

Disclaimer

This software was built starting from the Digital PLL made by jddes. The latter is based on the NIST digital control box software for most of the FPGA firmware and all the Python code, and a part of the Red Pitaya software for the Zynq embedded software and FPGA firmware.

Installation instructions for Windows (for MacOSX, see below)

1. Install WinPython-64bit-3.6.1.0Qt5. Other versions of WinPython or Python + numpy + PyQt5 + pyqtgraph might also work, but have never been tested.
2. Use a SD card image writing tool such as WinDiskImager32 to write the SD card image file "red_pitaya_dpll_2017-05-31.img" to a 4 GB SD card that came with the Red Pitaya. Note that sometimes, SD cards have very slightly differing capacities, and WinDiskImager32 might give an error message saying that the image file does not fit the SD card. If the size difference is only a very small fraction of 4 GB, you can try truncating the .img file to the SD card exact capacity and try again. The .img file contains a sizeable amount of zeros at the end of the file and thus truncating it slightly shouldn't affect the operation.
3. Put the SD card in the Red Pitaya, connect an Ethernet cable to the Red Pitaya and connect it either to a router with a DHCP server, or directly in an Ethernet port of a PC.
 - a. If using a router with a DHCP server, the Red Pitaya will be assigned an IP address in the router's subnet.
 - b. If connecting directly to a PC running Windows, the Red Pitaya's DHCP client will time out after 20 seconds and start using IP address 192.168.0.150 by default. This default IP address is configurable by editing the file "/etc/dhcp/dhclient.conf" inside the Linux distribution running on the Zynq. You also need to set your PC's network configuration to be a fixed IP address in the same subnet (192.168.0.x, where x is any integer from 1 to 254).
4. Apply power to the Red Pitaya using the micro-usb port and the power supply that came with the Red Pitaya. Note that the Red Pitaya's supply is capable of providing 2 A and thus a standard PC USB port might not be able to supply enough current for the Red Pitaya and thus using the furnished power supply is recommended. The Red Pitaya then boots Linux; the process takes roughly 1-2 min before you can connect.
5. Open Spyder (Python IDE that comes with WinPython) and run **MainWindow_AcqCard.py**, which is the top-level Python script to open the acquisition card user interface. If Python was installed correctly, you should see a window open that looks like figure 1 (it might not open at the topmost of the desktop so look in your taskbar if you cannot find it).
6. In this first window, you have two choices:
 - a. You can either type in directly the Red Pitaya's IP address if you know it already and check the "Use manual entry" radio button,

- b. or you can check the "Use listed" radio button if you can see the Red Pitaya in the list next to "Connected FPGAs". If this list is not populated, here are a few pointers that might help debugging this:
 - i. you might have an issue with your network's IP address assignments (they all need to be on the same subnet),
 - ii. If your network uses a different subnet than 192.168.0.XXX, for example 192.168.1.XXX, you need to change the content in the textbox next to "UDP Broadcast address" to the correct broadcast address. This is always equal to an address that has the first part equal to your network's subnet, and the last number(s) to "255". This broadcast mechanism is used to automatically detect all Red Pitaya's on the network by sending a broadcast packet, to which a program inside Linux (udp_discovery) will answer, allowing to figure out the Red Pitaya's IP and MAC addresses (used as a unique serial number for storing configuration files).
 - iii. You might have an issue with your Windows Firewall configuration. You need to make sure to allow the python executable (python.exe inside "WinPython-64bit-3.6.1.0Qt5\python-3.6.1.amd64") to receive all UDP packets from any port (see figure 2). Make sure that this exception applies to all "profiles" to avoid having to determine which profile was applied to the network that you have created for the Red Pitaya.
7. Once you have used either of the two options and pointed to the correct IP address for the Red Pitaya, click OK to connect.
8. At this point, the window shown in figure 3 will appear if the connection succeeded. Check "Auto-refresh" to display the diagnostics signals in the interface.

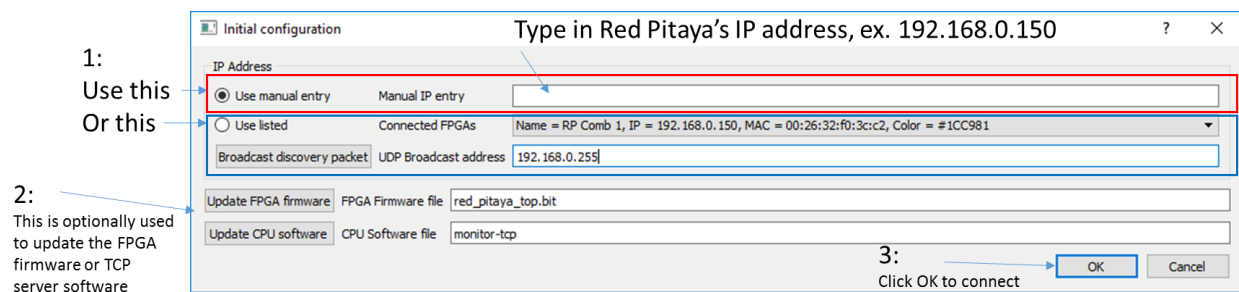


Figure 1 - First window that opens after running `MainWindow_AcqCard.py`, which allows connecting to a Red Pitaya on the network, and optionally updating its FPGA firmware or the TCP server running inside Linux on the Zynq's processor.

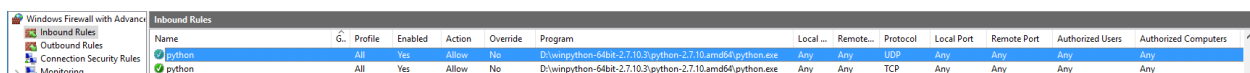
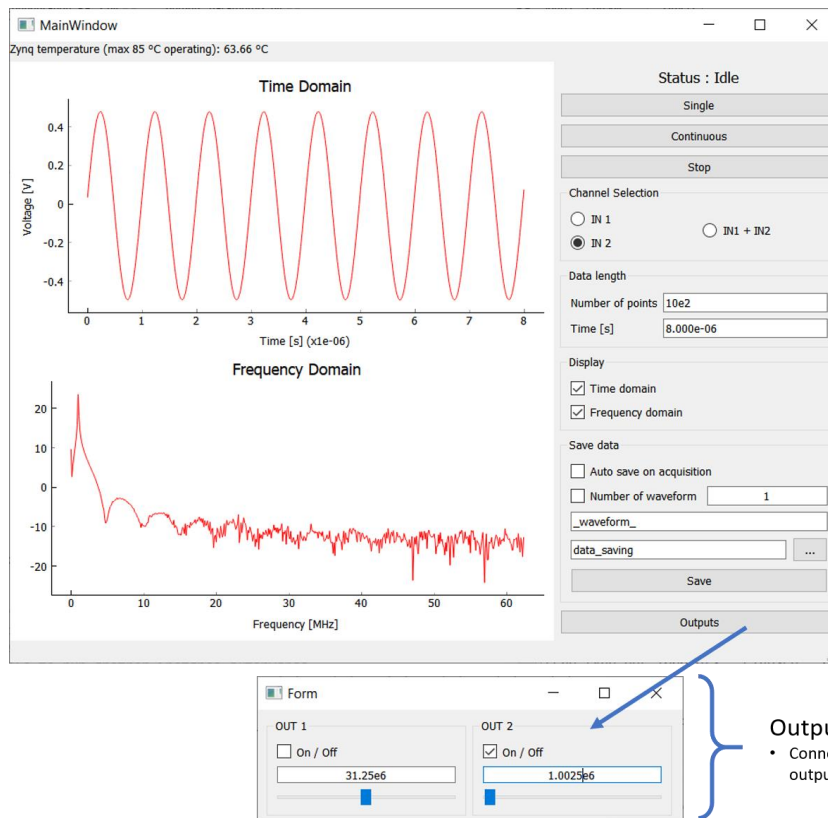


Figure 2 - Example entry in Windows Firewall with advanced security (tested on Windows 10) to allow the udp-discovery mechanism to work.



Acquisition type

- Single : one acquisition
- Continuous : Restart new acquisition after reception (for N times if « Number of waveform » is checked)

Channel selection

Data length :

- writing to one update the other
- Writing max to acquire the maximum length

Display type:

- Time
- Frequency ($10 \cdot \log_{10}(\text{abs}(\text{fft}))$)
- None (can only save data)

Save Data:

- Auto save [...] : Save on each acquisition (increment file name)
- Number of waveform : Acquire N waveform when pressing on continuous
- File name
- Manually enter saving path or browse
- Save button to manually save after acquisition

Outputs:

- Connect a DDS (sin wave) to one or both output

Figure 3 - Main user interface.

Installation instruction for MacOSX for Python+packages - Quick version

Install python 3.6 from: <https://www.python.org/downloads/mac-osx/>

In a terminal: `/Library/Frameworks/Python.framework/Versions/3.6/bin/pip3 install scipy matplotlib PyQt5 pyqtgraph`

This should install all the required packages and dependencies.

Follow the other instructions in the Windows installation instructions, starting at item 2. Replace the Spyder IDE by IDLE within the `/Applications/Python3.6/` folder.

Installation instructions Python+packages for Mac OS X – Detailed version

Installing python 3.x for Mac OS X

<https://www.python.org/downloads/mac-osx/>

This installs a packaged version of python, which is independent from any other system version that you might or might not have installed.

In your applications folder, you'll have a Python3.X folder containing a rather simple integrated development environment (IDLE) that you can use to write and run python scripts/programs.

This encapsulated python version looks for its packages and related files in `Library/Frameworks/Python.framework/Versions/3.X`

Each installed version of this packaged MacOS python distribution will look for files in the correspondingly numbered version folder, meaning that you can easily have several non interfering versions simultaneously installed.

It is important to understand that once a python module is opened with the IDLE, the search path for custom libraries and packages is:

`/Library/Frameworks/Python.framework/Versions/3.x/lib/python3.x/site-packages`

one can confirm this by opening the IDLE and selecting “path browser” from the file menu, making sure this path is listed in the window.

Installing libraries

This is most easily done using “pip”, but one has to make sure the proper version of pip is used.

In this case, we want to use:

```
/Library/Frameworks/Python.framework/Versions/3.x/bin/pip3
```

Open a terminal window, The command below should install commonly needed libraries:

```
/Library/Frameworks/Python.framework/Versions/3.6/bin/pip3 install numpy scipy matplotlib  
ipython jupyter pandas sympy nose
```

You might be asked to install the apple developer tools, just accept

You might want to check if your packages are indeed in:

```
/Library/Frameworks/Python.framework/Versions/3.6/lib/python3.x/site-packages
```

If you can see folders named “numpy” and “matplotlib”, then the installation worked

Installing PyQt and pyqt graph

```
/Library/Frameworks/Python.framework/Versions/3.x/bin/pip3 install PyQt5 pyqtgraph
```

```
/Library/Frameworks/Python.framework/Versions/3.6/bin/pip3 install pyqtgraph
```

This should install PyQt5, SIP and pyqtgraph

Running the python code to connect to the RedPitaya

You can then checkout or simply download the code base.

Open and run the file “MainWindow_AcqCard.py” using the IDLE within the
/Applications/Python3.x/ folder