BENCH ALIGNMENT PROCEDURE FOR TRANSMITTER MODELS 4ET48A10, 11, 12 & 13

This Bench Alignment Procedure is provided for completely realigning Transmitter Models 4ET48A10-13 or for changing their frequency. Instructions for adjusting the modulation level are also included.

ALIGNMENT PROCEDURE

TEST EQUIPMENT

The transmitter can be completely realigned, using a 20,000 ohm-per-volt voltmeter which covers the 0 to 3 volt range. The voltage indications given in the following alignment procedure are the values which should be read on such a meter. General Electric Test Set Types EX-1-C, D, or E are designed for the many metering applications encountered when tuning Radio Communication and associated equipment and includes a 20,000 ohm-per-volt meter.

If a meter equivalent to the one suggested is not available for tuning purposes, others may be used, but the meter reading obtained must be corrected to account for the shunting effect of the different meter resistance on the metering circuit.

The following test equipment is recommended:

1. A 20,000 ohm-per-volt meter which covers the 0 to 3-volt range.
2. A non-metallic screwdriver.
3. A frequency measuring device, such as Lampkin Type 105B or Gertsch Model FM-3.
4. An absorption wavemeter which will tune to 2, 6, 12 and 24 times the crystal frequency.

PROCEDURE

Refer to SERVICE OUTLINE RC-770 (see Table of Contents) to locate the tuning controls referred to in the following alignment procedure. All meter readings are measured between the jack indicated and ground.

1. Be sure that the oscillator crystal(s) is (are) correctly connected between the points shown in the following table. The crystal frequency for each channel is 1/24th of the channel frequency.

Crystal	Single-Frequency and Two-Frequency Transmitters
CHAN A	XY101-4 and 6
CHAN B	XY101-2 and 8 (2-Freq. only)

2. In multi-frequency transmitters, turn the Channel-Selector Switch on the Control Unit to CHAN A, if the greatest frequency separation between channels is less than 0.4% of the operating frequency. (Select the channel having the lowest frequency if CHAN A is not the lowest). For frequency separations greater than 0.4%, a crystal having a frequency which is the average of the crystal frequencies for the highest and lowest channels should be used to align the transmitter.

3. Connect the antenna or other load to the transmitter.

4. Set the TUNE-OPERATE switch (S101 on the PA housing) on TUNE.

5. Rotate the ANT COUPLING control (L121/L122) to its extreme clockwise position.

6. Turn the power on and allow 30 seconds for the transmitter to warm up to operating temperature.

7. (a) For 4ET48A10 & 12 only (130-150.8 MC): A voltage reading of approximately 1 volt between the MULT-1 jack J101 (green-negative) and ground when the transmitter is keyed indicates proper operation of the Oscillator and Modulator stages of the transmitter. Use the ground jack (J508-black) located on the Power Supply chassis. If the MULT-1 reading is less than 0.8 volt or more than 1.2 volt, adjust C106 for a reading of approximately 1 volt. C106 was adjusted at the factory and should not ordinarily require further adjustment. However, due to variations on tube characteristics, C106 may have to be readjusted when the Oscillator or Modulator tube is replaced.

NOTE

After any adjustment of C106, check the frequency and deviation of the transmitter.

(b) For 4ET48A11 & 13 only (150.8-174 MC): A voltage reading of approximately 1.5 volts between the MULT-1 jack J101 (green-negative) and ground when the transmitter is keyed indicates proper operation of the Oscillator and Modulator stages of the transmitter. Use the ground jack (J508-black) located on the Power Supply chassis.

8. With the meter lead moved to the MULT-2 jack, J102 (green-negative), key the transmitter and tune Z101 for maximum meter reading (approximately 1.5 volts).

CAUTION

Do not key the transmitter for longer than 30 seconds in each minute until the 4th Multiplier plate has been tuned.

9. Alternately tune Z103 and Z105 for maximum meter reading (approximately 1.8 volts) at the MULT-3 jack, J103 (green-negative).

When making a large change in frequency, it may not be possible to see any indication on the meter when Z103 is tuned, unless Z105 is tuned near the correct frequency. In this case, pre-tune Z103 by one of the following methods:

(a) With the 300-volt scale of a vacuum tube voltmeter or a 20,000 ohm-per-volt voltmeter connected at the screen of the 2nd Multiplier (pin 6 of XV103), tune Z103 for a slight dip in screen voltage.

(b) Hold an absorption wavemeter close to the bottom of Z103, and tune for resonance.

It is possible to tune Z103 and Z105 to the wrong harmonic of the crystal frequency. Z103 and Z105 will ordinarily be correctly tuned if their slugs are first screwed all the way out and then screwed in to the first indication of resonance. Check the tuning with a wavemeter.

10. Alternately peak Z107 and Z109 while metering at the MULT-4 jack, J104, (green-negative). Fixed bias on the MULT-4 grid will appear as a small initial reading (0.5-1.0 volts) at J104, whether or not Z107 and Z109 are correctly tuned. The meter should read approximately 1.5 volts or more for proper tuning.

A slight dip at J103 may be used as an indication of resonance of Z107 if both Z107 and Z109 are badly misaligned.

11. Peak the MULT-4 PLATE control (C140) while metering at the PA GRID jack, J105, (green-negative). Fixed bias on the PA GRID will appear as a small initial reading at J105, whether or not the MULT-4 PLATE control is correctly tuned.

WARNING

HIGH VOLTAGE is present under the transmitter chassis. Disconnect all power from the transmitter before proceeding.

The spacing between coils L110/L111 and L112/L113 should be adjusted for meter reading of 2.1 to 2.6 volts.

NOTE

In some services, FCC regulations do not permit the use of full rated power input to the final amplifier plate circuit. In such case, the Output Coupling control must not ordinarily be adjusted for a meter reading of 2.4 volts at J106. To find the maximum permissible meter reading at J106, measure the power amplifier plate voltage under load and calculate the J106 meter reading from the following formula:

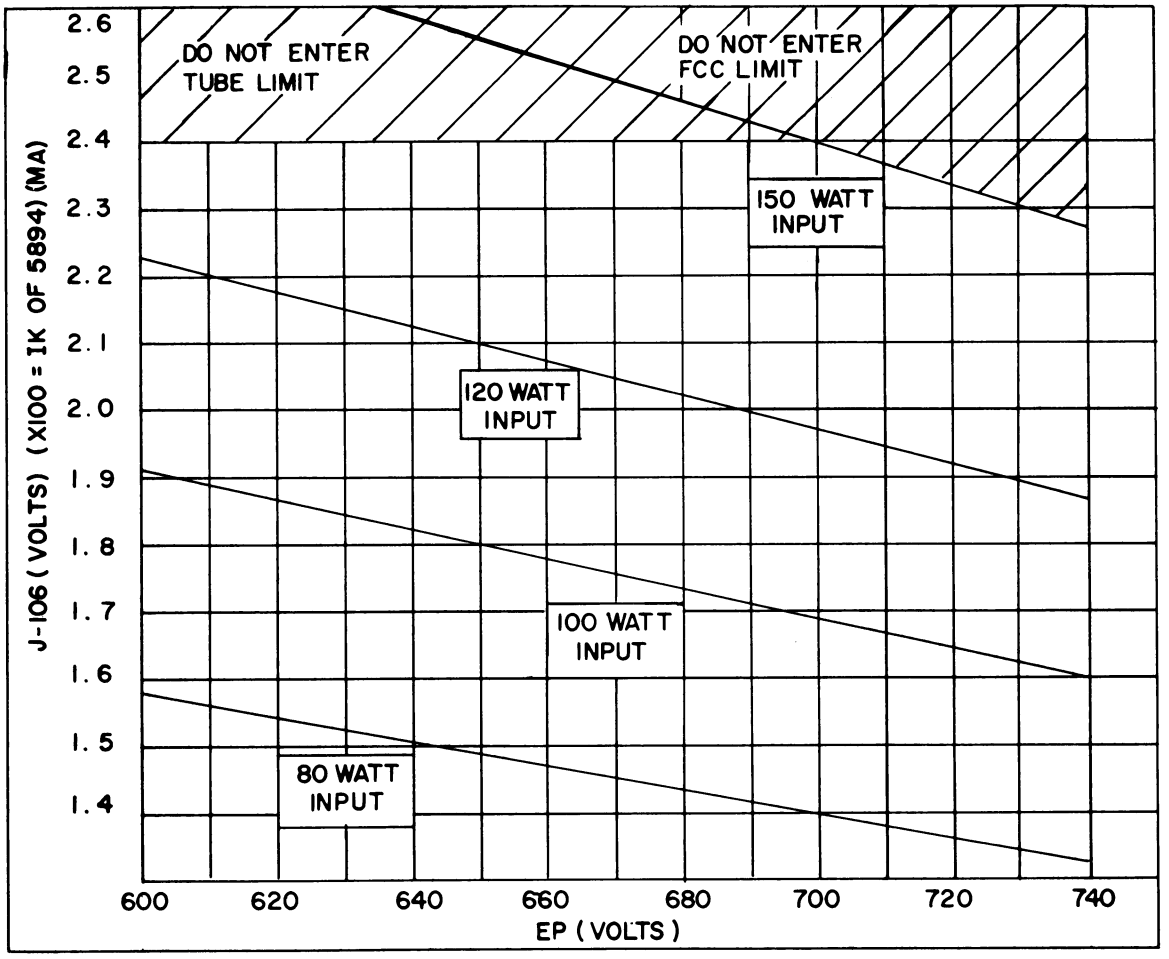
$$\text{J106 meter reading (volts)} = \frac{10P}{E}$$

Where P is the maximum permissible power input (in watts)
E is the power amplifier plate voltage under load.

The maximum permissible J106 meter reading vs. plate voltage is shown in the chart below for power inputs of 150 watts, 120 watts, 100 watts, and 80 watts.

IK - (IG + ISG) = IP
(IP) (EP) = PO IN

IG = 8. MA
ISG = 17. MA



If the transmitter is to be used for continuous duty or long duty cycles, set the PA GRID drive from 0.1 to 0.2-volt higher than the peak power output reading. The required grid drive for the PA tube (5894) may vary from tube to tube.

12. Place the negative probe of the test meter on ground, the positive probe in J106 "PA CATH". The ANT COUPLING control (L121/ L122) should be tuned completely clockwise. Key the transmitter and tune PA PLATE (C150) for minimum meter reading.

13. Switch the TUNE-OPERATE switch to "OPERATE". Key the transmitter and quickly tune PA PLATE (C150) and ANT TUNING (C167/ C168) for minimum reading (less than 1.0 volt) at J106. Repeat until lower reading cannot be obtained.

14. Tune ANT TUNING (C167/C168) for maximum reading at J106. If an increase at J106 cannot be observed, rotate ANT COUPLING (L121/ L122) slightly counterclockwise until it is possible to observe a slight increase when ANT TUNING is tuned through resonance.

15. Rotate ANT COUPLING (L121/L122) counterclockwise until a reading of approximately 2.4 volts is obtained at J106.

16. Repeat Step 14 and adjust ANT COUPLING (L121/L122) for reading of 2.4 volts at J106.

17. Repeat Step 10 through 16.

NOTE

It is possible to over-couple the ANT COUPLING. To avoid this, the ANT TUNING should be peaked for maximum load and ANT COUPLING adjusted for 2.40 volts at J106. Repeat this until the peak is found for ANT TUNING with minimum coupling of ANT COUPLING.

MODULATION LEVEL ADJUSTMENT

The modulation level control, R186, was adjusted to the proper setting before shipment and should not normally require readjustment. This setting permits approximately 60 percent modulation for the average voice level. The occasional audio peaks which would cause overmodulation are limited by the modulation limiter (V109). The limiter instantaneously limits the slope of the audio wave, preventing overmodulation, but preserving the intelligibility of the transmission.

TEST EQUIPMENT

1. An audio oscillator.

2. A frequency modulation monitor.

3. An output meter or a vacuum tube voltmeter.

PROCEDURE

1. Connect the audio oscillator and the meter across pin 1 and 2 of the microphone receptacle on the power supply chassis. (Pin 1 is the audio low).

2. Apply a 1.0-volt signal at 1000 cps across the microphone terminals.

3. Disconnect the microphone from the control unit, and key the transmitter by means of the test switch on mobile transmitters or by grounding pin 3 of the microphone jack in station transmitters.

4. 4. Set R186, the MOD control, for a 13 to 15-kilocycle swing (5-kilocycles for Narrow-Band) as indicated on the frequency modulation monitor.

If no audio oscillator is available, the modulation level control can be set by connecting a microphone to the transmitter, whistling a loud, clear tone into the microphone, and setting the MOD control (R186) for a 13 to 15-kilocycle swing*, as indicated on the modulation monitor.

TWO-FREQUENCY ALIGNMENT (4ET48A12 & 13)

Before proceeding with the two-frequency alignment, first make sure that the transmitter is correctly aligned on Channel A. Then follow the procedure outlined below.

1. Check readings of multiplier stages (J101 through J105) on Channel A and then Channel B. If the readings are not approximately equal (within 0.15-volt), adjust each stage for a balance between Channel A and B, keeping the highest jack readings possible. (Reading at J105 on both channels must remain within the 2.1 to 2.6 volt limit).

2. Place the positive lead of the test meter in J106 and the negative lead on ground. Turn the ANT COUPLING (L121/L122) control fully clockwise and tune ANT TUNING (C167/C168) for minimum meter reading on Channel A. Turn the channel selector switch to CHAN B. If the reading at J106 is different from that on Channel A, tune PA PLATE (C150) so as to decrease the meter reading slightly.

*Because of the high selectivity of General Electric Mobile Radio equipment, excessively high swings can impair communication effectiveness as well as excessively low swings. Within the range of settings recommended, good performance should be obtained. In general, more problems arise from high swing settings than from low; for this reason, the modulation control is set for ±13 kilocycles (±5 kilocycles for Narrow-Band) when the equipment is shipped from the factory.

3. Check the reading on Channel A. If the reading on Channel A is still less than that on Channel B, repeat Step 2 until the readings are equal. If, at any time, the reading on Channel A is greater than that on Channel B, tune PA PLATE so as to decrease the reading on Channel A.

4. On Channel A, tune ANT TUNING (C167/C168) for maximum reading on J106. If an increase at J106 cannot be observed, rotate ANT COUPLING L121/L122 slightly counterclockwise until it is possible to observe a slight increase when ANT TUNING is tuned through resonance.

5. Rotate ANT COUPLING counterclockwise until a reading of approximately 2.4 volts is obtained at J106.

6. Turn the channel selector switch to CHAN B. If the reading at J106 is different from that on Channel A, tune ANT TUNING (C167/C168) so as to increase the reading on Channel B.

7. Check J106 reading on Channel A. If the reading on Channel A is still greater than that on Channel B, repeat 5 and 6 until the readings are equal. If, at any time, the reading on Channel B is greater than that on Channel A, tune ANT TUNING so as to increase the reading on Channel A.

8. Turn the channel selector switch on CHAN B, and adjust ANT COUPLING (L121/L122) for reading of 2.4 volts at J106.

9. If the transmitter is to be used for continuous duty or long duty cycles, set the PA GRID drive from 0.1 to 0.2-volt higher than the peak power output reading. The required grid drive for the PA tube (5894) may vary from tube to tube.

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