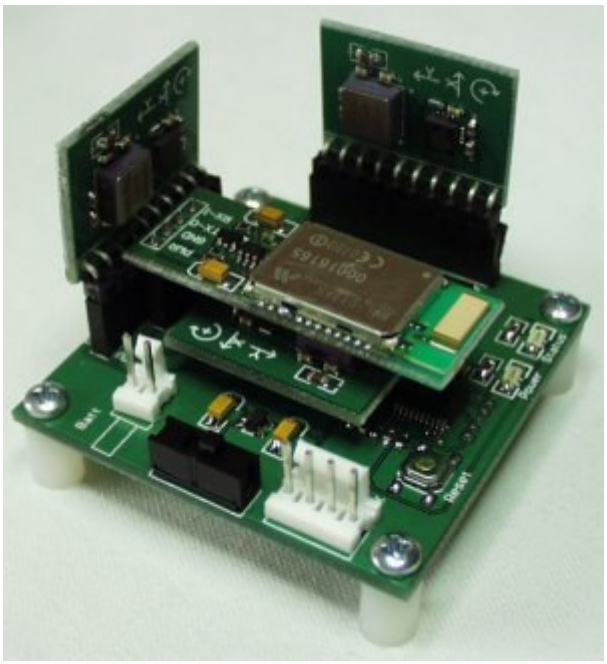

IMU 6-DOF

Six Degrees of Freedom
8/8/2005

1 Overview

The IMU 6-DOF unit was designed to provide a wireless 3 dimensional sensing platform development tool for a reasonable price. Combining a variety pre-existing of Spark Fun devices, this unit has applications in guidance control, industrial sensing, and a host of other applications where the user just has to know "what's going on over there".

The IMU 6-DOF kit is comprised of 1, 2 or 3 IMU units, a motherboard with a PIC16F88 for control, a BlueSMiRF unit and a Bluetooth USB dongle, and a 4xAA Battery holder with polarized connector.

The IMU 6-DOF unit provides:

- Three gyro readings
- Six tilt readings
- Three temperature readings from ADXRS sensors
- Three 2.5V outputs from the ADXRS sensors for error correction
- One battery level voltage

These readings are accessible through a terminal program, or optionally with the IMU 6DOF Mixer v1.0. Additionally, the unit may be connected to a serial port through the 4-pin debug header. **Caution:** care must be taken to remove the BlueSMiRF module before connecting to the debug header.

2 Installation and Configuration via Hyperterminal

The first thing you need to do is install the Bluetooth USB dongle, instructions for which can be found in a pamphlet contained in the manufacturer's shipping box.

Once the USB dongle is configured, the BlueSMiRF must be configured. This can be done by powering up the IMU 6-DOF unit and following the instructions detailed in the BlueSMiRF Datasheet . IMU units may or may not be installed for this procedure, it won't make a difference.

Once you've got the two BlueTooth modules talking to each other, you must remotely set the baud rate on the BlueSMiRF to 57600/8/N/1. This is the setting for the BlueSMiRF to talk to the PIC16F88 on the 6-DOF motherboard. First, open up Hyperterminal to the specified port for the BlueTooth dongle unit. The BlueTooth icon on the right side of the taskbar will turn green when the two units are connected. When the connection is good, send the command "+++<cr>".

You should then get an "OK" back from the remote unit and you are now in command mode. Next, send the command "ATSW20,236,0,0,1<cr>". No response will be given from this command, but you can immediately check to see if it took by entering "ATSI,8<cr>". If the baud rate changed, you'll get back "00EC,0000,0000". The last thing you need to do is to put the BlueSMiRF back into data mode by sending "ATMD<cr>". Once that's done, you can send "<ctrl>g" (ascii 7, "g" for "go"), and that will start the 6-DOF unit sending measurements.

3 Connecting via IMU 6DOF Mixer

After configuration is completed, you can get a graphical representation of the data returned from the 6-DOF unit by starting up the IMU 6-DOF Mixer application (this is without Hyperterminal running, of course). Once it's open, select the com port you wish to connect to and hit "Connect to IMU". The port you select can either be the BlueTooth dongle port or a hardwired port to the debug header on the 6-DOF unit. Again, **if you use the debug header, the BlueSMiRF must NOT be in!** Having it in will cause a UART conflict.

5 Hardware Layout

The 6-DOF unit motherboard is 2"x2" and sits on .375" stand-offs. Two of the three IMU units stand vertically on the motherboard, and stand 1.165" high when mounted with headers or .845" high when soldered directly onto the board. The third IMU and the BlueSMiRF module sit horizontally above the motherboard, as seen in the photo at the beginning of this data sheet.

The motherboard is equipped with a power switch, a polarized battery connector, two LED's (one for power, one for status), a reset button, a 5V regulator, a 4-pin debug header and a 5-pin ICSP socket. The kit also comes with a 4xAA battery holder and a set of stand-offs.

6 Firmware and Output Format

The theory of the 6-DOF's operation is very simple. Three SFE IMU units provide 5 measurements each. These fifteen measurements, plus battery voltage, are then multiplexed via a CD74HC4067 16-channel multiplexer to DAC on the PIC 16F88. The PIC then takes these measurements and sends them out it's UART at 57600bps, either to a hard-wired serial port or to the included BlueSMiRF.

As mentioned, the current firmware runs the PIC16F88's UART at 57600bps. We've found that we can safely run at this speed without compromising the accuracy of the DAC.

The output of the data stream on the receiving end of the 6-DOF unit is 34 bytes in length. The data stream begins with the ascii character 'A', followed by the 16 DAC measurements. The sequence of the measurements following the start character is:

1) Pitch, Rate Out
2) Pitch, 2.5V
3) Pitch, Temperature
4) Pitch, Yfilter
5) Pitch, Xfilter
6) Roll, Rate Out
7) Roll, 2.5V
8) Roll, Temperature
9) Roll, Yfilter
10) Roll, Xfilter
11) Yaw, Rate Out
12) Yaw, 2.5V
13) Yaw, Temperature
14) Yaw, Yfilter
15) Yaw, Xfilter
16) Battery Voltage

Each measurement is two bytes in the data stream. Each two-byte segment utilizes the lowest ten bits for the measurement (the upper six bits will be read as 0), and they are sent MSB first.

The last byte in the data stream is an ascii 'Z'. The first and last bytes were set to simple ascii

characters in an effort to simplify development, providing a simple way to sync to the data stream and a simple way to see if you're receiving properly. If in doubt, you can always open Hyperterminal and see what's going on. You won't be able to see the actual measurements that way, but you'll always see an 'A' and a 'Z'.

Data frames, which includes an 'A', 16 measurements and a 'Z', occur at a rate of 23.5Hz.