RF Signal Generator
WR-50B

Instruction Manual

RCA Electronic Instruments

Optional Price 50 Cents

Safety Precaution

This instrument is equipped with a three-wire power cord which connects the metal case and ground lead to the power-line ground. To prevent lethal shocks or equipment damage when servicing equipment not equipped with a three-wire power cord, ALWAYS ELECTRICALLY ISOLATE SUCH EQUIPMENT WITH AN ISOLATION TRANSFORMER, such as RCA WP-25A*, WP-26A*, or WP-27A Isotap.

Always become familiar with the equipment under test before working on it, bearing in mind that high voltages may appear at unexpected points in defective equipment.

* Use isolated sockets only.

WR-50B

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Description

The RCA WR-50B RF Signal Generator is an all-purpose instrument, designed primarily for aligning and servicing radio and television receivers. The generator produces tunable RF output from 85 kc to 40 Mc, 400 cps audio output, and sweep output 455 kc and 10.7 Mc. A crystal-controlled oscillator is also provided for use with an external crystal.

The variable oscillator covers the fundamental frequencies from 85 kc to 40 Mc in six ranges. For higher frequencies, the second or third harmonic of the high range can be used. A vernier tuning control permits precise setting of the output frequency. The rf output can be modulated with the internal 400 cps oscillator, or with an external audio signal. The modulation level is adjustable.

A two-position attenuator switch, together with a variable attenuator control provide complete adjustment of the rf output level.

Sweep output is provided at 455 kc and 10.7 Mc for sweep alignment of both am and fm if circuits. This sweep output makes it possible to obtain a continuous oscilloscope display of if bandpass characteristics. A return-trace blanking circuit is included to provide a zero-reference line.

The crystal oscillator circuit in the WR-50B enables the instrument to be used as a crystal calibrator. A convenient crystal socket is provided on the panel. This crystal oscillator can be used as a frequency calibration reference for the variable oscillator, or can be used directly as a crystal-controlled signal source.

The generator includes a shielded rf output cable to minimize radiation and hum pick-up. A phono-type panel jack is provided for af input/output.

The WR-50B has brushed aluminum panel with permanently etched two-color dial scale and markings. The instrument is readily portable, weighing just five pounds, and measuring only 4¾ inches × 5⅜ inches × 7¾ inches.

Accessories Available Separately

Crystals (Order from your local RCA Parts and Accessories Distributor)

Frequency	*Stock Number*
100 kHz	11C100
455 kHz	11C101
1 MHz	11C102
4.5 MHz	214796
10 MHz	11C103
10.7 MHz	11C104

Specifications

(Performance figures with line voltage at 120 volts, 60 Hz)

Sweep Output:
- 455 kc, center-frequency
- 10.7 Mc, center-frequency
- Sweep width approximately 10% of center frequency.

Variable Oscillator:
- Six Ranges (fundamental frequencies)
  - A ....85 kc to 200 kc
  - B ....200 kc to 550 kc
  - C ....550 kc to 1600 kc
  - D ....1.5 Mc to 4.5 Mc
  - E ....4.5 Mc to 14 Mc
  - F ....12 Mc to 40 Mc

RF Output (all ranges)* 0.05 volt rms (minimum)

Dial Calibration Accuracy .....±2%

Internal Modulating Frequency approx. 400 cps

Percent Modulation adjustable up to 30%

Audio Output....at least 8 volts rms across 15K load

External Modulation
- Modulating Frequency.15 kc max.
- Voltage Required for 30% Mod. Using 400 cps** approx. 10 volts rms
- Impedance at AF IN/OUT Connector (400 cps)† approx. 10K

Crystal Oscillator
- Maximum Output..0.02 volts rms
- Internal Mod. Percentage approx. 20%‡
- Frequency Range..100 kc to 15 Mc (Fundamental)

Attenuator
- VFO and Sweep Output 2-step 10-to-1 attenuator switch with potentiometer for fine adjustment.
- Crystal Oscillator Output Additional 7-to-1 attenuator switch

Tube Complement....2 RCA 12AT7

Power Supply§
- Voltage Rating......105-130 volts 50/60 cps
- Power Consumption......15 watts

Dimensions
- Height ....7¾ in.
- Width ....5⅝ in.
- Depth ....4¾ in.

Weight ....5 lbs.

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*Open-circuit value.
**With WR-50B tuned to 1 Mc.
†With % MOD control at maximum.
‡Varies with crystal cut and activity.
§May be re-wired for 240 V operation.

Functions of Controls

① TUNING DIAL — Tunes through all six ranges (A through F) of the variable rf oscillator.

② RANGE SWITCH — Selects 455 kc or 10.7 Mc sweep, and VFO ranges A through F.

③ RF HI/LO — Attenuates rf (VFO, crystal, and sweep) output when set to LO position.

④ RF ATTEN — Provides fine rf attenuation adjustment.

⑤ XTAL OSC HI/LO — Provides additional attenuation of crystal output.

⑥ RF OUT — RF output cable.

⑦ XTAL — Crystal socket. Accepts crystals with HC-6U type base. Inserting crystal activates crystal oscillator.

⑧ MOD IN/OUT — External modulating signal can be applied through this jack when MOD switch is set to "EXT".
Provides 400 cps output when MOD switch is set to "INT".

⑨ PWR OFF/% MOD — Applies power when turned clockwise from "PWR OFF" position. Varies modulation level. Varies level of 400 cps output.

⑩ VFO ON/OFF — Turns variable frequency oscillator on or off.

⑪ SWEEP/INT MOD/EXT MOD — Three position switch.
SWEEP — Provides sweep output with retrace blanking when range switch is set to one of the sweep positions.
EXT MOD — Permits external modulation of VFO or crystal oscillator. Removes blanking when used with sweep function.
INT MOD — Modulates VFO or crystal oscillator with 400 cps signal.

Operation

Plug the power cord plug into a 120 volt, 60 cps AC outlet. Turn % MOD/PWR OFF control clockwise to turn the instrument on.

VARIABLE FREQUENCY OSCILLATOR (VFO) OUTPUT

1. Set the range switch to the range that includes the desired frequency, as follows:

Range	*Frequency*
A	85 kc to 200 kc
B	200 kc to 550 kc
C	550 kc to 1600 kc
D	1600 kc to 4.5 Mc
E	4.5 Mc to 14 Mc
F	14 Mc to 40 Mc

Note: Frequencies higher than 40 Mc can be obtained by using second or third harmonics of the fundamental F band frequencies. For example, the second harmonic of the F band produces frequencies from 28 Mc to 80 Mc; the third harmonic produces frequencies from 42 Mc to 120 Mc; etc.

2. Turn the dial indicator to the desired frequency on the dial scale. Set the VFO switch to "ON".

3. If internal 400 cps modulation is desired, set the MOD switch to "INT MOD". If external modulation is to be applied, or if no modulation is desired, set switch to "EXT MOD".

4. Adjust output level with the RF/HI/LO SWITCH and RF ATTEN control.

SWEEP OUTPUT

1. Set the range switch to "455 KC" or "10.7 MC" and the VFO switch to ON. Set the MOD switch to "SWEEP" for sweep output with retrace blanking.

2. Set MOD switch to "EXT MOD" to remove blanking for adjusting oscilloscope phase.

3. Adjust output level with the RF HI/LO switch and the RF ATTEN control.

4. A marker can be inserted in the sweep trace by inserting a crystal of the marker frequency in the crystal socket. Adjust marker size with the XTAL OSC switch.

Refer to page 35 for further information regarding the use of sweep output.

CRYSTAL OSCILLATOR OUTPUT

1. Insert a crystal with a frequency between 100 kc and 15 Mc in the crystal socket. Use a crystal with HC-6U type base (pin diameter, .05"; pin space, .486"). Specify for use in parallel resonant circuit, with 32 pf loading. Crystals for several frequencies are available from RCA. See page 3.

Note: Crystals with other types of basing can be used by connecting short leads from crystal pins to the socket.

2. If the VFO is not to be used with the crystal oscillator, set the VFO switch to "OFF". Set the MOD switch to "INT" for modulation with the 400 cps internal oscillator, and to "EXT" for no modulation or if external modulation is to be applied.

3. Adjust modulation level with % MOD control. Adjust output level with RF switch, XTAL OSC switch, and RF ATTEN control .

400 CPS OUTPUT

1. Set MOD switch to "INT MOD". 400 cps output will be available at MOD IN/OUT jack. A coaxial audio cable with standard phono plug can be used. Output level is adjustable with the % MOD control.

Crystal Oscillator

The crystal-controlled oscillator of the WR-50B is operated simply by inserting a crystal of the desired frequency into the socket on the front panel of the instrument. Set the VFO ON/OFF switch to the "OFF" position to remove the variable frequency oscillator signal.

This crystal oscillator circuit features the ability to operate over a wide range of frequencies, with a rich production of harmonics. For this reason the WR-50B can be conveniently used for calibration purposes.

For extreme accuracy, crystals which oscillate at a fundamental mode, and are designed for operation in the type of circuit used in the WR-50B should be used. In this circuit, overtone crystals will oscillate at their fundamental mode — approximately one-third of their designated frequency.

The WR-50B may be utilized effectively as a crystal-calibrated signal generator by using the crystal oscillator circuitry of the instrument to calibrate the variable oscillator.

There are several methods of using the crystal oscillator in this manner. Two of these methods are described below. In these examples a 1000 Kc crystal is used, however any "fundamental-cut" crystal in the range from 100 Kc to 15 Mc can be used in a similar manner.

Example 1: Connect the RF OUT cable of the WR-50B to a diode circuit as shown in Figure 1. Connect the diode circuit to an audio amplifier and speaker. The amplifier circuit of a radio receiver having two stages of audio amplification can be used for this purpose. If a receiver is used, connect the diode circuit to the volume control, using shielded wire.

Set the RF ATTEN control fully clockwise, the RF HI/LO switch to "HI", the MOD switch to "EXT", and the VFO ON/OFF switch to "ON". Insert a 1000 Kc crystal into the socket on the front panel of the WR-50B. Turn the Range switch to "C", and tune the dial indicator between 950 Kc and 1050 Kc. A zero-beat will be heard in this area.

NOTE: A zero-beat can be identified as follows: As the dial approaches the zero-beat point, the sound starts from a high pitch, then reduces in frequency until it reaches "zero" and little or no sound can be heard. As the dial indicator passes beyond the zero-beat point, the sound again raises in pitch to beyond audibility.

The zero-beat occurs when the frequency of the variable oscillator is the same as the fundamental crystal frequency. Thus, this zero-beat point indicates the WR-50B variable oscillator is set at exactly 1000 Kc.

Since the Pierce-type crystal oscillator used in the WR-50B is rich in harmonics as mentioned above, the variable oscillator can be calibrated in a similar manner using the harmonics of the fundamental crystal frequency, such as 100 Kc, 125 Kc, 250 Kc, 333 Kc, 500 Kc, and 2 Mc, 3 Mc, 4 Mc, etc.

Example 2: The calibrating method described below is similar to that of example 1, except that an oscilloscope rather than an amplifier is used as the zero-beat indicator. The equipment is connected as shown in Figure 2.

Set the internal sweep of the oscilloscope to one of the high horizontal sweep ranges, with the internal sync "off". As the variable oscillator of the WR-50B is tuned in close to the crystal frequency, a "band-type" trace will be noted. At actual zero-beat, the band changes to a straight line. As the variable oscillator is turned past zero-beat, the band again appears until the beat frequency becomes high enough to be out of the scope and detector response range.

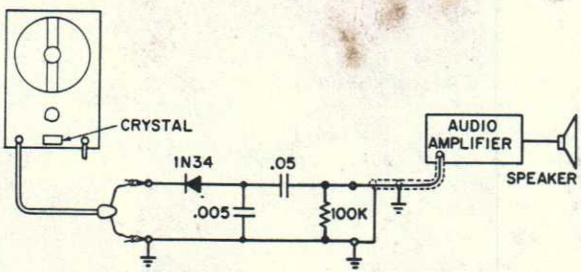


Figure 1. Using AF amplifier to crystal calibrate the WR-50B

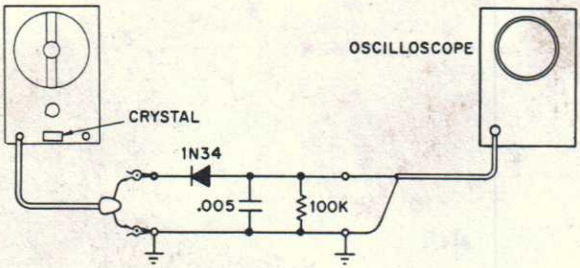


Figure 2. Using oscilloscope to crystal calibrate the WR-50B

Applications

General

Before the WR-50B is used for making adjustments or trouble shooting in either radio or television receivers, it is important that the functions of the controls and connectors be understood. Their purposes and features are described on page 4.

The application information given in the following paragraphs is intended to aid the technician in isolating a defective section or stage in the television receiver. Applying this information, however, does not preclude the usual preliminary service checks which the technician should make first on an apparently defective set. The application information does not include alignment adjustments in the tuner or picture-if amplifier. Alignment of these sections requires use of precision alignment equipment, such as an RCA WR-69A TV Sweep Generator, WR-99A Crystal-Calibrated Marker Generator, and an oscilloscope, such as the RCA WO-33A or WO-91A.

In checking a defective receiver, make a visual inspection first. Look for unlighted or loose tubes, cold solder joints, and mechanical defects.

If picture or raster trouble is encountered on a television receiver, the ion-trap magnet, brightness control, focusing magnet, and drive control should first be checked to see whether a normal raster with normal brightness can be obtained. A normal raster indicates that the kinescope, high-voltage section, vertical deflection circuits, and horizontal-deflection section are operating properly. If no raster or a poor raster is obtained, these sections should be checked and corrected. When a normal raster is obtained, apply picture signal and set the contrast control to the maximum contrast position. If no picture is present or is weak, the trouble is probably in the rf, if or video sections.

Generation of Horizontal Bars

When the internal audio oscillator is used to amplitude modulate the rf output signal, the WR-50B is extremely useful in checking picture-if and video amplifiers. Because the frequency of the audio signal is approximately 400 cps, six horizontal bars will be produced when the vertical oscillator in the receiver is operating at approximately its normal rate of 60 cps.

Some if amplifiers operate at frequencies which are above the fundamental tuning range of the WR-50B. In these cases, it will be necessary to tune the WR-50B to a frequency which will give a harmonic at the desired frequency. For signal tracing if amplifiers, harmonic output from the WR-50B is more than adequate for producing useable bars on the kinescope screen.

It will be noticed that when the WR-50B is used to produce horizontal bars, the shading of the bars may be varied from light to dark by adjustment of the % MOD/AF and the RF ATTEN control. These controls may be used to advantage in checking for stage gain and in isolating a defective stage in an amplifier section. For example, as the % MOD/AF control is varied, the degree of modulation of the rf output signal is changed. In servicing work, certain modulation percentages have been accepted. For example, a modulation percentage of 30% is customarily used in general laboratory work on radio receivers and transmitters, and up to 50% is usually satisfactory for radio and television servicing applications. A high percentage is desirable for television to provide maximum bar intensity without causing overload of the picture-if amplifier.

Methods of Checking Output

If it is desired to check the modulation percentage of the rf output signal from the WR-50B directly, it may be checked by observing the output waveshape on an oscilloscope, providing the rf frequency is within the frequency range of the oscilloscope. As the % MOD control is varied, the degree of modulation on the waveform will be seen to change. The oscilloscope and direct probe may also be used to measure the peak-to-peak value of the audio voltage at the AF IN/OUT connector. The peak-to-peak value of the audio output voltage may also be read directly on either the WV-77E VoltOhmyst or the WV-98C Senior VoltOhmyst, which have separate peak-to-peak scales.

In most applications in signal tracing, the RF HI-LO switch is set to the "HI" position, and adequate attenuation can be obtained with the RF ATTEN control. When a low-gain stage or amplifier section is tested however, the switch should be set to the "LO" position.

NOTE: It is important to remember that troubles in the agc circuit of television or radio receivers may cause the rf or if amplifiers to appear weak, dead, or intermittent. In case of doubt, it is advisable to eliminate temporarily the agc action by using fixed bias voltage as shown in Figure 12.

Applications in Television

Before connecting the WR-50B output cable to any test point, make sure the operating voltage of the test circuit does not exceed the maximum safe operating voltage as follows:

AF IN/OUT cable—400 dc volts max.
RF OUT cable—500 dc volts max.

Figure 3. Locating a dead video, if, or rf section.

1. Check the video section by applying a few volts of audio signal to the input of the video section, shown as point "1" in Figure 3. If the audio signal produces horizontal bars on the raster, the video amplifier is functioning. The vertical-hold control on the receiver should be adjusted to keep the bars stationary. If the bars are not visible, each stage in the video amplifier should be checked as shown in Figure 4.

2. If the video amplifier is functioning, the picture-if section should be checked. Tune the WR-50B to approximately the center of the picture-if pass band. If the picture if is

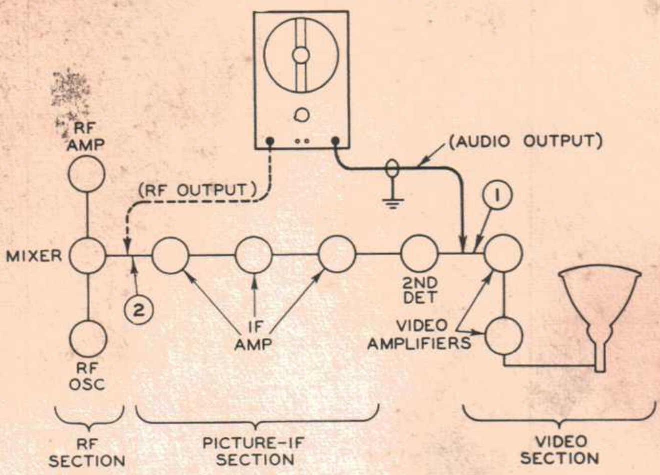


Figure 3. Setup for locating a dead video, if, or rf section

higher than 40 Mc, tune the WR-50B to one half the required frequency; the second harmonic will provide the necessary signal. Feed a modulated rf signal to the input of the picture-if amplifier, shown as point "2". If the amplifier is functioning, the input signal should produce horizontal bars on the raster. If the bars are not visible, check the agc voltage as described in the manufacturer's service notes. If any tubes in the if amplifier are shorted, or if the agc bus is shorted, waveshape clipping may occur in the if amplifier. If the agc circuit appears to be functioning normally, each stage in the picture-if amplifier should be checked as described in Figure 5.

3. If both the video and picture-if sections are functioning, the difficulty probably lies in the rf section, which should be checked as shown in Figure 6.

Figure 4. Locating a dead stage in the video amplifier.

1. Check the input circuit to the kinescope by applying the full audio output of the WR-50B as shown at point "1" in Figure 4. The audio signal should produce horizontal bars on the raster. With normal raster brightness, the bars produced by the audio signal in this step should be grey in tone, not black.

When the audio signal is applied to any portion of the video amplifier that comes after the sync take-off point, it will not be possible to sync the bars (keep them from rolling). The location of the sync take-off point may differ in different receivers. In some receivers it may come after the second detector, in others it may follow the first video stage. Other receivers may have the take-off point located after the second video stage.

2. Check the coupling capacitor, shown as C3 in Figure 4, by shifting the output cable from the WR-50B from point "1" to point "2". The horizontal bars may become weaker or lighter in shading. If the shadowing becomes extremely light or if the bars disappear, C3 may be defective.

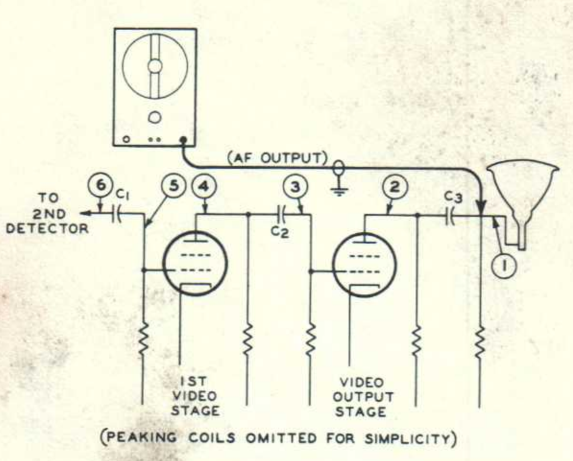


Figure 4. Setup for locating a dead stage in the video amplifier

3. Check the video output stage by applying the full audio output from the WR-50B to the grid circuit, shown as point "3" in Figure 4. The bars should become noticeably darker, indicating that the stage is functioning and providing amplification. If necessary, reduce the audio output from the WR-50B to prevent overloading of the amplifier.

4. Check the coupling capacitor to the output stage by shifting the output cable from point "3" to point "4". The intensity of the bars should remain nearly the same. If the bars become considerably lighter or disappear, C2 may be defective.

5. With the output cable connected to the plate of the first video stage, shown as point "4" in Figure 4, reduce the audio output until the bars on the kinescope become light grey. Shift the output cable to the grid of the first stage, shown as point "5". The bars should become much darker, indicating that the first stage is functioning and providing amplification.

6. Check coupling capacitor C1 by shifting the output cable from point "5" to point "6". The intensity of the bars should remain nearly the same. In direct coupled video amplifiers which do not use coupling capacitors, steps 2, 4, and 6 should be omitted.

Figure 5. Locating a dead stage in the picture-if amplifier.

Adjust the receiver to obtain a normal raster with normal brightness.

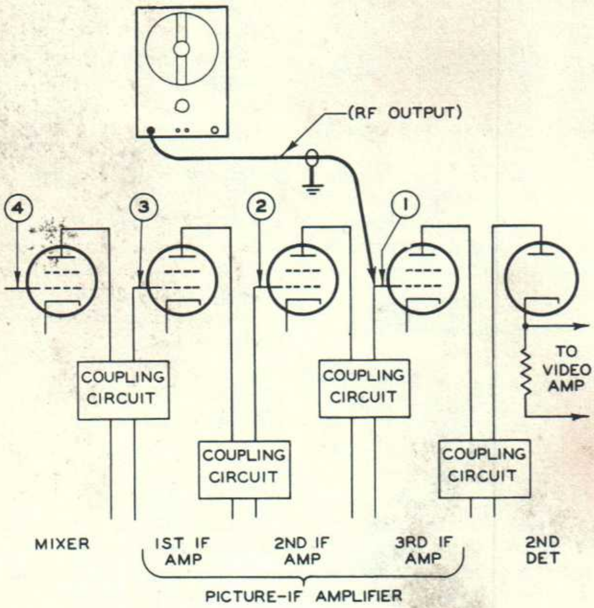


Figure 5. Setup for locating a dead stage in the picture-if amplifier

Set the contrast control to the maximum-contrast position. Tune the receiver to an unused high-frequency channel such as 12 or 13 or temporarily remove the rf-oscillator tube.

Tune the WR-50B to approximately the center of the picture-if pass band. If the frequency is higher than 40 Mc, tune the WR-50B to one half the required frequency; the second harmonic of the generator will supply a signal at the required frequency.

1. Adjust the generator for maximum rf output with modulation applied. Connect the output cable to the grid circuit of the last picture-if amplifier, shown as point "1" in Figure 5. The 400-cycle modulation should produce horizontal bars on the raster. Adjust the vertical-hold control on the receiver to lock the bars stationary on the kinescope screen. Presence of the bars indicates that the last picture-if amplifier and second detector stages are functioning.

2. If the shading of the bars is dark, reduce the rf output level from the WR-50B until the bars appear light grey. Move the output cable to point "2". The bars should become darker, indicating that the second if-amplifier stage is functioning.

3. The remaining stages in the picture-if amplifier should be checked in the same way.

4. If all the picture-if stages are functioning properly, check the mixer stage by applying the rf signal to the grid of the stage, shown as point "4". In some receivers, the rf tuned circuits act as a partial if short across the converter grid. In such cases, it may be necessary to remove the short during the procedure in step 4 by employing one of the following methods:

a. In tuners of the turret type, remove one of the mixer coil strips and turn the turret to the blank position.

b. Using a spare mixer tube, carefully bend out the grid pin for connection to the signal generator. In this step, and sometimes in step "a", it will be necessary to use a resistor of about 10,000 ohms or larger to ground to furnish a dc-return path for the grid current.

Figure 6. Locating a dead rf-amplifier or rf-oscillator stage.

If the previous checks show that the picture-if and video amplifier sections are functioning properly, the rf section should next be checked for trouble.

1. Check to determine whether the rf oscillator is operating by measuring the developed negative grid-bias in the oscillator circuit. It is important that a vacuum-tube voltmeter, such as an RCA VoltOhmyst having an isolating probe, be used for this measurement. The correct value of the bias voltage should be obtained from the service notes for the receiver being tested. The voltage usually ranges from —2 to —6 volts. If the measured voltage is a few tenths of a volt or less, it may be assumed that the rf oscillator is not functioning and the tube, components, and supply voltages in the oscillator circuit should be checked to determine the source of the trouble.

2. If the rf oscillator is functioning properly, the rf amplifier should be checked as follows:

Tune the receiver to channel 2 and tune the WR-50B to approximately 28 Mc with modulation applied. The 28-Mc setting of the WR-50B supplies a second harmonic of 56 Mc, which falls near the center of channel 2. Apply the modulated rf signal to the grid of the mixer tube, shown as point "2" in

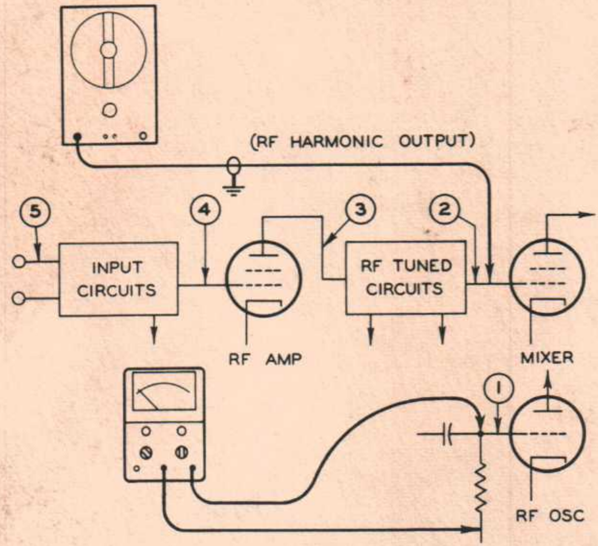


Figure 6. Setup for locating a dead rf-amplifier or rf-oscillator stage

Figure 6. Adjust the rf output from the generator so that the bars are plainly visible on the kinescope screen.

NOTE: On some tuners, usually those which employ a pentode-type mixer, connection of the output cable will not cause serious detuning of the high-impedance circuits. Tuners which employ triode mixers, however, may require that a capacitor of approximately 5 $\mu\mu$f or less be connected in series with the rf lead of the cable to minimize circuit loading. If serious detuning occurs with either type of tuner, however, it may be necessary to experiment with various methods of signal injection to avoid upsetting circuit impedance.

3. Shift the output cable to the plate of the rf amplifier, shown as point "3". The bars may become slightly lighter. If the bars become very faint or disappear, the trouble may lie in the rf tuned circuits between the rf-amplifier plate and the converter grid.

4. With the output cable connected to the plate of the rf amplifier, adjust the rf output from the WR-50B until the bars are light grey. Shift the output cable to the grid of the rf amplifier, shown as point "4". The bars should become darker, indicating that the rf amplifier is functioning.

5. Shift the output cable to the antenna input terminal of the receiver, shown as point "5". The intensity of the bars should remain approximately the same as in step 4 above. If the bars become very faint or disappear,

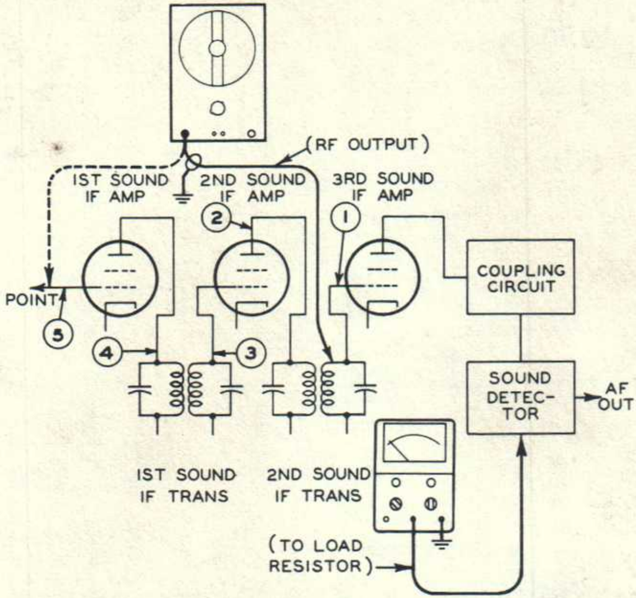


Figure 7. Method for localizing a dead stage in the sound-if amplifier

circuits ahead of the rf amplifier should be checked for trouble.

These methods for localizing trouble in the tuner have certain limitations. For thorough and accurate trouble-shooting work on tuners, standard sweep-alignment equipment should be used. An RCA WR-69A Television Sweep Generator, and RCA WR-99A Crystal-Calibrated Marker Generator, and the RCA WO-33A or WO-91A Oscilloscopes are recommended.

Figure 7. Localizing a dead stage in the sound-if amplifier.

If the picture is normal but sound is out on all channels, the trouble will probably be found in the sound circuits following the sound-if take-off circuit. The location of the sound-if take-off circuit will differ with different receivers; it may follow the converter stage or one of the picture-if amplifiers. It may also come after the second detector or one of the video amplifiers.

1. Check the audio section of the receiver to determine whether it is functioning, as described in Figure 14.

2. If the audio section is functioning properly, the FM sound detector should be checked next. In either the ratio or discriminator type detectors, the VoltOhmyst should be set up to use the zero-center scale and connected across the output load resistor of the detector.

3. The rf output cable should be connected from the WR-50B to the grid of the last sound-if stage, shown as point "1" in Figure 7, and the generator tuned to the center frequency of the sound-if amplifier.

4. Check the alignment of the sound detector by tuning the WR-50B back and forth through the sound-if setting. If the detector is aligned and functioning, the meter pointer of the VoltOhmyst should swing above and below center scale as the WR-50B is tuned. If the last if stage or the detector is defective, however, performance may be impaired.

5. Set up the VoltOhmyst to measure dc volts and connect the instrument to the grid of the last sound-if amplifier stage, shown as point "1" in Figure 7. The grid circuit usually employs a grid resistor of about 50,000 ohms. Under normal conditions, grid current flows in this stage when a sound-if signal is applied and produces a negative dc voltage across the resistor. The voltage may range from —1.0 volt on weak signals to —30 volts or more on strong signals. With no signal input, there is normally a small negative voltage of several tenths of a volt across the resistor because of contact potential in the tube. The effect of contact potential is explained briefly in Figure 20.

Tune the WR-50B to the center frequency of the sound-if amplifier, Apply full-signal output, without modulation, to the input of the sound-if amplifier as shown in Figure 7. Tune the generator for a maximum reading on the VoltOhmyst. If no reading is obtained, check the sound-if amplifier for trouble by connecting the rf output cable to the plate of the next-to-last if amplifier, shown as point "2", and working forward through points 3, 4, and 5.

Figure 8. Localizing intermittent picture trouble in cases where the raster is not affected. Tune the television receiver to an unoccupied channel in the high end of the band or remove the mixer tube. Tune the WR-50B to approximately the center of the picture-if pass band. If the required frequency is higher than 40 Mc, tune the generator to one-half the required frequency. Apply the generator signal, with modulation, to the input of the picture-if amplifier. Adjust the generator output and the receiver contrast control so that the 400-cycle modulation is plainly evident as horizontal bars on the raster.

Set the VoltOhmyst to a low dc-voltage range and connect the meter across the second-detector load resistor. The VoltOhmyst should indicate several volts of rectified signal.

Allow the equipment to operate until the intermittent trouble occurs. If the horizontal bars on the kinescope disappear but the meter continues to indicate approximately the same voltage drop across the second-detector load resistor, the trouble is in the video section or in the kinescope. If the bars disappear and the meter reading changes to a low value, the trouble is in the picture-if amplifier or in the second detector. If the intermittent condition does not occur, the trouble is probably in the rf section. The trouble may be localized to a particular stage in the suspected section by following the general methods outlined in Figures 4, 5, and 6. Intermittent troubles may be classified in four groups as follows:

a. Intermittent trouble caused by voltage breakdown. Insulation in a capacitor or other component may break down intermittently and cause a short circuit. The occurrence of this type

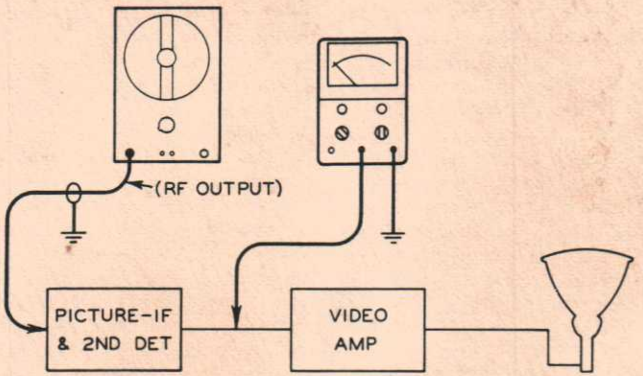


Figure 8. Method for localizing intermittent picture trouble

of trouble can usually be accelerated for service purposes by operating the receiver at higher-than-normal line voltage, such as 125 volts. The RCA TV Isotap, a combination isolation and adjustable-voltage transformer, is extremely useful for this purpose.

b. Intermittent trouble caused by mechanical expansion and contraction due to temperature changes. Connections inside tubes, capacitors, resistors, transformers, and other components may open up or become shorted as a result of expansion and contraction due to temperature changes as the receiver warms up or cools off with application and removal of power. The occurrence of such trouble can often be speeded up by heating the components in the suspected section. An ordinary electric lamp or an infrared lamp may be used.

c. Intermittent contacts. If the intermittent trouble, occurs when the chassis is tapped, shaken, or twisted slightly, the trouble is probably due to an intermittent contact, such as (1) an unsoldered joint, (2) a cold-soldered joint, (3) a stray strand of wire, (4) a stray lump of solder, or (5) a bare wire too close to another bare wire, or too close to a bare contact, etc. This type of trouble is usually located by tapping, pushing, or pulling gently on connections and components in the suspected section of the receiver.

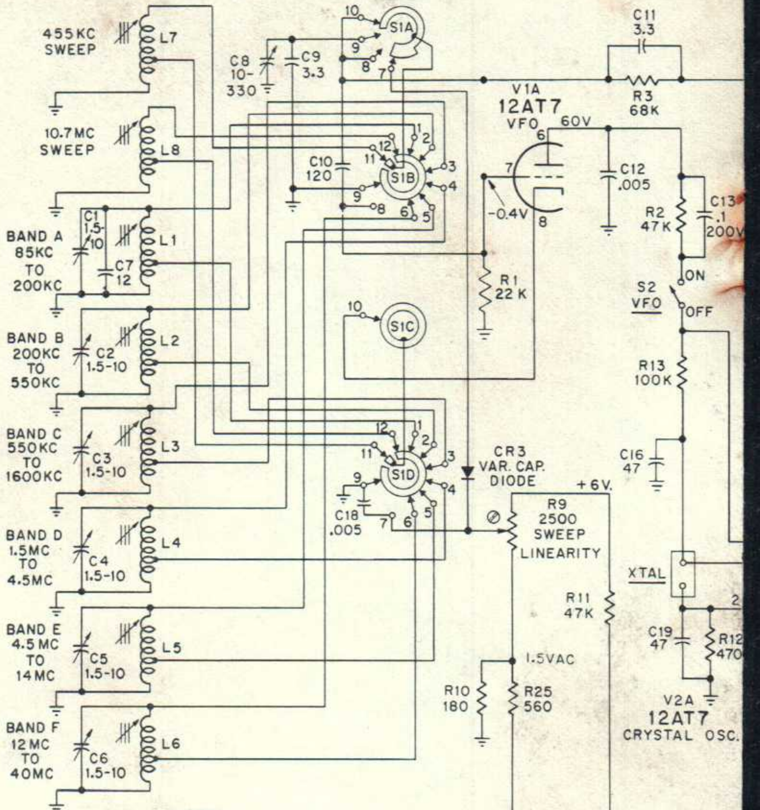
d. Intermittent rf oscillator action due to low line voltage. The rf oscillator may have a tendency to stop oscillating when the line voltage is lower than normal. When the rf oscillator stops working, both the sound and picture will be absent. The oscillator may function when the receiver is first turned on and then stop when the receiver is tuned to a different frequency. A weak or faulty oscillator or power rectifier, or dirty tuner contacts contribute to the condition. In cases where there is reason to suspect this trouble, it is advisable to check receiver operation at a line voltage which

continued on page 22

Replacement Parts List

When ordering replacement parts, include model and serial number of instrument. Parts should be ordered through a local RCA electronic instruments distributor.

Symbol No.	Description	Stock No.
	Capacitors	
C-1, C-6	Trimmer, 1.5-10 pf	219975
C-7	Ceramic, 12 pf, 10%, 500 V	235386
C-8	Variable, 10-330 pf	226326
C-9, C-11	Ceramic, 3.3 pf, 20%, 500 V	235385
C-10	Mica, 120 pf, 20%, 500 V	59481
C-12, C-14, C-18, C-24	Ceramic, .005 μf, GMV, 500 V	73473
C-13	Paper, 0.1 μf, 200 V	228040
C-15, C-27	Ceramic, .001 pf, GMV, 500 V	77252
C-16, C-19	Ceramic, 47 pf, 20%, 500 V	227754
C-17	Paper, .033 μf, 400 V	227885
C-20, C-21	Ceramic, .01 μf, 20%, GMV, 500 V	73960
C-22	Paper, 0.1 μf, 400 V	227530
C-23	Electrolytic, 40/40 μf, 150 V	226327
C-25	Paper, 0.1 μf, 100 V	228040
C-26	Paper, .047 μf, 400 V	227754
	Resistors	
R-1	22 K, 10%, ½ watt	502322
R-2, R-11	47 K, 10%, ½ watt	502347
R-3	68 K, 10%, ½ watt	502368
R-4	120 K, 10%, ½ watt	502412
R-5, R-15	330 ohms, 10%, ½ watt	502133
R-6	33 ohms, 10%, ½ watt	502033
R-7	100 ohms, 10%, ½ watt	502110
R-8	Variable, 500 ohms	226433
R-9	Variable, wire wound, 2500 ohms	235384
R-10	180 ohms, 10%, ½ watt	502118
R-12	470 K, 10%, ½ watt	502447
R-13, R-21	100 K, 10%, ½ watt	502410
R-14	2700 ohms, 10%, ½ watt	502227
R-16, R-17	1.5 meg, 10%, ½ watt	502515
R-18	390 ohms, 10%, ½ watt	502139
R-19	180 K, 10%, ½ watt	502418
R-20	Variable, 15 K, w/switch S-6	235378
R-22	1000 ohms, 10%, 1 watt	512210
R-23	6800 ohms, 10%, ½ watt	502268
R-24	2200 ohms, 10%, ½ watt	502222
R-25	560 ohms, 10%, ½ watt	502156
	Coils	
L-1	85-200 kc	226378
L-2	200-550 kc	226329
L-3	550-1700 kc	226330
L-4	1.5-4.5 mc	226331
L-5	4.2-14 mc	226332
L-6	12-40 mc	226333
L-7	550 kc	226329
L-8	10.7 mc	235387
	Miscellaneous	
CR-1	Diode, type IN3756	235382
CR-2	Diode, type IN3754	229040
CR-3	Diode, varactor	235383
S-1	Switch, range	235380
S-2	Switch, slide, SPDT	101247
S-3, S-4	Switch, slide, SPDT	235381
S-5	Switch, slide, DPDT	227560
S-6	Part of R-20	—
T-1	Power transformer	98192
T-1 V1	Power transformer for V1 units (240 V)	246333
T-2	Audio transformer	226325
	Case assembly	235379
	Connector, MOD IN/OUT	232121
	Handle	226241
	Knob, pointer	212148
	Knob, black rubber	94878
	Knob, w/set screw	226689
	Pilot light	229727
	Indicator assembly	227583
	Crystal socket	56262
	Shell, for probe (2 pieces)	219485



NOTES:

VOLTAGES MEASURED WITH AN RCA VOLTOHMYST® WITH CONTROLS SET AS FOLLOWS:

RANGE SW. (S1)-BAND F	% MOD — MAX. CW
FREQUENCY — 12MC	RF ATTEN.-MAX. CW
RF — HI	NO XTAL IN SOCKET
MOD — IN	
VFO — ON	

VOLTAGES MAY VARY ±20% FROM VALUES SHOWN

TRADE MARK ® REGISTERED
MARCA(S) REGISTRADA(S)

⊘ DENOTES SCREW DRIVER ADJUSTMENTS.

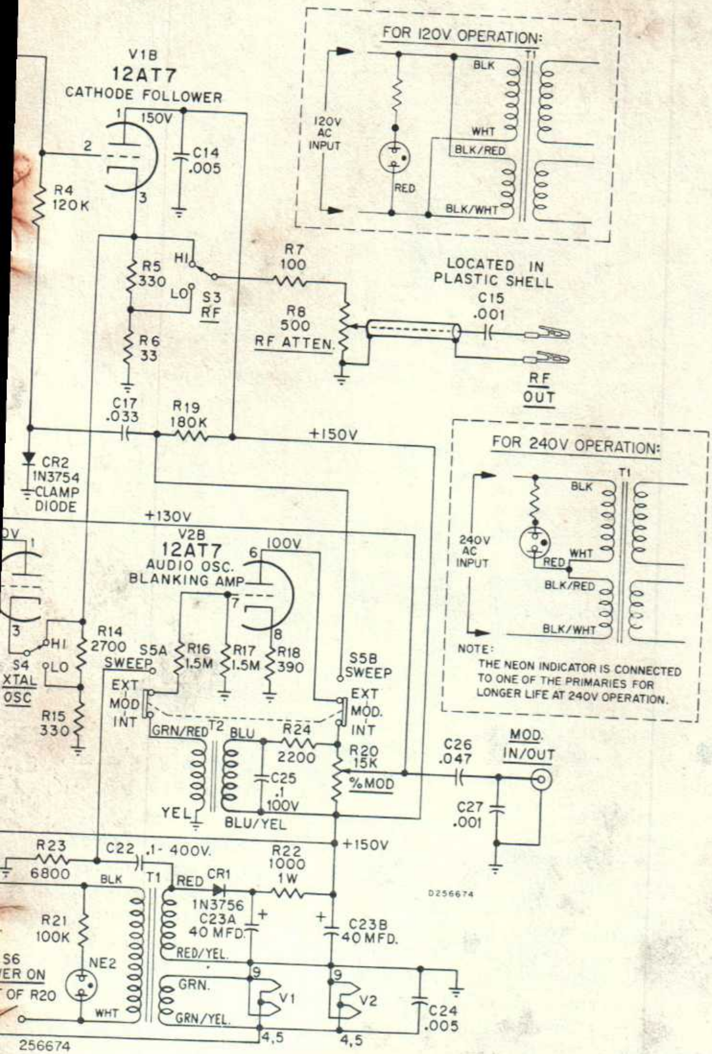
ALL SWITCHES SHOWN IN MAX CCW POSITION AND VIEWED FROM FRONT.

ALL RESISTORS IN OHMS AND ARE 1/2 WATT UNLESS OTHERWISE NOTED.

⏚ DENOTES CHASSIS CONNECTION.

* 3 WIRE LINE CORD USED IN SOME UNITS.

UNITS DESIGNATED "WR-50B VI," HAVE POWER TRANSFORMER THAT CAN BE WIRED FOR 120V OR 240V OPERATIO


FOR 120V OPERATION:
120V AC INPUT
RED
BLK
WHT
BLK/RED
BLK/WHT
T1
V1B
12AT7
CATHODE FOLLOWER
150V
C14 .005
R4 120K
R5 330
HI
LO
S3 RF
R6 33
R7 100
R8 500 RF ATTEN.
LOCATED IN PLASTIC SHELL
C15 .001
RF OUT
C17 .033
R19 180K
+150V
CR2 1N3754 CLAMP DIODE
FOR 240V OPERATION:
240V AC INPUT
NOTE:
THE NEON INDICATOR IS CONNECTED TO ONE OF THE PRIMARIES FOR LONGER LIFE AT 240V OPERATION.
+130V
V2B
12AT7
AUDIO OSC. BLANKING AMP.
100V
R14 2700
S4 XTAL OSC
R15 330
S5A SWEEP
EXT MOD INT
R16 1.5M
R17 1.5M
R18 390
S5B SWEEP
GRN/RED
T2
BLU
R24 2200
R20 15K %MOD
C25 .1 100V
YEL
BLU/YEL
C26 .047
MOD. IN/OUT
C27 .001
R23 6800
C22 .1- 400V.
R22 1000 1W
CR1 1N3756
C23A 40 MFD.
C23B 40 MFD.
RED/YEL.
R21 100K
NE2
S6
WER ON
OF R20
GRN.
GRN/YEL.
V1
V2
C24 .005
D256674
256674

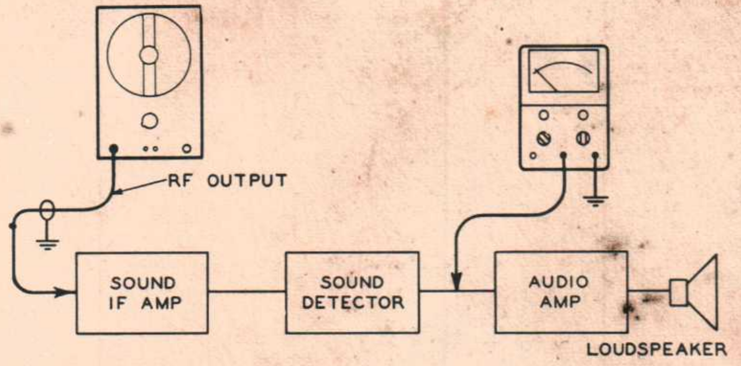


Figure 9. Method for localizing intermittent sound trouble

is slightly less than the lowest voltage encountered in that particular location. THE RCA WP-25A TV Isotap is extremely useful in detecting this intermittent trouble.

Figure 9. Localizing intermittent sound trouble. If the picture is normal but the sound is intermittently dead, the trouble is probably in the sound-if or audio section. In receivers having a separate sound channel, a shift in the frequency of the rf oscillator can produce somewhat similar symptoms.

With the VoltOhmyst set to the 50-volt dc range, connect the instrument to the output of the sound-if detector. Connect the rf output cable of the WR-50B with modulation applied, to the input of the sound-if amplifier. Tune the WR-50B slightly above or below the correct frequency for greatest positive or negative indication on the VoltOhmyst. Advance the receiver volume control and reduce the output from the generator to bring the if signal slightly below limiting level. Readjust the volume control for the desired sound level.

Allow the equipment to operate until the intermittent trouble shows up. Occurrence of the trouble can often be speeded up as described in the text for Figure 8. If the sound disappears but the meter reading remains approximately the same, the trouble must be in the audio section. If the meter reading drops to a low value, the trouble is in the sound-if amplifier or detector.

The trouble may be localized to a particular stage by applying the general method described in Figures 7 and 14. These methods may also be used to localize intermittent troubles in FM radio receivers.

Figure 10. Checking approximate stage gain in a video or audio amplifier. Remove or disable one of the if tubes so that external signals cannot reach the video or audio amplifier. Set up the VoltOhmyst to measure ac voltage. Set up the WR-50B to deliver audio output. If the video amplifier has a contrast control, set the control for maximum gain.

1. Connect the rf output cable of the signal generator to the grid of the output tube, shown as point "1". Connect

the VoltOhmyst to the same point. Adjust the generator to produce 1.0 rms volt of signal at the grid. Shift the VoltOhmyst to the plate and measure the audio signal voltage at the plate. The approximate voltage gain is equal to the numerical value of the signal voltage at the plate. For example, with 1.0 volt of signal at the grid and 15 volts of signal at the plate, the approximate gain is equal to $\frac{15}{1}$ or 15.

In ac/dc radio receivers and in some small ac receivers, considerable hum voltage, up to 10 or 15 volts, may be present at the plate of the output tube. To minimize error due to the hum voltage, it is necessary to measure the hum voltage separately at the plate and subtract the hum voltage from the previous reading. The hum voltage should be measured without application of an audio signal. When checking the gain of an audio-output stage, it is essential to have the speaker connected to the output transformer because the gain of the output stage without a load is much higher than normal.

2. The gain of the first stage should be measured in the same manner.

Figure 11. Checking approximate stage gain in a picture-if amplifier. The agc circuit should first be rendered inoperative as described in Figure 12. Set up the VoltOhmyst to measure dc voltage and connect the VoltOhmyst across the second-detector load resistor.

1. Connect the rf output cable of the WR-50B to the grid of the last picture-if tube, shown as point "1" in Figure 11. Tune the WR-50B to a frequency in the picture-if pass band for maximum indication on the meter. Adjust the output (without modulation) to produce 0.5 volt across the load resistor.

2. Shift the output cable to the grid of the next-to-last if amplifier, shown as point "2". The meter reading should change by a factor equal to the gain of the next-to-last stage. For example, if the meter reading increases from 0.5 volt to 2.5 volts, the approximate gain is equal to $\frac{2.5}{0.5} = 5$.

After determining the gain, and with the generator output cable connected as in step 2, reduce the output to produce 0.5 volt across the load resistor.

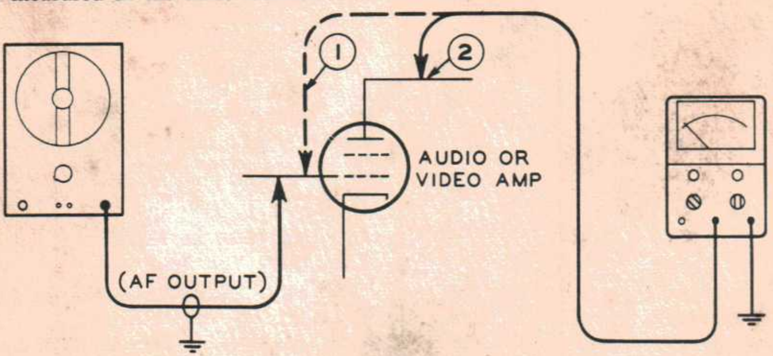


Figure 10. Setup for making approximate stage gain check in video or audio amplifier

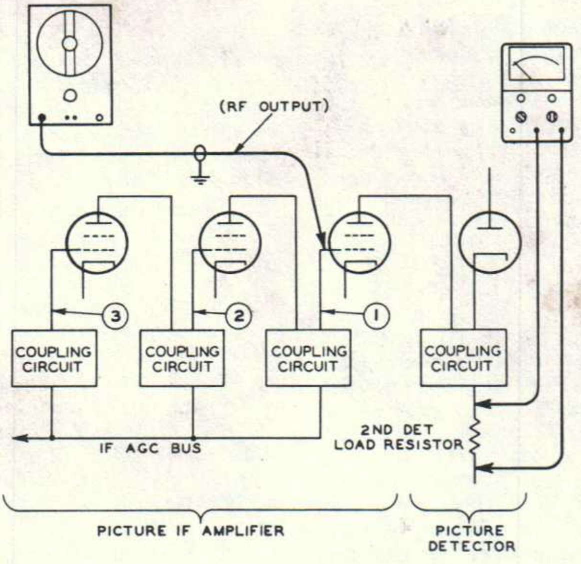


Figure 11. Setup for making approximate stage gain check in picture-if amplifier

3. Shift the output cable to the grid of the second-from-last stage. The meter reading should change by a factor equal to the gain of the stage.

Check any remaining stages in the same manner.

Figure 12. Eliminating AGC action when checking gain in rf and if amplifiers.

The procedure for locating a dead or exceedingly weak stage has been shown above. In cases where the receiver is not dead but performance is definitely weak, the WR-50B can be used to locate the faulty stage by measuring the approximate gain of each stage.

To measure rf and if gain in receivers employing agc, it is almost a necessity to eliminate agc action by applying a fixed bias voltage to the rf and if amplifiers. The RCA WG-307-B TV Bias Supply is ideally suited to this purpose. If the manufacturer describes a method in his service notes, his method should be followed. A typical method, however, is shown in Figure 12. For gain measurements, the rf and if amplifiers should be operated at nearly maximum gain by using a low bias voltage. A bias of —1.5 volts is generally satisfactory. In high-gain amplifiers or in noisy locations, it may be necessary to lower the gain by using a bias of —3 volts.

Applications in Radio Servicing

Figure 13. Locating a dead section in an AM broadcast receiver.

1. Check the audio section of the receiver by applying approximately

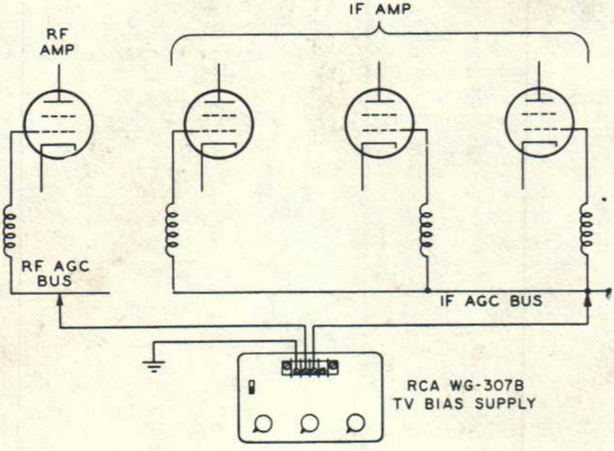


Figure 12. Use of fixed bias in agc circuit

0.1 volt audio signal to the input of the audio amplifier, as shown in Figure 13. Turn the volume control on the receiver to maximum-volume position. If a loud 400-cycle tone is heard, the audio section is functioning. If there is no sound, or if only a weak sound signal is heard, a stage-by-stage check of the audio section should be made as described in Figure 14.

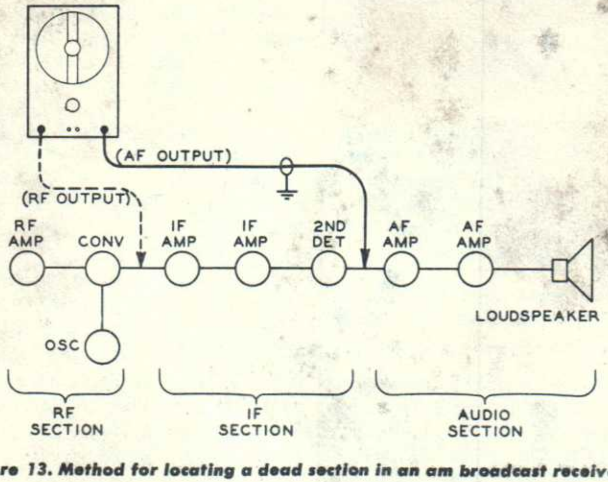


Figure 13. Method for locating a dead section in an am broadcast receiver

2. If the audio section is functioning, the if section should be checked by applying an if signal of very low level with modulation to the input of the if amplifier, as shown in Figure 13. Tune the WR-50B to the if of the receiver, which is 455 Kc in most cases. If a loud 400-cycle tone is heard, it indicates that the if section is funtioning. If no signal is heard, or if the sound is weak, a stage-by-stage check of the if amplifier should be made as described under Figure 15.

3. If both the audio and if sections of the receiver are functioning, it may be assumed that the difficulty is in the rf section, which should be checked as shown in Figure 17.

Figure 14. Locating a dead stage in the audio amplifier of a radio or television receiver.

1. Check the speaker and output transformer by applying the full audio-output signal of the WR-50B to the primary of the output transformer, shown as point "1". If a 400-cycle sound signal is heard, it indicates that the speaker and transformer are functioning.

2. Check the audio-output stage of the receiver by applying almost the full audio output of the generator to the grid of the output tube, point "2". If a loud 400-cycle tone is produced, the output stage is functioning.

For the following steps, the volume control should be set to the maximum-volume position.

3. Check the coupling capacitor, shown as C3 in Figure 14, by shifting the output cable from the generator from point "2" to point "3" The sound level should remain approximately unchanged. If the sound level changes, the capacitor may be open or otherwise defective.

4. Check the first audio stage. With the output cable connected to the plate of the first audio tube, reduce the audio signal level so that the 400-cycle sound is weak. Shift the generator output cable to the grid of the first audio tube, point "4". The sound should be greatly increased, indicating that the first stage is functioning.

5. Check coupling capacitor C2 by shifting the generator output cable from point "4" to point "5". The sound level should remain approximately the same. Otherwise, C2 is defective.

6. Check the volume control by applying about 0.1 volt of audio signal across the control. Turn the control through its complete range and observe whether it provides smooth, noiseless attenuation. Noise may be caused by a defective volume control or by dc leakage in either of the blocking capacitors.

7. Check the input coupling capacitor C1 by shifting the generator lead from point "6" to point "7". The sound level should remain practically unchanged.

Figure 15. Locating a dead stage in the if amplifier of an AM broadcast receiver. If the audio section is functioning, the if amplifier should be checked. The receiver volume control should be set to the maximum-volume position and the WR-50B should be tuned to the intermediate frequency used in the receiver.

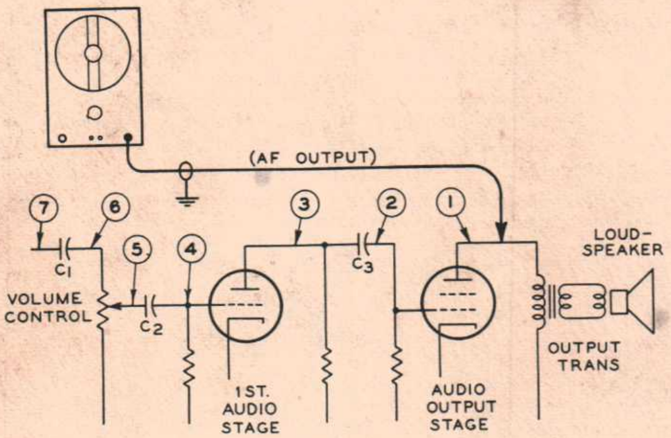


Figure 14. Method for locating a dead stage in the audio amplifier of a radio or television receiver

1. Apply an if signal, of very low level with modulation, to the grid circuit of the second-if amplifier, shown as point "1". Retune the generator for peak sound output. If a loud 400-cycle sound is produced, it indicates that the second-if amplifier is functioning. If there is no sound or if the sound is weak, the trouble may lie in the second-if amplifier or second-detector circuits.

2. Check the first-if amplifier in the same manner by feeding the signal in at point "2".

3. If both stages are operating properly, check the converter stage by shifting the output cable to the grid of the converter tube, point "3". If a loud 400-cycle sound is produced, it indicates that the converter is functioning. If there is no sound, or if the sound is weak, the trouble may lie in the converter or in the first if transformer.

In some receivers the rf tuned circuits may form a partial if short across the converter grid circuit. In these cases, it is necessary in step 3 to connect a resistor of 10,000 ohms or more between the converter grid and the rf tuned circuit. Remove the resistor after completing step 3.

Figure 16. Checking if transformers and if-coupling capacitors.

A stage-by-stage method for locating a dead if-amplifier stage is shown in Figure 16 Each stage includes a tube and a coupling transformer. When a dead stage is discovered, it is necessary to determine whether the trouble is in the coupling transformer or in other components associated with the tube.

A rough check of the condition of the coupling transformers can be made by connecting a low-value capacitor of about 5 $\mu\mu$f in series with the generator output lead. Capacitor leads should be kept short. The purpose of the capacitor is to reduce detuning

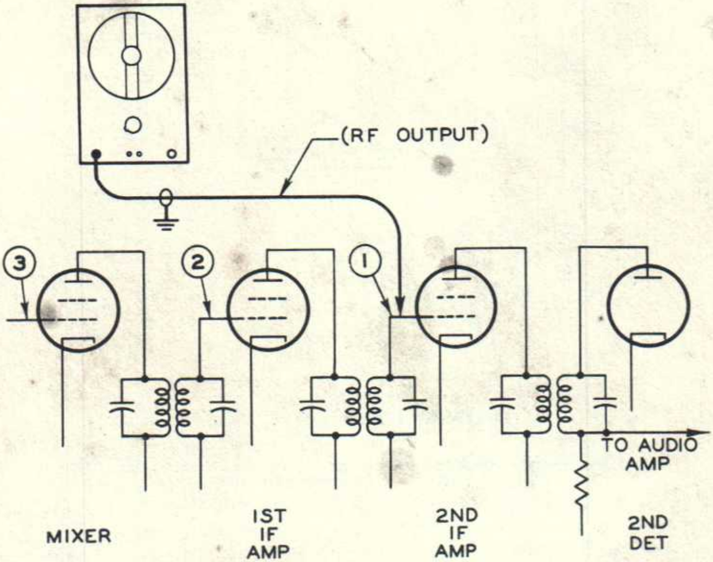


Figure 15. Method for locating a dead stage in the if amplifier of an am broadcast receiver

effects which might result from capacitive and resistive loading caused by the generator.

1. Apply the if signal, with amplitude modulation, to the grid circuit as shown in Figure 16. Note the intensity of the 400-cycle signal.

2. Shift the generator lead and the series capacitor to the plate circuit, point "2". The intensity of the 400-cycle sound signal may be somewhat less than that in step 1. If sound output is greatly reduced or drops to zero, the transformer may be defective or may require alignment.

This same check method may be used to locate open coupling capacitors.

Figure 17. Locating a dead rf stage or dead rf oscillator in an AM broadcast receiver.

1. Check the rf oscillator by measuring the developed negative grid-bias voltage, as described in step 1 of Figure 6. In AM broadcast receivers, this voltage normally ranges from about —5 to —15 volts.

If the rf oscillator is working, check the rf amplifier as follows:

2. Tune the WR-50B to about 600 Kc. Adjust the generator for low output with amplitude modulation. Connect a capacitor of about 5 $\mu\mu$f in series with the generator rf output lead; keep the capacitor leads short.

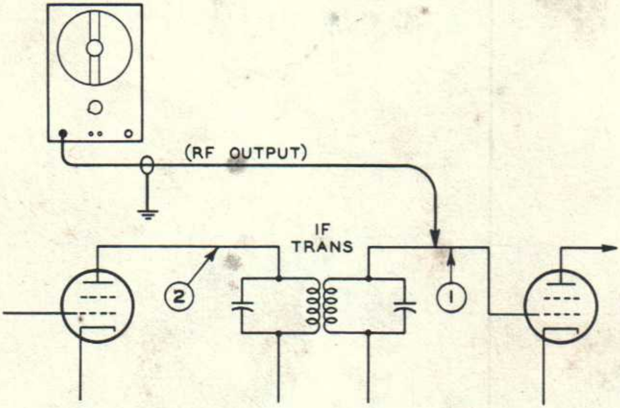


Figure 16. Method for checking if transformers and if-coupling capacitors

Connect the generator to the signal grid of the mixer tube, point "1", as shown. Tune the receiver for peak intensity of the 400-cycle sound. Adjust the receiver volume control for a comfortable sound level.

3. Apply the same modulated 600-Kc signal to the plate of the rf tube, point "2". If the 400-cycle sound becomes considerably weaker or disappears, look for trouble in the coupling circuit between the rf amplifier and the converter.

4. Check the rf amplifier by applying the modulated 600-Kc signal to the amplifier grid, point "3". Retune the receiver slightly, if necessary, for maximum sound output. The output may increase slightly when the generator is moved from the plate to the grid of the rf amplifier. If the sound becomes considerably weaker or disappears, look for trouble in the rf-amplifier circuit.

5. Check the antenna input coil by applying the 600-Kc signal to the antennt input terminal, point "4". The sound output may increase or decrease slightly, depending on the design of the antenna coil. If the sound becomes considerably weaker, or disappears, it indicates trouble in the antenna coil.

Figure 18. Avoiding hum and shocks when checking AC/DC receivers.

To avoid introduction of hum when working on ac/dc receivers, it is usually necessary to connect the generator ground cable to the common negative bus in the receiver, NOT to the receiver chassis. To prevent the case of the generator from becoming "hot" with respect to ground when the generator is connected to the common negative bus, it is necessary either to use a capacitor of about 0.05 μf, 600 volts rating in series with the generator ground lead or, preferably, to use an isolation transformer, as shown in Figure 18. The RCA WP-25A TV Isotap is well suited to this application. The Isotap may be used to isolate small ac/dc radio receivers and transformerless television receivers

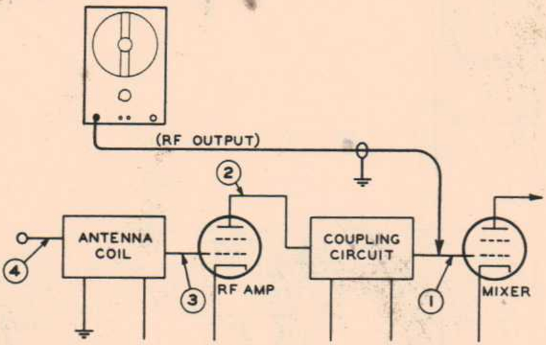


Figure 17. Method for locating a dead rf or oscillator stage in an am broadcast receiver

from the power line and other equipment on the service bench.

Figure 19. Checking the gain of an if amplifier in an AM broadcast receiver.

Eliminate the agc action, as described in Figure 12. Set up a VoltOhmyst to measure dc voltage. Connect the VoltOhmyst across the second-detector load resistor, point "1" in Figure 19. Connect the output cable of the WR-50B to the grid of the first if amplifier tube, point "2". Tune the generator for peak indication on the meter.

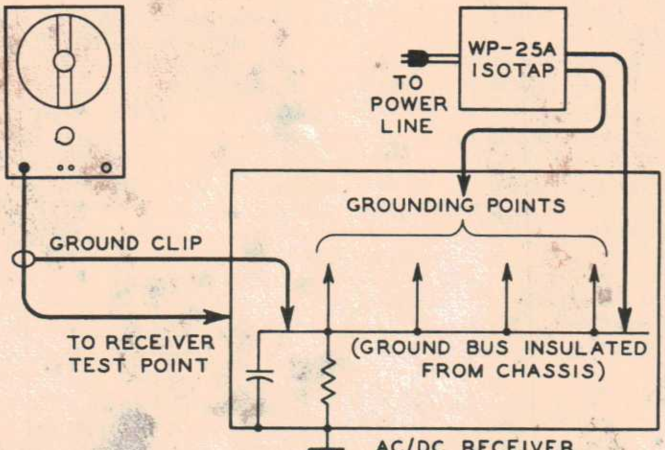


Figure 18. Use of isolation transformer in servicing of ac/dc receivers

1. Tune the WR-50B to the receiver if and adjust the output, without modulation, to produce 10 volts across the second-detector load resistor.

2. Disconnect the VoltOhmyst from the load resistor. Connect a crystal probe to the VoltOhmyst and measure the generator output voltage at the grid of the if amplifier. The approximate voltage gain is equal to:

$$\frac{\text{Signal voltage at 2nd-detector load resistor}}{\text{Signal voltage at if grid}}$$

For example, if the signal voltage at the grid is 0.1 volt, and the signal voltage at the second-detector load resistor is 10 volts, the approximate gain equals: $\frac{10}{0.1}$ or 100.

For possible correction due to contact potential, refer to Figure 20.

Figure 20. Correcting for the effect of contact potential.

When making if gain checks, if the second detector of the receiver is a vacuum-tube diode, it may be necessary to correct readings for the effect of contact potential. The effect of contact potential within the tube is to produce a dc voltage across the detector load resistor. This voltage usually ranges from about 0.1 volt across a video load resistor of a few thousand ohms, to about 0.5 volt across an audio load resistor of about 100,000 ohms.

In gain checks which deal with a relatively weak signal at the second

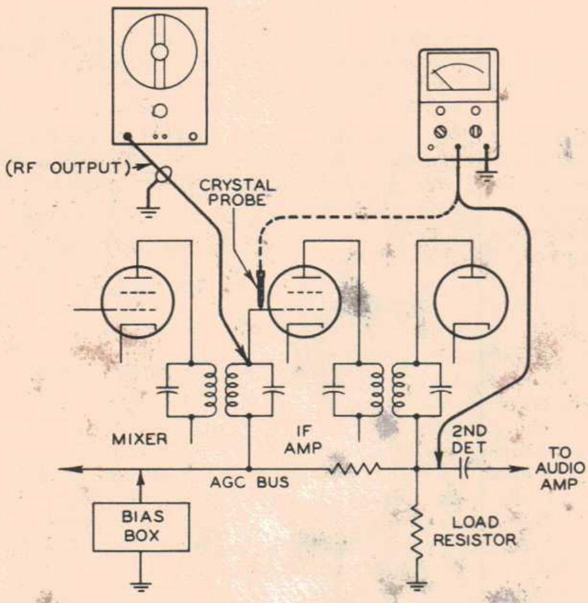


Figure 19. Method for checking if amplifier gain in an am broadcast receiver

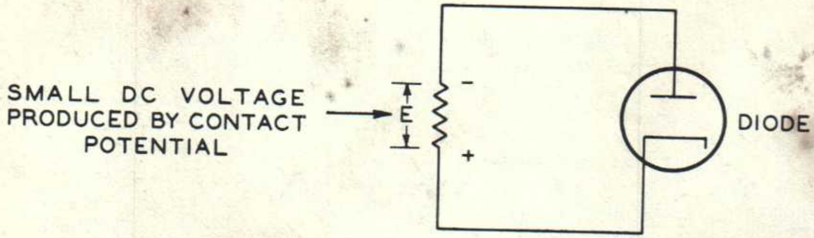


Figure 20. Voltage produced by effect of contact potential

detector, it is advisable to correct for contact potential. This may be done as follows:

1. Kill any input signal to the second detector by removing or disabling an if tube if necessary.

2. Measure the dc voltage across the load resistor with a VoltOhmyst. This voltage is the result of contact potential.

3. Subtract the contact-potential voltage from all subsequent measurements of voltage across the load resistor.

Suppose, for example, that the voltage across the load resistor, without input signal, is 0.1 volt. Assume, also, that when the desired signal is applied, the voltage across the load resistor is 0.5 volt. The actual voltage produced by the signal in this example is 0.5 volt minus 0.1 volt, or 0.4 volt.

The effect of contact potential is also evident in some limiter and amplifier stages, such as the last sound-if amplifier in many television receivers which operate without fixed grid bias and without cathode bias. The grid and cathode in these cases may be regarded as a diode section, and the grid resistor as the diode load. With no input signal, a small dc voltage will be produced across the grid resistor as a result of contact potential in the tube.

Figures 21 and 22. Aligning AM and FM broadcast receivers.

It is important that manufacturers recommendations given in the service notes be followed closely in aligning radio receivers.

Some receivers use over-coupled if transformers which ordinarily require a sweep generator for alignment. It is possible to use the peak alignment system described below if the degree of coupling is reduced by use of a shunt resistor across the windings. For over-coupled stages, a resistor of about 1000 ohms or less should be connected across the transformer winding opposite the winding being tuned.

Alignment of AM receivers

1. Set up the VoltOhmyst to measure dc voltage and connect it across the load resistor of the second detector, shown as point "1" in Figure 21.

2. Disable the avc circuit of the receiver. If necessary, use fixed bias as described in Figure 12. Set the radio dial to a quiet point near 1600 Kc.

3. Connect the rf output cable of the generator to the grid of the last if stage, shown as point "2" in Figure 21, and tune the WR-50B to the intermediate frequency of the receiver (usually 455 kc). Apply modulation and use only enough output to produce a usable meter reading.

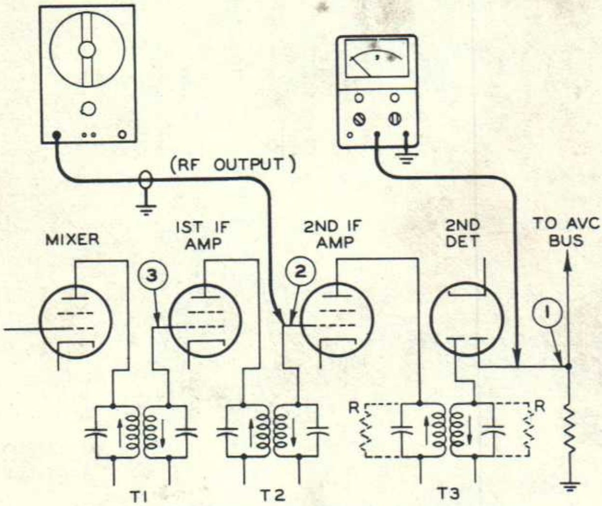


Figure 21. Setup for aligning am broadcast receivers

4. With a suitable alignment tool, adjust the secondary if T3 for peak indication on the VoltOhmyst. Then adjust the T3 primary for peak reading.

5. Move the rf output cable to point "3" and adjust the T2 secondary and primary respectively, for peak reading of the VoltOhmyst.

6. Move the rf output cable to the grid of the mixer and adjust T1 secondary and primary for peak reading on the VoltOhmyst.

Alignment of the receiver oscillator should be made after the if amplifier section is aligned. In am broadcast receivers, the oscillator may be aligned as follows:

1. Set up the VoltOhmyst to measure dc voltage and connect it across the load resistor of the second detector.

2. With the receiver antenna connected and placed in approximately the same position it will occupy when installed in the receiver cabinet, lay the output cable of the generator near enough to the antenna so a low level radiated signal will be picked up.

3. Tune the receiver to its highest frequency, approximately 1600 Kc for most types, and set the generator to this same frequency. With an insulated screw driver, adjust the trimmer capacitor on the receiver oscillator for maximum reading on the VoltOhmyst.

4. Return the generator and receiver to approximately 1400 kc. Adjust the antenna trimmer for peak indication on the meter.

5. Retune the receiver and the generator to 600 Kc, rock the tuning gang slightly, and adjust the oscillator coil for maximum reading on the meter.

Alignment of FM receivers — Refer to Figure 22.

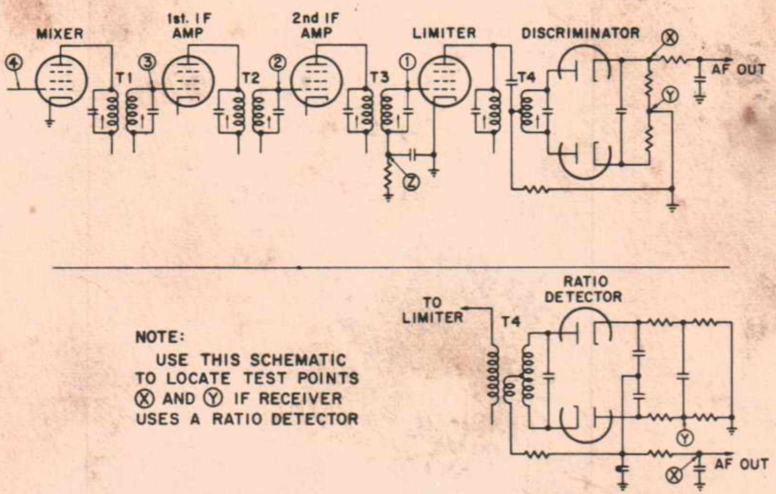


Figure 22. Setup for aligning fm broadcast receivers

1. Set the VoltOhmyst to measure DC voltage, with the meter pointer at the "Zero-Center" mark on the meter. (Use the "Zero" control to center the pointer.) Connect the VoltOhmyst from point "X" to ground.

2. Connect the WR-50B rf cable between the grid of the limiter tube and ground. Set the MOD switch to "OFF", the RF switch to "HI", and the RF ATTEN control fully clockwise. Tune the WR-50B frequency to 10.7 Mc. DO NOT CHANGE THIS FREQUENCY SETTING DURING THE ALIGNMENT PROCEDURE.

3. Adjust the primary winding of T-4 for peak indication on the meter.

4. Connect the VoltOhmyst probe to point "Y". Adjust the secondary winding of T-4 for zero output (Zero-center mark on VoltOhmyst meter). Note that the meter pointer can be made to swing from + to — during this adjustment.

5. Repeat steps 3 and 4.

6. Switch the VoltOhmyst to measure —DC. Adjust the zero control to return the meter pointer to the normal left-hand "0" on the scale. Connect the VoltOhmyst probe to point "Z".

7. Connect the WR-50B rf cable between point 2", the grid of the 2nd if tube, and ground.

8. Adjust both the primary and secondary of T-3 for peak indication on the VoltOhmyst. Note the final voltage indication at this point.

9. Connect the WR-50B rf cable between point 3", the grid of the 1st if tube, and ground. Adjust the RF ATTEN control of the WR-50B so that the VoltOhmyst indicates approximately the same voltage as noted after step 8 was completed.

10. Adjust both the primary and secondary of T-2 for peak indication on the VoltOhmyst.

11. Connect the rf cable of the WR-50B between point "4", the signal grid of the mixer or converter tube, and ground. Again, adjust the RF ATTEN control of the generator so that the VoltOhmyst indicates the voltage noted in steps 8 and 9.

12. Adjust the primary and secondary of T-1 for peak indication on the VoltOhmyst.

RF Alignment

Because of the various types of tuners used in FM sets, it is recommended that only the RF alignment procedure given by the receiver manufacturer be followed. In most cases the WR-50B can be used as a signal source in the 88-108 Mc region by utilizing the 4th harmonic output of the generator at frequencies 22-27 Mc.

Adjustment of the WR-50B to 22 Mc will generally provide more than enough output at the 88 Mc harmonic for calibration at the low end of RF tuner circuits. Adjustment to 27 Mc will provide an adequate signal for 108 Mc alignment of the high end of the RF range.

Sweep Output

The sweep output provided by the WR-50B permits checking and aligning both AM and FM intermediate-frequency (IF) amplifier circuits. Sweep alignment of the 10.7 Mc IF amplifier circuits is recommended by many manufacturers of FM receivers. Although the IF amplifiers in most AM receivers are aligned using the "peak" alignment method, the service notes for some sets, including newer transistor models, do specify sweep alignment.

Sweep alignment techniques enable the bandpass characteristics (frequency response) of a tuned circuit to be observed on an oscilloscope. This is accomplished by passing the sweep signal, which consists of a band of frequencies, through the circuit. Those frequencies amplified by the circuit will cause vertical deflection of the oscilloscope trace, thus forming the frequency response curve of the amplifier. Through the use of frequency markers, the circuit can be aligned to produce the necessary bandpass characteristics.

The Sweep Signal

A sweep signal is formed by repeatedly increasing and decreasing (sweeping) the frequency of an oscillator.

The basic frequency of the oscillator, before it is "swept," is known as the *center frequency*. The WR-50B has two separate sweep signals; one with a center frequency of 455 kc (for AM IF alignment), and the other with a center frequency of 10.7 Mc (for FM IF alignment).

The total amount of frequency variation above and below the center frequency is called the *sweep width* (or bandwidth). The WR-50B sweep signals have a sweep width of about 10% of the center frequency. The 455 kc sweep signal varies in frequency (sweeps) from approximately 432 kc to 478 kc. The 10.7 Mc sweep signal varies from approximately 9.6 Mc to 11.8 Mc.

The signal is swept back and forth through the band of frequencies a certain number of times per second. This is known as the *sweep rate*. The sweep rate of the WR-50B sweep signals is 60 times per second.

Observing Sweep Output Directly

The following procedure will help you become familiar with the technique of using the WR-50B sweep signal.

It is essential to have an oscilloscope with 60 cps horizontal sweep and with a phase control, such as the

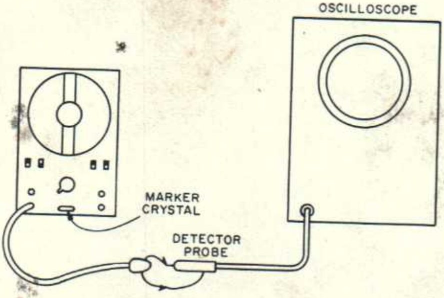


Figure 23. Equipment hookup for observing sweep output directly from WR-50B

RCA WO-33A or WO-91B, for any application using sweep signals. It is helpful to have a detector probe* for the oscilloscope, since it permits observing the detected sweep output directly from the generator.

Frequency markers can be inserted on the sweep trace either by using the WR-50B crystal oscillator, or an external marker generator. A separate RF generator, similar to the WR-50B can be used for this purpose.

Adjust the WR-50B and oscilloscope controls as follows:

Turn on equipment. Set WR-50B range switch to "455 kc", VFO switch to "ON", MOD switch to "EXT", RF switch to "HI", and RF ATTN control fully clockwise.

Connect detector probe of oscilloscope to the WR-50B output cable. Set the scope sweep selector switch to "60 cps" or "LINE", and adjust for a pattern as shown in Figure 24. Note that scope is set to 60 cps sweep, the same sweep rate as the WR-50B sweep signal. This detected sweep trace is simply a horizontal line, since all frequencies in the sweep signal are at the same voltage level.

Blanking

The illustration shown in Figure 24 is a sweep trace without retrace blanking. The signal sweeps from its lowest frequency up to its highest frequency, then sweeps back downward to the lowest frequency again, retracing the same waveform. When the sweep signal and retrace are properly phased, the two traces, which are identical, will overlap and appear as a single trace. Such a curve is useful for observing the general frequency response characteristics and for making phase adjustments, but it does not indicate relative amplitude (voltage) because there is no base line or zero voltage reference.

A base line can be produced in the generator by cutting off, or blanking, the sweep oscillator output during the retrace portion of the sweep cycle. The retrace will then form a base line at the bottom of the curve which will correspond to zero voltage level.

Note: Detector Probes for RCA Oscilloscopes are the WG-350A for the WO-33A, and WG-302A for the WO-91B.

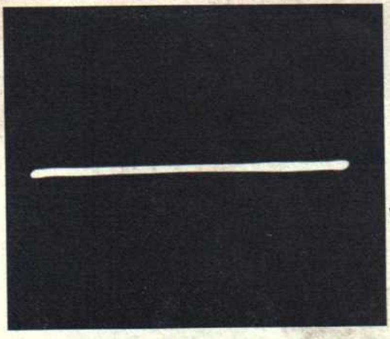


Figure 24. Detected sweep signal, without blanking

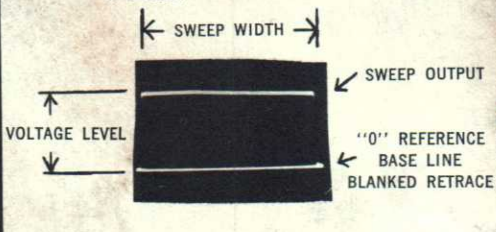


Figure 25. Detected sweep signal, with blanking

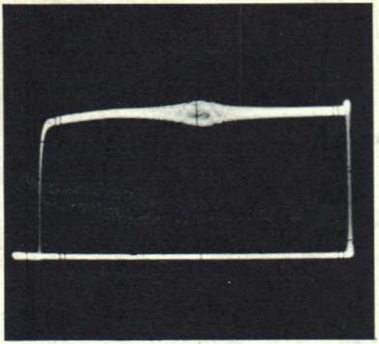


Figure 26. 455 Kc sweep signal with 455 Kc marker

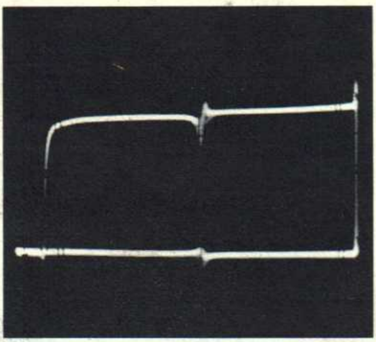


Figure 27. 10.7 Mc sweep signal with 10.7 Mc marker

To obtain a sweep trace with retrace blanking, set the WR-50B MOD switch to "SWEEP". A trace similar to that in Figure 25 should be obtained. Observe that the trace now consists of two parallel horizontal lines. The lower line represents the zero voltage level, or base line, and the upper line is the sweep output. The distance between the lines corresponds to the relative voltage amplitude of the sweep signal, and can be adjusted using either the WR-50B RF HI/LO and RF ATTEN controls or the scope vertical input gain controls. Note: If the polarity of the diode in the detector is reversed, the trace will appear upside-down, with the base line at the top. Some scopes are equipped with a polarity switch that can be used to reverse the trace polarity.

The horizontal length of the sweep trace indicates the sweep width, or frequency variation of the signal, with the lowest frequency at one end, and the highest frequency at the other end. The high and low end of the sweep trace can be interchanged by reversing the power cord plug on either the oscilloscope or the generator.

Frequency Markers

To fully interpret the characteristics of a sweep signal or response curve, it is necessary to use frequency markers. A marker can be inserted on the sweep trace simply by inserting a crystal of the marker frequency into the crystal socket on the WR-50B panel. The size of the marker can be adjusted with the XTAL OSC HI/LO switch. Figure 26 shows a 455 kc sweep trace with a 455 kc marker. Note that the marker is in the center of the sweep trace, indicating that the signal is sweeping above and below the marker frequency. Figure 27 shows a 10.7 Mc sweep trace with a 10.7 Mc marker.

The sweep width of the signal can be measured if a variable marker source is available, such as a separate RF generator. Connect the output of the marker generator to the oscilloscope detector probe, along with the WR-50B cable. Tune the marker generator one side of 455 kc to position the marker at one end of the sweep trace. Note the frequency of the marker generator. Tune the marker generator to position the marker at the other end of the trace, and note the frequency. The difference between these frequencies is the sweep width of the signal.

Phase Adjustment

It is important that the 60 cps sweep signal and the 60 cps horizontal sweep of the oscilloscope be "in-phase". If an "out-of-phase" condition exists, the trace may be cut off, double markers may appear, or if no blanking is used, two separate traces may result.

To adjust the oscilloscope phase, insert a marker on the trace, and set the WR-50B MOD switch to "EXT" to remove blanking. Adjust the oscilloscope phase control so that the markers coincide, as shown in Figure 28. Figure 29 shows a sweep trace with oscilloscope phase mis-adjusted.

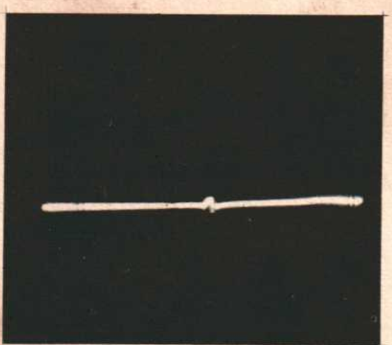


Figure 28. Illustration of sweep trace with oscilloscope phase properly adjusted. Note single marker

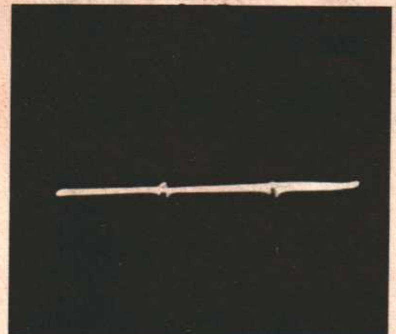


Figure 29. Illustration of sweep trace with oscilloscope out-of-phase with sweep signal. Note that the two markers do not overlap

Sweep Alignment

Many different types of receiver circuits are used by the various manufacturers. For this reason, it is not possible to provide an alignment procedure that will apply to all receivers. The procedure supplied by the manufacturer for the particular model of receiver should be followed.

For both AM and FM IF alignment, the basic procedure is to connect an oscilloscope to the output of the detector (or before the detector, but using a detector scope probe), then align each stage separately, starting with the last stage. The sweep and marker signals are applied to the input of the stage being aligned. Figure 30 shows a typical waveform obtained from a properly aligned AM IF stage. Figure 31 shows an FM IF waveform, which is similar. Note that in each trace, the waveform is peaked at the center of the center-frequency marker.

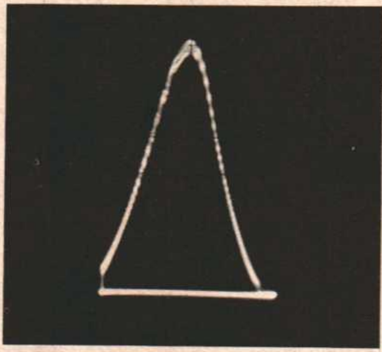


Figure 30. Typical AM IF response curve. Note that 455 Kc marker is spread over entire top half of the curve, with the center of the marker at the peak

Figure 32 indicates an example of an "S" curve obtained in sweep aligning an FM detector stage.

In any sweep alignment procedure, it is good practice to keep the sweep signal as low as possible. The attenuator controls on the WR-50B are used for this purpose. If a marker generator is used, it is important that the output of the generator be coupled to the amplifier in a manner that does not distort the sweep waveform.

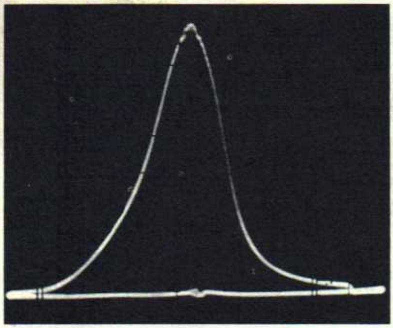


Figure 31. Typical FM IF response curve, with 10.7 Mc marker

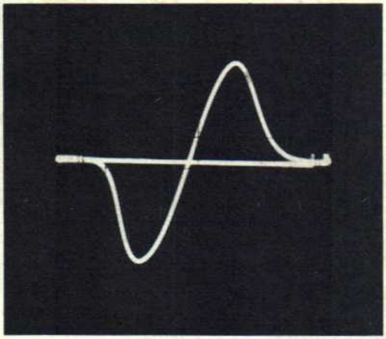


Figure 32. FM detector "S" curve

Maintenance

The RCA WR-50B Signal Generator employs two electron tubes and one selenium rectifier diode in circuits of conventional design. The rf oscillator utilizes one triode section of a 12AT7 in a Hartley oscillator circuit. The rf output is coupled to the second triode section, which serves as a cathode follower. One-half of a 12AT7 is used as a transformer coupled audio oscillator, and the other half as a Pierce-type crystal oscillator circuit.

Variable capacitance diode, CR-3, is used in conjunction with the 455 kc and 10.7 Mc tuned circuits to sweep the VFO oscillator. AC voltage is applied to CR-3 from the heater circuit to provide a 60 cps sweep rate. Tube section V-2B and diode CR-2 are used in a retrace blanking circuit.

The generator can be taken out of the case by removing the two #6 screws on the rear of the case, and the four #4 screws from the panel.

Indicator Adjustment

The clear plastic tuning indicator on the WR-50B can be adjusted by removing the instrument from the case, and loosening the set screws on the indicator shaft. Turn the tuning capacitor to fully meshed position. Set the indicator so that the F index line is aligned with the short reference mark between the upper and lower panel scales. Tighten the two set screws on the shaft of the indicator.

Frequency Alignment

The generator has six internal trimmer capacitors and eight inductance adjustments as shown in Figure 33. These internal adjustments are located on S-1, the Range Switch.

VFO Alignment Procedure

Equipment required:

General-coverage communications receiver, capable of tuning the range from 540 Kc to 36 Mc.

Crystal, 100 Kc.
Crystal, 1.0 Mc.
Crystal, 10.0 Mc.

In this alignment procedure, the receiver is tuned to a specified frequency or harmonic from the crystal oscillator in the WR-50B. The variable oscillator is then tuned to this frequency, and the internal adjustments of the instrument are set so that a zero-beat signal is heard from the receiver.

The complete alignment procedure is given in tabulated form in Figure 35. The following steps provide a more detailed description of this procedure.

1. Remove the snap-in plug from the rear of the case. Apply power and allow the instrument to warm up for at least 15 minutes.

2. Connect the equipment as shown in Figure 34. Plug the 100 Kc crystal into the WR-50B socket. Turn the % MOD switch fully counterclockwise, and the VFO ON/OFF switch to "OFF".

3. Tune the receiver to 900 Kc, and locate the exact point on the receiver dial where the effect of the unmodulated crystal oscillator harmonic frequency is noted (100 Kc x 9). Set the HI/LO switch and the RF ATTEN control so that the output is attenuated as much as possible, yet the effect of the crystal oscillator signal can still be heard.

NOTE: The unmodulated crystal oscillator signal can be identified by a "deadening" of the receiver background noise. If the receiver is equipped with an S" meter, the meter will indicate a rise at the crystal-oscillator frequency (or harmonic). As a check to be sure that it is the unmodulated crystal frequency being heard, remove the crystal from the WR-50B. The crystal oscillator signal will disappear when this is done.

4. Set the WR-50B Range Switch to position "A", and tune the indicator to 90 Kc on band A (the 10th harmonic of 90 Kc is 900 Kc). Set the VFO ON/OFF switch to "ON".

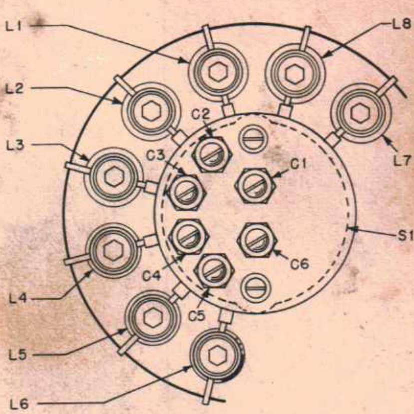


Figure 33. Location of coil adjustments L1—L8 and capacitor adjustments C1—C6

Adjust the coil, L-1, so that the zero-beat signal is heard.

5. Retune the receiver to 1000 Kc. Set the WR-50B VFO ON/OFF switch to "OFF", and locate the exact point on the receiver dial where the 1000 Kc harmonic of the 100 Kc crystal oscillator frequency is heard (100 Kc x 10). If necessary, adjust the RF HI/LO switch and the RF ATTEN control for minimum usable signal.

6. Tune the WR-50B to 200 Kc on band A (the 5th harmonic of 200 Kc is 1000 Kc). Set the VFO ON/OFF switch to "ON". Adjust the trimmer capacitor, C-1, so that the zero-beat signal is heard.

7. As a check, repeat steps 3 through 6.

8. In a similar manner, align the remaining five frequency ranges as indicated in the tabulation in Figure 35.

Tube Replacement — If it becomes necessary to replace V-1, 12AT7, re-alignment of the instrument as described above may be required.

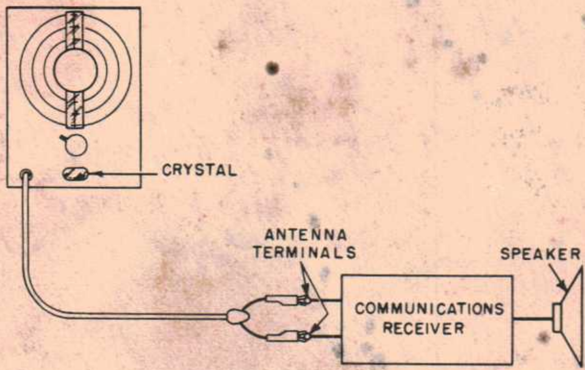


Figure 34. Recommended test setup for alignment of WR-50B

WR-50B Frequency Alignment Procedure

WR-50B Range	WR-50B Dial	XTAL	Receiver Dial	WR-50B Adj.
A (low frequency end)	90 Kc	100 Kc	900 Kc	L–1
(high frequency end)	200 Kc	100 Kc	1000 Kc	C–1
B (low frequency end)	225 Kc	100 Kc	900 Kc	L–2
(high frequency end)	550 Kc	100 Kc	1100 Kc	C–2
C (low frequency end)	600 Kc	100 Kc	600 Kc	L–3
(high frequency end)	1600 Kc	100 Kc	1600 Kc	C–3
D (low frequency end)	1600 Kc	100 Kc	1600 Kc	L–4
(high frequency end)	4000 Kc	1.0 Mc	4000 Kc	C–4
E (low frequency end)	5.0 Mc	1.0 Mc	5.0 Mc	L–5
(high frequency end)	14.0 Mc	1.0 Mc	14.0 Mc	C–5
F (low frequency end)	14.0 Mc	1.0 Mc	14.0 Mc	L–6
(high frequency end)	40.0 Mc	10.0 Mc	40 Mc	C–6

Figure 35. Alignment procedure

Sweep Circuit Alignment

Equipment required:

- VTVM, RCA VoltOhmyst or equiv.
- Oscilloscope, RCA WO-33A, WO-91A, B or equiv.
- Detector Probe for oscilloscope, RCA WG-302A, WG-350A, or equiv.
- Crystals — 455 Kc
  10.7 Mc

1. Remove the instrument from the case. Apply power and allow a warm-up time of several minutes. Set the controls as follows:

MOD	EXT
VFO	ON
RF	HI
XTAL OSC	HI
RF ATTEN	full clockwise
Range Switch	455 KC SWEEP

2. Connect VTVM dc probe to center lug of R-9, located in the approximate center of the chassis. Connect ground lead from the VTVM to the chassis. Adjust R-9 so that VTVM indicates 6 volts dc. Remove VTVM leads.

3. Connect detector probe from oscilloscope to the rf output probe of WR-50B. Adjust oscilloscope sweep selector to 60 cps line sweep, and the range switch to maximum sensitivity. Insert 455 Kc crystal in crystal socket. Adjust phase control of oscilloscope so that patterns overlap.

4. Set MOD switch to "SWEEP". Adjust core of coil L-7 so that 455 kc marker appears in the center of the trace, as shown in Figure 36. The marker will be quite broad, as shown. Reduce marker size by setting XTAL OSC switch to "LO".

5. Remove 455 kc crystal from crystal socket, and insert 10.7 Mc crystal. Set the Range Switch to "10.7 MC SWEEP". Adjust core of coil L-8 so that 10.7 Mc marker is in center of trace, as shown in Figure 37.*

**If instrument is badly misaligned, adjust core fully counterclockwise, then clockwise until marker appears.*

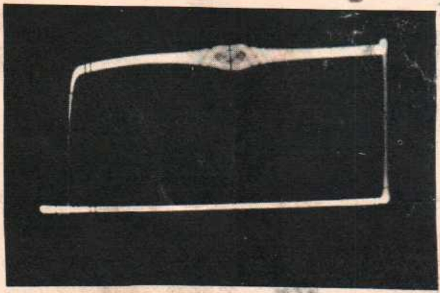


Figure 36. 455 kc Sweep Trace

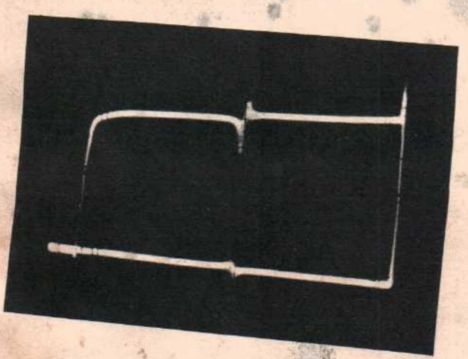


Figure 37. 10.7 Mc Sweep Trace

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