PRACTICAL WORK Nr. 1
BPSK, DPSK, NONCOHERENT DPSK GENERATION AND DEMODULATION

I. BPSK Modulator / Demodulator

I. 1. Built the BPSK modulator. Use the followin blocks

- a random number generator –"*Sources*"/"*Uniform Random Number*";
- sign detector –"*Math*"/ "*Sign*";
- sample circuit - "*Nonlinear*"/ "*Zero Order Hold*"
- local oscillator –"*Sources*" / "*Sine Wave*";
- multiplier –"*Math*"/ "*Product*";
- scope –"*Sinks*" / "*Scope*";
- spectrum analyzer –"*Blockset&Toolboxes*"/"*DSP Blockset*"/"*DSP Sinks*"/ "*Spectrum Scope*".

Connect them as shown in Fig 1.1

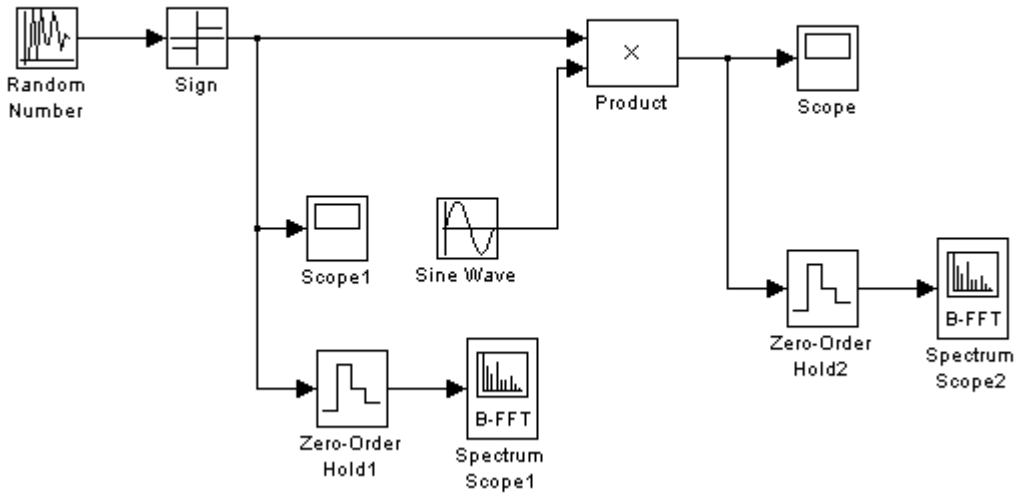

Fig. 1.1. Modulatorul BPSK

Set simulation time 10s, *Max Step Size*=0,01, *Minimum step size =auto*, *Initial Step Size* = 0,01. For the random data generator choose zero mean and variance 1, the sample time is 1 s and for the sinewave generator choose the frequency 2 Hz for time domani representation. The sample time before the Fourieer Transform has to be the same with the maximum sample time (*Sample Time*=0.01). For the spectrum scope block use the settings

- *Buffer Size*: 512 ;
- *FFT Length*: 512.

a) Vizualize the information signal and the modulated one in time domain E1.1.

I.2. Built the carrier recovery scheme from Fig 1.2. The blocks are :

- from "*Nonlinear*" – "*Saturation*"; limits 0, -1;
- from"*Math*" – "*Product*" or "*Square*";
- from "*Blockset and Toolboxes*" / "*DSP Blockset*" / "*Filtering*" / "*Filter Designs*" – "*Analog Filter Design*";
- from "*Math*" – blocul "*Gain*";
- from "*Blockset and Toolboxes*" / "*Simulink Extras*" / "*Flip Flops*" – "*J K Flip Flop*";
- from "*Signals & Systems*" "*Multiplexer*"

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For the 1st Butterworth filter the order is n_1=10, the lower frequency limit is $f_{L1} = 2(1\text{-}0{,}1)f_0$, the upper one is $f_{H1} = 2(1+0{,}1)f_0$, and for the second filter the order is n_2=10, the upper frequency limit is $f_{L2} = (1\text{-}0{,}1)f_0$ and the lower frequency limit is $f_{H2} = (1+0{,}1)f_0$, where f_0 is the carrier frequency set at the modulator (in our case 10Hz)

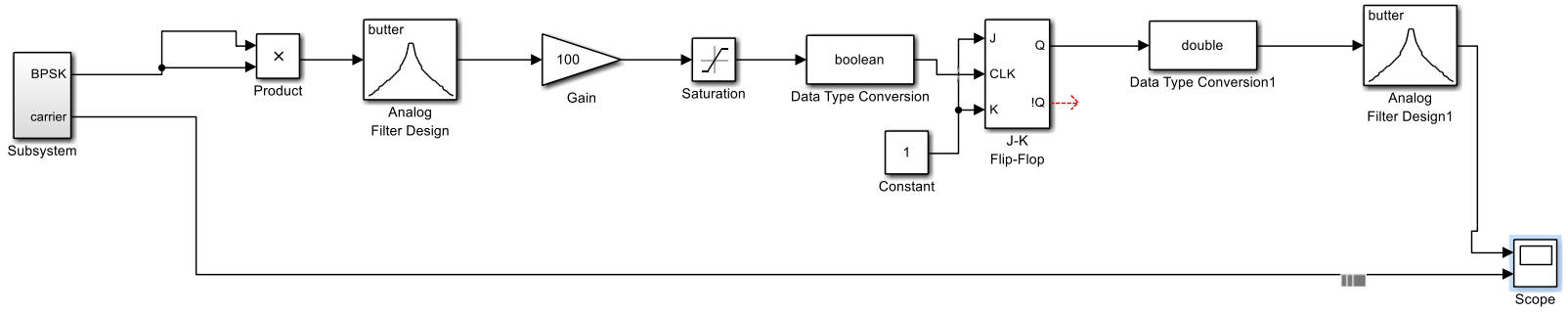

Fig. 1.2. Carrier recovery diagram

a) Visualize the signals in points (1), (2), (3), (4), (5) şi (6). What type of signals are and what is the period of each of them. Visualize their spectra. Comment the results.

I. 3. Built the BPSK demodulator as shown in Fig 1.3. the block *REF_PURT* includes the carrier recovery subsystem (option *Edit / Create subsystem*), input *In* being before the squaring block and the output *Out* after the second bandpass filter.

The cut-off frequency of the low-pass filter is around half of the carrier frequency, si around 5-10 Hz.

1. Visualise the signal in time domain and draw their corresponding spectra for points (7) and (8). Compare the original data with the recovered ones.

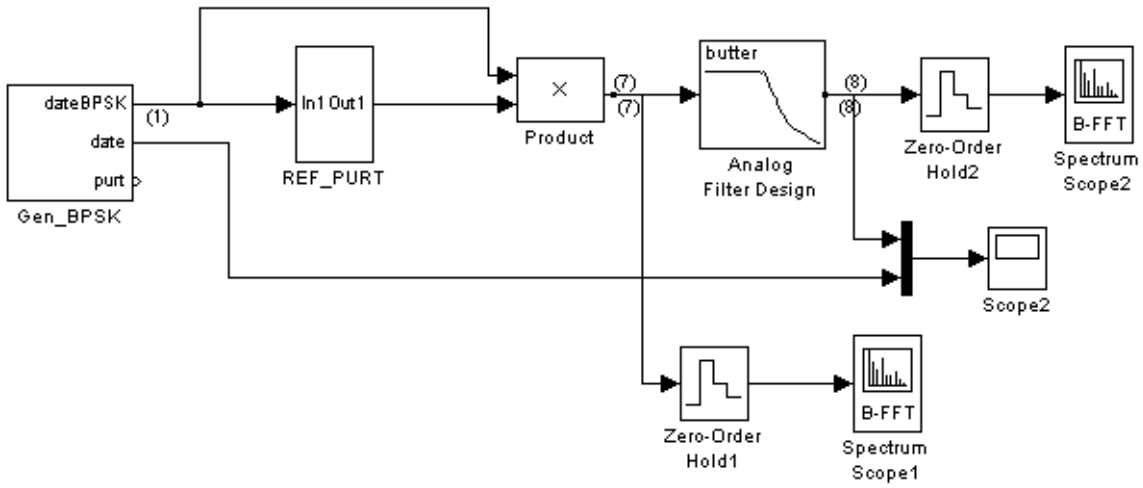

Fig. 1.3. Demodulatorul BPSK