VE311 Lab 4

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1. **Common-Source with NMOS Diode-Connected Load**
2. In this part, we first build the circuit below (Figure 1) in Pspice.

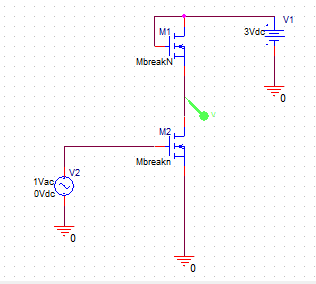


Figure 1. Pspice circuit

Then, we use DC sweep in Pspice to get vs (Figure 2).



Figure 2. DC sweep

From the figure, we can get (0.99, 1.9972), (1.01, 1.9769), and we can get at as follows:

In lab, we get the following data (Table 1).

|  |  |
| --- | --- |
| (V) | (V) |
| 0.1 | 2.354 |
| 0.2 | 2.335 |
| 0.3 | 2.316 |
| 0.4 | 2.197 |
| 0.5 | 2.007 |
| 0.6 | 1.809 |
| 0.7 | 1.612 |
| 0.8 | 1.42 |
| 0.9 | 1.234 |
| 1.0 | 1.057 |
| 1.1 | 0.907 |
| 1.2 | 0.799 |
| 1.3 | 0.739 |
| 1.4 | 0.702 |
| 1.5 | 0.675 |
| 2.0 | 0.605 |
| 2.5 | 0.572 |
| 3.0 | 0.55 |

Table 1. Measurement result

And we can get the following plot (Figure 3).

Figure 3. vs for measurement result

We can calculate the voltage gain at 0.75 is -1.92.

1. In this case, we modify the circuit. In Pspice, we can get the following figure (Figure 4).

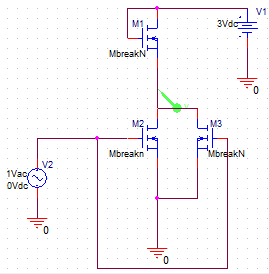
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Figure 4. Pspice circuit

Then, we use DC sweep in Pspice to get vs (Figure 5).

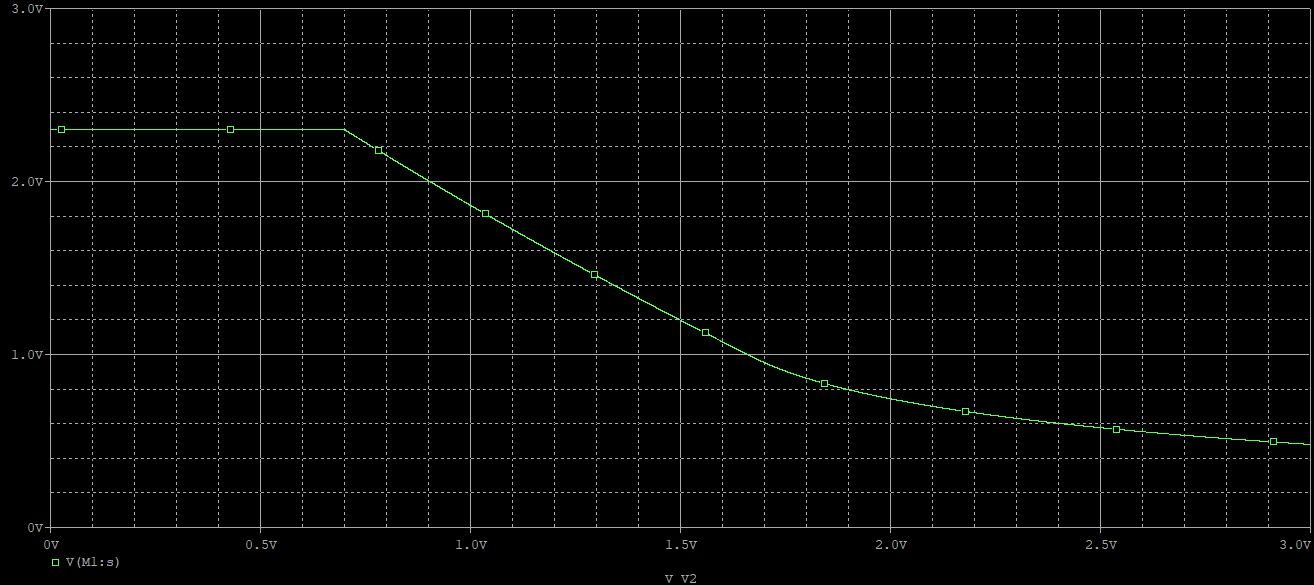


Figure 5. DC sweep

From the figure, we can get (0.99, 1.8762), (1.01, 1.8481), and we can get

It does not double. Previously, (||||||). Now, (||||||||). Therefore, the new is not double of the previous .

In lab, we get the following data (Table 2).

|  |  |
| --- | --- |
| (V) | (V) |
| 0.1 | 2.365 |
| 0.2 | 2.344 |
| 0.3 | 2.313 |
| 0.4 | 2.175 |
| 0.5 | 1.976 |
| 0.6 | 1.763 |
| 0.7 | 1.524 |
| 0.8 | 1.267 |
| 0.9 | 1.006 |
| 1.0 | 0.75 |
| 1.1 | 0.563 |
| 1.2 | 0.473 |
| 1.3 | 0.425 |
| 1.4 | 0.395 |
| 1.5 | 0.372 |
| 2.0 | 0.312 |
| 2.5 | 0.284 |
| 3.0 | 0.266 |

Table 2. Measurement result

And we can get the following plot (Figure 6).

Figure 6. vs for measurement result

We can calculate the voltage gain at 0.75 is -2.57.

It also does not double. Previously, (||||||). Now, (||||||||). Therefore, the new is not double of the previous .

1. In Pspice, we use and get the following figure (Figure 7).

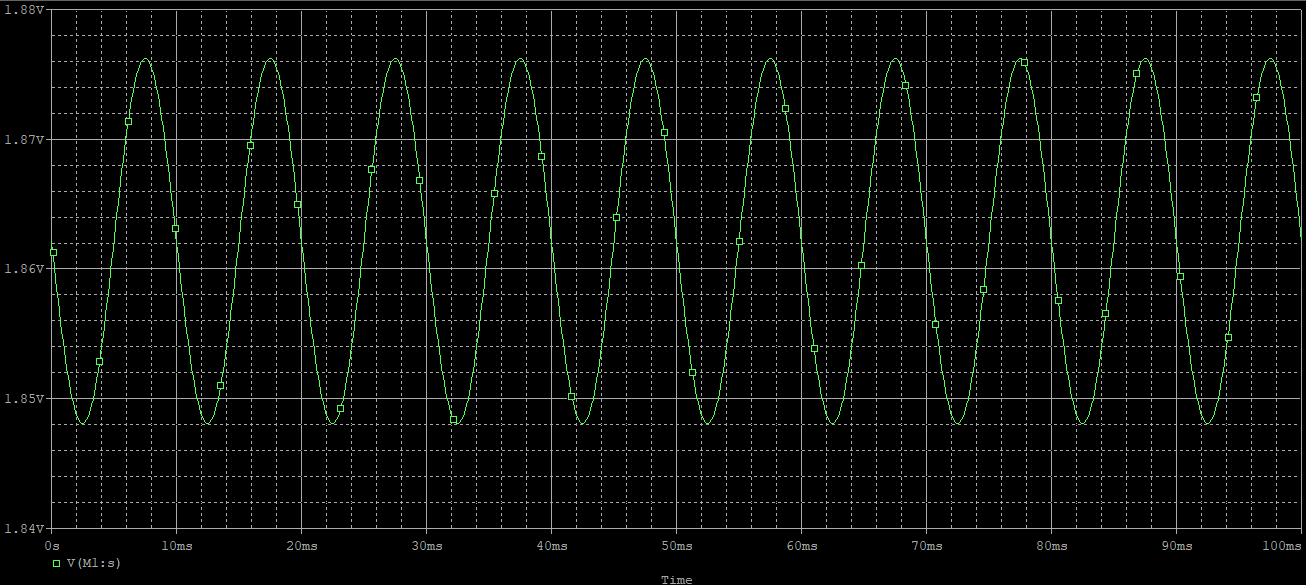


Figure 7. Simulation result

Using cursor, we can get

Also, from **(b)**, we have

They are close. Therefore, we can confirm that the amplitude of is close to .

In lab, since 0.01 is too small to generate and measure, we use instead and get the following figure (Figure 8).

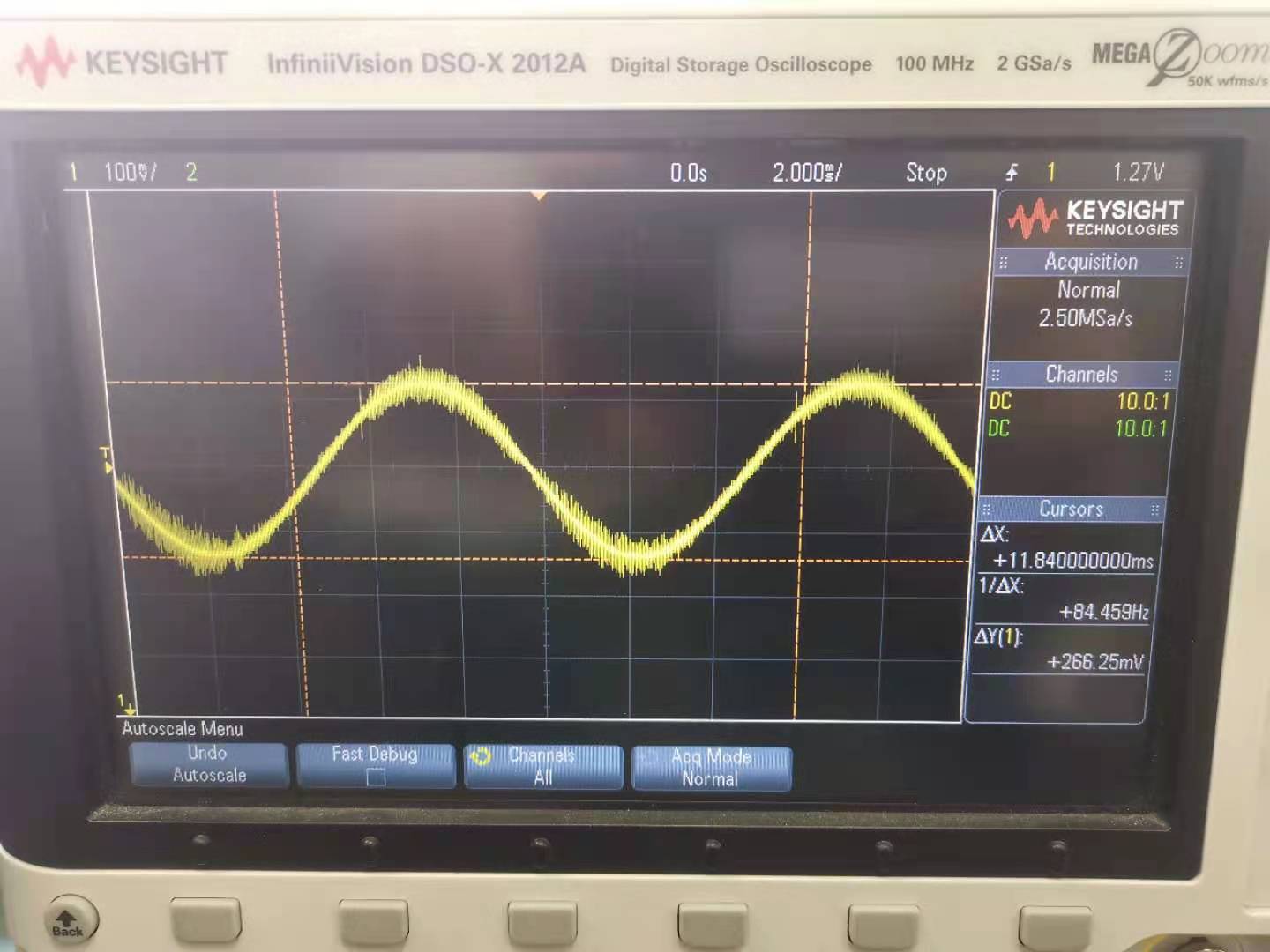


Figure 8. Measurement result for

We can get that . However, it is smaller than . It may be because that the circuit is not ideal and has inner resistance.

1. **Common-Source with PMOS Diode-Connected Load**
2. In this part, we first build the circuit below (Figure 9) in Pspice.

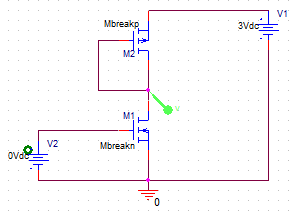


Figure 9. Pspice circuit

Then, we use DC sweep in Pspice to get vs (Figure 10).

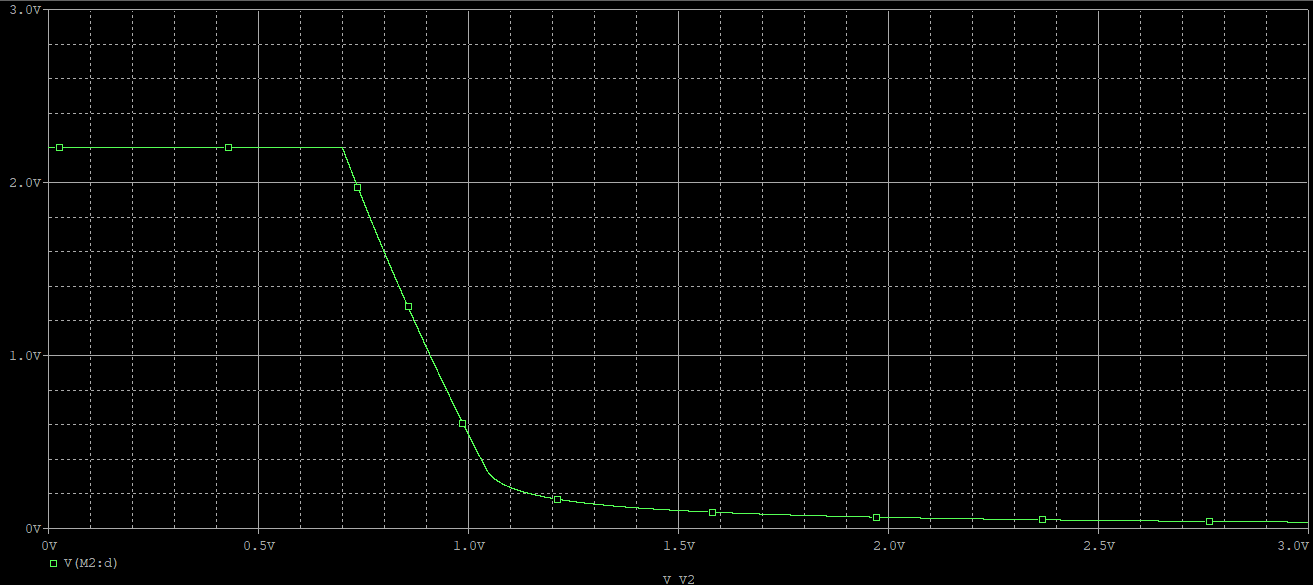


Figure 10. DC sweep

From the figure, we can get (0.89, 1.0990), (0.91, 0.994186), and we can get at as follows:

In lab, we get the following data (Table 3).

|  |  |
| --- | --- |
| (V) | (V) |
| 0.1 | 1.516 |
| 0.2 | 1.522 |
| 0.3 | 1.474 |
| 0.4 | 1.29 |
| 0.5 | 1.03 |
| 0.6 | 0.769 |
| 0.7 | 0.504 |
| 0.8 | 0.258 |
| 0.9 | 0.155 |
| 1.0 | 0.122 |
| 1.1 | 0.105 |
| 1.2 | 0.095 |
| 1.3 | 0.089 |
| 1.4 | 0.083 |
| 1.5 | 0.079 |
| 2.0 | 0.066 |
| 2.5 | 0.06 |
| 3.0 | 0.056 |

Table 3. Measurement result

And we can get the following plot (Figure 11).

Figure 11. vs for measurement result

We can calculate the voltage gain at 0. 5 is -2.6.

1. In this case, we modify the circuit. In Pspice, we can get the following figure (Figure 12).

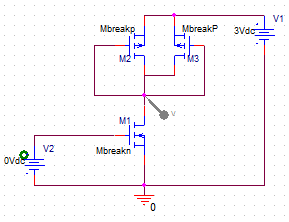


Figure 12. Pspice circuit

Then, we use DC sweep in Pspice to get vs (Figure 13).

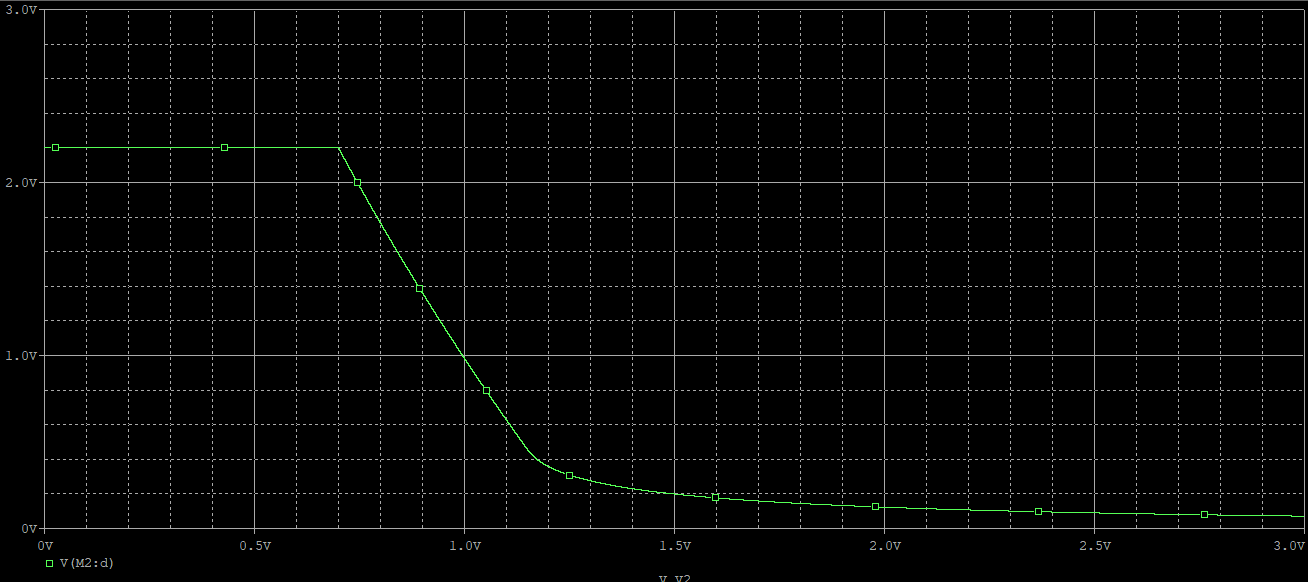


Figure 13. DC sweep

From the figure, we can get (0.89, 1.4008), (0.91, 1.3226), and we can get at as follows:

We can find that the absolute value of voltage gain becomes smaller. The reason may be that previously, (||). But, now, (||||). Therefore, the absolute value of new voltage is smaller.

In lab, we get the following data (Table 4).

|  |  |
| --- | --- |
| (V) | (V) |
| 0.1 | 1.548 |
| 0.2 | 1.541 |
| 0.3 | 1.503 |
| 0.4 | 1.324 |
| 0.5 | 1.068 |
| 0.6 | 0.824 |
| 0.7 | 0.596 |
| 0.8 | 0.389 |
| 0.9 | 0.255 |
| 1.0 | 0.203 |
| 1.1 | 0.179 |
| 1.2 | 0.166 |
| 1.3 | 0.155 |
| 1.4 | 0.148 |
| 1.5 | 0.14 |
| 2.0 | 0.123 |
| 2.5 | 0.115 |
| 3.0 | 0.109 |

Table 4. Measurement result

And we can get the following plot (Figure 14).

Figure 14. vs for measurement result

We can calculate the voltage gain at 0. 5 is -2.56, whose absolute value is smaller than the previous one. The reason may be the same. Previously, (||). But, now, (||||). Therefore, the absolute value of new voltage is smaller.

1. In Pspice, we use and get the following figure (Figure 15).

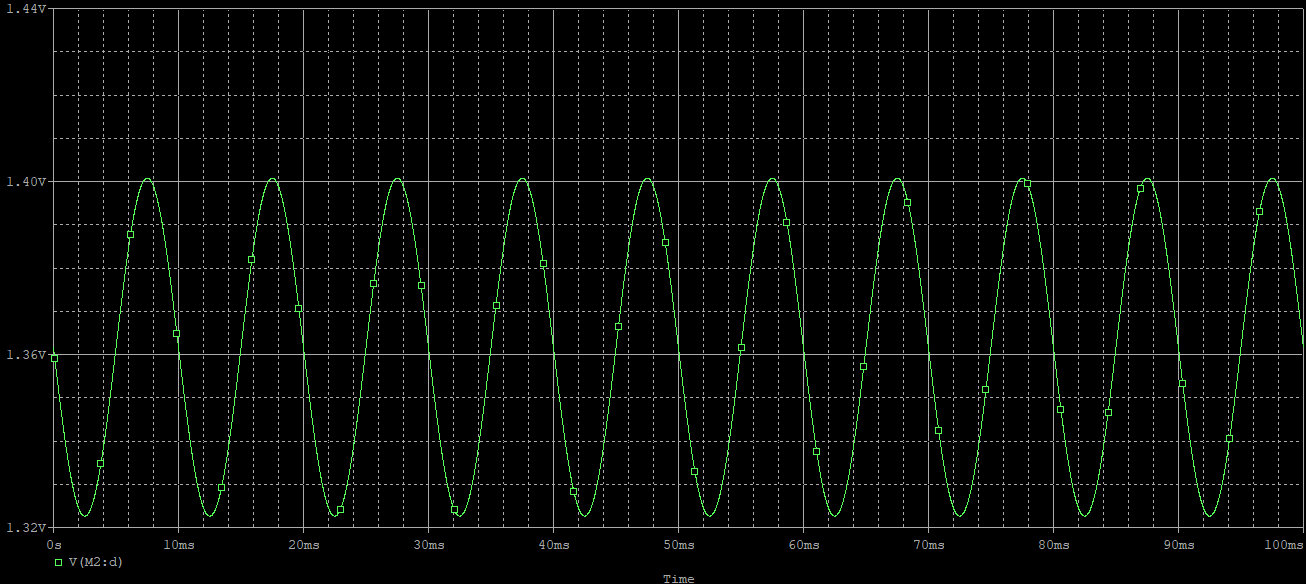


Figure 15. Simulation result

Using cursor, we can get

Also, from **(b)**, we have

They are close. Therefore, we can confirm that the amplitude of is close to .

In lab, since 0.01 is too small to generate and measure, we use instead and get the following figure (Figure 16).

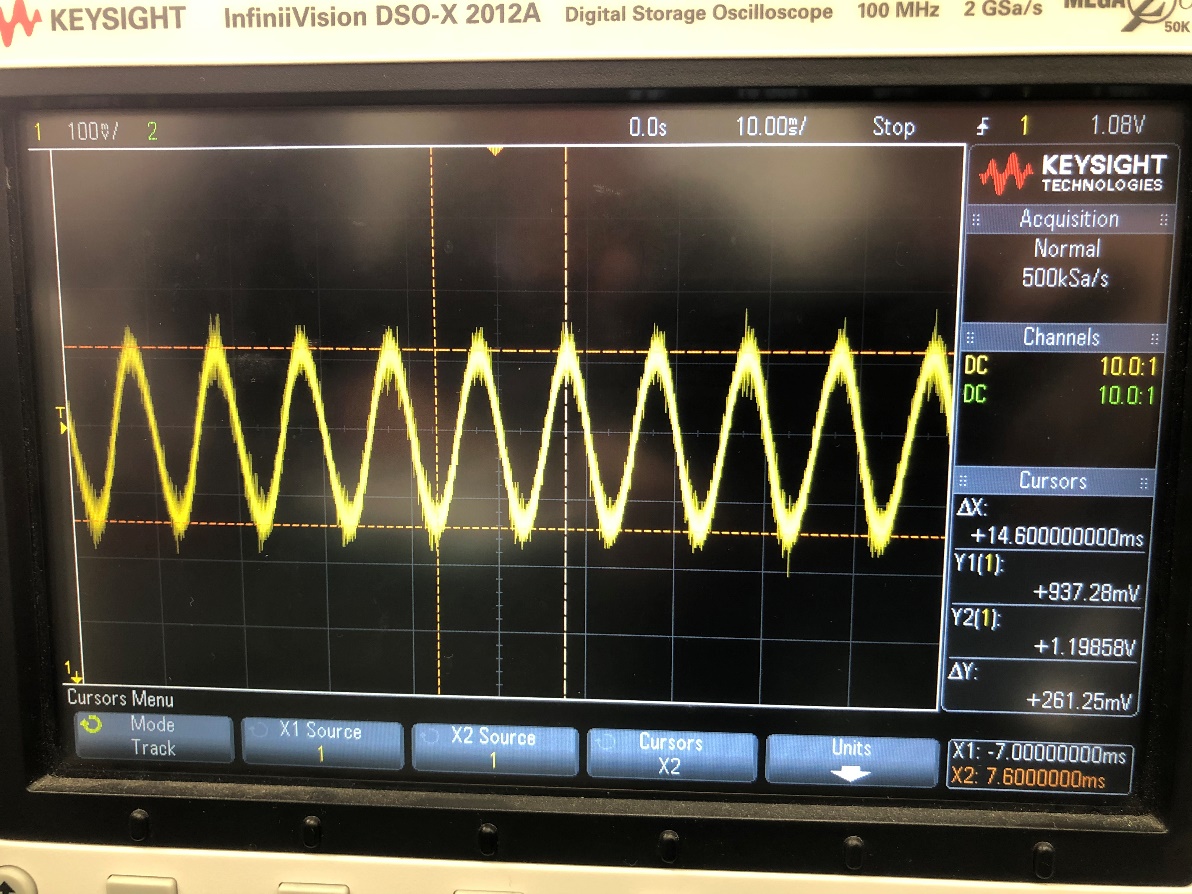


Figure 16. Measurement result for

We can get that . However, it is larger than . It may be because that the circuit is not ideal and has inner resistance.