Flattopsampling -- Overview

Flat Top Sampling

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OBJECTIVES:

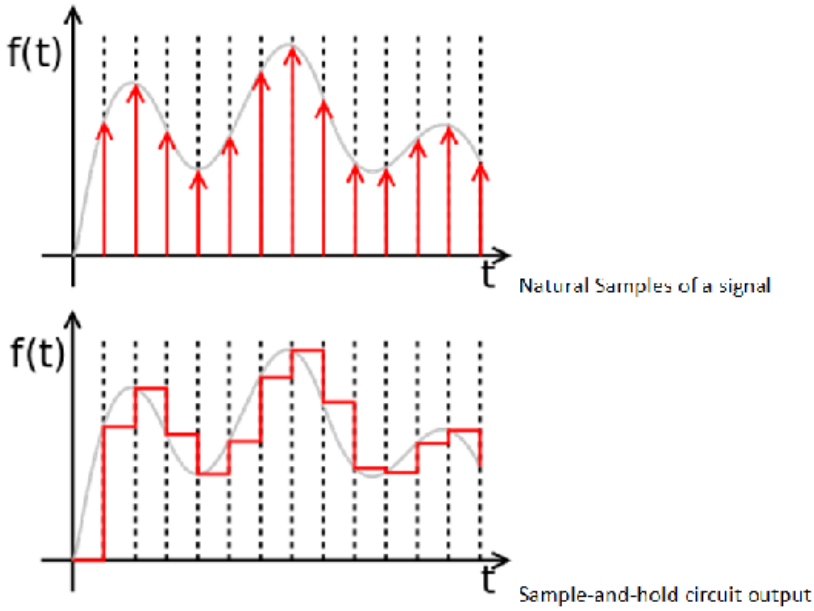
At the end of performing this experiment, learners would be able to:
• Describe the concept of sampling a time varying signal
• Obtain the naturally sampled signal from given input
• Obtain the flat-top sampled signal from given input
• Understand the working of LF398 IC (sample-and-hold circuit)

EQUIPMENT:

• IC LF398
• Signal generator
• Resistors – 47 kΩ, 1.5 kΩ
• Capacitor – 0.01 µF
• +/- 15V DC Power Supply
• Digital Storage Oscilloscope & probes
• Connecting wires & Bread Board

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 flat topped pulse has constant amplitude established by the sample value of the signal at some point within the pulse interval.
• The flat top sampling can be described by the convolution of sampled pulse train m(t) δT(t) with a unit amplitude rectangular p(t) of width T. The time convolution results in flat top sampled sequence s(t)



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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Flattopsampling -- Procedures

Step 1

Circuit setup:

Build the following circuit with given component values

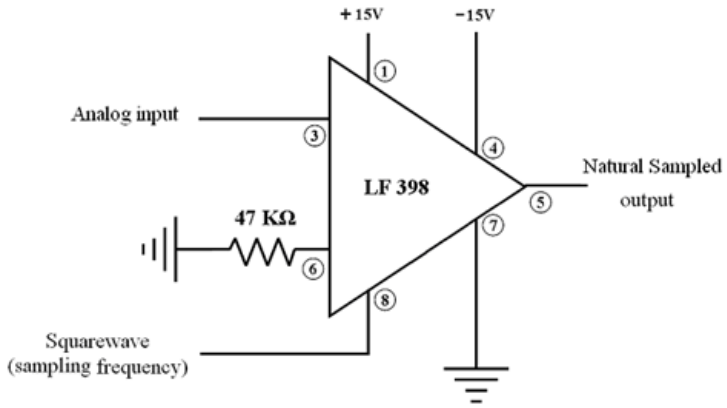


Figure: The circuit used to generate ‘Natural-sampled’ waveform

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

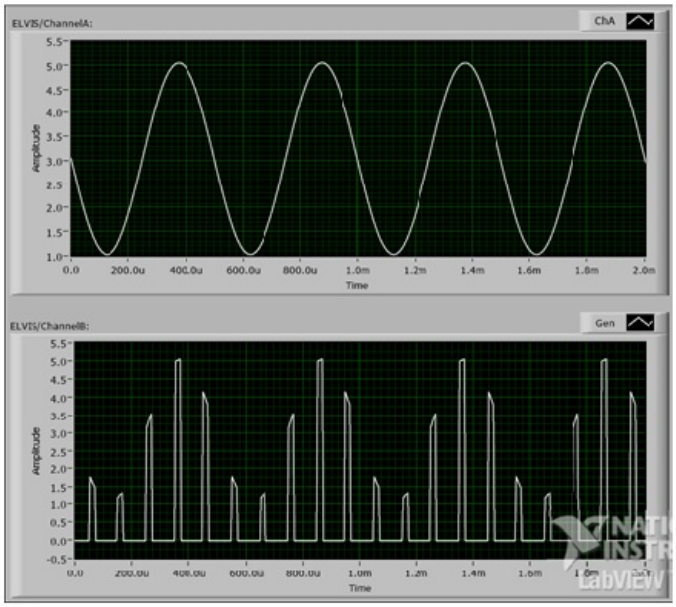
• Connect the DSO probe – CH1 at analog input (pin # 3 of LF398 IC), CH2 at sampling signal input (pin # 8 of LF398 IC) and CH3 at output (pin # 5 of the LF398 IC).
• Perform Autoset on DSO and capture the output signal.

Step 4

• Configure PEAK-to-PEAK measurement on the input and output signal
• Record the measurement and Observe – input and output on DSO and record the signal

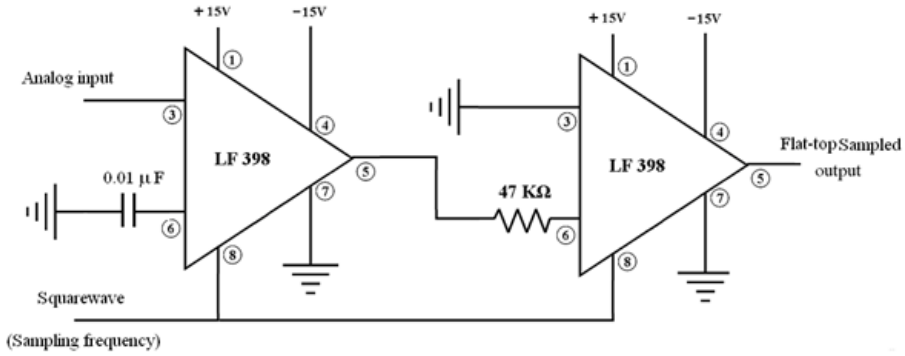
Step 5

Input message signal with dc-offset and sampled waveform



Step 6

• Now modify the circuit as following (to get flat-top sampled signals)



Step 7

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

Step 8

• 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 9

• Configure PEAK-to-PEAK measurement on the input and output signal
• Record the measurement and Observe – input and output on DSO and record the signal

Step 10

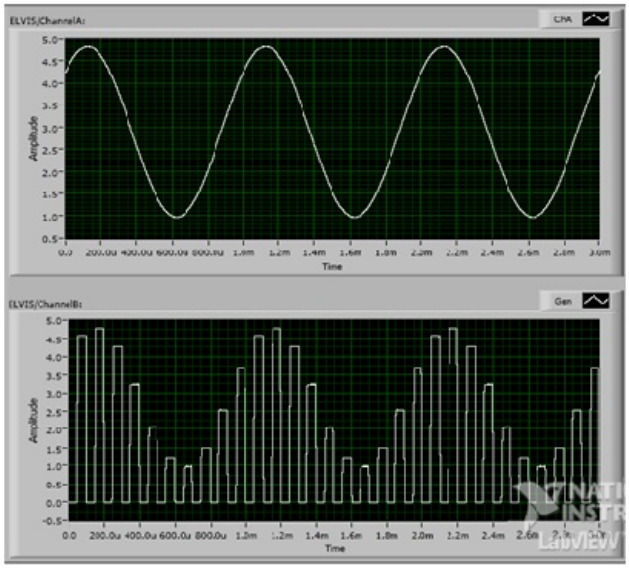


Figure: The message signal with its corresponding Flat-top sampled output

Step 11

- Open-ended Question / Can you answer this?

  What will be the effect on output waveform if:

  1) Duty cycle of the square pulse is increased to 50%?
  2) Capacitor value is changed from 0.01 μF to 1 μF?