

UDB4 Quick START GUIDE

Hugh Keir, February 2, 2012

This guide will take you blindly through the steps required from unpacking your UDB4 through to programming it for the first time.

Firstly I would like to show my gratitude and thanks to the key players that have made the UDB4 and the Matrix Pilot software possible for us all to enjoy:-

Bill Premerlani
Ben Levitt
Peter Hollands
Adam Barrow

Once you are more experienced you will be able to dispense with this guide and access the more advanced options available from the UDB4, but while the UDB4 is all new and unfamiliar, this procedure will take you through all the steps required.

Once programmed your UDB4 will, with the addition of a GPS module, combine with the output from the onboard gyros and accelerometers, be capable of advanced control of radio controlled planes cars boats and helicopters.

As you look at the UDB4 board pictured below, the top and bottom edges are used for GPS and Magnetometer connections in addition to communicating with the board via the PICKit 3 programmer, serial links and CAN connections.

The left and right edges of the PCB are for the board power supply plus eight channels from your radio transmitter to control the functioning parts of your project.

The + and - on the input and output (left and right edges) are common, supplying >5 volts dc power to any of them will power the UDB4.

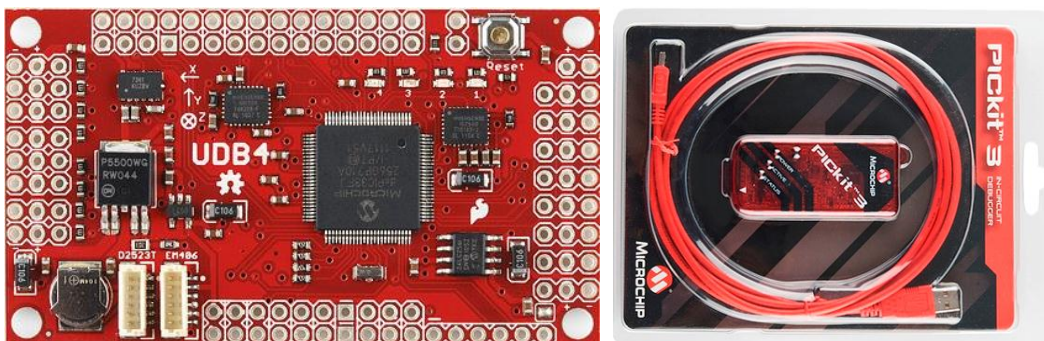
You can separate the UDB4 processor power supply from the other common power supply points using the top right +ve and -ve and removing a solder blob bottom right of the UDB4, but this is not necessary at this time, or for most applications.

Your Shopping list

What you will need is :-

A UDB4 from Sparkfun:- <http://www.sparkfun.com/products/10582>

A PICKit 3 programmer:- <http://www.sparkfun.com/products/9973>, but can also be found on ebay and good electrical retailers etc.



Your UDB4 arrives pre-programmed with test software (more correctly referred to as firmware) for the gyros and accelerometers that are at the heart of the UDB4, so our first step will be to power the board and perform a function test with the installed firmware.

You could solder a power supply directly to the UDB4, however solder makes wires very brittle, so the best way is to solder some header pins to the board first and connect your power supply using a wire crimped terminal.

What you will need are some 0.1" header pins:-

<http://www.sparkfun.com/products/116>



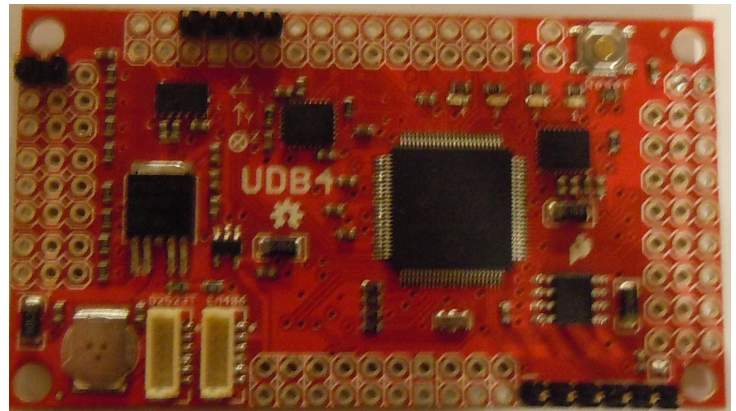
Now is a convenient time to solder a few header pins to your UDB4

You will see I have soldered three sets of header pins:-

The row of four at the top is for RS232 (serial) communication.

The row bottom right is for the PICKit 3 programmer.

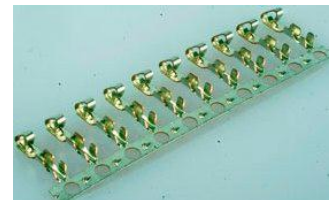
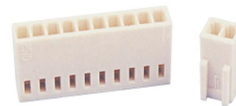
The row of two, header pins top left, is for power.



Next you will need some more items to complete the initial programming as follows:-

Some socket housings and terminals:-

<http://www.maplin.co.uk/0.1-series-socket-housing-1490>



A 4AA battery holder with batteries

The UDB4 will take voltages more than 5v but 5volts is best.

4 x AA's works the voltage regulator a little but is fine for now:-

<http://www.maplin.co.uk/aa-size-battery-holders-31427>



A PP3 snap connector:-



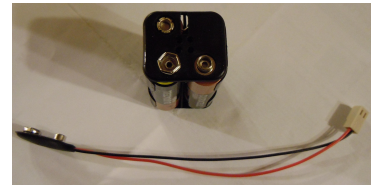
<http://www.maplin.co.uk/pp3-type-battery-snap-44392>

As mentioned above, wires must be crimped and not soldered, if you solder them they will snap very soon after in use.

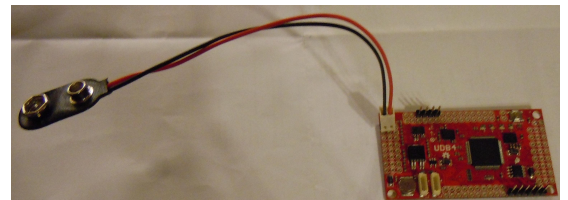
Most of us do not have the fancy aircraft loom crimp connector pliers used by the professionals, so here is a simple way to achieve a good crimp with a pair of pointed nose pliers.

<http://www.youtube.com/watch?v=KEm2PuHBt4Y>

Once crimped, your PP3 snap connector will look like this



You can then connect it to the UDB4



Once you connect the power, keep the board flat and motionless until the first test sequence has finished:-

The Red and Blue LEDs will flash 16 times, the UDB4 then blinks all 4 LEDs in sequence 2 times, while calibrating the sensors and testing the EEPROM.

The UDB4 then switches over to alternately testing the accelerometers and gyros for 15 seconds each.

The Red LED turns on while testing the gyros, and off while testing the accelerometers.

To test the gyros, rotate the board back and forth on one axis at a time and watch for the corresponding LED flash.

To test the accelerometers, you can let gravity do the work. Point a short edge of the board up and see one LED go on, then point a long edge up, then sit it flat to test the Z accelerometer.

In the unlikely event the EEPROM test fails, it freaks out and flashes all 4 LEDs 16 times.

UDB4 failures are almost unheard of, but here is a test that shows what you are looking for with one gyro axis not working.

<http://www.youtube.com/watch?v=fX-ErQbXTRY>

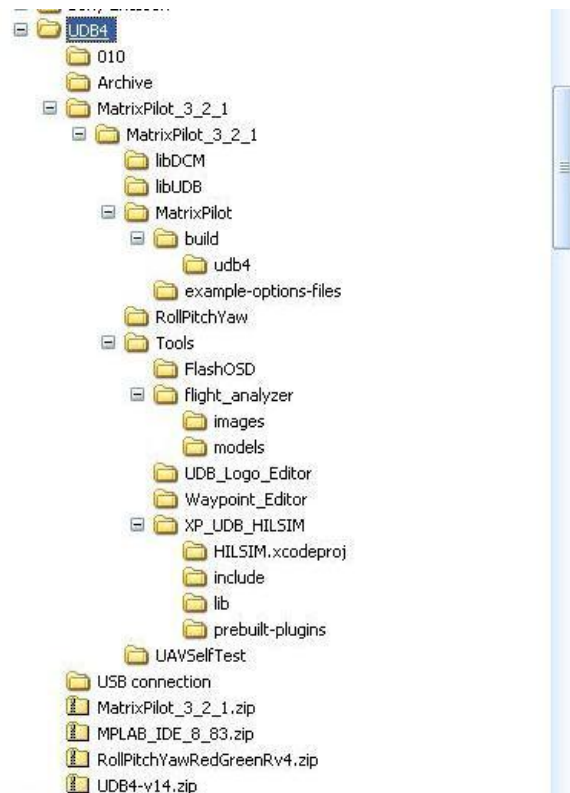
Programming the UDB4

To start programming your UDB4 you will need to install the following pieces of Software:-

- MPLAP, to control your PICKit3 programmer.
- MPLAB C compiler, to turn the Matrix Pilot instructions from C language into Hex language that is used by the dsPIC33FJ256GP710A chip that controls the UDB4.

First step is to create a directory that will make it easy to find your files in the future, something like UDB4 worked for me.

Below you will see an example of a directory structure that has all the files you will need downloaded and what it looks like when the software is installed.



First you need to download the latest version of Matrix Pilot from here:-

<http://code.google.com/p/gentlenav/downloads/list>

Double click on the Matrix Pilot file that has the highest version number, it will look something like this.

MatrixPilot 3.2.1 firmware

Save the zip file to your UDB4 directory then unzip it to the UDB4 directory, once installed, it will look similar to the above file structure.

Next you will need to install MPLAB IDE

The disc that is supplied with your PICKit 3 works just fine, or you can download the latest software version here :-

http://www.microchip.com/stellent/idcplg?IdcService=SS_GET_PAGE&nodeId=1406&dDocName=en019469&part=SW007002

Scroll to the bottom of the page and you will see the latest version shown as MPLAB_IDE_8_83.zip, or a later version.

If the above link does not work, Google "download MPLAB IDE" and you will get the latest location.

Save the MPLAB_IDE_8_83.zip file and Install MPLAB into the UDB4 directory, the installation is automatic just accept all the options.

Next you will need a C compiler.

This one is recommended :-

http://www.microchip.com/stellent/idcplg?IdcService=SS_GET_PAGE&nodeId=1406&dDocName=en010065

Scroll to the bottom of the page and select this one or a later version

[MPLAB C Compiler for PIC24 and dsPIC v3.31](#) 

You have to register to download the C compiler, it is free to download and to use, select the full version which times out after 6 months, the only loss of functionality after the 6 month period is a lack of compression of the code which is of no real consequence.

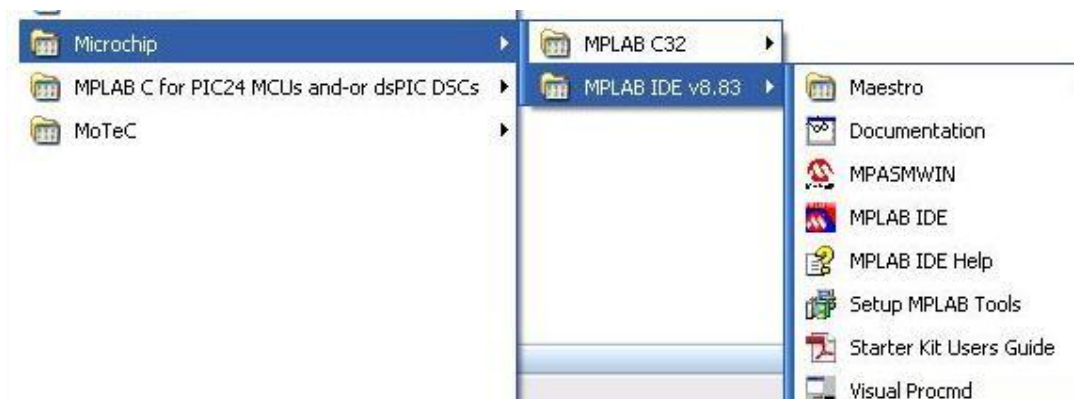
This time it is an exe file to download which at the time of writing is "mplabc30-v3_31-windows-installer.exe"

Again save it to your UDB4 directory and double click to install.

You are now ready to put it all together and programme your UDB4.

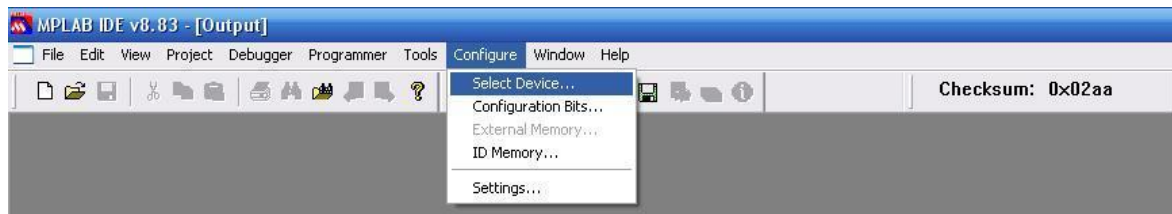
Open MPLAB as follows:-

Press Start > Microchip > MPLAB IDE V8.83 > MPLAB IDE as shown below.



Once MPLAB opens you need to set the type of chip MPLAB will be programming:-

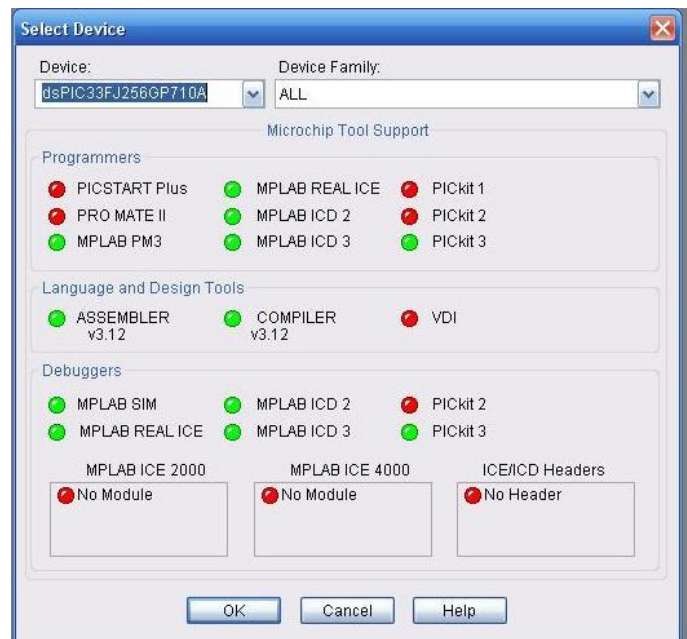
Select Configure > Select Device, as below.



Now you need to enter the chip type as :-

dsPIC33FJ256GP710A

Then click OK



You are now ready to prepare your "options.h" text file from within Matrix Pilot.

My directory structure looks like this, yours will be similar if you used the directory structure discussed earlier :-

C:\Documents and Settings\Owner\My Documents\UDB4\MatrixPilot_3_2_1\MatrixPilot_3_2_1\MatrixPilot

Open the "options.h file" in Notepad and configure it to suit this first bare board test, making sure you have selected the correct board type and for the bare board test define NORADIO as follows:-

```
#define BOARD_TYPE                UDB4_BOARD

#define NORADIO                    1
```

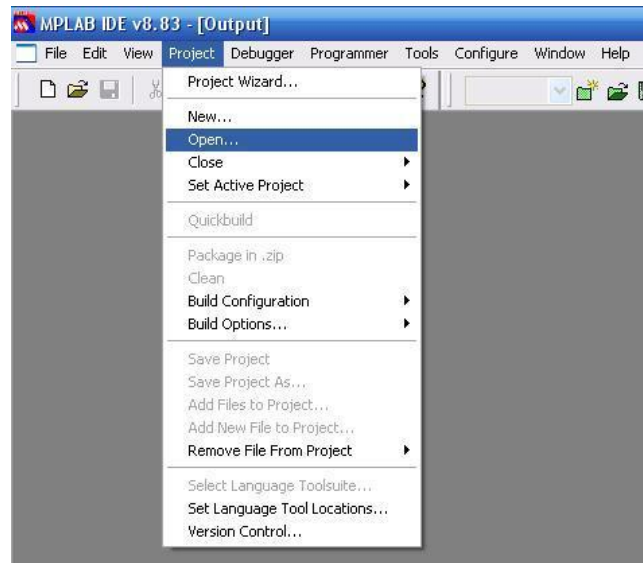
For now you need not worry about any other settings, but it's worth noting you will be modifying the options.h file over and over again as you tweak the settings on your plane.

Here are some instructions that will assist with options.h configuration :-

<http://code.google.com/p/gentlenav/wiki/HowToConfigure>

Once you have saved your options.h file, you are now ready to open MPLAB IDE and start the process of programming your UDB4.

Select Project > Open

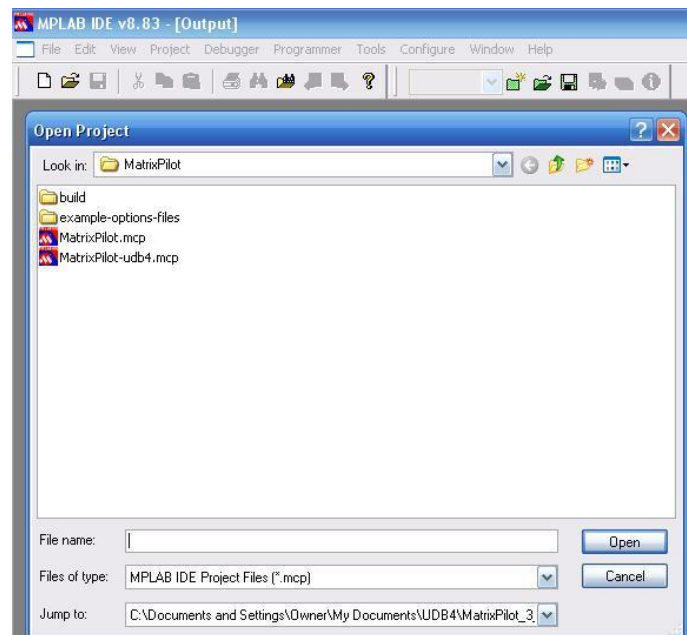


Select and double click

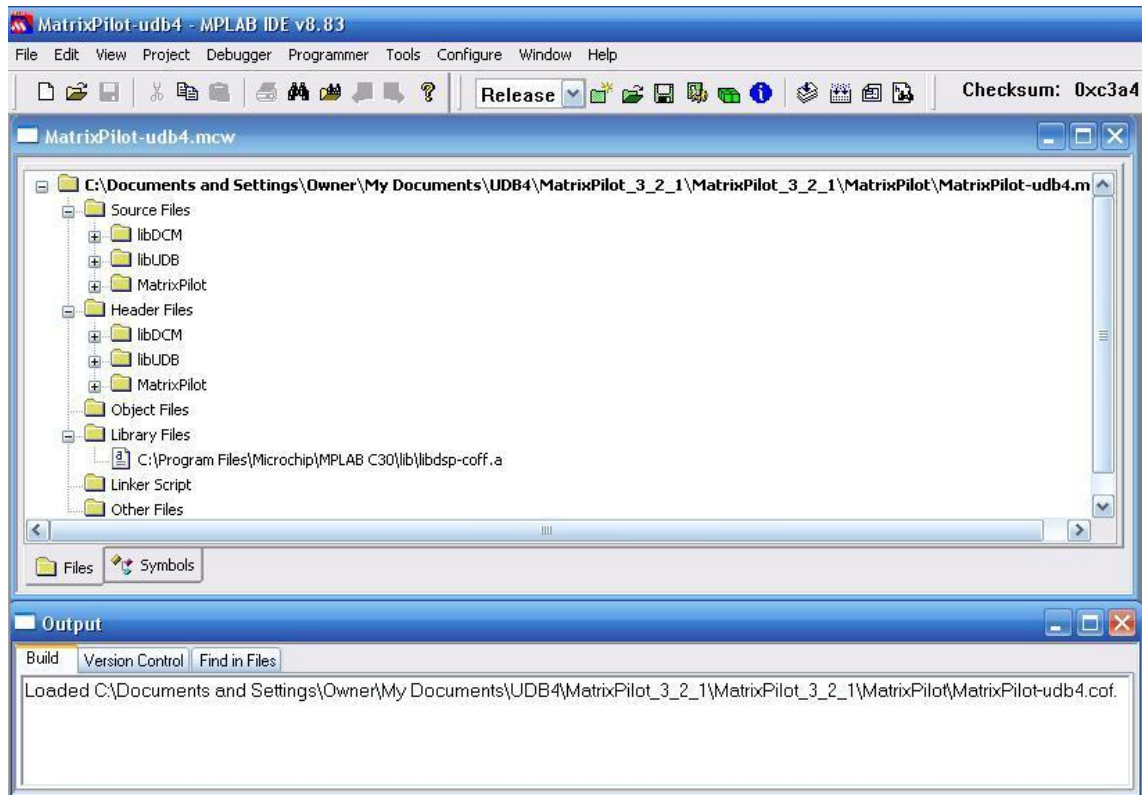
MatrixPilot-udb4.mcp

The way in which MPLAB IDE opens up your project can sometimes be confusing since there may be very little to see on your screen.

Two tabs will open, they may be hidden down in the bottom left hand corner of your MPLAB screen, they are called **Matrix Pilot – udb4.mcw** and **Output**.



I have played about with the size of the windows to show you how the tabs should look once you have resized them.



It is really important that you check for the presence of the library file **libdsp-coff.a**

You will see in the view above that I installed the Microchip C compiler in programme files :-

C:\Program Files\Microchip\MPLAB C30\lib\libdsp-coff.a

If the file is not shown in the **Matrix Pilot – udb4.mcw** window, right click the Library files folder in the **Matrix Pilot – udb4.mcw** window and use the options there to locate the **libdsp-coff.a** file.

Next set the Release / Debug tab top centre of the screen to **“Release”**

Once the above is complete, you are all set up and ready to compile Matrix Pilot and programme your UDB4 board.

The instructions that follow are the procedure you will use each time you programme your UDB4, you are part way through the instructions already, but recommend you shut MPLAB down so that you become familiar with the full sequence.

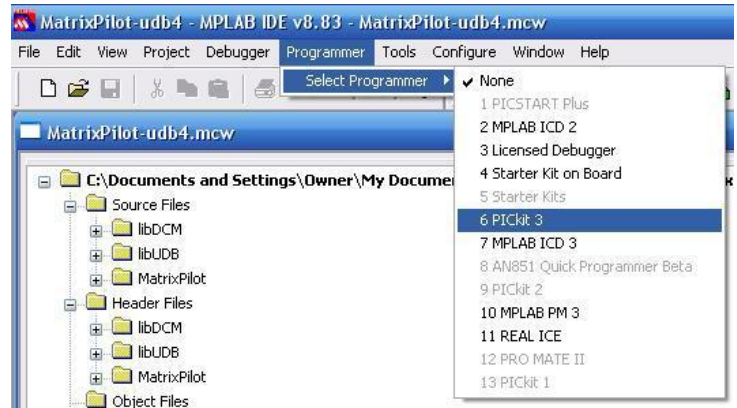
1. Start up MPLAB IDE.
2. Connect your PICKit3 to your computer via a USB port
3. Power up your UDB4

4. Connect your PICKit3 to your UDB4 using the picture to the right as a guide.



- 5. Open the project in MPLAB IDE, project menu > "open" > MatrixPilot-udb4.mcp
- 6. Make sure that the IDE is working in the RELEASE mode.

7. Select your PICKit3 as the programmer



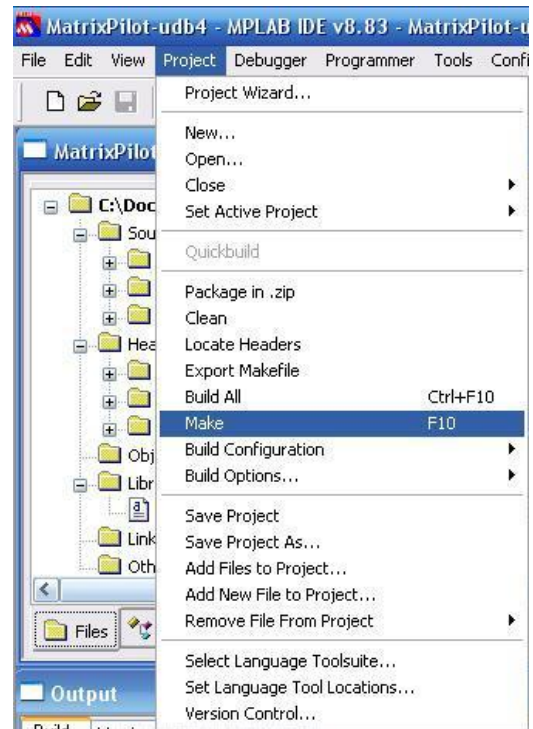
The PICKit 3 status light goes to on.

The following message then appears:-

```
PICKit 3 detected
Connecting to PICKit 3...
Running self test...
Self test completed
Firmware Suite Version..... 01.26.92
Firmware type.....dsPIC33F/24F/24H
PICKit 3 Connected.
Target Detected
Device ID Revision = 00003003
```

8. Select Project > "Make".

You will then see lots of messages coming over the MPLAB screen



•
Release build of project `C:\Documents and Settings\Owner\My Documents\UDB4\MatrixPilot_3_2_1\MatrixPilot_3_2_1\MatrixPilot\MatrixPilot-udb4.mcp' started.
Language tool versions: pic30-as.exe v3.30, pic30-gcc.exe v3.30, pic30-ld.exe v3.30, pic30-ar.exe v3.30
Wed Jan 11 20:37:59 2012

Executing: cscript "C:\Documents and Settings\Owner\My Documents\UDB4\MatrixPilot_3_2_1\MatrixPilot_3_2_1\MatrixPilot\..\libUDB\fixDeps.vbs" "C:\Documents and Settings\Owner\My Documents\UDB4\MatrixPilot_3_2_1\MatrixPilot_3_2_1\MatrixPilot\options.h" "C:\Documents and Settings\Owner\My Documents\UDB4\MatrixPilot_3_2_1\MatrixPilot_3_2_1\MatrixPilot\..\libUDB\fixDeps.h"
Microsoft (R) Windows Script Host Version 5.7
Copyright (C) Microsoft Corporation. All rights reserved.

Make: The target "C:\Documents and Settings\Owner\My Documents\UDB4\MatrixPilot_3_2_1\MatrixPilot_3_2_1\MatrixPilot\build\udb4\config_tests.o" is up to date.
Make: The target "C:\Documents and Settings\Owner\My Documents\UDB4\MatrixPilot_3_2_1\MatrixPilot_3_2_1\MatrixPilot\build\udb4\background.o" is up to date.
Make: The target "C:\Documents and Settings\Owner\My Documents\UDB4\MatrixPilot_3_2_1\MatrixPilot_3_2_1\MatrixPilot\build\udb4\behavior.o" is up to date.
Make: The target "C:\Documents and Settings\Owner\My Documents\UDB4\MatrixPilot_3_2_1\MatrixPilot_3_2_1\MatrixPilot\build\udb4\cameraCntrl.o" is up to date.
Make: The target "C:\Documents and Settings\Owner\My Documents\UDB4\MatrixPilot_3_2_1\MatrixPilot_3_2_1\MatrixPilot\build\udb4\main.o" is up to date.
Make: The target "C:\Documents and Settings\Owner\My Documents\UDB4\MatrixPilot_3_2_1\MatrixPilot_3_2_1\MatrixPilot\build\udb4\navigate.o" is up to date.

Make: The target "C:\Documents and Settings\Owner\My Documents\UDB4\MatrixPilot_3_2_1\MatrixPilot_3_2_1\MatrixPilot\build\udb4\pitchCntrl.o" is up to date.

Make: The target "C:\Documents and Settings\Owner\My Documents\UDB4\MatrixPilot_3_2_1\MatrixPilot_3_2_1\MatrixPilot\build\udb4\rollCntrl.o" is up to date.

Make: The target "C:\Documents and Settings\Owner\My Documents\UDB4\MatrixPilot_3_2_1\MatrixPilot_3_2_1\MatrixPilot\build\udb4\servoMix.o" is up to date.

Make: The target "C:\Documents and Settings\Owner\My Documents\UDB4\MatrixPilot_3_2_1\MatrixPilot_3_2_1\MatrixPilot\build\udb4\states.o" is up to date.

Make: The target "C:\Documents and Settings\Owner\My Documents\UDB4\MatrixPilot_3_2_1\MatrixPilot_3_2_1\MatrixPilot\build\udb4\yawCntrl.o" is up to date.

Make: The target "C:\Documents and Settings\Owner\My Documents\UDB4\MatrixPilot_3_2_1\MatrixPilot_3_2_1\MatrixPilot\build\udb4\libUDB.o" is up to date.

Make: The target "C:\Documents and Settings\Owner\My Documents\UDB4\MatrixPilot_3_2_1\MatrixPilot_3_2_1\MatrixPilot\build\udb4\telemetry.o" is up to date.

Make: The target "C:\Documents and Settings\Owner\My Documents\UDB4\MatrixPilot_3_2_1\MatrixPilot_3_2_1\MatrixPilot\build\udb4\servoPrepare.o" is up to date.

Make: The target "C:\Documents and Settings\Owner\My Documents\UDB4\MatrixPilot_3_2_1\MatrixPilot_3_2_1\MatrixPilot\build\udb4\estWind.o" is up to date.

Make: The target "C:\Documents and Settings\Owner\My Documents\UDB4\MatrixPilot_3_2_1\MatrixPilot_3_2_1\MatrixPilot\build\udb4\estYawDrift.o" is up to date.

Make: The target "C:\Documents and Settings\Owner\My Documents\UDB4\MatrixPilot_3_2_1\MatrixPilot_3_2_1\MatrixPilot\build\udb4\gpsParseCommon.o" is up to date.

Make: The target "C:\Documents and Settings\Owner\My Documents\UDB4\MatrixPilot_3_2_1\MatrixPilot_3_2_1\MatrixPilot\build\udb4\gpsParseSTD.o" is up to date.

Make: The target "C:\Documents and Settings\Owner\My Documents\UDB4\MatrixPilot_3_2_1\MatrixPilot_3_2_1\MatrixPilot\build\udb4\gpsParseUBX.o" is up to date.

Make: The target "C:\Documents and Settings\Owner\My Documents\UDB4\MatrixPilot_3_2_1\MatrixPilot_3_2_1\MatrixPilot\build\udb4\mathlibNAV.o" is up to date.

Make: The target "C:\Documents and Settings\Owner\My Documents\UDB4\MatrixPilot_3_2_1\MatrixPilot_3_2_1\MatrixPilot\build\udb4\rmat.o" is up to date.

Make: The target "C:\Documents and Settings\Owner\My Documents\UDB4\MatrixPilot_3_2_1\MatrixPilot_3_2_1\MatrixPilot\build\udb4\libDCM.o" is up to date.

Make: The target "C:\Documents and Settings\Owner\My Documents\UDB4\MatrixPilot_3_2_1\MatrixPilot_3_2_1\MatrixPilot\build\udb4\analog2digital_udb4.o" is up to date.

Make: The target "C:\Documents and Settings\Owner\My Documents\UDB4\MatrixPilot_3_2_1\MatrixPilot_3_2_1\MatrixPilot\build\udb4\magneto_udb4.o" is up to date.

Make: The target "C:\Documents and Settings\Owner\My Documents\UDB4\MatrixPilot_3_2_1\MatrixPilot_3_2_1\MatrixPilot\build\udb4\radioIn_udb4.o" is up to date.

```

Make: The target "C:\Documents and Settings\Owner\My
Documents\UDB4\MatrixPilot_3_2_1\MatrixPilot_3_2_1\MatrixPilot\build\udb4\servoOut.o" is
up to date.
Make: The target "C:\Documents and Settings\Owner\My
Documents\UDB4\MatrixPilot_3_2_1\MatrixPilot_3_2_1\MatrixPilot\build\udb4\serialIO_udb4.o"
is up to date.
Make: The target "C:\Documents and Settings\Owner\My
Documents\UDB4\MatrixPilot_3_2_1\MatrixPilot_3_2_1\MatrixPilot\build\udb4\flightplan-
waypoints.o" is up to date.
Make: The target "C:\Documents and Settings\Owner\My
Documents\UDB4\MatrixPilot_3_2_1\MatrixPilot_3_2_1\MatrixPilot\build\udb4\flightplan-
logo.o" is up to date.
Make: The target "C:\Documents and Settings\Owner\My
Documents\UDB4\MatrixPilot_3_2_1\MatrixPilot_3_2_1\MatrixPilot\build\udb4\deadReckoning.
o" is up to date.
Make: The target "C:\Documents and Settings\Owner\My
Documents\UDB4\MatrixPilot_3_2_1\MatrixPilot_3_2_1\MatrixPilot\build\udb4\osd.o" is up to
date.
Make: The target "C:\Documents and Settings\Owner\My
Documents\UDB4\MatrixPilot_3_2_1\MatrixPilot_3_2_1\MatrixPilot\build\udb4\mp_osd.o" is up
to date.
Make: The target "C:\Documents and Settings\Owner\My
Documents\UDB4\MatrixPilot_3_2_1\MatrixPilot_3_2_1\MatrixPilot\build\udb4\traps_udb4_asm
.o" is up to date.
Make: The target "C:\Documents and Settings\Owner\My
Documents\UDB4\MatrixPilot_3_2_1\MatrixPilot_3_2_1\MatrixPilot\build\udb4\EEPROM_udb4.o"
is up to date.
Make: The target "C:\Documents and Settings\Owner\My
Documents\UDB4\MatrixPilot_3_2_1\MatrixPilot_3_2_1\MatrixPilot\build\udb4\gpsParseMTEK.o
" is up to date.
Make: The target "C:\Documents and Settings\Owner\My
Documents\UDB4\MatrixPilot_3_2_1\MatrixPilot_3_2_1\MatrixPilot\build\udb4\altitudeCntrl.o"
is up to date.
Make: The target "C:\Documents and Settings\Owner\My
Documents\UDB4\MatrixPilot_3_2_1\MatrixPilot_3_2_1\MatrixPilot\MatrixPilot-udb4.cof" is up
to date.
Loaded C:\Documents and Settings\Owner\My
Documents\UDB4\MatrixPilot_3_2_1\MatrixPilot_3_2_1\MatrixPilot\MatrixPilot-udb4.cof.
-----
Release build of project `C:\Documents and Settings\Owner\My
Documents\UDB4\MatrixPilot_3_2_1\MatrixPilot_3_2_1\MatrixPilot\MatrixPilot-udb4.mcp'
succeeded.
Language tool versions: pic30-as.exe v3.30, pic30-gcc.exe v3.30, pic30-ld.exe v3.30, pic30-
ar.exe v3.30
Wed Jan 11 20:38:11 2012
-----
BUILD SUCCEEDED

```

9. Execute a "Connect" operation. programmer menu > reconnect

You will then see the following messages

```

PICKit 3 detected
Connecting to PICKit 3...
Firmware Suite Version..... 01.26.92
Firmware type.....dsPIC33F/24F/24H

```

PICkit 3 Connected.
Target Detected
Device ID Revision = 00003003

10. Execute a "Program" operation. . programmer menu > program

- Programming... Programming/Verify complete

11. Deselect the programmer, Programmer menu > Select programmer > None

12. Close the project. Project > close.

13. Disconnect the PICkit3

14. Power down and power up your UDB4.

The red LED starts to flash, signifying the gyro calibration sequence has commenced.

To find out more from your UDB4, you will need connect a serial cable, or begin the process of fitting it to your project.

To fit a serial cable the instructions are as follows:-

First read the main page :- <http://code.google.com/p/gentlenav/wiki/SerialConnection>

You will then need an RS 232 serial board from Sparkfun

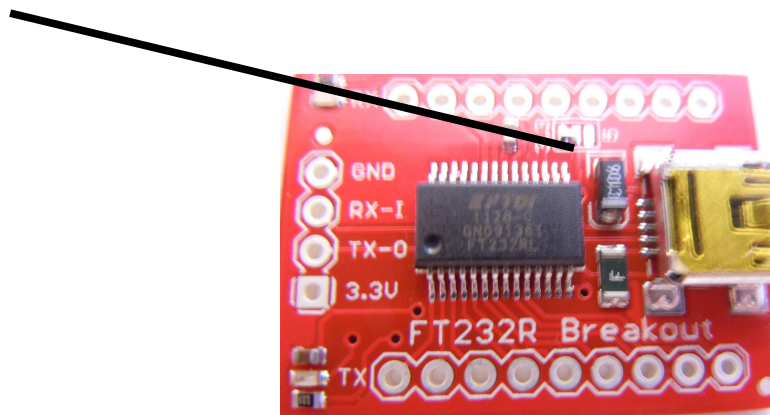
<http://www.sparkfun.com/products/718>

You will also need a USB 2.0 type A to Mini-B 5-pin cable

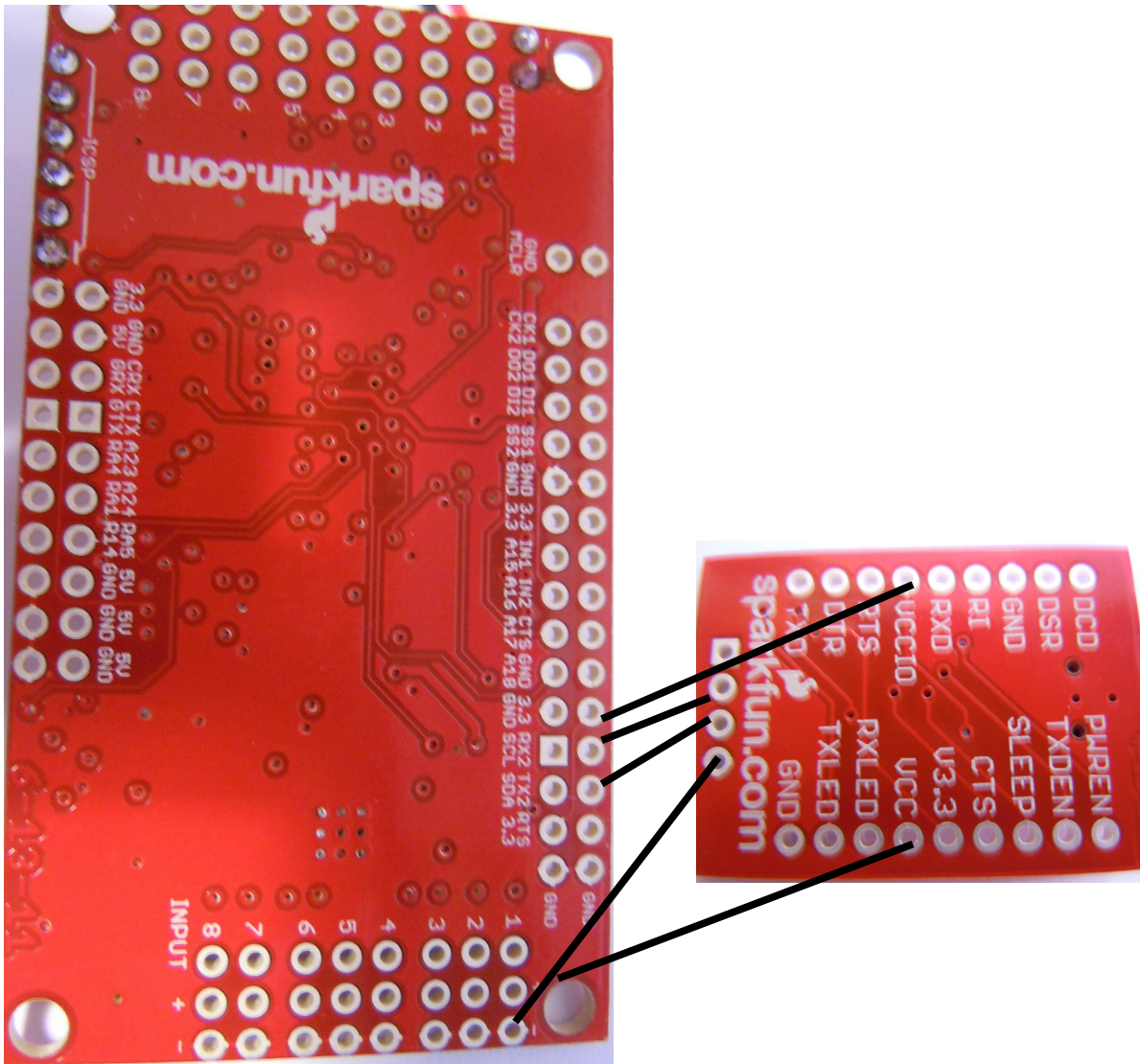
<http://www.sparkfun.com/products/598>

The serial board linked to above has a slight difference to the one in the Wiki page in that the solder blob selects 3 or 5 volts, it still needs to be removed though.

Remove solder blob



The connections to the UDB4 are shown below



Once set up, the use of the serial cable is automatic, as soon as you power up your UDB4, the data will stream to the Hyper terminal Window which you will have set-up using the procedures in the above gentlenav Wiki page.

Here is an example of the data stream that is produced when you set the options.h :-

```
#define SERIAL_OUTPUT_FORMAT SERIAL_UDB_EXTRA
b0:mc0:svs7:hd6:p1i3000:p2i3000:p3i0:p4i4000:p5i3000:p1o3000:p2o3000:p3o0:p4o300
0:imx0:imy0:imz0:fgs2000:ofc0:
```

F2:T112672750:S010:N571349550:E-21584630:A7540:W0:a-4790:b-15642:c-902:d15472:e-4872:f2312:g-2476:h-176:i16196:c2426:s27:cpu9:bmv0:as12:wvx-10:wvy-8:wvz-1:ma0:m b0:mc0:svs7:hd6:p1i3000:p2i3000:p3i0:p4i4000:p5i3000:p1o3000:p2o3000:p3o0:p4o300 0:imx0:imy0:imz0:fgs2000:ofc0:

F2:T112673000:S010:N571349560:E-21584650:A7541:W0:a-4750:b-15654:c-902:d15484:e-4832:f2312:g-2476:h-182:i16196:c2409:s27:cpu9:bmv0:as12:wvx-10:wvy-8:wvz-1:ma0:m b0:mc0:svs7:hd6:p1i3000:p2i3000:p3i0:p4i4000:p5i3000:p1o3000:p2o3000:p3o0:p4o300 0:imx0:imy0:imz0:fgs2000:ofc0:

F2:T112673250:S010:N571349560:E-21584650:A7544:W0:a-4710:b-15668:c-898:d15496:e-4792:f2314:g-2476:h-184:i16196:c2385:s27:cpu9:bmv0:as12:wvx-10:wvy-8:wvz-1:ma0:m b0:mc0:svs7:hd6:p1i3000:p2i3000:p3i0:p4i4000:p5i3000:p1o3000:p2o3000:p3o0:p4o300 0:imx0:imy0:imz0:fgs2000:ofc0:

To understand the data stream, you will need to refer to this document

https://docs.google.com/document/pub?id=1bPovneDV1UXBBEQE6yC3Ms9CCI_wmeCLGtVzUkJeoIw

When using the serial communication board, you can power the UDB4 from board as shown below with a MediaTek GPS receiver attached.

