This version (27 Jun 2022 23:08) was ***approved*** by Brandon Bushey.
The Previously approved version (31 Jan 2022 17:38) is available.

EVAL-ADPD410X-ARDZ Fluorescence Measurement Demo

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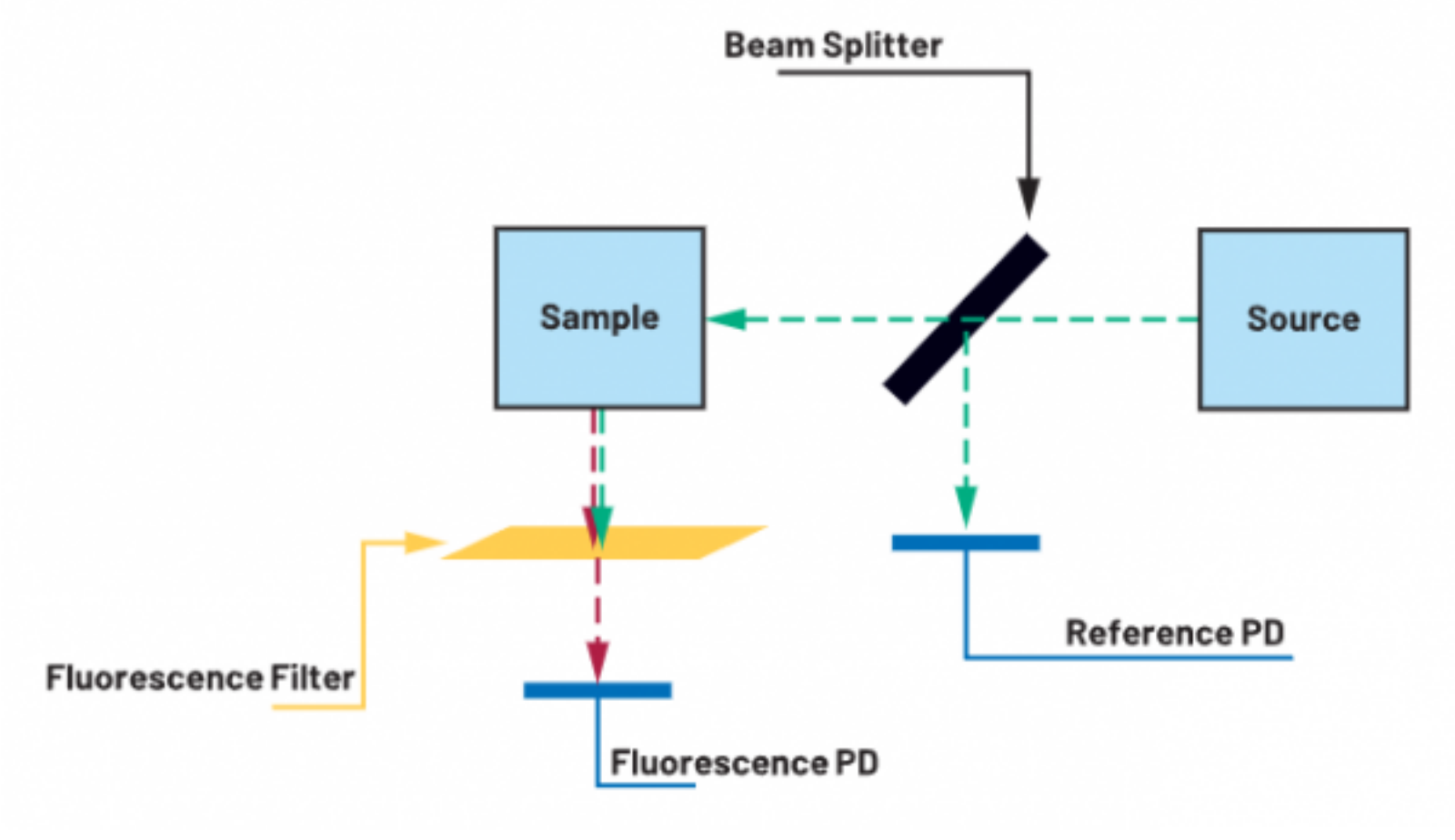
The **EVAL-ADPD4100-ARDZ** and **EVAL-ADPD4101-ARDZ** allow users to take advantage of the flexibility of the **ADPD4100** and **ADPD4101** as multimodal sensor front ends to a wide range of applications. One example of a specialized application is the **CN0503**, a reference design for optical water quality measurement. This demonstration shows how to perform fluorescence measurement using the **EVAL-ADPD4100-ARDZ** and **EVAL-ADPD4101-ARDZ**, similarly to the CN0503 Fluorescence Measurement Demo.

This demo uses a lot of the optical, mechanical, and photodiode and LED components from the CN0503 kit. This demo is especially prepared to show the ability of the EVAL-ADPD4100-ARDZ and EVAL-ADPD4101-ARDZ boards to perform the same measurements as the CN0503. For a less complex demo setup, refer to the Turbidity Demo.

General Description/Overview

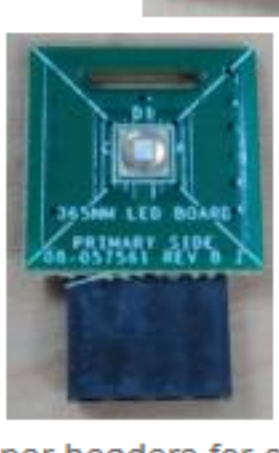
One method of measuring the amount of substance in a sample is by using fluorescent light. In this setup, a light is passed from a monochromatic source through the sample, and then the fluorescence in the substance is measured using a detector tuned to its wavelength. The intensity of the fluorescent light compared to the intensity of the incident light will be proportional to the amount of the fluorescent substance in the sample. An effective way of performing this is by using the setup shown below.

Light is emitted from an LED at 365 nm wavelength. It then passes through a beam-splitter, which directs some of the incident light to a reference photodiode detector for sampling. Quinine in the sample fluoresces due to the 365 nm light and emits ~450 nm light. Another photodiode detector, sensitive to blue light frequencies, is positioned at 90 degrees from the light path to measure the intensity. This placement decreases the effects of the light emitted from the source LED. Additionally, a monochromatic filter is placed in front of the detector to further isolate the measurement.



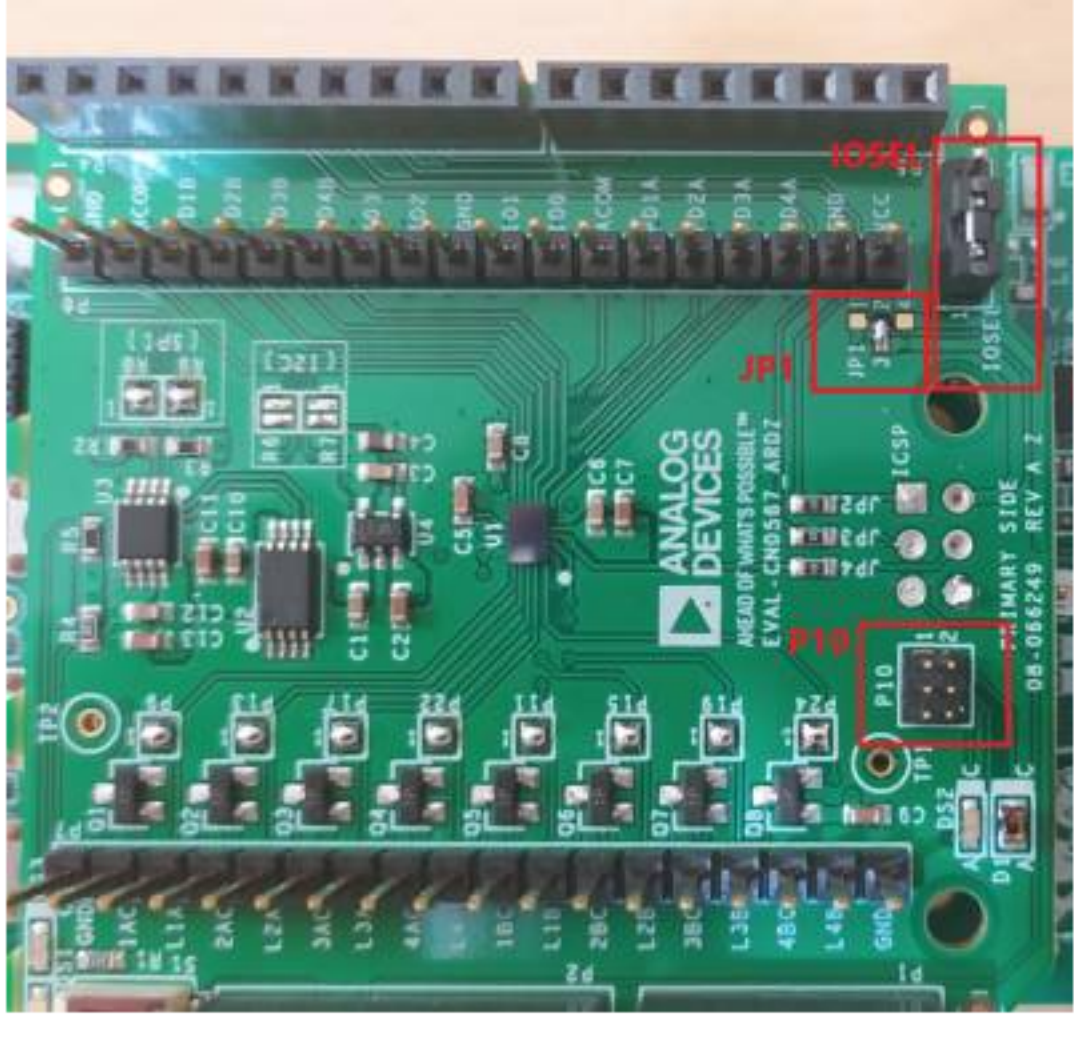
Demo Requirements

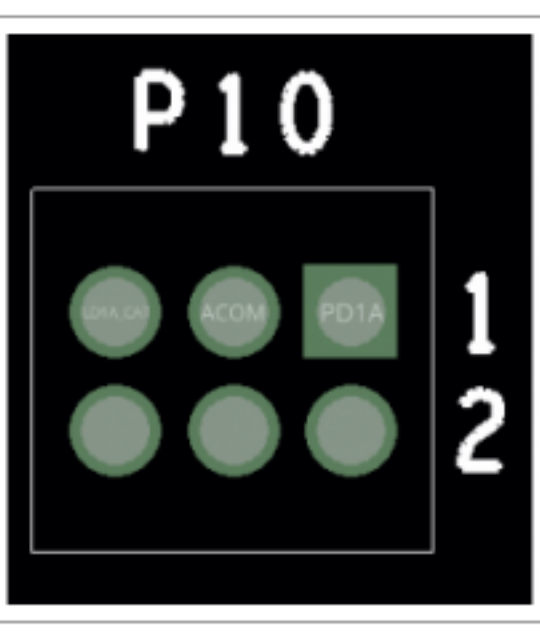
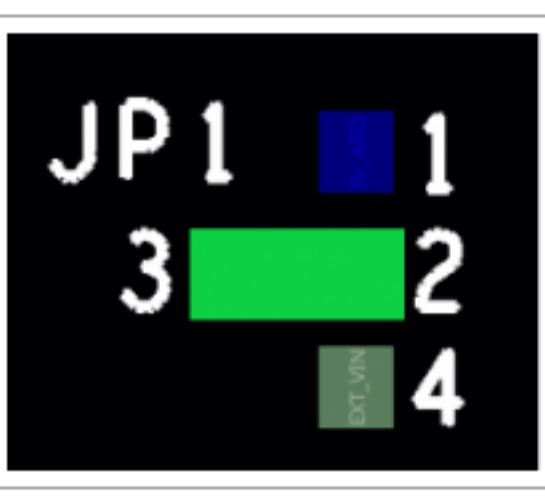
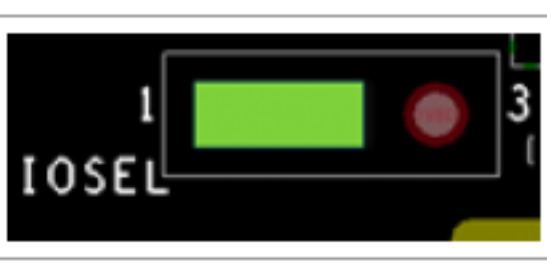
The following is a list of items needed to replicate this demo.

- EVAL-ADPD4100-ARDZ or EVAL-ADPD4101-ARDZ
- EVAL-ADICUP3029 with firmware (see Firmware Setup)
- Host computer with PyADI-IIO and relevant dependencies installed (See EVAL-ADPD410X-ARDZ Python Example)
- 3D Printed Single Path Base () (Also orderable from Shapeways)
- 3D Printed Cuvette Holder () (Also orderable from Shapeways)
- Type 1FLP Disposable Macro Cuvettes UV Plastic (Lightpath: 10mm)
- 10 mm Dia. x 6.6 mm FL, Uncoated Molded Aspheric Condenser Lens
- 12.5 x 17.5 mm, 50R/50T, Plate Beamsplitter
- Fluorescence Filter (SCHOTT GG-475, 12.5 mm Dia., Longpass Filter)
- Fluorescence Photodiode Board 
- Transmit Photodiode Board 
- 365 nm LED Board 
- Male-to-female jumper headers for connection
- (**Optional**) Prepared samples with known quinine concentration measurement

Setting up the EVAL-ADPD410X-ARDZ

Configure the onboard jumper header and solder jumper connections, as shown below.



Header	Setting	Image
P10	No connection	
JP1	Shorted Pin 2 and Pin 3	
IOSEL	Shorted Pin 1 and 2	

Set the following EVAL-ADICUP3029 switches according to their configuration on the table below.

Switch	Configuration
UART (S2)	USB
POWER (S5)	WALL/USB

Connect the EVAL-ADPD4100-ARDZ or EVAL-ADPD4101-ARDZ to the EVAL-ADICUP3029 using the headers shown below.

Firmware Setup

Connect the EVAL-ADICUP3029 to the PC using the micro-USB to USB cable. Drag and drop the appropriate .hex file from the list below to the Daplink Drive. (See driver-/-firmware-setup)

Pre-built hex files can be found here:

- EVAL-ADPD4100-ARDZ .Hex File (ADuCM3029_demo_adpd410x_spi_waterquality.hex)
- EVAL-ADPD4101-ARDZ .Hex File (ADuCM3029_demo_adpd410x_i2c_waterquality.hex)

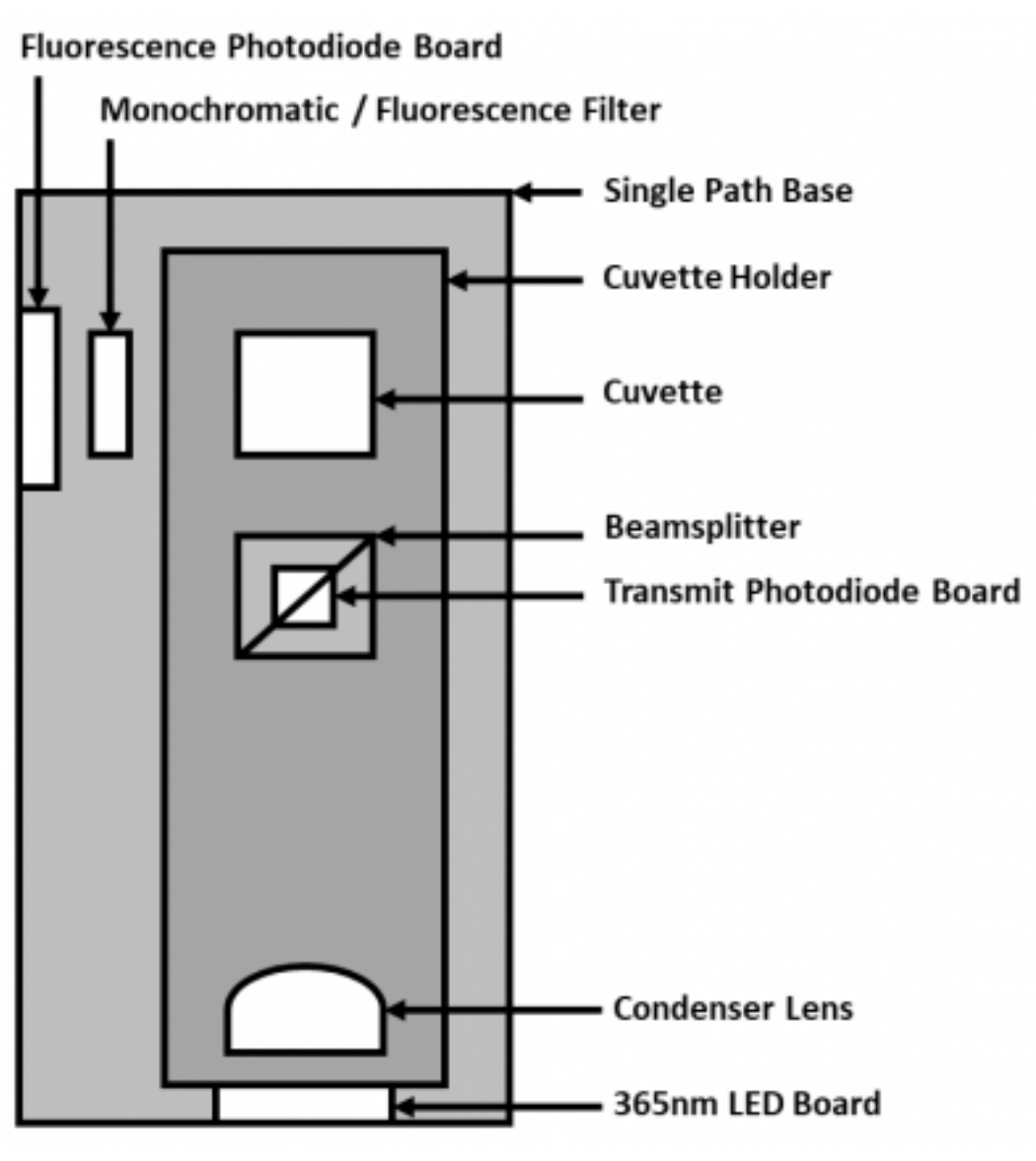
The latest source code can be found here:

- EVAL-ADICUP3029/tree/master/projects/ADuCM3029_demo_adpd410x

Optical Path Setup

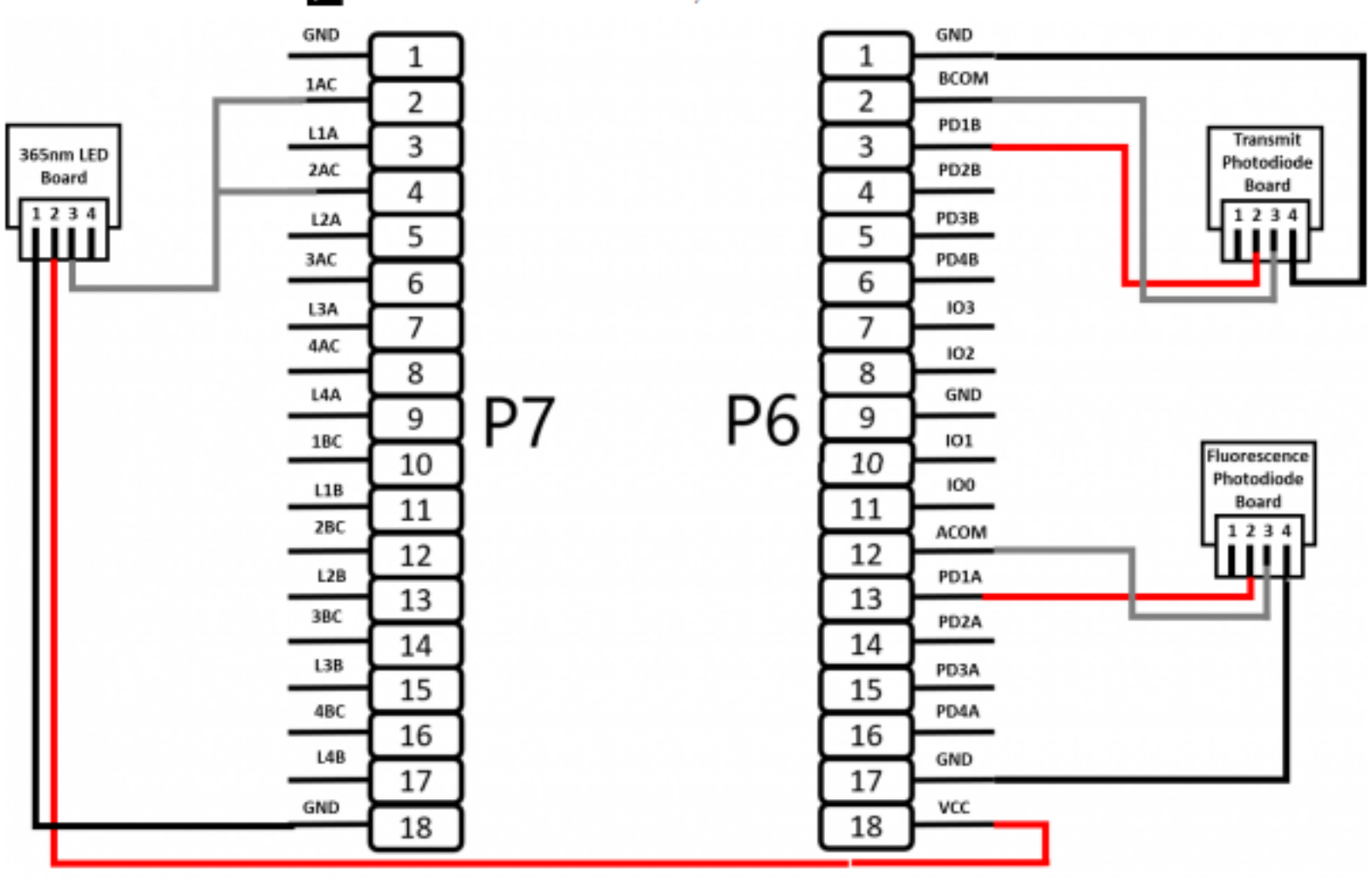
The demo utilizes an optical path similar to the one used by CN0503, but only for a single channel. The single path base and cuvette holder are available as 3D-printable designs () and can also be ordered using Shapeways.

1. Assemble the cuvette holder. See Assembling the Tower for instructions.
2. Insert the 365 nm LED Board to the base, as shown below.
3. Insert the Transmit Photodiode Board at the bottom of the base, as shown below. The Transmit Photodiode Board uses the same photodiode as the one used as reference in the CN0503.
4. Insert the Fluorescence Photodiode Board to the base, as shown below.
5. Insert the monochromatic or fluorescence filter to the slit in front of the Fluorescence Photodiode Board, as shown below.
6. Insert the cuvette with the quinine sample to measure.



Hardware Connection

Connect the 365 nm LED Board, Transmit Photodiode Board, and Fluorescence Photodiode Board to the prototyping connectors of the EVAL-ADPD4100-ARDZ or EVAL-ADPD4101-ARDZ, as shown below.



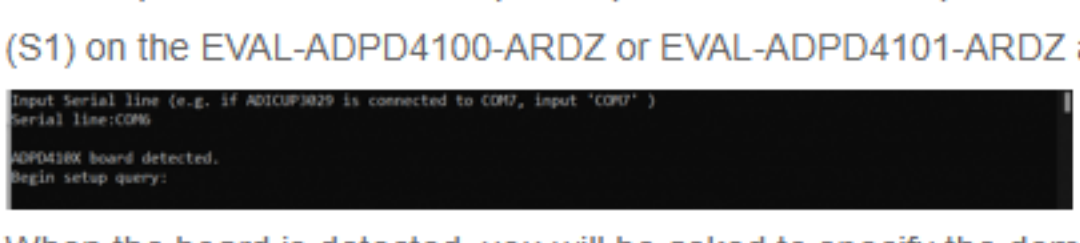
Software Setup

This demo uses a PyADI-IIO example script. See Software Setup for the complete installation instructions from libiio to pyadi-iio.

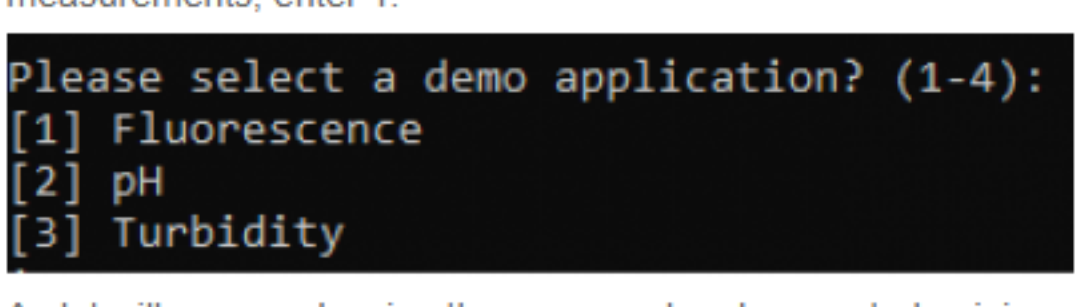
1. Connect the EVAL-ADPD4100-ARDZ or EVAL-ADPD4101-ARDZ to the EVAL-ADICUP3029.
2. Connect the EVAL-ADICUP3029 to the PC using the micro-USB cable and note the serial port from the Device Manager as in Connection.
3. Open command prompt or terminal and navigate through the examples folder inside the downloaded or cloned *pyadi-iio* directory.
4. Run the example script using the command.

```
...\pyadi-iio\examples>python adpd410x_demo.py
```

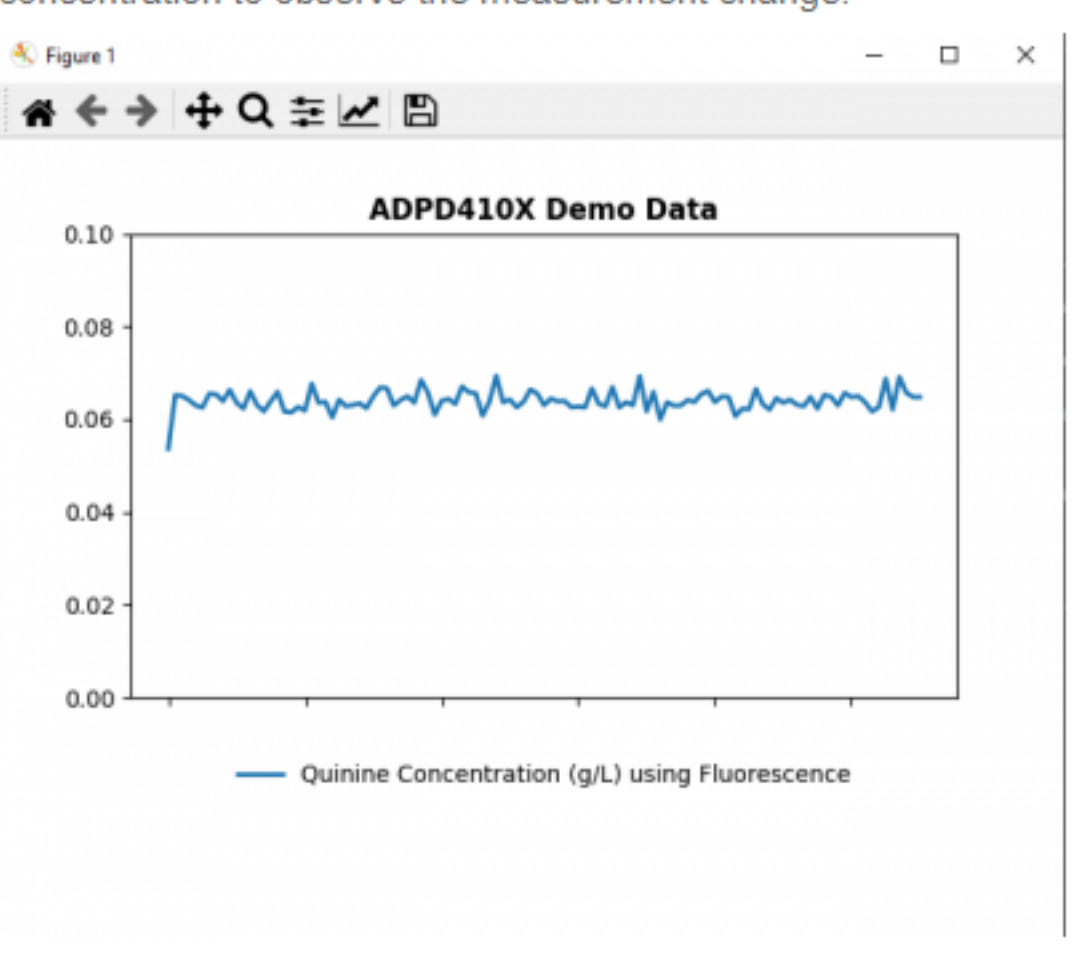
5. The script will ask for a serial port. Input the noted serial port and press Enter. In cases when the board is not found, press the reset button (S1) on the EVAL-ADPD4100-ARDZ or EVAL-ADPD4101-ARDZ and input the noted serial port again.



6. When the board is detected, you will be asked to specify the demo application to use. Since this setup is only applicable for fluorescence measurements, enter 1.



7. A plot will appear showing the measured and computed quinine concentration. You have the option to save a copy of the displayed waveform at any point in time using the matplotlib controls at the top. Remove the cuvette and replace the quinine sample with a different concentration to observe the measurement change.



The demo script uses the same polynomial approximation used in Computing Quinine Concentration.

Reference Links

- Hardware User Guide