How to Use the AMSAT CubeSatSim Raspberry Pi SD Card v2.0

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This file: https://cubesatsim.org/download/cubesatsim-readme.pdf

This SD card has the v2.0 software running which is for the new CubeSatSim hardware (blue PCBs), although it will run on the v1.3.2 Beta hardware and also the old v1.2 hardware (white PCBs) as well. You can find out about the latest release here: https://github.com/alanbjohnston/CubeSatSim/releases

The wiki instructions for the boards are here: https://cubesatsim.org/wiki

The Bill of Materials (BOM) is here: https://CubeSatSim.org/bom

This SD card (or SD card image if you downloaded it) has the AMSAT® CubeSatSim software pre-installed and can be plugged into a Raspberry Pi and will boot Raspberry Pi OS Lite and run the CubeSatSim software. For more information on the CubeSatSim see https://cubesatsim.org/ If a CubeSatSim board with a Low Pass Filter on the Main is plugged into the Raspberry Pi, it will transmit telemetry on 434.9 MHz. This frequency can be changed using the config command on the Pi. If the Pi does not have a CubeSatSim board plugged in, it will only transmit a CW ID then stop, since a filter is required to suppress harmonics and spurs.

This image has been tested on a Pi Zero W, Pi Zero 2 W, and Pi Zero. It is based on the Raspberry Pi OS Lite version (Raspberry Pi OS Lite Bullseye (Legacy)) essentially identical to the image available for free download http://cubesatsim.org/download/cubesatsim.iso.zip If your image becomes corrupted or damaged, you can flash this image onto a 16 GB SD card or larger to get the same thing. The full instructions for flashing an SD card or re-installing the CubeSatSim software are here https://github.com/alanbjohnston/CubeSatSim/wiki/2.-Software-Install.

The login username is **pi** and the password is **raspberry**, the same as the Raspberry Pi default. The hostname is **cubesatsim** (not raspberrypi the default). The first time you log into your Pi, you should immediately change your password by typing **passwd** or by running the Raspberry Pi configuration tool **sudo raspi-config**.

You can just plug the micro-SD card into your Pi and power it up and the software will run. If you want to customize or configure your CubeSatSim, for example, to add your callsign or add your latitude and longitude, there are multiple ways you can login to your Pi.

If you have an HDMI monitor (connect using a mini-HDMI adapter or cable) and a USB keyboard (connect using a micro-USB to USB adapter or OTG cable plugged into the inner micro-USB connector which is labeled "USB", not the one on the edge labeled "PWR IN", Power In), you can access the console directly and type in the commands described below. Once logged in, you can configure your WiFi network by typing **sudo raspi-config** then selecting Network Options then WiFi. SSH remote access is enabled on the image, so once your Pi is on your network, you can SSH into it using the IP address or hostname. VNC remote access can't be used since this image does not run the Raspberry Pi Desktop graphical UI.

You can also access your Pi from a computer using just a USB cable using SSH. This has been tested on a Raspberry Pi Zero W and Pi Zero, but is possible on other Pis. This Ethernet over USB service is known as RNDIS on Windows and USB Gadget on Linux. On your Pi Zero 2 or Pi Zero, connect a micro-USB cable to the inner micro-USB connector which is labeled "USB", not the one on the edge labeled "PWR IN" (Power In). The USB cable will power the Pi Zero 2 or Pi Zero, so you don't need to plug anything into the Power In micro-USB connector.

When you connect the USB cable to your computer, the USB cable will power up the Pi and after about a minute, you will have network connectivity to your Pi. For example, in the Terminal Window or Windows Command Prompt, you can type: **ssh pi@cubesatsim.local** and you can login using the default password raspberry. Alternatively, you can use a free application such as PuTTY on Windows. Download it here https://www.putty.org/ and open it, setting the Host Name to **cubesatsim.local** and then click Open to connect. You will then have a terminal window and can enter the commands below.

Finally, you can connect your Pi to your WiFi network by following the steps listed here https://www.raspberrypi.com/documentation/computers/configuration.html - set-up-a-headless-raspberry-pi. Then you would connect using SSH as described earlier in this document.

Once you login, you can set your callsign by typing this command then return: **CubeSatSim/config -c** (if this command doesn't work, you probably aren't in the /home/pi directory. Try typing **cd** return then type the command again.) The default in place of a callsign is AMSAT. You can set your latitude and longitude (for the APRS packets) by typing: **CubeSatSim/config -l** South latitude is entered as a negative number, and West longitude is entered as a negative number. The default latitude and longitude is for Washington, DC. To see the full set of configuration options, type: **CubeSatSim/config -h** You can also update to the very latest CubeSatSim software by typing: **CubeSatSim/update**

Once your CubeSatSim is transmitting, you will need to setup your Ground Station to decode the telemetry. The full instructions are here https://github.com/alanbjohnston/CubeSatSim/wiki/3.-Ground-StationThe CubeSatSim has five transmit modes, identified by the number of blinks of the green LED when pressing and holding the pushbutton, or set by command line configuration.

The Ground Station for the CubeSatSim utilizes FoxTelem, the open source AMSAT telemetry decoding software by Chris Thompson, G0KLA/AC2CZ. The latest version fully supports the CubeSatSim and is available for free download here https://www.amsat.org/foxtelem-software-for-windows-mac-linux/ This software can decode the FSK/DUV (2 blinks) and BPSK (3 blinks) telemetry modes. You will need an SDR to plug into a USB port on your computer such as the RTL-SDR. I recommend this one https://www.amazon.com/gp/product/B0129EBDS2 but many others will work, including the FunCube Dongle Pro+.

To decode SSTV images (4 blinks), you will need an application such as MMSSTV for Windows, QSSTV for the Raspberry Pi, Robot 36 for Android, or SSTV for iOS.

To decode APRS packets (1 blink), you can use Direwolf or Soundmodem. Note that the CubeSatSim only transmits on 434.9 MHz +/- 15 kHz, not any standard APRS frequency.

As with any Raspberry Pi SD card, you should gracefully shut down and not just turn off the power to avoid data corruption on the SD card. On the CubeSatSim or CubeSatSim Lite, this can be done using the push button. If you are logged into the Pi, you can type this command to safely shut down: **sudo shutdown now** To boot up your Pi again on the CubeSatSim, insert and remove the RBF plug. On your Pi, you can disconnect then reconnect the power to turn it on again.

All the CubeSatSim software is open source and available on GitHub at https://github.com/alanbjohnston/CubeSatSim/ If you are a developer, you can contribute to the project by modifying the code and adding features. If you have issues, feel free to email Alan Johnston, KU2Y, AMSAT VP Educational Relations at ku2y@arrl.net. We'd love to hear what you do with your CubeSatSim by sharing on social media with the hashtag **#CubeSatSim.**

You can ask questions and search for answers on the **CubeSatSim Discussion Forum:** https://github.com/alanbjohnston/CubeSatSim/discussions