

2.996/6.971 Biomedical Devices Design Laboratory Lab Project Description

Distributed: Sept 5, 2007

Introduction

The laboratory component of 2.996/6.971 is designed to introduce you to the process of creating a printed circuit board (PCB) based on a conceptual design. The design that you will implement in this lab will be a multipurpose data acquisition system with a microprocessor, USB connectivity, and wireless connectivity. This type of circuit is often found at the core of sensor systems and can be adapted for use in many different projects.

This lab will require approximately half of the semester to complete and has the following components:

Lab 1 – Design custom blocks for your circuit

Lab 2 – Learn to use PCB Artist, create schematic diagrams and library files for your design

Lab 3 – Layout the PCB

Lab 4 – Solder, test, and debug your PCB

Lab 5 – Microprocessor programming

Lab 6 – PC user interface design (optional)

Note: It is imperative that you complete each lab carefully as the product of one lab is used in the next lab.

The circuit of your PCB consists of a standard block and a custom block as shown in Figure 1. The design of the standard block will be given, while the custom block will be designed by you. If this is your first time working with circuits, however, please use the reference design provided for the custom block.

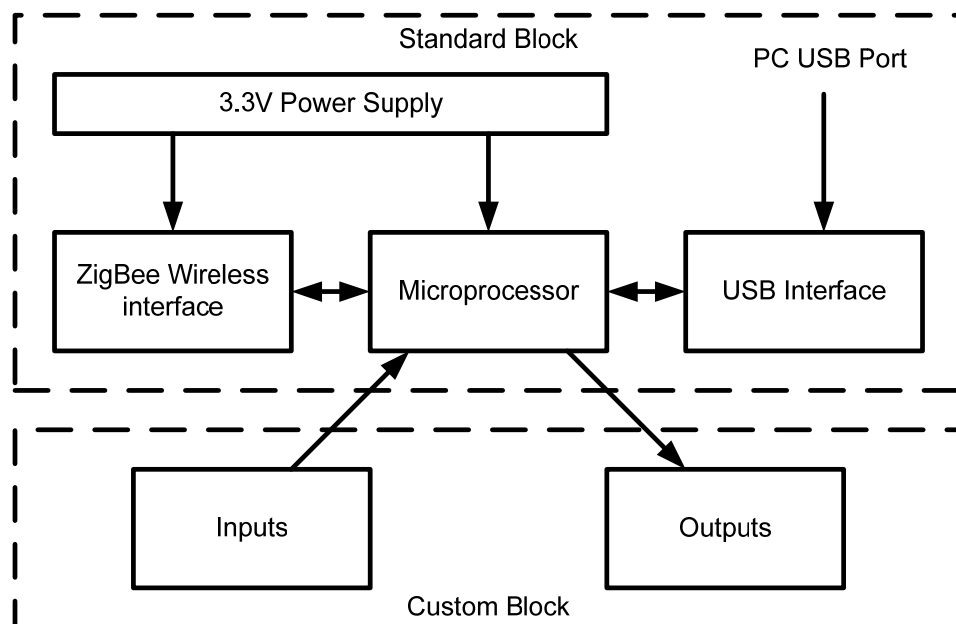


Figure 1: Conceptual blocks of the PCB that you will create

The schematic of the standard block is shown in Figure 2. If this schematic seems complicated at first, don't panic! You will come to understand the different connections with time. Remember some nets (a net is another name for a node) are connected by virtue of having the same name, even if there is no physical line between them. Below is a table of the main components and their functions. Download the datasheets from the manufacturers to get a sense of how to use these components are used.

#	Part Number	Manufacturer	Function
U4	MSP430F2274	Texas Instruments	16-bit low power microprocessor
U5	FT232RL	FTDI	Serial-USB interface
U1	XBee	Maxstream	2.4 GHz ZigBee radio module
U3	CSTCE	Murata	16 MHz crystal oscillator
D1	SSA34	Vishay	Reverse supply voltage protection diode
U7	LM1117	National	3.3V regulator
U2	SN74LVC1G3157	Texas Instruments	Analog switch for multiplexing the XBee and USB

Other things of note:

- R20 and R29 are an optional connection between the XBee and the USB chip that bypasses the microprocessor. This connection turns this PCB into a wireless transceiver for a PC. This connection cannot be active at the same time as R9, R10, R11, and R12. A simplified connection diagram is shown in Figure 3.
- J2 and J3 are breakout connectors for the pins on the microprocessor. These connectors are extremely useful for modifying the circuit without having to remake the PCB.
- U6 is a plastic holder for a 9V battery
- PL1 is the plug for an external power supply. Note, this is not done correctly since if the external power is connected while the battery is still connected, the external power will improperly charge the battery.
- R27 and C34 are a low pass filter for determining radio signal strength
- The USB chip is powered directly from the USB bus. It is off when not connected
- The MSP430F2274 microprocessor is programmed and debugged using a 2-wire JTAG (spy-bi-wire) protocol using J17.
- The MSP430F2274 microprocessor also contains a bootloader which allows the microprocessor to be programmed directly over a serial port via the USB or wirelessly via the XBee radio. Resistors R19 through R26 are used to access the bootloader. Zero ohm Resistors R21 through R24 allows the Tx and Rx to the bootloader to be changed later due to an ambiguity in the TI datasheet. The software PC interface of the bootloader is being written, please let course staff know if you want to help with this effort.

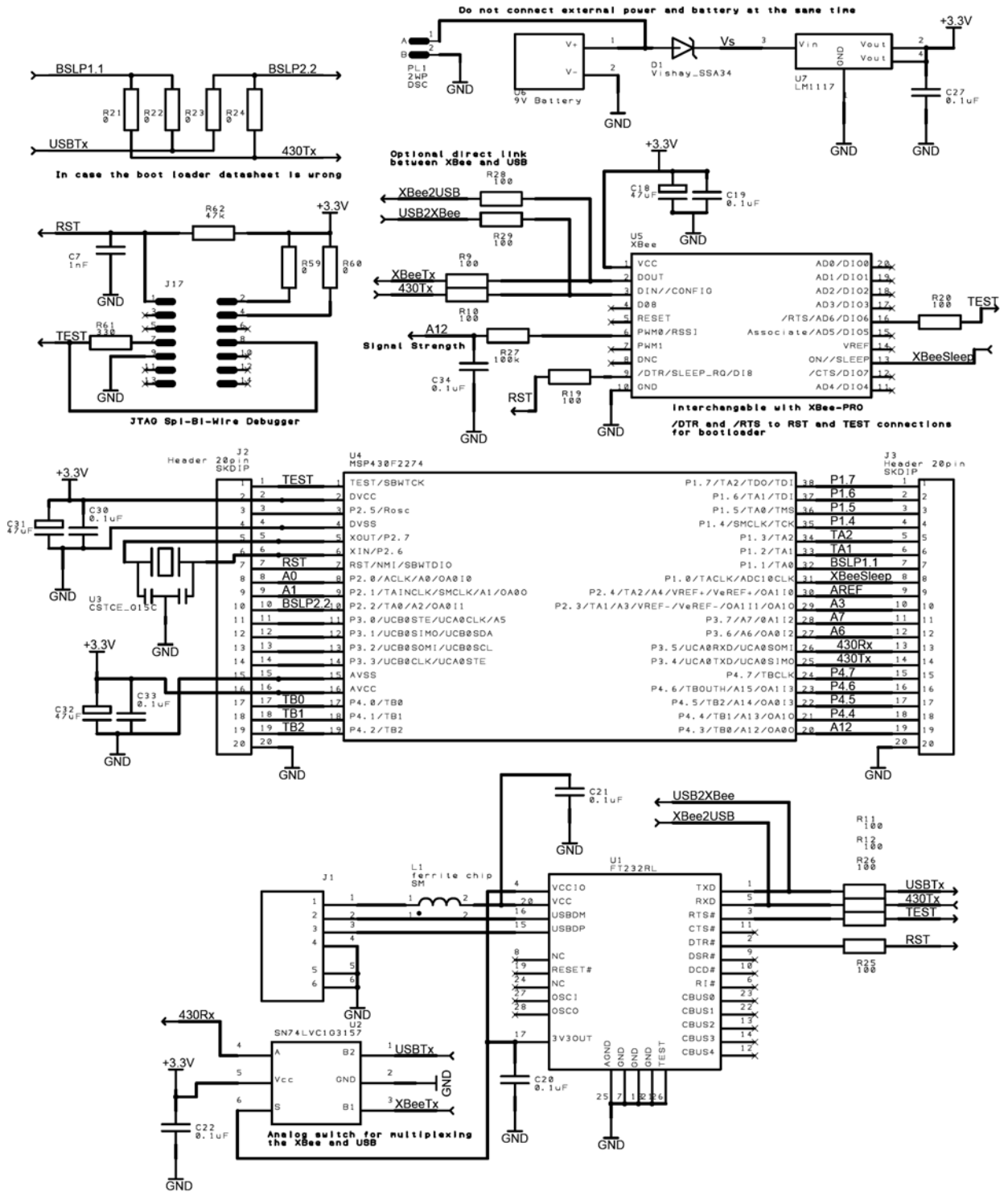


Figure 2: Schematic of the standard block

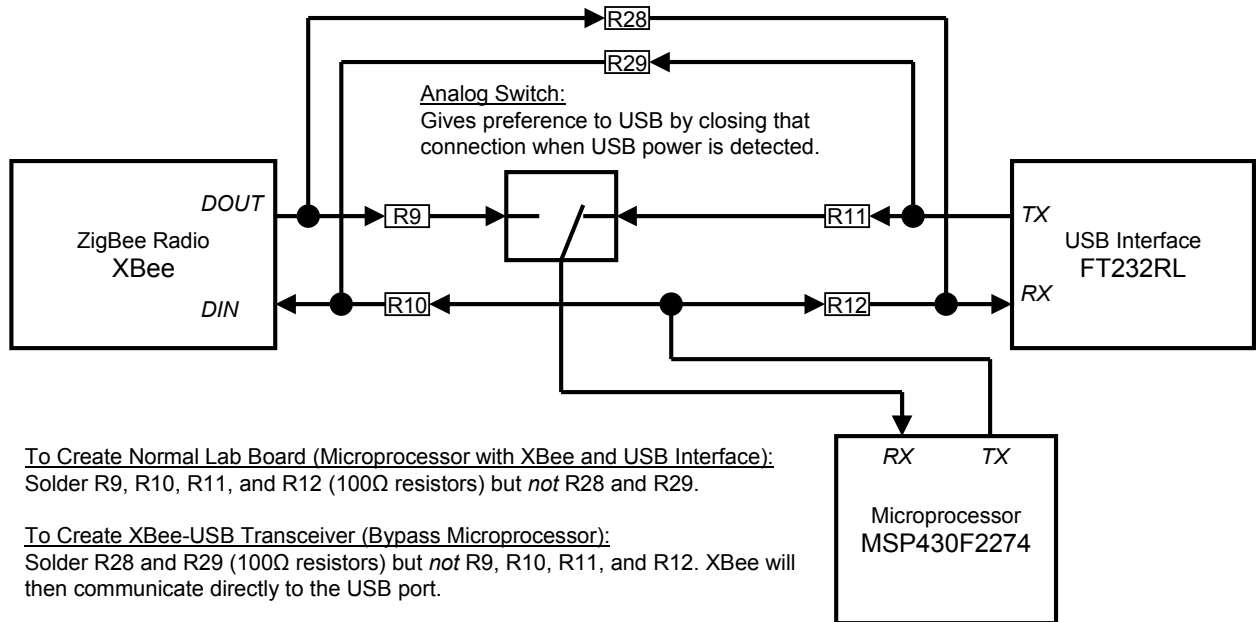


Figure 3: Simplified connection diagram between chips