

# **Status of the EIC HRPPD interface backplane re-design**

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**eRD110 meeting, June 26, 2024**

# Few words about these meetings

- Hosted by EIC eRD110 Consortium
  - With Incom colleagues attending per default (unless a particular meeting is about other MCP-PMTs)
- Other groups / experts outside of EIC are more than welcome to join ...
  - Contribute sharing their goals, expertise and vision
  - Hopefully gain something from the information exchange
- ... but [at least for the time being] these will not be “community wide HRPPD meetings”
  - Sometimes (like today) there are topics specific to eRD110 (FY25 proposal, budget discussion)
  - Main focus is on EIC HRPPDs, their evaluation, adaptation and development *for ePIC / EIC*
- The bottom line is:
  - We will try to pursue shared interests & produce community wide solutions / standards
  - There can be situations when EIC implementation timelines and requirements will prevail
  - Designs developed for ePIC / EIC purposes will be made public

# *Cross-talk evidence*

[Few slides from June 5<sup>th</sup> meeting]

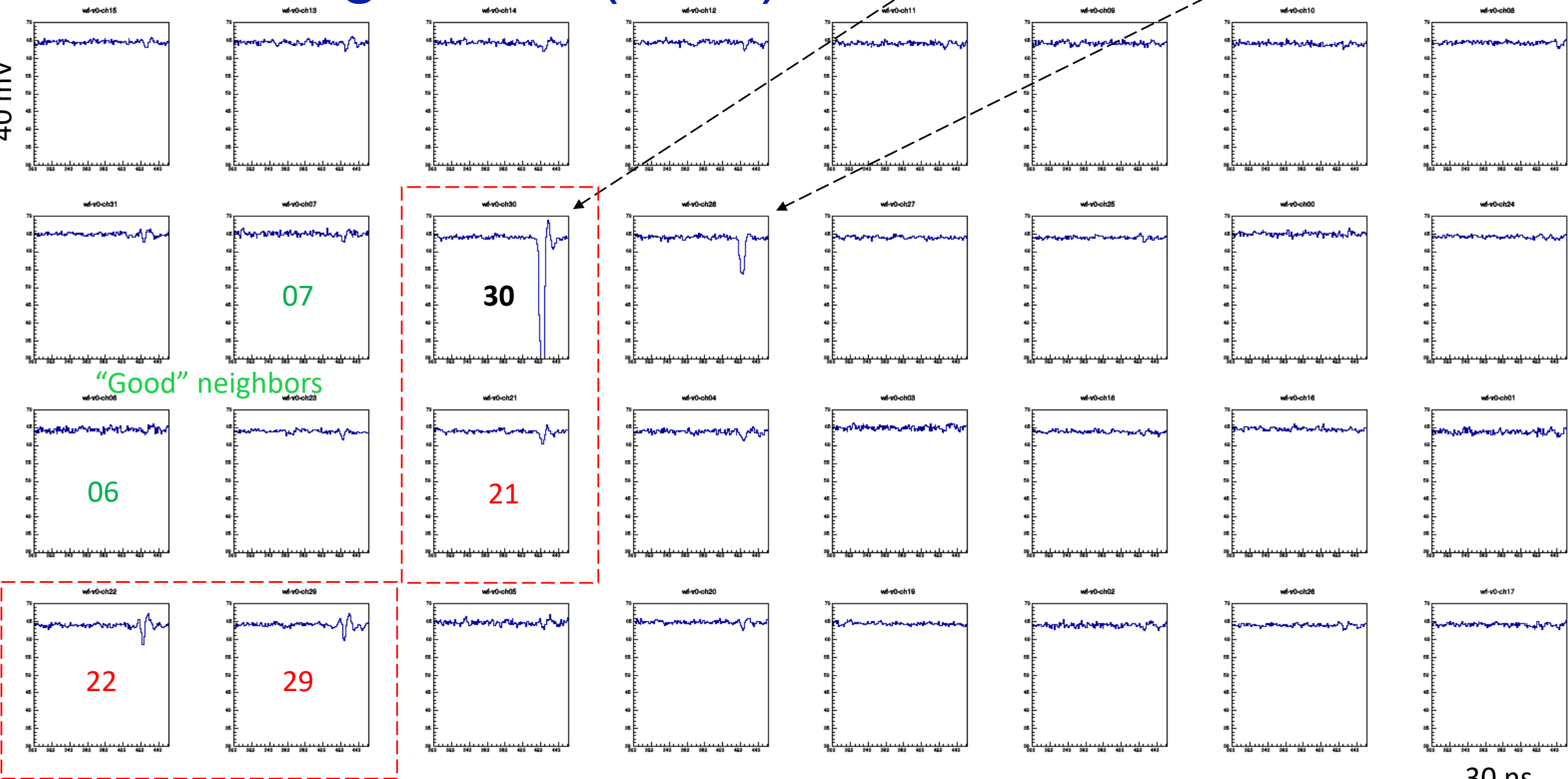
# Crosstalk signature (SPE)

40 mV

Laser spot here

“Normal” charge sharing

Capacitive crosstalk

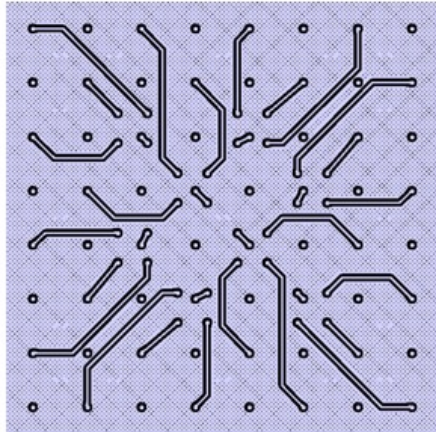


These four pads are neighbors on a Samtec ERF8 connector

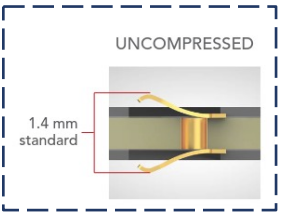
Waveforms (single event): bottom half of one 8x8 pixel field



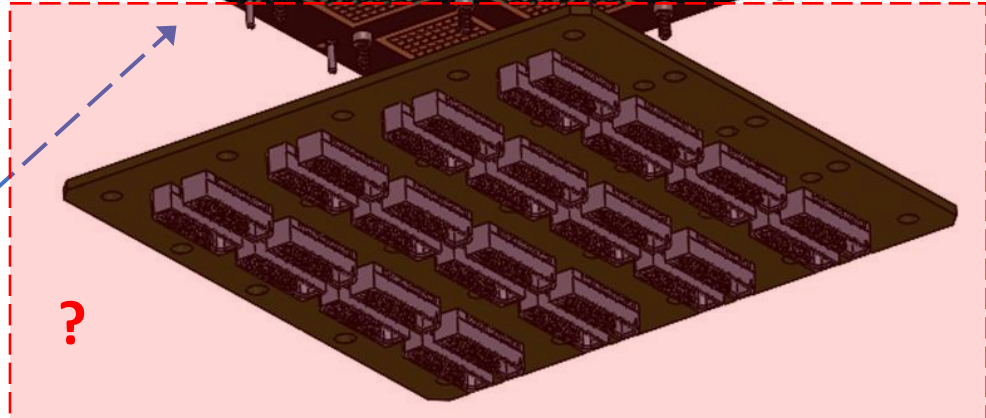
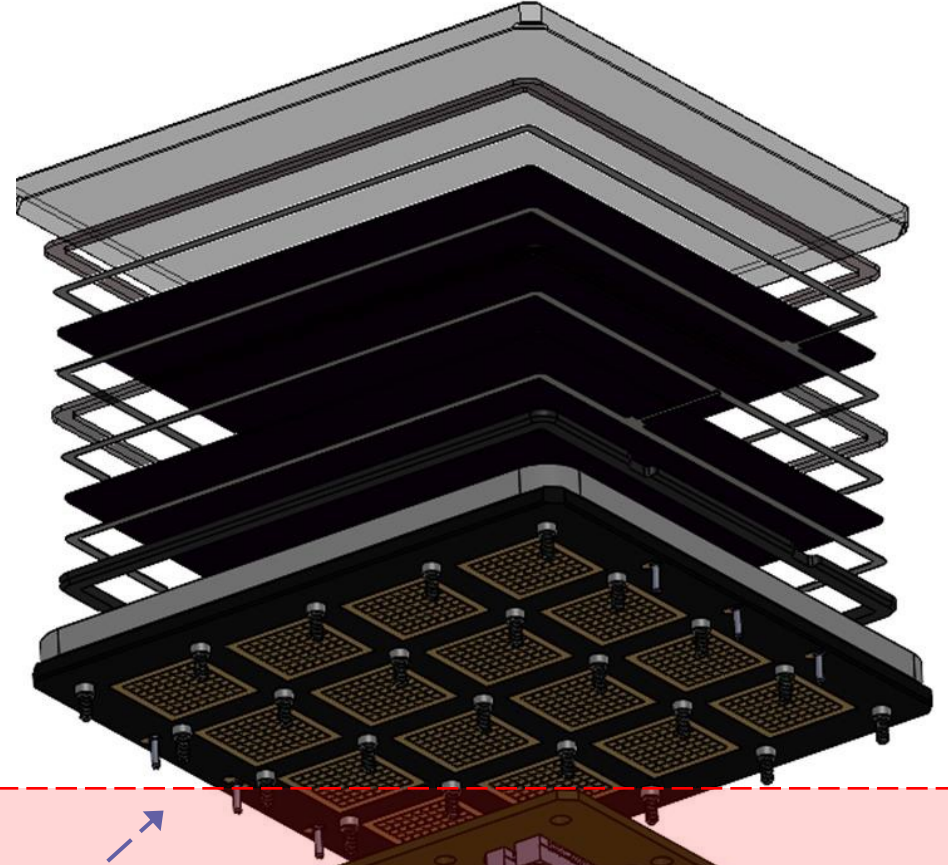
# EIC HRPPD assembly



pad pattern compressed from 3.25mm to 2.00mm pitch



- Fused silica window
- MCPs, spacers, etc
- Side wall
- Anode plate (Y03h), a pre-routing ceramic circuit board
- Compression interposers (not shown)
- Interface PCB (Y05f)



4x4 spots, each with 8x8 square pads; 3.25mm pitch

**Charge path: (1) vacuum side anode pads -> anode plane stackup -> air side pads -> compression interposers -> (2) interface PCB -> MMCX adapter PCB -> pigtail RG-316 (?) cables -> 6" RG-174 cables -> V1742 digitizer**

# Electronics channel routing of a single 4x8 pad area

Channel numbering 00 .. 31 as connected to a single V1742 digitizer

Neighbors on the Samtec connector (cross-talk evidence)

|    |    |   |    |    |    |    |   |    |    |    |    |   |    |    |    |    |   |    |    |
|----|----|---|----|----|----|----|---|----|----|----|----|---|----|----|----|----|---|----|----|
| 15 | 07 | G | 14 | 06 | 13 | 05 | G | 12 | 04 | 11 | 03 | G | 10 | 02 | 09 | 01 | G | 08 | 00 |
| 31 | 23 | G | 30 | 22 | 29 | 21 | G | 28 | 20 | 27 | 19 | G | 26 | 18 | 25 | 17 | G | 24 | 16 |

Samtec ERF8 / ERM8 connector pinout

Neighbor on the air side anode surface (no cross-talk)

|    |    |    |    |    |    |    |    |
|----|----|----|----|----|----|----|----|
|    |    |    |    |    |    |    |    |
|    |    |    |    |    |    |    |    |
|    |    |    |    |    |    |    |    |
|    |    |    |    |    |    |    |    |
| 15 | 14 | 13 | 12 | 11 | 10 | 09 | 08 |
| 07 | 06 | 05 | 04 | 03 | 02 | 01 | 00 |
| 31 | 30 | 29 | 28 | 27 | 26 | 25 | 24 |
| 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 |

Y05f -> HRPPD interface

Neighbor on the vacuum side anode surface (no cross-talk)

|    |    |    |    |    |    |    |    |
|----|----|----|----|----|----|----|----|
|    |    |    |    |    |    |    |    |
|    |    |    |    |    |    |    |    |
|    |    |    |    |    |    |    |    |
|    |    |    |    |    |    |    |    |
| 15 | 13 | 14 | 12 | 11 | 09 | 10 | 08 |
| 31 | 07 | 30 | 28 | 27 | 25 | 00 | 24 |
| 06 | 23 | 21 | 04 | 03 | 18 | 16 | 01 |
| 22 | 29 | 05 | 20 | 19 | 02 | 26 | 17 |

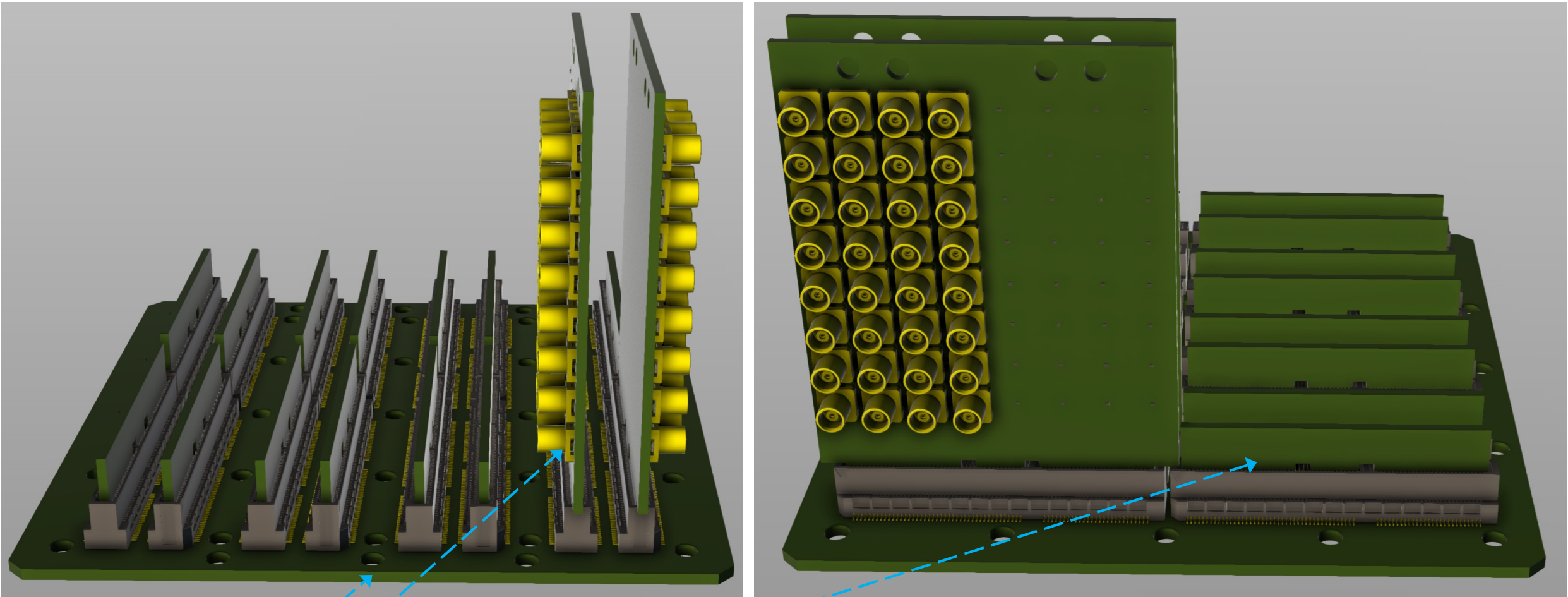
Physical HRPPD pad map (bottom half of one of the sixteen 8x8 pad spots, as seen on the previous slide)

*Mitigation effort*

# Activities

- A matter was being extensively discussed with EIC / ePIC experts over the last three weeks
- A meeting with Kayla Hernandez & John Kuczewski (BNL IO) was set up by Takao last week
  - This week we are / were supposed to measure the cross-talk in situ with a spectrum analyzer (assuming it does originate in the backplane connectors)
- In parallel, a new backplane design was developed
  - An 8-layer backplane with a proper trace isolation in the stackup
  - 12-layer 32-channel MCX adapter edge cards of a similar stackup
    - Samtec MEC6-DV connectors with interleaved signal & ground pins and a separation ground plane
  - 50 Ohm termination plugin cards
- A somewhat corrected plan still is
  - Confirm the cross-talk origin and frequency spectrum either this or next week
  - Converge on the connector choice & new backplane design promptly [but see next slides]
  - Obtain quotes and apply for EIC PED funds to produce N sets

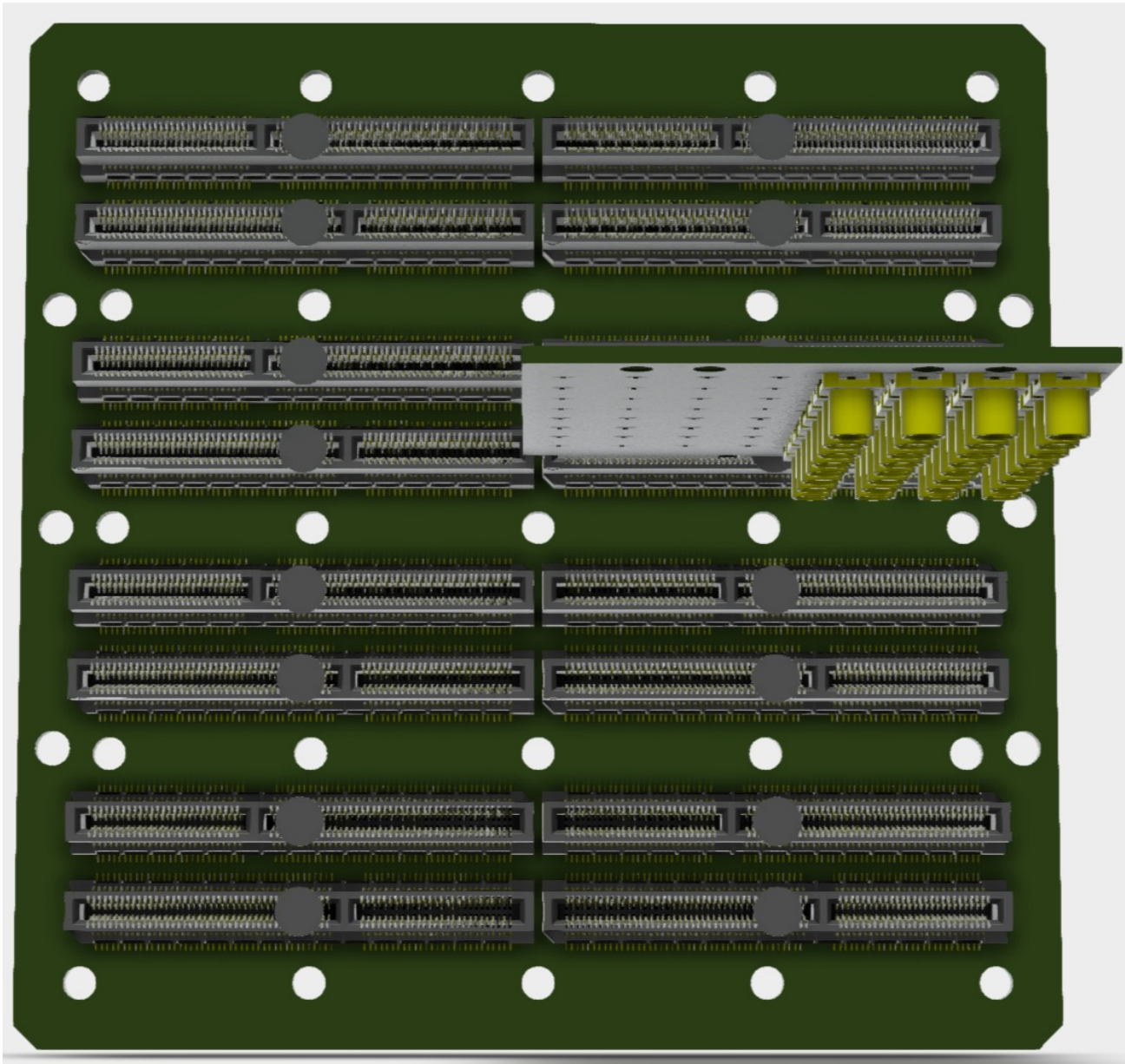
# Re-designed HRPPD inreface backplane



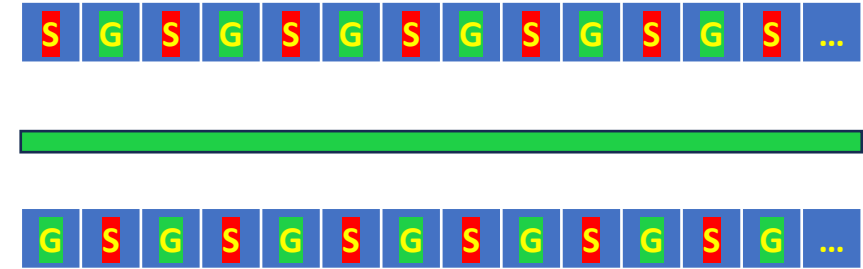
- Multi-layer boards, MEC6 DV connectors, trace isolation
  - Q01a: backplane itself (can be used with vertically mounted ASIC plugin cards if needed)
  - M01a: MCX adapter cards in 1-2 selected slots
  - S01a: 50 Ohm termination boards in all other slots



# Samtec MEC6-170-02-L-DV-A connector

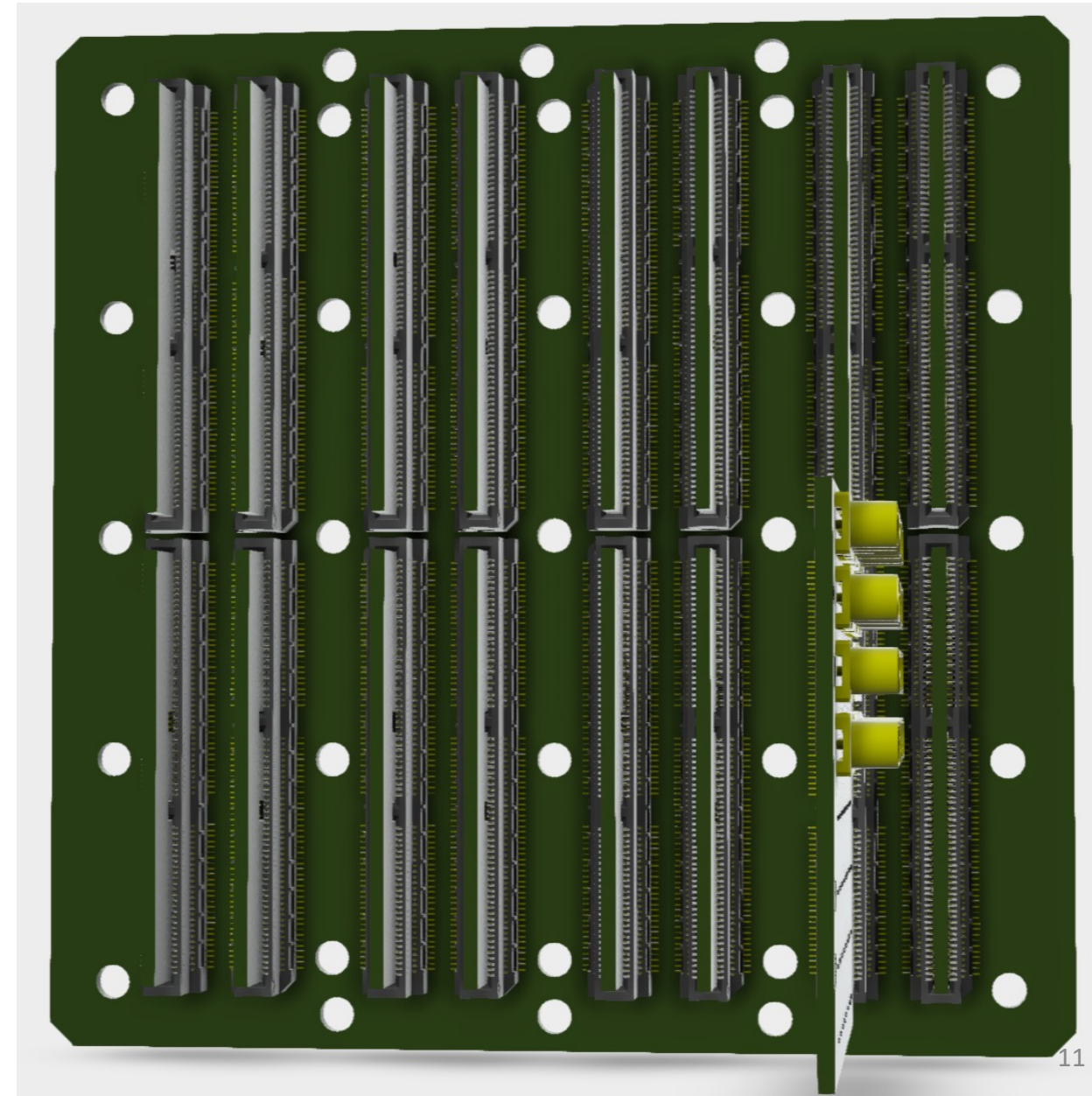
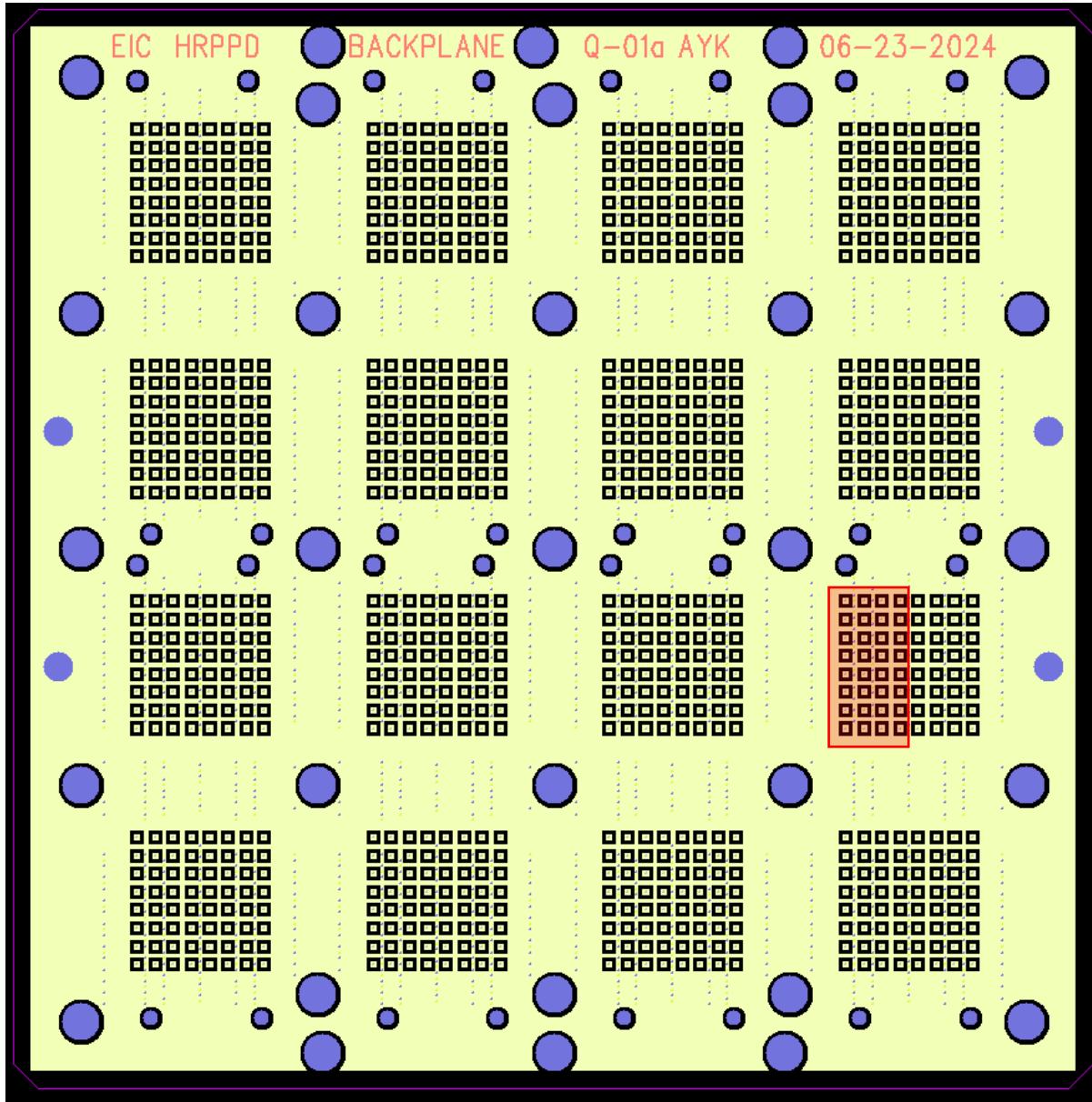


effective  
single  
connector  
pinout



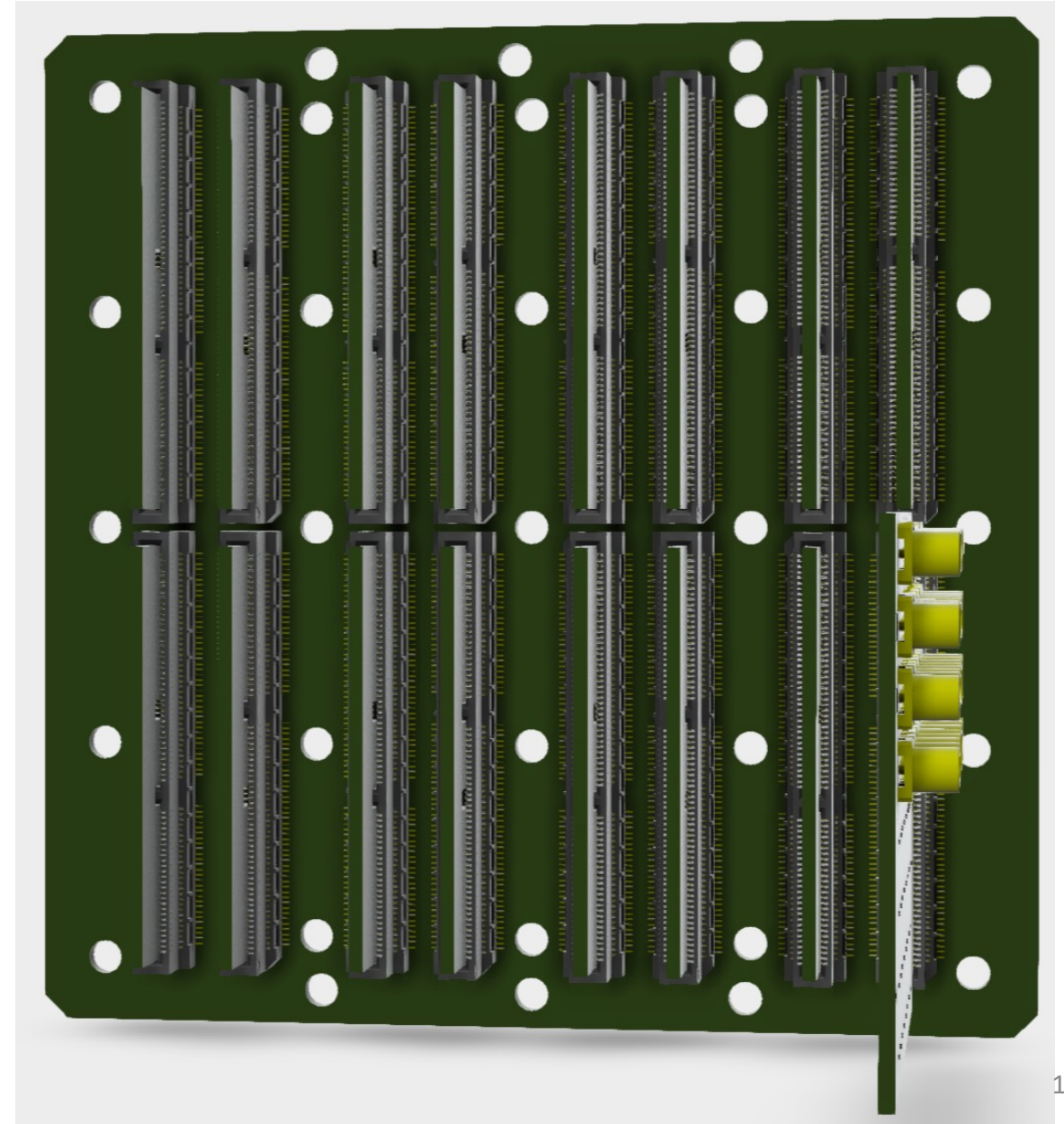
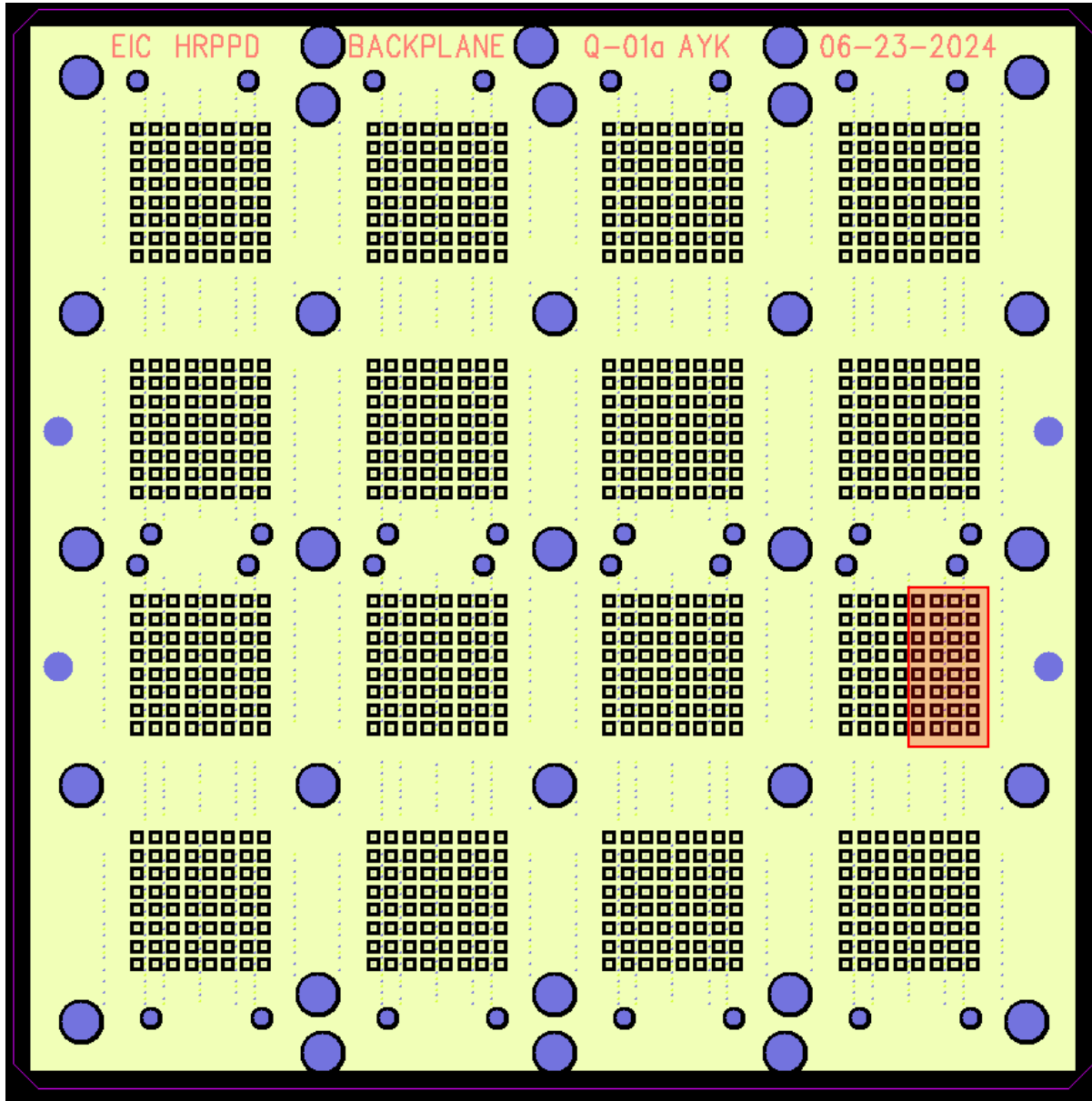
- 635  $\mu\text{m}$  pitch
- Insertion & extraction “force”: smaller than using other connector types
- 16x @ ~\$8.0 -> <\$150 / board
  - And no mating connectors on plugin cards
- **Pros**
  - Ground plane (provided by the edge card)
- **Cons**
  - No rotation symmetry in an 8x8 pad spot
    - But there is one in a shared 2x 8x8 pad spot
  - **Seem to be of a (lower quality?) old standard**

# A single L-adapter: location / orientation #1



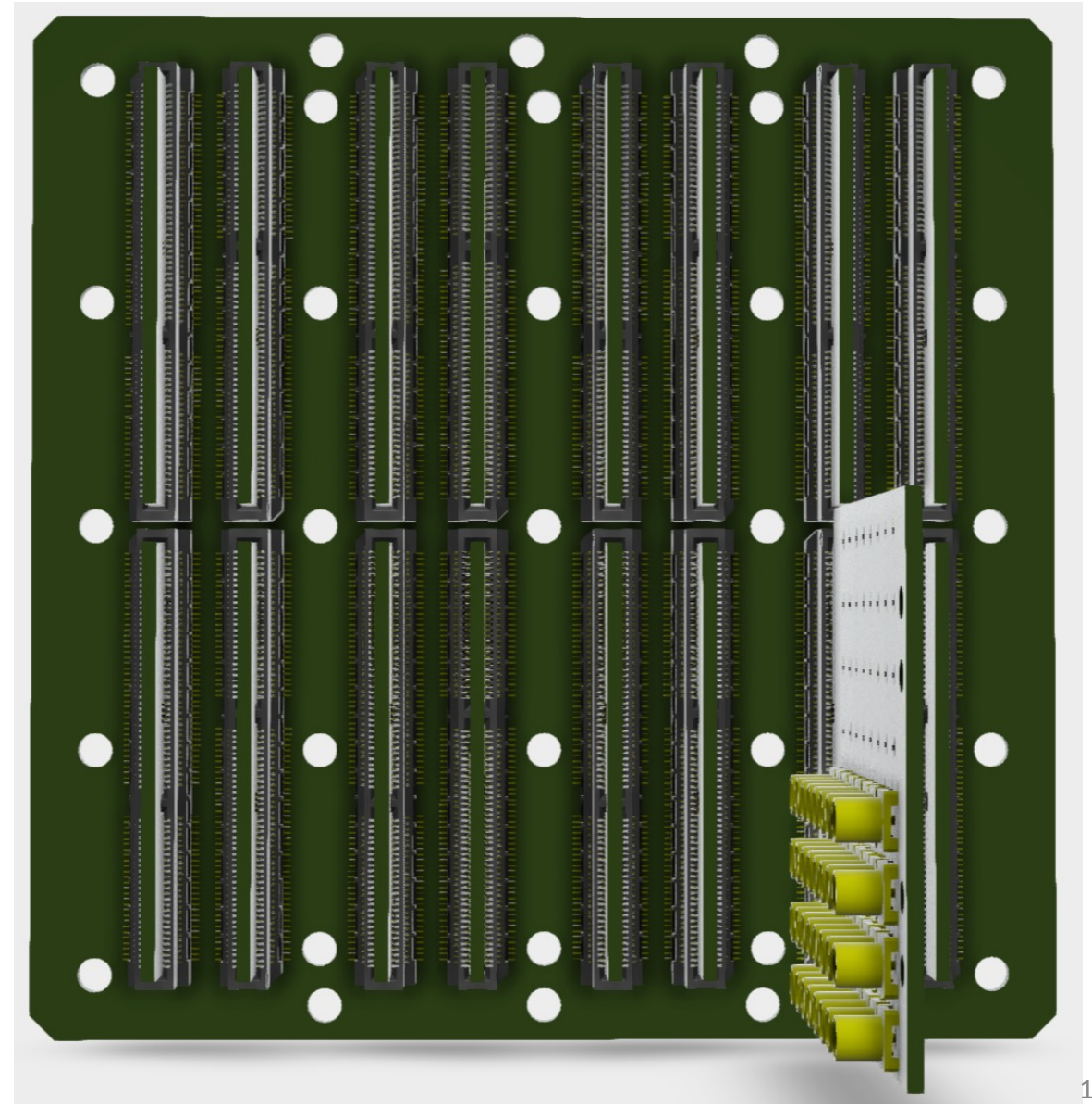
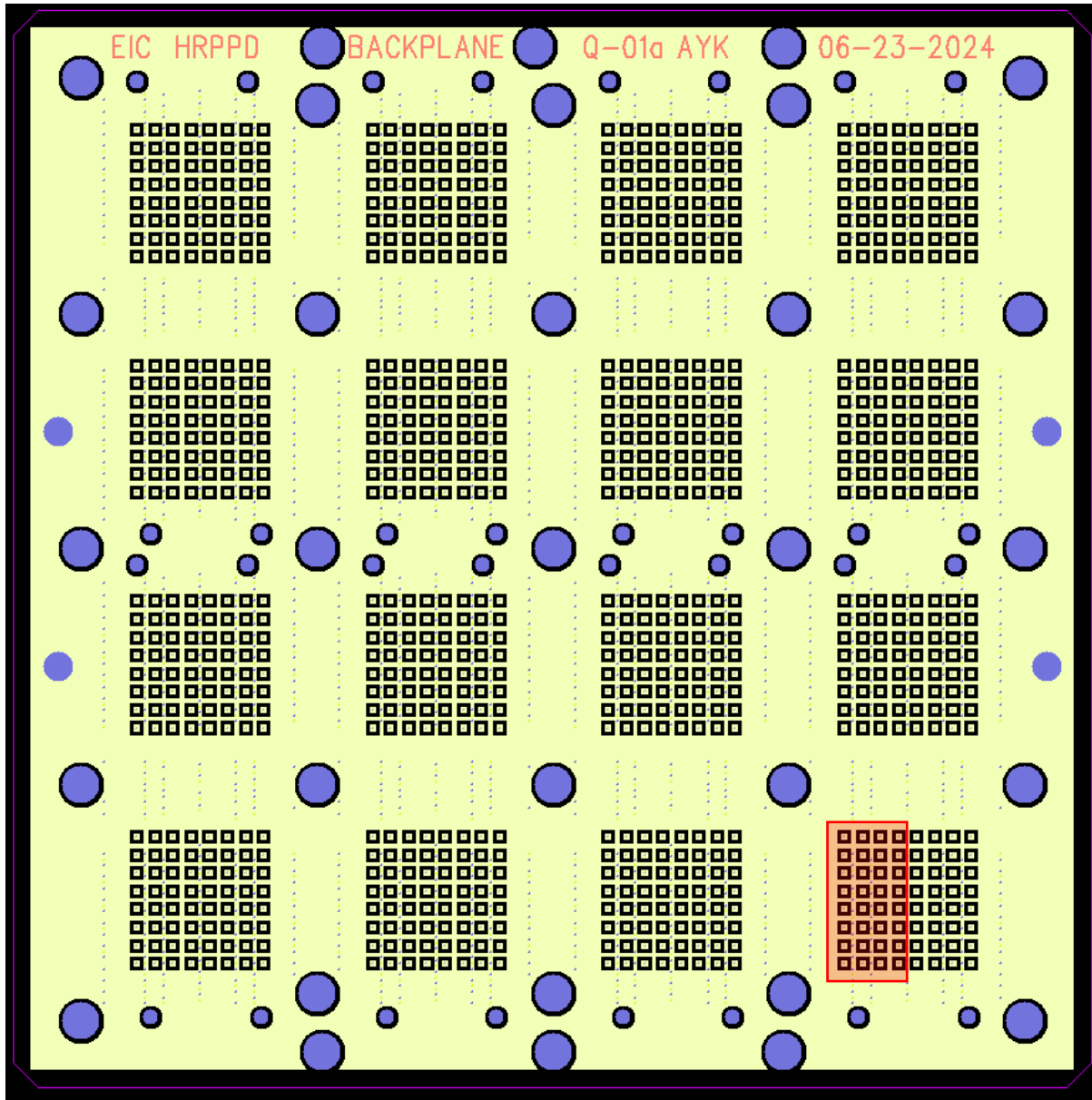


# A single L-adapter: location / orientation #2

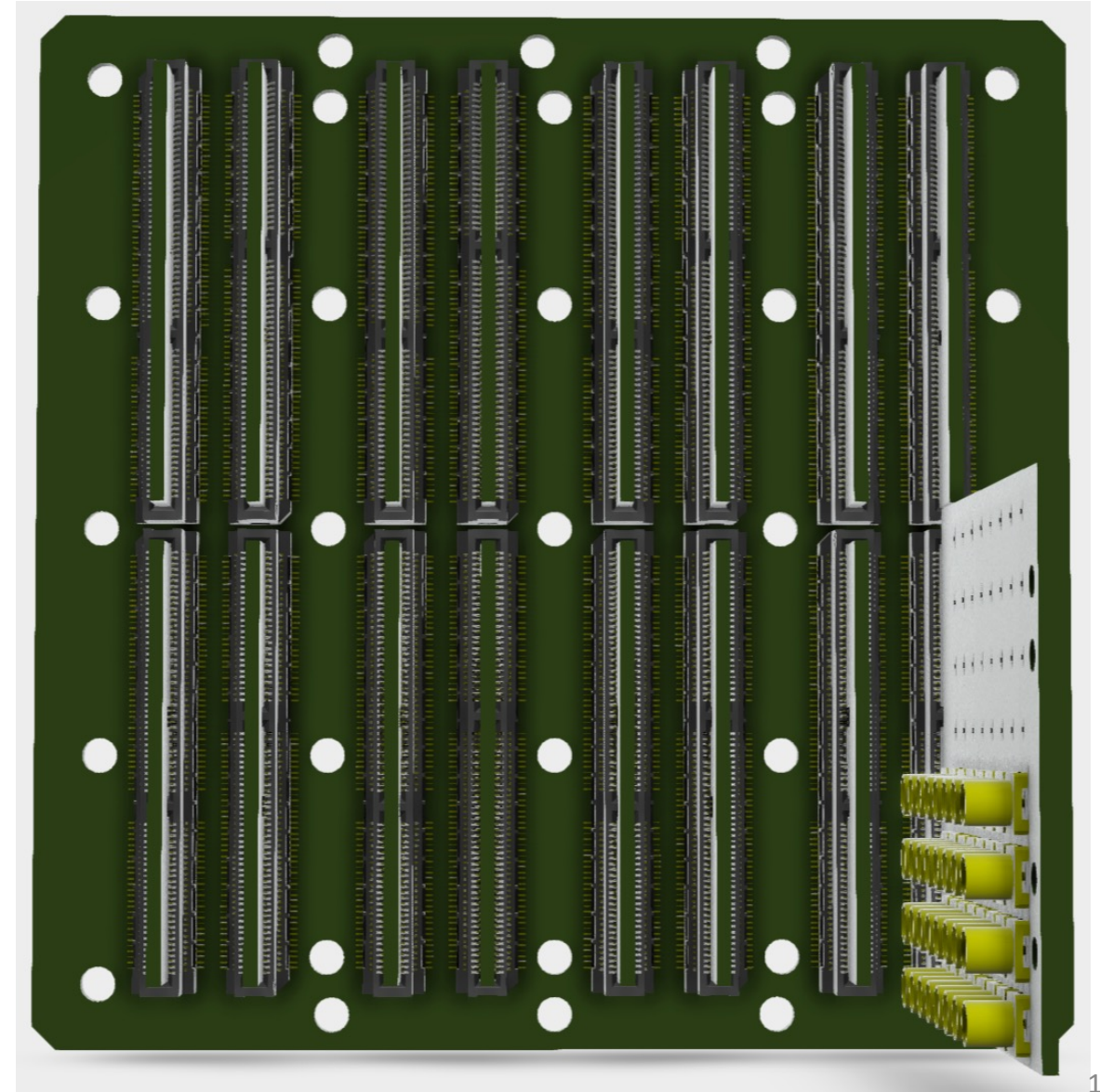
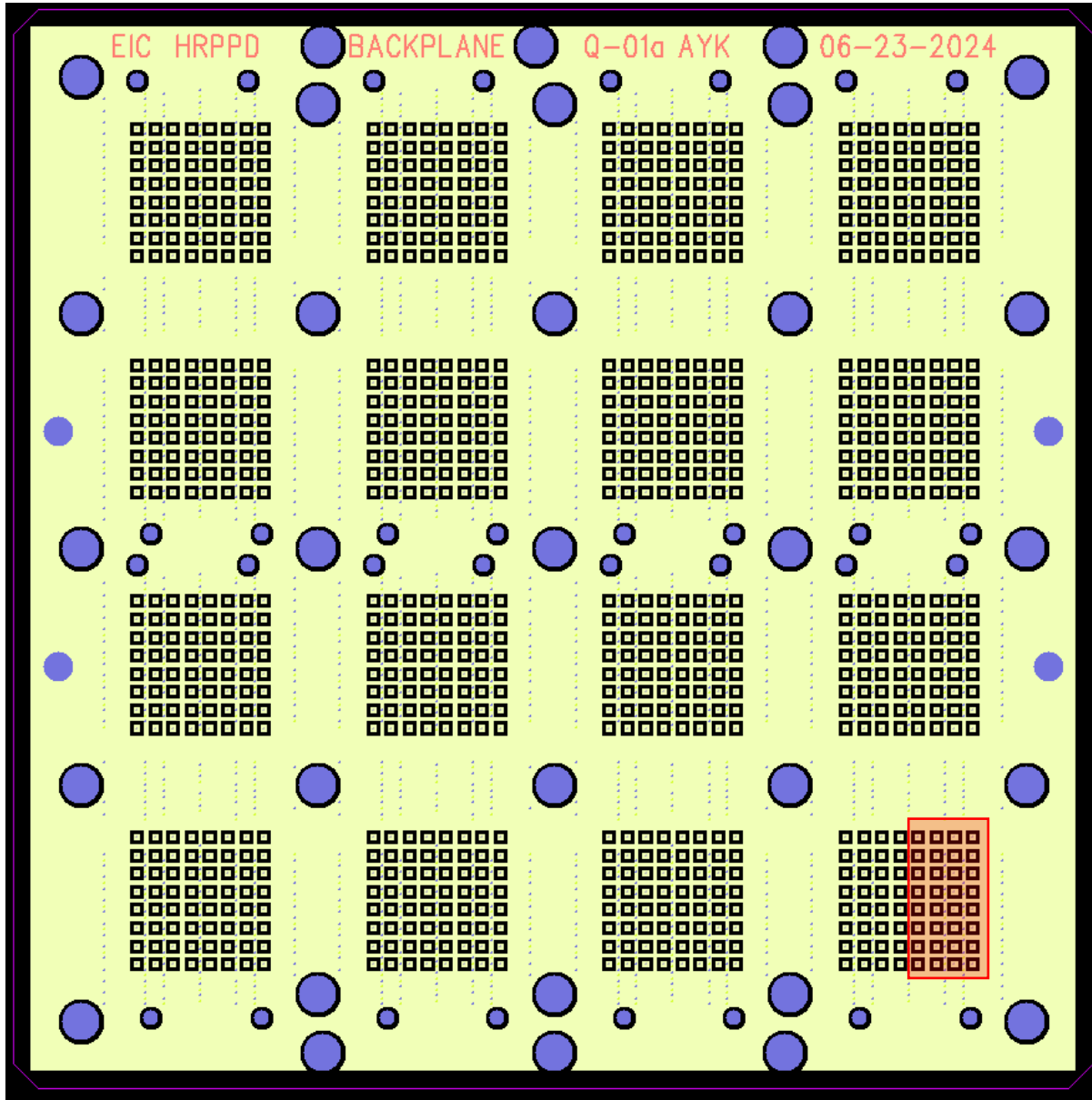




# A single L-adapter: location / orientation #3

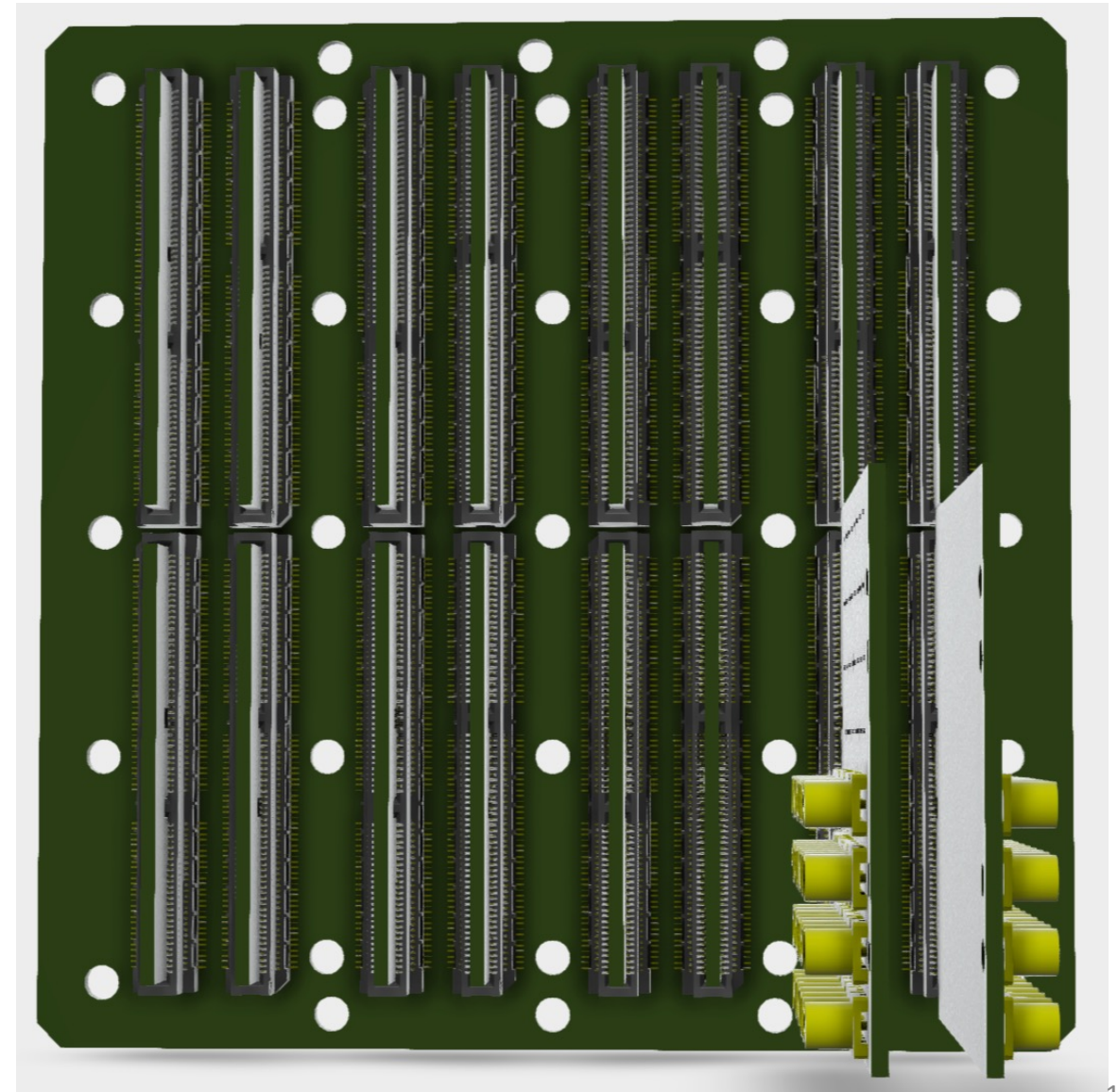
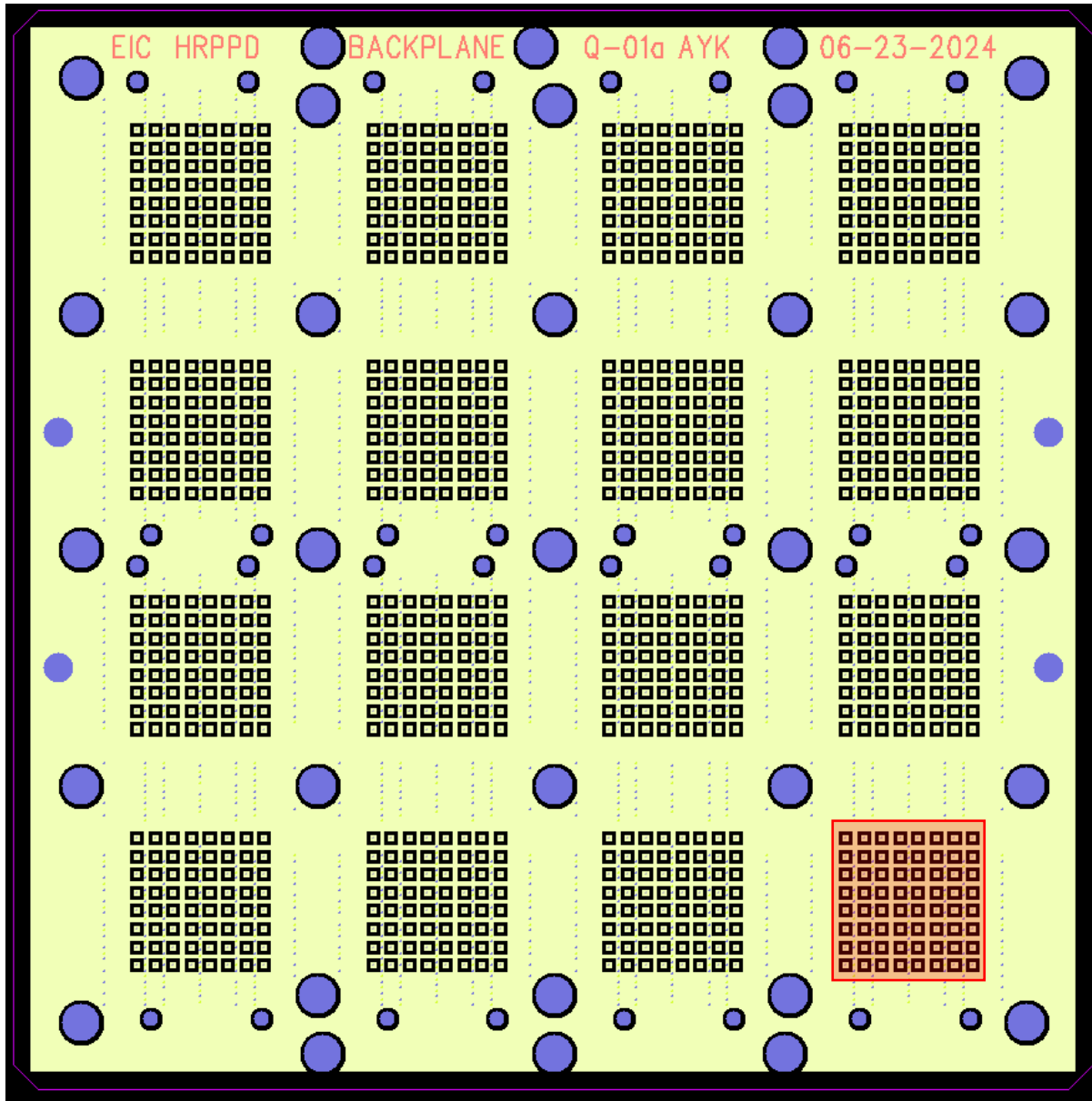


# A single L-adapter: location / orientation #4





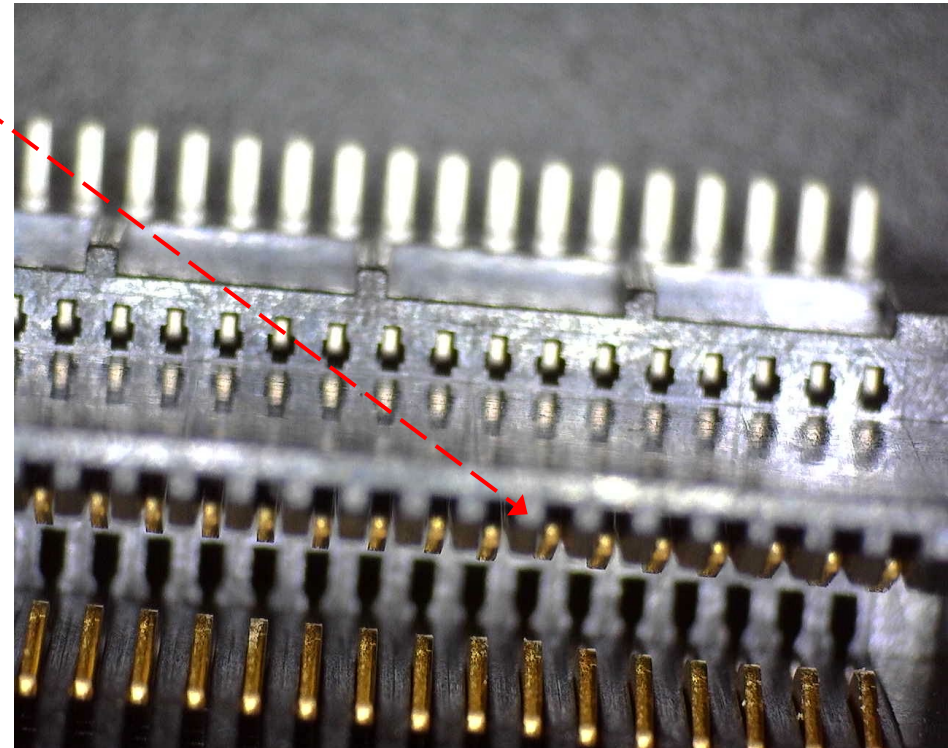
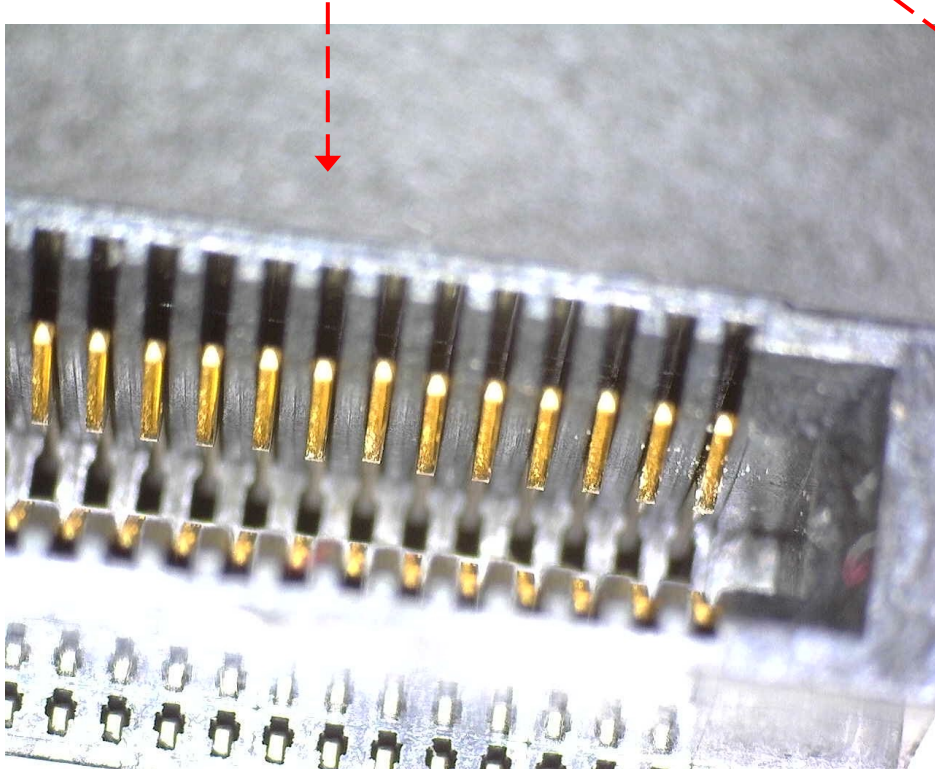
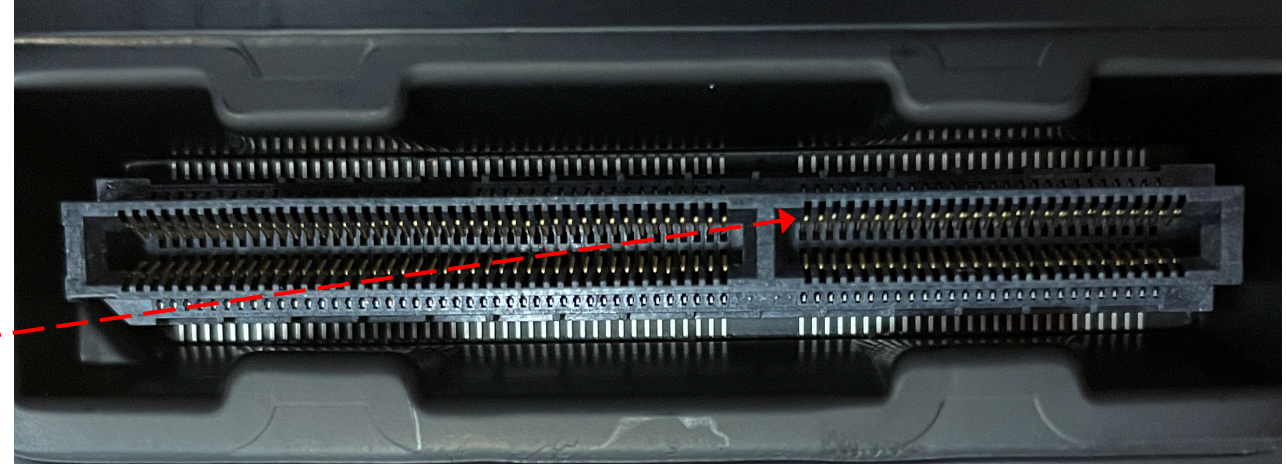
# A pair of L- & R- adapters



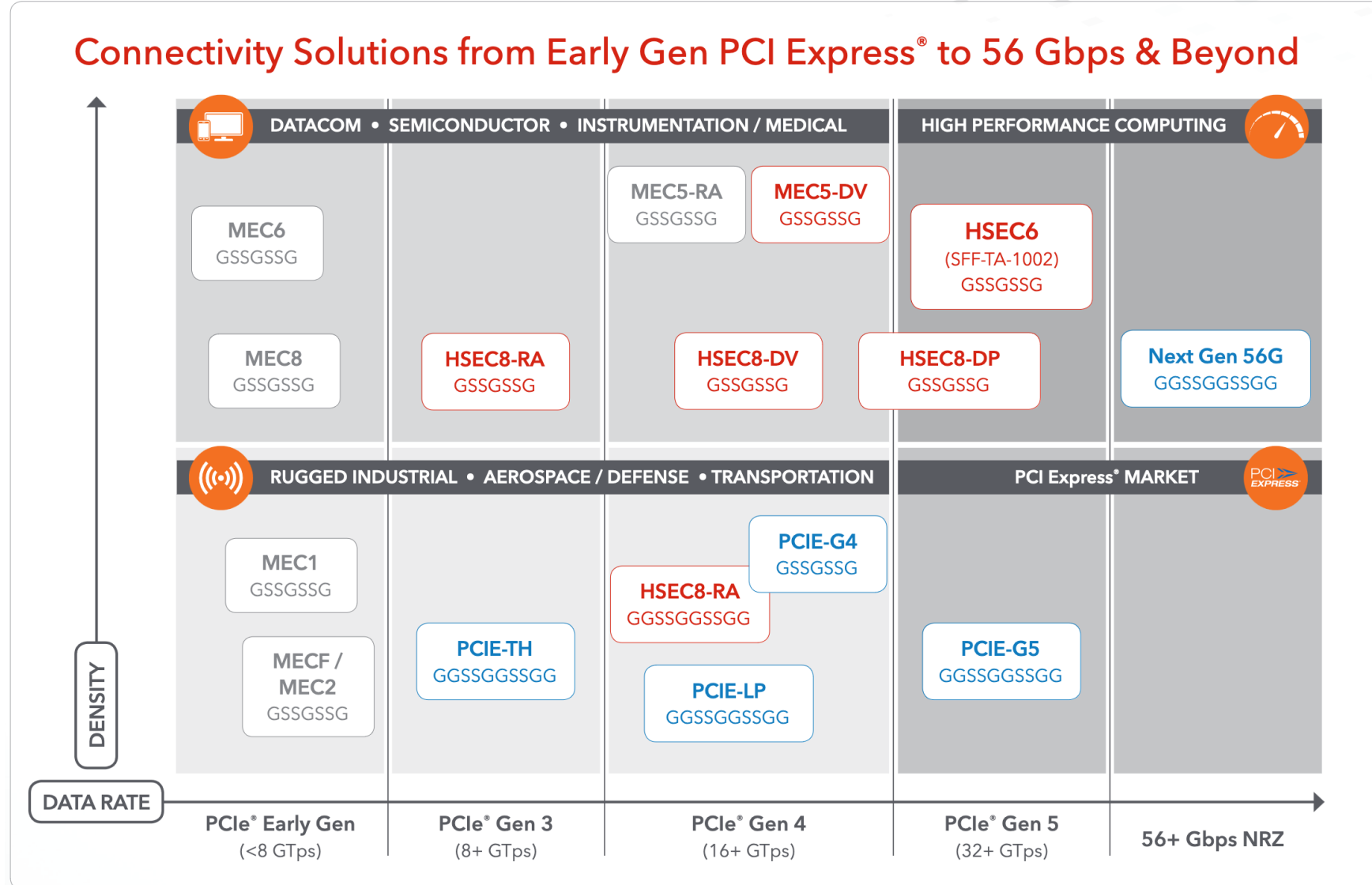


# Samtec MEC6 DV connector: real life evidence

- Appears to be of a lower quality than other Samtec edge connectors
  - As visually compared to SEAM, ERF5, ERF8, even MEC8 of the same family
- Noticeable wiggle in spring contact tips
- Kind of tarnished contacts



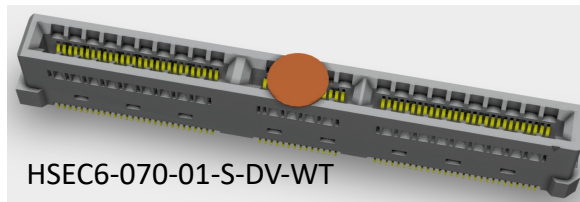
# Samtec edge connector map



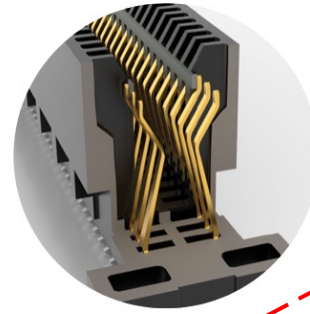


# Where do we go from here

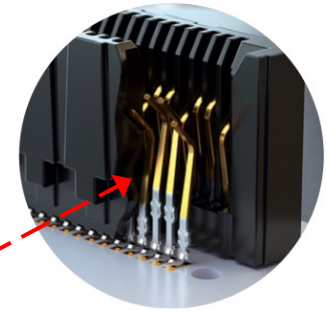
- Proceed with MEC6 DV nonetheless?
  - Well, after all it still qualifies according to the specs, right?
- Consider more modern Samtec edge connectors (MEC5 DV, HSEC6)?
  - MEC5: no chance to use for ASIC cards
    - Will be just a pair of connectors per 8x8 spot
  - HSEC6: same as HSEC8, optimized for differential pair configuration (?)
    - A 70-pair version would still fit and require a minimal re-design



- Back to square one?
  - Non-edge connector geometries
  - Other manufacturers



Rugged tuck beam technology (HTEC8)



Differential pair for increased speed (HSEC8-DP)

