**Evaluation and Repair of STARC Collins S-Line Equipment**

The following Collins radio components were evaluated:
75S-1 Receiver
32S-1 Transmitters
312B-4 Station Control
516F-2 AC Power Supply
Matching Speaker

## General

The units were cleaned up, as they were quite dirty. Otherwise they appear to be in fairly good physical condition.

These units can be connected together to operate as a transceiver, even though they are separate receiver and transmitter units. Sufficient interconnecting patch cords (phono-type plugs) are included to be able to connect them in this configuration.

I had never seen the S-Line equipment before, never operated one, and even much less ever worked on them. It is a pretty sophisticated state of the art (for the 1960's) tube type system. Dunn apparently installed a number of Collins factory recommended modifications. This is probably because these are some quite early S-Line units. I had to do a lot of research and figuring out how the circuits worked and what things did as the instruction manual does not go into enough theory. This took me much longer that it would have taken an experienced S-Line technician with better equipment and is by far the most challenging repair job I have undertaken.

## Operating Manuals

There were no manuals supplied, so I went to the Collins Collector Association website and downloaded manuals for all the items, except the speaker which does not need a manual as it just has a 4 ohm speaker. The 516F2 power supply instructions are included in the 32S-1 transmitter manual. I copied these manuals to a CD that is packed with the equipment. I reproduced only those sections I needed to be able to evaluate the units. STARC may want to copy the entire manuals, or they may order a better grade manual from a supplier such as Raymond Sarrio, who supplies vintage equipment manuals (at about $19 each). Whoever received all this equipment from Earl Dunn's estate may be able to locate the original equipment manuals, which would be preferred. .

## 75S1 Receiver

Eight of the tubes in this receiver had been substituted with solid-state equivalents (V1,3,4,5,6,7,8,9) some time in the past. I assume Earl Dunn did this for better stability with less drift, plus the unit should run much cooler. There is no record if any circuit changes were made as a result of these substitutions, and I was unable to find out who made the equivalents, as they had no manufacturer name on them. This receiver is about 35 years old, and I have no idea how long it had been sitting without use.

The AC power cord was damaged and dangerous and was changed out. I initially performed the following actions:

The electrolytic capacitors in the HV power supply circuit were changed out. These were C-59 A.B, and C, a single can type with three 40 mfd 250-volt capacitors. I left the disconnected can in place (on top of chassis for aesthetic purposes) and installed new axial type capacitors below the chassis. I used 47 mfd units (250 vdc), as 40 mfd units are apparently not standard any longer.

I also changed out the electrolytic capacitor on the bias voltage C-60, 40 mfd at 150 volts, just in case. Again I used a 47 mfd (160 vdc) as this is what is available and in the range of tolerance for this type circuit.

I replaced the fuse (2 amp slo-blo which was blown) and also one of the solid-state rectifiers CR1 that was shorted.

I made a new phono load plug P1 with a 100-ohm resistor to install in J1 on the chassis top. This plug was missing and is needed to provide proper oscillator plate circuit impedance. When using the receiver in transceiver service with the matching 32S1 transmitter, it is removed and replaced with the inter-connecting cable.

Once I got the receiver working, I was able to trouble-shoot the performance. I finally got it to operating fairly well. I took the following actions:

I replaced the 100 KC crystal oscillator tube V-9, as the oscillation was sporadic. This tube was originally a 6DC6, but had been replaced with a solid state equivalent. I used a NOS 6CB6A; an equivalent for the 6DC6, and the oscillator works normally. (Note: NOS means New Old Surplus). I zero beat the 100 KC oscillator with WWV (15 MHz).

I replaced V6, the product detector and BFO tube. This was originally a 6U8A that had been replaced with a solid state equivalent. It was causing a pronounced hum. I replaced it with a NOS 6U8A that eliminated the hum.

I replaced V4 the 1$^{st}$ IF amplifier tube with a NOS 6BA6. The original 6BA6 had been replaced with a solid state equivalent that was defective. This brought the signal levels up to normal. The 2$^{nd}$ IF amplifier tube was OK (it is also a 6BA6 solid state equivalent)

I adjusted the S-meter and checked the dial calibration and it appears adequate. It is off a little on 20 meters and you have to move the hairline just a little more (about a KHz) for 40/80 meters using the calibrator. The end spread between 0 and 200 on the dial appears proper as the zero beat is right on with both settings.

In summary, the receiver should not require additional work at this time. I was receiving strong signals on 20 and 40 meters with good signal quality and volume, at times peaking 30-40 DB over S9.

## 516F2 Power Supply (for 32S1 transmitter)

Supposedly someone plugged in the transmitter power supply and it smoked. No wonder, for when I opened up the power supply for inspection, it was obvious that all of the high voltage electrolytic filter capacitors were leaking and in very poor condition. One should never power up such a power supply that has not been used for such a long time and expect it to work properly. It should be visually inspected and then if it appears OK, then it should be brought up gradually with a Variac. In this case, I decided to replace all the electrolytic capacitors in the power supply with new ones. These were:

C2, C3 and C4- 30 mfd each at 400 volts. These are on the 800-vdc high voltage section, three in series with equalizing resistors. I replaced them with 33 mfd (450 vdc) units as these are standard and within tolerance.

C5-A (15 mfd) & C5-B (30 mfd), a dual electrolytic in the LV section (275 vdc). I replaced the 15 mfd portion with a 10 mfd (450 vdc) in parallel with a 4.7 mfd (450 vdc), to give me 14.7 mfd total, well within tolerances. I replaced the 30 mfd section with a single 33 mfd (450 vdc) unit, well within tolerance.

C5 (10 mfd) 150 vdc in the -65 volt bias supply. I replaced this with a single 10 mfd (250 vdc) unit.

After powering up the power supply (disconnected from the 32S-1), all voltages checked out OK and the fuse (4 amp) did not blow.

## Transmitter 32S-1

This unit required a very large amount of debugging time, as it is considerably more complicated than the 75S1 receiver and had many problems from being out of service for so long. . The unit was missing one tube, a 6U8A (V1A/B) that I replaced. When I plugged in the power supply and turned the unit on, the 4-amp power supply fuse blew. I unplugged the HV rectifier in the power supply (which eliminated the 800 HV to the finals) and the fuse did not blow, I therefore knew the short was in the HV section. I opened the top of the RF enclosure and found that one of the leads to the plate caps of the 6146 final tubes had come loose and was shorted to ground. Reconnecting this plate cap lead solved the fuse-blowing problem and I was able to proceed with debugging. I have no idea as to how it could have come loose as it is not that easy to pull off the cap. Maybe someone had been working on the unit in the past and left it that way.

Upon powering up the transmitter again, the VOX line keyed the transmitter, regardless of the position of the VOX gain control or the anti-VOX gain control (or any control for that matter). Pulling out the VOX keyer tube stopped this problem. I checked all the tubes in this circuit and ended up replacing V-11 (6U8A), a dual service tube that is the VOX keying tube (V11A) and the BFO oscillator (V11B). This tube apparently had a plate to grid/or cathode short that caused the tube to conduct continuously, which in turned keyed the transmitter as plate voltage to this tube is fed through the coil of the VOX relay. This tube did not show as being bad on my tube tester. The

way I finally solved the problem was by voltage and resistance checks all through circuit where I discovered the incorrect voltages on the plate (low) and grid. (high).

I then proceeded to check all voltages and resistances on the rest of the tubes and compared them to the voltage/resistance chart shown in the instruction manual. The voltages to both the plates and the screen grid of V1A/B (6U8A) were very low. This B+ supply has an electrolytic cap (C6A, 8 mfd) to ground that was leaking very bad and pulling down the voltages. I don't know the purpose of this capacitor. It is a dual can type mounted on the chassis and also contains C6B (25 mfd) in the BFO circuit. I decided to change both. I disconnected both capacitors from the can and installed regular axial caps under the chassis. I used a 10 mfd at 450 vdc to replace the 8 mfd as that is what I had on hand and I feel it is within tolerance. I replaced the 25 mfd cap with another 25 mfd unit. For aesthetic reasons I left the can in its position on the chassis.

Another problem I found with the voltage and resistance checks was improper resistances on the cathodes of V14 A/B, the 1st mixer. The two cathode resistors are connected to a mixer balancing pot, R27 (500 ohms) to ground. By just moving the pot back and forth I was able to get the resistances to the proper values. It had apparently been in the same position so long that it had a bad or dirty spot right where the wiper contacts with the resistance. I left the pot in the same original position and did not rebalance the circuit.

After the above changes, I finally got the unit to oscillate and tune in the TUNE position and load in LOCKKEY position to full power (100+ watts). However when I passed to the CW position and keyed the transmitter (it uses a tone oscillator and break-in keying via the VOX system), I could not get more than about 15-20 watts output as indicated on the SWR/Power meter in the station control. . I was able, however, to verify that the tone oscillator used to key for CW was working as I could hear it in the 75S1 receiver. The ALC meter indication was very high, indicating that the ALC was cutting back the power. The first thing I did was remove the ALC tube V-13 (6AL5) and try to transmit and was able to put out full power which led me to believe the problem was indeed in the ALC circuit. The ALC tube (and several others I tried) checked out OK on my tube tester. I proceeded to try to zero the ALC circuit using the procedure in the manual. The ALC zero pot is on the cathode of IF amplifier V-3. When I tried to zero, I observed very erratic operation of the pot and was not able to zero the circuit. I removed the pot (250 ohms) and verified that it was bad. I was unable to find one locally, so I installed one that I had that would physically fit but that had a higher value (500 ohm but with wrong taper)). It appears to work marginally but should be changed for the proper value in the future. While doing this, I also found out that the cathode resistor on this tube, R-19, 120 ohms, was bad (burned and broken) so I changed it also.

After making these changes, I still had high voltage on the ALC circuit. I found that two DC blocking capacitors between the finals grid circuit (normally about –60 vdc) and the ALC 6AL5 rectifier were leaking which caused the high voltage. ALC voltage is normally about –7 vdc. I replaced C83 (0.1 mfd) and C 142 (0.1 mfd) that solved the problem of ALC for the moment.

I was then able to load up properly, but the transmitter still operated erratically. I opted to change out essentially all the rest of the so-called "paper" capacitors. These were; C107 (0.1 mfd), C9 (0.47 mfd), C173 (0.5 mfd), C177 (4 mfd-elec.), C118 (0.1 mfd), C88 (0.5mfd) and C87 (0.1 mfd). I could then proceed without worrying about all these potentially leaking caps.

I loaded the unit again and the VOX started acting up again. In testing the tubes, I found that V11 had failed again. This tube is a 6U8A, a real problem tube type that are notorious for failing (and also causing hum). I replaced it with an equivalent tube, a 6EA8, which solved the problem. The other 6U8A tubes in the transmitter could be also be replaced in the future with either 6EA8 or 6GH8A that are equivalents except for the V2 position, which will not operate properly except with a 6U8A.

I checked the neutralization on finals and driver as best I could and it appears to operate satisfactory.

I made a couple of contacts on 20 meters and got good reports and was told the audio sounded real good and was "Collins quality".

**312B-4 Station Control**

This unit appears to be OK. I did not check out the phone patch, as I doubt it will ever be used plus it has very few components which might fail. The SWR meter, speaker and clock (manual wind-up) all work OK. I made an interconnecting RF cable with an N connector on one end (Station Control) and a phone plug on the other end (32S1) to connect the transmitter RF out to the Station Control unit. There is another cable out with N connector on one end and a UHF (Pl259) type connector on the other end to connect the outlet of the Station Control (N connector) to the antenna. .

**Storage**

I boxed the units up along with interconnecting cables (total of four boxes). Each box has a label stating what is in each one. These should be stored in a dry fairly cool place until we put them into service. We do not have a mike for this unit. I made an adapter to be able to use one of my own mikes. **We need a high impedance mike with the thin phone plug type connection (2 connections, ring and tip, one for audio and one for PTT), plus a key if we want to operate CW.**

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