Modifying 75A-2 and 75A-3 Receivers

Hints on Bringing Two Popular Receivers Up to Date

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• During the past several years, the Collins Company has introduced several receiver improvements. In this article two of their engineers tell how these improvements can be applied to some of the older models.

A PREVIOUS ARTICLE spoke of receiver design in general terms,[1] but this treatment may not have answered the needs of many receiver owners. While it is impossible to discuss each receiver specifically, perhaps a detailed commentary on the 75A-2 and 75A-3, with special emphasis on improving performance, might be in order. Since the production of the first 75A-2 some three and one half years ago, there has necessarily been a number of changes. As pointed out in the previous article, in some respects receiver design is one of compromise of conflicting factors. A change of viewpoint sometimes causes revision of circuits to effect a new compromise. Another reason for modification is the need for improvements to keep a design abreast of the state of the art. Yet another reason for circuit change is lack of consideration of production variations and engineering error, but it is very hard to get any engineer to admit this.

R.F. Stage Changes

The first 75A-2 receivers used a 6AK5 tube in the r.f. stage. This tube is very good from the standpoint of sensitivity but, since it has

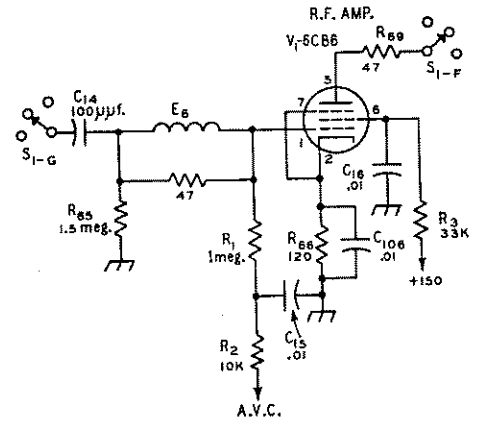


Fig. 1 — Revised 75A-2 r.f. stage circuit when replacing 6AK5 with 6CB6. All resistors ±10 per cent values, ½ watt. See Appendix I.

a sharp cut-off characteristic, it is not suitable in this application if the receiver is subject to strong signals on adjacent channels. It tends to cross-modulate at lower levels than are desirable. By changing to a 6CB6, as shown in Fig. 1, greater freedom from cross-modulation is obtained. To make this change, see Appendix I.

A recent tube development offers even greater freedom from receiver malfunctioning in the presence of strong interfering signals. This tube is the Type 6DC6 or 6BZ6, which was developed to meet the same problem in television receivers. Adding this tube to the 75A line-up really shows

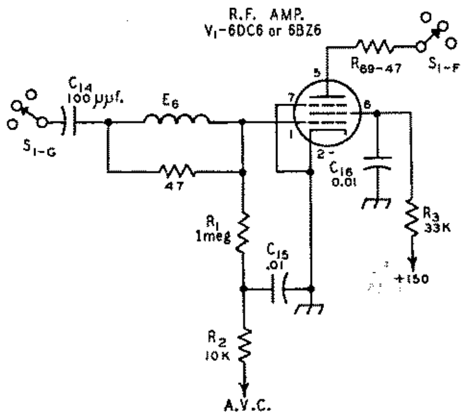


Fig. 2 — Revised r.f. stage for use of low cross-modulation 6DC6. All resistors ±10 per cent values, ½ watt. See Appendix II.

a great improvement. At the present time the 6DC6 as an r.f. stage offers much better performance in a strong-signal area and yet it possesses a good noise figure. The circuit diagram for the 6DC6 or 6BZ6 is shown in Fig. 2, and conversion instructions are given in Appendix II.

R.F. Attenuator

Now that a good front-end tube is available, what is the next step if this is not enough? If the receiver still suffers from cross-modulation, an r.f. attenuator can be used. Try the circuit of Fig. 3 between the antenna and the receiver antenna input terminal. As pointed out in the previous article, if both signals are well above the noise level, the loss in the antenna lead-in will not hinder reception of the desired signal. In fact, a.v.c. will bring up the gain so that it is almost impossible to detect a change in audio

* ℅ Collins Radio Company, Cedar Rapids, Iowa.

1 Pappenfus, "A Discussion of Receiver Performance," *QST*, Jan., 1955.

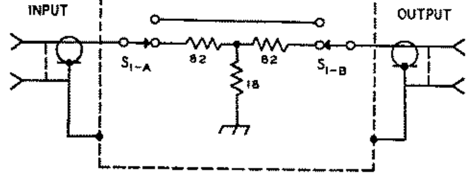


Fig. 3 — R.f. attenuator of 21-db. loss for reducing signals at antenna terminals. All resistors ±10 per cent values, ½ watt.
S_1 — D.p.d.t. toggle.

level when receiving a.m. signals. Thus the resistive r.f. attenuator can offer improvement in receiver characteristics in most cases. If maximum receiver sensitivity is needed, as in the case of DX reception, there is no satisfactory solution except added r.f. selectivity. R.f. selectivity can come only from large low-loss coils which are not practical in a receiver. The transmitter antenna coupler, however, does meet the requirements for good selectivity because ordinarily high-Q coils are used, to prevent loss of transmitter power. It is logical then to use the antenna coupler for both transmission and reception, if one is available in the station.

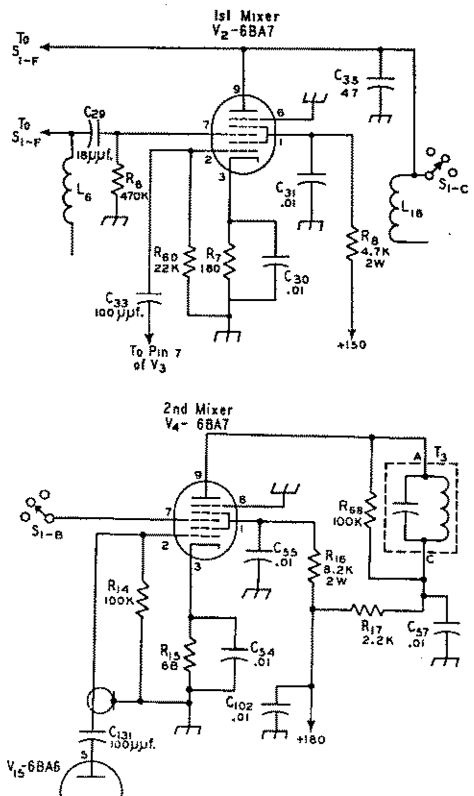


Fig. 4 — Revised mixer circuits for the 75A-2 where replacing 6BE6s with 6BA7s. All resistors ±10 per cent values, ½ watt, unless otherwise noted. See Appendix III.

For a better signal-to-noise ratio, generally do not forget the value of a beam antenna. A beam with its high gain and directivity, together with a transmission line of low noise pick-up, provides better signals at the receiver antenna terminals. The front-to-back ratio of the beam antenna also helps to discriminate against strong signals off the rear of the beam. If manmade noise is very bad, a filter in the a.c. line to the receiver may help.

Mixer Stages

One circuit problem facing every receiver designer is mixer noise. In the 75A-2 a 6BE6 was used for both first and second converters, as has been common practice in the past. Upon checking further into mixer noise level, it was found that the 6BA7 pentagrid mixer has less noise than the 6BE6. The tube replacement was made in the 75A, and over-all receiver performance improved. Unfortunately, the 6BA7 requires some blacksmith work on the chassis, since the seven-pin sockets must be replaced by the nine-pin version. See Appendix III and Fig. 4 for this modification. A further modification, resulting from extensive tests, was an increase in mixer bias level by changing R_7 in the V_2 mixer cathode from 68 to 180 ohms. This change refers to the 6BA7 mixer only.

Mechanical Filters

When it became evident that the mechanical filter contributed so much to the amateur receiver performance, it was decided to modify the set to secure the improved selectivity. The revision took the form of an adapter chassis occupying the space previously taken by i.f. transformers T_4 and T_5. This simple adaptation permits amateurs in the field to take advantage of the better selectivity now available through the use of a mechanical filter, without a difficult rebuilding job. See Fig. 5 for the new circuit and Appendix IV for modification instructions. The adapter chassis was designed with an added amplifier tube, V_{18}, to compensate for the 23-db. insertion loss of the original mechanical filter. The loss in the mechanical filter upset the gain distribution of the set so that V_{18} tended to add noise to the set, and a slightly degraded noise figure was present on some sets. By removing R_{78} and grounding the cathode of V_{18}, a reduction of internal receiver noise results.

When the new Collins mechanical filter with 10-db. insertion loss became available, loading resistors R_{81} (across the grid circuit of V_6) and R_{83} (82,000 ohms across the output of T_6) were added. The filter tuning capacitors were also changed when the low-loss filter replaced the high-loss element. See Fig. 5.

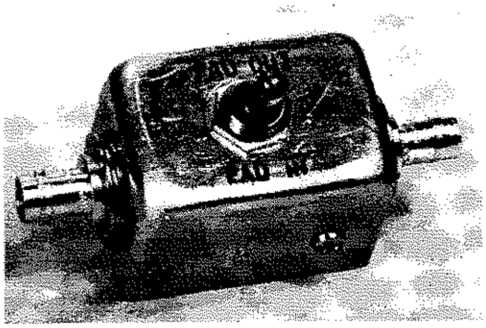
If your receiver has been in use for some time, it is wise to check the tubes and touch up the trimmers as explained in the instruction book. These routine tests will insure that peak performance of the receiver is maintained. This is, of course, a good practice in any communications receiver.

Selectivity

It was found that the shape of the 75A i.f. selectivity curve could be somewhat improved by stagger tuning the i.f. transformers. This effectively peaks the corners of the i.f. passband, resulting in less rounding of the corners of the passband than afforded by the mechanical filter and transformers peaked at the midfrequency. Instructions for the revision and realignment to accomplish this result will be found in Appendix IV.

It is desirable, from the standpoint of maintaining the audio output level nearly constant during fades, to obtain a flat a.v.c. characteristic, with the a.v.c. threshold occurring at levels of 1 to 2 microvolts. This flat a.v.c. characteristic has the undesirable effect of increasing the audio output when the receiver is detuned from a signal or when the received signal goes off the air. This difference in level is attributable to the noise appearing as a highly modulated signal with a very small carrier component. Because the a.v.c. time constants will not charge sufficiently on noise to hold down the set gain, the over-all result is an increase in audio output over what was obtained with the received signal. To aggravate this situation, many amateur signals are not 100 per cent modulated and, as a result, the difference between the audio output on a signal and noise between signals is further increased.

One solution to this problem is to back down the r.f. gain control to a point where the noise between stations is not objectionable but where there is still adequate receiver gain. It should be noted that when this is done, the S-meter reading for a given signal will not change appreciably unless the signal level approaches the a.v.c. threshold level. However, when tuning signals that are very weak, it is advisable to operate the r.f. gain control wide open, for maximum sensitivity.



To prevent receiver overload and cross-modulation on exceptionally strong signals, this simple attenuator can be used at the antenna terminals.

It was found that the noise immunity of the a.v.c. system could be improved by rearranging the a.v.c. time constants. This improvement is most noticeable in the presence of sharp pulses such as ignition noise. The necessary changes are shown in Appendix V.

It is hoped that these comments and modification instructions will be of assistance to receiver owners.

Appendix I

Revision from 6AK5 to 6CB6 r.f. amplifier in 75A-2 receiver.

1) Connect jumper between Pins 2 and 7 of V_1 socket.
2) Revise value of R_{65} from 1 megohm to 1.5 megohms (or add if not present).
3) Replace 6AK5 r.f. amplifier tube with Type 6CB6.

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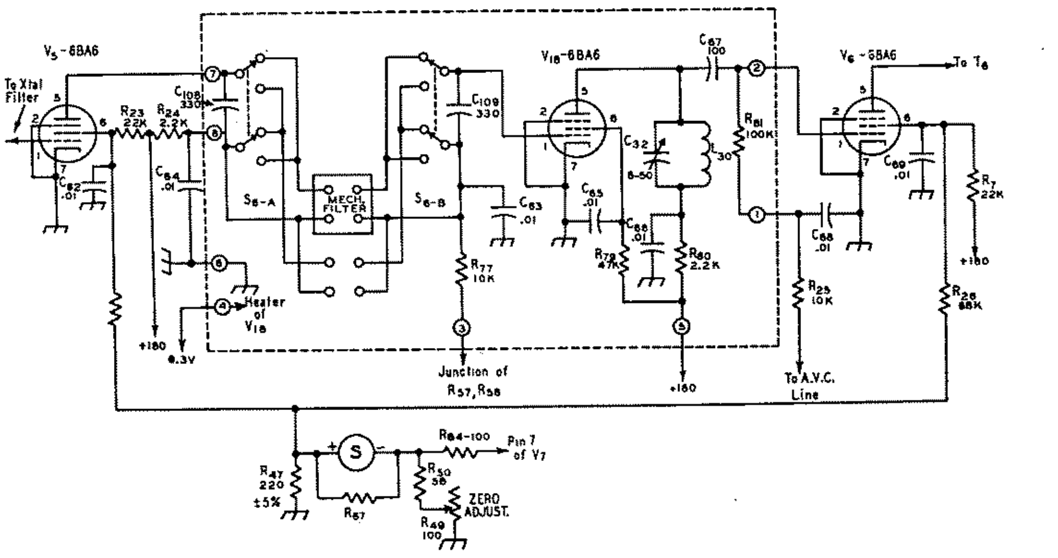

Fig. 5 — Circuit modifications for using 455B mechanical filter. All resistors ±10 per cent values, ½ watt. R_{67} — 150 ohms. If 455C mechanical filter is used, the following values change: C_{105}, C_{109} — 130 μμf. R_{81} — 10,000 ohms.

the bandswitch in the 80–20 position, and with the dial near midscale peak the slug in L_4. There should be some increase in signal strength in the receiver as the gain of the buffer stage is added. Next, set the bandswitch to the 160-meter position and listen for the signal around 10.9 Mc. Peak L_3 for maximum signal. The VFO dial will have to be moved toward the 5.5-Mc. end. Next, set the dial near the 5.4-Mc. point and the bandswitch to the 40-meter position, and look for the signal around 16.2 Mc. on the receiver. Now peak L_5. For accurate placement of the 5.0-Mc. point (about 5 on the logging scale) zero-beat the oscillator with the 5-Mc. signal of WWV and adjust the slug in L_1. This completes the adjustment, but after attaching the cover (bottom plate) with sheet metal screws, recheck all the above adjustments, touching up the slugs where needed.

The oscillator adjustment procedure can also be used to adjust the bandset dial on two-dial receivers. With the 10-A in "Cal," set the bandspread dial on the receiver to 4.0 Mc., then carefully tune the bandset dial until the signal is heard zero beat. The receiver is then calibrated for the 75-meter band at 4.0 Mc. (provided the 9-Mc. crystal in the exciter actually is on exactly 9 Mc.).

Your VFO is now ready to give you s.s.b. operation on four bands.

Receiver Modifications

(Continued from page 27)

Appendix II

Revision of 75A-3 to use 6DC6 or 6BZ6 as r.f. amplifier. All resistor tolerances ± 10 per cent unless otherwise marked.

For sets serial number 1299 and under using the 455B series of mechanical filter:

1) Replace 6CB6 with 6DC6 (V_1).
2) Remove R_{66} (120 ohms) and C_{106} (cathode by-pass), tie Pins 2 and 7 of r.f. amplifier to chassis.
3) Remove R_{65} (1.5 megohm). (Some sets may use 1 megohm.)
4) Change R_7 (V_2 cathode) from 68 ohms ½ watt to 180 ohms ½ watt.
5) Check to see that Pins 2 and 7 of V_{18} are connected to chassis. If not, connect them. (This modification has been made on sets with serial numbers higher than 950.)
6) Remove a.v.c. from Pin 3 of mechanical filter box assembly. Connect Pin 3 of filter box to junction of R_{57}, R_{58} (r.f. gain control and minimum bias resistor).
7) Add R_{84} (100 ohms, ½ watt) between R_{50} and Pin 7 of V_7. Move junction of R_{67} and negative side of meter to opposite side of R_{50}.
8) Change R_{67} (meter shunt) to 220 ohms, ½ watt ±5 per cent.
9) Change R_{47} to 220 ohms, ½ watt ±5 per cent.
10) Change R_{50} to 56 ohms, ½ watt ±10 per cent.

For sets serial number 1300 and over using 455C filter:

1) Replace 6CB6 with 6DC6 (V_1).
2) Remove R_{66} (120 ohms) and C_{106} (cathode by-pass), tie Pins 2 and 7 of r.f. amplifier to chassis.
3) Remove R_{65} (1.5 megohms).
4) Change R_7 (V_2 cathode) from 68 ohms ½ watt to 180 ohms, ½ watt.

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5) Change R_{81} from 4700 ohms, ½ watt to 10,000 ohms, ½ watt.
6) Change R_{67} to 150 ohms, ½ watt (S-meter shunt).
7) Remove a.v.c. from Pin 3 of mechanical filter box assembly. Connect Pin 3 of filter box to junction of R_{57}, R_{55} (r.f. gain control and minimum bias resistor).

Appendix III

Conversion of 75A-2 to replace 6BE6 mixers with 6BA7s.

1) Carefully unsolder pin connections of V_2 and V_4.
2) Remove 7-pin tube sockets and ream out holes to ¾ inch for clearance of 9-pin sockets. Be sure that all loose chips are removed from set, especially around bandswitches.
3) Mount new tube sockets. Orient V_2 socket so that Pin 7 is closest to r.f. amplifier. Orient V_4 socket so that Pin 2 is closest to crystal oscillator tube, V_3.
4) Wire sockets per schematics in Fig. 4, being sure that all grid and plate leads are as short as possible and that all chassis connections are returned to the same point they were made to in the original set-up.

Appendix IV

Revision to improve shape of i.f. selectivity curve.

1) Remove C_{110} (top coupling for T_6 — not present in all models).
2) Add 82,000-ohm ½-watt resistor across terminals A and C of T_6 (R_{83}).
3) Realign 455-kc. i.f. using the following procedure:
a) Connect v.t.v.m. d.c. lead to diode load (junction of R_{39} and R_{42}).
b) Connect signal generator output to receiver antenna terminals. Set signal generator to some frequency in the 80-meter band. Do not move signal generator frequency during the rest of the 455-kc. i.f. alignment procedure.
c) Tune receiver to signal frequency.
d) Adjust signal generator output control for an S-meter reading of S9 +20 db.
e) Tune receiver to the S9 point on the high-frequency side of the signal. Record the dial reading.
f) Tune receiver to the S9 point on the low-frequency side of the dial. Record the reading.
g) Set the dial halfway between the readings determined in steps (e) and (f).
h) Set the fiducial (zero set) accurately to some dial division. During the following adjustments, attenuate the signal generator output to keep the v.t.v.m. readings below 5 volts.
i) Tune dial 3 kc. lower than the center frequency (determined in step (g). Adjust T_6 (both top and bottom slugs) for maximum v.t.v.m. readings.
j) Tune the dial 3 kc. above center frequency. Adjust T_3 and top and bottom slugs of T_7 for maximum v.t.v.m. reading.
k) Retune to center frequency determined in step (g) and tune C_{32} (plate of V_{18}) for maximum readings.

Appendix V

Revision to improve a.v.c. noise immunity.

1) Replace C_{82} with .05-μfd. 300-volt capacitor (grid-plate coupling at V9).
2) Replace R_{35} with 0.33-megohm + 10 percent, ½-watt resistor (grid-plate coupling at V9).
3) Replace C_{81} with 0.2-μfd. 200-volt capacitor (grid shunt at V9).
4) Add 180-μμfd. mica or ceramic capacitor from Pin 2 of V9 to chassis.
5) Remove C_{98} (on a a.v.c. line).

Strays

W3LUD is curious as to when ARRL will get around to issuing a WASEN award — WAS *except* Nevada, that is!