BPM AMC Card Testing

BPM Testing

Color Codes:

root@shm-b084-sp01 (Green)

lcls-dev3 (Blue)

laci@cpu-b34-bp01 (Orange)

Board Dependent Information (Magenta)

1. Boot/Reboot board in shelf

- `ssh root@shm-b084-sp01`
  - Password:
  - Important commands to know
  - `clia deactivate board <slot#>`
  - `clia activate board <slot#>`

2. Program the FRU

- Program the AMC FRU's EEPROM
- Source the setup script
  - For bash `source /afs/slac/g/reseng/IPMC/env.sh`
  - For C-Shell `source /afs/slac/g/reseng/IPMC/env.csh`
- If the bin is made skip down to the next bullet point (This should be done)
    - Create a binary (.BIN) file from the.INF file (should be done already)
      - `python /afs/slac/g/cci/package/pps-tools/frucom/fruc.py <file>.inf <file>.bin`
        - For 230-60 MHz boards
          - `379-396-03-c04-230-60.inf`
          - `pc_379_396_03_c04_230_60.bin`
        - For 300-30 and 300-60 MHz
          - `pc_379_396_03_c04_300_60.inf`
          - `pc_379_396_03_c04.bin`
- `cba_amc_init --file /afs/slac/g/lcls/users/BPM/LCLS_II/BPM/Fru/<bin> --serial --tag <tag> <shm>/<slot>/<bay>`
    - The tag is the XX in C04-XX
      - shm: `shm-b084-sp01`
      - slot: 2
      - bay: 2
- To read the EEPROM back
  - `cba_amc_init --dump <shm>/<slot>/<bay>`

3. Verify the board voltages

- All test points have common ground
- 12VS should not have voltage

4. RF testing using E4438 generator

- Connect low noise RF generator to inputs:
  - LCLS II
    - 300-30 MHz @ -20dBm
    - 300-60 MHz @ -20dBm
    - 230-60 MHz @ -23dBm
  - FACET II
    - 300 MHZ-30 @ -8dBm
  - Generate test files
    - `ssh laci@cpu-b34-bp01`
    - `cd /afs/slac/g/lcls/users/BPM/LCLS_II/BPM/software/lcls2-py-scripts/`
    - `./launch.sh striplineTakeData.py -A0 -B0 -Y stripline_yaml/*_project.yaml/000TopLevel.yaml -D stripline_yaml/*_project.yaml/config/defaults_ss.yaml -b1 -n1 -d /data/cpu-b34-bp01/bpm_data/`

    Log onto a machine that you can get a Matlab license for
    - `ssh <username>@rdsrv223`
    - Copy test files to the proper directory
      - `cd /afs/slac/g/lcls/users/BPM/LCLS_II/Data`
      - `scp -r laci@cpu-b34-bp01:/data/cpu-b34-bp01/bpm_data/<filename>/ .`

      Open data in Matlab
      - Source the following
        - `bash`
        - `source /afs/slac/g/lcls/epics/setup/epicsenv-7.0.3.1-1.0.bash`

        - export MLM_LICENSE_FILE=27010@license701,27010@license702,27010@license703 --> new
        - `source /afs/slac/g/controls/development/package/matlab/setup/matlab_2017b_setup_local.bash`
    - `cd /afs/slac/g/lcls/users/BPM/LCLS_II/matlab`
        - `matlab &`
        - Run SNR*b84*Gbe.m
            - Be sure to close Matlab when done
        - Change line 19 to have the right filename
        - Change line 28 to ADC.index=4
            - 4==chan0
            - 5==chan1
            - 6==chan2
            - 7==chan3

          Look for and record the values:
            - sig_power > 1
            - SNR > 60
- Repeat for indices (5,6,7)

5. Attenuation Sweep

- `ssh laci@cpu-b34-bp01`
- `cd /afs/slac/g/lcls/users/BPM/LCLS_II/BPM/software/lcls2-py-scripts/`
- `./launch.sh attnsweep_test.py -b1 -s512 -n1 -d /data -Y stripline_yaml/*_project.yaml/000TopLevel.yaml 2>&1 | tee /data/cpu-b34-bp01/bpm_data/attn_sweep_SN<SerialNumber>.txt`

    - Is the ATTN variance <1dB

        - Record the point when the variance is off by 1dB for each channel
        - What is the 1dB compression?

On rdsrv223 or lcls-dev3

    - `cd /afs/slac/g/lcls/users/BPM/LCLS_II/Data`
    - `scp -r laci@cpu-b34-bp01:/data/cpu-b34-bp01/bpm_data/attn_sweep_SN<SerialNumber>.txt <space> .`

6. Fake Beam testing

Configure 4131A pulse generator

- Ext trigger from the crate
- Width 700ps
- Depending on the board
    - For 300 Mhz
        - 30MHz Amp 4.25 V (Use High & Low to set this value is easier)
        - 60 MHz Amp 1.8 V
        - Attenuators (Matlab Script will do this automatically)
            - LCLS II
                - Att 1 = 4
                - Att 2 =8
            - FACET II (Uses 4.25V)
                - Att 1 = 6
                - Att 2 =0
    - For 230 Mhz
        - Amp 1.50 V
        - Attenuators (Matlab script will do this automatically)
            - Att 1 = 4
            - Att 2 = 8

Run test software

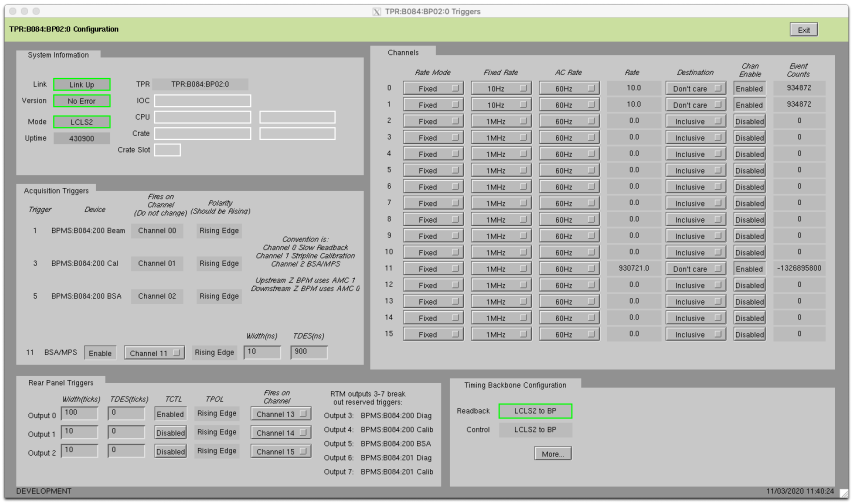
    - `siocRestart sioc-b084-bp02`
        - `Environment issues source these commands`
            - `source /afs/slac/g/lcls/tools/script/ENVS.bash`
            - `source /afs/slac/g/lcls/epics/setup/epicsenv-cur.bash`
    - `iocConsole sioc-b084-bp02`
        - quitting `iocConsole` `ctrl-a` then `ctrl-d`
            - To shut down press enter to see a new line
            - type `exit()` (open and close parentheses)
        - Troubleshooting issues
            - From the cpu ping the carrier slot
                - `ssh laci@cpu-b34-bp01`
                - `ping 10.0.1.102`
        - Open EPICS and TPG windows
        - In a Bash shell
            - `~disco/scripts/bash/bpm_launcher.sh`

- Script above does the following
- `edm -x bpm_b084_dev &`
  - Source an EPICS 3.15 script
    - `.<space> /afs/slac/g/lcls/epics/setup/go_epics_3.15.5-1.0.bash`
    - Select BPMS:B084:200
  - `cd /afs/slac/g/lcls/epics/iocTop/Tpg/Tpg-git/tpgApp/srcDisplay/`
    - `./tpg2_screen &`
      - In bsa_resolution.m on line 7 sets the edef you can open the corresponding edef to see the NtoAcq count up.

Configure/Verify LCLS-II or LCLS-I timing

- Verify the trigger settings in both SIOC:B084:BP02 Triggers screen and the TPR expert screen, see attached pictures
  - SIOC:B084:BP02 Triggers screen
    - Verify the TDES for DIAG and BSA match at 150ns
    - Verify the TDES for calibration at 1000000

  - TPR expert screen
    - Verify that the event counts for the enabled channels increments
    - Verify the BSA/MPS Acquisition Trigger is enabled and the corresponding channel is enabled
      - 1 MHz is fine here



    - Verify channel 0 and 1 are enabled with a fixed rate of 10Hz

Set up your EDEF (Matlab sets up during run):

- NtoAvg - number of shots to average
- NtoAcq - number of samples to acquire
- Set Rate Mode = Fixed Rate
- Set Measurement Severity = Invalid
- Set Destination Mode = Disable
- Set Fixed Rate# to match your trigger rate (typically use [4] 100Hz)
  - 0 = 1 MHz
  - 1 = 71 kHz
  - 2 = 10 kHz

- 3 = 1 kHz
- 4 = 100 Hz
- 5 = 10 Hz
- 6 = 1 Hz

In a Matlab window run bsa_resolution

- Open Matlab
  - Source the following if not done
    - `bash`
    - `source /afs/slac/g/lcls/epics/setup/epicsenv-7.0.3.1-1.0.bash`
    - `source /afs/slac/g/controls/development/package/matlab/setup/matlab_2017b_setup_local.bash`
  - `cd /afs/slac/g/lcls/users/BPM/LCLS_II/matlab`
    - `matlab &`
    - Run `bsa_resolution.m`
    - Be sure to close Matlab when done
- Change SN inline 6
- Sets to acquire: 2000
- Is the resolution <1.5um in both planes?

7. Calibration Test

- Before starting verify the IOC is not running
- Install 50 ohm terminators on the front end of the board
- Start the IOC
- Refer to the SIOC:B084:BP02 Triggers screen for the calibration triggers status
- Adjust the RF Pulse Width from the RTM:
  - caput BPMS:B084:200:RFWD 6
    - This sets the RF width to 200ns
- Adjust the attenuators of the board
  - `caput BPMS:B084:200:ATT2 #`
    - I set this to about 10
  - `caput BPMS:B084:200:ATT1 #`
    - I typically do not change this attenuation setting
  - caput BPMS:B084:200:CALA #
    - Set this to 10
- Check the calibration calibration in the triggers window)
  - CAL RED should have a waveform on the left
  - CAL GRN should have a waveform on the right
  - CAL TOGGLE should show both the RED and GRN waveforms simultaneously
  - **CAL signals should be constant, no skipped pulses**
- Disconnect the cables from the splitter and connect to oscilloscope
  - Verify a 10 dB of attenuation in line on the front of the oscilloscope for the port/ports to be used
  - Disable the calibration triggers
  - Remove the 50 ohm terminators
  - Connect a cable to the red and green input of the AMC and to the scope
    - If only using one channel at a time verify calibration triggers are disabled in between switching the channel under test
  - Enable the calibration triggers
  - Verify calibration toggle is set for only one channel at a time
  - Record the Vpp for both green and red channels

Using the 2-slot debug crate

- Start the software:
  - log in to lcls-dev3
  - `ssh laci@cpu-b084-sp01`
  - In bash:
    - `. /afs/slac.stanford.edu/g/lcls/vol9/package/cpsw/framework/R4.4.2/env.slac.sh`
    - `rssi_bridge -a 10.0.0.101 -p8193 -p8194`

  Open the UI
  - open a new lcls-dev3 window
  - `cd /afs/slac/g/lcls/package/cpsw/cpswTreeGUI/current/`
  - `./env.slac.sh`
  - `python3 cpswTreeGUI.py --ipAddress=10.0.0.101 --rssiBridge=cpu-b084-sp01 --disableStreams ~disco /scripts/B084_TestStand/stripline_yaml/AmcCarrierBpmStriplineDDV1_project.yaml/000TopLevel.yaml NetIODev&`
    - Or `~disco/scripts/bash/ControlGUI.sh`
  - Under the mmio tab "right mouse" click "load file" <default.yaml>

Notes

- Use 300MHz, -5dB to start. Change amplitude as needed. If using a splitter, -2dB is good
- Bay 0 is the left bay, Bay 1 is the right bay
- Attenuator controls are under AppTop -> AppCore -> AmcBayX -> StriplCalCtrl
- 1f = attenuator full-on (lowest/no signal)
- 00 = attenuator full off (highest signal)

- DataValid and RawData are under AppTop -> AppTopJesd[XX] -> JesdRx
- TriggerCount is under AppTop -> DaqMuxV2[X]
- Typical things to check:
- Input capacitors:
    - C229
    - C230
    - C231
    - C232
- Does the signal show up? Is it significantly lower than other channels?
- Try removing caps on bad channels to see if the signal improves. If not, it's a problem with the SMA connectors.
- Filters:
    - U18
    - U23
    - U28
    - U33
- Check the top right corner (facing faceplate)- Is the signal less than 80% of the input signal?
- Bad filters have to be sent out for replacing
- Amplifiers:
    - U16
    - U17
    - U21
    - U22
    - U26
    - U27
    - U31
    - U32
    - Remember to change attenuator values, the best are:
        - 0a (10dB)
        - 00 (0dB)
- MAKE SURE TO LOOK ACROSS THE CAPS AFTER THE AMPLIFIER
- Compare with a good channel to check that amplifier is working correctly
- ADC Clock Signal:
    - R105A/B
        - R105 should have a 1.5GHz square wave

      185A/B
        - 185 should have a 370MHz sine wave
- ADC bias along the bottom (for pins 2, 7 and 8)
    - Should have [some voltage] CHECK WITH A GOOD BOARD
    - Bad ADCs need to be sent out for replacing
- R26 and R27 should have 0V and 8V (or vice versa)
- R?? should have 5V

Programming AMC Carriers

1. Log onto lcls-dev3
2. `cd /afs/slac/g/lcls/users/BPM/LCLS_II/BPM/firmware`
3. Run bash script (This will change depending on where you're doing the programming. Check the program to make sure it has the right SHM, slot, and CPU addresses.)
    - For the RF lab in B84: `./ProgramBPM_li00_sp01_s3.bash`
    - For Thuy's lab in B34: `./ProgramBPM_CPU_hp05_s3.bash`

Useful Commands

```
Caput [address] value - set a value
Caget [address] value - read a value
Ps -ef | grep ??? - check to see if matlab is hung up/still running
~disco/scripts/bash/bpm_launcher.sh
```

Other Programs

These programs can be found in ~disco/scripts/python

matViewer

- This can be used to look at the .mat files that were made for running the fake beam test.
- Two files are needed to run:
    - 000FileViewer.py
    - matplotlib_window.py
- The main window is 000FileViewer.py, this shows all the serial numbers for the found files
- matplotlib_window does what it sounds like, it will show the array that was made from the raw wave and the x y graph.

Graph_Attn_Sweep.py

- This takes the output of the attnsweep program and makes a graph
- it can take two arguments:
    - Required: the input file to process

    - Optional: an output image
- The program will run with bash invoked and will draw a window on the screen with relevant data in a text box
- This can also be found in /afs/slac/g/lcls/users/BPM/LCLS_II/BPM/software/lcls2-py-scripts