What the heck is a dongle?

The FunCube Dongle pro+, a review by Andrew Barron ZL3DW

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As many of you will know I have been interested in software defined radio (SDR) for quite a while. I experimented with a couple of 'SoftRock' receivers and eventually ended up buying a Flex1500 QRP SDR transceiver. So I was very interested in the release of a new SDR receiver with the rather unusual name of 'The FUNcube Dongle' which was invented and developed by Howard Long G6LVB specifically to provide a cheap ground station receiver to complement the AMSAT-UK FUNcube Satellite project.

The FUNcube satellite, scheduled for launch in 2013, is an educational single unit CubeSat developed with the goal of enthusing and educating young people about radio, space, physics and electronics. It will have a linear (SSB/CW) UV mode transponder for amateur radio use. The idea behind the SDR FUNCube Dongle was for schools and students to be able to receive signals from the FUNCube satellite at a minimal cost.

What Howard came up with was revolutionary. An SDR receiver not much bigger than a USB flash drive, that plugs directly into a USB port on a PC. It covers 64MHz to more than 1700MHz, needs no software drivers and works with Windows, Linux and MAC PCs. The 'dongle' was an instant hit and initial supplies sold out in seconds. Since then 1000s have been sold and a few have made their way to New Zealand. But I didn't buy one because I don't need a receiver that works from 64MHz to 1.7GHz. Around June 2012 Howard's project hit a snag, Elconics the manufacturer of the surface mount tuner chip went into receivership and then liquidation. Howard tried to buy a supply of the remaining stock from the liquidator but was not able to, so he set about re-designing the FUNcube Dongle. The result is an even better version using a completely different chip-set and more than twice as many components mounted on a six layer printed circuit board. The new model is called the FUNcube Dongle Pro+. It is slightly larger and 25 Pounds more expensive, but is still very good value at 142.38 Pounds including freight to New Zealand. Due to export orders not having to pay VAT, this is actually cheaper than the price in the UK.
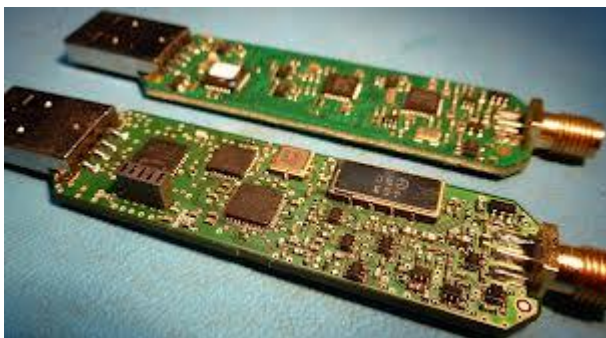
FUNcube Dongle Pro and Pro Plus versions

The new 'dongle' is guaranteed to work from 150kHz to 240MHz and from 420MHz to 1.9GHz but it typically works from 150kHz to 260MHz and 410MHz - 2.05GHz. It has eleven discrete front end filters for different frequency bands including SAW filters for the 2m and 70cm amateur bands. The filters are inserted automatically according to the frequency the unit is tuned to. With the 30dBm LNA, the noise figure ranges from 2.5db at 50MHz, to 3.5dB at 2m and 70cm, and up to 5.5dB at 1296MHz. The noise floor is 8dB – 9dB lower than the old model and the new TXCO is providing frequency stability of around 1.5ppm which is another big improvement over the earlier model. It even has an internal bias T and can send +5V up the coax to a low noise preamplifier.

Wow an "LF to L Band" receiver with pretty good specifications at a reasonable cost! Even though I still did not need another receiver in the shack, I decided to buy one. I put my name down on the waiting list in September. On the 17th of November I got an email saying that my number had come up and I could place an order, it shipped on the 21st and I received it less than a week later.

The FUNcube Dongle Pro+ plugs into a USB port

The packaging was good. The 'dongle' arrived in an antistatic bag, inside a plastic box, inside a bubble pack, inside an A4 bubble pack envelope. As advertised, the dongle was 'discovered' by Windows as a 'HID' (human interface device – basically a mouse) and no driver software installation was required. But of course some form of SDR receiver software is required. There are several SDR software packages that can be used but the best integrated is SDR#, "SDR Sharp" which can be downloaded for free. SDR# has full frequency control, the usual demodulation and filtering features, recording, and memories but no scan function or notch filters. For other SDR programs that don't have built in frequency control for the FUNcube dongle, a program called FCD+ can be downloaded from the FUNcube Dongle website to manage the tuning and configuration settings.

An initial problem for me was that the antenna connector is an SMA female and I didn't have a suitable cable, so I had to go out and buy an SMA to BNC adaptor. I initially tried the receiver with a short piece of hookup wire inserted (gently) into the SMA connector. I could receive the local 2m and National System repeaters with no problem and I was able to receive FM broadcast stations but the front end was overloaded even with the wire 'antenna'. With the LNA and mixer gain turned off the FM stereo reception is OK. You can set a wide filter setting and FM stereo in the SDR# software. At HF I was disappointed to see noise spikes right across the 200 kHz wide display. But as soon as I was able to connect the receiver to a proper HF antenna the noise spikes disappeared. I believe that the problem is probably interference from low level leakage of the DDS oscillator or clock signals. The sensitivity at HF seems similar to the Flex radio, so no complaints there. Initially the receiver was well off frequency. This is adjusted by changing a config setting in the software and should only need to be done once. I ended up moving it from the original setting of +128ppm down to +2.5ppm using WWV as a reference frequency.

You need a proper antenna at some distance from the shack for good HF reception. Connecting a random length of wire directly to the antenna connector will lead to disappointing results, especially at HF.

The online reviews are rather mixed, with reviews of all three FUNcube variants combined together. Some love it, some hate it, some praise the excellent sensitivity and some say it is extremely insensitive. Several complained about the lack of front end filtering which has been addressed in the pro+ version. My experience is that the pro+ is sensitive, it is possible to switch off the LNA and IF gain using the config software in the FCD+ program or

SDR# which reduces the sensitivity considerably so I wonder if that is what confused some of the reviewers. The only quoted sensitivity is '12dB SINAD NBFM for 0.15uV at 145MHz'.

The FUNcube Dongle Pro+ is more capable and much cheaper than most other commercial SDR receivers, so it is a great introduction to software defined radio. Using the Flex1500 transceiver, I found that once I got used to using the mouse driven SDR rather than operating the knobs on my conventional transceiver that going back feels like I am operating blind. You very quickly get used to seeing how wide a transmission is, clicking exactly on each signal up the band, precisely filtering out interference and using super narrow CW filters. The delay caused by the PC processing the signal is annoying though.

Overall at less than $280 delivered to your door, there is no other receiver available that will cover the frequency range that the FUNcube Dongle Pro+ can, or offer a similar level of performance. Yes, you need a PC as well and you do need to download a free program or two. It is not perfect, but it is pretty good and I am sure that more SDR software will support the tuning function in the future. So much 'radio' in such a small package, it is hard not to be impressed.

What is a dongle? Traditionally a dongle is a small piece of hardware that plugs into an electrical connector on a computer and serves as an electronic 'key' for a piece of software; the program will run only when the dongle is plugged in. The term 'dongle' was originally used to refer only to software-protection devices; however, currently 'dongle' is often used to refer to any small piece of hardware that plugs into a computer.

References: Internet sources including AMSAT UK, http://funcube.org.uk/ , http://www.funcubedongle.com/