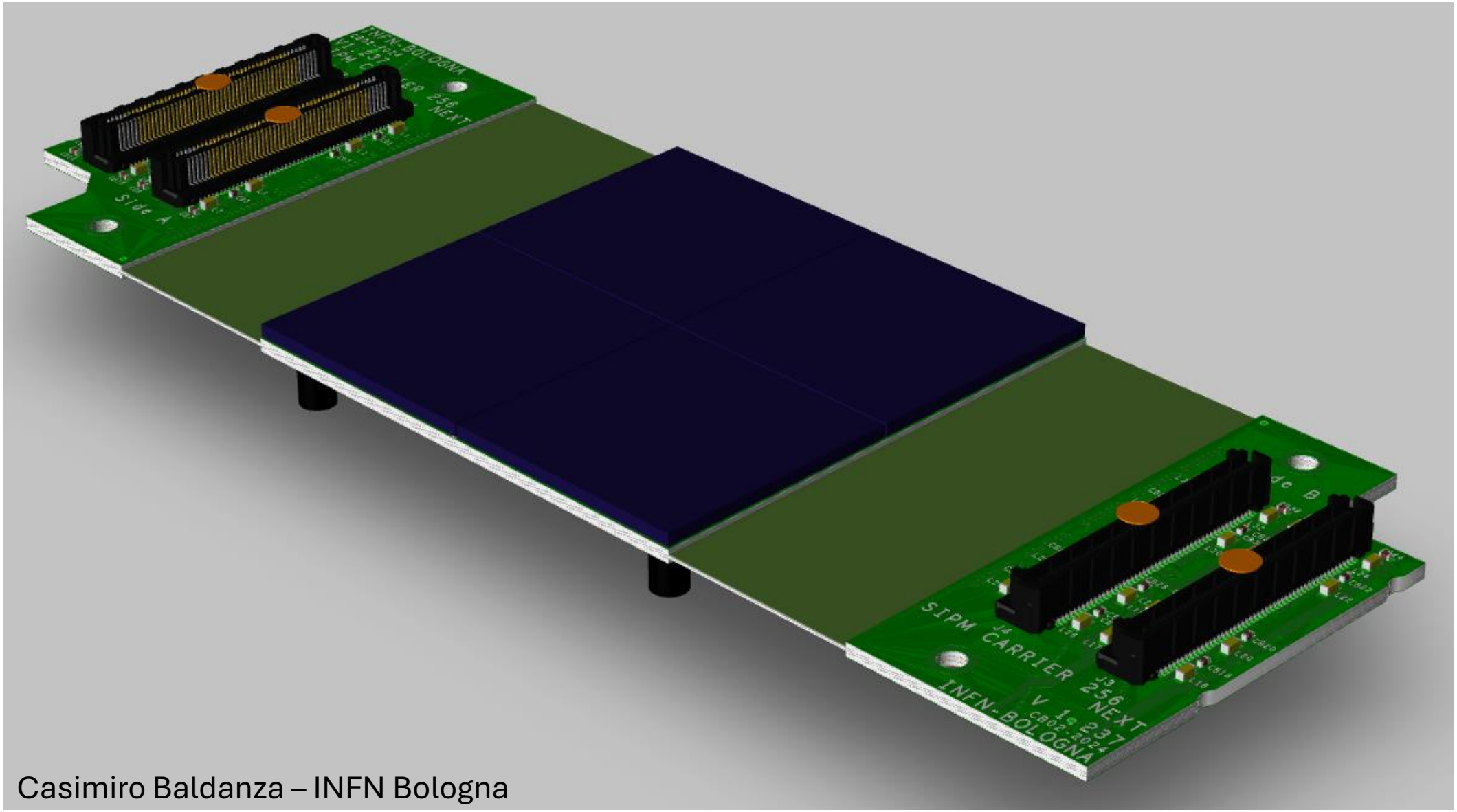
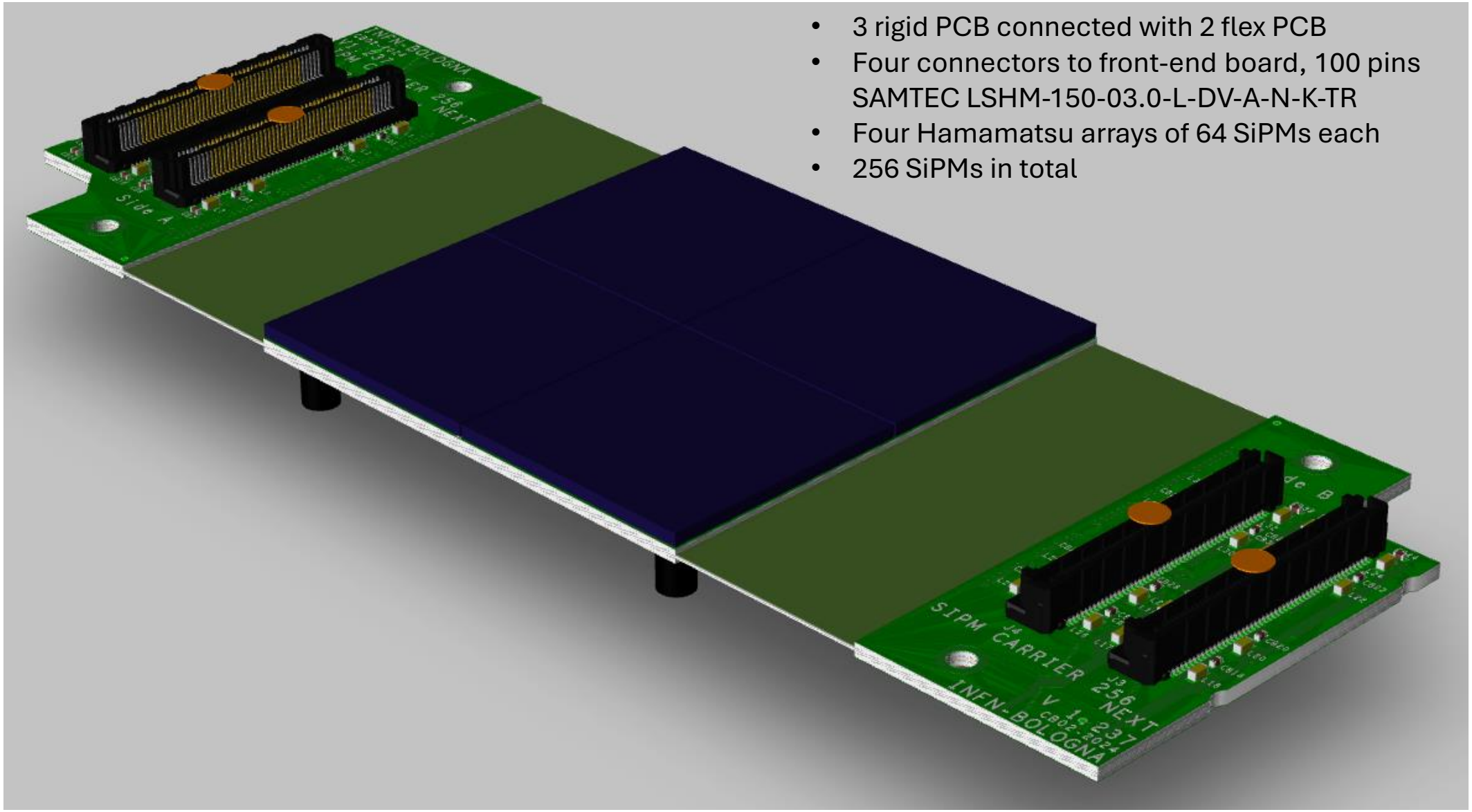
SIPM CARRIER 256 V3



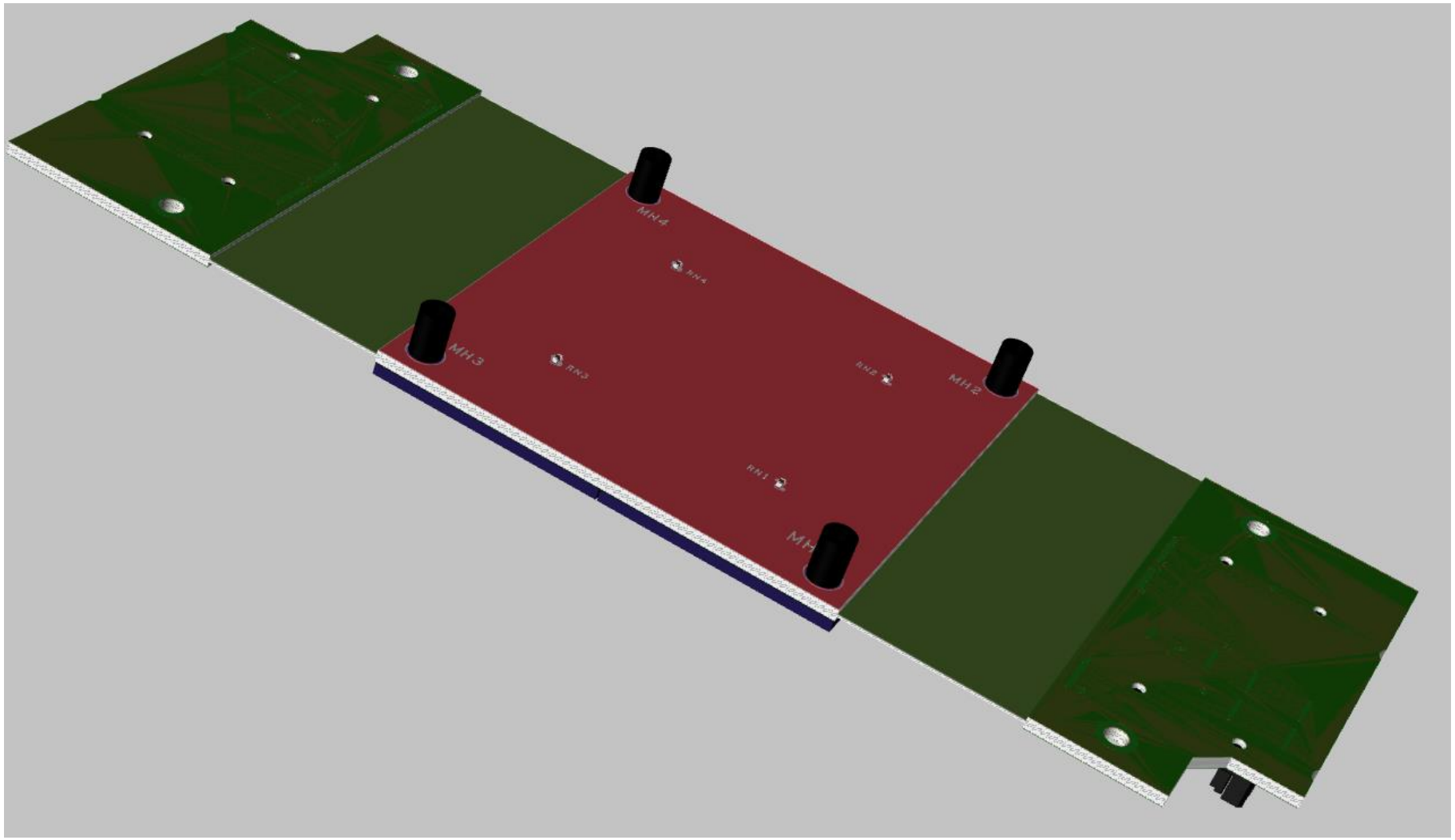
Casimiro Baldanza – INFN Bologna

SIPM CARRIER 256 V3

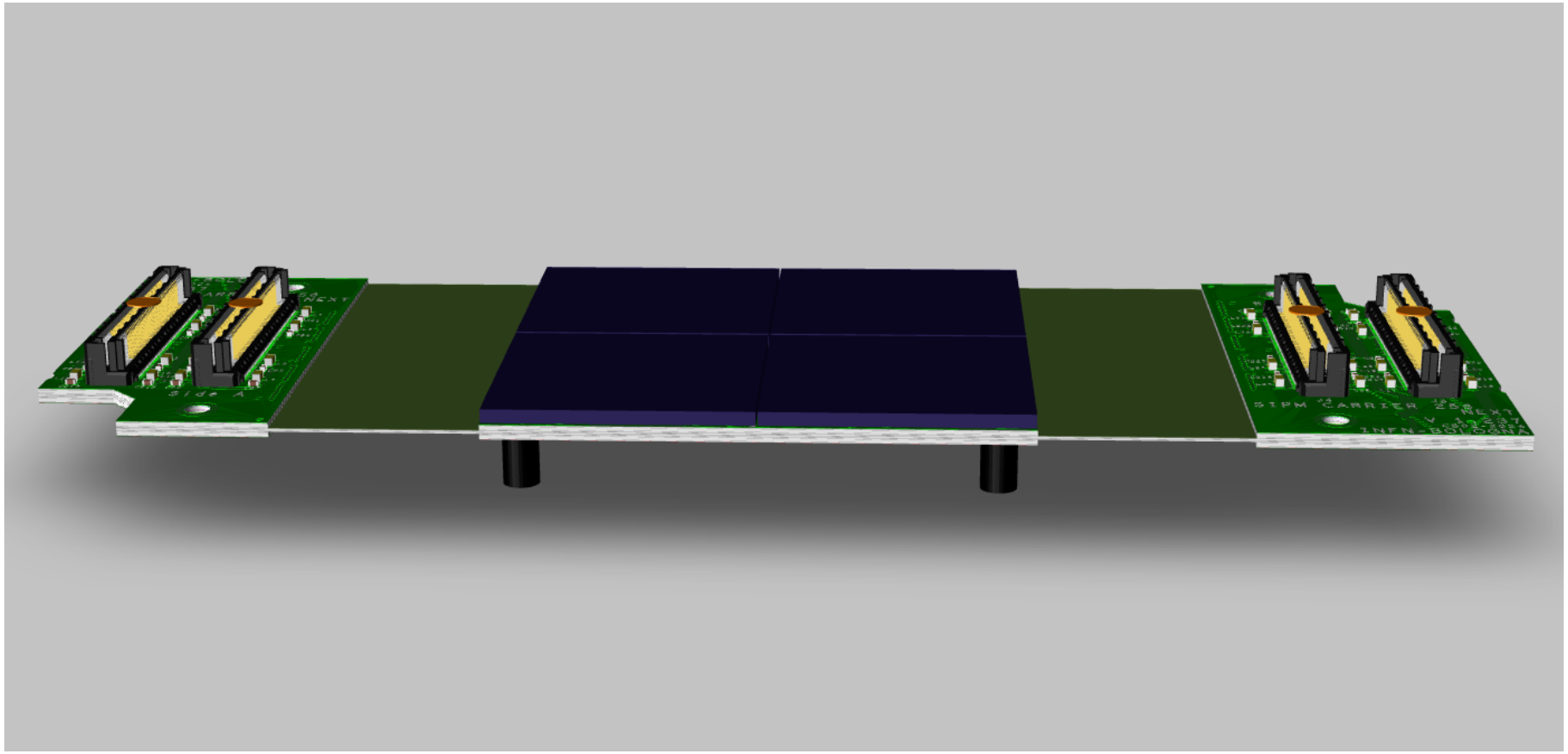


- 3 rigid PCB connected with 2 flex PCB
- Four connectors to front-end board, 100 pins SAMTEC LSHM-150-03.0-L-DV-A-N-K-TR
- Four Hamamatsu arrays of 64 SiPMs each
- 256 SiPMs in total

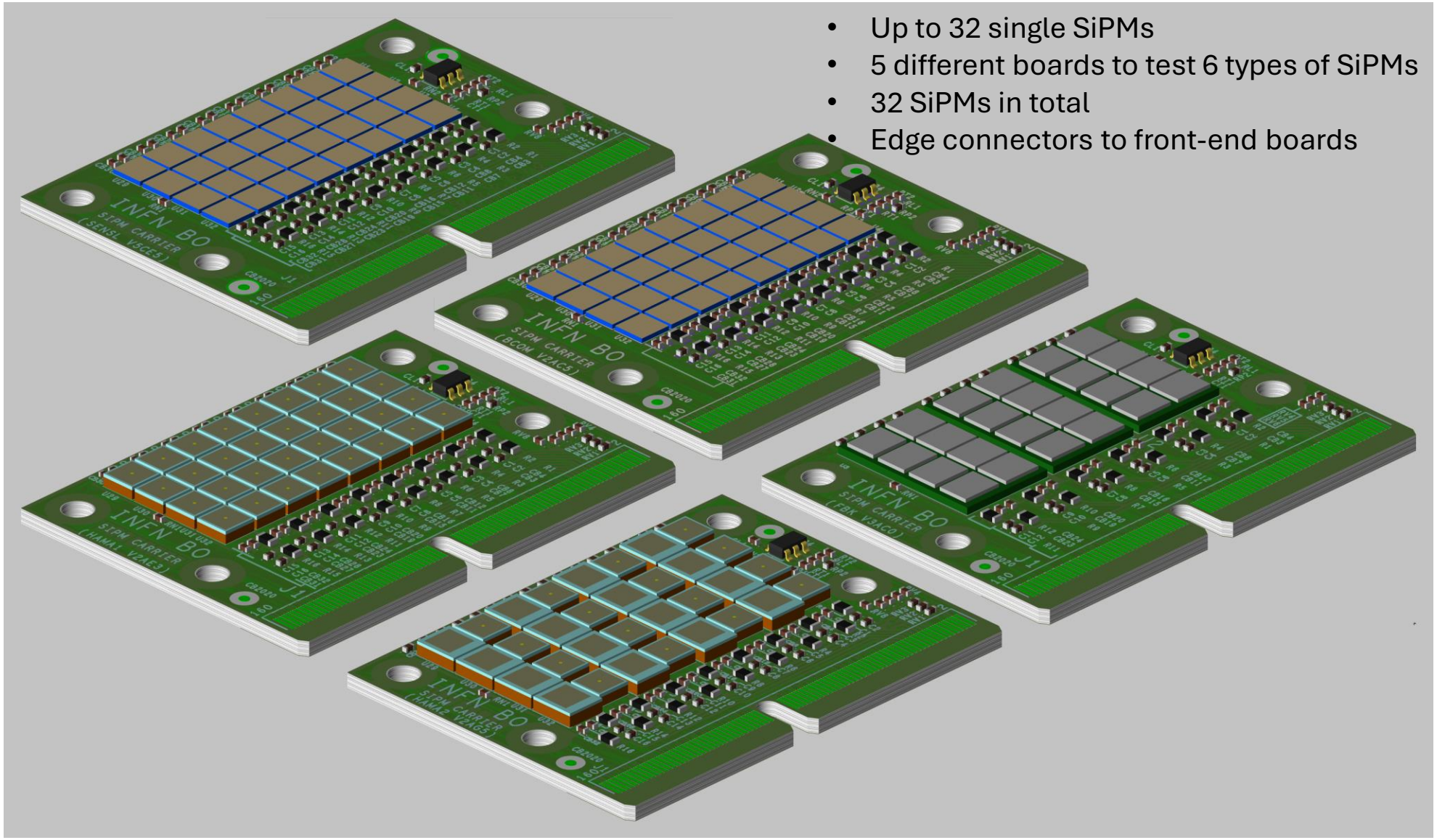
SIPM CARRIER 256 V3



SIPM CARRIER 256 V3

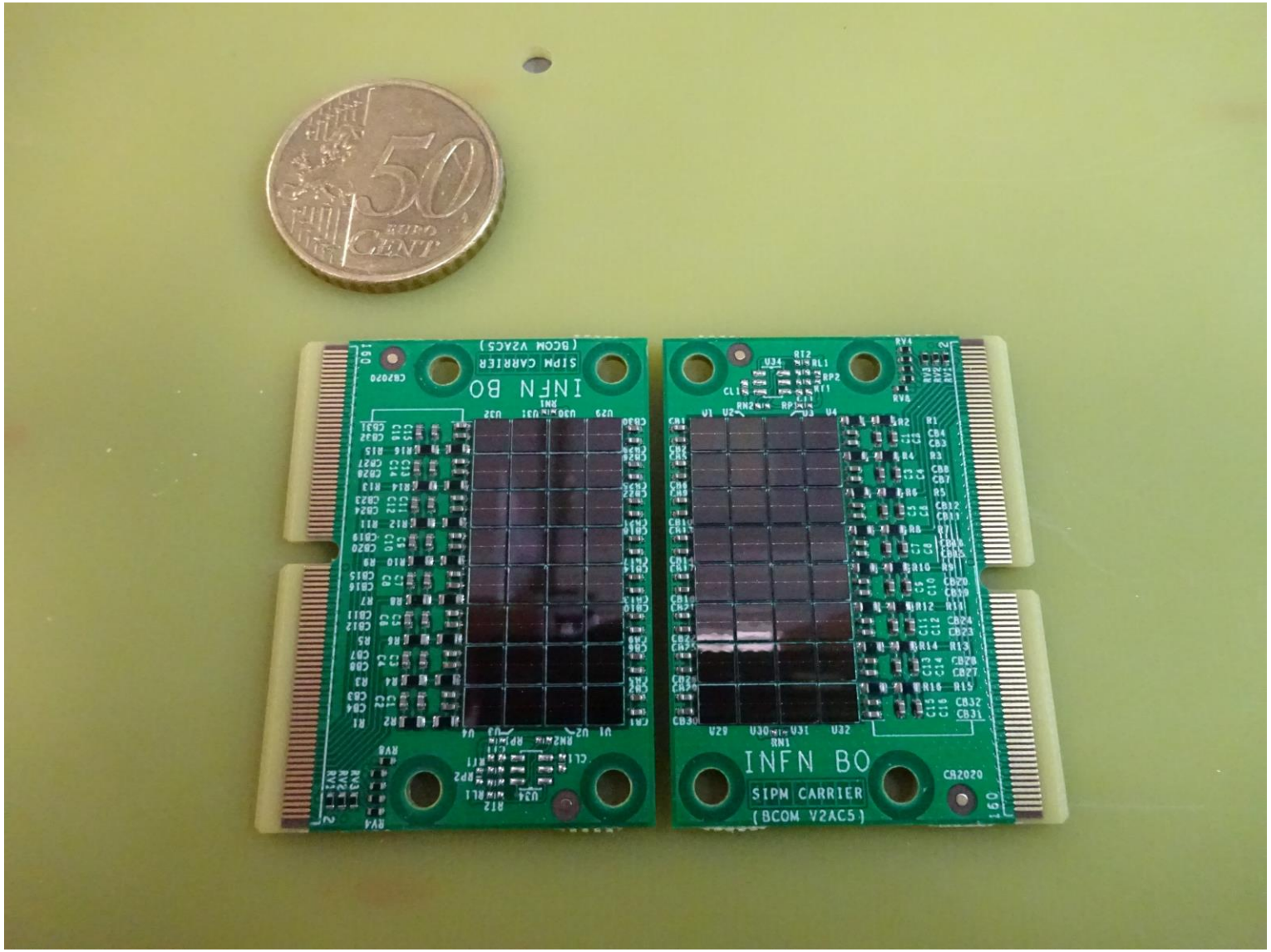


OLD VERSIONS: SIPM_CARRIER V1

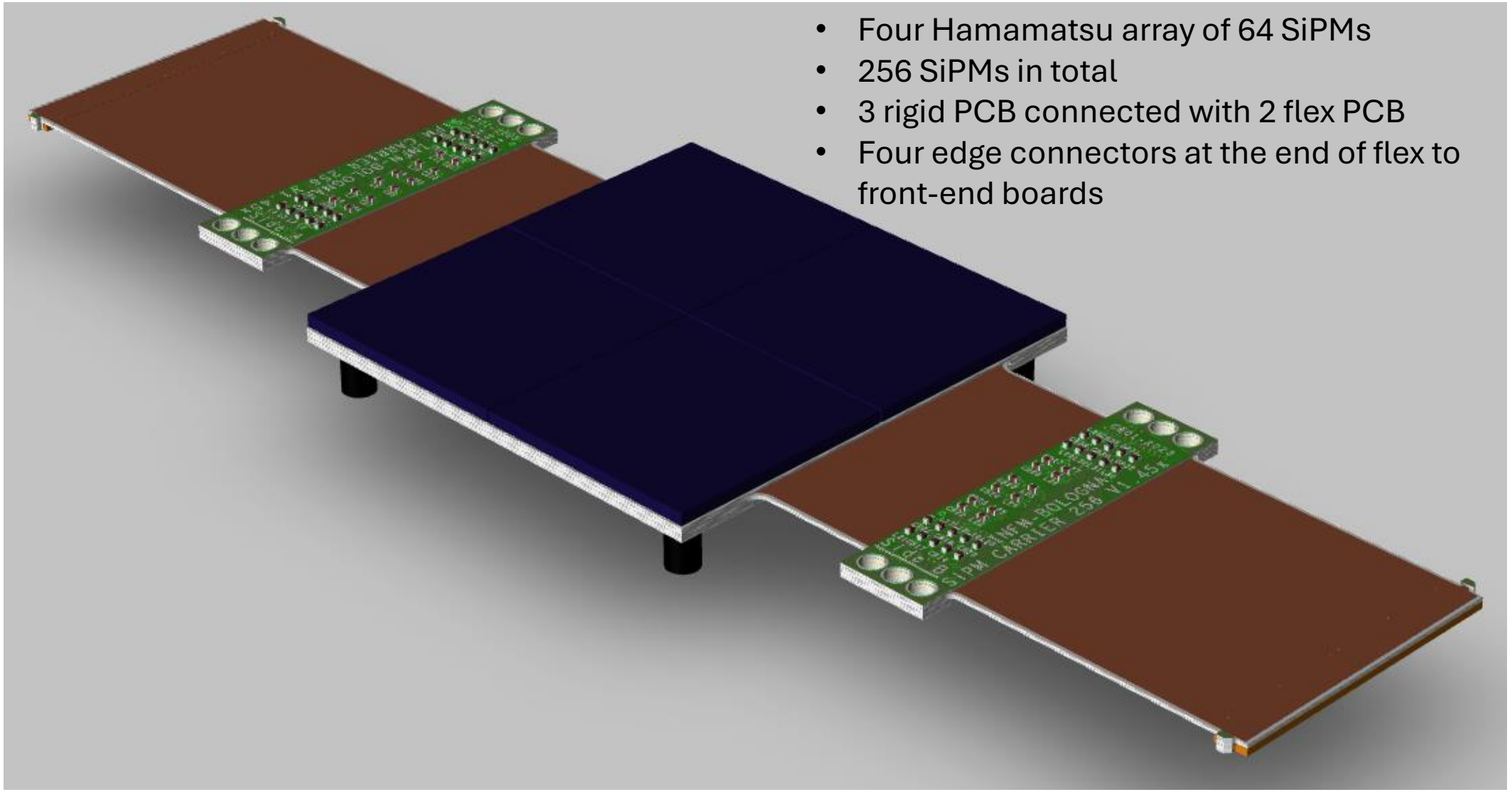


- Up to 32 single SiPMs
- 5 different boards to test 6 types of SiPMs
- 32 SiPMs in total
- Edge connectors to front-end boards

OLD VERSIONS: SIPM_CARRIER V1

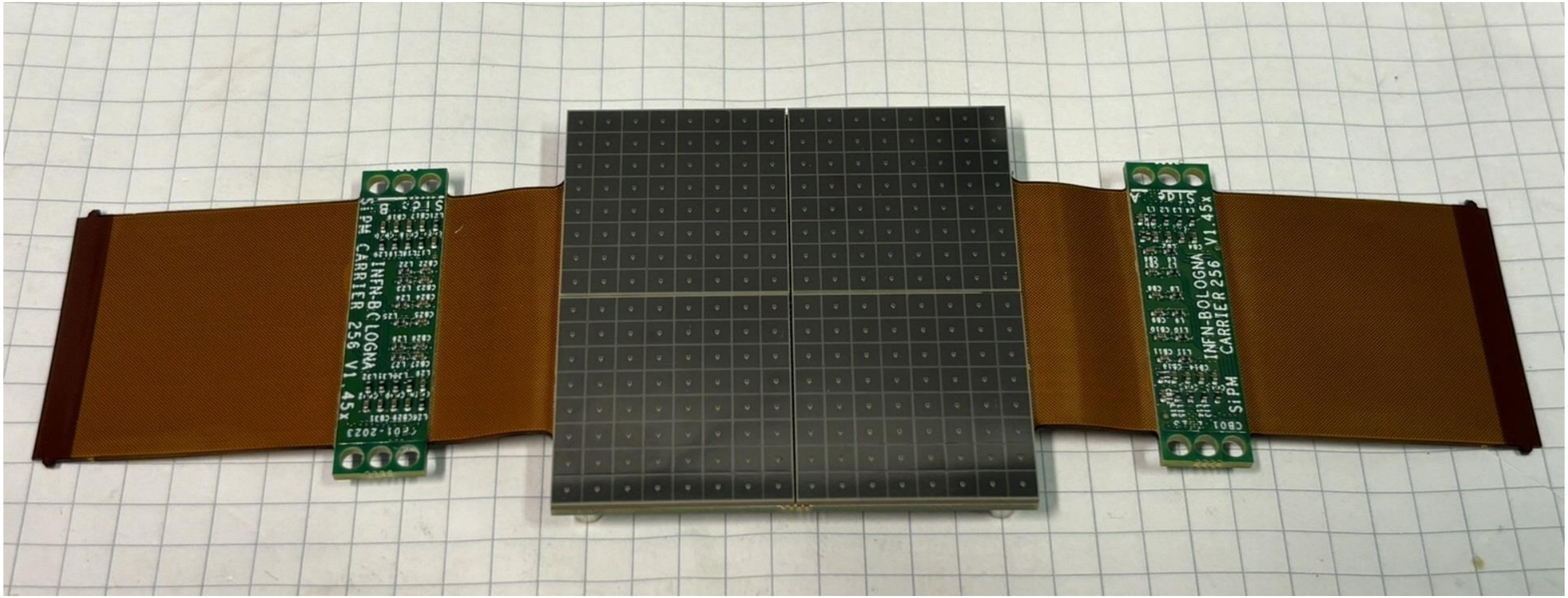


OLD VERSIONS: SIPM_CARRIER V2

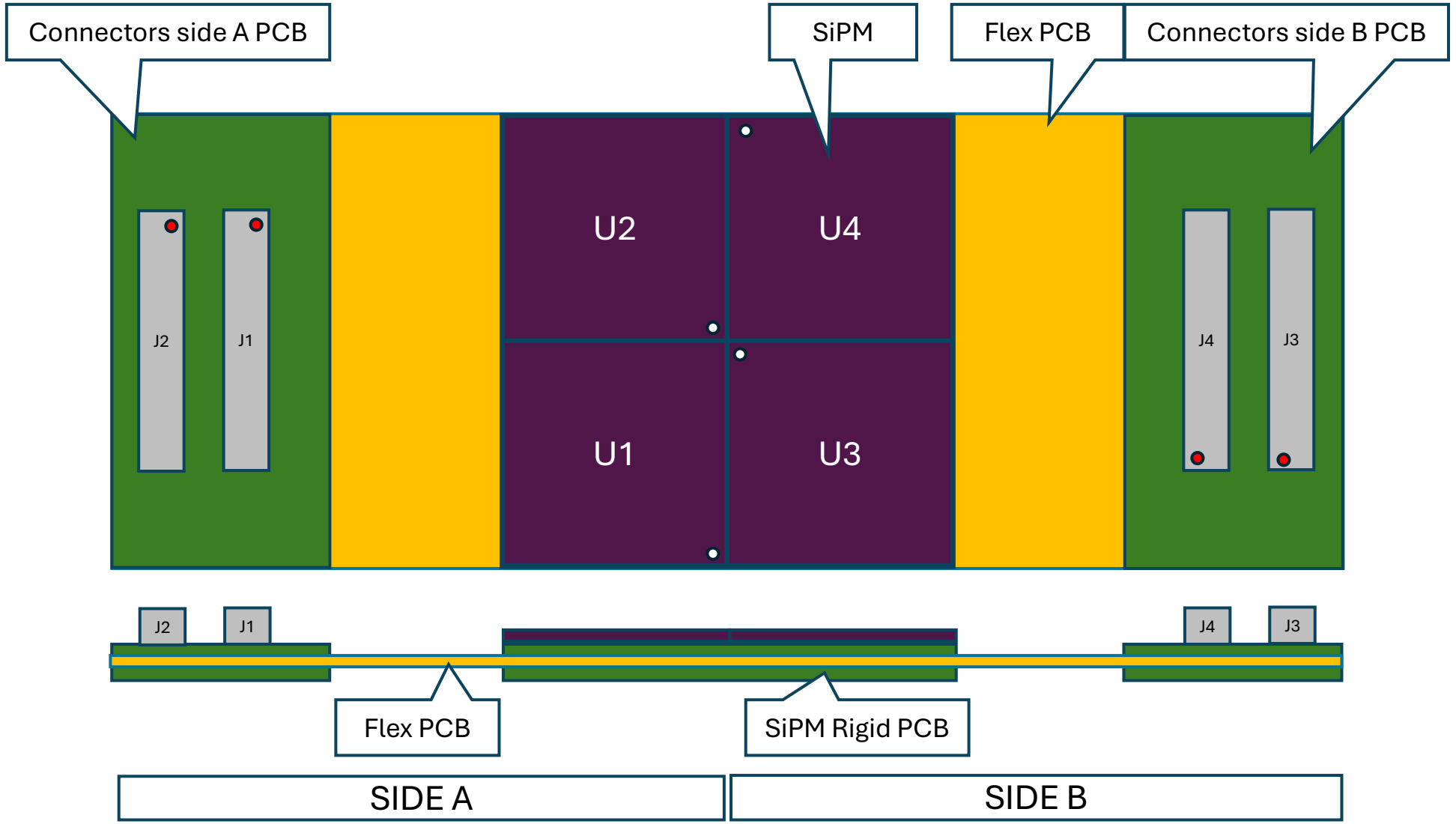


- Four Hamamatsu array of 64 SiPMs
- 256 SiPMs in total
- 3 rigid PCB connected with 2 flex PCB
- Four edge connectors at the end of flex to front-end boards

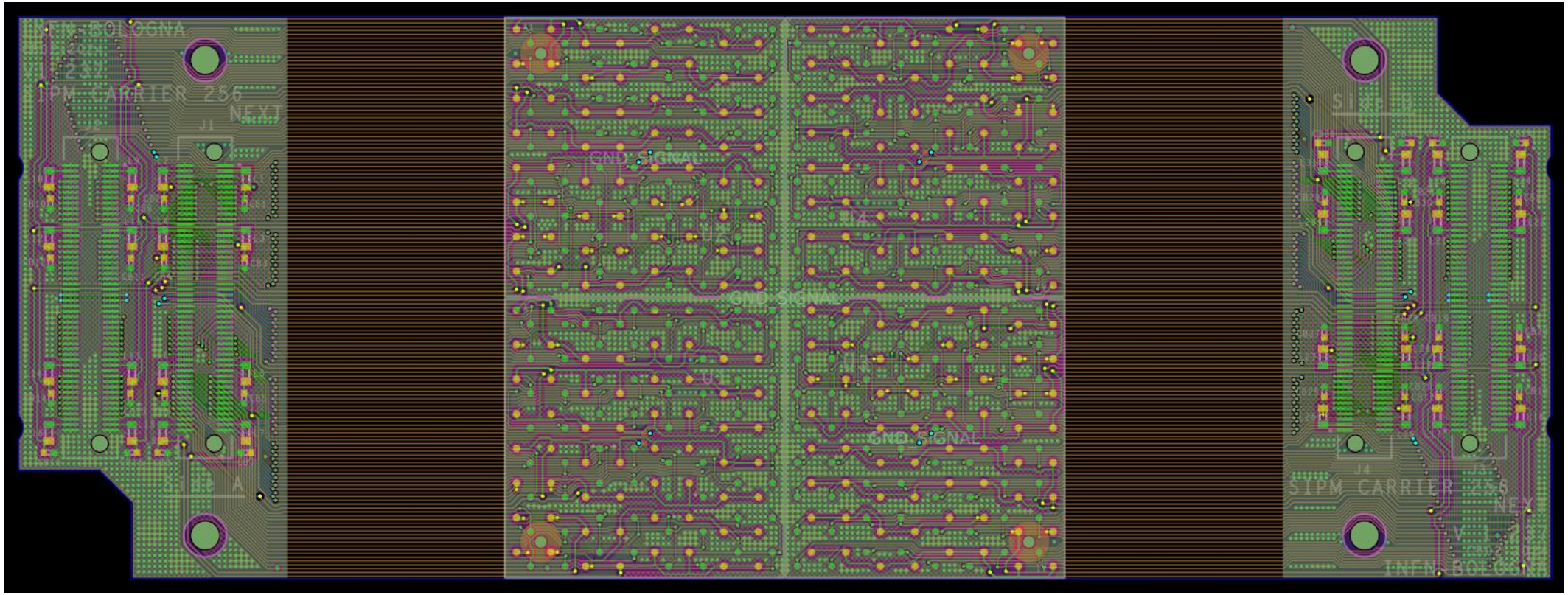
OLD VERSIONS: SIPM_CARRIER V2



Carrier V3: Main components and PCB



PCB



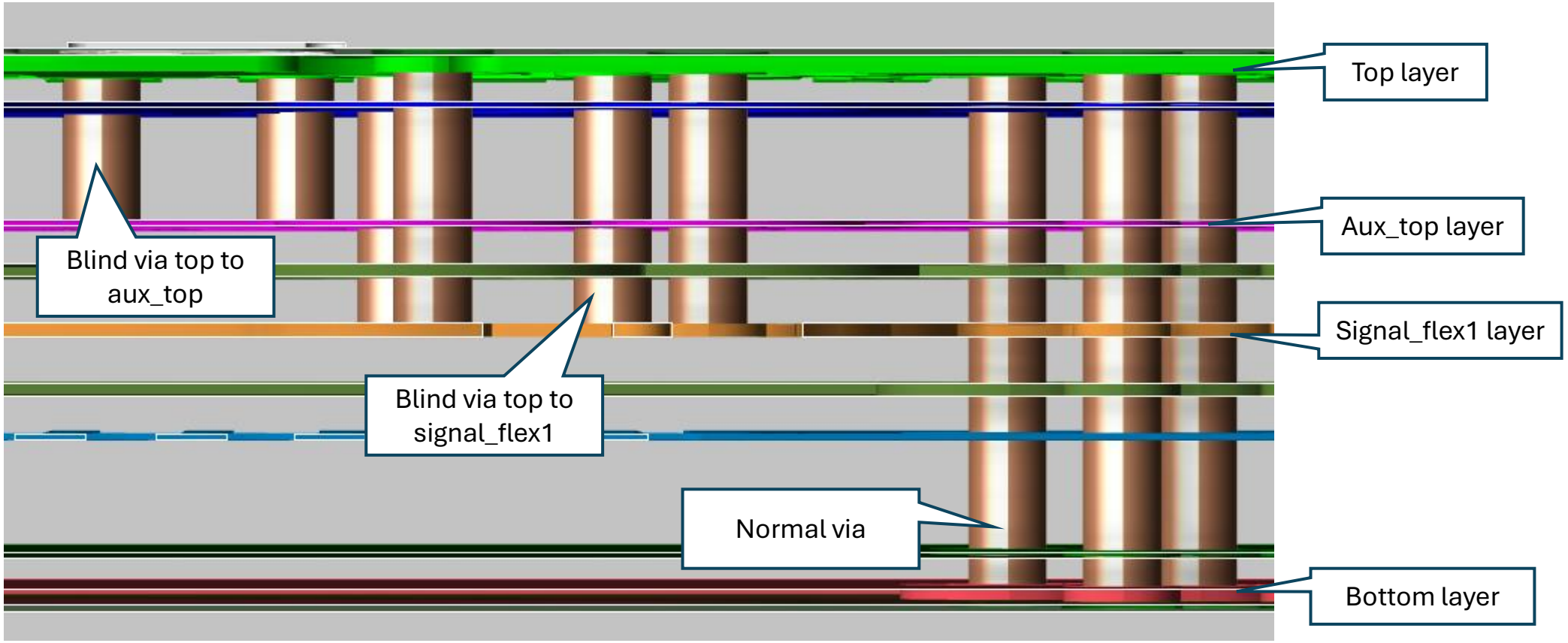
- Dimensions: 142x52mm (5.59x2 inch)
- Three rigid PCBs connected together by two flex PCBs
- Rigid PCBs: 9 layers, minimum track width 0.127mm (5mils), minimum hole 0.15mm (5.9mils), minimum spacing 0.12mm (4.7mils), normal and blind vias
- Flex PCB: 3 layers, minimum track width 0.127mm (5mils), minimum spacing 0.12mm (4.7mils), no vias

PCB: Stackup

Objects		Types	Thickness	Material	Primary	Flex	Add Stackup
#	Name	Layer	mm				
*	*	*	*	*	*	*	*
		Surface			☑	☑	
	SOLDERMASK_TOP	Mask	0.02	Soldermask	☑	☐	
1	TOP	Conductor	0.042	Copper	☑	☐	
		Dielectric	0.08	Fr-4 No Flow Pre...	☑	☐	
2	GND_TOP	Plane	0.017	Copper	☑	☐	
		Dielectric	0.3	Fr-4	☑	☐	
3	AUX_TOP	Conductor	0.017	Copper	☑	☐	
		Dielectric	0.1	Fr-4 No Flow Pre...	☑	☐	
	COVERLAY_TOP	Mask	0.04	Polyimide	☐	☑	
4	GND_FLEX_EXT	Plane	0.035	Copper	☑	☑	
		Dielectric	0.125	Polyimide Film	☑	☑	
5	SIGNAL_FLEX1	Conductor	0.035	Copper	☑	☑	
		Dielectric	0.125	Polyimide Film	☑	☑	
6	GND_FLEX_INT	Plane	0.035	Copper	☑	☑	
	COVERLAY_BOTTOM	Mask	0.04	Polyimide	☐	☑	
		Dielectric	0.1	Fr-4 No Flow Pre...	☑	☐	
7	AUX_BOTTOM	Conductor	0.017	Copper	☑	☐	
		Dielectric	0.3	Fr-4	☑	☐	
8	GND_BOTTOM	Plane	0.017	Copper	☑	☐	
		Dielectric	0.08	Fr-4 No Flow Pre...	☑	☐	
9	BOTTOM	Conductor	0.042	Copper	☑	☐	
	SOLDERMASK_BOTTOM	Mask	0.02	Soldermask	☑	☐	
		Surface			☑	☑	

- 9 layers in total
- 5 layers for signals including one in the flex PCB
- 4 ground planes including two in the flex
- On the Flex PCB the signal layer is inserted between two ground plane layers
- The bottom layer of the central rigid PCB, in direct contact with the cooling plane, is not equipped with a solder mask to improve the thermal transmission.
- Blind vias have been used in this project to improve the tracks routing.
- The PCB core are currently between layer 2 and 3 and symmetrically 7 and 8
- Track impedence is 50Ω

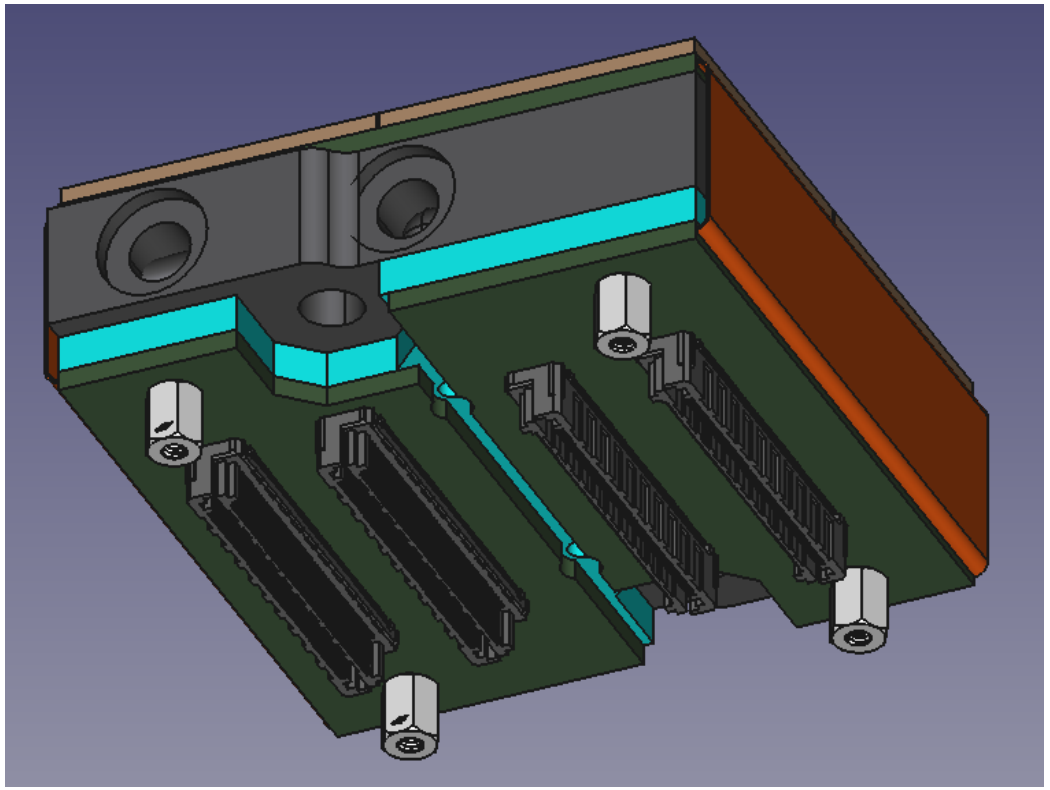
PCB: vias

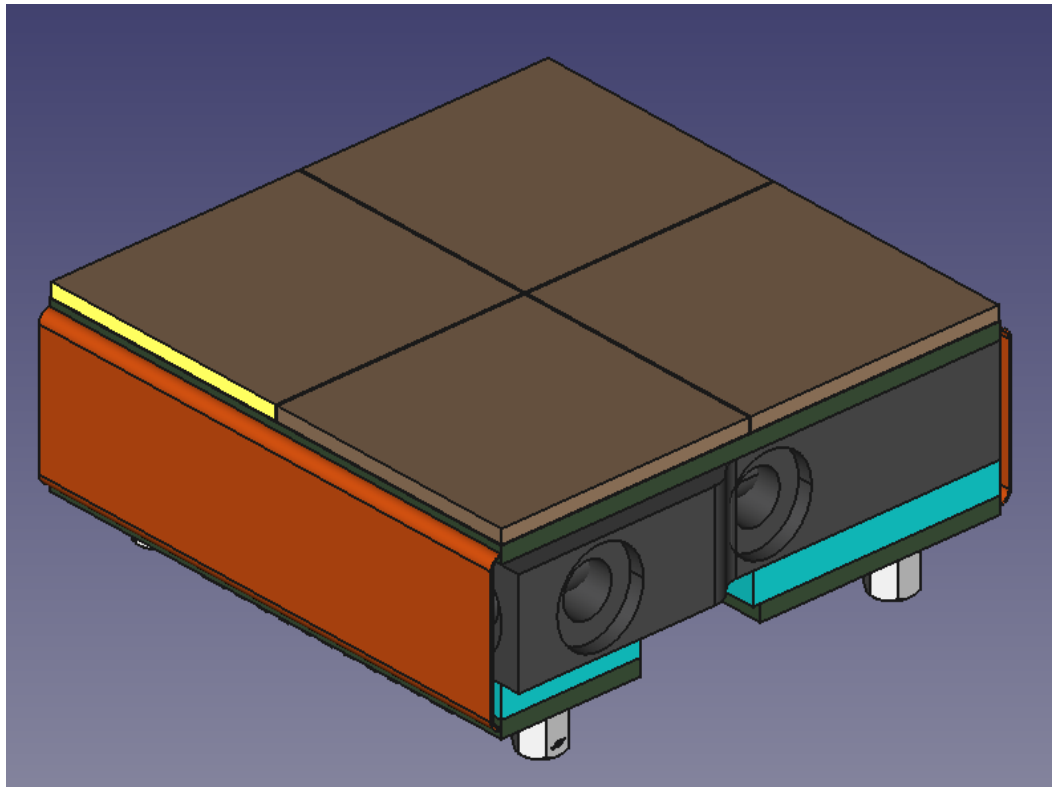


Three types of vias have been used for the routing:

- One from the top layer to the aux_top layer, the first internal conductors layer
- The second from the top layer to the signal_flex1 layer through the aux_top layer
- The third type are normal vias, for connection between the top layer and the bottom aux layer or the bottom layer, and for the ground plane connections.

PCB folding





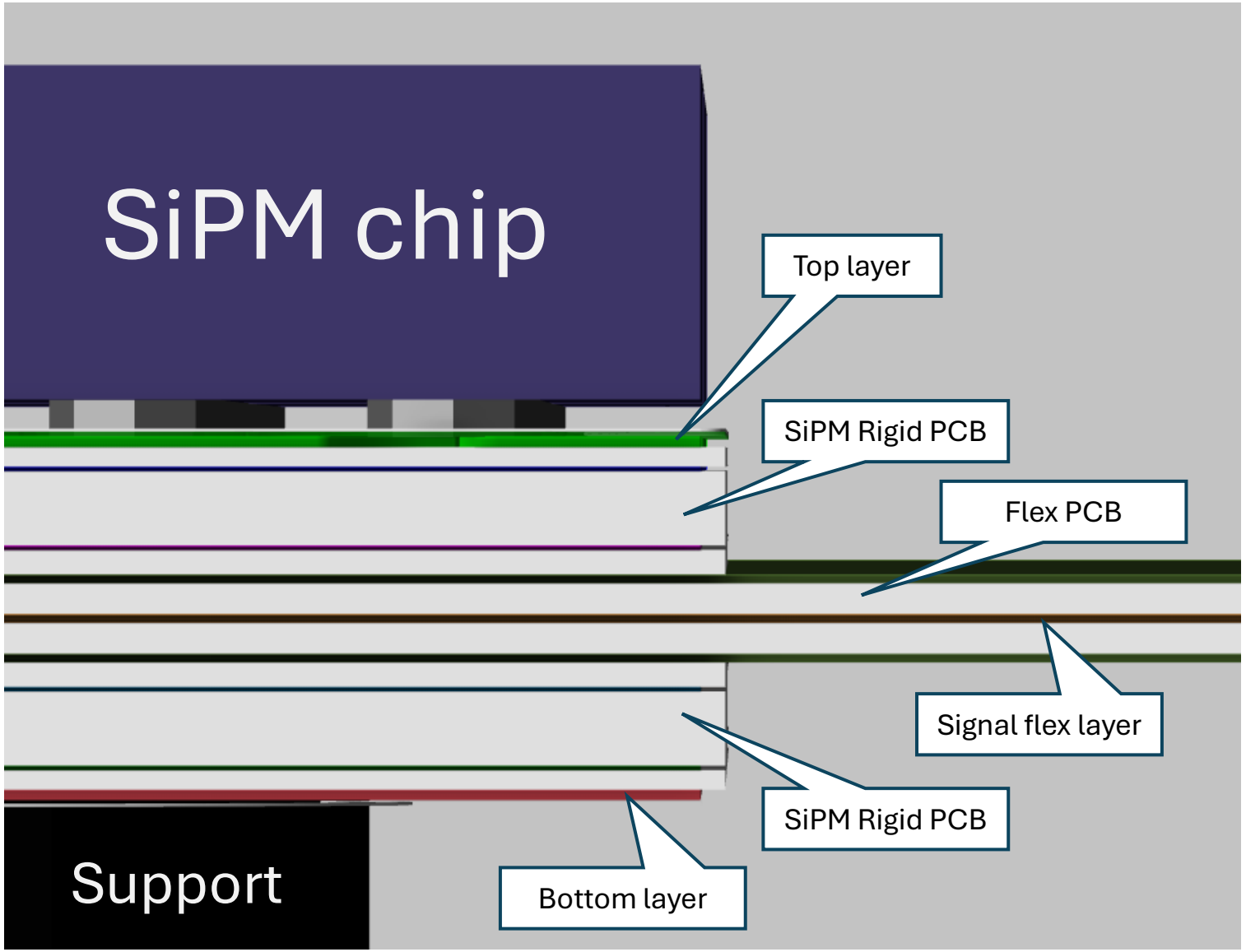
- PCB folding around the cooling plate
- Cut-out for the cooling pipes

Conclusions

- The board schematic is complete
- The PCB layout is complete
- An offer has been requested from the PCB manufacturer for 8 boards
- Feedback was requested from the PCB manufacturer about the available materials, including the electrical and mechanical characteristics of:
  - Dielectrics (thickness, electrical permittivity ε_r)
  - The copper planes on FR4 associated with the cores (also thickness, electrical permittivity ε_r of the FR4 part)
  - Polymide sheets for the flex part (thickness, electrical permittivity ε_r)

  Once these parameters have been obtained, the stackup will then be checked and in case of changes, the new files will be sent for production

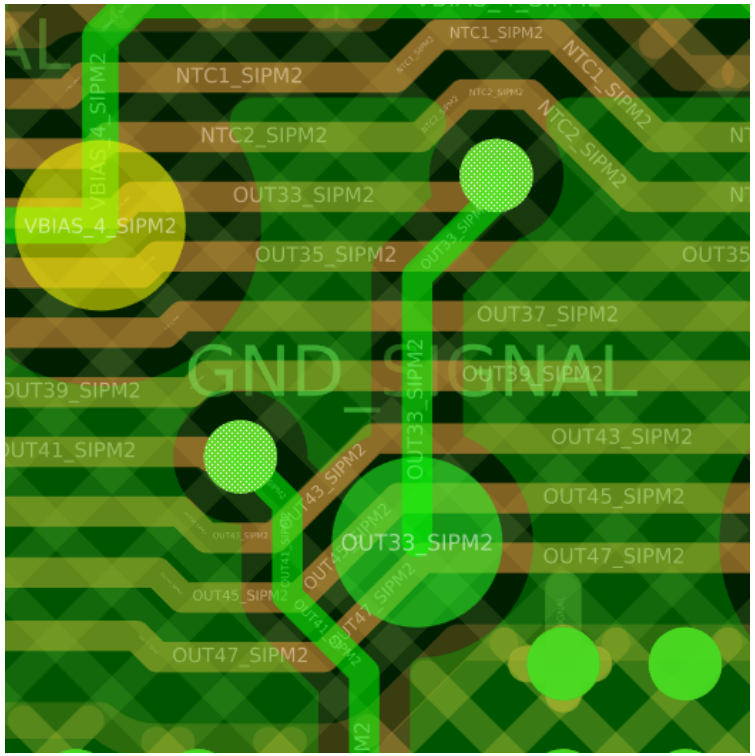
Backup: PCB stack



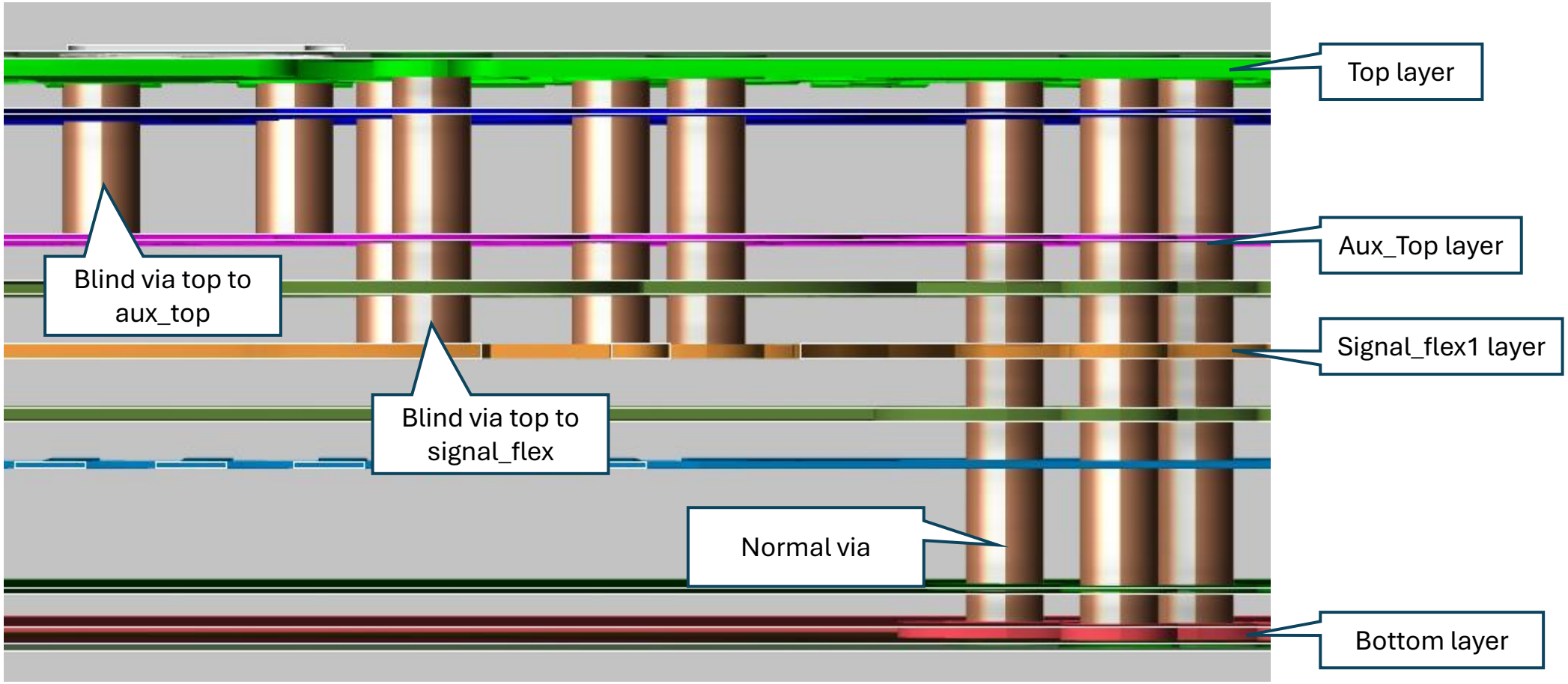
Backup PCB: blind via

Two tipes of blind via has been used:

- One from the top layer to the aux_top layer, the firts internal conductor layer (left image)
- The second from the top layer to the signal_flex1 layer through the aux_top layer (bottom image)

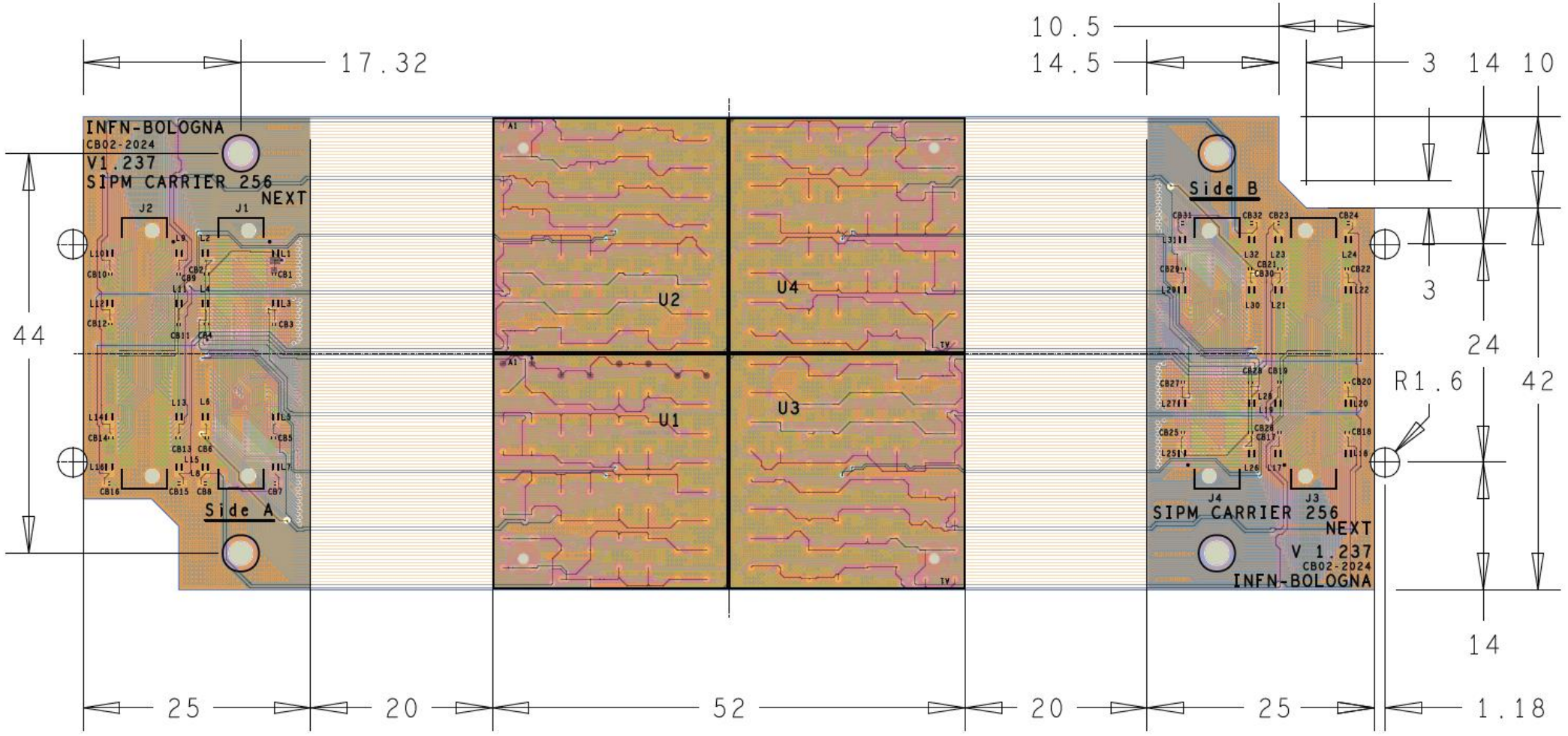


Backup: vias and blind vias

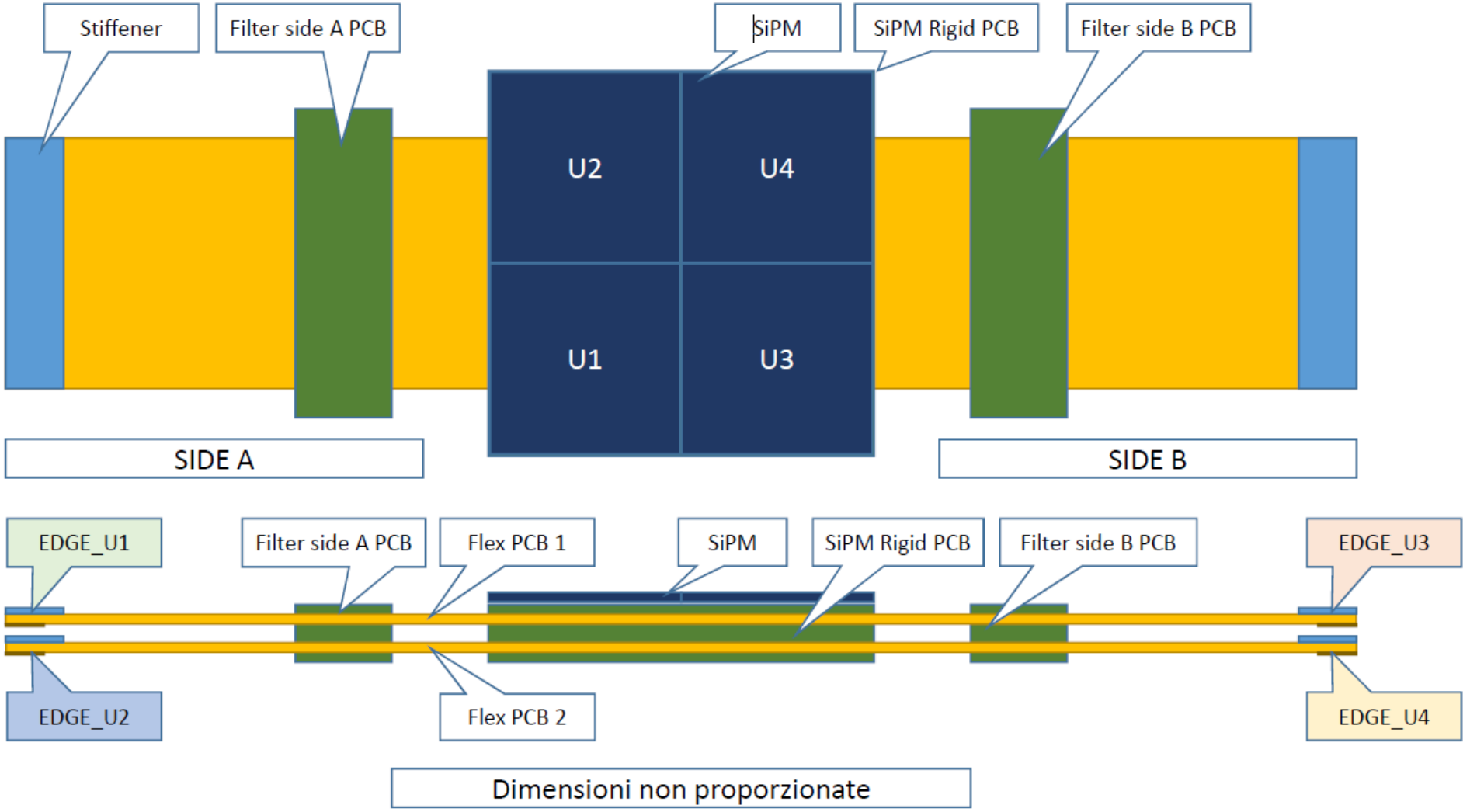


Support

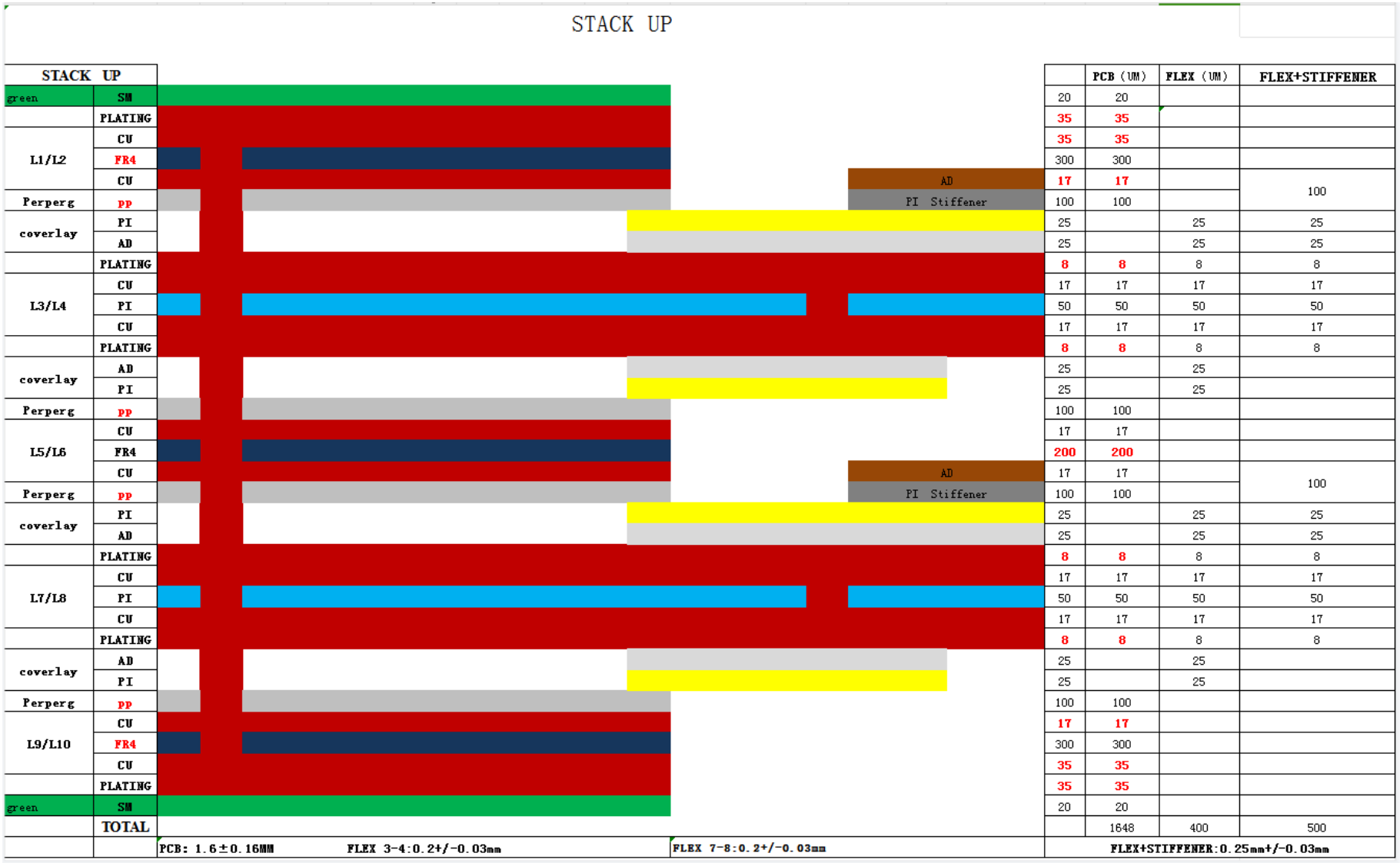
Backup: PCB


17.32
10.5
14.5
3
14
10
44
INFN-BOLOGNA
CB02-2024
V1.237
SIPM CARRIER 256
NEXT
J2
J1
Side A
U2
U4
U1
U3
Side B
J4
J3
SIPM CARRIER 256
NEXT
V 1.237
CB02-2024
INFN-BOLOGNA
3
24
R1.6
42
14
25
20
52
20
25
1.18

Backup: SIPM_CARRIER_V2



Backup: SIPM_CARRIER_V2 Stack Up



STACK UP			PCB (UM)	FLEX (UM)	FLEX+STIFFENER
green	SM	20	20		
	PLATING	35	35		
L1/L2	CU	35	35		
	FR4	300	300		
	CU	17	17		100
Perperg	pp	100	100		
coverlay	PI	25		25	25
	AD	25		25	25
	PLATING	8	8	8	8
L3/L4	CU	17	17	17	17
	PI	50	50	50	50
	CU	17	17	17	17
	PLATING	8	8	8	8
coverlay	AD	25		25	
	PI	25		25	
Perperg	pp	100	100		
L5/L6	CU	17	17		
	FR4	200	200		
	CU	17	17		100
Perperg	pp	100	100		
coverlay	PI	25		25	25
	AD	25		25	25
	PLATING	8	8	8	8
L7/L8	CU	17	17	17	17
	PI	50	50	50	50
	CU	17	17	17	17
	PLATING	8	8	8	8
coverlay	AD	25		25	
	PI	25		25	
Perperg	pp	100	100		
L9/L10	CU	17	17		
	FR4	300	300		
	CU	35	35		
	PLATING	35	35		
green	SM	20	20		
	TOTAL		1648	400	500
		PCB: 1.6±0.16MM FLEX 3-4:0.2+/-0.03mm	FLEX 7-8:0.2+/-0.03mm		FLEX+STIFFENER:0.25mm+/-0.03mm