HA12017

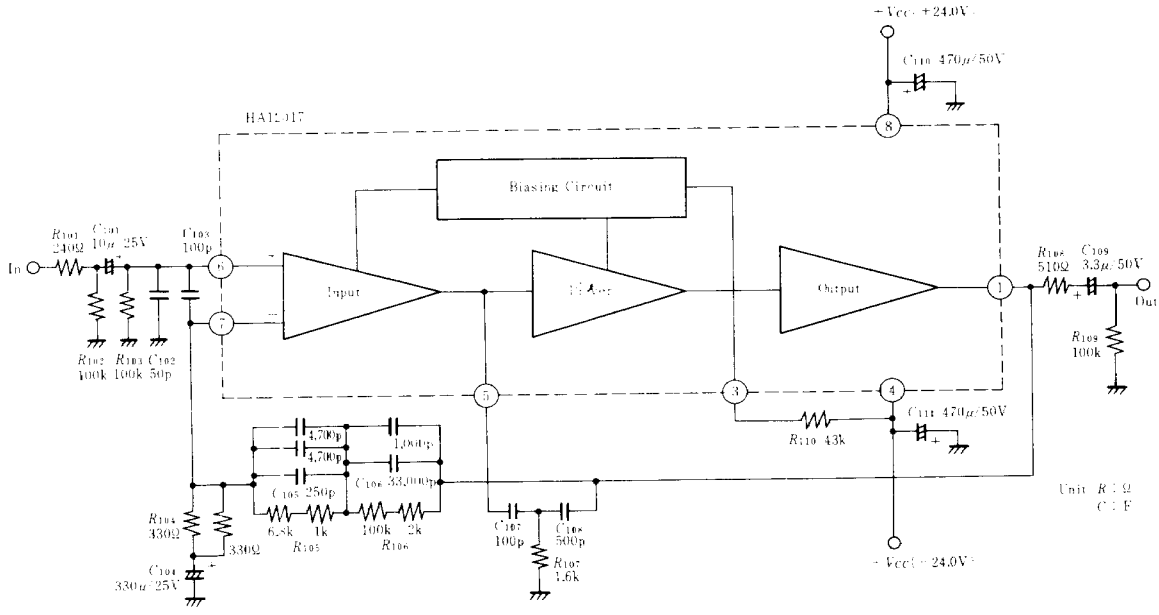
Low Noise Preamplifier

■ FEATURES

- Low Noise: Vn(in)=0.185μV typ. (IHF-A Network, Rg=43Ω, RIAA)
- Wide dynamic range: Vin=235mVrms typ. (Vcc=±24.0V, f=1kHz, THD=0.1%, Gv=35.9dB)
- Low distortion: THD=0.002% typ. (f=20Hz to 20kHz, Vout=10Vrms, RIAA)
- Excellent supply ripple rejection:
  SVR(+Vcc)=56dB typ. (f=100Hz, Rg=43Ω)
  SVR(-Vcc)=45dB typ. (f=100Hz, Rg=43Ω)

(SP-7)

■ BLOCK DIAGRAM & TYPICAL APPLICATION CIRCUIT



■ ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Rating	Unit
Supply Voltage	V_{CC}	±26.5	V
Power Dissipation	P_T*	500	mW
Operating Temperature Range	T_{opr}	−30 to +75	°C
Storage Temperature Range	T_{stg}	−55 to +125	°C

* Value at $Ta = 75°C$

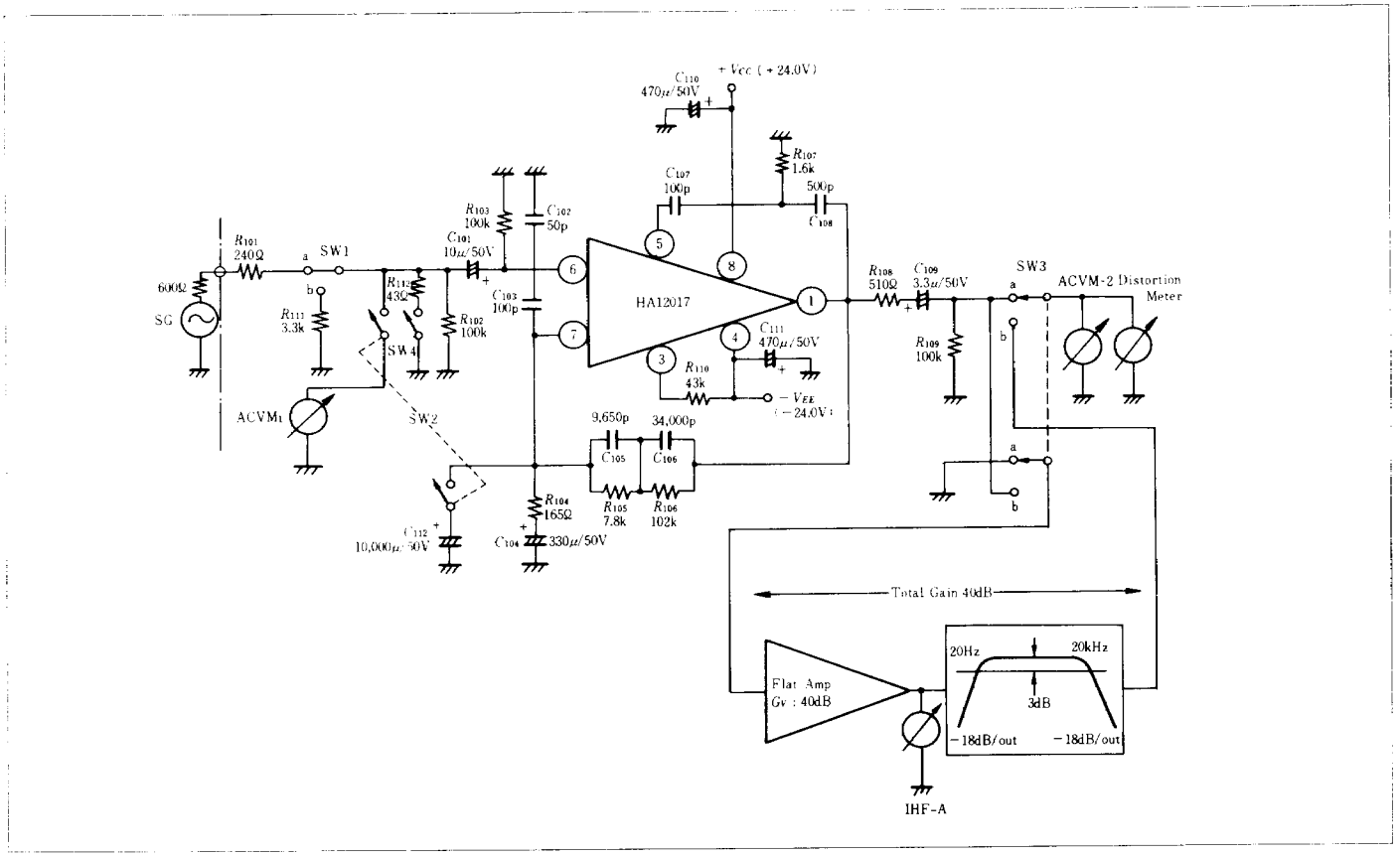
HITACHI

■ ELECTRICAL CHARACTERISTICS (V_{CC} = ±24V, Ta = 25°C)

Item*	Symbol	Test Conditions	min.	typ.	max.	Item
Quiescent Current	I_Q	no input signal	—	4.0	6.0	mA
Open Loop Voltage Gain	$G_{V(OL)}$	f = 1kHz	95	105	—	dB
Total Harmonic Distortion	THD	f = 1kHz, V_{out} = 10V	—	0.002	0.01	%
Output Voltage	V_{out}	f = 1kHz, THD = 0.1%	13.5	14.7	—	V
Output Noise Voltage 1**	V_{n1}	R_g = 43Ω, IHF-A Network	—	1.15	1.56	mV
Output Noise Voltage 2**	V_{n2}	R_g = 3.3kΩ, BW = 20Hz to 20kHz	—	5.3	9.0	mV

Notes : * All the items except $G_{V(OL)}$ is tested with RIAA curve and G_V = 35.9dB.
** These items are measured after the flat amplifier (G_V = 40dB).

■ TEST CIRCUIT

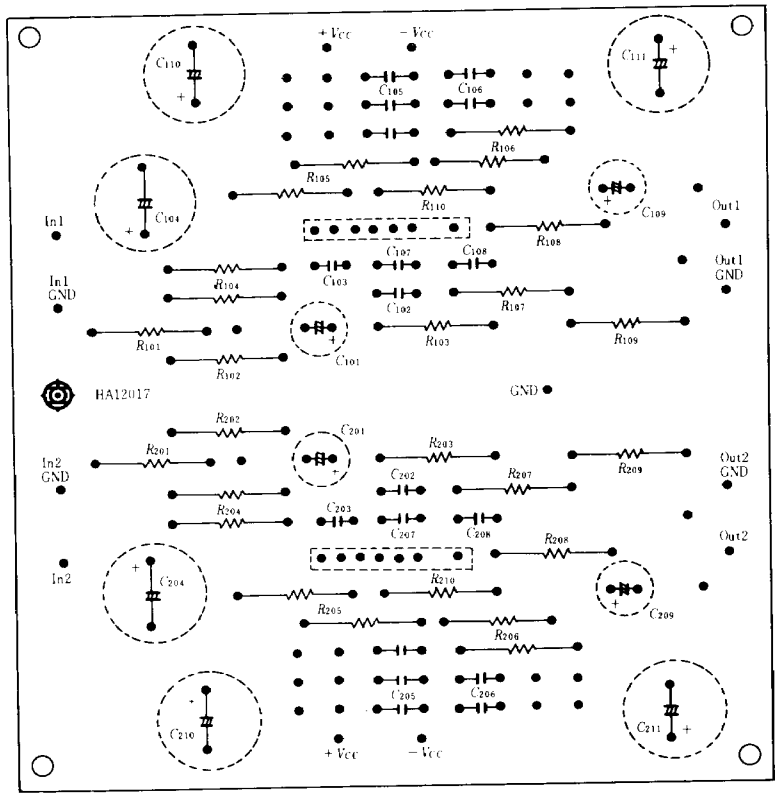


• NOTES "ON" TESTING

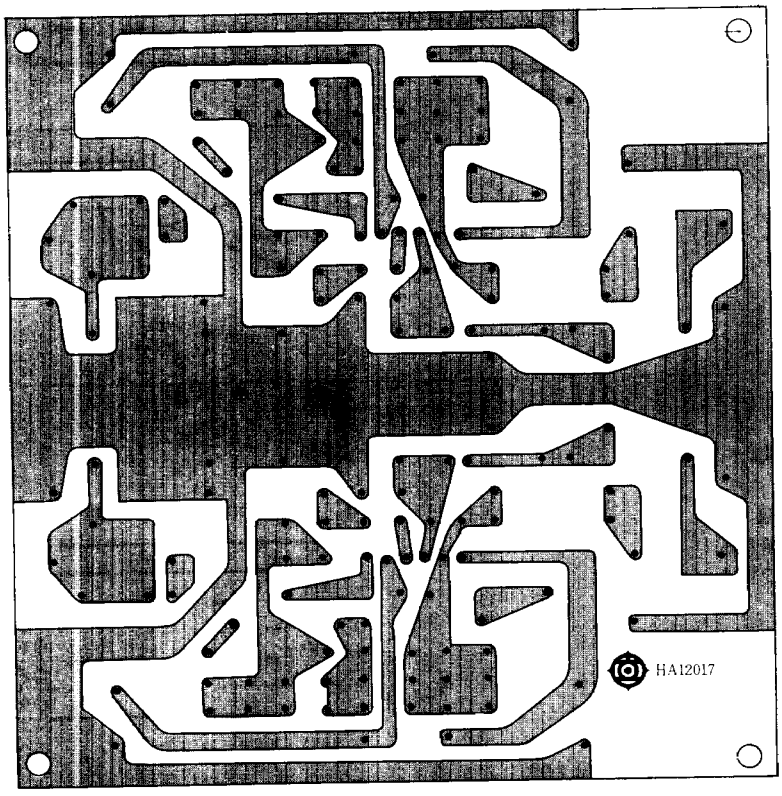
1. Measuring Apparatus
   SG: Matsushita VP7220B
   Distortion Meter: NF DM155
   IHF-A ACVM 3: B & K 2112
   ACVM 1 & 2: HP 400EL
2. Tolerance of External Parts
   Resistors: ±1%
   Mira Capacitor (C_{105}, C_{106}): ±2%
   Chemical Capacitor: ±10%
   Ceramic Capacitor (C_{102}, C_{105}, C_{107}, C_{108}): ±5%
   Temp. Coefficient −80ppm/°C
3. Positions of Switches

Item	SW1	SW2	SW3	SW4
$G_{V(OL)}$	a	ON	a	OFF
V_{out}	a	OFF	a	OFF
THD	a	OFF	a	OFF
V_{n1}	b	OFF	b	ON
V_{n2}	b	OFF	b	OFF

■ PC-BOARD LAYOUT PATTERN



(Top View)



(Bottom View)

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■ EXTERNAL COMPONENTS

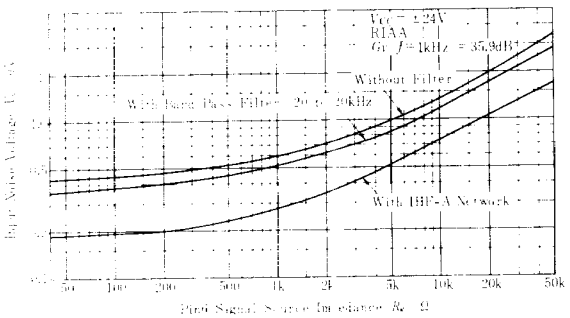
1. Resistor

Part No.	Recommended Value	Functions	Deteriorations by using a value less than recommended	Deteriorations by using a value more than recommended	Cautions
R_{101}	240Ω	• Protects the IC from abnormal input voltage. • Prevents parastic oscillation caused by signal-source impedance. • Decreases high-frequency disturbance.	• High-frequency often disturbed. • Using less than 43Ω deteriorates stability to a high degree.	• Thermal noise generates, resulting in signal-to-noise ratio deterioration.	
R_{102}	100kΩ	• Passes the electric charge of C_{101}. • Decides Rin (input resistance) $Rin = R_{101} + (R_{102}/R_{103})$	• Input resistance decreases.	• Electric-charge passing lowered.	
R_{103}	100kΩ	• Supplies DC bias to pin-6 (input pin) • Decides input resistance.	• Input resistance decreases.	• Output offset voltage increases.	• $R_{103} \fallingdotseq R_{105} + R_{106}$
R_{104}	165Ω	• Decides voltage gain as feedback resistance.	• Load of pin-1 (output pin) increases in high-frequency range, reducing output voltage.	• Thermal noise generates, resulting in signal-to-noise ratio deterioration.	
R_{105} R_{106}	7.8kΩ 102kΩ	• Decides RIAA characteristics, in pairs with C_{105} and C_{106}.	• Unbalance with R_{103} increases output offset voltage.	• Unbalance with C_{103} increases output offset voltage.	• The errors of R_{105} and R_{106} must be small enough.
R_{107}	1.6kΩ	• In a pair with C_{108}, decides the frequency at which $G_{V(OL)}$ chracteristic changes from −12dB/oct to −6dB/oct.	• Incomplete phase-compensation deteriorates stability.	• Total harmonic distortion increases.	
R_{108}	510Ω	• Prevents parastic oscillation caused by capacitive load.	• Prevention of parastic oscillation lowered.		
R_{109}	100kΩ	• Keeps the voltage of output terminals at DC standard level. • Prevents shock noise caused by function-switching.	• Load increasing, max. output voltage decreases.	• Prevention of shock noise lowered.	
R_{110}	43kΩ	• Decides basic bias current $R_{110} = \{+V_{CC} - (-V_{CC}) - 5\}$ kΩ	• Excessive P_T causes breakdown • $G_{V(OL)}$ increasing, stability deteriorates. • Noise caused by current increases.	• $G_{V(OL)}$ decreasing, total harmonic distortion increases. • Noise increases.	• Capacitance must not connected between R_{110} and pin-4/GND.

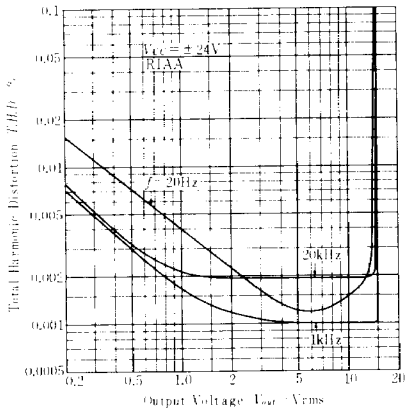
2. Capacitor

Part No.	Recommended Value	Functions	Deteriorations by using a value less than recommended	Deteriorations by using a value more than recommended	Cautions
C_{101}	10μF	• Makes input-coupling.	• Impedance of signal source increasing, 1/f noise increases.		• The leakage-current of C_{101} must be small enough.
C_{102}	50pF	• In combination with C_{103}, increases stability of large-amplitude operation in high frequency range.	• Prevention of parastic oscillation lowered.	• Input impedance decreases at high frequency range. • Prevention of parastic oscillation lowered.	• High-frequency characteristic of C_{102} must be sufficient.
C_{103}	100pF	• In strong field, prevents detection of TV, FM and AM signals.	• High-frequency often disturbed in a strong field. • Prevention of parastic oscillation lowered.	• Prevention of parastic oscillation lowered.	• High-frequency characteristic of C_{103} must be sufficient.
C_{104}	330μF	• Supplies full DC-feedback. • Decides roll-off frequency (f_L) in low frequency range. $f_L = 3$Hz (Typical application) $f_L = \frac{1}{2\pi C_{104} \cdot R_{104}}$	• Roll-off frequency in low-frequency range goes higher.	• More time is required to stabilize the potential of pin-1.	
C_{105} C_{106}	9650pF 34000pF	• Decides RIAA characteristics in pairs with R_{105} and R_{106}.	• RIAA characteristics deteriorates.	• RIAA characteristics deteriorates.	• The errors of C_{105} and C_{106} must be small enough.
C_{107}	100pF	• Supplies phase-compensation.	• Incomplete phase-compensation deteriorates stability.	• Total harmonic distortion increases.	• For C_{107}, temperature and high-frequency characteristics must be sufficient, and the error must be small enough.
C_{108}	500pF	• In a pair with R_{107}, decides the frequency at which $G_{V(OL)}$ characteristic changes from −12dB/oct to −6dB/oct.	• Incomplete phase-compensation deteriorates stability.	• Total harmonic distortion increases.	• For C_{108}, temperature and high-frequency characteristics must be sufficient, and the error must be small enough.
C_{109}	3.3μF	• Makes output-coupling.	• Too low capacitance increases output-impedance and reduces output voltage in low frequency range.		
C_{110} C_{111}	470μF 470μF	• Removes ripple on V_{CC} line.	• Increases cross-talk between left and right channels.		

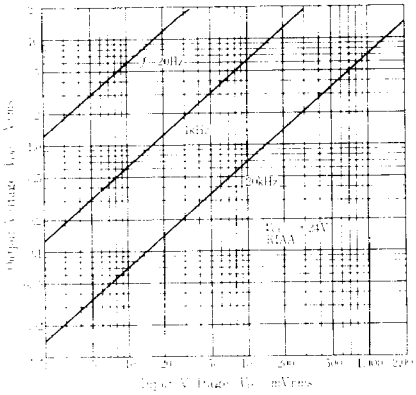
INPUT NOISE VOLTAGE
vs. SOURCE IMPEDANCE



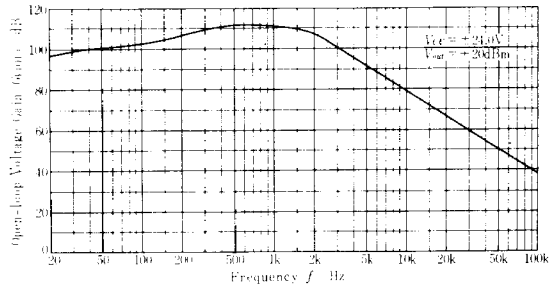
TOTAL HARMONIC DISTORTION
vs. OUTPUT VOLTAGE



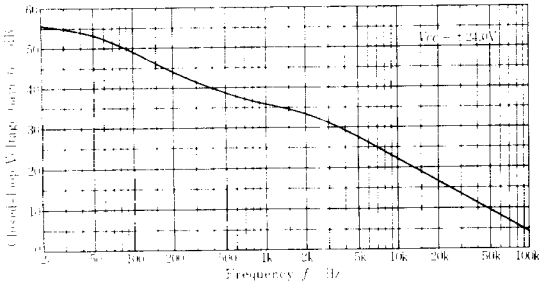
OUTPUT VOLTAGE
vs. INPUT VOLTAGE



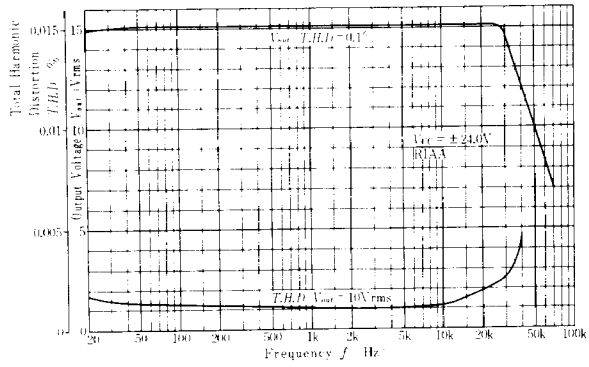
OPEN-LOOP VOLTAGE GAIN
vs. FREQUENCY



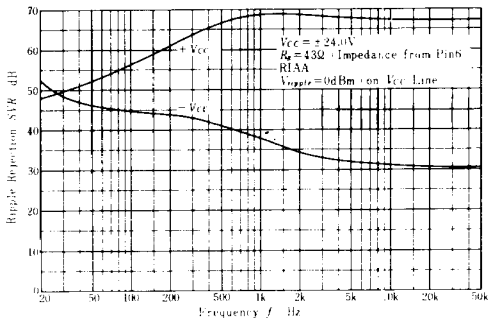
CLOSED-LOOP VOLTAGE GAIN
vs. FREQUENCY



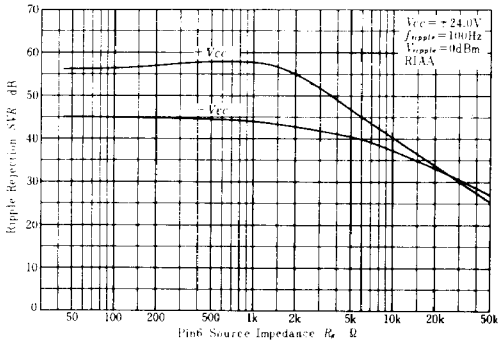
OUTPUT VOLTAGE AND TOTAL HARMONIC
DISTORTION vs. FREQUENCY



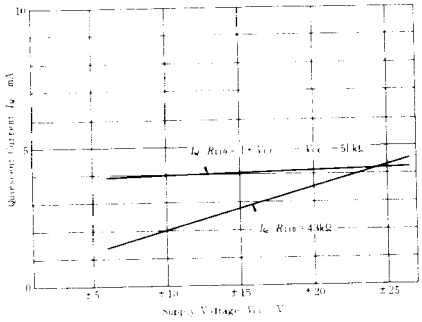
RIPPLE REJECTION VS. FREQUENCY



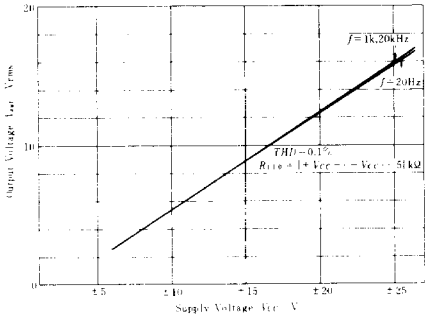
RIPPLE REJECTION VS. SOURCE IMPEDANCE



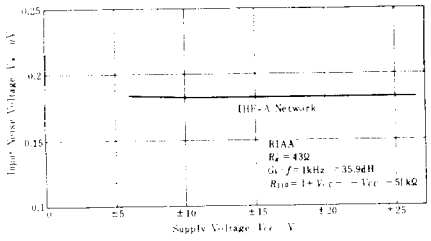
QUIESCENT CURRENT VS. SUPPLY VOLTAGE



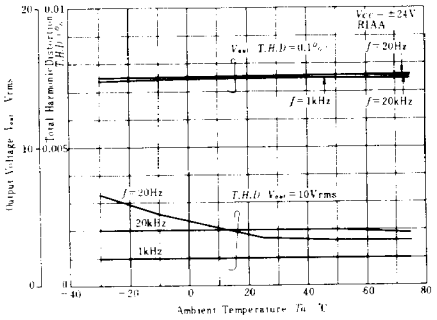
OUTPUT VOLTAGE VS. SUPPLY VOLTAGE



INPUT NOISE VOLTAGE VS. SUPPLY VOLTAGE



OUTPUT VOLTAGE AND TOTAL HARMONIC DISTORTION VS. AMBIENT TEMPERATURE



QUIESCENT CURRENT VS. AMBIENT TEMPERATURE