SONY

CXA3081R

4-channel Read/Write Amplifier for MR-Ind Head Hard Disk Drive

Description

The CXA3081R is a Read/Write amplifier for MR-Ind (Magneto Resistive-Inductive) heads used in hard disk drives, and is capable of supporting up to four channels.

Features

- Single +5 V power supply.
- Drives up to four heads.
- Servo Write function, drives four channels.
- Differential P-ECL write data input.
  Write data passes through the T flip-flop.
- Power-saving function.
- Read amplifier has an emitter follower differential output.
- Bias-on function activate the read amplifier in write mode.
- Input noise of 0.85 nV/$\sqrt{\text{HZ}}$ (typ.), R_{MR}=30 Ω, I_B=20 mA.
- Single - ended input is terminated by MR head to GND
- Head unsafe detection circuit.
- Without Damping resistors.
- Fast recovery time. Write to read ; 1 µs.

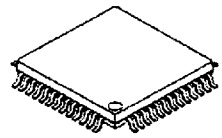
Applications

Hard disk drives with MR-Ind heads.

Structure

Bipolar silicon monolithic IC.

52 pin LQFP (Plastic)



Absolute Maximum Ratings (Ta=25 °C)

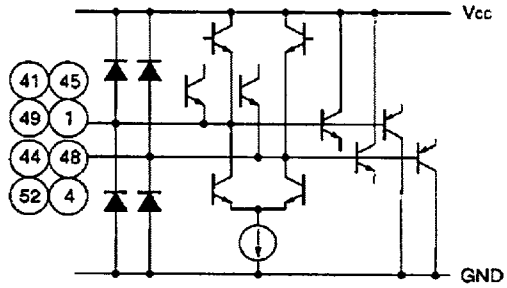
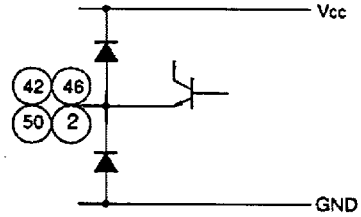
• Supply voltage	Vcc	7	V
• Allowable power dissipation (on board)	P_D	1300	mW
• Write current	Iw	50	mA
• Bias current	I_B	22	mA
• Operating temperature	Topr	−20 to +70	°C
• Storage temperature	Tstg	−55 to +150	°C

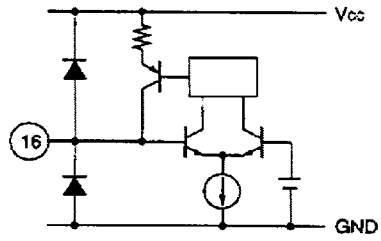
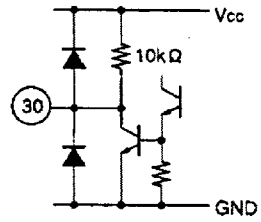
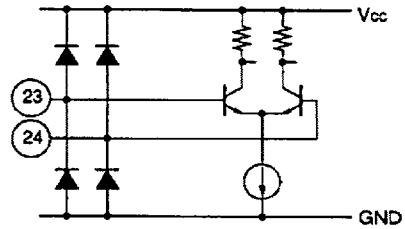
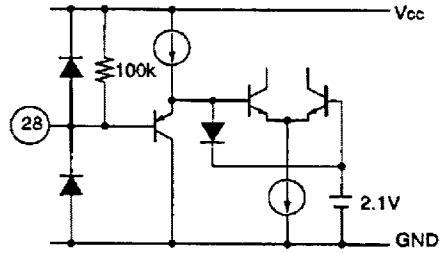
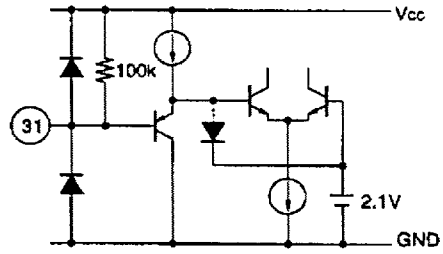
Operating Conditions

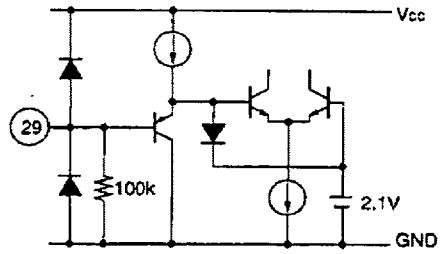
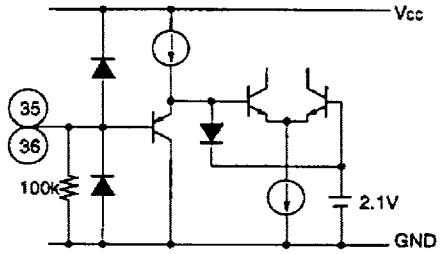
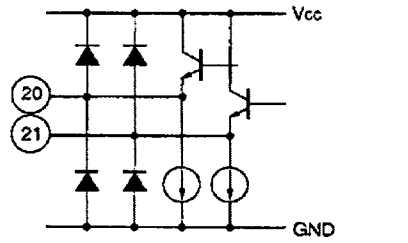
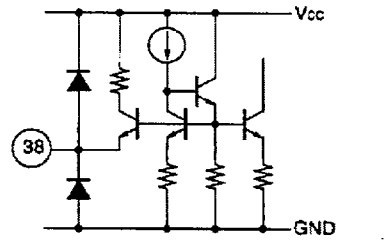
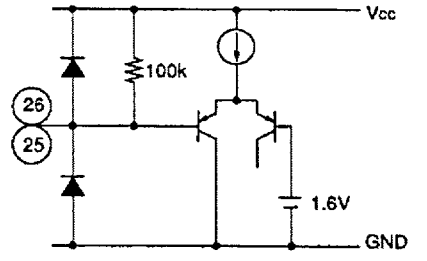
• Supply voltage	Vcc	5 V ±10	%
• MR bias voltage	V_{MR}	130 to 650	mV
• Bias current	I_B	10 to 20	mA
• Write Current in Servo Write Mode (Ta≦30 °C) four channels Servo Write	Iws	10 to 20	mA

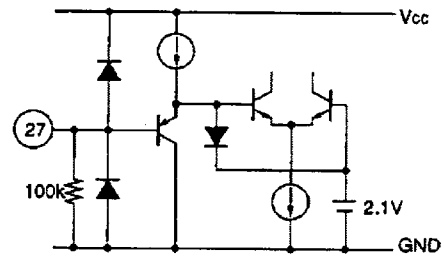
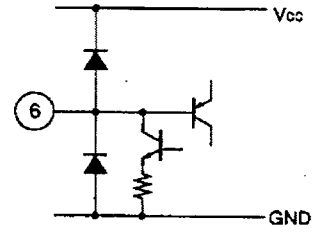
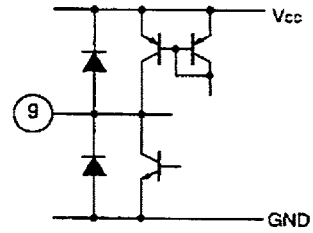
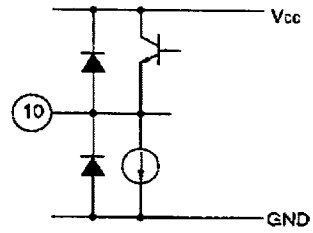
E95Z11A63-TE

Pin Description

Pin No.	Symbol	Equivalent circuit	Description
41 44 45 48 49 52 1 4	IN0X IN0Y IN1X IN1Y IN2X IN2Y IN3X IN3Y		Inductive heads for write. Four channels are provided.
42 46 50 2	MR0+ MR1+ MR2+ MR3+		MR heads for Read. Connect the MR heads between each pin and GND. Four channels are provided.
43 47 51 3	MR0– MR1– MR2– MR3–		MR head GND. Connect each pin to GND.
11	DVCC		5 V power supply (Digital) .
12	AVCC		5 V power supply (Analog) .
7 18 34	GND		Ground.
33	DGND		Ground.
5 8 13 14 15 17 19 22 32 37 40	NC		

Pin No.	Symbol	Equivalent circuit	Description
16	WC		Write current setting resistor is connected between this pin and GND.
30	HUS		Head unsafe detection output. Detects abnormal states when the collector output transistor is OFF in the Read mode, and the collector output transistor is OFF in the Write mode.
23 24	WDX WDY		Differential write data input for P-ECL. Includes T-FF.
28	PS		Power saving signal input. The power saving function is activated when high.
31	R/$\overline{W}$		Read / Write signal input. Read when high, write when low.

Pin No.	Symbol	Equivalent circuit	Description
29	WSER		Servo Write signal input. Servo Write mode when high.
35 36	HS0 HS1		Head select signal. Selects one of the four heads as shown in table 2.
20 21	RDX RDY		Read amplifier output. High impedance in the write mode. (with coupling capacitors)
38	BC		Connect a current control resistor between this pin and GND.
39	CEX3		Connect an external capacitor of Read amplifier between this pin and GND.
26 25	B0 B1		Current control signal input. See the bias current of MR heads as shown in Table 4.

Pin No.	Symbol	Equivalent circuit	Description
27	IBON		IBON signal input. In Write mode, read amplifier is activated when high, keeping output high impedance.
6	CEX1		Connect an external capacitor of Read amplifier between this pin and GND.
9	CEX2		Connect an external capacitor of Read amplifier between this pin and pin 10 (CEX2V).
10	CEX2V		Regulator terminal of Read amplifier.

Electrical characteristics

(Unless otherwise specified Vcc=5 V, Ta=25 °C, Iw=30 mA, IB=20 mA, CEX1=0.047μF, CEX2=CEX3=0.1 μF)

No.	Item	Symbol	Measurement conditions	Min.	Typ.	Max.	Unit
1-1	Current consumption for Read	I_{CCR}		31 +IB	44 +IB	59 +IB	mA
1-2	Current consumption for Write	I_{CCW}		26 +Iw	37 +Iw	49 +Iw	mA
1-3	Current consumption for Servo Write	I_{CCS}	Drives four channels Iw=20 mA		93+ Iw×4		mA
1-4	Current consumption for Power saving	I_{CCP}		1.4	2	2.7	mA
2-1	Digital input low input voltage	V_{IL}	Digital input: Pins 25, 26, 27, 28, 29, 31, 35, and 36			0.8	V
2-2	Digital input high input voltage	V_{IH}		2.0			V
2-3	Digital input low input current	I_{IL}	High voltage: 5 V Low voltage: 0 V	−100			μA
2-4	Digital input high input current	I_{IH}				100	μA
3-1	Write data input low input voltage	V_{WDL}	Write data input: Pins 23, 24	Vcc− 2.0		Vcc− 1.5	V
3-2	Write data input high input voltage	V_{WDH}		Vcc− 1.0		Vcc− 0.5	V
3-3	Write data input current	I_{WD}		−20		20	μA
4-1	Head unsafe output low output voltage	V_{HUSL}	10 kΩ internal resistance pull up			0.5	V
4-2	Head unsafe output high output voltage	V_{HUSH}	10 kΩ internal resistance pull up	4.8		5.0	V
5	Power supply ON/OFF detector threshold voltage	V_{TH}	For write, When Vcc drops below 5 V, the Vcc voltage at which Iw stops flowing is regarded as V_{THOFF}. When Vcc rises above 3 V, the Vcc voltage at which Iw begins flowing is regarded as V_{THON}.	3.6		4.3	V
6	Write current setting range	Iw		10		40	mA
7-1	Write current setting constant	Kw	Assuming the Write current as Iw [mA] (Rwc=2.7 kΩ) Kw=Rwc×Iw=2.7×Iw	75.9	82.5	89.1	
7-2	Write current setting terminal voltage	Vwc		1.21	1.295	1.38	V

No.	Item	Symbol	Measurement conditions	Min.	Typ.	Max.	Unit.
8	Read amplifier differential voltage gain	Av	Input voltage: 1 mVp-p, 1 MHz Output voltage: V0 [mVp-p] $Av=\frac{Vo}{1}$ resistance (RDX, RDY): 1 kΩ R_{MR}=30 Ω, R_{BC}=10 kΩ at B0=H, B1=H	158	193	228	V/V
9	Frequency band-Low frequency cut-off	F_{CL}	Low frequency where Av drops by 3 dB		100	200	kHz
10	Frequency band-High frequency cut-off	F_{CH}	High frequency where Av drops by 3 dB	70	90		MHz
11-0	Bias current setting constant	K_B	Assuming the Bias current as I_B [mA] (R_{BC}=10 kΩ) $K_B=R_{BC}\times I_B$ at B0=H, B1=H	173	192	211	
	Bias current ratio B0, B1 control		Assuming I_{BO} [mA] as the bias current at B0=H, B1=H				
11-1		K_{RB1}	I_{B1}; I_B at B0=L, B1=H $K_{RB1}=I_{B1}/I_{BO}$	0.935	0.955	0.975	
11-2		K_{RB2}	I_{B2}; I_B at B0=H, B1=L $K_{RB2}=I_{B2}/I_{BO}$	0.89	0.91	0.93	
11-3		K_{RB3}	I_{B3}; I_B at B0=L, B1=L $K_{RB3}=I_{B3}/I_{BO}$	0.84	0.86	0.88	
12	Input referred noise voltage	E_{NO}	Head impedance: 30 Ω Assuming V_N [Vrms] as the voltage which the read voltage output is amplified by a factor of 100 is passed through a BPF (band width of 100 kHz to 50 MHz): $E_{N30}=\frac{V_N}{100\cdot Av\sqrt{49.9\times 10^6}}$ $E_{NO}=\sqrt{(E_{N30})^2-(4KT30)}$		0.85	1.05	$nV/\sqrt{Hz}$
13	Power supply rejection ratio	PSRR	Ripple voltage: 100m Vp-p, 5 MHz Assuming the Read amplifier output as Vp [mVp-p] $PSRR=20\log\frac{100}{V_P}$ +20 logAv	40			dB
14	Read data output offset voltage for read	V_{OFFR}	$V_{OFFR}=V_{RDX}-V_{RDY}$	–400		400	mV
15	Unselected head voltage	V_{USH}	MR Head			100	mV

No.	Item	Symbol	Measurement conditions	Min.	Typ.	Max.	Unit.
16	Head differential voltage amplitude	V_{SW}	Difference in electric potential between INX and INY when the Write current is switched: head open	4.4	5.2		Vp-p
17	Mode switching time from Read to Write	T_{RW}	T_{RW} is the time interval between the change of Pin 31 from high to low and the Write current reaches 90 %.		0.3	0.5	µs
18-1	Mode switching time from Write to Read	T_{WR1}	T_{WR1} is the time interval between the change of Pin 31 from low to high and the Read amplifier output reaches 90 %, ±100 mV of read DC		1.0	2	µs
18-2	Mode switching time from Write to Read	T_{WR2}	T_{WR2} is the time interval between the change of Pin 31 from low to high and the Write current falls to 10 %.		0.2	0.5	µs
19	Mode switching time from Power saving to Read	T_{PR}	T_{PR} is the time interval between the change of Pin 28 from high to low and the Read amplifier output reaches 90 %.		3	4.5	µs
20	Head switching time	T_H	T_H is the time interval between the change of the selected head and the Read output* reaches 90 % in the Read mode.		3	4	µs
21	Write current propagation delay time	T_{PD}	L_H=0 µH R_H=0 Ω T_{PD} is the time interval between the write data rising transition and the Write current reaches 90 %.		10	25	ns
22	Write current rise/fall time	T_R/T_F	L_H=0 µ R_H=0 Ω T_R is the time for the write current to rise from 10 % to 90%. T_F is the time for the Write current to fall from 90 % to 10 %.		3	6	ns
23	Mode switching time Read safe.	T_{RS}	T_{RS} is the time interval between the change of pin 31 from low to high and Pin 30 becomes low.		0.5	1	µs
24	Mode switching time safe to unsafe	T_{SA1}	T_{SA1} is the time required for Pin 30 to turn "High" after the last transition of Write data** when Write data is stopped in Write mode.	3	5	8	µs
25	Mode switching time unsafe to safe.	T_{SA2}	T_{SA2} is the time required for Pin 30 to turn "Low" after the first transition of Write data** in Write mode.		0.3	1	µs

*Read output 100 mVp-p 10 MHz,**Write data f_{WD}=5 MHz

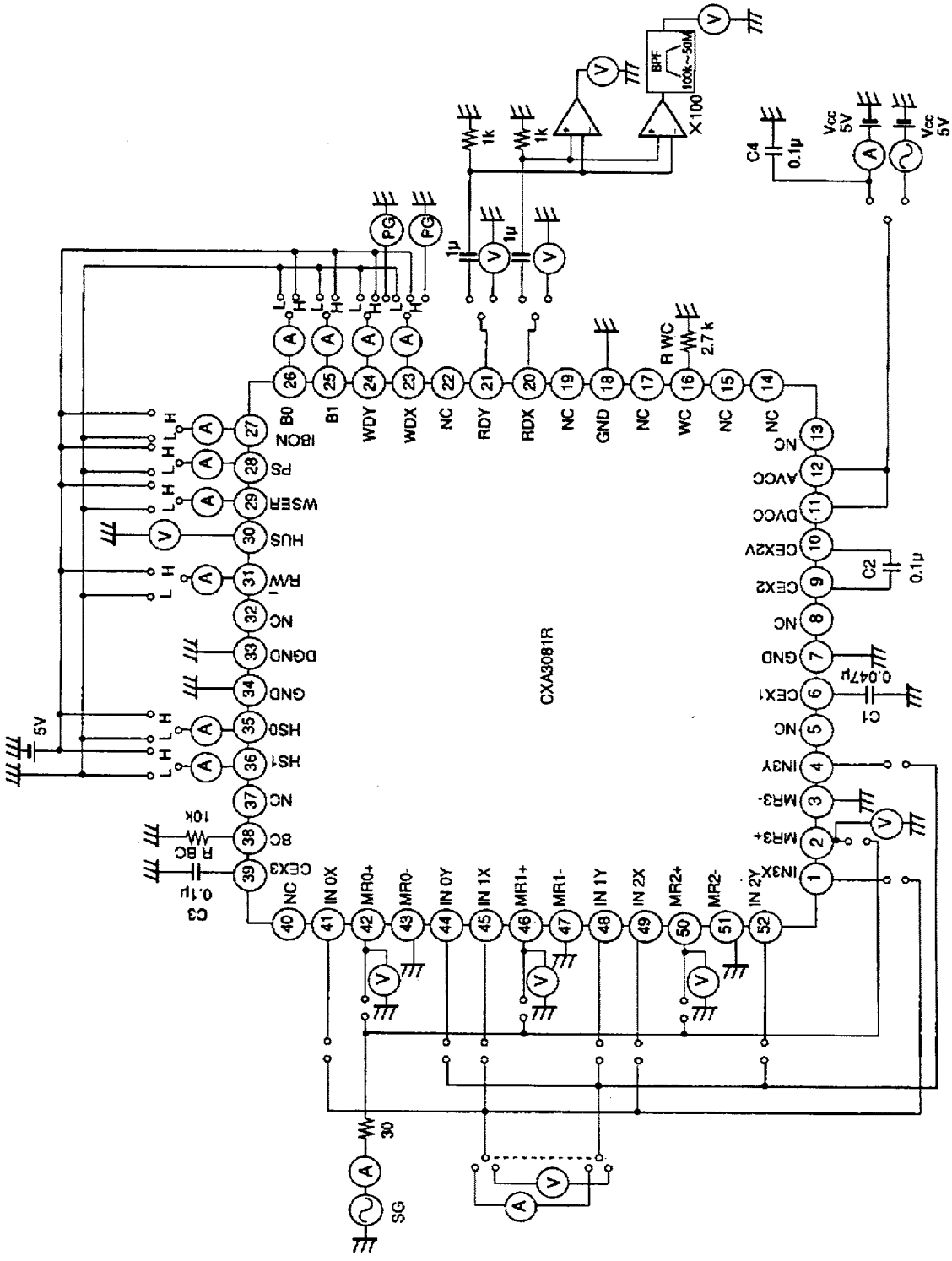


Fig. 1 TEST CIRCUIT 1 (for Test 1 to 16)

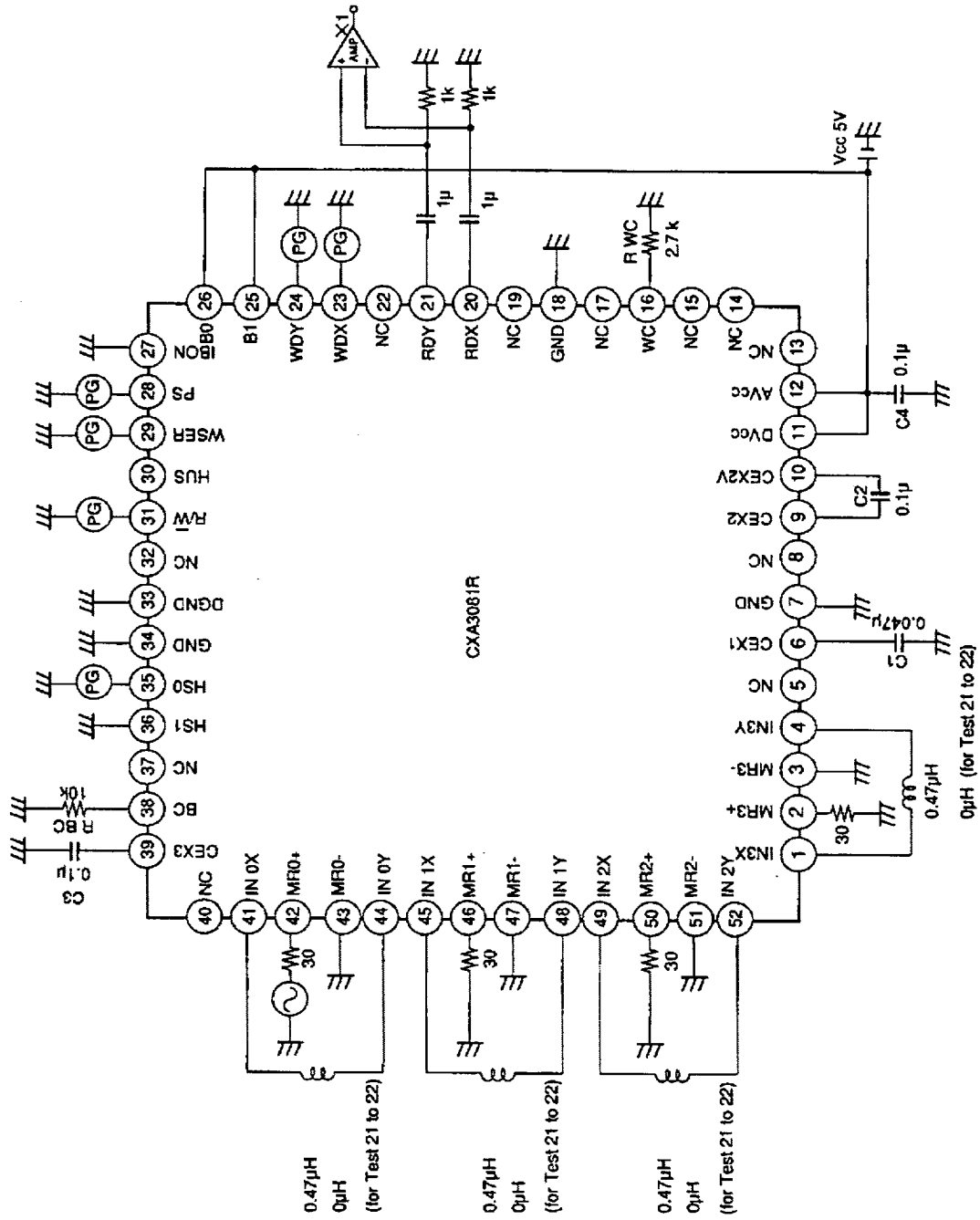


Fig. 2 TEST CIRCUIT 2 (for Test 17 to 25)

Description of Functions

• Read amplifier

This is a low-noise amplifier for amplifying the micro signals generated from the heads, in write mode the emitter follower outputs become high impedance with coupling capacitors. The differential output signal appears at RDX and RDY pins.

• Write circuit

Write data which is input to WD pin passes through a T flip-flop and frequency is divided by 2. Then it drives the write switch circuit and flows write current to the head.
Write current flows into X side after R/$\overline{W}$ pin changed from high to low.

• Mode control

The modes are set by R/$\overline{W}$, WSER and PS pins as shown in Table 1.

R/$\overline{W}$	WSER	PS	HS0	HS1	Mode
L	L	L	X	X	Write
H	L	L	X	X	Read
X	H	L	L	L	0, 1, 2, 3 head Servo Write
X	X	H	X	X	Power save

Table 1 Mode selection

• Head selection

The heads are selected by HS0 and HS1 pins as shown in Table 2.

HS0	HS1	Head
L	L	0
H	L	1
L	H	2
H	H	3

Table 2 Head selection

• Head unsafe detection circuit

This circuit detects abnormal states.
The normal and abnormal states for read and write are shown in Table 3.
An abnormality occurs for write in the following instances:

- The head is open under the condition which write data frequency is ≦ 20 MHz.
- The head is shorted either to GND or to Vcc.
- The write data frequency is abnormally low.
- There is no write current.
- At abnormal supply voltage.
  (Refer to the item "Power supply ON/OFF detection".)

An abnormality occurs for read in the following instances:

- The MR head is open.
- The MR head is shorted to GND.
- At abnormal supply voltage. (Refer to the item "Power supply ON/OFF detection".)

Mode	Normal	Abnormal
Read	L	H
Write/Servo Write	L	H
Power save	H	H

Table 3 Head unsafe

• Power supply ON/OFF detection

This circuit monitors Vcc to detect erroneous writes.

The error status is established when Vcc falls below the threshold voltage (V_{TH}) of the power supply ON/OFF detector, in which case the recording and playback function are prohibited.

When Vcc is above V_{TH}, the prohibition of these functions is released.

• Bias current control

The bias current of MR heads are controlled by B0 and B1.

B0	B1	Bias current
L	L	0.86IB0
H	L	0.91IB0
L	H	0.955IB0
H	H	IB0

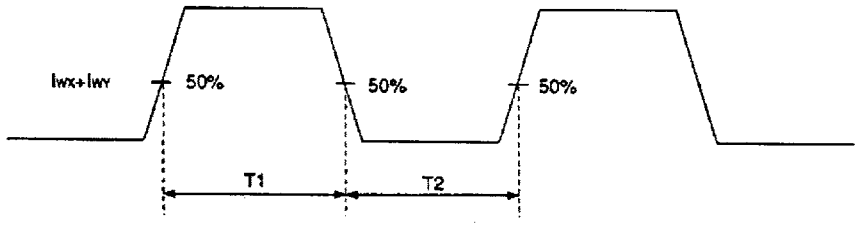
Table 4 Bias control

Application Notes

Use the following characteristics for reference. Vcc=5 V, Ta=25 °C

Item		Symbol	Conditions	Min.	Typ.	Max.	Unit
Write Head	Differential output capacitance	Co	Between head input pins			15	pF
	Differential output resistance	Ro		100			kΩ
Read	Output resistance	R_{RD}	RDX or RDY, f=5 MHz		40	60	Ω
Unselected head differential current in write mode		Ius	L_H=0.3 µH, R_H=30 Ω Iw=20 mA			0.5	mAp-p
Write current symmetry		T_{AS}*	L_H=0 µH , R_H=0 Ω Iw=20 mA	−0.5		0.5	ns

T_{AS}*=T1-T2



Notes on operation

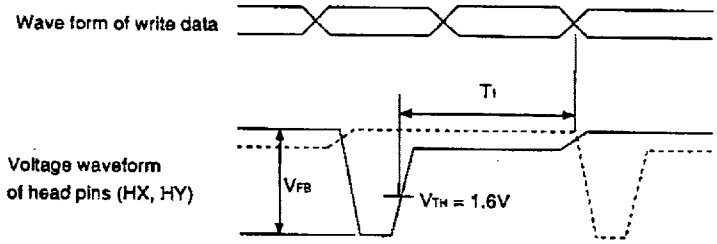
- This device handles high frequency and high gain signals. Please note the following;
  - Connect Vcc decoupling capacitor of approximately 1000 pF near the device.
  - Make the GND area as large as possible.

- When using for only two channels, leave the unused head pins open.

- The BC pin is a constant voltage pin. When noise affects this pin affects the noise of read amplifier, therefore locate the external resistor, R_{BC}, to the device as close as possible.

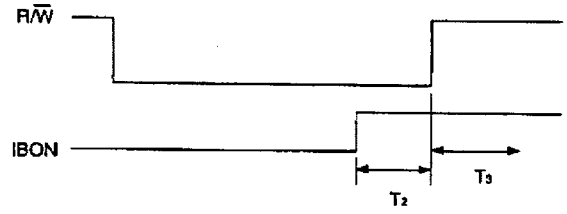
- The WC pin is a constant voltage pin. When noise affects this pin affects the noise of write current, therefore locate the external resistor, Rwc, to the device as close as possible.

- Write unsafe detection circuit
  This circuit uses the voltage waveforms of the head pins for detection.



  - The condition of T1 > 5 ns must be met for the WUS detection circuit to operate properly.
  - V_{FB} must be more than 2 V. When V_{FB} < 2 V, it is possible that write unsafe detection maximum frequency becomes more than 1 MHz.

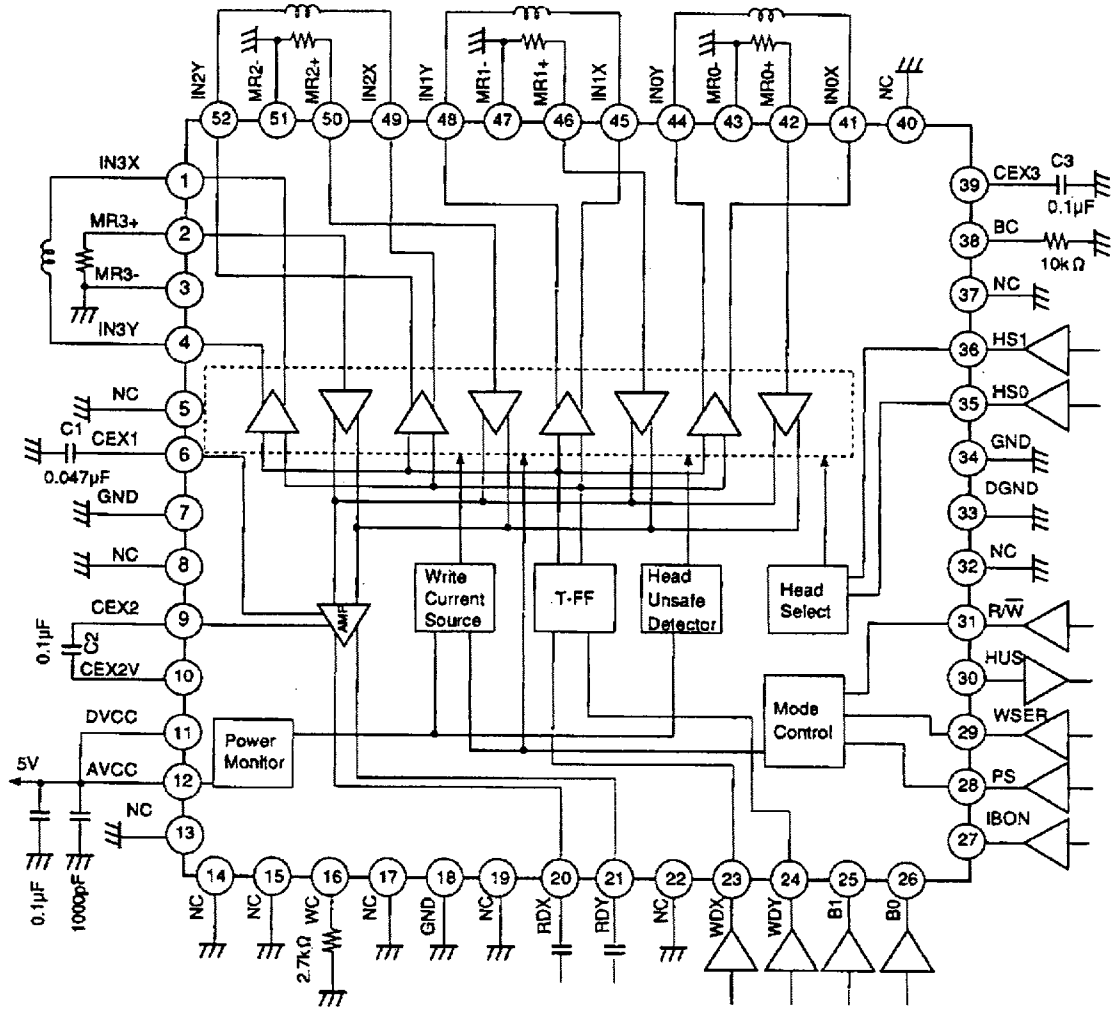
- IBON function
  IBON control will enable bias current during the last part of write mode to decrease the read recovery time.
  T_2 must be less than 20 µs to keep IC the under maximum junction temperature.
  Please keep T_3 more than 1 µs. T_3 is high level time of IBON after R/$\overline{W}$ goes to high.



- In Servo write mode, use the IC with Ta at 30 °C or less.

Application circuit

Top view



Application circuits shown are typical examples illustrating the operation of the devices. Sony cannot assume responsibility for any problems arising out of the use of these circuits or for any infringement of third party and other right due to same.

Fig. 3 Normalized Write current vs. Supply voltage

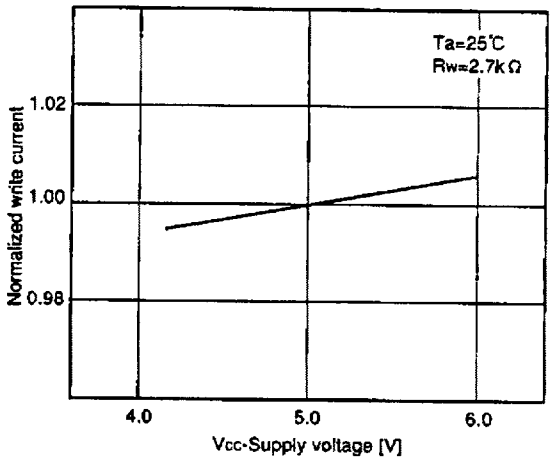


Fig. 4 Normalized Write current vs. Ambient temperature

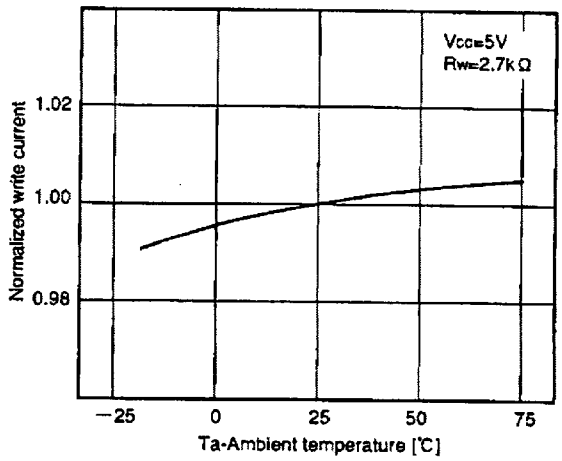


Fig. 5 Normalized Bias current vs. Supply voltage

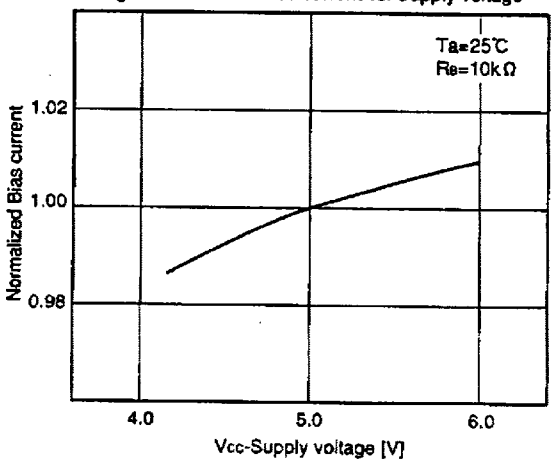


Fig. 6 Normalized Bias current vs. Ambient temperature

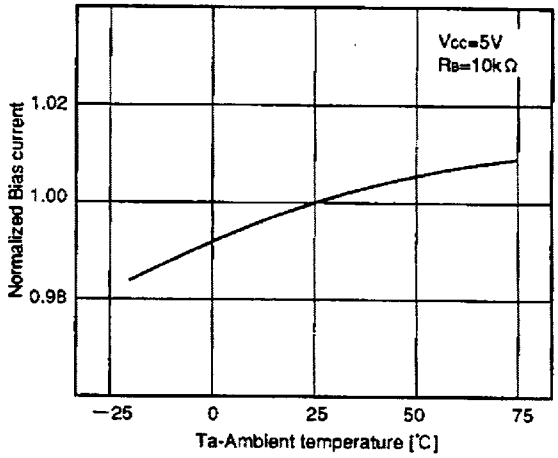


Fig. 7 Normalized Read amplifier voltage gain vs. Supply voltage

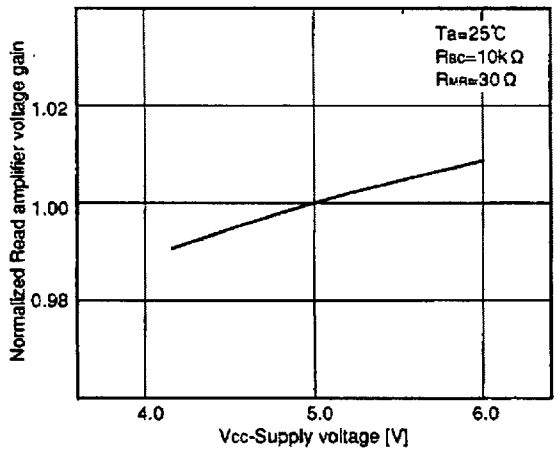


Fig. 8 Normalized Read amplifier voltage gain vs. Ambient temperature

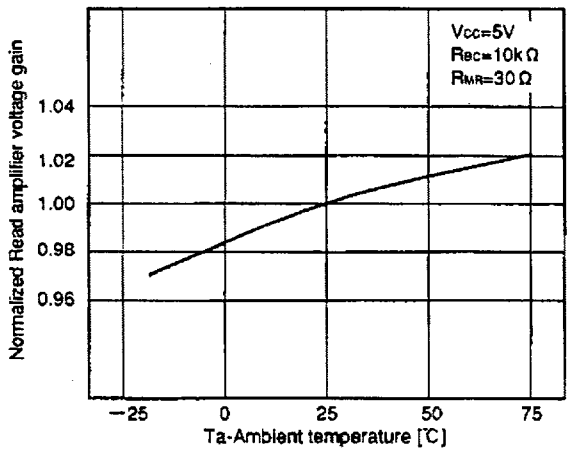


Fig. 9 Power supply ON/OFF detector threshold voltage vs. Ambient temperature

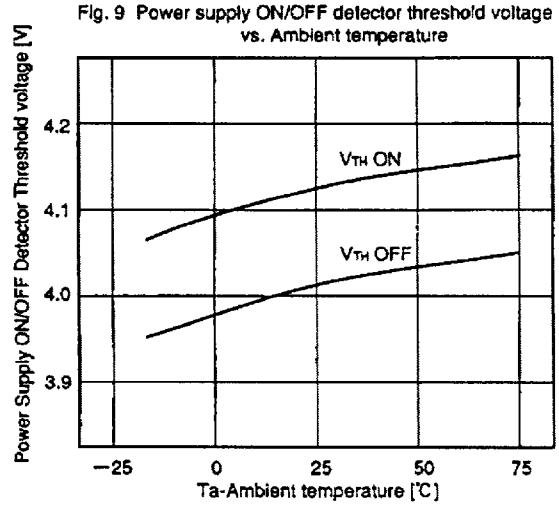


Fig. 10 Bias current setting constant K vs. Bias current

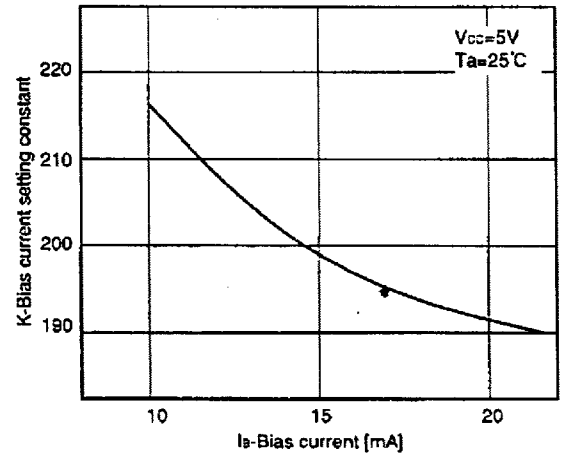
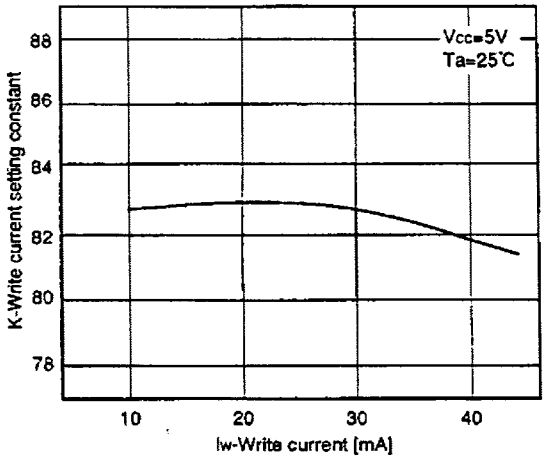
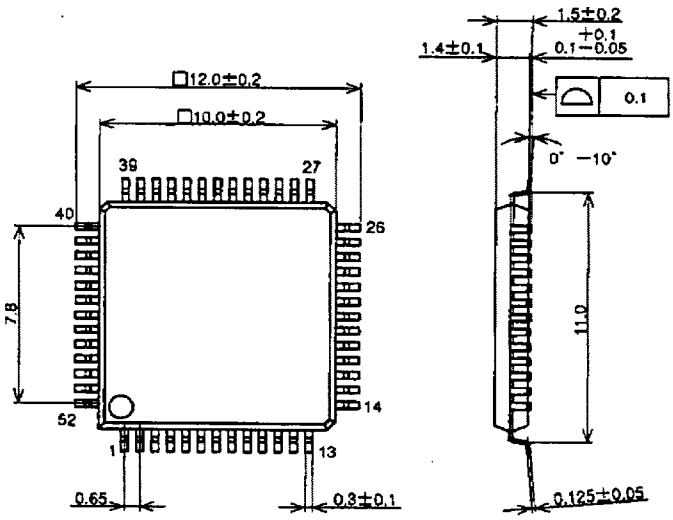


Fig. 11 Write Current setting constant K vs. Write Current



Package Outline Unit : mm

52PIN LQFP(PLASTIC)



SONY CODE	LQFP-52P-L081
EIAJ CODE	LQFP052-P-1010
JEDEC CODE	————

PACKAGE STRUCTURE

PACKAGE MATERIAL	EPOXY RESIN
LEAD TREATMENT	SOLDER PLATING
LEAD MATERIAL	COPPER ALLOY
PACKAGE WEIGHT	0.4g