FPAA BOARD USER GUIDE

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Benjamin Criton, Hugo Schindler,
Bertrand Thia Thiong Fat, Yassine Kamri,
Joseph Brisson, Corentin Tafani

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1 Installing the virtual machine

The first thing you have to do to use the board is to install the virtual machine on which you will run the program used for the board.
To do so, you can follow the instructions of the document *Becoming Familiar with the RASP Tools Suite for FPAAs*.

When you have installed the virtual machine, it is important to change some parameters. Indeed, the board uses USB 3.0 and it is paramount to set the virtual machine to use this technology. To do this change, you have to:

1. Open VirtualBox
2. Choose your virtual machine and go in settings

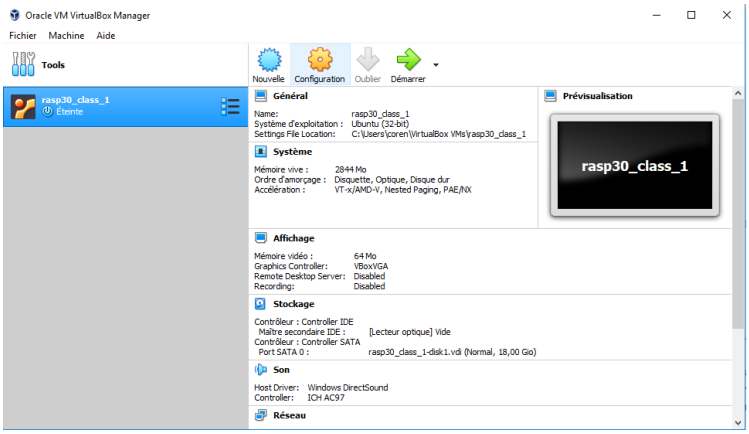

Figure 1

3. Select USB
4. Choose USB 3.0
   If you can not choose 3.0, you just have to create a new port using USB 3.0 and delete the previous one.

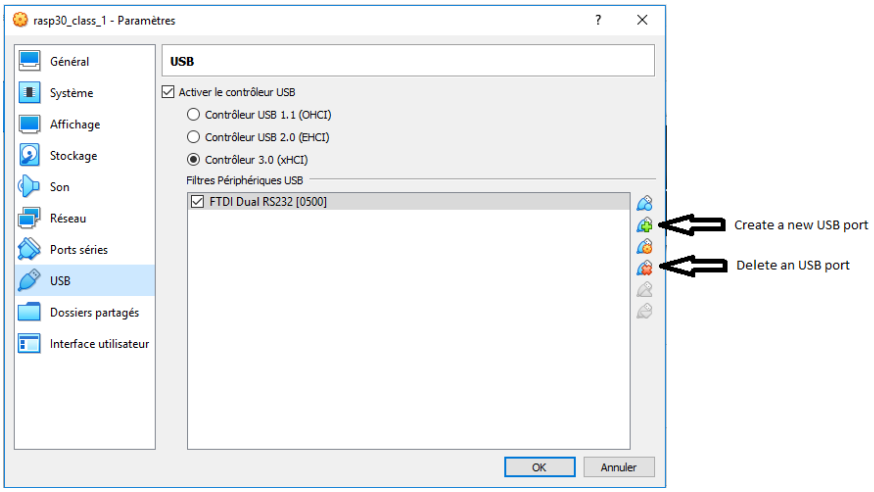

Figure 2

2 Using the virtual machine

2.1 Launching the virtual machine

To launch the virtual machine, you have to:

1. Launch VirtualBox
2. Choose you virtual machine
3. Click on start

The virtual machine will launch and the password is *reverse*. (All these steps are already detailed in the document *Becoming Familiar with the RASP Tools Suite for FPAAs*). Then you can launch CADSP, which is the program used to communicate with the board.

2.2 Creating a design

The blue GUI shown on figure 3 allows you to create a design if you click on the button new design.

When you create a design, two new windows open (figure 4): the palette browser and a blank design. In the palette browser, you will find all the blocks needed to create your designs.

Figure 3: Blue GUI

Some designs are already made. You can find them in the "examples" tab of the blue GUI.

If you want to know the functionality of a block, you can find a documentation in the "Docs" tab of the blue GUI: Docs > Block Library Information (figure 5).

If you want to use the pins, you can find a plan of the board in the "Docs" tab of the blue GUI: Docs > RASP 3.0a Board (figure 5). This plan details the use of each pin of the board (figure 6).

Once you have created your design, you can save it in a directory: as usual, you

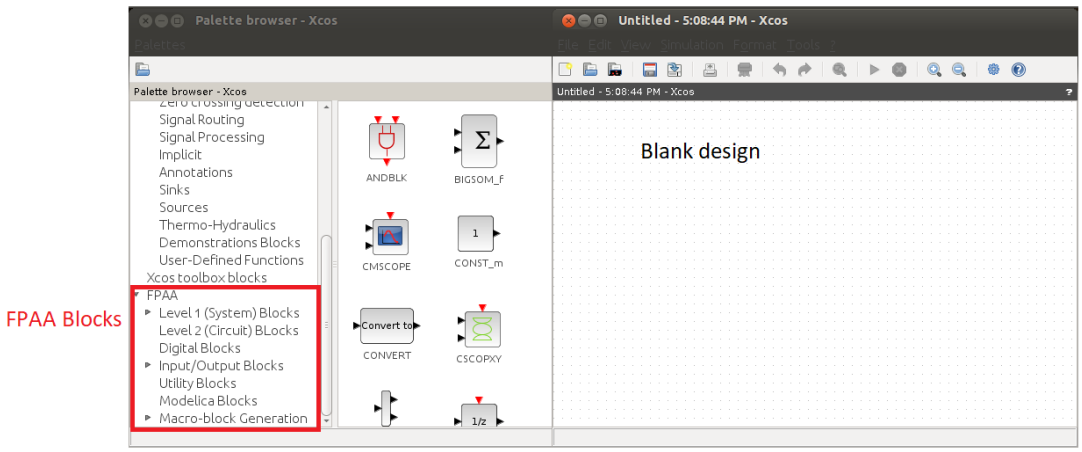

Figure 4: New design

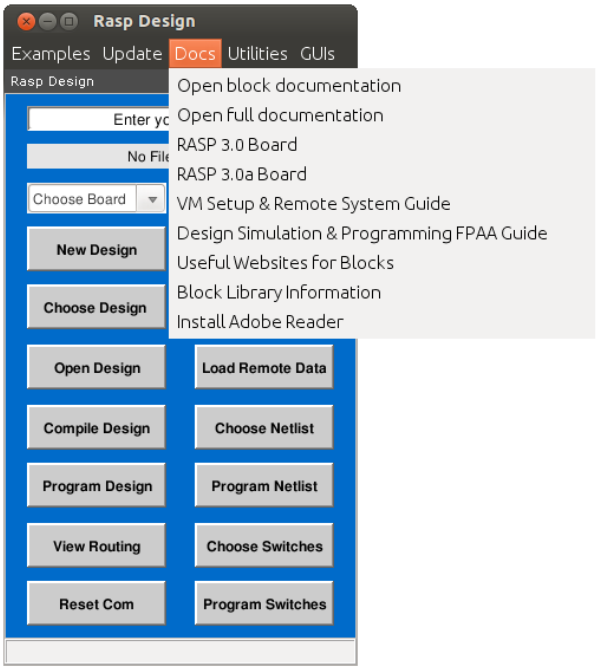

Figure 5: Library documentation

just have to click on the blue floppy disk icon.

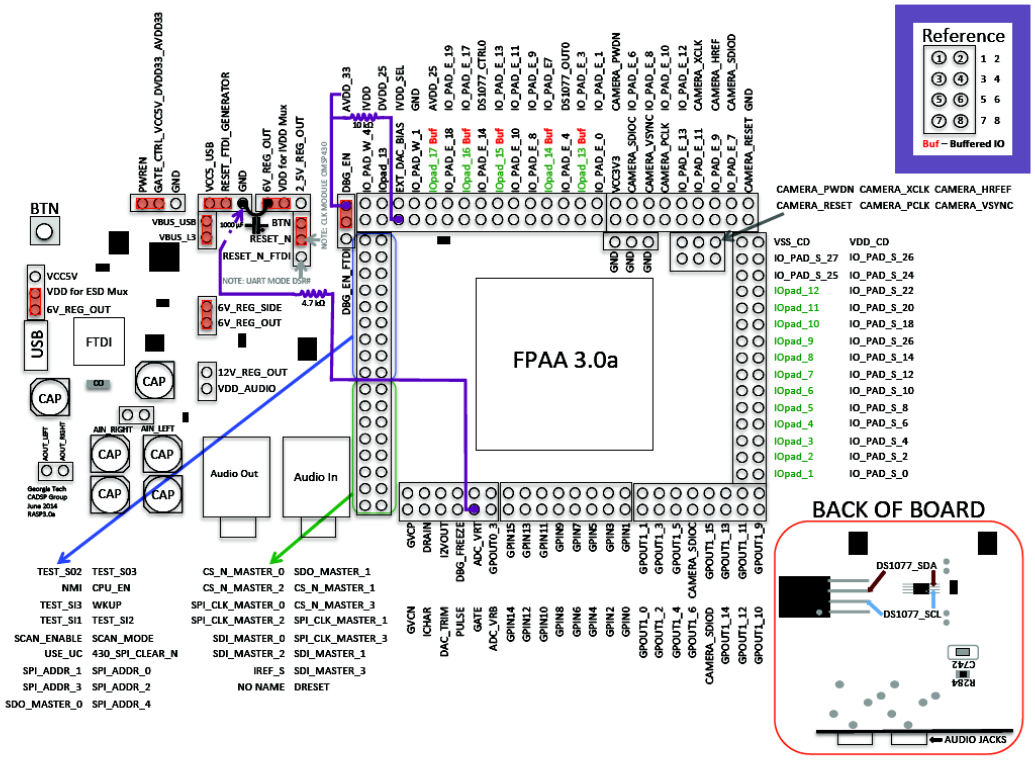

Figure 6: Plan of the board

2.3 Testing your design

2.3.1 Choosing the right board

On the blue GUI you can choose the board and the chip number (figure 7). Our board is a 3.0a board and the chip number is 11. It is important to enter correctly this information, otherwise your designs may not work.

2.3.2 Choosing the design

In the blue GUI, if you click on "Choose design", you can select a previously made design in one of your directory. Then, by clicking on "Open design" in the blue GUI, you can open the chosen design.

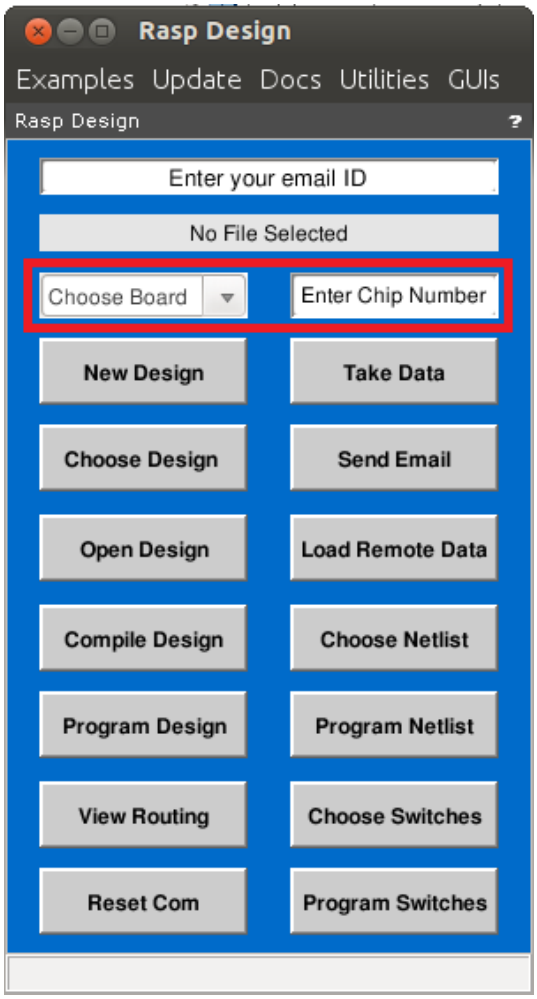

Figure 7: Blue GUI

2.3.3 Compiling

When you have finished your design and you have created all the necessary variables, you need to compile the design, by clicking on "Compile design" in the blue GUI.

2.3.4 Programming

After compiling your design, you need to program it by clicking on "Program design" in the blue GUI. During the programming of the board, there are four phases (figure 8).

During the first phase of the programming, a connection issue can occur if it is

Figure 8: The four phases of the programming

the first design you have programmed since you have launched the virtual machine (figure 9). To solve this problem, you just have to change the USB port you are using (unplug the board and plug it on another USB port of your computer). Then the issue will disappear and the programming will pursue normally.

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Programming...

connection issue -> it is trying again
-->
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Figure 9: Connection issue during the first phase of the programming

2.3.5 Displaying the results

After creating, compiling and programming your design, you may want to display the results of it. Again, in the blue GUI, you have to click on "Take Data". If you are doing an on chip experiment, it will display some graphs and if you are doing an off chip experiment, it will allow you to make measurements (for example on a multimeter wired to the board). An example of an on-chip experiment and an example of an off-chip experiment will be detailed in the further sections.

3 Examples

3.1 On-chip design

In this section, we will detail an example of on-chip design made on the board. We will recreate the LPF example.

1. Obviously, you first have to launch the virtual machine and RASP tools.

2. In the blue GUI, choose board 3.0a and the chip number is 11.

3. Create a new design.

4. In your new design, create your circuit with the FPAA blocks of the library. An example of what type of circuit you should obtain is shown on figure 10. The first block allows you to create your signal. The second block of the low-pass filter. The last blocks allow you to measure your output signal and to display it. The *Measure Voltage* block measures the output signal. The blue block will display the signal and the *Clock* block allows you to choose at which frequency you want to display the output value (since the signal is numeric, you have to synchronize the clock frequency with the sampling frequency of the signal).
   If you double-click on each block, you can have access to their parameters. The parameters used are shown on figure 11.

5. You have to create your input signal. Here, the input signal is called *lpf_in* (see the *Arbitrary waveform generator* block parameters). So you just have to enter the formula of your input signal in Scilab. Here we choose:
   $lpf\_in = 1 + 0.5 * sin(2 * \pi * 5 * (0 : 0.005 : 2))$
   The operation $(0 : 0.005 : 2)$ allows you to create an array going from 0 to 2 by increment of 0.005 (a frequency of 200Hz).

6. You can display your results by clicking on *Take Data* in the blue GUI. You should obtain two curves like the ones shown on figure 12.

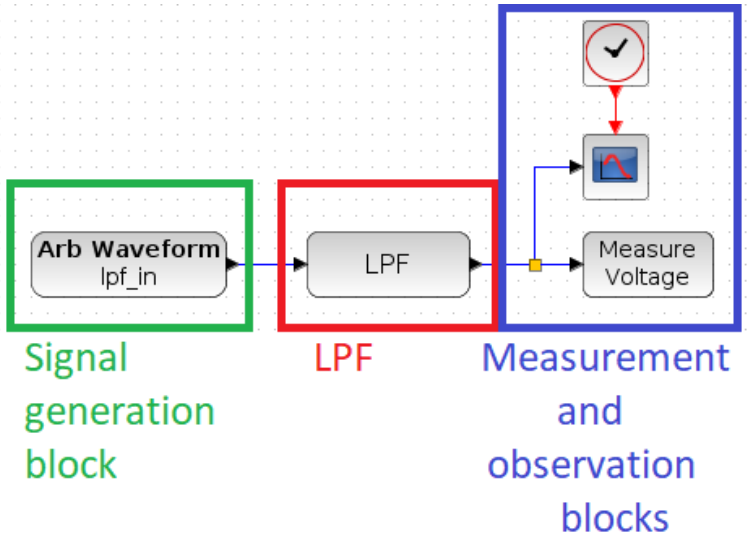
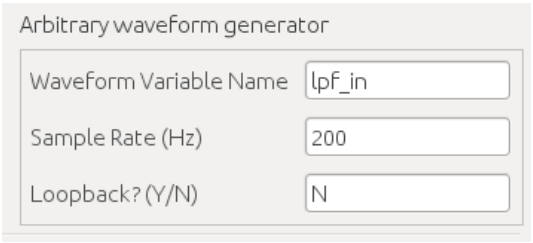
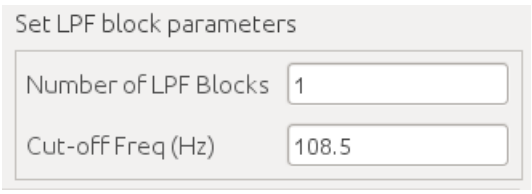


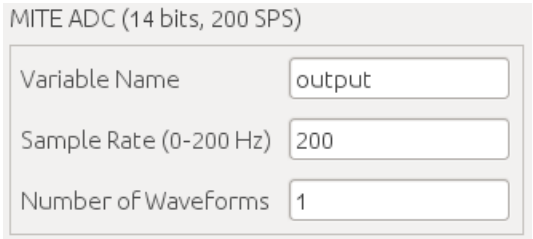
Figure 10: On-chip low-pass filter



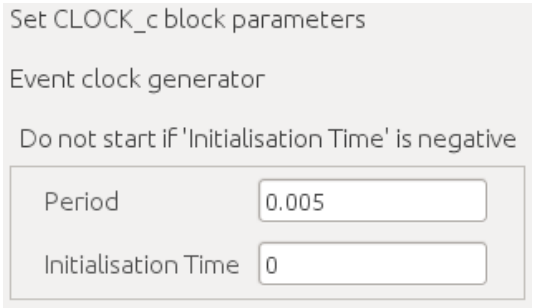
(a) Arbitrary waveform generator parameters



(b) LPF block parameters



(c) Measure voltage block parameters



(d) Clock block parameters

Figure 11: Parameters of the blocks of the LPF circuit

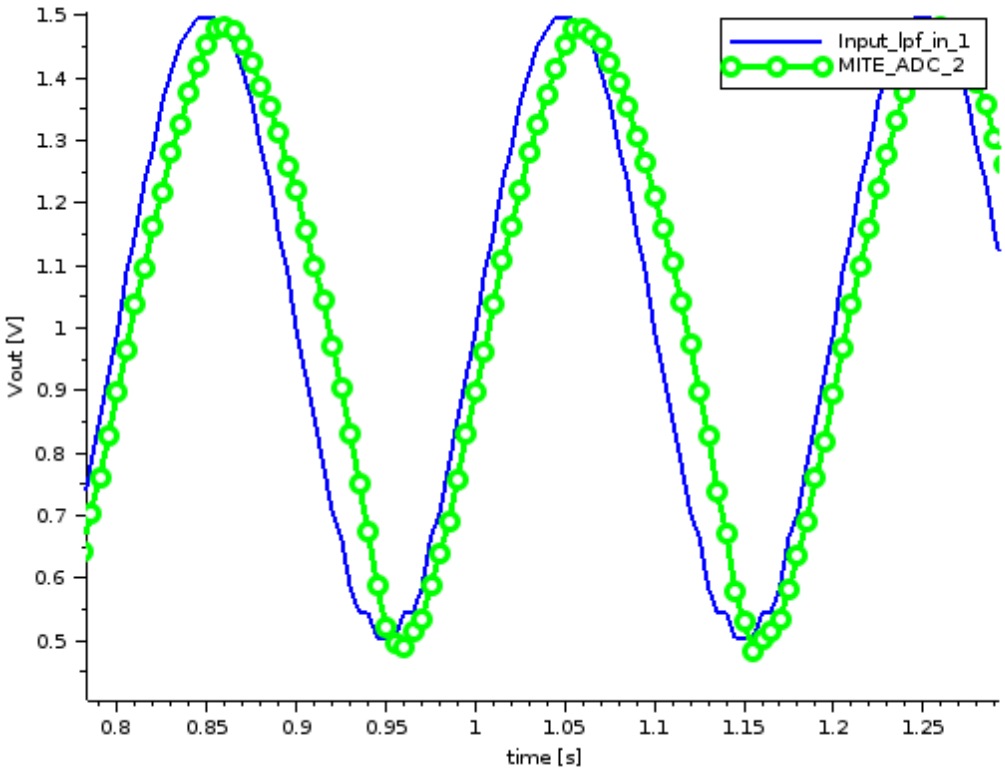


Figure 12: Results

3.2 Off-chip design

An off-chip design uses pins to connect the board to another device, for example the *Analog discovery 2 by Digilent*.

4 Some bugs you may encounter and how to solve them

4.1 Connection issue

When you launch the virtual machine and you program your first design, you may encounter a *connection issue* (figure 13). Indeed, the virtual machine seems to

choose a random USB port for the communication when launched. It may also be choosing a port which is already connected to something. So if you encounter this problem, connect the board to another USB port and the problem will eventually disappear when you find the right USB port.

```
Programming...

connection issue -> it is trying again
-->
```

Figure 13: Connection issue during the first phase of the programming

4.2 Aberrant output

Sometimes, you may have aberrant output when you make a *Take Data*. An example of such an aberrant output is shown on figure 14. This example only uses the design of a low-pass filter. The input of the low-pass filter is the blue curve and the output is the green curve. Obviously a low-pass filter which such an entry can not give such a result. Moreover, the board can not give an output with a voltage of 28V. We do not know the origin of this problem. But after talking to one of the PhD student working with Pr. Hasler (Ms. Aishwarya Natarajan), the only solution seems to restart the programming until the results are good.

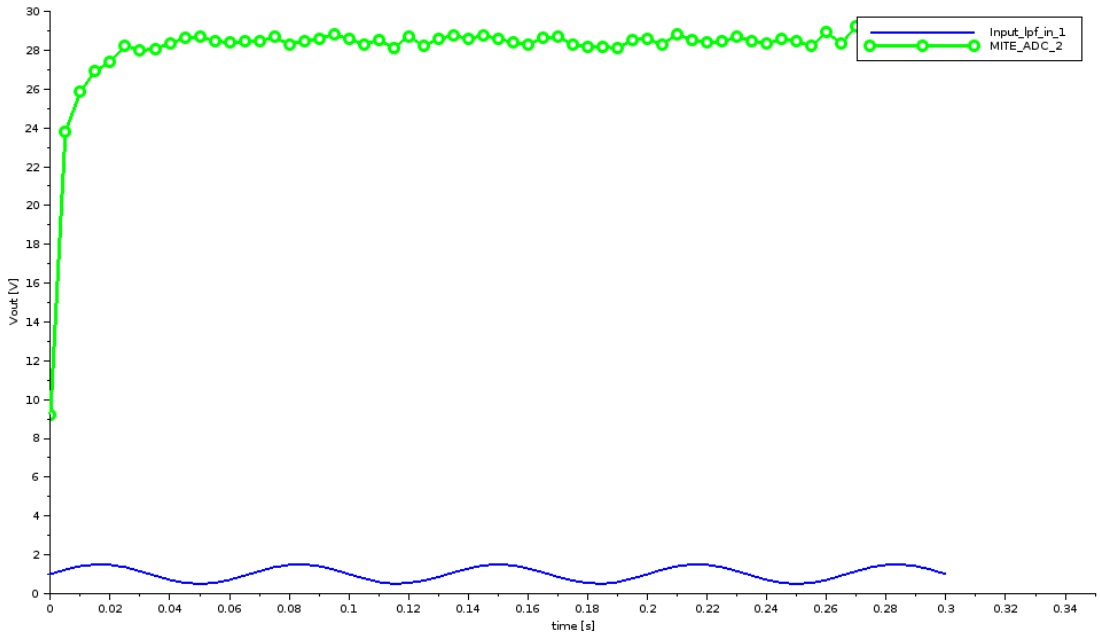


Figure 14: Example of an aberrant output