Using a MAX 2870/71 Signal Source Generator as a Pulsar Simulator

Richard A. Russel

Abstract

A pulsar was simulated using a signal source generator that swept between 4 GHz and 6 GHz at a 10 MHz step size. This signal resulted in a simulated pulse period of 4.036 second and a pulse width (w50) of 85 millisecond. This approach had an added benefit of providing 2 GHz of signal which could be used by a remote observer to estimate the pulsar distance by measuring the dispersion measure of the high and low frequencies as they pass through the interstellar medium.

Components

The pulsar transmitter consists of a 5 GHz antenna and a signal source generator. (figures 1 and 2)

Figure 1: 5 GHz Antenna (amazon.com)

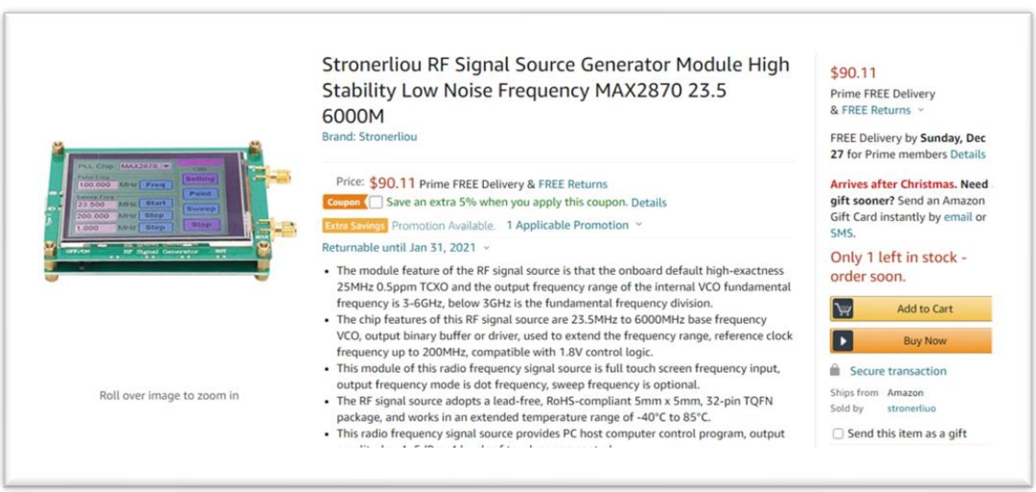

Figure 2: Signal Source Generator (amazon.com)

Assembly

The pulsar simulator was assembled using the MAX 2870/71 signal generator and the 5 GHz antenna. Note that the 5 GHz antenna can be replaced with a similar antenna for the chosen frequency range. (figure 3)

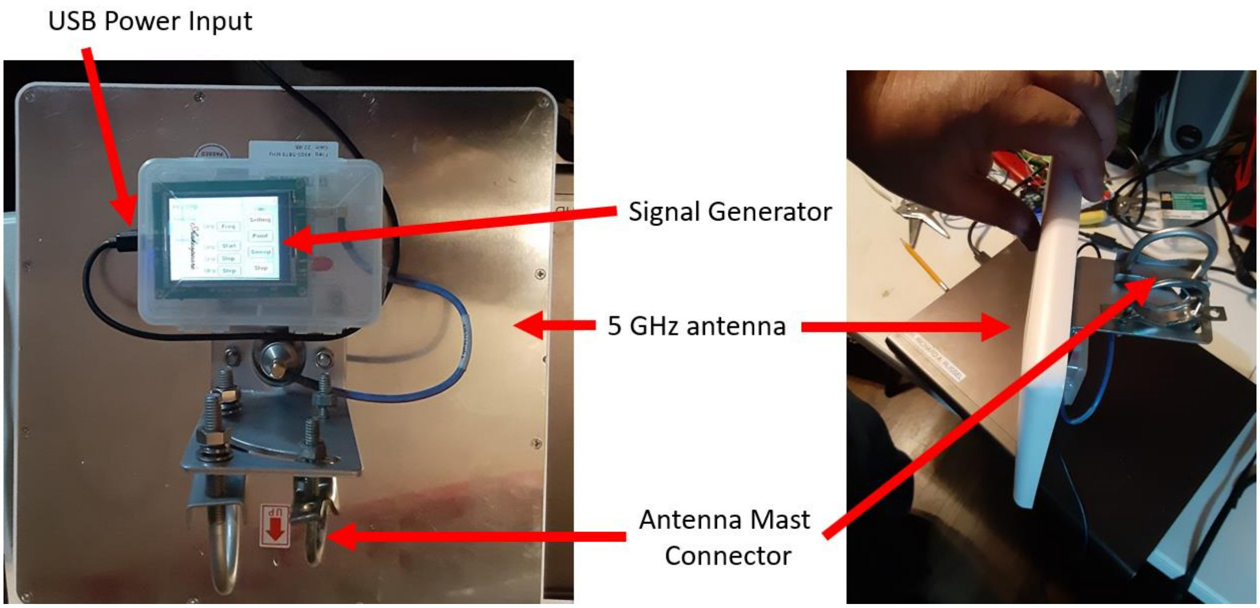

Figure 3: Pulsar Simulator Assembly

Signal Generator Setup

The signal generator was setup to sweep a signal from 4 GHz to 6 GHz using 10 MHz steps. This provided a simulated pulsar period of 4.036 second and a pulse width (W50) of 85 millisecond. The signal generator only required a USB power source. There is an ON/OFF switch on the lower right below the display.

The signal generator setup is shown in figure 4. Start the pulsar simulator by touching the sweep button.

Figure 4: Signal Source Generator setup

Pulsar Simulator Output

The pulsar simulator was put next to a USRP B210 receiver that was tuned to 5 GHz. The signal was captured for 5 minutes and processed using PRESTO. The resultant output shows a characteristic pulsar. (figure 5)

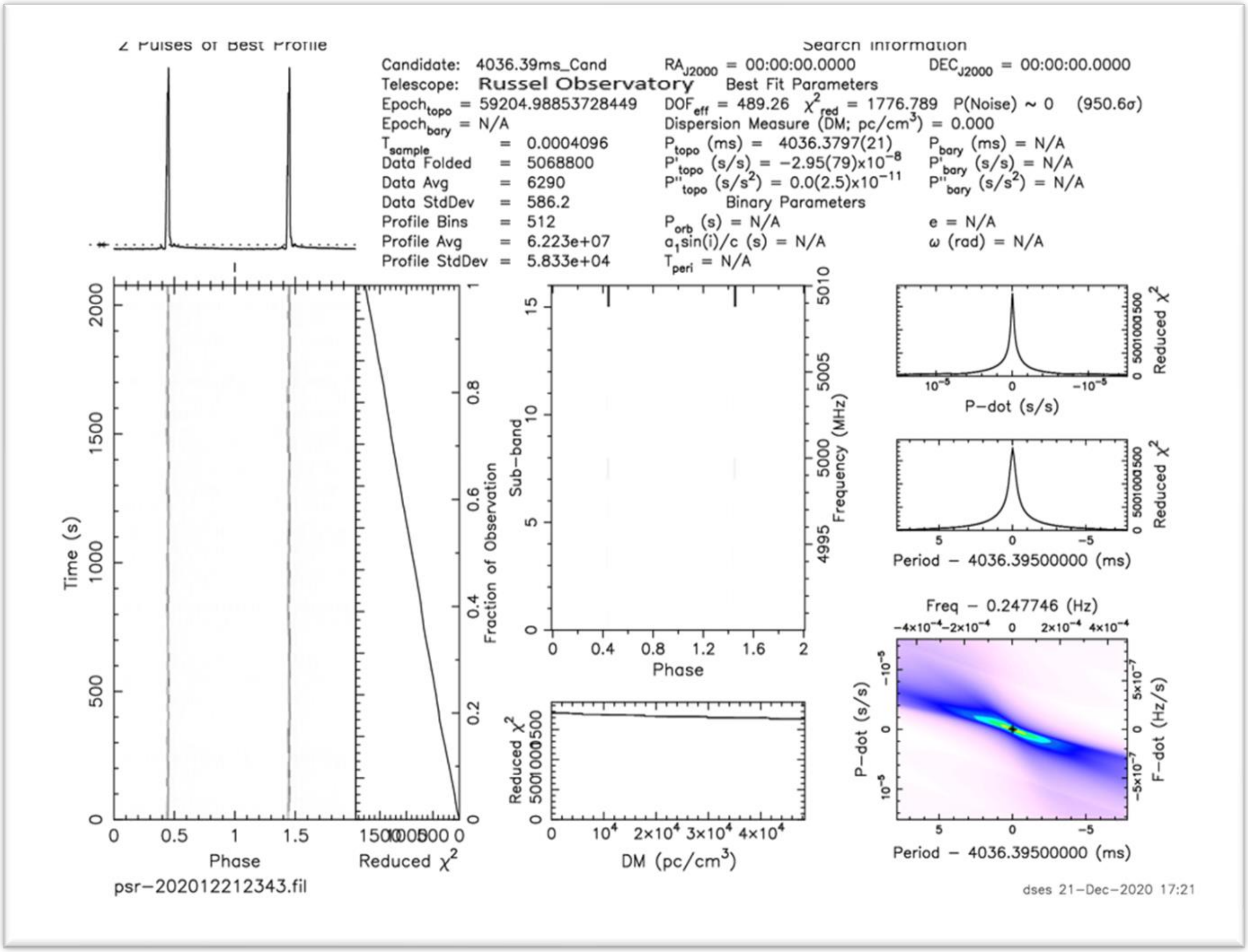

Figure 5: Pulsar Output

Analysis of the simulated pulsar data shows that the resultant pulse period is 4.036 second and the pulse width (W50) is 85 millisecond. (figure 6)

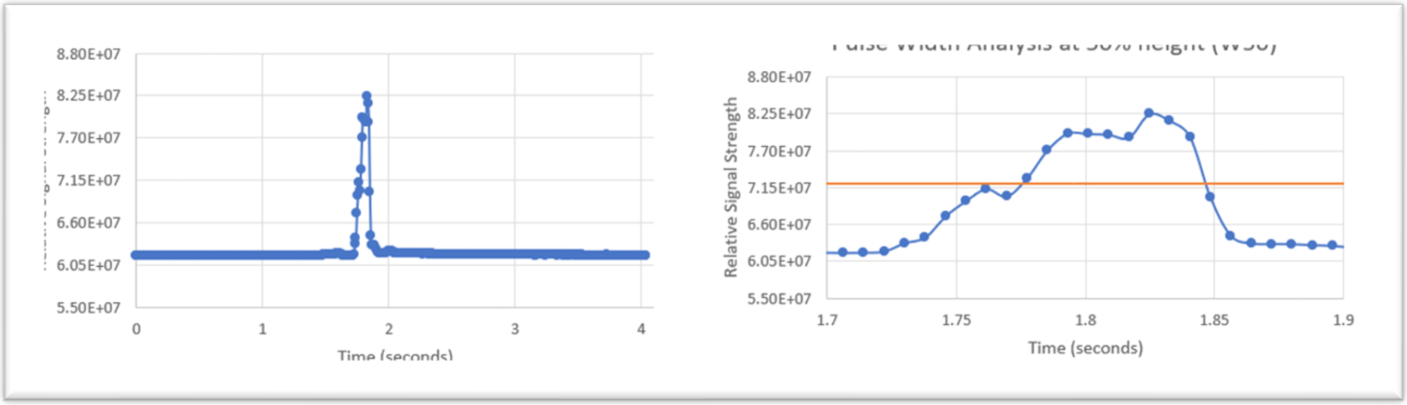

Figure 6: Pulsar Characteristics: period and pulse width analysis

Pulsar Simulator Settings Analysis

The signal source produced a pulsar signature when combined with a receiver that collected a signal at a certain center frequency and bandwidth. The pulsar simulation results of multiple combinations of frequency source settings and receiver settings are shown in figure 7.

MAX 2871 Settings		B210 Settings		Pulsar Results
Freq Range	Step Size	CTR Freq	BW	Period (seconds)
4-6 GHZ	10 MHZ	5GHZ	30 MHZ	4.016
4-6 GHZ	10 MHZ	5GHZ	20 MHZ	4.036
4-6 GHZ	10 MHZ	5GHZ	10 MHZ	4.040
4-6 GHZ	10 MHZ	5GHZ	5 MHZ	4.039
3-5 GHZ	10 MHZ	4GHZ	5 MHZ	4.039
3-5 GHZ	10 MHZ	4GHZ	10 MHZ	4.039
3-5 GHZ	10 MHZ	4GHZ	20 MHZ	4.036
3-5 GHZ	10 MHZ	4GHZ	30 MHZ	4.023
3-5 GHZ	5 MHZ	4GHz	30 MHZ	8.009
3-5 GHZ	5 MHZ	4GHZ	20 MHZ	8.033
3-5 GHZ	5 MHZ	4GHZ	10 MHZ	8.033
3-5 GHZ	5 MHZ	4GHZ	5 MHZ	8.033
300 - 500 MHZ	1 MHZ	400 MHZ	5 MHZ	1.010
300 - 500 MHZ	1 MHZ	400 MHZ	10 MHZ	1.010
300 - 500 MHZ	1 MHZ	400 MHZ	20 MHZ	1.094
300 - 500 MHZ	1 MHZ	400 MHZ	30 MHZ	1.006

Figure 7: Pulsar Simulation Results Analysis

Summary

The MAX 2870/71 signal source was configured to simulate a pulsar. This allowed for receiver setup and pulsar processing training. The ease of use of the MAX 2870/71 provided a quick pulsar simulator that is an excellent tool for pulsar receive systems.

Richard A. Russel (AC0UB)

Dr. Rich Russel is the vice president for SARA and the current science lead for the Deep Space Exploration Society. He is a retired Northrop Grumman Senior Systems Engineer and served as the Chief Architect for the Satellite Control Network Contract (SCNC). In this capacity he was charged with planning the future architecture of the Air Force Satellite Control Network (AFSCN) and extending the vision to the Integrated Satellite Control Network (ISCN). Dr. Russel has been the lead architect and integrator for the Space-Based Blue Force Tracking project for U.S Space Command, the Center for Y2K Strategic Stability, and CUBEL Peterson. Dr. Russel also has led the SPAWAR Factory team in the deployment of the UHF Follow-On Satellite system. He has a Doctorate in Computer Science, an Engineers Degree in Aeronautics and Astronautics, a Master's in Astronautical Engineering, and a Bachelor's in Electrical Engineering. He is also certified as a Navy Nuclear Engineer and he is a retired Navy nuclear fast attack submariner and Navy Space Systems Engineer.