

# FEB2 Status Update

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on behalf of the LAr HL-LHC FEB2 group



NEVIS LABORATORIES  
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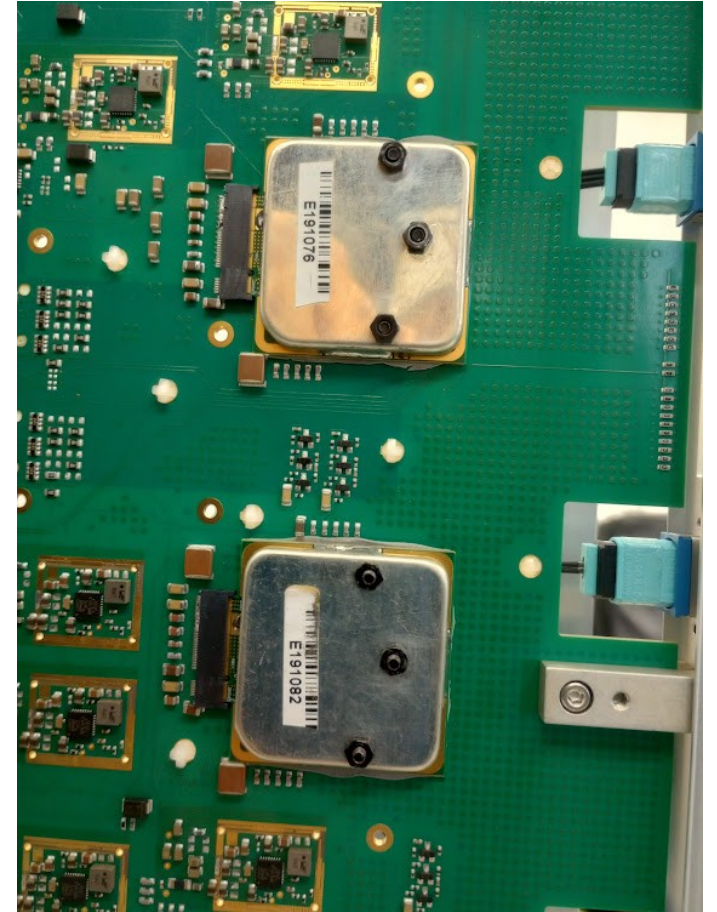
# Overview

(Last update given by John on Nov 13<sup>th</sup>; see [indico](#))

- Initial power and noise measurements with “new” Small Mezzanines
- Updates on FEC power bus issues
  - Measurements of AC filtering capacitors and GND-PGND connections
- Thermal images with “new” Small Mezzanines

# New Small Mezzanines

- Small Mezzanines (SM) convert high voltage 48V input down to 12V using CERN bPOL48V chips
- Received 8 new SM tested by INFN Milano at Nevis on Nov 19<sup>th</sup>
- Installed on all 4 FEB2 v2.5 boards
  - So far, only thoroughly tested 1 v2.5 board



# Power Measurements

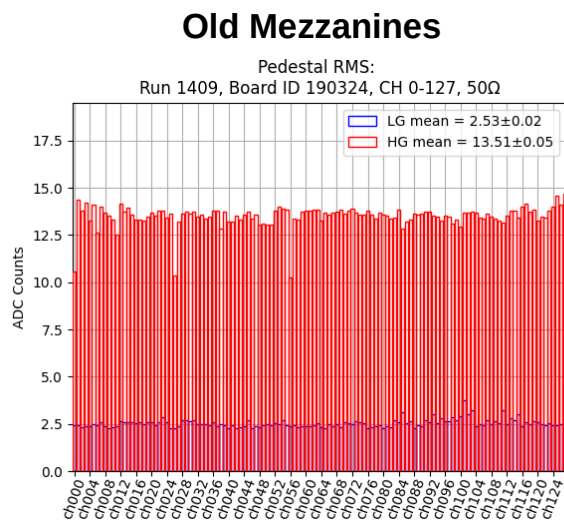
- Initial power measurements on v2.5 show small increase in power draw of 0.5W without LSB2 attached

Board	PS power draw [W]
190324 + “old” SM + no LSB2	125.0
190324 + “new” SM + no LSB2	125.5

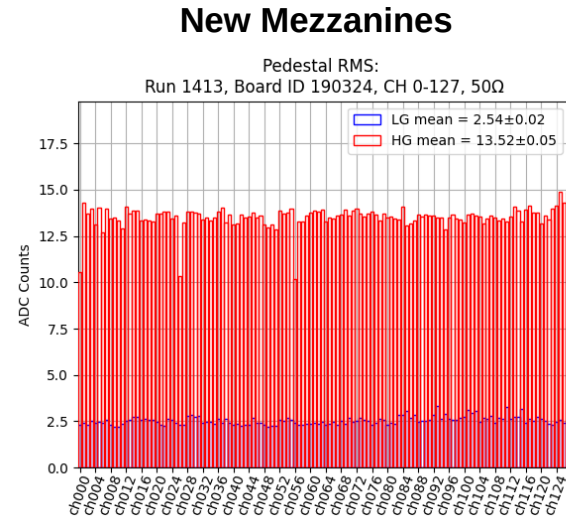
- “New” SM don’t have integrated heat sink
  - Need to investigate if increased 0.5W draw could be due to temperature differences
- Only thoroughly tested one v2.5, measurements across multiple boards still to come

# Noise Performance

- Initial noise measurements show slightly increased noise
  - 14.7 counts with “old” SM vs 14.9 counts with “new” SM on channel 127
  - Most noticeable on channels closest to input power connector (right of graph)



Run 1409

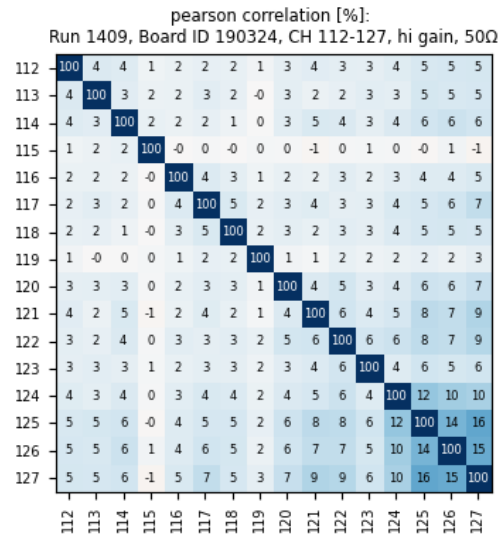


Run 1413

# Noise Performance cont.

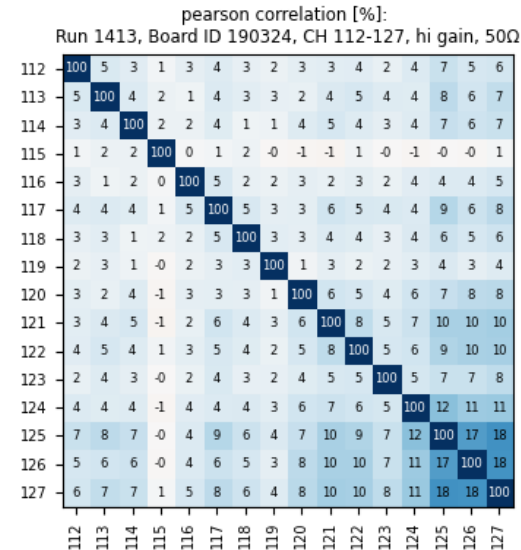
- Correlated noise near input connector, between channel 126 and channel 127, increases from 15% to 18%

Old Mezzanines



Run 1409


New Mezzanines



Run 1413

# Power Bus Issues

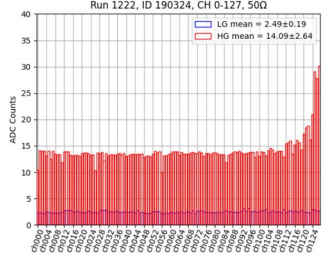
- Performing tests to mitigate increased noise near input connector while using FEC power bus

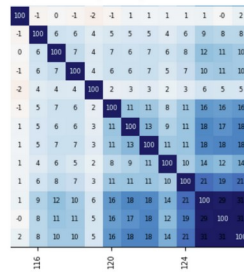


## FEC Power Bus Issues

- ❖ Recall power bus mounted on each FEC has 10 conductors, to accommodate 7 different input voltages plus 3 GND lines
- ❖ For HL-LHC, FEC powering scheme will have only  $V_{in} = 48V$  (+ GND) delivered over long cables from LVPS
  - In terms of maximum current rating, a single pin for 48V and a single for GND would suffice for the FEB2
  - For reliability, decided (so far) to use 2 pins for each, in common FEB2/CALIB scheme proposed by Stefan Simion
  - Also allows separation between LVPS return ('PGND') and FEB2 board GND ('GND'), to allow flexibility in connection
- ❖ However, recent FEB2 performance measurements in FEC with power bus at Nevis reveal noise issue
  - Readout channels near power connector show higher noise, and large degree of correlation

Pedestal RMS:  
Run 1222, ID 190324, CH 0-127, 50Q





Channel-to-channel correlations up to ~30%

John Parsons | LAr HL-LHC Mtg, AUW, November 13/2024 | 9

See  
John's Nov 13th AUW  
talk  
for more details

# AC Filtering

- Added 1nF capacitor on 48V and GND power bus bars for filtering
  - Significantly reduces noise near input power connector

Board	Configuration	Channel 126-127 Correlation [%]	Channel 127 High Gain RMS [Counts]
190324	“old” SM + No AC filtering	13.0	14.4
190324	“old” SM + 1nF cap added on 48V and PGND pins	8.0	14.0

**Note: measurements done with “old” SM**

- Tested various resistor and capacitor values with current setup showing best results
  - Further tests required to determine “optimal” value

# GND-PGND Connections

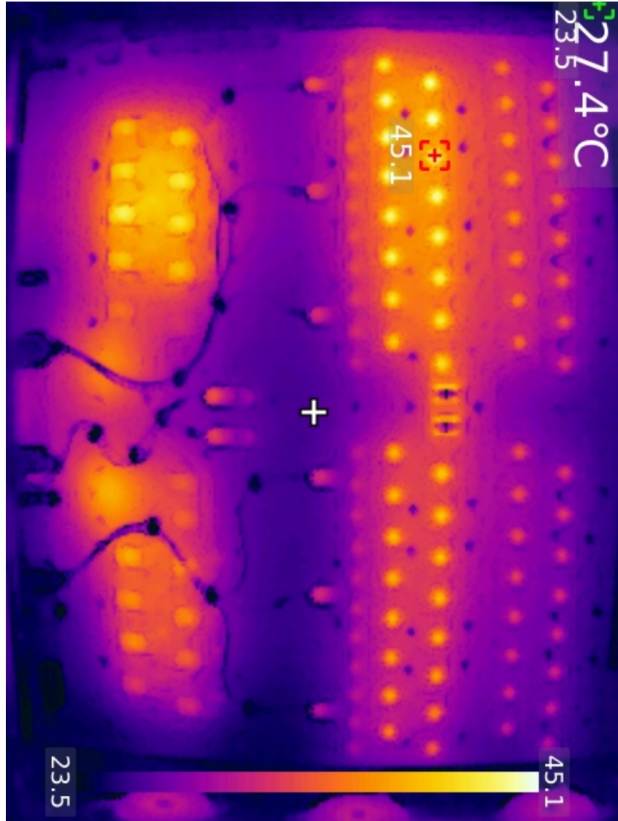
- Adding additional connection between GND and PGND significantly decreases noise
  - Tested two connections, including on-board PGND-GND connection and between PGND and GND on input power connector

Board	Configuration	Channel 126-127 Correlation [%]	Channel 127 High Gain RMS [Counts]
190324	AC Filtering + “new” SM	17.6	14.9
190324	AC Filtering + “new” SM + on-board connection	9.3	14.2
190324	AC Filtering + “new” SM + on-board connection + PGND-GND connection	7.4	14.0

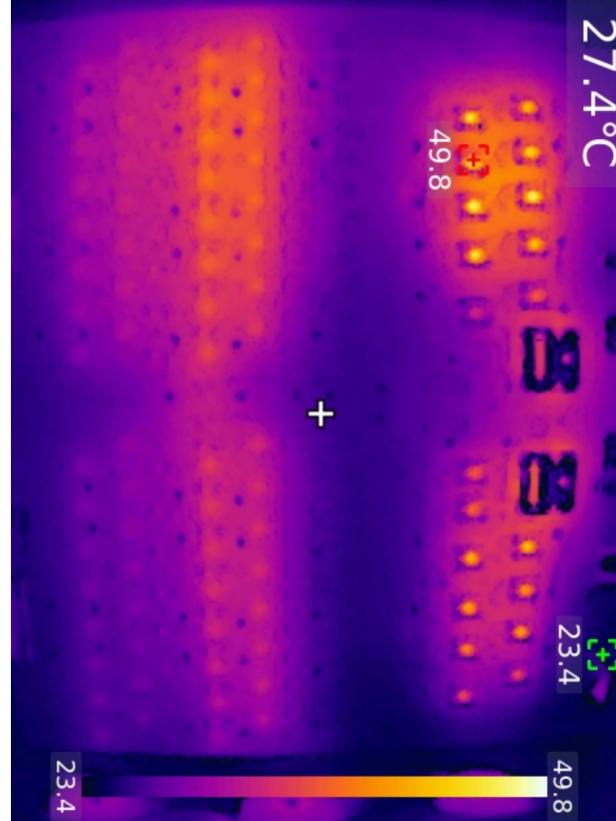
# Thermal Images

Note: Air cooling from bottom of image

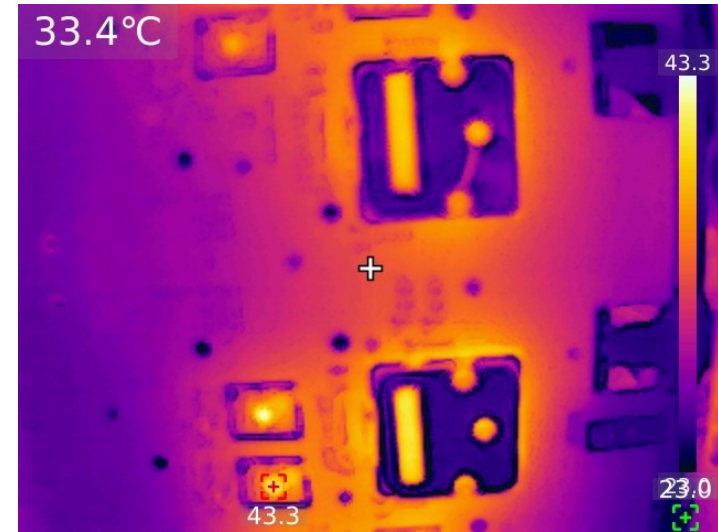
Top of FEB2



Bottom of FEB2



Close up of SM on back side of FEB2 v2.5

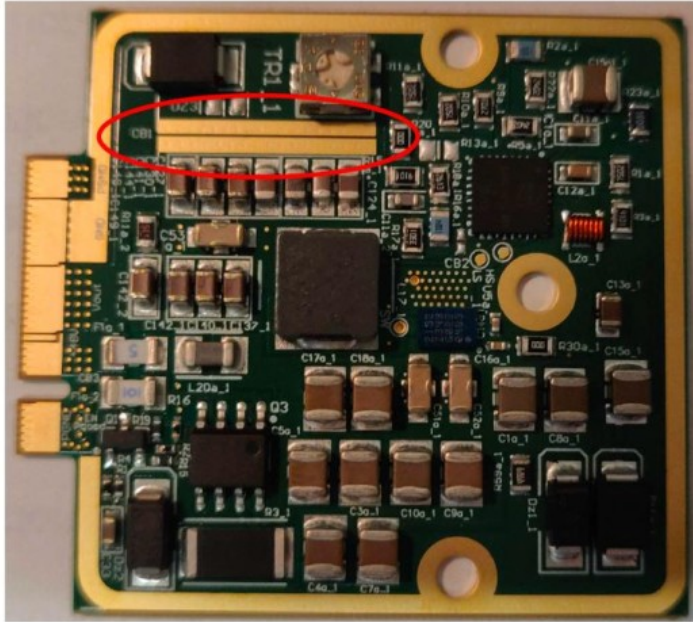


# Conclusion

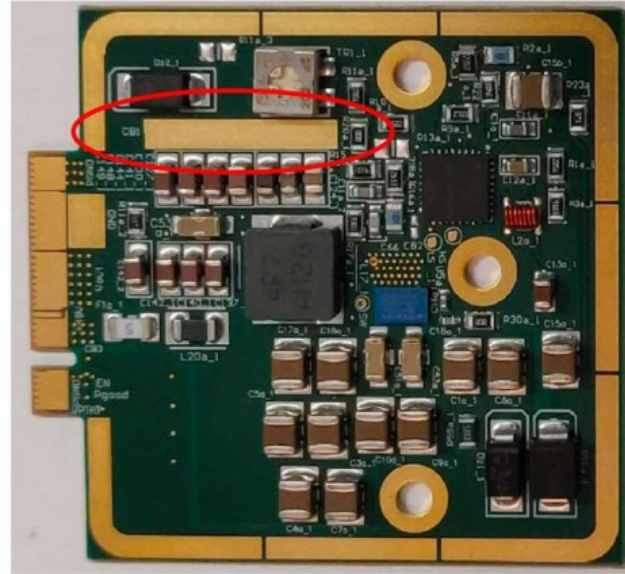
- Nevis received 8 “new” Small Mezzanines on Nov. 19<sup>th</sup>
  - Testing across all 4 v2.5 boards is underway. Aiming for more complete tests in time for upcoming LAr week
- New SM work on v2.5 FEB2, though initial measurements show slight increase in both power and noise
- Further testing is underway to reduce noise from FEC power bus near input connector
  - Addition of filtering capacitors and more connections between GND-PGND significantly reduce noise
- Proceeding with assembly of additional 6 v2.5 FEB2 boards, including 2 using HPS for HEC

# Backup

# SM Without Heat Spreader



Old SM



New SM