General Purpose Superheterodyne Phase Coherent X-band Receiver
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1. **Figure 1 shows a block diagram of the superheterodyne phase coherent X-band receiver.**
2. **Figure 2 shows the two-tone RF input with 50 KHz separation centered on 9 GHz at -115 dBm.**
3. **Figure 3 shows the downconverted IF signal between the downconverter and B205mini-I software defined radio centered on 1575 MHz.**
4. **Figure 4 shows an expanded view of the IF signal from 1 MHz to 6 GHz. Improved filtering would be helpful to reduce unwanted spectral noise.**
5. **Figure 5 shows the folded spectral density plot from the SDR with SDR LO = 1580 MHz.**
6. **Figure 6 shows a closer view of the two-tone output from the SDR with SDR LO = 1580 MHz.**
7. **With RF input level at -115 dBm, the C/N is +36 dB. With a C/N of +11 dB, it can be concluded that the minimum RF input signal would be -140 dBm.**
8. **Figures 7 and 8 are included to complete the experiment documentation and show that when the SDR LO (1580 MHz) is above the SDR IF (two tones centered on 1575 MHz), the spectral energy is in the lower, or negative spectrum.**
9. **Figure 9 shows the folded power spectral density plot from SDR with SDR LO = 1570 MHz.**
10. **Figure 10 is an expanded view of Figure 9 showing the two tone SDR output with C/N = +36 dB. Matching the results reported in line 7, if the C/N were reduced to +11 dB the X-band receiver minimum sensitivity would be -140 dBm.**
11. **Figures 11 and 12 are included for report completeness and show that when the SDR LO (1570 MHz) is below the SDR IF (two-tones centered on 1575 MHz), the spectral energy is in the upper, or positive spectrum.**
12. **Figures 13, 14, and 15 are screenshots of the custom B205mini-I GUI controlling the downconversion process.**

Figure 1. General Purpose Superheterodyne Phase Coherent X-Band Receiver

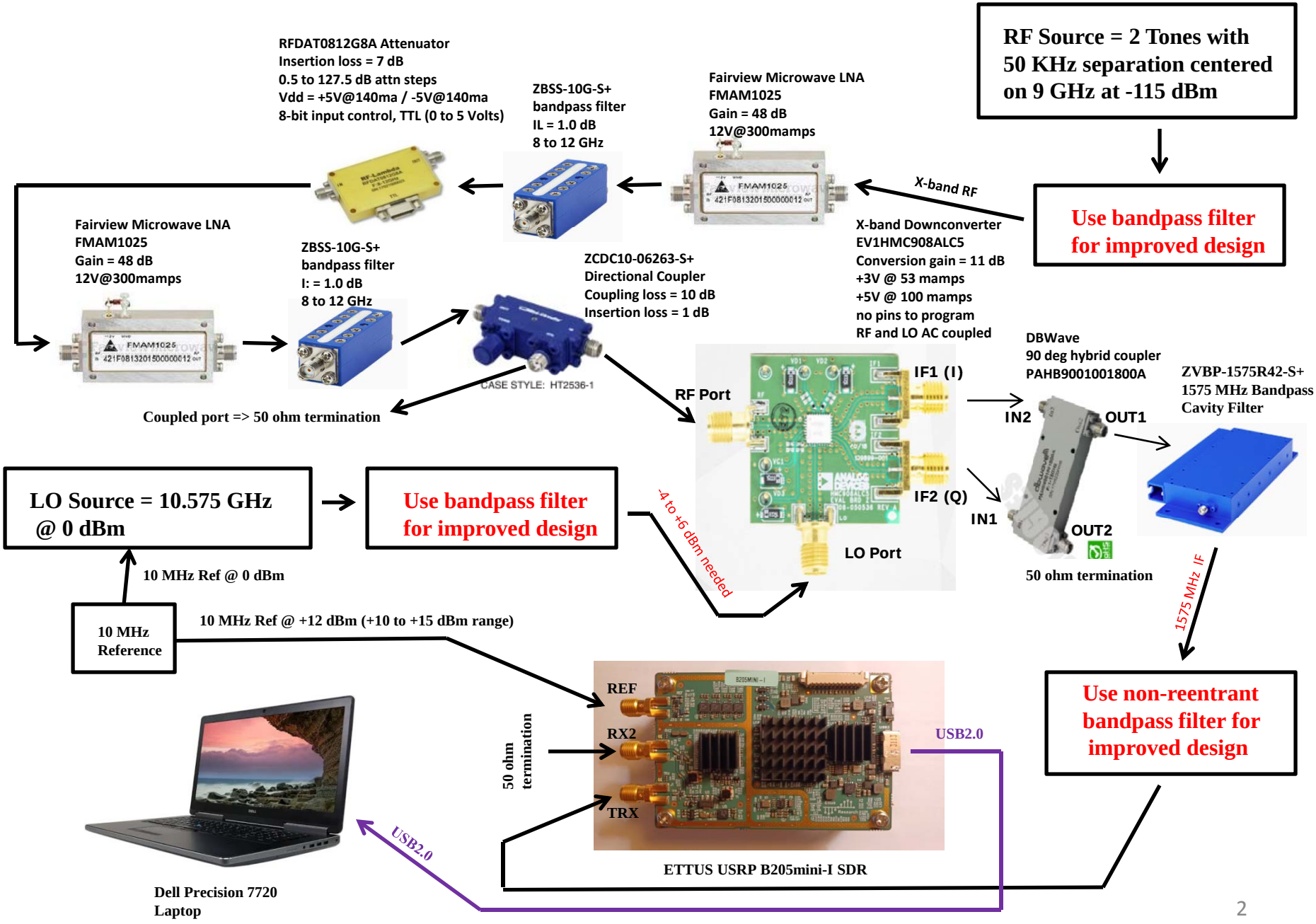
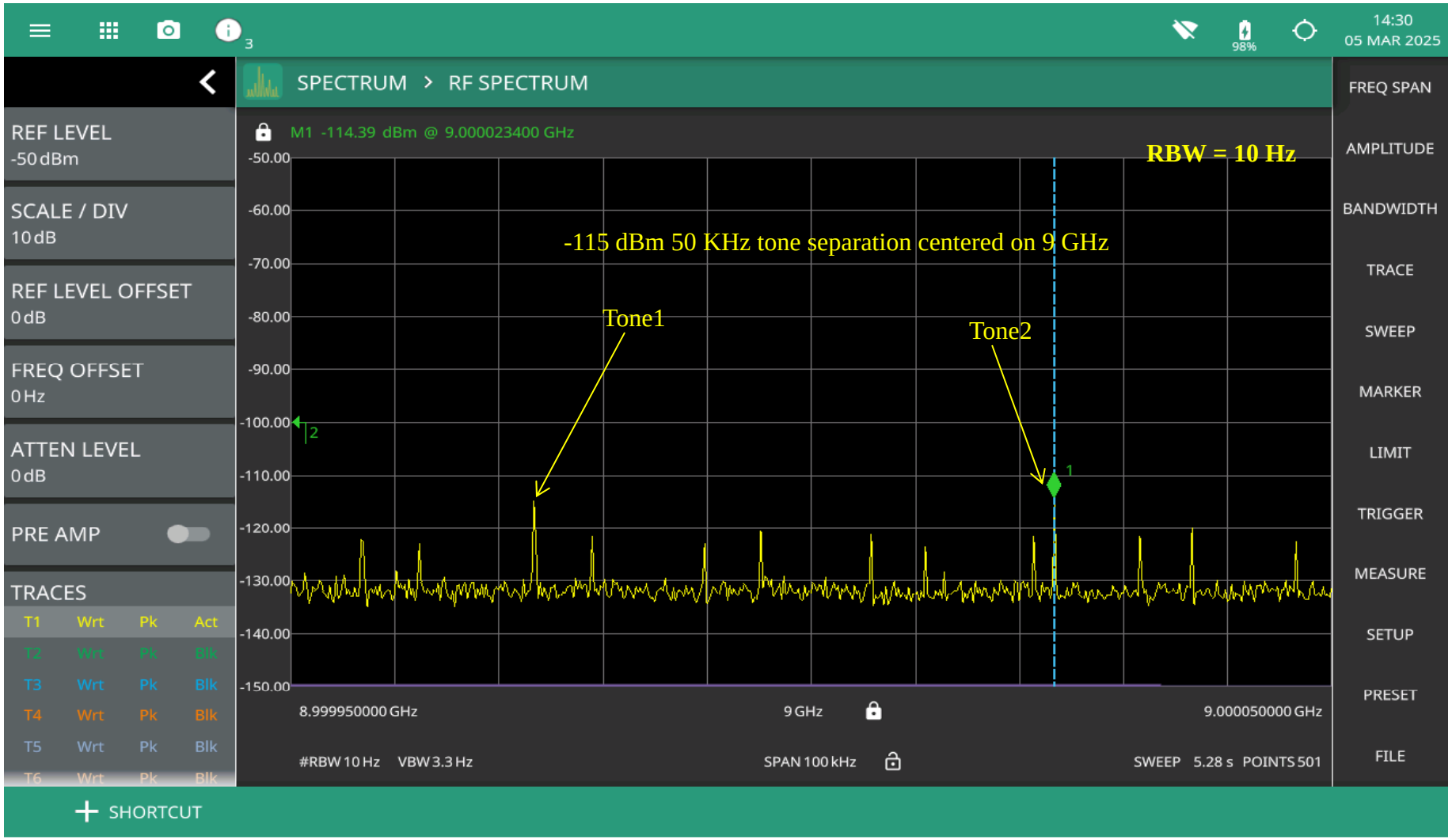
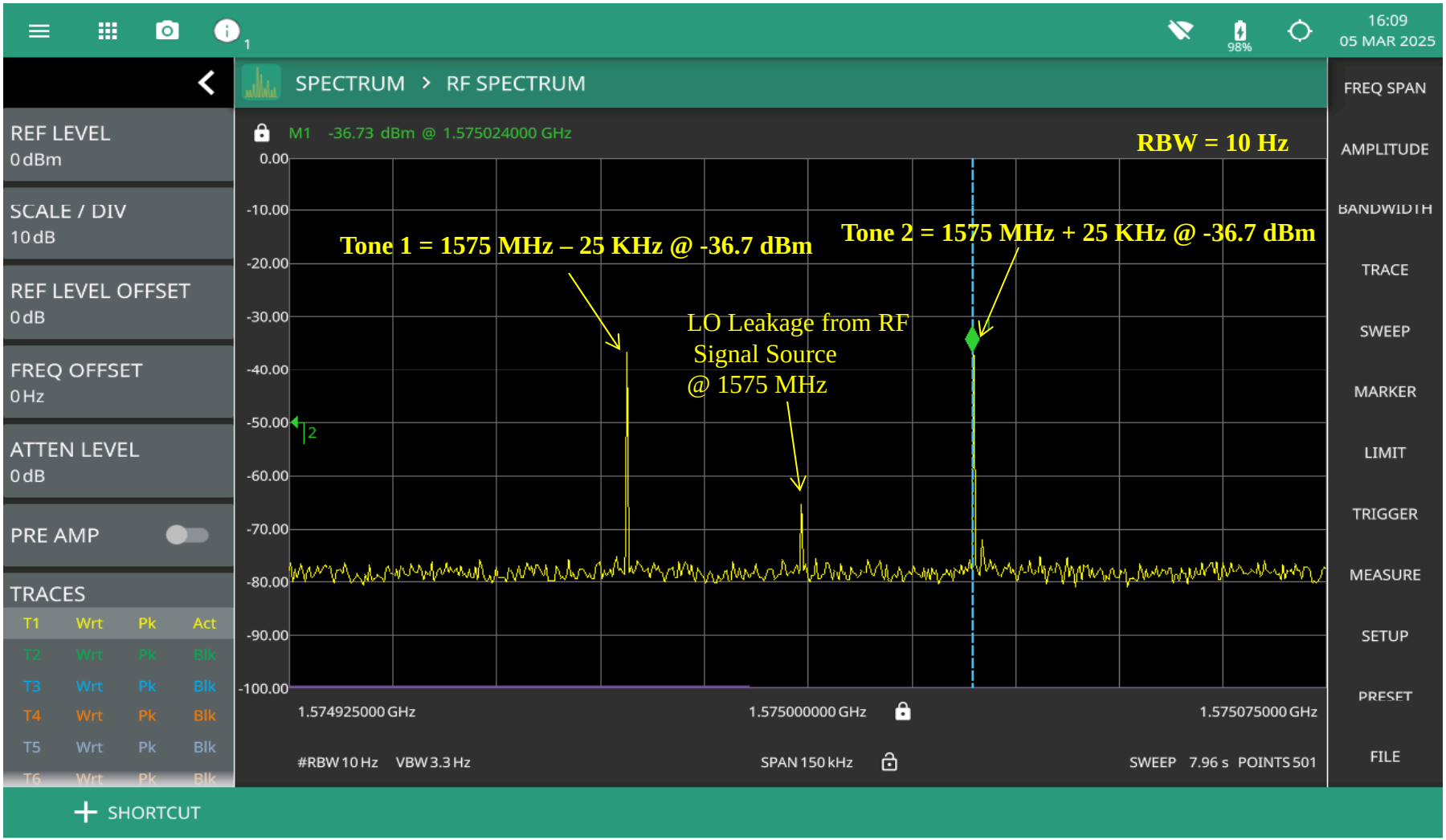


Figure 2. Two Tone RF Input



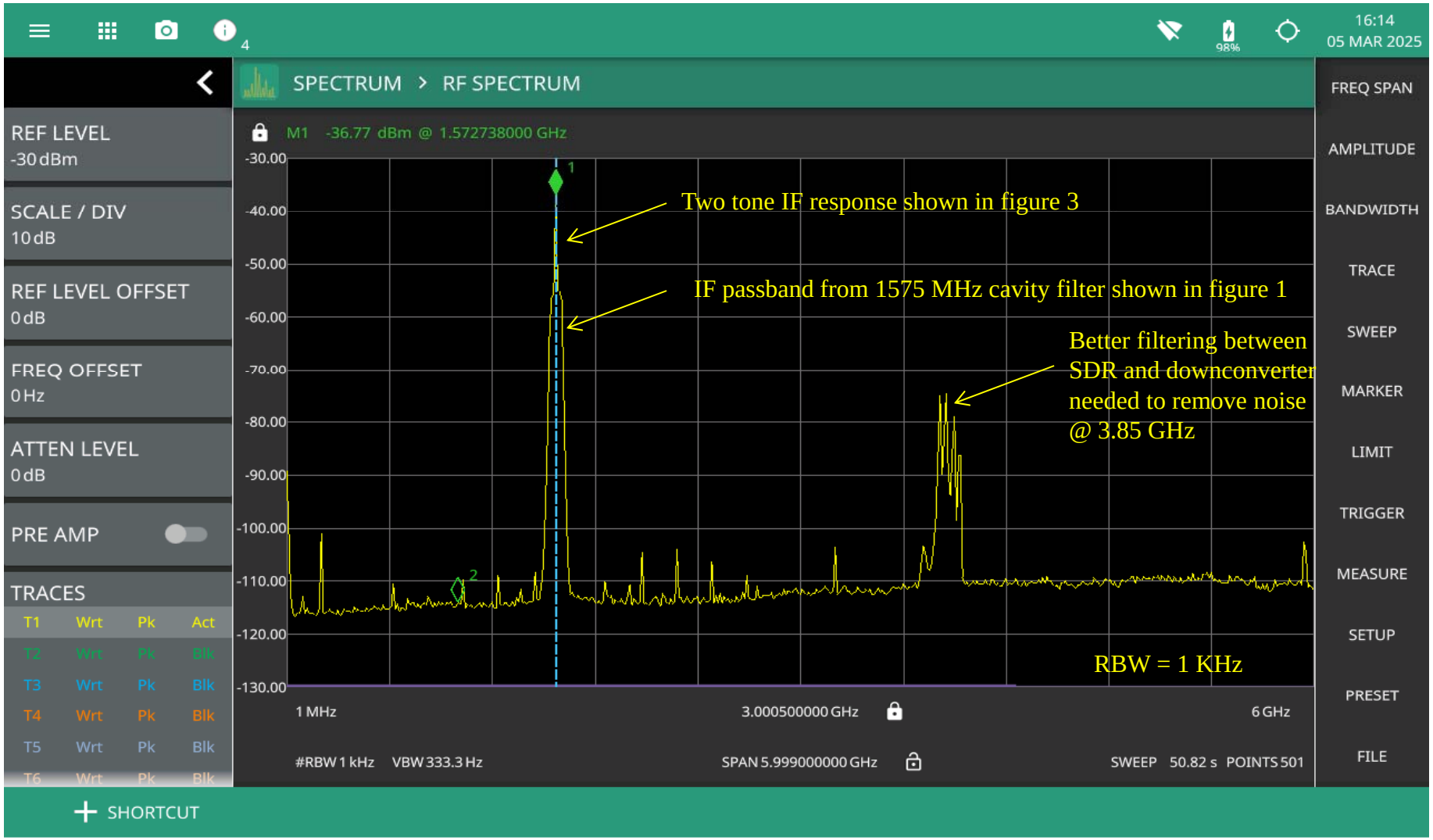
Anritsu MS2090A SN: 2303019 SW Package: V2023.3.1
Options: 0031,0104,0124,0125,0128,0199,0743
Date/Time: 05 Mar 2025 14:31:51 CST GPS: ---

Figure 3. IF Input to SDR



Anritsu MS2090A SN: 2303019 SW Package: V2023.3.1
Options: 0031,0104,0124,0125,0128,0199,0743
Date/Time: 05 Mar 2025 16:10:24 CST GPS: ---

Figure 4. IF Input to SDR (Wider Spectral View)



Anritsu MS2090A SN: 2303019 SW Package: V2023.3.1
Options: 0031,0104,0124,0125,0128,0199,0743
Date/Time: 05 Mar 2025 16:15:21 CST GPS: ---

Figure 5. Folded Power Spectral Density Plot from SDR (SDR LO = 1580 MHz)

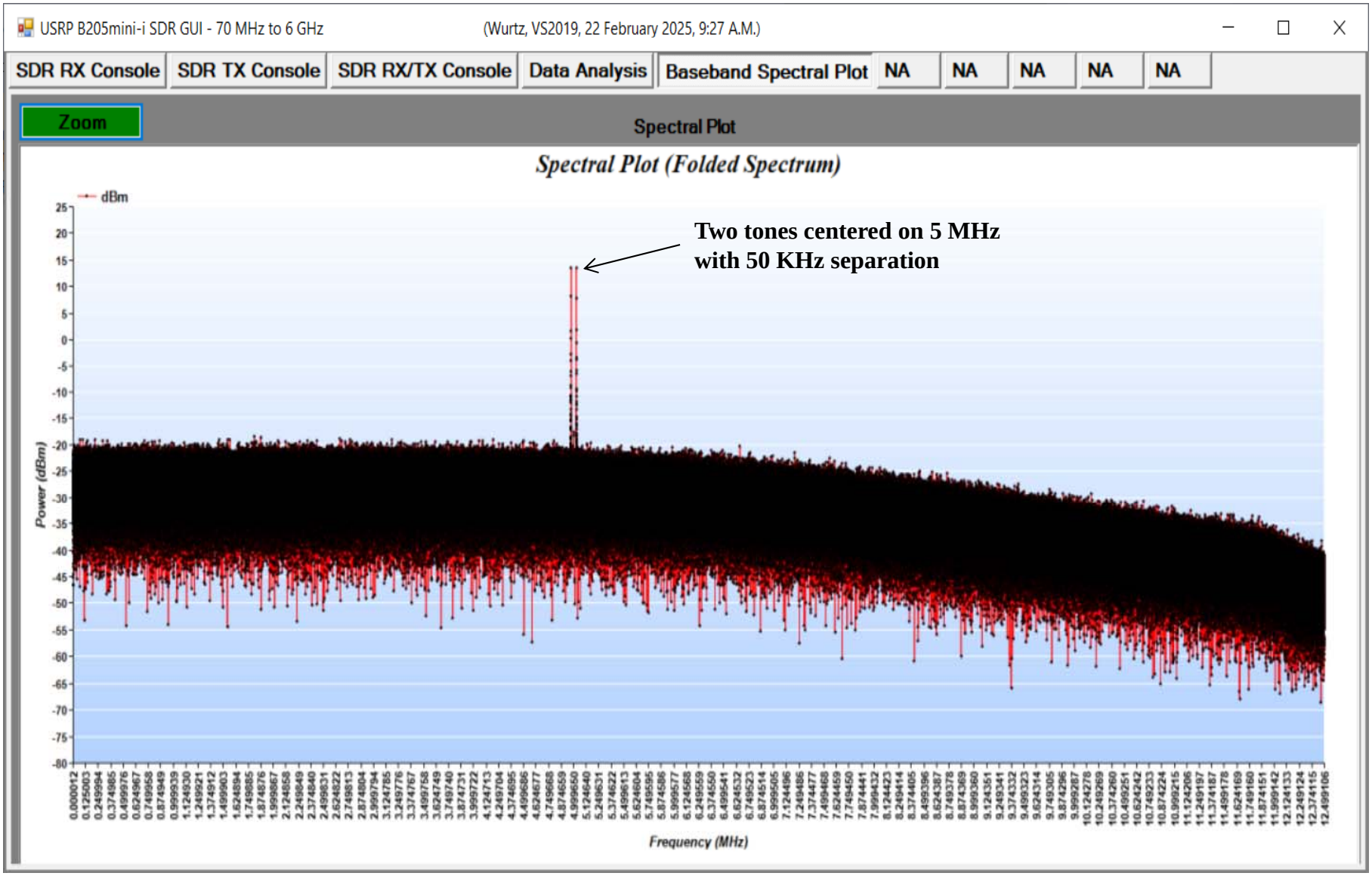


Figure 6. Folded Power Spectral Density Plot from SDR (SDR LO = 1580 MHz)
Closer View

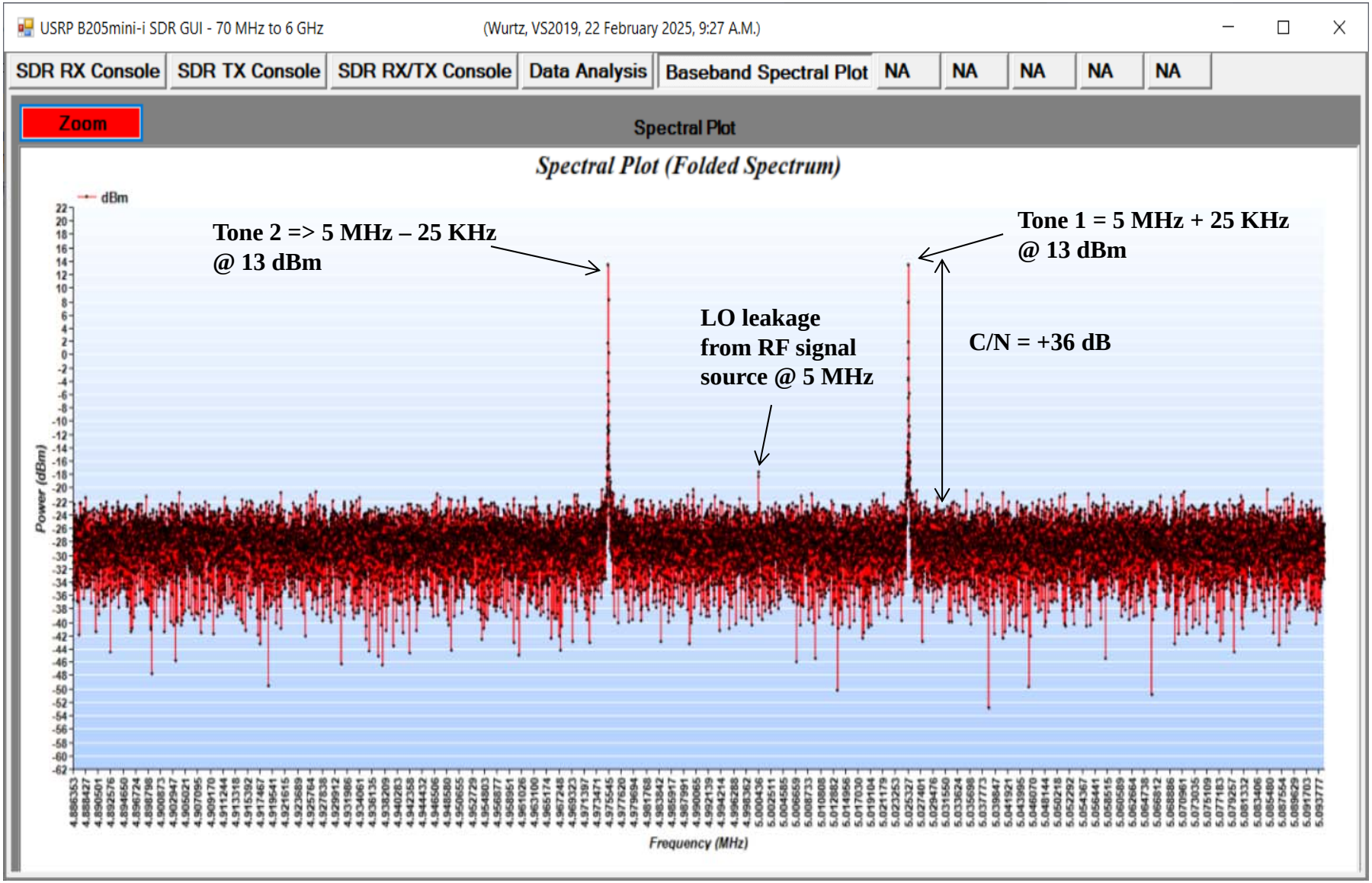


Figure 7. Power Spectral Density Plot from SDR (SDR LO = 1580 MHz) Lower Spectrum

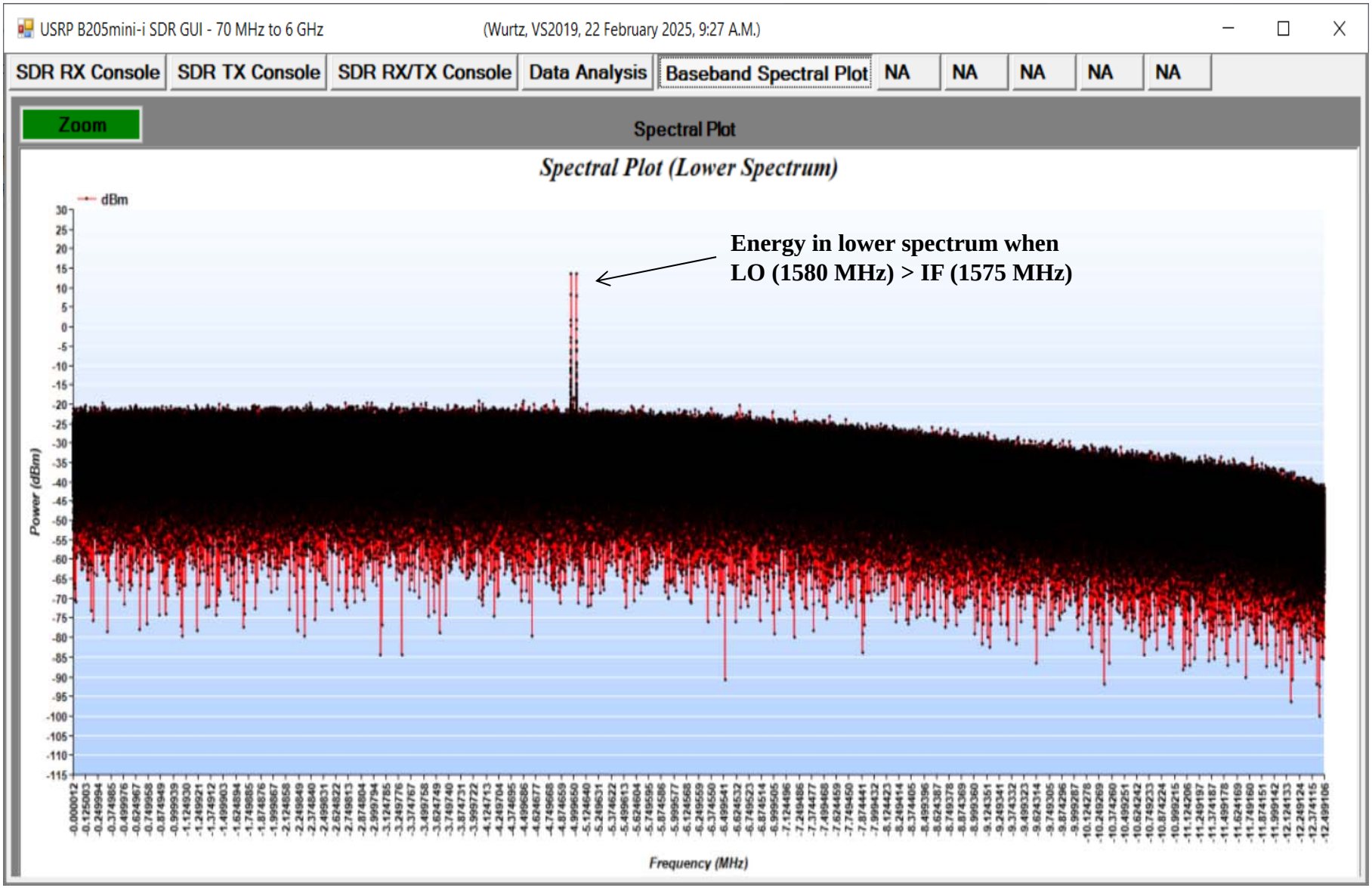


Figure 8. Power Spectral Density Plot from SDR (SDR LO = 1580 MHz)
Upper Spectrum

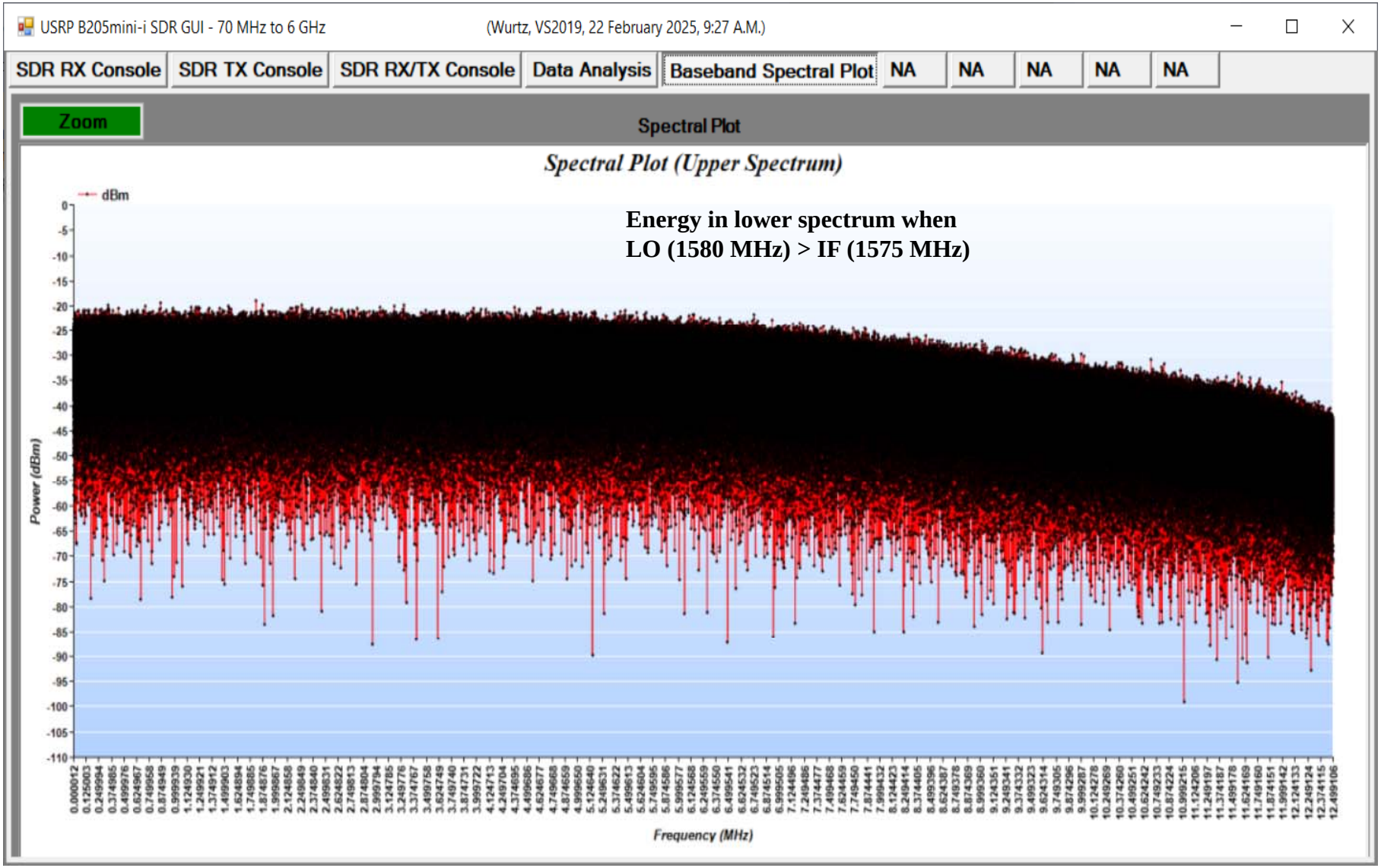


Figure 9. Folded Power Spectral Density Plot from SDR (SDR LO = 1570 MHz)

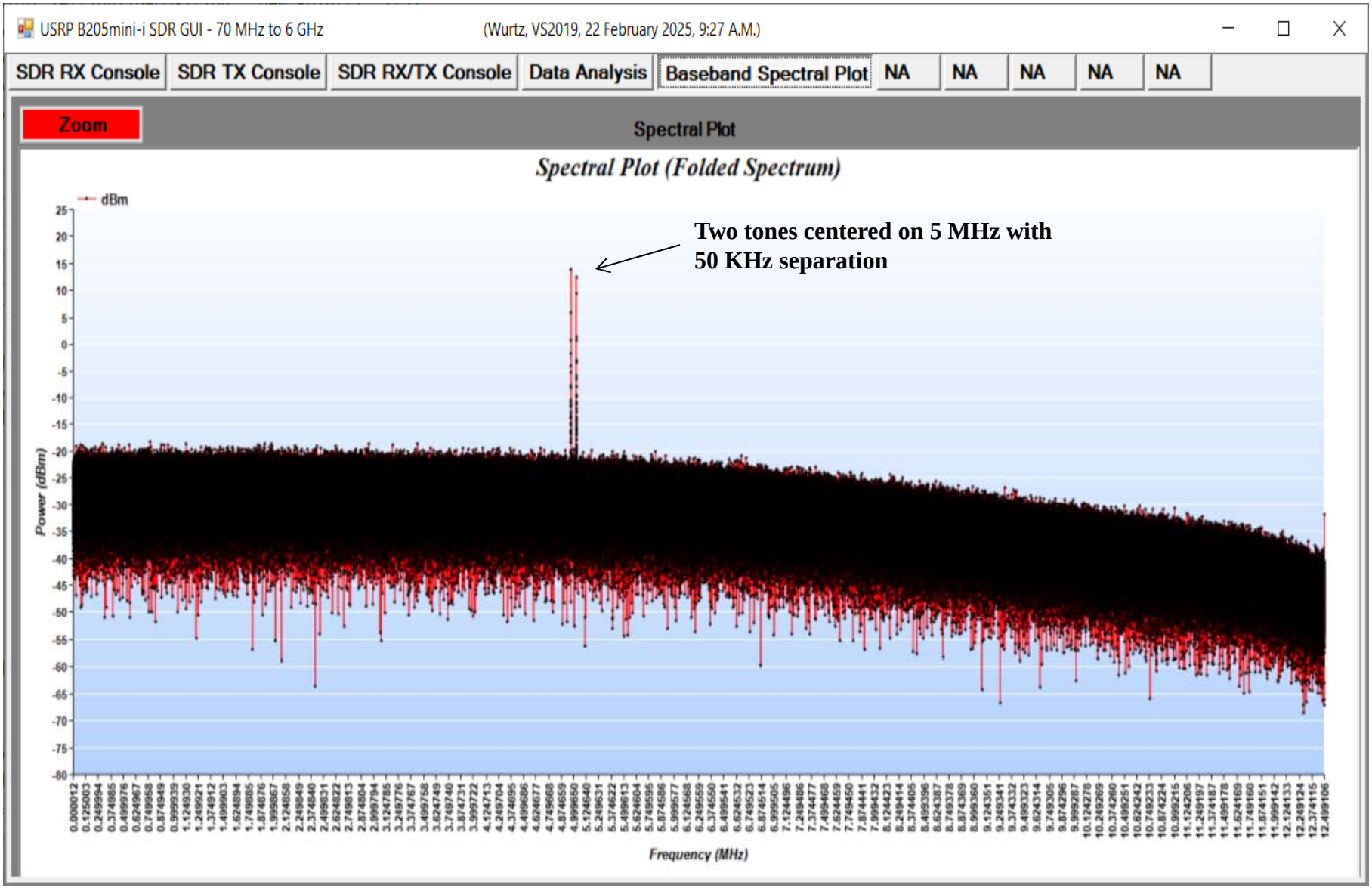


Figure 10. Folded Power Spectral Density Plot from SDR (SDR LO = 1570 MHz)
Closer view

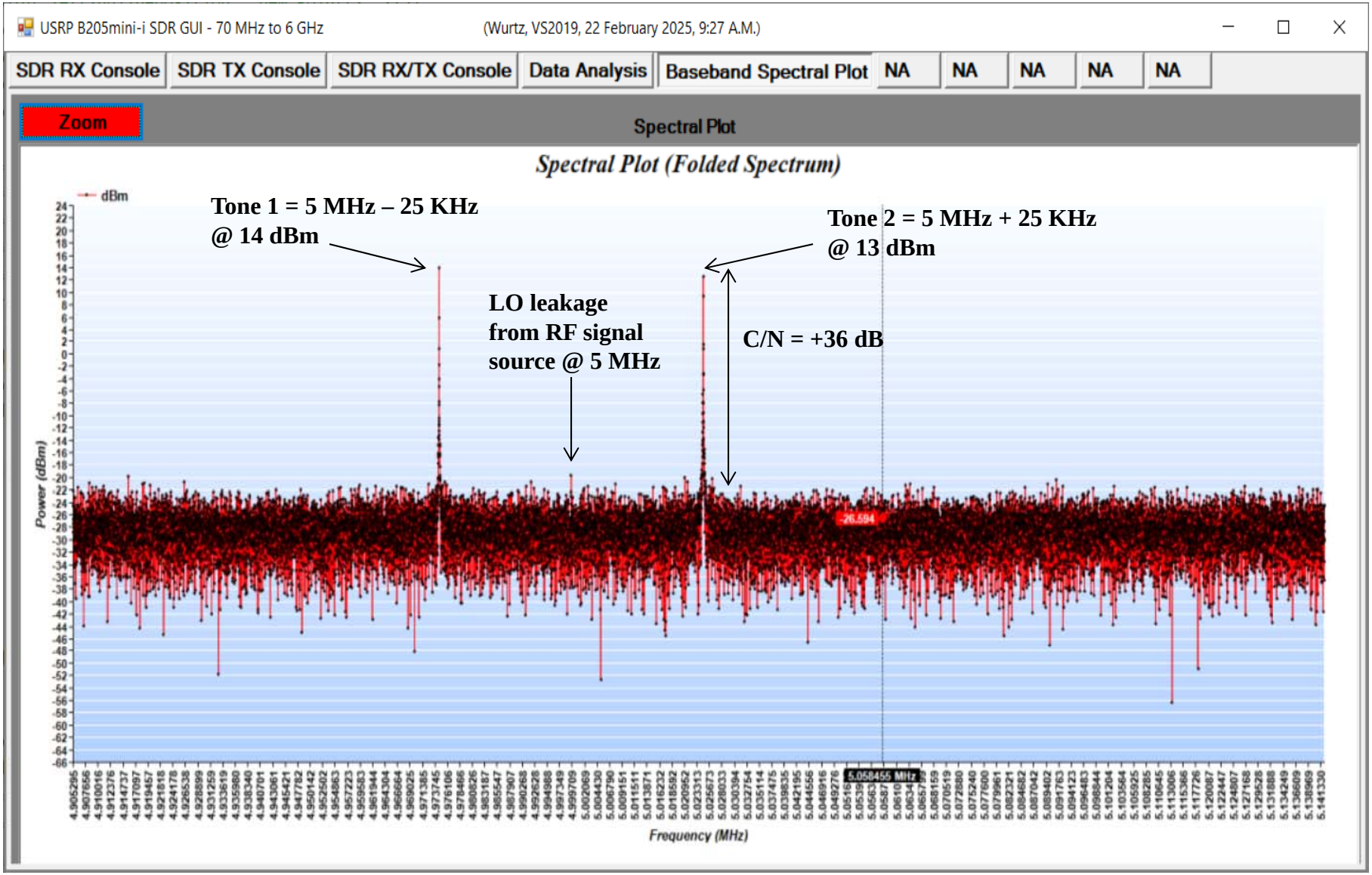


Figure 11. Power Spectral Density Plot from SDR (SDR LO = 1570 MHz)
Upper Spectrum

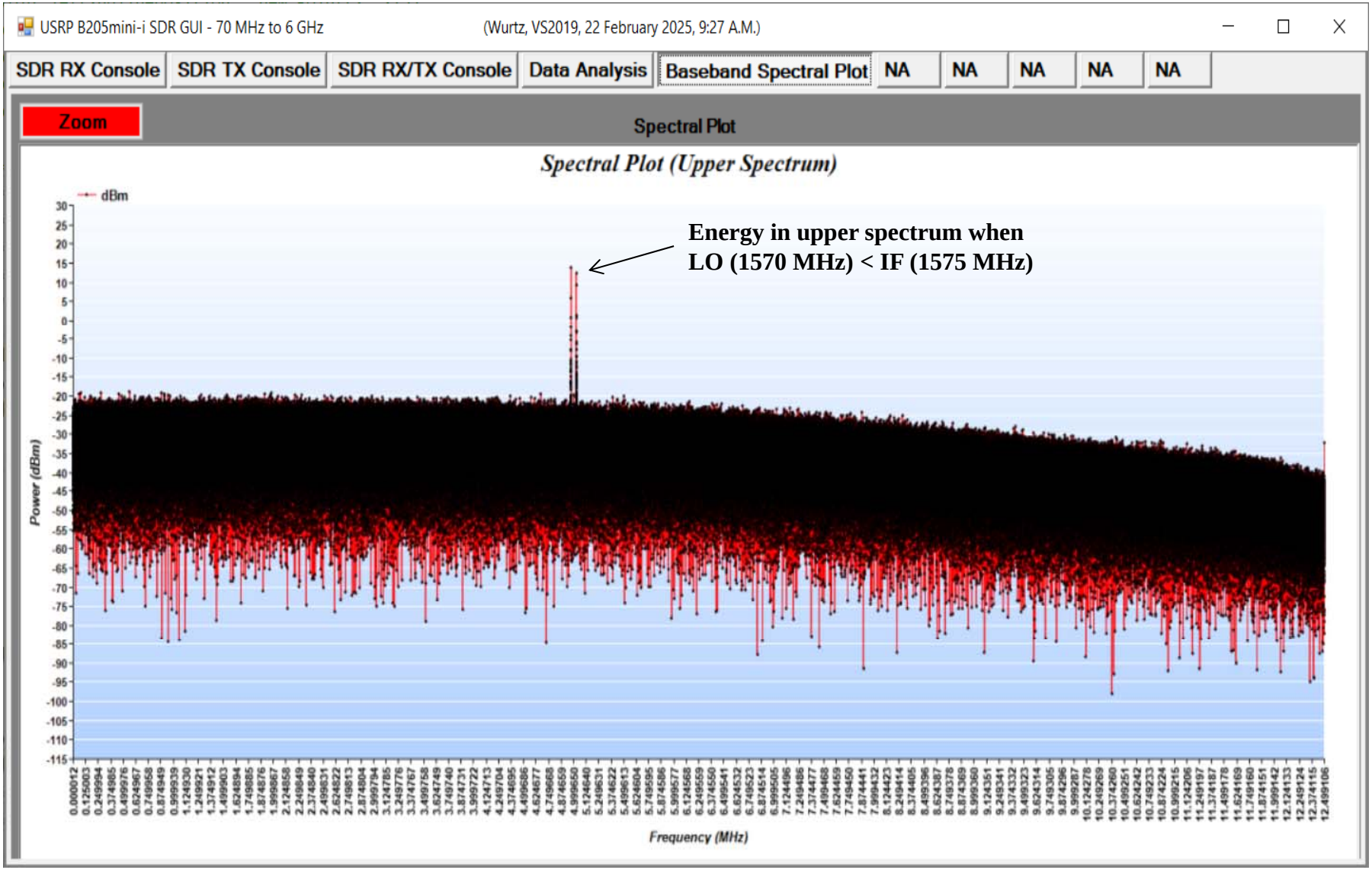


Figure 12. Power Spectral Density Plot from SDR (SDR LO = 1570 MHz) Lower Spectrum

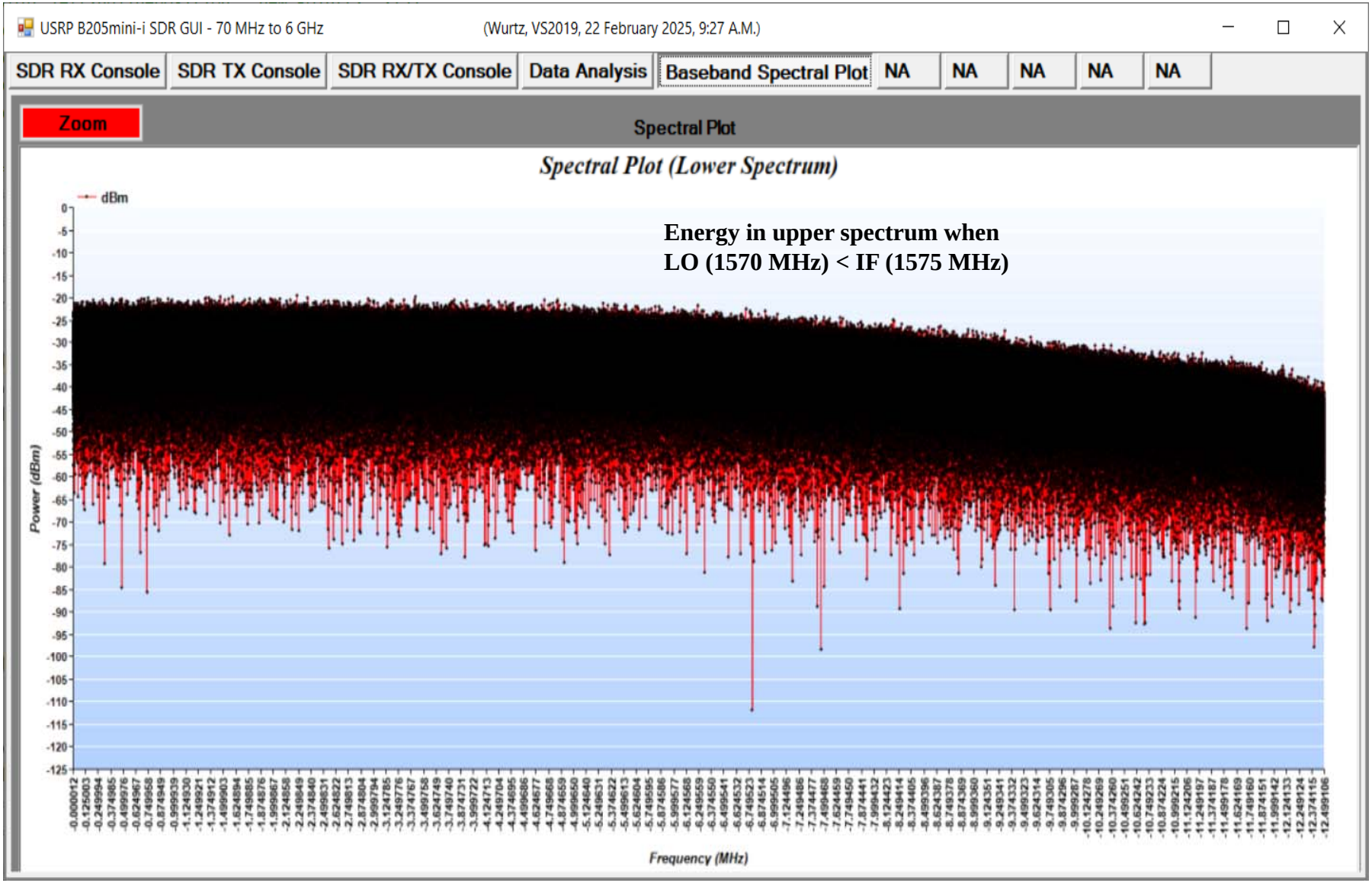


Figure 13. ETTUS USRP B205mini-I GUI
Screenshot 1

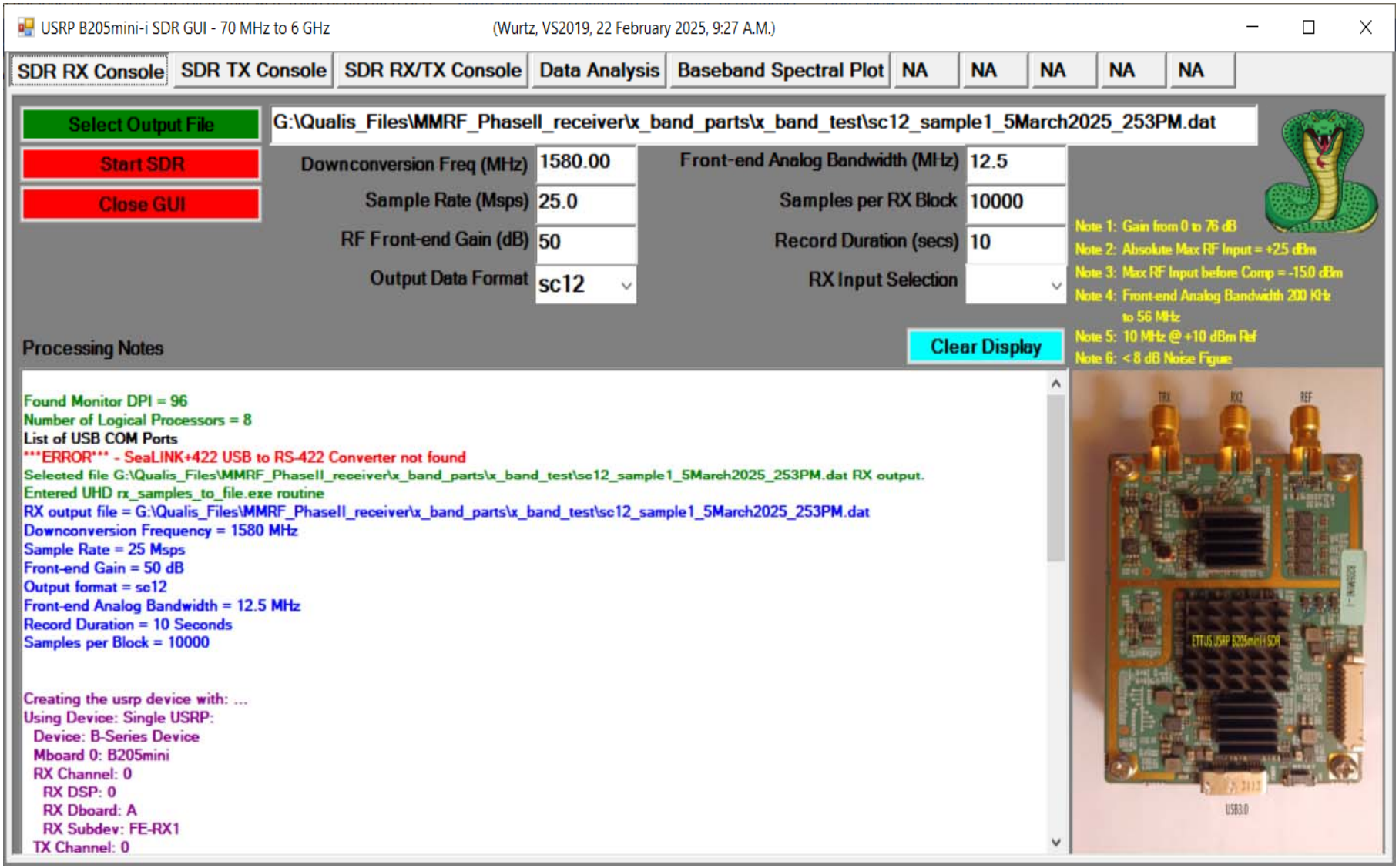


Figure 14. ETTUS USRP B205mini-I GUI Screenshot 2

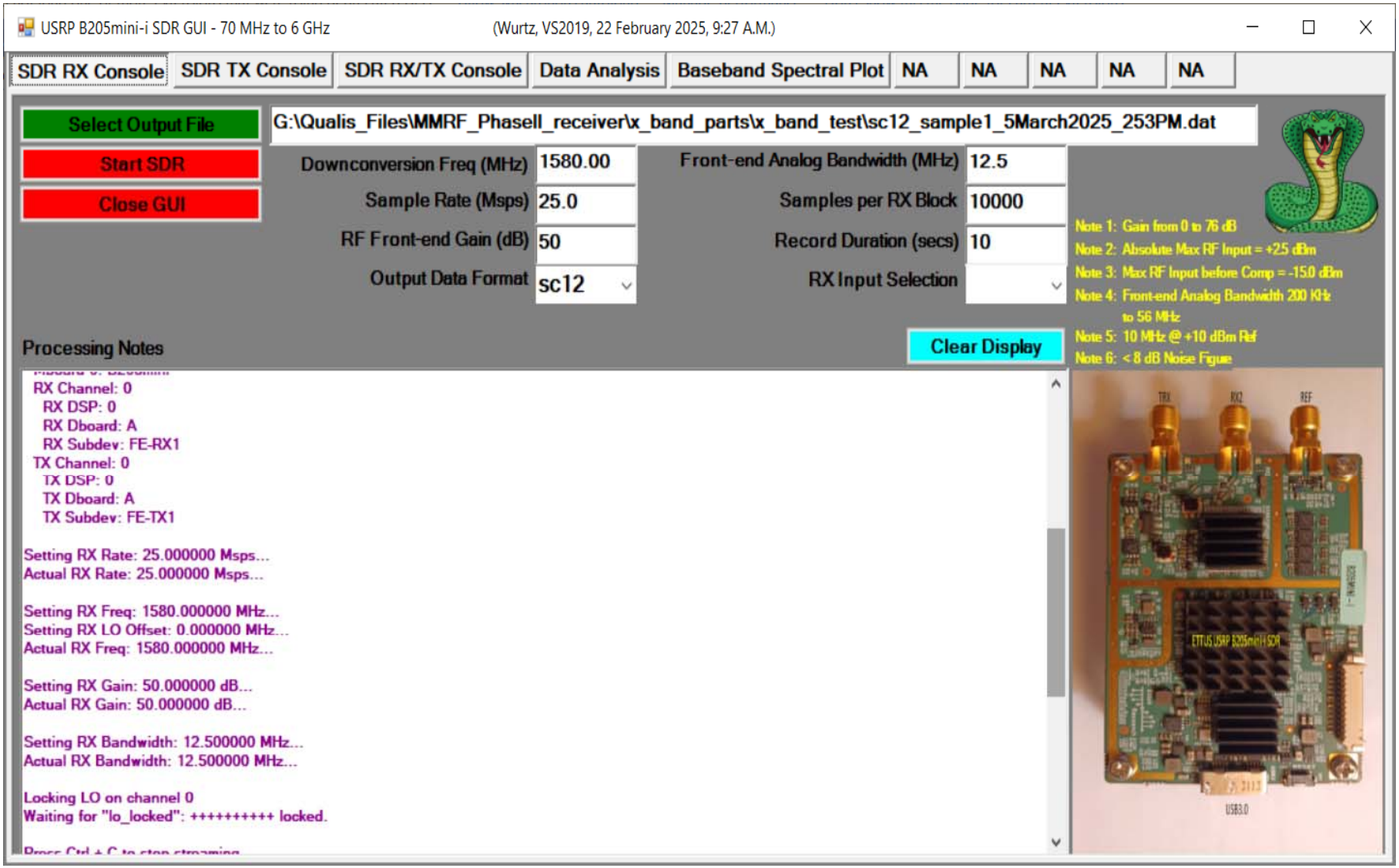


Figure 15. ETTUS USRP B205mini-I GUI Screenshot 3