GJU

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<u>**German Jordanian University**</u>

Department of Communication Engineering

Digital Communication Systems Lab

CME 313-Lab

Experiment 4

Modeling Digital Communication System

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Experiment 4

Modeling Communication System

Objectives:

By the end of this experiment, the student should be able to:

1. Simulate digital communication system.
2. Understand the noisy channel model.
3. Understand decision maker operation.

Introduction

Communications is the study of the transmission of various data through different systems. We can transfer the information from one region to another without any loss of the data. A communication system is a collection of network systems which includes transmission system noisy channel, receiving system. All these components perform effectively in a good communication system.

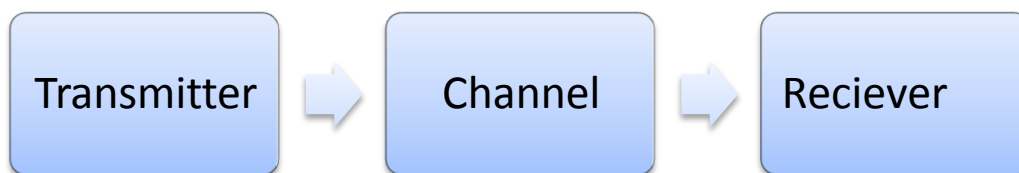The block diagram representing the communication system is given in Figure 1 .

Figure 1. Communication System Block Diagram

Transmitter:
Transmitter is the first component in this block diagram. Using this system we can generate the messages which is to be sent through this system.

Noisy Channel:
This is the third block in the block diagram of communication system. Noisy channel is nothing but the medium through which the message is transmitted. Messages are conveyed through this channel. Different channels have different strengths and weaknesses. Each channel has its own frequency and different applications have different operating frequencies..

Receiver:
This is the final block in block diagram of communication system. This can be said as the target to which the information need to be delivered.

The Noisy Channel Model:

In many experiments it is necessary to test a modulation scheme by transmitting a signal over a noisy, bandlimited channel. Bandlimiting is either at baseband or bandpass around 100 kHz.

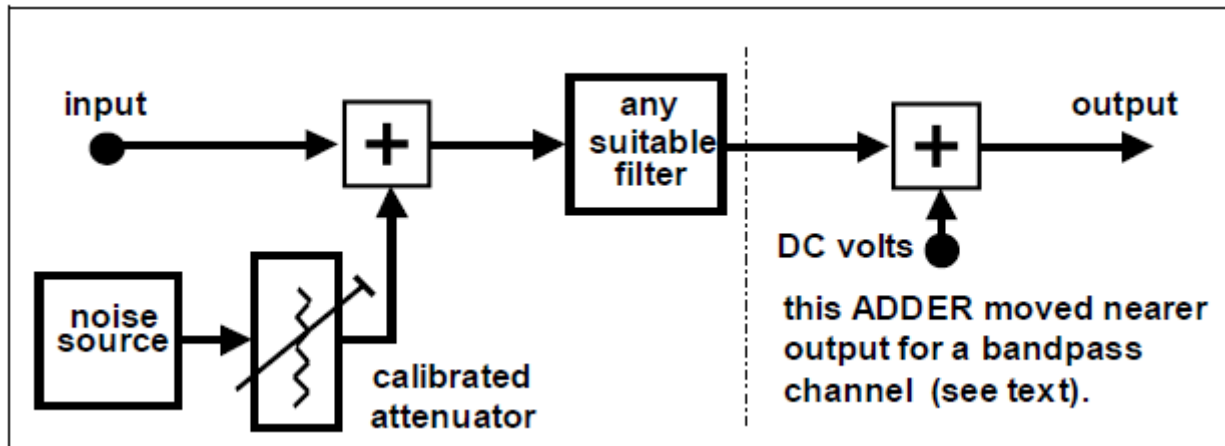The general block diagram of such a channel is illustrated in Figure 2.

Figure.2 The Standard Baseband Noisy Channel

- For a baseband channel either a TUNEABLE LPF or a BASEBAND CHANNEL FILTERS module is suitable.
- For the bandpass channel a 100 kHz CHANNEL FILTER is used. In this case the output
- ADDER is *omitted*, since DC cannot be added to a bandpass signal.
- The TIMS NOISE GENERATOR supplies wideband noise. So that this noise will be bandlimited to the same bandwidth as the signal the noise is added at the *input* to the channel.
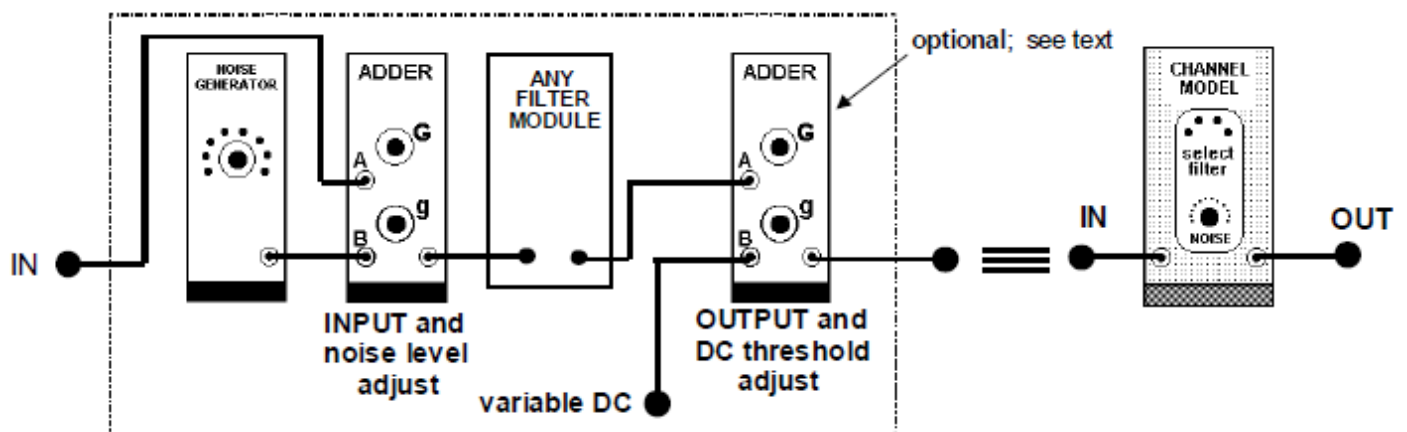
A model of a baseband channel is shown in Figure 3

Figure .3 The Baseband Channel Model.

Decision Maker

In communication systems, when the signals are transmitted through long lines (channel) it needs to be amplified and cleaned up. With digital signaling, nonlinear processing can be used to regenerate a noise-free digital signal. Regeneration includes reshaping of the incoming signal and decision-making based on the pulse sample.

Decision maker can perform these two operations. It is basically a comparator that produces a high-level output when the input value is larger than V_T and low -level output when the input value is less than V_T, as shown in Fig. 4.1. The generated signal is noise free except for bit errors that are caused when the input noise alter the sample values sufficiently so that the samples occur on the wrong side of V_T (bit error).
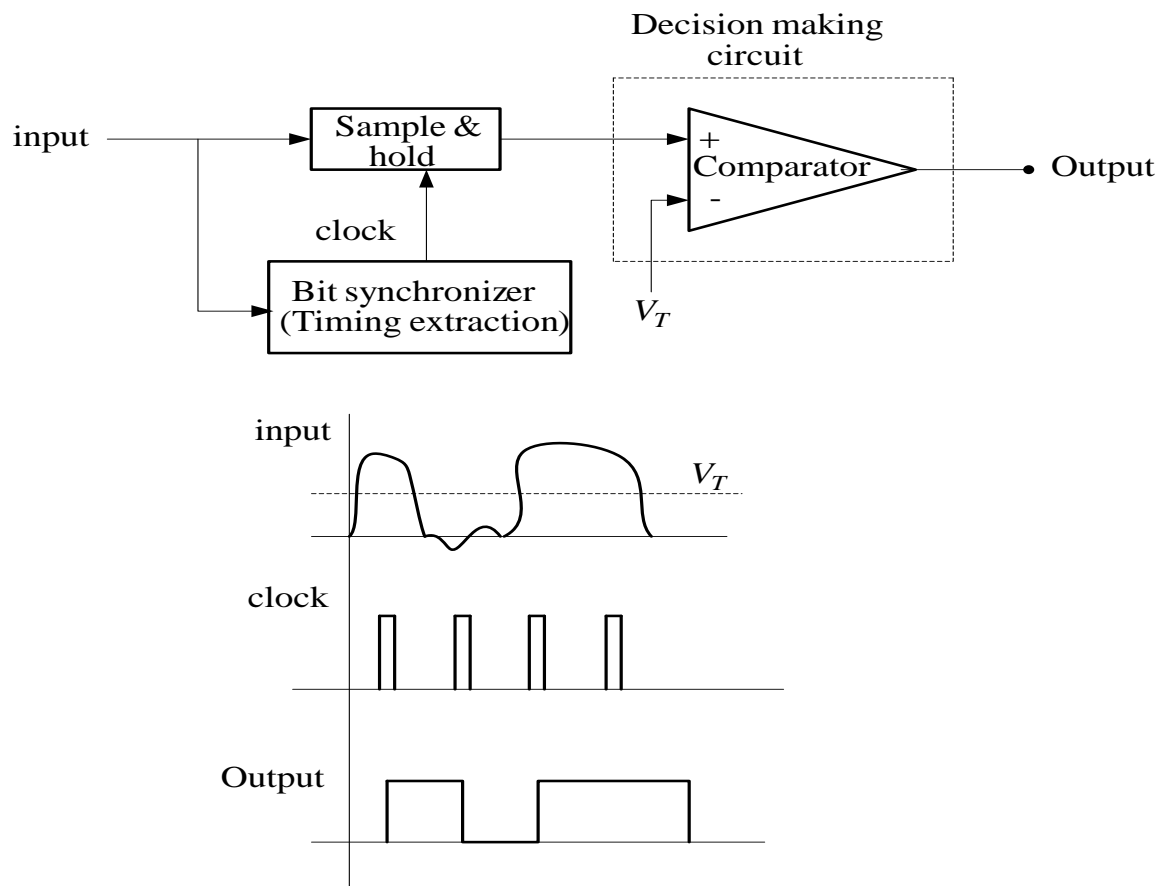
Figure .4 Decision Maker and its Operation

Part l: Modeling Communication System

1- Connect the TRANSMITTER shown in Fig. 4.5. Press the reset on the LINE-CODE ENCODER.

- **Observe the NRZ-L output and input of the LINE-CODE ENCODER**.
- **Save and print the signals**.

3- Connect the CHANNEL as shown in Fig.5.

4- Set the front panel attenuator of the NOISE GENERATOR to maximum output; but reduce the channel noise to zero by rotating the INPUT ADDER gain control 'g' fully anti-clockwise.

5- With the ADDER gain control 'G', adjust the amplitude of the signal into the BASEBAND CHANNEL FILTERS module (from the output of ADDER) to 2 volt peak-to-peak.

6- Select channel #3 of the BASEBAND CHANNEL FILTERS module.

7- Using the VARIABLE DC module connect the DC threshold adjustment path to GND.

- **Save the signal at the output of the BASEBAND CHANNEL FILTERS module.**
- **Write a complete comments about this signal. (Shape and relation between it and the input signal at the transmitter)**
- **Monitor the signal at the output of the ADDER. Add as much noise as is available, to implement the worst SNR possible, by maximizing the gain through the ADDER (using control 'g').**
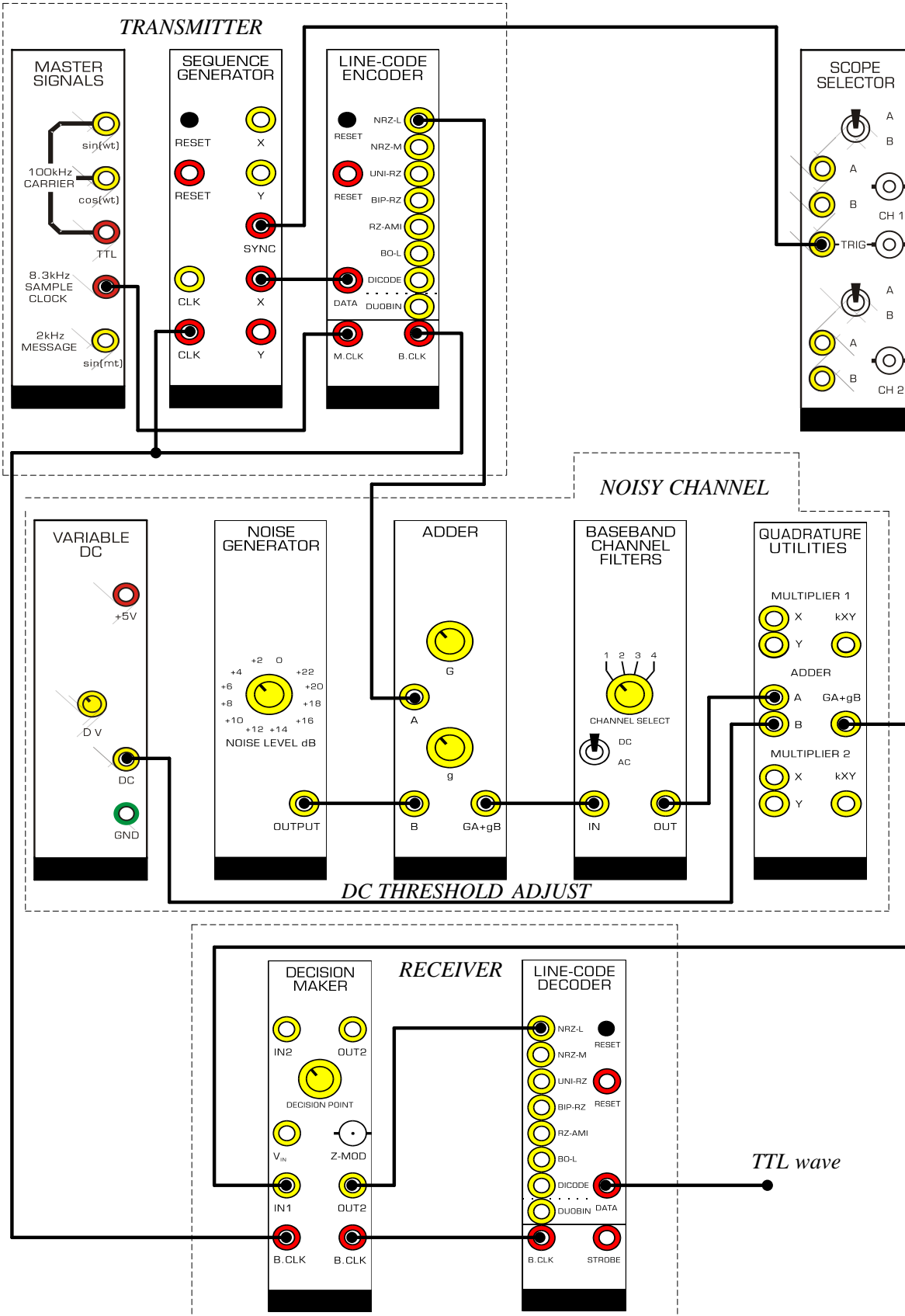- **Save the signal at the output of the AADER module.**

Figure.5   TIMS Model of Communication System

8. Before plugging in the DECISION MAKER:

   a) Switch the on-board switch SW2 to 'INT'.

   b) Select the NRZ-L line code with the on-board rotary switch SW1.

9. Connect the RECEIVER as shown in Fig 5.

- **Save and print the signal at the output of LINE CODE ENCODER, and the signal at the output of DECISION MAKER.**

- **What is the relation between the two signals?**

10. Connect the DC threshold adjustment path to DC, turn the VARIABLE DC clockwise.

- **What happen to the signal at the output of the DECISION MAKER as the VARIABLE DC voltage increases? Why?**

- **At what voltage this change happen? Why?**

11. Turn the VARIABLE DC anti-clockwise.

- **Re-answer the last two points Reset DC threshold adjustment path to GND.**

- **What type of signal you have at the output of LINE-CODE DECODER.?**

- **Save the signals at the output of LINE-CODE DECODER with the   signal at the input of the LINE CODE ENCODER.**