FUNcube Dongle Pro+ User Manual

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+: 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.
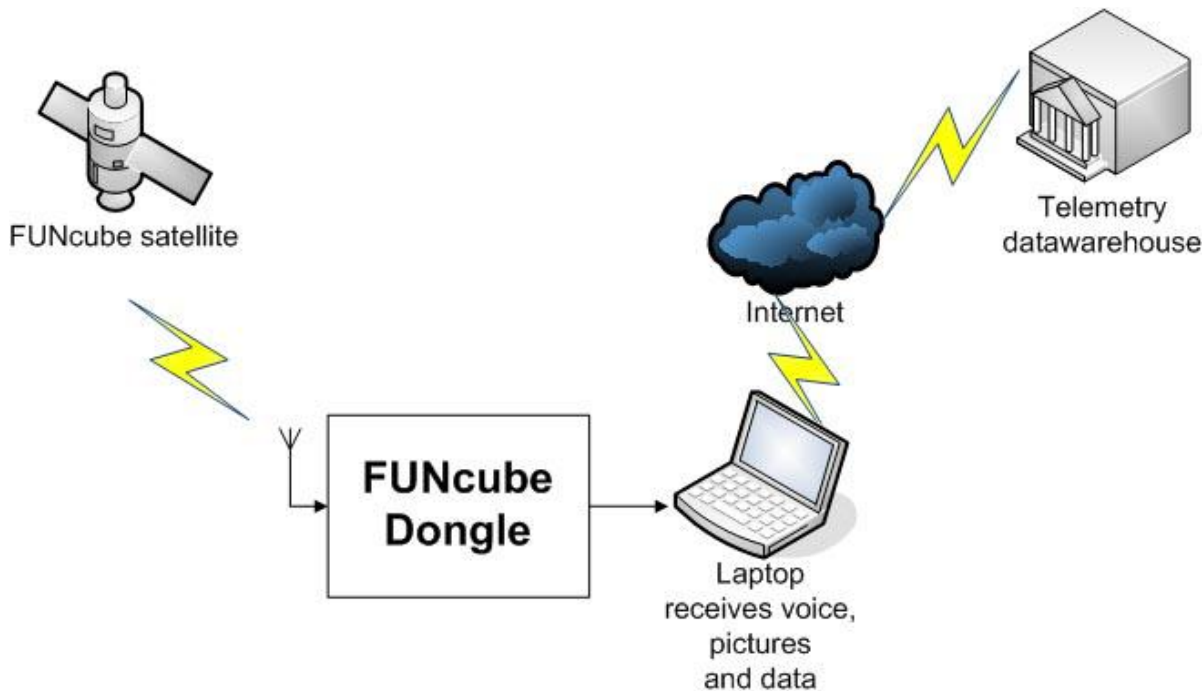

The FUNcube satellite also includes an analogue voice transponder that can also be received with the FUNcube Dongle.

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.
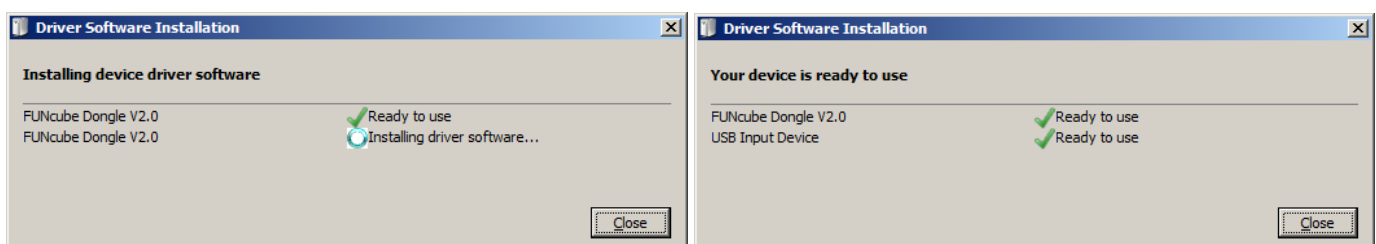
Further details of the FUNcube satellite and the project as a whole can be found here: http://funcube.org.uk

Initial Windows installation

Insert the dongle into a free USB port. Windows should proceed by automatically installing drivers:
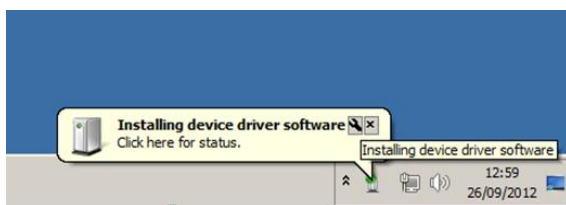
If the balloon is clicked, the progress of installation can be tracked:

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

Two concurrently running applications are required to operate the FUNcube Dongle Pro+. One program (**FCHid2**.exe) controls the tuning and other adjustments of the FUNcube Dongle Pro+ hardware. The second application performs the demodulation of signals. There are many demodulation programs that are compatible with the FUNcube Dongle, and for this example the **SDRSharp** program will be used.

- Download FCHid from http://www.funcubedongle.com/MyImages/FCHid2Exe.zip
- Download the SDRSharp program from http://sdrsharp.com/downloads/sdr-stable.zip

Unzip the programs into appropriate directories, and run *both* the FCHid and the SDRSharp executables. It may be convenient to create desktop icon shortcuts at this point if desired.

Each time SDRSharp is started, it is recommended that the following settings are adjusted for use with the FUNcube Dongle Pro+:

- Radio section: Check Swap I & Q
- Audio section: Set Rate to 192k Sample/s
- Audio section: Set Input to FUNcube Dongle V2.0

To start demodulation, press the Play button.
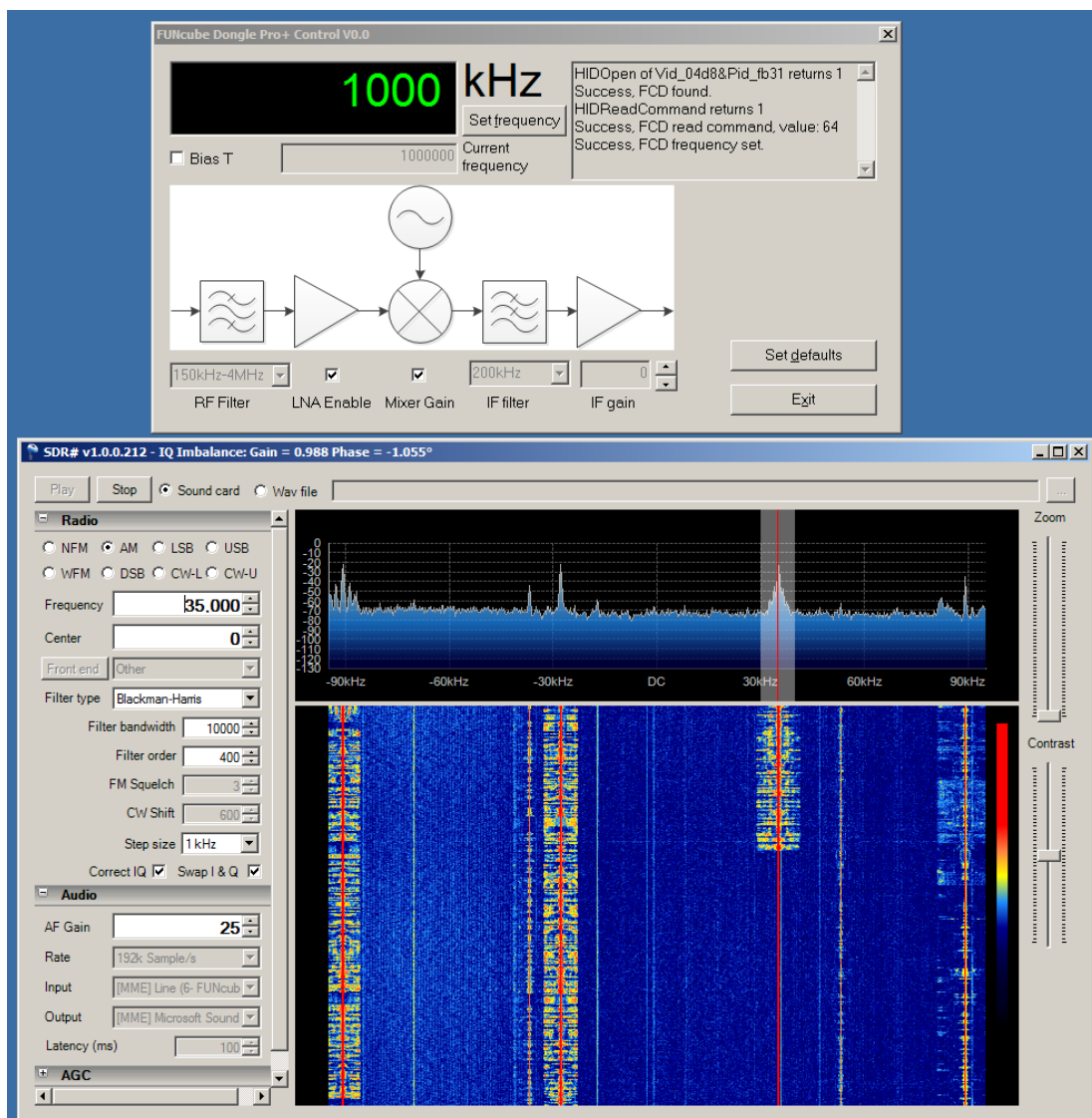
For wideband FM (WFM) signals, almost the entire 192kHz is required for demodulation, and it is recommended that that the demodulation's carrier (the vertical red line) is set to the centre DC position. In this case, the FCHid frequency is the same as the broadcast signal's frequency. In radio terms, this is a single, direct conversion receiver.

For narrow band signals, such as NFM, AM, SSB and CW, typically the centre DC position is often avoided as there are hardware artefacts such as local oscillator phase noise that can interfere with reception.

When receiving narrow band signals, avoiding the centre DC position, there is a second conversion defined by the host software's NCO (numerically controlled oscillator). The actual frequency of the received signal will be the first conversion shown by FCHid, plus the Frequency shown by SDR Sharp. So, it's much like a conventional dual conversion receiver, except the second conversion is performed in software, and that second conversion is at a much lower frequency than would be used in a hardware receiver.

Usually it is unnecessary to adjust the settings in the FCHid program other than the frequency, 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])