SERVICE AND MAINTENANCE NOTES

for

# TYPE 1170-B
# AND
# TYPE 1170-BT
# FREQUENCY-MODULATION MONITORS

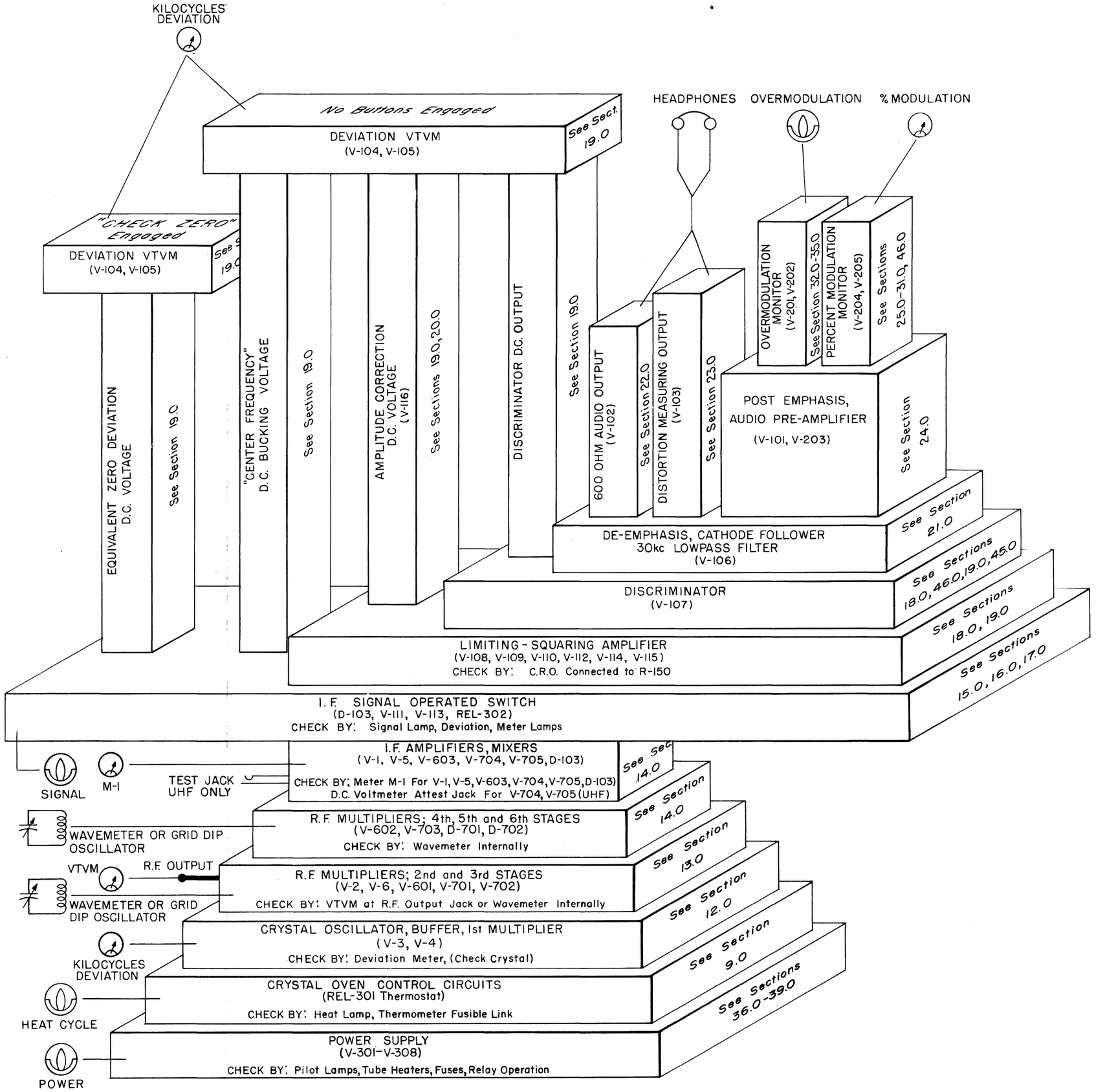
Form 666-SD
August, 1953

GENERAL RADIO COMPANY

CAMBRIDGE 39 MASSACHUSETTS

NEW YORK CHICAGO LOS ANGELES

U. S. A.




# THE 1170-B FREQUENCY DEVIATION MONITOR

A DELICATELY BALANCED INSTRUMENT

A GUIDE FOR THE TROUBLE SHOOTER

# SERVICE AND MAINTENANCE INSTRUCTIONS

# for

# TYPE 1170-B AND TYPE 1170-BT

# FREQUENCY-MODULATION MONITORS

## 1.0 FOREWORD

1.1 These Service Instructions together with the information given in the Operating Instructions should enable the user to locate and correct ordinary difficulties resulting from normal usage.

1.2 Most of the components mentioned in these instructions can be located by referring to the photographs, Figures S-1 through S-6.

1.3 Major service problems should be referred to the Service Department which will cooperate as far as possible by furnishing information and instructions, as well as by shipping any replacement parts which may be required. If the instrument is more than one year old, a reasonable charge may be expected for replacement parts or for complete reconditioning if the instrument is returned.

1.4 Changes of transmitter frequencies which require shifting of channel or offset operation should be considered a major problem, and the Service Department should be consulted for detailed information.

1.5 Detailed facts giving type and serial numbers of the instrument and parts, present channel of operation, changes in frequency desired, as well as operating conditions should always be included in your report to the Service Department.

1.6 The Type 1170-BT model is used for monitoring the sound transmitters of television stations. The operating procedure is the same for all models, and any differences are noted in the instructions. Otherwise, reference will be made to the Type 1170-B for brevity.

## 2.0 SPARE PARTS

### 2.1 Tubes:

2.11 It is recommended that the following spare tube types be kept in reserve since they are sometimes difficult to obtain on short notice:

1 - Type 815
2 - Type 3 - 4 Amperite
1 - Type 6AS7-G
1 - Type 2050
1 - Type 6SU7-GTY
1 - Type 5964
1 - Type 9005 (for UHF only)

2.12 At transmitter installations where other equipment does not already require additional spare tubes sufficient to satisfy F.C.C. requirements under Rule 3.687 (h)(1), the following spare tubes are required:

| Number Used | Type | Spares Required | Number Used | Type | Spares Required |
|---|---|---|---|---|---|
| 1 | 12AU7 | 1 | 2 | 6C4 | 1 |
| 1 | 6AK6 | 1 | 1 | 815 | 1 |
| 2 | 6AG7 | 1 | 2 | OD3/VR 150 | 1 |
| 1 | 6AC7 | 1 | 1 | 5964 | 1 |
| 1 | 6SN7-GT | 1 | 2 | 6SU7-GTY | 1 |
| 1 | 6AG5 | 1 | 1 | 991 | 1 |
| 2 | 2050 | 1 | 1 | 6SK7 | 1 |
| 2 | 6SJ7 | 1 | 1 | 6AS7-G | 1 |
| 6 | 6AL5 | 3 | 1 | OC3/VR 150 | 1 |
| 2 | 6SL7-GT | 1 | 2 | 3-4 | 1 |

| Number Used | Type | Spares Required | |
|---|---|---|---|
| 1 | 6BE6 | 1 | Type 1170-P1 R-F Tuning Unit; Used in Type 1170-BT1 |
| 1 | 6AG5 | 1 | |
| 1 | 6BE6 | 1 | Type 1170-P2 R-F Tuning Unit; Used in Type 1170-BT2 |
| 1 | 6AG5 | 1 | |
| 3 | 6AG5 | 2 | Type 1170-P3 R-F Tuning Unit; Used in Type 1170-BT3 |
| 1 | 6J6 | 1 | |
| 1 | 9005 | 1 | |

### 2.2 Rectifiers:

The selenium rectifier elements, RX-304 through RX-311, used in the plate voltage supply are standard units and may be obtained locally, or directly from the General Radio Company. If replacements are necessary, use the same type as supplied with the monitor. The type used is:

*Seletron #5Q1, GR #2RE-7
(rated 250 ma. d.c. - 130 v. rms)

### 2.3 Fuses:

2.31 A stock of spare fuses should always be on hand. Refer to Instruction Book for ratings.

2.32 Fusible links (GR #547-50), used to protect the crystal oven against overheating, should al-

*Radio Receptor Company, New York, New York.

ways be on hand. Order replacements directly from the General Radio Company.

## 3.0 RECOMMENDED TEST EQUIPMENT

3.1 Suitable test equipment is required for checking and servicing the monitor. This equipment may be divided into two major categories; equipment essential to adequate testing, and auxiliary equipment which is extremely helpful:

3.12 Essential equipment

Vacuum-Tube Voltmeter (Such as General Radio Type 1800-A)
Grid-Dip Oscillator
Volt-Ohm Milliammeter (20,000 ohm per volt d.c. preferred)

3.13 Auxiliary equipment

Oscilloscope
Test Oscillator 130 to 170 kc
Audio Oscillator 50 to 15,000 cycles (Such as General Radio Type 1301-A, Type 1304-A, Type 1302-A)

## 4.0 LOCALIZING FAILURES

If there is a failure:

Refer immediately to the BLOCK DIAGRAM located inside the front cover. The trouble must be a tube or circuit component which when replaced will restore normal operation.

If any block fails, all blocks resting on it will be out of order. Conversely if any block is operating properly, (as evidenced by any indicator resting upon it), all blocks on which it rests down to and including the crystal oscillator block, but not necessarily including the crystal oven heat control circuit and the power supply, must be operating properly.

Therefore, to locate the blocks in which the trouble exists, note ALL the blocks that have failed (as evidenced by indicators resting upon them). The trouble will be in the lowest block above which everything has failed, or in some section of the power supply. Once the block is located, refer to the section of the service notes as indicated on the block in question.

4.1 Examples in the use of the Block Diagrams

4.12 EXAMPLE NUMBER 1

4.121 If an audio program monitoring output is present at the 600-ohm AUDIO OUTPUT jack on the front panel but no audio is available to operate the Distortion and Noise Meter at terminals No. 9 and No. 12 (ground) on the lower Jones Plug located near the upper left corner on the rear of the instrument, the Block Diagram indicates the following condition:

4.122 The de-emphasis network, the cathode follower tube V-106 (6C4) and the 30-kc low-pass filter circuit are operating properly.

4.123 The trouble must be in the Distortion measuring output circuit V-103 (6SL7-GT) or its components.

4.13 EXAMPLE NUMBER 2

4.131 If the Deviation VTVM indicator reads off scale with no switches engaged, but the audio circuits are normal, the Block Diagram shows the following to be true:

1. All the blocks below the audio output down to and including the crystal oscillator are functioning.
2. The thermometer will indicate whether the crystal oven circuits are functioning.
3. Engaging the CHECK ZERO button will indicate whether V-104 (6SU7-GTY) and V-105 (6SU7-GTY) circuits are functioning properly. If they are working correctly, then,
4. The trouble must be in either the Center Frequency D-C Bucking Voltage circuits, the Amplitude Correction D-C Voltage circuits, or the Discriminator D-C Output circuits, refer to Section 19 or 20 as indicated on the block in question.

## 5.0 ROUTINE MAINTENANCE

Scheduled tube checking should take place every six months and defective tubes discarded.

5.1 Regulated B+ Voltage. The regulated B+ voltage must be 300 volts d.c.

5.11 R-317, located on the power supply chassis between the high-voltage rectifier stack and V-301 (6AS7-G), can be adjusted to satisfy this condition.

5.12 Regulated B+ voltage may be measured from terminals No. 3 or No. 6 of V-301 (6AS7-G) to ground.

5.2 Discriminator Input Tube Heater Supply.

The heater voltage of the limiter amplifier tube V-108 (815) must be maintained between 6.3 and 6.9 volts d.c. with 115 (or 230) volts a-c input. This may be measured across C-314 which is located on the power supply just below the time delay relay.

5.21 R-341 shunts R-320 and can be changed to satisfy these conditions. Location is just below the time delay relay (S-301).

5.22 If the tube is changed, the heater voltage must be measured and possibly adjusted.

5.23 Drifting or erratic readings of the KILOCYCLES DEVIATION meter and noise in the Distortion measuring output can be caused by this tube.

5.3 Audio Heater Supply.

The heater voltage on the cathode follower stage tube V-106 (6C4) and the audio amplifier tube V-103 (6SL7) should be between 6 and 6.6 volts d.c.

5.31 This voltage can be measured across C-308 located in the power supply section to the right of T-302.

5.32 R-307 can be shunted or R-340 can be reduced in value to adjust this voltage.

## 6.0 GENERAL

If the monitor becomes inoperative, a few simple checks should be made before removing the instrument from the rack. All pilot lamps can be replaced from the front panel. The meter illuminating lamps can be reached by removing the meter front cover by means of the two screws.

6.1 Make certain that the voltage and frequency of the power line source are correct, and that no surges or erratic conditions are present.

6.2 Test the power supply line cords for open circuits or for poor contacts in the power outlets.

6.3 Check the fuses, F-301, F-302, F-303, and F-304, mounted at the rear of the instrument for open circuits, and make certain that they are tight in their clips.

6.4 Make certain that the EXTERNAL METER cable connector socket SO-103 has connections between pins* #7 and #10 and between pins* #9 and #12 and is mating with plug PL-103. IF THIS CONNECTOR IS NOT IN PLACE, THE KILOCYCLES DEVIATION AND MODULATION METERS WILL BE INOPERATIVE.

## 7.0 MONITOR INOPERATIVE

7.1 HEAT lamp does not light; refer to Section 8.0.

7.2 HEAT CYCLE lamp does not operate normally; refer to Section 9.0.

7.3 Neither MONITOR pilot lamp nor MODULATION meter lamps light when MONITOR switch is turned on; refer to Section 10.0.

7.4 HEAT and MONITOR pilot lamps light but the MONITOR is completely inoperative; refer to Section 11.0.

7.5 KILOCYCLES DEVIATION meter does not indicate to red line or beyond when CHECK CRYSTAL switch is engaged; refer to Section 12.0.

7.6 Crystal Oscillator does not provide signal at R-F OUTPUT jack J-1, J-601 or J-701; refer to Section 13.0.

7.7 R-F input meter, M-1, cannot be set to 100 with r-f signal applied; refer to Section 14.0.

7.8 R-F input meter, M-1, can be set to 100 with r-f signal applied but SIGNAL lamp and KILOCYCLES DEVIATION meter lamps do not burn brightly; refer to Section 15.0.

7.9 SIGNAL lamp lights to full brilliance with no r-f signal applied; refer to Section 16.0.

7.10 SIGNAL and KILOCYCLES DEVIATION meter lamps light to full brilliance, panel ZERO adjustment can be set, DEVIATION meter on scale but panel meters otherwise inoperative; refer to Section 17.0.

7.11 SIGNAL lamp lights to full brilliance, KILOCYCLES DEVIATION meter reads off scale low, MODULATION meter does not read; refer to Section 18.0.

7.12 KILOCYCLES DEVIATION meter erratic, monitor operating normally otherwise; refer to Section 19.0.

7.13 KILOCYCLES DEVIATION meter off scale high with r-f signal applied, MODULATION meter operating normally; refer to Section 20.0.

7.14 MODULATION meter does not indicate, no audio signal available at AUDIO OUTPUT jack nor at plug PL-104, KILOCYCLES DEVIATION meter indicates properly; refer to Section 21.0.

7.15 No audio monitoring signal available at AUDIO OUTPUT jack, monitor operating normally otherwise; refer to Section 22.0.

7.16 No audio signal at AUDIO OUTPUT plug for distortion measurement, monitor operating normally otherwise; refer to Section 23.0.

7.17 Neither MODULATION meter nor OVER MODULATION lamp indicates but an audio signal is present at the AUDIO OUTPUT jack; refer to Section 24.0.

7.18 OVER MODULATION lamp operates normally but MODULATION meter does not work on any position of MODULATION PEAKS switch; refer to Section 25.0.

7.19 MODULATION meter does not indicate on the POSitive position of MODULATION PEAKS switch and shows 1/2 sensitivity on FULL WAVE position, monitor operating normally otherwise; refer to Section 26.0.

7.20 MODULATION meter does not indicate on the FULL WAVE position of MODULATION PEAKS switch only, monitor operating normally otherwise; refer to Section 27.0.

*Unless external meters are used. Leads to external meters will then be #7 and #8 and #11 and #12, respectively.

7.21 MODULATION meter does not indicate on the NEGative position of the MODULATION PEAKS switch and shows 1/2 sensitivity of the FULL WAVE position, monitor operating normally otherwise; refer to Section 28.0.

7.22 ZERO SET adjustment does not affect MODULATION meter zero reading, monitor operating normally otherwise; refer to Section 29.0.

7.23 MODULATION meter reads upscale with no modulation applied to transmitter; refer to Section 30.0.

7.24 MODULATION meter does not indicate modulation percentages correctly; refer to Section 31.0.

7.25 OVER MODULATION lamp fails to flash, MODULATION meter indicates normally; refer to Section 32.0.

7.26 OVER MODULATION lamp remains lighted all the time, MODULATION meter indicates normally; refer to Section 33.0.

7.27 OVER MODULATION lamp flashes erratically, MODULATION meter indicates normally; refer to Section 34.0.

7.28 Setting of MODULATION PEAKS dial disagrees with reading of MODULATION meter and/or OVER MODULATION lamp; refer to Section 35.0.

7.29 Power Supply inoperative; refer to Section 36.0.

7.30 Monitor blows fuses; refer to Section 37.0.

7.31 Table of Power Supply Voltages; refer to Section 38.0.

7.32 Resistance Chart, Power Supply Circuits; refer to Section 39.0.

7.33 Noise or distortion level excessive when used with external distortion and noise meter, monitor normal otherwise; refer to Section 40.0.

7.34 Tube microphonic noise excessive on distortion and noise output; refer to Section 41.0.

7.35 Service adjustments; refer to Section 42.0.

7.36 Effects of replacing tubes; refer to Section 43.0.

7.37 Vacuum-tube data; refer to Section 44.0.

7.38 Table of intermediate frequency voltages, discriminator section; refer to Section 45.0.

7.39 Table of r-m-s audio signal voltages, discriminator and modulation meter sections; refer to Section 46.0.

7.40 Table of d-c test voltages, modulation meter section; refer to Section 47.0.

8.0 HEAT LAMP DOES NOT LIGHT

8.1 Test HEAT lamp P-402 and thermometer illuminating lamp P-403 behind thermometer window plate for open filaments. THESE LAMPS ARE SERIES OPERATED.

8.2 Test fuses F-303 and F-304 for open circuits.

8.3 Check that HEAT switch, S-404, operates properly.

8.4 Test resistor, R-411, for an open circuit.

8.5 Test transformer T-302 between pins #7 and #8 for continuity and for proper voltage. Refer to Section 38.0.

9.0 HEAT CYCLE LAMP DOES NOT OPERATE NORMALLY.

9.1 Test HEAT CYCLE lamp, P-404, for an open filament, and short to ground; also R-415.

9.2 Check fusible link located inside the crystal oven.

9.21 Due to the cold flowing of the soft metal used, the mounting screws of the link should be tightened occasionally.

9.22 CAUTION: Do not replace the fusible link with a substitute. Serious damage to the oven, crystal, thermometer, and thermostat will result. Always keep a few spare fusible links on hand. Replacement links can be shipped promptly from the factory when those supplied with the instrument are exhausted. The part number of the link is 547-50.

9.3 Test fuses F-303 and F-304 for open circuits.

9.4 Test operation of thermostat S-405.

9.41 Breaks in the mercury column can be corrected by carefully heating the bulb so that some of the mercury is driven into the top well. When the heat is removed, the column should then be intact.

9.42 Proper operation of the thermostat should be checked by connecting a d-c voltmeter across the coil of the relay and noting that the voltage across this coil drops to .05 volt or less when the thermostat operates. Never use an ohmmeter to test the thermostat for continuity.

9.5 Check relay REL-301 for proper operation.

9.51 Test coil for an open circuit. The d-c coil resistance should be approximately 1000 ohms.

9.52 Check operation of armature. About 3.5 volts d.c. should appear between terminals #3 and #4, when the thermostat contacts are open circuited.

9.53 Relay contacts should be clean and free from pitting. These may be cleaned using crocus cloth.

9.6 Check resistance between pins #1 and #2 in plug PL-302 with the plug removed. This resistance should be 105 ohms ± 10% and will check the condition of the oven heater resistors as well as the fusible link.

9.7 Test resistor R-321 for an open circuit.

9.8 Test resistors R-337 and R-338 for open or short circuits and proper values.

9.9 Test capacitors C-322, C-323, and C-324 for open or short circuits.

9.10 Test transformer T-302 between pins #5 and #10 and pins #7 and #8 for continuity and proper voltages. Refer to Section 38.0.

9.11 Check output of rectifier RX-303. This should be -14.0 v. d.c. ±10% from the negative terminal to ground.

9.12 Check condition of thermometer. Refer to procedure of Section 9.41.

10.0 NEITHER MONITOR PILOT LAMP NOR MODULATION METER LAMPS LIGHT WHEN MONITOR SWITCH IS TURNED ON.

10.1 Check that all tube heaters are burning.

10.2 Check MONITOR fuses F-301 and F-302 for open circuits.

10.3 Check that MONITOR switch, S-403, operates properly.

10.4 Test transformer T-301 between pins #9 and #18 for proper voltage and continuity. Refer to Section 38.0.

10.5 Test lamps P-401 (MONITOR) and P-408 (inside MODULATION meter) for open filaments.

10.6 Test resistors R-410 and R-414 for open circuits.

11.0 HEAT AND MONITOR PILOT LAMPS LIGHT BUT THE MONITOR IS COMPLETELY INOPERATIVE.

NOTE: This condition can be verified by observation of V-303 (OD 3 - VR/150) (in the Power Supply Section) which should glow when B+ is applied through the time delay relay S-301; r-f meter (M-1) will not show a deflection; engaging CHECK CRYSTAL switch, S-402, will not cause KILOCYCLES DEVIATION meter to show a reading.

11.1 Check operation of time delay relay S-301. This should operate within one minute or less of the time the MONITOR switch, S-403, is turned on.

11.2 Refer to Sections 36.0, 37.0, and 38.0.

12.0 KILOCYCLES DEVIATION METER DOES NOT INDICATE TO RED LINE OR BEYOND WHEN CHECK CRYSTAL SWITCH IS ENGAGED.

NOTE: The CHECK CRYSTAL switch located on the panel connects the panel meter into the grid circuit of the second multifier stage V-2 (6AG7). By measuring the grid current at this point, the output of the crystal is indirectly determined, hence it is necessary that the crystal be oscillating and that the first multiplier stage be correctly tuned, to obtain a deflection.

12.1 Meter does not deflect at all:

12.11 Check that the crystal Q-1 is plugged into its jacks in the oven.

12.12 Check tubes V-2 (6AG7), V-3 (6AC7) and V-4 (12AU7) and operating voltages. Refer to Sections 43.0 and 44.0.

12.13 Connect an a-c vacuum-tube voltmeter from the stator of C-22 to ground. A voltage at this point of approximately 3 volts indicates that the crystal is oscillating.

12.14 Test resistors R-8 through R-21, R-32 and R-33 for open or short circuits and proper values.

12.15 Test capacitors C-9 through C-23 and C-42 (in crystal oven) for open or short circuits and leakage.

12.16 Test inductors L-3, L-4, and L-5 for open or short circuits.

12.17 Check condition of KILOCYCLES DEVIATION meter M-401.

12.171 Full-scale sensitivity is 100 - 0 - 100 microamperes d.c. The internal resistance is 450 ohms ±20%.

12.172 Refer to Section 14.32.

12.18 Make certain that CHECK CRYSTAL switch S-402 operates properly.

12.19 Test resistor R-162 for open or short circuit.

12.2 Meter deflects, but not far enough:

12.21 Check adjustment of capacitor C-13; refer to Section 42.23.

12.22 Try replacing tubes V-2 (6AG7), V-3 (6AC7), and/or V-4 (12AU7); refer to Sections 42.0 and 44.0.

12.23 Test resistors R-10 and R-11 for open or short circuits and proper values.

12.24 Test capacitor C-11 for an open or short circuit.

12.25 Check condition of KILOCYCLES DEVIATION meter M-401.

13.0 CRYSTAL OSCILLATOR DOES NOT PROVIDE SIGNAL AT R-F OUTPUT JACK J-1, J-601 OR J-701.

NOTE: The R-F drive from the third multiplier stage, regardless of frequency or channel, may be measured with a VTVM at the R-F OUTPUT jack J-1, J-601, or J-701.

13.1 Check the following crystal harmonic multiplier tubes and their associated components, V-2 (6AG7), V-3 (6AC7), V-6 (6AG5), V-601 (6AG5), V-701 (6AG5), and V-702 (6AG5). Refer to Section 43.0 and 44.0.

13.2 With MONITOR power switch OFF, check tuned circuits C-13, L-3 and C-7, C-8, and L-2 using a grid-dip oscillator. The indications obtained should check the frequency and sharpness of resonance of the tuned circuits. If the indication obtained by checking C-7, C-8, and L-2 does not give a sharp resonance dip at the frequency shown for the second multiplier stage in Table I in the Instruction Book, C-8 (button - mica feed-through capacitor) is probably defective. This defective component should be replaced before attempting further checks. (See Section 42.23.) Low output from V-2 (6AG7), with adequate deflection on CHECK CRYSTAL meter, is an indication of the necessity for this test.

14.0 R-F INPUT METER, M-1, CANNOT BE SET TO 100 WITH R-F SIGNAL APPLIED.

14.1 Make certain that the r-f input signal level is adequate. This should be greater than 1 volt r.f.

14.2 This meter responds directly to the amplitude of the i-f signal delivered to the input of the discriminator section. When the monitor circuits are normal, this signal level will be proportional to the r-f input signal level.

14.21 Check the i-f amplifier tube V-1 (6AK6) and its associated circuit.

14.22 Check the crystal diode rectifier D-103 (Discriminator Section).

14.221 Forward resistance should be 300 ohms, or less. Back resistance should be 100 kilohms, or greater. An ohmmeter may be used to determine these resistance values.

14.3 Check condition of meter M-1.

14.31 Full-scale sensitivity is 200 microamperes d.c. ±2%. The internal resistance is 500 ohms ±20%.

14.32 If the meter is defective, a replacement may be ordered from the Service Department. The General Radio Company will not assume responsibility for any local repairs to this meter. Substitution of any standard 200 μa meter can be made for test purposes.

14.4 Check the R-F Tuning Units: F.M., Type 1170-P1; T-V Channels 2-6, Type 1170-P1; T-V Channels 7-13, Type 1170-P2; T-V Channels 14-83, Type 1170-P3;

14.41 Type 1170-P1 R-F Tuning Unit (F.M., T-V Channels 2-6):

14.411 Check tuned circuits C-30, L-8, C-33, using a grid-dip oscillator. A sharp resonance dip should be observed at the frequency indicated for this stage in Table I of the Instruction Book. If it is not possible to obtain a sharp dip, it is probable that C-33 is defective and should be replaced.

14.412 Check mixer tube V-5 (6BE6) and its associated circuit; refer to Sections 42.251 and 44.0.

14.42 Type 1170-P2 R-F Tuning Unit (T-V Channels 7-13):

14.421 Check the frequency multiplier stage V-602 (6AG5) and its associated circuit; refer to Sections 42.27 and 44.0.

14.422 Check mixer tube V-603 (6BE6) and its associated circuit; refer to Section 44.0.

14.43 Type 1170-P3 R-F Tuning Unit (T-V Channels 14-83):

14.431 Check the fifth frequency multiplier stage V-703 (6J6) and its associated circuit; refer to Section 44.0. Tuning and output of this stage may be checked with an absorption-type wavemeter.

14.432 Check operation of input circuit to sixth frequency multiplier stage, D-701 and D-702, by measuring the d-c voltage developed across R-715. Under normal conditions, this voltage should be 12-20 volts d.c.

14.4321 Check the condition of the frequency multiplier crystal diodes D-701 and D-702; refer to Section 14.221.

14.433 Check the operation of the mixer stage V-704 (9005) by measuring the d-c voltage at the TEST JACK J-702. This test point connects across R-716. This must be at least 1 volt d.c. Check V-704 (9005); refer to Section 42.28 and 44.0.

14.434 Check the i-f amplifier stage V-705 (6AG5) by checking the tube and its associated components. Insert an i-f signal at the TEST JACK J-702. Meter M-1 should indicate proportional to the input signal level.

15.0 R-F INPUT METER M-1, CAN BE SET TO 100 WITH R-F SIGNAL APPLIED BUT SIGNAL LAMP AND KILOCYCLES DEVIATION METER LAMPS DO NOT BURN BRIGHTLY.

The SIGNAL and DEVIATION meter lamps should burn very dimly with the MONITOR switch turned on and no r-f signal applied to the instrument.

15.1 Monitor otherwise operative.

15.11 Test resistors R-333, R-412, and R-413 for open or short circuits, and relay REL-302 contacts.

15.12 Test lamps P-405 and P-407 for open filaments.

15.2 Monitor otherwise inoperative.

15.21 Check that neon bulb V-113 (991) glows only when an r-f signal is present. Check that voltage regulator tube V-110 (OD3/VR150) glows only when an r-f signal is present.

15.22 Check tube V-111(5964) and operating voltages; refer to Sections 43.0 and 44.0.

15.23 Test resistors R-165, R-166, R-167, R-169, R-172, R-173, and R-332 for open or short circuits and proper values.

15.24 Test capacitor C-137 for an open or short circuit and for leakage.

15.25 Check relay REL-302 for proper operation.

15.251 Test coil for an open winding. The d-c resistance should be about 1000 ohms.

15.252 Check operation of armature. About 33 volts d.c. should appear between terminals #1 and #8, when meter M-1 reads 100 or greater.

15.253 Relay contacts should be clean and free from pitting. These may be cleaned using crocus cloth or a very fine file.

15.26 Check tube V-307 (3-4) and operating voltages.

15.27 Test resistors R-171, R-332, R-334, and R-335 for open or short circuit and proper values.

15.28 Test capacitor C-321 for an open or short circuit and for leakage.

15.29 Test transformer R-302 between pins #5 and #11 for continuity and for proper voltage; refer to Section 38.0.

15.30 Refer to Section 9.9.

16.0 SIGNAL LAMP LIGHTS TO FULL BRILLIANCE WITH NO R-F SIGNAL APPLIED.

16.1 Check relay REL-302 for proper operation; refer to Section 15.25.

16.2 Check rheostat R-334. This should be set to the full counter clockwise position. Refer to Section 42.92.

16.3 Check tubes V-111 (5964) and V-307 (2050) and operating voltages. (Lamp should go out when V-307 is removed from its socket.)

16.4 Check tube socket of V-307 for accidental short circuits or grounds.

17.0 SIGNAL AND KILOCYCLES DEVIATION METER LAMPS LIGHT TO FULL BRILLIANCE, PANEL ZERO ADJUSTMENT CAN BE SET, KILOCYCLES DEVIATION METER ON SCALE BUT PANEL METERS OTHERWISE INOPERATIVE.

17.1 Check that tubes V-110 (OD 3/VR 150) and V-113 (991) glow normally, when an r-f signal is applied.

17.11 Check that relay REL-302 is operating normally and that contacts #2 and #3 are closing conducting the B+ voltage to the proper circuits. Refer to Section 15.25.

18.0 SIGNAL LAMP LIGHTS TO FULL BRILLIANCE, KILOCYCLES DEVIATION METER READS OFF SCALE LOW, MODULATION METER DOES NOT READ.

This assumes that the transmitter is within ±6 kilocycles of its correct carrier frequency, as verified by an outside frequency measuring service, and is being modulated in a normal manner.

18.1 Measure the voltage across capacitor C-116 to ground using a d-c vacuum-tube voltmeter. This should be -12.75 d.c. +1 volt with the transmitter on frequency.

18.2 Check tubes V-112 (6AL5), V-114 (6SK7), V-115 (6AL5), V-110 (OD/VR150), V-109 (6AG7), V-108 (815), and V-107 (6AL5) and operating voltages in that order. Refer to Sections 39.0, 43.0, and 44.0.

18.3 Test resistors R-140, R-146, R-147, R-148, R-149A, R-149B, R-149C, R-150, R-151, R-153, R-154, R-155, R-159, R-170, R-174, R-175, and R-176 for open and short circuits and proper values.

18.4 Test capacitors C-122 through C-125, C-129, C-131, C-140 through C-143 for open and short circuits and leakage.

18.5 Test capacitor C-120 for a short circuit but DO NOT DISTURB setting. This capacitor is factory set and MUST NOT be changed as it affects the overall accuracy and performance of the monitor.

18.6 Test inductors L-102 and L-105 for open or short circuits.

18.7 Check tube V-304 (3 - 4) and operating voltages. Removing V-107 (6AL5) or V-304 (3 - 4) will cause the meter to deflect off-scale LOW.

19.0 KILOCYCLES DEVIATION METER ERRATIC, MONITOR OPERATING NORMALLY OTHERWISE.

KILOCYCLES DEVIATION meter readings are dependent on many circuits so that a series of tests to localize the trouble must be made.

19.1 Make certain that the transmitter frequency is stable and not subject to erratic variations due to a-c power line surges or variations. Refer to Section 6.1.

19.2 Isolation of trouble to (a) the crystal oscillator or (b) discriminator output and meter circuits:

19.21 In v-h-f monitors (having Type 1170-P1 or 1170-P2 R-F Tuning units), remove the mixer tube V-5 (6BE6) or V-603 (6BE6) and using a very stable external oscillator connect a signal of the correct intermediate frequency (see Calibration Data supplied with the instrument) through a blocking condenser to pin #5 of the tube socket. In u-h-f monitors (having

Type 1170-P3 R-F Tuning Unit) insert the test signal on the tip terminal of the telephone plug in TEST JACK, J-702.

If the readings of the DEVIATION meter are now stable, the difficulty is in the crystal oscillator circuit.

Refer to Section 12.0.

If the readings of the DEVIATION meter are still unstable, the difficulty is in the discriminator section. Refer to Section 18.0.

19.3 Isolation of trouble may also be made as follows as an alternate method to Section 19.2 above.

19.31 Connect to an oscilloscope the i-f frequency from the monitor. This can be obtained by placing a small pickup loop of wire adjacent to the plate leads of the 815 tube, V-108.

19.32 The output of a very stable 140 to 160 kc oscillator can then be connected to the other pair of plates in the oscilloscope. (See data supplied with monitor for I-F frequency.) With the transmitter unmodulated the KILOCYCLES DEVIATION meter stability can be checked by comparing it with the stability of the Lissajous figure on the scope.

19.4 If KILOCYCLES DEVIATION meter is affected by line voltage variations between 105 - 125 volts a.c., check heater voltage on tube V-108. This should be within 5.8 - 6.6 volts d.c.

19.5 Engage CHECK ZERO switch, S-401.

19.51 If KILOCYCLES DEVIATION meter readings are then stable, refer to Section 19.6.

19.52 If KILOCYCLES DEVIATION meter readings are still unstable, refer to Section 19.7.

NOTE: These circuits have very high sensitivities, making location of trouble very difficult. In general, each circuit should be examined carefully for signs of poorly soldered joints, loose contacts, etc. It is quite possible that the trouble will be traced to a wire-wound resistor which has developed an internal erratic contact. An ohmmeter check will not disclose such a fault. Substitute for the suspected element!

19.6 Meter stable with CHECK ZERO switch engaged.

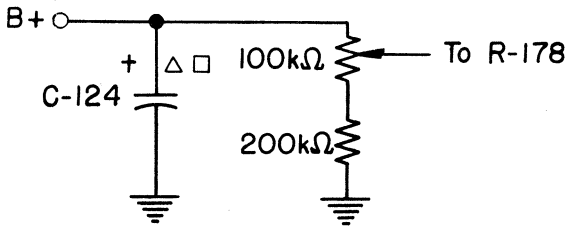
19.61 Discriminator output:

Remove tube V-107 (6AL5). Connect an external battery voltage of -13 volts to pin #7 of the tube socket.

If meter is now stable: Check tube V-107 and associated circuit components (resistors R-140 through R-144; inductor L-102; capacitor C-120).

19.62 B+ Compensation Circuit:

Disconnect the orange-red colored wire from resistor R-178. Connect the following circuit:




Adjust the 100 kΩ rheostat so that the KILOCYCLES DEVIATION meter reads zero deviation.

If the meter is now stable, check resistors R-406 through R-409, R-417, and R-418; otherwise, check R-126, and R-178, R-179, and R-180. Check by substituting another resistor of the same value.

19.63 Compensation Diode, Tube V-116 (6AL5):

Check resistors R-130, R-156 through R-160. This should be done by substituting for each resistor individually. Refer to NOTE, Section 19.52.

19.7 Meter still unstable with CHECK ZERO switch engaged.

19.71 CHECK ZERO switch (S401) may be erratic.

19.72 D-C Vacuum-tube Voltmeter circuit:

19.721 Check tubes V-104 and V-105 and operating voltages; refer to Sections 43.0 and 44.0.

19.722 Check resistors R-124, R-125, R-127, R-128, and R-129 by substituting for each one individually. Refer to NOTE, Section 19.52.

19.723 Check resistors R-404 and R-405 for erratic contacts and leakage to ground. Try substitution of external resistors.

19.724 Remove and replace PL-101 and PL-102 several times to remove any contact resistance which may have developed.

19.7241 Check that the contact resistance of pin #17 and #18 is very low between plug and socket contacts.

20.0 KILOCYCLES DEVIATION METER OFF SCALE HIGH WITH R-F SIGNAL APPLIED, MODULATION METER OPERATING NORMALLY.

These conditions show that all circuits up to and including the discriminator are operating normally.

20.1 Check tube V-116 (6AL5) and operating voltages. Removing this tube should cause the meter to swing off scale toward the plus or HIGH side.

20.2 Check resistors R-126, R-140, R-144, R-156, R-157, R-161, R-177 through R-180, R-406, R-407, R-408, R-417, and R-418 for open or short circuits and proper values.

20.3 Check inductor L-102 and capacitor C-127 for open or short circuits.

21.0 MODULATION METER DOES NOT INDICATE. NO AUDIO SIGNAL AVAILABLE AT AUDIO OUTPUT JACK NOR AT PLUG PL-104. KILOCYCLES DEVIATION METER INDICATES PROPERLY.

21.1 Check tube V-106 (6C4) and operating voltages; refer to Sections 43.0 and 44.0.

21.2 Test resistors R-131 through R-139, and R-145 for open and short circuits and for proper values.

21.3 Test capacitors C-112 through C-116, C-118 and C-119 for open and short circuits and leakage.

21.4 Test filter unit LC-102 for continuity. (About 15,000 ohms from input to output is normal.)

22.0 NO AUDIO MONITORING SIGNAL AVAILABLE AT AUDIO OUTPUT JACK, MONITOR OPERATING NORMALLY OTHERWISE.

22.1 Check tube V-102 (6C4) and operating voltages; refer to Sections 43.0 and 44.0.

22.2 Test resistors R-110 through R-115 for open and short circuits and proper values.

22.3 Test capacitors C-104 and C-105 for open and short circuits.

23.0 NO AUDIO SIGNAL AT AUDIO OUTPUT PLUG FOR DISTORTION MEASUREMENT, MONITOR OPERATING NORMALLY OTHERWISE.

The ADJust DISTortion METER panel control, R-116, must be advanced from its full counter-clockwise position (engraved MONITORING) before an output can be obtained from this source.

23.1 Test filter unit LC-101 for continuity.

23.2 Check tube V-103 (6SL7-6T) and operating voltages; refer to Sections 43.0 and 44.0.

23.3 Test resistors R-116 through R-123, and R-164, for open and short circuits and proper values.

24.0 NEITHER MODULATION METER NOR OVER MODULATION LAMP INDICATES BUT AN AUDIO SIGNAL IS PRESENT AT THE AUDIO OUTPUT JACK.

Check that coaxial input plug, PL-202, in modulation meter section, is firmly seated in its socket, J-101, in discriminator section.

24.1 Check tubes V-101 (6AG5) and V-203 (6SN7-GT) and operating voltages; refer to Sections 43.0 and 44.0.

24.2 Test resistors R-101 through R-109, R-152, and R-215 through R-223 for open or short circuits and proper values.

24.3 Test capacitors C-101, C-102, C-201 through C-204, C-206, and C-207 for open or short circuits and leakage.

24.4 Test inductor L-101 for an open or short circuit.

24.5 Check operation and contacts of MODULATION PEAKS switch S-201.

25.0 OVER MODULATION LAMP OPERATES NORMALLY BUT MODULATION METER DOES NOT WORK ON ANY POSITION OF MODULATION PEAKS SWITCH.

25.1 Check MODULATION meter, M-402, and external meter if used.

25.11 Full-scale sensitivity of M-402 is 600 microamperes d.c. $\pm 2\%$. Internal resistance is 700 ohms $\pm 20\%$.

25.12 If the meter is defective, a replacement may be ordered from the Service Department. The General Radio Company will not assume responsibility for any local repairs to this meter, although such repairs might be necessary in an emergency.

25.2 Test resistor R-163, mounted on EXTERNAL METERS connector PL-103, for proper value.

25.3 Check tubes V-204 (6AL5) and V-205 (6SL7-GT) and operating voltages; refer to Sections 44.0, 46.0, and 47.0.

25.4 Test resistors R-205, R-231, R-233, and R-234 for open and short circuits and proper values.

25.5 Test capacitor C-212 for an open or short circuit.

26.0 MODULATION METER DOES NOT INDICATE ON THE POS. POSITION OF MODULATION PEAKS SWITCH AND SHOWS 1/2 SENSITIVITY ON FULL WAVE POSITION, MONITOR OPERATING NORMALLY OTHERWISE.

26.1 Check tubes V-204 (6AL5) and V-205 (6SL7-GT) and operating voltages; refer to Sections 44.0, 46.0, and 47.0.

26.2 Test resistors R-225, R-228, R-229, and R-232 for open and short circuits and leakage.

26.3 Test capacitors C-203 and C-206 for open and short circuits and leakage.

26.4 Make certain that MODULATION PEAKS switch S-201 operates properly.

27.0 MODULATION METER DOES NOT INDICATE ON THE FULL WAVE POSITION OF MODULATION PEAKS SWITCH ONLY, MONITOR OPERATING NORMALLY OTHERWISE.

27.1 Make certain that MODULATION PEAKS switch S-201 operates properly.

27.2 Test resistor R-202 for an open circuit.

28.0 MODULATION METER DOES NOT INDICATE ON THE NEG. POSITION OF MODULATION PEAKS SWITCH AND SHOWS 1/2 SENSITIVITY ON FULL WAVE POSITION, MONITOR OPERATING NORMALLY OTHERWISE.

28.1 Check tubes V-204 (6AL5) and V-205 (6SL7-GT) and operating voltages; refer to Sections 44.0, 46.0, and 47.0.

28.2 Test resistors R-206, R-224, R-226, R-227, and R-230 for open or short circuits and proper values.

28.3 Test capacitors C-210, C-216, and C-217 for open or short circuits and leakage.

28.4 Make certain that MODULATION PEAKS switch S-201 operates normally.

28.5 Modulation meter off scale toward zero end of scale.

28.51 Check resistors R-205 and R-233 for open circuits.

28.52 Check resistors R-204 and R-234 for short circuits.

28.53 Check tube V-205 (6SL7-GT) and operating voltages; refer to Sections 44.0, 46.0, and 47.0.

29.0 ZERO SET ADJUSTMENT DOES NOT AFFECT MODULATION METER ZERO READING, MONITOR OPERATING NORMALLY OTHERWISE.

29.1 Check tube V-205 (6SL7-GT) and operating voltages; refer to Sections 43.0 and 44.0.

29.2 Test resistors R-204 and R-205 for open and short circuits and proper values.

30.0 MODULATION METER READS UP SCALE WITH NO MODULATION APPLIED TO TRANSMITTER.

Make certain that the transmitter is unmodulated and that noise, hum, or other parasitic modulation is not present, by means of an aural test.

If trouble is present, the meter will usually read at about 20 - 30%, with no modulation applied. The electrical zero adjustment (R-205) will have some effect but will not restore the zero reading.

30.1 Check the voltage across C-301 to be +290 volts ±10%.

30.2 Check the voltage at L-301 #7 to be +420 volts ±10%.

30.3 Check resistors R-301 and R-302 for open and short circuits and proper values.

30.4 Check capacitors C-301 and C-302 for short circuits and leakage.

30.5 If the above voltages are low, check rectifiers RX-304 through RX-311; refer to Section 36.13.

31.0 MODULATION METER DOES NOT INDICATE MODULATION PERCENTAGES CORRECTLY.

31.1 Check calibration of MODULATION meter M-402.

This can be done using a heterodyne frequency meter or a radio receiver. If the latter, extreme care must be taken to avoid spurious responses.

This method makes use of the fact that the amplitude of the carrier frequency component of an f-m wave becomes zero at definite ratios of frequency swing to modulating frequency. It is important that the detector be tuned to the carrier frequency, NOT one of the side band components.

| MODULATION TEST FREQUENCY = 5000 cycles<br>100% MODULATION = ±75 Kc | | | MODULATION TEST FREQUENCY = 1500 cycles<br>100% MODULATION = ±25 Kc | | |
|---|---|---|---|---|---|
| Null Point | Frequency Swing | % Modulation | Null Point | Frequency Swing | % Modulation |
| 1 | 12.0 kc | 16.0% | 1 | 3.6 kc | 14.4% |
| 2 | 27.6 kc | 36.8% | 2 | 8.25 kc | 33.0% |
| 3 | 43.1 kc | 57.5% | 3 | 12.9 kc | 51.5% |
| 4 | 59.0 kc | 78.6% | 4 | 17.7 kc | 70.5% |
| 5 | 75.0 kc | 100.0% | 5 | 22.5 kc | 90.0% |

31.11 With the heterodyne frequency meter (General Radio Type 720-A for frequencies over 100 Mc or Type 620-A for frequencies less than 100 Mc are suitable), obtain a beat note from the unmodulated transmitter carrier frequency.

31.12 Apply a sine-wave modulating frequency to the transmitter, gradually increasing amplitude. As the amplitude is increased the heterodyne beat note will go to zero several times in accordance with the following table. Set calibration as necessary using R-220.

31.13 Refer to Section 4.31 in the Instruction Book.

32.0 OVER MODULATION LAMP FAILS TO FLASH; MODULATION METER INDICATES NORMALLY.

32.1 Test OVER MODULATION lamp P-406 for an open circuit.

32.2 Check tubes V-201 (2050) and V-202 (6SJ7) and operating voltages; refer to Sections 43.0 and 44.0. (Grounding pin #5 of V-201 or pin #6 of V-202 should make the lamp light.)

32.3 Test resistors R-207 through R-216, R-319 and R-402 for open and short circuits and proper values.

32.4 Test capacitors C-205 and C-209 for open circuits.

33.0 OVER MODULATION LAMP REMAINS LIGHTED ALL THE TIME; MODULATION METER INDICATES NORMALLY.

33.1 Check tube V-201 (2050) and operating voltages; refer to Sections 43.0 and 44.0. (Lamp should go out when V-202 (6SJ7) or V-201 (2050) is removed from socket.)

33.2 Test resistors R-207, R-208, R-214, and R-216 for open and short circuits and proper values.

33.3 Test capacitors C-205 and C-209 for short circuits and for leakage.

33.4 Make certain that MODULATION PEAKS rheostat, R-401, has a clean surface and that the blade is making good contact.

34.0 OVER MODULATION LAMP FLASHES ERRATICALLY; MODULATION METER INDICATES NORMALLY.

34.1 Make certain that OVER MODULATION bulb P-406 is making good contact in its socket.

34.2 Check tube V-201 (2050) and operating voltages; refer to Sections 43.0 and 44.0.

34.3 Make certain that rheostat R-401 has a clean surface and that the blade is making proper contact.

34.4 Refer to Sections 32.0 and 33.0.

35.0 SETTING OF MODULATION PEAKS DIAL DISAGREES WITH READING OF MODULATION METER AND/OR OVER MODULATION LAMP.

Instruments must be thoroughly warmed up before making comparisons.

35.1 Make certain that dial is securely fastened to the shaft of MODULATION PEAKS rheostat R-401.

35.2 Readjust rheostats R-214 and R-216; refer to Section 42.8.

NOTE: The OVER MODULATION lamp and the MODULATION meter should agree very closely when modulation is sinusoidal or steady-state. However, due to the short transients contained in program modulation and the fact that the meter has some mechanical inertia, its speed of response is slower than is that of the lamp circuit. Therefore, agreement may not be good under such conditions. Refer to the Instruction Book, Section 3.0, page 7.

36.0 POWER SUPPLY INOPERATIVE

36.1 B+ Section

36.11 Check operation of time delay relay S-301. This should operate within 1 minute after the MONITOR switch S-403 is turned on. Refer to Section 38.0.

36.12 Check tubes V-301 (6AS7G), V-302 (6SJ7), V-303 (OD3/VR150) and operating voltages; refer to Sections 43.0 and 44.0.

36.13 Check selenium rectifiers RX-304 through RX-311. The front to back resistance should be approximately 1:2 as measured with an ohmmeter. Actual resistances may vary over wide ranges. Check that the 4 connecting resistors between the stacks have continuity.

36.14 Test resistors R-301 through R-306, R-308 through R-318 for open and short circuits and proper values.

36.15 Test capacitors C-301 through C-306, C-309, C-310, and C-325 for open and short circuits and leakage.

36.16 Test inductor L-301 for an open or short circuit.

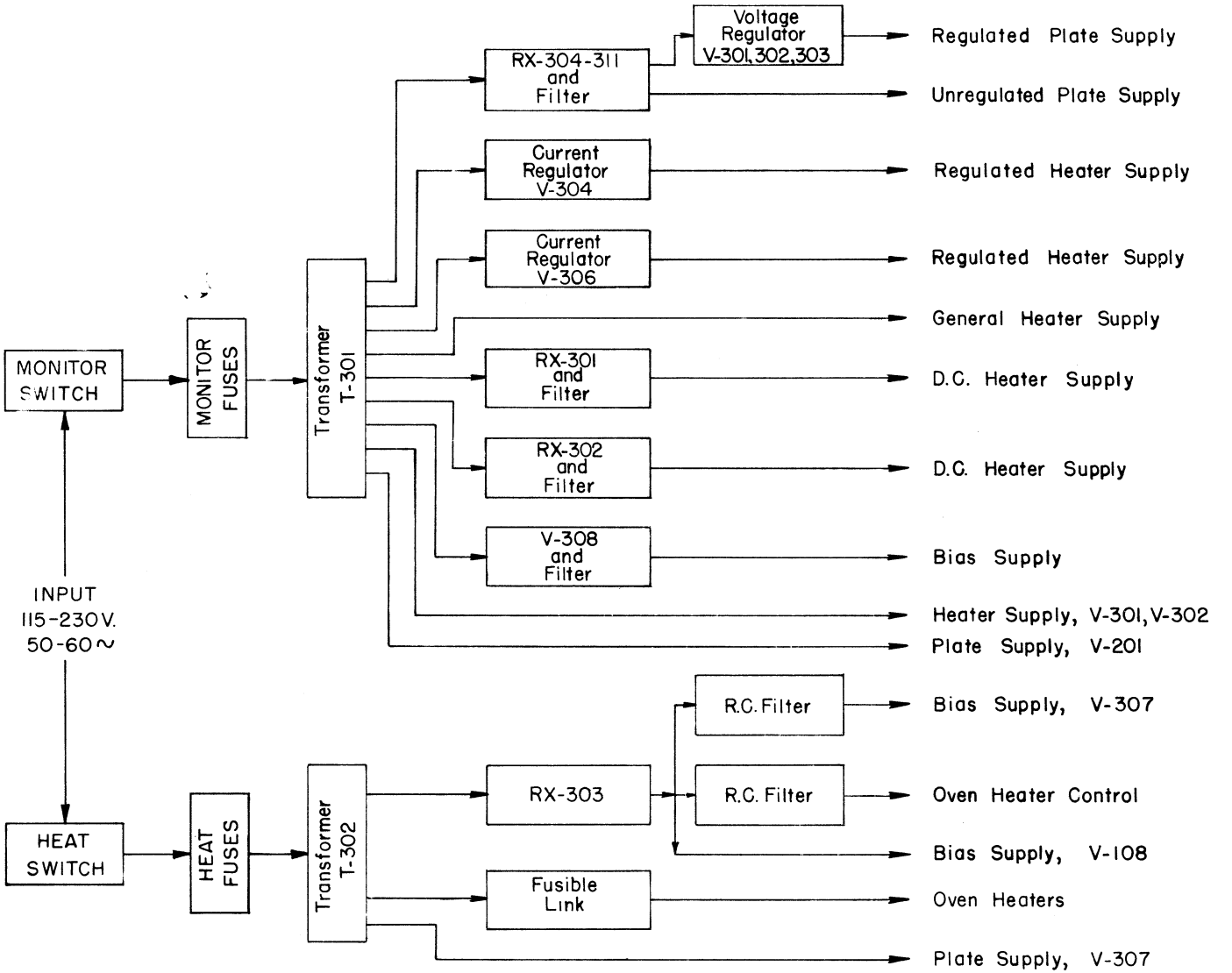
36.2 Heater Supply for Tube V-108 (815):

36.21 Check selenium rectifier RX-302. The front to back resistance should be approximately 1:1000. The front resistance should be less than 100 ohms while the back resistance should be greater than 10,000 ohms as checked with an ohmmeter.

36.22 Test resistors R-320 and R-341 for open and short circuits.

36.23 Test capacitor C-314 for open and short circuit and leakage.

# POWER SUPPLY — FUNCTIONAL BLOCK DIAGRAM




| VISUAL CHECK |
|---|
| V-303 Glowing |
| MODULATION Meter Electrical Zero can be set |
| Filament Lit, V-107 |
| Filaments Lit, V-104, V-105 |
| MONITOR Pilot Lamp Lit |
| Filaments Lit, V-103, V-106 |
| Filament Lit, V-108 |
| V-305 Glowing |
| Filament Lit, V-301 |
| OVERMODULATION Lamp Flashes |
| HEAT and Thermometer Lamps Lit |
| REL-301 Operates |
| |
| HEAT CYCLE Lamp Lights |
| REL-302 Operates |

36.3 Heater Supply for Tubes V-103 (6SL7-GT) and V-106 (6C4):

36.31 Check selenium rectifier RX-301. The front to back resistance should be approximately 1:3 or smaller as checked with an ohmmeter.

36.32 Test resistors R-307* and R-340 for open and short circuits and proper values.

36.33 Test capacitor C-308 for open or short circuit and leakage.

36.4 Bias Supply for Tubes V-112 (6AL5), V-115 (6AL5) and V-202 (6SJ7):

36.41 Check tubes V-305 OC3/VR 105 and V-308 (6AL5) and operating voltages; refer to Sections 43.0 and 44.0.

36.42 Test resistors R-322 through R-331 for open and short circuits and proper values.

36.43 Test capacitors C-315 through C-320 for open and short circuits and leakage.

## 37.0 MONITOR BLOWS FUSES

The following procedure will prove useful in localizing and locating the circuit involved in case the monitor blows a fuse. Older instruments not using slow-blow fuses may be expected to blow fuses occasionally due to switching transient, especially if the line voltage is high.

37.1 Turn off both MONITOR and HEAT switches. Remove R-F input signal. Note which fuse has blown, i.e., whether a HEAT of a MONITOR fuse.

37.2 HEAT fuse blown, trouble is in circuits fed by transformer T-302. Refer to Section 9.0.

37.3 MONITOR fuse blown, replace fuse and turn on both HEAT and MONITOR switches. If fuse blows again note carefully whether this occurs before or after the B+ time-delay relay, S-301, is energized. If before, trouble lies in circuits fed by transformer T-301, other than the B+ supply. Refer to Section 39.0. If after, trouble lies in one of the B+ circuits. If fuse blows only when an r-f signal is applied and relay REL-302 operates, trouble is in the discriminator section and is associated with tubes V-108 (815), V-109 (6AG7), V-110 (OD3/VR150), etc., or wiring to R-416 which is located on the panel.

*NOTE: Resistor R-307 may have several 33 ohm, 1 watt resistors added in parallel, and R-340 removed, as necessary.

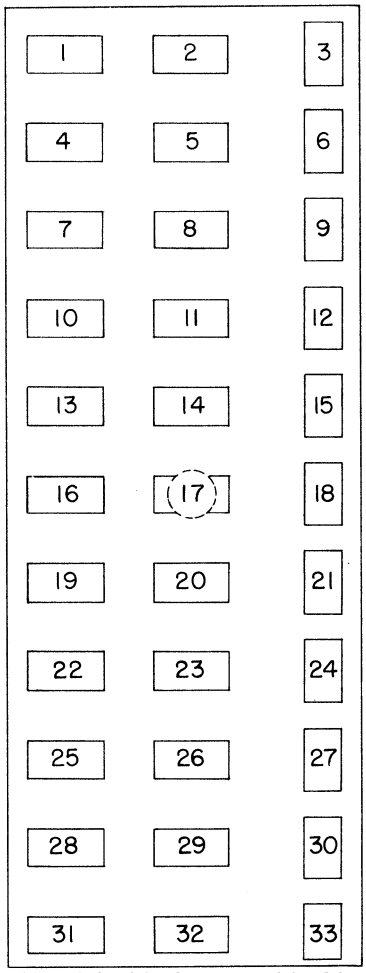
37.31 Remove plugs PL-1, PL-101, and PL-201 from sockets. Replace fuse, turn on HEAT and MONITOR switches. If fuse blows again, trouble is in power supply section or panel assembly.

37.32 Turn off MONITOR switch, plug in PL-101, turn on switch. If fuse blows, trouble is in discriminator section.

37.33 Turn off MONITOR switch, plug in PL-201, turn on switch. If fuse blows, trouble is in modulation meter section.

37.34 Turn off MONITOR switch, plug in PL-1, turn on switch. If fuse blows, trouble is in r-f section.

37.4 Refer to Section 39.0 to further localize trouble.



SOCKETS SO-101 AND SO-301
VIEWED FROM REAR OF MONITOR

## 38.0 TABLE OF POWER SUPPLY VOLTAGES

D-C voltages measured with a 20,000 ohms-per-volt meter unless otherwise noted.
A-C voltages measured with a 1000 ohms-per-volt meter.

| FROM | TO | VOLTAGE | FUNCTION |
|---|---|---|---|
| Pin #3, V-301 | Ground | 300 ±1% d-c | Regulated B+, Plate Supply |
| Pin #5, V-102 | Ground | 290 ±10% d-c | Unregulated B+, Plate Supply |
| Pin #3, PL-301 | Ground | 6.3 ±10% a-c | Heater Supply, V-107 |
| Pin #4, PL-301 | Ground | 12.6 ±10% a-c | Heater Supply, V-104, V-105 |
| Pin #7, V-103 | Pin #8, V-103 | 6.3 ±10% d-c | Heater Supply, V-103 |
| Pin #7, V-103 | Ground | 90.0 ±10% d-c | |
| Pin #1, V-108 | Ground | 6.3 ±10% d-c | Heater Supply, V-108 |
| Pin #5, V-112 | Ground | +1.5 ±10% d-c | Cathode Bias, V-112, V-115 |
| Pin #7, V-112 | Ground | -1.5 ±10% d-c | Plate bias, V-112, V-115 |
| Pin #5, V-210 | Ground | -2.0 ±10% d-c * | Grid Bias, V-201 |
| Pin #5, V-201 | Ground | -6.0 ±10% d-c * | Screen Bias, V-201 |
| Pin #6, V-201 | Pin #5, V-305 | -105.0 d-c | Bias Supply |
| Pin #2, V-305 | Ground | -12 Nominal d-c* | Grid Bias, V-108, V-307 |
| Terminal #32, T-301 | Terminal #33, T-301 | 178 a-c | Power Supply High Voltage |
| Terminal #19, T-301 | Terminal #25, T-301 | 6.3 a-c | Heater Supply, V-301, V-302 |
| Terminal #12, T-301 | Terminal #14, T-301 | 12.0 a-c | Heater Supply Source, V-103, V-106 |
| Terminal #10, T-301 | Terminal #17, T-301 | 11.0 a-c | Heater Supply Source, V-108 |
| Terminal #15, T-301 | Terminal #16, T-301 | 160.0 a-c | Plate Supply Source, V-201 |
| Terminal #23, T-301 | Ground | 15.0 a-c | Heater Supply Source, V-107 |
| Terminal #22, T-301 | Ground | 19.5 a-c | Heater Supply Source, V-104, V-105 |
| Terminal #20, T-301 | Terminal #21, T-301 | 150.0 a-c | Bias Rectifier Plate Supply |
| Terminal #24, T-301 | Terminal #21, T-301 | 150.0 a-c | Bias Rectifier Plate Supply |
| Terminal #9, T-301 | Terminal #18, T-301 | 6.3 a-c | Main Tube Heater Supply |
| Terminal #7, T-302 | Terminal #8, T-302 | 13.0 a-c | Lamps P-402, P-403 |
| Terminal #10, T-302 | Ground | 46.0 a-c | Oven Heater Supply |
| Terminal #11, T-302 | Ground | 123.0 a-c | Plate Supply, V-307 |

*Use a d-c vacuum-tube voltmeter with an input impedance of at least 10 megohms.

CONDITIONS: Input: 115/230 v. a-c, 60 cycles
HEAT switch: ON
MONITOR switch: ON
No r-f input

## 39.0 RESISTANCE CHART, POWER SUPPLY CIRCUITS

| CHECK POINTS | | All Plugs in Place | Plug PL-1 Removed | Plugs PL-1 PL-201 Removed | Plugs PL-1, PL-101, PL-301 Removed | Plugs PL-1, PL-101, PL-201, PL-301 Removed | Circuit |
|---|---|---|---|---|---|---|---|
| From | To | | | | | | |
| Pin #6, V-301 | Ground | 20 kω | 20 kω | 24 kω | 150 kω | 150 kω | Regulated B+ |
| +Terminal, C-301 | Ground | 70 kω | 100 kω | 100 kω | 200 kω | 200 kω | Unregulated B+ |
| Pin #7, V-304 | Ground | 1 ω | 1 ω | 1 ω | 1 ω | 1 ω | Heater Supply, V-107 |
| Pin #7, V-306 | Ground | 1 ω | 1 ω | 1 ω | 1 ω | 1 ω | Heater Supply, V-104, V-105 |
| Arm Relay, REL-301 | Ground | 116 ω | 116 ω | 116 ω | 116 ω | 116 ω | Oven Heaters |
| Pin #9, T-301 | Ground | 1ω or less | ∞ | ∞ | ∞ | ∞ | Main Tube Heaters |
| Pin #1, V-305 | Ground | 75 kω | 75 kω | 75 kω | ∞ | ∞ | Heater Circuit, V-103, V-106 |
| Pin #1, V-305 | -Terminal, C-308 | 3 ω | >10 kω | >10 kω | >10 kω | >10 kω | Heater Circuit, V-103, V-106 |
| Pin #15, T-301 | Ground | 800 ω | 800 ω | 800 ω | 800 ω | ∞ | Plate Supply, V-201 |
| +Terminal, C-314 | Ground | 1 ω | 1 ω | 1 ω | >10 kω | >10 kω | Heater Circuit, V-108 |
| Pin #5, V-305 | Ground | 240 ω | 240 ω | 240 ω | 240 ω | 240 ω | +Bias Supply |
| Pin #2, V-305 | Ground | 16.5kω | 16.5kω | 16.5kω | 16.5kω | 16.5kω | -Bias Supply |

CONDITIONS: No power connected to monitor; all tubes in place; HEAT and MONITOR switches ON.

40.0 NOISE OR DISTORTION LEVEL EXCESSIVE WHEN USED WITH EXTERNAL DISTORTION AND NOISE METER, MONITOR NORMAL OTHERWISE.

If the transmitter residual noise level measurement suddenly appears to increase and this is not substantiated by listening tests try the following procedure.

40.1 Connect a cathode ray oscilloscope to the output of the distortion and noise meter so that the type of noise can be observed.

40.2 Disconnect the coupling cable from the monitor to the noise meter. The indicated noise level should now become minimum as specified by its manufacturer (-80 db for a General Radio Type 1932-A). Be sure that the cable is making a good ground connection at both ends. Refer to Section 2.7 of the Operating Instructions.

40.3 Turn the ADJust DISTortion METER control to full counter clockwise position. Plug coupling cable into the monitor jack. The indicated noise level should be -75 db or less (referred to a calibration level of 75 kilocycle modulation).

40.31 If noise level is high turn MONITOR switch OFF. If noise still persists it is due to pickup between the two instruments.

40.32 Check ground connections on cable, monitor, and noise meter. The noise meter, if used on a portable mount, can be grounded to the relay rack through an additional cable but this may establish a ground loop causing extraneous pickup. Local tests should govern this use.

40.4 Turn MONITOR switch ON. If noise level increases:

40.41 Check tube V-103 (6SL7-GT) and operating voltages. Try replacing this tube; refer to Sections 43.0 and 44.0.

40.42 Check resistors R-116 through R-123 for open and short circuits and proper values.

40.43 Check capacitor C-308 for an open circuit.

40.44 Remove tubes V-102 (6C4) and/or V-101 (6AG5). If noise level improves, replace these tubes; refer to Section 43.0.

40.45 Remove tube V-304 (3-4). If noise level improves, try replacing tubes V-107 (6AL5) or V-304 (3-4); refer to Section 43.0.

40.5 Remove the Crystal Oscillator Tube V-4 (12AU7). This stops the crystal oscillations. Meter M-1, ADJust RF INPUT to 100, should now read zero. If it does not, parasitic oscillations in the r-f section are present.

40.6 If distortion level is too high, but noise level appears normal, check V-103 (6SL7-GT) heater voltage to be 6.3 ±10% d.c.

41.0 TUBE MICROPHONIC NOISE EXCESSIVE ON DISTORTION AND NOISE OUTPUT.

41.1 Try replacing tubes V-103 (6SL7-GT) and V-106 (6C4); refer to Section 43.0.

42.0 SERVICE ADJUSTMENTS

42.1 R-F Input Attenuator C-28:

This attenuator may be adjusted by loosening the two screws on the R-F INPUT clamping washer.

42.2 Adjusting Monitor to an Operating Frequency:

R-F Tuning Circuits: C-13, C-7, C-30, C-604, C-704, C-710, C-608, C-611, C-715, C-716, C-717, and C-718.

NOTE: The following adjustments and checks are performed after the operating (carrier) frequency has been determined and after the correct crystal, R-F Tuning Unit and coils pertaining to that frequency have been installed. The tuning adjustment chart on page 10 and Table I, page 19-22, in the Instruction Book must be consulted for this information. Refer to Section 4.131 (Paragraph #1 and #2) and 4.132 (Paragraph #1) of the Instruction Book.

42.21 Adjustment of C-22 and C-23:

NOTE: Capacitors C-22 and C-23 have been set at the factory for optimum conditions with the particular crystal supplied; readjustment should be made only if a new crystal is installed. See Section 4.11 of the Instruction Book.

42.211 Allow the crystal oven to come up to operating temperature, 60°C.

42.212 Connect an a-c vacuum-tube voltmeter from the stator of C-22 to ground. Set this voltage to 3 volts (or as low as possible, if higher) with C-22 and C-23. Keep the capacitance adjustments of C-22 and C-23 as nearly identical as possible.

42.22 Adjustment of C-42:

NOTE: The main frequency adjustment is furnished by capacitor C-42 which is located inside the constant temperature crystal oven. This adjustment has been carefully set at the factory and should be reset only if a commercial frequency monitoring check of the transmitter carrier frequency is available to confirm the adjustment of the crystal operating frequency. See Section 2.511 and 2.512 of the Instruction Book.

42.221 Adjust C-42 so that the plates are 3/4 meshed.

42.23 First multiplier adjustment (C-13)

42.231 Engage the CHECK CRYSTAL switch and adjust C-13 for a maximum deflection of the KILOCYCLES DEVIATION meter. The correct har-

monic must be checked by using an absorption or grid-dip type wavemeter set to the correct frequency, chosen from Table I of the Operating Instruction manual. Bring the wavemeter close to L-3 while keeping the CHECK CRYSTAL switch engaged. Proper tuning will be indicated if the Deviation meter shows a pronounced dip.

NOTE: When changing channels of operation, difficulty may be experienced in obtaining a CHECK CRYSTAL reading to the red line or beyond or, conversely, the reading may be off scale on the KILOCYCLES DEVIATION meter. Resistor R-10 is used as a meter shunt in the CHECK CRYSTAL position and may be changed to a value between 150 ohms and 20,000 ohms to obtain a satisfactory reading. Although R-10 is usually located in the r-f section, it may be mounted between terminals #1 and #3 on the CHECK CRYSTAL switch S-402.

42.24 Second multiplier adjustment (C-7):

42.241 Connect a d-c vacuum-tube voltmeter across C-40 in 1170-P1 or C-601 in 1170-P2 or C-701 in 1170-P3, with the positive terminal grounded. Tune C-7 (to correct harmonic, Table I, Operating Instructions) for a maximum reading of the voltmeter.

42.242 The voltage across C-40, C-601 or C-701 must be between 10 and 30 volts. If this voltage exceeds 30 volts, shunt L-2 with a 10 kilohms, 1 watt resistor and retune C-7.

42.243 The voltmeter reading should decrease when the wavemeter, tuned to the correct frequency for the second multiplier, (Table I, Operating Instructions) is brought close to L-2.

42.25 Operating Frequency 30-160 Mc, 1170-P1 Tuning Unit. Third multiplier adjustment C-30:

42.251 Connect a d-c vacuum-tube voltmeter from AT #4 to ground. Tune C-30 (to correct harmonic, Table I, Operating Instructions) for maximum screen voltage on V-5 (6BE6). Check with a d-c vacuum-tube voltmeter, with a 1 megohm isolating resistor in series with the high probe, that the local oscillator signal changes the grid voltage of the Type 6BE6 Tube (Pin No. 1, V-5) at least 1 volt in the negative direction. Normal voltage in the absence of any drive is approximately plus 2 volts. The grid voltage reading will dip when the wavemeter, tuned to correct frequency for the third multiplier (Table I, Operating Instructions), is brought close to L-8 if tuning is correct.

42.252 Install the cover plate.

NOTE: Nearly all the tuned circuits will become detuned when the cover plate is installed, making it necessary to go over each frequency adjustment to make sure that it is properly peaked.

42.253 Engage the CHECK CRYSTAL switch and readjust C-13 for maximum CHECK CRYSTAL indication.

42.254 Apply r.f. at the transmitter frequency to the r-f input receptacle. It must be possible to make meter M-1 read full scale.

42.26 Operating Frequency 160-200 Mc, 1170-P2 Tuning Unit. Third multiplier adjustment C-604.

42.261 Connect a d-c vacuum-tube voltmeter, with a 1 megohm isolating resistor in series with its probe, between Pin No. 1 of V-602, Type 6AG5 Tube, and ground with the positive terminal grounded. Tune C-604 (to correct harmonic, Table I, Operating Instructions) for maximum voltmeter reading. The voltmeter reading will dip when the wavemeter, tuned to correct frequency for the third multiplier, is brought close to L-602.

42.27 Fourth multiplier adjustment C-608 and C-611:

42.271 Connect the d-c vacuum-tube voltmeter with probe, across C-610 (low end of L-605). Normal voltage at this point, with crystal not oscillating is about plus 1 volt; excitation from the local oscillator drives this voltage in a negative direction.

42.272 Tune C-608 and C-611 (to correct harmonic, Table I, Operating Instructions) for maximum voltmeter reading. Check for a dip in voltmeter reading when the wavemeter tuned to the correct frequency is brought close to L-605.

42.273 Stop the local oscillator by shorting C-22. The d-c voltage across C-610 must revert to about plus 1 volt, otherwise self-oscillation exists and must be corrected. The local oscillator must change the d-c voltage across C-610 at least 1 volt in the negative direction.

42.274 Install the cover plate. This will disturb the tuning adjustments slightly. Engage the CHECK CRYSTAL switch and readjust C-13 for maximum CHECK CRYSTAL indication.

42.275 Apply r-f at the transmitter frequency to the r-f input receptacle. Adjust C-28 (SET INPUT) for a small deflection of M-1. Retune trimmers C-7, C-30 or C-604 for maximum deflection of M-1. Do NOT retune C-608 or C-611.

42.28 Operating Frequency 470-890 Mc, 1170-P3 Tuning Unit:

42.281 Turn the Type 1170-BT off. Adjust C-704, C-710, C-715, and C-716 to approximately their correct frequencies (see Table I, Operating Instructions) by means of a grid-dip meter.

42.282 Interrupt the crystal frequency multiplier chain by removing a frequency multiplier tube V-701 (6AG5) or V-702 (6AG5) . Turn the Type 1170-BT on. Connect a 20,000 ohm-per-volt meter across R-716, via J-702 to measure mixer voltage. Apply r-f at the transmitter frequency to the r-f input receptacle. Adjust C-718 for maximum mixer voltage.

42.283 Re-insert multiplier stage tube to re-energize frequency multiplier chain. Remove the transmitter signal from the r-f input receptacle and adjust C-717 for maximum mixer voltage using a screwdriver made of insulating material.

42.284 Measure the voltage across R-716. The voltage must be between 1 and 3 volts d.c. when all tuned circuits are properly adjusted and when the cover plate is in place. The coupling between L-710 and L-711 may be altered to satisfy this condition.

42.285 Install the cover plate and shield can covering V-704 and C-718. Remove the phone plug

from J-702 and apply an r-f signal of the transmitter frequency to the R-F INPUT receptacle. It should be possible to make meter M-1 read full scale. Peak the P-3 tuning unit adjustments using M-1 as a tuning indicator or with a 20,000 ohms-per-volt meter in J-702.

42.3 Crystal Oscillator Frequency:

The oscillator frequency can be shifted to correct for small errors in crystal frequency where the error is known and can be checked by precise, reliable, outside frequency measurements.

42.31 Remove thermometer window.
42.32 Insert long screwdriver into hole at right of thermometer and adjust C-42 which is in series with the crystal.

42.4 MODULATION Meter Electrical Zero:

42.41 Turn monitor ON and apply an unmodulated signal from the transmitter to it.
42.42 Remove EXTERNAL METERS socket, SO-103, and set the mechanical zero of the meter. Replace the socket.
42.43 Adjust rheostat R-205 until the meter reads zero.

42.5 MODULATION Meter Circuits:

Modulate the transmitter with a sine wave audio frequency of very low distortion. Set modulation to 100% using the method outlined in Section 31.0.

42.51 Set the MODULATION PEAKS switch, S-201, to the POSitive position.
42.52 Adjust the CALibrate POSitive-NEGative control, R-233, until MODULATION meter reads 100%. Turn switch to the NEGative position. The meter should read 100%. If it does not, refer to Section 42.6.
42.53 Set MODULATION PEAKS switch to the FULL WAVE position.

Adjust the CALibrate FULL WAVE control, R-203, until the meter reads 100%.

42.6 MODULATION Meter Balance:

42.61 With symmetrical sine wave modulation, the meter should read the same on either POSitive or NEGative position of the MODULATION PEAKS switch.
42.62 This adjustment is made at the factory and ordinarily should not require adjustment.
42.63 If readjustment does become necessary, remove the r-f input to the monitor, set switch to POSitive and apply a 400-cycle sine wave having less than 0.1% distortion across capacitor C-116.
42.64 Adjust signal level so that MODULATION meter reads 100%. Change switch to the NEGative position. The meter should still read 100%. If not, adjust rheostat R-231 until the readings do agree.

42.7 Recalibration of MODULATION meter to a New Frequency Swing:

42.71 Remove r-f input signal from monitor. Apply a 400-cycle audio signal as in Paragraph 42.63 above across capacitor C-116. Adjust level so that MODULATION meter reads 100%.
42.72 Measure the input audio voltage across C-116 accurately and note this reading. Let it equal $E_m$.

$$\text{Then } E_m \times \frac{\text{DESIRED CARRIER SWING}}{\text{PRESENT CARRIER SWING}} =$$

$E_m'$ = the audio input level necessary to make the MODULATION meter read 100% at the new frequency swing.
42.73 Set the audio voltage to the value $E_m'$. Adjust rheostat R-220 until the meter reads 100%.

42.8 Adjustment of OVER MODULATION Lamp Circuit to Agree with MODULATION METER:

42.81 Apply an r-f signal of the carrier frequency, modulated by a variable amplitude 400-cycle signal, to the monitor.

Set the MODULATION PEAKS switch to POSitive.

Set the MODULATION dial to 100 PER CENT.

42.82 Use the audio voltage input level to adjust the MODULATION meter readings.

Adjust rheostat R-216 so that the lamp is out when the meter reads 100% but lights when the meter reads 101%.

42.83 Reset the MODULATION PEAKS dial to 10 PER CENT. Adjust rheostat R-214 so that the lamp is extinguished when the meter reads 10% but lights when the meter reads 11%.
42.84 Repeat this procedure until the dial tracks with the meter.

42.9 Power Supply Adjustments:

42.91 Regulated B+ voltage. Set rheostat R-317 so that the voltage from tube V-301 (6AS7-G), pin #6 to ground, is 300 volts ±1%.
42.92 Signal thyratron bias, V-307 (2050) voltage. With no r-f voltage applied to the monitor, set rheostat R-334 so that the SIGNAL lamp, P-405, is extinguished. (Full counter-clockwise position of R-334 is usually satisfactory.)
42.93 Hum Control: Adjust rheostat, R-315, for minimum second harmonic of the power line frequency as measured between tube V-301 (6AS7-G), pin #6 and ground.

42.10 Center Frequency Circuit Adjustments, R-150, R-156, and R-407.

These may need adjusting after tube replacements are made but should not be touched unless absolutely necessary.

These three controls are interdependent, each affecting the other two.

42.101 To adjust rheostat R-160 remove the r-f signal to the monitor. Engage the CHECK ZERO switch, note the reading of the KILOCYCLES DEVIATION meter, M-401, release the switch and adjust R-160 so that the KILOCYCLES DEVIATION meter will read the same. This meter reading is not necessarily zero.

42.102 To adjust rheostat R-156, apply an r-f signal to the monitor and adjust meter M-1 to read 100. By means of a Variac Transformer, vary the input power voltage from 105 to 125 volts.

The reading of the KILOCYCLES DEVIATION meter should change less than 100 cycles.

If variation exceeds 100 cycles, adjust R-156 until the change in meter reading is minimum over this line voltage range, then readjust CENTER FREQuency control R-407 so that the meter reads the same as it did before R-156 was changed.

42.103 To adjust CENTER FREQuency control, R-407: Set CENTER FREQuency control, R-408, to its mid-position. Apply r-f signal to monitor. Adjust R-407 until KILOCYCLES DEVIATION meter agrees with the results of an independent frequency measurement of the transmitter frequency.

42.104 Repeat adjustments of R-160, R-156, and R-407 until the KILOCYCLES DEVIATION meter reading is correct within 100 cycles for any line voltage from 105 to 125 volts.

42.11 Vacuum-Tube Voltmeter Circuit Electrical Zero:

42.111 Set ZERO (fine) control, R-404, to its mid-position.

42.112 Apply an r-f signal from the transmitter to the monitor and engage the CHECK ZERO switch.

42.113 Set the KILOCYCLES DEVIATION meter to zero reading by means of ZERO (coarse) control, R-405, (under nameplate).

## 43.0 EFFECTS OF REPLACING TUBES

| TUBE | ADJUSTMENT REQUIRED | MAXIMUM ERROR INVOLVED |
|---|---|---|
| V-1 | None | None |
| V-2 | C-7 | None |
| V-3 | C-13 | None |
| V-4 | C-22 and C-23 | ±.5 Parts Per Million Deviation Error |
| V-5 | None | None |
| V-6 | C-30 | None |
| V-601 | C-604 | None |
| V-602 | C-608 | None |
| V-603 | C-611 | None |
| V-701 | C-704 | None |
| V-702 | C-710 | None |
| V-703 | C-715 and C-716 | None |
| V-704 | C-717 and C-718 | None |
| V-705 | None | None |
| V-101 | R-214, R-216, R-233 | 10% in Modulation Meter and Over Modulation Check |
| V-102 | None | None |
| V-103 | None | Possible Noise and/or Hum |
| V-104, V-105 | R-405 | Zero Drift |
| V-106 | None | Possible Noise and/or Hum |
| V-107 | R-407 and/or R-408 | 1500 cycle Deviation Error |
| V-108 | R-407 and/or R-408 R-156, R-160 | 400 cycle Deviation Error. Dependence on Line Voltage. |
| V-109 | None | Possible Microphonic Noise |
| V-110 | R-407 and/or R-408 | 200 cycles Deviation Error |
| V-111 to V-115 | None | None |
| V-116 | Same as V-108 | Same as V-108 |
| V-201 | R-214 and R-216 | Over Modulation Lamp Won't Track with Meter by 10%. |
| V-202 | R-214 and R-216 | Over Modulation Lamp Won't Track with Meter by 10%. |
| V-203 | R-214, R-216, R-233 | Modulation % Incorrect 5%. Also Over Modulation 5%. |
| V-204 | R-231 and R-233, R-205 | Modulation % <5% |
| V-205 | R-205, R-231, R-233 | Modulation % <5% |
| V-301 | None | None |
| V-302 | R-317 | Proportional to B+ change of 2% Maximum. |
| V-303 | R-317 | Proportional to B+ change of 5% Maximum. |
| V-304 | R-407 and/or R-408 | 500 cycles Maximum |
| V-305 | None | None if tube fires. |
| V-306 | R-404 and/or R-405 | None |
| V-307 | None | None |
| V-308 | None | None |

## 44.0 VACUUM-TUBE DATA

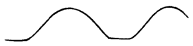
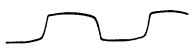
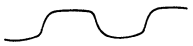
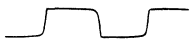
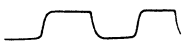
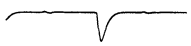
Table of tube socket voltages measured from socket pin to ground unless otherwise indicated. Measurement made using a 20,000 ohms-per-volts meter (Weston 772 Analyzer) unless otherwise noted. D-C voltages may vary ±20%.

| SYMBOL | TYPE | CONDITION | SOCKET PIN NUMBER | | | | | | | | | | FUNCTION |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | CAP | |
| V-1 | 6AK6 | B | 0 | 5.9 | 0 | 6.3v.a-c | 132 | 155 | 5.8 | -- | | | Buffer Amplifier |
| V-2 | 6AG7 | F | 0 | 0 | 0 | 0 | 2.1 | 147 | 6.3v.a-c | 185 | -- | | Multiplier |
| V-3 | 6AC7 | F | 0 | 0 | 0 | 0 | 2.15 | 150† | 6.3v.a-c | 240 | -- | | Multiplier |
| V-4 | 12AU7 | F | 260 | 0 | 21.5 | 0 | 0 | 50 | -.07 | 0.2 | 6.3v.a-c | | Oscillator Buffer Amplifier |
| V-5 | 6BE6 | F | 1.7 | 1.7 | 0 | 6.3v.a-c | 220 | 60 | 0 | -- | -- | | Mixer |
| V-6 | 6AG5 | F | 0 | 1.6 | 0 | 6.3v.a-c | 245 | 120 | 1.6 | -- | -- | | Multiplier |
| V-101 | 6AG5 | B | 0 | 15.5 | 3-4 6.3v.a-c | -- | 250 | 150 | 15.5 | -- | | -- | Amplifier - Audio Re-emphasis |
| V-102 | 6C4 | B | 300 | -- | 3-4 6.3v.a-c | -- | 300 | 44 * | 57 | -- | | -- | Cathode Follower 600 Ω Audio Output |
| V-103 | 6SL7-GT | B | 0 | 142 | 0.85 | 0 | 225 | 1.6 | 90 | 96 | | -- | Audio Pre-amplifier |
| V-104 | 6SU7-GTY | N | 0 | 223 | 2.6 | 0 | 223 | 2.6 | 12.6v.a-c | 6.3v. a-c | | -- | Deviation Meter |
| | | S | 1.1 * | 205 | 3.2 | 1.1 * | 205 | 3.2 | | | | -- | Voltmeter Tube |
| V-105 | 6SU7-GTY | N | 0 | 223 | 2.6 | 0 | 223 | 2.6 | 6.3v.a-c | 0 | | -- | Deviation Meter |
| | | S | 1.1 * | 205 | 3.2 | 1.1 * | 205 | 3.2 | | | | -- | Voltmeter Tube |
| V-106 | 6C4 | B | 280 | -- | 90 | 96 | 280 | 150 * | 153 | -- | | -- | Audio Amplifier Cathode Follower |
| V-107 | 6AL5 | N | + | + | 6.3v.a-c | 0 | 3.25 | -- | 0 | -- | | -- | Discriminator |
| | | S | + | + | | | + | -- | Δ | -- | | -- | Diode |
| V-108 | 815 | N | 6.3 | -12.4 * | 0 | 0 | 0 | 0 | -12.4 * | 6.3 | | 0 | Limiter - Discriminator |
| | | S | | -30.5 * | 0 | 150 | 0 | 0 | -30.5 * | | | 165 | Driver |
| V-109 | 6AG7 | N | 0 | 6.3v.a-c | 0 | -0.7 * | 0 | 0 | 0 | 0 | | -- | Limiter - Amplifier |
| | | S | 0 | | 0 | -2.0 * | 0 | 67 | 0 | 103 | | -- | |
| V-110 | 0D3/VR-150 | N | -- | 0 | 0 | -- | 0 | -- | 0 | -- | | -- | Regulator |
| | | S | -- | 0 | 150 | -- | 150 | -- | 150 | -- | | -- | |
| V-111 | 5964 | N | 50 | 180 | 3-4 | | 9.0 | 21.0 | 20.0 | -- | | -- | Flip-Flop Signal Control Tube |
| | | S | 150 | 55 | 6.3v.a-c | | 15.5 | 6.0 | 15.0 | -- | | -- | |
| V-112 | 6AL5 | N | -0.7 * | -0.7 * | 3-4 | | 1.5 * | -- | -1.5 | -- | | -- | Clipper Diode |
| | | S | -0.04 * | -0.04.* | 6.3v.a-c | | 1.8 * | -- | -1.75 | -- | | -- | |
| V-113 | 991 | N | No Voltage Across Terminals Not Glowing | | | | | | | | | | Neon Regulator |
| | | S | 60 volts d-c across Terminals Glowing | | | | | | | | | | |
| V-114 | 6SK7 | N | 0 | 2.7 | 0.12 | -0.7 * | 0.12 | 0 | -- | 300 | | -- | I-F Amplifier |
| | | S | 0 | 6.3v.a-c | 3.9 | -0.04 * | 3.9 | 90 | -- | 110 | | -- | |
| V-115 | 6AL5 | N | 0.6 * | 0.6* | 3-4 | | 1.5 * | -- | -1.5 * | -- | | -- | Clipper |
| | | S | 0.06 * | 0.04 * | 6.3v.a-c | | 1.85 * | -- | -1.75 * | -- | | -- | |
| V-116 | 6AL5 | N | 0 | 0 | 3-4 | 0 | 1.5 * | -- | 0 | -- | | -- | Amplitude Compensator |
| | | S | 165 | Δ | 6.3v.a-c | 0 | 2.6 * | -- | 19 * | -- | | -- | |
| V-201 | 2050 | N | -- | 2-7 | 162 a-c | -- | -1.25 | -1.0 | | 0 | | -- | (OVER MODULATION) |
| | | S | -- | 6.3v.a-c | 85 a-c | -- | -1.25 | -1.0 | | 0 | | -- | Trigger Tube |
| V-202 | 6SJ7 | N | 0 | 2-7 | 0 | Δ | 0 | 56 | | 62 | | -- | Trigger Amplifier |
| | | S | 0 | 6.3v.a-c | 0 | Δ | 0 | 52 | | 40 | | -- | |
| V-203 | 6SN7-GT | B | 30 | 150 | 35 | 0 | 125 | 5.0 | 7-8 6.3v.a-c | | | -- | (Modulation Meter) Pre-Amplifier |
| V-204 | 6AL5 | B | Δ | Δ | 3-4 6.3v.a-c | | Δ | -- | Δ | -- | | -- | Modulation Diode Voltmeter |
| V-205 | 6SL7-GT | N | -- | 300 | 5.5 | -- | 300 | 5.5 | 7-8 | | | -- | Modulation Meter Voltmeter |
| | | S | -- | 300 | 37 | -- | 300 | 36 | 6.3v.a-c | | | -- | |
| V-301 | 6AS7-G | B | 265 | 400 | 300 | 265 | 400 | 300 | 7-8 6.3v.a-c | 200 | | -- | Regulator |
| V-302 | 6SJ7 | B | 0 | 2-7 6.3v.a-c | 150 | 140 | 150 | 280 | 200 | 265 | | -- | Control |
| V-303 | 0D3/VR-150 | B | -- | 0 | 178 | -- | 150 | -- | 178 | -- | | -- | Regulator |
| V-304 | Amperite 3-4 | B | -- | 15v. a-c | -- | -- | -- | -- | 6.3v.a-c | -- | | -- | Ballast |
| V-305 | 0C3/VR-105 | B | -- | -103.5 | 50 | -- | 1.5 | -- | 50 | -- | | -- | Regulator |
| V-306 | Amperite 3-4 | B | -- | 19.5v.a-c | -- | -- | -- | -- | 12.6v.a-c | -- | | -- | Ballast |
| V-307 | 2050 | N | -- | 2-7 | 123 a-c | -- | 0 | -0.3 | | -- | | -- | Signal Control Thyratron |
| | | S | -- | 6.3v.a-c | -24 | -- | 1.25 to 4.25 | to 0.9 | | -- | | -- | |
| V-308 | 6AL5 | B | 50 | 145v. a-c -107 | 3-4 6.3v.a-c | | 50 | 0 | 145v. a-c -107 | -- | | -- | Bias Rectifier |
| V-601 | 6AG5 | F | 0 | 1.6 | 6.3v.a-c | 0 | 202 | 105 | 1.6 | -- | -- | | Multiplier |
| V-602 | 6AG5 | F | 0 | 1.28 | 6.3v.a-c | 0 | 212 | 86 | 1.28 | -- | -- | | Multiplier |
| V-603 | 6BE6 | F | 1.0 | 1.5 | 0 | 6.3v.a-c | 203 | 40 | 0 | -- | -- | | Mixer |
| V-701 | 6AG5 | F | 0 | 2.5 | 0 | 6.3v.a-c | 200 | 150 | 2.5 | -- | -- | | Multiplier |
| V-702 | 6AG5 | F | 0 | 1.47 | 0 | 6.3v.a-c | 207 | 125 | 1.47 | -- | -- | | Multiplier |
| V-703 | 6J6 | F | 210 | 210 | 6.3v.a-c | 0 | 0 | 0 | 7.1 | -- | -- | | Multiplier |
| V-704 | 9005 | F | 6.3v.a-c | 0 | 0 | 0 | -- | -- | -- | | | | Mixer |
| V-705 | 6AG5 | F | 0 | 0 | 0 | 6.3v.a-c | 172 | 164 | 2.9 | -- | -- | | Amplifier |

CONDITIONS: R-F input of carrier frequency; METER M-1 set to 100 (10 x 10); input signal modulated 100% (+75 kc) at 1 kc. (All used as indicated under SYMBOLS below.) CENTER FREQUENCY set to zero; OVERMODULATION lamp lit; MODULATION PEAKS switch - FULL WAVE; MONITOR switch ON; HEAT switch ON.

SYMBOLS: N - No r-f signal applied.
S - R-F signal applied as shown above.
B - Same values with or without r-f signal.
F - Voltages taken with crystal in non-oscillating condition and no r-f signal applied.
Grid and cathode voltages will vary with signal frequency.
* - Use d-c vacuum-tube voltmeter with high input impedance. (GR-728-A, GR-1800-A, etc.)
+ - No measurement possible
Δ - Use circuit resistance checks.
† - Will be 50-150v depending upon laboratory adjustment for channel used.

## 45.0 TABLE OF INTERMEDIATE FREQUENCY SIGNAL VOLTAGES - DISCRIMINATOR SECTION.

| FROM | TO | WAVEFORM | VOLTAGE |
|---|---|---|---|
| C-135 | Ground |  Sine Wave | 62 volts peak to peak |
| V-112, pin 2<br>V-114, pin 4 | Ground |  Clipped Sine Wave | 5.8 volts peak to peak |
| V-114, pin 8 | Ground |  Distorted Sine Wave | 67.0 volts peak to peak |
| V-115, pin 2<br>V-109, pin 4 | Ground |  Semi-Square Wave | 5.5 volts peak to peak |
| V-109, pin 8<br>V-108, pin 2 | Ground |  Semi-Square Wave | 78 volts peak to peak |
| V-108, Caps | Ground |  Square Wave | 280 volts peak to peak |
| V-107, pin 7 | Ground |  Negative Peaks | Visual check for wave form only. |

CONDITIONS:

Unmodulated transmitter frequency applied to monitor. Intermediate frequency is 150 kilocycles which is fundamental or repetition frequency of the square waves. Voltages measured using a low capacitive, high impedance probe connected to a wide range cathode ray oscilloscope to check voltage levels and waveform.

## 46.0 TABLE OF R-M-S AUDIO SIGNAL VOLTAGES - DISCRIMINATOR AND MODULATION METER SECTIONS.

| FROM | TO | VOLTAGE | AUDIO MODULATING FREQUENCY |
|---|---|---|---|
| V-106, pin 6 | Ground | 4.3 v. ≡ ±75 kc Carrier Deviation<br>1.45v. ≡ ±25 kc Carrier Deviation (TV) | 400 cycles ** |
| V-106, pin 7 | Ground | 4.0 v. ≡ ±75 kc Carrier Deviation<br>1.33v. ≡ ±25 kc Carrier Deviation (TV) | 400 cycles ** |
| C-106 and R-116<br>V-102, pin 6<br>V-101, pin 1 | Ground | 3.5 v. ≡ ±75 kc Carrier Deviation<br>1.17v. ≡ ±25 kc Carrier Deviation (TV) | 400 cycles ** |
| V-101, pin 5<br>J-101, Plug<br>V-203, pin 1 | Ground | 3.5 v. ≡ ±75 kc Carrier Deviation<br>1.17v. ≡ ±25 kc Carrier Deviation (TV) | 400 cycles |
| V-203, pins 2 and 4 | Ground | 3.7 v. ≡ 100% Modulation * | 400 cycles |
| V-203, pin 5 | Ground | 22.5v. ≡ 100% Modulation * | 400 cycles |

CONDITION: Transmitter modulated 100%, r-f signal applied to monitor.

* For any position of MODULATION PEAKS switch.

** Voltages will change with audio modulating frequency according to 75 microsecond pre-emphasis.

NOTE: An audio voltage of correct frequency and magnitude may be introduced at any of the above points for test purposes.

## 47.0 TABLE OF D-C TEST VOLTAGES - MODULATION METER VACUUM-TUBE VOLTMETER CIRCUITS.

| FROM | TO | VOLTAGE | MODULATION PEAKS Switch Setting | MODULATION Meter Reads |
|---|---|---|---|---|
| V-205, pin 4 | Ground | +30.0 v. | POS | 100% |
| V-205, pin 1 | Ground | +30.0 v. | NEG | 100% |
| R-234 | Ground | +5.8 v. | Any Position | 100% |

These are test voltages to be applied by means of a battery to check operation of vacuum-tube voltmeter circuit.
Remove r-f signal from monitor before applying.

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