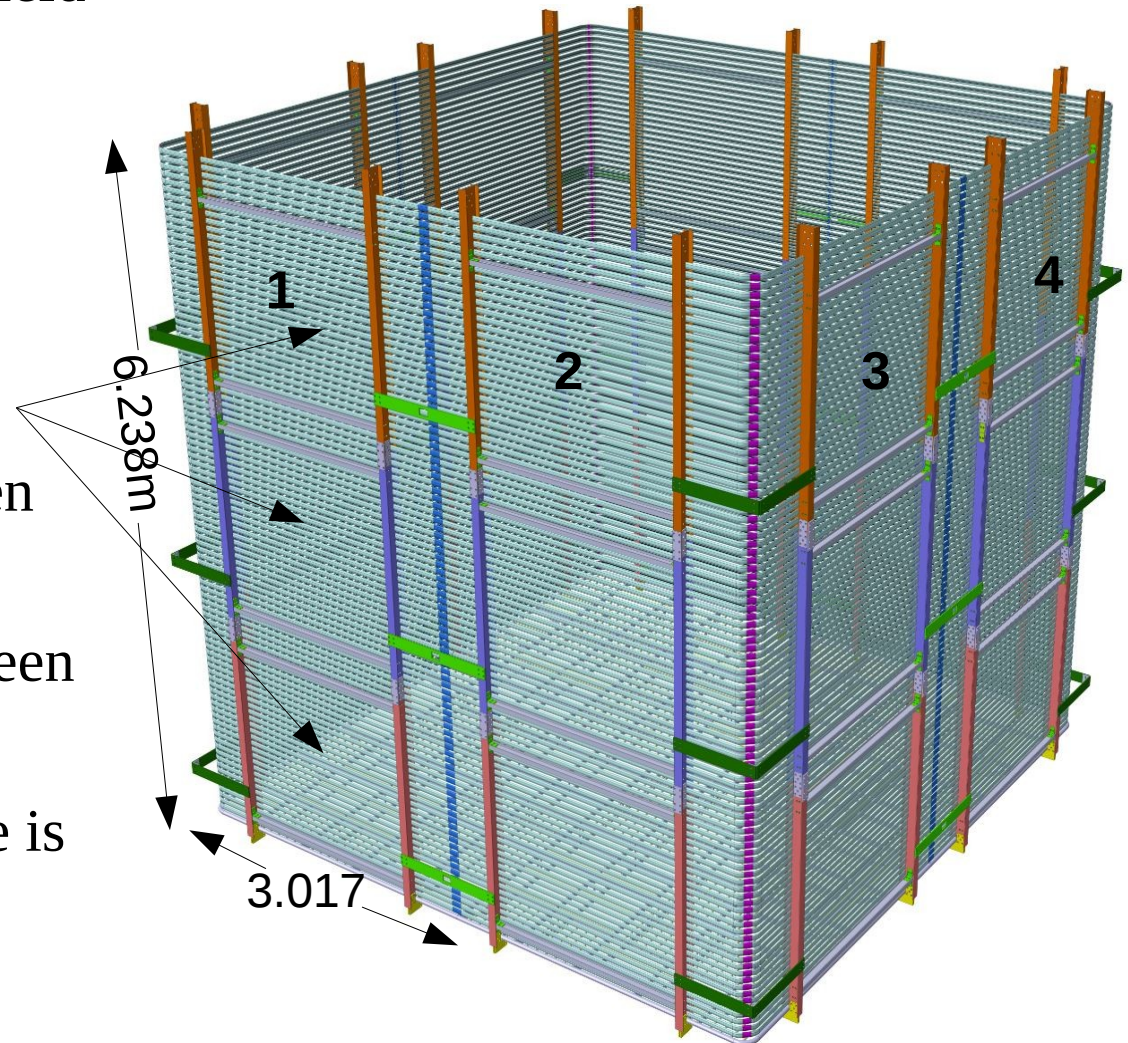


Preliminary design of PCB board for DP FC

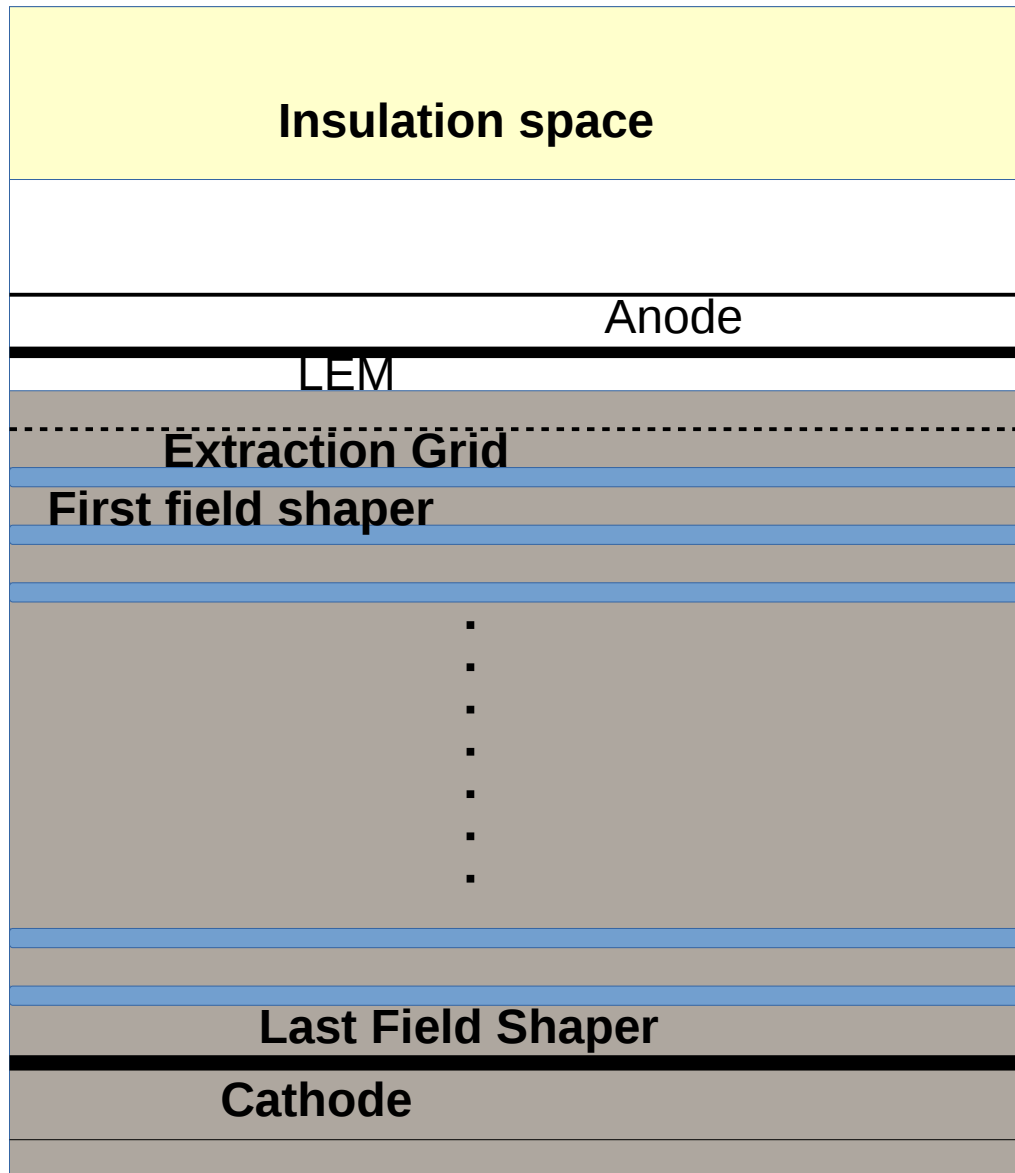
Animesh Chatterjee, Jae Yu, Michael Hibbard
UTA HEP Group
02/15/2017

Overview of DP-FC

- Goal to have uniform electric field of 500V/cm across the drift volume.
- Total 98 profiles.
- 3 Sub modules with 33, 33, 32 profiles respectively.
- 3 kV voltage difference between each profile.
- Total 98 stages (97 gapes between profiles + cathode).
- Current flow across the module is 3uA.
- Voltage difference between the first field shaper and the cathode will be $3\text{kV} \times 98 = 294\text{ kV}$.



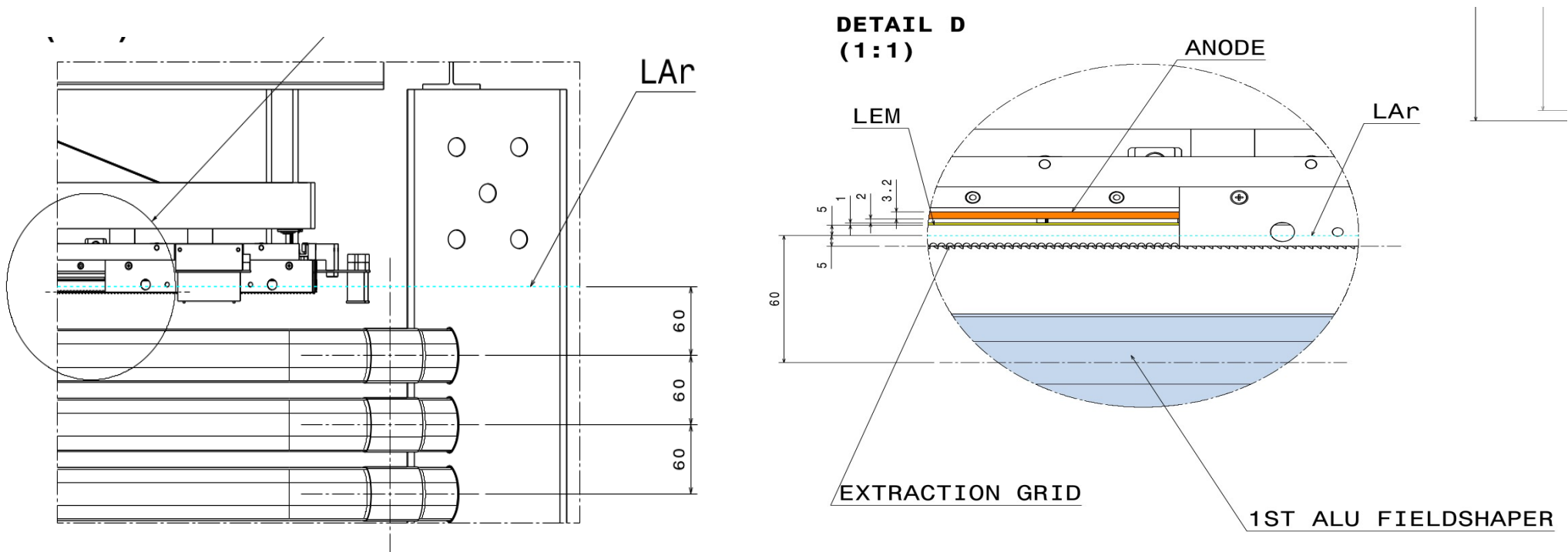
High Voltage system



Power supply
Ground

Voltage across the detector

Elements	voltage	Drift field	Distance from last elements
Anode	0 kV	0 kV/cm	0
LEM(upper electrode)	-1kV	5kV/cm	2mm
LEM(lower electrode)	-4 kV	30kV/cm	1mm
LAr Level			5 mm
Extraction Grid	-6.5 kV	2.5kV/cm	5mm
First field shaper	-9.5 kV	500V/cm	60mm
Last field shaper	-300.5 kV	500V/cm	60mm
Cathode	-303.5 kV	500V/cm	60mm



PCB board for 6x6 (preliminary)

Parameter	Values	Note
Total number of profiles	98	
Number of profiles in each sub module	33, 33, 32	
Number of profiles connected with each PCB Board	11	
Number of stages	10	
Distance between two profiles	60 mm	
Total number of PCB board for entire volume	10	
Length of each PCB board	(10x60 mm) + 15 mm+ 15 mm = 630 mm	
Width and thickness	61 mm wide, 2mm thick	
Resistance in each stage	1 Gohm	2 resistors in parallel (each of 2 Gohm)
Varistors in each stage	3 varistors in series.	
Voltage drop between two profiles	3 kV	

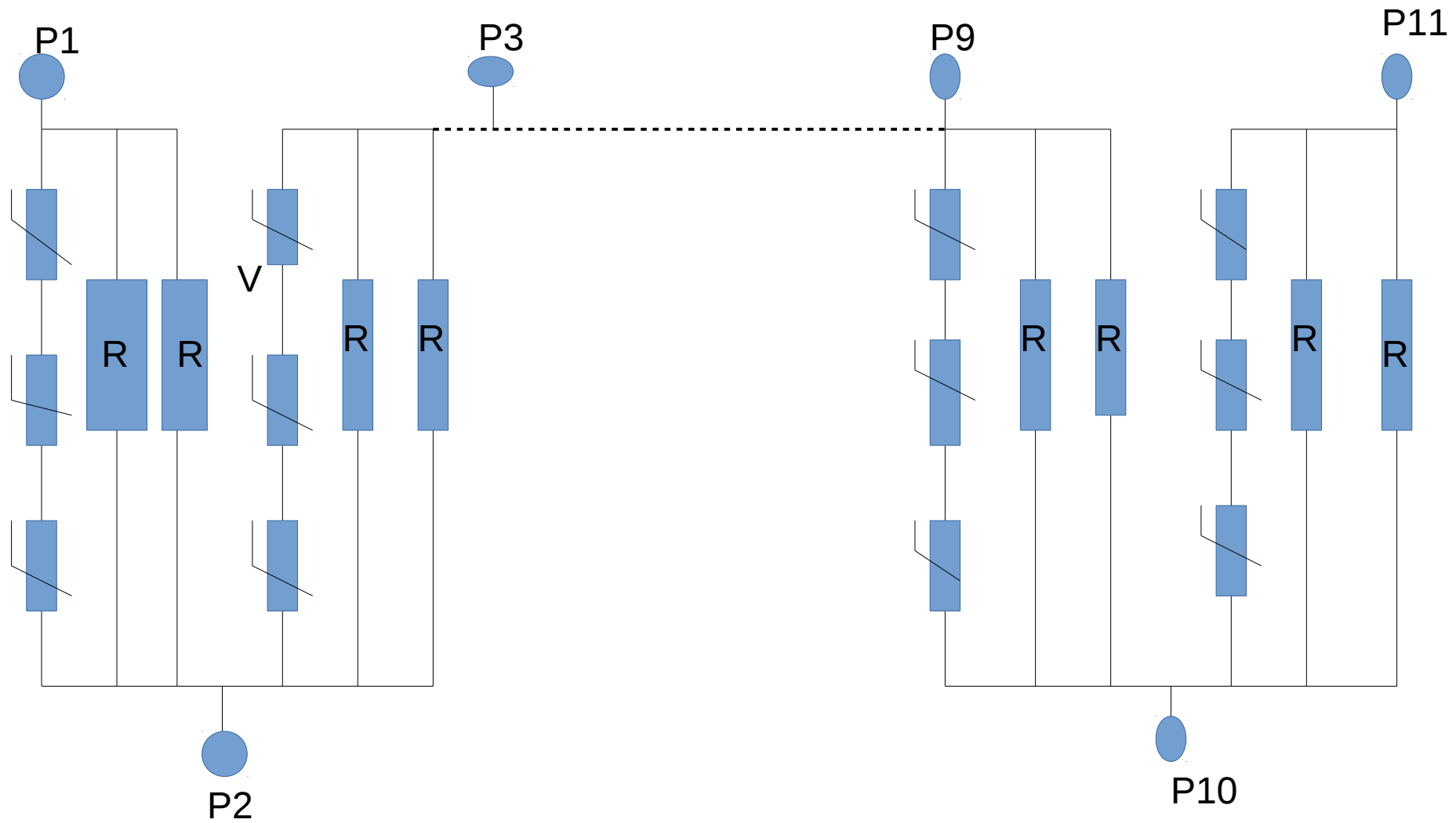
Requirements for the Board

	Parameter	Values	units	notes
Correct resistance as specified in the design	FC-resistance tolerance	+ - 1	%	
Divider chain must have the resistance tolerance	FC- total resistance tolerance	+ - 1	%	
All FC elements should hold maximum voltage	FC max voltage	150	%	
Maximum leakage current		1	nA	
Heat generated	Maximum heat generated	0.1	Watt	0.9 mW in case of 500 V/cm

Components of the boards

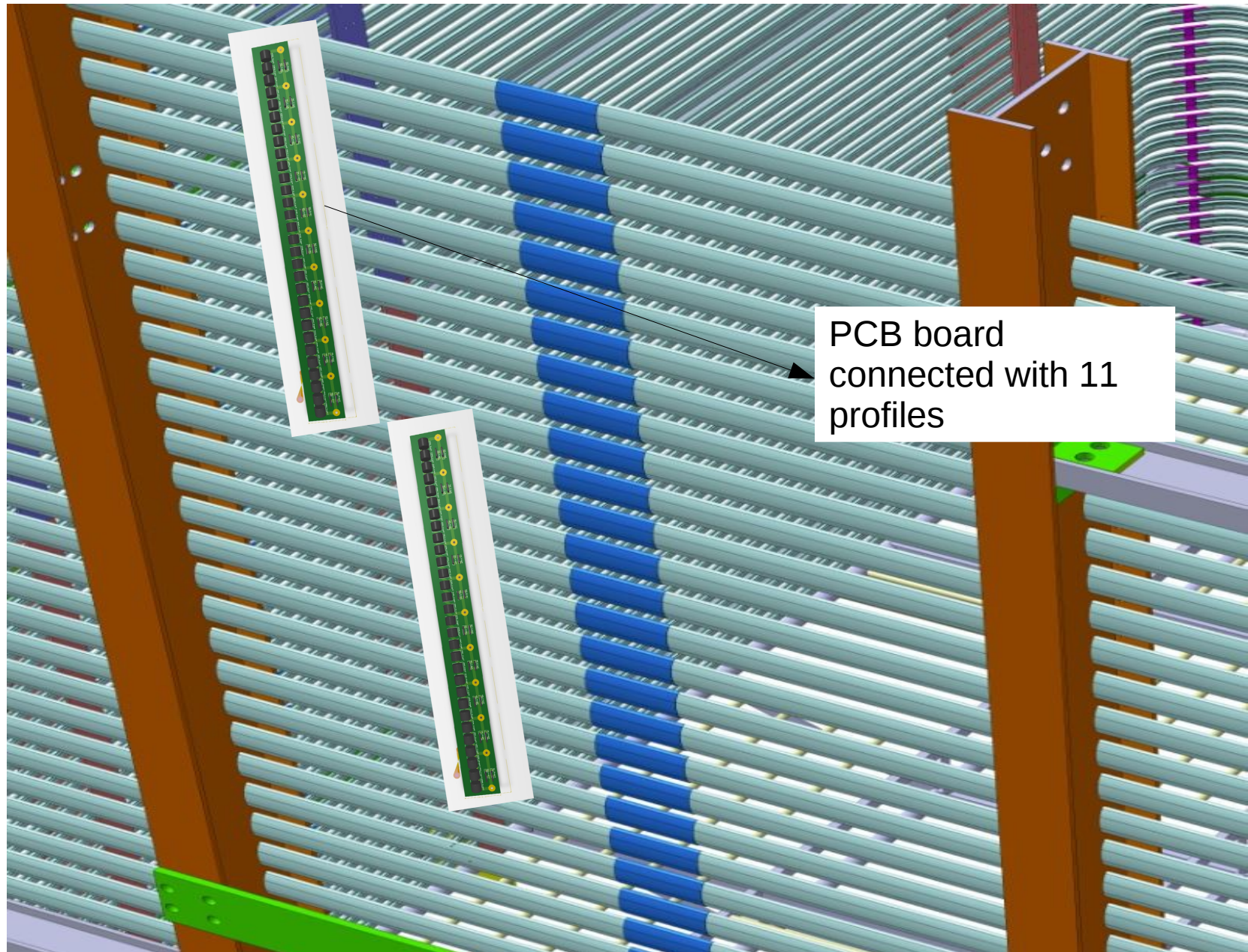
Elements	Values (unit)	Part#	Requirement for each board	#Total (with spare)	Picture	Price estimate
Resistors	2 GOhm	SM102032007F E	20	200 (260)		\$600.00
Varistors	3 varistors in series	ERZV14D 182	30	300 (400)		\$700.00
Connections with profiles	M4 size brass screw		11	110 (150)		
Nuts and washers			11	110 (150)		

Schematic circuit diagram of single PCB board

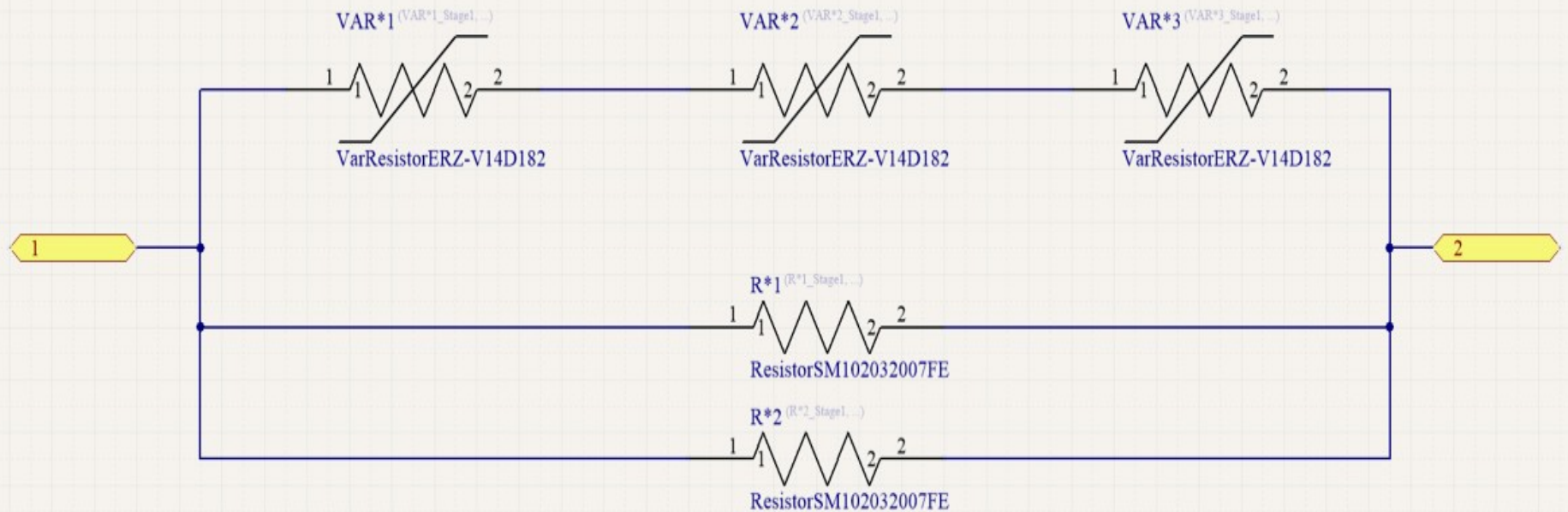


R= 2 Gohm, V= varistors, P1, P2, .. P11 connections with each profile

Mechanical Connection of the Board

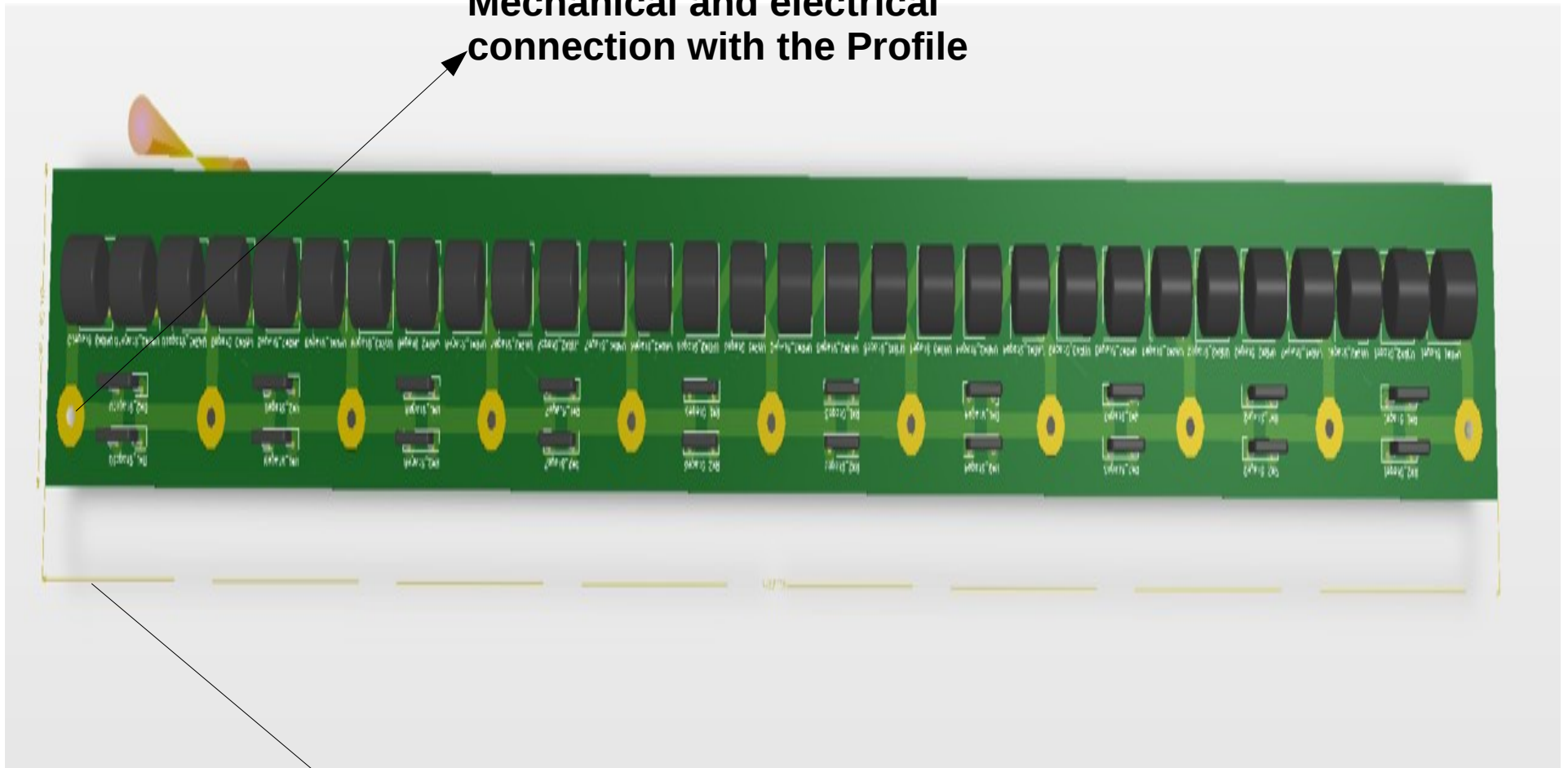


Circuit for 1 stage



PCB board Top layer

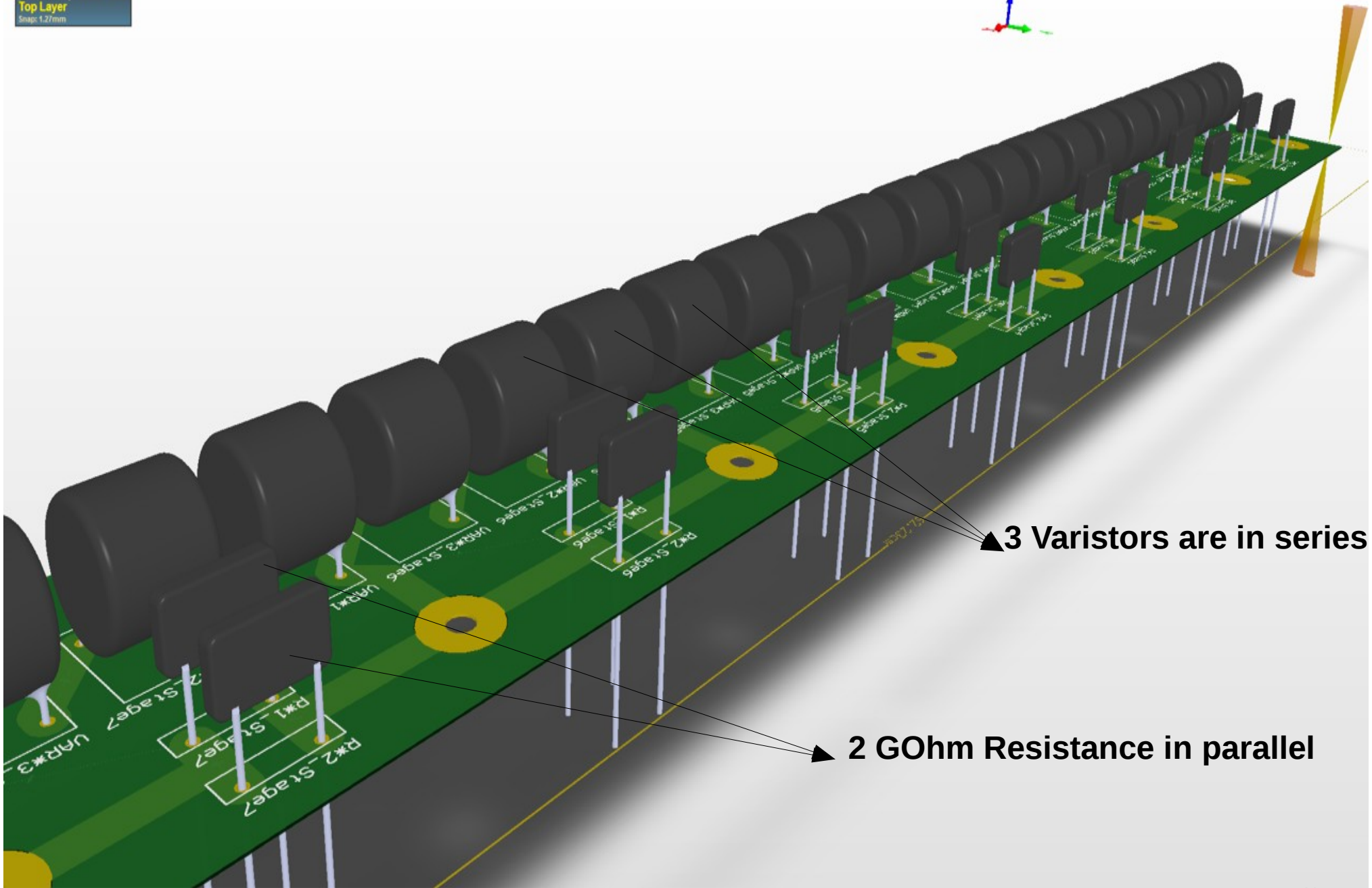
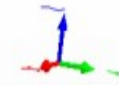
Mechanical and electrical connection with the Profile



Center to center distance 6 cm (60 mm)

More closely: Top layer

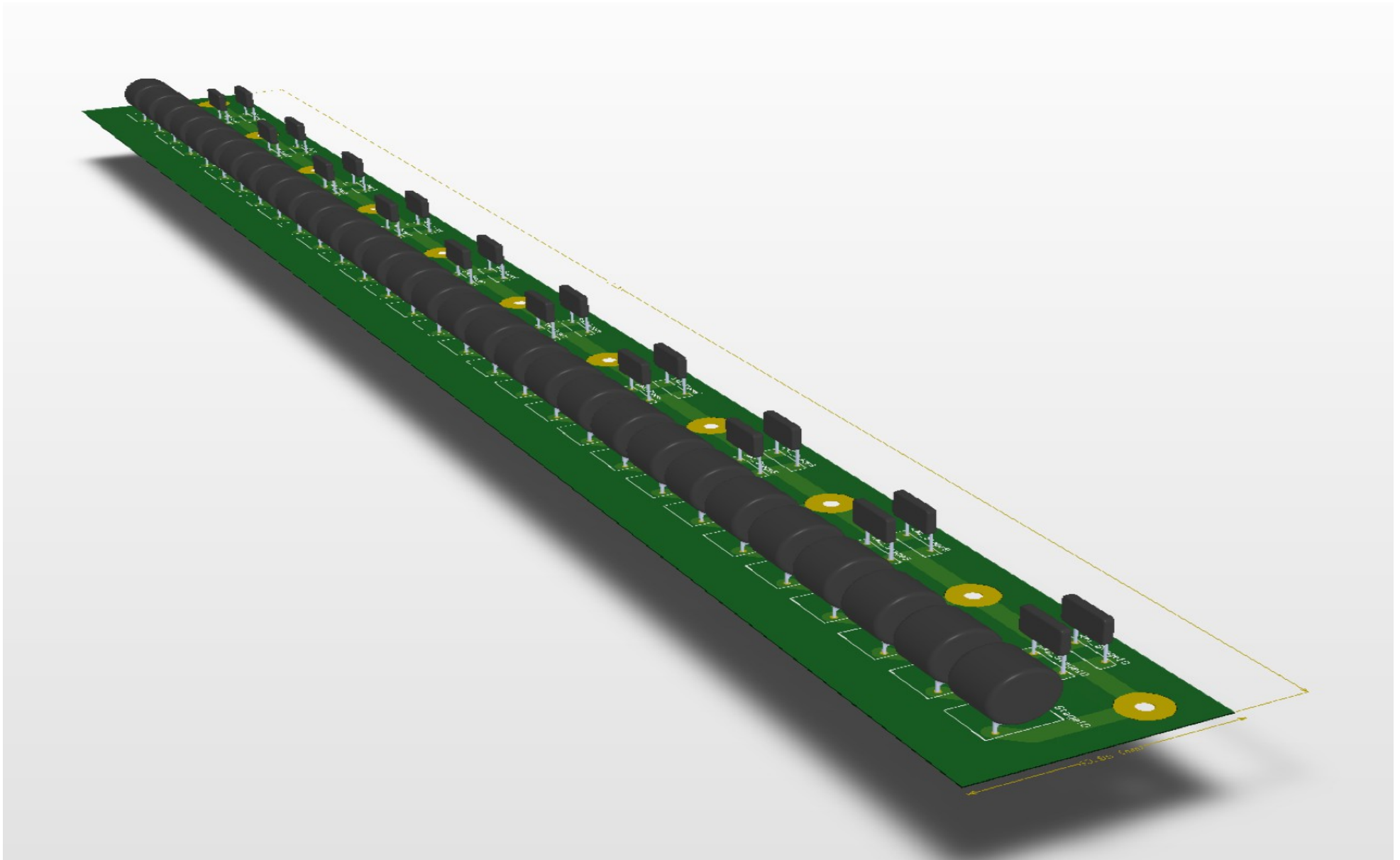
x:107.950 dx: 626.110 mm
y:173.990 dy: 33.020 mm
Top Layer
Snap: 1.27mm



▲ 3 Varistors are in series

▲ 2 GOhm Resistance in parallel

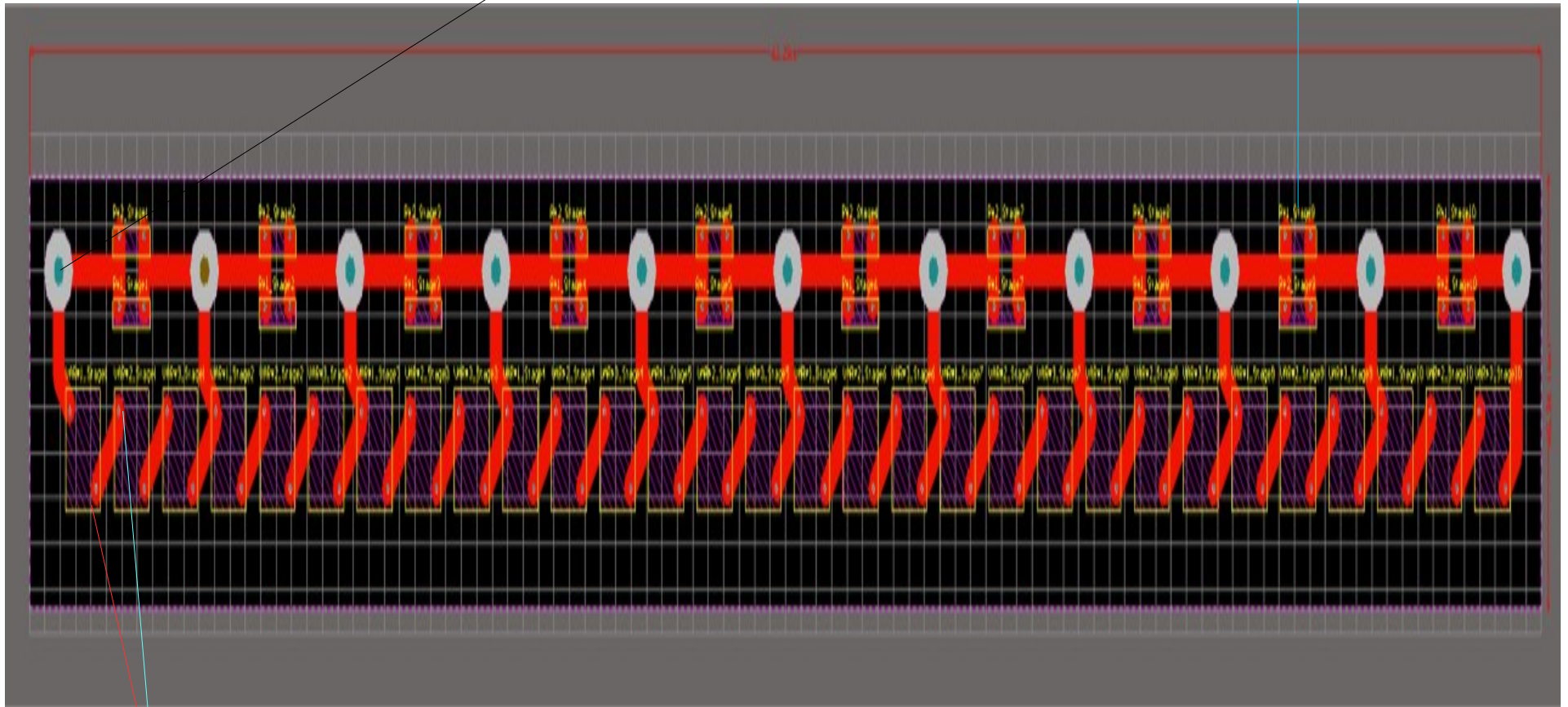
PCB:Side view



Bottom layer

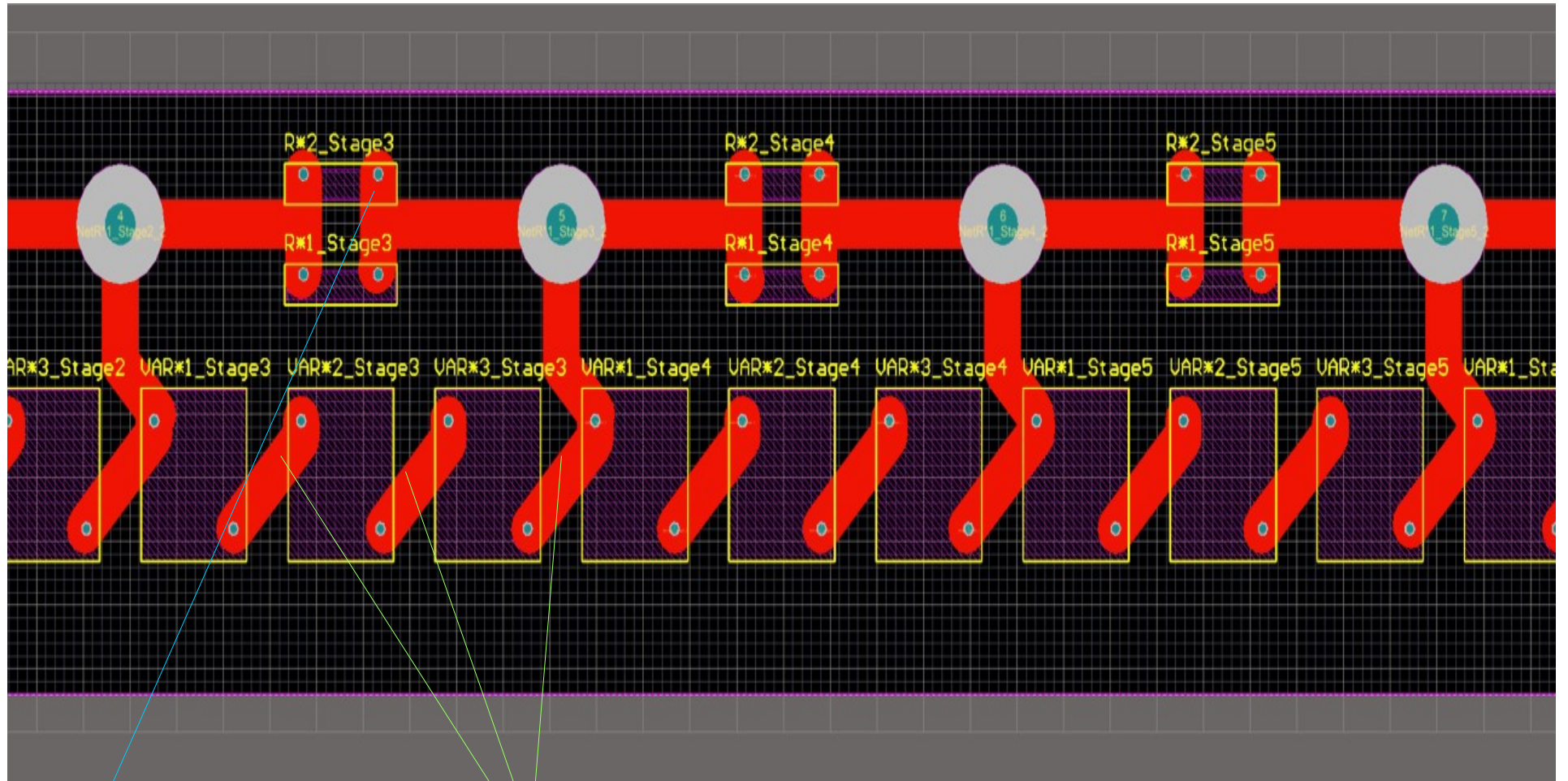
Connections with profile

Resistor in parallel



Varistors connection

Bottom layer: More closely



Resistors connections

3 varistors connected in series (in parallel with resistors)

PCB board: Outlook

- PCB board design for 6x6x6 is completed.
- It looks promising.
- We have to check one more about the dimensions to be 100% sure.
- Implementing 3D design of the FC along with the PCB board is under process.
- Finalize the PCB design and order the board and the components.
- Test the board in warm and in cold.