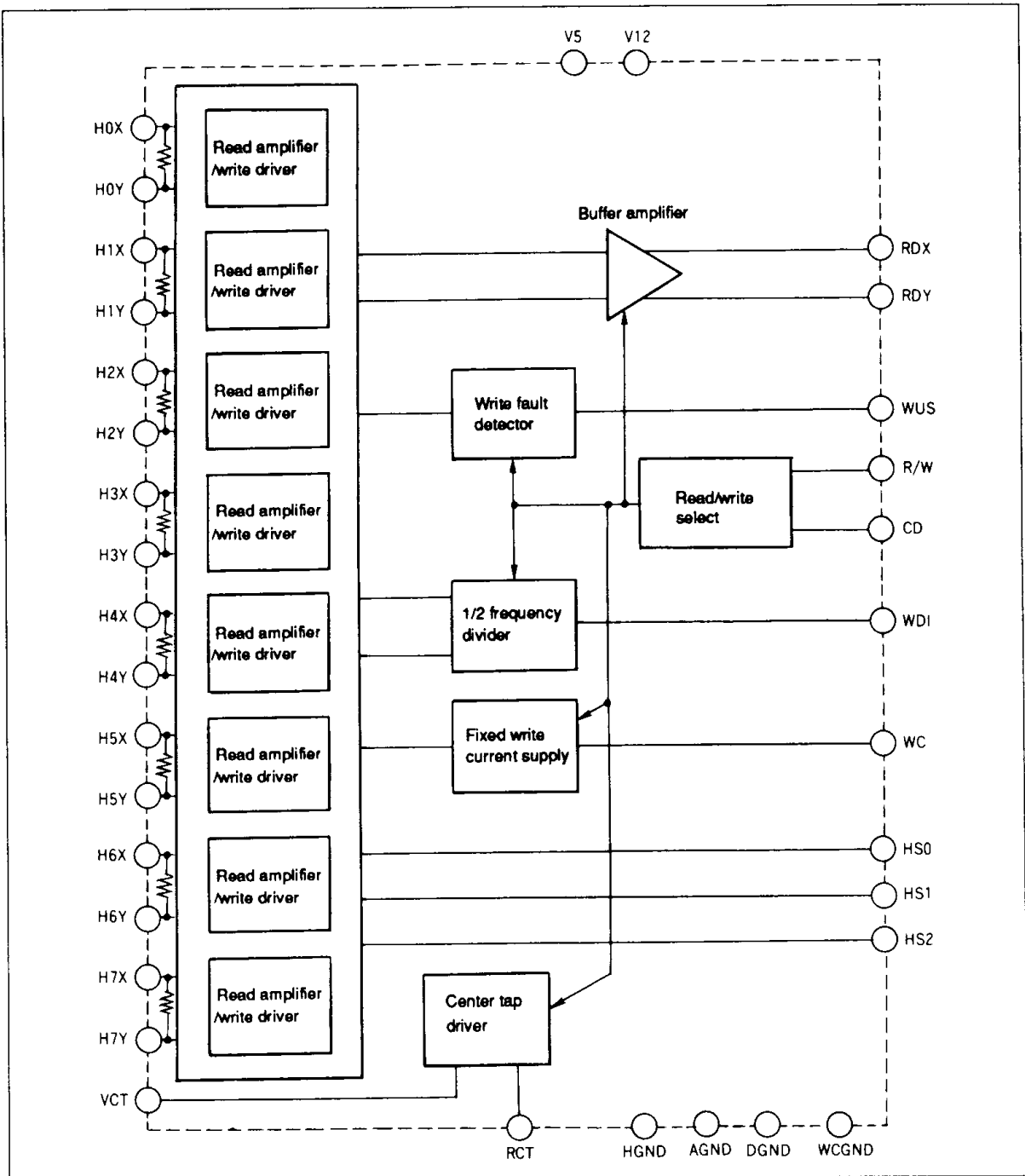
Type No.	Package
HA16689MP	MP-44



### Pin Assignment



Block Diagram



# HA16689MP

## 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 $\Omega$ (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. $\text{WRITE CURRENT} = K/R_{WC} \text{ [A]} \quad (\text{Equation 1})$
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: <ol style="list-style-type: none"> <li>1. Head coil is shorted to ground or open-circuited</li> <li>2. Center tap is open-circuited</li> <li>3. WDi input frequency is too low</li> <li>4. There is no write current</li> <li>5. Chip is in read mode</li> <li>6. Chip is not selected</li> </ol>
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 <sub>W</sub>	60	mA	
Input voltage	V <sub>in</sub>	-0.3 to V5 + 0.3	V	HS0, HS1, HS2, WDi, R/W, CD
WUS voltage	V <sub>WUS</sub>	14.0	V	WUS
WUS output current	I <sub>WUS</sub>	12	mA	WUS
Center tap output current	I <sub>co</sub>	-60	mA	VCT
Read data output current	I <sub>ro</sub>	-10	mA	RDX, RDY
Head voltage	V <sub>h</sub>	-0.3 to 14	V	H0X, H0Y to H7X, H7Y
Operating temperature	T <sub>opr</sub>	0 to +70	°C	
Storage temperature	T <sub>stg</sub>	-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	I5	—	—	25	mA	Read mode
	I5	—	—	30	mA	Write mode
	I5	—	—	20	mA	Idle mode
+12 V power supply current	I12	—	—	35	mA	Read mode
	I12	—	—	20 + I <sub>W</sub>	mA	Write mode
	I12	—	—	20	mA	Idle mode

**Digital Inputs**

Parameter	Symbol	Min	Typ	Max	Unit	Test Conditions
Input low voltage	V <sub>IL</sub>	-0.3	—	0.8	V	
Input low current	I <sub>IL</sub>	-400	—	—	μA	V <sub>IL</sub> = 0.8 V (applies to WDi)
	I <sub>IL</sub>	-100	—	—	μA	V <sub>IL</sub> = 0.8 V (applies to HS0, HS1, HS2, CD, and R/W)
Input high voltage	V <sub>IH</sub>	2.0	—	V5 + 0.3	V	
Input high current	I <sub>IH</sub>	—	—	100	μA	V <sub>IH</sub> = 2.0 V
Read/write transition time	t <sub>rw</sub>	—	—	600	ns	R/W to 90% VCT write voltage
Write/read transition time	t <sub>wr</sub>	—	—	600	ns	R/W to 90% VCT read voltage
Head select delay	t <sub>hs</sub>	—	—	600	ns	Read or write mode
Chip disable delay	t <sub>irw</sub>	—	—	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 <sub>OL</sub>	—	—	0.5	V	I <sub>OL</sub> = 8 mA
US high current	I <sub>OH</sub>	—	—	100	μA	V <sub>OH</sub> = 5.0 V
Fault to no-fault delay	t <sub>df2</sub>	—	—	1.0	μs	
No-fault to fault delay	t <sub>df1</sub>	1.6	—	8.0	μs	

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## Read Amplifiers

Parameter	Symbol	Min	Typ	Max	Unit	Test Conditions
Differential voltage gain	$A_{vd}$	170	200	230	V/V	$f = 300 \text{ kHz}$
Bandwidth (-3 dB)	$B_W$	—	20	—	MHz	
Input noise voltage	$V_n$	—	1.5	—	nV/√Hz	$f \leq 15 \text{ MHz}$ , input shorted
Input bias current	$I_b$	—	—	35	μA	Read mode
Common mode rejection ratio	CMRR	50	—	—	dB	$V_{in(CM)} = V_{CT} + 100 \text{ mV}_{p-p}$ , 0.0 VDC, $f = 5 \text{ MHz}$
Supply voltage rejection ratio	PSRR	45	—	—	dB	$V_5, V_{12} \pm 100 \text{ mV}_{p-p}$ , $f = 5 \text{ MHz}$
Channel separation	Sep	45	—	—	dB	$V_{in} = 100 \text{ mV}_{p-p}$ on unselected channels and $V_{in} = 0 \text{ mV}_{p-p}$ on selected channel $f = 1 \text{ MHz}$
Output offset voltage	$V_o$	-600	—	600	mV	Input shorted
Differential input impedance	$R_{in}$	570	750	930	Ω	$f = 300 \text{ kHz}$
	$R_{in}$	—	500	—	Ω	$f = 5 \text{ MHz}$
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	$I_W \text{ Lhead} > 200 \text{ mA } \mu\text{H}$
Head current rise time	$T_{hc}$	—	—	20	ns	$L_h = 0 \text{ } \mu\text{H}$ , $R_h = 0 \text{ } \Omega$ , 10% to 90% point
Head current switching delay time	$T_{d3}$	—	—	25	ns	$R_h = 0 \text{ } \Omega$ , $L_h = 0 \text{ } \mu\text{H}$ , From 50% point
Head current switching symmetry	$T_{d4}$	—	—	2	ns	WDi duty cycle = 50% rise/fall time = 1 ns
WDi minimum input frequency	$F_W$	125	—	—	kHz	WUS = Low
Head current gain	$I_h/I_{WC}$	—	20	—		Head current $I_{WC}$
VCT output voltage	VCT	3.8	4.3	5.0	V	Read mode $I_b = -35 \text{ } \mu\text{A}$
	VCT	5.0	6.0	6.6	V	Write mode $I_{WC} = -45 \text{ mA}$
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

