

Recording Equalizer IC for Stereo Cassette Deck

Description

The CXA1398P/M is a bipolar IC developed for recording equalizer used in analog cassette deck. It is especially suited for double cassette deck. A built-in filter circuit greatly reduces external parts.

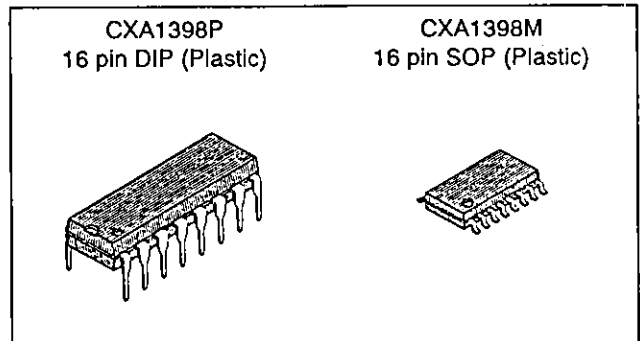
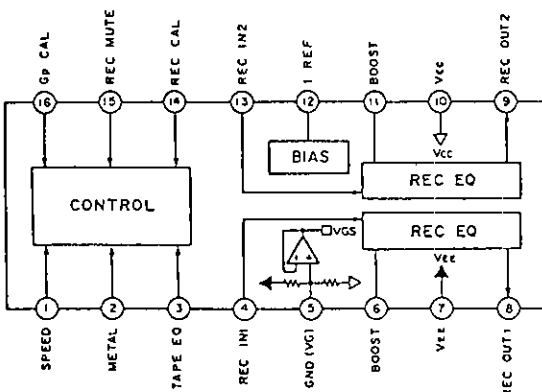
Features

- Built-in filter for recording equalizer.
- Inductor (coil) unnecessary
- Low frequency boost possible only by fixing an external capacitor
- Built-in recording mute function (Soft mute is possible by installing an external time constant circuit.)
- Fade IN/OUT DC control possible
- Built-in NORMAL/CrO₂/METAL Tape mode switch function
- Built-in NORMAL/HIGH Speed recording switch function
- DC control possible for recording level calibration (approx. ± 5 dB variation)
- DC control possible for high frequency equalizer characteristics (gain) calibration (approx. ± 4 dB variation)
- Built-in 2 channels
- Compact package (16 pin DIP)

Applications

Recording equalizer for stereo analog cassette deck (ALPS ELECTRIC CO., LTD. HADKH55 series head applicable)

Block Diagram and Pin Configuration (Top View)



Supply Voltage Range

- Supply voltage $V_{CC}, V_{EE} \pm 4.5$ to ± 8.0 V
(Pos/Neg dual power supply)
 $V_{CC} 9.0$ to 16.0 V
(Single power supply)
- Operating temperature $T_{opr} -20$ to $+75$ °C

Functions

- Recording equalizer (low frequency boost possible with external capacitor)
- Recording mute (DC control possible for soft mute, fade IN/OUT)
- Mode switch (6-mode switch; NORMAL/CrO₂/METAL Tape, NORMAL/HIGH Speed)
- Recording calibration (DC control possible for recording level calibration)
- High frequency calibration (DC control possible for calibration of high frequency equalizer characteristics)

Structure

Bipolar silicon monolithic IC

Absolute Maximum Ratings ($T_a=25$ °C)

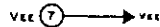
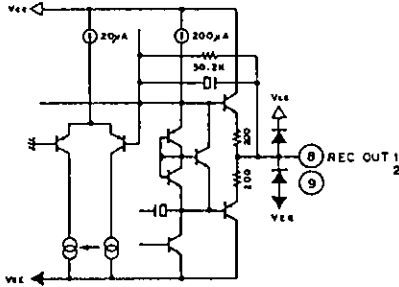
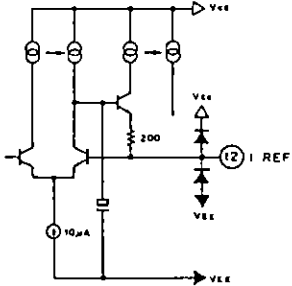
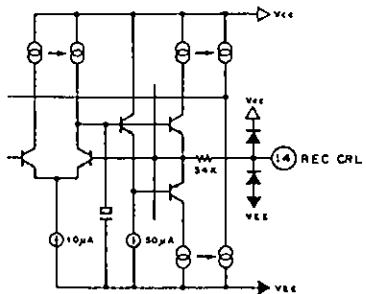
- Supply voltage $V_{CC} 17$ V
- Operating temperature $T_{opr} -20$ to $+75$ °C
- Storage temperature $T_{stg} -65$ to $+150$ °C
- Allowable power dissipation $P_D 930$ mW

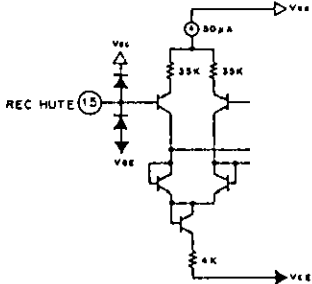
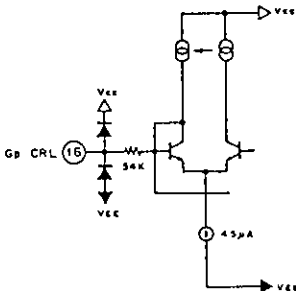
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Pin Description and Equivalent Circuit

(Ta=25°C, VCC=+7.5V, VEE= - 7.5V, No signal)

Pin No.	Symbol	DC voltage	I/O	Zin	Equivalent circuit	Description
1	SPEED	—	I	—		Tape speed select pin (NORMAL/HIGH Speed) "H" → HIGH Speed "L" → NORMAL Speed
2	METAL	—	I	—		Metal tape select pin (METAL/METAL) "H" → METAL Tape "L" → NORM, CrO ₂ Tape
3	Tape EQ	—	I	—		Tape equalizer select pin (120 μs/70 μs EQ) "H" → 70 μs EQ (CrO ₂) "L" → 120 μs EQ (NORM)
4 13	REC IN1 REC IN2	0.0V	I	50kΩ		Input pin of recording equalizer
5	GND (VG)	0.0V	I	15kΩ		During Pos/Neg dual power supply → Connect to GND During single power supply → VCC/2 (Connect to capacitor over 10 μF)
6 11	BOOST1 BOOST2	0.0V	I	9.5kΩ		Pin connecting external capacitor for low frequency boost * When low frequency boost is not executed: During Pos/Neg dual power supply → Connect to GND During single power supply → Connect to capacitor over 3.3 μF

Pin No.	Symbol	DC voltage	I/O	Zin	Equivalent circuit	Description
7	V _{EE}	-7.5V	—	—		During Pos/Neg dual power supply → Connect to negative power supply During single power supply → Connect to GND
8 9	REC OUT1 REC OUT2	0.0V	O	—		Output pin of recording equalizer
10	V _{CC}	7.5V	—	—		Positive power supply pin
12	I _{REF}	-6.3V	O	—		Reference current setting pin for the monolithic filters
14	REC CAL	2.5V	I	54kΩ		Recording calibration pin * Calibrating pin of recording level. Control by applying 0 to 5V DC voltage. "H" → recording level gain down "L" → recording level gain up * When recording calibration function is not used, keep pin open.

Pin No.	Symbol	DC voltage	I/O	Zin	Equivalent circuit	Description
15	REC MUTE	5.0V	I	—		Select pin for recording mute ON/OFF * Control recording mute volume using 0 to 5V DC voltage "H" → recording mute OFF "L" → recording mute ON * Soft mute/fader selection is possible by changing the time constant of the external time constant circuit
16	Gp CAL	2.5V	I	54kΩ		High frequency calibration pin * Calibrating pin for high band of recording level. Control by applying 0 to 5V DC voltage. "H" → high frequency level gain down "L" → high frequency level gain up * When high frequency calibration function is not used, keep pin open.

Electrical Characteristics

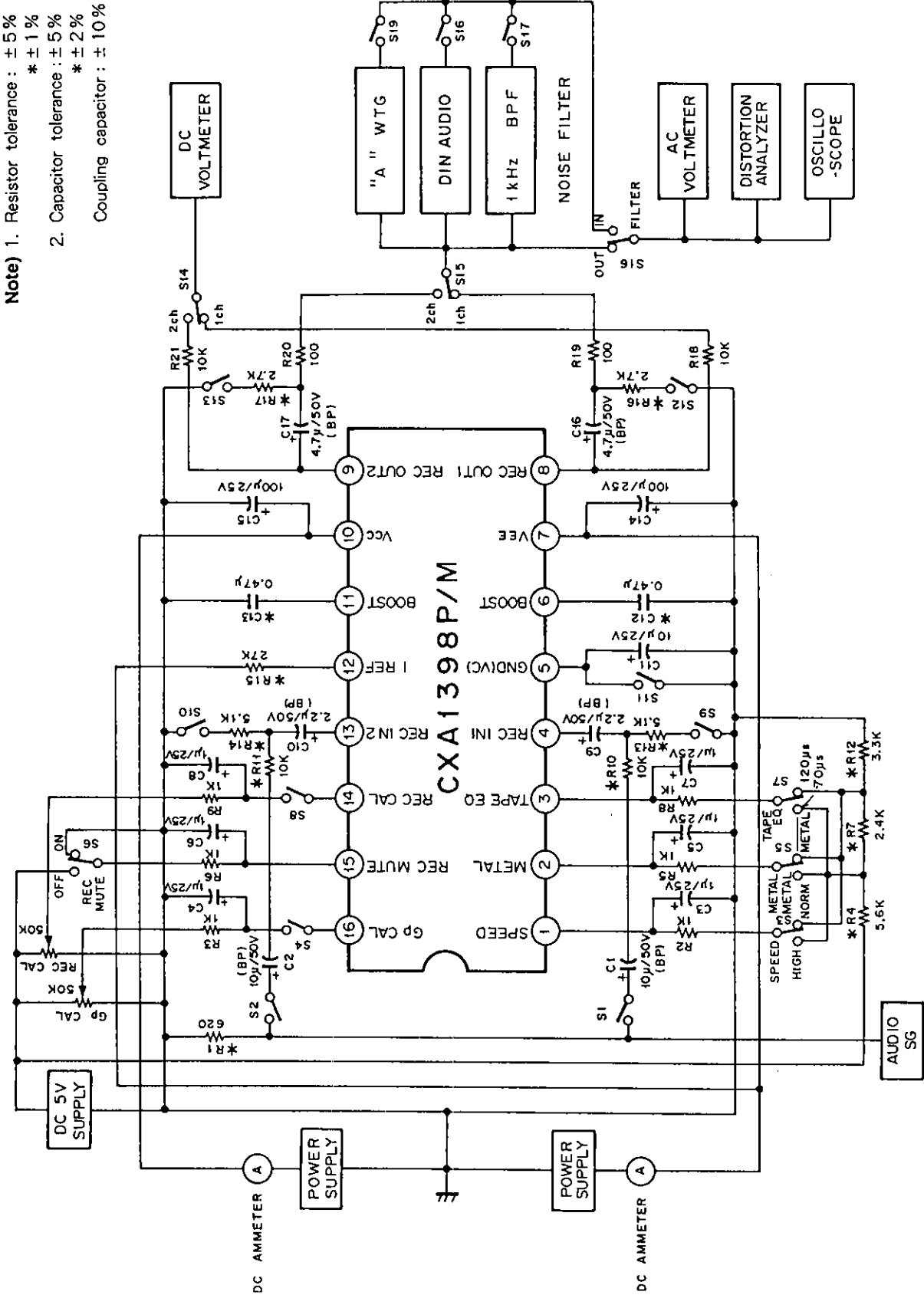
(Ta=25°C, Vcc=+7.5V, VEE=-7.5V)

Item	Symbol	Condition	Note)	Min.	Typ.	Max.	Unit
Operating voltage	Vopr	Pos/Neg dual power supply		± 4.5	—	± 8.0	V
		Single power supply		9.0	—	16.0	V
Current consumption	Icc	NORM-NORM, No signal		9.0	12.5	18.5	mA
Reference input level	VIN	NORM-NORM, 315Hz		-21.5	-20.0	-18.5	dBm
Reference output level	VOUT	NORM-NORM, 315Hz		—	-5.0	—	dBm
S/N ratio (NORM-NORM)	SN (A-WTG)	Rg=5kΩ, "A"-WTG filter		55.0	58.2	—	dB
Signal handling	SH	RL=2.7kΩ, 1kHz, THD=1%		15.0	18.0	—	dB
Total harmonic distortion	THD	RL=2.7kΩ, 1kHz, 0dB		—	0.23	0.5	%
Output offset voltage	VOFF	NORM-NORM		-0.5	0.0	0.5	V
NORM-NORM mode frequency characteristics 0dB=315Hz, -20dB	FNN-1	3kHz, -20dB	NORM-NORM against 315Hz -20dB	-2.0	-1.0	0.0	dB
	FNN-2	8kHz, -20dB		2.3	4.3	6.3	dB
	FNN-3	12kHz, -20dB		8.5	12.0	15.5	dB
CrO ₂ -NORM mode frequency characteristics	FCN-1	3kHz, -20dB	NORM-NORM against 315Hz -20dB	3.8	4.8	5.8	dB
	FCN-2	8kHz, -20dB		7.2	9.2	11.2	dB
	FCN-3	12kHz, -20dB		12.7	15.7	19.2	dB
METAL-NORM mode frequency characteristics	FMN-1	3kHz, -20dB	NORM-NORM against 315Hz -20dB	3.9	4.9	5.9	dB
	FMN-2	8kHz, -20dB		7.1	8.6	10.1	dB
	FMN-3	12kHz, -20dB		11.3	13.8	16.8	dB
NORM-HIGH mode frequency characteristics	FNH-1	5kHz, -20dB	NORM-NORM against 315Hz -20dB	-4.6	-3.6	-2.6	dB
	FNH-2	15kHz, -20dB		0.1	1.6	3.1	dB
	FNH-3	20kHz, -20dB		4.3	6.8	9.8	dB
CrO ₂ -HIGH mode frequency characteristics	FCH-1	5kHz, -20dB	NORM-NORM against 315Hz -20dB	1.4	2.4	3.4	dB
	FCH-2	15kHz, -20dB		6.4	7.9	9.4	dB
	FCH-3	20kHz, -20dB		10.5	13.0	15.5	dB
METAL-HIGH mode frequency characteristics	FMH-1	5kHz, -20dB	NORM-NORM against 315Hz -20dB	1.2	2.2	3.2	dB
	FMH-2	15kHz, -20dB		4.9	6.4	7.9	dB
	FMH-3	20kHz, -20dB		8.2	10.7	13.2	dB
Recording mute ratio	MT-1	NORM-NORM, 1kHz, +15dB		—	-95.0	-80.0	dB
Recording mute characteristics	MT-2	NORM-NORM, 1kHz, 2.5V (Pin voltage)		-7.5	-6.0	-4.5	dB
REC CAL characteristics 0dB=315Hz, -20dB	R-CAL1	NORM-NORM, 315Hz, 0V (Pin voltage)		5.1	6.1	7.1	dB
	R-CAL2	NORM-NORM, 315Hz, 5V (Pin voltage)		-7.9	-6.9	-5.9	dB
GP CAL characteristics 0dB=8kHz, -20dB	G-CAL1	NORM-NORM, 8kHz, 0V (Pin voltage)		4.9	5.9	6.9	dB
	G-CAL2	NORM-NORM, 8kHz, 5V (Pin voltage)		-4.9	-3.9	-2.9	dB
Control voltage "H" level	VCH	Threshold voltage of mode control pin		3.0	—	Vcc	V
Control voltage "L" level	VCL	Threshold voltage of mode control pin		GND	—	1.0	V

Note) NORM-NORM=NORMAL Tape, NORMAL Speed
 CrO₂-NORM=CrO₂ Tape, NORMAL Speed
 METAL-NORM=METAL Tape, NORMAL Speed

NORM-HIGH=NORMAL Tape, HIGH Speed
 CrO₂-HIGH=CrO₂ Tape, HIGH Speed
 METAL-HIGH=METAL Tape, HIGH Speed

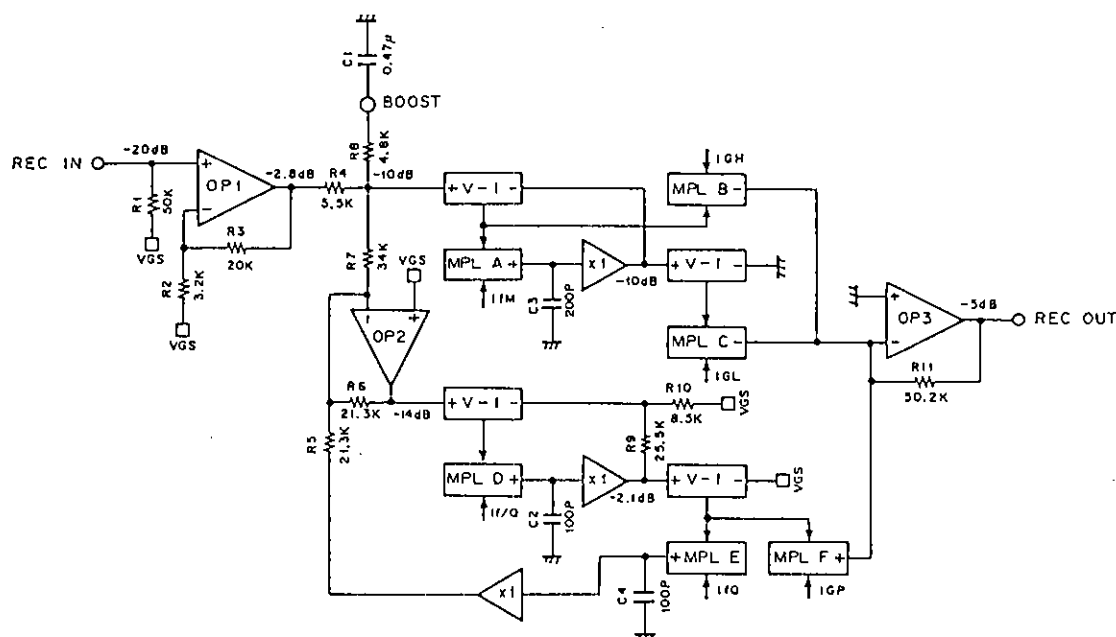
Electrical Characteristics Test Circuit



- Note) 1. Resistor tolerance : $\pm 5\%$
 * $\pm 1\%$
 2. Capacitor tolerance : $\pm 5\%$
 * $\pm 2\%$
 Coupling capacitor : $\pm 10\%$

1. Recording equalizer

As shown in the function circuits block diagram of Fig. 1, the circuit structure of CXA1398P/M realizes the frequency characteristics necessary for the recording equalizer.



Symbol (V-I) shown in Fig. 1 indicates a circuit for "Voltage to current converter" and (MPL) a "Multiplier". "Voltage to current converter" (V-I) converts the voltage between the positive and negative input pins into current, by means of the diffused resistor inside the IC. "Multiplier" (MPL) multiplies the current converted in the "Voltage to current converter" to a certain coefficient. Accordingly, to realize the recording equalizer frequency characteristics indicated in Fig. 2, there are 6 necessary parameters (G_L , G_H , G_P , f_M , f_P , Q). Those are controlled by the respective control currents (I_{GL} , I_{GH} , I_{GP} , I_{fM} , $I_{f/Q}$, I_{fQ}) shown in Fig. 1.

In CXA1398P/M blocks that determine the gain utilize current dependent on diffused resistors while blocks that determine the filter time constant utilize current dependent on external resistors.

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The time constants of f_M , f_P , Q are obtained from the product of the current converted in the "Voltage to current converter" and the capacitance inside the IC connected to the output of the respective "Multiplier". Using current determined by an external resistor not depending on the diffused resistor as control current allows for characteristics that do not depend on the diffused resistor. This because the coefficient from the voltage to current conversion adopts the ratio of the diffused resistor.

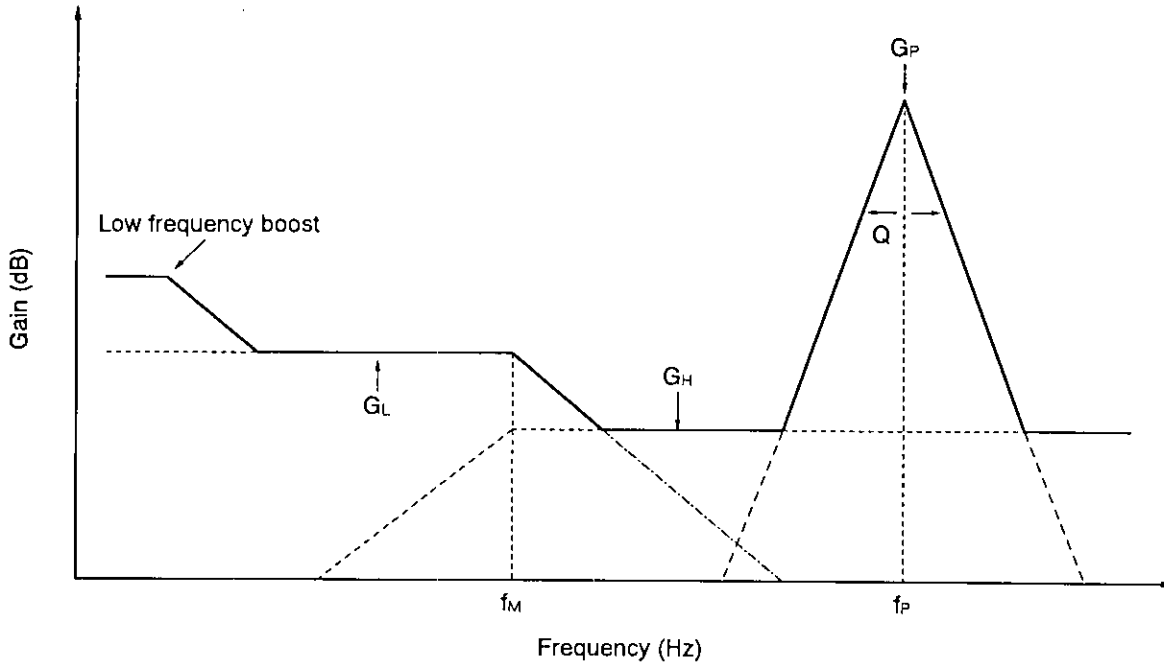


Fig. 2 Outline diagram of CXA1398P/M frequency characteristics

2. Low frequency boost function

With CXA1398P/M low frequency boost is obtained just by fixing an external capacitors. As can be seen from Fig. 1, in CXA1398P/M, after the input amplifier there is an attenuation circuit due to the resistors. One of these resistors is connected to BOOST pins (Pins 6 and 11). By connecting a capacitor to the BOOST pins (Pins 6 and 11) a transfer function such as that shown below can be obtained.

$$G_{\text{BOOST}}(s) = \frac{s \cdot C_1 \cdot R_7 \cdot R_8 + R_7}{s \cdot C_1 \cdot (R_4 \cdot R_7 + R_7 \cdot R_8 + R_8 \cdot R_4) + (R_4 + R_7)} \quad (s = j\omega)$$

From the above, f_1 , f_2 , A_1 , A_2 in Fig. 3, turn out as follows.

$$f_1 = \frac{R_4 + R_7}{2\pi \cdot C_1 \cdot (R_4 \cdot R_7 + R_7 \cdot R_8 + R_8 \cdot R_4)} = \frac{1}{2\pi \cdot C_1 \cdot \left(\frac{R_4 \cdot R_7}{R_4 + R_7} + R_8 \right)}$$

$$f_2 = \frac{1}{2\pi \cdot C_1 \cdot R_8}$$

$$A_1 = \frac{R_7}{R_4 + R_7}$$

$$A_2 = \frac{R_7 \cdot R_8}{R_4 \cdot R_7 + R_7 \cdot R_8 + R_8 \cdot R_4} = \frac{\frac{R_7 \cdot R_8}{R_7 + R_8}}{R_4 + \frac{R_7 \cdot R_8}{R_7 + R_8}}$$

Here as $R_4=5.5k\Omega$, $R_7=34k\Omega$ and $R_8=4.8k\Omega$, A_1 and A_2 value turns out to

$A_1=0.861$ (ratio) = -1.30 (dB), $A_2=0.433$ (ratio) = -7.26 (dB)

Accordingly, as the difference between A_1 and A_2 stands at about 6dB, for the low boost a 6dB boost is possible. The boost frequency characteristics can be freely set with the value of the external C_1 capacitor.

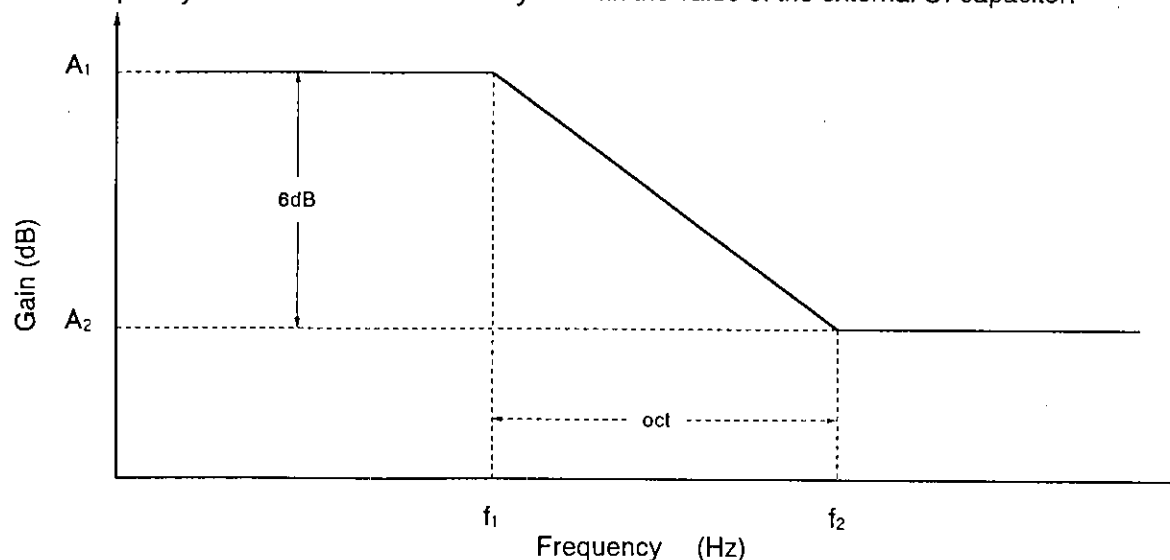


Fig. 3. CXA1398P/M low frequency boost frequency characteristics

3. Recording mute function

CXA1398P/M recording mute function consists of a built-in recording mute circuit that varies the recording equalizer gain, electronic volume wise according to the amplitude of the DC voltage applied to REC MUTE pin (Pin 15). Therefore, soft mute (The signal is gradually attenuated without distorting) and fader (fade IN/OUT) can be freely formed according to the variation in the time during which DC voltage is applied to REC MUTE pin (Pin 15).

CXA1398P/M recording mute is performed by reducing the control current of respective gains (G_L , G_H , G_P) indicated in the function circuits block diagram of Fig. 1. There, mute is performed with the respective gain ratios at a constant value. This control current can be varied through the input of voltage to REC MUTE pin (Pin 15). Accordingly as the mute condition is fully attained, only the final stage I-V amplifier is connected to the output pin (REC OUT). Noise at the monolithic filter that consists of "Voltage to current converter" and "Multiplier" is reduced with the signal attenuation. As a result, I-V amplifier almost at the last stage turns to buffer condition to provide large muting ratio. Fig. 4 shows waveforms of recording mute.

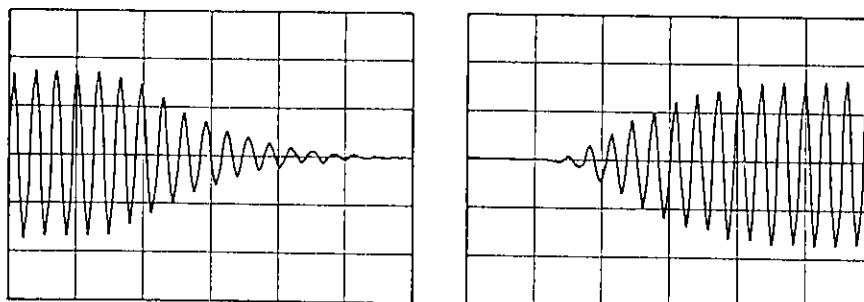


Fig. 4. Waveform of recording mute

4. Recording level calibration function

With CXA1398P/M, recording level calibration can be performed using the DC. Just by applying DC voltage to REC CAL pin (Pin 14) will vary the recording equalizer gain by approx. $\pm 5\text{dB}$. The circuit operation is similar to that of the recording mute circuit. That is by varying the reference voltage source voltage of control currents (IGL, IGH and IGP) that control (G_L , G_H and G_P), the respective gains are relatively varied. Moreover, as was mentioned in the paragraph for Pin Description, REC CAL pin (Pin 14) input resistor is at $54\text{k}\Omega$ and diffused resistor inside the IC. Accordingly, the difference between the DC voltage applied to REC CAL pin (Pin 14) and the reference voltage (2.5V) inside the IC is converted into current at the diffused resistor.

As was mentioned in the paragraph on the "Recording equalizer", all the coefficients become the diffused resistor ratio and recording level calibration that is not dependent on the IC particular temperature characteristics and unevenness, is possible.

Also, this recording level calibration is effective under all 6 modes (NORM/CrO₂/METAL tape, NORM/HIGH speed and of course during recording mute operation).

When recording level calibration function is not used, REC CAL pin (Pin 14) is just kept open (free), REC CAL pin (Pin 14) voltage turns to reference voltage (2.5V) inside the IC is set to the typical output gain.

5. High frequency equalizer calibration function

With CXA1398P/M, beside recording level calibration, calibration of the high frequency equalizer characteristics can be performed by means of the DC voltage. As for the recording level calibration, just by applying DC voltage to GP CAL pin (Pin 16) the recording equalizer GP gain only can be varied by approx. $\pm 4\text{dB}$. This function also varies relatively GP gain when recording level calibration is activated. Circuit operation is similar to that of recording level calibration. Voltage applied to the pin is converted into current by means of the diffused resistor inside the IC. Moreover, the "Multiplier" provides the coefficient to the control current according to the value of GP gain control current (IGP) for mode currently set.

Accordingly, similar to the recording level calibration, calibration of high frequency equalizer characteristics not dependent on temperature characteristics and unevenness of IC particular is possible. Also, this function is effective under all modes.

When the high frequency equalizer calibration is not in use, just by keeping GP CAL pin (Pin 16) open, the IC internal circuit is set to typical output gain (high frequency equalizer characteristics). Fig. 5 shows an outline diagram of recording level/high frequency equalizer calibration.

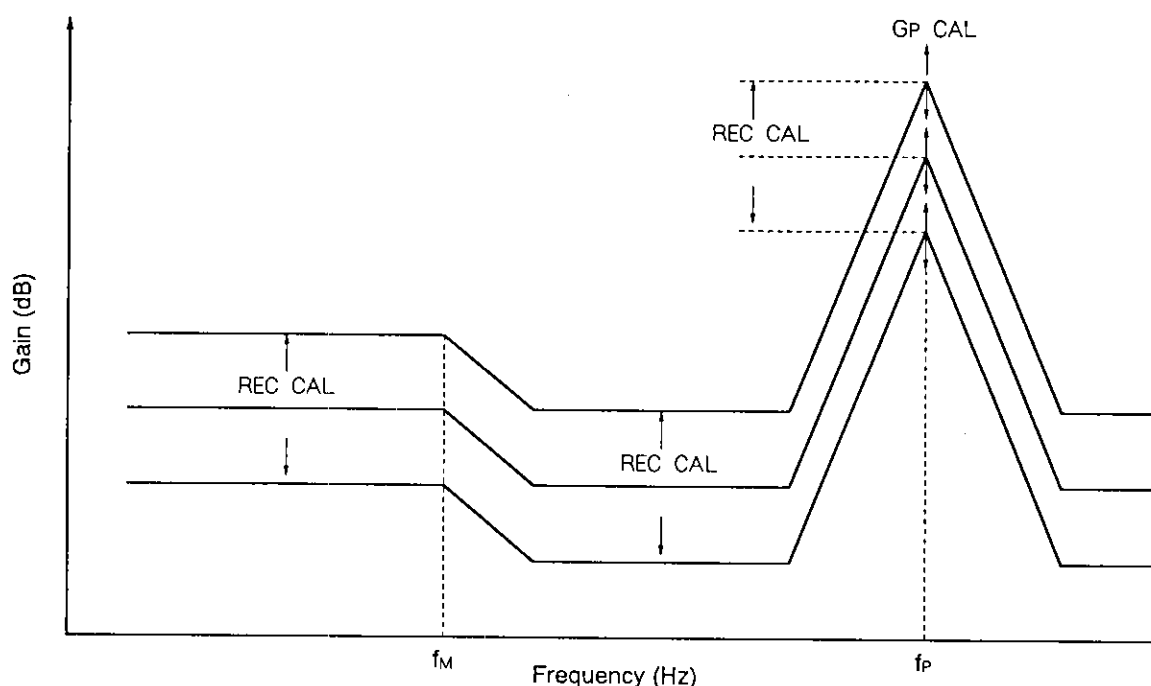


Fig. 5. Outline diagram for Recording level/High frequency equalizer calibration

Also, by varying CXA1398P/M recording level/high frequency equalizer calibration, the noise level of the recording equalizer also varies relatively.

6. Temperature characteristics and precision of the recording equalizer amplifier

The temperature characteristics of the monolithic filter built in CXA1398P/M and the filter cut off frequency are dependent on the $27\text{k}\Omega$ external resistor connected to I REF pin (Pin 12). However as the time constant is formed by the product of the external capacitor and the diffused resistor inside the IC, the low frequency boost cut off frequency becomes uneven due to the temperature characteristics and unevenness of diffused resistor inside the IC.

On the other hand, the recording equalizer frequency characteristics depend on the unevenness of both the absolute value of the capacitance inside the IC and that of the relative value. Moreover, as the band pass filter Q is high, the high frequency characteristics indicate a high element sensitivity at the filter. A comparison with low frequency shows likely effects from the IC characteristics unevenness. However channels 1 and 2 are not uneven individually, but rather, relatively.

Notes on Operation

1. Power supply

CXA1398P/M is an IC designed for a standard Pos/Neg dual power supply usage. However, single power supply usage is also possible. Supply connections for respective cases are indicated in the table below.

	V _{CC} (Pin 10)	V _{EE} (Pin 7)	GND (Pin 5)
Pos/Neg dual power supply	Pos. power supply	Neg. power supply	GND
Single power supply	Power supply	GND	— *1

* 1) For single power supply usage connect a decoupling capacitor (over 10 μ F) to GND (VG) pin (Pin 5). Ripple rejection ratio and crosstalk between channels, in connection to the power supply, depend on the size of this capacitor.

Moreover in relation to the usage of respective supplies, the capacitor connection for low frequency boost, and regulations for the control voltage of respective control pins are given in the respective items paragraphs. Please refer to the given explanations.

2. Operation mode control (6 modes; NORM/CrO₂/METAL Tape, NORM/HIGH Speed)

CXA1398P/M features a built-in electronic switch circuit. The operation is controlled through the DC voltage applied to the 3 mode control pins, Tape EQ pin (Pin 3), METAL pin (Pin 2) and Speed pin (Pin 1).

The threshold value regulation for the respective mode controls (V_{CH}, V_{CL}) is as follows.

- a) For Pos/Neg dual power supply operation
 - $3.0V \leq V_{CH} \leq V_{CC}$
 - $GND \leq V_{CL} \leq 1.0V$
- b) For single power supply operation *2
 - $V_{CC}/2 + 3.0V \leq V_{CH} \leq V_{CC}$
 - $GND \leq V_{CL} \leq V_{CC}/2 + 1.0V$

*2) Threshold level of mode control is based on GND pin (Pin 5).

Operation mode condition during respective mode controls is indicated in the table below.

TAPE EQ \ METAL	(METAL) L	(METAL) H
(TAPE EQ) L	NORMAL (Type- I)	METAL (Type- IV)
(TAPE EQ) H	CrO ₂ (Type- II)	METAL (Type- IV)

SPEED	L	H
Recording speed	NORMAL Speed	HIGH Speed

Should the clicking noise during switching be disturbing add a circuit with a time constant of 100m second to 1 second to the mode control pin. As there is an approx. $\pm 300mV$ linear region in the mode control circuit, this will reduce the clicking noise during switching.

3. Recording mute function (soft mute, fade IN/OUT)

CXA1398P/M recording mute function, as mentioned in the paragraph on Description of Operation, is a recording mute circuit that varies the recording equalizer gain in electronic volume fashion through the magnitude of DC voltage applied to REC MUTE pin (Pin 15). Therefore, mute time also varies according to the variation in the time during which DC voltage is applied to REC MUTE pin (Pin 15). Furthermore the signal is not distorted and is gradually attenuated. The table below shows the relation between the DC voltage applied to REC MUTE pin (Pin 15) and the attenuation ratio. (Please note that the regulation range varies according to the power supply employed.) *3

Control voltage	Recording mute ON	Attenuation ratio -6dB	Recording mute OFF
Pos/Neg dual power supply	$V_{EE}+2.0V$ to $0.35V$	$2.5V$	$4.5V$ to V_{CC}
Single power supply	$2.0V$ to $V_{CC}/2+0.35V$	$V_{CC}/2+2.5V$	$V_{CC}/2+4.5V$ to V_{CC}

*3) Design based on GND pin (Pin 5).

4. Low frequency boost (Low frequency equalization)

As mentioned in the paragraph on Description of Operation CXA1398P/M low frequency boost function is activated only by fixing a capacitor to BOOST pins (Pins 6 and 11). The boost ratio is fixed at 6dB, but the time constant that determines the cut-off frequency can be set at will by means of the value of capacitor. Fig. 3 Pole (f_1) indicated in the low frequency boost frequency characteristics (paragraph on Description of Operation) and Zero (f_2) turn to the following formula when the external capacitor is taken as C_B .

$$f_1 = \frac{1}{2\pi \cdot C_B \cdot (9.53k\Omega)} \text{ (Hz)}, \quad f_2 = \frac{1}{2\pi \cdot C_B \cdot (4.8k\Omega)} \text{ (Hz)}$$

Accordingly, determine the most suitable low frequency boost characteristics for each particular set using the above formula as base.

However, as resistors with a determined time constant are diffused resistors inside the IC, they fluctuate according to the unevenness and the temperature characteristics particular to the IC. Note that the unevenness and temperature characteristics of diffused resistors that have determined low frequency boost frequency characteristics are approx. $\pm 20\%$ for the unevenness and approx. $+2500 \text{ ppm/}^\circ\text{C}$ for the temperature characteristics.

On the other hand, when low frequency boost is not performed, proceed as follows.

a) When Pos/Neg dual power supply used

Connect BOOST pins (Pins 6 and 11) to GND.

b) When single power supply used

Either connect a rather large capacitor (over $3.3 \mu\text{F}$) to BOOST pins (Pins 6 and 11) or keep BOOST pins open. However, when BOOST pins are kept open, as the output level rises by 6dB, design the input at 6dB below standard. Note that this IC is designed for standard Pos/Neg dual power supply usage and that during single power supply usage, it can not merely be connected to GND.

5. Recording calibration (Calibration of recording level)

As was mentioned in the paragraph on Description of Operation, with this IC recording level calibration can be controlled by means of DC voltage. Only by applying 0 to 5V (during Pos/Neg dual power supply usage) DC voltage to REC CAL pin (Pin 14), recording level can be varied by approx. ± 5 dB. Note, however, that the range of the DC voltage that controls varies according to the power supply in usage.

The table below indicates the input range specification of the control voltage according to the power supply in usage.

Power supply in usage \ Recording level	Up	Standard	Down
Pos/Neg dual power supply	V_{EE} to 2.5V	2.5V	2.5V to V_{CC}
Single power supply	GND to $V_{CC}/2+2.5V$	$V_{CC}/2+2.5V$	$V_{CC}/2+2.5V$ to V_{CC}

* 4) Input to the control pins is possible within the range indicated in the above table.
Controllable input voltage range is as follows.

a) During Pos/Neg dual power supply usage

$$2.5V < V_{DOWN} \leq 5.0V$$

$$GND \leq V_{UP} < 2.5V$$

b) During single power supply usage * 5

$$V_{CC}/2+2.5V < V_{DOWN} \leq V_{CC}/2+5.0V$$

$$V_{CC}/2 \leq V_{UP} < V_{CC}/2+2.5V$$

* 5) This IC is designed for standard Pos/Neg dual power supply usage GND pin (Pin 5) is the standard for control voltage. When the recording calibration function is not used, only by keeping REC CAL pin (Pin 14) open, REC CAL pin turns to the value of the reference voltage (2.5V) inside the IC and the gain is set to the typical value.

6. High frequency calibration (Calibration of high frequency equalizer characteristics)

As mentioned in the paragraph for Description of Operation, calibration of the high frequency characteristics in the recording equalizer can be controlled by the DC voltage. Only by applying a DC voltage of 0 to 5V (during Pos/Neg dual power supply usage) to G_P CAL pin (Pin 16), the high frequency peaking gain can be varied to approx. ± 4 dB. But note that the DC voltage range changes according to the power supply in usage.

The table below indicates the input range specification of the control voltage according to the power supply in usage. * 6

Power supply in usage \ High frequency level	Up	Standard	Down
Pos/Neg dual power supply	V_{EE} to 2.5V	2.5V	2.5V to V_{CC}
Single power supply	GND to $V_{CC}/2+2.5V$	$V_{CC}/2+2.5V$	$V_{CC}/2+2.5V$ to V_{CC}

* 6) Input to the control pins is possible within the range indicated in the above table. However, the controllable input voltage range is as follows.

a) During Pos/Neg dual power supply usage

$$2.5V < V_{DOWN} \leq 5.0V$$

$$GND \leq V_{UP} < 2.5V$$

b) During single power supply usage *7

$$V_{CC}/2 + 2.5V < V_{DOWN} \leq V_{CC}/2 + 5.0V$$

$$V_{CC}/2 \leq V_{UP} < V_{CC}/2 + 2.5V$$

* 7) This IC is designed for standard Pos/Neg dual power supply. GND pin (Pin 5) is the standard for control voltage.

When the high frequency calibration function is not in use, only by keeping Pin G_P CAL pin (Pin 16) open, G_P CAL pin turns to the value of the reference voltage (2.5V) inside the IC and the gain is set to the typical G_P value.

7. Reference resistor of the monolithic filter (Resistor connected to I REF pin)

To improve the frequency characteristics precision of the monolithic filter inside the IC, the control current that determines the time constant is controlled by means of an external resistor. This 27k Ω external resistor is connected to I REF pin (Pin 12). As the frequency characteristics precision of the recording equalizer amplifier is determined by the resistor connected to I REF pin, usage of a resistor superior in terms of unevenness and temperature characteristics is recommended. (i.e. metallic film resistor)

Also, by varying the value of the resistor connected to I REF pin the frequency characteristics of the recording equalizer can be shifted. That is, by reducing the resistor value a shift can be performed to the high frequency side and by increasing it, to the low frequency side.

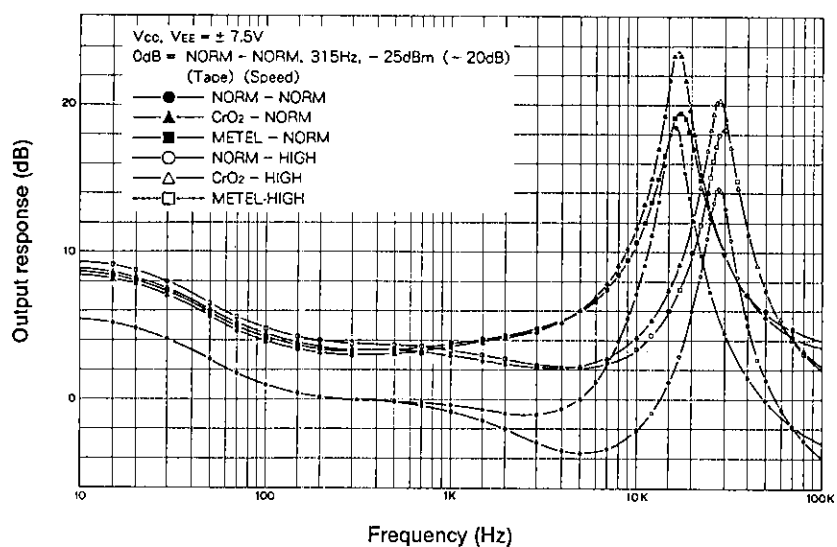
8. Recommended magnetic audio head

CXA1398P/M is developed for standard use with the HADKH55 series head for recording/playback auto reverse (revolving type) manufactured by ALPS Corporation.

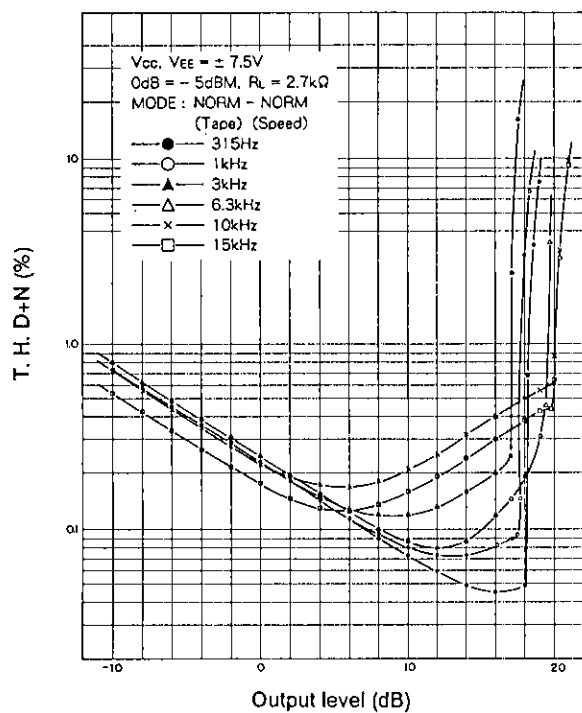
The main specifications of HADKH55 series manufactured by ALPS are

- Impedance (1kHz, Test current 100 μ A)
- Playback sensitivity
- Playback frequency characteristics
- Recording/playback sensitivity
- Recording/playback frequency characteristics
- Enter effective under 2.5dB (50Hz recording/playback peak to peak)
- External induction noise Under -75dBV

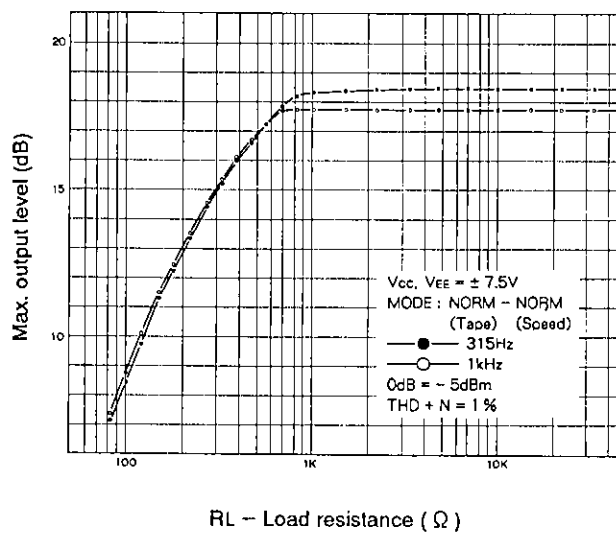
Frequency characteristics



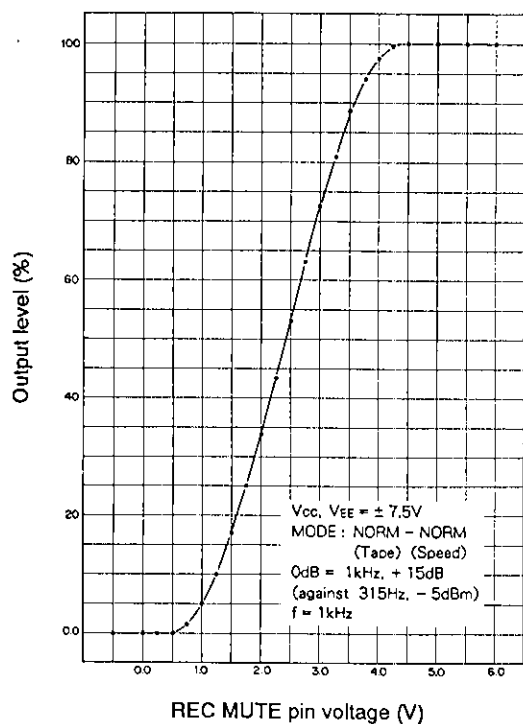
Total harmonic distortion



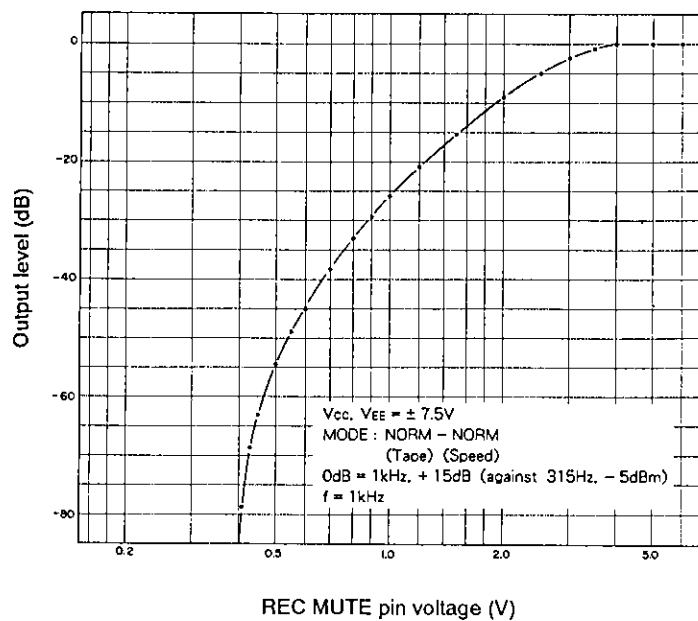
Load characteristics



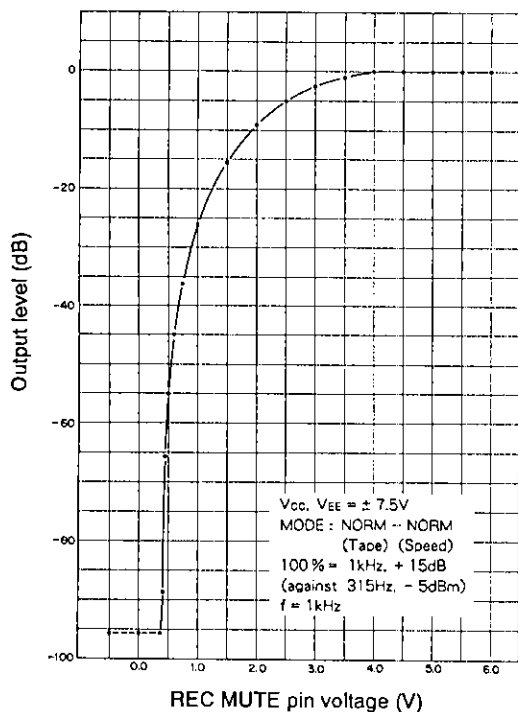
Output level vs. Mute voltage



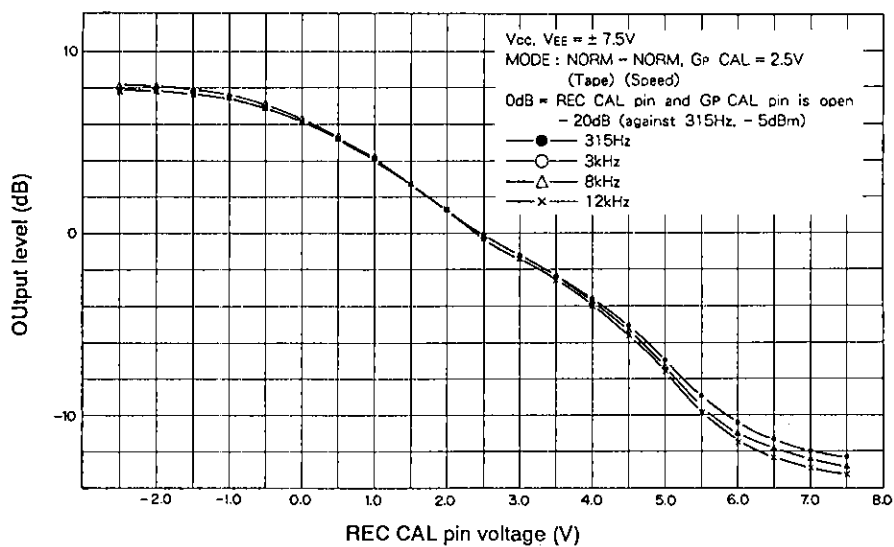
Output level vs. Mute voltage



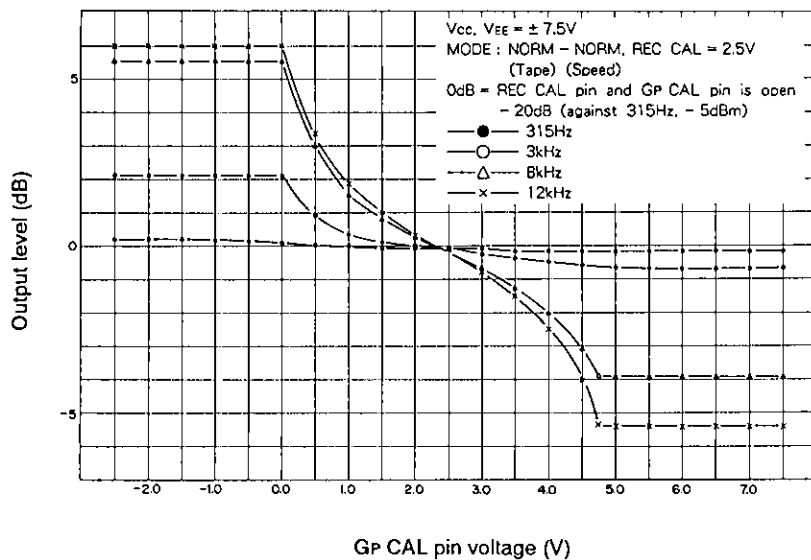
Output level vs. Mute voltage



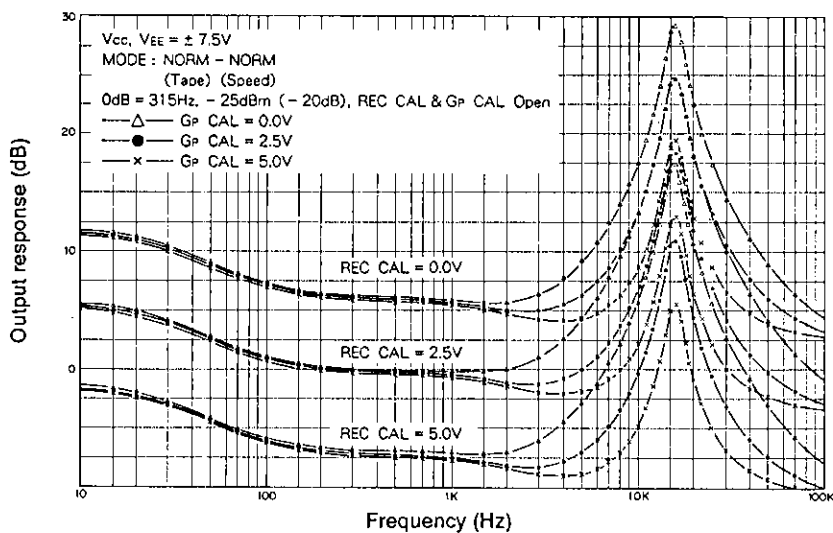
Output level vs. REC CAL voltage



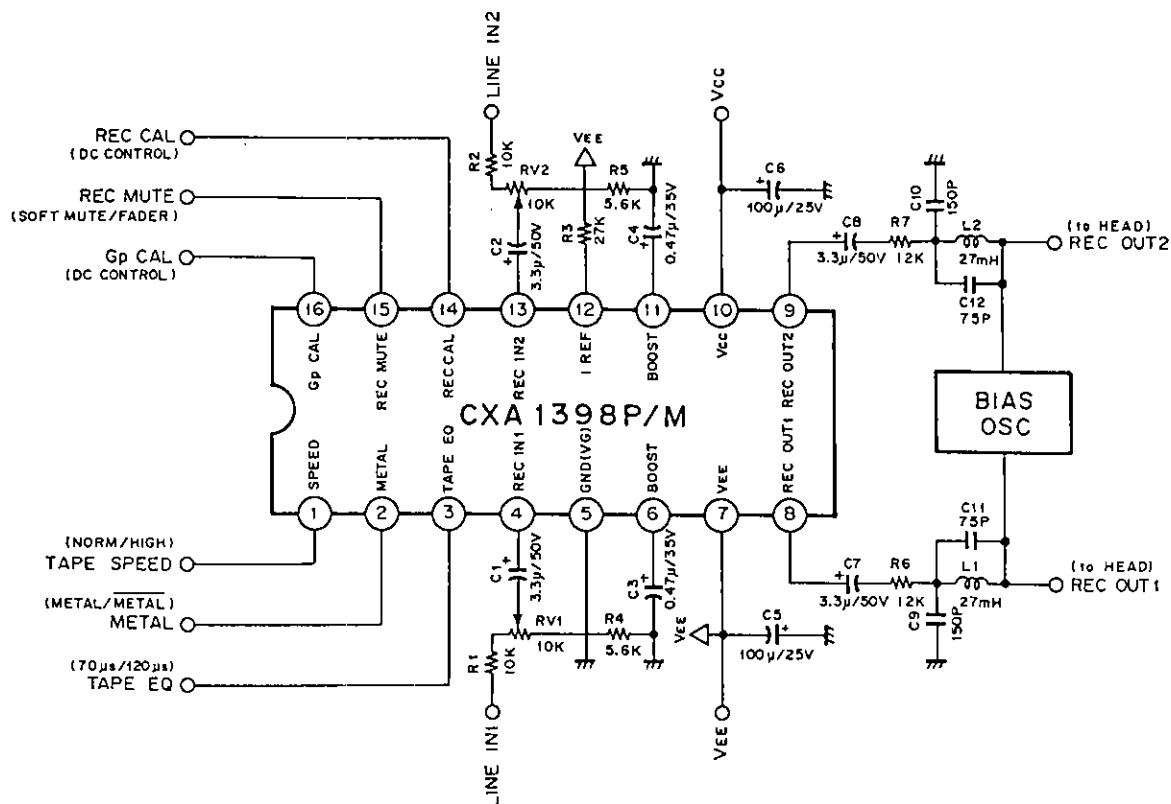
Output level vs. GP CAL voltage



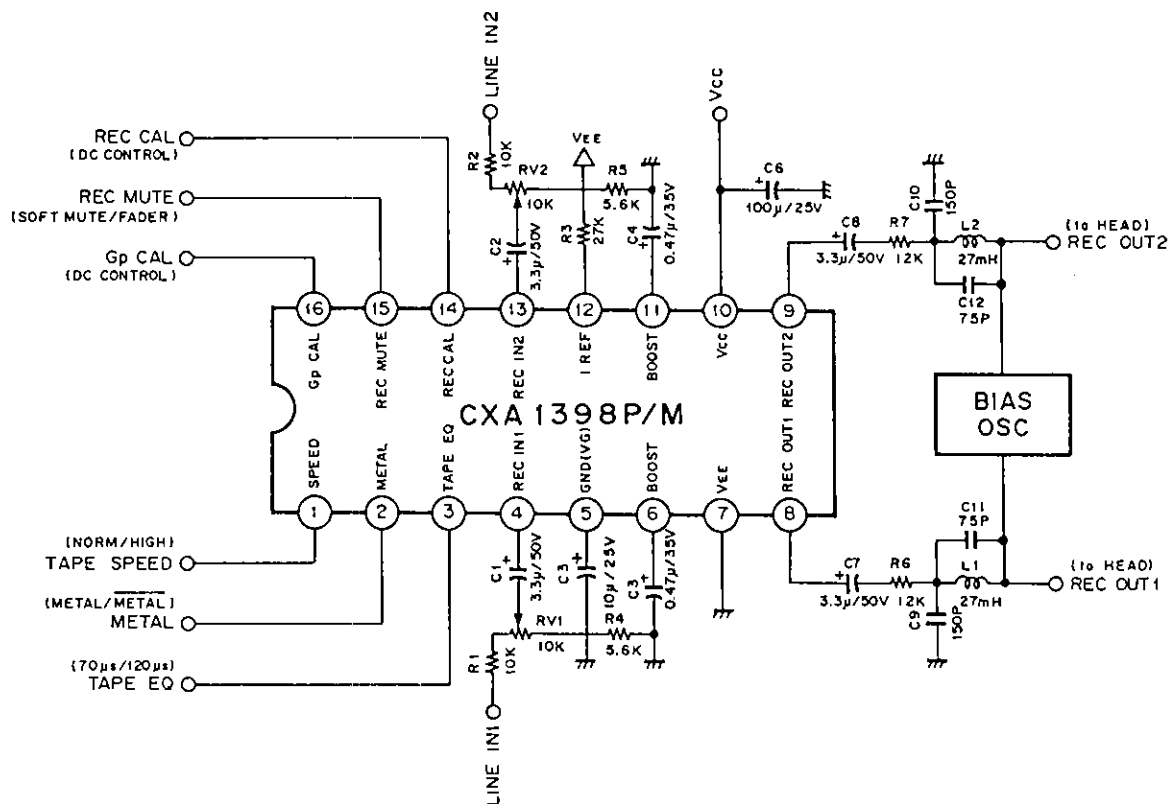
REC CAL and GP CAL frequency characteristics



Application Circuit (During Pos/Neg dual power supply)

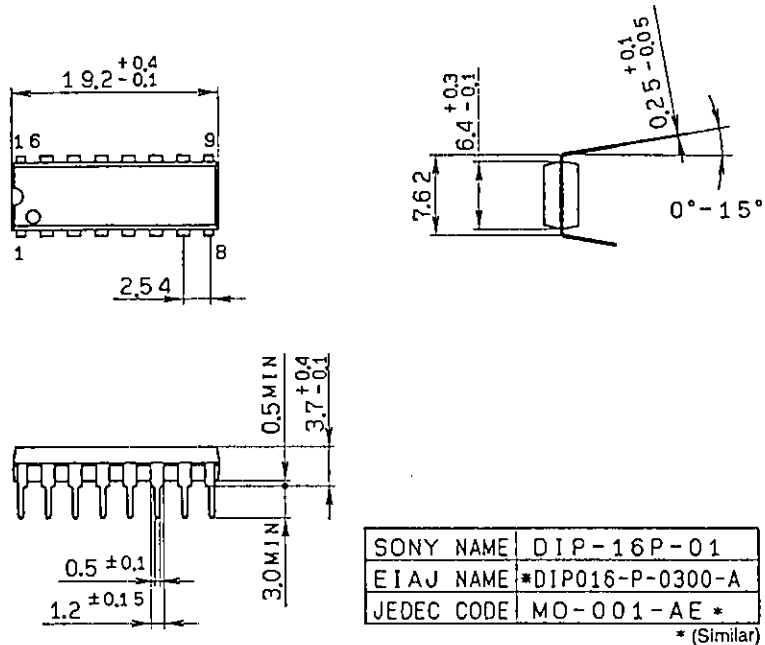


Application Circuit (During Single power supply)



Package Outline Unit : mm

CXA1398P 16pin DIP (Plastic) 300mil 1.0g



CXA1398M 16pin SOP (Plastic) 300mil 0.2g

