The SB-600 SSB adapter from Treetop Circuits (Fig. 1) is designed specifically as an accessory to the Hammarlund SP-600 series of receivers. It provides enhanced performance on SSB and CW signals, using a product detector with wide dynamic range and a dual-time-constant AGC circuit. In AM mode, the adapter is switched out of the circuit entirely, so performance on AM is unchanged, except for an extended bass response.

The SB-600 comes ready to install and operate. It mounts under the chassis on standoffs, using the holes provided for C129A/B, and is connected to the original circuitry by eight wires. Power is derived from the receiver. Control functions are unchanged.

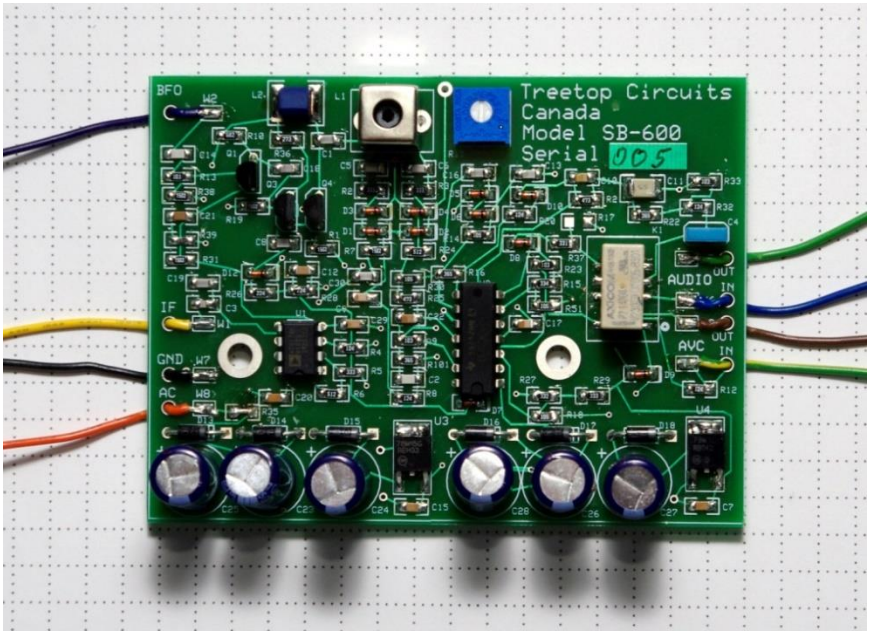

Figure 1: The SB-600 as received

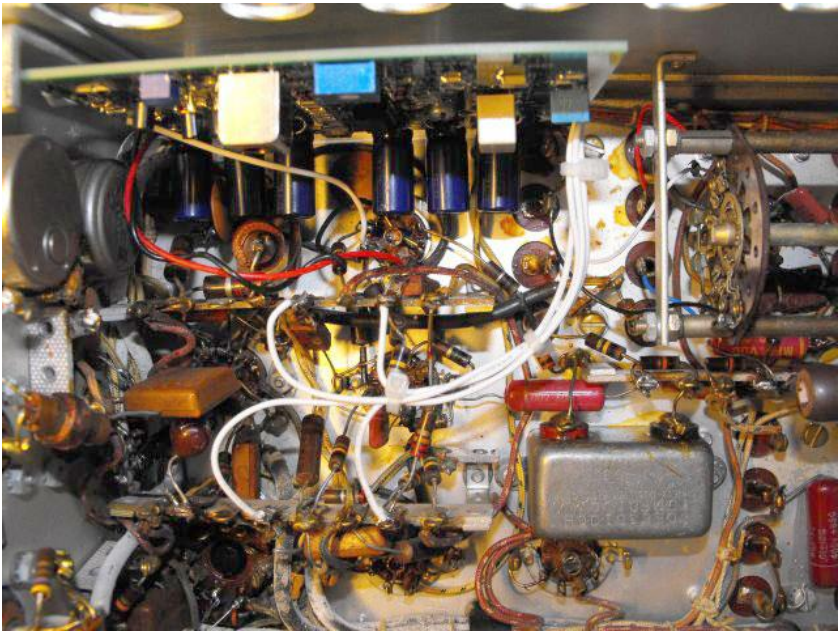

Figure 2: The SB-600 installed (prototype unit shown)

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.

Preparing for Installation

Make sure that you have the manual for the exact version of the radio that you have. Be aware that a few later versions incorporated a product detector; this adaptor is not intended for these versions. Also, it is possible that modifications (documented and otherwise) were done by various owners. Make sure that the IF, detector, and BFO circuitry in your radio agree with the manual; if they do not, the adapter may not function properly, and damage to the radio and/or the adapter may result.

The radio should be in good working order in all modes, and properly aligned, before you start installation. Since the SB-600 depends on IF and BFO signals derived from the receiver, it is particularly important that the IF and BFO circuits are correctly aligned. This is more critical in SSB operation than it is with AM or CW.

A small bag containing parts needed for the installation is included with the adapter.
We recommend that you read through the entire installation procedure before proceeding further.

Installation

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

Hint – The soldered joints in these radios are many decades old, and often have developed a tough oxide film which makes it difficult to solder to them. Before attempting to solder a wire to a terminal, remelt the existing joint while adding a bit of rosin-core solder. This will produce a bright, shiny "new" surface which will accept solder easily.

1. Remove V12 (the BFO buffer tube) from its socket. This tube is no longer needed.

2. Remove the dual capacitor C129A/C129B and its leads. The adapter will be mounted in its place, using the existing mounting holes and the hardware provided.

3. Locate and remove R111, (R60 in some versions), 100k between terminals 2 and 4 of terminal strip E16

4. Locate and remove C143, 5100pF, between terminals 2 and 5 of terminal strip E15.

5. Install one of the .047 uF capacitors provided between pins 6 and 7 (ground) of V11. This replaces C129A, which was removed.

6. Install the other .047 uF capacitor between terminal 5 of terminal strip E16 and pin 2(ground) or pin 4 (ground) of V12. This replaces C129B, which was removed. Use the plastic tubing provided as required.

7. Mount the two threaded standoffs to the back (non-component) side of the adapter board, using the two longer (1/4") screws, with a lockwasher under each screw

head. Leave these screws slightly loose to allow the standoffs to align with the holes in the chassis

8. Carefully move the board into position, with the standoffs aligned with the holes in the chassis. Make sure that all components in the radio are clear of the board; you may have to move some components to ensure that there is no mechanical stress or danger of electrical contact.

9. Using either the shorter (3/16") screws or the screws that held the dual capacitor (to retain the original look), finish mounting the board, tightening all screws securely. If you use the original capacitor-mounting screws, you may have to shorten them so they don't "bottom". The main RF ground is through the standoffs, so make sure all surfaces are clean and all screws are firmly tightened. The black ground wire (which is mentioned below) is provided as a safety measure to prevent the board from becoming "hot" under any circumstances.

10. With the board in place, the colored wires can be cut to length and connected. The BFO (violet) and IF (yellow) wires should be run directly, but should not be tight and should not be bundled with other wires. The remaining wires can be bundled and/or dressed according to preference. Fig. 2 shows the wires organized using plastic wire ties. The wires in the prototype unit are not the same colors as used in production units. Running the AC and ground wires together (red and black in the prototype, orange and black in production units) is good practice.

11. Connect the wires as follows:

    - BFO (violet) to V12, pin 1
    - IF (yellow) to V11, pin 5.
    - GND (black) to any convenient ground.
    - AC (orange) to V12, pin 3 (6.3 volt filament supply).
    - AVC IN (green/yellow) to terminal 2 of terminal strip E16.
    - AVC OUT (brown) to terminal 4 of terminal strip E16.
    - AUDIO IN (blue) to terminal 2 of terminal strip E15.
    - AUDIO OUT (green) to terminal 5 of terminal strip E15

Operation

All controls should operate as before. In AM mode, the only change that should be observed is an extended bass response. This happens because C143 (5100 pF or 5.1 nF) is replaced by C4 (47 nF) on the board. The adapter was designed this way to simplify installation, and replacing C143 with the larger value is a popular modification, so we decided to use the larger value.

When the BFO is turned on (using the MOD-CW switch), or an external BFO signal is applied, the adapter detects this and switches into SSB (and CW) mode..

You can find the best settings for the BEAT OSC control (which controls the frequency of the BFO signal) by trial and error. But the following paragraphs describe a more methodical approach:

In SSB operation, best results are obtained with the BFO frequency offset to one side of the IF passband. Then, when the receiver is tuned so that the received signal falls within the IF passband, the BFO signal will fall just above or below the received signal; that is, it will be in the right place to replace the "missing" carrier, and the audio will be intelligible.

If the receiver is aligned correctly, setting the BEAT OSC knob to zero will place the BFO signal in the middle of the IF passband. Due to the conversion process used in the receiver, signals appear in the IF section in inverted form. For example, an upper-sideband signal coming in on the 20-meter band will appear as a lower-sideband signal at the SSB adapter. Therefore, the BFO signal should be at a frequency slightly above the IF passband.

Remember that LSB is normally used on frequencies below 10 MHz, and USB above 10 MHz.

To get started, set the SELECTIVITY switch to 3 kHz and the BEAT OSC to plus 1.5, and find a suitable USB signal on the 20 meter ham band. You should be able to tune in the signal easily, and no overload should occur, even with the RF GAIN control at maximum. Try various settings of the BEAT OSC control, readjusting the main tuning each time. Remember the BEAT OSC setting that gives best results. This will be the setting you want for any USB signal when you're using this selectivity setting.

Change the selectivity to 1.3 kHz, make sure the XTAL PHASING control is at zero, and repeat the procedure to find the best setting of the BEAT OSC. It will likely a bit lower this time.

Change to the 40 or 80 meter band, and repeat the procedure to determine the best settings for LSB. Ideally, the best settings will correspond to the ones you already found, but will be on the MINUS side. However, some asymmetry is to be expected because of crystal aging and similar effects.

The SELECTIVITY settings discussed here are typically the most useful for SSB. You can, of course, use other selectivity settings. In general, the narrower settings are best in a crowded band, but wider settings produce more natural audio.

The blue trimming potentiometer (R11) on the board can be adjusted if desired to get the AM and ssb audio levels to match. If you adjust it, make sure to tune in a strong ssb signal to make sure that the audio section of the receiver does not overload.

Circuit Description

The SP-600 SSB adapter is installed under the chassis of the receiver, and wired into the receiver circuitry. When the receiver BFO is turned off, the adapter is inactive, and AM reception is unaffected. If the BFO is turned on, the adapter detects the presence of the BFO signal and takes over the detection and AGC functions. Referring to Fig. 3a, operation is as follows:.

If the BFO signal is not present, as in AM operation, relay K1 is not operated and the original receiver circuitry is restored via the normally-closed contacts of K1; R11 in the receiver is replaced by a similar resistor R12 in the adapter, and C143 in the receiver is replaced by C4 in the adapter.

If the BFO signal is turned on, the BFO signal is amplified and amplitude-limited by Q1, Q3, Q4 and associated components. The BFO signal appearing at the collector of Q3 is rectified by D12, and the resulting DC voltage drives part of U2, which operates a Schmitt Trigger comparator and operates relay K1, which connects the audio and AGC signals from the adapter to the appropriate points in the receiver circuits.

The BFO signal appearing at the collector of Q4 is coupled by C1 to a resonant circuit consisting of L1, C5, and C6. This circuit is configured so that the BFO signal on C6 is 180 degrees out of phase with the signal on C5; the result is that D1-D4 conduct on one half-cycle and are cut off on the next half-cycle. This drives the junction of R7 and C9 to ground on alternate half-cycles

of the BFO signal. The IF signal from the plate of V11 is connected to amplifier U4 via a voltage divider consisting of C3 and C19. This divider puts a capacitive load on the circuit which is similar to the load presented by V12 (which has been removed). U1 provides a small voltage gain, but mainly provides a low-impedance drive for the mixer circuit.

Since the junction of R7 and C9 is forced to ground on alternate half-cycles of the BFO, the signal at this point will consist of the IF signal, the BFO signal and harmonics thereof, and the difference between these frequencies. This difference signal is the audio signal; all the other components are at much higher frequencies, and are removed by C2. R11 allows some adjustment of the audio level so it is reasonably close to the level of AM signals. The audio signal goes to the receiver circuitry via K1 and C4.

In order to provide the AVC function, the output of U1 also drives a rectifier circuit consisting of D5, D6, and other components; this produces a negative DC voltage proportional to the IF signal level. A section of U2 acts as a non-inverting amplifier, while R24 and R25 set the AVC threshold. D10, C10, C11, and associated resistors provide a dual-time-constant , fast-attack, slow-return AGC function. Another section of U2 acts as a buffer amplifier which drives the AVC line in the receiver via D8, R37, and K1.

Referring to Fig. 3b, regulated DC power for the adapter is obtained from the 6.3 volt filament supply in the receiver, using voltage tripler circuits followed by linear regulators U3 and U4.

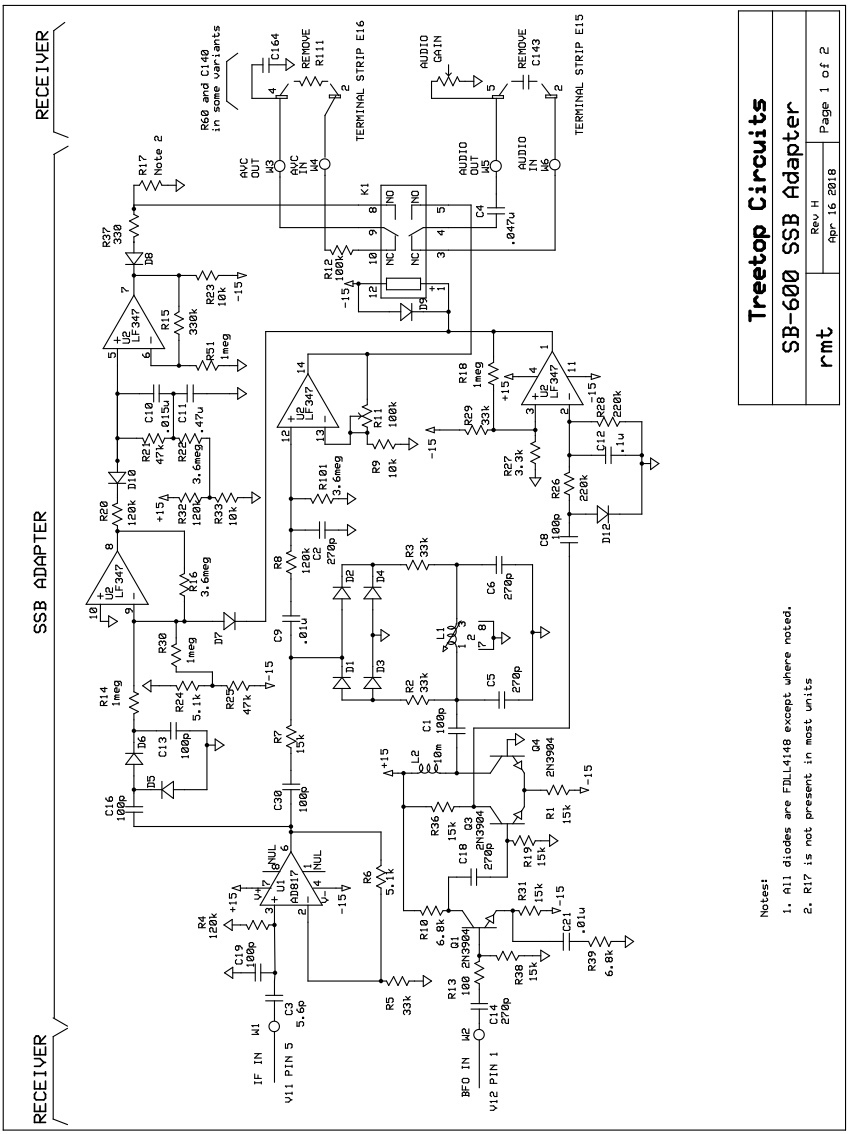

Fig. 3a: BFO, IF, audio, and AVC circuits

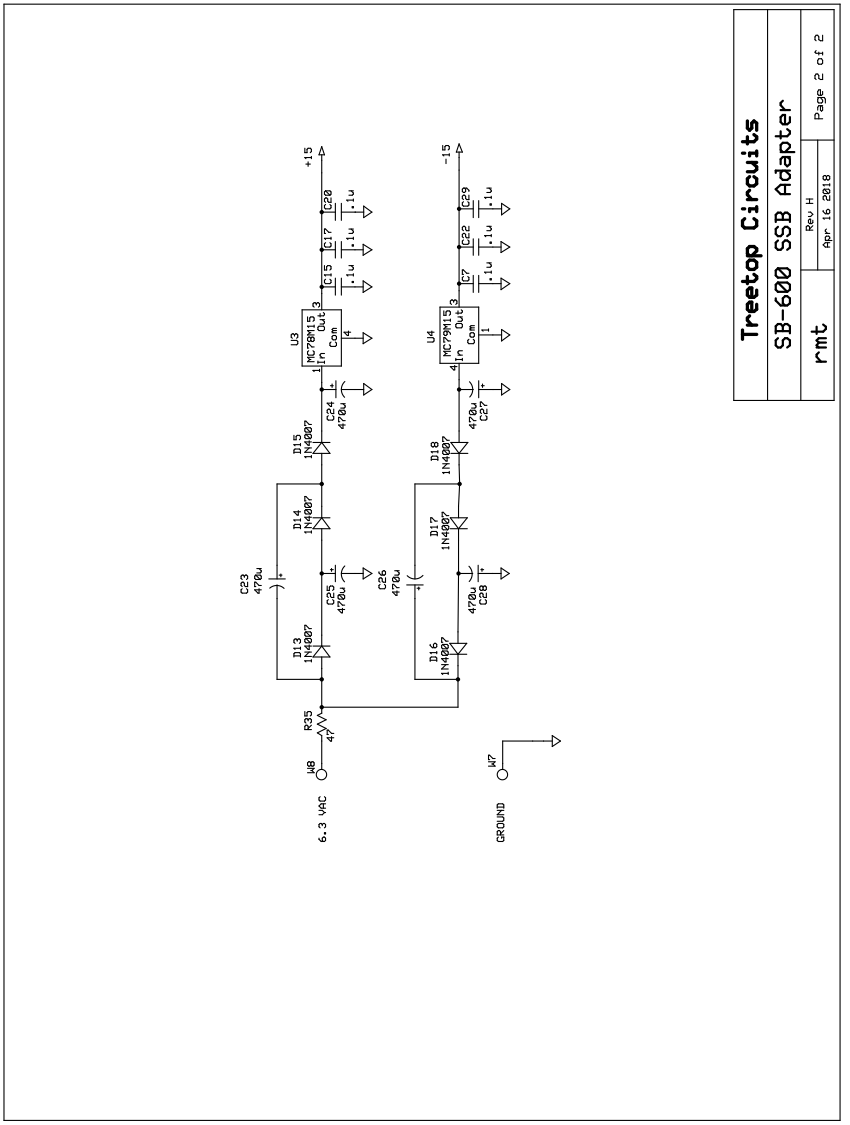

Fig. 3b: Voltage tripler and regulator circuits

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 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