OPERATING INSTRUCTIONS

TYPE 1206-B

UNIT AMPLIFIER

GENERAL RADIO COMPANY

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Form 1206-0100-F
October, 1964

GENERAL RADIO COMPANY
WEST CONCORD, MASSACHUSETTS, USA

SPECIFICATIONS

Power Output: With 300-v plate supply, 600-ohm load: from 10 cps to 50 kc, 3 w; from 5 cps to 100 kc, 1.5 w; at 250 kc, 0.5 w.

Distortion: Less than 1% harmonic distortion with 2-w output (2% at 3 w) into 600 ohms from 20 cps to 40 kc.

Pulse Response:	No Load	600 Ω
Droop in 30-cps square wave:	15%	20%
Approx rise time: 50 v peak-to-peak:	1 μsec	2 μsec
100 v peak-to-peak:	2 μsec	4 μsec
Max output, peak-to-peak:	260 v	120 v

Load Impedance: 600 ohms optimum. Blocking capacitor is 100 μf. (Internal impedance about 100 ohms.)

Input Impedance: 100,000 ohms in parallel with 35 μμf.

Frequency Response: Down less than 3 db at 2 cps and 500 kc at 10-v (or less) output, with gain control at maximum. See also Power Output, above.

Voltage Gain: Continuously adjustable. Maximum gain is 50 to 1 (34 db), with no load; 42.5 to 1 (32.6 db) into 600 ohms.

A-C Hum in Output: Less than 15 mv rms, with Type 1203 Unit Power Supply; less than 3 mv rms, with Type 1201-A Unit Regulated Power Supply.

Power Requirements: 300 v at 50 ma; 6.3 v at 2.7 amp.

Power Supply: Type 1203 Unit Power Supply is recommended. Amplifier plugs directly into any one of the Unit Power Supplies.

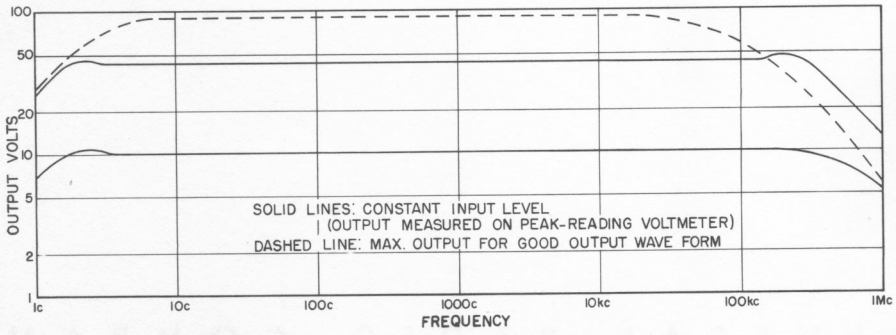
Accessories Supplied: Two connector channels for attaching power supply.

Mounting: Aluminum cabinet and chassis for bench mounting. Relay Rack panel (Type 480-P4U3) available for amplifier and power supply.

Dimensions: Width 9-7/8, height 5-3/4, depth 6-1/4 inches (250 by 150 by 160 mm), over-all.

Weight: 4 lb. (1.9 kg).

U.S. Patent Nos 2,659,775 and 2,802,907.



Frequency-Response with 600-Ohm Load.

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Figure 1. Panel View, Type 1206-B Unit Amplifier with Type 1203-B Power Supply

TYPE 1206-B
UNIT AMPLIFIER

Section 1
INTRODUCTION

1.1 PURPOSE. The Type 1206-B Unit Amplifier (Figure 1) is designed as a general-purpose laboratory instrument useful as a bridge amplifier, a driver for low-power electronic and electroacoustic devices, and as an amplifier for the Type 1210 Unit Oscillator and other low-power signal sources. The normal operating range covers the audio and ultrasonic frequencies.

1.2 DESCRIPTION. The Unit Amplifier uses a single-ended push-pull circuit,[1] with the advantage of push-pull operation of the output tubes and without the usual low- and high-frequency limitations of the output transformer. The circuit consists of a triode amplifier stage, a phase inverter, and series output tubes operated in push-pull parallel. Degenerative feedback is returned to the cathode of the input stage.

The elementary schematic diagram (Figure 2) shows the operation of the series push-pull output stage. Note that the drive for the upper tube (V3) is applied from grid to cathode and not from grid to ground. If either tube were replaced by a resistor, therefore, the other would act as an amplifier with gain, and the upper tube would give an output in phase with its input.

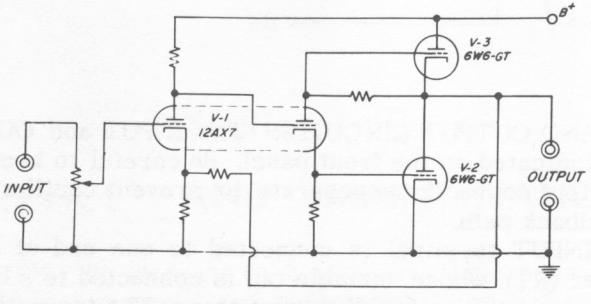

Figure 2. Elementary Schematic Diagram.

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1. Peterson, A.P.G. and Sinclair, D.B., "A Single-Ended Push-Pull Audio Amplifier", Proc. IRE, January, 1952, pp. 7-11.

Section 2

OPERATING PROCEDURE

2.1 POWER SUPPLY. Connect an external power source to the connecting jack as shown in Figure 3. Recommended power sources are the Type 1203 Unit Power Supply, Type 1201 Unit Regulated Power Supply, and Type 1204 Unit Variable Power Supply. The power supply should be able to deliver 2.7 amp at 6.3 volts (60 cps) and 50 ma at 300 volts dc. The heater supply should be left floating, and not tied to B- (ground). When using the Type 1201 Unit Variable Power Supply, set the output to 300 volts.

If the Type 1203 Unit Power Supply is used, it will not be possible to obtain the full 3 watts output if the line voltage is substantially below 115 volts. A Variac® autotransformer or other means of increasing line voltage should be used if the full 3 watts are desired. At line voltages of over 115 volts, an output of over 3 watts is obtainable; however, the amplifier should not be operated from the Type 1203 Unit Power Supply with a line voltage of over 130 volts.

The Type 1201 Unit Regulated Power Supply supplies 300 volts regulated power, and also has the advantage of reducing the hum output of the amplifier.

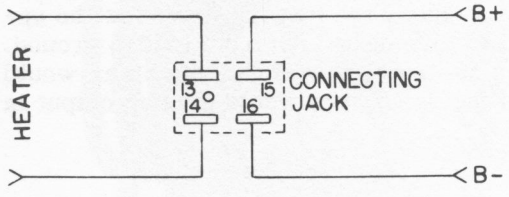

Figure 3.
Connection of External Power Source.

2.2 INPUT AND OUTPUT CIRCUITS. The INPUT and OUTPUT terminals are so indicated on the front panel. Be careful to keep the external input and output connections separate to prevent oscillation due to an external feedback path.

Each INPUT terminal is connected to one end of a logarithmic potentiometer (R1), whose variable tap is connected to a blocking capacitor that leads to the grid of the input stage. The input, therefore, may have a d-c component, which should be under 100 volts. The 100,000-ohm potentiometer (R1) should be turned fully clockwise for full gain.

Leakage in the 100-μf blocking capacitor in the output circuit results in a d-c voltage across the output terminals. The voltage is about 1 volt open-circuit, 0.1 volt with a 600-ohm load.

The optimum load is 600 ohms. Due to feedback, the actual source impedance is about 100 ohms, but the amplifier cannot supply enough current to develop 3 watts into a load impedance much smaller than 600 ohms.

2.3 FREQUENCY RESPONSE. The frequency ranges given for various power levels (refer to Specifications) are the ranges over which the output waveform is essentially sinusoidal for a sinusoidal input. Any given output is available over a wider frequency range than indicated, but the waveform is visibly distorted at frequencies much beyond those given.

High-frequency response is a function of amplitude, and is due to the limited frequency response of the phase inverter, which results in overloading of the phase inverter at high frequencies.

Although this series-tube operation permits a much better frequency response than that which is ordinarily possible with an output transformer and conventional push-pull circuit, the response is limited by the effective multiplication of the grid-to-ground capacitance of the upper tube by the gain of the output stage.

2.4 PULSE RESPONSE. The Specifications indicate that the rise time is a function of amplitude. This is due to the limited response of the phase inverter, which results in overloading of the phase inverter. At low levels the rise time of the phase inverter is improved by feedback. At sufficiently high levels the phase inverter is driven to cutoff. At cutoff, the impedance of the tube's output circuits is changed so that the circuit has a longer time constant and slower rise time. The period of time over which cutoff exists depends on the amplitude. The fall time is shorter, indicating that driving the phase inverter grid positive has less effect on the time constants of the phase inverter's output circuits.

With potentiometer R1 turned fully clockwise, a small overshoot appears on the output waveform when the amplifier is driven from a low-impedance pulse generator. To eliminate this overshoot, turn R1 slightly counterclockwise. The rise time, however, is best when R1 is near either end.

Section 3

SERVICE AND MAINTENANCE

3.1 WARRANTY. We warrant that each new instrument sold by us is free from defects in material and workmanship, and that, properly used, it will perform in full accordance with applicable specifications for a period of two years after original shipment. Any instrument or component that is found within the two-year period not to meet these standards after examination by our factory, district office, or authorized repair agency personnel will be repaired, or, at our option, replaced without charge.

3.2 SERVICE. The two-year warranty stated above attests the quality of materials and workmanship in our products. When difficulties do occur, our service engineers will assist in any way possible. If the difficulty cannot be eliminated by use of the following service instructions, please write or phone our Service Department (see rear cover), giving full information of the trouble and of steps taken to remedy it. Be sure to mention the serial and type numbers of the instrument.

Before returning an instrument to General Radio for service, please write to our Service Department or nearest sales engineering office, requesting a Returned Material Tag. Use of this tag will ensure proper handling and identification. For instruments not covered by the warranty, a purchase order should be forwarded to avoid unnecessary delay.

3.3 TROUBLE-SHOOTING INFORMATION.

3.3.1 EXCESSIVE DISTORTION. Excessive distortion may be due to improper operation of the output tubes. Before replacing either of the tubes, check to see that the plate supply voltage (V3, pins 3 and 4) and the bias voltage (V2, pin 5) are correct. After replacing either V2 or V3, readjust R13 for minimum distortion. R13, a bias adjustment on V3, is set at the factory to give minimum distortion at 1 kc when delivering 3 watts into 600 ohms with a line voltage of 115 volts on the Type 1203-B Unit Power Supply.

3.3.2 LOW GAIN OR EXCESSIVE HUM. In the event of either low gain or excessive hum, check to see if V1 is defective, and replace it if necessary.

3.3.3 TEST VOLTAGES. Table 1 gives test voltages as an aid to trouble-shooting. Unless otherwise indicated, voltages are dc, to ground, with no input signal applied. A 20,000-ohm-per-volt multimeter was used.

TABLE 1
TEST VOLTAGES

Tube	*Element*	*Pin*	*Volts to Ground*	*Tube*	*Element*	*Pin*	*Volts to Ground*
V1	Plate	1	200	V2	Heater	2	6.3 ac**
(12AX7)	Grid	2	0	(6W6-GT)	Plate	3	150
	Cathode	3	1.6		Screen	4	150
	Heater	4	-8		Grid	5	-16
	Heater	5	-8		Heater	7	-8
	Plate	6	250		Cathode	8	0
	Grid	7	High Impedance	V3	Heater	2	6.3 ac**
	Cathode	8	40	(6W6-GT)	Plate	3	300
	Heater	9	6.3*		Screen	4	300
					Grid	5	134†
					Heater	7	-8
					Cathode	8	150

* Between pins 4 and 9 and 5 and 9.
** Between pins 2 and 7.
† Use dc vacuum-tube voltmeter.

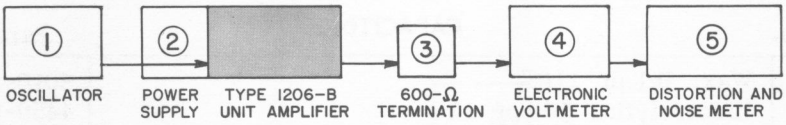

Figure 7. Calibration Test Setup.

3.4 CALIBRATION PROCEDURE.

3.4.1 TEST SETUP. For a description of the connections necessary for a complete calibration of the Type 1206-B Unit Amplifier, see Figure 7.

1. Oscillator – Capable of output signals of 50 cps to 19 kc, ±5% or better accuracy; 0.5 to 1.5 volts, rms, into 600 ohms. Distortion must be less than 0.5% from 50 cps to 19 kc. The Type 1304-B Beat-Frequency Audio Generator may be used.
2. Power supply – Capable of 2.7 amperes at 6.3 volts, 60 cps, and 50 milliamperes at 300 volts, dc. The Type 1203-B Unit Power Supply or the Type 1201-C Unit Regulated Power Supply may be used.
3. 600-ohm termination – 600-ohm, ±0.5%; 5-watt, noninductive (not wire-wound) resistor.
4. Electronic voltmeter – Accurate to ±3% or better and capable of measuring signals of 30 to 50 volts, rms; 50 cps to 19 kc. The Type 1806-A Electronic Voltmeter may be used.
5. Distortion and Noise Meter – Accurate to ±5% or better; capable of measuring the distortion of signals with frequencies of 50 cps to 19 kc and amplitudes of 30 to 50 volts, rms; capable of measuring noise as low as 10 millivolts, rms. The Type 1932-A Distortion and Noise Meter may be used.

3.4.2 DISTORTION AND NOISE. To check distortion and noise, follow the procedure given in Table 2. Before making measurements, set GAIN control fully clockwise.

TABLE 2
DISTORTION AND NOISE

Oscillator Settings		
Frequency	*Output Amplitude*	*Distortion*
1 kc	42.5 v (3 watts) on electronic voltmeter.	Adjust R13 for minimum distortion, not to exceed 3%. Excessive distortion may be due to V2 or V3.
1 kc	34.6 v (2 watts)	1%, maximum
50 cps	34.6 v (2 watts)	1%, maximum
50 cps	42.5 v (3 watts)	2%, maximum
19 kc	34.6 v (2 watts)	1%, maximum
19 kc	42.5 v (3 watts)	2%, maximum

Connections	*Noise*
Disconnect oscillator and short the Type 1206-B INPUT terminals together.	15 mv, rms, maximum. Excessive noise may be due to V1.

PARTS LIST

CAPACITORS

Ref. No.			Part No.
C1	Wax, 0.1 μf ±10%		5010-2700
C2	Electrolytic, 200 μf 12 v		4450-0400
C4	Electrolytic Block, 25 μf 350 v	Part of	4460-1600
C5	Wax, 0.047 μf ±10%		5020-1000
C6	Wax, 0.1 μf ±10%		5010-0700
C7	Wax, 0.22 μf ±10%		5010-3300
C8	Electrolytic, 10 μf 250 v		4450-2100
C9	Mica, 39 pf ±10%		4660-1700
C10	Electrolytic Block, 100 μf 350 v		4460-1600
C11	Electrolytic, 16 μf 150 v		4450-0200
C12	Electrolytic, 16 μf 150 v		4450-0200
C13	Electrolytic Block, 75 μf 350 v	Part of	4460-1600

RESISTORS

R1	POTENTIOMETER, Composition, 100 kΩ ±10%	6020-0700
R2	Composition, 1 MΩ ±5%	6100-5105
R3	Composition, 1 kΩ ±5%	6100-2105
R4	Film, 200 Ω ±1%	6450-0200
R5	Composition, 6.8 kΩ ±5%	6100-3685
R6	Composition, 10 kΩ ±5%	6100-3105
R7	Film, 13 kΩ ±1%	6450-2130
R8	Composition, 1 MΩ ±5%	6100-5105
R9	Composition, 1.5 kΩ ±5%	6100-2155
R10	Film, 39 kΩ ±1%	6450-2390
R11	Film, 28.5 kΩ ±1%	6450-2285
R12	Composition, 27 kΩ ±5%	6100-3275
R13	POTENTIOMETER, Composition, 5 MΩ ±20%	6010-2700
R14	Composition, 6.8 MΩ ±5%	6100-5685
R15	Composition, 1 MΩ ±5%	6100-5105
R16	Composition, 100 kΩ ±5%	6100-4105
R17	Composition, 4.7 MΩ ±5%	6100-5475
R18	Composition, 100 Ω ±5%	6100-1105
R19	Composition, 100 Ω ±5%	6100-1105

MISCELLANEOUS

D1	DIODE, Type 1N3253	6081-1001
D2	DIODE, Type 1N3253	6081-1001
J1	BINDING POST, Insulated, INPUT	4060-0100
J2	BINDING POST, Uninsulated, INPUT	4060-0100
J3	BINDING POST, Insulated, OUTPUT	4060-0100
J4	BINDING POST, Uninsulated, OUTPUT	4060-0100
PL1	PLUG, Input	4220-4201
V1	TUBE, Type 12AX7	8370-0900
V2	TUBE, Type 6W6-GT	8360-8000
V3	TUBE, Type 6W6-GT	8360-8000

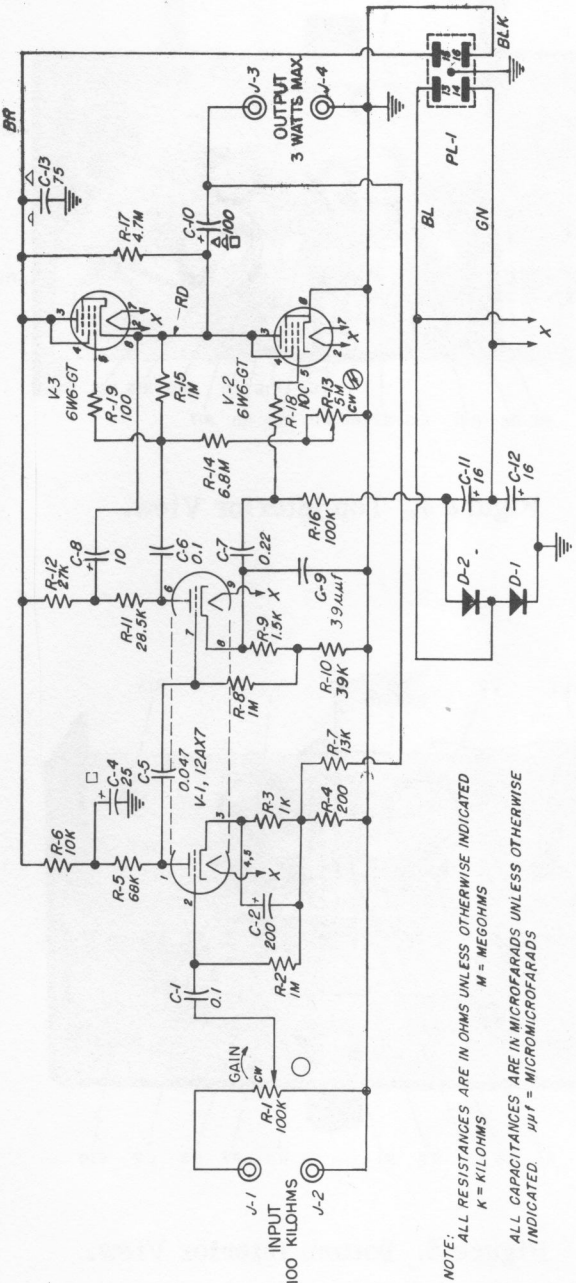

Figure 6. Schematic Diagram, Type 1206-B Unit Amplifier.

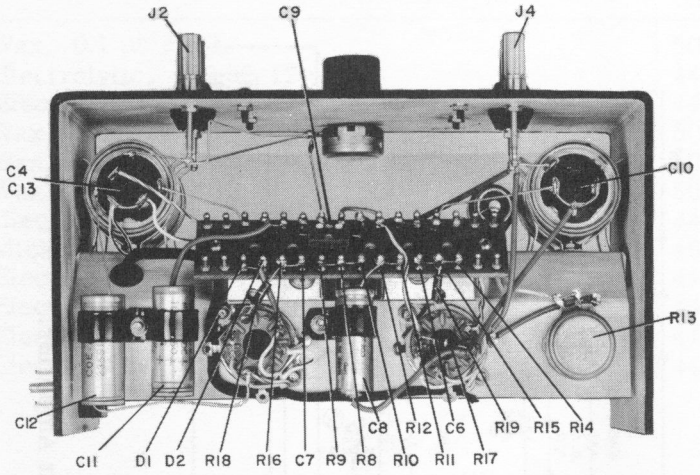

Figure 4. Top Interior View.

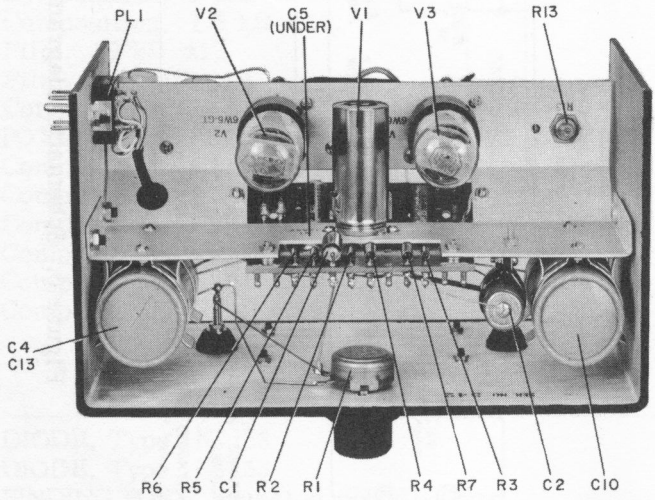

Figure 5. Bottom Interior View.

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