Testing Parts for Phys1600

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Contents

1 Related Pages

- pic18lf_sound_project[1] – moved some "other things of interest" not related to sound from that page to this page.
- Bitbucket repository pic18_serial_io[2] – some basic code for testing the serial/USB interface

[1] http://www3.telus.net/danpeirce/notes/pic18lf_sound_project.html
[2] https://bitbucket.org/danpeirce/pic18_serial_io

is on that public page – branches of the project related to specific projects has not been added to that repository.

- hello33[3] even more basic code used to test the USB to UART bridge.

2 The Parts

1. PIC18LF2620[4]
2. uUSB-MB5[5] – this board comes fully assembled as shown. (note on driver[6])
3. PICkit3[7]
4. Digikey Part number CTX743-ND[8]

The uUSB-MB5 provides 3.3Vdc to the PIC18LF2620. The uUSB-MB5 has an on-board 3.3V regulator which converts the USB supplied nominal 5 V to the regulated 3.3volts. The regulator also provides short circuit and thermal protection. It can supply a maximum of 100 mA.

3 Important Note Regarding Using an Oscilloscope when using the uUSB-MB5

In APSC1299 the output of the power supply used floats relative to earth ground as long as the PICkit2 is not attached to the circuit. When the uUSB-MB5 is used power comes from the computer USB port. With a desktop computer the negative side of the supply does not float relative to ground. It is grounded. The oscilloscope ground clip is also grounded. Connected the oscilloscope ground clip to anything but the USB ground will cause a short circuit.

The situation is different when using a laptop powered from the battery. In this case the negative side of the supply is floating relative to earth ground. I tested one laptop with the charging power supply plugged in and found the USB ground was still floating.

4 Using an External Oscillator

More than one variant of the supply wiring has been tested.

Figure 1 shows a CTX743-ND on a breadboard. It is a five volt oscillator. In this variant of the wiring the positive rail at the bottom of the solderless breadboard is used for 5 V and the positive rail at the top of the breadboard is used for 3.3 volts.

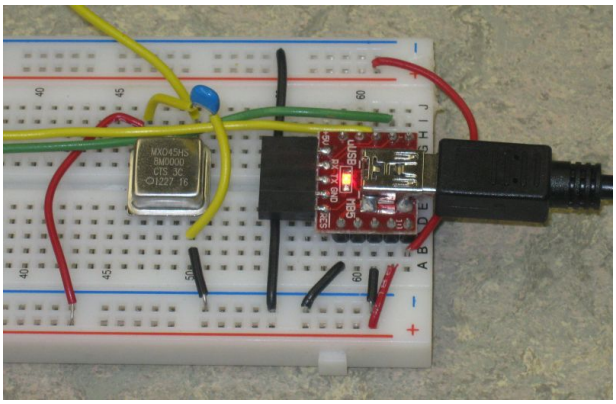

Figure 1: The CTX743-ND Oscillator on Breadboard

Figure 2 shows the complete breadboard in a wider view but is the same circuit as Figure 1.

Note that the PIC is tolerant of 5 volt inputs when powered at 3.3 volts! **For student use the jumper wire from 5 volts out of the USB-MB5 could to the nearby power rail could be replaced by a 400 mA axial leaded fuse.**

[3] http://www3.telus.net/danpeirce/notes/hello33.html
[4] http://ww1.microchip.com/downloads/en/devicedoc/39626b.pdf
[5] http://www.abra-electronics.com/products/%CE%BCUSB%252dMB5-Breakout-Board-for-CP2102-mini-USB-to-Serial-.html
[6] http://www3.telus.net/danpeirce/notes/usb_mb5.html
[7] http://www.microchip.com/stellent/idcplg?IdcService=SS_GET_PAGE&nodeId=1406&dDocName=en538340&redirects=pickit3
[8] http://www.digikey.ca/product-detail/en/MXO45HS-3C-8M0000/CTX743-ND

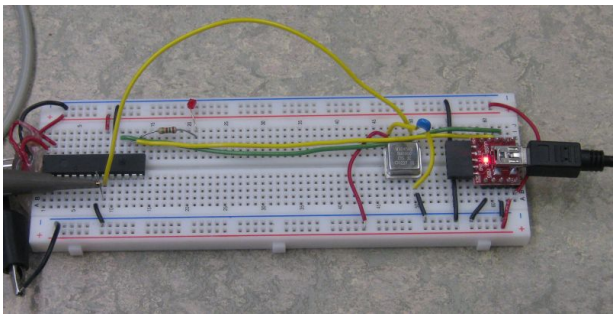

Figure 2: Wider View of CTX743-ND on Breadboard

4.1 Alternate Layout for 5 volt Bus

The circuit in Figures 1 and 2 have the 3.3 volt rail as the positive rail at the top of the board and the +5 volt rail as the positive rail at the bottom of the board. Rather then use the lower supply rail for 5 volts an alternative is to use just one internal row for 5 volts and keep both positive rails at 3.3 volts. We would like to minimize the use of the raw 5 volts. This is shown in Figure 3

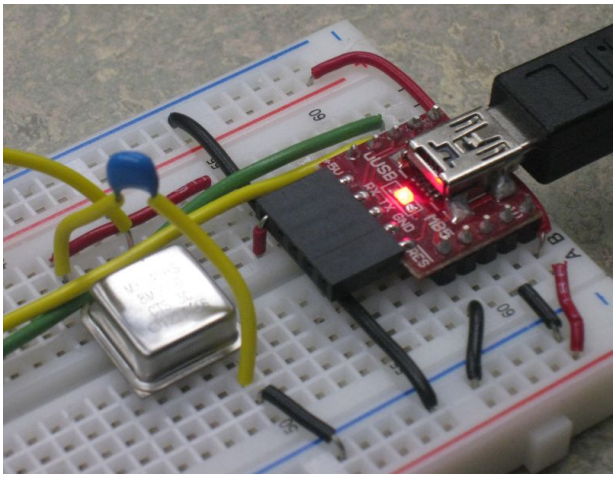

Figure 3: Alternate Layout for 5 volt Supply (coming out of connector of breakout board)

4.2 Oscillator on Protoboard for Short Signal Path

Since the oscillator is at an RF frequency it is a good idea to keep the lead short. Building the oscillator on a little piece of protoboard facilitates this. This can be seen in Figure 4.

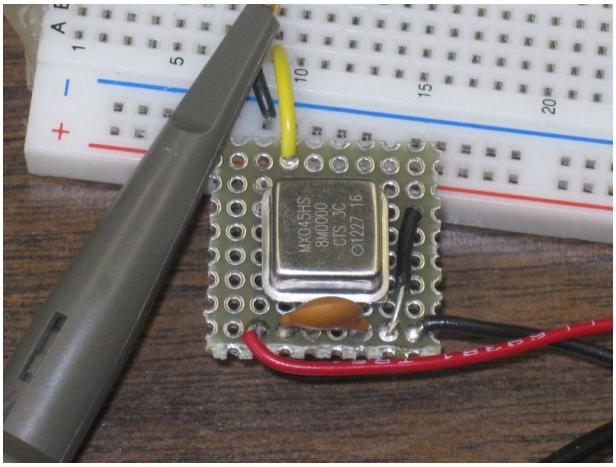

Figure 4: 8 MHz Oscillator on Proto-Board

Figure 5 shows the connection between the PIC and oscillator.

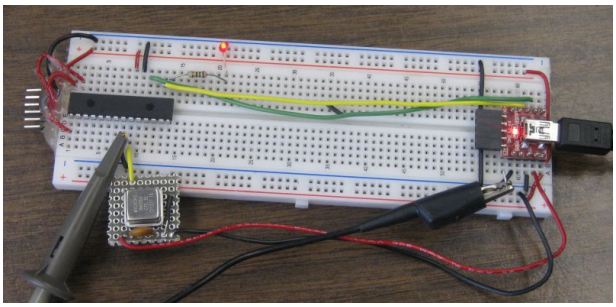

Figure 5: Oscillator Proto-Board Mounted Near PIC

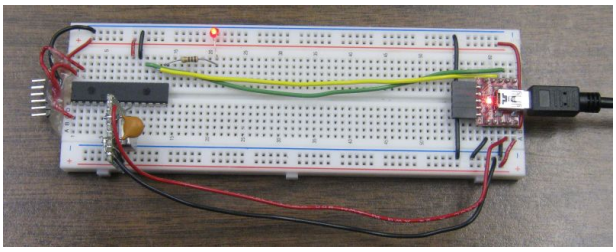

Figure 6: Vertical Oscillator Proto-Board

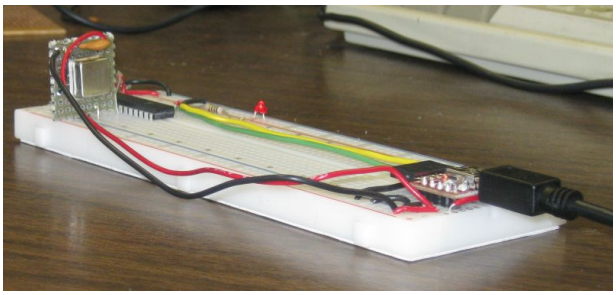

Figure 7: Side View of Vertical Oscillator Proto-Board

4.3 Oscillator Protoboard Vertical for Even Shorter Signal Path

The conductor between the oscillator output and the osc1 input of the PIC can be made shorter still if the oscillator board is mounted vertically as shown in Figures 6 and 7.

4.4 Signal from Oscillator

Signal from Oscillator when loaded by PIC is shown in Figure 8. The external oscillator can be used when very precise time measurements are to be made. The oscillator signal is not an idealized square wave but contains some overshoot on the trailing edge of sharp transitions.

The internal oscillator is quite adequate for many applications.

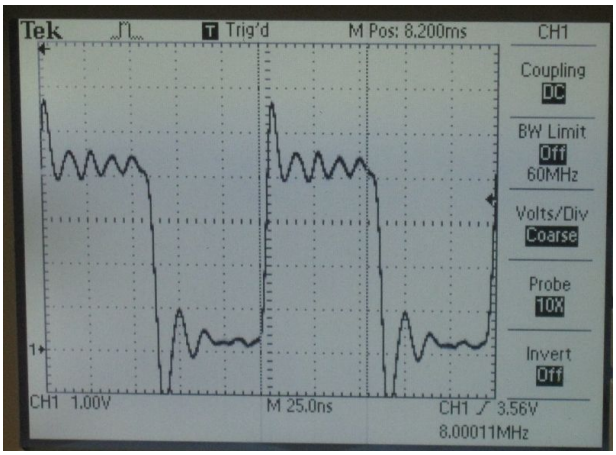

Figure 8: 8MHz Signal Shown on DSO

4.5 New Branch on bitbucket repository

I created a new branch on my git bitbucket repository to reflect the use of an external oscillator.

- https://bitbucket.org/danpeirce/pic18_serial_io/diff/USARTfunc.c?diff2=9517adf437b4&at=ext_osc

5 Without an External Oscillator

Figure 9 shows the connection between a PIC18LF2620 and a USB-MB5 without an External Oscillator. In this case the PIC oscillator signal is not available. The oscillator divided by four frequency is available on the OSC2 pin.

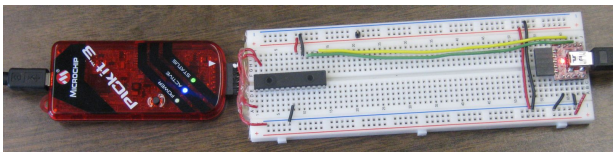

Figure 9: PIC18LF2620 USB-mb5 PICkit3

6 The USB-MB5 for Serial Communication

The USB-MB5 provides power to the breadboard and it also provides serial communication to the computerhost. Figure 10 is a closeup of the wiring to the USB-MB5. The green and yellow wires are for serial communication between the PIC and the USB-MB5.

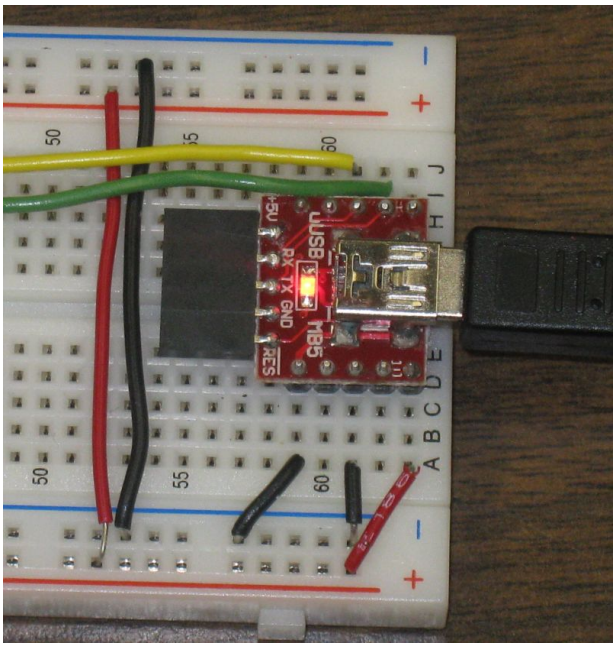

Figure 10: USB-MB5

In this case I have not used the 5 volt output from the USB-MB5.

6.1 PIC Test Program

Made use of existing program **pic18_serial_io**[9]. That project was written for the PIC with interacting with a Raspberry Pi in mind but it will interact with a Windows PC just as well (see Figure 11).

Currently this PIC program recognizes three commands.

[9] https://bitbucket.org/danpeirce/pic18/serial/io

Figure 11: Terminal Window on a Laptop Desktop

1. "M" – sends a menu message - this was used for the test.

2. "L" – intended to turn on an LED.

3. "F" – intended to turn off an LED.

Note that to test the "L" and "F" commands a 200 ohm resistor should be connected to pin 15 of the PIC and the other end of the resistor should connect to the anode of a LED. The cathode of the LED is connected to ground.

The PIC will also echo any character it receives back over the serial link for a loopback test. If it receives a '\r' it will add a '\n'. see https://bitbucket.org/danpeirce/pic18_serial_io/src/b8c10af1b10d/commands.c

Complete set of project files can be obtained from https://bitbucket.org/danpeirce/pic18_serial_io/get/b8c10af1b10d.zip.

Within these files the header file p18f2620.h is used. There is no p18lf2620.h file but from a the programming point of view the devices are equivalent. Also, when the project wizard was used to create the project file the PIC18F2620 device was selected. The resulting HEX file is still suitable for the PIC18LF2620.

6.2 Computer Terminal Program

On Windows XP I used hyperterminal. Windows 7 does not ship with hyperterminal.

I tested PuTTY[10].

I have been using PuTTY as a SSH client but it also works as a simple serial terminal.

Figure 11 is a screen shot shows a PuTTY session connected to the PIC18LF2620 via the USB to serial bridge uUSB-MB5.

Note that the PuTTY terminal screen will be empty until something is typed on the computer (laptop). What ever is typed will be echoed to the screen (by the PIC) if everything is set-up correctly. Typing "m" sends the menu message (from the PIC). Figure 11 shows part of the desktop.

6.2.1 PuTTY Settings

The following screen shots show the PuTTY settings:

PuTTY -> Connection -> Serial see Figure 12

PuTTY -> Window -> Colours
Select **Use System Colours** to avoid getting white on black. See Figure 13

PuTTY -> Session (Connection type must be selected as **Serial** See Figure 14)

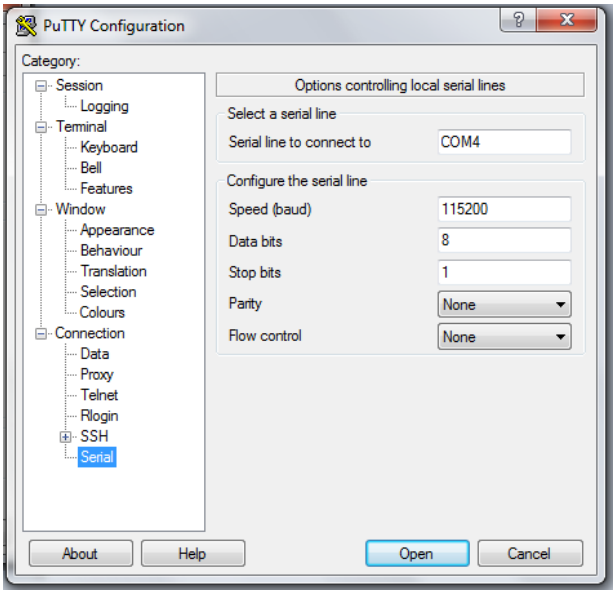

Figure 12: PuTTY Serial Setting

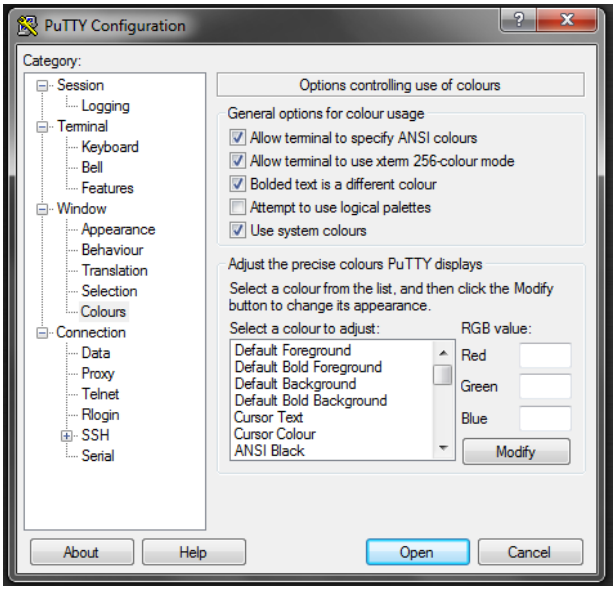

Figure 13: PuTTY Window Colours

7 Getting the PICkit3 to work with the PIC18LF2620

7.1 With PICkit3 Pin 2 to 3.3 Volt Connection

Please note that when this was tested the connections between the PICkit3 and the PIC18LF2620 were as shown in Figure 15.

Once the **OK** is selected (Figure 16) the device ID will be shown:

[10] http://www.putty.org/

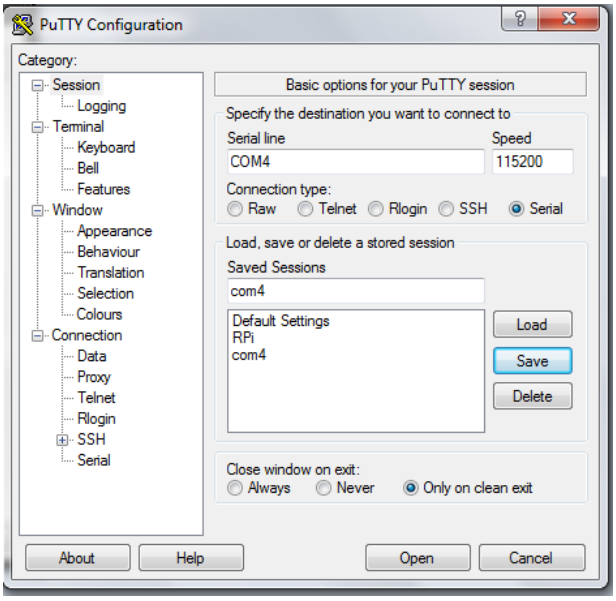

Figure 14: PuTTY Session (serial settings)

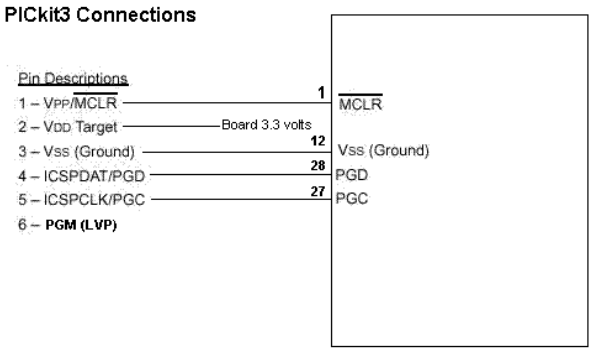

Figure 15: Wiring Between PICkit3 and PIC18LF2620

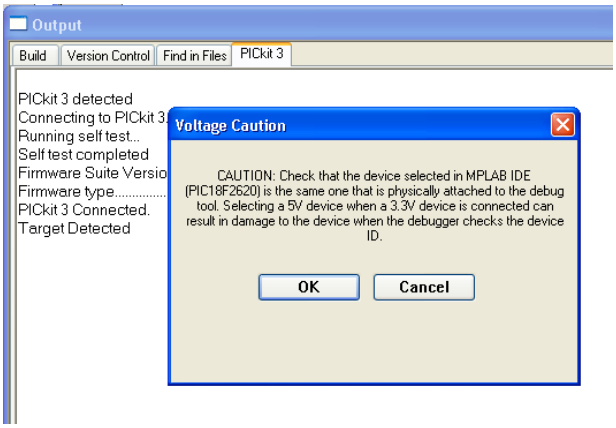

Figure 16: Warning Message: Click OK

```
Device ID Revision = 00000007
```

It is possible to read the source voltage with the PICkit3 and display the result in a MPlab IDE window (see Figure 17).

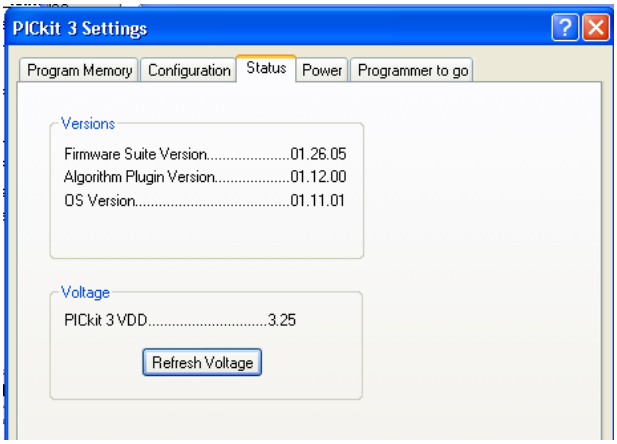

Figure 17: Reading Voltage With PICkit3

If the PICkit3 pin2 is connected to the circuit and the circuit is powered from the USB connection it is essentially that Powering from the PICkit3 is not checked on the power tab!

7.2 With PICkit3 Pin 2 Left No Connection

With the PICkit2 we left the power connection open because we did not plan to power the board from the PICkit2 and it seemed to avoid the possible issue of someone inadvertently powering the board from the PICkit2. With the PICkit3 we still don't want to power our board from the PICkit3 (and risk damage to it). It appears that with the PICkit3 it would not be easy to power the board from the PICkit3 unintentionally and as shown below leaving PIN2 open leads to many extra steps being necessary. **This part is included for completeness – For the PICkit3 I recomend adding the wire from PIN2 to VDD.**

Note that a PICkit2 will attempt to read the voltage on its pin2. If no voltage is pressent the firmware will assume that the target needs to be powered from the PICkit2's supply. It appears that the firmware on the PICkit3 is different. If no voltage is sensed on pin2 it will give the following error: (also shown in Figure 18)

```
PK3Err0045: You must connect a target device to use PICk
```

Perhaps a better error message would have said that no voltage was detected. One could use a wire from the board positive rail to the PICkit3 pin2 or one could use the following procedure which I worked out by trial and error.

The error: (see Figure 18)

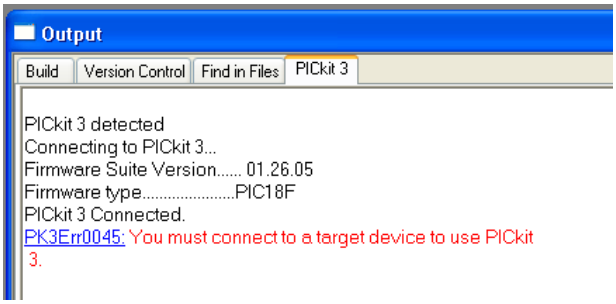

Figure 18: The Error Message

Select **Programmer -> Settings** (see Figure 19

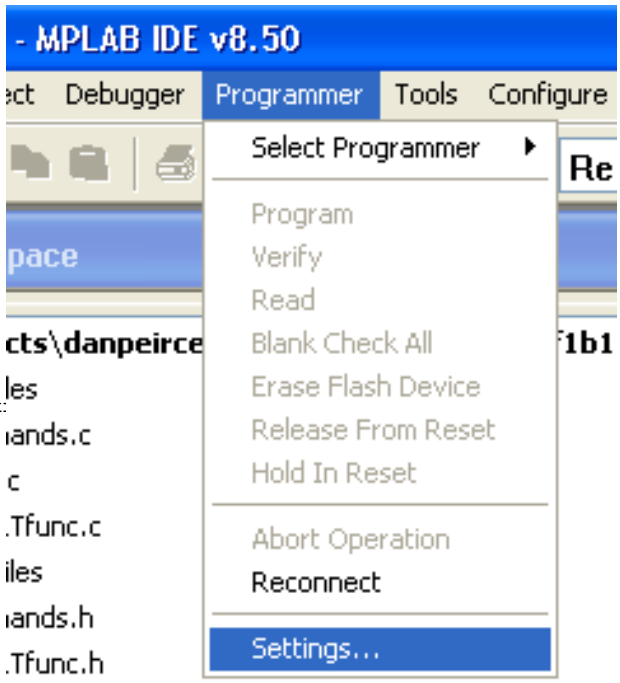

Figure 19: Finding Programmer Settings

Select the **Power** tab and set the voltage to **3.375 volts** by dragging the slider (see Figure 20). Also, ensure that the **Power target circuit from PICkit3** check box is checked! When that is all done click on **apply**. **Keep in mind these steps would only be used in the case of the power wire from the board not being connected to the PICkit3**. I'm actually not recomending it be done this way in general and believe it is better to use the extra wire for the PICkit3 as discussed in the previous section. This procedure will work in a pinch.

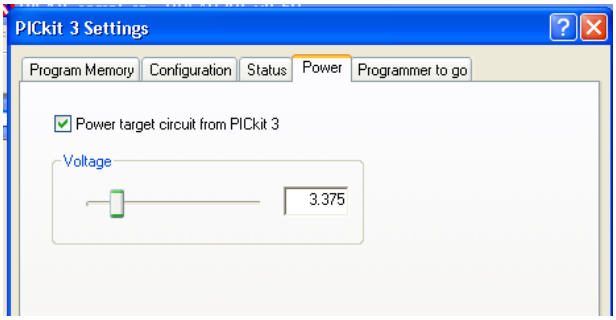

Figure 20: Voltage Setting Using the PICkit3 and IDE (not needed Power Lead Included)

A warning message will pop up (shown in Figure 21). It will say the same thing regardless if the voltage has been shifted down to 3.375 volts or not. The dialog box can be moved around so check that the voltage is set to 3.375. The checking is not essential if Pin2 of the PICkit3 is not actually connected to anything! Click on **OK**.

The PICkit3 firmware progresses and says shows the **Device ID Revision = 00000007** (see Figure 22). At this point the MPlab IDE tools for interacting with the PIC device become visible, the tools contain color and are responsive meaning the device can now be programmed (see Figure 23.

Once printed the error message does not go away (unless it scrolls up out of view) but the new line with the device id is an indication that the MPlab IDE is now talking to the PIC18LF device (still refering to Figure 22.

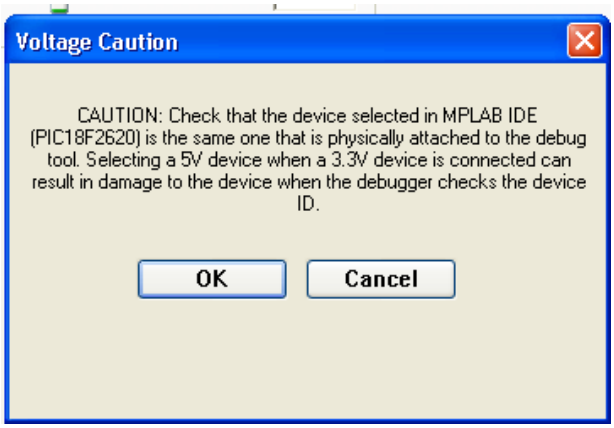

Figure 21: Warning Of Possible Voltage Issue

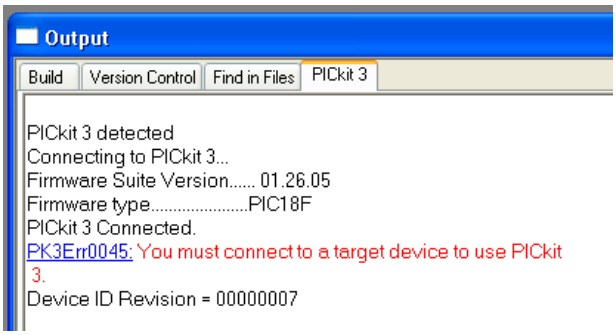

Figure 22: Device ID Pops Up after Error Message Once the OK Button Clicked

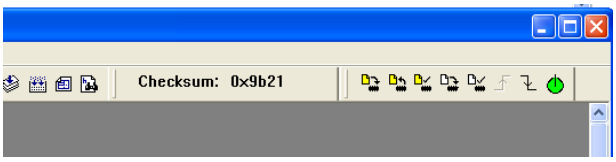

Figure 23: Programming Tools Active

8 For Standalone Projects

In Phys1600 there will be some projects which are standalone. In these cases power from a USB port will not be available and a computer will not be available to display results. In those cases battery power will be needed. The LCD module that we typically use requires 5 VDC (the LCD is not required when attached to a laptop since we can run a terminal program on the laptop).

I found a suitable DC-DC converter that can provide a regulated 5 Volts out even when the input voltage is substantially less than 5 volts. See http://www3.telus.net/danpeirce/notes/dc_dc_converter.html.

9 Other things of Interest

9.1 TFT LCD

4D Systems makes small TFT LCDs with full color, built-in controller, sound, touch screen and SD-card interface. They package some in kits complete with serial interface to a raspberry pi. The displays could also be used with a microchip PIC.

See 4D_LCD[11]

9.2 Keypad

I have been looking at keypads. It appears one can get much better value purchasing a 3x4 keypad rather than a 4by4 keypad. It would actually be cheaper to have two 3x4 keypads on a project than one 4x4 so I'd recomend getting the 3x4. I expect the 3x4 ones are less expensive because they are sutiable for telephones.

this one looks like a good deal from a Canadian source:

- http://www.solarbotics.com/product/50847/

[11] http://www3.telus.net/danpeirce/notes/4d_lcd.html

9.3 Breakout Board for SC16IS750 I2C/SPI-to-UART IC

Breakout Board for SC16IS750 I2C/SPI-to-UART IC – while this is a real interesting little board and one could gain an extra USART interface, it would actually cost less and gain more functionality to connect to another PIC18LF2620!

9.4 Breakout Board for SD-MMC Cards

Looks like this sparkfun breakout board has been discontinued. Breakout Board for SD-MMC Cards – "With SD and MMC memory prices dropping, the time is right for mass storage and datalogging. This breakout board will allow you to breakout the SD/MMC socket to a standard .1" 11-pin header. Perfect for breadboarding and the likes. Board comes fully assembled and tested as shown." see http://www.maxim-ic.com/app-notes/index.mvp/id/3969

http://www.solarbotics.com/product/13200/ **Looks like this one costs less and has more on it (changed link as old link was broken Nov. 21, 2012 – nothing stands still).** Also, this is from a Canadian source.

Links to http://site.gravitech.us/MicroResearch/Others/SD-ADP/SDmanual.pdf

9.5 3.3 volt 8 MHz Crystal

http://www.digikey.ca/product-detail/en/CB3LV-3C-8M0000/CTX264LVCT-ND/280258

- http://www.ctscorp.com/components/Datasheets/008-0256-0_F.pdf

9.6 Line in vs Mic input of PC

- http://circuits.radio-electronics.co/audio/speakers-systems/line-level-signal-to-microphone-input-adapter/