

OB module: development increments and planning horizon

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Pre-TDR

- To use the pre-TDR table of content to drive planning and implementation.

- Authors of this section:
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WP3: Electrical Interfaces
Coordinators: Marcello Borri, TBC

WP3: Electrical interfaces	
3.1	Electrical interfaces IB (L0–2)
3.1.1	Definition of specifications for FPCs & electrical interconnection
3.1.2	Design & supplier evaluation
3.1.3	Prototyping & testing of module, FPCs & electrical interconnection
3.1.4	Iterative improvements of FPC design & electrical interconnection
Milestone	FPC design complete & electrical interconnection validated
3.1.5	Pre-production of FPCs for system test, including QC
3.1.6	Production of FPCs for production
3.2	OB HIC (L3–4)
3.2.1	Definition of specifications for FPCs & electrical interconnection
3.2.2	Design & supplier evaluation
3.2.3	Prototyping & testing of module, FPCs & electrical interconnection
3.2.4	Iterative improvements of module design, FPC & electrical interconnection
Milestone	OB module design complete
3.2.5	Pre-production of FPC for system test, including QC
3.2.6	Production of FPCs for detector grade modules, including QC
	back plate
Milestone	Disk module design complete
3.3.5	Pre-production of FPCs for system test
3.3.6	Production of detector grade FPCs, including QC

Chapter 4

Modules

4.1 Overview

Rationale for modules (already well written for main document)

4.2 OB module concept

Product break-down structure; Candidate techniques for micro-electronics interconnection techniques; Describe options like curved and flat configurations; Estimate of material budget;

4.2.1 Tooling and assembly

Tooling and assembly sequence for curved configuration; Tooling and assembly sequence for flat configuration;

4.3 Disks module concept

4.3.1 Tooling and assembly

4.4 Characterization and production testing (QC)

Characterization: Mechanical characterization of modules (what tests); Electrical characterization of modules (what tests: pwr tests, communication tests, in-pixel tests inc. parameter tuning, radioactive sealed source and in-beam tests);

Production: Receptions tests/inspection of parts; Rationale for selection of parts (especially AncAsic and LAS); QC for gluing of parts; QC for electrical interconnection of parts; Electrical tests after completed assembly; Storage (as well?);

4.5 Prototype studies

Any results of prototypes; tooling development

OB modules: production estimate

ALICE ITS2 IB published yield

OB module: units estimate

Total staves (inc. 10% spare): 49 staves L3; 77 staves L4;

Total sensors: 396 L3; 1232 L4;

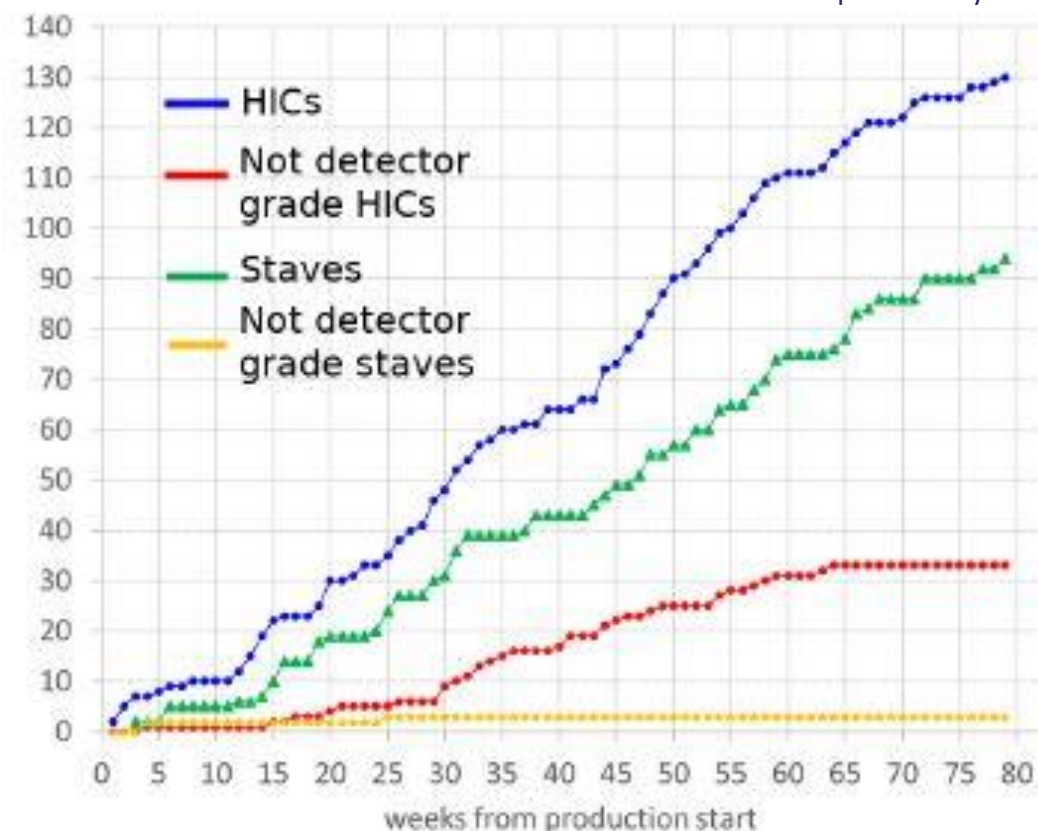
Total modules (opt. 2 LAS per module): 198 L3; 616 L4;

Module yield 75%, modules to produce: 248 L3; 770 L4;

Each site (DL/Bham) to produce 50% of total: $\sim(248+770)/2 = 509$

Production duration 215 days/year * 2 years = 430 days

Production rate: 1.18 module/day

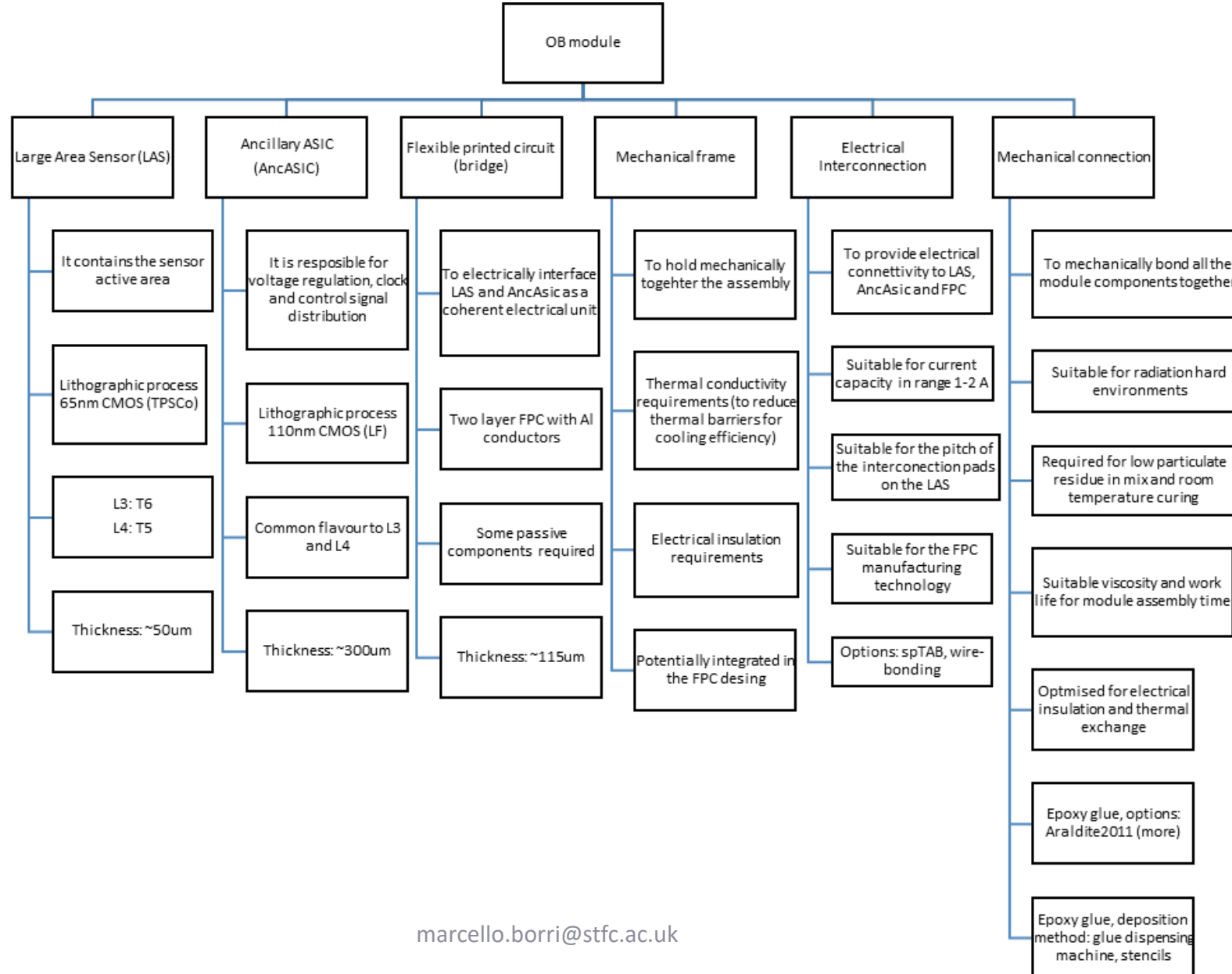


Prioritised requirement list (PRL)

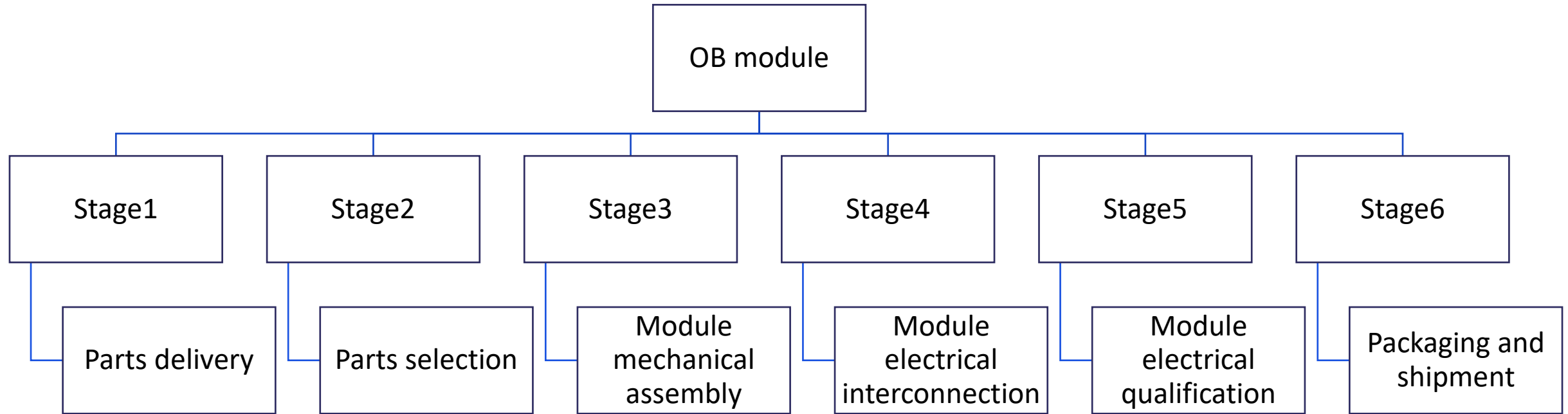
Requirement	Priority
Respect a logical boundary to enable electrical testing i.e. to group units of (LAS + AncASIC + Bridge FPC)	MUST
Have a low mass	MUST
Be thermally efficient	MUST
Easy to handle	SHOULD
Componets to be aligned to 10's of um accuracy	SHOULD
Push the ultimate granularity i.e. 1 LAS + 1 AncASIC + 1 Bridge per modules	COULD
Support unjustified change w.r.t. ALICE ITS2 modules	WILL NOT

Risk averse approach

Product break down structure



WBS – module production (high level)



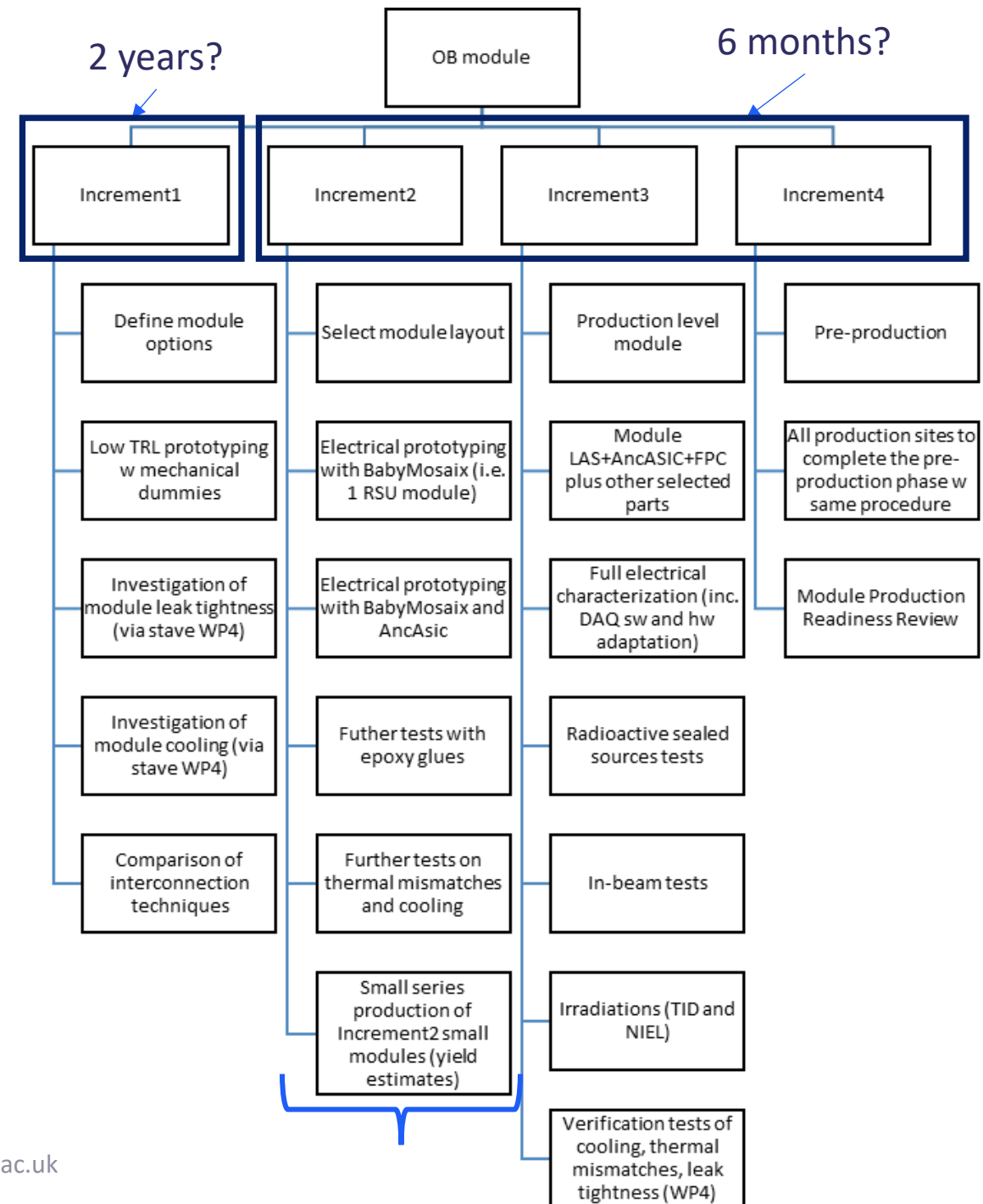
The expansion and detailing of this WBS will form the foundation of the quality plan for the module production;

Module production to be completed by 30/06/2030 (from Peter's submitted proposal);

Incremental development

Key dates: (from Peter's submitted proposal)

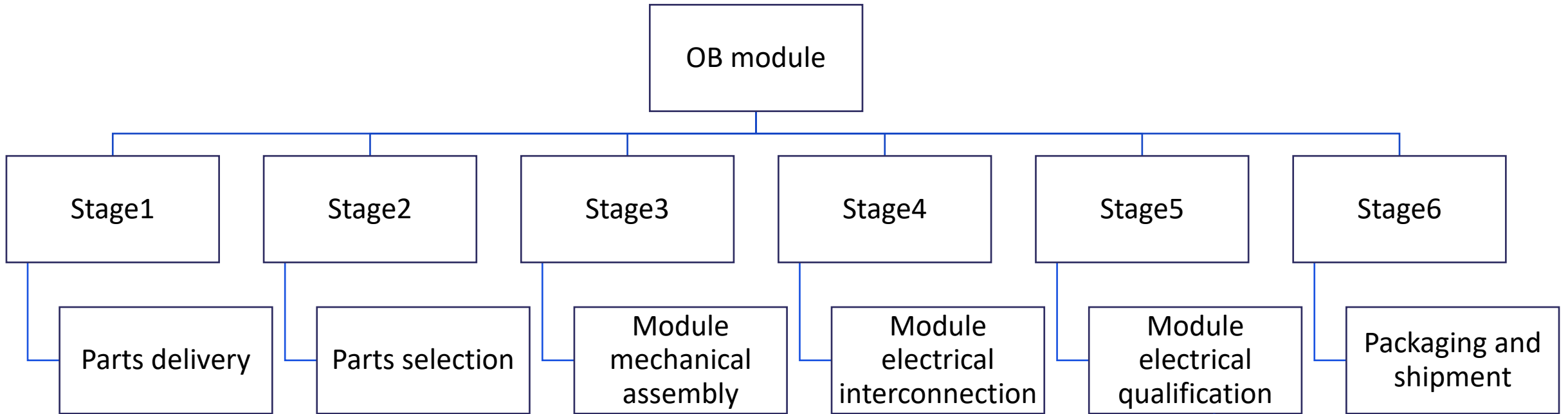
- LAS design/characterization ends on
 - 30/09/2027 (design)
 - 31/12/2027 (characterisation)
- AncAsic design/testing ends on
 - 01/08/2026 (design)
 - 30/09/2027 (testing)
- Module pre-production completed by 31/06/2028.



Responsibility assignment matrix

University of Birmingham	Level of commitment	Comments
Process development (e.g interconnection, gluing)	High	
Procurement of parts	Medium	
Electrical tests definition & implementation	Medium	
NIEL irradiations	High	
University of Liverpool	Level of commitment	Comments
Jigs manufacturing	High	Commitment available until start of production inc. TJ as tech advisor inc. JL (TBC)
Process development (e.g interconnection, gluing)	Low	
Procurement of parts	Low	
Electrical tests definition (& implementation?)	Medium	
Daresbury Laboratory	Level of commitment	Comments
Process development (e.g interconnection, gluing)	Medium	Followers on interconnection
Procurement of parts	Low	
Electrical tests definitions & implementation	High	
Adaptation of DAQ Hw and Sw for Module testing	High	
TID irradiations	High	

Areas of work for pre-TDR



Resources in near future for pre-TDR.

K.Davies design
E.Tse prototyping
L.Godfrey gluing tests

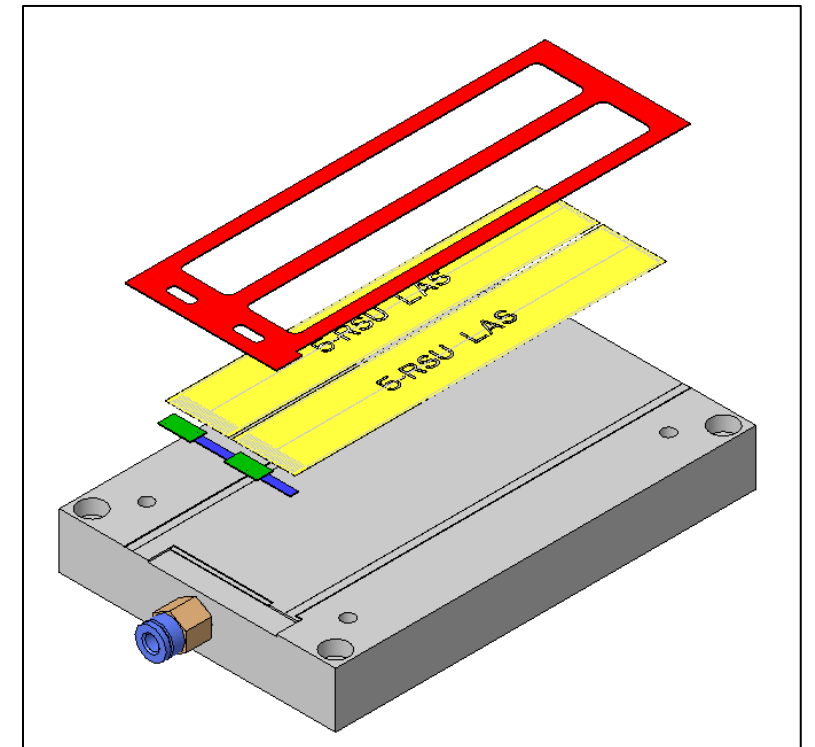
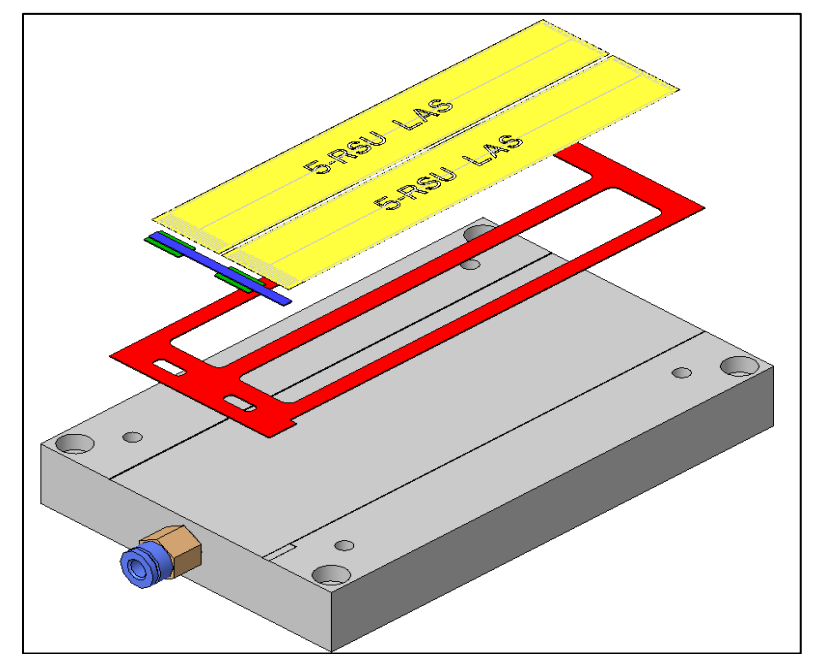
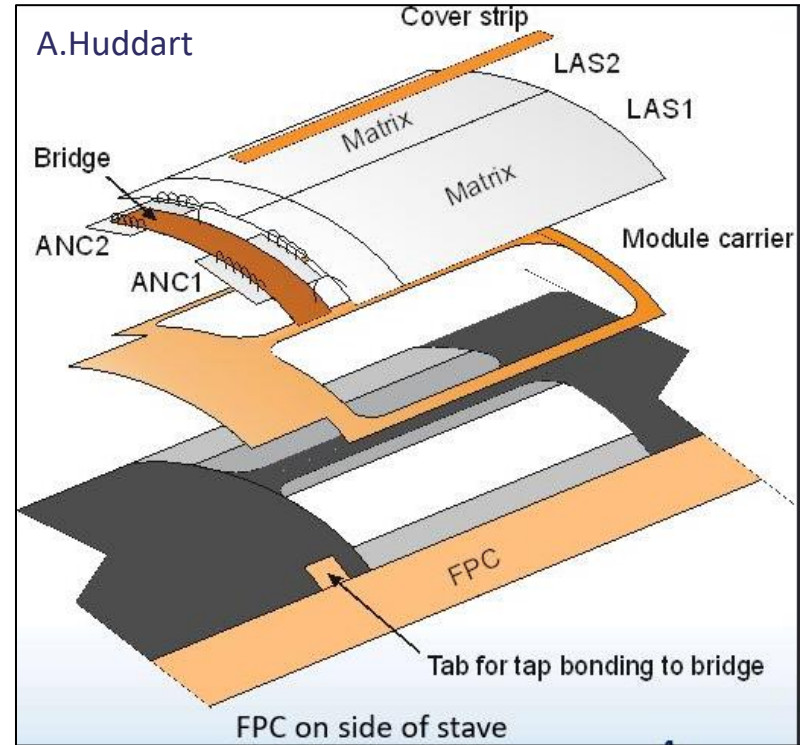
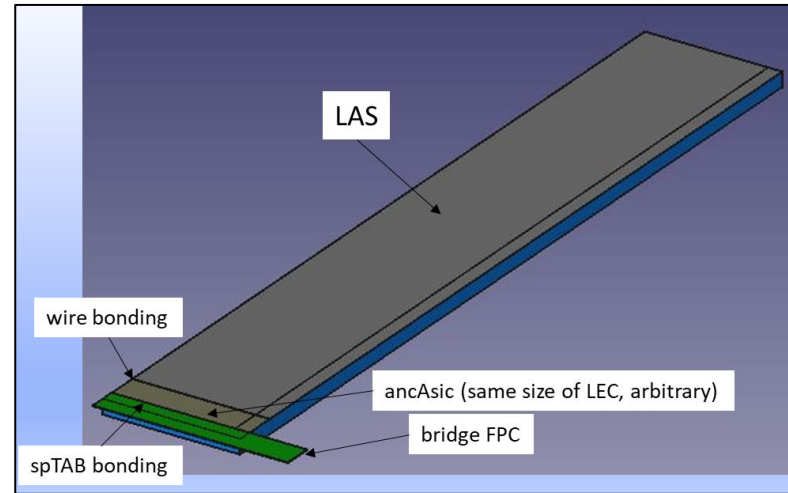
Interconnection tests
E.Tse
L.Boynton

Test plan
J.Liu (TBC)
M.Buckland

See also A.Huddart work on WP4.

T.Jones technical advisor
M.Borri + J.Glover coordination (TBC)

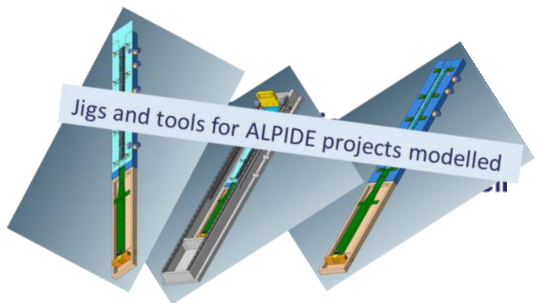
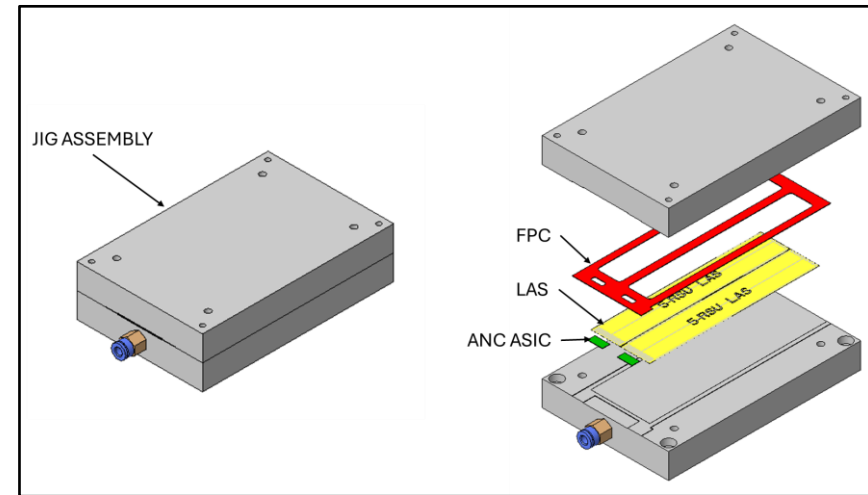
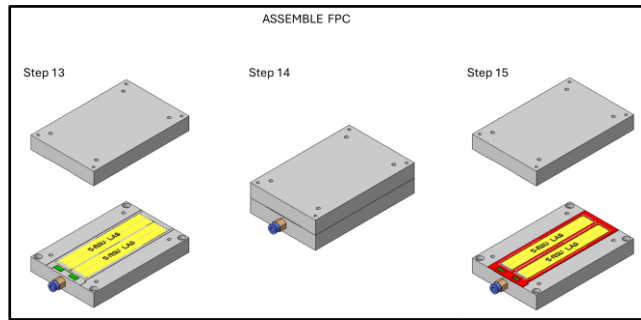
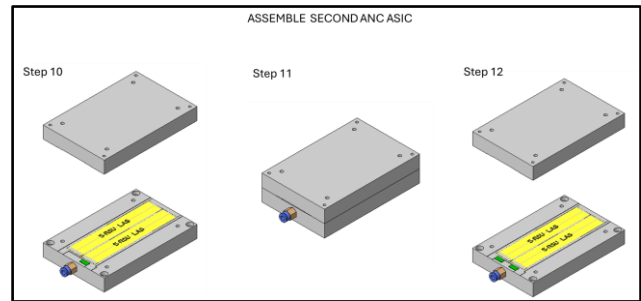
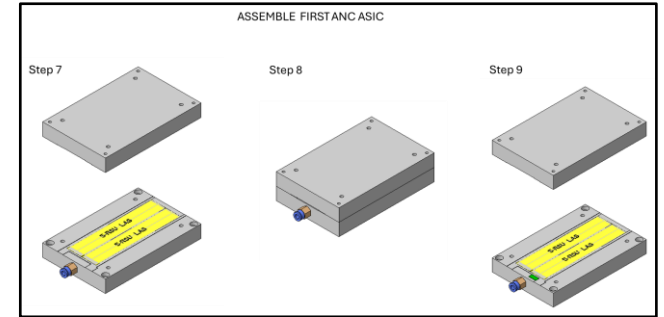
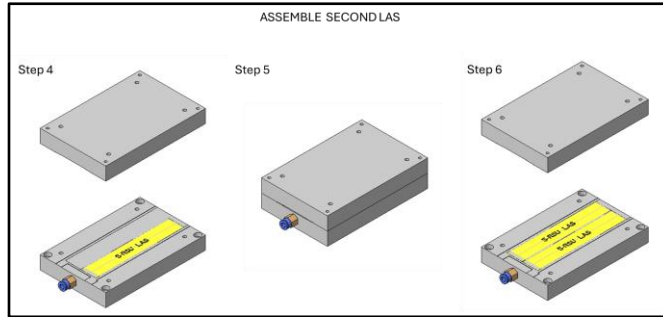
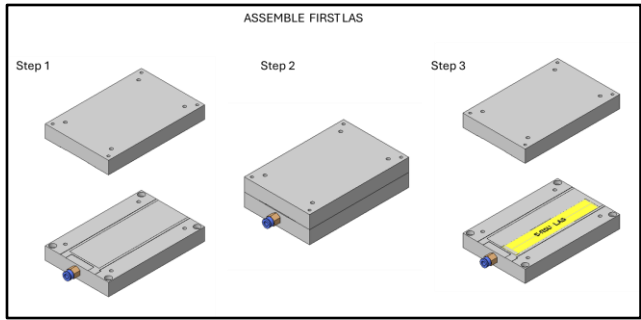
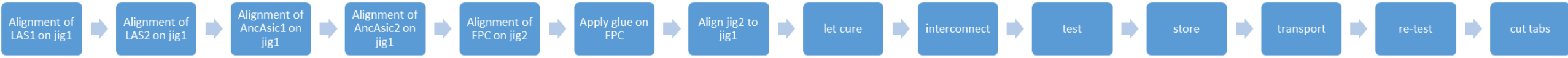
Module options – work in progress



Different options to consider with pros and cons.

Network diagram for module – work in progress

See also A.Huddart past work



Interconnection and gluing – work in progress



SpTAB test element



Existing FPC work already informing interconnection

Peel tests with Kapton tape



Technical Data – HB830

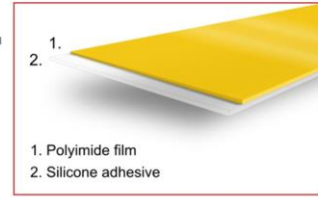


Product description

- Very high temperature resistance, excellent chemical and electrical resistance, high grade silicone adhesive, clean removable
- Excellent insulation properties
- Colour: Amber

Construction

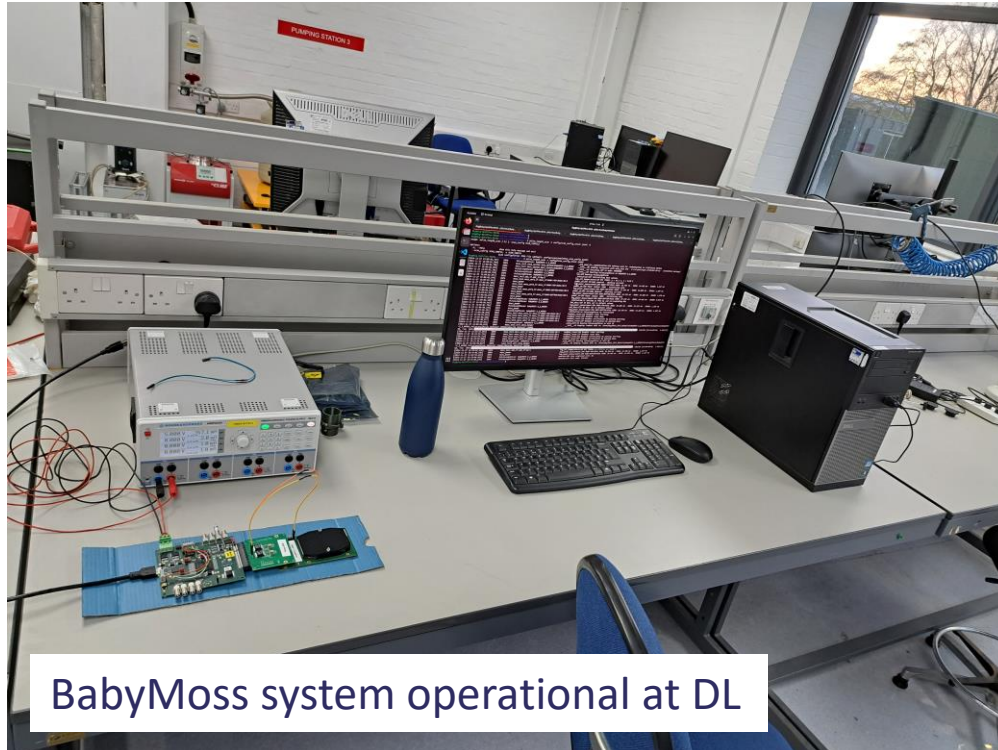
- Polyimide film (25±2µm)
- Silicone adhesive



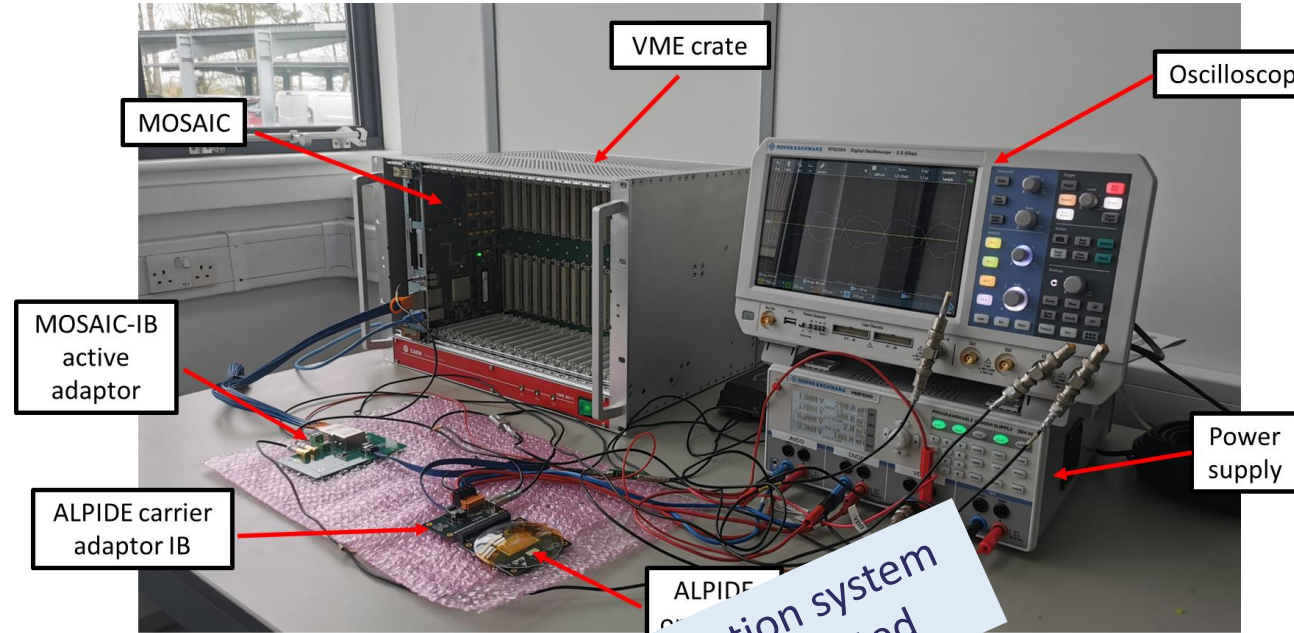
Technical data

Item	Unit		Spec.		Test method
Base thickness	µm	Inch	25±2	.001	ASTM D3652
Total thickness	µm	Inch	70±3	.0028	ASTM D3652
Peel strength	gf/25mm	lbf/in	600±100	1.32±0.22	ASTM D3330
Tensile strength	kg/25mm	lb/in	15-17	33-37.5	ASTM D3759
Elongation	%	-	85-95	-	ASTM D3759
Temperature resistance	°C	°F	260	500	-
Chemical resistance	-	-	Good	-	(20% HCl, NaOH / 20hrs)
Dielectric strength	kV/mm	-	98.5	-	ASTM D149
Dielectric breakdown	kV	-	6.9	-	ASTM D149
Conductivity	Ω/cm	S/m	-	-	-
Surface resistivity	Ω/sq	-	10 ¹³	-	ASTM D257

Module electrical qualification – work in progress



BabyMoss system operational at DL



VME crate
MOSAIC
MOSAIC-IB active adaptor
ALPIDE carrier adaptor IB
ALPIDE
Oscilloscope
Power supply

ALPIDE module qualification system operational and recently adapted

scan		
1	Power Test	
2	Dctrl Measurement	
3	Fifo Scan	
4		
5		Done (in 0 min)
6		Done (in 0 min)
7		Done (in 0 min)
8		Done (in 0 min)
9		Done (in 0 min)
10		Done (in 0 min)
11	Tune VCASN Scan 0.0 V	Done (in 0 min)
12	Tune ITHR Scan 0.0 V	Done (in 0 min)
13	Threshold Scan 0.0 V	Done (in 5 min)
14	Noise Occupancy 0.0 V	Done (in 0 min)
15	Noise Occupancy 0.0 V	Done (in 0 min)
16	Digital Scan BB 3	Done (in 0 min)
17	Digital White Frame BB 3	Done (in 0 min)
18	Threshold Scan 3.0 V	Done (in 5 min)
19	Tune VCASN Scan 3.0 V	Done (in 0 min)
20	Tune ITHR Scan 3.0 V	Done (in 0 min)
21	Threshold Scan 3.0 V	Done (in 5 min)
22	Noise Occupancy 3.0 V	Done (in 0 min)
23	Noise Occupancy 3.0 V	Done (in 0 min)
24	EyeMeasurement D3 P15	Done (in 5 min)
25	EyeMeasurement D2 P10	Done (in 4 min)
26	EyeMeasurement D2 P8	Done (in 4 min)
27	EyeMeasurement D1 P5	Done (in 2 min)
28	ReadoutTest 600 10 10	Done (in 0 min)
29	ReadoutTest 600 2 2	Done (in 0 min)
30	ReadoutTest 1200 3 15	Done (in 0 min)
31	ReadoutTest 1200 2 10	Done (in 0 min)
32	ReadoutTest 1200 2 8	Done (in 0 min)
33	ReadoutTest 1200 1 5	Done (in 0 min)

Hands on experience with relevant technology to support test plans for OB module

Conclusion

- A conservative approach on module development would increase likelihood of success within cost and budget
- To ramp up work on increment1 in order to provide as much info as possible for pre-TDR
- Team up across B'ham, DL, L'pool with existing availability.
- Proposing ad-hoc meeting on Mon. 06/01/2025 @ 14:00