Alignment Procedures for the Model 60-96-00400-G1 One-Way Signal Booster System

WHEN NEEDED

There are two tunable subassemblies within the system including the preselector filters and the amplifiers. Both the preselectors and amplifiers are pre-tuned at the factory and under normal conditions do not require tuning. Re-tuning the filters to their original frequencies may be required if a filter is being repaired or replaced. The amplifier tuning procedure needs to be done whenever the RF transistors and/or the matching network components are replaced.

The procedures described in this addendum are designed as field alignments for the model 60-96-004000-G1 One-Way Signal Booster. All steps should be carried out in a step-by-step fashion and all work should be performed by a qualified electronics technician.

FILTERS

Combline preselector filters provide the input and output selectivity for the system. These are 6 section bandpass filters which have a carefully shaped response curve that passes a number of contiguous communication channels. Both the input and output filter have a factory set bandwidth of 3 MHz. **The preselector filters are factory tuned and do not normally need adjustment unless they are damaged or replaced**. These devices will stay properly tuned indefinitely unless they have been physically damaged or are tampered with.

Input/Output Filters (3-14478)

Tuning the filters is a matter of obtaining reasonably low insertion loss and a return loss of -15 dB or better at the specified frequencies. This may be done in the field when adequate test equipment is available.

Required Test Equipment

A two channel network analyzer that simultaneously displays both transmission and reflection is best for properly tuning a preselector. However, a single channel tracking generator/spectrum analyzer combination may be adequate but will be a bit more cumbersome since return loss is not simultaneously displayed along with insertion loss. For best results a return loss bridge is also required when using a tracking generator/spectrum analyzer. Skill and experience are needed and the personnel doing the work should be thoroughly familiar with the use of the test equipment. Figures 1 and 3 illustrate the use of an IFR A-7550 spectrum analyzer/tracking generator combination for filter tuning. Figures 2A and 2B show the preselector response curves displayed on a network analyzer. Listed below is a typical combination of equipment:

1) IFR A-7550 Spectrum Analyzer / Tracking Generator combination.

2) Eagle RLB150N3 Return Loss Bridge or equivalent (35 dB directivity).

3) Double shielded coaxial cable test leads (RG142 B\U or RG223/U).

4) 50 Ohm load with at least -35 dB return loss (1.10 : 1 VSWR). JFW Industries model 50T-007 or equivalent.

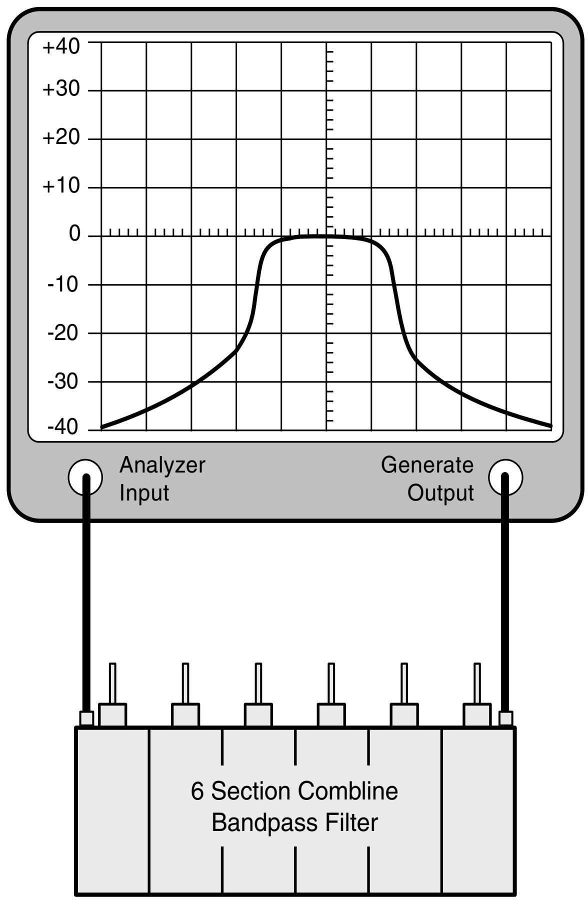

Figure 1: Tuning a combline filter.

Equivalent equipment but from other manufacturers should yield acceptable results.

Filter Tuning

The following steps are an outline of the general procedure:

1) Connect the test equipment to the filter assembly as shown in figure 1.

2) Set the analyzer to the desired center frequency and necessary bandwidth.

3) Loosen the tuning rod locking nuts.

4) If the preselector is severely out of tune, set the analyzer for a 10 dB / division vertical scale on the transmission channel and alternately adjust the tuning rods in pairs working from the center to the end rods for maximum signal at the center frequency.

5) Repeat step 4 tuning to maximize the signal at the center frequency. The response should start to take on the desired shape and symmetry as shown in figures 2A (10 MHz per/division) and 2B (2 MHz per division).

6) Setup the analyzer for 1 dB per division (2 dB per division when using a tracking generator) and re-adjust the rods in the same fashion for the response with minimum insertion loss at the pass frequency or across the desired passband.

7) Connect the equipment as shown in figure 3. Make sure that the return loss curve provides adequate performance (better than -15 dB) over the range and is relatively symmetrical. Fine adjust the tuning rods to adjust symmetry.

8) Repeat steps 6 and 7 until acceptable insertion and return loss are obtained.

9) Lock all tuning rods after the desired response is obtained. Note that a slight dissymmetry in either the transmission or reflection response may be unavoidable.

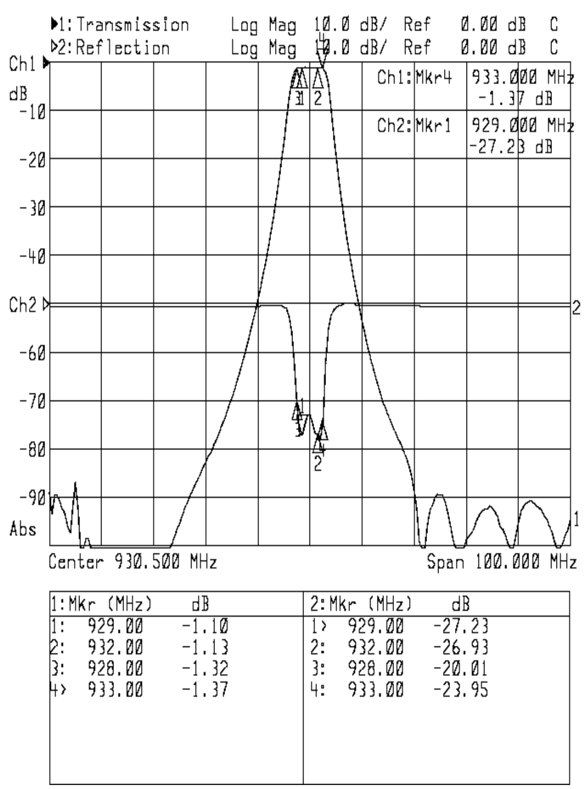

Figure 2A: Preselector response curve shown at 10 MHz per/division.

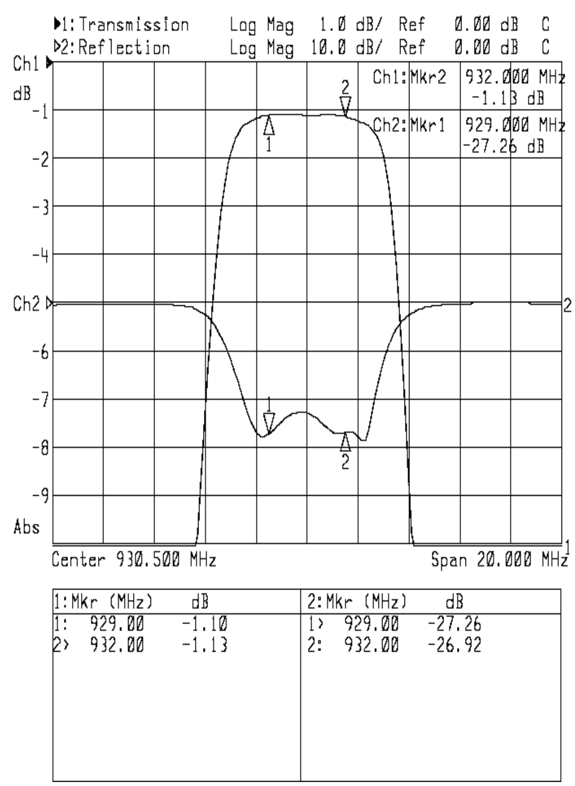

Figure 2B: Preselector response curve shown at 2 Mhz per/division (expanded passband).

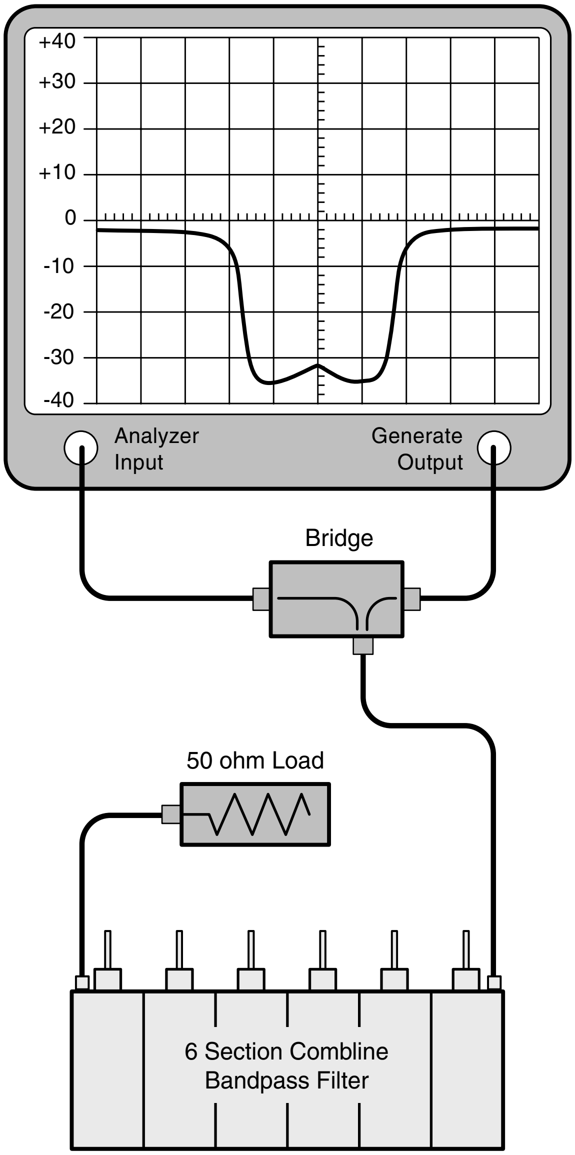

Figure 3: Measuring return loss.

AMPLIFIERS

The amplifier assemblies use bi-polar transistors operating as class A linear amplifiers with varying RF output power capability. They offer a good compromise between low noise figure and low levels of intermodulation distortion. In addition, these amplifiers use narrow band impedance matching circuitry which offers significant improvements in noise figure compared to broadband designs. However, narrowband circuits necessitate having to tune the matching networks to obtain the best performance.

Each amplifier (see figure 4) uses a bias regulator circuit to keep the RF transistor biased for constant collector current with changes in temperature. The collector current remains constant when these amplifiers are running properly. The actual value of bias current will be different for the different types of amplifiers but can also vary slightly if the power supply voltage varies.

Note: The 400 milliwatt amplifiers (part #3-7718) are interconnected with short lengths of double shielded coaxial cable for the RF interconnection. The individual stages are mounted on a common bracket with a DC distribution wire running internally between the stages. These multistage amplifiers are tuned on a per stage basis. **Never attempt to tune these amplifiers while they are interconnected**. Individually tuned single stages do not require any further adjustment after they are connected together forming a multistage assembly. The three and six watt amplifiers are similarly constructed but are used as discrete stages only.

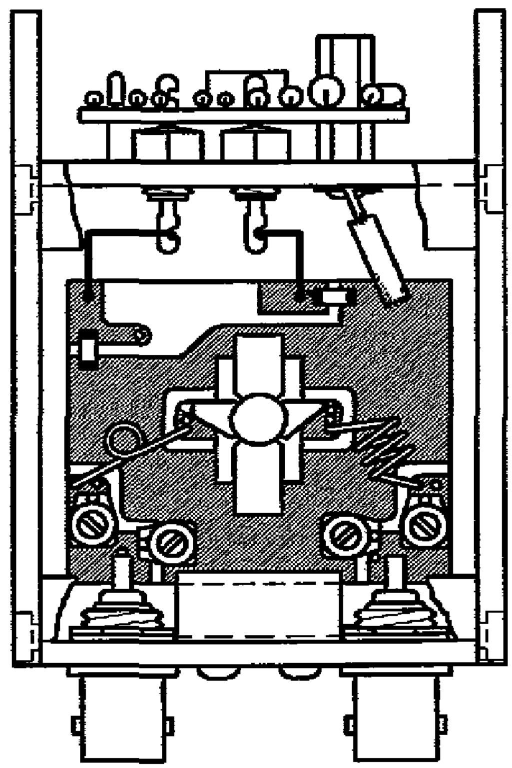

Figure 4: Mechanical layout of a typical amplifier. assembly 3-7718 shown here.

Amplifiers (3-11432 / 3-11795 / 3-3948)

Field repair and tuning of our amplifiers is supported by TX RX Systems Inc. and the following procedures will allow satisfactory operation to be obtained. These procedures were designed to be a practical field bench service procedure.

Required Test Equipment

The following equipment or its equivalent will be required in order to complete the amplifier tuning procedures.

1) IFR A-7550 Spectrum Analyzer / Tracking Generator combination.

2) Eagle RLB150N3 Return Loss Bridge or equivalent (35 dB directivity).

3) Double shielded coaxial cable test leads (RG142 B\U or RG223/U).

4) 50 Ohm load with at least -35 dB return loss (1.10 : 1 VSWR). JFW Industries model 50T-007 or equivalent.

5) Regulated DC power supply at the required voltage.

6) Insulated metal blade tuning tool for adjusting ceramic and/or piston variable capacitors (TX RX part # 95-00-01).

Amplifier Tuning

1) Set the tracking generator output level to -20 dBm, the desired center frequency and a sweep width of 20 MHz.

2) Connect the test leads together through a female barrel connector to obtain a zero dB reference level.

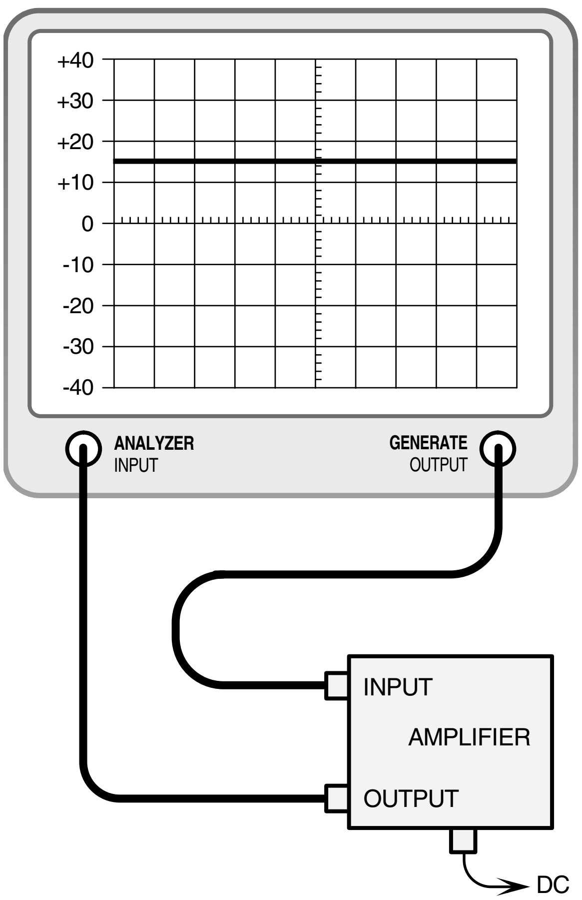

Figure 5: Measuring amplifier gain.

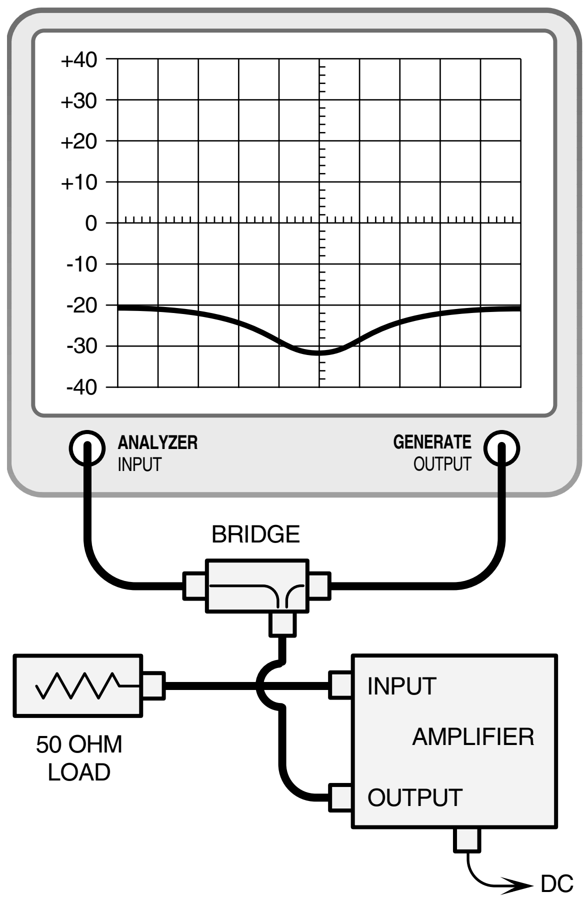

Figure 6: Measuring input return loss.

NOTE: For the IFR A-7550 proceed as follows:

a) Make sure that the unit is in "LIVE" mode when performing step 2.

b) From the Mode Menu, "STORE" the above trace.

c) Switch to the Display Menu and select "REF".

3) Remove the female barrel connector and connect the equipment as shown in figure 5.

4) Remove the amplifier top cover. Engage the variable capacitors nearest the OUTPUT connector and rotate them for maximum gain.

5) Engage the variable capacitors nearest the INPUT connector and alternately rotate them for maximum gain.

NOTE: If the gain peaks at a level about 60% of maximum, one variable capacitor should be rotated 180 degrees and steps 4 and 5 repeated.

6) Connect the return loss bridge to the tracking generator as shown in figure 6 but do not connect it to the amplifier. Leave the test port on the bridge open.

7) Set up the 0 dB return loss reference.

NOTE: when using the IFR A-7550 perform the following procedure:

a) Make sure that the unit is in "LIVE" mode when performing step 7.

b) From the Mode Menu, "STORE" the above trace.

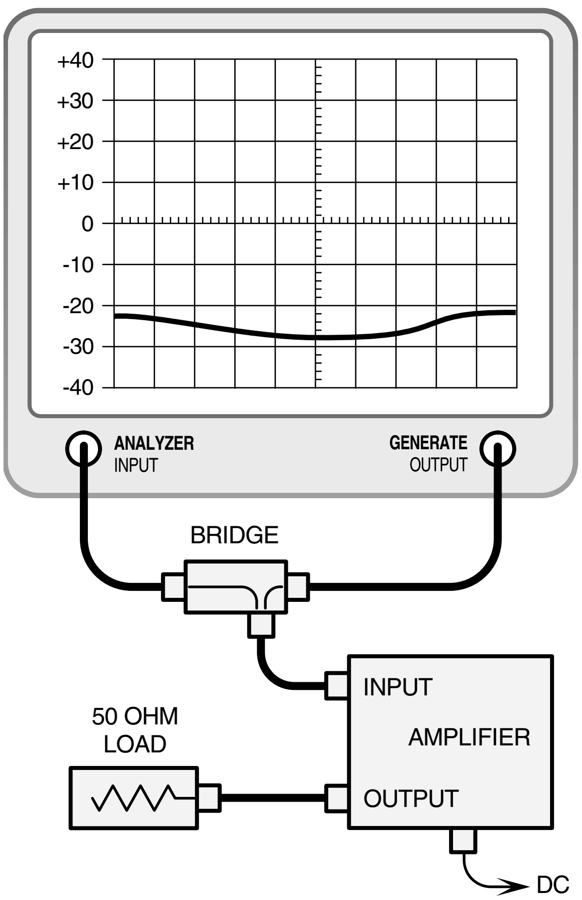

Figure 7: Measuring output return loss.

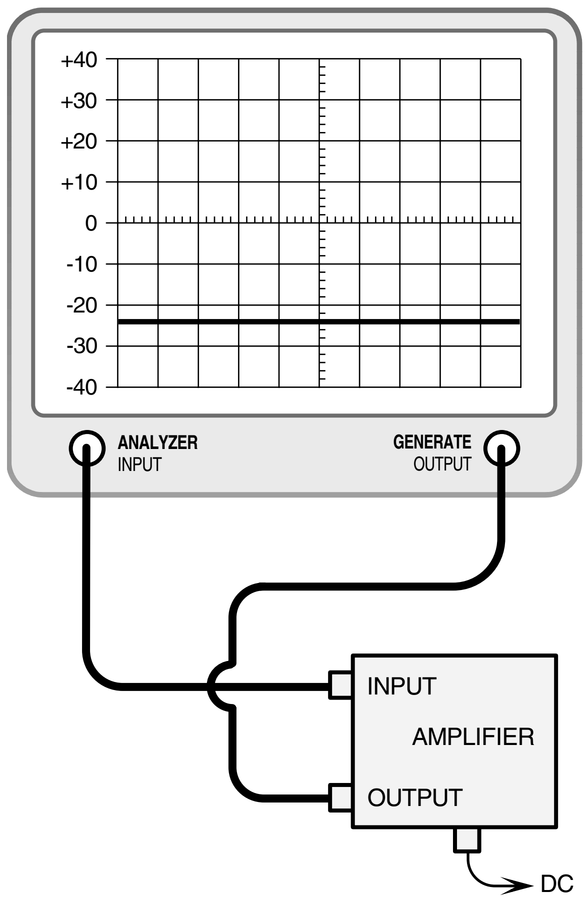

Figure 8: Measuring reverse isolation.

c) Switch to the Display Menu and select "REF". The trace should appear at the 0 dB level.

8) Connect the bridge and load to the amplifier as shown in figure 6 and see if the input return loss is down -16 dB or more. If it is, skip to step 10.

9) Alternately adjust the capacitors nearest the INPUT connector for increased return loss. It should be possible to obtain -20 to -30 dB loss with maximum loss at the center frequency.

10) Reverse the connections as shown in figure 7 and see if the output return loss is -16 dB or more. If it is, skip to step 12.

11) Alternately adjust the capacitors nearest the OUTPUT connector for increased return loss. It should be possible to obtain -20 to -30 dB loss with maximum loss at the center frequency.

12) Due to interaction, tuning the output circuitry affects the input tuning and vise-versa. Repeat steps 8 through 11 until acceptable input and output return loss occurs without further tuning.

13) Connect the equipment as shown in figure 8 but connect the test leads together through a female barrel connector. Repeat the zero reference procedure of step 2.

14) Using the figure 8 connection, verify that the Reverse Isolation is at least -20 to -22 dB. This value will occur normally as the result of proper tuning.

The greater the reverse isolation the better as this value must exceed the gain of the amplifier or oscillation may occur. If after proper tuning this value remains low, it may indicate a bad bypass capacitor or defective RF transistor.