



**QUAID-E-AWAM UNIVERSITY OF ENGINEERING, SCIENCE
& TECHNOLOGY, NAWABSHAH-67480 SINDH PAKISTAN
DEPARTMENT OF ELECTRONIC ENGINEERING**

Analog and Digital communication

(6th Term Third Year)

Lab. Experiment # 01

Name: _____

Roll No. _____

Signature of Teacher: _____

Date: _____

Objective: To examine the principle diagram of the operation of a transmitter (MCM 24) and receiver (MCM 25).

THE TRANSMITTER:

The purpose of the transmitter is to convert the information that is to be transmitted into modulated radio frequency signal. Through a transmission line, this signal is applied to the antenna that radiates the information in space as electromagnetic waves. Fig.01 shows the principle diagram of the transmitter.

The transmission can be obtained not only via radio, but even using other supports, such as copper and the optical fiber.

THE TRANSMITTER:

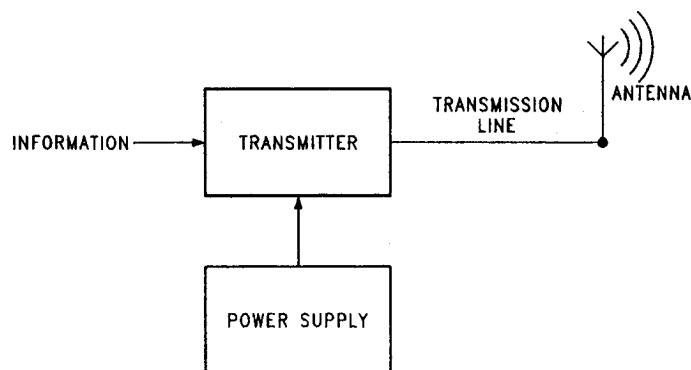


Fig.01 Principle diagram of the Transmitter

Principle diagram:

In the past **direct modulation** was used which consisted in directly modulating the RF carrier containing the information, and which guaranteed a circuit simplicity to the detriment of the quality in the communication.

Today, modulation is achieved on a fixed and well stabilized frequency (intermediate frequency) signal that translates at the frequency channel that is to be used and the greater circuit complexity is balanced with a greater simplicity of control and greater quality of the generated signal.

Fig.02 shows the block diagram typical of a modern transmitter. The operation is as follows:

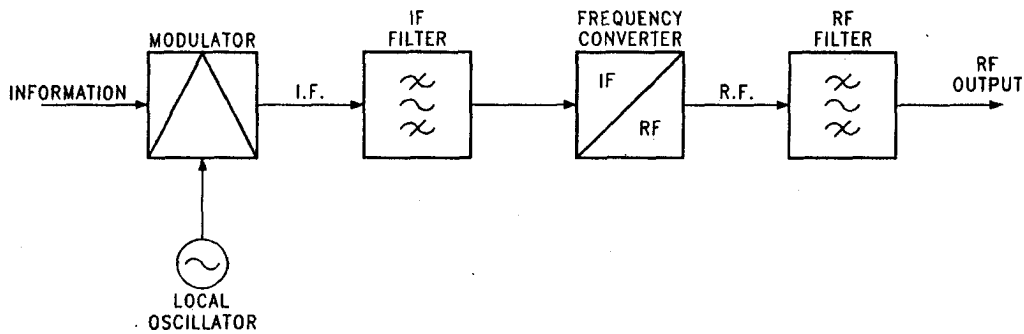


Fig.02 Block diagram of the Transmitter

- **The local oscillator:** It provides the modulator with a signal whose frequency is stabilized through a PLL circuit.
- **The modulator:** It changes the frequency spectrum of the signal provided by the local oscillator, according to the kind of modulation used and the provided information, and generates the IF signal (intermediate frequency). The IF frequency is always equal and does not depend on the frequency of the RF channel that is to be used. This enables the optimization of the modulation and filtering circuits.
- **The IF filter:** It cleans the useful signal from any intermodulation products or noise. As the IF is always the same, the filter does not need regulations or calibrations, and can be a commercial component optimized for this purpose.
- **The frequency converter:** It has the purpose to translate the frequency from IF to RF so to the frequency of the channel that is to be used.

The frequency conversion consists in translating the used carrier or frequency of a fixed quantity by means of a local oscillator and a frequency mixer. The process is called **heterodyne** or **superheterodyne**, too.

Fig.03 shows the block diagram of the converter.

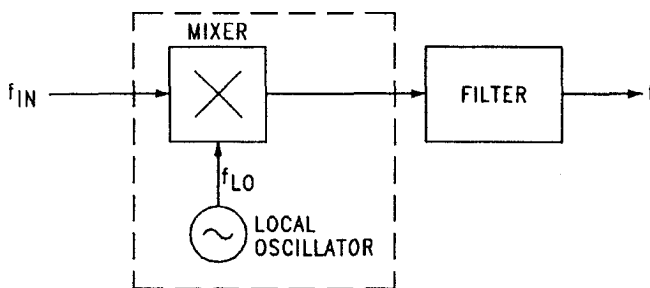


Fig. 03

Given the following signals: the input signal with frequency f_N and the signal generated by the local oscillator f_{LO} , the output signal to the converter will be the sum of the signals with frequency sum and difference of the two just mentioned signals. In conclusion, the mixer output signal will contain signals with frequency equal to:

$$m \times f_N \pm n \times f_{L0}$$

with **m** and **n** as whole numbers.

The useful output signal, with frequency f_{out} , is separated by the components that are not of interest, called **spurious**, via the output filter.

See that the frequency f_{L0} generated by the local oscillator is synthesized and frequency stabilized through a PLL circuit.

- **The RF Filter or output filter:** It cleans the useful signal from the intermodulation products that add during frequency conversion. As the RF can be changed, the filter must be calibrated again.

THE RECEIVER:

The purpose of the transmitter is to convert the modulated radiofrequency signal into the information that is to be received. Using an antenna, this radiofrequency signal is picked up by the space in which it traveled as electromagnetic wave, and sent through a transmission line to the electronic circuits of the receiver in order to be demodulated.

Fig.04 shows the principle diagram of the receiver. The reception can not only be the radio, but can be obtained even with other supports, as copper and optical fiber.

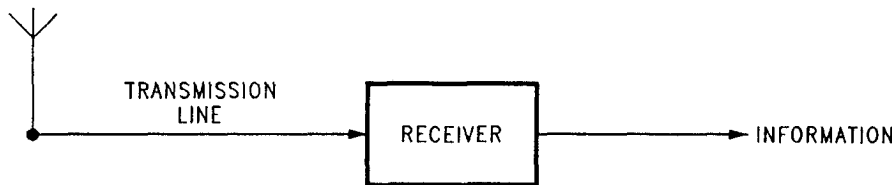


Fig.04 Principle diagram of the receiver

Principle diagram:

Receivers were manufactured in the past with simple modulations which extracted the information directly from the RF carrier. These choices guaranteed a circuit simplicity to the detriment of the quality of the received signal information. Today, demodulation, i.e. the transmission inverse process that consists in the extraction of the information from the carrier, is obtained differently: first there is a translation of the frequency of the channel that is to be received to a fixed frequency (intermediate frequency), and this is demodulated.

This process offers more simplicity in the control and a higher quality of the extracted signal, but also more circuit complexity. Fig.04 shows the typical block diagram of a modem receiver, called **superhetrodyne receiver**. The operation is the following:

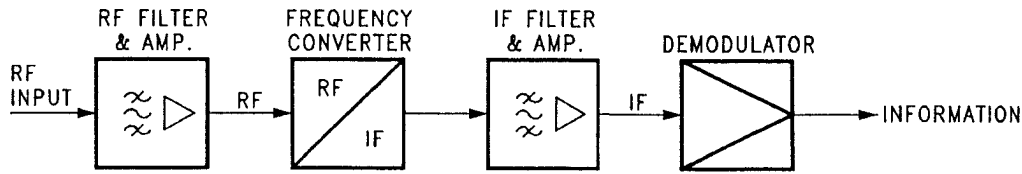


Fig.05 Block diagram of the Receiver

- **The filter and RF amplifier:** It removes the channels we don't want to receive from the useful signal and increases its amplitude level. As the RF channel can be different, the input filter must change its characteristic. Typically this occurs automatically, without the user intervention, by means of d.c. control circuits.
- **The frequency converter:** It translates the frequency from RF - channel frequency that is to be received - to IF. It employs a frequency stabilized oscillator, with a PLL circuit.
- **The filter and IF amplifier:** It cleans the useful signal from any intermodulation products or noise and increases its amplitude level. As the IF is always the same, the filter does not need regulations or calibrations, and can be a commercial component optimized for this purpose.
- **The demodulator:** It must receive or extract the information contained into the IF signal. The frequency spectrum of the IF signal depends on the kind of used modulation and on the same information. The IF frequency is always equal and does not depend on the frequency of the RF channel that is to be used. This optimizes the modulation and filtering circuits.

Review Questions

Q # 01 what is the function of a Modulator in a transmitter?

Q # 02 what is the function of a frequency converter in a transmitter?

Q # 03 what is another name of a modulator?

Q # 04 Why the IF signal is converted into RF signal in a transmitter?

Q # 05 what is the function of a Demodulator in a receiver?