

## **Add a Buffered Main Receiver IF Output to the Kenwood TS-990S**

This modification outlines the steps necessary to add a buffered 8.248 MHz main receiver IF Output to the Kenwood TS-990S transceiver.

### Liability Statement:

Caution: This modification will void your TS-990S warrantee. I will not be held personally responsible, or financially liable, for any damage you, or others, do to your TS-990S as a result of these modification instructions.

If you're skilled with a soldering iron, electro-mechanically proficient, have electronic assembly experience and are able to read and understand the TS-990S Service Manual along with these instructions, then you are a candidate to do the MOD. However, if you're the least bit tentative about voiding your warrantee, using a soldering iron or cutting a small hole in your \$8K radio then please DO NOT attempt this MOD!

### Parts needed:

1 Ea. Z10000B Buffer Amplifier board (built and set for ZERO db gain)

[http://www.cliftonlaboratories.com/z10000\\_buffer\\_amp.htm](http://www.cliftonlaboratories.com/z10000_buffer_amp.htm)

3 Ea. Standard 2-pin, 0.1 inch spaced Pin Header Connectors (Added to Z10000B)

1 Ea. 3ft. length of RG-174 coax or equivalent

1 Ea. small zip tie (strain relief for IF output cable)

1 Ea. small right angle metal clip (used to mount the Z10000B Buffer Amp board using existing receiver board mounting screw). More info on clip is provided in the MOD instructions.

### Tools needed:

1 Ea. Phillips Head Screwdriver #1 cross slot – Magnetic makes it much easier to both remove and replace screws in tight places.

1 Ea. sharp point X-acto Knife (prefer #11 style sharp point blade)

1 Ea. small wire or side cutters

1 Ea. small needle nose pliers

### MOD Instructions:

1. Place the TS-990S upside down with the rear panel facing you.
2. Remove the bottom cover by removing a total of 14 Ea. screws (left side 3 Ea, right side 3 Ea, bottom side 8 Ea.). You do not have to remove any of the bottom cover feet. Once the 14 screws are removed the bottom cover will lift off easily from the TS-990S main chassis.
3. Refer to Photo 1: With the bottom cover removed, locate the Main Receiver Shield Cover which is held in place by 8 Ea. screws. Remove screws as shown.
4. Refer to Photo 2: With the main receiver shield cover removed locate X42-343 Accessory Unit. Disconnect 2 Ea. TMP cables (PRE0 - white band and PRE1 - blue band). Next remove 4 Ea. screws holding the X42-343 shield cover. Remove the shield cover being careful not to hit or damage the Accessory Unit board.

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5. Refer to Photo 3: Once the shield cover is removed, carefully tilt the Accessory Unit board up and lay it on its top side being careful not to pull on the multi conductor flat ribbon cable. Remove 4 Ea. remaining screws and remove the X42-343 mounting bracket from the main receiver board. This will expose the IF output tap location which will be identified in Step 7.
6. Refer to Photo 4: Mounting Cliftonlaboratories Z10000B Buffer Amplifier board. The Z10000B board is mounded vertically to the main receiver board using a small right angle metal bracket. Each side of the bracket requires a hole that will clear a #4 screw. I fashioned my bracket using an old component terminal strip. I drilled out the mounting bracket and used it to mount the amplifier board by its lower left corner. The other side of the bracket will be secured by an existing mounting screw on the main receiver board (see Photo 4a for photo of the type component terminal strip used to fabricate the right angle bracket). Once you make the bracket, mount it to the amplifier board in the lower left hand corner using a #4 screw, lock washer and nut. Position the Z10000B board in the approximate area shown in Photo 4. The mounting bracket hole should line up with an existing screw that holds the BPF board in place (see photo 4b). Remove the screw and secure the amplifier board in place. It should replicate the mounting and location shown in Photo 4.
7. Refer to Photo 5: Preparing the IF Output Tap Points. In this step you are going to identify, and solder tin the circuit trace going to the junction of Resistor R141, 0000 ohms and Capacitor C244, 0.010 Mfd (located below and to the left of Relay K10) on the main receiver board. Using a small tip low wattage soldering iron, solder tin both the IF Tap Point and IF Ground. Next carefully strip and prepare the end of a short length of RG-174 coax (or equivalent) so the center conductor and shield braid exactly fit the IF Tap Point and IF Ground. Tin both the center conductor and ground pigtail prior to soldering the coax cable to the IF Tap Points. Solder the coax ground braid to the IF Ground first so it will act as an anchor and hold the coax cable in place. Next route the inner connector and solder to the IF Tap Point (junction of R141 & C244).
8. Refer to Photo 6: Once soldered to the IF Tap Point and IF Ground, the other end of the coax can be routed to the RF input terminals of the Z10000B pre amp. Prepare the end of the coax for soldering to the Z10000B RF Input. Solder tin the coax leads but do not solder to the Z10000B board yet.
9. Refer to Photo 7: Connecting the Z10000B to +13.8 VDC. Locate connector CN2 in the lower left corner of the main receiver board. The top most "Yellow" wire carries 13.8 VDC which we will use to power the Z10000B. Using an X-acto knife carefully remove approximately 1/16 inch of insulation being very careful not to nick or damage the insulation of the other connector wires. Once the insulation is removed, solder tin the exposed wire area being careful not to melt the connector body or other connector wires. Next you will connect and solder

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one end of a 5 inch length of insulated hook-up wire (24 gauge). Ensure the soldered wire is not a cold solder joint. Route the other end of the wire to the B+ input of the Z10000B. Cut the wire to length but do not solder to the Z10000B at this time.

10. Refer to Photo 8: Making the IF output cable. First you need to double the size of one specific air vent hole on the rear panel of the radio. Look closely at the photo to determine which slot to enlarge. Using a sharp pair of small wire or side cutters, carefully cut (nip) one side of the vent slat (soft aluminum). Cut the slat as close as possible on each side of the vent hole. Study Photo 8 to see what I am referring to. Once the size of the vent hole is increased you can proceed to step 11.
11. Refer to Photo 9: Installing and routing the IF output coax. Insert the remaining length of RG-174 through the rear panel enlarged slot. The cable is stiff enough to allow you to guide it into the main receiver compartment. Continue pulling on the cable until it reaches the Z10000B RF Output terminals. Once you determine the length, cut, and solder-tin the coax for connection to the IF Output terminal on the Z10000B pre amp. Do not solder to the Z10000B at this time.
12. Refer to Photo 10: (Note: The Z10000B input, output and power pads are spaced to accommodate standard 2-pin 0.1 inch spaced pin header connectors. As a result, I installed 3 Ea. pin headers to make it easier to solder the coax cables and power lead to the board). At this stage you should have both IF In and IF Out coax cables prepped and solder tined. You should also have the 13.8 VDC lead ready for connection. Solder all three to the Z10000B making sure to observe polarity (coax braid to ground). Inspect and check your work to ensure there are no shorts or cold solder connections.
13. Reassemble the TS-990S: Reinstall the X42-343 mounting bracket and its associated screws (Photo3). Next carefully position the X42-343 Accessory Unit board back onto the mounting bracket. Be careful not to pull on the flex cable. Reinstall the X42-343 Shield Cover and secure with associated screws (Photo2). Reinstall TMP Cables PRE0 (white band) and PRE1 (blue band) coax connectors making sure the TMP connectors are fully seated (Photo2). Ensure that all TMP cables are installed. Next reinstall the Main Receiver Shield Cover and its associated screws (Photo1). Make sure that all screws are tight.
14. Adding the IF Output in-line coax connector: Strip and prepare the IF output cable exiting out the back of the transceiver (I cut my cable length to 12 inches). I used an in-line gold plated female RCA connector. You are free to choose what ever type of in-line coax connector you want (SMA, BNC, RCA, Etc.).
15. Reinstall the transceiver bottom cover and associated screws. Ensure all 14 screws are tight.

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16. Initial checkout: Connect the TS-990S to AC Power and Antenna. Verify normal operation of the radio. Next connect the TS-990S IF Output to the antenna input of a 2<sup>nd</sup> receiver. Tune the receiver to the IF frequency of 8.248 MHz. (you can also use an LP-PAN, SDR-IQ, or other SDR receivers). As the TS-990S is tuned you should hear the receive frequency on the 2<sup>nd</sup> receiver.
17. End of MOD assembly.

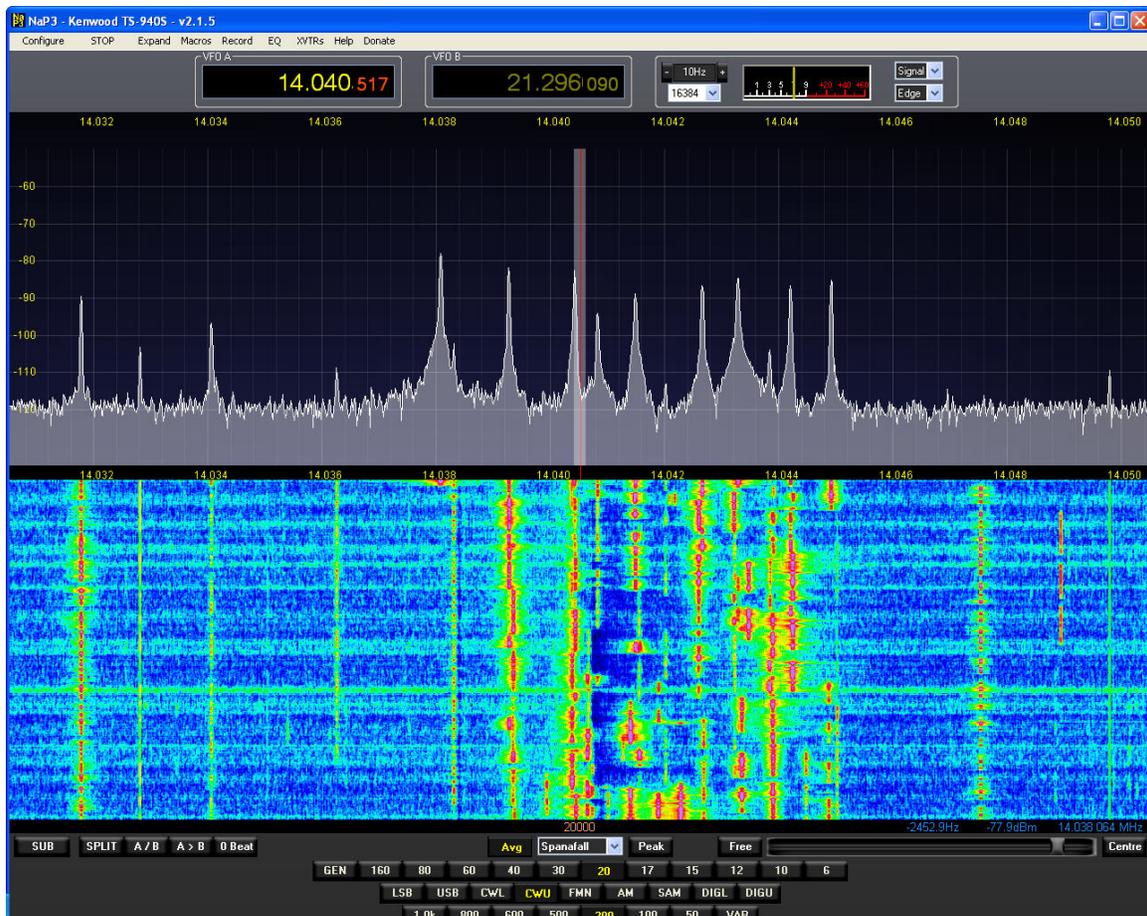
On my setup I use a standard K3 version LP-PAN Unit modified with a “off the shelf” 33 MHz crystal. This puts the LP-PAN DSP receive center frequency at 8.250 MHz which is close enough for proper operation. Using the latest version of LPB2 and NaP3 I am pleased with the end result. Below is a screen capture of the TS-990S main display.

Note the scope is set for Fixed Mode with a band span that covers the entire 20 meter band. I like this view as it gives me a single look at all band activity. In this TS-990S screen capture the rig is tuned to the CW portion of the band. There is activity at the indicated frequency.



Below is a screen capture of NaP3 Hi-Res Panadapter software which is simultaneously tracking the TS-990S. The panadapter band span is set to 20 KHz which provides a clear display of individual CW signals. This allows me to see detailed station activity in addition to the TS-990S broad spectrum display. I can also “point and click” on the NaP3 displayed signals to quickly jump from one station frequency to another. The combination of the two screens is a distinct advantage when doing search and pounce operation in a contest.

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The TS-990S built-in scope is the best I have seen in big box rigs. However, the flexibility of having an IF Output to run third party hardware and software is a real enhancement to what is already an outstanding radio.

This mod document was researched and authored by:  
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Use this document at your own risk.

Many thanks to:  
Larry (N8LP) for his well designed LP-PAN2 DSP Receiver and LPB2 software.  
<http://www.telepostinc.com/LP-PAN.html>

Pete (F5VNB) for his great work on NaP3 panadapter software.  
<http://www.telepostinc.com/NaP3.html#Installation>