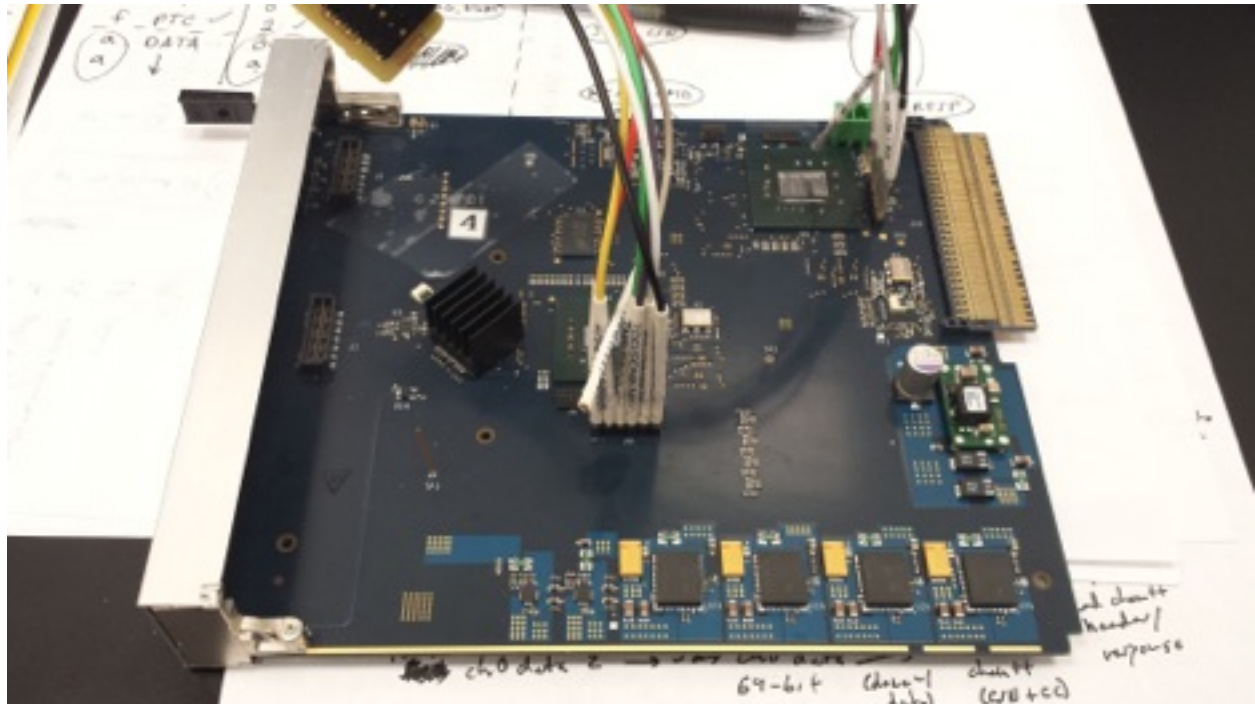
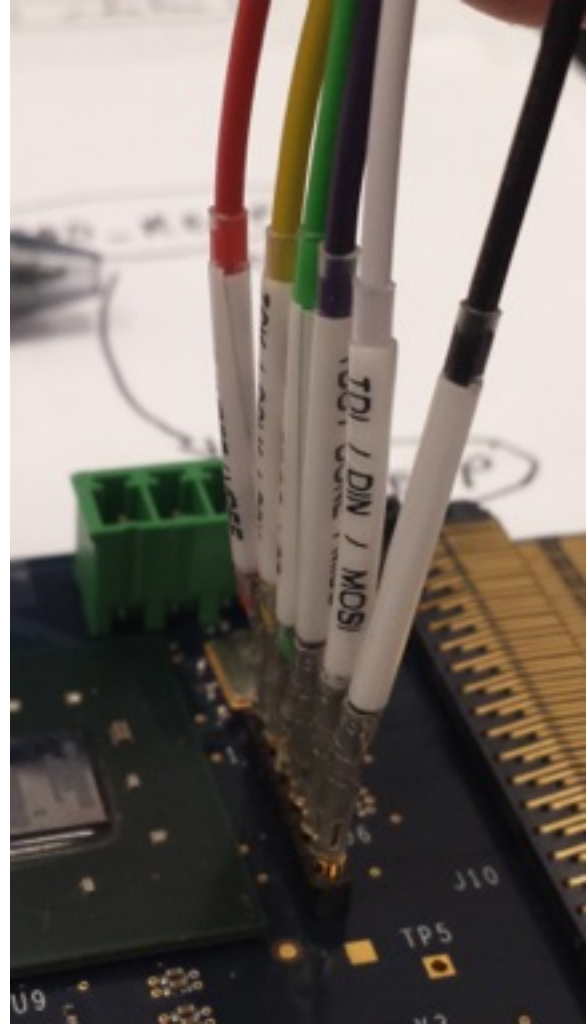


The first step is to connect the JTAG rainbow-colored wires to the Master and Channel FPGA on the WFD1 board. In the below photo, the Master FPGA is in the upper right-hand corner, and the Channel FPGA is in the center. This is how the board should look after properly connecting all of the JTAG wires.





Each JTAG connection to a FPGA requires 6 wires: (format: COLOR = LABEL)

- RED = VREF
- YELLOW = TCK
- GREEN = TMS
- PURPLE = TDO
- WHITE = TDI
- BLACK = GND

There is a seventh wire (GREY = HALT) which is not used in our setup. Be sure to tuck this unconnected wire between the other wires so that it does not hit the uTCA crate fan when running.

Next to each FPGA, there is a set of 6 pins which is what gets connected to the 6 JTAG wires. These connections go in the same order as in the above list, i.e., in rainbow color order, with the first (RED/VREF) wire at the pin labeled "1". To make this especially clear, the two photos above show how the JTAG connections should be made for the Master FPGA (right photo) and the Channel FPGA (left photo).



The other end of each set of JTAG wires is then connected to a flying wire adapter. The flying wire adapter is the brown-yellow item in the bottom right-hand corner of the photo above. The other end of the adapter is next connected into the matching pin configuration on the JTAG programmer box (labeled Xilinx platform cable USB II). This box is the large, red item in the bottom left-hand side of the photo above. The programmer box is connected on the other end to a USB cable which should then be plugged into the laptop. Note that only the USB port in the back-right of the laptop is working. Also note that the programmer box has a status light which is yellow when powered on and which turns green when interfacing with the FPGA.

Now, you will only be able to connect one of the adapters to the programmer box we sent you — that is okay. This just means that you will have to program each FPGA one at a time. As you program each FPGA, you will have to come back to this step to reconnect the programmer box to the other adapter and repeat the subsequent steps.

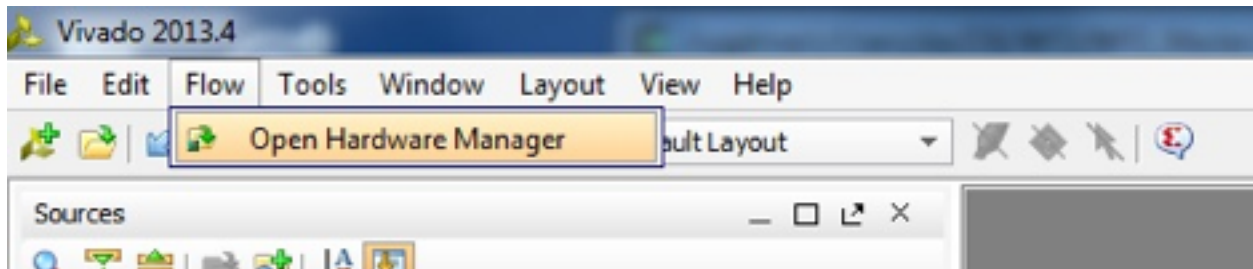


If you have not already, you should now put the WFD1 board into the uTCA crate. We suggest that you use slots “AMC5” and “AMC11” to allow for as much room as possible for the JTAG connections. You should also try to prop up the programmer box somehow so as not to stress the pins on the board. Next, turn on the power to the uTCA crate and wait for all of the blue lights to turn off from all of the connected components. This may take a little while.

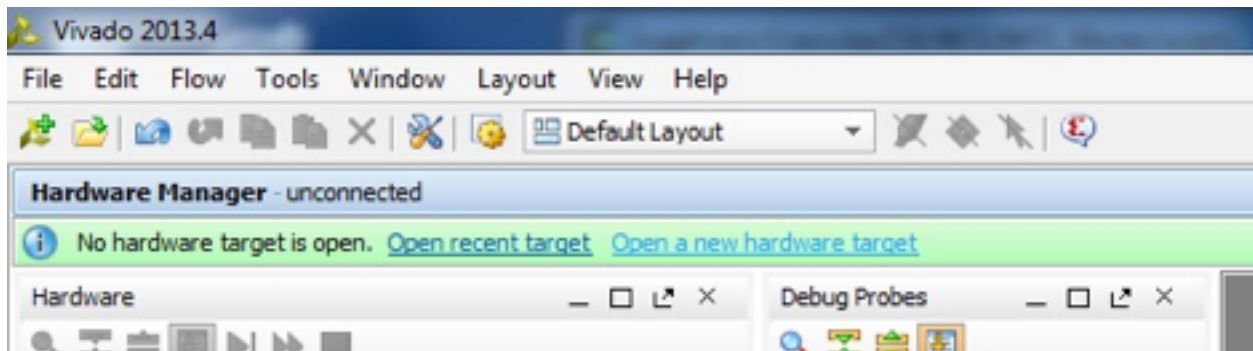
When the uTCA crate is powered on, the second LED from the top on the front of the WFD1 board will light up green (see photo above). This indicated that the 3.3 V management power has been obtained from the MCH. A bit later, the top LED should then also light up green which means that the board now has the 12 V operating voltage applied. If these top two LEDs never come on, check that the board is completely plugged in. It can sometimes take a bit of force to hear it click all the way in.

To program the FPGA, you will have to open the “Vivado 2013.4” program on the laptop. Note that this program uses a great deal of memory which means that it can be slow at times. Also ignore any initial prompts to download or install a newer version of the program.

After the main window appears, click on “Flow > Open Hardware Manager” from menu bar (see photo below).



Next, click on “Open a new hardware target” located in the green status bar (see photo below).

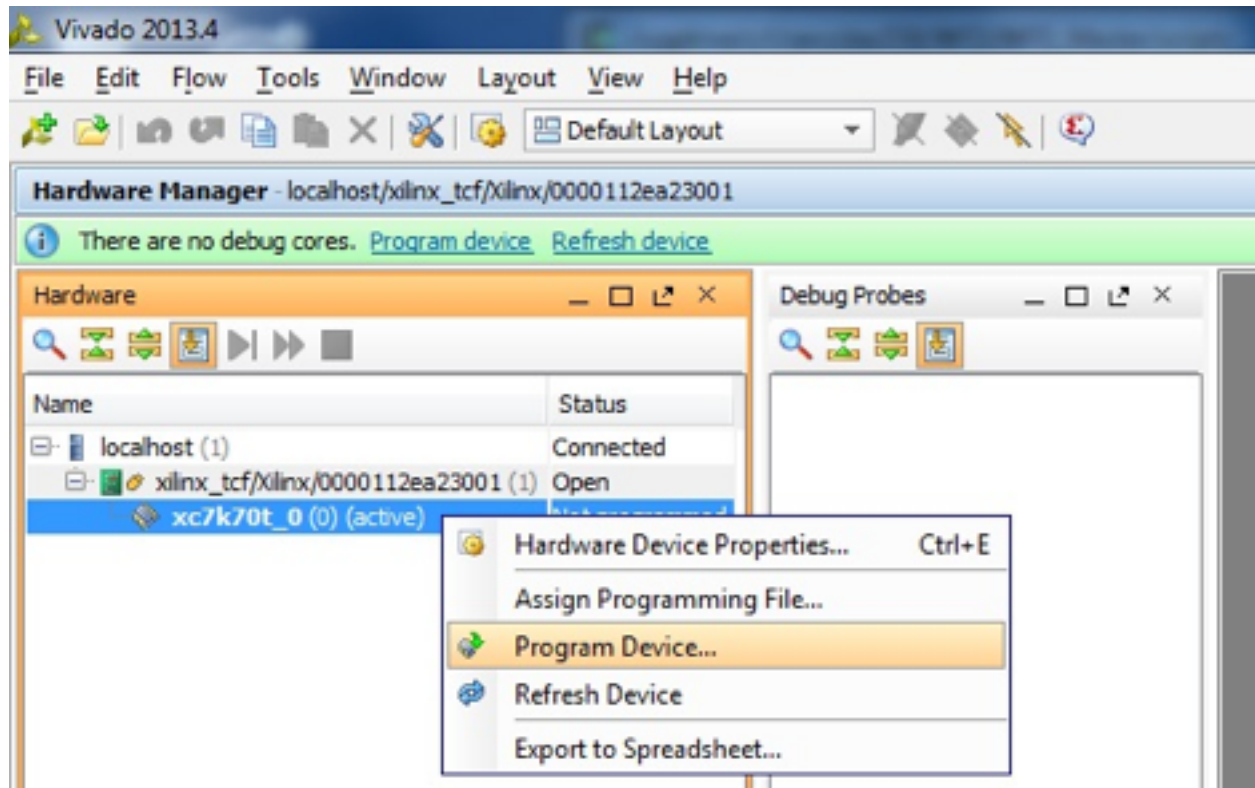


A dialog should pop up on your screen. Keep clicking “Next >” until the end and click “Finish”. If you get an error message about firewalls, just click okay and ignore it. If you get the error message “No Valid Target”, then your FPGA is not currently connected to the computer. In this case, try to check the wire connections to make sure that they are secure and then try it again.



You should then see something similar to the photo below. The name of the FPGA to which you are connected appears at the bottom of the list. In the below case, the name is “xc7k70t\_0”. The FPGA name with “70” in it (like this one) is the Channel FPGA, and the FPGA name with “160” in it is the Master FPGA.

Right-click on the FPGA name and select “Program Device...” (see photo below).



You will receive a prompt for the bitstream file which contains our programmed logic for the firmware. We will be providing you with the necessary bitstream files. Locate the bitstream file we sent you for the appropriate FPGA you are currently programming (i.e., “wfd\_master.bit” or “wfd\_channel.bit”) and click “OK”. If there are no error messages that appear, then you have successfully programmed the FPGA. Note that if any problems do arise, we suggest checking the JTAG connections and restarting the Vivado program.



When you program the Master FPGA, the bottom LED on the front of the WFD1 board lights up green. This can be used as a check that you programmed it successfully. When you program the Channel FPGA, the second LED from the bottom will flash red. If the Master FPGA is already programmed, this LED will also light up solid green. As a result, this LED will appear to alternate between green and orange when everything is programmed on the board.

When you finish programming your current FPGA, you should reconnect the JTAG programmer box to the other FPGA and repeat the same steps to program it. When done with the WFD1 board, you will have to also move the flying wire adapters to the JTAG connections on the other WFD1 board and repeat the same procedure. At the end, you will end up with a beautiful setup which looks similar to the one in the above photo.

If you want to re-program any of the FPGAs on the WFD1 board, you must power cycle the uTCA crate first. There is a known bug on these boards where the ethernet connection does not reestablish itself. If you forget to power cycle, then the bottom two LEDs on the front of the WFD1 board will turn solid red.