

**OPERATING INSTRUCTIONS**  
FOR  
**TYPE 804-B**  
**U-H-F SIGNAL**  
**GENERATOR**  
Form 536-C



**GENERAL RADIO COMPANY**  
CAMBRIDGE A, MASSACHUSETTS

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## OPERATING INSTRUCTIONS FOR TYPE 804-B U-H-F SIGNAL GENERATOR

### 1.0 DESCRIPTION

#### 1.1 PURPOSE

The Type 804-B U-H-F Signal Generator is a device for producing radio-frequency oscillations over a wide frequency band and is so arranged and shielded that a continuously-variable calibrated output voltage is obtainable. It is designed primarily for testing radio receivers.

#### 1.2 FREQUENCY RANGE

The frequency range is 7.5 megacycles to 330 megacycles. This range is covered by five steps, any one of which can be chosen by means of a band-change switch on the front of the panel. Within each range the frequency is controlled by a worm-driven tuning condenser. The driving shaft carries a 100-division dial. Fifteen turns of this dial are required to cover each frequency range. Geared with this tuning dial is a large indicator dial which carries on the outside a scale with 15 uniform divisions and, in addition, five direct-reading frequency scales corresponding to the five frequency ranges. The band change switch is located in the center of the indicator dial and covers with a mask all scales that are not used.

In addition to the five frequency ranges, a sixth position of the frequency range switch has been provided for the

convenience of the user. A plug-in type of coil without winding is furnished with the instrument.

#### 1.3 OUTPUT

The output of the Type 804-B U-H-F Signal Generator is continuously variable between 1 microvolt and 20 millivolts. The output is determined by the reading of the output meter on the panel and by the setting of the single calibrated attenuator dial. The output may be obtained either unmodulated or modulated. Modulation is adjustable up to 60%. An internal source for modulation at 400 cycles is provided. Provision is also made for use of external modulation.

#### 1.4 POWER SUPPLY

The Type 804-B U-H-F Signal Generator is intended for use on 115-volt or 230-volt power lines of 42- to 60-cycle frequency. The primary of the power transformer has two windings which can be connected in parallel or in series. The correct voltage for which a particular instrument is wired is indicated on the name plate located below the receptacle for line connection. The power consumption is approximately 25 watts.

### 2.0 PRINCIPLES OF OPERATION

#### 2.1 DIAGRAMS

A wiring diagram which follows closely the actual arrangement of component parts in the instrument will be found on the inside of the cabinet. A more functional diagram is shown in Figure 1.

The power supply furnishes filament and plate power for the Type 955 Acorn Oscillator Tube, V4, and the Type 6G6G Modulator Tube, V3. The modulator tube can be used as a generator of 400-cycle modulating voltage or as an amplifier for external modulating voltages. The output of the oscillator is connected to a capacitive attenuator and is available after

attenuation at a jack at the lower right-hand corner of the instrument.

#### 2.2 OPERATING VOLTAGES

The heaters of all tubes operate at 6.3 volts. Plate voltage is obtained in a full-wave rectifier circuit and is maintained at 150 volts by means of a Type VR-150 Stabilizer Tube, V2. A resistance-capacitance filter is used to smooth out power supply ripples.

#### 2.3 CARRIER OSCILLATOR

The plate and the grid of the 955-

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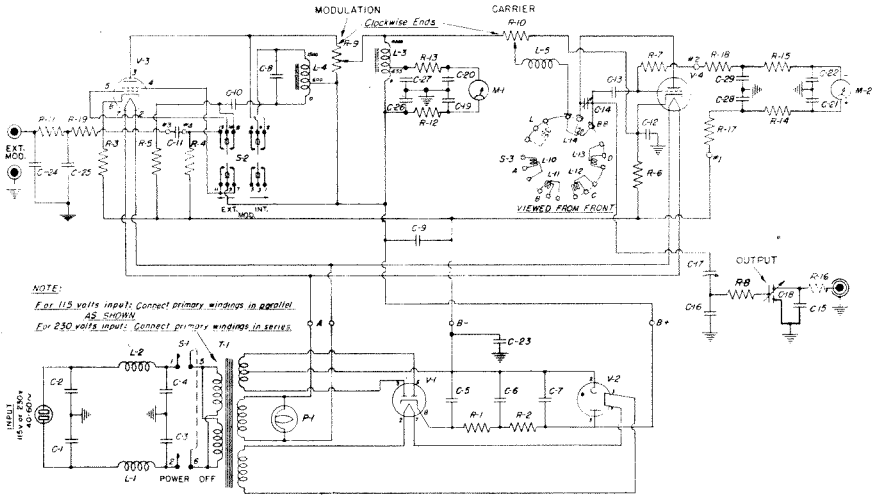


FIGURE 1. Circuit diagram of Type 804-B U-H-F Signal Generator.

### PARTS LIST

#### Resistors

- R-1 = 1250  $\Omega$
- R-2 = 1250  $\Omega$
- R-3 = 500  $\Omega$
- R-4 = 500 k $\Omega$
- R-5 = 30 k $\Omega$
- R-6 = 200  $\Omega$
- R-7 = 25 k $\Omega$
- R-8 = 30  $\Omega$
- R-9 = 20 k $\Omega$
- R-10 = 50 k $\Omega$
- R-11 = 500  $\Omega$
- R-12 = 500  $\Omega$
- R-13 = 500  $\Omega$
- R-14 = 500  $\Omega$
- R-15 = 500  $\Omega$
- R-16 = 75  $\Omega$
- R-17 = 500  $\Omega$
- R-18 = 500  $\Omega$
- R-19 = 500  $\Omega$

#### Condensers

- C-1 = 0.001  $\mu$ f
- C-2 = 0.001  $\mu$ f
- C-3 = 0.001  $\mu$ f
- C-4 = 0.001  $\mu$ f
- C-5 = 10  $\mu$ f
- C-6 = 10  $\mu$ f
- C-7 = 5  $\mu$ f
- C-8 = 0.1  $\mu$ f
- C-9 = 0.8  $\mu$ f
- C-10 = 0.1  $\mu$ f
- C-11 = 0.01  $\mu$ f
- C-12 = 400  $\mu$ f
- C-13 = 50  $\mu$ f
- C-14 = 12-150  $\mu$ f
- C-15 = 100  $\mu$ f
- C-16 = 30  $\mu$ f
- C-17 = 2  $\mu$ f
- C-18 = 0-15 & 15-0  $\mu$ f
- C-19 = 0.001  $\mu$ f
- C-20 = 0.001  $\mu$ f
- C-21 = 0.001  $\mu$ f
- C-22 = 0.001  $\mu$ f
- C-23 = 0.25  $\mu$ f
- C-24 = 0.0004  $\mu$ f
- C-25 = 0.0004  $\mu$ f
- C-26 = 0.001  $\mu$ f
- C-27 = 0.001  $\mu$ f
- C-28 = 0.001  $\mu$ f
- C-29 = 0.001  $\mu$ f

#### Inductors

- L-1 = 804-310
- L-2 = 804-310
- L-3 = 745-200
- L-4 = 745-201
- L-5 = 804-32
- L-10 = 804-844 (240-330 Mc)
- L-11 = 804-87 (120-240 Mc)
- L-12 = 804-36 (50-120 Mc)
- L-13 = 804-37 (22-50 Mc)
- L-14 = 804-38 (8-22 Mc)

#### Tubes

- V-1 = RCA Type 6X5G
- V-2 = RCA Type VR-150-30
- V-3 = RCA Type 6G6G
- V-4 = RCA Type 955

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type Oscillator Tube, V4, are permanently connected to rotor and stator, respectively, of the tuning condenser. Rotor and stator are balanced to ground. The maximum and minimum capacitances of the tuning condenser C<sub>14</sub> are 150  $\mu\text{f}$  and 12  $\mu\text{f}$ . By means of the FREQ. RANGE switch any one of the five tuning coils can be connected across the tuning condenser. The cathode of the oscillator tube is grounded for radio frequencies by a condenser, C<sub>12</sub>. The plate voltage is supplied at a tap of each coil. The plate voltage is controlled by the CARRIER potentiometer and is set to give 100 microamperes grid current as read on the right-hand meter on the front panel. The grid current of the oscillator tube is proportional to the amplitude of oscillation, and is used to establish the proper level of carrier voltage fed to the attenuator.

## 2.4 MODULATOR

The MODULATION switch S<sub>2</sub> controls the operation of the Type 6G6G Modulation Tube, V3. In the OFF position of this switch the screen of the modulator tube is disconnected and the tube is not in operation. In the INT. position, the tube is connected to a circuit which is tuned to 400 cps, and delivers about 70 volts modulating voltage to the MODULATION potentiometer. Depending on the position of the potentiometer arm, modulating voltage correct for up to 60% modulation is inserted in series with the d-c plate supply of the oscillator tube. Since the d-c supply is regulated at 150 volts, the amount of modulating voltage introduced is directly proportional to the percentage modulation obtained, independent of the actual plate voltage of the oscillator tube which is determined by the position.

of the CARRIER potentiometer. The percentage modulation is read directly on the left-hand panel meter. This meter is a copper-oxide-rectifier type meter of 7.5 volts full scale, which is connected to about one-tenth of the turns of the modulation choke L<sub>3</sub>. In the EXT. position of the modulation switch the modulator tube acts as an amplifier with the modulation potentiometer as the plate load.

Changing the plate voltage of the oscillator tube will change the oscillator frequency in addition to changing the oscillator amplitude. Such a change in oscillator frequency is known as frequency modulation. The amount of frequency modulation increases with carrier frequency and is inversely proportional to tuning condenser capacitance. Allowance for frequency modulation must be made in tests of selective receivers.

## 2.5 ATTENUATOR

The oscillator is connected to the attenuator by means of a capacitance voltage divider C<sub>17</sub> and C<sub>16</sub>. The actual voltage at the attenuator input is about one-tenth of the grid voltage of the oscillator. The output capacitance of the attenuator is 100  $\mu\text{f}$ , and the variable attenuator capacitance varies between very small values and 15  $\mu\text{f}$ . The attenuator dial is calibrated between 0.001 and 20 millivolts (1 and 20,000 microvolts). At the low output, the variable attenuator capacitance has the low value of 0.00075  $\mu\text{f}$ . As a matter of fact, this capacitance can be further decreased but the MILLIVOLTS dial has not been calibrated below 0.001 millivolt. The attenuator is compensated to present a constant capacitance to the oscillator circuit to avoid carrier frequency changes with attenuator

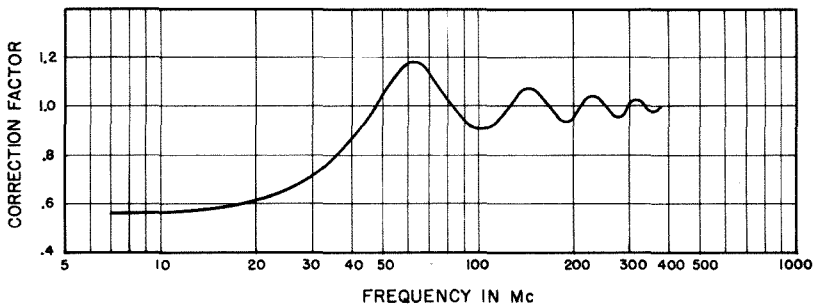


FIGURE 2. Plot of correction factor for output voltage as a function of frequency.

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setting. The compensation is adjusted with 9 screws which can be seen on the attenuator housing.

## 2.6 OUTPUT CIRCUIT.

Output voltages are obtained at the output jack at the lower right-hand corner of the front panel, across a 100  $\mu\text{f}$  condenser,  $C_{15}$ , which is built into the attenuator housing and in series with the 75 $\Omega$  resistor  $R_{16}$  which is located inside the output jack. A concentric shielded output cable 3-feet long with a characteristic impedance of 75 $\Omega$  is furnished with the Type 804-B Signal Generator. This cable is fitted with male and female plugs and should be inserted into the output jack.

The Type 774-YA-1 Terminal Unit which is furnished in addition serves merely to convert the concentric output terminal into convenient screw terminals.

The calibration of the attenuator dial is given in terms of open-circuit output voltage at the output jack. For high

frequencies the output voltage at the far end of the output cable is practically the same. For lower frequencies a correction has to be applied. The output impedance approaches 75 $\Omega$  at the high-frequency end and corresponds to 185  $\mu\text{f}$  at low frequencies (100 in the output and 85  $\mu\text{f}$  in the cable). Correction factor and output impedance plotted against frequency are shown in Figures 2 and 3, respectively. The resistive and reactive components of the output impedance are shown in Figure 4.

To obtain low output voltages beyond the last calibration point of the attenuator dial, an additional external attenuator, the Type 774-X-1 Insertion Unit, can be connected to the output cable. This unit contains a T pad attenuator of 60, 15 and 61.4 $\Omega$  and reduces the output voltage at high frequencies by a factor of 10:1; at low frequencies the attenuation is higher. Figure 5 shows the correction factor plotted against frequency. The output impedance of the insertion unit is practically constant at 75 $\Omega$ .

## 3.0 OPERATING INSTRUCTIONS

### 3.1 TUBES AND PILOT LIGHTS

Type	Function	Location
955	Carrier Oscillator Tube	Isolantite socket on top of tuning condenser
6G6G	Modulator Tube	Left-hand side of instrument compartment
6X5G	Rectifier Tube	Vertically in power supply compartment
VR-150	Regulator Tube	Horizontally in power supply compartment
5-6 Volt Pilot Light		Front Panel

### 3.2 POWER SUPPLY

Before connecting the instrument to the line make sure that line voltage and frequency agree with those shown on the name plate below the power cord receptacle. The power transformer is made with a split primary which can be connected in parallel or in series. Whenever a change in connection of the power transformer is made, the name plate below the receptacle should be unscrewed and reversed.

To follow more easily instructions in the next paragraphs it is suggested that the modulation switch be set to the OFF

position and that the MODULATION and CARRIER potentiometers be turned all the way in a counterclockwise direction before throwing the ON-OFF switch to ON.

### 3.3 SETTING OF CARRIER FREQUENCY

The carrier frequency is set by the FREQ. RANGE switch and the tuning condenser dial and can be adjusted to the desired value on the direct-reading frequency scale which is exposed.

### 3.4 SETTING OF CARRIER AMPLITUDE

To establish the proper level of carrier amplitude at the attenuator input, the CARRIER potentiometer is set to give 100 microamperes grid current on the right-hand meter. If it is not possible to set to 100

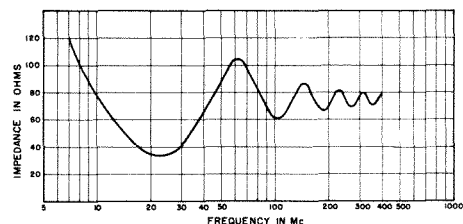


FIGURE 3. Plot of output impedance at end of cable as a function of frequency.

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on the two highest frequency ranges, the meter can be set to a convenient lower value, and the output of the signal generator will be correspondingly reduced.

**3.5 SETTING OF INTERNAL 400-CYCLE MODULATION** Internal 400-cycle modulation is obtained by throwing the modulation switch into the INT. position. The percentage modulation is controlled by the MODULATION potentiometer, and the desired value is set on the left-hand meter. The carrier and modulation controls show a slight interaction. For correct output both meters should be set to the desired values.

### 3.6 SETTING OF EXTERNAL MODULATION

External modulation is obtained by throwing the modulation switch into the EXT. position and by connecting a source of external modulating voltage to the EXT. MOD. binding posts. The input impedance at the binding posts is 0.25 megohm. The modulation characteristic is flat within  $\pm 2$  db, between 100 and 20,000 cps, and within 1 db between 200 and 10,000 cps. Control and setting of the desired percentage modulation is exactly the same as for internal modulation (see Paragraph 3.5). When external modulation is used, do not overload the input circuit. The best procedure is to turn the MODULATION control to maximum, and use the external oscillator volume control to regulate the percentage modulation. It takes about 7 volts to

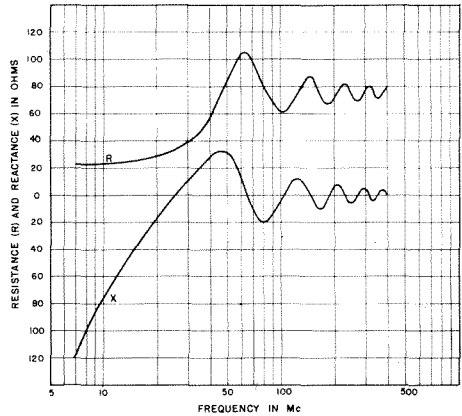


FIGURE 4. Resistive (R) and reactive (X) components of output impedance.

get 50% modulation under these conditions. Twelve volts is the maximum that should be applied to the EXT. MOD. terminals under any condition.

### 3.7 SETTING OF ATTENUATOR

After establishing the correct level of unmodulated or modulated carrier at the desired frequency, the output voltage can be set to any value between 0.001 and 20 millivolts, as marked on the calibrated attenuator dial. As explained in paragraph

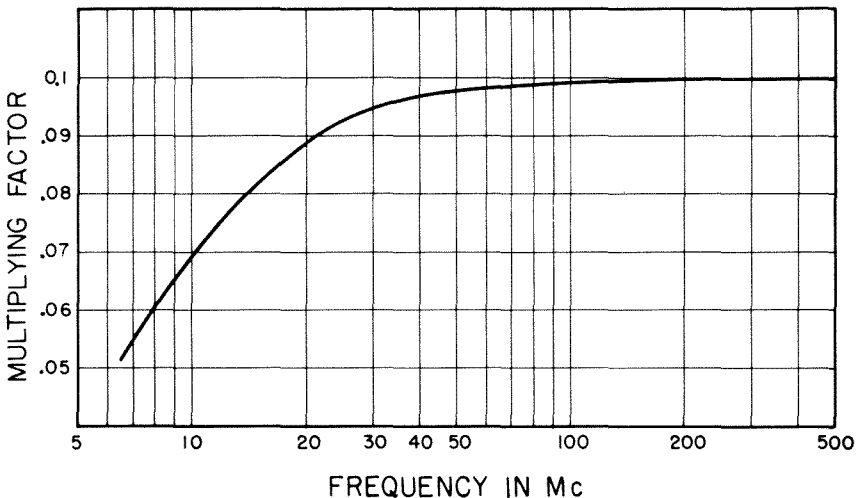


FIGURE 5. Correction factor for output voltage when Type 774-X-1 Insertion Unit is connected to end of cable.

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2.6, the output voltage then is correct for the open circuit condition at the output jack and for the open circuit condition at the end of the 3-foot output cable for high frequencies. For low frequencies, particularly below 50 Mc, the correction factors shown in Figure 2 must be used.

## 3.8 EXTERNAL ATTENUATOR

For low output voltages, beyond the last calibration point of the attenuator, the Type 774-X-1 Insertion Unit is plugged into the output cable. This unit reduces the output voltage by a factor of 10:1 except at low frequencies where the correction factors of Figure 5 must be used.

## 3.9 TESTING OF SELECTIVE RECEIVERS

As explained in Paragraph 2.4, pure amplitude modulation cannot be obtained with the Type 804-B U-H-F Signal Generator. In addition to amplitude modulation, frequency modulation will be present, particularly at the high-frequency end of each frequency range. This frequency modulation will be very noticeable in testing selective receivers. It will be observed that the receiver output does not increase with

increased percentage modulation and that additional peaks are observed as the receiver is detuned. Testing of selective receivers should therefore be confined to testing with unmodulated carrier.

## 3.10 PLUG-IN COIL FORM

A plug-in coil form is furnished with the Type 804-B U-H-F Signal Generator. This can be plugged into the mycalex disc of the range changing switch in a position corresponding to the blank sector of the indicator dial. No winding is furnished. This position is intended for an additional frequency range. It can be used, for instance, with a fixed shunt capacitance for reduced frequency spread and improved setting accuracy. Owing to the plug-in type construction of the coil, frequencies above 100 Mc cannot be obtained, but frequencies well below the range of the Type 804-B U-H-F Signal Generator can be produced. As an example, a coil with a 3-bank winding of 140 turns No. 30 DCC wire with a tap at 70 turns and with a shunt capacitance of 100  $\mu\text{f}$  will have a range of 0.8 Mc to 1.2 Mc. With a 3/8" diameter dust core, the range will be 0.6 Mc to 0.9 Mc.

## 4.0 MAINTENANCE

The only parts of the Type 804-B U-H-F Signal Generator which are subject to wear and deterioration, and which require periodical attention are the vacuum tubes, the tuning condenser contacts, and the band-change switch contacts. In addition, as a result of aging or excessive temperature variation, the calibration of the inductors may show slight drifts.

### 4.1 TUBES

The location of the tubes is given in paragraph 3.1. The heaters of all tubes operate on 6.3 volts. Plate voltage and current of the 955-type Oscillator Tube, V4, depends on the selected frequency and on the setting of the controls. The maximum values of voltage and current are 150 volts and 10 milliamperes. These values are obtained at the low frequency end of Coil A and B. The plate current for most of the other ranges is around 5 milliamperes.

Plate and screen voltage of the Type 6G6G Modulator Tube, V3, are 150 volts. In the INF. and EXT. positions of the MODULATION switch, plate current is about 8

milliamperes and screen current about 4 milliamperes.

The regulated power supply should deliver 150 volts at about 20 milliamperes to the instrument. There should be a purple glow inside the Type VR-150 Rectifier Tube. The alternating-current ripple voltage as measured across the regulator tube should not be more than 150 millivolts.

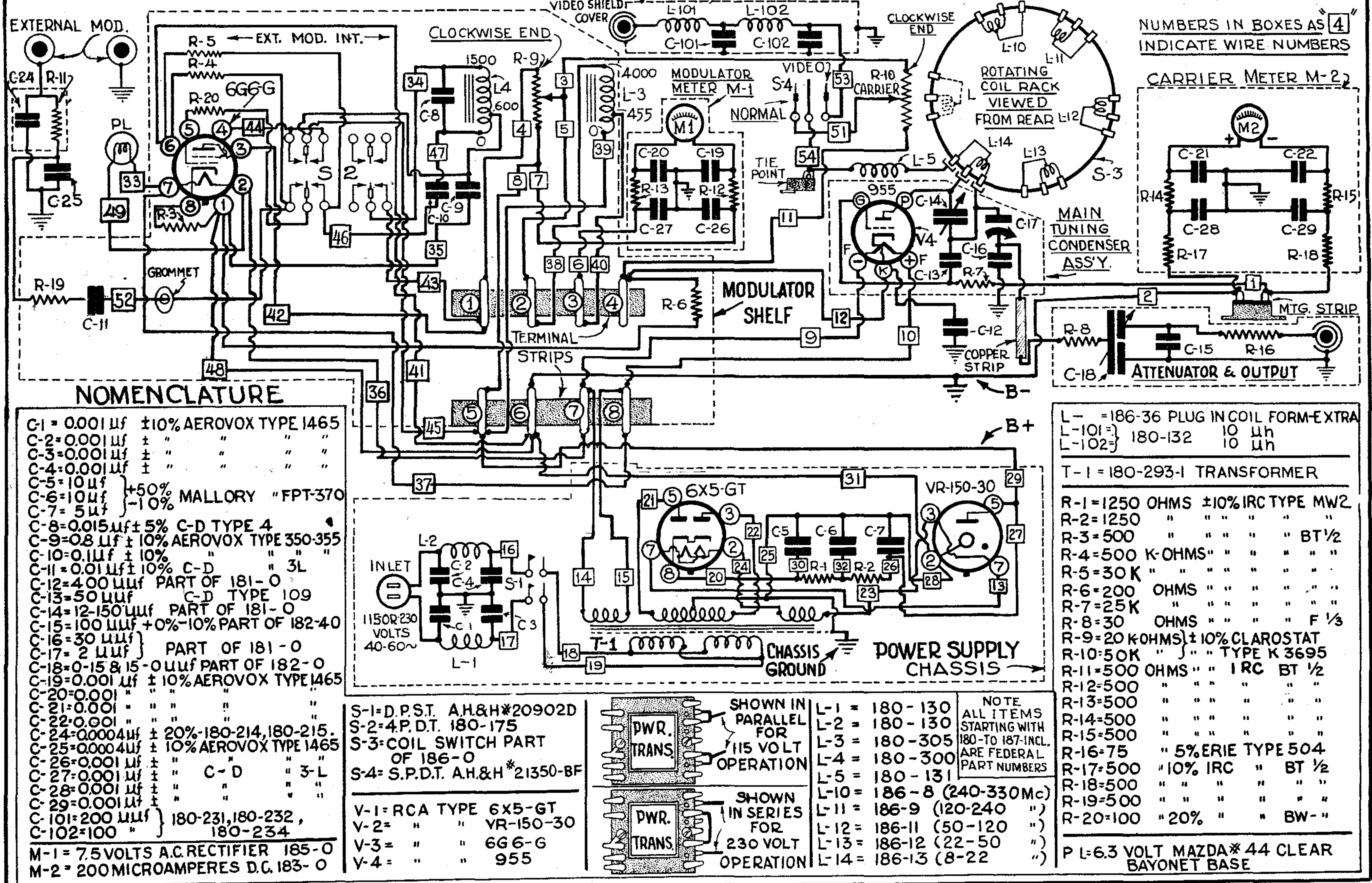
### 4.2 BAND-CHANGE SWITCH AND CONDENSER CONTACTS

The band-change switch and the condenser contacts may become erratic in operation after long use as a result of dust accumulating on the contacts. When this occurs the contacts should be carefully cleaned with a dry cloth.

### 4.3 FREQUENCY CALIBRATION

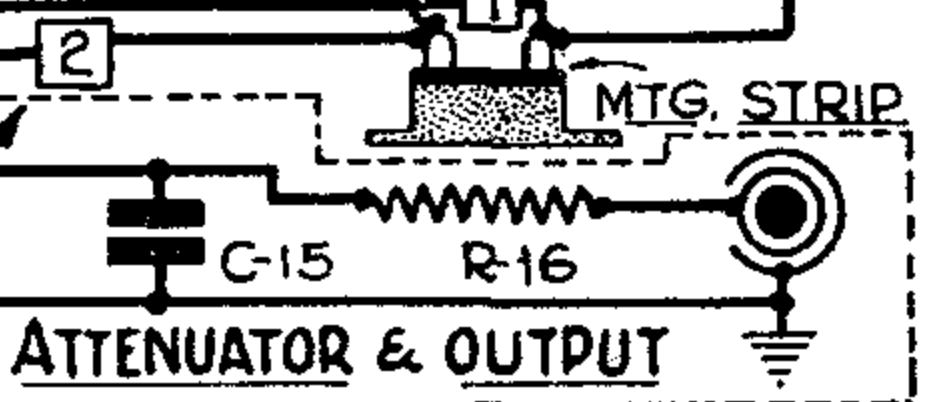
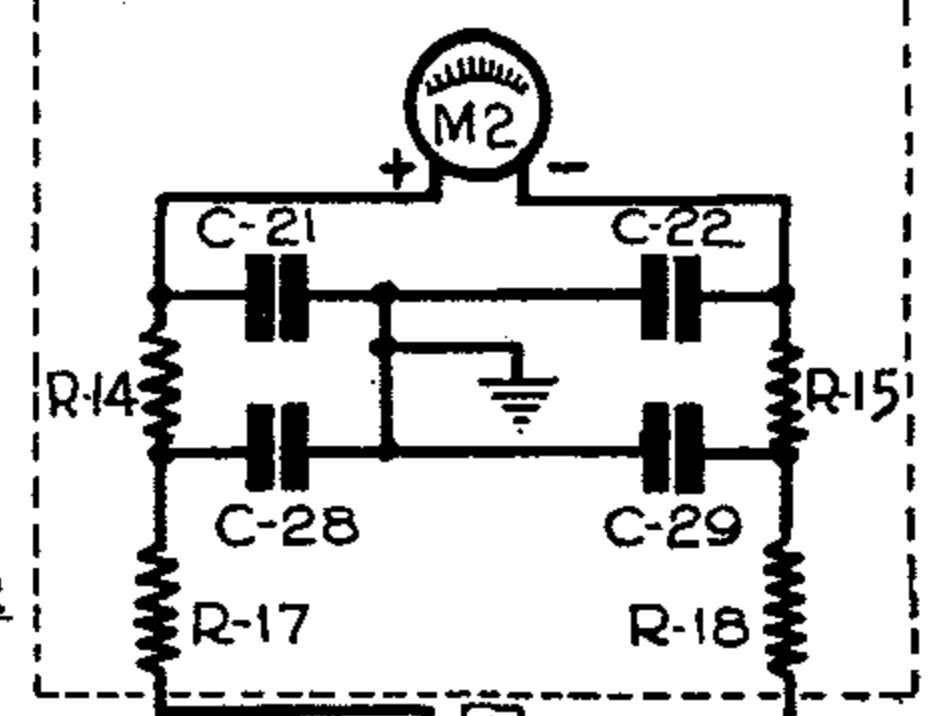
Some of the inductors are provided with adjustable dust cores to compensate for slight variations. If adjustments have to be made on any of the ranges it is suggested that the frequency in the middle of the range be set accurately.

# 804-CS2 U.H.F. SIGNAL GENERATOR



NUMBERS IN BOXES AS 4 INDICATE WIRE NUMBERS

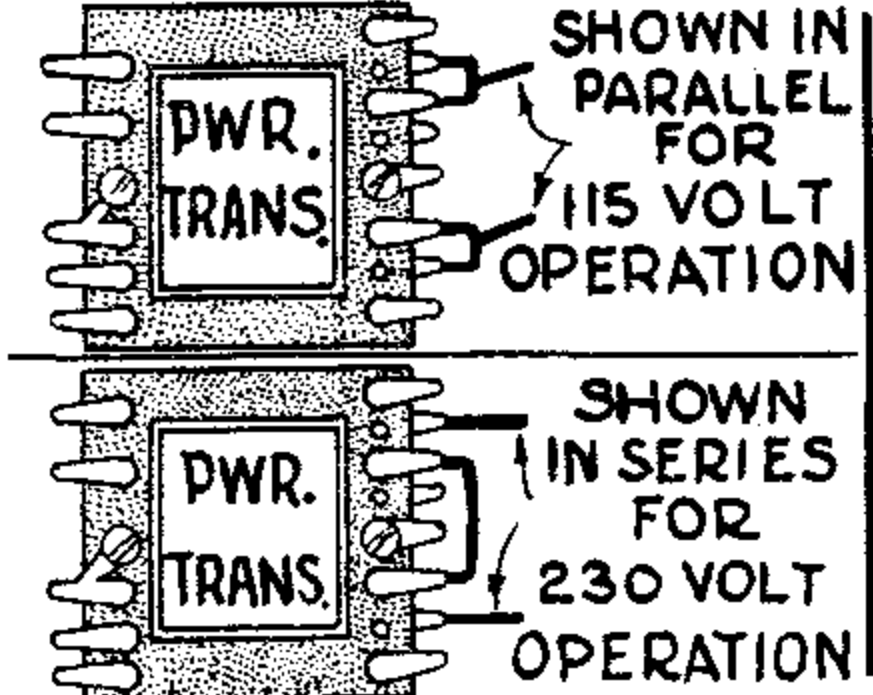
CARRIER METER M-2



## NOMENCLATURE

- C-1 = 0.001 uf ±10% AEROVOX TYPE 1465
- C-2 = 0.001 uf ± " " " " "
- C-3 = 0.001 uf ± " " " " "
- C-4 = 0.001 uf ± " " " " "
- C-5 = 10 uf
- C-6 = 10 uf } +50% MALLORY "FPT-370
- C-7 = 5 uf } -10%
- C-8 = 0.015 uf ± 5% C-D TYPE 4
- C-9 = 0.8 uf ± 10% AEROVOX TYPE 350-355
- C-10 = 0.1 uf ± 10% " " " "
- C-11 = 0.01 uf ± 10% C-D " 3L
- C-12 = 4.00 uf PART OF 181-0
- C-13 = 50 uf C-D TYPE 109
- C-14 = 12-150 uf PART OF 181-0
- C-15 = 100 uf +0%-10% PART OF 182-40
- C-16 = 30 uf PART OF 181-0
- C-17 = 2 uf PART OF 181-0
- C-18 = 0-15 & 15-0 uf PART OF 182-0
- C-19 = 0.001 uf ± 10% AEROVOX TYPE 1465
- C-20 = 0.001 " " " " "
- C-21 = 0.001 " " " " "
- C-22 = 0.001 " " " " "
- C-24 = 0.0004 uf ± 20% 180-214, 180-215.
- C-25 = 0.0004 uf ± 10% AEROVOX TYPE 1465
- C-26 = 0.001 uf ± " C-D " 3-L
- C-27 = 0.001 uf ± " " " "
- C-28 = 0.001 uf ± " " " "
- C-29 = 0.001 uf ± " " " "
- C-101 = 200 uf } 180-231, 180-232,
- C-102 = 100 " } 180-234
- M-1 = 7.5 VOLTS A.C. RECTIFIER 185-0
- M-2 = 200 MICROAMPERES D.C. 183-0

- S-1 = D.P.S.T. AH&H\*20902D
- S-2 = 4.P.D.T. 180-175
- S-3 = COIL SWITCH PART OF 186-0
- S-4 = S.P.D.T. AH&H\*21350-BF
- V-1 = RCA TYPE 6X5-GT
- V-2 = " " VR-150-30
- V-3 = " " 6G6-G
- V-4 = " " 955



- L-1 = 180-130
- L-2 = 180-130
- L-3 = 180-305
- L-4 = 180-300
- L-5 = 180-131
- L-10 = 186-8 (240-330 Mc)
- L-11 = 186-9 (120-240 " )
- L-12 = 186-11 (50-120 " )
- L-13 = 186-12 (22-50 " )
- L-14 = 186-13 (8-22 " )

NOTE ALL ITEMS STARTING WITH 180- TO 187- INCL. ARE FEDERAL PART NUMBERS

- L- = 186-36 PLUG IN COIL FORM-EXTRA
- L-101 = 180-132 10 uh
- L-102 = 180-132 10 uh
- T-1 = 180-293-1 TRANSFORMER
- R-1 = 1250 OHMS ±10% IRC TYPE MW2
- R-2 = 1250 " " " " "
- R-3 = 500 " " " " BT 1/2
- R-4 = 500 K-OHMS " " " " "
- R-5 = 30K " " " " "
- R-6 = 200 OHMS " " " " "
- R-7 = 25K " " " " "
- R-8 = 30 OHMS " " " " F 1/3
- R-9 = 20 K-OHMS ± 10% CLAROSTAT
- R-10 = 50K " " " TYPE K 3695
- R-11 = 500 OHMS " " IRC BT 1/2
- R-12 = 500 " " " " "
- R-13 = 500 " " " " "
- R-14 = 500 " " " " "
- R-15 = 500 " " " " "
- R-16 = 75 " 5% ERIE TYPE 504
- R-17 = 500 " 10% IRC " BT 1/2
- R-18 = 500 " " " " "
- R-19 = 500 " " " " "
- R-20 = 100 " 20% " " BW-
- P L-6.3 VOLT MAZDA\* 44 CLEAR BAYONET BASE

## FEDERAL MANUFACTURING & ENGINEERING CORPORATION

Figure 8. Substitute physically and electrically equivalent parts of other manufacturers may be used  
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