

FreeFlightWx Mainboard Overview

The FreeFlightWx mainboard provides the core of your remote weather station for real time monitoring of conditions at flying sites. It does the hard part of capturing the data from sensors, uploading it to the server, monitoring power, and dealing with fickle internet connections.



FreeFlightWx v4.1 Mainboard

Micro SIM Card Holder

Level Translator IC

SD Card Holder

Removable STM32 Processor Module

UART 2 Interface

3.3V LDO (Processor and most IC's)

Power Input (5.0v)

4.1V LDO (4G Modem)

Voltage Sensor Input

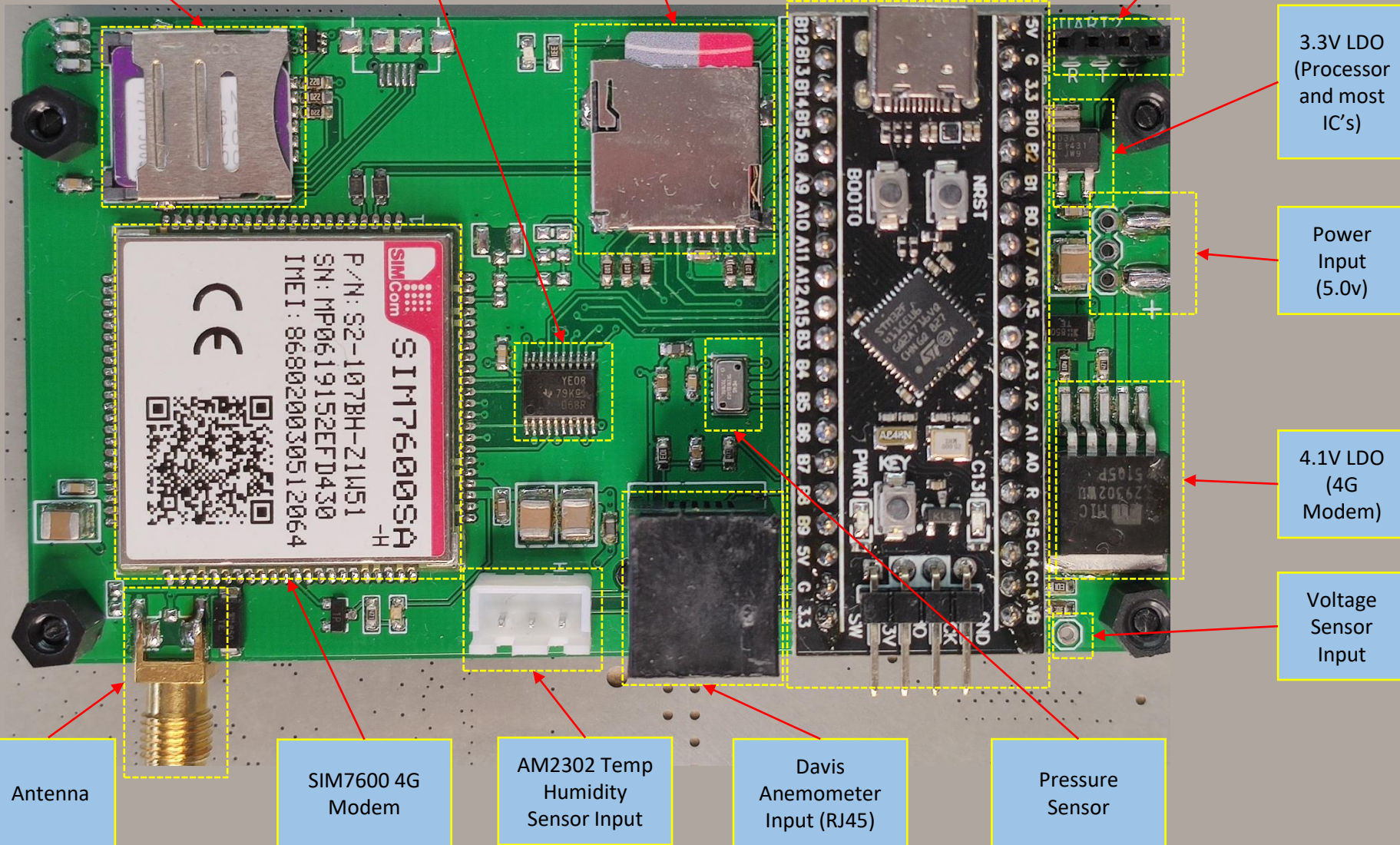
Antenna

SIM7600 4G Modem

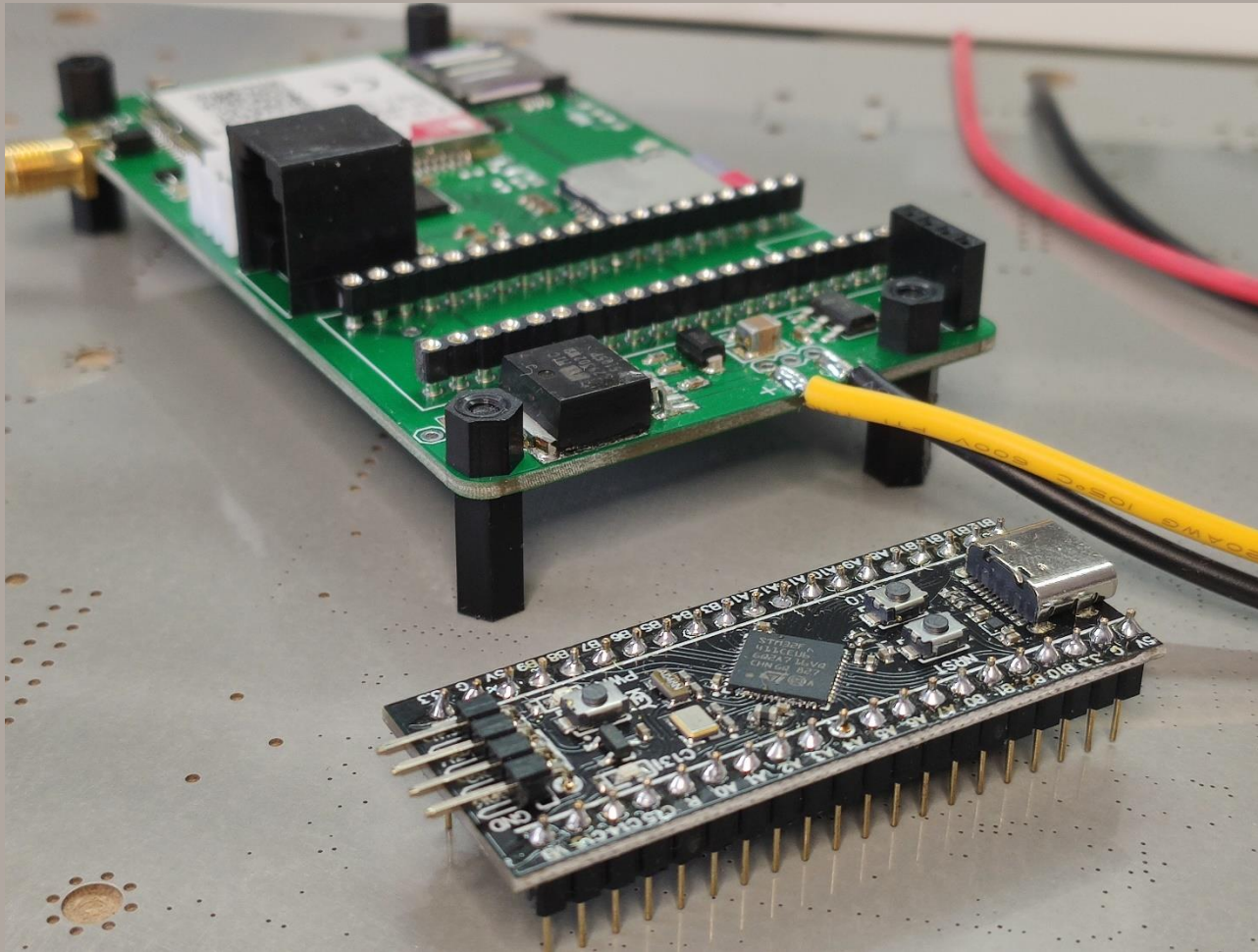
AM2302 Temp Humidity Sensor Input

Davis Anemometer Input (RJ45)

Pressure Sensor



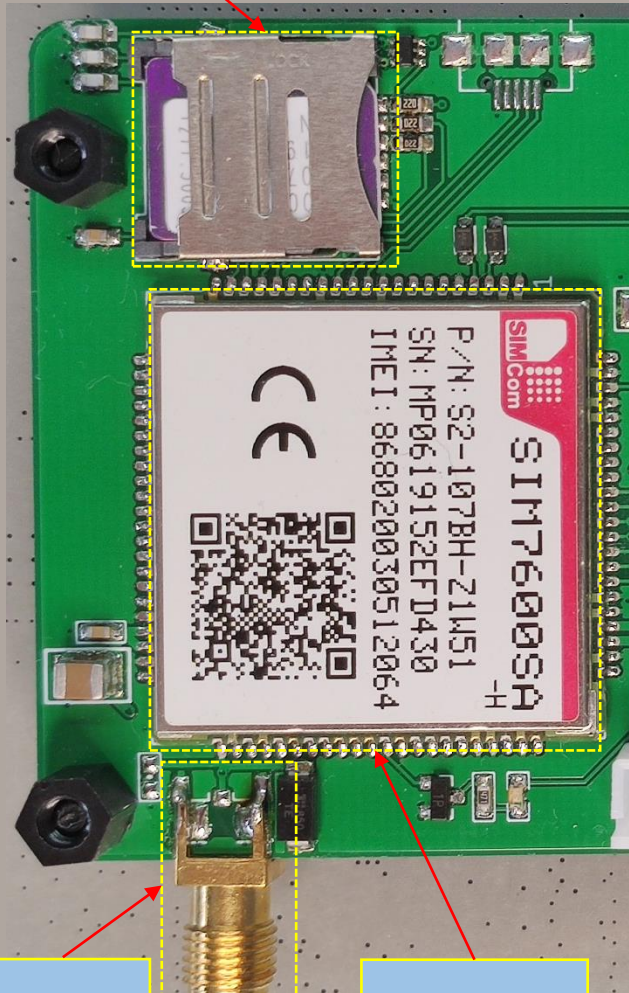
Removable STM32 Processor Module



- Based on the popular STM32 'Black Pill' module.
- Processor operates at 60 MHz.
- Lots of spare capacity for program size and processing.
- Populated with reliable round header pins to match the mainboard.
- USB-C interface can be used to update firmware via STM DFU mode.
- Reset and restart with the NRST button.

Modem Interface

Micro SIM Card Holder



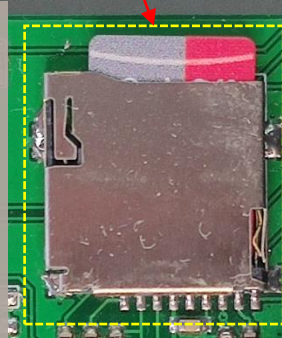
Antenna

SIM7600 4G
Modem

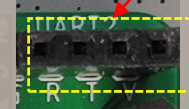
- SIM7600SA-H modem (or other model SIM7600X-H) 4G LTE Cat 4 modem.
- Blue LED indicates modem operation.
- In normal operation (11.25s updates) modem uses less than 10Mb of data each day.
- 4G antenna SMA connector for a wide variety of antennas.
- Antenna includes a TVS diode to protect from power surges.
- Reliable fold up/lock down micro SIM card tray.
- SIM protected from power surges with TVS diode.
- Commands can be sent to the SIM card number to adjust settings.

External Interfaces

SD Card Holder



UART 2 Interface

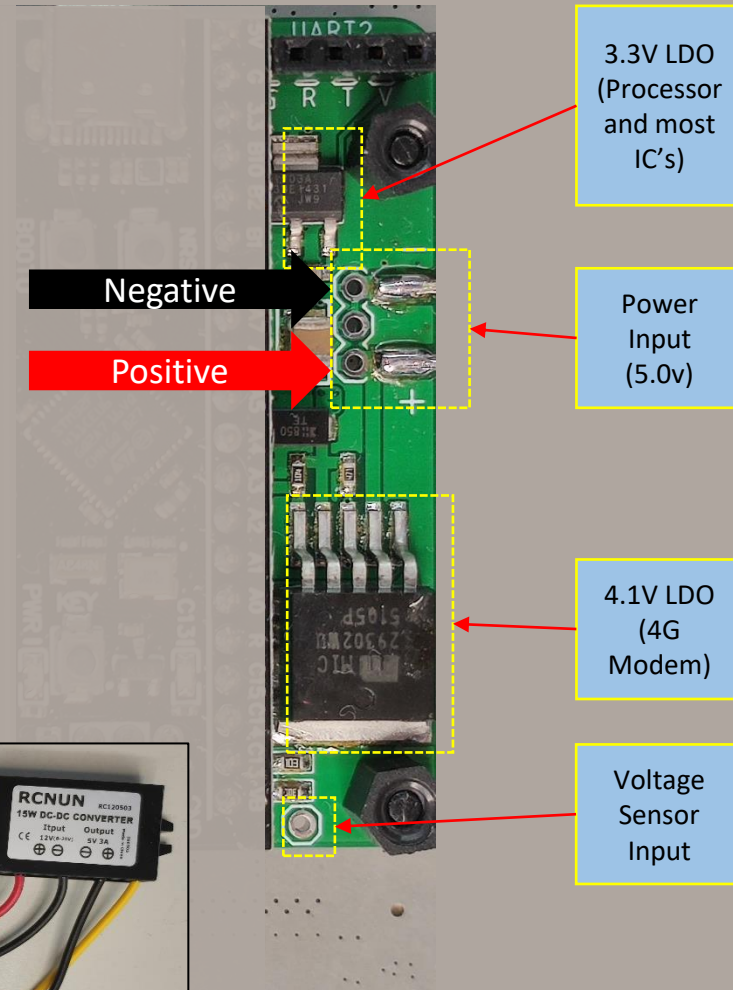
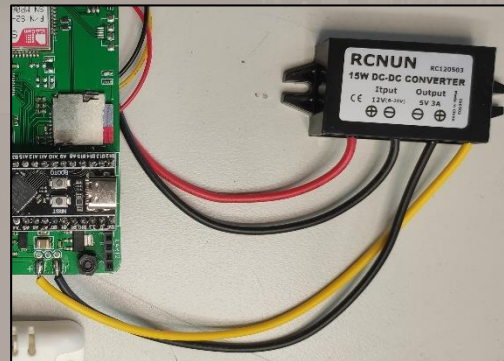


- Push/Push type SD Card holder for easy access.
- 16 Gb SD Card (included).
- Observation data logged on SD Card for historical records (<1Mb per day using default settings).
- Green LED flashes indicate logging.
- File 'SETTINGS.TXT' can be edited to adjust station settings.
- If SD Card is not present settings are also stored for each station (by IMEI) on freeflightwx.com main server.

- UART 2 interface for debugging and sending commands.
- Interface with USB-Serial adapter (not included).

Power

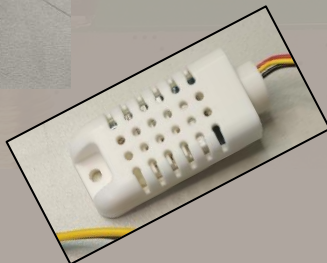
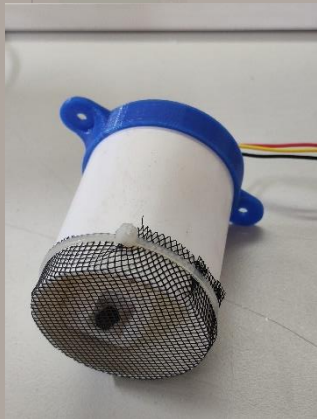
- Flexible voltage input (5.0v nominal, up to 16V).
- TVS diode on voltage input to provide some protection for power surges.
- 15 w DC-DC converter included.
 - Nominally 12 V input, but can range from 6 to 20v.
 - 5V 3A output to the mainboard voltage input.
- Power input via solder tabs (default) or headers.
- 3.3V TC1703 LDO regulator provides power to processor and most other circuits.
- 4.1V MIC29302A LDO regulator provides power to 4G modem. It is switched by the processor and can be used to restart the modem without restarting the processor.
- Voltage sensor input used to connect to monitor main battery voltage (max input 16V).
- Power consumption about 550mW in normal operation.



Sensors

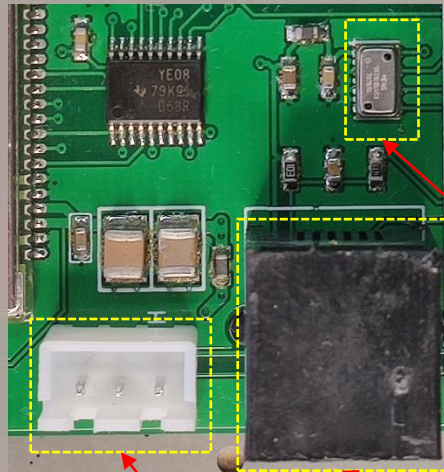
Temperature and Humidity

- AM 2302 temperature and humidity sensor included with 50 cm of cable and JST connector.
- AM 2302 to be mounted externally, but protected from rain and insects. (example 50mm PVC pipe mount shown below)



Pressure

- Onboard MS5611 pressure sensor provides atmospheric pressure in pascals.



AM2302 Temp
Humidity
Sensor Input

Davis
Anemometer
Input (RJ45)

Pressure
Sensor

Wind Speed and Direction

- Designed for use with reliable Davis 6410 anemometer (not included).
- RJ45 input.
- Wind speed and direction measurements taken every 2.25 seconds:
 - Number of rotations in this period is windspeed in mph.
 - Direction taken at end of period.
- Every 11.25 seconds five measurements vector averaged to produce average windspeed and direction (max and min speed also recorded).



Station Operation

The firmware does this:

1. Power on
 2. Initialize sensors, sdcard, etc.
 3. Take measurements and upload every 11.25s (by default – see AVN), then repeat.
- At all times, the mainboard:
 - *React to commands.*
 - *Update clock from upload response.*
 - *Check if we have reached restart hour.*

Station Clock Time

- Measurements are only saved/uploaded if there is a valid station clock time.
- Clock time is sought from the network NTP.
- After the first successful upload clock time comes from the server.
- Clock time is sent from the server every 3 minutes in upload response.
- User can also manually change clock time.
- Measurement time record uses the clock time.

Sending Commands

- Commands (**\$FFWX,3,CMD**) can be sent via:
 - UART 2 interface (115200 baud)
 - SMS to the station sim card
 - *Website admin interface (TBI)*
- Update Settings Command: (**\$FFWX,3,SET=Setting**). Examples:
 - Set the URL:
\$FFWX,3,URL=freeflightwx.com/test/up4.php
- Action Commands:
 - Restart the station: **\$FFWX,3,RST**
 - Save settings: **\$FFWX,3,SAV**
 - Get settings: **\$FFWX,3,GET**
 - Set the time in UTC using the specific format below:
\$FFWX,3,CLK=20/11/28,12:23:16+00
 - Formats the SD Card – use with care:
\$FFWX,3,FMT

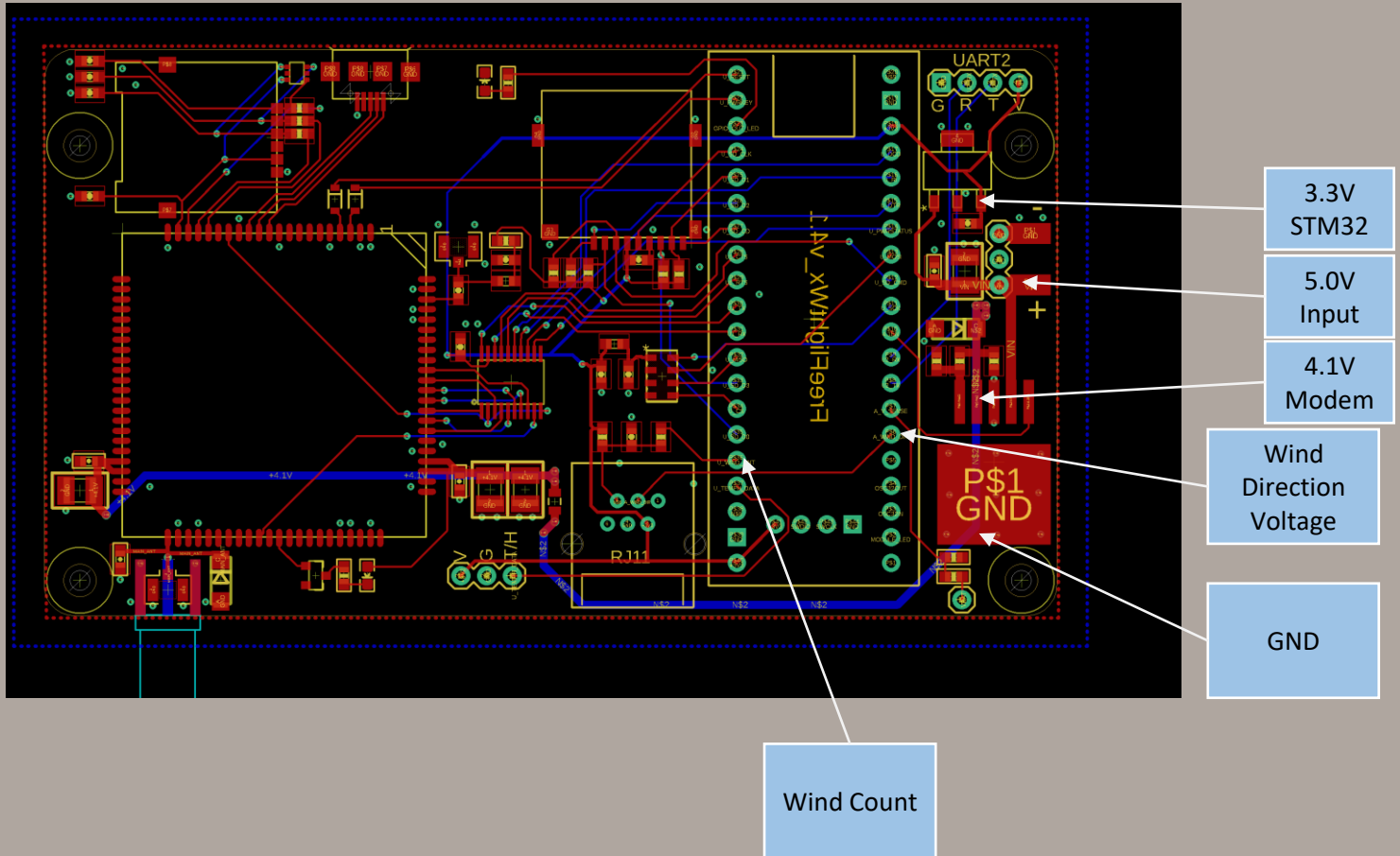
FFWX Message Format

- **\$FFWX,0**, {individual 2.25ms measurement data ...}
- **\$FFWX,1**, {11.25 s upload data ...}
- **\$FFWX,2**, {server response data...}
- **\$FFWX,3**, {command or setting data ...}
- **\$FFWX,4**, {settings data from main server...}

Settings

- Settings are loaded from, in order if available:
 - SD Card SETTINGS.TXT file
 - freeflightwx.com IMEI backup
- When a setting is updated, it is saved to both locations.
- Settings include [**SET** = **default value**]:
 - **SID** – Station ID (16 bit unsigned integer). In the future to be used like a password[**1234**].
 - **URL** – URL for uploading of station data to a site [**freeflightwx.com/test/up4.php**].
 - **LOG** – Level of logging to be saved to SD Card [**0-no logging, 1-logging**].
 - **BCL** – Battery voltage conversion level factor. Used to convert the measured ADC value (0 to 4095) to battery voltage (0 to 16.17V). Tweak the value to get accurate voltage measurements. [**0.0039487**]
 - **RSH** – Restart hour in UTC (8 bit unsigned integer). The station will restart daily as the clock enters this hour. Set to something other than 0-23 to not restart automatically. [**99**]
 - **AVN** – Average number. The number of 2.25 second measurements included in a measurement. [**5**]
- *More settings TBA*

Debugging



Included

- FreeFlightWx 4.1 mainboard including Removable STM 32 Processor Module.
- 16 Gb SIM Card with SETTINGS.TXT configured to your station.
- 15W DC-DC converter for powering from 12V battery.
- AM2302 Temperature Humidity Sensor with cable and adapter.
- Battery Voltage monitor wire.
- freeflightwx.com website configured for your station.
- 1 year warranty and support.

You will need

- Davis 6410 anemometer.
 - Amazon is a good supplier (https://www.amazon.com/Davis-Instruments-Anemometer-Vantage-Pro2/dp/B004GK9MFO/ref=sr_1_2?crid=2TAP0XI639RBE&keywords=davis+6410&qid=1650964730&sprefix=davis+6410%2Caps%2C273&sr=8-2), alternately, you might also check Davis Australia.
- A case and internal mounting hardware.
 - Finding an appropriate case can be tricky. You might find the right one at Jaycar, or on ebay, but they are changing all the time.
 - The internal mounting hardware can be custom cut from acrylic or wood.
- External mounting hardware for the Temp/Humidity sensor to protect from rain and insects, such as small length of pvc pipe.
 - Although, you might also consider just putting it inside the case – it will last longer.
- Power supply, such as a solar configuration including:
 - 40W or 50W solar panel (this is more than is needed, but allows for many cloudy days in a row).
 - Search ebay for 50w solar panel. Something like this: <https://www.ebay.com.au/itm/292963274036?epid=9029088843&hash=item4435f8cd34:g:L~0AAOSwu4Zg6-k6&frcectupt=true>
 - 7.2Ah 12V SLA battery (again, more than is needed).
 - Get this from Jaycar
 - Solar charge regulator.
 - Search ebay.
- Pole (suggest anemometer mounted at least 5m off the ground), pole base (designed to allow the pole to be lowered), mount for solar panel and case.
 - Design this yourself, see the images on the next page

Installation Examples

