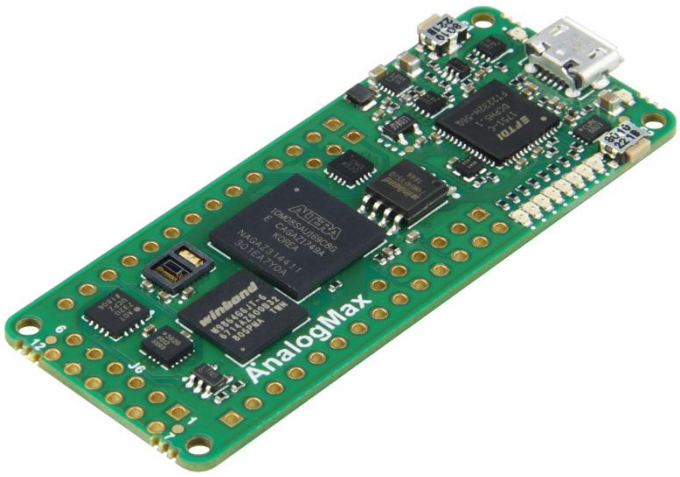
AnalogMAX

Jupyter Demo



Software and hardware requirements to complete all exercises

Software Requirements: Quartus® Prime Programmer Tools

Hardware Requirements: ARROW AnalogMAX Board

Revision 1.0.3

1. Introduction

This tutorial demonstrates the various features of AnalogMAX board. It visually displays the values of the interfaces on a graph such as accelerometer, analog-digital converter, smoke and temperature sensor.

2. Getting Started

The first objective is to ensure that you have all the necessary hardware items and software installed so that the lab can be completed successfully. Below is a list of items required to complete this lab:

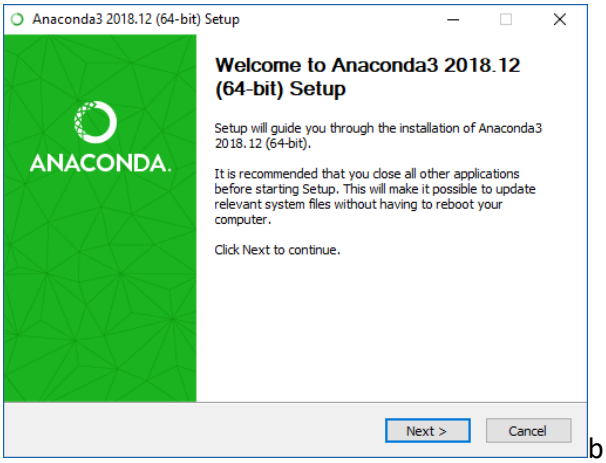
- AnalogMAX Board **(**10M08SAU169C8G)
- USB Cable
- Lab files: JupyterDemo is required to complete the lab. It includes the Anaconda3 installation file, the configuration file for the FPGA, and the project files.
- Quartus Prime Programmer Tools. (If no Quartus Prime is installed, refer to MAX1000 User Guide for instructions)
- Installed Arrow USB Drivers (If not, refer to MAX1000 User Guide for instructions)
- Personal computer or laptop running 64-bit Linux / Windows 7 or later with at least an Intel i3 core (or equivalent), 4GB RAM and 12 GB of free hard disk space
- A desire to learn!

3. Jupyter Demo

3.1 Software environment preparation

3.1.1 Installation of Anaconda

3.1.1.1 Open the directory where you store your demo files and navigate to **<project_directory>/JupyterDemo/installation** and open **Anaconda3-2018.12-Windows-x86_64.exe**.



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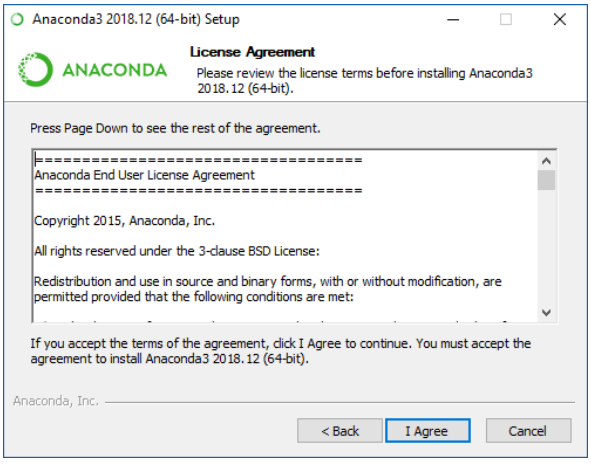
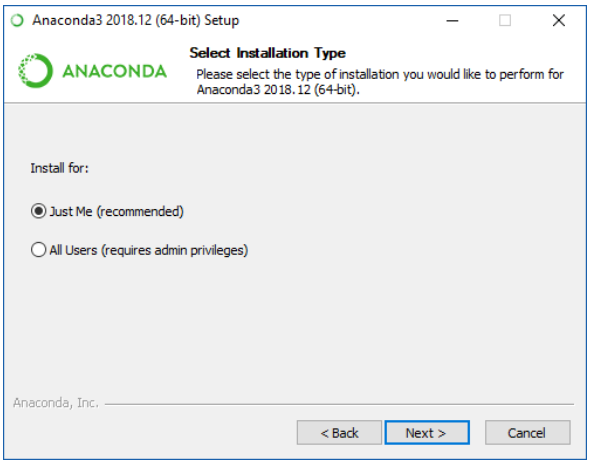
3.1.1.2 Click **Next**.

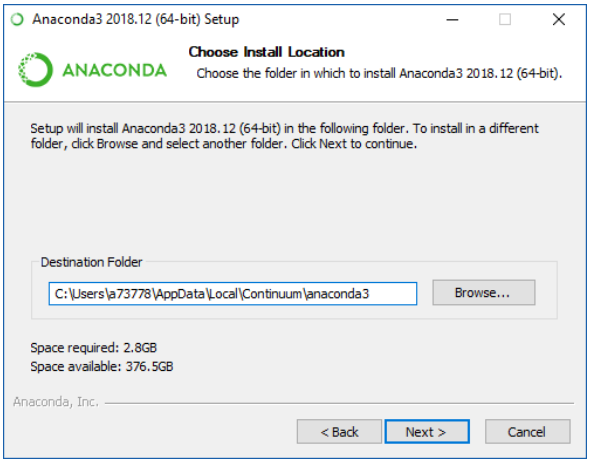
3.1.1.3 Read the licensing term and press **I Agree**.



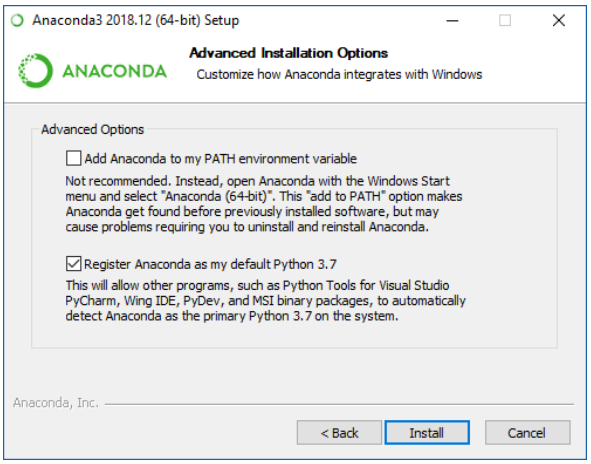
3.1.1.4 Select Just Me (recommended) for the installation and click **next**.



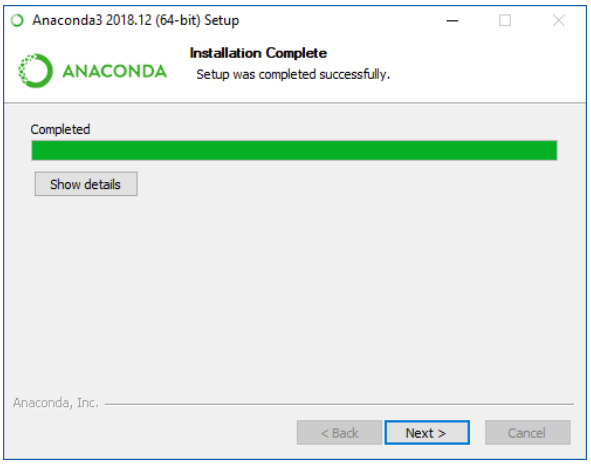
3.1.1.5 Select destination folder for Anaconda and click **next**.



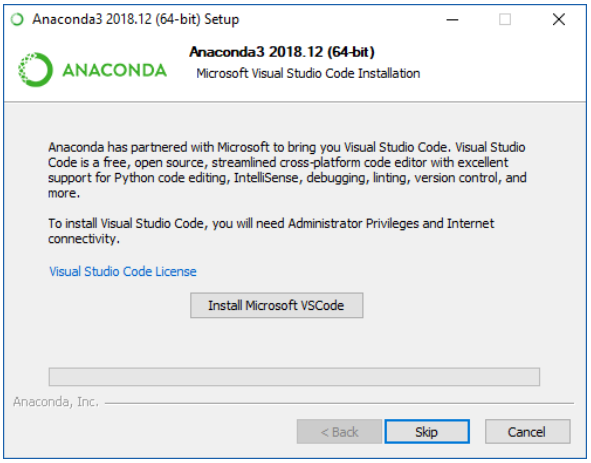
3.1.1.6 Check “Register Anaconda as my default Phyton 3.7” and click **Install**.



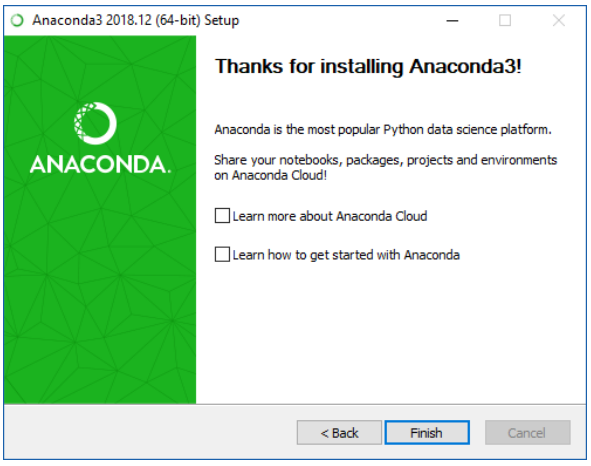
3.1.1.7 When it is completed, click **next**.



3.1.1.8 Click the **Skip** button.



3.1.1.9 Uncheck the boxes and click **finish**.

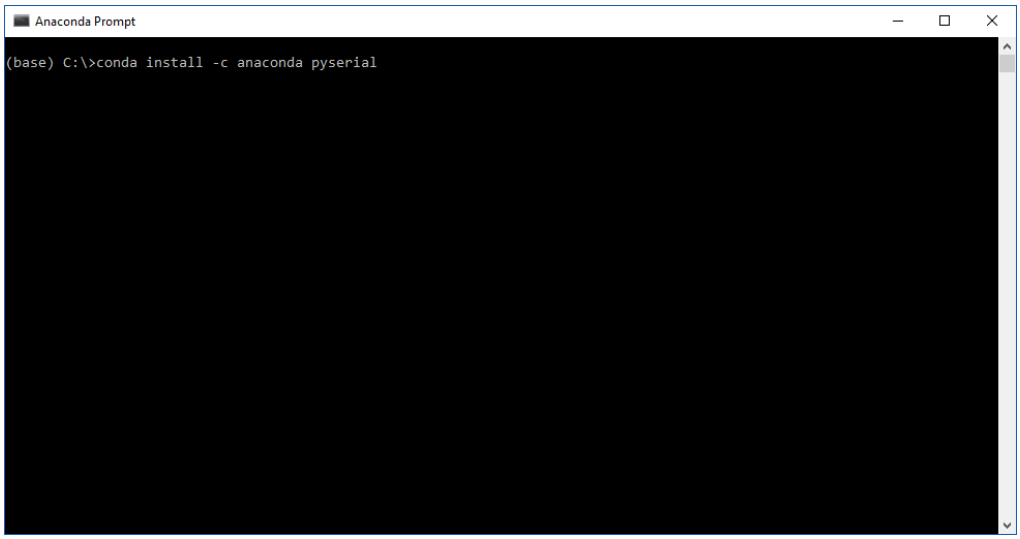


3.1.2 Installation of Pyserial

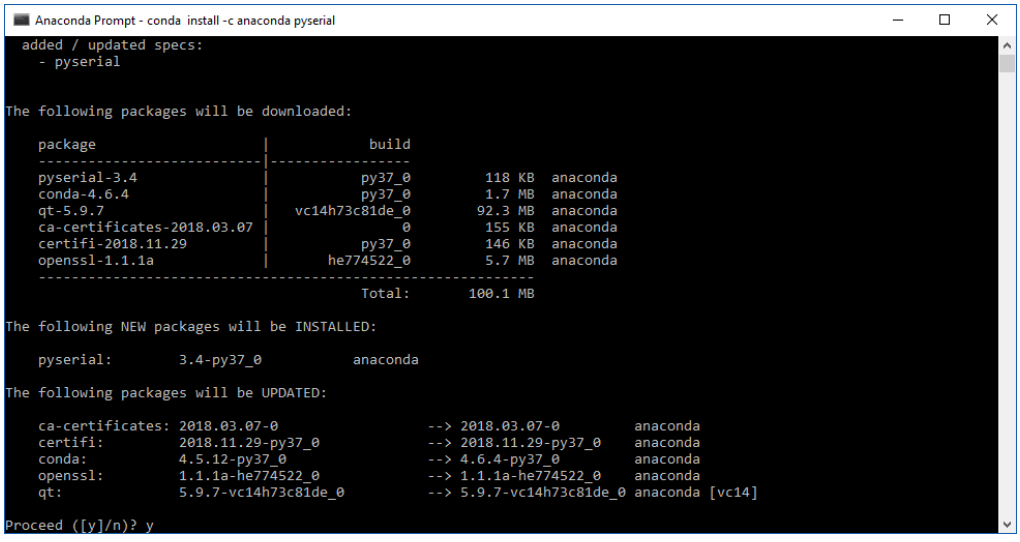
3.1.2.1 Open Anaconda Prompt from **Start menu → All Programs → Anaconda3 (64-bit)**.

3.1.2.2 Type the following command into the command prompt and press enter:

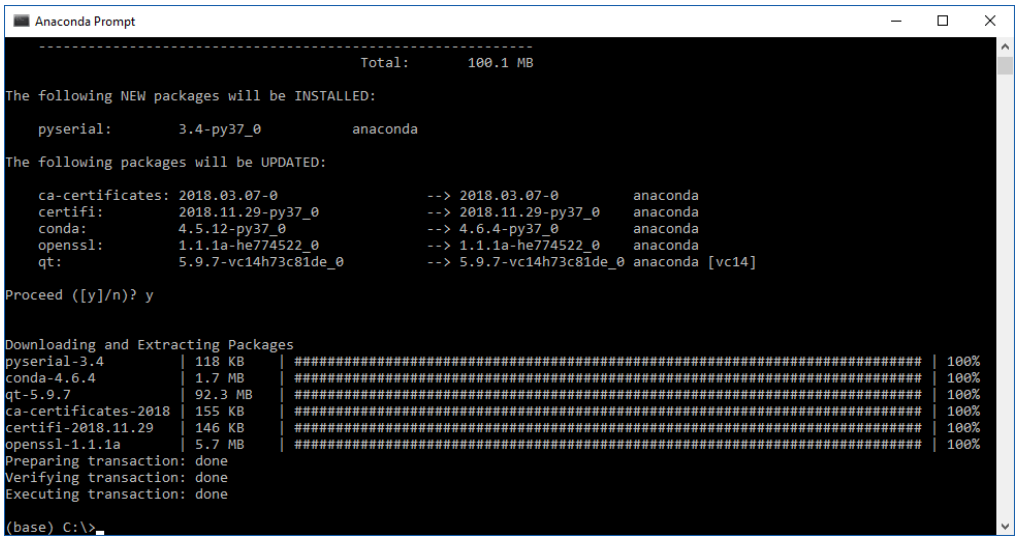
```
conda install -c anaconda pyserial
```



3.1.2.3 It starts to search for software dependencies of pyserial. If you are asked to proceed, type **Y** to the command prompt and press enter.



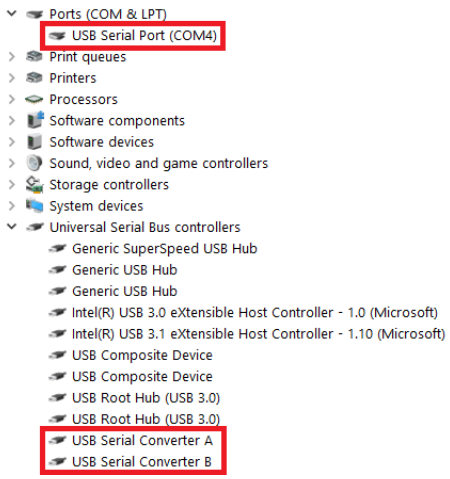
3.1.2.4 When it finished with the installation, **close** Anaconda Prompt window.



3.2 Hardware environment preparation

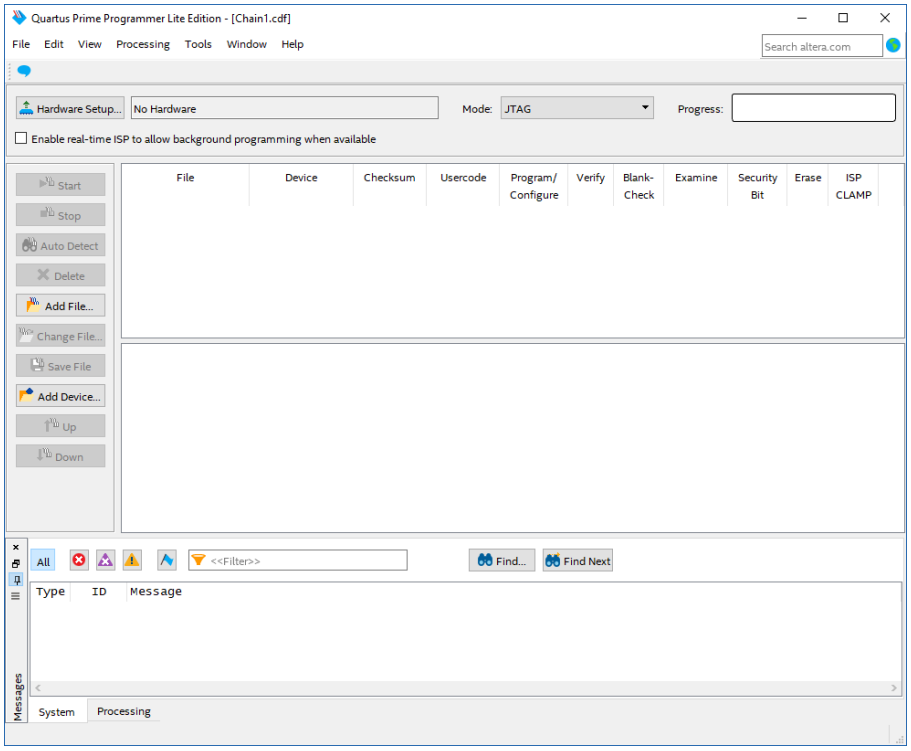
3.2.1 Configuration

3.2.1.1 Connect your AnalogMAX board to your PC using an USB cable. Since the Arrow USB Blaster should be already installed, the Window's Device Manager should display the following entries are highlighted in red (port number may differ depending on your PC):

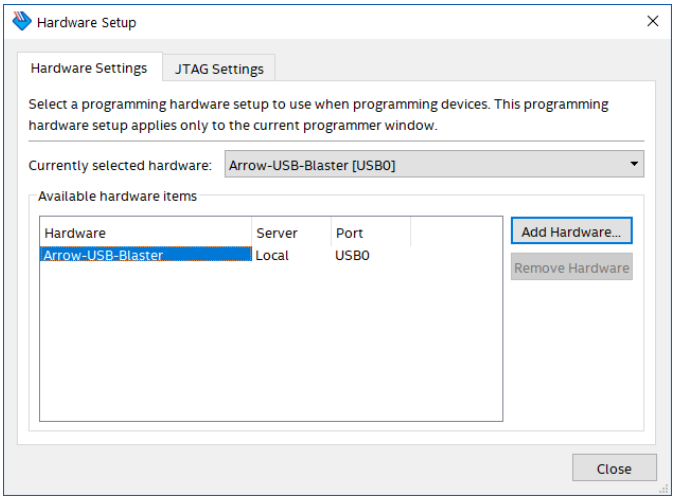


3.2.1.2 Check the Port number ("COMX") and memorize it for the later use within the AnalogMAX demos.

3.2.1.3 Open Programmer(Quartus Prime 18.0) from **Start menu → All Programs → Intel FPGA 18.0.0.614 Lite Edition**.

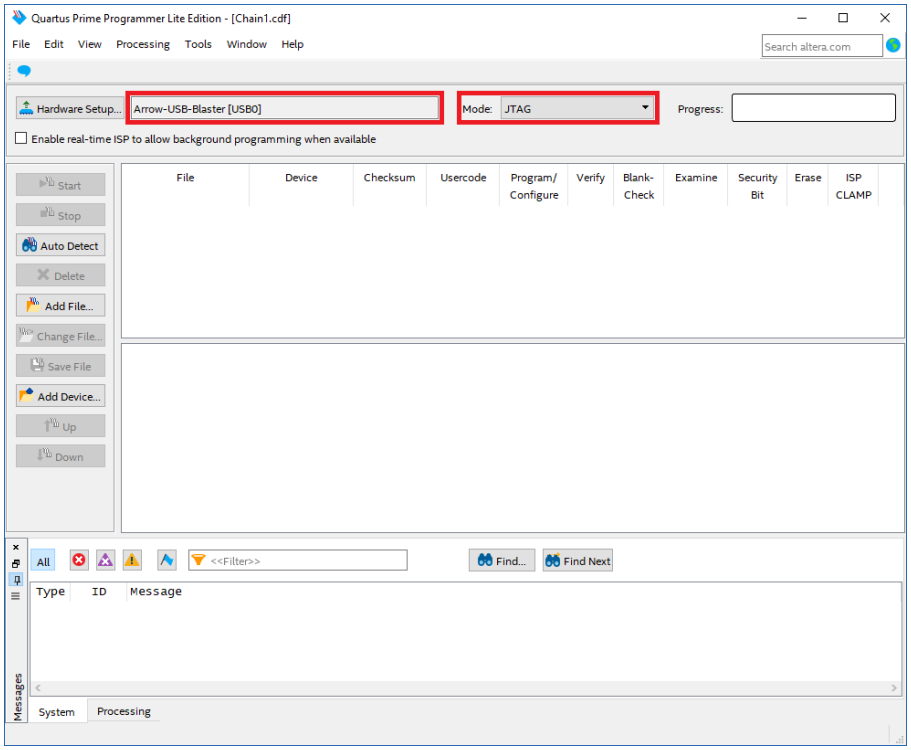


3.2.1.4 Click **Hardware Setup…** and double click **Arrow-USB-Blaster** entry in the Hardware Setup tab. The Currently selected hardware should now show Arrow-USB-Blaster [USB0] (depending on your PC, the USB port number may variant).



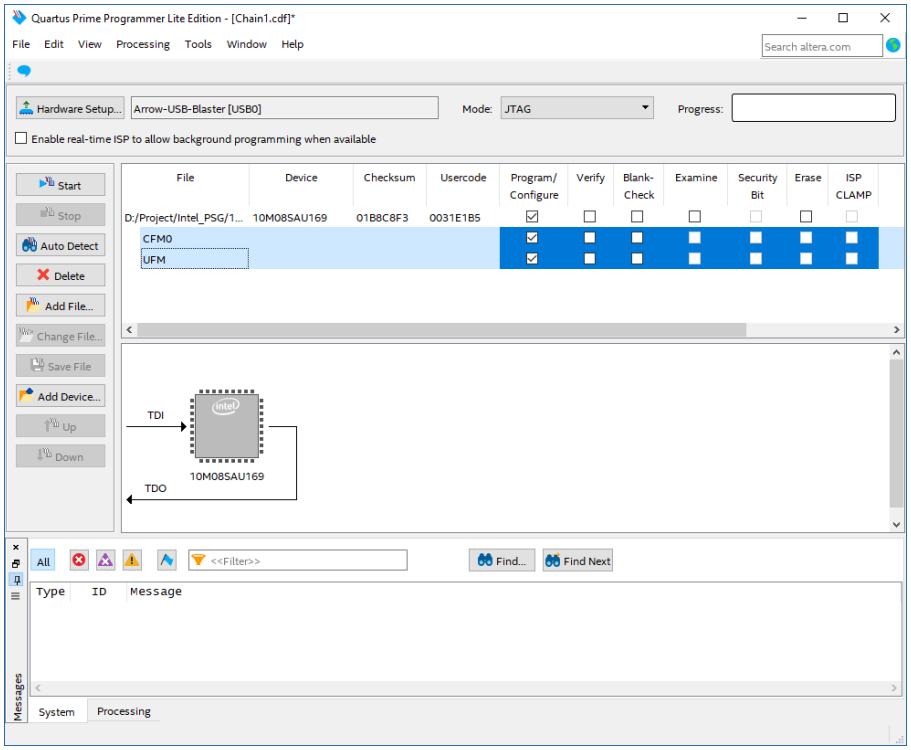
3.2.1.5 Click **Close**.

3.2.1.6 Make sure the hardware setup is Arrow-USB-Blaster [USB0] and the mode is JTAG. Click **Add File...** to choose the programming file.

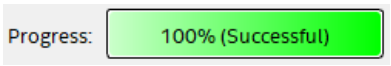


3.2.1.7 Navigate to **<project_directory>/JupyterDemo/firmware/** and open the **AnalogMax_1_0.pof** file.

3.2.1.8 Check the Program/Configure checkbox for the .pof file, CFM0 and UFM.



3.2.1.9 Click **Start** to program the board. When the configuration is complete, the Progress bar should show 100% (Successful).



3.2.1.10 **Close** Quartus Prime Programmer Lite Edition.

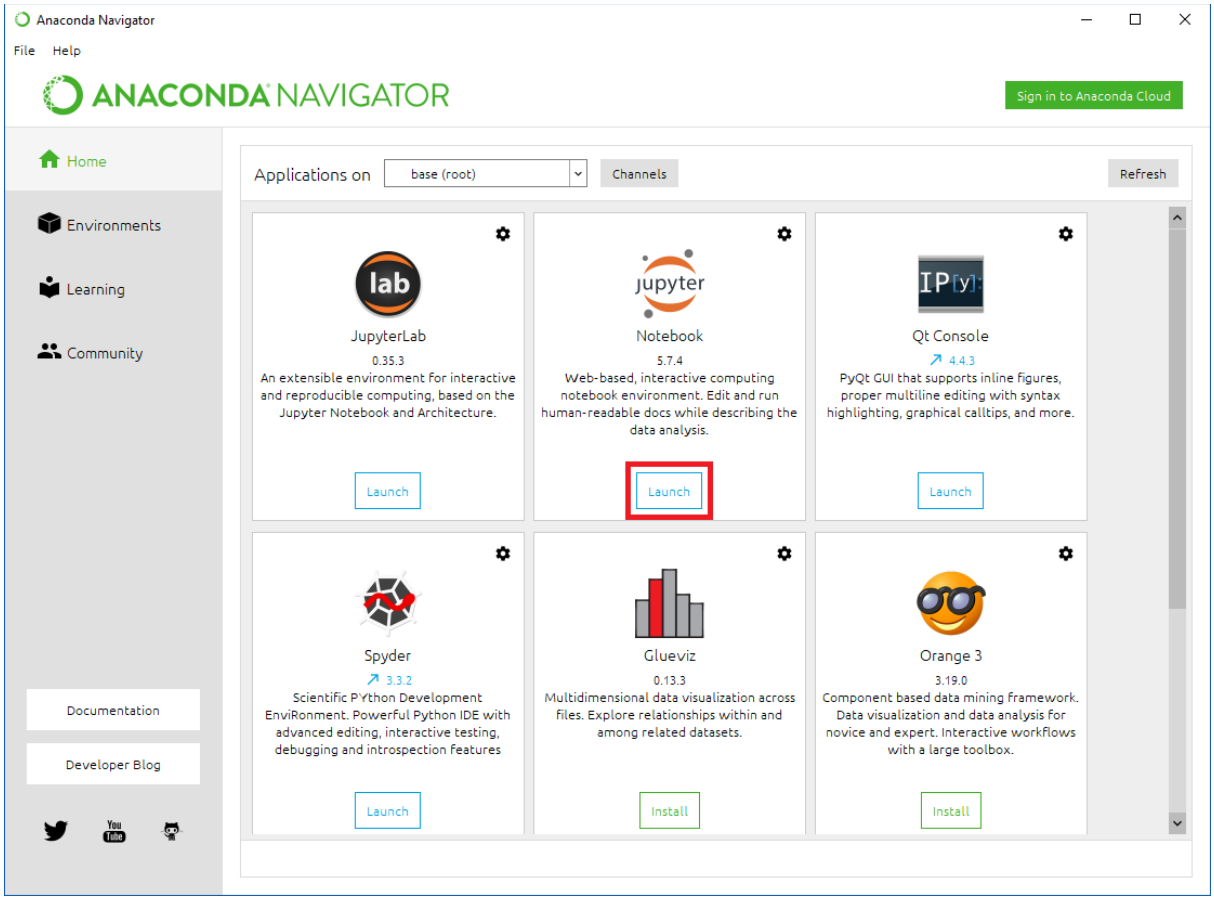
3.3 Running the demo

3.3.1 Anaconda Navigator

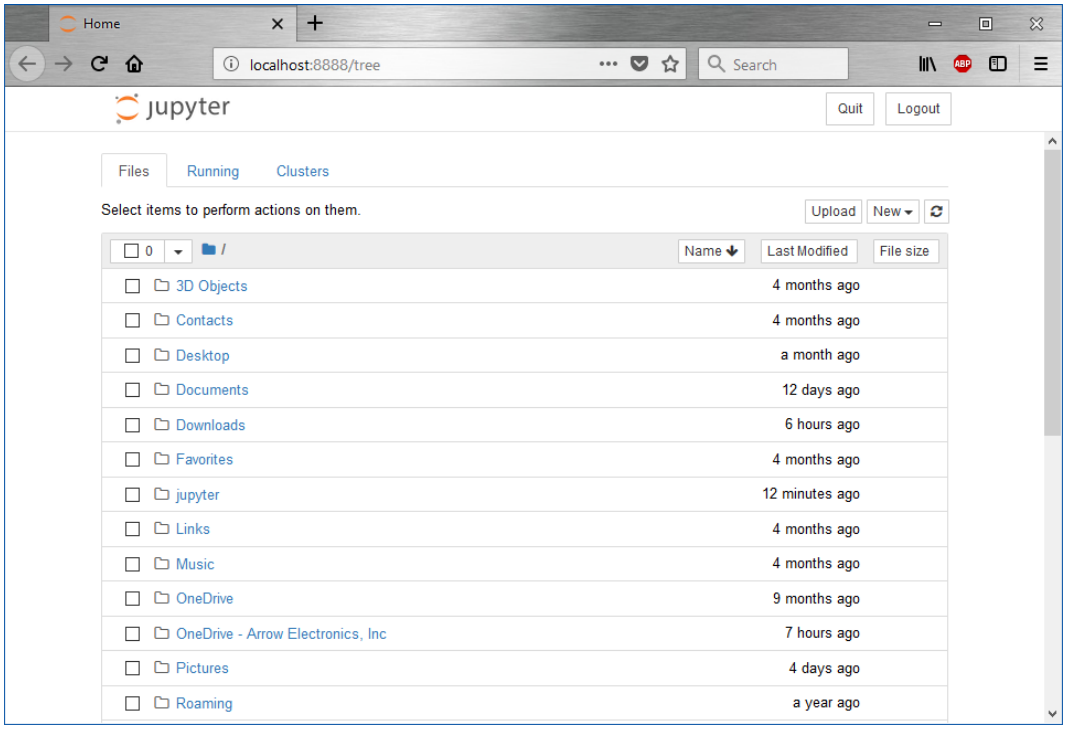
3.3.1.1 Open the directory where you store your demo files and navigate to **<project_directory>/JupyterDemo/**. Copy-paste jupyter folder to your user folder, C:\Users\Username.

3.3.1.2 Open Anaconda Navigator from **Start menu → All Programs → Anaconda3 (64-bit)**.

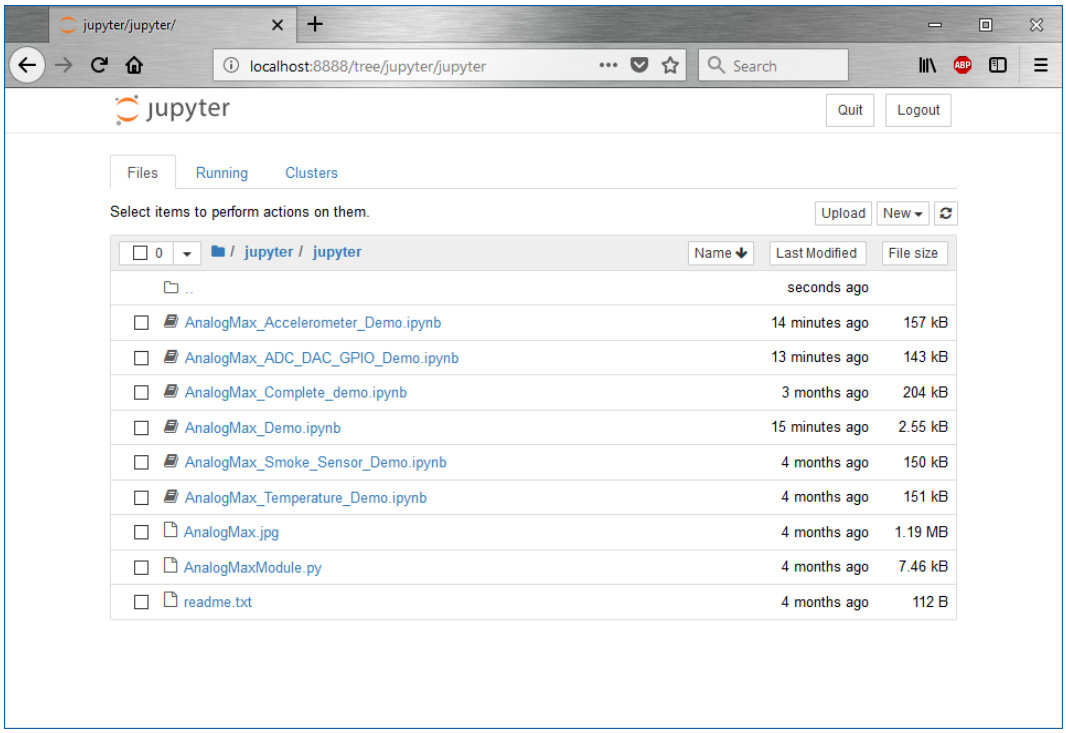
3.3.1.3 Click Launch of jupyter Notebook application.



3.3.1.4 The application will open in your browser which displays your user respectively home folder.



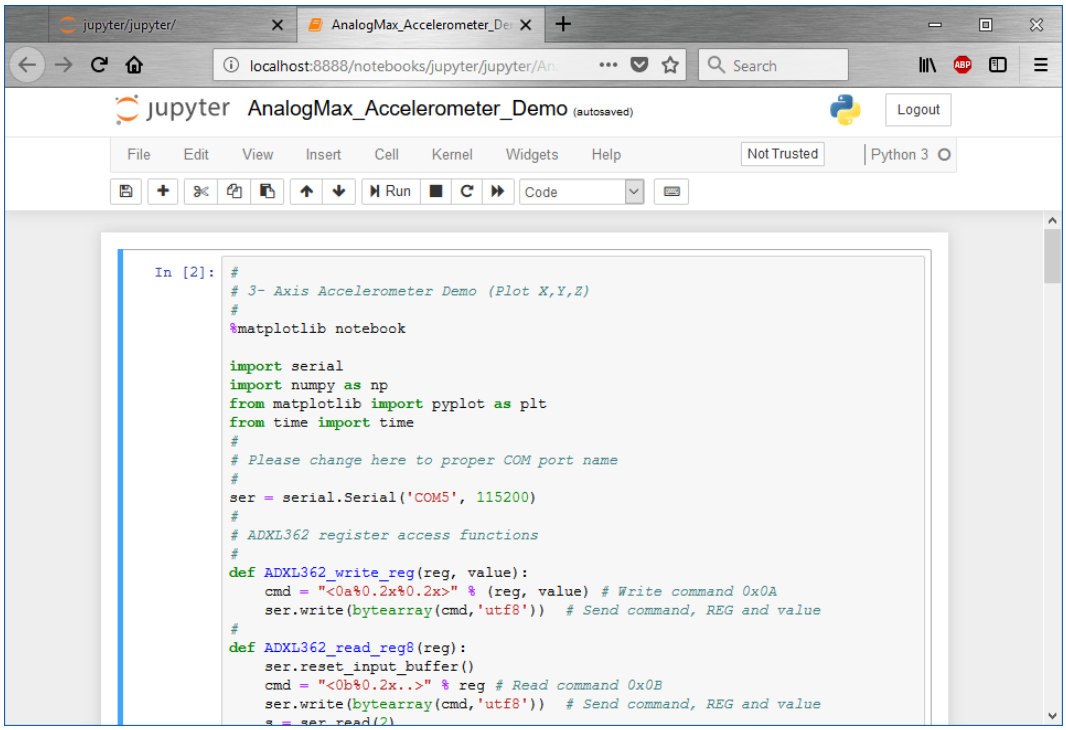
3.3.1.5 Open jupyter/jupyter folder.



Currently there are four demos included:

- AnalogMax_Accelerometer_Demo
- AnalogMax_ADC_DAC_GPIO_Demo
- AnalogMax_Smoke_Sensor_Demo
- AnalogMax_Temperature_Demo

3.3.1.6 Choose a demo and it will be open in a new tab.



Each demo consists of 2 section:

- The code section, which contains the functionality of the demo and is simultaneously a python code editor so that you easily can implement your own ideas
- The graphs section, which displays the raw data during script execution and a second graph, which displays all captured data after the script finishes.

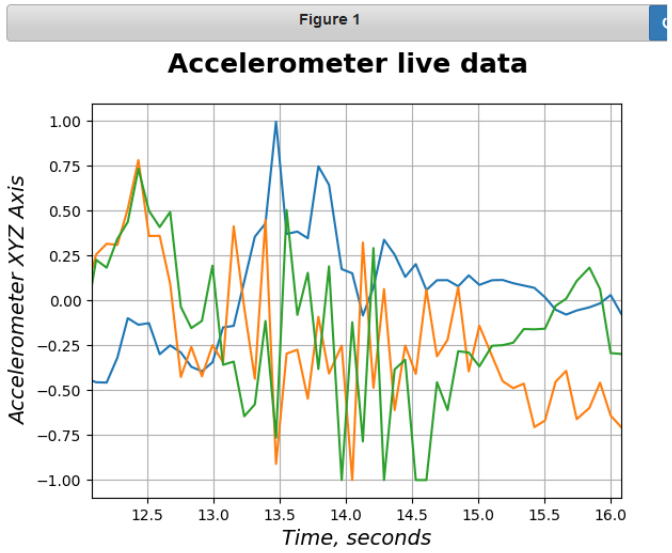
```
    except: pass

    # update the plot
    fig1.canvas.draw()

# plot all of the data you collected
fig2 = plt.figure()
fig2.suptitle('Complete Accelerometer data', fontsize='18', fontweight='bold')
plt.axes().grid(True)
plt.xlabel('Time, seconds', fontsize='14', fontstyle='italic')
plt.ylabel('Accelerometer XYZ Axis', fontsize='14', fontstyle='italic')

plt.plot(timepoints, xdata, timepoints, ydata, timepoints, zdata)
plt.ylim(yrange)
fig2.show()

ser.close()
```



3.3.1.7 At the beginning of the code, there is a line that selects the COM port in use. It has to be change to the one, you got during the board connection.

```
#
# Please change here to proper COM port name
#
ser = serial.Serial('COM5', 115200)
#
```

3.3.1.8 Tu run demo, make sure, that the mouse cursor is placed inside the python code editor. Click the Run button on the toolbar to start the demo. During the running time, you have time to interact with the sensor.

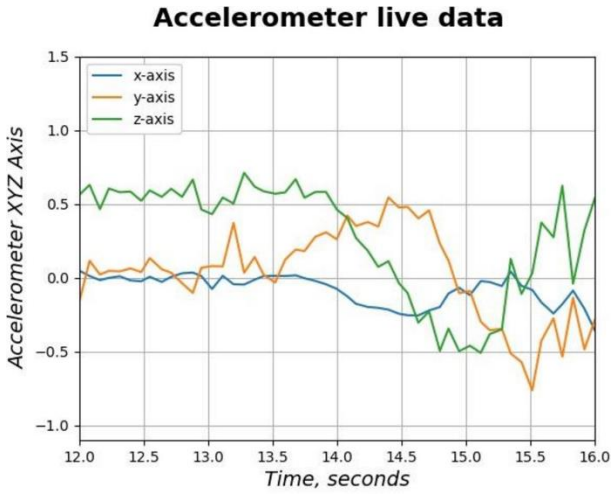
4. Accelerometer demo

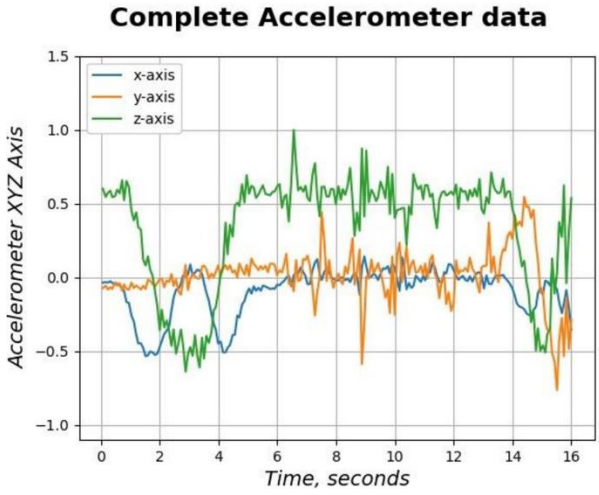
The accelerometer demo shows the gravitational acceleration.

If all was setup properly , you should see collected accelerometer data. Make sure you move the AnalogMAX board to make the chart more interesting.

A long USB cable is helpful when interacting with it.

As a suggestion, you can normalize it to show g=9.8 m/s^2.





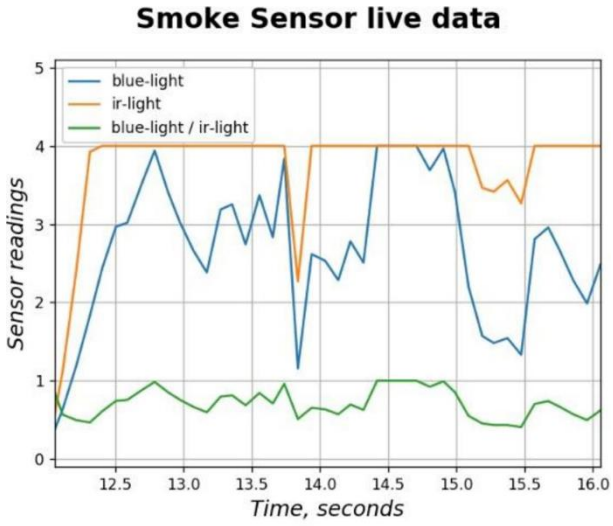
5. Smoke sensor demo

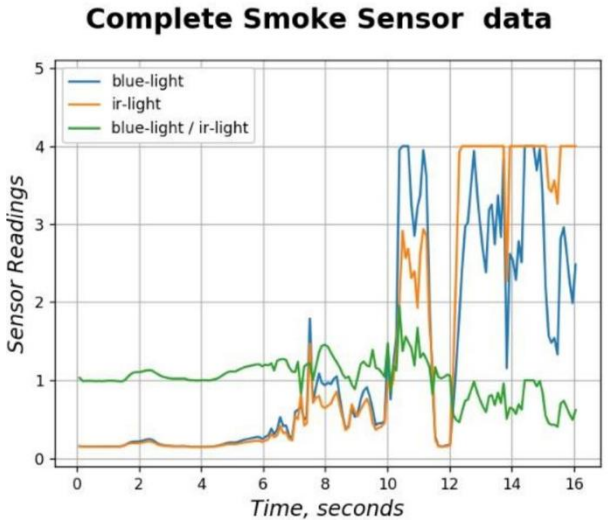
This sensor emits light of two different light spectra, the infrared and visible spectrum (blue light).

As a means to interact with the sensor, use your breath, the gas of a not lighted lighter or any convenient and safe source of gas or smoke.

Also, different material can be placed above the sensor.

It should be noted, that the sensor maxes out on reading greater than 4.

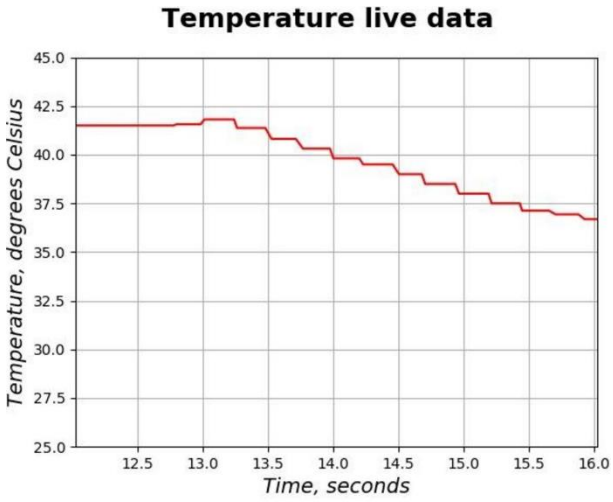


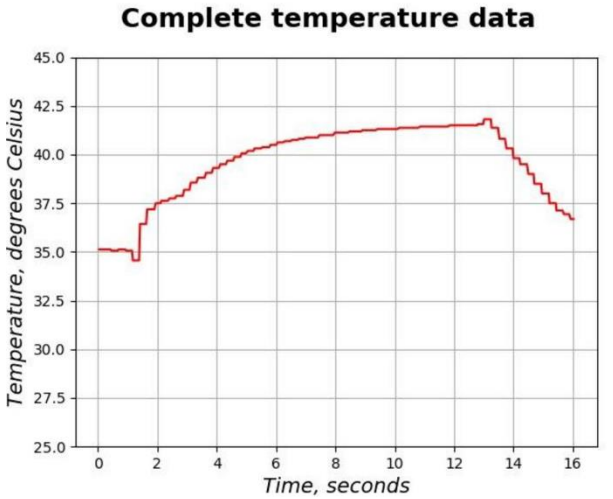


6. Temperature demo

Temperature is very slow changing but if you touch the ADT7320 sensor with the fingers you will get clearly visible temperature changes.

The graphs have been obtained by placing a lightly warmed soldering iron on top the sensor.

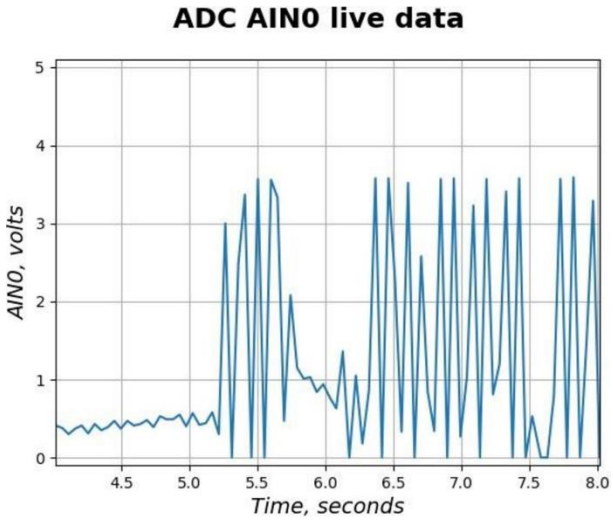


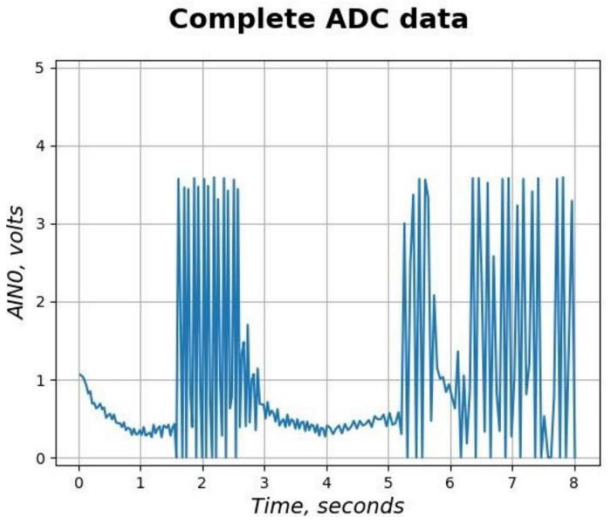


7. ADC/DAC/GPIO demo

This demo for AD559R does configure IO7 as DAC with midscale output, IO0 as Analog Input, IO1 as digital Input and IO2...IO6 as digital outputs with high value.

Then the AIN0 input pin sampled and Analog voltage displayed on screen, the signal visible is from the finger touching the PCB at the AIN0 pin via a 20kΩ resistor.



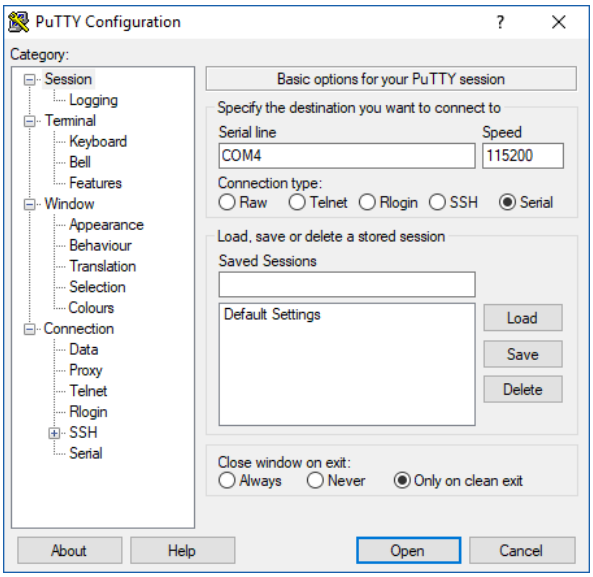


8. Troubleshooting

If there is an error in python code or you unplug the USB cable while the notebook is running, the serial port will not be properly closed. To “free” the serial port, the python “kernel” has to be restarted from the “notebooks” menu.

UART Connection to AnalogMAX can be tested with any UART terminal (as example putty) Open a serial connection to the com port, the AnalogMAX board is connected to.

The speed needs to be 115200. If you copy the command *<0b0f..>* and insert it via a right mouse click into the terminal, you should get to see the answer *00*.



CONGRATULATIONS! YOU HAVE SUCCESSFULLY COMPLETED THE JUPYTER DEMO!

5 Revision History

Version	Change Log	Date of Change
V1.0	Initial release, support for sensors connected to the SPI bus, I^2C bus support not included. Python code is much WIP in every sense, major code cleanup is required.	-
V1.0.1	Added Smoke Sensor support	-
V1.0.2	Updated all demos.	-
V1.0.3	- Formal changes - Corrections / clarity changes	19/02/2019

6 Legal Disclaimer

ARROW ELECTRONICS

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The Evaluation Board is not to be disposed as an urban waste. At the end of its life cycle, differentiated waste collection must be followed, as stated in the directive 2002/96/EC. In all the countries belonging to the European Union (EU Dir. 2002/96/EC) and those following differentiated recycling, the Evaluation Board is subject to differentiated recycling at the end of its life cycle, therefore: It is forbidden to dispose the Evaluation Board as an undifferentiated waste or with other domestic wastes. Consult the local authorities for more information on the proper disposal channels. An incorrect Evaluation Board disposal may cause damage to the environment and is punishable by the law.