

4ch. Read/Write Amplifier for high capacity Floppy Disk Drive

Description

The CXA3224N is a Read/Write Amplifier for high capacity floppy disk drive and designed to handle up to 4 channel heads.

Features

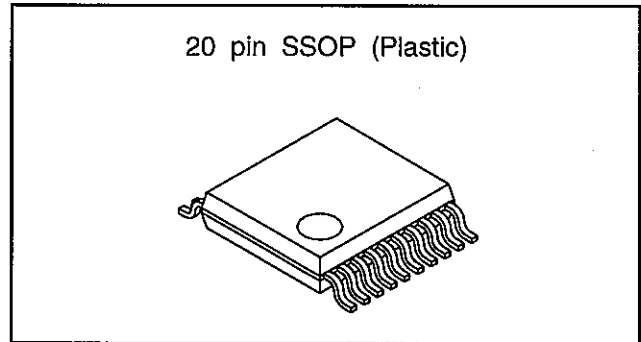
- Operate on single +5 V power supply
- Low power consumption
 - Read : 85 mW
 - Write : 115 mW + I_w × 5
 - Idle : 8 mW
- Designed for two terminal thin-film or MIG heads
- Read amplifier emitter follower output featuring 325 times gain (typ).
- Differential input capacitance for Read : 6pF (typ)
- Input noise : 0.47 nV / √Hz (typ)
- Write current range : 4 to 17 mA
- Differential Head voltage swing : 6.8 V_{p-p} (typ)
- Differential P-ECL write data input
- Built-in write unsafe detection circuit.
- Built-in Servo write function (2 ch).
- Built-in IC protection circuit for short of head to GND.
- Read data outputs are high impedance in write mode.
- Unselected head voltage is GND potential.
- Built-in supply voltage monitor circuit prohibits incorrect write during power on or abnormal voltage.
- Self switching damping resistance at head 0, 2 (R_d = 570 Ω).

Function

Read, Write and Write unsafe detection, power supply ON/OFF detection.

Structure

Bipolar silicon monolithic IC



Absolute Maximum Ratings (T_a=25 °C)

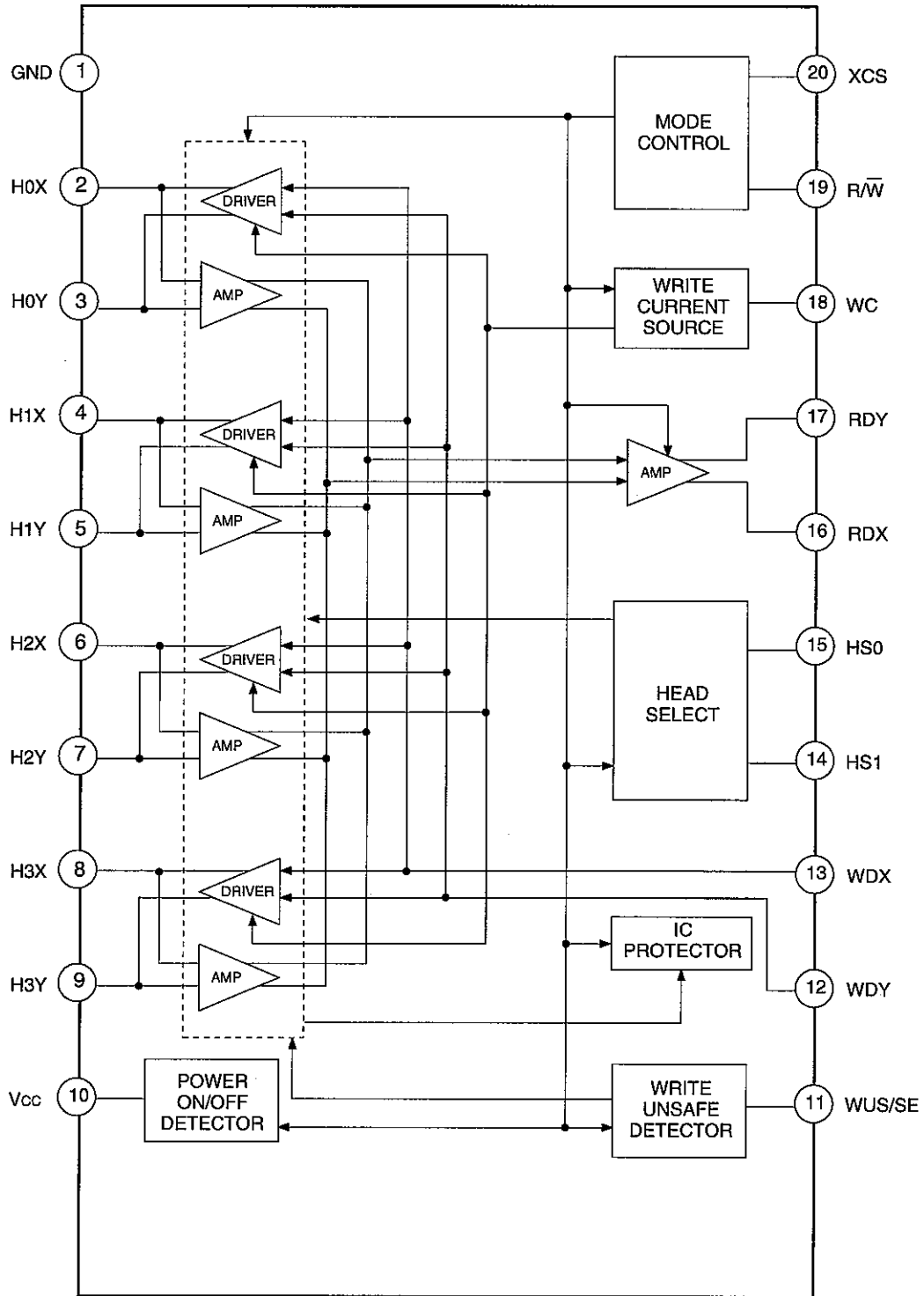
- Supply voltage V_{CC} 6 V
- Write current I_w 20 mA_{o-p}
- Operating temperature T_{opr} -20 to +75 °C
- Storage temperature T_{stg} -55 to +150 °C
- Allowable power dissipation
 - P_D 620 mW
- WUS/SE pin input current
 - I_{SEH} 15 mA

Recommended Operating Conditions

- Supply voltage V_{CC} 5.0 V ± 10 %
- Write current I_w 4 to 17 mA_{o-p}

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Block Diagram and Pin Configuration



Pin Description

No.	Symbol	Equivalent circuit	Description
1	GND		
2 3 4 5 6 7 8 9	H0X H0Y H1X H1Y H2X H2Y H3X H3Y		Head. 4 channels provided.
10	Vcc		5 V power supply.
11	WUS/SE		Write unsafe detection output / Servo Enable signal input.
12 13	WDY WDX		Differential P-ECL write data input.

No.	Symbol	Equivalent circuit	Description
14 15	HS1 HS0		Head select signal input. Selects one of 4 heads according to Table 2.
16 17	RDX RDY		Read Amplifier output.
18	WC		A setting resistor for the write current value is connected between this pin and GND.
19	R/W		Read/Write signal input At "High" : Read, at "Low" : Write.
20	XCS		Power save signal input At "High" : Power save.

Electrical Characteristics

(Unless otherwise specified, V_{CC}=5 V, T_a=25 °C, Write current I_w=15 mA)
Refer to Fig.1

No.	Item	Symbol	SW conditions														Measurement conditions	Min.	Typ.	Max.	Unit
			1	2	3	4	5	6	7	8	9	10	11	12	13	14					
1-1	Current consumption for Read	I _{CCR}	a	a	a	a	a	a	a	a	a	a	b	a	b	a	12	17	26	mA	
1-2	Current consumption for Write	I _{CCW}	a	a	a	a	a	a	a	a	a	b	a	a	b	a	17 +I _w	23 +I _w	36 +I _w	mA	
1-3	Current consumption for idle	I _{CCI}	a	a	a	a	a	a	a	a	a	b	a	a	b	a	1.0	1.6	2.3	mA	
2-1	Digital input "Low" input voltage	V _{IL}																	0.8	V	
2-2	Digital input "High" input voltage	V _{IH}															2.0			V	
2-3	Digital input "Low" input current	I _{IL}	a	a	a	a	a	a	a	a	a	b	a	a	a	-100			μA		
2-4	Digital input "High" input current	I _{IH}	a	a	a	a	a	a	a	a	b	b	b	b	b			750	μA		
2-5	Write data input "Low" input voltage	V _{WDL}														V _{WDH}		V _{WDH}	V		
2-6	Write data input "High" input voltage	V _{WDH}														V _{CC}		V _{CC}	V		
2-7	Write data input current	I _{WD}	a	a	a	a	a	a	a	a	a	b	a	a	a			50	μA		
2-8	Unselected head voltage	V _{unsel}																0.3	V		
3-1	Write unsafe output saturation voltage	V _{wus}	b	a	a	a	b	a	c	c	c	c	b	a	a			0.5	V		
3-2	Write unsafe output leak current	I _{wus}	a	a	a	a	a	a	a	b	a	a	b	a	a			50	μA		

No.	Item	Symbol	SW conditions														Measurement conditions	Min.	Typ.	Max.	Unit
			1	2	3	4	5	6	7	8	9	10	11	12	13	14					
4	Supply power ON/OFF detector threshold voltage	V_{TH}	b	a	a	a	a	a	a	a	a	b	a	b	a	a	When V_{CC} is lowered from 5 V in Write mode and I_w does not flow anymore, V_{CC} voltage is set to V_{THOFF} . When V_{CC} is raised from 3 V and I_w starts to flow, V_{CC} voltage is set to V_{THON} .	3.4	3.9	4.3	V
5-1	Write current setting range	I_w																4		17	mA_{O-P}
5-2	Write current voltage	V_{WC}	a	a	a	a	a	a	b	a	a	b	a	b	a	a		1.8	2	2.2	V
5-3	Write current gain	A_w															$I_w = A_w \cdot V_{WC} / R_{WC}$	23.4	26	28.6	mA/mA
5-4	Write current setting constant	K_w	b	a	a	a	a	a	b	a	a	b	a	b	a	a	$I_w = K_w / R_{WC}$	46.8	52	57.2	
6-1	WUS/SE voltage	V_{SEH}															Servo write enabled	$V_{CC} + 1$		$V_{CC} + 1.2$	V
6-2	WUS/SE sink current	I_{SEH}	b	a	a	a	a	b	a	b	a	b	a	b	a	a	Servo write enabled	0.5		14	mA
7	Read amplifier differential voltage gain	A_v	b	a	a	a	c	b	a	a	b	a	b	b	a	a	Input voltage SG1 : 1 mVp-p, 300 kHz Load resistance (RDX, RDY) : 1 k Ω Test point : V4 [Vp-p] $A_v = \frac{V_4}{SG1}$	275	325	375	V/V
8	Frequency band width (-3 dB)	BW	b	a	a	a	c	b	a	a	b	a	b	b	a	a	Frequency at which A_v lowers by 3 dB	70	100		MHZ

No.	Item	Symbol	SW conditions														Measurement conditions	Min.	Typ.	Max.	Unit
			1	2	3	4	5	6	7	8	9	10	11	12	13	14					
9	Input referred noise	E_N	a	a	a	a	a	a	a	b	a	a	a	b	b	a	Head impedance : 0 Ω , when the read amplifier output voltage is amplified 100 times and voltage passed through a LPF (low pass filter of cutoff frequency 15 MHz) is V_N [Vrms], $E_N = \frac{V_N}{100 \cdot AV \sqrt{15 \times 10^6}}$ Test point : V_5	0.47	0.65		$\frac{nV}{\sqrt{Hz}}$
10	Common mode rejection ration	CMRR	b	a	a	a	d	b	a	a	a	b	a	b	b	a	In-phase input voltage SG2 : 100 mVp-p, 5 MHz When the Read amplifier output is V_{CM} [mVp-p], $CMRR = 20 \log \frac{100}{V_{CM}}$ +20 log A_V Test point : V_4	50			dB
11	Power supply rejection ratio	PSRR	a	a	a	a	a	a	a	b	a	a	a	b	b	a	Ripple voltage SG3 : 100 mVp-p, 5 MHz When the Read amplifier output is V_P [mVp-p], $PSRR = 20 \log \frac{100}{V_P}$ +20 log A_V Test point : V_4	50			dB

No.	Item	Symbol	SW conditions														Measurement conditions	Min.	Typ.	Max.	Unit	
			1	2	3	4	5	6	7	8	9	10	11	12	13	14						
12	Channel separation	CS	a	b	a	a	a	a	b	a	a	a	b	b	a	Selected head input voltage : 0 mVp-p Unselected head input voltage SG1 : 100 mVp-p, 5 MHz When the Read amplifier output is Vcs [mVp-p]. $CS = 20 \log \frac{100}{V_{cs}}$ +20 log Av Test point : V4			50			dB
13	Read data output offset voltage for Read	V _{OFFR}	a	a	a	a	a	a	b	a	a	a	a	b	a	V _{OFFR} = V ₂ -V ₃ Test point : V ₂ , V ₃			-250		250	mV

Unless otherwise specified, $V_{CC}=5\text{ V}$, $T_a=25\text{ }^\circ\text{C}$, f_{WD} (Write data frequency) =5 MHz, $I_w=15\text{ mA}$, L_H (Head inductance) =1 μH , R_H (Head DC resistance value) =30 Ω

Refer to Fig. 2 to Fig. 4

No.	Item	Symbol	Measurement conditions	Min.	Typ.	Max.	Unit
14	Head differential voltage amplitude	V_{SW}	Differential voltage between HX pin and HY pin at switching of Write current (open Head)	5.8	6.8		Vp-p
15-1	Mode switching time Read to Write	T_{RW}	T_{RW} is the time required for Write current to turn to 90 % after Pin 19 changes from "High" to "Low".		0.2	0.4	μs
15-2	Mode switching time Write to Read	T_{WR1}	T_{WR1} is the time required for the Read amplifier output* to turn to 90 % after Pin 19 changes from "Low" to "High".		0.3	0.5	μs
		T_{WR2}	T_{WR2} is the time required for Write current to decrease to 10 % after Pin 19 changes from "Low" to "High".		0.2	0.4	μs
16	Mode switching time to Read	T_{IR}	T_{IR} is the time required for the Read amplifier output* to turn to 90 % after Pin 20 changes from "High" to "Low".			1	μs
17-1	Mode switching time safe to unsafe	T_{SA1}	T_{SA1} is the time required for Pin 11 to turn "High" after the last transition of Write data when Write data is stopped in Write mode.	1.5	3	5	μs
17-2	Mode switching time unsafe to safe	T_{SA2}	T_{SA2} is the time required for Pin 11 to turn "Low" after the first transition of Write data in Write mode.			0.6	μs
18	Head switching time	T_H	T_H is the time required for the Read amplifier output* to reach 90 % when the selected head switched in Read mode.			0.6	μs
19	Write current propagation delay time	T_{PD}	T_{PD} is the time required for Write current to reach 90 % after the Write data falling edge. $L_H=0\text{ }\mu\text{H}$, $R_H=0\text{ }\Omega$		2	7	ns
20	Write current rise/fall time	T_R/T_F	T_R is the time required for Write current to reach 90 % from 10 %; T_F is the same time required to reach 10 % from 90 %. $L_H=0\text{ }\mu\text{H}$, $R_H=0\text{ }\Omega$		1	3	ns

*Read amplifier output 100 mVp-p 10 MHz

Timing Chart 1

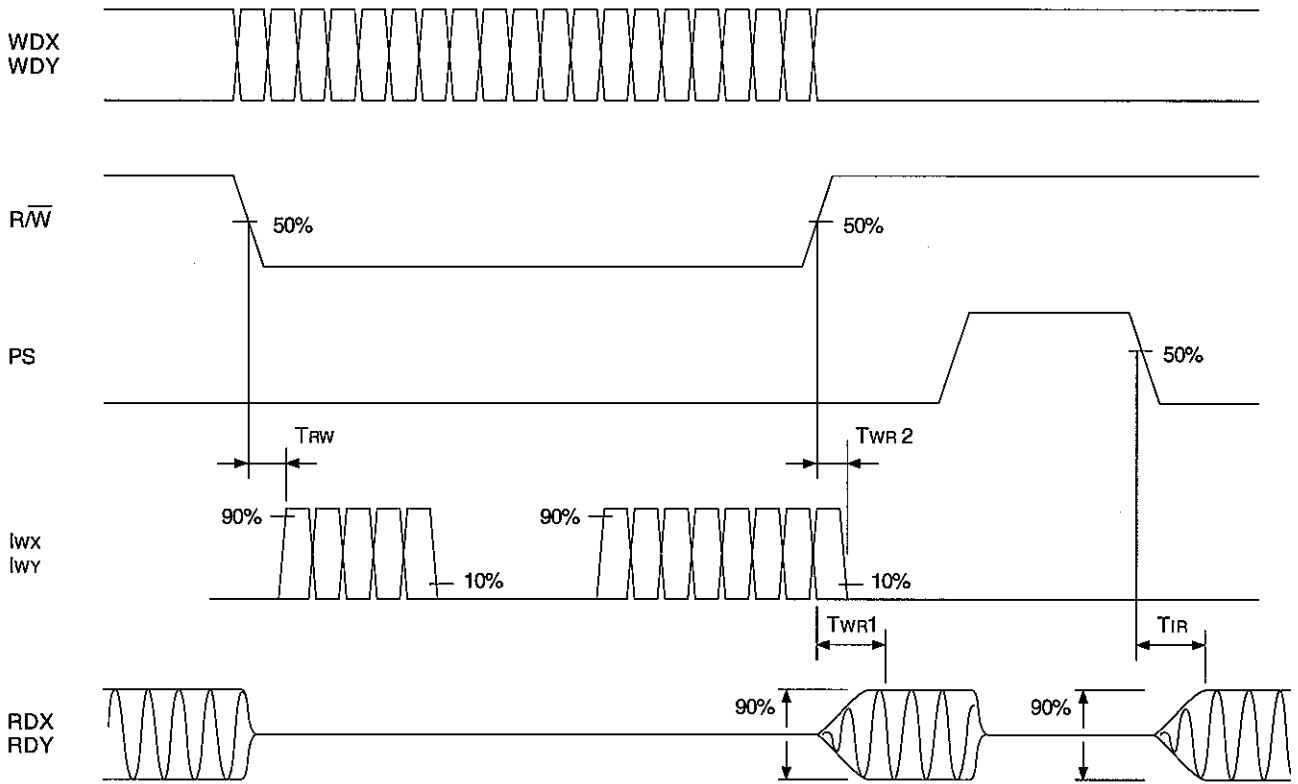


Fig. 3

Timing Chart 2

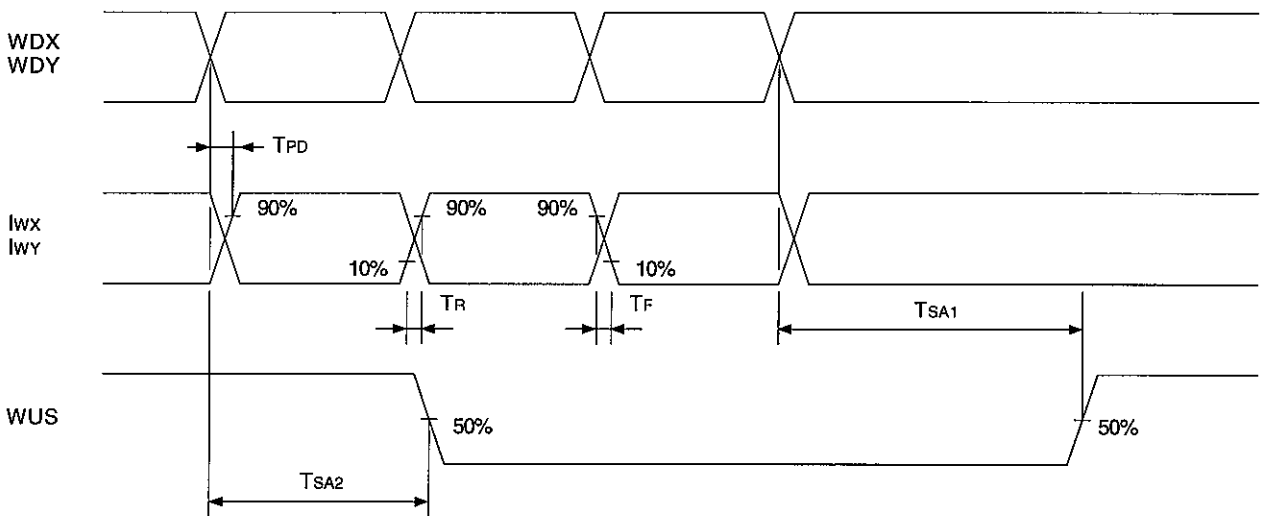


Fig. 4

Description of Functions

Read amplifier

This is a low noise amplifier for amplifying the signals from the heads with an emitter follower output.

The RDX and RDY are the outputs of the differential amplifier whose polarity between the RDX and X side of the head input is same.

Write circuit

The Write data input to WDX pin and WDY pin passes through the buffer amp. It drives the Write switch circuit which supplies the Write current to the heads.

The Write current flows into the X side when WDX is "Low" and WDY is "High".

Mode control

The mode are set as shown Table 1 by XCS, R/W and WUS/SE.

XCS	R/W	WUS/SE	HS0	HS1	Mode
L	L	X	See Table 2		Write
L	H	X			Read
L	L	**	See Table 3		Servo Write
H	X	X	X	X	Idle

Table 1. Mode selection

Head selection

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

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

Table 2. Head selection

Servo write mode **

This mode allows for writing to multiple channels at once.

To enable servo write mode follow these steps:

- (1) Place the device in the Read mode.
- (2) Set HS0 and HS1 following Table 3.
- (3) Set WUS/SE to V_{SEH}, or input I_{SEH} to WUS/SE.
- (4) While maintaing step (2) and (3) above make R/W low, placing the device in servo write mode.

Write unsafe detection circuit

This circuit detects write errors.

In normal Write mode, the WUS output is low; in the conditions listed below, it is high.

- Head inputs is open (under the condition which. $RH=\infty$ and Write data frequency is ≤ 10 MHz)
- Head input is shorted to GND or VCC.
- Write data frequency is abnormally low.
- No write current.
- In read mode.
- Supply voltage is abnormal (see power supply ON/OFF detection).

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

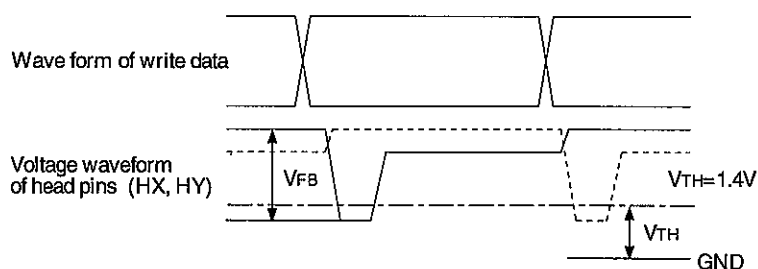
HS0	HS1	Head
L	L	0, 2
H	L	—
L	H	1, 3
H	H	—

Table 3. Head selection in Servo Write mode

Notes on operation

- This device handles high frequency and high gain signals. Please note the following;
 - ◆ Connect V_{CC} decoupling capacitor of approximately 1000 pF near the device.
 - ◆ Make the GND area as large as possible.
- When using as 2-channel, short-circuit the X and Y sides of unused head pins or leave them open.
- The WC pin is a constant voltage pin. When noise affects this pin, it creates noise in Write current. Therefore, locate R_{WC} as close to the device as possible.
- Write unsafe detection circuit

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



- ◆ 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.
- ◆ The normal operating area of write unsafe detection circuit is changed by head inductance, head DC resistance, write current and other.

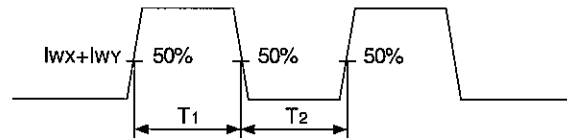
Application Notes

Use the following characteristics for reference.

Vcc=5V, Ta=25 °C

Item		Symbol	Conditions	Min.	Typ.	Max.	Unit
Write mode	Differential output capacitance	Co				10	pF
	Differential output resistance	Ro	Head 0, 2	420	570	720	Ω
			Head 1, 3	3.2 k	4 k	5 k	
Read mode	Differential input capacitance	Cl	Between head input pins		6	10	pF
	Differential input resistance	Ri	f=5 MHz	0.6	1.2		kΩ
	Output resistance	R _{RD}	RDX or RDY, f=5 MHz			50	Ω
Unselected head differential current in Write mode		I _{US}	LH=1 μH, RH=30 Ω I _w =15 mA			0.2	mAp-p
Write current symmetry		T _{AS} *	LH=0 μH, RH=0 Ω I _w =15 mA	-0.5		0.5	ns

*T_{AS}=T₁-T₂



Setting of Write current

Write current can be set with resistor R_{wc} (kΩ) at Pin 18.
I_w=K/R_{wc} (mA) Refer to Fig. 5.

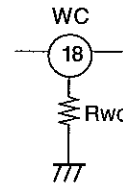
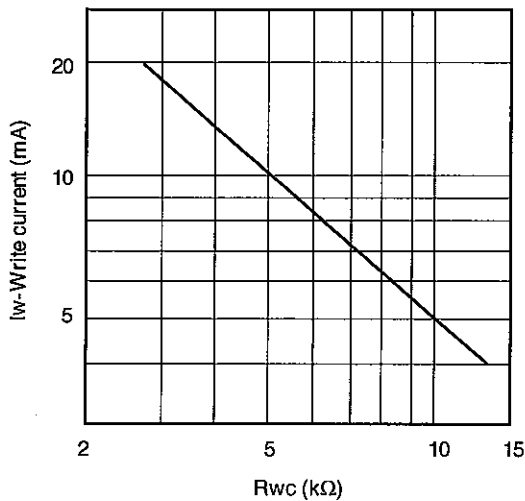
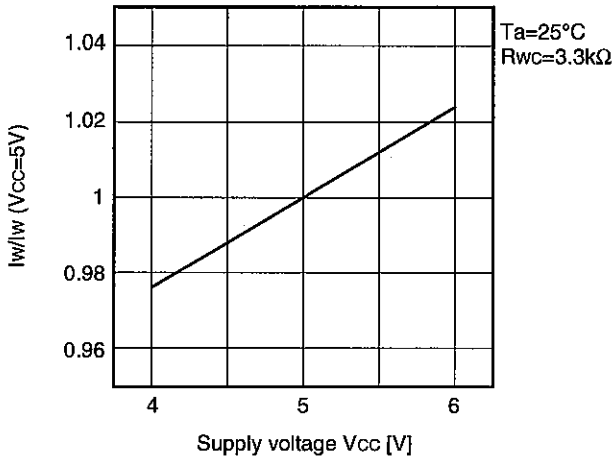


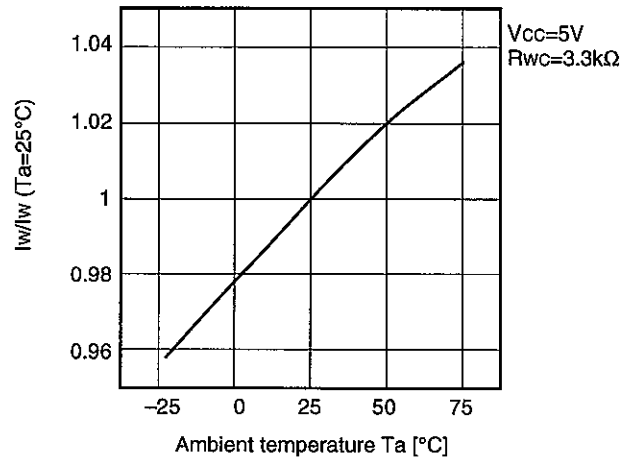
Fig.5 Write current vs. R_{wc}



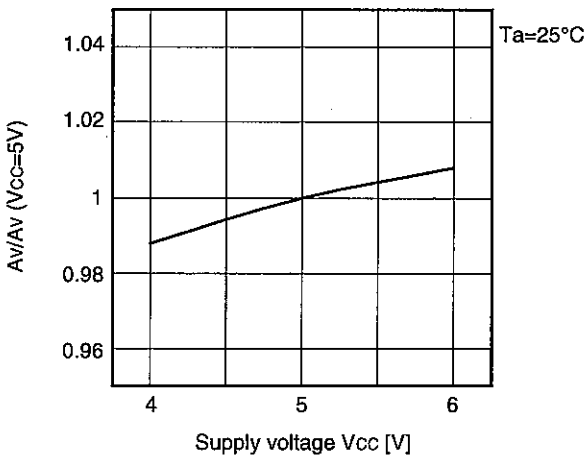
Normalized write current vs. Supply voltage



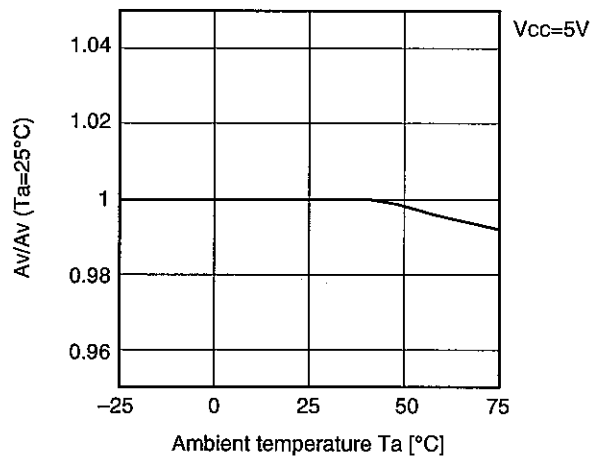
Normalized write current vs. Ambient temperature



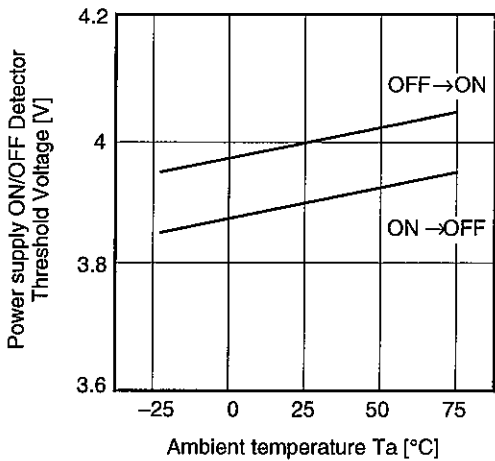
Normalized read amplifier voltage gain vs. Supply voltage



Normalized read amplifier voltage gain vs. Ambient temperature

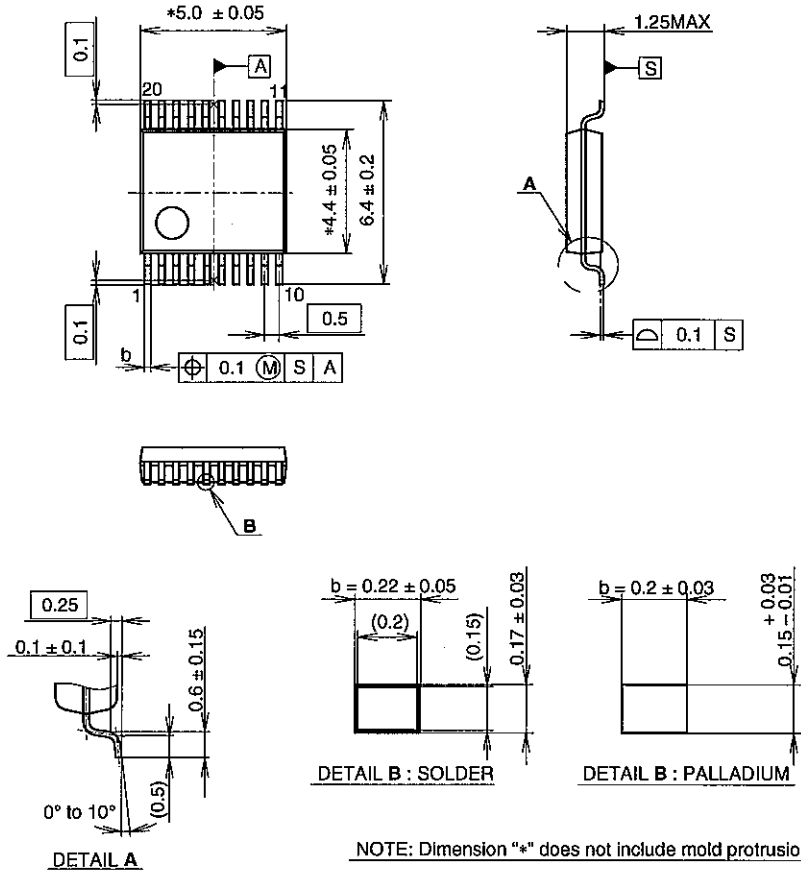


Power supply ON/OFF detector threshold voltage vs. Ambient temperature



Package Outline Unit : mm

20PIN SSOP(PLASTIC)



NOTE: Dimension "*" does not include mold protrusion.

PACKAGE STRUCTURE

SONY CODE	SSOP-20P-L03
EIAJ CODE	SSOP020-P-0044
JEDEC CODE	_____

PACKAGE MATERIAL	EPOXY RESIN
LEAD TREATMENT	SOLDER/PALLADIUM PLATING
LEAD MATERIAL	COPPER ALLOY
PACKAGE MASS	0.1g

NOTE : PALLADIUM PLATING
 This product uses PdPPF (Palladium Pre-Plated Lead Frame).



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