SONY

CXA1940N

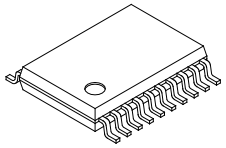
4ch. Read/Write Amplifier for Thin Film Head of Hard Disk Drive

For the availability of this product, please contact the sales office.

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.

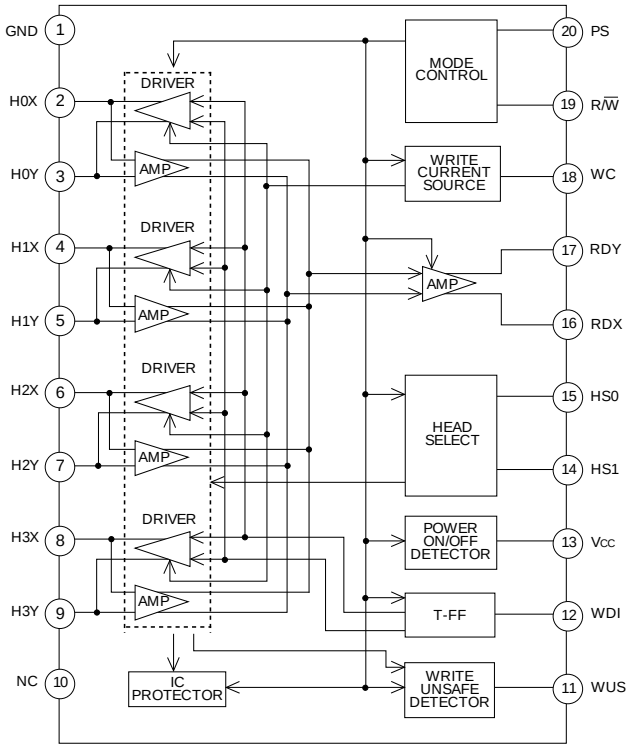
20 pin SSOP (Plastic)



Features

- Operate on single +5V power supply.
- Low power consumption.
  - Read : 95mW
  - Write (Iw=20mA) : 130mW+Iw × 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



E93X03-TE

Structure

Bipolar silicon monolithic IC

Function

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

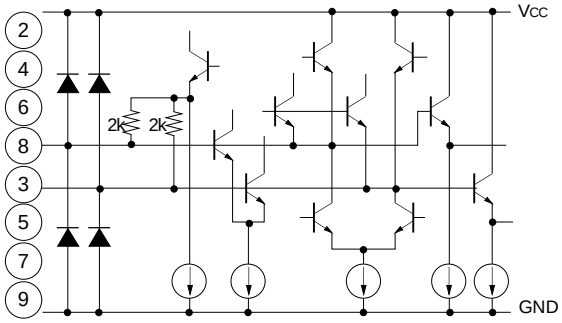
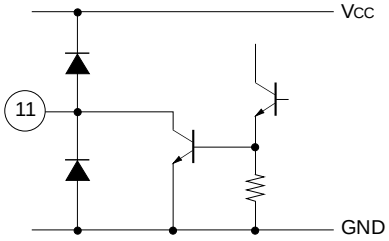
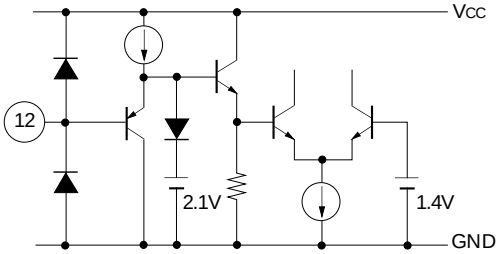
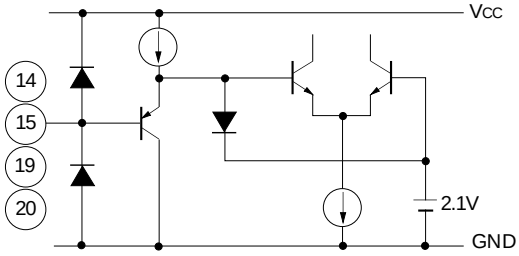
Absolute Maximum Rating (Ta=25°C)

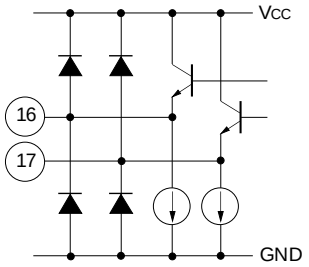
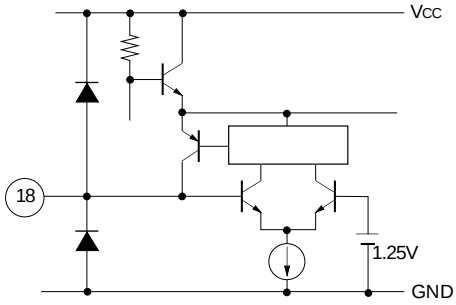
• Supply voltage	V_{CC}	7	V
• Write current	Iw	25	mAo-p
• Operating temperature	Topr	–20 to +75	℃
• Storage temperature	Tstg	–55 to +150	℃
• Allowable power dissipation	P_D	375	mW

Recommended Operating Conditions

• Supply voltage	V_{CC}	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/$\overline{W}$		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, V_{CC}=5V, Ta=25°C, Write current I_W=20mA)

No.	Item	Sym-bol	SW Conditions 1	2	3	4	5	6	7	8	9	10	11	12	Measurement conditions	Min.	Typ.	Max.	Unit
1-1	Current consumption for Read	I_R	b	a	a	a	a	b	a	a	a	a	b	a	Test point : I_4	12	19	26	mA
1-2	Current consumption for Write	I_W	b	a	a	a	a	b	a	a	a	a	a	a	Test point : I_4	17 +I_W	26 +I_W	35 +I_W	mA
1-3	Current consumption for Power save	I_P	b	a	a	a	a	b	a	a	a	a	b	b	Test point : I_4	0.6	1.1	1.5	mA
2-1	Digital input “Low” input voltage	V_{IL}													Digital input : Pins 12, 14, 15, 19, 20			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	a	a	a	“High” applied voltage : 5V “Low” applied voltage : 0V	–20			µA
2-4	Digital input “High” input current	I_{IH}	a	a	a	a	a	b	a	b	b	a	b	b	Test point : I_3, I_5, I_6, I_7, I_8			70	µA
3-1	Write unsafe output saturation voltage	V_{WUS}	b	a	a	a	b	c	a	a	a	a	a	a	Output current : 1mA Test point : V_1			0.5	V
3-2	Write unsafe output leak current	I_{WUS}	b	a	a	a	e	c	a	a	a	a	a	a	Test point : I_2			20	µA
4	Supply power ON/OFF detector threshold voltage	V_{TH}	b	a	a	a	a	b	a	a	a	a	a	a	When V_{CC} is lowered from 5V in Write mode and I_W does not flow anymore, V_{CC} voltage is set to V_{THOFF}. When V_{CC} is raised from 3V and I_W starts to flow, V_{CC} voltage is set to V_{THON}.	3.6	3.9	4.3	V
5	Write current setting range	I_W	b	a	a	a	a	b	a	a	a	a	a	a		5		20	mAo-p
6	Write current tolerance	ΔI_W	b	a	a	a	a	b	a	a	a	a	a	a		-8		8	%
7	Read amplifier differential voltage gain	A_V	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 A_V lowers by 3dB	30			MHz

No.	Item	Sym-bol	SW Conditions 1	2	3	4	5	6	7	8	9	10	11	12	Measurement conditions	Min.	Typ.	Max.	Unit
9	Input referred noise	E_N	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 V_N [Vrms], $E_N=\frac{V_N}{100 \cdot AV \cdot \sqrt{15 \times 10^6}}$ Test point : V_5		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 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	b	b	a	a	b	b	a	Ripple voltage SG3 : 100mVp-p, 5MHz When the Read amplifier output is V_P [mVp-p], $PSRR=20 \log \frac{100}{V_P} + 20 \log$ Test point : V_4	50			dB
12	Channel separation	CS	a	b	a	a	c	b	a	a	a	b	b	a	Selected head input voltage : 0mV_{P-P} Unselected head input voltage SG1 : 100mVp-p, 5MHz When the Read amplifier output is V_{CS} [mVp-p], $CS=20 \log \frac{100}{V_{CS}} + 20 \log A_V$ Test point : V_4	50			dB
13	Read data output offset voltage for Read	V_{OFFR}	b	a	a	a	a	b	a	a	a	a	b	a	$V_{OFFR}=V_2-V_3$ Test point : V_2, V_3	–200		200	mV

Unless otherwise specified, V_{CC}=5V, Ta=25°C, f_{WD} (Write data frequency)=5MHz, I_W=20mA, L_H (Head inductance)=1µH, R_H (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	V_{SW}	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	F_{WUS}	F_{WUS} 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	T_{RW}	T_{RW} 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	T_{WR}	T_{WR} 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	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.	3	7	11	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 in Write mode.			1.0	µs
18	Mode switching time Power save to Read	T_{PR}	T_{PR} 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	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
20	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=0µH, R_H=0Ω			30	ns
21	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=0µH, R_H=0Ω		5	10	ns

*Read amplifier output 100mVp-p 10MHz

Test Circuit 1

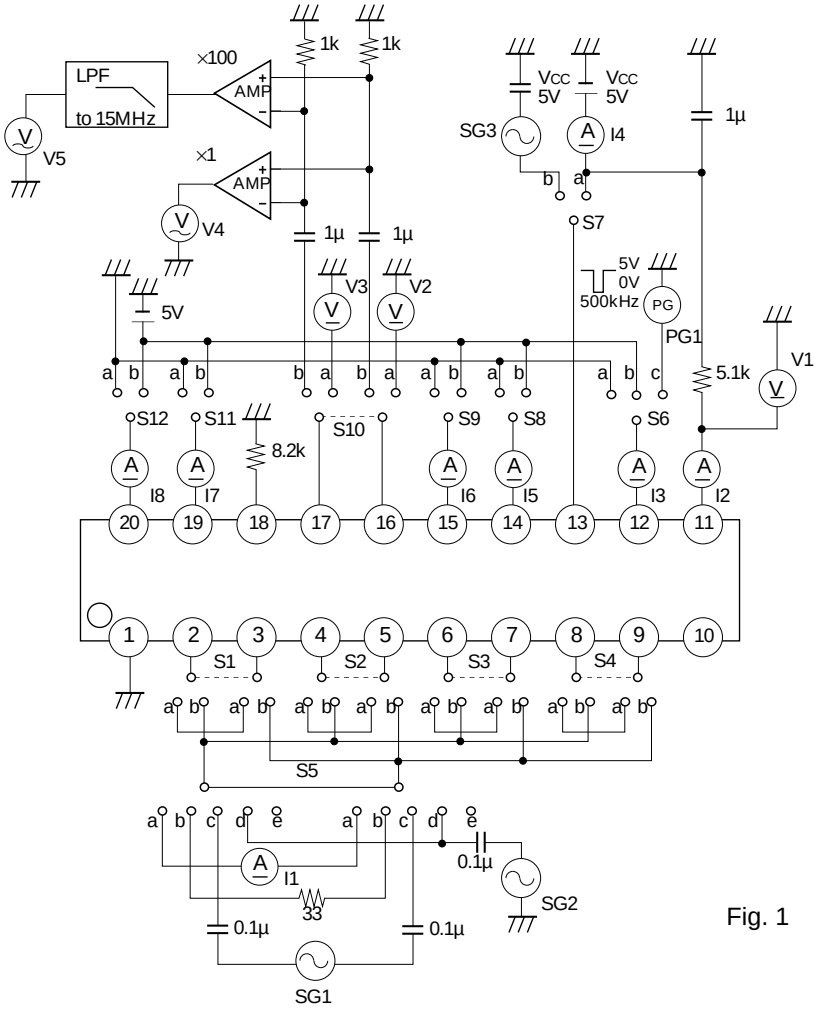


Fig. 1

Test Circuit 2

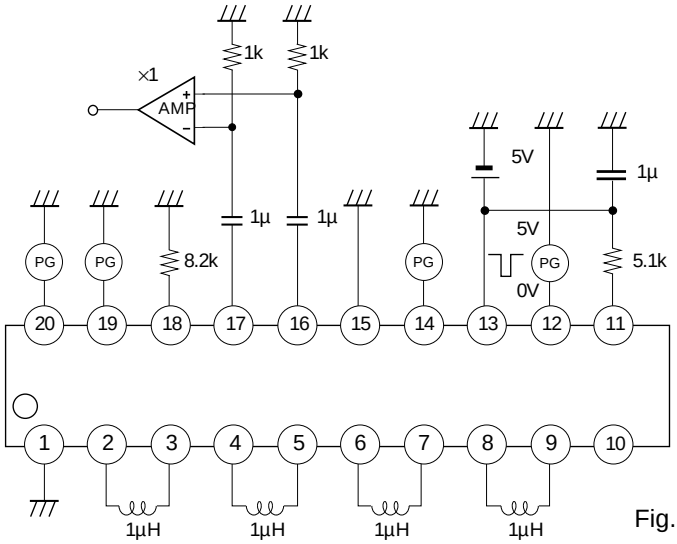


Fig. 2

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

Timing Chart 1

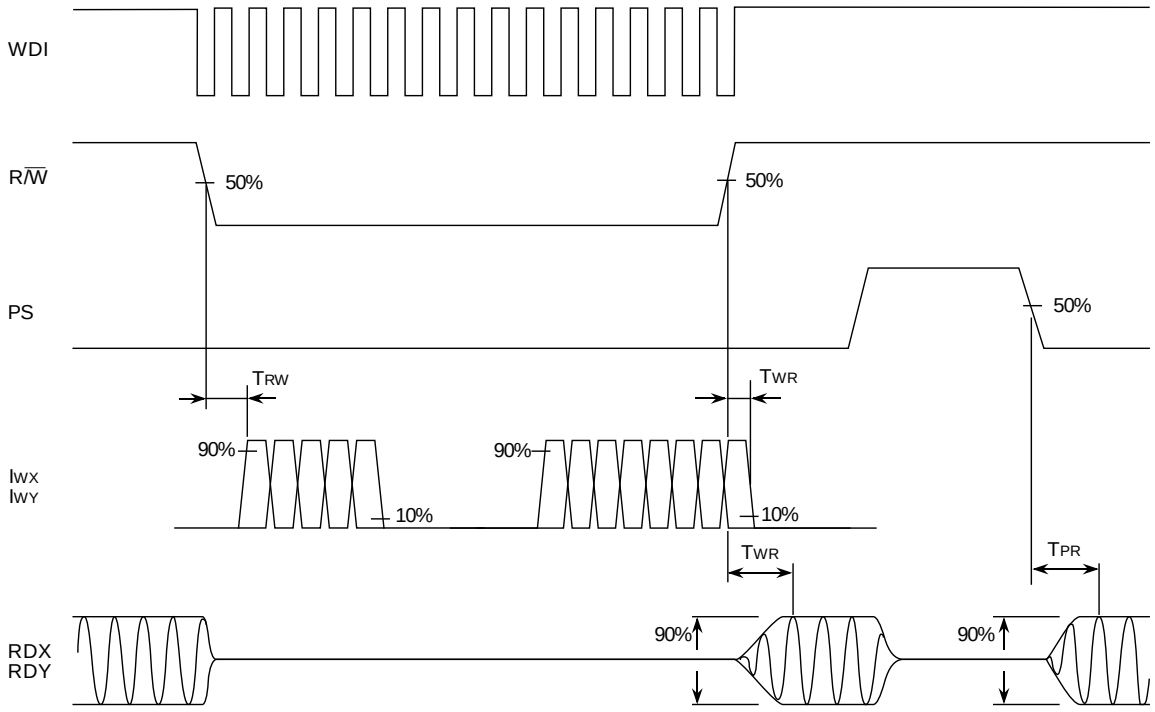


Fig. 3

Timing Chart 2

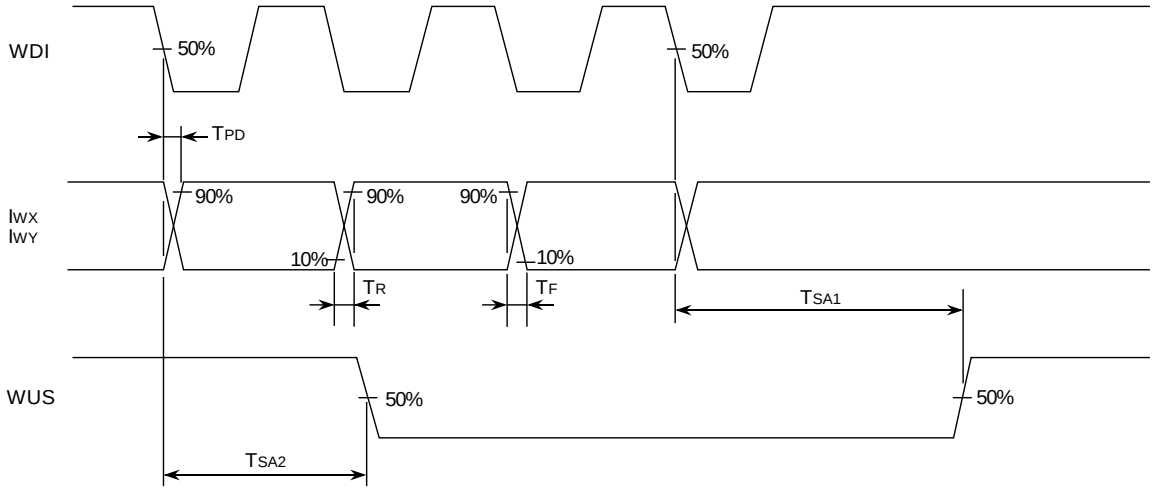


Fig. 4

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 R/$\overline{W}$ and PS pins.

R/$\overline{W}$	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”.

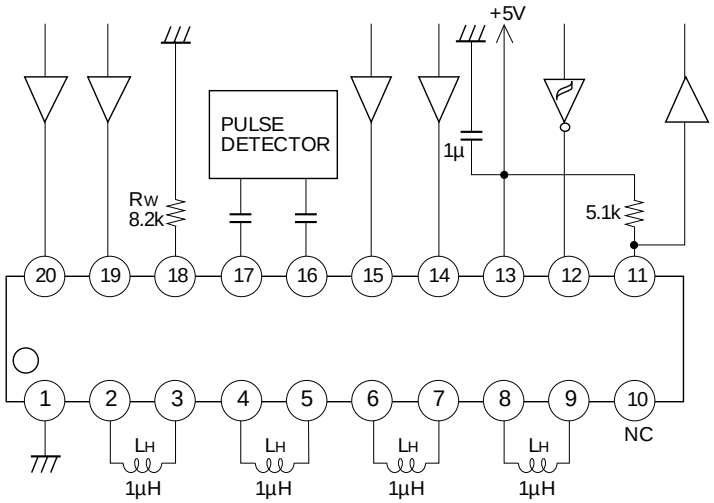
- Head input is open.
- Head input is shorted to GND.
- Write data frequency is abnormally low.
- No write current
- In read
- In power save

Power supply ON/OFF detection

V_{CC} is monitored to avoid incorrecting Write.

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

Application Circuit



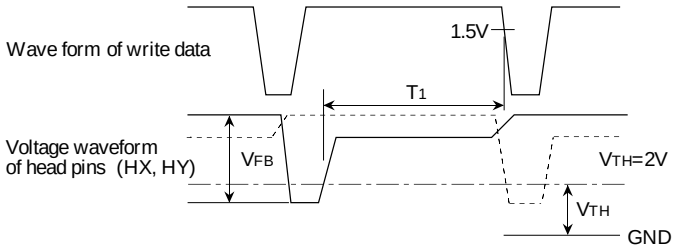
Application circuits shown are typical examples illustrating the operation of the devices. Sony cannot assume responsibility for any problems arising out of the use of these circuits or for any infringement of third party and other right due to same.

Notes on operation

- This device handles high frequency and high gain signals. Please note the following;
  - ♦ Connect V_{CC} 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 R_W 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 T1 >10ns must be met for the WUS detection circuit to operate properly.
  - ♦ VFB 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.

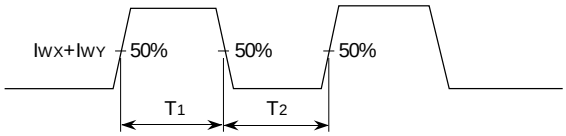
Application Notes

Use the following characteristics for reference.

V_{CC}=5V, Ta=25°C

Item		Sym-bol	Conditions	Min.	Typ.	Max.	Unit
Write mode	Differential output capacitance	C_O	Between head input pins			15	pF
	Differential output resistance	R_O		230	310	390	Ω
Read mode	Differential input capacitance	C_I	Between head input pins f=5MHz		14	20	pF
	Differential input resistance	R_I		0.7	1.4		kΩ
	Output resistance	R_{RD}	RDX or RDY, f=5MHz		40	60	Ω
Unselected head differential current in Write mode		I_{US}	L_H=1µH, R_H=30Ω Iw=20mA			0.2	mAp-p
Write current symmetry		T_{AS}*	L_H=0µH, R_H=0Ω Iw=20mA	–1		1	ns

*TAS=T1—T2



Setting of Write current

Write current can be set with resistor Rw (kΩ) at Pin 18.

Iw=K/Rw (mA) Refer to Fig. 5 and 6.

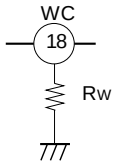


Fig.5 Write current vs. Rw

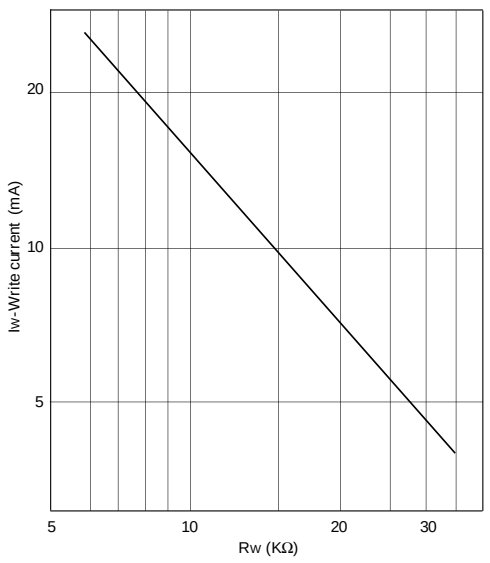


Fig. 6 Write current setting constant vs Write current

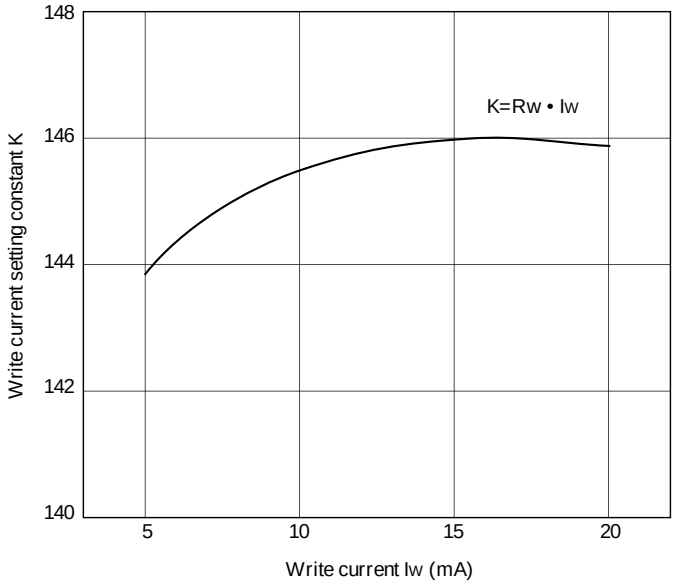


Fig.7 Normalized write current vs Supply voltage

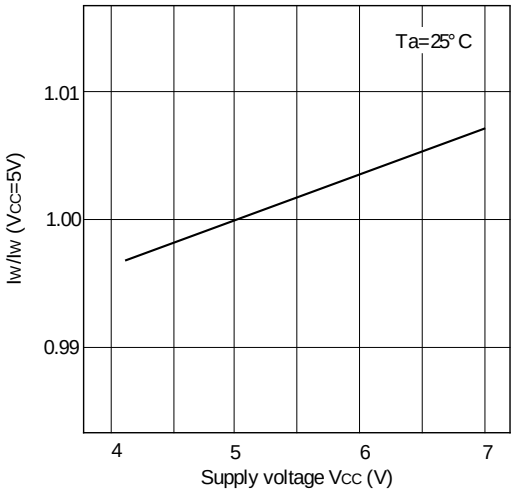


Fig. 8 Normalized write current vs Ambient temperature

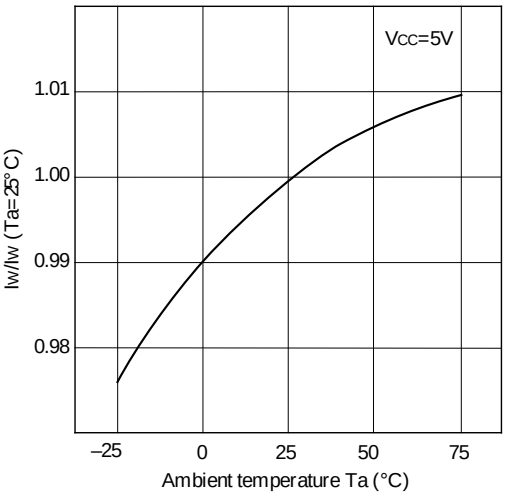


Fig. 9 Normalized read amplifier voltage gain vs Supply voltage

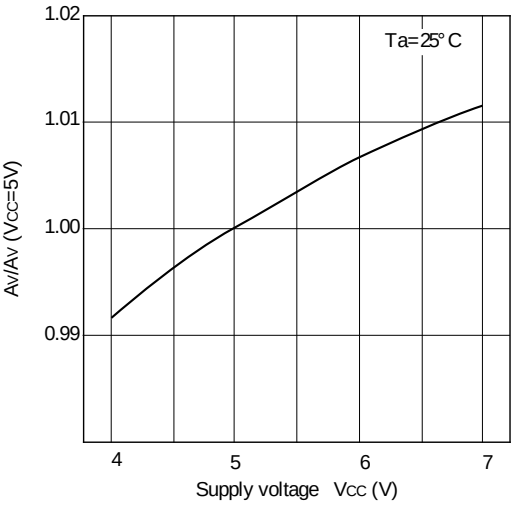


Fig. 10 Normalized read amplifier voltage gain vs Ambient temperature

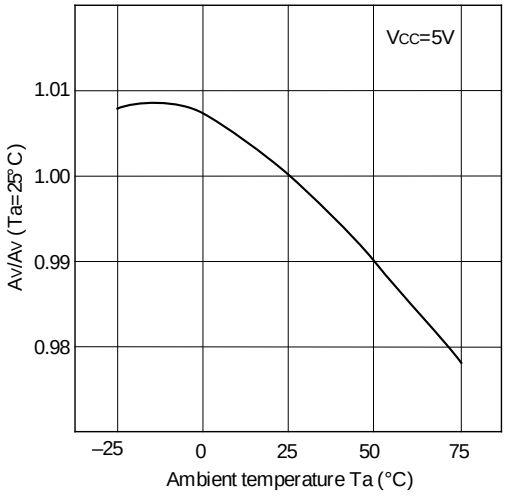
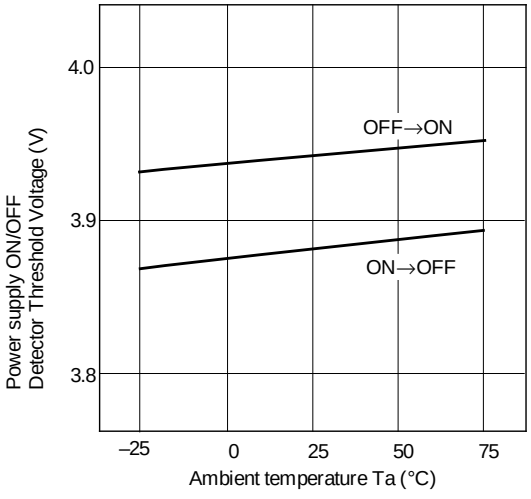
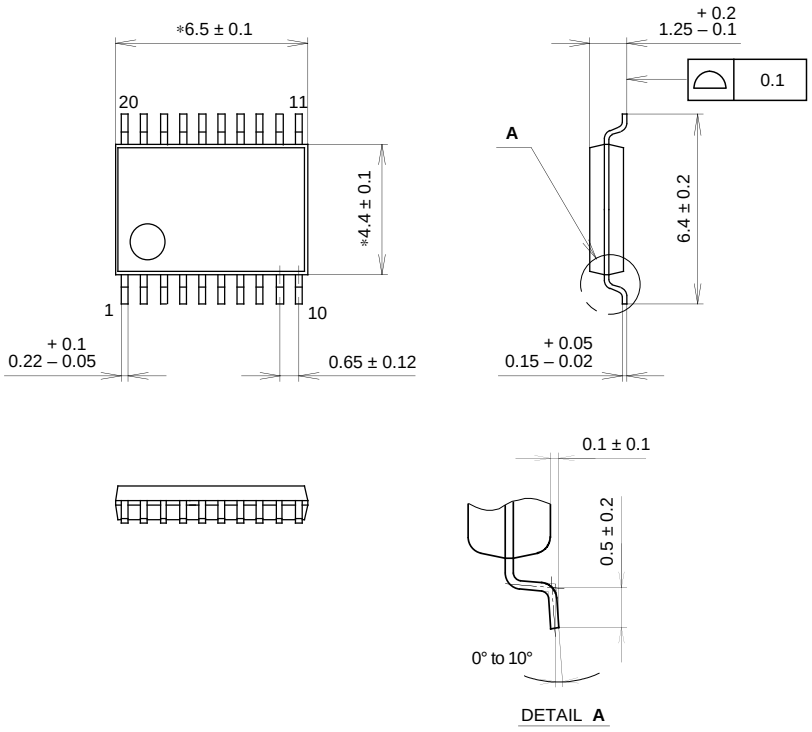


Fig. 11 Power supply ON/OFF detector threshold voltage vs Ambient temperature



Package Outline Unit : mm

20PIN SSOP (PLASTIC)



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

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

PACKAGE STRUCTURE

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