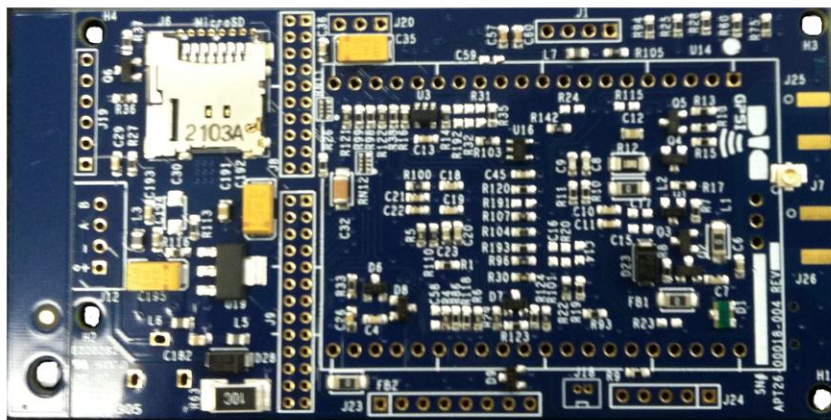




# FLIGHT RECORDER 1 (FR-1) - GPS LOGGER



The Flight Recorder - 1 telemetry module is a high performance, GPS data logging system which enables local logging of GPS data via onboard Micro-SD storage, temperature, power, and ADC channel data are also logged in separate files. Add a 9V battery, SD-Card, connect antenna, and go! Full data logs available for import later via MicroSD. Also outputs NMEA data on CPU\_TXD/CPU\_RXD host interface and can be interfaced to BT/Wi-Fi/RF.

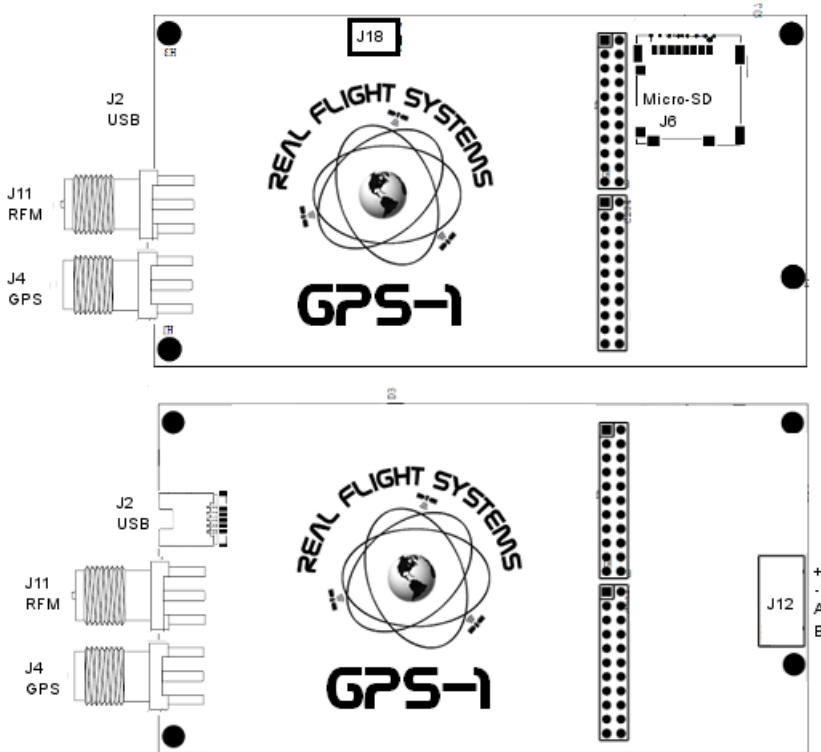
- 16MIPS RISC CPU for high-performance GPS system processing
  - Filtering for GPGGA/GPGSA to preserve RF Link bandwidth and real-time background processing
  - Output on CPU\_TXD/CPU\_RXD for interfacing to an external Modem
- SDIO Micro-SD Memory Card support (J6) for data logging
  - FAT16/FAT32 media (up to T10 V2.0 32GB Cards)
- High-performance uBlox LEA-6 GPS Receiver Module with uBlox u-Center USB support
- External SMA connector for active input GPS Receiver antenna
  - Sarantel SL1206R GeoHelix®-P2 high-performance, high-gain, low-noise amplified active input GPS receiver antenna (recommended)

- Up to 12V, 10A input power support
- Temperature Sensing from -55°C to +125°C with 0.5°C Accuracy
- Voltage Metering of Primary battery, Current, and GPS Almanac Battery
- Supported software: any NMEA GPS Program (ExpertGPS, VisualGPS, Google Earth, etc)
- 3V External battery for GPS Almanac back up and uBlox-6 Hot-Start™

## MECHANICAL

Dimensions: 49.35mm W x 91.35mm L (1.94" W x 3.59" L)

PCB Mounting hole dimensions: 86.65mm x 43.65mm



- J6: Micro-SD Slot: Any Micro-SD card formatted as either FAT16 or FAT32 media is supported.
- J18: GPS Battery, attach GPS 3V Almanac battery to this connector. The connector is keyed for connection.
- J2: uBlox uCenter USB Port
- J11: RF Modem connection, RPSMA plug
- J4: GPS Modem connection, SMA plug
- J12: Power + Switch: Connective positive to +, negative to -, A/B to switch
  - To use without switch, either shunt A/B or connect positive(red) to B lead, and negative(black) to - lead.

## CONFIGURATION JUMPER (CFG1/CFG2)



- Default, Normally pins 11-12 are shorted (which runs GPS processing at boot). Note that this is the 6<sup>th</sup> Jumper position from the edge of the board.

NOTE: When this jumper is removed, the system allows for remote login and control (default password=rfs1)

NOTE: If this jumper is removed, your Base-station will NOT show any data on the display until the “gps” command is issued via the USB connection on the Basestation to the host computer.

## UART INTERFACE

Pin-1 is the square hole, jumper goes 1-2,3-4,etc across. All IO is 3.3V logic levels. UART baud rate is fixed at 9600 baud (9600, N, 8, 1).

Jumper	Pin	Function	
J9	1	3V3_DC	
	2	CPU_TXD	- console output (line based - \r\n)
	4	CPU_RXD	- console input (line based - \r\n)

## LEDS

- D22: BPWR – glows red with Battery Power
- D14: Activity – blinks green with RF Modem activity
- D4: Fix – Glows Blue with GPS position
- D3: Sys – Toggles with system activity
- D29: SDIO – Toggles when writing data to SD-Card

## GPS CONFIGURATION

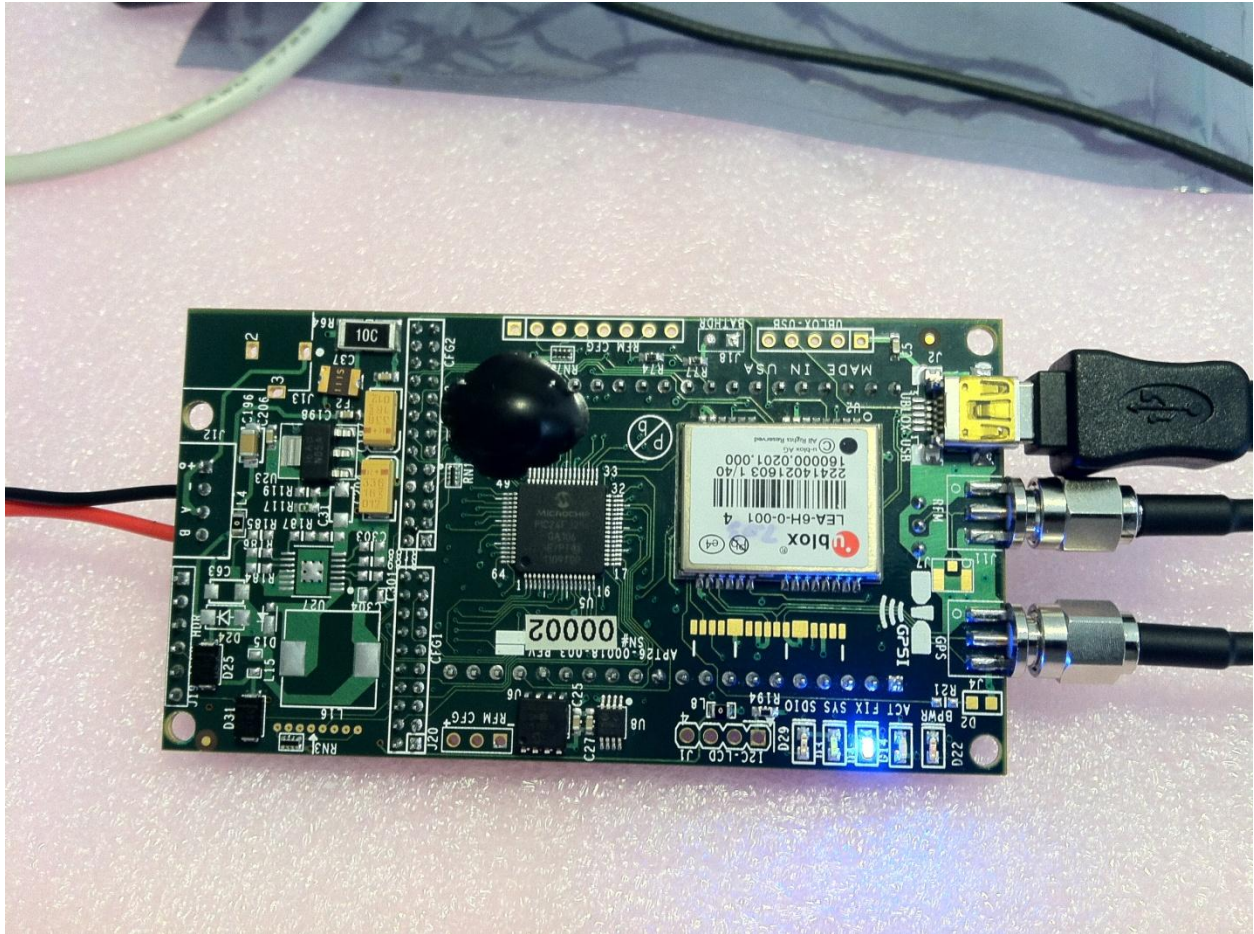
Your GPS1 module comes with factory defaults. The uBlox GPS chipset also features a 2 week GPS Almanac (cache) which works in conjunction with the GPS almanac cache battery. The GPS Almanac aids navigation by providing for Ephemeris data at start-up and allows for a so-called “hot-start”. When the GPS module is powered down, the GPS Back-up battery keeps the Almanac up to date until the unit is powered back on again. If the GPS almanac is pre-programmed, initial lock times can take as long as 5 minutes while the uBlox chip-set downloads the GPS Almanac over the air (OTA). To accelerate start-up and provide a 2-week cache of data (with battery back-up), the following procedure is recommended for pre-flight configuration.

1. Install uCenter (7.02) or later
2. Connect the GPS battery to J18

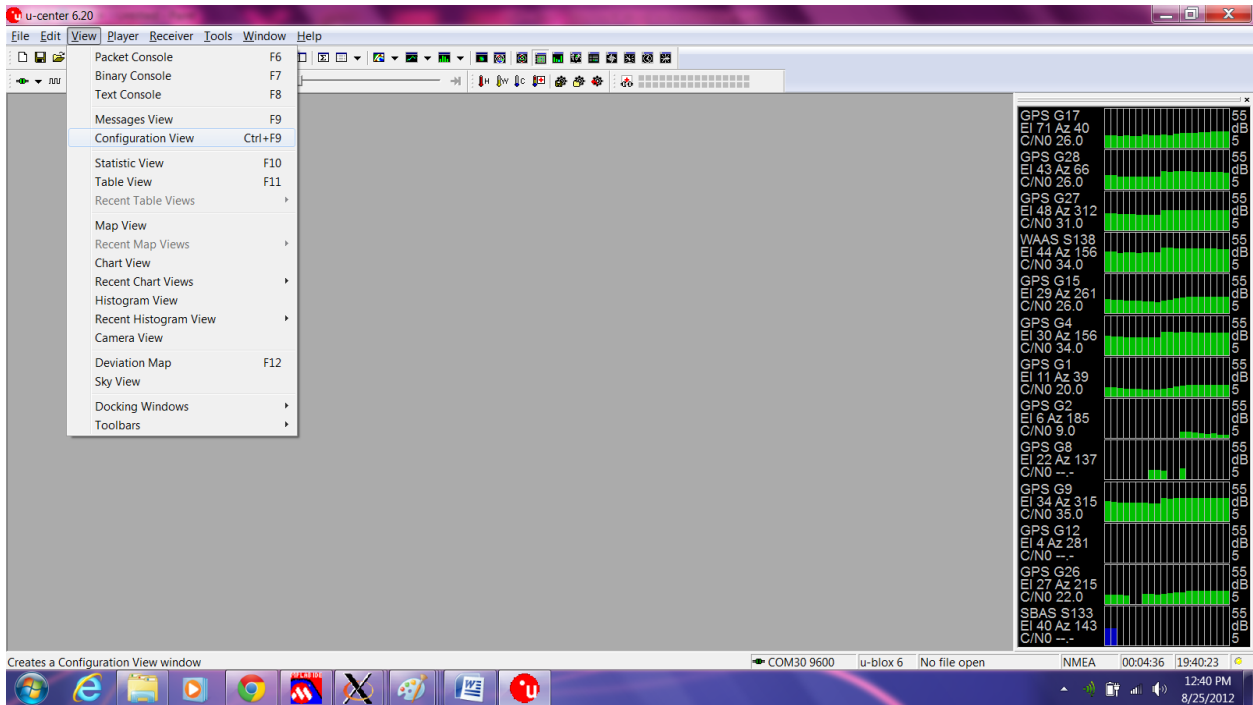


3. Connect the main 9.6v battery or turn on the power switch connected to J12
4. Connect a mini-USB cable to the GPS1 USB port and the other side to the computer

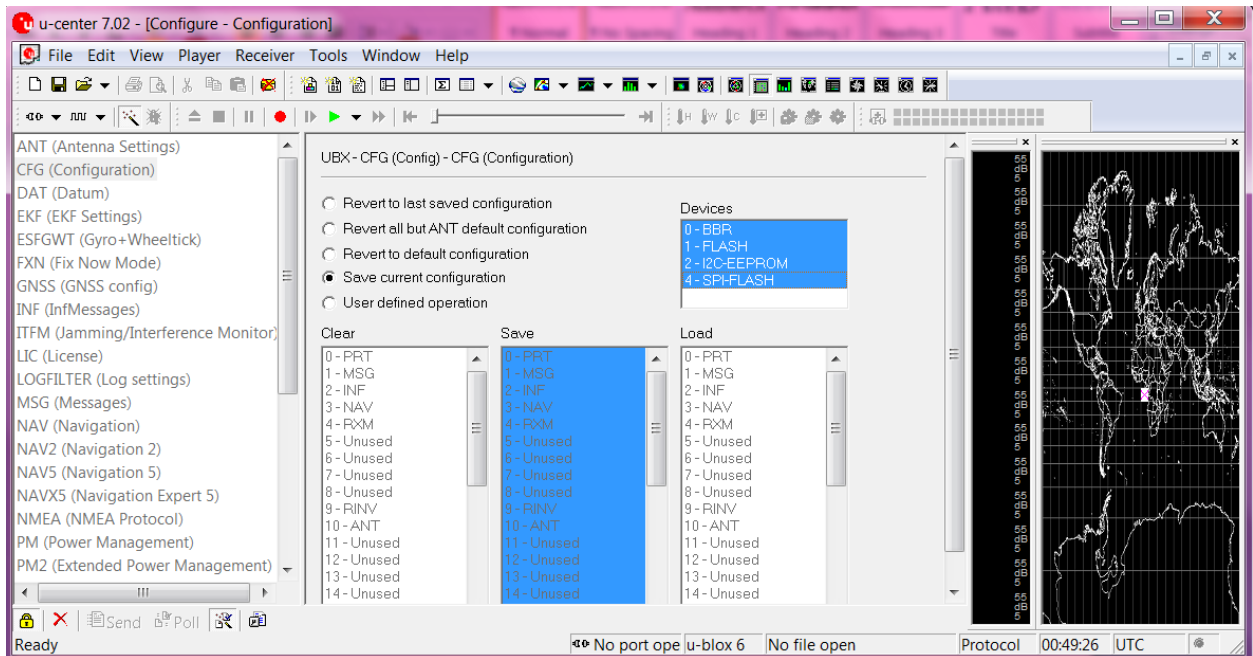




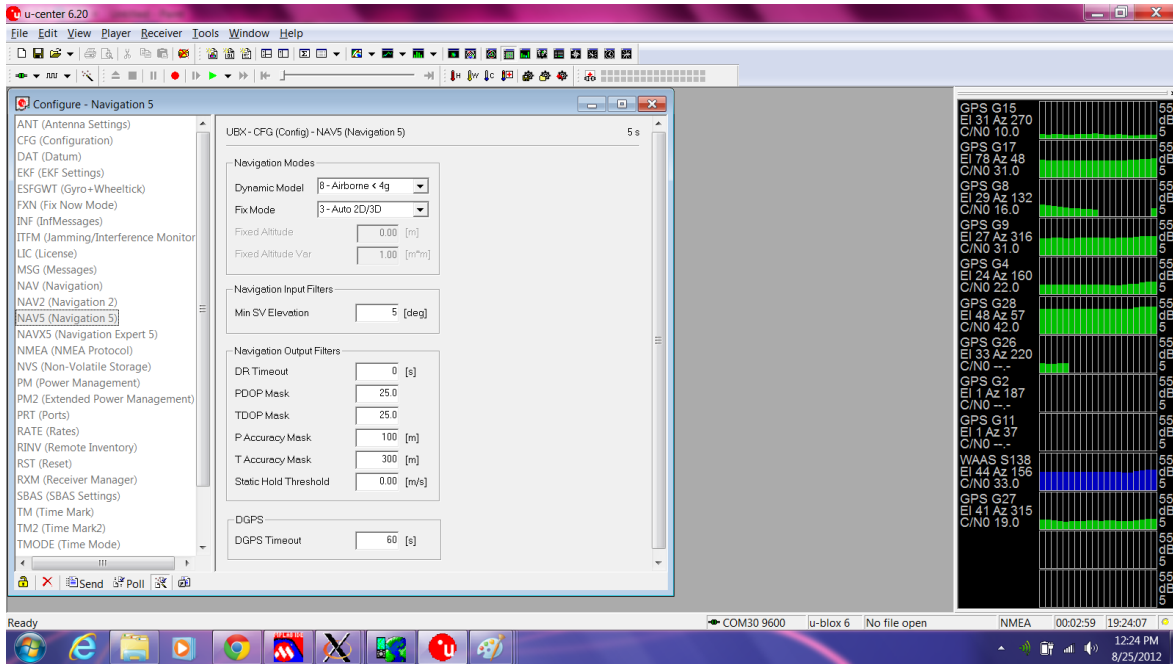
5. Start uCenter, select the "Receiver->Port->XXX" where XXX is the USB port found by your computer attached to GPS1. NOTE: you can use DeviceManager under Windows and find the uBlox USB Device port.
  
6. NOTE: once uCenter is installed, the uBlox should be detected under Device Manager. To download the latest version of uCenter, visit <http://www.u-blox.com/>
  
7. Select Configuration View as below



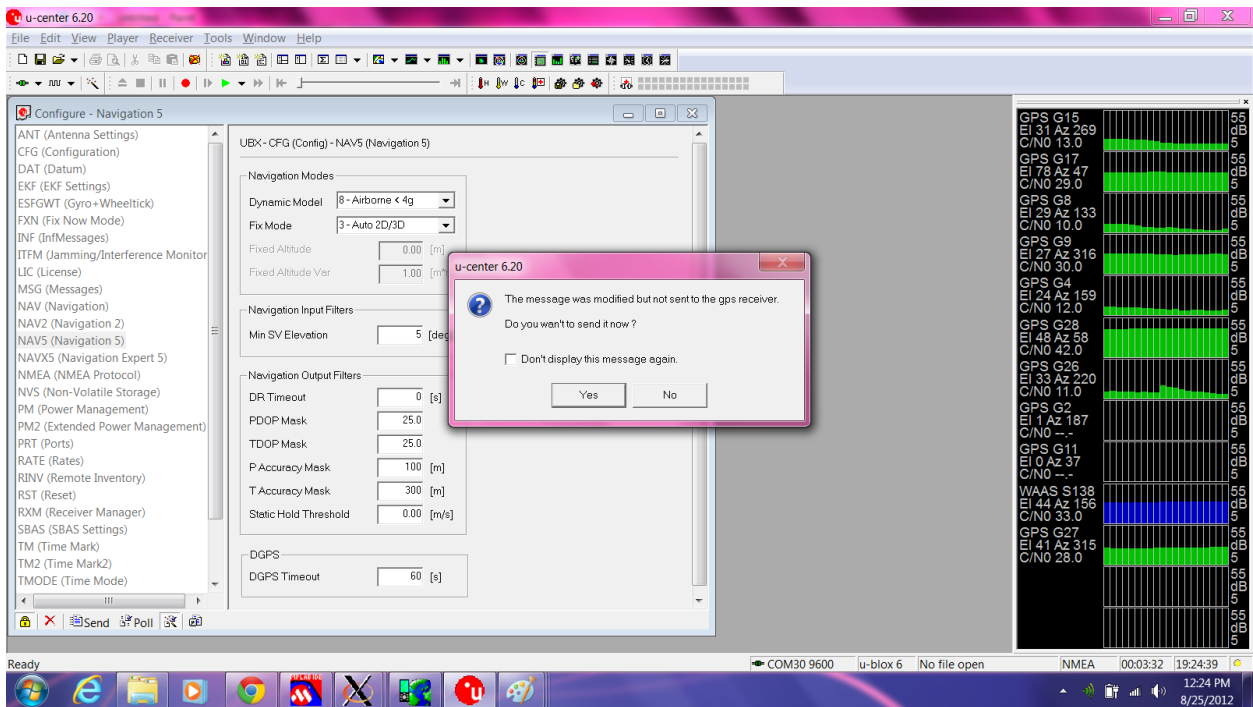
8. Verify that the configuration data will be saved to the device (BBR, FLASH, I2C EEPROM selected)



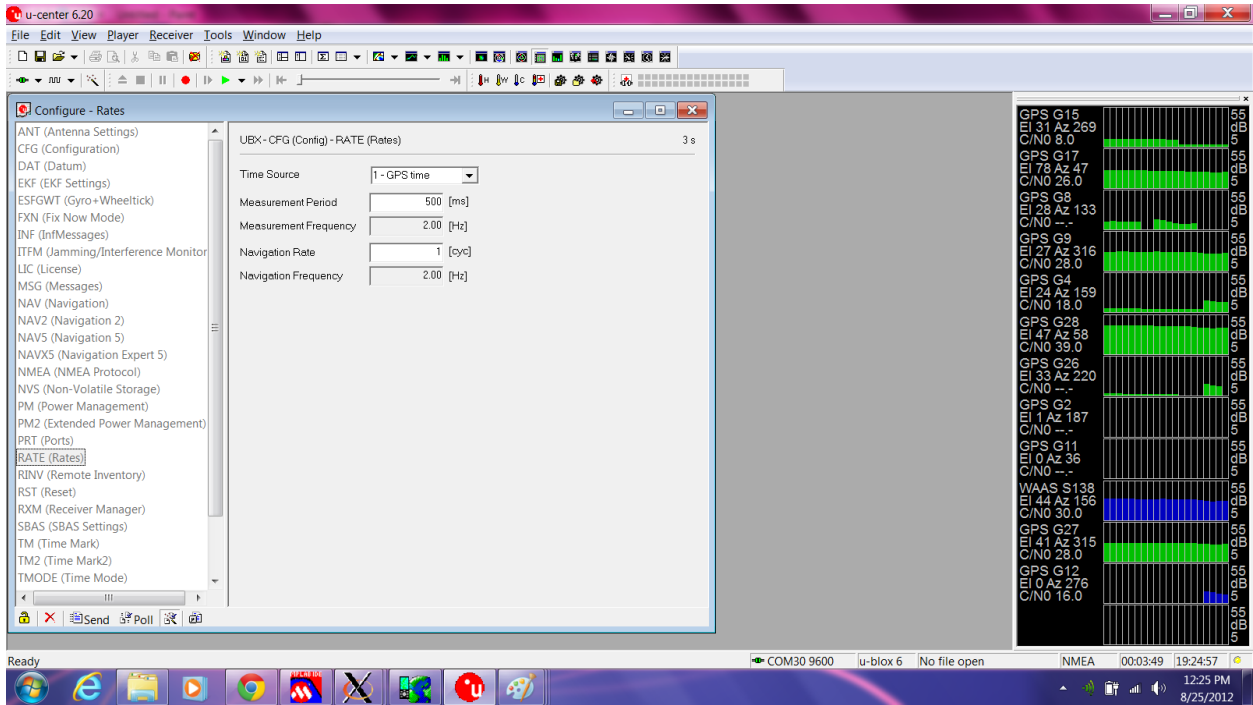
9. Verify that NAV5 is set to Airborne Mode



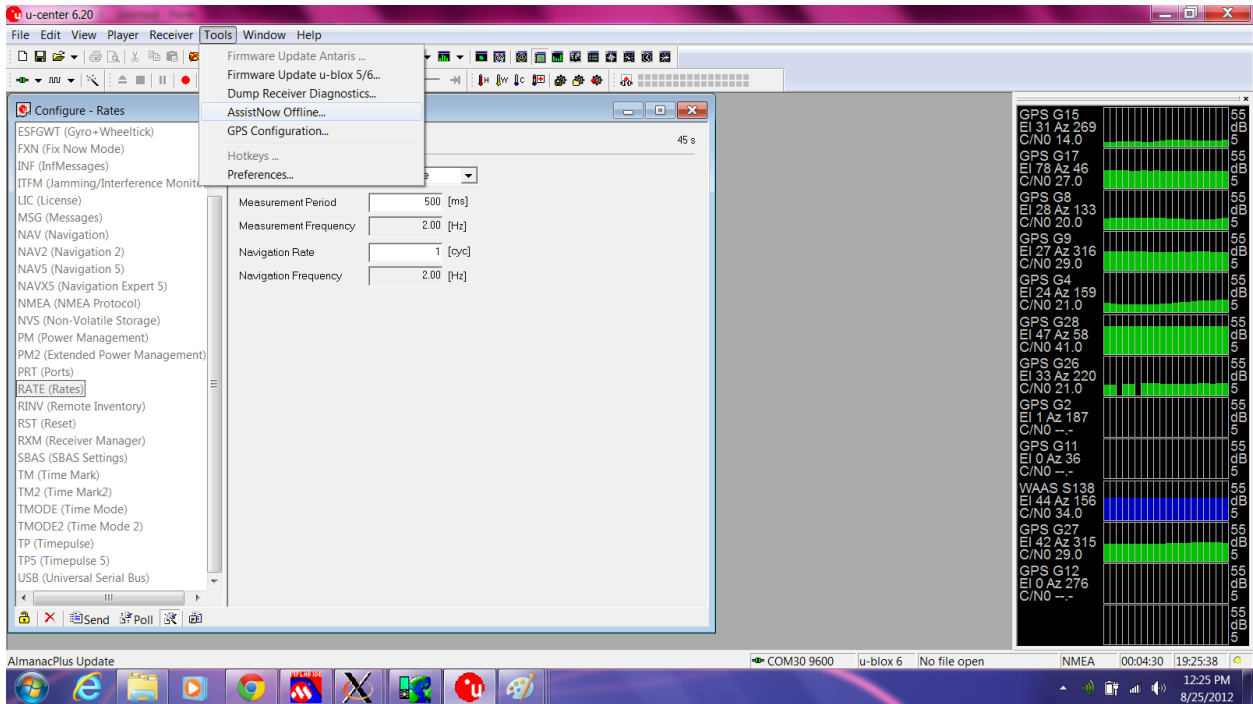
Note that if the configuration is not set, uCenter will prompt to write back the data to the receiver. Always answer Yes if you are sure of your configuration, if not, press “No”



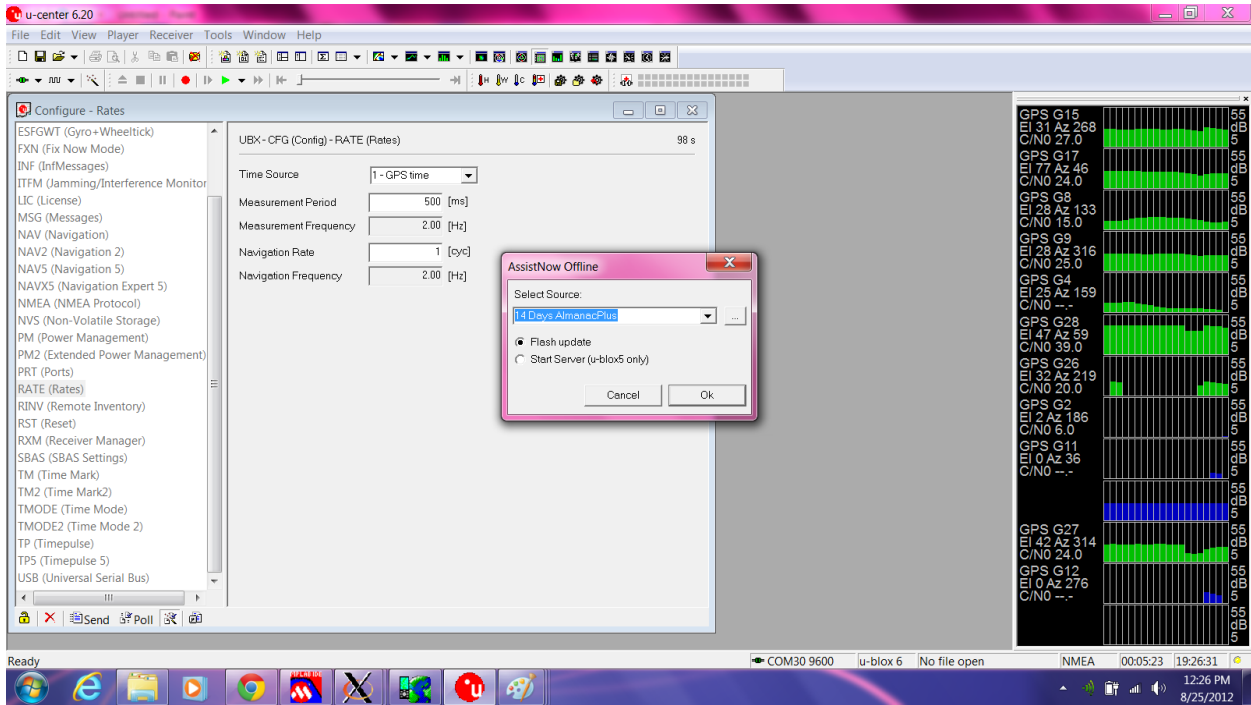
10. Verify the Rate is set to 2HZ (500msec) for 1-second real-time response with the Base station receiver



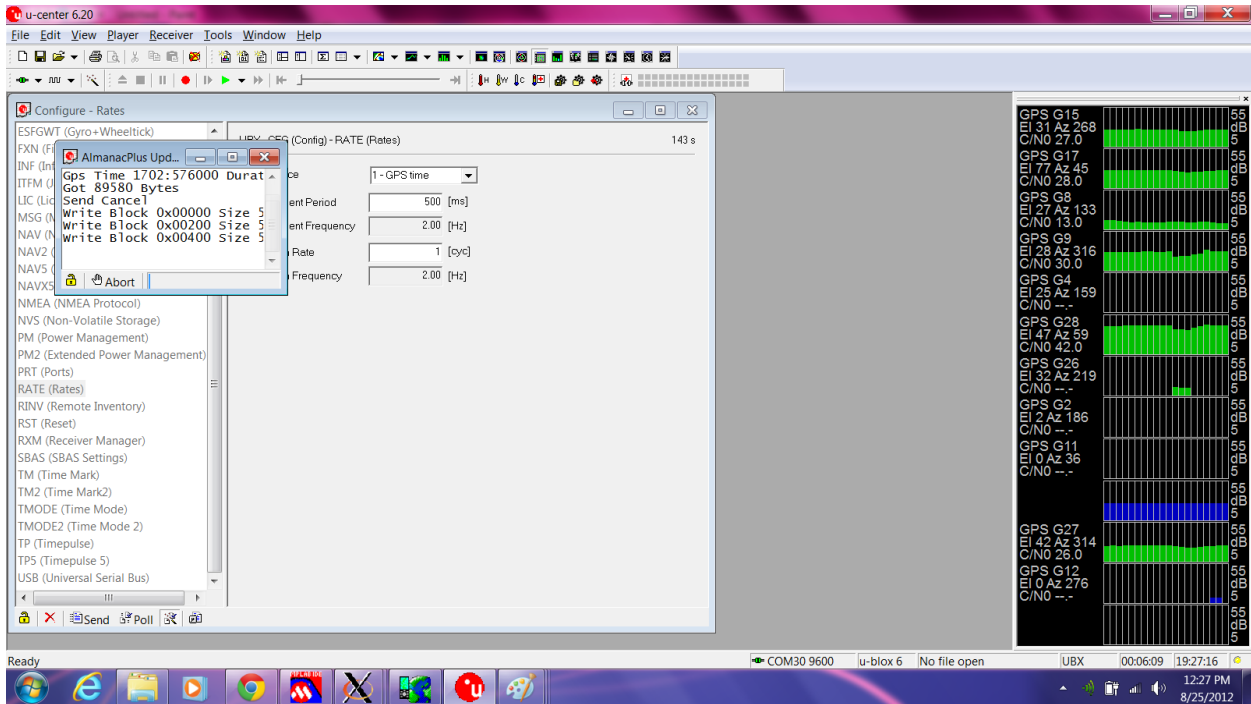
11. Select "Tools->AssistNow Offline"







## 12. Select 14 Days AlmanacPlus, and FLASH update



The unit is now configured. Be sure to leave the GPS Battery connected to the module so that the GPS Almanac data is preserved up to and during flight. Should the GPS lose telemetry lock during flight, the GPS battery will ensure hot-start and re-acquisition of fix in < 1 second with hot-start enabled.

When completed, use the uCenter menu options: GPS Configuration -> (GPS->File) to save your GPS configuration.

For fast recovery, use the GPS Configuration (File->GPS) option to program your receiver. Verify the firmware and uCenter version first before following this procedure (and note that newer versions of firmware require newer versions of uCenter for correct programming).

Sample configuration files may also be found at <http://www.realflightsystems.com/techpubs/ublox/>

## **TROUBLESHOOTING**

When powering up the board without using a switch, make sure you plug in the connector quickly to avoid transients. When powering up the board using a twist-wire switch, make sure you firmly press the two leads together first and then twist the wire (also to avoid transients).

Note that when properly functioning, D29, SDIO will blink RED when writing data to SD-Card, if you do not see this behavior, power down the board, remove the SD-Card and re-insert it to make sure it is properly seated.

Verify the jumper on CFG\_1 is set - normally pins 11-12 are shorted (which runs GPS processing at boot). Note that this is the 6<sup>th</sup> Jumper position from the edge of the board.

NOTE: removing CFG\_1 jumper pins 11-12 for Basestation-2 users will render their system inoperable until the jumper is re-inserted (in this mode, GPS-1 waits for remote login from the Basestation-1 forever).

## **BATTERIES**

- DC voltage 6.0 - 14V DC (LD117STR, LM317)
- Average current: 200-245ma

Note that any battery 6V, 7V, 9V, 12V may be used.

, select one with a current rating of 250mAh for one hour of use, higher mAh ratings for proportionally longer runtime (depending on battery type and chemistry).

## **GPS OPERATIONAL LIMITS**

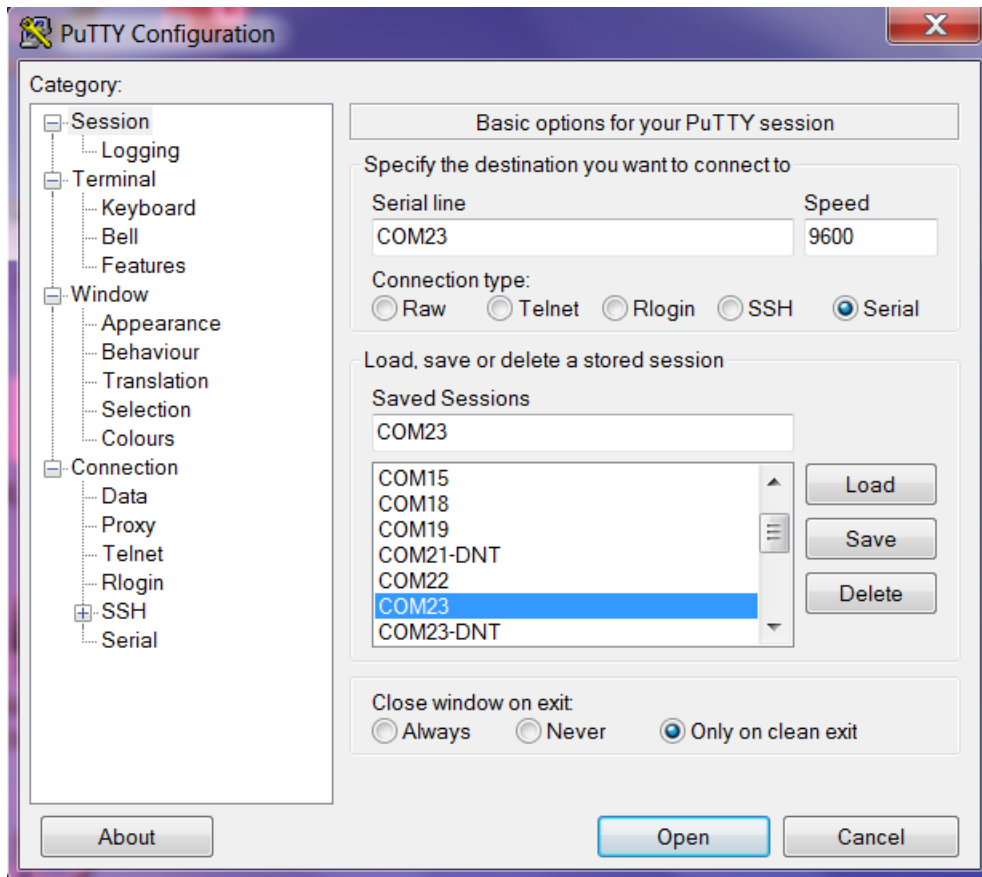
uBlox-6 Operational Limits under good GPS signal conditions and assuming Airborne platform configuration as documented.

- Dynamics:  $\leq 4$  g
- Altitude: 50,000 m (164,042 ft MSL)
- Velocity: 500 m/s (1,118.47 MPH or 1640.42 feet/second, Mach 1.49)

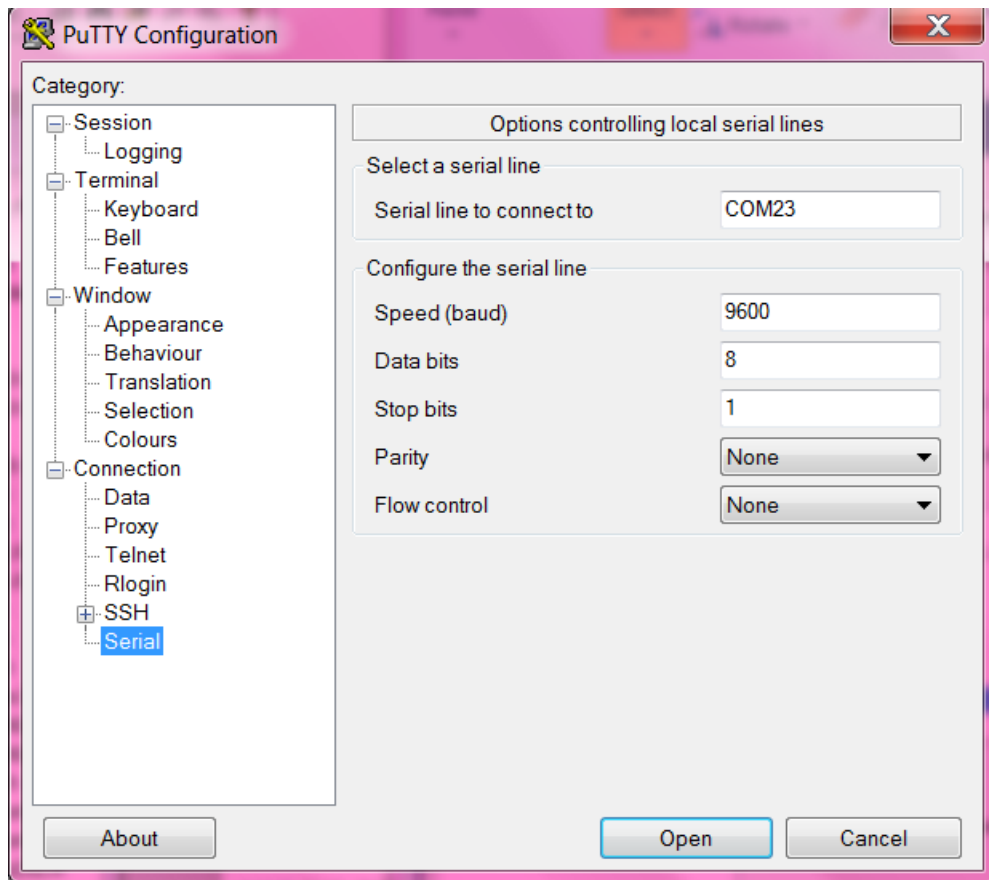
## COMMAND INTERFACE

When the configuration jumper on pins 11-12 is removed (the 6<sup>th</sup> Jumper position from the edge of the board), and the CPU\_TXD/CPU\_RXD is connected to the host computer (3.3v level CMOS), the system will boot up and provide a remote control serial console. Following is the remote control console procedure using an FTDI 3.3v USB->Serial adapter cable connected to the UART pins.

1. Connect the USB port of the Base station to the host PC. Windows will install drivers for the FTD232 serial device.
2. For Windows, use any terminal emulation program you have installed (e.g. Hyperterminal), or use Putty (located on the CD). Go to Device Manager and look under Com ports to find the name of the COM port to connect to. Launch Putty, you will want to type the NAME of the Com-Port (e.g. COM23) into "serial line", "9600" into speed, and type the name of the COM-Port (e.g. COM23) into the "Saved Sessions Field". Press "Save".



3. Next, click on the Serial item on the list to the left titled "Category"



4. Confirm flow control off and 8,1,N serial settings. *Note that the default settings for the Putty terminal emulation program have XON/XOFF selected!* Keep in mind that if you use a new USB port on Windows, you may have to go through this process again (a well endowed desktop system may support dozens of USB ports). When satisfied with the new connection profile click on "Session" (under Category) to return to the previous menu. Press "Save", then press "Open".
5. Now, the next time you run Putty you may load the configuration and just press "Open".
6. Now start putty and reboot the Base station (power cycle)
7. Press enter when the prompt below is seen. NOTE: if the enter key is not pressed (e.g. you type nothing when the Base station boots), the USB connection acts as an NMEA output console allowing other programs (e.g. ExpertGPS) to perform real-time mapping of the data.



```
COM41 - PuTTY
J8 [5-6] : JP2 [SDA3] OFF
J8 [7-8] : JP3 [Base] ON
J8 [9-10] : JP4 [GPS ] OFF
J8 [11-12]: JP5 [RSVD] ON
J8 [13-14]: JP6 [RSVD] OFF
J8 [15-16]: JP7 [RSVD] OFF
J8 [17-18]: JP8 [RSVD] ON
J8 [19-20]: JP9 [RSVD] ON
J8 [21-22]: PWR VCC 5V

-----
J8 [7-8] : ON - Base-Station mode enabled
J8 [9-10] : OFF - Enter GPS2 console mode
rf0: DNT900C - channel: 0
SD:adding/opening SD/MMC (SPI) volume "sd:0:"...no SD-Card found!
NOTICE: FS initialization failed
Real Flight Systems - [GPS2] system init complete

Checking for user input on USB system console, Press enter to continue ...

USB Console: Base-station-1 console mode
Waiting for connection to remote ...
```

8. Boot the GPS-1 transmitter with the jumper removed. Note, one should be careful removing the 2MM jumper, it is not designed to be pried off. Use a small-tipped flat-head screw-driver and gently lift up on the bottom of the jumper.

```
COM41 - PuTTY
PIC24 ADC
System +/- Power: 10.23 V
GPS Backup Power: 1.22 V
Current      : 230 mA
-----: 0 mA
J9 Pin 3     : 0.00 V
J9 Pin 5     : 0.00 V
J8 Pin 4     : 0.01 V
-----: 0.00 V

SD:adding/opening SD/MMC (SPI) volume "sd:0:"...no SD-Card found!
NOTICE: FS initialization failed
Real Flight Systems - [GPS1] system init complete

GPS-2 login
Password:**
Login incorrect
GPS-2 login
Password:*****
GPS-2 login success
Welcome to GPS-2!
GPS-2>
```

9. Login using the default password **rfs1** - commands may now be issue to the Telemetry transmitter.

## **APPENDIX-1      FR-1 COMMANDS**

gps - go into GPS mode, press "x" to exit

adc - show adc

stat - show statistics

pass <password> - set the password

hn <hostname> - set hostname of the system

tz <offset> - set timezone offset (firmware versions 1.01 and later)

    e.g. "tz +8" will set to PST time. (NOTE: use "save" command to make persist across reboots)

tm X - telemetry output mode 0=NMEA0183 1=hostname,NMEA0183

    e.g. "tm +1" will output "hostname,\$GPGG.." etc - useful for multiple nodes on the same channel/link

save - save configuration

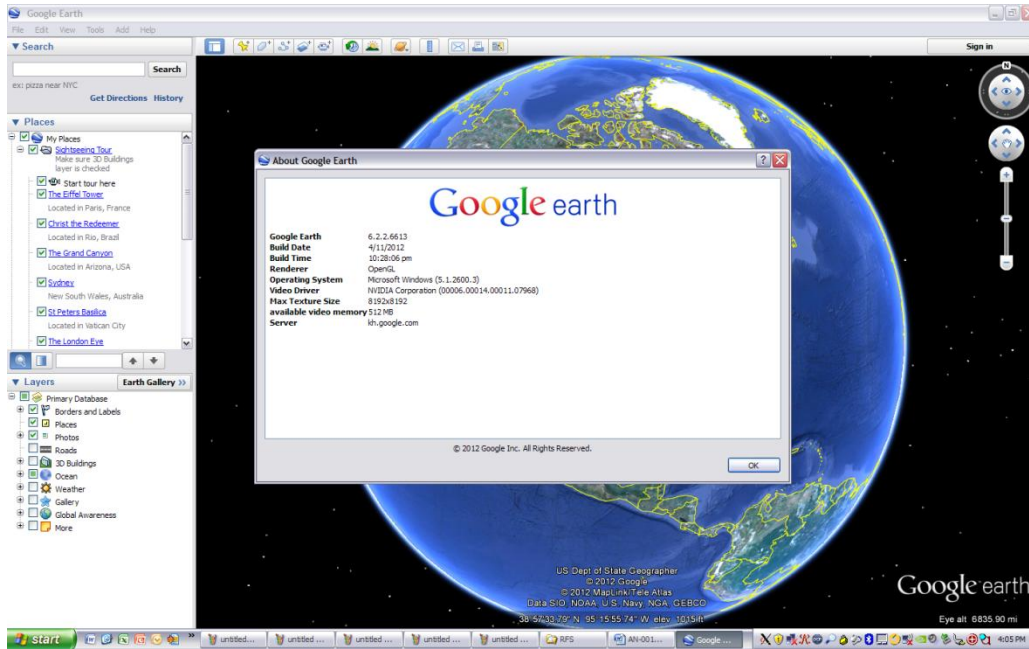
restore - restore defaults

reboot - reboot the system

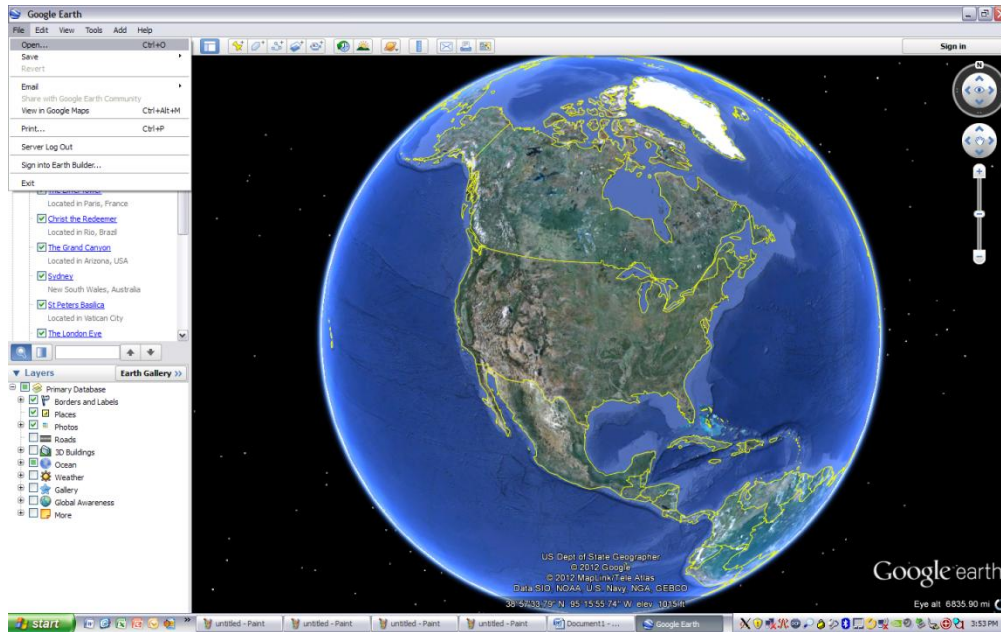
### **OPENING NMEA DATA FILES WITH GOOGLE EARTH**

- 1) GPS Log files are stored as gpslogXX.log resulting in up to 100 files being named gpslog00.log to gpslog99.log. The date and time stamp of the file is updated every time the file is updated with GPS data. Note that the timestamps are stored in GMT time (which is GPS native time) by default. Basestation-1 users may change the timezone for localtime
- 2) Launch Google Earth, the version used is as shown (6.2.2.6613)

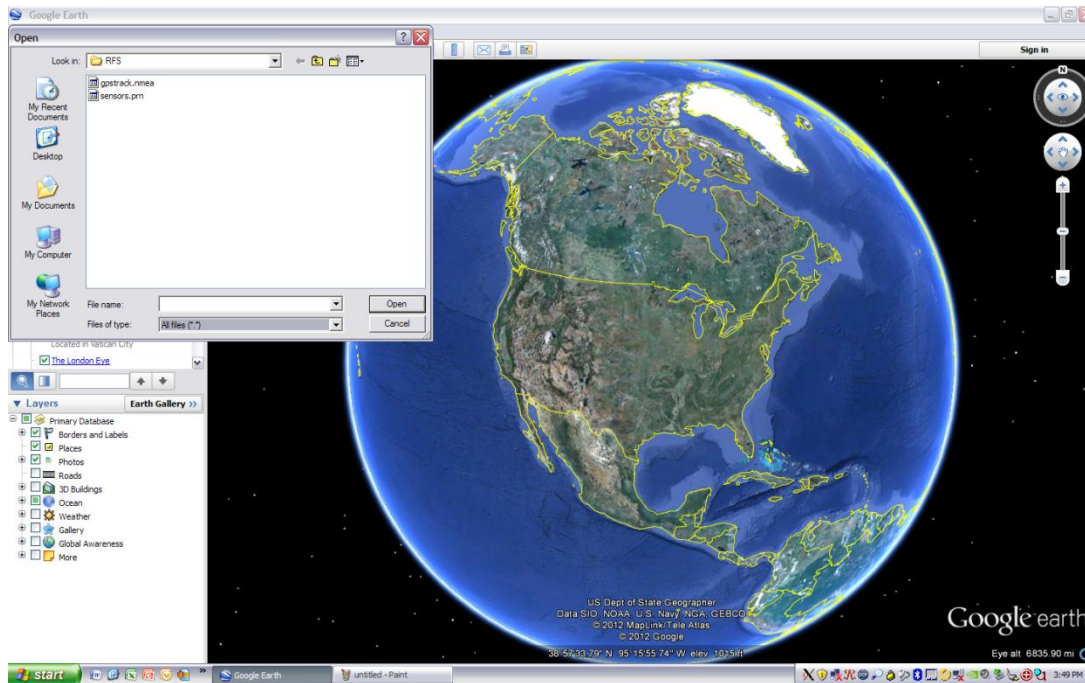
#### **CHECK VERSION**



## FILE->OPEN

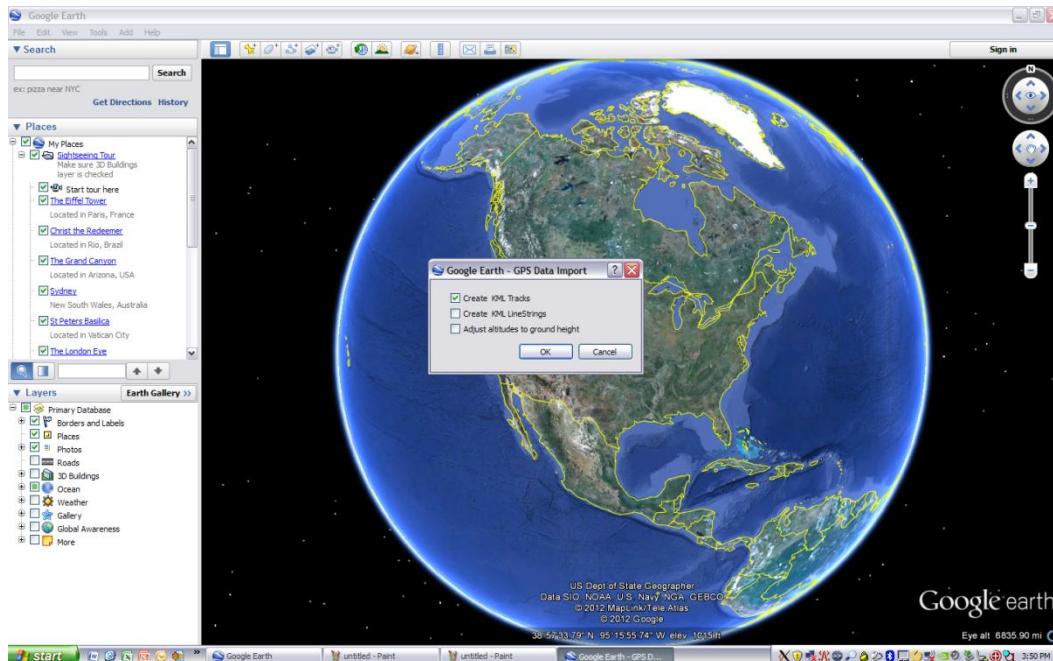


## SELECT "ALL FILES"



Double click on the NMEA data file (gpslogXX.log (where XX=0-99)). A Dialog is presented to show options for the NMEA data-file import.

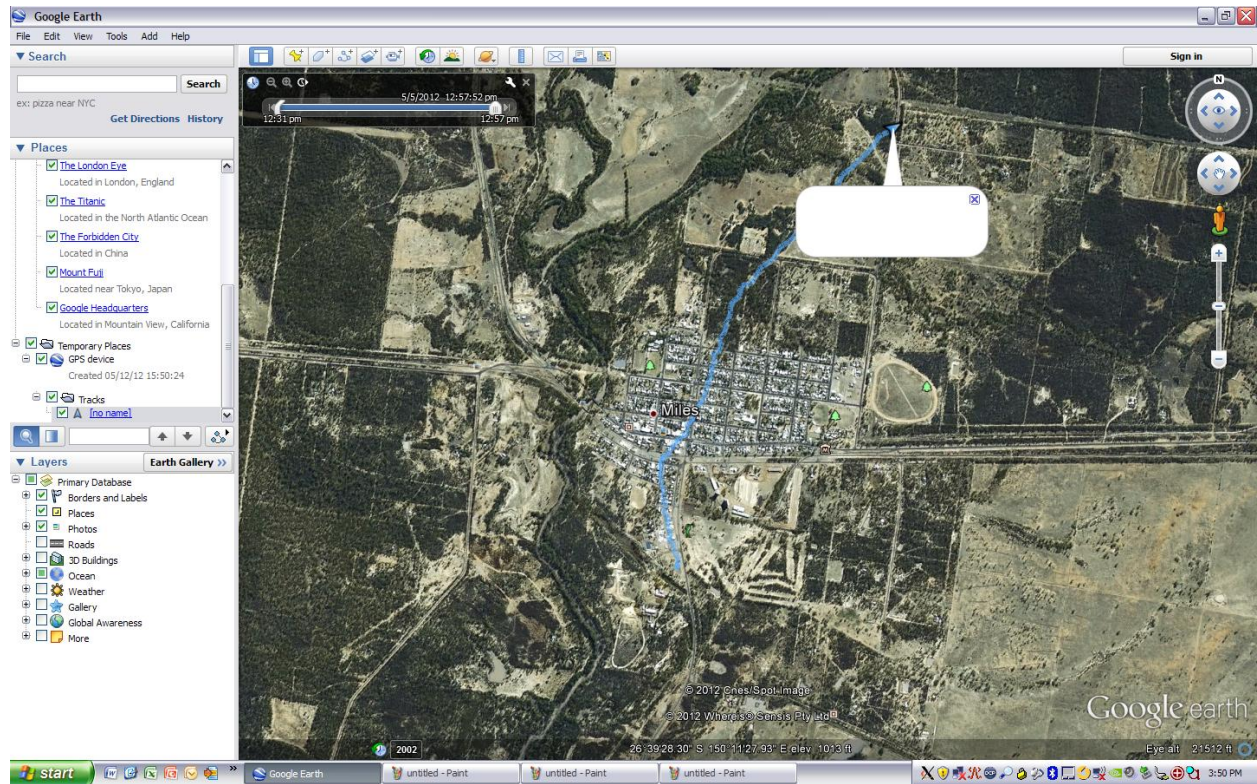
## SELECT IMPORT OPTIONS



The above dialog is display, Select "Create KML Tracks", deselect other options. The file is opened and the Globe will move to the tracks just imported.



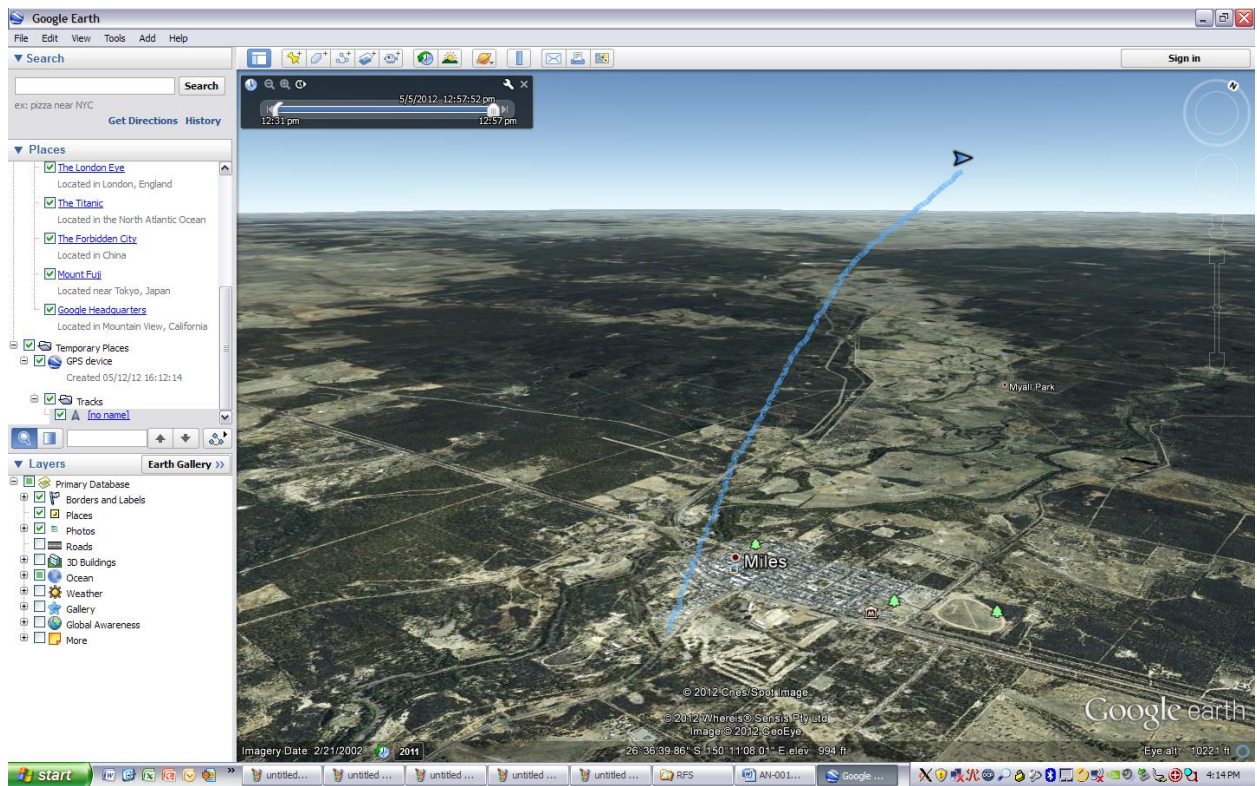
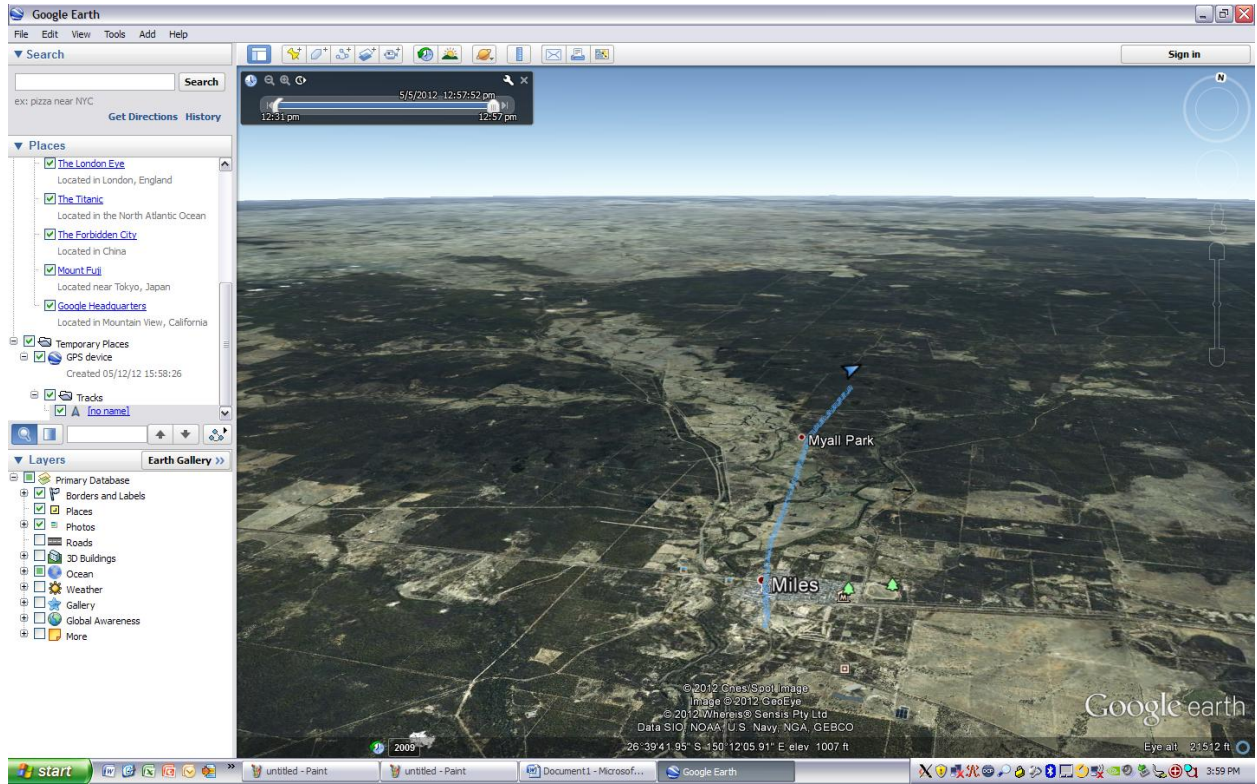
## MOVE TO LOCATION



Double click on the GPS Device, then click on the Tracks, and then the Arrow symbol entitled "No Name". Google Earth will Zoom in on the area of interest, you can move the Google earth knobs to get a better view of the data.



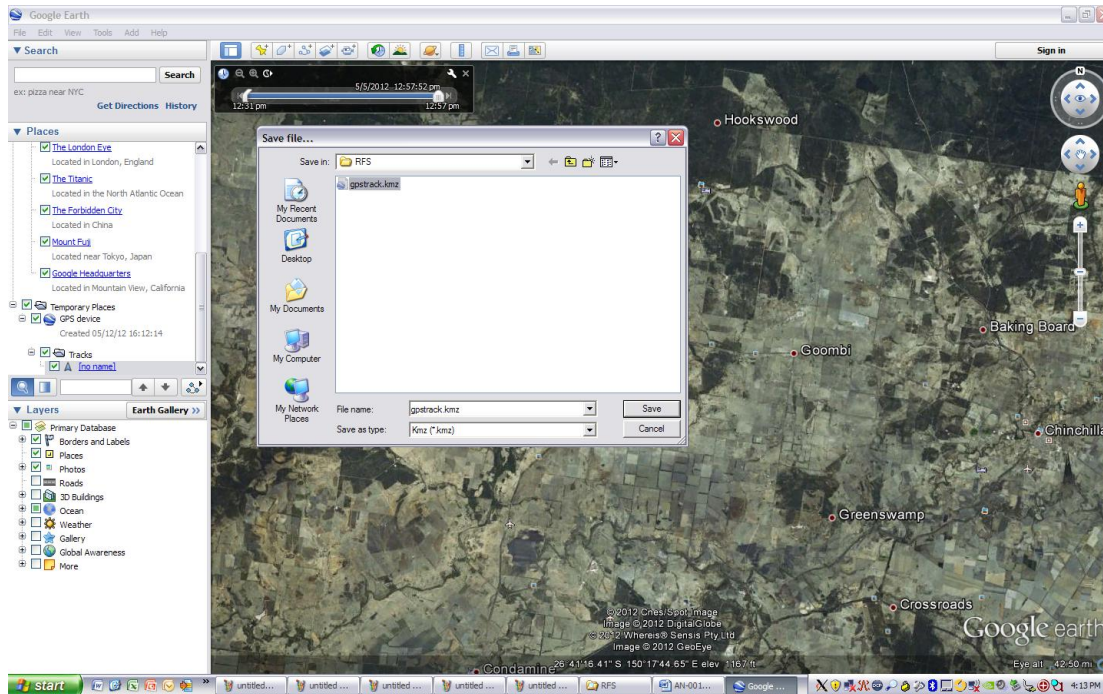
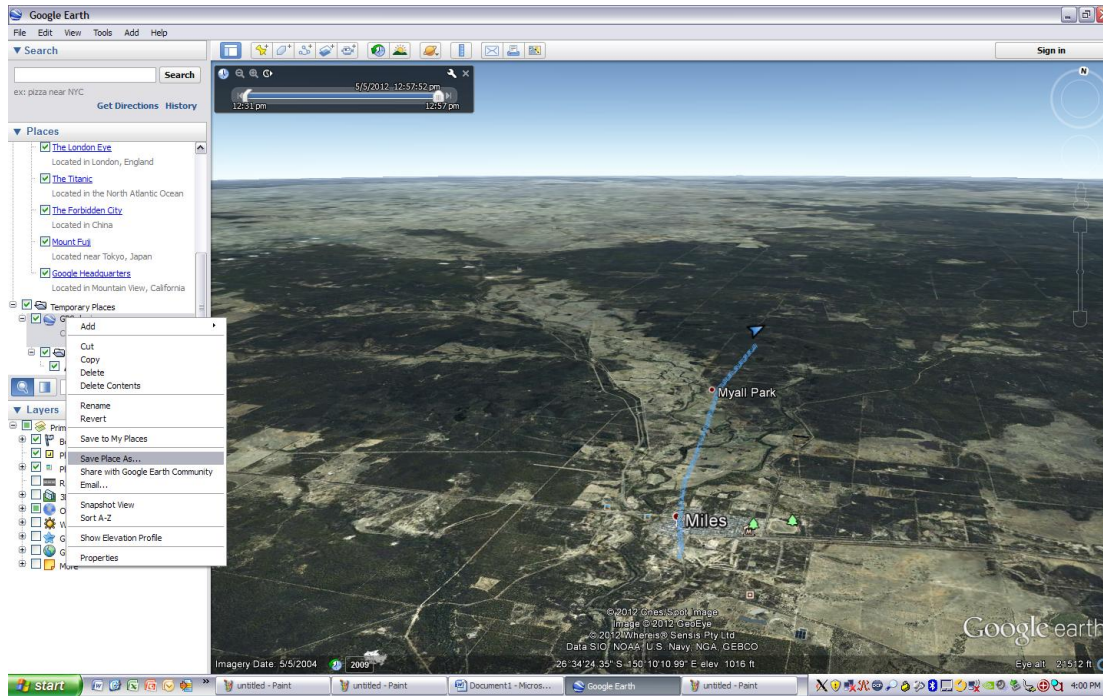
# REPOSITION VIEW





# SAVE GPS TRACK AS KMZ FILE

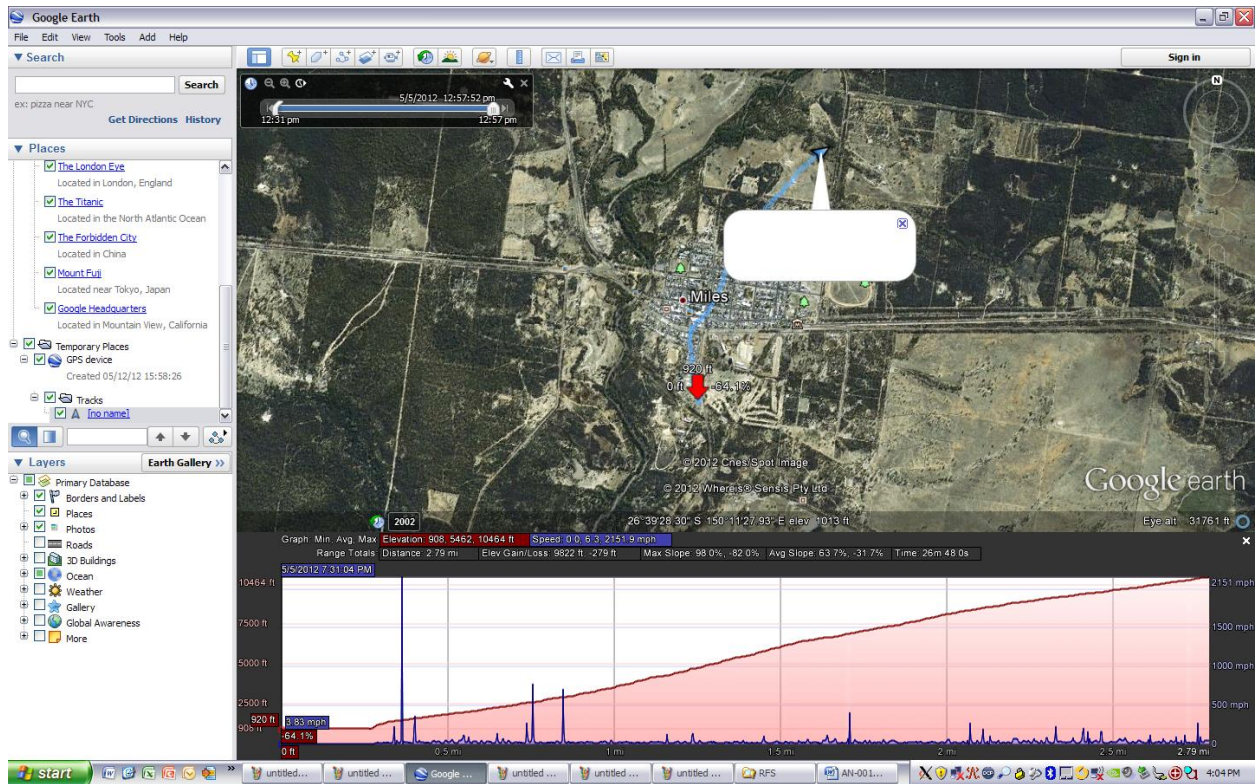
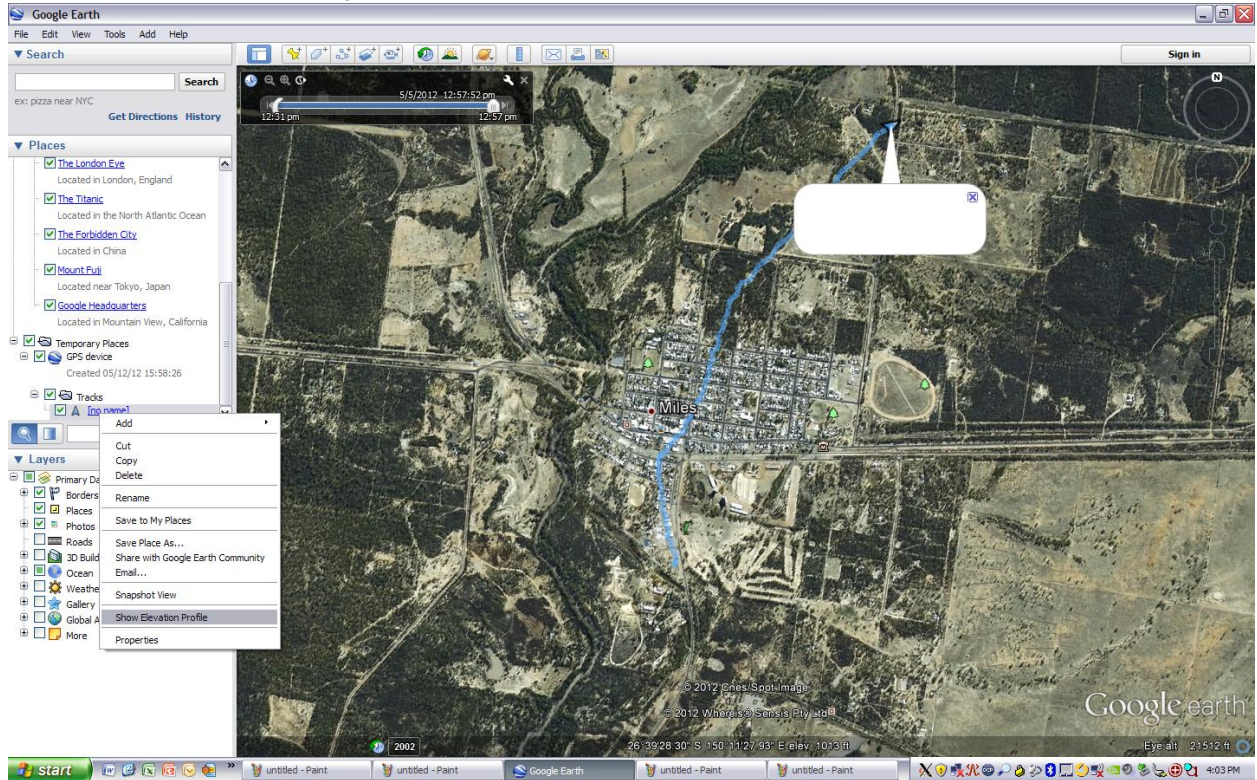
Right click on the GPS Device and select "Save Place as"





# ELEVATION PROFILE.

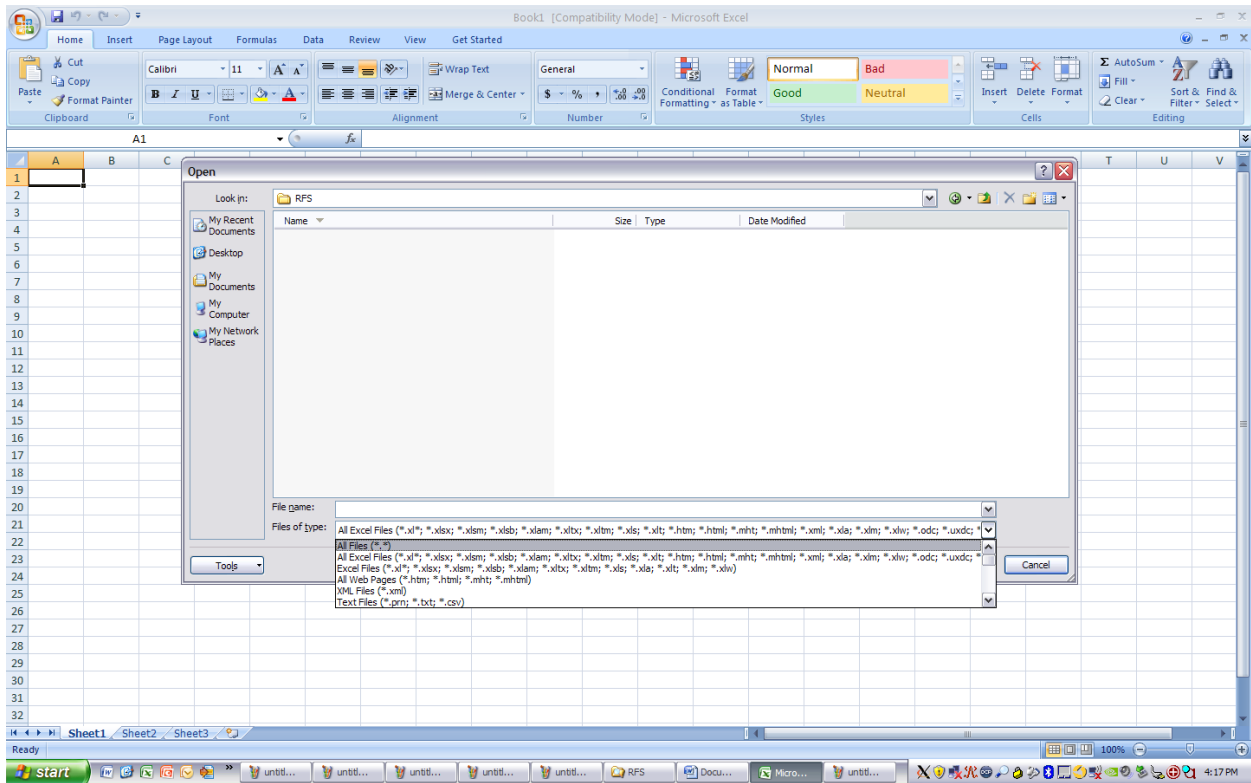
To show the Elevation Profile, right click on the tracks as below:



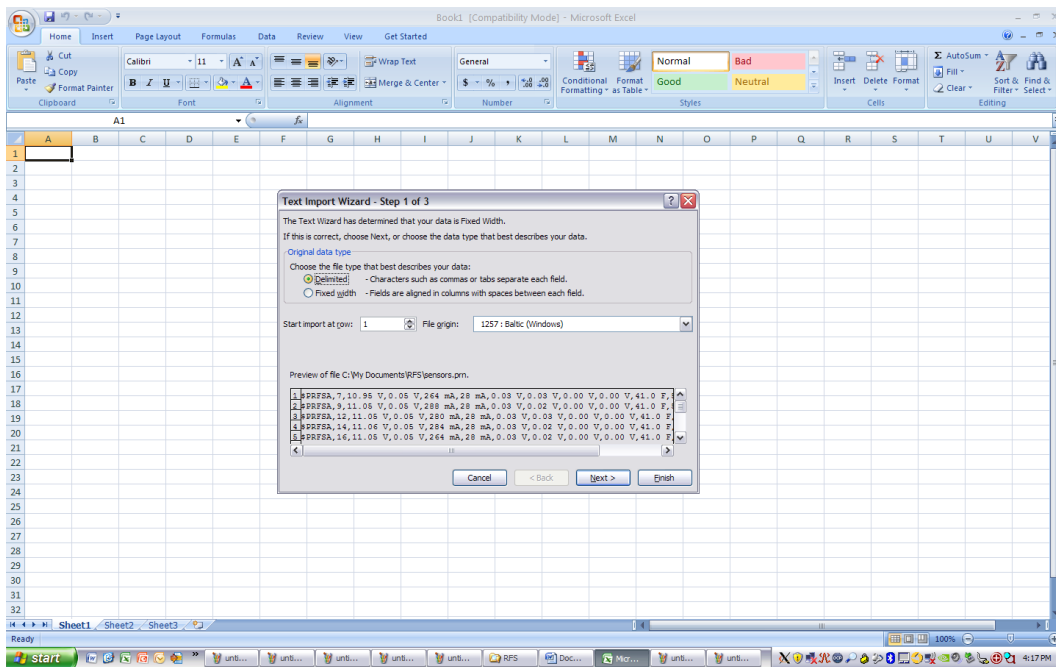


# IMPORTING SENSOR DATA INTO MICROSOFT EXCEL

1) Launch Microsoft Excel, File->Open, All Files Selected

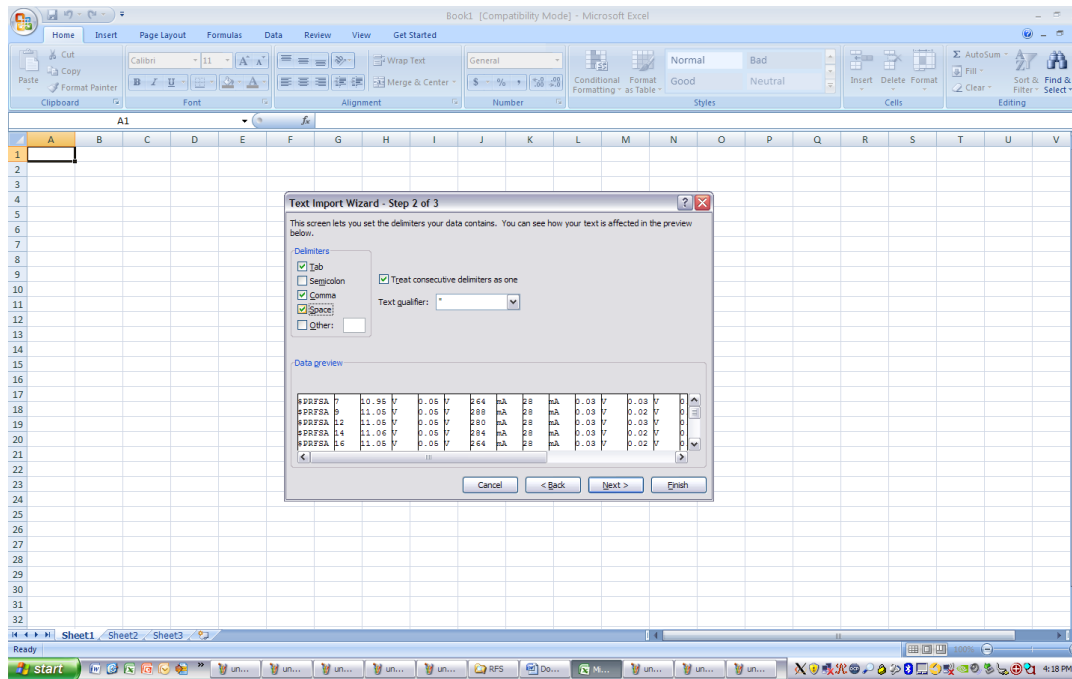


## IMPORT WIZARD PAGE ONE



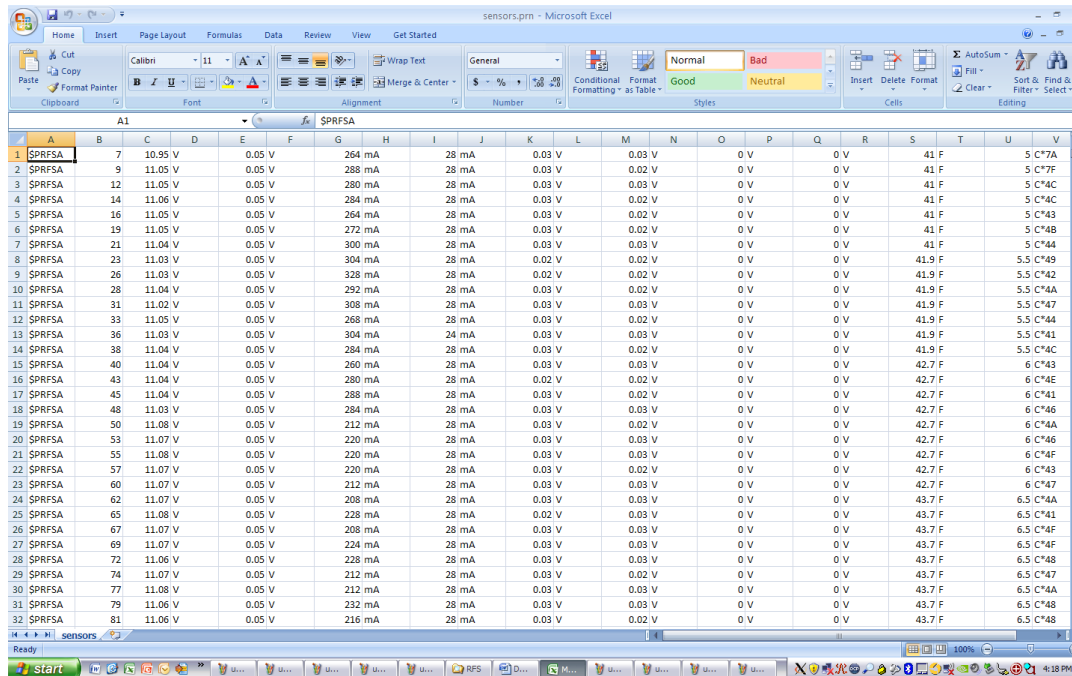
Select Delimited File, Press Next

## WIZARD PAGE TWO: SELECT DELIMITERS



Select Tab, Comma, Space, and option “Treat consecutive delimiters as one”, “Text pattern” is “\*”, press Finish”

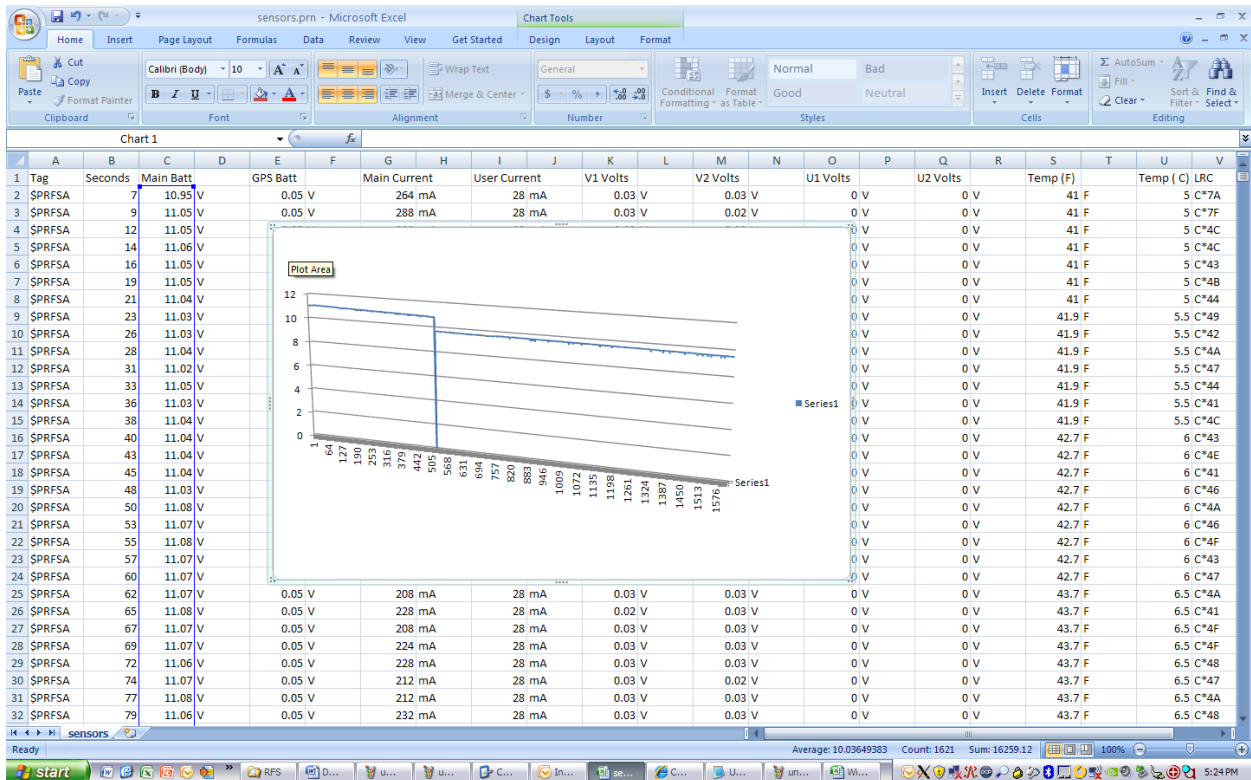
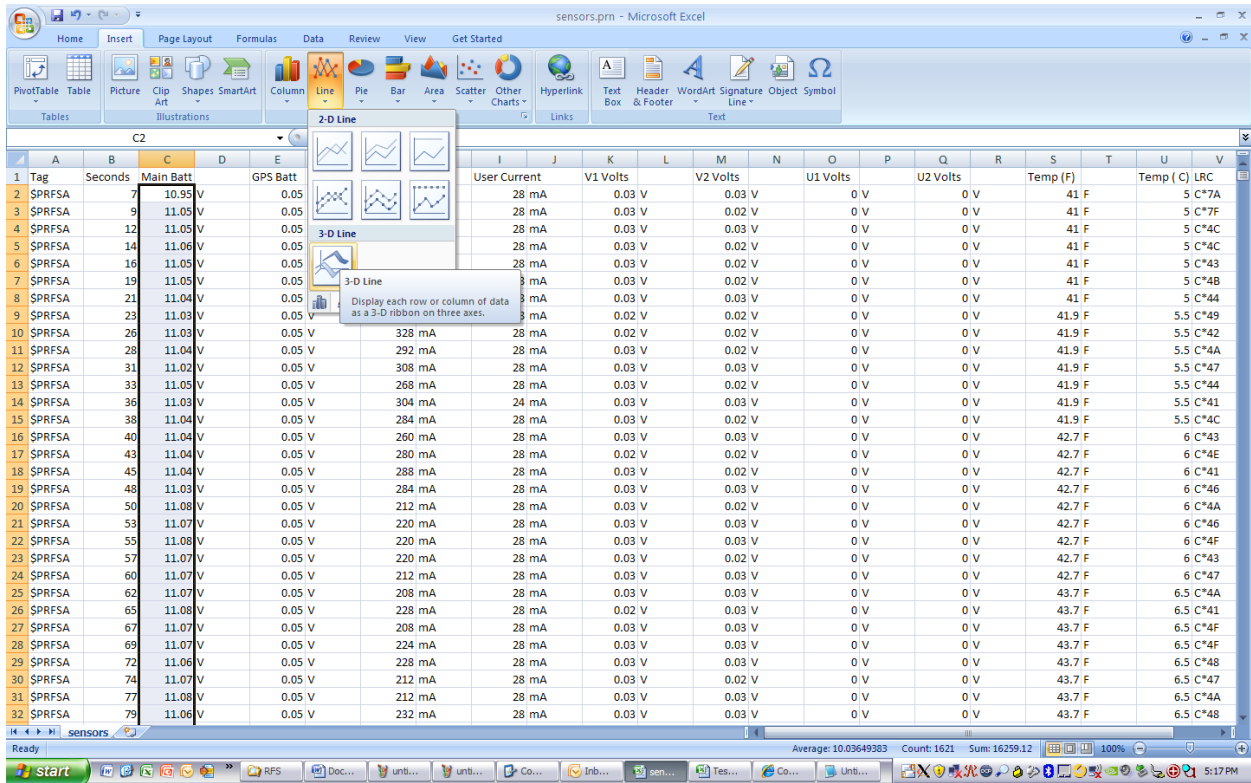
## DATA IMPORTED



Insert Row for Labels, press “ALT+i+” to insert a row with the cell cursor centered at 1A, the labels are as below:

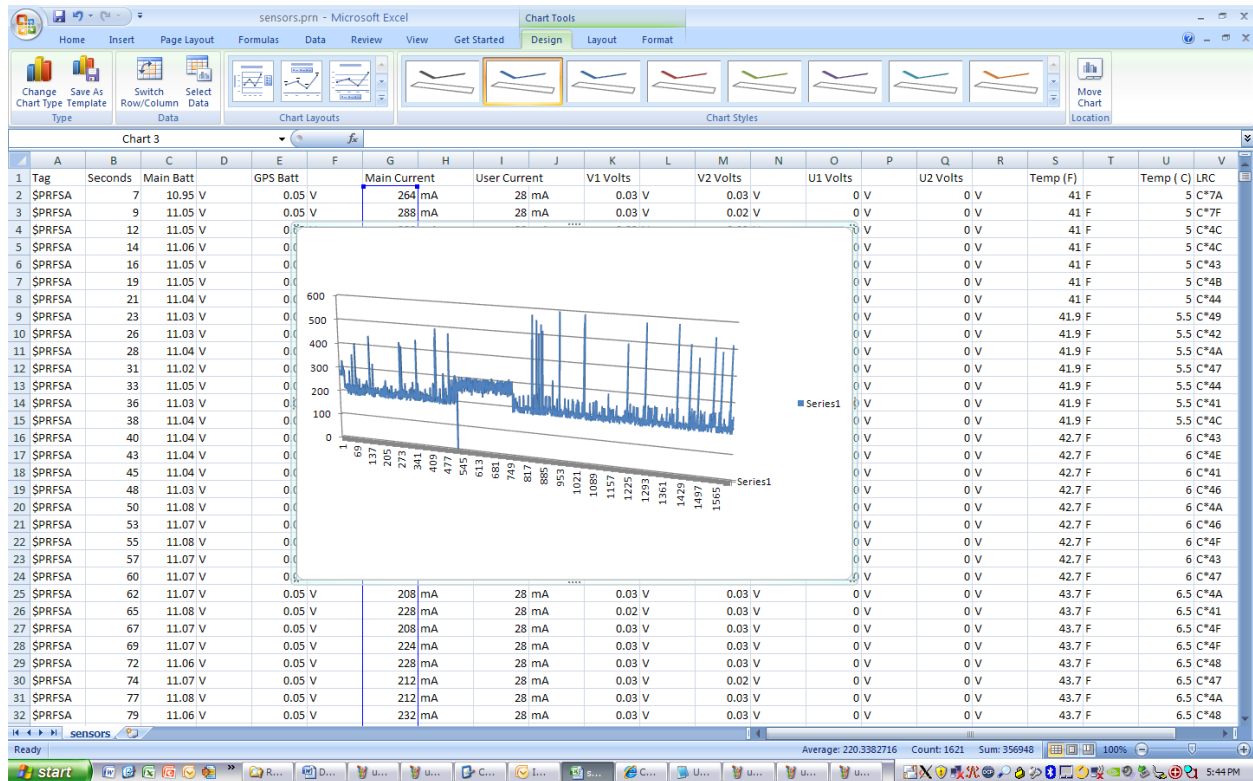
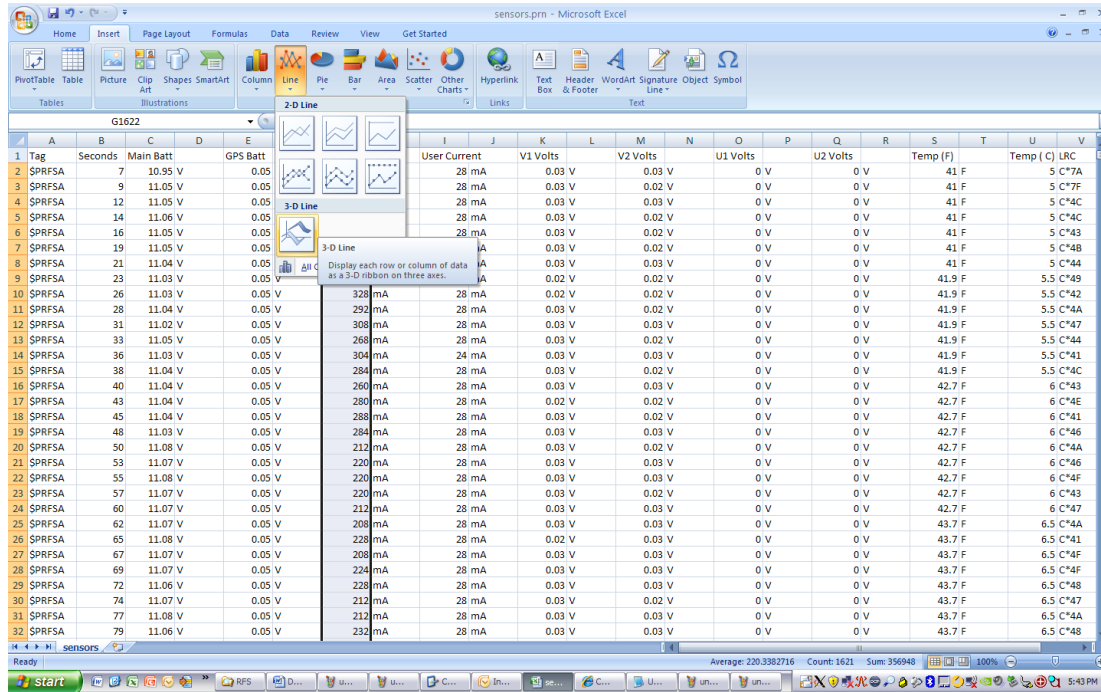
Tag,Seconds,Main Batt,GPS Batt,Main Current,User Current,V1 Volts,V2 Volts,U1 Volts,U2 Volts,Temp (F),Temp ( C),LRC

### PLOT MAIN BATTERY VOLTAGE



Select all Main Batt cells, press Insert->Chart, etc.

## PLOT MAIN BATTERY CURRENT



Select the Main current column, select Insert, Chart->3DLine and notice the plot.



# PLOT TEMPERATURE

The screenshot shows Microsoft Excel with a 3D line chart titled "Chart 4". The chart displays temperature data in Fahrenheit (F) over 32 data points. The Y-axis ranges from 0 to 90. The X-axis represents data points from 1 to 32. The chart shows a blue line representing the temperature, which starts at approximately 41°F and generally increases to about 43.7°F by the end of the series. The chart is titled "Chart 4" and is located in the "Temp (F)" column of the spreadsheet.

The Excel interface shows the "Insert" tab with the "3-D Line" chart option selected. The spreadsheet data is as follows:

Tag	Seconds	Main Batt	GPS Batt	User Current	V1 Volts	V2 Volts	U1 Volts	U2 Volts	Temp (F)	Temp (C)	LRC
2	7	10.95 V	0.05	28 mA	0.03 V	0.03 V	0 V	0 V	41 F	5 C	*7A
3	9	11.05 V	0.05	28 mA	0.03 V	0.02 V	0 V	0 V	41 F	5 C	*7F
4	12	11.05 V	0.05	28 mA	0.03 V	0.03 V	0 V	0 V	41 F	5 C	*4C
5	14	11.06 V	0.05	28 mA	0.03 V	0.02 V	0 V	0 V	41 F	5 C	*4C
6	16	11.05 V	0.05	28 mA	0.03 V	0.02 V	0 V	0 V	41 F	5 C	*43
7	19	11.05 V	0.05	28 mA	0.03 V	0.02 V	0 V	0 V	41 F	5 C	*4B
8	21	11.04 V	0.05	28 mA	0.03 V	0.03 V	0 V	0 V	41 F	5 C	*44
9	23	11.03 V	0.05	28 mA	0.02 V	0.02 V	0 V	0 V	41.9 F	5.5 C	*49
10	26	11.03 V	0.05	28 mA	0.02 V	0.02 V	0 V	0 V	41.9 F	5.5 C	*42
11	28	11.04 V	0.05	28 mA	0.03 V	0.02 V	0 V	0 V	41.9 F	5.5 C	*4A
12	31	11.02 V	0.05	28 mA	0.03 V	0.03 V	0 V	0 V	41.9 F	5.5 C	*47
13	33	11.05 V	0.05	268 mA	0.03 V	0.02 V	0 V	0 V	41.9 F	5.5 C	*44
14	36	11.03 V	0.05	304 mA	0.03 V	0.03 V	0 V	0 V	41.9 F	5.5 C	*41
15	38	11.04 V	0.05	284 mA	0.03 V	0.02 V	0 V	0 V	41.9 F	5.5 C	*4C
16	40	11.04 V	0.05	260 mA	0.03 V	0.03 V	0 V	0 V	42.7 F	6 C	*43
17	43	11.04 V	0.05	280 mA	0.02 V	0.02 V	0 V	0 V	42.7 F	6 C	*4E
18	45	11.04 V	0.05	288 mA	0.03 V	0.02 V	0 V	0 V	42.7 F	6 C	*41
19	48	11.03 V	0.05	284 mA	0.03 V	0.03 V	0 V	0 V	42.7 F	6 C	*46
20	50	11.08 V	0.05	212 mA	0.03 V	0.02 V	0 V	0 V	42.7 F	6 C	*4A
21	53	11.07 V	0.05	220 mA	0.03 V	0.03 V	0 V	0 V	42.7 F	6 C	*46
22	55	11.08 V	0.05	220 mA	0.03 V	0.03 V	0 V	0 V	42.7 F	6 C	*4F
23	57	11.07 V	0.05	220 mA	0.03 V	0.02 V	0 V	0 V	42.7 F	6 C	*43
24	60	11.07 V	0.05	212 mA	0.03 V	0.03 V	0 V	0 V	42.7 F	6 C	*47
25	62	11.07 V	0.05	208 mA	0.03 V	0.03 V	0 V	0 V	43.7 F	6.5 C	*4A
26	65	11.08 V	0.05	228 mA	0.02 V	0.03 V	0 V	0 V	43.7 F	6.5 C	*41
27	67	11.07 V	0.05	208 mA	0.03 V	0.03 V	0 V	0 V	43.7 F	6.5 C	*4F
28	69	11.07 V	0.05	224 mA	0.03 V	0.03 V	0 V	0 V	43.7 F	6.5 C	*4F
29	72	11.06 V	0.05	228 mA	0.03 V	0.03 V	0 V	0 V	43.7 F	6.5 C	*48
30	74	11.07 V	0.05	212 mA	0.03 V	0.02 V	0 V	0 V	43.7 F	6.5 C	*47
31	77	11.08 V	0.05	212 mA	0.03 V	0.03 V	0 V	0 V	43.7 F	6.5 C	*4A
32	79	11.06 V	0.05	232 mA	0.03 V	0.03 V	0 V	0 V	43.7 F	6.5 C	*48

Select the Temperature (F) row (all cells). Select the Insert 3D Line chart option.

