Samplingtheorem -- Overview

Sampling Theorem

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OBJECTIVES:

At the end of performing this experiment, learners would be able to:
• Describe the concept of sampling a time varying signal
• Obtain the naturally sampled signal from given input
• Understand the working of LF398 IC (sample-and-hold circuit)

EQUIPMENT:

• IC LF398
• Signal generator
• Resistors – 47 kΩ, 1.5 kΩ
• Capacitor – 0.1 μF
• +/- 15V DC Power Supply
• Digital Storage Oscilloscope & probes
• Connecting wires & Bread Board

DESIGN:

For First ,Second and Third order filter
f = 1kHz
R = ?
C= 0.1μF
$f = \frac{1}{2\pi RC}$
R= 1.59kΩ taken 1.5kΩ

THEORY:

• LF398 is a monolithic sample-and-hold circuit utilizing BI-FET technology for accurate fast acquisition of input signal.

• A sample and hold circuit is an analog device that samples (captures) the voltage of a continuously varying analog signal and holds (locks) its value at a constant level for a specified minimum

period of time (hold time). They are typically used in analog-to-digital converters to eliminate variations in input signal that can corrupt the conversion process.

• A band limited signal of finite energy which has no frequency components higher than W Hz is completely described by specifying the values of the signal at instants of time separated by 1/2 W seconds

Reference reading:
B Kanmani, “Some applications of the combination: LM-741 and LF - 398”, WASET CESSE 2009: International conference on Computer, Electrical and Systems science and Engineering, Rome, 28th-30thApril, Italy, 2009.Volume 52, April 2009, ISSN: 2070-3724, pages 335-340.

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Samplingtheorem -- Procedures

Step 1

Circuit setup:

Build the following circuit with given component values

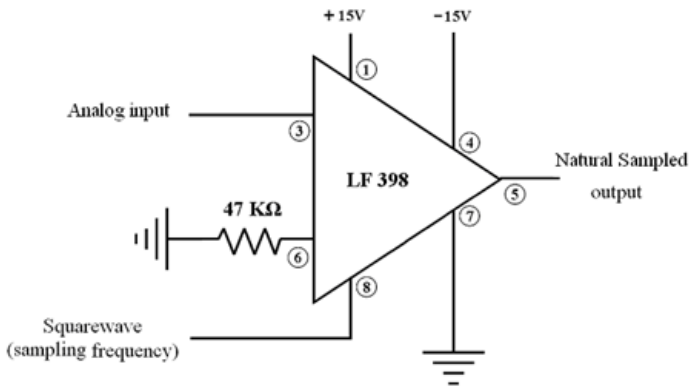


Figure: The circuit used to generate ‘Natural-sampled’ waveform

Step 2

• Use a signal generator to generate analog input and sampling (square wave signal). The analog input will be set to 1 kHz Sine wave(or triangular wave) and sampling signal will be 15-20 kHz Square-wave of 20% duty cycle.

• Turn on the supply of the circuit and enable signal generator that is feeding signal to the circuit.

Step 3

• Connect the DSO probe – CH1 at analog input (pin # 3 of LF398 IC), CH2 at sampling signal input (pin # 8 of LF398 IC) and CH3 at output (pin # 5 of the LF398 IC).

• Perform Autoset on DSO and capture the output signal.

Step 4

• Configure PEAK-to-PEAK measurement on the input and output signal

•Obeserve the output Message with dc-offset and sampled waveform

Step 5

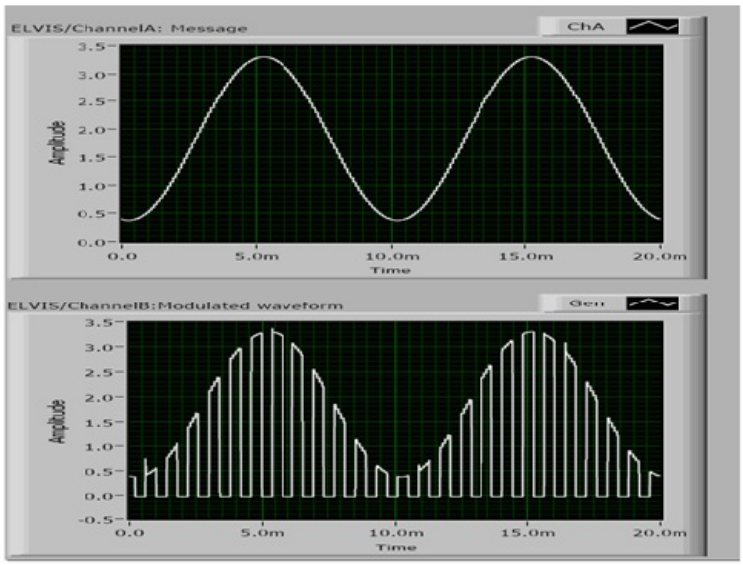


Figure: The sinusoidal message with dc-offset and the corresponding sampled waveform

Step 6

Obeserve the output Message without dc-offset and sampled waveform

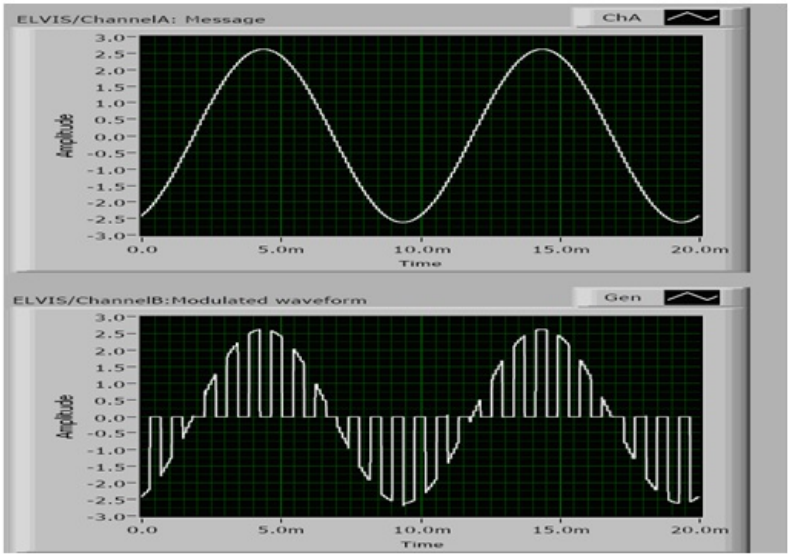
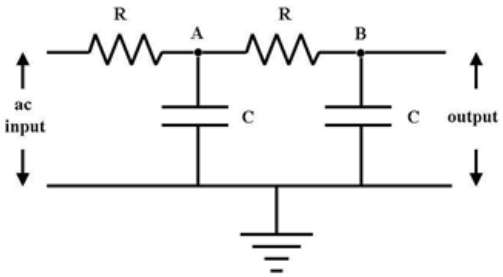


Figure: The sinusoidal message without dc-offset and the corresponding sampled waveform

Step 7

•Record the measurement and Observe – input, output on DSO
The output of the LF398 is given to an Low Pass Filter (First or Second or Third order)
As shown in the following figure



Step 8

Observations:

Obtain the minimum sampling frequency for 1KHz message signal when recovery is using
i) first order LPF is _____
ii) second order LPF is _____
iii) third order LPF is _____

Step 9

• Open-ended Question / Can you answer this?

What will be the effect on output waveform if:
1) Order of the LPF is increased