RCA Victor

Gain Data Instructions (2nd Edition)

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SERVICE DIVISION • RCA MANUFACTURING COMPANY, INC. • CAMDEN, N. J., U. S. A.

A Service of the Radio Corporation of America

Introduction

Complete gain data is published in the Service Notes for RCA Victor radio receivers, starting with 1941 models.

For speed and convenience, the gain data is printed on the schematic diagram of each model.

For the utmost utility in signal tracing, so that any trouble may be quickly narrowed down to a single point, the gain is given for each separate RF, IF and AF tube, and also for each RF and IF transformer. In addition, the AVC voltage is shown, and also the oscillator grid voltage on all frequency ranges.

Tube Gain Is Shown With 3-Volt Fixed Bias

To provide more definite operating conditions, the R-F and I-F gain data for RCA Victor Service Notes is now obtained with a fixed 3-volt bias on the AVC bus.

To duplicate this gain data, it is necessary to connect a 3-volt bias battery temporarily to the set as indicated in the service notes. The negative side of the 3-volt battery should be connected to the AVC bus, and the positive side of the battery should be connected to the chassis. In a.c.-d.c. receivers, the positive side of the battery should be connected to the common negative wiring.

The battery may consist of two small flashlight cells connected in series.

Use of the fixed bias eliminates necessity for shorting out the AVC circuit, and minimizes difficulty due to over-loading with resultant grid current.

(A few RCA Service Notes show gain data with the AVC working, and also shorted out.)

Gain Tolerance

Several variable factors influence the gain of sections in a receiver, including **tubes,** which may vary more than 25%, **regeneration,** adjustment of the **tuned circuits, accuracy of tuning, line voltage,** and **experience** on the part of the operator.

Obviously it is impossible to specify definite receiver tolerances. Two-to-one variations may be regarded as normal.

Make Gain Checks With 600 kc Signal Fed into Antenna Terminal of Receiver

All gain checks throughout the entire receiver circuit (radio-frequency, intermediate-frequency, and audio-frequency sections) can be made with the signal generator connected to one point (the antenna terminal), and tuned to one frequency (600 kc).

This naturally simplifies the procedure and speeds up the work.

Preliminary Set-Up

Signal Generator Connections

Connect the output cable of the signal generator to the antenna and ground terminals of the receiver.

Dummy Antenna

Use the recommended dummy (usually 100, 200, or 300 mmfd. for the broadcast band) in series with the antenna terminal.

Tune Signal Generator to 600 kc

Adjust the signal generator to 600 kc, or to some frequency near 600 kc that is free from local broadcast interference.

The exact frequency is not important. If the signal generator is slightly off calibration, set it to the 600 kc mark, because both the receiver and the Chanalyst will be tuned to the actual generator frequency even though this may be slightly above or below 600 kc. In other words, the generator frequency is the starting point, and both the receiver and the Chanalyst will be tuned to it.

Use 400 Cycle Audio Modulation (30%)

Set the signal generator to give 400 cycle internal audio modulation on the 600 kc signal. The percentage of modulation is not important in making gain checks, but the standard value of 30% is recommended.

Connect 3-Volt Fixed Bias to AVC Bus

Strap two 1-½ volt flash-light cells together and connect them in series. Connect the negative to the AVC bus in receiver. Connect the positive to the chassis, or to the common negative wiring in a.c.-d.c. sets.

Tune the Receiver to 600 kc

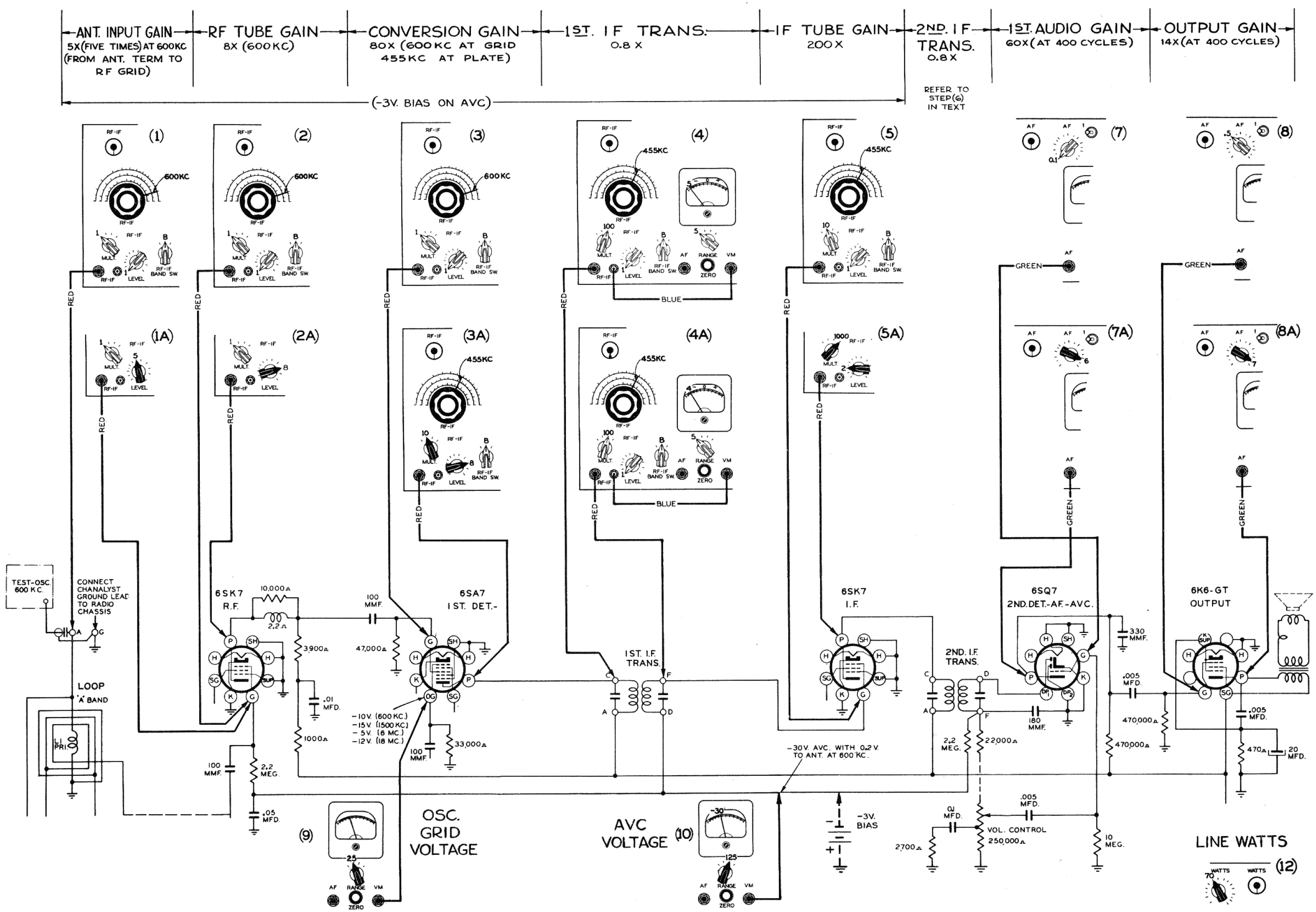
Tune the receiver carefully for peak output on the signal (assumed to be 600 kc) from the generator.

Connect Chanalyst Ground Lead to the Receiver Chassis

Connect the clip on the end of the Chanalyst ground lead (black) to the receiver chassis. In a.c.-d.c. sets, connect the Chanalyst ground lead to the common negative wiring.

Tune RF-IF Channel to 600 kc

Place the Chanalyst RF-IF probe (red cable) on the receiver antenna terminal. Set the RF–IF controls as shown in step (1), and tune the RF–IF channel for peak output as indicated on the RF–IF magic eye.


ANT. INPUT GAIN
5X (FIVE TIMES) AT 600KC (FROM ANT. TERM TO RF GRID)
RF TUBE GAIN
8X (600KC)
CONVERSION GAIN
80X (600KC AT GRID 455KC AT PLATE)
1ST. IF TRANS.
0.8 X
IF TUBE GAIN
200X
2ND. IF TRANS.
0.8X
REFER TO STEP (6) IN TEXT
1ST. AUDIO GAIN
60X (AT 400 CYCLES)
OUTPUT GAIN
14X (AT 400 CYCLES)
(-3V. BIAS ON AVC)
TEST-OSC 600 K.C.
CONNECT CHANALYST GROUND LEAD TO RADIO CHASSIS
LOOP
'A' BAND
6SK7 R.F.
6SA7 1ST. DET.-
1ST. I.F. TRANS.
6SK7 I.F.
2ND. I.F. TRANS.
6SQ7 2ND.DET.-AF.-AVC.
6K6-GT OUTPUT
-10V. (600 KC.)
-15V. (1500 KC.)
-5V. (6 MC.)
-12V. (18 MC.)
-30V. AVC. WITH 0.2 V. TO ANT. AT 600 KC.
-3V. BIAS
VOL. CONTROL 250,000Ω
OSC. GRID VOLTAGE
AVC VOLTAGE
LINE WATTS
(1)
(1A)
(2)
(2A)
(3)
(3A)
(4)
(4A)
(5)
(5A)
(7)
(7A)
(8)
(8A)
(9)
(10)
(12)

Making Gain Checks

(Refer to drawing on facing page, which shows each step in checking a typical radio receiver.)

Step (1). Antenna Input Gain

With the RF-IF channel tuned to the 600 kc signal, and with the **level** and **multiplier** controls set at 1 and 1, as shown at (1) in the drawing, adjust the output of the signal generator until the RF–IF Magic Eye just closes (or electronic voltmeter reads–5 volts). See note under "Miscellaneous Data" about using the electronic voltmeter in conjunction with the magic eye.

Move the RF–IF probe from the antenna terminal to the grid prong of the RF tube. If there is a gain, the RF–IF magic eye will overlap. Adjust the **level** control until the eye is just closed. In this example, the **level** control has been turned from 1 to 5, indicating a voltage step-up or gain of five times from the antenna terminal to the grid of the first tube. (This is the gain from the antenna coil to the tuned loop.)

The service note for this particular model (Model 16T3) specifies an approximate gain of five times from the antenna terminal to the RF control grid. If the gain is appreciably less than specified, the tracking should be checked. The simplest and most definite method for doing this is described later.

Step (2). RF Tube Gain

Place RF–IF probe on grid of RF tube. Set RF–IF input controls as shown in (2). Adjust signal generator output until RF–IF Magic Eye is just closed.

Move RF–IF probe to plate of RF tube. Adjust **level** control until RF–IF eye just closes. If new **level** setting is 8 the gain from grid to plate is 8 times.

Move the probe to the grid of the 1st-detector tube, which is resistance-coupled to the RF tube in this particular model. There should be only a slight drop through the coupling circuit.

With a receiver that has transformer coupling between the RF and 1st-detector tubes, check the gain from primary to secondary.

Step (3). 1st-Detector Conversion Gain

Place the RF–IF probe on 1st-detector control grid and turn RF–IF **level** and **multiplier** controls to 1 and 1. Adjust signal generator output so the RF–IF Magic Eye is just closed.

Move the RF–IF probe to the 1st-detector plate. Tune the RF–IF channel for peak output on the IF signal. Adjust **multiplier** and **level** controls so RF–IF Magic Eye is just closed.

In this example (3A) the **multiplier** is turned from 1 to 10 (10 times), and the **level** control is turned from 1 to 8 (8 times). The conversion gain is therefore 80 times.

The IF signal voltage across the plate circuit of the 1st-detector tube is 80 times greater than the 600 kc signal voltage across the 1st-detector grid circuit.

If the conversion gain is appreciably less than specified, it may be due to incorrect IF alignment, but first try retuning the set for peak output. (The voltmeter channel provides an excellent output meter for this purpose by using it to measure AVC voltage.)

Step (4). Checking 1st-IF Transformer

On this set, there is a decrease or loss, instead of a gain, from primary to secondary of the 1st-IF transformer.

Place the RF–IF probe on the primary of the 1st-IF transformer and adjust the signal generator output so the RF–IF Magic Eye just closes, or so the electronic voltmeter indicates –5 volts.

Move the probe to the secondary. In this example (4A), the eye opens slightly, and the meter drops to –4 volts, indicating a loss of 5 to 4 or 0.8 times.

Step (5). IF Tube Gain

Place RF–IF probe on the IF grid. Set **multiplier** at 10 and **level** at 1. Adjust signal generator output so that RF–IF Magic Eye is just closed.

Move RF–IF probe to plate of the IF tube and adjust **multiplier** and **level** controls until eye is just closed.

In this example (5A) the **multiplier** is turned from 10 to 1000 (100 times) and the **level** control is turned from 1 to 2 (2 times). The gain is therefore 100 times 2, or 200.

Owing to the high gain obtained in the IF stage, there may be some tendency toward regeneration or oscillation when measuring IF gain. To minimize this effect, the RF–IF probe should be placed so that it does not increase coupling between the I–F grid and plate circuits.

Step (6). Checking 2nd-IF Transformer

In this particular set, the 2nd-IF transformer has the same loss as the 1st-IF transformer, and is checked as in step (4), except with **multiplier** at 1,000.

Step (7). 1st-Audio Gain

In making audio gain checks, the tone controls should be set for maximum response.

Turn Chanalyst AF control to 0.1 and set AF toggle switch to 1.

Place the AF channel probe (green cable) on the arm of the receiver volume control. Adjust the receiver volume control so the AF channel Magic Eye just closes.

Move the probe to the 1st-audio grid. There should be only a slight drop through the coupling condenser.

With the AF channel probe on the grid of the 1st-audio tube, reset the receiver volume control so the AF eye is just closed.

Move the AF probe to the plate of the 1st-audio tube. Adjust the AF channel control so the AF eye is just closed. In this example (7A) the control is turned from 0.1 to 6.0, indicating a voltage step-up or gain of 60 times (0.1 divided into 6.0 equals 60).

Move the AF probe to the grid of the output tube. There should be only a slight drop through the coupling capacitor.

If the receiver has a phase inverter tube, check its gain in the same way as described for the 1st-audio tube.

Step (8). Output Stage Gain

Turn Chanalyst AF control to 0.5 and place AF probe on the grid of the output tube. Adjust the receiver volume control so the AF Magic Eye is just closed.

Move the probe to the plate of the output tube. Adjust the AF channel control so the AF eye is just closed. In this example (8A), the control is turned from 0.5 to 7.0, indicating a voltage step-up or gain of 14 times (0.5 divided into 7.0 equals 14).

With a push-pull (or parallel push pull) output stage, check each tube separately, with the other output tube (or tubes) removed from the set. This gives a definite check on each output tube. The published data gives the gain with all of the output tubes in operation.

On some sets, particularly AC–DC types, hum voltage on the output tube plate may be quite high, reaching values of 10 or 15 volts. In such cases, it is necessary to use a strong signal at the output grid, so that the signal at the plate will be high enough to "mask" the hum voltage. An AF Adaptor, stock No. 9907, will prove very helpful in making accurate AF gain measurements because it attenuates the 60- and 120-cycle hum components without materially affecting the 400-cycle signal. The adaptor is designed to "plug-in" between the AF cable and the AF input jack on chanalyst.

Step (9). Measuring Oscillator Grid Voltage

Checking the oscillator grid current (by measuring the rectified oscillator signal across the oscillator grid leak) is a valuable and quick method of determining whether the oscillator is working throughout the range on each band.

Connect the electronic voltmeter channel probe (blue cable) to the oscillator grid. Observe the voltage reading while tuning across each band.

The published RCA gain data gives the oscillator grid voltage at the high-frequency and low-frequency end of each band.

It will be observed that the oscillator grid voltage generally increases when tuning through stations. The published data is taken at quiet points on the dial.

"Dead spots" or points where the oscillator ceases to work may be caused by absorption due to resonance in adjacent coils through defects in shorting action of the range switch and will show up as dips in the oscillator grid voltages.

Step (10). Measuring AVC Voltage

Remove the 3-volt bias battery.

Connect the voltmeter channel probe (blue cable) to the AVC bus. Turn the signal generator from low output up to high output and observe the AVC voltage. It will be found to increase rapidly at first, and then more slowly up to an approximate maximum (in this particular example) of –30 volts.

In the published RCA gain data, the AVC voltage is given for a large input to the antenna. The specified AVC voltage may be regarded as the approximate maximum.

Checking Oscillator Frequency

Place the oscillator channel probe (brown cable) near the oscillator circuit in the receiver. Tune the oscillator channel for maximum indication on the oscillator channel Magic Eye.

The correct oscillator frequency should equal the sum of the input signal frequency plus the intermediate frequency. In this particular example, the input signal is 600 kc, and the intermediate frequency is 455 kc, so the correct oscillator frequency is 600 plus 455, or 1,055 kc.

Wattage Indicator

Plug the Chanalyst into a 110-volt a.c. supply, and plug the receiver into the Chanalyst **test watts** receptacle. Turn "on" the power switches of both Chanalyst and receiver. After a brief warm-up period, adjust the **watts** control so the **watts** Magic Eye just closes. The setting of the **watts** control indicates the power consumption of the receiver.

The rated power consumption of radio receivers (as printed in service data and on the chassis or cabinet labels) is seldom accurate to within 10% of the actual consumption.

Quick Over-All Gain Checks on RF, IF, and AF Sections

The approximate over-all gain of any section (RF, IF, or AF) can be found by multiplying together the gain of the parts that comprise the particular section.

Using the accompanying diagram as an example:

The RF section extends from the antenna terminal to the 1st-detector grid. This includes the antenna transformer (which in this case has a primary coil and a loop secondary) with a gain of 5, and the RF tube, with a gain of 8. The over-all RF gain is 5 times 8, or 40.

The 1st-detector conversion gain, and the 1st-IF transformer should be checked separately.

The IF tube and the 2nd-IF transformer may be checked as one section, feeding IF signal from the generator into the IF grid.

The AF section extends from the 1st-AF grid to the output plate, and includes the 1st-AF tube and the output tube. The over-all AF gain is 60 times 14, or approximately 800.

Miscellaneous Data

Electronic Voltmeter May Be Used in Conjunction With the Magic Eye

When tuning the RF–IF channel, the electronic voltmeter may be used as an auxiliary resonance indicator, and for level checks as shown in step (4).

Connect the voltmeter cable (blue) between the VM jack and the RF–IF tip jack.

Set the **meter range** to 5, and, with no signal input to the RF–IF channel, adjust the **zero** control so the meter needle is at center zero.

When connected in this way, the meter indicates the rectified signal voltage at the **grid** of the RF–IF Magic Eye. Approximately –5 volts are required to just close the eye.

Tracking at 600 kc

In using the published gain data it is advisable to check, and if necessary adjust, the tracking between the RF tuned circuits and the oscillator circuit.

The following method is unequalled for speed and accuracy because no "rocking" of the gang condenser is necessary.

(a) Align the IF to the correct IF frequency.

(b) Feed a 600 kc signal into the antenna circuit of receiver through the specified dummy antenna.

(c) Place RF–IF probe (red cable) on grid of first tube in receiver, and tune the RF–IF channel to the 600 kc signal.

(d) Carefully turn the receiver gang condenser for maximum output on the RF-IF Magic Eye (not for maximum output on the receiver.)

(e) Leave the receiver gang in this position even though the receiver dial may indicate 10 or 20 kc off, because this is the correct setting of the gang to tune the receiver's antenna circuit to 600 kc.

(f) Connect the electronic voltmeter probe (blue cable) to the AVC circuit of the receiver.

(g) Adjust the oscillator magnetite core or low-frequency padder for maximum AVC voltage as indicated on the electronic voltmeter.

Another simple method is as follows:

Place the RF–IF probe (red cable) on the 1st-detector plate and tune the Chanalyst to the 600 kc signal.

Turn the receiver gang condenser for **maximum output** on the RF–IF "eye." Adjust Chanalyst RF–IF controls so the RF–IF eye is just closed. Adjust the oscillator core or low-frequency padder in the set for maximum **opening** of the RF–IF "eye." (The "eye" opens when the oscillator in the set is tuned to the correct point because the AVC voltage increases and this decreases the gain of the RF or 1st-detector.)

Input to Loop Receivers

Some loop receivers have a link that must be opened when feeding the signal generator into the antenna terminal.

On console loop receivers, such as RCA Model 110K, if only the chassis has been brought in for service, and the loop is not available, connect the signal generator through an .01 mfd. capacitor to the control grid of the first tube. Tune the receiver for maximum AVC voltage on the 600 kc signal.

Chanalyst Ground Connection to AC-DC Receivers

On a.c.-d.c. receivers where one side of the 110-volt line is connected to the chassis, attach the Chanalyst ground lead to the receiver chassis.

If the 110-volt line is isolated from the receiver chassis, connect the Chanalyst ground lead to the common negative wiring in the chassis.

In either of these cases it must be remembered that the receiver and the Chanalyst may be "hot," and due care must be taken to prevent grounding of either. The best method is to use an isolating power transformer as described below.

Isolating Power Transformer

When working on a.c.-d.c. receivers, it is becoming general practice to use a one-to-one ratio power transformer between the a.c. power supply and the receiver. This avoids grounding difficulties and certain hum conditions.

The isolation power transformer may be used in conjunction with the Chanalyst when testing a.c.-d.c. receivers by plugging one winding of the transformer into the Chanalyst **test-watts** receptacle, and connecting the a.c.-d.c. receiver to the other winding.