ASSEMBLING AND USING YOUR . . . . . .

Heathkit

LABORATORY TYPE SIGNAL GENERATOR

MODEL LG-1

HEATH COMPANY
BENTON HARBOR, MICHIGAN

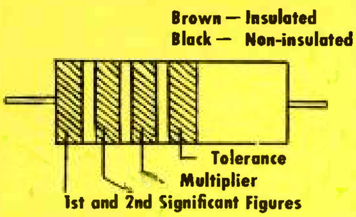
595-87

PRICE $1.00

THE WORLD'S *Finest* TEST EQUIPMENT IN KIT FORM

STANDARD COLOR CODE — RESISTORS AND CAPACITORS

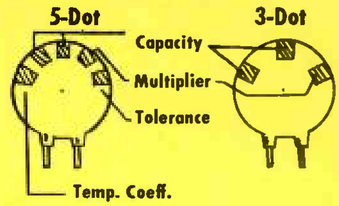
AXIAL LEAD RESISTOR



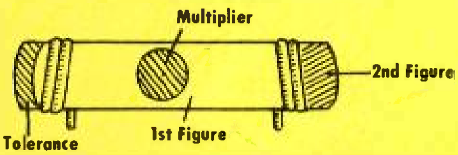
Wire wound resistors have 1st digit band double width

INSULATED UNINSULATED Color	FIRST RING BODY COLOR First Figure	SECOND RING END COLOR Second Figure	THIRD RING DOT COLOR Multiplier
BLACK	0	0	None
BROWN	1	1	0
RED	2	2	00
ORANGE	3	3	,000
YELLOW	4	4	0,000
GREEN	5	5	00,000
BLUE	6	6	000,000
VIOLET	7	7	0,000,000
GRAY	8	8	00,000,000
WHITE	9	9	000,000,000

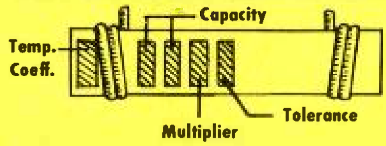
DISC CERAMIC RMA CODE



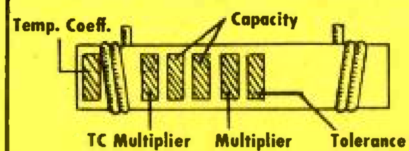
RADIAL LEAD DOT RESISTOR



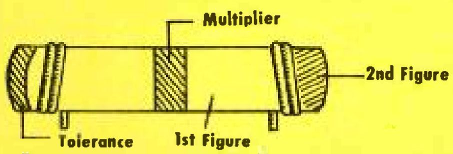
5-DOT RADIAL LEAD CERAMIC CAPACITOR



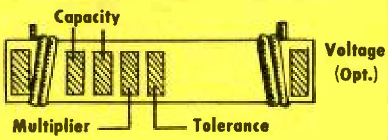
EXTENDED RANGE TC CERAMIC HICAP



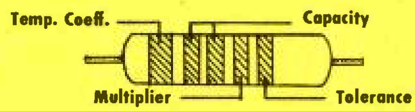
RADIAL LEAD (BAND) RESISTOR



BY-PASS COUPLING CERAMIC CAPACITOR



AXIAL LEAD CERAMIC CAPACITOR

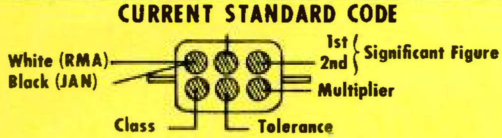


The standard color code provides all necessary information required to properly identify color coded resistors and capacitors. Refer to the color code for numerical values and the zeroes or multipliers assigned to the colors used. A fourth color band on resistors determines tolerance rating as follows: Gold = 5%, silver = 10%. Absence of the fourth band indicates a 20% tolerance rating.

The physical size of carbon resistors is determined by their wattage rating. Carbon resistors most commonly used in Heathkits are ½ watt. Higher wattage rated resistors when specified are progressively larger in physical size. Small wire wound resistors ½ watt, 1 or 2 watt may be color coded but the first band will be double width.

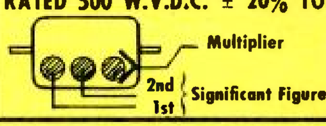
MOLDED MICA TYPE CAPACITORS

CURRENT STANDARD CODE

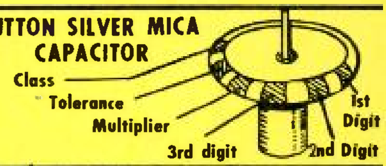


JAN & 1948 RMA CODE

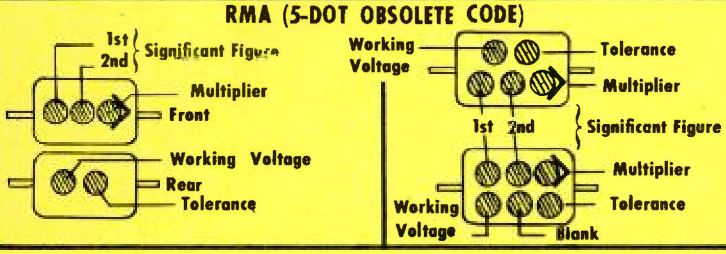
RMA 3-DOT (OBSOLETE) RATED 500 W.V.D.C. ± 20% TOL.



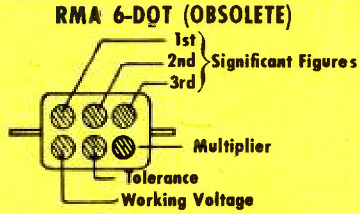
BUTTON SILVER MICA CAPACITOR



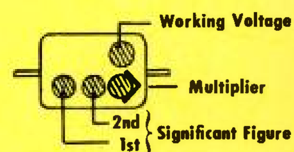
RMA (5-DOT OBSOLETE CODE)



RMA 6-DOT (OBSOLETE)

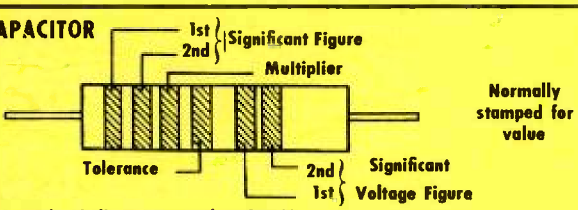


RMA 4-DOT (OBSOLETE)



MOLDED PAPER TYPE CAPACITORS

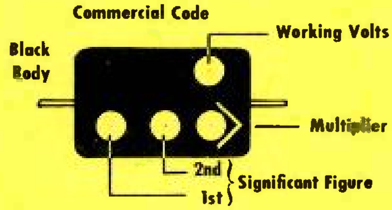
TUBULAR CAPACITOR



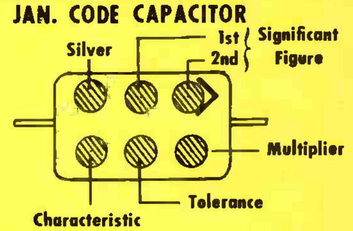
A 2 digit voltage rating indicates more than 900 V.
Add 2 zeros to end of 2 digit number.

MOLDED FLAT CAPACITOR

Commercial Code



JAN. CODE CAPACITOR



The tolerance rating of capacitors is determined by the color code. For example: red = 2%, green = 5%, etc. The voltage rating of capacitors is obtained by multiplying the color value by 100. For example: orange = 3 × 100 or 300 volts. Blue = 6 × 100 or 600 volts.

In the design of Heathkits, the temperature coefficient of ceramic or mica capacitors is not generally a critical factor and therefore Heathkit manuals avoid reference to temperature coefficient specifications.

Courtesy of Centralab

ASSEMBLY AND OPERATION OF THE HEATHKIT LABORATORY TYPE SIGNAL GENERATOR

MODEL LG-1

SPECIFICATIONS

Frequency Range	
Band A	100-290 kc
Band B	280-1000 kc
Band C	0.95-3.1 mc
Band D	2.9-9.5 mc
Band E	9-31 mc
Output	
Impedance	50 ohms
Voltage	100,000 microvolts maximum
Attenuator	
Step	10:1 per step, 5 steps
Fine	10:1 continuous, indicated on meter
Amplitude Modulation	CW, internal 400 cycles or external audio frequencies
Modulation Depth	Variable, meter indicates to 50%
Tube Complement	6AF4 Oscillator 6AV5 Grid Modulated Amplifier 12AU7 Audio Oscillator and Modulator OB2 Voltage Regulator
Power Requirements	105-125 volts 50/60 cycles
Dimensions	13" wide x 8 1/2" high x 7" deep

IMPORTANT NOTICE

This manual is intended to aid YOU in obtaining optimum performance of this kit. Therefore, DO THIS:

1. CHECK THE PARTS against the parts list.
2. LOOK OVER THE MANUAL and become familiar with its contents.
3. PROCEED CAREFULLY as good workmanship gives greater satisfaction.

GENERAL NOTES

By checking the parts against the parts list as you unpack the kit carefully, you will become familiar with the parts and reduce the chance of discarding a part with the packaging materials. If after diligent search a shortage is found, please notify us promptly and return the inspection slip with your letter to us. Hardware items are counted by weight and if a few are missing, please obtain them locally if at all possible.

Read the note on soldering on the inside of the back cover. Crimp all leads tightly to the terminal before soldering. Be sure both the lead and the terminal are free of wax, corrosion, or other foreign substances. Use only the best rosin core solder, preferably a type containing the new activated fluxes, such as Kester "Resin-Five," Ersin "Multicore," or similar types.

NOTE: ALL GUARANTEES ARE VOIDED AND WE WILL NOT REPAIR OR SERVICE INSTRUMENTS IN WHICH ACID CORE SOLDER OR PASTE FLUXES HAVE BEEN USED. WHEN IN DOUBT ABOUT SOLDER, IT IS RECOMMENDED THAT A NEW ROLL PLAINLY MARKED "ROSIN CORE RADIO SOLDER" BE PURCHASED.

Resistors and condensers generally have a tolerance rating of ±20% unless otherwise stated in the parts list. Therefore a 100 KΩ resistor may test anywhere from 80 KΩ to 120 KΩ. (The letter K is commonly used to designate a multiplier of 1000.) Tolerances on condensers are generally even greater. Limits of +100% and -50% are common for electrolytic condensers. The parts furnished with your Heathkit have been specified so they may not adversely affect the operation of the finished instrument.

In order to expedite delivery to you, we are occasionally forced to make minor substitutions of parts. Such substitutions are carefully checked before they are approved and the parts supplied will work satisfactorily. By checking the parts list for resistors, for example, you may find that a 2.2 megohm resistor has been supplied in place of a 2 megohm as shown in the parts list. These changes are self-evident and are mentioned here only to prevent confusion in checking the contents of your kit.

We strongly urge that you follow the wiring and parts layout shown in the manual. The position of wires and parts is extremely critical in circuits operating at high frequencies and changes may seriously affect the characteristics or calibration of the generator.

STEP-BY-STEP ASSEMBLY INSTRUCTIONS

The following instructions are presented in a simple, logical, step-by-step sequence to enable you to complete your kit with the least possible confusion.

Be sure to read each step all the way through before starting. When a step is completed, check it off in the space provided. This makes it easy to resume construction after your work has been interrupted. After such interruption, begin by reading over the last three or four completed steps before resuming work.

Leads on condensers, transformers and resistors are generally much longer than they need be to make the indicated connections. In these cases, the excess leads should be cut off as the parts are added to the chassis. Not only does this make the wiring much neater, but in radio frequency work, the excess length of leads may actually create tuned parasitic circuits at undesired frequencies.

NOTE: We suggest that you make the following preparations before any work is started:

1. Select from the large fold-in pictorials included with the manual, the diagram showing the phase of construction you are engaged in at the time. Attach this diagram to the wall above your work space.
2. After identifying the parts from the parts list, lay them out in a large shallow box so that they are readily accessible. This will save considerable time in construction.
3. Read thoroughly the assembly and wiring instructions on the inside rear cover of the manual and refer to the general information on both inside covers of the manual to identify parts.

NOTE: In assembling the kit, use lockwashers under all nuts unless a solder lug is used.

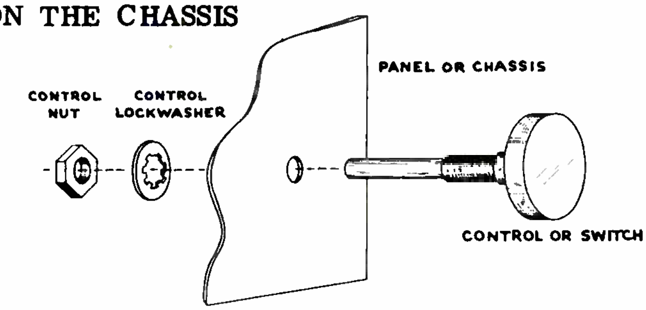
Unless otherwise stated, 6-32 screws, lockwashers and nuts are used in mounting of parts. Wire is to be insulated unless otherwise specified.

MOUNTING THE PARTS ON THE CHASSIS

( ) Install six rubber grommets on the chassis.

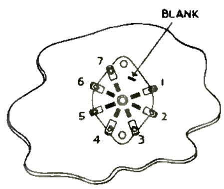
( ) Mount the two 10 KΩ calibrating controls on the chassis with control nut and lockwashers.

( ) Mount the 7-pin tube socket with 3-48 screws and nuts and #3 lockwashers with a small solder lug under nut and lockwasher nearest the blank space.

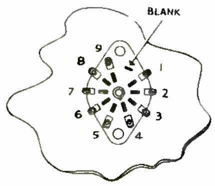


MOUNTING CONTROLS and SWITCHES

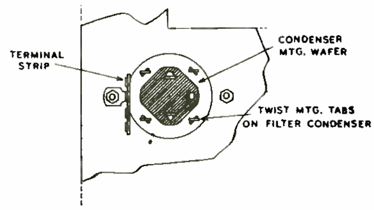
( ) Mount the 9-pin tube socket with 3-48 screws and nuts and #3 lockwashers with a small solder lug under the nut and lockwasher nearest the blank space.



NUMBERING ON 7-PIN TUBE SOCKET



NUMBERING ON 9-PIN TUBE SOCKET



( ) Mount the condenser mounting wafer on top of the chassis with 6-32 screws and nuts and #6 lockwashers with a 3-lug + one grounded lug terminal strip B nearest the front of the chassis.

( ) Install the filter condenser on the mounting wafer with the blank space toward the terminal strip. Position the condenser and push the tabs through the slots in the mounting wafer. Twist the tabs 1/8 turn with pliers to secure the condenser.

( ) Install a 2-lug terminal strip A with a 6-32 screw and nut and a #6 lockwasher.

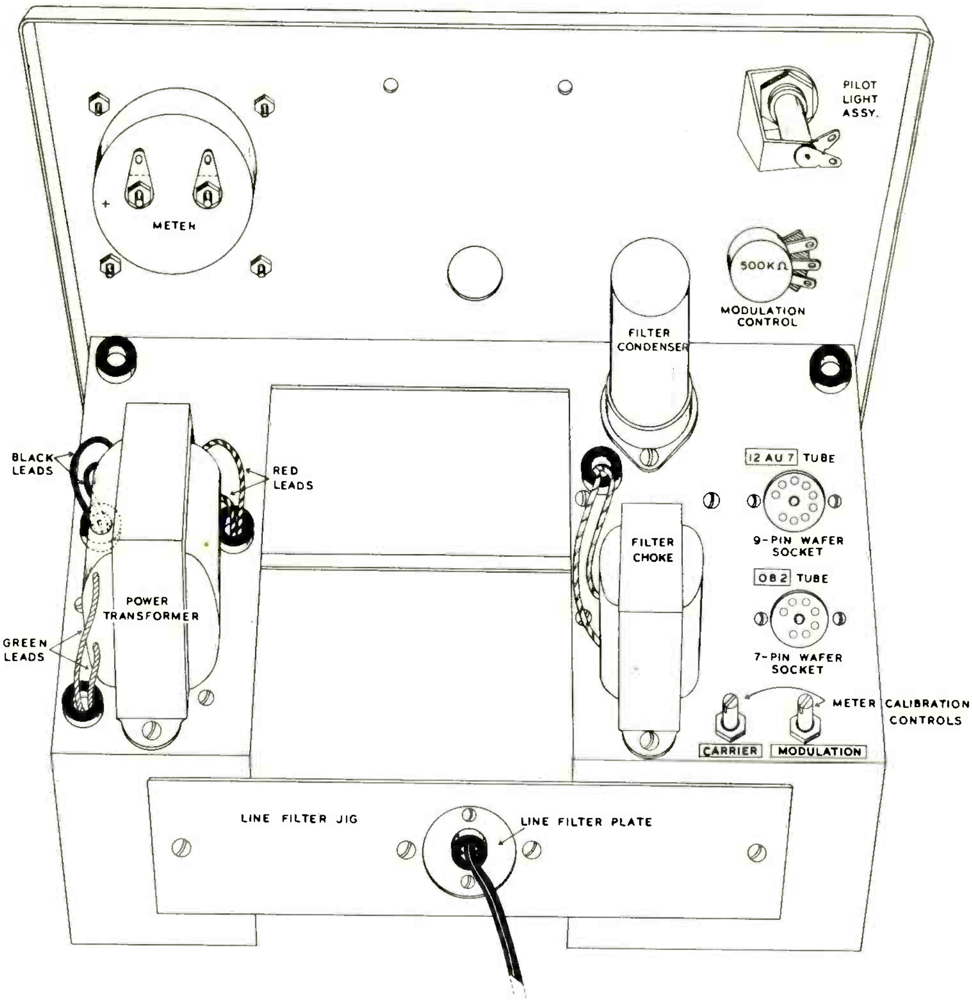
( ) Install the selenium rectifier with a long (6-32 x 1") screw, nut and lockwasher. Make sure the side marked positive (+) is away from the chassis.

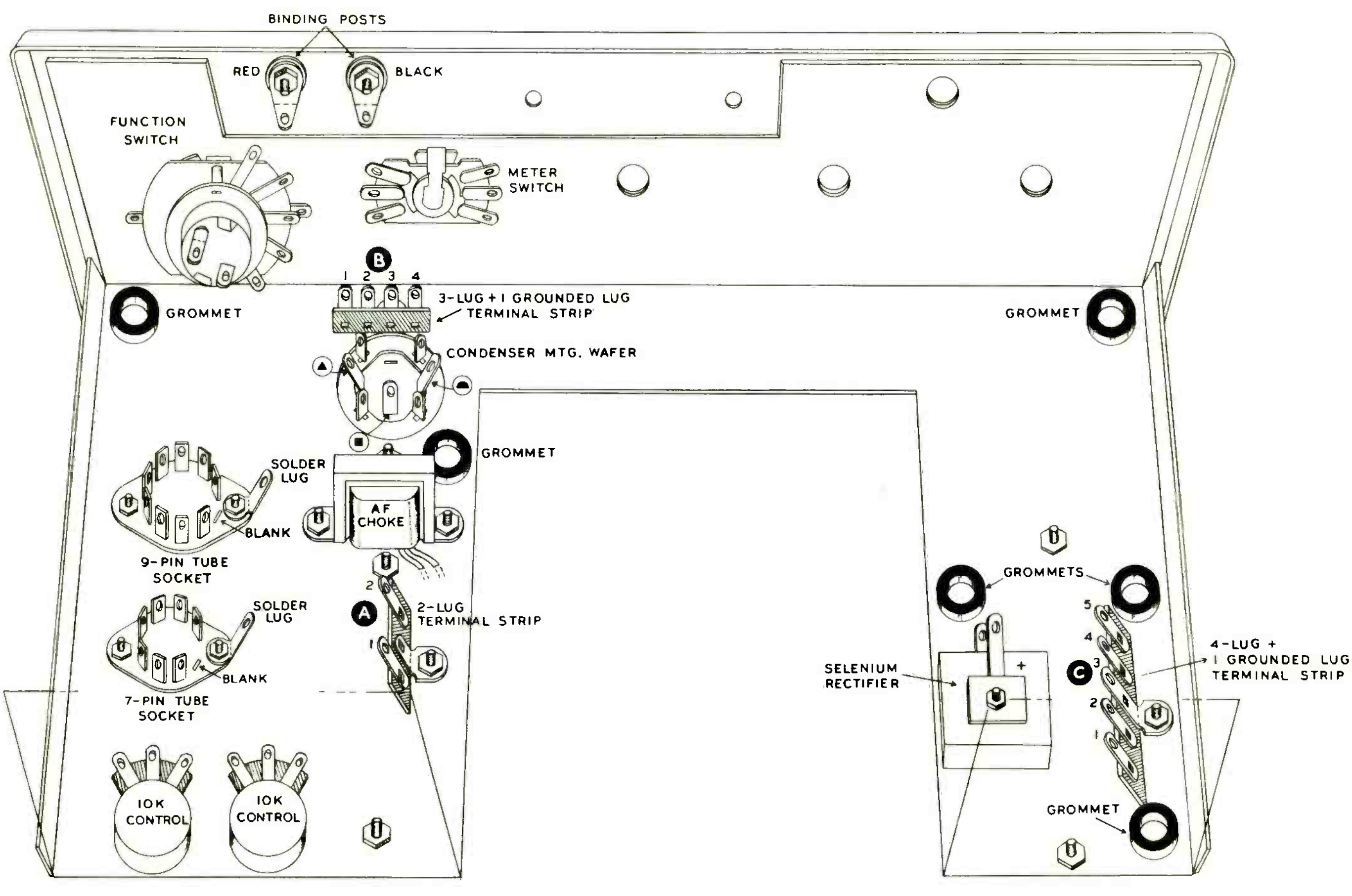
( ) Install a 4-lug + one grounded lug terminal strip C with a 6-32 screw, nut and lockwasher.

( ) On top of the chassis, install the power transformer with 8-32 screws, nuts and #8 lockwashers. Place the leads through the grommets.

( ) On top of the chassis, install the filter choke with 8-32 screws, nuts and #8 lockwashers. Place the leads through the grommet.

( ) Below the chassis, install the small AF choke with 6-32 screws, nuts and #6 lockwashers.

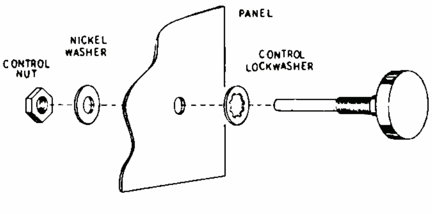

PILOT LIGHT ASSY.
METER
500KΩ
MODULATION CONTROL
FILTER CONDENSER
BLACK LEADS
RED LEADS
12 AU 7 TUBE
9-PIN WAFER SOCKET
FILTER CHOKE
POWER TRANSFORMER
0B2 TUBE
GREEN LEADS
7-PIN WAFER SOCKET
METER CALIBRATION CONTROLS
CARRIER
MODULATION
LINE FILTER JIG
LINE FILTER PLATE


BINDING POSTS
RED
BLACK
FUNCTION SWITCH
METER SWITCH
B
1 2 3 4
3-LUG + 1 GROUNDED LUG TERMINAL STRIP
GROMMET
GROMMET
CONDENSER MTG. WAFER
GROMMET
SOLDER LUG
BLANK
AF CHOKE
9-PIN TUBE SOCKET
A
2-LUG TERMINAL STRIP
SOLDER LUG
BLANK
7-PIN TUBE SOCKET
10K CONTROL
10K CONTROL
GROMMETS
SELENIUM RECTIFIER
C
4-LUG + 1 GROUNDED LUG TERMINAL STRIP
GROMMET

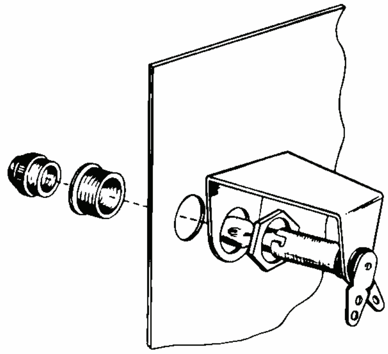
MOUNTING THE PARTS ON THE PANEL

( ) Install the pilot light assembly.

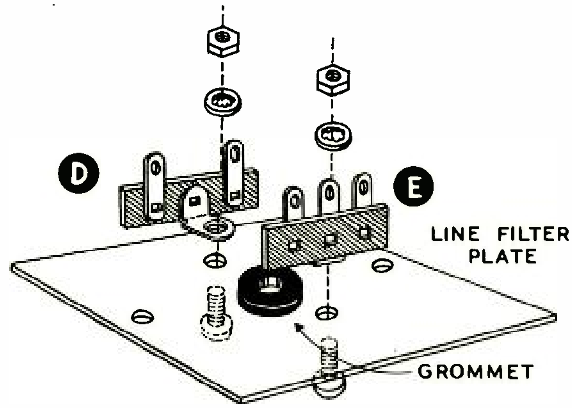
( ) Install the 500 KΩ modulation control with a control nut, lockwasher and nickel washer.



HOW TO MOUNT CONTROLS & SWITCHES



PILOT LIGHT ASSEMBLY



( ) With due care, install the meter on the panel with the hardware supplied. NOTE: Do not overtighten the nuts as the studs are brass and may break.

( ) Install the binding posts below the modulation control.

MOUNTING THE CHASSIS TO THE PANEL

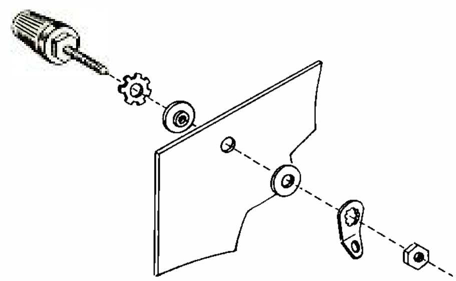
( ) Line up the panel and chassis holes and install the function switch with a control nut, lockwasher and nickel washer.

( ) Install the meter switch in the same manner.

( ) Install a grommet on the line filter plate.

( ) On this plate, install a 2-lug terminal strip D with a 6-32 screw, nut and lockwasher.

( ) On the same plate, install a 2-lug + one grounded lug terminal strip E in the same manner.



( ) Temporarily mount the line filter jig to the rear of the chassis with two #6 sheet metal screws.

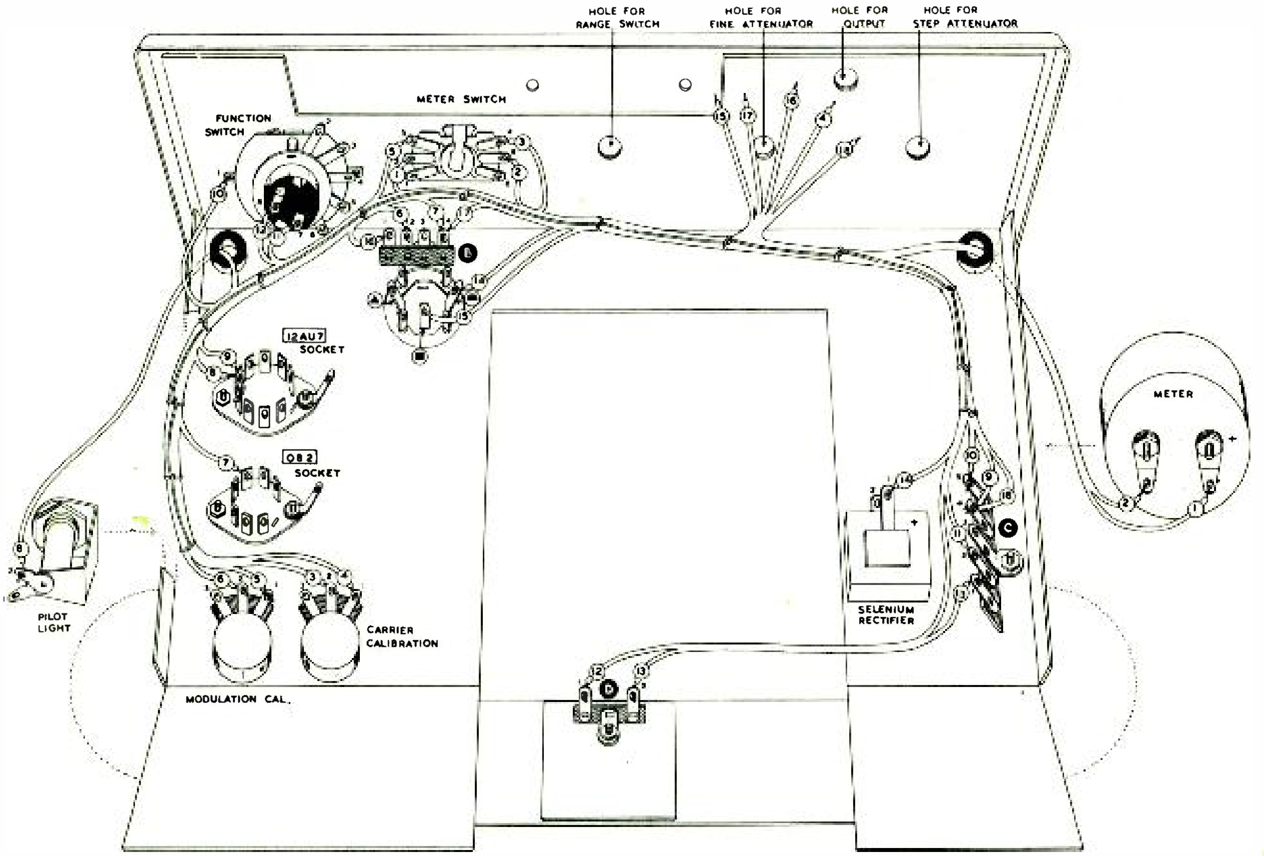
( ) Temporarily mount the line filter plate on the line filter jig with two #6 sheet metal screws.

This places the line filter plate in the position which it will actually occupy in the cabinet when the instrument is completed.

WIRING THE CHASSIS - MAIN HARNESS

Read again the note on soldering on the inside rear cover of the manual.

(S) means solder the connection just made. (NS) means do not solder the connection yet. There are more wires to go to this connection point.



( ) Connect a wire to the positive (+) terminal (S) on the meter and run it through the grommet in the chassis to just below the meter switch and then up to lug 2 (S) on the meter switch. This wire is marked ① in the pictorial.

( ) Connect a wire to the other terminal (S) on the meter and along the first wire to lug 5 (S) on the meter switch. This wire is marked ② in the pictorial.

(✓) Connect a wire to lug 4 (S) on the meter switch and run it down to the chassis, to the corner and along the edge to lug 2 (S) on the carrier calibration control. This is wire ③.

(✓) Connect a wire to lug 1 (S) on the carrier calibration control and along the preceding wires to a point below the hole for the fine attenuator, then up to the edge of the panel. Cut the wire to at least this length and after stripping and tinning the end with solder, temporarily place it through the hole. This is one of the leads that will connect to the oscillator section. This is wire ④. This wire and wires ⑮, ⑯, ⑰ and ⑱ should be suitably marked, so that they can be identified properly after the oscillator section is installed. Use crayon, lipstick or strips of tape for identification. Note code for wire ④ here......

(✓) Connect a wire to lug 1 (S) on the modulation calibration control and along the other wires to lug 3 (S) on the meter switch. This is wire ⑤.

(✓) Connect a wire to lug 2 (S) on the modulation calibration control and along the other wires to lug 2 (NS) on terminal strip B. This is wire ⑥.

(✓) Connect a wire to pin 5 (S) on the 7-pin OB2 socket and along the other wires to lug 4 (NS) on terminal strip B. This is wire ⑦.

(✓) Connect a wire to lug 2 (S) on the pilot light socket, then place it to the front panel and along the modulation control through the grommet in the chassis to pin 5 (NS) on the 9-pin 12AU7 socket. This is wire ⑧.

(✓) Connect a wire with one end through pin 5 (S) to pin 4 (S) on the 12AU7 socket and along the other wires and the other edge of the chassis to lug 4 (NS) on terminal strip C. This is wire ⑨.

(✓) Connect a wire to lug 1 (S) on the function switch and along the other wires to lug 5 (NS) on terminal strip C. This is wire ⑩.

(✓) Connect a wire to lug 7 (S) on the function switch and along the other wires to lug 2 (NS) on terminal strip C. This is wire ⑪.

(✓) Connect a wire to lug 8 (S) on the function switch and along the other wires and past terminal strip C to lug 1 (NS) on terminal strip D. This is wire ⑫.

(✓) Connect a wire to lug 1 (NS) on terminal strip C and along the preceding wire to lug 2 (NS) on terminal strip D. This is wire ⑬.

(✓) Connect a wire to the ▬ marked lug (NS) on the filter condenser and along the other wires to lug 1 (S) on the selenium rectifier. That is the lug farthest from the chassis (+ terminal). This is wire ⑭.

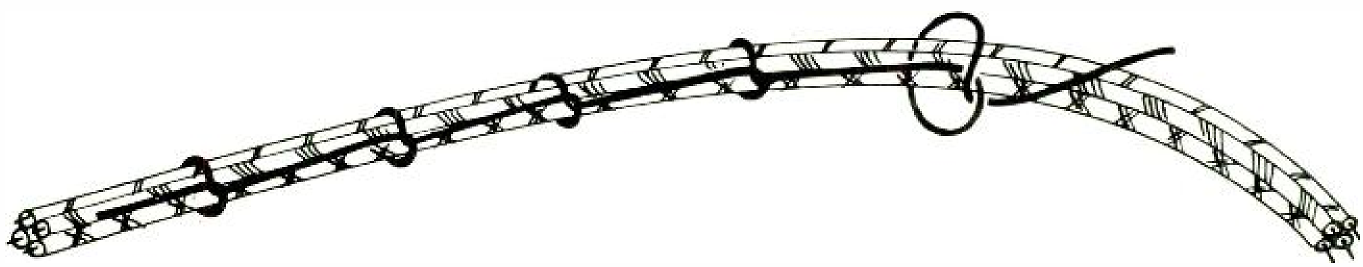
(✓) Connect a wire to the ■ marked lug (NS) on the filter condenser and along the preceding wire to a point below the hole for the fine attenuator, then up to the edge of the panel. Cut the wire to at least this length and after stripping and tinning the end with solder, temporarily place it through the hole. This is the second wire that will connect to the oscillator section and is marked wire ⑮. Note your code here: . . . . . .

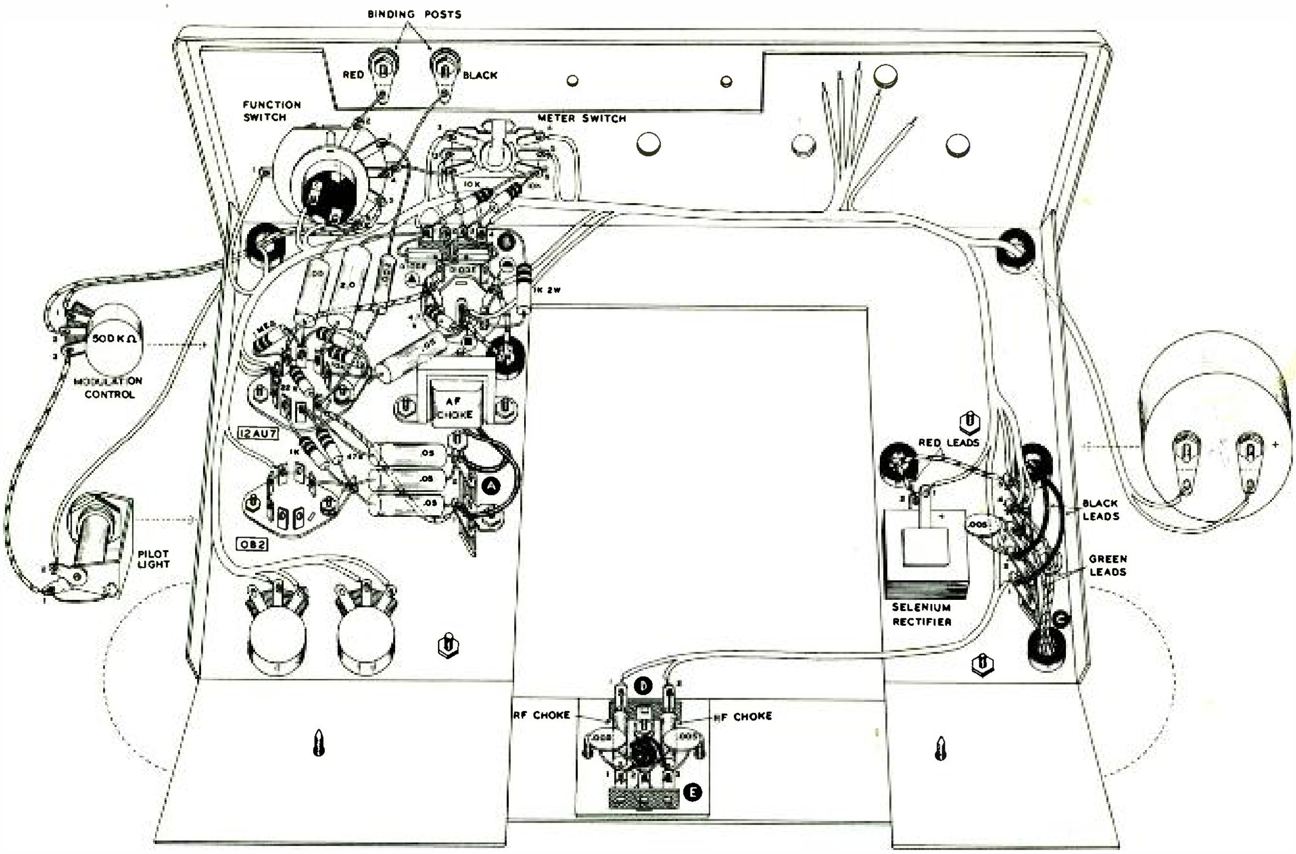
(✓) Connect a wire to lug 1 (NS) on terminal strip B and along the preceding wire. Cut to the same length and place through the hole. This is wire ⑯. Note code: . . . .

(✓) Connect a wire to lug 4 (NS) on terminal strip B and along the preceding wire in the same manner. This is wire ⑰. Note code: . . . .

(✓) Connect a wire to lug 4 (NS) on terminal strip C and along the other wires to the same place as the preceding wire. This is wire ⑱. Note code: . . . .

To present a professional appearance and to facilitate further wiring, all the wires thus far installed should be laced together with string or lacing cord.





CHASSIS WIRING - TRANSFORMER AND CHOKES

Disregard "outside foil" markings on all condensers unless otherwise stated.

( ) Connect one green transformer lead to lug 3 (NS) on terminal strip C.

( ) Connect the other green lead to lug 4 (S) on terminal strip C.

( ) Connect one black transformer lead to lug 1 (S) on terminal strip C.

( ) Connect the other black lead to lug 2 (NS) on terminal strip C.

( ) Connect one red transformer lead to lug 5 (S) on terminal strip C.

( ) Connect the other red lead to lug 2 (S) on the selenium rectifier. This is the lug nearest the chassis. Make sure this connection does not touch the chassis.

( ) Connect a .005 μfd disc type condenser between lug 2 (S) and lug 3 (S) on terminal strip C.

( ) Connect one lead from the filter choke to the ▲ marked lug (S) on the filter condenser.

( ) Connect the other lead from the filter choke to the ■ marked lug (NS) on the filter condenser.

( ) Connect one lead from the AF choke to lug 2 (NS) on terminal strip A.

( ) Connect the other lead from the AF choke to lug 1 (NS) on terminal strip A.

CHASSIS WIRING - LINE FILTER

(✓) Install the line cord by running it through the grommet, tying a knot for strain relief and then placing one lead to lug 1 (NS) and the other lead to lug 3 (NS) on terminal strip E. Make the distance between the knot and terminal strip as short as possible but long enough so that a pull on the line cord is carried by the knot and the grommet and not by the connections to the terminal strip.

(✓) Install one RF choke between lug 1 (S) on terminal strip D and lug 1 (NS) on terminal strip E.

(✓) Install the other RF choke between lug 2 (S) on terminal strip D and lug 3 (NS) on terminal strip E.

(✓) Install a .005 μfd disc type condenser between lug 1 (S) and lug 2 (NS) on terminal strip E. Keep the leads short and dress the part parallel to the line cord plate.

(✓) Install another .005 μfd disc type condenser between lug 2 (S) and lug 3 (S) on terminal strip E in the same manner.

CHASSIS WIRING - AUDIO OSCILLATOR

(✓) Connect a wire between lug 1 (NS) on terminal strip A and pin 1 (NS) on the 12AU7 socket.

(✓) Connect a .05 μfd condenser between lug 2 (NS) on terminal strip A and pin 2 (NS) on the 12AU7 socket.

(✓) Connect another .05 μfd condenser between lug 2 (S) on terminal strip A and the solder lug (NS) on the OB2 socket.

(✓) Connect a third .05 μfd condenser between lug 1 (S) on terminal strip A and the solder lug (NS) on the OB2 socket.

(✓) Connect a 47 KΩ resistor between pin 2 (S) on the 12AU7 socket and the solder lug (NS) on the OB2 socket.

(✓) Connect a 1 KΩ resistor between pin 3 (S) on the 12AU7 socket and the solder lug (NS) on the OB2 socket.

(✓) Connect a bare wire between the solder lug (S) and pin 7 (S) on the OB2 socket.

CHASSIS WIRING - MODULATOR

(✓) Connect a wire between pin 6 (NS) on the 12AU7 socket and the ▲ marked lug (NS) on the filter condenser.

(✓) Connect a wire between lug 6 (NS) on the function switch and through the grommet to lug 2 (S) on the modulation control.

(✓) Connect a wire between lug 5 (S) on the function switch and through the grommet to lug 1 (S) on the modulation control.

(✓) Connect a wire between lug 3 (S) on the modulation control and along the earlier wire to lug 1 (NS) on the pilot light.

(✓) Connect a bare wire between lug 1 (S) and the pilot light frame (S).

(✓) Connect a .05 μfd condenser between lug 6 (S) on the function switch and pin 7 (NS) on the 12AU7 socket.

(✓) Connect a 2.0 μfd condenser between lug 1 (NS) on terminal strip B and pin 8 (NS) on the 12AU7 socket.

(✓) Connect a 10 KΩ resistor between the solder lug (NS) and pin 8 (S) on the 12AU7 socket.

(✓) Connect a 470 KΩ resistor between the solder lug (NS) and pin 7 (NS) on the 12AU7 socket.

(✓) Connect a bare wire between the solder lug (NS) and pin 9 (S) on the 12AU7 socket.

(✓) Connect a 1 megohm resistor between pin 7 (S) and pin 6 (NS) on the 12AU7 socket.

(✓) Connect a 22 KΩ resistor between pin 6 (S) and pin 1 (NS) on the 12AU7 socket.

(✓) Connect a .05 μfd condenser between the ■ marked lug (NS) on the filter condenser and the solder lug (S) on the 12AU7 socket.

(✓) Connect a 4.7 KΩ resistor between the ▲ marked lug (S) and the ■ marked lug (NS) on the filter condenser.

CHASSIS WIRING - SWITCHES

(✓) Connect a bare wire between the solder lug (S) on the red binding post and lug 2 (S) on the function switch.

(✓) Connect a bare wire between the solder lug (S) on the black binding post and lug 4 (NS) on the function switch. Note that lug 4 is a double lug. Run the wire through both holes.

(✓) Connect a bare wire between lug 4 (S) on the function switch and lug 1 (NS) on the meter switch.

(✓) Connect a bare wire between lug 1 (S) on the meter switch and lug 3 (NS) on terminal strip B.

(✓) Connect a 10 KΩ resistor between lug 6 (NS) on the meter switch and lug 3 (NS) on terminal strip B.

(✓) Connect another 10 KΩ resistor between lug 6 (S) on the meter switch and lug 1 (NS) on terminal strip B.

(✓) Connect a diode with the unmarked side to lug 1 (S) and the side marked +, POS., CATH., or indicated by the arrow point to lug 2 (NS) on terminal strip B.

(✓) Connect another diode with the unmarked side to lug 3 (S) and the positive side to lug 2 (S) on terminal strip B.

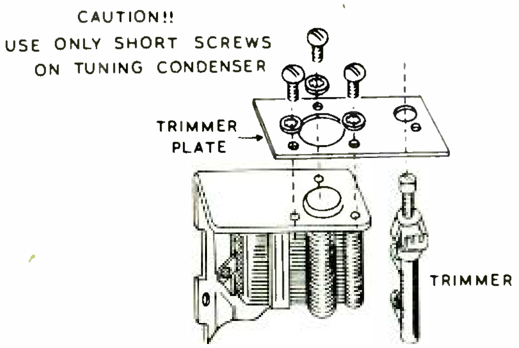
(✓) Connect a 1 KΩ 2 watt resistor between lug 4 (S) on terminal strip B and the ■ marked lug (S) on the filter condenser.

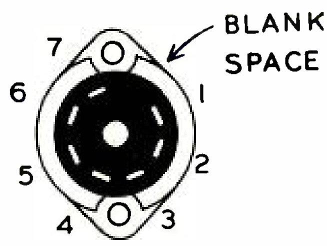
(✓) Connect a .002 μfd condenser between pin 1 (S) on the 12AU7 socket and lug 3 (S) on the function switch.

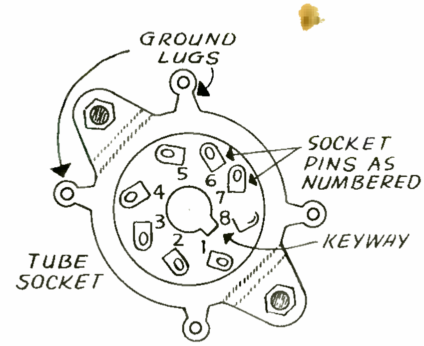
This completes the chassis wiring.

ASSEMBLING THE OSCILLATOR SECTION

(✓) Mount the tuning condenser on the front shield section with three short 6-32 x 3/16 screws with #6 lockwashers under the heads. DO NOT USE longer screws as they will run into the tuning condenser plates and ruin it. HANDLE THE CONDENSER WITH CARE. Always keep the plates fully meshed during construction of the instrument. DO NOT TOUCH THE PLATES as this may destroy the calibration accuracy.





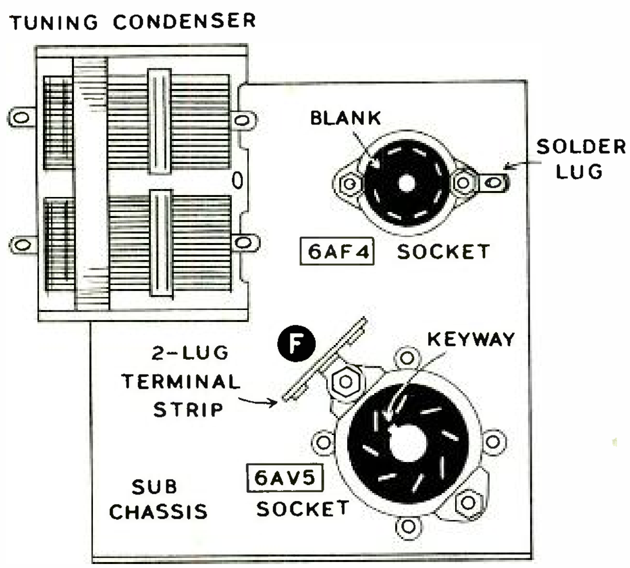


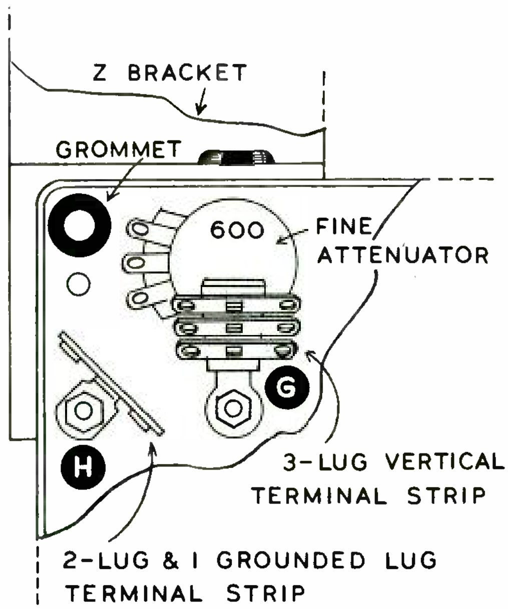
(✓) Mount the trimmer plate on the rear of the tuning condenser with three short 6-32 x 3/16 screws and with #6 lockwashers under the heads.

(✓) Install the trimmer by pushing it through the hole. Make sure the locating tab seats in the small hole.

(✓) Mount the sub-chassis on the bottom of the tuning condenser with three short 6-32 x 3/16 screws and with #6 lockwashers under the heads.

(✓) Mount the 7-pin miniature 6AF4 socket with 3-48 screws and nuts and #3 lockwashers. Make sure the blank space is toward the tuning condenser. Include a small solder lug under the lockwasher farthest from the condenser.





(✓) Mount the 8-pin 6AV5 socket with 6-32 screws and nuts and #6 lockwashers. Make sure the keyway is toward the tuning condenser. Include a 2-lug terminal strip under the lockwasher nearest the condenser.

(✓) Assemble the Z bracket to the shield front section by installing the 600 Ω fine attenuator control through both with a control nut and lockwasher.

(✓) Install the 3-lug vertical terminal strip G with a 6-32 screw through both bracket and shield and a 6-32 nut and lockwasher.

(✓) Install the 2-lug + one grounded lug terminal strip H in the same manner.

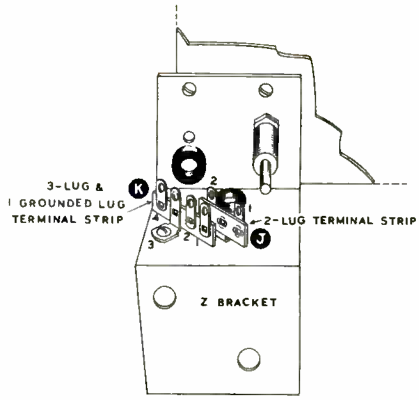
(✓) Install a grommet through both bracket and shield.

(✓) Install another grommet in the Z bracket.

(✓) Mount a 2-lug terminal strip J on the Z bracket with a 6-32 screw and nut and a #6 lockwasher.

(✓) Mount a 3-lug + one grounded lug terminal strip K in the same manner.

(✓) Mount the range switch and coil assembly with a control nut and lockwasher. HANDLE THIS ASSEMBLY WITH CARE.

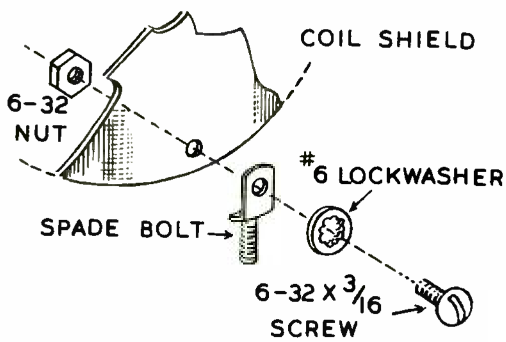


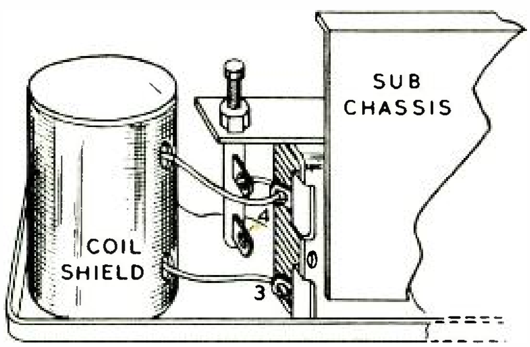
WIRING THE OSCILLATOR SECTION

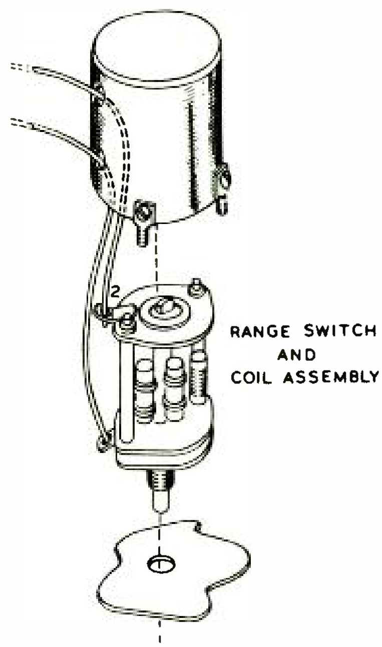
(✓) Connect a bare wire at least 5" long to lug 1 (S) on the range switch.

(✓) Connect another bare wire of similar length to lug 2 (S) on the range switch.

(✓) Install the four spade bolts on the coil shield with four short 6-32 x 3/16 screws, lockwashers under the screw heads and just the nut on the inside of the shield can.







(✓) Install the coil shield over the coil and switch assembly by passing the two bare wires through the appropriate holes in the shield can and using lockwashers and 6-32 nuts on the spade bolts.

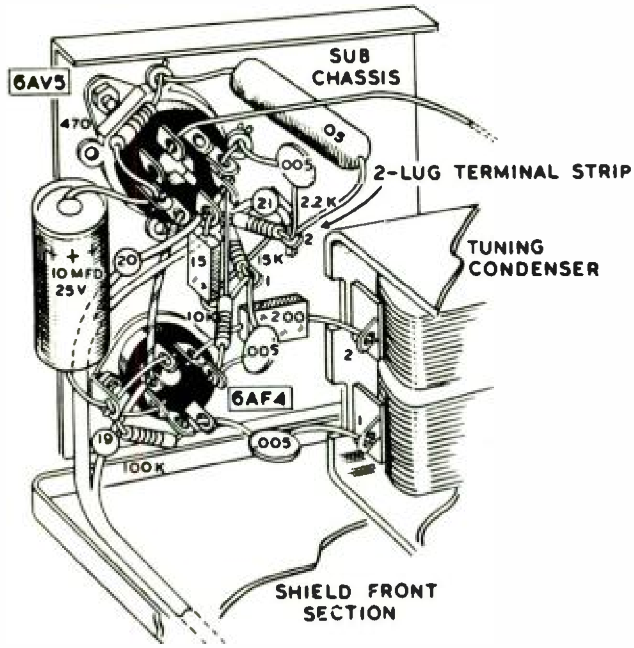
(✓) Connect a short bare wire between a lug (S) on the trimmer and lug 4 (NS) on the tuning condenser.

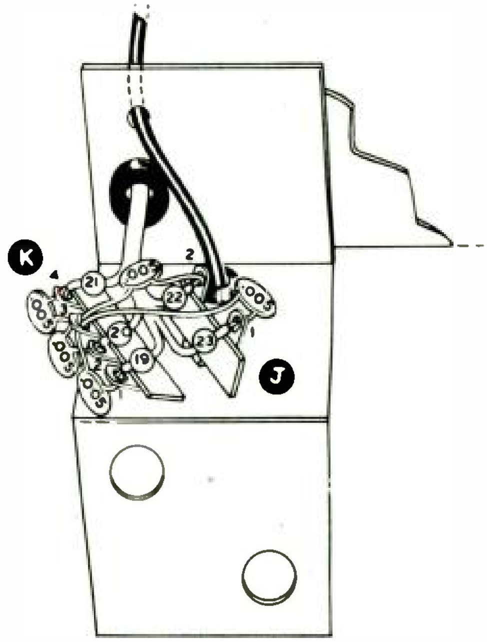
(✓) Connect the bare wire from the nearest hole in the coil shield to lug 3 (S) on the tuning condenser. Make this lead short and direct and cut off the excess length. Dress this lead through the center of the hole in the shield.

(✓) Connect the other bare wire out of the coil shield in the same manner to lug 4 (S) on the tuning condenser.

(✓) Install a wire between pin 2 (S) on the 6AV5 socket and pin 4 (NS) on the 6AF4 socket.

(✓) Install a wire between pin 4 (S) on the 6AF4 socket and in a wide curve, clearing the tuning condenser, through the grommet to lug 1 (NS) on terminal strip K on the Z bracket. This is wire ⑲

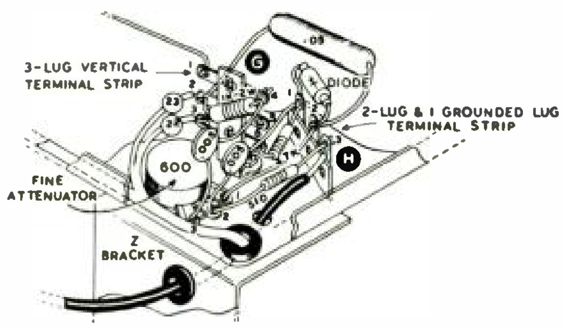




(✓) Install a wire between pin 8 (NS) on the 6AV5 socket and along the preceding wires to lug 2 (NS) on terminal strip K. This is wire ⑳.

(✓) Install a wire between lug 2 (NS) on terminal strip F and along the other wires to lug 4 (NS) on terminal strip K. This is wire ㉑.

(✓) Install a wire between lug 3 (S) on terminal strip G and around the control, along the other wires to lug 2 (NS) on terminal strip J. This is wire ㉒.



(✓) Install a wire between lug 2 (NS) on terminal strip G and along the preceding wire to lug 1 (NS) on terminal strip J. This is wire ㉓.

To present a professional appearance and to facilitate further wiring, the wiring at this point should be laced together with string or lacing cord.

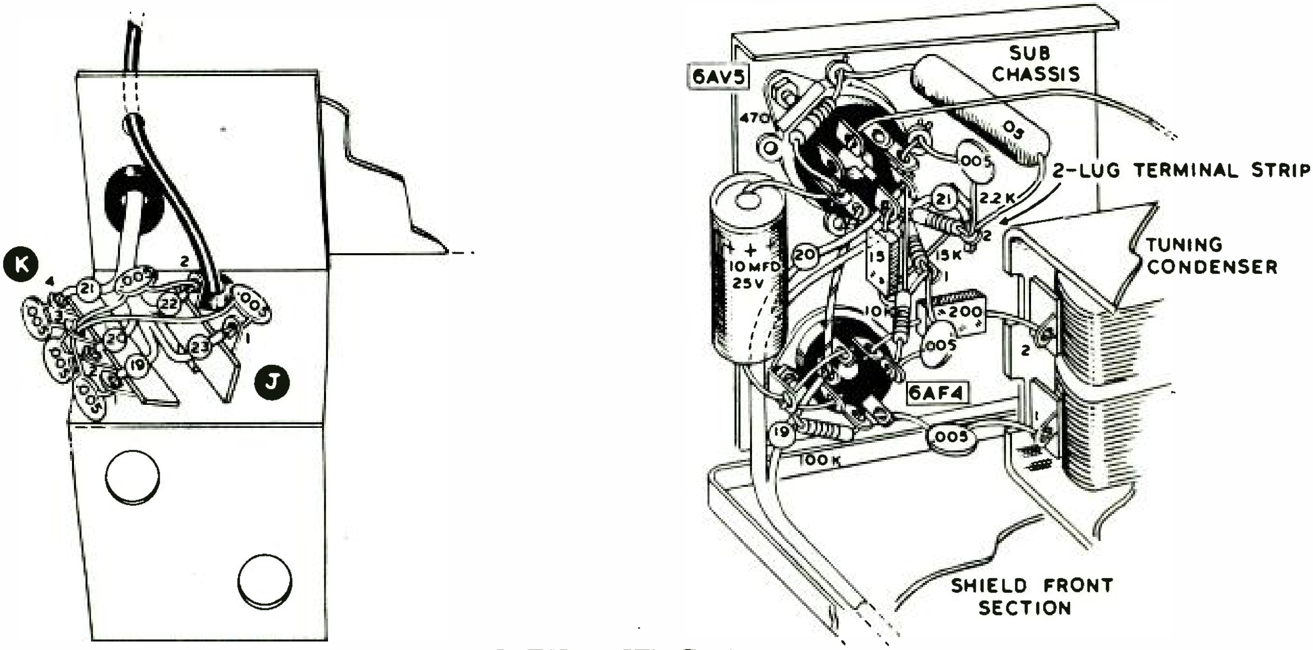
(✓) With as short leads as possible, install a .005 μfd disc type condenser between lug 3 (NS) and lug 4 (NS) on terminal strip K. Dress the condenser so that the terminals are readily accessible.

(✓) In the same manner, install another .005 μfd condenser between lug 2 (NS) and lug 3 (NS) on terminal strip K.

(✓) Likewise, install a third .005 μfd condenser between lug 1 (NS) and lug 3 (NS) on terminal strip K.

(✓) Install a fourth .005 μfd condenser between lug 2 (NS) on terminal strip J and lug 3 (NS) on terminal strip K.

(✓) Finally, install a fifth .005 μfd condenser between lug 1 (NS) on terminal strip J and lug 3 (S) on terminal strip K.



WIRING THE SUB-CHASSIS

(✓) Install a .005 μfd disc type condenser between lug 1 (S) on the tuning condenser and pin 1 (S) on the 6AF4 socket.

(✓) Install a 100 KΩ resistor between pin 2 (S) and the solder lug (NS) on the 6AF4 socket.

(✓) Connect a short bare wire between pin 3 (S) and the solder lug (NS) on the 6AF4 socket.

(✓) Connect another short bare wire between pin 5 (S) and the solder lug (NS) on the 6AF4 socket.

(✓) Install a 200 μμf mica condenser between lug 2 (S) on the tuning condenser and pin 6 (S) on the 6AF4 socket. Dress this condenser close to, but not against, the chassis.

(✓) Connect a .005 μfd disc type condenser between pin 7 (NS) on the 6AF4 socket and lug 1 (NS) on terminal strip F.

(✓) Connect a 15 μμf mica condenser between lug 1 (NS) on terminal strip F and pin 1 (NS) on the 6AV5 socket.

(✓) Connect a 15 KΩ resistor between lug 1 (S) on terminal strip F and pin 1 (NS) on the 6AV5 socket.

(✓) Connect a 2.2 KΩ resistor between pin 1 (S) on the 6AV5 socket and lug 2 (NS) on terminal strip F.

(✓) Connect a .005 µfd disc type condenser between lug 2 (NS) on terminal strip F and the nearest ground lug (NS) on the 6AV5 socket.

(✓) Connect a short bare wire between pin 7 (S) and the ground lug (S) on the 6AV5 socket.

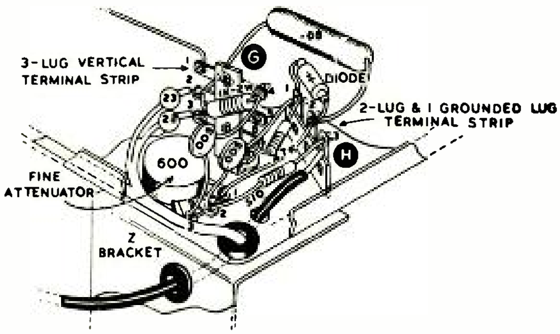
(✓) Connect a .05 µfd condenser between lug 2 (S) on terminal strip F and the ground lug (NS) nearest pin 5 on the 6AV5 socket.

(✓) Connect a 10 KΩ resistor between pin 8 (S) on the 6AV5 socket and pin 7 (S) on the 6AF4 socket.

(✓) Connect a 470 Ω resistor between pin 3 (NS) and the ground lug (S) nearest pin 5 on the 6AV5 socket.

(✓) Connect the positive lead of a 10 µfd 25 volt condenser to pin 3 (S) on the 6AV5 socket and the remaining lead to the solder lug (S) at the 6AF4 socket.

WIRING THE VERNIER ATTENUATOR



(✓) Connect a 4.7 KΩ resistor between lug 6 (S) on terminal strip G and lug 1 (NS) on terminal strip H.

(✓) Connect a short bare wire between lug 1 (S) on the vernier control and lug 2 (NS) on terminal strip H.

(✓) Connect a diode with the unmarked side to lug 1 (NS) and the side marked +, POS., CATH., or indicated by the arrow point to lug 2 (NS) on terminal strip H.

(✓) Connect a .005 µfd disc type condenser between lug 1 (S) on terminal strip H and lug 2 (NS) on the vernier control.

(✓) Connect a 510 Ω resistor between lug 2 (S) on the vernier control and lug 3 (NS) on terminal strip H.

(✓) Connect a 1 KΩ 2 watt resistor between lug 2 (NS) and lug 4 (NS) on terminal strip G.

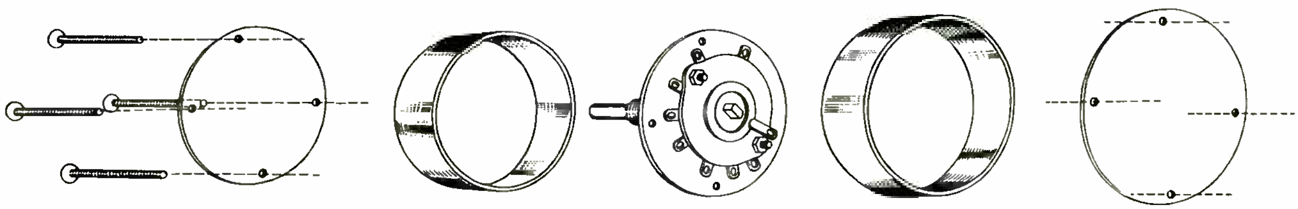
(✓) Connect a .005 µfd disc type condenser between lug 4 (S) on terminal strip G and lug 3 (S) on the vernier control.

(✓) Connect a .05 µfd condenser between lug 2 (S) on terminal strip H and lug 2 (S) on terminal strip G.

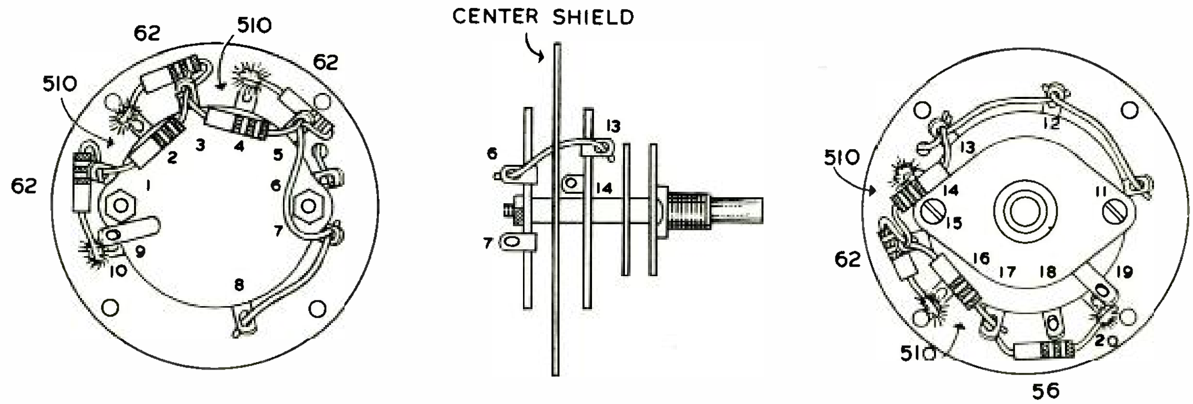
(✓) Connect a bare wire between lug 1 (S) on terminal strip G and, allowing ample clearance for the tuning condenser plates to turn, to pin 5 (S) on the 6AV5 socket.

WIRING THE ATTENUATOR SWITCH

Consider that the attenuator switch and all the resistors and wires on it will have to fit inside the shield parts. Visualize the space available by holding the shield rings in position. Remember also that the four holes near the edge of the center shield have to remain unobstructed so the long flathead screws can pass through them.



(✓) Install a 62 Ω resistor between lug 1 (NS), and the center shield and lug 10 (S). The lead of the resistor should be placed against both lug 10 and the shield and solder applied to all three without filling the hole in lug 10. Make sure the resistor is at least 1/16" inside the edge of the center shield by trying the shield ring on.



REAR SIDE FRONT

(✓) In the same manner, install another 62 Ω resistor between lug 3 (NS), and the center shield and lug 2 (S). In addition to the above precautions, make sure the hole for the screw remains unobstructed.

(✓) Install a third 62 Ω resistor between lug 5 (NS), and the center shield and lug 4 (S).

(✓) Install a fourth 62 Ω resistor on the front of the switch between lug 15 (NS), and the center shield and lug 16 (S) in the same manner.

(✓) Install a 56 Ω resistor between lug 17 (NS), and the center shield and lug 20 (S) as above.

(✓) Solder lug 14 to the center shield. Make sure the adjacent hole remains unobstructed.

(✓) Install a 510 Ω resistor between lug 1 (NS) and lug 3 (NS) on the rear of the switch.

(✓) Install another 510 Ω resistor between lug 3 (S) and lug 5 (NS).

(✓) Install a third 510 Ω resistor between lug 13 (NS) and lug 15 (NS) on the front of the switch.

(✓) Install a fourth 510 Ω resistor between lug 15 (S) and lug 17 (S).

(✓) Connect a bare wire between lug 6 (S) on the rear and through the hole in the center shield to lug 13 (NS) on the front of the switch. Dress this wire so it does not touch the shield.

(✓) Connect a bare wire between lug 5 (S) and lug 7 (NS) on the rear of the switch.

(✓) Connect a bare wire between lug 7 (S) and lug 8 (S).

(✓) Connect a bare wire between lug 13 (S) and lug 12 (NS) on the front of the switch.

(✓) Connect a bare wire between lug 12 (S) and lug 11 (S).

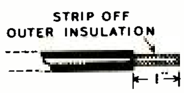
(✓) Prepare the end of a piece of coaxial cable which is 3" long by stripping off the outer insulation for 1". Unbraid the shield and split it into two halves. Twist these into wires or pigtails and tin them (apply a little solder) to keep them from fraying. Strip a little insulation from the center conductor and tin the end.

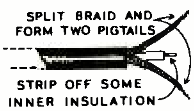
( ) Prepare the other end of this coaxial cable as above but form a single pigtail.

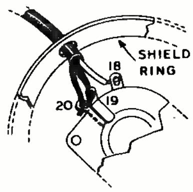
(✓) Attach the end with the pigtails to the front section of the attenuator switch by connecting one pigtail to lug 20 (S), the other pigtail to lug 19 (S) and the center conductor to lug 18 (S).

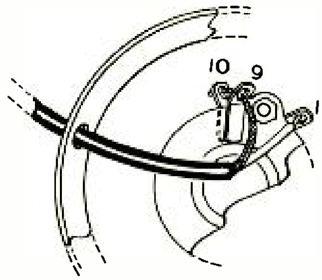
(✓) Pass the other end through the hole in a shield ring from the inside out and slip the ring around the front section of the switch.

(✓) Prepare the end of a 5" length of coaxial cable with two pigtails as previously described.







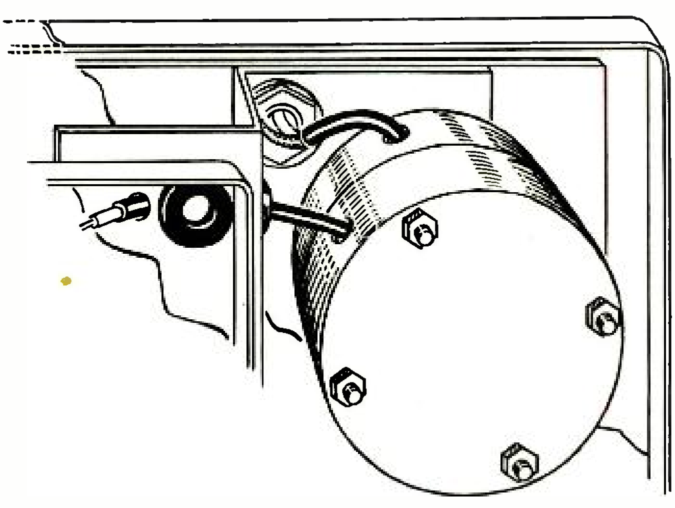


( ) Prepare the other end without pigtails, by stripping off 1" of both outer insulation and shield braid.

(✓) Attach the end with the pigtails to the rear section of the attenuator switch by connecting one pigtail through lug 9 (S) and lug 10 (S) and the center conductor to lug 1 (S). Cut off the other pigtail.

(✓) Pass the other end through the hole in the other shield ring from the inside out and slip the ring around the rear section of the switch.

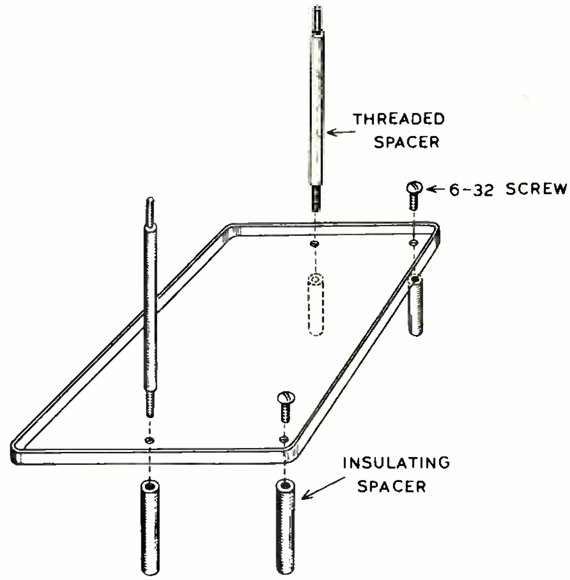
(✓) Install the front and back shields and pass the four long flat head 6-32 screws through front, center and back shield plates. Fasten with nuts and lockwashers.



INSTALLING THE OSCILLATOR ASSEMBLY

(✓) Install two insulating spacers at the corners of the shield front section with 6-32 screws.

(✓) Install the other two insulating spacers on the shield front section with the threaded spacers.



(✓) Install an insulated shaft extension (hollow type) on the tuning condenser shaft with a short 8-32 set screw.

(✓) Install two insulated shaft extensions, one on the vernier attenuator and the other on the range switch, with short 8-32 set screws.

(✓) Temporarily remove the screw nearest the calibrating controls that holds the line filter jig and swing the jig out of the way.

(✓) Install the oscillator assembly on the front panel with four 6-32 screws through the panel into the insulating spacers.

(✓) Swing the line filter jig back into position and fasten again.

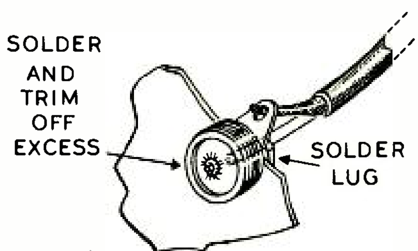
(✓) Install the output chassis connector through front panel, chassis and Z bracket using a control lockwasher under the special nut supplied with this connector. Place the special solder lug between Z bracket and lockwasher.

(✓) Install the attenuator switch assembly through the Z bracket, chassis and panel with a lockwasher between the attenuator and Z bracket and a nickel washer between the control nut and the panel. Place the coaxial cable from the rear section of the attenuator through the grommet in the Z bracket and the plain hole in the Z bracket and shield front section.

(✓) Attach this end of the coaxial cable by connecting the center conductor to lug 3 (S) on terminal strip H.

(✓) Attach the end of the coaxial cable from the front section of the attenuator switch by placing the center conductor through the eyelet in the output connector (S).

(✓) Connect the single pigtail to the special solder lug (S).



CONNECTING THE OSCILLATOR ASSEMBLY

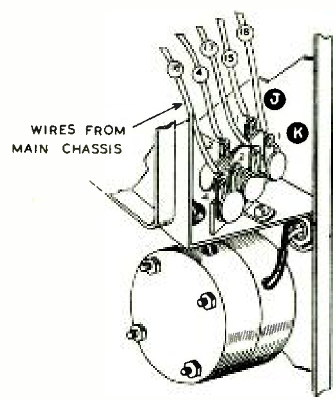
(✓) Connect the wire identified as wire ⑮ in the pictorials to lug 1 (S) on terminal strip J.

(✓) Connect the wire identified as wire ④ in the pictorials to lug 2 (S) on terminal strip J.

(✓) Connect wire ⑱ to lug 1 (S) on terminal strip K.

(✓) Connect wire ⑰ to lug 2 (S) on terminal strip K.

(✓) Connect wire ⑯ to lug 4 (S) on terminal strip K.



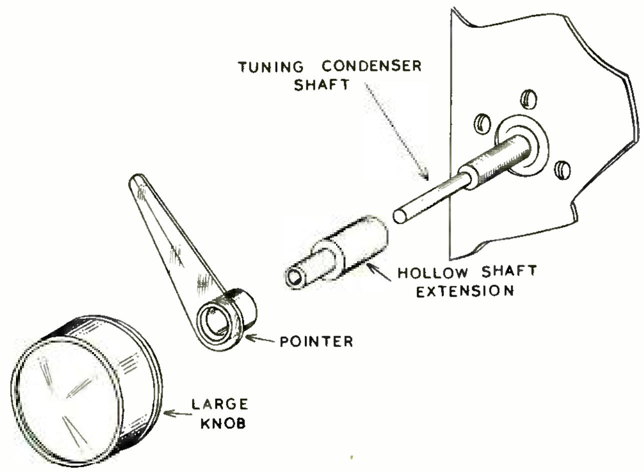
PREPARING FOR INITIAL TEST

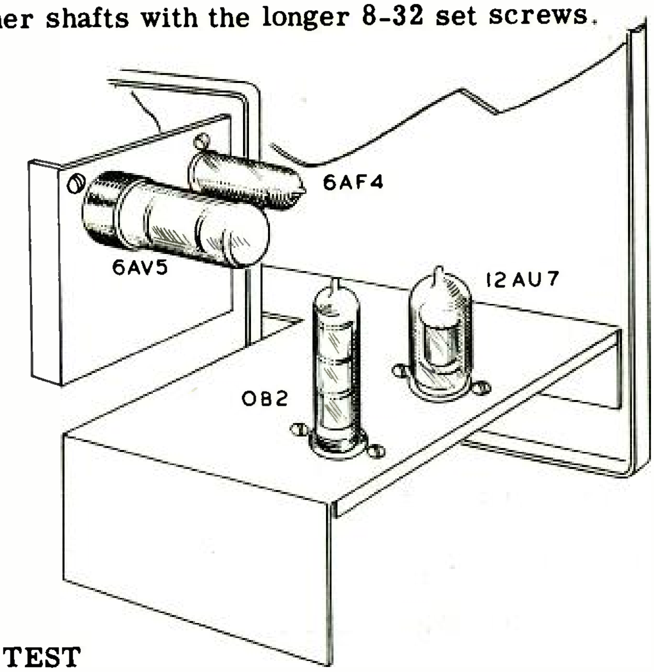
(✓) Install the dial pointer on the tuning condenser with a short 8-32 set screw. Adjust the pointer so that it covers the panel calibration from end to end as the tuning condenser is turned through its full range.

(✓) Install the large knob on the small tuning condenser shaft with a longer 8-32 set screw.

(✓) Install a small skirted knob on each of the other shafts with the longer 8-32 set screws.

( ) Install the four tubes in their proper sockets.





INITIAL TEST

( ) Recheck the wiring briefly and shake out all foreign particles that may have accumulated, such as solder or pieces of wire. Make sure that no obvious short circuits exist.

( ) Plug the line cord into a 105-125 volt 50/60 cycle AC outlet. DO NOT PLUG INTO A DC OUTLET. Like all transformer operated devices, this instrument will not operate on DC and the transformer will be damaged if connected to a DC source.

( ) Turn the function switch to STANDBY and see if the pilot light and tube heaters light. The OB2 should remain dark.

( ) Set all other controls fully counterclockwise. Turn the FUNCTION switch to CW (continuous wave, without modulation). Now the OB2 should show a purple glow.

( ) Set the RANGE switch to B.

( ) Tune a radio receiver, placed near the instrument, to a broadcast station near 900 kc, but below the upper limit of the dial calibration of the instrument for this range.

( ) Turn the tuning control on the instrument until a squeal is heard in the radio receiver. Adjust for the lowest pitched squeal or preferably, a point where there is a slow popping with an increasing squeal on either side of this setting. The slow popping or its complete cessation is known as "zero beat." The pointer should now indicate a frequency very close to the frequency of the station to which the receiver is tuned.

( ) Reset the tuning condenser on the instrument so that the indicator shows the same frequency as that of the broadcasting station. Turn the screw in the trimmer to reestablish the zero beat condition.

( ) Set the FUNCTION switch to MCW (modulated continuous wave) and turn the MODULATION control up. Observe the meter and note that full scale readings (50% modulation) can be obtained.

( ) Set the METER switch to RF and turn the FINE ATTENUATOR up. Observe the meter and note that full scale readings (10 microvolts carrier level) can be obtained.

CALIBRATING THE METER

The meter readings can be varied within a limited range by adjustment of the calibration controls. The use of this instrument is generally not dependent on the absolute accuracy of the meter calibration, because generally sensitivity and stage-gain measurements are made on a comparative basis. If no suitable instruments are available for calibration, satisfactory results will generally be obtained by setting the calibration controls at the midway position. If a vacuum tube voltmeter is available, set the carrier calibration as follows:

( ) Connect a VTVM set for 3 or 5 volts AC full scale between lug 2 on the Fine Attenuator control and the chassis.

( ) Set the instrument FUNCTION switch to CW, the Meter switch to RF, the RANGE switch to A.

( ) Advance the Fine Attenuator until the VTVM reads 2 volts.

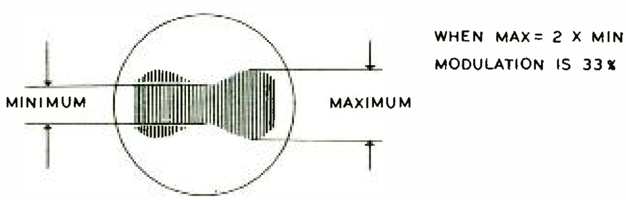
( ) Adjust the Carrier Calibration control to give a full scale reading.

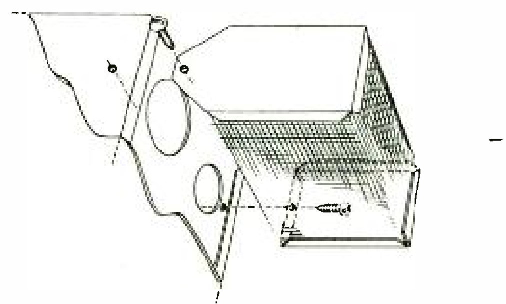
Similar results mav be obtained with an RF meter probe, but then it is desirable to set the RANGE switch at C or D.

If an oscilloscope of adequate bandwidth is available, set the modulation control as follows:

( ) Connect the oscilloscope between lug 2 on the Fine Attenuator control and chassis.

( ) Set the instrument FUNCTION switch to MCW, the Meter switch to MOD., the RANGE switch to A.





( ) Advance the Modulation and Fine Attenuator controls partly and adjust oscilloscope for a stationary pattern of a modulated signal.

( ) Adjust the Modulation control for a pattern so that the maximum height is twice the minimum height.

( ) Adjust the Modulation Calibration control for a reading of 33%.

Similar results may be obtained using the trapezoidal type modulation pattern.

FINAL ASSEMBLY

( ) Temporarily remove the 6AF4 and 6AV5 tubes.

( ) Swing the line filter jig out of the way again.

( ) Install the shield mid-section and shield rear section on the front section. Make sure the holes in the mid-section fall over the tube sockets and that the holes in the rear section match the threaded spacers, the trimmer and the hole in the sub-chassis.

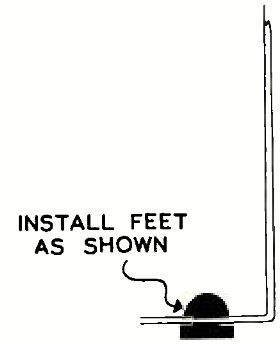
( ) Fasten the shields together with #6 lockwashers and 6-32 nuts on the threaded spacers.

( ) Swing the line filter jig back in place again.

( ) Re-install the 6AF4 and 6AV5 tubes.

( ) Install the tube shield with two #6 sheet metal screws.

( ) Check the calibration again as described under Initial Test and readjust the trimmer slightly as required.



( ) Install the plug button in the hole over the trimmer.

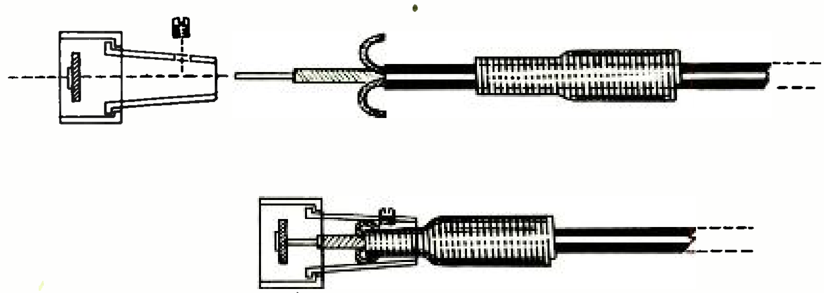
( ) Prepare the cabinet by installing the handle with two 10-24 screws and by placing the four rubber feet in the holes in the bottom.

( ) Remove the line filter jig and install the instrument in the cabinet. Fasten the line filter plate and chassis to the cabinet rear just as they were fastened to the jig before.

The line filter jig may be discarded or retained with the manual to be used in case the instrument should require service.

CONSTRUCTING THE OUTPUT CABLE

( ) Prepare one end of the remaining length of coaxial cable by removing 1/2" of the outer insulation.



( ) Loosen the set screw on the cable connector and remove the spring.

( ) Slip the spring with the large end first over the stripped end of the cable.

( ) Fold the braid back over the small end of the spring.

( ) Strip off 1/4" of the insulation around the center conductor and tin this center conductor to prevent fraying.

( ) Install the connector with the center conductor through the eyelet and the body of the connector over the braid that is folded over the spring.

( ) Tighten the set screw and solder the center conductor to the eyelet. Trim off the excess wire.

The other end of this cable is used to connect to the equipment under test. For specific applications, particular connectors may be attached to the cable to match such equipment. For general use, the termination described below will prove most satisfactory.

( ) Prepare the end of the cable by removing 3/4" of the outer insulation.

( ) Unbraid the shield and twist to form a single pigtail. Tin this pigtail to prevent fraying.

( ) Strip off 1/4" of the insulation around the center conductor and tin this conductor to prevent fraying.

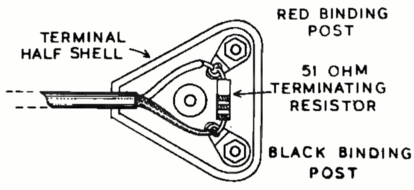
( ) Prepare the output connector by mounting two binding posts on the terminal half-shell with a #6 external tooth lockwasher between binding post and shell, and a #6 solder lug between the shell and a 6-32 nut.

( ) Install a red binding post cap on the one and a black binding post cap on the other binding post.

( ) Connect the center conductor to solder lug (NS) on the red binding post.

( ) Connect the pigtail to the solder lug (NS) on the black binding post.

( ) Install the 51 Ω resistor (terminating resistor) between the two solder lugs (S).



( ) Install the other terminal half-shell with a long 6-32 screw and nut. Make sure the cable is properly clamped with a little slack between the clamping point and the solder lugs.

The instrument is now completed and ready for use.

IN CASE OF DIFFICULTY

If difficulties are experienced in the initial testing of this instrument, proceed as outlined below.

1. Check the wiring very carefully against the pictorials. Make sure the proper value condensers and resistors are in their proper places. Make sure the leads to tube sockets and terminal strips connect to the proper pin and lug numbers. Double check all solder joints.

2. Have a friend check with you. Frequently a simple mistake becomes invisible to you but is clearly evident to another, even unskilled person.

3. Check the voltages between tube socket pins and chassis. The voltage table indicates nominal values of the voltages to be expected when a vacuum tube voltmeter is used. Other type meters will frequently give lower readings. Substantial deviations from the listed values indicate the possible source of difficulty and a thorough check of the circuit involved is indicated.

TUBE	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8	Pin 9
6AF4	65	10-30 Neg.	0	5-7 AC	0	10-30 Neg.	65		
6AV5	0	5-7 AC	12	0	100	0	0	100	
12AU7	60	1.0 Neg.	2.0	5-7 AC	5-7 AC	100	30	33	0
OB2	100	0	0	0	100	0	0		

CIRCUIT DESCRIPTION

The circuit of this instrument may be divided into various sections as follows:

1. Power Supply section.
2. RF Oscillator section.
3. AF Oscillator section.
4. Modulator section.
5. Amplifier section.
6. Attenuator section.
7. Metering section.

The power supply section comprises: the line filter, which reduces the signal radiation through the line cord; the power transformer; the 100 MA halfwave selenium rectifier; the 3-section electrolytic filter condenser; the filter choke; the OB2 voltage regulator tube. This section provides the various operating voltages for the other sections of the circuit, including a stable source for the RF oscillator.

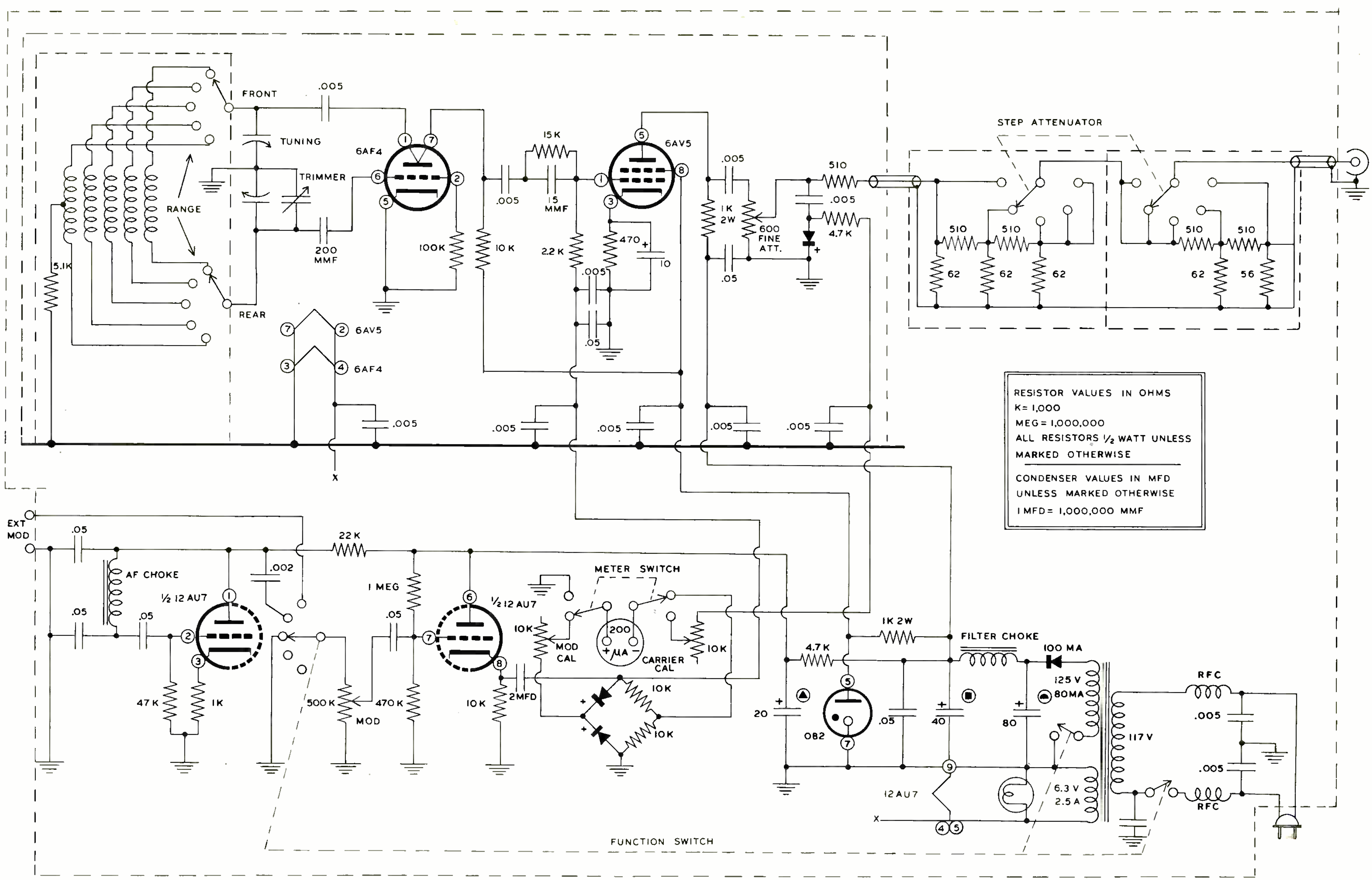
The RF oscillator section consists of a 6AF4 triode in a Colpitts circuit. The five coils on the range switch provide coverage from 100 kc to 30 mc. The lowest frequency coil is center tapped and grounded through a resistor to stabilize the output voltage. The generated signal is taken from the plate circuit.

The AF oscillator section uses half of a 12AU7 twin triode tube in a Colpitts circuit. The signal is taken from the plate circuit. The oscillator frequency is fixed at a value determined by the inductance of the AF choke, the two .05 μfd condensers and the other constants in the grid and cathode circuits. The nominal frequency is 400 cycles. No provision is made for adjusting this value.

The modulator section uses the other half of the 12AU7 tube connected as a cathode follower. The function switch in the grid circuit selects one of three modes of operation: No signal for CW or unmodulated RF carrier; 400 cycle modulation from the AF oscillator for MCW or modulated RF carrier; external modulation with an audio signal fed from an external audio generator or other signal source through the binding posts. The modulation level is adjusted with the modulation control.

The amplifier section is built around a 6AV5 pentode operated as a grid modulated buffer amplifier. The RF signal from the RF oscillator section is fed to the grid through an equalizing network to keep the RF output level reasonably constant through the various ranges. The AF modulation signal is fed to the grid through the grid resistor. This signal is relatively large and shifts the operating point, thus the transconductance and the stage gain, at an audio rate. The signal at the plate contains therefore, not only the AF signal, but also the resulting RF signal that varies with the gain variation. The AF signal is blocked by the relatively small coupling condenser and the low resistance attenuator, so that practically only the modulated RF signal is present in the generator output. The modulation percentage depends solely on the variation in transconductance and not on the RF grid voltage.

The attenuator section consists of a continuously variable control and a switch controlled step attenuator. This section is fed with a modulated RF signal of several volts and attenuates or cuts down this voltage to a desirably small value. While at first glance this appears easy, several difficulties arise in practice. A large attenuation requires that the stray leakage of the generator is kept down so low that the attenuation of the shielding is greater than the desired attenuation of the intended signal path. Thus in this instrument, triple shielding is used: oscillator coil shield, oscillator section shield, instrument case as a shield. Yet the shielding is not perfect and several microvolts of signal may be found to leak out through the shielding. Another difficulty is stray capacities in the attenuator itself, which tends to couple signal voltages from a high level point to a low level point. This has been counteracted by placing the first leg (510 Ω) of the step attenuator inside the oscillator section shield and by dividing the remain-


STEP ATTENUATOR
RESISTOR VALUES IN OHMS
K= 1,000
MEG= 1,000,000
ALL RESISTORS 1/2 WATT UNLESS
MARKED OTHERWISE
CONDENSER VALUES IN MFD
UNLESS MARKED OTHERWISE
1 MFD= 1,000,000 MMF
FRONT
TUNING
TRIMMER
RANGE
REAR
6AF4
6AV5
200 MMF
15 MMF
600 FINE ATT.
EXT MOD
AF CHOKE
1/2 12 AU7
METER SWITCH
MOD CAL
CARRIER CAL
MOD
FILTER CHOKE
100 MA
125 V
80 MA
117 V
6.3 V
2.5 A
RFC
12 AU7
OB2
FUNCTION SWITCH

ing attenuation into two sections, separated by a shield. Thus the two section shielded attenuator switch. The low resistance of the attenuator elements also reduces the effects of stray capacity.

The actual values of the attenuator resistors are chosen so that the output cable is terminated on both ends by practically 50 Ω. The attenuation per step is very close to 10 to 1, except that step to which the output cable is connected. The terminating resistor halves the signal again so that on that step the attenuation is 20 to 1. Thus for an input signal from the vernier attenuator of 2 volts and the step attenuator in the third (middle) position, the actual attenuation is 10:1 or 200 millivolts at the first step, plus 10:1 or 20 millivolts at the second step, plus 20:1 or 1 millivolt on the third step and at the terminals at the end of the output cable.

The metering section is used to determine the level of the RF output and the percentage of modulation. The metering circuit for the RF level consists of a crystal diode rectifier connected to the arm of the vernier attenuator control. The resulting DC is led through the calibrating control to the meter switch.

The metering circuit for the modulation consists of a half bridge using two crystal diodes, fed from the output of the modulator. It provides a DC output that indicates the AF signal level fed to the amplifier grid circuit. This DC output is fed through a calibrating control to the meter switch.

As the modulation percentage is independent of the RF level generated, it may be adjusted to a desired value (30% in most cases) and left there. Then the meter may remain switched to RF to determine the various levels required. Thus a single meter is adequate for most purposes.

ACCURACY

This instrument is designed to give the accuracy required for the intended use. Greater accuracy would only infrequently be sufficiently desirable to offset the increased complexity and cost. Thus this instrument is designed to perform as a signal source, adjustable to any frequency between 100 kc and 30 mc with an accuracy of ±3%.

The RF output voltage is adjustable between approximately 5 microvolts and 100,000 microvolts with an accuracy of ±20%.

The RF output voltage may be modulated with an AF signal to a modulation depth of between 0 and 50% with and accuracy of ±5%.

APPLICATION

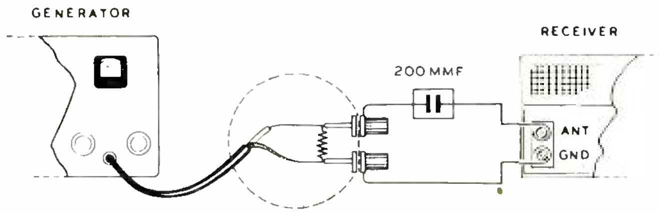
This instrument is designed to facilitate the designing, testing and aligning of radio receivers. It will find application in the alignment of IF and RF sections of production receivers and may simultaneously be used to determine the sensitivity of such receivers as compared with a standard receiver. This is achieved by noting the signal generator output signal level fed into the receivers for a standard output level.

Even in service work on a variety of receivers, the experienced service man may be able to tell rapidly if a set is operating with the sensitivity to be expected from the particular type.

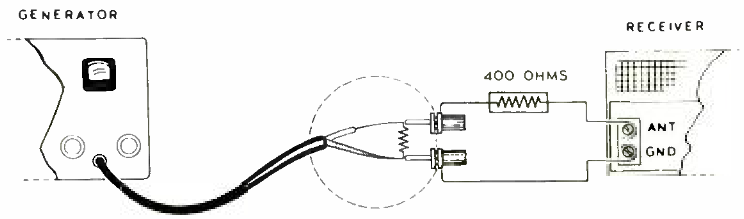
Stage gain measurements are made by feeding the output of the generator into various points of the equipment under test and noting the ratio of the levels required for standard output. Selectivity measurements may be made by increasing the generator output to two, ten or a hundred times the nominal value required for standard output and then noting the detuning of the generator required on each side of resonance to reestablish standard output. The sum of such deviation above and below resonance is known as the band width at 2x, 10x or 100x down.

Image ratio is a measure of specific selectivity or discrimination toward the image frequency. This image frequency is generally twice the IF frequency higher than the desired signal. The image ratio may be determined by dividing the signal level required at the image frequency by the signal required at the desired frequency for the same output, without changing the receiver tuning.

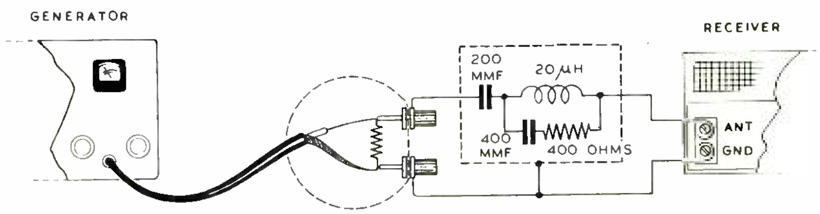
In all the above applications, the actual connection to the circuits under test is of prime importance. The generator output impedance is nominally 50 Ω. With the standard cable termination of 51 Ω the Source Impedance at the binding posts is 25 Ω. An attempt to simulate actual operating conditions with an average broadcast type receiving antenna requires a network as follows: The generated voltage is in series with the Source Impedance of 25 Ω (which may be neglected in this case) and in series with the antenna capacity (which averages about 200 $\mu\mu$f).



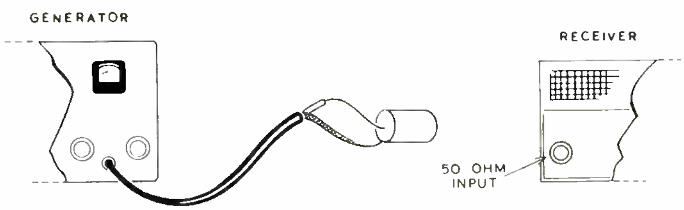
For a short wave receiver, the same type antenna looks like about 400 Ω resistance.



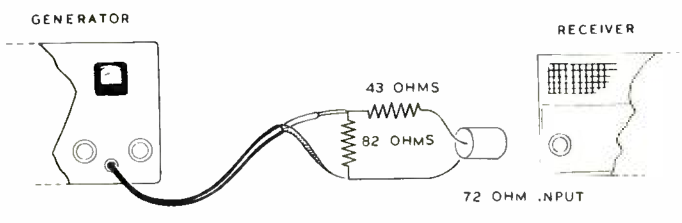
For general test work on all-wave receivers, the I. R. E. (Institute of Radio Engineers) developed a standard dummy antenna. This may be used in place of the 200 $\mu\mu$f broadcast dummy and the 400 Ω shortwave dummy.



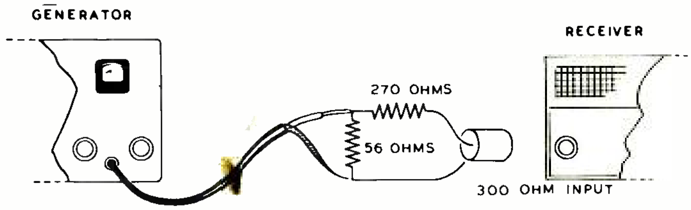
In the case of a device with 50 Ω input, the standard termination may be replaced by a suitable connector. The 51 Ω resistor should be omitted, as the device serves as the termination for the cable.



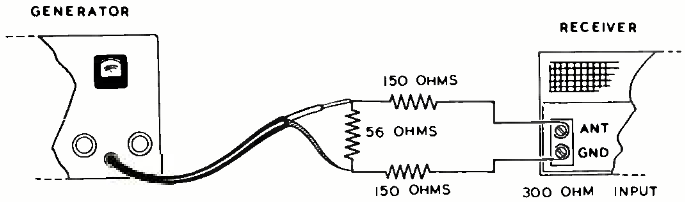
In the case of a device with 72 Ω input, a simple "pad" may be constructed out of two small composition (NOT wirewound) resistors: 82 Ω between center conductor and shield, and 43 Ω between center conductor and the device under test. This pad introduces a loss of 4 db and thus the voltage applied to the device is only 62% of the value indicated by the generator.



For a device with 300 Ω input, a similar pad may be made up with values of 56 Ω between center conductor and shield, and 270 Ω between center conductor and the device under test.



A balanced 300 Ω input may be fed by connecting 56 Ω between center conductor and shield, and 150 Ω between center conductor and one terminal, and another 150 Ω between shield and the other terminal. In the last two cases, the loss is 6 db and the voltage drop 50%.



Other circumstances may require the development of different dummy antennas. In the case of IF or stage by stage testing, the signal is generally connected to a grid or plate circuit through a large (.01 to .1 μfd) condenser. This is done to protect the generator as well as the receiver by keeping the DC voltages from the receiver out of the attenuator and by preventing the attenuator from shorting out the DC operating voltages in the receiver.

In addition to the above applications, the generator may be used to determine signal-to-noise ratio. This may be done by noting the drop from standard output level of the receiver when the generator is switched from MCW to CW (from modulated to unmodulated signal). In some cases, a minimum desirable signal-to-noise ratio, for instance, of 16:1 in power or 4:1 in voltage or 12 db may not be obtained with maximum gain settings, because of inherent noise generated in the receiver circuits. Then both receiver gain control and generator output control should be readjusted (gain down and output up) for standard output, until the desired signal-to-noise ratio is obtained. The generator output level is then a measure of sensitivity for a specified signal-to-noise ratio and a specified standard output level at a specific signal frequency for that receiver.

Frequently, the CW position may prove helpful in locating noisy components in the receiver. Obtain standard output on MCW, switch to CW and lightly tap tubes and other components to test for noise.

The uses of this instrument for other purposes such as a transfer instrument for frequency calibration, operation of RF bridges, etc. fall outside of the scope of this manual. Experienced users will be able to apply this instrument frequently in such manner successfully, if they consider both the capabilities and limitations designed into it.

BIBLIOGRAPHY

Further information on the design and use of signal generators may be found in many books and technical periodicals. A few of such books are listed below.

Terman and Pettit; Electronic Measurements, 2nd Edition, McGraw-Hill, 1952
Turner; Basic Electronic Test Instruments, Rinehart Books, 1952
Zepler; Technique of Radio Design, Wiley, 1943
Langford Smith; Radiotron Designer's Handbook, 3rd Edition, R.C.A., 1941

REPLACEMENTS

Material supplied with Heathkits has been carefully selected to meet design requirements and ordinarily will fulfill its function without difficulty. Occasionally improper instrument operation can be traced to a faulty tube or component. Should inspection reveal the necessity for replacement, write to the Heath Company and supply all of the following information:

A. Thoroughly identify the part in question by using the part number and description found in the manual parts list.
B. Identify the type and model number of kit in which it is used.
C. Mention the order number and date of purchase.
D. Describe the nature of defect or reason for requesting replacement.

The Heath Company will promptly supply the necessary replacement. Please do not return the original component until specifically requested to do so. Do not dismantle the component in question as this will void the guarantee. If tubes are to be returned, pack them carefully to prevent breakage in shipment as broken tubes are not eligible for replacement. This replacement policy does not cover the free replacement of parts that may have been broken or damaged through carelessness on the part of the kit builder.

SERVICE

In event continued operational difficulties of the completed instrument are experienced, the facilities of the Heath Company Service Department are at your disposal. Your instrument may be returned for inspection and repair for a service charge of $5.00 plus the cost of any additional material that may be required. THIS SERVICE POLICY APPLIES ONLY TO COMPLETED INSTRUMENTS CONSTRUCTED IN ACCORDANCE WITH THE INSTRUCTIONS AS STATED IN THE MANUAL. Instruments that are not entirely completed or instruments that are modified in design will not be accepted for repair. Instruments showing evidence of acid core solder or paste fluxes will be returned NOT repaired.

The Heath Company is willing to offer its full cooperation to assist you in obtaining the proper operation of your instrument and therefore this factory repair service is available for a period of one year from the date of purchase.

SHIPPING INSTRUCTIONS

Before returning a unit for service, be sure that all parts are securely mounted. Attach a tag to the instrument giving name, address and trouble experienced. Pack in a rugged container, preferably wood, using at least three inches of shredded newspaper or excelsior on all sides. DO NOT SHIP IN THE ORIGINAL KIT CARTON AS THIS CARTON IS NOT CONSIDERED ADEQUATE FOR SAFE SHIPMENT OF THE COMPLETED INSTRUMENT. Ship by prepaid express if possible. Return shipment will be made by express collect. Note that a carrier cannot be held liable for damage in transit if packing, in HIS OPINION, is insufficient.

SPECIFICATIONS

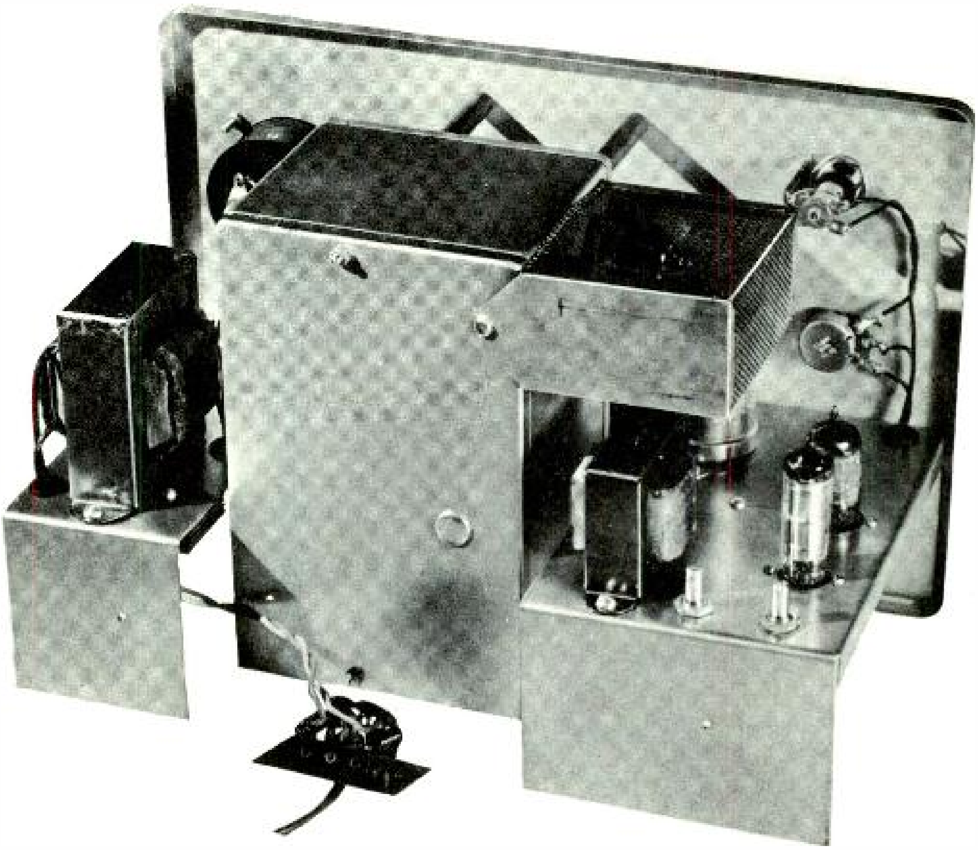
All prices are subject to change without notice. The Heath Company reserves the right to discontinue instruments and to change specifications at any time without incurring any obligation to incorporate new features in instruments previously sold.

WARRANTY

The Heath Company limits its warranty of parts supplied with any kit to a period of three (3) months from the date of purchase. Replacement will be made only when said part is returned postpaid, with prior permission and in the judgment of the Heath Company was defective at the time of sale. This warranty does not extend to any Heathkits which have been subjected to misuse, neglect, accident and improper installation or applications. Material supplied with a kit shall not be considered as defective, even though not in exact accordance with specifications, if it substantially fulfills performance requirements. This warranty is not transferable and applies only to the original purchaser. This warranty is in lieu of all other warranties and the Heath Company neither assumes nor authorizes any other person to assume for them any other liability in connection with the sale of Heathkits.

The assembler is urged to follow the instructions exactly as provided. The Heath Company assumes no responsibility or liability for any damages or injuries sustained in the assembly of the device or in the operation of the completed instrument.

HEATH COMPANY
Benton Harbor, Michigan



PARTS LIST

PART No.	PARTS Per Kit	DESCRIPTION
Resistors		
1-62	1	51 Ω
1-83	1	56 Ω
1-84	4	62 Ω
1-6	1	470 Ω
1-63	5	510 Ω
1-9	1	1 KΩ
1-15B	2	1 KΩ 2 watt
1-44	1	2.2 KΩ
1-16	2	4.7 KΩ
1-20	4	10 KΩ
1-21	1	15 KΩ
1-22	1	22 KΩ
1-25	1	47 KΩ
1-26	1	100 KΩ
1-33	1	470 KΩ
1-35	1	1 megohm
Condensers		
20-29	1	15 $\mu\mu$f mica
20-2	1	200 $\mu\mu$f silver mica
23-18	1	.002 μfd tubular
21-27	13	.005 μfd ceramic disc
23-10	7	.05 μfd tubular
23-17	1	2 μfd metalite
25-4	1	10 μfd 25 v elec.
25-23	1	80-40-20 μfd 150 v elec.
26-19	1	Tuning condenser
31-8	1	Trimmer condenser
Switches-Controls		
63-49	1	Meter switch
63-57	1	Attenuator switch
63-59	1	Function switch
10-34	1	600 Ω control
10-9	2	10 KΩ control
10-16	1	500 KΩ control
Rectifiers-Coils		
56-2	3	Crystal diode
57-15	1	100 MA selenium rectifier
45-6	2	RF choke
100-41	1	Coil and switch assembly
Chokes-Transformer-Meter		
46-1	1	AF choke
46-8	1	Filter choke
54-22	1	Power transformer
407-25	1	Meter

PART No.	PARTS Per Kit	DESCRIPTION
Tubes-Lamp		
411-25	1	12AU7 tube
411-44	1	6AF4 tube
411-46	1	OB2 tube
411-61	1	6AV5 tube
412-1	1	#47 lamp
Terminal Strips		
431-2	4	2-lug terminal strip
431-4	1	3-lug terminal strip
431-10	2	2-lug + 1 grounded lug strip
431-11	1	4-lug + 1 grounded lug strip
431-12	2	3-lug + 1 grounded lug strip
Terminals-Connectors		
75-15	1	Terminal half-shell, drilled
75-16	1	Terminal half-shell, plain
100-M16B	2	Binding post cap, black
100-M16R	2	Binding post cap, red
427-2	4	Binding post base
432-1	1	Output cable connector
432-3	1	Output chassis connector
Sockets-Wafers		
434-15	1	7-pin wafer socket
434-16	1	9-pin wafer socket
434-34	1	7-pin miniature socket
434-39	1	Octal socket
481-1	1	Condenser mounting wafer
Pilot Light Assembly		
252-12	1	Nut
413-1	1	Jewel
434-22	1	Socket
455-1	1	Bushing
Pointer-Shafts-Knobs		
100-M10	1	Dial pointer
453-5	1	Hollow shaft extension
453-7	2	Shaft extension
462-19	6	Skirted knob, small
462-26	1	Knob, large
Wire-Cable		
89-1	1	Line cord
340-2	1	length Bare wire
343-2	1	length Coaxial cable
344-1	1	length Hookup wire

PART No.	PARTS Per Kit	DESCRIPTION
Hardware		
250-2	6	3-48 screw
250-7	13	6-32 x 3/16 screw
250-8	6	#6 x 3/8 sheet metal screw
250-9	20	6-32 x 3/8 screw
250-13	1	6-32 x 1 screw
250-15	4	8-32 x 1/8 set screw
250-18	4	8-32 x 3/8 screw
250-19	2	10-24 x 3/8 screw (handle)
250-43	7	8-32 x 1/4 set screw
250-47	4	6-32 x 2 flathead screw
250-48	1	6-32 x 1/2 screw
251-1	4	Spade bolt
252-1	6	3-48 nut
252-3	34	6-32 nut
252-4	4	8-32 nut
252-7	8	Control nut
253-1	2	#6 flat fiber washer
253-2	2	#6 fiber shoulder washer
253-10	4	Control nickel washer
254-1	38	#6 lockwasher
254-2	4	#8 lockwasher
254-4	7	Control lockwasher
254-6	4	#6 external lockwasher
254-7	6	#3 lockwasher
259-1	4	#6 solder lug
259-6	3	#3 solder lug
261-1	4	Rubber feet
485-2	1	Plug button
73-1	9	3/8 grommet

PART No.	PARTS Per Kit	DESCRIPTION
Sheet Metal Parts		
90-24	1	Cabinet
200-M60	1	Chassis
200-M61	1	Sub-chassis
203-46F74	1	Panel
204-M64	1	Z-bracket
205-M1	1	Line filter plate
205-M30	1	Trimmer plate
205-M32	1	Line filter jig
206-8	1	Shield front section
206-9	1	Shield mid section
206-10	1	Shield rear section
206-11	2	Attenuator shield ring
206-M12	1	Attenuator back shield
206-M14	1	Attenuator front shield
206-M17	1	Tube shield
206-M18	1	Coil shield
211-1	1	Handle
255-7	4	Insulating spacer
255-8	2	Threaded spacer

Notes

HELPFUL KIT BUILDING INFORMATION

Before attempting actual kit construction read the construction manual through thoroughly to familiarize yourself with the general procedure. Note the relative location of pictorials and pictorial inserts in respect to the progress of the assembly procedure outlined.

This information is offered primarily for the convenience of novice kit builders and will be of definite assistance to those lacking thorough knowledge of good construction practices. Even the advanced electronics enthusiast may benefit by a brief review of this material before proceeding with kit construction. In the majority of cases, failure to observe basic instruction fundamentals is responsible for inability to obtain desired level of performance.

RECOMMENDED TOOLS

The successful construction of Heathkits does not require the use of specialized equipment and only basic tools are required. A good quality electric soldering iron is essential. The preferred size would be a 100 watt iron with a small tip. The use of long nose pliers and diagonal or side cutting pliers is recommended. A small screw driver will prove adequate and several additional assorted screw drivers will be helpful. Be sure to obtain a good supply of rosin core type radio solder. Never use separate fluxes, paste or acid solder in electronic work.

ASSEMBLY

In the actual mechanical assembly of components to the chassis and panel, it is important that the procedure shown in the manual be carefully followed. Make sure that tube sockets are properly mounted in respect to keyway or pin numbering location. The same applies to transformer mountings so that the correct transformer color coded wires will be available at the proper chassis opening.

Make it a standard practice to use lock washers under all 6-32 and 8-32 nuts. The only exception being in the use of solder lugs—the necessary locking feature is already incorporated in the design of the solder lugs. A control lock washer should always be used between the control and the chassis to prevent undesirable rotation in the panel. To improve instrument appearance and to prevent possible panel marring use a control flat nickel washer under each control nut.

When installing binding posts that require the use of fiber insulating washers, it is good practice to slip the shoulder washer over the binding post mounting stud before installing the mounting stud in the panel hole provided. Next, install a flat fiber washer and a solder lug under the mounting nut. Be sure that the shoulder washer is properly centered in the panel to prevent possible shorting of the binding post.

WIRING

When following wiring procedure make the leads as short and direct as possible. In filament wiring requiring the use of a twisted pair of wires allow sufficient slack in the wiring that will permit the twisted pair to be pushed against the chassis as closely as possible thereby affording relative isolation from adjacent parts and wiring.

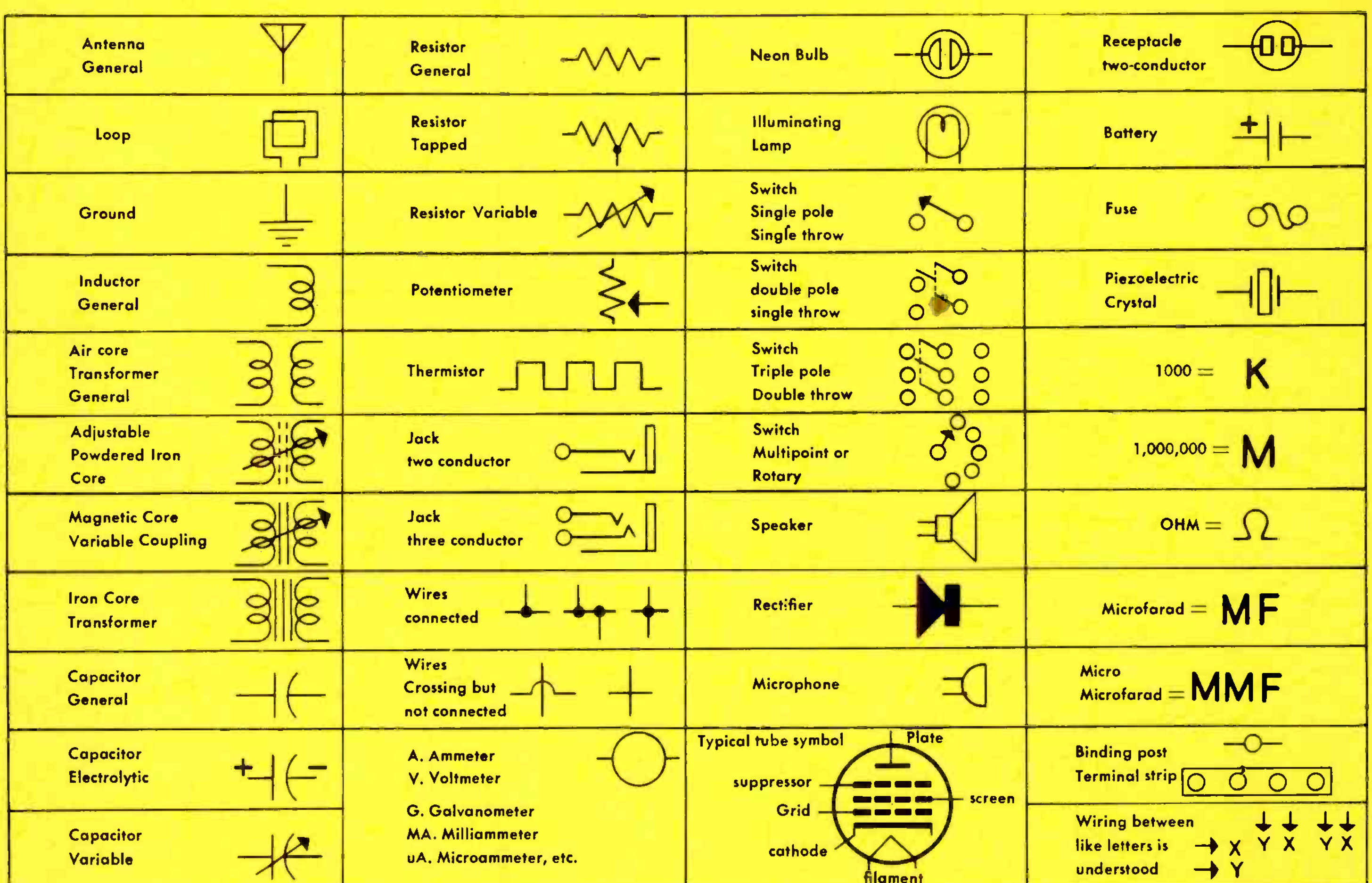
When removing insulation from the end of hookup wire, it is seldom necessary to expose more than a quarter inch of the wire. Excessive insulation removal may cause a short circuit condition in respect to nearby wiring or terminals. In some instances, transformer leads of solid copper will have a brown baked enamel coating. After the transformer leads have been trimmed to a suitable length, it is necessary to scrape the enamel coating in order to expose the bright copper wire before making a terminal or soldered connection.

In mounting parts such as resistors or condensers, trim off all excess lead lengths so that the parts may be installed in a direct point-to-point manner. When necessary use spaghetti or insulated sleeving over exposed wires that might short to nearby wiring.

It is urgently recommended that the wiring dress and parts layout as shown in the construction manual be faithfully followed. In every instance, the desirability of this arrangement was carefully determined through the construction of a series of laboratory models.

SOLDERING

Much of the performance of the kit instrument, particularly in respect to accuracy and stability, depends upon the degree of workmanship used in making soldered connections. Proper soldered connections are not at all difficult to make but it would be advisable to observe a few precautions. First of all before a connection is to be soldered, the connection itself should be clean and mechanically strong. Do not depend on solder alone to hold a connection together. The tip of the soldering iron should be bright, clean and free of excess solder. Use enough heat to thoroughly flow the solder smoothly into the joint. Avoid excessive use of solder and do not allow a flux flooding condition to occur which could conceivably cause a leakage path between adjacent terminals on switch assemblies and tube sockets. This is particularly important in instruments such as the VTVM, oscilloscope and generator kits. Excessive heat will also burn or damage the insulating material used in the manufacture of switch assemblies. Be sure to use only good quality rosin core radio type solder.



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