

Memory Sweep Analysis for Memorial
Polynomials

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July 2025

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1 Introduction

In this document, we analyze which memory terms are dominant when the memory order is 5. To do this, we test all possible combinations of memory terms for two cases: when the polynomial order is 5 and when it is 7.

Since our main goal is to identify the dominant term at memory step $(t-5)$, we always include this term in the analysis. The other terms, $(t-1)$, $(t-2)$, $(t-3)$, and $(t-4)$, will either be included or excluded in each combination.

Finally, the THD values for each case will be plotted to compare the results. To have a better understanding of plots, the table will be helpful to comprehend what X-label represents in binary.

Memory Sweep	$x(t)$	$x(t-1)$	$x(t-2)$	$x(t-3)$	$x(t-4)$	$x(t-5)$
0b0000	Exists	Not Exists	Not Exists	Not Exists	Not Exists	Exists
0b0001	Exists	Not Exists	Not Exists	Not Exists	Exists	Exists
0b0010	Exists	Not Exists	Not Exists	Exists	Not Exists	Exists
0b0011	Exists	Not Exists	Not Exists	Exists	Exists	Exists
0b0100	Exists	Not Exists	Exists	Not Exists	Not Exists	Exists
0b0101	Exists	Not Exists	Exists	Not Exists	Exists	Exists
0b0110	Exists	Not Exists	Exists	Exists	Not Exists	Exists
0b0111	Exists	Not Exists	Exists	Exists	Exists	Exists
0b1000	Exists	Exists	Not Exists	Not Exists	Not Exists	Exists
0b1001	Exists	Exists	Not Exists	Not Exists	Exists	Exists
0b1010	Exists	Exists	Not Exists	Exists	Not Exists	Exists
0b1011	Exists	Exists	Not Exists	Exists	Exists	Exists
0b1100	Exists	Exists	Exists	Not Exists	Not Exists	Exists
0b1101	Exists	Exists	Exists	Not Exists	Exists	Exists
0b1110	Exists	Exists	Exists	Exists	Not Exists	Exists
0b1111	Exists	Exists	Exists	Exists	Exists	Exists

Table 1: Detailed explanation of the variable, Memory Sweep, in THD plots

Input and output voltage waveform spectrum are shown below

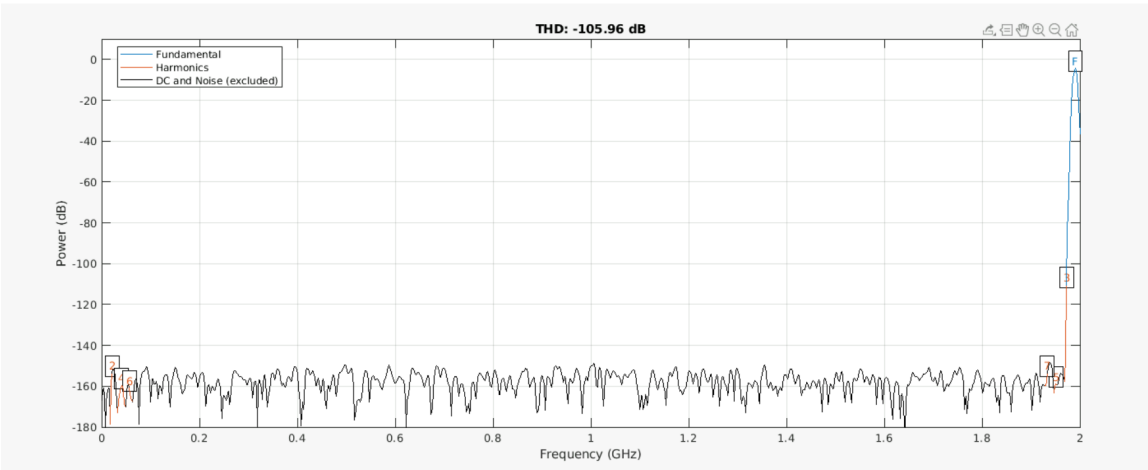


Figure 1: Input Voltage Waveform

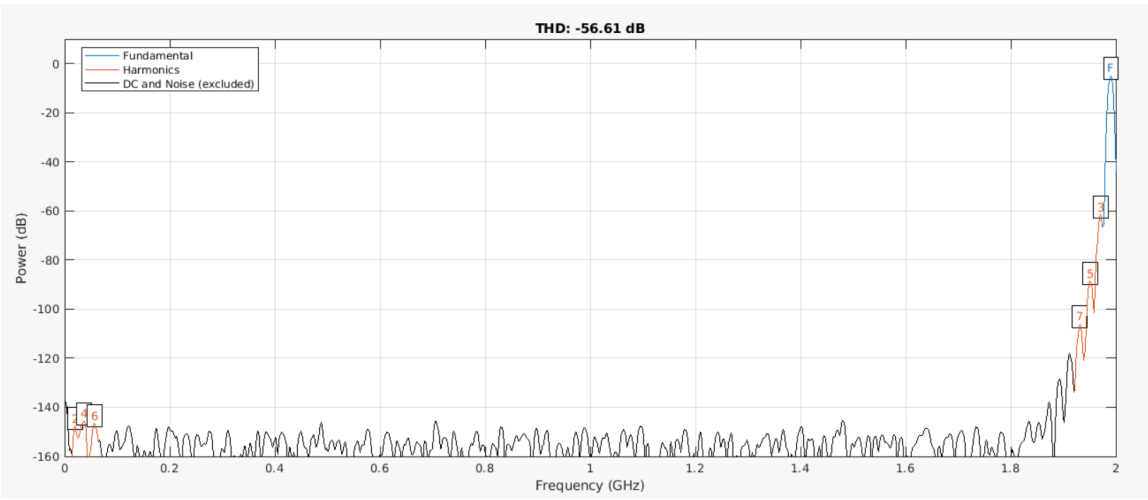


Figure 2: Output Voltage Waveform

2 Results & Comments

2.1 Polynomial order: 5

When the polynomial order is fixed at 5, what we expect to see is that we are able to eliminate only third and fifth harmonics.

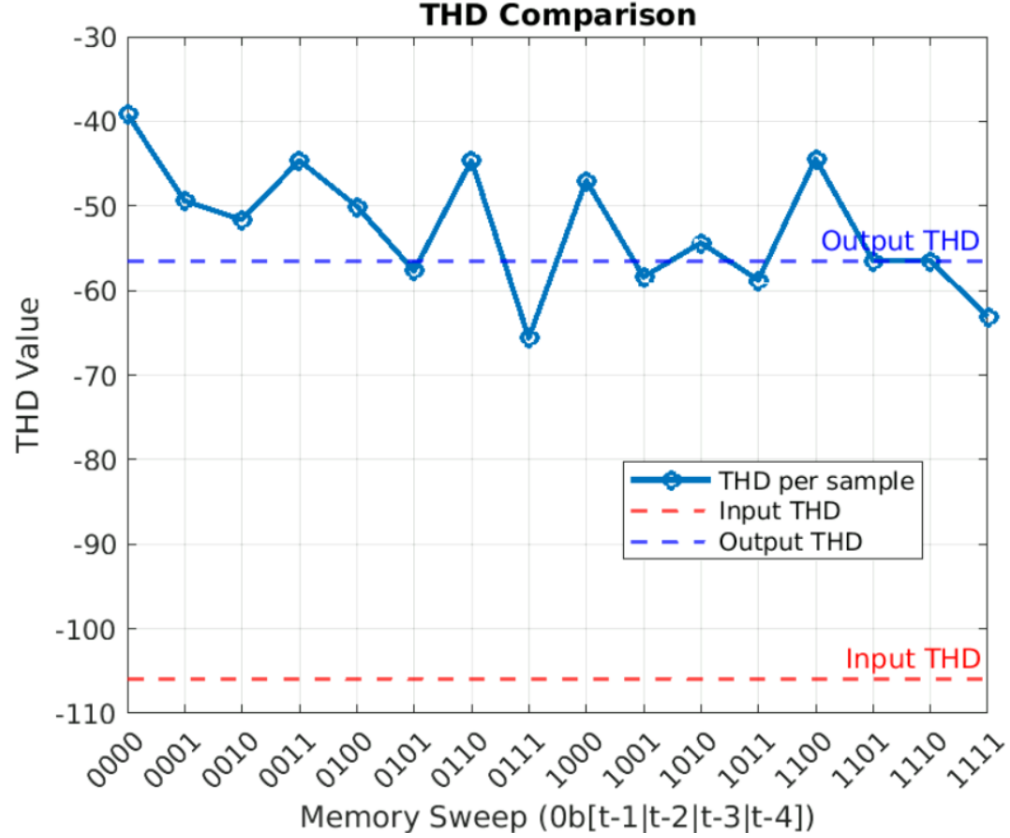


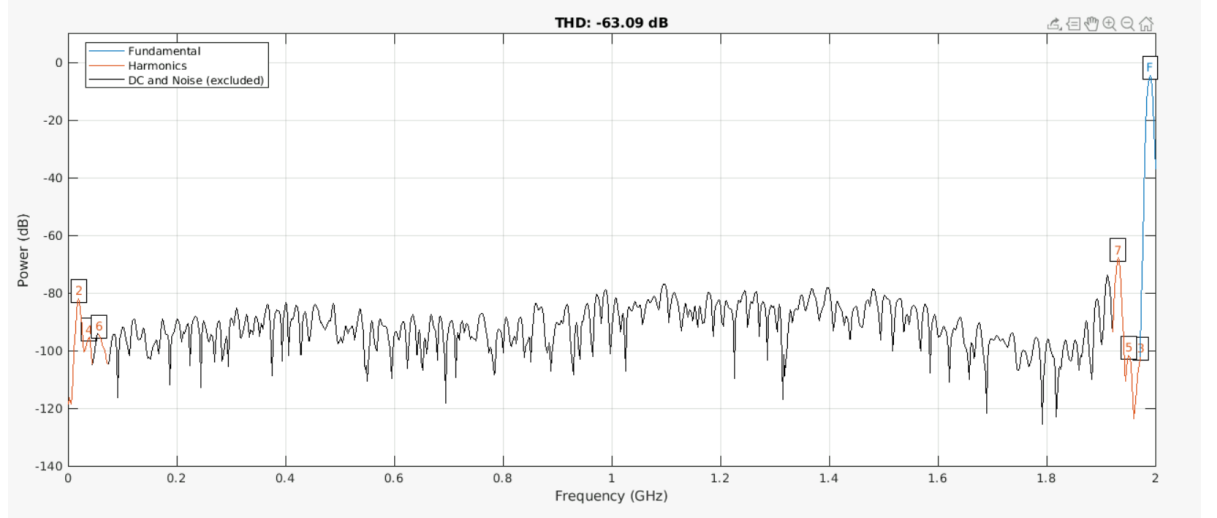
Figure 3: THD Values based on different memory sweep @ 2GHz

As shown in Figure 3, the case 0111 produces nearly the same result as memory order 5. The other cases fail to properly calibrate the output voltage. As seen in Table 1, the 0111 case corresponds to ignoring only the $t - 1$ terms, while keeping the rest the same. However, for a better comparison, the case 1011 will be discussed in the following sections.

2.1.1 Memory Sweep 1111

As Table 1 and polynomial order of 5 shows that we have total of **18 coefficients**.

The calibrated voltage spectrum is



2.1.2 Memory Sweep 1011

As Table 1 and polynomial order of 5 shows that we have total of **15 coefficients**.

The calibrated voltage spectrum is

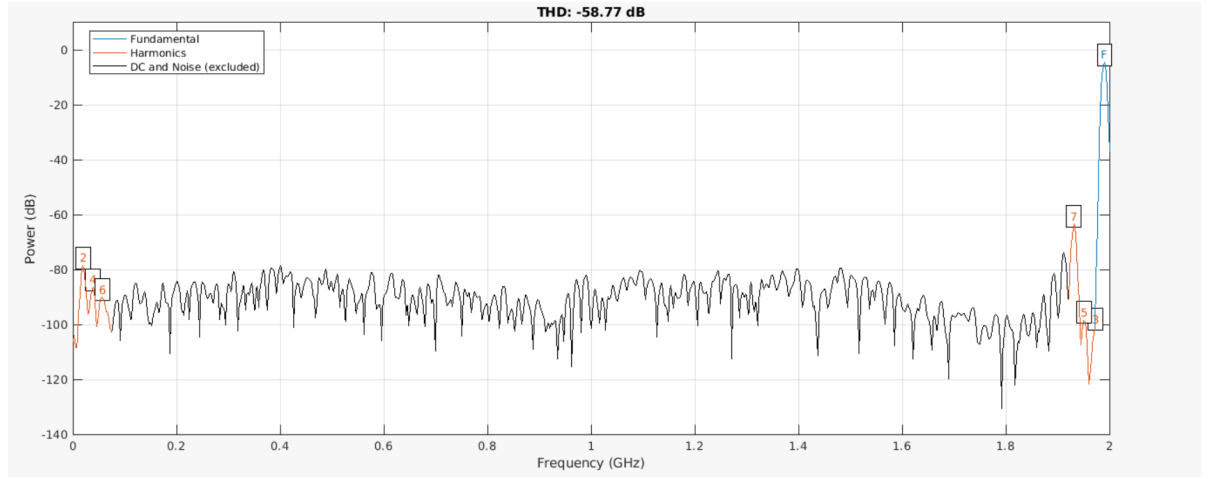


Figure 5: Calibrated output voltage waveform when memSweep is *0b1011*

2.1.3 Memory Sweep 0111

As Table 1 and polynomial order of 5 shows that we have total of **15 coefficients**.

Surprisingly, the seventh harmonic is being calibrated although we didn't consider the 7th order polynomial yet.

The calibrated voltage spectrum is

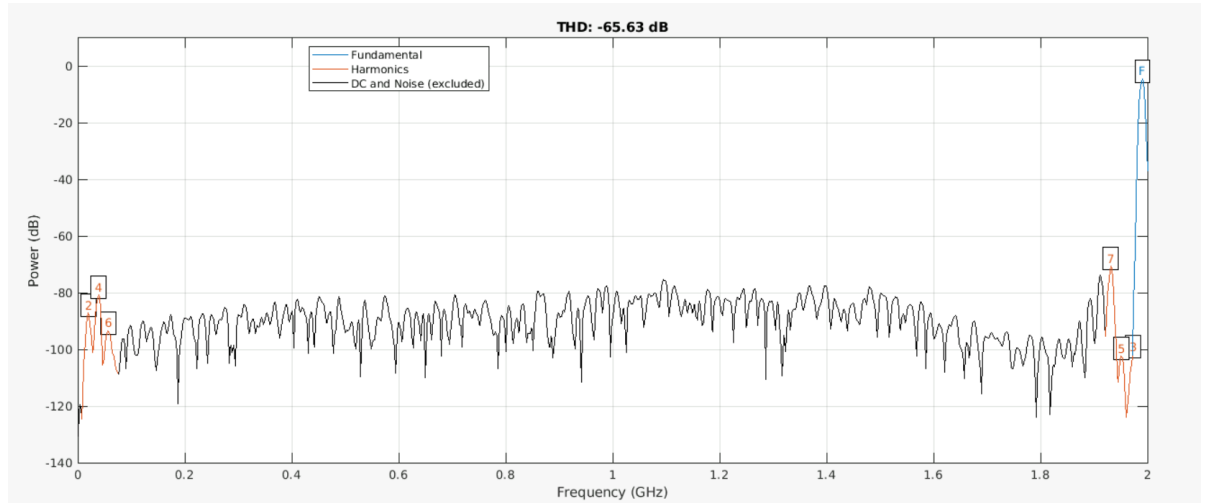


Figure 6: Calibrated output voltage waveform when memSweep is *0b0111*

2.2 Polynomial order: 7

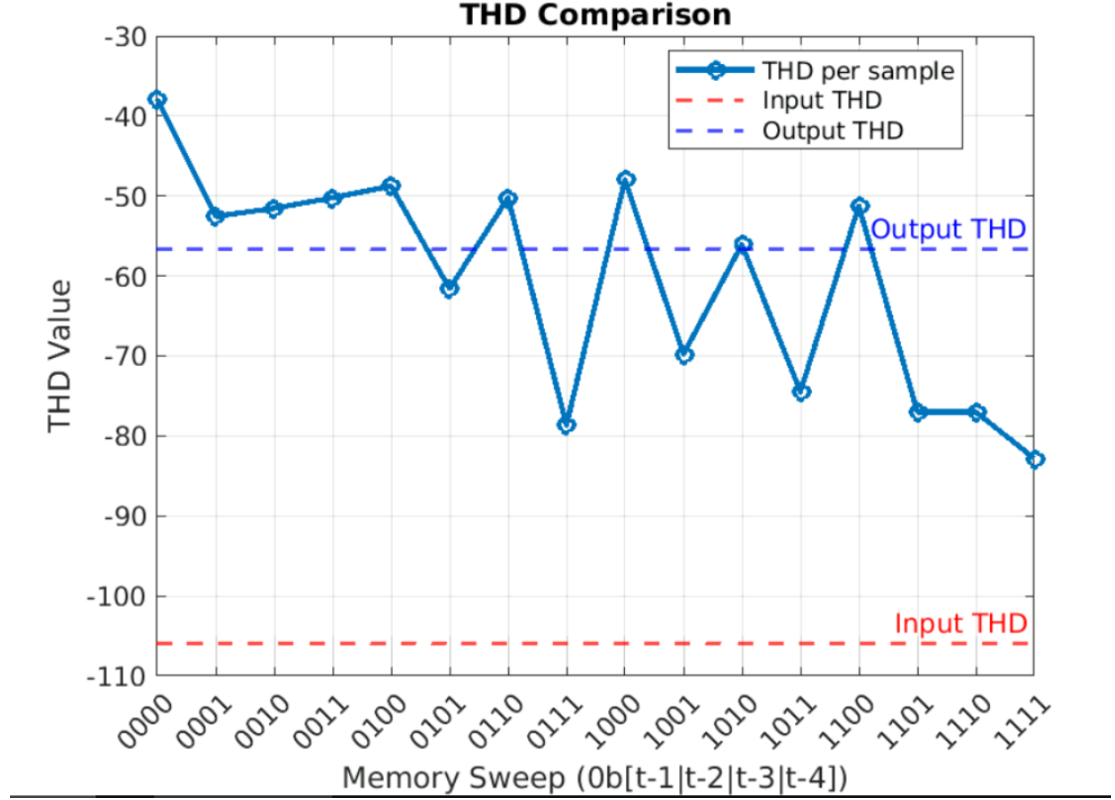


Figure 7: THD Values based on different memory sweep @ 2GHz

As shown in Figure 7, the case 0111 gives results very similar to memory order 5. As you can see from the table 1, it is a case where 4 memory terms out of 5 are used. Since the cases 1110, 1101, 1011, and 0111 all include the same number of coefficients, only 0111 will be analyzed in the following sections. To comprehend what is going on with the harmonics and THD values, the case 1001 will also be considered. Even though it uses only 3 memory terms, it performs quite well compared to the 4-term cases.

The main problem of this type of memory sweep is that the 9th harmonics is becoming dominant when we try to decrease the number of coefficients.

2.2.1 Memory Sweep 1111

As Table 1 and polynomial order of 7 shows that we have total of **24 coefficients**.

The calibrated voltage spectrum is

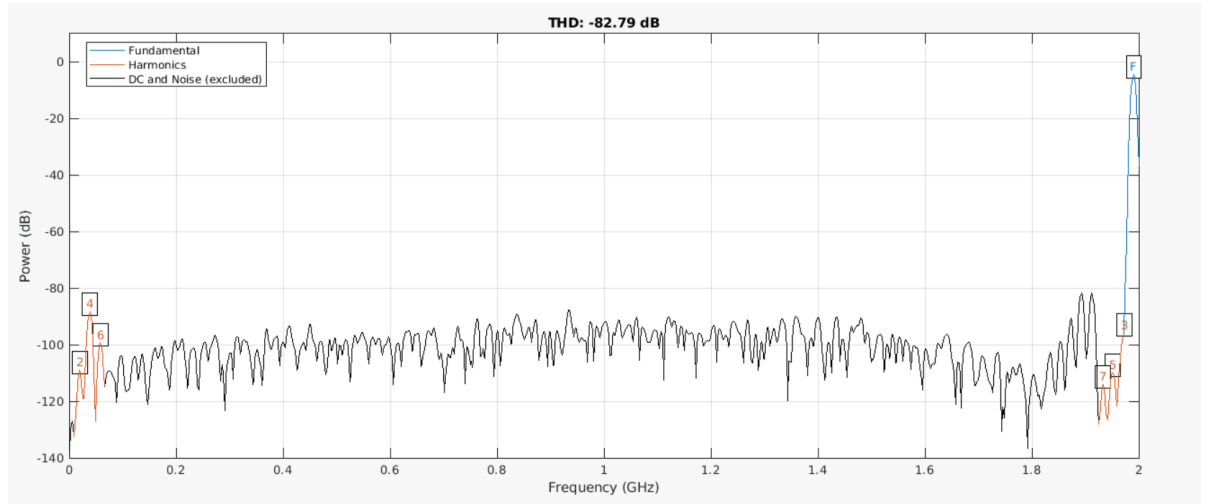


Figure 8: Calibrated output voltage waveform when memSweep is *0b1111*

2.2.2 Memory Sweep 0111

As Table 1 and polynomial order of 7 shows that we have total of **20 coefficients**.

The calibrated voltage spectrum is

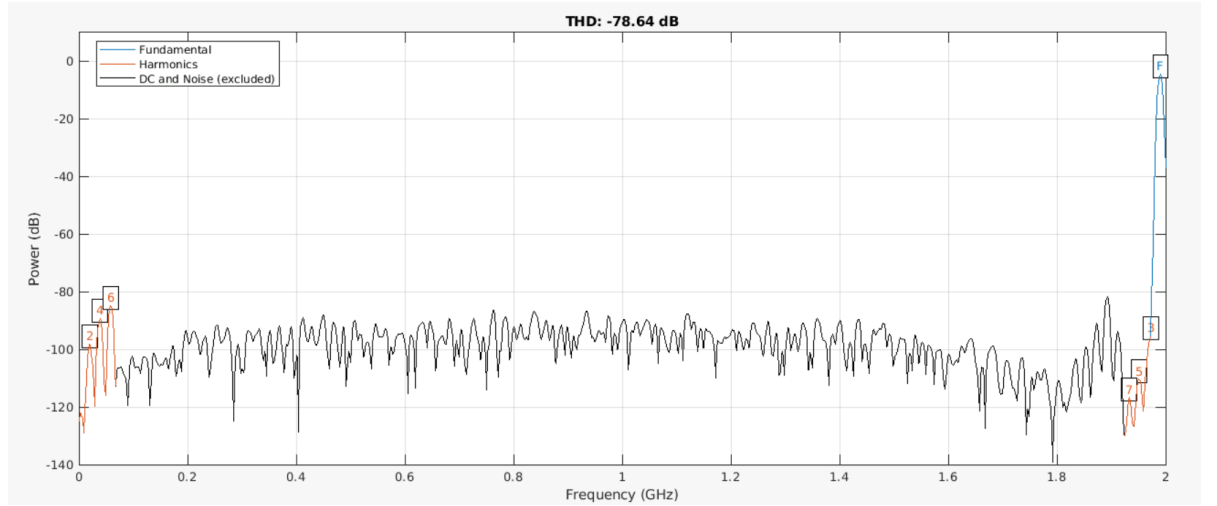


Figure 9: Calibrated output voltage waveform when memSweep is *0b0111*

2.2.3 Memory Sweep 1001

As Table 1 and polynomial order of 7 shows that we have total of **16 coefficients**.

The calibrated voltage spectrum is

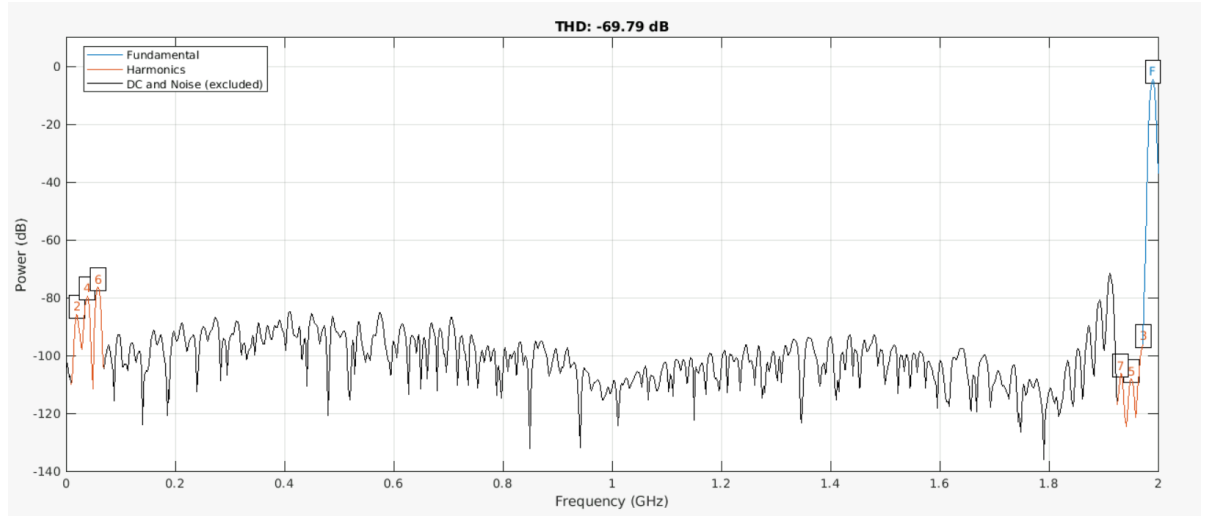


Figure 10: Calibrated output voltage waveform when memSweep is *0b1001*