VCS^3 Development Kit

Getting Started Guide

Table of Contents

Version	Notes	Initials	Date
0.1	Initial Version	CH	30th Oct 2024
0.2	Fixed some language issues	CH	31st Oct 2024
0.3	Added password & Username for QSPI linux	CH	13th Nov 2024

Kit Contents

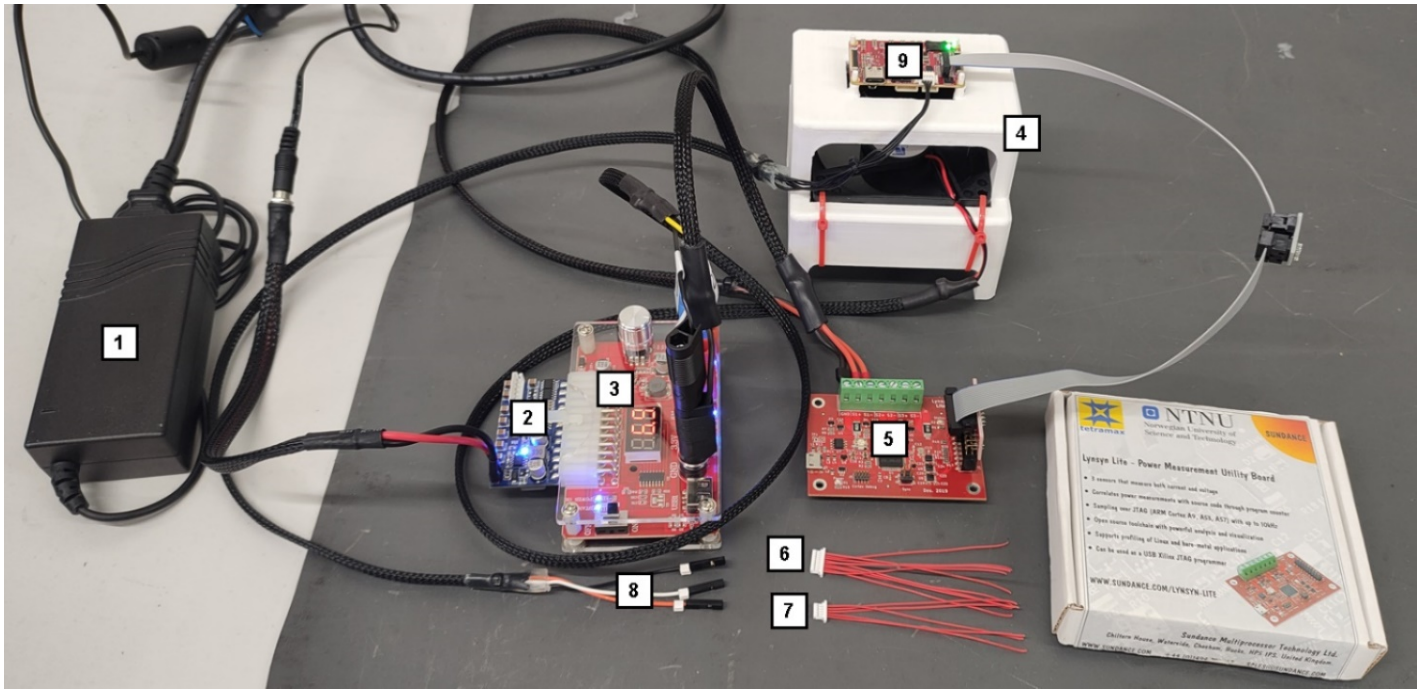

Figure 1 - Kit Contents

1. 12V AC-DC PSU
2. PicoATX power supply
3. ATX breakout card with female banana sockets
4. VCS^3 holder and fan unit
5. Lynsyn Lite power measurement card & virtual JTAG cable
6. 9-way cable for expansion
7. 5-way cable for CAN bus and UART-1
8. Main power and UART-0 (main UART) cable
9. VCS^3 module

Required, but not included:

- USB UART dongle/device
- MicroUSB cable

Hardware Setup

1. Connect the PSU brick to the PicoATX power supply and plug this into the breakout board.
   DO NOT CONNECT MAINS POWER YET.

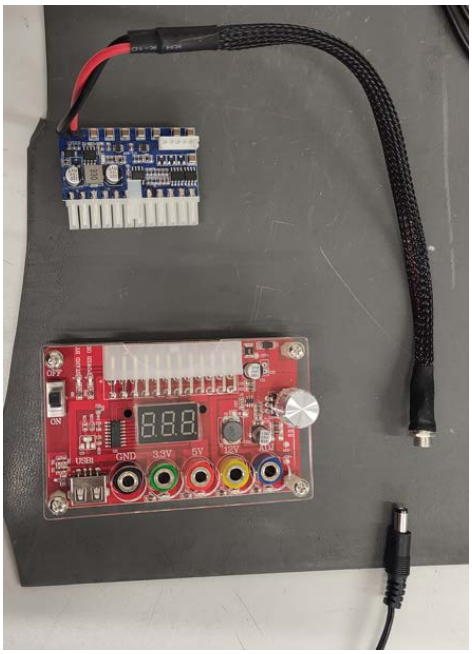

Figure 2 - Power Supply Components

2. Connect the RED and BLACK banana plugs from the VCS[3] power and UART harness to the RED and BLACK sockets on the breakout card.
   Connect the BLUE and BLACK banana plugs from the VCS[3] holder and fan unit to the BLUE and BLACK sockets on the breakout card.

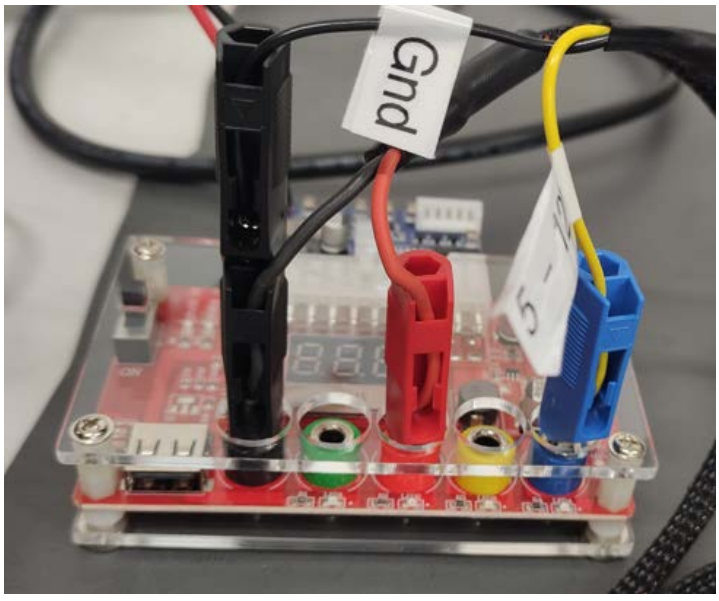

Figure 3 - Banana Plug Connections

3. Connect the RED and BLACK ferrule crimped ends to the Lynsyn Lite.

Figure 4 - Power Cable Ends

BLACK goes into GND.
RED from the PSU (Banana plug) goes go S1+.
RED to the VCS^3 goes to S1-.
(If they are the wrong way round, you will view some strange current readings.)

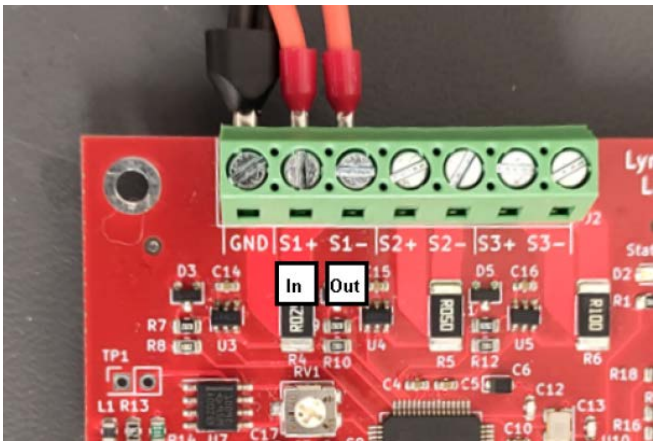

Figure 5 - Cable Locations in Lynsyn Lite

The other end of the power / main UART cable connects to the VCS^3 on header J9. This is on the bottom on the VCS^3. It is the only 4-way header. It is connected with the "prongs" of the connector up (flat side down).

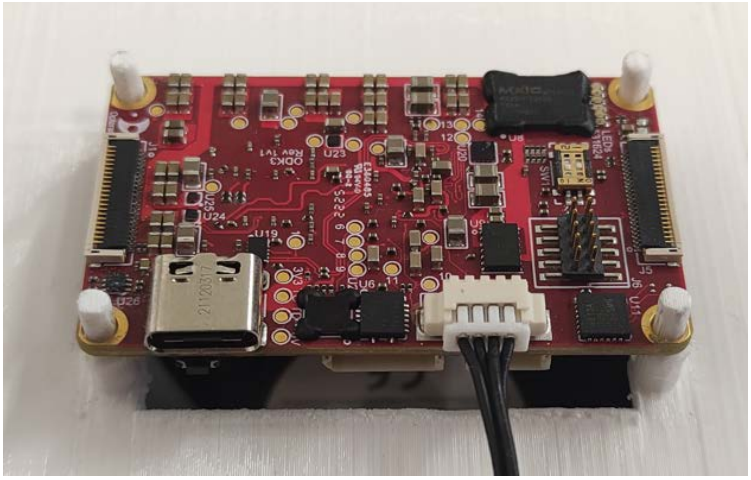

Figure 6 - VCS^3 Main Power Connection

4. Connect the AMD/Xilinx JTAG cable to the VCS^3. This plugs in via the adaptor on J6. Pin 1 is the BLUE cable in the ribbon. On the board, pin 1 is next to U11.

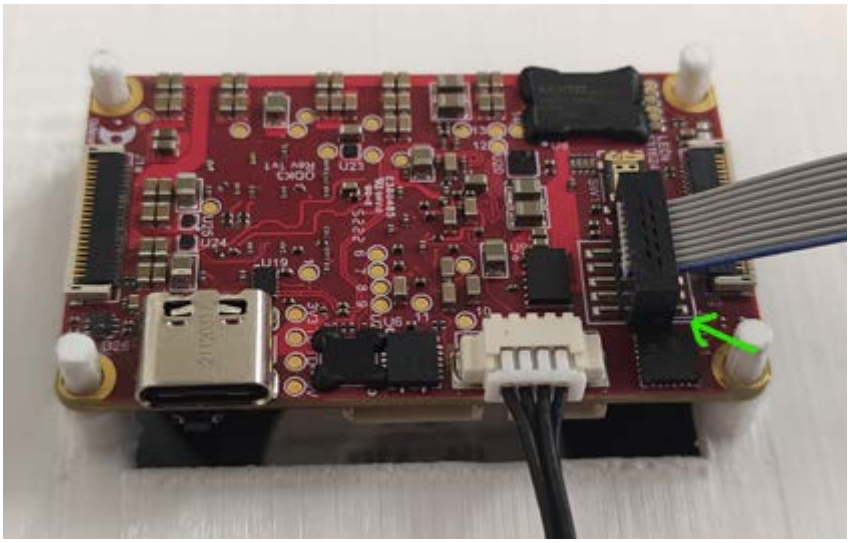

Figure 7 - JTAG In on the VCS^3 Note Pin 1

The other end of the AMD / Xilinx JTAG cable is connected to the Lynsyn Lite. There is a second adaptor needed to convert the 0.1" header on the Lynsyn Lite to the standard 2mm JTAG cable. It is included in the box. Both connections are keyed meaning it should be hard to get it the wrong way round.

Figure 8 - JTAG on the Lynsyn Lite

Connect the MicroUSB connector of the Lynsyn Lite to the cable (not supplied) and if required, connect the UART cables to your UART – USB device (not supplied). The cable is labelled for Transmit, Receive and Ground.
These are as designated on the VCS^3, so need to be reversed when connecting to the UART – USB device (T – R, R – T and G – G).

10. Connect the mains power to the 12V AC-DC PSU. A LED should illuminate on the breakout board indicating Standby power is on. Switch the switch, and the system should power up. If the fan is not spinning, adjust the voltage using the knob on the breakout card.
    On the VCS^3, one GREEN LED should be on solid, and another GREEN LED should be flashing.

Lynsyn Lite

About

The Lynsyn Lite is a dual-purpose card for both power measurement and JTAG communications.

It can monitor voltage and current on three independent sensors, with voltage ranges between 0V and 23V and currents between 0A and 5A.

By default, and as supplied for the V3.1 hardware, the sensors are set to be as the table below:

Sensor	Current Range	Shunt Resistor	Shunt Size
S1	0 - 5 Amps	R4	0.025 Ohms
S2	0 - 2.5 Amps	R5	0.05 Ohms
S3	0 – 1.25 Amps	R6	0.1 Ohms

For this set up guide, we have used sensor S1 as it has the largest range but for developments where the current draw is known to be within the lower ranges, these would be better to use as they would give a more detailed view of currents drawn at different times.

Full information on the Lynsyn Lite can be found here:
https://github.com/EECS-NTNU/lynsyn-host-software/wiki

Software Setup

Windows

(https://github.com/EECS-NTNU/lynsyn-host-software/wiki/Installing-on-Windows)

1. Download the pre-built binaries (executables) of the Lynsyn tools. These can be found here:
   DOWNLOAD LYNSYN TOOLS V1.3 LINK
   (https://github.com/EECS-NTNU/lynsyn-host-software/releases)

2. Unzip the tools to a location on your computer. The software tools are not installed and are just run from within this folder so it can be anywhere, but for ease of use we would suggest **`C:\lynsyn\.`**

3. Install the driver for the card.

    1. Connect the Lynsyn Lite to your PC. It gets power over the MicroUSB connection so the VCS^3 system does not need to be on at this time.

    2. Open the Zadig application. Your PC may ask if you want to run it (UAC), you do. It should pop up like this:

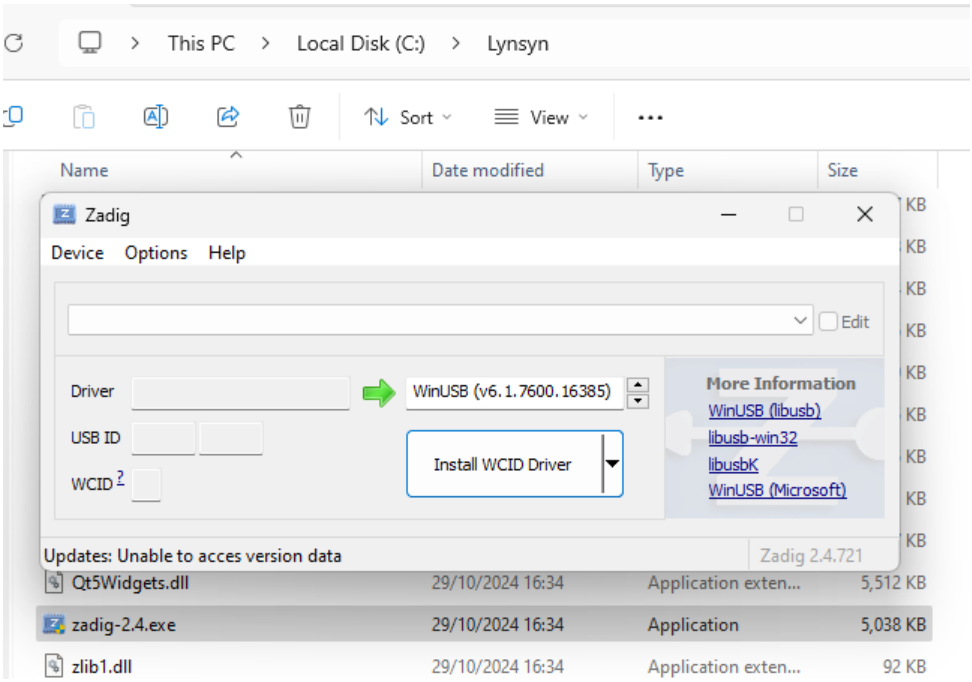

Figure 9 - Zadig Application

3. From the “Options” menu, select “List All Devices”.

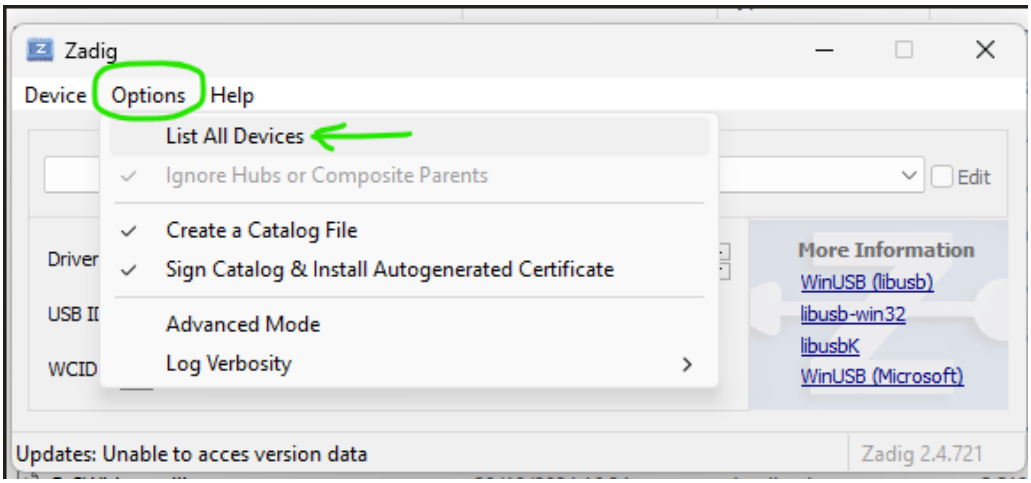

Figure 10 - Zadig List All

4. The drop-down box in the middle of the application will now be populated. Open this and select the Lynsyn.

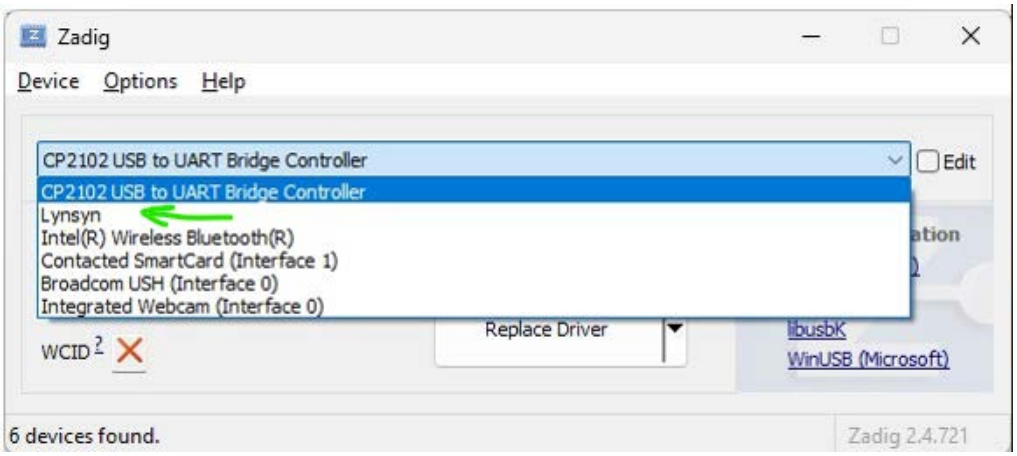

Figure 11 - Zadig Select Lynsyn

5. Press the button to Install / Reinstall driver.

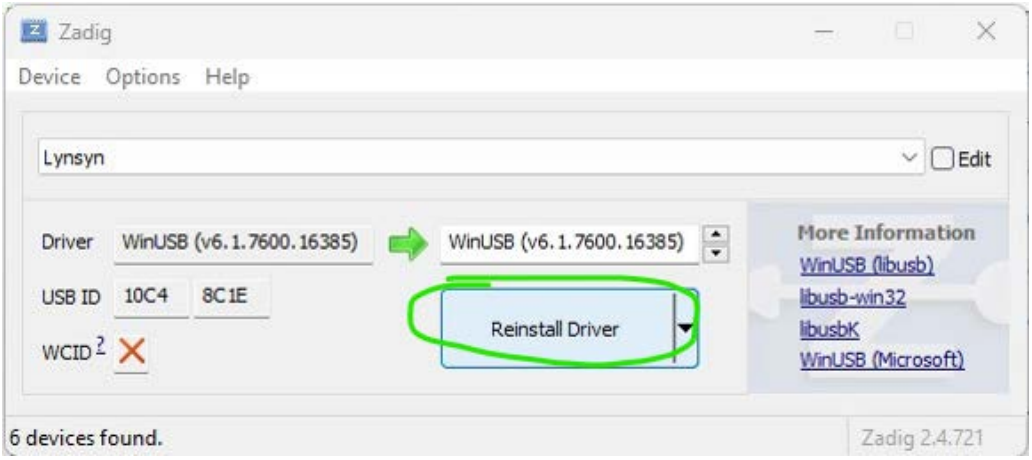

Figure 12 - Zadig Install (Reinstall) Driver

This may take a few minutes, please wait till you see the pop up saying that the driver was successfully installed:

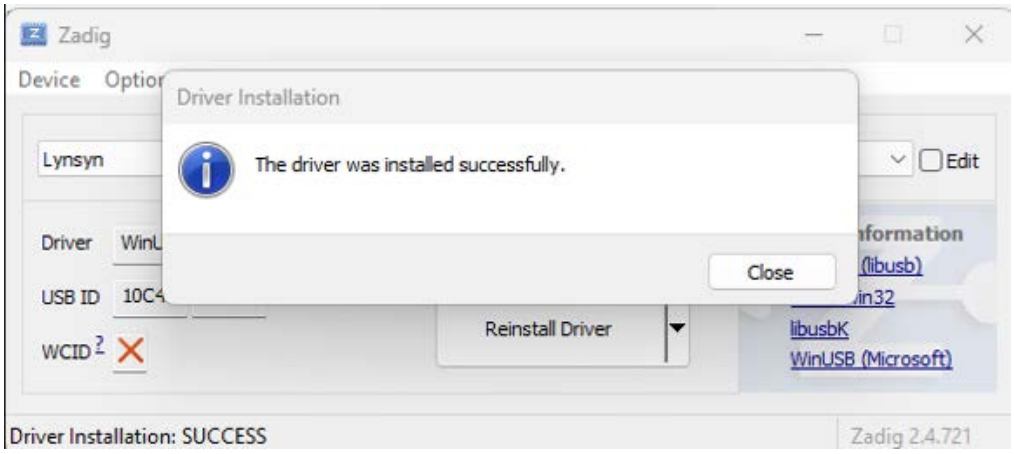

Figure 13 - Zadig Successfully Installed

The Lynsyn Lite should now be ready to use.

Linux

As there are many variations of Linux, this guide is for Ubuntu 22.04.

1. Open a terminal window and update and upgrade
   `sudo apt-get update && sudo apt-get upgrade`

2. Install the required dependencies for the Lynsyn project.
   `sudo apt install build-essential qtbase5-dev libqt5sql5-sqlite libusb-1.0-0-dev git dbus-x11`

3. Clone the GitHub repository to your machine.
   `git clone` `https://github.com/EECS-NTNU/lynsyn-host-software.git`

4. Go to the cloned directory
   `cd lynsyn-host-software/`

5. Run the make (Just type "make" – no inverted commas) file to compile the software. It will look like a lot has gone wrong, but as long as it says "Host software compilation successful" at the end, you are OK.
   `make`

6. Install the made software by running this command:
   `sudo make install`
   Again, it will say a lot, but as long as it shows "**Host software compilation successful**" and "**Software and hardware installed**" it is all OK.

You have now built the software packages required for the Lynsyn Lite.

Running the Power Measurement Tools

Windows

Recording a Session

From the command line

1. Open a command prompt window and navigate to **`C:\Lynsyn`** (or wherever you saved the tools earlier)
2. To start logging a session you need to use the `lynsyn_sampler` application.

```
C:\Lynsyn>lynsyn_sampler.exe --help
Usage: lynsyn_sampler.exe [OPTION...]
A sampling tool for Lynsyn boards

  -c, --cores=cores          Cores to sample
  -d, --duration=duration    Duration
  -e, --endaddr=endaddr      End Address
  -f, --frameaddr=frameaddr  Frame Address
  -o, --output=filename      Output File
  -s, --startaddr=startaddr  Start Address
  -?, --help                 Give this help list
      --usage                Give a short usage message

Mandatory or optional arguments to long options are also mandatory or optional
for any corresponding short options.
```

Figure 14 - lynsyn_sampler Options

For this simple example we will be just setting to run the application for a 30 second session and saving the data to the default "output.csv" file. To run it for longer or shorter, just change the number at the end.

WARNING – These files can get large fast. This 30 second sample is around 63Mb.

The format for this is:
`lynsyn_sampler -d 30`

```
C:\Lynsyn>lynsyn_sampler -d 30
Sampling power
Duration 30.000000s
Output file: output.csv
```

Figure 15 - Running the Sampler for 30 Seconds

Once finished you will get the command line prompt back.

From the GUI

From the Lynsyn folder you created, launch the "**`lynsyn_viewer.exe`**" application.

In the top left corner there are two buttons, "Profile" and "Live"

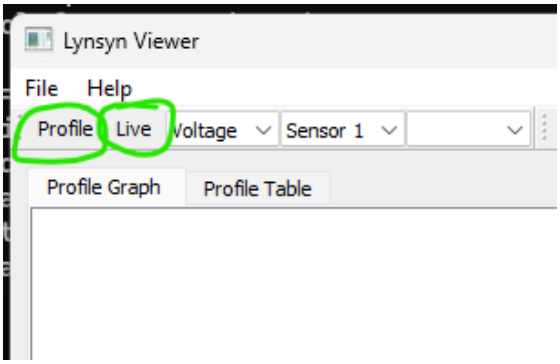

Figure 16 - Lynsyn Viewer Profile and Live

Pressing the "Live" button brings up a box showing what is happening NOW:

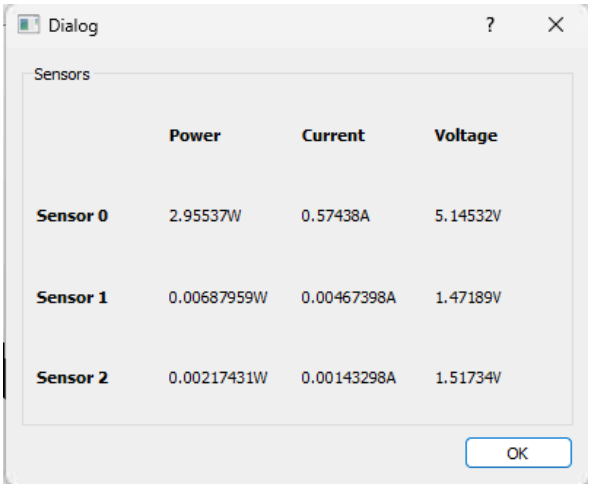

Figure 17 - Lynsyn Viewer Live

The "Profile" button brings up a box in which you select the length of the sampling you wish to have.
Pressing OK starts the sampling. When complete, "Profiling Done" is shown and the new set of samples are shown in the graph.

Next to these two buttons are three dropdown lists. One selects the parameter shown (Current, Voltage or Power), the second selects which sensor.
In our example, the third is un-used.

You can interact with the graph using your mouse. If you draw a box round a section (left button), it will zoom in. Left clicking will show the values at that point.
Right clicking will zoom out again.

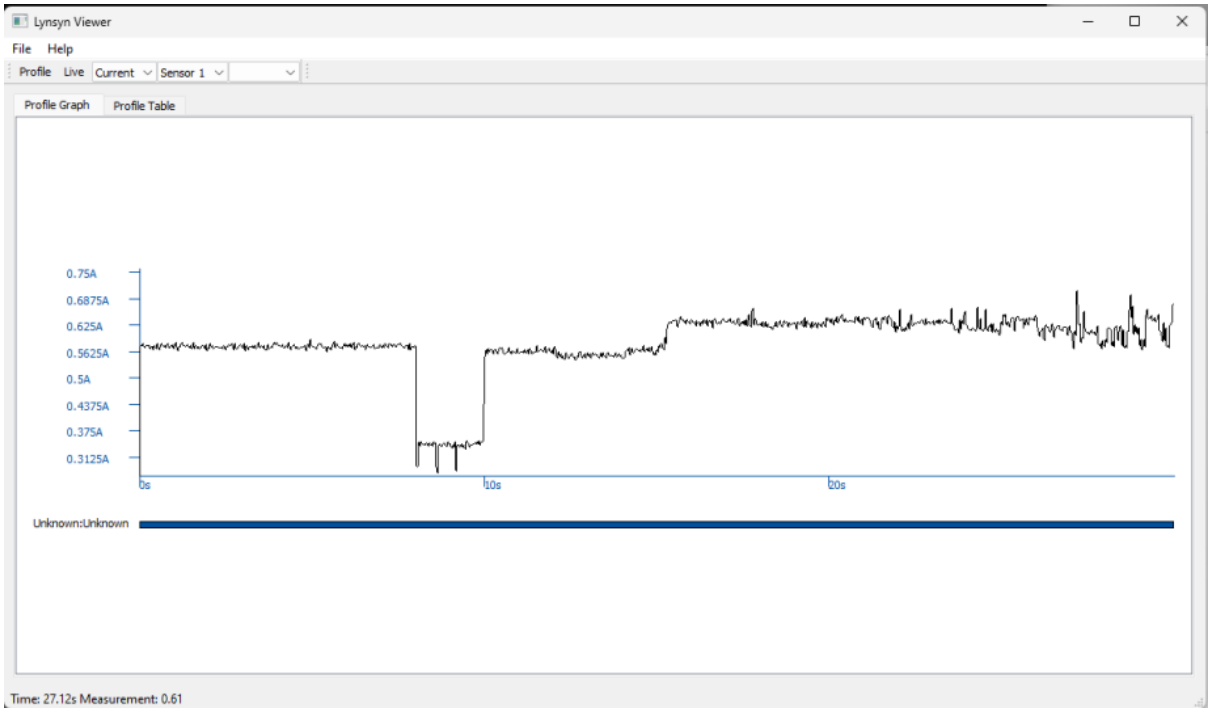

Figure 18 - Lynsyn Viewer Profile Graph

To save this data, go to “File” then “Export CSV.”

Viewing a Session if Recorded from the Command Line or from a Previous Save

If you recorded the session via the command line, from the Lynsyn folder you created, launch the “lynsyn_viewer.exe” application.

When opening it will display the previous result by default. To load the latest set of sampled data, go to “File” then “import CSV.”

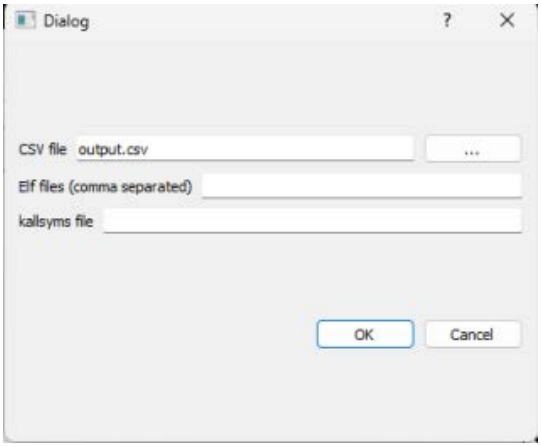

Figure 19 - Lynsyn Viewer Import CSV

Select the file (by default it has “output.csv”) and press OK.
After a few moments it should say “Import Done” and a graph of the recorded session will be shown.

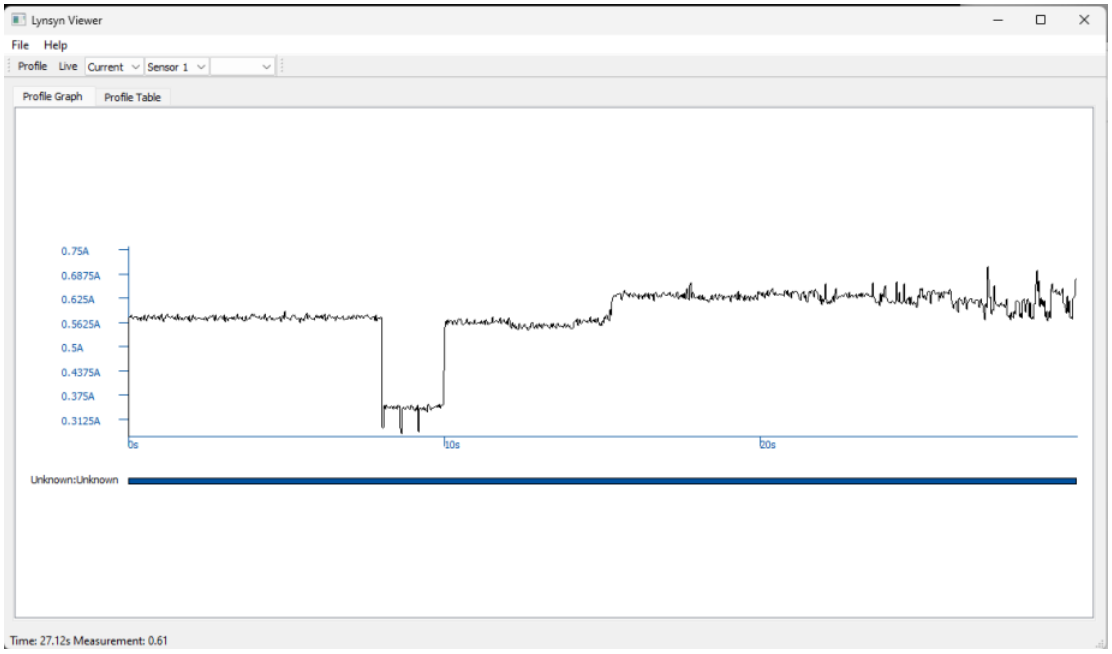

Figure 20 - Lynsyn Viewer Profile Graph

You can interact with the graph using your mouse. If you draw a box round a section (left button), it will zoom in. Left clicking will show the values at that point.
Right clicking will zoom out again.

Linux

Recording a Session

From the terminal

1. Open a terminal window

2. To start logging a session you need to use the lynsyn_sampler application.

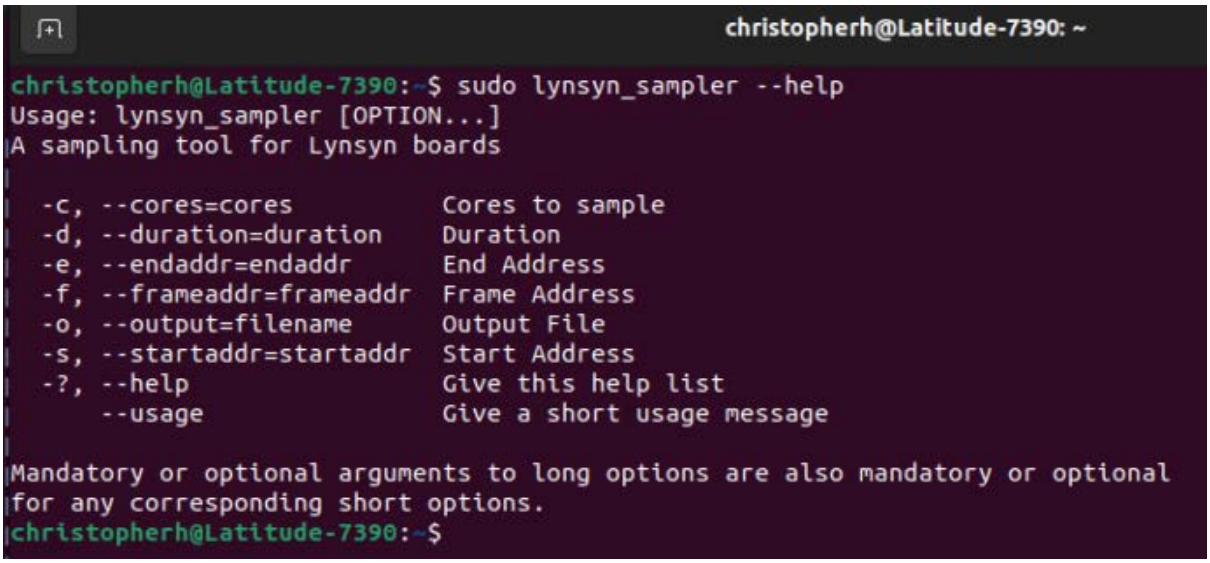

Figure 21 - Linux version of lynsyn_samplerFigure 22 - Linux Version of lynsyn_sampler

For this simple example we will just be setting to run the application for a 30 second session and saving the data to the default "output.csv" file. To run it for longer or shorter, just change the number at the end.

WARNING – These files can get large fast. This 30 second sample is around 63Mb. You need to be sudo so the computer can interact with the Lynsyn Lite.

The format for this is:
`sudo lynsyn_sampler -d 30`

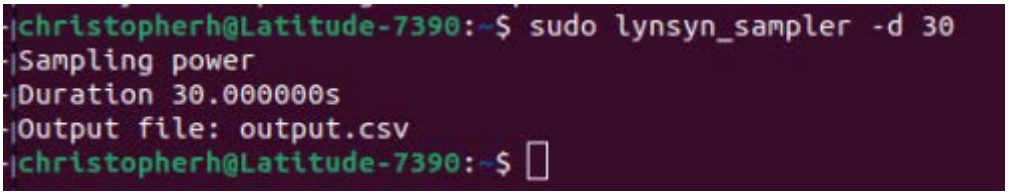

Figure 23 - Running the Sampler for 30 Seconds

Once finished you will get the command line prompt back.

From the GUI

Open a terminal window and type:

`sudo lynsyn_viewer`

You need to be sudo for the computer to interact with the Lynsyn Lite.

This will launch the Lynsyn Viewer application.

In the top left corner there are two buttons, “Profile” and “Live”

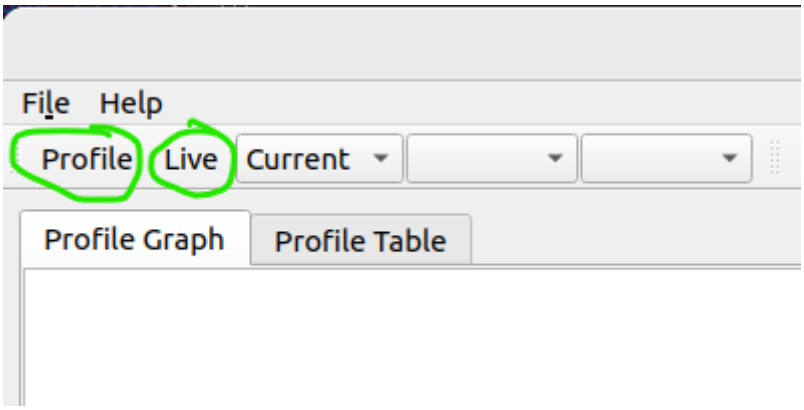

Figure 24 - Lynsyn Viewer Profile and Live

Pressing the “Live” button brings up a box showing what is happening NOW:

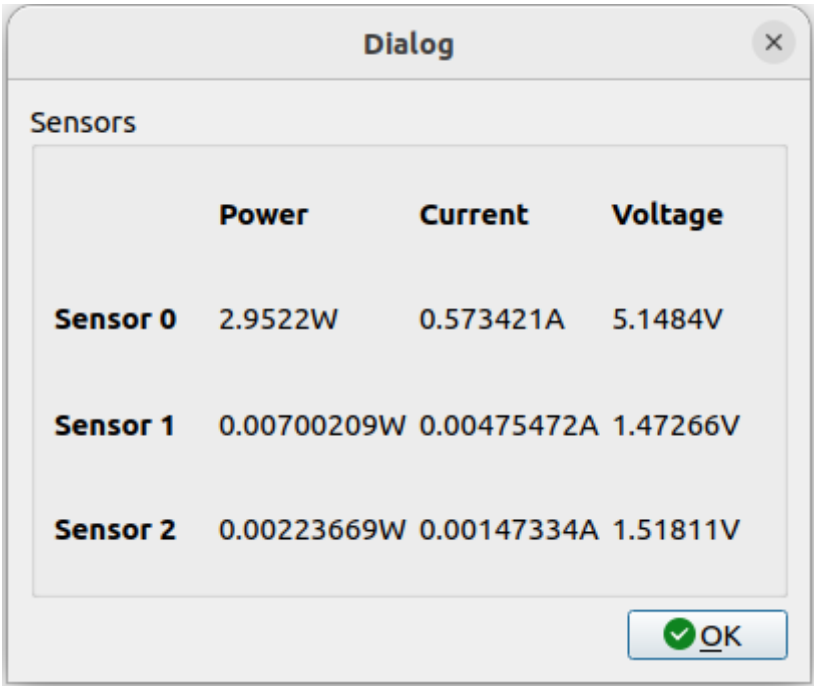

Figure 25 - Lynsyn Viewer Live

The “Profile” button brings up a box in which you select the length of the sampling you wish to have.

Pressing OK starts the sampling. When complete, “Profiling Done” is shown and the new set of samples are shown in the graph.

Next to these two buttons are three dropdown lists. One selects the parameter shown (Current, Voltage or Power), the second selects which sensor.
In our example, the third is un-used.

You can interact with the graph using your mouse. If you draw a box round a section (left button), it will zoom in. Left clicking will show the values at that point.
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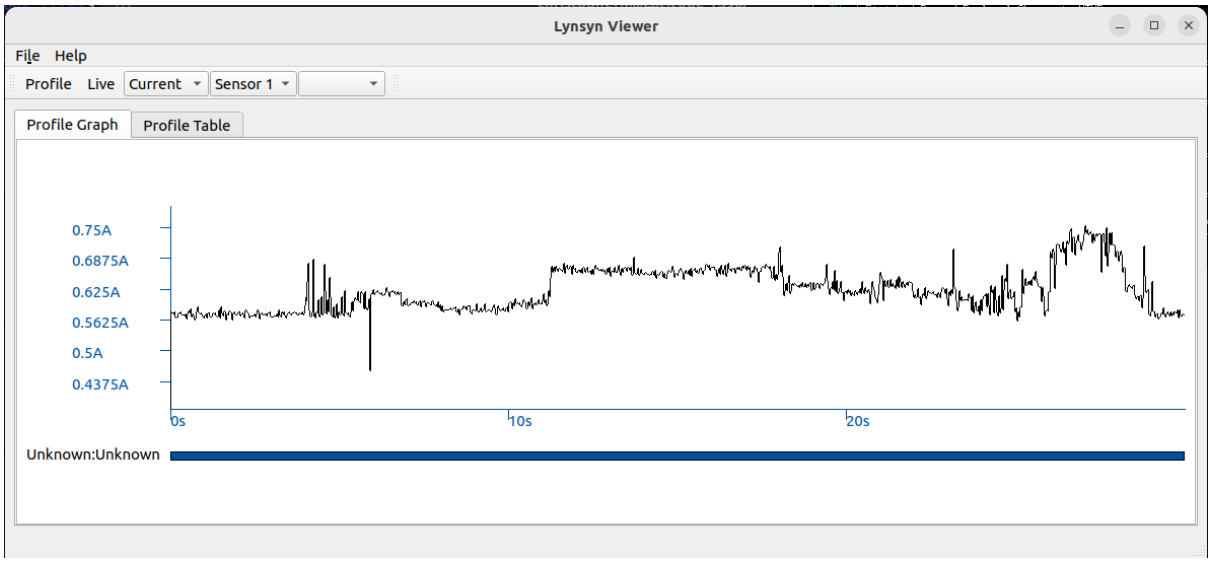

Figure 26 - Lynsyn Viewer Profile Graph

To save this data, go to “File” then “Export CSV.”

Viewing a Session if Recorded from the Command Line or from a Previous Save

If you wish to see a session recorded previously via the command line, launch the "lynsyn_viewer" application.

```
sudo lynsyn_viewer
```

When opening it will display the previous result by default. To load the latest set of sampled data, go to "File" then "import CSV."

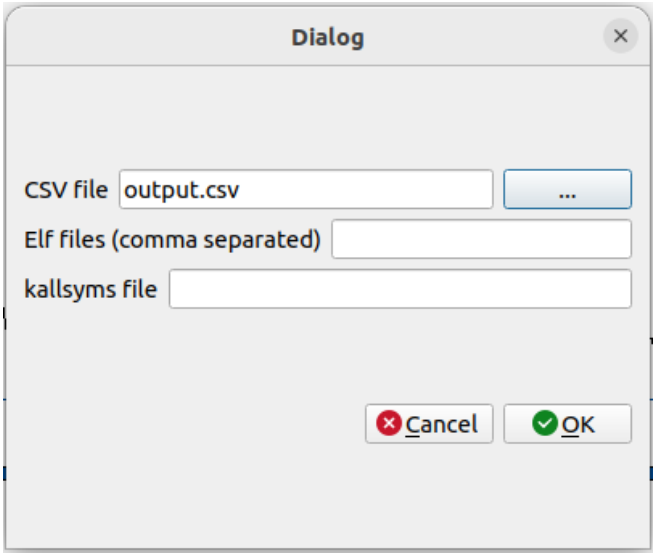

Figure 27 - Lynsyn Viewer Import CSV

Select the file (by default it has "output.csv") and press OK.
After a few moments it should say "Import Done" and a graph of the recorded session will be shown.

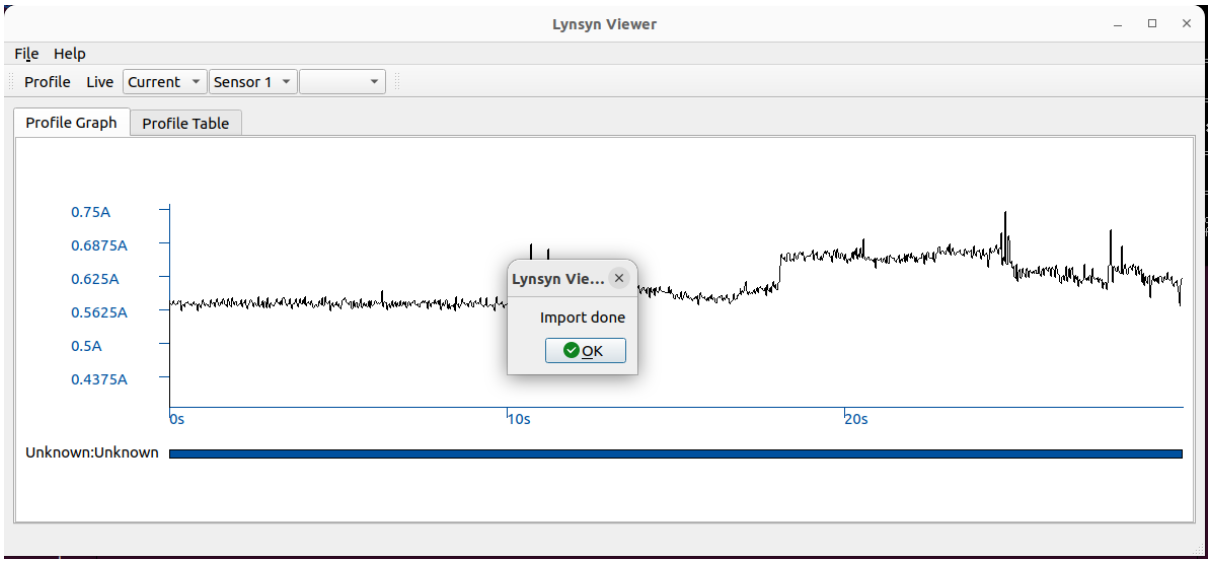

Figure 28 - Lynsyn Viewer Profile Graph

You can interact with the graph using your mouse. If you draw a box round a section (left button), it will zoom in. Left clicking will show the values at that point.
Right clicking will zoom out again.

Using the Lynsyn Lite as an AMD/Xilinx JTAG Cable

Windows

The Lynsyn Lite also enables you program the FPGA on the VCS[3].

1. From the Lynsyn folder run “**lynsyn_xvc.exe**”
   Windows Firewall may ask if you want to allow this application. Press Allow.

Without that running in the background, the lynsyn will not work as a JTAG pod. Do not close this window.

2. Open Vivado and select “Open Hardware Manager”:

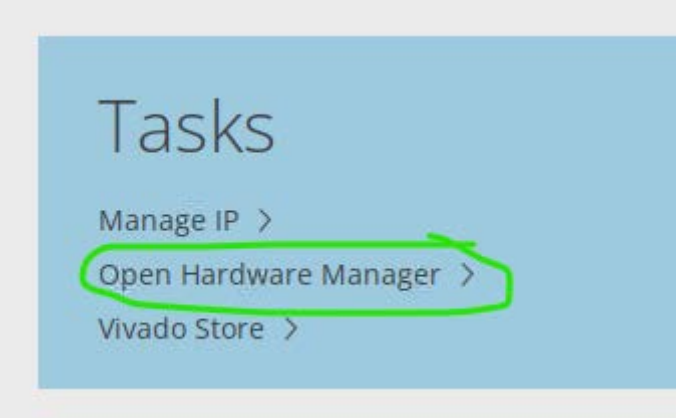

*Figure 29 - Vivado Hardware manager**Figure 30 - Vivado Hardware Manager*

3. Start the Open New Target wizard: “Tools -> Open new Target”
   Press “Next” on the first screen.
   On the next screen, ensure that Local Server is selected. Press next.

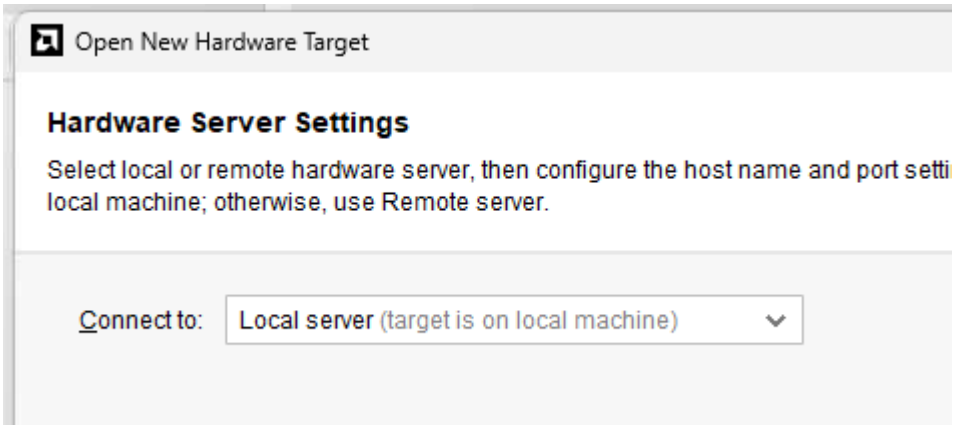

Figure 31 - Open Hardware Wizard Local Server

The next screen will look blank, this is OK.
Press the Add Xilinx Virtual Cable (XVC) button.

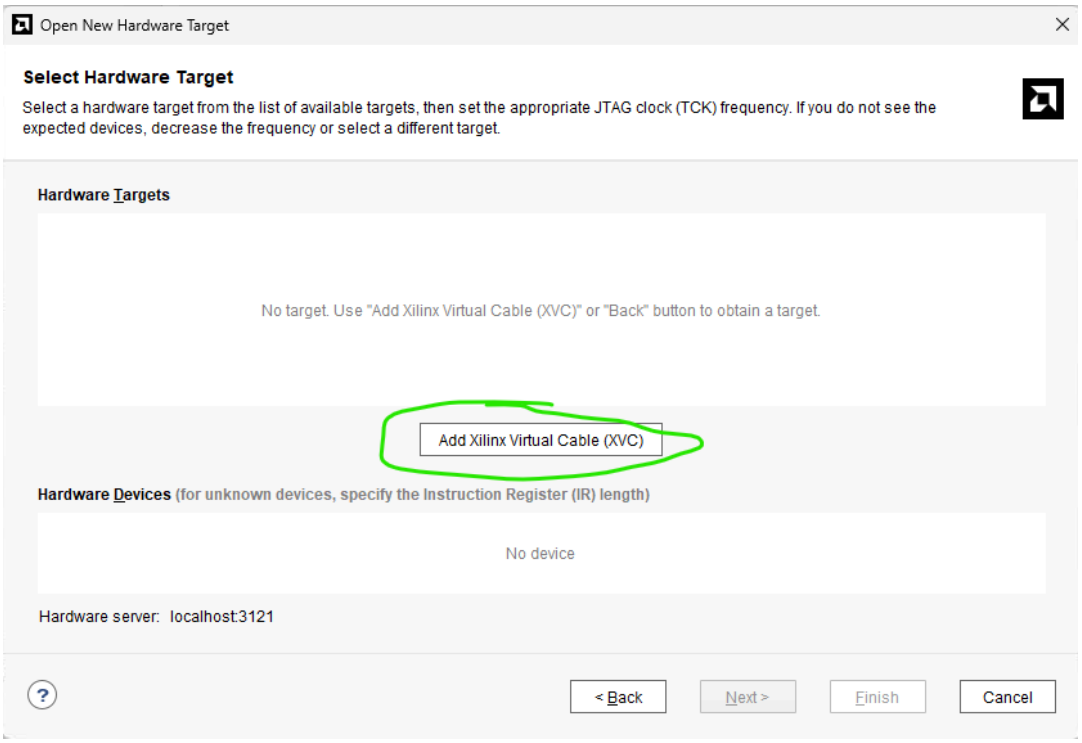

Figure 32 - Add Xilinx Virtual Cable

In the box that pops up, set the host name to “localhost.” Leave the port as 2542.

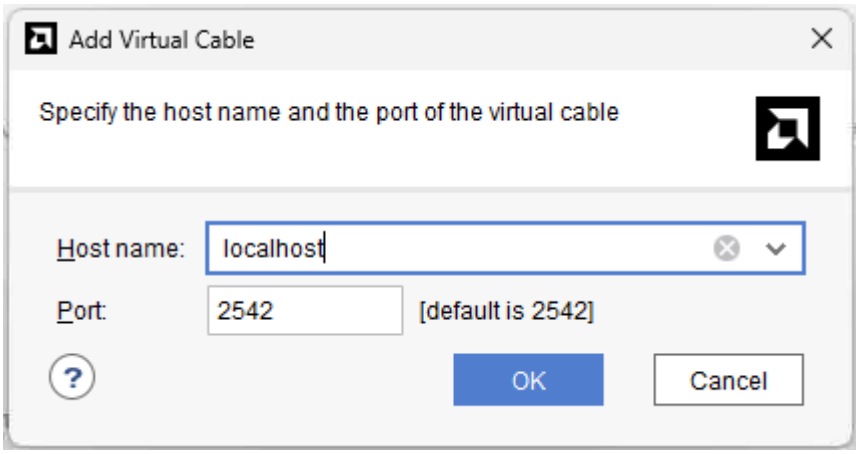

Figure 33 - Virtual Cable Settings

Press OK.

The wizard then connects to the Lynsyn Lite and checks what is connected.

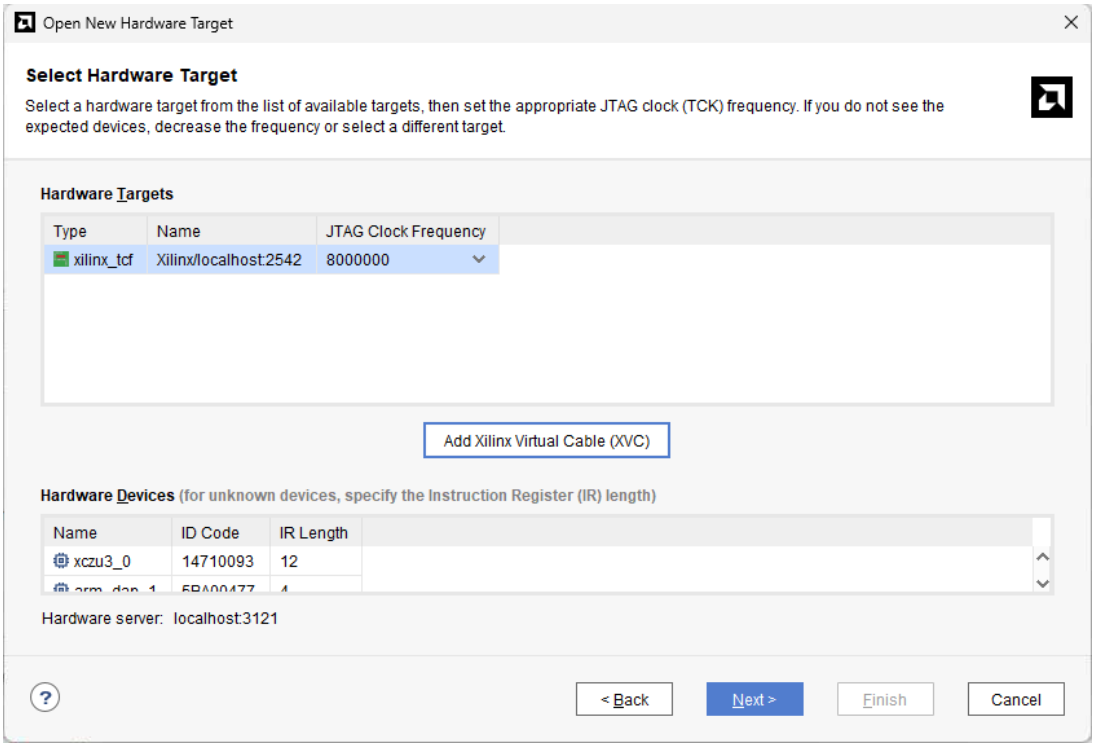

Figure 34 - Virtual Cable: Good Result

It should show like above, where there is a hardware target listed, and two hardware devices show, the xczu3 and the arm core.

Press next, then finish.

It will then connect and refresh the devices. You can now use it as normal.

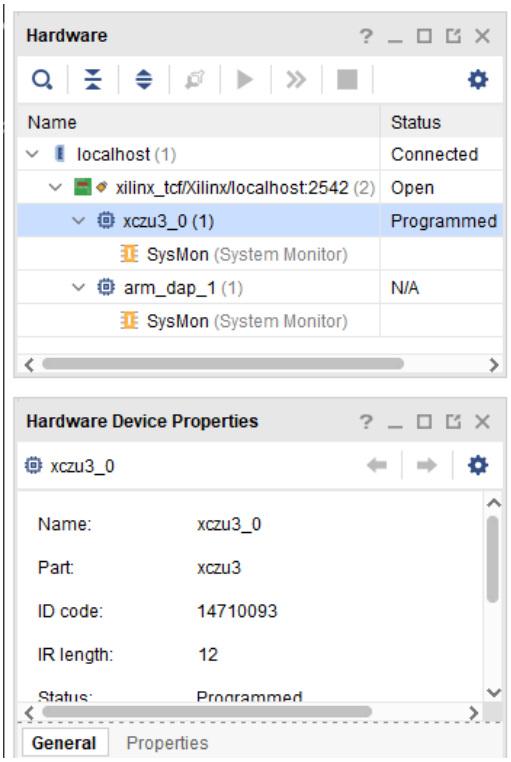

Figure 35 - Vivado Connected Devices

Linux

The Lynsyn Lite also enables you program the FPGA on the VCS[3].

1. From the terminal run "**sudo lynsyn_xvc**"

Without that running in the background, the lynsyn will not work as a JTAG pod. Do not close this window.

```
christopherh@Latitude-7390:~$ sudo lynsyn_xvc
INFO: To connect to this lynsyn_xvc instance, use url: TCP:Latitude-7390:2542
```

Figure 36 - lynsyn_xvc Running

2. Open Vivado and select "Open Hardware Manager":

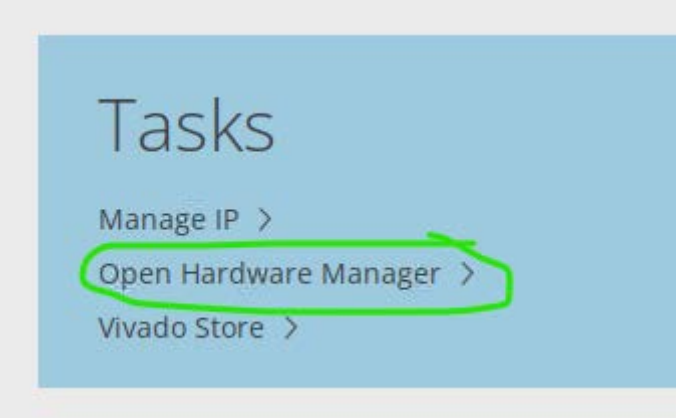

Figure 37 - Vivado Hardware manager *Figure 38 - Vivado Hardware Manager*

3. Start the Open New Target wizard: "Tools -> Open new Target"
   Press "Next" on the first screen.
   On the next screen, ensure that Local Server is selected. Press next.

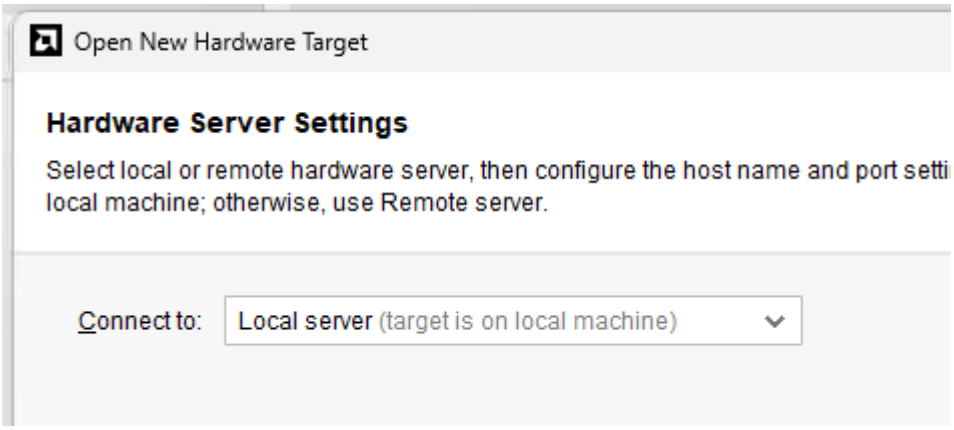

Figure 39 - Open Hardware Wizard Local Server

The next screen will look blank, this is OK.
Press the Add Xilinx Virtual Cable (XVC) button.

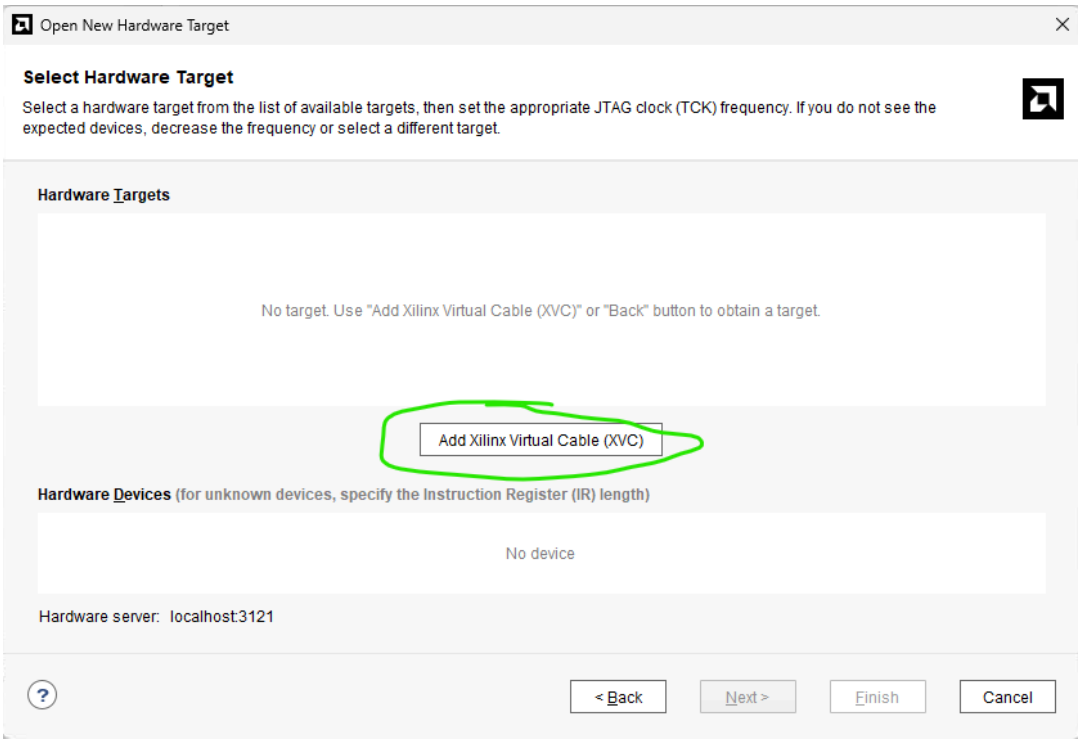

Figure 40 - Add Xilinx Virtual Cable

In the box that pops up, set the host name to "localhost." Leave the port as 2542.

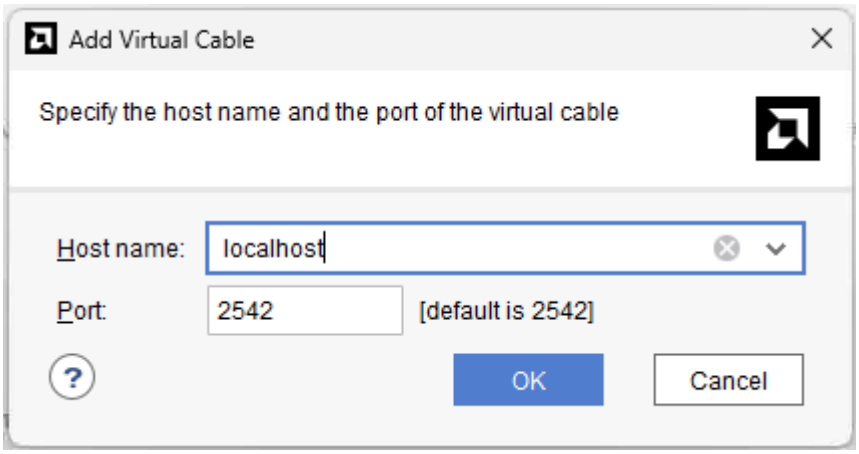

Figure 41 - Virtual Cable Settings

Press OK.

The wizard then connects to the Lynsyn Lite and checks what is connected.

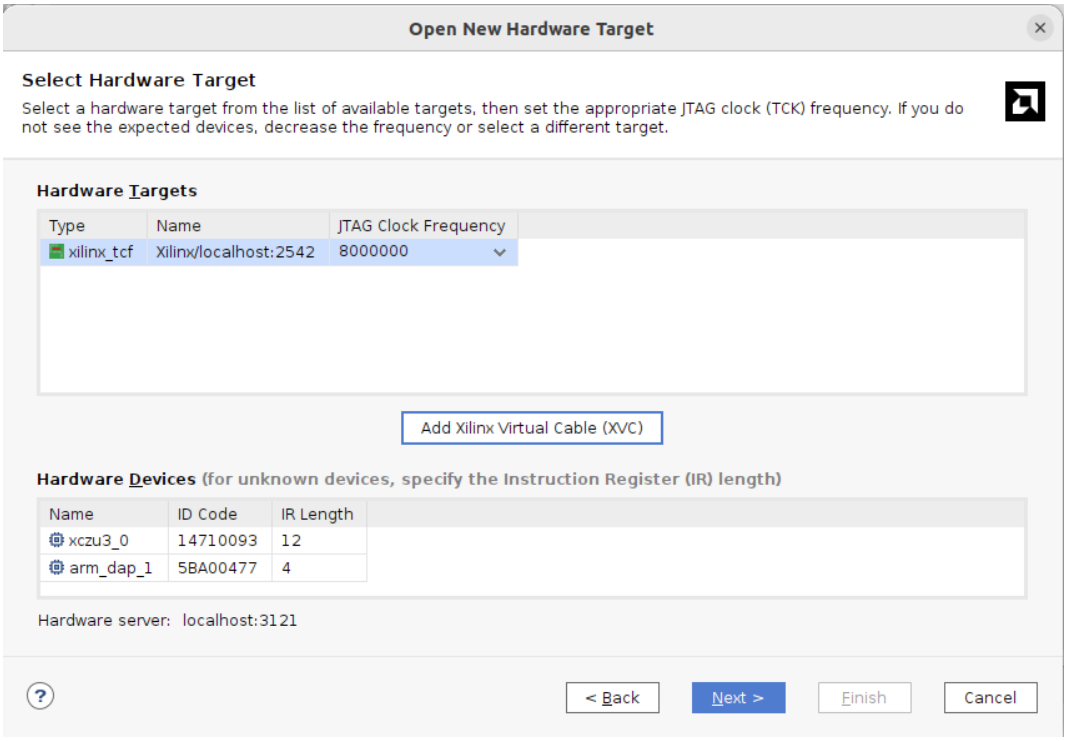

Figure 42 - Virtual Cable: Good Result

It should show like above, where there is a hardware target listed, and two hardware devices show, the xczu3 and the arm core.

Press next, then finish.

It will then connect and refresh the devices. You can now use it as normal.

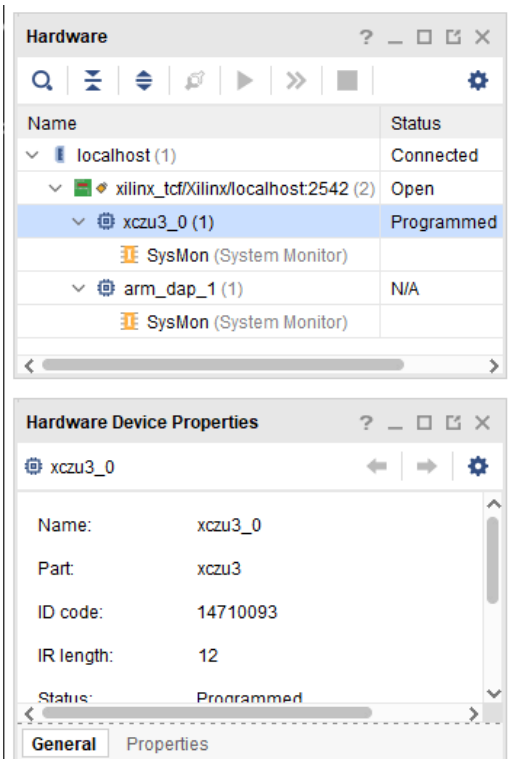

Figure 43 - Vivado Connected Devices

About the VCS^3

Description

The VCS^3 is 'probably' the smallest single-board computer based on an AMD Zynq MPSoC.

An ultra-compact, low-power, vision, control, and sensors solution for precision robotics.

The VCS^3 is a small single-board computer with an AMD© ZYNQ™ device with integrated ARM CPUs and FPGA fabric. Measuring just 30mm x 50mm, this tiny workhorse can be placed almost anywhere, opening the benefits of FPGAs to many more applications.

The VCS^3 utilizes an AMD UltraScale+ MPSoC coupled with high-speed LP-DDR4 memory to produce a highly compact evaluation platform. Together with four digital camera interfaces, a 9-axis IMU, and a CAN-bus interface, this platform is ideally suited for autonomous machines, cameras, or automation.

Device booting can be from SPI ROMs, eMMC flash or for development, JTAG.

Numerous onboard power rails are generated from a single external 5V supply, either from a dedicated connector or via a USB3 Type-C interface.

Several LEDs indicate board functionality, and eight connectors allow access to the various interfaces.

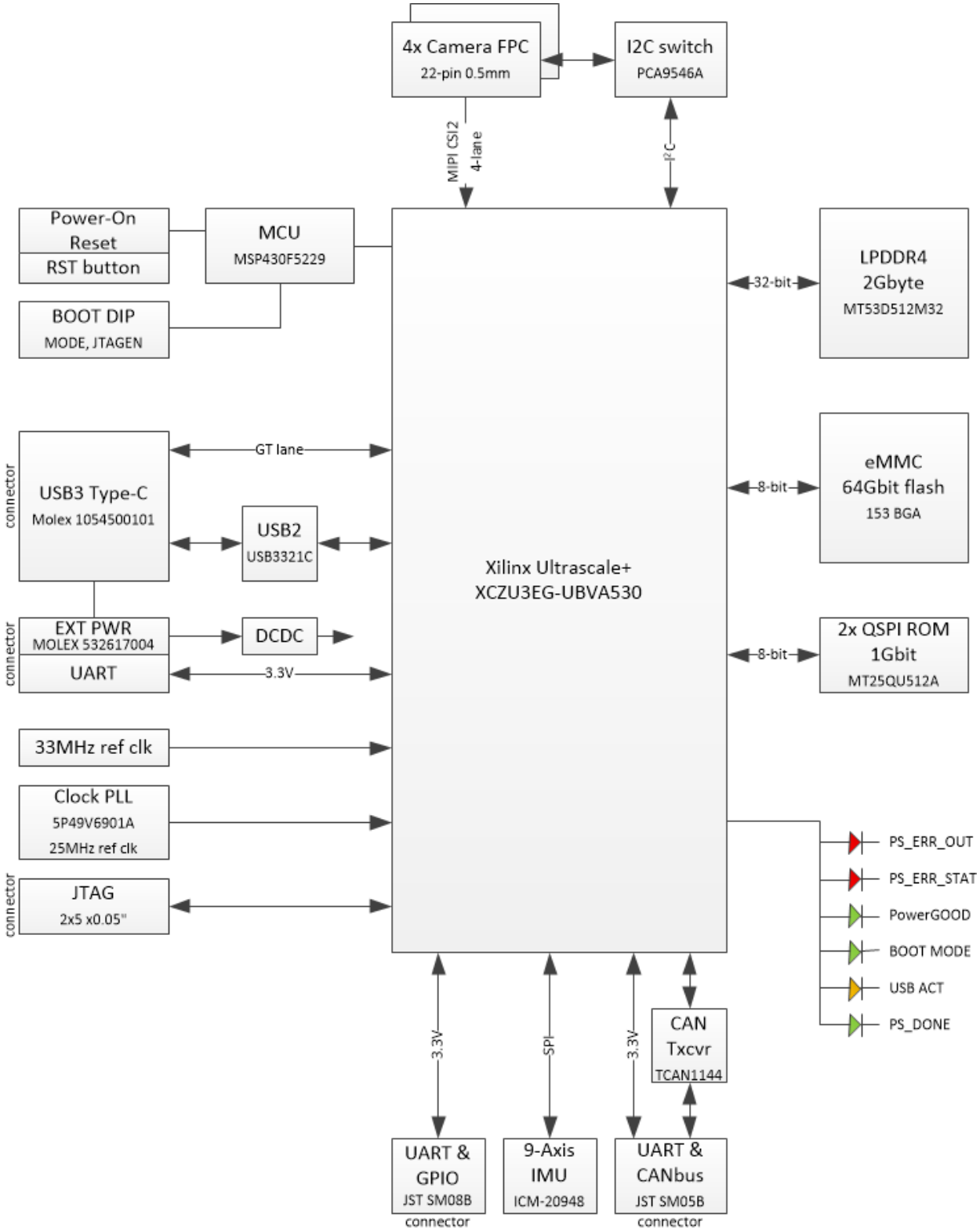

*Figure 44 - Block diagram of the VCS[3]*Figure 45 - Block Diagram of the VCS[3]

Parts of the VCS^3

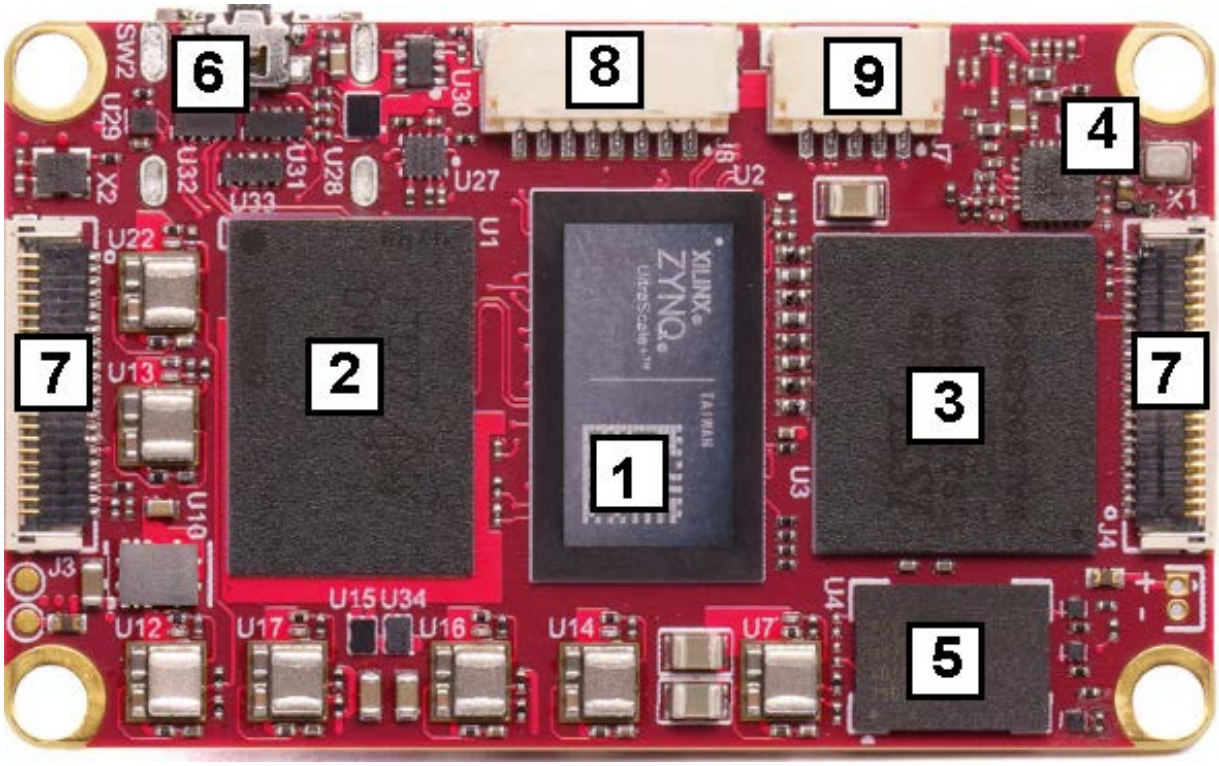

Figure 46 - VCS^3 Top

1	AMD Zynq MPSoC	2	LP-DDR4	3	eMMC	4	9-axis IMU	5	SPI ROM
6	Reset Switch	7	MIPI Camera Connectors	8	GPIOs	9	CAN BUS and UART	10	JTAG header
11	BOOT Mode Switch	12	CAN BUS Interface	13	Power and UART	14	Microcontroller	15	USB3 Type C

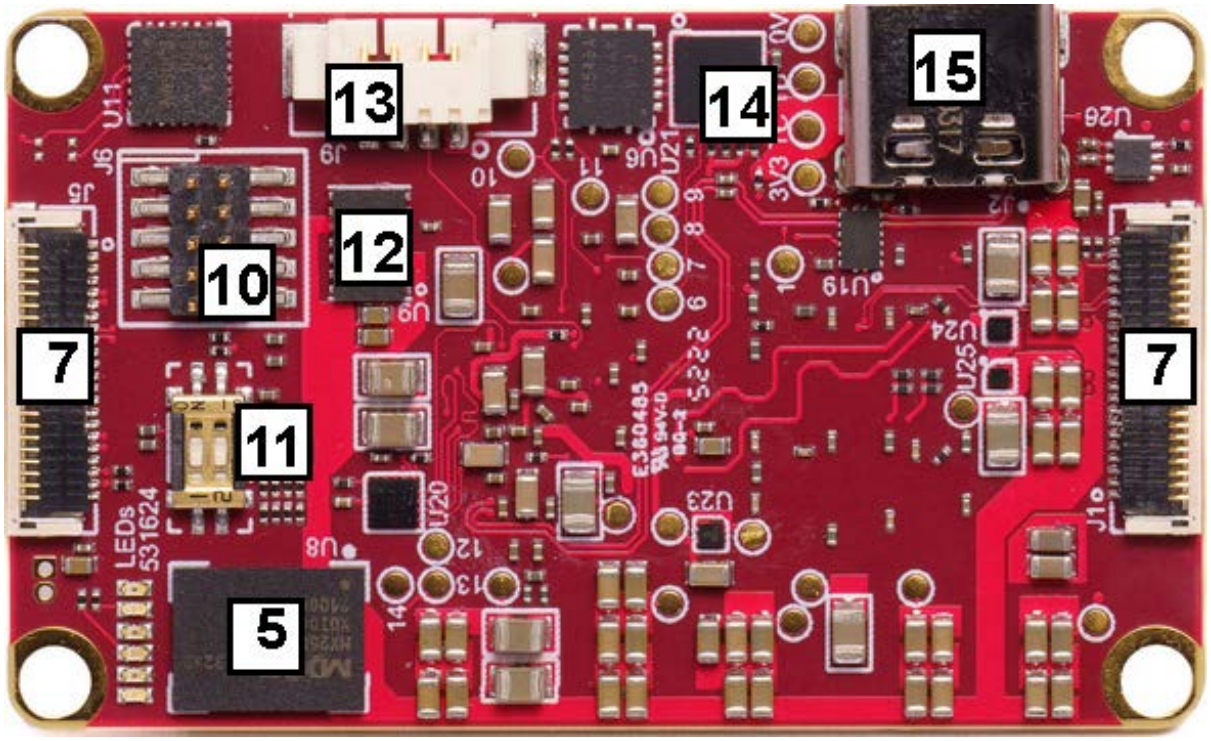

Figure 47 - VCS^3 Bottom

Boot Options

There are three boot options at present for the VCS[3]. These are controlled from SW1 (Item 11 above).

Switch 1	Switch 2	
OFF	**OFF**	**JTAG**
ON	**OFF**	**eMMC**
OFF	**ON**	**QSPI ROM**
ON	**ON**	

Petalinux in QSPI ROM

Username: sundance
Password: sundance