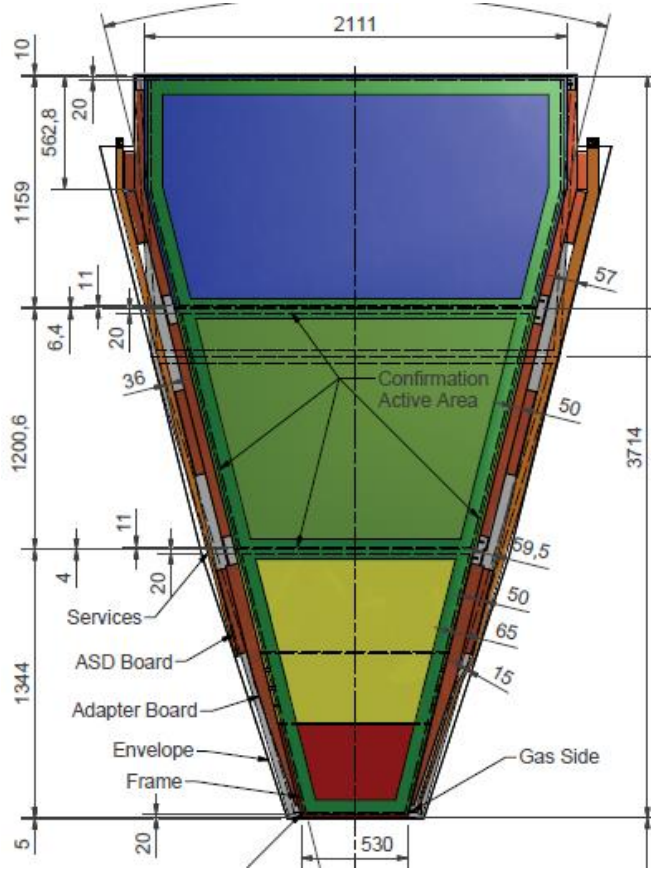
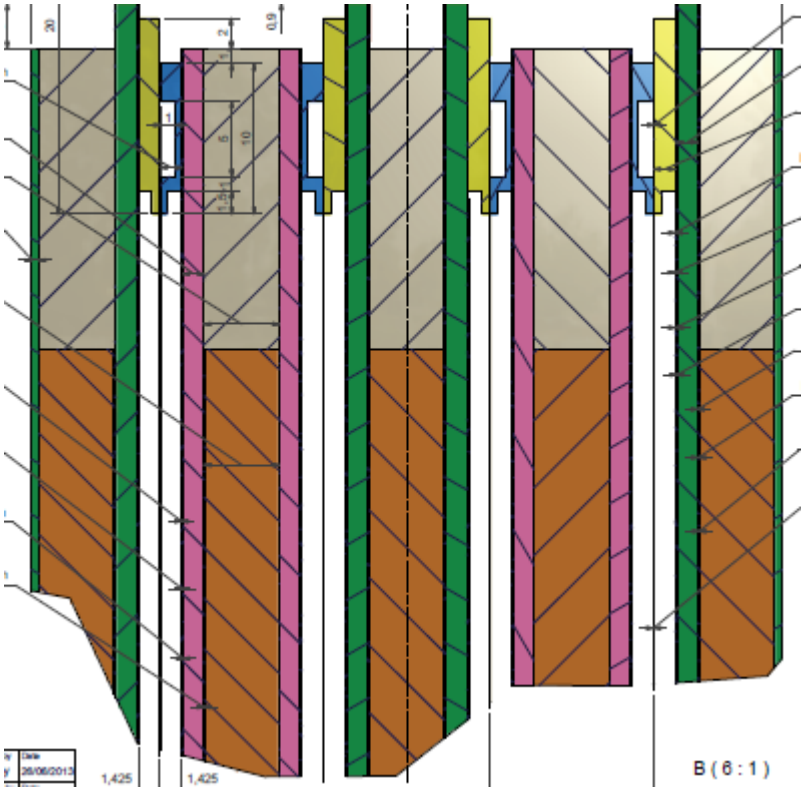
Production of precise large PCB's

- Introduction to the problem
- Achievement in collaborating with industry (Print Electronics in IL and MDT in Italy).
- Conclusions

Introduction to the problem



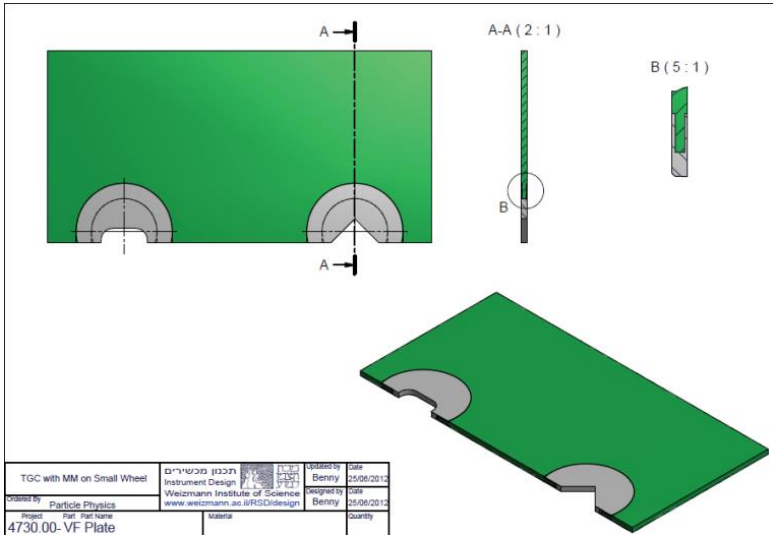


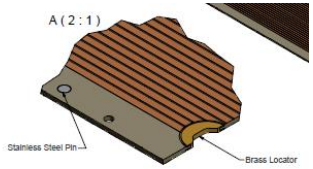
- Need to construct large PCB with precise strips over surfaces of 2.1X1.2m², flat to within 50µm that can be aligned with respect to each other within the same precision.

Introduction

- Single PCB's can be purchased with dimensions of 1.28X3.00m² that are flat to within 50µm, except at the edges.
- Using usual PCB print methods are not very reproducible to the precision one needs.
- One needs VERY PRECISE external references, in order to align each plane with the design accuracy.
- CNC machining provides the necessary accuracy.
- Combined the 2 technologies.

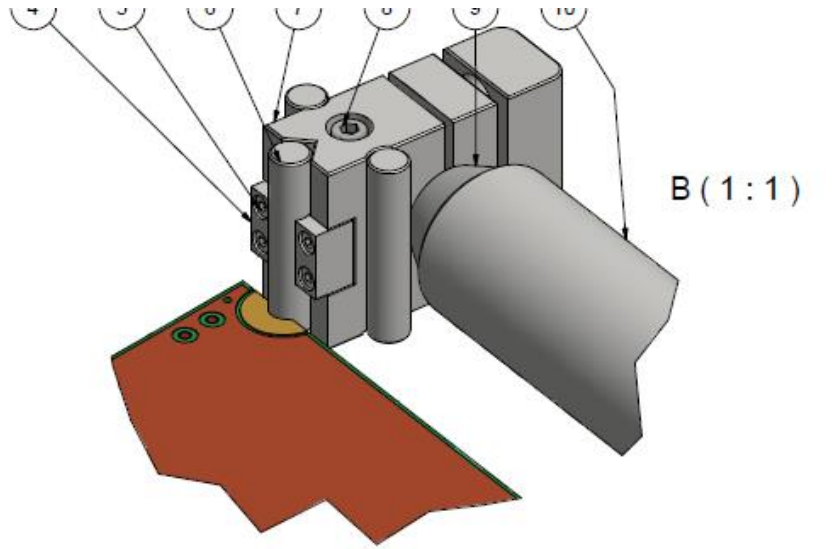
Method utilize to get the precision

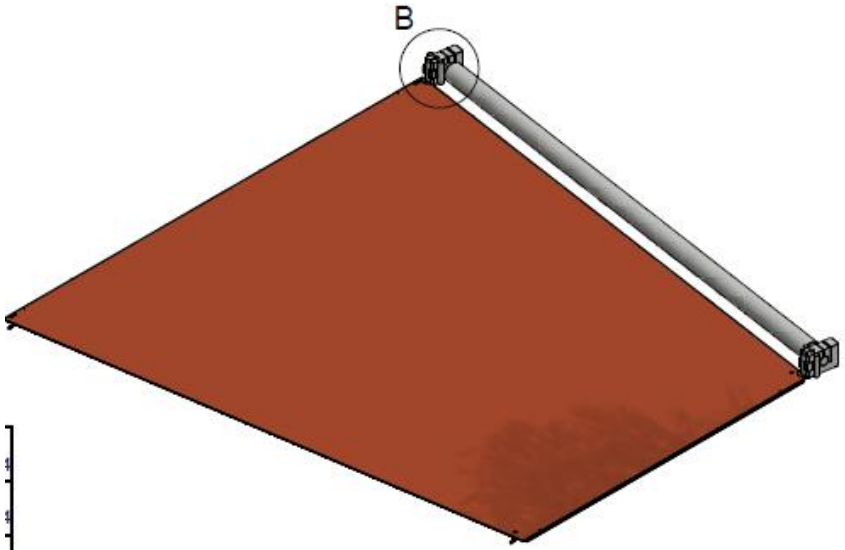




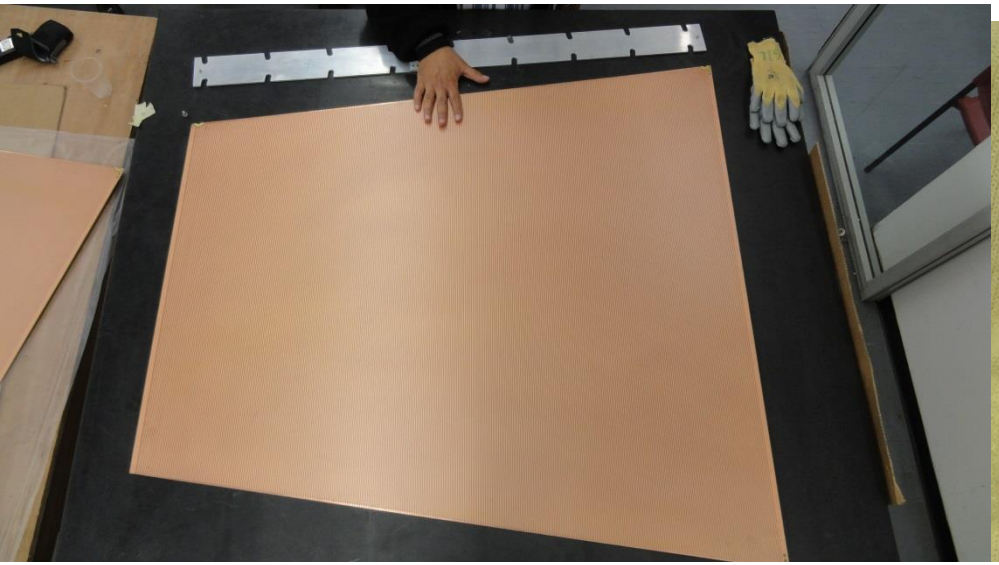
- Use the inserts that are machined together with the strips to get the precision

Use a precision jig to transfer the precision across layers



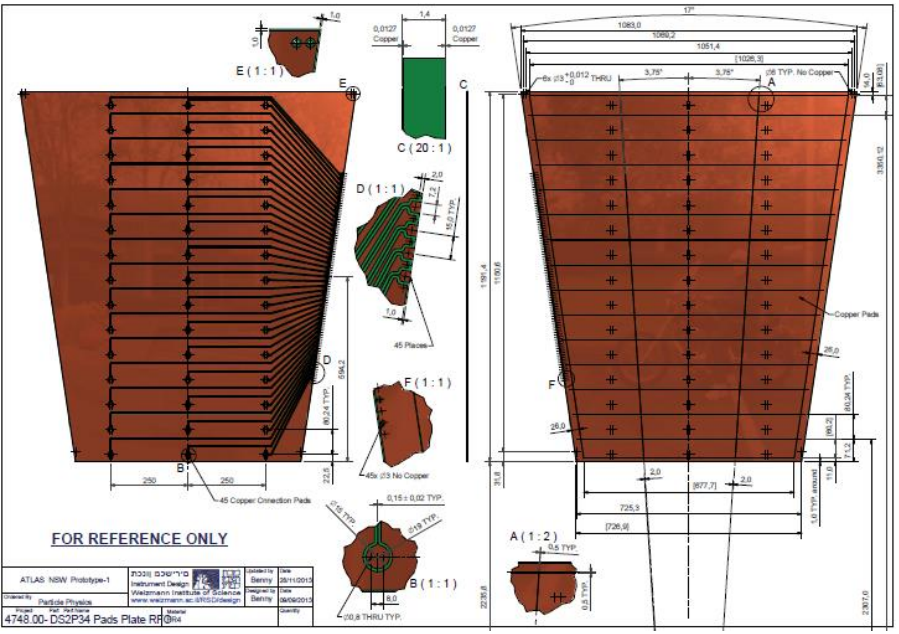


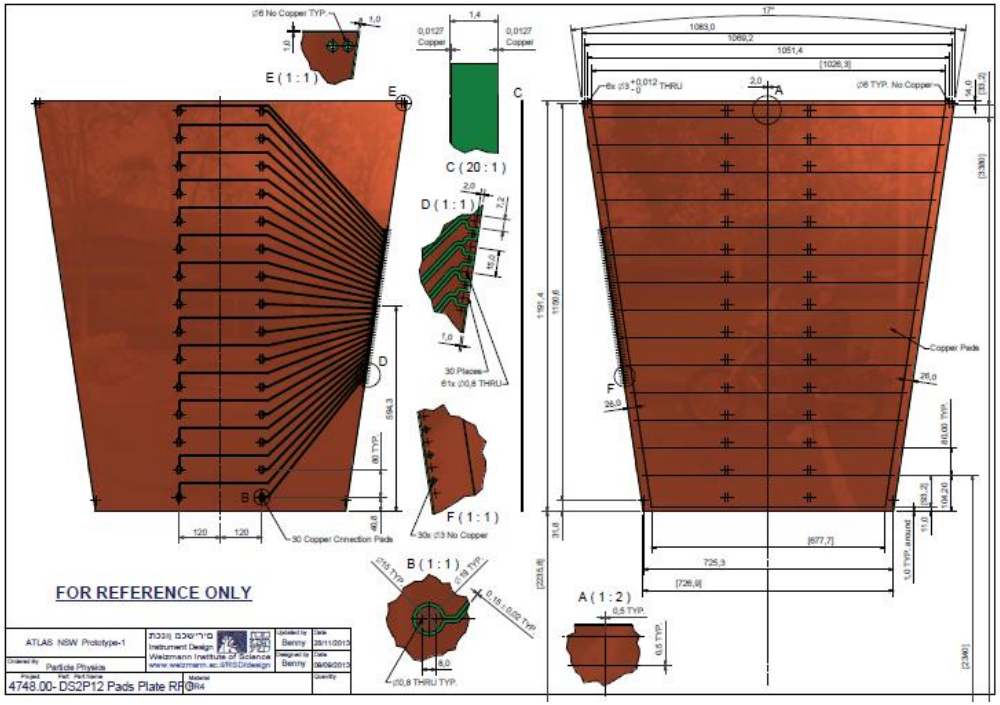
Achieved results (MDT)



- Introduce brass inserts that are machined together with the strips and then use PCB multilayer techniques to apply the 100µm isolating layer, on which the graphite can be applied.

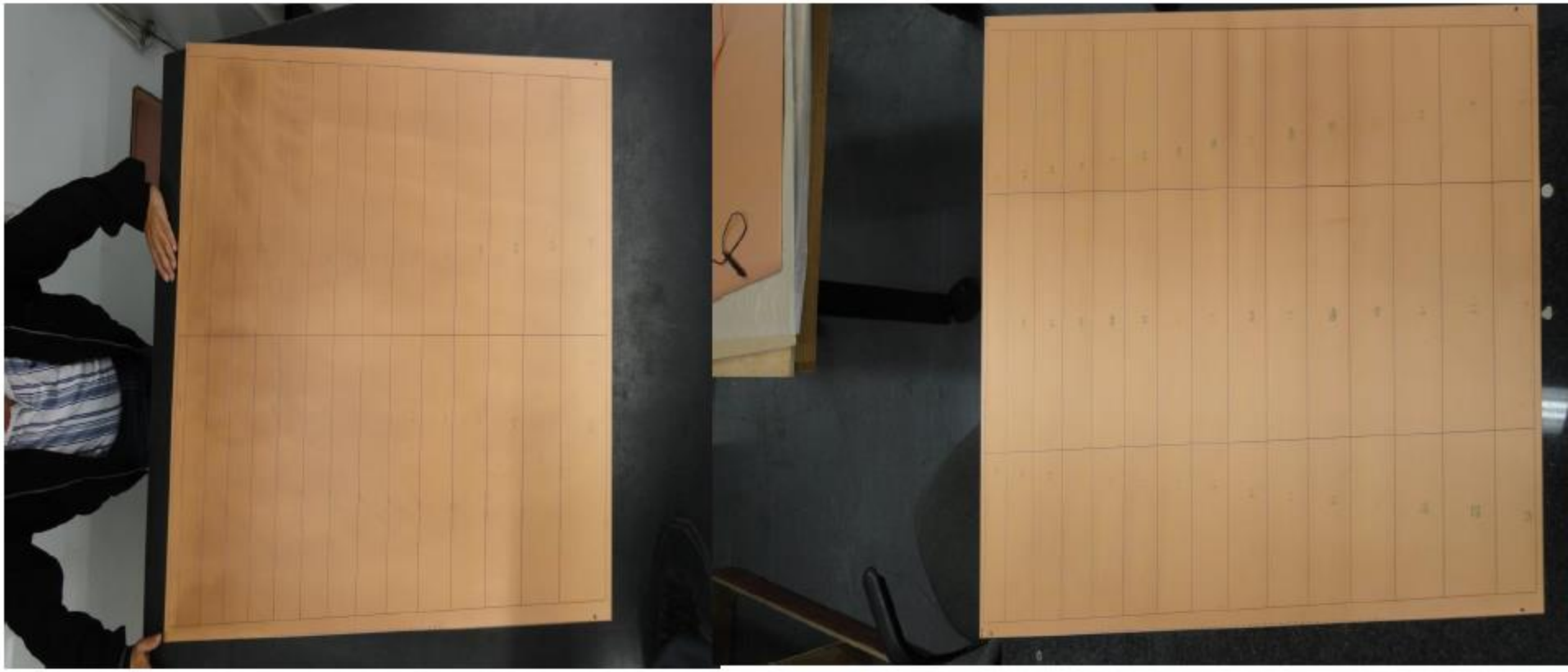
The pads boards are 4 layer boards





- Only precision on the thickness is needed.
- Outside ground layer provides the needed impedance matching.

Pad boards

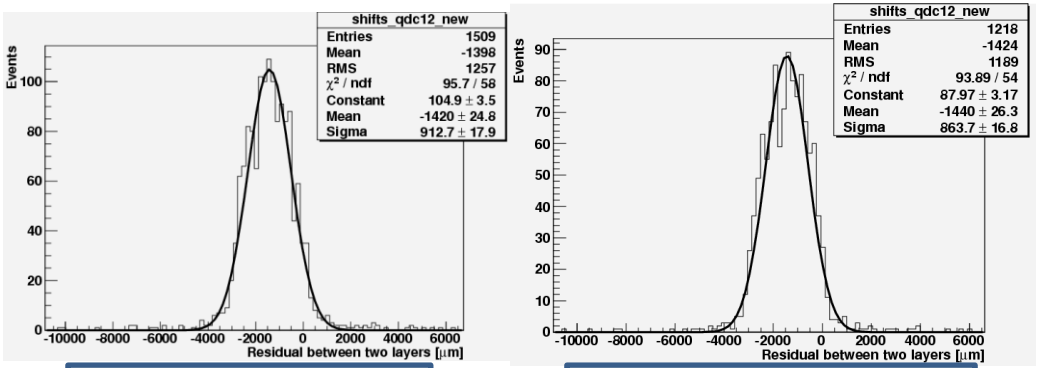


Thickness uniformity of large boards

	pads boards				strip boards			
	board 1	board 2	board 3	board 4	board1	board2	board3	board4
1	1.75	1.69	1.67	1.68	1.59	1.56	1.59	1.57
2	1.73	1.7	1.68	1.71	1.59	1.57	1.58	1.56
3	1.75	1.75	1.76	1.73	1.6	1.53	1.6	1.58
4	1.72	1.72	1.73	1.66	1.58	1.57	1.58	1.56
5	1.73	1.73	1.71	1.55	1.59	1.57	1.59	1.57
6	1.75	1.75	1.7	1.7	1.59	1.56	1.6	1.57
7	1.72	1.72	1.69	1.68	1.58	1.55	1.6	1.57
8	1.72	1.72	1.72	1.73	1.58	1.55	1.58	1.57
9	1.76	1.76	1.7	1.73	1.6	1.55	1.58	1.57
10	1.72	1.72	1.75	1.66	1.57	1.56	1.6	1.57
11	1.73	1.73	1.7	1.67	1.58	1.57	1.59	1.56
12	1.74	1.74	1.68	1.7	1.57	1.56	1.58	1.55
average	1.735	1.7275	1.7075	1.683333	1.585	1.558333	1.589167	1.566667
stdav	0.01446	0.020505	0.028002	0.049421	0.01	0.011934	0.009003	0.007785

- All boards are within the 50µm rms
- The worst one (50µm rms) is due to a defect of fabrication (wrong machining of connection lines that were re-made for the pads)

Relative alignment between 2 planes using this method were measured in smaller (40X60cm²) detectors



Mean = -1420 ± 25 μm

Mean = -1440 ± 26 μm

Performing the measurement of position of

plane1-plane2 (remember offset is 1.45mm)

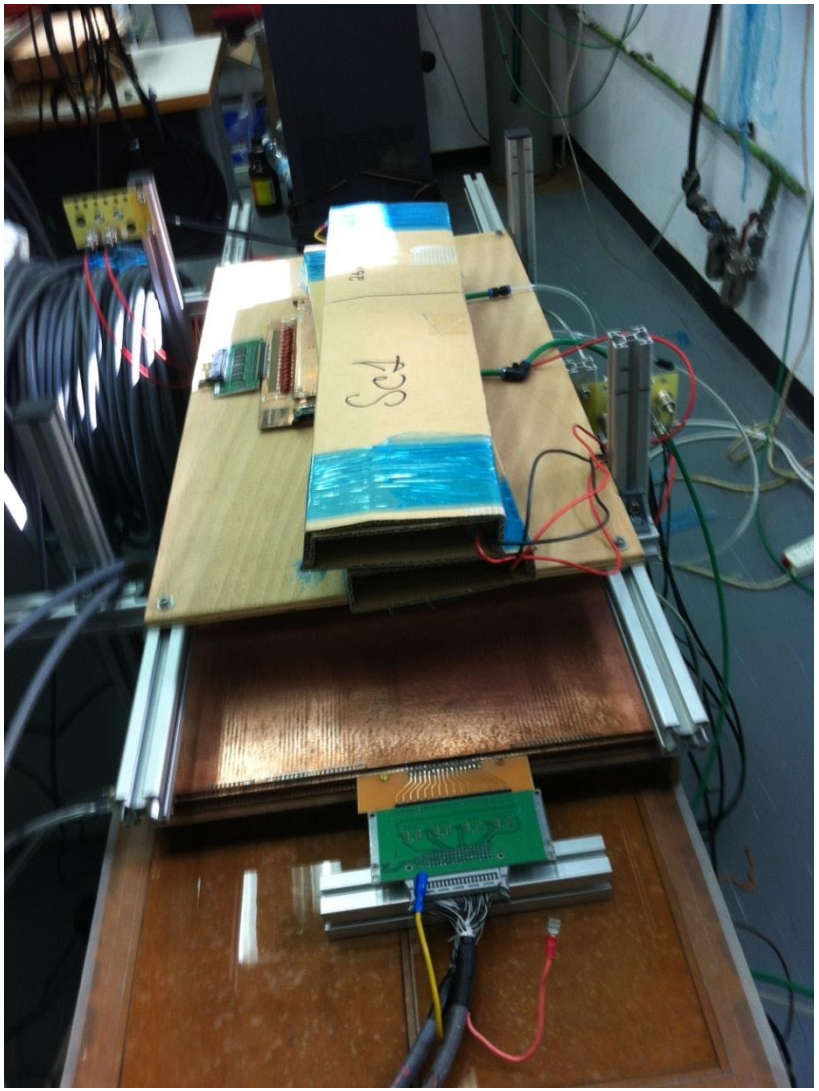
At 2 different positions, spaced by 45cm, gives a difference of

20+/-36μm,

consistent with good alignment but

limited by the statistics.

Boards fabricated by Print Electronics in Israel



Conclusions

- Industry is able to achieve the necessary requirements on relative alignment between layers (50µm over 1m) for large boards, by combining mechanical machining with multi-layer PCB techniques.
- By eliminating the edges of the boards, a thickness uniformity of better than 50µm over large surfaces has been achieved by industry.