EXPERIMENT NO. 2

ASK MODULATION

NAME: ___________________________________    MATRIC NO: __________________

DATE: _______________________________    SECTION: ____________________________
Objectives
• To describe the ASK (Amplitude Shift Keying) modulation and demodulation
• To carry out an ASK connection, without data coding
• To examine the noise effect on the connection

Instruments
• oscilloscope and MCM31 module.

THEORETICAL NOTIONS
Amplitude Shift Keying – ASK

In this form of modulation the sine carrier takes 2 amplitude values, determined by the binary data signal. Usually the modulator transmits the carrier when the data bit is "1", it completely removes it when the bit is "0" (fig 2.1). There are also ASK shapes called "multi-level", where the amplitude of the modulated signal takes more than 2 values.

The demodulation can be coherent or non-coherent. In the first case, more complex as concerns the circuits but more effective as against the noise effect, a product demodulator multiplies the ASK signal by the locally regenerated carrier. In the second case the envelope of the ASK signal is detected via diode. In both cases the detector is followed by a low pass filter, which removes the residual carrier components, and a threshold circuit which squares the data signal (fig 2.2).

The main factors characterizing the ASK are:
• it is mainly used for radiotelegraphy
• it requires not complex circuits
• it is much sensible to disturbances (high possibility of error)
• called $F_b$ the bit transmission speed, the minimum spectrum $B_w$ of the modulated signal is higher than $F_b$
• the efficiency of transmission, defined as the ratio between $F_b$ and $B_w$, is lower than 1
• the Baud, defined as the modulation or symbol speed, is equal to the transmission speed $F_b$.

Fig 2.1: ASK Modulation
**ASK Modulator**

The block diagram of the ASK modulator is shown in fig 2.3. The sine carrier (1200 or 1800 Hz) is applied to an input of the balanced modulator 1; a data signal (indicated with I) is connected to the other circuit. The circuit usually carries out the balanced modulator function, and multiplies the two signals applied across the inputs. Unbalancing, though, the circuit with switch SW6 (in position ASK/FSK), it operates as amplitude modulator generating in this way the ASK signal of fig 2.1. The last, then, enters the adder used for FSK/QPSK/QAM modulations, and exits via a separator stage. The 6dB attenuator cuts the signal amplitude into half, and is activated only with the QAM. To block the operation of the balanced modulator 2 in ASK mode, the data input of the same modulator must be set on ASK (J3=d).
ASK Demodulator

The ASK demodulator consists of the sections represented in fig 2.4:
· a full wave envelope detector (ASK DEM)
· a low pass filter
· a threshold circuit (with output across TP29) in case of asynchronous data, which are not re-timed
· a clock extraction and data re-timing circuit, in case of synchronous data (data output on TP31, clock on TP32).

The filter, the clock extraction circuit and the data re-timing one are used to demodulate also other kind of signals.

![Fig 2.4: ASK Demodulator](image)
EXPERIMENT PROCEDURE

Disconnect all jumpers
MCM31 - Set all switches S "OFF"

Wave-forms of the ASK Modulator

- Power the module
- Set the circuit in ASK mode, with 24-bit data source and without data coding (connect J1c-J3d-J4-J5-J6a; set SW2=Normal, SW3=24_bit, SW4=1200, SW6=ASK, SW8=BIT, ATT=min, NOISE=min)
- Set an alternated data sequence 00/11 and push START
- Connect the oscilloscope to TP6 and TP16 to display the data signal and the ASK signal.
- Adjust the phase of the carrier (PHASE) to make the zero of the sine wave correspond to the starting of the bit intervals
- Use the 1800Hz frequency as carrier (set SW4=1800)

Q1 What can you detect?

Wave-forms of the ASK demodulator

- Keep the last conditions (J1c-J3d-J4-J5-J6a; SW2=Normal, SW3=24_bit, SW4=1200, SW6=ASK, SW8=BIT, ATT=min, NOISE=min)
- Set an alternated data sequence 00/11 and push START
- Connect the oscilloscope to TP16 and TP20, to examine the ASK signal before and after the communication channel
- Note the effect of the communication channel on the ASK signal. As the communication channel is limited band (the frequency response is low pass), the ASK output signal is slightly beveled. The effect is the more evident if a 1800-Hz carrier is used (switch SW4). Take SW4 to the position 1200 again

Q2 What kind of signal can you detect across TP23?
- the signal supplied by the ASK demodulator is filtered by a low-pass filter, which removes the ASK carrier components. At the filter output (TP24, fig2.5) you get the detected data signal, which shape is affected by the amplitude of the ASK carrier (and so by the conditions of the communication channel).
- in asynchronous data transmission, i.e. when no clock regeneration and data re-timing is required, it is sufficient to square the signal supplied by the filter. The output of the squarer (threshold circuit) can be detected across TP29. Note the correspondence between the transmitted (TP6) and the received data (TP29).
- introduce line attenuation (ATT), and see that the received data are not equal to the transmission data anymore. The noise insertion (NOISE) causes an alternation of the received data, too.

**Q3** *Why is the ASK much sensible to signal amplitude variations?*

- take the line attenuation and noise to the minimum
- **MCM31** Turn *ON* switch S13

**Q4** *The data across TP29 is not correct. Why?*

- **MCM31** Turn *OFF* switch S13
Fig 2.5: Waveforms ASK