QPSK - DEMODULATION

modules

basic: ***for the transmitter***: ADDER, 2 x MULTIPLIER, SEQUENCE GENERATOR

basic: ***single channel recovery*** MULTIPLIER, PHASE SHIFTER, TUNEABLE LPF

optional basic: ***two channel recovery*** MULTIPLIER, PHASE SHIFTER, TUNEABLE LPF

preparation

It is necessary that the Lab Sheet entitled ***QPSK - generation***, which describes the generation of a quadrature phase shift keyed (QPSK) signal, has already been completed. That generator is required for *this* experiment, as it provides an input to a QPSK demodulator.

A QPSK demodulator is depicted in block diagram form in Figure 1.

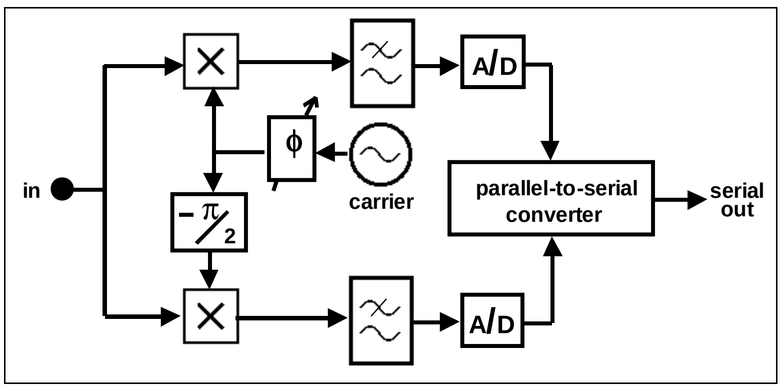

Figure 1: a QPSK demodulator.

This demodulator assumes the original message data stream was split into two streams, A and B, at the transmitter, with each converted to a PSK signal. The two PSK signals were then added, their carriers being in phase quadrature.

The demodulator consists of two PSK demodulators, whose outputs, after analog-to-digital (A/D) conversion, are combined in a parallel-to-serial converter. This converter performs the recombination of the two channels to the original single serial stream. It can only do this if the carriers at the demodulator are synchronous, and correctly phased, with respect to those at the transmitter.

In this experiment only the principle of recovering the A and B channels from the QPSK signal is demonstrated. So neither the A/D nor the parallel-to-serial converter will be required.

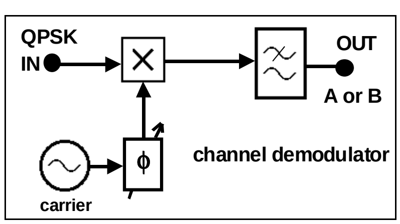

Figure 2

Since you will be recovering these signals separately only one half of the demodulator need be constructed.

Such a simplified demodulator is shown in the block diagram of Figure 2. You will model this structure. Appropriate adjustment of the PHASE SHIFTER will recover either the A or the B message.

experiment

transmitter

Set up the transmitter according to the plan adopted in the Lab Sheet entitled ***QPSK - generation***. There should be *short* sequences from the SEQUENCE GENERATOR. Trigger the oscilloscope with the SYNCH output from the SEQUENCE GENERATOR and observe, say, the '**A**' message on CH1-A.

receiver

A model of the block diagram of Figure 2 is shown in Figure 3.

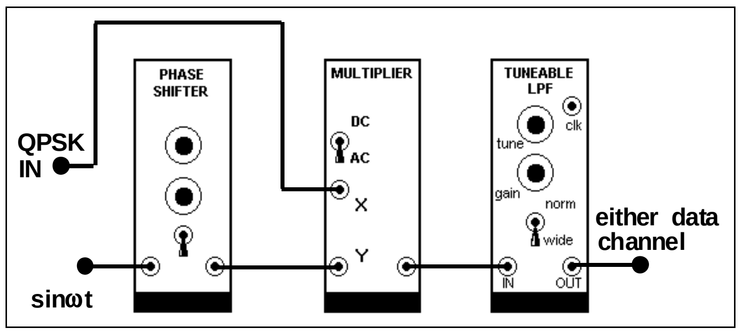

Figure 3: model of a channel demodulator

Before plugging in the PHASE SHIFTER, set it to its HI range with the on-board switch.

The 100 kHz carrier sinωt comes from MASTER SIGNALS. This is a 'stolen' carrier. In commercial practice the carrier information must be derived directly from the received signal. The parallel-to-serial converter can be used to aid in this process.

The TUNEABLE LPF can be set to its widest bandwidth. Observe the output from this filter with the oscilloscope on CH2-A. Since sequence '**A**' is already displayed on CH1-A, a comparison can be made. There is unlikely to be any similarity - yet.

Now slowly rotate the coarse control of the PHASE SHIFTER. The two waveforms should slowly come into agreement. If there is a polarity reversal, then flip the 180^0 front panel switch of the PHASE SHIFTER.

Note that the phase adjustment is not used to *maximise* the amplitude of the wanted waveform but to *minimize* that of the other - unwanted - one. Provided the phasing at the transmitter is anywhere near quadrature this minimization can *always* be achieved. The magnitude of the wanted waveform will be the maximum possible when true quadrature phasing is achieved at the transmitter. An error of 45^0 results (after accurate adjustment at the receiver) in a degradation of 3dB. This is a signal-to-noise degradation; the noise level is not affected by the carrier phasing.

In later Lab Sheets it will be shown how the received and transmitted sequences can be compared electronically, to give a quantitative assessment, rather than by eye (qualitatively), as here. The modulated signals will be transmitted via noisy, bandlimited channels. Noise will be added, and errors counted.

The addition of differential line encoding and decoding would overcome the possibly ambiguous polarity reversal.

