Interconnection studies for SiW Ecal

By Patrick Cornebise

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- Solution 1
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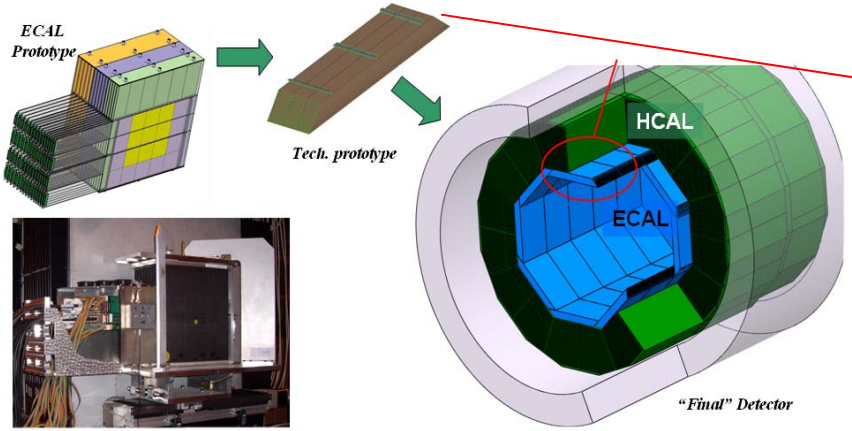
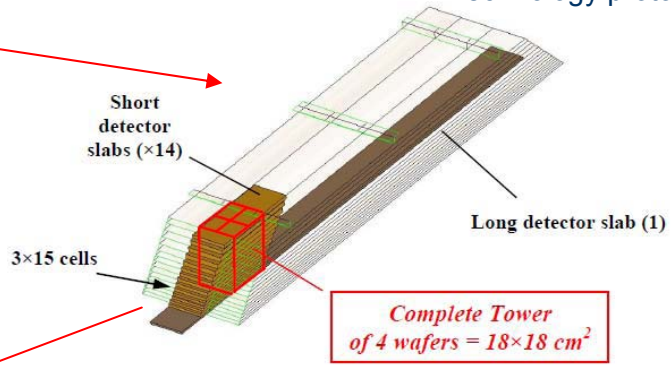
- Solution 3
- Comparative
- Next step

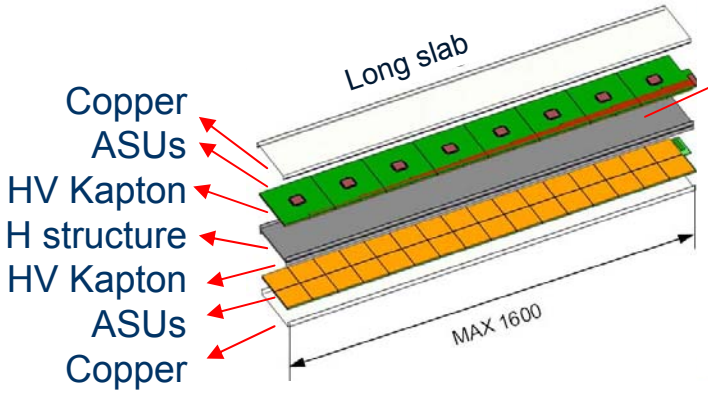
The goal is realize interconnection of ASUs for Technology prototype



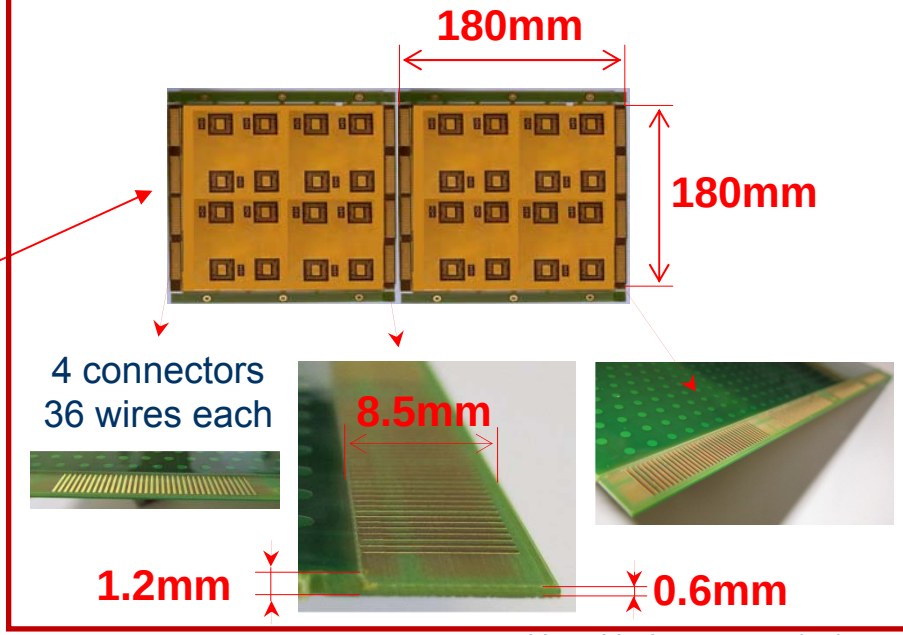
Technology prototype



1x Long slab with:
7 ASUs+1Adapter-card+1Dif each side
14x Short slab with:
1ASU+1Adapter-card+1Dif each side
Will be interconnected



This presentation focuses on the ASUs interconnections study



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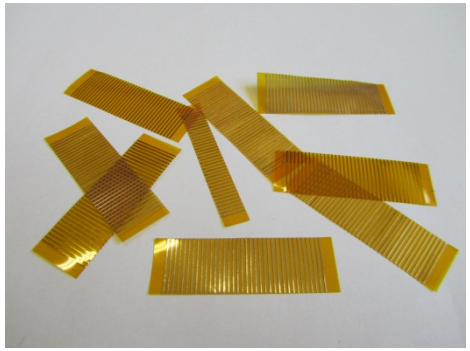
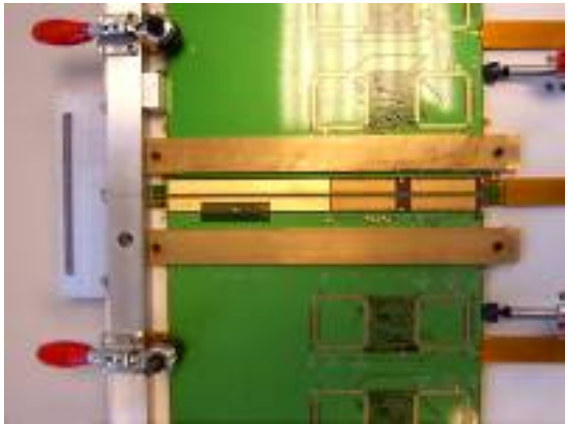
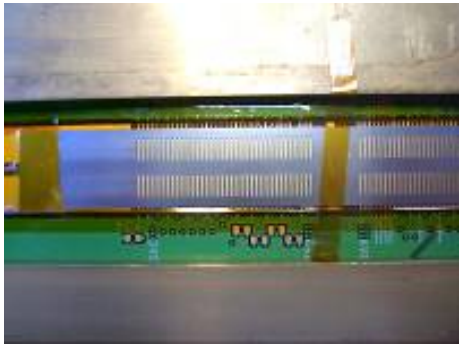
ASU interconnection by soldering



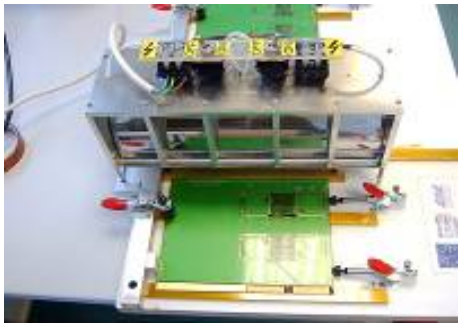
Kapton comb 1 connector
with 36 wires



Solder bench



Silk screen for
manual solder paste laying
(very delicate operation)



Halogen lamp for the solder
200°C for 2min 30sec

We developed this method with the
and used it to interconnect 8 FEV-temps

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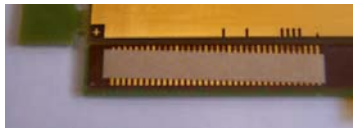
ASU interconnection with ACF 3M
Anisotropic Conductive Film adhesives

Film ACF 3M 7303 l=5mm

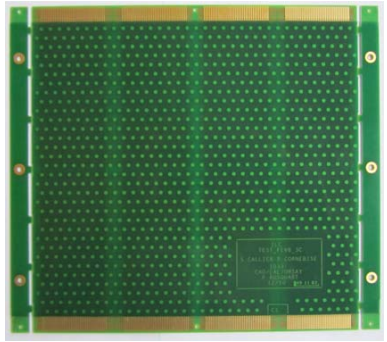


Adhesive Type: Epoxy/Acrylate blend
Particle Type : Silver-coated glass
Particle Size : 43 µm
Liner Type: Polyester-coated Kraft with Silicone Release
Adhesive Thickness: 74 µm
Liner Thickness: 100 µm

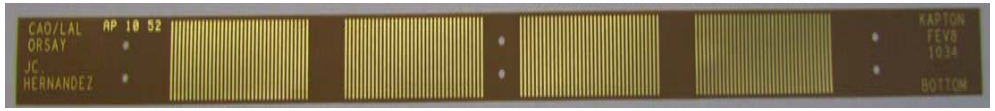
FEV8-3C

4 connectors each with 36 channels

Wire by wire



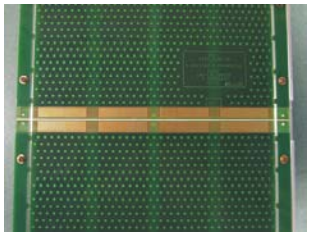
Kapton combs

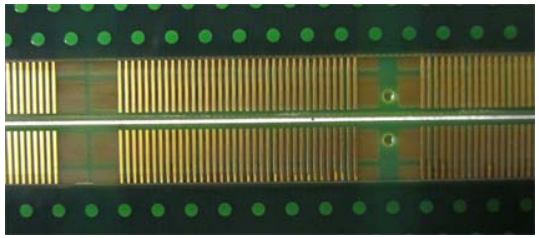


4 connectors with 36 copper pads
length=14mm width=0.5mm thickness 35µm
Thickness of kapton = 50µm
Total thickness = 85µm

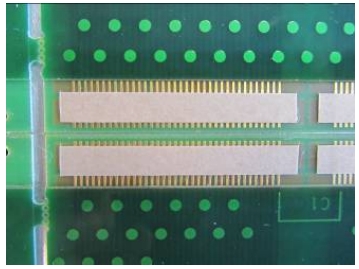
ASU interconnection with ACF 3M Anisotropic Conductive Film adhesives

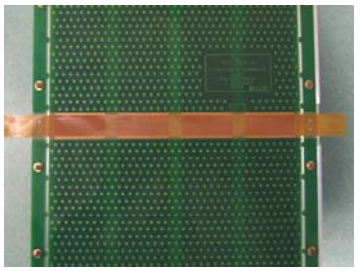
3x FEV8-3C
4x4 connectors each with 36 channels



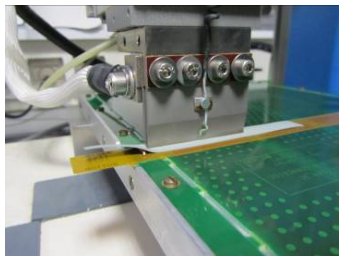


Positioning ACF on boards and positioning kapton combs



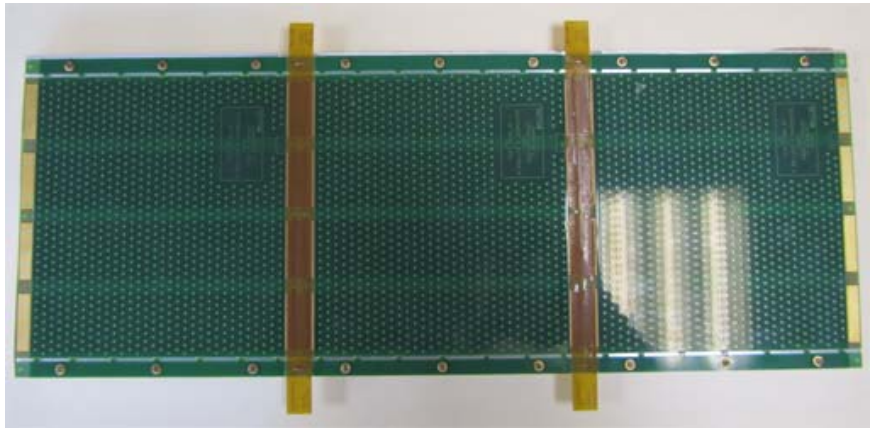


Using Myachi Thermode



Temperature 150°C
Time 25 seconds
Pressure 1,8 MPa

3x FEV8-3C are ready for the electrical test



ASU interconnection with ACF 3M Anisotropic Conductive Film adhesives

4x4

- **Problems encountered due to the lack of support planarity, and a non-adaptability of the Myachi thermode for our boards.**
- **Due to this problem many connections are defective.**

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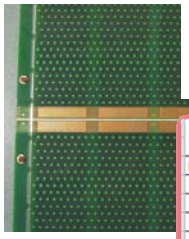

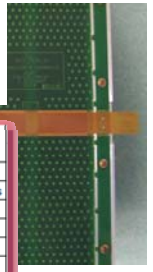

U

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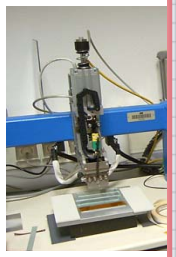

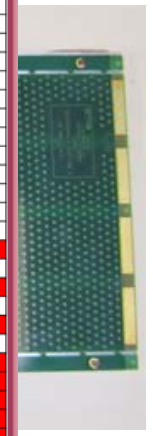

1 ACF entre PCB N° 1-2 piste à piste							
B1-C1		B2-C2		B3-C3		B4-C4	
Piste	Résultats	Piste	Résultats	Piste	Résultats	Piste	Résultats
1	0.4	1	0.6	1	0.3	1	0.3
2	1.5	2		2	0.3	2	0.5
3		3		3	0.3	3	0.3
4	4.4	4		4	0.3	4	0.3
5	2.5	5		5	0.3	5	0.2
6	7.8	6		6	0.3	6	0.3
7		7		7	0.3	7	0.3
8		8		8	0.3	8	0.3
9	0.6	9		9	0.3	9	0.3
10		10		10	0.3	10	0.3
11	4.2	11		11	0.3	11	0.3
12		12	1.5	12	0.3	12	0.3
13		13		13	0.3	13	0.3
14		14		14	0.3	14	0.3
15		15		15	0.3	15	0.3
16	15	16		16	0.3	16	0.3
17		17		17	0.3	17	0.3
18		18		18	0.3	18	0.3
19		19	8	19	0.3	19	0.3
20		20		20	0.3	20	0.4
21		21		21	0.3	21	0.3
22		22		22	0.3	22	0.3
23		23		23	0.3	23	0.3
24		24		24	0.3	24	0.4
25		25		25	0.3	25	0.3
26		26		26	0.3	26	0.3
27		27		27	0.3	27	0.3
28		28		28	0.3	28	0.7
29		29		29	0.4	29	0.3
30		30		30	0.4	30	0.4
31		31		31	0.3	31	0.8
32		32		32	0.3	32	2.8
33		33	2	33	0.5	33	0.6
34		34	0.7	34	0.4	34	0.4
35	5.8	35		35	0.4	35	0.4
36	6.2	36	1	36	0.3	36	0.6

1 ACF entre PCB N° 2-3 piste à piste							
D1-E1		D2-E2		D3-E3		D4-E4	
Piste	Résultats	Piste	Résultats	Piste	Résultats	Piste	Résultats
1	0.3	1	0.3	1	0.3	1	0.3
2	0.3	2	0.3	2	0.3	2	0.3
3	0.3	3	0.3	3	0.3	3	0.3
4	0.3	4	0.3	4	0.3	4	0.3
5	0.3	5	0.3	5	0.3	5	0.3
6	0.3	6	0.3	6	0.3	6	0.3
7	0.3	7	0.3	7	0.3	7	0.3
8	0.3	8	0.3	8	0.3	8	0.3
9	0.4	9	0.3	9	0.3	9	0.3
10	0.3	10	0.3	10	0.3	10	0.3
11	0.3	11	0.3	11	0.3	11	0.3
12	0.3	12	0.3	12	0.3	12	0.3
13	0.3	13	0.3	13	0.3	13	0.3
14	0.3	14	0.4	14	0.3	14	0.3
15	0.3	15	0.3	15	0.3	15	0.3
16	0.3	16	0.3	16	0.3	16	0.3
17	0.3	17	0.3	17	0.3	17	0.3
18	0.3	18	0.9	18	0.3	18	0.3
19	0.3	19	0.3	19	0.3	19	0.3
20	0.3	20	0.3	20	0.3	20	0.3
21	0.3	21	0.7	21	0.3	21	0.3
22	0.4	22	0.3	22	0.3	22	0.3
23	0.4	23	0.4	23	0.3	23	0.3
24	0.3	24	0.3	24	0.3	24	1
25	0.3	25	0.4	25	0.3	25	0.3
26	0.3	26	0.3	26	0.4	26	0.5
27	0.4	27	0.3	27	0.3	27	0.3
28	0.3	28	0.3	28	0.3	28	0.5
29	0.3	29	0.3	29	0.3	29	0.4
30	0.2	30	0.3	30	0.4	30	0.4
31	0.3	31	0.3	31	0.3	31	0.3
32	0.3	32	0.3	32	0.4	32	0.3
33	0.3	33	1.3	33	0.4	33	1
34	0.3	34	0.4	34	0.3	34	0.6
35	0.3	35	0.4	35	0.4	35	1.8
36	0.3	36	0.2	36	0.8	36	0.8

3 PCB N° 1-2-3 piste à piste via 2 ACF							
A1-F1		A2-F2		A3-F3		A4-F4	
Piste	Résultats	Piste	Résultats	Piste	Résultats	Piste	Résultats
1	1.3	1	1.5	1	1.2	1	1.2
2	2.6	2		2	1.2	2	1.4
3		3		3	1.3	3	1.3
4	11	4		4	1.3	4	1.3
5		5		5	1.2	5	1.3
6	8	6		6	1.3	6	1.3
7		7		7	1.3	7	1.3
8		8		8	1.3	8	1.3
9	1.8	9		9	1.3	9	1.3
10		10		10	1.3	10	1.3
11		11		11	1.3	11	1.3
12		12	2.7	12	1.3	12	1.3
13		13		13	1.3	13	1.3
14		14		14	1.3	14	1.3
15		15		15	1.3	15	1.3
16	21.5	16		16	1.3	16	1.3
17		17		17	1.3	17	1.3
18		18		18	1.4	18	1.3
19		19	17	19	1.3	19	1.3
20		20		20	1.3	20	1.3
21		21		21	1.3	21	1.3
22		22		22	1.3	22	1.4
23		23		23	1.3	23	1.3
24		24		24	1.3	24	1.9
25		25		25	1.3	25	1.3
26		26		26	1.4	26	1.6
27		27		27	1.3	27	1.4
28		28		28	1.3	28	2.2
29		29		29	1.3	29	1.4
30		30		30	1.5	30	1.6
31		31		31	1.3	31	2
32		32		32	1.3	32	3.8
33		33		33	1.6	33	2.3
34		34	2.5	34	1.5	34	1.7
35	3.3	35		35	1.5	35	3.4
36	2.4	36	2.5	36	1.8	36	1.9

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- Solution 2
- **Solution 3**
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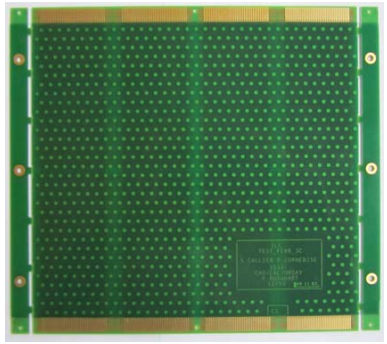
ASU interconnection with special kapton

FEV8-3C

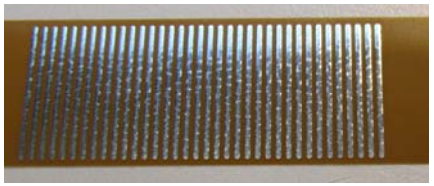
4 connectors each with 36 channels

Wire by wire



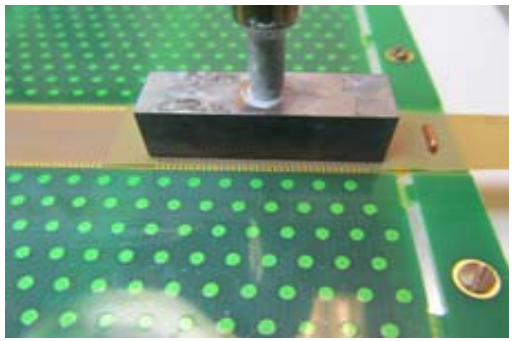
Kapton combs

4 connectors with 36 copper pads
with tin and lead
length=14mm width=0.5mm
Thickness of copper = 35µm
Thickness of kapton = 50µm
Thickness of tin and lead = 65µm



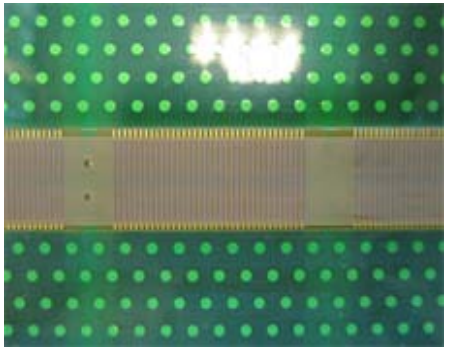
Using Weller Solder tool

WS81 95W



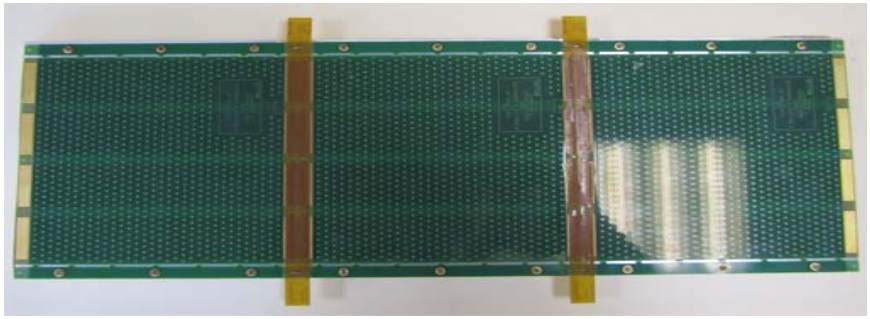
300°C for 5 seconds

Result



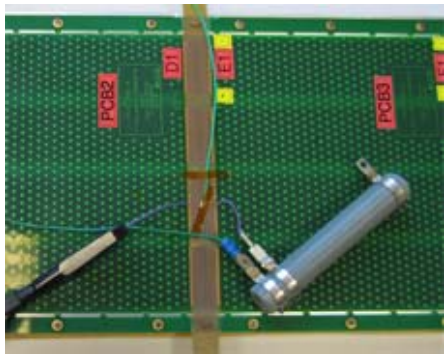
ASU interconnection with special kapton

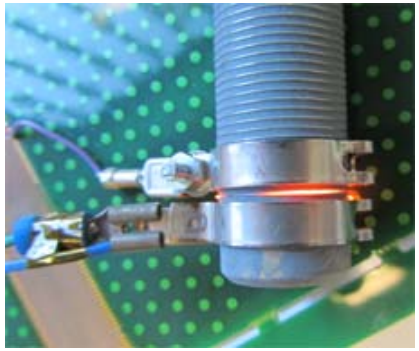
Continuity test



Made with a precision multimeter Keithley
Resistance between wires in PCB = 0.21 ohms
Isolation between wires in PCB = ∞

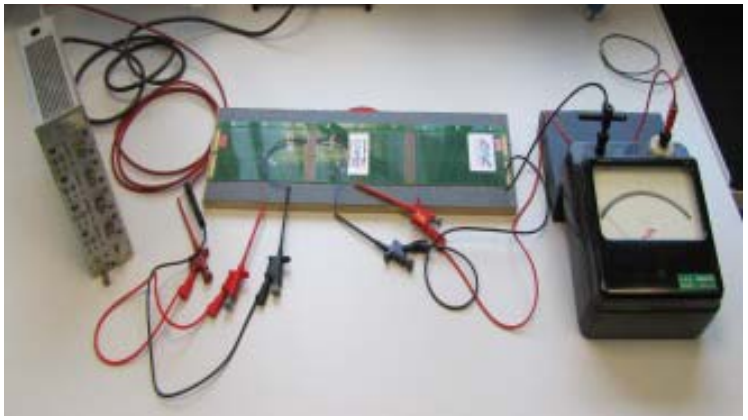
Power test

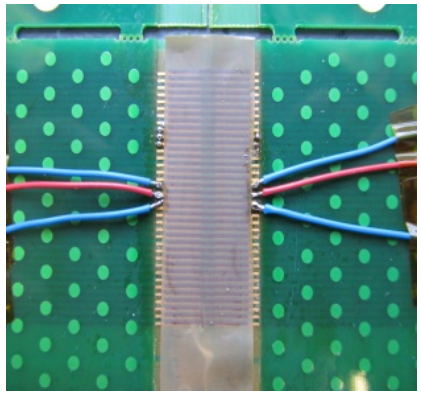




Sfernice adjustable resistance
R = 2.5 ohms, U = 12.8V, I = 5A

HV tests

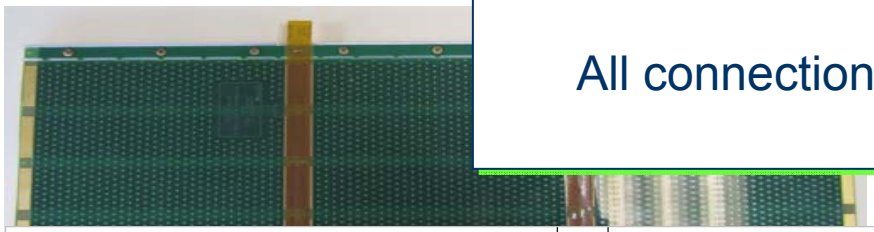




1 wire with Max 1350V between 2 ground wires

ASU interconnection with special kapton

Continuity test



All connections are good !!!

HV tests

1 ACF entre PCB N° 1-2 piste à piste							
B1-C1		B2-C2		B3-C3		B4-C4	
Piste	Résultats	Piste	Résultats	Piste	Résultats	Piste	Résultats
1	0.21	1	0.21	1	0.21	1	0.21
2	0.21	2	0.21	2	0.21	2	0.21
3	0.21	3	0.21	3	0.21	3	0.21
4	0.21	4	0.21	4	0.21	4	0.21
5	0.21	5	0.21	5	0.21	5	0.21
6	0.21	6	0.21	6	0.21	6	0.21
7	0.21	7	0.21	7	0.21	7	0.21
8	0.21	8	0.21	8	0.21	8	0.21
9	0.21	9	0.21	9	0.21	9	0.21
10	0.21	10	0.21	10	0.21	10	0.21
11	0.21	11	0.21	11	0.21	11	0.21
12	0.21	12	0.21	12	0.21	12	0.21
13	0.21	13	0.21	13	0.21	13	0.21
14	0.21	14	0.21	14	0.21	14	0.21
15	0.21	15	0.21	15	0.21	15	0.21
16	0.21	16	0.21	16	0.21	16	0.21
17	0.21	17	0.21	17	0.21	17	0.21
18	0.21	18	0.21	18	0.21	18	0.21
19	0.21	19	0.21	19	0.21	19	0.21
20	0.21	20	0.21	20	0.21	20	0.21
21	0.21	21	0.21	21	0.21	21	0.21
22	0.21	22	0.21	22	0.21	22	0.21
23	0.21	23	0.21	23	0.21	23	0.21
24	0.21	24	0.21	24	0.21	24	0.21
25	0.21	25	0.21	25	0.21	25	0.21
26	0.21	26	0.21	26	0.21	26	0.21
27	0.21	27	0.21	27	0.21	27	0.21
28	0.21	28	0.21	28	0.21	28	0.21
29	0.21	29	0.21	29	0.21	29	0.21
30	0.21	30	0.21	30	0.21	30	0.21
31	0.21	31	0.21	31	0.21	31	0.21
32	0.21	32	0.21	32	0.21	32	0.21
33	0.21	33	0.21	33	0.21	33	0.21
34	0.21	34	0.21	34	0.21	34	0.21
35	0.21	35	0.21	35	0.21	35	0.21
36	0.21	36	0.21	36	0.21	36	0.21

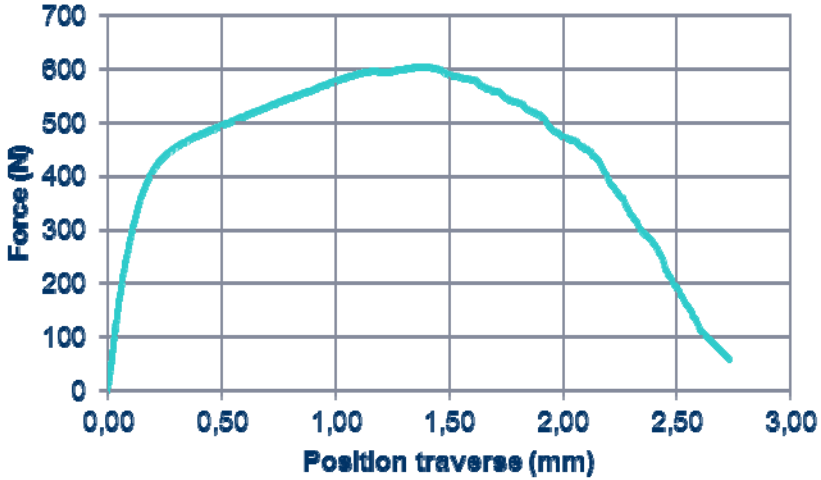
1 ACF entre PCB N° 2-3 piste à piste							
D1-E1		D2-E2		D3-E3		D4-E4	
Piste	Résultats	Piste	Résultats	Piste	Résultats	Piste	Résultats
1	0.21	1	0.21	1	0.21	1	0.21
2	0.21	2	0.21	2	0.21	2	0.21
3	0.21	3	0.21	3	0.21	3	0.21
4	0.21	4	0.21	4	0.21	4	0.21
5	0.21	5	0.21	5	0.21	5	0.21
6	0.21	6	0.21	6	0.21	6	0.21
7	0.21	7	0.21	7	0.21	7	0.21
8	0.21	8	0.21	8	0.21	8	0.21
9	0.21	9	0.21	9	0.21	9	0.21
10	0.21	10	0.21	10	0.21	10	0.21
11	0.21	11	0.21	11	0.21	11	0.21
12	0.21	12	0.21	12	0.21	12	0.21
13	0.21	13	0.21	13	0.21	13	0.21
14	0.21	14	0.21	14	0.21	14	0.21
15	0.21	15	0.21	15	0.21	15	0.21
16	0.21	16	0.21	16	0.21	16	0.21
17	0.21	17	0.21	17	0.21	17	0.21
18	0.21	18	0.21	18	0.21	18	0.21
19	0.21	19	0.21	19	0.21	19	0.21
20	0.21	20	0.21	20	0.21	20	0.21
21	0.21	21	0.21	21	0.21	21	0.21
22	0.21	22	0.21	22	0.21	22	0.21
23	0.21	23	0.21	23	0.21	23	0.21
24	0.21	24	0.21	24	0.21	24	0.21
25	0.21	25	0.21	25	0.21	25	0.21
26	0.21	26	0.21	26	0.21	26	0.21
27	0.21	27	0.21	27	0.21	27	0.21
28	0.21	28	0.21	28	0.21	28	0.21
29	0.21	29	0.21	29	0.21	29	0.21
30	0.21	30	0.21	30	0.21	30	0.21
31	0.21	31	0.21	31	0.21	31	0.21
32	0.21	32	0.21	32	0.21	32	0.21
33	0.21	33	0.21	33	0.21	33	0.21
34	0.21	34	0.21	34	0.21	34	0.21
35	0.21	35	0.21	35	0.21	35	0.21
36	0.21	36	0.21	36	0.21	36	0.21

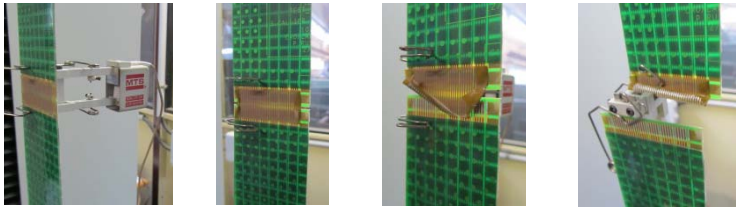
3 PCB N° 1-2-3 piste à piste via 2 ACF							
A1-F1		A2-F2		A3-F3		A4-F4	
Piste	Résultats	Piste	Résultats	Piste	Résultats	Piste	Résultats
1	0.21	1	0.21	1	0.21	1	0.21
2	0.21	2	0.21	2	0.21	2	0.21
3	0.21	3	0.21	3	0.21	3	0.21
4	0.21	4	0.21	4	0.21	4	0.21
5	0.21	5	0.21	5	0.21	5	0.21
6	0.21	6	0.21	6	0.21	6	0.21
7	0.21	7	0.21	7	0.21	7	0.21
8	0.21	8	0.21	8	0.21	8	0.21
9	0.21	9	0.21	9	0.21	9	0.21
10	0.21	10	0.21	10	0.21	10	0.21
11	0.21	11	0.21	11	0.21	11	0.21
12	0.21	12	0.21	12	0.21	12	0.21
13	0.21	13	0.21	13	0.21	13	0.21
14	0.21	14	0.21	14	0.21	14	0.21
15	0.21	15	0.21	15	0.21	15	0.21
16	0.21	16	0.21	16	0.21	16	0.21
17	0.21	17	0.21	17	0.21	17	0.21
18	0.21	18	0.21	18	0.21	18	0.21
19	0.21	19	0.21	19	0.21	19	0.21
20	0.21	20	0.21	20	0.21	20	0.21
21	0.21	21	0.21	21	0.21	21	0.21
22	0.21	22	0.21	22	0.21	22	0.21
23	0.21	23	0.21	23	0.21	23	0.21
24	0.21	24	0.21	24	0.21	24	0.21
25	0.21	25	0.21	25	0.21	25	0.21
26	0.21	26	0.21	26	0.21	26	0.21
27	0.21	27	0.21	27	0.21	27	0.21
28	0.21	28	0.21	28	0.21	28	0.21
29	0.21	29	0.21	29	0.21	29	0.21
30	0.21	30	0.21	30	0.21	30	0.21
31	0.21	31	0.21	31	0.21	31	0.21
32	0.21	32	0.21	32	0.21	32	0.21
33	0.21	33	0.21	33	0.21	33	0.21
34	0.21	34	0.21	34	0.21	34	0.21
35	0.21	35	0.21	35	0.21	35	0.21
36	0.21	36	0.21	36	0.21	36	0.21

ASU interconnection with special kapton

Tensile tests

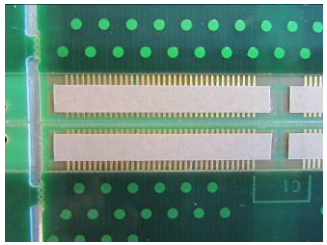
2x small PCBs with 36 wires interconnected by 2 kaptons and series connections





Max 600N before destruction

- Introduction
- Solution 1
- Solution 2
- Solution 3
- Comparative
- Next step

Technology	Advantages	Disadvantages
N°1 Solder 	-Proven technology -Possible to repair -~3 euros/connector	-Difficult procedure -Too much heat for the glue of wafers -Cannot be industrialized
N°2 ACF 	-Easy to install -Easy to remove -Easy to industrialize	-Needs to have a perfect planarity -Needs to have a thermode ~15Keuros -10mA maximum per wire -~30 euros/connector -Too much pressure =mechanical stress for the wafers
N°3 Spécial Kapton 	-Easy to install -Good reliability -Possible to repair -Easy to industrialize -Good strength -~4 euros/connector	-I don't know yet

- Introduction
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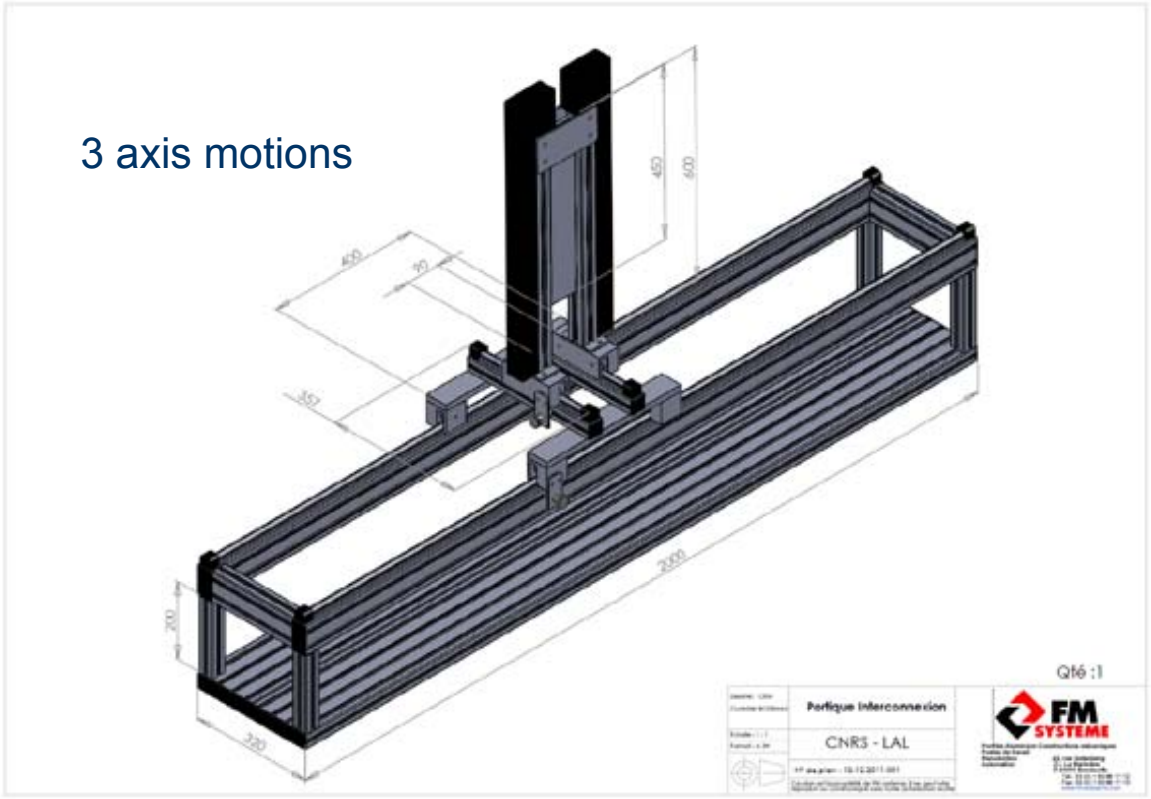
- Solution 2
- Solution 3
- Comparative
- **Next step**

- Test solution n°3 (special kapton) with a manipulator system, was delivered before this conference and is ready for settings.
- Realize the interconnection of 1ASU+1Adapter-card+1DIF for summer test beam



Can easily be automated

- Study a new long HV kapton and short HV kapton for the Adapter-card
- Realize the interconnection of all ASUs for a the technological prototype

Thankyou for your kind attention

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