

# WeatherBox for real-time measurement of atmospheric data and microwave propagation prediction

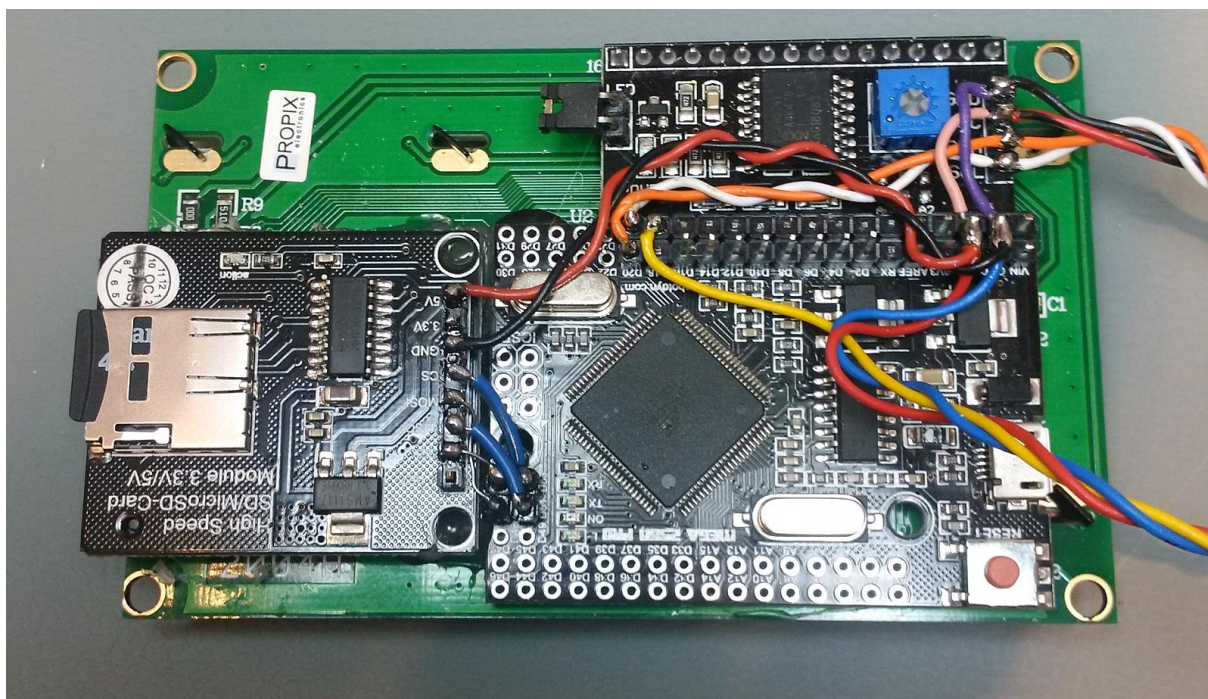
Matthias DD1US July 3<sup>rd</sup>2020

As I plan to get more active on the microwave bands I was interested in the WeatherBox developed by Barry Chambers G8AGN which provides microwave propagation predictions based on the real-time measurement of barometric pressure, ambient temperature and relative humidity. A small sensor module with the BOSCH BMP280 sensor IC is used to measure pressure, temperature and humidity.

A friend, Marek SP4ELF, was kind enough to help me with the electronics and programming of the Arduino Mega2560. The code was provided by G8AGN.

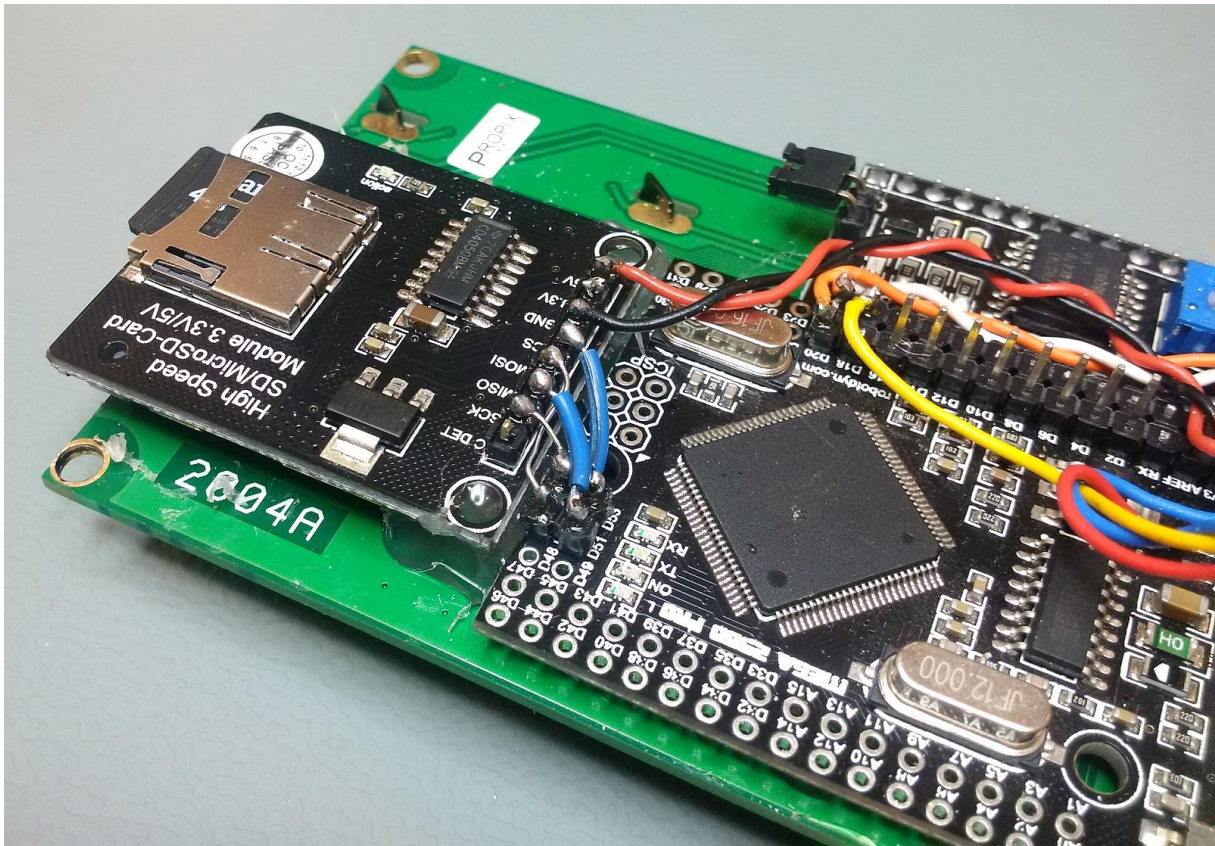
Barry uses the attenuation model given in the ITU-676-12 report which is covering the frequency range between 1 and 1000 GHz.

Here are some pictures of the unit before integration in the encasing.



SD-card reader (left) and Arduino MEGA2560 board (right) attached to the back of the display module





Connections of SD-card reader to Arduino board



GPS board with ublox NEO-6M module (left) and sensor board (right)



I integrated the various components including the Display, Mega2560 board, GPS module, keypad and a USB power pack in a plastic encasing which I had at hands.

The sensor module is mounted outside of the encasing to guarantee that the measurements are not influenced by the heat generated by the electronics.

Due the integration of the USB power pack the unit is completely portable and perfectly suited for field operations.

The unit can be recharged through a micro-USB port.



Display after powering up the WeatherBox



After some seconds the display changes to the first entry screen, asking for which data shall be used. You can also save input data in the EEPROM and recall them later.





After selecting “default data” you can see this screen. Here a frequency of  $F=122.4\text{GHz}$ , a path length (distance to the other station) of  $PL=10.0\text{km}$ , a TX-Power of  $TXP=0.5\text{mW}$ , a TX antenna gain of  $TXG=21\text{dB}$ , a RX antenna gain  $RxG=21\text{dB}$ , a receiver noise figure of  $NF=12\text{dB}$  and a receiver bandwidth of  $BW=2.4\text{kHz}$  has been chosen.



After closing the data entry with the # key you can see the next screen. Here the GPS unit has already logged to the GPS system. You can see the QTH locator (10 digits), the chosen frequency here F=2.4GHz, the date DDMMYY



here the 3<sup>rd</sup> of July 2020, the UTC time hh:mm here 10:31, the path length PL=200km, the relative humidity H=36.9%, the relative pressure P=993hPa, the ambient temperature T=24.4 degC. The last line shows the calculated parameters which are the water content in the atmosphere  $W=8.2\text{mg/m}^3$ , the additional path loss due to the presence of water vapour and atmospheric gases GL=1.3dB and finally the expected carrier to noise ration at the receiver C/N=52dB.



View of the bottom side of the WeatherBox



View of the lower end of the WeatherBox, on/off switch (left) and microUSB charging port (right)



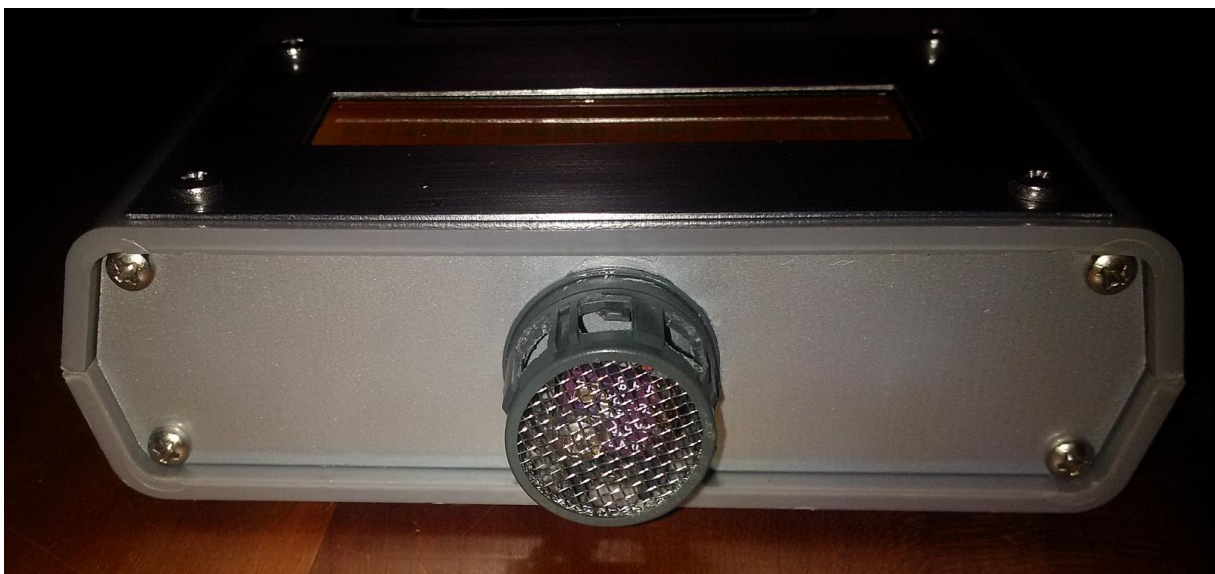
At the top end, outside of the Weatherbox, the small sensor board is attached

Finally, I added a protection around the sensor board. This needs to allow a free air flow but provide mechanical protection when operating the unit in the field. I came across a filter device which can be inserted into a faucet. It was easy to modify. The “base” ring is glued to the encasing and the clip on “top” can be removed when needed, e.g. if the filter board needs to be replaced.





Base ring glued on the top metal plate



Cover clipped onto the base ring

There is still one small problem with my Weatherbox: I did not get the SD-card reader working properly. When trying to log the measured and calculated values on the microSD card I get the error message “No SD card in reader”.



Finished

I hope my little description might get other radio amateurs interested in this very useful application. I would like to thank Barry Chambers G8ABN for developing this useful tool and making it freely available. Further information and a copy of the Arduino sketch for WeatherBox may be obtained from him on request via [b.chambers@sheffield.ac.uk](mailto:b.chambers@sheffield.ac.uk).

A special thanks to Marek SP4ELF who helped me with the kit.

If you have questions or comments please send them to the Email address given below.

vy 55 & 73 de

Matthias DD1US

Email: [dd1us@amsat.org](mailto:dd1us@amsat.org)

Website: [www.dd1us.de](http://www.dd1us.de)