M-5576
PROGRAM AMPLIFIER

INSTRUCTION BOOK

GATES

GATES RADIO COMPANY

A Subsidiary of Harris-Intertype Corporation

QUINCY, ILLINOIS

TELEMETRY AMP

INSTRUCTION BOOK

FOR

M5576 PROGRAM AMPLIFIER

M5576 PROGRAM AMPLIFIER

SPECIFICATIONS

GAIN:	75 db, ±2 db @ 1000 cycles.
RESPONSE:	±1.5 db from 30 to 15,000 cycles.
DISTORTION:	.5% or less from 50 to 15,000 cycles @ +12 dbm output.
	.75% or less @ 30 cycles @ +12 dbm output.
	1% or less from 50 to 15,000 cycles @ +22 dbm output.
MAXIMUM INPUT:	-35 dbm for 1% or less distortion from 50 to 15,000 cycles.
NOISE:	60 db or better below +12 dbm output with -60 dbm input or a relative input noise level of -120 dbm or better.
POWER CONSUMPTION:	105/125 volts, 50/60 cycles, 15 watts.
INPUT IMPEDANCES:	150/250-500/600 ohms balanced or unbalanced.
OUTPUT IMPEDANCES:	150/250-500/600 ohms balanced or unbalanced.
TUBES:	(1) 6X4, (3) 5879 and (1) 12AU7.
FUSE:	1/2 Ampere.
SIZE:	19" wide, 5-1/4" high and 7-1/2" deep.
WEIGHT:	12 pounds.

INTRODUCTION

Gates M5576 Program Amplifier employs rack mounted construction for use in a standard 19" relay rack. It used only 5-1/4" of vertcial rack space. It may be uses as a high quality line or program amplifier for radio or television service. The front panel is hinged to drop down for internal inspection and servicing. The tubes and most of the components are accessible from the rear (through the back door of the relay rack).

The amplifier has four stages of gain. The tandem connected dual volume control is an interstage control; connected between the first and second, and the second and third stages for best signal to noise ratio over the entire input level range. This volume control, the main switch, fuse and pilot lamp are located on the front panel.

The amplifier utilizes a printed wiring chassis for the four amplifying tubes and their associated components. The power supply is very conventional and uses hand-wired construction. Input and output connections are on screw terminations at the rear of the unit. Power is connected through a television set type plug.

INSTALLATION

The unit will be received in one packing carton with all of the tubes installed in the tube sockets. Carefully remove all the fillers and packing tape from the unit. Give it a complete visual examination prior to installing it in the equipment rack. It would be a good idea to perform a brief operating check on it before its initial use to see if anything has happened to it since its final test at the factory.

The unit mounts in the rack cabinet with four standard rack mounting screws, through the slots in the sides of the panel. Connect the input circuit to TB1, the outside terminals. Connect the shield and/or earth ground to the center terminal of TB1. Connect the output circuit to the outside terminals of TB2, the shield to the center terminal. Plug the power cord into the rack A.C. receptacle. Or, if the rack does not contain receptacles, cut the plug off and attach lugs to permit wiring into the common A.C. line in the rack. The power required is 105/125 volts, 50/60 cycles.

PREOPERATION

Turn on the power switch. The neon lamp should glow at once. If it does not, check the fuse and the voltage into the unit. Allow a five minute warm-up period. With all the adjacent rack equipment operating (that is normally operated) adjust the "hum balance" control on the rear of the chassis for the lowest amount of noise. This should be done with no signal applied to the amplifier. It will be necessary to use a noise and distortion analyzer or a vacuum tube voltmeter capable of reading minute hum voltages to get an optimum setting on this control. However, if the amplifier is fed into a high gain monitoring amplifier, the gain can be increased until the hum is easily heard on the speaker. Rotate the control back and forth, then reverse the power cord and repeat the process. Choose the phasing and control position that gives the lowest amount of hum.

Apply the input signal. If the output sounds (or measures) highly distorted, probably the input level is too high. The maximum input level of the amplifier is -35 dbm. You really should allow a 10 db margin, so the normal input should be padded down (if necessary) to -45 dbm to - 50 dbm. A 10,000 to 600 ohm bridging pad would allow the unit to be connected to most circuits without causing any mismatch. This pad has a minimum loss of 31 db. If it is desired to bridge a circuit with +8 dbm level, a 22 db 600/600 ohm pad could be inserted between the bridging pad and the amplifier. This would reduce the level to -45 dbm. About the only precautions that are necessary in adjusting the levels are: Do not exceed 40 db attenuation in one pad or the high frequency leakage will probably destroy the frequency response. Keep the circuits and amplifier terminated in the proper impedance at all times.

OPERATION

Operation is quite simple and consists of turning the unit on and adjusting the gain for proper output level. For small variations in input level, or where the input to the amplifier ranges from -63 dbm to -35 dbm, adjustment of the front panel volume control is sufficient to keep a constant output. As explained in the Preoperation chapter, levels above -35 dbm must be padded down to prevent overloading of the input circuits of the amplifier. The maximum output level of the amplifier is +22 dbm, it is suggested that the normal output level should be +12 dbm or lower for optimum operation.

THEORY OF OPERATION

The amplifier has four stages of gain: Three pentode connected stages of voltage gain and a parallel connected dual triode for power output. The tandem connected dual volume control has the first section connected between the first and second stages. The second section is connected between the second and third stages. This gives the best noise reduction with signal reduction with signal reduction over the usable range of input and output levels. Negative feedback is employed around the last two stages. It is connected from the tertiary winding of the output transformer, through an R-C network, back to the cathode of the third stage. This stabilizes the operation of the amplifier, reduces distortion, reduces noise and reduces the reflected output impedance to minimize the effects of changes of output circuit loading.

The main amplifier section is constructed on a printed wiring chassis: This method uses a phenolic base with etched copper conductors laminated to it. Standard components are used, not printed components as used with "printed circuits", some of the components are in special enclosures to facilitate their use with a printed chassis. Thus, the components are very reliable and of a type the station engineer is acquainted with. The printed chassis assures extreme uniformity, high reliability and easy maintenance (when approved methods of repair are used, see the bulletin "Replacing Components On The Printed Chassis".) This will answer most questions and serve as a guide for working out any others.

C-77870 is the schematic diagram of the printed chassis amplifier. It is quite conventional and there is practically nothing to explain about it that is not covered in most general electronic text and reference books. Of course, optimum values have been chosen for all components to do the job that the amplifier is specifically designed for.

C-77867 is the wiring diagram of the entire unit. It shows the wiring of the power supply section, the front panel volume control and the connections into the printed chassis. A full wave rectifier is used along with a pi section L-C filter network. Perhaps the only unusual feature of the circuitry is the filament bias and balancing network.

This consists of R1 and R2 (the voltage divider which develops about +25 volts of bias), C1 (a .5 MFD. capacitor which furnishes a low impedance path to ground for any signal and hum frequencies present on the filament string) and R3 (the hum balancing control). When the cathode is more positive than the filament there is current flow from filament to cathode. Even when they are both at ground potential there is some flow because the very hot filament has a lot more free electrons, a reverse bias is required to minimize this flow. It has been determined that +20 to +25 volts on the filaments will reduce this current flow to a value which is sufficient to achieve our goal.

This filament to cathode current flow would not cause trouble with a D.C. filament supply. However, the 60 cycle supply causes 60 cycle modulation of the current flow and results in hum being introduced into the signal circuit. This could be reduced by using grounded cathodes or very heavy bypass capacitors but neither method works out to best advantage in all stages of a high gain amplifier.

The best method is the use of bias and balance to reduce the hum to a minimum. This method has a further advantage in the fact that it can cancel out small amounts of hum inductively coupled into the input and output transformers or into the external circuits. Thus, it is possible to actually improve the hum ratio of an input circuit with this method, where an amplifier without any hum generated at all could not have any effect.

MAINTENACE

One of the most common causes of failure in electronic equipment is the accumulation of dirt and dust. With proper cleaning and periodic tube checking, this equipment will give long trouble-free service. A soft clean brush should be used to remove the dust from the printed chassis. Compressed air may be used if it has an accurate regulator that limits the maximum air pressure to 60 pounds per square inch. Grease and oily residue may be removed with naptha or cleaning fluid (DANGER: FIRE HAZARD), or carbon tetrachloride (DANGER:AVOID SKIN EXPOSURE AND INHALING FUMES). We strongly urge that the unit be removed from the rack and carried outdoors to be cleaned with naptha or lighter fluid type of cleaning fluid, where there is no danger of an explosion, when it is necessary to use a grease solvent. We do not recommend the use of carbon tetrachloride! It is a great health hazard and actually requires much more ventilation than naptha. It should not be allowed to touch the skin, swallowed or the fumes inhaled - so, it is best to discontinue its use.

Voltage readings are inserted on the schematic diagrams. These are typical readings taken with a certain meter under a certain set of conditions. Perhaps your meter and/or conditions will differ enough to give a substantial variation in the readings. It would be good practice to take your own readings on the unit and tabulate them on the drawings; with your meter and with your own set of conditions. If this is done when the unit is on test and functioning correctly, it will be of much more value in trouble shooting than factory values.

Should it be necessary to replace any of the parts on the amplifier deck, follow the instructions on the section titled "Replacing Components On The Printed Chassis". The methods outlined will assure the success of the operation. Of course, there are other ways of accomplishing the same results, but if you are not thoroughly familiar with them you should be very careful. The coupling capacitors are in special cases. They may be replaced temporarily with standard capacitors. Exact replacements may be ordered from the Gates Radio Company.

When ordering replacement parts be sure to list the number of the unit (M5576), the symbol number (C5), the description (0.1 MFD, 400 V.), and the number of the part (C-D BC 105). This will allow the item to be double checked and assure that the correct replacement will be received.

PARTS LIST

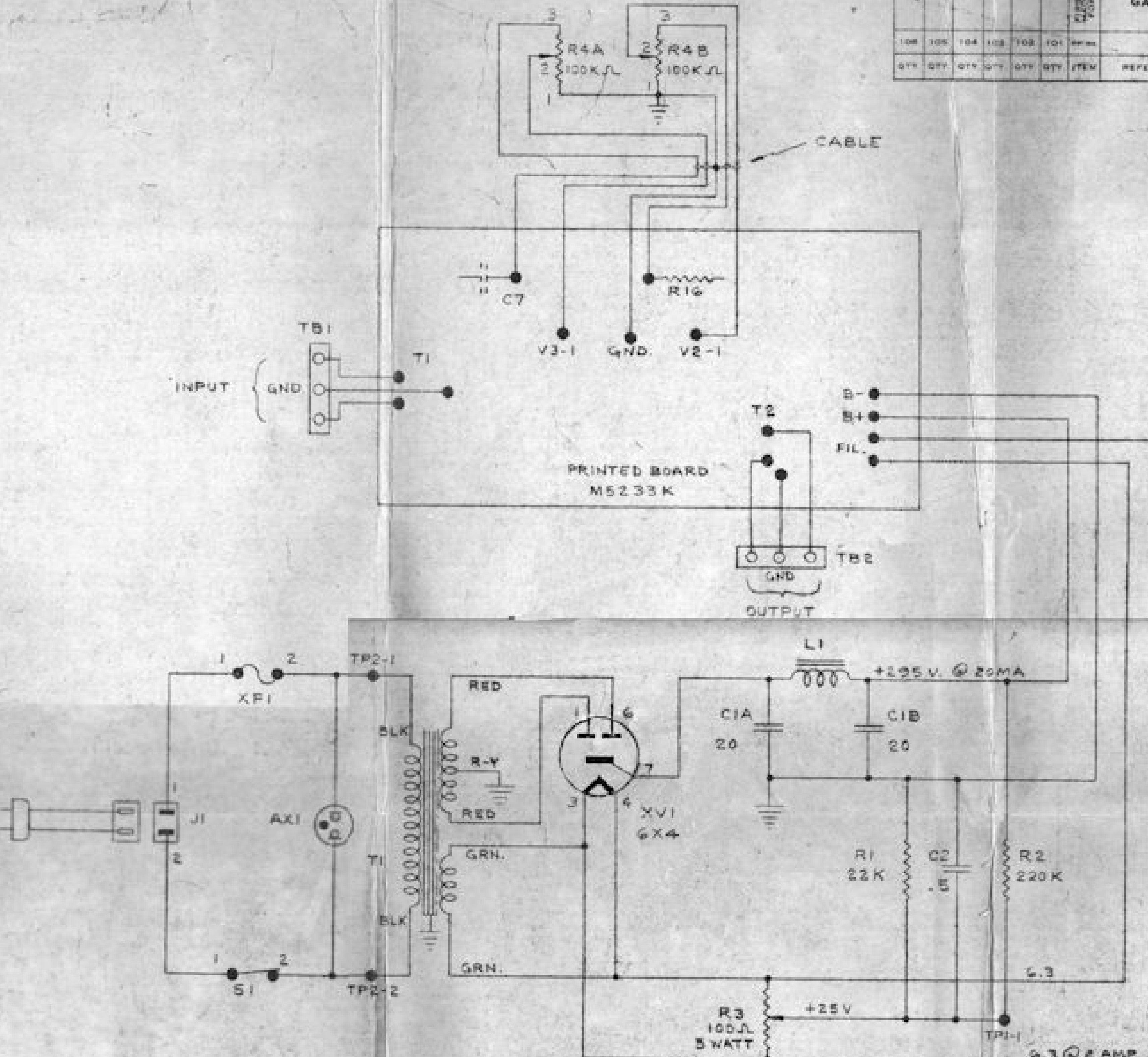
Symbol No.	Gates Part No.	Description
A1	406 0252 000	Glow Light
C1A,C1B	524 0062 000	Cap., 20/20/450 V.
C2	506 0007 000	Cap., .5 mfd., 200V.
F1	398 0017 000	Fuse, 1 Amp.
J1		Receptacle (Pt. of A.C. Line Cord)
L1	476 0003 000	Choke
R1	540 0484 000	Res., 22K ohm, 1W., 10%
R2	540 0496 000	Res., 220K ohm, 1 W., 10%
R3	552 0541 000	Control, 100 ohm
R4A,R4B	550 0198 000	Dual Control 100K ohm
S1	604 0001 000	Toggle Switch
T1	472 0006 000	Transformer
TB1,TB2	614 0214 000	Terminal Board
TP1	614 0172 000	Tie Point
TP2	614 0132 000	Tie Point
V1	370 0105 000	Tube 6X4
XF1	402 0021 000	Fuseholder
XV1	404 0032 000	Socket

M5233 Basic Program Amplifier

Symbol No.	Gates Part No.	Description
C1	524 0079 000	Cap., 15-15-10 mfd., 450 V.
C2	524 0062 000	Cap., 20-20 mfd., 450 V.
C3	508 0143 000	Cap., .0056 mfd., 400V. w/1/4" leads
C4	506 0028 000	Cap., .1 mfd., 400 V.
C5,C7,C8	506 0028 000	Cap., .1 mfd., 400 V. (Min. lead length 1/4")
C6		Cap., (Det. by Freq. Response)
C9	506 0026 000	Cap., .47 mfd., 200 V. (Min Lead length 1/4")
C10,C14	506 0026 000	Cap., 47 mfd., 200 V. (Min. Lead length 1/4")
R1	540 0469 000	Res., 1200 ohms, 1 W., 10%
R2,R6,R11	540 0503 000	Res., 820K ohms, 1W., 10%
R3,R7	540 0495 000	Res., 180K ohms, 1 W., 10%

Symbol No.	Gates Part No.	Description
(R4A,R4B)	550 0198 000	Control, Dual 100K ohms
R5,R8	540 0470 000	Res., 1500 ohms, 1 W., 10%
R9	540 0480 000	Res., 10K ohms, 1W., 10%
R10	540 0478 000	Res., 6800 ohms, 1 W., 10%
R12,R13	540 0494 000	Res., 150K ohms, 1W., 10%
R14	540 0329 000	Res., 750 ohms, 1 W., 5%
R15	540 0349 000	Res., 5100 ohms, 1W., 5%
R16	540 0114 000	Res., 510K ohm, 1/2W., 10%
R17	540 0202 000	Res., 100K ohm, 1/2W., 10%
R19	540 0166 000	Res., 100 ohm, 1/2W., 10%
R20	540 0051 000	Res., 1200 ohm, 1/2W., 5%
R21	540 0097 000	Res., 100K ohm, 1/2W., 5%
T1	478 0144 000	Input Transformer
T2	478 0120 000	Output Transformer
V1,V2,V3	370 0155 000	Tube, 5879
V4	370 0114 000	Tube, 12AU7
XV1,XV2, XV3,XV4	404 0059 000	Socket

							GATES RADIO COMPANY QUINCY, ILLINOIS			C-77867 SCALE
106	105	104	103	102	101		LIST OF PARTS				
QTY	QTY	QTY	QTY	QTY	QTY	ITEM	REFERENCE		FIN.	DESCRIPTION	MATERIAL



2	ECN 8672 FHS 12-7-60
1	ECN 7434 CUN 5-8-59

TITLE
M5576 PROGRAM AMPLIFIER
WIRING DIAGRAM

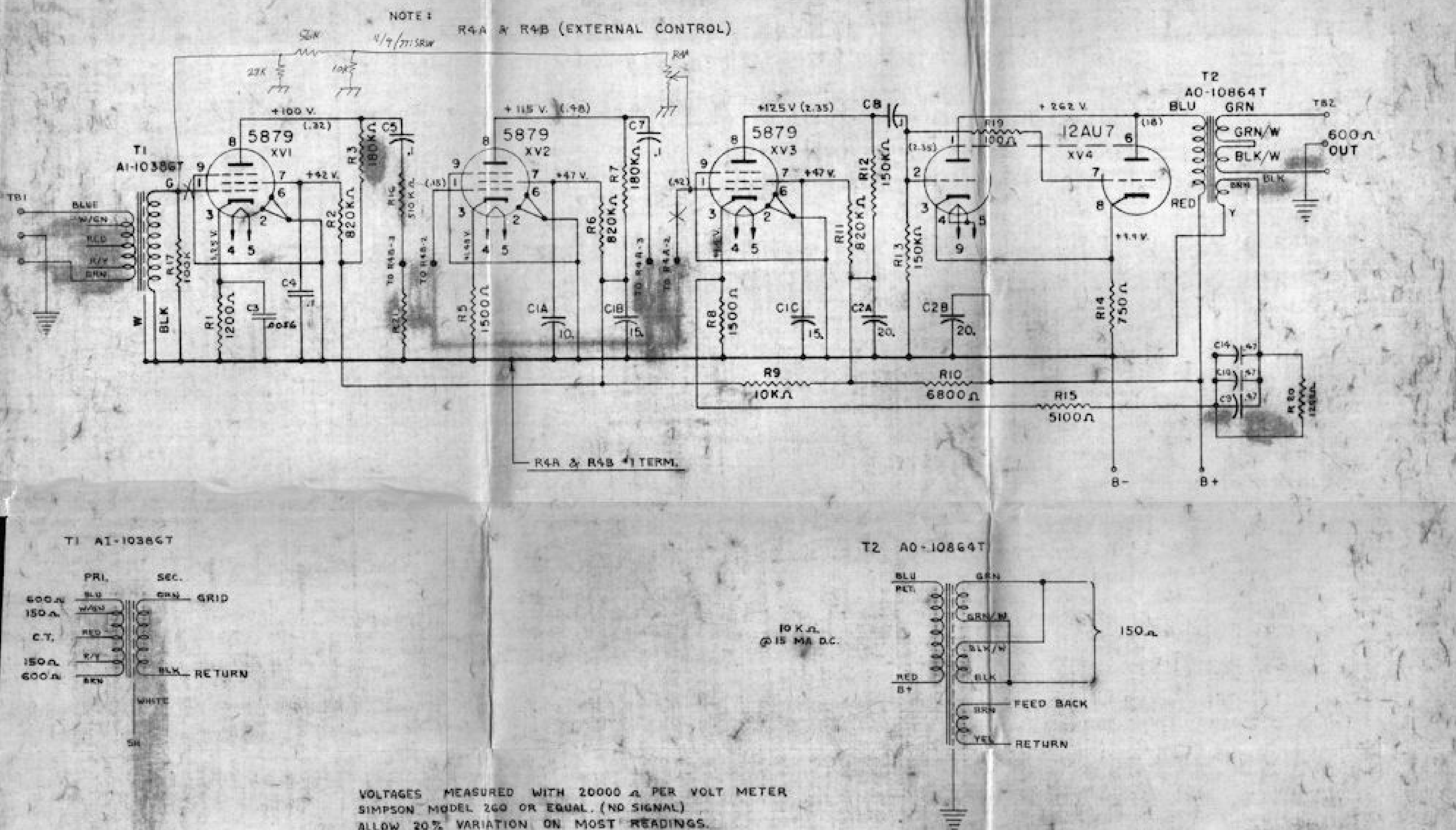
C-77867

GATES RADIO COMPANY
QUINCY, ILLINOIS

C-77870
SCALE —

LIST OF PARTS

106	105	104	103	102	101						
QTY.	QTY.	QTY.	QTY.	QTY.	QTY.	ITEM	REFERENCE		FIN.	DESCRIPTION	MATERIAL



VOLTAGES MEASURED WITH 20000 Ω PER VOLT METER SIMPSON MODEL 260 OR EQUAL. (NO SIGNAL)
ALLOW 20% VARIATION ON MOST READINGS.
( ) SIGNAL VOLTAGES TAKEN WITH -60 DBM INPUT AT 1000 CY, +12 DBM OUTPUT. ALL SIGNAL VOLTAGES EXPRESSED IN RMS

3	2	1
ECN # 8239 AWC 5-31-60	REDRAWN	ECN 7700

TITLE SCHEMATIC, PROGRAM AMPLIFIER, MS233K

C-77870

REPLACING COMPONENTS ON THE
PRINTED CHASSIS

Since this is a destructive operation, the engineer must be reasonably sure that the part is defective before removing it. He may determine this from the D.C. and signal voltage measurements or by visual observation.

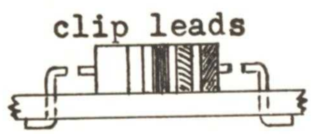
<u>WARNING:</u> The copper conductors are only .0027" thick on the printed chassis. They are easily damaged! Do not attempt to pull one component lead loose to check the component. Use only the approved procedure as outlined in the sketches and the sub-paragraphs listed below.

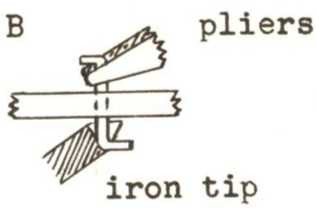
Use a small electric soldering iron (60 watts or less) and allow it to come up to full heat before starting the repair job. The tip must be clean and well tinned.

> <u>CAUTION</u>: Do not use a soldering gun. The extremely high temperature of the tip will damage the phenolic board.

Put the iron tip on the fillet under the chassis, right beside the component lead being removed. Put a gentle, but firm pressure on all leads and components being moved while the heat is applied. Do not hold the iron to the printed chassis for long periods of time. If the lead or component is difficult to remove, make repeated short passes at it rather than one long period that may overheat the board.

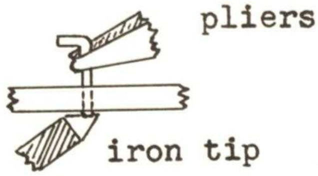
1. REMOVING PARALLEL MOUNTED COMPONENTS WITH AXIAL LEADS:

A


B


push wire through hole until hook can be clipped off.

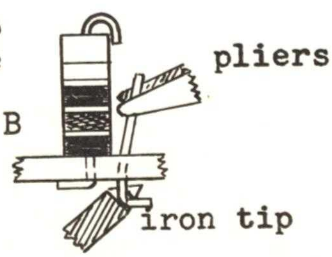
clip off hook that was soldered to chassis.

C


place iron on fillet again and pull the wire out of the hole on the top side of the chassis.

2. REMOVING VERTICALLY MOUNTED RESISTORS AND COMPONENTS WITH AXIAL LEADS:

A

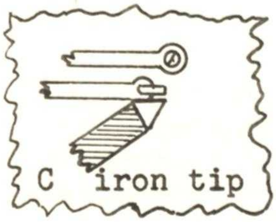

B


place iron on fillet and push wire through the hole until the hook can be clipped off.

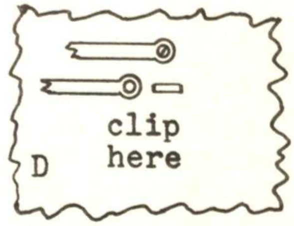
clip off hook that was soldered to chassis.

remove wire as illustrated in paragraph 1. (c).

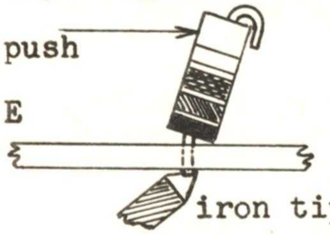
2. (continued)



place the iron against the folded wire and rotate it away from the conductor leading into the fillet (2-c).

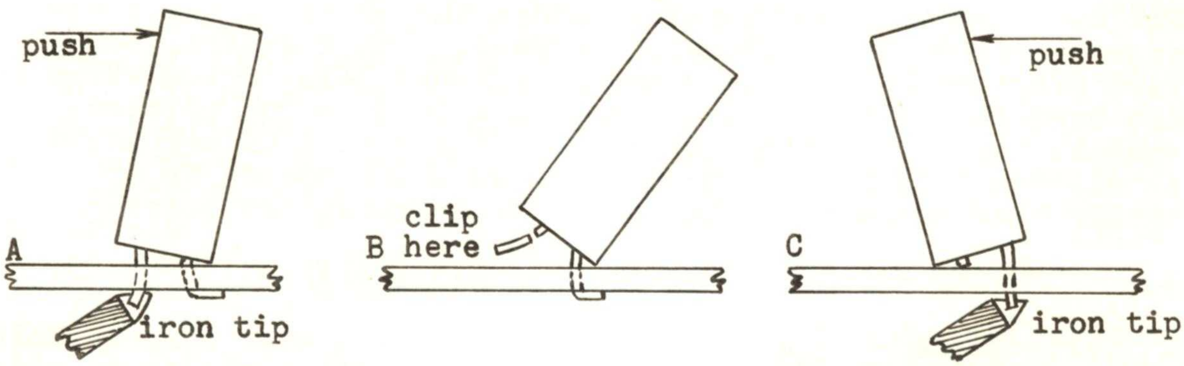


cut the wire as near the chassis as possible after removing as much excess solder as possible. Remove solder by carrying it away with the iron tip and wiping the tip on a clean cloth. Repeat until the hook can be clipped with small sharp diagonal cutters, illustrated in (2-D).



place iron on fillet again and push the resistor body over until the lead comes out of the hole.

3. REMOVING PRINTED WIRING TYPE CAPACITORS:

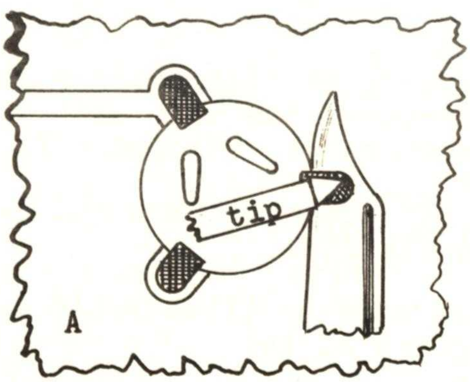


(A) hold iron tip on one of the folded leads, as soon as the solder melts - push gently but firmly on the side that will lift this lead. The capacitor should be pushed over just far enough to clear the lead from the hole.

(B) cut the lead off to prevent it from going back into the hole when removing the other lead.

(C) hold the iron tip to the other lead and push the capacitor over until it comes free.

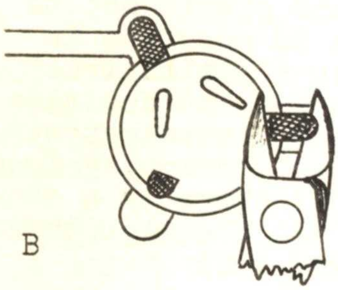
4. REMOVING SADDLE TYPE ELECTROLYTIC CAPACITORS:



Place the iron tip on top of the folded over mounting ear. As the solder melts, slip a thin knife between the mounting ear and the copper conductor pad. DO NOT PRY THE TAB UP WITH THE KNIFE! See (4-B) for bending ears away from chassis. When the knife is completely under the ear, remove iron and let the solder cool.

Repeat on other two mounting ears.

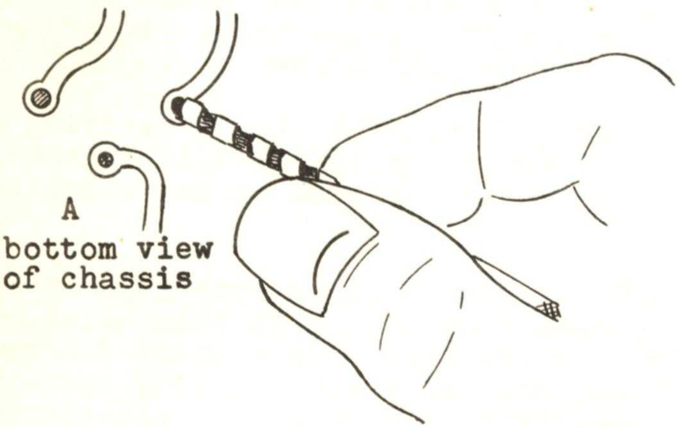
4. (continued)



Using a pair of small sharp diagonal cutters, bend the mounting ears up and away from the copper conductor pads. DO NOT PRY THE MOUNTING EARS UP WITH A KNIFE OR SCREWDRIVER!

Repeat the process on the other two mounting ears and drop the capacitor off the board.

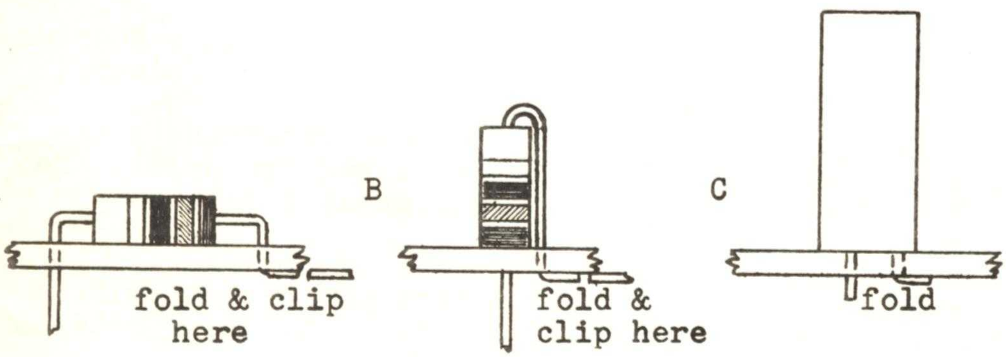
5. PREPARING THE HOLES FOR THE REPLACEMENT COMPONENT:



Use a small metal twist drill (1/8" dia. or less) to clear the hole only in the fillet of solder. Twirl the drill by hand. Do not attempt to remove all of the solder in one turn, do it slowly and carefully.

Do not attempt to increase the hole size, just remove the solder. It is soft and easily removed in this way.

6. REPLACING THE COMPONENTS:



(A) & (B) Fold the leads on the new part to the same spacing as the mounting holes. Insert the part and fold the leads under the chassis to hold the part tightly against the top of the chassis. Clip off the excess wire.

Put the iron tip on the fillet and lead. Solder swiftly and securely. If the printed chassis is damaged by accident it is seldom necessary to scrap it. If one of the conductors is broken, lay a piece of small wire (#18 to #24 AWG) across the break and solder each end to the conductor. If a fillet is pulled loose, break it off to get rid of the loose end. Fold the new component lead toward the end of the conductor and solder the lead to the conductor. If the component lead is cut too short, lay a small piece of wire across the gap solder it in.

7. REPLACING TUBE SOCKETS:

Tube sockets are very difficult to replace and should not be replaced until you are positive that the one in question is actually defective. Resolder all of the socket pin fillets to assure that this is not the trouble. Inspect the top side to see if the tube pin sleeve is bent and can be straightened. Use a socket alignment tool to re-size. Check continuity from the top to the bottom side of the chassis. If there is a connection and the socket sleeve is not out of alignment or spread open, the socket is O.K. and should not be removed.

(A) If the socket has been damaged or is excessively corroded it must be replaced. Stand the unit so that the chassis is vertical. Hold a small iron to the hex nut in the center of the socket (if the socket is retained in this manner). After the solder has melted, unscrew the retaining screw.

(B) Remove the excess solder from all pin fillets by carrying it away with the tip of the iron. Repeat until all solder that will come loose is removed. Do not hold the iron to the chassis for long periods of time.

(C) Starting at pin 1 or pin 7 (8 or 9 on other sockets), apply the iron and push against the socket to raise it at this point. Use the thumb and fingers only to raise socket to prevent damage to the board. The socket will not move very much but any movement at all is helping. Place the iron on each pin in rotation around the socket while pushing up on the side of the socket adjacent to the pin being heated. After several passes around the socket it will no longer be held in by solder. Gently rock the socket and pull it free of the holes.

(D) Use a small metal twist drill as illustrated in paragraph 5 of these instructions to clear the fillet holes of solder.

(E) Install the new socket and put in a new retaining screw similar to the one removed (if retaining screws are used). Do not tighten the nut excessively and put a great strain on the phenolic board.

(F) Solder the screw, nut and each socket pin fillet swiftly and securely. Be sure that there is no solder bridging between adjacent fillets or conductors.

(G) If one of the fillets was damaged in the replacement operation, form a small loop on the end of a small piece of wire. Drop the loop over the socket pin and lay the wire to join the proper conductor. Flow solder on the connections and clip off the excess wire.

From the Engineering Department of
The Gates Radio Company
A Subsidiary of the Harris-Intertype Corp.