BPSK - DEMODULATION

modules

basic: MULTIPLIER, PHASE SHIFTER, TUNEABLE LPF
optional advanced: LINE-CODE DECODER
for the received signal: see the Lab Sheet entitled ***BPSK** - generation*.
  basic: MULTIPLIER, SEQUENCE GENERATOR
  optional basic: TUNEABLE LPF
  optional advanced: LINE-CODE ENCODER, 100kHz CHANNEL FILTERS

preparation

Demodulation of a BPSK signal can be considered a two-stage process.

1. translation back to baseband, with recovery of the bandlimited message waveform
2. regeneration from the bandlimited waveform back to the binary message bit stream.

Only the first of these will be demonstrated in this experiment. The second stage is examined in the Lab Sheet entitled ***DPSK - carrier acquisition and BER***.

In this experiment translation back to baseband is achieved with a 'stolen' local synchronous carrier.

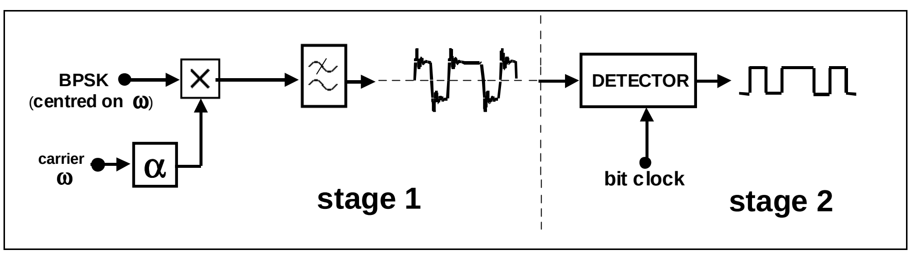

Figure 1: synchronous demodulation of BPSK

The translation process does not reproduce the original binary sequence, but a bandlimited version of it. In this experiment the received data will be compared qualitatively (oscilloscope inspection of a short sequence) with that sent. Notice that a 180^0 phase reversal of the local carrier will invert the received data.

phase ambiguity

Phase ambiguity must be resolved in the demodulation of a BPSK signal.

There are techniques available to overcome this. One such sends a training sequence, of known format, to enable the receiver to select the desired phase, following which the training sequence is replaced by the normal data (until synchronism is lost !).

An alternative technique is to use differential encoding, as in this experiment.

experiment

BPSK generator

For details see the Lab Sheet entitled ***BPSK - generation***. Use a short sequence from the SEQUENCE GENERATOR. This is because data integrity will be checked qualitatively by eye. Instrumentation, for a quantitative check, is included in the Lab Sheet entitled ***DPSK - carrier acquisition and BER***.

BPSK demodulator

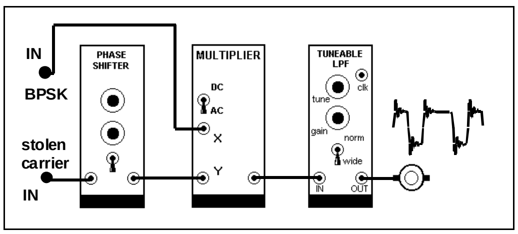

Figure 2

Figure 2 shows a model of Stage I of the demodulator of Figure 1.

Varying the phase of the stolen carrier through 360^0 will vary the amplitude of the recovered analog waveform; this includes two nulls, with polarity inversion on either side. This phase ambiguity needs to be resolved.

regeneration to TTL; assessment

As stated earlier, to 'clean up' the analog waveform from the demodulator output filter, TIMS can offer the DECISION MAKER module.

phase ambiguity

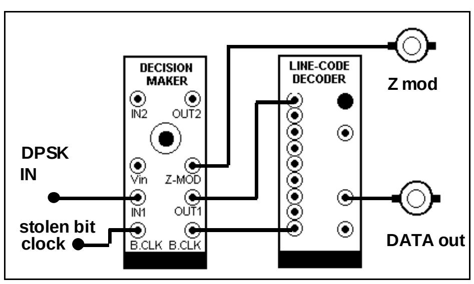

Figure 3

Phase ambiguity can be resolved with appropriate line codes. These can be introduced by a LINE-CODE ENCODER at the transmitter, and a LINE-CODE DECODER at the demodulator. The decoder module requires a regenerated waveform to operate reliably. A model of a suitable arrangement is shown in Figure 3.

Find the codes which are insensitive to phase reversals. Remember to re-set both modules after a code change.

In this experiment data integrity has been checked visually (qualitatively), using a short sequence. Instrumentation can also be modelled to confirm data integrity, and to quantify the errors when noise is present. See the Lab Sheet entitled ***DPSK - carrier acquisition and BER.***