BENCH ALIGNMENT PROCEDURE FOR RECEIVER MODELS 4ER25C4, 05, 14 & 15; AND MODELS 4ER25D2, 03, 12 & 13

GENERAL

The following instructions cover the procedure for completely aligning the Receiver. Whenever a stage has been tampered with, misaligned or modified, etc., follow the procedure outlined in this instruction.

ALIGNMENT USING SERVICE OUTLINE

The Simplified Alignment Procedure found in the Service Outline for the Receiver may be used if only the oscillator, multiplier, limiter or the secondary of the discriminator need retuning.

METHODS OF BENCH ALIGNMENT

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 transformers 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 over-coupled stage. Placing the proper load resistors across the coils makes the coils cricitally 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 over-coupled 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

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 warm-up.

Voltage

Check for proper battery or supply voltage (6.6, 13.2 or 26.4 volts DC or 117 volts AC).

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. This same crystal oven cycling is also present on the transmitter. 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 ohm-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% of J303 (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
MODEL 4ER25C4, 05, 14 & 15
SIGNAL INPUT TO OBTAIN READING OF 40 MICROAMPS AT LIM-1 JACK

SIGNAL GENERATOR FREQUENCY	SIGNAL LEVEL IN MICROVOLTS (Approx.)	INPUT POINT
Receiver Frequency	8	RF grid (XV301-1)
8.70 MC	60	1st Mixer grid (XV302-7).
290-KC	120	2nd Mixer grid (XV304-2).
290-KC	900	XV305-1
290-KC	85,000	XV306-1

TABLE 2
MODEL 4ER25D2, 03, 12 & 13
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 MC	35	1st Mixer grid (XV302-7).
290-KC	60	2nd Mixer grid (XV304-2).
290-KC	300	XV305-1
290-KC	50,000	XV306-1

DISCRIMINATOR ALIGNMENT

EQUIPMENT REQUIRED

1. A non-metallic screwdriver.

2. A 0-3 volt DC 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 XV307-1. Use a signal strong enough to saturate the 2nd LIMiter grid.

2. Connect voltmeter between DISC jack (J304-orange) and ground.

3. Remove 8410-KC crystal (Y302) 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-volt 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 (T334)

Equipment Required:

1. A non-metallic screwdriver.

2. A 0-3 volt DC 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 (J302-green) and ground.

3. Leave the 8410-KC crystal (Y302) in its socket.

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

Discriminator Idling:

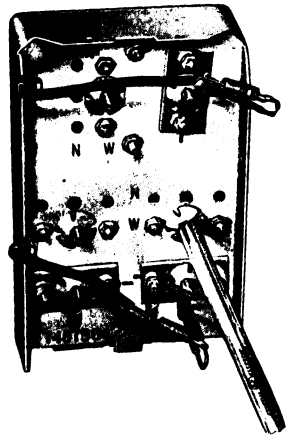
When a set has been completely and properly aligned, the no-signal reading of the discriminator (noise only) should be within ±0.6-volt of zero when read on a VTVM. This is equivalent to 10.0-microamperes on a 2400-ohm microammeter or 0.2-volt on a 20,000-ohm-per-volt meter. Whenever a receiver has been 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.

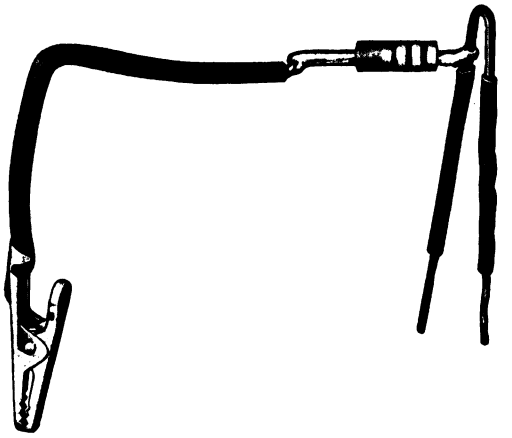
MODEL 4ER25C4, 05, 14 & 15 290-KC IF TRANSFORMER (T342 and T343)

Equipment Required:

1. A non-metallic screwdriver.

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





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. Load Resistor Assembly

3. A 290-KC signal source.

4. Two load resistor assemblies made up as shown in Fig. 1 for resistor loading method (22,000-ohm resistors for wide-band, and 39,000-ohm resistors for narrow band).

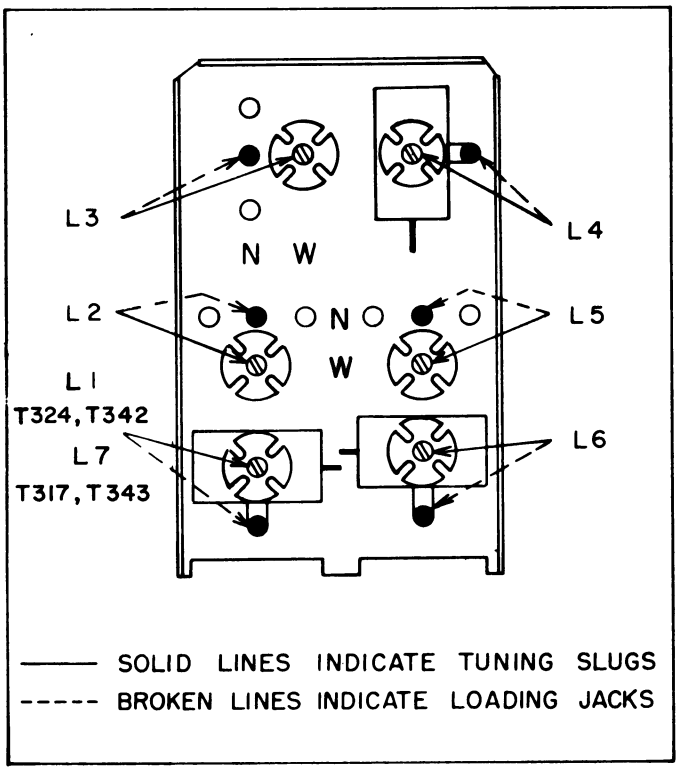
Resistor Loading Procedure (Best):

1. Apply a 290-KC signal through a .01-mfd capacitor to XV304-2, when aligning the 1st LO IF or to XV305-1 when aligning the 2nd LO IF.

2. Connect meter between LIM-1 jack (J302-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 L-7 (or L1).



RC-1024

Figure 2. Location of Tuning Slugs and Jacks, 290-KC IF transformers - T342, T343, and T324.

5. Remove load from L-2. Load L-7 (or L1) and L-3 and peak L-2.

6. Remove loads from L7 (or L1) and L-3. Load L-2 and L-4. Peak L-3.

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.

Peak and Dip Procedure:

1. Locate tuning slugs and pin jacks as shown in Fig. 2.

2. Connect meter between L-7 (or L1) pin jack and ground.

3. Short coils with jumper wire and tune as in following table:

Short	Tune	Meter Reading
L-2	L-7 (or 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

MODEL 4ER25D2, 03, 12 & 13 290-KC IF TRANSFORMER (T335)

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 XV305-1.

2. Connect meter between LIM-1 jack (J302-green) and ground.

3. Remove 8410-KC crystal (Y302) 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 (Y302).

290-KC IF TRANSFORMERS (T324 OR T318)

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. 22,000-ohm resistors are recommended for a wide-band transformer (T324) and 39,000-ohm resistors are recommended for a narrow-band transformer (T318).

Resistor Loading Procedure (Best):

1. Apply a 290-KC signal through a .01-mfd capacitor to XV304-2, when aligning the 1st LO IF.
2. Connect meter between LIM-1 jack (J302-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-3.
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.

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:

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 the frequency is changed by only one or two channels (60 kilocycles), the multiplier retuning can usually be omitted. The RF PLATE tuning transformer T332/T333/T325 and the antenna pre-selector, however, should always be retouched as they contain very selective circuits. If the receiver needs to be completely re-tuned, use the procedure outlined in the fore-going 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 (between 10.1 and 13.77 megacycles).

4. A signal generator with a 130-174 megacycle range. 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 battery or supply voltage is normal (6.6 or 13.2 volts DC or 117 volts AC).

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, J305 (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, then clockwise to the first peak. Note the reading and turn the iron core 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 6.6 for 13.2 volts DC or 117 volts AC 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 or 0-500 microampere range, the reading equivalent to 1.3 volts on the 0.3 v meter is 365 microamperes. Other multimeters may read as much as two to one lower.

5. Connect a microammeter or a 0-3 volt meter to the MULT jack, J306 (green-negative) and peak the top and bottom slugs of T310. 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 T311 (or T326/T307) and protected by a rubber grommet. Use caution around this capacitor.

6. Set trimmers of T311 (or T326/T307) to approximately the correct position. At high end of receiver range, the trimmer should be set at MIN (use dot of solder on ceramic part of rotor as a pointer). At low end of receiver range, the trimmer should be set at maximum. Adjust proportionately for mid-frequencies.

7. Connect signal generator to pin 8 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 T311 (T326/T307).

9. Move the signal generator to pin 1 of XV301. With the generator adjusted to zero discriminator and output below limiting,

peak T332 (T333/T325) trimmers marked RF on chassis. It is suggested that the grid circuit of the 1st Converter (C385) be tuned to resonance first, followed by the RF Amplifier plate circuit (C305).

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

11. With the meter at LIM-1 (J302) and signal applied, peak the antenna transformer T336 (or T337/T320) 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 T336 (or T337/T320) 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 (C352) for zero discriminator.

13. Monitor a weak unmodulated signal with the normal antenna connected, and adjust the tuning of C8 and C9 of T336 (T337/T320) for maximum quieting.

PHASE TUNING

Phase Tuning is very effective in improving receiver performance on noise having steep wave fronts (e.g. - ignition noise). The Phase Tuning procedure outlined below can only be used when the following conditions are met:

1. The Receiver must be properly aligned and have a sensitivity of 20 db of quieting for 0.5-uv input.

2. The discriminator reading on both noise and signal must be no greater than ±0.2-volt on a DC meter (20,000 ohms-per-volt).

Equipment Required:

1. A non-metallic screwdriver

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

3. A 130 to 174 MC signal source (signal generator or station transmitter).

4. A noise generator constructed as shown in Fig. 3.

Procedure:

1. Connect the antenna or signal generator, and the output of the noise generator to the Receiver antenna input through a "T" connector. If a noise generator is not available, phase tune the

receiver in the vehicle,with the engine running and with the radio connected to the mobile antenna. Since generator noise cannot be phase tuned, be sure that the generator noise has been adequately suppressed at its source.

2. Connect meter between LIM-1 jack (J302-green) and ground.

3. Radiate a weak on-frequency signal enough to quiet the receiver about 20 to 25-db (40 to 70 microamperes at the LIM-1 jack).

4. Turn the noise generator switch to "ON".

5. Connect meter between DISC jack (J304-orange) and ground.

6. Tune L10 (bottom right) or L7 (top left) of T334 (one-quarter turn in either direction for a noise null while on zero discriminator).

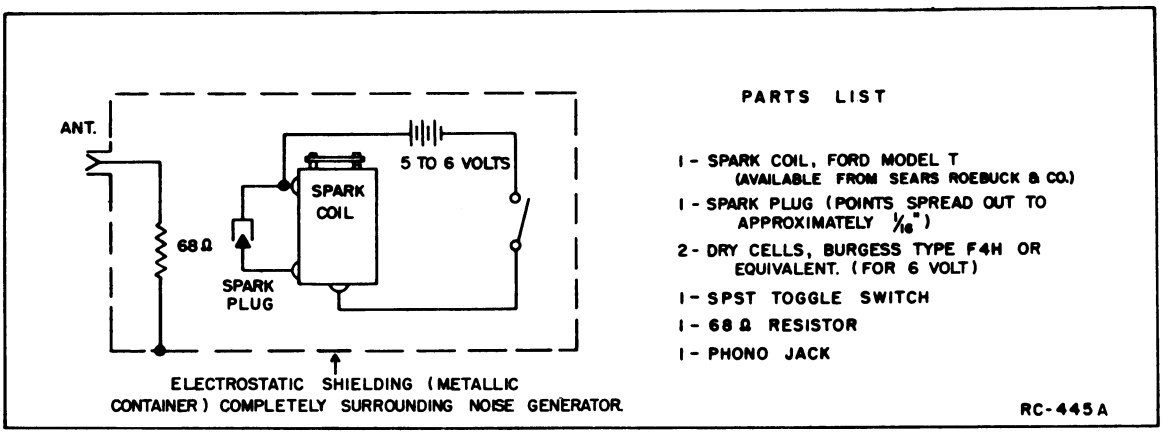


FIG. 3 - Noise Generator

7. If a noise null cannot be obtained, return the slugs to their original position, (maximum meter reading at LIM-1 jack), and proceed as follows:

Model 4ER25C4, 05, 14 & 15 only, tune L4 and L6 of T318 for best noise null but do not turn slugs any more than one-quarter turn.

Model 4ER25D2, 03, 12 & 13 only, tune L4 and L6 of T342 for best noise null but do not turn slugs any more than one-quarter turn.

8. Recheck phase tuning in the high IF.

9. The loss of 1st LIMiter current should not exceed 5.0 microamperes as the result of phase tuning (an indication of misalignment of the low IF).

NARROW-BAND CONVERSION

This procedure describes how to convert a Type ER-25-D Receiver for narrow-band operation. Basically, the conversion involves changing the coupling in the 6-coil Lo-IF transformer, clipping out a coupling capacitor, and changing two resistors. Parts for making the conversion may be obtained by ordering Conversion Kit PL-4032043-G2. For users who desire the conversion without making it themselves, a narrow-band 6-coil Lo-IF transformer is available on an exchange basis. This transformer may be obtained by ordering PL-7487564-G5. Also specify if using a one or two frequency Transmitter.

PARTS REQUIRED

Number Required	G-E Part No.	Description
1	7488184-P9	Capacitor, ceramic: insulated, temp. compensating; 5.5 mmfd ±0.10 mmfd, 500 VDCW, -80 ±60 temp. coef.
1	7488184-P8	Capacitor, ceramic: insulated, temp. compensating; 2.2 mmfd ±0.10 mmfd, 500 VDCW, -80 ±120 temp. coef.
1	3R77-P334K	Resistor, composition: 0.33 megohm ±10%, 1/2 w.
2	3R77-P393K	Loading resistors, composition: 39,000 ohms ±10%, 1/2 w.

PROCEDURE

1. Six-coil LO-IF transformer T324 should be either converted to narrow band, as described in this step, or replaced by a pre-tuned transformer (PL-7487564-G5) ordered from your G-E Service Shop or your nearest District Sales Office.

   (a) Disconnect the leads from transformer T324 and remove the transformer from the receiver chassis.

   (b) Remove the outside cover and the three small inner shields from T324.

   (c) Clip out and discard C3, the 7.25-mmfd coupling capacitor between L2 and L3; and C6, the 6.0-mmfd coupling capacitor between L4 and L5. See Fig. 4.

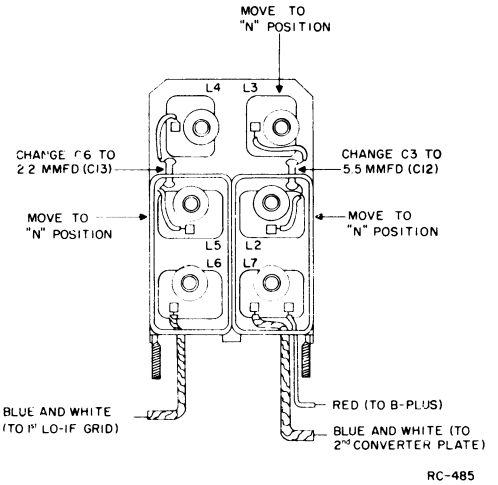


Figure 4. Narrow-Band Conversion of 6-Coil Transformer

(d) Remove the mounting hardware (two #4 nuts and lockwashers) from coil L2 and remove the coil assembly. Then, while holding the slug inside the can, remove the tension nut from the top with a small screwdriver. Move the slug from the "W" hole to the "N" hole and replace the tension nut back on the slug.

(e) Solder one end of 5.5-mmfd capacitor C12 to the same terminal of L2 from which C3 was removed in Step 3. Leave a lead length of one inch, covered by sleeving.

(f) Rotate the coil assembly 180° (to provide mechanical fit) and re-install it over the slug in the "N" holes.

(g) Remove the coil assembly and slug of L3 and re-install them in the "N" holes, following the same procedure used with L2.

(h) Solder the other end of the 5.5-mmfd capacitor to the same terminal of L3 from which C3 was clipped in Step 3. Use sleeving on lead.

(i) Remove the coil assembly and slug of L5 and re-install them in the "N" holes, following the same procedure used with L2.

(j) Solder one end of 2.2-mmfd capacitor C13 (using sleeving) to the same terminal of L5 from which C6 was removed in Step 3. Leave a lead length of one inch, covered by sleeving.

(k) Solder the other end of the 2.2-mmfd capacitor to the same terminal of L4 from which C6 was removed. Use sleeving on the lead.

(l) Replace the three inside shield covers on the transformer, remount it on the receiver chassis, and resolder the connections to T324:

Red Wire to TB12-1.
Blue & White Wire (plate) to TB12-2.
Blue & White Wire (grid) to XV305-1.

2. Make the following component changes:

(a) Solder a 330,000-ohm resistor from TB8-20 to TB8-7, in parallel with R386 (470K-ohm noise rectifier plate resistor).

(b) Clip out and discard R333 (33K-ohm resistor) from VOL. CONTROL HI to ground.

(c) Clip out and discard R406 (22K-ohm 2nd converter plate resistor).

(d) Clip out and discard C402 (3.0-mmfd capacitor across two-coil low-IF transformer T335).

3. Change the Receiver Model Number from 4ER25D1, 2, 11 or 12 to 4ER25C1, 2, 11 or 12, respectively. T324 should now be referred to as T318 (PL-7489565-G5).

4. Check the alignment of 6-coil transformer T318 and 2-coil transformer T335, as described earlier in this instruction. Replace the outside cover on T318.

5. If ignition noise interference is present after converting the receiver, it is recommended that the receiver be phase tuned. (See preceding section).

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