

# ePIC SVT L4

## multilayered multicomponent FPC

### from LTU: current status

**RPE LTU:**

Vyacheslav (Slava) Borshchov

Ihor Tymchuk (*responsible, speaker*)

Maksym Protsenko

# Outline

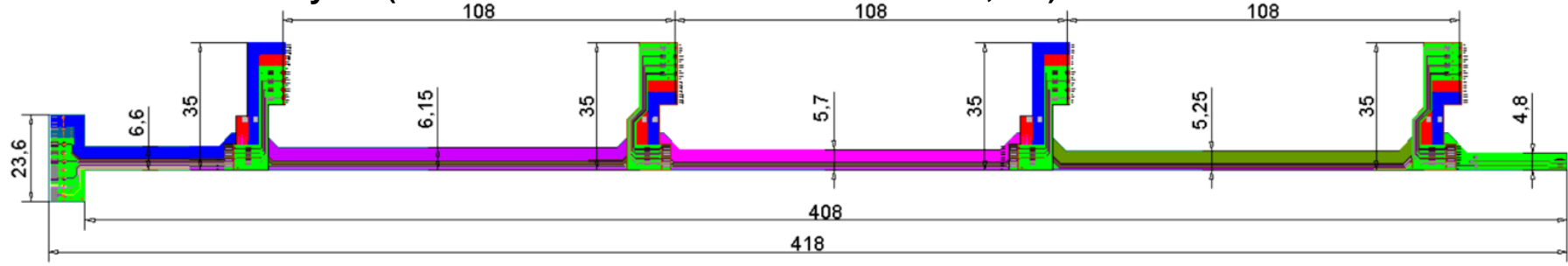
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- ❖ Base layout, cross-sections and some design features
- ❖ Flexible layers of M-FPC and B-FPCs
- ❖ Base assembly work flows
- ❖ Assembling M-FPC and B-FPCs
- ❖ Assembled technological ePIC SVT L4 FPC
- ❖ Possible approach to aligning M-FPC and B-FPCs
- ❖ Outcomes from technological FPC creating stage
- ❖ Conclusions

# Base layout and cross-section

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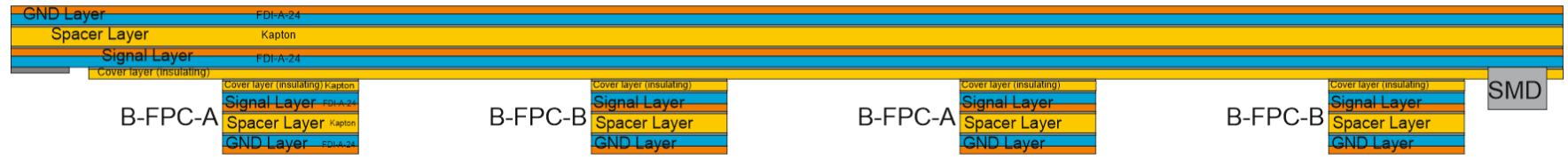
Latest schematic layout (based on latest information from STFC team, v03)



Composition of the ePIC SVT FPC:

- a) Main FPC (M-FPC in short) – 1pc
- b.1) Bridge FPC type A (B-FPC-A) – 2 pcs
- b.2) Bridge FPC type B (B-FPC-B) – 2 pcs

Schematic cross-section of assembled ePIC SVT FPC  
M-FPC

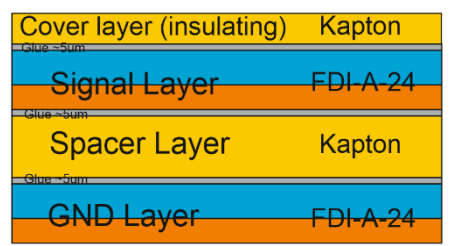


Height (H):	<input type="text" value="89"/>
Height1 (H1):	<input type="text" value="45"/>
Width (W):	<input type="text" value="60"/>
Width1 (W1):	<input type="text" value="70"/>
Separation (S):	<input type="text" value="130"/>
Thickness (T):	<input type="text" value="14"/>
Dielectric Constant (Er):	<input type="text" value="3.4"/>
<input type="button" value="Impedance Calculated"/>	
Differential Impedance (Zo):	<input type="text" value="99.10"/>

Notes:

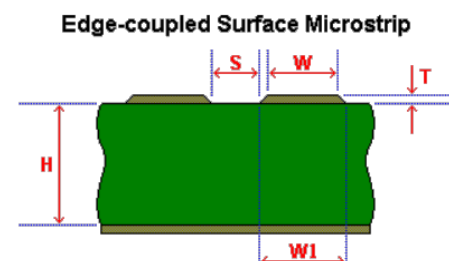
- Base approach, design etc. discussed within biweekly STFC-LTU ePIC SVT meetings within January-May 2024
- Design approved in the end of May, 2024
- All design and assembly features are verifying by creating technological FPC

Cross-section of M-FPC and B-FPCs

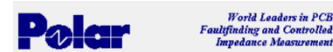


Total thickness ~110um

Design features (diff. pairs)



Note: estimating done in CITS25 software from Polar Instruments



- Width of traces – 70um
- Space between traces – 130um
- Pitch of traces – 200um



# Technological M-FPC: flexible layers

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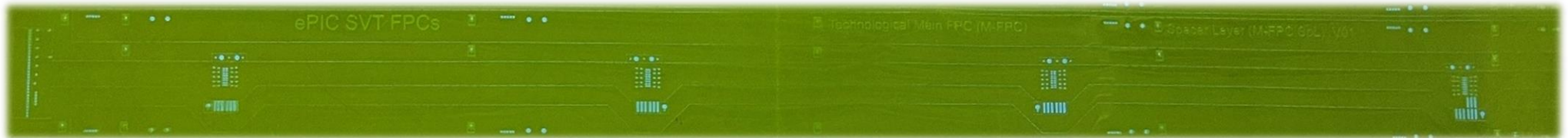
**Cover Layer (M-FPC-CL) – Kapton (25um)**



**Signal Layer (M-FPC-SL) – LTU-15-10 (Al 15um, Pi-10um)**



**Spacer Layer (M-FPC-SpL) – Kapton 25um**



**GND Layer (M-FPC-GL) – LTU-15-10 (Al 15um, Pi-10um)**

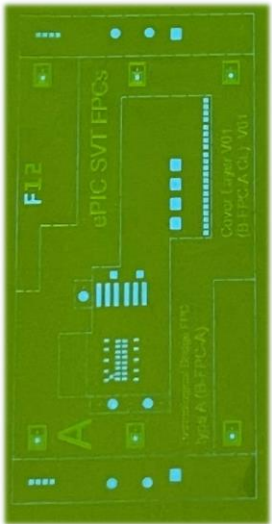


# Technological B-FPCs: flexible layers

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## B-FPC type A

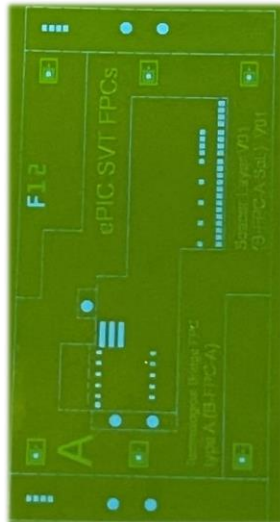
**Cover Layer  
(B-FPC-A-CL)**  
*Kapton (25um)*



**Signal Layer  
(B-FPC-A-SL)**  
LTU-15-10  
(Al 15um, Pi-10um)



**Spacer Layer  
(B-FPC-A-SpL)**  
*Kapton (25um)*



**GND Layer  
(B-FPC-A-GL)**  
LTU-15-10  
(Al 15um, Pi-10um)

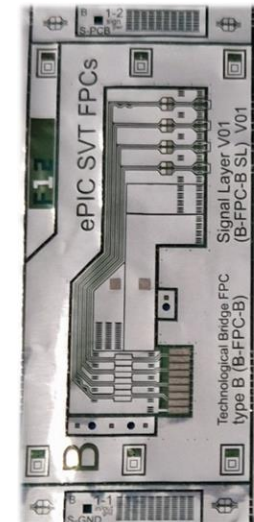


## B-FPC type B

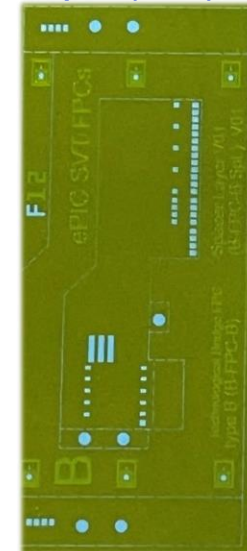
**Cover Layer  
(B-FPC-B-CL)**  
*Kapton (25um)*



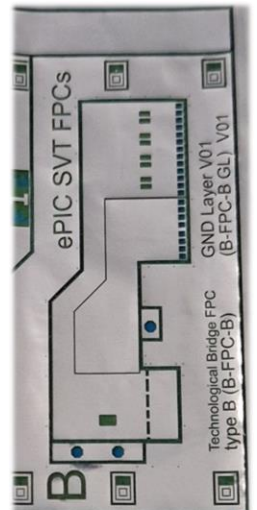
**Signal Layer  
(B-FPC-B-SL)**  
LTU-15-10  
(Al 15um, Pi-10um)



**Spacer Layer  
(B-FPC-B-SpL)**  
*Kapton (25um)*



**GND Layer  
(B-FPC-B-GL)**  
LTU-15-10  
(Al 15um, Pi-10um)



# Base assembly work flow(s) for M-FPC and B-FPCs

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## Stage 1: 2-layered FPC (Signal Layer + Spacer Layer)

- Aligning and laminating Spacer Layer to Signal Layer
- Visual inspection

## Stage 2: 3-layered FPC (2-layered FPC + GND Layer)

- Aligning and laminating GND Layer to 2-layered FPC
- SpTABing Signal Layer to GND Layer
- Electrical tests (circuits integrity), visual inspection
- Protecting SpTAB joints (glue)
- Electrical tests (circuits integrity), visual inspection

## Stage 3: 4-layered FPC (3-layered FPC +Cover Layer+SMDs)

- Aligning, laminating Cover Layer to 3-layered FPC
- Visual inspection
- Soldering SMDs (0201 capacitors on B-FPC or resistors on M-FPC)
- Electrical tests (capacitance or resistance)
- Electrical tests (SpTABs), visual inspection

# Assembling technological M-FPC

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**Stage 1: 2-layered FPC (Signal Layer + Spacer Layer)**



**Stage 2: 3-layered FPC (2-layered FPC + GND Layer)**



**Stage 3.1: 4-layered FPC (3-layered FPC + Cover Layer+SMDs)**



**Stage 3.2: 4-layered FPC (4-layered FPC +SMDs)**



# Assembling technological B-FPCs

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**Stage 1: 2-layered FPC**  
(Signal Layer + Spacer Layer)

**Stage 2: 3-layered FPC**  
(2-layered FPC + GND Layer)

**Stage 3.1: 4-layered FPC**  
(3-layered FPC + Cover Layer)

**Stage 3.2: 4-layered FPC**  
(4-layered FPC+SMDs)

B-FPC-A

B-FPC-A

B-FPC-A

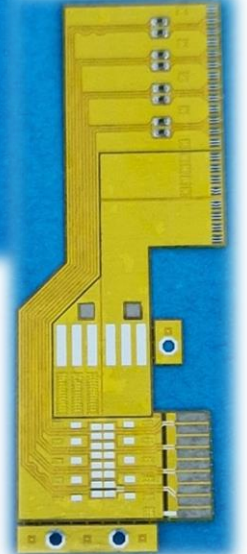
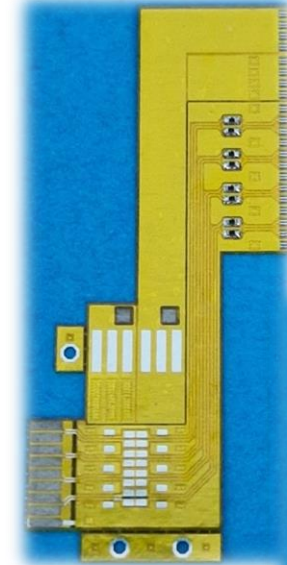
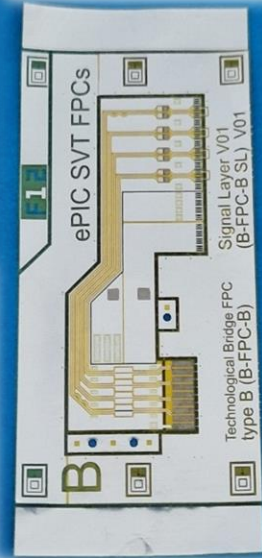
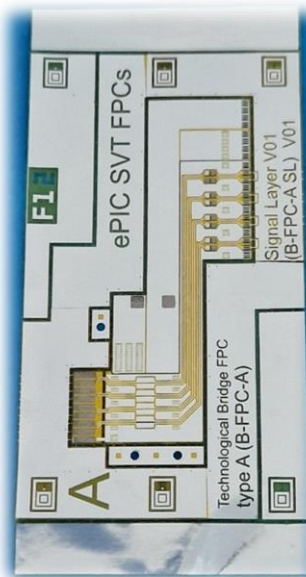
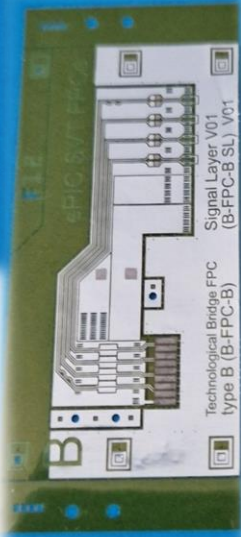
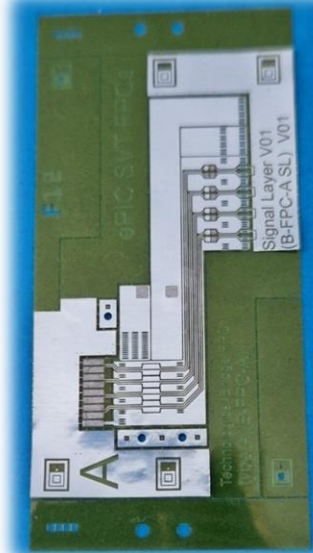
B-FPC-A

B-FPC-B

B-FPC-B

B-FPC-B

B-FPC-B

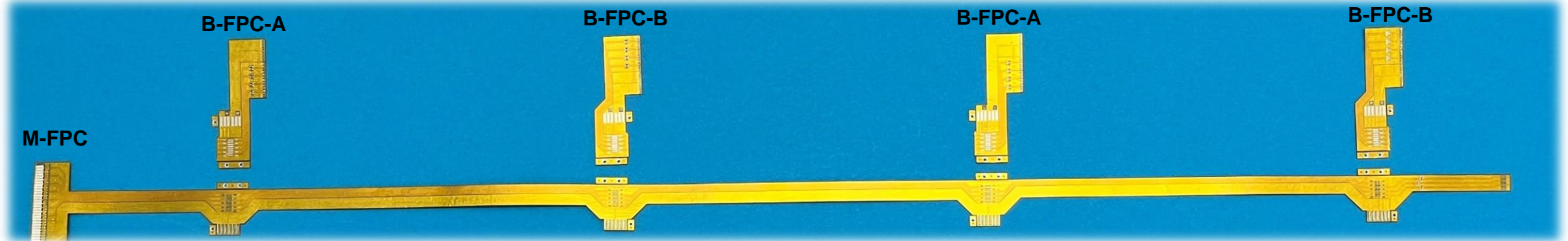




# Technological ePIC SVT L4 FPCs

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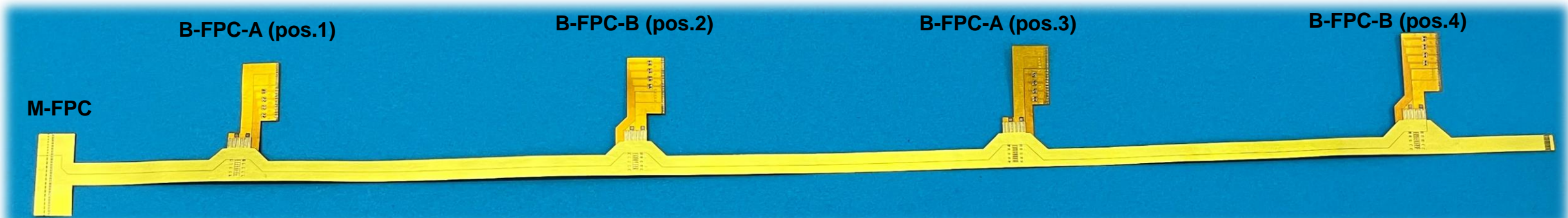
Set of multilayered FPCs (M-FPC+ B-FPCs) for ePIC SVT multilayered multicomponent FPC



## Assembly steps M-FPC+B-FPCs

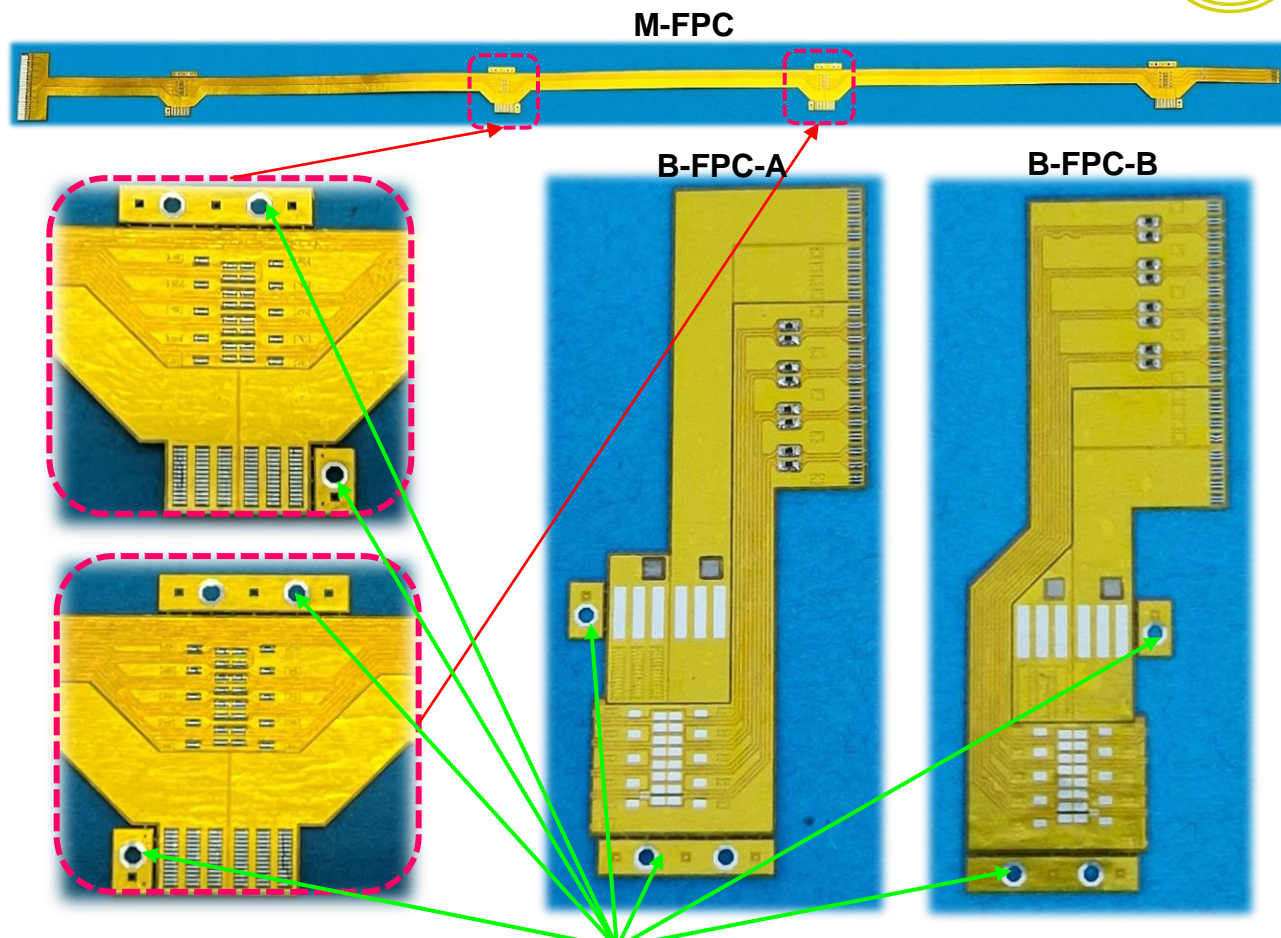
- *Aligning and laminating M-FPC to B-FPC*
- *SpTABing Signal Layer M-FPC to Signal Layer B-FPC-A*
- *Electrical tests (circuits integrity), visual inspection*
- *Protecting SpTAB joints (glue)*
- *Electrical tests (circuits integrity), visual inspection*

Assembled technological multilayered multicomponent ePIC SVT L4 FPC



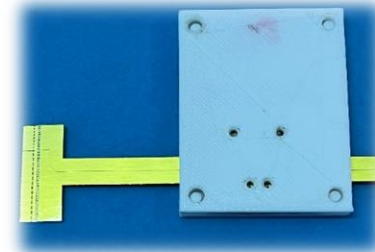
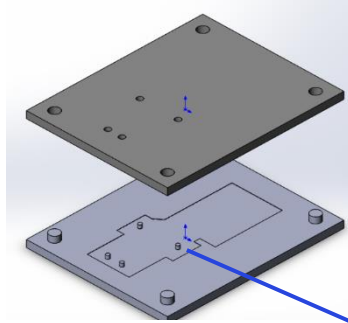
# Possible approach to aligning FPCs and 3-D printed jig for assembling ePIC SVT FPC

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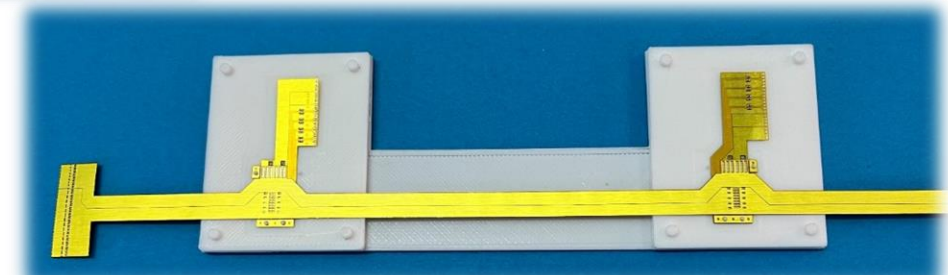
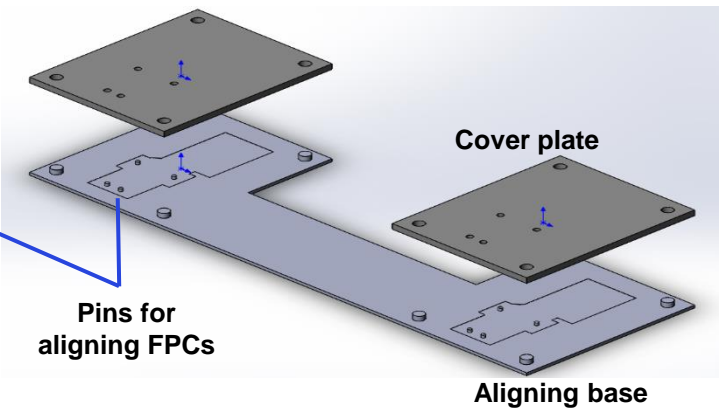


Holes for aligning FPCs

## Single B-FPC approach



## Two B-FPC approach



## Notes:

- Single-B-FPC jig is intended for aligning both B-FPC-A and B-FPC-B
- Base approach is verified (set of jig 3-D printed out, few iterations)



# Outcomes from creating technological FPC

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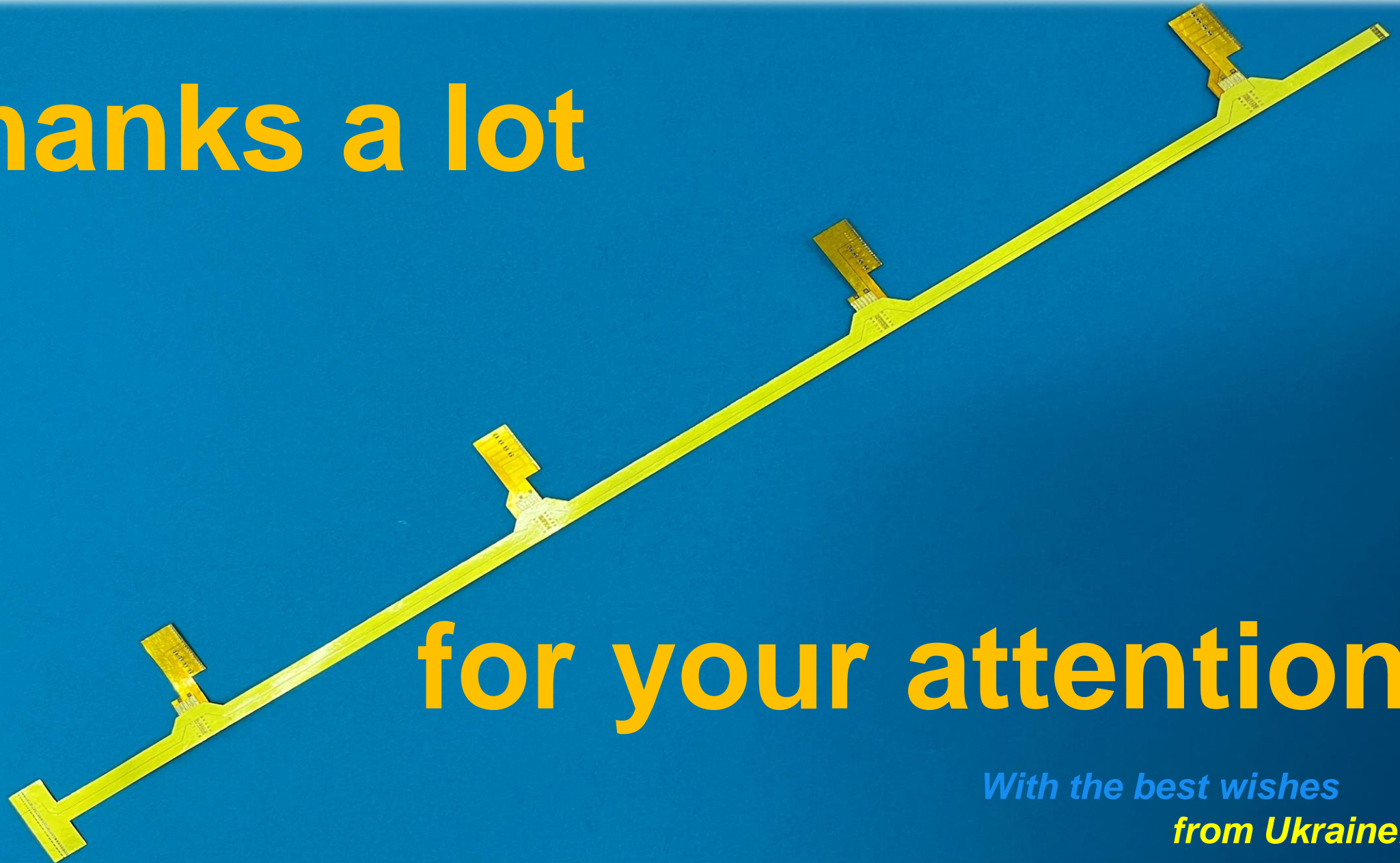
- *Designs of flexible layers and assembled M-FPC and B-FPCs are checked and verified*
- *The designs are ok but some insignificant but important modifications (relating to manufacturing but not to base design/routing) need to be implemented in the designs for next iteration (prototypes)*
- *Assembly work flows for M-FPC and B-FPCs are checked and verified*
- *Assembly work flow for ePIC SVT FPC preliminary verified (1<sup>st</sup> FPC) but will be confirmed/verified (2<sup>nd</sup> FPC)*
- *Possible approach for aligning M-FPC with B-FPCs based on aligning pins is developed, proposed and improved. Possible approach is preliminary tested and verified on improved 3D-printed jig. Proposed approach might be considered as possible option for further assembling ePIC SVT FPCs with real LAS during creating staves*
- *Modifying designs (photomasks) for the prototypes is launched this week*

# Conclusions

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- Designs of ePIC SVT FPC and its components (M-FPC and B-FPCs) are developed and designed in close cooperation with STFC team, designs are approved in the end of May
- For checking and verifying base approach, design and assembly features technological ePIC SVT FPCs and components for them are developed, designed and manufactured.
- Technological FPCs are assembled (M-FPC, B-FPCs, ePIC SVT FPC) and developed assembly work flows are verified and worked-off
- Possible approach for aligning M-FPC on B-FPCs is developed, proposed and preliminary verified (3D-printed out jig is used). Proposed approach might be implemented in further assembling ePIC SVT FPCs with real LAS during creating staves

# Thanks a lot



# for your attention!

*With the best wishes  
from Ukraine!*