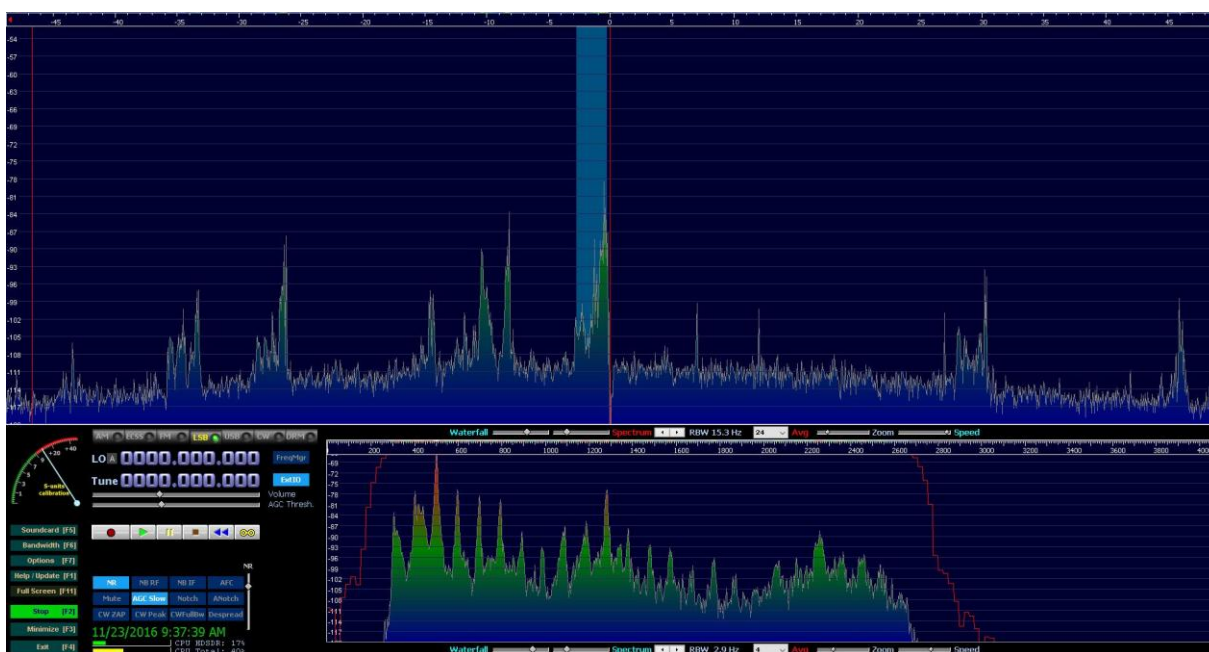


Atlas 210X/215X Transceivers Panadapter Install

Includes the LE Model

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M. PAT 6M SCHEMATIC 20

N. 210X IF TAP POINT 20

I. OVERVIEW

Since the early 1930's, ham radio operators have been using receiver add-on boxes so that would allow them to see a visual display of RF signals across a given band. This add-on box is called a panadapter, which is short for panoramic adapter. The early panadapters used CRTs for the display. Today's units use LCD screens on either a standalone box or on a PC. Prices range from a low of around \$30 for the eBay RTL units to a high of \$700+ for the Elecraft P3 standalone box.

The panadapter's vertical axis of the display shows signal strength amplitude and the horizontal axis shows the frequency, with the center of the display being the frequency that the receiver is tuned to. At a single glance, one could instantly see all the signals across a segment of a band. This mostly eliminated the need for manually tuning the receiver frequency across the band in small frequency increments, in search of signals.

A panadapter can be used as a separate receiver, using either common antenna or it can be connected to an IF tap point within the receiver. This article discusses the installation of a panadapter at an IF tap point on the first IF of an Atlas 210X/215X transceiver.

A. Audience

This document is written for amateur radio operators that want to install a panadapter in their Atlas radio. This project is low in cost and only requires minimal modification to the radio. The radio can easily be returned to the previous state if one wishes to remove the panadapter option at a later date.

B. Objectives

This document was written with the following objectives:

Provide an IF Output jack on the rear of the radio so that an external panadapter can be connected

The IF tap should work with the 5520 KHz and the 5645 KHz IF of the receiver

Use a prepackaged panadapter device that does not require a PC sound card

Use a panadapter device that can be used as a standalone receiver

Use freeware software for the panadapter display

II. Engineering Considerations

There are a number of different ways to implement a panadapter on an Atlas radio. This design is divided into two separate areas – the IF tap point in the receiver and the device used to convert the IF signals into visual signals on a LCD display.

A. General Considerations

The implementation requires a minimal amount of modification to the radio and is moderate in cost. The most expensive part is the SDRPlay RSP1 receiver. The cost of this unit is about \$130 new and used ones can be found on the ham classified forums for around \$100.

The key objective for the selected IF tap point is to insure that there is no degradation of the received/transmitted signal. Another important consideration is to obtain maximum displayed bandwidth. This implementation places the IF tap point on the output of the PC-120 1st IF amplifier. This tap point provides a flat display response of about 80 KHz and a usable bandwidth of about 200+ KHz. The bandwidth is limited by the bandwidth of the L124 IF transformer.

There is limited space on the rear panel of the Atlas radio to install a female SMA jack. Installing a jack on the rear panel would require drilling a hole in the panel. The area between the antenna jack and the key jack would have enough space for a bulkhead mount SMA jack. The IF tap coax cable is brought out through the center hole of the J6 Auxiliary socket. This prevents plugging a connector into the J6 socket, but I never use that socket.

The G4HUP PAT-6M amplifier board provides a high degree of isolation between the output of the 1st IF amp and the attached SDRPlay receiver. The overall gain of the amp is about 1 db. The RF signal fed into the SDRPlay receiver should be at the same level as the signal being fed into the antenna jack of the radio.

A total of 33 db of attenuation is needed between the output of the PAT amp and the input of the SDRPlay receiver. Ten db of attenuation is installed on the PAT board. External attenuation of about 20 db needs to be installed. Mini Circuit 20 db SMA attenuators can be found on eBay for about \$10 to \$15. G4HUP has designed the board to take up to a -20 dbm input signal with no overload.

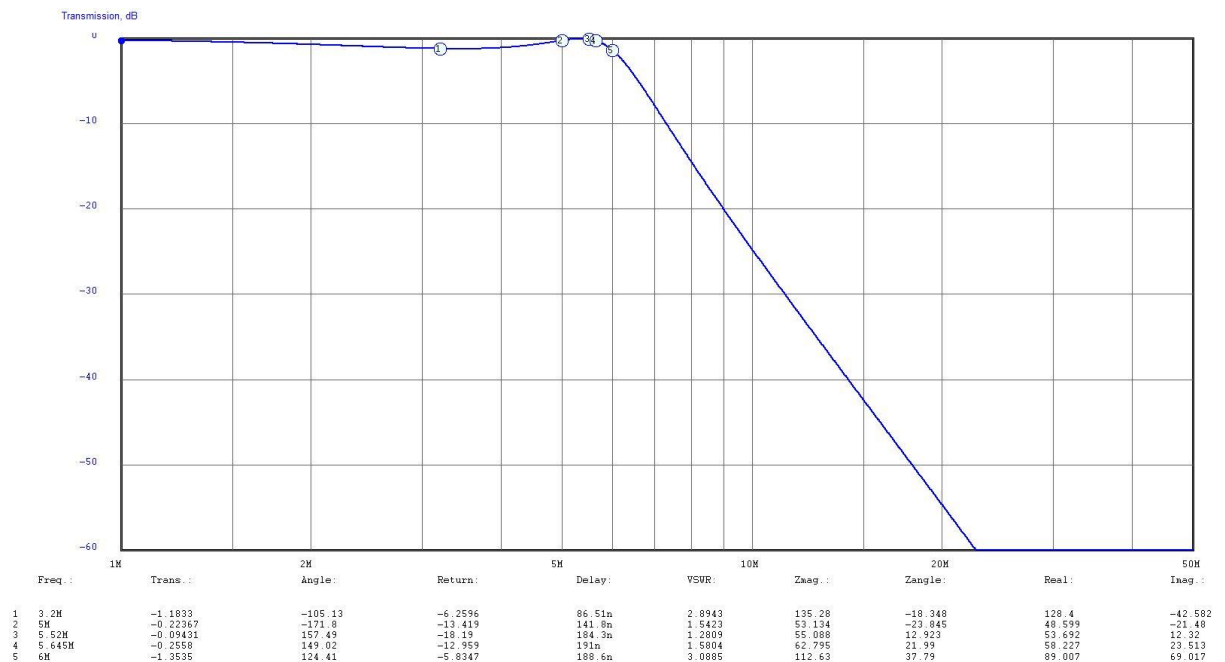
There are several different SDR apps that can be used with the SDRPlay hardware. SDR Console and SDR Uno have some interesting features. However, the HSDR software seemed to be less prone to overloading at high received signal levels.

B. Location of PAT Board

There are a number of locations in the Atlas radio for installing the PAT board. The easiest accessible location is the bottom on the chassis next to the PC-120 edge card socket. This location would require a long coax cable to go from the 1st IF Amp collector to the input of the board. By locating the board on the foil side of the PC-120 board, then the input cable wire is about 1" long.

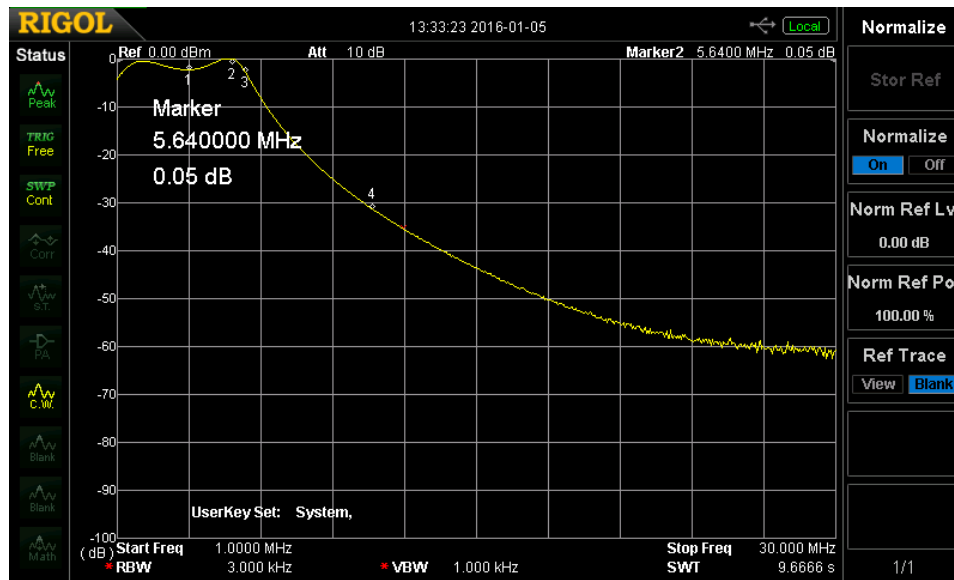
C. Elsie PAT 6M Low Pass Filter Simulation

The PAT 6M board has a low pass filter cutoff of 6 MHz for use with an Elecraft transceiver. The cut off frequency works very well with an Atlas radio. Here is an Elsie simulation of the filter:



D. PAT 6M Low Pass Filter

Here is the measured curve using a Rigol DSA 815 spectrum analyzer:



III. Installation

Here are the installation steps for installing a SDRPlay receiver as a panadapter on an Atlas transceiver:

A. Procure Parts

Purchase PAT 6M amplifier board

The board is available in kit form or pre-assembled

<http://huprf.com/huprf/orders-prices/#PAT>

Here are some good articles on the design and operation of the PAT boards

<http://huprf.com/huprf/wp-content/uploads/2016/03/PAT-Radcom-14.pdf>

<http://g4hup.com/PAT%20V2%20description.pdf>

<http://g4hup.com/PAT.htm>

10 db SMD resistors

Attenuator calculator:

<http://chemandy.com/calculators/matching-pi-attenuator-calculator.htm>

20 db MCL SMA attenuator

<https://www.minicircuits.com/pdfs/VAT-20+.pdf>

Small diameter Teflon coax cable terminated on one end with a female SMA jack

<http://www.ebay.com/itm/Pigtail-SMA-female-SMA-jack-bulkhead-RG316-LOW-LOSS-COAX-RF-Cable-4-24-/162181071026?var=&hash=item6b5eef2918>

Double-backed tape

SDRPlay RSP1 receiver

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

SDRPlay drivers

<http://www.sdrplay.com/windows.html>

HDSDR software

<http://www.hdsdr.de/>

It is recommended that you use the 2.70 version

B. Install parts and software

Assemble the PAT board if purchased as a kit

Install the 10 db pad resistors on the board

Install the PAT board on the foil side of the Atlas PC-120 board with double back tape

Install a short wire from the PC-120 Q125 collector pad to the input to the PAT board

Install a short ground wire from the PAT board ground plane to the PC-120 ground plane

Install a short coax cable from output pad on the PAT board to Pin 9 on the PC-120 board

Feed a female SMA terminated coax cable through the center hole on the J6 Aux socket

Terminate the other end of the coax cable on pin 9 of the PC-120 edge card connector

Steps for installing the software:

<https://www.dropbox.com/sh/7434avup8mrkzti/AAADNCEM9p6XDoVh-tjoKxTHa?dl=0&preview=RSPHSDR.pdf>

Download and install HDSDR software on your PC

<http://www.hdsdr.de/>

Download and install SDRPlay drivers on your PC

<http://www.sdrplay.com/downloads/>

Help Info for configuring HDSDR software

<https://sites.google.com/site/g4zfqradio/installing-and-using-hdsdr/>

<http://www.sdrplay.com/Panadapterintro1.pdf>

HFSDR FAQs

<http://www.hdsdr.de/faq.html>

It is recommended that you use the “start here” tab on the SDRPlay Web site.

IV. Calibration & Adjustment

There are seven major calibration and adjustment areas on the HDSDR application:

A. Frequency Calibration

Tune in a strong WWV signal on the Atlas radio

Adjust for equal volume levels from your PC (SDRPlay signal) and the Atlas radio

Adjust the Tune setting on the HDSDR screen for zero beat between the two audio signals

Here is a typical Frequency Calibration screen:



B. Input Channel Calibration for RX

This calibration should follow the standard HDSDR instructions.

Here is a typical calibration screen

Channel Adjustment Panel (RX)

Raw Fine **1 to 4 samples delay** **RX DC Removal** Mode: Bandwidth

Left: 0 + Right: 0 + Left: 0.0007719 Right: -0.0003884 100 [Hz]

Some sound cards exhibit the annoying problem of a phase and amplitude skew between channels, i.e. samples digitized with one channel are delivered to software sooner or later than those processed by the other channel and also with some amplitude unbalance. This plays havoc with a program like HDSDR, that needs a precise phase and amplitude relationship between the I and Q channels, when working in I/Q mode.

To compensate for this skew, please feed an I/Q strong, steady carrier, offset by approximately +10 kHz from the band center, and observe an image response at -10 kHz.

By using the Amplitude and Phase (raw and fine) sliders, slowly try to minimize this image response. The controls interact somewhat, so you will have to repeat two or three times the adjustment. You should be able to get 70 dB of difference between the desired and the image signals. Move the sliders very slowly. When done, click on the OK button. The settings will be remembered from session to session.

Raw Phase: 0.229 Deg

Fine

Amplitude: 0.78333

C. HDSDR Soundcard Configuration

Default settings are used

Sound Card selection

RX Input (from Radio)

No input soundcard device available

TX Input (from Microphone)

No input soundcard device available

RX Output (to Speaker)

Remote Audio

TX Output (to Radio)

Remote Audio

D. HDSDR RF Front-End + Calibration Configuration

SDR hardware coupling

☐ SDR hardware connected to antenna (default)
☒ SDR on IF output, which is controlled manually

Sync Mode
☐ Full sync in both directions
☐ Independent Tune in HDSDR
☒ Independent Tune, but sync on external change

IF-frequency: 5645000 [Hz] Global Offset: 0 [Hz]

Additional Offset per Mode in Hz

AM	FM	LSB	USB	CW_U	CW_L	DIG_U	DIG_L
0	0	0	0	0	0	0	0

☒ Mirror RF Spectrum in general
☐ Mirror RF Spectrum for Tune >= 15 kHz
☐ operate CW in lower sideband (LSB)
☐ Swap CW and CWR for Omni-Rig

☐ SDR hardware on Down/Up-Converter
 LO Frequency of Down/Up-Converter in Hz: 120000000

☐ SDR hardware in undersampling mode
 Samplerate of Analog-Digital Converter in Hz: 80000000

Apply

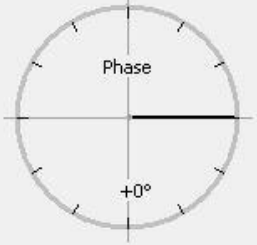
LO frequency calibration

Current Tune Frequency [Hz] 0.00 Correct Tune Frequency [Hz] 0

Reset Calculate

Frequency correction: **+4.95 ppm**

Hint: Tune to a station with known frequency as reference, e.g. a WWV or RWM time signal. Use ECSS mode with AFC to automatically tune the reference carrier exactly. Use highest possible frequency for best calibration results.



E. S Meter Calibration

Input a -73 dbm signal into the antenna jack of the Atlas radio

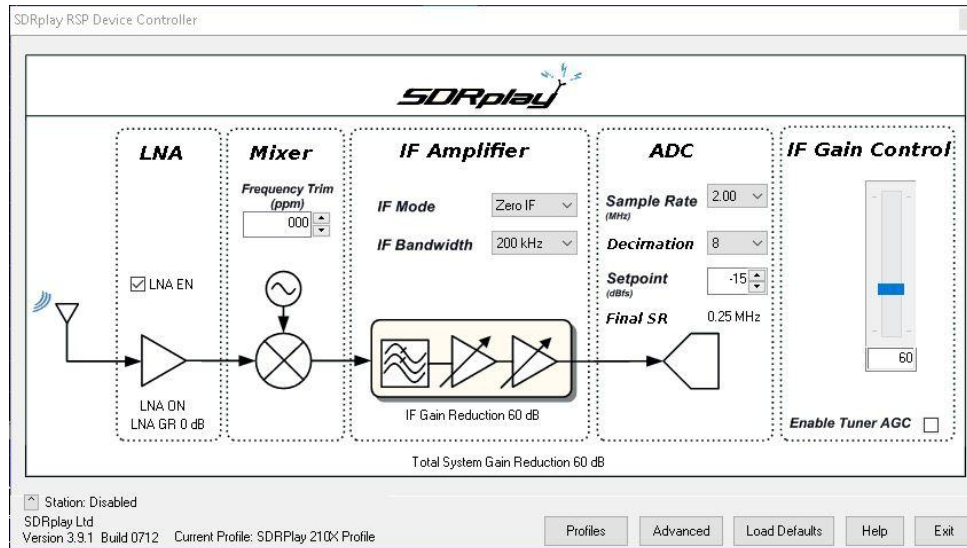
Select the S Meter Calibration option and adjust the HDSDR signal on the dbm chart for -73 dbm

Here are typical readings that you should see for various signal generator levels:

Signal Generator Level	HDSDR S- Meter	HDSDR dbm Level	210X LE S-Meter
-120 dbm	S4	-119 dbm	S0
-110 dbm	S5	-110 dbm	S0.5
-100 dbm	S6	-100 dbm	S3
-90 dbm	S7.5	-90 dbm	S6.5
-80 dbm	S9	-80 dbm	S8
-70 dbm	S9 +10	-70 dbm	S9 +1
-60 dbm	S9 +20	-60 dbm	S9 +10
-50 dbm	S9 +30	-50 dbm	S9 +20
-40 dbm	S9 +39	-41 dbm	S9 +30
-30 dbm	S9 +42	-36 dbm	S9 +40
-20 dbm	S9 +43	-34 dbm	S9 +50

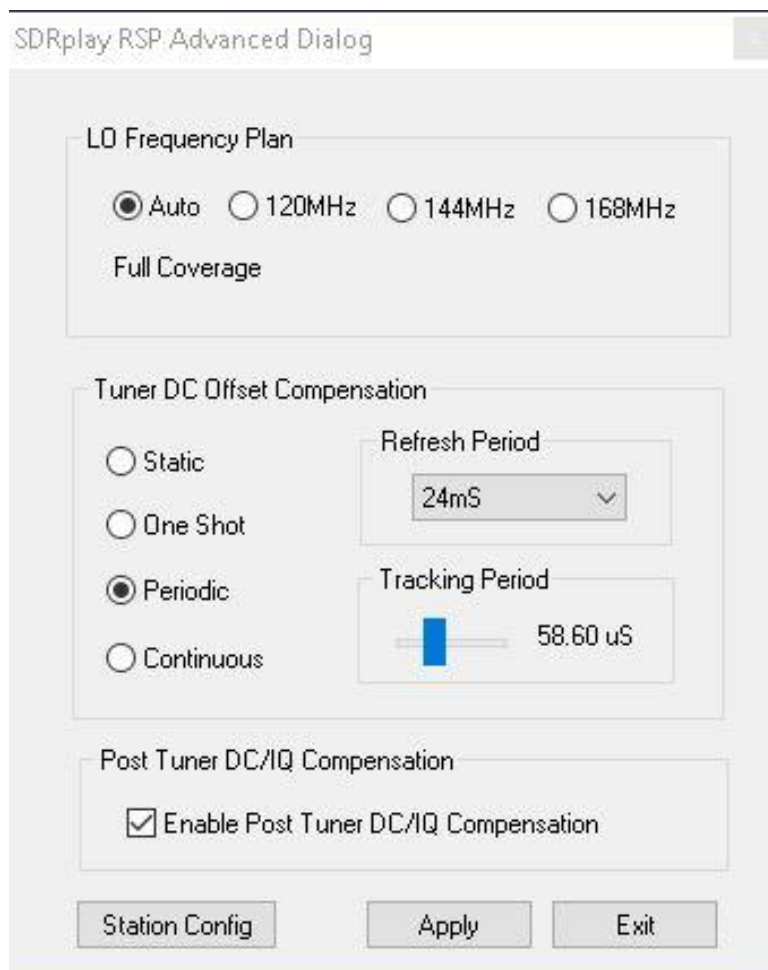
F. SDRPlay RSP1 Basic Configuration

The SDRPlay RSP1 configuration option is found under the HDSDR ExtIO option.



G. SDRPlay RSP1 Advanced Configuration

Default settings are used.



V. **Operation**

Here are some detailed instructions for using the SDRPlay receiver with HSDR:

http://sdrplay.com/docs/Using_HSDR_with_SDRplay_Module_R2P4%20.pdf

A. **Non-tracking of VFOs**

Once the HSDR app is configured with the initial settings, then you are ready to start testing. There is no computer interface between the Atlas radio and the PC that runs the HSDR software. Thus, the VFOs in the SDRPlay receiver and the Atlas radio do not automatically track to each other. By setting the LO and TUNE frequencies to 0.00, then the center of the display will be the frequency that you are tuned to on the Atlas receiver. As you change the frequency of the Atlas receiver, the panadapter display will remain centered on your receiver frequency.

B. **Displayed Bandwidth**

At any given time, you can see signals above and below your received frequency. The displayed bandwidth is controlled by the slider bar to the left of the Zoom control for the main display. At maximum zoom, a total bandwidth of 240 KHz will be displayed. At this bandwidth, the display baseline noise amplitude will drop off on either side of the center frequency. This is the result of the narrow bandwidth of the 1st IF amplifier.

Please note that there are two options for the LO control – A and B. Additional functionality can be obtained by making use of both VFOs. The display on the front page of the doc has been configured to remove the waterfall display. Please see the Appendix for a snapshot with the Waterfall option enabled.

C. **Quirks**

There are some quirks in the operation of panadapter. This is a result of the SDRPlay not being under the control of the Atlas radio.

Atlas radios use high side LO injection on 80M/40M and low side injection for 20M/15M/10M. For the 80M/40M bands, you will need to set the mode to LSB and enable the HSDR option for “Swap I and Q channel for RX Input”. When you change to the 20M/15M/10M bands, USB stations will be readable without changing HSDR to the USB mode. The panadapter display will show the signal to the left of the centerline frequency. Also, the highest frequency on the display will be on the left hand side of the display and the lowest frequency will be on the right hand side of the display.

To get the correct responses on 20M/15M/10M, please perform the following changes:
Switch to the USB mode on the HSDR screen
Disable the option “Swap I and Q channel for RX Input”.

D. **Frequency Manager**

If you use the Frequency Manager option on HSDR, you can program up the desired center frequency for each band, along with the desired mode. In the Frequency Manager mode, the display frequencies remain fixed and signals will move across the display as you change the frequency of you Atlas radio. In this mode, the display centerline frequency will only be correct when the Atlas radio is tuned to the same frequency.

In this mode, you can also use the SDRPlay as a second receiver and the frequency can be changed with the HSDR Tune control. The received frequency will move up and down the band according to the Tune frequency that you dial in.

The recommended mode is to not use the Frequency manager and keep the LO and Tune frequencies at 000.000.000 MHz on each band.

VI. Windows Tablet For Display

There are a number of inexpensive Windows tablets that can be used to run the HSDR application. Most of these tablets only have 1 GB of memory, but this is enough to run the app. These tablets also have enough CPU horsepower to provide quick updates to the display. Using a tablet eliminates the need to tie up your main computer for running HSDR or having to install a second computer.

For my setup, I am using a HP Stream 7 5709. This tablet has 1 GB of memory, has a 7" display, and comes standard with Windows 8.1. I am using Windows 10 Home because the previous owner had upgraded to this version of OS while it was still free from Microsoft. Windows 8.1 should also work OK, but I have not tested it. These HP tablets are readily available on eBay for about \$60.

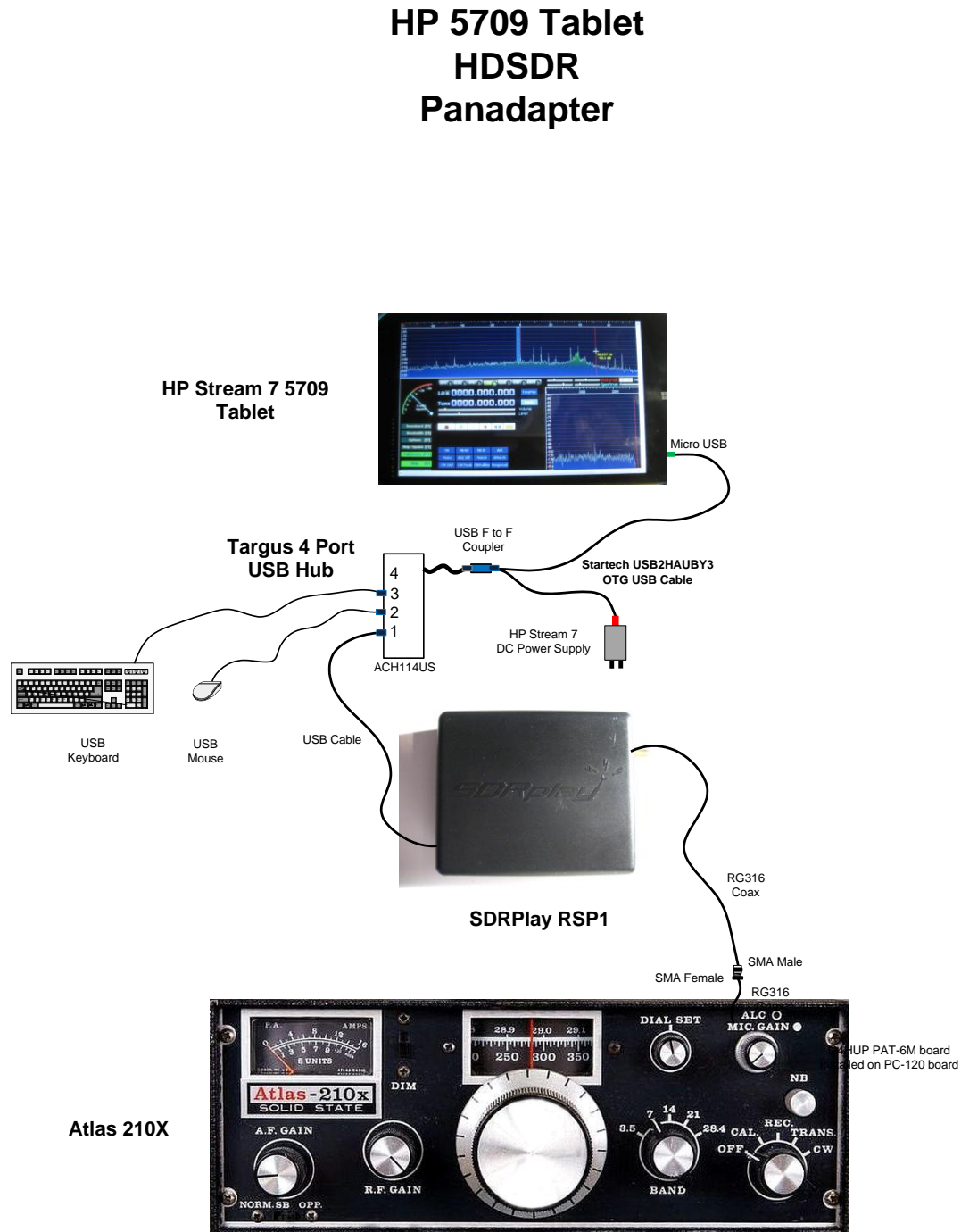
Another possibility is the Dell Venue 8 Pro 5855. This tablet has a 8" display, has 2 GB of memory, and comes with Windows 10. These tablets can be picked up as factory refurbished for less than \$200.

Here is a picture of the HP tablet sitting on top of my Atlas 210X LE radio:



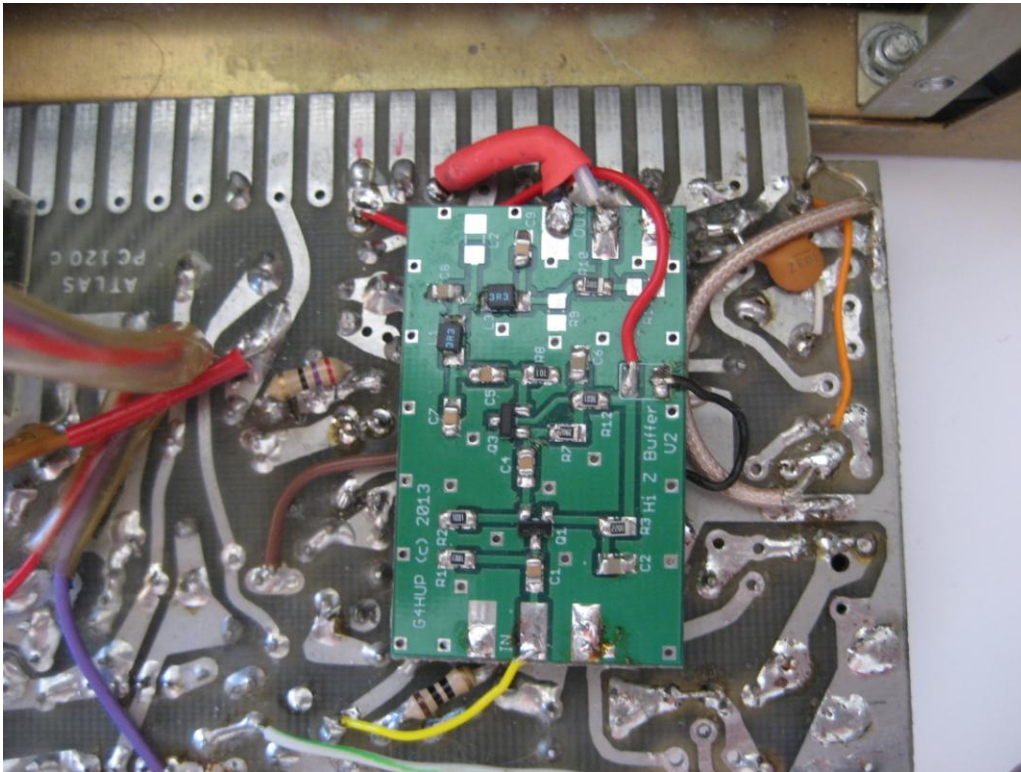
A. Block Diagram

Here is a block diagram of the panadapter setup using a HP tablet:

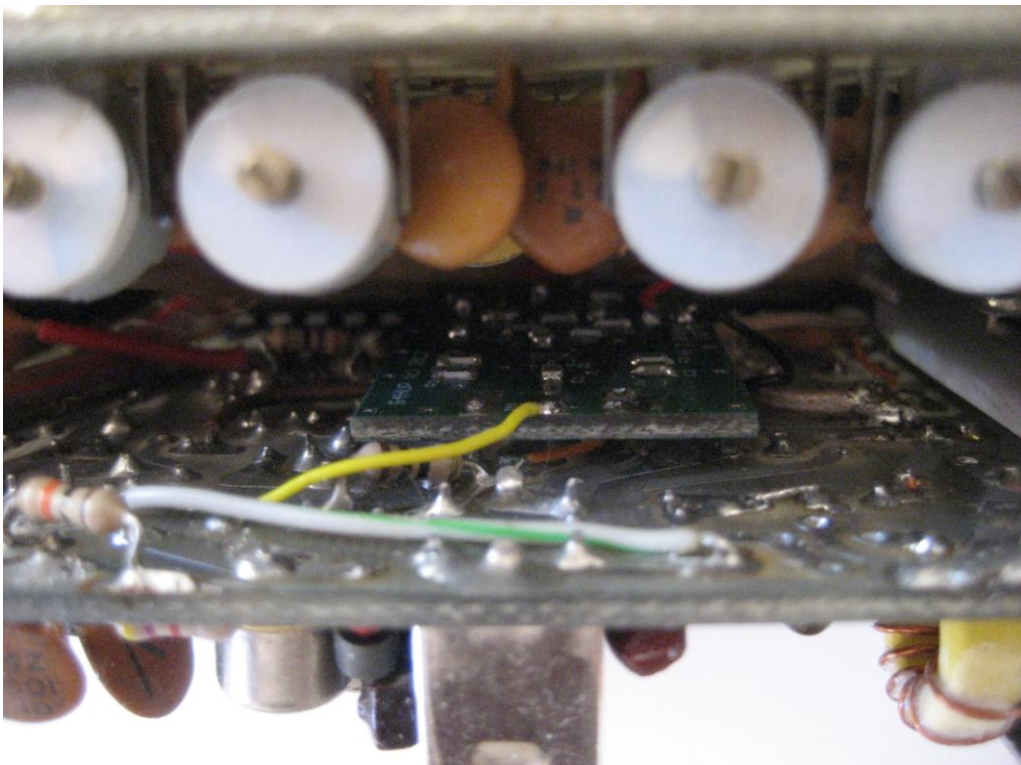


VII. Appendix

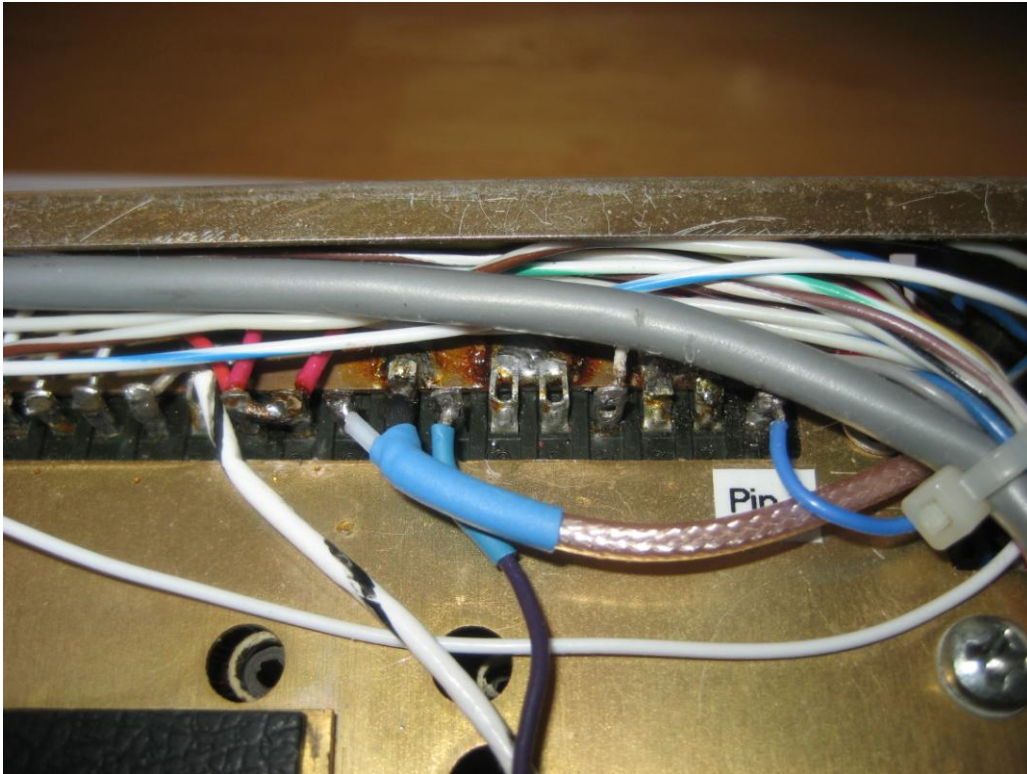
A. PAT 6M board installed on Atlas PC-120 board



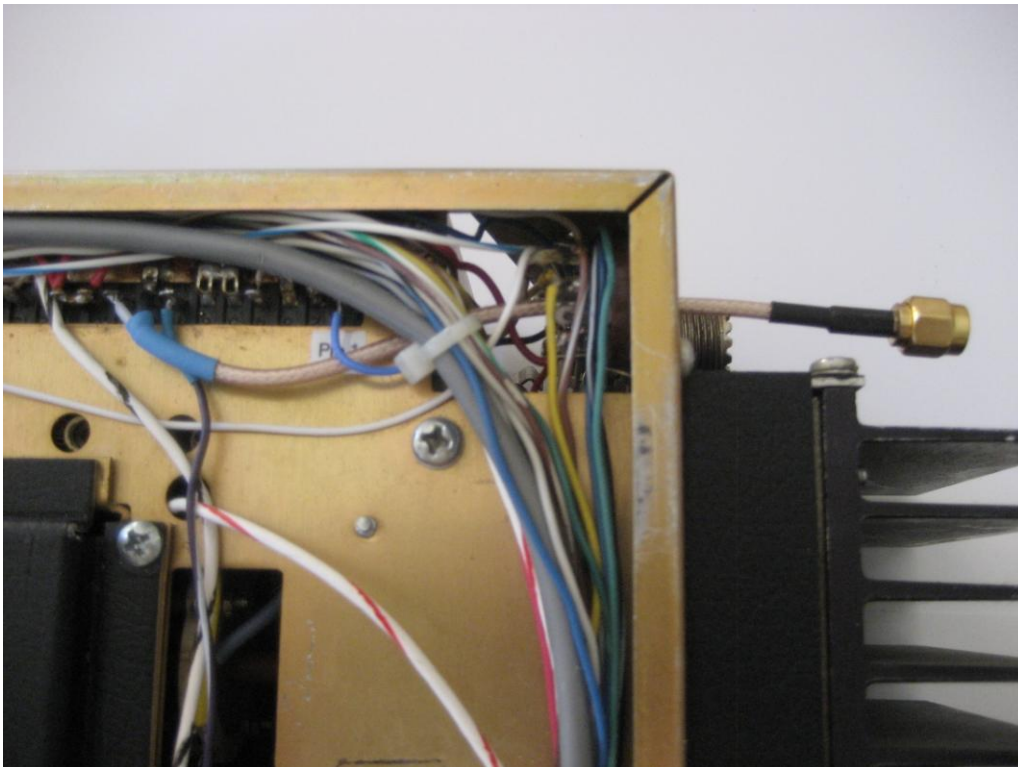
B. Top View Showing PAT board on PC-120 Board



C. PAT 6M board interface cable to PC-120 Edge Card Connector



D. IF Tap Interface Cable fed through J6 Aux socket



- E. IF Tap Interface Cable with SMA Jack**
Shown with male SMA – female SMA is preferred

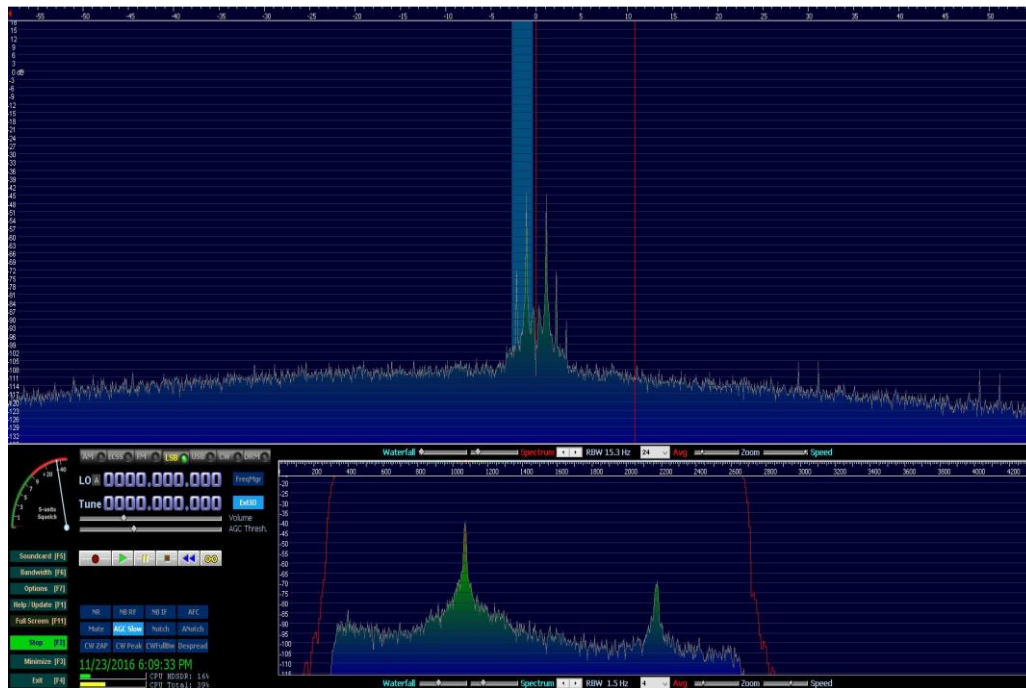


- F. Potential Location for installing bulkhead mount SMA jack**

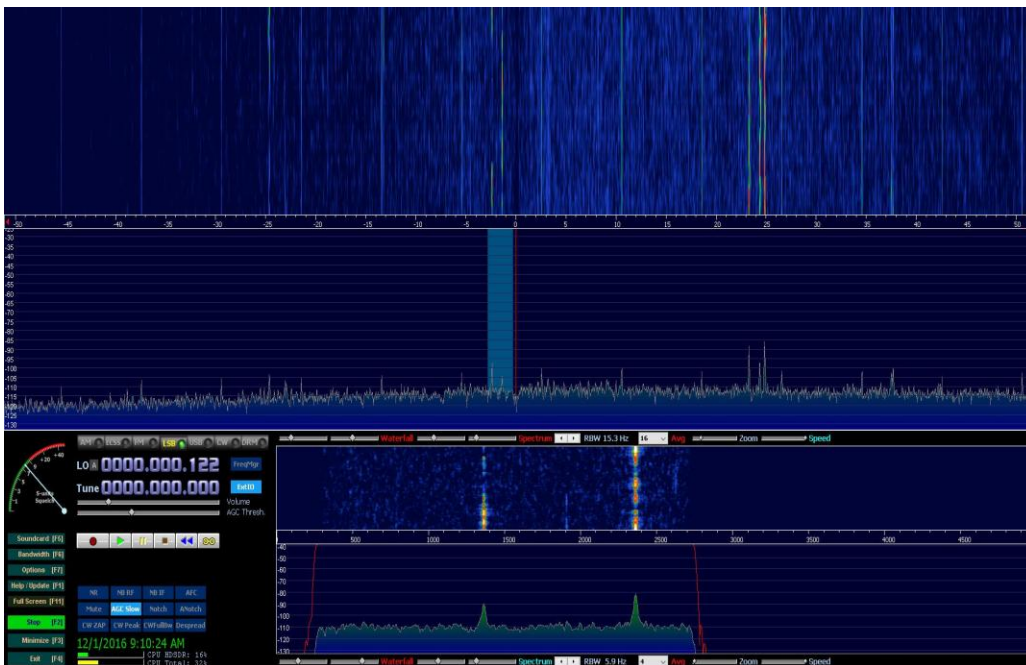


G. Signal Display In TX Mode

This is a display of the double sideband transmit signal when in the transmit mode while whistling into the microphone.



H. Waterfall Display with CW Signals

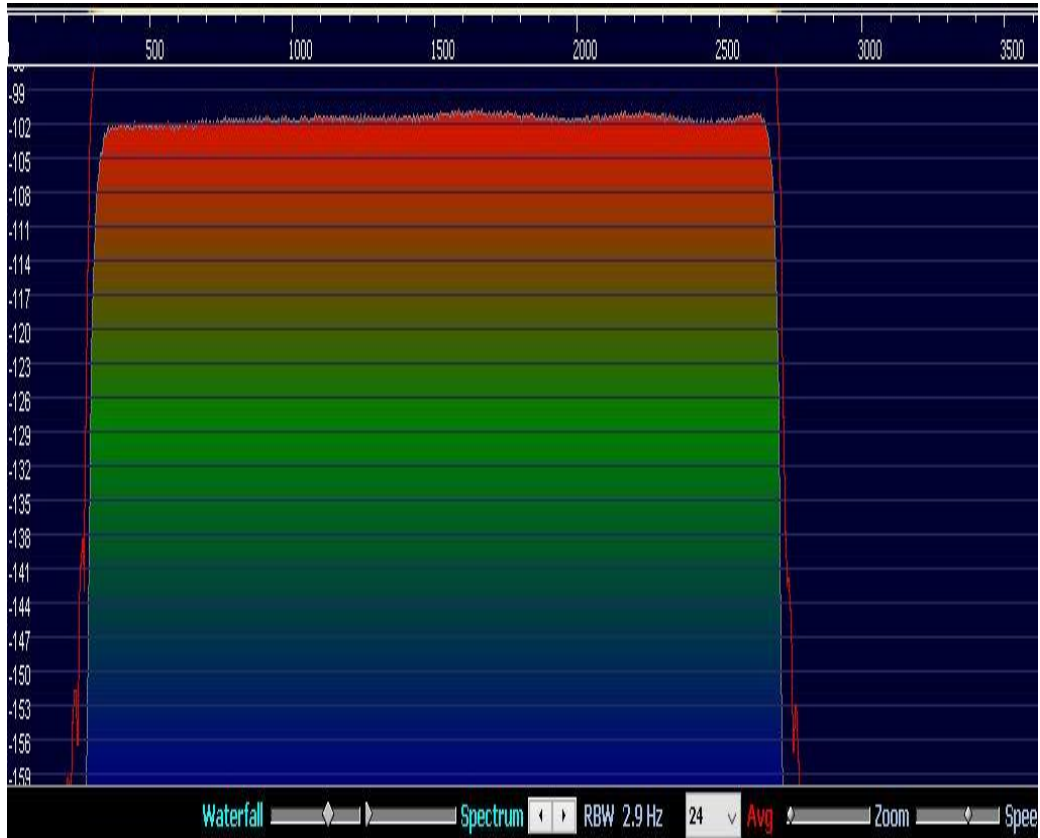


I. SDRPlay RSP1 Interfaced to Atlas Radio and PC

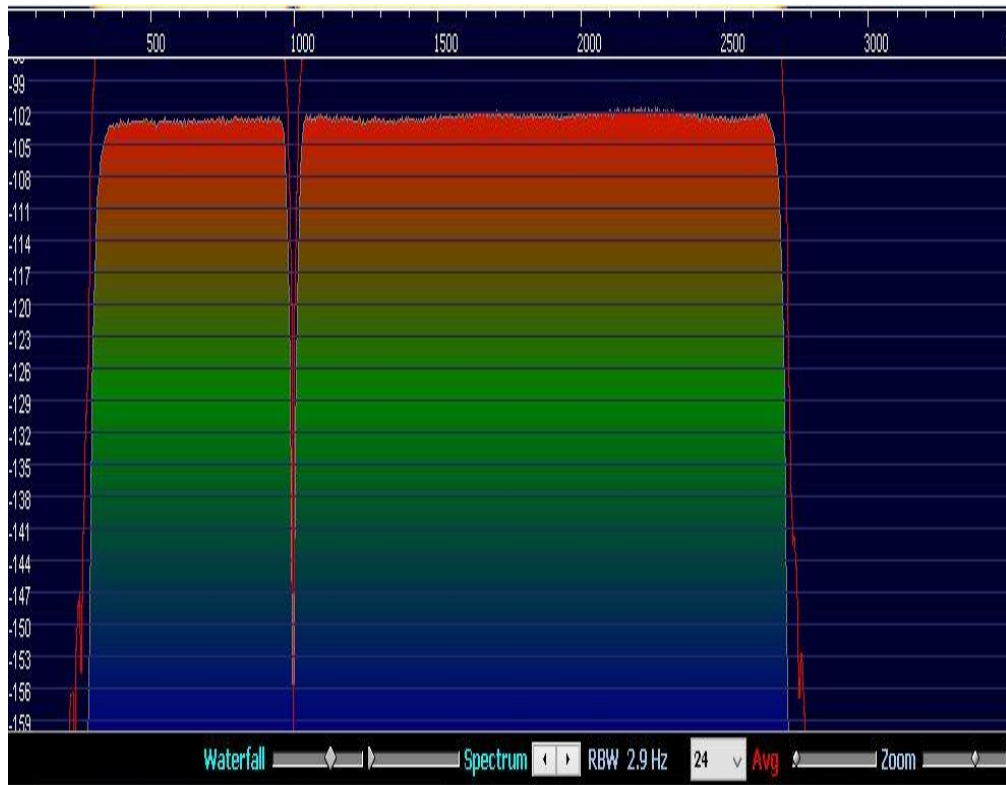


J. HDSDR RX DSP Bandwidth

Filter bandwidth set for 300 Hz to 2700 Hz

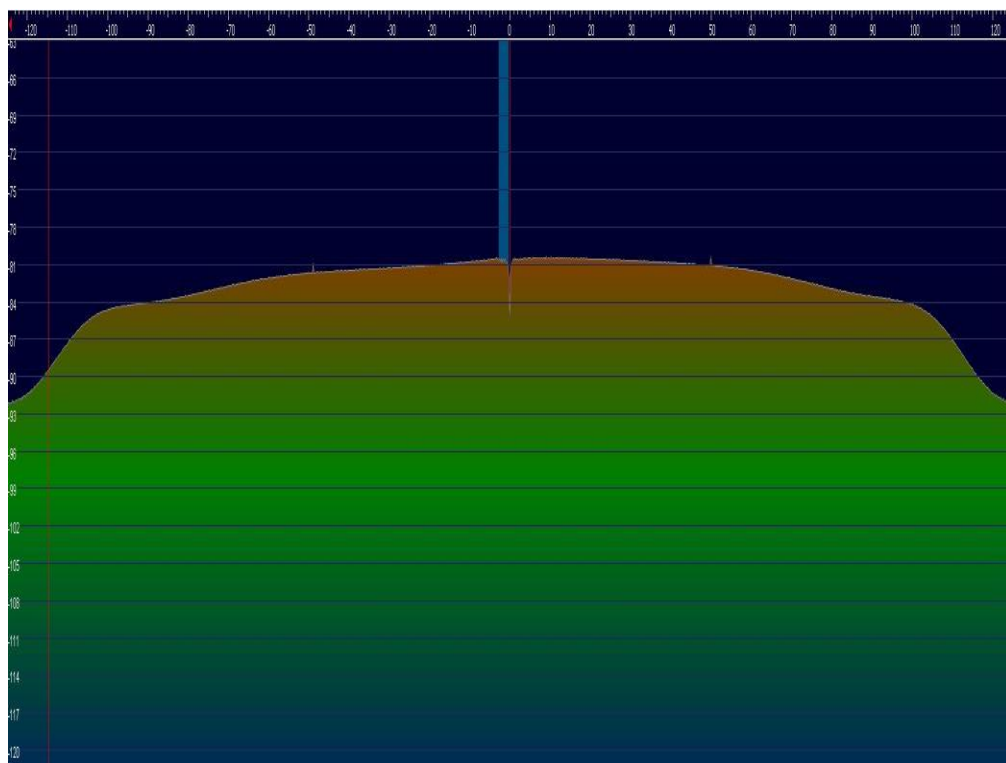


K. HDSDR RX DSP 1000 Hz Notch

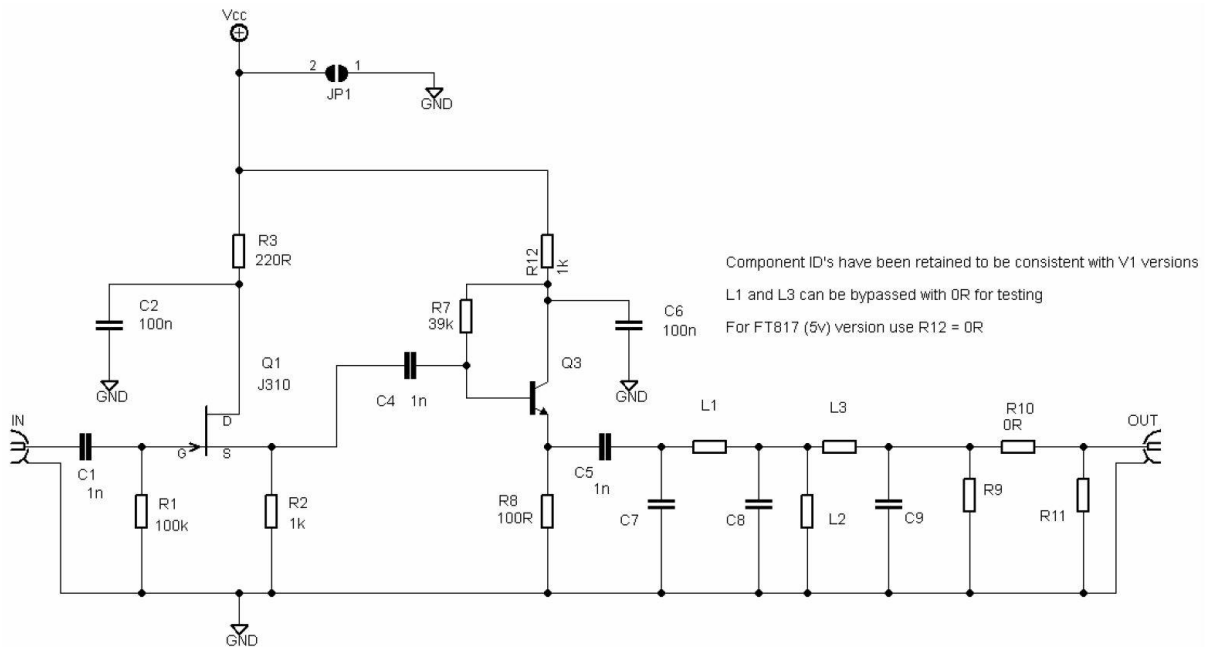


L. Spectrum Analyzer Sweep of Receiver Front End

At the -3db points on the sweep, the bandwidth is about 180 Khz.



M. PAT 6M Schematic



N. 210X IF Tap Point

