

Treetop Circuits
Owner's Manual for SB-75 SSB Adapter

Version 4

The SB-75 SSB adapter (*Fig. 1*) from Treetop Circuits is designed specifically as an accessory for the Collins 75A-2 and A-3 receivers. It provides enhanced performance in SSB and CW modes. Performance in AM mode is largely unchanged.

To maintain consistency with the receiver documentation, and in deference to the distinguished history of these receivers, we use 1950's terminology -- for example "megacycles", not "MHz" -- in this document.

The unit plugs into the radio in place of the detector/AVC tube V-8 (*Fig. 2*), and most connections are made through the tube socket. In addition one wire is connected from the SB-75 to the radio, two wires are disconnected and two added in the radio, and two components are removed. With the SB-75 installed, all controls operate as before, but performance in SSB and CW modes is markedly improved.

To achieve this improved performance, the SB-75 replaces the diode detector with a high-level product detector, and provides a fast-attack slow-return AVC circuit. These circuits are automatically switched in when the receiver's BFO is turned on. With the BFO turned off, AM detector and AVC circuits which closely mimic the original circuits are switched in.

The SB-75 comes as a PC board, ready to install and operate.

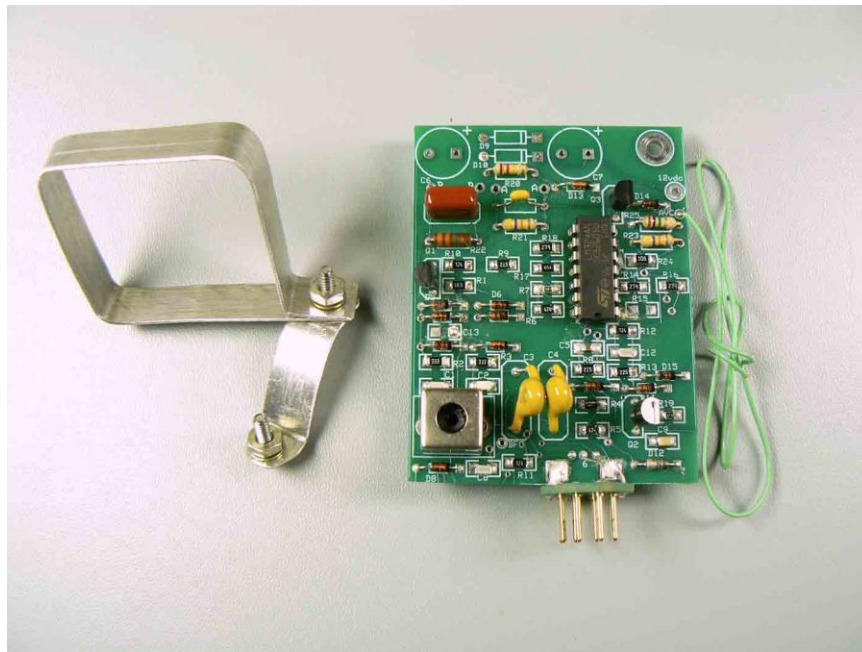


Fig. 1 – The SB-75 as supplied.

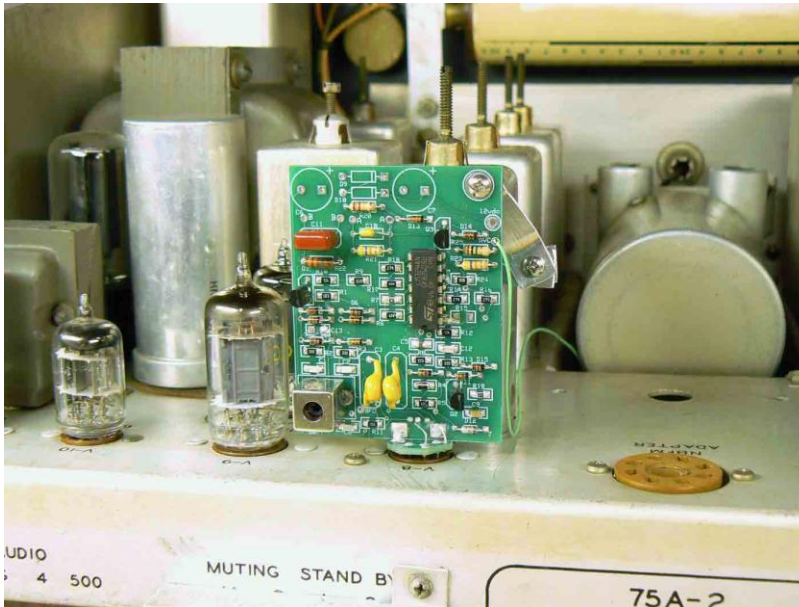


Fig. 2 – As installed in the receiver

Degree of Difficulty

Installation will present no problem for an experienced technician or hobbyist. However, it does require some skill, and should not be undertaken as a “first project”. If you are uncertain about this, the best bet is to read the instructions thoroughly and make sure you are comfortable with all the steps.

Treetop Circuits can provide clarification on specific points, so please do not hesitate to e-mail. But please also bear in mind that there is no substitute for basic electronic skills and good workmanship.

And as always, remember that voltages approaching 300 volts are present in this receiver.

Modifications by Owner

Some owners will want to experiment with the circuit. To facilitate this, through-hole resistors and capacitors are used in parts of the AVC circuit, and extra holes are provided near C10 and C11. Please read the section on warranty before modifying the circuit.

Before Proceeding

We recommend that you check our web page <http://treetopcircuits.com/docs> for the latest version of this manual. Do not hesitate to e-mail us at radio@treetopcircuits.com if you need assistance.

Like all semiconductor circuits, the SB-75 can be damaged by electrostatic discharge. Appropriate practices should be used when handling it.

Preparing the Radio

The radio should be in good operating condition and properly aligned. If this is not the case, it is recommended that a performance check and alignment be performed before proceeding. In particular, the BFO alignment procedure (part 5.3.3 in the 75A-2 manual, or Section V, part 5 in the 75A-3 manual) should be performed in detail.

Installation

Unplug the receiver from the power source. Do not trust the switch.

As you proceed, please keep in mind that individual receivers may contain variations in wiring details as a result of changes made in the course of production, or changes made by a previous owner. If these are found in your receiver, we strongly recommend that you take photos of the areas involved before making further changes.

Be particularly careful not to contact the insulation on the wires with the soldering iron. It melts and burns more easily than modern insulation.

Remove V-8 from its socket.

Remove or disconnect C-92 (the small capacitor from V-12 pin 5 to V-8 pin 2) (*Fig. 4*).

Remove or disconnect C-80 (the 100 pF capacitor from pin 1 to pin 2 of V-8) (*Fig 4*).

Cut the jumper between pins 6 and 7 of V-8 (*Fig. 4*). In some radios, the -50 volt wire and/or the resistor or capacitor are connected to pin 7. Move them to pin 6, leaving pin 7 free.

Add the green wire from V-12 pin 5 to V-8 pin 7 (*Fig. 5*). This carries the BFO signal. Route it directly, as shown.

Put the SB-75 in the socket, replacing V-8. Attach and adjust clamp (*Fig. 2 and 3*). If your radio is collector quality, you may want to put a paper label on the clamp first to ensure you don't scratch the IF can.

Route the long green wire through the chassis and connect it (*Fig. 2 and 6*). This wire carries the AVC signal. You can route it as shown, or according to your preference.

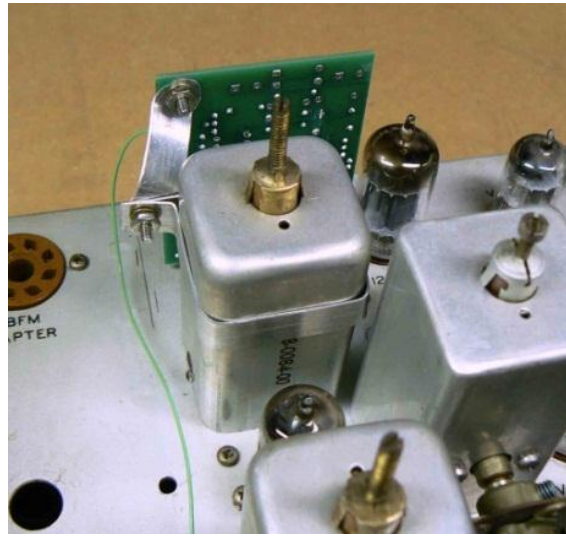


Fig. 3 – The clamp has been installed and tightened.

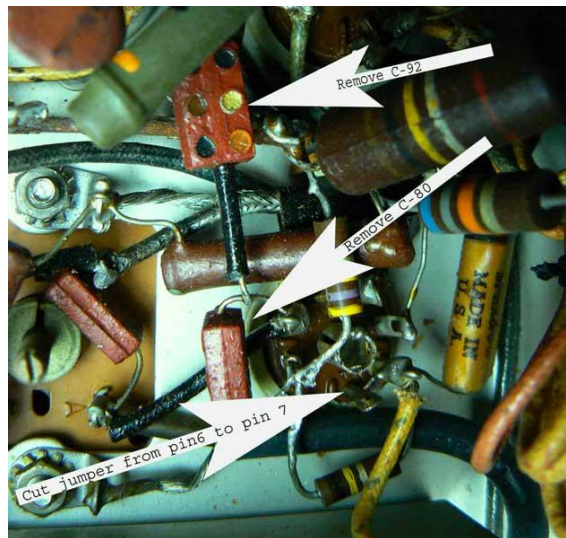
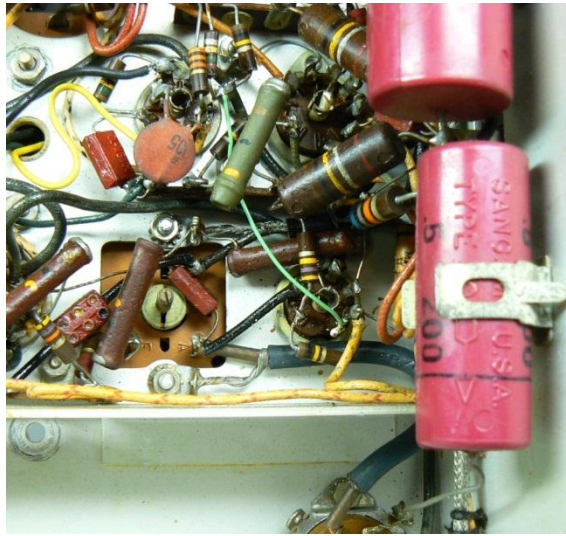


Fig. 4 – Showing the capacitors and jumper which must be removed.



*Fig. 5 – The green wire from V-12 pin 5 to V-8 pin 7 will carry the BFO signal.
Pin 6 is used for -50 volts.*

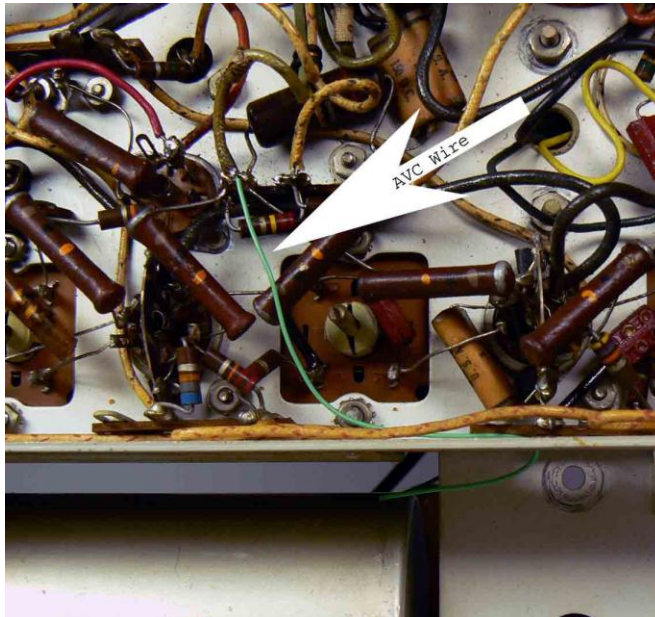


Fig. 6 – AVC wire connection.

The work under the chassis is now complete. Next, the connections to switch S-3 (CW-AM-FM) must be changed. In the original circuit, the AVC function is defeated in the CW mode and the AVC voltage is controlled only by the RF GAIN control. These changes allow both the SB-75 and the RF GAIN control to affect the AVC voltage.

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To permit easier access to the switch, you will probably want to remove the large cover which shields the slug rack and trimmers. Remove the four screws holding it and lift it off.

As shown in *Fig. 7* and *8*, remove the orange wire from the terminal at the top of the switch. Place a short section of shrink tubing over the exposed end, and warm it up with the soldering iron to shrink it in place. In case you haven't used this material before, we've included enough that you can do a couple of trial runs. Just wipe the excess solder from the iron and hold it close to, but not touching, the tubing, which will shrink in a few seconds.

Next, clean up the terminal you just removed the wire from and connect it to the next terminal over, as in *Fig. 8*. Replace the cover and screws.

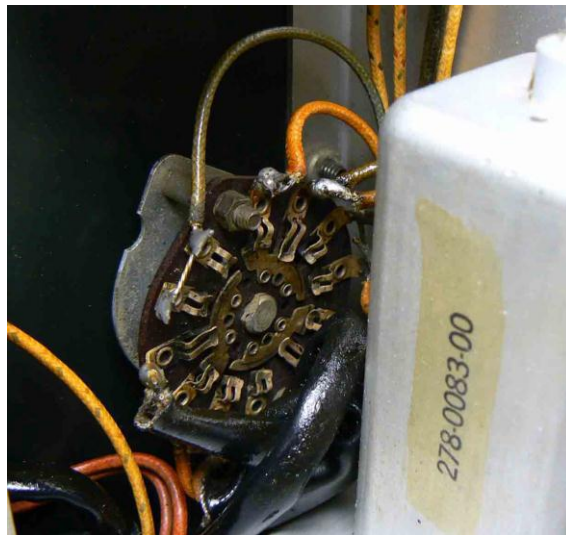


Fig. 7 – S3 before the changes. The large cover has been removed for access.

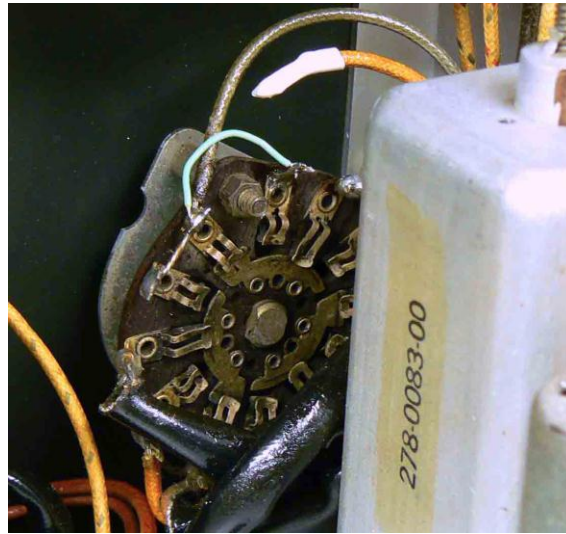


Fig. 8 – After the changes.

Operation

Now you can connect an antenna and try it out.

Control functions are unchanged. In particular, AM operation is completely unaffected. On SSB, the receiver will be much easier to operate. In most situations, you can leave the RF gain turned up. It will no longer be necessary to “ride” the RF gain control.

The AM limiter does not work in SSB mode, with or without the SB-75 installed. It depends on the presence of an AM carrier to set its threshold. Based on some brief tests, the CW limiter works well in some situations.

Set the controls for CW operation. Make sure the LIMITER is OUT, the CW LIMITER is at 0, the SELECTIVITY at 0, and the mechanical filter (if present) is switched out.

With these settings, the BFO PITCH control will be least critical. But it is still necessary to have it on the correct side of the passband. For the 80 and 40 meter bands, LSB is normally used, so the BFO PITCH control should be at +1. On 20, 15, 11, and 10 meters, set it near -1 to provide USB operation. On 160 meters, LSB is normally used, but you have to set the BFO PITCH control to -1. This is because the receiver uses single conversion on this band, so the signal spectrum is inverted in the IF section.

When the narrower crystal filter settings are used, or the mechanical filter is switched in, the setting becomes more critical and will vary from radio to radio. Using the settings above as a starting point, you can find the best settings for your radio.

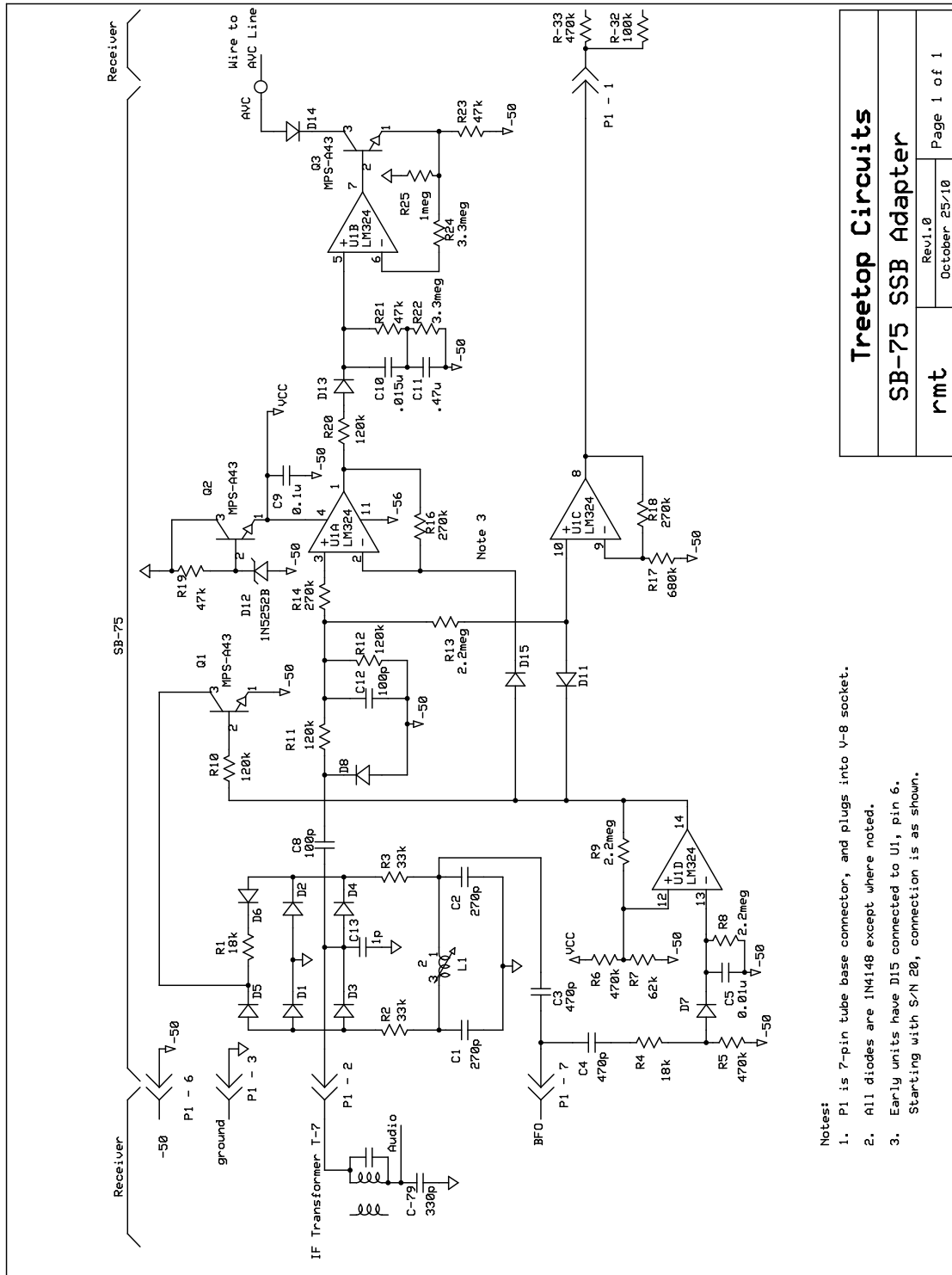
The required setting is a function of the filter, not the band. So once you’ve found the best point for, say, 20 meters with a given filter, the same setting will work for 160, 15, 11, and 10 meters. Similarly, the best setting for 40 meters will also be best on 80 meters.

The AVC system has enough range that it should produce clean audio on all but the strongest signals, and you should rarely have to touch RF GAIN control.

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Notes:

1. P1 is 7-pin tube base connector, and plugs into V-8 socket.
2. All diodes are 1N4148 except where noted.
3. Early units have D15 connected to U1, pin 6. Starting with S/N 20, connection is as shown.

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Fig. 9 - SB-75 schematic.

Circuit Description:

In the following description, references to components on the SB-75 circuit board are shown in bold (**C1**, etc.), and those in the receiver are in normal text. To assist in following this description, the schematic (*Fig. 9*) shows some of the receiver circuitry.

The SB-75 plugs into the V-8 socket instead of the tube. Most interconnections are made through the 7-pin connector P1. In addition, a direct wire is made to the AVC line.

Operating power is derived from the -50 volt line in the receiver, which appears at pin 6 of P1. Since the AVC amplifier in the receiver uses this line as a reference, it is convenient to reference most of the circuitry in the SB-75 to this line as well. Zener diode **D12** and transistor **Q1** provide a regulated voltage (VCC), which is held at +23 volts relative to the -50 volt supply line. This powers the quad amplifier **U1**.

In the original receiver circuitry, an envelope detector circuit is used for AM, CW, and SSB reception. The AVC circuit is useful only for AM. To receive CW or AM, the BFO is simply switched on. The SB-75, on the other hand, uses a product detector and fast-attack, slow-return AVC system for CW and SSB, so mode switching is required.

Mode switching in the SB-75 occurs automatically when the BFO signal is present. **D7** and associated components rectify the BFO signal; **U1D** acts as a comparator, with the threshold set by **R6** and **R7**.

For AM reception, the BFO is switched off. The output of **U1D** goes positive. **Q1** saturates, applying nearly -50 volts to the anodes of **D1** and **D3** so they do not conduct. Current flows through **D6** and **D2** to ground. Additional current flows through **D2** to ground via the path **D5-R2-L1-R3**. This keeps its cathode, and the cathode of **D4**, at an essentially constant voltage of about 0.7 volts below ground. **D4** then acts as a pre-biased diode detector, replacing one section of V-8. As in the original circuit, this causes the audio component to appear on C-79.

For CW or SSB reception, the rectified BFO signal causes the output of **U1D** to approach the -50 volt line, turning **Q1** off. Diodes **D1-D4** and associated components form a high-level single-balanced mixer. The BFO voltage (about 30 volts RMS, 453 to 457 kilocycles) is applied via **C3** to the resonant circuit consisting of **C1**, **C2**, and **L1**. **C3** blocks the DC component, so the voltage on **C2** swings above and below ground. Due to the resonant circuit, the voltage on **C1** is equal to that on **C2** but in opposite phase. When the voltage on **C2** is negative, the voltage on **C1** is positive, so current flows through **R2**, **R3**, and **D1-D4**. This forces the IF signal line to ground. On the alternate half-cycle, diodes **D1-D4** are reverse-biased, so they present an open circuit to the IF signal. The path from ground via pin 1 and T-7 to C-79 is thus interrupted at the BFO rate, causing the demodulated audio signal to appear on C-79.

In either mode, The AVC signal is developed using **D8** and associated components. The resulting roughly-filtered positive DC signal is applied to non-inverting amplifiers **U1A** and **U1C** via **R13** and **R14**.

In AM mode, since the output of **U1D** is near VCC, the inverting input of **U1B** is driven positive via **D15**; this cuts off **Q3**. **D11** is reverse-biased, so the AVC signal is applied via non-inverting amplifier **U1C** to the original time-constant circuit and thence to the grid of the AVC amplifier V-9. AM operation is thus essentially the same as the original.

In CW/SSB mode, the input of **U1C** is driven close to -50 volts, thus forcing its output below the threshold of the AVC amplifier in the receiver, which is not used in SSB mode. The AVC signal is applied via **U1A** to the fast-attack, slow-return network. The main time-constant capacitor is **C11**, with the attack time controlled by **R20** and **R21**, and the return time by **R22**. **R21** and **C10** provide a fast-attack fast-return function which prevents overload on brief noise pulses while avoiding desensitization. **U1B** drives inverting amplifier **Q3**, which drives the main AVC line in the receiver. **R25** provides a small threshold voltage, eliminating the long “tail” on the AVC return.

Warranty and Return Policy

If you are not satisfied with the product for any reason, you can ship it back to us. Provided that it is shipped within 30 days of your receiving it, and we receive it in good shape, we will credit your PayPal account with the amount you paid us – that is, full purchase price including shipping one way.

If the product fails in normal use within one year from when you received it, return it to us at your expense. We will repair it and ship it back to you at no charge or replace it (our option). “Normal use” means that it is installed in a correctly functioning Collins 75A-2 or A-3 receiver, according to the instructions provided and using good workmanship. Also, we will not be responsible for damage caused by receiver malfunction or other events beyond our control, including (but not limited to) power surges and lightning hits.

Non-warranty repairs will be carried out for a flat fee of \$20 U.S. plus shipping both ways. We reserve the right to refuse to repair heavily damaged units under this policy.

If you ship the unit, use an anti-static bag like the one it came in, or wrap it in aluminum foil, to protect it from static electricity generated by packing material.

You can modify the unit without automatically voiding the warranty. However, you must tell us in detail what changes were made, the workmanship must be good (in our judgment), and we have the final word on whether your actions caused the failure. We make this provision so that knowledgeable owners can alter the AVC time constants and other properties according to individual preferences.

73,

Bob Thomas VE3TOU

Owner, Treetop Circuits