COMMUNICATIONS LAB.: QPSK Modulation/Demodulation

OBJECTIVES

Understand the mechanism behind the detection of PSK/QAM signals.

INFORMATION

M-PSK and M-QAM are forms of representing symbols with carriers with different phases and carriers with different phases & amplitudes respectively. Although it is possible to generate these signals differently, it is more intuitive and trackable to generate them using I-Q look-up table followed by quadrature carrier modulation block, as shown in Fig. 1. Example table is for QPSK.

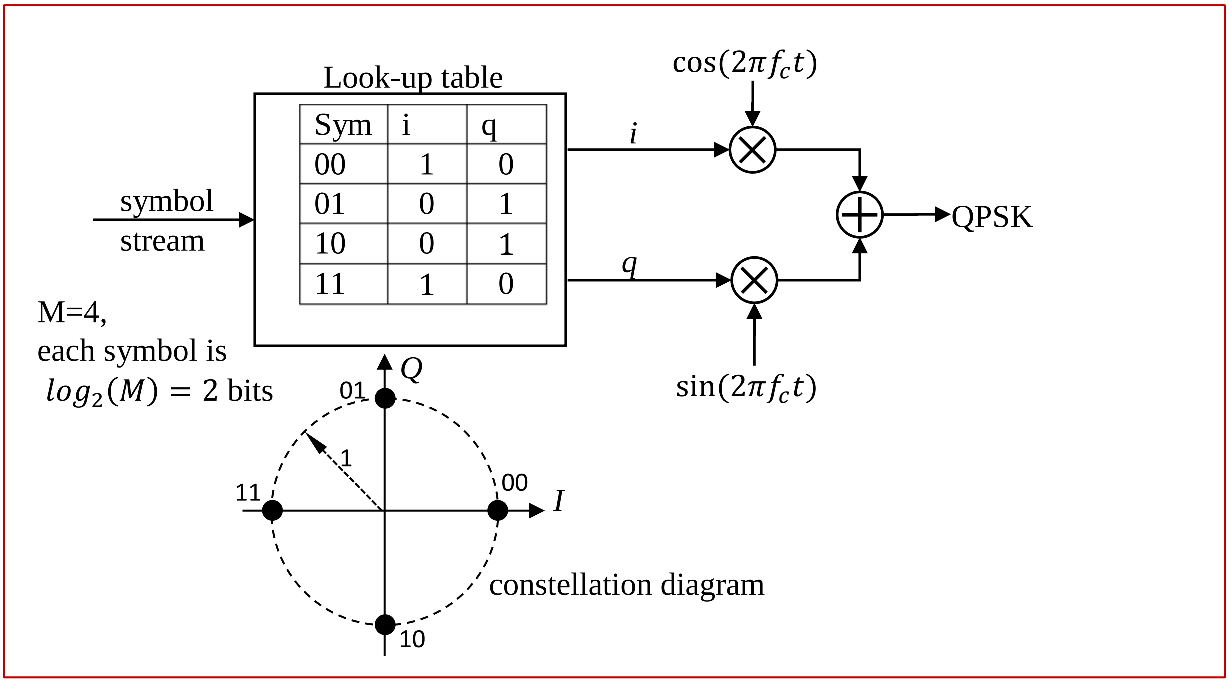

Figure 1 : Implementation of QPSK. All PSK and QAM signals can be generated with this approach.

The receiver/detector, for all *M*, consists of two correlators with quadrature carriers (cos and sin), so that correlator outputs at the decision instants are *i* and *q* coefficients (projections on *I* and *Q*). Decisions are made by finding the closest point from the same table and outputting the corresponding symbol (reverse look-up).

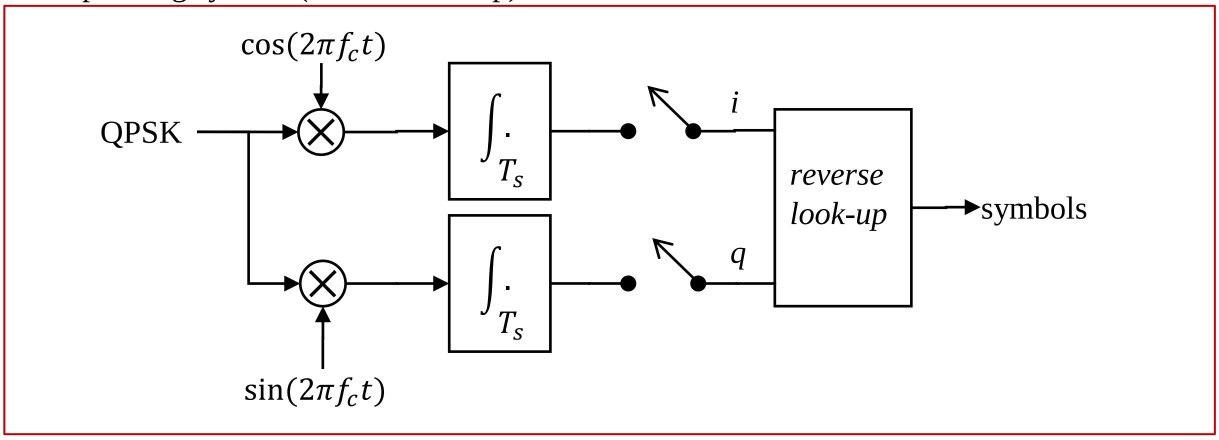

Figure 2 : General quadrature correlator receiver.

Note that, one still needs *sin* and *cos* carriers be synchronously generated at the receiver.

Experiment:

- **a)** Create the bitstream array $b(n) = [0\ 1\ 1\ 0\ 0\ 0\ 1\ 1\ b_3\ b_2\ b_1\ b_0\ c_3\ c_2\ c_1\ c_0]$ where b and c are bcd representations of last two digits in your student id. Expand the bit-stream by 100 by repeating each bit 100 times, so that when drawn it will look like a continuous graph of the bit stream.
- **b)** Generate arrays of $\cos(\ldots)$ and $\sin(\ldots)$ carriers with 16 periods within 1600 samples. (1 symbol ≡ 2 bits ≡ 200 samples ≡ 2 carrier periods).
  Keep in mind that, in practice, we usually have thousands of periods per symbol. Since it would be difficult to view such a high number of periods, we will only have 2 carrier periods per symbol here.
- **c)** Generate QPSK signal as described in Fig. 1. Draw the result.
- **d)** Implement the quadrature-correlator receiver. Draw the signals just after the multipliers and before the integrators and comment on them.
- **e)** Generate i and q components. Draw the constellation diagram for the received i and q.
- **f)** Add zero mean Gaussian noise to the signal generated in step (c). Draw the constellation diagram for noisy i and q again.