INSTRUCTION MANUAL

B&K Model E-200D

RF Signal Generator

A Product of DYNASCAN CORPORATION 1801 West Belle Plaine • Chicago, Illinois 60613

B&K

PRICE $2.00

Dear Friend:

Congratulations on your purchase of B & K — Precision Test Equipment, and welcome to the B & K family. We hope your experience with your new test equipment will make you a lifetime B & K customer.

Your instrument is backed by more than 20 years of experience in designing and manufacturing. Our most important goal is your satisfaction. At B & K, test equipment is made to meet the demands of the field, focusing on dependability and accuracy. We also concentrate on simplicity and operating ease with features that reduce the possibility of human error and speed the servicing process.

In order to determine the type of test units that are needed we have been guided by letters and reports from technicians and engineers who use the equipment daily. Our field tests and studies have helped provide better and faster service techniques. Close contact has been maintained with the manufacturers of consumer products which our test units will be checking and trouble-shooting.

Key personnel in our company cut their eye teeth in the TV service business. This is why we have more "sensitivity" for the problems and conditions under which the test equipment will be used.

B & K product designs are constantly reviewed, and refinements are made or new models developed to meet advances in our industry and to fill your needs. We set our standards high so you can be assured that the B & K test instruments you buy represent advanced design, quality construction, and dependable long-term performance at a price you can afford.

If you have any comments or thoughts about our products, or test equipment in general, I would be delighted to hear from you.

Thanks for your confidence in B & K and we look forward to serving you for a long time to come.

Sincerely,

Carl Korn

Carl Korn
President

INSTRUCTION MANUAL

FOR

B & K/PRECISION

MODEL E-200D

R F SIGNAL GENERATOR

B & K DIVISION OF DYNASCAN CORPORATION

1801 W. Belle Plaine Avenue

Chicago, Illinois 60613

B&K/PRECISION MODEL E-200D
R F SIGNAL GENERATOR

TABLE OF CONTENTS

SPECIFICATIONS

FREQUENCY RANGE	100 kHz to 54 MHz in five fundamental bands. 32 MHz to 216 MHz in two harmonic bands. BAND A 100 kHz to 370 kHz BAND B 370 kHz to 1400 kHz BAND C 1.4 MHz to 5.1 MHz BAND D 5.1 MHz to 16 MHz BAND E 16 MHz to 54 MHz BAND H_2 32 MHz to 108 MHz (harmonic) BAND H_4 64 MHz to 216 MHz (harmonic)
FREQUENCY ACCURACY	± 1.5% of highest frequency on any given band, usable to ± 0.1% with crystal calibrator.
MAXIMUM OUTPUT LEVEL	Output open circuited, meter uncalibrated: BAND A 3 V rms minimum BAND B 2 V rms minimum BAND C 0.6 V rms minimum BAND D 0.3 V rms minimum BAND E 0.3 V rms minimum BAND H_2 uncalibrated harmonic output BAND H_4 uncalibrated harmonic output
CALIBRATED OUTPUT	—106 dB (0.5 microvolt) to + 2 dB (126,000) microvolts) into 50-ohm load. Carrier meter covers —10 to + 2 dB range (reference 0 dB = 100,000 microvolts into 50-ohm load); attenuators extend range to —106 dB.
CALIBRATED OUTPUT ACCURACY	±1 dB 100 kHz to 54 MHz

ATTENUATORS	Six step attenuators of 20 dB, 20 dB, 20 dB, 20 dB, 10 dB and 6 dB (96 dB total) plus fully adjustable fine attenuator control.
MODULATION TYPE	CW or amplitude modulation
INTERNAL MODULATION	400 Hz ± 20% from bridged "T" two-stage oscillator; adjustable level.
EXTERNAL MODULATION SENSITIVITY	Approximately 1 V rms for 50% modulation at 400 Hz.
MODULATION METER	Reads 0 to 50% modulation for internal or external modulation; accuracy ± 5% from 100 kHz to 30 MHz.
CRYSTAL CALIBRATOR	Crystal calibration points every 1 MHz and 100 KHz (derived). Accuracy 0.05%. Built-in detector, amplifier and speaker for "zero beating".
400 Hz OUTPUT	Output of internal modulation oscillator available for external use at EXT MOD jacks. Level: 1.25 volts maximum Impedance: 5K ohms at maximum level. Distortion: Less than 0.5%
POWER REQUIREMENTS	117 VAC, 50/60 Hz, 6 watts
SIZE	12¾" wide x 7¼" high x 8" deep
SHIPPING WEIGHT	Approximately 14 pounds

FEATURES

WIDEST FREQUENCY RANGE

Continuous coverage from 100 kHz to 216 MHz in seven frequency bands (54 MHz to 216 MHz signals use harmonic output). No gaps in coverage. Covers AM broadcast band, FM broadcast band, amateur, short wave and two-way communications bands, and all VHF television channels, plus all i-f frequencies.

FULLY SOLID STATE

Uses 18 semiconductor devices for all the advantages of solid state technology; reliability, ruggedness, instant warm-up, low power consumption, no high voltage, light weight and compactness.

FULLY SHIELDED

Oscillators and attenuators are shielded to reduce "spray" radiation; a neccessity when testing and aligning high sensitivity receivers.

SINUSOIDAL OUTPUT

Sinusoidal rf output signal has very low distortion on fundamental output ranges to 54 MHz.

VERNIER SCALE TUNING

A 6.1 gear reduction ratio between the tuning knob and the dial allows the dial to be easily and accurately set.

EASY-TO-READ DIAL

A large circular two-color dial (15-inch circumference with seven separate frequency scales provides easy, accurate direct frequency readings.
Key frequencies and frequency ranges are identified: Broadcast receiver i-f; FM i-f; TV i-f sound and video frequencies; FM band; VHF TV Video Carrier frequencies for all 12 VHF channels.

CALIBRATED OUTPUT LEVEL

A carrier level meter and step attenuators provide accurately calibrated output level measurement from —106 dB to +2 dB (0.5 uV to 126,000 uV) when using the 50-ohm terminated cable that is supplied with the instrument.

ADJUSTABLE MODULATION

A modulation percentage meter and modulation level adjustment permit calibrated modulation from 0 to 50%, with higher uncalibrated levels (up to 100%) possible.

FREQUENCY ACCURACY

A built-in crystal controlled oscillator, "zero beat" circuit and adjustable cursor marker provide dial accuracy of 0.1%.

INTERNAL MODULATION

Internal 400 Hz oscillator provides low distortion modulation voltage.

400 Hz OUTPUT

The output of the 400-Hz oscillator is available at the external modulation jacks for use as an audio test signal. Thus, the signal generator can be used for complete testing of both the rf and audio sections of a receiver. The level is fully adjustable from 0 to 1.25 volts rms.

PILOT LAMP EASE OF OPERATION

Lets you tell at a glance whether instrument is on or off.
Controls and indicators are "operator designed". Related controls are grouped, lettering is easy to read and "explains" rather than confuses. Simplified control layout for calibration accuracy eliminates complicated conversion tables and graphs for precision frequency and output level settings.

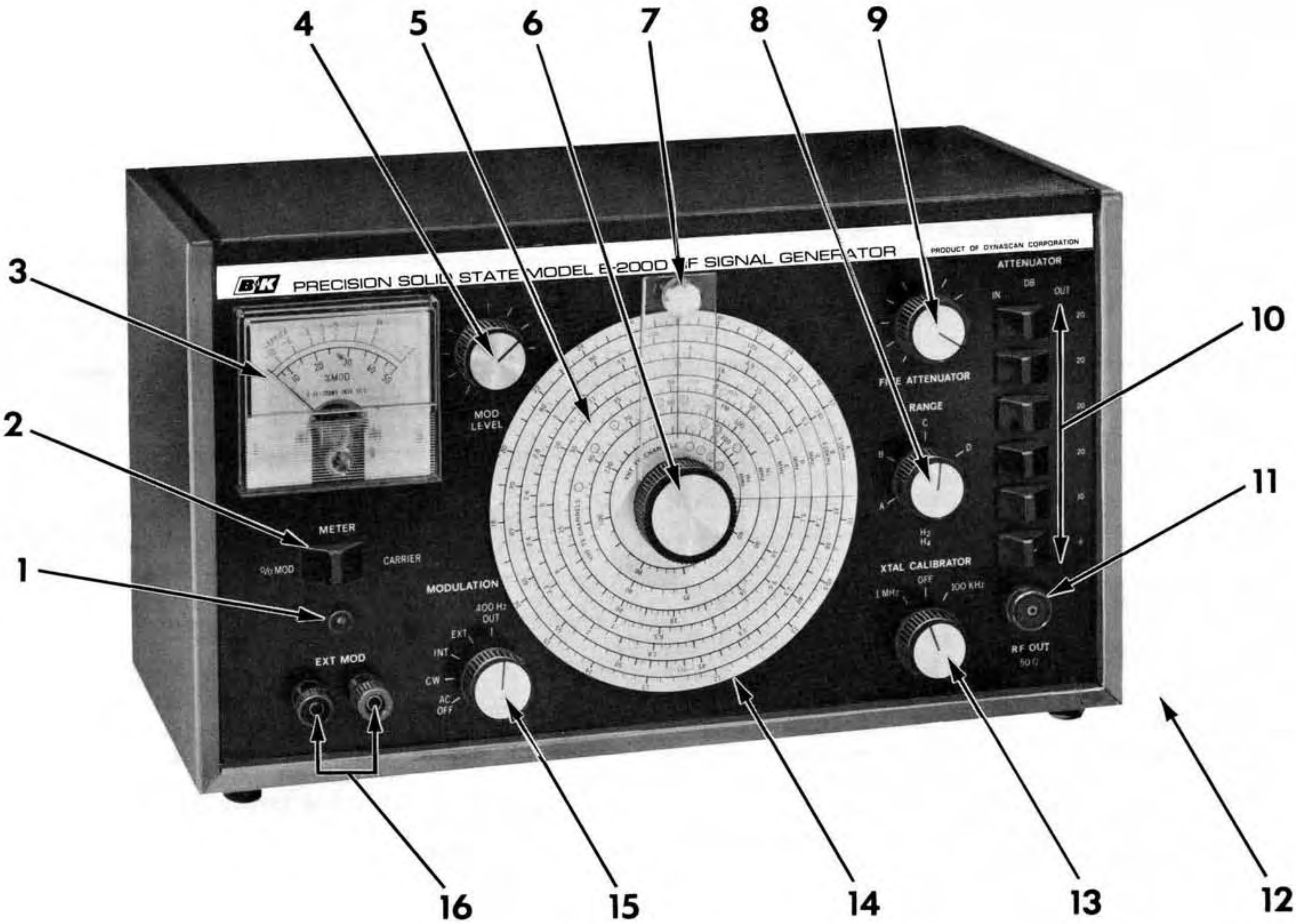


Figure 1. Operator's Controls and Indicators

OPERATOR'S CONTROLS AND INDICATORS

(Refer to Figure 1)

1. Pilot lamp—Lights continuously when signal generator is turned on.

2. METER switch

   % MOD position—Connects meter to measure percentage of modulation.

   CARRIER position—Connects meter to measure carrier (rf output signal) level.

3. Meter—Indicates carrier level in dB on top (red) scale or percentage of modulation on bottom (black) scale. Use the scale which corresponds to the METER switch position.

   NOTE

   The rf output must be terminated in a 50-ohm lead when using the carrier scale for calibrated output level.

4. MOD LEVEL control—Adjusts percentage of modulation for internal or external modulation. Adjusts level of 400-Hz tone output when MODULATION switch is in 400 Hz OUT position.

5. Dial—Indicates the frequency of the output signal. Use the scale which corresponds to the RANGE switch position.

6. Frequency control—Adjusts the dial frequency.

7. Cursor marker adjustment—Adjusts the cursor marker for highly accurate frequency readings when used with the crystal calibrator.

8. RANGE switch—Selects the frequency range for the output signal as follows:

   Range A —100 kHz to 370 kHz

   Range B —370 kHz to 1400 kHz

   Range C —1.4 MHz to 5.1 MHz

   Range D —5.1 MHz to 16 MHz

   Range E —15 MHz to 54 MHz

   Range H_2—30 MHz to 108 MHz

   Range H_1—60 MHz to 216 MHz

9. FINE ATTENUATOR control—Fine setting of output level.

10. ATTENUATOR selectors—Coarse setting of output level. Six individual attenuators of 20, 20, 20, 20, 10 and 6 dB permit steps from 0 to 96 dB. Each switch has two positions as follows:

    IN position—adds attenuation

    OUT position—removes attenuation

11. RF OUT jack — Connector for output signal. Mates with microphone type connector.

12. RF output cable—Connects output signal to equipment being tested or aligned. Cable contains 50-ohm termination. Use an unterminated cable if the output is being fed directly to a 50-ohm circuit.

13. XTAL CALIBRATOR switch

    1 MHz position—Provides crystal calibration at each multiple of 1 MHz.

    OFF position — disables calibration oscillators.

    100 KHz position—Provides crystal calibration points at each multiple of 100 kHz.

14. Speaker (behind dial)—Provides audible "zero beat" for crystal calibration procedure.

15. MODULATION switch

    AC OFF position—turns off unit. Unit is on in all other positions.

    CW position — Provides unmodulated CW (continuous wave) output.

    INT position — Provides 400 Hz internally modulated output.

    EXT position—Provides externally modulated output. The external modulation voltage is connected to EXT MOD jacks when using this switch position.

    400 Hz OUT position—Provides 400-Hz output at the EXT MOD jacks.

16. MOD jacks—Input jacks for external modulation and output jacks for 400-Hz tone. Universal binding post type jacks accept banana plug, meter leads, spade lugs, etc. Black post is grounded, red post is audio high.

OPERATING INSTRUCTIONS

PRELIMINARY SET-UP

1. Connect the plug of the ac power cord to a 117-volt, 50/60 Hz ac power outlet.
2. To turn on the signal generator, set the MODULATION switch **15** to the CW position. The pilot lamp **1** should light.
3. Set the XTAL CALIBRATOR switch **13** to the OFF position.
4. Set the RANGE switch **8** to the desired frequency range.
5. Set the dial **5** to the desired frequency with the frequency control knob **6**
6. Connect the rf output cable to the RF OUT jack 11. The cable supplied with the signal generator is normally used. It contains a built-in 50-ohm termination. However, if the rf output signal is to be applied directly to a 50-ohm circuit, an unterminated rf cable should be used. Such a cable can be made from a length of 50-ohm coaxial cable (RG-58A/U) terminated in a microphone type female connector on one end and the desired connector or terminations on the other end.
7. Connect the rf output cable to the equipment being tested. Connect the black lead to the chassis first, then the red lead to the signal injection point.

PRECAUTIONS

A. When performing stage-to-stage measurements, always use a dc blocking capacitor between the red probe of the rf output cable and the circuit into which the signal is injected. This protects the attenuators of the signal generator from possible damage by the dc from the circuit under test. Trim the capacitor leads as short as possible, while still permitting adequate length for connections. The value of the blocking capacitor is dependent upon the frequency of the rf output signal. Suggested values are:
Ranges A and B: .1 uF, 400 V
Ranges C and D: .01 uF to .02 uF 400 V
Ranges E, H_2, H_4: 1000 pF

B. If the equipment into which the rf signal is being injected uses an ac powered, transformerless power supply, always use an isolation transformer between the 117-volt outlet and the equipment to prevent electrical shock and possible damage to the equipment. The equipment chassis becomes grounded through the rf signal generator when the rf cable is connected.

C. When connecting the rf output cable to equipment under test, always connect the black lead to the equipment chassis first. Otherwise, a transient voltage spike may occur when the connection is made that may damage transistorized equipment.

D. Use a dc blocking capacitor in series with the black lead of rf or 400-Hz output cables if other than chassis reference is used in equipment which has its chassis at earth ground. The black terminal of the EXT MOD jacks and the black probe of the rf cable are at earth ground potential through the 3-wire power plug. Serious damage to equipment could result by using a direct connection.

SETTING THE SIGNAL LEVEL

1. Be sure the output is terminated in a 50-ohm load.
2. Set the MODULATION switch **15** to the CW position.
3. Set the METER switch **2** to the CARRIER position.
4. Determine the amount of attenuation required to produce the desired output level (refer to the accompanying table). The desired output level may be in millivolts, microvolts, or dB, but must be converted to dB to correspond with the labelling on the controls. In this unit 0 dB = 100 millivolts into a 50-ohm load.
5. Place as many ATTENUATOR selectors **10** in the IN position as required to come within 0 to + 5 dB of the desired total attenuation. All the other ATTENUATOR selectors **10** must be in the OUT position.
6. Set the FINE ATTENUATOR control **9** for the additional attenuation, as indicated on the meter **3** (this should always be in the 0 to —5 dB region of the meter scale).
The total of all ATTENUATOR selectors and the meter reading equals the total attenuation below the 0 dB (100 millivolt) reference level.
7. Higher levels of output are possible but seldom required. Levels above + 2 dB must be measured with external equipment. At these higher levels, the meter **3** will peg, but no damage will occur since the meter is protected against overload damage. For output levels above + 2 dB, connect an rf voltmeter to measure the output signal level and adjust the FINE ATTENUATOR control **9** for the desired signal level.

NOTES

A. For greater accuracy, use an unmodulated signal level (MODULATION switch in CW position).

B. If the output is not terminated in 50 ohms, the output level is not calibrated. However, the meter and ATTENUATOR selectors still provide indication of relatively higher or lower level.

C. For ranges H_2 and H_4, which provide harmonic signals, the meter reads the level of the fundamental (Range E signal) only. The level of the harmonic is not indicated on the meter, but is proportional to the level of the fundamental signal.

DESIRED CONDITION

output signal level = 25 microvolts

PROCEDURE

- from table 25 microvolts = —72 dB total attenuation

—20 dB
—20 dB
—20 dB
—10 dB
—2 dB
—72 dB

- set three of the 20 dB ATTENUATOR selectors to the IN position (any three may be used)
- set the 10 dB ATTENUATOR selector to the IN position
- set the FINE ATTENUATOR for a meter reading of —2 dB

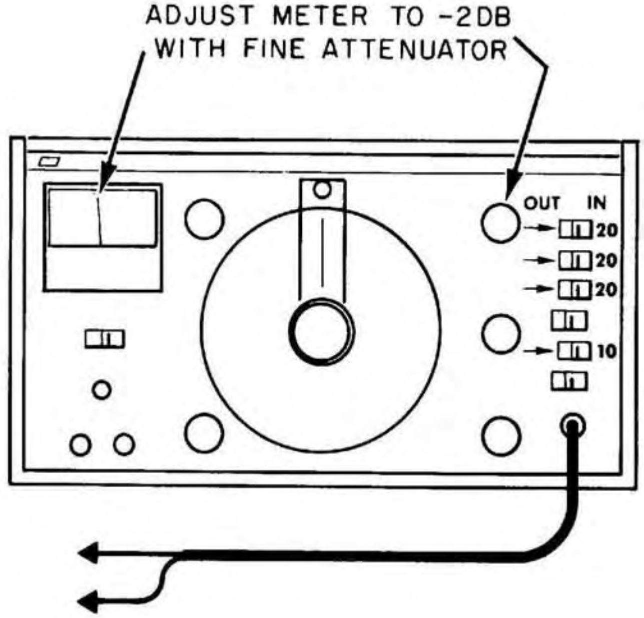
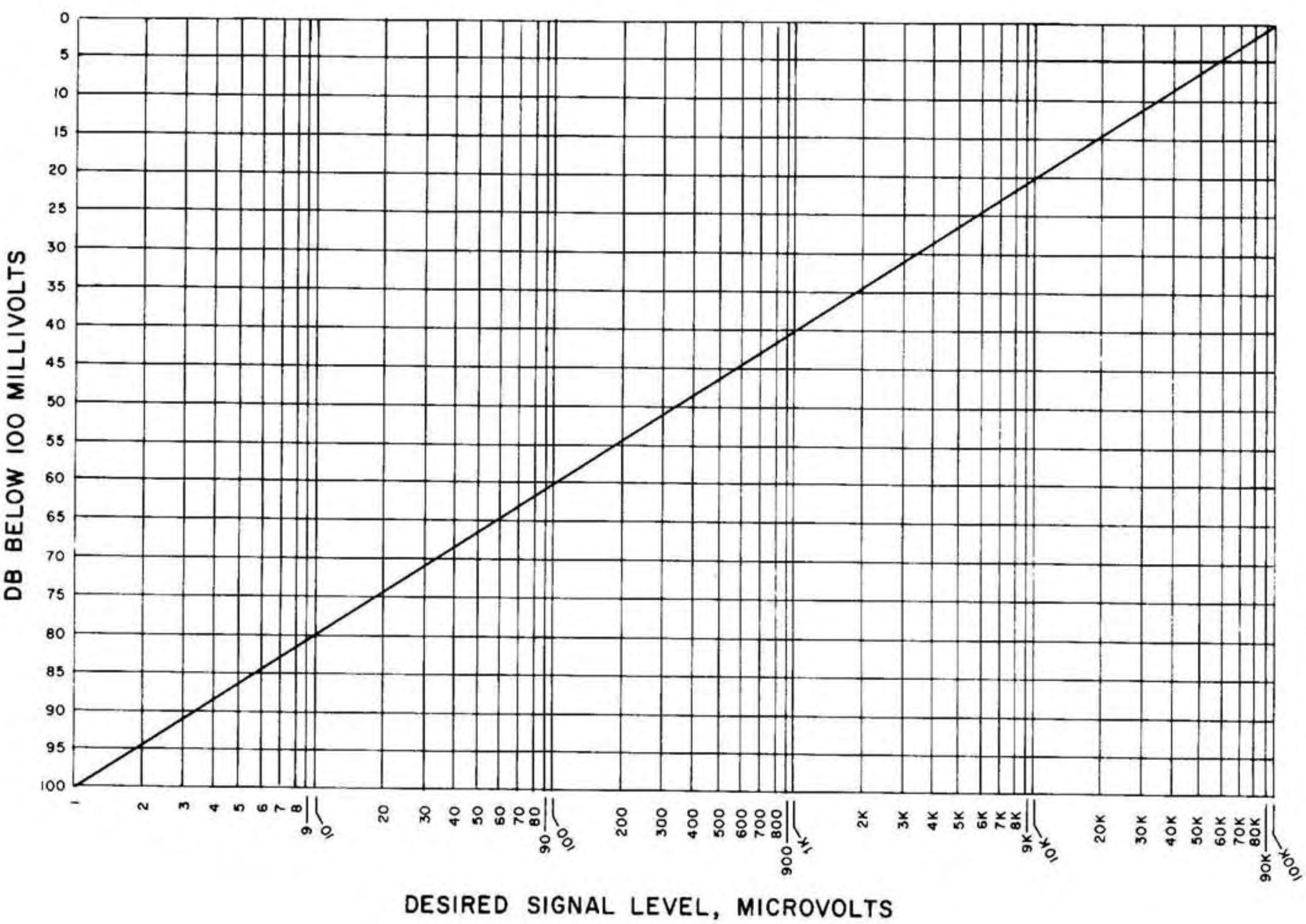


Figure 2. Typical Example, Setting Signal Level



DB-to-Voltage Conversion Table

SETTING MODULATION

1. To use 400 Hz internal modulation, set the MODULATION switch **15** to the INT position.
   To use external modulation, connect the audio signal to the EXT MOD jacks **16** (black = ground, red = audio high) and set the MODULATION switch **15** to the EXT position.
2. Set METER switch **2** to the % MOD position.
3. Adjust the MOD LEVEL control **4** for the desired percentage of modulation as indicated on the meter **3**.

The meter indicates percentage of modulation from 0 to 50%. Typical modulation for testing is 30%. Uncalibrated modulation greater than 50% is possible. Maximum modulation with the MOD LEVEL control fully clockwise is approximately 100%.

To determine per cent modulation for levels greater than 50 per cent, an oscilloscope may be used, provided the bandwidth of the oscilloscope is sufficient to observe the modulated signal. Refer to Figure 3. The voltage A is one-half the unmodulated carrier level. The level B is the modulation depth measured from the original unmodulated carrier level. The ratio of B to A is used to determine per cent modulation:

Modulation, per cent, = B/A x 100

CRYSTAL CALIBRATION

The crystal calibrator uses the "zero beat" method to obtain a high degree of frequency dial accuracy. It operates as follows. A crystal controlled oscillator produces calibration signals that beat with the signal generator output. When the two frequencies are separated by only a small amount, the difference frequency is in the audio range and is heard as an audio tone (whistle) in the speaker. As the signal generator output frequency approaches the crystal oscillator frequency, the pitch of the audio tone decreases. When both signals are the same frequency, a "zero beat" occurs where no tone is heard in the speaker. If the adjustable oscillator is tuned in either direction from the "zero beat" frequency, the tone is heard. The crystal controlled oscillator is rich in harmonics, which provides calibration points at each multiple of the crystal frequency.

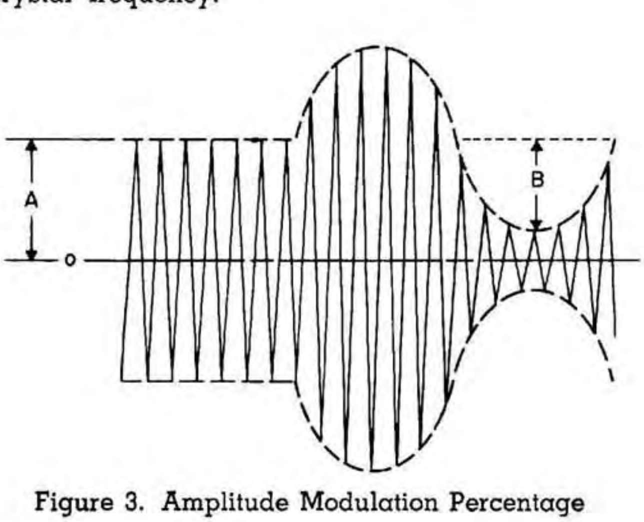


Figure 3. Amplitude Modulation Percentage

NOTE

Set the output level before setting the frequency. Although the oscillator and attenuators are isolated by an emitter follower, slight frequency pulling can occur when the FINE ATTENUATOR is adjusted or step attenuators are switched in and out.

1. Set the cursor marker **7** to the center of its travel.
2. Select the desired frequency range with the RANGE switch **8**.
3. Set the dial **5** to the desired frequency with the frequency control **6**.
4. For ranges A, B and C, set the XTAL CALIBRATOR switch **13** to the 100 KHz position. For ranges D, E, and H_2 H_4, set the XTAL CALIBRATOR switch **13** to the 1 MHz position. (The 1 MHz position can also be used for range C, but the calibration points are widely separated.)
5. Set the dial **5** to the nearest calibration frequency as follows:
   If the XTAL CALIBRATOR switch is in the 100 KHz position, calibration points occur at each multiple of 100 kHz. If the XTAL CALIBRATOR switch is in the MHz position, calibration points occur at each multiple of 1 MHz.
   On range H_2 calibration points occur at multiples of 2 MHz, and on range H_4 calibration points occur at multiples of 4 MHz.
6. Carefully set the dial **5** to obtain the "zero beat". A properly set "zero beat" is identified as a very precise dial setting where rocking the dial in either direction will produce a whistle.

   NOTES

   A. At higher frequencies, the "zero beat" whistle is progressively weaker. Listen carefully for the "zero beat" whistle at the high end of range C and the high end of ranges E, H_2 and H_4.

   B. Some less predominant beat frequencies are audible at other than calibration points. Disregard theses tones and use only multiples of 100 kHz or 1 MHz.
7. Carefully set the cursor marker **7** to exactly align with the calibration frequency mark on the dial. The dial is now calibrated for all frequencies near the calibration point.
8. Set the XTAL CALIBRATOR switch **13** to the OFF position.
9. Carefully readjust the dial **5** to the desired output frequency.

EXAMPLE

Desired Condition: Calibrated 455 kHz output
Procedure:

RANGE switch .... B
XTAL CALIBRATION switch .... 100 kHz
Dial .... 50 (500 kHz); as read on scale B (nearest calibration point)
Tune dial in vicinity of 50 for "zero beat"
Adjust cursor marker to exactly 50 on dial
XTAL CALIBRATION switch .... OFF
Set dial to .... 45.5 (455 kHz)

ALIGNING AM BROADCAST BAND RECEIVERS

(Refer to Figure 4)

NOTES

A. For best results, always follow the manufacturer's alignment procedure explicitly. However, if such procedure is not available, or only a condensed procedure is available, the following general instruction should be helpful for aligning most AM broadcast band radios (and the AM portion of AM-FM radios). Since circuit designs vary widely, some of the circuits shown may not be included in all radios, and other radios may have additional circuits or a different arrangement of components.

B. If a transformerless ac-dc receiver is to be aligned, be sure to use an isolation transformer.

C. When preparing to align transistorized receivers, turn off all equipment while connections are being made or being removed to eliminate the possibility of transient voltage spikes which could damage transistors.

D. Keep the signal output level of the signal generator low. Use just enough signal to provide a usable reading on the alignment meter. High signal levels may overdrive amplifiers, resulting in improper alignment. As the receiver is aligned, the meter reading increases. Continuously reduce the signal generator output level, as required, to maintain approximately the original meter reading.

1. Disable the local oscillator as recommended by the radio manufacturer, or short across the oscillator coil.
2. Set the volume control of the receiver to the normal listening level.
3. Connect a VTVM to measure the audio voltage across the speaker voice coil. Use a convenient ac voltage scale.
4. Connect the rf cable from the signal generator to inject a signal at the input of the converter. First, connect the black probe to signal ground near the signal injection point, then connect the red probe through a series dc blocking capacitor to the converter input.
5. Set the signal generator to the receiver i-f frequency. Most AM broadcast band receivers use a 455-kHz i-f signal, except automobile radios, some of which use a 262-kHz i-f signal.

To set the rf signal generator at 455 kHz:

RANGE switch .... B

Dial .... 45.5 (scale B)

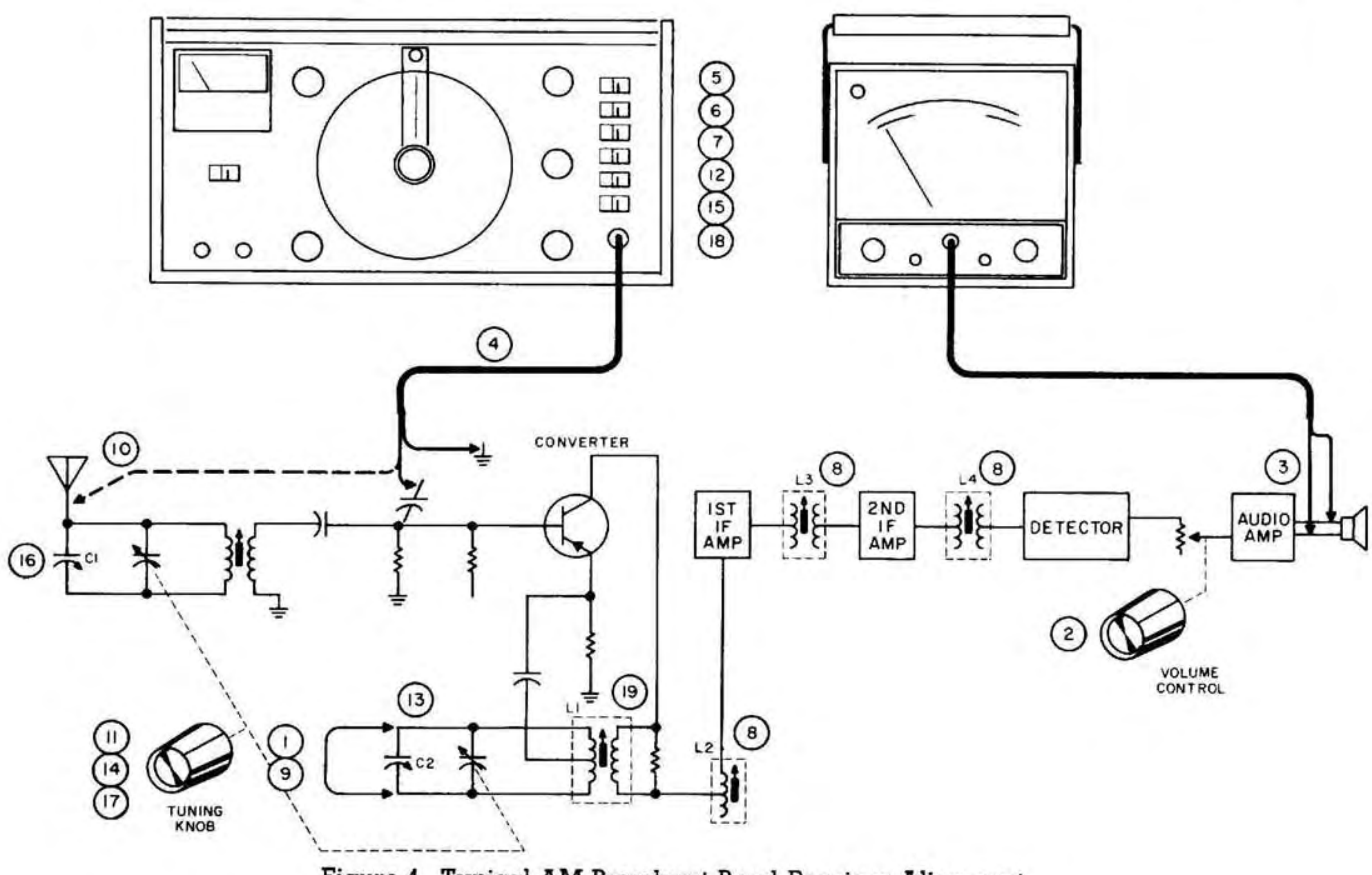


Figure 4. Typical AM Broadcast Band Receiver Alignment

6. Modulate the signal generator output with a 400-Hz audio signal at 30% modulation.

   Set the rf signal generator controls as follows:
   MODULATION switch .... INT
   METER switch .... % MOD
   MOD LEVEL control... Adjust for 30% reading on the modulation meter

7. Set the controls on the signal generator to provide the minimum signal level that will provide a usable meter reading on the VTVM.

   METER switch .... CARRIER

   FINE ATTENUATOR .... Adjust for 0 dB on carrier meter.

   ATTENUATOR selectors .... Place as many in the IN position as required to obtain proper signal level.

   A satisfactory level should be a comfortable listening level in the speaker. The volume control may be readjusted if audio output is excessive with the rf signal fully attenuated.

8. Starting at the detector and working toward the antenna, adjust each of the i-f coils for maximum meter reading on the VTVM (in Figure 4, adjust L4, L3, then L2 in that sequence). Reduce the signal generator output level as required to maintain suitable meter reading and speaker volume. REPEAT THE ADJUSTMENTS UNTIL NO FURTHER IMPROVEMENT CAN BE OBTAINED.

   If the radio is badly misaligned, it may be necessary to inject the signal directly into the 2nd i-f amplifier to adjust L4, then move the injection to the input of the 1st i-f amplifier to adjust L3, and to the input of the converter to adjust L2.

9. Enable the local oscillator by removing the short from the oscillator coil.

10. Move the red probe of the rf cable to the antenna input of the receiver.

    If the radio uses a ferrite loopstick attenna, wind several loops of insulated wire into a coil, connect the probes of the rf cable to the two ends of the coil, and place the coil in the vicinity of the antenna (See Figure 5). The signal radiated by the coil will be picked up by the antenna. Do not place the coil so close to the antenna that overcoupling will detune the antenna circuit.

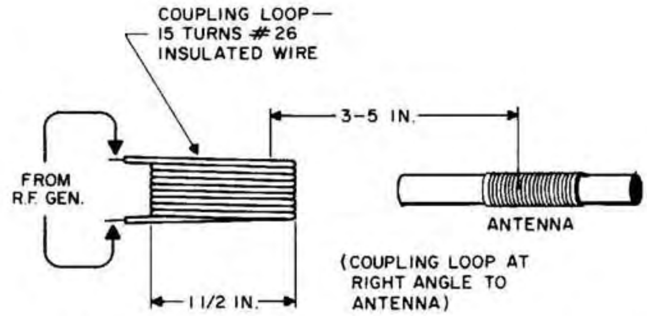


Figure 5. Signal Injection Coupling Loop for Ferrite Loopstick Antenna

11. Tune the receiver to 600 kHz.

12. Set the signal generator to 600 kHz as follows:
    RANGE switch .... B
    Dial .... 60 (scale B)
    If necessary, readjust the signal level.

13. Adjust oscillator coil (L1) for maximum meter reading on the VTVM.

14. Tune the receiver to 1600 kHz.

15. Set the signal generator to 1600 kHz (1.6 MHz) as follows:
    RANGE switch C
    Dial .... 1.6 (scale C)
    If necessary, readjust the signal level.

16. Adjust the oscillator trimmer capacitor (C2) for maximum meter reading on the VTVM.

17. Tune the receiver to 1400 kHz.

18. Set the signal generator to 1400 kHz (1.4 MHz) as follows:
    RANGE switch C
    Dial .... 1.4 (scale C)
    If necessary, readjust the signal level.

19. Adjust the antenna trimmer capacitor (C1) for maximum meter reading on the VTVM.

20. Repeat steps 11 through 19 until no further improvement can be obtained.

ALIGNING FM BROADCAST BAND RECEIVER

(Refer to Figure 6)

NOTES

A. An FM signal generator is not required for proper alignment of an FM receiver. Excellent results may be obtained by injecting an unmodulated carrier signal from an rf signal generator and measuring the dc voltage output of the ratio detector (discriminator in many receivers).

B. For FM receivers and tuners, it is important to follow the manufacturer's procedure. However, the accompanying procedure is very typical and applies to many FM receivers (and the FM portion of AM-FM radios). In all cases, the procedure exemplifies the use of the rf signal generator for alignment.

C. If a transformerless ac-dc receiver is to be aligned, be sure to use an isolation transformer.

D. When preparing to align transistorized receivers, turn off all equipment while connections are being made or being removed to eliminate the possibility of transient voltage spikes which could damage transistors.

E. Keep the signal output level of the signal generator low. Use just enough signal to provide a usable reading on the alignment meter. High signal levels may overdrive amplifiers resulting in improper alignment indications. As the receiver is aligned, the meter reading increases. Continuously reduce the signal generator output, as required, to maintain approximately the original meter reading.

1. Disable the local oscillator as recommended by the radio manufacturer, or short across the oscillator coil.

2. If the radio has an AFC switch, place it in the OFF position.

3. Connect a VTVM to measure the dc voltage output of the ratio detector (discriminator in many receivers) at test point A. Use a low range (1.5 volt) dc voltage scale.

NOTE

Many variations in circuit design cause the reference point to vary widely. Most often, chassis ground is *not* the reference point for this reading. Refer to the manufacturer's instructions for the exact location of test point A and the reference point.

4. Connect the rf cable from the signal generator to inject a signal at the input of the mixer (converter in some radios). First connect the black probe to the signal ground near the signal injection point then connect the red probe through a series dc blocking capacitor to the mixer input.

5. Set the controls on the signal generator to provide an unmodulated carrier signal at precisely 10.7 MHz as follows:

   MODULATION switch .... CW

   RANGE switch C

   Crystal calibrate at 11 MHz (see crystal calibration instructions).

   XTAL CALIBRATION switch .... OFF

   Dial 10.7

6. Set the controls on the signal generator to provide the minimum signal level that will provide a usable meter reading on the VTVM.

METER switch	CARRIER
FINE ATTENUATOR	Adjust for 0 DB on carrier meter.
ATTENUATOR selectors	Place as many in the IN position to obtain proper signal level.

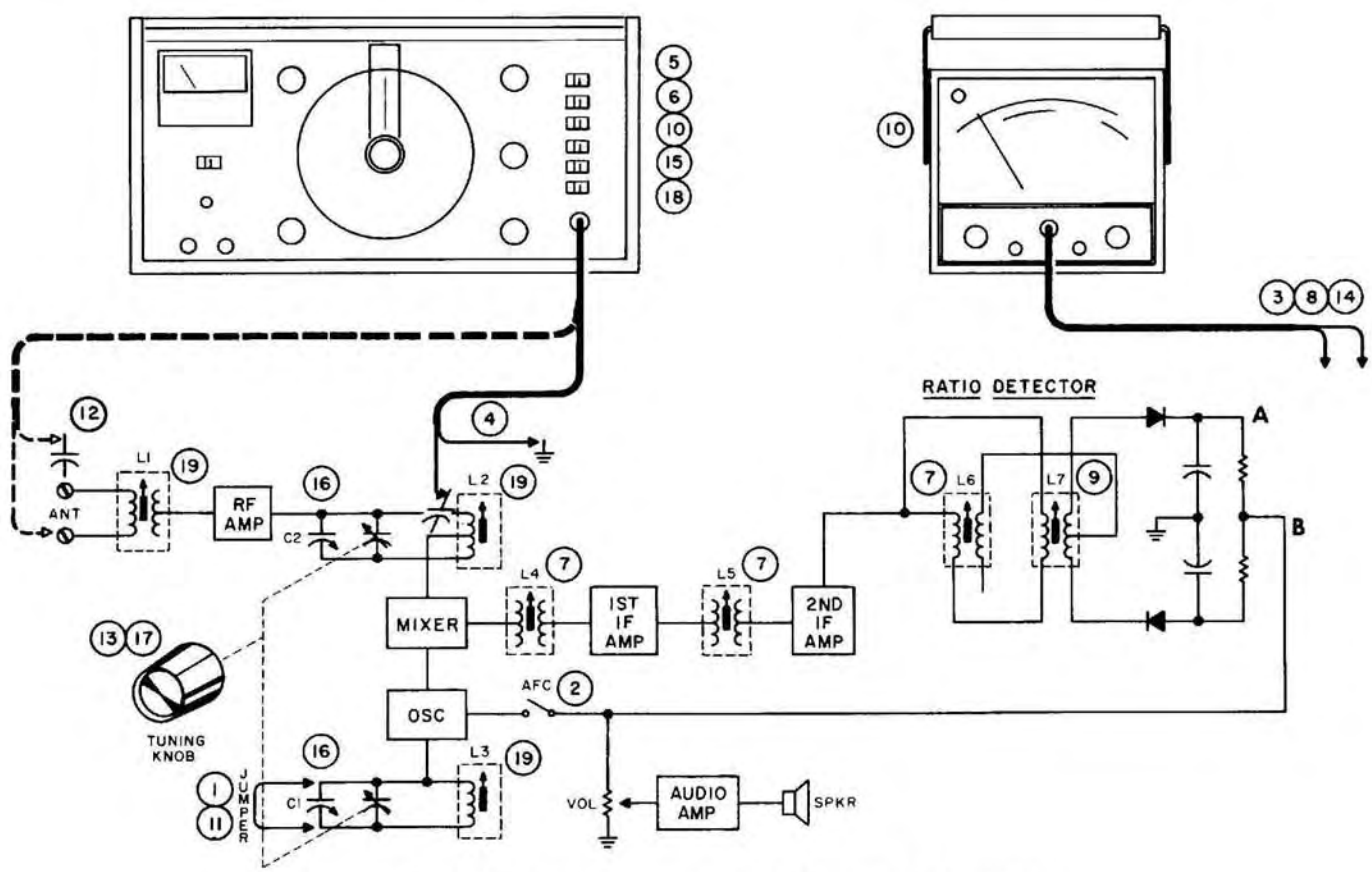


Figure 6. Typical FM Broadcast Band Receiver Adjustment

7. Beginning with the primary coil of the ratio detector (or discriminator) and progressing toward the antenna, align each i-f coil for maximum meter reading on the VTVM (in figure 6, adjust L6, L5, and L4 in that order). Reduce the signal generator output level as required to maintain a small meter reading. REPEAT THE ADJUSTMENTS UNTIL NO FURTHER IMPROVEMENT CAN BE OBTAINED.

   If the radio is badly misaligned, it may be necessary to inject the signal directly into the 2nd i-f amplifier to adjust L6, then move the injection to the input of the 1st i-f amplifier to adjust L5, and to the input of the mixer to adjust L4.

8. Change the VTVM connections to measure the voltage at test point B. Again refer to the manufacturers' data for the exact location of test point B and the reference point to be used for this measurement.

9. Adjut the secondary coil (L7) of the ratio detector (discriminator) for an exact zero meter reading. Adjusting the coil in one direction must cause a positive dc voltage, and a negative dc voltage if adjusted in the other direction. Use the most sensitive scale of the VTVM for the most accurate reading.

10. Check ratio detector (discriminator balance. If unbalanced, repeat i-f alignment until balance or near balance can be obtained.

    Balance shou'd be checked as follows:

    a. Set the signal generator dial equal amounts above and below the 10.7 MHz i-f center frequency. Refer to the radio manufacturer's data for the specific amount, usually approximately 100 kHz. If 100 kHz is used, dial settings of 10.6 MHz and 10.8 MHz should be used.

    b. Read the voltage on the VTVM at each of the frequencies. The voltages must be equal and of opposite polarity.

    c. Use care in setting the dial of the signal generator an equal amount above and below the center frequency, and in reading the VTVM. Inaccuracies will result in unsatisfactory alignment.

11. Enable the local oscillator by removing the short across the coil.
    the coil.

12. Move the rf cable to the antenna terminals of the radio.

13. Reconnect the VTVM as in step 3.

14. Tune the radio to 90 MHz.

15. Set the signal generator to 90 MHz.

    RANGE switch .... H_2
    Dial 90

    Select a signal level that will produce a small voltage reading on the VTVM.

16. Adjust the oscillator, mixer and antenna coils L3, L2 and L1 for maximum meter indication on the VTVM.

17. Tune the radio to 108 MHz.

18. Set the signal generator to 108 MHz. If necessary, readjust the output level for a usable meter reading.

19. Adjust rf trimmer capacitors C1 and C2 for maximum meter indication on the VTVM.

20. Repeat steps 13 through 19 until no improvement can be obtained.

ALIGNING TELEVISION RECEIVERS

SOUND I-F

The rf signal generator may be used to align the sound i-f section of television receivers. The procedure is essentially the same as for the i-f portion of FM broadcast band receivers except that a 4.5-MHz i-f signal is used.

VIDEO I-F

Proper alignment of the video i-f section requires close adherence to the television set manufacturer's alignment procedure. Due to the wide bandwidth involved, stagger tuning is required. Refer to the manufacturer's instructions for the frequency at which each coil is to be tuned. Although the rf signal generator can be used for such alignment by setting it to the specified frequency for each coil and tuning the coil for maximum output from the i-f section, a more common and preferable method is to use a sweep generator.

Set up the sweep generator to inject a signal into the i-f section which covers the entire video i-f spectrum and display the output of the i-f section on an oscilloscope. The rf signal generator is used as a marker generator. The marker generator creates a "pip" (visible marker) on the oscilloscope pattern. By adjusting the frequency of the rf signal generator, the marker can be moved to any required position, thus measuring data such as the lower bandpass limit, upper bandpass limit, adjacent channel rejection, effectiveness (proper adjustment) of trap circuits, and any other data required. Since the rf signal generator is continuously adjustable, all points on the video i-f response curve can be checked for waveshape configuration and bandwidth. Likewise, chroma and sound response curves may be checked.

TUNER ADJUSTMENT

The harmonic output of the rf signal generator in ranges H and H covers the VHF television spectrum. This output can be used as a marker signal when aligning VHF tuners with a sweep generator. Refer to the television manufacturer's instructions for the proper alignment procedure.

USING THE RF SIGNAL GENERATOR TO LOCATE TROUBLES

The rf signal generator is an excellent instrument for locating defective circuits in equipment that can be tested with 400-Hz audio, and CW or amplitude modulated rf signals. Not only broadcast band AM and FM receivers, but short wave, marine band, amateur and two-way communications receivers plus almost any electronic equipment using tuned rf circuits can be tested. Audio, i-f and rf sections of receivers can be tested with this single instrument.

The "signal substitution" technique of troubleshooting is used to quickly locate the defective circuit. The "signal substitution" technique uses the output from the rf signal generator to substitute for the missing signal in the defective radio. The signal is usually injected at the speaker first, then moved one stage at a time toward the antenna until no output is obtained. The stage which produces no output is defective. All series components in the defective stage, such as coupling capacitors, transformers, etc. should be checked by the signal injection method to isolate the defect to as small an area as possible.

A typical example of the technique, using the rf signal generator to troubleshoot an AM receiver follows (also refer to Figure 7):

1. Connect test leads from the EXT MOD jacks of the signal generator to both sides of the speaker voice coil.

   CAUTION

   Use a dc blocking capacitor in series with the red probe to the high side of the speaker voice coil if there is any dc potential at this point. If the radio chassis is common to earth ground and the speaker voice coil is not common to the chassis, also use a dc blocking capacitor in series with the black probe.

2. Set the MODULATION switch to the 400 Hz OUT position.
3. Adjust the MOD LEVEL control for audible 400-Hz tone from the speaker. If the speaker is defective, no tone will be heard.
4. Move the test probes to the input of the audio output amplifier. Connect the black probe to chassis and use the red probe for signal injection. When testing push-pull amplifiers, inject the signal into each amplifier individually and listen for equal volume speaker output from each. If no tone is heard or unbalanced outputs are obtained, the stage is defective.

   Since amplification takes place in the stage, the tone heard in the speaker should be at higher volume than in step 3. Reduce the signal level as required with the MOD LEVEL control for a comfortable listening volume.
5. If the output in step 4 was normal, move the signal injection point to the input of the driver. The gain of the stage should provide a louder tone in the speaker. No tone means that the driver or the coupling to the output amplifier is defective.
6. Move the injection to the input side of the volume control. With the volume set to maximum, there will be less speaker output than in step 5 because an emitter follower has no gain. Check the volume control for smooth operation. No speaker tone indicates a defective component in the emitter follower stage.

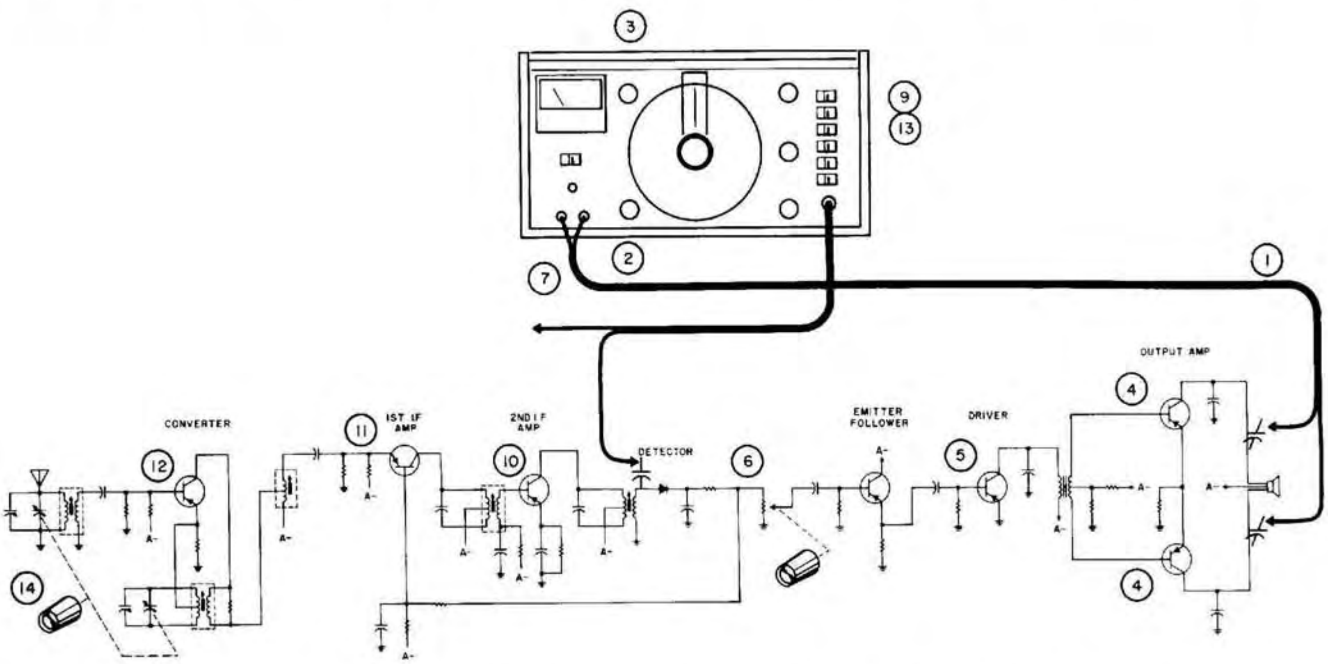


Figure 7. Typical Troubleshooting Technique Using RF Signal Generator

7. The audio section testing is completed, and the 400-Hz output is no longer required. Remove the test leads from the EXT MOD jacks and continue by testing the i-f section.

8. Connect the rf cable from the signal generator RF OUT jack to the input of the detector. Use a dc blocking capacitor in series with the red probe and connect the black probe to chassis.

9. Set the controls on the signal generator to produce a modulated 455-kHz i-f signal output as follows:

MODULATION switch	INT
METER switch	% MOD
MOD LEVEL	30% (as indicated on modulation meter)
RANGE switch	B
Dial	45.5 (scale B)
METER switch	CARRIER
FINE ATTENUATOR	0 dB on carrier meter
ATTENUATOR selectors	Set as many to IN as possible with the 400-Hz tone audible in the speaker

If no tone is heard, the detector is defective.

10. Move signal injection to the input of the 2nd i-f amplifier. The gain of the stage should cause a louder tone from the speaker than in step 9. Reduce the signal level to maintain a comfortable listening level. If no tone is heard, the 2nd i-f amplifier is defective.

11. Move signal injection to the input of the 1st i-f amplifier. The speaker volume should again increase if the stage is operating normally.

12. Move signal injection to the input of the converter. If the tone is still aduible, the i-f section is ok. Continue testing in the rf section.

NOTE

A significant drop in volume as the injection is moved from the detector toward the converter should be checked as a possible source of trouble. It is possible that a defect has been detected, but due to 455-kHz signal radiation it is picked up at a subsequent point in the circuit after the defect with sufficient strength to provide an audible output. Keeping the signal level as low as possible for adequate testing helps reduce radiation and its related possible misinterpretation of test results.

13. With the rf cable still connected to the input of the converter, set the signal generator to any convenient broadcast band frequency (for example, 1000 kHz). Use a moderate signal level.

14. Tune the receiver to approximately the same frequency as selected in step 13. Search for the signal by tuning, as if tuning for a station. If no signal can be found, the local oscillator portion of the converter is defective. If the 400-Hz tone can be tuned in, the antenna circuit is defective.

OTHER USES FOR THE RF SIGNAL GENERATOR

ALIGNMENT

The rf signal generator may be used for alignment of receivers operating on short wave bands, marine bands, and most other frequency bands as well as the AM and FM broadcast bands. Refer to the manufacturer's instructions for alignment procedure.

MEASURING GAIN (Refer to Figure 8)

The voltage gain of an rf amplifier (or group of amplifiers) may be measured as follows:

1. Connect a VTVM or oscilloscope to measure the signal level at some convenient point in the output circuit.

2. Connect the rf signal to the output of the stage being tested.

3. Adjust the signal level for a convenient measurement level on the VTVM or oscilloscope. The signal level must be within the approximate range of normal operation for the stage. Let us assume, for an example, that the VTVM reads 1 volt. Using the carrier meter reading and the step ATTENUATOR settings, note the total attenuation in dB. Let us assume, for example, that the total attenuation is —54 dB.

4. Move the signal injection to the input of the amplifier.

5. Using the step ATTENUATOR's and FINE ATTENUATOR control, reduce the signal level until the VTVM or oscilloscope shows the same reading as in step 3. Again note the total attenuation. Let us assume for our example, that this total attenuation is —78 dB.

6. The gain of the stage (or group of stages) being tested is the difference between the total attenuation in step 5 and the total attenuation in step 3. In our example, the gain is 24 dB.

$$\begin{array}{r} 78 \text{ dB} \\ -54 \text{ dB} \\ \hline 24 \text{ dB gain} \end{array}$$

NOTE

This is a check of voltage gain, not power gain. Variations in impedance between the two injection points can substantially affect the reading in dB. Losses of non-gain circuits may be checked by the same method as gain.

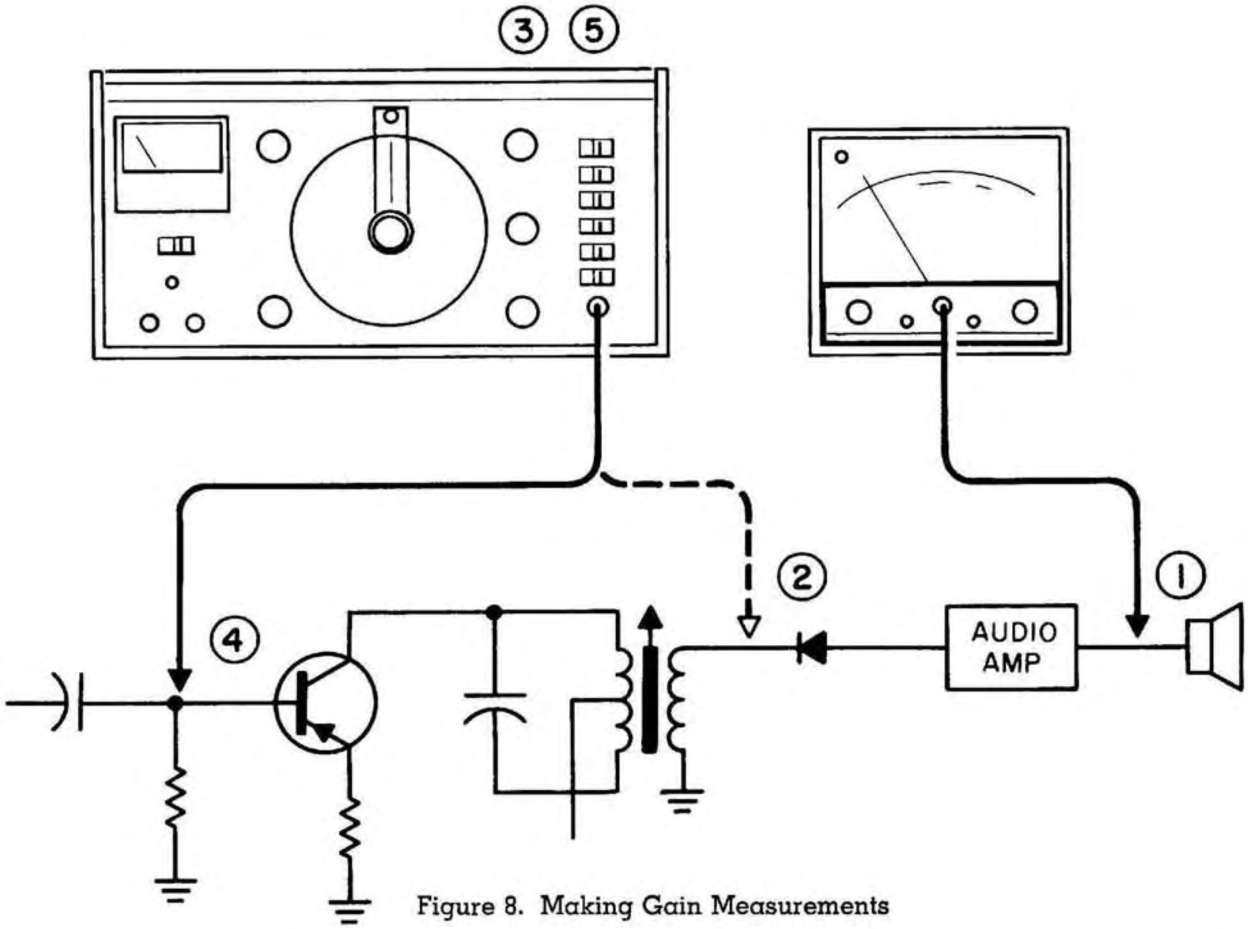
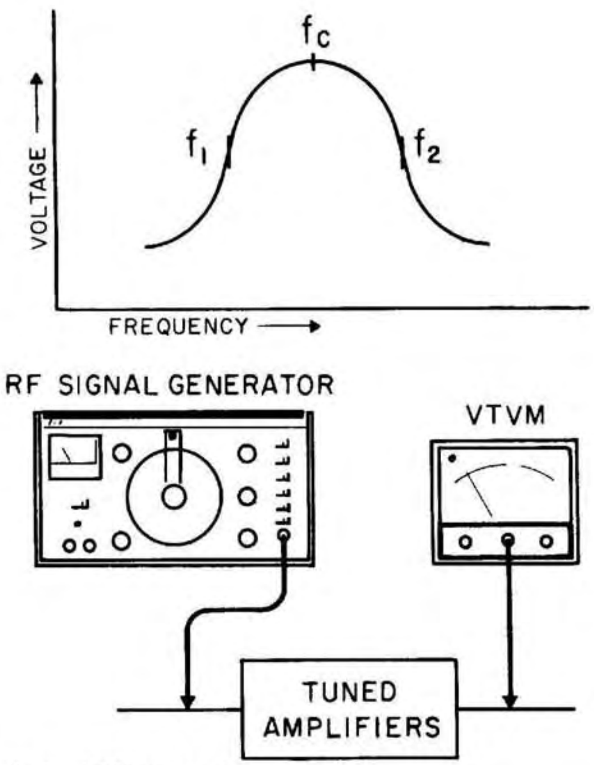


Figure 8. Making Gain Measurements



At f_c the VTVM reads maximum.

At f_1 and f_2 the VTVM reads $\frac{max}{2}$ (—6 dB)

Bandwidth $= f_2 - f_1$

Figure 9. Measuring Bandwidth

MEASURING BANDWIDTH (refer to Figure 9)

The bandwidth of a stage or group of stages (such as an entire i-f section) may be measured as follows:

1. Connect a VTVM or oscilloscope to measure the output level of the circuit being measured.
2. Inject rf signal at the input of the circuit being measured.
3. Tune the frequency of the signal generator for maximum output on the VTVM or oscilloscope (f_c).
4. Decrease the frequency of the signal generator until the VTVM or oscilloscope reads one half the value in step 3. Note the frequency (f_1).
5. Increase the signal generator frequency past the maximum VTVM reading until the VTVM reads the same as in step 4. Again note the frequency (f_2).
6. The difference between f_1 and f_2 is the bandwidth.

NOTE

This procedure uses the standard —6 dB voltage points (one half maximum voltage) for measurement of bandwidth. Other criteria may be substituted if desired.

Another method of measuring bandwidth is to use a sweep generator as the signal source, the rf signal generator as a marker generator, and display the results on an oscilloscope. This method presents a visual display similar to the response curve shown in figure 9.

CIRCUIT DESCRIPTION

The following circuit description is made with reference to simplified block diagram Figure 10 and the schematic diagram. Oscillator stage Q-1 is operative for all ranges. The desired operating band is selected by range selector switch S2, and tuning is performed by tuning capacitor C-41. The output of oscillator Q-1 is coupled to buffer amplifier Q-2. This stage isolates the oscillator from the modulator and detector buffer stages. In addition, the emitter follower configuration of this stage provides a low output impedance which is applied across FINE ATTENUATOR control R-60. Two outputs are provided from buffer amplifier Q-2. The first is applied through FINE ATTENUATOR R-60 to the input of the modulator Q-3. The second output is coupled to detector buffer amplifier Q-4.

The modulator stage operates as a variable gain RF amplifier. The gain of this stage is varied by the application of audio voltage from the MOD LEVEL control R-79. With a fixed RF input determined by the setting of R-60, the instantaneous output is varied at an audio rate. Either internal or external audio modulation can be employed. Internal modulation is provided by the two-stage audio oscillator consisting of Q-9 and Q-10. The output frequency is approximately 400 Hz. The output of this oscillator is coupled to MODULATION selector switch S-3. The generator can be modulated externally by application of an audio voltage to the EXT MOD jack. This audio signal is also coupled to the MODULATION selector switch S-3. Either the internal or external modulation is supplied to MOD LEVEL adjustment R-79 by the MODULATION selector switch S-3. The amplitude of the audio signal is sampled by modulation detector D-8 which provides a d-c voltage proportional to the audio signal level. This is applied to METER switch S-4. When the METER switch is in the % MOD position, the modulation detector output is switched to meter amplifier Q-11 and from there to the carrier and modulation meter M-1. The meter is calibrated to indicate per cent modulation relative to the amplitude of the modulating voltage supplied. In the CW position of the MODULATION switch no audio voltage is applied to modulator Q-3.

MODULATION switch S-3 is designed to make available at the EXT MOD jacks the output of the internal audio oscillator when the switch is in the 400 HZ OUT position. This signal is useful in signal tracing audio circuits.

The RF output level of modulator Q-3 is sampled by RF detector D-3. The d-c output of the detector is supplied to METER switch S-4. When the METER switch is in the CARR position, the detector voltage is supplied to meter amplifier Q-11 and from there to the carrier and modulation meter M-1. The relative output level of modulator Q-3 is indicated on meter M-1 in decibels.

The output of modulator Q-3 is coupled into the attenuator switching network consisting of switches S-5 through S-10. The output of the attenuator is supplied to RF OUT jack J-1. The RF cable provided with the generator has a built-in 50Ω termination. When this cable is connected to the RF OUT jack J-1, the generator is effectively terminated in 50Ω. Under these conditions (a 50Ω output termination) a 0 db indication on meter M-1 indicates an RF signal level of 100,000 μv at the output of modulator Q-3. The actual RF voltage level appearing at RF OUT jack J-1 is determined by the settings of ATTENUATOR switches S-5 through S-10 as described in the OPERATING section of this manual.

Internal reference oscillators are provided for calibration of the RF carrier frequency. Crystal controlled 1 MHz oscillator Q-5 and 100 KHz oscillator Q-6 are provided for this purpose. The XTAL CALIBRATOR switch S-2 selects either the 1 MHz oscillator output or the 100 KHz oscillator output and applies the selected signal to detector Q-7. The calibration signal is then heterodyned against the carrier signal supplied through detector buffer Q-4. When the difference frequency is within the audible frequency range, this is amplified by audio amplifier Q-8 and deliverd to the speaker. The audio frequency decreases as the frequency of the generator approaches a harmonic of either the 1 MHz or the 100 KHz oscillator. When the frequencies are equal, a zero beat indication is obtained at the speaker.

CALIBRATION OF 100 KHz OSCILLATOR

The 100 Kilohertz calibration oscillator provided in the Model E-200D is of the L-C type and is extremely stable with respect to temperature and aging. If it is ever desired to check the accuracy of this oscillator, proceed as follows:

1. Remove the plug button provided on the bottom of the generator case. This makes the 100 KHz oscillator coil accessible for adjustment.
2. Set the RANGE SWITCH to Band A.
3. Set MODULATION SWITCH to CW position.
4. Set the TUNING DIAL to 10 on the A band (100 KHz). No output level adjustments are required.
5. Set the XTAL CALIBRATOR SWITCH to the 1 MHz position.
6. Slowly adjust the frequency dial until an exact zero beat is obtained at the speaker output.
7. Set the XTAL CALIBRATOR SWITCH to the 100 KHz position.
8. Adjust the 100 KHz oscillator coil through the access hole on the bottom of the unit very slowly to obtain an exact zero beat indication at the speaker output.
9. Reset the XTAL CALIBRATOR SWITCH to the 1 MHz position and verify that the unit is at the exact zero beat position. The 100 KHz oscillator is now calibrated against the internal 1 MHz crystal oscillator.
10. Replace the plug button in the access hole on the bottom of the generator case.

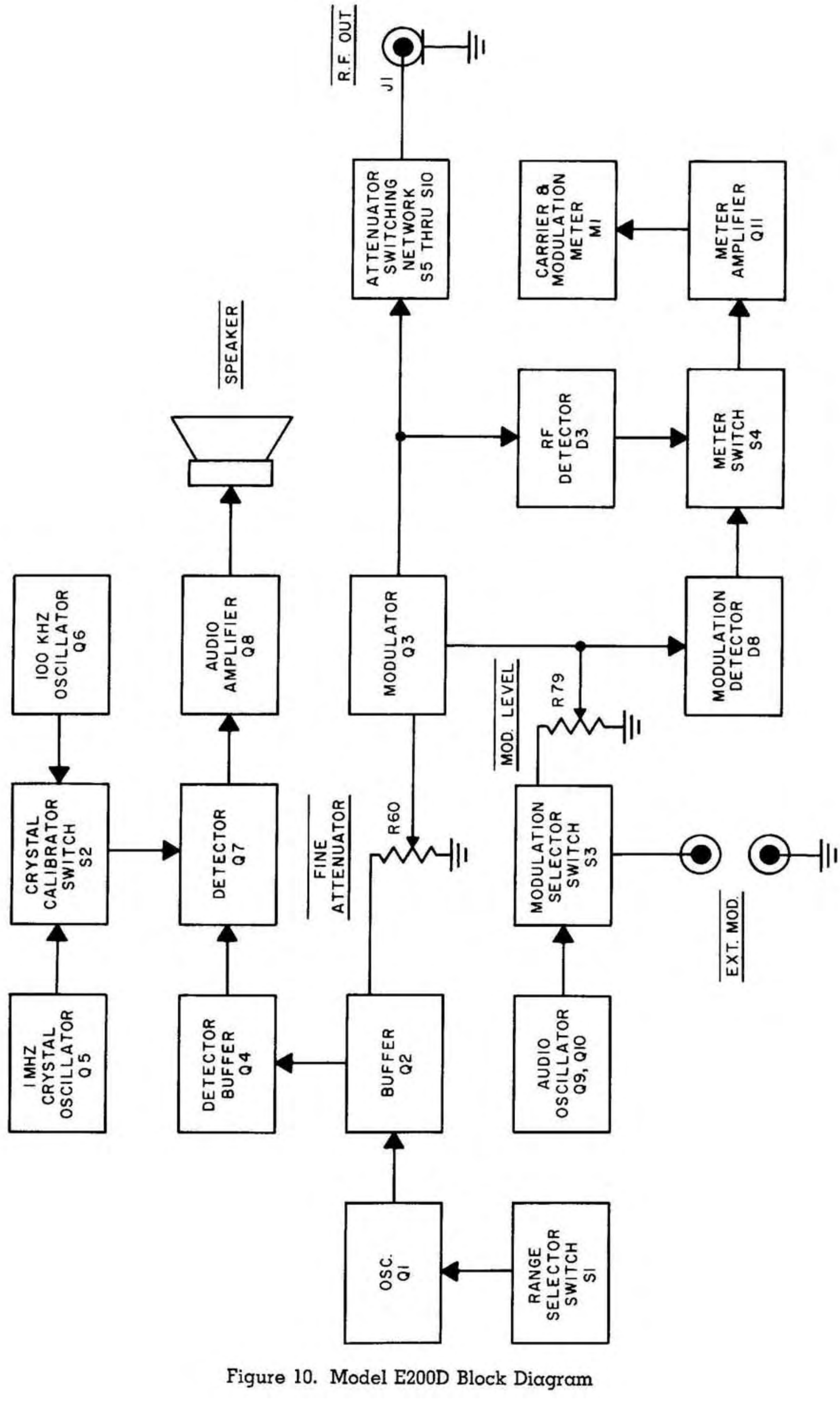


Figure 10. Model E200D Block Diagram

WARRANTY SERVICE INSTRUCTIONS

1. Refer to the maintenance section of the instruction manual for adjustments that may be applicable.
2. Defective parts removed from units which are within the warranty period should be sent to the factory prepaid with model and serial number of product from which removed and date of product purchase. These parts will be exchanged at no charge.
3. If the above-mentioned procedures do not correct the difficulty, pack the product securely (preferably in original carton or double-packed). A detailed list of troubles encountered must be enclosed as well as your name and address. Forward prepaid (express preferred) to the nearest B & K-Precision authorized service agency.

Contact your local B & K-Precision Distributor for the name and location of your nearest service agency, or write to

Service Department

B & K-Precision Product Group
DYNASCAN CORPORATION
2815 West Irving Park Road
Chicago, Illinois 60618

ONE YEAR LIMITED WARRANTY

"DYNASCAN warrants that each product manufactured by it will be free from defects in material and workmanship under conditions of normal use and service for a period of one (1) year from the date of purchase from an authorized DYNASCAN distributor. DYNASCAN will, at its option, repair or replace any product or component not conforming with the foregoing warranty and which is returned, transportation prepaid, to our factory or our authorized service contractor. *DYNASCAN shall not otherwise be liable for any damages, consequential or otherwise.* DYNASCAN makes no other express warranties. *Any implied warranties (including any warranty of merchantability) are limited in duration to (1) one year from the date of purchase.* This warranty does not apply to (i) damage resulting from unauthorized alterations and repairs, misuse, negligency or accident; or (ii) damage resulting from improper installation, connection or adjustment otherwise than in accordance with DYNASCAN's authorized Instruction Manual. This warranty is void if the serial number has been altered, defaced or removed. DYNASCAN reserves the right to discontinue any model at any time or change specifications or design without notice and without incurring any obligation. To register this warranty, the enclosed DYNASCAN warranty registration card should be completed and mailed to DYNASCAN CORP., 1801 W. Belle Plaine Avenue, Chicago, Illinois 60613, within ten (10) days after date of purchase.

480-108-9-001E

B & K MODEL E-200D PARTS LIST

SCHEMATIC SYMBOL	DESCRIPTION	B & K PART No.
	MISCELLANEOUS	
T-1	Output Transformer	061-011-9-001
T-2	Power Transformer 117V AC Primary	065-060-9-001
T-2	Power Transformer 117/234V AC Primary	065-060-9-002
ME-1	Meter, 2¼", 200 μA, 600 Ω	320-027-9-001
	Fuse, ¼ amp. 3AG	191-251-3-104
	Case, Top & Back	272-080-9-902
	Case, Sides & Bottom	272-070-9-903
	Cursor Marker	380-144-9-001
	Glamor Cap (Black)	384-008-9-001
PL-1	Neon Lamp w/100K Resistor	401-001-9-002
	Line Cord 3-wire	420-013-9-001
	RF Cable Assembly	532-004-1-000
	Speaker, 8 Ω, 2¼"	580-005-9-001
	Clip Tinnerman (Speaker)	652-027-9-001
	Red Jewel w/Nut	750-003-9-001
	Knob, Small	751-005-9-002
	Knob, Large	751-005-9-004
	Knob, Cursor Drive Assembly	521-079-9-001
	Dial Frequency	756-005-9-903
	Dial Drive, Planetary	769-042-9-001
	Extender Shaft	769-047-9-001
	Coupling, ¼" Shaft	769-057-9-001
	Binding Post, Red	773-022-9-805
	Binding Post, Black	773-023-9-805
	Instruction Manual	480-108-9-001
	Container, Shipping	500-170-9-001
	Fillers, Carton	503-047-9-001
	Attenuator Printed Circuit Board Complete	532-004-1-100

NOTE: Standard value resistors and capacitors are not listed, values may be obtained from schematic diagram.

Minimum charge $5.00 per invoice. Orders will be shipped C.O.D. unless previous open account arrangements have been made or remittance accompanies order. Advance remittance must cover postage or express charge.

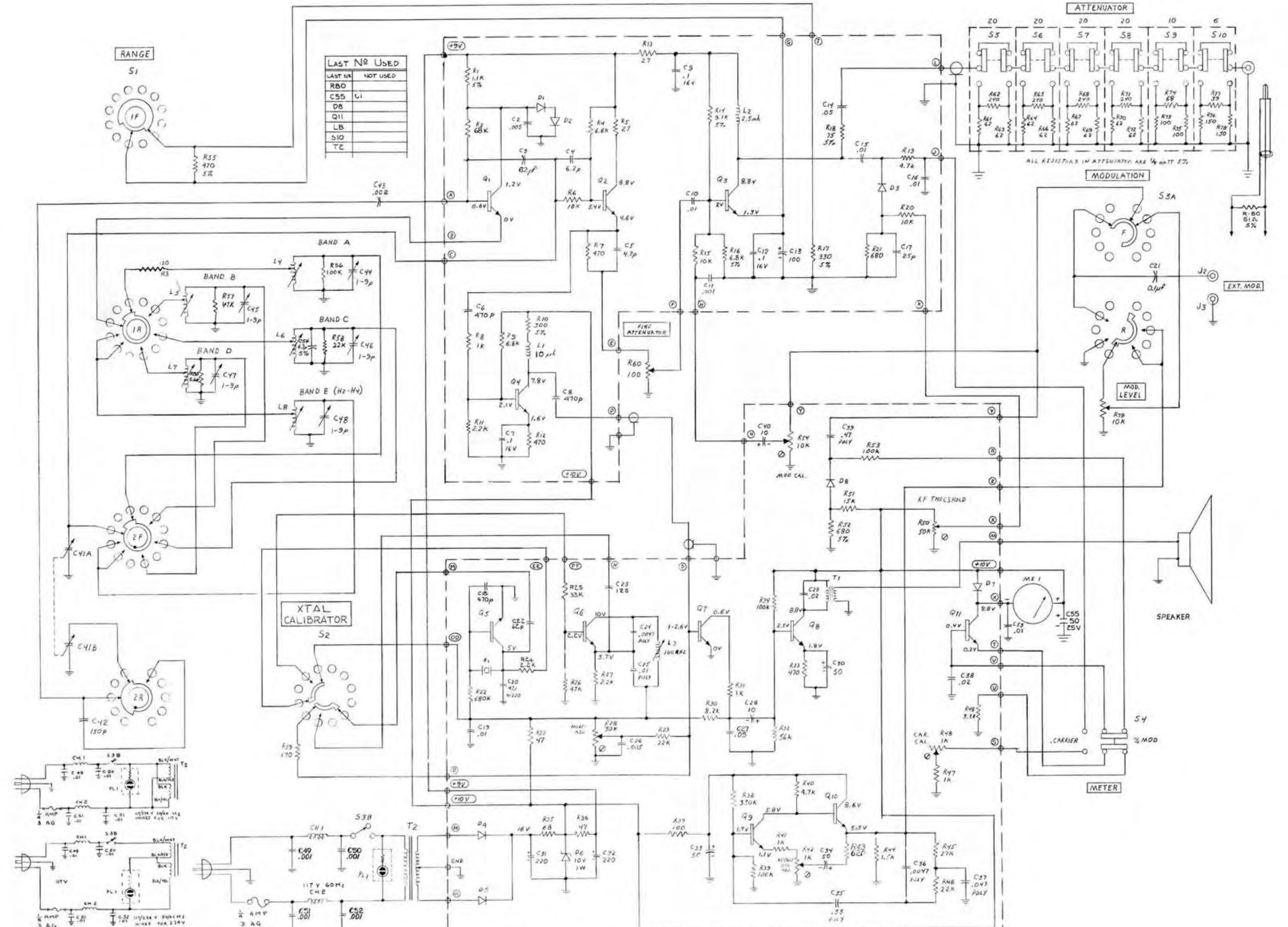
Specify serial number when ordering replacement parts.

B & K MODEL E-200D PARTS LIST

488-101-9-002F

SCHEMATIC SYMBOL	DESCRIPTION	B & K PART No.
	CONTROLS	
R-28	30K Ω, Trim Pot—Mixer Adjust	008-049-9-002
R-42, 48	1K Ω, Trimpot—Carrier Cal. & Audio Osc.	008-068-9-001
R-50	50K Ω, Trimpot—RF Threshold	008-093-9-001
R-54	10K Ω, Trimpot—Mod. Cal.	008-058-9-001
R-60	100 Ω, Fine Attenuator	008-132-9-001
R-79	10K Ω, Pot. Mod. Level	008-133-9-001
	CAPACITORS	
C-41A, 41B	Dual, Var. Condenser	029-010-9-001
	DIODES AND TRANSISTORS	
D-1, 2, 4, 5, 7	Diode, Silicon, 1 Amp 600 PIV	151-018-9-001
D-3	Diode, Germanium	150-003-9-001
D-6	Diode, Zener, 10V, 1 W, 5%	152-016-9-001
D-8	Diode, Germanium	150-001-9-001
Q-1	NPN, Transistor	176-040-9-001
Q-2, 5, 7, 8, 11	NPN, Transistor	176-021-9-001
Q-3	NPN, Transistor	176-022-9-001
Q-4	NPN, Transistor	176-005-9-001
Q-6, 9, 10	NPN, Transistor	176-020-9-001
	SWITCHES	
S-1	Range Rotary Switch	083-097-9-001
S-2	Xtal Rotary Switch	083-103-9-001
S-3	Mod. Selector Rotary Switch	083-099-9-001
S-4	Slide Switch Meter	084-014-9-001
S-5, 6, 7, 8, 9, 10	Slide Switch (Step Attenuator)	084-029-9-001
	COILS AND CHOKES	
CH-1, 2	Choke, Line Filter	041-034-9-001
L-1	Choke, 10 mh	041-001-9-023
L-2	Peaking Coil 2.5 mh	041-028-9-001
L-3	Oscillator Coil 100 KHz	044-011-9-001
L-4	Oscillator BAND "A" 100 KHz-370 KHz	044-022-9-001
L-5	Oscillator BAND "B" 370 KHz-1.4 MHz	044-022-9-002
L-6	Oscillator BAND "C" 1.4 MHz-5.1 MHz	044-022-9-003
L-7	Oscillator BAND "D" 5.1 MHz-16 MHz	044-022-9-004
L-8	Oscillator BAND "E" 16 MHz-54 MHz	044-022-9-005

COMPOSITE
499-024-9-001J



LAST Nº USED	
LAST Nº	NOT USED
R80	
C55	C1
D8	
Q11	
L8	
S10	
T2	

488-101-9-001H

NOTE: SCHEMATIC SUBJECT TO CHANGE WITHOUT NOTICE