UNIVERSITY OF ROCHESTER

ECE 216 - MICROPROCESSORS & DATA CONVERSION

Laboratory 2 Report

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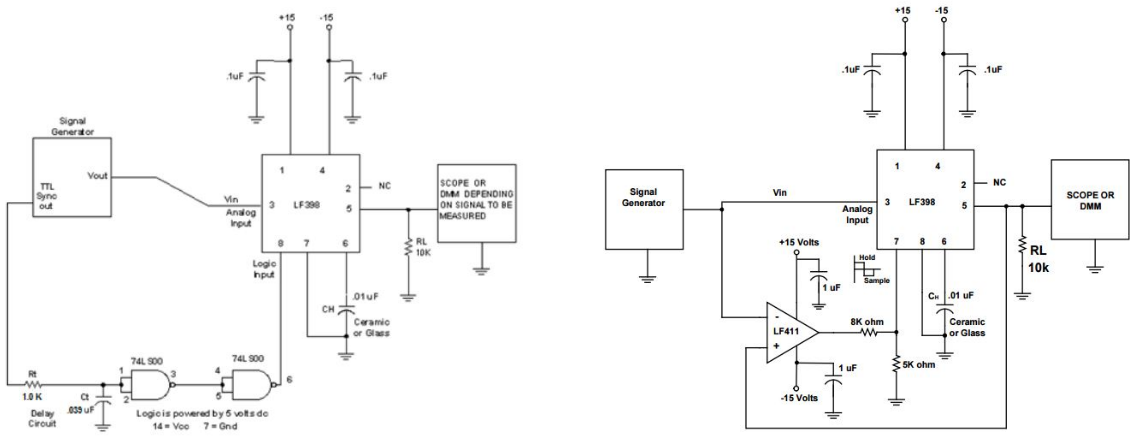
Abstract

This lab requires us to design and implement a Sample and Hold Circuit to verify different characteristics of device (LF 398) by measuring them and comparing them to manufacturer's data. We observe the following properties of circuit: Acquisition Time, Offset Voltage, Non-Linearity/Gain Error, Tracking frequency, Switching Offset Voltage, Feedback Attenuation Ratio and Drop Rate. After verifying this data with manufacturer's data sheet, we build a peak detector with this S/H device to measure the peak output voltage. At the end of this lab, we were clear about the functioning of the S/H device and how it worked and can be implemented in the circuit.

October 19, 2016

1 Introduction

The objective of this project is to investigate some of the static and dynamic characteristics of a general purpose sample-and-hold device and then compare the manufacturer's data to the data measured. In addition, to build a circuit using a sample-and-hold device, specifically a peak detecting circuit.



(a) S/H Test Circuit (b) Peak Detector Circuit

Figure 1: Circuits Used in Lab (Images taken from Project Assignment)

2 Verifying characteristics of S/H device

For the first part of lab we verified different characteristics of S/H device and comparing them to manufacturer's data sheet.

2.1 Acquisition Time

Acquisition Time: $2.3600\mu S$

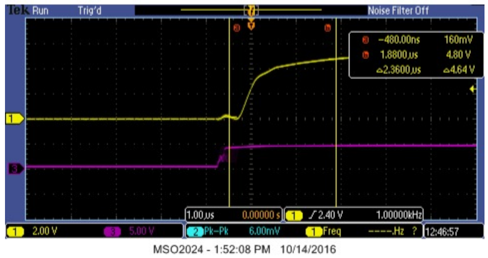


Figure 2: Acquisition Time

2.2 Offset Voltage

Offset Voltage: 2mV

This observation is the typical offset voltage specified by manufacturer in the data sheet. Our data agrees with the manufacturer's specifications.

2.3 Gain Error

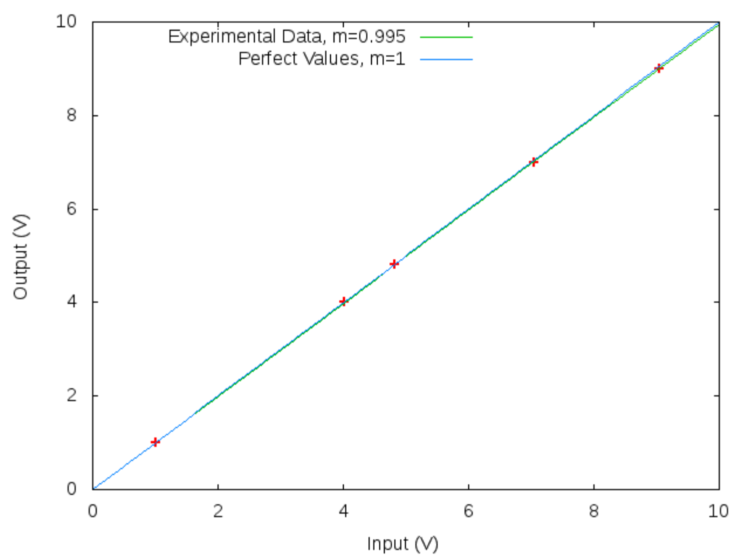
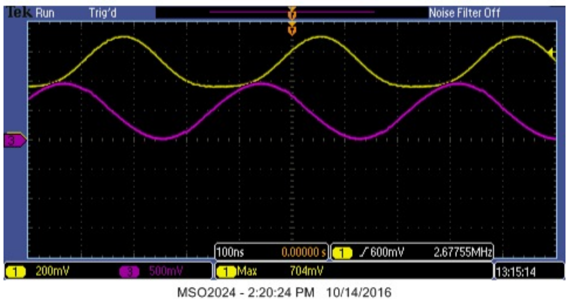


Figure 3: Part C Results

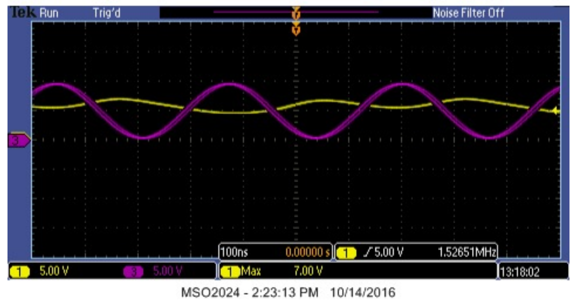
We got a gain error of 0.5% which does not match the manufacturer's data sheet exactly. It is 0.45 higher then the expected value because of the imperfections in circuit like loose connections, improper wire heads.

2.4 Bandwidth

Tracking Frequency at 1V: 2.67MHz
Tracking Frequency at 10V: 1.52MHz



(a) Bandwidth @ 1V



(b) Bandwidth @ 10V

2.5 Switching Offset

Switching Offset Voltage: $8.628\mu Vs$
This value is reasonable as it is 0.000172% of the input value. Since this is not an ideal device, this much error is expected and tolerable.

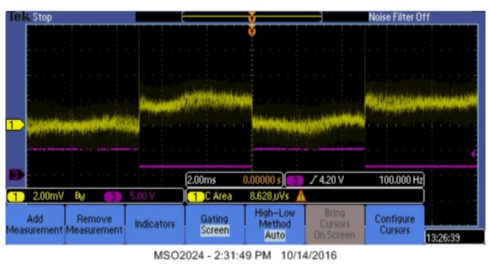


Figure 5: Switching Offset

2.6 Feedthrough Attenuation Ratio

At Frequency 1KHz

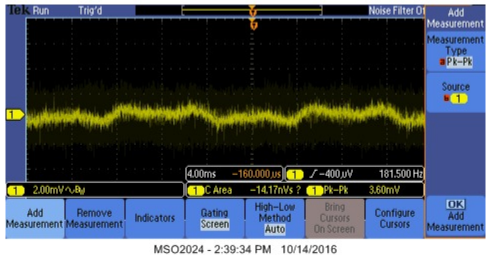


Figure 6: Attenuation Ratio at 1KHz

At Frequency 1MHz

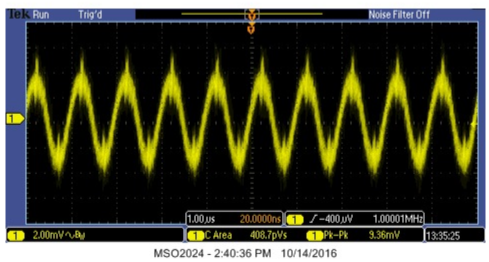


Figure 7: Attenuation Ratio at 1MHz

The feedthrough Attenuation Ratio specified by manufacturer at 1Khz is 98dB but our readings gives us an attenuation ratio of 39dB which is way less than the manufacturer's value. The problem might be improper and loose connections on the circuit.

2.7 Droop Rate

Increased 0.02 V over 1 min and 45 sec (5.02V to 5.04V) 0.12uF capacitor.

The Manufacturer does not provide data for droop rate because droop rate depends on capacitor to capacitor. So it will depend on the type of capacitor used.

3 Peak Detector

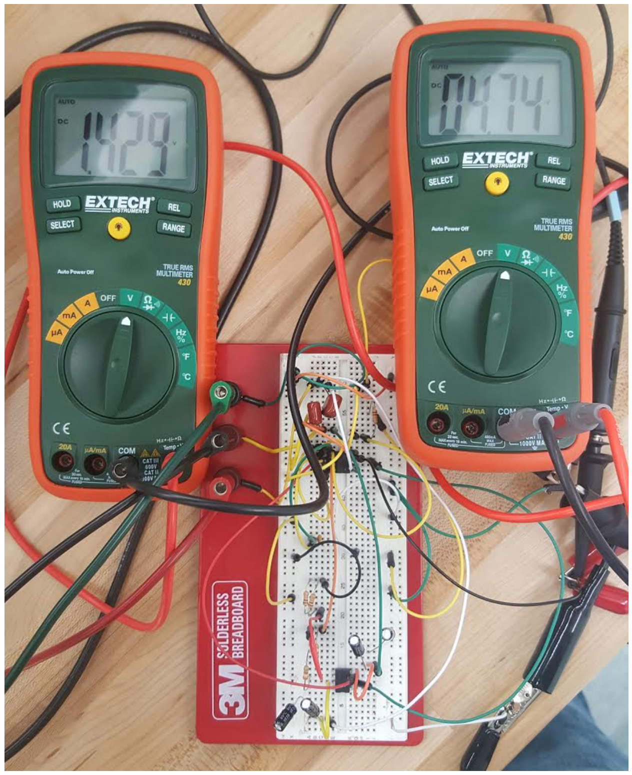


Figure 8: Circuits Created in Lab (Input Voltage on Left & Output Voltage On Right)

For this part of lab we built a peak detector and drove the input voltage from 0 V to 4.26 V. The output voltage increased with the input voltage and when we started reducing input voltage, the out remained fixed at the highest point it was at to signify peak voltage.

(a) Reaction Time: 0.05V

(b) Since the device is not ideal, there is a forward voltage drop in LF 398 which causes this difference in magnitude.

(c) Time within 5% of value: 1 Minute 24 Seconds

(d) $20\mu s$

4 Source Of Error

1. Resistors were not of the exact required value.
2. Noise in circuit because of loose connections.
3. Measuring the voltage from Signal generator was not precise when measured with voltmeter.

5 Conclusion

Through this lab we were able to understand the working of an S/H device. The data from the manufacturers sheet was within a $\pm 5\%$ of our value which could have happened because of the sources of error mentioned above. The Peak Detector performed the way it was was suppose to and we got the appropriate results as expected.