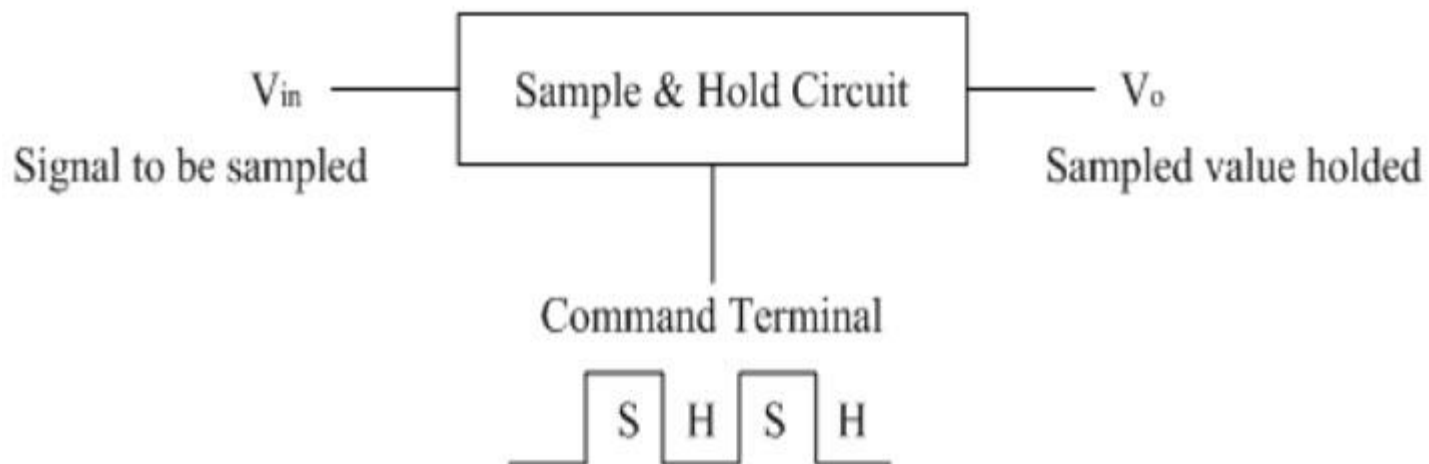


Introduction

A Sample and Hold Circuit, sometimes represented as S/H Circuit or S & H Circuit, is usually used with an Analog to Digital Converter to sample the input analog signal and hold the sampled signal.

In the S/H Circuit, the analog signal is sampled for a short interval of time, usually in the range of $10\mu\text{S}$ to $1\mu\text{S}$. After this, the sampled value is hold until the arrival of next input signal to be sampled. The duration for holding the sample will be usually between few milliseconds to few seconds.

The following image shows a simple block diagram of a typical Sample and Hold Circuit.

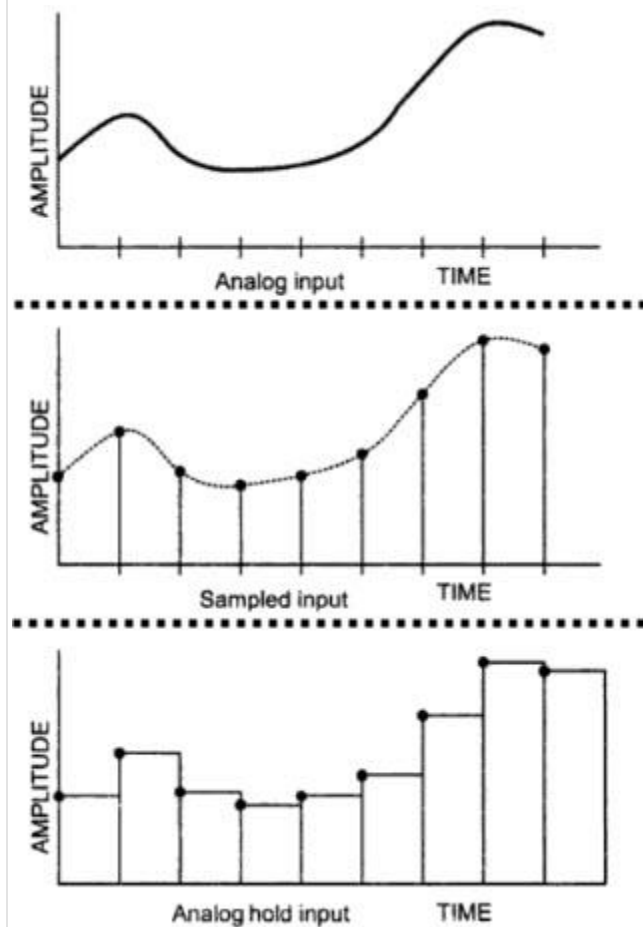


Need for Sample and Hold Circuits

If the input analog voltage of an ADC changes more than $\pm 1/2$ LSB, then there is a severe chance that the output digital value is an error. For the ADC to produce accurate results, the input analog voltage should be held constant for the duration of the conversion.

As the name suggests, a S/H Circuit samples the input analog signal based on a sampling command and holds the output value at its output until the next sampling command is arrived.

The following image shows the input and output of a typical Sample and Hold Circuit.

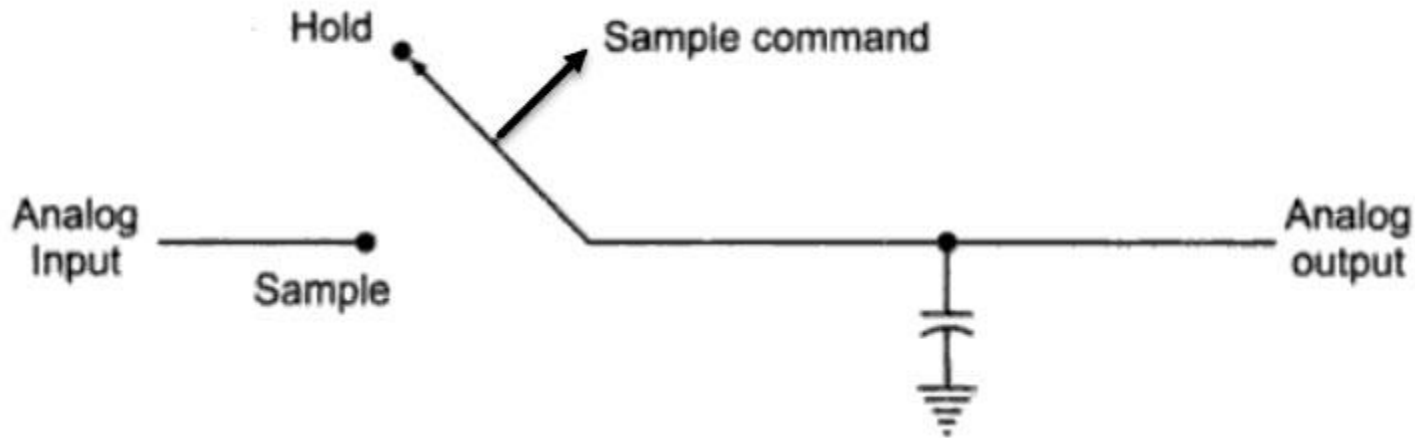


Simple Sample and Hold Circuit

Let us understand the operating principle of a S/H Circuit with the help of a simplified circuit diagram. This sample and hold circuit consist of two basic components:

- Analog Switch
- Holding Capacitor

The following image shows the basic S/H Circuit.



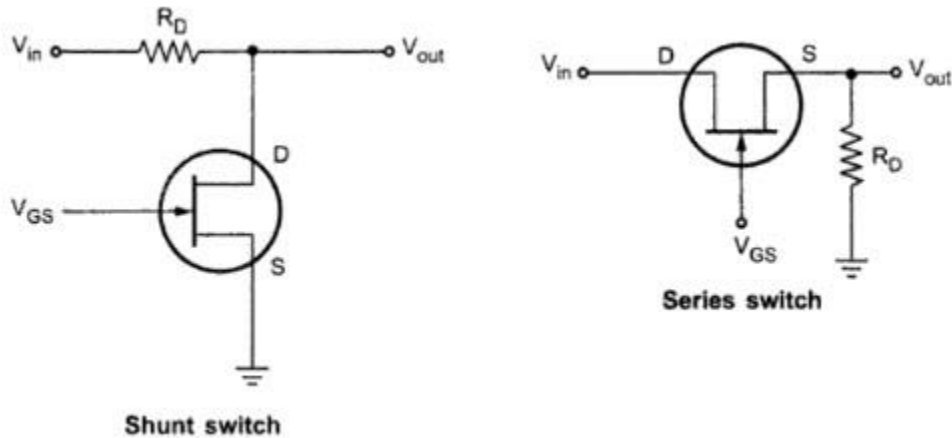
This circuit tracks the input analog signal until the sample command is changed to hold command. After the hold command, the capacitor holds the analog voltage during the analog to digital conversion.

Analog Switch

Any FET like **JFET** or **MOSFET** can be used as an Analog Switch. In this discussion, we will concentrate on JFET. The Gate-Source voltage V_{GS} is responsible for switching the JFET.

When V_{GS} is equal to 0V, the JFET acts as a closed switch as it operates in its Ohmic region. When V_{GS} is a large negative voltage (i.e. more negative than $V_{GS(OFF)}$), the JFET acts as an open switch as it is cut-off.

The switch can be either a Shunt Switch or a Series Switch, depending on its position with respect to input and output. The following image shows a JFET configured as both a Shunt Switch and as a Series Switch.



Advantages

- The main and important advantage of a typical SH Circuit is to aid an Analog to Digital Conversion process by holding the sampled analog input voltage.
- In multichannel ADCs, where synchronization between different channels is important, an SH circuit can help by sampling analog signals from all the channels at the same time.
- In multiplexed circuits, the crosstalk can be reduced with an SH circuit.

Applications of Sample and Hold Circuit

Some of the important applications are mentioned below:

- Analog to Digital Converter Circuits (ADC)
- Digital Interface Circuits
- Operational Amplifiers
- Analog De-multiplexers
- Data distribution systems
- Storage of outputs of multiplexers
- Pulse Modulation Systems