



# GPS-1



The GPS-1 telemetry module is a high performance, secure, tracking, monitoring, and data logging system which enables transmission of GPS position and telemetry data up to 100 miles LOS (Line of sight) to the Base-station-1 or Base-station-2 receiver. It also features local logging of all sensor and GPS data onboard Micro-SD storage..

- 16MIPS RISC CPU for high-performance GPS system processing
  - Filtering for GPGGA/GPGSA to preserve RF Link bandwidth and real-time background processing
- 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
- 30dbm (1Watt) 900Mhz Frequency Hopping Spread Spectrum Transceiver supporting up to 500Kbps data rate
  - Up to 16 independent channels operate concurrently
  - AES Encryption for link security
  - Requires no field configuration/provisioning or HAM Radio License
  - FCC and Canadian IC Certified for Unlicensed Operation
- 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™
- Over 9hrs operational time (running all features) using 9.6V 2200mah NiMh 8xAA battery pack

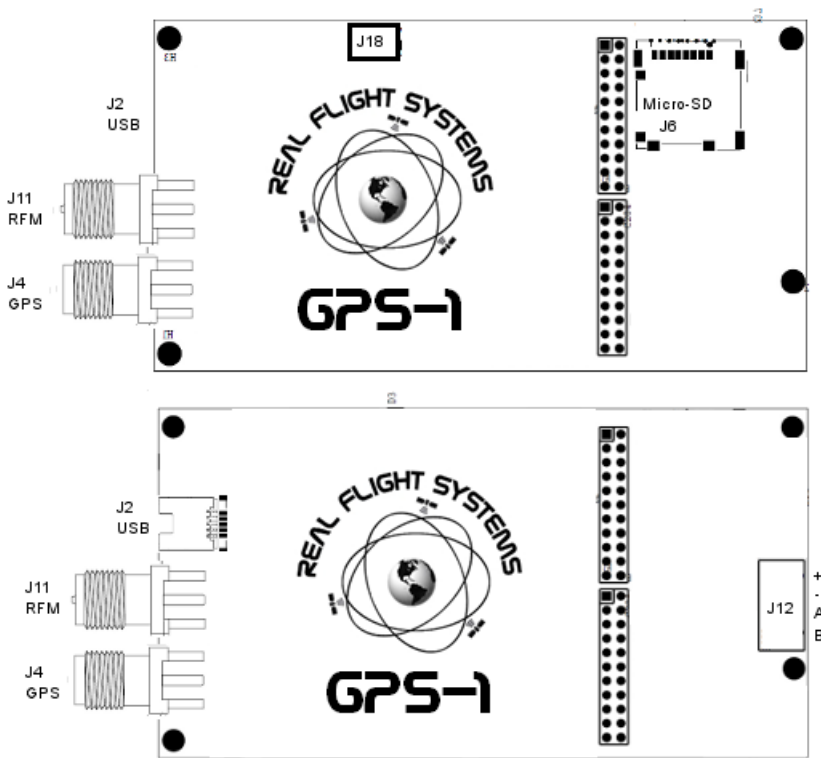
## ACCESSORIES

- Sarantel SL1206R GeoHelix®-P2 high-performance, high-gain, low-noise amplified active input GPS antenna
- 0dBi RF Antenna + low-loss RG174 RPSMA extension cable
- Deans Male plug
- Micro-SD Card
- External 3V GPS Battery with JTEK connector

## 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 to B lead, and negative to - lead.

## CONFIGURATION JUMPER (CFG/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)

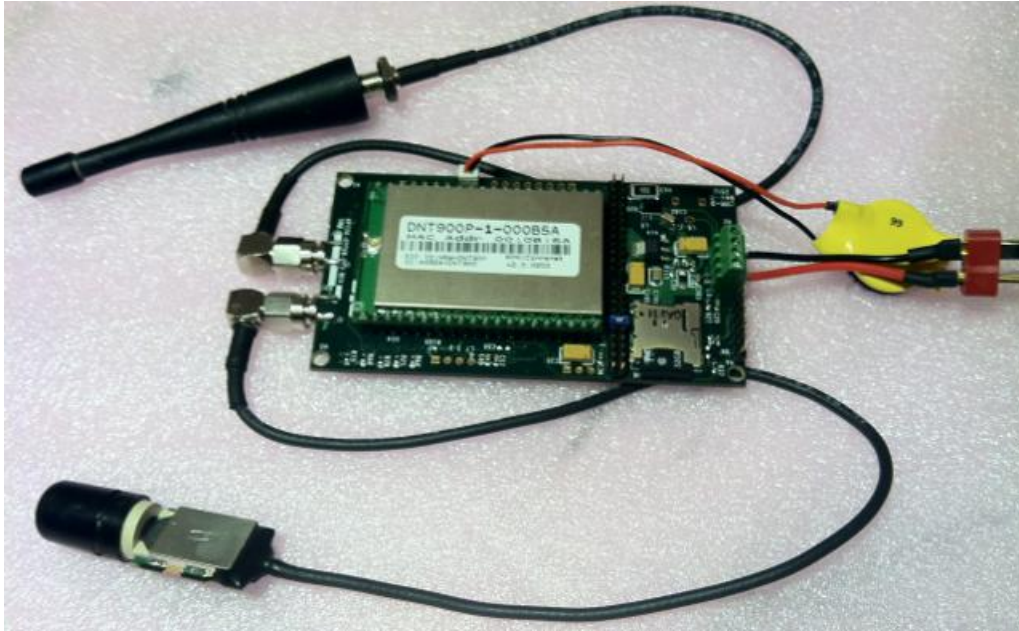
NOTE: If this jumper is removed, your Base-station will NOT show any data on the display until the “gps” command is issued via the USB connection on the Basestation to the host computer.

## 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

## CONFIGURATION AND PRE-FLIGHT

1. Attach RPSMA Modem Antenna
2. Attach SMA GPS Antenna
3. Attach J18 GPS Battery
4. Download GPS Almanac to the device, connect J2 Mini-USB to host Computer and use uCenter
5. Verify CFG\_1 Jumper pins 11-12 are shorted (this is the 6<sup>th</sup> position from the far left of the pin header)
6. Connect Power, and optionally, power switch
7. Verify a fresh FAT32 or FAT16 formatted SD-Card is installed in J6, Micro-SD Slot
8. Wait for GPS Lock LED and airplane symbol on receiver



## **MOUNTING GPS-1**

GPS1 requires a firm mounting in order to operate properly, mechanical vibrations may reduce performance and can damage your system if it is not mounted securely. It is best to mount the unit using stand-offs and 4-40 mounting bolts.



## **GPS PRE-FLIGHT CONFIGURATION**

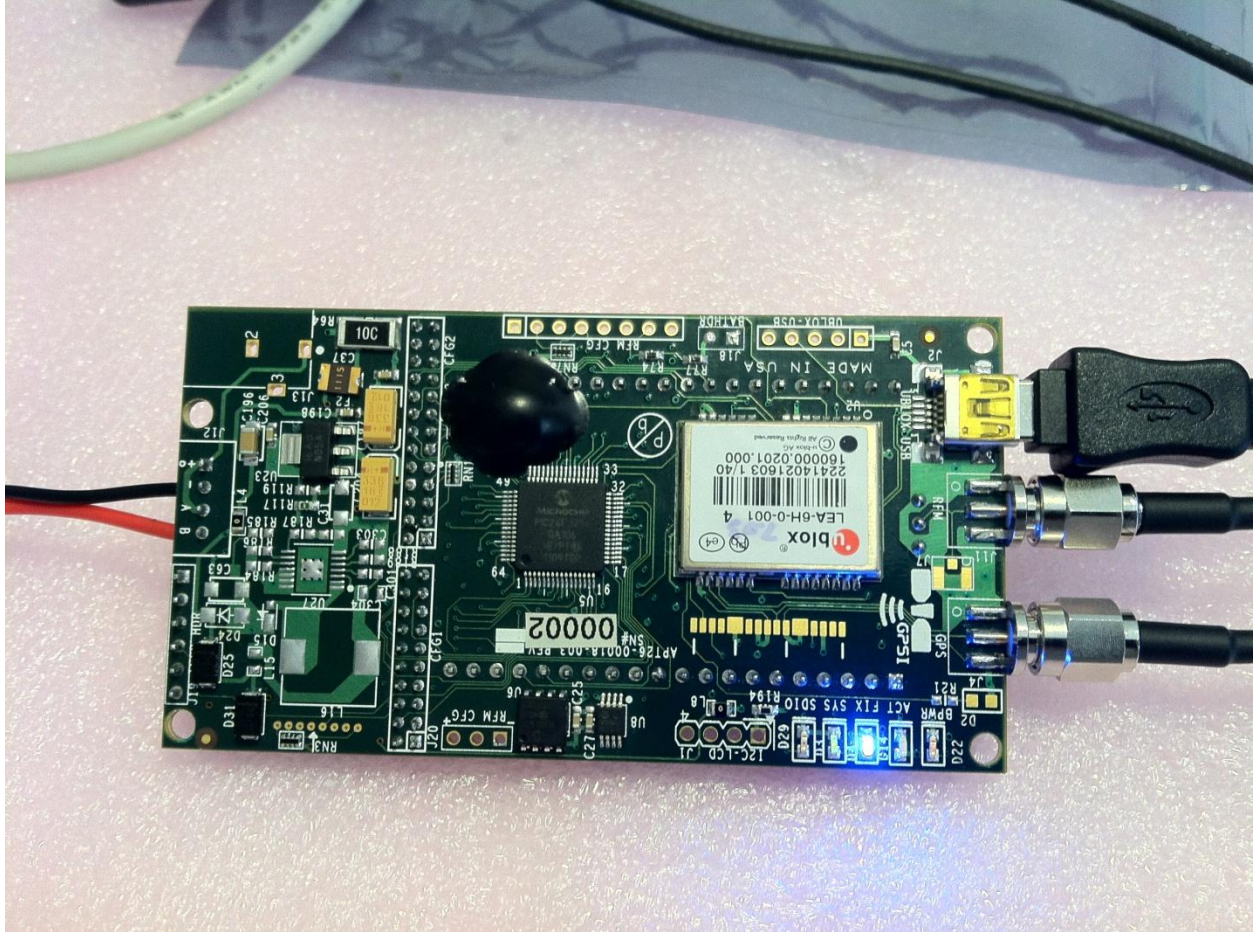
Your GPS1 module comes pre-configured for Aircraft mode GPS telemetry. The uBlox GPS chipset also features a 2 week GPS Almanac (cache) which works in conjunction with the GPS almanac cache battery. The GPS Almanac aids navigation by providing for Ephemeris data at start-up and allows for a so-called “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.

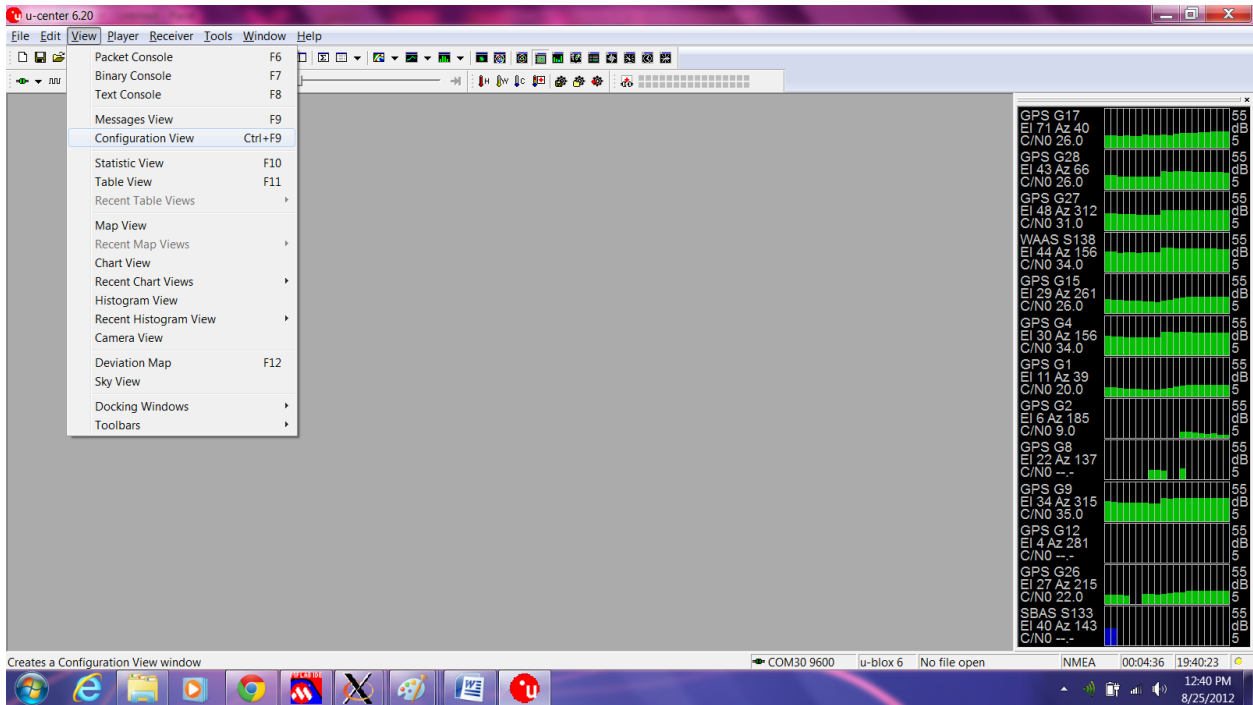
1. Install uCenter (6.20) or later as located on the CD-ROM
2. Connect the GPS battery to J18



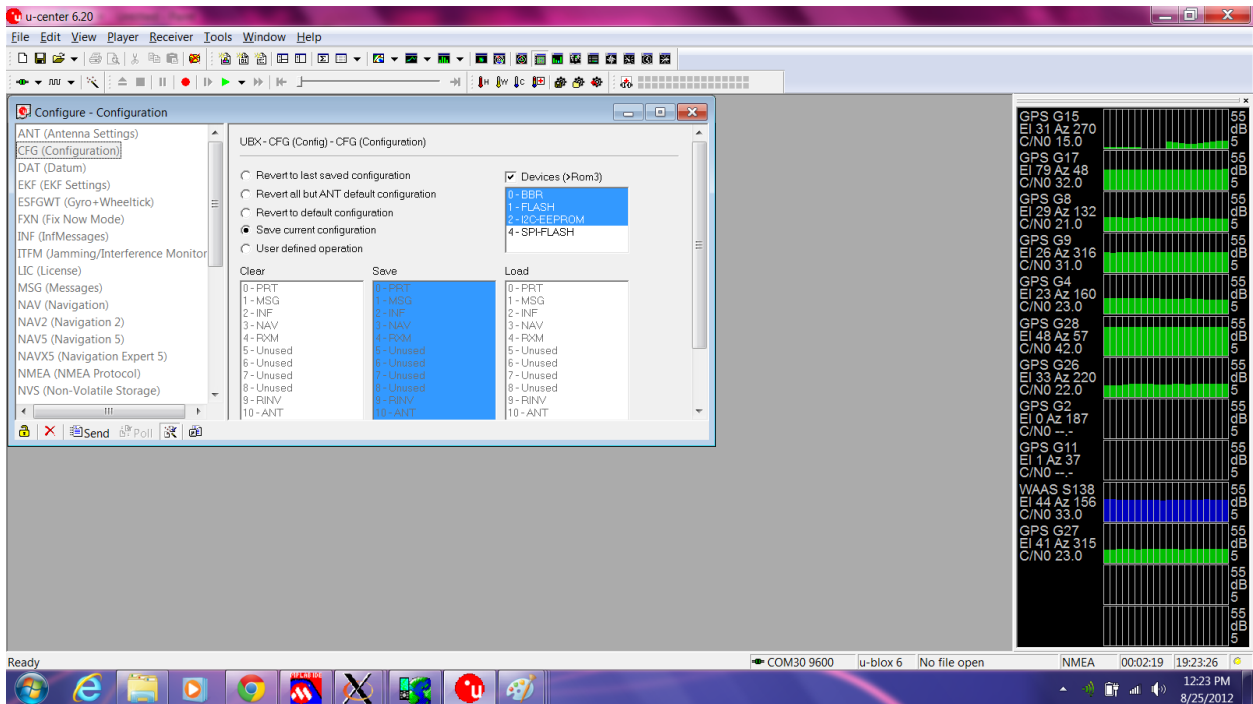
3. Connect a mini-USB cable to the GPS1 USB port and the other side to the computer



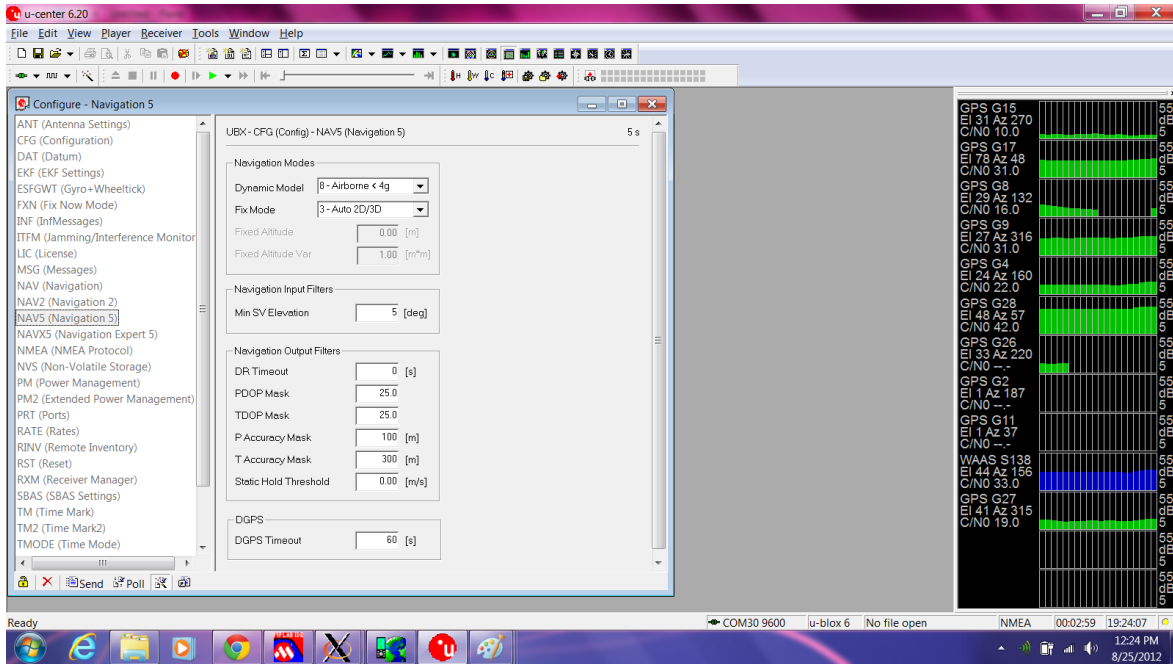
4. Start uCenter, select the "Receiver->Port->XXX" where XXX is the USB port found by your computer attached to GPS1. NOTE: you can use DeviceManager under Windows and find the uBlox USB Device port.
  
5. Select Configuration View as below



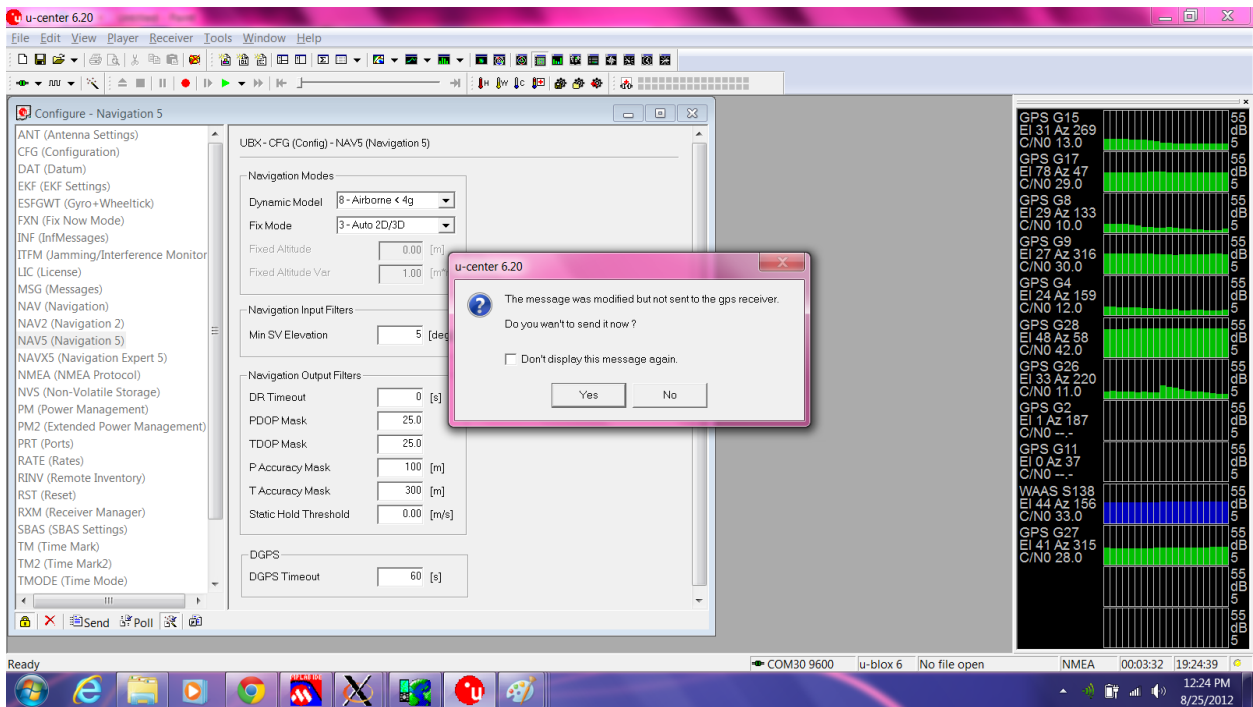
6. Verify that the configuration data will be saved to the device (BBR, FLASH, I2C EEPROM selected)



7. Verify that NAV5 is set to Airborne Mode

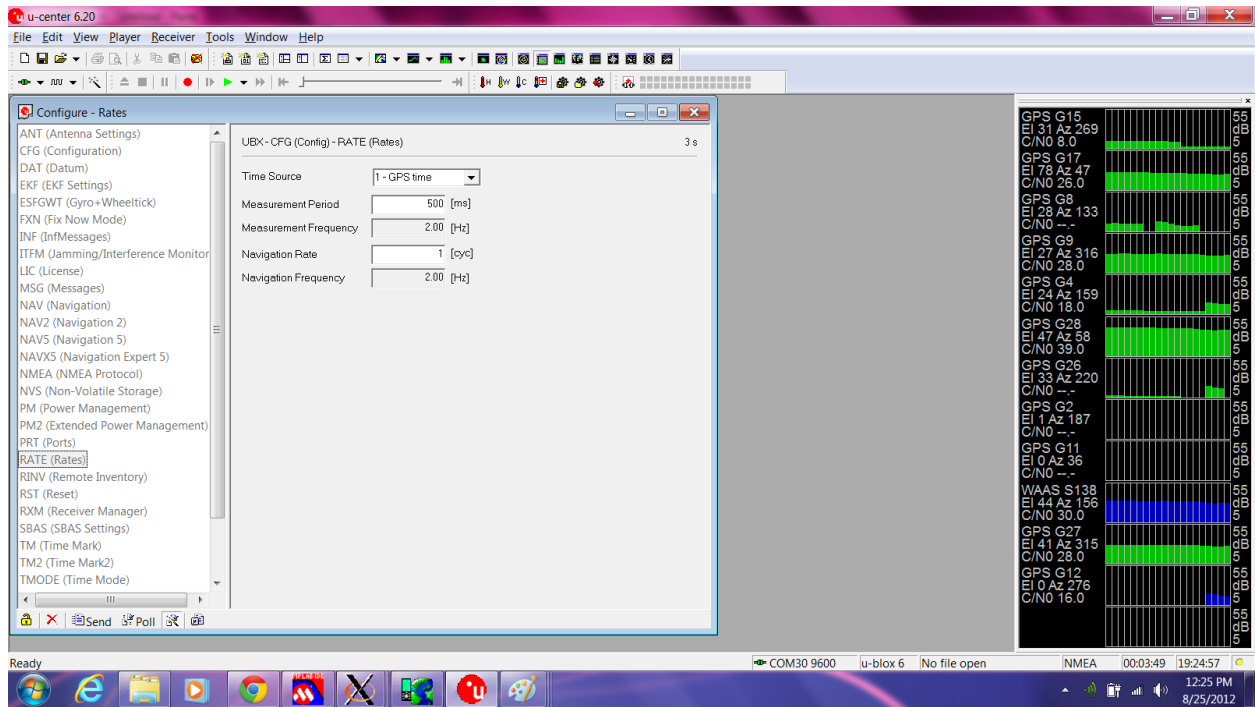


Note that if the configuration is not set, uCenter will prompt to write back the data to the receiver. Always answer Yes if you are sure of your configuration, if not, press “No”

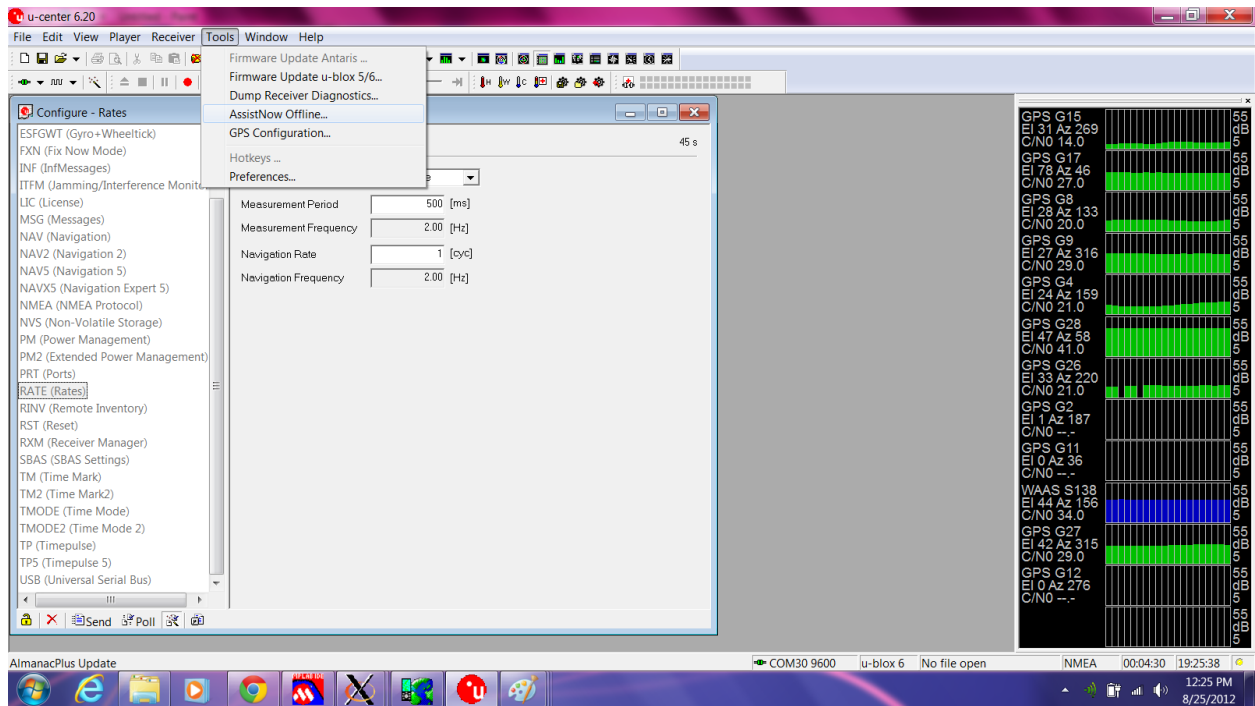


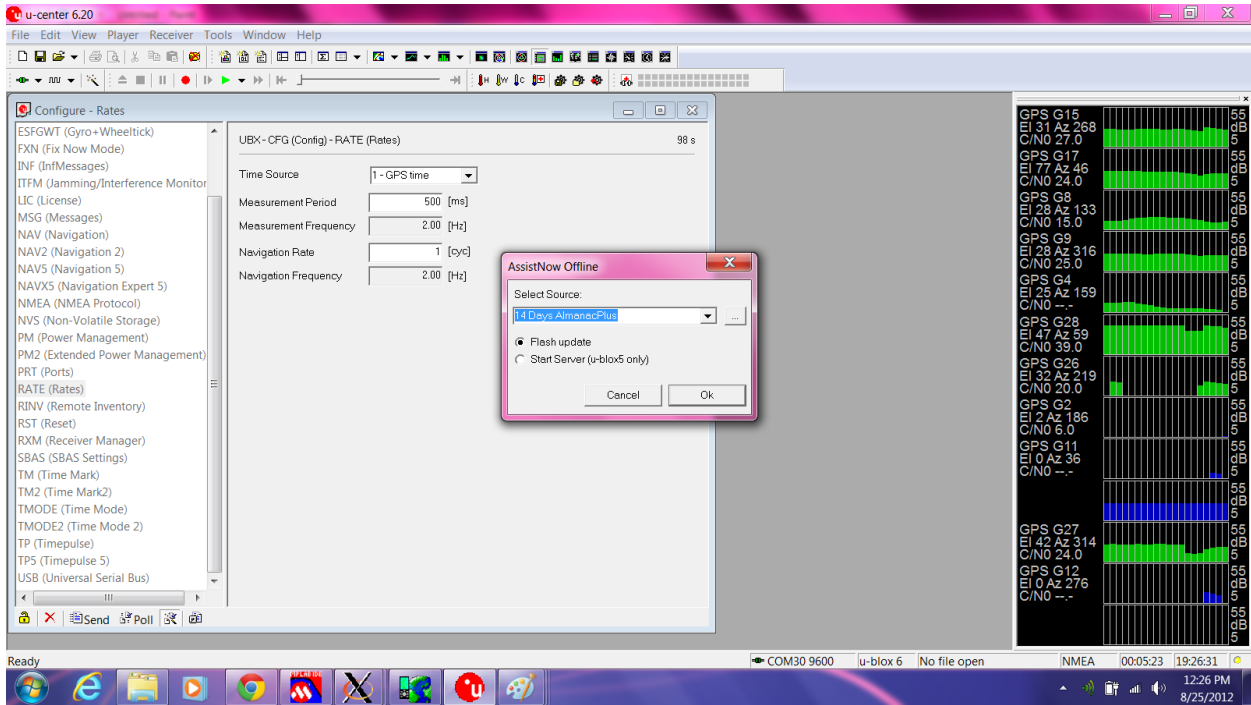
8. Verify the Rate is set to 2HZ (500msec) for 1-second real-time response with the Base station receiver



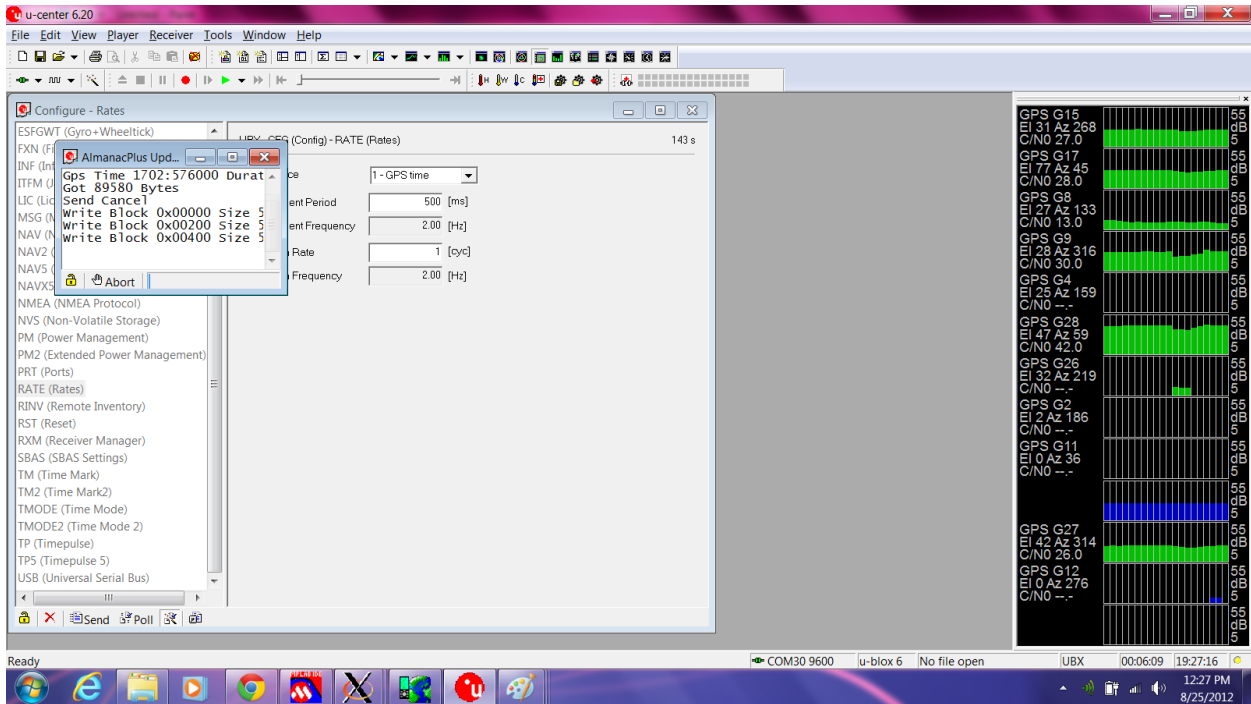


9. Select "Tools->AssistNow Offline"





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



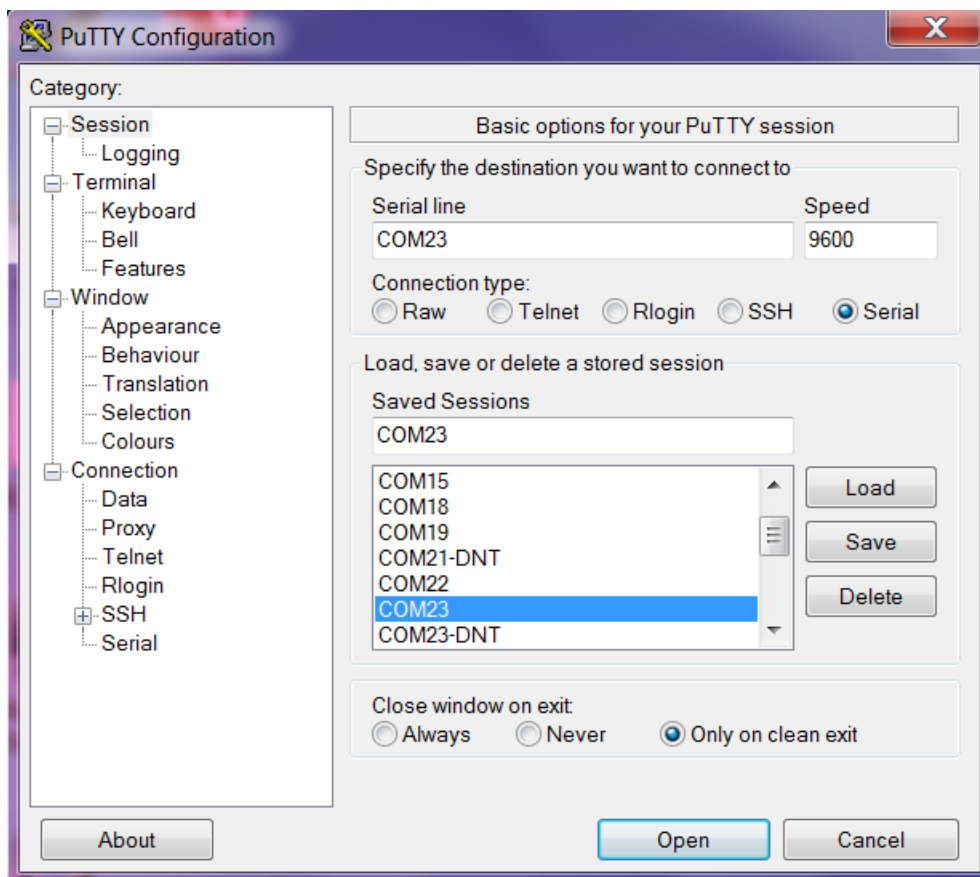
The unit is now configured. Be sure to leave the GPS Battery connected to the module so that the GPS Almanac data is preserved up to and during flight. Should the GPS lose telemetry lock during flight, the GPS battery will ensure hot-start and re-acquisition of fix in < 1 second with hot-start enabled.

Should your unit become accidentally reconfigured mis-configured, please visit the website <http://www.reallightsystems.com/> for the latest uBlox configuration file.

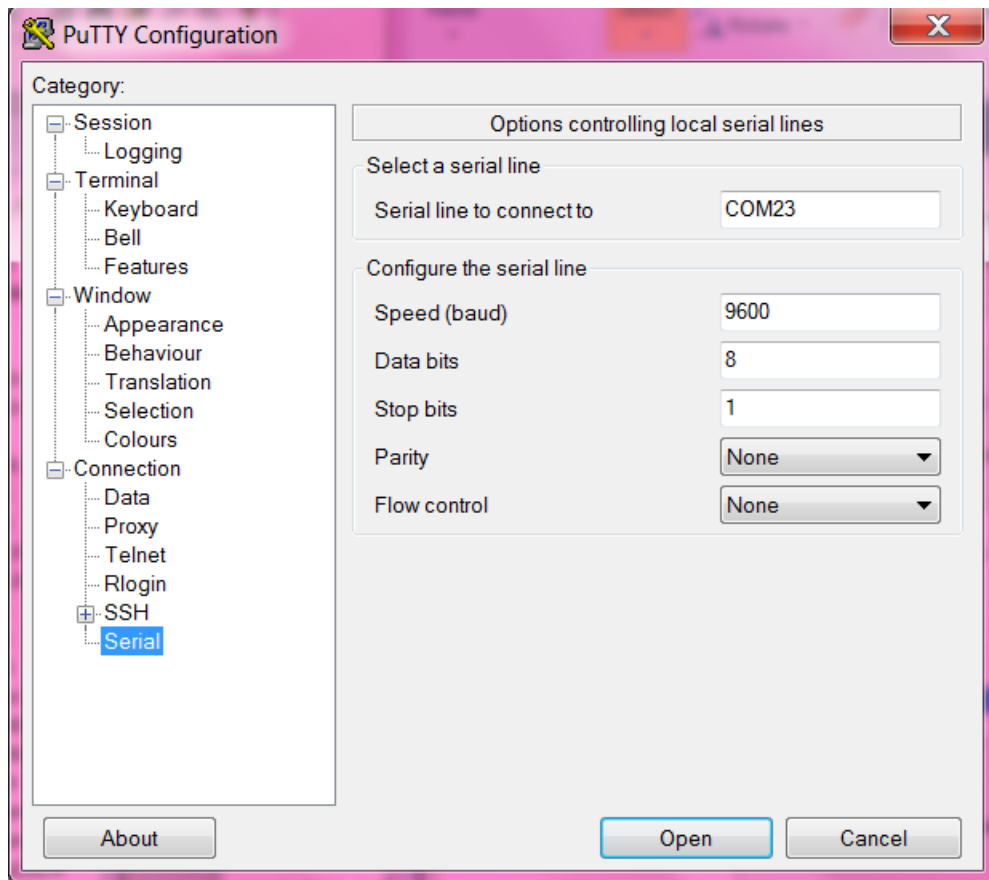
## APPENDIX-1 GPS-1 REMOTE SHELL

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 Base-station is connected to the host computer USB port, the system will boot up and provide a remote control serial console (like the remote control console on the GPS-2). Following is the remote control console procedure.

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. 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-2 GPS-1 COMMAND REFERENCE**

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

adc - show adc

stat - show statistics

restore - restore defaults

save - save configuration

pass <password> - set the password

reboot - reboot 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)

## **PRE-FLIGHT**

- Charge all batteries, they should be about 11V or more when fully charged.
  - The systems will shut down when the battery voltage reaches 5.36v, this is nominally 3-4hrs later on the base-station and 8hrs on the remote (2500ma battery on remote).
  - At 6 volts, a warning will appear on the base-station.
- Install GPS Battery
- Load the GPS Almanac – use uCenter (on the CDROM) and select "14 Day Almanac Plus"
- Verify Lock sequence where you have multiple (> 4 total) satellites, a flashing airplane, and altitude.
- Freshly format SD Card, install into SD-Card
- Check Connections to battery and optional switch.

## **POST-FLIGHT**

- Power off
- NOTE: on older firmware versions (green board)
  - Immediately remove SD-Card, do not re-insert, it will overwrite your files!

- On newer firmware versions (blue board and version 1.01 and later)
  - A new data-file is created (up to 100 datafiles). After 100 data-files the first file is perpetually overwritten.
  - All files are written with their appropriate time-stamp (GMT + TZ-Offset)
  - See also the “tz” timezone command.

## FIRMWARE HISTORY

The log below describes changes in each GPS-1 firmware release.

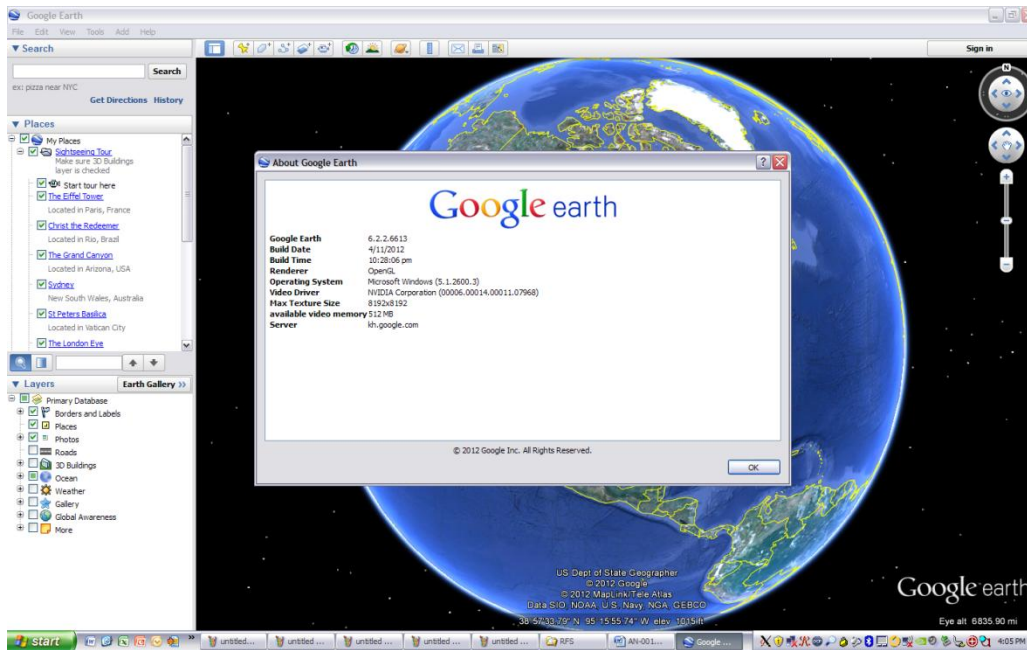
1.00 –07/12/12 Initial firmware for revision A/B PCB's

1.01 –12/29/12 Flight testing on over 14 flights, update time of day and system clock from GPRMC when data is known, add support for timezone offset (for localtime). Update time of day on files using localtime (GMT by default). Update logger subsystem to create a new file every time the system is booted. Up to 100 unique sequentially numbered files are supported, afterwards the initial files is perpetually overwritten. The new datafiles are “gpslogXY.log” and “syslogXY.csv” where XY increment on every file.

## OPENING NMEA DATA FILES WITH GOOGLE EARTH

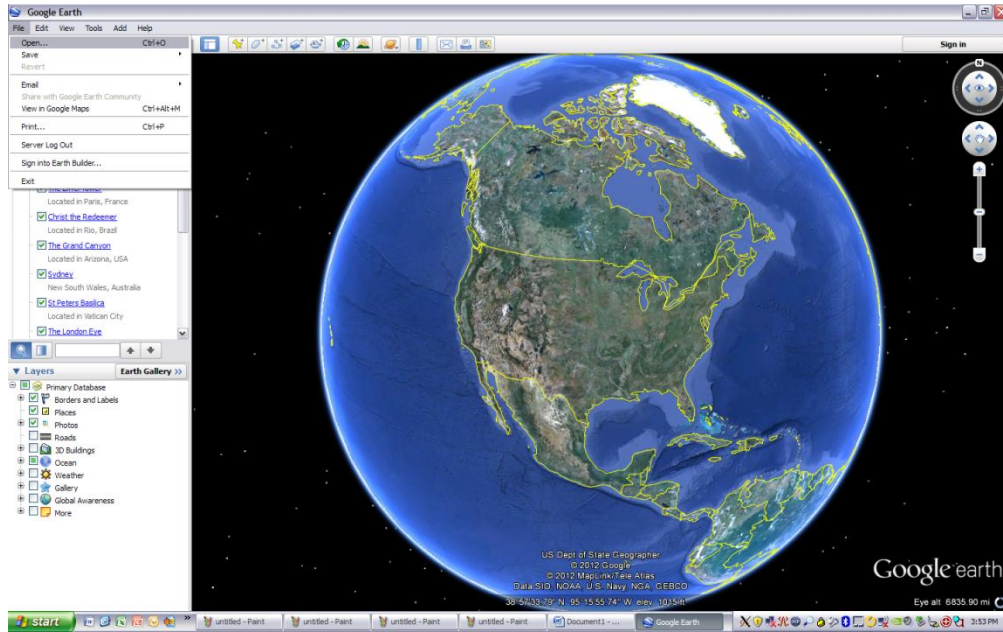
- 1) Rename the NMEA log file `gpstrack.nme` to `gpstrack.nmea`
- 2) Launch Google Earth, the version used is as shown (6.2.2.6613)

### CHECK VERSION

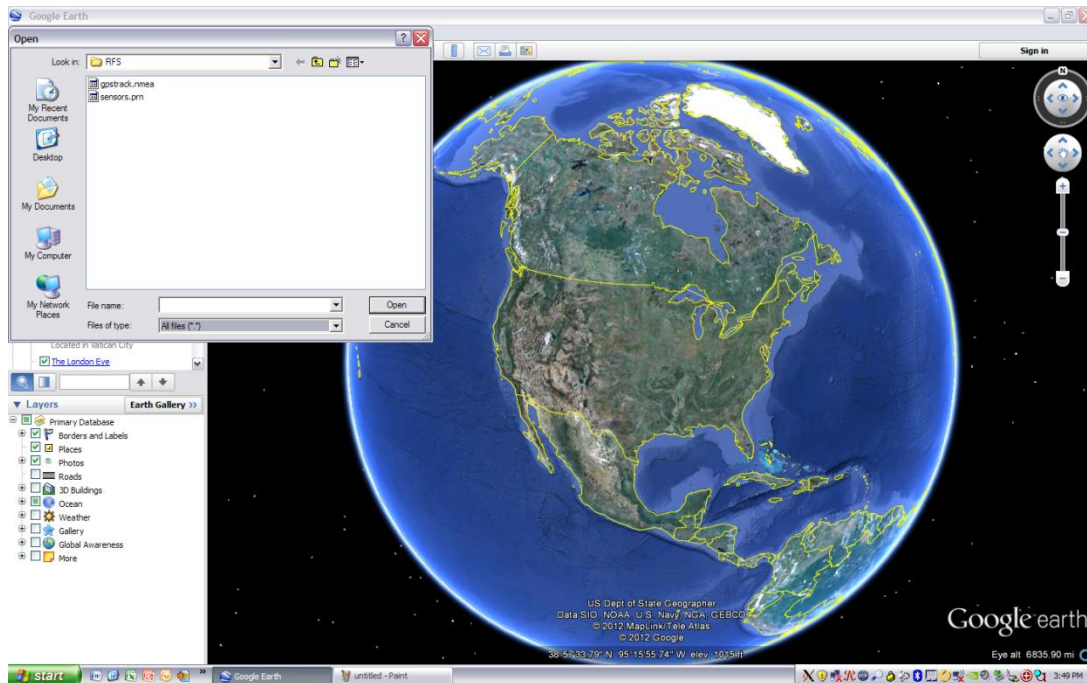




## FILE->OPEN

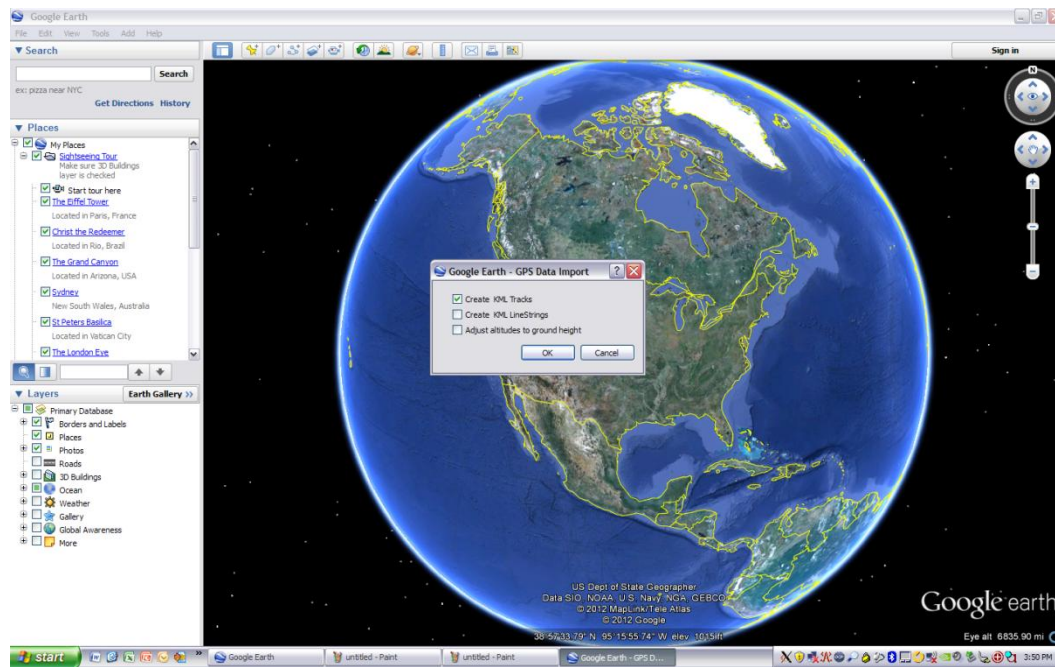


## SELECT "ALL FILES"



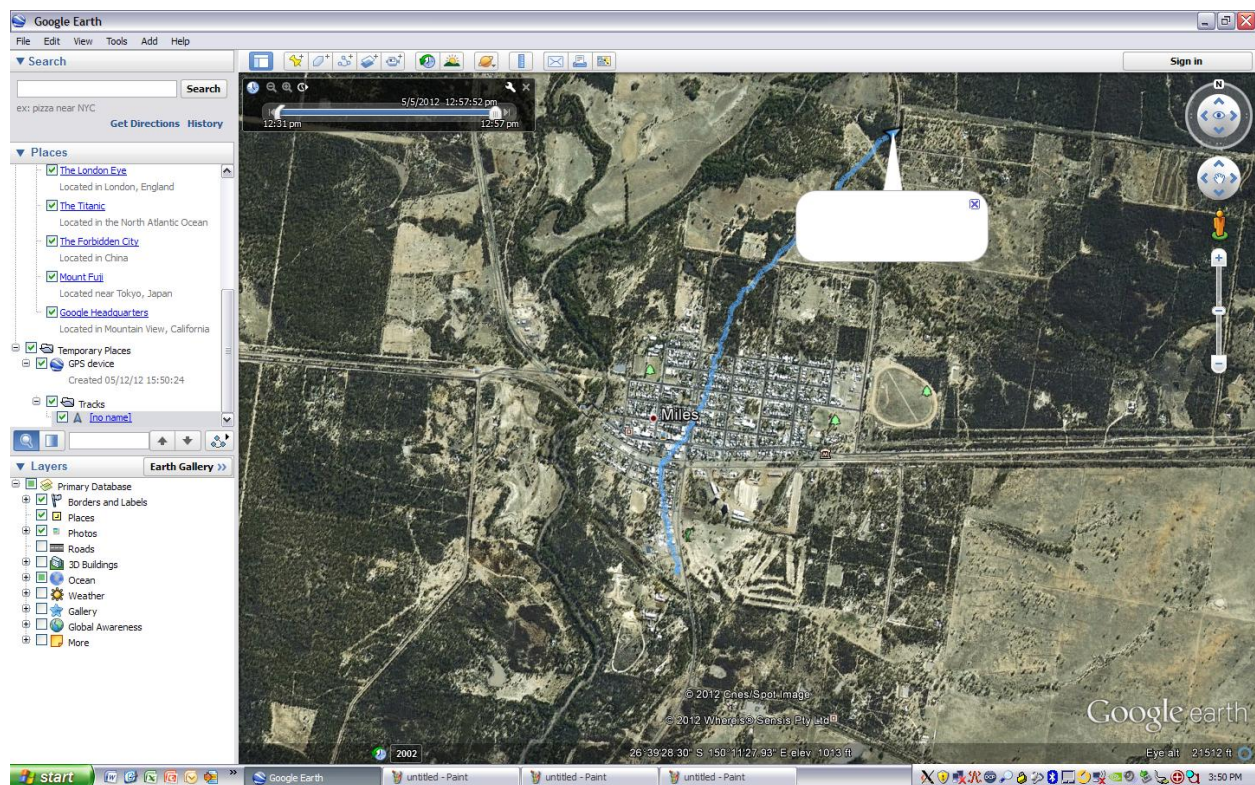
Double click on the NMEA data file (gpstrack.nmea). A Dialog is presented to show options for the NMEA data-file import.

## SELECT IMPORT OPTIONS



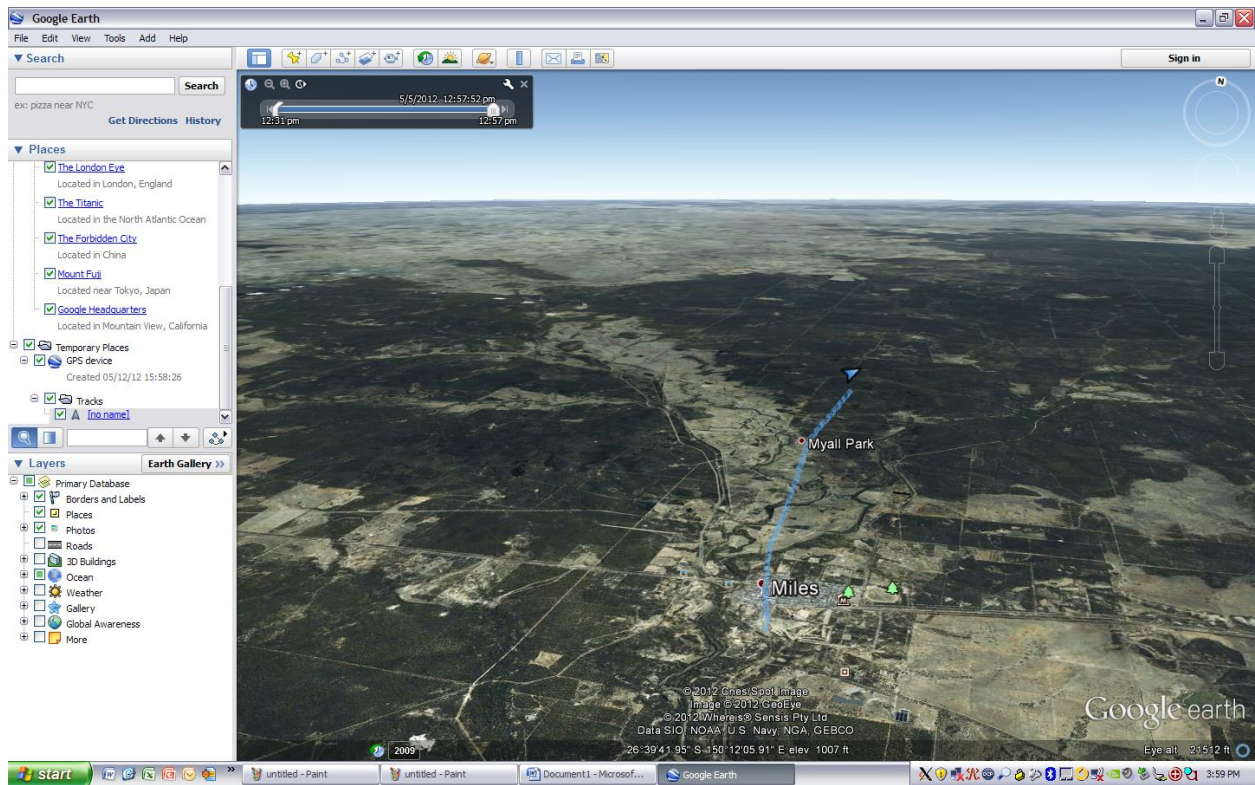
The above dialog is display, Select “Create KML Tracks”, deselect other options. The file is opened and the Globe will move to the tracks just imported.

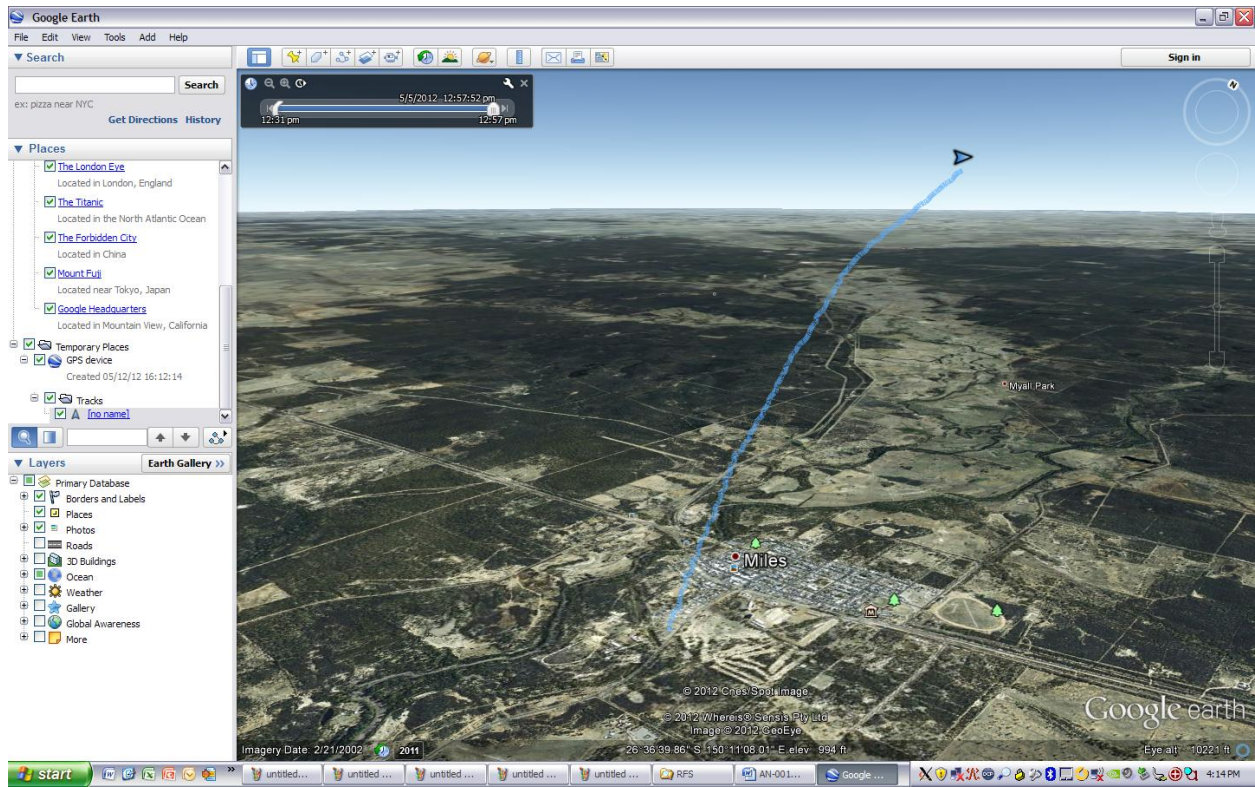
## MOVE TO LOCATION



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.

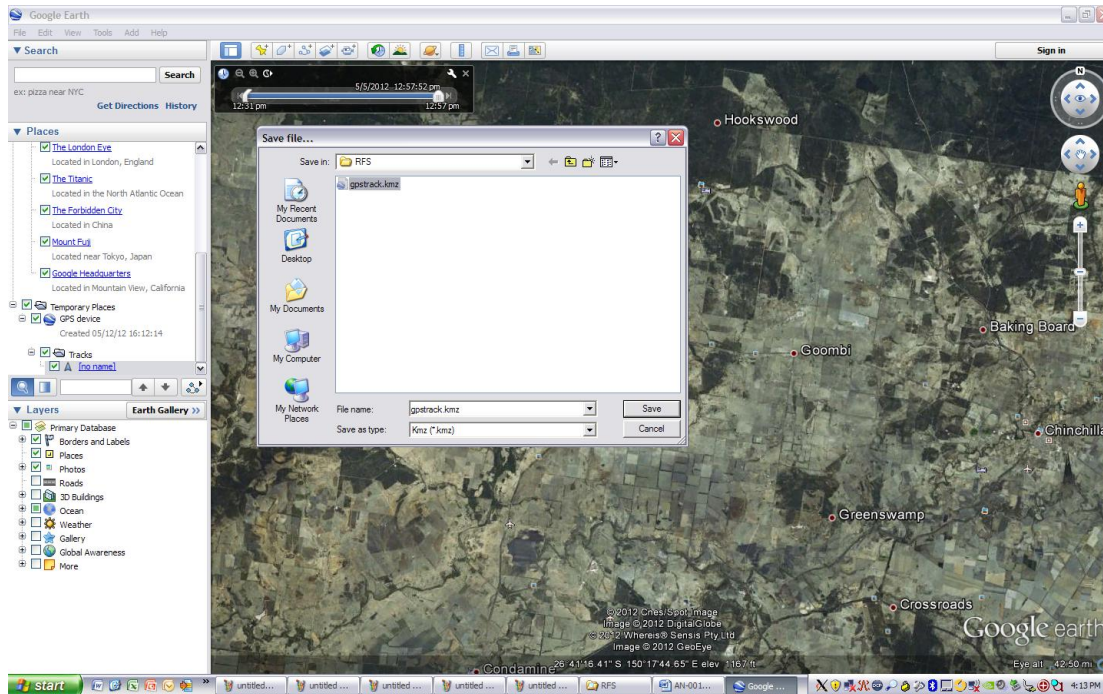
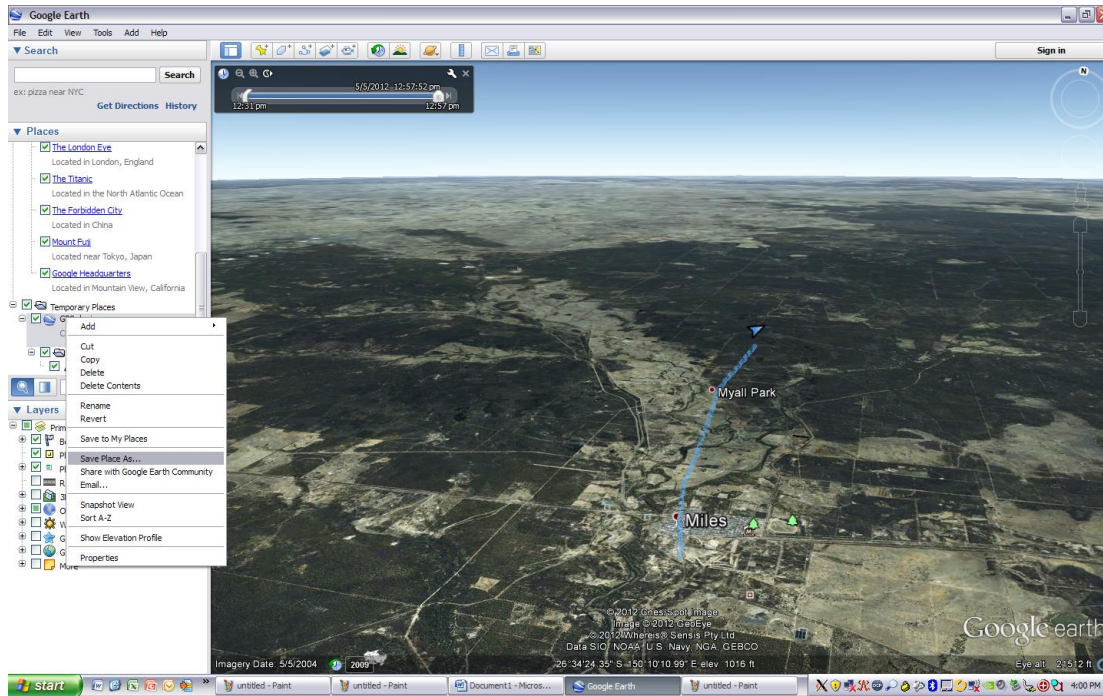
# REPOSITION VIEW





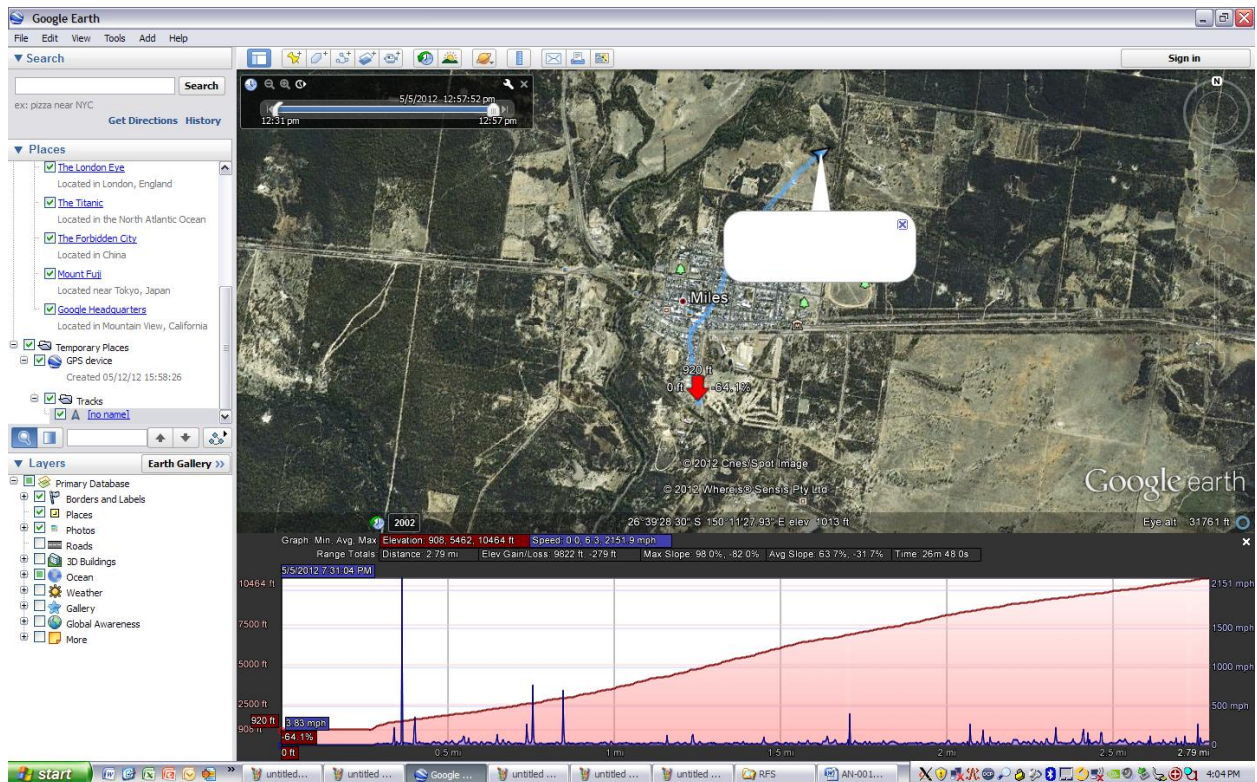
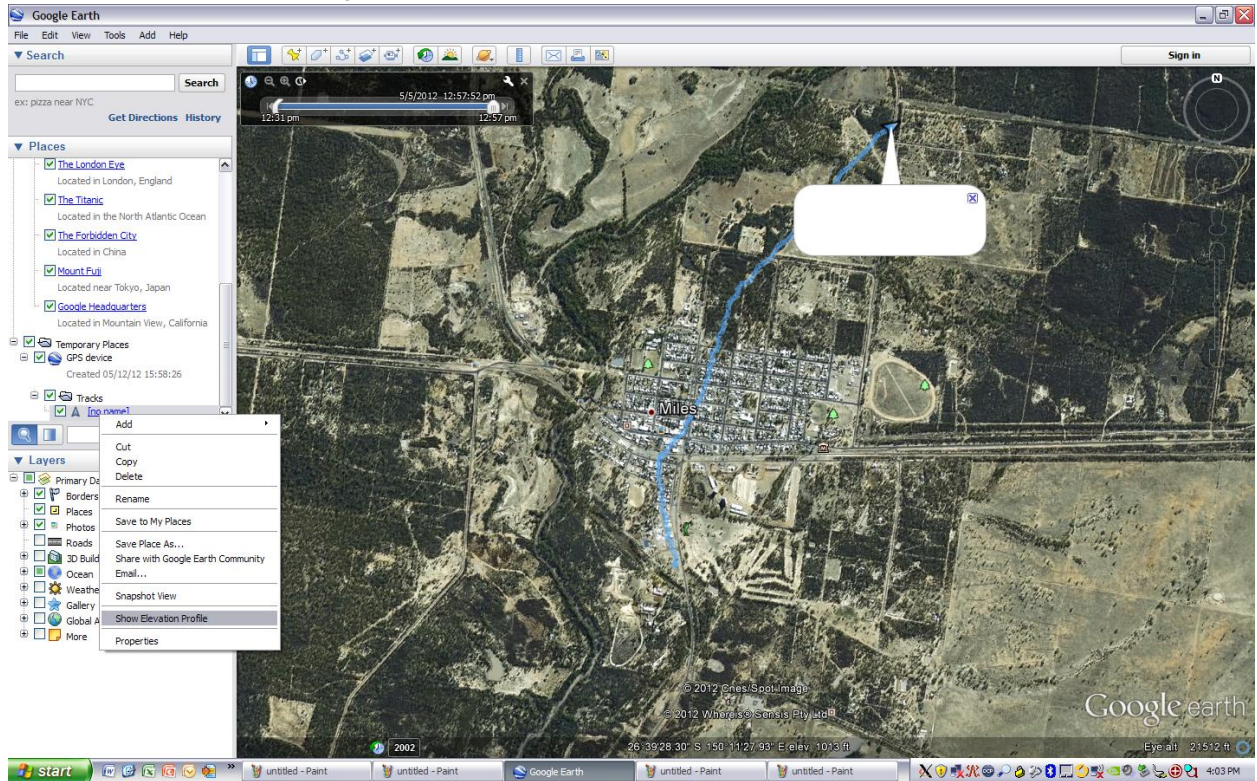
# SAVE GPS TRACK AS KMZ FILE

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



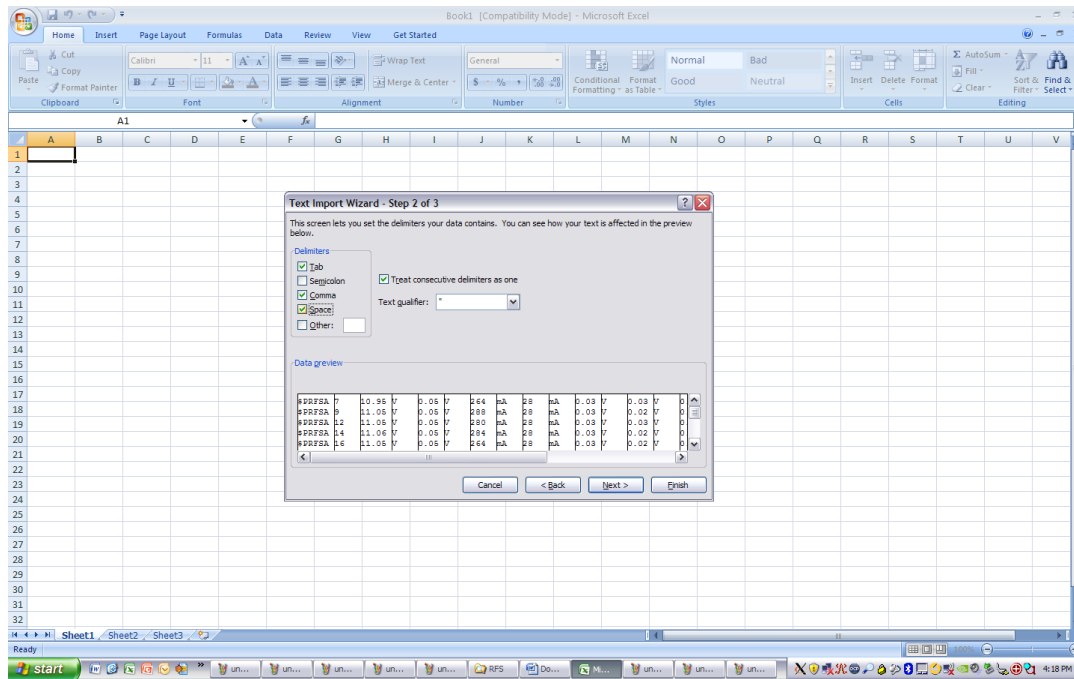
# ELEVATION PROFILE

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



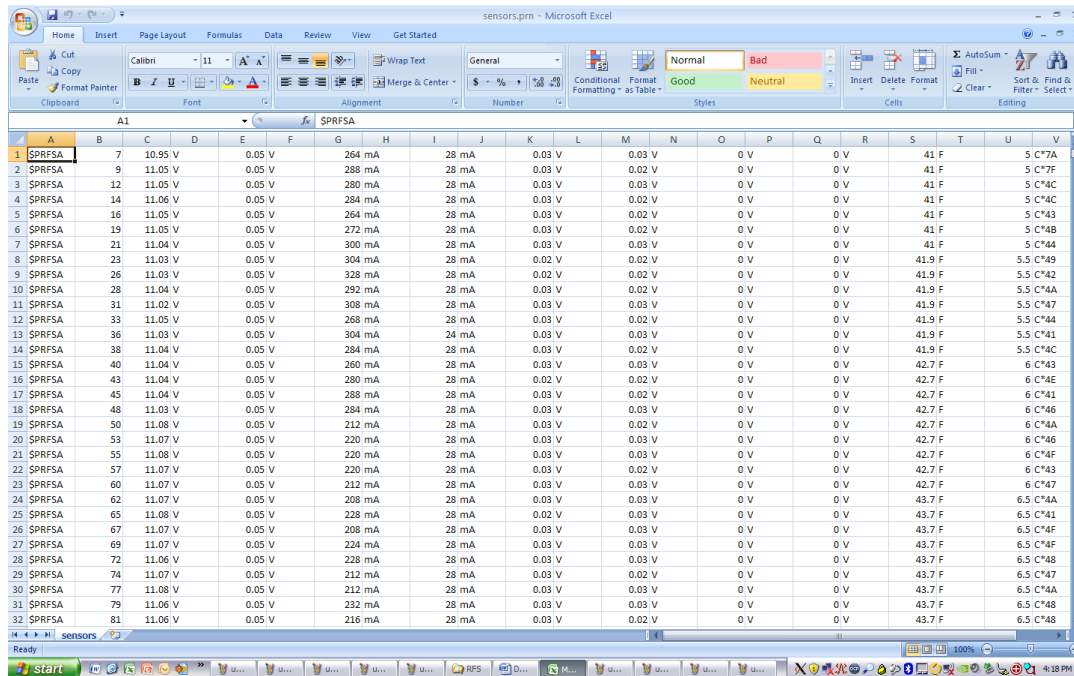


## WIZARD PAGE TWO: SELECT DELIMITERS



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

## DATA IMPORTED

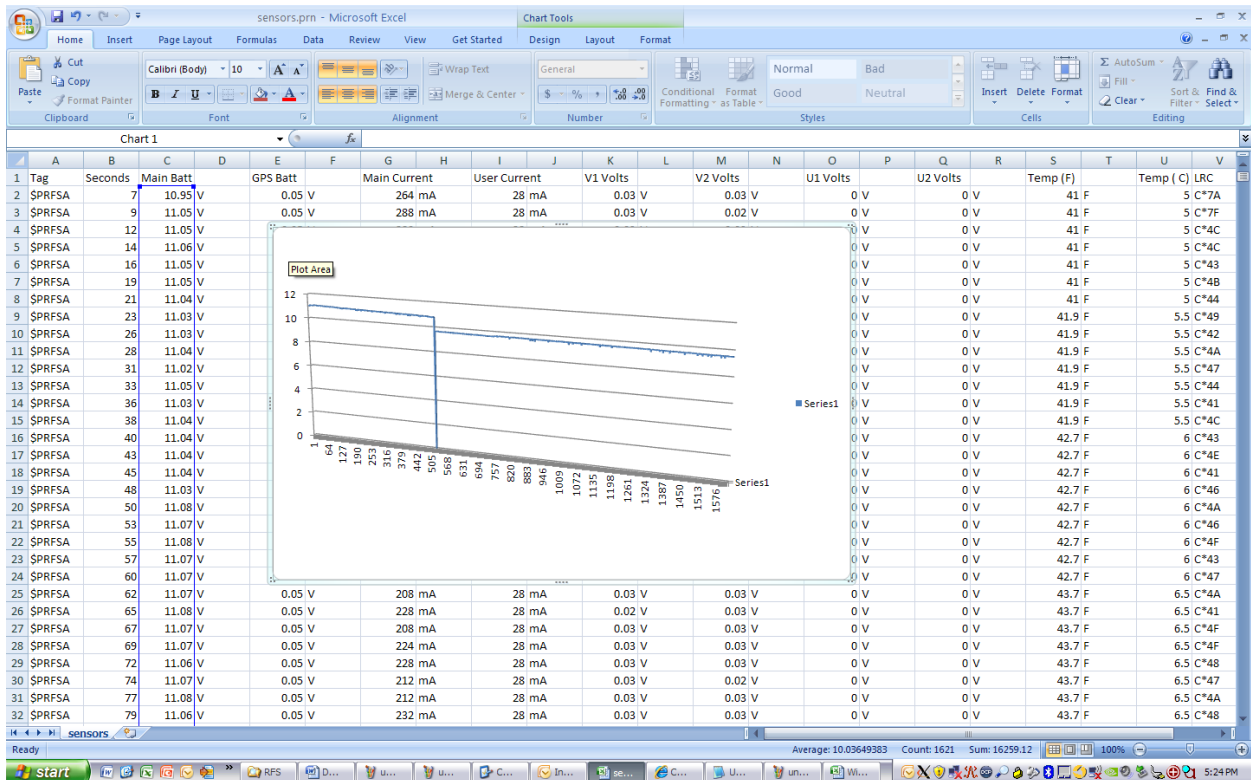
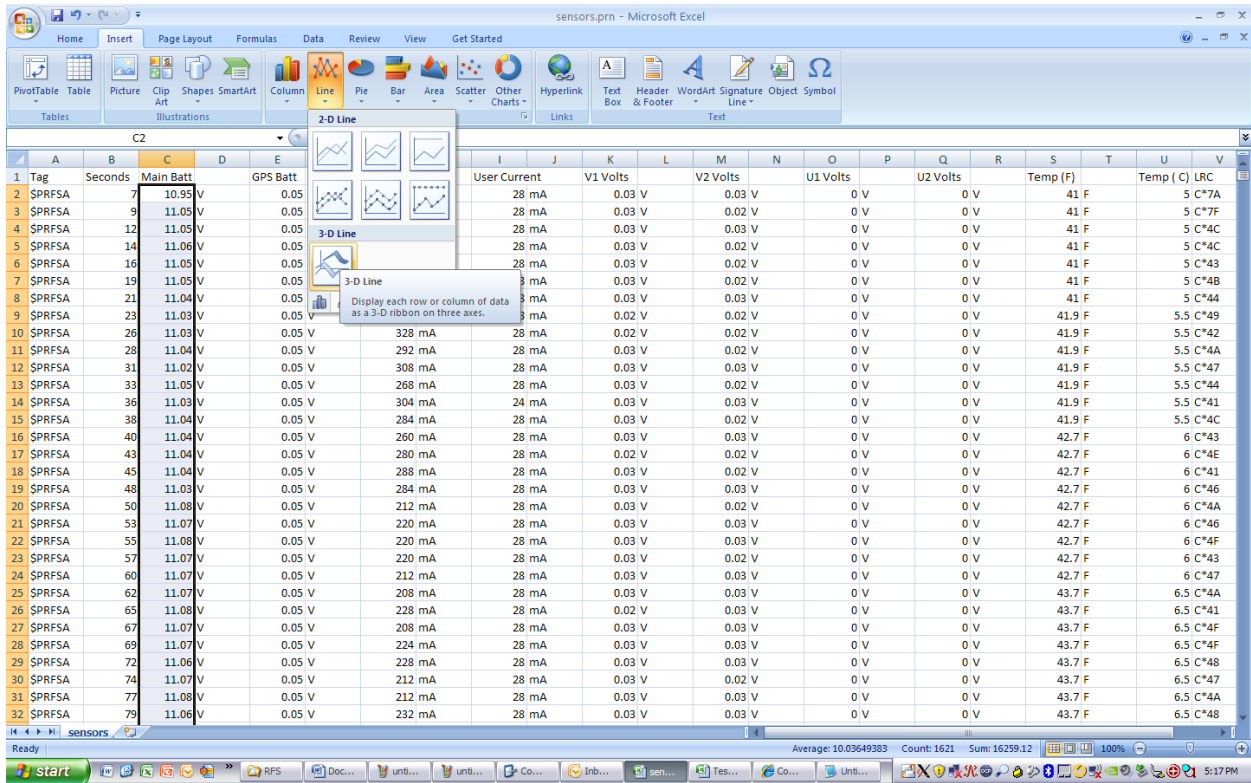


Insert Row for Labels, press “ALT+i+” to insert a row with the cell cursor centered at 1A, the labels are as below:



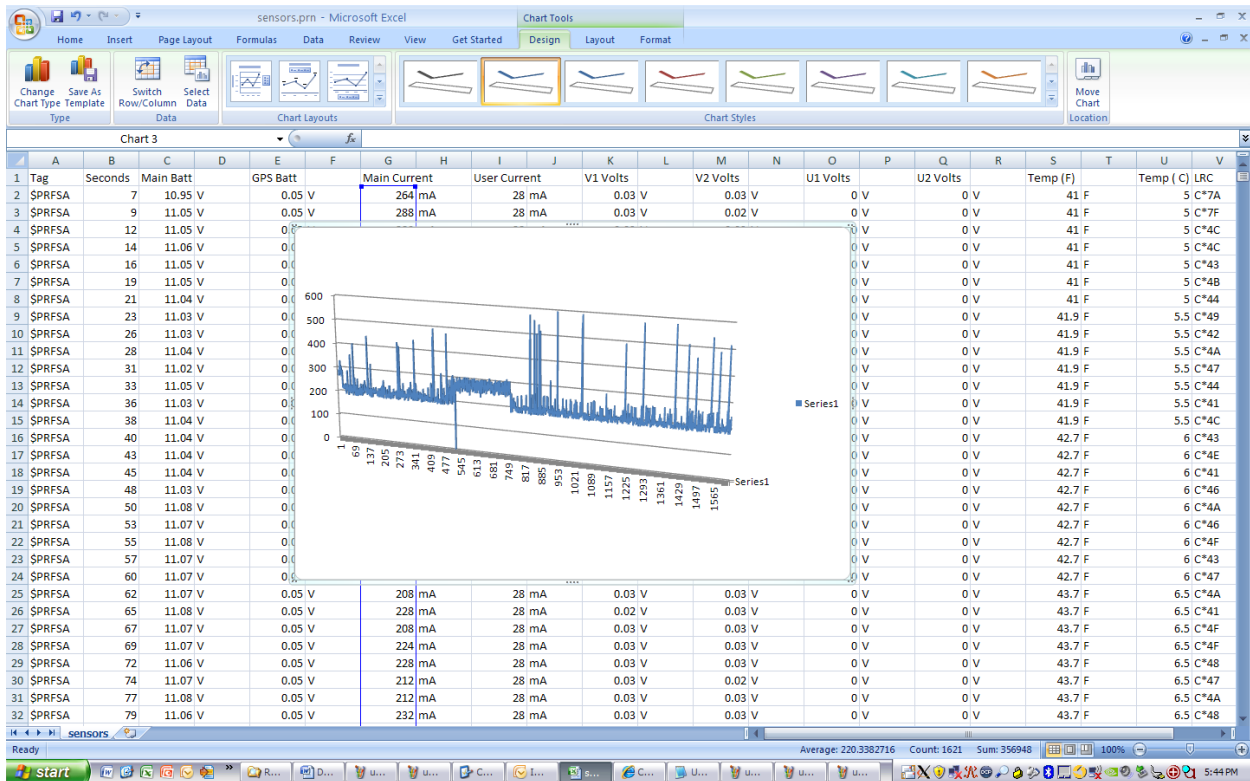
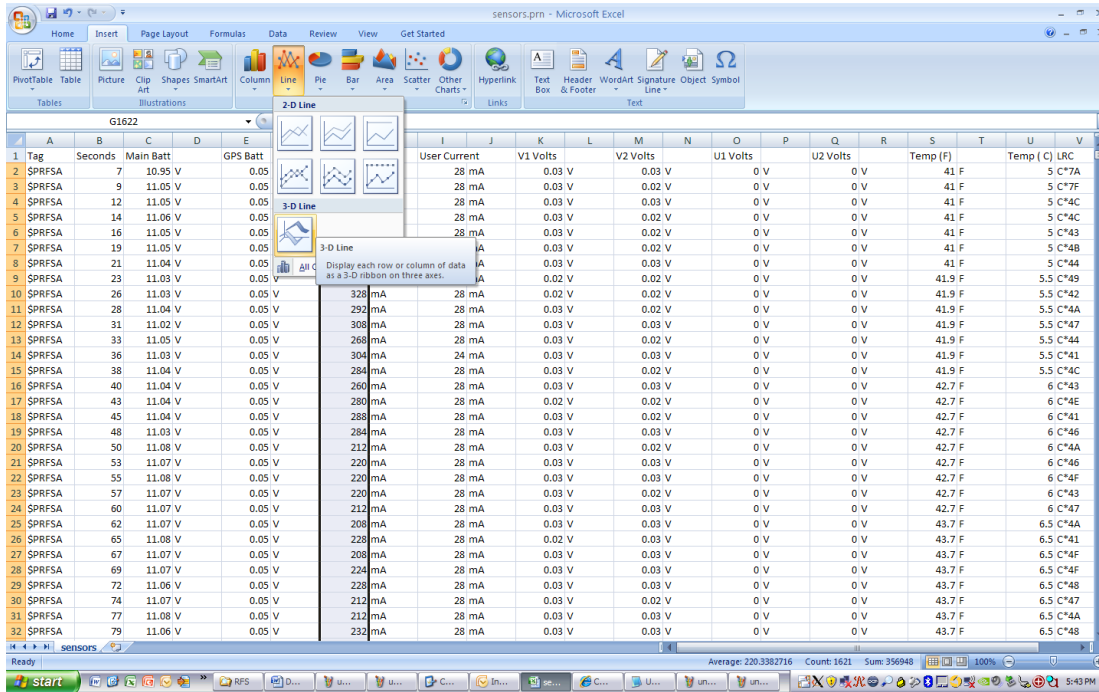
Tag,Seconds,Main Batt,GPS Batt,Main Current,User Current,V1 Volts,V2 Volts,U1 Volts,U2 Volts,Temp (F),Temp ( C),LRC

### 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 image shows two screenshots of Microsoft Excel. The top screenshot shows the 'Insert' tab with the '3-D Line' chart option selected. The bottom screenshot shows the resulting 3D line chart for the 'Temp (F)' data series.

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.





WARNING: All liability waived. Rocketry is an inherently dangerous undertaking. Make your choices and take personal responsibility for the outcome of your endeavors, protect your privilege to fly rockets by not making the headlines or becoming a statistic.