FTOF service hybrids design and layout optimization

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ePIC TOF WP2 working meeting
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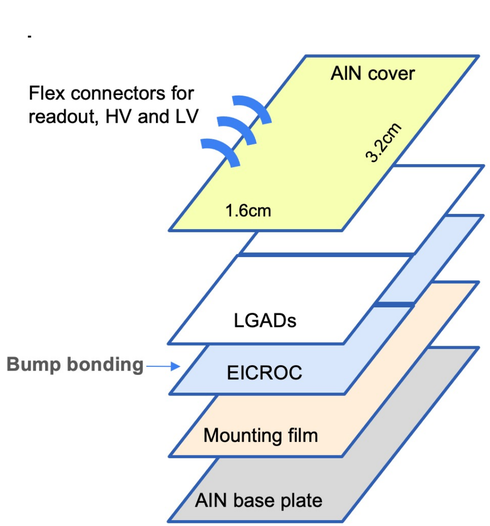
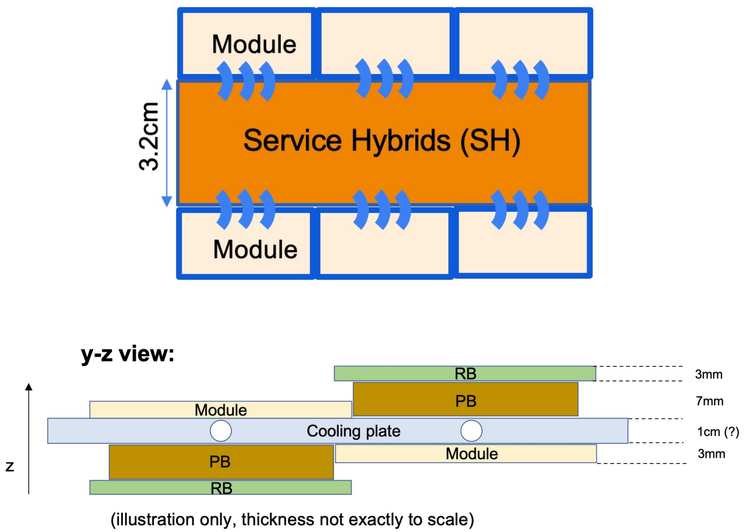
Electron-Ion Collider

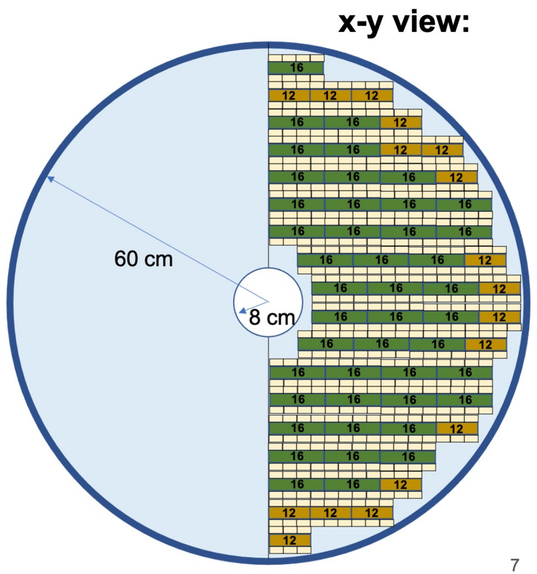
BROOKHAVEN NATIONAL LABORATORY | Jefferson Lab | U.S. DEPARTMENT OF ENERGY | Office of Science

Overview

Initial FTOF layout design from the Jan. collaboration meeting







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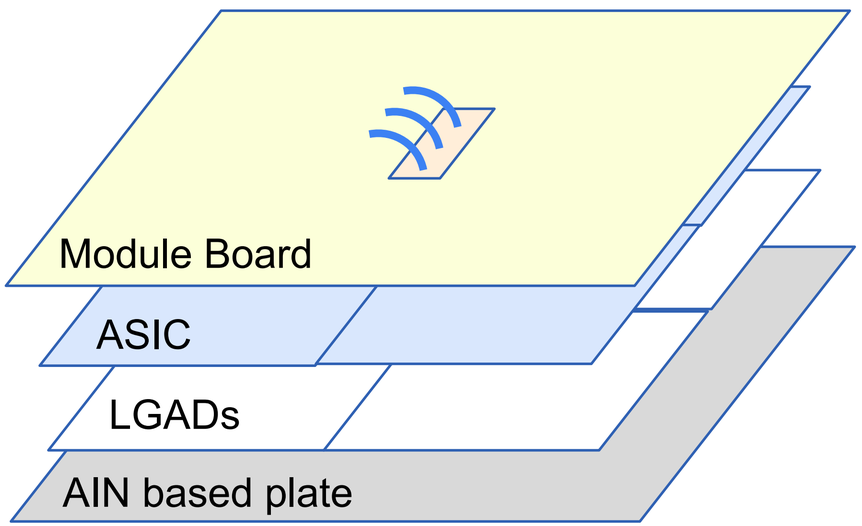
As the pre-prototype service hybrids development is progressing, it is time to refine the design in preparation for the first SH prototyping in FY25 (eRD109) and module prototyping

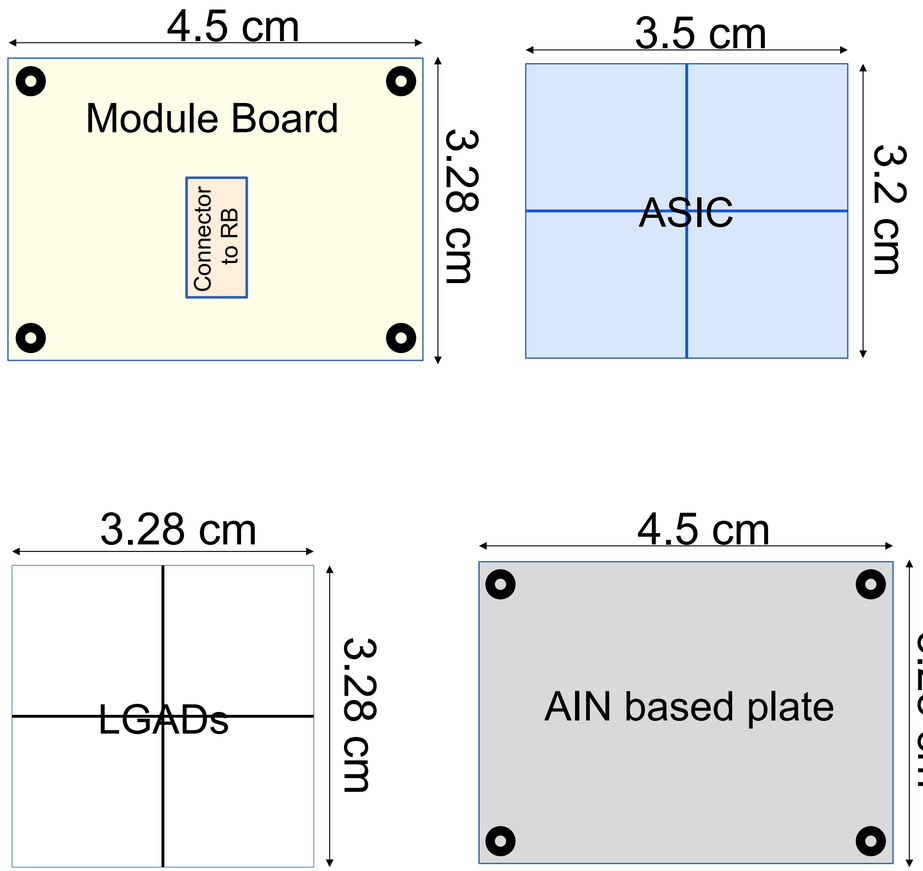
Consider the scenario of each SH servicing up to 32 ASICs (previously 16)

The recent change in the FTOF envelope in z from 15 cm to potentially only 5cm also requires us to be more cautious in the z thickness of the design, which is in part driven by FEE.

FTOF module

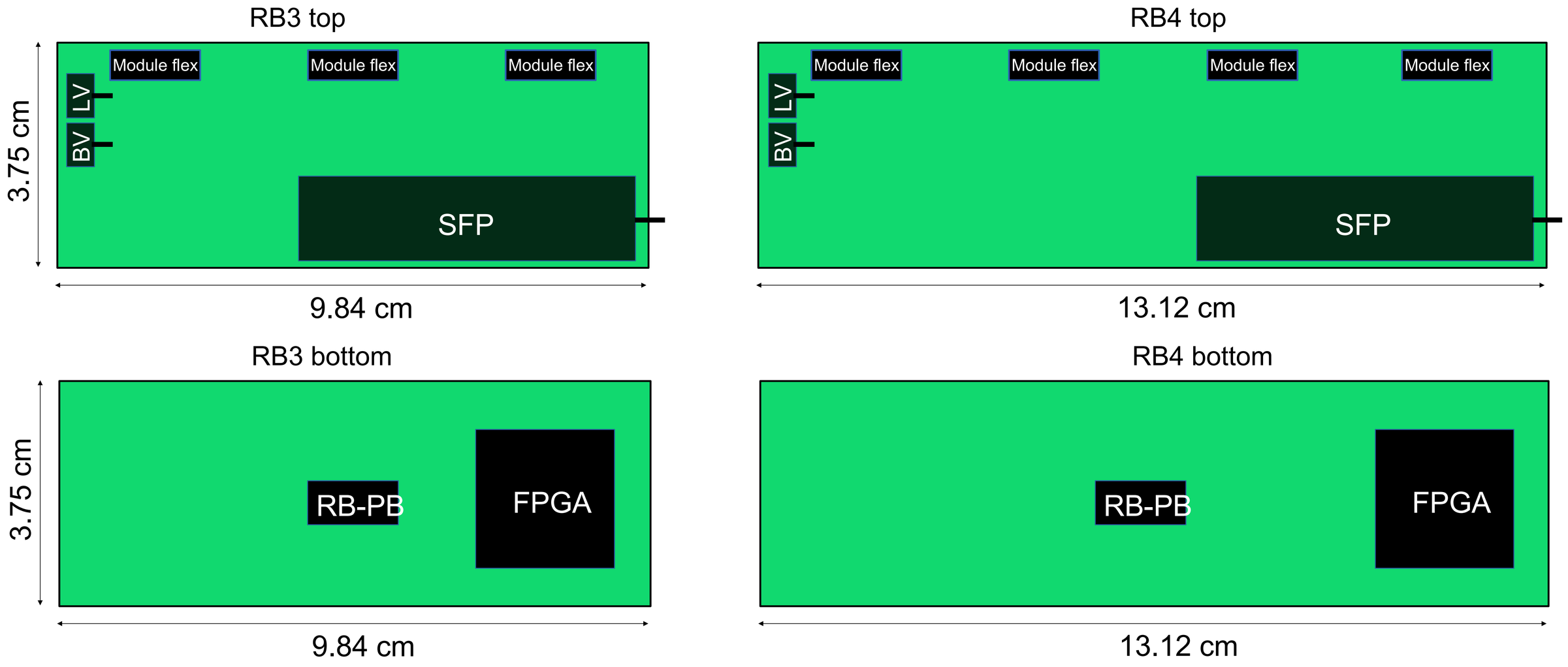
- 4 AC-LGADs sensor per module
- Each sensor: 32x32 pixels and 1.6x1.6 cm^2



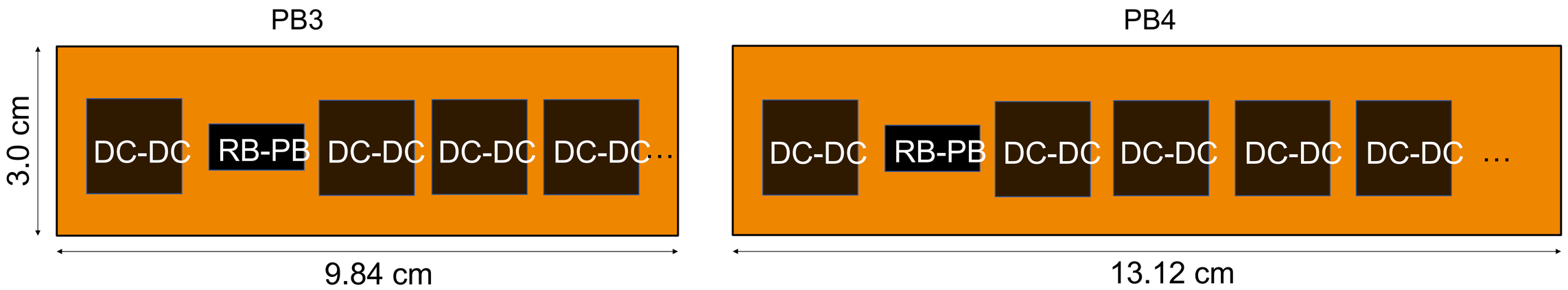


More realistic dimensions considering guard rings, mounting holes etc.

Readout board design

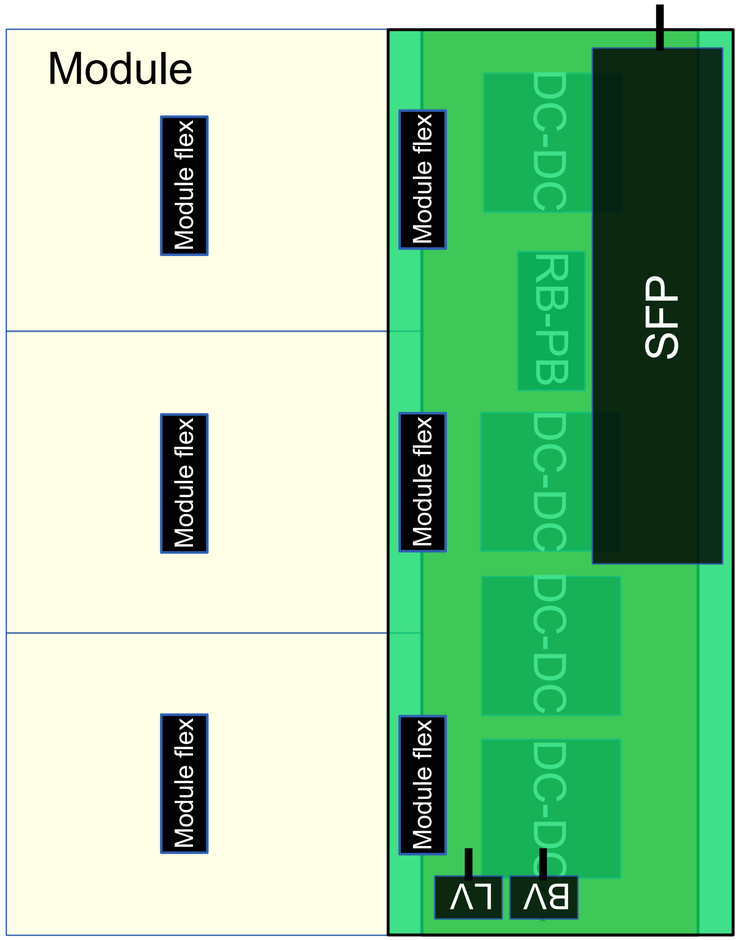


Power board design

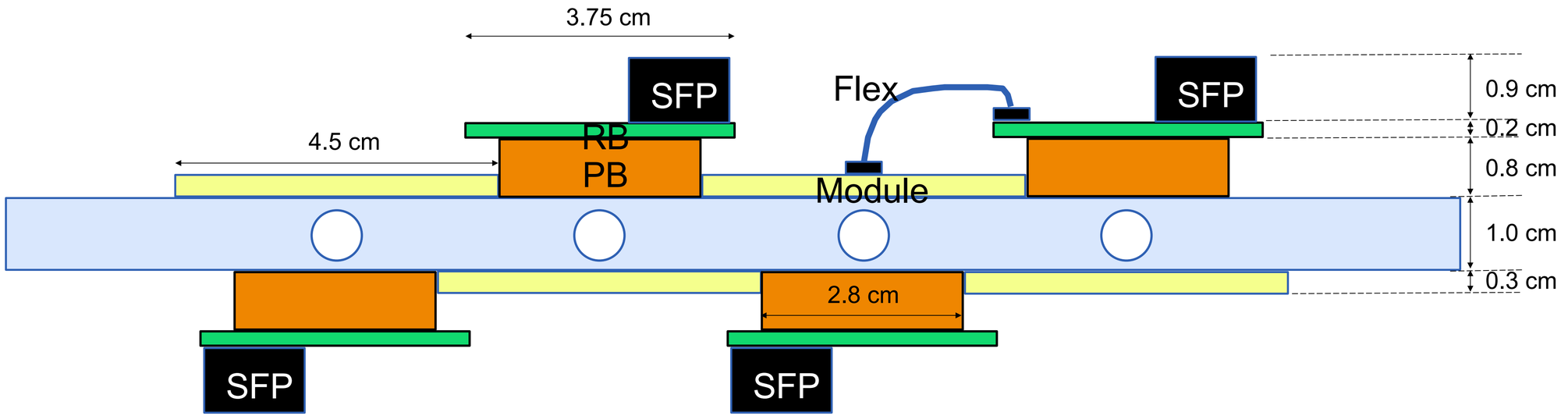


Number of DC-DC converters to be decided, depending on the choice of converters

Service hybrids and modules



FTOF layout (cross section view)



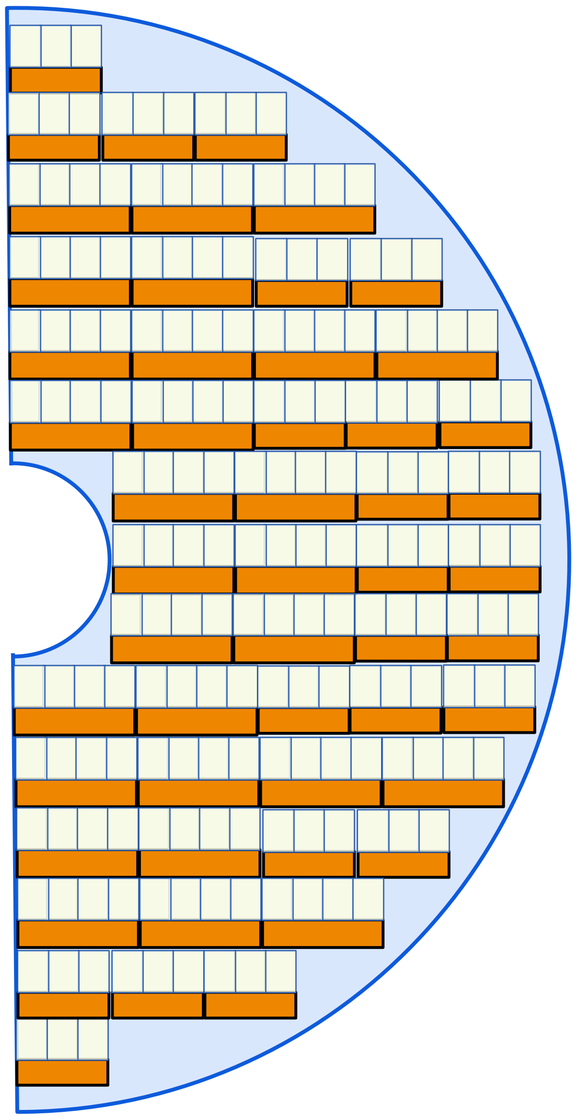
Z thickness requirement:

- At least 7.5 cm
- Can be reduced to 5cm if SFP is replaced by VTRx+

FTOF Layout (x-y view): Scenario 1

Outer radius: 60 cm

Inner radius: 10.5 cm



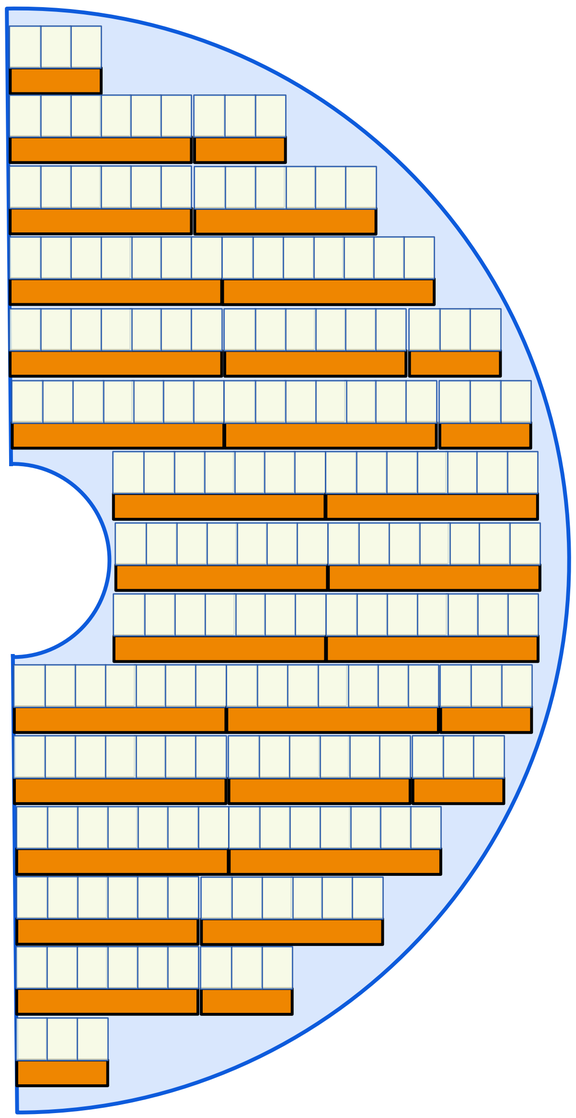
Row	modules	RB3	RB4	All RBs
1	3	1	0	1
2	9	3	0	3
3	12	0	3	3
4	14	2	2	4
5	16	0	4	4
6	17	3	2	5
7	14	2	2	4
8	14	2	2	4
9	14	2	2	4
10	17	3	2	5
11	16	0	4	4
12	14	2	2	4
13	12	0	3	3
14	9	3	0	3
15	3	1	0	1
Sum	**184**	24	28	**52**

Total number of modules: 184*4 = **736**
Total number of service hybrids: 52*4 = **208**

FTOF Layout (x-y view): Scenario 2

Outer radius: 60 cm

Inner radius: 10.5 cm



Row	modules	RB3	RB6	RB7	All RBs
1	3	1	0	0	1
2	9	1	1	0	2
3	12	0	2	0	2
4	14	0	0	2	2
5	16	1	1	1	3
6	17	1	0	2	3
7	14	0	0	2	2
8	14	0	0	2	2
9	14	0	0	2	2
10	17	1	0	2	3
11	16	1	1	1	3
12	14	0	0	2	2
13	12	0	2	0	2
14	9	1	1	0	2
15	3	1	0	0	1
Sum	**184**	8	8	16	**32**

Total number of modules: 184*4 = **736**
Total number of service hybrids: 32*4 = **128**

Summary

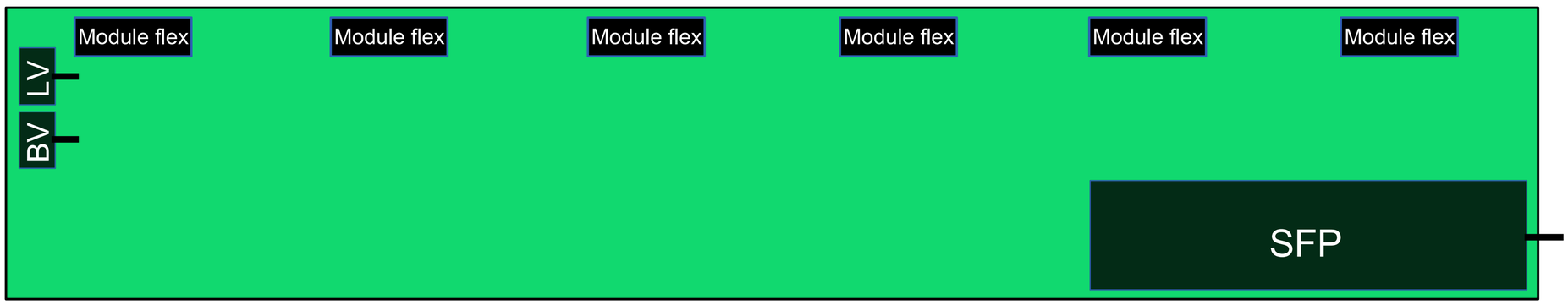
A new iteration of module, service hybrids and layout design

- Define more realistic dimensions, placement of components on the SH
- A new layout with longer SHs: reduce power, cables and material budgets
- z envelope requirement: 7.5cm needed for current design and can be reduced to 5cm if using VTRx+

Next steps:

- Need CAD drawings at some point
- Layout documentation (in preparation)
- Prepare for first prototyping in FY25

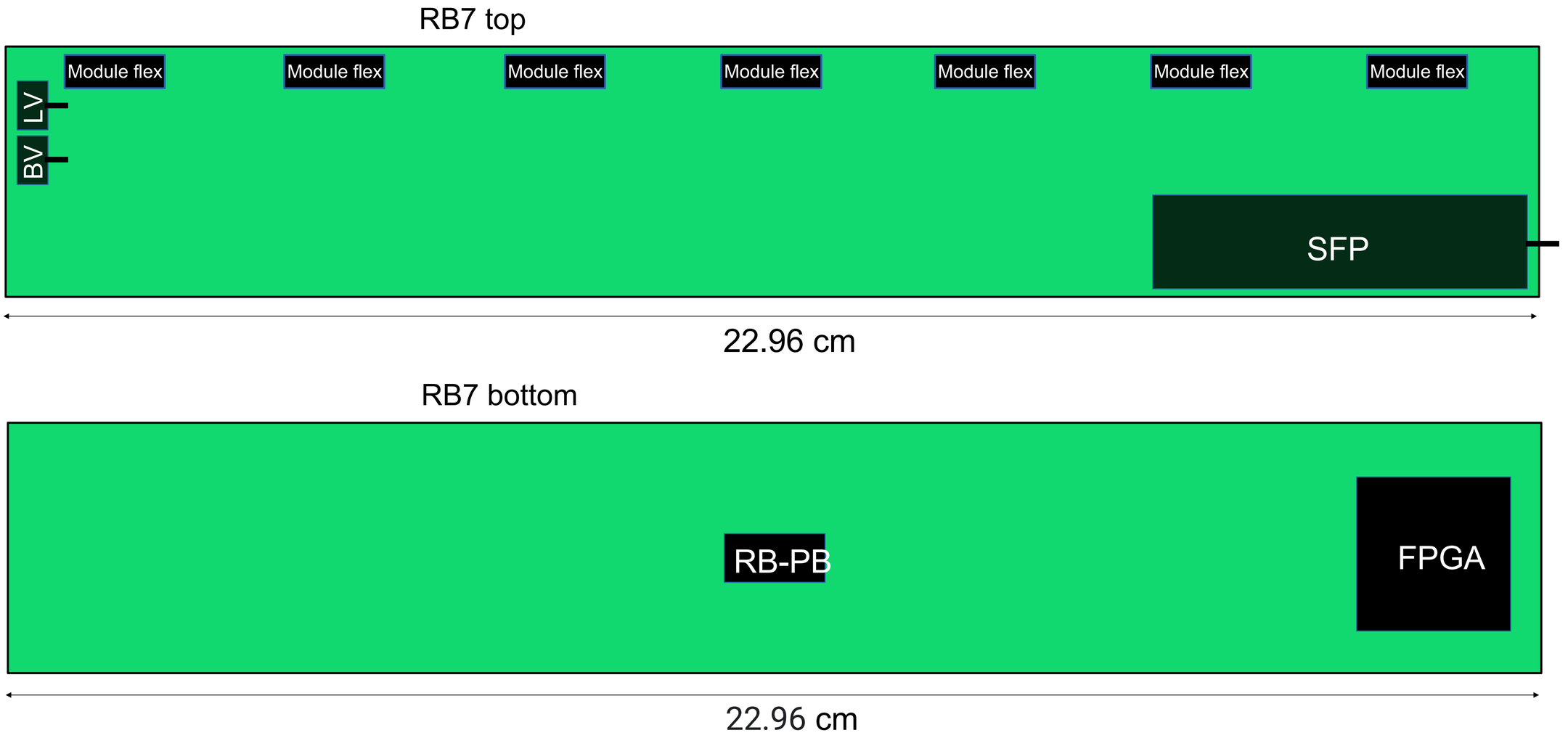
RB6 top



19.68 cm

RB6 bottom

19.68 cm


RB7 top
Module flex
Module flex
Module flex
Module flex
Module flex
Module flex
Module flex
LV
BV
SFP
22.96 cm
RB7 bottom
RB-PB
FPGA
22.96 cm