General Purpose Superheterodyne Phase Coherent Ka-Band Receiver based on the ADMV1014 Downconverter and ETTUS USRP B205mini-I SDR

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1. **Superheterodyne Phase Coherent Ka-Band Receiver with Image rejection and IF = 1575 MHz.**
2. **Bandwidth = 26.5 GHz to 40 GHz.**
3. **Figure 1 shows a block diagram of the Ka-band receiver.**
4. **Figure 2 shows a 2-tone RF signal input with 50 KHz separation on a 29 GHz carrier at -115 dBm. The intent of this measurement was to determine the receiver sensitivity.**
5. **Figure 3 shows the SDR IF input from the ADMV1014 downconverter.**
6. **Figure 4 shows an output spectral density plot from the SDR with gain = 50, sample rate = 25 Msps, SC12 data format, and low-pass filter set to 12.5 MHz.**
7. **Figure 5 shows an expanded view of Figure 4 with two-tone response and LO leakage from the RF signal source. Receiver sensitivity is < -115 dBm with C/N >= 32 dB.**
8. **Figure 6 shows the ADMV1014 downconverter GUI settings with register map shown in Figure 7.**
9. **Figures 8, 9, and 10 show a custom GUI controlling the SDR. Specifically, SDR gain = 50, downconversion frequency = 1580 MHz, data capture is in the "SC12" mode, sample rate = 25 Msps with low-pass bandwidth = 12.5 MHz.**

Continued Notes

10. **Figure 11 shows a schematic of the ETTUS USRP B205mini-I SDR.**
11. **Figure 12 shows IF Input to SDR with 2 Tone RF Input separated by 50 KHz centered on 29 GHz @ -55 dBm per Tone. This measurement shows the performance with what is considered the maximum RF input. Also shown are the 1st order intermodulation distortion spurs.**
12. **Figure 13 shows the SDR Output Power Spectral Density Plot with 2 Tone RF input separated by 50 KHz centered on 29 GHz @ -55 dBm per Tone.**
13. **Figure 14 shows an expanded view of Figure 13 with 2 tone response, LO leakage from the RF signal source, and 1st order IMD spurs.**
14. **Receiver RF input dynamic range is a conservative 60 dB with lowest RF input sensitivity < -115 dBm and C/N = 32 dB. The maximum signal is considered to be -55 dBm. With a Millimeter Wave 18 inch Ka-band cassegrain parabolic dish antenna, the lowest sensitivity extends down to < -154 dBm. By inserting an attenuator between the ADMV1014 downconverter RF input and LNA, the maximum RF signal can be increased to ~ -49 dBm.**

Figure 1. Ka-Band Receiver Block Diagram

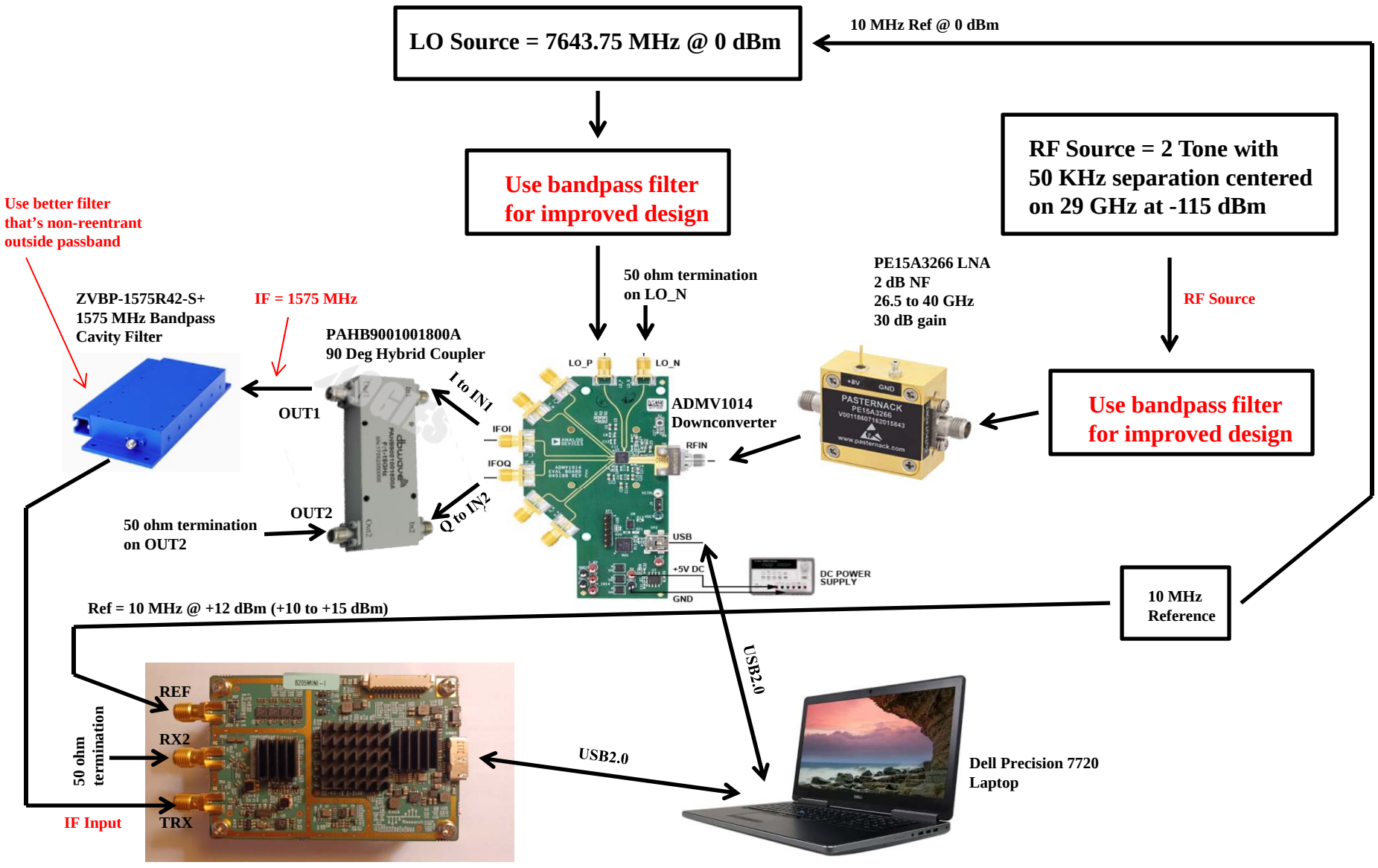
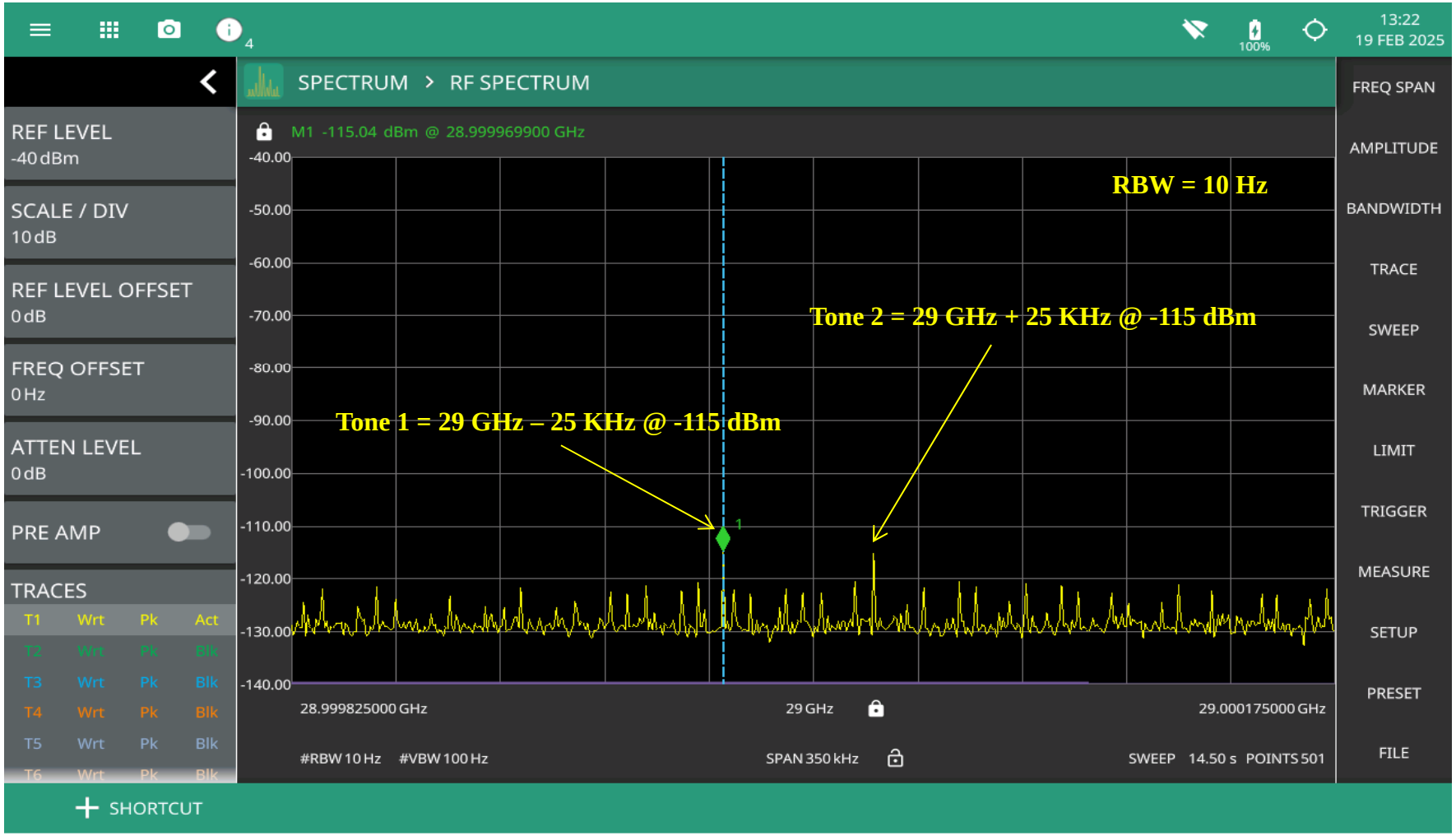


Figure 2. 2-Tone RF Input



Anritsu MS2090A SN: 2303019 SW Package: V2023.3.1
Options: 0031,0104,0124,0125,0128,0199,0743
Date/Time: 19 Feb 2025 13:23:29 CST GPS: ---

Figure 3. IF to SDR

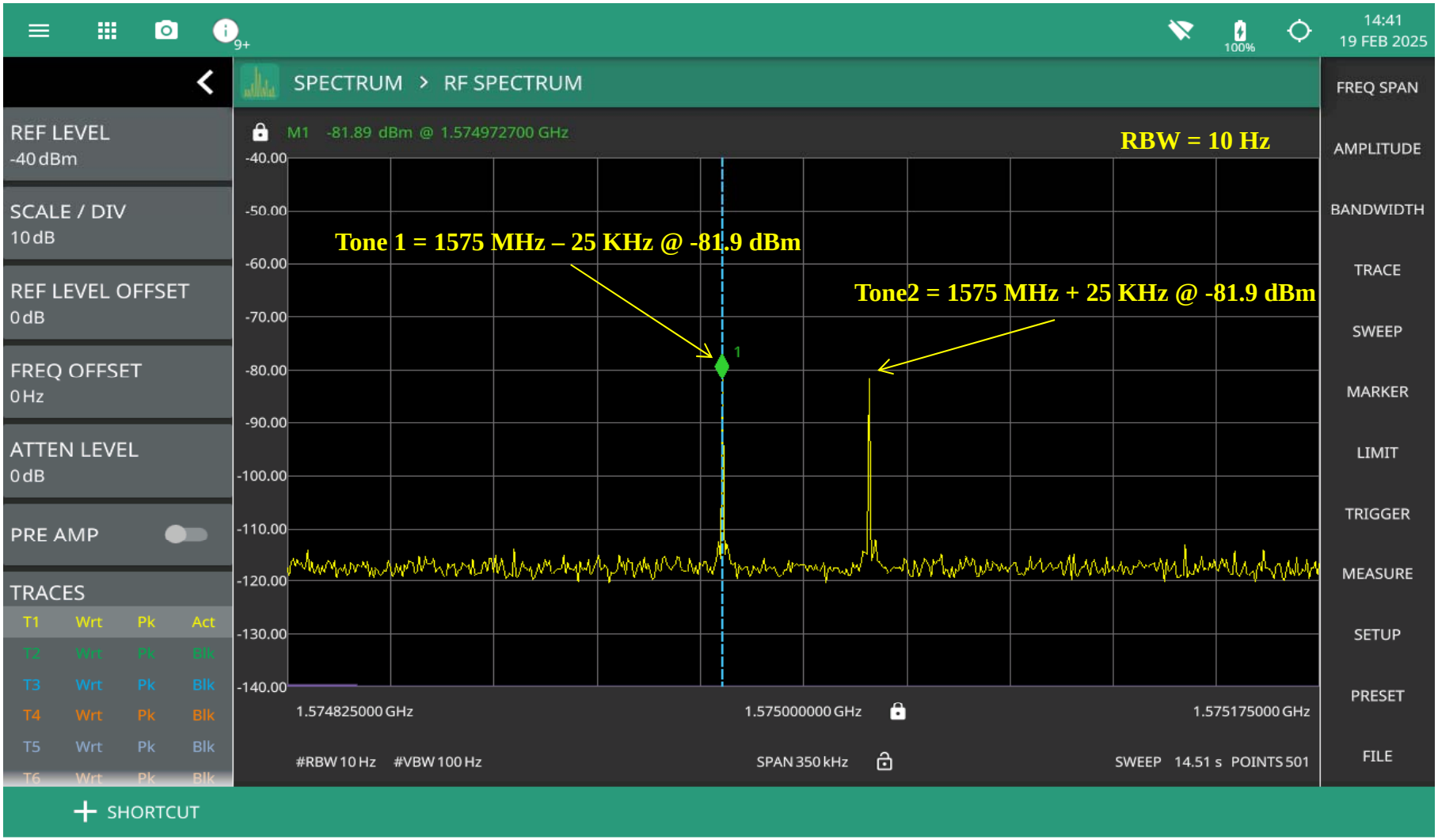


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Figure 4. SDR Output Power Spectral Density Plot

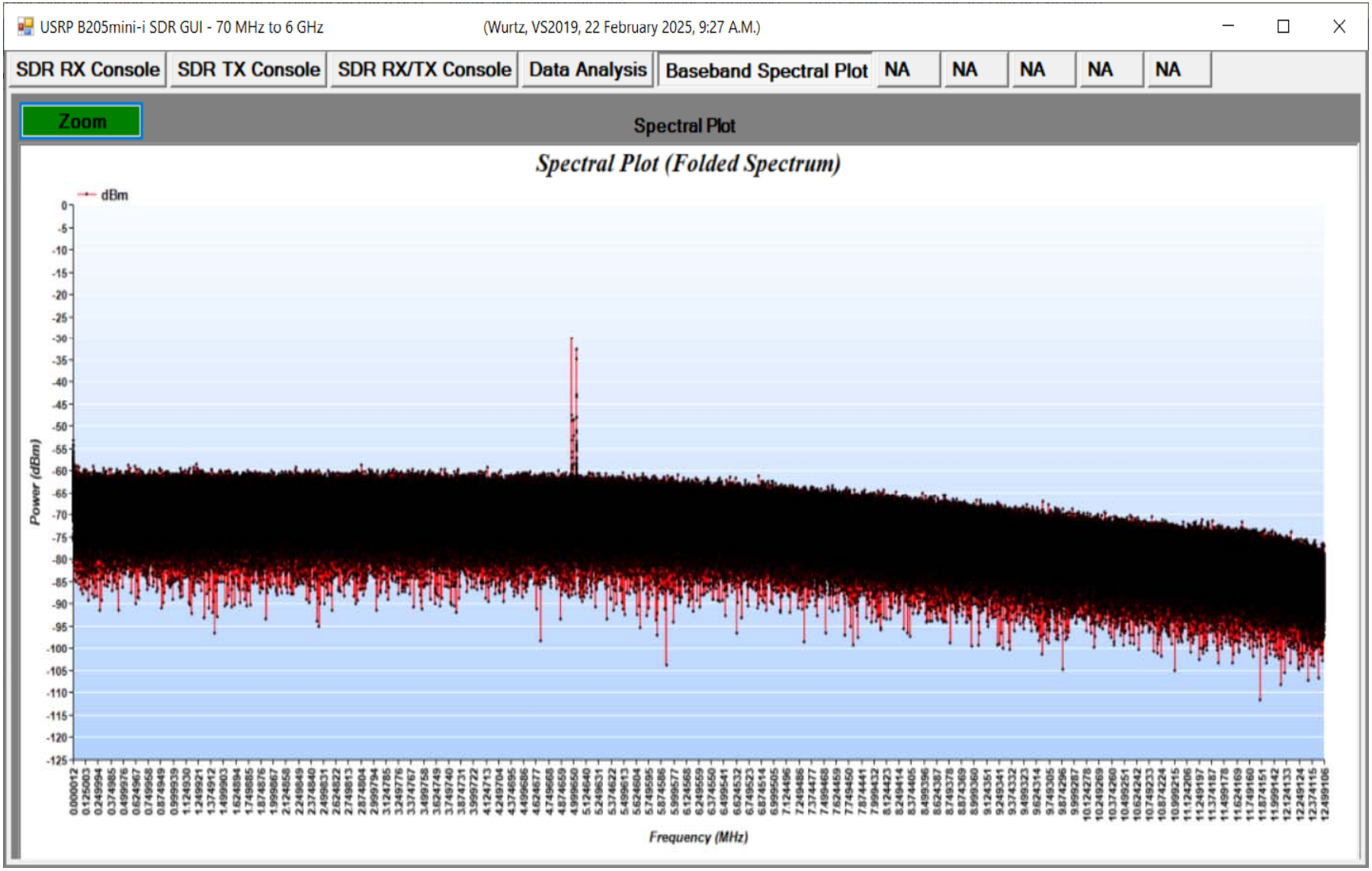

Figure 5. SDR Output Spectral Density Plot (Expanded View)

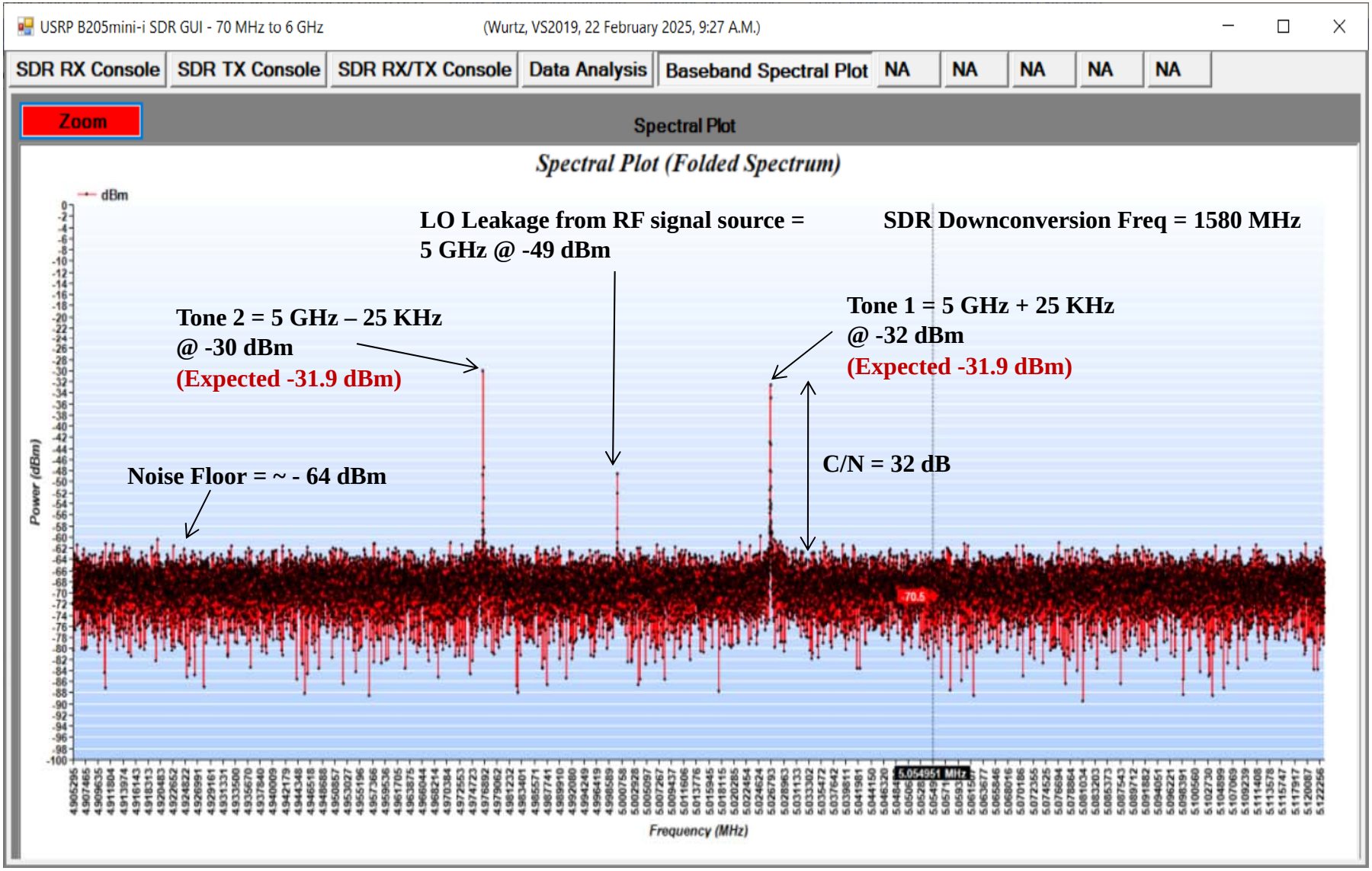

Figure 6. ADMV1014 Downconverter GUI from Analog Devices

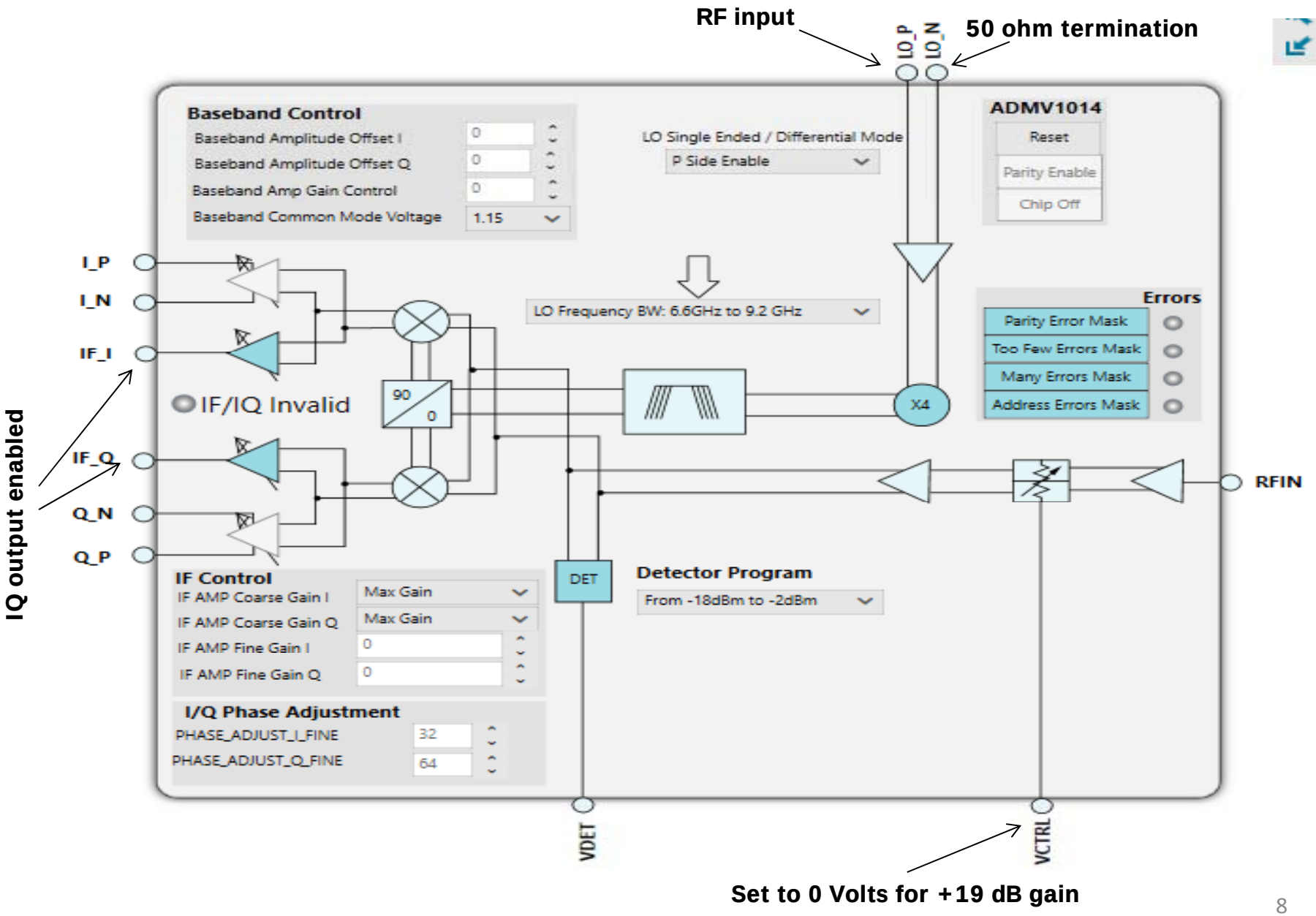

Figure 7. ADMV1014 Downconverter Register Map

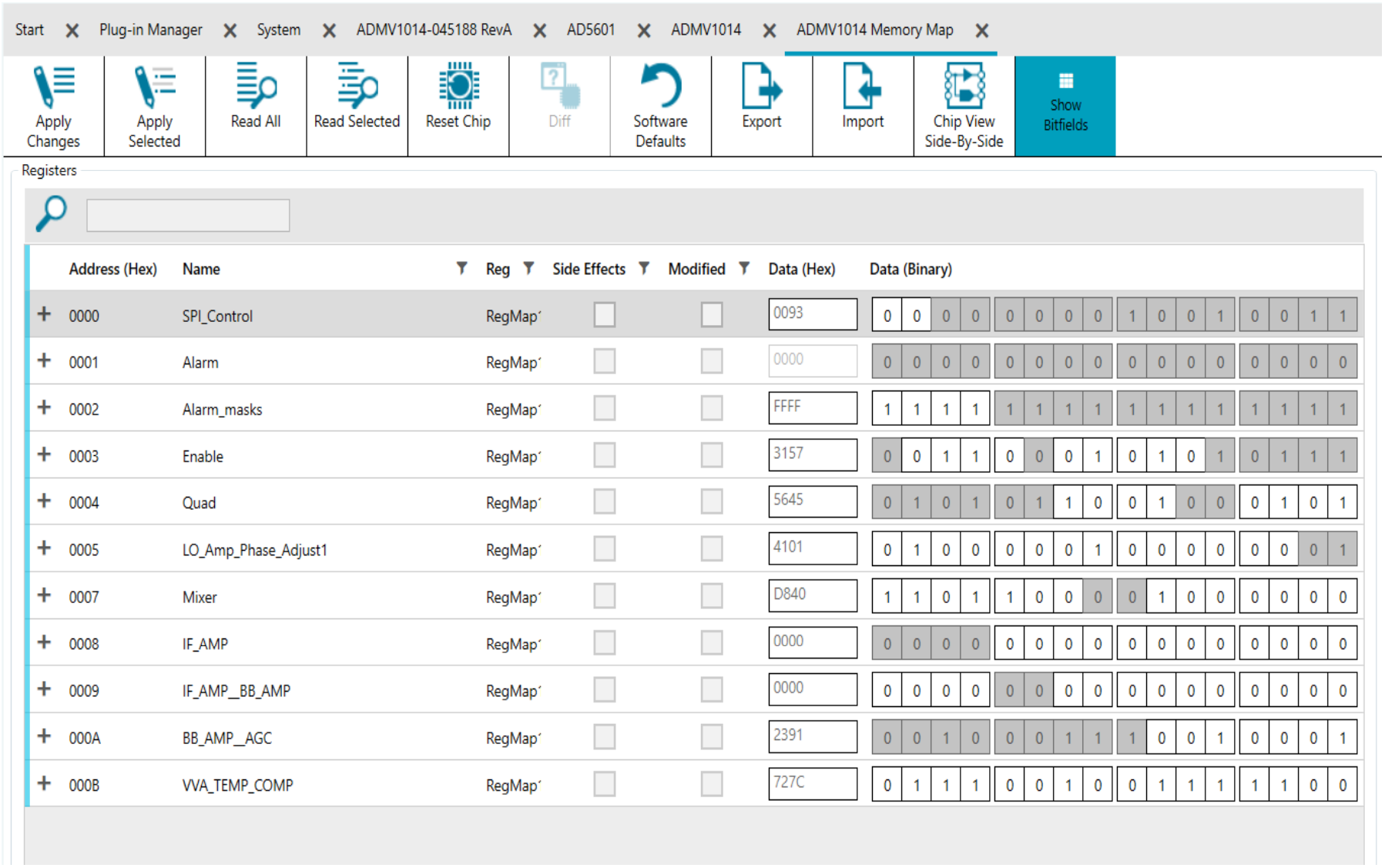

Figure 8. B205mini-I SDR GUI Screenshot 1

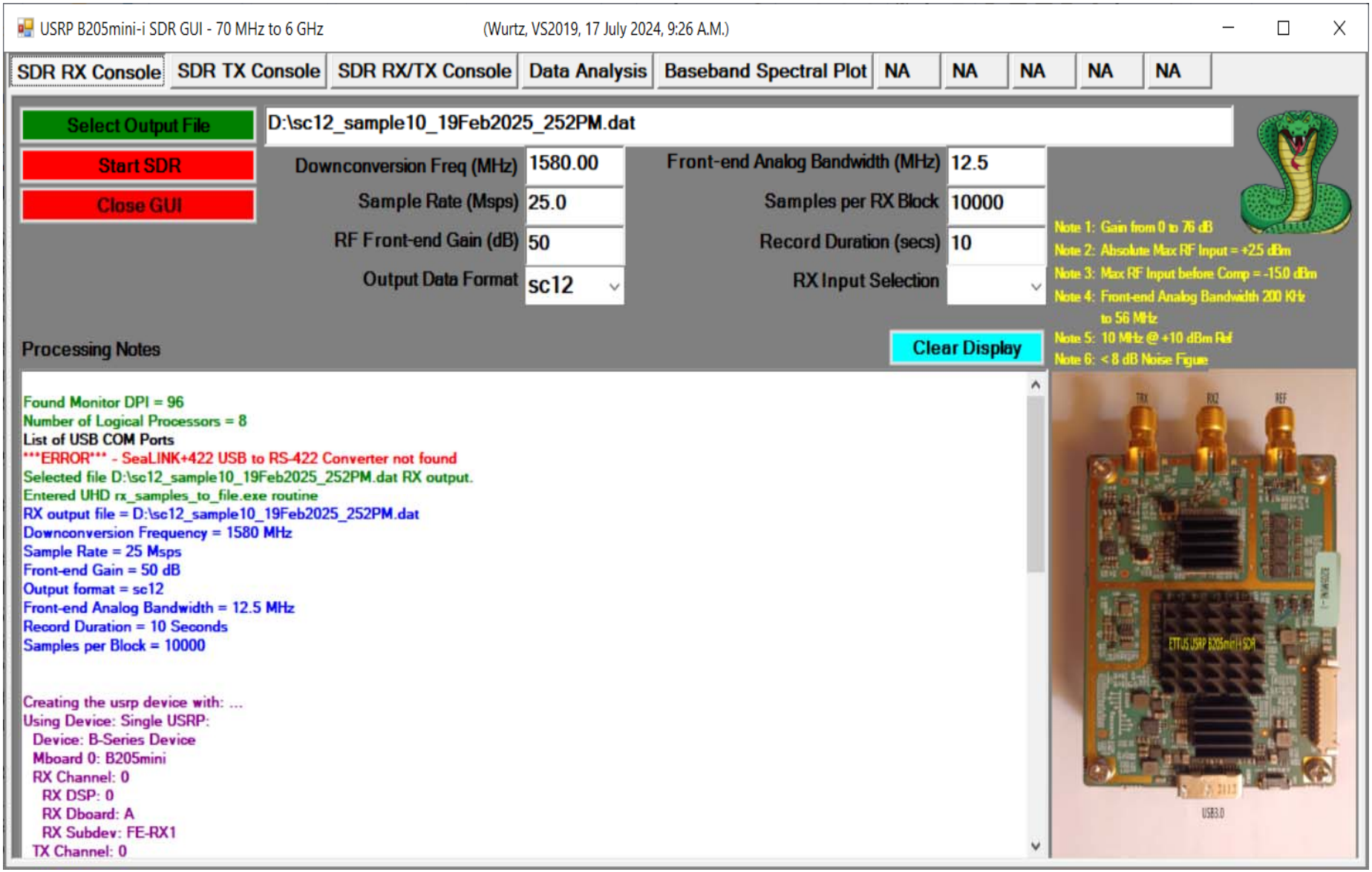

Figure 9. B205mini-I SDR GUI Screenshot 2

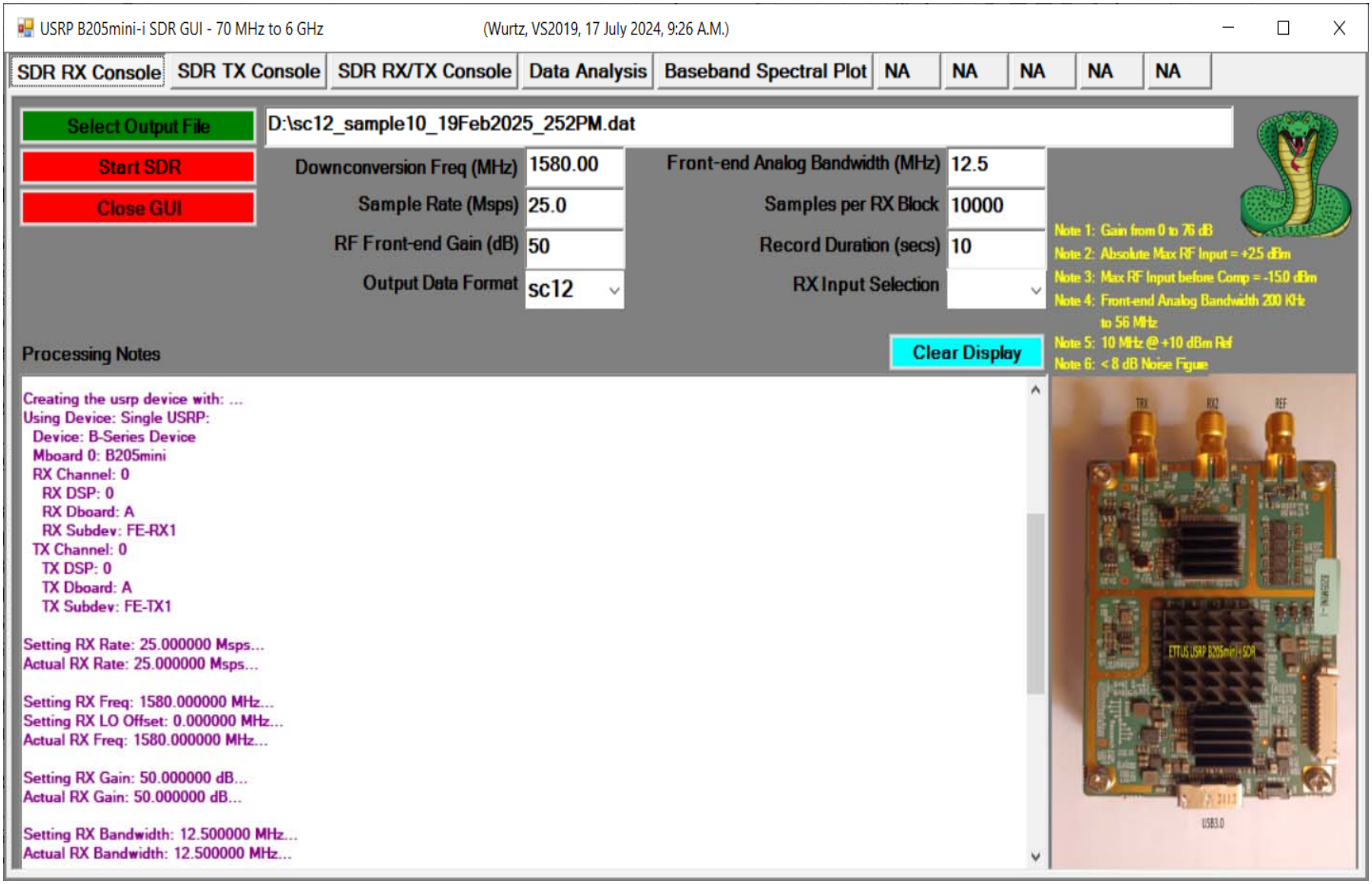

Figure 10. B205mini-I SDR GUI Screenshot 3

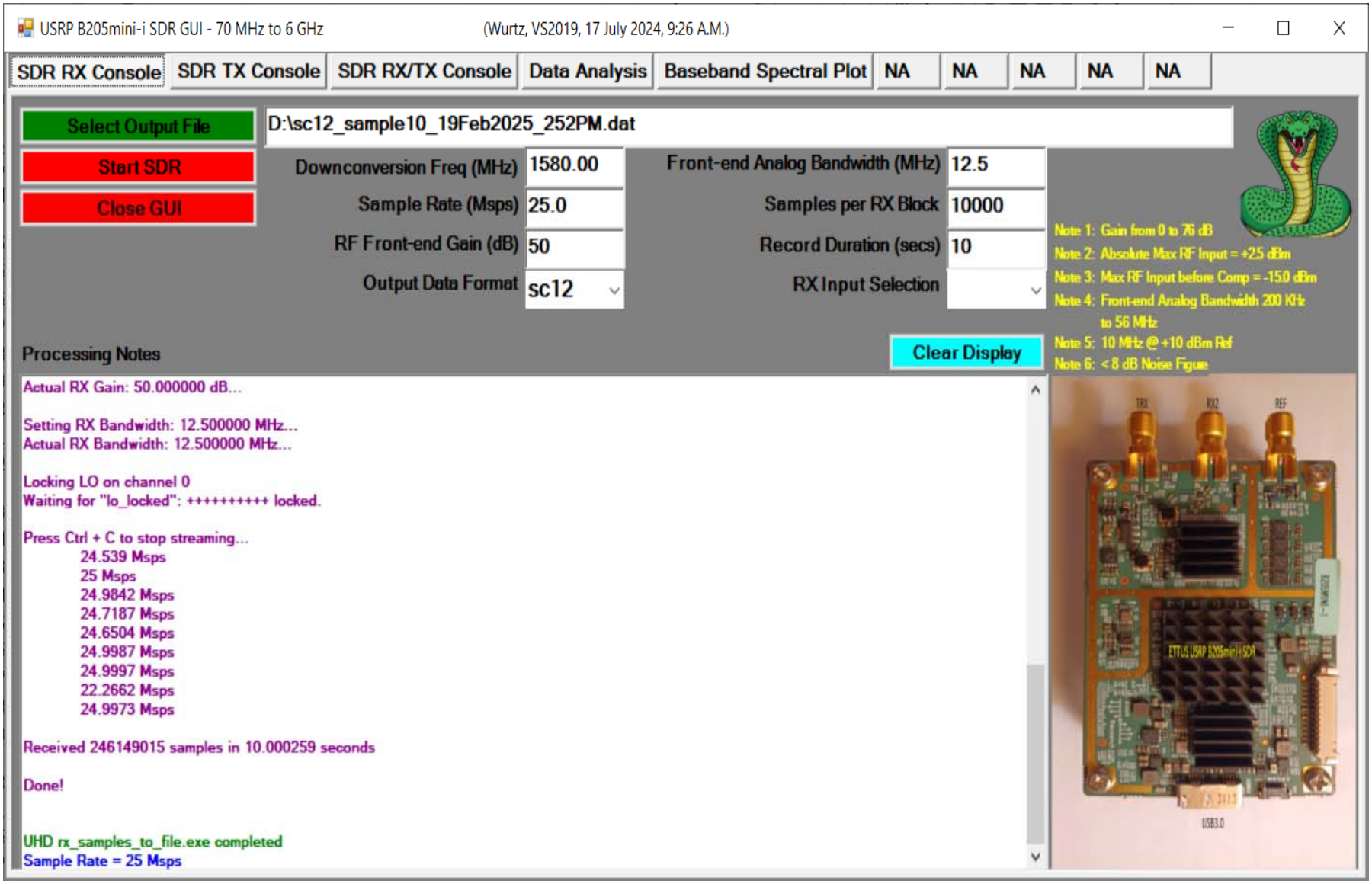

Figure 11. ETTUS USRP B205mini-I Schematic

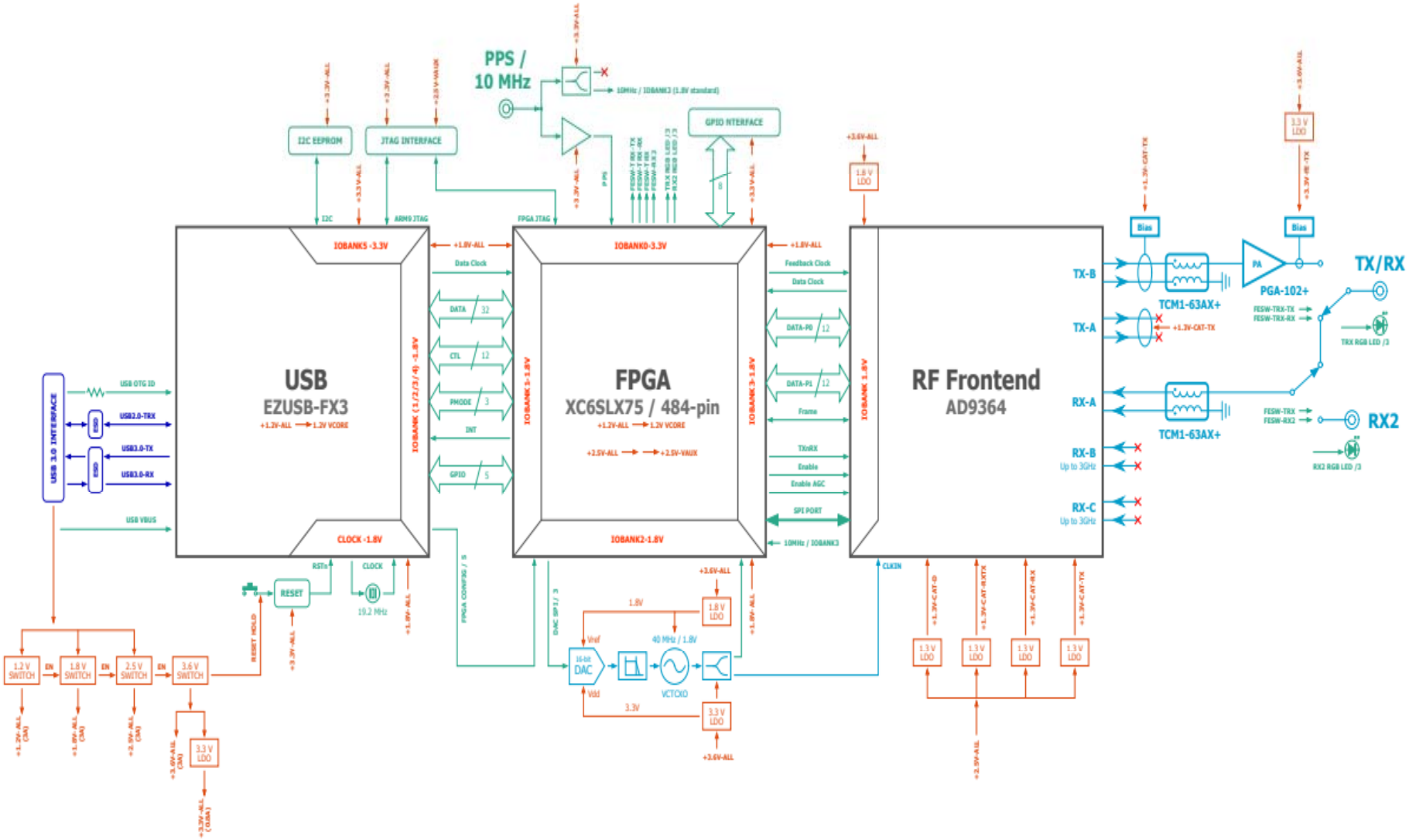

Figure 12. IF Input to SDR with
2 Tone RF Input separated by 50 KHz centered on 29 GHz @ -55 dBm per Tone

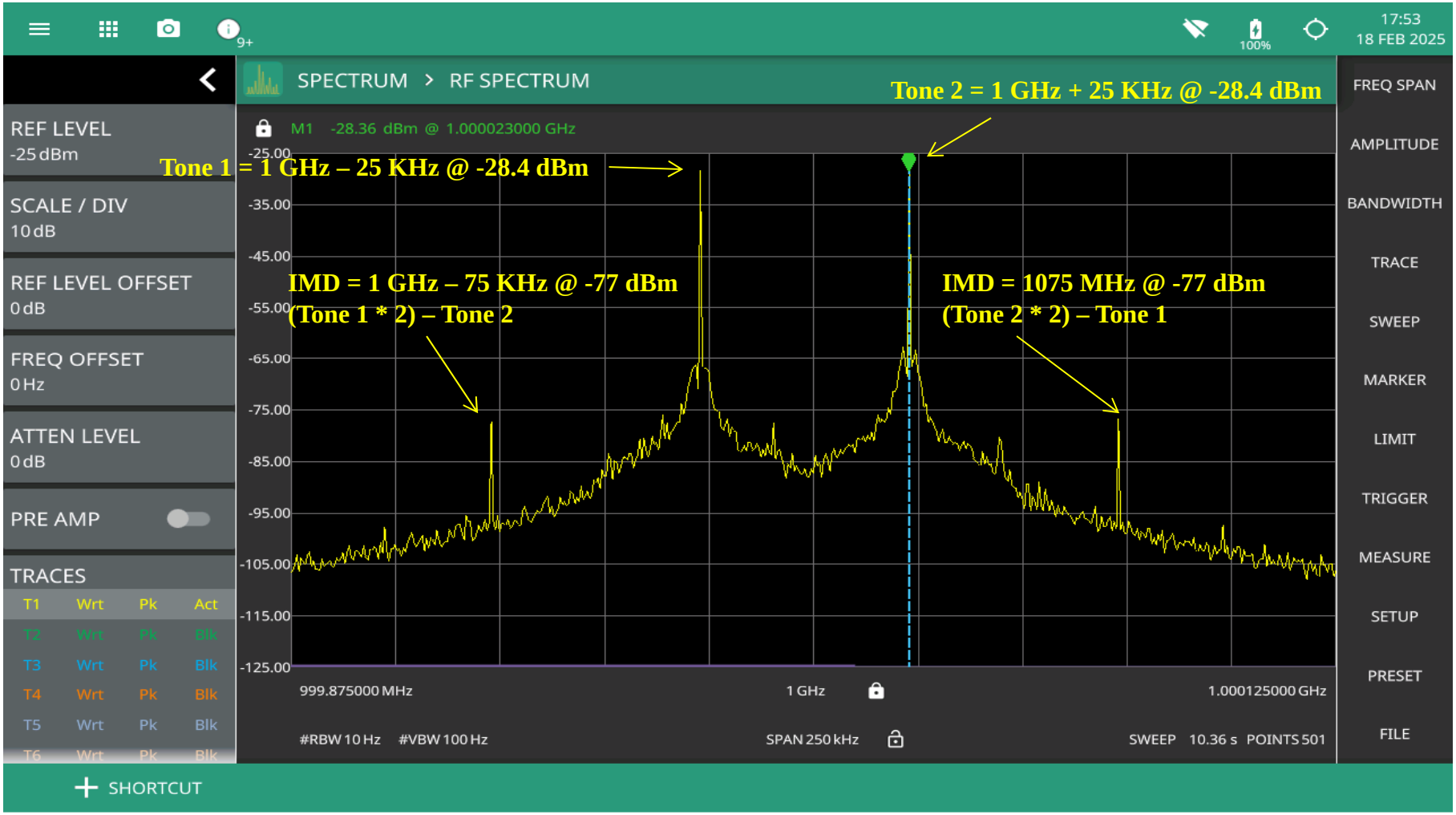

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Figure 13. SDR Output Power Spectral Density Plot with 2 Tone RF input separated by 50 KHz centered on 29 GHz @ -55 dBm per Tone

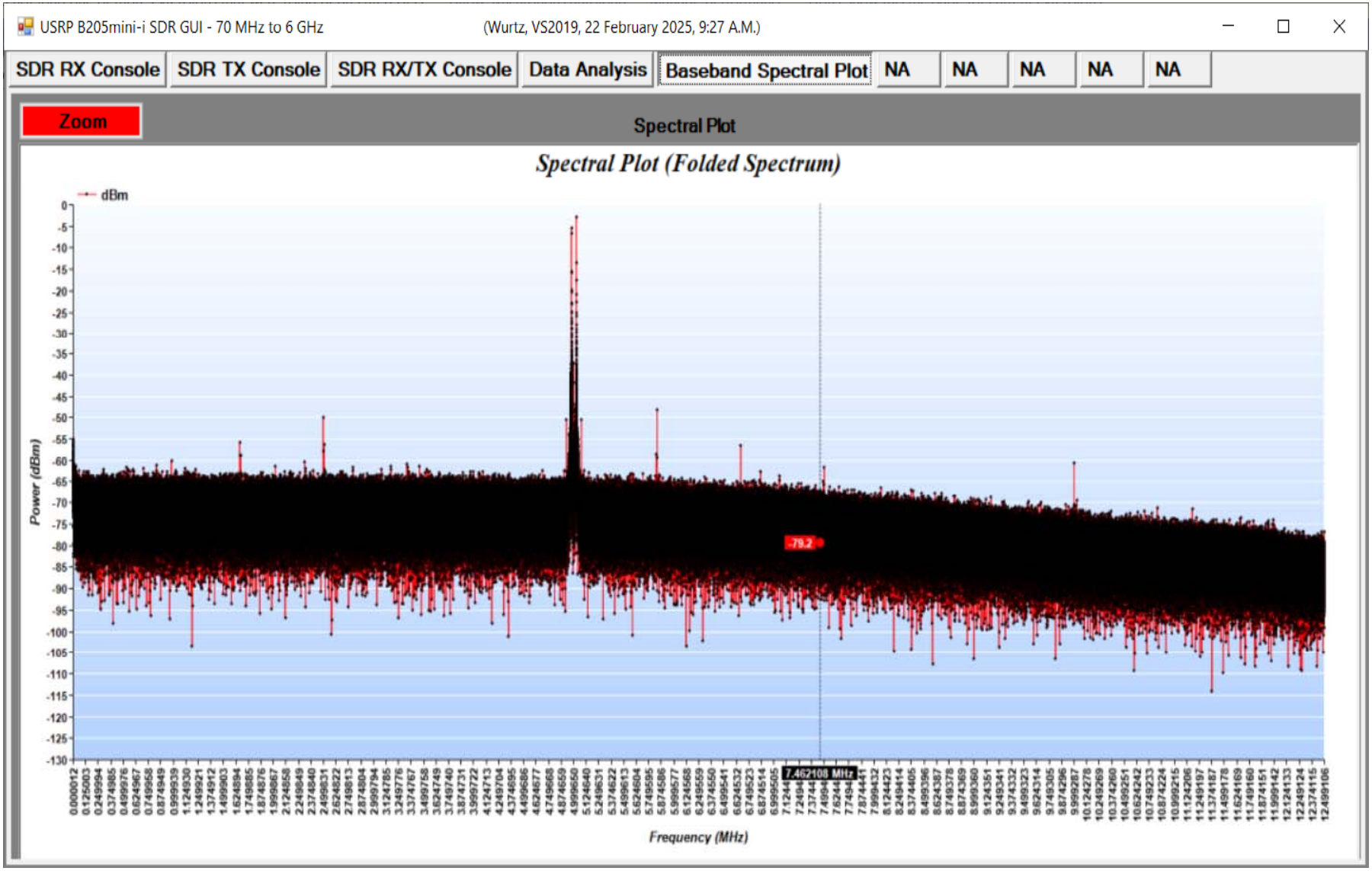

Figure 14. Expanded View of Figure 13