

HA16688MP

Read/Write Circuit

Description

The HA16688MP is a low-noise, 8-channel read/write circuit developed for use with small hard disk drives.

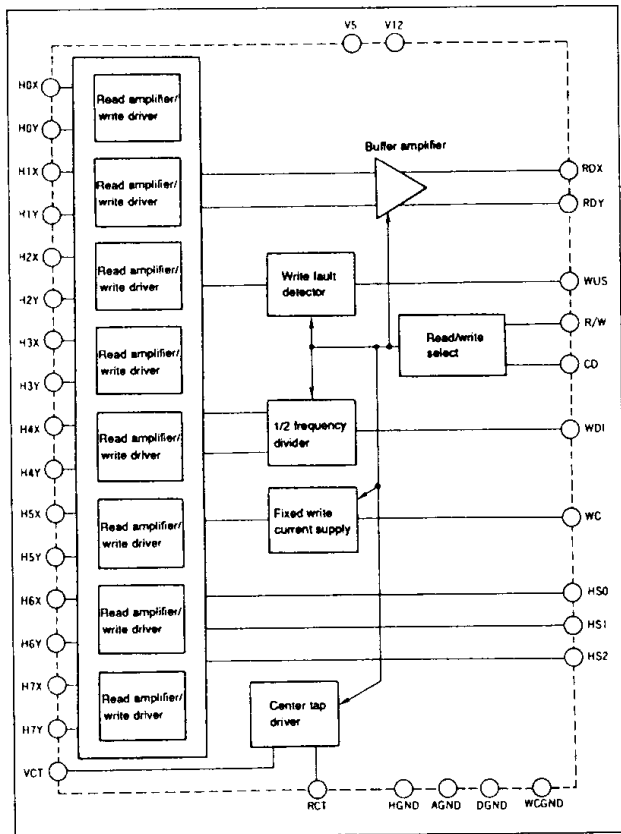
Functions

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

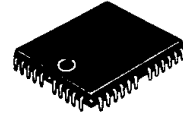
Features

- Two-power supply design (+5 V and +12 V)
- Easily extendable for systems with more than 8 channels
- Low noise read amplifier has differential gain of 200 (typ)
- Emitter-follower fixed current read amplifier output
- Write current can be selected by 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

Block Diagram

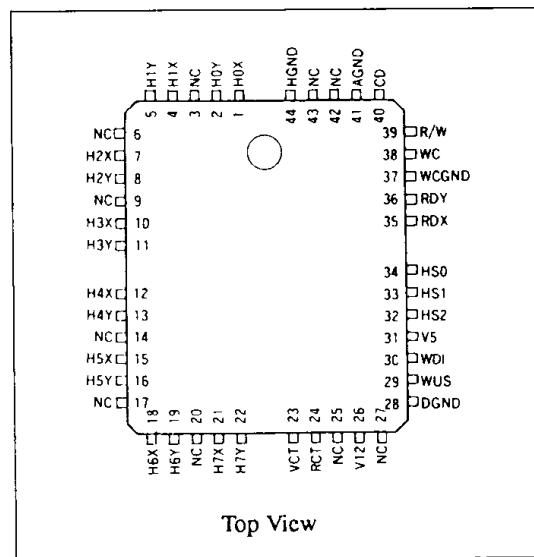


HA16688MP



(MP-44)

Pin Assignment



Ordering Information

Type No.	Package
HA16688MP	MP-44



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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 high, 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 write current.
RCT	24	Power supply for center tap	Power consumption can be reduced by connecting RCT to V12 through a 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. Select from head channels 0 to 7 (see table 1).
HS1	33	Head select 1	
HS2	32	Head select 2	
HS3	31	Head select 3	
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 WC and GND: $\text{WRITE CURRENT} = K/R_{WC} \text{ [A]}$
WDi	30	Write data input	The write data signal frequency is divided by two, then fed to a write driver.
WUS	29	Write fault detector output	WUS goes high when a write fault is detected. WUS will go high if: 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	V5	6.0	V	V5
Analog power supply	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	HOX, HOY 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 _{rw}	—	—	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	



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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	—	30	—	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}	8.0	15.5	—	kΩ	$f = 300 \text{ kHz}$
	R_{in}	—	0.8	—	kΩ	$f = 5 \text{ MHz}$
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	$I_W \cdot L_{head} > 200 \text{ mA } \mu\text{H}$
Head current rise time	T_{hcx}	—	—	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 $I_d = -35 \text{ } \mu\text{A}$
	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

