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DESIGN OF AN ASK MODULATION DIGITAL SIGNAL CONVERSION SYSTEM

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ABSTRACT

Digital modulation is a special kind of modulation where the message signal is digital in nature and has three types that consist of the ASK (Amplitude Shift Keying), FSK (Frequency Shift Keying), and PSK (Phase Shift Keying). The ASK (Amplitude Shift Keying) is a modulation method to compress bits into each pulse of a signal transmission where the amplitude of the carrier wave is changed according to the digital input signal, therefore, making it analogous to AM (Analog Modulation). If the digital signal value is 1 then the carrier wave amplitude remains the same. When the digital signal value is 0 the amplitude of the carrier wave is much weaker. At present, the ASK is utilized at nearly every digital communication devices, cellular phones and televisions included. Certain devices like satellites and smart televisions manipulate two parallel ASK links which are 16 in level and has a 90-degree phase rotation. The 16 by 16 integration is further acknowledged as a 256 QAM. This research will design an ASK Modulation Digital Signal Conversion System.

Keywords: digital modulation, amplitude shift keying, amplitude, carrier wave.

1. INTRODUCTION

There are many kinds of modulation to point out, but in this paper, the focus in particular is on ASK modulation part of the digital modulation [1]. The idea of making this modulation was to prevent a lot of unexpected events like eavesdropping, or like interference with other signal that collides with the other signal, hacking, and many other ways to make the data, info, file, or etc secure in a way, so that making a modulation to the transmitter and the receiver is the best option for most electronic devices.

The ASK aka amplitude shift keying is one of the kinds of digital modulation. An ASK modulation is a combination or more like transformation of carrier signal and the original signal sent. The original signal sent to be modulated has to go through line encoding in order to make the signal understandable for modulation. The basic system on how ASK work is shown below [2].

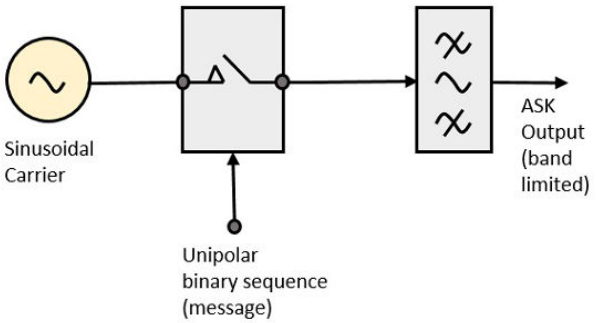

Figure-1. ASK Modulated Signal Sample.

A sample diagram shown above can also be done using simulink of MATLAB. Anyway, as can be seen in the picture above, the leftmost part is the carrier frequency then added to the middle one, which is message turn into unipolar line encoding so that i can be added with carrier, as a result is the ASK modulated signal. The sample result shown below [3]:

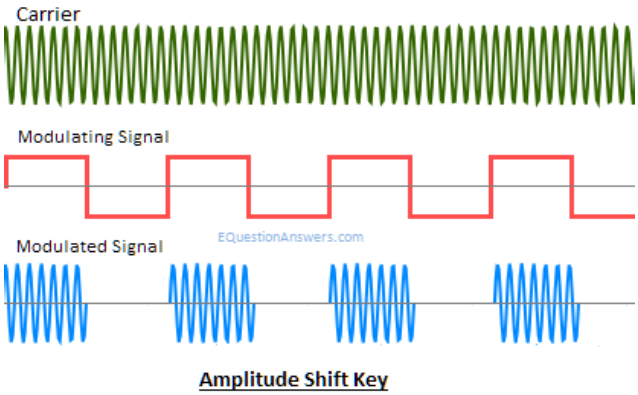

Figure-2. ASK Modulation Signal with carrier.

The application on this how the ASK modulation works is that when the bit message is zero, then it shows the low frequency, which is the original signal and when bit message is one, then the high frequency is shown, which was the frequency of the carrier frequency. As can be seen above is that as said, a while ago, when the bit message is at one, then result would use the carrier frequency at the modulated signal. as for having a zero-bit message, then the signal of the original frequency, however seeing as the frequency is too low it can be seen having no frequency at all due to the low frequency input used as output for modulated signal [4].

2. BACKGROUND OF THE STUDY

In every electronics device, there will be a lot of data and many other things. Nowadays, the existence of text message, video chat, and voice call is very much needed in society in order to connect with people in a faraway distance. As to this point of view, just how is

possible to make long distance connection [5]. To start with the connection can be done by means of wire, cable, and even radio waves. The text message, video chat, and voice call have very low frequency, which means to say that it can only travel at a certain distance, can even be at a short distance. In short, it does not propagate through space and will most definitely be attenuated. In most electronic devices, it has both transmitter and receiver inside the device, which is already built in. A transmitter is the one that generates the signal wave, most common use here is radio waves, that has data, info, file, and etc with it; however, a receiver now is the polar opposite of transmitter, which what it does now make use of antenna like to capture the signal waves with or without data, info, file, etc. with it [6].

Knowing this, what must be known next is the how the data, info, file, and etc. with it is sent. The main idea in this paper was the modulation, which was how the data, info, file, and etc. with it is being transferred [7]. A modulation is from the groups understanding is the combination of signal plus the carrier signal that has a higher frequency than the signal given. There are many kinds of modulation. The kinds of modulation are analog modulation and digital modulation.

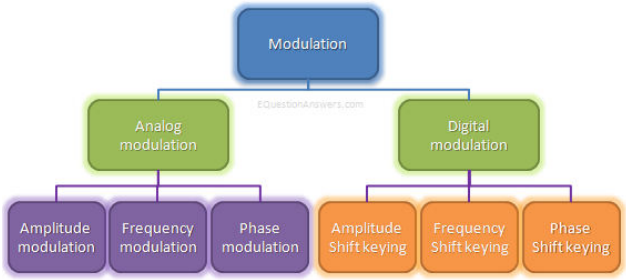

Figure-3. Modulation Block Diagram.

The analog modulation is for a way of transferring analog low passband frequency, as for digital modulation, it is just the same as analog, except it uses digital with same process. Given graph above. For the most common kinds of analog modulation are amplitude modulation, frequency modulation, and phase modulation. As for common most digital modulation are amplitude shift keying, frequency shift keying, and phase shift keying.

3. STATEMENT OF THE PROBLEM

Technology majorly affects our capacity to communicate and the advancement of innovation has had great changes in the improvement of the industry. People from the previous times utilized outdated technology to communicate over distances but as seen from the modern perspective, people convey messages easily over any distances, utilizing different devices invented at present. Technology legitimately influences how we connect and converse every day. It even affects up close and personal interchanges, as communication technology is basically available and accessible on a large scale in our day by day lives; it is available on radio, on TV, on the web, in cell phones and cameras, with clients regularly conveying by means of a few gadgets at the same time. These certain devices sometimes encounter difficulty in transmitting and receiving data in which applied shift keying, can improve its efficiency. The ASK (Amplitude Shift Keying) aims to address these problems through it being simple, inexpensive, and power conserving which makes it affordable and efficient at the same time.

4. SIGNIFICANCE OF THE STUDY

The modulation of signal is very essential in the field of communications in general - it is an extremely bread-and-butter concept in the industry. One of the most ingenious things than humans have been able to do is the propagation of signals over notable distance - nowadays this is manifested in the form of SMS, the internet and microwaves. When the message signal modulates the much more powerful and more frequent carrier oscillation the strength of the signal is enough to withstand several obstacles depending on how well the modulation process goes [8, 9].

Nowadays, because of modulation, physical conducting materials are not needed for signals to pass through like electrons do in current flow - signals can be propagated through the air. The gasses in the air alone are a hindrance to a normal signal being transmitted, let alone solid objects flying with the win, random magnetic fields from surrounding conducting materials, other signals being transmitted through the air and even the ultraviolet solar radiation. Modulation amplifies the signals enough so that wireless of signals is feasible [10, 11].

Not to be ignored are the advantages of Digital Communications itself which is a fundamental enhancement from Analog. Its implementation is simpler and less expensive, merging if signals (multiplexing) is feasible unlike in Analog, signals can be encrypted providing an security option for the signal if a situation called for it, errors can be searched for and corrected and it is much more easily adaptable to data applications than Analog because of its fundamental basis on binary [12].

5. DESCRIPTION OF THE SYSTEM

The framework for the given research is partitioned into two sections. The initial segment of the venture is the execution of the binary data into a digital signal since it is what an ASK is. It is intended to acknowledge the contribution of binary data which is then converted to the form of a square wave [13]. After this, the system at that point actualizes ASK modulation onto the initial signal. The transporter frequencies for the ASK regulation is coded into the program which can be changed and altered to the preference of the user. Following this, the second segment actualizes the ASK adjustment onto the digital signal for transmission. The ASK method follows a pattern of carrier switches in linearity to the baseband signal which can be presented as the waveforms below.

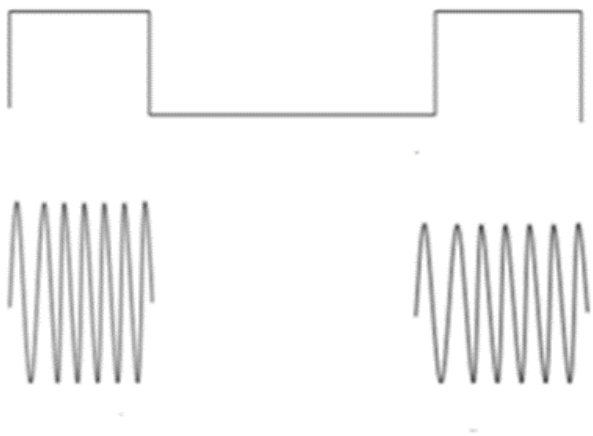

Figure-4. ASK Waveforms.

6. METHODOLOGY

The research goal for this project was to simulate a system that prepares a digital signal for transmission through ASK modulation. We accomplished this goal by creating a software program that properly simulates and represents a signal before and after modulation. The problem that arises from software implementation, however, is that the results may be inaccurate when implemented in hardware applications due to several external factors. To remedy this, the group plans to introduce noise to the system. This is done in order to simulate real-life properties and application which is why the system puts the signal through an AWGN channel. Although the group thought about using Simulink to accomplish the implementation, the group decided to use MATLAB codes instead due to its utility and simplicity. Additionally, the signals would be better represented in using the plot function in the software. The group aims to show the utility and importance that ASK modulation brings in signal transmission through the processes mentioned.

7. REVIEW OF RELATED LITERATURE

One research project in which involvement in Amplitude Shift Keying is represented by a journal composed by Peng Wu and Jianxin Ma. These two administered the generation of four-amplitude shift-keying single-sideband millimeter wave that is based on optical phase modulation, specifically by easily using +2nd-order and -4th-order sidebands for the modulation. Here, a signal in the radio-frequency range that is amplitude-shift-keyed is superposed by a local oscillator signal with an identical frequency to the first one. That ASK signal modulates a lightwave using an optical phase modulator with appropriate amplitude levels. The +2nd-order sideband carries the radio-frequency signal with a constant slope while a constant amplitude is observed with the other -4th-order sideband. The two sidebands could be summarized by a switch that is wavelength-selective to form an optical millimeter wave of dual tone using only one tone carrying the Amplitude-Shift-Keying signal, and as such, each of the two tones is different - one is digitally modulated and the other is not and the resultant millimeter wave signal has a large dispersion tolerance [14].

Another research paper that tackles Amplitude Shift Keying is one composed by Hussain A. Attia and MaenTakruri which the real-world application is RFID wireless transceiver systems. As it sites, wireless communications have been of massive use lately with the rise of modern technologies. A lot of of monitoring and control systems are implemented in the world based on a variety of wireless communications technology, and these systems include Global Positioning System (GPS), ZigBee and the Global System for Mobile Communication (GSM). The research paper presents the two authors - the two researchers - present a wireless transceiver system made for the transfer of code signals from a Radio Frequency Identification system (RFID) with the aid of Amplitude Shift Keying as the modulation technique. As the results of the research show in the paper, the constructed design proved to be effective and reliable as a means to send RFID codes for what it may be useful for [15].

Another research paper by Feng Wan, Bao-Jian, Wu Feng Wen, and KunQiu uses ASK modulation as an "All-optical modulation format conversion from star-QAM to PSK and ASK signals" which this does was to QAM to PSK then to ASK. The point of this to make use of simpler ways to understand the complexity of the start QAM. To start with using star QAm is very complex, due to the angle and what their x and y distance just to make the start QAM, but with this it can be made easier to understand it [16].

Another research effort by Jeremy Scerri, Ivan Grech Edward Gatt, and Owen Casha uses ASK modulation as the designed and fabricated MEMS device is able to convert BPSK signaling to ASK signal as part of the process, since the main use of this research paper was to Dimensional optimisation of a MEMS BPSK to ASK converter in SOIMUMPs. This research paper is an optimization to the electronic devices that uses BPSK signal then just have made of ASK modulation simplicity to made easier to understand it faster, then reevaluating all after converting [17].

Atul Kumar and Bhartendu Chaturvedi made used of ASK modulation an output, which the circuit that this research paper has made 2 kinds, one is ASK/BPSK modulator-1 and ASK/BPSK modulator-2. Both of them have different embeddedness in each kind and each one of them has its own different kind of uses. Those are proposal circuit that can be made to make the idea easier to comprement etc. [18].

ASK is only 1 out of a trio of major digital modulation techniques which are used widespread in the field of communications. One of them, Frequency Shift-Keying (FSK), is tackled in one research paper authored by Rudi de Buda about fast FSK signals and their demodulation. Fast FSK is a specific form of the modulation technique where digital data or information is transmitted within a radio frequency channel that happens to be restricted in both power levels and bandwidth levels. This research paper in question administers a

demonstration of the definition of the fast FSK and the demodulation of involved signals with the assistance of presented practical circuits that use it to operate [19].

8. THEORETICAL CONSIDERATION

In relation to the theme and topic of Amplitude Shift Keying (ASK), it is important to have some decent knowledge in regards with how to implement modulators and demodulators for the digital technique in signal modulation. It is good to simply start with points regarding the implementations of modulators [20].

ASK is the simplest of the digital modulation methods. It is essential to note that any system that involves digital signals works in relation to a clock that runs with periodic pulses. One thing that could be added to the modulator is a 24-bit accumulator that operates with the rising edge of the clock (the edge where each periodic pulse begins as the signal amplitude instantaneously increases). Stored in a lookup table is a singular cycle of a sine wave in the form of 256 samples, therefore an 8-bit bus is required. 8 of the most significant bits in the applied accumulator can be used in order to select the corresponding samples [21].

The message signal can then be used in the multiplexer circuit as a selector, and the selection runs based on binary logic. A binary '0' message signal alludes to an output with no value. On the other hand, the '1' signifies that the output signal is sinusoidal. The output in ASK is typically a sine that has these couple of distinct amplitudes [22].

For the implementation of a demodulator for ASK, what typically is firstly needed is a full wave rectifier to properly convert the sinusoidal received signal into a pulsating wave which is still in the continuous time domain. Then, a current adder and non-linear amplifier is needed to essentially broaden the modulation index, and the combined output of these circuits gets fed to a Schmitt Trigger which operates on a binary logic process to generate pulses based on the amplitude progression of the signal. A final circuit that work on digital operations fully demodulates the signal [23, 24].

9. DATA AND RESULT

```
function [output,messageWave]=
GetASK(message,pulseWidth,carrierAmplitude,carrierFre
q)
% takes input message as an array of values, pulse width
in
% microseconds, amplitude or carrier, and carrier
frequency in Hz
%set sampling frequency which is double myquist rate for
minimal error
stepSize=(1/(carrierFreq*(10^6)*4));
 % convert binary sequence into square waveform
messageWave=zeros(1,length(message)*pulseWidth);
for i=1:pulseWidth
messageWave(i:pulseWidth:end)=message;
end
% set carrrier signal
t=      0:stepSize:(length(message)*pulseWidth*stepSize)-
stepSize;
carrier =
carrierAmplitude*sin(2*pi*carrierFreq*(10^6)*t);
%multiply message and carrier to produce ASK signal
output= carrier.*messageWave;
end
```

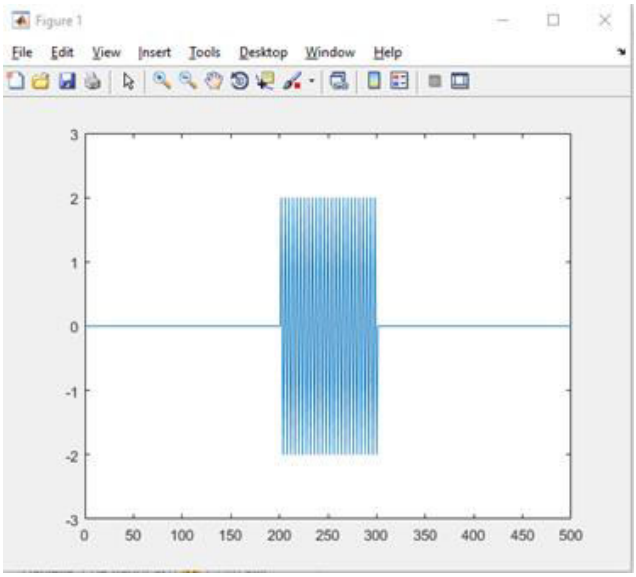

Figure-5. ASK Simulation.

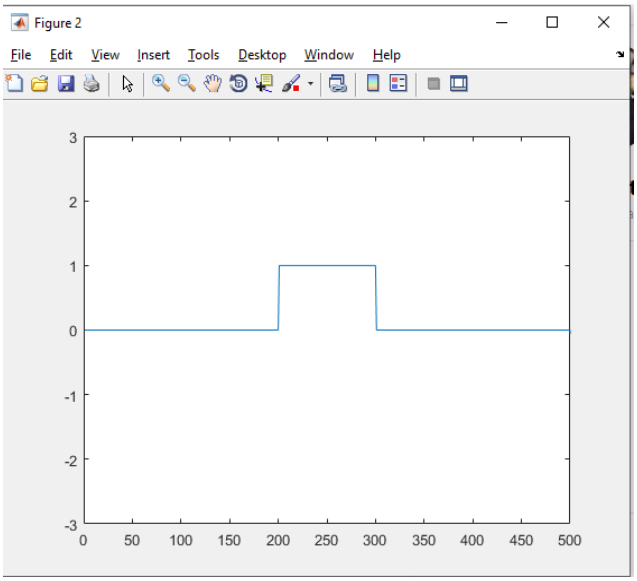

Figure-6. ASK Square wave Simulation.

10. ANALYSIS OF THE DATA

The main concern of the ASK modulation was the algorithm itself. If thoroughly search through the net the possible uses are definitely a lot, due to coding it, in a manner of liking or manner of shortest line, or etc. The thing is that there is a lot of codes out there, that can be used. The analysis in this project paper was the coding itself, because one line that is misplaced can affect a lot of outcome. Or like missing a letter for the code make

everything wrong. The coding is essential, when making a trial run for the setup, when the setup shows good outcome, then it can be said that the algorithm works very well. Many things are needed to make it work. In this project it tools the group quite the time to finish the right and perfect code to make sure that the result is as planned. Most the problem encountered was the right understanding the ASK modulation process, due to lack of understanding, the result will most definitely be wrong. Another mistake done, during the project was that the code can be in one script or split the file, so that it looks cleaner that the long one. When the results came out, the group was a bit surprised, due to the fact that the group weren't sure if result was right or wrong. To solve the groups problem, the group had to rely on other sources that can be used and made to compare, whether it was correct, as it turns out, the group first run was wrong, then after realizing the mistake with the code, the result of both should be the same and correct.

11. CONCLUSIONS

Amplitude Shift Keying is such an effective way of making sure that a digital signal is able to go where it needs to travel with good efficiency. The simulation that the researchers did in this project was a success. ASK modulation was done on the hypothetical message signal and the result at the end of it all is a proper ask signal. The spike in amplitude variation at the point the digital message signal pulses indicates the very ASK technique used here. In this case, every time there is a pulse in the message that is of the high value, then the oscillations that come from the modulated carrier wave should manifest. The waveform should then look completely flat (the amplitude should just constantly be '0') at the corresponding time periods where no pulse is seen the message waveform.

Using ASK on a signal comes with really good benefits in the digital signals industry. For one, it provides high bandwidth efficiency which means that a lot of the bits that get sent in different specific frequency levels end up arriving at the receiver. In other words, the message as a whole is sent with very good quality. Using ASK also comes with a much less complicated design for the receiver which therefore means less cost is spent, optical fiber transmission is possible with ASK which means the bits can travel nearly lightning fast to desired destinations should the circumstances call for it [25, 26].

Despite of such a good way to transmit signals it has a few drawbacks. On basic disadvantage of Amplitude Shift Keying is in relation to the high bandwidth efficiency. Unfortunately, with high quality transmission comes poor power efficiency; a lot of power is used for the bandwidth efficiency to be good. It is wise to note that when using the modulation technique. The pros outweigh the cons at the end of it all highlighting the simplicity and inexpensive nature of the process so ASK is an approved tool to use.

12. RECOMMENDATION

Making use of the process of modulating a signal means to say that it can also be used for sources especially in AC sources. This idea was very much common in a lot of ways, since if knowing the idea that signal can be change meaning to say like AC to DC or vice versa can be applied to be able to control the flow of electricity [27]. In this project, the group has made quite the question, while making the project. Those questions were if the application, can we just make this common to most simple electronic devices such as using ASK modulation in communication in cheapest way, so that like when going to unknown jungle long ranged communication is needed in order not to get lost or can it be used for detecting where your current location just like how GPS works, since it emits signal, which we can say that it can be detected by the receiver then located whenever needed or like can this be used for making in another way like as an electronic devices such as toys for long ranged connection of controller and the toy or something or lastly like can this be used for control switch at home so that switch are needed phones will just have to detect the signal, then just control everything from your phone or something like that [28, 29, 30].

From what i can see, the basis of making a recommendation is unlimited due to the technology evolving every day. The very existence of technology has been very much useful to the people in all over the world; even so making better of it is why the world is in rapid change with technology [31]. The recommendation in this project is very much like how technology evolves, since various plans can be improved with the use of ASK modulation as something inside then just improves it.

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