Wrocław University of Science and Technology

FUNDAMENTALS OF TELECOMMUNICATION LABORATORY REPORT

FSK & PSK

Submission Date: 09.04.2024

1. Introduction

Our report is structured as an instructional guide, focusing on the practical exploration of modulation and demodulation techniques through Frequency Shift Keying (FSK) and Phase Shift Keying (PSK). It sets out to enrich students' understanding by providing hands-on experience with digital signals, employing ready-made training kits for a comprehensive learning experience. Beginning with a deep dive into the theoretical foundations, including the critical concept of Bit Error Rate (BER) as a key performance indicator in digital communications, the report further traces the historical development of keying techniques, underscoring their pivotal role in telecommunication advancements. Through meticulously designed exercises, we are guided to uncover the nuances, applications, and practical aspects of FSK and PSK, thereby equipping ourselves with the knowledge and skills necessary to navigate the complexities of digital signal processing in contemporary telecommunication landscapes.

2. Tasks for FSK

5.1.2

After making the connection we measured our voltage values by using multimeter:

V+	V-
4.9885	-4.885

5.1.3

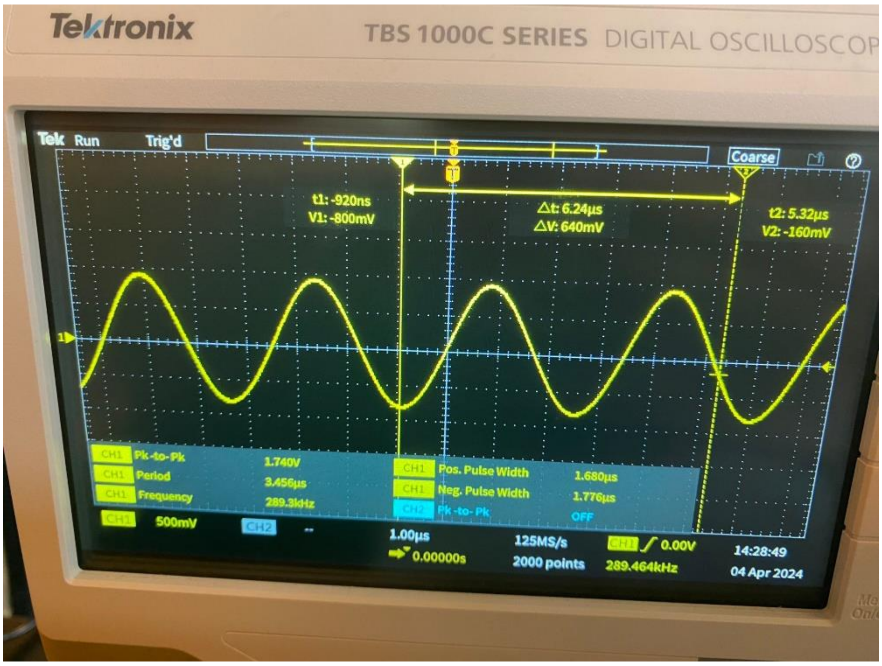
We individually examined the waveform of each data generator, noting variations in frequencies, periods, and positive pulse widths.

Parameter/Generator	Frequency (kHz)	Period (µs)	Positive Pulse Width (µs)	Negative Pulse Width (µs)
1st Output	584.5	1.711	714.3	1000
2nd Output	292.2	3.420	1700	1725
3rd output	2.281	438.3	219.2	219.2
4th output	1.143	877.6	438.9	438.9
5th output	596.7 Hz	1.755 ms	878.4	878.4

5.1.4

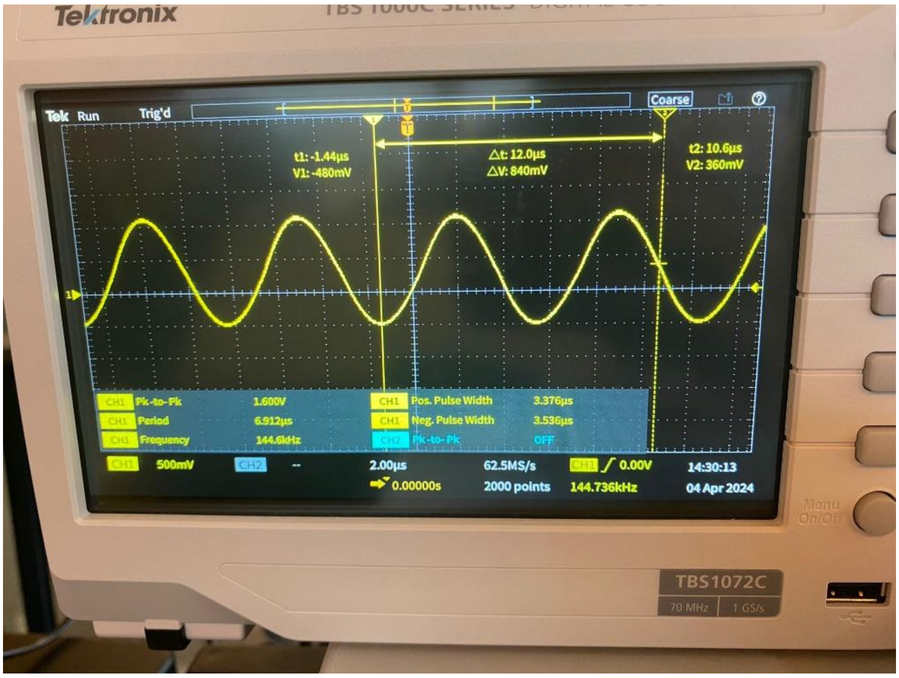
We encountered an error with the data generator output in the FSK module, which prevented us from observing the expected waveforms with varying pulse widths.

5.1.5



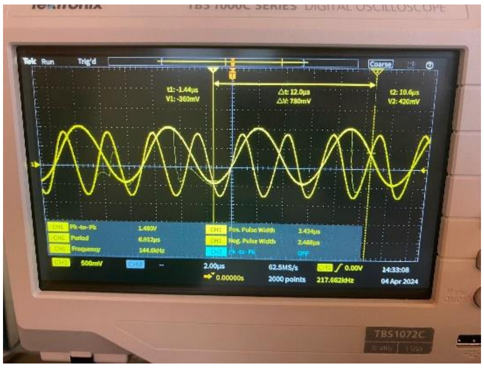
Upon connecting the oscilloscope probe to carrier-1, we successfully captured and documented the waveform within the time domain. The measurement cursors indicate a positive pulse width of 1.680 microseconds and a frequency of approximately 289.34 kHz. The peak-to-peak voltage measures at 1.740 V, and the oscilloscope display corroborates that the signal maintains a consistent amplitude over time, suggesting stable signal generation from the carrier-1 output.

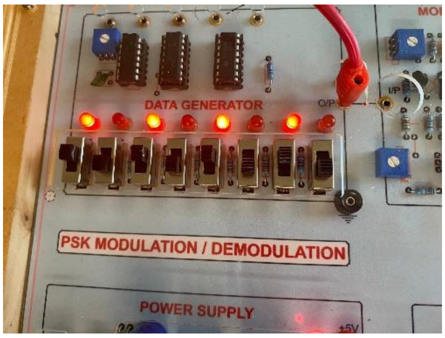
5.1.6

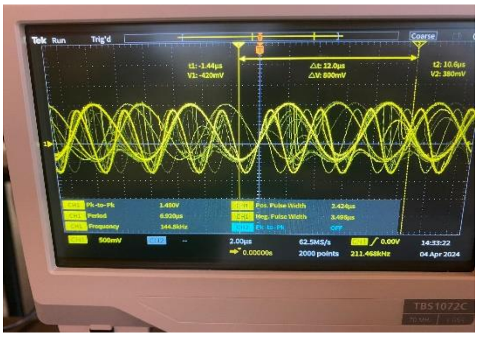


When we probed carrier-2, the oscilloscope displayed a waveform with a peak-to-peak voltage of 1.600 V and a period of 6.912 microseconds, corresponding to a frequency of 144.6 kHz. The cursors revealed a positive pulse width of 3.376 microseconds, indicating a clear distinction in waveform characteristics from carrier-1. This consistent waveform, without any observable distortions, confirms the reliable function of carrier-2 in generating the expected signal in the time domain.

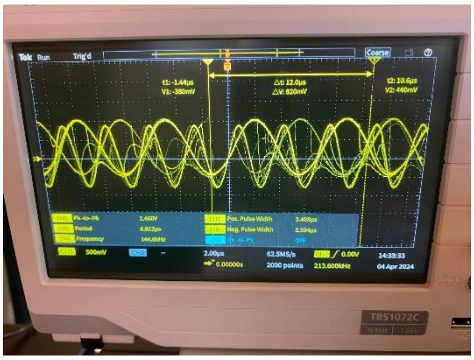
5.1.7




DATA GENERATOR
PSK MODULATION / DEMODULATION
POWER SUPPLY


TBS1072C


DATA GENERATOR
PSK MODULATION / DEMODULATION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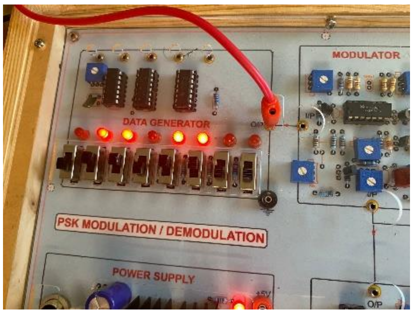
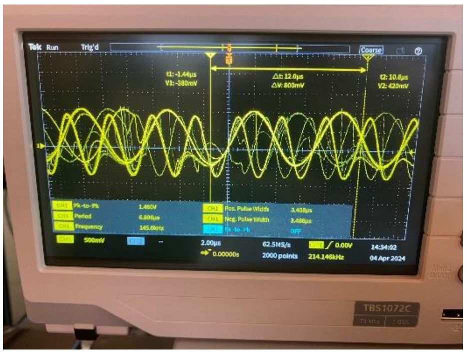

MODULATOR
DATA GENERATOR
PSK MODULATION / DEMODULATION
POWER SUPPLY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Upon connecting the data generator along with carrier-1 and carrier-2 to the modulator section, we observed dynamic changes in the modulated signal in response to variations in the eight-bit data settings. The oscilloscope images captured these changes, showing clear shifts in the waveform characteristics such as amplitude and frequency. This hands-on task demonstrated the impact of digital input variations on the resulting signal, thus highlighting the practical aspects of signal modulation within communication systems.

5.1.8

DATA COULDN'T BE OBTAINED DUE TO FSK MODULATION ERROR

5.1.9

DATA COULDN'T BE OBTAINED DUE TO FSK MODULATION ERROR

3. Tasks for PSK

5.2.2

After making the connection we measured our voltage values by using multimeter:

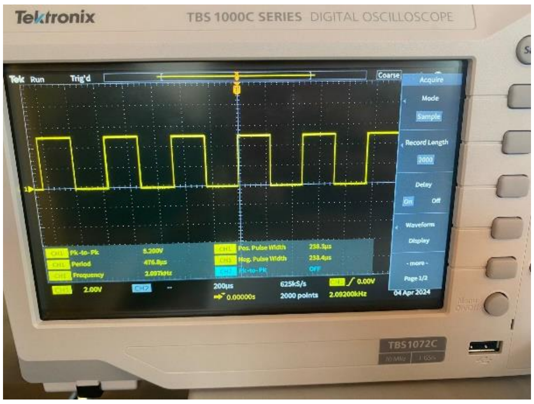
V+	V-
5.0088	-5.1355

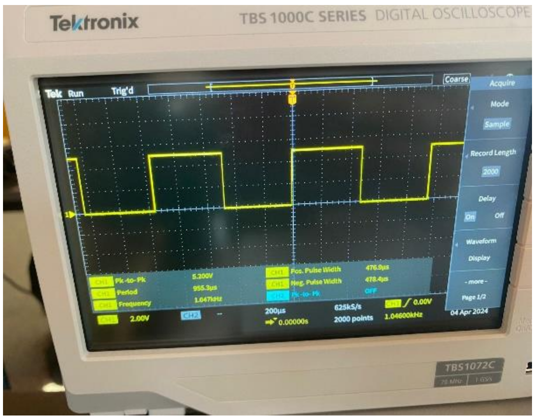
5.2.3

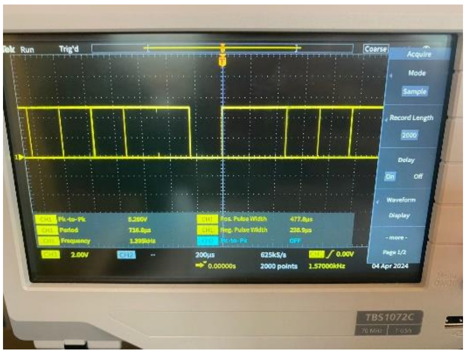
We individually examined the waveform of each data generator, noting variations in frequencies, periods, and positive pulse widths.

Parameter/Generator	Frequency (kHz)	Period (µs)	Positive Pulse Width (µs)	Negative Pulse Width (µs)
1st Output	535.5	1.867	782.1	1.804
2nd Output	267.8	3.753	1.854	1.880
3rd output	2.092	478.3	238.7	240
4th output	1.045	956.8	478.1	1.784
5th output	522.5 Hz	1.910	956.7	956.7

5.2.4

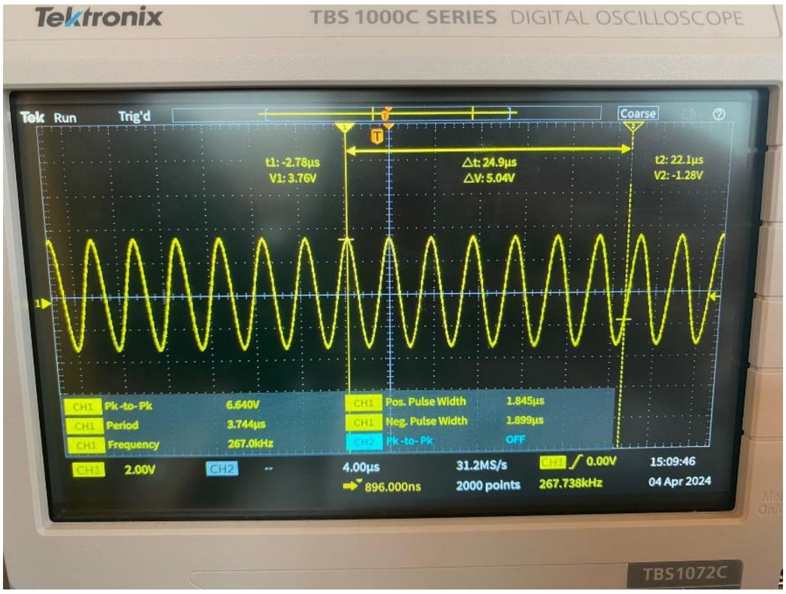






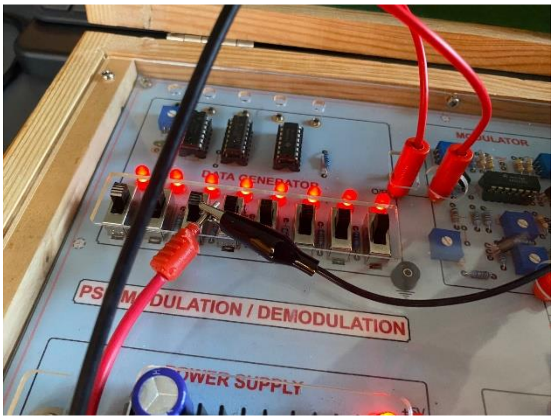
Through the adjustment of switches on the data generator, we generated various eight-bit data signals, each resulting in a distinctive waveform as observed on the oscilloscope. The recorded waveforms exhibited different pulse widths, demonstrating the effect of changing parameters on the signal's characteristics. These documented shifts validate the direct correlation between the input settings on the data generator and the corresponding output waveforms, essential for understanding signal modulation processes.

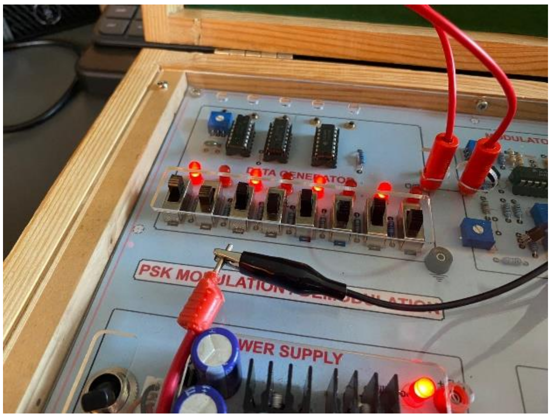
5.2.5

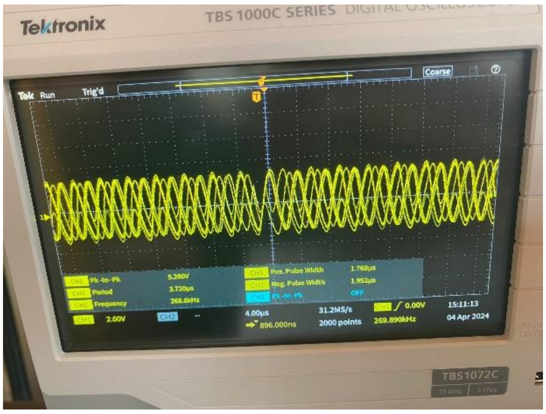


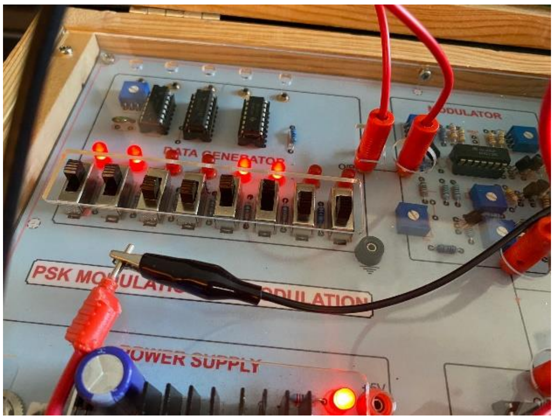
Upon connecting the oscilloscope probe to the carrier wave generator, we observed a stable sinusoidal waveform in the time domain with a peak-to-peak voltage of approximately 6.640V. The waveform's period was measured at 3.744 microseconds, correlating to a frequency of approximately 267.01 kHz. These measurements suggest a well-functioning carrier generator producing a clear and consistent signal necessary for effective modulation.

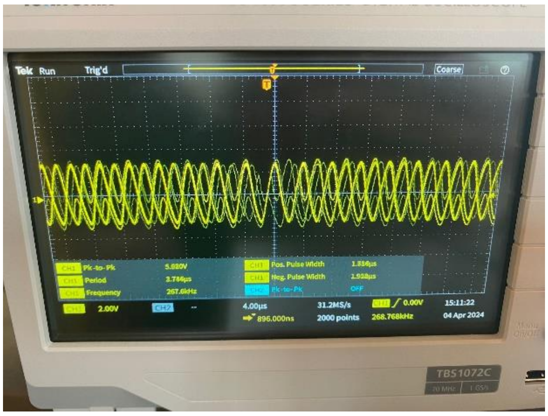
5.2.6

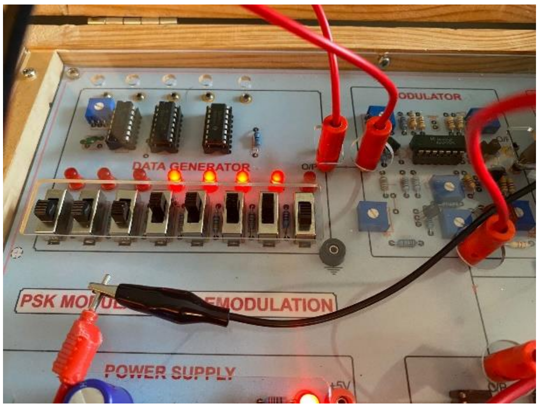


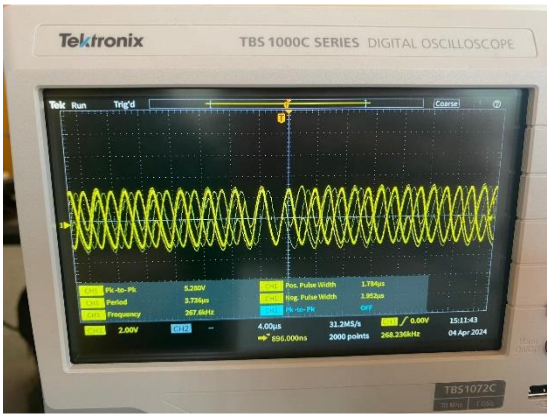






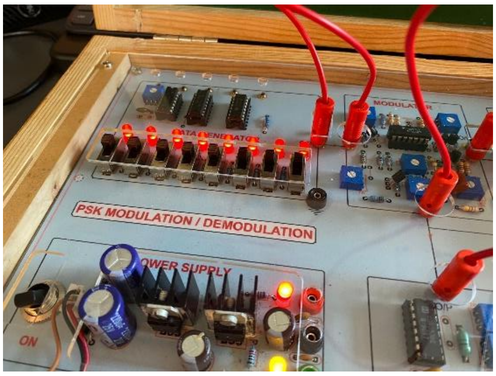


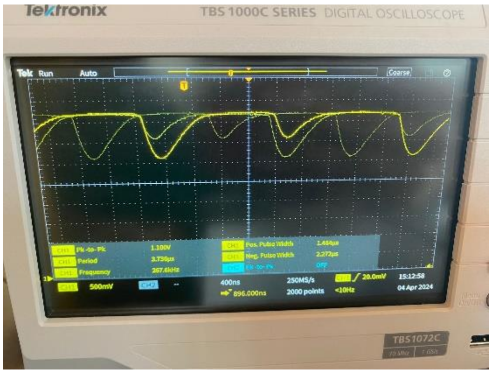




In the task of connecting the data generator with the carrier generator to the modulator, we noted distinct variations in the modulated signal as the eight-bit data settings were altered. The observed waveforms on the oscilloscope displayed changes in both the amplitude and frequency, indicating the modulation process was actively responding to the input data changes. This activity highlights the direct influence of digital signal inputs on the modulation outcome, which is crucial for understanding the transmission and reception dynamics in telecommunications.

5.2.7


PSK MODULATION / DEMODULATION


Tektronix
TBS 1000C SERIES DIGITAL OSCILLOSCOPE
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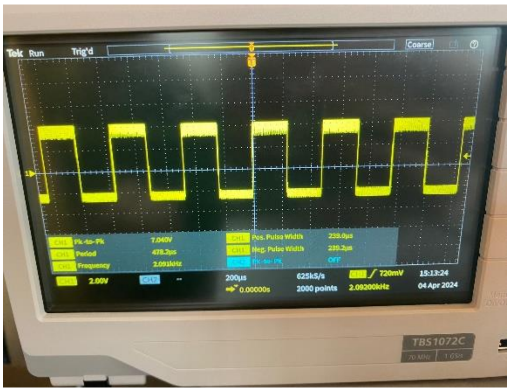
MODULATOR
DATA GENERATOR
PSK MODULATION / DEMODULATION
POWER SUPPLY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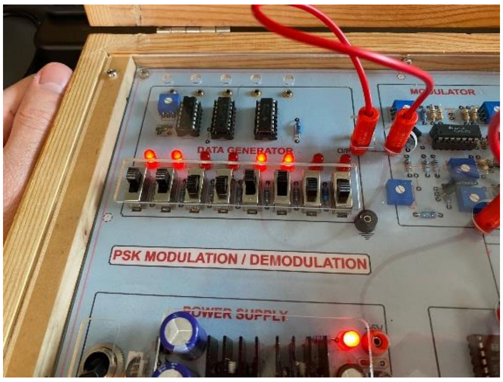
DATA GENERATOR
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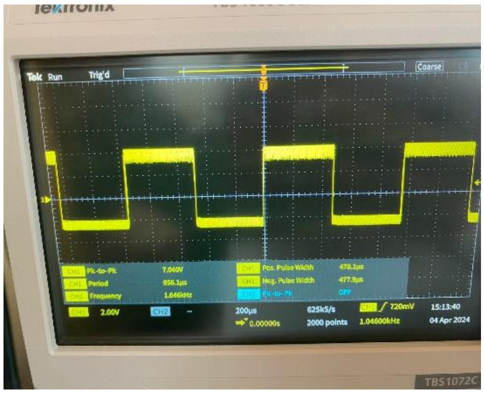
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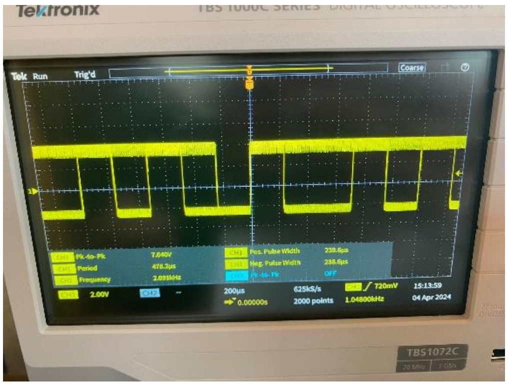
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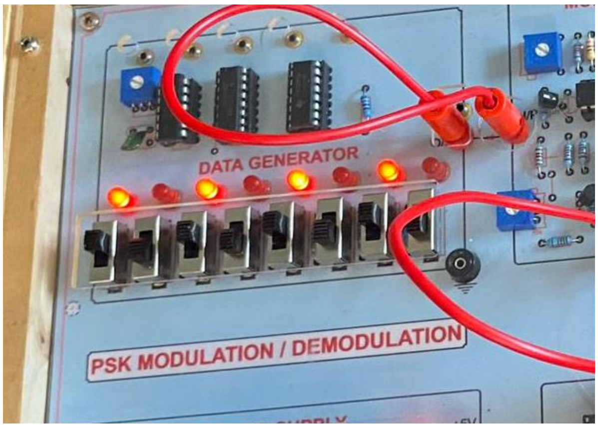
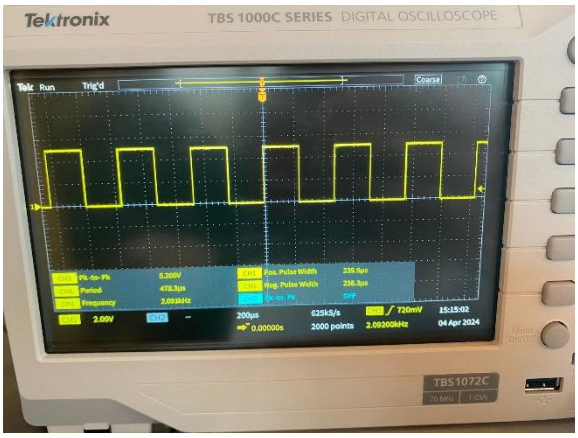
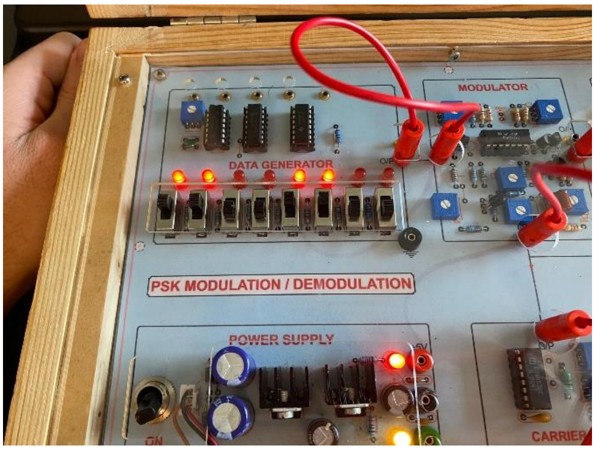
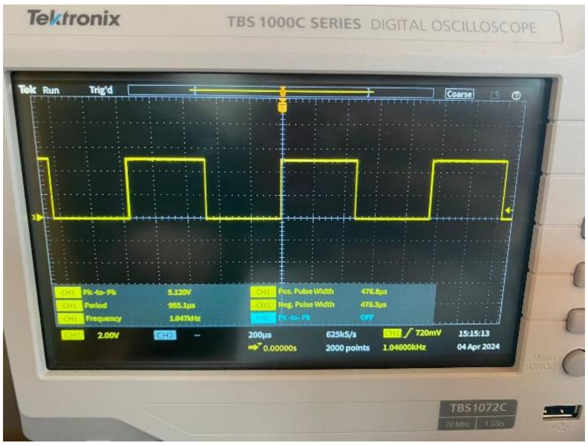
Upon linking the modulator and demodulator sections, we monitored the changes in the waveform as a result of various eight-bit input combinations. The oscilloscope captured the modulated signals, which showed clear and distinct square waves, indicative of the digital data being processed through the system. These images verify that the modulation and demodulation processes were functioning as expected, translating the digital signals into modulated waveforms suitable for transmission and then successfully demodulating them back into a form that represents the original data.

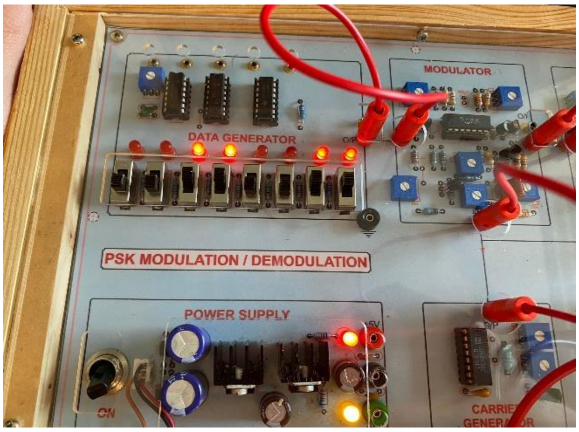
5.2.8

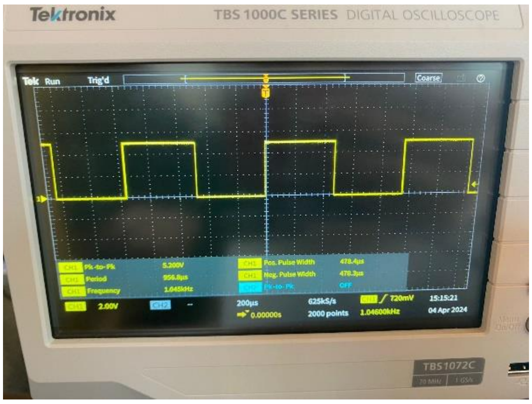


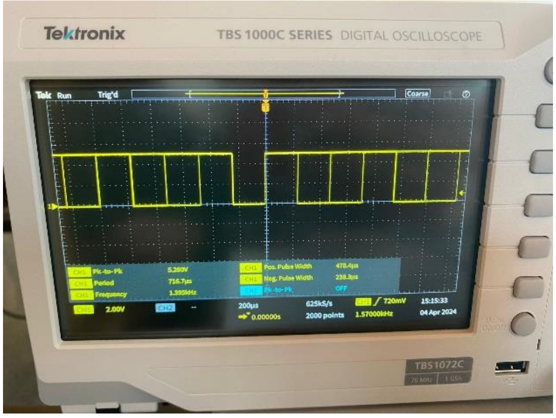












The setup appears to involve a PSK modulation and demodulation process, as indicated by the labeled sections on the electronic board. The connections made and the switches toggled result in different waveforms being displayed on the oscilloscope, reflecting the changes in the signal as it undergoes demodulation and rectification. By observing the differences in waveforms (such as frequency, amplitude, and pulse width), we can infer that the demodulation and rectification processes are successfully altering the characteristics of the signal, which is essential in the decoding of PSK modulated data.

4. Conclusion

In this laboratory exercise, we explored the principles and applications of Frequency Shift Keying (FSK) and Phase Shift Keying (PSK) in modulating and demodulating digital signals. Through practical exercises, we gained insights into how digital information is encoded and decoded using these techniques, highlighting their importance in telecommunications. The hands-on experience with FSK and PSK revealed their distinct operational characteristics, such as FSK's simplicity and noise resistance and PSK's efficient bandwidth utilization. We also tackled the challenge of phase ambiguity in PSK and the role of differential encoding in ensuring accurate data transmission. This exercise not only enriched our understanding of digital modulation but also underscored the significance of these techniques in the evolution and functionality of modern communication systems.