Testing Module Documents and Procedures

Warning: Always turn off bias voltage to FEBs before unplugging/plugging HDMI cables.

Documents

Main Folder

Replaced (Bad) Manifolds Spreadsheet

Manifold SiPM and CMB ID Spreadsheet

Rivanna Desktop Session

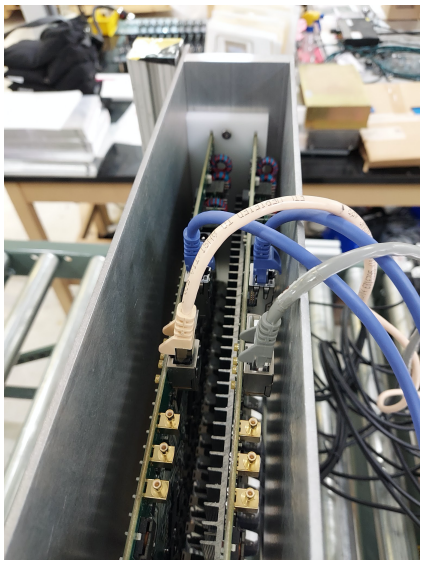
Procedures

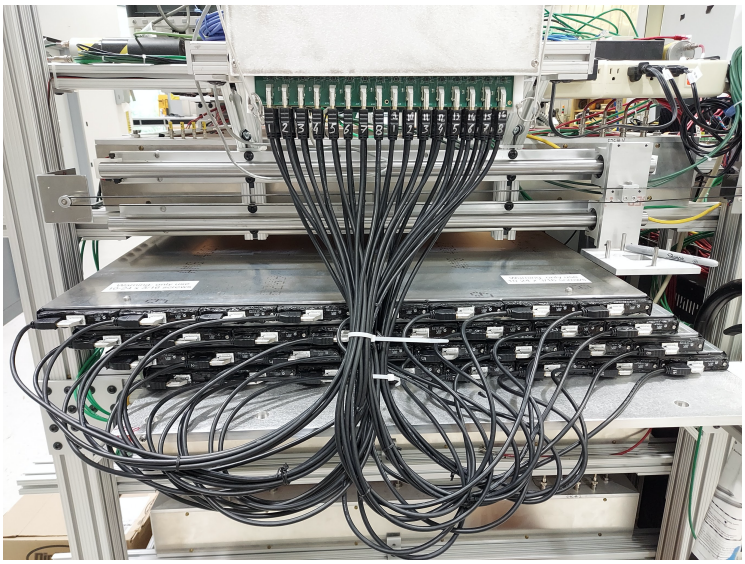
Cable Connections and Manifold Tests

Connect cables accordingly. Facing the module on the near end, the HMDI cables should start at cable 1 and go to 8 at each row. On the far end, facing the module, the reverse is true (such that the same cable number corresponds to the same scintillator bar). The FEB numbering starts at the outside of the near end at FEB 0 and continues to the outside of the far end at FEB 3. FEB 0 is connected to the near side top, FEB 1 the near side bottom, FEB 2 far side top, and FEB 3 far side bottom.

The blue ethernet cables (power and data) are connected to each FEB and to the Readout Controller. The tan/gray ethernet cables (network) are connected to the router.

The HDMI and ethernet cable connections are shown in the pictures below.





Open the Mu2e DAQ GUI on the DAQ laptop. Apply the settings and bias voltages to the FEBs by clicking “LOAD” on the FEB tab. Load the correct configuration files for each FEB. The generic settings are sufficient for now, later you will apply the channel-by-channel bias voltage settings. **Do not plug/unplug HDMI cables while the bias voltage to the FEBs is on.**

Test the current of each channel by running the QC. Channels with currents >80 nA or <15 nA are suspect and should be either replaced or re-checked when the channel-by-channel breakdown voltage is applied.

Replacing Manifolds

If any manifold needs to be replaced for any reason:

1. Record the manifold ID and reason in the log book.
2. Record the manifold ID and reason in the *Replaced (Bad) Manifolds* spreadsheet.
3. Record the manifold ID and reason in comments section of the SMBs tabs in the *crvmod-*_SMBs* file.

Light Leak Tests

Check for light leaks by shining the flood lights on both ends of the module. Measure the current difference between the scenario in which the room lights are off and the scenario in which the flood lights on. A difference in current of > 10 nA in a single channel or > 5 nA in multiple channels is usually indicative of a possible light leak.

Fix any light leaks using RTV.

Record light leak data in the Desktop/Module.txt file. Checking the “record” box will automatically record the data. Make sure you note which side is Side A and Side B and take the light leak data in the correct order. Transfer Module.txt to Rivanna and overwrite existing file here: */project/hep_aag/testbeam/crvraw/*

Copy Light leak data to “Data” tab on the *crvmod-<module number>_LightLeak.xlsx* spreadsheet in the module directory.

SiPM Breakdown Voltages

Each SiPM is now given its measured breakdown voltage. The breakdown voltages and SiPM IDs are recorded in the database, and these must be uploaded with the configuration to the FEBs.

In the *crvmod-<module number>_SMBs* spreadsheet in the module directory, create a new tab entitled *SiPMs*. Copy the SiPM IDs from a previous module into the new tab, this will copy the formulas and transformations, not the IDs themselves.

On Rivanna, copy the column of SiPM IDs for each FEB into the file *teststand/FEBsettings/Module<module number>FEB<feb number>.txt* (each FEB gets its own file).

Change the *feb_trim_bias_new.py* script for the current module. Specifically, update the *Module<module number>FEB0.txt* and *SettingsModule<module number>FEB0.txt* texts in the script. Then run:

```
source feb_trim_bias_new.sh
```

This will create the *SettingsModule<module number>FEB*.txt* files. Check if all the SiPM IDs are present by running:

```
ls –l SettingsModule<module number>FEB*.txt
```

This should return exactly 775 bytes for each FEB. If it does not, it is indicative of missing SiPM IDs. The *Module<module number>FEB<feb number>.txt* file will list the SiPM IDs missing. First, check the *SiPM and CMB ID* spreadsheet for a possible error in recording of the SiPM ID. If it looks alright, it may be missing from the database and you will have to email those that maintain the database.

Copy *SettingsModule<module number>FEB*.txt* to the DAQ laptop and load these settings for the run configuration.

Taking a Run

Load the correct configuration for each FEB with the channel-by-channel breakdown voltages with the *SettingsModule<module number>FEB*.txt* files.

Type the following settings in the ROC terminal.

```
WR 30 3C
WR 31 14
WR 0 10
WR 43 1
```

Type the following setting for each FEB.

```
WR 317 3
```

Load the *phaseSettings.txt* configuration for each FEB.

To start a run, click “Prepare for Run”, then “Start Run”, then “Initialize Values.” Type the following in the ROC terminal.

```
WR 0 110
```

Record run number in logbook. The run will take about 3 hours to obtain sufficient statistics (about 1e5 - 1.5e5 triggers is sufficient). To stop the run, press “Stop Run” and enter the following to the ROC terminal:

```
WR 0 10
```

The data will be recorded in */data/RUN_FEB_<module number>_<a long string>.data*. Copy the run data to Rivanna here: */project/hep_aag/teststand/crvraw/*

Analyzing data

Rename the data file to the following:

```
mv /project/hep_aag/teststand/crvraw/RUN_FEB_<module number>_<a long string>.data /project/hep_aag/teststand/crvraw/crv.raw.module<module number>.run<run number>.txt
```

It is recommended that you run the following in a Rivanna Desktop Session since it takes some time to run the following. Enter your *teststand/crv* directory and run the parser script.

```
./parserCrv <run number>
```

Run the calibration script.

```
./calibCrv <run number>
```

The pdf file with the results of the calibration is placed here: */project/hep_aag/teststand/crvcalib/log.crv.calib.module<module number>.run<number>.pdf*

Check the summary plots at the end of the pdf. The software should flag anything problematic like dead channels, missing calibrations, calibrations outside the accepted range, noisy channels, etc. If an issue is flagged, sometimes the manifold will need to be replaced. If so, replace the manifold and repeat the steps to load the individual SiPM bias voltages and redo the run. If the channel is dead, it may be recovered by following the steps below.

If the calibration is sufficient, run the reconstruction script.

```
./recoCrv <run number>
```

The pdf file with the results of the reconstruction is placed here: */project/hep_aag/teststand/crvreco/log.crv.reco.module<module number>.run<number>.pdf*. The software should flag any channel that has a PE yield out of range.

Debugging a Dead Channel

If a channel is dead (i.e. very few hits), it may sometimes recovered if you unplug the HDMI cable and plug back in again on both sides (after turning the bias off on the FEBs). Instead of doing a full run to see if this has recovered, you can take a short run (about 30 s) and look for pulses.

Take a ~30 second run. Transfer the data file from the DAQ laptop to Rivanna and change the name as described above. Enter your *teststand/crv* directory and run the parser script.

Then edit the script *plotSample.C* by changing the run number, the FEB number, and the two channels of interest (the dead channel and a neighboring channel on the same manifold). Run the script to see if you see any pulses in the dead channel:

```
root -l plotSample.C
```

This will plot many snapshots of pulses. On average, you will see about one real pulse from a MIP every 20 snapshots. Find a real pulse and if both channels have the pulse, they are good. If only one channel has the pulse, the channel is still dead.

If the dead channel is recovered, redo the run to obtain a calibration. If not, you will have to replace the manifold following the steps above and redo the run. You should remove all the png files when finished so you don't crowd your directory.

Recording CMB IDs

In the DAQ GUI, press the "START LOG" button. For each FEB (preferably in order) enter the `CMB` command to record the CMB IDs. Press the "STOP LOG" button.

This will record the CMB IDs in the */data/FEB_commands__<date>_<time>.txt* file. Open the file and add the module number to the top and save. Copy the file to Rivanna in this directory: */project/hep_aag/teststand/crvraw/*

Open FEB_commands file. Copy CMB ids to the tabs entitled something like "Right_to_Left_UpperCMBs" in the *crvmod-<module number>_SMBs* in the module directory. You may have to copy to an Excel spreadsheet first to get the format correctly. You will only copy to two out of the four tabs, and this depends on the orientation of the module so you should double check to make sure you are recording the data correctly.

Copy manifold and CMB IDs to *Manifolds_CMBs_To_Sort* sheet in the *Manifold SiPMs and CMBs* file.

Final Touches

Make a presentation in the module directories entitled *crv_module_qc_module<module number>.pptx*. Include the summary plots from the calibration and the reconstruction and note anything unusual about the module (e.g. light yields and calibration constants slightly out of range).

Update the run log here: */project/hep_aag/teststand/notes/runlog.txt*
Include all the runs you attempted while testing the module and note any manifold replacements. Use the examples from past run if you're unsure what to include.