Good figures, Good conclusions Good summary of objectives and procedures.

Lab 1 – Electronic Signal Waveforms

ECE 3410
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Objectives

The main objective of the Electronic Signal Waveforms Lab was to gain experience with configuration and display of signal waveforms in the time and frequency domains. Three types of waveforms, namely sinusoidal, triangular, and square, were explored in both the time and frequency domains.

Procedures

The initial setup was to simply connect the function generator to the oscilloscope. The main output of the function generator, and channel one of the oscilloscope were used. The procedures will be summarized in three sections: sinusoidal waveform, triangular waveform, and square waveform.

Sinusoidal Waveform

The function generator was set to a 1 kHz sinusoidal waveform with a 1v zero-to-peak amplitude. The oscilloscope displayed the waveform in the time domain. Figure 1-1 shows how the waveform appeared. Table 1-1 shows measurements that were taken using the oscilloscope.

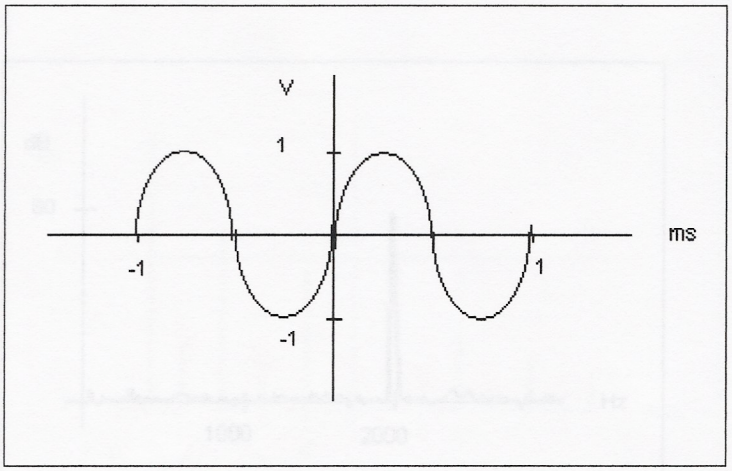


Figure 1-1

Figures should have captions.

Period:		998 us
Amplitude:	zero-to-peak	1.01 V
	rms	703 mV

Table 1-1

The oscilloscope is capable of displaying waveforms in the frequency domain by way of the Fourier transform (FFT) function. The FFT function is found in the Math menu of the oscilloscope.

The waveform was displayed in the frequency domain. The flat top window setting was used. There was an impulse at 1000 Hz which was approximately 80 dB. Figure 1-2 shows how the display appeared.

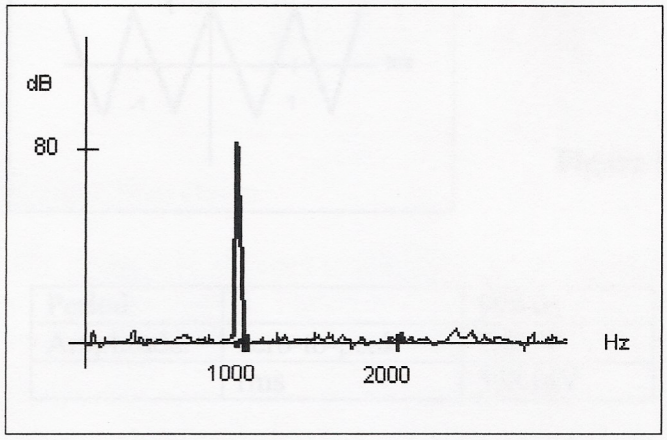


Figure 1-2

The frequency was changed to 2000 Hz. The Settings on the oscilloscope were not changed. The impulse was at 2000 Hz instead of 1000 Hz. The resulting waveform appeared as shown in Figure 1-3.

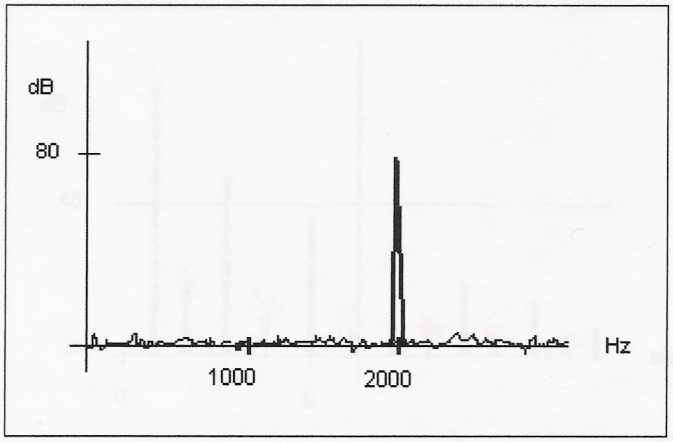


Figure 1-3

The frequency was changed back to 1000 Hz and the amplitude was reduced by one half. In the frequency domain, a reduction in the amplitude of the impulse was observed. It was discussed that if the 1 V amplitude of the sinusoidal wave were to be doubled, the impulse in the frequency domain would increase by 20log(2) or 6 dB.

Triangular Waveform

The signal was changed to a triangular waveform with a 1 kHz frequency and an amplitude of 1 V zero-to-peak. Figure 1-4 shows, roughly, how the display appeared. Table 1-2 shows the measurements that were taken using the oscilloscope.

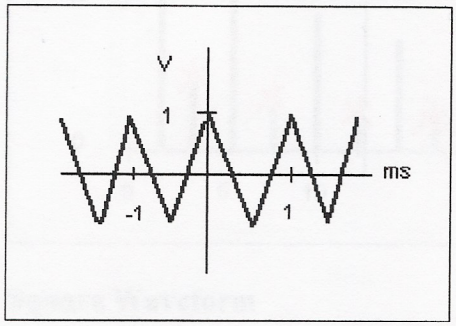


Figure 1-4

Period:		998 us
Amplitude:	zero-to-peak	1.01 V
	rms	568 mV

Table 1-1

The waveform was then viewed in the frequency domain. Figure 1-5 shows the approximate locations of the impulses. There were also some harmonic impulses observed in between each impulse.

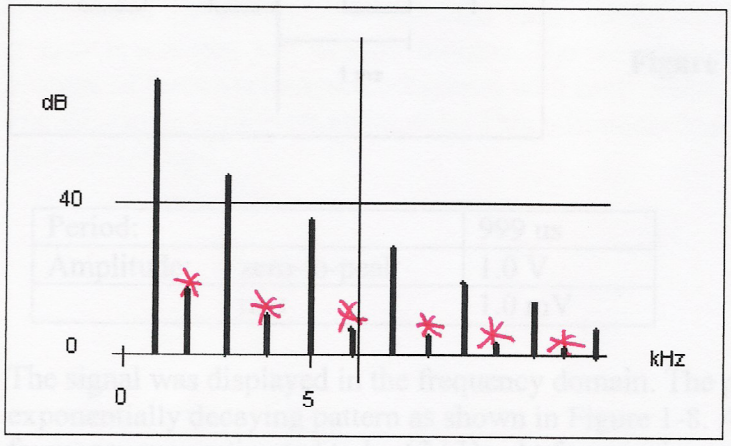
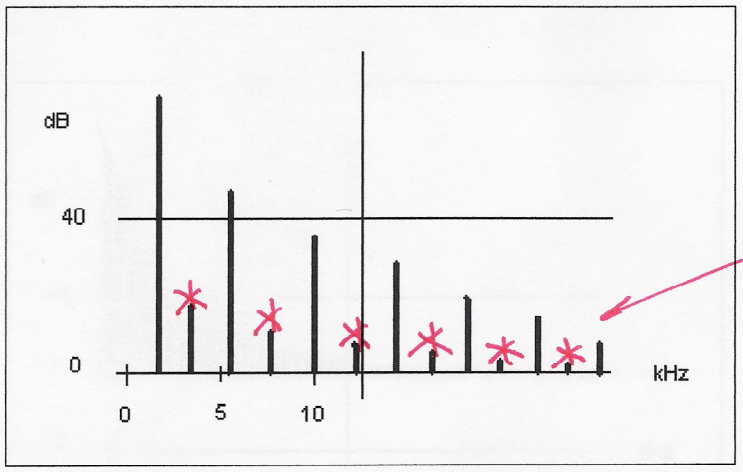


Figure 1-5

When the frequency was doubled, the impulses were spread out on the frequency axis by a factor of 2. This is shown in Figure 1-6. The plot looks the same as in Figure 1-5 but the frequency scale has been adjusted appropriately.

The acceptable pass-band frequency for a 1 kHz triangular waveform is approximately 17 kHz. This was determined by looking at the waveform in the frequency domain and observing the frequency at which the impulses could not be distinguished from the noise.



* what about these peaks? Should they be there?

Figure 1-6

You should document any unexpected features.

Square Waveform

The signal was changed to a square waveform with a 1 kHz frequency and an amplitude of 1 V zero-to-peak. Figure 1-7 shows how the display appeared. Table 1-3 shows the measurements that were taken using the oscilloscope.

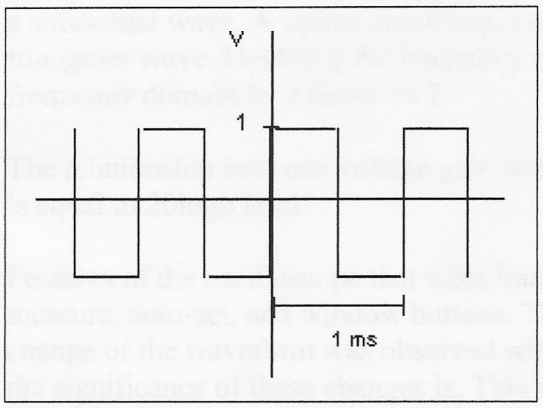


Figure 1-7

Period:		999 us
Amplitude:	zero-to-peak	1.0 V
	rms	1.0 mV

Table 1-1

The signal was displayed in the frequency domain. The peaks of the impulses created an exponentially decaying pattern as shown in Figure 1-8. An acceptable pass-band frequency was estimated to be 63 kHz. At frequencies greater than 63 kHz, the impulses could not be distinguished from the noise.

Conclusion

The oscilloscope was used to compare and contrast different signals in the time and frequency domains. Triangular waves and square waves can be interpreted as sinusoidal waves of different frequencies and amplitudes superimposed on each other. Because of

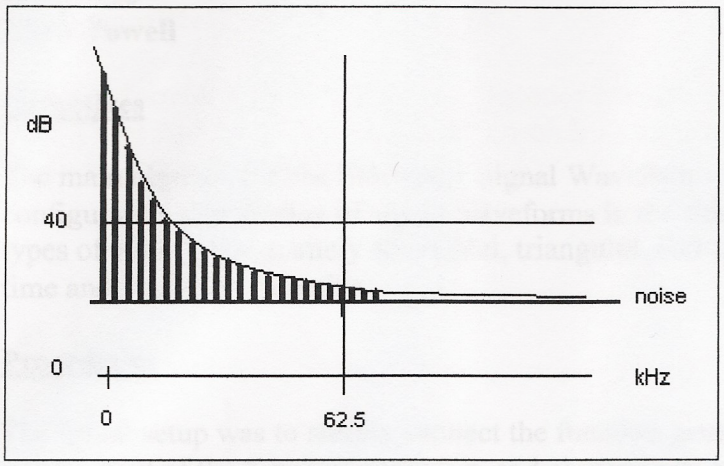


Figure 1-8

this, when triangular and square waves were displayed in the frequency domain, the impulses appeared at the frequencies of each superimposed sinusoid.

It was discovered that a triangular wave requires a larger pass-band frequency range than a sinusoidal wave. A square wave requires a greater pass-band frequency range than a triangular wave. Doubling the frequency of any signal stretches the waveform in the frequency domain by a factor of 2.

The relationship between voltage gain and decibels was explored. An increase in decibels is equal to 20log(Gain).

Features of the oscilloscope that were found useful are the FFT function, the cursor, measure, auto-set, and window buttons. The window buttons were used, and a noticeable change of the waveform was observed with each setting, but it is unclear at this time what the significance of these changes is. This will undoubtedly be clarified with further use of the oscilloscope.