

# Chapter 8

## Phase Shift Keying

In this chapter, the PCI-5640R IF transceiver is used to implement a high-rate, packet-based digital modulator/demodulator (modem) using *phase shift keying* (PSK) symbol constellations.

### 8.1 Design Specifications

Your challenge is to maximize the spectral efficiency of an operating packet communication system using the PCI-5640R IF transceiver. Spectral efficiency is defined in the units of bits per second per Hertz. For a symbol period  $T$  and SRRC pulse with excess bandwidth parameter  $\alpha$ , the bandwidth is  $\frac{1+\alpha}{T}$  Hz. Thus, for a signal constellation of  $M$  points, the spectral efficiency is given by

$$\frac{\log_2 M \text{ bits}}{T \text{ sec}} \times \frac{T}{1+\alpha} \text{ Hz} = \frac{\log_2 M}{1+\alpha} \text{ b/s/Hz}. \quad (8.1)$$

You are asked to wirelessly transmit your packet over a distance not less than 1.5 meters. The bit error rate must not exceed  $10^{-2}$ .

### 8.2 Implementation

For your implementation, you should build on the BPSK receiver implemented in laboratory exercise #7. In addition, you will need to

1. Input ascii characters, convert to bits, and map bits to symbols.

2. Implement decision regions at the receiver.
3. Map bits back to ascii characters at the receiver.
4. Count bit errors (not ascii character errors) to report performance.

You are free to implement block codes for error correction, if you wish (e.g., [www.schifra.com](http://www.schifra.com)). If you do, then the spectral efficiency is reduced by the parity bits used in the block code. Note error correction coding is *not* required.

In your implementation, you are free to design any and all system parameters, subject to the system constraints. The IF transceiver imposes many of the constraints (such as list of possible `IQrate` selections). Design choices include: carrier frequency,  $f_c$ , symbol duration,  $T$ , upsampling factor  $P$ , `IQrate`, pulse shaping filter, PSK or QAM constellation, packet size, etc.

After you have a working modem, use the constellation diagram to visualize the effect of a mismatch between the carrier frequencies set at the transmitter and receiver.

### 8.3 Reporting

Each team of two students will demonstrate a working modem to the GTA.

For your laboratory report, document your design, with reasons given for your design choices. Present a table summarizing your design parameters. Report the results of your bit error tests; to measure bit error to  $10^{-d}$ , record results for at least  $100 \cdot 10^d$  bits. Include example screen shots of your received constellation. Finally, show the constellation for the frequency offset case. Include LabView or Matlab code in an appendix.