BENCH ALIGNMENT PROCEDURE FOR RECEIVER MODELS 4ER25C16 & 4ER25C17

METHODS OF BENCH ALIGNMENT

The following instructions cover the procedure for completely aligning the Receiver. Most of the stages in this receiver are designed for either loose or critical coupling and can be tuned by simple peaking methods. The 1st and 2nd IF's are overcoupled and must be tuned by the resistor loading method (best) or the peak and dip method.

1. Peaking Method:

   An RF Signal of the proper frequency is fed to a loosely or critically coupled stage and the stage is then adjusted for maximum meter reading at its output.

2. Discriminator Adjustment Method:

   An unmodulated RF signal of the proper frequency (i.e., 290-KC) ±10 KC is applied to the discriminator stage. The signal source should be of a constant amplitude over this ±10 KC deviation. The primary tuning slug (bottom of transformer) is adjusted to obtain equal plus and minus voltages for ±10 KC deviation. At -10 KC the voltage is negative and at +10 KC the voltage is positive.

3. Resistor Loading Method:

   An RF signal of the proper frequency is fed to an overcoupled stage. Placing the proper load resistors across the coils makes the coils critically coupled, so that they can be tuned by a simple peaking procedure. After peaking, the resistor loads are removed, returning the coils to normal (overcoupled).

4. Peak and Dip Method:

   An RF signal of the proper frequency is fed to an overcoupled stage. The first coil is adjusted for maximum, while the second coil is shorted out. The short is removed and then placed on the third coil, while the second coil is tuned for minimum. The remaining coils are also shorted and alternately peaked and dipped. The metering is done across the first coil during the entire procedure.

PRELIMINARY OPERATIONS

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Warmup

The receiver should be allowed to warm up for 5 minutes or more before tuning.

The signal generator may require as much as a half hour for warmup. See individual signal generator manual for recommended warmup.

The RF GAIN control (R362) should be at its maximum gain position.

Voltage

Check for proper supply voltage (117 VAC).

Discriminator Zero

During the entire alignment, the generator frequency must be checked every few minutes for zero discriminator (after the discriminator has been correctly set at 290 KC). The 290-KC signal should just saturate the second limiter grid. The 290-KC signal can be inserted at any stage ahead of the stage being tuned.

Crystal oven cycling, causing a slight frequency variation with temperature (.0005% of crystal frequency), can be observed when setting the discriminator for zero. When setting for discriminator zero, this cycling can be taken into account by first observing the maximum meter variation and then setting zero for an average of this variation.

Signal Generator Connections

Signals from the signal generator should be applied through a .01-mfd capacitor for all the procedures except when applying the signal to the antenna jack. The leads from the capacitor should be as short as possible. Connect the generator ground probe as close to the point of signal input as possible.

Metering

Before using a 20,000 ohms-per-volt meter or VTVM for metering, make certain that the meter reads exactly zero for the position it is being used. Since adjustments are to be made within 1-4 microamperes of zero, it is very important that zero is accurately set.

RECEIVER SENSITIVITY

Noise Current

The 2nd Limiter noise current was 110 microamperes or more when shipped. No loss of receiver sensitivity will occur as tubes age, until the noise current drops below 60% at J302 (2nd Limiter grid). To check for normal gain, make certain that the antenna transformer and RF tanks are both peaked. Replace the antenna with a 50-ohm load resistor. A reading of 100-microamperes or more at the 2nd Limiter grid will indicate normal gain.

Stage Gains

As a means of checking stage gains, the signal levels given in Table 1 may be used. When applied at the points indicated, these signal levels will give a reading of 40 microamperes at the LIM-1 jack. A variation in readings greater than 2-to-1, indicates a possible source of trouble. High noise current in a set may interfere with proper measurement of the first three figures in this table, in which case, both the input and 1st Limiter current may be doubled or tripled to estimate performance. An input of 25,000 microvolts at the 1st Limiter grid will produce a reading of 40 microamperes at the LIM-2 jack.

TABLE 1

SIGNAL INPUT TO OBTAIN READING OF 40 MICROAMPS AT LIM-1 JACK

SIGNAL GENERATOR FREQUENCY	SIGNAL LEVEL IN MICROVOLTS (Approx.)	INPUT POINT
Receiver Frequency	4	RF grid (XV301-1)
8.70	35	1st Mixer grid (XV302-7).
290-KC	60	2nd Mixer grid (XV303-2).
290-KC	300	XV304-1
290-KC	50,000	XV305-1

DISCRIMINATOR ALIGNMENT

EQUIPMENT REQUIRED

1. A non-metallic screwdriver.

2. A 0-3 VDC meter. (20,000 ohm-per-volt or VTVM) or a 0-100 microampere DC meter (EX-1-C).

3. A 290 KC calibrated signal source. (Generator can be calibrated against the 290 KC signal present in another receiver which has not been tampered with).

PROCEDURE

1. Apply 290 KC ±.002% signal through .01 mfd capacitor to XV306-1. Use a signal strong enough to saturate the 2nd LIMiter grid.

2. Connect voltmeter between DISC jack (J303-orange) and ground.

3. Remove 8410 KC crystal (Y301) to prevent signals or noise from interfering with alignment.

4. Tune top slug (secondary) of discriminator transformer (T308) for zero reading on voltmeter.

5. Turn signal generator dial to 280 KC and note value of negative voltage on meter.

6. Turn signal generator dial to 300 KC and note value of positive voltage on meter.

7. Positive and negative voltages noted in steps 4 and 5 must be equal in amplitude. If not equal, tune bottom slug (primary) of discriminator transformer (T308) until the voltages are equally positive and negative within 0.3 volts on a VTVM or 0.1 volt on a 0-3 voltmeter. Adjusting the primary slug will require that the secondary be readjusted.

IF ALIGNMENT

8.7 MC IF TRANSFORMER (305)

Equipment Required:

1. A non-metallic screwdriver.

2. A 0-3 VDC meter or a 0-100 microampere DC meter.

3. An 8.7 MC signal source.

Procedure

1. Apply an 8.7 MC signal through a .01 mfd capacitor to XV302-7. Do not saturate the 1st Limiter. Keep signal zeroed to discriminator (Remove the 1st Osc. crystal).

2. Connect meter between LIM-1 jack (J301-green) and ground.

3. Leave the 8410 KC crystal (Y301) in its socket.

4. Tune the four coils of the transformer for maximum meter reading.

Discriminator Idling:

When a set has been completely and properly aligned, the no-signal reading of the discriminator (noise only) should be within ±0.6 volt of zero when read on a VTVM. This is equivalent to 10.0-microamperes on a 2400-ohm microammeter or 0.2 volt on a 20,000 ohm-per-volt meter. Whenever a receiver has been phase tuned (see section on Phase Tuning), the discriminator idling is determined by the phase tuning adjustment. For a properly aligned receiver, the discriminator idling should not exceed 0.6 to 0.9 volt, as read on a VTVM.

290-KC IF TRANSFORMER (307)

Equipment Required:

1. A non-metallic screwdriver.

2. A 0-100 microampere DC meter (G-E Type EX-1-C).

3. A 290-KC calibrated signal source.

Procedure:

1. Apply a 290 KC signal through a .01 mfd capacitor to XV304-1.

2. Connect meter between LIM-1 jack (J301-green) and ground.

3. Remove 8410 KC crystal (Y301) to prevent signals or noise from interfering with alignment.

4. Load the primary by soldering a 39,000-ohm, 1/2-watt resistor across the transformer leads.

5. Tune the secondary of the transformer for maximum reading at the LIM-1 jack.

6. Load the secondary by soldering a 22,000-ohm, 1/2-watt resistor across the transformer leads. Do not remove the primary load.

7. Tune the primary of the transformer for maximum reading at the LIM-1 jack.

8. Remove both loading resistors.

9. Replace the 8410 KC crystal (Y301).

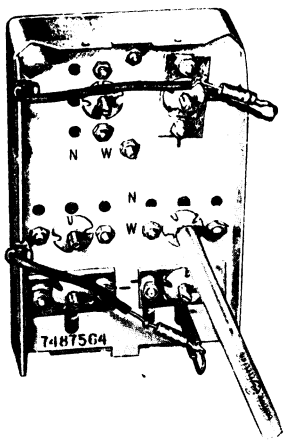
290 KC IF TRANSFORMER

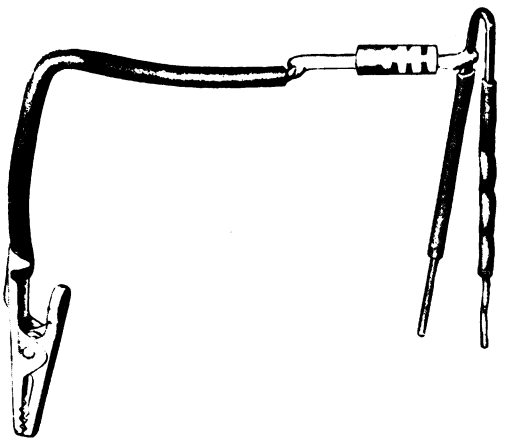
Equipment Required:

1. A non-metallic screwdriver.
2. A 0-100 microampere DC meter (G-E Type EX-1-C).
3. A 290 KC signal source.
4. Two load resistor assemblies, made up as shown in Fig. 1, if resistor loading method is to be used. 39,000-ohm resistors are recommended.

Resistor Loading Procedure (Best):

1. Apply a 290 KC signal through a .01 mfd capacitor to XV303-2, when aligning the 1st LO IF.
2. Connect meter between LIM-1 jack (J301-green) and ground.
3. Refer to Fig. 1 for proper use of load resistors and Fig. 2 for location of coils and loading jacks.
4. Load L-2 and peak L1.
5. Remove load from L-2. Load L1 and L-3 and peak L-2.
6. Remove loads from L1 and L-3. Load L-2 and L-4. Peak L-4.
7. Remove loads from L2 and L-4. Load L-3 and L-5. Peak L-4.
8. Remove loads from L-3 and L-5. Load L-4 and L-6. Peak L-5.
9. Remove loads from L-4 and L-6. Load L-5 and peak L-6.
10. Remove load resistor from L-5.
11. Repeat steps 4 to 10 to insure proper alignment.





LOADING RESISTOR ASSEMBLY

MATERIAL

1/4 watt resistor, common bobbypin, insulating sleeving for bobbypin, alligator clip and a 3-inch piece of test lead.

CONSTRUCTION

Flatten the tips of the bobbypin together so that they are flush, then spread the bobbypin legs out to form a "V". This is done so that when the bobbypin is inserted into the pin jack it will spread out and bind in the test jack for good electrical contact. Solder one lead of the resistor to one leg of the bobbypin near its loop, and solder the other resistor lead to the test lead terminated in an alligator clip. Clean and tin the bobbypin ends to prevent corrosion and to assure good electrical contact. Slide insulating sleeving over the bobbypin ends to prevent shorting. Sleeving should be tight enough to prevent slipping.

USING LOAD RESISTOR ASSEMBLY

Fasten the alligator clip to the chassis and insert the bobbypin into the pin jack. Two loading resistor assemblies can be used simultaneously while peaking coils in the six coil transformer assembly.

(RC-444A)

Figure 1

Peak and Dip Procedure:

1. Locate tuning slugs and pin jacks as shown on Fig. 2.
2. Connect meter between L1 pin jack and ground.
3. Short coils with jumper wire and tune as in following table:

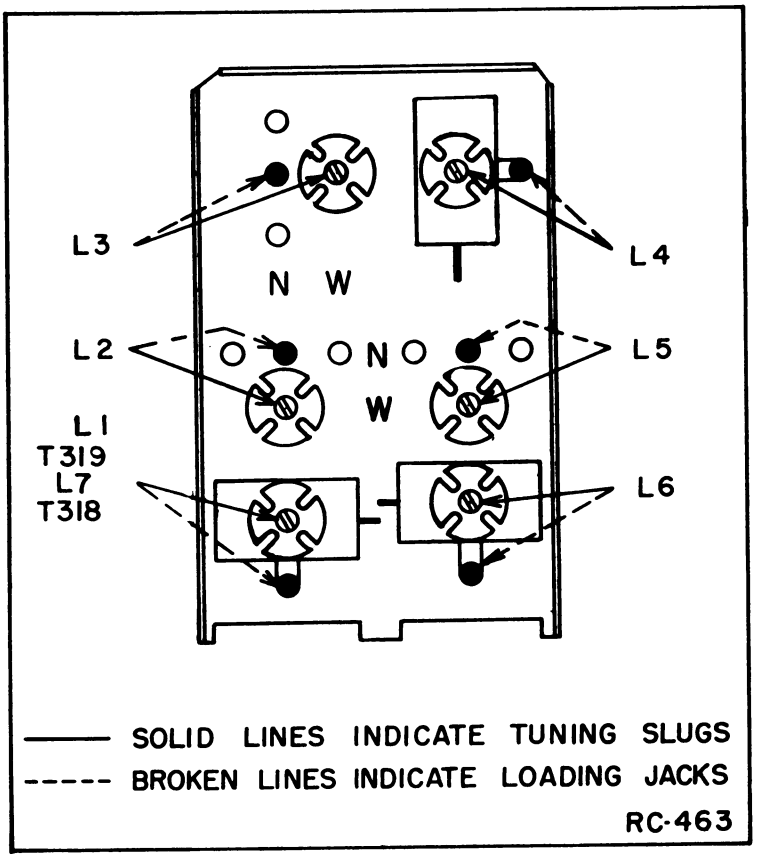


Figure 2 Location of Tuning Slugs and Jacks, 290 KC IF Transformers - T324 and T318

Short	Tune	Meter Reading
L-2	L1	Peak
L-3	L-2	Dip
L-4	L-3	Peak
L-5	L-4	Dip
L-6	L-5	Peak
None	L-6	Dip

FRONT END TUNING

The frequency of the receiver may be changed by replacing the 1st oscillator crystal and retuning the oscillator, multiplier and RF stages as described below.

If frequency is changed by only one channel, the multiplier retuning can usually be omitted. The RF PLATE tuning transformer (T303 or T304) and the antenna preselector, however, should always be retouched as they contain very selective circuits. If the receiver needs to be completely retuned, use the procedure outlined in the foregoing portion of this instruction.

Equipment Required:

1. A non-metallic screwdriver.

2. A microammeter with a 0-50 and 0-500 microampere scales (General Electric Test Set Type EX-1-C) or a 20,000 ohm-per-volt voltmeter with a 0-3 volt scale.

3. A crystal of the proper frequency for the first oscillator.

4. A signal generator with a 130-174 megacycle range, such as Measurements Corp. Model 80, General Radio 1021 AV, or a Boonton 202-C. If a signal generator is not available when tuning the receiver in the field, connect the proper antenna to the receiver and transmit a weak signal from the transmitter with which the receiver is intended to operate.

Procedure

To change frequency or align the RF and antenna stages, proceed as follows. Meter readings are between the jack indicated and ground.

1. Turn the receiver on and allow it to warm up for five minutes. Be sure that the supply voltage is normal (117 VAC).

2. Insert the new crystal in the First Oscillator crystal socket. This is an octal socket and care must be exercised to place the crystal in the correct position.

3. Connect the 0-500 microammeter or the 0-3 volt meter to the OSC-1 jack, J304 (green-negative).

4. Tune the oscillator tank coil, Z301 for maximum oscillator grid meter indication. If there is any doubt about being on the correct peak, turn the adjustment fully counterclockwise until the meter reads 80% of the maximum grid metering voltage or 1.3 volts whichever is lower. A minimum of about 1.1 volts should be obtained after tuning for 80% of the maximum with a standard supply voltage of 117 VAC to the power supply. A 0-500 μa meter may be used for these measurements. However, not all microammeters will give the same reading depending on the internal resistance of the meter. For EX-1-C meter of 0-500 microampere range the reading equivalent to 1.3 volts on the 0-3 volt meter is 365 microamperes. Other multimeters may read as much as two to one or lower.

5. Connect a microammeter or a 0-3 volt meter to the MULT jack, J305 (green-negative) and peak the top and bottom slugs of T310/T311. This current should be 30 microamperes (.7 volts on a 0-3 volt meter) or more. Since the value of the shunt resistor is much higher in this circuit, the correct reading will be more than 30 microamperes on any multimeter or microammeter.

CAUTION

The recessed adjustment of ceramic trimmer capacitor C1 is in the B-plus circuit of multiplier transformer T310 (or T311) and protected by a rubber grommet. Use caution around this capacitor.

6. Set trimmers of T310 (or T311) to approximately the correct position. At high end of receiver range, trimmer should be set at MIN (use dot of solder on ceramic part of rotor as a pointer). At low end of receiver range, trimmer should be set at maximum. Adjust proportionately for mid-frequencies.

7. Connect signal generator to pin 7 of XV302. Using maximum generator output, zero generator to discriminator. This zeroing should coincide with an increase in LIM-1 meter indication.

8. Reduce the signal generator output until the LIM-1 meter indicates below saturation, but above noise. Peak both trimmers of T310 (T311).

9. Move the signal generator to pin 1 of XV301. With the generator adjusted to zero discriminator and output below limiting, peak T303 (T304) trimmers marked RF on chassis. It is suggested that the grid circuit of the 1st Converter be tuned to resonance first, followed by the RF amplifier plate circuit.

10. Move the signal generator to the antenna jack (J1) on antenna transformer.

11. With the meter at LIM-1 (J301) and signal applied, peak the antenna transformer (T301 or T302) trimmer C8 and C9 (top and bottom of housing). Always peak trimmer C9 (bottom of housing) first and follow by peaking trimmer C8 (top of housing). Once peaked it is suggested that trimmers C9 and C8 of T301 or T302 be tuned for maximum quieting. Depending upon the receiver operating frequency, maximum LIM-1 current and maximum quieting may not occur together. Where this is the case, always tune for maximum quieting as noted on an output meter or in its absence by speaker response while keeping input signal level from signal generator low.

12. Monitor a strong unmodulated signal from a system transmitter known to be on frequency. Recheck the adjustment of the OSC-1 trimmer (C334) for zero discriminator.

13. Monitor a weak unmodulated signal with the normal antenna connected and adjust the tuning of C8 and C9 of T301 (T302) for maximum quieting.

RF GAIN AND SQUELCH ADJUSTMENT

Equipment Required:

1. RF signal generator.
2. Triplett Model 630 VOM or Station Monitor Panel.
3. Audio voltmeter.
4. Coaxial tee with pin of cross-arm removed.
5. Dummy plug.
6. Screwdriver.

RF Gain Control Adjustment:

1. Insert dummy plug in the LINE IN jack to prevent carrier indication.
2. Set RF Gain Control fully clockwise.
3. Disconnect antenna from the receiver input. Measure 1st limiter grid current on 3-volt scale of VOM or panel meter.
4. Reconnect receiver input while observing limiter current. If the current increases more than one scale division, turn the RF Gain Control counterclockwise just enough so that when the receiver input is connected and disconnected, the current change is approximately one scale division.

CODAN Threshold Adjustment

1. Turn CODAN dropout control fully clockwise and CODAN threshold fully counterclockwise.
2. With antenna connected, loosely couple an RF signal generator (adjusted to the correct frequency) to the receiver input. Use the tee having the center pin in the line to the generator removed.
3. With the generator output set to minimum, measure audio noise at receiver output. Depressing the audio test button (S502) will place noise on the line even though the CODAN is not operated.
4. Increase the signal generator output level until the desired noise quieting is obtained (between 15 and 30 db). Release the audio test button. Advance the threshold control slowly until the CODAN relay operates. Note the level of the generator output.

CODAN Drop-Out Adjustment

1. Reduce the level of signal generator by an amount equal to the desired differential between CODAN threshold and drop-out points. If no other value is specified, this differential should be 6-db. (Minimum drop-out should never be set below 12-db quieting).

2. Adjust drop-out potentiometer counterclockwise until the receiver mutes.

3. Check operation by turning up the level of the signal generator until the receiver unmutes then reducing the level until the receiver mutes, noting the quieting and signal generator values to see that all are as specified. If not, repeat the adjustments.

4. Remove the signal generator and dummy plug and restore the receiver to normal service.

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