Module prototype R&D plan at IHEP

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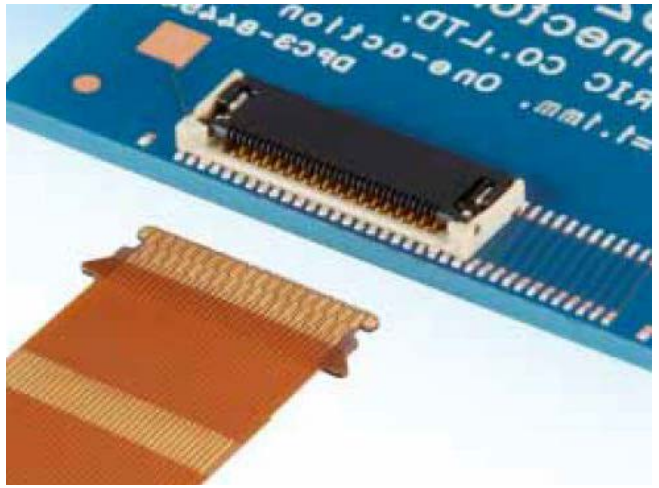
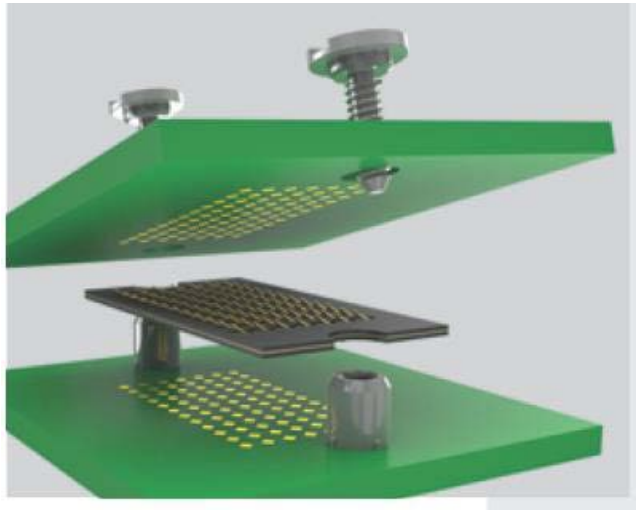
Motivation

Things to evaluate: module, connector, flex and PEB

- Electrical specifications
  - Up to 1.28Gbps transmission along about 600mm
  - Power distribution on PEB
  - Compatible with HV
- Assembling and installation
  - SMT connector soldering on the carrier board
  - Height limitation
  - Low insertion force & high retention force
    - No downward force on module
  - Mechanical assembling process
  - Dimension variation measurement with temperature

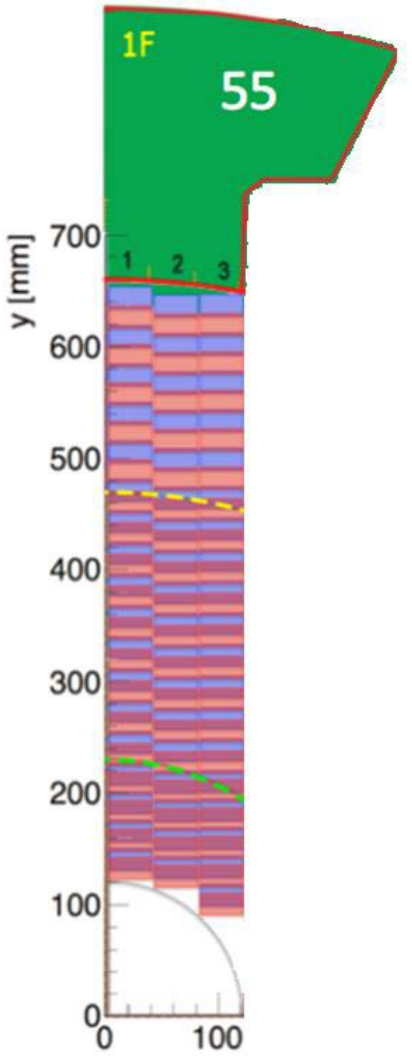




R &D proposal

1. Demonstrator with transfer board+ connector+ Flex + PEB
   - wire bonding scheme between the bare module and the transfer board
   - Layout of the modules with mechanical support

2. Select suitable sensors, chips and special carrier board to evaluate the bump bonding between carrier board and chips , this module can also match to the demonstrator



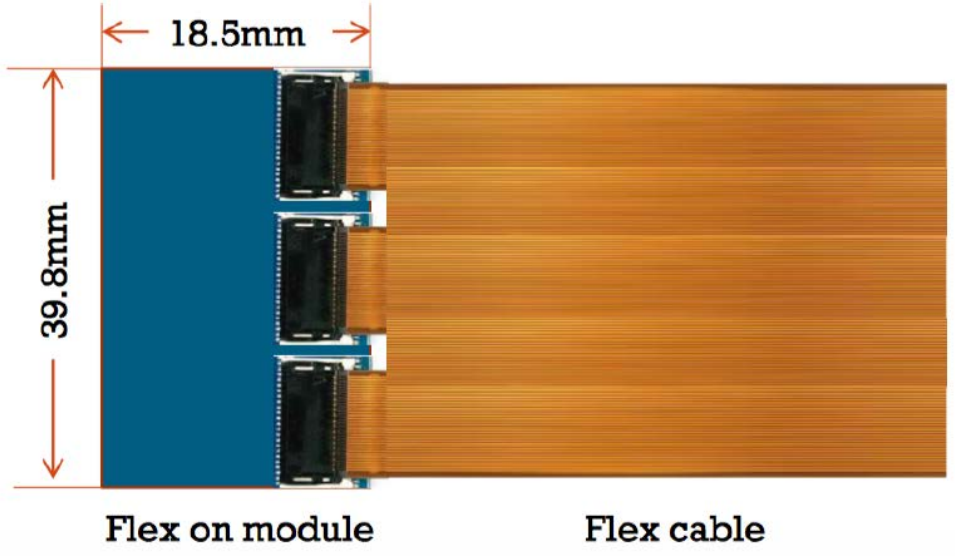
Connector

- Horizontal inserting connector was determined

Part No.	Manufa	Height	Length & Width	No. of contacts	Voltage (max.)	Current (max.)	Performance	Operating range	Accept thickness of the flex	Durability (min.)
FH62–35S–0.25SHW	HIROSE	1.1mm	11.96 x 4 mm	35	30V	0.25A	Supporting USB3.0 (5 Gbps)	-55 to +85°C	0.3 mm	10 cycles
FH72–11S–0.3SHW	HIROSE	0.9mm	6.7 x 3.5 mm	11	30V	0.2A	To test	-55 to +85°C	0.2 mm	10 cycles
503908-4100	Molex	3.75mm	32.85 x 5.85 mm	41	50V	0.5A	Up to 5.4Gbps	-20° to +85°C	0.33 mm	20 cycles

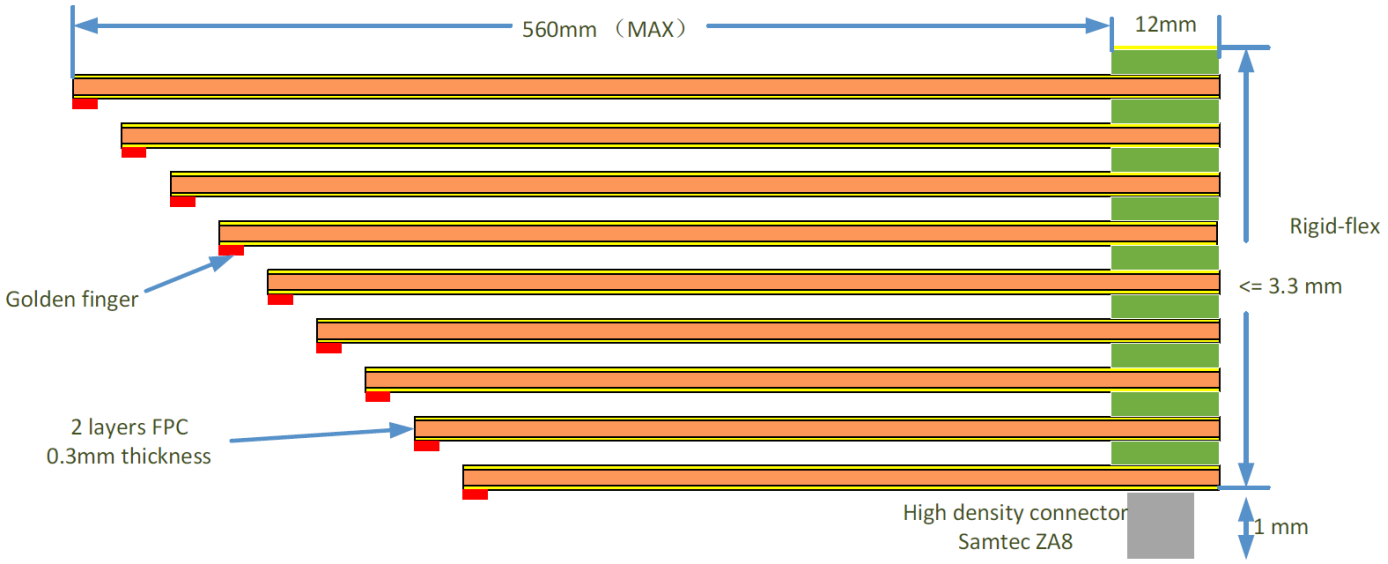
- Can we find more suitable connectors?
- Buy some samples
- Do some tests

Jiezhang 's talk (https://indico.cern.ch/event/777893/)



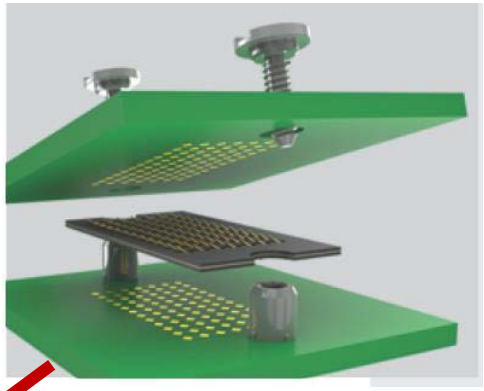
Multi-layer rigid-flex cables

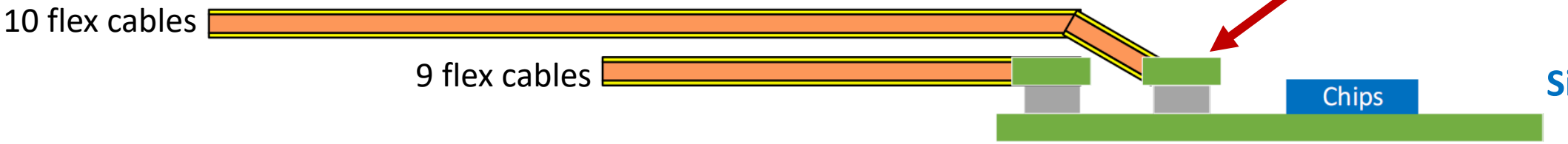
- Design rigid-flex PCB
  - Merge several independent flex cables to one rigid-flex PCB
- Use high density connectors between rigid-flex cable and PEB



One Unit:

- Two for signals and LV power
  SamtecZA8-40-2-1.00-Z-10
  400 pins
  39.7 x 9.0 x 1.0 mm
- One for HV
  SamtecZA8-10-2-1.00-Z-10
  12.5 x 9.0 x 1.0 mm



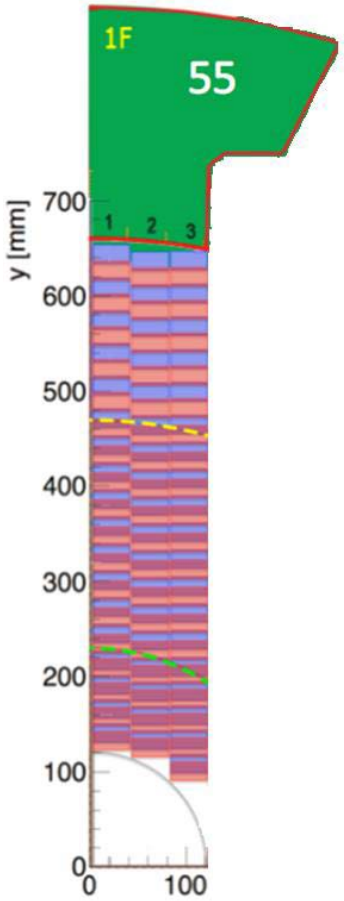


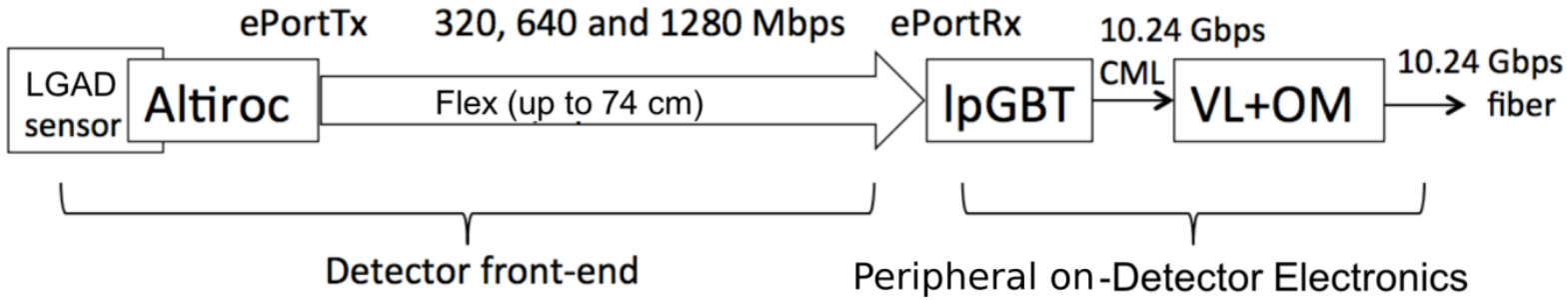
Side view

PEB thickness: 1.6mm

PEB

- Emulate the function of flex, optical module and DC/DCs





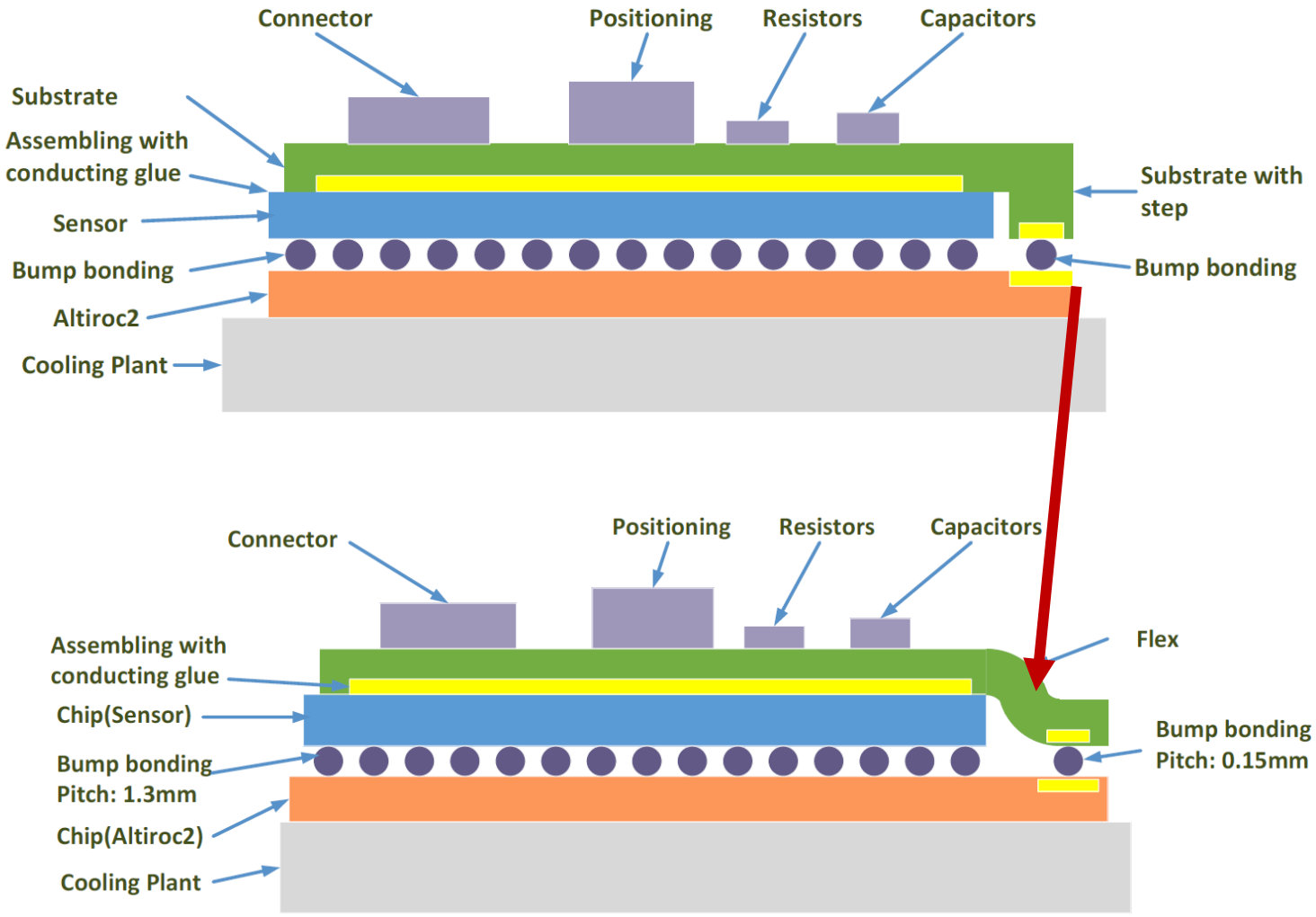
Kintex-7 FPGA: act as lpGBT
- SFP+ : act as VL+OM
- TPS56428RHLR: act as bpol12V
- High density connectors
- LV/HV connector

Plan

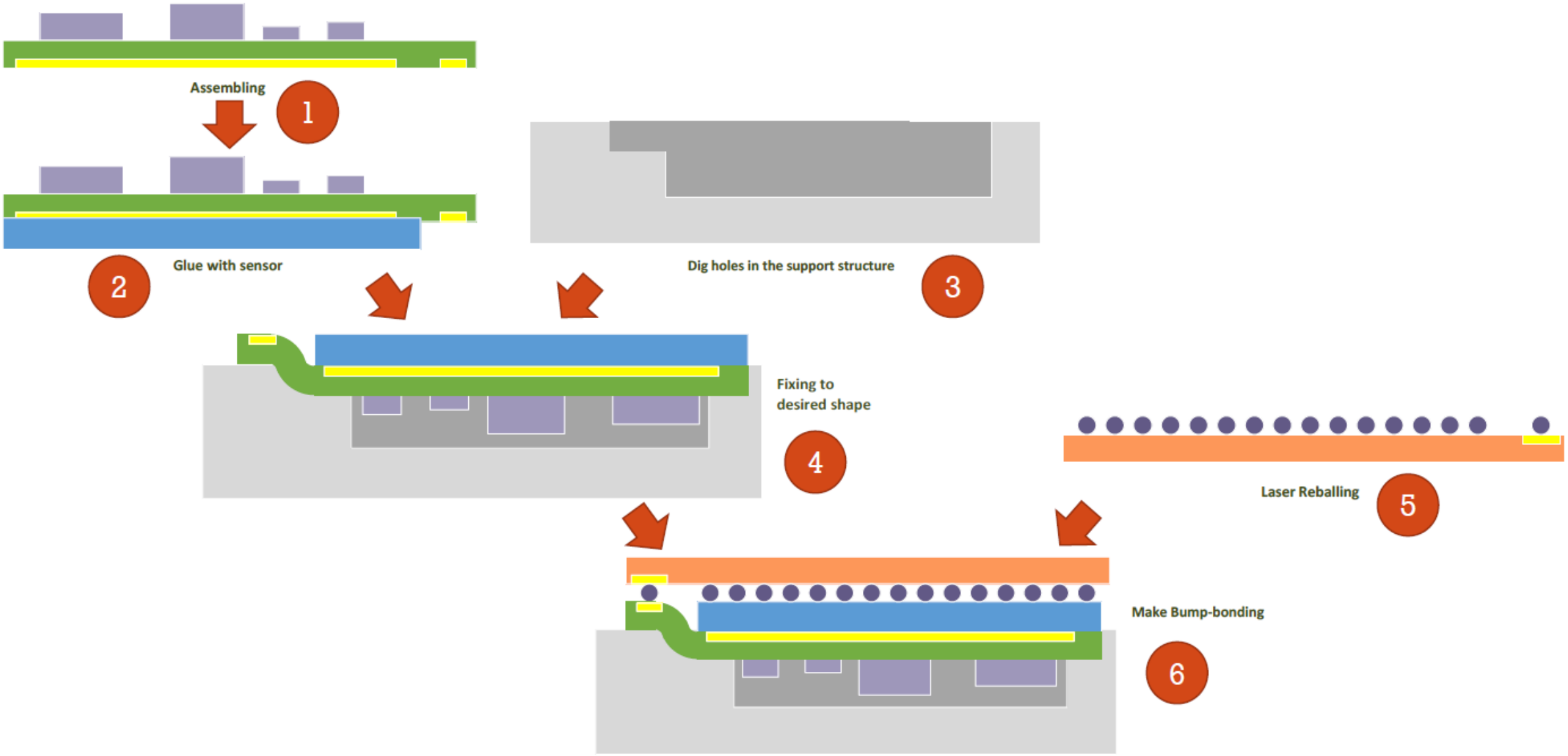

2019
Nov
Dec
2020
Feb
Mar
2020
Today
Module
Schematics and PCB design
Nov 19 - Dec 6
PCB Assembling and Test
Dec 6 - Jan 3
Flex
Schematics and PCB design
Nov 26 - Dec 13
PCB Assembling and Test
Dec 13 - Jan 23
PEB
Schematics and PCB design
Dec 3 - Dec 31
PCB Assembling and Test
Dec 31 - Feb 11
FPGA firmware
Dec 3 - Feb 24
Integration Test
Mechanical assembly
Mar 1
Temperature Cycle Test
Mar 2 - Mar 20

Bump bonding between carrier board and chips

- Use bump-bonding to replace all of wire-bonding
- Use flex PCB to match the height difference (about 300um), which is better than carrier board with a small step

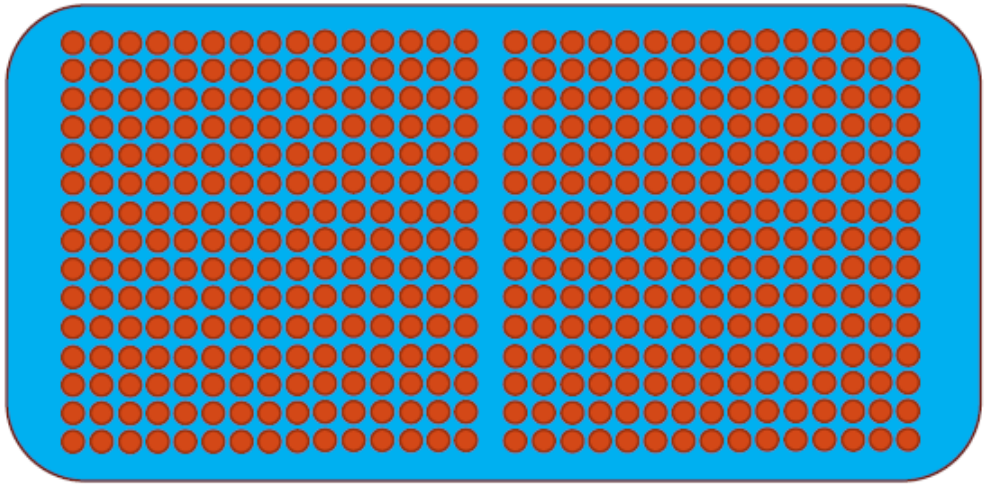


Bump bonding between carrier board and chips

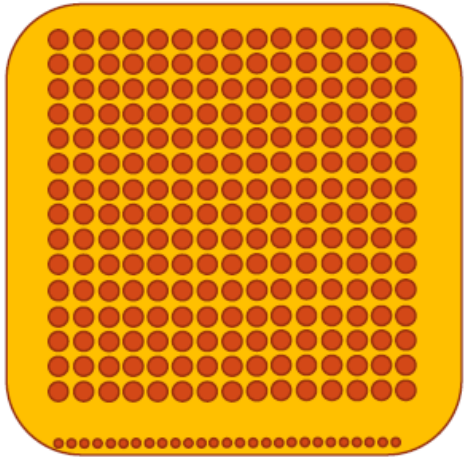


Proposal for dummy emulator

- We are not likely to get the key chips, Altiroc2, by the middle of next year
- Use 0.35um process to get dummy chips to verify the all bump-bonding scheme
  - Dummy sensor
    - 4cm x2cm with 30 x 15 balls (1.3 mm pitch)
  - Dummy ASIC
    - 2cm x 2cm with 15 x 15 balls (1.3 mm pitch) and 130 x 1 balls (0.15mm pitch)
  - Include connectivity test circuit



Dummy sensor



Dummy chip

Thanks