Receiving Examples

Digital Communication
and
Measurement Receiver / Transceiver

RDR54 / 50

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Content

Introduction

Congratulation! You are now in possession of the first stand-alone Software Defined Receiver (SDR) for the consumer market. As you can see, it works without the need of an external PC or laptop.

The RDR54 and 50 are manufactured by Reuter engineering from Dessau Germany. And when "Dessau" and "Bauhaus" mean something to you, you will understand why we have only one large knob and a small amount of pushbuttons because they follow the Bauhaus philosophy that "less is more".

This document is intended to serve as an addition to the Operator Manual. It neither replaces it, nor can the complexity of the RRD54 or RDR50 receiver be fully understood without reading the manual.

I was given the chance to evaluate the receiver's fantastic possibilities and the ergonomics of its controls over a longer period of time. I am not new to receivers of this quality: Kneisner& Döring KWZ-30, Perseus SDR, PM-SDR and classic boat-anchors like the Collins R390A/URR and rare TELEFUNKEN E-52b "Köln" are among my daily receivers. An ICOM 8500 was used for reference in the 2m band.

I nevertheless find that the Reuter RDR54 deserves a place in this line-up of top receivers. Its sound on AM with the Envelope-Detector challenges the legendary sound quality of the Collins R-390A while at the same time the endless filter bandwidth selection reminded me of a Perseus SDR. It's incredible sensitivity on 2m made the ICOM 8500 come second in many direct A/B comparisons.

In addition it serves as a measuring device with an accuracy of under 1dB total, offers more FM IF filter choices than the best FM tuners ever made and (if that wouldn't be enough) it is lightweight, compact and a joy to operate.

Its raw sensitivity and ultra-low noise pushes the technical limits of reception to the absolute thresholds of physics, e.g. the antenna noise in bands like FM and 2m.

Operating this receivers is different, sure. But after a short while, you will see that you will be much faster than with other receivers of the classic multi-knob arrangements.

At this point, I would like to thank Mr. Burkhard Reuter for letting me evaluate this fine instrument.

It clearly follows the tradition of excellence in the field of receivers "Made in Germany".

Saarbrücken, October 2012

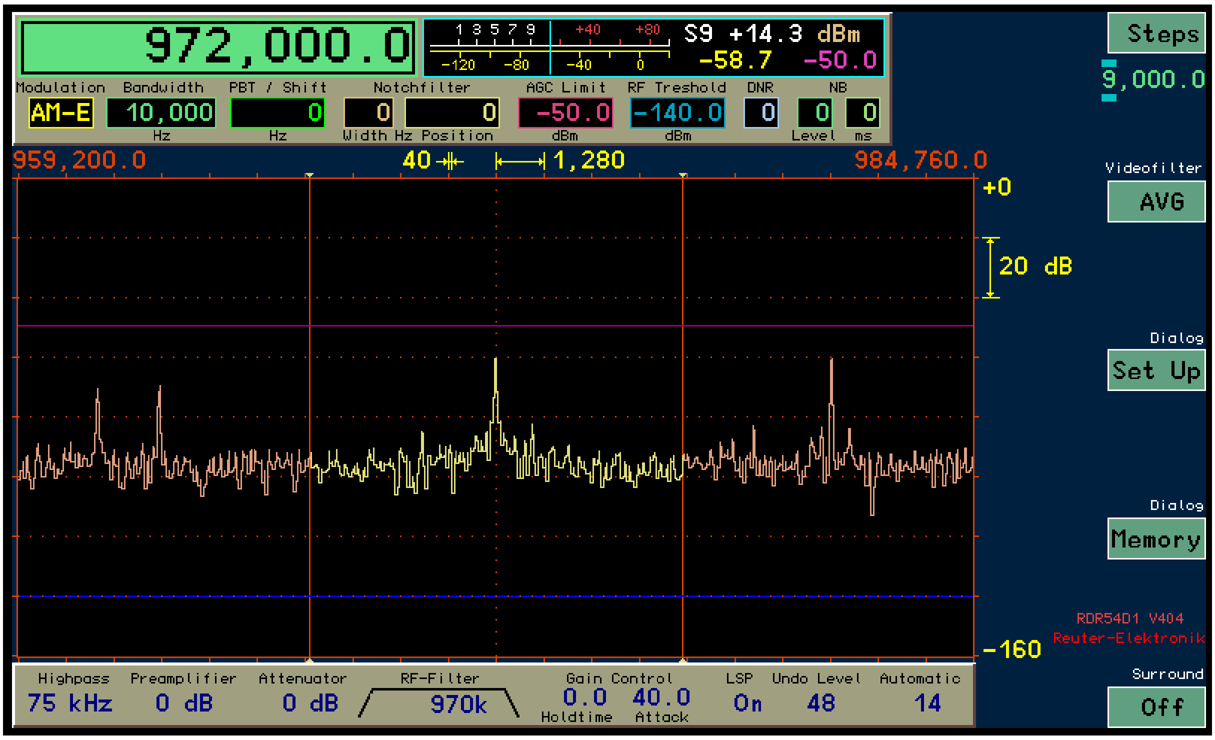
Dipl.-Ing. R.Menn

1.) AM broadcast band station

The display settings are chosen so that the signal can be seen well and an optimal listening experience can be guaranteed.

Demodulator: AM-E(nvelope), 10 kHz Bandwidth, AGC limit –50 dBm (medium strong station)

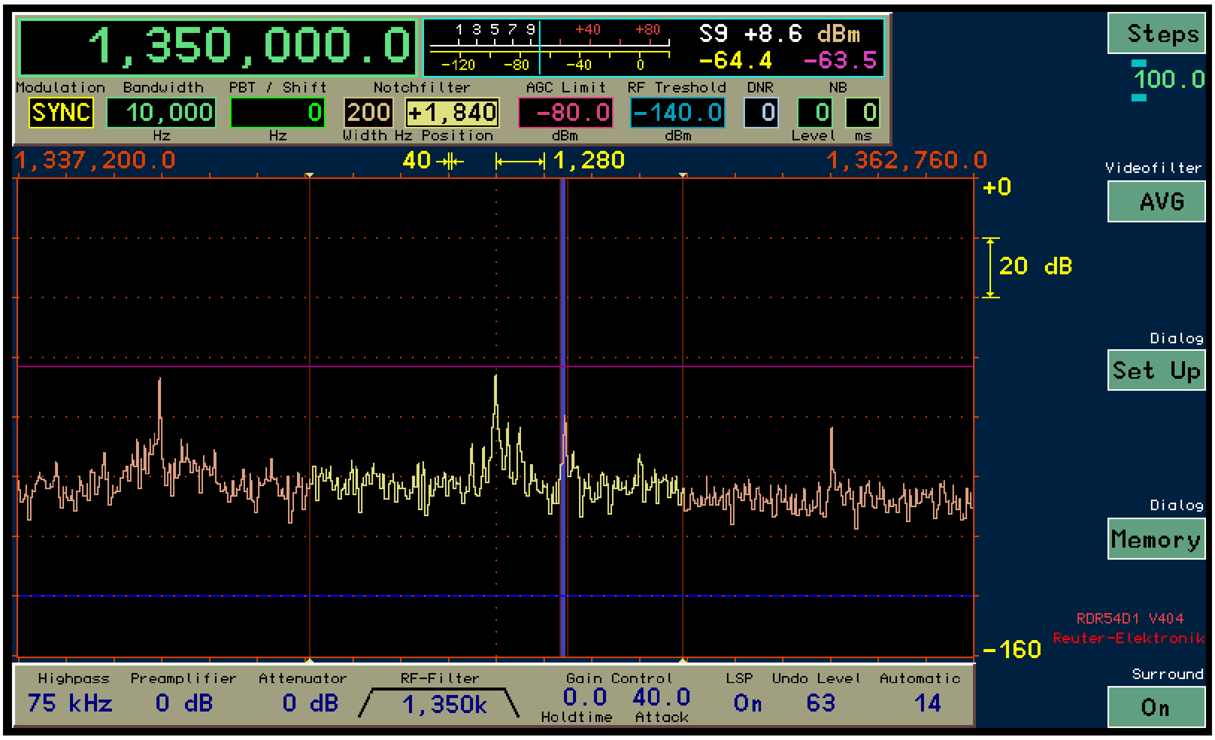
The station was received using a loop antenna, a good choice for this band. The next image shows the same station at the same time using a small active antenna, the SONY AN-1. As you can see, the signal/noise ratio is less good and the modulation of the signal is weaker at the same time - > no optimal reception possible!



2.) **AM reception with an interfering signal**

In the upper part of the spectrum you see a dominant “whistler”, a typical small interference signal which will be heard as a loud constant tone.

Using the sharp edged Notch Filter, we can blank out the unwanted signal without losing too much information of the passband. 200 Hz is a good width for such a notch. With the position control window “Position”, it can be placed precisely around the interfering signal.



3.) Reception of a shortwave station with a strong interference in one sideband

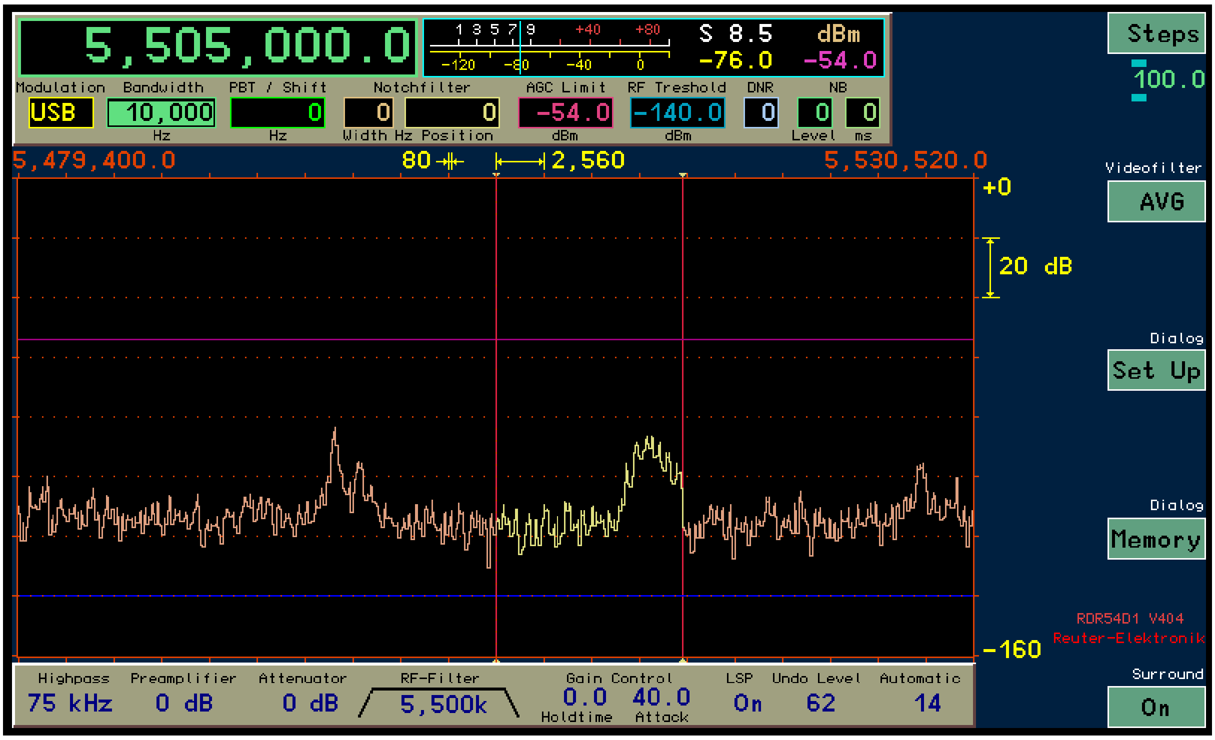
Shown here is the signal of Radio Rebelde Cuba, 5025 kHz, as it can be received in the early morning hours in Europe. The lower sideband has a relatively wide interference which we can eliminate in a couple of ways.

First, we can use the SYNC-mode and simply chose the Upper Side Band, thus engage SUSB mode (trivial, not shown). For a notch filter operation, this interference would be too wide, too much information would be cut out.

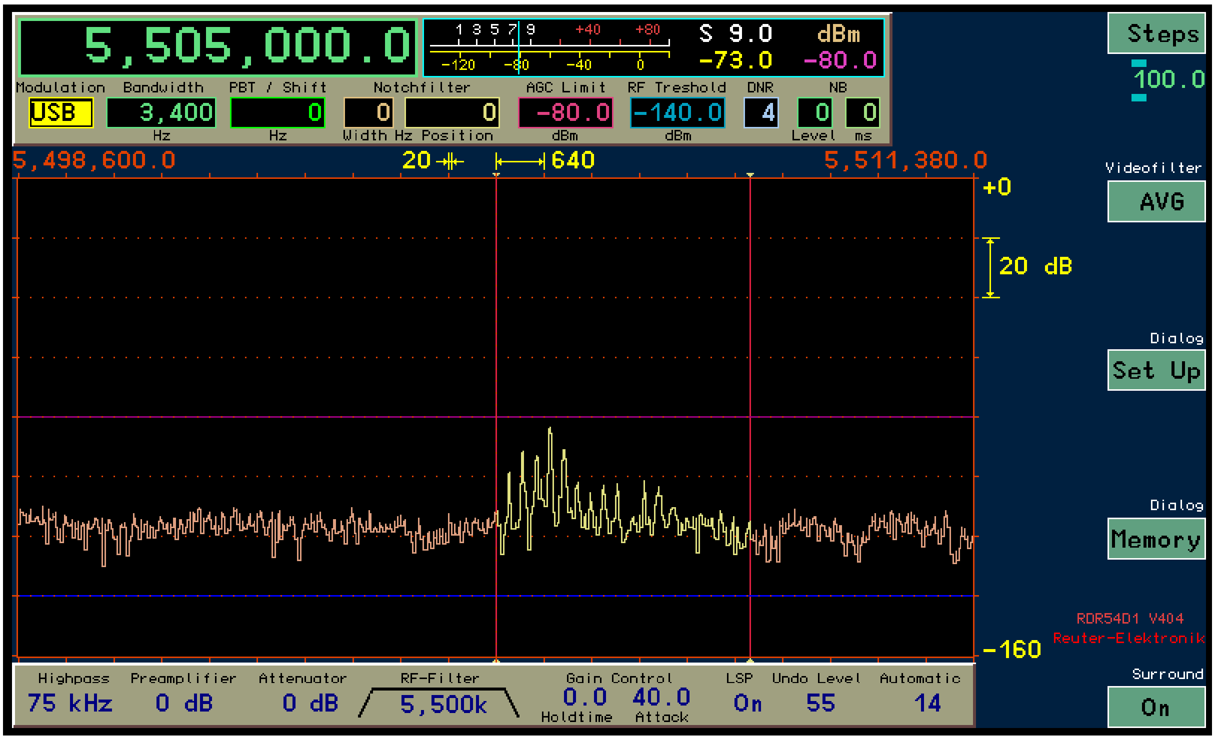
A more elegant method would be using the Passband Shift “PBT / Shift” as seen in the screenshot. Please note that the bandwidth should be narrowed at the same time otherwise the audio gets too bright.

4.) SHANNON Volmet 5505kHz with interference

Intentionally, the RDR54 was set to 10,000 Hz audio bandwidth. As you can see, the signal is displayed quite compressed, but the interference “hump” can be seen well. In this setting, the audio of the VOLMET is completely dominated by the interference.



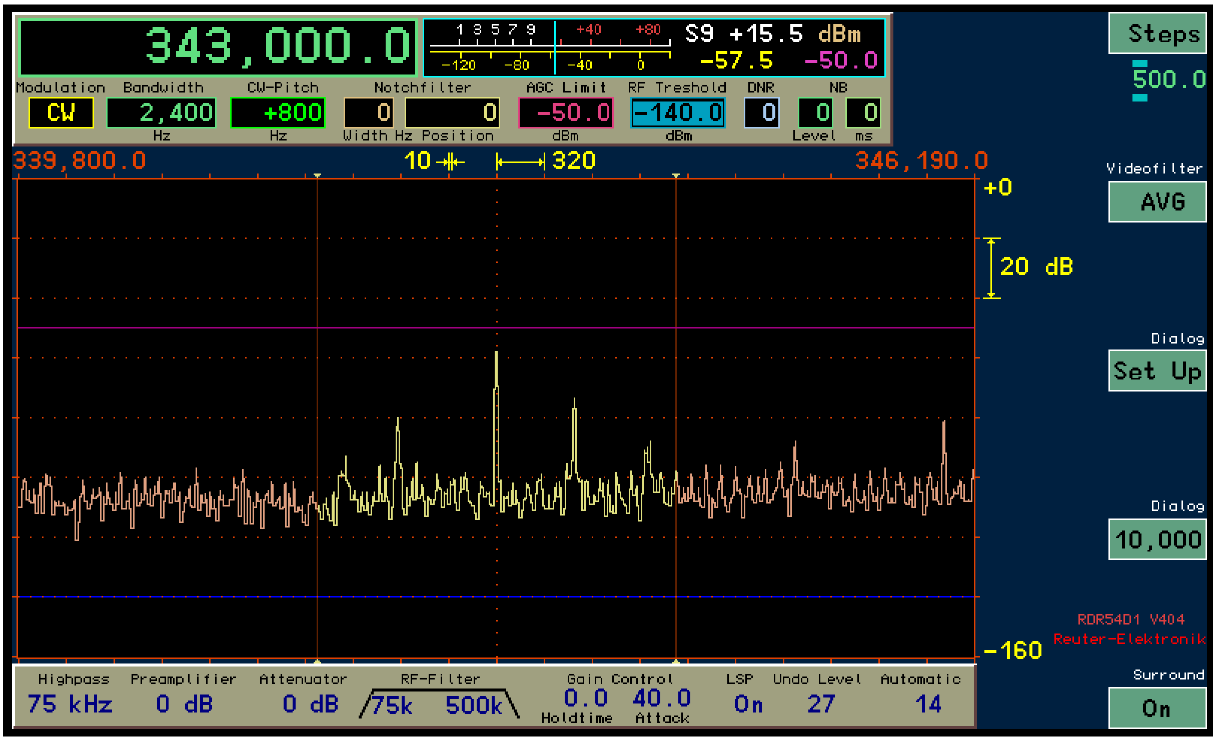
Using the RDR’s options, the reception can be optimized by changing the bandwidth to 3400 Hz, thus cutting out the interference. A mild Denoising (DNR=4) helps the intelligibility of the signal. In a case like this, it is recommended to change the spectrum display resolution to 640/display unit.



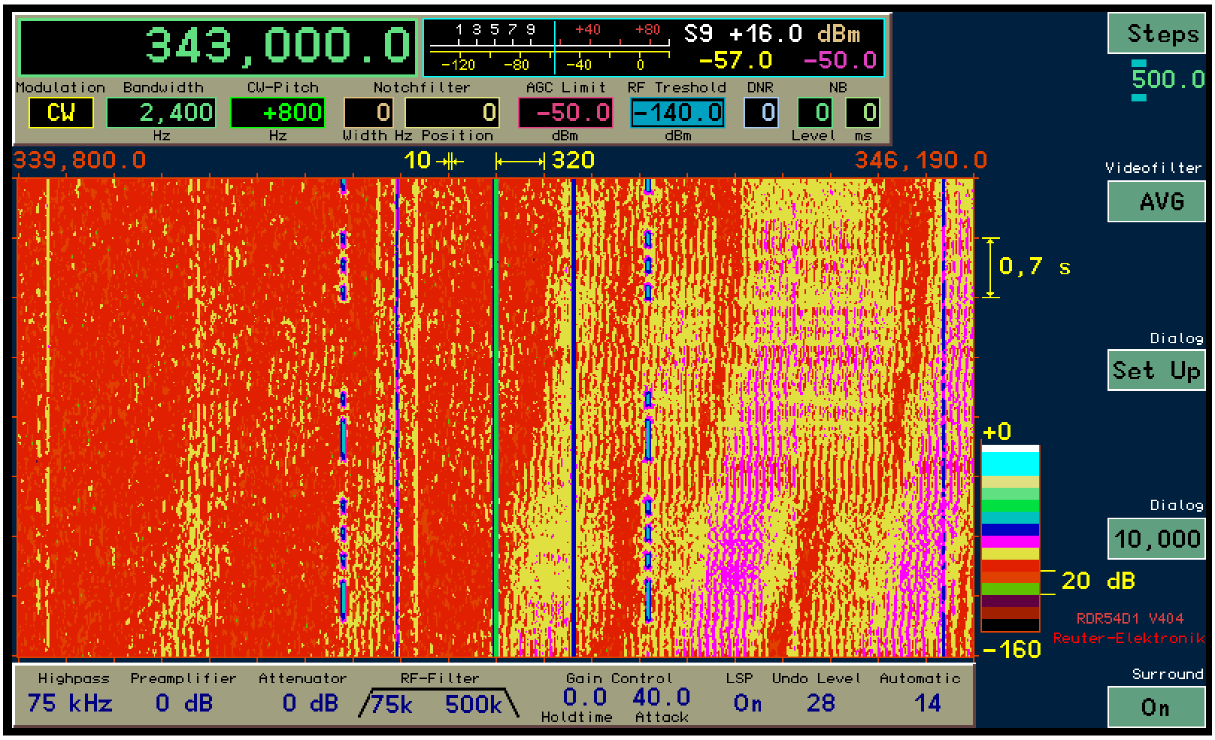
5.) Reception of an NDB and decoding the stations ID using the waterfall diagram

In Europe, you can receive a lot of NDBs (=non directional beacons) in the upper LW band. A local station broadcasts on 343 kHz.

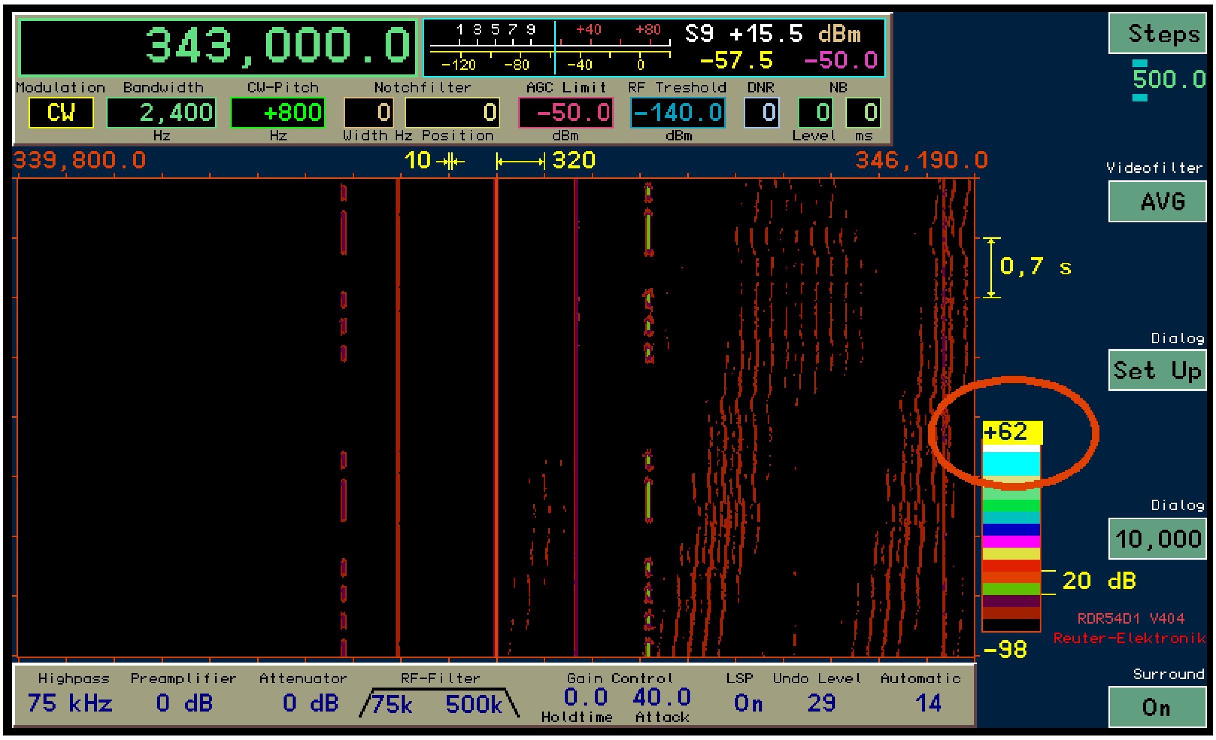
Set the display resolution from 1,280 to 320 to visualize the signal better. Now the two sidebands can be seen clearly.



Switching to the waterfall display shows the spectrum as follows. The CW type sidebands can be seen, but the coloring is quite distracting.

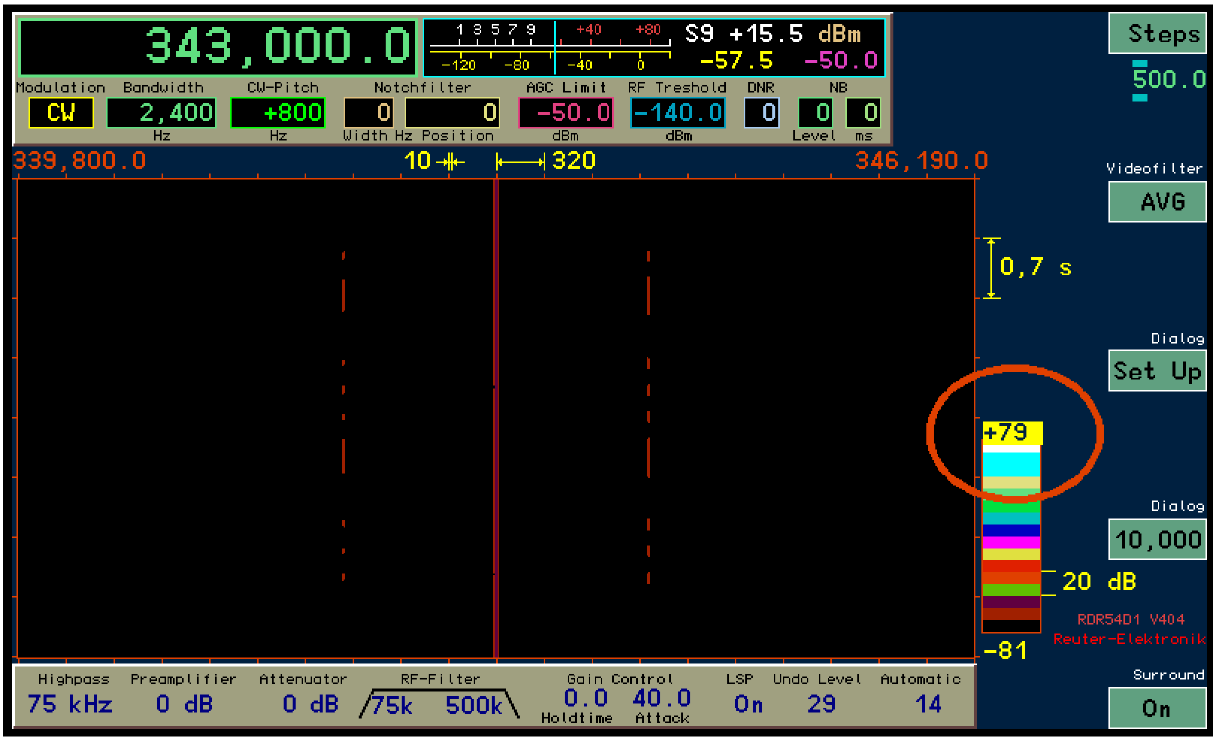


We now shift the color table so that the signal can be interpreted better (+62). It’s still the same signal, but we “desensitized” the receiver by shifting the color table so that only the peak signals are coded in a color and the noise stays in black.



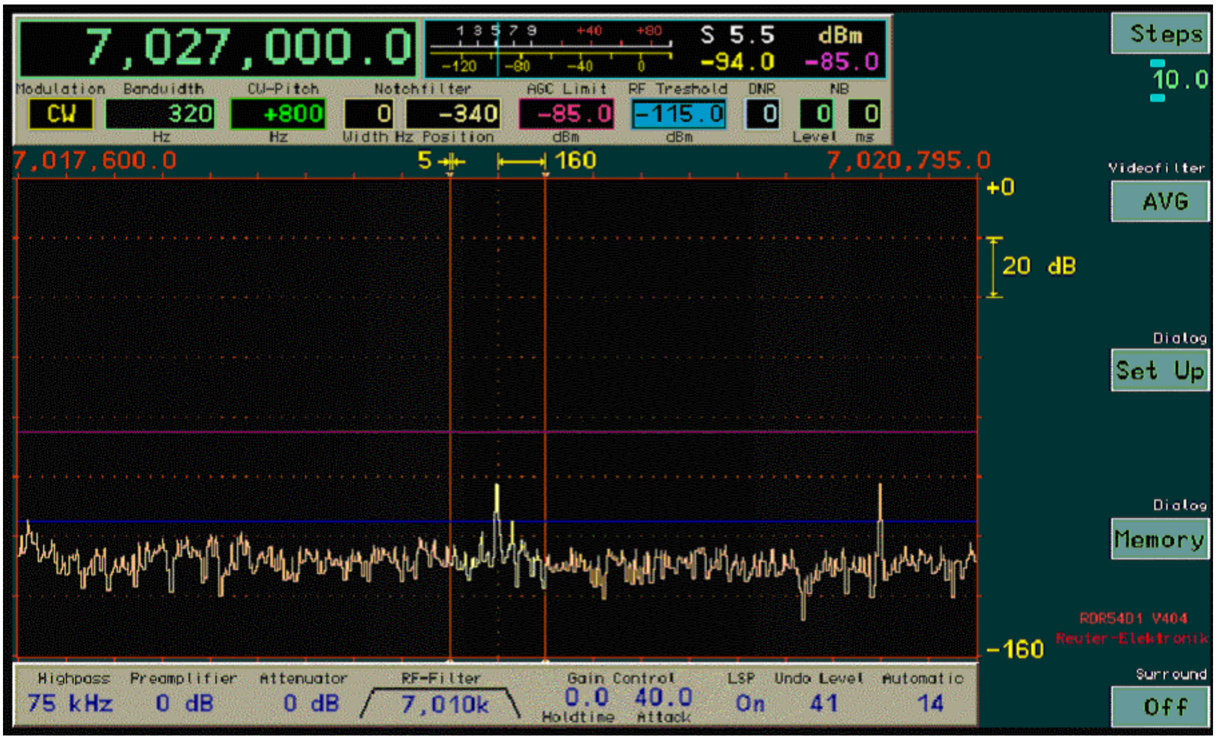
Further shifting the color table (+79) lets now the waterfall display the dash and dots quite clearly. Any other signal other than the peaks are suppressed.

The station ID is ... -... ... -... ... -... or “SB” “SB” “SB”.



6.) **CW reception and decoding**

For the CW signal (which is usually very weak) a combination of some of the RDR54’s unique features can be used to make the signal more intelligible. First, we use one of the highest display resolutions (160 or 320 pixel/unit), then shrink the bandwidth to a super narrow 320 Hz or even smaller. Afterwards we lift the RF threshold OVER the noise floor of the signal (here –115 dBm).



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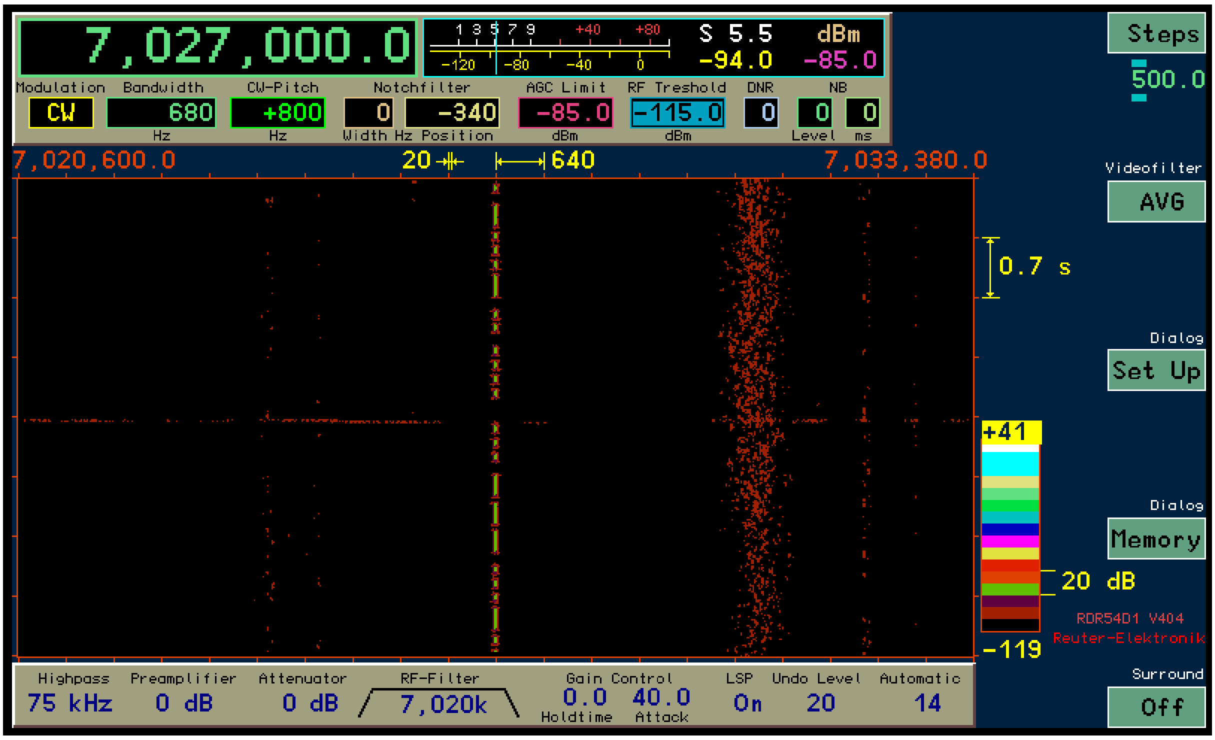
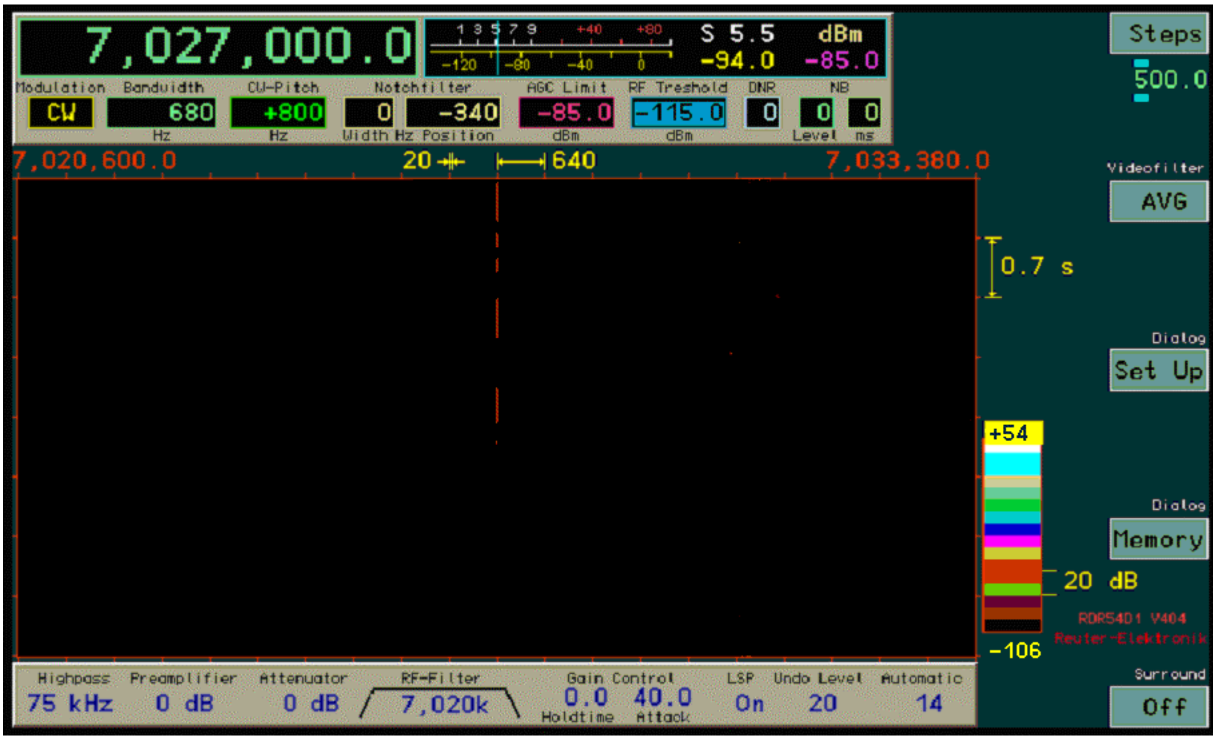
This will result first in a gargling sound, if we continue, the dashs and dots will be literally “punched” out of the noise which will make the CW signal very easy to understand.

Again we use the waterfall display to verify our settings.



A further adaptation of the color table (from “41” to “54”) helps further in the interpretation of the CW coding. Not bad for a S 5.5 signal, or?

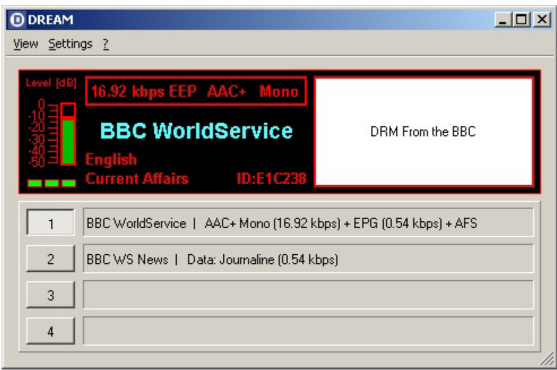


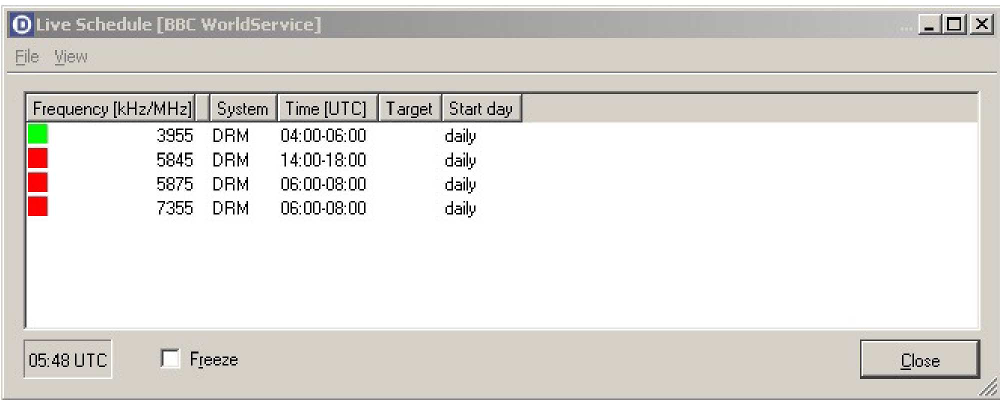
7.) DRM reception "Reuter" style

Nothing could be easier. Simply switch on the "IFIQ" demodulator when you see a signal like this on the RDR's spectrum display. Turn down the loudspeaker's volume completely.

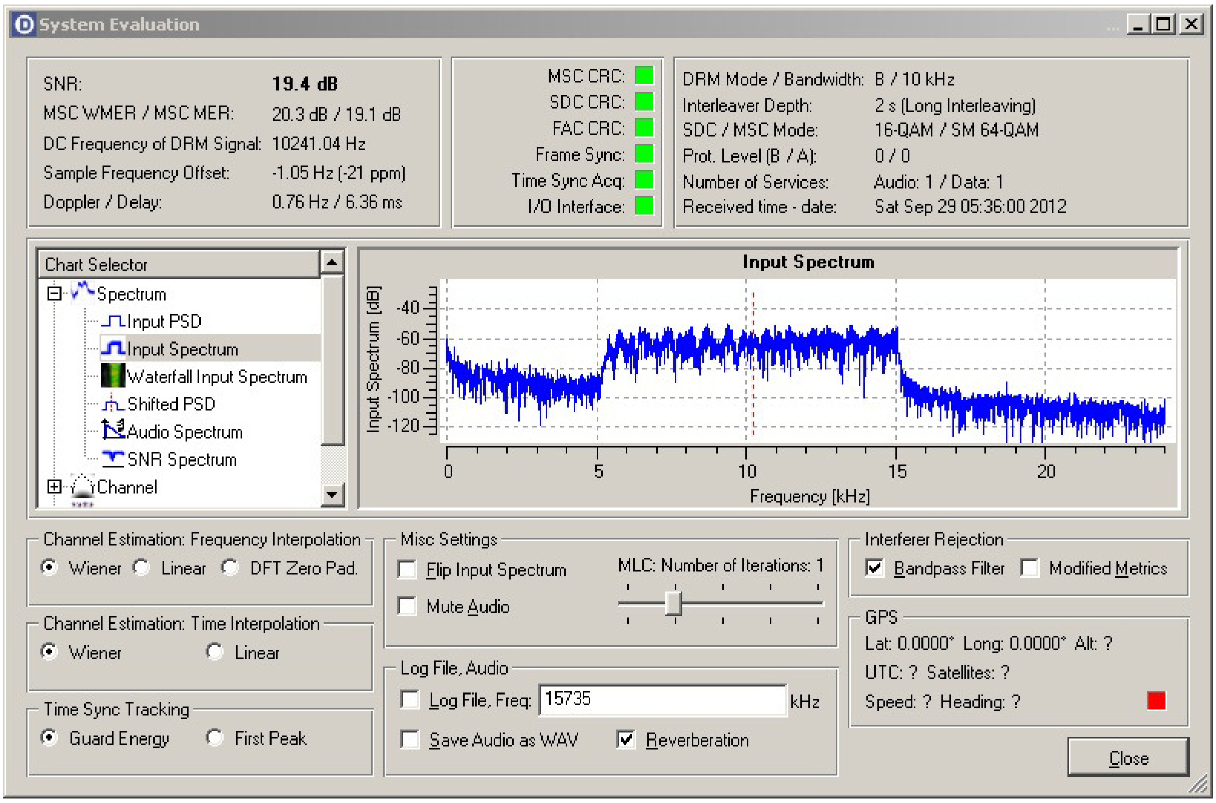
Connect the RDR's headphone out to the soundcard input of your PC or laptop. In case of the latter, the settings for microphone sensitivity might be a little tricky (overall loudness, mic-amp engaged or "off" etc.). Be patient! Once you found your settings, it's done. No need for a Virtual Audio Cable (VAC) or anything else. Simply an audio cable with 3.5 mm jack on both sides.

A free and easy to use DRM demodulator is DREAM v1.13. I cannot recommend the 1.14 version.





A few seconds after all six status LEDs in this window turn green, you will have a station ID in the little status window and the audio of the DRM signal will be played back through your PC's speakers.



True, this is not a complete stand-alone application anymore and the advantage of Perseus and alike seems to shrink. Simply remember that you don't need a costly software (Virtual Audio cable isn't free) nor after market modifications of your receiver (eg. a 12 kHz mixer board) nor a lot of settings to be changed in your PC or laptop. Simply allow the signal from the RDR54 to enter your soundcard and let DREAM do the trick.

8.) Reception of a weak SW station right next to a strong one

Shown here is a typical situation of two shortwave stations spaced only 5kHz apart from another. Voice of America (VoA) broadcasts around 16 UTC on 15580 kHz from Botswana, Radio Exterior de España (REE) with a much stronger signal on 15585 kHz. A true challenge for any receiver, type or make. The difference in signal strength can be as much as 40dB as seen here on the screenshots.

There is no best way to receive this station but the RDR54 offers some options.

Seen here is the receiver set to the Synchronous detector and LSB as an option. This will cut out all of the overlapping sideband of REE and allow an astonishingly clear reception of VoA. Set the bandwidth of the S-LSB to your like, keep in mind that a wider bandwidth means also a more "open" audio sound and eventually more noise.

As an alternative, you can set the receiver into the Double-Sideband mode (DSB) and use the Passband-Shift option to cut out all of the unwanted signals. Note that the bandwidth will not change automatically (it's always identical to the bandwidth you started with). If the sound is too open or you hear too much high frequency noise, simply adjust the bandwidth to your liking after you set the PBT.

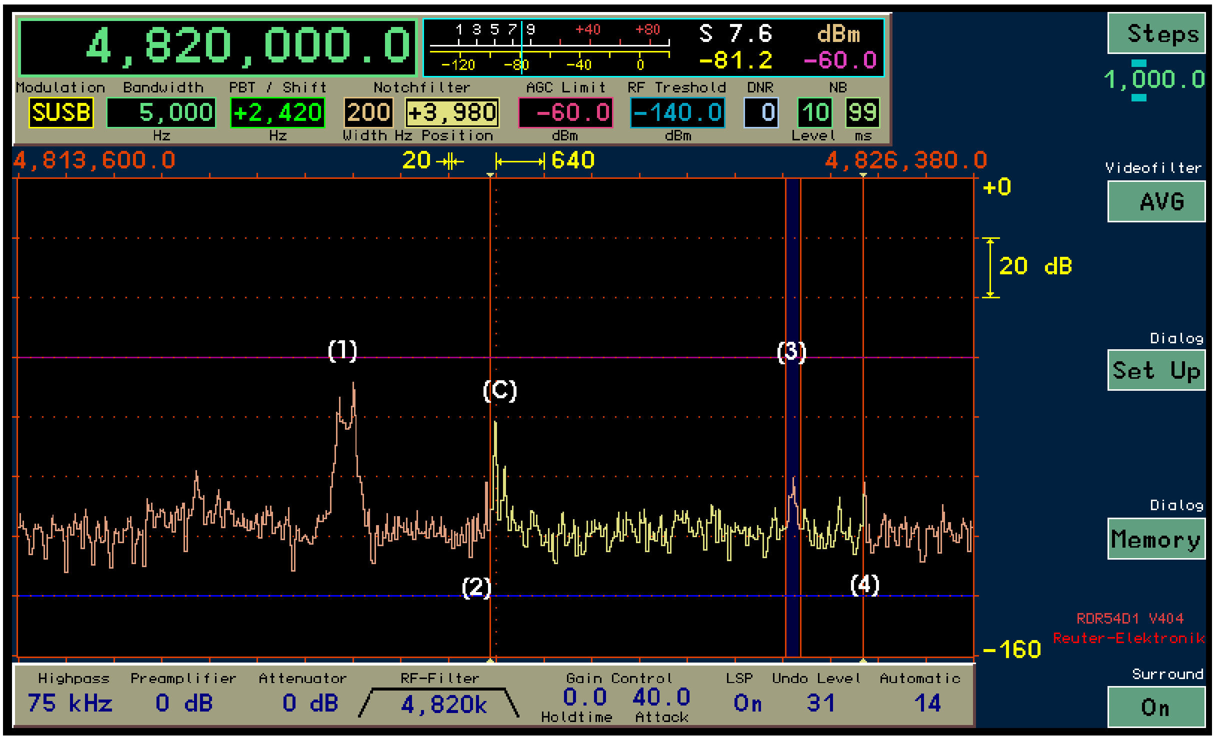
VoA reception using the Synchronous detector and LSB as an option.
Audio and sideband bandwidth set to 5000 Hz.

VoA reception using DSB and a Passband shift of 4000 Hz to cut out the REE signal completely.
Note that the bandwidth needs to be adjusted afterwards also.

9.) Reception of a multiple challenged station, LHASA 4820kHz, 20:30 UTC

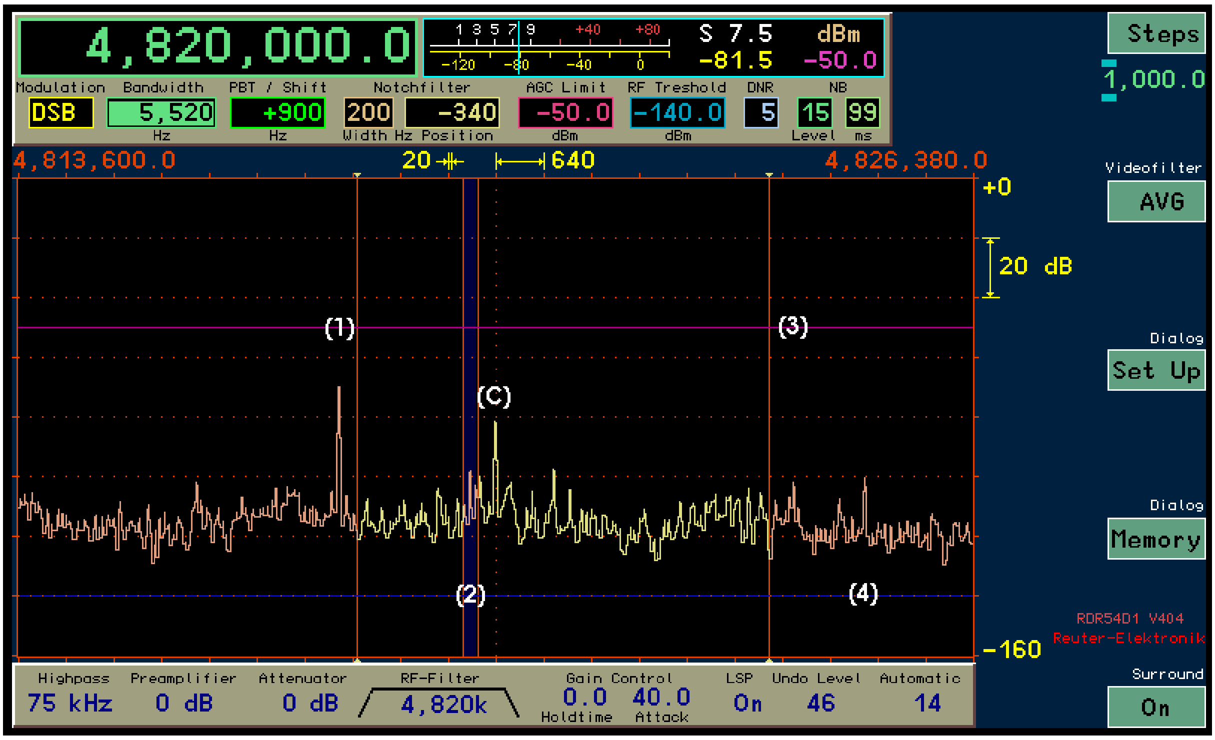
The reception of PBS Xizang,Lhasa-Baiding on 4820 KHz is challenged in many ways. The dominant problem is the RTTY station (1) in the lower sideband of the signal's slope. In addition there is a warbling sound (2) close to the carrier, again in the lower sideband. Two het tones (3, 4) appear in the upper sideband, one 5kHz away from the carrier (4).

Again, the RDR54 gives us some options to optimize the reception.



The RTTY signal and the warbling sound can be cut out completely by using the Synchronous detector and USB as an option. Then we can use the notch filter for the somewhat broader HET tone (3) and narrow the bandwidth just so that we just cut out the +5 kHz carrier (4).

Alternatively, we can use the DSB mode of the receiver which offers a somewhat better sound and use another combination of filters/settings to overcome the before mentioned problems.



This time, we use the Double-Sideband mode (DSB) and shift the spectrum so that the RTTY signal's effect is eliminated. Then we set the Notch Filter with a 200 Hz width so that it filters out the warbling sound close to the carrier (C). Leaves the two HET tones. Narrowing the bandwidth so that the dominant one (3) is safely suppressed does the trick. Note that the PBT and bandwidth settings are independent from another, so you might want to go back and adjust the PBT again in order to get the most audio out of the signal.

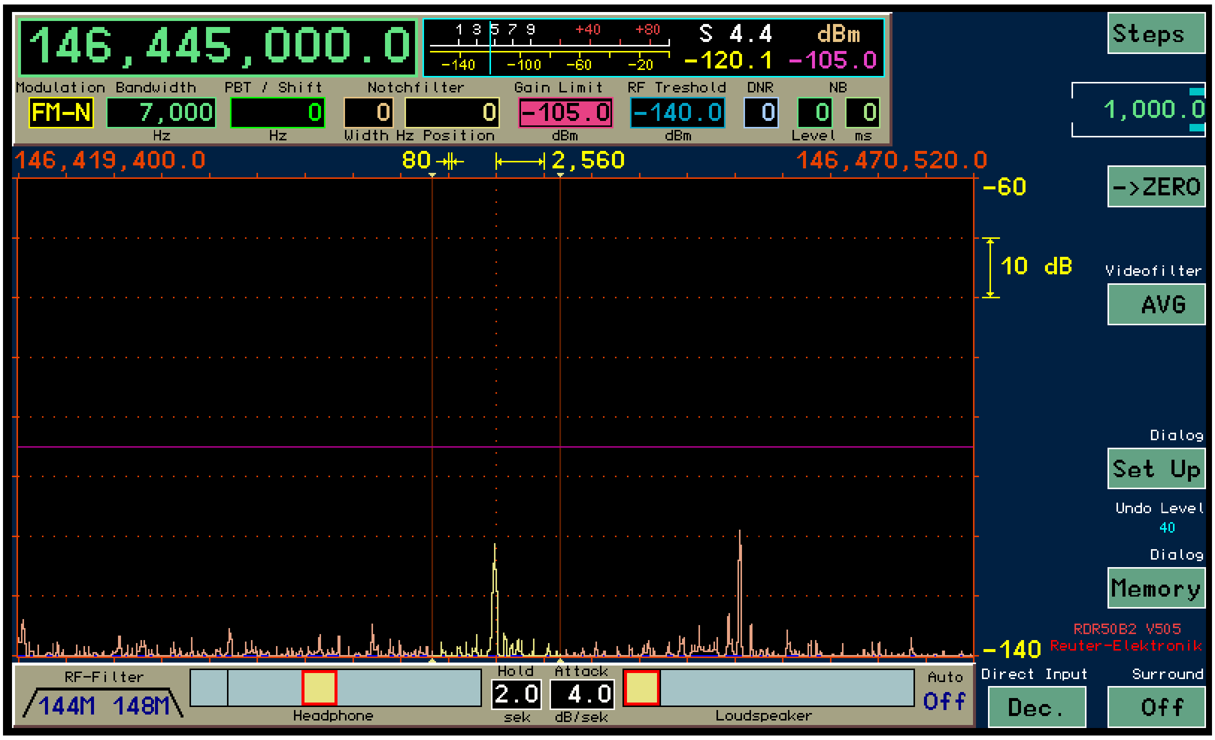
The signal isn't strong as you can see, only S7-8. Use the Noise Reduction with a mild setting of 2-5 to eliminate some of the noise. At the same time, the reception was also challenged by rapid atmospheric crashes from thunderstorms which we can eliminate to some extent with the Noise Blanker set to 99 ms delay and a level of 10-12.

A trick that works with almost any receiver is setting the manual gain (here –50 dBm) lower than needed. This way, noise is underrepresented in comparison to the audio of the signal. A physiological effect which helps us again to improve the intelligibility of this difficult signal.

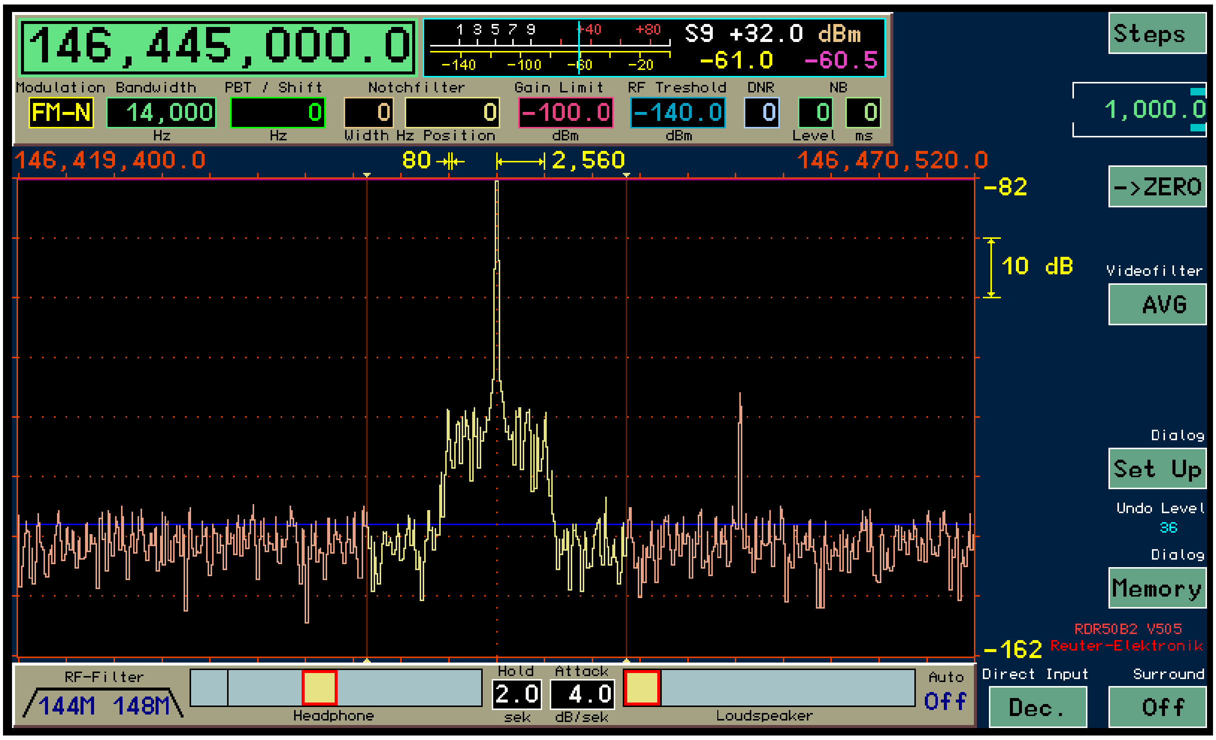
10.) Reception of weak signals close to the noise ground on 2m

Reception of signals in the 2m band is always a challenge. The atmospheric noise in this band is so low that the entire reception chain (seen from the antenna to the receiver) can show its merits. And this is where the RDR54/50 really shine.

Seen here is a weak signal with medium modulation on 2m. The low axis setting is set at the median of the noise floor of the signal to emphasize the presence of weak signals and to eliminate the clutter of the negative valleys of the random noise.



As you can see, the receivers's Gain limit was set approximately 15 dB above the signal's peak. Which leaves a lot of headroom for the acoustic loudness control which we explained in the LHASA example. The loudspeaker control doesn't need to be touched for this. In the narrowband FM mode the acoustic volume depends on the frequency spread as opposed to the amplitude of the signal level. For a weak signal the signal bandwidth is relatively narrow and the 5 or 7 KHz filter settings produce the best match to the signal bandwidth and produce the strongest audio. For stronger signals as shown below the 10 or 14 KHz filter settings will produce the least distorted audio.



In this example of a strong local signal, the minimum signal level is raised so that we can make exact measurements and set the controls optimally.

SQUELCH: There is no separate control for squelch operation. A squelch capability is important for listening to FM wide or narrowband signals. When a FM-N signal is not present the broadband acoustic noise from the demodulator is both very annoying and fatiguing. A squelch function cuts off the audio when a signal is not present, such as when tuning through the band or in between transmissions between communicating stations. Instead of a dedicated Squelch control, we can use the Gain Limit function for the very same purpose. In the FM demodulating modes (wide and narrow) you can raise the Gain Limit to a point where the squelch operates to cut off the noisy audio output. Adjust the Gain Limit to open the squelch when a signal of the desired signal strength is received. In addition you can use any setting of DNR to further reduce noise.

The display bandwidth can be decreased to monitor the central carrier frequency of the FM transmitter. Aside from providing an accurate carrier frequency measurement you may find the carrier of the transmitter shifting from the initial start of the transmission with no modulation to when the operators are talking. This can be used to fingerprint the dynamic transmission characteristics of individual transmitters.

AGC settings are very critical. We usually set the receiver’s Hold-time within a range of 0-2.0 sec and the Attack-rate anywhere from 4-40 dB/sec. These settings can be optimized according to the particular conditions of fading and signal characteristics.