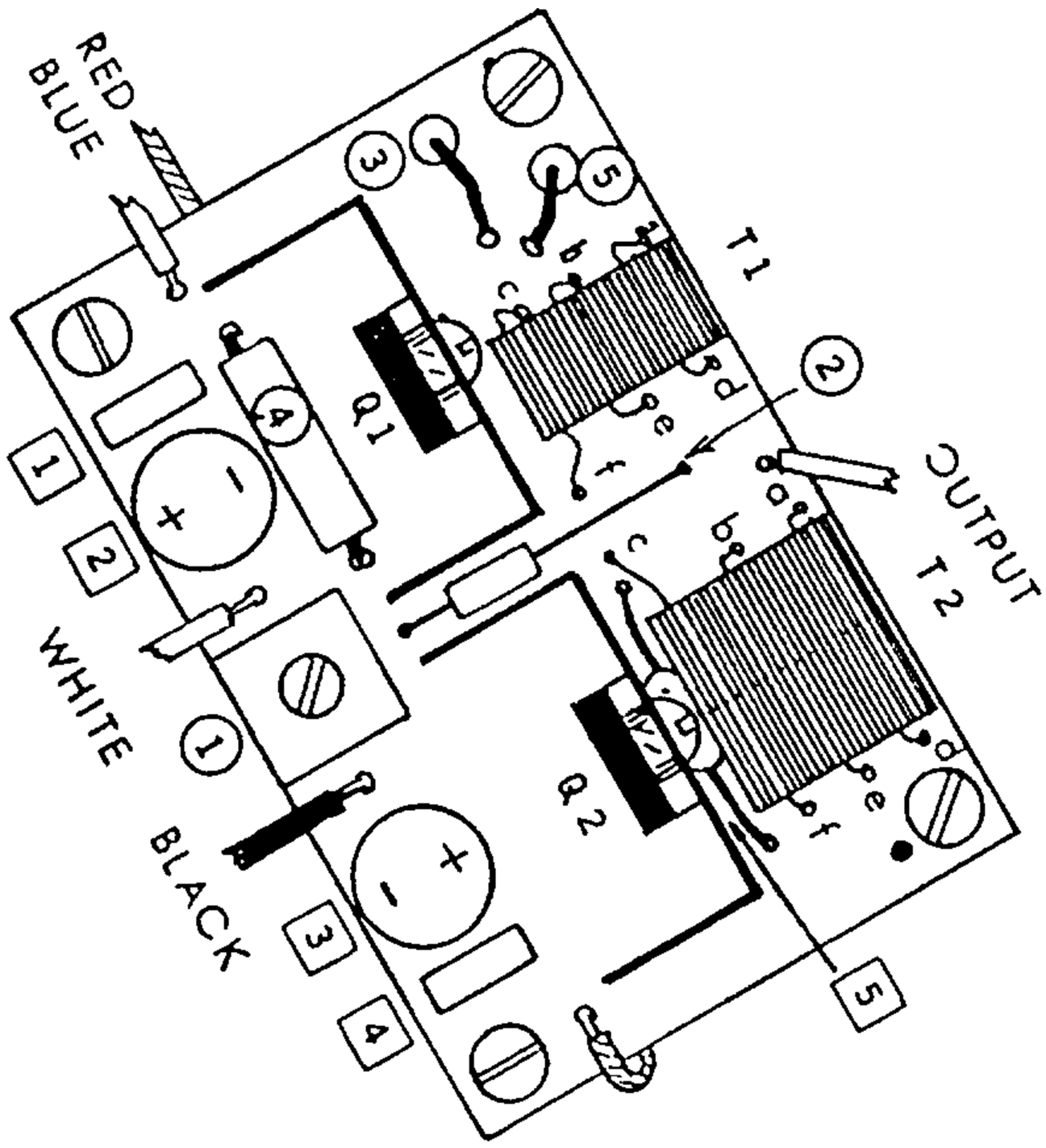
AMA 5000

Broadband

MW Power

Amplifier

.5-3 Watts



CONSTRUCTION PLANS

AM POWER AMPLIFIER AMA-5000

The AMA-5000 is a small linear amplifier. It has a broadband response to cover frequencies of 540 kHz through 1600 kHz without tuning. It has a nominal power gain of 17 dB - essentially 50 times its input power. Its maximum rated power output is 5 watts. A 100 mW input will give a 5 watt output into a 50 ohm load.

The amplifier was designed to boost power in carrier-current applications but may be used in other areas as well. It can be used as a repeater or remote RF amplifier. it can be used to drive signals through 50 ohm coax cable for induction type broadcasting. It can be used in school coridors and dormitories, churches, condo's, drive-in theaters, and apartment complexs.

Although the AMA-5000 is capable of feeding an antenna system, either simple or complex, it is strictly against FCC Rules. An even fair antenna and 5 watts can cover up to 20 miles and more under the right conditions. If you use this unit for that purpose you must be prepared to take full responsibility.

The AMA-5000 may be installed in any cabinet you wish. It requires a dual 12 volt power supply of - 12 and + 12 at .6 amps. It was designed however to fit within the AM-100 (100 mW) transmitter cabinet and share the common power supply.

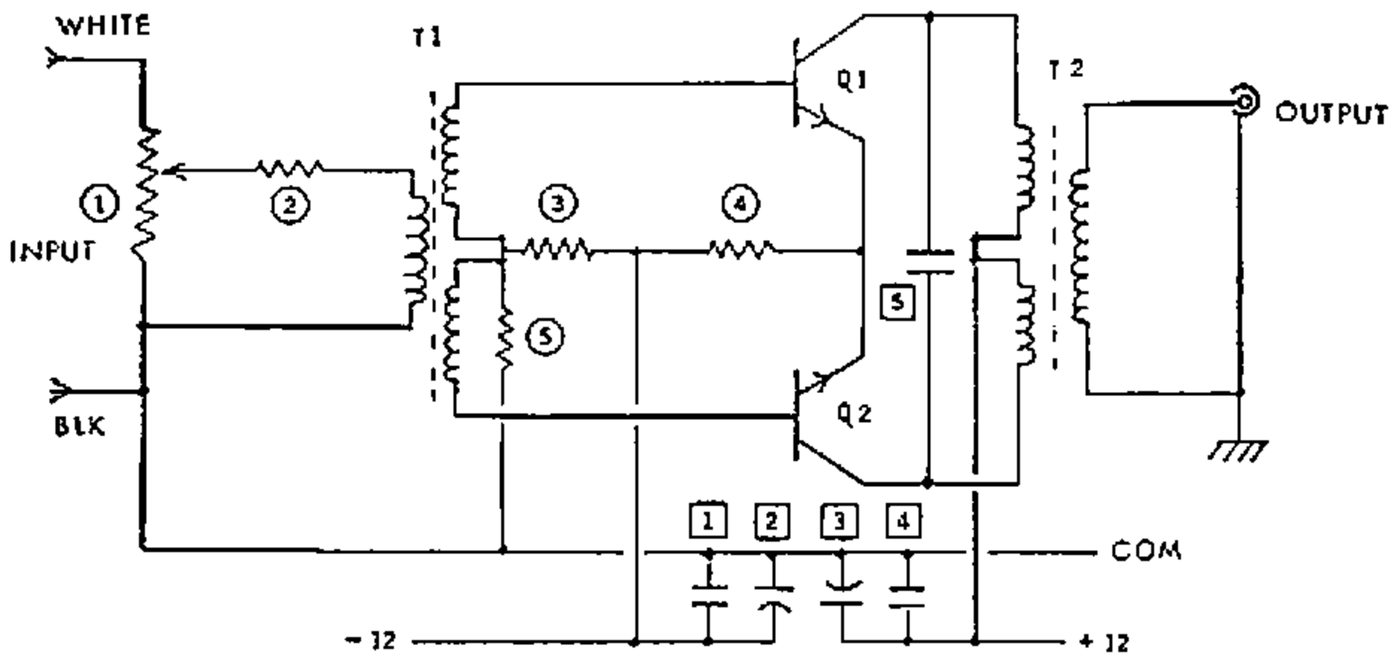


Fig. 1 Schematic Diagram

PARTS LIST

Part Number	Value/Description	Color Code/Remarks
R1	500 ohm trimmer pot	pc mcunt 3/8" square
R2, R3	22 ohm 1/4 watt resistor	(Red)(Red)(Blk)
R4	2.2 ohm 1 watt resistor	(Red)(Red)(Gold)
R5	680 chms 1/4 watt resistor	(Blu)(Gra)(Brn)
C1,C4	.1 uF, 12 volt disc capacitor	may be marked 104
C2,C3	330 uF, 16 volt electrolytic	Radial leads, 3/8" dia
	.002 uF, 100 v or better disc	may be marked 202
Q1,Q2	2SC1909 or 2SC1678 or 2SC1975	
2-heatsinks	Thermalloy 6030B or equiv.	
T1	3 windings of 14 turns each #24 varnished wire (60")	Wound on Amidon FT50A-75 ferrlte core
T2	2 windings of 14 turns each & 1 winding of 28 turns, all #24 varnished wire (75")	Wound on Amidon FT50B-75 or two FT50A-75 cores held together
PC Board	PanaxisAMA-5000	
Hardware	2-each 4-40 x 1/4" screws	
	1-each 3/4" 4-40 screw	
	3-each 4-40 hex nuts	
	1-each aluminum spacer 1/2" L.	
	3-each pvc spacers 1/2" long	
	6-each 4-40 x 1/4" tap screws	
Hookup wire	8" each of blue and red #24	

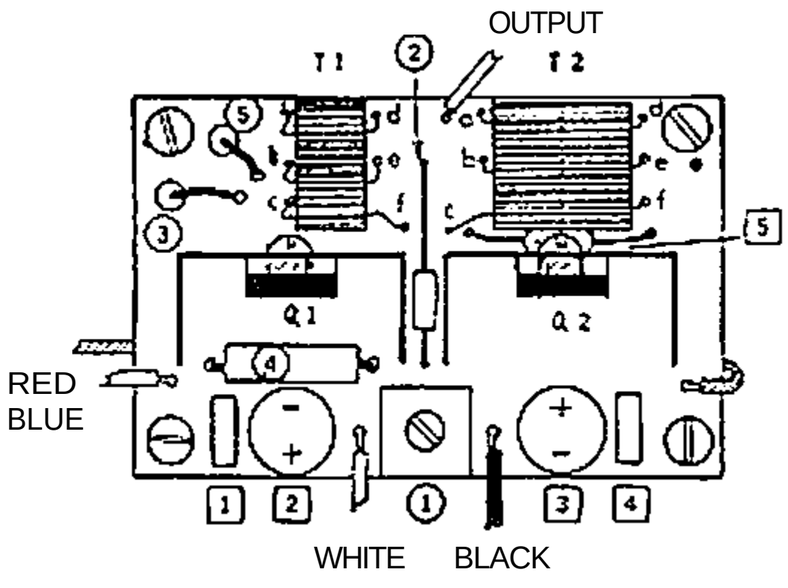


Fig. 2 Assembly Drawing

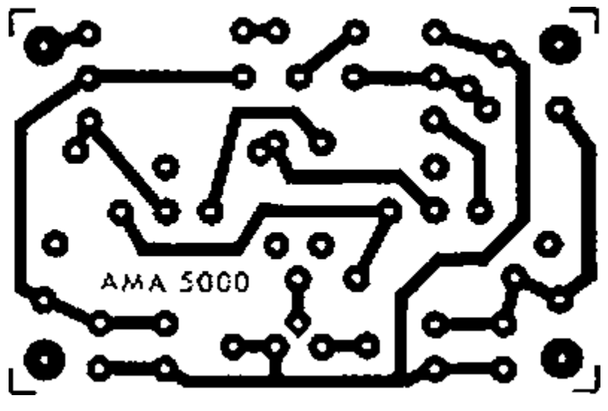


Fig. 3 Printed Circuit Layout

ASSEMBLY INSTRUCTIONS

Transformer Preparation:

Take three 20" lengths of #24 varnished wire and lay them out parallel to each other. Put one end of each wire into the chuck of an electric drill and tighten the chuck. Hold the wires at the other end while keeping tension on them to reduce any slack In the wire. The idea now is twist the wires together gently, not too tight nor too loose - about 3 to 5 turns to the inch. Operate the electric drill in short bursts until the wires are twisted together properly. These will be used in winding transformer T1.

Take two 20'' lengths of # 24 varnished wire and do the same thing with them. These will be used in winding transformer T2.

Take the Amidon FT50A-75 core and your twisted three wires and begin winding. Thread the wires through the center hole of the core bring it around and through the hole again, etc. Stop when you have 14 turns. You may have an excess of wire, but you will only need a couple of inches of ends sticking out.

Take the Amidon FT50B-75 core, or two FT50A-75 cores held together, and your twisted two wires and wind transformer T2. Stop at 14 turns. Leave about two inches of ends sticking cut.

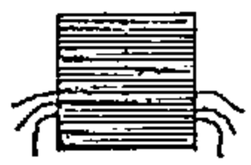
Take 36" of #24 varnished wire and wind it onto T2. Go around twice placing the wire, one turn at a time, between the previous twisted windings. Start where the previous winding begins, you should end where the previous winding ends. All the wire ends should be about the same location on the core (see drawing example). You should have 28 turns on this last winding.

Installation of transformers

You have 3 separate windings on each transformer. These must be identified and the ends installed in the proper holes in the pc board.

Scrape a little varnish off the ends of each wire. Untwist the twisted wires so they can be separated from each other.

With the aid of an ohmmeter find each of the windlngs ends. Install T1 first. Note that a winding's wire ends come out on opposite sides of the core. Install the ends of one winding in holes (a) and (d). The next winding in holes (b) and (f). The last winding's ends go In holes (c) and (e). At no time does any wire cross over to the other side of the core!



Example of T2

Gently pull on each wire to remove slack and to hold the core against the board.

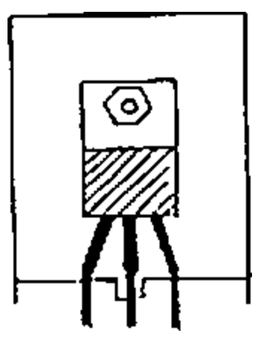
Now install T2. Again find the windings with an ohmmeter, Untwist the double wires so they are free of each other. The 28 turn winding ends go in holes (a) and (d). One of the 14 turn windings has its ends going in holes (b) and (f). The other 14 turn winding has its ends going to holes (c) and (e). At no time do any wire ends cross over to the other side of the core.

Gently pull on each wire to remove slack and to hold the core against the board. (RECHECK YOURSELF TO BE SURE EACH WIRE IS IN THE RIGHT HOLE) Most of the good varnished wire is designed to burn away the varnish when it is soldered. Try a piece of your wire to see if the varnish will burn away and the wire take a solder coat. If it does not then you will have to scrape away the in— sulation before ycu can solder the wire ends. Solder ends of wires and cut off excess wire.

Congratulations! You have just completed the most difficult part of the AMA-5000 assembly.

Component installation:

Take your two power transistors and gently bend the leads as shown: The drawing is to scale so you can lay the transistor down on the page to get your bending proper. Fasten the power transistors to their heatsinks with 4-40 x 1/4" screws and nut as shown. Set aside for a moment.



Install all your resistors and capacitors. Resistors R3 and R4 are stood on end as shown in the assembly drawing. Observe the polarity of the electrolytic capacitors C2 and C3, If these are put in wrong they could explode when power is applied! Solder all installed leads and cut off excess lead length.

Now install the power transistors and their heatsinks. You have 6 different points for each that have to go into holes at the same time. Take it slowly and don't bend any leads. The heatsink mounting tabs may be bent over slightly to hold the sink in place. When each is secure you may solder the transistor leads.

Install and solder red and blue wires at the points shown in Fig. 2. Wires should be about 6" long. They may bo twisted together to form a single unit but kept separate from each other at the free ends. These will connect to the power supply.

Solder a bare wire in each of the holes next to the trimmer potentiometer (white & black). Let the wires stand up an inch or so from the board. If the unit is not to be installed next to the AM-100 board then go ahead and solder in white and black wires as required.

Solder a short length of wire, 2 or 3 inches, to the point marked "output".

Fasten 3 pvc spacers to the board with 4-40 x 1/4 tap screws. Leave the hole marked with a black dot (assembly drawing) free.

Use the assembly drawing as a template and mark the centers of the mounting screw holes on the bottom of chassis pan or cabinet. Drill the holes in the cabinet for 4-40 screw clearance.

Install the board in the cabinet. Fasten it in place with 4-40 tap screws driven into the pvc spacers. The remaining support point (black dot on assembly drawing) is fastened with a 4-40 screw 3/4" long, with an aluminum spacer and nut. Be sure that the aluminum spacer makes electrical contact with the cabinet. If paint is in the way scrape a little of it off around the hole.

Solder your red and blue (+ 12 volts and - 12 volts) wires to your power supply, Do not connect the white wire yet. Do connect the black wire to either the AM-100 or to the ground point of your power supply if the AM-100 is not used.

You are ready for smoke testing!

TESTING

Switch on power momentarily and check for the things at the right. If any happen recheck all your work for solder bridges, shorts, and possibly T1 and T2 wires in the wrong holes.

Shut off power if any of the following occurs: Power supply LED is dim
You see or smell smoke
Anything appears to be very hot
You can not obtain a nominal -12 and + 12 volts from the power supply,

If all goes well you may connect the white wire. The white and black wires of the AM-100 are simply cut short, the ends stripped, and are then soldered to the two bare wires sticking up on either side of the trimmer pot.

Connect the output wire to your coax jack center terminal and solder.

Make a dummy load by soldering wires to one of the following lamps:

#1895 or # 1471 or # 57 (available from auto parts stores)
or two # 46 lamps connected in series (available from radio stores)

Connect the dummy load to your antenna jack. Switch on the power supply. It is assumed that you have a working 100 mW transmitter feeding the AMA-5000 by way of the white and black wires. The lamp should glow dim. it it does not, adjust R1 (trimmer pot) until you get a glow, Modulation of the transmitter should cause the lamp to glow brightly. If music is used for modulation the lamp should glow dim and bright in time with the music and its volume level. Adjust R1 for the desired power level but keep below distortion level (listen with your radio).

THEORY OF OPERATION

The circuit is a basic push-pull class B amplifier. The push-pull configuration minimizes second harmonics which could cause interference to other radio stations. The input signal is fed to T1 via R1 and R2, R1 provides a means of controlling power output. R2 safeguards against overloading the driving exciter or overdriving the power amplifier.

The transformer action of T1 provides equal amplitude but opposite polarity drive for the two power transistor bases. Resistors R3 and R5 provide a forward bias potential for the transistor bases with the dc path thrcugh the secondary windings of T1 . This bias is necessary to minimize cross over distortion that would arise if the transistors were to operate in "class C"- without bias. Slightly more power is available from the circuit this way also, but this also results in some heating of the transistors. Normally the transistors will be quite warm when operating. Resistor R4 tends to stabilize the bias against variation in supply voltage, resistor tolerances, and transistor heating.

Trensformer T2 matches the output of the transistors to that of the load impedance. C5 attenuates the higher frequencies and helps to resonate the transformer at the lower frequencies. The overall result is a broadband response that does not require tuning over the frequencies of 540 kHz to 1600 kHz.

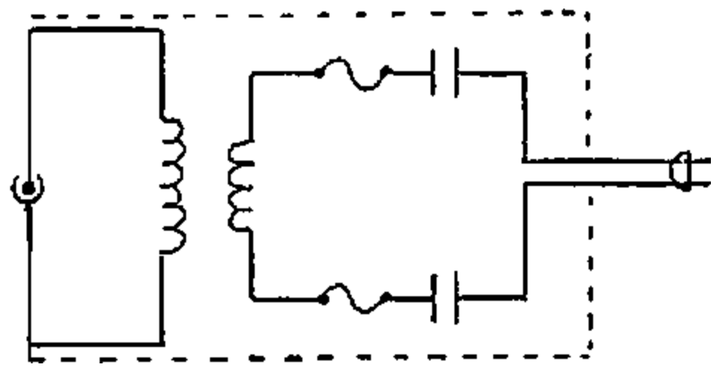
Capacitors C1, and C4 bypass any stray RF signal to keep it out of the power supply and other circuitry, C2 and C3 are large value electrolytic capacitors that are used as "reservoirs'', High current peaks are drawn by the power transistors. The storage caps help supply this current during peaks and fill up again from the power supply between peaks. This helps keep the +12 and - 12 volts stable for the rest of the circuitry being fed by the power supply.

The output impedance of the AMA-5000 is nominally 50 ohms.

OPERATION

If you have come this far your AMA-5000 is already in operation. It may be connected directly to coax cables of 50 ohm impedance. If it is to be used on low impedance transmission lines, such as the ac power lines, you will need a coupling unit. The coupling unit is simply a transformer like T2. Its primary winding has 28 turns of #24 varnished wire. The secondary should be wound with #20 wire. The number of turns is calculated from the impedance ratio required: (assume 5 ohm ac line impedance)

\/50/5 = 3.15 28 turns/3.15 = 9 turns



Fuses are 2 amp types. Coupling caps are .1 uF, 1 kV ceramic discs. The whole unit is enclosed in a metal box for safety. For further details see our book "Carrier—Current".

The no-modulation RF output of the AM-100 is only a few milliwatts. As modulation increases the effective carrier level increases. This is what allows up to 300% modulation capabilities for the AM-100. The AMA-5000 will of course follow this carrier-shift (increase of carrier) during modulation. The resting carrier (no-modulation) will also be low in power, around .75 to 1 watt, increasing to 5 watt peaks at high modulation levels.

Inexpensive wattmeters such as the CB units sold in many radio stores can not measure these frequencies accurately. Most of these use a directional coupler method of reading the output power. This method is somewhat frequency dependent. That is it may give an accurate reading at the frequency it is designed for but will a much lower reading at other frequencies. If you want to measure the power output you will need a commercial AM broadcast type wattmeter or measure the output with an RF voltmeter.

To measure power with an RF voltmeter first connect the unit to a proper load, in this case 50 ohms resistive. Measure the voltage across the load. The power is found with the formula:

$$\frac{E^2}{R_L} = P$$

Example:

$$\frac{(7)^2}{50} = \frac{49}{50} = \text{approx. 1 watt}$$

This would be the normal output of the unit - 7 volts,(rms) into a 50 ohm load for idle carrier.

For best modulation capability it is recommended that the idle carrier be kept (adjusted for) at .75 to 1 watt maximum. If you do not need that much power it wculd be best to adjust your power output to just the amount needed to give the desired coverage.

There will be a great deal of RF current flowing around your unit. Under some conditions this can cause hum pickup. If you experience large amounts of hum on the receiving end you will need a transformer input to the AM-100. This simply means that you will have to isolate your audio source equipment from the AM-100 with an audio transformer. A 1:1 transformer should work fine. If you need to match impedances to a 600 ohm line the you must terminate the secondary of the transformer with about 600 ohms (resistor 620 ohms).

PARTS SOURCES

MOUSER ELECTRONICS
11423 WOODSIDE AVE
SANTEE, CA 92071
(619) 449-2229

AMIDON ASSOC.
12033 OTSEGO ST
NORTH HOLLYWOOD, CA 91607
(213) 760-4439

GOOD LUCK.