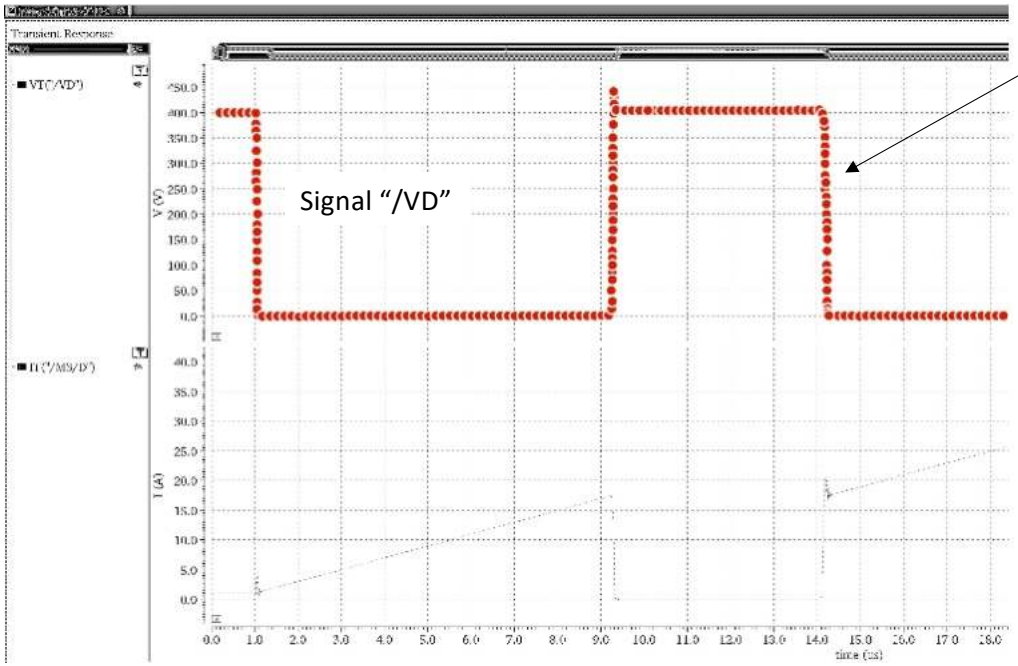
Summary and Outline of Effort to Provide Guidance on use of Cadence dft() Function for Forum Poster in [1]



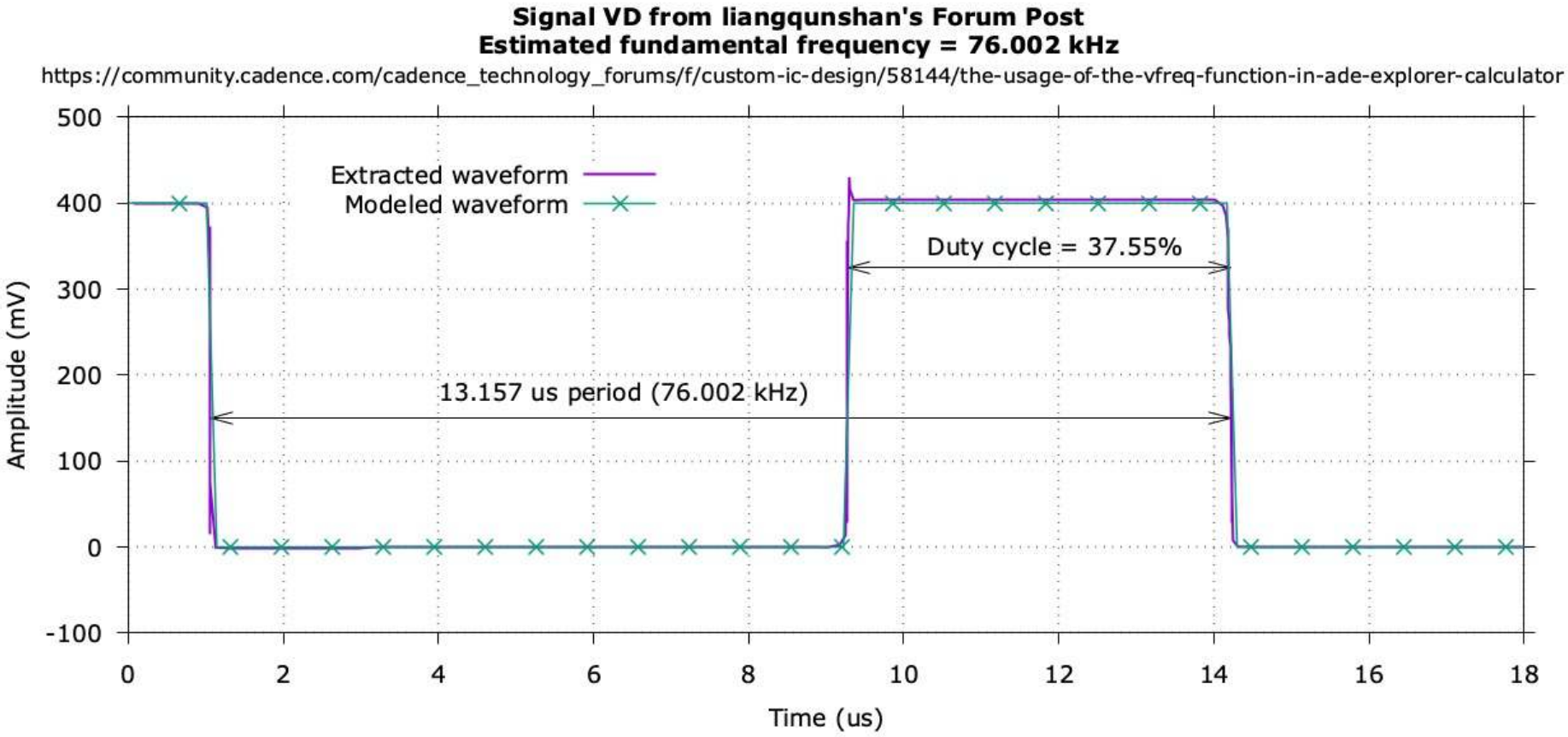
- Signal "/VD" from Forum post screenshot [1] was extracted using WebPlotDigitizer[2] and subsequently analyzed for its fundamental frequency and duty cycle
- Using a custom C program (*vpulse*) designed to generate periodic square waves with programmable transient parameters and optional AM/PM, a periodic signal with the extracted waveform parameters was created for further analysis
- Several sets of the waveform transient time data were analyzed using a FFTW[3] based Discrete Fourier Transforms (DFT) to illustrate the impact of sample size (number of periods of the waveform), sampling frequency (number of sample points per period), and DFT length (number of data samples used in FFT)
- The screenshot of the Cadence based dft() of signal "/VD" in [1] is compared to the FFTW based result
- Based on the FFTW based results, suggestions are provided to the Forum poster through two additional analyses to allow greater frequency resolution and accuracy

[1] https://community.cadence.com/cadence_technology_forums/f/custom-ic-design/58144/the-usage-of-the-vfreq-function-in-ade-explorer-calculator

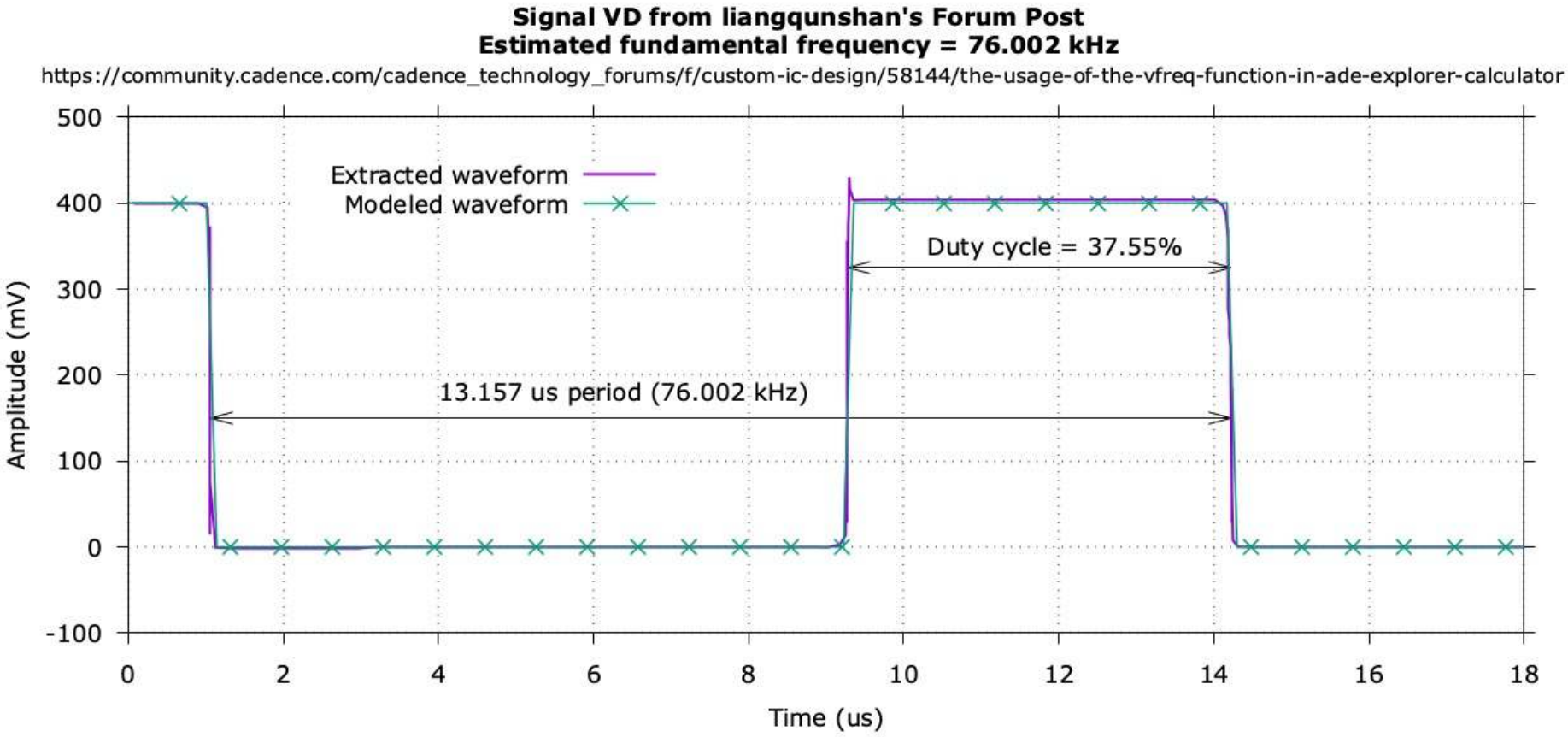
[2] https://automeris.io/WebPlotDigitizer/

[3] https://www.fftw.org/

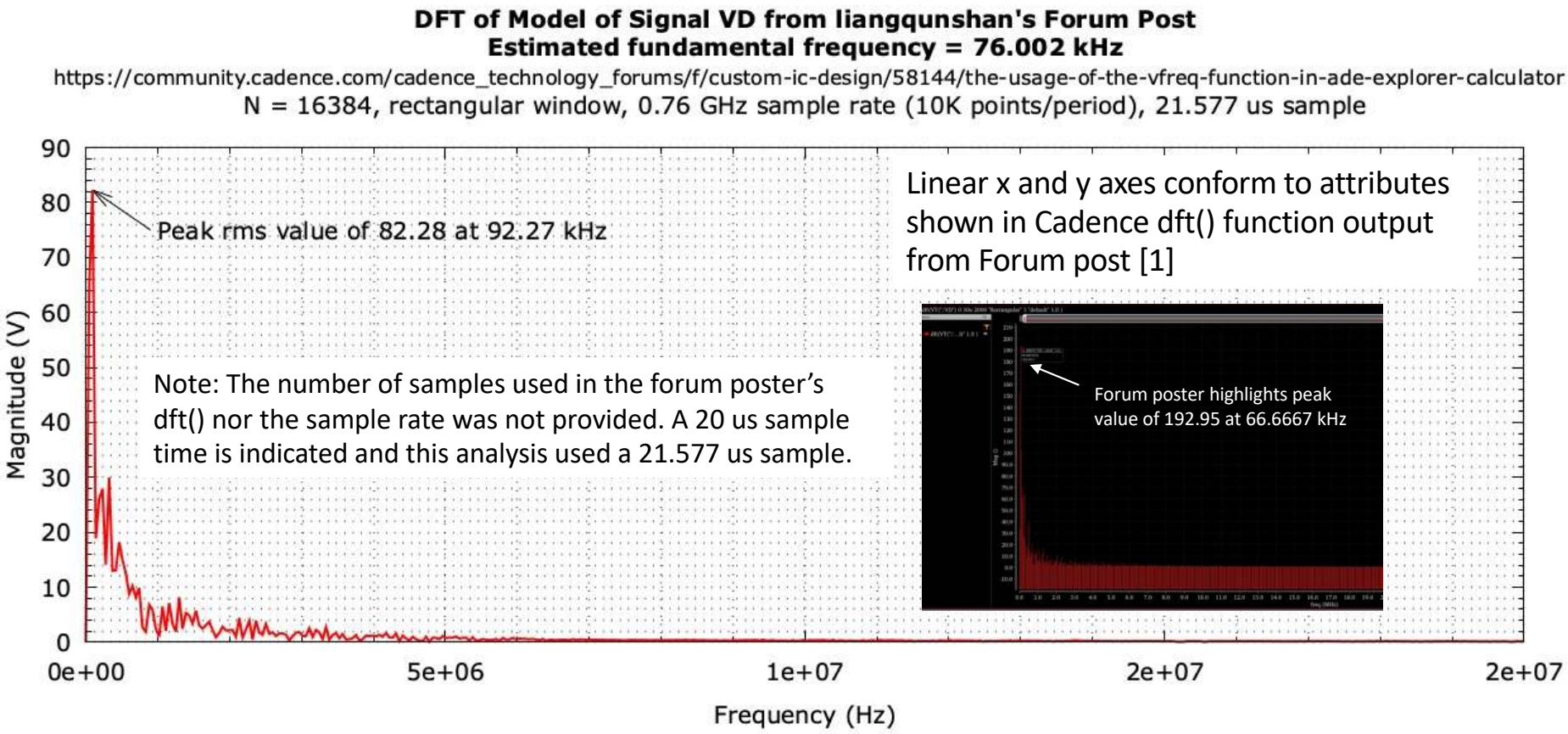
Extracted Waveform "/VD" from Screenshot in [1] and Model Created by *vpulse* Function



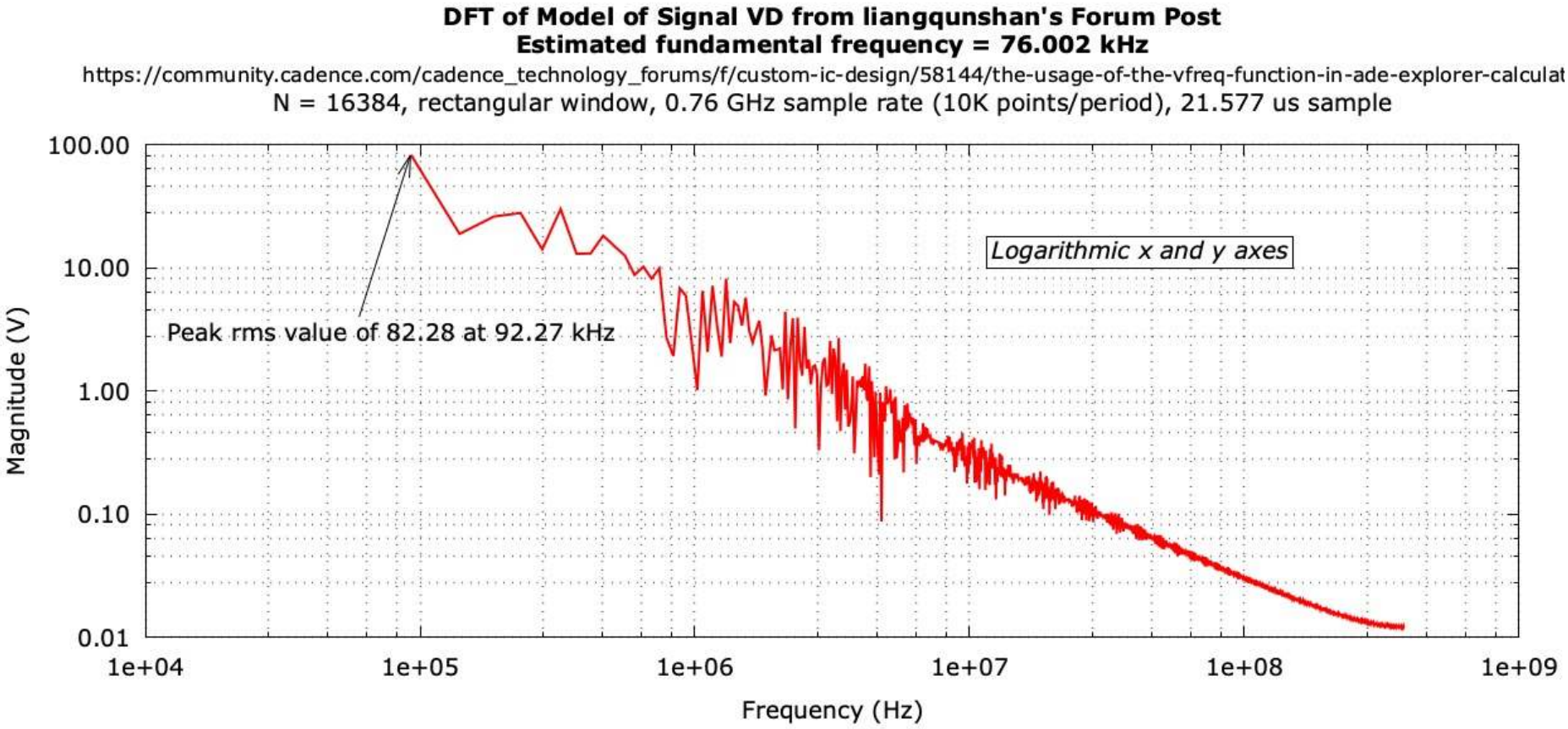
Extracted Waveform "/VD" from Screenshot in [1] and Model Created by *vpulse* Function



FFTW Based Discrete Fourier Transform of 21.5 us Sample of Waveform using 10K Samples/period



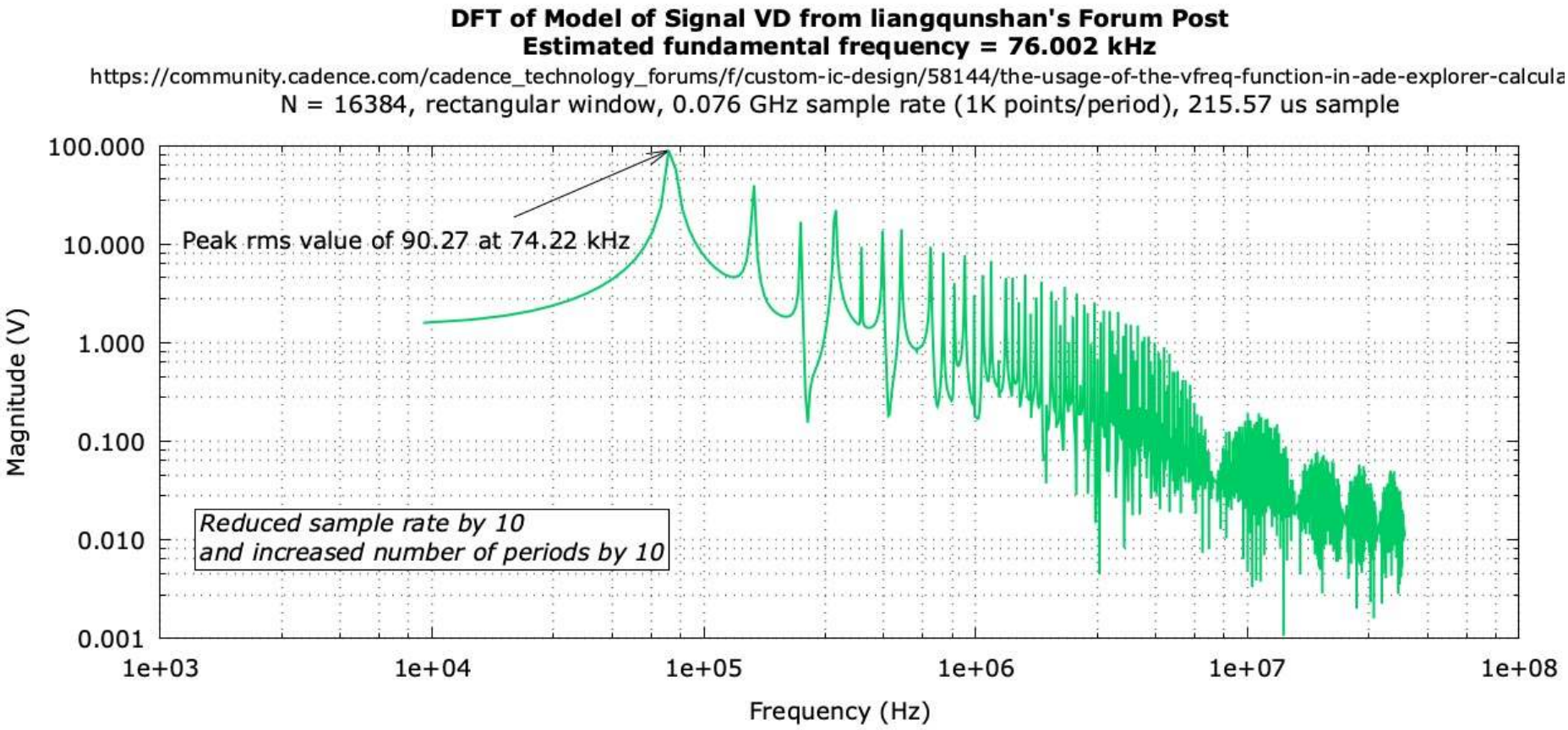
FFTW Based Discrete Fourier Transform of 21.5 us Sample of Waveform using 10K Samples/period (*logarithmic axes*)



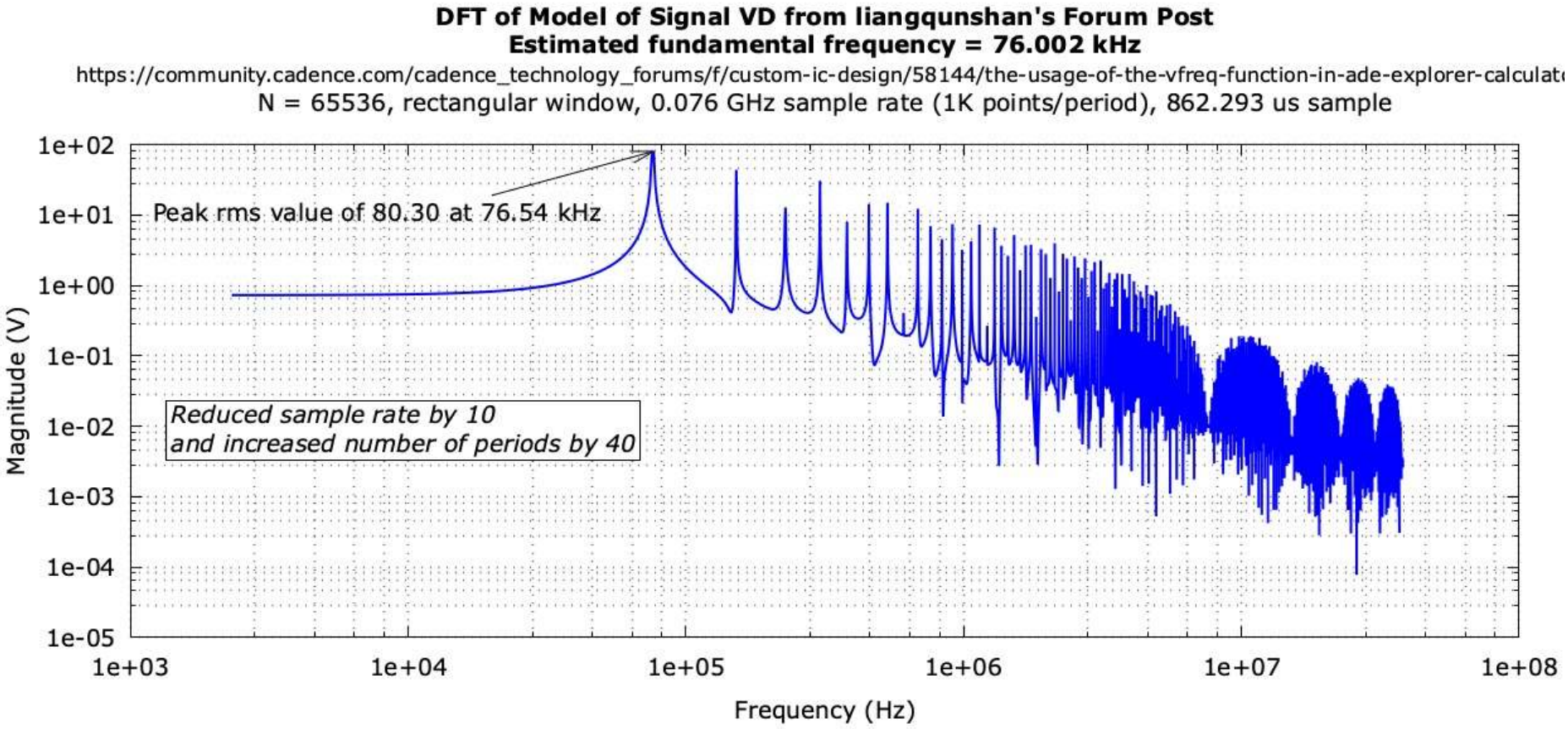
Comments on FFTW Based Discrete Fourier Transform of 21.5 us Sample of Waveform using 10K Samples/period and Forum Poster's Cadence dft() result

- Signal "/VD" peak amplitudes differ between FFTW based DFT and Cadence dft() function
  - This is a known issue with the Cadence dft() function. It does not express amplitudes in rms and has been reported previously.
- The dominant frequency components are easier to see when the x-axis is logarithmic in lieu of linear
- The accuracy of the fundamental frequency of the waveform from this DFT analysis is poor. Neither this analysis nor the Forum poster's analysis predict the fundamental frequency of 76 kHz well.
- The poor fundamental frequency estimate is a result of insufficient number of waveform periods in the 20 us sample.
- As a result, the author chose two additional DFT analyses of the waveform to illustrate the impact on frequency resolution and accuracy
  - Case 2: Increase the number of waveform periods by a factor of 10, reduce the number of samples per period to 1K from 10K, and use the same size DFT (16384)
  - Case 3: Increase the number of waveform periods by a factor of 40, reduce the number of samples per period to 1K from 10K, and use a larger size DFT (65536)
- Each analysis result and a comparison of the three DFT analyses are shown on pages 7, page 8, and page 9 respectively

Case 2: FFTW Based Discrete Fourier Transform of 215.6 us Sample of Waveform using 1K Samples/period



Case 3: FFTW Based Discrete Fourier Transform of 862 us Sample of Waveform using 1K Samples/period



Summary of FFTW Based Discrete Fourier Transform Results of 76 kHz Square Waveform