# 6089-127 Rev A Step 1 Procedure

### Attach a serial number

1. Unpack a board. Use one of the anti-static wrist connectors when handling the board prior to installing the back cover.
2. Obtain and attach a serial number label to the large connector that mates with the SM.

Close-up of a computer chip

AI-generated content may be incorrect.

### Check FPGA orientation

1. Visually verify that the FPGAs have been installed with the correct orientation. Each one has a dimple in one corner. That dimple should align with the “A1” mark on the board.

A close-up of a circuit board

AI-generated content may be incorrect.

### Check polarized capacitors on top side

1. Visually verify the orientation of the 14 120uf capacitors, in round aluminum cans, on the top side of the board. The blue mark indicates the negative terminal. Looking at the board with the large P1 connector pointing away from you, the 4 pairs of capacitors on the left side of the board should have the blue mark pointing to the right. The 3 pairs of capacitors on the right side of the board should have the blue marks pointing away from each other.

A close up of a circuit board

AI-generated content may be incorrect.



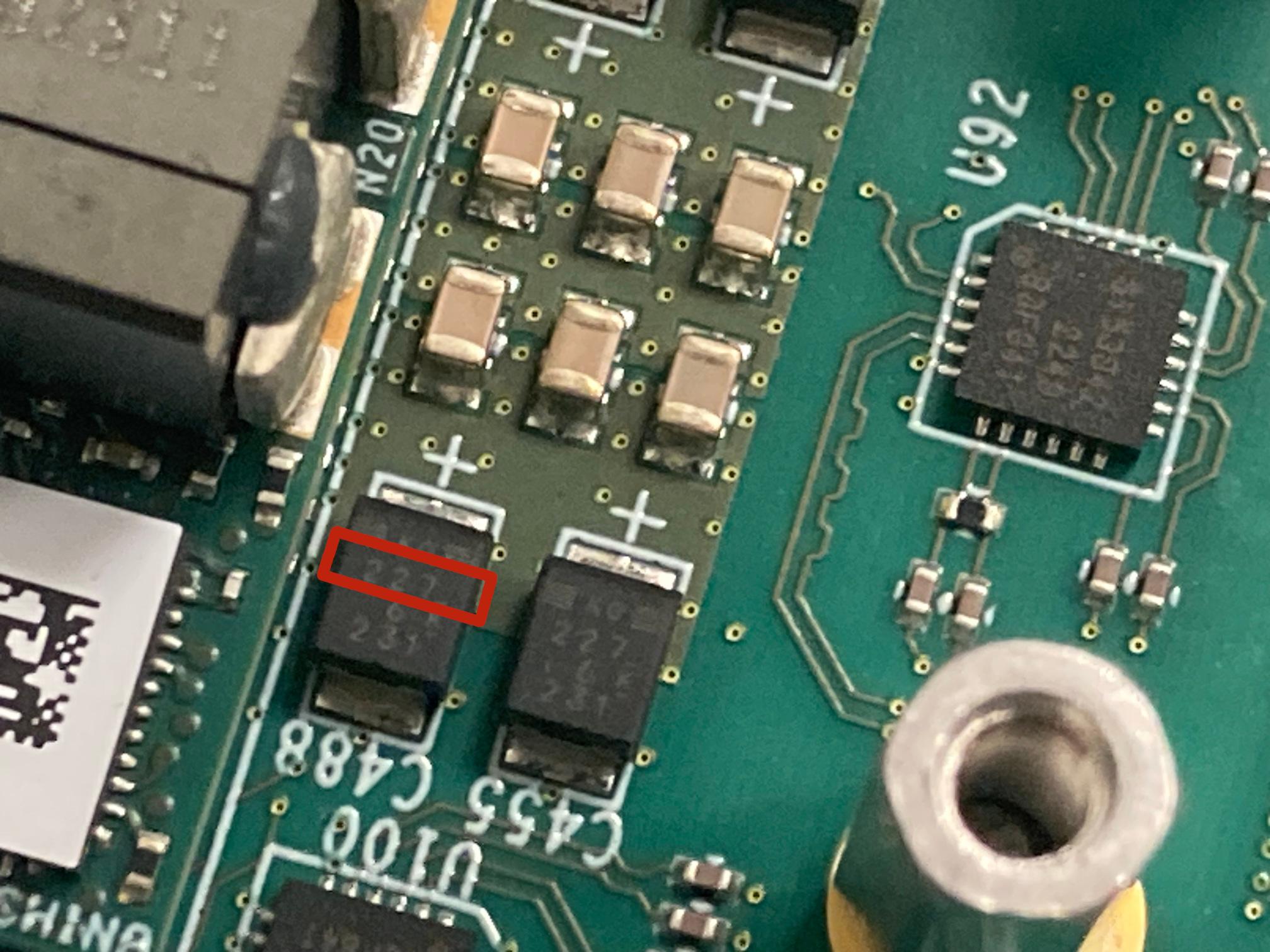
1. Visually verify the orientation of the 28 220 uf or 330 uf capacitors on the top side of the board. Four are adjacent to each of the 7 large LGA80D voltage regulators. The gray bars indicate the positive terminal. The bar should be near the “+” symbol on the silkscreen.

A close-up of a circuit board

AI-generated content may be incorrect.



1. Visually verify the value of the 8 220uf capacitors connected to the LGA80D regulator in the middle of the row, U109. Look at 4 on the top side now (C455, C456, C488, and C489) and after the next step look at 4 on the bottom side of the board (C673, C674, C702, and C703). Use a magnifier or microscope to examine them. They should have “227” (see photo on next page) written on them. These are 220 uf 6.3 volts capacitors. If they have “337” written on them, then they are the wrong value for this location, because they are 330 uf 2.5 volt capacitors and the voltage rating is insufficient.



### Check polarized capacitors on bottom side

1. Flip the board over.
2. Visually verify the orientation of the 28 220 uf or 330 uf capacitors on the bottom side of the board. They are on the opposite side from the capacitors checked in the previous step. The gray bars indicate the positive terminal. The bar should be near the “+” symbol on the silkscreen.
3. Perform the examination of the 220 uF capacitors that are on the bottom side of the board. The details are in the previous step.
4. This concludes the visual inspection. Using a CLASSE computer, connect to <http://lnx4108:5001> to access the testing database interface and record if the board passed the visual inspection. As you progress through later steps, record the results of each test in the testing database.

A close-up of a circuit board

AI-generated content may be incorrect.

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### Remove Standoffs Blocking FireFly Cables

1. Remove and set aside 5 standoffs that are located between the FireFly sockets and the front of the board. Unscrew them from the bottom side of the board. They obstruct the installation of copper FireFly test cables. Place the standoffs, screws, and washers in a plastic box.

A close up of a circuit board

AI-generated content may be incorrect.

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### Attach bottom cover

1. Attach a bottom cover using six M2.5 x 4mm Flat-Head screws into countersunk holes.

A close up of a circuit board

AI-generated content may be incorrect.

### Set slide switches to 3.3V

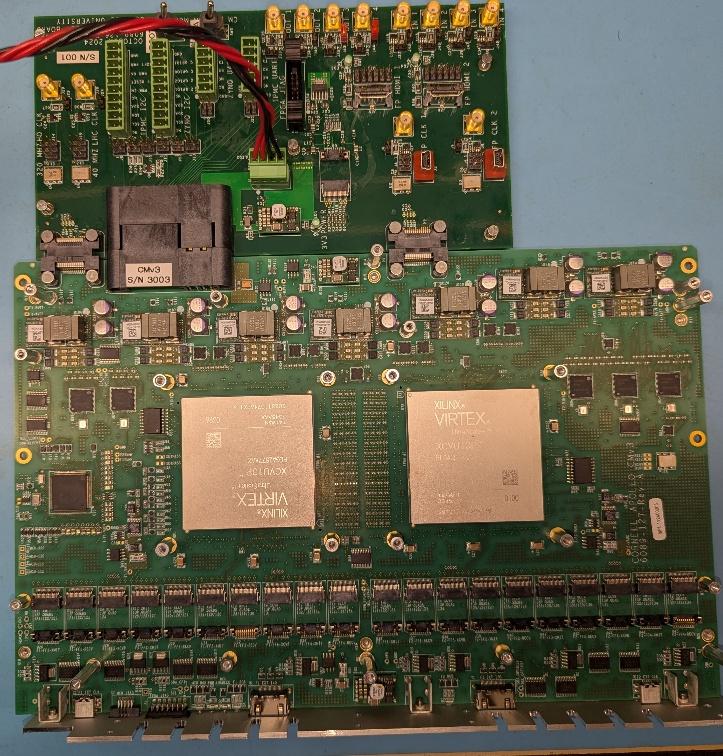
1. There are 8 slide switches on the bottom side of the board. Set all of them to the “3.3V” position, which is to the left with the board oriented as shown (NOT the 3.8V position).

A close up of a circuit board

AI-generated content may be incorrect.

### Connect the test board

1. Flip the board back over to the top-side up position.
2. Verify that the power supply is OFF.
3. Mate the CM with the test board.



1. The power cable, JTAG programmer, and ZYNQ UART cable should all be connected.

### Connect MCU Segger JTAG programmer

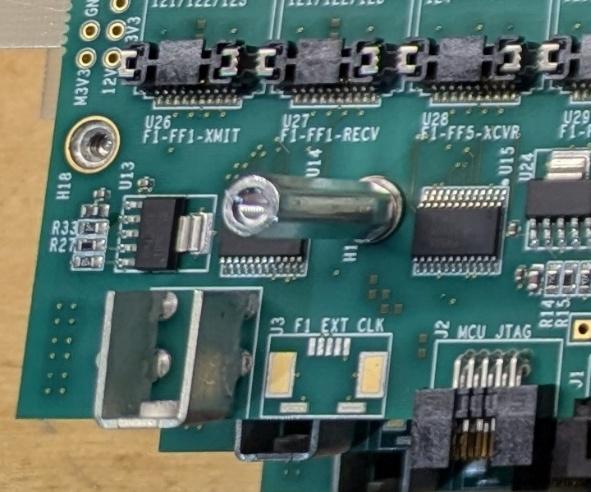
1. Plug the cable for the Segger programmer into the front panel MCU JTAG connector. The polarization pin and the red stripe should be as shown below. The connector is fragile. Do not force it.

A picture containing text, electronics

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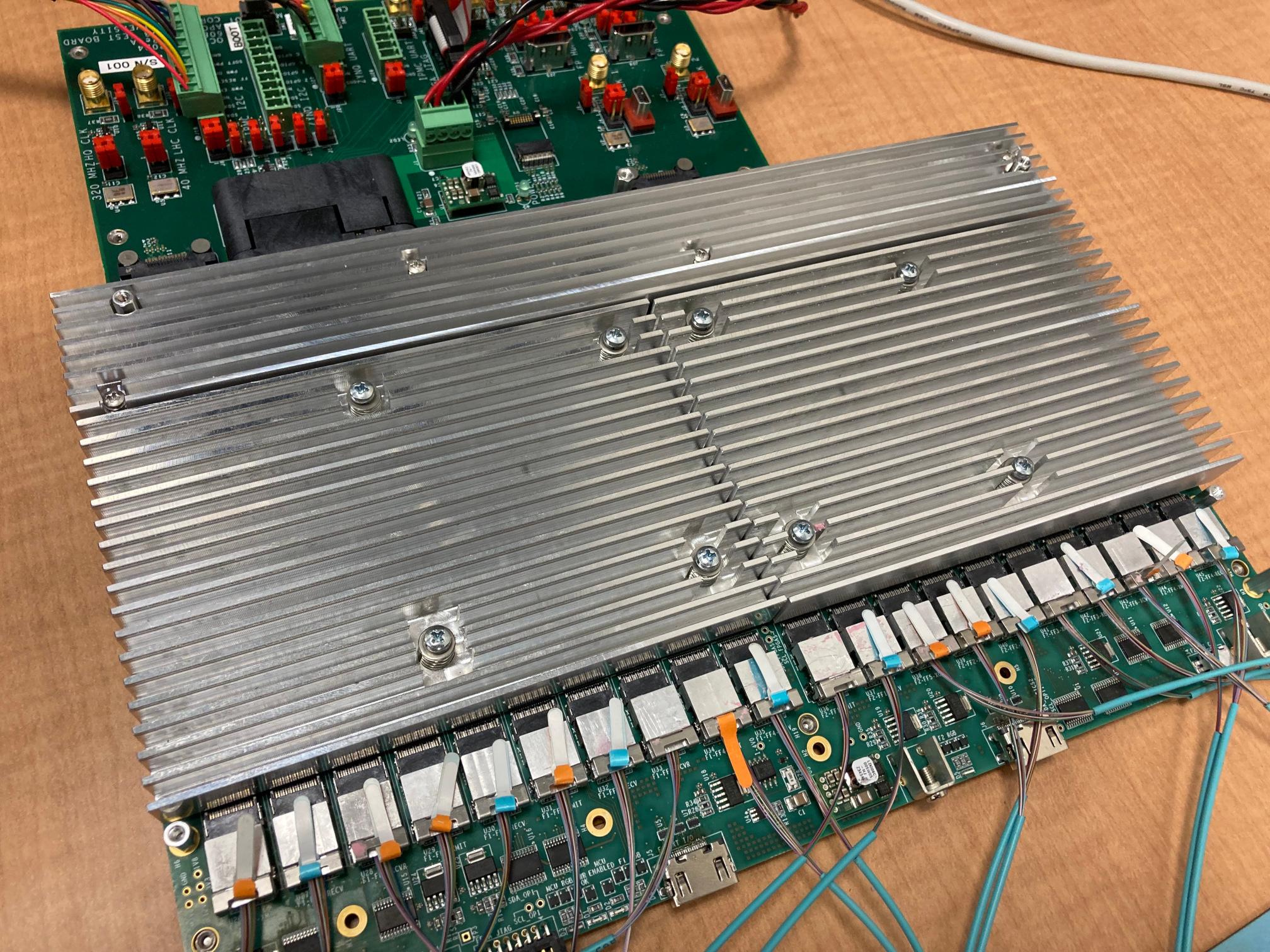
### Check M3V3 management voltage

1. Connect a voltmeter to the “M3V3” and “GND” test points. These are located close to where you just connected the MCU Segger JTAG programmer. The voltmeter setting on the lab multimeter is denoted with a V with a straight solid and dashed lines above it. The extender pieces on the probes sometimes come loose, so if you do not measure any voltage in the next step, double check the voltmeter probes.
2. Set the variable voltage source that is powering the test board to its minimum voltage.
3. In the next step, STOP if the voltmeter exceeds 3.4 volts. This indicates a regulator problem, and further increases in the voltage may damage other parts.
4. Turn on the power supply. Gradually increase the voltage while observing the voltmeter. The voltmeter should jump to the 3.3 volt level when the power supply meter is around 6.5 volts. Note the voltage. STOP if the 3.3 volt level is not achieved by the time the power supply is at 7.5 volts. Continue to increase the voltage to 12 volts and note the input current on the power supply. It should be around 0.6 amps.



### Install fireflies for I2C test

1. Turn off the power to the board
2. Remove black plastic covers on each firefly slot along the front of the board.
3. Install firefly optical transceivers. There are three types: 12-channel transmitters, 12-channel receivers, and 4-channel two-way devices. In front of each slot on the board is written “F\*-FF\*-XMIT”, “F\*-FF\*-RECV”, or “F\*-FF\*-XCVR” for the 12 channel transmitters, 12 channel receivers, and 4-channel transmit/receive pair respectively. The 12 channel devices come connected in pairs with an orange tag on the transmitter and a blue tag on the receiver. The 4 channel devices come in single modules with an orange tag. Install the fireflies in the appropriate slots as shown in the following picture. Note that they can be somewhat difficult to slide in; you should try to keep the metal latch up and push them forward (parallel to the board) into the slot. **This should not take much force**, so if you encounter much resistance, try repositioning the device and ensuring the latch is all the way up.



### Program MCU for production testing

1. Log onto the machine lnx231.classe.corrnell.edu and go to the directory /nfs/cms/tracktrigger/apollo/mcu\_bit.
2. Program the boot loader:
   1. ` ./load\_bl.sh`
3. Load the MCU testing program:
   1. `./load\_prodtest.sh`
4. If there are any errors, log them and fail the board.

### Verify successful programming and proceed with software tests

1. After programming, the green MCU\_ENABLED and PWR\_OK LEDs should be lit. Note the current on the 12V power supply. It should be around 0.6 amps.

### MCU software tests

Run the production MCU test firmware testing suite. To connect to the MCU, on lnx231, run the command `screen /dev/ttyUSB1 115200`. (Note, the device might be a different USB device such as /dev/ttyUSB0. If this is the case, you should update this on subsequent steps as well. To exit screen, type “C-A k y”).

From the prompt, run the command `prodtest1` . If the output says ‘All tests successful’, record success. If not, record the information and fail the board.

### Uninstall fireflies

1. Remove the firefly modules from the board, by ensuring the latch is up and sliding out. This again should not take much force.

**[ GO TO HEAT SINK INSTALLATION STEP]**

### Program MCU with main firmware

1. Connect board back to test board/programmer cable connected to lnx231
2. Log onto the machine lnx231.classe.corrnell.edu and go to the directory /nfs/cms/tracktrigger/apollo/mcu\_bit.
3. Load the MCU testing program:
   1. `./load\_main.sh`
4. If there are any errors, log them and fail the board.

**Load board ID into the internal EEPROM**

1. Open the MCU console via `screen /dev/ttyUSB1 115200`.
2. At the prompt, type `first\_mcu <ID> 3 0 0 `. Replace <ID> with the CM serial number (just numbers) from the sticker you placed on the board. (The final three numbers are as follows: 3 is the board revision, and the other two are flags that can be used to debug fireflies or power supplies.)
3. Type “id” at the prompt and confirm that the entry took.

### Clock testing program

1. Setup python and vivado environment using:

export PATH="/cdat/tem/pw94/miniconda/bin:${PATH}"

. "/cdat/tem/pw94/miniconda/etc/profile.d/conda.sh"

conda activate

source /nfs/opt/Xilinx/Vivado/2020.2/settings64.sh

export XILINXD\_LICENSE\_FILE=2100@lnxlm

1. Program each FPGA using VIVADO with the following bit file (see appendix on programming with Vivado if you are not familiar):
   1. /nfs/cms/tracktrigger/apollo/clocktest/clock\_test.bit
2. Run the following script to load the testing clock programs into the clocks. This script takes about 2 minutes to complete.
   1. /nfs/cms/tracktrigger/apollo/clocktest/loadall\_test1.sh
3. Compare test output to expectation by connecting to the MCU with `screen /dev/ttyUSB1 115200`, and running the command `clk\_freq\_fpga` at the MCU prompt.
4. If there are any errors, try the command up to two more times. If there are still errors, log them and fail the board.
5. NEED TO UPDATE TO OTHER CLOCK TESTING PROGRAMS
6. Load final clocking programs into EEPROMs by running
   1. /nfs/cms/tracktrigger/apollo/clocktest/loadall\_normal.sh
   2. This script takes about 30(?) minutes to complete.

### Install copper cables and mount cooling shroud

1. Power off the board and connect medium length flyover copper cables as shown below. Adjacent TX and RX sites (labeled F\*-FF1/2/3/4-XMIT and F\*-FF1/2/3/4-RECV on the board) should be connected using the joined cables. The two-way F\*-FF5-XCVR and F\*-FF6-XCVR sites should be connected to each other using the copper cables that have the individual fibers separated. The connectors should slide easily into the slot, and can be secured in with the metal latch.



1. Place the board under the cooling shroud as shown in the next picture and turn on the shroud fan.



3 ) Switch to Link testing. Once the eyescans have been running for a while record the FPGA temperature by connecting to the MCU with `screen /dev/ttyUSB1 115200` and using the command `fpga`. Record the temperature in the database.