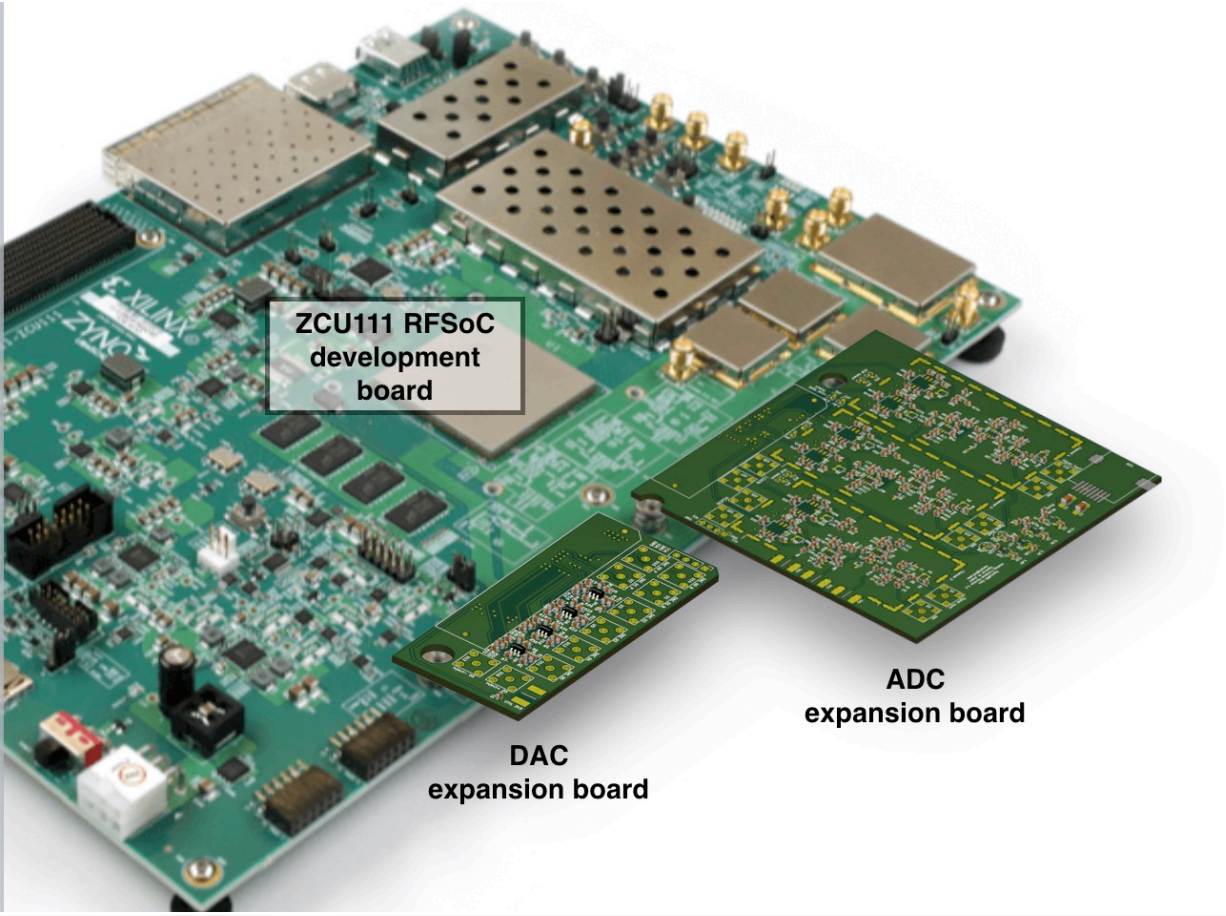
Expansion analog boards

Documentation for ZCU111

Spencer N Axani - September 14, 2020

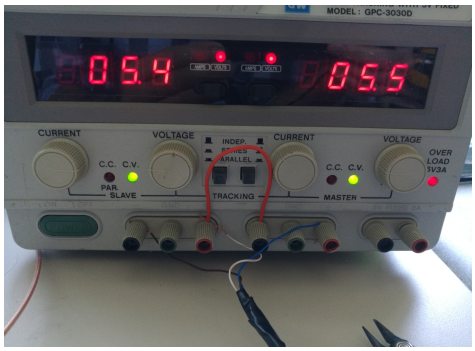
Located in the GitHub repo:
https://github.com/spenceraxani/KamLAND-FEA



Connecting to a CosmicWatch

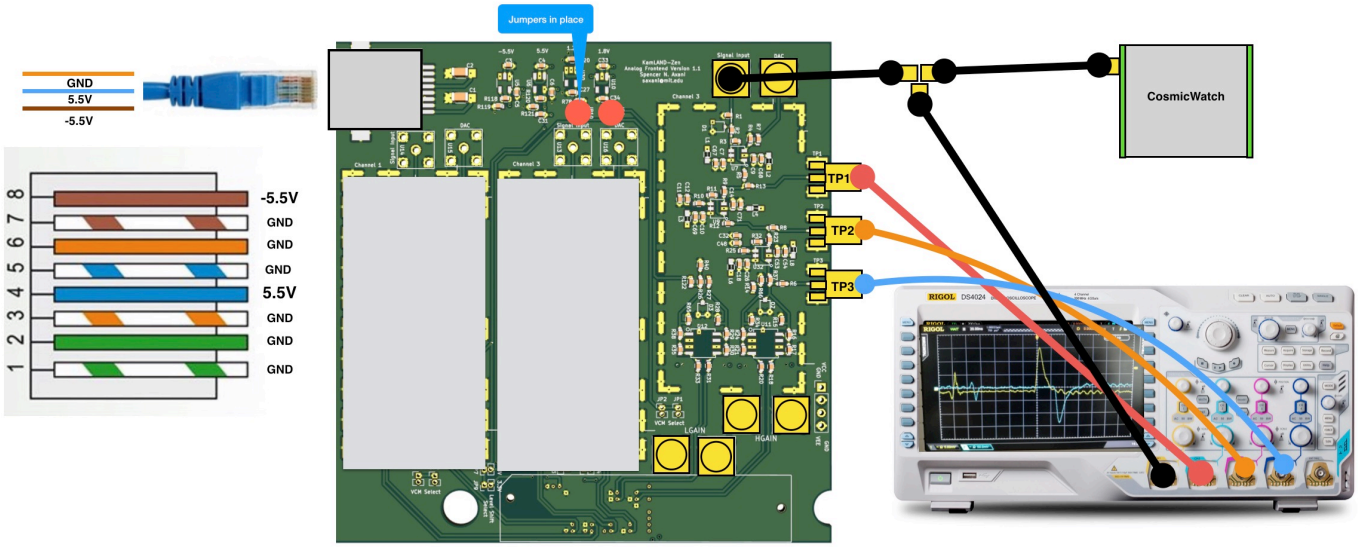
1. Connect RJ45 cable to a **+/- 5.5** (check with multimeter) power supply. In the image below:
    - Brown cable is connected to -5.5V
    - White with brown stripe is GND
    - Blue is +5.5V

No component on the board should be hot to the touch. The LMH6552 will be warm, but not hot.



2. Connect the CosmicWatch detector to a microUSB power supply. You should see a count rate on the screen of 2-5Hz.

3. Plug the CW detector into Channel 3, as shown in the diagram below. The output from the CW detector is 10-100mV pulses ~300ns in length. However, they are positive polarity pulses, unlike the PMT.



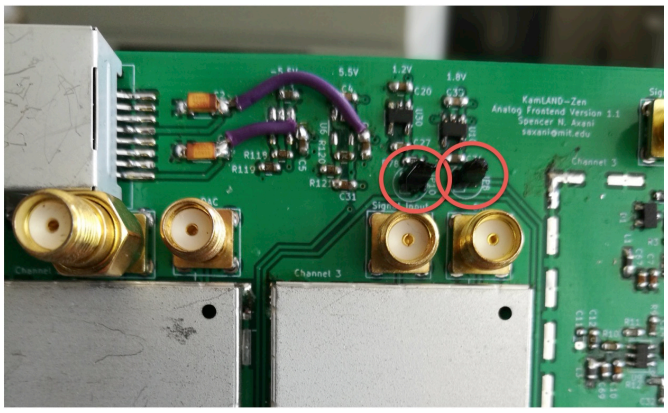
3. Check TP1, TP2, TP3 (using AC coupling on the oscilloscope). TP1 should be attenuated by 2, TP2 and TP3 should be amplification by ~4x.

4. Check the HGAIN testpoints using DC coupling. They should have baselines of 0.8V and 1.6V, with the pulses riding along (this can be checked with AC coupling). Similarly, perform the same test on the LGAIN testpoints. LGain is the signal attenuated by ~15x.

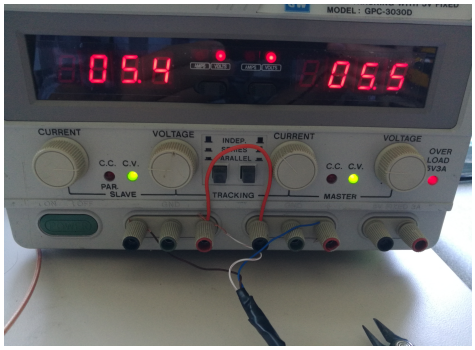
Once verified, we are done the CosmicWatch detector.

Connecting the ADC PCB to the ZCU111

1. The board will arrive with two jumpers, highlighted in red, below. **Theses Jumpers need to be removed before connecting to the ZCU111.** These jumpers set the common mode voltage (Vcm) to a 1.2V voltage regulator. Remove to set the Vcm to the 1.2V from the ZCU111. The other jumper sets the biasing voltage to a 1.8V regulator. Unplug to use the 1.8V from the ZCU111.

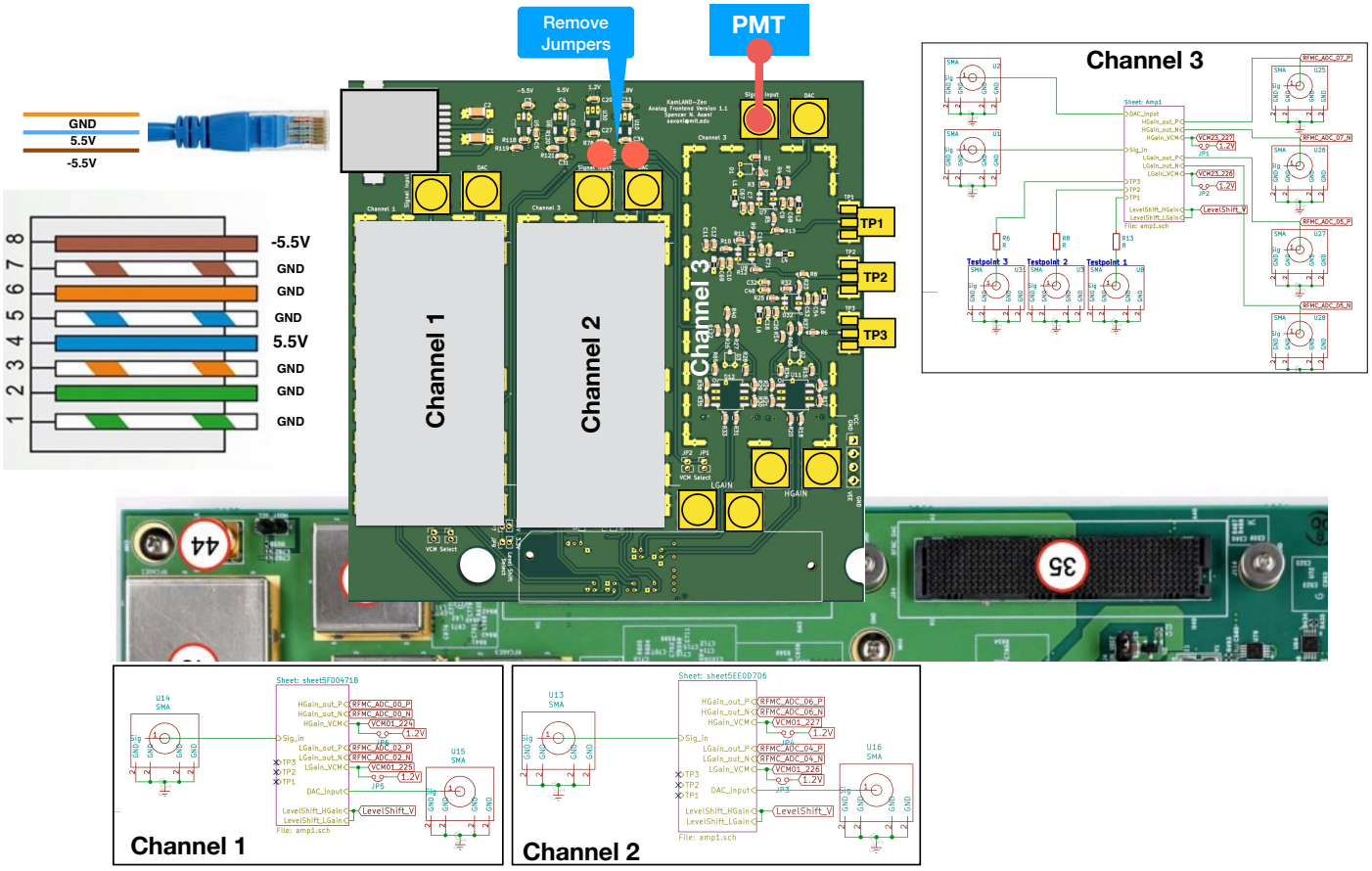


2. Verify **+/- 5.5V** (check with multimeter) on the power supply.
   - Brown cable is connected to -5.5V
   - White with brown stripe is GND
   - Blue is +5.5V



4. Turn off the power supply.
   - Plug in the ADC board (larger PCB) into the ZCU111.
   - Connect a PMT to channel 3 (the channel on the right).
   - Connect the +/-5.5V Ethernet cable.
   - Look at the Testpoints (TP1, TP2, TP3) to verify that they are working as expected.

Ensure that the HGAIN and LGAIN differential signal also looks as expected. You should still see 800mV on one of the differential outputs and 1.6V on the other.



5a. It is now time to read the data on the ZCU111 through channel 3 (right-most channel).

- HGain on Channel 3 is connected to **RFMC_ADC_07_P** and **RFMC_ADC_07_N**.
- LGain on Channel 3 is connected to **RFMC_ADC_05_P** and **RFMC_ADC_05_N**.
- HGain Vcm on Channel 3 is connected **VCM23_227**.
- LGain Vcm on Channel 3 is connected **VCM23_226**.

5b. Let's now check Channel 1 (left-most channel).

- HGain on Channel 1 is connected to **RFMC_ADC_00_P** and **RFMC_ADC_00_N**.
- LGain on Channel 1 is connected to **RFMC_ADC_02_P** and **RFMC_ADC_02_N**.
- HGain Vcm on Channel 1 is connected **VCM01_224**.
- LGain Vcm on Channel 1 is connected **VCM01_225**.

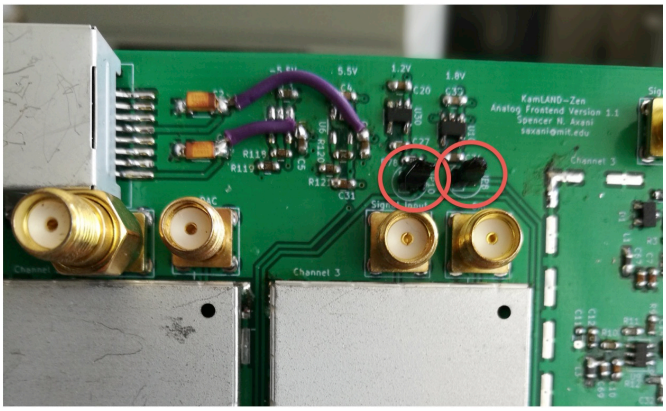
5c. Let's now check Channel 2 (center channel).

- HGain on Channel 2 is connected to **RFMC_ADC_06_P** and **RFMC_ADC_06_N**.
- LGain on Channel 2 is connected to **RFMC_ADC_04_P** and **RFMC_ADC_04_N**.
- HGain Vcm on Channel 2 is connected **VCM01_227**.
- LGain Vcm on Channel 2 is connected **VCM01_2256**.

If that all looks good. I would recommend taking data continuously throughout a day. After that, the ADC board tests are finished and we should be comfortable taking data in-situ.

Connecting the DAC PCB to the ZCU111

1. The board will arrive with two jumpers, highlighted in red, below. **Theses Jumpers need to be removed before connecting to the ZCU111.** These jumpers set the common mode voltage (Vcm) to a 1.2V voltage regulator. Remove to set the Vcm to the 1.2V from the ZCU111. The other jumper sets the biasing voltage to a 1.8V regulator. Unplug to use the 1.8V from the ZCU111.



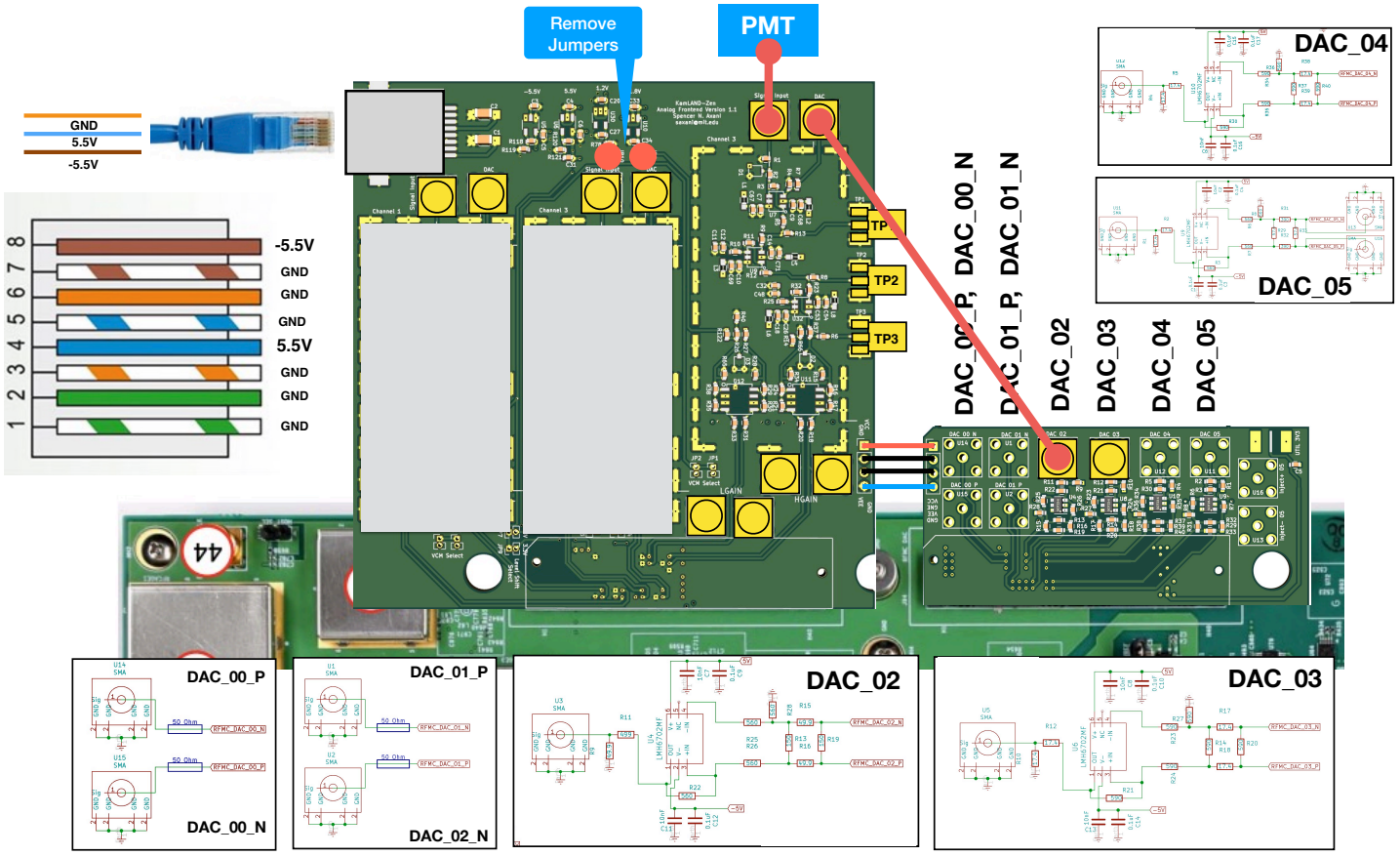
2. Verify **+/- 5.5V** (check with multimeter) on the power supply.
   - Brown cable is connected to -5.5V
   - White with brown stripe is GND
   - Blue is +5.5V

3. We can now connect the DAC PCB. Any of the outputs on the DAC PCB can be used for the digital baseline restoration. I would recommend staring with DAC_02, as shown in the next image. DAC_02-05 use an op amp to combine the P and N output from the DAC.

4. Let's now check the DAC_02 output. Connect it up to an oscilloscope and generate a signal on DAC_02
   - DAC_02 is connected to **RFMC_DAC_02_N** and **RFMC_DAC_02_P**

The signal should be attenuated by ~50x. Other DAC connections are available, each of which has its circuit diagram in the image inset.

5. If that looks good, you can plug it into the DBLR for channel 3, as shown in the next image. The can now be used to test the DBLR.


Remove Jumpers
PMT
GND
5.5V
-5.5V
1 2 3 4 5 6 7 8
-5.5V
GND
GND
GND
5.5V
GND
GND
GND
TP
TP2
TP3
DAC_00_P
DAC_00_N
DAC_01_P
DAC_01_N
DAC_02
DAC_03
DAC_04
DAC_05
DAC_00_P
DAC_00_N
DAC_01_P
DAC_02_N
DAC_02
DAC_03
DAC_04
DAC_05

1