**Applying the Harmonic Cavities Transfer Function to Oscilloscope Data:**

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Step 1. Acquire the data from the oscilloscope; the trace must include at least 668 ps, one wavelength of 1497 MHz.

Step 2: Trim the acquired waveform to be to as close as possible to 668 ps. The number of points in this trace will be referred to as N in the following steps.

Step 3: Calculate the waveforms FFT. If Python has options for the format of the returned FT select complex. Hopefully Python will return two columns of numbers, each row being N/2 long in the real + imaginary format. If it returns the FFT in a magnitude and phase format, we will need to add to or change the following steps.

Step 4: Multiply the returned FFT, with the harmonic cavities transfer function. The harmonic cavities transfer function is also two columns of numbers in the real + imaginary format. The two series of complex numbers should be line by line multiplied. Recall that the multiplication of complex numbers is the same as multiplying the amplitude of both complex numbers, and adding their phase. Each of the N/2 terms of these series correspond to the TM0N0 modes of the harmonic cavity. This step scales the amplitude of each mode and shifts its phase to remove distortion caused by cavity and coupling imperfections. Below is pretty good estimate of the harmonic cavities transfer function. We will tweak these numbers when we get new data from the new location.

|  |  |
| --- | --- |
| 1 | 0 |
| 1.314 | 0.662 |
| 0.600 | -0.753 |
| -0.471 | -0.628 |
| -0.185 | -0.705 |
| -0.403 | -0.734 |
| -0.813 | -0.355 |
| -0.775 | 0.0101 |
| -0.643 | 0.162 |
| -0.684 | 0.277 |
| -0.742 | 0.502 |
| -0.048 | 0.972 |
| -0.505 | -0.106 |
| -0.183 | 0.314 |
| 0 | 0 |
| 0 | 0 |
| 0’s continue to fill N/2 rows | 0’s continue to fill N/2 rows |

Step 5: Calculate the real IFFT of the product of the oscilloscope waveform and the harmonic cavities transfer function, and plot; Voila!