# FUNcube Dongle Pro+ User Manual (V4)



## AMSAT-UK FCD2 regulatory statements

### FCC statement

WARNING: MODIFICATION OF THIS DEVICE TO RECEIVE CELLULAR RADIOTELEPHONE SERVICE SIGNALS IS PROHIBITED UNDER FCC RULES AND FEDERAL LAW.

### Industry Canada statement

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

## Introduction

Many thanks for purchasing the FUNcube Dongle Pro+! The FUNcube Dongle Pro+ is a software-defined radio (SDR) covering all broadcast and amateur radio bands from 150kHz to 1.9GHz. With an SDR, many of the functions of a traditional hardware-only radio are performed in software, such as demodulation, decoding and frequency conversion. The FUNcube Dongle Pro+ hardware is designed to be very simple to set up, with the only connections being an antenna connection and a USB connection. There are no physical controls on the FUNcube Dongle Pro+ itself: all the settings for the FUNcube Dongle Pro+ are controlled from host computer.
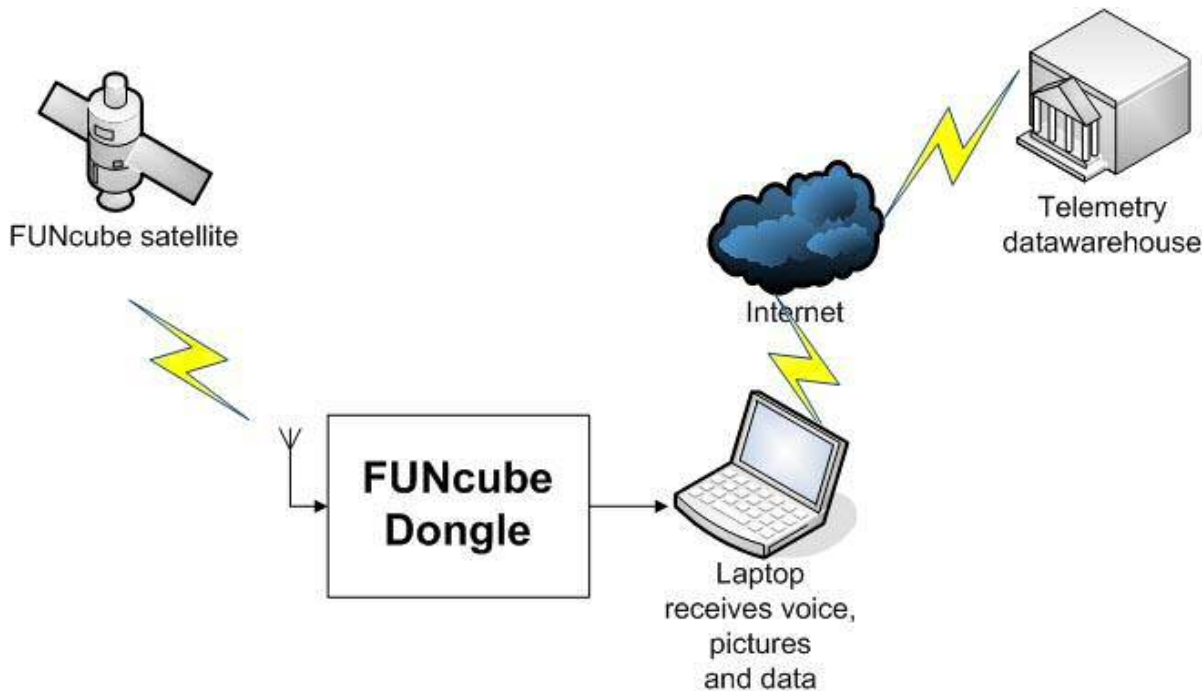
## History

When the original FUNcube Dongle was designed, it proved far more popular than we ever anticipated. Then when we had an opportunity to update the design for the FUNcube Dongle Pro+, we took into account the user feedback, and re-engineered the device from scratch as a result.

Although there are numerous applications for FUNcube Dongle devices, first and foremost it is designed to be a radio receiver for the FUNcube satellite. Let's briefly take a look at what the FUNcube satellite project is all about.

The FUNcube satellite is an AMSAT-UK project, and its primary goal is to encourage and educate young people in the disciplines of radio, space, physics and electronics, and to support Science, Technology, Engineering and Mathematics (STEM) initiatives by using practical demonstration.

The fundamental design criteria of FUNcube Dongles is to allow the target audience of primary and secondary school students to *directly* receive data and voice from the FUNcube satellite.

The satellite itself contains a materials science experiment linked to a 145MHz telemetry beacon that schools can receive using a FUNcube Dongle, and can then decode and compare the telemetry data with results they obtain from their own experiments in the classroom. In addition, the pupils can request their own messages, similar to SMS text messages, to be sent into space and have them retransmitted by the FUNcube satellite as part of its telemetry data stream. The transmissions will be received globally by a network of thousands of FUNcube Dongle owners, and with appropriate software, the messages will be distributed through a central telemetry datawarehouse.
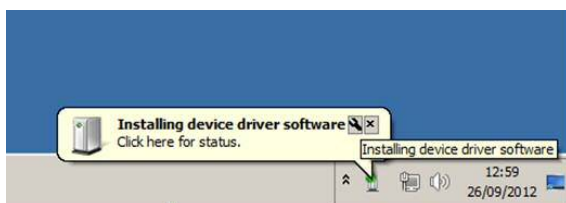


The FUNcube satellite also includes an analogue voice transponder that can also be received with the FUNcube Dongle.

To produce a receiver suitable for school use, the device has to be both simple to install and to use. As the USB dongle is nowadays so ubiquitous, that form factor was chosen. In addition, it needs to be inexpensive. The FUNcube Dongle is designed to connect between the antenna feed and a PC, and with the use of appropriate software, enable the display and sharing of the received telemetry.
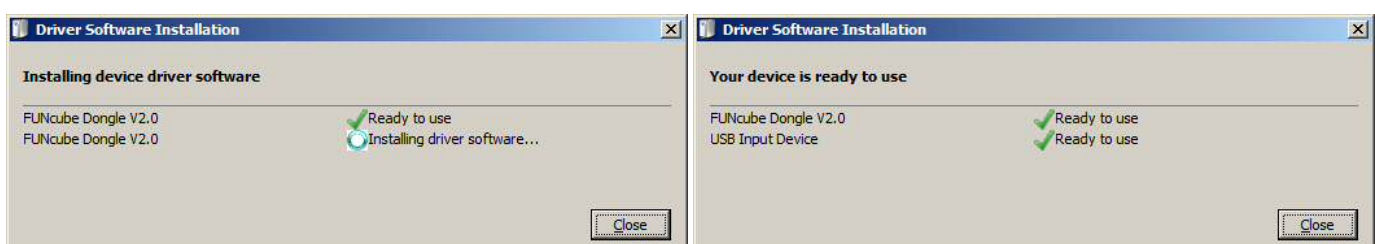
Further details of the FUNcube satellite and the project as a whole can be found here: http://funcube.org.uk

## Initial Windows installation

Insert the dongle into a free USB port. Windows should proceed by automatically installing drivers:



If the balloon is clicked, the progress of installation can be tracked:

This initial installation process takes from a few seconds up to a minute or so. If the dongle is inserted into a new port, the process is repeated.

## Application software – getting started with SDRSharp

The control of the FCD+ and the demodulation can be performed from a single program if that program supports the FCD+ directly, for example **SDRSharp** now supports the FCD+ fully. Alternatively, if your SDR software doesn't support the FCD+ directly, you can use the FCD+ in conjunction with its frequency control program (**FCHid2**.exe).
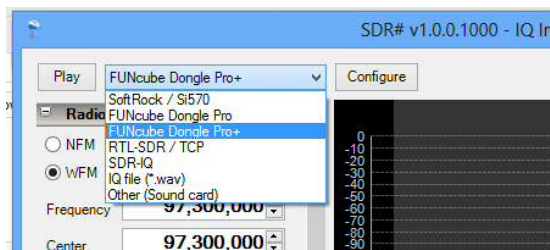
This documentation covers SDRSharp build 1000 which includes full FCD+ support.

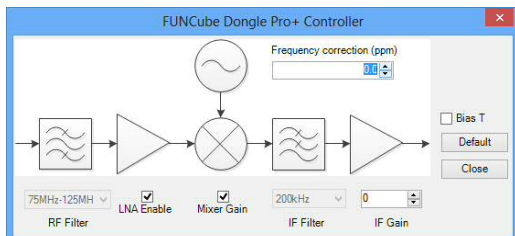You can download it from http://sdrsharp.com/downloads/sdr-stable.zip

Unzip the program into an appropriate directory, and run the SDRSharp executable. It may be convenient to create desktop icon shortcuts at this point if desired.

It is important that the FCD+ is already inserted *before* running SDRSharp. Once the FCD+ is inserted, run the SDRSharp application.

Once SDRSharp is running, from the drop down at the top of the program, select FUNcube Dongle Pro+.
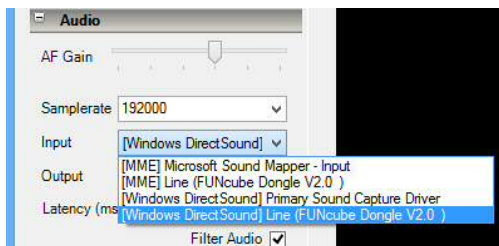


The first time you run SDRSharp, it's also wise to check some of its settings. Press the Configure button just to the right of the drop down. In particular, check that the frequency correction is set to 0.0ppm (the default is 120.0ppm).



The controller configuration window can be closed at this point.

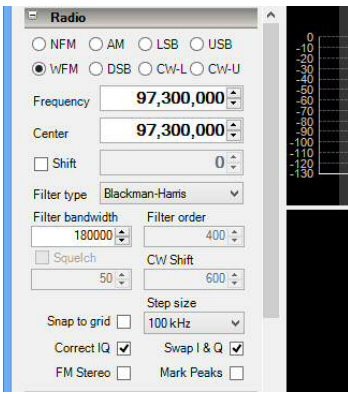In the Audio section, in the Input drop down, select the FUNcube Dongle V2.0 (either MME or DirectSound).

Check that the sample rate is 192000.
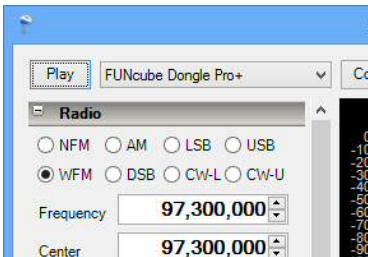


In the Radio section, select the WFM radio button.

Also in the Radio section, enter the frequency in Hz of any local FM broadcast station.

Finally, in the radio section, check both the Correct IQ and Swap I & Q checkboxes.
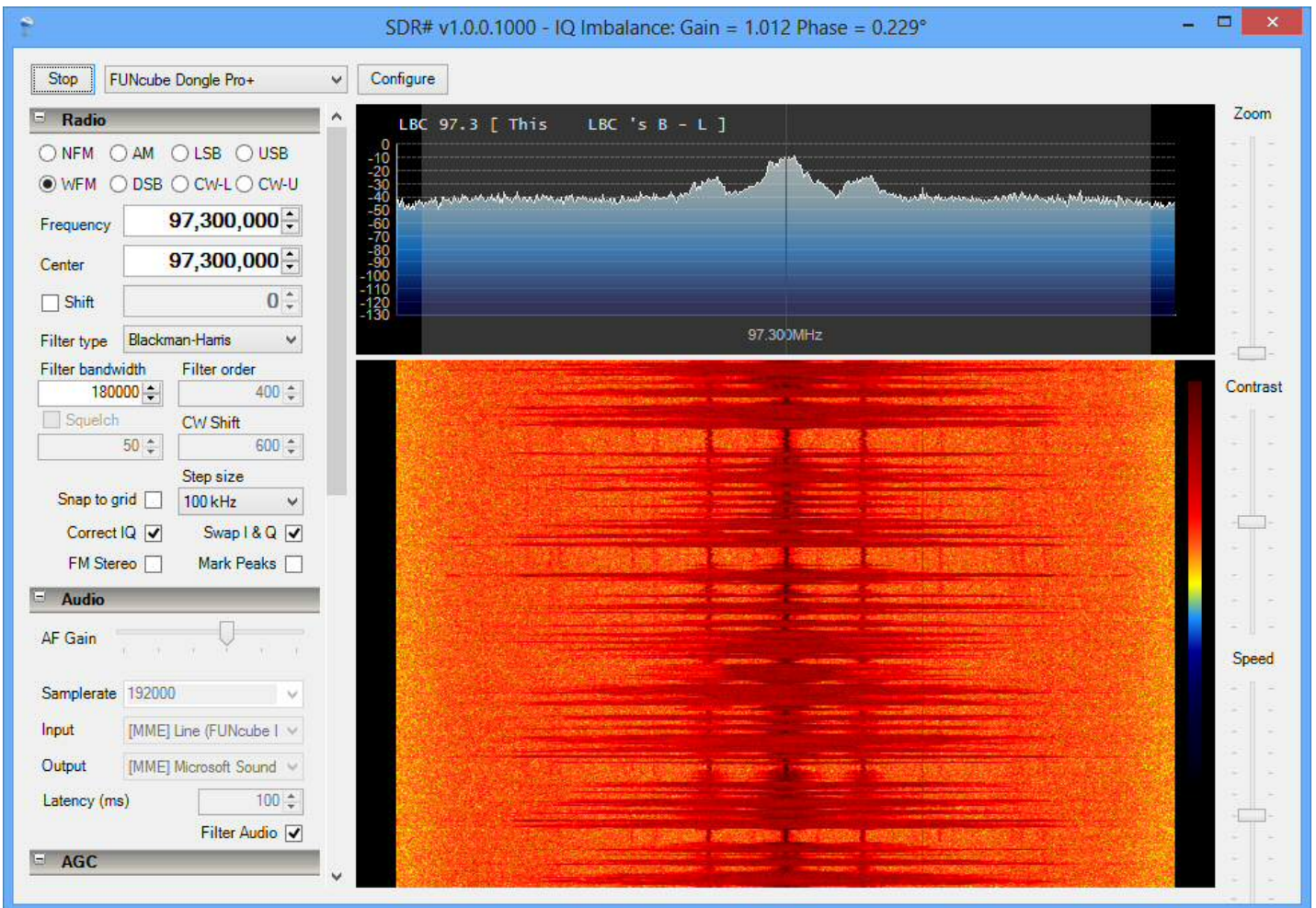
This concludes the initial setup: these settings should now be saved, and won't need to be adjusted again.
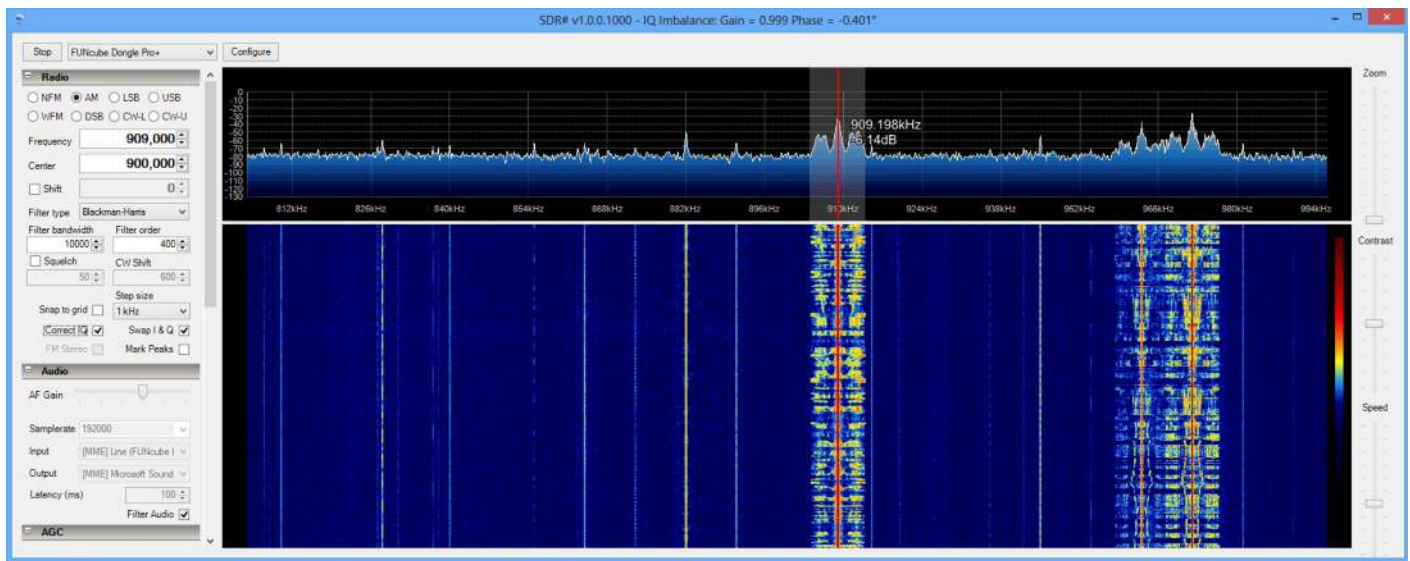
With all the appropriate settings are now made, to start the radio, press the Play button at the top left of the SDRSharp application.



Here's a typical SDRSharp display from a broadcast FM station:

Broadcast FM is a fairly wideband signal. To receive narrowband signals such as on the AM broadcast band, set the Center frequency a few kHz away from the required frequency and then fine tune either by adjusting the Frequency setting or simply clicking on the spectrum display at the desired station. For example, below shows the reception of 909kHz on medium wave.



The reason to keep the center frequency a few kHz away from the frequency of interest when receiving narrowband signals like AM, SSB, NBFM and CW is that there are some artefacts from local oscillator phase noise that can interfere with signal reception.

Usually it is unnecessary to adjust the Configure settings although sometimes in extremely strong signal conditions, adjusting the LNA, Mixer or IF gain may be beneficial.

## Specifications

- Frequency range          150kHz-240MHz and 420MHz-1.9GHz
- Sensitivity               Typically 12dB SINAD NBFM for 0.15uV at 145MHz
- Reference oscillator    1.5ppm 26MHz
- Sampling rate            192kHz
- Bit depth                16 bits (32 bits used internally)
- PC interface             USB 1.x Male A Full Speed (12Mbps)
- RF interface             Standard SMA female (**not** Reverse Polarity [RP])