

TEN-TEC Orion (Model 565 and 566) 9 MHz IF Output

Prepared by Rick Williams, VE7TK

(Note: Those undertaking this modification **do so at their own risk**. The procedures outlined provided a 9 MHz IF output to the **Spare** jack on the rear of the Orion Model 565/566. This procedure has not been approved by TEN-TEC, Inc. or any of its staff.)

Under no circumstances will the author be liable for any damage to your amateur radio equipment resulting from the installation of this modification.

Purpose:

This paper describes how I extracted a wideband 9 MHz IF sample signal from a TEN-TEC Orion (Model 565). The wideband signal is obtained from the Orion's 9 MHz IF board using a Clifton Laboratories Z10000 buffer amplifier and will be connected to a TelePost Inc. LP-PAN Digipan digital panadapter. The LP-PAN provides improved scan speed and resolution compared with the Orion's stock panadapter. (The Orion's internal panadapter – Sweep - function remains unchanged by this modification.)

With the Orion II (Model 566) the 9 MHz IF board was redesigned. A complete set of installation instructions for the Orion II can be found in Appendix A. Photos for this appendix and a review of the text were provided by Grant Bright, W4OJC.

IF Circuit Tap (Model 565)

The 9 MHz IF board schematic (A4 – 81910) for the **Orion (Model 565)** is provided on the web by TEN-TEC. In the upper left of the schematic there is a portion of the signal that is extracted for use in the Orion's 565 sweep circuitry. This portion of the schematic is shown in Figure 1.

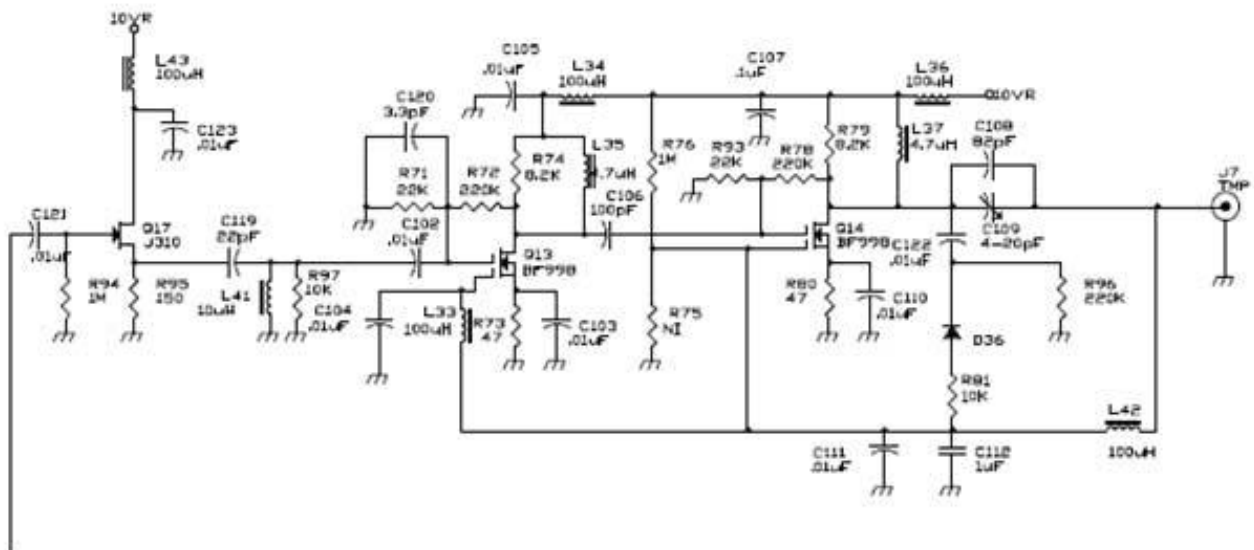


Figure 1: Partial 9 MHz IF schematic for the 565

In the model 565, the JFET (Q17) provides significant isolation from the remainder of the IF circuitry and the output of this FET (across R95 – 150 ohm resistor) seemed a good point to collect the IF signal for a panadapter.

IF Circuit Tap (Model 566)

The 9 MHz IF board schematic (1stIF.pdf) for the **Orion II (Model 566)** is provided on the web by TEN-TEC. In the upper left of the schematic there is a portion of the signal that is extracted for use in the Orion's 566 sweep circuitry. This portion of the schematic is shown in Figure 1A.

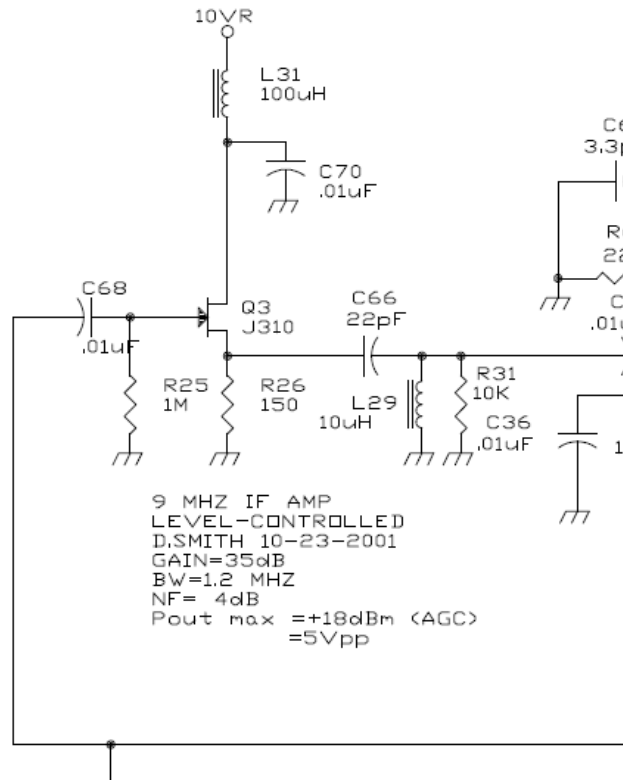


Figure 1A: Partial 9 MHz IF schematic for the 566

In the Model 566, the JFET (Q3) provides significant isolation from the remainder of the IF circuitry and the output of this FET (across R26 – 150 ohm resistor) seemed a good point to collect the IF signal for a panadapter.

Selection of a Buffer Amplifier

Extracting a signal for the panadapter ran the risk of loading down the signal chain for the Orion's existing sweep circuitry. As a result it was obvious that a buffer amplifier was needed. In discussion with Larry Phipps, N8LP, of TelePost Inc. he suggested I look into the buffer amplifier designed by Jack Smith, K8ZOA (SK), of Clifton Laboratories. The Z10000C buffer amplifier seemed like it would do the trick. DXEngineering has acquired Clifton Laboratories and plan to have the buffer amplifier available in December 2017:

<https://www.dxengineering.com/techarticles/dxpressreleases/dx-engineering-acquires-clifton-laboratories>

Prior to K8ZOA becoming a silent key, I purchased a completed amplifier with about 2 feet of RG-178 coax. At Jack's suggestion, I ordered the amp with 0 dB gain. Resistors to raise or lower the gain as needed were included with the completed kit. (The gain setting of 0 dB was an excellent choice for this modification.)

Installation of the Buffer Amplifier in the Orion (565)

For installation in the Orion II (Model 566) please refer to Appendix A (page 9).

The installation of the buffer amplifier requires removal of the top cover from the Orion. In addition, the **9 MHz IF** board (front left) and the **Sweep board** (mounted vertically close to the Sweep board) must be removed (Figure 2).

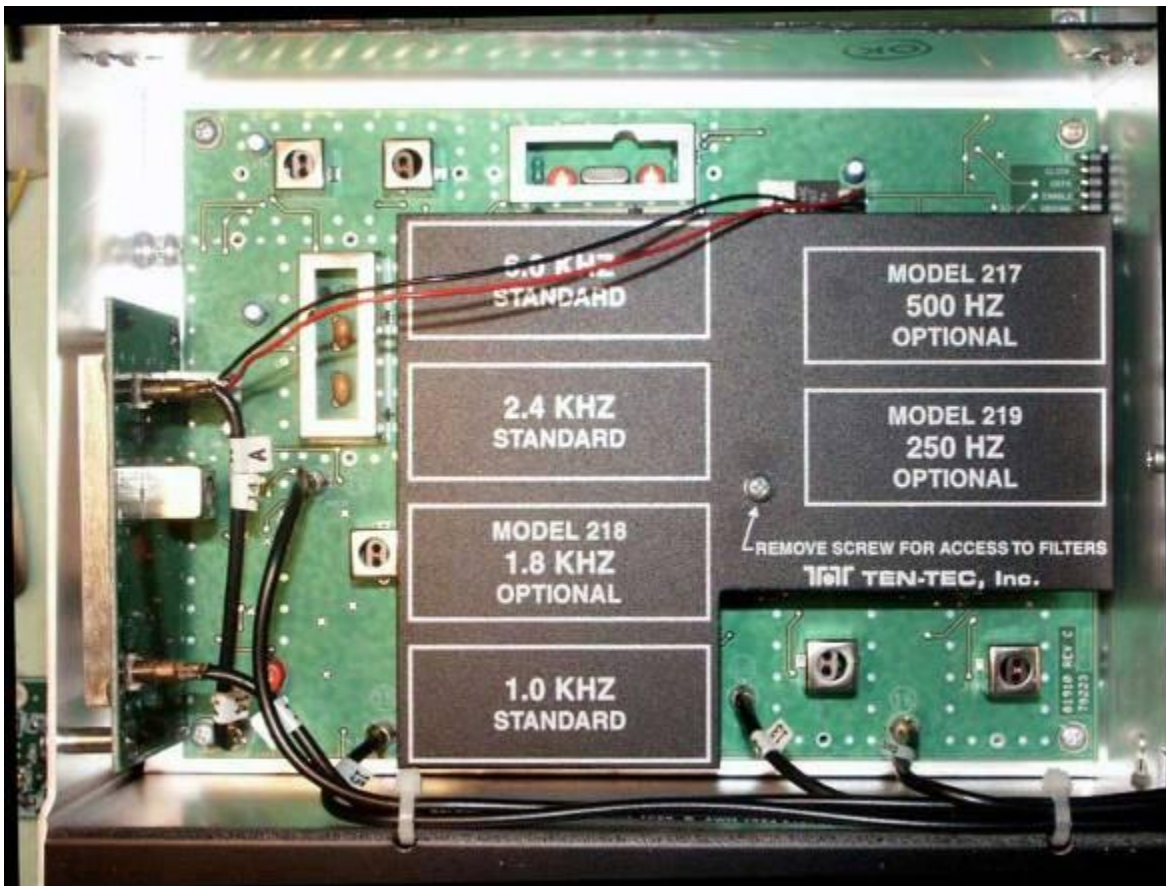


Figure 2: Stock 9 MHz IF board and Sweep Board

1. Unplug the coax cables feeding both the IF and sweep boards. Note the orientation of the **DC power plug** feeding the sweep board and unplug the power plug.
2. Remove the Sweep board by removing the 2 screws in the left hand chassis.
3. Remove the 4 screws at the corners of the IF board.
4. Remove the panel covering the roofing filters.

5. Remove the stud that the roofing filter cover screws to (Figure 3 below).

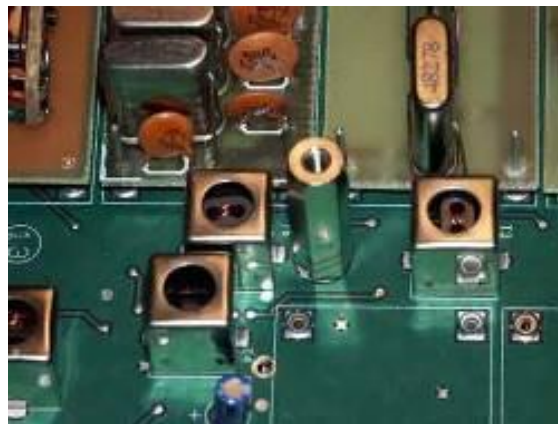


Figure 3: Location of 1/4th Inch Stud

6. Carefully slide the IF board to the left to disengage the multi-pin connector nearest the 500 Hz roofing filter slot.
7. **Note** the area directly below the **RX1IF** and **14** connector jacks on the IF board. This area has a shield covering Q17 and the access point.
8. Remove the shield by unsoldering the tabs at each end and carefully lifting the shield upward. The screw driver tip in Figure 4 shows R95 with the shield removed. **Note:** Some have reported that the shield may be soldered in several places requiring the judicious use of *Solder Wick* to remove.

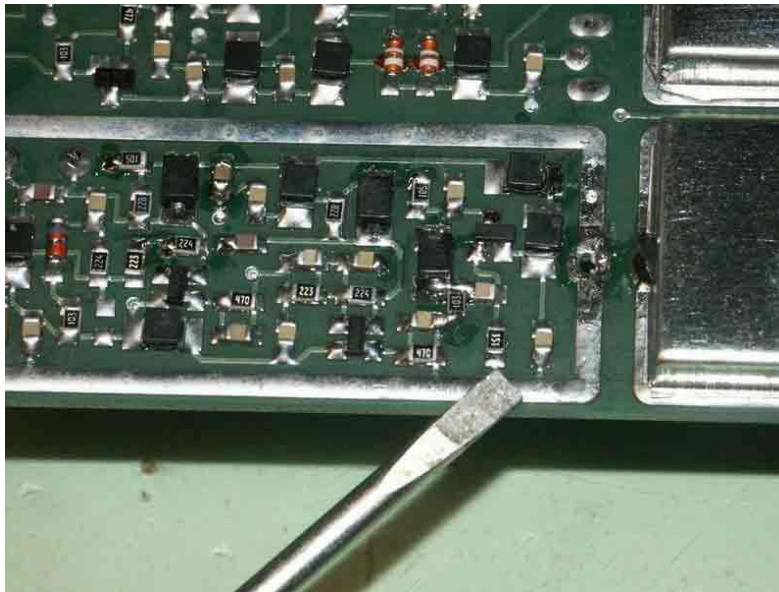


Figure 4: Location of R95

9. Attach a piece of the RG-178 coax across R95 with the coax shield attached to the ground plane (Figure 5 below).

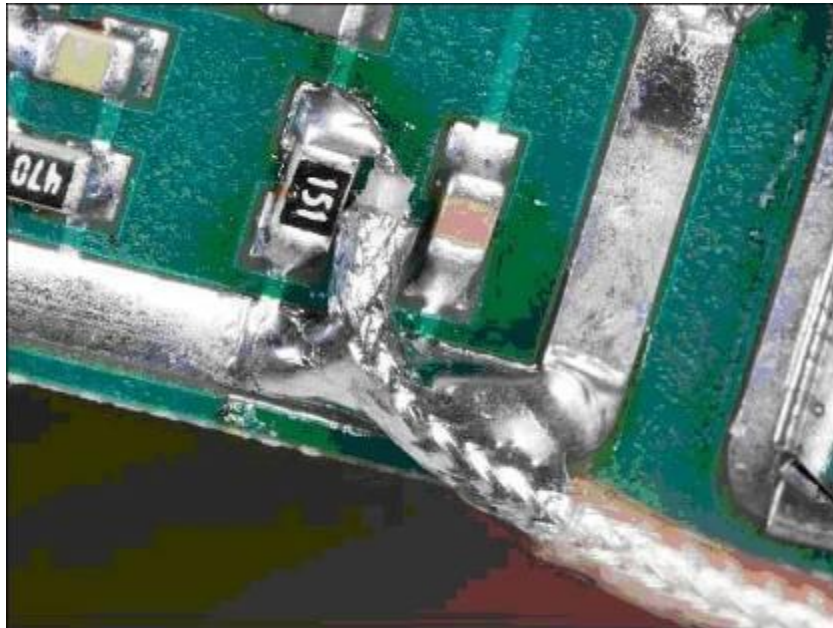


Figure 5: Attachment of RG-178 Coax Cable
(Photo Courtesy of Roberto Barrios, EB4EQA)

10. The bottom edge of the shield must be carefully enlarged to accommodate the RG-178 coax (Figure 6). Reseat the shield and re-solder the two tabs. **(If you are not using an internal buffer amplifier proceed to Step 15.)**

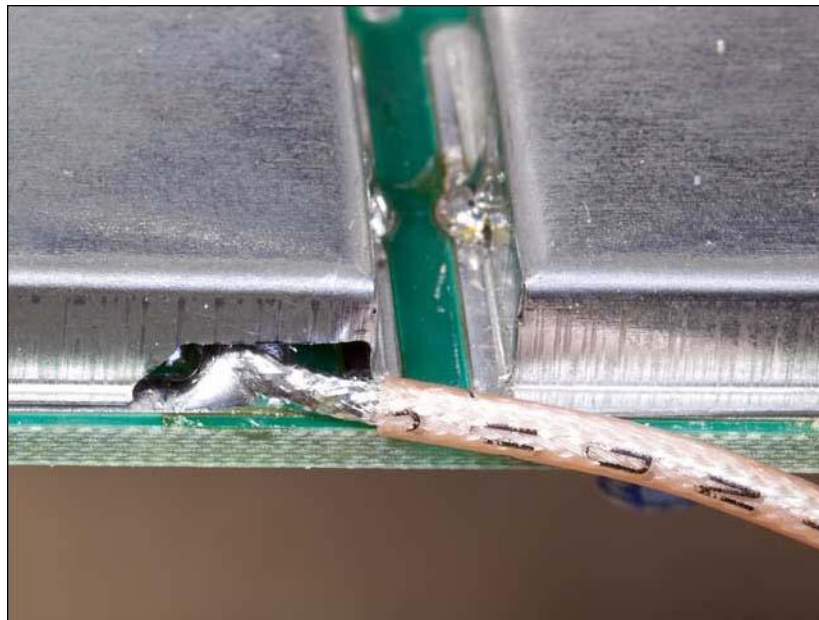


Figure 6: Coax Exiting Shield
(Photo Courtesy of Roberto Barrios, EB4EQA)

11. Route an appropriate length of coax to the input connector on the Z10000 board and attach the RG-178 coax as shown in Figure 7 (below).

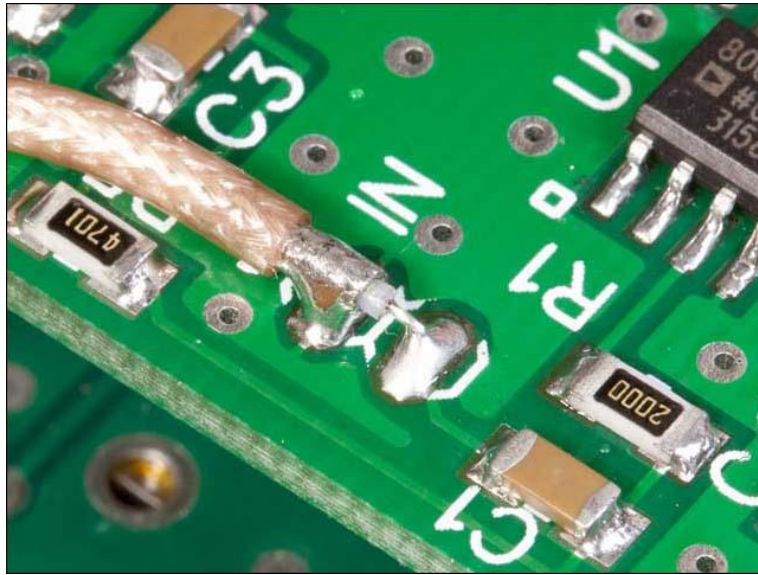


Figure 7: Coax attachment to Z10000 Buffer
(Photo Courtesy of Roberto Barrios, EB4EQA)

12. Reinstall the 9 MHz board and Sweep board. **Do not** install the screw in the upper left corner and do not yet install the roofing filter cover.

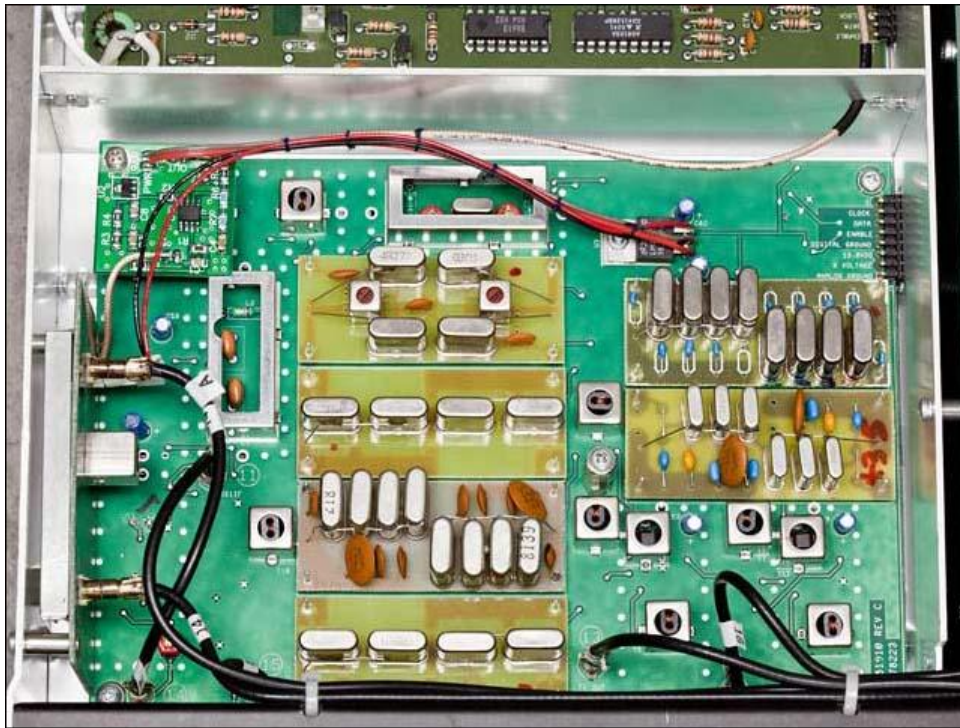


Figure 8: Modified 9 MHz IF board with Z10000 Buffer at upper left
(Photo Courtesy of Roberto Barrios, EB4EQA)

13. Mount the Z10000 buffer with a 1 inch metal stand-off and appropriate longer 4-40 screw in the upper left corner of the 9 MHz IF enclosure (Figure 8).

14. Power for the Z10000 board is found on the 9MHz IF board at the same location as the Orion's sweep amp board. The 13.8 VDC input to 10 VDC voltage regulator attachment is shown in figure 9 and power is taken off the left lead (+) and centre lead (GND).

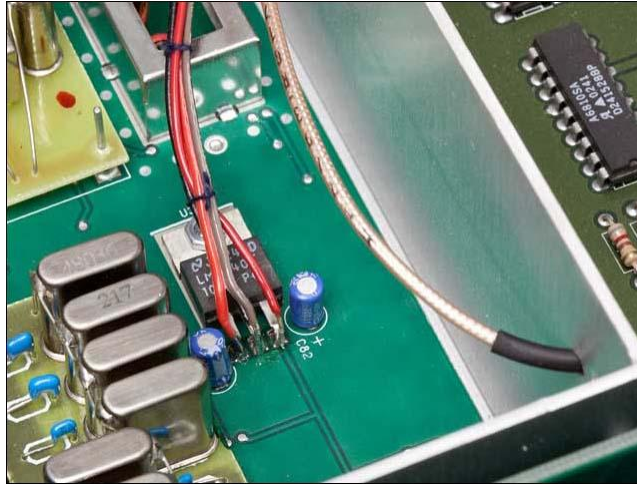


Figure 9: Power Source for Z10000 Buffer
(Photo Courtesy of Roberto Barrios, EB4EQA)

15. The RG-178 coax from R95 or the output of the Z10000 buffer, if installed, was fed through an **existing hole** between the IF board and the Low Pass Filter board (see Figures 8 & 9 above). The cable was run through existing zap straps on the left of the chassis and along the rear of the rig to the **SPARE** connector jack.
16. The coax was soldered to the rear of the mini coax connector labelled SPARE. (In figure 10 below the photo on the left is **looking down** on the internal connector for the **SPARE** jack. The photo on the right is taken from the **rear of the rig**. The buffer output is the small brown RG-178 cable coming in from above the **Band Data 1** jack.)



Figure 10: Spare jack connection
(Photo at Right Courtesy of Roberto Barrios, EB4EQA)

After reinstalling the top of the rig the only remaining thing is to label the **Spare** jack (Figure 11).



Figure 11: Rear Connector on Orion 565

Note: Since the output coax goes through a hole in the bulkhead between two major boards, I added a 0.1 inch header and appropriate connectors for the output coax to the Z10000 board. This will enable me to remove the 9 MHz IF board and Z10000 board without unsoldering the coax at the rear of the Orion.

Testing

There are several methods to test the IF board output. One of the simplest is to use a calibrated signal source and a second receiver.

I used an Elecraft KG1 50 μ V and 1 μ V calibrated source. With my Orion on 7.040 MHz and connected to the 50 μ V input of the KG-1, I connected the 9 MHz IF output to my TEN-TEC Argonaut V. With the Argonaut on 9.000 MHz an S-9 signal on the Orion created a near S-9 signal on the Argonaut. Success!

Since originally drafting this document I have successfully used the 9 MHz IF output with an LP-PAN panadapter from N8LP:

<http://www.telepostinc.com/>

Acknowledgements

Thanks to Jack Smith (K8ZOA), Larry Phipps (N8LP) and Joe Young (VE7BFB) for their assistance. Thanks also to Grant Bright (W4OJC) for helping with the section on installation in the Orion II (Model 566) and Roberto Barrios (EB4EQA) for additional [detailed photos](#).

Original document prepared June 2008
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Appendix A added August 2008

Appendix A

Installation of the 9 MHz Modification in the Orion II (Model 566)

NOTE: I do not own an Orion II (Model 566) and some of the photos and descriptions that follow have been provided by others. Any additional photos or comments that might improve this document are welcome.

Installation of the Buffer Amplifier in the Orion (566)

The installation of the buffer amplifier requires removal of the top cover from the Orion. In addition, the **9 MHz IF** board (front left) and the **Sweep board** (mounted vertically close to the Sweep board) must be removed (Figure A-1).

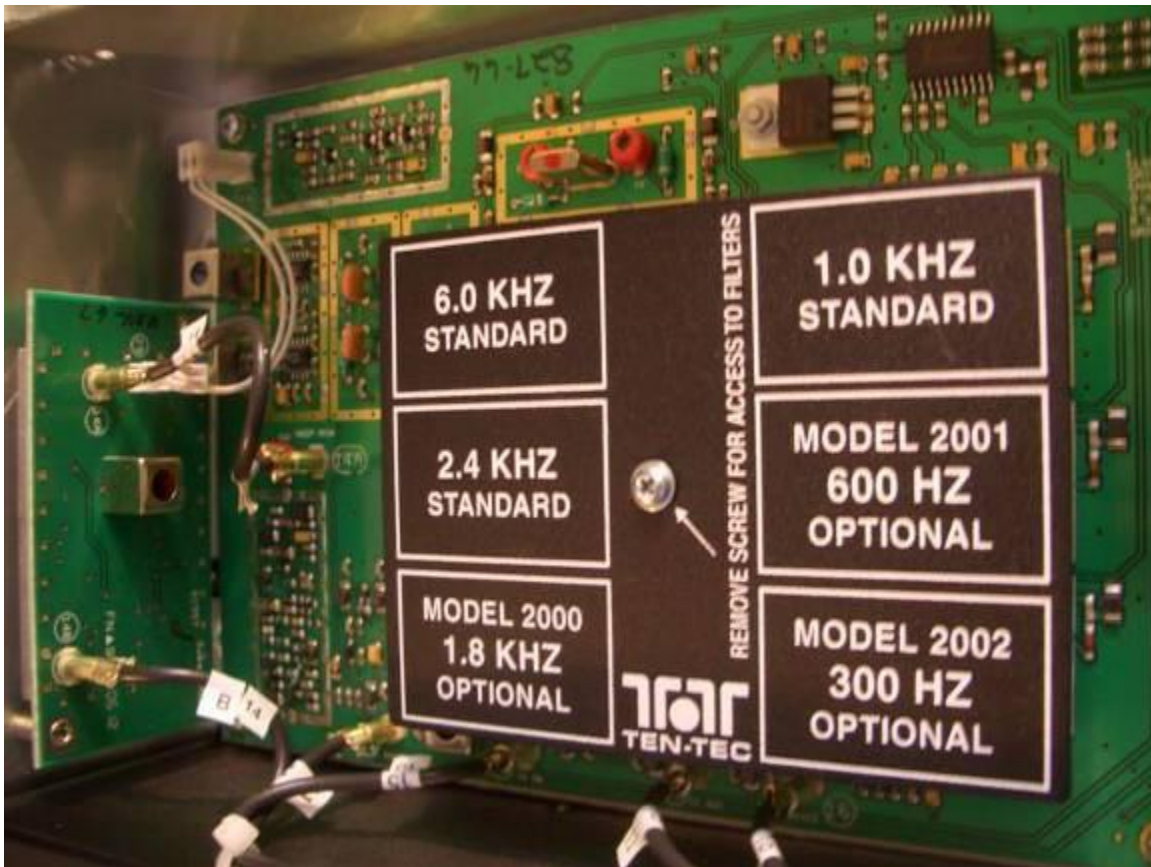


Figure A-1: Stock 9 MHz IF board and Sweep Board
(Photo Courtesy of Grant Bright, W4OJC)

1. Unplug the coax cables feeding both the IF and sweep boards. Note the orientation of the **DC power plug** feeding the sweep board and unplug the power plug.
2. Remove the Sweep board by removing the 2 screws in the left hand chassis.

3. Remove the 4 screws at the corners of the IF board.
4. Remove the panel covering the roofing filters.
5. Remove the stud that the roofing filter cover screws to.
6. Carefully slide the IF board to the left to disengage the multi-pin connector nearest the 1.0 kHz roofing filter slot.
7. **Note** the rectangular area directly between the **14A** connector jack and the front edge of the IF board (immediately to the left of the 1.8 kHz roofing filter). The pointer tip in Figure A-2 shows R26.

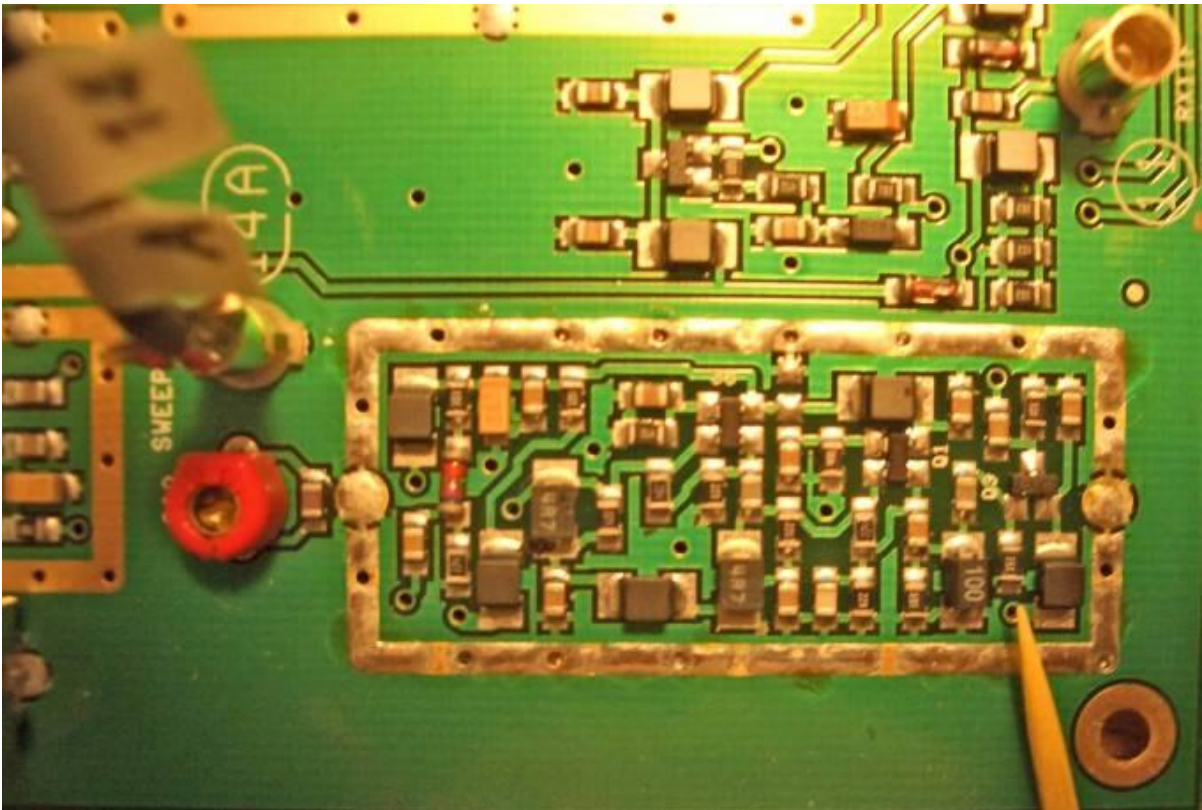


Figure A-2: Location of R26
(Photo Courtesy of Grant Bright, W4OJC)

8. Attach a piece of the RG-178 coax across R26 with the coax shield attached to the ground plane (the ground plane is the end nearest the pointer in Figure A-2.). (**If you are not using an internal buffer amplifier go to step 14.**)
9. Route an appropriate length of coax to the input connector on the Z10000 board. (The final mounting of the Z10000 board can be seen in the following figure.)
10. Reinstall the 9 MHz board and Sweep board. **Do not** install the screw in the lower left corner and do not yet install the roofing filter cover.

11. Mount the Z10000 buffer with a 1 inch metal stand-off and appropriate longer 4-40 screw in the lower left corner of the 9 MHz IF enclosure (Figure A-3 below).



Figure A-3: Modified 9 MHz IF board with Z10000 Buffer at lower left
(Photo Courtesy of Grant Bright, W4OJC)

12. The necessary 13.8 VDC power can be obtained at the edge connector in the upper right of Figure A-3. When the DC power connection is completed replace the filter cover.
13. Solder a piece of RG-178 coax from the output of the Z10000 buffer and route it through an existing wiring harness at the front of the rig and then down the centre to the rear Orion (see Figure A-3 above) to the **SPARE** connector jack.
14. The RG-178 coax from R26 or the output of the Z10000 buffer, if installed, was fed through an **existing hole** between the IF board and the Low Pass Filter board (see Figures 8 & 9 above). The cable was run through existing zap straps on the left of the chassis and along the rear of the rig to the **SPARE** connector jack. The buffer output is the small brown RG-178 cable coming in from above the **Band Data 1** jack.)

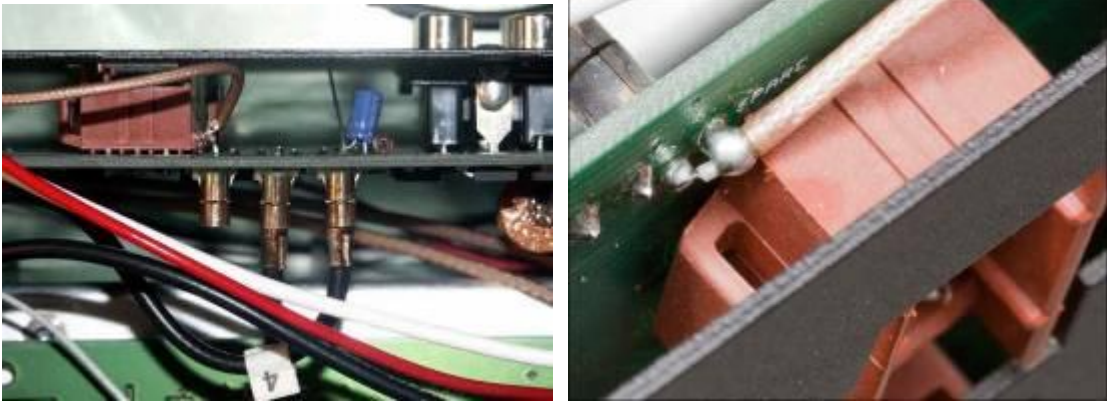


Figure A-4: Spare jack connection
(Photo at right Courtesy of Roberto Barrios, EB4EQA)

15. After reinstalling the top of the rig the only remaining thing is to label the **Spare** jack (Figure A-5).



Figure A-5: Rear Connector on Orion 566

Testing

Please return to page 8.