

# Sampling Theorem

## 1. Objective

This lab is designed to give you insight into the concepts of signal bandwidth and sampling theorem

## 2. Pre-Lab

Before you go to the lab, read this handout entirely and study the circuit diagrams. When building your circuits, be aware of the following guidelines:

- Build your circuits as neatly as possible.
- Label the inputs and outputs of each functional unit. This makes measurements and troubleshooting much easier.
- Learn to think in the frequency domain. This is probably one of the first classes you have had in which a large amount of the analysis is done in the frequency domain. Try to get a feel for the meaning of the information on the spectrum analyzer.

## 3. Procedure

### 3.1 Circuit Setup

Set up the circuit as shown in Figure 1. X is an input signal from AFG310. The clock Ck is chosen to be a 50kHz square wave with 16Vp-p and 0V offset. Set the duty cycle to be around 10 %. Use PUL as the function in AFG310 and set the duty cycle by pressing SHIFT and FUNC. The power supplies for both the ICs should be +/- 8 volts.

### 3.2 Measurements

Use TDS7104 oscilloscope to make time domain measurements and either the Spectrum Analyzer ADVANTEST R3131A or the scope to make the frequency domain measurements. Connect the output Y of the switch to the input of the low pass filter circuit. Measure and record the time waveforms and magnitude spectra at each of the following points; **have a 455 TA stamp these measurements, (a) X, (b) Y, and (c) Output of the Low Pass Filter.** Do this for the following Input Signals, (i) 1 kHz sine, (ii) 6 kHz sine, (iii) 1 kHz triangle, and (iv) 6 kHz triangle.

## 4. Discussion Questions

In the discussion section of your report, answer the following questions:

1. How well could you recover the original input signals from the **switch** output?
2. Was the sampling frequency adequate for the input signals? Explain.
3. How did the cut-off frequency of the filter affect the output waveforms?
4. Rank the four signals in order of increasing bandwidth. Explain your reasoning.

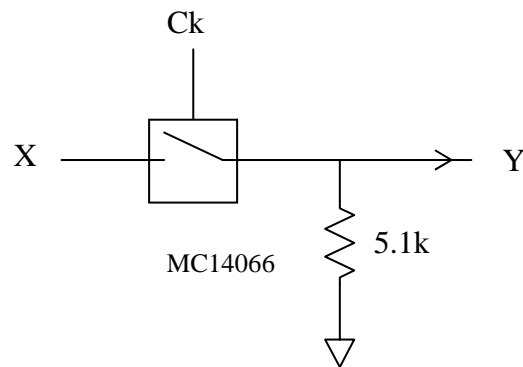


Figure 1: Sampling Circuit

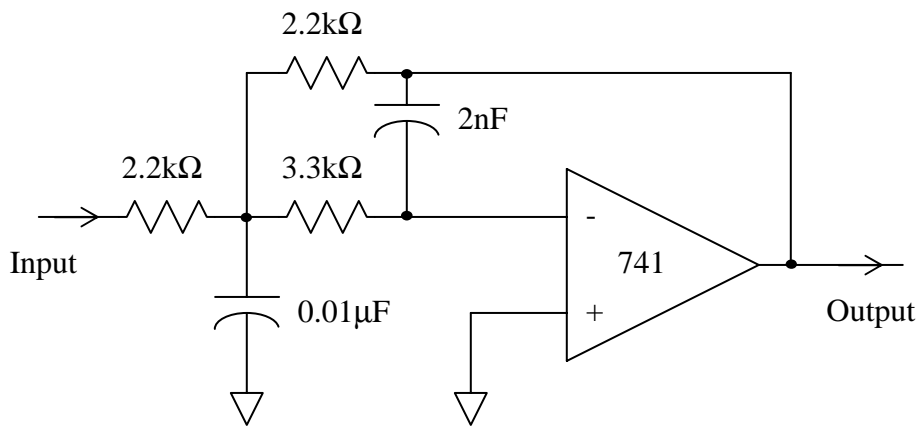


Figure 2: Low pass filter circuit