

Collins S-line - Modification for CW transceive operation

1. Foreword

Scope of the proposed modification to the S-line is to permit real transceive operation on CW, i.e. without having to zero beat the transmitter VFO.

The modification can be removed at any time leaving no sign of it.

The description applies to a “round” 32S-3 / 75S-3B pair, however it should be also possible on earlier Collins equipment (see sect. 8).

2. The Issue

Contrary to modern transceivers, when operating CW on transceive with the Collins S-line, the transmit carrier frequency will not precisely coincide with the receive carrier frequency.

Reason is that, to get an audible tone on CW, you must obviously tune your 75S-3B away from zero beat, typically 800 Hz - 1200 Hz depending on your personal preference. When on transceive, the 32S-3 generates a carrier exactly on the 75S-3B zero-beat frequency, this meaning that the transmit frequency will result offset with respect to the carrier of your correspondant.

Purpose of this modification is to recover this offset by automatically counter-shifting (only in CW mode!!) the transmit frequency.

A few more words on receiver tuning (you may skip this if you will):

- if you do not have a narrow CW filter, for CW operation you shall set your 75S-3B to USB. The IF filter being 2.7-KHz wide, you will then have quite a freedom in tuning the CW signal such as to suit your preferred audio pitch;
- if you instead have a narrow CW filter (500 Hz or 200 Hz), you shall tune the receiver for maximum signal strength, irrespective of the audio pitch. If, then, you judge the audio pitch too low or too high, you can vary it by the BFO control. In my case (I have a 200-Hz crystal filter) I have determined that, to center the received carrier in that narrow filter, I have to tune my 75S-3B about 1200 Hz away from zero beat; this pitch is too high from my taste, so I reduce it by the BFO knob.

3. Modification Rationale

One immediate solution to the problem would be that of procuring a new crystal in the 455 KHz range (precise frequency to be calculated), and modifying the 32S-3 such that, on CW, the new crystal replaces the original 456.35 KHz USB crystal. This modification is conceptually very simple, but the crystal should be ordered on purpose.

Ham spirit: squeeze your brain and spare your bucks. My approach is instead that of shifting the 75S-3B VFO frequency by some 800 Hz - 1200 Hz only when the following conditions occur:

- the 32S-3 is on CW;
- the 32S-3 is set to transceive;
- the 32S-3 is on transmit (i.e. the PTT line is keyed).

In this way:

- the 32S-3 (whose frequency, on transceive, is determined by the 75S-3B VFO) will transmit on the offset frequency;
- the 75S-3B will continue to receive on the original frequency.

4. How To Do It?

The problem is that of making a simple modification that you can remove at any time, with no evidence of it.

Giving a look to the 75S-3B VFO, you will note a ceramic trimmer close to the 6AU6 tube. This trimmer is used to shift the VFO frequency when switching LSB-USB, so that the dial shows the same frequency in either modes. The trimmer has a little metal “square” (with a notch for adjustment), which I have determined to be directly connected to the 6AU6 cathode (pin 7).

I then got the idea to utilize another ceramic trimmer for obtaining the desired shift, by connecting it to the metal square of the original trimmer without soldering it but finding instead a way to get a very stable and reliable contact between the two trimmers.

By looking at the 75S-3B schematic diagram, you will easily get convinced that the two trimmers (i.e. the original and the new one) do not interfere with each other, i.e. that the adjustment of the original trimmer to compensate for the LSB-USB switch remains unaffected by the setting of the new trimmer. And in practice it works so. It should also be noted that the two shifts (i.e. that for LSB-USB, and that for CW transceive) both go in the sense of lowering the VFO frequency.

5. The Proposed Mechanical Arrangement

The 75S-3B top VFO panel has five screws, two of which are used to support the 6AU6 tube socket. Fig. 1 shows that there are two screws which can be unscrewed with no risk of losing the nut, and which you can use to fix a strip with at least 5 insulated + 2 ground lugs (it was not a problem to find a strip with suitably spaced support lugs).

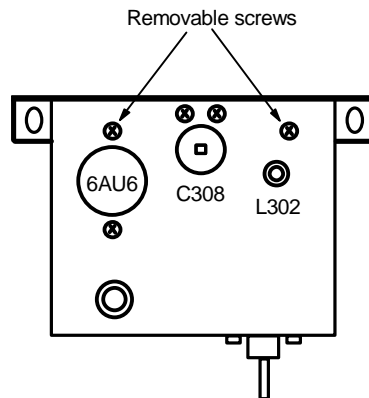


Fig. 1 75S-3B VFO Top View

As shown in fig. 2, after mounting the strip by the said two screws, you shall solder a silver-plated spring finger on it (salvaged from any old piece of RF equipment), which firmly touches the metal square of the original trimmer.

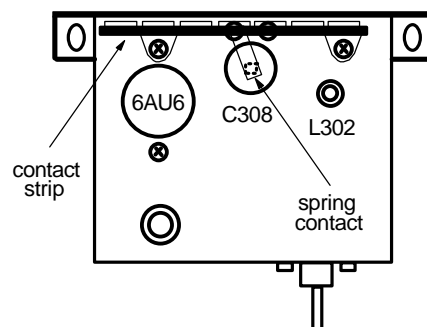
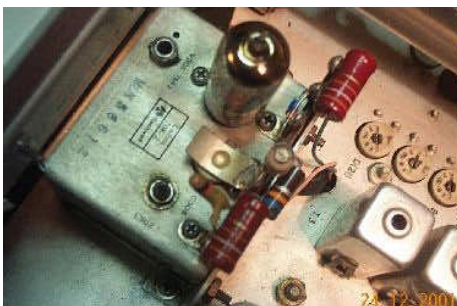


Fig. 2 Mounting the Strip and Soldering the Spring Finger

Pictures below should help.



6. The Modification Schematic Diagrams

Fig. 3 shows the schematic diagram of the additions to be made in the 75S-3B

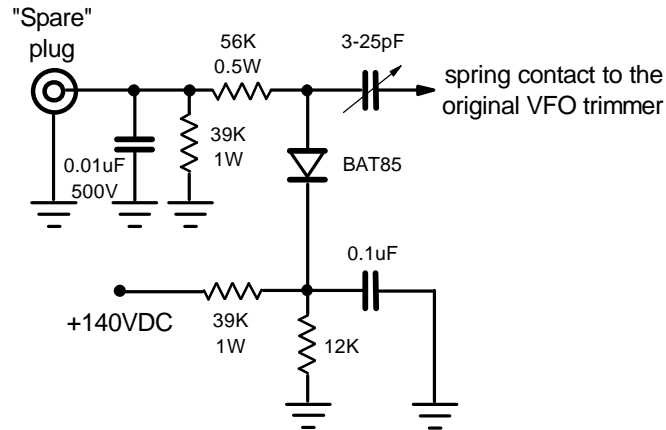


Fig. 3 Additions to the 75S-3B

Notes:

- there are several places where you get access to the unstabilized +140VDC line (see schematic diagram);
- BAT85 is a Schottky diode, but any silicon signal-level diode should work;
- the "Spare" plug is already available in the 75S-3B back panel.

Fig. 4 shows the schematic diagram of the additions to be made in the 32S3.

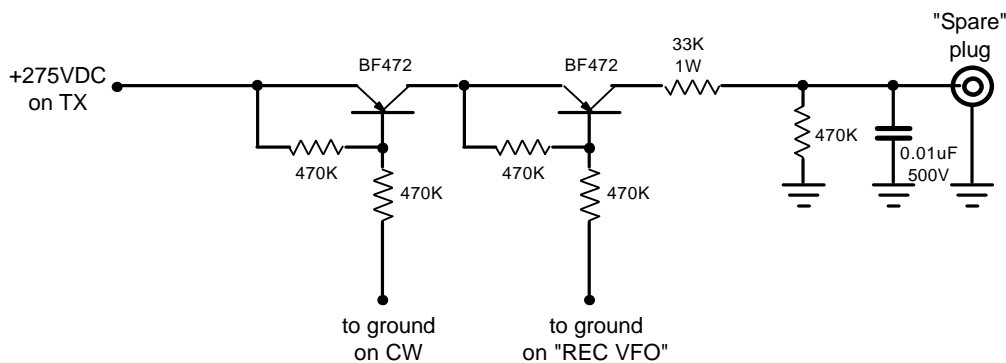


Fig. 4 Additions to the 32S3

Notes:

- the “to ground on CW” terminal goes to a free contact of the 32S3 “EMISSION” switch (look in the schematic diagram for pin 11 of wafer S8D). This has an easy access, close to the front panel;
- the “to ground on REC VFO” terminal goes to a free contact of the 32S3 “FREQUENCY CONTROL” switch (look in the schematic diagram for pin 6 of wafer S9D). This is a contact of the external wafer, facing the chassis;
- the BF472 transistors can be replaced by any high-voltage PNP (300V at least);
- the “+275 V on TX” line can be taken close to the RX/TX switching relay;
- the “Spare” plug is already available in the 32S3 back panel.

It goes without saying that the 75S-3B and the 32S3 “Spare” plugs shall be interconnected by a suitable cable.

7. Adjustments

Once you have completed the modification, you may perhaps note a small change in the 75S-3B dial setting, due to the stray capacitance of the added components. You should be able to recover this small shift by the small calibration knob on the front panel. If you like the dial hairline to be perfectly vertical, you may slightly re-adjust L302 on the VFO top panel (the VFO linearity will not be significantly affected by a small inductance change).

To adjust the new trimmer having no instruments proceed as follows (after equipment warm-up):

- use a modern radio as an auxiliary transceiver, put it on CW (better if with a narrow CW filter), and keep it steadily keyed on any frequency with CW carrier on (very low power, on a dummy load);
- set the 32S-3 on CW;
- disable the 75S-3B BFO (BFO knob fully counterclockwise);
- then:
 - * if the 75S-3B has a CW filter, set it to CW and accurately tune the auxiliary transceiver carrier for maximum S-meter reading, irrespective of whether you like the pitch or not;
 - * if the 75S-3B has not a CW filter, set it to USB and tune the auxiliary transceiver carrier just for your preferred pitch;
- switch the auxiliary transceiver to receive;
- switch the 32S3 to transmit, and keep it steadily keyed with CW carrier on (very low power, on a dummy load).
- then:

- * if the auxiliary transceiver has a CW filter, adjust the new trimmer on the 75S-3B VFO until the signal peaks on the auxiliary transceiver S-meter;
- * If the auxiliary transceiver has not a CW filter, adjust the new trimmer on the 75S-3B VFO for your preferred pitch.

At the end, re-check that dial calibration does not change when switching LSB-USB. Should this unlikely occur, then slightly re-adjust then original VFO trimmer (while keeping the added spring contact on it), and then re-adjust the new trimmer.

8. Earlier equipment

I am a relatively newcomer to Collins equipment, so I do not precisely know which differences exist between my “round” 75S-3B/32S-3 line and earlier products.

The only problems I can think of are:

- the possible absence, on the transmitter switch wafers, of the contacts marked “to ground on CW” and “to ground on REC VFO” in fig. 4. In that case you shall devise some other way to produce a +275VDC voltage (through a 33K resistor) when the transmitter is on CW and on transmit;
- the possible absence of the “Spare” plugs. In that case, you shall necessarily set-up an external connection between the receiver and the transmitter (or drill a hole on the chassis for a spare plug).

9. Conclusions

It is a real pleasure not having to “zero-beat” the transmitter frequency for each QSO. To tell the truth, I still miss the absence of a RIT (Receiver Incremental Tuning) control; in principle one may further modify the 75S-3B to have the BFO knob acting as a RIT control (the BFO frequency could be set once for all on your preferred pitch), but this would be quite a heavy modification although conceptually simple.

Any comments and suggestions are welcome. Tony, IOJX (k0jx@amsat.org)