T-77-21

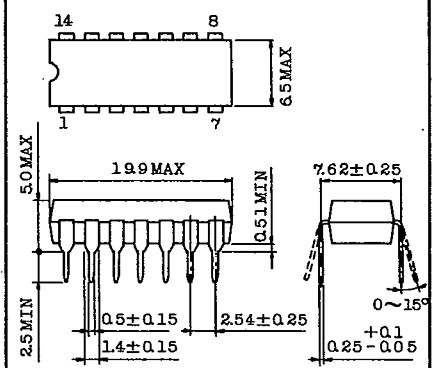
TA7658P

DUAL PREAMPLIFIER FOR TAPE RECORDER

The TA7658P is a dual preamplifier with ALC (Automatic Level Control) designed for use in a record/playback amplifier of tape recorder. It is suitable for a stereo set and a radio-cassette recorder.

- DIP 14 PIN (Dual In-Line Package)
- Built-in Buffer Amplifier (It permits meter drive and ALC to be easily performed)
- No Input Coupling Capacitor
- Quick Stabilization at Power ON.
- Wide Supply Voltage Range: V_{CC}=3~16V

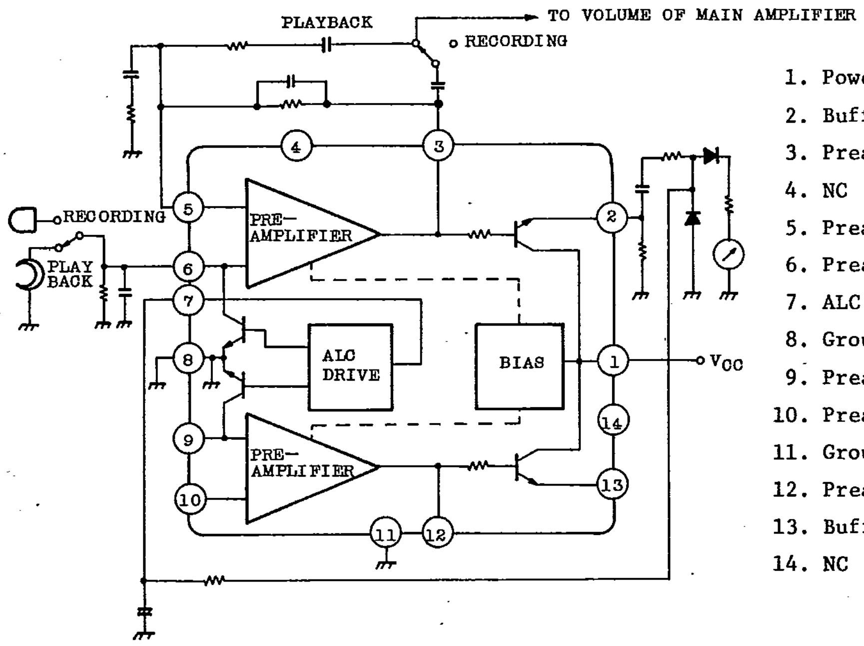
Unit in mm



.Lead pitch is 2.54 and tolerance is ±0.25 against theoretical center of each lead that is obtained on the basis of No.1 and No.14 leads.

JEDEC	—
TOSHIBA	3D14A-P

BLOCK DIAGRAM



1. Power supply
2. Buffer amplifier output (L)
3. Preamplifier output (L)
4. NC
5. Preamplifier feedback (L)
6. Preamplifier input (L)
7. ALC control input
8. Ground (ALC side)
9. Preamplifier input (R)
10. Preamplifier feedback (R)
11. Ground
12. Preamplifier output (R)
13. Buffer amplifier output (R)
14. NC

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MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Supply Voltage	V_{CC}	16	V
Output Current (Buffer amplifier Pin 2, Pin 13)	I_2, I_{13}	3	mA
Output Current (Preamplifier Pin 6, Pin 9)	I_6, I_9	2	mA
Power Dissipation (Note)	P_D	625	mW
Operating Temperature	Topr	-25～75	°C
Storage Temperature	Tstg	-55～150	°C

Note: Derated above Ta=25°C in the proportion of 5mW/°C.

ELECTRICAL CHARACTERISTICS

(Unless otherwise specified Ta=25°C, V_{CC}=5V, f=1kHz)

CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Quiescent Current	I_{CCQ}	1	-	6	10	15	mA
Input Terminal DC Voltage	V_6, V_9	1	-	-	15	50	mV
Output Terminal DC Voltage	V_3, V_{12}	1	-	2.2	2.5	2.8	V
Buffer Output DC Voltage	V_2, V_{13}	1	-	1.4	1.6	2	V
ALC Bias Voltage	V_7	1	-	0.4	0.55	0.7	V
ALC ON Voltage	$V_{IN(ALC)}$	1	V_7=1.4V	-	5	30	mV
ALC Range	R_{ALC}	2	V_{IN}=-60dBm	35	40	-	dB
ALC Level	$V_{OUT(ALC)}$	2	V_{IN}=-20dBm	-3	-1	1	dBm
Total Harmonic Distortion (ALC)	THD(ALC)	2	V_{IN}=-20dBm	-	0.6	2	%
ALC Balance	B_{ALC}	2	-	-	0	2	dB
Max. Output Voltage	V_{OM}	2	THD=1%	1.3	1.7	-	V_{rms}
Channel Crosstalk	CT	2	R_g=2.2kΩ, V_{OUT}=0dBm	40	50	-	dB
Open Loop Voltage Gain	G_{VO}	2	V_{IN}=-80dBm	67	75	-	dB
Equivalent Input Noise Voltage	V_{NI}	2	R_g=2.2kΩ	-	1.3	2.7	μV_{rms}

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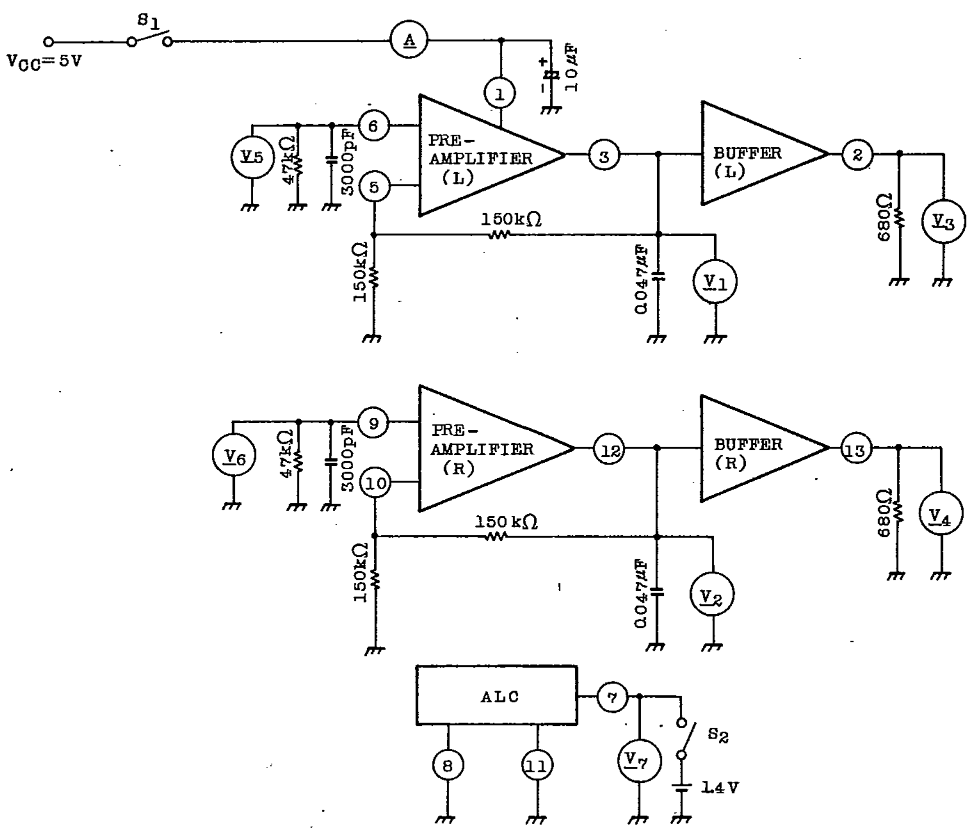
TEST CIRCUIT 1



TEST METHOD

SYMBOL	S_1	S_2	TEST POINT	TEST PROCEDURE
I_{CCQ}	ON	OFF	A	Read ammeter
V_6, V_9	ON	OFF	V_5, V_6	Read voltemter
V_3, V_{12}	ON	OFF	V_1, V_2	Read voltmeter
V_2, V_{13}	ON	OFF	V_3, V_4	Read voltmeter
V_7	ON	OFF	V_7	Read voltmeter
$V_{IN(ALC)}$	ON	ON	V_5, V_6	Measure the voltage on pin 6 and pin 9 when 1.4V in applied to pin 7

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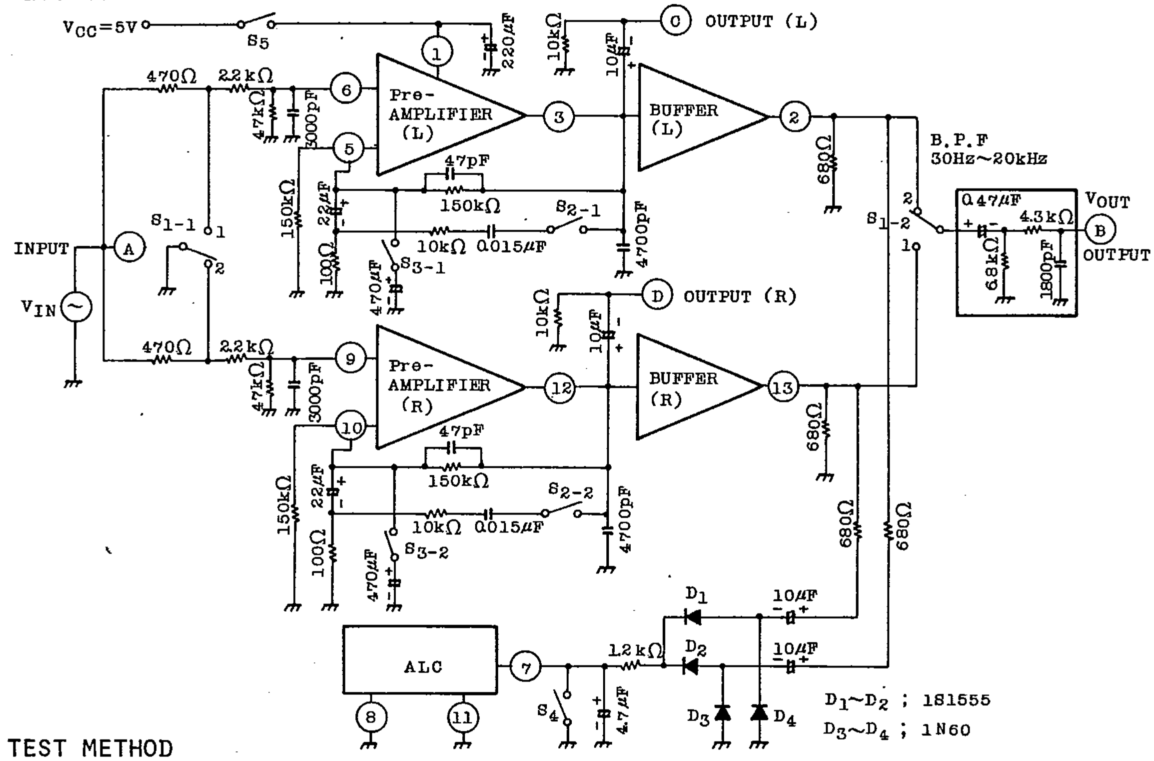
TEST CIRCUIT 2



TEST METHOD

SYMBOL	S_1 L	S_1 R	S_2	S_3	S_4	S_5	TEST POINTS	TEST PROCEDURE
G_{VO}	1	2	OFF	ON	ON	ON	A,C,D	G_{VO} is obtained by G_{VO}=20 log V_{OUT}/V_{IN} (dB). If input voltage is V_{IN} and output voltage is V_{OUT}
V_{OUT}(ALC)	1	2	OFF	OFF	OFF	ON	B	Output voltage V_{OUT} is measured with a VTVM when input voltage V_{IN}=-20dBm is applied.
THD(ALC)	1	2	OFF	OFF	OFF	ON	B	Output voltage V_{OUT} is measured with a distortion meter when input voltage V_{IN}=-20dB is applied.
V_{NI}	S_{1-1}=1 S_{1-2}=2	S_{1-1}=2 S_{1-2}=2	ON	OFF	ON	ON	B	Output voltage V_{OUT} at R_g=2.2kΩ is measured with a VTVM, and is converted by the gain of 1kHz.
V_{OM}	1	2	ON	OFF	ON	ON	C,D	Measure output voltage V_{OUT} at total harmonic distortion THD=1% is measured with a VTVM.
CT	1	2	ON	OFF	ON	ON	B	Crosstalk between(L) and (R) at output voltage V_{OUT}=0dBm is measured.
R_{ALC}	1	2	OFF	OFF	OFF	ON	B	Input voltage range from V_{IN}=-60dBm to output voltage V_{OUT} 3dB UP.
B_{ALC}	1	2	OFF	OFF	OFF	ON	B	Level difference between output voltages V_{OUT} (L) and (R) at the time when input voltage V_{IN}=-20dBm is applied.

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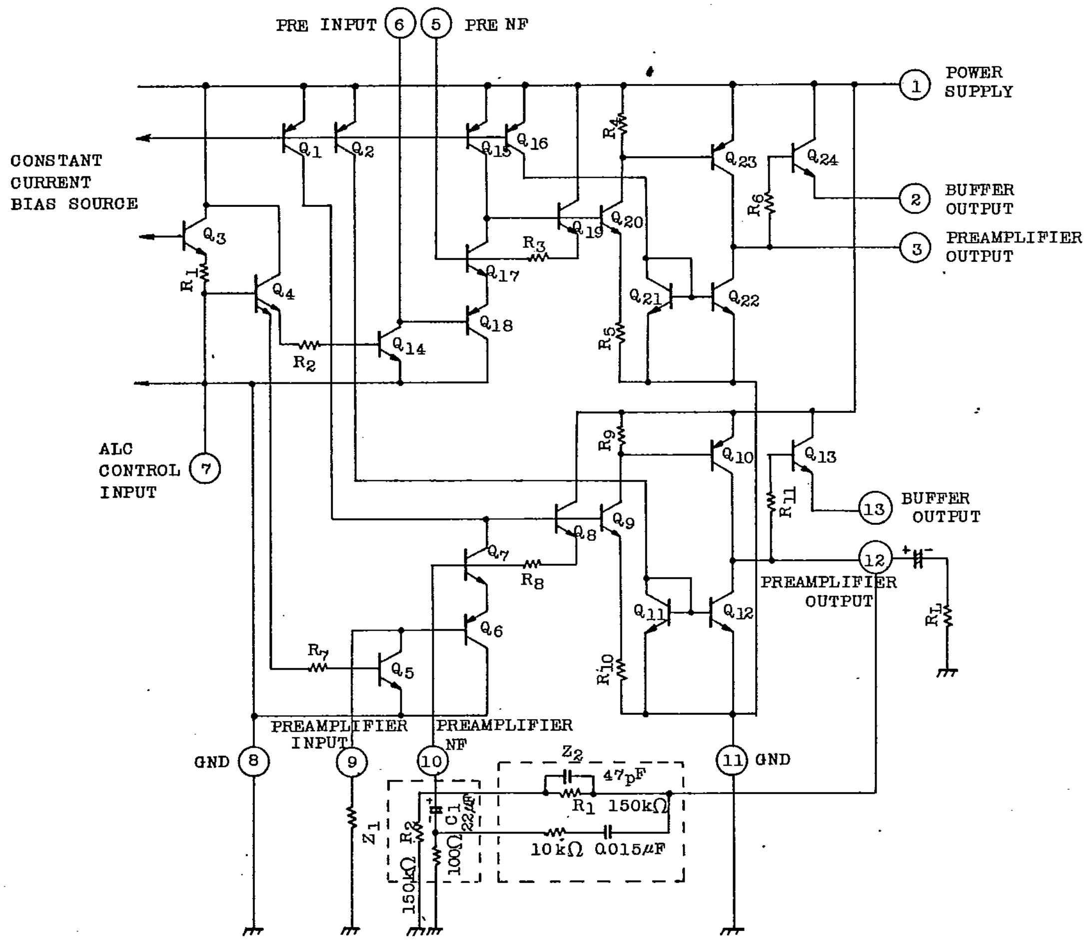
EQUIVALENT CIRCUIT



DESCRIPTION OF EQUIVALENT CIRCUIT

1) BIAS CIRCUIT

The constant current circuit formed by Q_1 and Q_2 is connected to the constant current bias source composed of being free from power supply variation for the purpose of obtaining a bias source of higher power supply ripple suppression ratio. Therefore, the operating current of the first stage transistor Q_6 is not affected by the power supply variation, and the ripple suppression ratio shows a good characteristic since the operating electric potential of the first stage (Q_7 collector) is stabilized, thus requiring no decoupling at the first stage.

2) AMPLIFIER

The first stage is a complimentary differential stage of Q_6 and Q_7, the input terminal voltage (Q_6 base) is about "0"V, and the playback head can be directly coupled without a chemical capacitor.

Q_1 not only sets the first stage current, but also functions as an active load. The medium stage Q_9 is approximately a phase inverter and level shift stage for the gain 1. The output stage Q_{10} is the emitter ground stage changing Q_{12} to an active load. The current is defined by Q_{11} and Q_{12} as $I(Q_{10}) \cong 1.6mA$.

At the back of the output stage, the emitter follower Q_{13} is directly coupled in IC for buffering. Q_{13} is an open emitter, and the operating current can be arbitrarily selected by an external resistor.

3) ALC CIRCUIT

The transistor Q_5 for ALC (Automatic Level Control) is DC-coupled to the input terminal. Therefore, Q_6 bias resistor is connected in parallel between the collector and emitter of Q_5. ALC control terminal ⑦ (Q_4 base) is DC-biased in about 0.55V by Q_3. Consequently, attack time can be shortened since the smoothing capacitor for ALC has been biased in 0.05V from the beginning.

4) VOLTAGE GAIN

o Open Loop Voltage Gain G_{VO} (1kHz) in Amplifier

$$G_{VO}(1kHz) = \frac{\frac{1}{h_{oe}(Q_1)}}{2r_e(Q_6) \cdot R_{10}} \times h_{FE}(Q_{10}) \times R_L \text{ is obtained.}$$

IF $\frac{1}{h_{oe}(Q_1)} = 50k\Omega$
$h_{FE}(Q_{10}) = 20$
$R_L = 10k\Omega$
$2r_e(Q_6) = 1k\Omega$
$R_{10} = 1.8k\Omega$

is given, $G_{VO} \fallingdotseq 5.5 \times 10^3 \fallingdotseq 74.9dB$ is realized.

($\frac{1}{h_{oe}(Q_1)}$ ······ Q_1 output impedance
$2r_e(Q_6)$ ······ Q_6 emitter junction resistance)

o Close Loop Voltage Gain $G_V(1kHz)$

$$G_V(1kHz) = \frac{G_{VO}}{1 + \beta \cdot G_{VO}} \quad \cdots\cdots\cdots\cdots (1) \quad (\beta = \text{Feedback ratio})$$

$$\beta = \frac{Z_1}{Z_1 + Z_2} \quad \cdots\cdots\cdots\cdots\cdots\cdots (2) \quad \text{is made.}$$

If $G_{VO}=75dB$
$Z_1=100\Omega$
$Z_2=13.3k\Omega$

are given, put the equation (1) into the equation (2),

$G_V(1kHz) = 1.32 \times 10^2 = 42.4dB$ is obtained.

o Selection of External Resistors R_1 and R_2

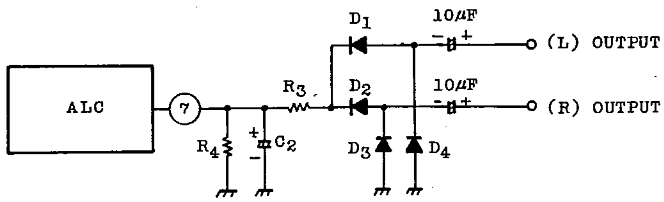
R_1 and R_2 in the internal equivalent circuit should be appropriately selected to obtain output as much as possible. Output terminals (L) = pin 3 and (R) = pin 12 can obtain the maximum output at the time of 1/2 V_{CC}. Therefore, the values of R_1 and R_2 may be selected according to the following equations.

$$V_{12}(V_3) = \frac{V_{CC}}{2} = \frac{R_1+R_2}{R_2} \times V_{10}(V_5) \qquad V_{10}(V_5) = 1.1 \sim 1.2V$$

L channel is shown in (V_3).

Graph "V_{OM}, R_2-V_{CC}" shows the relation between V_{CC} and the maximum output at the time when $R_1=150k\Omega$ as parameter R_2. The value of R_2 should be selected by taking the characteristics at decreasing voltage into due consideration.

5) ALC ATTACK TIME AND RECOVERY TIME SETTING



The attack time from the application of the input signal to the starting of ALC can be adjusted by the time constants of R3 and C2, while the recovery time from no application of the input signal to the restoration of amplifier gain can be adjusted by the time constants of R4 and C2. In addition, silicon diode should be used for D_1 and D_2, while germanium diode for D_3 and D_4. A capacitor of 47μF or more should be used for C_2.

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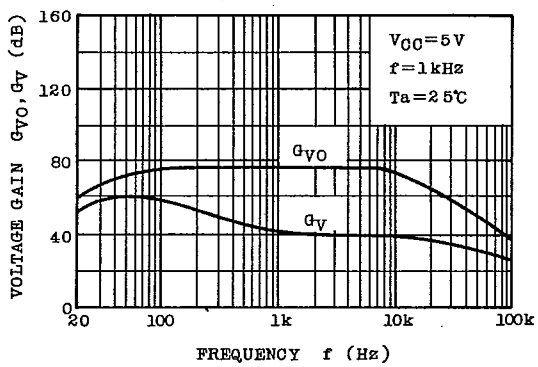
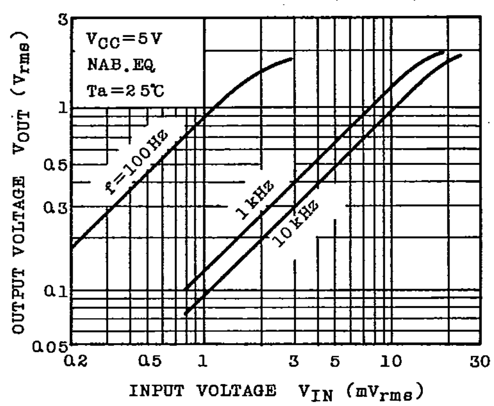
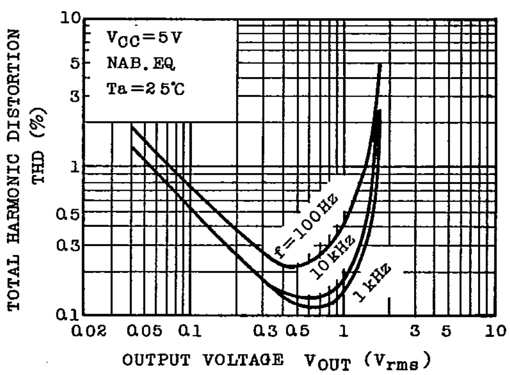
G_{VO}, G_V − f



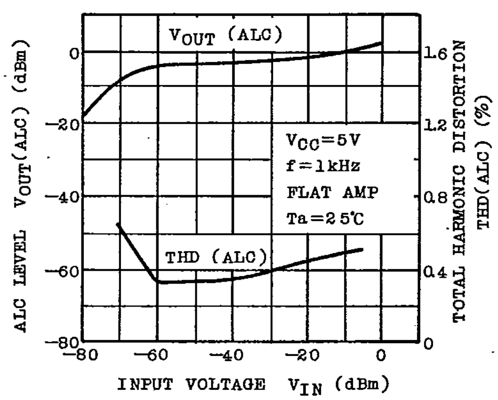
V_{OUT} − V_{IN}



THD − V_{OUT}



V_{OUT} (ALC) − V_{IN}
THD (ALC)



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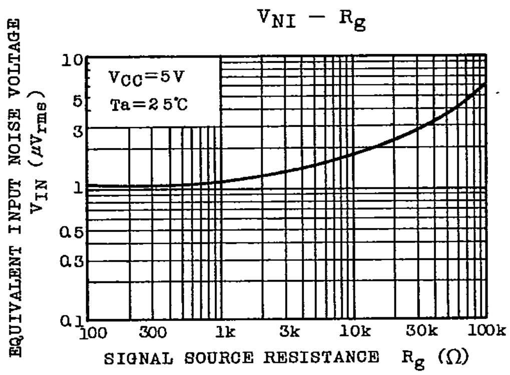
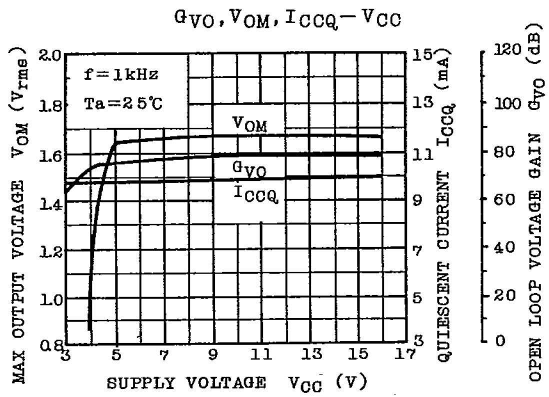
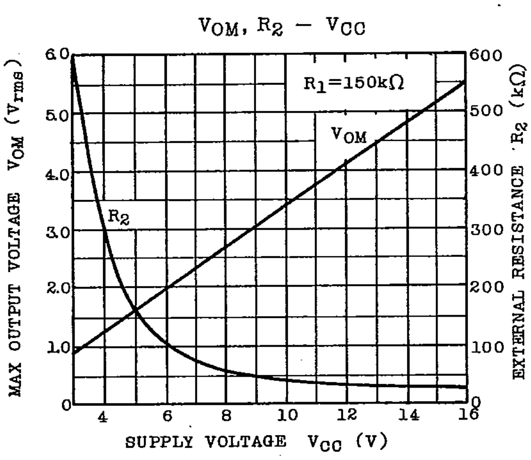


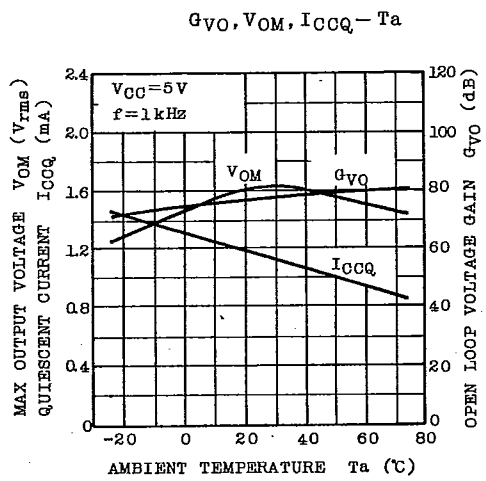
VNI — Rg
VCC=5V
Ta=25°C
EQUIVALENT INPUT NOISE VOLTAGE VIN (μVrms)
SIGNAL SOURCE RESISTANCE Rg (Ω)



GVO, VOM, ICCQ — VCC
f=1kHz
Ta=25°C
VOM
GVO
ICCQ
MAX OUTPUT VOLTAGE VOM (Vrms)
QUIESCENT CURRENT ICCQ (mA)
OPEN LOOP VOLTAGE GAIN GVO (dB)
SUPPLY VOLTAGE VCC (V)



VOM, R2 — VCC
R1=150kΩ
VOM
R2
MAX OUTPUT VOLTAGE VOM (Vrms)
EXTERNAL RESISTANCE R2 (kΩ)
SUPPLY VOLTAGE VCC (V)



GVO, VOM, ICCQ — Ta
VCC=5V
f=1kHz
VOM
GVO
ICCQ
MAX OUTPUT VOLTAGE VOM (Vrms)
QUIESCENT CURRENT ICCQ (mA)
OPEN LOOP VOLTAGE GAIN GVO (dB)
AMBIENT TEMPERATURE Ta (°C)

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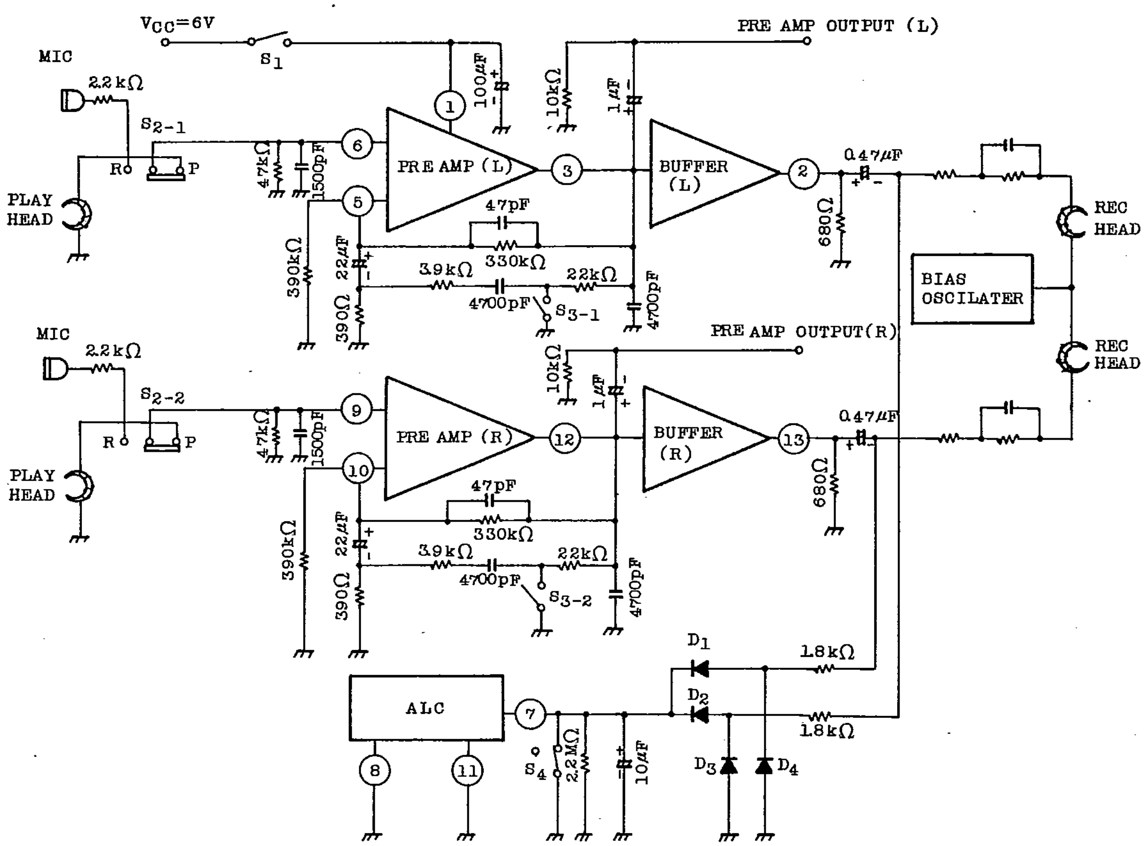
APPLICATION CIRCUIT (REC/P.B)



Each switch position is playback.

$D_1 \sim D_2$: 1S1555 or Equivalent
$D_3 \sim D_4$: 1N60 or Equivalent

DATA OF APPLICATION CIRCUIT