Assembling and Using your

CONAR

Signal Tracer

Model 231

QUALITY EQUIPMENT BUILT ON A HALF CENTURY OF SERVICE IN ELECTRONICS

THE CONAR MODEL 231 SIGNAL TRACER

SPECIFICATIONS

Probe: High input impedance FET connected in a source-follower circuit

Input Modes: Untuned rf, audio, and three selectable ceramic-filter tuned inputs covering the standard broadcast i-f frequencies (262 kHz, 455 kHz, and 10.7 MHz)

Semiconductors: Three integrated circuits, three transistors, and five diodes

Controls: Volume control, band switch, coarse attenuator switch, fine attenuator/on-off switch, and AM/FM switch

Power Requirements: 110 to 120 VAC 60 Hz

Dimensions: 8-1/2″ wide, 6″ high, and 6-1/2″ deep

Shipping Weight: 6 lb

CONTENTS

THE MODEL 231 SIGNAL TRACER

The Model 231 is an all solid-state tuned signal tracer of advanced design. It features an active probe with an input impedance greater than 10 megohms. Band switch selection of fixed ceramic filters tunes the instrument to any one of the three common i-f frequencies. In addition, an untuned rf input and an audio input enable you to trace a signal from the antenna to the loudspeaker in almost any AM, FM, or AM/FM receiver you might be called upon to service.

If you purchased your signal tracer wired, turn to page 32 and read the operating instructions. If your instrument is the kit version, you are probably anxious to begin construction, so let's get started.

ASSEMBLY HINTS

There is no satisfaction like that of building a kit and having it work perfectly the first time you try it. Here are some suggestions that will help you reach this goal.

It's a good idea to read over the entire assembly section before beginning actual construction. This way you get an overall picture of what is to be done and how each stage of the assembly relates to the others. When you are ready to begin construction, read each step through and make sure you understand what must be done. After you perform each step, check it off in the space provided and proceed to the next step.

Follow the Instructions. Perform each step in the exact order given. Don't try shortcuts such as omitting steps or assembling the kit from the schematic diagram. Our experience has shown that even veteran kit builders make wiring errors when they fail to follow directions. Tracking down and correcting wiring errors in completed kits can be a tedious and time-consuming process. By far, the quickest shortcut is to follow the assembly instructions to the letter.

Do a Good Soldering Job. Poor soldering is the greatest single cause of problems in completed units. Most of the soldering in this kit will be done on a printed circuit board. This makes it easy to do a professional-looking construction job without being a professional. You will need a small pencil soldering iron.

To mount components on the circuit board, first bend the leads to fit the holes in the board using your longnose pliers. Next, pass the leads through the holes and press the component down until it rests squarely on the surface of the board. You may bend the leads on the other side of the board slightly outward so that the component stays put when you turn the board over for soldering.

To solder the component leads to the foil pads, apply the tip of the iron so that it touches both the lead and the foil. At the same time, feed the end of the solder to the lead and the foil until a small mound of molten solder surrounds the lead and covers the pad. When this happens, withdraw the solder and then the iron.

After the solder has solidified, clip off the lead close to the solder mound with your diagonal cutters. When soldering components on the circuit board, watch out for solder bridges that cause short circuits. Each time you solder a connection, make sure that the solder mound covers only that connection and does not run over to a nearby pad or foil path.

When you connect wires and components to controls and switches on the front panel, be sure the mechanical connection of the wire or lead to the terminal lug is secure before you solder. Do this by hooking the wire or lead through the terminal lug, then crimping it with your longnose pliers before soldering.

Each chassis wiring step will include a notation such as (NS), (S1), (S2), or (S3). These notations tell you whether to solder the connection made in that step and, if so, the total number of wires to be connected at that point. Each time you make a solder connection, check to see that you have the correct number of wires connected to the terminal lug. The notation (NS) indicates that a connection should not yet be soldered because other wires will be added. When you install the last wire, you solder the terminal, and this will be indicated by the letter S followed by a number. The number tells you how many leads are supposed to be connected to the terminal before it is soldered. For example, if a step says, "Connect a wire to lug 6 (S3)," there should be three leads connected to this terminal before it is soldered. In cases where a wire or component lead passes through a terminal or lug and connects to another terminal or lug, it counts as two leads, one entering and one leaving the terminal or lug.

As stated earlier, poor soldering is the greatest single cause of problems in equipment returned to us for repair. You can greatly reduce the possibility of poorly soldered connections in your signal tracer if you clean the leads on the resistors and capacitors before installing them. Do this by scraping the leads lightly with a knife, or twisting them between two pieces of fine sandpaper. You can further guard against poor soldering by using a clean, hot iron at all times. Be sure that enough heat is applied to avoid rosin joints. *This is of the utmost importance.*

Another important point to remember is to avoid using too much solder. Use only enough to lightly cover the leads and terminal you are soldering. Let any excess solder flow onto the tip of your iron and wipe it off with a damp rag or sponge. Big blobs of solder on terminals or circuit board pads are almost certain to result in trouble.

Lastly, use only the solder supplied with this kit. If, for some reason, you buy more solder locally, make sure the container is marked "rosin-core solder." Do not use acid-core solder or solder paste flux. If you use either of these, you will ruin your instrument. We cannot service any instrument on which acid-core solder or solder paste flux has been used.

Use the Figures. Pictorial diagrams throughout this manual show the placement of parts and the details of construction steps. In some cases a part may fit into position in more than one way, only one of which is correct. Study the figures carefully and make sure that you know exactly how a part is to be mounted before proceeding. In some cases the illustrations may be slightly distorted to show certain details. In most instances, however, the illustrations in this manual show all parts in proper perspective. Be sure to route and position all wiring exactly as shown in the diagrams.

CHECKING PARTS

All of the small parts in this kit are packed in plastic bags. The bags have identifying labels on them so that you can select the bag or bags that you need for a particular assembly stage. For example, the first bag of parts that you will need has a label that reads in part 5A-231. This bag is divided into five separate compartments. The parts in each compartment are used in the assembly of the circuit boards. Parts should be removed from the individual compartments only as they are called for in the instructions.

The individual parts list with each of the assembly stages gives the part number, quantity, description, and price of the parts used in that particular assembly stage. You should refer to these parts lists if you ever have to order a replacement part for your signal tracer or if a part is missing from your kit.

Do not try to check the entire parts contents of this kit at one time. Instead, gather and check the parts called for in each of the assembly steps. If you find you are missing a part or if a part is damaged, go ahead with the assembly after you write us for a replacement.

In cases where we feel you may have difficulty in identifying a part, we have placed a small drawing near the parts list which should help you identify the parts. Nuts and screws are shown actual size.

You may find an occasional parts substitution in your kit such as a capacitor rated at a higher voltage (400 V instead of 200 V) than one called for in the parts list or a resistor having a closer tolerance (5% instead of 10%). These changes are minor and will not affect the operation of your instrument. If any radical changes are made, a notice will be enclosed with your kit. Be sure to read all enclosures before you start the assembly.

ASSEMBLY

For your convenience, the assembly of the Model 231 is broken down into four separate stages. At the end of each of the first three stages, you will have built a complete subassembly of your signal tracer. Then, in the last stage, you will connect the subassemblies to make the completed instrument.

PROBE ASSEMBLY

Locate the following parts from bag 5A-231:

Part No.	Quan.	Description	Price Each
CN102	1	0.01 μF, 50 volt disc, +80%, −20% tolerance	.38
CN113	1	75 pF disc, 10% tolerance	.10
CN261	1	1 μF tantalum, 10% tolerance	.74
EC68	1	Probe circuit board	.60
HA902	5	Solder	.06/ft
JA10	1	Phono jack with nut and washer	.25
NU15	1	3/8" X 32 hex nut	.03
PL15	1	Probe tip	.35
PR-2	1	Black probe tip	.20
PR12	1	Signal tracer probe housing	.40
RE73	1	1 megohm, 5%, 1/2 watt (brn-blk-grn)	.24
RE129	1	2k-ohm, 5%, 1/2 watt (red-blk-red)	.24
RE158	1	470k-ohm, 5%, 1/2 watt (yel-vio-yel)	.24
RE165	1	15k-ohm, 10%, 1/2 watt (brn-grn-orn)	.24
TS20	1	2N5457 transistor	1.00
TS47	1	2N4126 transistor	.50
WA14	1	Flat washer	.03

Refer now to Fig. 1 and perform the assembly steps in the order indicated.

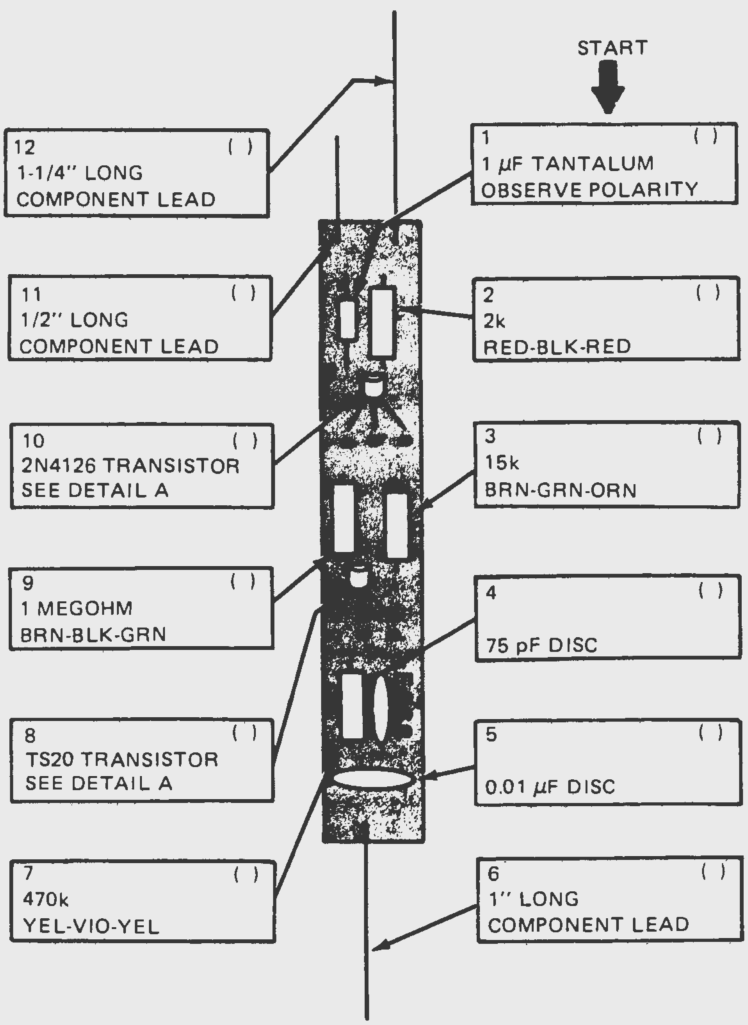


Fig. 1. Assembling the probe circuit board.

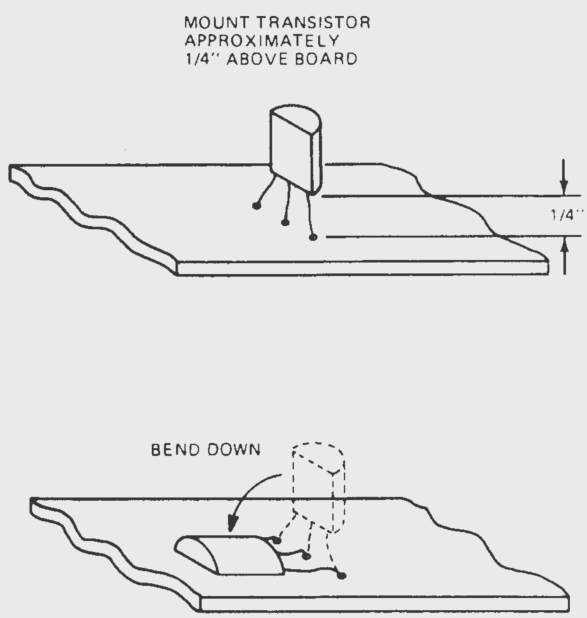


Fig. 1. Detail A.

Refer to Fig. 2 for the following steps:

(1) Locate your completed probe circuit board. Solder the shorter of the two wires connected to one end of the board to the center terminal on the phono socket. The socket should end up approximately 1/2" from the end of the board as shown . . . . ( )

(2) Wrap the second wire around the threaded portion of the phono socket as shown . . . . ( )

(3) Carefully insert the probe circuit board assembly inside the probe housing as shown. The threaded portion of the phono socket should protrude from the end of the probe . ( )

(4) Secure the assembly in place by tightening the nut and washer (WA14) on the phono socket firmly up against the probe housing . . . . ( )

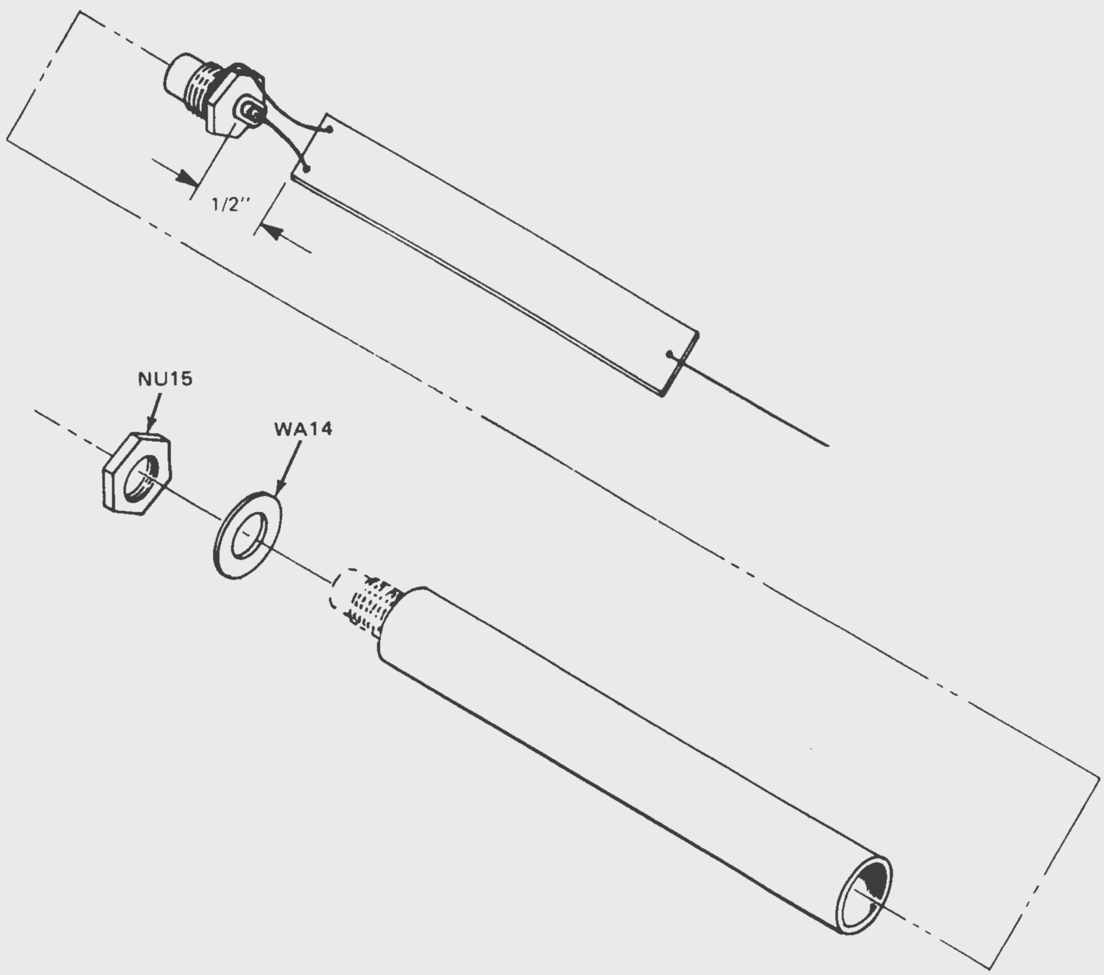


Fig. 2. Installing the probe circuit board in the probe housing.

Refer to Fig. 3 for the following steps:

(5) Screw the probe tip as far as it will go into the plastic nosepiece . . . . ( )

(6) Unscrew the knurled collar from the probe tip and set it aside temporarily . . . . ( )

(7) Slide the probe tip assembly into the probe housing, being careful to guide the free end of the bare wire coming from the probe circuit board down through the center of the tip. This wire should come out of the small hole on the side of the probe tip . . . . ( )

(8) Wrap the wire around the probe tip in a clockwise direction as shown. Secure the wire in place by reinstalling and tightening the collar on the probe tip . . . . ( )

This completes the assembly of the probe. Set it aside in a safe place until called for later.

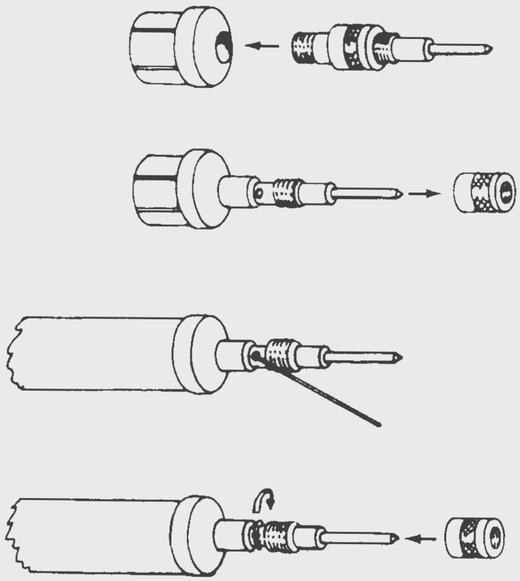


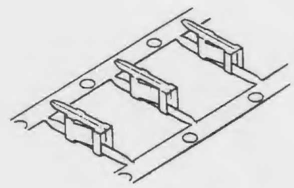
Fig. 3. Installing the probe tip and nosepiece.

MAIN CIRCUIT BOARD ASSEMBLY

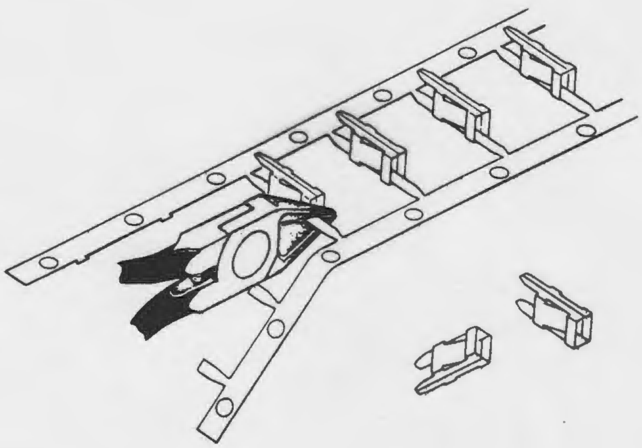
Locate the following parts:

Part No.	Quan.	Description	Price Each
EC91	1	Main circuit board	1.75
From bag 5A-231:			
SO84	1	14-pin IC socket	.75
SO86	1	16-pin IC socket	.75
SO95	1	8-pin IC socket	.50
SO96	19	Circuit board receptacles	.05

Refer now to Fig. 4 and complete the numbered steps in the order shown.



SO96



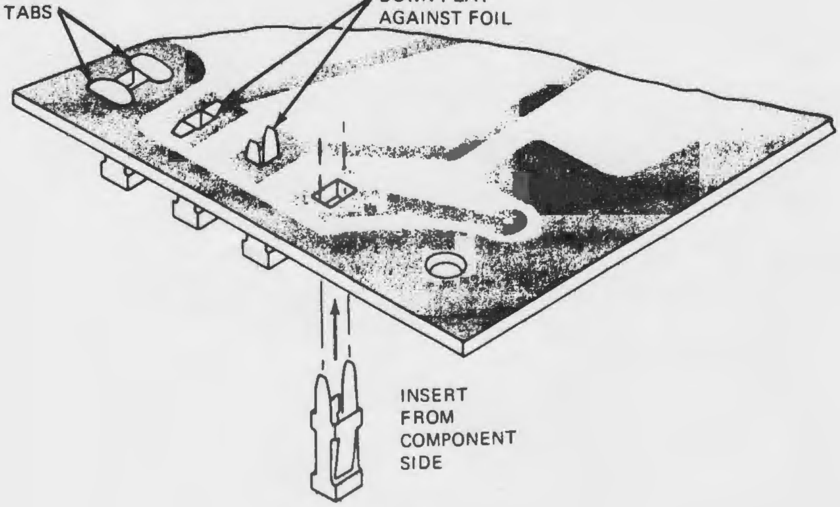


Fig. 4. Detail A.

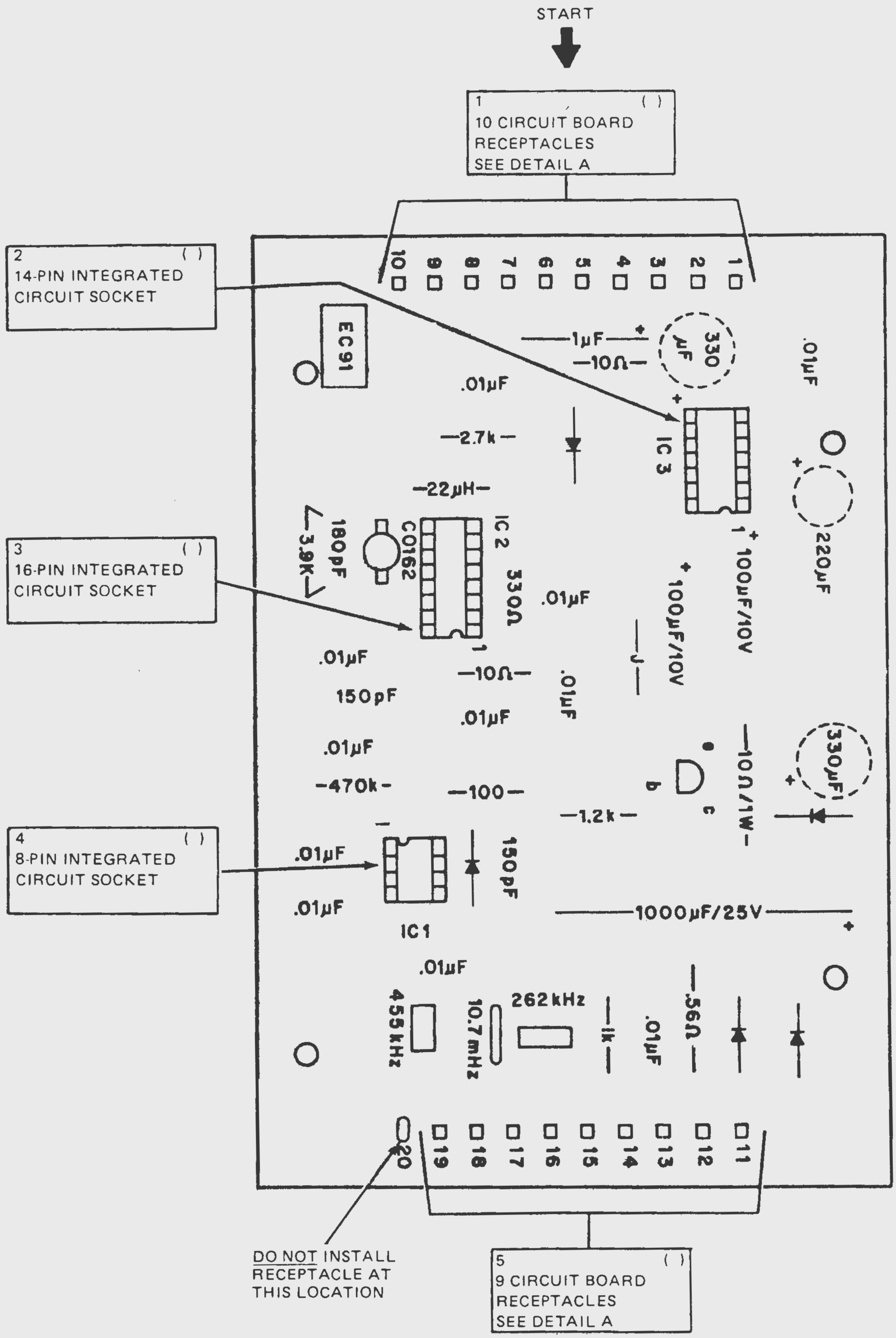


Fig. 4. Circuit board assembly, Stage I.

Locate the following parts from bag 5A-231:

Part No.	Quan.	Description	Price Each
CN261	1	1 μF tantalum	.74
CO175	1	22 μH coil	.30
CR4	2	1N60 diodes	.45
CR32	1	12 volt, 10% zener diode	.30
RE1	2	10 ohm, 5%, 1/2 watt (brn-blk-blk)	.24
RE3	1	100 ohm, 5%, 1/2 watt (brn-blk-brn)	.24
RE126	1	330 ohm, 5%, 1/2 watt (orn-orn-brn)	.24
RE139	1	0.56 ohm, 5%, 1/2 watt	.24
RE154	1	3.9k-ohm, 5%, 1/2 watt (orn-wht-red)	.24
RE158	1	470k-ohm, 5%, 1/2 watt (yel-vio-yel)	.24
RE164	1	1k-ohm, 5%, 1/2 watt (brn-blk-red)	.24
RE176	1	1.2k-ohm, 5%, 1/2 watt (brn-red-red)	.24
RE179	1	2.7k-ohm, 5%, 1/2 watt (red-vio-red)	.24
RS4	1	10 ohm, 10%, 1 watt (brn-blk-blk)	.20
SR17	2	Silicon diodes, 1 ampere, 50 PIV	.21

Refer now to Fig. 5 and complete the numbered steps in the order shown.

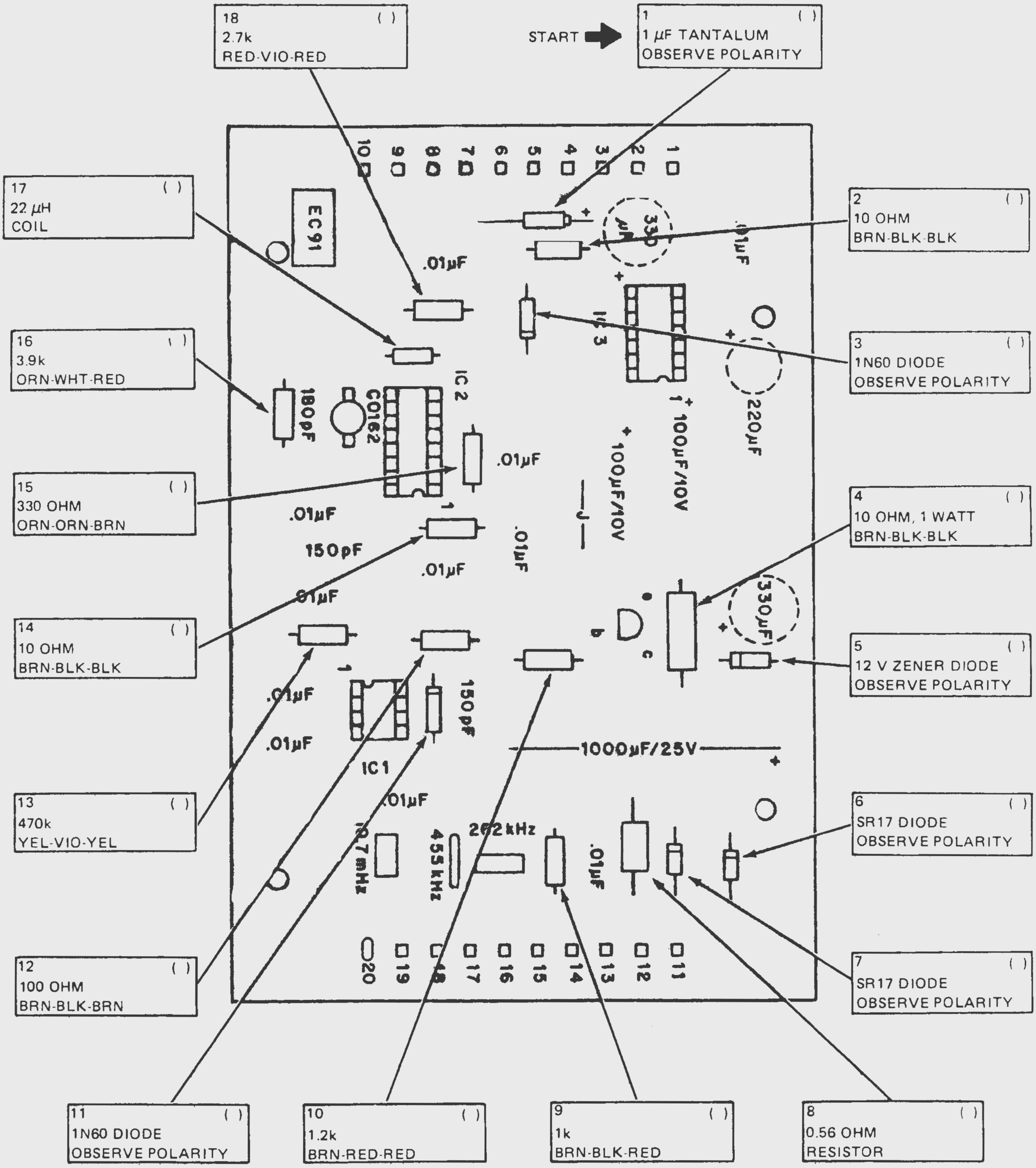


Fig. 5. Circuit board assembly, Stage II.

Locate the following parts from bag 5A-231:

Part No.	Quan.	Description	Price Each
CN46	2	100 μF, 25 volt electrolytic	.45
CN86	11	0.01 μF, 1 kV disc	.18
CN159	2	150 pF disc NPO	.09
CN288	1	180 pF, 500 volt silver mica, 5% tolerance	.25

Refer now to Fig. 6 and complete the numbered steps in the order shown.

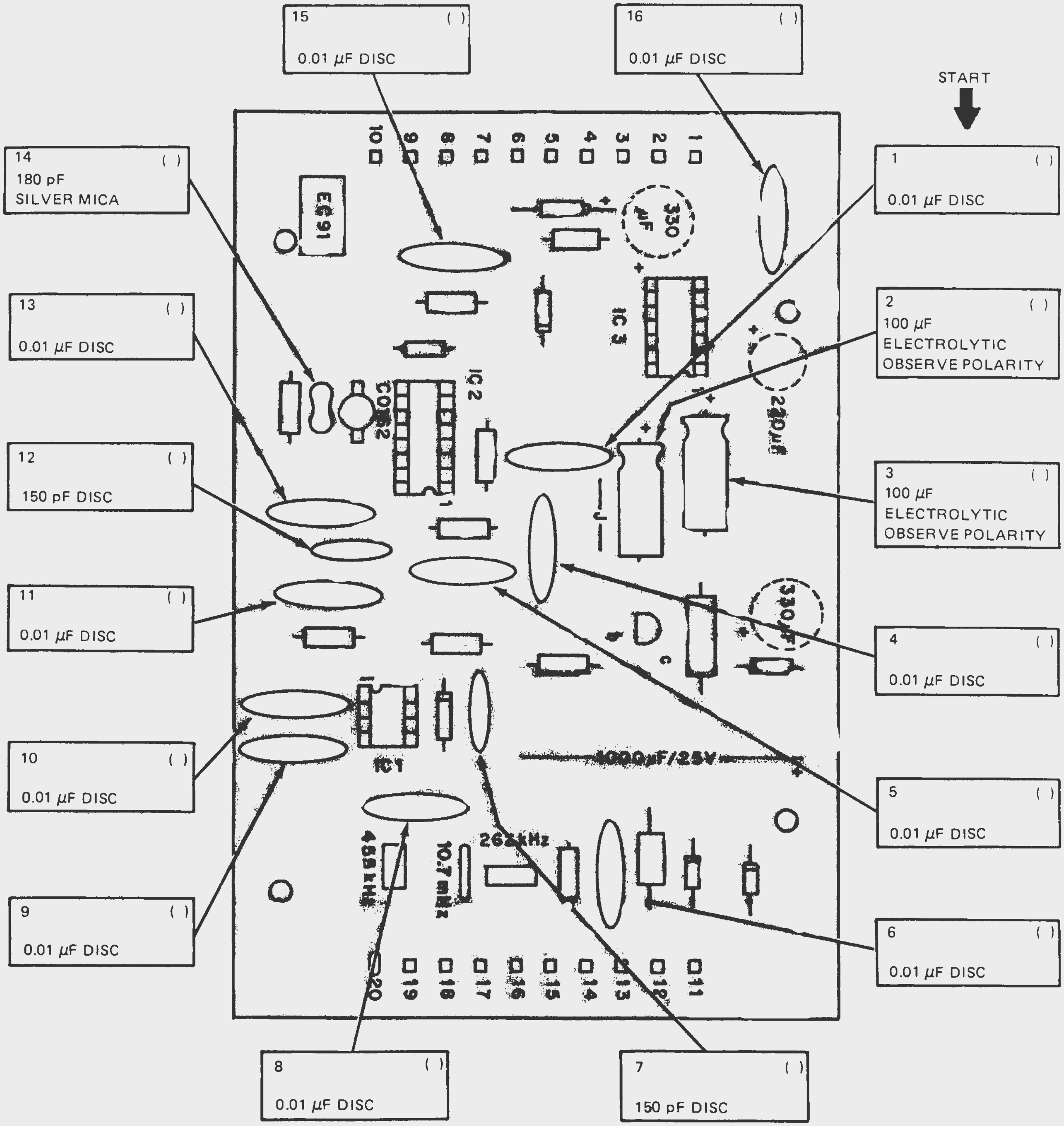


Fig. 6. Circuit board assembly, Stage III.

Locate the following parts from bag 5A-231:

Part No.	Quan.	Description	Price Each
CN279	2	330 μF, 16 volt electrolytic	.40
CN334	1	220 μF 35 volt electrolytic	.45
CN347	1	1000 μF, 25 volt electrolytic	.75
CO162	1	Quadrature coil	.75
CR27	1	10.7 MHz ceramic filter	2.00
CR28	1	455 kHz ceramic filter	2.00
CR29	1	262 kHz ceramic filter	2.00
IG65	1	CA3089 integrated circuit	2.00
IG66	1	LM380 integrated circuit	2.50
IG67	1	753 integrated circuit	1.75
TS43	1	2N4124 transistor	.45

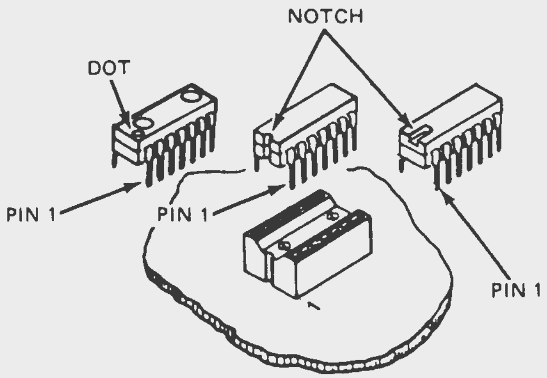
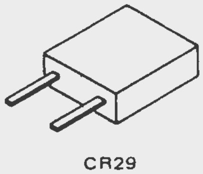


Fig. 7. Detail A.

Refer now to Fig. 7 and performed the numbered steps in the order shown.

This completes the assembly of the main circuit board. Set the completed board aside in a safe place until called for later.



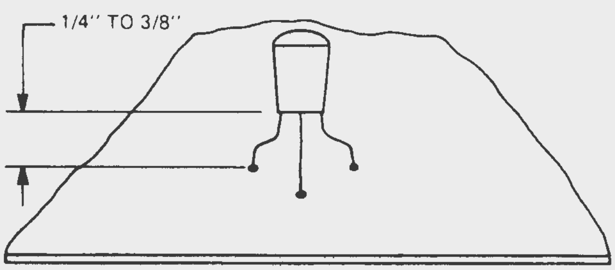


Fig. 7. Detail B.

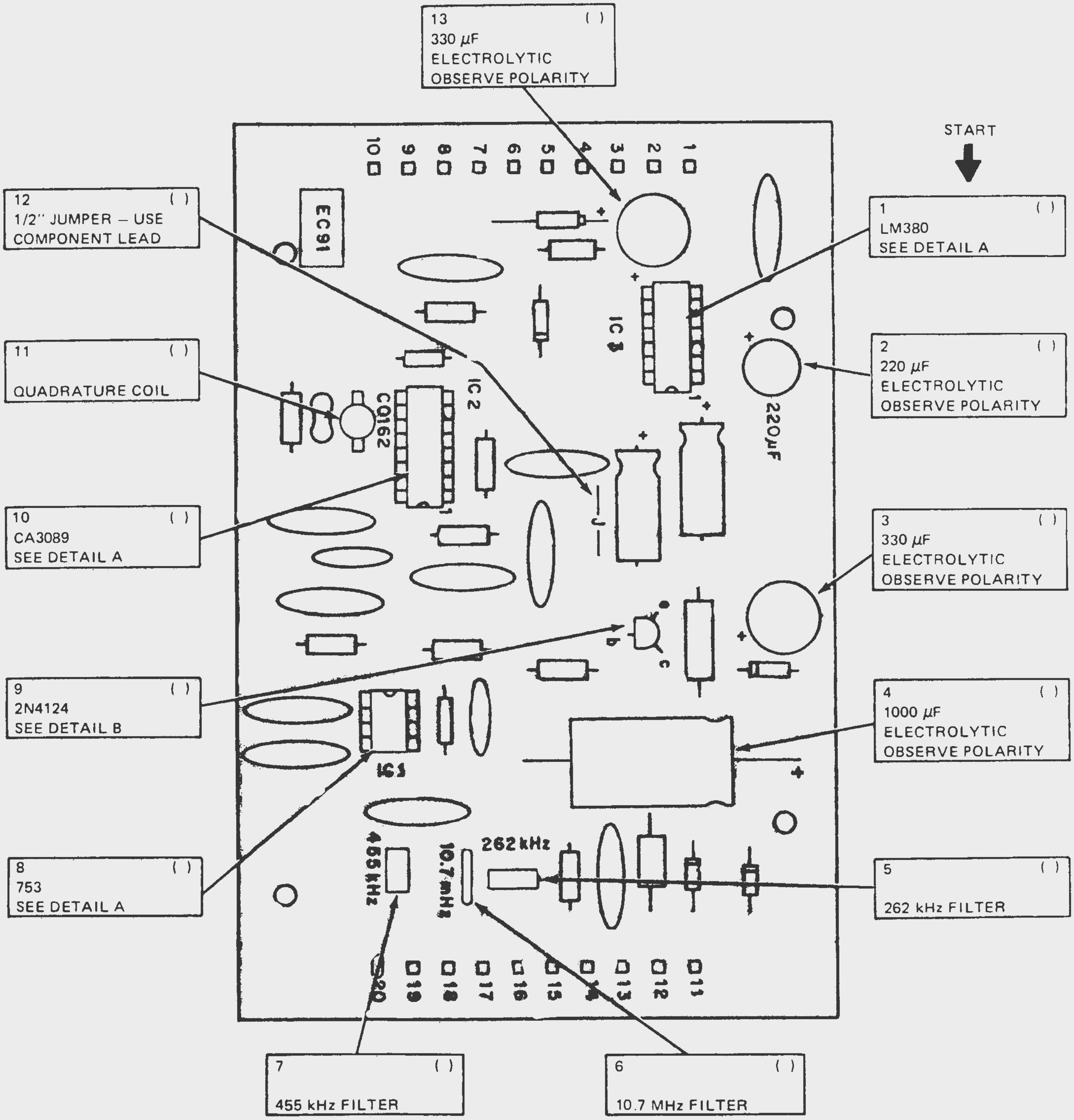
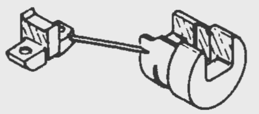


Fig. 7. Circuit board assembly, Stage IV.

CHASSIS/REAR PANEL ASSEMBLY

Locate the following parts:

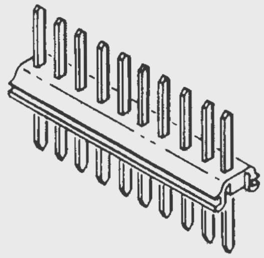
Part No.	Quan.	Description	Price Each
CH86	1	Main chassis	1.75
PA56	1	Rear panel	1.75
TR106	1	Power transformer	2.50
From bag 3B-231:			
FU6	1	1 ampere fuse	.22
GR8	1	Strain relief	.15
HA86	4	Circuit board standoff insulators	.05
IN21	1	Fuse holder	.43
NU1	4	6-32 nuts	.03
PC1	1	Line cord	.40
PL13	2	Chassis mount PC connectors	.40
SC97	4	6-32 X 3/8" black Phillips-head screws	.03
WA15	4	No. 6 lockwashers	.02



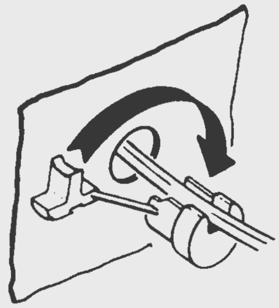
GR8

NU1

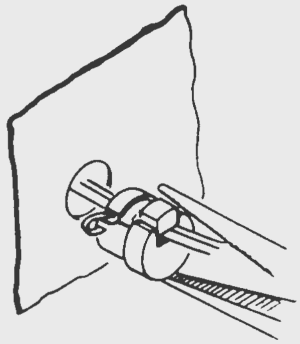
SC97



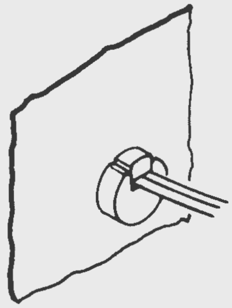
PL13



(A)



(B)



(C)

Fig. 8. Detail A.

(1) Locate the power transformer and prepare its leads by cutting them to the lengths indicated and stripping 1/4" of insulation from the end of each.

One black lead to 3" . . . . ( )

Remaining black lead to 9 " . . . . ( )

Yellow lead to 4-1/2" . . . . ( )

Both green leads to 6" . . . . ( )

(2) Mount the transformer on the rear panel as shown in Fig. 8, using two No. 6 screws, lockwashers, and nuts to secure the transformer to the panel . . . . ( )

(3) Install the fuse holder next to the transformer and secure it in place with the large lockwasher and nut furnished . . . ( )

(4) Refer to Fig. 8, Detail A, and place the strain relief 11" from the end of the line cord as shown. Pass the free end of the line cord through the hole in the rear panel and secure it in place by forcing the strain relief into the hole . . . . ( )

(5) Pull apart the two wires in the free end of the line cord all the way back to the strain relief . . . . ( )

(6) Cut one of the wires to 3" and strip 1/4" of insulation from the end . . . . ( )

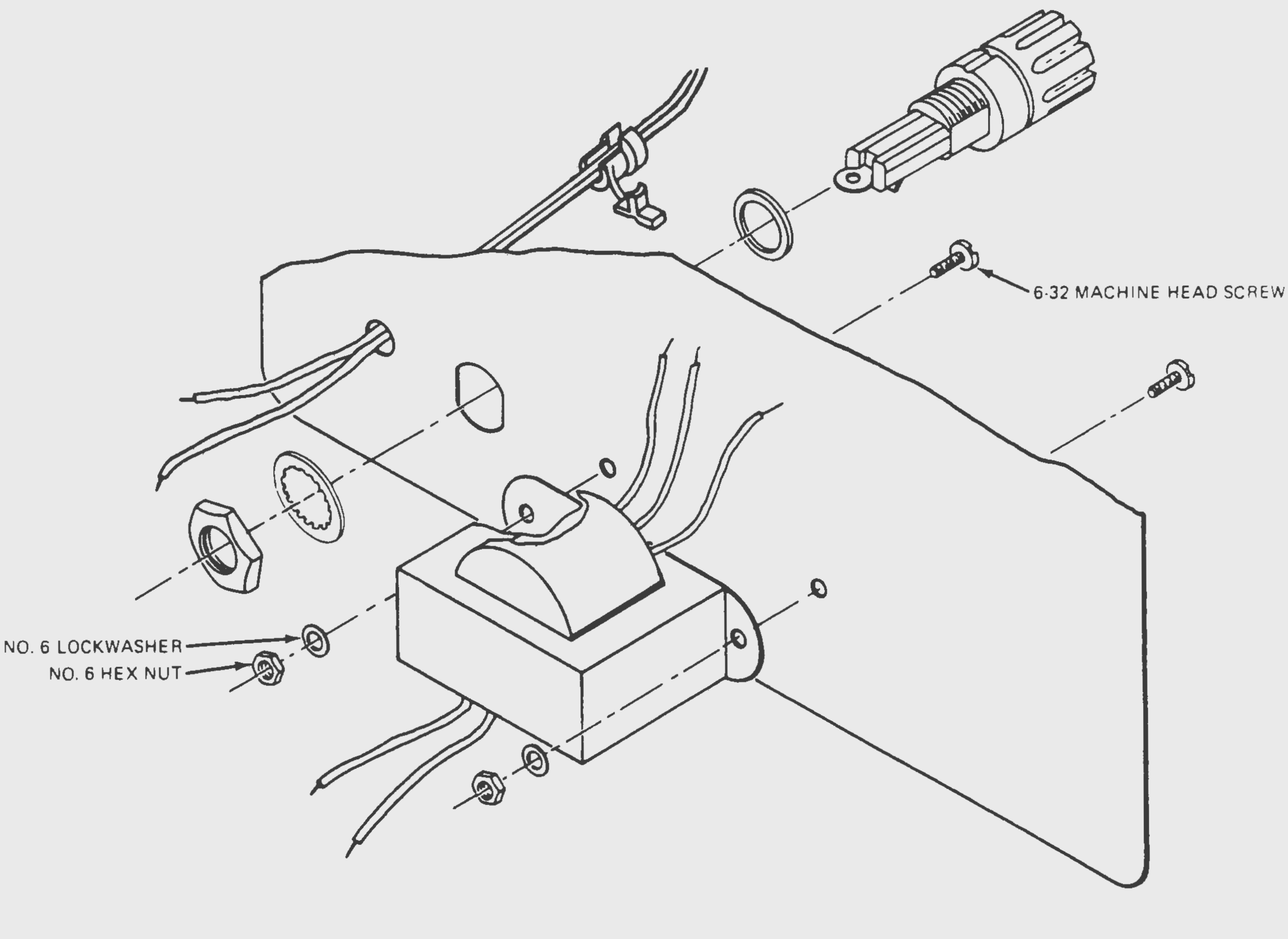
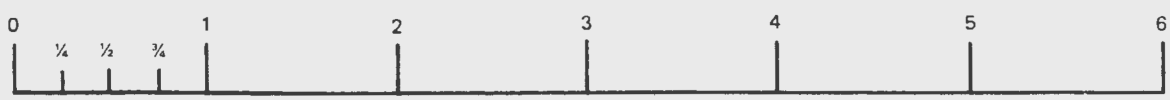


Fig. 8. Mounting the rear panel parts.



Refer to Fig. 9 for the following steps. To make it easier to install the circuit board supports (HA86) and the 10-pin connectors (PL13), and to prevent them from breaking, place the connectors in a bowl of warm-to-hot water a few minutes before you install them.

(1) Install four circuit board standoff insulators on the main chassis in the positions shown in Fig. 9. The insulators are installed by pressing the short end into the holes until they snap into place. Refer to Fig. 9, Detail A .... ( )

(2) Install a 10-pin circuit board connector in each of the oblong holes on the chassis. Refer to Fig. 9, Detail B, and insert the connector into the hole from the wiring side of the chassis. Seat one edge of the connector in the edge of the hole, then push the connector into place by rotating it into position .... ( )

(3) Attach the rear panel to the main chassis using two 6-32 X 1/4" black Phillips-head screws, nuts, and lockwashers .... ( )

This completes the assembly of the chassis/rear panel assembly. Set this assembly aside until called for later.

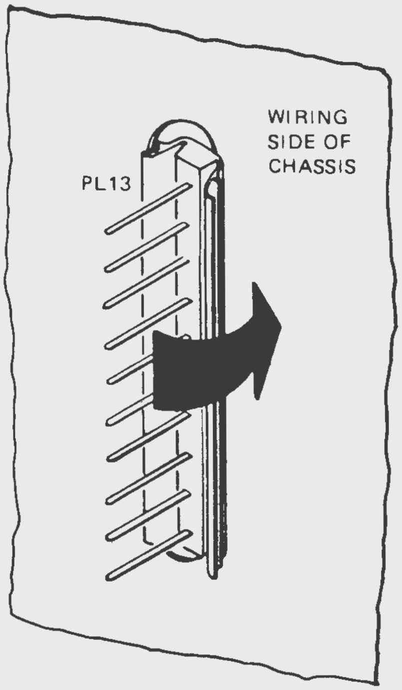


Fig. 9. Detail B.

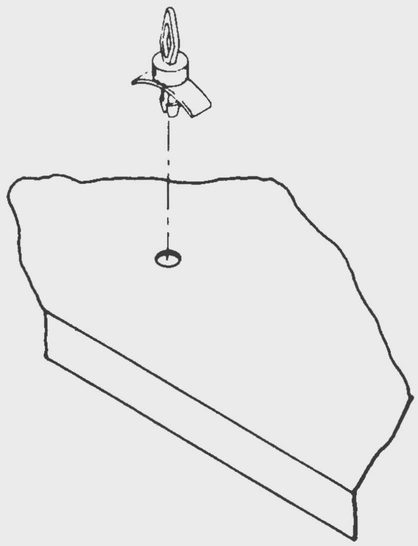


Fig. 9. Detail A.

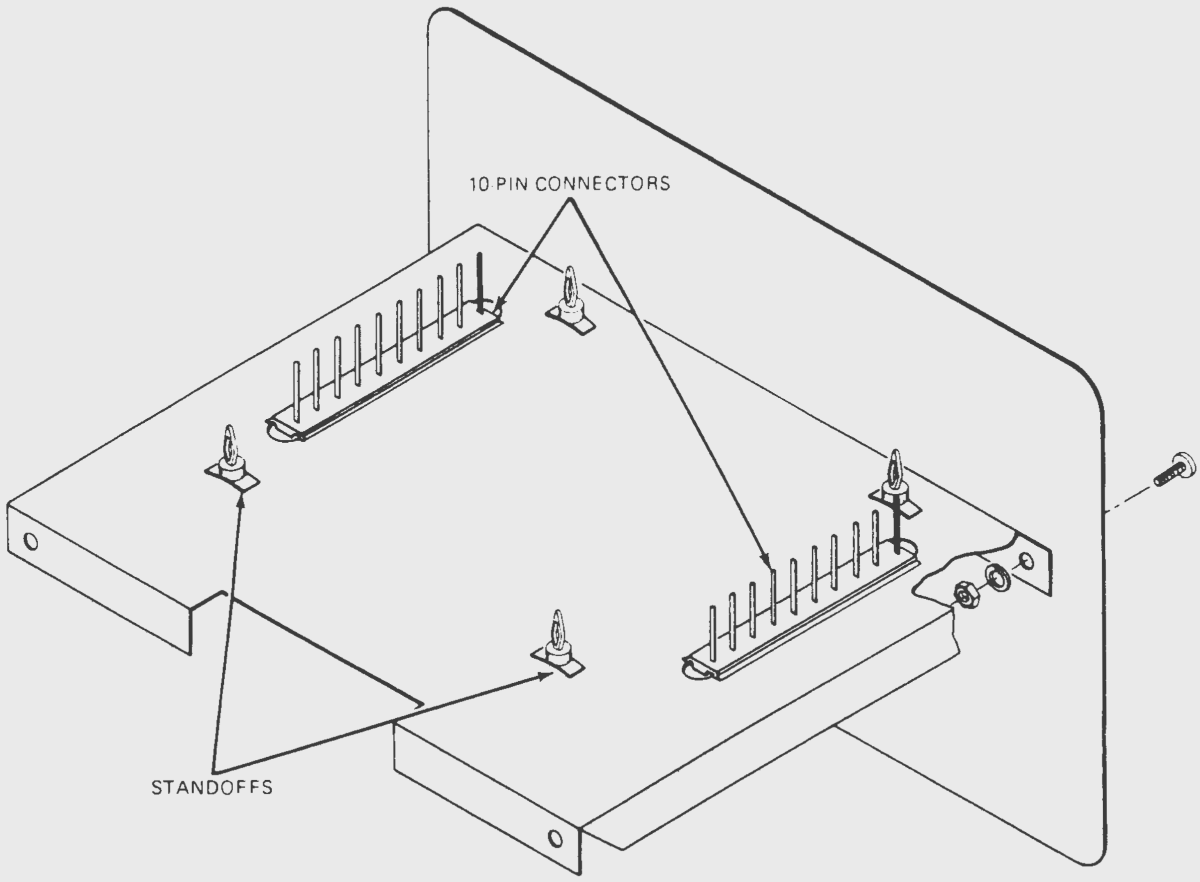


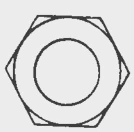
Fig. 9. Preparing the chassis/rear panel assembly.

FRONT PANEL ASSEMBLY

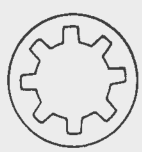
Locate the following parts:

Part No.	Quan.	Description	Price Each
HA83	1	Speaker grille cloth	.25
PA57	1	Front panel	4.50
SP16	1	Loudspeaker	1.20
From bag 3B-231:			
CL56	4	Speaker mounting clips	.15
CN204	1	0.05 μF disc capacitor	.30
CR23	1	1N914 diode	.40
IN901	2″	Clear spaghetti sleeving	.03/ft
JA9	1	Black banana jack with nut	.25
JA10	1	Phono jack with lug and nut	.40
LP30	1	Neon lamp assembly	.65
ME33	1	Meter	5.50
NU1	8	6-32 nuts	.03
NU5	2	4-40 nuts	.03
NU15	6	Control nuts	.04
PO35	1	50k-ohm control	.85
PO97	1	2.5k-ohm control with switch	1.00
RE19	1	510 ohm, 5%, 1/2 watt (grn-brn-brn)	.24
RE137	1	5.1k-ohm, 5%, 1/2 watt (grn-brn-red)	.24
RE138	1	51 ohm, 5%, 1/2 watt (grn-brn-blk)	.24
RE141	1	5.1 ohm, 5%, 1/2 watt (grn-brn-gld)	.24
SC87	2	4-40 black nylon screws	.03
SC97	8	6-32 black Phillips-head screws	.03
SW23	2	5-position rotary switches	.94
SW66	1	DPDT slide switch	.30
WA14	5	Control washers	.03
WA15	10	No. 6 lockwashers	.02
WA25	4	Control lockwashers	.04
WR901	2′	Red hookup wire	.03/ft
WR902	3′	Green hookup wire	.03/ft
WR903	1′	Blue hookup wire	.03/ft
WR904	2′	White hookup wire	.03/ft
WR905	1′	Brown hookup wire	.03/ft
WR906	1′	Orange hookup wire	.03/ft
WR907	2′	Yellow hookup wire	.03/ft
WR908	1′	Purple hookup wire	.03/ft
WR909	2′	Black hookup wire	.03/ft


NU5


NU15


WA15


WA25

Refer to Fig. 10 for the following steps:

(1) Mount the meter at the top center of the front panel as shown, using two 4-40 black nylon screws, No. 6 lockwashers, and No. 4 nuts . . . . ( )

(2) Slip a control lockwasher over the threaded bushing on the 50k-ohm control. Mount the control at the upper right corner of the panel and secure it in place with a control washer and nut . . . . ( )

(3) In a similar manner, mount the 2.5k-ohm control with switch in the hole directly under the control just installed ( )

(4) Mount the DPDT slide switch at the lower right-hand corner of the panel. Secure the switch with two 6-32 black Phillips-head screws, lockwashers, and nuts . . . . ( )

(5) Refer to Detail A and install the neon lamp assembly at the bottom center of the panel. The lamp is secured in place by pressing the face of the lamp flush up against the front of the panel . . . . ( )

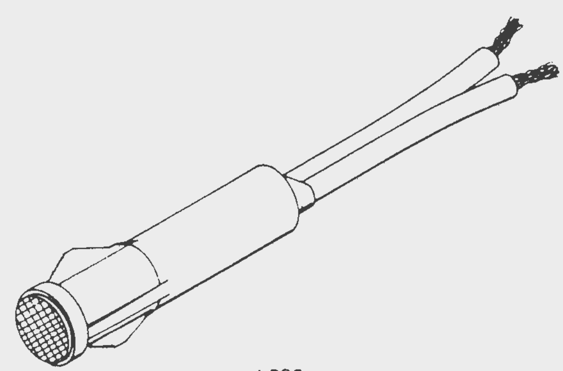
(6) Mount the black banana jack at the lower left corner of the panel, using the large nut supplied to secure it in place ( )

(7) Mount the phono jack and large solder lug at the lower left corner of the panel next to the banana jack just installed. Use a nut and a control washer to secure this assembly in place . . . . ( )

(8) Place a control lockwasher over the threaded bushing on one of the 5-position switches. Install the switch at the left center location on the panel and secure it in place with a flat washer and control nut. Make sure the switch terminals are positioned as shown in Fig. 10 . . . . ( )

(9) In a similar manner, mount the remaining 5-position switch at the upper left corner of the panel using a control washer between the switch and panel as before. Secure this switch with a flat washer and control nut after you have properly positioned the switch terminals as shown in Fig. 10 . . . . ( )

(10) Locate the piece of grille cloth and the loudspeaker. Using a pair of scissors, cut the grille cloth into a 2-1/4″ square as shown in Detail B . . . . ( )


LP30

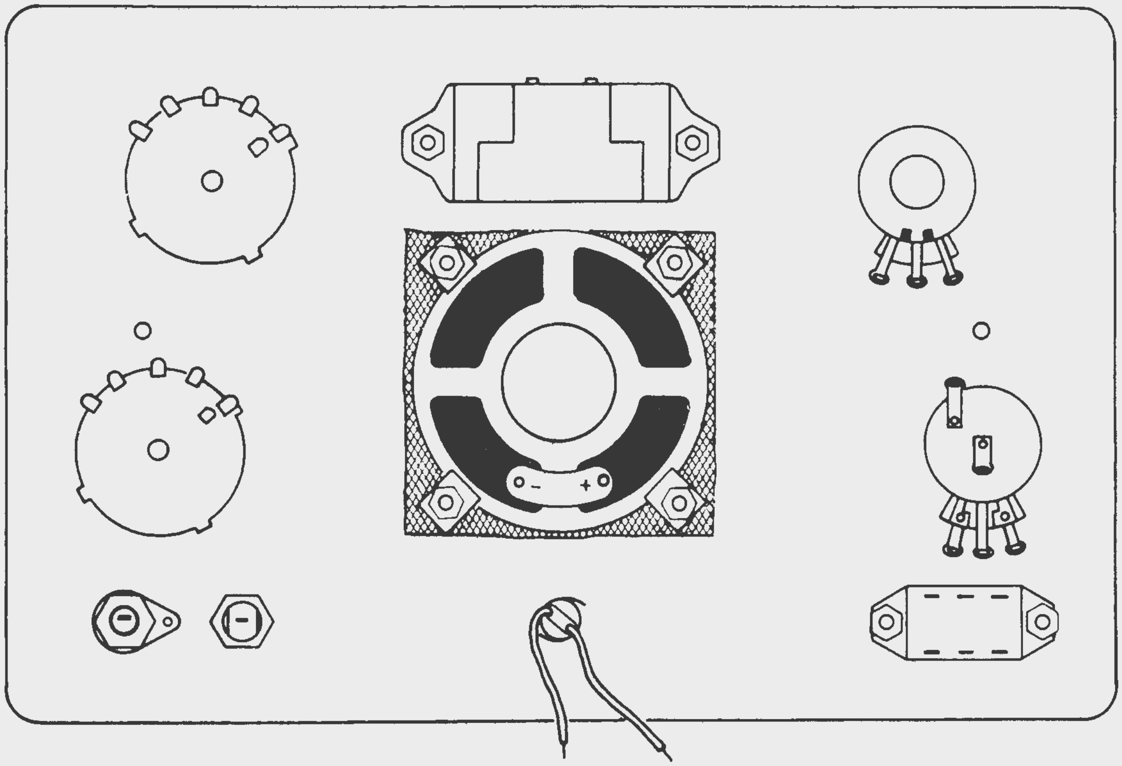


Fig. 10. Mounting parts on the front panel.

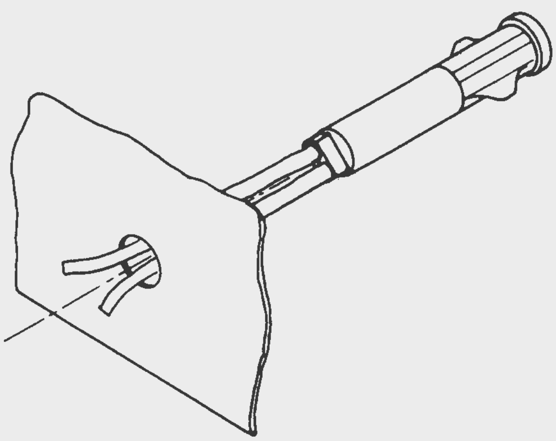


Fig. 10. Detail A.

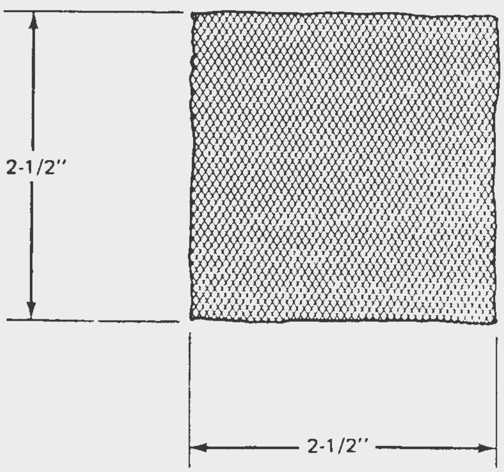


Fig. 10. Detail B.

(11) Center the grille cloth over the speaker grille on the back of the front panel. Using the tip of your hot soldering iron, form four holes in the grille cloth corresponding to those around the speaker grille, as shown in Detail C . . . . ( )

(12) Place the grille cloth and the loudspeaker into position on the panel and secure them in place with four 6-32 × 3/8" black Phillips-head screws, speaker mounting clips, lock-washers, and nuts as shown in Detail D. Make sure the speaker terminals are positioned toward the neon lamp assembly as shown . . . . ( )

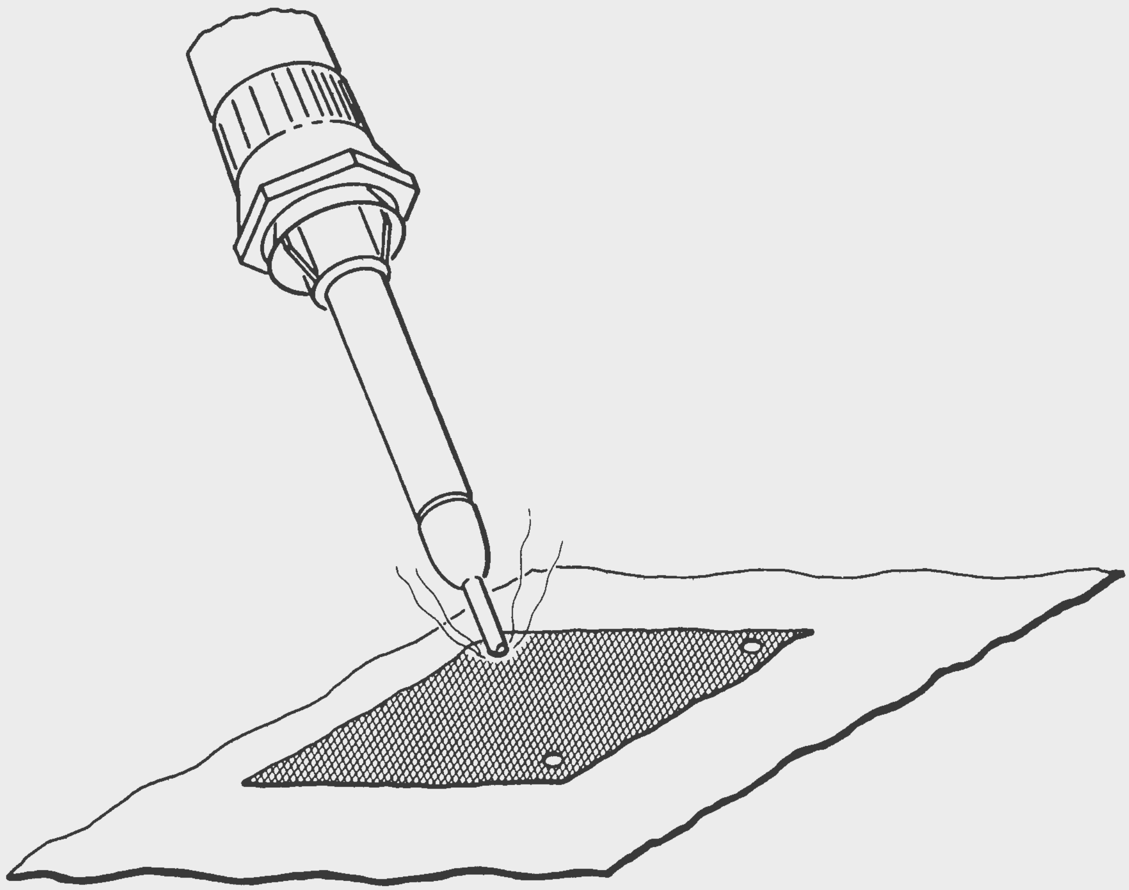


Fig. 10. Detail C.

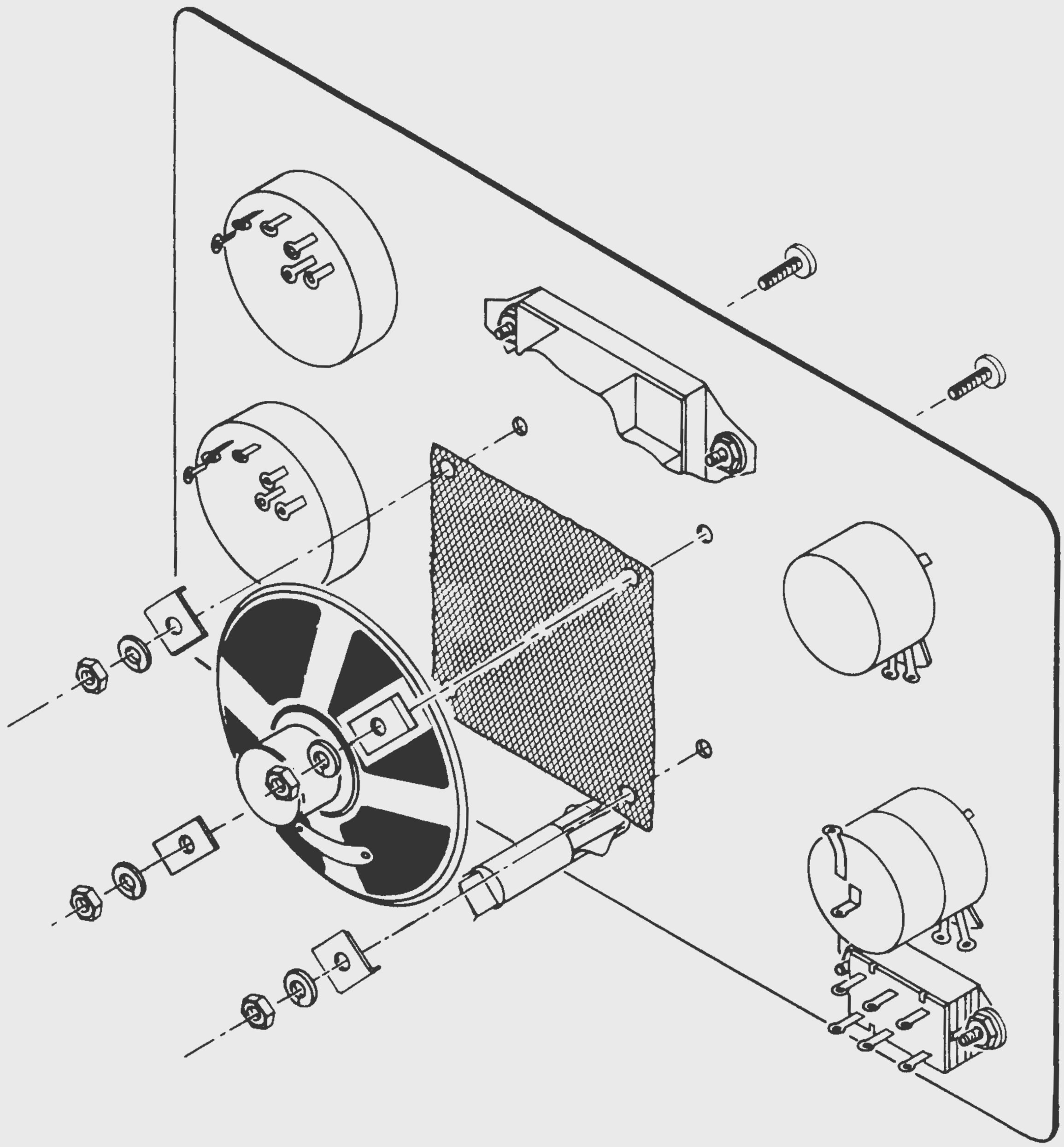


Fig. 10. Detail D.

In the following steps wires will be connected to the controls just mounted on the front panel. When a length of wire is called for, cut the wire to the length specified. Prepare the wire by stripping 1/4″ of insulation from both ends. As a reminder, the (NS) and (S) designations in the instructions indicate no solder and solder respectively. There will always be a number included in the (S) designator indicating the number of wires that should be connected at that joint. Refer to Fig. 11 for the following steps:

(1) Prepare six lengths of hookup wire by cutting to the lengths indicated and stripping 1/4″ of insulation from both ends of each wire as follows:

8″ length of red wire . . . . ( )

7-1/2″ length of purple wire . . . . ( )

7″ length of red wire . . . . ( )

7-1/4″ length of yellow wire . . . . ( )

6-3/4″ length of green wire . . . . ( )

5-1/2″ length of blue wire . . . . ( )

The six wires just prepared will now be connected to the band switch located at the upper left corner of the panel.

(2) Connect the longer of the two red wires from terminal 1 (S1) of the band switch to terminal 1 (NS) of the volume control . . . . ( )

(3) Connect one end of the purple wire to terminal 2 (S1) of the band switch. The free end of this wire will be connected later . . . . ( )

(4) Connect one end of the remaining red wire to terminal 3 (S1) of the band switch. The free end of this wire will be connected later . . . . ( )

(5) Connect one end of the yellow wire to terminal 4 (S1) of the band switch. The free end of this wire will be connected later . . . . ( )

(6) Connect one end of the green wire to terminal 5 (S1) of the band switch. The free end of this wire will be connected later . . . . ( )

(7) Connect one end of the blue wire to terminal 6 (S1) of the band switch. The free end will be connected later . . . . . . ( )

(8) Cut the leads on a 1N914 diode to 1/2″. Connect the cathode (banded end) of the diode to terminal 2 (NS) of the meter. Connect the other end of the diode to terminal 1 (NS) . . . . ( )

(9) Connect a 4″ length of red wire from terminal 2 (S2) on the meter to terminal 2 (NS) on the loudspeaker . . . . ( )

(10) Connect one end of an 8″ length of green wire to terminal 1 (S2) on the meter. The free end of this wire will be connected later . . . . ( )

(11) Connect one end of a 4-1/2″ length of green wire to terminal 2 (S2) on the loudspeaker. The free end of this wire will be connected later . . . . ( )

(12) Connect one end of a 6″ length of brown wire to terminal 1 (S1) on the loudspeaker. The free end of this wire will be connected later . . . . ( )

(13) Connect one end of a 7-1/2″ length of orange wire to terminal 2 (S1) on the volume control. The free end of this wire will be connected later . . . . ( )

(14) Connect one end of a 6-1/2″ length of black wire to terminal 3 (S1) of the volume control. The free end of this wire will be connected later . . . . ( )

(15) Connect a 6″ length of blue wire to terminal 1 (S2) on the volume control. The free end of this wire will be connected later . . . . ( )

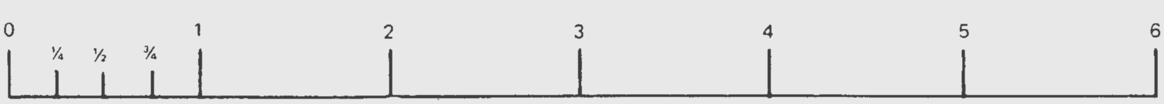
(16) Connect one end of a 5″ length of yellow wire to terminal 1 (S1) on the slide switch. The free end of this wire will be connected later . . . . ( )

(17) Connect one end of a 4-1/4″ length of green wire to terminal 3 (S1) on the slide switch. The free end of this wire will be connected later . . . . ( )

(18) Strip all the insulation from a 1-1/2″ length of red wire. Connect the bare wire from the black banana jack (NS) to the large lug (S1) on the phono socket . . . . ( )

(19) Connect one end of an 8-1/2″ length of white wire to the black banana jack (S2). The free end of this wire will be connected later . . . . ( )

(20) Connect one end of a 3″ length of yellow wire to the center terminal (S1) on the phono socket. The free end of this wire will be connected later . . . . ( )



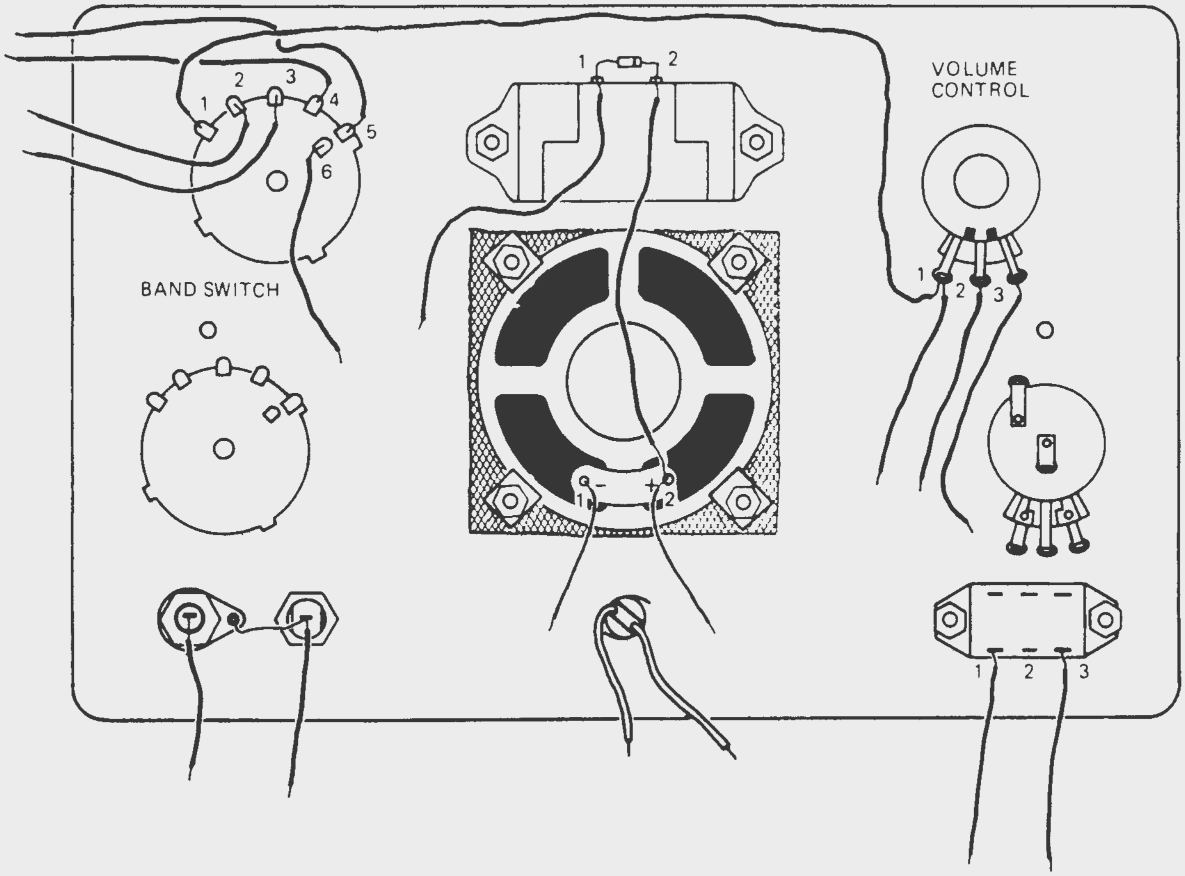


Fig. 11. Wiring the front panel.

Refer to Fig. 11, Detail A, for the following steps. These steps refer to the coarse attenuator switch at the left center position on the panel.

(1) Connect one end of a 4-1/4" length of orange wire to terminal 1 (NS) of the coarse attenuator switch. The free end of this wire will be connected later . . . . ( )

(2) Cut both leads on a 5.1 ohm resistor (green-brown-gold) to 1/2". Connect this resistor from terminal 1 (S2) to terminal 2 (NS) of the coarse attenuator switch . . . . ( )

(3) Cut both leads on a 51 ohm resistor (green-brown-black) to 1/2". Connect this resistor from terminal 2 (S2) to terminal 3 (NS) . . . . ( )

(4) Cut both leads on a 510 ohm resistor (green-brown-brown) to 1/2". Connect this resistor from terminal 3 (S2) to terminal 4 (NS) . . . . ( )

(5) Cut both leads on a 5.1k-ohm resistor (green-brown-red) to 1/2". Connect this resistor from terminal 4 (S2) to terminal 5 (NS) . . . . ( )

(6) Cut one of the leads on the 0.05 μF capacitor to a length of 1/2". Slip a 1/4" length of clear spaghetti over this lead and connect the end to lug 6 (S1). The other lead of this capacitor will be connected later . . . . ( )

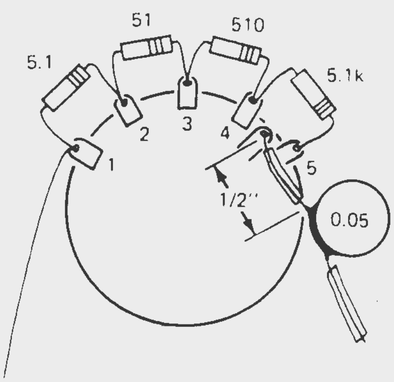


Fig. 11. Detail A.

Refer to Fig. 12 for the following steps:

(1) Mount the chassis/rear panel assembly to the front panel using two 6-32 X 3/8" black Phillips-head screws, lockwashers, and nuts . . . . ( )

(2) Route the three wires from the volume control and the unconnected wire from the meter through the cutout in the front center of the main chassis directly below the meter assembly. Check to be sure the volume control solder lugs *do not* make contact with the main chassis. Reposition those lugs if necessary . . . . ( )

(3) Route the five unconnected leads from the band switch through the cutout directly below the meter assembly as shown . . . . ( )

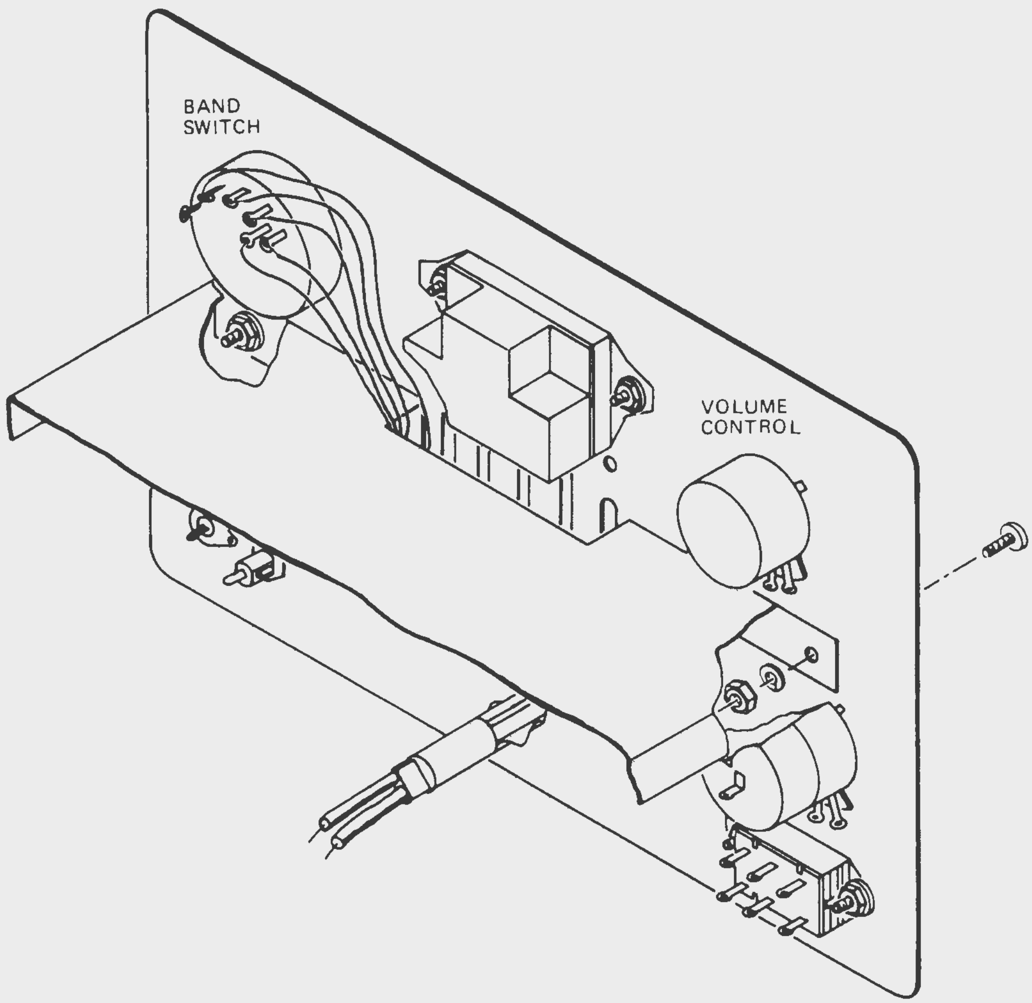


Fig. 12. Joining the front panel to the chassis.

Refer to Fig. 13 for the following steps:

(1) Position the chassis in front of you as shown. Mark terminal identification numbers on the chassis next to each of the two circuit board connectors as shown. One way to do this is to affix a piece of masking tape on the chassis next to each connector and print the terminal numbers on the tape with a ball-point pen . . . . ( )

(2) Connect the shorter of the two wires coming from the line cord to terminal 1 (S1) on the fuse post . . . . ( )

(3) Twist together the remaining line cord wire and the longer of the two black transformer leads as shown . . . . ( )

(4) Connect the black transformer lead to terminal 1 (NS) of the fine attenuator control . . . . ( )

(5) Connect the line cord lead to terminal 2 (S1) of the fine attenuator control . . . . ( )

(6) Connect the remaining black transformer lead to terminal 2 (NS) of the fuse post . . . . ( )

(7) Cut both the leads from the neon lamp assembly to 4-1/2", then strip 1/4" of insulation from the end of each ( )

(8) Connect one of the leads from the neon lamp assembly to terminal 2 (S2) of the fuse post. Connect the second lead from the neon lamp assembly to terminal 1 (S2) of the fine attenuator control . . . . ( )

(10) Connect either of the two green leads from the power transformer to terminal 11 (S1) of the circuit board connector . . . . ( )

(11) Connect the remaining green transformer lead to terminal 12 (S1) of the circuit board connector . . . . ( )

(12) Connect the yellow lead from the transformer to terminal 8 (S1) of the circuit board connector . . . . ( )

(13) Connect the white wire from the black banana jack to terminal 6 (S1) of the circuit board connector . . . . ( )

(14) Connect the yellow wire from the phono plug to terminal 5 (S2) of the coarse attenuator switch as shown . ( )

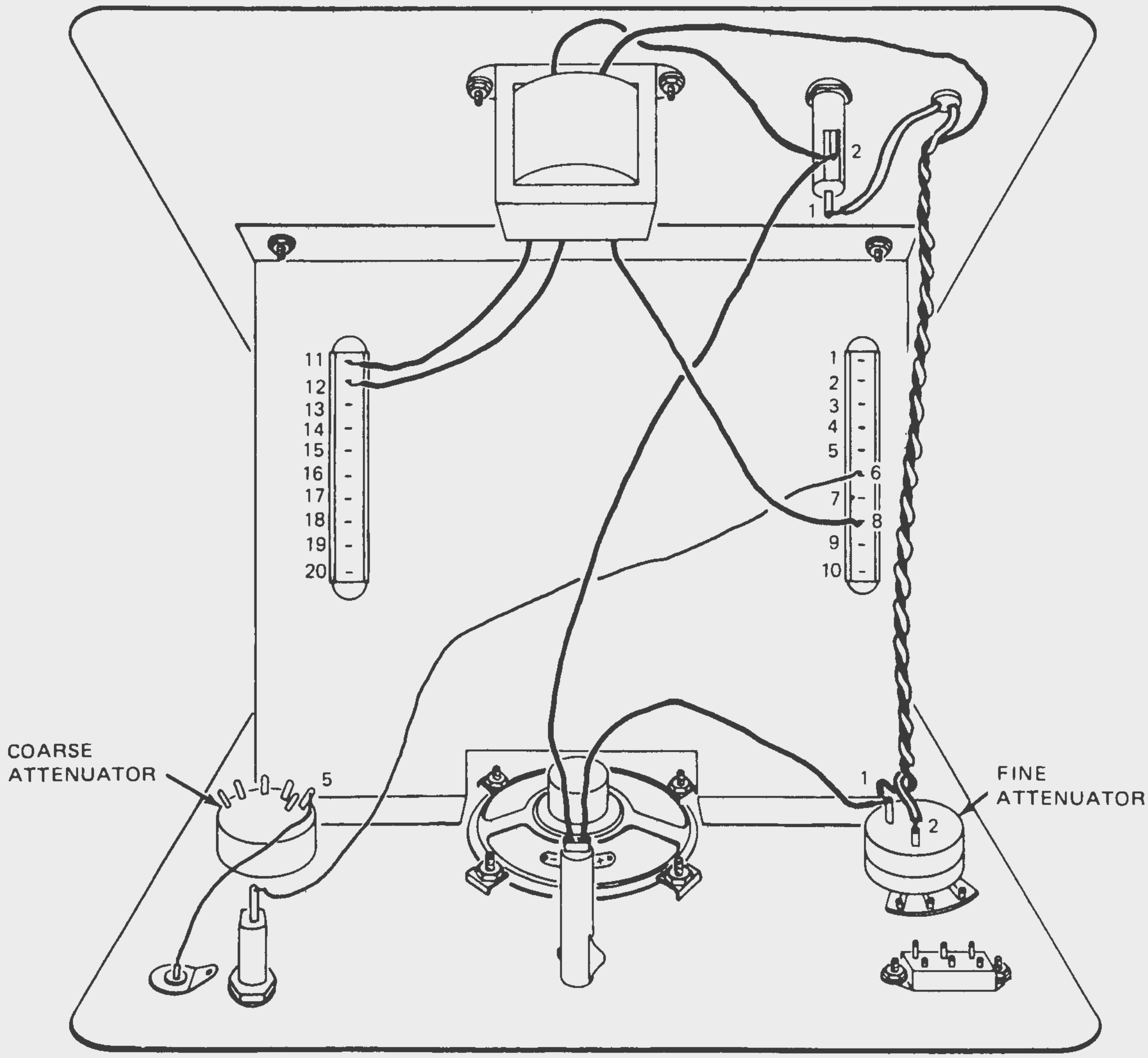


Fig. 13. Chassis wiring, Stage I.

The following steps refer to the wires coming from the chassis cutout above the loudspeaker, as shown in Fig. 14.

(1) Connect the purple wire to terminal 16 (S1) of the circuit board connector . . . . ( )

(2) Connect the yellow wire to terminal 17 (S1) of the circuit board connector . . . . ( )

(3) Connect the red wire to terminal 18 (S1) of the circuit board connector . . . . ( )

(4) Connect the green wire coming from terminal 5 of the band switch to terminal 19 (S1) of the circuit board connector . . . . ( )

(5) Connect the blue wire coming from terminal 6 of the band switch to terminal 20 (S1) of the circuit board connector . . . . ( )

(6) Cut the free end of the 0.05 μF capacitor to a length of 1-1/2". Slip a 1" piece of spaghetti tubing over the bare lead and connect this lead to terminal 20 (S2) of the circuit board connector . . . . ( )

(7) Connect the orange wire to terminal 1 (S1) of the circuit board connector . . . . ( )

(8) Solder the free end of the green wire connected to terminal 1 of the meter to terminal 5 (S1) of the circuit board connector . . . . ( )

(9) Connect the black wire to terminal 8 (S2) of the circuit board connector . . . . ( )

(10) Connect the blue wire to terminal 2 (S1) of the slide switch . . . . ( )

(11) Connect the orange wire coming from terminal 1 of the attenuator switch to terminal 13 (S1) of the circuit board connector . . . . ( )

(12) Connect an 8-1/2" length of black wire from terminal 14 (S1) of the circuit board connector to terminal 1 (S1) of the fine attenuator control . . . . ( )

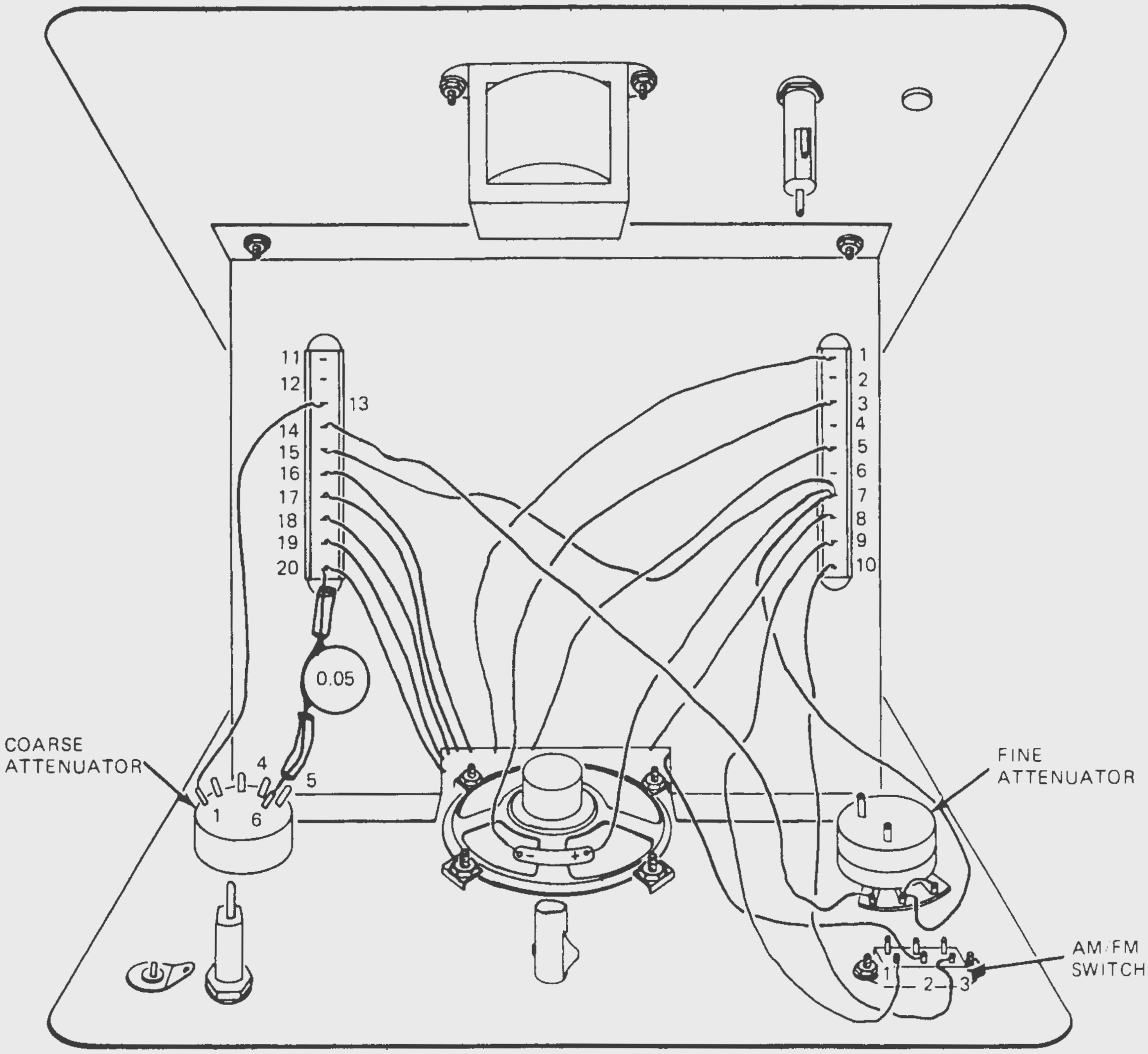


Fig. 14. Chassis wiring, Stage II.

(13) Connect a 6" length of green wire from terminal 15 (S1) to terminal 7 (S1) of the circuit board connector ...... ( )

(14) Cut a 4-1/2" length of white wire. Strip 1/4" of insulation from one end and 1/2" of insulation from the other. Pass the end with 1/2" of insulation removed through terminal 3 and connect it to terminal 2 of the fine attenuator control. Solder the wire to terminals 2 and 3. Connect the other end of this wire to terminal 7 (S2) of the circuit board connector . ( )

(15) Connect the green wire from the loudspeaker to terminal 7 (S3) of the circuit board connector . . . . ( )

(16) Connect the brown wire from the loudspeaker to terminal 3 (S1) of the circuit board connector .... ( )

(17) Connect the yellow wire from the slide switch to terminal 9 (S1) of the circuit board connector .... ( )

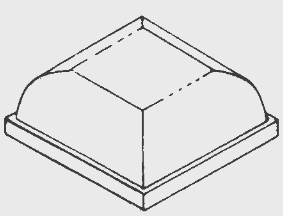
(18) Connect the green wire from the slide switch to terminal 10 (S1) of the circuit board connector .... ( )

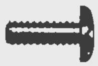
FINAL ASSEMBLY

Locate the following parts:

Part No.	Quan.	Description	Price Each
BR103	2	Cabinet alignment brackets	.55
CB47	2	Cabinets	1.25
CB49	2	Trim strips	.45
From bag 3B-231:			
AT3	1	Alignment tool	.40
CA44	1	Probe cable	1.75
CL43	1	Alligator clip	.18
HA72	1	Alligator clip boot	.06
HA93	4	Plastic cabinet feet	.09
KN46	4	Knobs	.40
NU18	8	Tinnerman nuts	.04
PL3	1	Black banana plug	.25
SC95	8	8-32 X 3/8" black Phillips-head screws	.03
WR918	3	Ground cable	.35


NU18


HA93


SC95

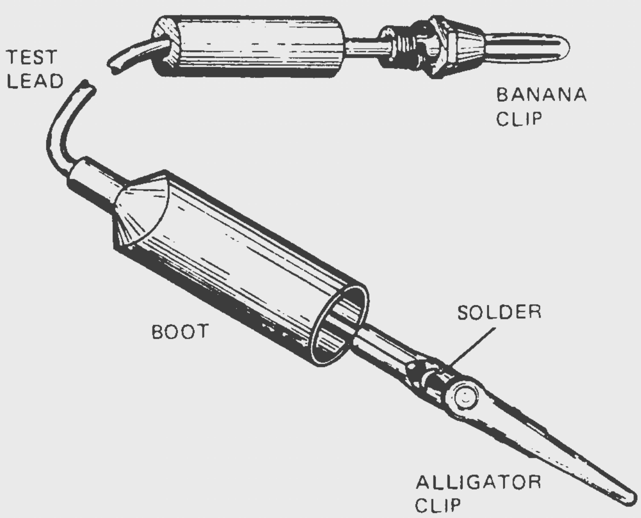


Fig. 15. Assembling the ground lead.

(1) Refer to Fig. 15 and assemble the ground lead as shown .... ( )

(2) Locate the completed main circuit board and install it on the main chassis. The circuit board is installed by placing it over the connectors with a standoff insulator aligned with the four holes at the edges of the board. Press the board down over the standoffs until it stamps into position, making sure that the connectors meet properly with the receptacles on the circuit board .... ( )

(3) Turn the shaft on the volume control fully counter-clockwise. Now install a knob on the shaft to this control with the white dot pointed toward the MIN position on the volume control dial. Tighten the set screw in the knob to hold it in place .... ( )

(4) In a similar manner, install the knob on the fine attenuator control after making sure that the shaft is turned completely counterclockwise and the switch is in the OFF position. Secure the knob with a white dot pointing toward the OFF position on the attenuator dial .... ( )

(5) Using a pair of pliers, turn the shaft on the band switch fully counterclockwise. Install a knob on the shaft of this control by tightening the set screw up against the flat in the shaft. The white dot on the skirt of the knob should point toward the RF position on the dial. If the white dot on the skirt of the knob is not aligned with the RF position on the dial, remove the knob and loosen the nut holding the switch to the panel. Adjust the switch as necessary to bring the white nut into alignment with the RF position. When they are aligned, tighten the nut to secure the switch, then install the knob and tighten the set screw against the flat .... ( )

(6) Mount the remaining knob on the shaft of the coarse attenuator control. If necessary, adjust the position of this control by loosening the nut securing it to the panel to bring the dot into alignment with the legend printed on the panel .... ( )

(7) Locate the probe cable and plug one end of it into the input jack on the front of the signal tracer. Plug the other end of this cable into the back of the probe . . . . ( )

(8) Locate the ground lead and connect the banana plug to the banana jack on the front of the instrument . . . . ( )

(9) Preset the controls on the front of your signal tracer as follows:

CONTROL	POSITION
Fine attenuator	Fully counterclockwise (off) ( )
AM/FM switch	FM position . . . . ( )
Volume	Mid-position . . . . ( )
Band	10.7 MHz . . . . ( )
Coarse attenuator	10^0 . . . . ( )

(10) Before installing the signal tracer in the cabinet, locate the four plastic mounting feet found in bag 3B-231. Remove the backing from the feet and mount them on one of the cabinet halves as shown in Fig.16 . . . . ( )

(11) Now locate the two cabinet alignment brackets (BR103) and mount four Tinnerman nuts on the brackets over the four holes as shown in Fig.17. The raised portion of the Tinnerman nut goes on the inside of the U-shaped brackets . . . . ( )

(12) Next, locate two of the black Phillips-head 8-32 screws. Put the screws through the two holes on one side of the black trim strip, and through the holes in the cabinet half on which you mounted the feet. Then screw them into the Tinnerman nuts on the cabinet aligning brackets as shown in Fig. 18. Do *not* tighten the screws. Do the same thing with the second cabinet trim strip and alignment bracket on the other side of the cabinet bottom . . . . ( )

(13) Now carefully lift the signal tracer and lower it inside the cabinet bottom so that the alignment brackets are on the inside of the front and back panels . . . . ( )

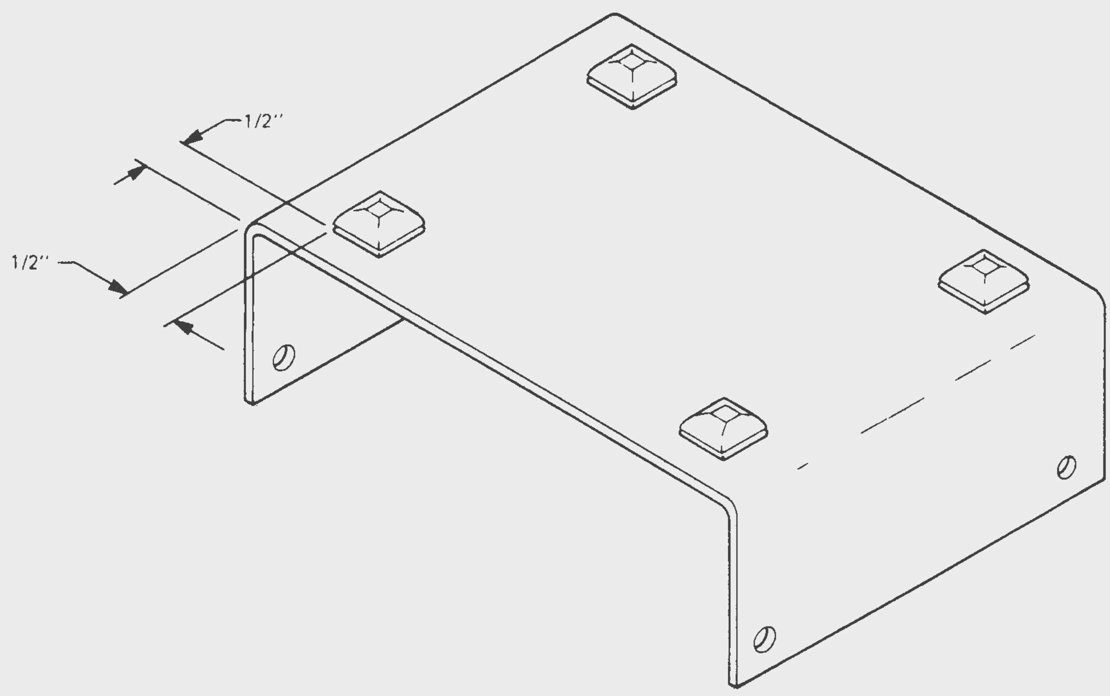


Fig. 16. Mounting the feet on one of the cabinet halves.

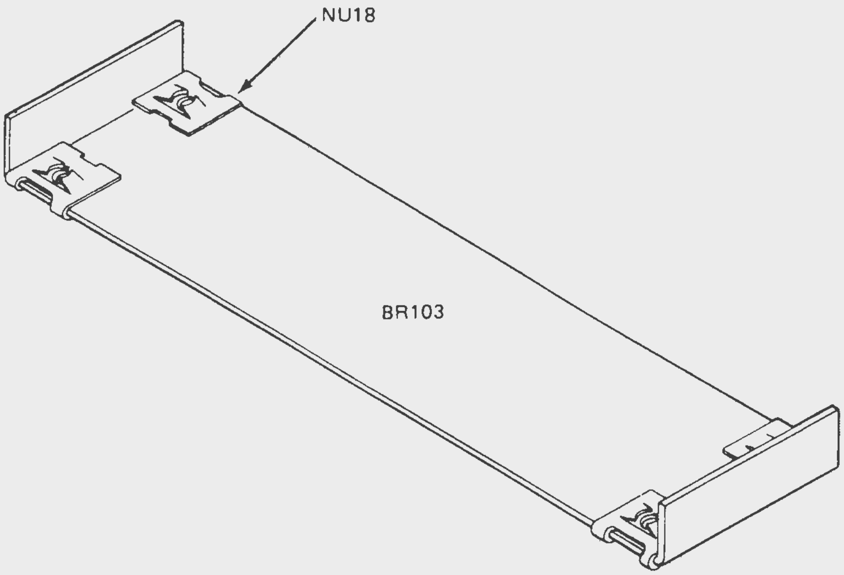


Fig. 17. The alignment bracket with four Tinnerman nuts in place.

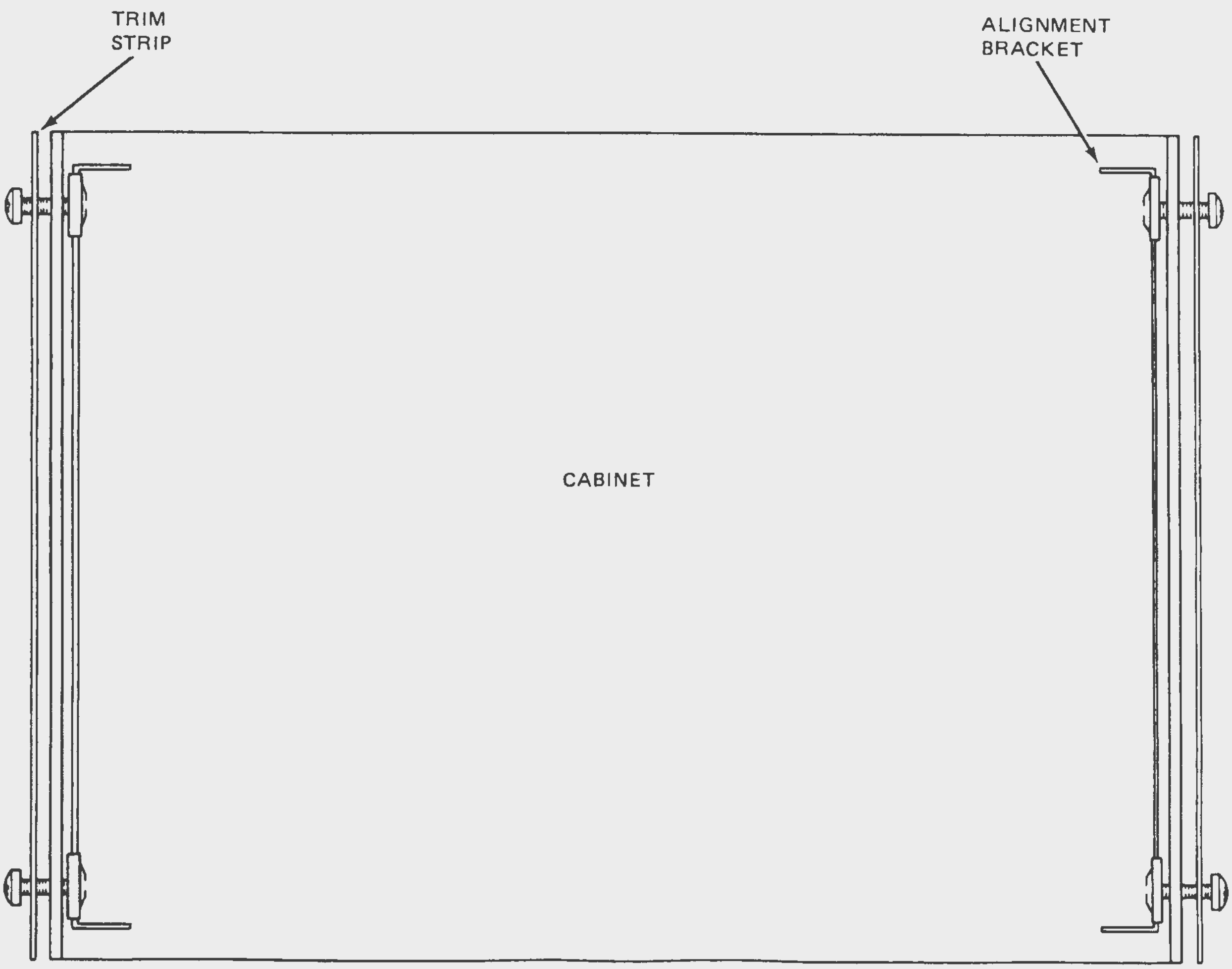


Fig. 18. Mounting the trim strips and the alignment brackets on the cabinet bottom.

INITIAL ADJUSTMENTS

All of the frequency selective input circuits in your Model 231 are fixed-tuned with ceramic filters. No adjustment to these is possible or necessary. The FM section of the instrument, however, utilizes a quadrature detector which must be tuned to 10.7 MHz.

In order to adjust the FM quadrature coil, you will need an FM receiver in good operating condition and the alignment tool (AT3).

WARNING

If your FM receiver does not use a power transformer, you must connect the receiver to the ac power line through an isolation transformer for this adjustment. Failure to observe this precaution will result in a serious electrical shock hazard.

Preset the slug in the quadrature coil (Fig. 19) as follows. Turn the slug counterclockwise until the top of the slug is flush with the top of the coil form. Now turn the slug clockwise exactly 3-1/2 turns.

Take the receiver out of its cabinet and remove whatever covers necessary for you to gain access to the components in the i-f strip. Turn on the power to your signal tracer by turning the fine attenuator control to its mid-position. Now tune in a strong FM station on the receiver and touch the probe tip of your signal tracer to the plate or collector of the last i-f amplifier in the receiver. Adjust the slug in the quadrature coil for the clearest loudest sound from the loudspeaker of the signal tracer.

Set the coarse attenuator to the 10^1 position and again adjust the quadrature coil for the clearest loudest sound. Continue increasing the coarse attenuator setting and adjusting the quadrature coil until no further improvement can be obtained.

Install the remaining cabinet half on the signal tracer and secure it in place with four black Phillips-head screws.

OPERATING CONTROLS

It will be helpful in understanding the functions of the various operating controls if you refer to the block diagram in Fig. 20 as you read the following discussion.

Coarse Attenuator. This control provides selectable attenuation in 10X increments to the signal from the probe. It should always be set to the highest attenuator position possible while still maintaining a usable output from the instrument. This prevents overloading and distortion of the signal as it passes through the amplifiers in the tracer.

Band. This control routes the signal from the coarse attenuator either directly to the wide-band amplifier (rf position), through one of the three ceramic filters covering the standard i-f frequencies, or directly to the audio amplifier (audio position).

Fine Attenuator. Turning this control clockwise increases attenuation (decreases gain) over a narrow range. Notice that audio signals bypass the wide-band amplifier and are therefore unaffected by the setting of this control. This control also turns off the power to the instrument when set in the fully counterclockwise position.

AM/FM. This control routes the signal from the wide-band amplifier to either the AM or FM demodulator within the instrument.

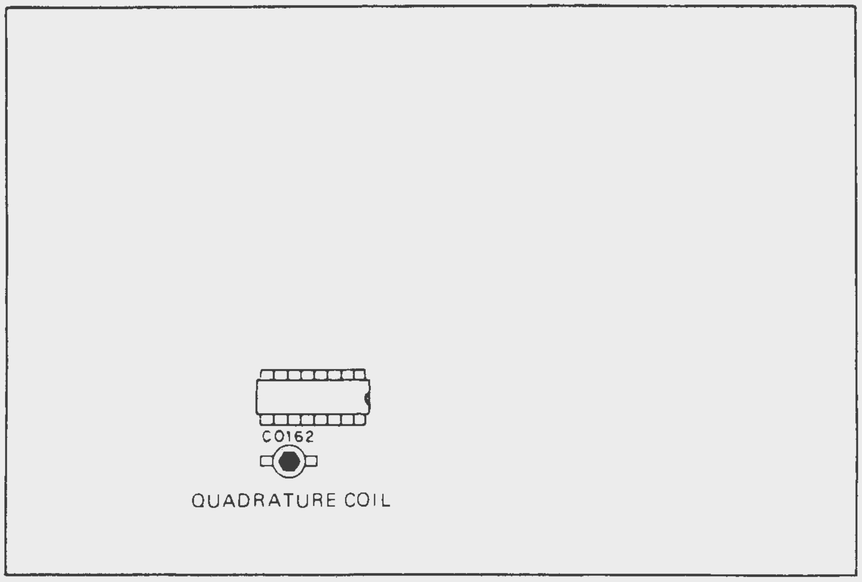


Fig. 19. Illustration showing the location of the quadrature coil.

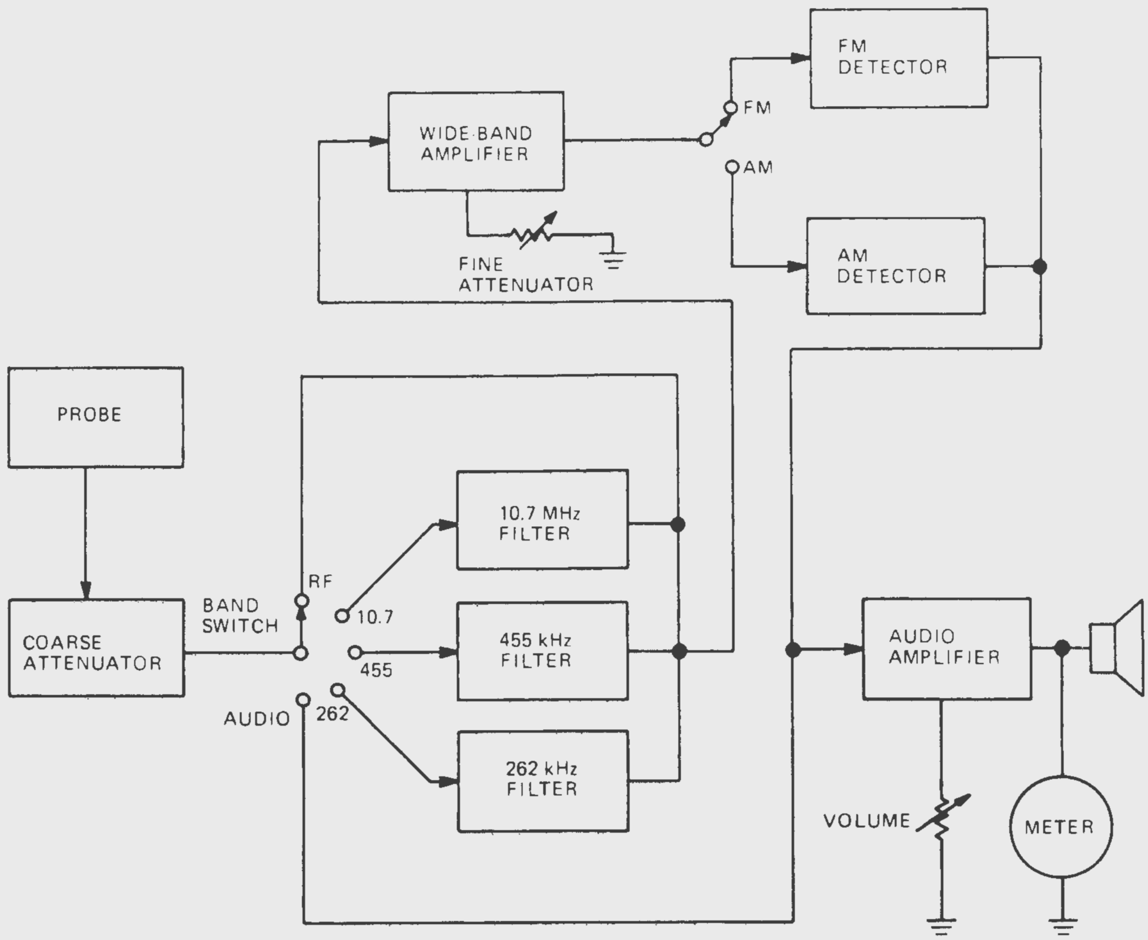


Fig. 20. Block diagram of the Model 231 signal tracer.

Volume. This control adjusts the level of sound from the loudspeaker and the sensitivity of the meter.

The Model 231 has the capability of tracing signals in AM receivers from the antenna to the loudspeaker. From the antenna terminals to the input of the mixer stage, the band switch on the signal tracer should be set to the RF position; the AM/FM switch, of course, should be set to the AM position. From the output of the mixer stage to the input of the detector, the band switch should be set to the i-f frequency of the receiver under test. This will normally be 455 kHz; however, many automobile radios use 262 kHz for the i-f frequency. From the output of the detector to the loudspeaker, the band switch should be set to the audio position.

The Model 231 employs a quadrature FM detector which is tuned to 10.7 MHz, the standard i-f frequency used in FM receivers. For this reason, you must begin signal tracing in FM receivers at the output of the mixer where the 10.7 MHz signal originates. The band switch should be set to the 10.7 MHz position and the AM/FM switch to the FM position. At the output of the detector, the band switch should be switched to the audio position.

It is very important to keep the coarse attenuator switch at the highest possible position while still maintaining a usable output from the signal tracer. Too low a setting will overload the input to the wide-band amplifier and generate distortion. A mid-position setting of the fine attenuator control will usually be ideal. This will permit you to either increase or decrease the attenuation by small amounts as may be necessary.

WARNING

When servicing transformerless receivers with the Model 231, you must use an isolation transformer between the receiver and the ac power line. Failure to observe this precaution will result in a serious electrical shock hazard.

WHAT IS SIGNAL TRACING?

Signal tracing means sampling or examining the signal voltage at various points in a receiver as it passes from the antenna through the receiver to the loudspeaker. In using a signal tracer, when you pass from a point of normal signal to the point at which your signal tracer verifies or confirms a complaint, you have just passed into or through the defective stage.

The signal tracer enables you to examine the frequency, quantity, and quality of the signal. If the set is dead, you can determine where the signal stops. If the complaint is weak reception, you can find which stage is causing a loss rather than a gain in signal strength. If distortion, noise, hum, or oscillation is the symptom, the signal tracer will quickly narrow your search to the defective stage, and in many cases to the defective part itself.

Shortcuts in Checking Receivers. After you become familiar with the use of your tester, you can save time by applying some of the shortcut methods listed below.

(1) The first quick check should be the i-f stages, because this immediately enables you to determine whether the trouble is in the rf/i-f section or the audio section. The signal tracer is extremely sensitive, and it is not always necessary to get at the bottom of the receiver chassis to locate test points. Very often you need only hold the tracer probe near the i-f stages to pick up an i-f signal. A better pickup can be obtained by touching the probe to the case of a transistor. If the transistor case is not grounded, a considerable signal will be present. Also, where powdered iron cores are used in the i-f transformers, you can touch the probe tip to the core and pick up a signal at this point. As you progress from the output of the mixer toward the second detector, each succeeding stage will deliver a stronger signal.

(2) In many instances signals may be picked up in the audio section with the band switch set to AUDIO by touching the probe tip to the cases of the audio transistors. Where this is not possible, it will be necessary to remove the chassis from the cabinet so you can get at the various electrode connections of the audio transistors.

SERVICING RECEIVERS THAT DISTORT

The receiver in which distortion is to be localized should be tuned to a station so that its loudspeaker will reproduce that distortion. With the receiver volume set at a low level, connect the Model 231 ground lead to B– on the receiver. Set the band switch to AF, and touch the probe to the ungrounded side of the receiver voice coil. (If one side of the voice coil is not grounded, the Model 231 ground lead should be clipped directly to one side of the voice coil, and the probe to the other side.) Turn up the signal tracer volume, so that the audio output from the signal tracer exceeds the output from the receiver. Listen for the distortion. If it is absent in the output from the signal tracer, you know at once that the receiver loudspeaker is at fault and appropriate steps should be taken to correct the speaker trouble.

If the distortion is present across the speaker voice coil, it is still possible that the loudspeaker is defective. You should proceed to mute the speaker by disconnecting one lead of its voice coil. Substitute a dummy load of a 10 ohm, 5 to 10 watt resistor in place of the speaker voice coil. Using the signal tracer, check the audio voltage appearing across the dummy load resistor for distortion. If reception is now normal, the loudspeaker is definitely at fault. (Note: In making this check, the signal tracer ground lead should go to the grounded side of the speaker voice coil if one side of the voice coil is grounded. Otherwise, connect the probe to either side of the dummy load and the ground lead to the other.)

If the distortion continues, reconnect the Model 231 ground lead to the receiver B– lead, and touch the probe to the ungrounded side of the diode load resistor, where the detected audio signals are first developed. If the distortion is not present at the diode load, proceed to trace the audio signal toward the loudspeaker, using the audio section of the signal tracer as previously described. The first point at which the distortion is present indicates that you have just passed through the defective stage. You should then concentrate on that stage, checking the operating voltages with a dc voltmeter and being on the lookout for defective parts, tubes, or transistors.

Perhaps the most common cause for distortion is a defective transistor, a leaky coupling capacitor, or a gassy tube. Many technicians who regularly use a signal tracer will first, in the case of distortion, check for leaky coupling capacitors and gassy tubes with a dc voltmeter before resorting to the signal tracing procedure. DC voltage measurement will often show up a leaky transistor or incorrect base-emitter bias.

If distortion is present across the diode load resistor, set the band switch to prepare the signal tracer to pick up the i-f signals.

Touch the rf probe to the input of the diode detector. If there is no distortion at the input of the detector, but the af output of the detector is distorted, a new second detector should be tried. Also, the resistance of the diode load resistor should be checked with an ohmmeter. Too high a diode load resistance can cause distortion.

If the distortion is present across the input to the diode detector, touch the rf probe to the input of the i-f amplifier driving the second detector. If distortion does not exist here, but is present at the output, try a new tube, or if a transistor is used, check its operating voltages before trying a replacement transistor. Also, use a high-resistance dc voltmeter to check the avc voltage applied to this stage. Lack of avc voltage can cause the stage to deliver a distorted signal to the second detector. Check the avc circuit for continuity and the avc filter capacitors for leakage or for a short.

SERVICING RECEIVERS FOR EXCESSIVE HUM

In most sets, excessive hum is caused by leaky electrolytic capacitors, defective rectifiers, or cathode-to-heater leakage in tubes. It is advisable to check these parts first before trying to localize the point at which hum enters the receiver circuit. The tubes may be checked for leakage in a reliable tube tester. To check the capacitors you can shunt them with good capacitors, or check them with an RC tester. Rectifiers may be checked with an ohmmeter.

The signal tracer can be used to check for excessive hum voltage across the filter capacitors. To do this, prepare the Model 231 for af listening tests by setting the band switch to AUDIO. Clip the ground lead to the negative lead of the capacitor under test. (Do not unsolder the capacitor leads.) Touch the probe to the positive capacitor lead. Set the volume so that the amount of hum can be readily heard. The hum should be very loud across the input filter capacitor. However, hum should be at a low level across the output filter capacitor.

After you have made this test on a few receivers in first-class condition, you will know how to interpret the results of this test. If the rectifiers, tubes, and filter capacitors are not at fault, trace the hum to its point of entry into the receiver and then concentrate on that circuit.

If hum modulation is the complaint, tune the receiver to a powerful local station, or use the unmodulated signal from a signal generator. Trace the signal from the antenna toward the second detector until you find the stage in which the hum modulation first starts. The regular rf signal-tracing procedure previously explained should be used.

HOW TO SERVICE A NOISY RECEIVER

When a receiver is noisy, certain clues will lead directly to the noise source. (We are assuming that you have definitely concluded that the noise is originating within the receiver.) A change in noise level when you are actually moving the wave-band switch, a pushbutton switch, the volume control, the tone control, or the tuning capacitor indicates that the device being moved is at fault. Even if you do not have any of these clues, the noise can be localized to one section rather simply.

In a modern superheterodyne receiver, the volume control is either the diode load resistor or is in the input circuit of the first af stage. Therefore, the volume control separates the rf/af section from the audio section of the receiver. If you turn the volume control to the minimum volume position and the noise disappears, the source of the noise is in the rf/i-f section of the receiver. If the noise remains with the volume control set at minimum, the source of the noise is in the audio amplifier section or in the power supply of the receiver. (This is not quite always true. Severe changes in current, such as may be caused by a circuit defect in an rf or i-f stage, may affect the power supply to the audio amplifier enough to introduce noise – even when the volume control is turned to zero volume. However, in such cases, turning down the volume control will decrease the noise intensity greatly.)

Noise signals pass through the receiver stages in the same way as other signals do. Their source can be readily located with the Model 231 signal tracer.

To trace noise signals with the signal tracer, tune the receiver and signal tracer to some quiet point on the dial (not to a station). Trace from the first stage of the defective section (rf/i-f section or af section) toward the loudspeaker of the set. When you first hear the noise coming from the signal tracer speaker, you have located the defective stage.

Remember that noises originating in one stage may feed back into a number of previous stages through a power supply circuit common to these stages. This can occur only when the noise signal is unusually strong, or in sets in which there is insufficient bypassing of the supply leads. Therefore, in rare cases, it is possible to pick up a noise signal in the output circuit of one stage when the noise is actually originating in a later stage. Short the output of the first stage in which noise is traced, using a 0.1 μF capacitor. If the noise disappears in the receiver's output, this stage is more than likely introducing the noise. If the noise is still present in the receiver's output, suspect a following stage.

MAINTENANCE

Hopefully, you will not have occasion to use the material in this section of your manual. If you do have a problem with your initial checkout, however, the information here should help you find and correct it as quickly as possible.

GENERAL

As a purchaser of a piece of electronic test equipment such as the Model 231, you probably have considerable familiarity with electronic circuits. Nevertheless, our experience shows that any difficulties you might have in obtaining correct results during initial checkout are most likely caused by assembly errors or poor soldering. Either of these causes can further result in component failures, so that even when you have corrected a wiring error or a solder bridge on a circuit board, your equipment still does not work properly. Thus, the first step in locating the cause of an abnormal indication is to verify that your wiring and component installation are correct. Do this by going back over the assembly steps and carefully checking your work against the illustrations in the manual. It is often helpful to have another person check your work. Someone unfamiliar with your equipment can sometimes spot an error that you have consistently overlooked.

CHECKING DIODES

The basic job of a diode is to pass current flow in one direction and to block it in the other. How well the diode does this job can be determined using your ohmmeter.

To check a diode, first connect the leads from your ohmmeter to those of the diode and read the resistance. Now reverse the ohmmeter connections to the diode by swapping the leads or using the normal/reverse switch if your meter has one. Again measure the resistance.

One of the readings you obtain, the front or forward resistance, should be quite low – perhaps less than 100 ohms. The other reading, the back resistance, should be very high – several megohms or more. The important consideration in determining whether or not the diode is good is the ratio of the two resistance readings. All the diodes used in your Model 231 use silicon as the semiconductor material. The ratio of the front-to-back resistance of a properly operating silicon diode should be at least 1000:1. In other words, if the forward resistance reading is 50 ohms, the back resistance should be at least 1000 times as great or 50k-ohms.

In general, a defective diode will either be completely open or shorted. The open diode will measure infinity in both directions while the shorted diode will measure the same low resistance value in both directions.

CHECKING TRANSISTORS

The equivalent circuit of a transistor can be represented as two back-to-back diodes as shown in Fig. 21. To check a transistor, you must measure the resistance from base to collector and base to emitter in both directions to determine the condition of the emitter-base and the collector-base diodes. This, of course, is the same technique used for checking conventional diodes. The front-to-back ratios of the transistor equivalent diodes, however, are not as high as for conventional diodes. As a rule, a front-to-back ratio of 10:1 is acceptable for the emitter-base diode and 100:1 is acceptable for the collector-base diode. As in the case of conventional diodes, defective transistors will usually have one or both diodes completely open or shorted.

SCHEMATIC DIAGRAM

Figure 22 is an overall schematic diagram of the complete signal tracer. Normal operating voltages are shown on each of the transistor leads and integrated circuit pins. A comparison between these voltages and those you obtain in your malfunctioning instrument will provide you with helpful troubleshooting information.

If you should encounter difficulty with your Model 231 signal tracer that you are unable to fix, write CONAR Instruments consultants for further help. If you are still unable to fix your signal tracer, send the unit prepaid via United Parcel Service to CONAR for repair. Be sure to include the minimum service charge of $7.50. We will repair your signal tracer and return it to you.

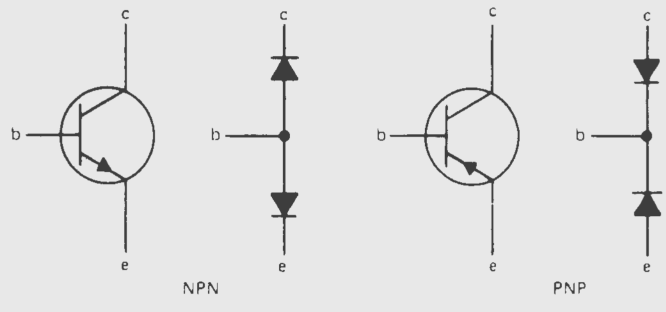
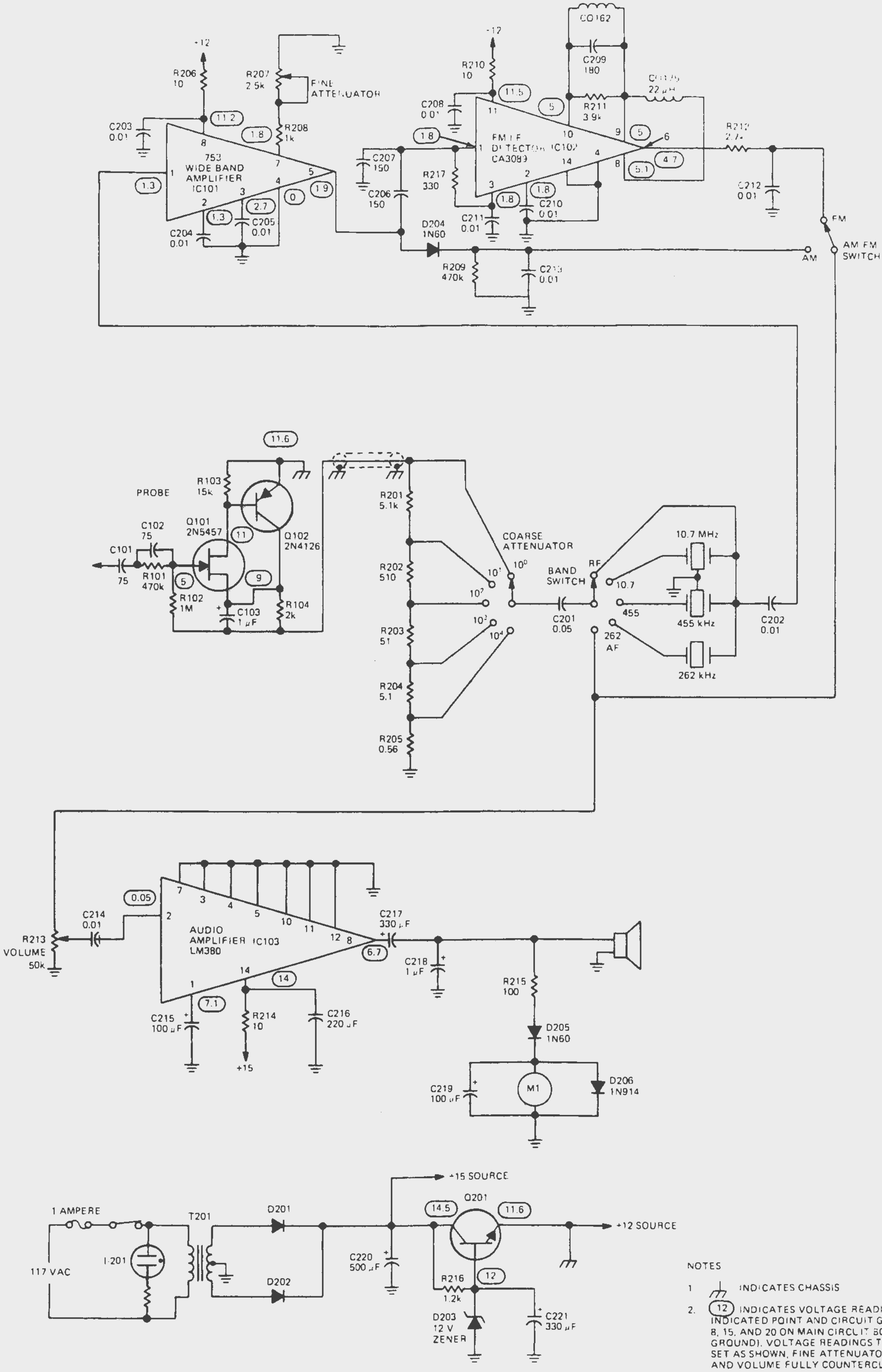


Fig. 21. Diode equivalent circuits of npn and pnp transistors.



NOTES

1. INDICATES CHASSIS

2. (12) INDICATES VOLTAGE READING TAKEN BETWEEN INDICATED POINT AND CIRCUIT GROUND (PINS 2, 4, 7, 8, 15, AND 20 ON MAIN CIRCUIT BOARD ARE AT CIRCUIT GROUND). VOLTAGE READINGS TAKEN WITH SWITCHES SET AS SHOWN, FINE ATTENUATOR FULLY CLOCKWISE AND VOLUME FULLY COUNTERCLOCKWISE.

3. RESISTOR VALUES ARE IN OHMS. CAPACITOR VALUES LESS THAN 1 ARE IN MICROFARADS AND GREATER THAN 1 ARE IN PICOFARADS (UNLESS INDICATED)

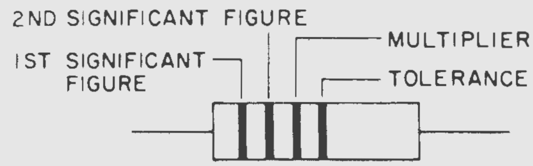
Fig. 22. Overall schematic diagram for the Model 231 signal tracer.

RESISTOR AND CAPACITOR COLOR CODES

JAN and EIA stand for the two common color codes (Joint Army-Navy and Electronics Industries Association). The two codes are the same except as indicated. We have not indicated temperature coefficients or characteristics of capacitors, because they are not necessary for identifying your parts.

COLOR	SIG. FIG.	MULTIPLIER	RESIS.	TOLERANCE: CERAMIC CAPACITORS 10 MMF OR LESS	TOLERANCE: CERAMIC CAPACITORS OVER 10 MMF	TOLERANCE: MICA CAPACITORS (As below, or ± 1 mmf, whichever is larger)	TOLERANCE: PAPER CAP
Black	0	1		± 2.0 MMF	± 20%	± 20%	20%
Brown	1	10		± 1.0 MMF	± 1%	± 1%	
Red	2	100			± 2%	± 2%	
Orange	3	1000			± 2.5%	± 2.5%	
Yellow	4	10,000					
Green	5	100,000		± 0.5 MMF	± 5%	± 5% (EIA)	5%
Blue	6	1,000,000					
Violet	7	10,000,000					
Gray	8			± 0.25 MMF			
White	9			± 1.0 MMF	± 10%		10%
Gold		.1	± 5%			5% (JAN)	5%
Silver		.01	± 10%			10%	10%
No color			± 20%				20%

RESISTORS — RESISTANCE GIVEN IN OHMS

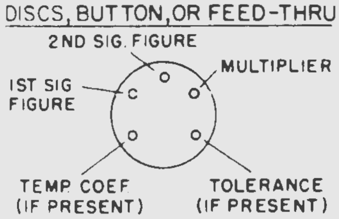


Black body = composition, non-insulated.
Colored body = composition, insulated.
Double width band for 1st sig. figure indicates wire-wound.

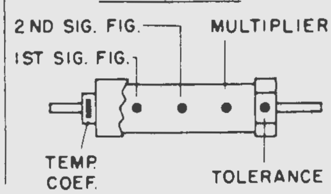
CAPACITORS — CAPACITY GIVEN IN MMF

CERAMIC

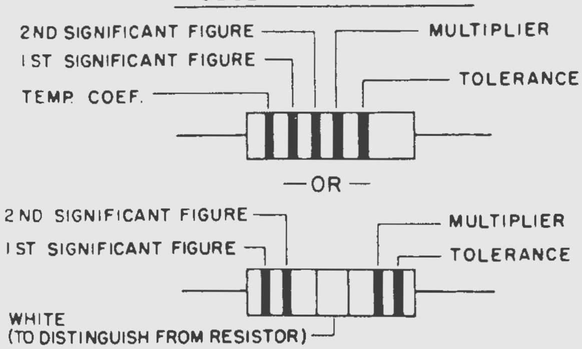
DISCS, BUTTON, OR FEED-THRU



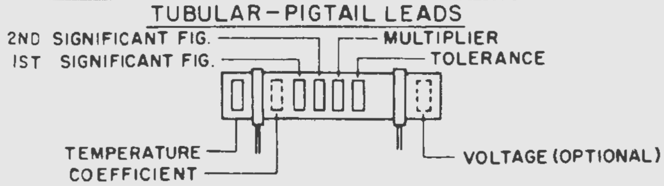
STAND-OFF



TUBULAR-AXIAL LEADS



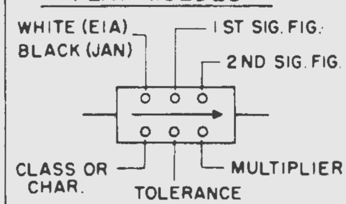
TUBULAR-PIGTAIL LEADS



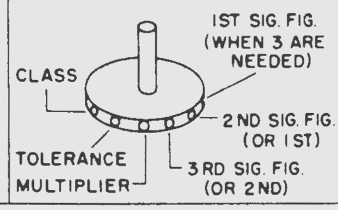
MICA

CLASS OR CHARACTERISTIC REFERS TO Q FACTOR, TEMPERATURE COEFFICIENT, AND PRODUCTION TEST REQUIREMENTS

FLAT MOLDED

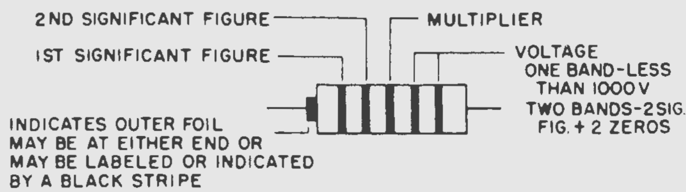


BUTTON SILVER



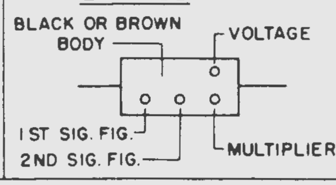
PAPER

TUBULAR



FLAT

EIA CODE



JAN CODE