M6108 TRANSISTOR MONITOR AMPLIFIER

INSTRUCTION BOOK

GATES RADIO COMPANY
A Subsidiary of Harris-Intertype Corporation
QUINCY, ILLINOIS

IB #888 0646 001

TECHNICAL DATA

Gain:

53 db (matching 600 ohm).
39 db min. (bridging 6,000 ohm)

Frequency Response:

± 1.0 db from 20 to 20,000 cps @ normal output level.

Harmonic Distortion:

Under 1.0% from 30 to 15,000 cps @ + 38 dbm output (6 watts).
Under 1.0% from 50 to 15,000 cps @ + 39 dbm output (8 watts).

Intermodulation Distortion:

Under 1.0% at + 38 dbm equivalent sine wave power output, using 40 and 7000 cps mixed 4:1.

Noise Level:

- 85 db below rated output level (+ 39 dbm).

Source Impedances:

600 ohms for 600 ohms matching input.
150/600 for 6000 to 10,000 ohm bridging input.

Input Impedances:

600 ohms matching input, balanced (transformer input).
6,000 ohms, bridging input, balanced (bridging pad and transformer input).

Load Impedances:

4 to 16 ohms (8 ohms nominal), unbalanced (transformerless output, isolated from AC ground by power transformer).

Output Impedance:

1.2 ohms, approximately.

Maximum Input Level:

0 dbm.

Maximum Output Level:

+ 39 into 8 ohms (8 watts).

Maximum Operating Ambient Temperature:

55° C. (131° F.)

Maximum Storage Ambient Temperature:

85° C. (185° F.)

Power Requirements:

117 Volts at 50/60 cps., 18 watts.

Transistors:

2 - 2N1414	1 - 2N1225
1 - 2N214	2 - 2N1539
2 - 2N1183	

Rectifiers:

4 - X5A2 (silicon)

Finish:

Light grey cover, flat black heat sink chassis.

Mounting:

Two keyhole slots, rubber bumpers on bottom, permanent or movable mounting in any position.

Size:

3-1/4" high, 4-3/8" deep, 8-1/2" long.

Weight:

4 lbs., net. 7 lbs., packed.

Cubage:

0.9 cu. ft., domestic pack.

DESCRIPTION

The M6108 Monitor Amplifier is a transistorized, self-contained amplifier designed for use in broadcasting, recording, and general sound reinforcement applications. Special techniques have been employed to obtain reliability, low distortion, and good temperature stability. The amplifier can be mounted in any position and does not require ventilation when handling 8 watts of program material. The input, power, output connections, fuse and input level control are mounted on end panels of the chassis.

INSTALLATION

MOUNTING

The amplifier has been provided with two keyhole slots for #8 screws for fixed or permanent mounting.

INPUT CONNECTIONS

Provisions are made for changing from 600 ohm matching to 6,000 ohm bridging on the input terminal strip. Fig. 1 shows the connection for 600 ohms. Fig. 2 shows the connection for 6,000 ohm bridging.

In the event that a preamplifier driver is used requiring a minimum load of 10,000 ohms, a 2200 ohm resistor may be added at each bridging input terminal. With this change, 1.5 volts input will be required for full output.

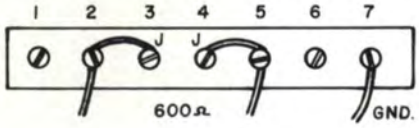


Fig. 1

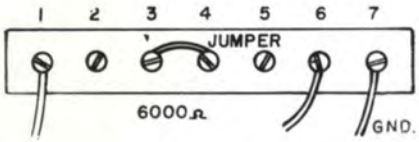


Fig. 2

OUTPUT CONNECTIONS

Output connections are made to the two lug terminal strip on the end plate of the chassis. Groups of speakers may be driven with this amplifier; connected in series, parallel, or series parallel; but the combined impedance should not be less than 4 ohms. With an impedance of more than 12 ohms, the amplifier will not be able to deliver full output power. Speaker matching transformers permit the paralleling of a number of speakers, depending on the unit required. Gates Part No. 813 0601 001 transformer is available, having a primary of 48 ohms and a secondary of 8 ohms for matching purposes.

In wiring speaker loads it should be remembered that 8 watts at 8 ohms represents 1 ampere of audio current. The recommended use of No. 16 gauge twisted and shielded wire will prevent power losses and possible interaction of circuits.

AMPLIFIER PARALLELING

It is not recommended that amplifiers of this type be paralleled at their outputs to obtain higher power. Where more power is required than can be supplied by one amplifier, the speaker load should be divided between several amplifiers which have their inputs bridged across the common signal source.

POWER CONNECTIONS

117 volts A.C., 50/60 cycles is supplied thru the power cord and power plug on the chassis end plate. A power switch is not required due to the low power consumption and heat dissipation.

NOTE

While the amplifier can handle a continuous 8 watts of program material, CAUTION should be exercised during full power sine wave testing to avoid exceeding the thermal capabilities of the chassis heat sink. During these tests it is recommended that a duty cycle of 30 seconds on to 3 minutes off be used to allow heat build-up to dissipate.

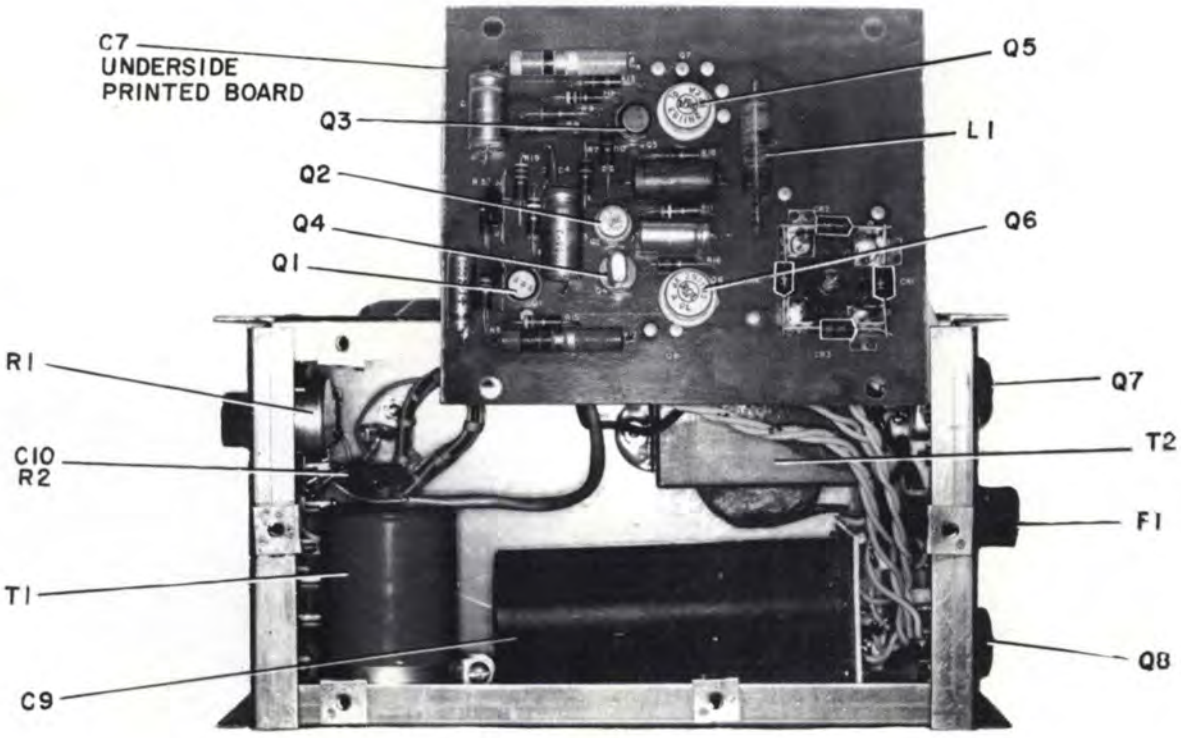
M6108 MONITOR AMPLIFIER

THEORY OF OPERATION

The amplifier is driven by an input transformer which provides for isolation and matching functions in the primary by means of split windings and resistive pads. The input level control provides a constant load to the input transformer secondary while furnishing a gain control function. Transistor Q1 operates as an emitter follower and provides impedance matching from the input to the voltage amplifier, Q2. Note that Q2 is the only stage which has voltage gain. A high frequency transistor is used at this point to improve stability. The output stages of the amplifier operate Class B, and are arranged in the circuit configuration known as "single ended push-pull" or a "followed emitter follower". The upper and lower units are in series across the power supply, and the load is connected at their junction. When the signal at the collector of Q2 goes negative; Q3, Q5, and Q7 conduct; since they are all PNP types. When the signal goes positive; Q4, Q6, and Q8 all conduct; since Q4 is an NPN type. Thus, the full signal appears at the junction point. Q3, Q5, Q7, and Q6, Q8 are connected in a compound or "Darlington" configuration, a connection which provides extremely high current gain, and improves linearity at high signal levels.

General feedback loops are employed in the amplifier including R3, R19, C2, C4, and C5. C2 and C4 provide high frequency feedback while C5 supplies positive feedback from the output to the collector circuit of Q2 to increase the signal handling capacity of this stage.

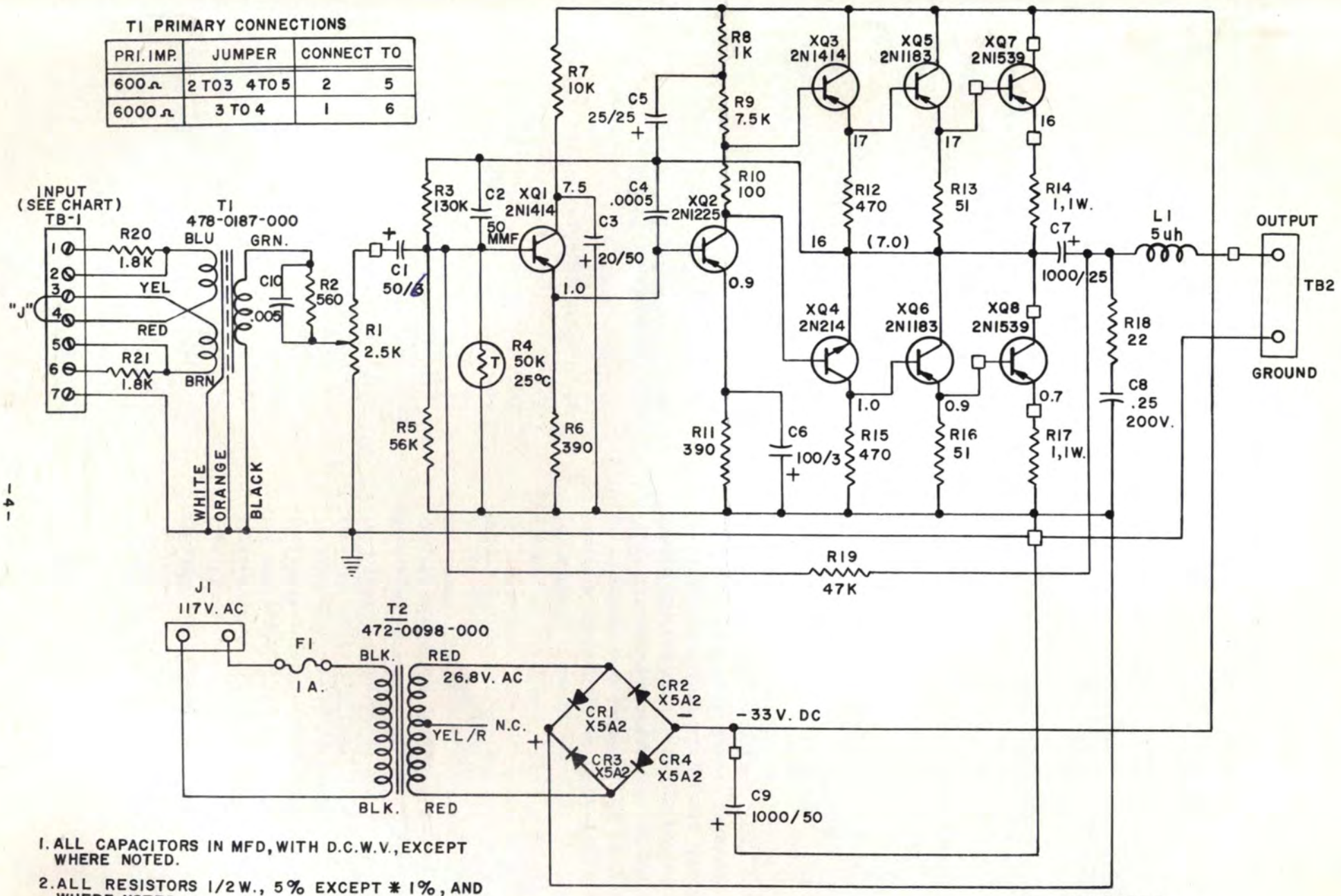
Thermistor R4 compensates for variations in the amplifier bias due to temperature changes. Choke L1 renders the amplifier insensitive to changes in capacity across the output leads. The power supply is a conventional full wave bridge rectifier with filter capacitor circuit.



PARTS LOCATION
M6108 TRANSISTOR
MONITOR AMPLIFIER

T1 PRIMARY CONNECTIONS

PRI. IMP.	JUMPER	CONNECT TO	
600Ω	2 TO 3 4 TO 5	2	5
6000Ω	3 TO 4	1	6



1. ALL CAPACITORS IN MFD, WITH D.C.W.V., EXCEPT WHERE NOTED.
2. ALL RESISTORS 1/2W., 5% EXCEPT * 1%, AND WHERE NOTED.
3. □ DESIGNATES BOARD LUG CONNECTIONS.
4. D.C. VOLTAGES MEASURED AGAINST B+, WITH 20KΩ VOLT METER, AT +38 DBM OUTPUT.
5. ( ) R.M.S. SIGNAL VOLTAGES AT 1KC, -15 DBM INPUT, (600Ω) +38 DBM OUTPUT.

SCHEMATIC
M6108 TRANSISTOR
MONITOR AMPLIFIER
6-19-61 813 6261 001

MAINTENANCE

PREVENTIVE MAINTENANCE

The M6108 Monitor Amplifier is designed for long, trouble-free service. However, as with all high quality electronic equipment, a regular program of inspection should be followed. These points should be covered:

1. Check the power amplifier supply voltage at the collector of Q5 or Q7. On the power transistors, such as the 2N1183 and 2N1539, the collector is connected to the case.

2. Check the speaker bus voltage, which appears at the collectors, or cases of Q6 and Q8.

3. Remove dust which collects on the printed board or in the housing, with a soft brush.

It is recommended that when the amplifier is first placed in operation, that D.C. voltages be measured with the same voltmeter that will be used for maintenance and troubleshooting, and that these readings be recorded on the amplifier schematic. The speaker bus and B- voltages should be recorded with an without signal.

SERVICING

When servicing the amplifier, the following points should be observed:

1. The condition of the power supply can be most readily checked by measuring the D.C. voltage between the chassis and the case of output transistor Q8. (One of the two power transistors mounted on the end of the chassis). This voltage will be much higher or lower than normal if trouble is present in the power amplifier.

2. Voltages may be checked with Q5, Q6, Q7 and Q8 removed, provided that the speaker load is disconnected.

3. Circuit resistances should be measured only after removing the associated transistor or transistors, to prevent damage due to ohm-meter battery voltage.

4. Do not remove or insert transistors with the power on.

5. Do not probe the printed board with a metal probe with the power on.

6. Circuit voltages are reversed from standard vacuum tube practice, as is the polarity of all electrolytic capacitors.

7. The location of the positive end of each electrolytic capacitor is indicated by the white dot marked on top of the circuit board.

8. When replacing either Q7 or Q8, and before turning on the power, check with an ohm-meter between transistor case and chassis to make certain that a short circuit does not exist. Note that insulating washers are placed under the transistors to provide insulation.

PRINTED CHASSIS COMPONENT REPLACEMENT

1. CHECKING COMPONENTS

The components should be carefully checked by measuring circuit voltages and resistances before attempting to remove one of the leads from the printed chassis. Extreme care must be exercised in removing the lead to prevent damage to the board or conductors. This operation should not be considered unless it is the only way the component can be checked.

If one lead must be removed without damage to the component, apply a well cleaned and tinned 25 to 60 watt iron to the fillet adjacent to the lead. With small long nose pliers or thin screwdriver, pry the folded portion of the lead in line

with the hole. Applying the iron for more than four seconds at a time may damage the chassis base material.

Remove as much solder from the lead as possible. Remove all the kinks in the wire. With heat applied, gently pull the wire through the hole.

2. RESOLDERING THE COMPONENT LEAD

If the component is good, replace as follows: Use a metal twist drill (1/8" dia. or less) to clear the hole only in the fillet of solder. Turn with the fingers only. Remove solder slowly to prevent the drill from tearing the fillet.

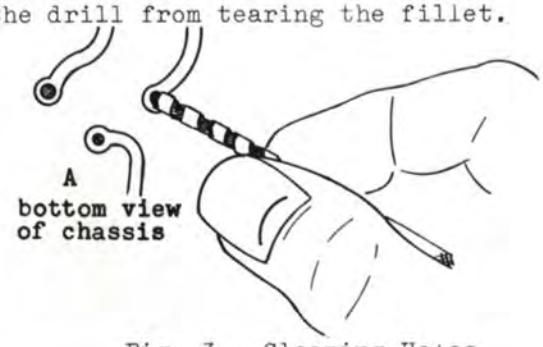


Fig. 3 - Cleaning Holes

With the iron applied to the fillet, pull the wire gently out of the component side of the chassis:

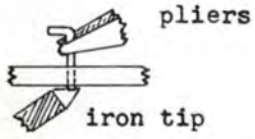


Fig. 4 - Removing Lead

Be sure the component lead is straight and free of solder. Push it gently back thru the hole until some of it shows on the other side. Solder carefully but rapidly to prevent chassis damage.

3. REPLACING COMPONENTS

Components can be replaced with less chance of damage to the chassis than the removal and rewiring of one of the leads. Remove as follows: Clip the leads close to the body of the component. Heat the fillet and gently push the wire thru until the hook may be clipped off. Clip the hook off (on the soldered side) with sharp cutters.

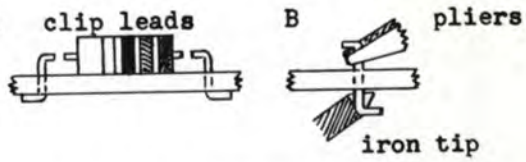


Fig. 5 - Removing Components

After removing the leads, prepare the chassis for the new component as explained in paragraph 2 and Fig. 3.

To replace the component, 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 component firmly against it:

Fig. 6 - Installing New Component

Clip off the excess wire. Place the iron on both the component lead and fillet. Solder carefully and rapidly to prevent damage to the chassis base. If one of the conductors is damaged, it is seldom necessary to scrap the printed chassis. Lay a small piece of wire (#18 to 24 ga.) across the break and solder each end to the conductor.

If the fillet is pulled loose, break it off to get rid of the loose end. Fold the new component lead to lay on the conductor and solder. If the component lead is too short, solder in another piece of wire to bridge the gap. Printed chassis construction places no mechanical strain on repairs of this nature, thus, soldering alone will provide sufficient mechanical strength even with heavy shock and vibration in almost every case.

The base material used on the printed chassis is the best available for this service. The two ounce copper is twice as heavy as used in average applications of this type of equipment. This assures reliable service and repair.

MODIFICATION OF THE GATES'

M-6108 TRANSISTOR MONITOR AMPLIFIER

FOR CURRENT LIMITING.

If the output of the M-6108 Monitor Amplifier should be accidentally shorted, or if oscillation in the amplifier should develop, excess current flow through the output stage could damage the 2N1539 output transistors or the emitter resistors in this stage.

A current limiting device has been incorporated in the amplifier to limit the output stage current under such conditions to a safe level, thus preventing damage to the amplifier. This device in no way affects the normal operation of the amplifier.

Refer to drawing 813 6261 001, the schematic of the monitor amplifier and drawing 813 7719 001, the schematic of the current limiter for a better understanding of the operation of this circuit. Transistors XQ9 and XQ10 are connected as a direct coupled amplifier and act to amplify the voltage drop across R17, the emitter resistance for XQ8, one of the output transistors. When the voltage drop across this resistor exceeds a certain predetermined level, (due to excess current flow in the output stage) XQ11 becomes saturated since its base is direct coupled to the collector of XQ10 of the voltage sensing amplifier. The collector of XQ11 is connected to the collector of XQ2. When XQ11 reaches saturation, the effective impedance between collector and emitter becomes very low. Therefore, the collector of XQ2 is effectively grounded through R26. This action pulls the center bus of the single-ended push-pull output stage down, limiting the output stage current to a safe value.

It should be remembered that a full 8 watts of program material can be handled safely by the amplifier. If this limit is exceeded, program peaks will cause the amplifier to go into current limiting as explained above. This is not a fault of the amplifier but simply a result of the current limiting device performing properly.

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.

WARNING: 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.

CAUTION: 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 clip leads

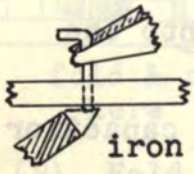
B pliers

iron tip

push wire through hole until hook can be clipped off.

clip off hook that was soldered to chassis.

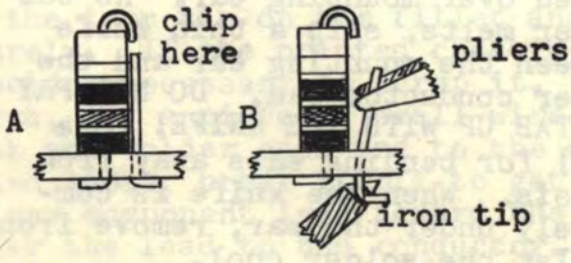
C pliers



iron tip

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:

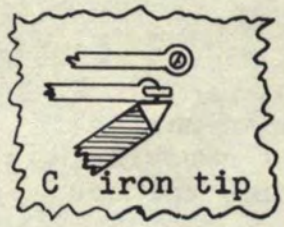


place iron on fillet and push wire through the hole until the hook can be clipped off.

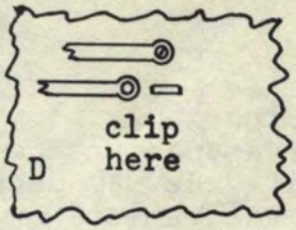
clip off hook that was soldered to chassis.

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

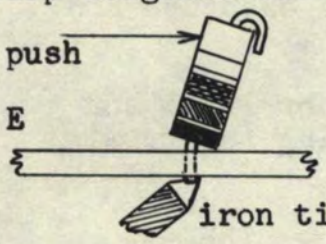
2. (continued)



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

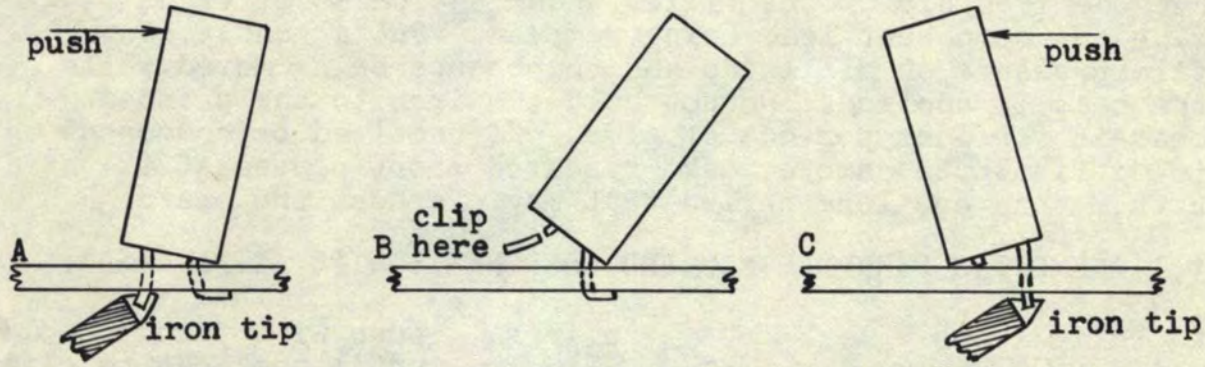


cut the wire as near the chassis as possible after removing as much excess solder as possible. Remove solder by carrying it away with the iron tip and wiping the tip on a clean cloth. Repeat until the hook can be clipped with small sharp diagonal cutters, illustrated in (2-D).



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:

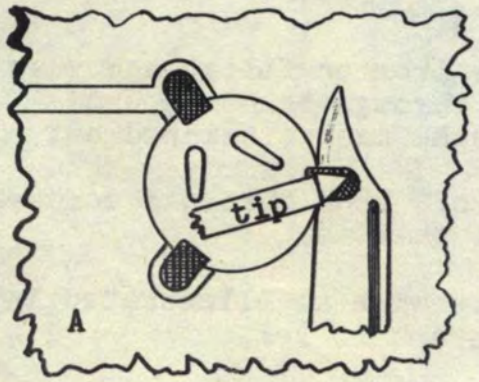


(A) hold iron tip on one of the folded leads, as soon as the solder melts - push gently but firmly on the side that will lift this lead. The capacitor should be pushed over just far enough to clear the lead from the hole.

(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.

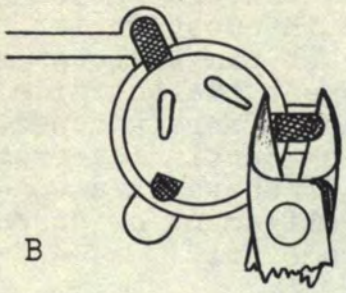
4. REMOVING SADDLE TYPE ELECTROLYTIC CAPACITORS:



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.

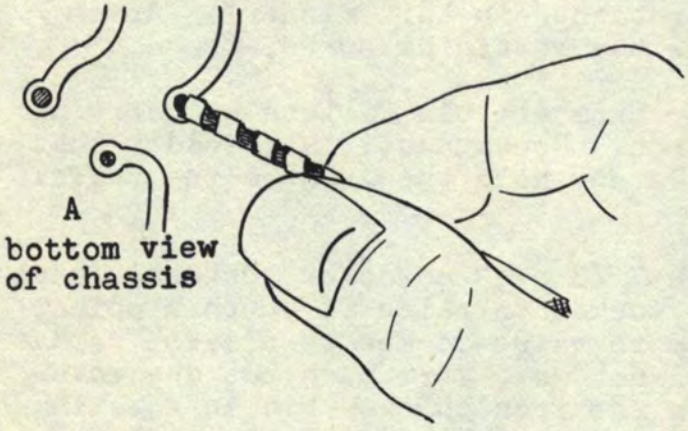
4. (continued)



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.

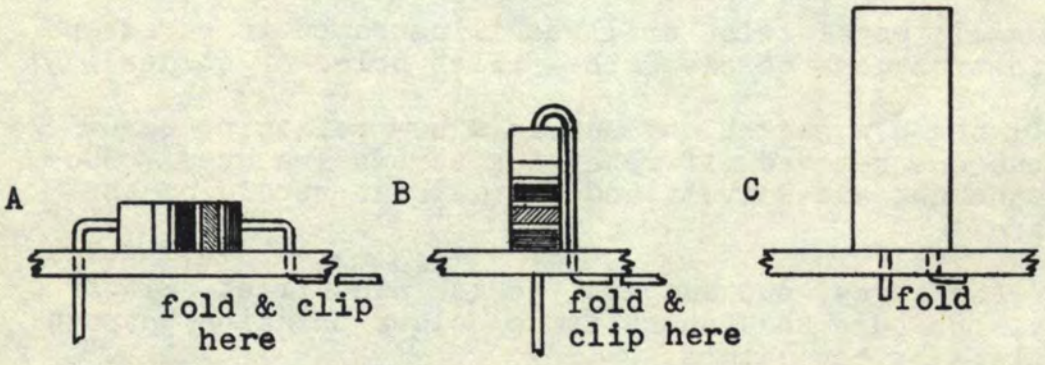
5. PREPARING THE HOLES FOR THE REPLACEMENT COMPONENT:



Use a small metal twist drill (1/8" dia. or less) to clear the <u>hole only</u> 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.

PARTS LIST

Symbol No.	Gates Part No.	Description
C1	522 ~~0158~~ 0182 000	Cap., 50 ufd., ~~3~~ 6 V.
C2	500 0818 000	Cap., 50 uufd., 500 V.
C3	522 0256 000	Cap., 20 ufd., 50 V.
C4	516 0045 000	Cap., .0005 uf., 1 KV. ± 10%
C5	522 0242 000	Cap., 25 ufd., 25 V.
C6	522 0160 000	Cap., 100 ufd., 3 V.
C7	522 0306 000	Cap., 1000 ufd., 25 V.
C8	506 0006 000	Cap., .25 ufd., 200 V.
C9	524 0100 000	Cap., 1000 ufd., 50 V.
C10	508 0076 000	Cap., .005 ufd., 100 V.
CR1, CR2, CR3, CR4	384 0062 000	Silicon Rectifier
F1	398 0054 000	Fuse, 1 amp., 250 V.
J1	250 0025 000	Receptacle and A.C. Line Cord
L1	494 0135 000	Choke, RF, 5 uh.
Q1, Q3	380 0014 000	Transistor, 2N1414
Q2	380 0013 000	Transistor, 2N1225
Q4	380 0011 000	Transistor, 2N214
Q5, Q6	380 0012 000	Transistor, 2N1183
Q7, Q8	380 0016 000	Transistor, 2N1539
R1	550 0218 000	Potentiometer, 2500 Ohm
R2	540 0043 000	Res., 560 Ohm, 1/2 W., 5%
R3	540 0100 000	Res., 130K ohm, 1/2 W., 5%
R4	559 0002 000	Thermistor, 50K ohm
R5	540 0091 000	Res., 56K Ohm, 1/2 W., 5%
R6	540 0039 000	Res., 390 Ohm, 1/2 W., 5%
R7	540 0073 000	Res., 10K Ohm, 1/2 W., 5%
R8	540 0049 000	Res., 1K Ohm, 1/2 W., 5%
R9	540 0070 000	Res., 7.5K Ohm, 1/2 W., 5%
R10	540 0025 000	Res., 100 Ohm, 1/2 W., 5%
R11	540 0039 000	Res., 390 Ohm, 1/2 W., 5%
R12, R15	540 0041 000	Res., 470 Ohm, 1/2 W., 5%
R13, R16	540 0018 000	Res., 51 Ohm, 1/2 W., 5%
R14, R17	540 0843 ~~542 0703~~ 000	Res., 1 Ohm, 1 W., 5%
R18	540 0009 000	Res., 22 Ohm, 1/2 W., 5%
R19	540 0089 000	Res., 47K Ohm, 1/2 W., 5%
R20, R21	540 0055 000	Res., 1.8K Ohm, 1/2 W., 5%
T1	478 0187 000	Transformer, Input
T2	472 0098 000	Transformer, Power
TB1	614 0218 000	Terminal Strip, 7 terminal
TB2	614 0213 000	Terminal Strip, 2 terminal
XCR1, XCR2, XCR3, XCR4	402 0039 000	Diode Board
XF1	402 0023 000	Fuseholder
XQ1, XQ2, XQ3, XQ4	404 0066 000	Socket
XQ7, XQ8	404 0136 000	Socket