MC1306P

1/2-WATT AUDIO AMPLIFIER

The MC1306P is a monolithic complementary power amplifier and preamplifier designed to deliver 1/2-Watt into a loudspeaker with a 3.0 mV(rms) typical input. Gain and bandwidth are externally adjustable. Typical applications include portable AM-FM radios, tape recorder, phonographs, and intercoms.

- 1/2-Watt Power Output (12 Vdc Supply, 8-Ohm Load)
- High Overall Gain – 3.0 mV(rms) Sensitivity for 1/2-Watt Output
- Low Zero-Signal Current Drain – 4.0 mAdc @ 9.0 V typ
- Low Distortion – 0.5% at 250 mW typ

1/2-WATT AUDIO AMPLIFIER

PLASTIC PACKAGE
CASE 626

TYPICAL APPLICATIONS

FIGURE 1 – AM-FM RADIO, AUDIO SECTION

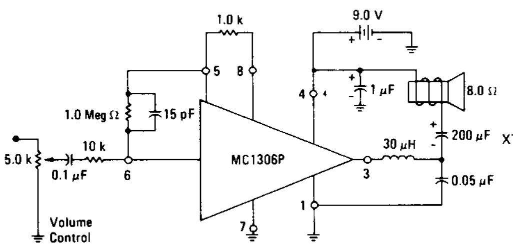
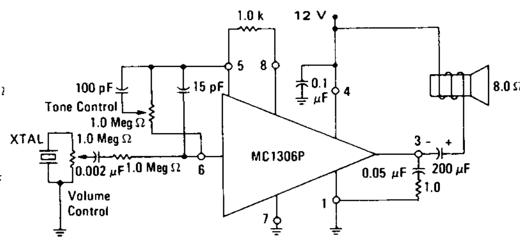
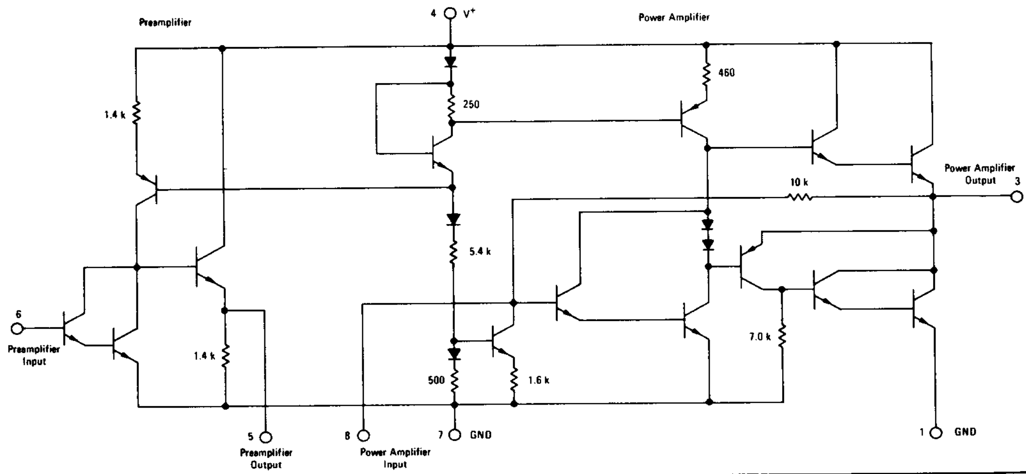


FIGURE 2 – PHONOGRAPH AMPLIFIER (CERAMIC CARTRIDGE)



CIRCUIT SCHEMATIC



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MAXIMUM RATINGS (T_A = +25°C unless otherwise noted)

Rating	Symbol	Value	Unit
Power Supply Voltage	V^+	15	Vdc
Load Current	I_L	400	mAdc
Power Dissipation (Package Limitation) T_A = +25°C Derate above T_A = +25°C	P_D $1/\theta_{JA}$	 625 5.0	 mW mW/°C
Operating Temperature Range	T_A	0 to +75	°C
Storage Temperature Range	T_{stg}	-65 to +150	°C

Maximum Ratings as defined in MIL-S-19500, Appendix A.

ELECTRICAL CHARACTERISTICS (V^+ = 9.0 V, R_L = 8.0 ohms, f = 1.0 kHz, (using test circuit of Figure 3), T_A = +25°C unless otherwise noted.)

Characteristic	Symbol	Min	Typ	Max	Unit
Open Loop Voltage Gain Pre-amplifier R_L = 1.0 k ohm Power-amplifier R_L = 16 ohms	A_{VOL}	 – –	 270 360	 – –	V/V
Sensitivity (P_o = 500 mW)	S	–	3.0	–	mV(rms)
Output Impedance (Power-amplifier)	Z_o	–	0.5	–	Ohm
Signal to Noise Ratio (P_o = 150 mW, f = 300 Hz to 10 kHz)	S/N	–	55	–	dB
Total Harmonic Distortion (P_o = 250 mW)	THD	–	0.5	–	%
Quiescent Output Voltage	V_o	–	$V^+/2$	–	Vdc
Output Power (THD ≤10%, V^+ = 12 V)	P_o	 500	 570	–	mW
Current Drain (zero signal)	I_D	–	4.0	–	mA
Power Dissipation (zero signal)	P_D	–	36	–	mW

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FIGURE 3 – TEST CIRCUIT

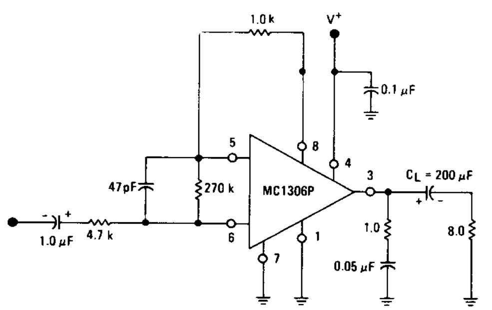
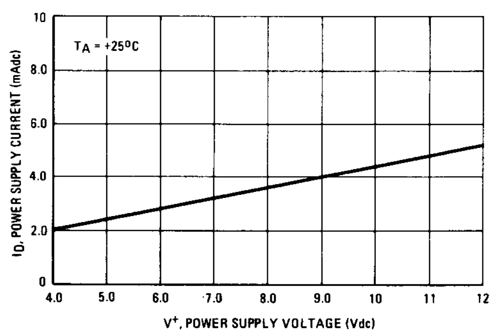


FIGURE 4 – ZERO SIGNAL BIAS CURRENT



TYPICAL CHARACTERISTICS

(V^+ = 9.0 V, f = 1.0 kHz, T_A = +25°C unless otherwise noted)

FIGURE 5 – EFFICIENCY

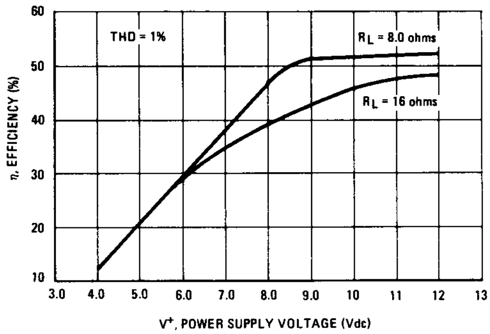


FIGURE 6 – OUTPUT POWER

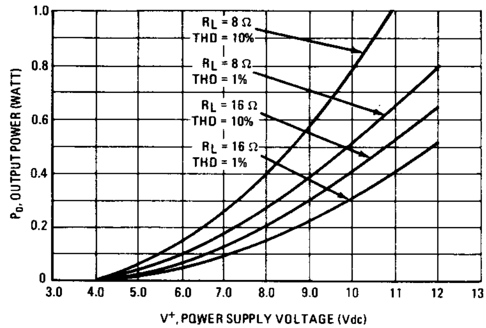


FIGURE 7 – TOTAL HARMONIC DISTORTION

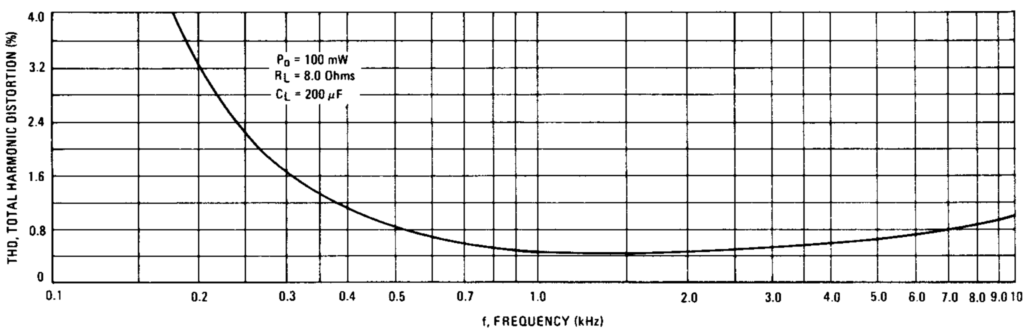


FIGURE 8 – EFFECT OF BATTERY AGING ON LOW-LEVEL DISTORTION

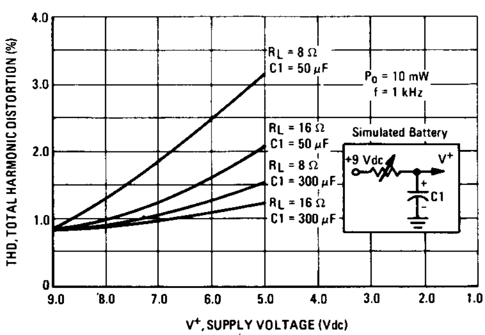


FIGURE 9 – DISTORTION

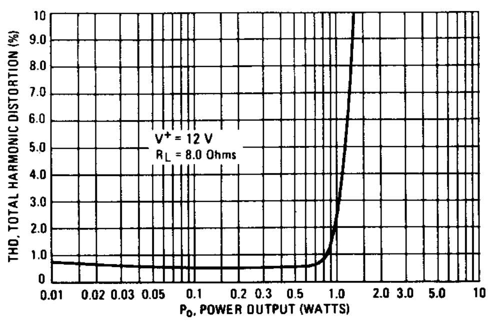
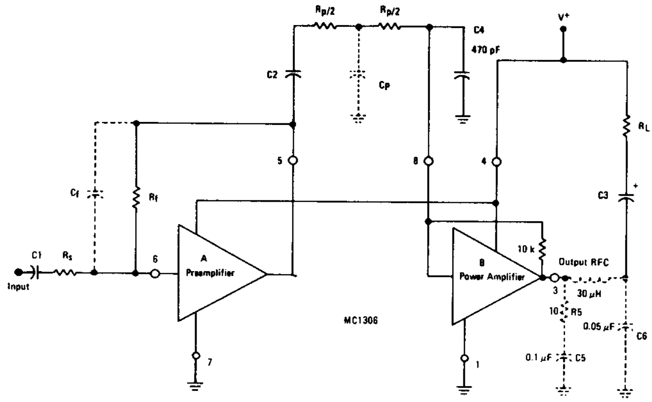


FIGURE 10 – TYPICAL CIRCUIT CONNECTION



DESIGN CONSIDERATIONS

The MC1306P provides the designer with a means to control preamplifier gain, power amplifier gain, input impedance, and frequency response. The following relationships will serve as guides.

1. Gain

The Preamplifier Stage Voltage Gain is:

$$A_{VA} \approx \frac{R_f}{R_s}$$

and is limited only by the open-loop gain (270 V/V). For good preamplifier dc stability R_f should be no larger than 1.0-megohm.

The Power Amplifier Voltage Gain is controlled in a similar manner where:

$$A_{VB} \approx \frac{10\ k}{R_p}$$

The 10-k ohm feedback resistor is provided in the integrated circuit.

Recommended values of R_p range from 500-ohms to 3.3-k ohms. The low end is limited primarily by low-level distortion and the upper end is limited due to the voltage drive capabilities of the pre-amplifier. (A resistor can be added in the dc feedback loop, from pin 6 to ground, to increase this drive). The Overall Voltage Gain, then, is:

$$A_{VT} = \frac{R_f\ 10\ k}{R_s\ R_p}$$

2. Input Impedance

The Preamplifier Input Impedance is:

$$Z_{in\,A} \approx R_s$$

and the Power Amplifier Input Impedance is:

$$Z_{in\,B} \approx R_p$$

3. Frequency Response

The low frequency response is controlled by the cumulative effect of the series coupling capacitors C1, C2, and C3. High-frequency response can be determined by the feedback capacitor, C_f, and the −3.0 dB point occurs when

$$X_{C_f} = R_f$$

Additional high frequency roll-off and noise reduction can be achieved by placing a capacitor from the center point of R_p to ground as shown in Figure 10.

Capacitor C4 and the RC network shown in dotted lines may be needed to prevent high frequency parasitic oscillations. The RF choke, shown in series with the output, and capacitor C6 are used to prevent the high-frequency components in a large-signal clipped audio output waveform from radiating into the RF or IF sections of a radio (Figure 10).

4. Battery Operation

The increase of battery resistance with age has two undesirable effects on circuit performance. One effect is the increasing of amplifier distortion at low signal levels. This is readily corrected by increasing the size of the filter capacitor placed across the battery (as shown in Figure 8; a 300-µF filter capacitor gives distortions at low-tonal levels that are comparable to the "stiff" supply). The second effect of supply impedance is a lowering of power output capability for steady signals. This condition is not correctable, but is of questionable importance for music and voice signals.

5. Application Examples: (1) The audio section of the AM-FM radio (Figure 1) is adjusted for a preamplifier gain of 100 with an input impedance of 10-k ohms. The power amplifier gain is set at 10, which gives an overall voltage gain of 1000. The bandwidth has been set at 10-kHz. (2) The phono amplifier (Figure 2) is designed for a preamplifier gain of unity and a power amplifier gain of 10. The input impedance is 1.0-megohm. An adjustable treble control is provided within the feedback loop.

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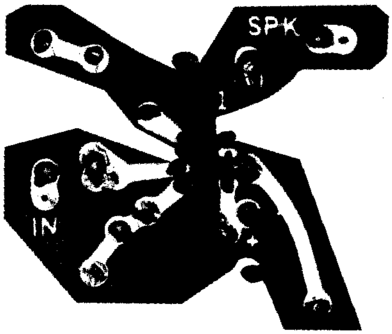
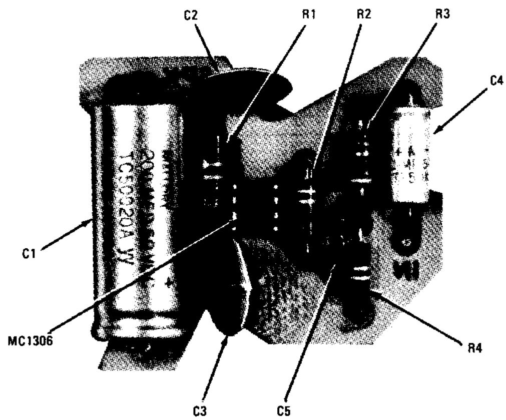
TYPICAL PRINTED CIRCUIT BOARD LAYOUT



LOCATION OF COMPONENTS



See Figure 3 for schematic diagram.

PARTS LIST

Component	Value
C1	200 µF
C2	0.1 µF
C3	0.05 µF
C4	1.0 µF
C5	47 pF
R1	1 ohm
R2	1 k ohm
R3	4.7 k ohms
R4	270 k ohms
MC1306	–
PC Board	–