

PRICE \$2.00

HEATHKIT® ASSEMBLY MANUAL



RF SIGNAL GENERATOR

MODEL RF-1

Scanned by Ward Willats • KG6HAF • Felton, CA • October 26, 2003

ASSEMBLY AND OPERATION OF THE HEATHKIT RF SIGNAL GENERATOR MODEL RF-1



SPECIFICATIONS

Frequency Range:

Band A:.....	100 kc to 320 kc.
Band B:.....	310 kc to 1100 kc.
Band C:.....	1 mc to 3.2 mc.
Band D:.....	3.1 mc to 11 mc.
Band E:.....	10 mc to 32 mc.
Band F:.....	32 mc to 110 mc.
Calibrated Harmonics:.....	100 mc to 220 mc.

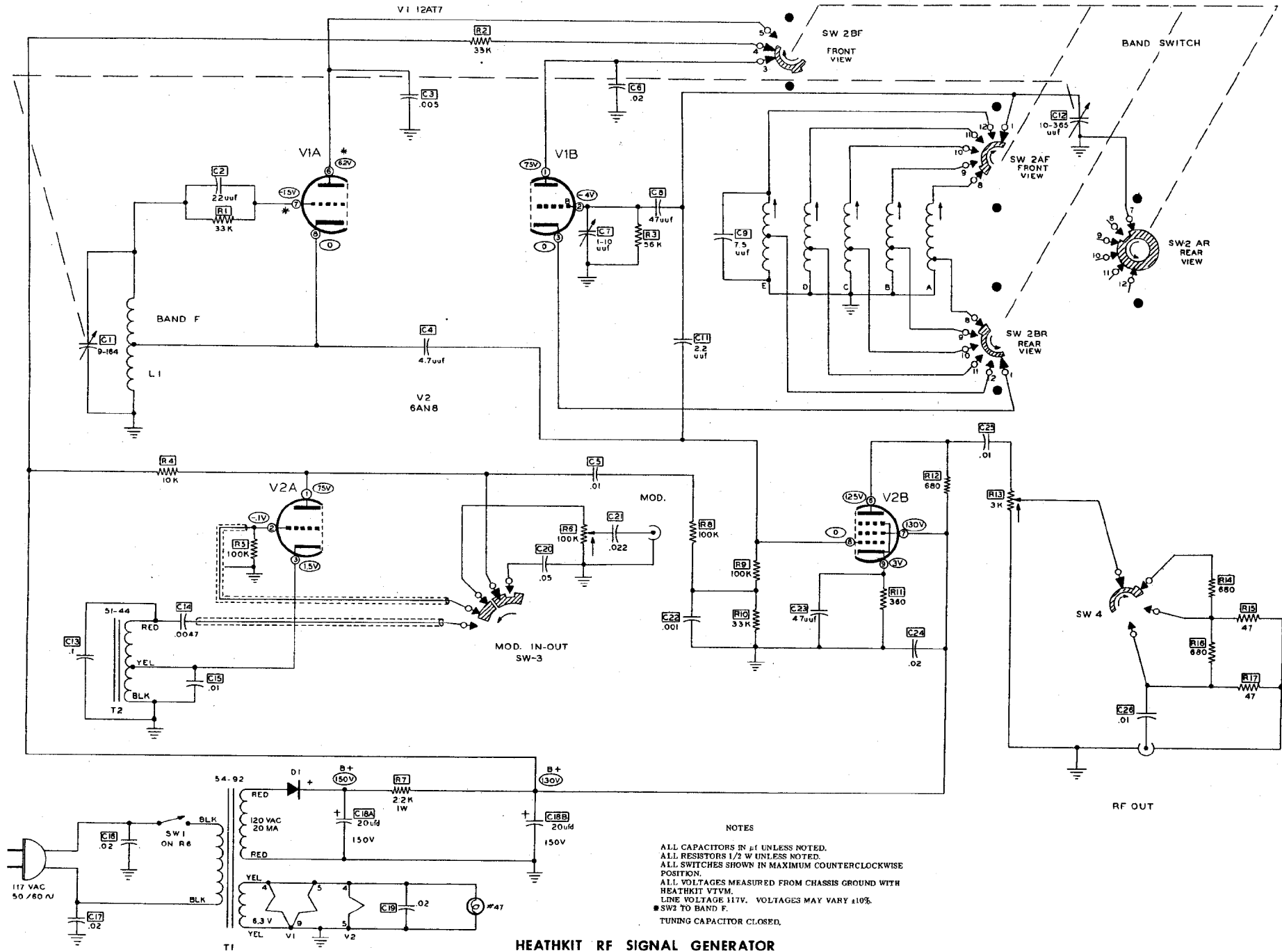
Accuracy:..... 2%.

Output:

Impedance:.....	50 Ω .
Voltage:.....	In excess of 100,000 μ v.

Modulation:

Internal:.....	400 cycle, approximately 30% depth.
External:.....	Approximately 3 volts across 50 K Ω for 30%.



400 Cycle Audio Output:..... Approximately 10 volts open circuit.
Tube Complement:..... V1 - 12AT7 - RF oscillator.
V2 - 6AN8 - modulator and RF output.
Power Requirements:..... 105-125 volts 50/60 cycle AC 15 watts.
Aluminum Cabinet Dimensions:..... 6 1/2" wide x 9 1/2" high x 5" deep.
Net Weight:..... 4 1/2 lbs.
Shipping Weight:..... 7 lbs.

INTRODUCTION

The Heathkit RF (radio frequency) Signal Generator Model RF-1 has been designed to provide the service technician, ham and experimenter, with an accurate and stable source of RF signals. A preassembled band switch and coil assembly, aligned to factory precision standards, eliminates the necessity of having costly equipment to calibrate the finished kit. To insure that the maximum performance that is available in this kit be realized, it is suggested that the builder take a few minutes now to read the CIRCUIT DESCRIPTION and CONSTRUCTION NOTES.

CIRCUIT DESCRIPTION

The RF oscillator for Bands A, B, C, D and E consists of one-half of a 12AT7 tube (V1B), the tuning capacitor C12 and the five adjustable Hartley oscillator coils. These coils are supplied as a pre-aligned band switch assembly (SW2). The cathode of the tube is connected to the tap of the coils through switch SW2-BR. Because one end of each coil is grounded, the current from the cathode will excite the coil at resonance. The feedback necessary to maintain oscillation is coupled from the "hot" end of the coil through switch SW2-AF and then through capacitor C8 to the tube grid. Switch SW2-AR shorts out the unused coils to prevent any undesirable suckouts.

The coil for Band F is mounted directly on the tuning capacitor and is permanently connected to the other half of the 12AT7 oscillator tube (V1A). This arrangement eliminates the stray capacities that would be involved in switching and thus provides a more desirable LC ratio. Band switching is accomplished by switching the B+ to Band F through switch SW2-BF.

The triode of a 6AN8 (V2A) is used for the 400 cycle oscillator. A Hartley Oscillator is also used in this circuit but, of course, the coil or reactor is of the iron core type because of the frequency involved. The modulation in-out switch SW3 connects either the plate or the grid through control R6 to the modulation jack. This arrangement enables the 400 cycle output to be amplitude controlled, and also controls the level of external modulation applied to the grid of V2A.

RF signals are coupled to the grid of the 6AN8 output tube (V2B) through capacitors C4 and C11. Modulation is coupled to the grid through capacitor C5, resistors R8 and R9. These components, along with resistor R10, establish the modulation level. The modulated RF signal is then coupled from the plate of V2B through capacitor C25, fine attenuator R13 and the step attenuator switch SW4 to the RF output jack.

The power for the RF-1 is supplied through transformer T1. A conservatively rated silicon diode (D1) is used in a half-wave rectifier circuit to supply the B+ for the generator.

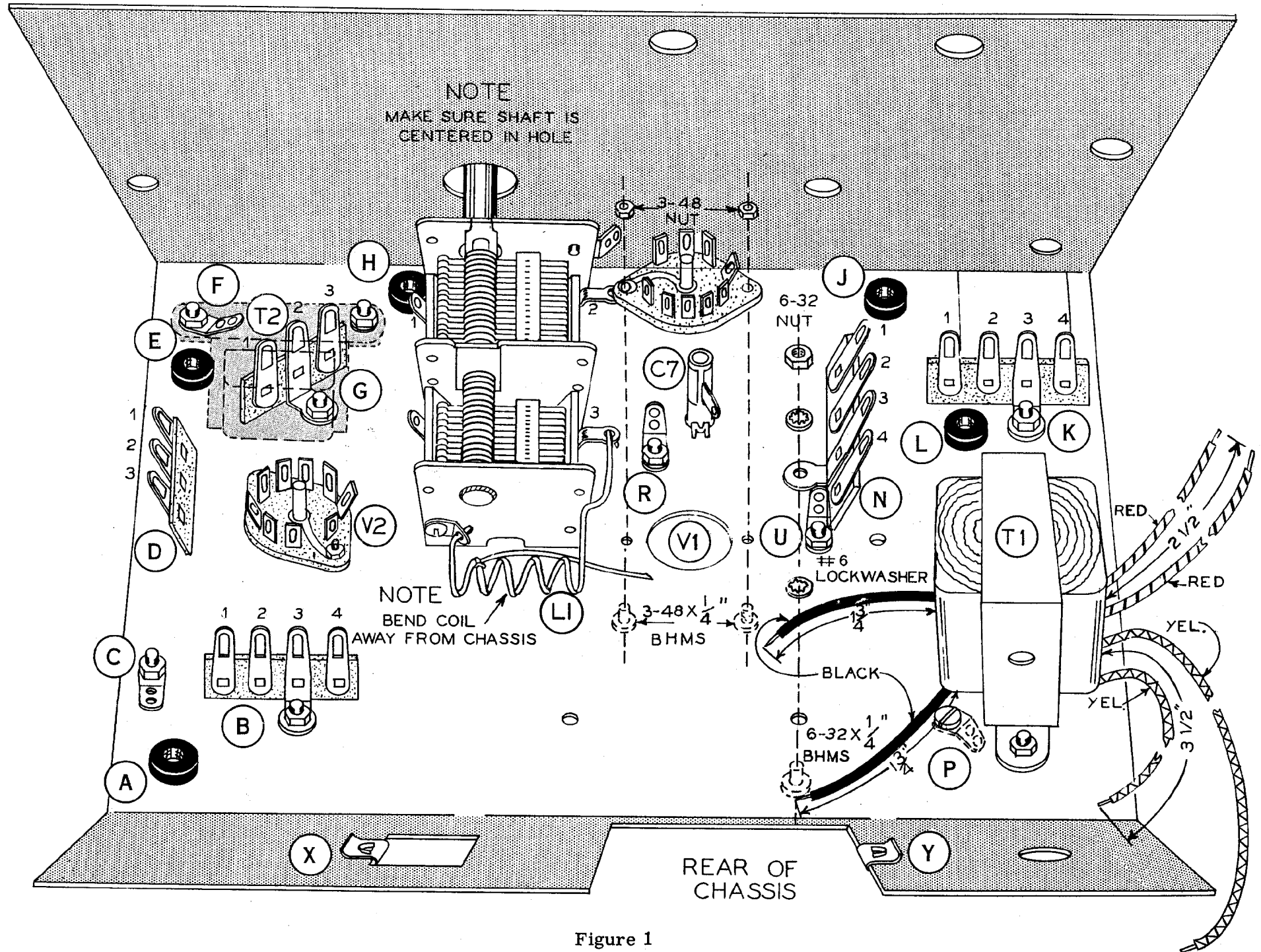


Figure 1

ACCURACY

Any signal generator is designed as a convenient and controlled source of modulated, or unmodulated, signals. No ordinary signal generator is designed as a frequency standard. Expensive standard signal generators have very accurate (3% to 20%) attenuators which control the output voltage. The frequency calibration accuracy is rarely closer than 1%. The Heathkit RF-1 Signal Generator may be expected to fall within 2% of the dial calibration, which is quite satisfactory for service work and alignment. In receiver adjustment the frequency at which the particular adjustment is made is not very critical, but the adjustment itself for maximum signal output from the receiver is frequently quite critical. For accurate calibration of home-built receivers or equipment, proceed as follows: Make a rough calibration with a signal generator, then with a receiver tune in WWV (Bureau of Standards) at 2.5 mc, 5 mc or 10 mc. Set the generator to a suitable subharmonic such as 500 kc or 1000 kc, then adjust the generator for zero beat. Now, harmonics of the signal generator occur every 500 kc or 1 mc, and these harmonics may be used to give accurate calibration at points 500 kc or 1000 kc apart, such as 2500 kc or 3000 kc. These known frequency points can be marked on the dial of the equipment being calibrated. The object of the rough calibration is merely to furnish a means of identifying, for example, the 3000 kc point from the 2500 kc point, or 3500 kc point. For calibration of higher frequency equipment, a choice of higher reference frequency will reduce the confusion between the multitude of harmonics and will also insure adequate signal strength. When checking the calibration accuracy of the RF-1, the most convenient standards of comparison of sufficient accuracy are broadcast and FM stations of known frequencies. Do not depend on the receiver dial calibrations, however, because they are usually not of sufficient accuracy to warrant consideration.

IN CASE OF DIFFICULTY

1. Recheck the wiring. Trace each lead in colored pencil on the pictorial as it is checked. It is frequently helpful to have a friend check your work. Someone who is not familiar with the unit may notice something consistently overlooked by the constructor.
2. It is interesting to note that about 90% of the kits that are returned for repair are defective due to poor connections and soldering. Therefore, many troubles can be eliminated by reheating all connections to make sure that they are soldered as illustrated in the Figures found in the SOLDERING TECHNIQUES section of this manual.
3. Check to be sure that all tubes are in their proper locations. Make sure that all tubes light up properly.
4. Check the values of the component parts. Be sure that the proper part has been wired into the circuit, as shown in the pictorial diagram and as called out in the wiring instructions.
5. Check for bits of solder, wire ends or other foreign matter which may be lodged in the wiring, tube sockets or terminal strips.
6. Check the tubes with a tube tester or by substituting a known good tube of the same type.
7. If, after careful checks, the trouble is still not located and a voltmeter is available, check voltage readings against those found on the Schematic Diagram. NOTE: All voltage readings were taken with a Heathkit Vacuum Tube Voltmeter. Voltages may vary 10% due to line voltage variations.
8. A review of the circuit description will prove helpful in indicating where to look for trouble.
9. If the RF-1 fails to function on any one particular band, the coil for that band may be open.

USING THE RF-1

In order to realize the maximum usefulness of this instrument, the operator should thoroughly familiarize himself with the following information on panel markings, operating procedures, alignment, etc.

The six bands of the RF-1 are calibrated on three large dial scales, rather than six separate scales. This arrangement permits the use of larger lettering and radius on the scales, thereby increasing readability and accuracy. Bands A, C and E are on the first scale, which is calibrated from 10 to 32. On Band A it is necessary to multiply the number by 10, just as is done on many radio dials. For example, if the band switch was on Band A and the pointer at 23 (see Figure 13), the frequency would be 230 kc. On Band C, it is necessary to divide by 10. In other words, 23 on Band C is 2.3 mc. Band E is read directly. Bands B and D are on another scale. On Band B, you must multiply by 10. Therefore, 75 would be 750 kc. On Band D, the number must be divided by 10, thus making 75 equal 7.5 mc. Band F is a separate scale and can be read directly. Another feature of the dial scales is the special markings at 10.7 mc and 455 kc. These are the most commonly used IF frequencies for FM and AM radios, respectively.

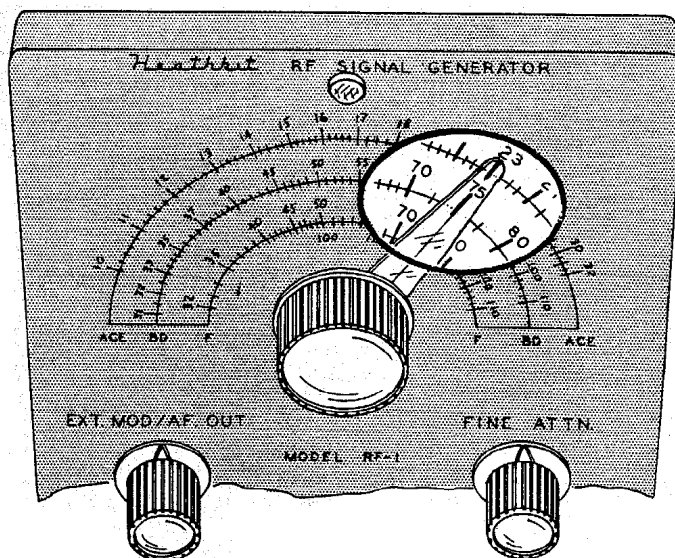


Figure 13

The RF fine attenuator, coarse attenuator and RF output are self explanatory. 400 cycle audio frequency is available at the EXT MOD IN/AF OUT jack, when the modulation switch is in the internal modulation position. When the switch is in the external modulation position, the internal 400 cycle modulation is turned off, and the RF signal may be modulated by feeding an audio frequency signal into the modulation jack. Approximately 3 volts is required for 30% modulation. The EXT MOD/AF OUT control enables the user to control the level of external modulation and also the level of the 400 cycle output. This control also turns the instrument off and on.

ALIGNMENT OF AM TUNERS AND RECEIVERS

Today's modern AM radios have become quite standardized; therefore, it is seldom necessary to refer to a specific manufacturer's alignment instructions. The most important thing to note is the IF frequency used. 455 kc is by far the most common; however, 262 kc and 460 kc are used occasionally. The following Step-By-Step Procedure can be used in most cases.

The schematic diagram of Figure 14 illustrates a typical AM receiver; the following alignment procedure would be applicable.

1. () Turn both the signal generator and the receiver on and allow several minutes for both to reach normal operating temperature.
2. () While the speaker may be used as an indication of output, it is much more desirable to use some other type of output indicator. This may be an AC voltmeter, connected directly across the speaker voice coil or perhaps a VTVM, connected to measure AVC voltage, would be more desirable.

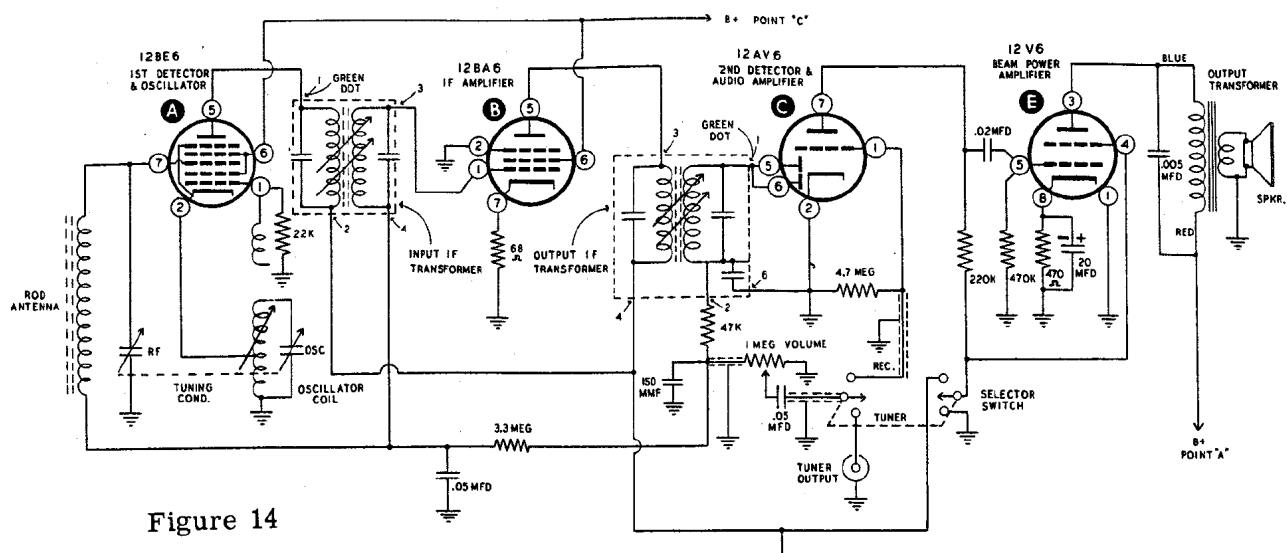


Figure 14

3. () Turn the receiver dial so that the tuning capacitors are completely open (high frequency end of dial).
4. () Couple the signal generator to the receiver antenna. The most convenient method of accomplishing this is to place the "hot" lead of the generator output cable in close proximity to the loop or rod antenna. In some extreme cases it may be necessary to connect directly to the antenna terminals or the IF grid. Set the generator to the IF frequency (455 kc) and set the modulation switch to INT MOD.
5. () Adjust the output of the signal generator to the point where the signal can just be heard, or read on the output indicator.
6. () Adjust the IF transformers for maximum output. Keep reducing the signal generator output as necessary to keep a low reading on the output indicator. Repeat these adjustments at least once to correct for any interaction between primary and secondary windings of the individual transformers. Interaction is most likely to occur in sets where adjustment is by means of iron core slugs rather than trimmer capacitors.
7. () Next, tune the receiver to its highest calibrated frequency setting (usually somewhere around 1600 kc). Set the generator to the same frequency and adjust the oscillator trimmer for maximum output.
8. () Now tune the receiver and signal generator to 1400 kc and adjust the RF trimmer for maximum output.
9. () Set the signal generator to 600 kc and tune the receiver to the low frequency end of the dial. Now "rock" (turn slightly back and forth) the receiver tuning capacitor while at the same time adjusting the oscillator trimmer (or slug) for maximum output. In some receivers, the low frequency oscillator adjustment will be made by means of an iron core slug in the oscillator coil rather than by a trimmer. On receivers that have no low end oscillator adjustment, it may be necessary to compromise between the high and low end tracking.
10. () Step 8 should be repeated if it was found necessary to readjust the trimmer, or slug, as directed in Step 9.

The RF alignment procedure for multiband AM receivers is essentially the same as outlined above for a single band set. Each band is aligned separately, starting with the highest frequency and working toward the lowest. The technique outlined above should be used but with appropriate high and low frequency settings for each band.

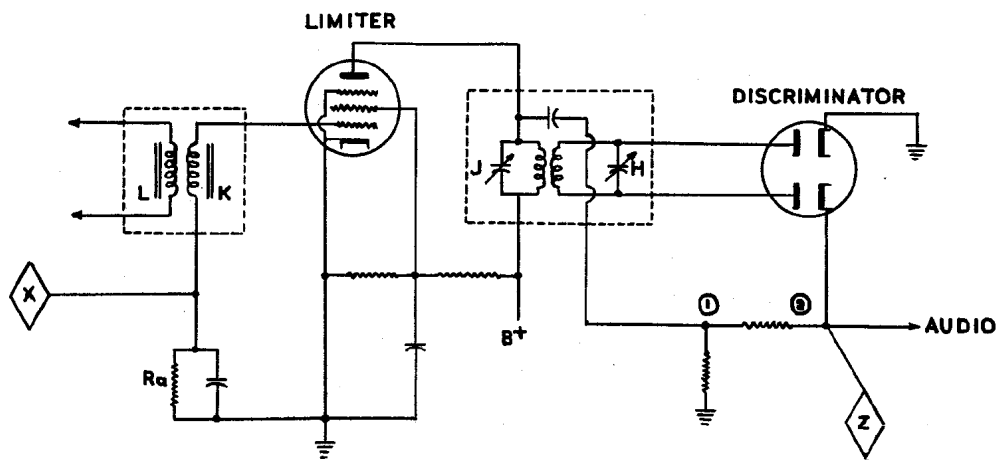


Figure 15

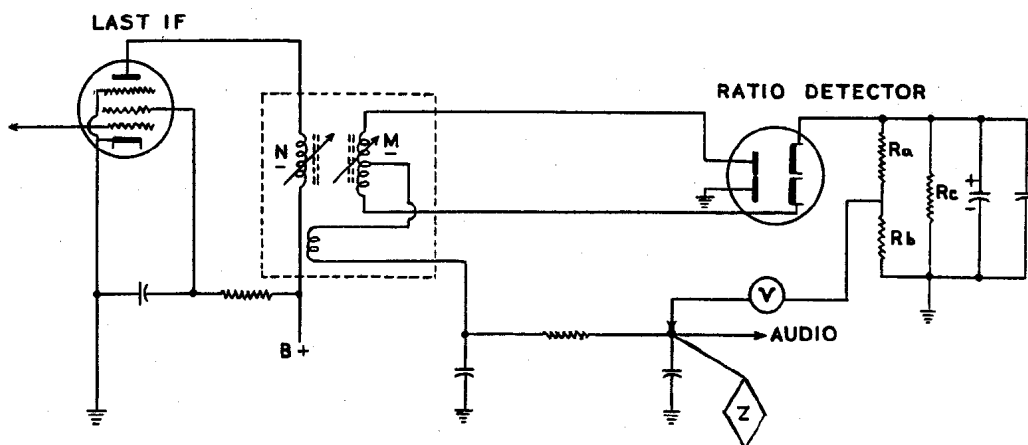
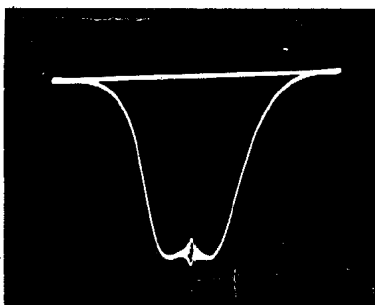
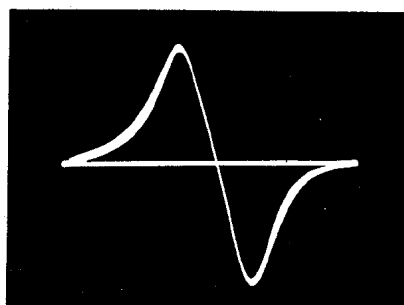


Figure 16



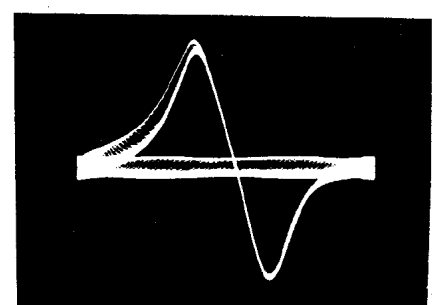
17A

FM IF response with
10.7 mc marker.



17B

Ratio detector or dis-
criminator response
with 10.7 mc marker
at 0.



17C

Ratio detector or discriminator
response with 10.7 mc marker
not at 0. Note 400 cycle
modulation.