Laboratory 6: UART

Objectives

1. Understand the asynchronous serial communication
2. Understand how to use FPGA to interface with external devices

Background

One use of the FPGA is to interface with external devices that require precise timing. In this lab, we will be looking at serial communication (UART).

UART

Universal Asynchronous Receiver/transmitter or UART is a computer protocol that enables data transfer between two devices. UARTs are commonly used with the electrical layer standard such as TIA, RS-232, RS-422 or RS-485. The board you have in the lab has a UART port through the USB.

The minimal communication requirement by UART uses only two wires, TX and RX. Figure 1 shows a typical UART communication.

In order for a device to send the data out, both devices must use the same clock rate (baud), data bit size, parity and stop bits. http://www.unm.edu/~zbaker/ece238/slides/UART.pdf provides good details on the protocol.
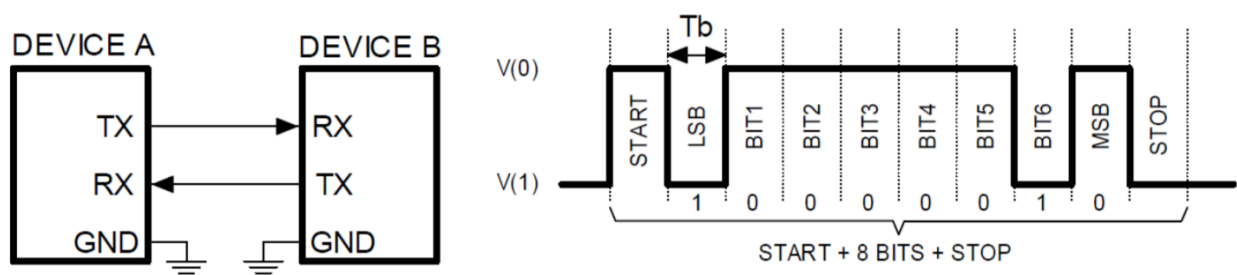

Figure 1 UART communication

In order to communicate with the UART on the Basys 3 board, you will need to install some serial communication software such as Putty, Tera Term, etc. You can also find more information about the USB-UART Bridge on the Basys 3 in the reference manual.

Exercises

1. You will implement a simple state machine that receives UART inputs, returns the character to the UART as well as displays that character to a 7-segment display.

   To display a character, please implement the 7-segment font as attempted by Siekoo Alphabet. (See the figure below.)

   You may choose any baud rate you would like to use. I recommend testing with 9600bps or 115200bps. You may also want to test the loopback, i.e. wiring TX and RX together.

Note: You might need terminal software to connect your computer to BASYS3. On Linux (and Mac OS X), try minicom or screen. On Windows, try RealTerm[7], TerraTerm, or PuTTY.

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[7]   https://sourceforge.net/projects/realterm/