

**PHILCO****SERVICE**

## Shop Practices and Service Techniques

RADIO

MAY, 1951

### THE SERVICING OF RF SIGNAL GENERATORS



FIGURE 1

This article is the second in a series pertaining to the servicing of test equipment. As in the preceding article on multimeters, the examples are taken from current Philco gear, but it is believed that the ideas and suggestions can be utilized by the serviceman so that he will be able to intelligently attack a test equipment problem and effect a repair.

The signal generators under discussion in this article are the Models 7070 and the 7170. These two models are identical in every respect except for the addition of an FM sweep oscillator used in the Model 7170, (Figure 1).

A signal generator is a precision instrument, accurately calibrated, and very stable. It is not greatly affected by line voltage variation, temperature, humidity load, or hand capacity. Even though

this unit is designed as a shop frequency standard and that the prime considerations of its design are accuracy and stability, this type of equipment bears a marked resemblance to portions of a normal radio. As can be seen from the schematic, Figure 2, the power supply is perfectly normal. The oscillator is quite similar to that used in converter circuits, and as shown in Figures 2 and 3 appear quite simple when disregarding the switch and considering only one band. We are all familiar with the phase inverter as used to drive push-pull output tubes; the cathode follower used here is the same except there is no output taken from the plate. The attenuator is a simple voltage divider and needs no comment. The audio oscillator is a Hartly which supplies the 400 cycle audio which is used as a test signal or as modulation applied to the R-F output. The R-F output is plate modulated by drawing the cathode follower's plate current through a portion of the audio oscillator's tank.

In the Model 7170 the FM sweep is accomplished through the use of a 60MC oscillator that has its frequency varied, above and below its center frequency, (to a controllable extent) by a reactance tube across the oscillator.

The rugged construction of this instrument and the use of heavy duty parts reduces the failure of components to a minimum. A great percentage of the troubles encountered with these generators will be tube failure, long term drift (requiring realignment), and power supply hum (leaky filters). Alignment procedures are located at the end of this article.

Power supply troubles, usually show up as hum in the output (especially in the audio signal) caused by leaky filters, or as a dead generator (no

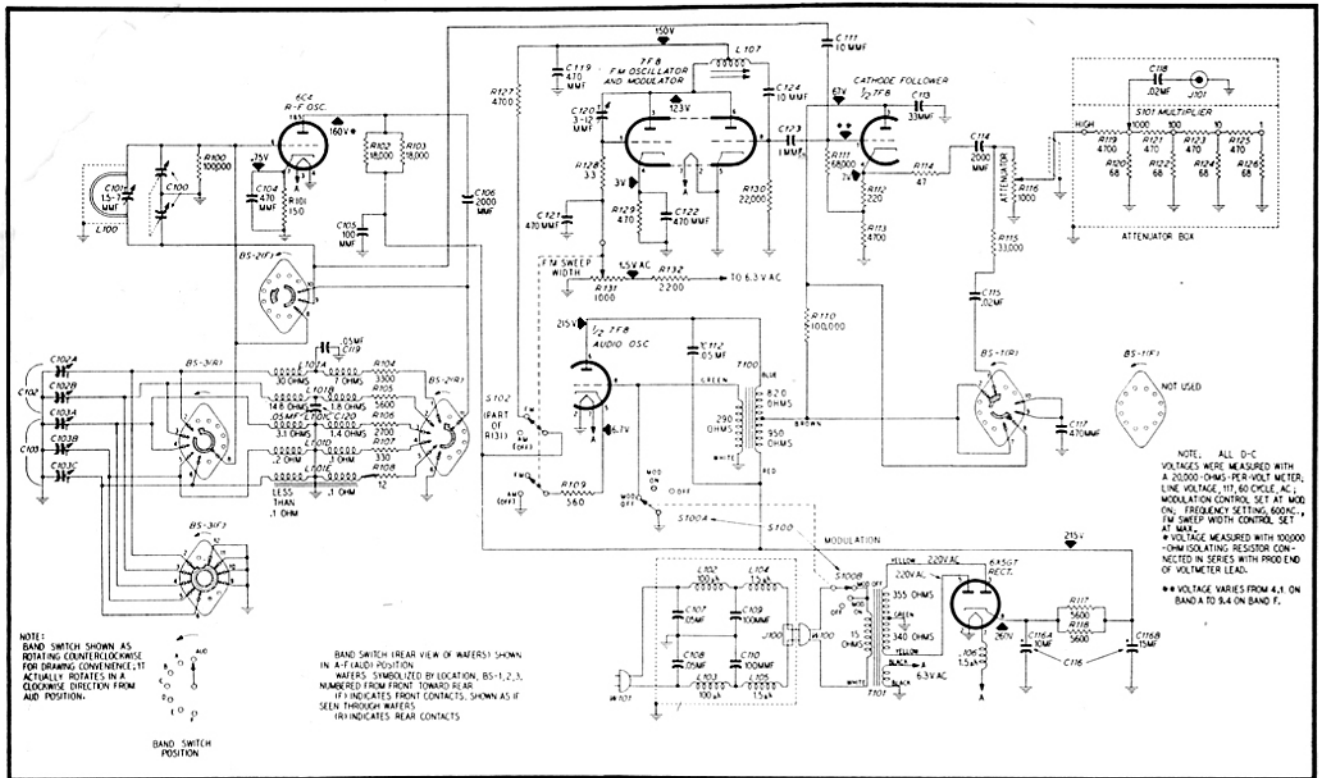


Figure 2. Philco FM and AM Signal Generator Model 7170, Schematic Diagram

audio—no R-F) caused by a defective 6X5GT. Hum can also be caused by open filters or cathode to filament leakages in any of the tubes. Lack of B+ can easily be found by voltage checks in the power supply. In this manner an open filter resistor, a defective rectifier tube or transformer, or an open isolating choke can be located.

If the generator is dead (no audio—no R-F) and the B+ voltage is correct at the output of the rectifier, the trouble is probably in the attenuator box. This can be checked by obtaining output from the arm of the attenuator pot; and the faulty multiplier can be located through a continuity test. If no output is attained from the center arm of the attenuator, and none attained from the high side of this control in either audio or RF positions, the B+ to tap portion of the plate winding of the modulation transformer is probably open (check for B+ at plates of the audio oscillator and cathode follower).

If audio is not present at the output when in audio position, but modulated R-F is, the trouble is in the switch BS-1 (R), C115 or R115.

If audio is not present either as modulation or alone, the oscillator section of the 7F8 is probably defective. Other possibilities are open R109 or T100 or shorted C112 or S100A.

When the proper audio signal is present at the output but no R-F is available, the cathode follower may be at fault. This may be ascertained by coupling a lead to the grid of the follower, setting the frequency control to an appropriate frequency, and feeding the lead to the input of a radio. If output is attained, the cathode follower section of the 7F8 is probably defective. Other troubles could be open R110, R111, R112, R113, R114, or C114.

Oscillator failure is indicated by lack of signal at the grid of the cathode follower. No oscillation at all would probably be caused by a defective 6C4 tube. Other possibilities, though not likely, are open cathode resistor R101, open plate dropping R102 and R103 (this would be caused by a shorted tube and accompanied by smoke and odor) and shorted C104, cathode by-pass, these components are shown in Figures 3 and 4. Loss of

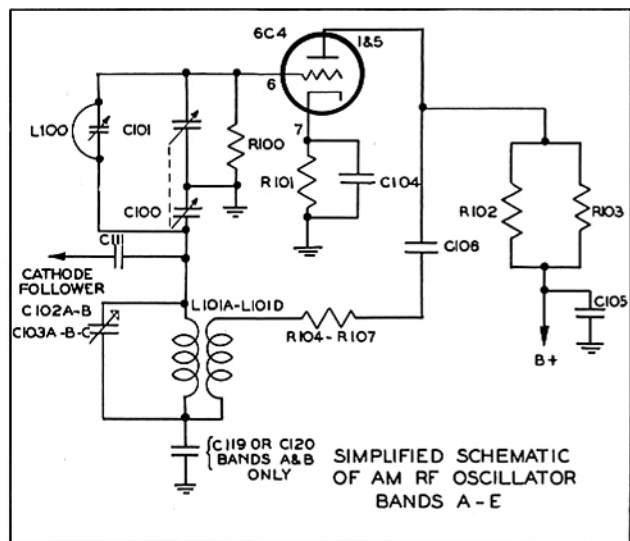


FIGURE 3

oscillation on a single band could be due to an open coil or a defective switch contact used only on that one band. Intermittent operation can often be traced to dirty switch contacts; these can usually be cleaned with carbon tetrachloride and then lubricated with a suitable contact lubricant. An output which falls off in strength as the frequency increases (often no output on the higher one or two bands) is usually attributed to the tube. This is caused by tube aging to a point where operation is unsatisfactory. A sudden increase of

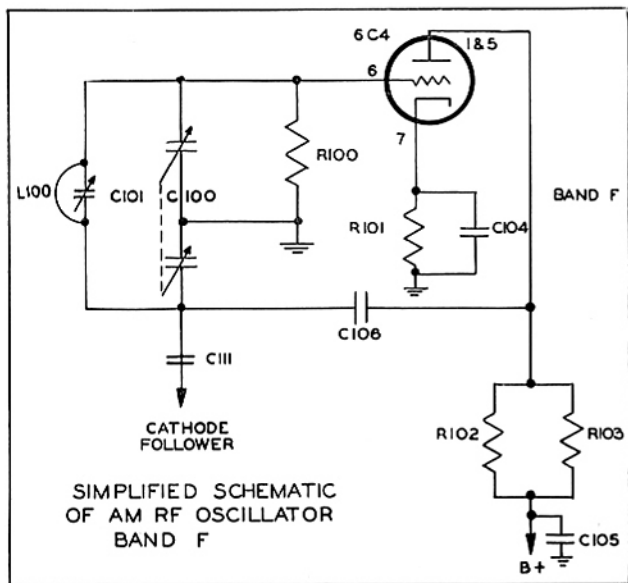


FIGURE 4

frequency on an individual band is caused by the shorting of a few turns on the grid coil. Often this band can be readjusted at its high end but will not track; the coil should be replaced.

Failure of the FM oscillator will be due to either that section of the 7F8 tube or to an open in L107, the oscillator coil. If the sweep modulator does not function, the cause could be (other than that portion of the 7F8) open R131, R132, R129, or a damaged C120.

After replacing any parts in the oscillator circuits, be sure to check calibration and re-align if necessary as explained in the following text.

### REPLACEMENT OF TUBES IN MODELS 7070 AND 7170 SIGNAL GENERATORS

To replace tubes, first remove the cross-recess-head screws from around the edges of the front panel. Tilt the panel forward, remove the power-transformer plug from the socket in the line-filter shield, then remove the signal generator from its case. Since the R-F oscillator is well stabilized, replacement of the 6C4 tube should not cause appreciable change in calibration; however, because of certain variations in different tubes, it is advisable, after replacing the oscillator tube, to check the calibration against stations of known frequencies in the broadcast and short-wave bands. If the calibration has shifted noticeably, try another tube. If the desired accuracy is not obtained with available tubes, calibration adjustments may be made as described below.

### CALIBRATION ADJUSTMENTS—

#### AM Calibration Adjustments

A separate trimmer condenser is provided for each R-F band, for correcting the calibration of the Model 7070 or 7170 signal generator. Remove the signal generator from its case, as for replacement of tubes; the adjusting trimmers are located as shown in figure 5. To make accurate adjustments, it is necessary to use some calibrated signal source for obtaining a "standard" signal, against which the signal frequency of the signal generator can be compared; the signals are picked up on a radio that is capable of responding at the various frequencies to be used in making the adjustments. The calibration of the radio should be sufficiently accurate to permit identification of the frequency

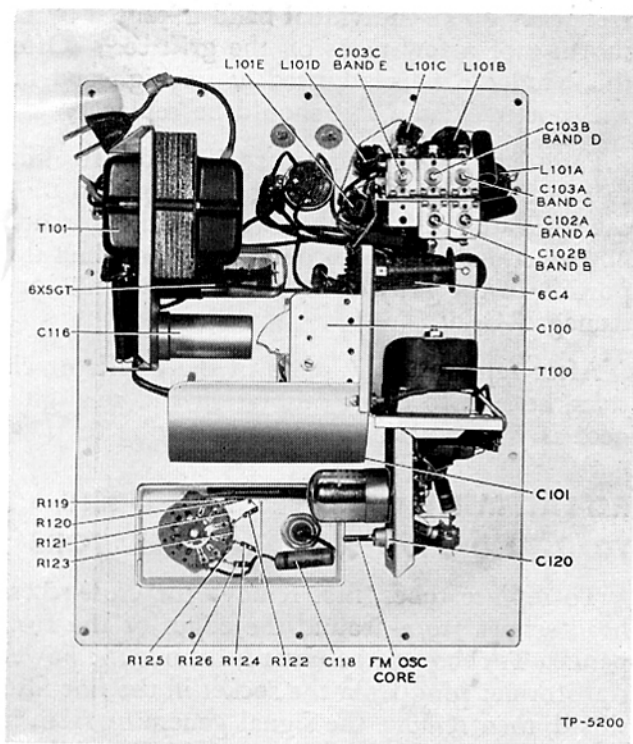


Figure 5. Location of Calibration Adjustments

of the standard signal at each desired calibration point.

Any one of the following combinations may be used, according to the equipment available.

1. A crystal-controlled frequency standard and an all-wave radio.
2. Another R-F signal generator, known to be accurately calibrated, and an all-wave radio.
3. An all-wave radio with aerial connected, for picking up standard signals from broadcast or code stations of known frequencies.

The adjustment of each trimmer should be made near the high-frequency end of the band to be calibrated. No special sequence of adjustments need be observed, since each trimmer and coil circuit is independent of the others.

Allow the signal generator and associated equipment to warm up for at least ten minutes. Turn off the audio modulation. Set the frequency standard to the desired frequency, and tune in the signal on the radio; the signal from the generator can then be zero beat against the standard signal.

With the BAND SWITCH of the Model 7070 or 7170 properly set, turn the dial to the point at

which the frequency is to be adjusted. Then turn the correct calibrating trimmer for zero beat; the sharpest zero beat indication will be obtained if the two signals are moderately weak. Repeat the adjustments for each band.

### FM Calibration Adjustments

If the 7F8 FM-oscillator and reactance-modulator tube is ever replaced in the Model 7170, the calibration adjustment outlined below should be performed, in order to retain the accuracy of the instrument.

1. Turn the FM SWEEP WIDTH control from the extreme counterclockwise position until the switch operates. Leave the control at this position for minimum deviation.
2. Loosely couple the generator to a receiver, or to a frequency meter equipped with either a visual or aural indicator, and capable of tuning to 60 mc. Then adjust the FM-oscillator tuning core for a frequency of exactly 60 mc. (the generator tuning control should be set to some frequency other than 60 mc.).
3. Set FM SWEEP WIDTH control to its maximum clockwise position (greatest deviation), and set phasing adjustment C120 for a maximum deviation of  $\pm 500$  KC. When the receiver or frequency meter is tuned to either side of 60 mc., the signal will disappear at a frequency which is just a little more than the amount of deviation. The signal sounds like rough A-C hash on an AM receiver, and like a smooth 60-cycle hum on an FM receiver.
4. Recheck the FM-oscillator center frequency; if it is not exactly 60 mc., retune oscillator core for correct frequency.
5. If necessary, repeat steps 3 and 4 until the center frequency is 60 mc. with a total deviation of 1 mc. ( $\pm 500$  KC.).

### NOTE

Whenever the unit is removed from the case and then replaced, the alignment of the auxiliary vernier dial should be checked with the pointer set to its maximum counterclockwise position, the pointer center index line should coincide with the red line which divides the calibrated dial into two semicircles, and should also coincide with 1 and 19 on the vernier scale.