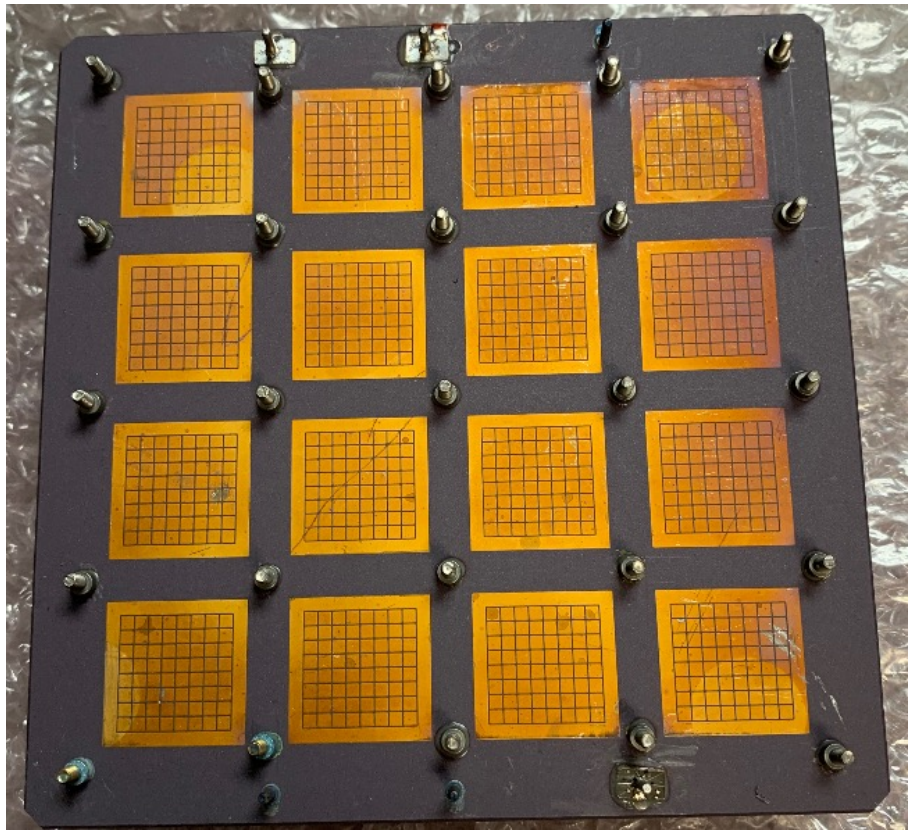
HRPPD Progress Report – March 21, 2024



HRPPD #15 – EIC #1

Arshak Asaturyan, Beni Zihlmann, Carl Zorn (presenter) - JLAB
Alexander Kiselev (BNL)
March 21, 2024

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Initial JLAB Test Program

- JLAB purchased 5 initial samples of current generation of HRPPD
- @ JLAB ➔ Show that the device is “alive” so that it can “approved” and payment made to Incom
- Collect data on all 1024 channels (if possible) and whatever other data can be collected in reasonable time frame
- Then ship to BNL for full test program
- Eventually JLAB will build full test station (Arshak Asaturyan)
- Yale is also preparing full test station

Two setups

Current – ARC L215 - Detector Group Lab

In preparation for future full test program

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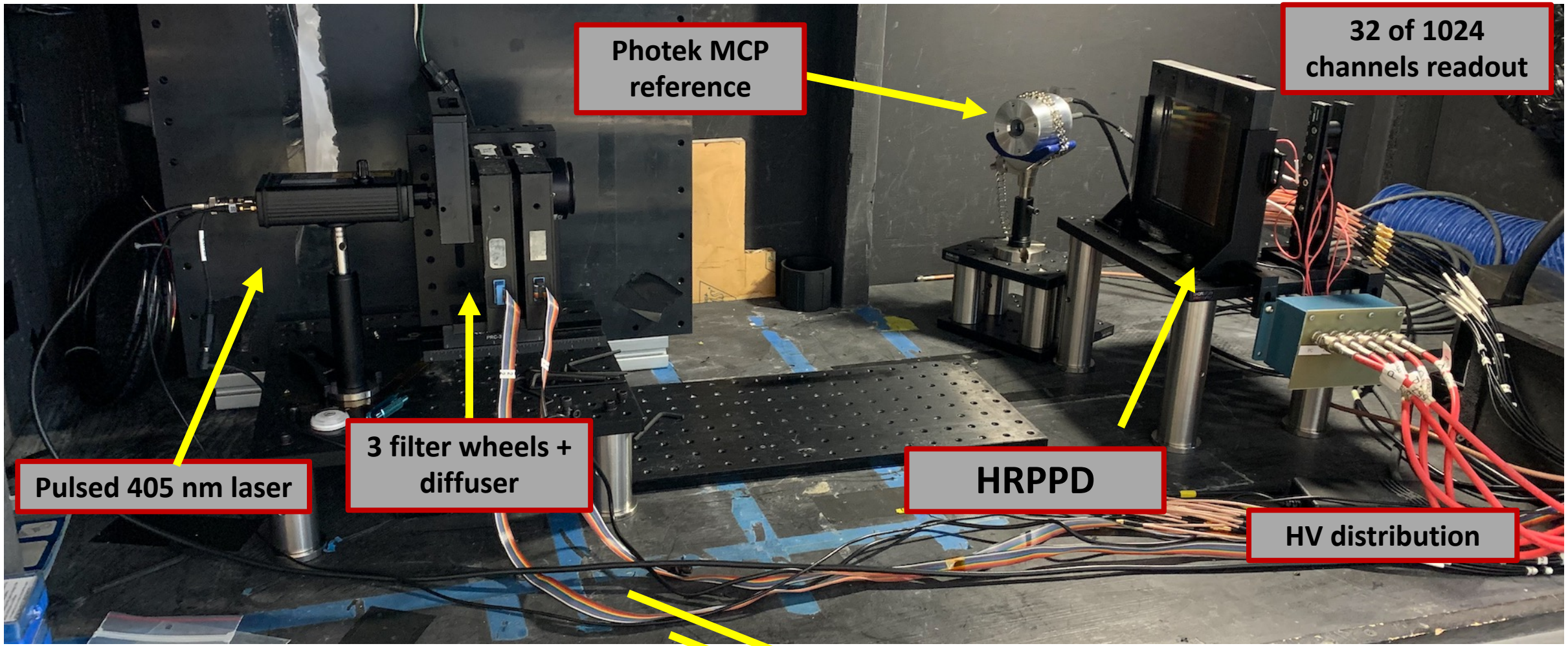
Current Test Setup



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Status of JLAB setup

- Much of HRPPD readout equipment is on loan from BNL – HRPPD enclosure, 3D-printed parts, interposers, readout board + connectors, MMCX adapters, MCX cables – thank you Alexander

- We have VME crate with QDC and new V1742 digitizer (both 32 channels) – but need JLAB DAQ personnel to finish the JLAB software/hardware setup
  - Have several oscilloscopes on hand

- Initial data for now based on oscilloscope measurements (transit time variation) and dark rate studies with NIM electronics

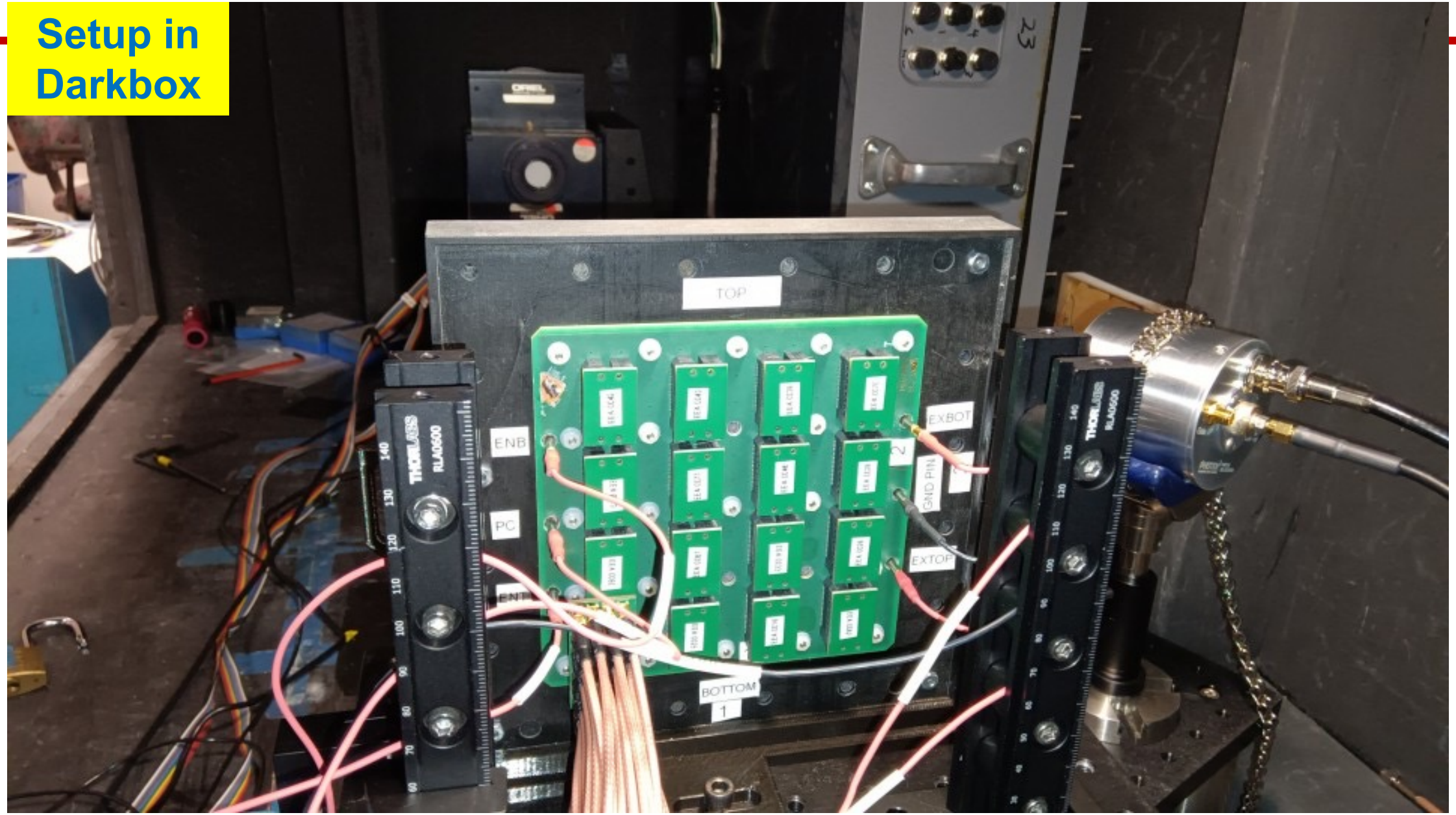
- Measurement test program is still evolving

- Note – every HRPPD sample comes with test report generated by Incom

- We have weekly Wednesday meetings with Incom to discuss status

- For those with JLAB computer access https://logbooks.jlab.org/book/hrppd

Setup in Darkbox



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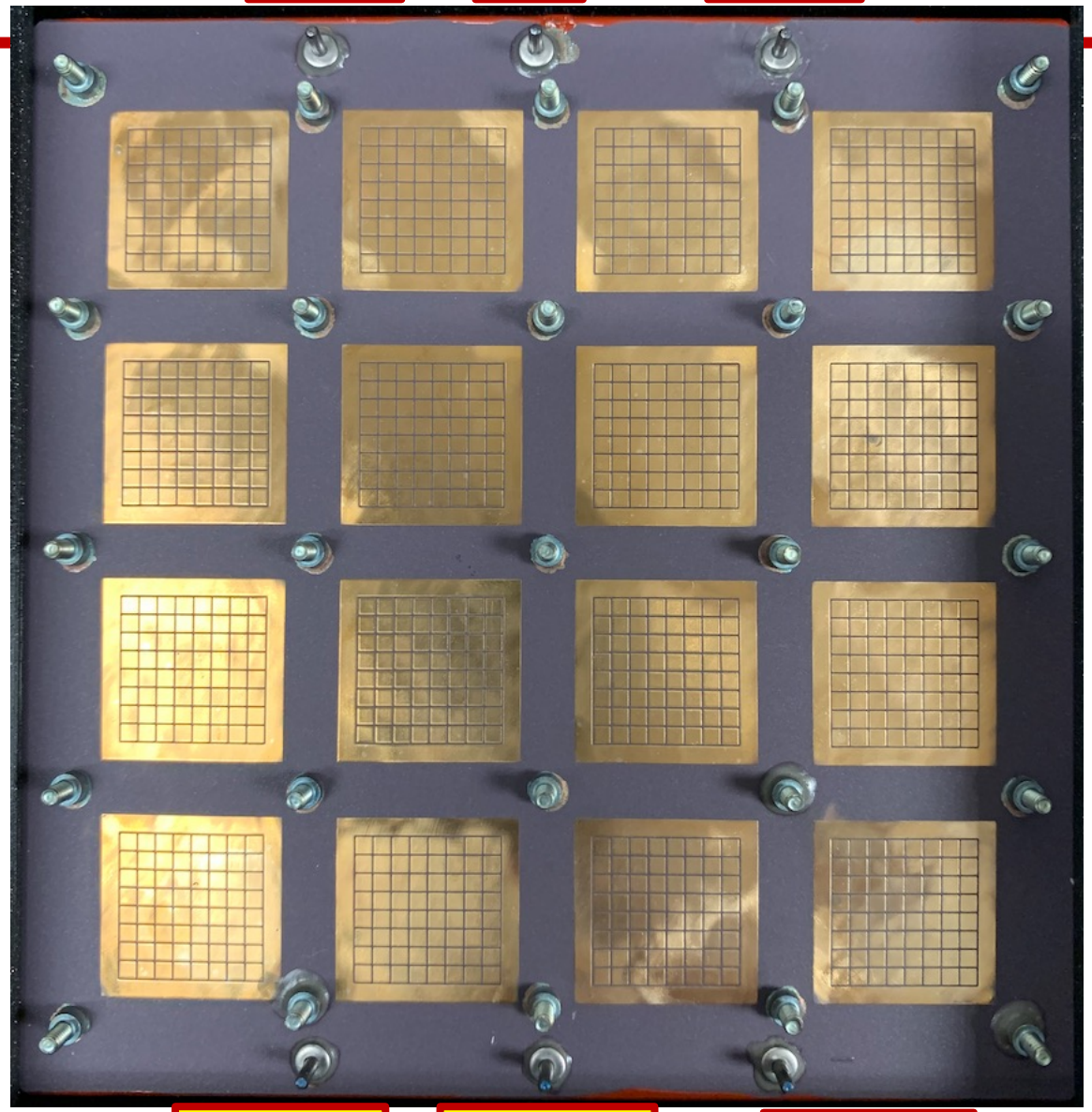
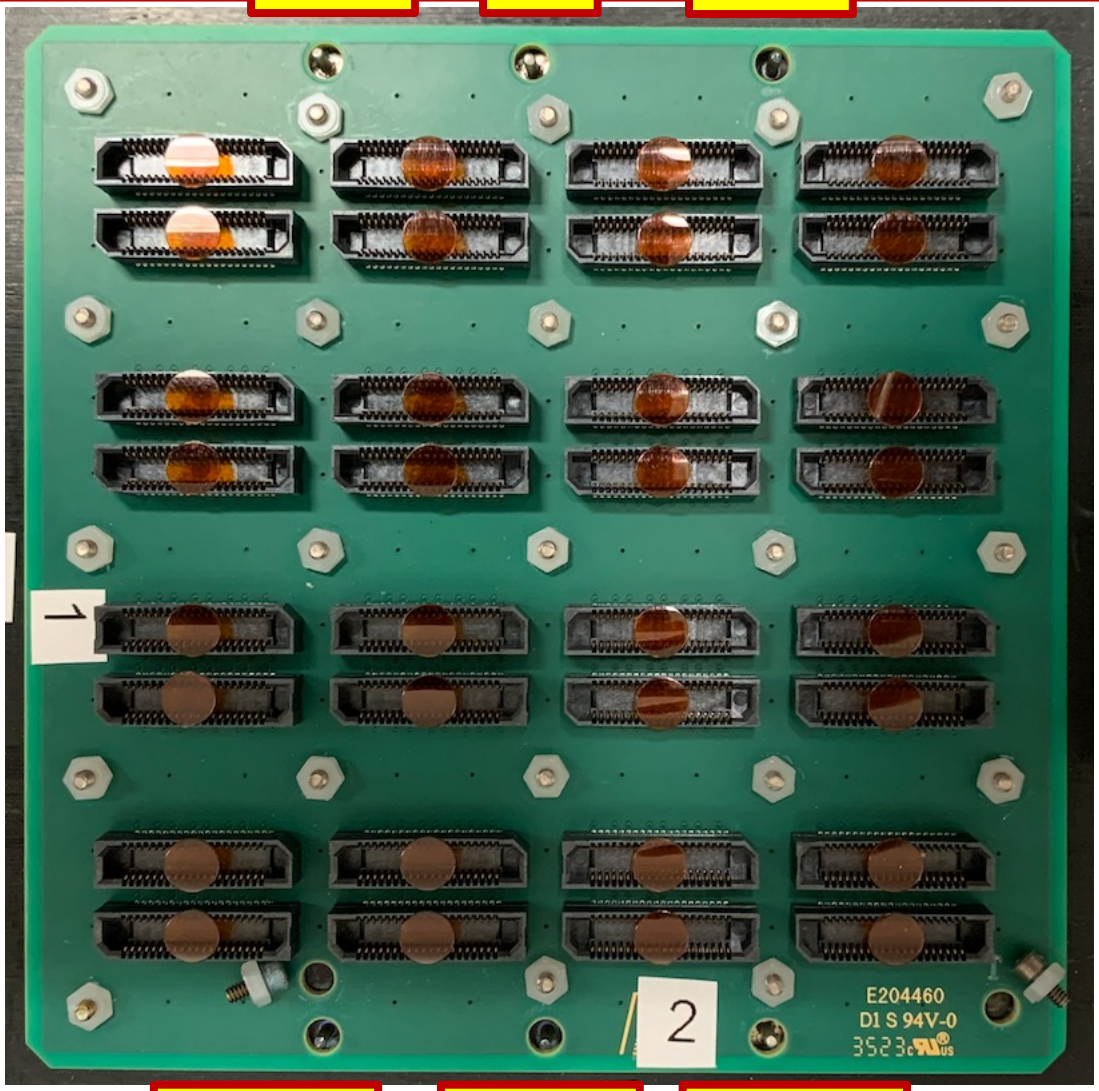
ENT PC ENB



EXTOP GRND EXBOT

ENT PC ENB



EXTOP GRND EXBOT

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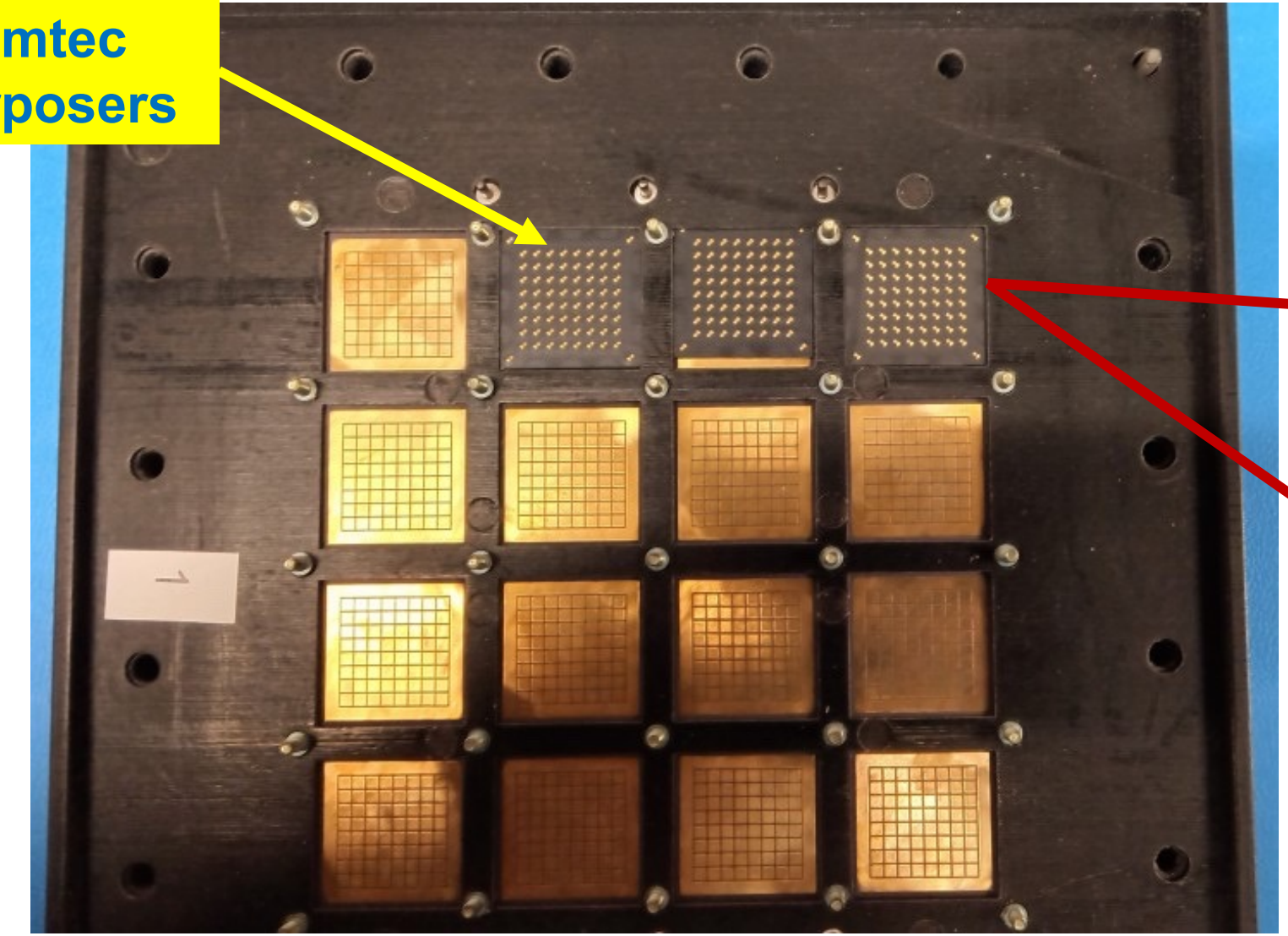
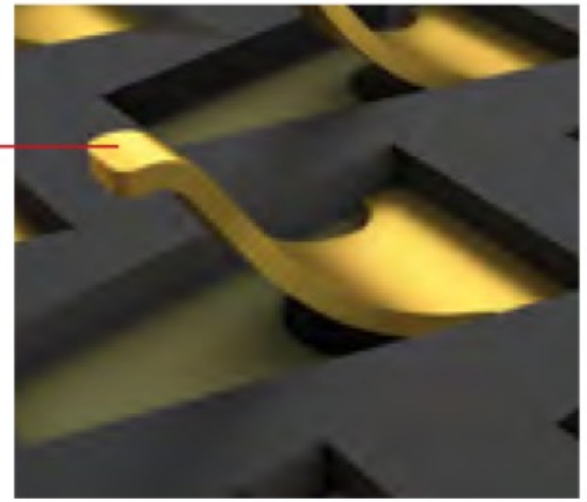
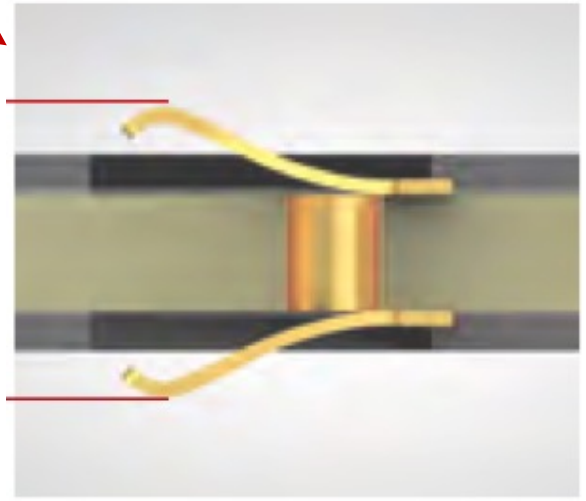
Install interposers between anode array and readout board

Samtec interposers







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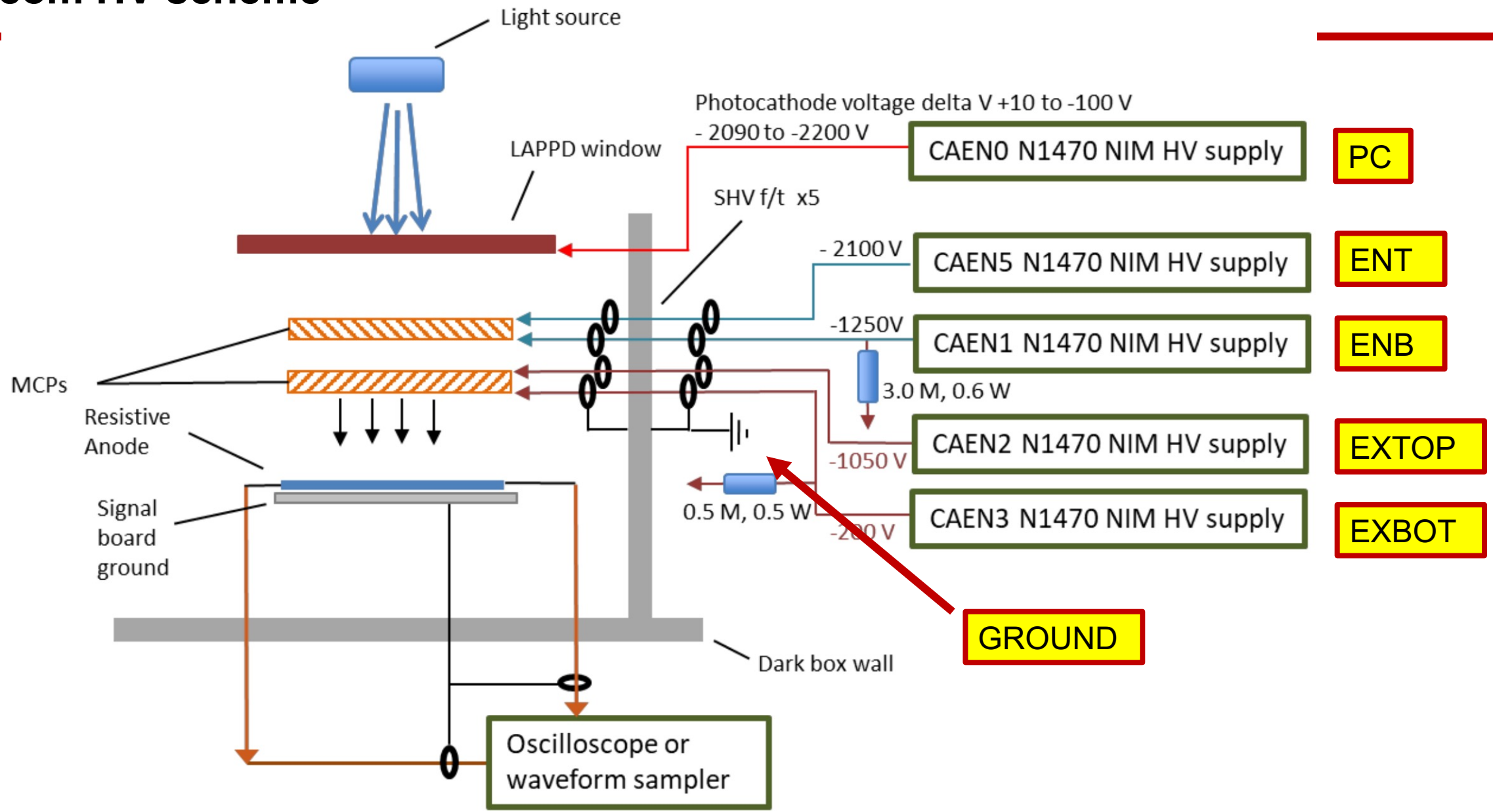
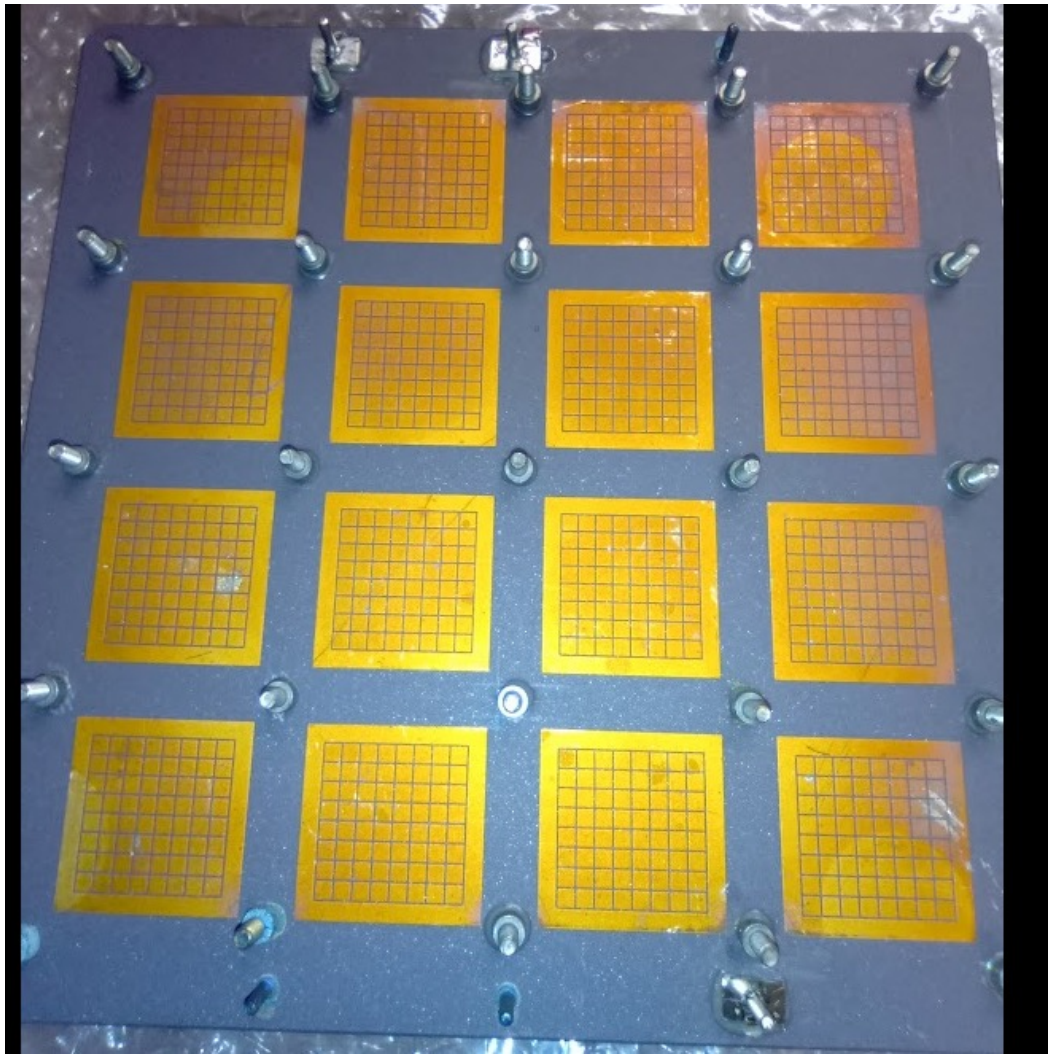
Incom HV scheme



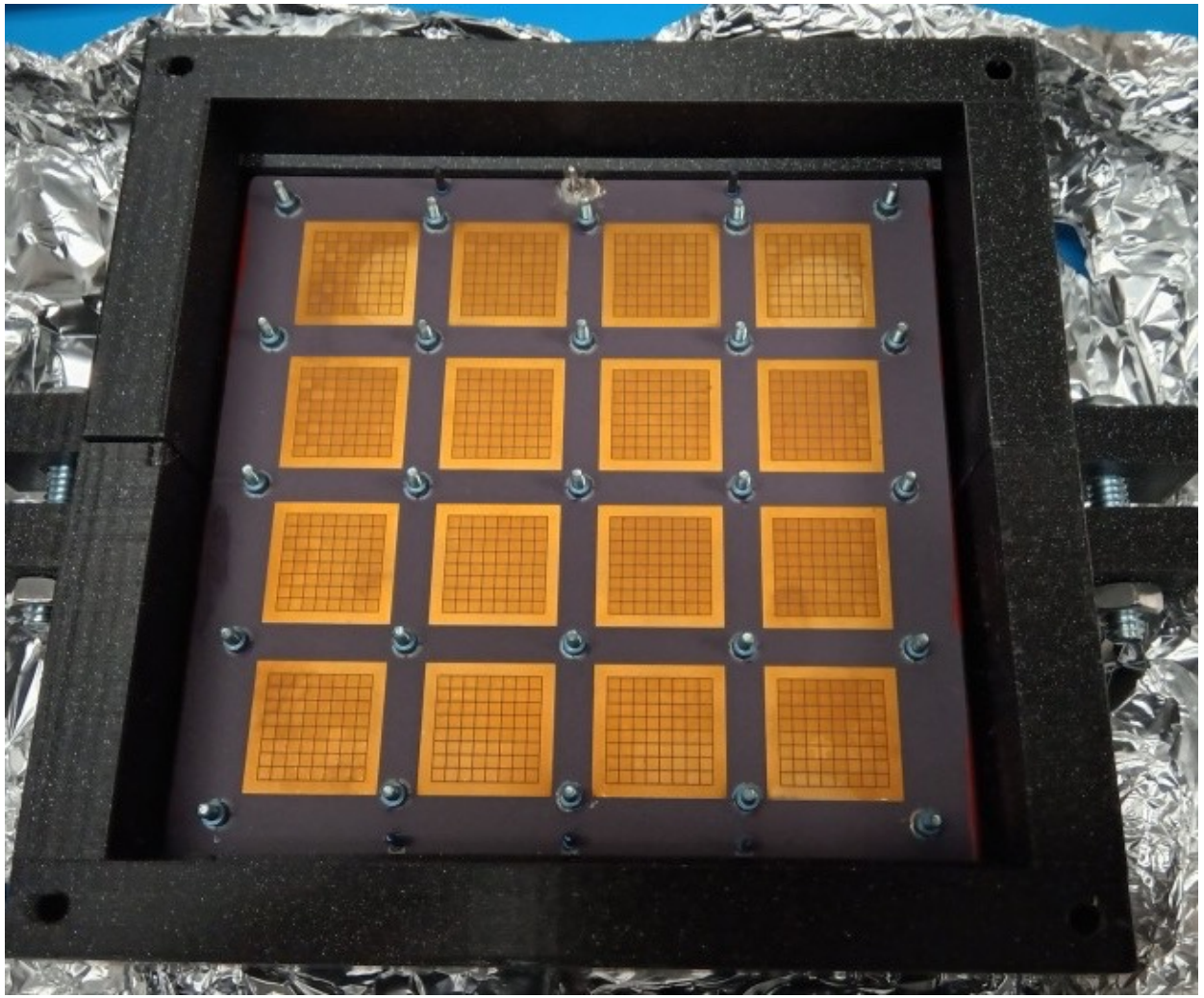
Incom recommended HV values

	HRPPD 15 (1)	HRPPD 16 (2)	HRPPD 17 (3)	HRPPD 18 (4)
PC	-2,150	-2,100	-1,950	-2,200
ENT	-1,950	-1,700	-1,650	-2,100
ENB	-1,175	-1,050	-1,025	-1,250
EXTOP	-975	-850	-825	-1,050
EXBOT	-200	-200	-200	-200
PC MAX	-2,350	-2,100	-2,050	-2,500

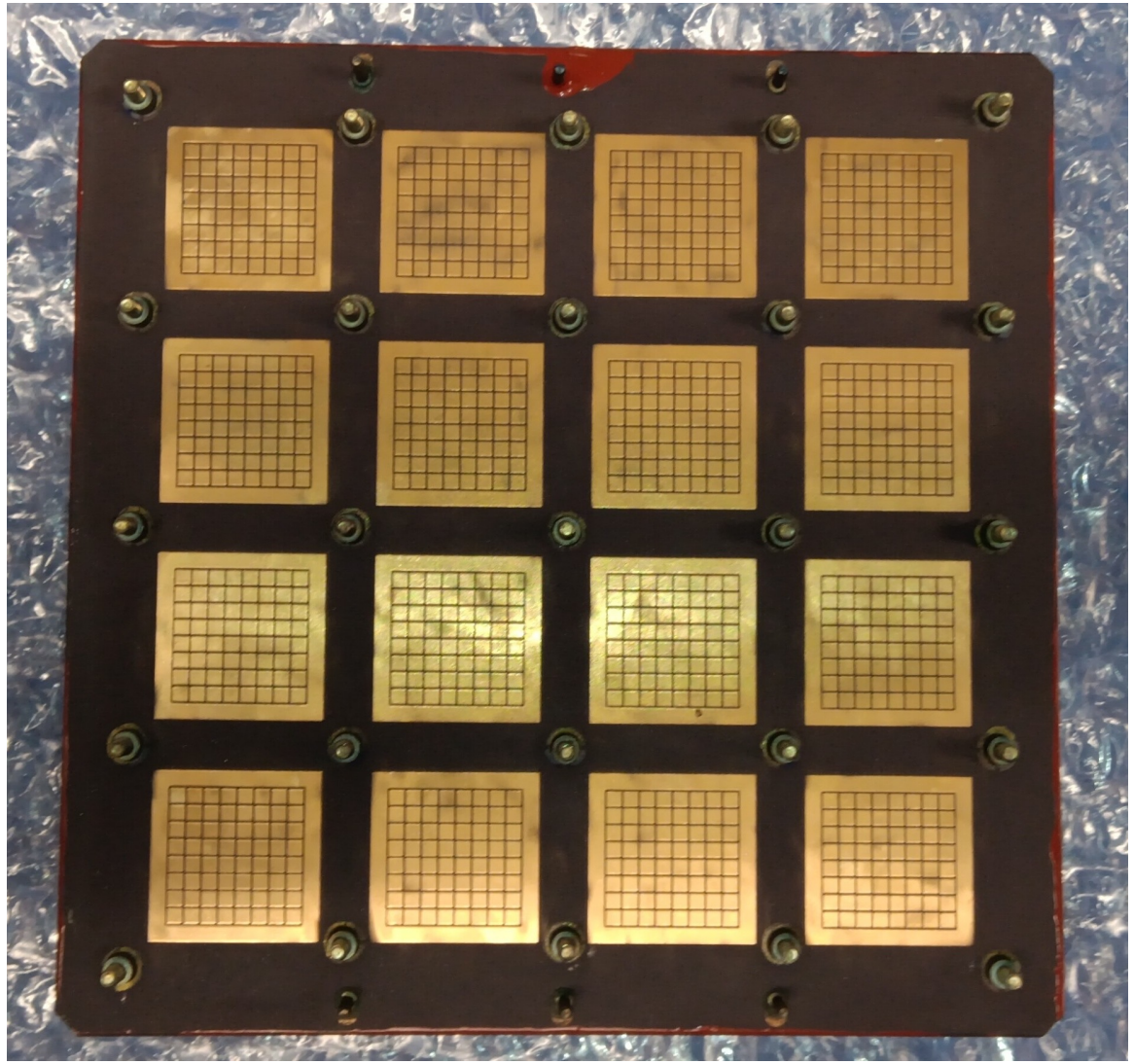
HRPPD 15



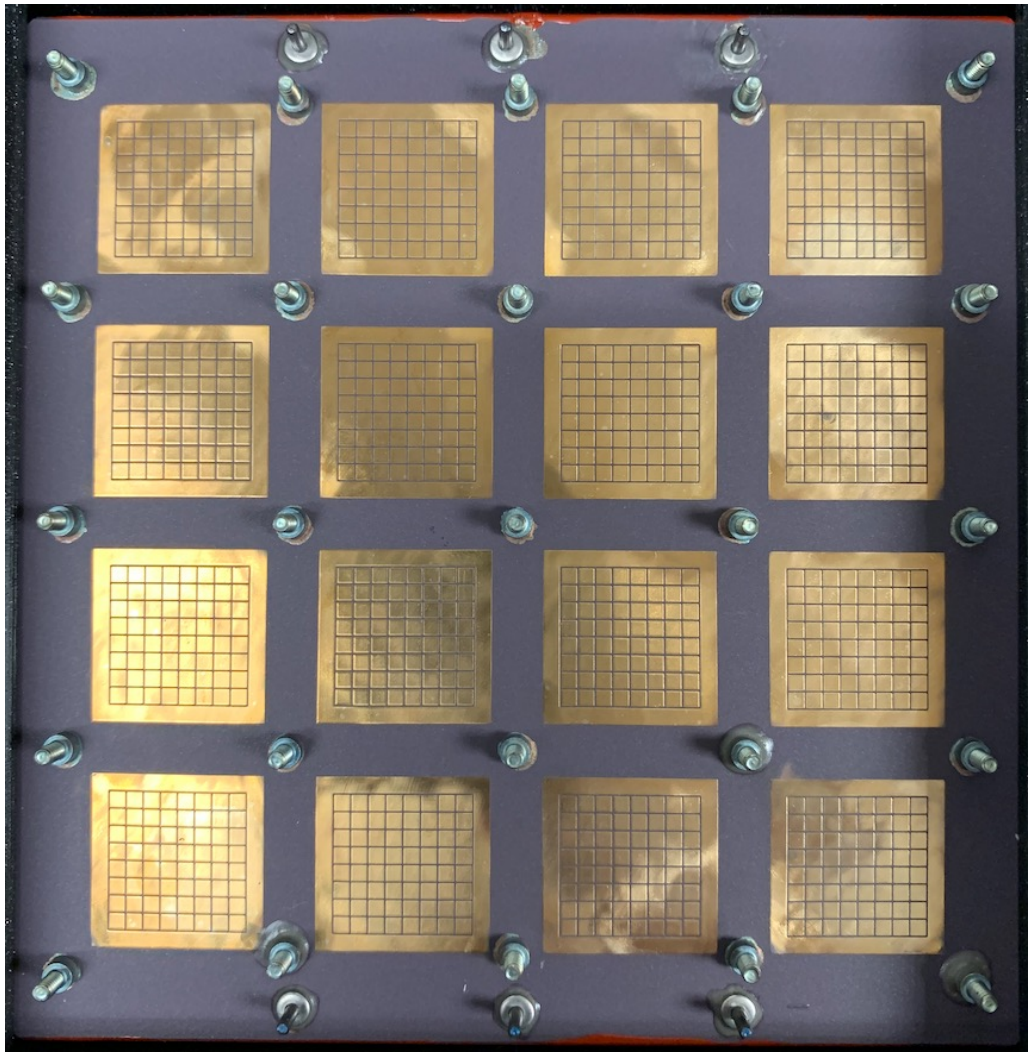
HRPPD 16



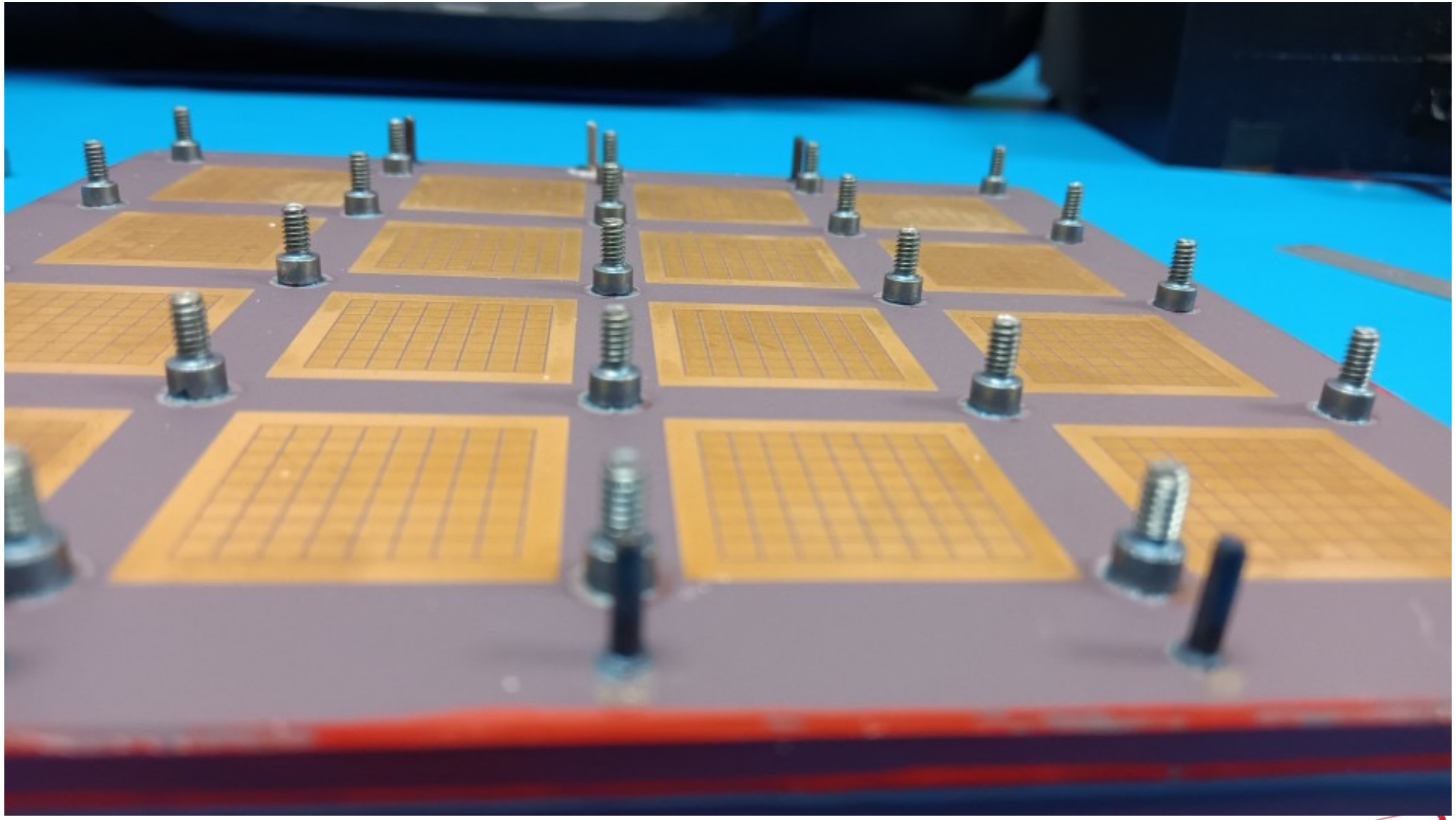
HRPPD 17



HRPPD 18



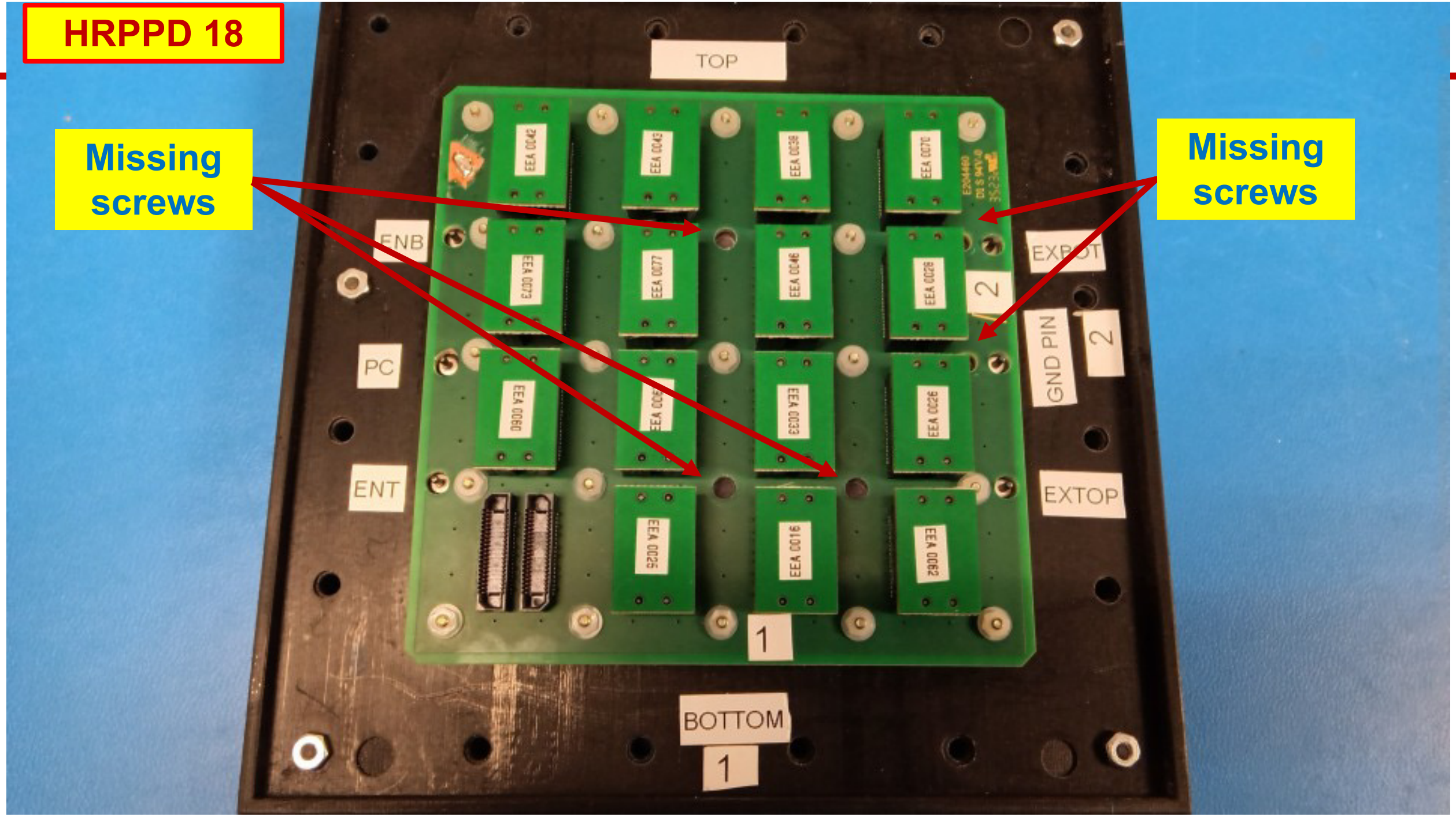
2-56 screws attached to ceramic



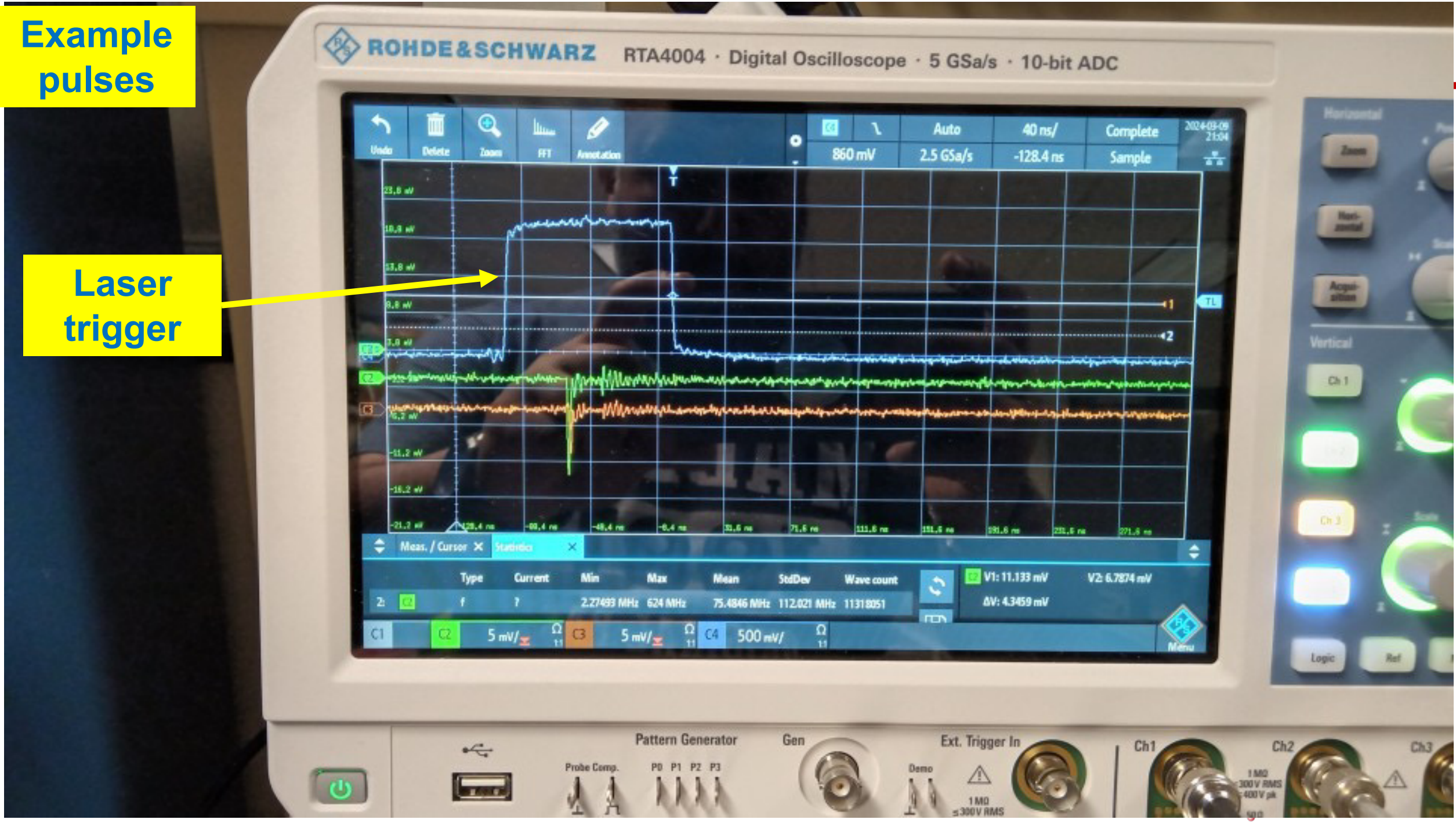
Some Notes for first four HRPPD samples

- when tightening small nylon 2-56 nuts – found that several of the screws would simply pop off with very small torque
- In addition – some HV power pins would also come off when installing or removing HV connections despite the care taken
- First two (#15 & #16) shipped back for repairs
- Third (#17) was operated and (noisy) signal seen despite ground pin broken – afterwards sent back to Incom for repair
- Fourth (#18) is first to operated with minimum problem despite loss of some screws – and excessive glue made it difficult to attach readout board - it is also being returned to Incom (5 screws popped off)
- Repaired #15 and #16 are back onsite - #15 operating successfully

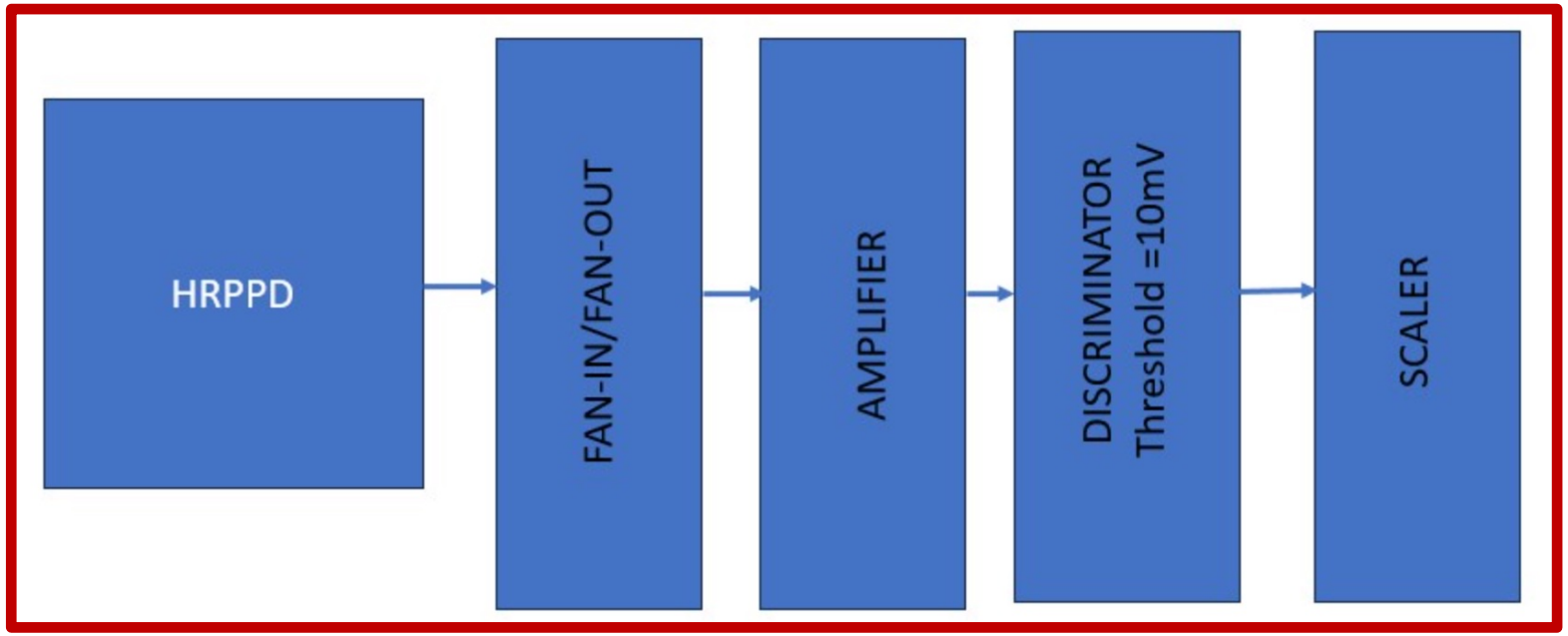
HRPPD 18


Missing screws
Missing screws
TOP
ENB
PC
ENT
EXBOT
GND PIN
2
2
EXTOP
1
BOTTOM
1

Example pulses

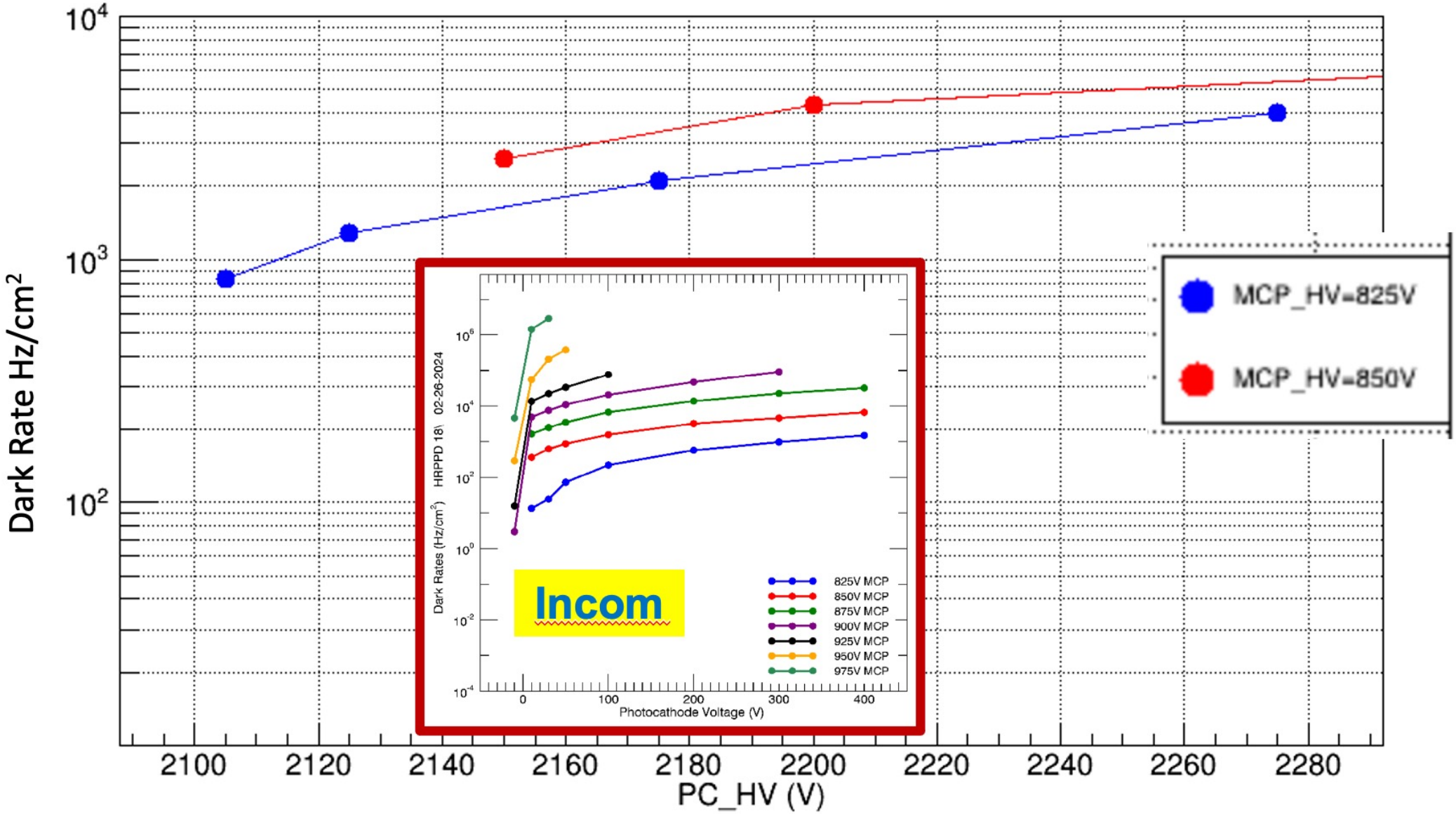


Dark Rate Measurements



Incom uses oscilloscope directly – measures the Trigger rate on dark pulses > 4 mV

HRPPD#4 (INCOM#18)



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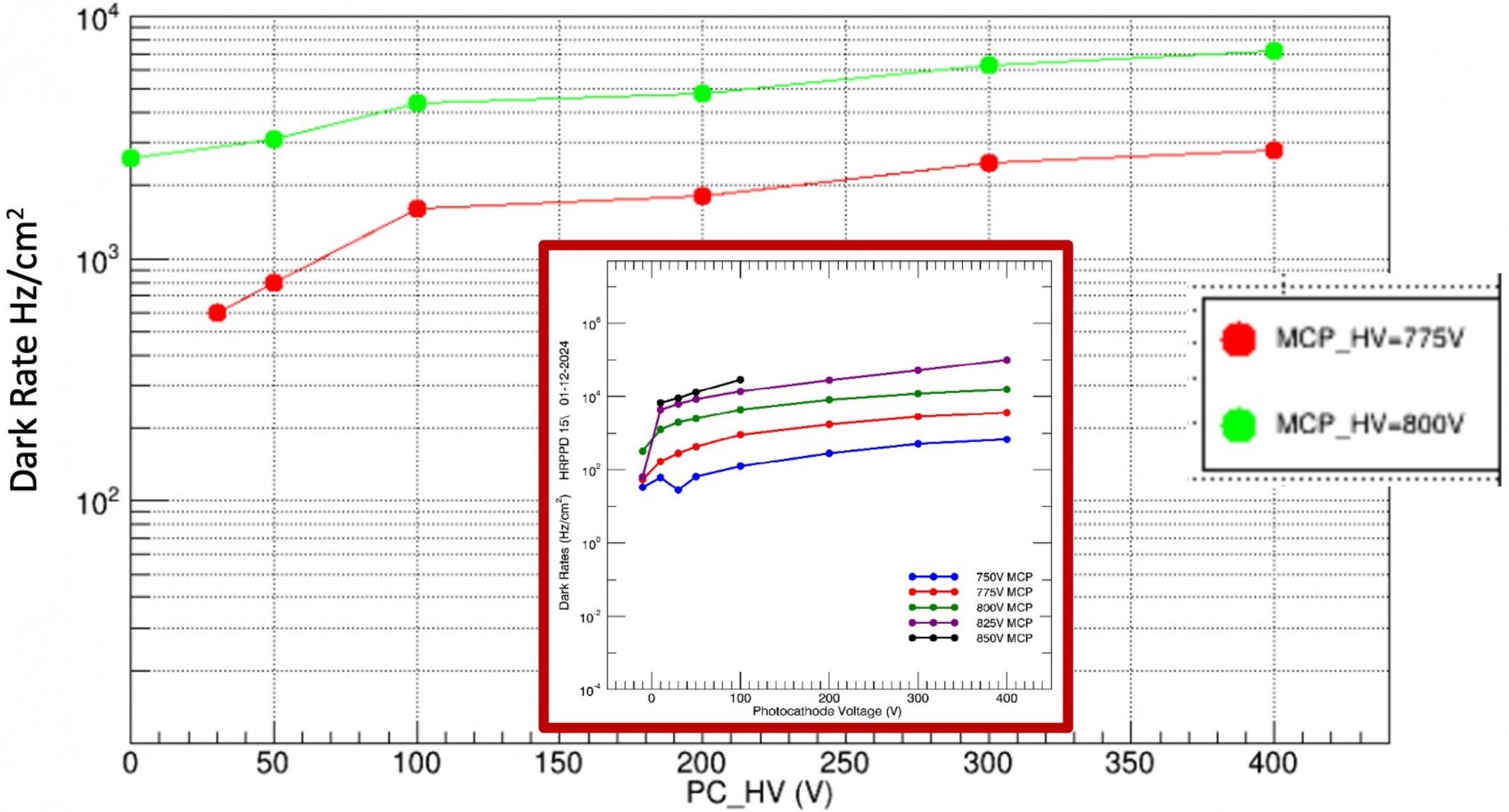
HRPPD#1 (INCOM#15)



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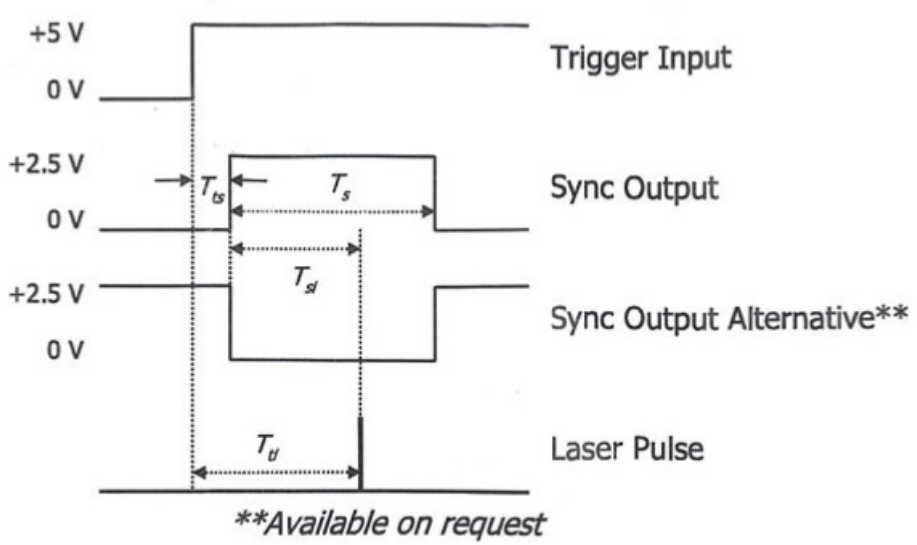
- Transit time variation (TTV) measured with scope with SPE levels of light - laser intensity attenuated to $4x10^{-5}$ (neutral density filters) plus diffusion filter + black mask with 3 mm hole
- Laser trigger rate = 3 kHz
- TTV = 125 ps for HRPPD #17 and 102 ps for HRPPD #15

Typical Timing Parameters	
Trigger – Laser Delay T_{tl}	46 ns
Trigger – Sync Delay T_{ts}	14 ns
Sync – Laser Delay T_{sl}	32 ns
Sync Pulse Width T_s	90 ns
T_{tl} Jitter	3 ps r.m.s.
T_{sl} Jitter	2 ps r.m.s.



Laser Timing Parameters

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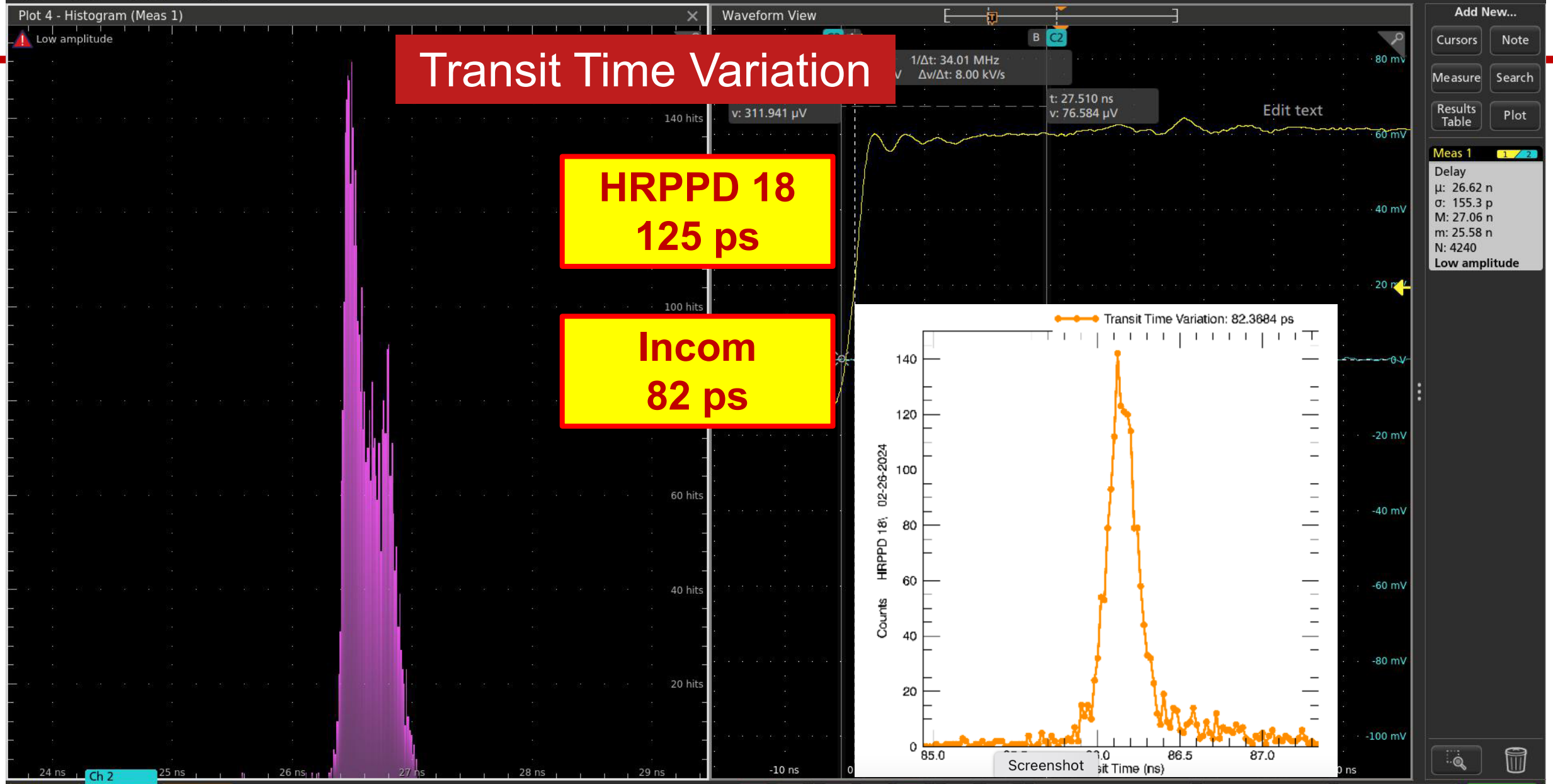
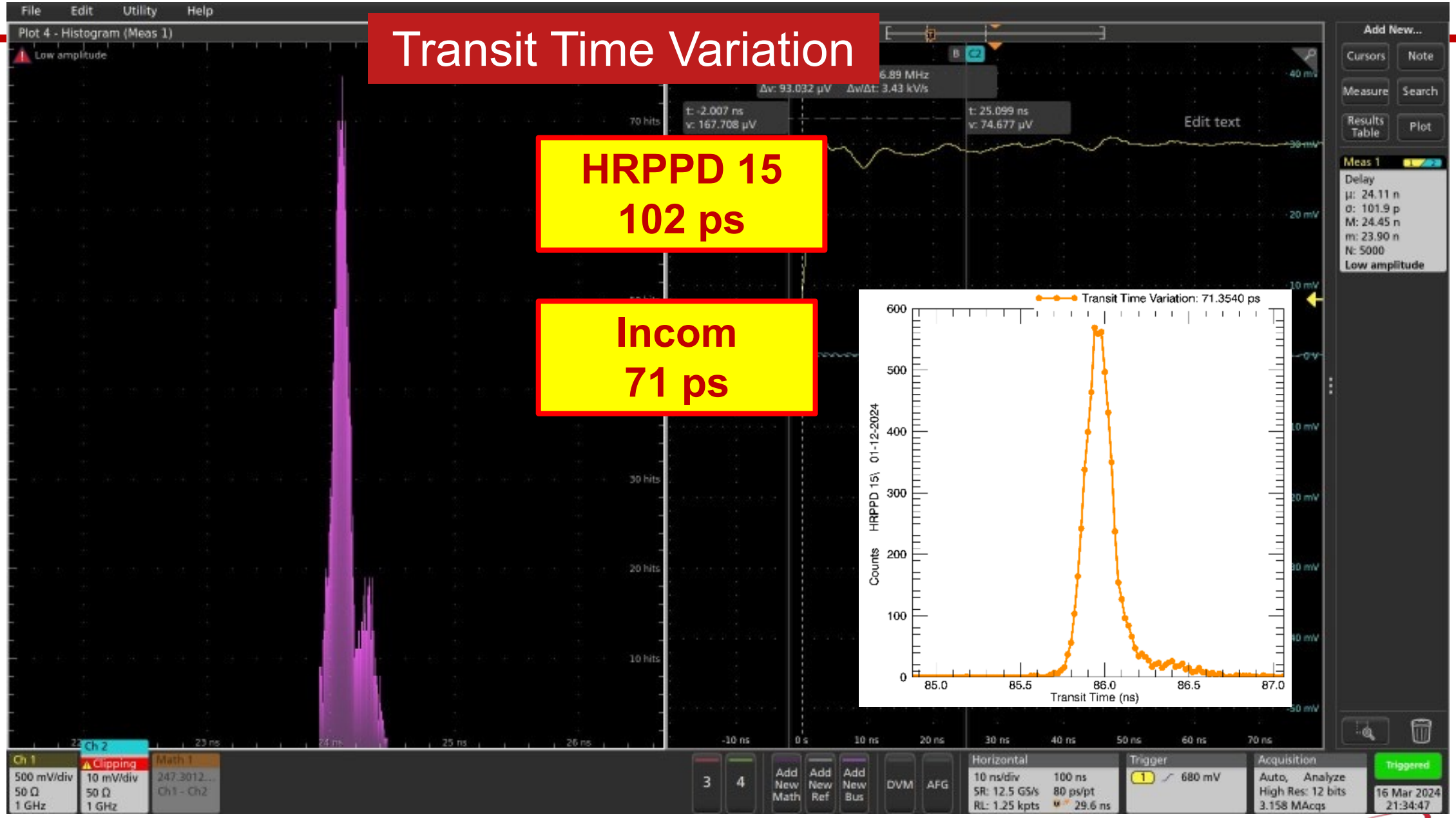
Transit Time Variation

HRPPD 18
125 ps

Incom
82 ps



Transit Time Variation



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Summary

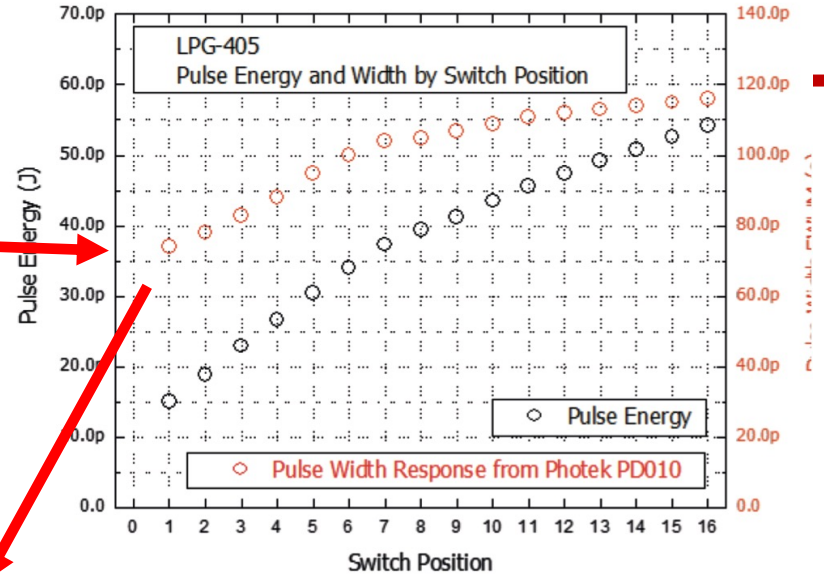
- **Lots of time lost in dealing with initial mechanical problems – spending time on repair cycle - these issues needs to plateau at some point**

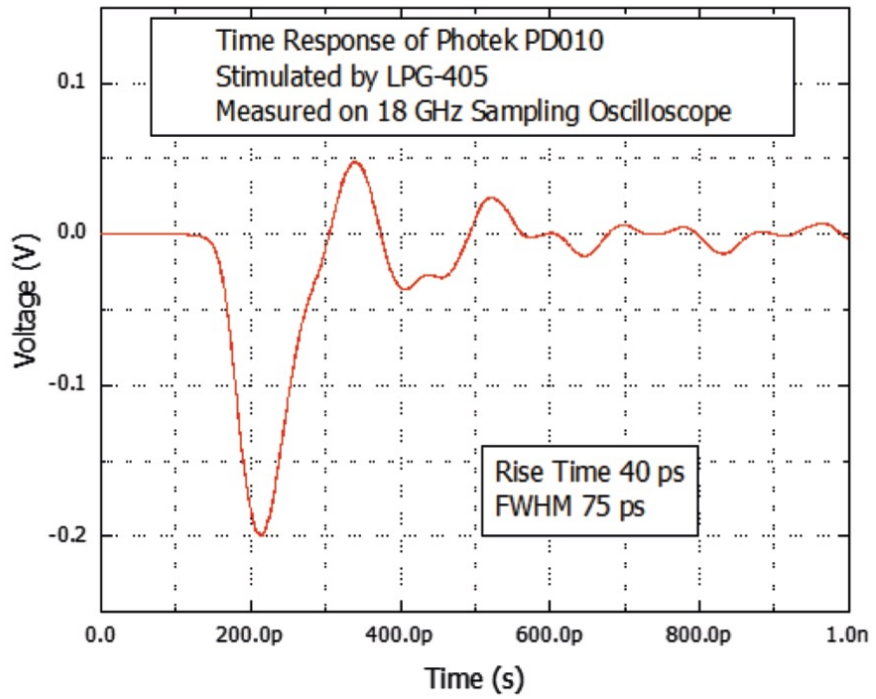
- **Need to get full DAQ up and running for efficient test system**

- **Need criteria for Pass/Fail of HRPPD for QA purpose ➔ pay for module before shipment to full test center (BNL) – BNL is *very* eager to start their program**
  - **Test signals from all 1,024 channels?**

Appendix

Photek LPG-405 pulsed laser
405 nm - pulse width = 75 ps
Freq range = single shot to 300 kHz
Class 1(!!!) – inherently eye safe





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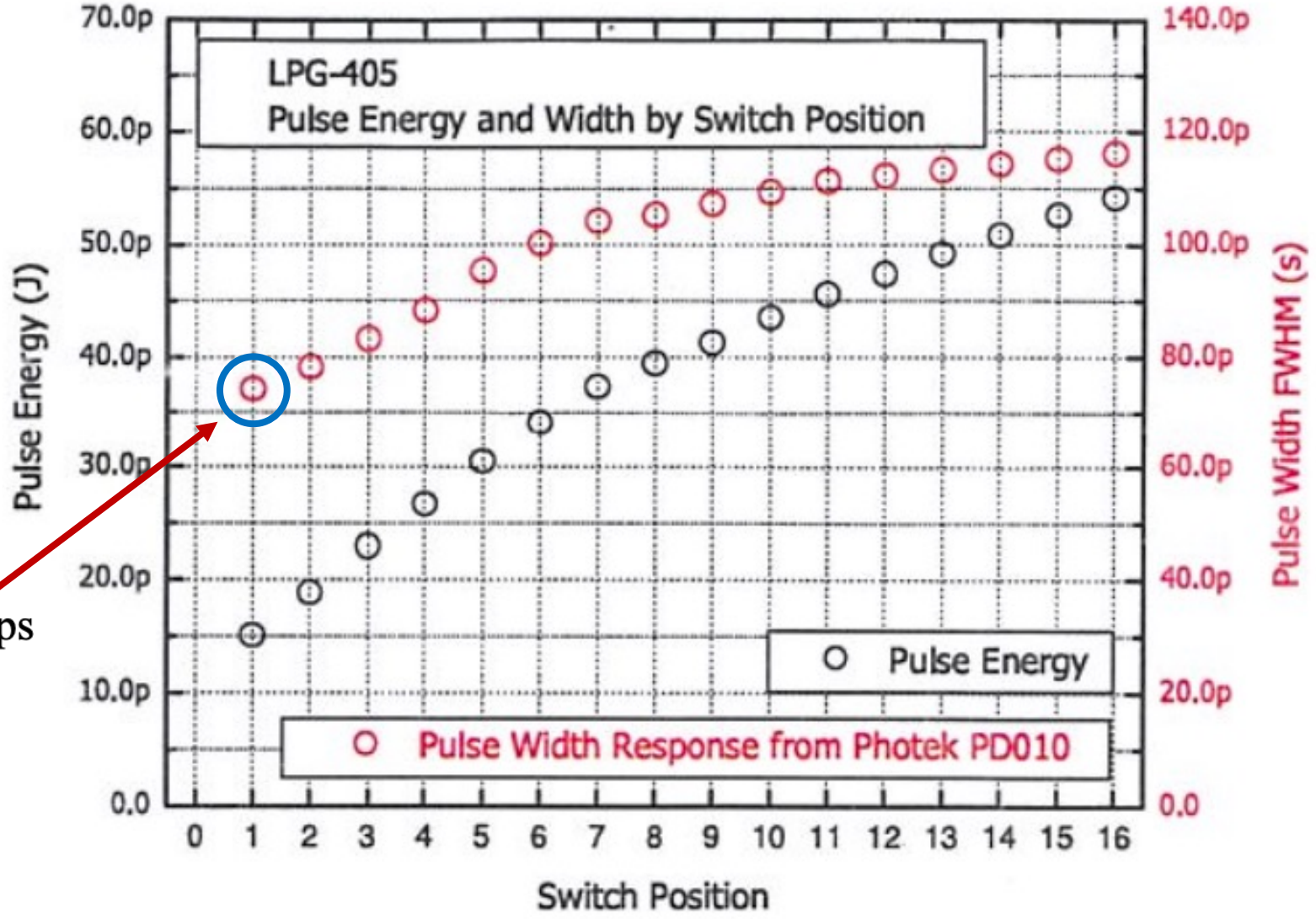
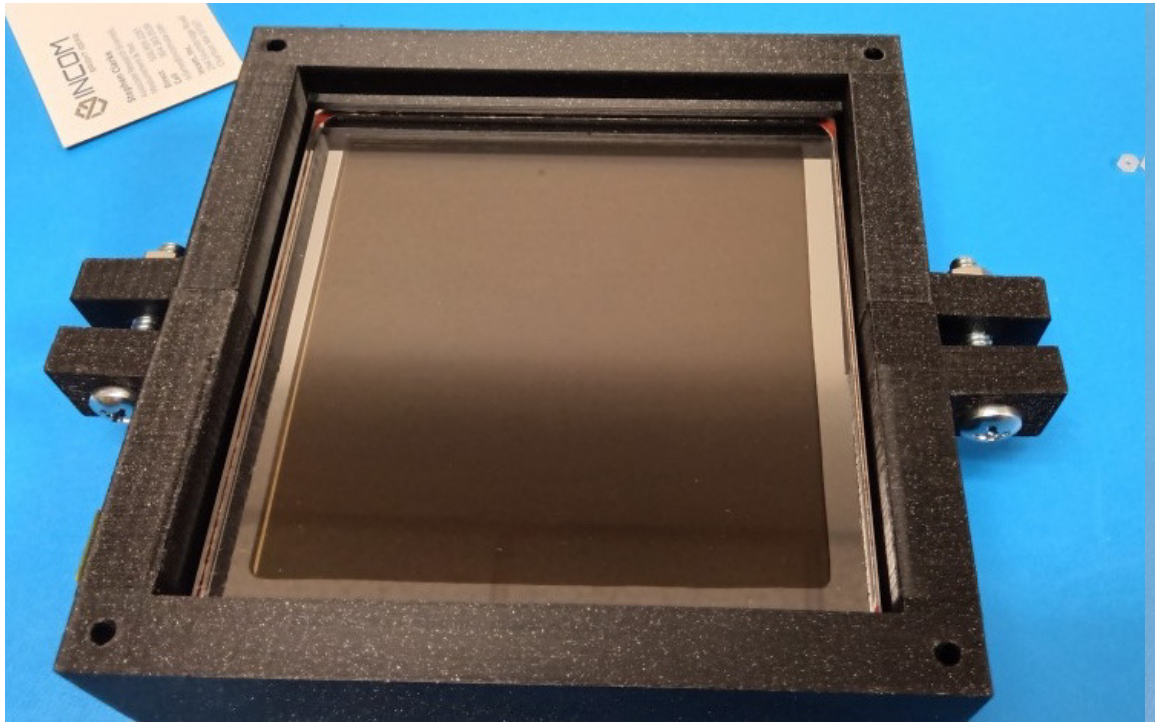
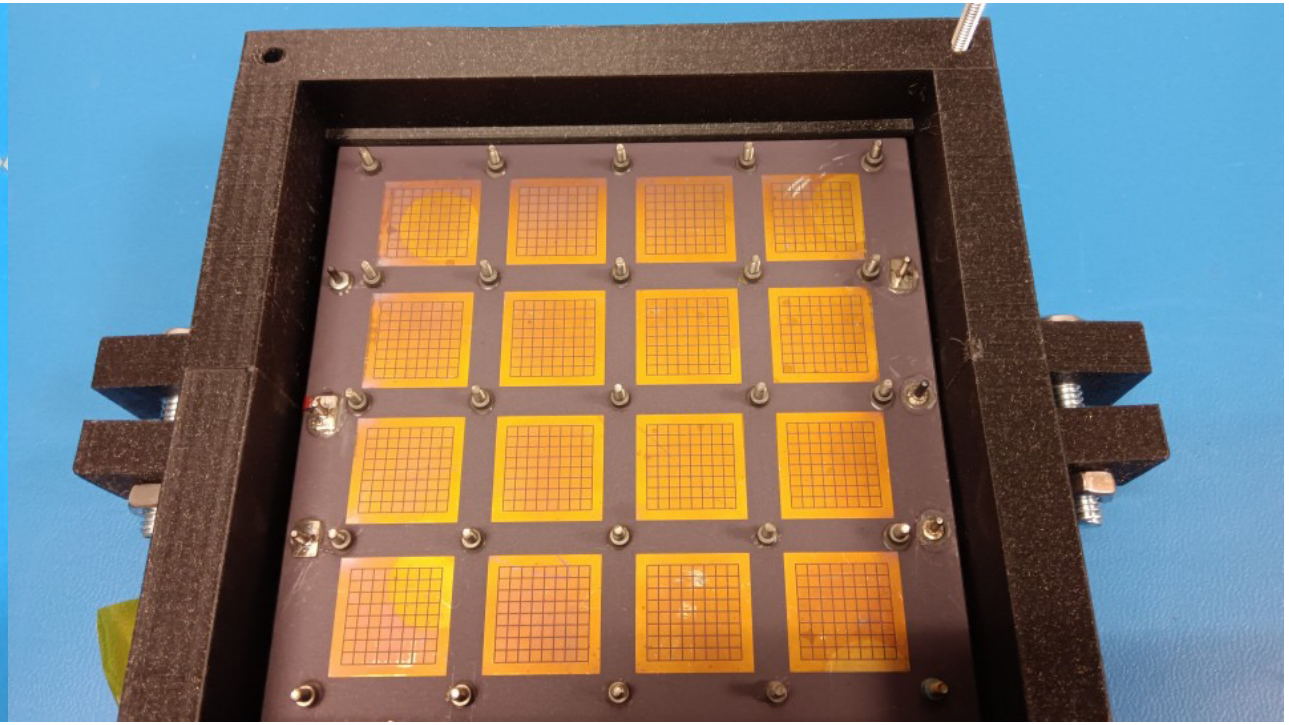


$\sigma = 30$ ps

$$\mathrm{FWHM} = 2\sqrt{2\ln 2}\,\sigma \approx 2.355\,\sigma$$

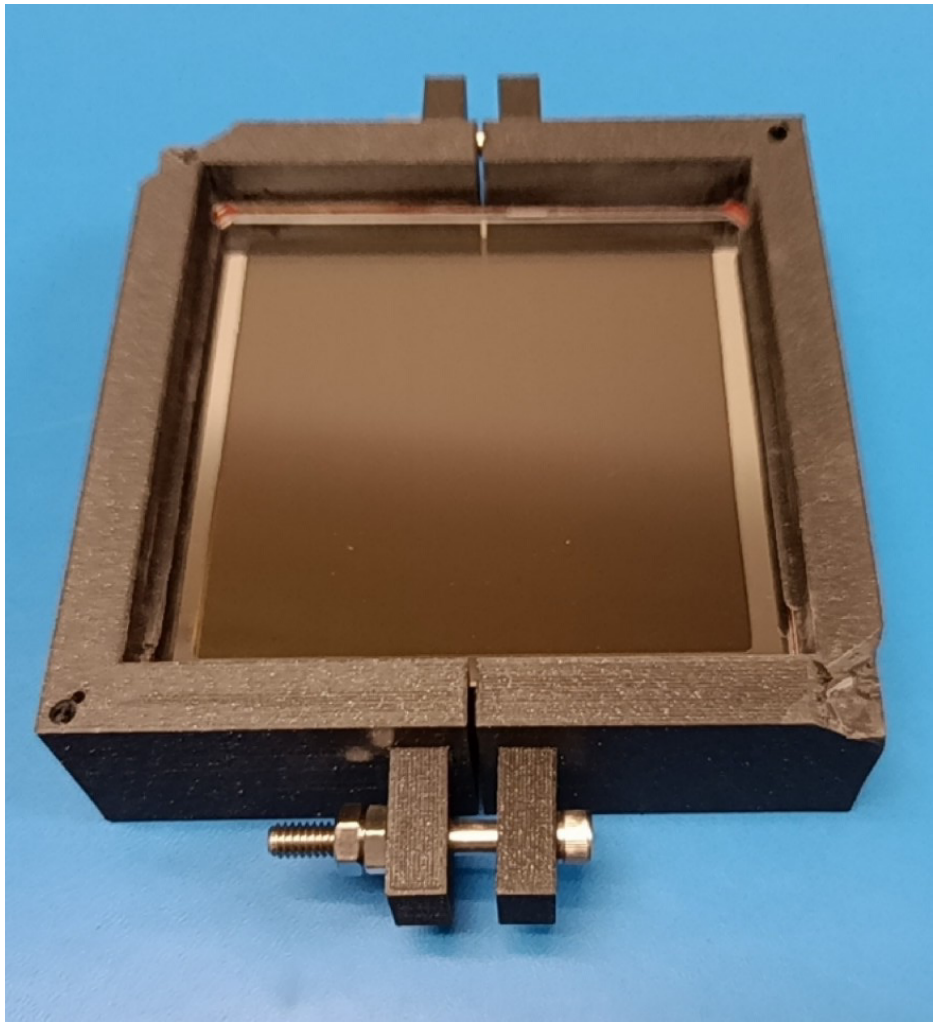
HRPPD 15 - repaired

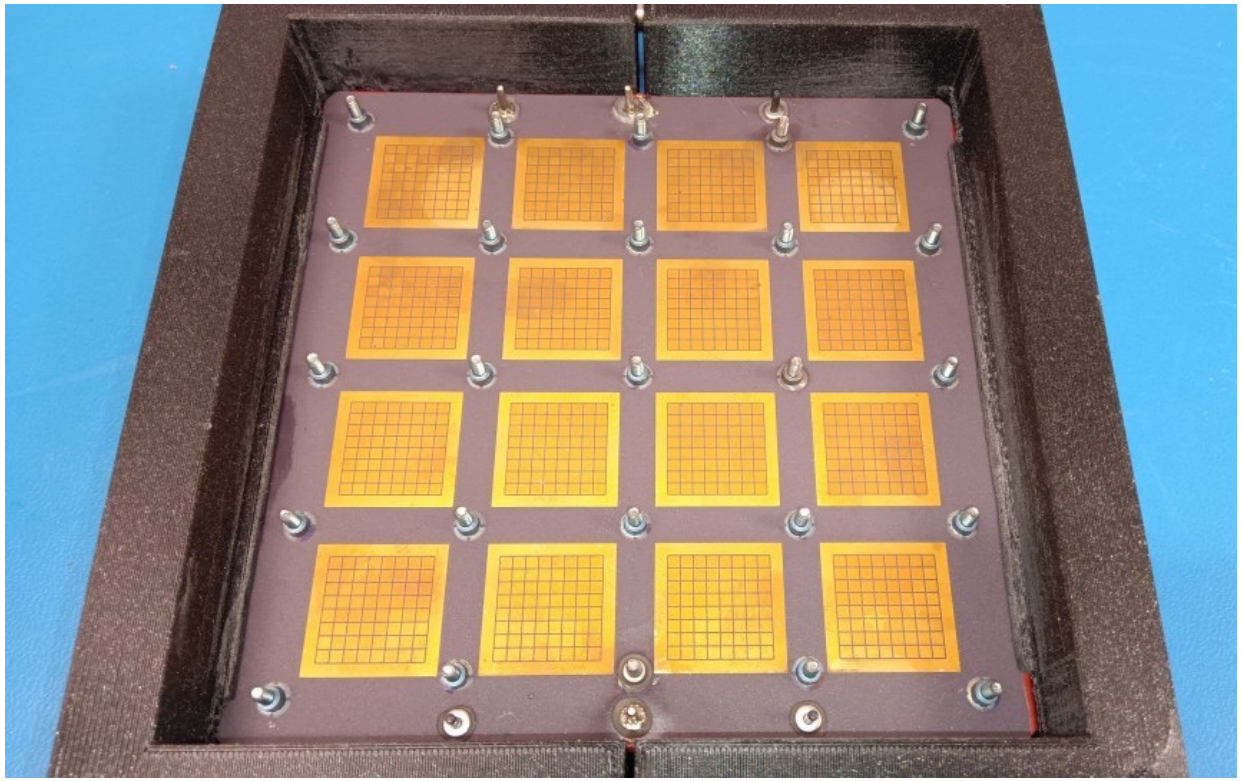




Visual inspection ✅

HRPPD 16 - repaired





Visual inspection ✅

Occasional Noise

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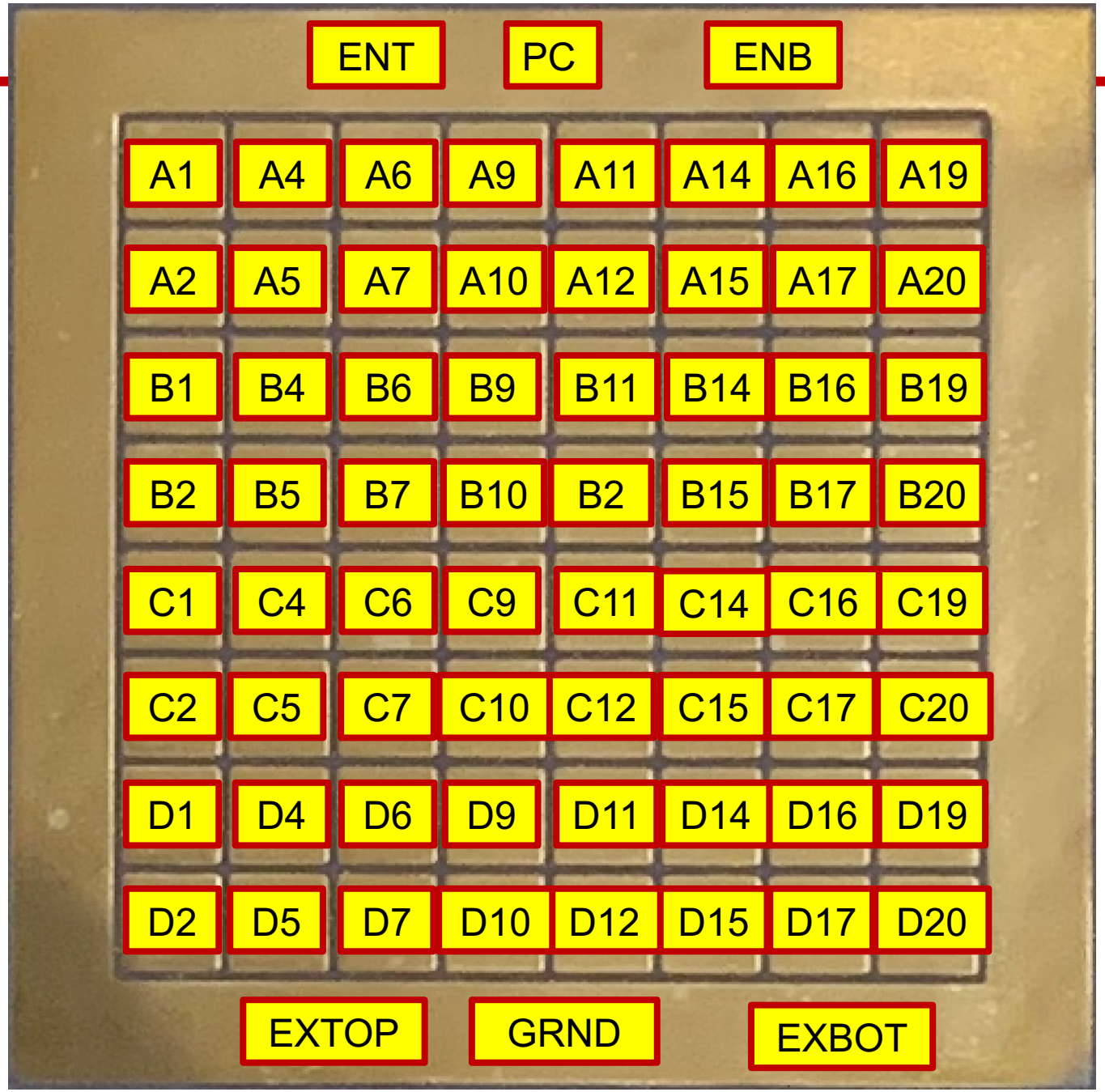
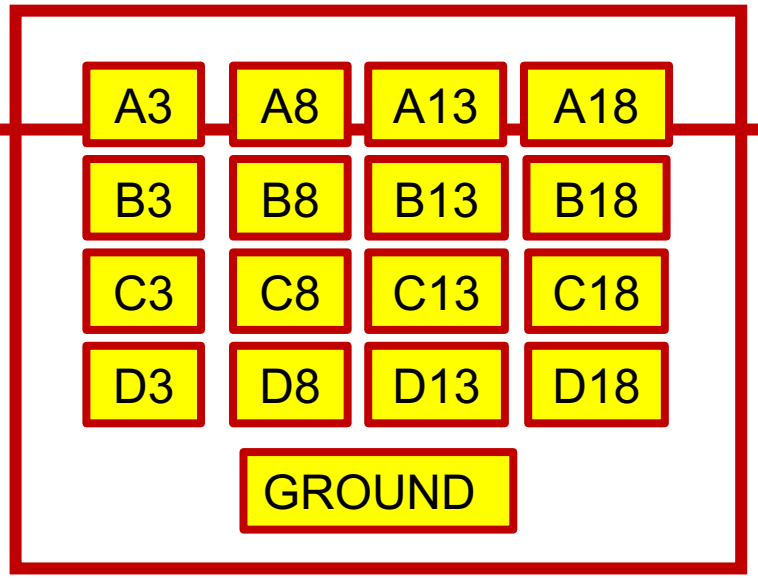
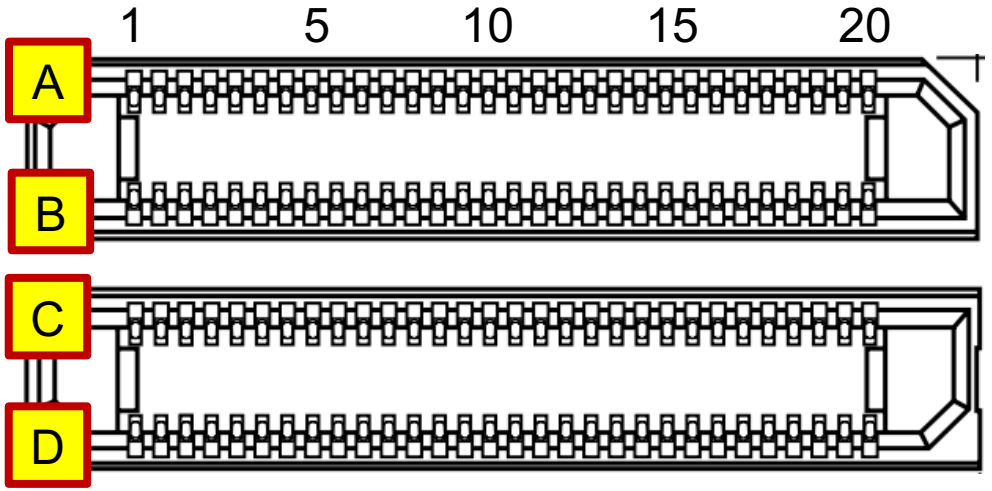

ENT
PC
ENB
A1 A4 A6 A9 A11 A14 A16 A19
A2 A5 A7 A10 A12 A15 A17 A20
B1 B4 B6 B9 B11 B14 B16 B19
B2 B5 B7 B10 B2 B15 B17 B20
C1 C4 C6 C9 C11 C14 C16 C19
C2 C5 C7 C10 C12 C15 C17 C20
D1 D4 D6 D9 D11 D14 D16 D19
D2 D5 D7 D10 D12 D15 D17 D20
EXTOP
GRND
EXBOT


A3 A8 A13 A18
B3 B8 B13 B18
C3 C8 C13 C18
D3 D8 D13 D18
GROUND


1
5
10
15
20
A
B
C
D

Readout Map