SDR-IQ CODAR Reception

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www.rfspace.com

This document describes the procedures needed to receive CODAR pulses with the SDR-IQ.

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1 Introduction

Many have run across some strange sweeping signals on the HF bands and discovered something called “CODAR” (Coastal Ocean Dynamics Applications Radar). Typical signals are a downward sweeping carrier at a 1 second rate with various sweep widths. They can be found all across the HF band:

4-6 MHz

12-14 MHz

24-27 MHz

47-50 MHz

Reaction has been anything from mild interest to livid hatred of these “interference” signals. Rather than try to get the transmitters and their owners destroyed, one could see if a possible amateur use can be made of them. One idea is for propagation studies. The codar signal is essentially a radar pulse on the HF band used to measure ocean waves but these signals also manage to illuminate the various ionosphere layers. By knowing where the transmitters are and your own location it may be possible to perform meaningful research into various propagation modes.

Googling CODAR shows there is a lot of information out there.

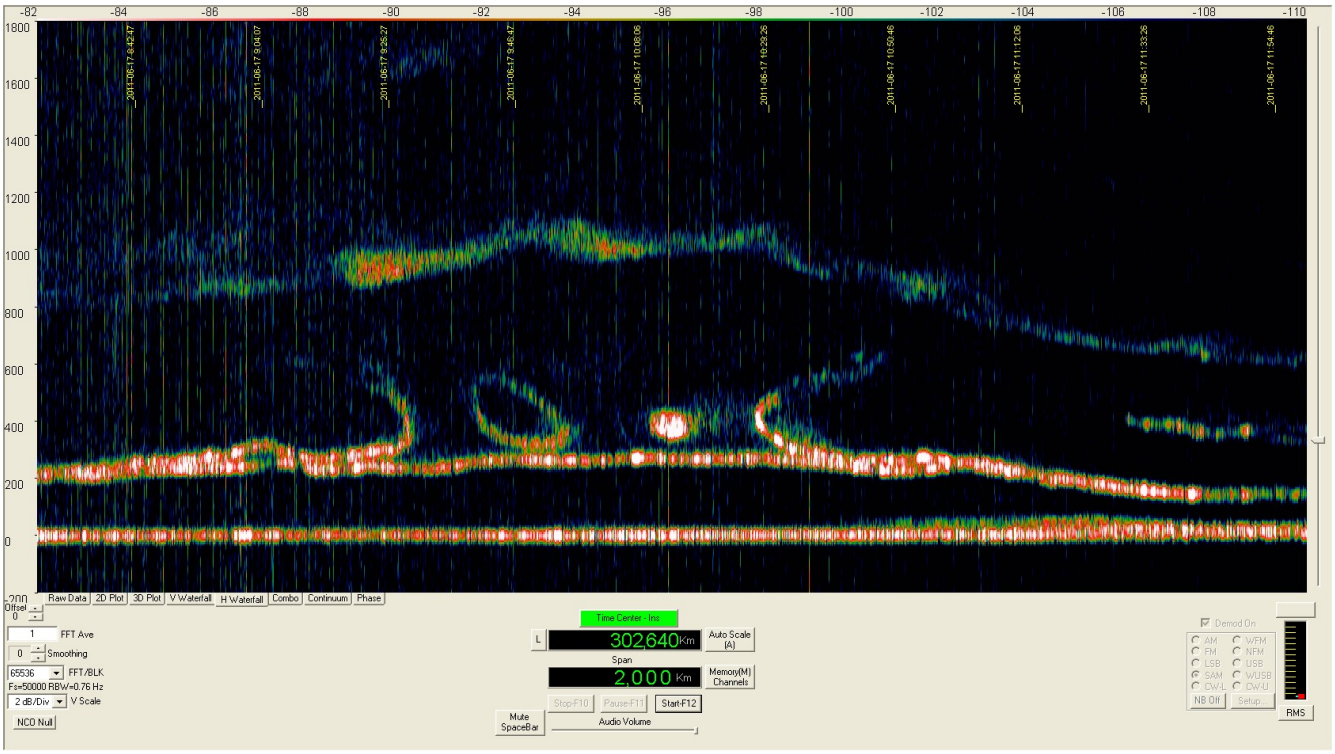
http://cordc.ucsd.edu/projects/mapping/maps/

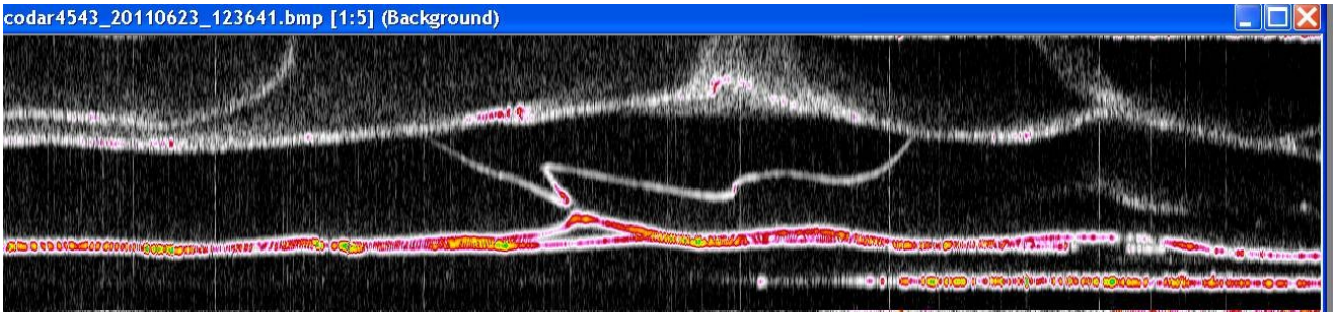
http://www.codar.com/index.htm

Since these CODAR signals are a sweeping carrier, listening to them as a normal radio signal is of little use. However if one processes the signal as a frequency chirp radar signal, the signal can be displayed in the time domain as a single pulse and its reflections.

A couple of example waterfalls of an overnight capture from Atlanta Georgia of one of the coastal CODAR stations.

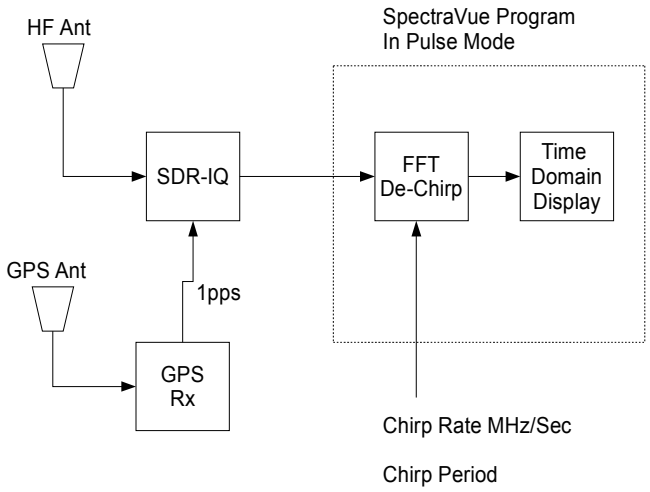
The center part of the image shows activity before and after sunrise as the ionosphere is moving.





2 Setup

The following block diagram shows the basic setup for receiving CODAR signals.

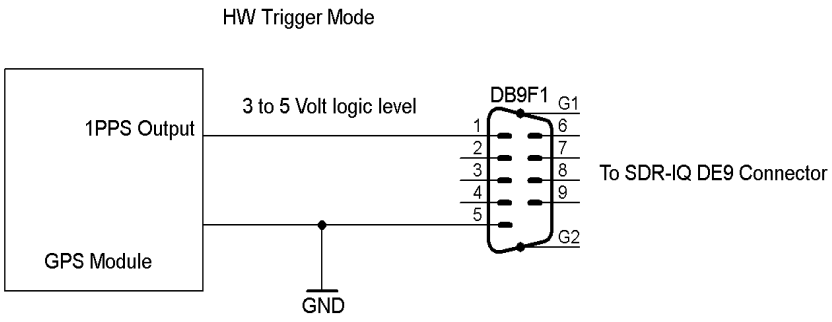


2.1 What you will need:

- SDR-IQ receiver with latest firmware(Ver 1.05 or greater)
- SpectraVue Software
- GPS receiver with 1pps 3 to 5 volt logic output
- HF Antenna

2.2 Hardware Setup

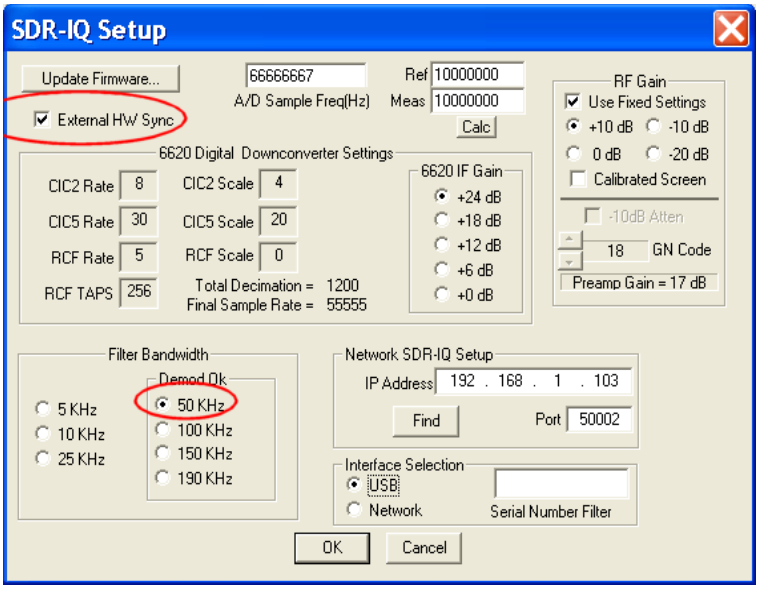
The 1pps signal from the GPS receiver connects to the SDR-IQ as follows:



2.3 SpectraVue Setup for CODAR

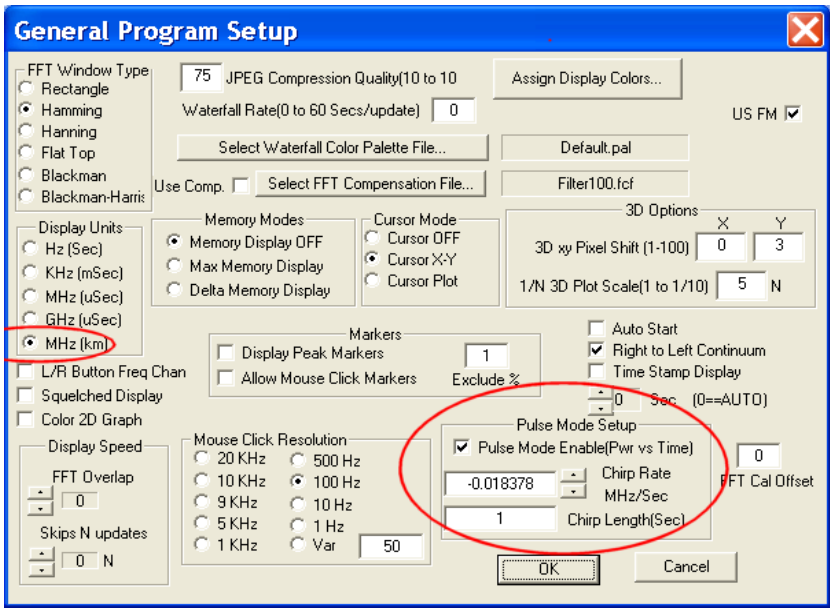
Go to SDR-IQ Setup menu and set Filter bandwidth to 50KHz.

Select "External HW Sync" checkbox



Go to General Setup Menu and select "Pulse Mode Enable"

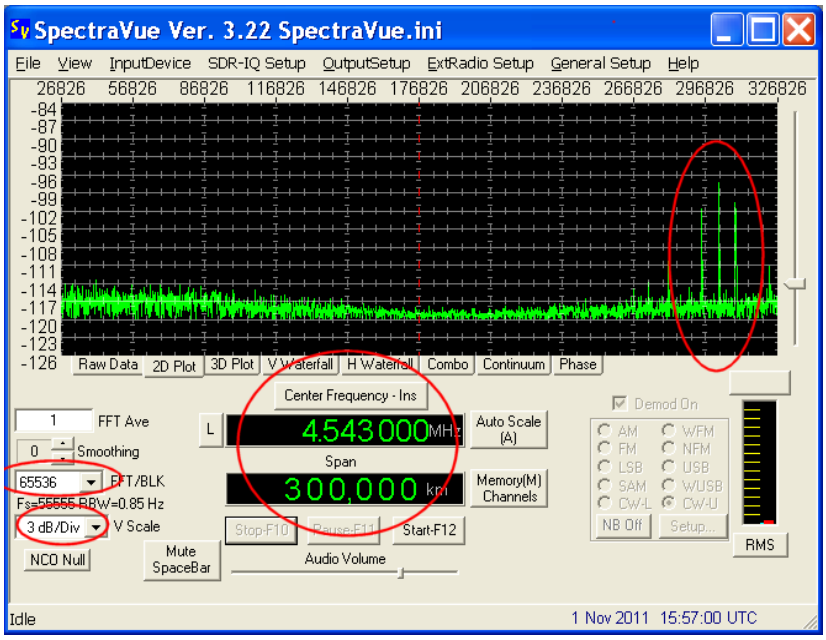
Enter -0.018378 for the chirp rate. For Display Units select MHz(km)



Select 65536 as the FFT/BLK size.

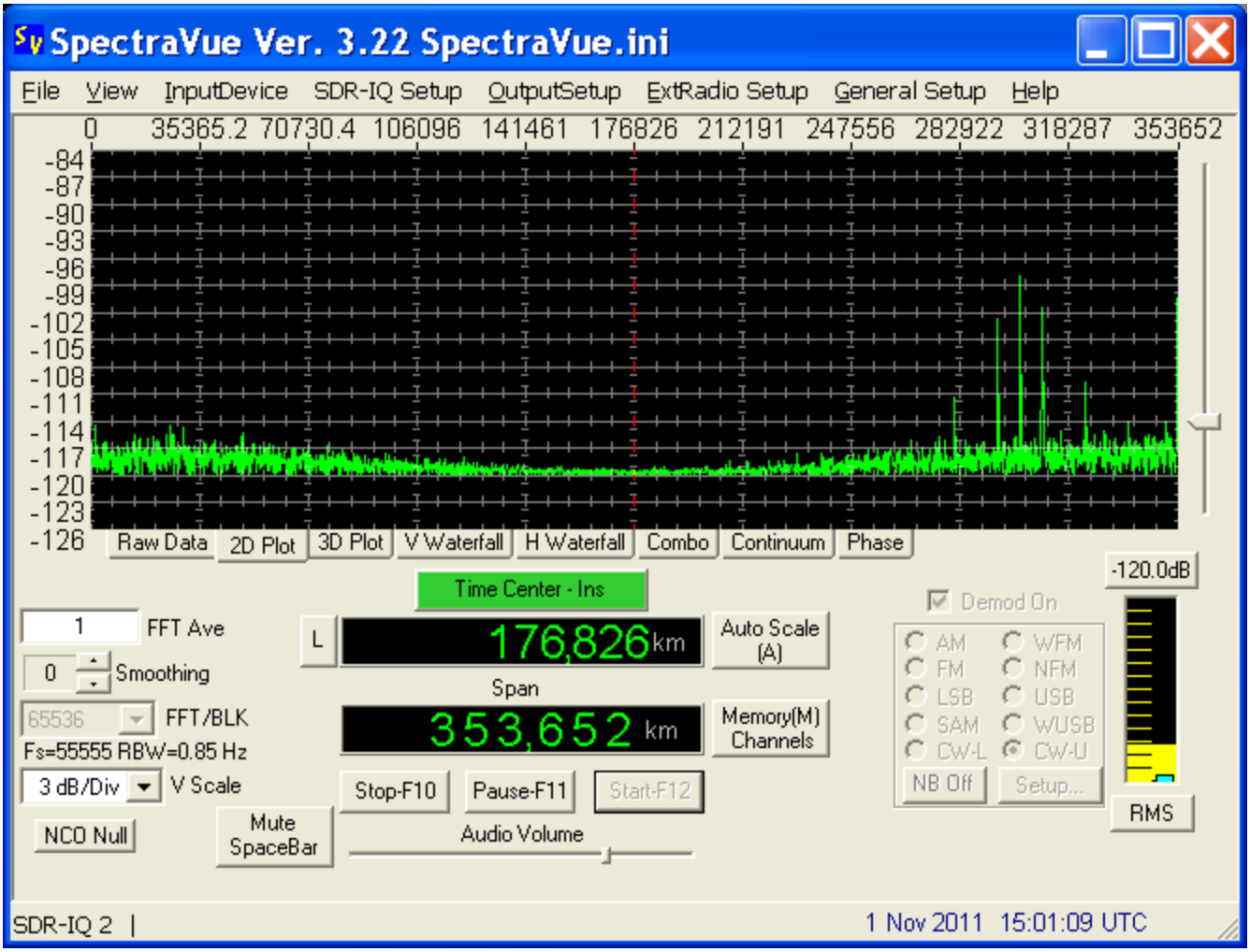
Set the vertical scale to 3 to 5 dB/div depending on signal strength.

For Center frequency, select 4.543MHz or 4.66MHz

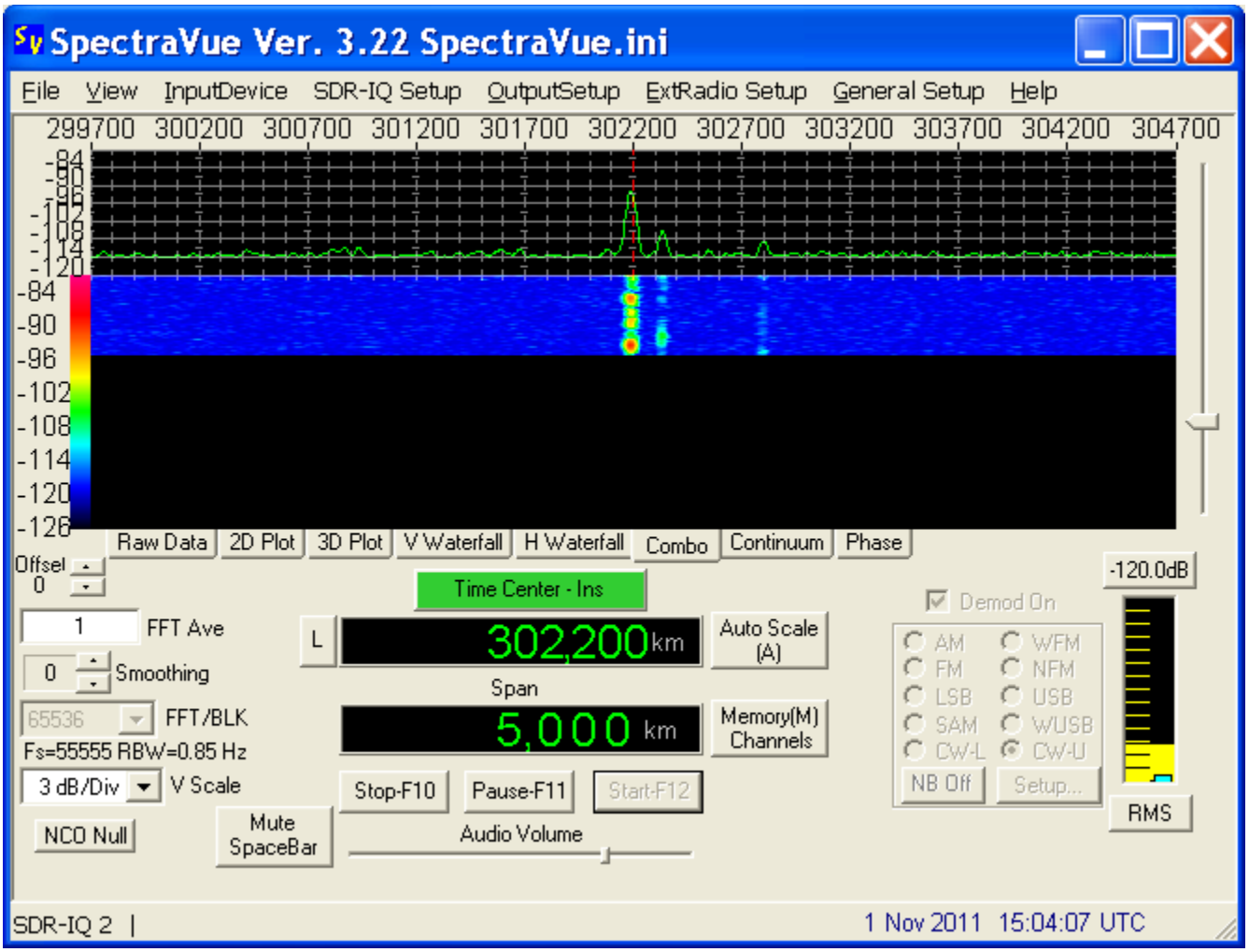


The button above the frequency control toggles the control between center frequency of the radio and the display time(distance) center of the screen. The Span control adjusts the span in time(distance) units. Start out with maximum span to initially find the pulses.

Start the SDR-IQ and the screen should update every 2 seconds if the trigger is working properly. Adjust the vertical scale and you should see something like this:



Note the largest pulses position then reduce the span to zoom the screen while readjusting the time center value close to the pulses position until you are able to center it on the screen.



There are multiple pulses due to having several transmitters on the same frequency but shifted in time. Also there are pulse artifacts from the signal since the sweep has blanking intervals that codar uses to be able to listen for reflections while transmitting.

The pulse position is sensitive to center frequency changes so the SDR-IQ will drift a bit especially if it hasn't warmed up for a while. It is advised to have the SDR-IQ powered on for several hours and kept at a reasonably stable room temperature before doing long data captures. Also it is easier to capture the raw I/Q data to a wave file then play it back later for analysis since you can still adjust a lot of display parameters. If you just save the waterfall graphics you are stuck with the display settings as they were recorded.

2.4 Disclaimer

The frequencies and sweep rates givien here are a good starting point for the eastern part of the US. Other areas are on their own in finding the CODAR stations that are within range and figuring out their frequencies and sweep rates.

Obtaining critical information concerning the CODAR transmitters can be difficult. Their frequencies may change or other timing parameters without any notice as these stations adjust for various data collecting tasks. The most critical is the sweep rate as it must be very accurate or one will not see any pulses at all.

One can look at a CODAR signal in the normal frequency domain and try and determine the min and max sweep frequency to get the sweep rate in MHz/Sec as well as if it has a one second period. Using a 1pps GPS trigger limits it to only those CODAR sweeps that are also 1 second(or perhaps multiples of 1 sec). Note that if the sweep goes from high to low then a negative sign is required for the sweep rate.

While one can get lots of pretty displays, interpreting them is quite another issue. Perhaps as more knowledgeable users start gathering data, more interesting results can be obtained.