

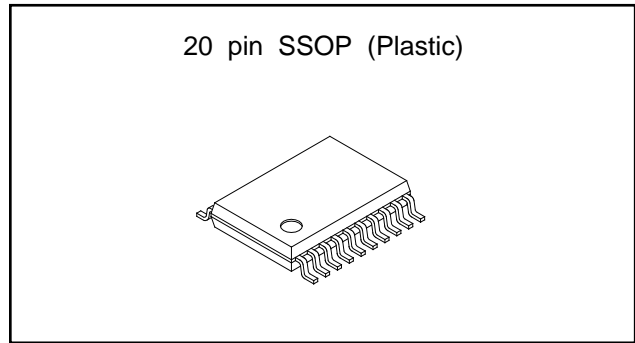
## 4ch. Read/Write Amplifier for Thin Film Head of Hard Disk Drive

**Description**

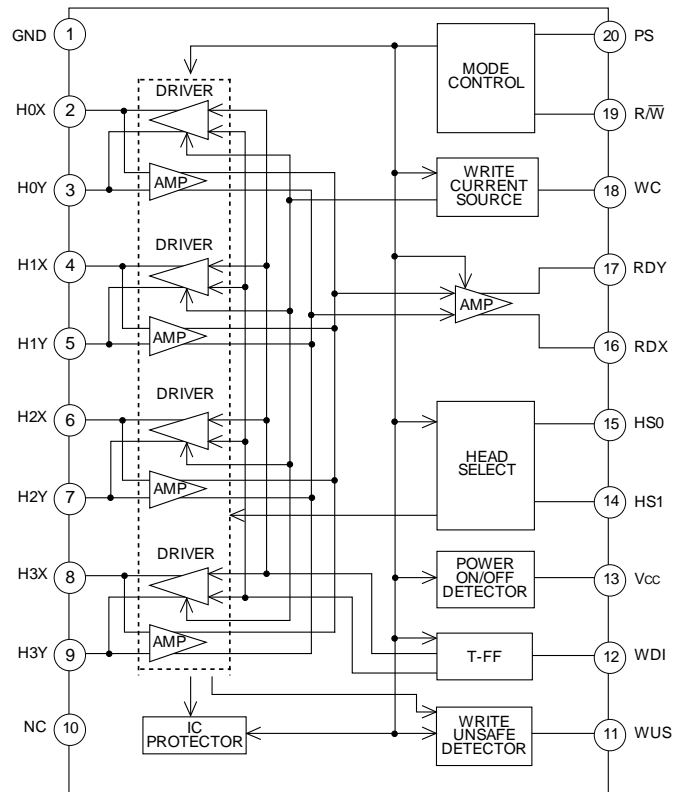
The CXA1940N is a Read/Write Amplifier for the thin film head of hard disk drives and designed to handle up to 4-channel heads.

**Features**

- Operate on single +5V power supply.
- Low power consumption.  
 Read : 95mW  
 Write (I<sub>w</sub>=20mA) : 130mW+I<sub>w</sub> × 5  
 Power save : 5.5mW
- Write current can be varied through an external resistor. Built-in stabilizing circuit provides stable current during voltage and temperature drift.
- Drives up to 4 heads.
- Designed for two-terminal thin-film or MIG heads.
- Built-in power save function.
- Read amplifier emitter follower output featuring 290 times gain (Typ.).
- Built-in Write unsafe detection circuit.
- Built-in supply voltage monitor circuit prohibits incorrect Write during power on or abnormal voltage.
- Built-in IC protection circuit for short of head and GND.
- Differential input capacitance for Read : 14pF (Typ.).
- Write data input minimum pulse width : 10ns
- Read data output become high impedance in write mode to improve read data offset when switching from write to read mode.
- Unselected head DC voltage is GND potential.
- Self switching damping resistance (RD=310Ω)



**Block Diagram and Pin Configuration**



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**Structure**

Bipolar silicon monolithic IC

**Function**

Read, Write and Write unsafe detection for HDD, Power supply ON/OFF detection.

**Absolute Maximum Rating (Ta=25°C)**

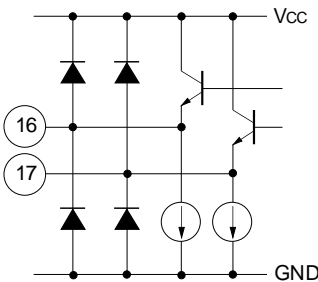
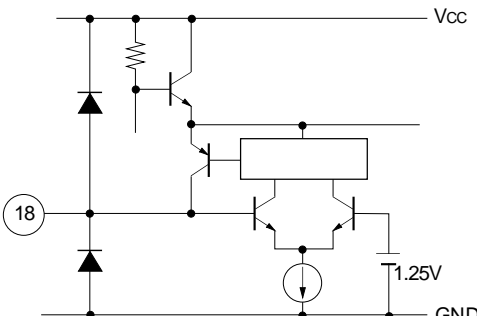
• Supply voltage	VCC	7	V
• Write current	Iw	25	mAo-p
• Operating temperature	Topr	-20 to +75	°C
• Storage temperature	Tstg	-55 to +150	°C
• Allowable power dissipation	PD	375	mW

**Recommended Operating Conditions**

• Supply voltage	VCC	5V±10	%
• Write current	Iw	5 to 20	mAo-p

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	NC		
11	WUS		Write unsafe detection output. Open collector output. When it is off in Write mode, it means an error is detected.
12	WDI		Write data input. At "High" → "Low", input is triggered.
13	Vcc		5V power supply
14 15	HS1 HS0		Head select signal input. Selects one of 4 heads according to Table 2.
19	R/W		Read/Write signal input. At "High": Read, at "Low": Write.
20	PS		Power save signal input. At "High": Power save.

No.	Symbol	Equivalent circuit	Description
16 17	RDX RDY		Read Amplifier output.
18	WC		A setting resistor for the write current value is connected between this pin and GND.

**Electrical Characteristics** (Unless otherwise specified, VCC=5V, Ta=25°C, Write current Iw=20mA)

No.	Item	Sym- bol	SW Conditions												Measurement conditions	Min.	Typ.	Max.	Unit
			1	2	3	4	5	6	7	8	9	10	11	12					
1-1	Current consumption for Read	IR	b	a	a	a	a	b	a	a	a	a	b	a	Test point : I4	12	19	26	mA
1-2	Current consumption for Write	IW	b	a	a	a	a	b	a	a	a	a	a	a	Test point : I4	17 +IW	26 +IW	35 +IW	mA
1-3	Current consumption for Power save	IP	b	a	a	a	a	b	a	a	a	a	b	b	Test point : I4	0.6	1.1	1.5	mA
2-1	Digital input "Low" input voltage	VIL													Digital input : Pins 12, 14, 15, 19, 20			0.8	V
2-2	Digital input "High" input voltage	VIH														2.0			V
2-3	Digital input "Low" input current	IIL	a	a	a	a	a	a	a	a	a	a	a	a	"High" applied voltage : 5V "Low" applied voltage : 0V	-20			μA
2-4	Digital input "High" input current	IiH	a	a	a	a	a	b	a	b	b	a	b	b	Test point : I3, I5, I6, I7, I8			70	μA
3-1	Write unsafe output saturation voltage	Vwus	b	a	a	a	b	c	a	a	a	a	a	a	Output current : 1mA Test point : V1			0.5	V
3-2	Write unsafe output leak current	IWUS	b	a	a	a	e	c	a	a	a	a	a	a	Test point : I2			20	μA
4	Supply power ON/OFF detector threshold voltage	VTH	b	a	a	a	a	b	a	a	a	a	a	a	When VCC is lowered from 5V in Write mode and Iw does not flow anymore, VCC voltage is set to VTHOFF. When VCC is raised from 3V and Iw starts to flow, VCC voltage is set to VTHON.	3.6	3.9	4.3	V
5	Write current setting range	Iw	b	a	a	a	a	b	a	a	a	a	a	a		5		20	mAop
6	Write current tolerance	ΔIw	b	a	a	a	a	b	a	a	a	a	a	a		-8		8	%
7	Read amplifier differential voltage gain	Av	b	a	a	a	c	b	a	a	a	b	b	a	Input voltage SG1 : 1mVp-p, 300kHz Load resistance (RDX, RDY) : 1kΩ Test point : V4 [Vp-p] $AV = \frac{V4}{SG1}$	245	290	335	V/V
8	Frequency band width (-3dB)	BW	b	a	a	a	c	b	a	a	a	b	b	a	Frequency at which Av lowers by 3dB	30			MHz

No.	Item	Sym- bol	SW Conditions												Measurement conditions	Min.	Typ.	Max.	Unit
			1	2	3	4	5	6	7	8	9	10	11	12					
9	Input referred noise	EN	a	a	a	a	a	b	a	a	a	b	b	a	Head impedance : 0Ω, when the read amplifier output voltage is amplified 100 times and voltage passed though a LPF (low pass filter of cutoff frequency 15MHz) is VN [Vrms],  $EN = \frac{V_N}{100 \cdot AV \cdot \sqrt{15 \times 10^6}}$ Test point : V5		0.55	0.7	$\frac{nV}{\sqrt{Hz}}$
10	Common mode rejection ratio	CMRR	b	a	a	a	d	b	a	a	a	b	b	a	In-phase input voltage SG2 : 100mVp-p, 5MHz When the Read amplifier output is VCM [mVp-p],  $CMRR = 20 \log \frac{100}{V_{CM}} + 20 \log AV$ Test point : V4	50			dB
11	Power Supply rejection ratio	PSRR	a	a	a	a	a	b	b	a	a	b	b	a	Ripple voltage SG3 : 100mVp-p, 5MHz When the Read amplifier output is VP [mVp-p],  $PSRR = 20 \log \frac{100}{V_P} + 20 \log$ Test point : V4	50			dB
12	Channel separation	CS	a	b	a	a	c	b	a	a	a	b	b	a	Selected head input voltage : 0mVP-P Unselected head input voltage SG1 : 100mVp-p, 5MHz 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	VOFFR	b	a	a	a	a	b	a	a	a	a	b	a	VOFFR=V2-V3 Test point : V2, V3	-200		200	mV

Unless otherwise specified, VCC=5V, Ta=25°C, fWD (Write data frequency)=5MHz, Iw=20mA, LH (Head inductance)=1μH, RH (Head DC resistance value)=30Ω

Refer to Fig. 2 to Fig. 4

No.	Item	Sym- bol	Measurement conditions	Min.	Typ.	Max.	Unit
14	Head differential voltage amplitude	VSW	Differential voltage between HX pin and HY pin at switching of Write current	4.4	5.2		Vp-p
15	Write unsafe detection max. frequency	FWUS	FWUS is the max. Write data frequency when Pin 11 turns "High" in Write mode.		280	1000	kHz
16-1	Mode switching time Read to Write	TRW	TRW is the time required for Write current to turn to 90% after Pin 19 changes from "High" to "Low".			0.6	μs
16-2	Mode switching time Write to Read	TWR	TWR is the time required for either Write current to decrease to 10% or for the Read amplifier output* to turn to 90% after Pin 19 changes from "Low" to "High".			0.6	μs
17-1	Mode switching time safe to unsafe	TSA1	TSA1 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.	3	7	11	μs
17-2	Mode switching time unsafe to safe	TSA2	TSA2 is the time required for Pin 11 to turn "Low" after the first transition of Write in Write mode.			1.0	μs
18	Mode switching time Power save to Read	TPR	TPR is the time required for Read amplifier output to turn to 90% after Pin 20 changes from "High" to "Low".			1.0	μs
19	Head switching time	TH	TH is the time required for the Read amplifier output* to reach 90% when the selected head switched in Read mode.			0.6	μs
20	Write current propagation delay time	TPD	TPD is the time required for Write current to reach 90% after the Write data falling edge. LH=0μH, RH=0Ω			30	ns
21	Write current rise/fall time	TR/TF	TR is the time required for Write current to reach 90% from 10%; TF is the same time required to reach 10% from 90%. LH=0μH, RH=0Ω		5	10	ns

\*Read amplifier output 100mVp-p 10MHz

Test Circuit 1

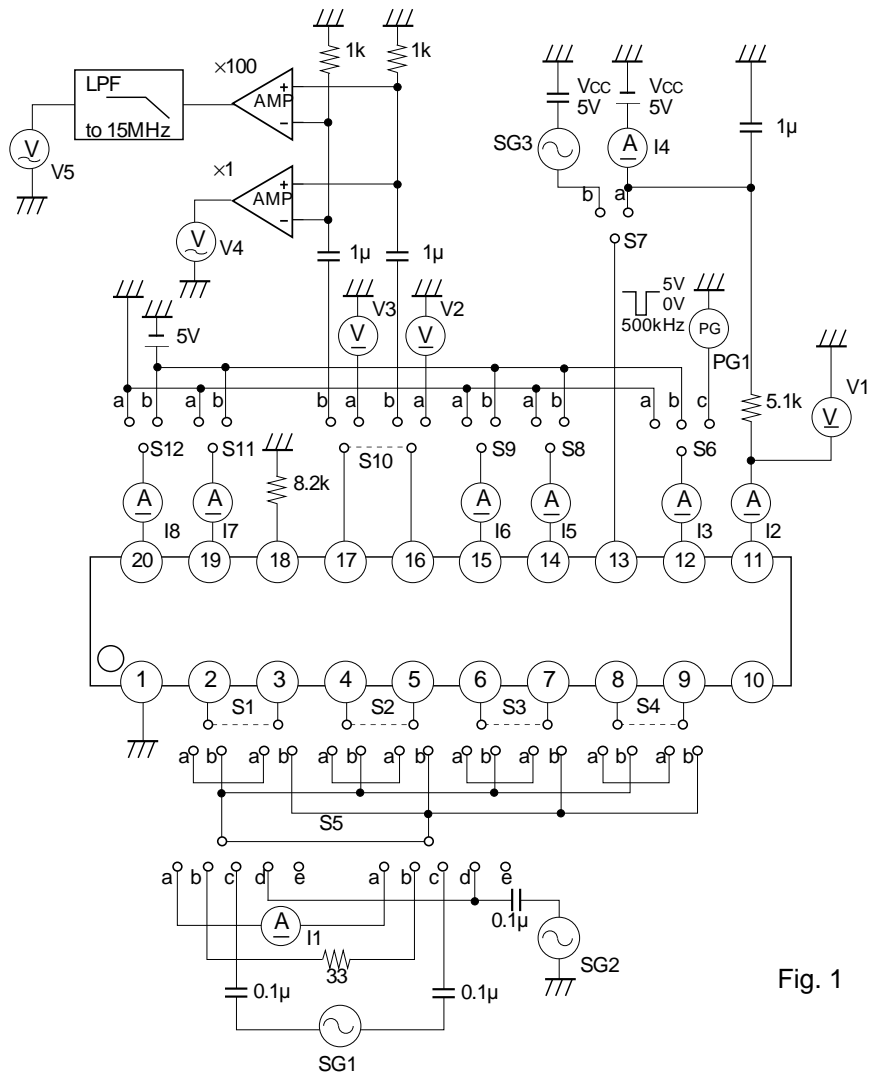


Fig. 1

Test Circuit 2

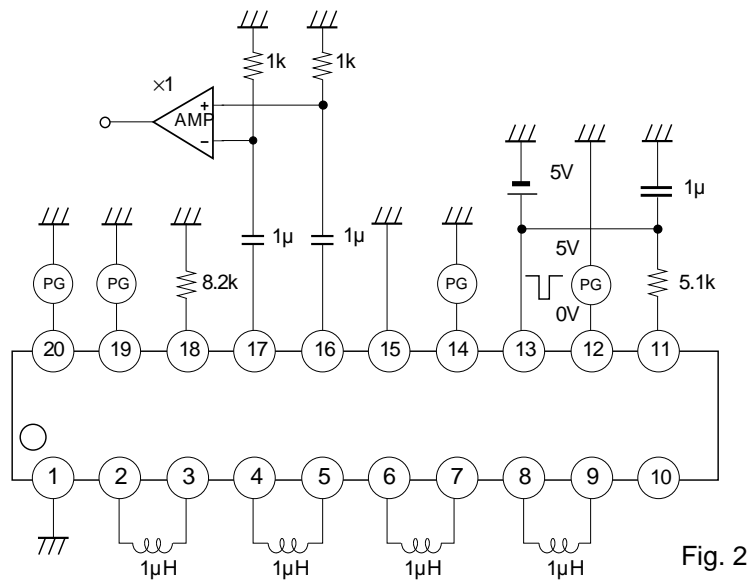


Fig. 2

Note) Write current is measured with current probe. Use an oscilloscope to test items related to time.



Timing Chart 1

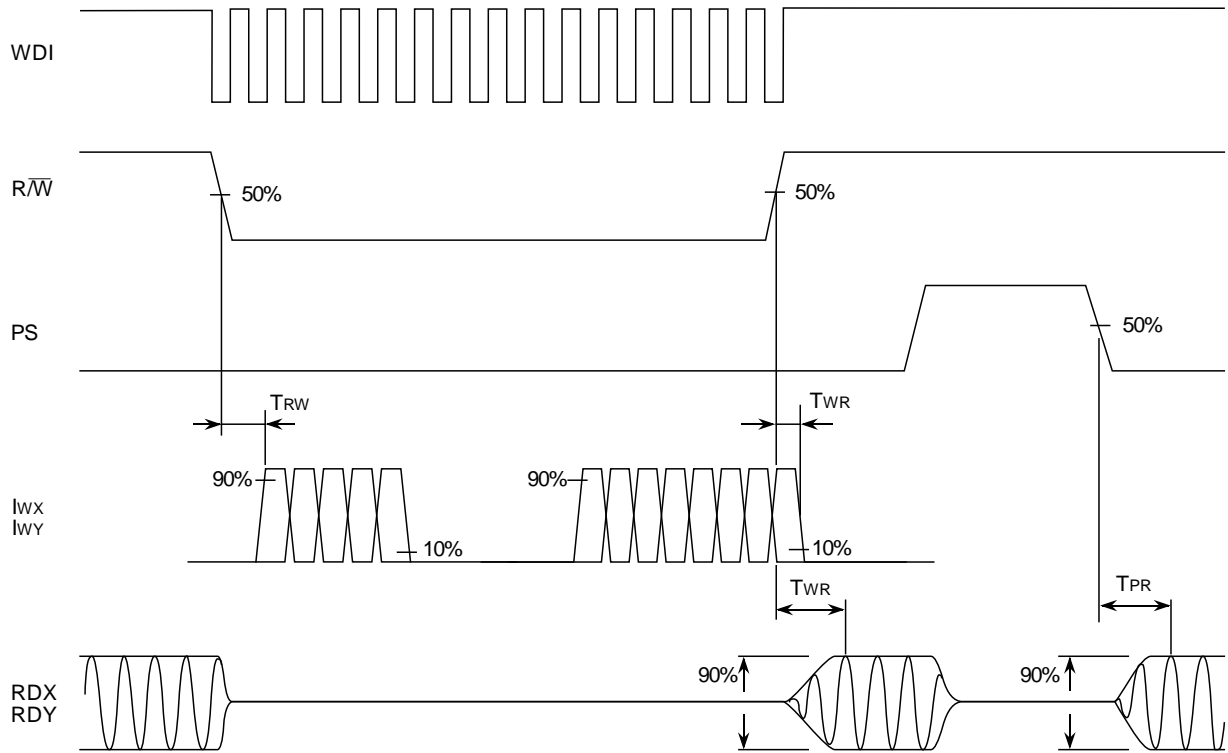


Fig. 3

Timing Chart 2

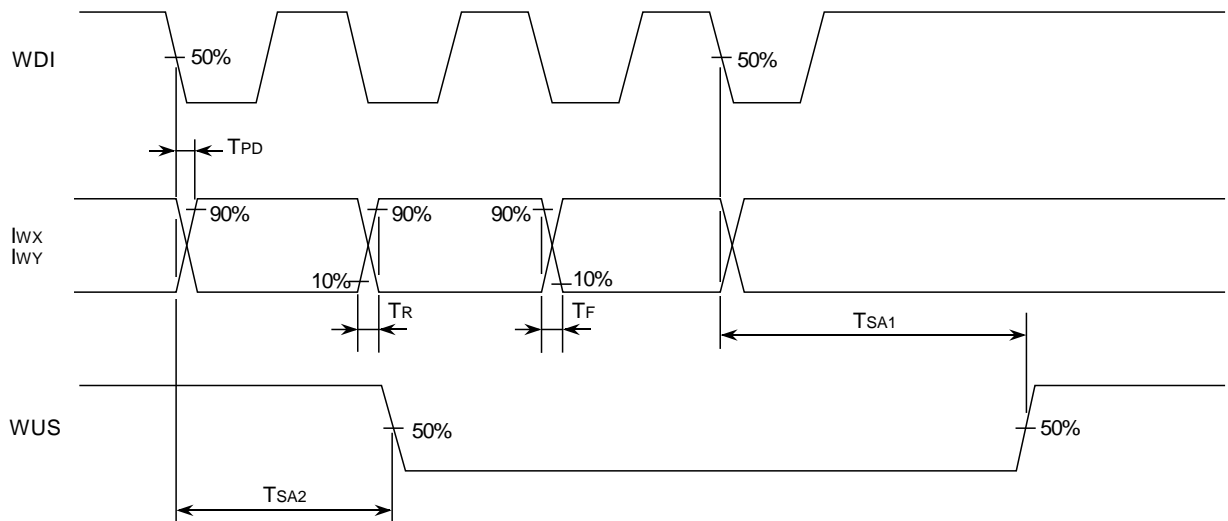


Fig. 4

## Description Functions

### Read amplifier

This is a low noise amplifier amplifying the signals from the head and is an emitter follower output. It outputs to RDX and RDY pins differentially. The head X side and RDX pin, the head Y side and RDY pin have the same polarity. RDX, RDY outputs become high impedance in write mode (when these outputs is AC coupled to the load).

### Write circuit

Write data which is input to WDI pin passes through a T flip-flop and frequency is divided into 1/2. It then drives the Write switch circuit and flows Write current to the head.

Write data is triggered where from "High" to "Low" and Write current is switched.

Write current flows from X side when Read changes to Write.

### Mode control

Modes are set as shown in Table 1 using  $\overline{R/W}$  and PS pins.

$\overline{R/W}$	PS	Mode
L	L	Write
H	L	Read
H	H	Power save

Table 1. Mode selection

### Head selection

Heads are selected as shown in Table 2 using HS0 and HS1 pins.

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

Table 2. Head selection

#### Write unsafe detection circuit

Abnormal Write mode is detected.

In normal Write mode, WUS output turns to “Low” and in the following other conditions, WUS output turns to “High”.

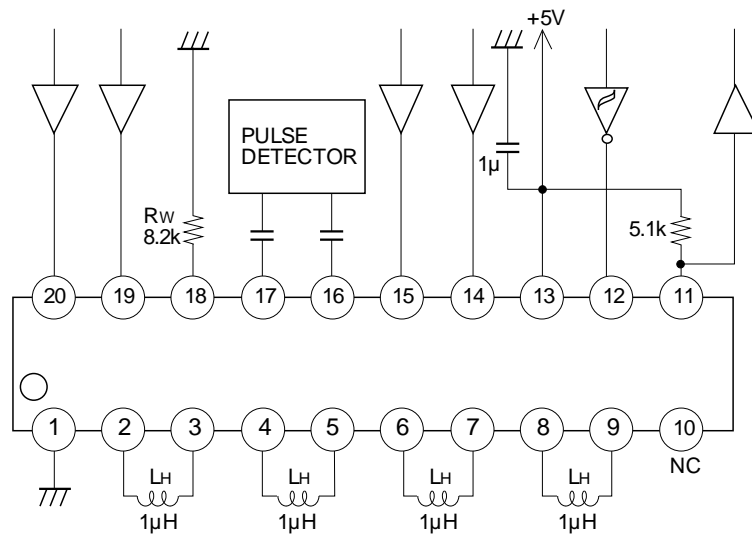
- Head input is open.
- Head input is shorted to GND.
- Write data frequency is abnormally low.
- No write current
- In read
- In power save

#### Power supply ON/OFF detection

VCC is monitored to avoid incorrecting Write.

Recording and Playback functions are inhibited as detected as abnormal when VCC decreases below the power supply ON/OFF detector threshold voltage ( $V_{TH}$ ). When VCC is higher than  $V_{TH}$ , the above inhibition is released.

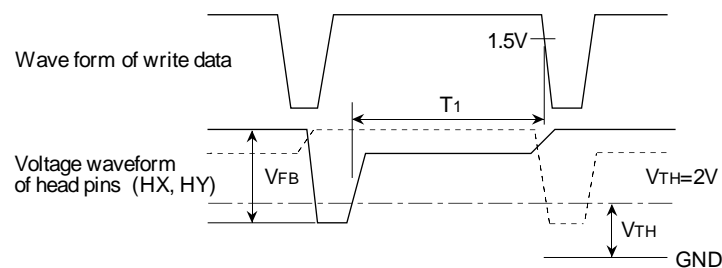
Application Circuit



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.

### Notes on operation

- This device handles high frequency and high gain signals. Please note the following;
  - ◆ Connect Vcc decoupling capacitor of approximately 1000pF 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.
- Write data pulse width
  - Set the pulse width to 10ns or more at 1.5V to prevent misoperation.
- The WC pin is a constant voltage pin. When noise affects this pin, it creates noise in Write current. Therefore, locate RW as close to the device as possible .
- Write unsafe detection circuit
  - This circuit uses the voltage waveforms of the head pins for detection.



- ◆ The condition of  $T_1 > 10\text{ns}$  must be met for the WUS detection circuit to operate properly.
- ◆  $V_{FB}$  must be more than 2V. When  $V_{FB} < 2V$ , it is possible that Write unsafe detection maximum frequency becomes more than 1MHz.
- ◆ The normal operating area of write unsafe detection circuit is changed by head inductance, head DC resistance, write current and other.

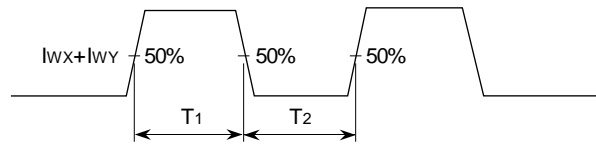
**Application Notes**

Use the following characteristics for reference.

VCC=5V, Ta=25°C

Item		Sym- bol	Conditions	Min.	Typ.	Max.	Unit
Write mode	Differential output capacitance	CO	Between head input pins			15	pF
	Differential output resistance	RO		230	310	390	Ω
Read mode	Differential input capacitance	CI	Between head input pins f=5MHz		14	20	pF
	Differential input resistance	RI		0.7	1.4		kΩ
	Output resistance	R <sub>RD</sub>	RDX or RDY, f=5MHz		40	60	Ω
Unselected head differential current in Write mode		I <sub>US</sub>	LH=1μH, RH=30Ω I <sub>w</sub> =20mA			0.2	mA <sub>p-p</sub>
Write current symmetry		T <sub>AS</sub> *	LH=0μH, RH=0Ω I <sub>w</sub> =20mA	-1		1	ns

\*T<sub>AS</sub>=T<sub>1</sub>—T<sub>2</sub>



**Setting of Write current**

Write current can be set with resistor R<sub>w</sub> (kΩ) at Pin 18.

I<sub>w</sub>=K/R<sub>w</sub> (mA) Refer to Fig. 5 and 6.

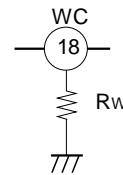


Fig.5 Write current vs. R<sub>w</sub>

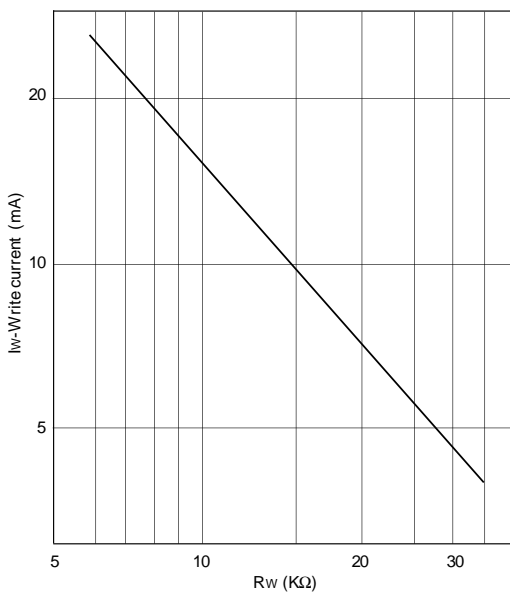


Fig. 6 Write current setting constant vs Write current

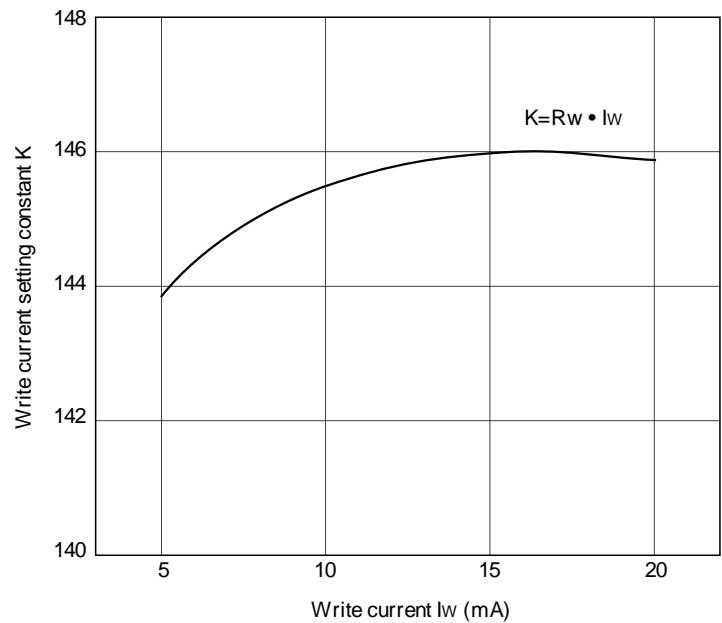


Fig.7 Normalized write current vs Supply voltage

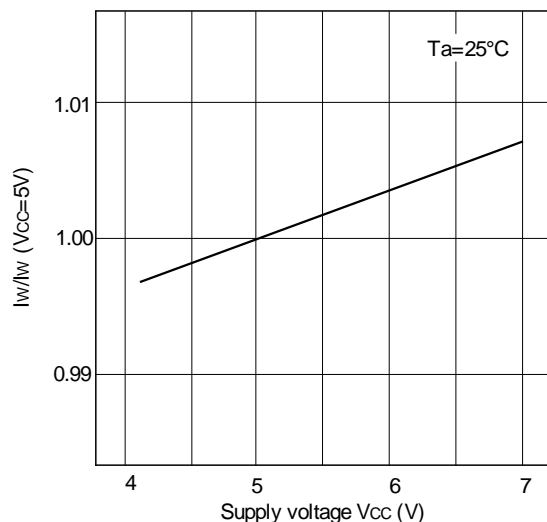


Fig. 8 Normalized write current vs Ambient temperature

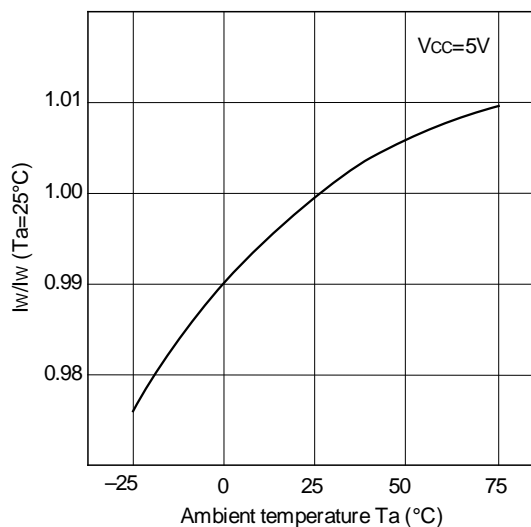


Fig. 9 Normalized read amplifier voltage gain vs Supply voltage

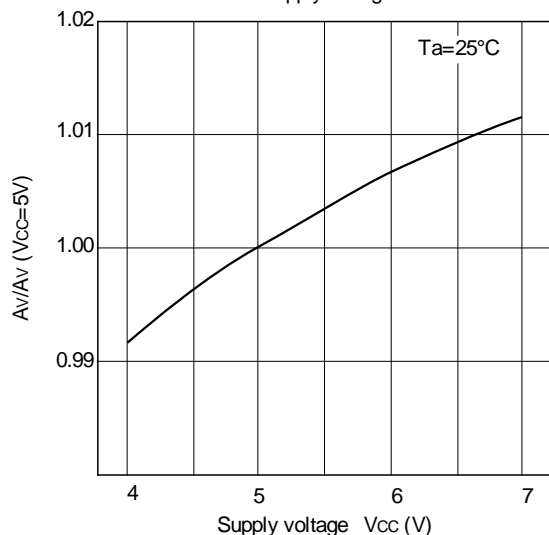


Fig. 10 Normalized read amplifier voltage gain vs Ambient temperature

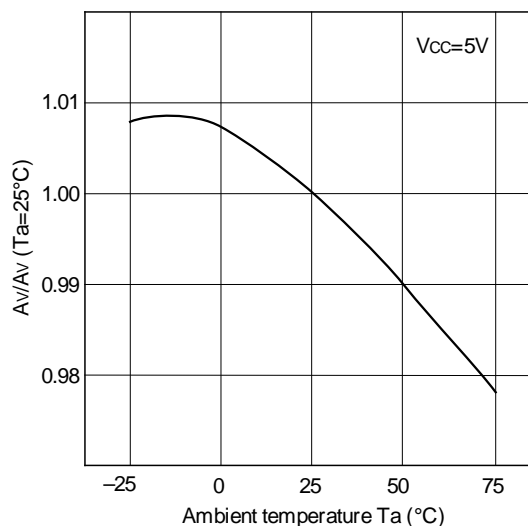
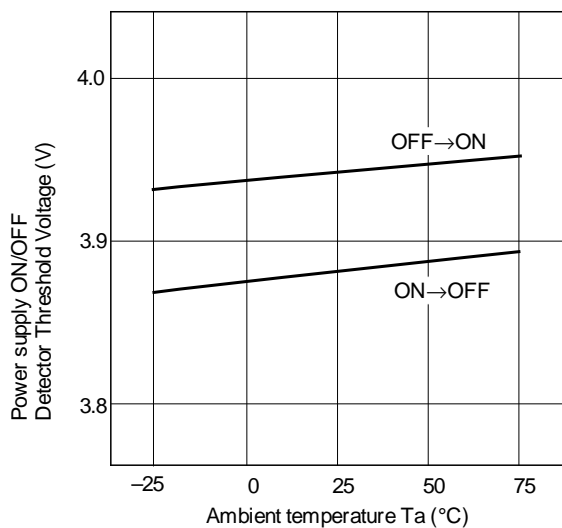
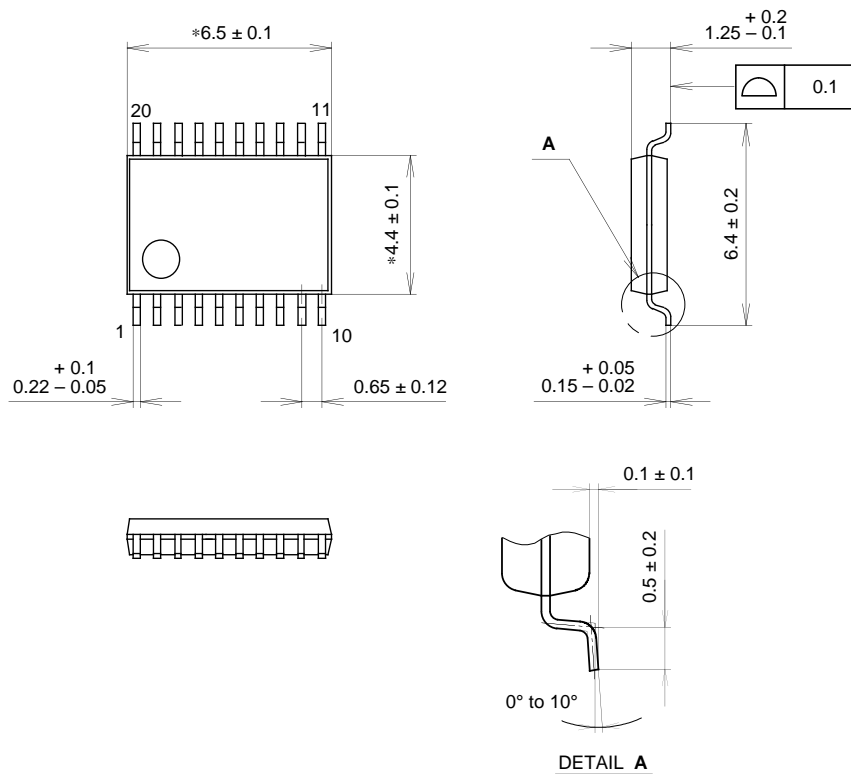


Fig. 11 Power supply ON/OFF detector threshold voltage vs Ambient temperature



Package Outline Unit : mm

20PIN SSOP (PLASTIC)



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

PACKAGE STRUCTURE

SONY CODE	SSOP-20P-L01
EIAJ CODE	SSOP020-P-0044
JEDEC CODE	_____

PACKAGE MATERIAL	EPOXY RESIN
LEAD TREATMENT	SOLDER / PALLADIUM PLATING
LEAD MATERIAL	COPPER / 42 ALLOY
PACKAGE WEIGHT	0.1g