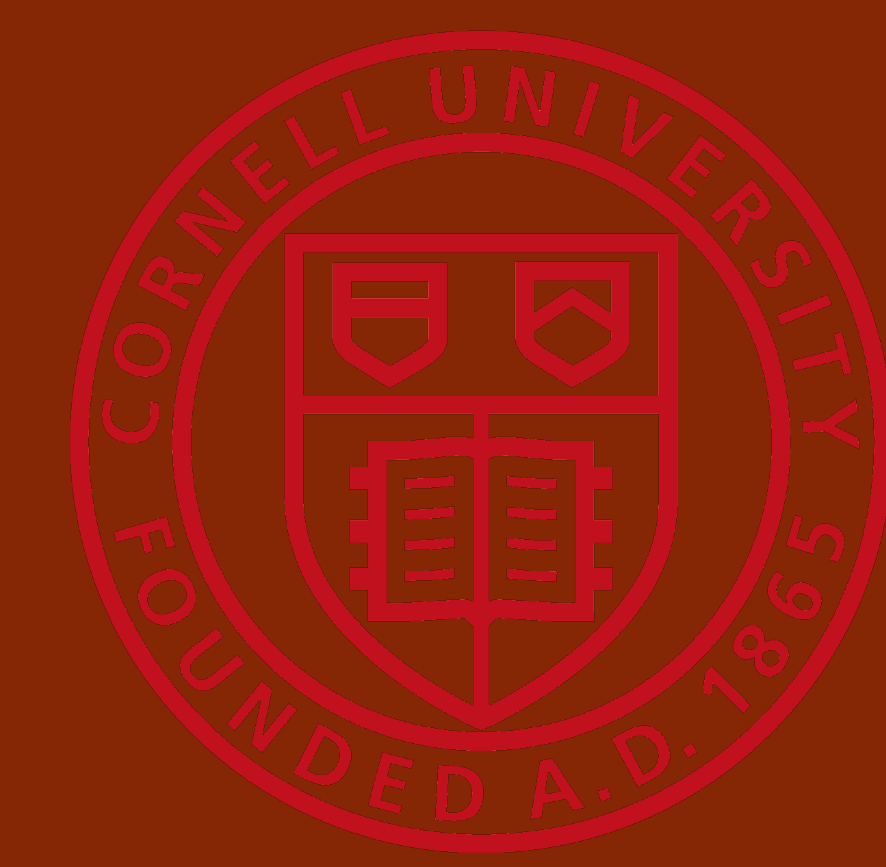


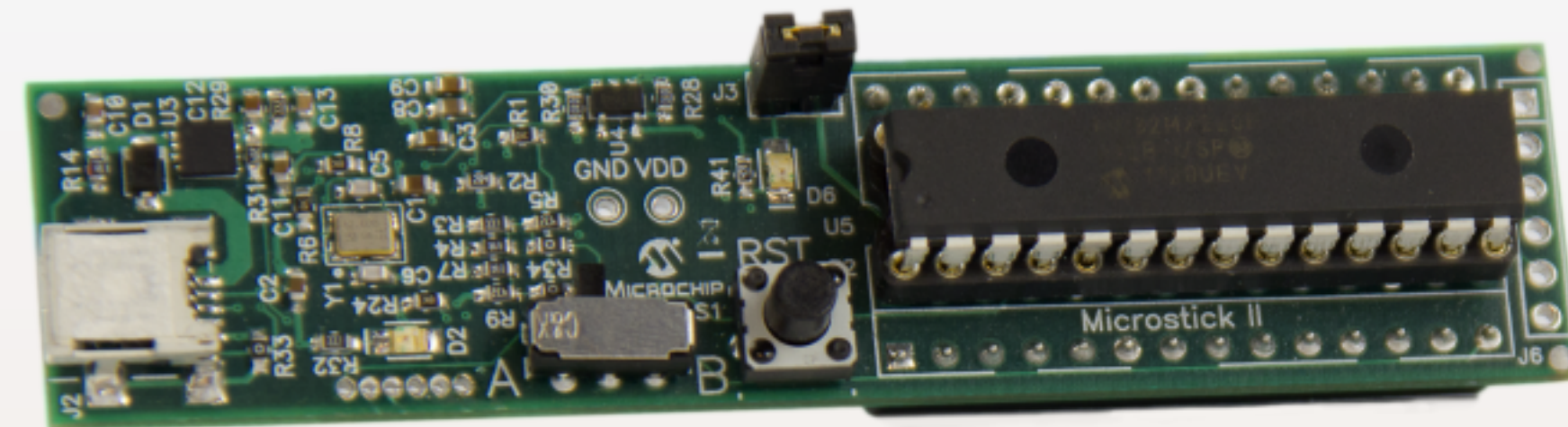
# PIC32 DEVELOPMENT

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## What is PIC32



Microstick II

PIC32 microcontroller is a powerful, 32-bit CPU with many peripherals and available libraries. PIC32 is Microchip's 32-bit microcontroller. It offers high performance and all tools to develop embedded projects.

Microstick II is used in this project. Microstick II delivers a complete development hardware platform for Microchip's 16-bit and 32-bit microcontrollers and digital signal controllers.

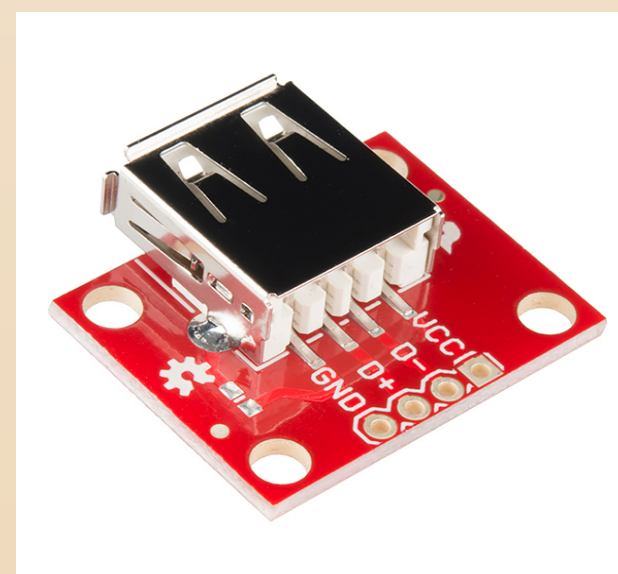
## Introduction

This project mainly focuses on the development of USB module of PIC32, enabling the USB port to transfer data between end devices (mouse and keyboard) and the microcontroller PIC32MX250F128B.

Both software code and hardware verification are necessary for the project. Certain data transfer functions are realized. When a device such as a keyboard or a mouse plug in to the USB interface of PIC32, PIC32 should be able to get every letter we type on a keyboard or get every input command we click on a mouse

The final outcome is a finished working USB module and can be used by students in Course ECE4760 to incorporate into their course work directly.

## Materials



USB Type A Female Breakout Board

As this project is to enable USB interface data transfer, a USB board is necessary. There are a variety of USB boards on market. For this designing project, USB Type A Female Breakout board is used. It has a USB interface requiring 2 power wires (VCC, GND) and 2 data wires (D+ and D-).



USB to Serial Breakout - CP2102

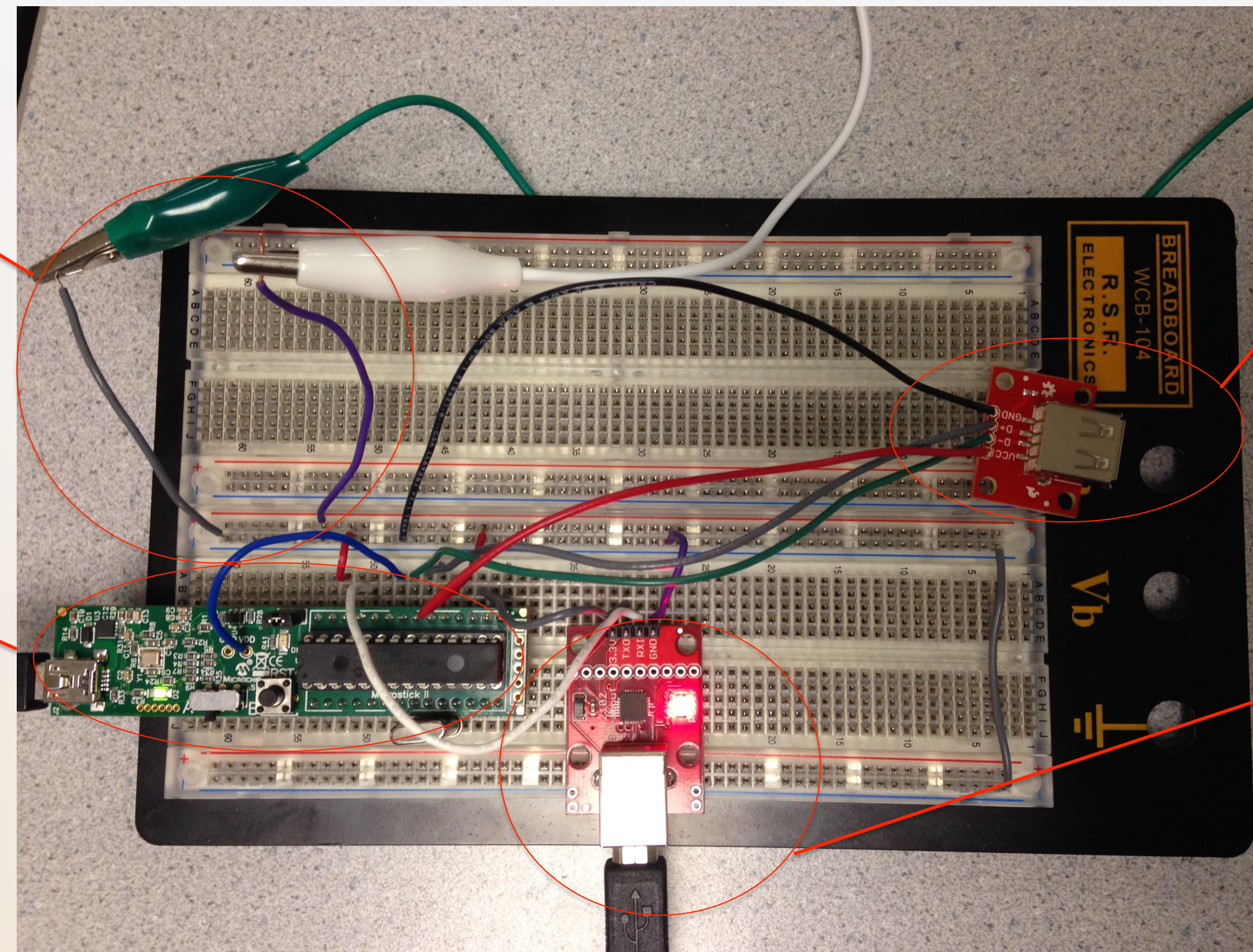
This is a great little tool for embedded systems that require a serial connection to a computer. The board can simply attach to a USB bus via a standard type B female connector and will appear as a standard COM port.

## Implementation

### Development board

External power 5v for USB port

Microstick II Featuring microcontroller PIC32MX250F128B



USB port Used to connect to end devices

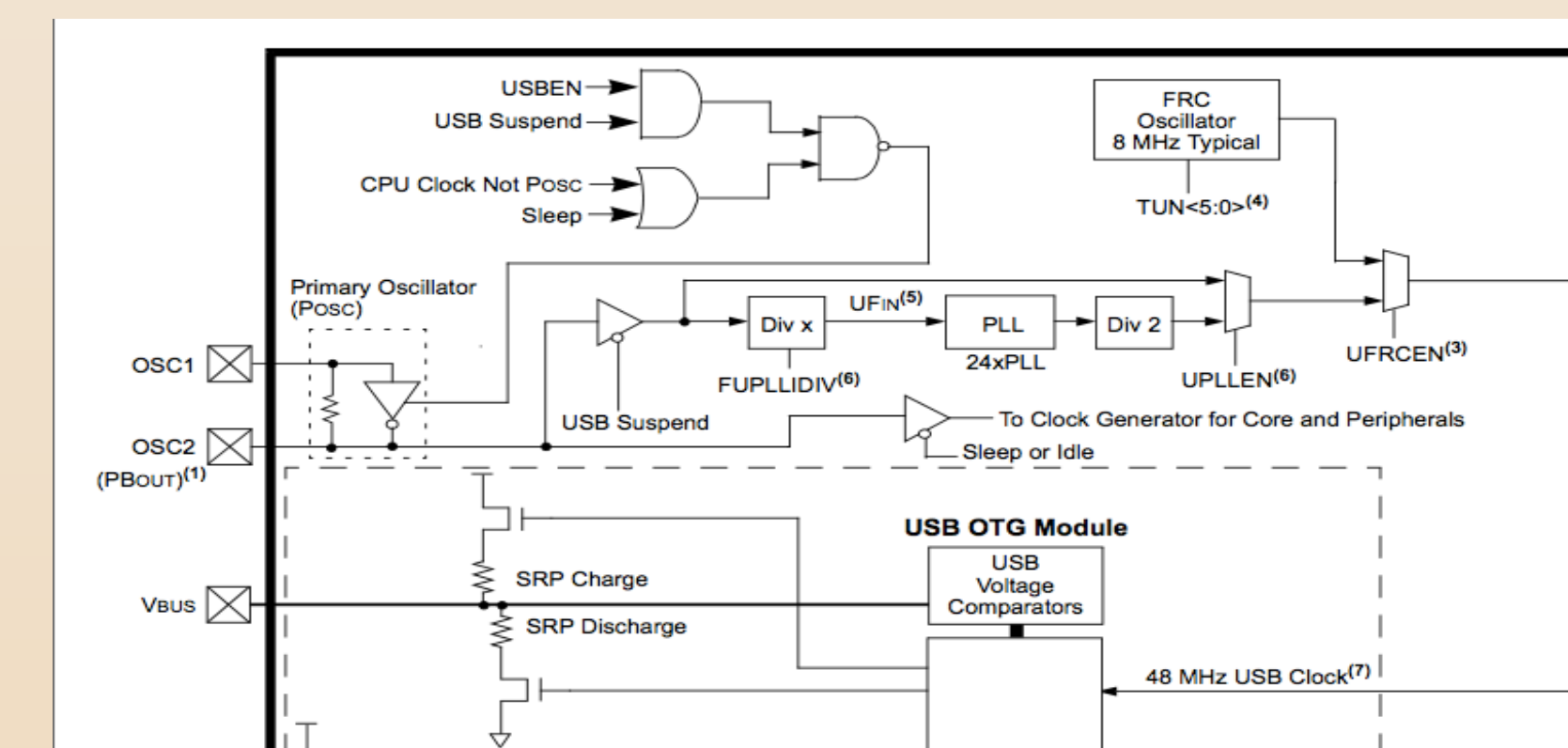
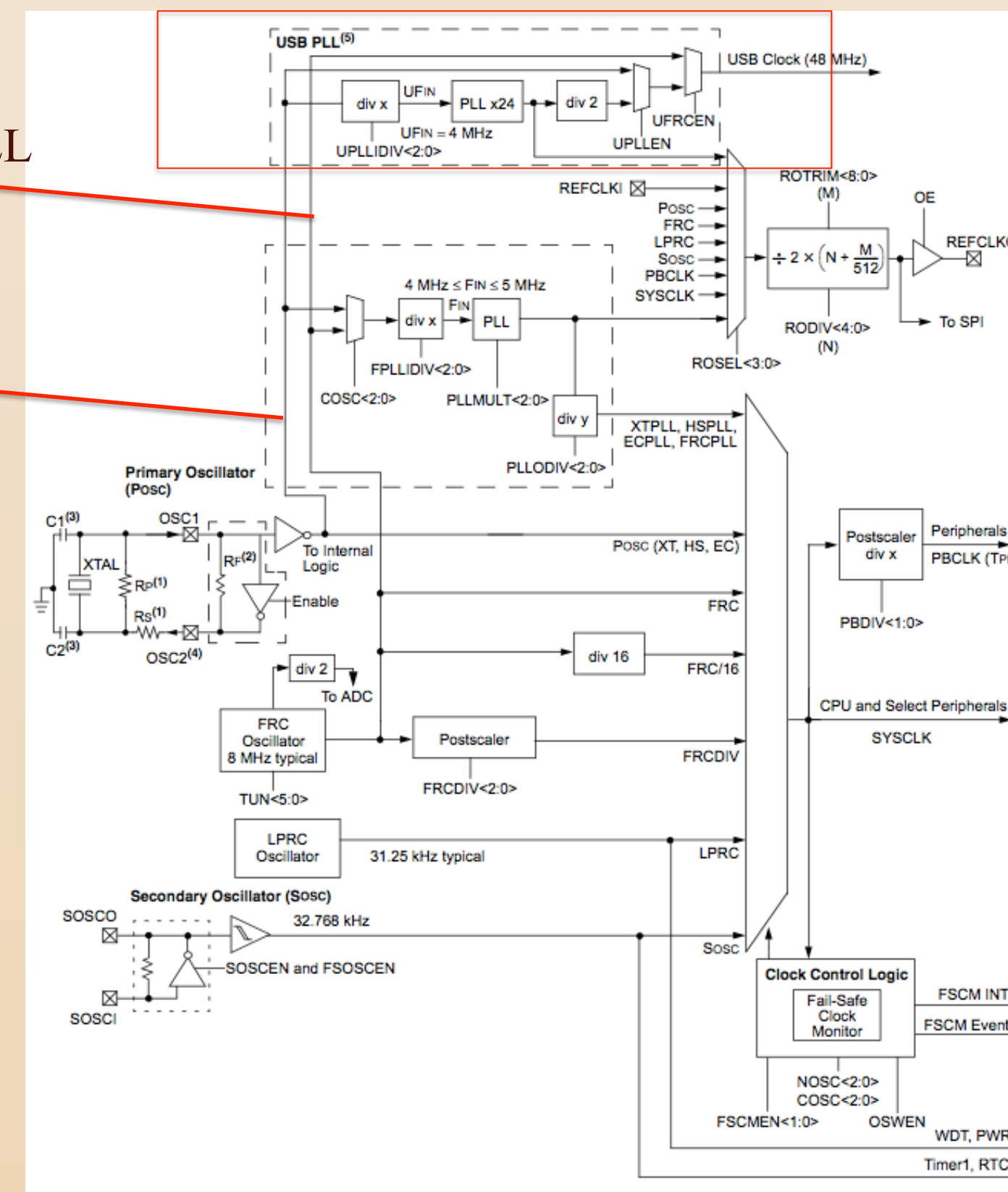
Serial port Connect to a computer to show results

A power supply of 3.3V should give to the Vusb3.3v pin to enable USB function of PIC32. Then the external USB board should be connected to the microcontroller correctly. The data wires (D+, D-) should be connected to PIN 18, PIN 19 of PIC32MX250F128B and the power supply wires (VCC, GND) should be connected to the board to share the same ground power with the microcontroller. 5v power is needed for USB board to operate properly. Since Microstick only provide 3v power, an external power is used. Configure 2 pins on microstick to communicate with the serial port.

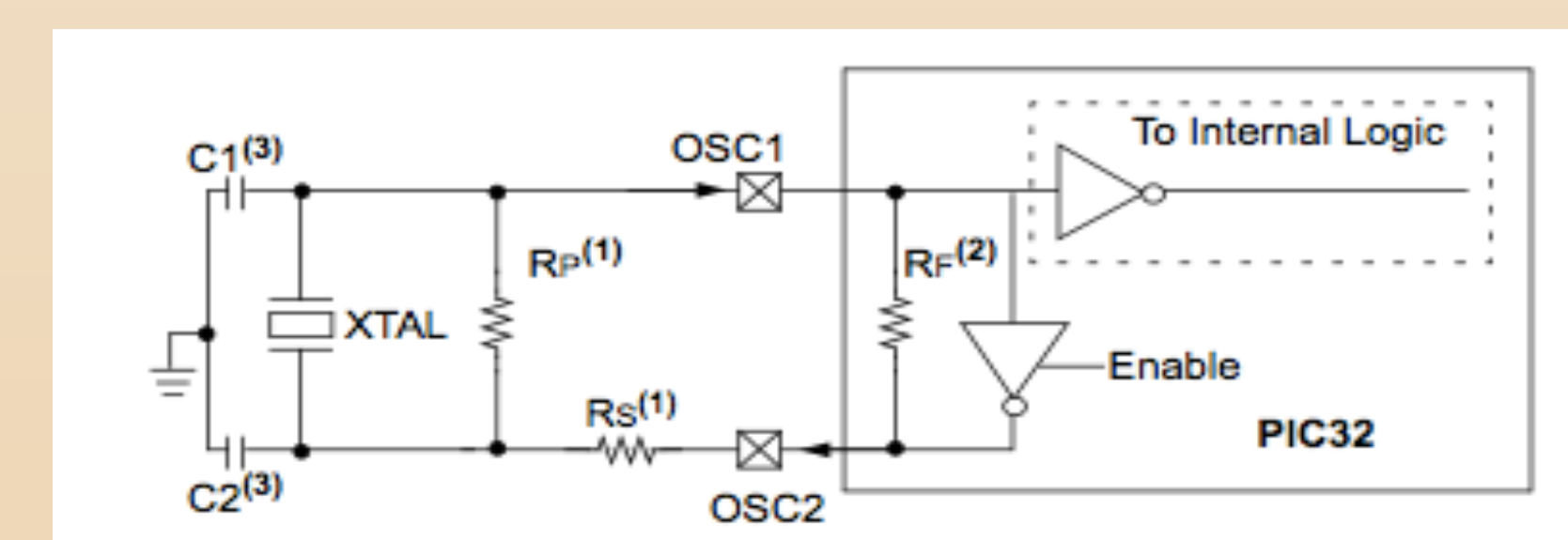
### Oscillator diagram

Internal Oscillator-FRC Feed into USB without PLL

External Oscillator Feed into USB with PLL



PIC32 USB OTG Interface Diagram (Clock Part)

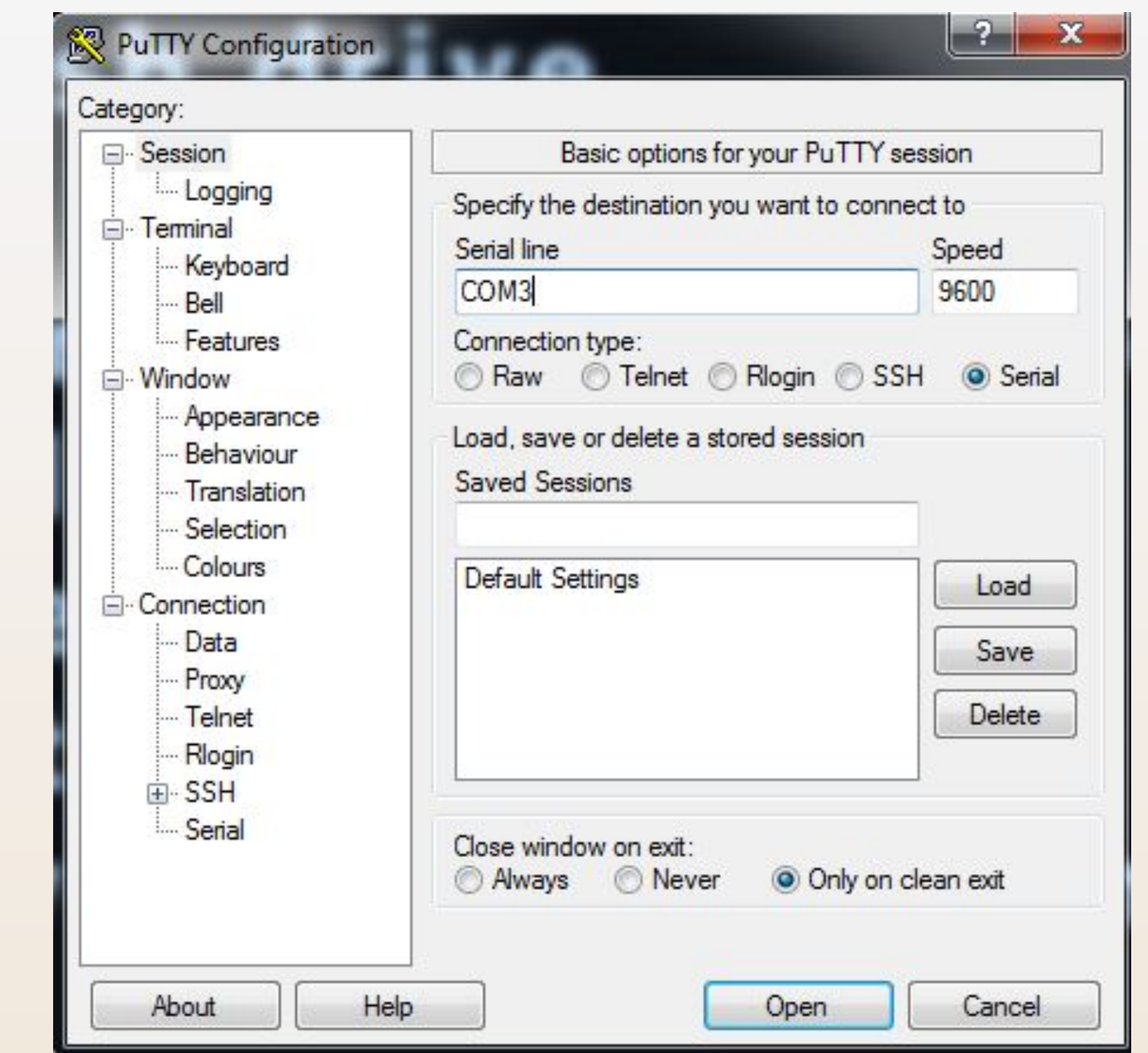


The configuration circuit of primary oscillator

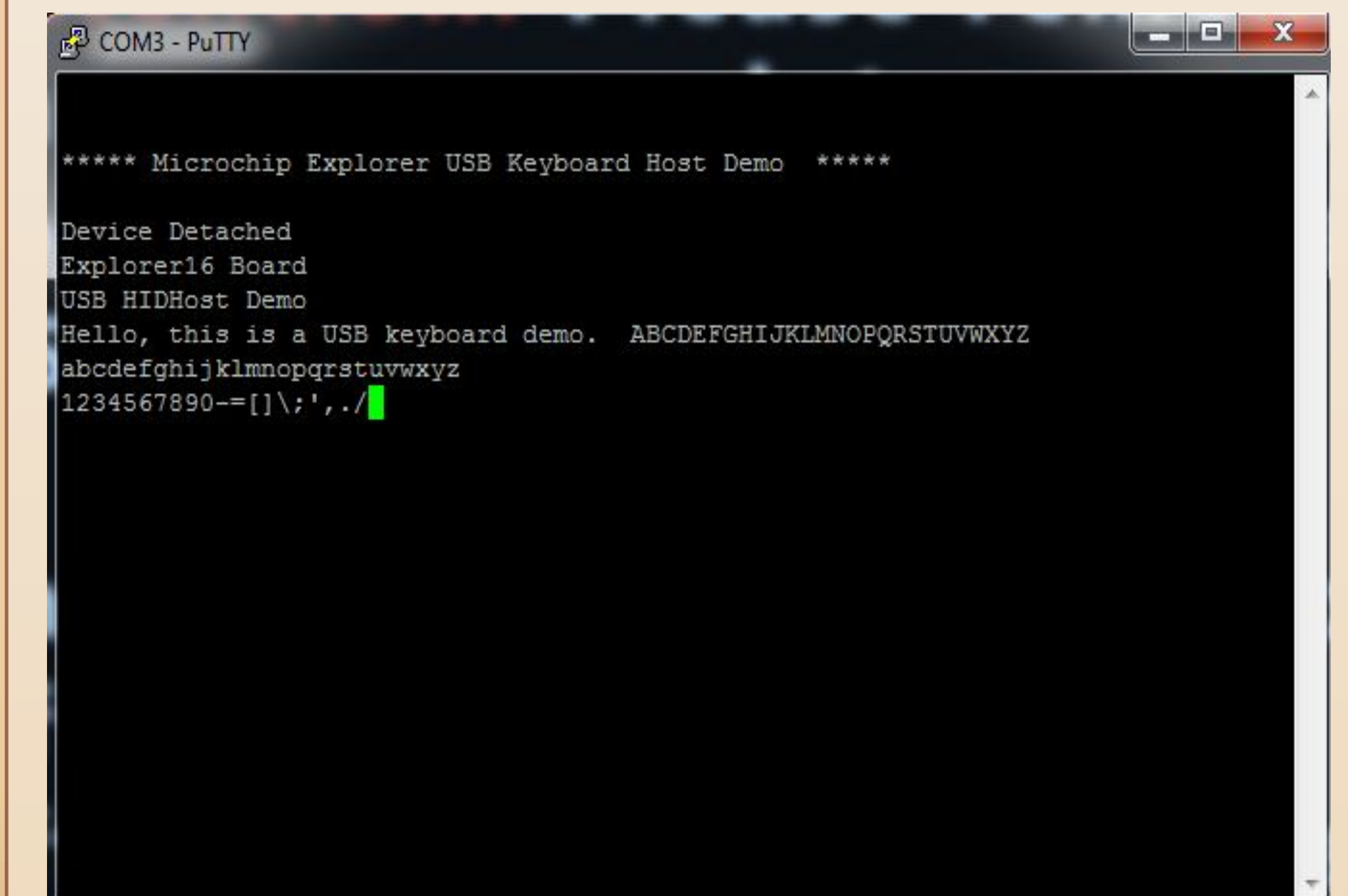
I checked the diagram of USB module and found that the possible cause might be the use of internal oscillator FRC. USB module could not use FRC. The reason is that the internal oscillator is fed into USB module directly without passing through a PLL as we can see. Therefore, 8MHz of FRC is far from enough to provide the USB module with the required 48MHz clock. The possible solution is to put an external oscillator to the OSC1 and OSC2 pins with some configuration circuits. As the USB module needs a 48 MHz clock, the external oscillator of 8 MHz will be adequate. To ensure the external oscillator works properly, the ground should be placed as close as possible to the oscillator.

As for the configuration circuits for the external oscillator, the OSC1 and OSC2 pins should both be connected to a capacitor and then connected to the ground. The capacitors would be 20-30 pF for an oscillator of 8MHz. Since the capacitors are so small that the breadboard can provide enough capacitance, so I just put an 8MHz crystal oscillator on OSC1 and OSC2 pins without any additional connections.

## Results



PuTTY is used to display the results. The serial line should be set properly. And the baud rate should be set the same as that of PIC32.



The displayed information shows what I typed on a keyboard, including characters(both upper and lower cases), digits, symbols and some special characters such as space, enter, backspace and so on.

PIC32 is able to process end devices(both keyboard and mouse) request immediately, continuously and correctly.

## Acknowledgements

I would like to thank my advisor Bruce Land for his advice, encouragement, and continued support of this project.

## References

- [1]Microchip PIC32MX1XX/2XX family datasheet
- [2] PIC32 Family Reference Manual 27 USB OTG
- [3] <http://people.ece.cornell.edu/land/courses/ece4760/PIC32/index.html>