

Digital Spectrometer Captured Spectra from the LWDA Site

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1 Introduction

A digital spectrometer, developed between UNM and VT, is being used for spectral evaluation and measurement of the analog signal path for the Long Wavelength Array. This report documents the first captures on the sky from the LWDA Site, located at the VLA in New Mexico.

2 System Description

The signal path under test consists of the following components:

- *Antenna:* Burns Prototype Antenna, fielded in Sept. 2008, North-South oriented.
- *Active Balun:* LWA Front-End Electronics (FEE) version 1.6
- *Coax Cable:* 150m of LMR-240.
- *ARX:* Brassboard ARX, PCBv2. All three filters and gain control were exercised. FEE was powered using the ARX internal bias-T.
- *DIG:* LWA Prototype ADC, designed by Mahmud Harun and Steve Ellingson (VT).
- *Clock:* ADC clocked at 200 MSPS with a 200 MHz Synthesizer.
- *Data Capture:* Analog Devices, Inc. HSC-ADC-EVALC. The digital capture board interfaces to a PC via USB and bursts coherent time data at a rate of about 0.1 ms per second.
- *Digital Spectrometer:* Software, written in LabVIEW, reads the captured time data files and performs the FFT and integration over the full bandwidth. The digital spectrometer software automatically saves integrated spectra at the time intervals specified. A screenshot of the spectrometer software is shown in Figure 1.

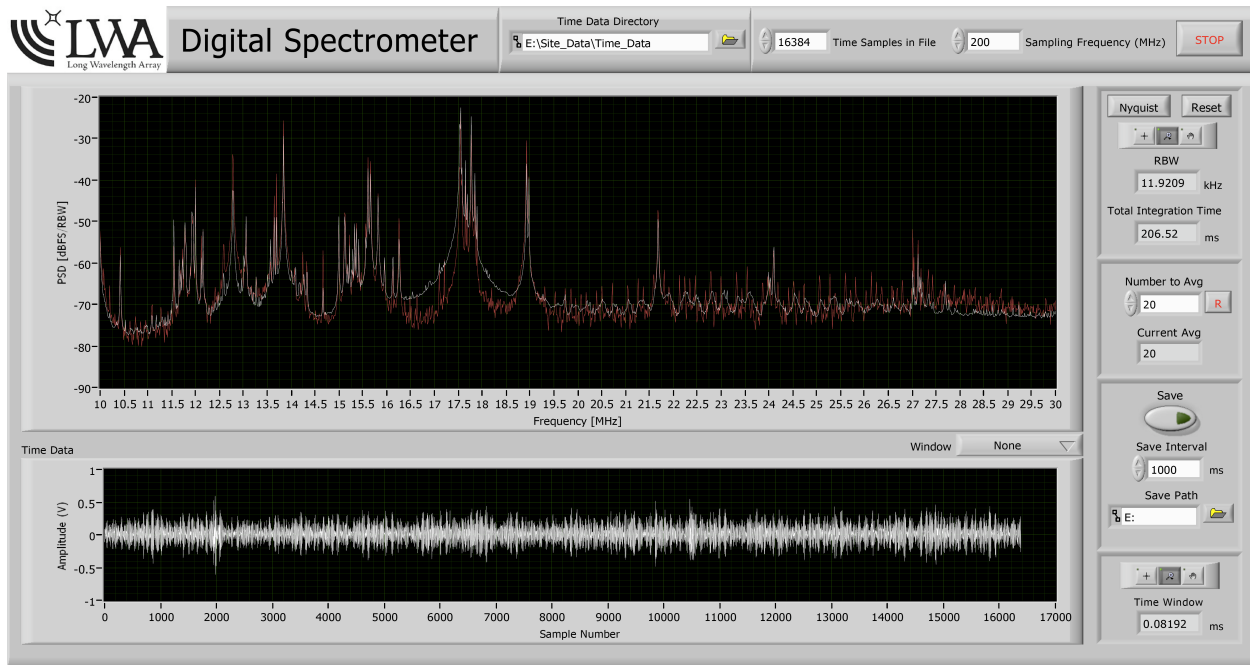


Figure 1. Digital Spectrometer software to visualize captured data in time and frequency. It is also planned to add dynamic spectra visualization.

2 Captured Spectra

The data presented is the signal seen by the AD9230 ADC, which has a full scale dynamic range of $\pm 1V$, 12 bits. The spectral density is given in dBFS/RTW, which is zero-referenced, in dB, from the full-scale range of the digitizer. PSD, in mW, is roughly +10 dBm to 0 dBFS, i.e. signal levels of -20 dBFS/RTW are approximately -10 dBm/RTW.

- *Full Bandwidth Filter Configuration:* ARX configured gains of -20dB on attn1 & -20dB on attn2. Approximate ARX gain of +30dB, over 10-80MHz. Captured spectra was integrated for 500ms.
- *Reduced Bandwidth Filter Configuration:* ARX configured gains of -8dB & -8dB on attn1 & attn2, respectively. Approximate ARX gain of +54dB, over 28-54MHz. Captured spectra was integrated for 200ms.
- *Split Bandwidth Filter Configuration:* ARX configured gains -8dB & -8dB on attn1 & attn2, respectively. Split BW attenuator was set to -20dB, which corresponds to approximately 10 MHz being 14dB below the gain at 80 MHz. Approximate ARX gain of +48dB at 80MHz and +34dB at 10MHz. Captured spectra was integrated for 200ms.

All three filter configurations, on the sky at the LWDA site, are shown in Figure 2.

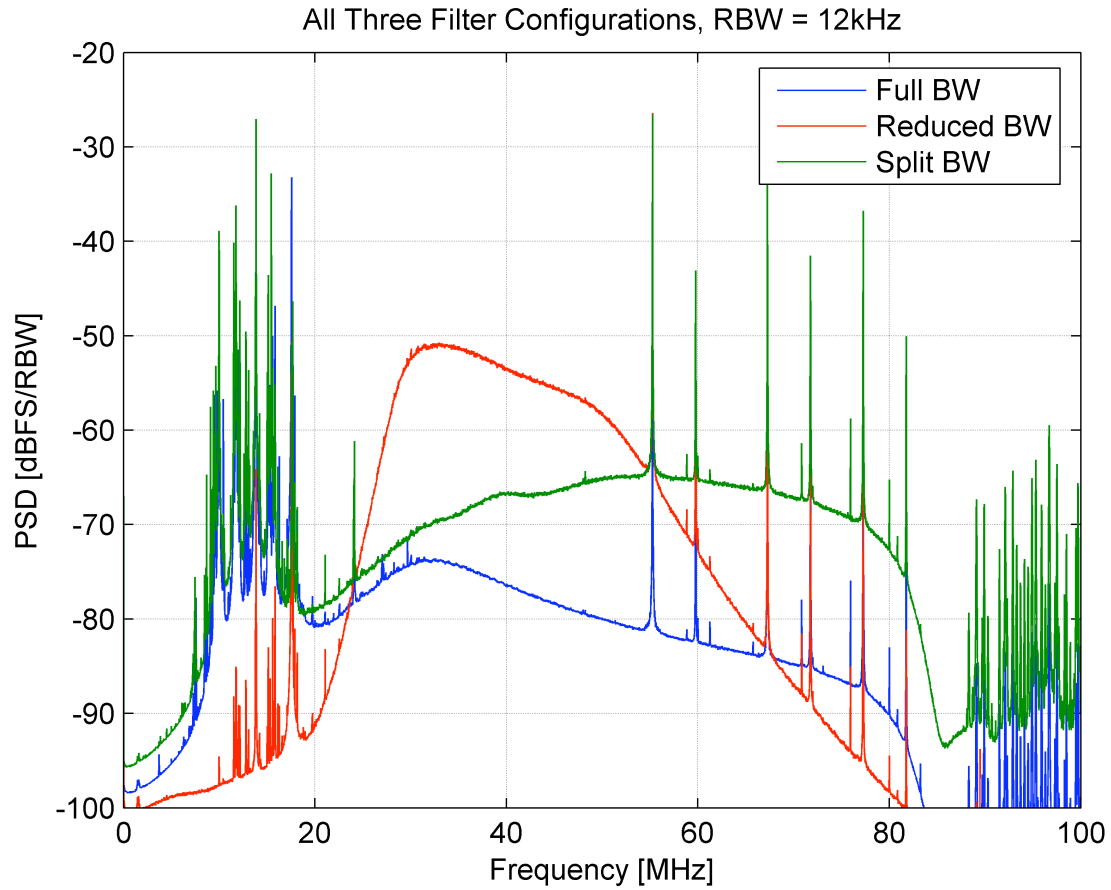


Figure 2: Captured Data as seen by N-S oriented LWA Antenna at the LWDA Site in NM. The Full BW was integrated for 500ms; Reduced BW and Split BW were integrated for 200ms. Note, the weak RFI shown, specifically around 20-30MHz, which we are unable to visualize with a traditional spectrum analyzer monitoring system.

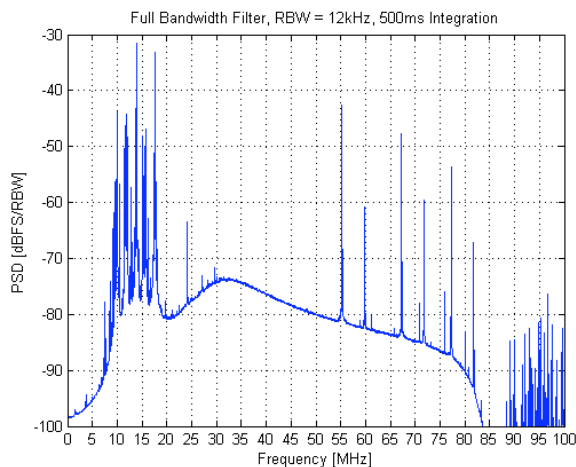


Figure 3: Full Bandwidth Filter Configuration.

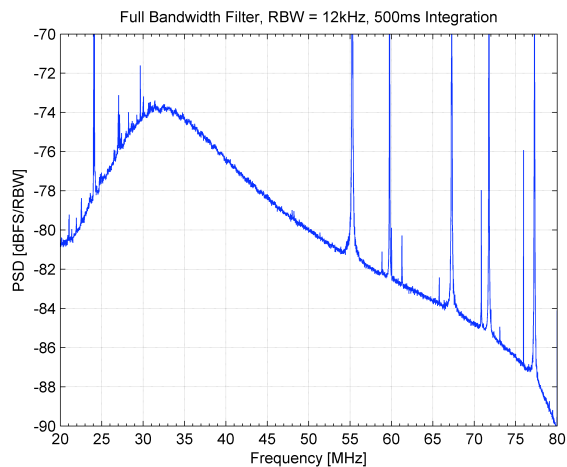


Figure 4: Full Bandwidth Filter Configuration, zoomed to passband.

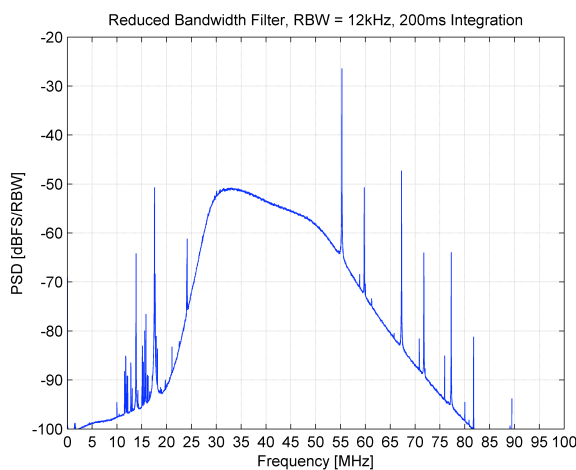


Figure 5: Reduced Bandwidth Filter Configuration.

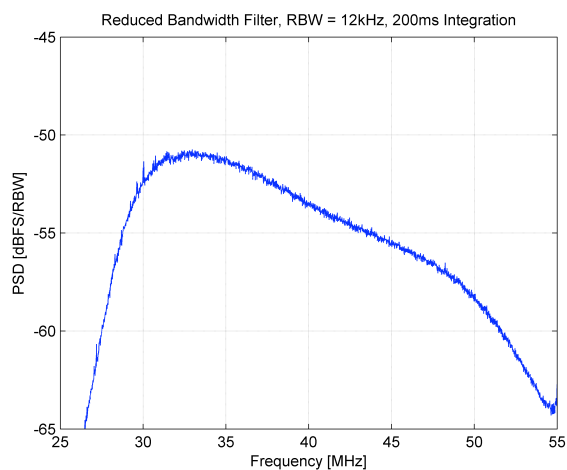


Figure 6: Reduced Bandwidth Filter Configuration, zoomed to passband.

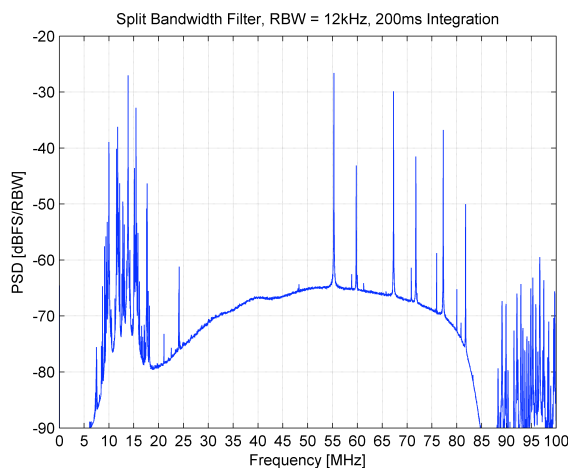


Figure 7: Split Bandwidth Filter Configuration.

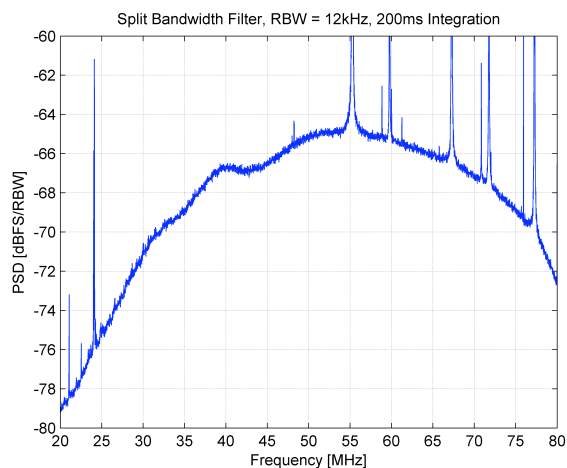


Figure 8: Split Bandwidth Filter Configuration, zoomed to passband.