FUNDAMENTALS OF TELECOMMUNICATION

Lab. 4. Modulation and demodulation with Amplitude Shift Keying (ASK)

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Introduction

This report summarizes a laboratory session dedicated to exploring Amplitude Shift Keying (ASK) for the modulation and demodulation of digital signals, a key technique in digital communications that encodes data via amplitude variations. Our experimentation employed training kits to investigate ASK's practical applications, with subsequent observations and analysis detailed herein.

Task 5.

For the first 2 steps we connected the power supply and measured the supply voltage through the multimeter.

V+ [V]	V- [V]
4.965	-5.013

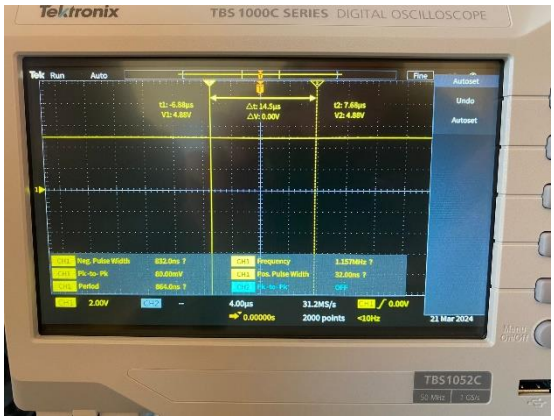
5.3

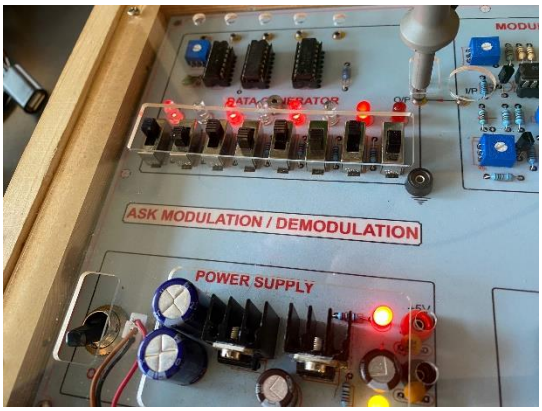
The exercise involved connecting an oscilloscope probe to each data generator's output to observe and document the waveform's frequency, period, and pulse width, utilizing either the PosWidth function or cursors, with the findings systematically compiled into a table, ensuring the inclusion of appropriate units.

Frequency [Hz]	Period [µs]	Negative Pulse [µs]	Positive Pulse [µs]
225800	4.430	2.608	1.818
112800	8.864	4.430	4.424
880.2	1136	5.68	568
440.1	2272	1136	1.136
220	4544	2272	2.272

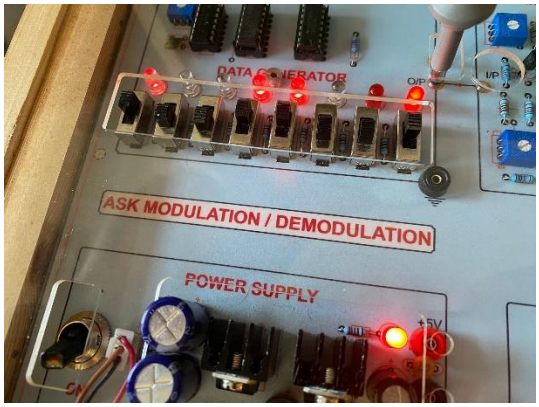
5.4

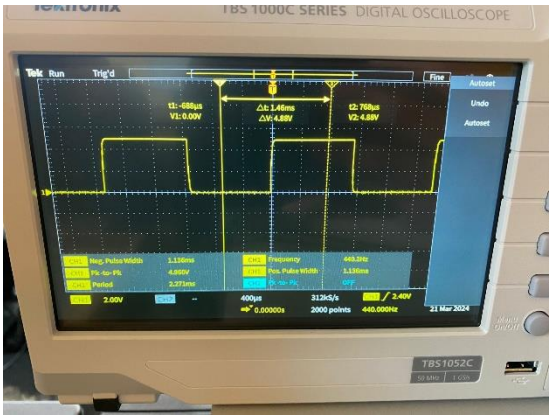
We generated an eight-bit data signal, adjusting the data generator's parameters via switches and using an oscilloscope to observe the waveform. The pulse length, measured with the "PosWidth" function, illustrated the effects of parameter changes on signal properties.

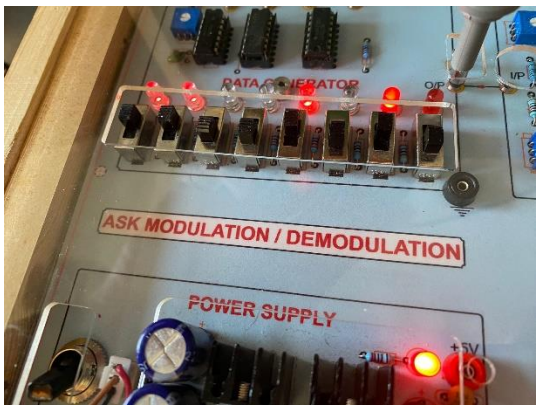



ASK MODULATION / DEMODULATION
POWER SUPPLY

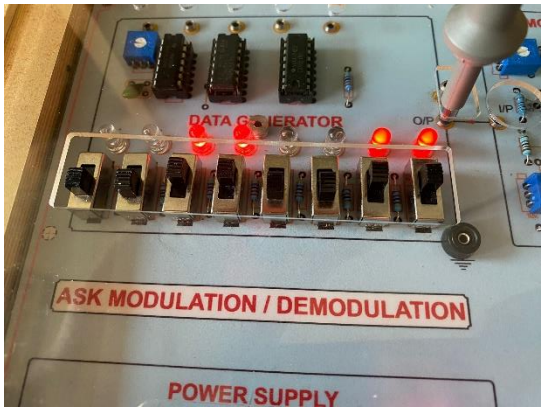

Tek Run Trig'd
Δt: 1.46ms
ΔV: 4.88V
TBS1052C


ASK MODULATION / DEMODULATION
POWER SUPPLY


TBS 1000C SERIES DIGITAL OSCILLOSCOPE
Tek Run Trig'd
Δt: 1.46ms
ΔV: 4.88V
TBS1052C


ASK MODULATION / DEMODULATION
POWER SUPPLY


Tek Run Trig'd
Δt: 1.46ms
ΔV: 80.0mV
TBS1052C

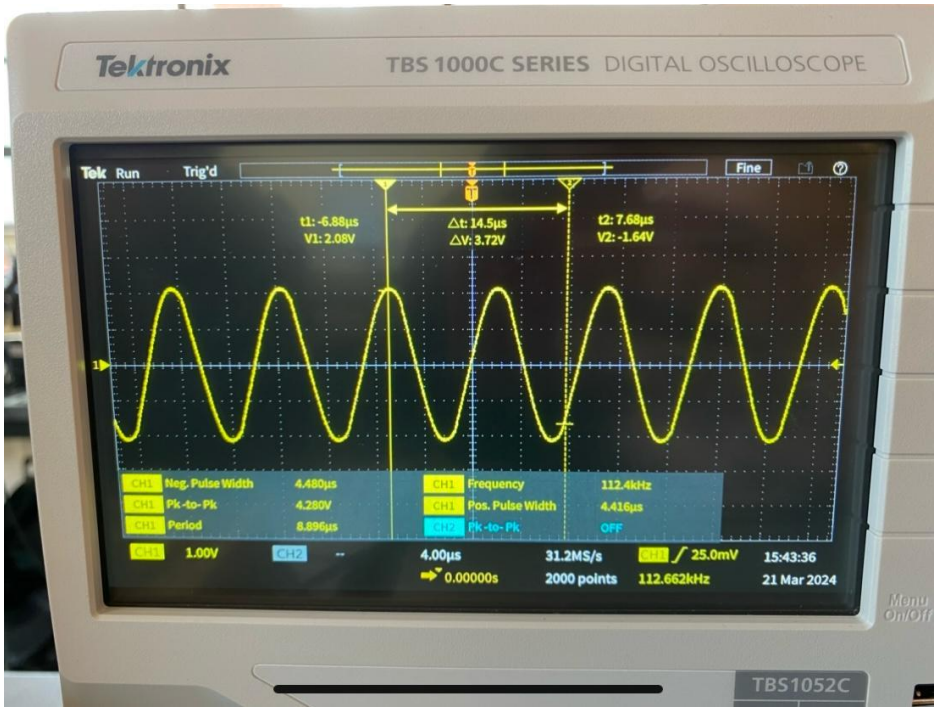

ASK MODULATION / DEMODULATION
POWER SUPPLY


Run Trig'd
Δt: 1.46ms
ΔV: 4.88V
TBS1052C

With this exercise, we observed changes in frequency, pulse width and period values.

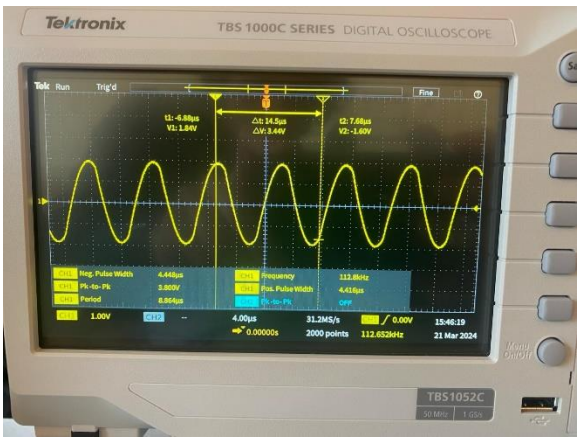
5.5

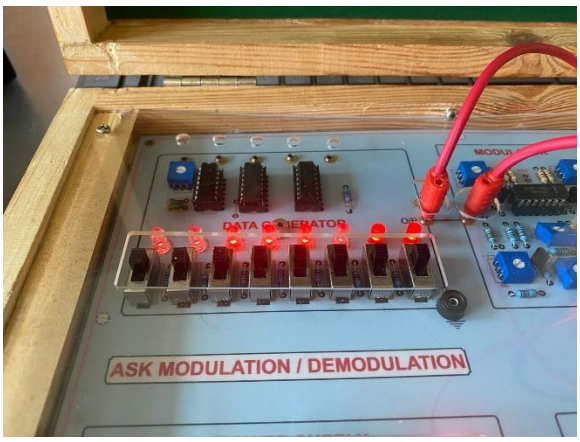
By connecting the oscilloscope probes to the carrier wave generator, we got the carrier wave appearing below.

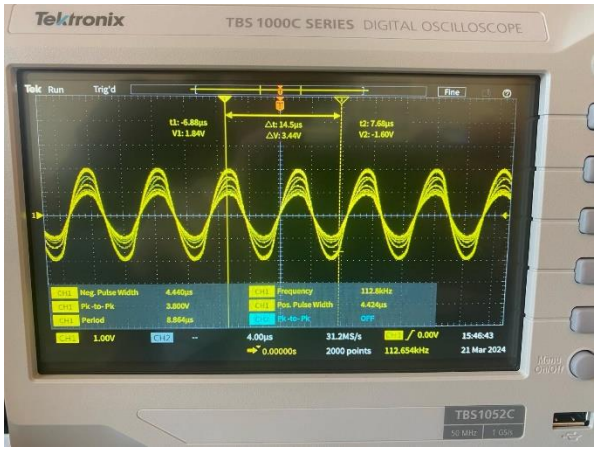


The oscilloscope shows a sinusoidal carrier wave at 112.8 kHz with a symmetric pulse width around 4.4 µs and a peak-to-peak voltage of 3.800V, indicating a stable signal for modulation.

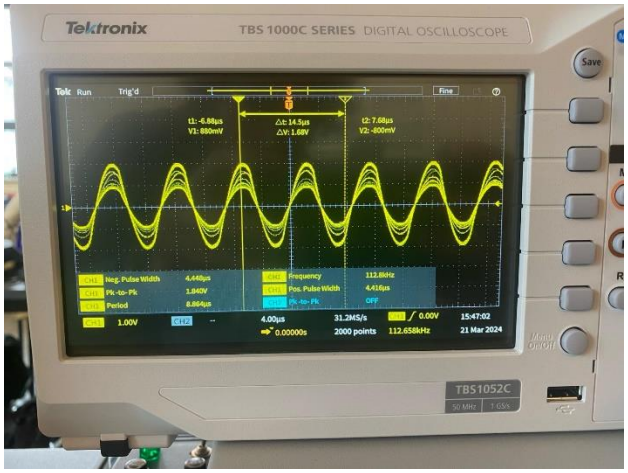
5.6

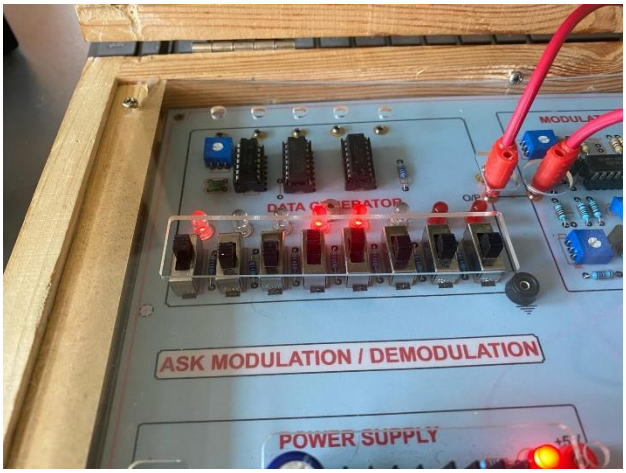


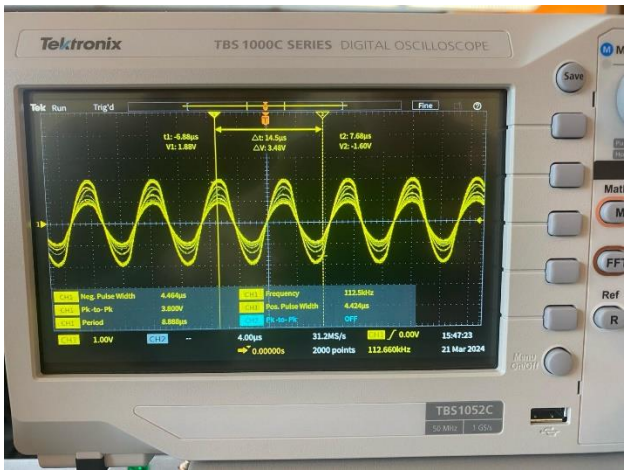



Tektronix
TBS 1000C SERIES DIGITAL OSCILLOSCOPE
TBS1052C


ASK MODULATION / DEMODULATION
POWER SUPPLY


Tektronix
TBS 1000C SERIES DIGITAL OSCILLOSCOPE
TBS1052C


ASK MODULATION / DEMODULATION
POWER SUPPLY

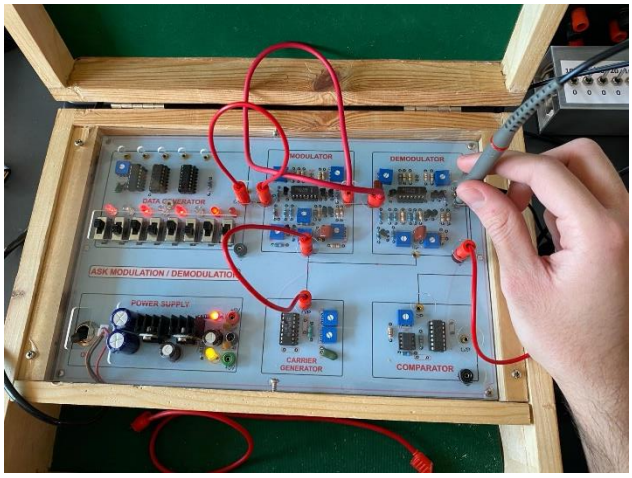

Tektronix
TBS 1000C SERIES DIGITAL OSCILLOSCOPE
TBS1052C

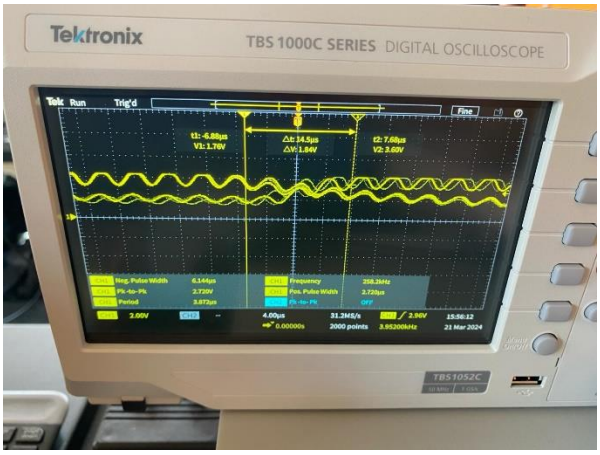

ASK MODULATION / DEMODULATION
POWER SUPPLY

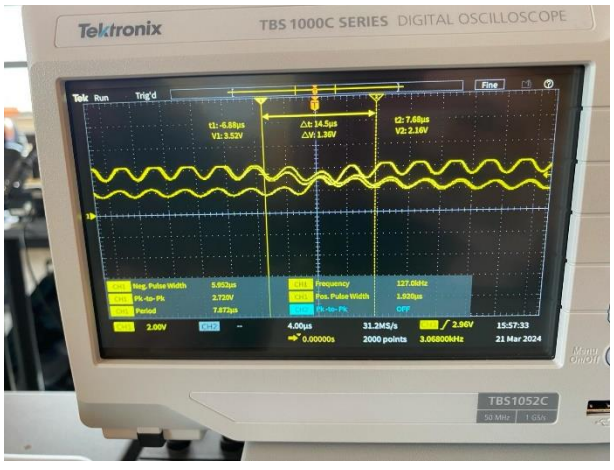
Upon connecting the data generator and carrier wave generator to the modulator, and varying the data generator's parameters with at least four combinations, we observed the resultant changes in the modulated signal's characteristics. This includes alterations in amplitude, frequency, phase, and pulse width of the output signal, reflecting the modulation's responsiveness to the input parameter variations.

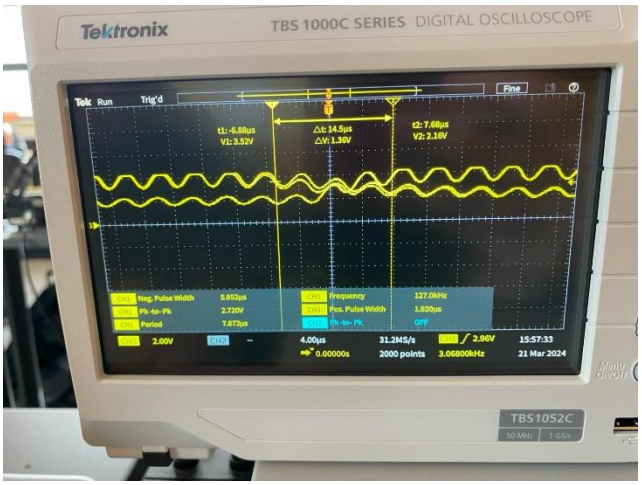
5.7

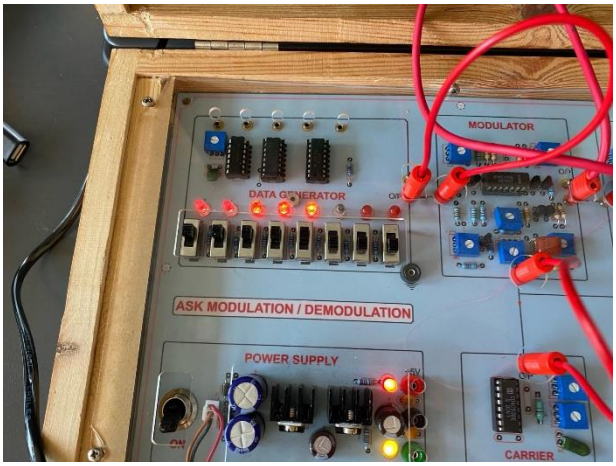
The oscilloscope readings after demodulation suggest variations in the amplitude and pulse width of the carrier wave, reflecting the encoded data from the modulating signal. The visible changes in waveform characteristics between different parameter settings on the data generator demonstrate how modulation translates data input into signal alterations.

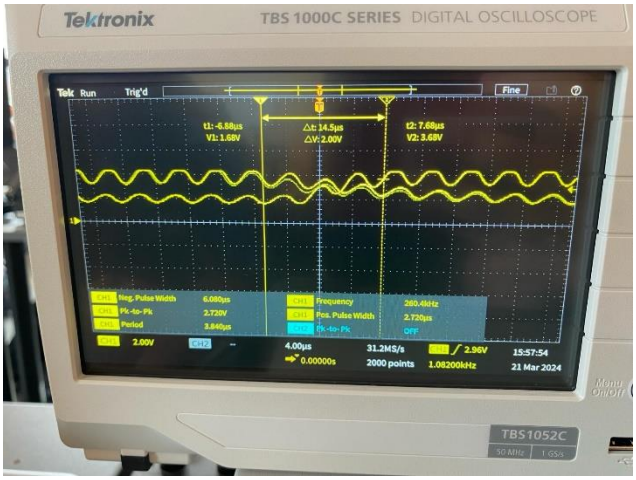






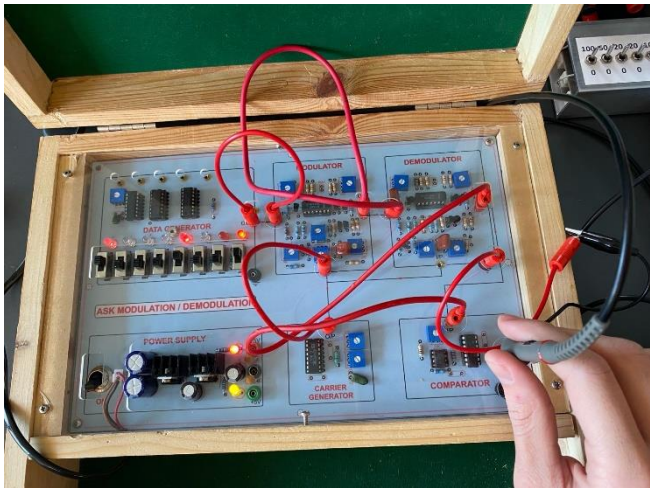


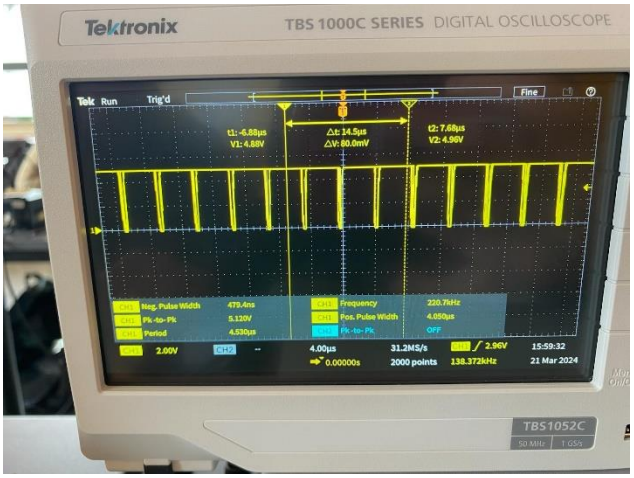


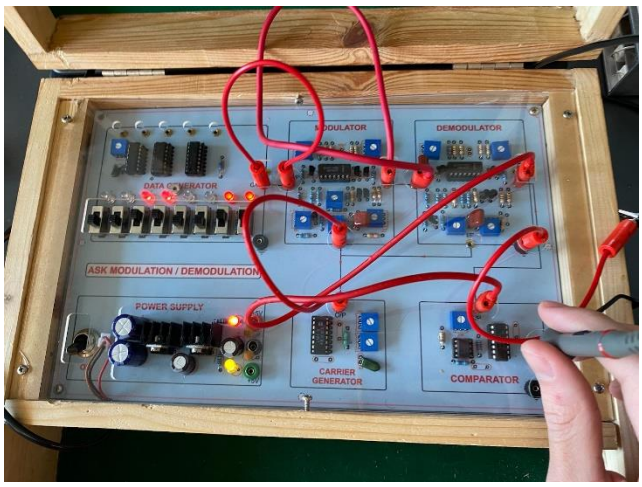


5.8

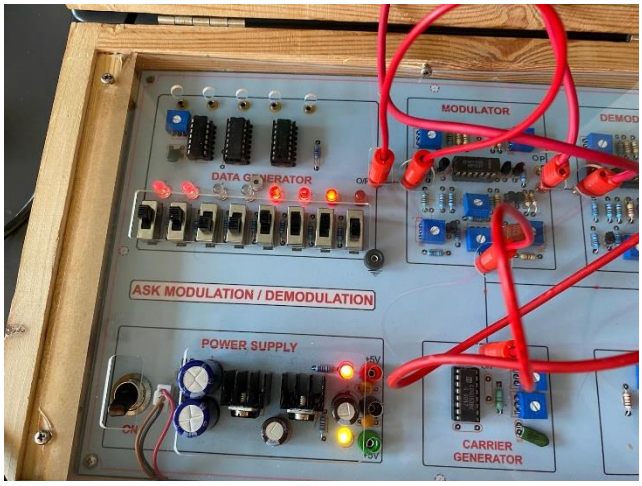
By connecting the demodulator to the comparator, the oscilloscope displayed showing square waveforms resulting from a comparator converting an analog input into digital output, with varying pulse widths and consistent high-frequency signals showing effective analog-to-digital

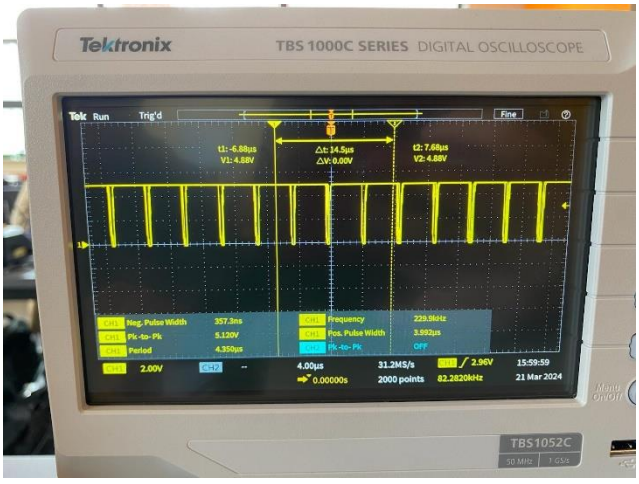

MODULATOR
DEMODULATOR
DATA GENERATOR
ASK MODULATION / DEMODULATION
POWER SUPPLY
CARRIER GENERATOR
COMPARATOR


Tektronix
TBS 1000C SERIES DIGITAL OSCILLOSCOPE
Tek Run
Trig'd
Fine
t1: -6.88µs
V1: 4.88V
Δt: 14.5µs
ΔV: 80.0mV
t2: 7.68µs
V2: 4.96V
Neg. Pulse Width 479.4ns
Pk-to-Pk 5.120V
Period 4.530µs
Frequency 220.7kHz
Pos. Pulse Width 4.050µs
Pk-to-Pk OFF
2.00V
4.00µs
31.2MS/s
2.96V
15:59:32
0.00000s
2000 points
138.372kHz
21 Mar 2024
TBS1052C
50 MHz 1 GS/s


MODULATOR
DEMODULATOR
DATA GENERATOR
ASK MODULATION / DEMODULATION
POWER SUPPLY
CARRIER GENERATOR
COMPARATOR


Tek Run
Trig'd
Fine
t1: -6.88µs
V1: 4.88V
Δt: 14.5µs
ΔV: 0.00V
t2: 7.68µs
V2: 4.88V
Neg. Pulse Width 185.0ns
Pk-to-Pk 5.120V
Period 6.632µs
Frequency 113.2kHz
Pos. Pulse Width 8.646µs
Pk-to-Pk OFF
2.00V
4.00µs
31.2MS/s
2.96V
15:59:42
0.00000s
2000 points
110.438kHz
21 Mar 2024
TBS1052C
50 MHz 1 GS/s


MODULATOR
DATA GENERATOR
ASK MODULATION / DEMODULATION
POWER SUPPLY
CARRIER GENERATOR


Tektronix
TBS 1000C SERIES DIGITAL OSCILLOSCOPE
Tek Run
Trig'd
Fine
t1: -6.88µs
V1: 4.88V
Δt: 14.5µs
ΔV: 0.00V
t2: 7.68µs
V2: 4.88V
Neg. Pulse Width 357.3ns
Pk-to-Pk 5.120V
Period 4.350µs
Frequency 229.9kHz
Pos. Pulse Width 3.992µs
Pk-to-Pk OFF
2.00V
4.00µs
31.2MS/s
2.96V
15:59:59
0.00000s
2000 points
82.2820kHz
21 Mar 2024
TBS1052C
50 MHz 1 GS/s

CONCLUSION

The study of ASK modulation and demodulation demonstrates its advantages in terms of simplicity and cost-efficiency for digital communication. Its uncomplicated design and stable carrier frequency and phase facilitate implementation. Nevertheless, ASK's vulnerability to noise poses significant challenges to data integrity, limiting its practicality in adverse conditions. While it serves well in fiber-optic systems due to its low cost, other environments requiring high robustness and efficiency may necessitate alternative modulation strategies.