# Electronic service group

Active for over twenty-five years, the group is composed by three engineers and two technicians
- Design of microelectronic devices
- Design of PCB – Multilayer, Rigid Flexible and Flexible
- Assembly of prototypes – test and rework

ASIC Design

- *From signal amplifiers for detectors to digital signal processing systems*

- *Workstation: HP Z840 – CPU:72 threads - RAM: 512 GB*

- *CADs:*
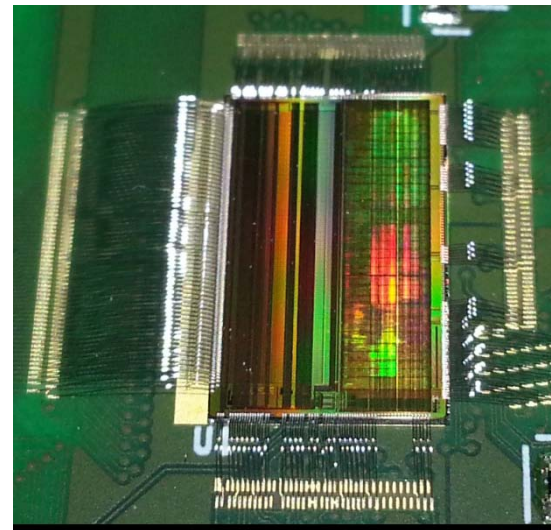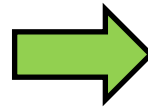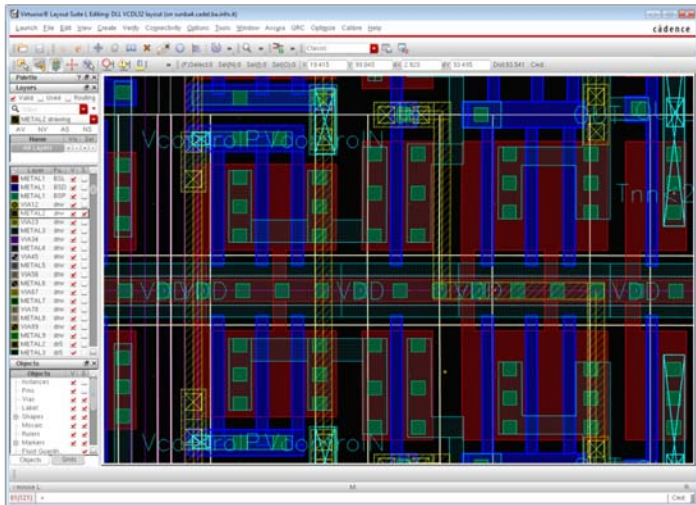
25 years of ASICs

Year	Technology	Project
1993	ES2 - 1 um	ASTROS: Digital processor for ALEPH
1994	ES2 - 0.7 um	PCI⇔FutureBus+ Bridge for KLOE computer farm
1997	MAXIM	RPC-FE: First prototype of Front End electronics for CMS RPC
1998	AMS – 0.8 um BiCMOS	SORTER: Trigger processor for CMS muon trigger
1999	AMS – 0.35 um BiCMOS	RPC-FE: Front End electronics for CMS RPC
2006	AMS – 0.35 um	RPC-MINI: Front End electronics for small pitch RPC detectors
2010	IBM - 130 nm	TOPEM: Fast Front End electronics for SiPM detectors on PET-TOF applications
2010	IBM - 130 nm	STRURED: Digital redundancy implementation for Rad-Hard environment application

25 years of ASICs – Part 2

| Year	Technology	Project
2012	AMS – 0.35 um BiCMOS	CHIPSODIA: Front End electronics for Si-Diamond integration
2012	AMS - 0.35 um	GASTONE64: Front End electronics for KLOE2 GEM tracker
2015	TSMC - 130 nm	VFAT3: Front End electronics for CMS GEM chambers
2016	TSMC - 65 nm	CHIPIX65: INFN Pixels demonstrator in 65 nm
2016	TSMC - 130 nm	FATIC: Front End electronics for FTM/uRwell detector with ADC and TDC
2017	AMS - 0.35 um BiCMOS	CTA: SiPM Front End electronics for CTA experiment
2017	TSMC - 65 nm	RD53A: Demostrator of Si Pixel detector ReadOut Chip for CMS/ATLAS
2018/19	TSMC - 65 nm	ATLAS/CMS Pixel electronics for HL-LHC (RD53 collaboration)

PCB design history
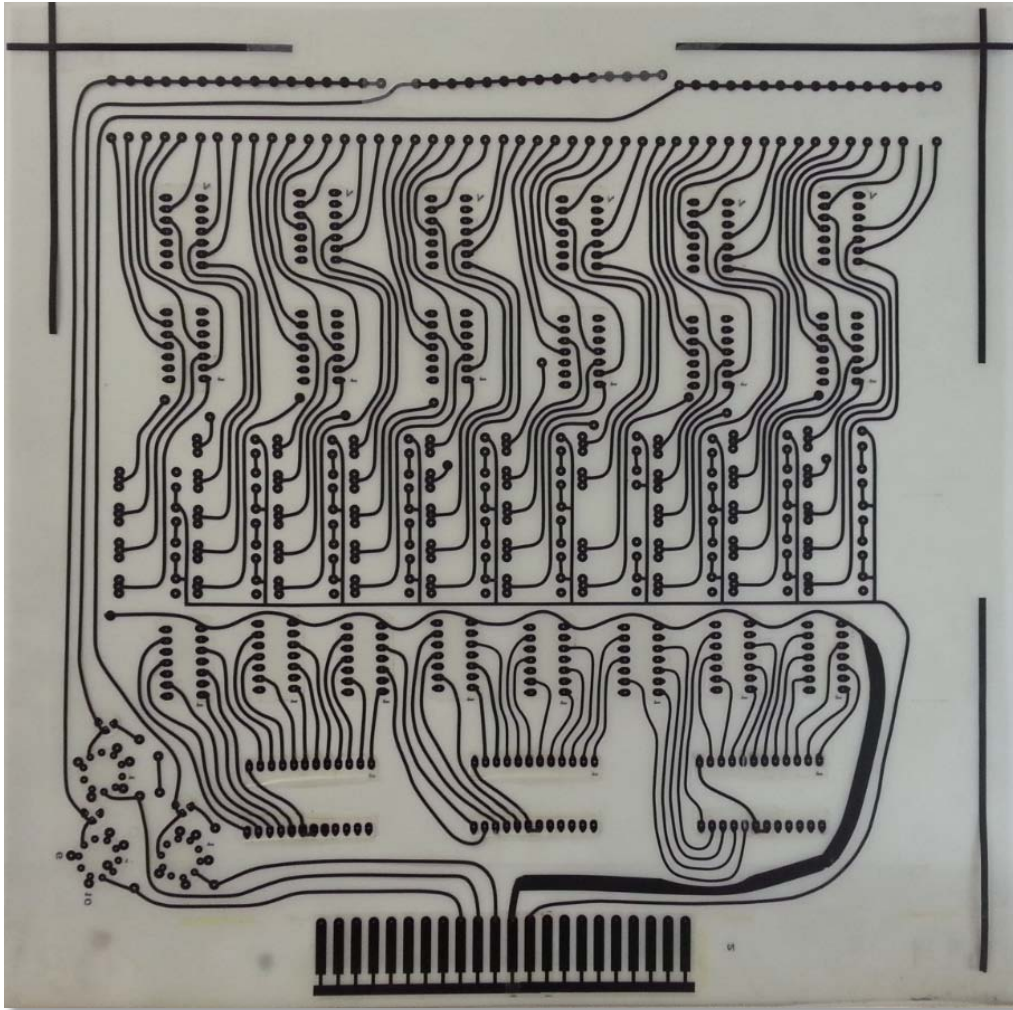
1980 - PCB design made with adhesive tape and pressure-sensitive adhesive backing

Boards design now

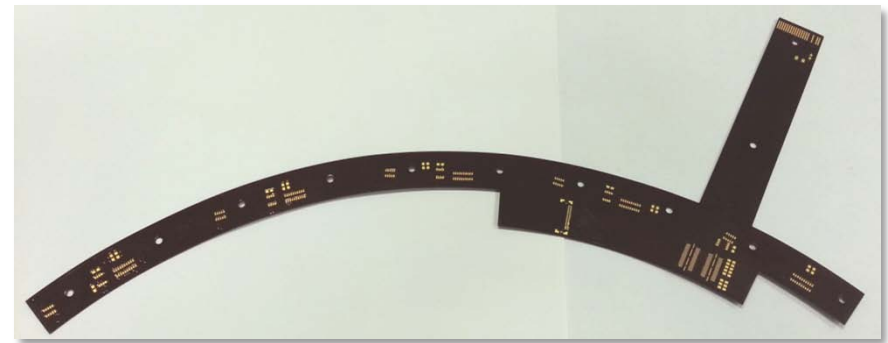- Multilayer printed circuits using blind and buried vias.
- SMT, BGA, Fine Pitch components.
- Crosstalk and Signal Integrity simulation.
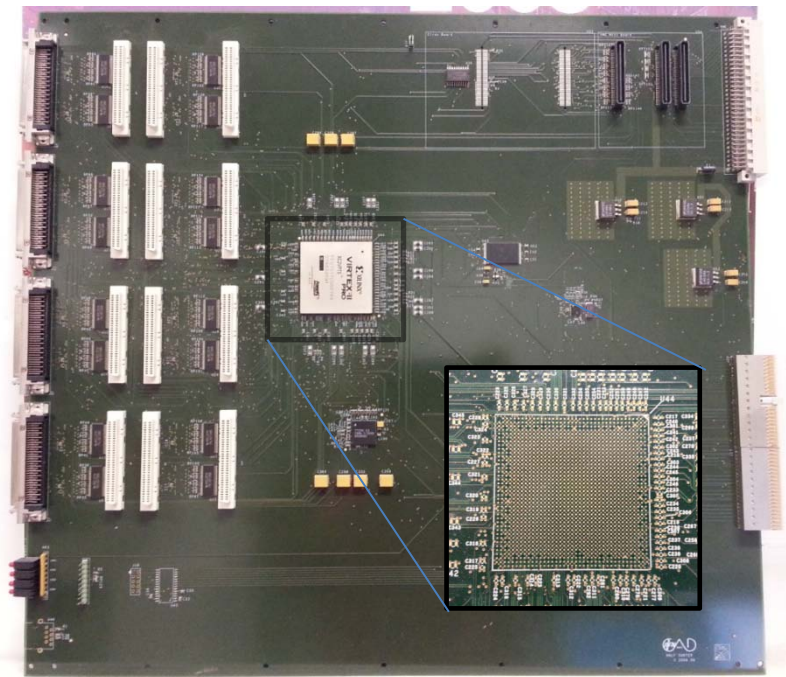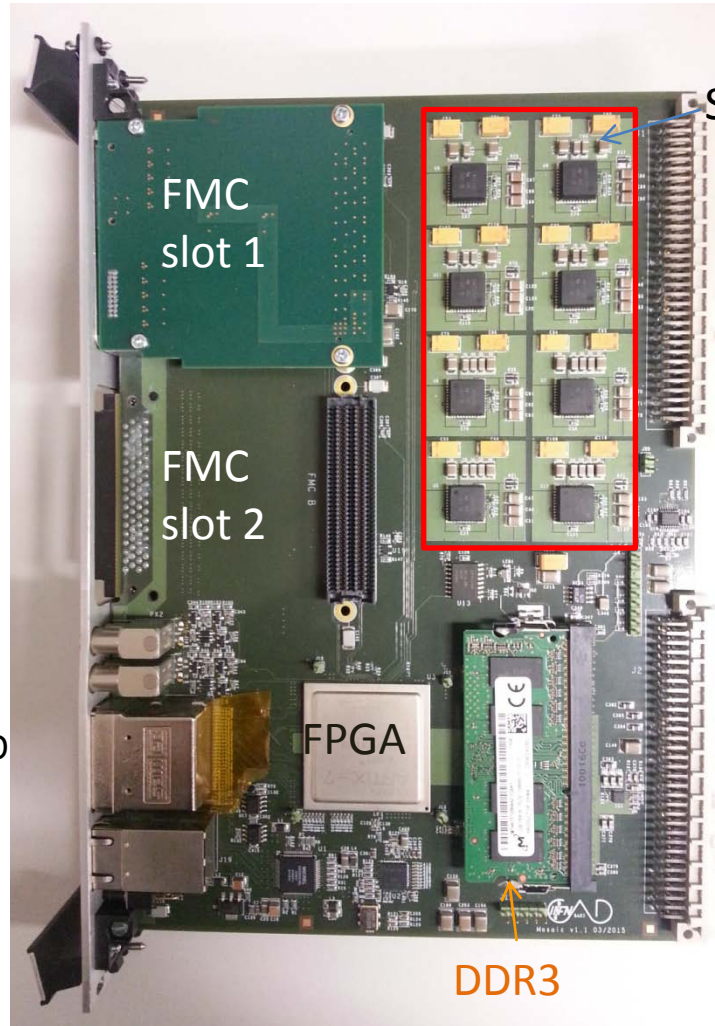

MOSAIC (2015)

9U - CMS Sorter board (2006)
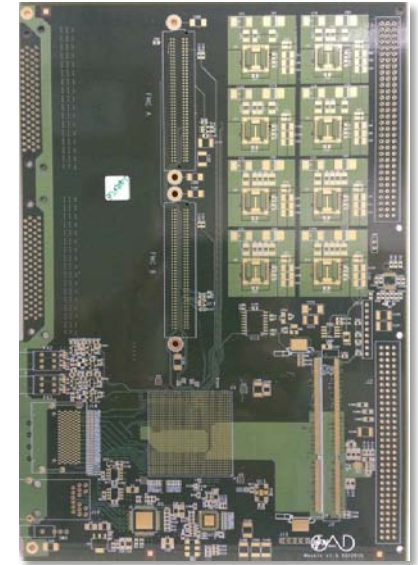
5 layer Kapton-Cu PCB for CMS Inner silicon tracker (2004)
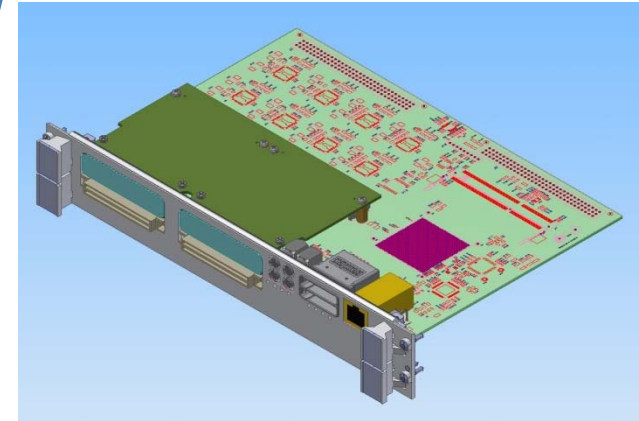
MOSAIC Board

General purpose LVDS I/O

General purpose LVDS I/O

NIM I/O

HI Speed I/O

Gigabit Ethernet

FMC slot 1

FMC slot 2

FPGA

DDR3

Switching voltage regulators

Backplane connectors

PCB Stackup

Subclass Name	Type		Material		Thickness (MM)	Con
	SURFACE		AIR			
	DIELECTRIC	▼	CONFORMAL_COAT	▼	0.02	
TOP	CONDUCTOR	▼	COPPER	▼	0.037	
	DIELECTRIC	▼	FR-4	▼	0.065	
02_GND1	PLANE	▼	COPPER	▼	0.0175	
	DIELECTRIC	▼	FR-4	▼	0.075	
03_SIG1	CONDUCTOR	▼	COPPER	▼	0.0175	
	DIELECTRIC	▼	FR-4	▼	0.105	
04_GND2	PLANE	▼	COPPER	▼	0.0175	
	DIELECTRIC	▼	FR-4	▼	0.075	
05_SIG2	CONDUCTOR	▼	COPPER	▼	0.0175	
	DIELECTRIC	▼	FR-4	▼	0.105	
06_GND4	PLANE	▼	COPPER	▼	0.035	
	DIELECTRIC	▼	FR-4	▼	0.075	
07_PWR1	PLANE	▼	COPPER	▼	0.035	
	DIELECTRIC	▼	FR-4	▼	0.21	
08_PWR2	PLANE	▼	COPPER	▼	0.035	
	DIELECTRIC	▼	FR-4	▼	0.075	
09_GND5	PLANE	▼	COPPER	▼	0.035	
	DIELECTRIC	▼	FR-4	▼	0.105	
10_SIG4	CONDUCTOR	▼	COPPER	▼	0.0175	
	DIELECTRIC	▼	FR-4	▼	0.075	
11_GND6	PLANE	▼	COPPER	▼	0.0175	
	DIELECTRIC	▼	FR-4	▼	0.105	
12_SIG5	CONDUCTOR	▼	COPPER	▼	0.0175	
	DIELECTRIC	▼	FR-4	▼	0.075	
13_GND7	PLANE	▼	COPPER	▼	0.0175	
	DIELECTRIC	▼	FR-4	▼	0.065	
BOTTOM	CONDUCTOR	▼	COPPER	▼	0.037	
	DIELECTRIC	▼	CONFORMAL_COAT	▼	0.02	
	SURFACE		AIR			

| Total Thickness:	Layer Type	Material	Field to Set	Value to Set
1.604 MM	ALL	ALL	Thickness	

OK   Apply   Cancel   Refresh Materials ->

- 6 Routing Layers
- 6 Ground planes
- 2 Power planes
- **Total 14 Layer 1.6 mm**

- Signal Integrity driven routing (Impedance – Spacing)
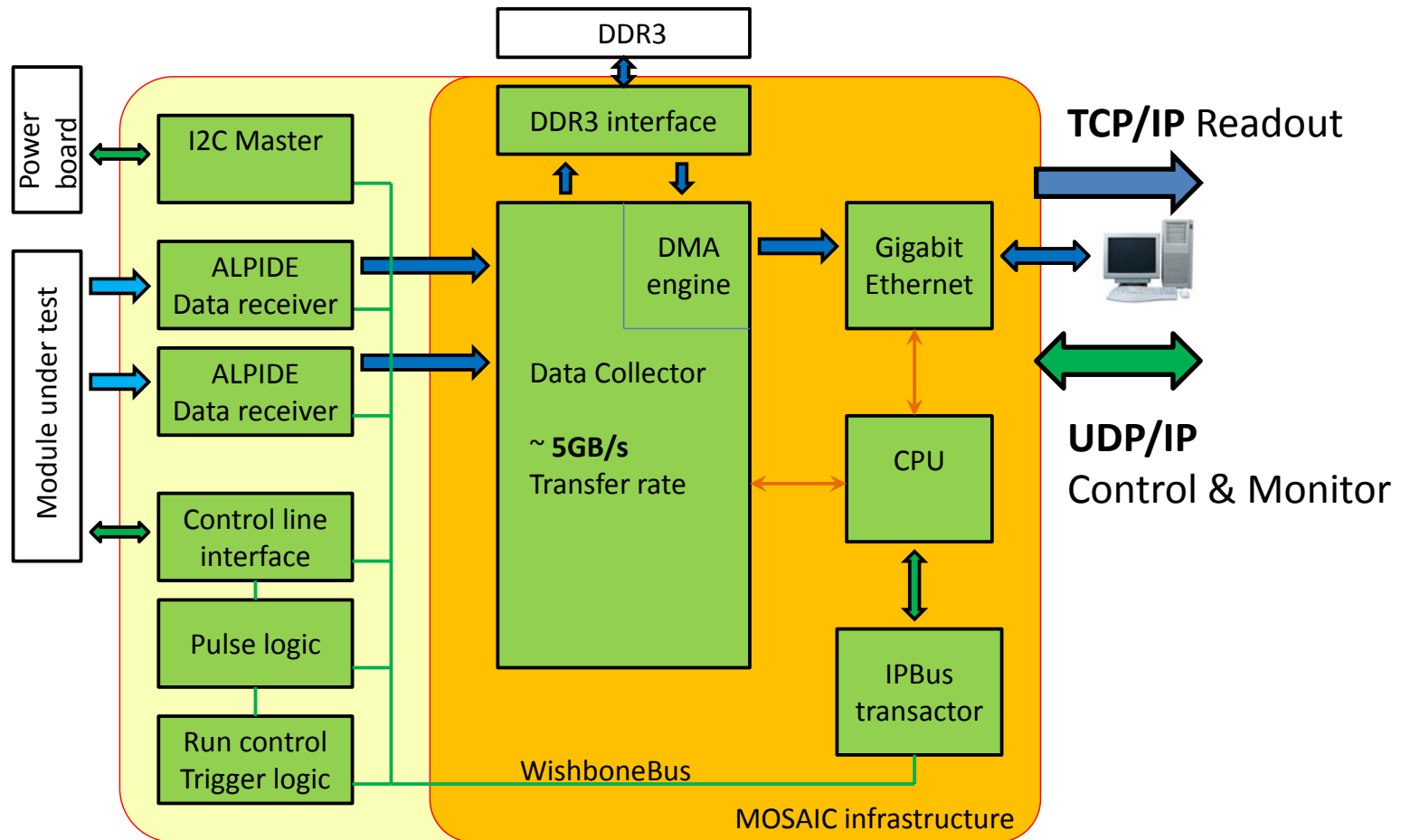
Delay matching

All DDR3 and FMC traces are tuned to meet the time matching constraints

- Data Lane mismatch < 10ps
- Address & Control mismatch < 25ps
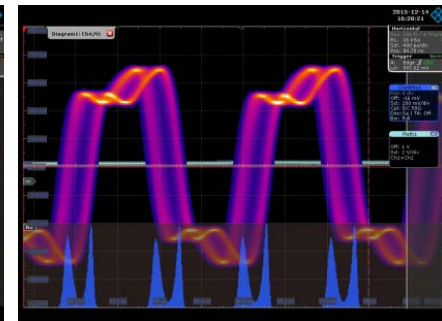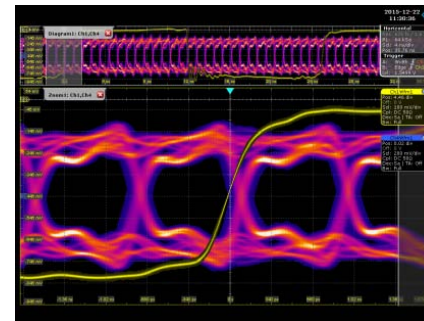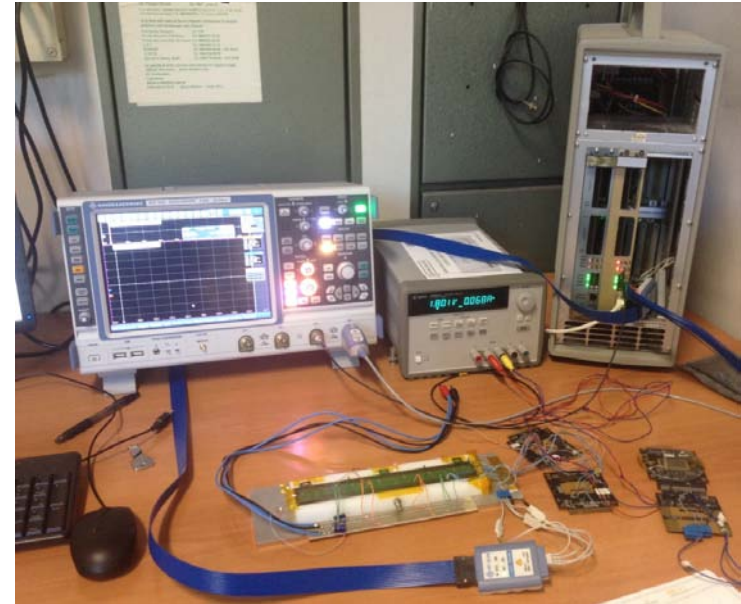- Board Simulation using IBIS models
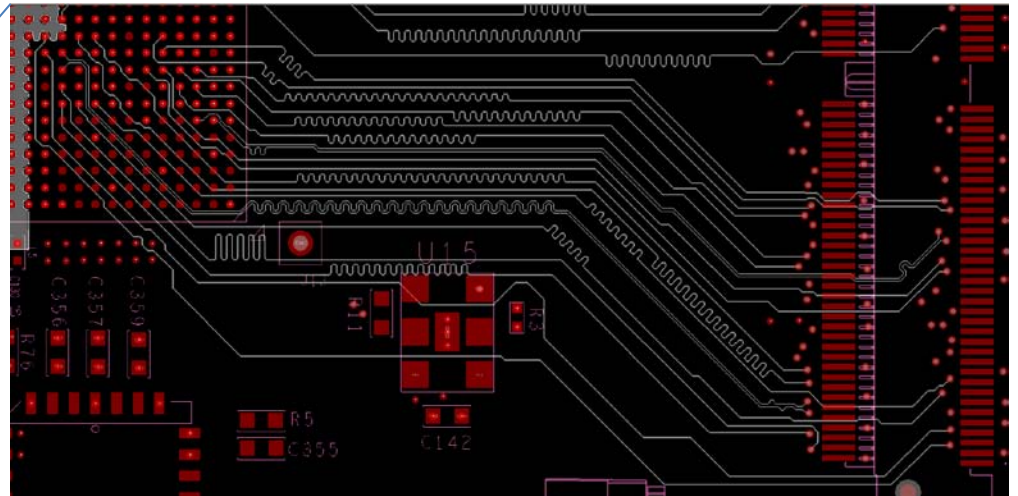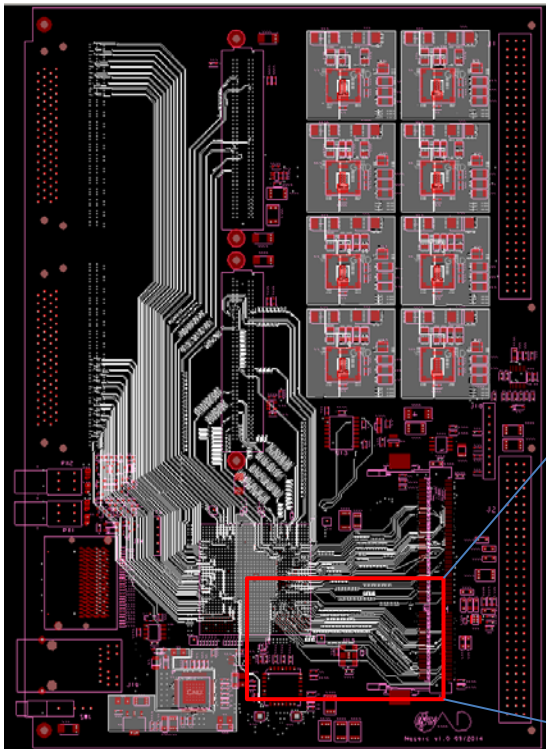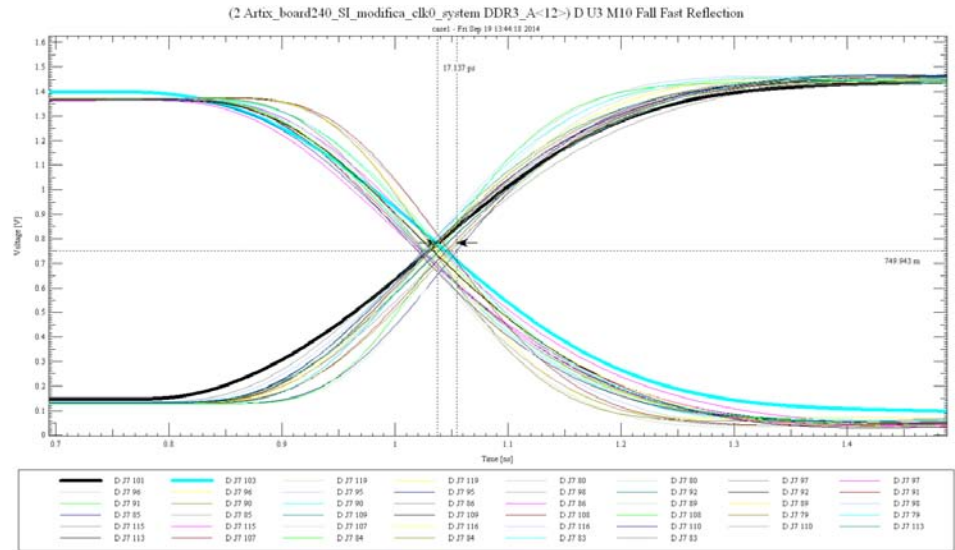
Firmware block diagram – ALPIDE TB

Electronic workshop

Cutting-edge equipment:

- Oscilloscope up to 4 GHz - 20 GS/s

- Logic state analyzer: 2 GHz 272 canali

- Arbitrary waveform generator

- Pulse generator with rising edge < 1 ns

- Semiconductor device analyzer

SMT – BGA rework

SMT- BGA rework machine and prototypes assembly

Xray PCB inspection system

NIKON - XT V 160

- Focal spot size 1um
- Defect recognition capability 500nm
- System magnification up to 36000
- Manipulator 5-axis