Objective

To verify the sampling theorem.

Aim of the Experiment

To obtain the sampled output for given modulating signal input.
Verify the sampling theorem for different modulating frequencies $f_s < 2f_m$, $f_s = 2f_m$ and $f_s > 2f_m$
Reconstruct the original signal from the sampled signal.

Equipment Required

Sampling Theorem Trainer Kit
Digital storage oscilloscope (100MHz,1GSa/S)
Power supply
Probes
Patch cord
Connecting wires

Theory

Sampling is the process of conversion of analog signal to discrete signal. Sampling Theorem shows that a continuous-time band-limited signal may be represented perfectly by its samples at uniform intervals of T seconds, if T is small enough. In other words, the continuous-time signal may be reconstructed perfectly from its samples; sampling at a high enough rate is information-lossless.
Sampling theorem states that:
1. The band limited signal of finite energy, which has no frequency component higher than w hertz, is completely described by specifies the value of signal at instant of time separated by 1/2w second.
2. The band limited signal of finite energy, which has no frequency component higher than w hertz, must be completely recovered from knowledge of its samples taken at rate of 2w per second.
$F_s >= 2\ f_m$
If the sampling frequency is less than Nyquist rate, then a distortion is called aliasing.

$$g_\delta(t) = \sum_{n=-\infty}^{\infty} g(nT_s)\delta(t - nT_s)$$

$$g_\delta(t) = \text{the ideal sampled signal}$$

$$f_s = \frac{1}{T_s} : \text{sampling rate}$$

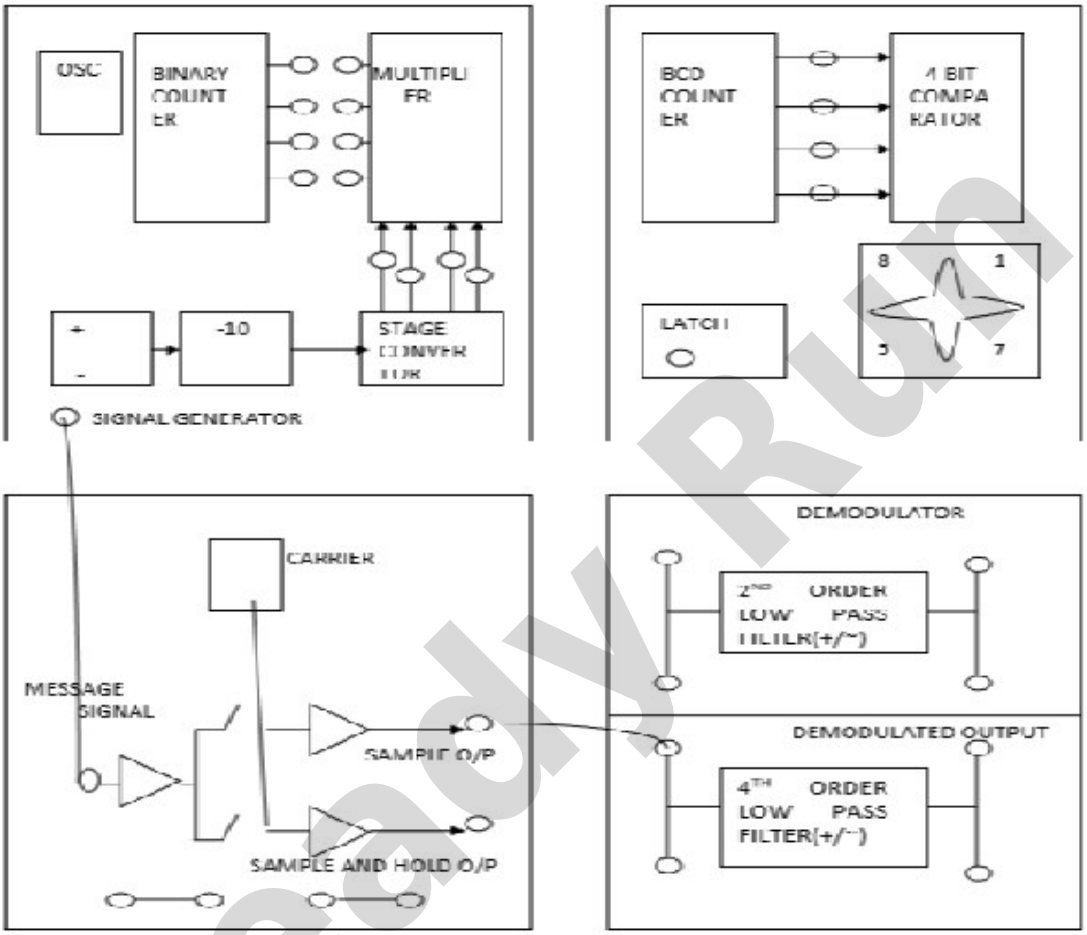
$$T_s : \text{sampling period}$$

Procedure

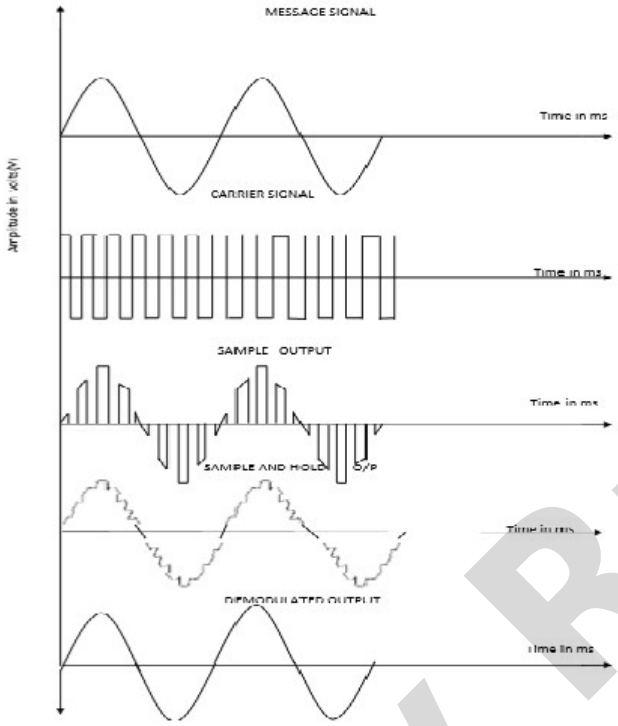
1. Connections are given as per the block diagram.
2. Take the sine wave as input of 1KHZ from signal generator block.
3. Observe the carrier waveform and note down the amplitude and time period of the signal.
4. Observe the sampled signal and note down the amplitude and time period of the signal.
5. Observe the sampled and hold signal and note down the amplitude and time period of the signal.
6. Then the sampled signal is given as an input to low pass filter and then reconstructed waveform is obtained in output of low pass filter.

7. Plot the graph for the Sampled signal and Sample and Hold Signal.

Block Diagram / Circuit Diagram



Graph



Observation Table

Modulating signal				Carrier signal			
Signal Type	**Time Period**	**Frequency**	**Amplitude**	**Signal Type**	**Time Period**	**Frequency**	**Amplitude**
Sine Wave				Square Wave			

Demodulated Output			
Signal Type	**Time Period**	**Frequency**	**Amplitude**
Sine Wave			

Result

The sampling theorem is verified successfully.

Conclusion

The modulating signal can be reconstructed from sampled signal successfully when $F_s >= 2\ f_m$.

Precautions

1) Do not use open ended wires to connect 230V, 50Hz power supply.
2) Check the connection before giving the power supply.
3) Observations should be done carefully.
4) Disconnect the circuit after switched off the power supply