Experiment no.1 report examples

Art & Culture, Symbolism

(QAM) Laboratory Report

For (XXX)

Objective:

Components required:

A carrier source, data source, phase shifter, multiplier, symbol mapping, noise channel, PCB board, phase scope and oscilloscope.

Theory:

There are two types of modulation technique namely analog and digital. QAM is a technique that uses both analog and digital modulation technique. It is the abbreviation used for Quadrature amplitude modulation.

In analog modulation scheme it passes the two message signals by varying the amplitude of the two carrier waves using amplitude modulation method. In the case of digital modulation technique two digital bit streams are transferred in which amplitude shift keying (ASK) is used.

The quadrature amplitude is named so because, the two carrier waves used in this process are 90 degrees out of phase with each other i. e., they are sinusoids and thus the technique is named Quadrature amplitude modulation. The two modulated waves are added together and the output produced is both a combination of amplitude shift keying (ASK) and phase shift keying (PSK) in the case of analog modulation scheme. The two methods applied in analog modulation scheme are phase modulation and amplitude modulation methods as its two parameters. The least condition to be fulfilled is phases and amplitude as the minimum requirement.

Since the amplitude of the modulated carrier is not constant the modulators used in PSK scheme often employ Quadrature amplitude modulation but are not recognized under this category.

The most favored technique in digital telecommunication systems is Quadrature amplitude modulation. Quadrature amplitude modulation provides high efficiencies and is used in the field of optical fiber communication.

In Quadrature amplitude modulation two amplitude modulated waves are merged together and uses a single path which utilizes bandwidth efficiently. Quadrature amplitude modulation is also used in the field of wireless systems by using pulse amplitude modulation technique.

In a Quadrature amplitude modulation signal each carrier has same frequency only the phase differs by an angle of 90 degrees. In this one signal is referred as the I signal and the other is called as the Q signal. Graphically, the two signals can be represented as sine and cosine waves.

At the transmitting end, the two signals are merged and at the receiver the data is extracted from the modulated signal. The block diagram shown below shows how the Quadrature amplitude modulation is generated and the figure proceeding show their characteristics.

First of all a carrier source is generated which is fed to two different phase shifting units. A phase shifting equipment shifts the wave by +45 degrees and the other unit shifts the phase by -45 degrees. The outputs of these units are then fed to the multipliers which further add them and transfer the output to the noise channel. The data source is inserted to the symbol mapping unit, the output of which is transferred to both the multipliers which combine the data and the carrier.

PCB implementation diagram:

The PCB implementation is shown as below

Block diagram:

We have made connections according to the block diagram

Observation1:

Initially the phase scope is set to 90 degrees, the characteristics generated for this condition are shown in the figure below.

Observation 2:

When the phase setting for 16-QAM constellation is done we get the following characteristics:

Observation 3:

The figure below shows the 64 QAM where we achieve persistence

Observation 4:

This figure shows the constellation for 266 QAM.

Observation5:

More amplitude levels are achieved for 256 QAM as compared to the 16-QAM scheme

Observation6:

When applied the same time period the 16QAM shows 4 levels of amplitude which is explained by the following figure:

Observation7:

The figure below shows the similar results in X-Y mode as it did in the constellation mode in the phase-scope.

Observation8:

The effect of noise is displayed on the phase scope, there are clusters present around the original position due to the effect of noise. The figure below shows it:

Observation9:

Each individual symbol is indistinguishable due to the effect of noise in 64 QAM which is clearly seen in the figure

Experiment no. 2

Objective:

In the second practical the effect of the amplitude and phase noise on QAM constellation is studied.

Components required:

Noise source, carrier source, data source, phase shifters, QAM generator, local oscillator, and multiplier.

Block diagram:

The block diagram below shows how the units should be connected in order to carry out the practical.

Theory:

The procedure for studying the effect of amplitude and phase noise on QAM constellation is explained below.

Initially we insert some noise into the carrier source; the output of the carrier source is inserted into three different units. The units are the multiplier and two phase shifters (one which phase shifts by 45 degrees and the other by -45 degrees). the output of the phase shifters is fed to the QAM generator unit. The data source is connected to this QAM generator. After mixing the data and the carrier, the final result is promoted to the multiplier which has a noise source joined to it. A local oscillator which generates the frequency is connected to the carrier source which is also connected to another multiplier. The multiplier gets its input from the low pass filter.

Where there is aggressive RF/microwave QAM application environment for e. g. in broadcasting and telecommunications, multipath interference increases in higher order QAM constellations, it becomes a complex task for the receiver to demodulate the signal because of the decreasing separation between the adjacent states. The decline in partition is the result of spreading of the spots amid the constellations. In short, the noise immunity is decreased.

In high carrier frequency systems if large QAM constellations are occupied, system designers should ensure that the system is forceful i. e., it can exterminate the consequences of noise and supply a highly efficient system performance. Phase noise is generated together by the oscillators and synthesizers applied in frequency translation of the modulated signal. The phase noise can be suppressed by the use of PLL which acts as a high pass filter. There are many tools available in order to compute the error generated by the system.

PCB implementation diagram:

The circuit below shows the implementation on the printed circuit board.

Observation1:

The figure below shows the phase difference of 90 degrees. In order to obtain a +90 degree phase shift instead of -90 degree the variable phase shift has been switched over.

Observation2:

The figure of phase scope given below shows a steady display which implies that the system is phase locked.

Observation3:

When the lower multiplier offset control is set to maximum with a 16 QAM the view of the constellation is as shown in the figure.

Observation4:

When the lower multiplier offset control is set to two-third of the scale with 16 QAM the view of the constellation is as shown in the figure.

Observation5:

When the noise amplitude in the transmitting channel is set to half of the original the 16QAM

Constellation is displayed as shown in the figure below;

The figure clearly shows that the noise is acting in one direction i. e. along the line of phases.

After referring to the make connection diagram the connection 11 is removed and 12 is added.

Observation6:

The below figure shows the constellation display with the noise set to the maximum level. We can see that noise is acting in arcs around the center point.

These two effects let us understand QAM in a better way.

Experiment no. 3

Objective:

Components required:

Carrier source, data source, phase shifter, QAM generator, local oscillator, multiplier, PLL (phase locked loop), low pass filter.

Block diagram:

In order to obtain a signal at the receiver end we have to demodulate it. The block diagram for connecting equipments which are required to demodulate a QAM is shown in the below figure:

Theory:

Various functions are used in order to demodulate a QAM signal. The functions are Automatic gain control, Quadrature down conversion, nyquist filtering, clock recovery, carrier recovery, Adaptive equalizer and demapping. The noise has to be filtered and the original signal has to be represented in the form of bits.

A carrier source generates a carrier wave which is phase shifted by 90 degrees using phase shifters that phase shift it by +45 degrees and -45 degrees. The two carriers are then transmitted to the QAM generator. The data source is connected to the QAM generator. The output of the QAM generator is fed to the two multipliers and to the local oscillator.

Between the multipliers and the local oscillators phase shifters are connected. The output of the multipliers is fed to the low pass filters. The local oscillator also receives an input from a phase locked loop (PLL). The phase locked loop (PLL) receives its input from the carrier source.

Nowadays, a new Viterbi-type algorithm is constructed with the help of data aided frequency estimation to achieve a burst carrier synchronization and demodulation of the received signal.

Every equipment used in the demodulation process contributes some noise and disturbance apart from the channel noise. This has to be overcome using filters and appropriate algorithms that produces the transmitted signal in an accurate manner.

PCB implementation diagram:

The connections on the printed circuit board are shown in the figure below:

Observation1:

The figure below shows the phase difference of 90 degrees. In order to obtain a +90 degree phase shift instead of -90 degree the variable phase shift has been switched over.

Observation2:

When the local oscillator variable phase shift is just past the half scale mark, the phase scope displays the following Image. Since the scope showed a -90 degree instead of +90 degree, the +45 degree and -45 degree wires on the local oscillator were switched over.

Observation3:

The figure below displays the 16 QAM constellations with offset of 1 and weak signal level controls in the phase scope.

Observation4:

The diagram shown below displays the oscilloscope in X-Y mode with signal level controls to about one third of scale. Thed. c. source are set to just below the half scale. The D. C. source rotates the constellation and the IQ modulations are set to about the half scale.

Observation 5:

When the local oscillator variable phase shift scale is changed from half to one-third, same constellation is displayed. The trapezoid leans the other way when the phase shift is turned past half scale towards maximum. The variable phase shift is set to just past the half scale for a square constellation.

Observation6:

After removing connection 17 the local oscillator becomes unlocked. This shows that a carrier lock has been achieved.

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