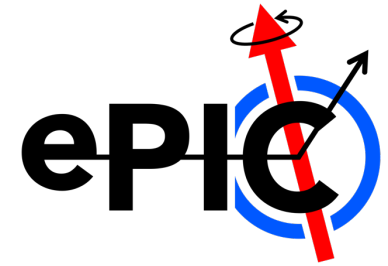




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Update on IB FPC work

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ePIC SVT WP3 meeting

3 September 2026

- Latest update: [talk by Kshitij at SVT General Meeting 21st July](#)
- Work continues on
 - Characterization of the 2025 prototypes
 - ANSYS simulations
 - MATLAB calculation framework
 - Definition of the next prototypes with LTU

- Kshitij and Piermario (Master student) have done a lot of work on the measurements, in particular they worked on different options for gating and de-embedding to obtain the s-parameters and TDR of the FPC only (excluding all other test fixtures)
- Piermario has setup ANSYS simulations of the 2025 prototypes and preliminary results of comparison with the measurements show the expected agreement in comparison with other such works
- Alessio (internship student) is analyzing the profile of the lines on the 2025 prototypes with a profilometer to extract surface roughness
- This work will be presented by them at one of the next meetings

Considerations for 2026 FPC prototypes



- Longer IB FPC with respect to what we knew last year
- From the ongoing work we know we need **more aluminum** for the high-speed (HS) lines with respect to what we have prototyped so far

We need to prototype and test **longer, wider, thicker** transmission lines

SVT-IB Parameters		Layer-0	Layer-1	Layer-2
Barrel Radius [mm]		38	50	126
No. of MOSAIX Segments		12	16	40
Signal FPC Length [mm]	Old	181	159	84
	New	415	387	310

[talk by Kshitij at SVT General Meeting 21st July](#)

Maximising trace cross-section to minimise conductor loss

- Conductor loss is the dominating contributor to signal loss
- Matching conductor loss between the FPCs, i.e., IB Al and ITS3 Cu

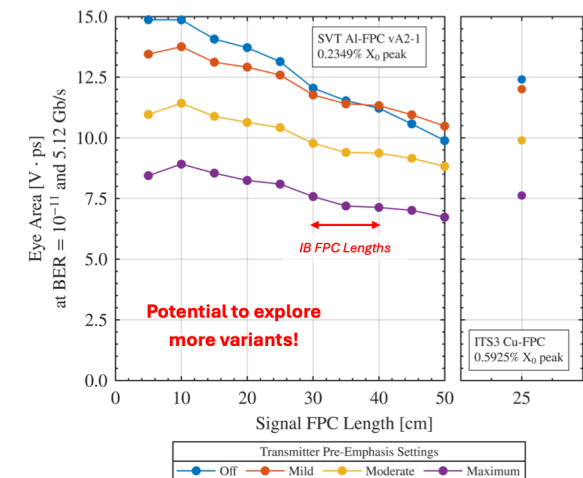
$$\alpha_c \propto \frac{\sqrt{\rho}}{w + t} \cdot l$$

$$\Rightarrow (w + t)_{IB} = (w + t)_{ITS3} \cdot \frac{l_{IB}}{l_{ITS3}} \cdot \sqrt{\frac{\rho_{IB}(Al)}{\rho_{ITS3}(Cu)}} \approx 500 \mu m$$

- Constraints to maximise trace cross-section and fill factor:
 - Trace width → MOSAIX pad layout and slow control lines
 - Trace thickness → Available LTU foils

Properties	SVT IB Aluminium		ITS3 Copper
	Variant A2	Variant A2-1	
Differential Impedance [Ω]		≈ 100	
Trace Thickness [μm]	15	50	35
Trace Width [μm]	70, 60	350, 310	220, 200
Differential Separation [μm]	80	300	160
Cover Layer Thickness [μm]	50	50	40
Dielectric Thickness [μm]	50 + 10	250 + 20	150

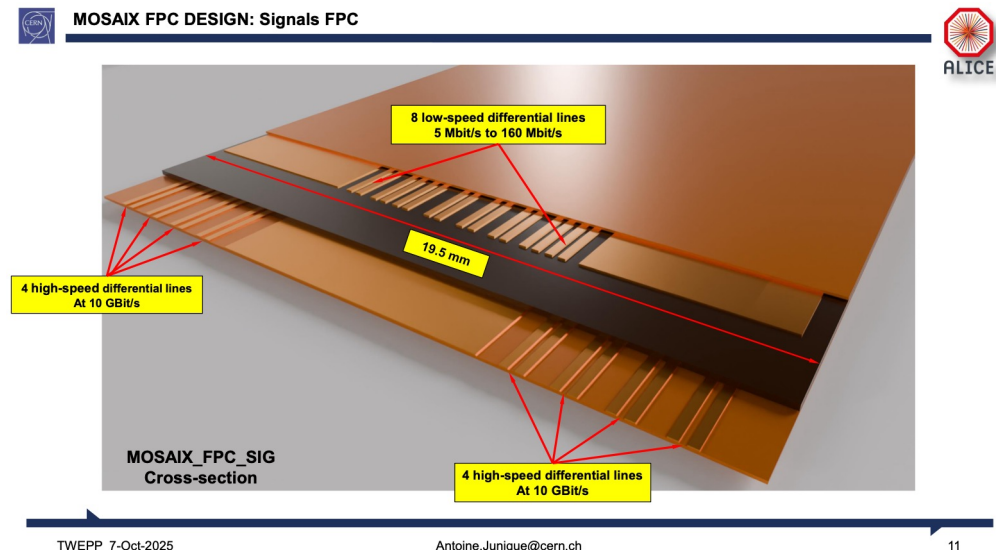
Increasing the FPC trace cross-section can sizably open the Eye Area at BER = 10^{-11} and 5.12 Gb/s for ≈ 40 cm long IB FPCs



Considerations for 2026 FPC prototype



- Constraint: MOSAIX segment width and pad layout need to be matched by the FPC
 - The production IB signal FPC will need to terminate with the **same pad layout and same width** as the ITS3 FPC to match MOSAIX (see picture below)
- The **necessary increase of the width and spacing of the high-speed lines** affects the available space for the slow control lines
 - To stay within the ITS3 FPC width, the production IB signal FPC, will need to have **different width and spacing of HS and slow ctrl (SC) lines**



- **Signal FPC** with differential pairs for signal integrity tests to be performed in Trieste
 - Design similar to the current prototype but with updated stack-up, line width and spacing, length
 - Validate design with 415 mm length and new stack-up options
 - Include both HS and SC differential pairs (as they have different width and spacing)
- **Test coupons** to exercise wire bonding between bent FPC and MOSAIX in Bari
 - To be used in the IB half-barrel test article made with MOSAIX pad wafers
 - Width and wire bonding pads layout of these prototypes must be as in ITS3 FPC to match MOSAIX segment width and pad layout
- Two stack-up options, with calculation of width and spacing of HS and SC lines, have been proposed to LTU and are under discussion
- Possible design of signal FPC and test coupons proposed to LTU and under discussion
- All to be shown when agreed upon

Longer term planning

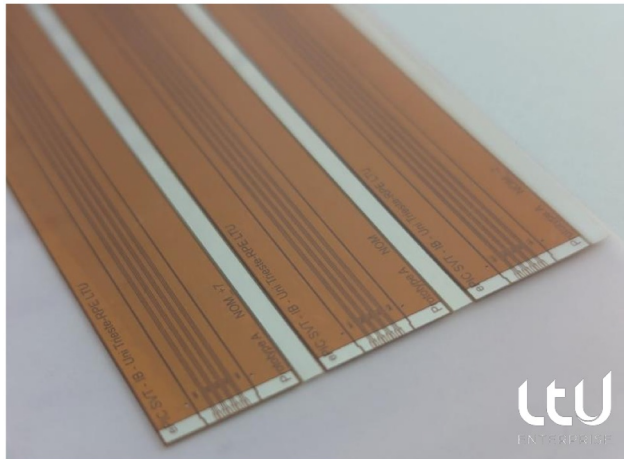


- 2026:
 - Complete test of 2025 prototypes
 - ANSYS simulation of 2026 prototypes
 - Order and production of 2026 prototypes
 - Tender process for purchase of 20 GHz oscilloscope
- 2027:
 - Delivery of 2026 prototypes and 20 GHz oscilloscope
 - Tests of 2026 prototypes
 - Design of complete IB FPC demonstrator (signal, digital, analog FPC)
 - Order and production of complete IB FPC demonstrators (L0, L1, L2)
 - Test and validation of IB FPC demonstrators

Backup



Reminder 2025 prototypes



- For each stack-up, three groups of 4 differential pairs with different line width: nominal ($Z = 100 \text{ Ohm}$), $\pm 10\%$
- Length = 180 mm
- So far tests ongoing on A1 nominal prototype

