EEE342

Intro to Communication

Semester: Summer 2018

Section: 002

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Sampling: When we digitalise any analog signal, we take some discrete point values of that signal which is called sampling.

Sample and Hold: Efficiency while reconstructing from sampled signal is low because it loses its values immediately after that discrete sample. In order to overcome this problem we use sample and hold circuit. Basically it holds the highest value of a sampled signal until we take the next sample. Thus sample and hold create the reconstructed output smooth and precise.

Duty Cycle: Duty cycle is the ratio between on time and off time of a pulse of a signal. Generally we consider 50% duty cycle.

Input Message: We used a MODICOM 1 board for this experiment. The internal analog input signal of this board is 1kHz.

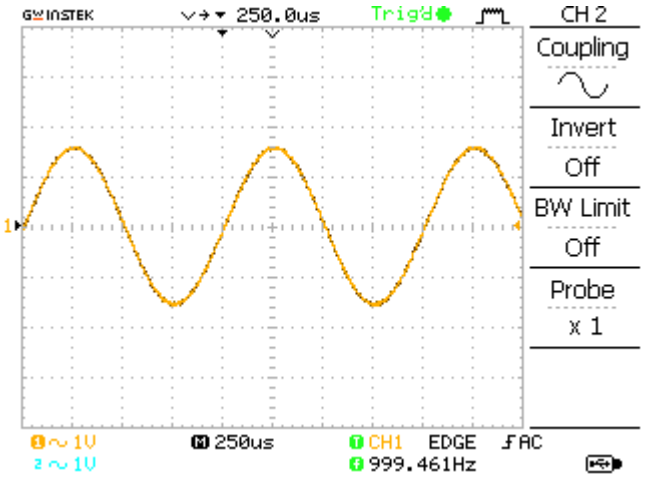

Fig 1: Input Message Signal

Sampling: Then we took some discrete sample of that analog signal. We have measured data at 2kHz, 8kHz & at 32khz and observed how the waveshape graph looks like.

As 2khz sampling rate is quite low, we merely got the original waveshape configuration.

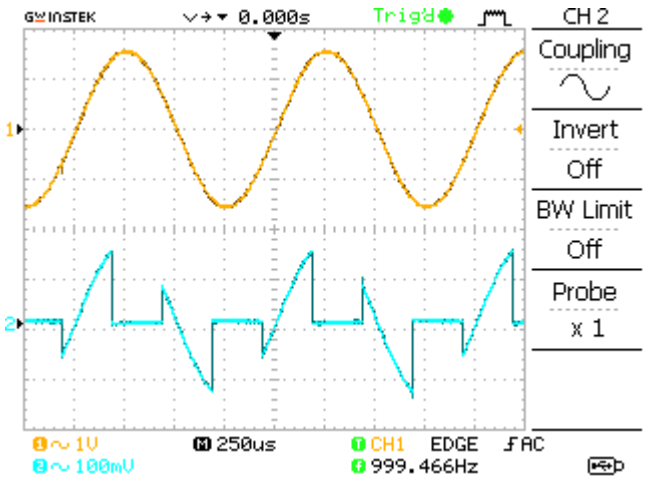

Fig 2: 2 kHz Sampling

As we increase sampling frequency, it starts to look alike more accurately.

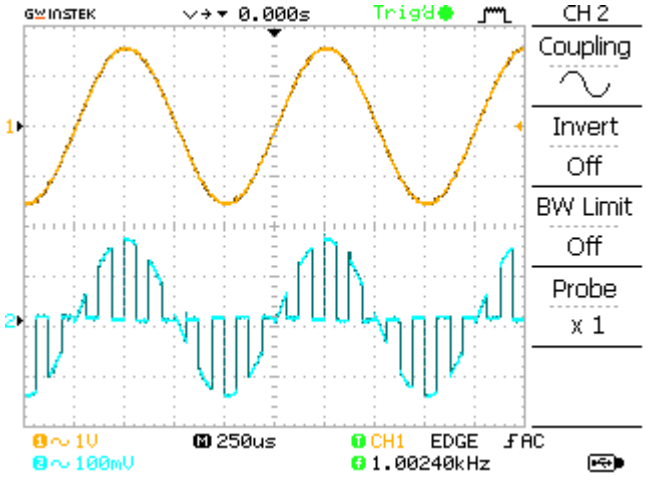

Fig 3: 8 kHz Sampling

At 32kHz, Despite having some distortion the waveshape of sampled signal almost looks like as the input signal.

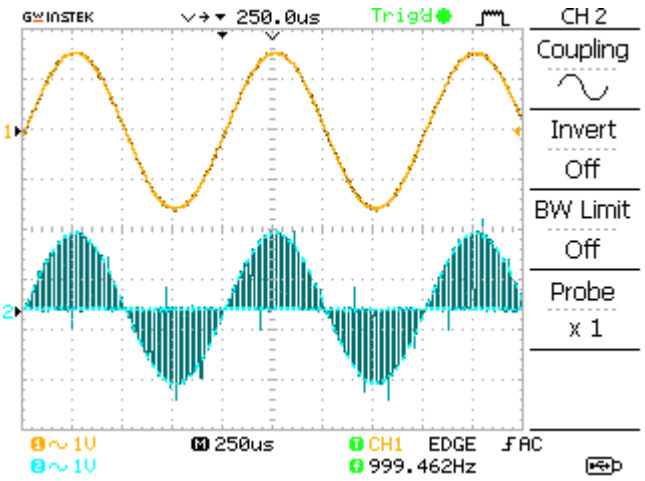

Fig 4: 32 kHz Sampling

Sample and Hold: In this section of our experiment we will observe more accurate output waveshape than before because it holds is last highest value for the next change or pulse.

For 2kHz of sample and hold action we get more accurate output than just sampling at 2kHz.

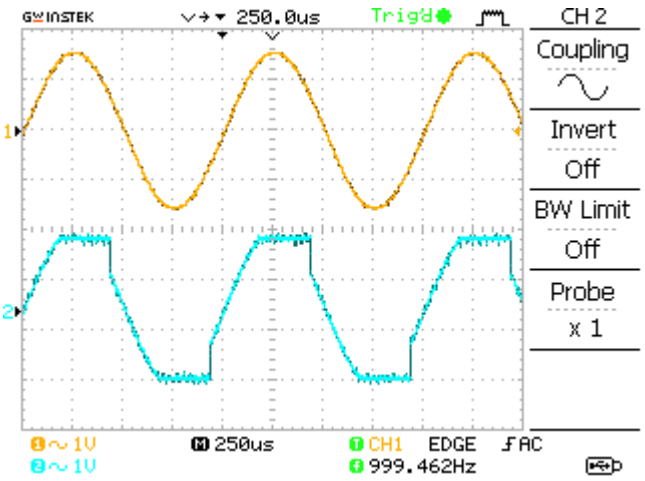

Fig 5: 2 kHz Sample and Hold

Then at 8kHz we get more accurate sampled signal than 2kHz .

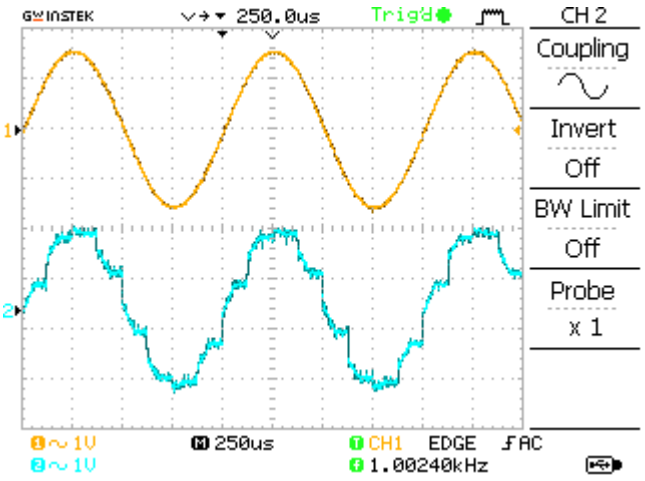

Fig 6: 8 kHz Sample and Hold

As we can see, 32kHz sampling rate is high enough to create almost identical output as input. And we included hold operation in addition. Thus we get the best possible output sampled signal for our experiment.

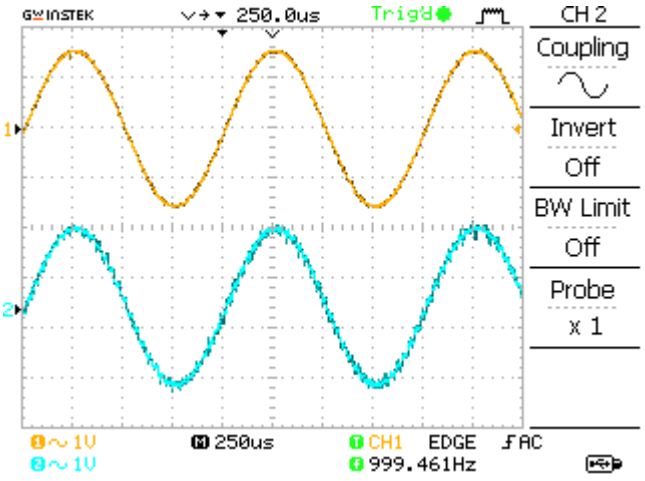

Fig 7: 32 kHz Sample and Hold

Reconstruction : From the sampled signal, now our task is to reconstruct the original signal. Or as close to original as possible. For this method we used 2 techniques. One is using 2^{nd} order circuit. Another is 4^{th} order circuit. The 4^{th} order circuit definitely gives us more accurate and precise reconstructed signal.

Reconstruction using 2nd Order:

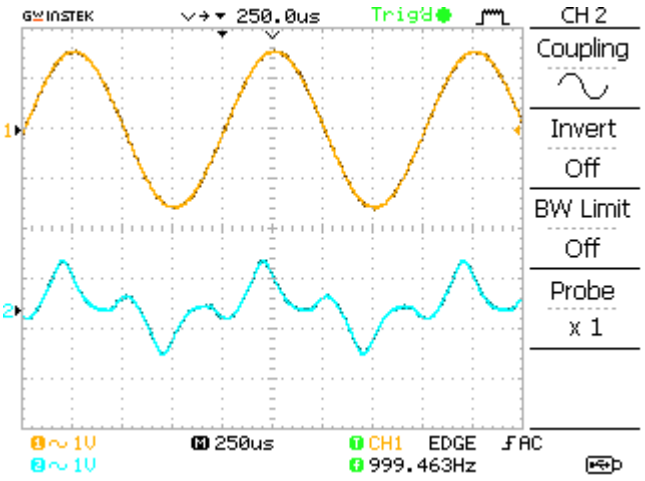

Fig 8: 2 kHz Reconstructed 2nd Order

Reconstruction using 2nd order circuit is much less accurate. However, for 2kHz the reconstruction is too poor.

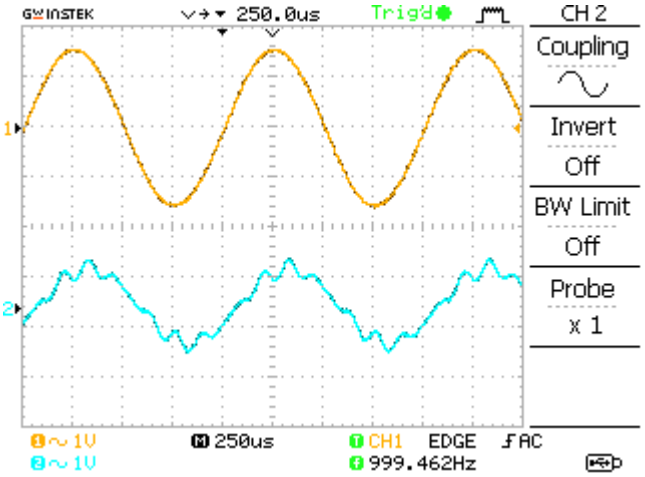

Fig 9: 8 kHz Reconstructed 2nd Order

As we can see here 8kHz gives more precise reconstructed signal than the previous 2khz sampled signal.

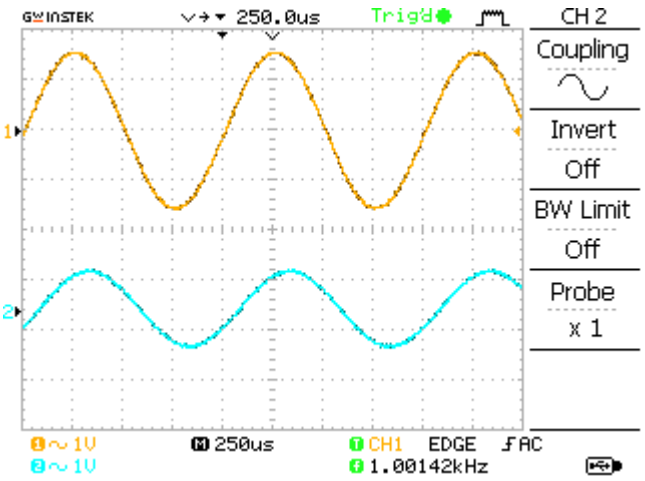

Fig 10: 32 kHz Reconstructed 2nd Order

Here, 32kHz is the best reconstructed output signal among 2kHz, 8kHz & 32khz. This proves that if we take higher sampling rate we will get almost identical to the original input signal.

Reconstruction using 4th Order:

4th order reconstruction will be more accurate than what we saw for 2nd order reconstruction. Also the higher the frequency, the accurate reconstruction is. Higher is better.

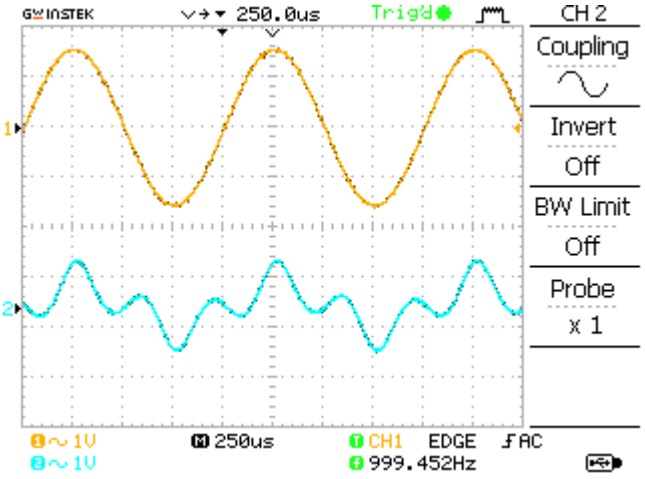

Fig 11: 2 kHz Reconstructed 4th Order

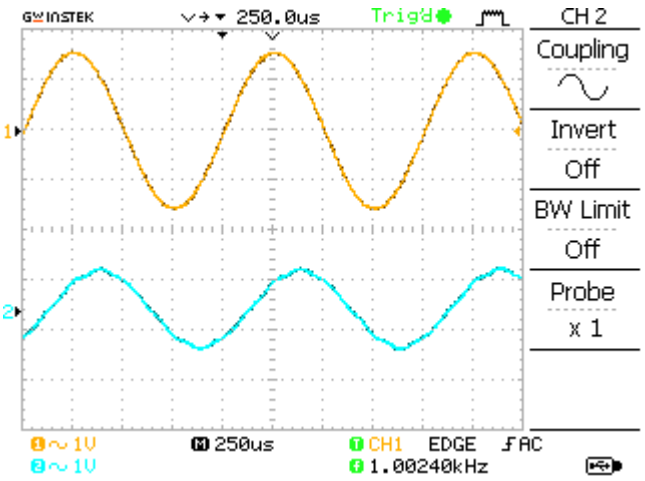

Fig 12: 8 kHz Reconstructed 4th Order

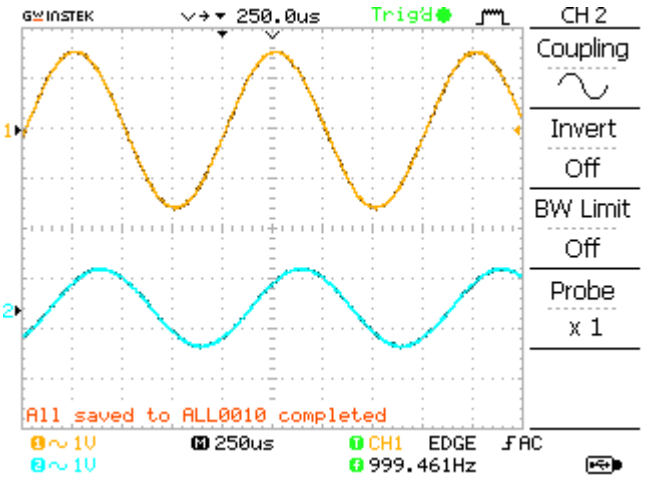

Fig 13: 32 kHz Reconstructed 4th Order

Reconstruction and Hold 2nd Order:

Previously we examined reconstruction for just using sample at 2nd order and 4th order. There is a way to get reconstruction more efficiently just by using sampling and hold.

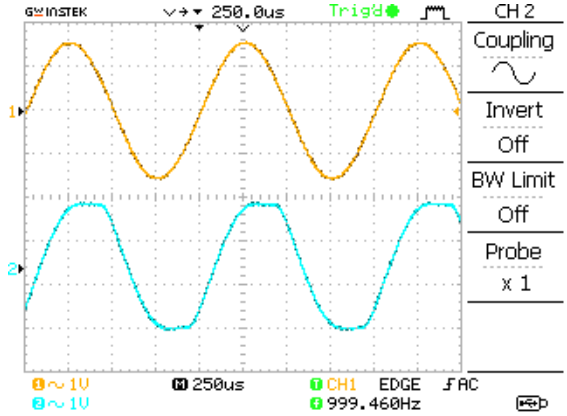

Fig 14: 2 kHz Reconstruct and Hold 2nd Order

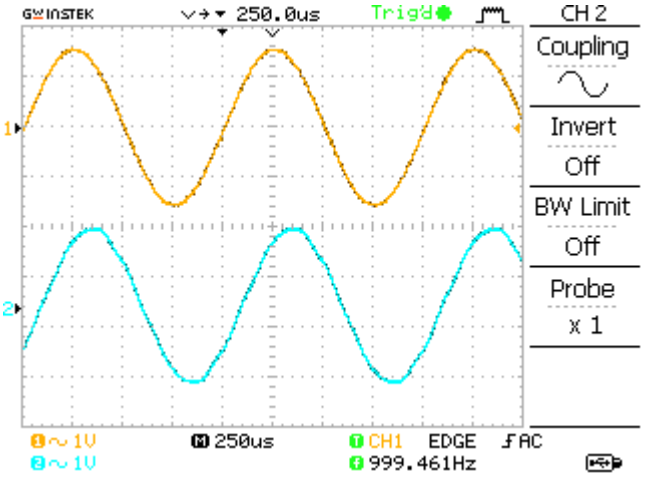

Fig 15: 8 kHz Reconstruct and Hold 2nd Order

Again, by increasing frequency we get more accurate reconstructed signal. This time it even better due to that hold action.

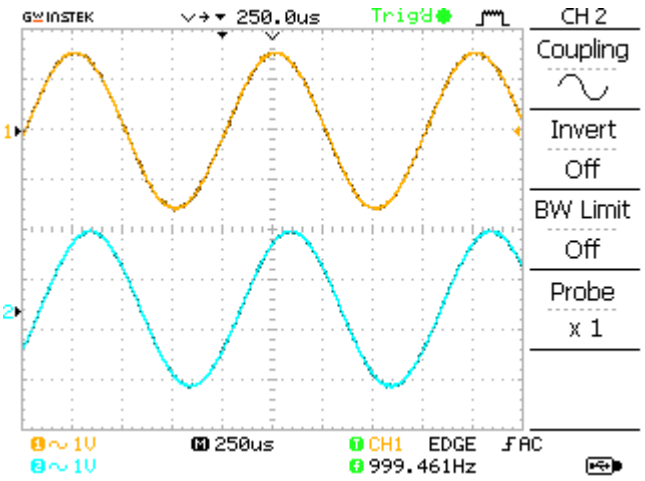

Fig 16: 32 kHz Reconstruct and Hold 2nd Order

Reconstruction and Hold 4th Order:

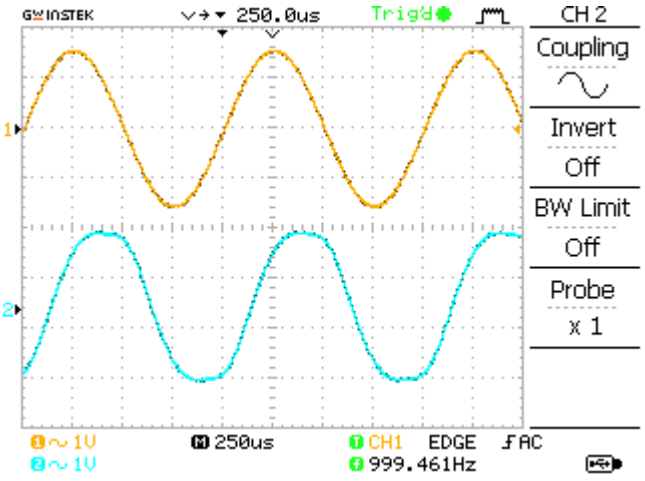

Fig 17: 2 kHz Reconstruct and Hold 4th Order

Reconstruction using sample and hold at 4th order is the closest to original we can get. Even in 2kHz sampling rate the signal is very accurate.

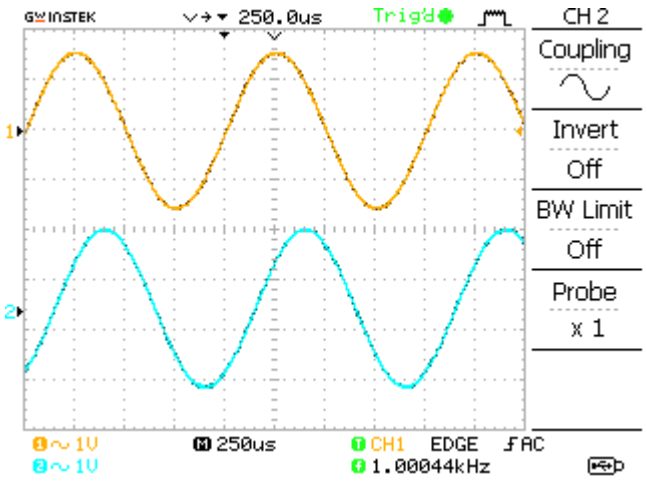

Fig 18: 8 kHz Reconstruct and Hold 4th Order

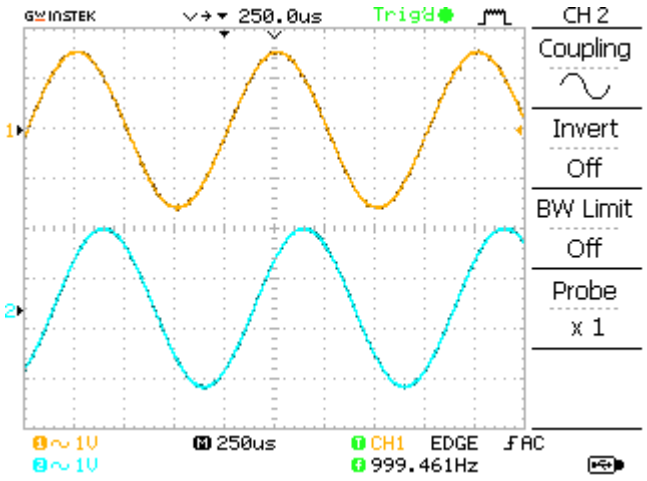

Fig 19: 32 kHz Reconstruct and Hold 4th Order

Its very hard to differentiate reconstructed signal of 8kHz and 32kHz and the original one.