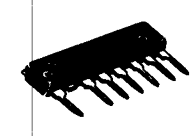
HA1457

HIGH VOLTAGE LOW NOISE PREAMPLIFIER

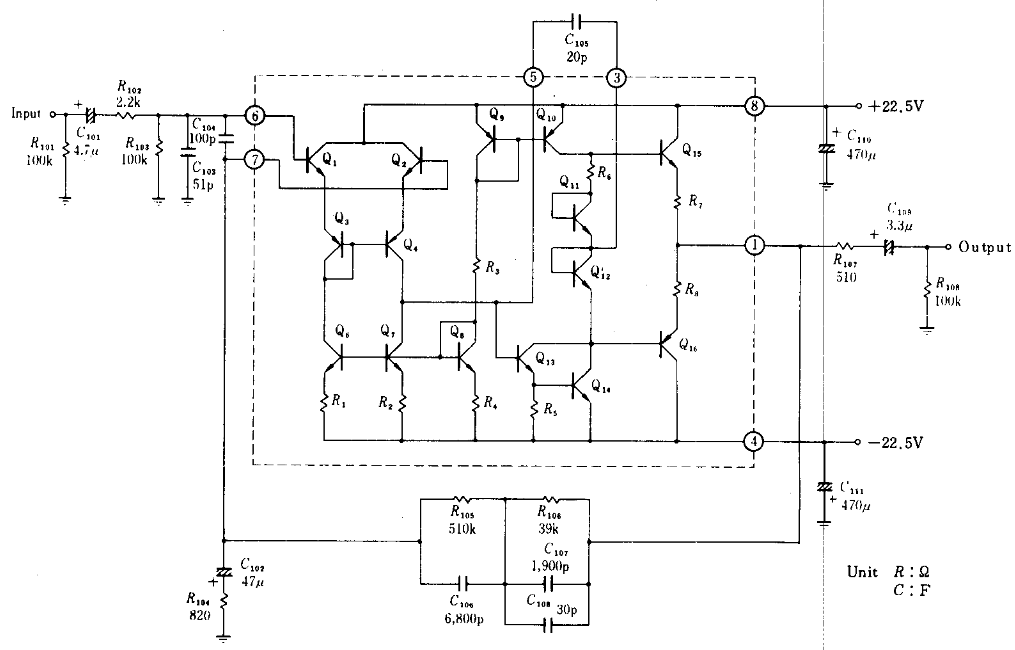
The HITACHI HA1457 is a monolithic integrated circuit mainly developed for the pre-amplifier for use in a Hi-Fi stereo tuner set and has the following features:

- Low Noise (RIAA Characteristic Rg = 3.3kΩ, Input Conversion Noise 0.88V typ, BW = 20Hz to 20kHz)
  Wide Dynamic Input Range of 245mVrms (f = 1kHz, T.H.D. = 0.1%, G_V = 35.6dB) due to its high voltage resistant capability. (±25Vmax. under double power supply, 50Vmax. under single power supply)
- High Stability against parasitic oscillations due to its new circuit system
- Operable as a high gain and low distortion amplifier due to its high open loop voltage gain ($G_{V(OL)}$ = 99dB typ at f = 60Hz)
- Drivable down to low load due to its push-pull circuit at output stage (with output voltages up to 15Vrms, operable in A class operation zone with in A class operation zone with load impedances down to 10kΩ and in B class operation zone with load impedances therebelow.)



(SP-8A)

■ CIRCUIT SCHEMATIC AND TYPICAL APPLICATION CIRCUIT



■ ABSOLUTE MAXIMUM RATINGS (Ta = 25°C)

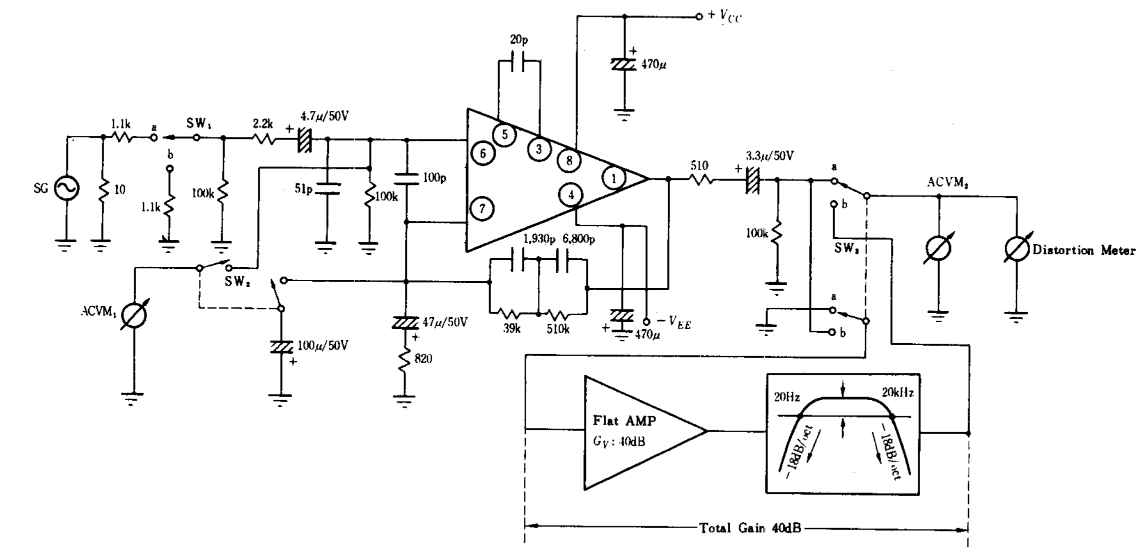
Item	Symbol	Ratings	Unit
Supply Voltage	V_{CC}	±25	V
Power Dissipation	P_T*	500	mW
Operation Temperature	T_{opr}	−30 to +75	°C
Storage Temperature	T_{stg}	−55 to +125	°C

* Value at Ta = 75°C

■ ELECTRICAL CHARACTERISTICS (V_{cc} = 22.5V, Ta = 25°C)

Item	Symbol	Test Condition	min	typ	max	Unit
Quiescent Current	I_Q	at Zero Signal	—	4.3	—	mA
Voltage Gain (Open loop)	$G_{V(OL)}$	f=1kHz	75	82	—	dB
Output Voltage	V_{out}	f=1kHz, H.H.D=0.1% T.	13.0	14.8	—	V
Total Harmonic Distortion	T.H.D	f=1kHz, V_{out}=5V	—	0.005	0.02	%
Output Noise Voltage	V_n	R_g=3.3kΩ, BW=20Hz to 20kHz	—	53	90	μV

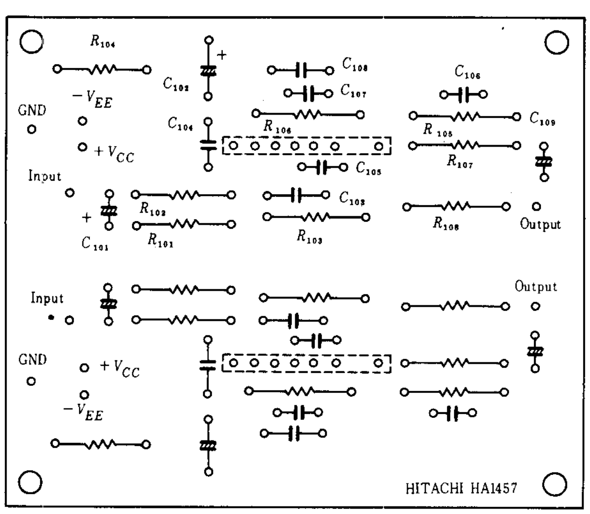
■ TEST CIRCUIT



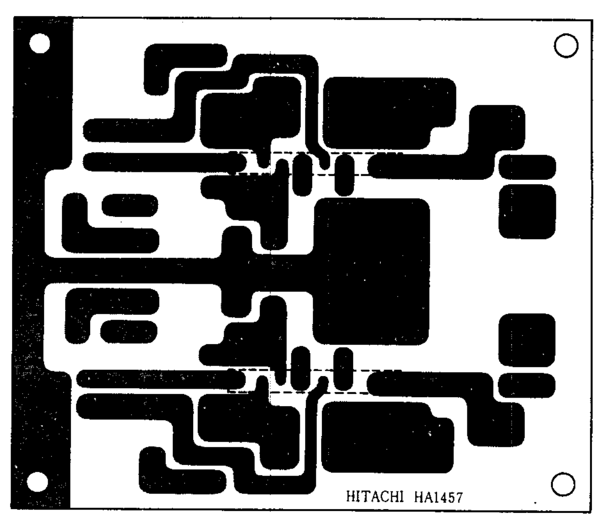
Meauuring Item	Switch Position		
	SW1	SW2	SW3
$G_{V(OL)}$	a	ON	a
V_{out}	a	OFF	a
T. H. D	a	OFF	a
V_n	b	OFF	b

Notes:
1. For AC Voltmeters (ACVM1 and ACVM2), Distortion Meter and SG, use HP400E, NF circuit Design Block DM-155 and Matsushita Tsushin's VP-721A or equivalent, respectively.
2. Accuracy of external constant is R ± 1%. For capacitors, Use Mylar Condenser of R less than ±5% and of Chemical Condenser less than ±10% after measurements.

■ PC-BOARD LAYOUT PATTERN



(Top View)



(Bottom View)

■ GUIDE FOR SELECTION OF EXTERNAL ELEMENT

● Condenser

C_{101}

This condenser is an input coupling type. As the gain is high at low frequencies in the RIAA equalizer amplifier, 1/f noise of transistor is emphasized within the IC as output noise. Therefore, when the reactance of the condenser increases at low frequencies, the output noise is worsened by the signal source resistance dependability of 1/f noise.For this reason, it is necessary to make the reactance sufficiently small as compared to the signal source resistance. About 4.7μF is proper for the condenser, and the withstand voltage needs be more than V_{CC} (V_{EE}). Also, leak current should be at a minimum. It is necessary to select a condenser in consideration of the foregoing.

C_{102}

Low cut-off frequency is determined by the capacitance of this condenser. The low boost is made by the RIAA equalizer, and the low voltage gain is dictated by $(R_{105} + R_{106})/R_{104}$ assuming that the frequency (low cut-off frequency) that makes the gain −3dB is now f_L, the condenser C_{102} is given by

$$C_{103} = \frac{1}{2\pi f_L \cdot R_{104}} \quad [F]$$

When C_{103} = 47μF and R_{104} = 820Ω, f_L becomes about 4Hz.

C_{103}

This condenser is used for broadening the oscillation margin such as in blocking oscillation at the time of large amplitude operation at high frequencies (above 20kHz).

(It has a multiplication effect with C_{104}.)

When the frequency is lowered to an extreme extent, parasitic oscillation may be caused. So a condenser of 51pF should be inserted in that case.

C_{104}

This is a condenser for the detection of frequencies in TV, FM, or AM broadcasting with high electric field.

A condenser with 100pF or so will be most proper as it may affect the margin for parasitic oscillation. (A combined use of R_{102} and C_{103} serves to make frequency detection based on the effect of low-pass filter up to the IC input pin.)

C_{105}

This condenser is a phase compensating type of main feedback loop design. About 20pF is most proper because it may more or less affect the distortion factor at the time of large amplitude operation at high frequencies (above 20kHz).

C_{106}, C_{107}, and C_{108}

The frequency characteristics of the equalizer amplifier is determined by this condenser and R_{105}, R_{106}. To obtain standard RIAA characteristics, for example, C_{106}, R_{105} = 3180μs and C_{106}, R_{106} = 318μs, and $(C_{107} + C_{108})$ = 75μs.

C_{110}, C_{111}

This is a by-pass condenser for power line. It is suggested to insert a condenser with good high frequency characteristics (above several μF) at a point as near to the power supply pin as possible.

● Resistor

R_{101}

This resistor is used for C_{101} leak current pass. Also, it serves to determine the input resistance R_{in}.

Thus

$$R_{in} = R_{101} \ // \ (R_{102} + R_{103})$$

R_{102}

This resistor is intended to protect IC from abnormal input, parasitic oscillation due to various signal source impedance characteristics, and to step down the voltage to prevent high frequency radio disturbance. When the voltage is dropped to an extreme extent, it is probable sometimes that the oscillation is caused at the time of power turn off.

R_{103}

This is a resistor for d-c bias of the input pin 6. It determines the input resistance, described in the section of R_{101}.

R_{104}

This is a feedback resistor which determines the voltage gain. Also, this resistor constitutes an important factor in determining the output noise voltage as it becomes the signal source resistance of the initial stage amplifier and consequently causes thermal noise. Increasing the resistance results in disadvantage for low noise realization.

R_{105}, R_{106}

This resistor is used in combination with the C_{106}, C_{107}, or C_{108} to determine RIAA characteristics.

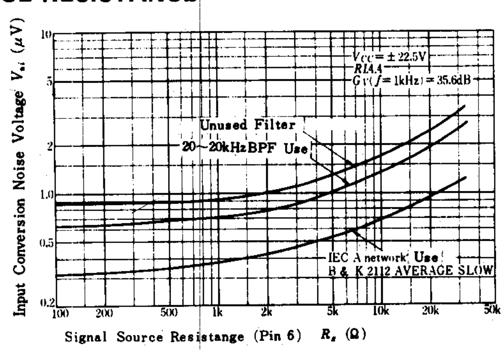
R_{107}

This resistor is used for prevention of parasitic oscillation under a capacitive load.

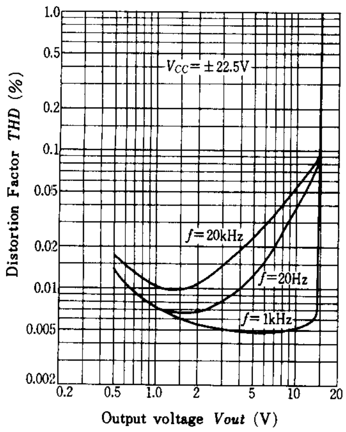
R_{108}

This resistor is intended to hold the output terminal to the d-c reference level. Without use of this resistor, a shock noise is bound to be generated at the time of set function switching.

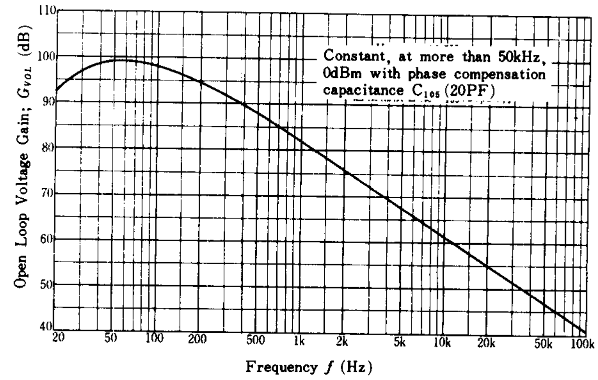
INPUT CONVERSION NOISE VOLTAGE VS. SIGNAL SOURCE RESISTANCE



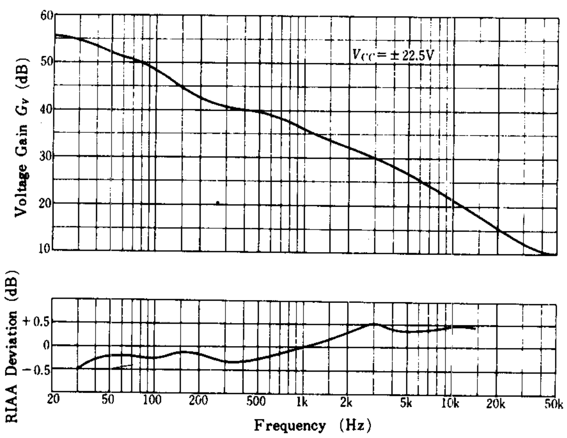
TOTAL HARMONIC DISTORTION VS. OUTPUT VOLTAGE



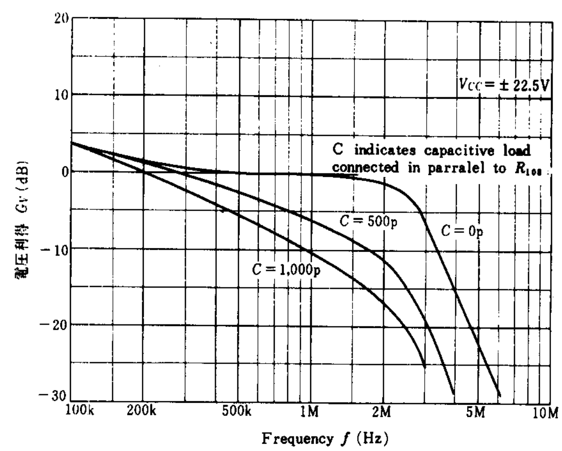
OPEN LOOP VOLTAGE GAIN VS. FREQUENCY



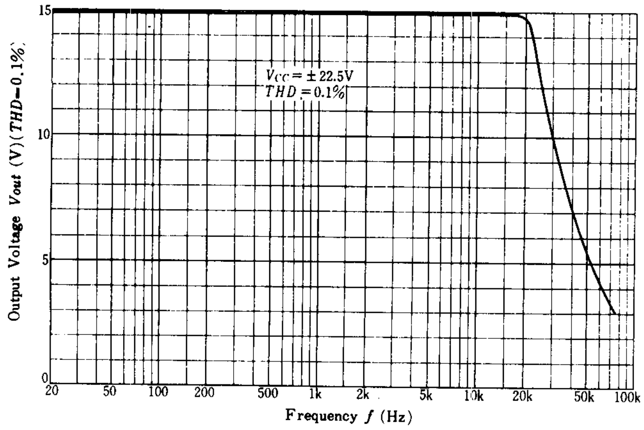
VOLTAGE GAIN VS. FREQUENCY



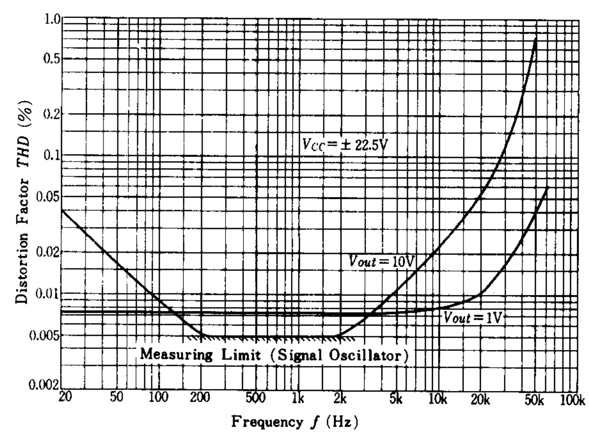
VOLTAGE GAIN VS. FREQUENCY



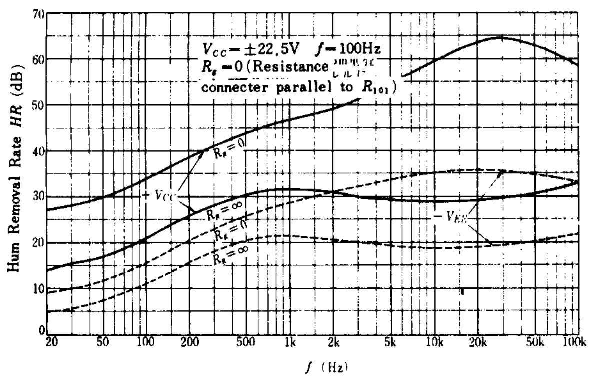
OUTPUT VOLTAGE VS. FREQUENCY



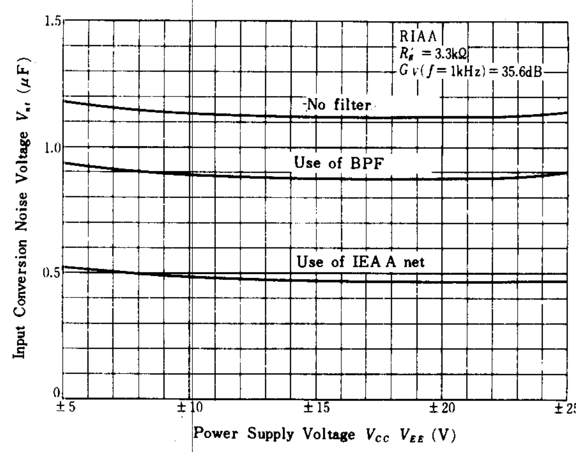
TOTAL HARMONIC DISTORTION VS. FREQUENCY



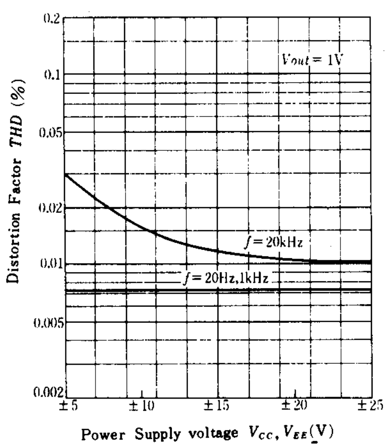
HUM REJECTION VS. FREQUENCY



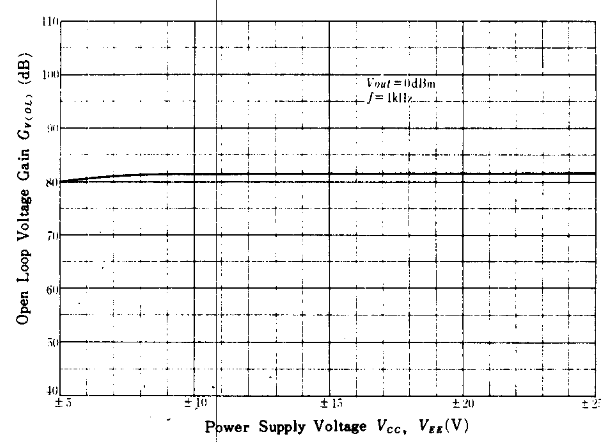
INPUT CONVERSION NOISE VOLTAGE VS. SUPPLY VOLTAGE



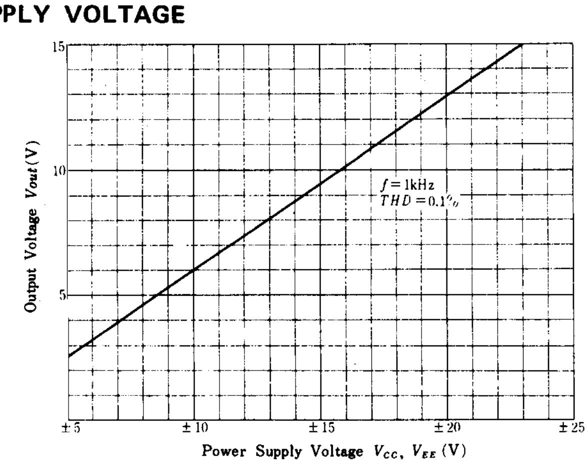
TOTAL HARMONIC DISTORTION VS. SUPPLY VOLTAGE



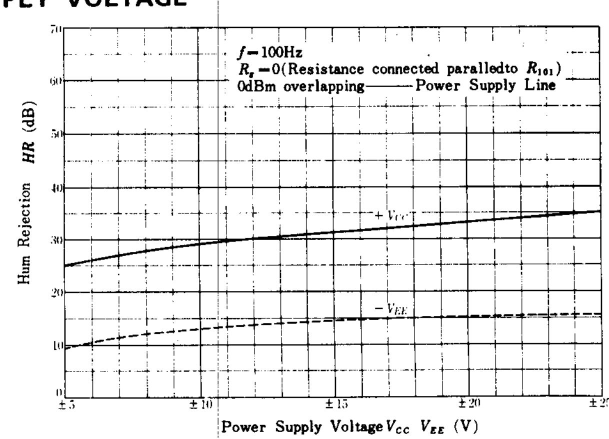
OPEN-LOOP VOLTAGE GAIN VS. POWER SUPPLY VOLTAGE



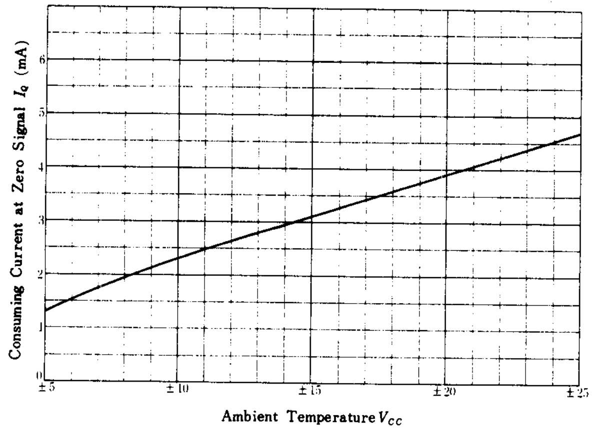
OUTPUT VOLTAGE VS. SUPPLY VOLTAGE



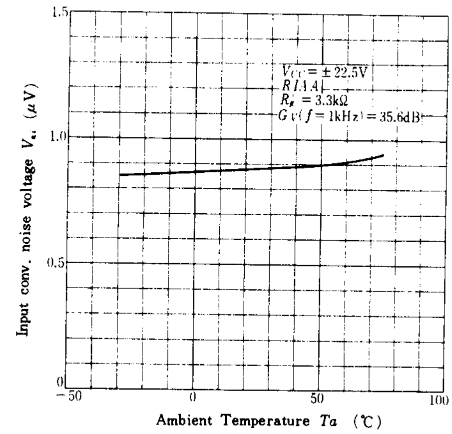
HUM REJECTION RATIO VS. SUPPLY VOLTAGE



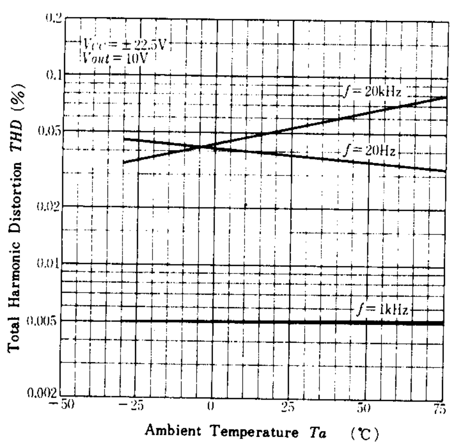
QUIESCENT CURRENT VS. SUPPLY VOLTAGE



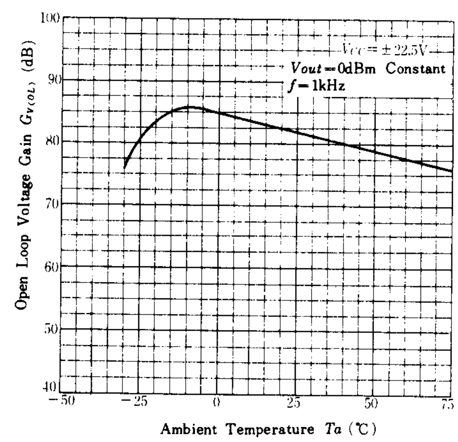
INPUT CONVERSION NOISE VOLTAGE VS. SUPPLY VOLTAGE



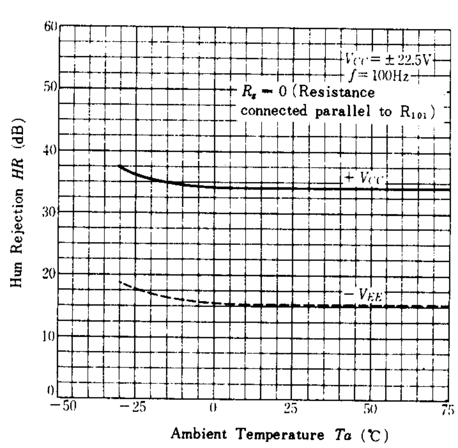
TOTAL HARMONIC DISTORTION VS. SUPPLY VOLTAGE



OPEN-LOOP VOLTAGE GAIN VS. AMBIENT TEMPERATURE



HUM REJECTION RATIO VS. AMBIENT TEMPERATURE



QUIESCENT CURRENT VS. AMBIENT TEMPERATURE