SONY

CXA1554N

Read/Write Amplifier 4ch. for Hard Disk Drive

Description

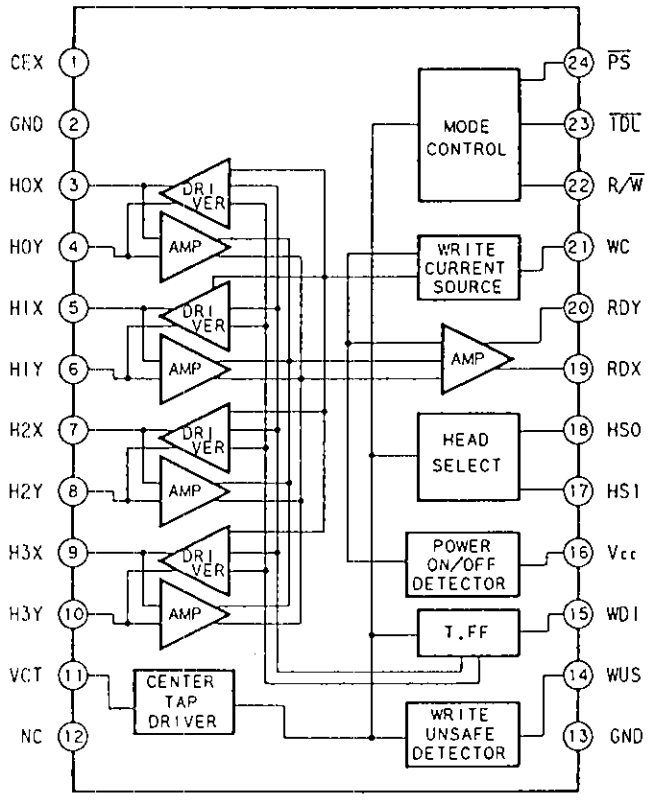
The CXA1554N is a Read/Write Amplifier for the ferrite head of hard disk drives, is designed to handle up to 4-channel heads.

24pin VSOP (Plastic)

Features

- Operates on +5V, single power supply.
- Low power consumption. Read: 90mW/Write: (I_W=30mA): 130mW+I_W×5/Idle: 40mW
- Write current can be varied through an external resistor. Built-in stabilizer circuit provides stable current during voltage and temperature drift.
- Drives 4 heads.
- Built-in power saving function.
  Power save: 7mW
- Control signal input compatible with TTL.
- Read Amplifier features 220 times gain (Typ.). Output pin is of the emitter follower type.
- Built-in Write unsafe detection circuit.
- Built-in supply voltage monitor circuit prohibits error writing during power surge or abnormal voltage.
- Differential input capacitance at read: 22pF (Typ.)
- Write data minimum pulse width: 15ns

Block Diagram and Pin Configuration



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Structure

Bipolar silicon monolithic IC

Function

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

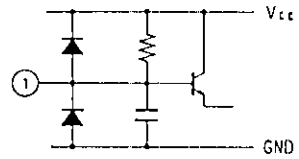
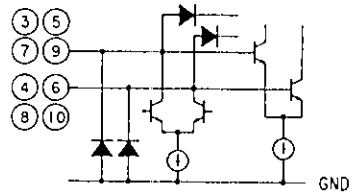
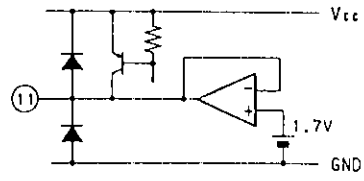
Absolute Maximum Ratings (Ta=25°C)

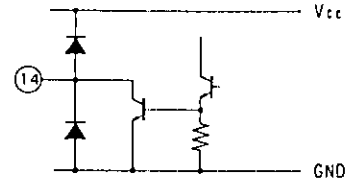
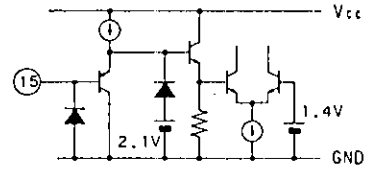
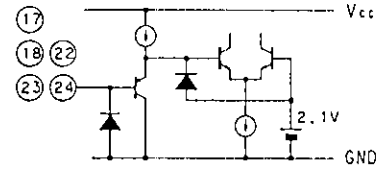
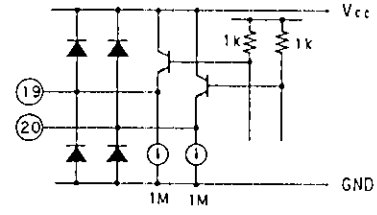
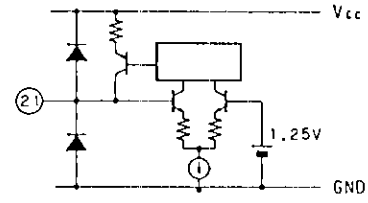
• Supply voltage	V_{CC}	7	V
• Write current	I_W	50	mA
• Operating temperature	T_{opr}	−20 to +75	°C
• Storage temperature	T_{stg}	−55 to +150	°C
• Allowable power dissipation	P_D	440	mW

Recommended Operating Conditions

• Supply voltage	V_{CC}	5V±10	%
• Damping resistance	R_D	500 to 2000	Ω
• Write current	I_W	10 to 40	mA

Pin Description

No.	Symbol	Equivalent Circuit	Description
1	CEX		Supply point of internal power supply. Supplies the ripple small power by connecting a capacitor.
3 4 5 6 7 8 9 10	H0X H0Y H1X H1Y H2X H2Y H3X H3Y		Head input port. 4 channels provided.
2 13	GND		
11	VCT		Voltage source for center tap.

No.	Symbol	Equivalent Circuit	Description
12	NC		
14	WUS		Write unsafe detection output. Open collector output. When it is off in Write mode, it means an error is detected.
16	V_{CC}		5V power supply
15	WDI		Write data input port. At "H" →"L", input is triggered.
17 18	HS1 HS0		Head select signal input port. 4 heads are selected according to the attached table.
22	R/$\overline{W}$		Read/Write signal input port. At "H": Read, at "L": Write.
23	$\overline{IDL}$		Idle signal input port. At "L": Idle.
24	$\overline{PS}$		Power save signal input port. At "L": Power save.
19 20	RDX RDY		Read amplifier output.
21	WC		A setting resistor for Write current value is connected.

Electrical Characteristics

(Unless otherwise specified, V_{CC}=5V, Ta=25°C, Write current I_W=30mA)

See Fig. 1

No.	Item	Symbol	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Test conditions	Min.	Typ.	Max.	Unit
1-1	Current consumption at V_{CC} for Read	I_{5R}																13	18	24	mA
1-2	Current consumption at V_{CC} for Write	I_{5W}										b						18 +I_W	26 +I_W	35 +I_W	mA
1-3	Current consumption at V_{CC} for Idle	I_{5I}											b					5.0	7.5	10.0	mA
1-4	Current consumption at V_{CC} for Power save	I_{5P}												b				1.0	1.4	1.8	mA
2-1	Digital input "L" input voltage	V_{IL}															Digital input [Pins 15, 17,18, 22, 23 and 24]			0.8	V
2-2	Digital input "H" input voltage	V_{IH}																2.0			V
2-3	Digital input "L" input current	I_{IL}					b		b	b		b	b	b			"H" input voltage: 2.4V "L" input voltage: 0.4V	−100			μA
2-4	Digital input "H" input current	I_{IH}																		20	μA
3-1	Write unsafe output saturation voltage	V_{WUS}										b				c	Output current: 1mA			0.5	V
3-2	Write unsafe output leak current	I_{WUS}															Input voltage: 5V			20	μA
4-1	Center tap voltage for Read	V_{CTR}																1.6	1.7	1.8	V
4-2	Center tap voltage for Write	V_{CTW}										b					I_O=30mA	4.7	4.8		V
5	Power ON/OFF Detector threshold voltage	V_{THS}										b					When V_{CC} is lowered from 5V in Write mode and Iw does not flow anymore, V_{CC} voltage is set to $V_{THS\ OFF}$. When V_{CC} is raised from 3V and I_W starts to flow, V_{CC} voltage is set to $V_{THS\ ON}$.	3.6	4.0	4.3	V
6	Write current range	I_W										b						10		40	mA
7	Write current constant	K		b	b	b			b	b		b					When Write current is I_W [mA] (R_W=5.1kΩ) K=R_W · I_W=5.1 I_W	144	155	166	
8	Read amplifier differential voltage gain	A_V	b						b	b	b						Input voltage: 1mVp-p, 300kHz Load resistance (RDX, RDY): 1kΩ	175	220	265	V/V
9	Bandwidth (−3dB)	BW	b						b	b	b						Input voltage: 1mVp-p	30			MHz
10	Input referred noise voltage	E_N							b	b	b						Head impedance: 0Ω V_N [Vrms] is the read amplifier output voltage amplified 100 times and voltage passed through a LPF with a cutoff frequency of 15MHz. Then: $E_N=\frac{V_N}{100 \cdot A_V \cdot \sqrt{15\times10^6}}$		0.85	1.2	nV/ Hz
11	Input bias current	I_B		b	b	b			b	b							Current flowing either to X or Y side of the head.			10	μA

No.	Item	Symbol	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Test conditions	Min.	Typ.	Max.	Unit
12	Common mode rejection ratio	CMRR		b	b	b			b	b	b				b	b	In-phase input voltage: 100mVp-p, 5MHz. When the Read amplifier output is V_{CM} [mVp-p], $CMRR = 20 \log \frac{100}{V_{CM}} + 20 \log A_V$	50			dB
13	Power supply rejection ratio	PSRR						b	b	b	b						Ripple voltage: 100mVp-p, 5MHz When the Read amplifier output is V_P [mVp-p], $PSRR = 20 \log \frac{100}{V_P} + 20 \log A_V$	50			dB
14	Channel separation	CS		b					b	b	b						Selected head input voltage: 0mVp-p Unselected head input voltage: 100mVp-p, 5MHz When the Read amplifier output is V_{CS} [mVp-p], $CS = 20 \log \frac{100}{V_{CS}} + 20 \log A_V$	45			dB
15	Read data output offset voltage for Read	V_{OFFR}															When Pin 19 voltage is V_{XR} and Pin 20 voltage is V_{YR}, $V_{OFFR} = V_{XR} - V_{YR}$	−200		200	mV
16	Read data output offset voltage for Write	V_{OFFW}										b					When Pin 19 voltage is V_{XW} and Pin 20 voltage is V_{YW}, $V_{OFFW} = V_{XW} - V_{YW}$	−40		40	mV
17	Read data output voltage variation from Write to Read	V_{WR}															$V_{WR} = \frac{V_{XR} + V_{YR} - (V_{XW} + V_{YW})}{2}$	−200		0	mV

(Unless otherwise specified, V_{CC}=5V, Ta=25°C, f_{WD} (Write data frequency)=5MHz, L_h=10μH, R_D=750Ω)
See fig. 2, to 4

No.	Item	Symbol	Test conditions	Min.	Typ.	Max.	Unit
18	Head voltage amplitude	V_{SW}	Potential difference between HX pin and HY pin at selection of Write current.	7.0			Vp-p
19	Write unsafe detection max. frequency	F_{US}	F_{US} is the maximum Write data frequency when Pin 14 turns "H" in Write mode.		450	800	kHz
20-1	Mode switching time Read to Write	T_{RW}	T_{RW} is the time required for Write current to turn to 90% after Pin 22 changes from "H" to "L".			1.0	μs
20-2	Mode switching time Write to Read	T_{WR}	T_{WR} is the time required for either Write current to decrease to 10% after Pin 22 changes from "L" to "H" or for the Read output* to turn to 90%.			1.0	μs
21-1	Mode switching time Safe to Unsafe	T_{SA1}	T_{SA1} is the time required for Pin 14 to turn "H" after the last transition of Write data when Write data is stopped in Write mode.			8.0	μs
21-2	Mode switching time Unsafe to Safe	T_{SA2}	T_{SA2} is the time required for Pin 14 to turn "L" after the first transition of Write data in Write mode.			1.0	μs
22	Mode switching time Idle to Read	T_{IR}	T_{IR} is the time required for Read amplifier output to turn 90% after Pin 23 changes from "L" to "H".			1.0	μs
23	Mode switching time Power save to Read	T_{PR}	T_{PR} is the time required for the Read amplifier output to turn to 90% after Pin 24 changes from "L" to "H".			2.0	μs
24	Head switching time	T_H	T_H is the time required for Read output* to reach 90% when the select head is changed in Read mode.			1.0	μs
25	Write current propagation delay time	T_{PD}	R_D=0Ω L_h=0μH T_{PD} is the time required for Write current to reach 90% after the Write data falling edge.			50	ns
26	Write current rise/fall time	T_R/T_F	R_D=0Ω L_h=0μH 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%.			20	ns

* Read output: 100mVp-p, 10MHz

Test Circuit 1

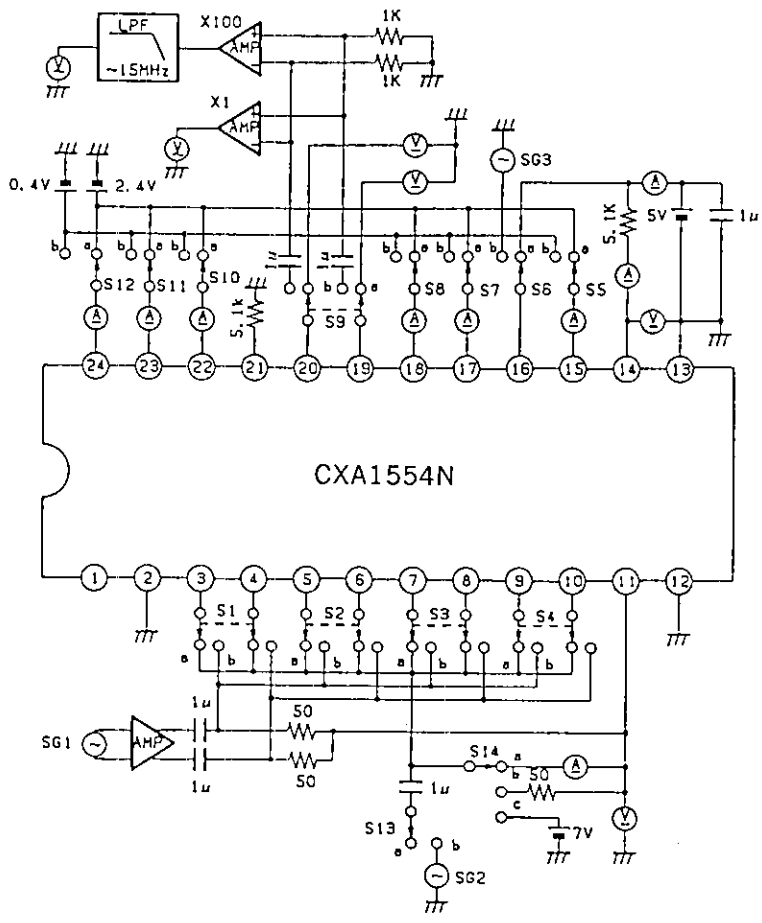
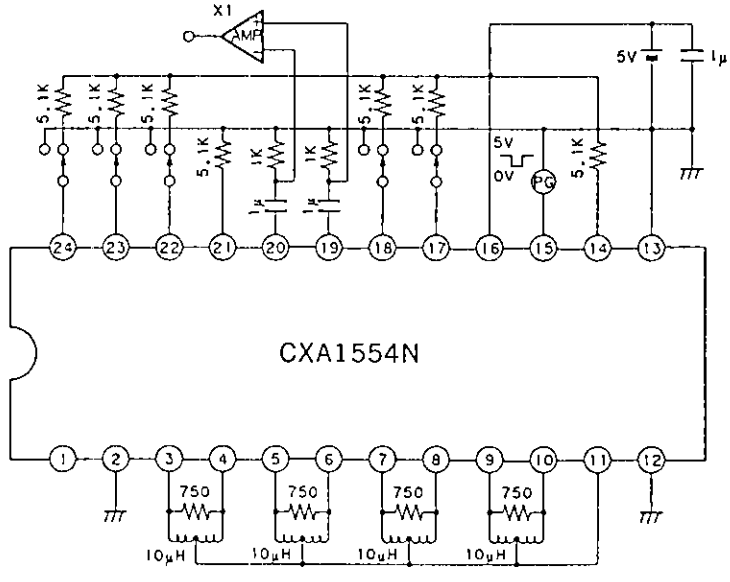


Fig. 1

Test Circuit 2



Note) Write current is tested at current probe. Use an oscilloscope to test items related to time.

Fig. 2

Timing chart 1

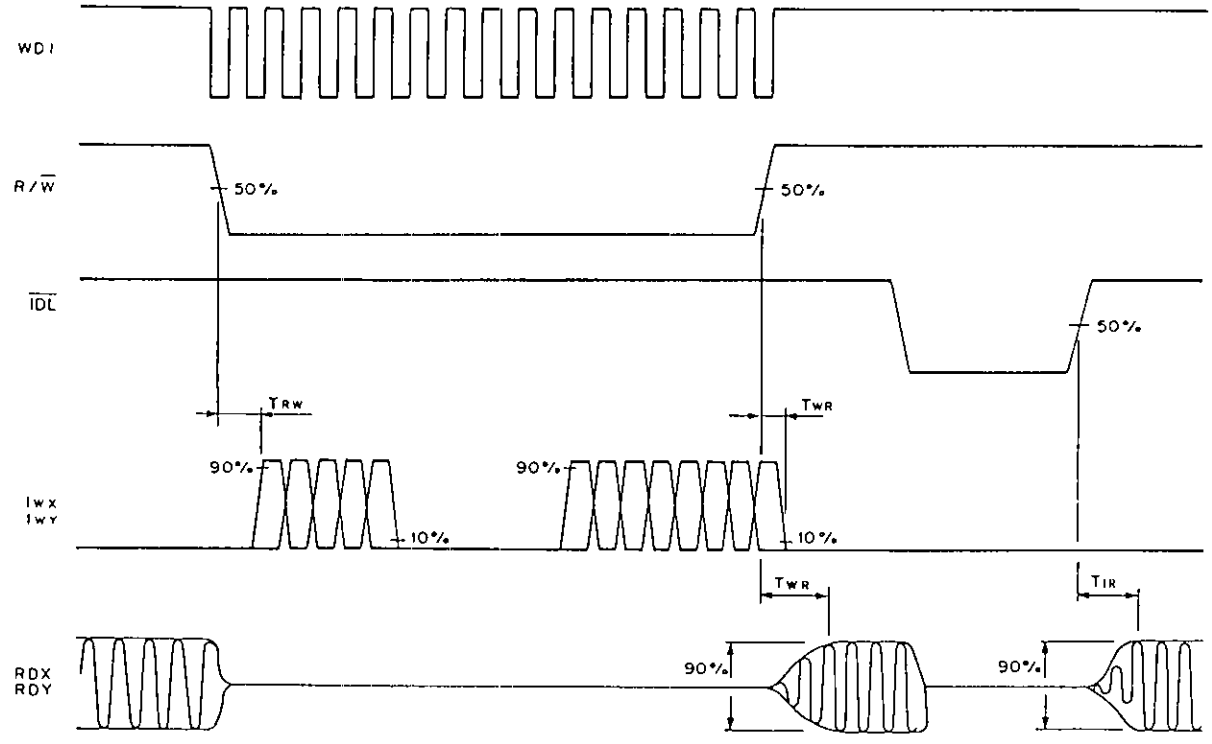


Fig. 3

Timing chart 2

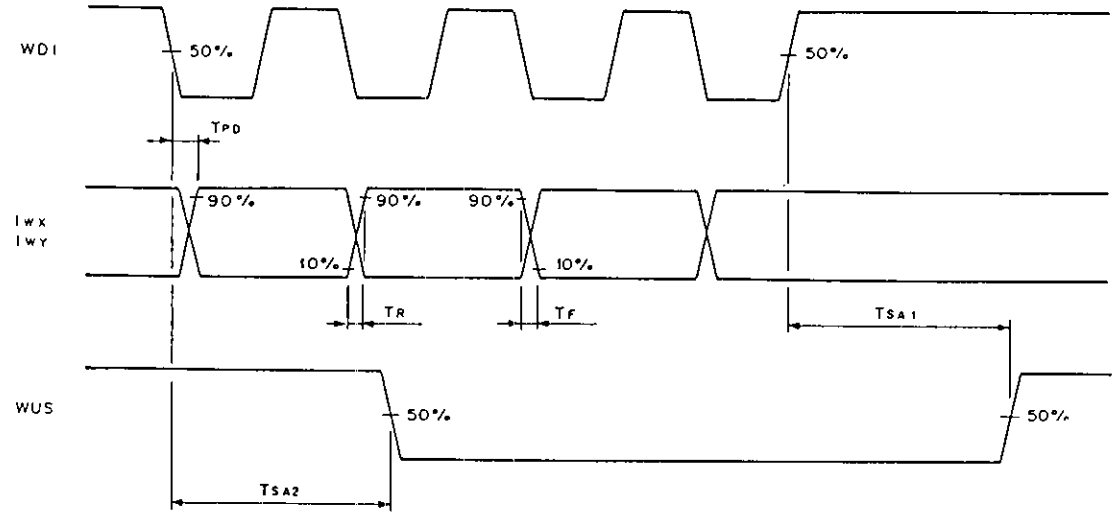


Fig. 4

Description of Functions

Read amplifier

This is a low noise amplifier amplifying the signals from the head. It is an emitter follower output. The head X side and RDX pin, the head Y side and RDY pin have the same polarity.

Write circuit

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

Write data is triggered from "H" to "L" and the recording current is switched.

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

Read/Write control

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

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

Table 1 Mode Select

Head select

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

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

Table 2 Head Select

Write unsafe detection circuit

In normal Write mode, WUS output turns to "L" and in the following other conditions, WUS output turns to "H".

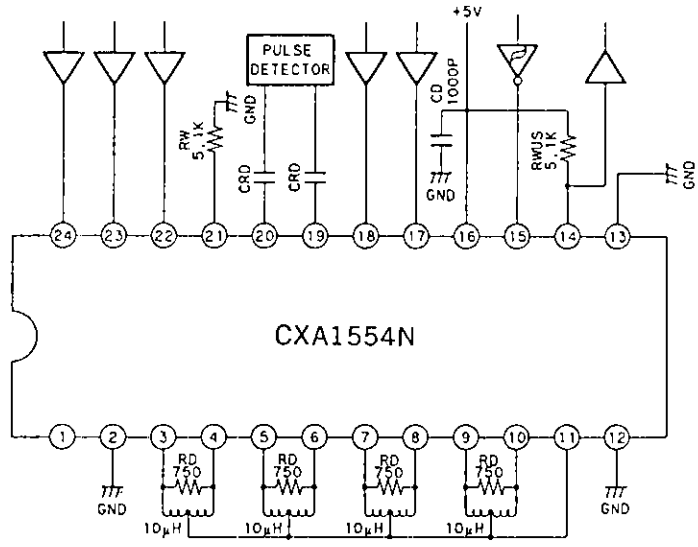
- Head input is open
- Head input is shorted to GND
- Head input is shorted to the center tap
- Head inputs are shorted with each other
- The center tap is open
- Write data frequency is abnormally low
- Write current is abnormally small
- In Read mode
- In Idle mode
- At an abnormal power supply voltage (Refer to the Power ON/OFF Detection.)

Power ON/OFF detection

Recording and Playback functions are inhibited as detected as abnormal supply voltage when V_{CC} decreases below the power ON/OFF detector threshold voltage (V_{TH5}).

When V_{CC} is higher than V_{TH5}, the above inhibition is discontinued.

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 patent and other right due to same.

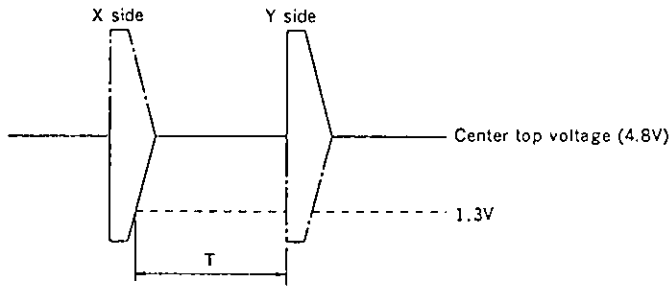
Notes on Operation

- This device handles high frequency and high gain signals. Please note the following ;
  - ○ Connect Vcc decoupling capacitors of about 1000pF near the device.
  - ○ GND should be as large as possible.
  - ○ Inserting ferrite beads in the center top wiring minimizes over-shooting and ringing in the write current.

- WC pin is a constant voltage pin. When noise affects this pin it creates noise in the write current. Therefore, locate R_W as close to the device as possible.

- Connect unused head pin to VCT when using at 2-channel.

- Make sure T period in the Fig. below does not go below 50ns. Should that happen, WUS output turns to "H" even if write state is normal.



Head pin voltage waveform

- GND
  There are two GNDs : Main GND is Pin 2. It does not matter whether Pin 13 is kept open but GND is recommended to Pin 13. because of an effect to raise efficiency of radiation of heat.

- Pin CEX
  This is a pin fixes external capacitance to raise PSRR. When capacitance is not fixed, this pin is kept open.

- Pin NC
  Keep open or connect to GND.

- Write data pulse width
  Set pulse width 15ns or more at 1.4V to prevent misoperation.

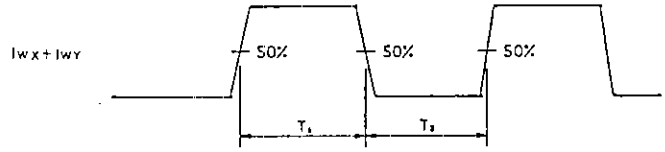
Application Notes

Use the following characteristics for reference.

Vcc=5V Ta=25°C

Item		Symbol	Conditions	Min.	Max.	Unit
Write mode	Differential output capacitance	C_O	Across head input pins f=5MHz		15	pF
	Differential output resistance	R_O		10		kΩ
Read mode	Differential input capacitance	C_I	Across head input pins f=5MHz		26	pF
	Differential input resistance	R_I		2		kΩ
	Output resistance	R_{RD}	RDX or RDY f=5MHz		60	Ω
Unselected head differential current in Write mode		I_{US}	Lh=10μH, RD=750Ω, Iw=30mA		2	mA
Write current symmetry		T_{AS}	Lh=0μH, RD=0Ω, Iw=30mA*1	−2	2	ns

* 1. $T_{AS}=T_1-T_2$



Setting of Write current

Set the write current with Pin 21 resistor R_W (kΩ).

$I_W=155/R_W$ [mA] See Fig. 5.

Fig. 5 Write current vs. R_W

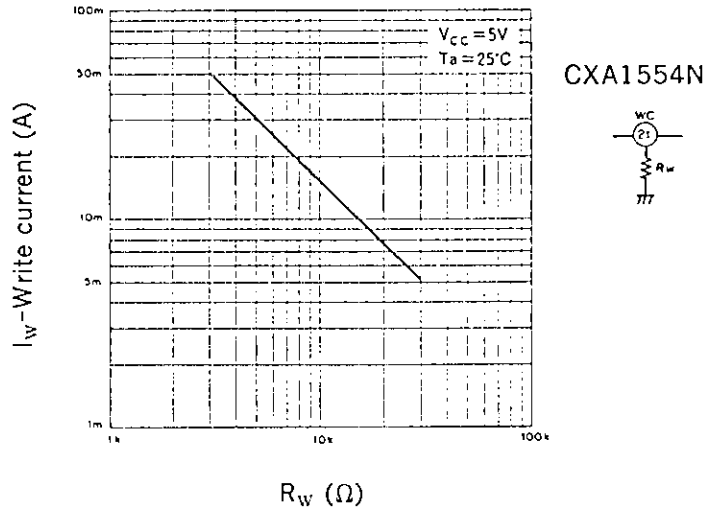


Fig. 6 Normalized read amplifier voltage gain vs. Supply voltage

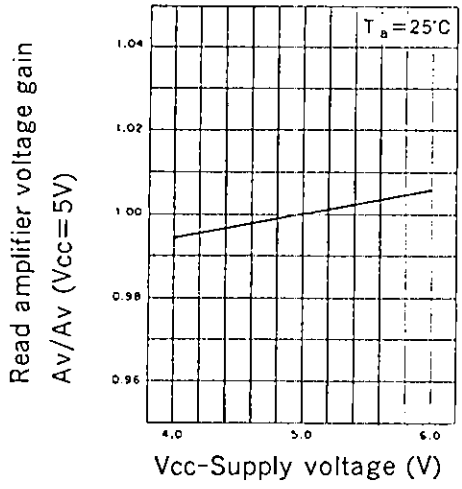


Fig. 7 Normalized read amplifier voltage gain vs. Ambient temperature

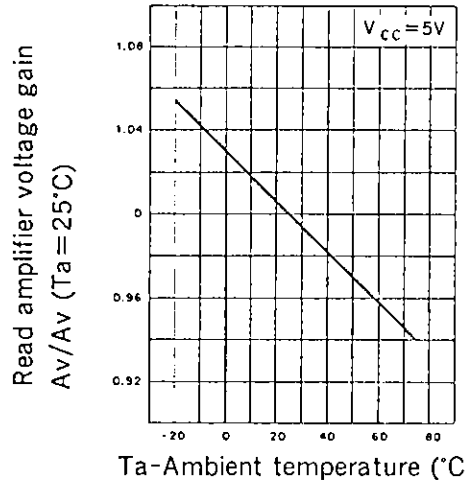


Fig. 8 Normalized write current vs. Supply voltage

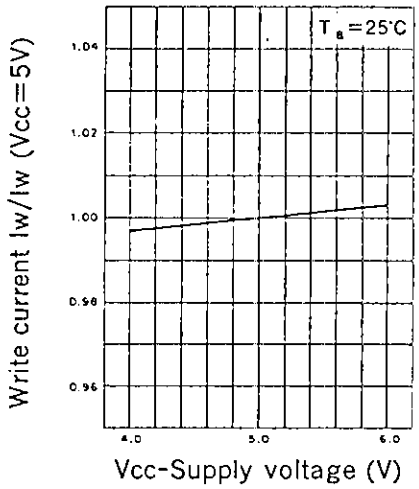


Fig. 9 Normalized write current vs. Ambient temperature

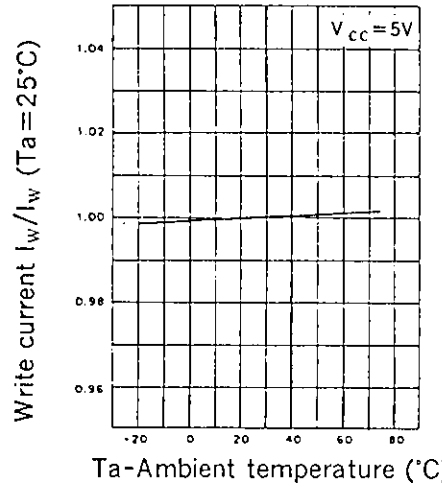
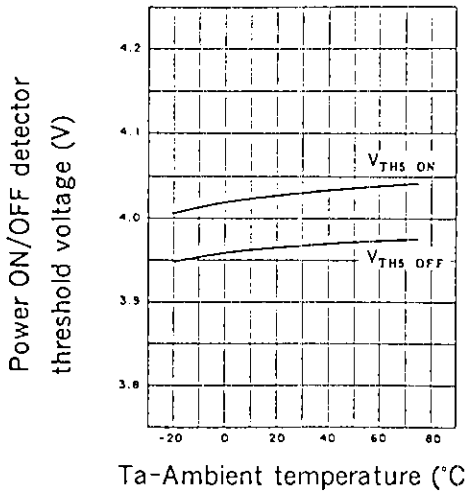
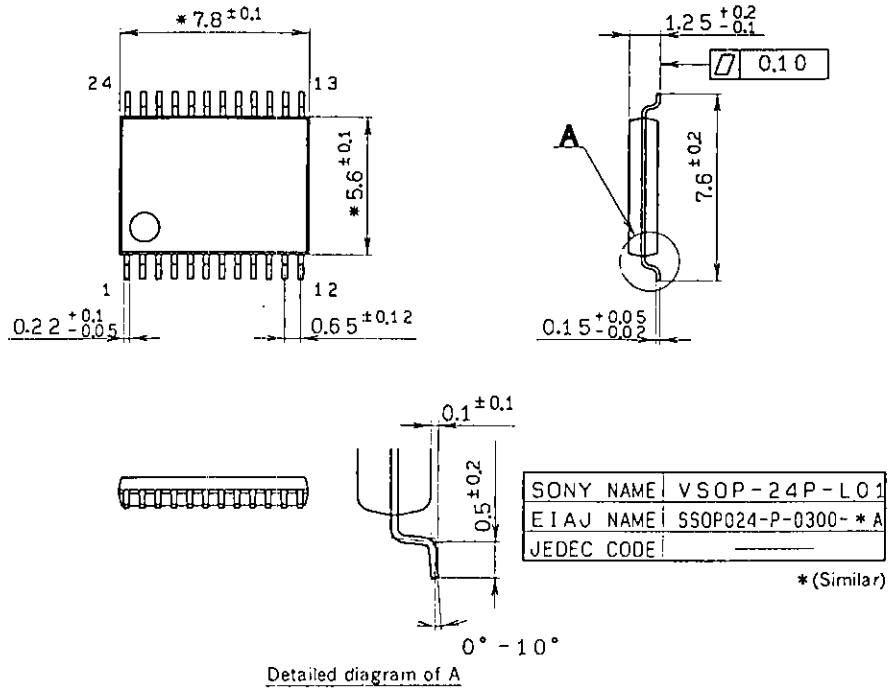


Fig. 10 Power ON/OFF detector threshold voltage vs. Ambient temperature



Package Outline Unit : mm

24pin VSOP (Plastic) 300mil 0.1g



Detailed diagram of A

Note) Dimensions marked with * do not include resin residue.