First ITkPixV1 Digital Quads

— Student Instrumentation Meeting—

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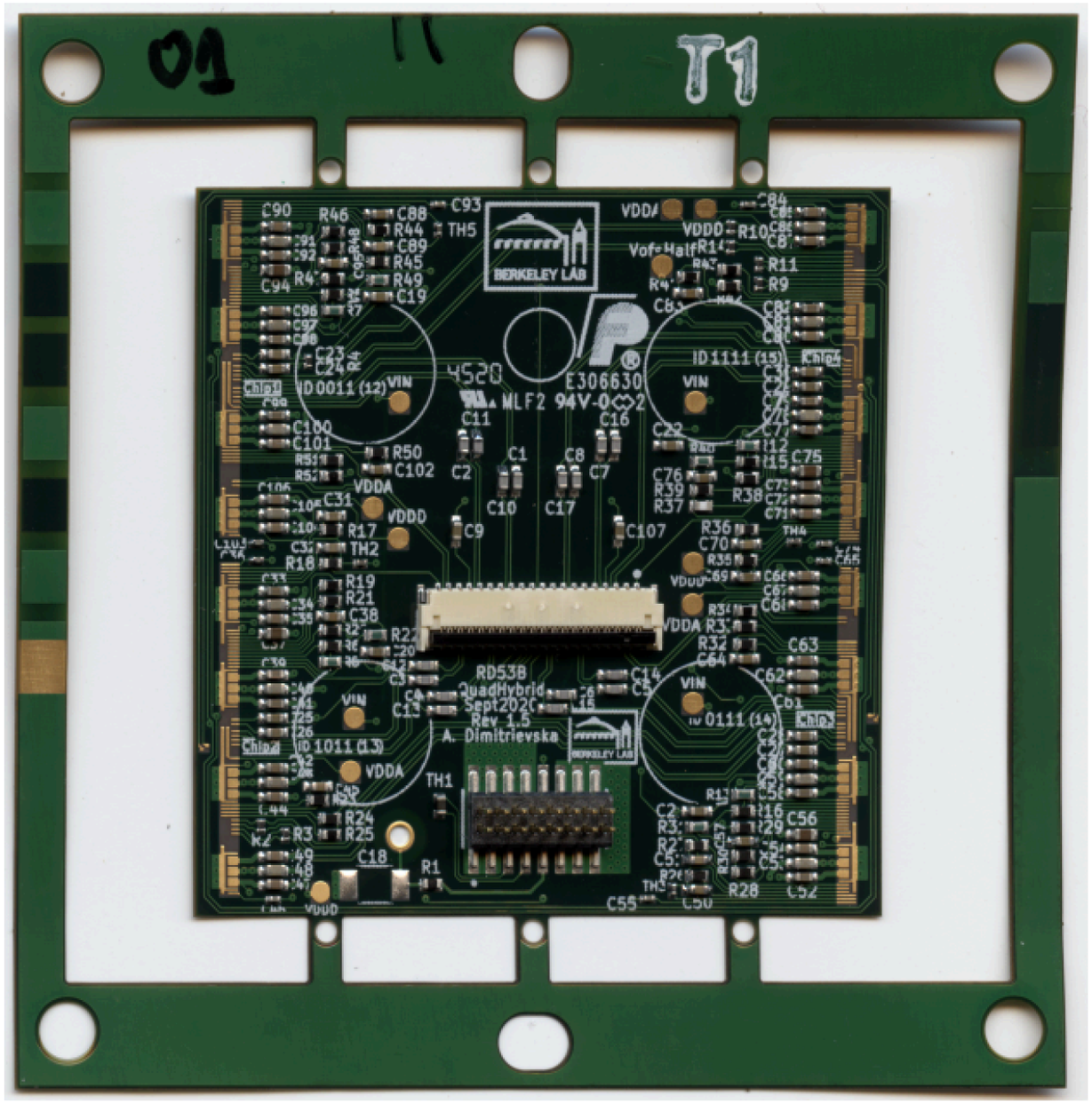
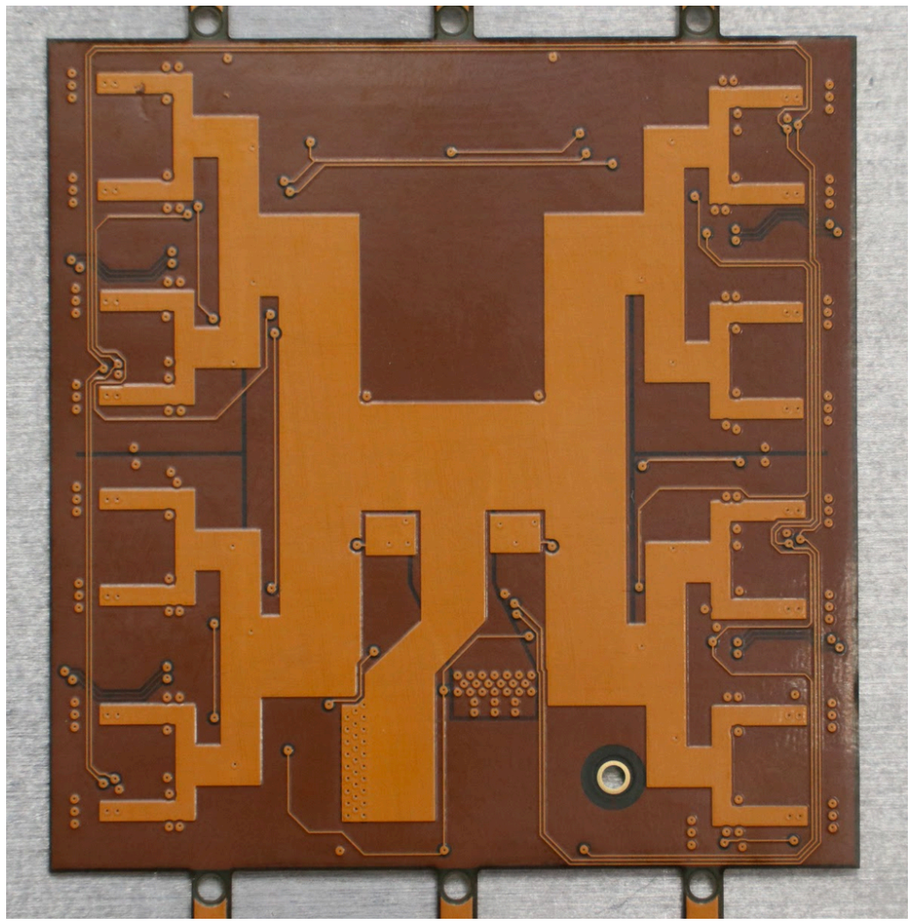
Quad design for the first prototypes

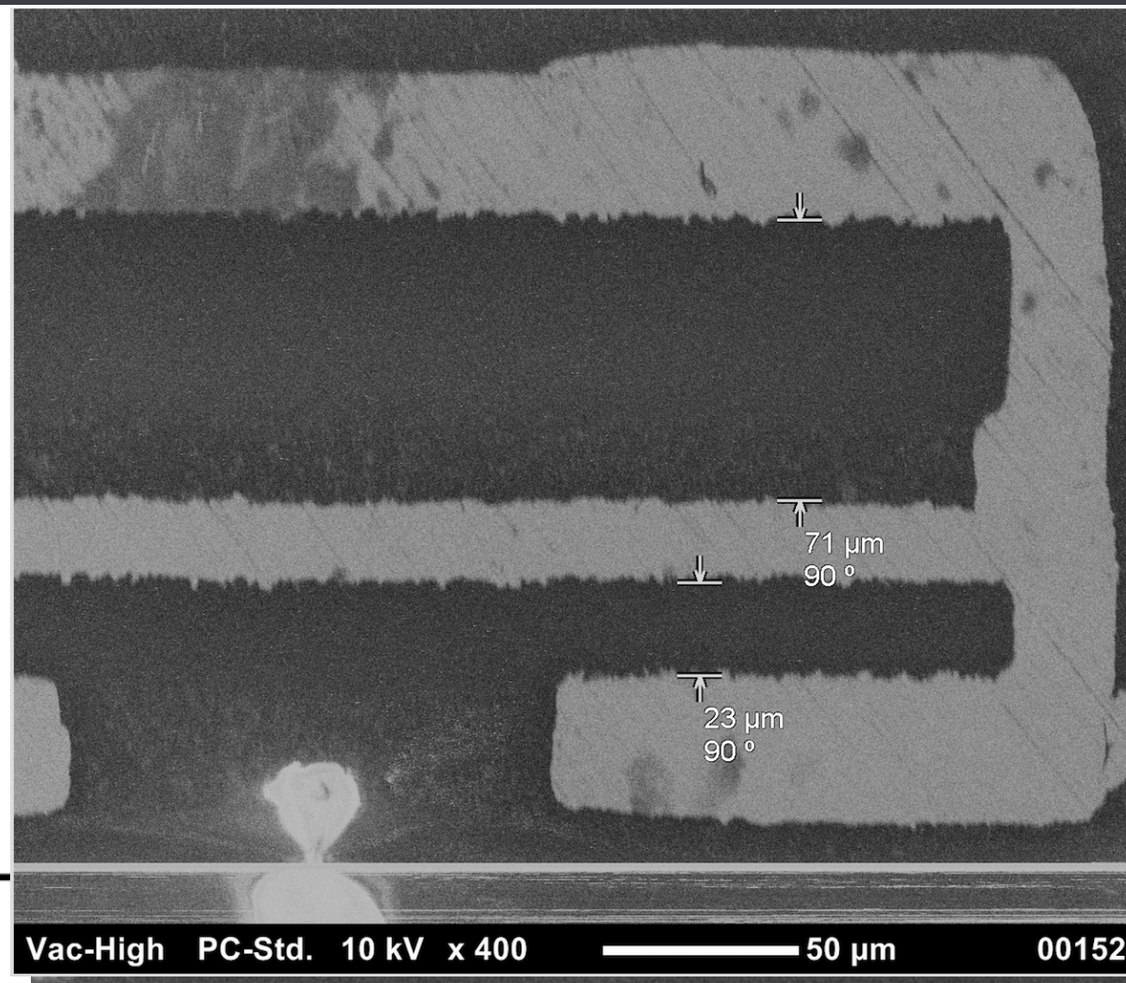
- Quad Modules for ITk Pixel
- GitLab Design Files
- 3-layer design





Quad design for the first prototypes

- Total thickness: 220 um
- Inner layer: 18 um, outer layers: 35 um
- Average plated Cu in Hole: 25.4 um
- Minimum hole plating thickness: 20.3 um
- Differential impedance test result: 95.32 - 105.86 Ohm
- Contamination level: 0.0563 ug/in^2 (0.0087 ug/cm^2)



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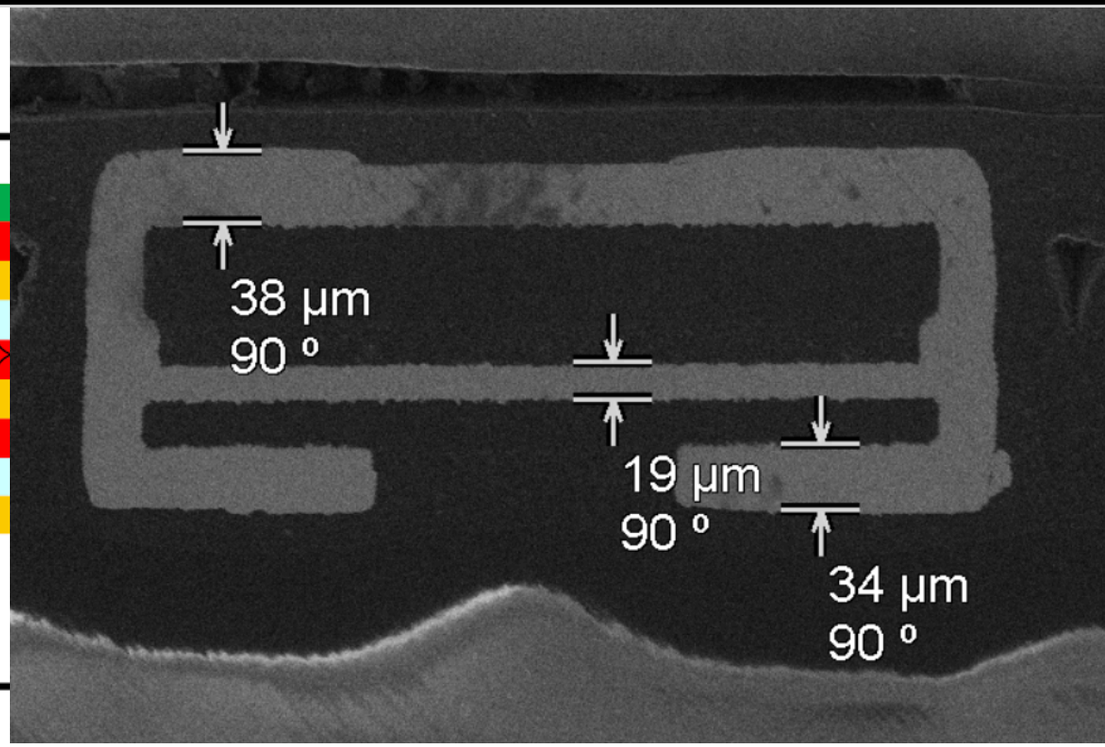
Material Stack Up: Flex

Part Number: RD53B QUAD HYBRID REV -

	18 um	LPI Soldermask (Flexible)	
Layer 1	18 um	Base Copper 18 um + Plated ____ um min.	
	50 um	Polyimide (Adhesiveless)	
	25 um	Adhesive	
Layer 2	18 um	Copper	
	12 um	Polyimide (Adhesiveless)	
Layer 3	18 um	Base Copper 18 um + Plated ____ um min.	
	25 um	Coverlay Adhesive	
	25 um	Coverlay	

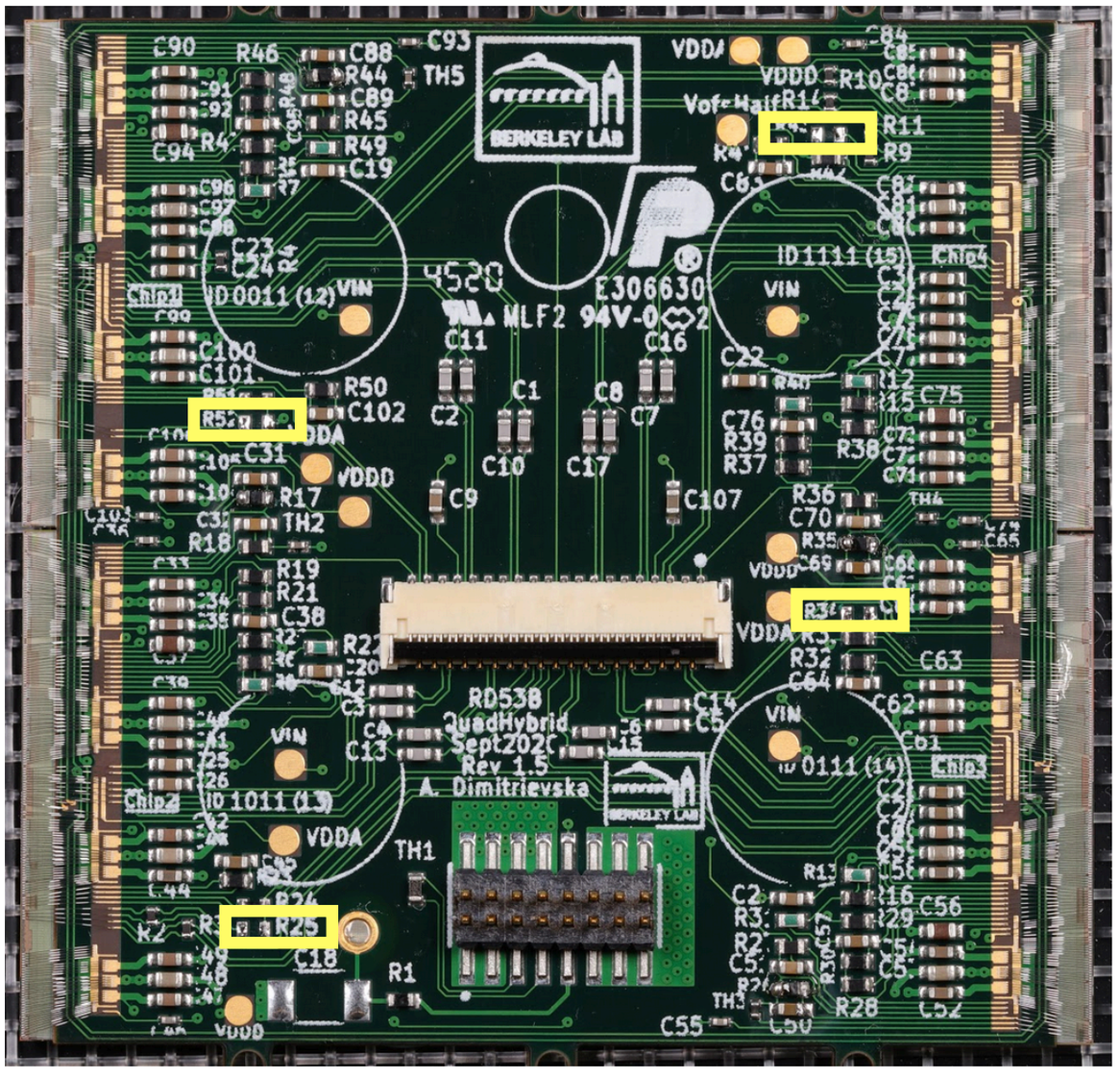
Flex Thickness: 209 um Spec: 200 um +/- 50 um



First ITkPixV1 Digital Quads

- First Digital Quads with ITkPixV1 Chips

Hybrid	Chip1 Id	Chip2 Id	Chip3 Id	Chip4 Id	Configuration
02	0x10A98	0x10A88	0x10A89	0x10A99	LDO
03	0x10AB8	0x10AA8	0x10AA9	0x10AB9	LDO
04	0x10ABA	0x10AAA	0x10AAB	0x10ABB	LDO
05	0x10A9A	0x10A8A	0x10A8B	0x10A9B	LDO

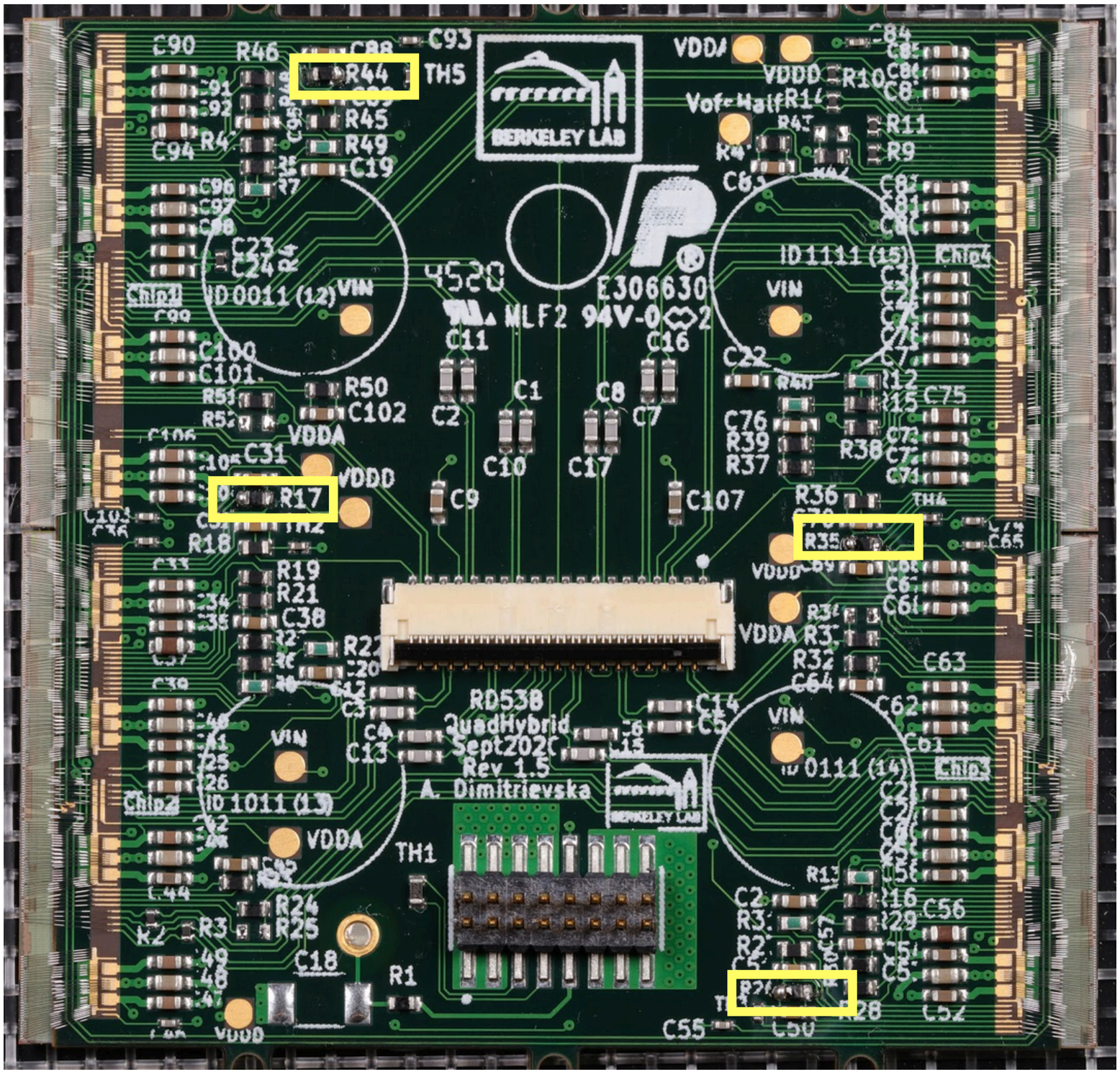


HighRes Image

- Glueing by hand (no tooling used)
- ITkPixV1 chips are not probed
- LDO powering, ShuntEn resistor removed
- Reminder there is a bug in ToT memories which induces high digital current
- ITkPixV1.1 probed chips with bug fix should arrive soon at LBL

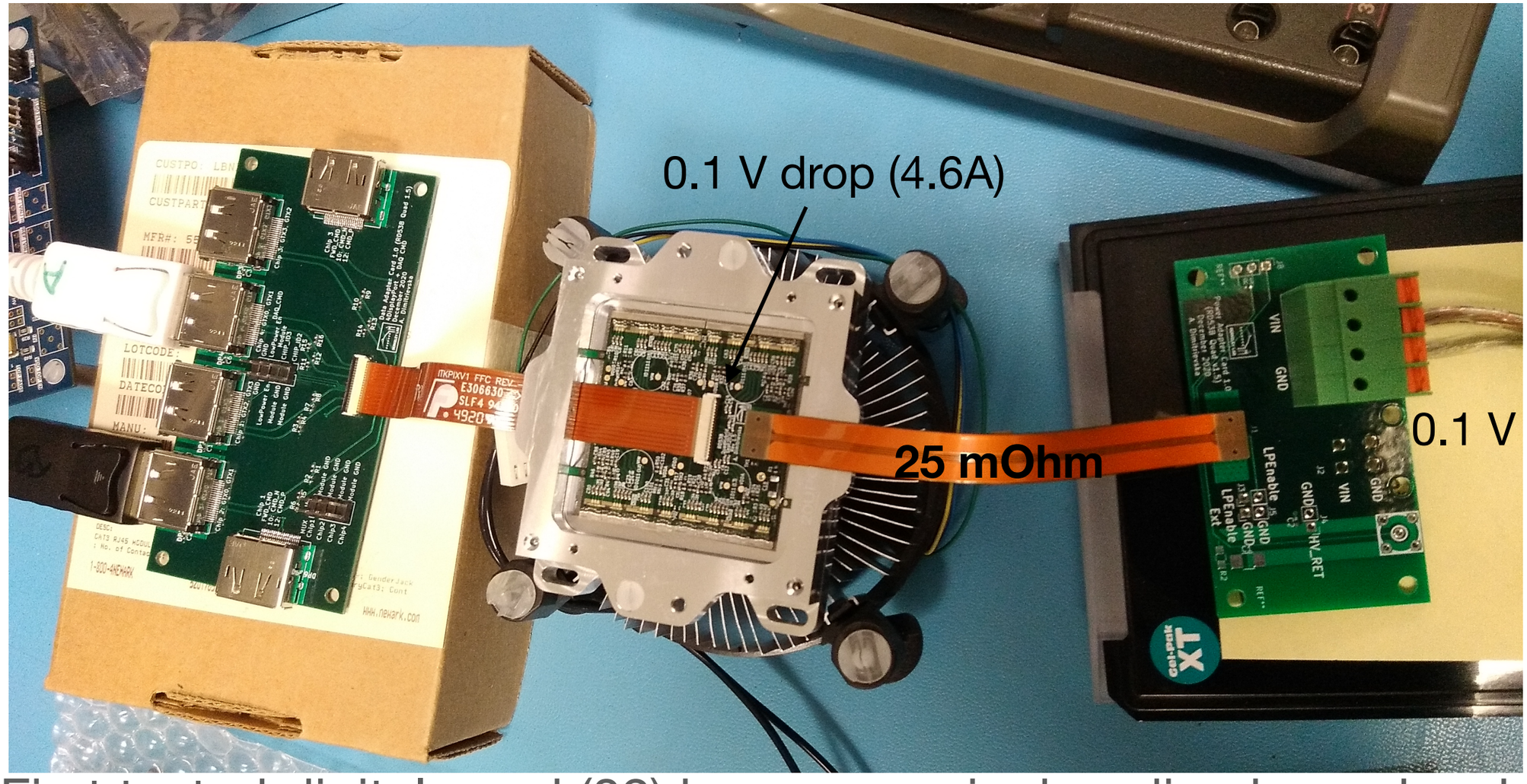
First ITkPixV1 Digital Quads

- There is a bug in the value of one loaded resistor 84.5->84.5**k** Ohm



First ITkPixV1 Digital Quads

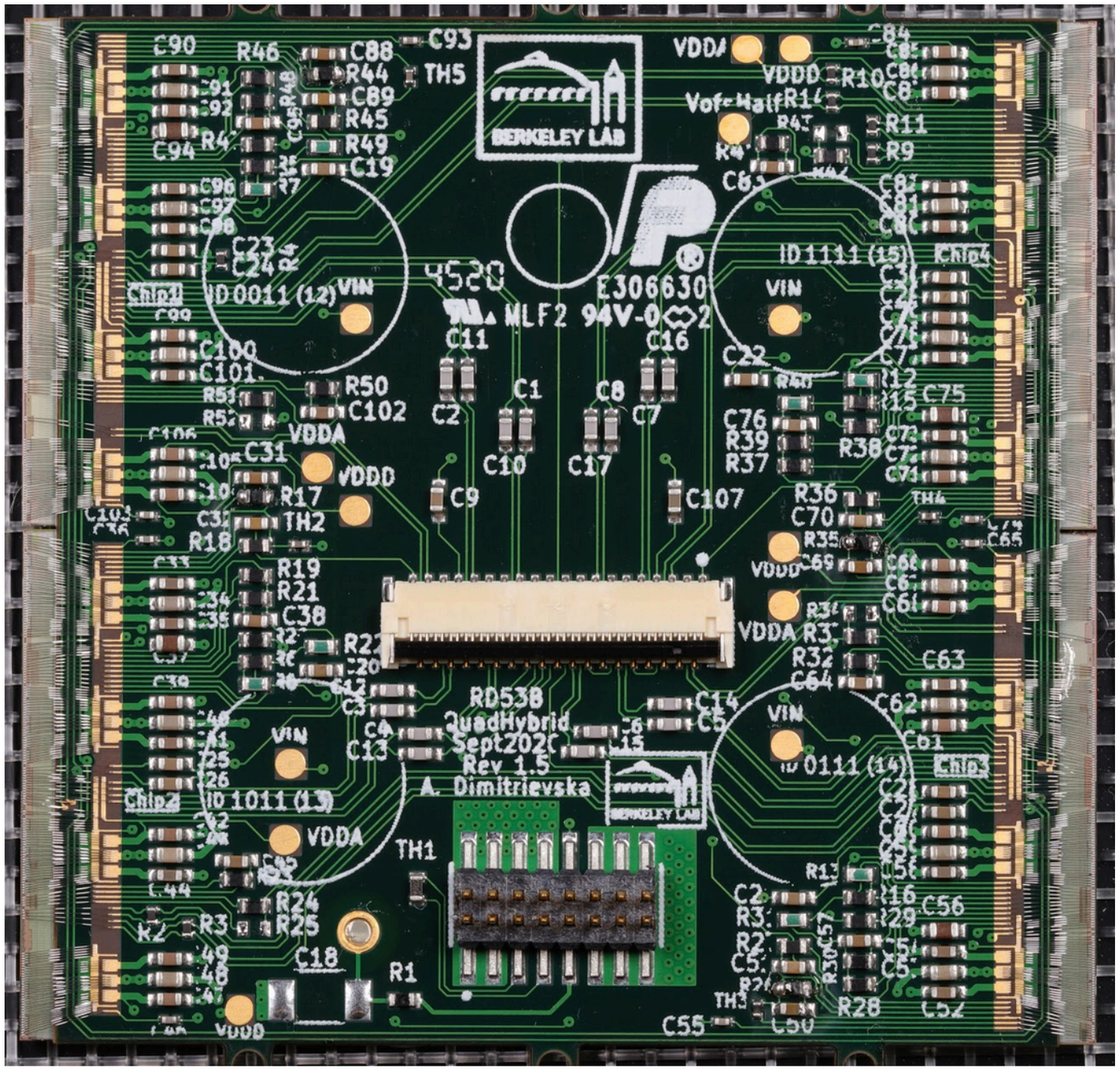
- The setup

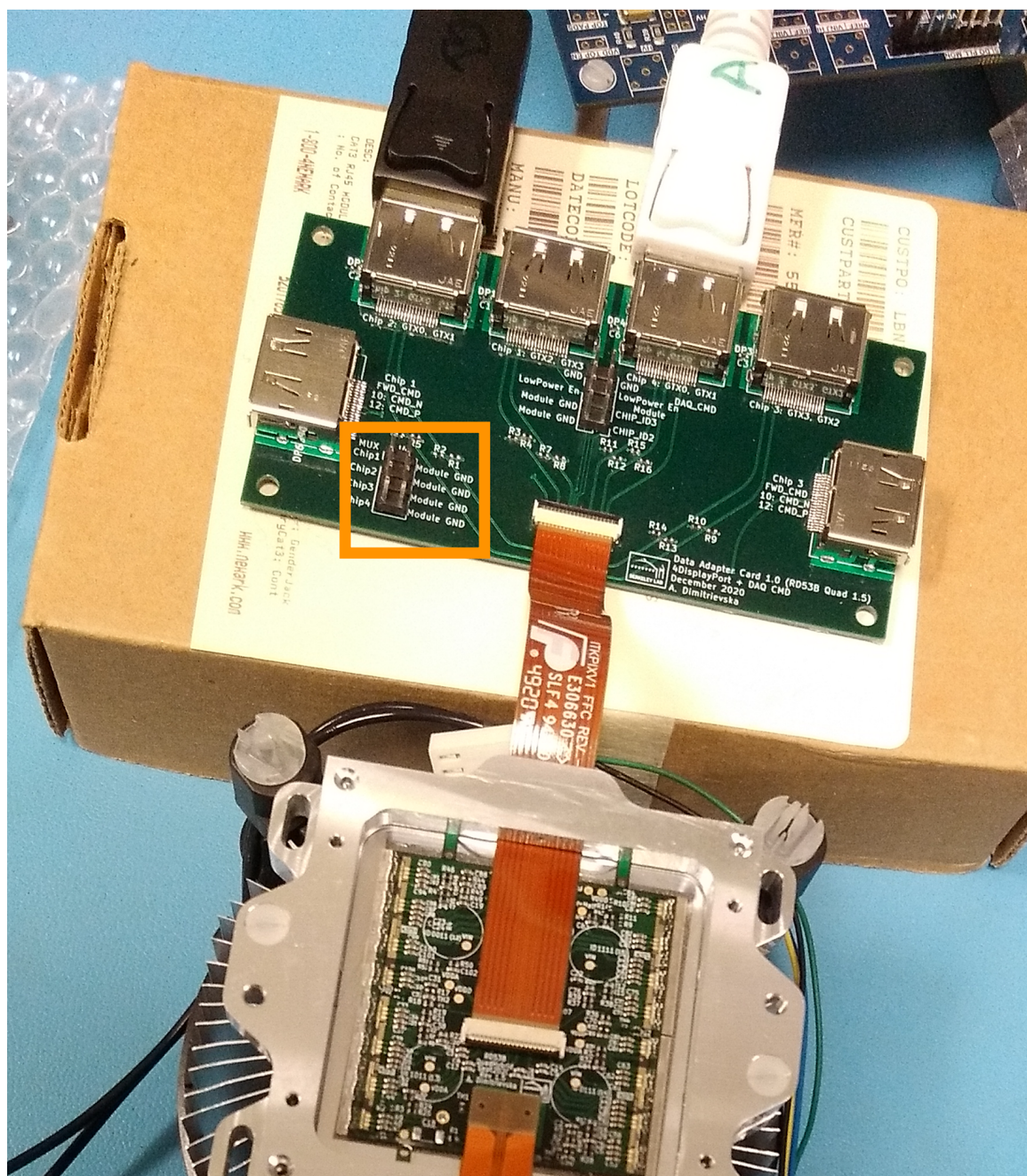


- First tested digital quad (02) has some wire bonding bugs, has high current consumption 14 A
- Other two digital quads (03 and 04) are working as expected, depending on configuration settings, the current is about 1 - 1.2 A per chip
- Quad 05 not tested yet

First ITkPixV1 Digital Quads

- Vdda/Vddd measure
  - Probe pads on the module
  - Measure from the MUX on the pinheaded on adapter card



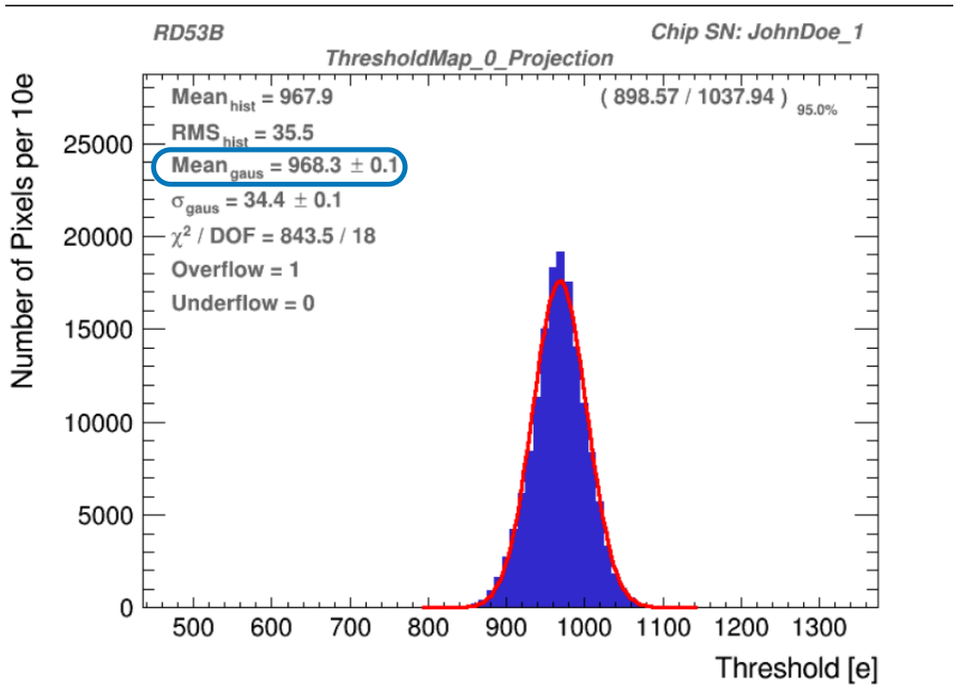


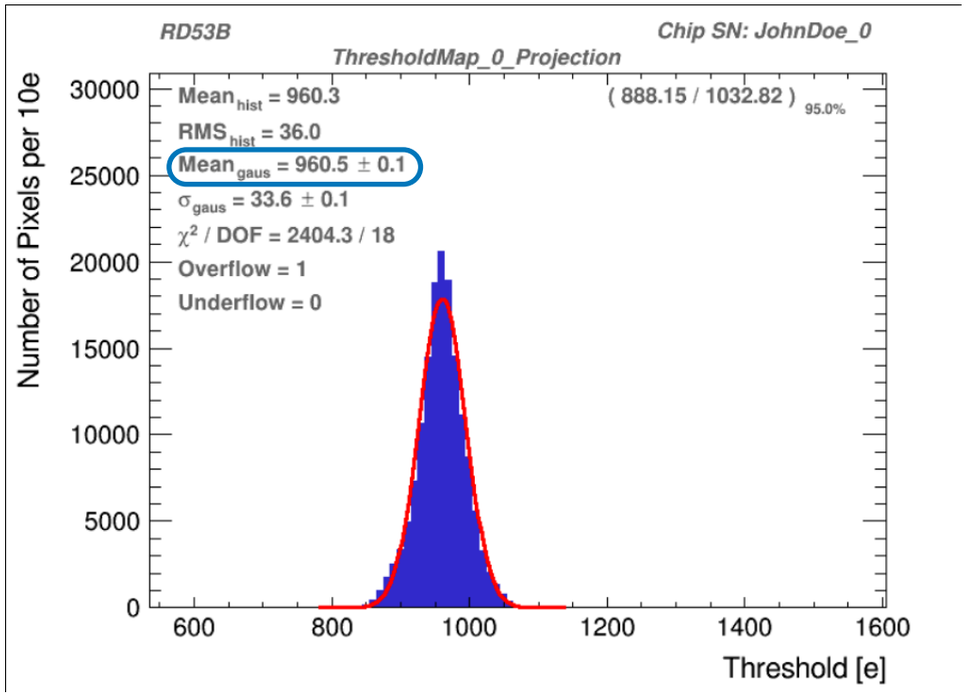
First ITkPixV1 Digital Quads

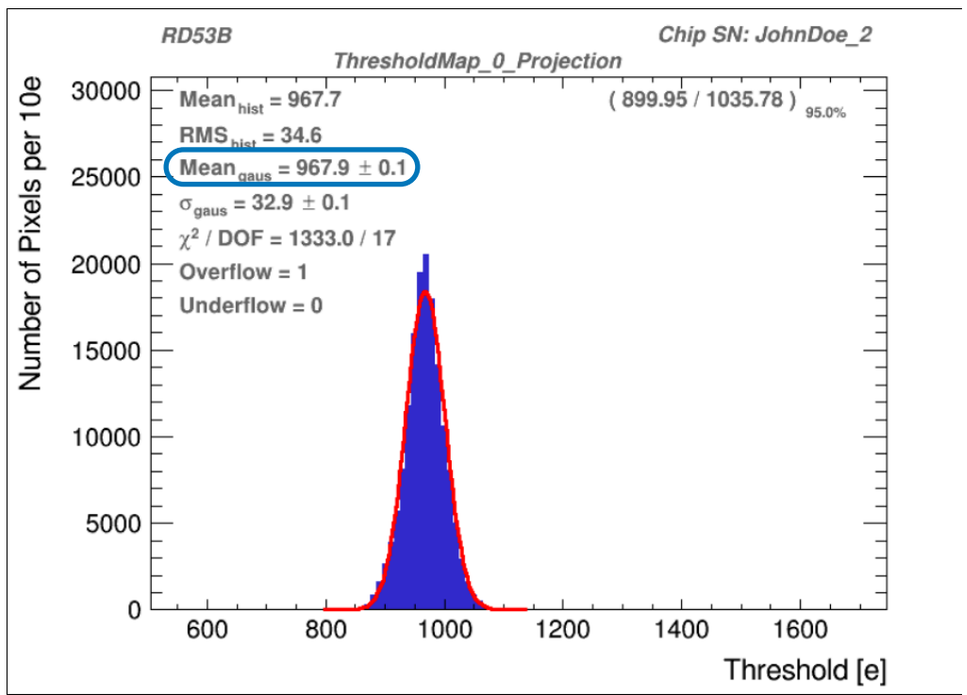
- Tuning procedure

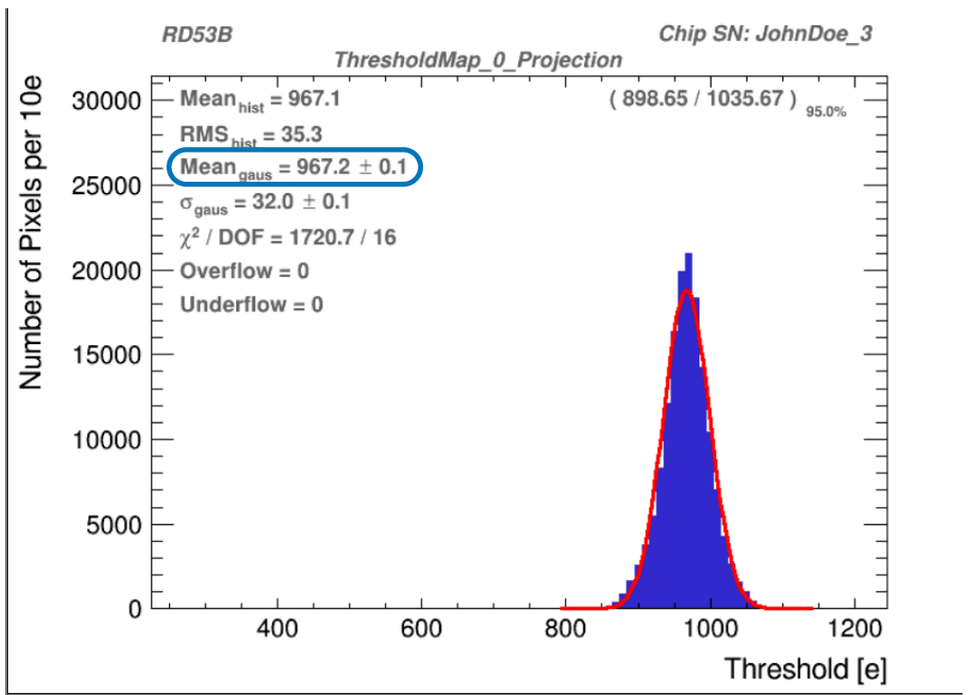
```
)/ptot_digitalscan.json -p -n 1
)/ptot_analogscan.json -p -n 1
)/ptot_tune_globalthreshold.json -t 1500 -p -n 1
)/ptot_tune_pixelthreshold.json -t 1500 -p -n 1
)/ptot_retune_globalthreshold.json -t 1000 -p -n 1
)/ptot_retune_pixelthreshold.json -t 1000 -p -n 1
)/ptot_thresholdscan.json -p -n 1
```

Threshold Distribution









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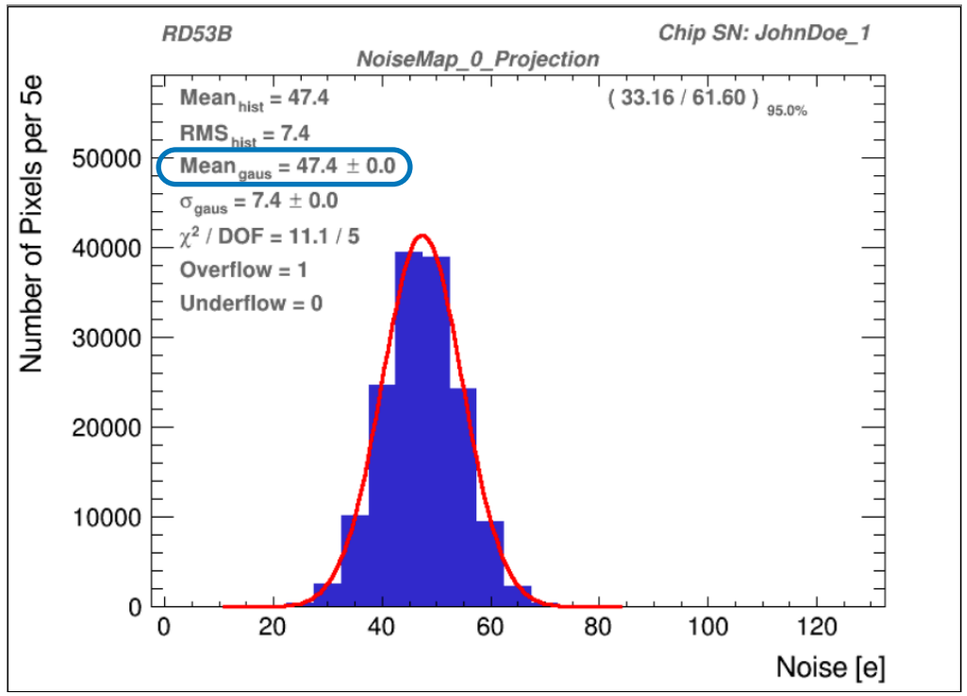
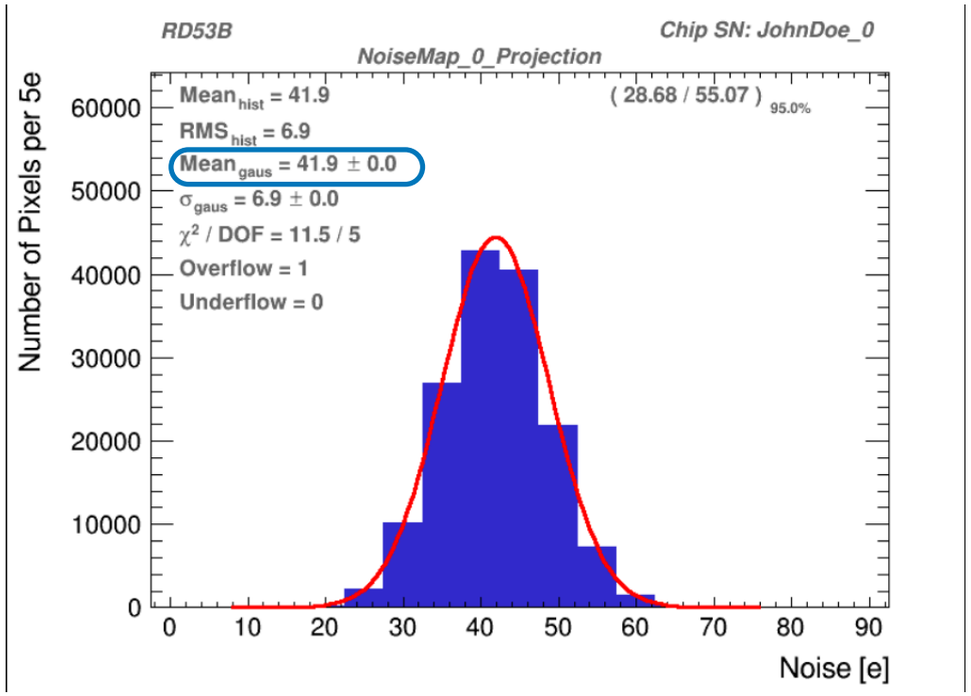
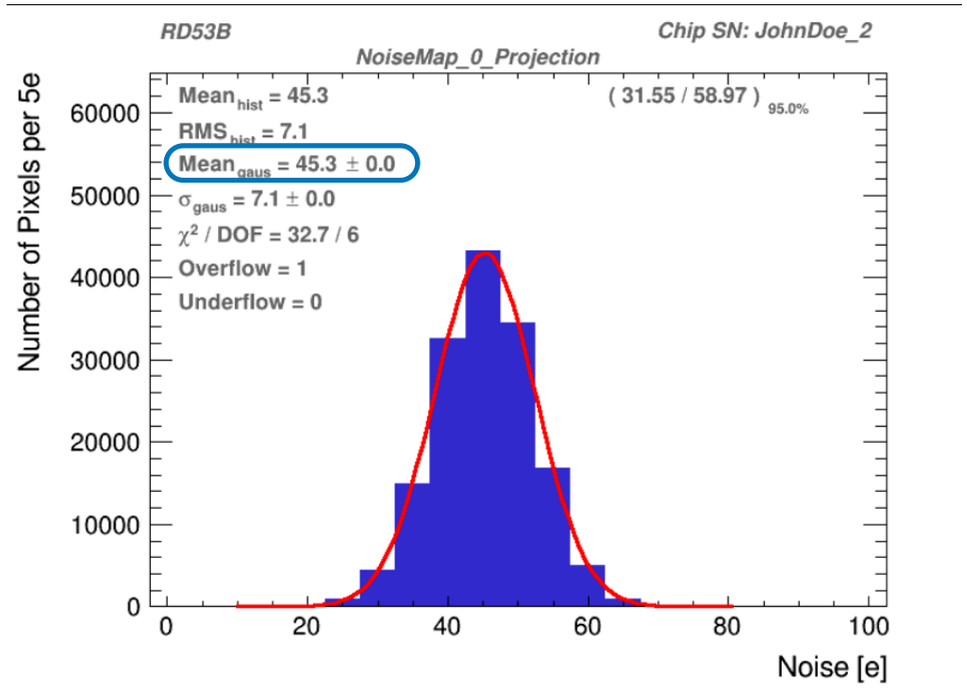
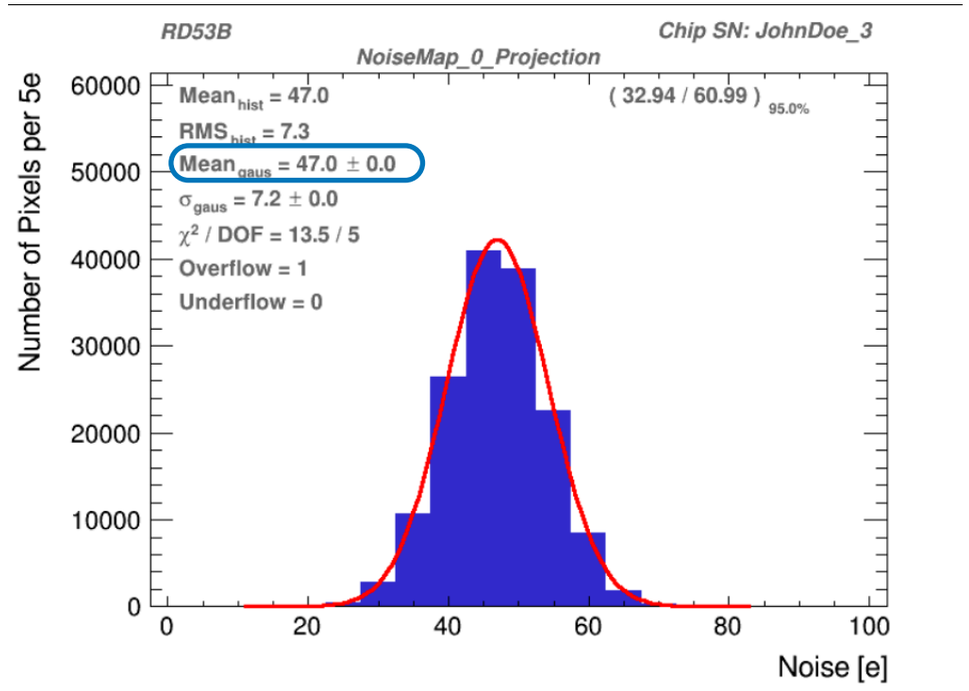
)/ptot_retune_pixelthreshold.json -t 1000 -p -n 1
)/ptot_thresholdscan.json -p -n 1
```

Noise Distribution



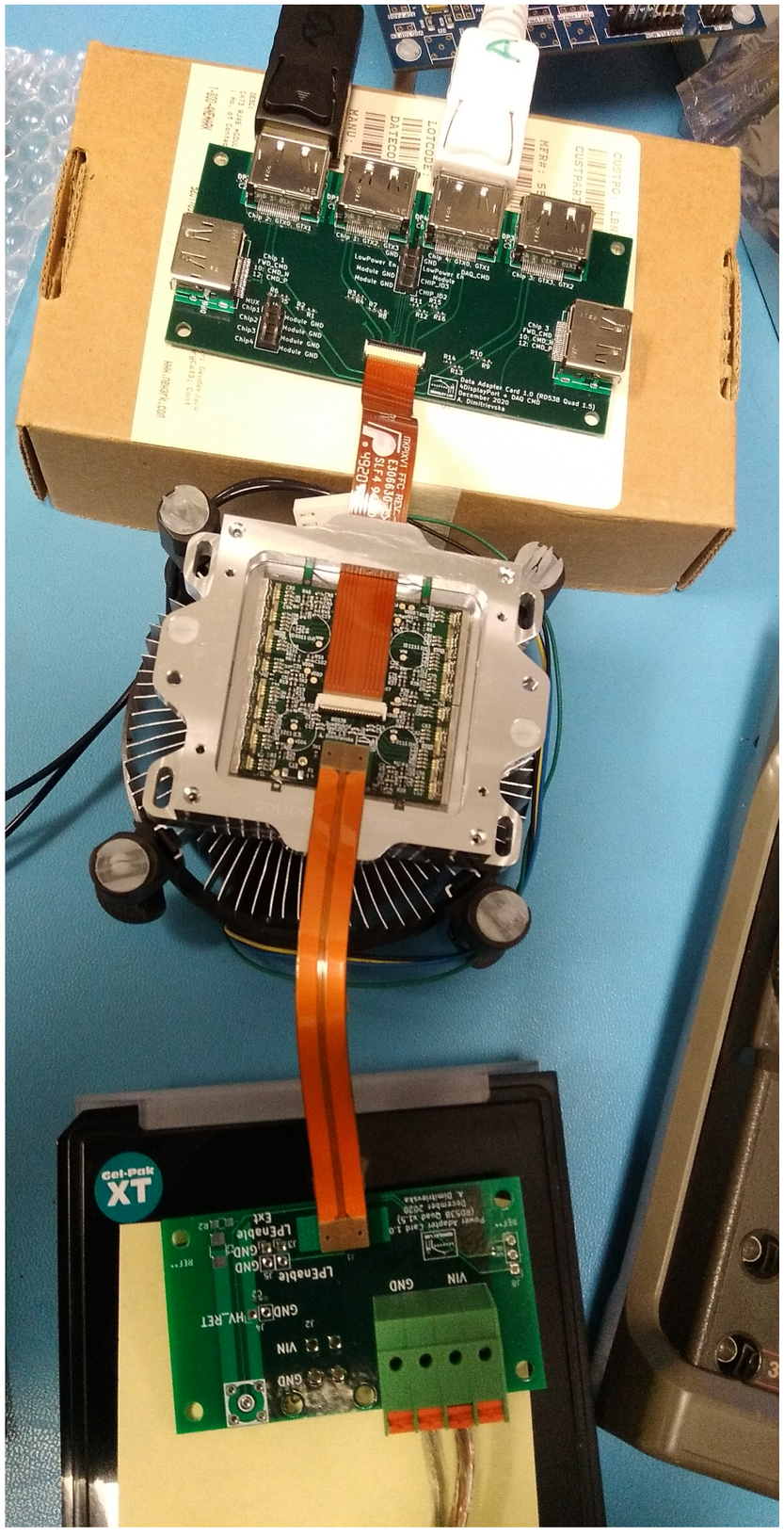






Summary

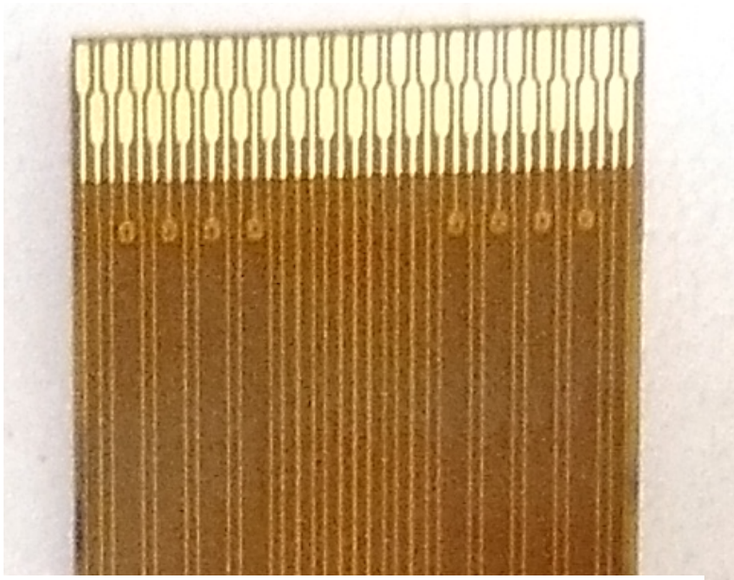
- 25 quad prototype hybrids produced
- 50 data and power pigtails produced
- 10 data and power adapter cards produced
- First ITkPixV1 Digital Quads assembled
- Initial tests show that everything is working as expected
- Working on Iref calibration for unprobed chips
- Expected to build and test ITkPixV1.1 digital quads in the next weeks



BACKUP

Quad Data pigtail

- Custom 10 cm long data pigtail with 100 Ohm controlled differential impedance (2-layer design)
- GitLab design files
- 50 produced (20$)



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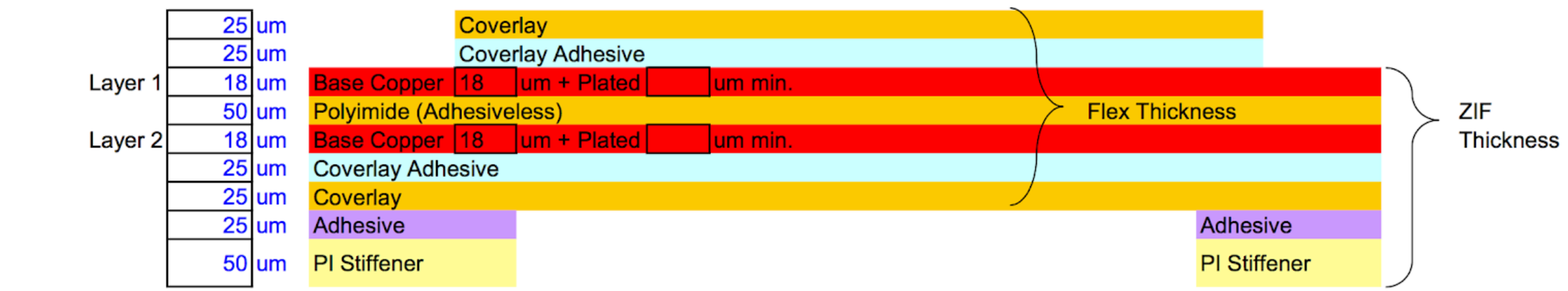
Material Stack Up: Flex

Part Number: ITKPIXV1 FFC



Flex Thickness: 186 um Spec: 180 um +/- 25 um

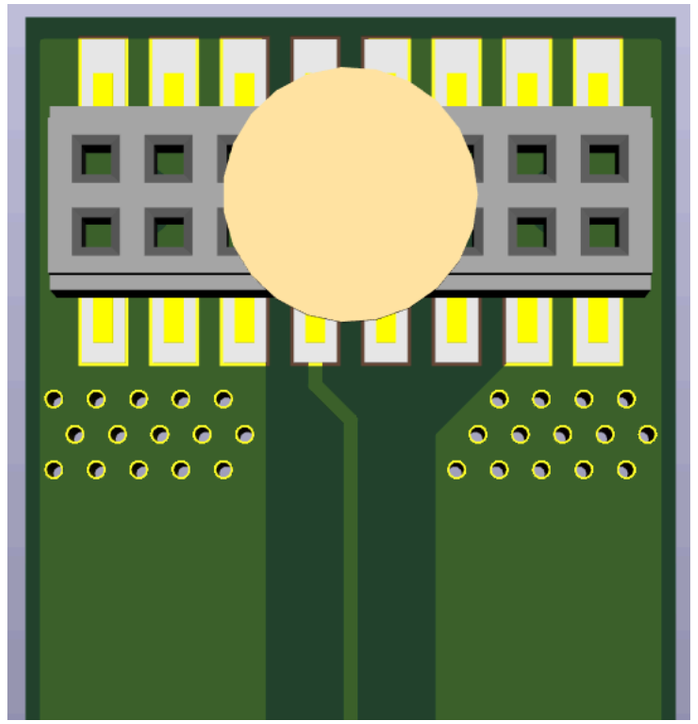
ZIF Thickness: 211 um Spec: 200 um +/- 25 um

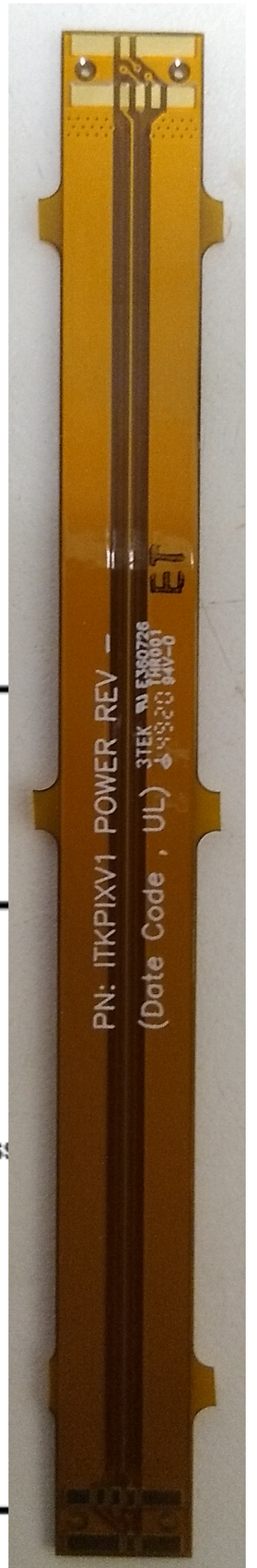
Created By: PT
Date: 10/22/2020

4/6/2016

Quad Power pigtail

- 10 cm long, custom power pigtail (2-layer)
- 1.5 oz of copper to reduce the voltage drop
- GitLab design files
- 50 produced (20$)





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Material Stack Up: Flex

Part Number: ITKPIXV1 POWER REV -

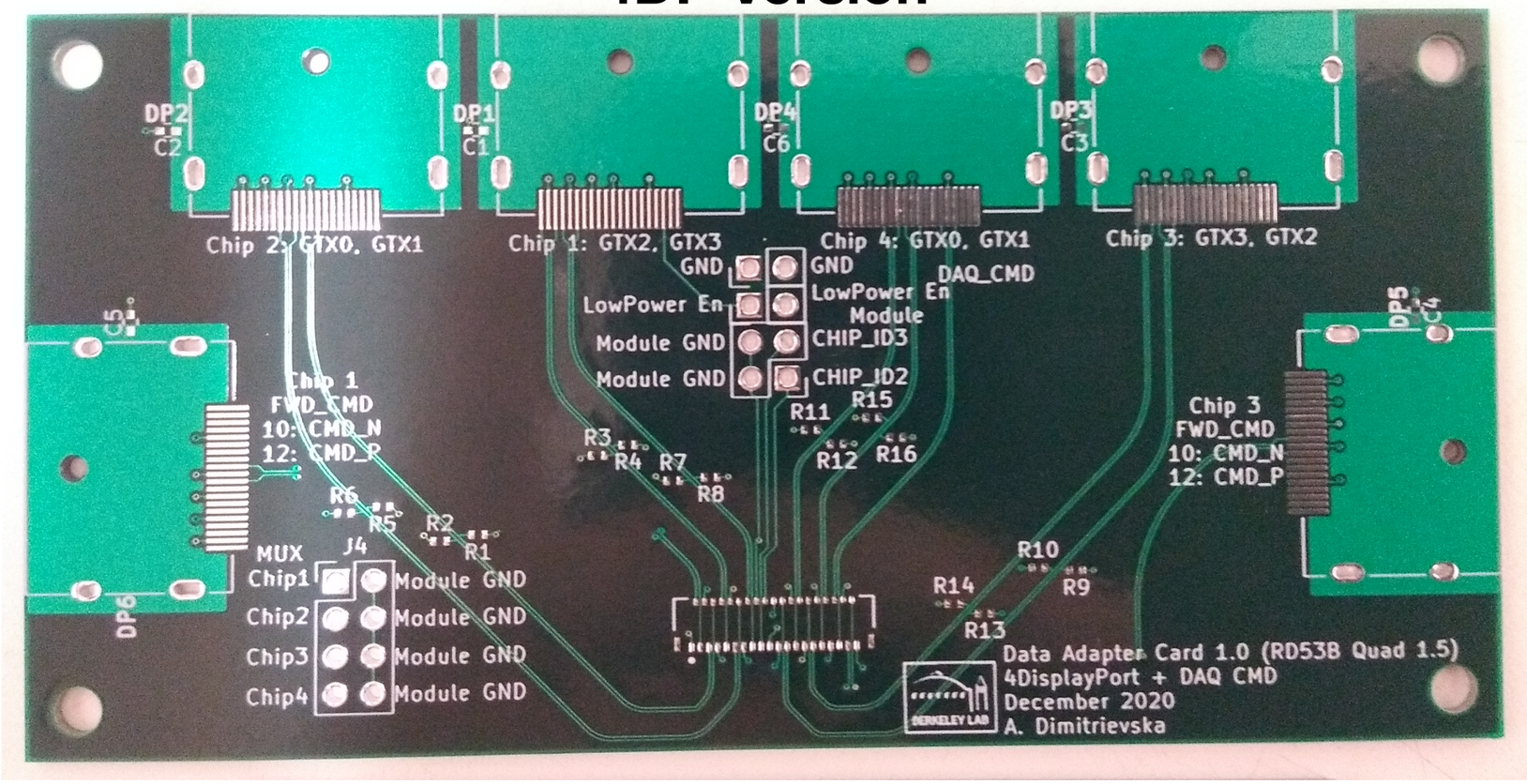
	25 um	Coverlay		
	50 um	Coverlay Adhesive		
Layer 1	47 um	Base Copper 35 um + Plated 12 um min.	Flex Thickness	Total Thickness
	25 um	Polyimide (Adhesiveless)		
Layer 2	47 um	Base Copper 35 um + Plated 12 um min.		
	50 um	Coverlay Adhesive		
	25 um	Coverlay		
	50 um	Adhesive	Adhesive	
	500 um	FR4 Stiffener	FR4 Stiffener	

Total Thickness:	819 um	Spec:	800 um	+/- 100 um	
Flex Thickness:	269 um	Spec:	250 um	+/- 50 um	

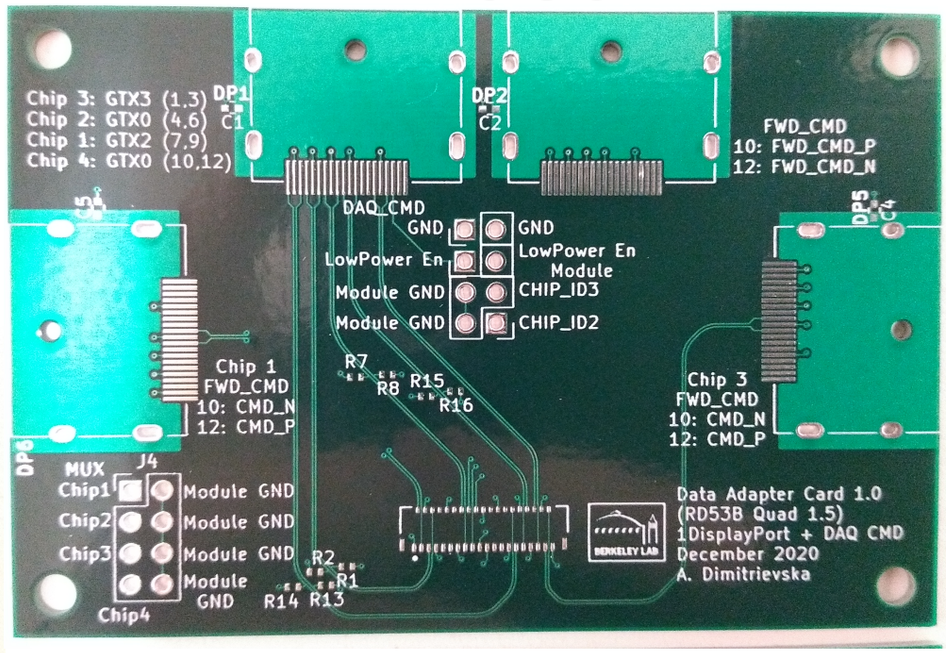
Quad Data Adapter cards

- 4-layer design, ~100 Ohm differential impedance (impedance is not controlled)
- GitLab design files
- 10 produced

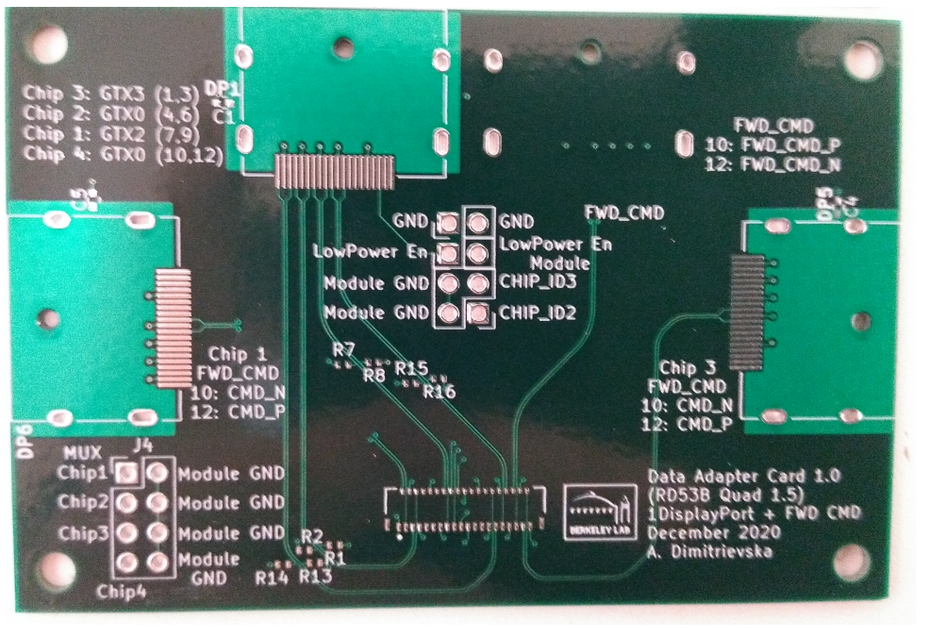
4DP Version



1DP Version

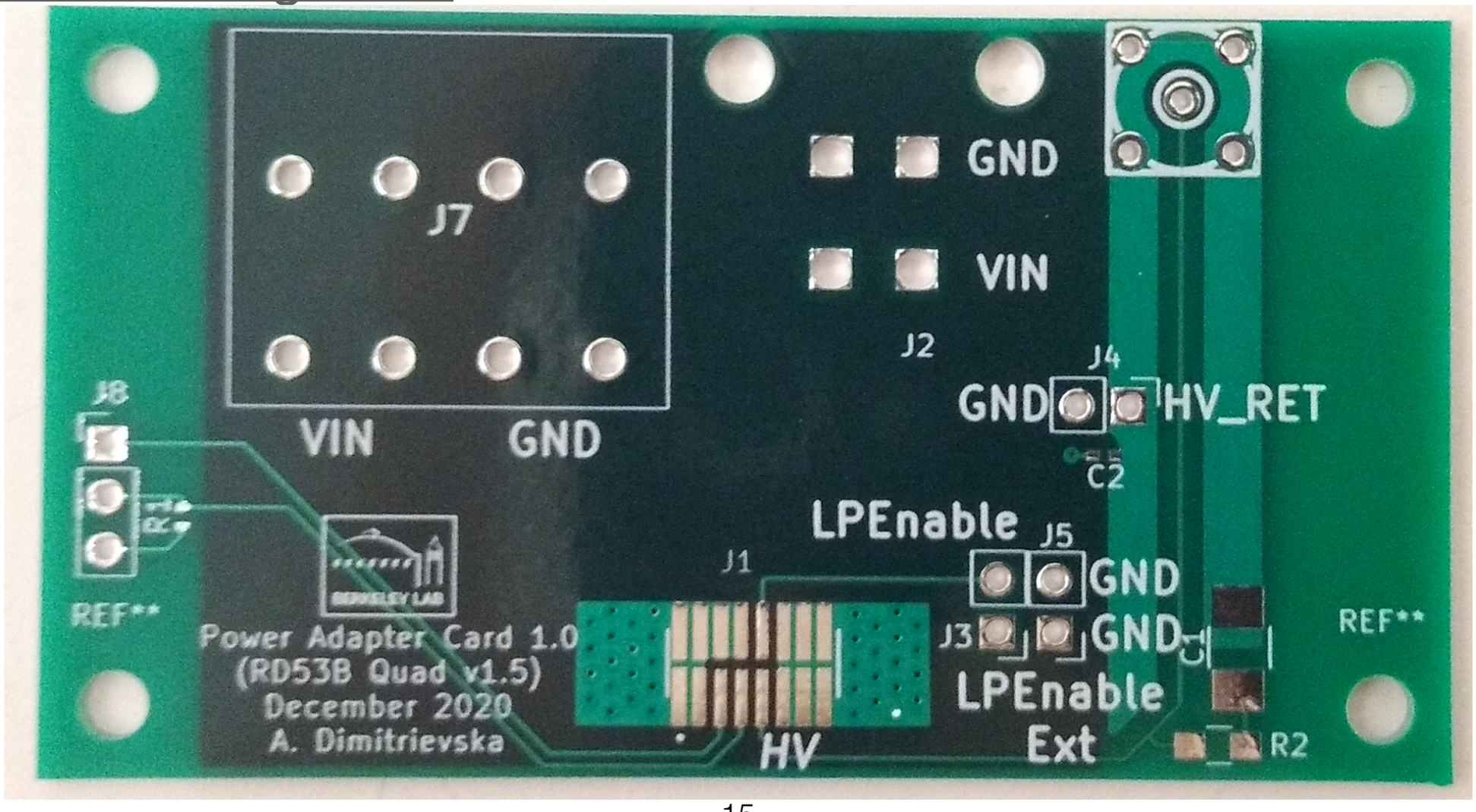


1DP Version with FWD CMD

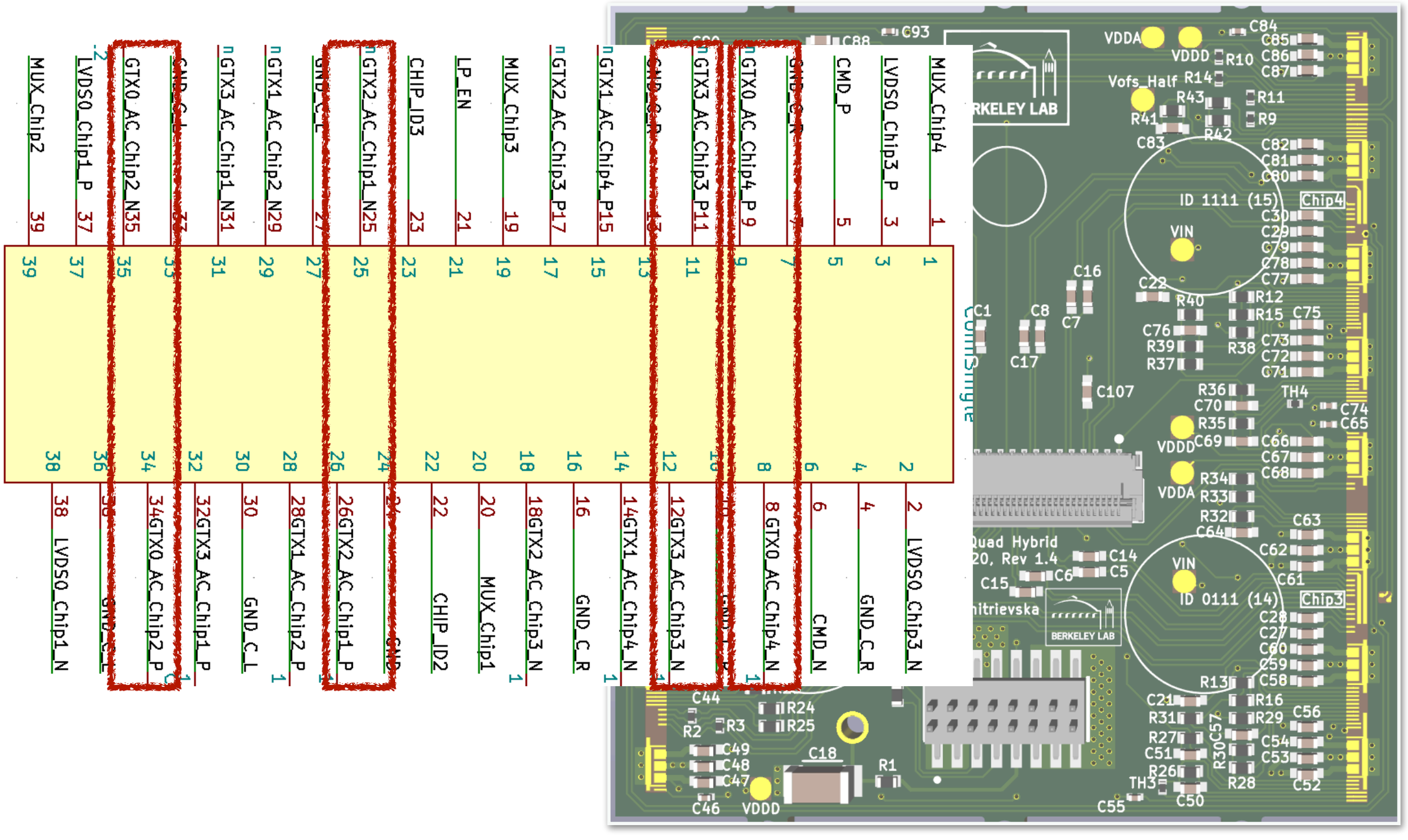


Quad Power Adapter cards

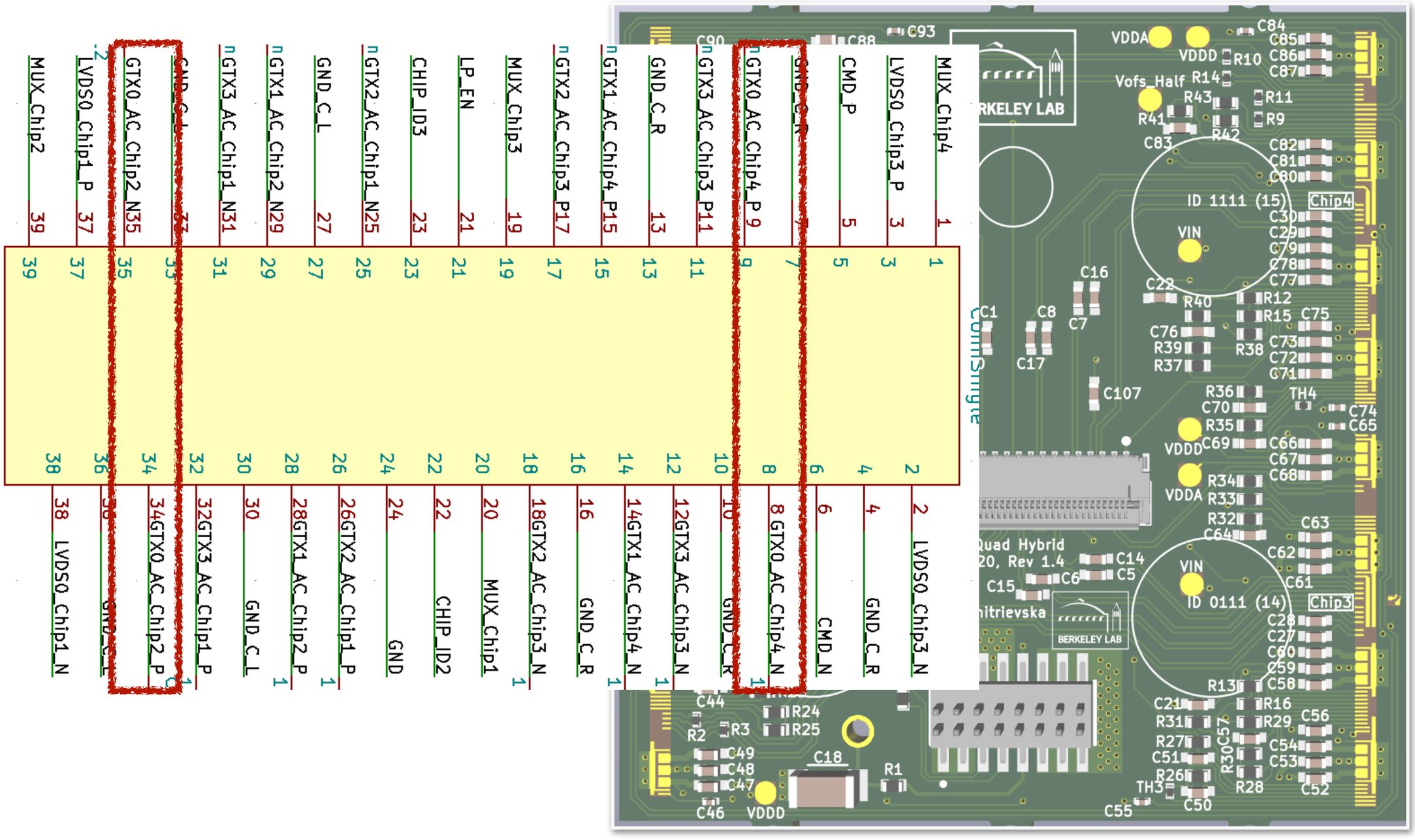
- 4-layer design, 10 produced
- Choice of LV connector
  - Molex (as on SCC)
  - Terminal block
- GitLab design files



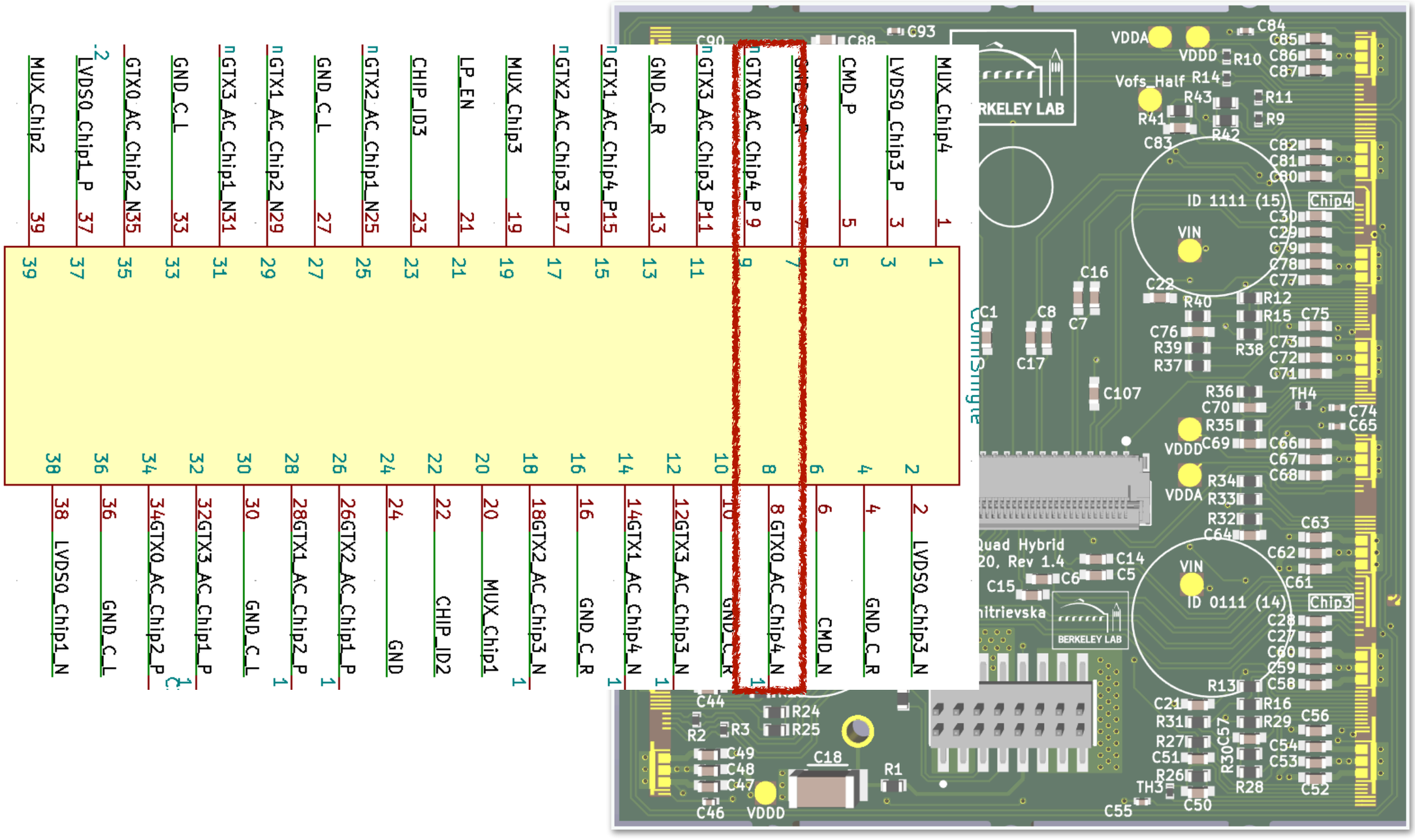
Data Sharing (1 link per FE)



Data Sharing (0.5 link per FE)



Data Sharing (0.25 link per FE)



CMD Forwarding

- Chip 1 and Chip3 can forward the CMD
- ChipID of the forwarded module should be changed (connect to the GND)