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by Morgan Jones

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Introduction

In this report I be will be comparing the performances of variations of amplitude shift keying (ASK) and phase shift keying (PSK) in the presence of additive white Gaussian noise (AWGN). There will be three section to this report a Method which will contain a detailed design information, detailed simulation results and a discussion concerning the results and any problems.

ASK

“Amplitude Shift Keying (ASK) is a type of Amplitude Modulation which represents the binary data in the form of variations in the amplitude of a signal. Any modulated signal has a high frequency carrier. The binary signal when ASK modulated, gives a zero value for Low input while it gives the carrier output for High input.” [1]

The ASK is built with a modulator and demodulator

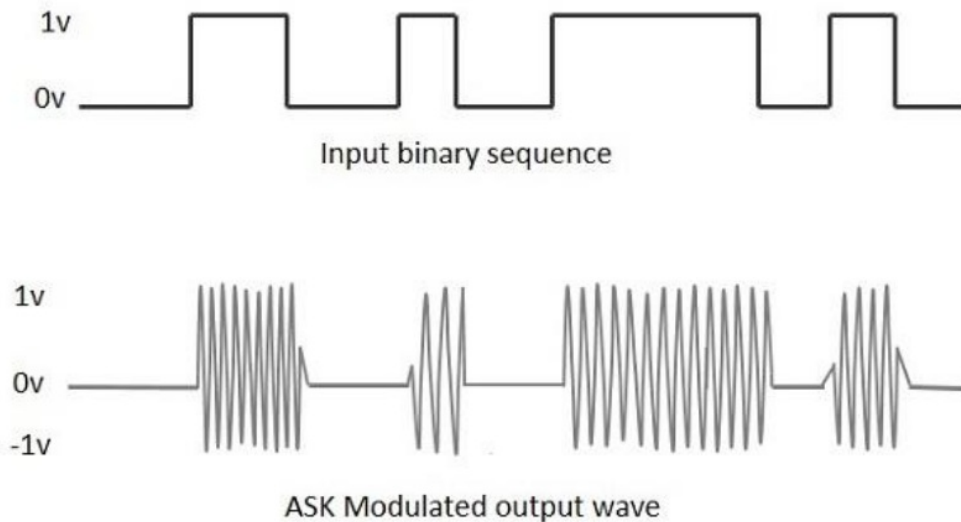


Figure 1 represents ASK modulated waveform along with its input. [1]

ASK Modulator

"The ASK modulator comprises of a carrier signal generator, the binary sequence from the message signal and the band-limited filter." [1]

ASK Generation method

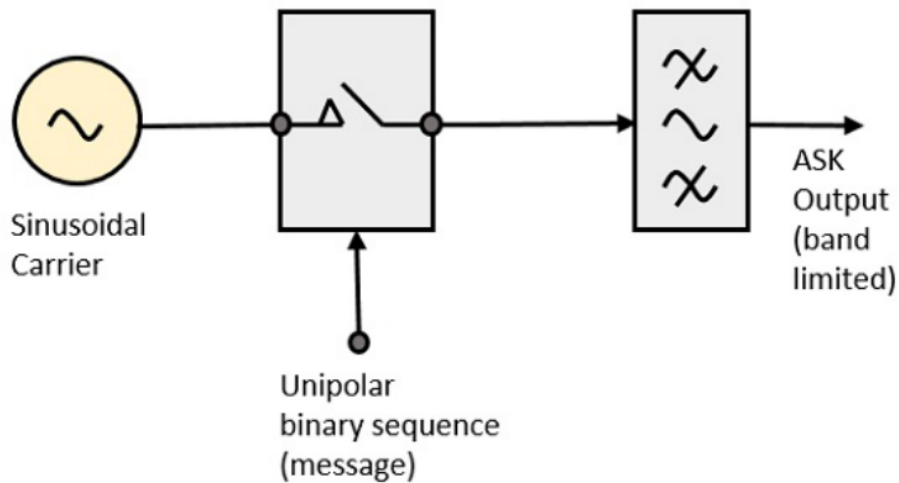


Figure 2 a diagram of an ASK Modulator. [1]

"The generator sends a non-stop high-frequency signal. The binary sequence from the signal makes the unipolar input to be either High or Low. If there is a high signal it closes the switch, allowing a carrier wave. Therefore, the output of the carrier signal is high. When there is low input, the switch opens, allowing no voltage to appear. Consequently, the output will be low." [1]

"The band-limiting filter shapes the pulse depending upon the amplitude and phase characteristics of the band-limiting filter or the pulse-shaping filter." [1]

ASK Demodulator

“There are two types of ASK Demodulation techniques. They are –

- Asynchronous ASK Demodulation/detection
- Synchronous ASK Demodulation/detection

The clock frequency at the transmitter when matches with the clock frequency at the receiver, it is known as a Synchronous method, as the frequency gets synchronized. Otherwise, it is known as Asynchronous.” [1]

Asynchronous ASK Demodulator

“The Asynchronous ASK detector consists of a half-wave rectifier, a low pass filter, and a comparator. Following is the block diagram for the same.” [1]

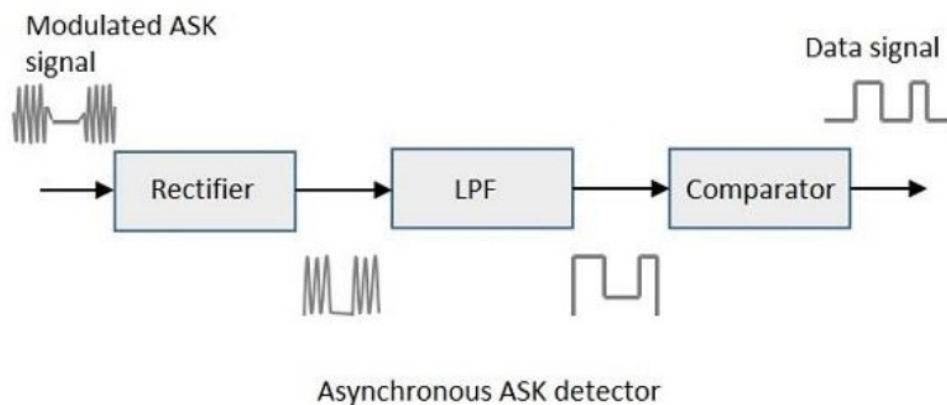


Figure 3

“The modulated ASK signal is given to the half-wave rectifier, which delivers a positive half output. The low pass filter suppresses the higher frequencies and gives an envelope detected output from which the comparator delivers a digital output.” [1]

Synchronous ASK Demodulator

"Synchronous ASK detector consists of a Square law detector, low pass filter, a comparator, and a voltage limiter. diagram ." [1]

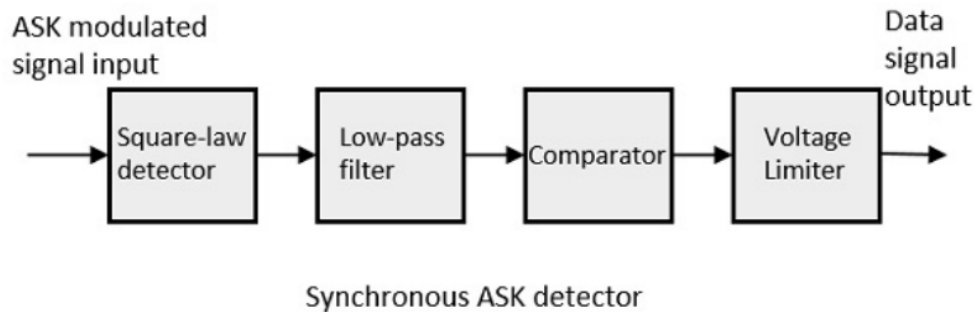


Figure 4 diagram of Synchronous ASK detector [1]

"The ASK modulated input signal is given to the Square law detector. A square law detector with an output voltage that is proportional to the square of the amplitude modulated input voltage. The low pass filter minimizes the higher frequencies. The comparator and the voltage limiter help to get a clean digital output." [1]

PSK

"Phase Shift Keying (PSK) is a digital modulation system in which the phase of the a signal is changed by varying the sine and cosine inputs at a specific time. PSK is widely used for wireless LANs, bio-metric, contactless operations, along with RFID and Bluetooth communications." [2]

"PSK has two types, depending upon the phases and how the signal gets shifted. They are –" [2]

Binary Phase Shift Keying (BPSK)

"This is also called as 2-phase PSK or Phase Reversal Keying. In this method, the sine wave carrier takes two phase reversals such as 0° and 180° . BPSK is essentially a Double Side Band Suppressed Carrier (DSBSC) modulation system." [2]

Quadrature Phase Shift Keying (QPSK)

"This is the phase shift keying process, in which the sine wave carrier takes four phase reversals such as 0° , 90° , 180° , and 270° ." [2]

If this kind of method is further extended, PSK can be done by eight or sixteen values also contingent upon the system requirements." [2]

BPSK Modulator

"The below diagram of Binary Phase Shift Keying consists of a balance modulator which has the sine wave as one input and a binary sequence as the other input." [2]

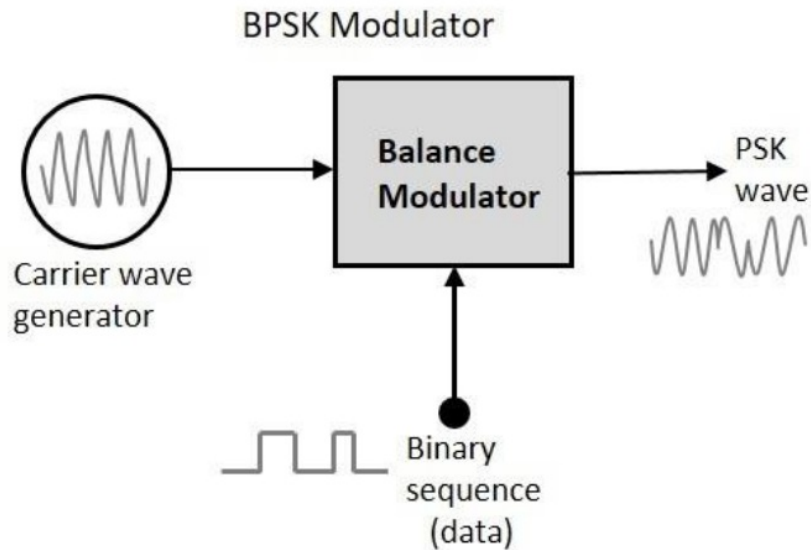


Figure 5 modulator diagram [2]

"The modulation of BPSK is done using a balance modulator, which multiplies the two signals used at the input. For a zero binary input, the phase will be 0° and for a high input, the phase reversal is of 180° ." [2]

"Following is the diagram representation of BPSK Modulated output wave along with its given input."

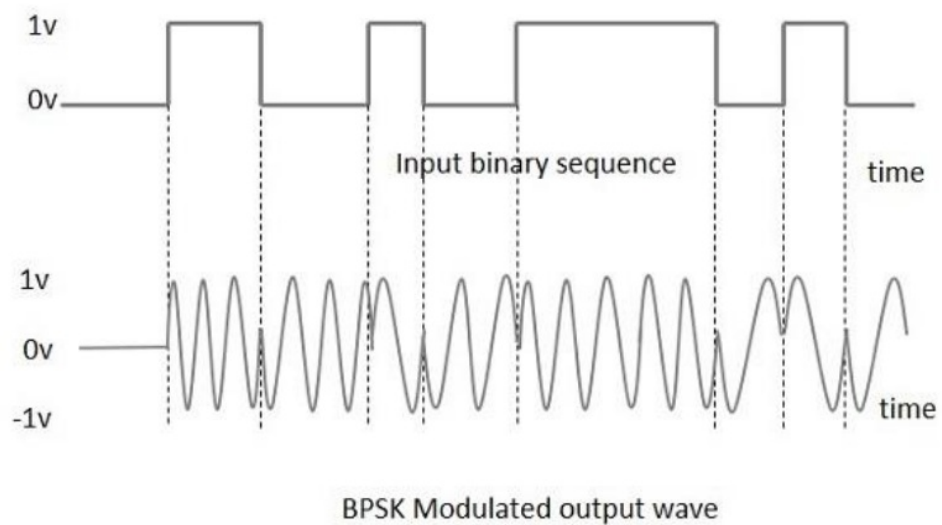


Figure 6 [2]

"The output sine wave of the modulator will be the direct input carrier or the inverted (180° phase shifted) input carrier, which is a function of the data signal." [2]

BPSK Demodulator

"The below is a diagram of BPSK demodulator consists of a mixer with local oscillator circuit, a bandpass filter, a two-input detector circuit. The diagram is as follows." [2]

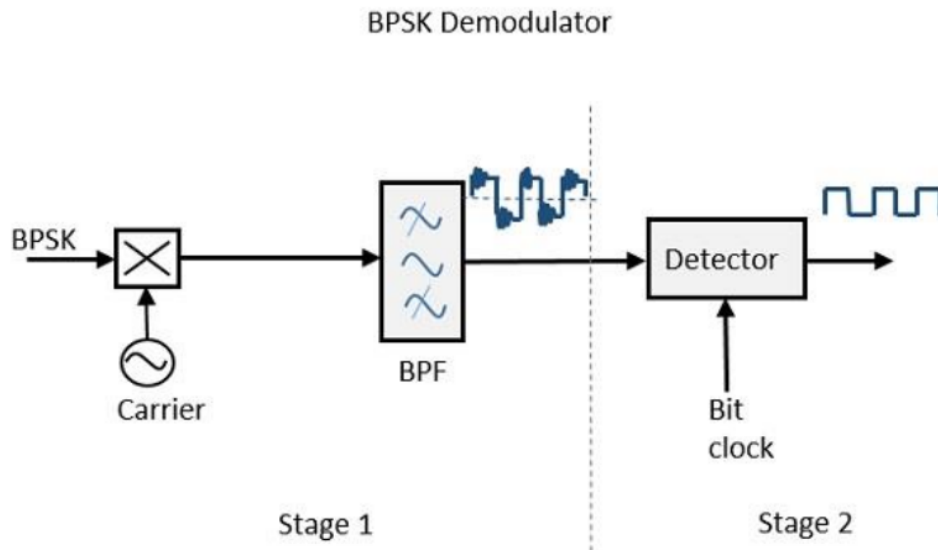


Figure 7 [2]

"By recovering the band-limited message signal, with the help of the mixer circuit and the band pass filter, the first stage of demodulation gets completed. The base band signal which is band limited is obtained and this signal is used to regenerate the binary message bit stream." [2]

"In the next stage of demodulation, the bit clock rate is needed at the detector circuit to produce the original binary message signal. If the bit rate is a sub-multiple of the carrier frequency, then the bit clock regeneration is simplified. To make the circuit easily understandable, a decision-making circuit may also be inserted at the 2nd stage of detection." [2]

Additive white Gaussian noise

"Additive white Gaussian noise (AWGN) is a noise model used to mimic the effect of random processes that occur in nature. The modifiers denote specific characteristics." [3]

"Additive because it is added to any noise that might be essential to the system. White refers to the idea that it has uniform to power across the frequency band for the system. It is an analogy to the colour white which has uniform emissions at all frequencies in the visible spectrum. Gaussian because it has a normal distribution in the time domain with an average time domain value of zero." [3]

"Wideband noise comes from many natural sources, such as the thermal vibrations from conductors, shot noise, black-body radiation from the earth and other warm objects, and from celestial sources such as the Sun. The central limit theorem of probability indicates that the sum total of many random processes that will tend to have distribution called Gaussian." [3]

"AWGN is often used as a model in which the only impairment to communication. white noise with a constant spectral density (expressed as watts per hertz of bandwidth) and a Gaussian distribution of amplitude. The model does not account for fading, frequency selectivity, interference, nonlinearity or dispersion. However, it produces simple and tractable mathematical models which are useful for gaining insight into the underlying behaviour of a system before these other phenomena are considered." [3]

"The AWGN channel is a good for satellite and deep space communication links. However it the best for most terrestrial links because of multipath, terrain blocking, interference, etc. However, for terrestrial path modelling, AWGN is commonly used to simulate background noise of the channel under study, in addition to multipath, terrain blocking, interference, ground clutter and self-interference that modern radio systems encounter in terrestrial operation." [3]

Method (detailed design information)

ASK



At the start of the circuit you have Bernoulli binary generator which connect to a scope, product and transport delay there is also a sine wave generator which connects to a product and the same scope as the Bernoulli generator. The product connects to a scope and an AWGN channel. The AWGN connects to the same scope as the Bernoulli generator and sine wave generator this AGWN also connects to a sine wave to a product. This product connects to a Digital filter design which connect the above-mentioned scope and a switch. This switch also two inputs 1 and 0 and connects to a error rate calculator and the same scope as the Bernoulli generator. The transport delay connects to a signal specification both these components connect so the same scope. The signal specification connects to an error rate calculator and in turn a display which shows the amount of errors, number of samples and total number of symbols compared.

The values of each components

Bernoulli generator parameters: –

probability of zero - 0.5, source of initial seed –Auto, Sample time – 1, samples per frame – 1, output data type – double.

Sine wave generator parameters :–

Sine type – time based,

Time(t) - use simulation time,

amplitude – 1, bias – 0,

frequency (rad/sec) – $2\pi \times 100$,

Phase(rad) - 0,

sample time – 1/1000.

Product parameters: –

number of inputs – 2.

AWGN channel parameters: –

initial seed – as shown in figure 7 as frequency but this is different with each individual person,

mode - signal to noise ratio (SNR),

Input signal power, referenced to 1 ohm (watts) - 1,

SNR (dB) – “To find SNR you must divide the value of the main signal by the value of the noise, and then take the common logarithm of the result: $\log(S \div N)$. There's one more step: If your signal strength figures are units of power (watts), multiply by 20; if they are units of voltage, multiply by 10.” [4]

Digital filter design :-

Response type – lowpass,

Design method – FIR,

filter order – minimum order,

frequency specifications – units = Hz, $f_s = 1000$, $F_{pass} = 5$, $F_{stop} = 75$

Magnitude specifications – units dB, $A_{pass} = 1$, $A_{stop} = 85$

Switch:-

Threshold – 0.25

Transport delay:-

Time delay – 0.039

Initial output – 0

Initial buffer size – 1024

Signal specification:-

Minimum - []

Maximum - []

Data type- inherit :auto

Units – inherit

Dimensions = -1

Sample time - 1

Signal type – auto

Error rate calculation :-

receive delay – 0

Computational delay – 1

Computational mode - entire frame

Display –

Format – short

Decimation – 1

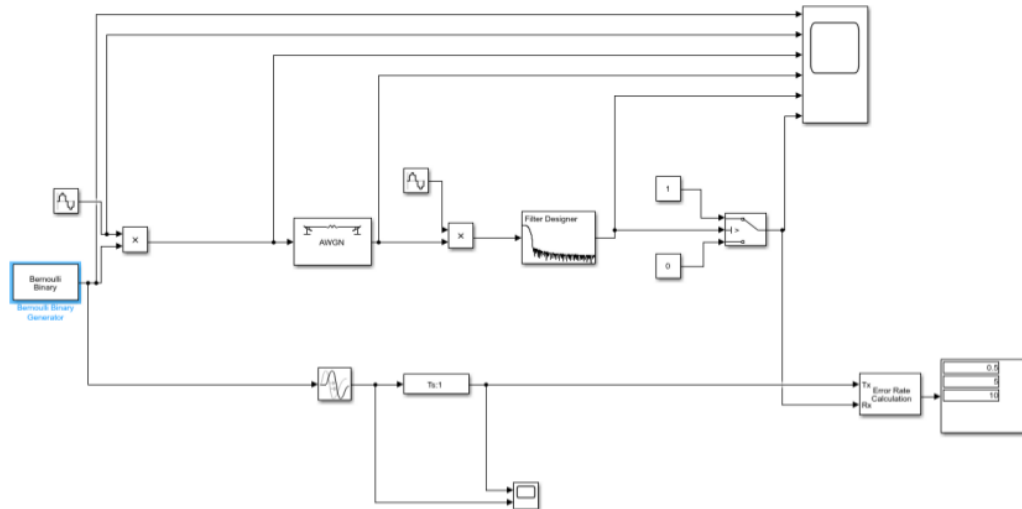


Figure 5 diagram of ASK circuit

At the start of the PSK there is a sine wave generator, a constant block and a Bernoulli binary generator. The sine wave connects to a scope and product there is also a constant connected to the product. The Bernoulli binary generator connects to a switch, a delay and a scope. The switch connects to a product and scope. There is another sine wave which connects to a product and a scope. The product connects to a scope and low pass filter. The low pass filter connects to a add block along with a constant block. The add block connects to a switch along two constant block 1 and 0. The delay connects to subtract block which connects to a scope.

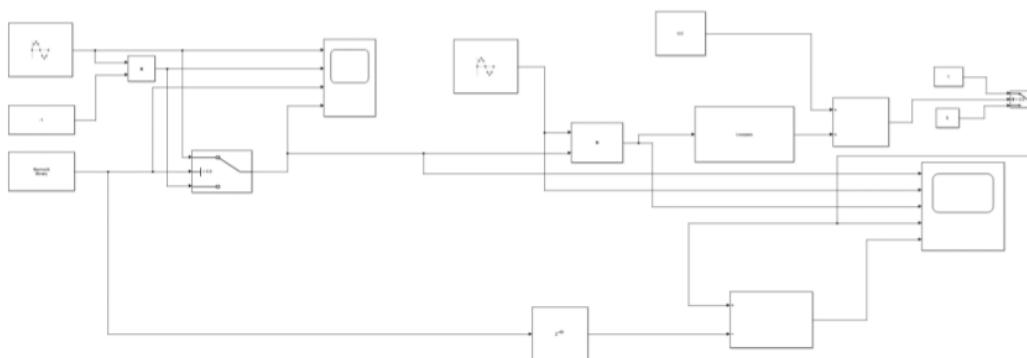


Figure 6 uncompleted diagram of PSK circuit

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Simulation results (detailed simulation results)

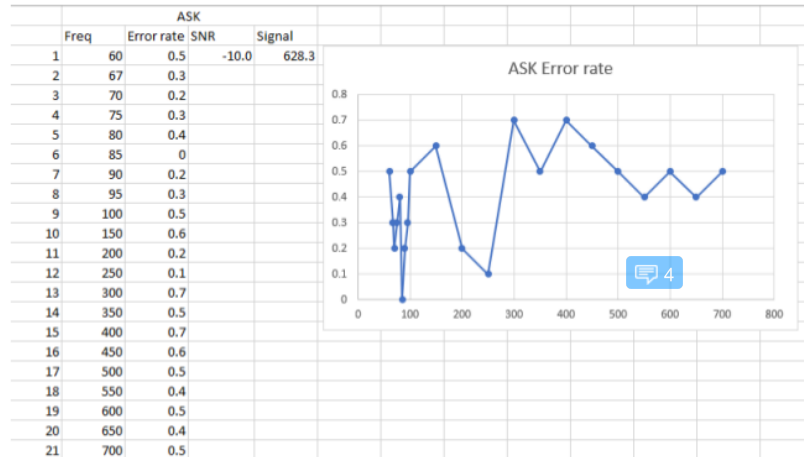


Figure 7 image of ASK results with error rate graph

The numbers 1 – 21 represent the number of attempts

Freq is the noise generated

Error rate is error found in the received data when testing the circuit

SNR is signal to noise ratio

Signal is the signal sent through the circuit

The Results table show the error rate by frequency

Discussion

The result shown in figure 7 show that when you change the frequency the error rate changes going higher or lower than the frequency before this is also affected by the signal to noise ratio. There is no comparison as the psk circuit is incomplete (figure 6) and unable to produce the required results

References

- [1 "Amplitude Shift Keying," tutorialspoint, [Online]. Available:
] https://www.tutorialspoint.com/digital_communication/digital_communication_amplitude_shift_keying.htm. [Accessed 20 December 2019].
- [2 "Digital Communication - Phase Shift Keying," tutorialspoint, [Online]. Available:
] https://www.tutorialspoint.com/digital_communication/digital_communication_phase_shift_keying.htm. [Accessed 20 December 2019].
- [3 "Additive white Gaussian noise," wikipedia, [Online]. Available:
] https://en.wikipedia.org/wiki/Additive_white_Gaussian_noise. [Accessed 20 December 2019].
- [4 "How to Calculate Signal to Noise Ratio," sciencing.com, [Online]. Available:
] <https://sciencing.com/how-to-calculate-signal-to-noise-ratio-13710251.html>. [Accessed 20 December 2019].

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University of Wales
Trinity Saint David

5 Appendices

FINAL GRADE

GENERAL COMMENTS

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Instructor

PAGE 1

PAGE 2

PAGE 3



Comment 1

Do not use the first person voice when writing technical reports. Always use the passive third person voice.

try:

"This report compares the performances of various digital modulation methods in the presence of additive white gaussian noise."

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PAGE 5

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Comment 2

Refer to the figure number when talking about something shown in a diagram.



Comment 3

This IS the complete system



Comment 4

It looks like you have made a graph of Bit Error Rate vs Frequency.

You were asked to make a graph of Bit Error Rate vs Signal to Noise Ratio. (BER vs SNR).

I'm not sure what frequency you have changed.



Comment 5

Empty appendices - Why include them if they are empty?

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**MORGAN
JONES**

38

ENGAGEMENT WITH LITERATURE

including reading, referencing, academic conventions and academic honesty



References to a limited range of mostly relevant sources. Referencing conventions mostly consistently applied. You should not rely so heavily on quotes. 8 pages of quotes is not acceptable - I cannot judge from this what your understanding is of the subject as you did not write the content. YOU NEED TO PARAPHRASE the material you reference. All you have shown is that you are able to research but you are unable to process the information independently.

4

KNOWLEDGE & UNDERSTANDING

Knowledge of the basic underlying concepts and principles of a subject.



Gaps in knowledge, with only superficial understanding. Some significant inaccuracies.

7

COGNITIVE & INTELLECTUAL

Evaluate underlying concepts and principles of a subject and interpret qualitative and quantitative data in order to develop lines of argument and make sound judgements.



Some evidence of analytical intellectual skills, but for the most part descriptive. Ideas/findings sometimes illogical and contradictory. Generalised statements made with scant evidence. Conclusions lack relevance. You need to read the assignment brief - you should have produced graphs of BER vs SNR. I have no idea what frequency you were changing.

10.5

PRACTICAL APPLICATION SKILLS

Different approaches to solving problems in particular contexts.



Rudimentary application of methods, tools and techniques but without consideration and competence. Flawed appreciation of the context of the application.

11.4

TRANSFERABLE SKILLS

Communicate the results of their study/work accurately and reliably, and with structured and coherent arguments; the qualities needed for employment requiring the exercise of some personal responsibility within a structured and managed environment.



Can communicate effectively in a suitable format, but may have minor errors. Mostly coherent work and is in a suitable structure.

5.1