ALCOR status

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Updates

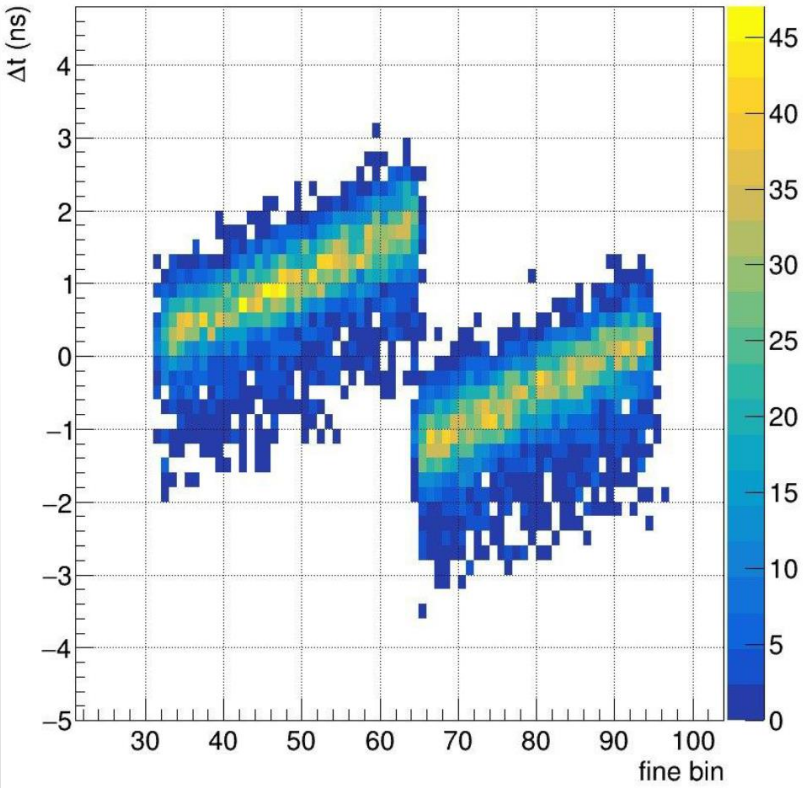
- TDC clock ambiguity
- TOT orphans and data coupling
- 400 MHz operation
- 64 channels packaging

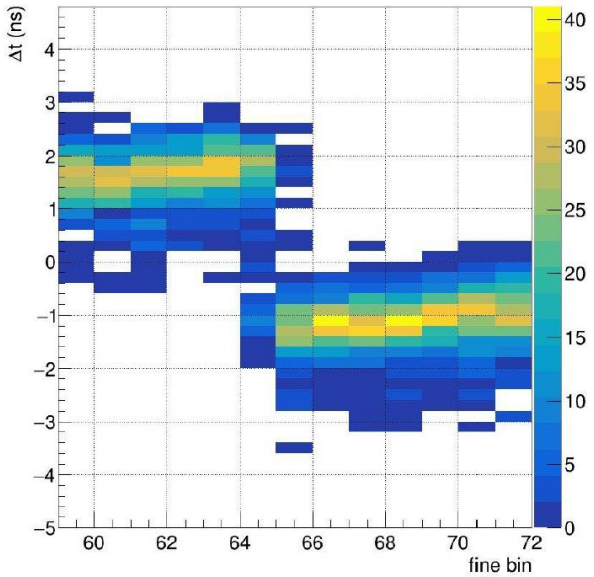
TDC clock ambiguity

ALCOR fine TDC measurement

observed ambiguity in ALCOR fine TDC measurement for same TDC bin (two peak structures)

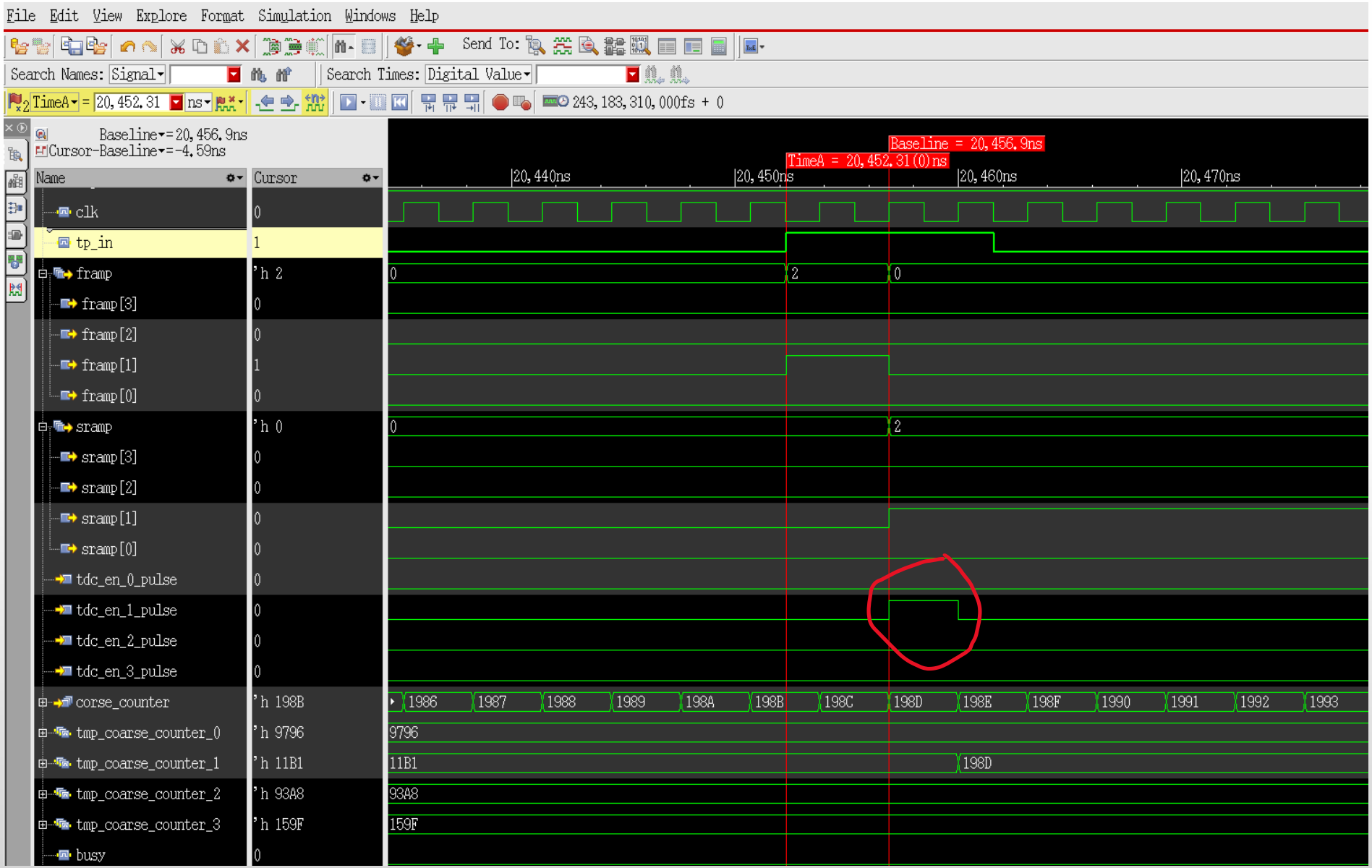
there are worse cases than this, need to look into this together and replicated in lab



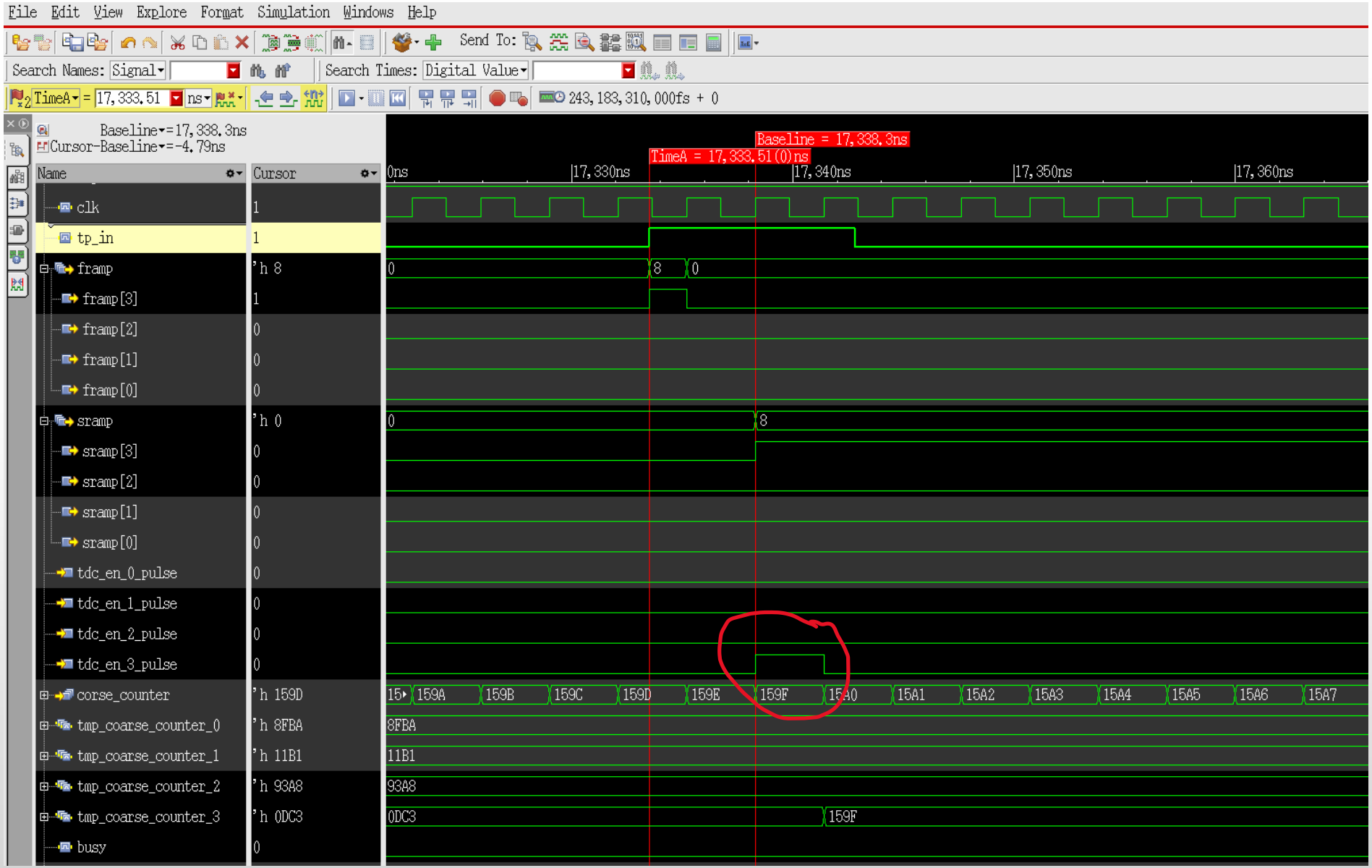


Roberto's slides

TDC clock ambiguity



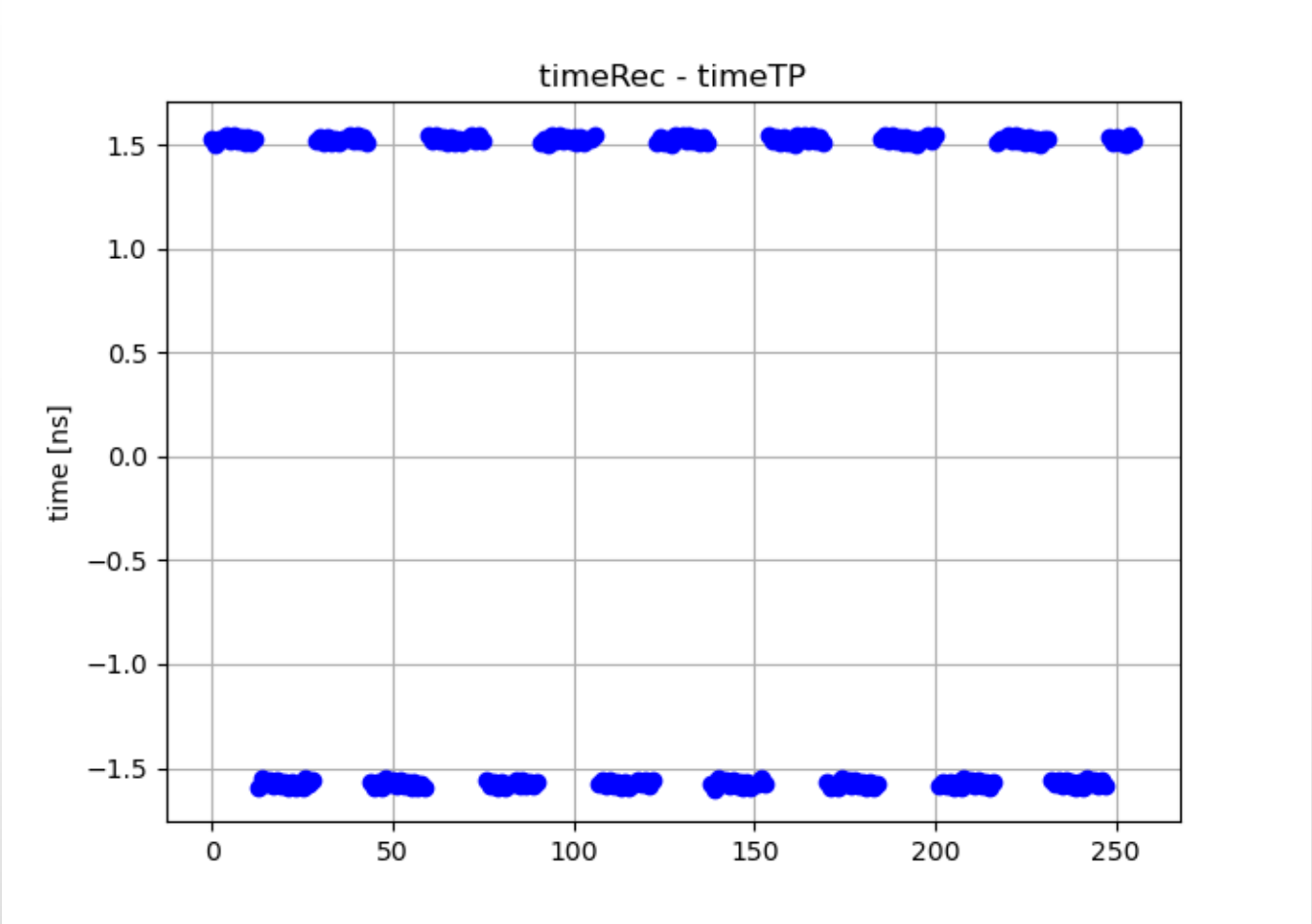
TDC clock ambiguity



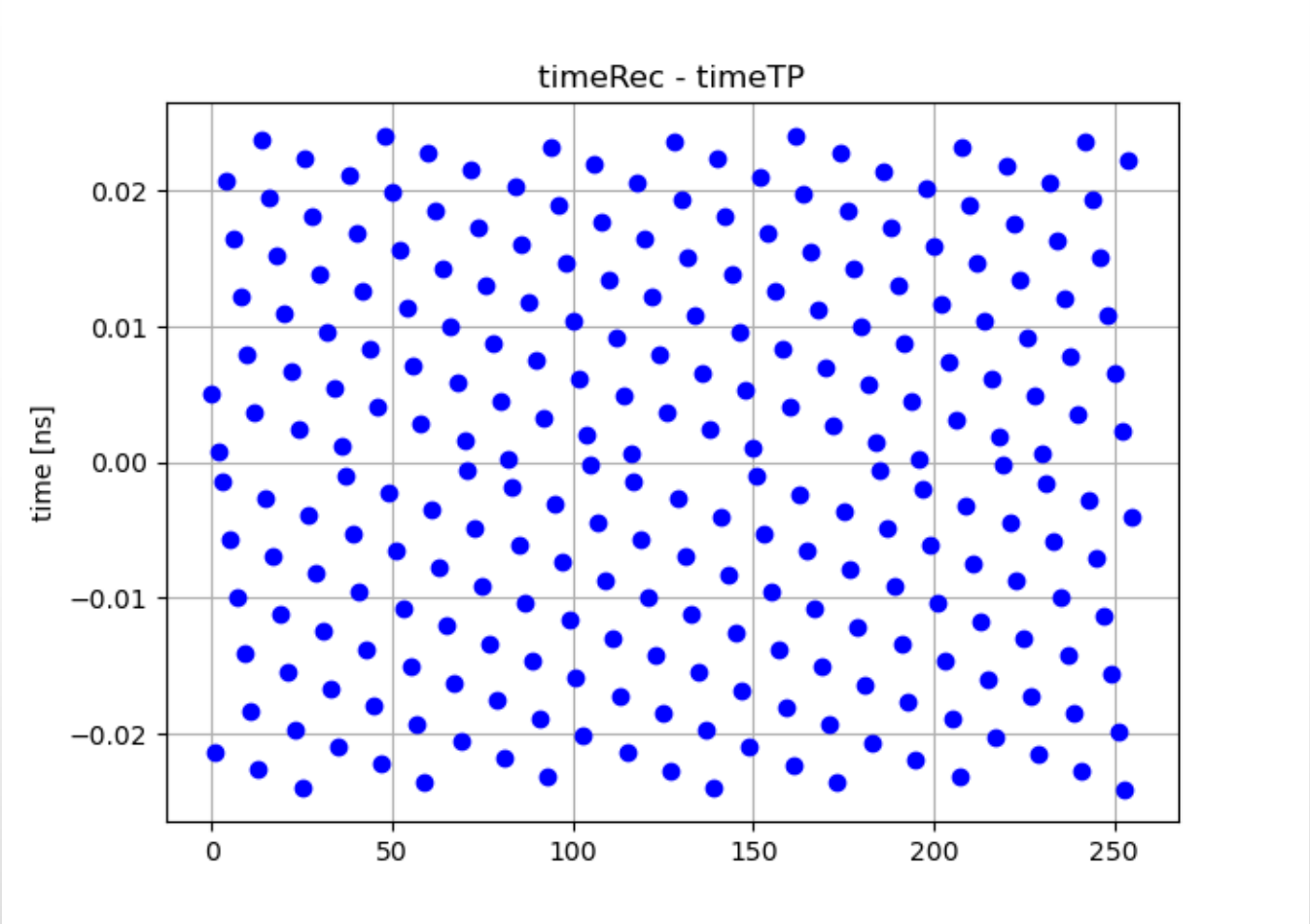
TDC clock ambiguity: solution

- The Coarse Counter is latched on the fast ramp signal
- Fast ramp signal: rising edge asynchronous – falling edge synchronous
- Source code digitally simulated with a scan of Test Pulse phase
- Reconstructed time after simulations is now correct

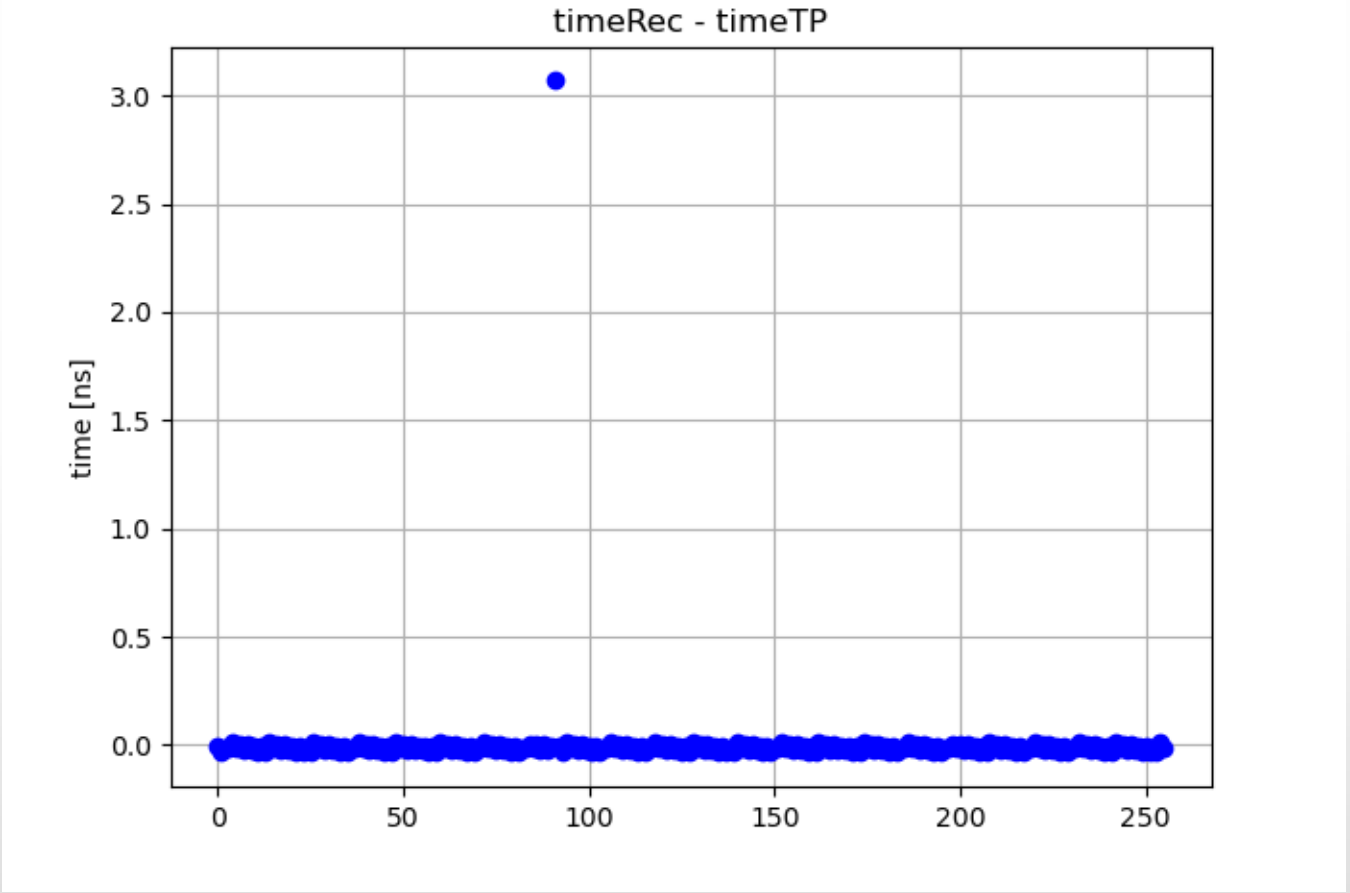
Alcor V2



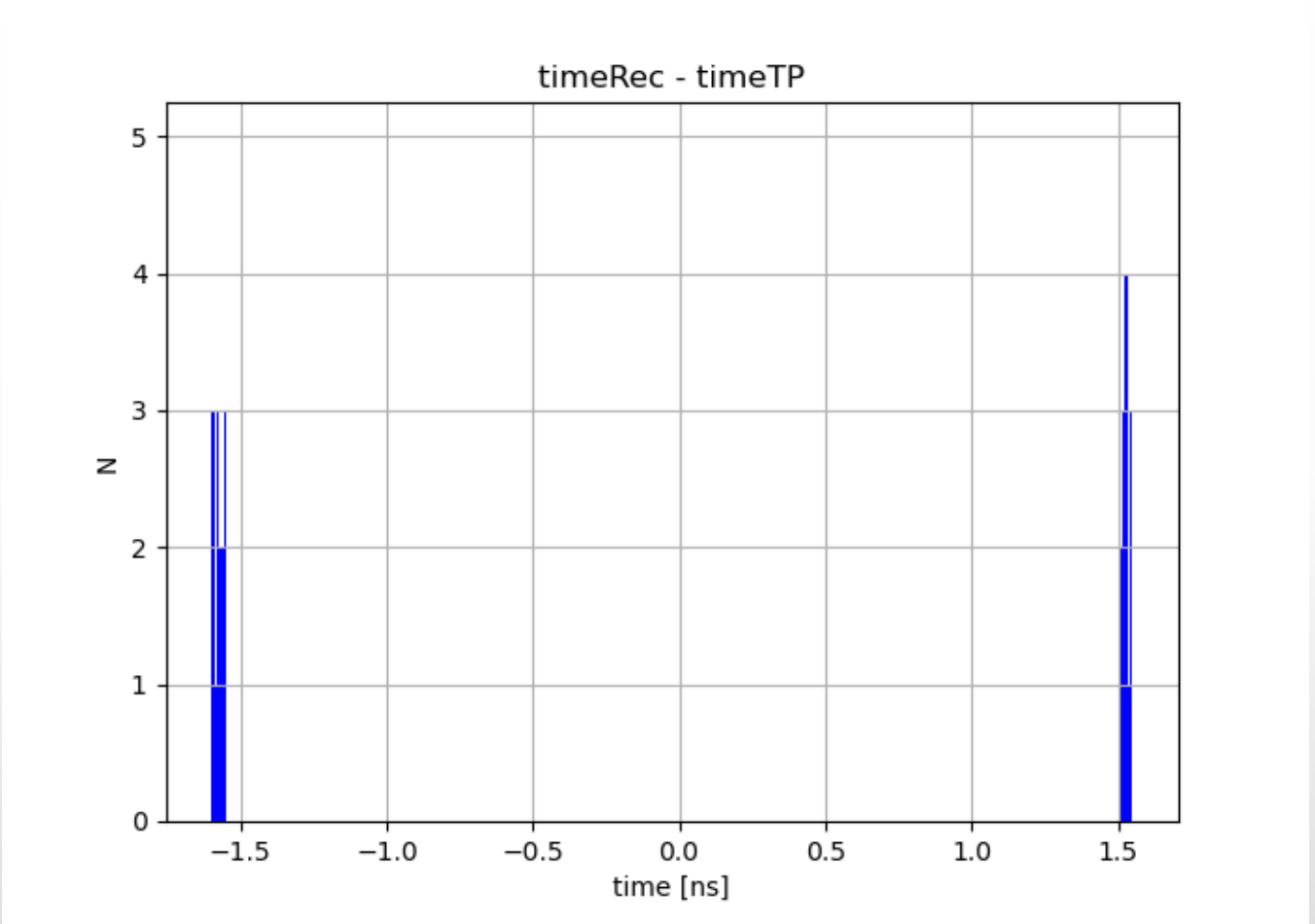
Alcor V3



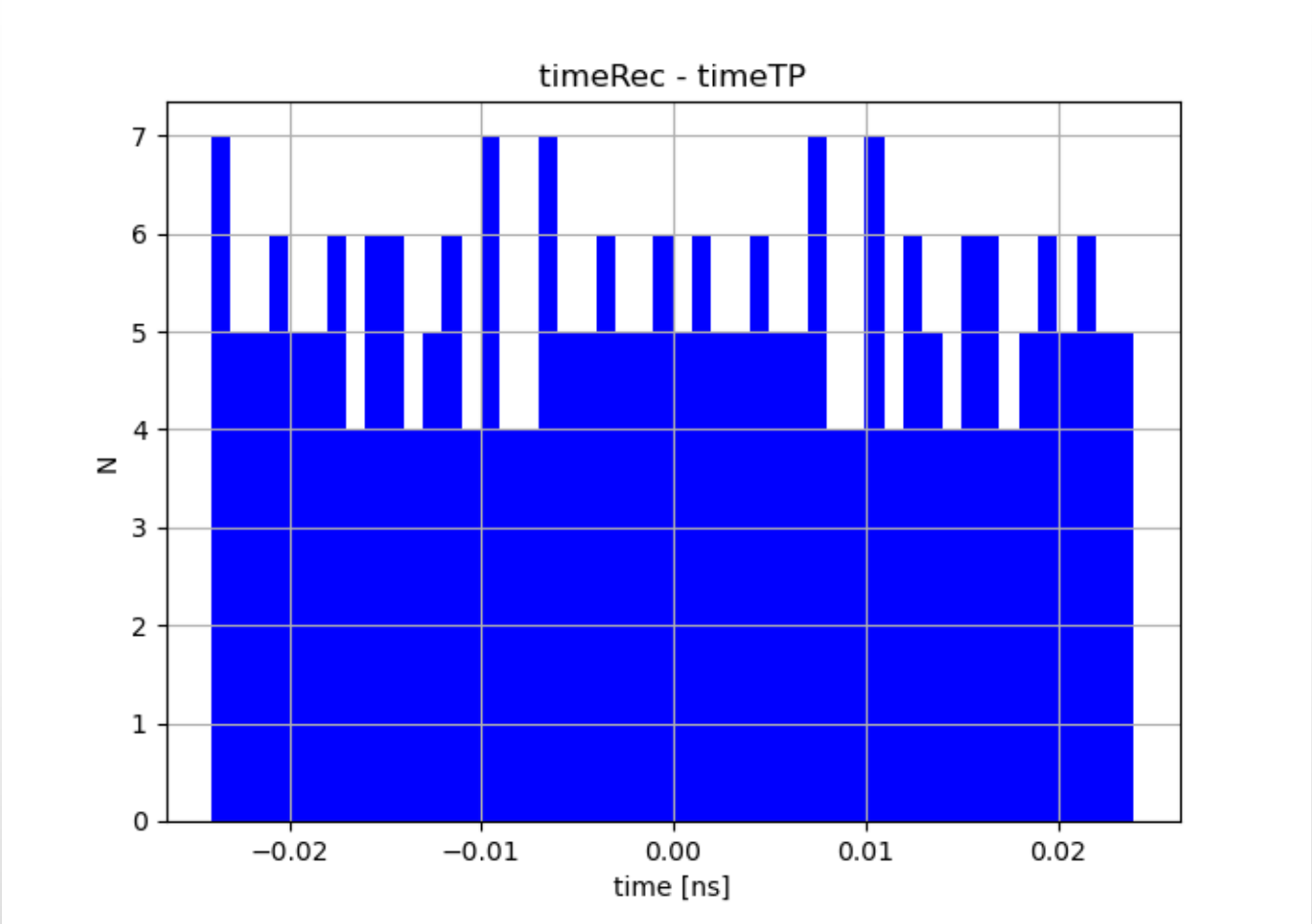
Alcor V2



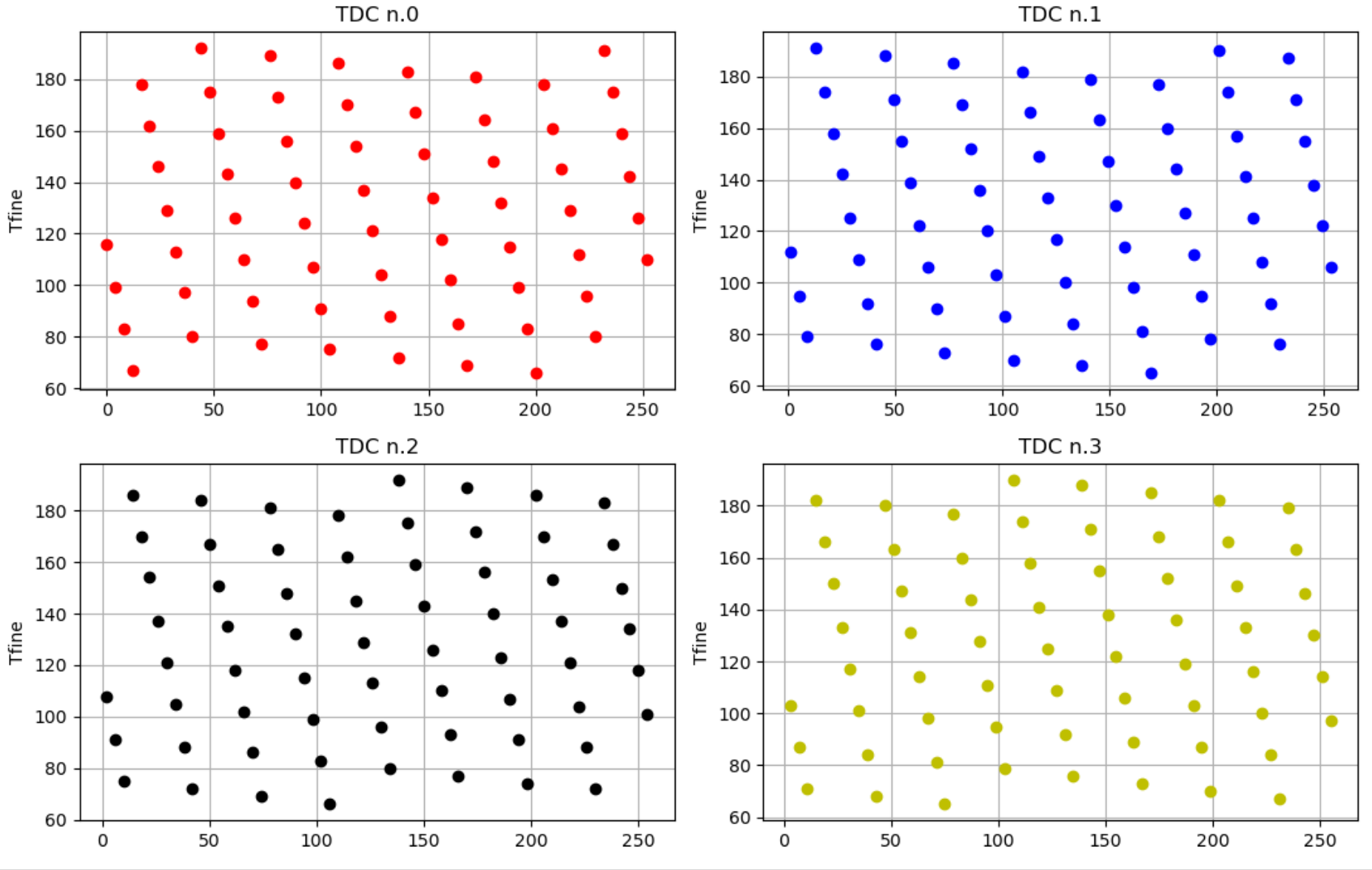
Alcor V2



Alcor V3



Alcor V3


TDC n.0
TDC n.1
TDC n.2
TDC n.3
Tfine
60
80
100
120
140
160
180
0
50
100
150
200
250

Works in progress: 400 MHz

- New firmware with clock frequency 390 MHz: done
- Data transmission at 390 MHz x2 (DDR mode) seems to be correct
- CRC checks: ongoing
- TDC behaviour: some effects to understand in few pixels/TDC
- In any case a new implementation of the serializers is required to have a clean STA

Works in progress: TOT

- TOT «Orphans effect» reproduced in simulation
  - Due to a bad implementation of the Fake Trigger function
  - Always occurs with the Coarse Counter rollover
  - Always on TDC1 and TDC3 (TOT falling edge)
  - Works in progress to change this part of the code
- TOT mixed events (rising and falling edge are not consecutive in data stream)
  - A different readout mechanism should be implemented for the TOT readout

Packaging: Europractice

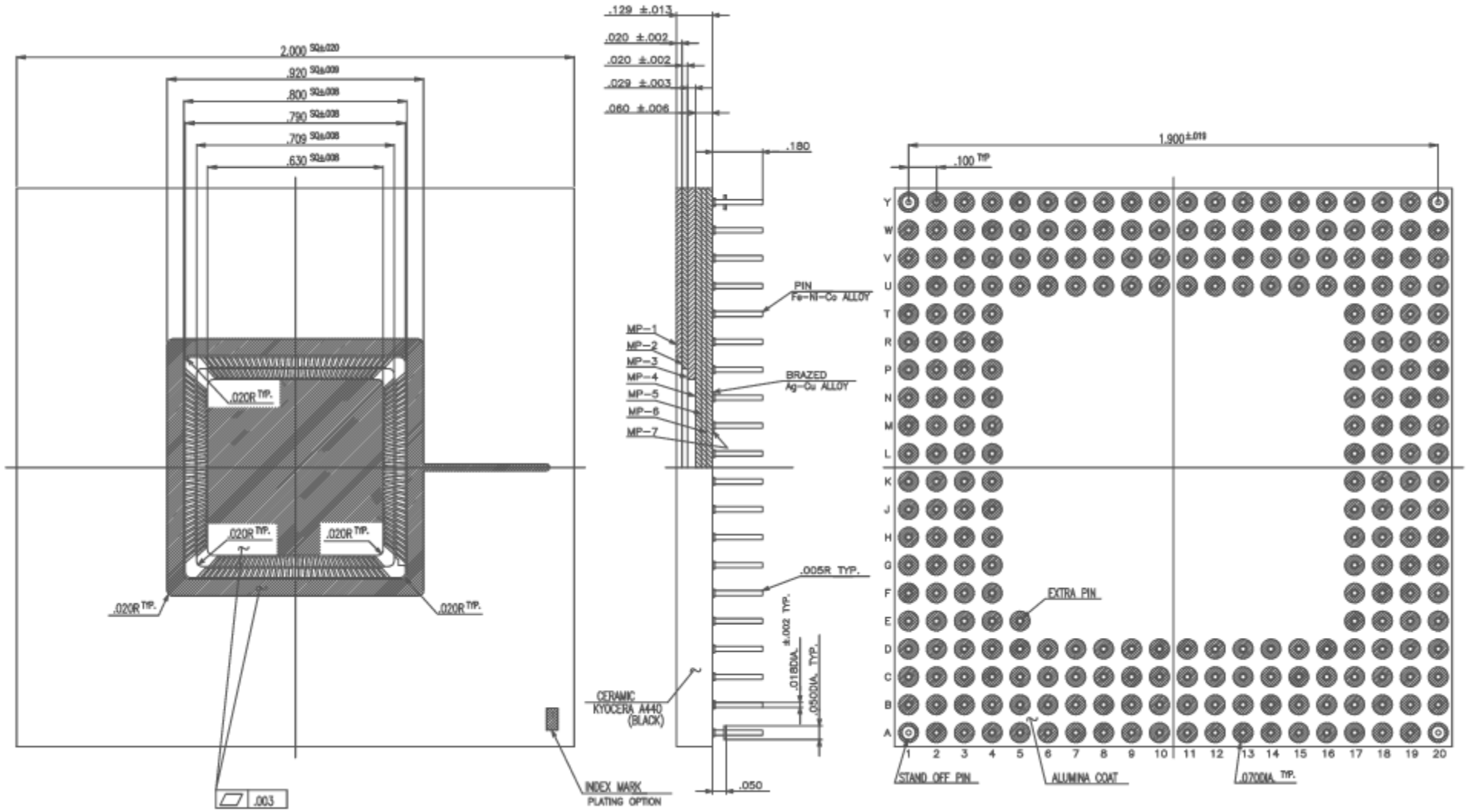
- Europractice service does not provide BGA packaging
- Standard packaging is cheap but not suitable for a good implementation of the 64 channels ASIC
- BGA packaging could be done through Europractice as Customized Packaging with one of their partner or outside the Europractice IC Service

https://europractice-ic.com/services/packaging/asic-packaging/

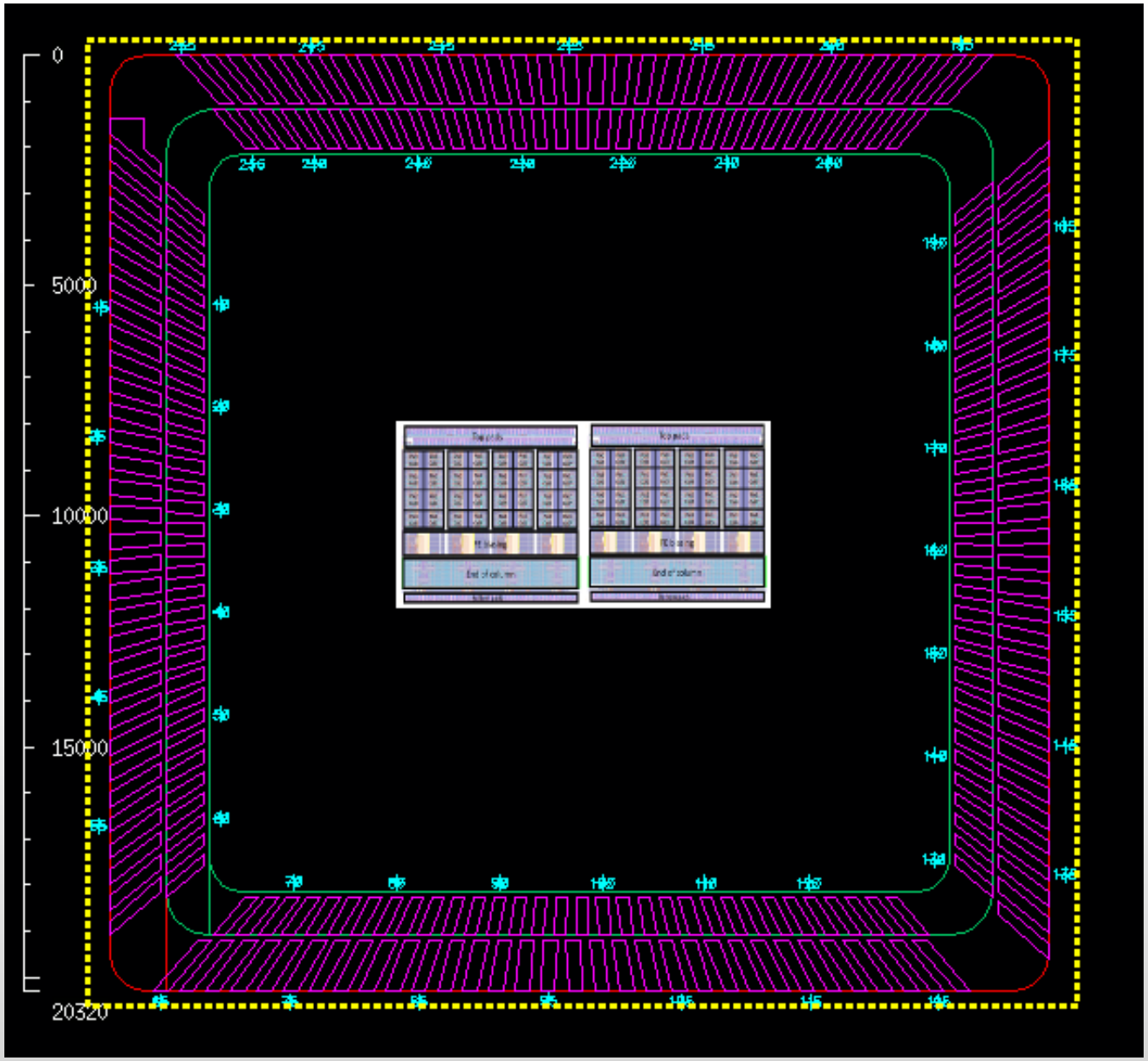
Packaging examples

- ALCOR V2: 126 pads (32 channels)
- From the Europractice list (but maybe there are others on request…)
  - 256 pin: PBGA (Through Hole)
  - 208 pin: QFP

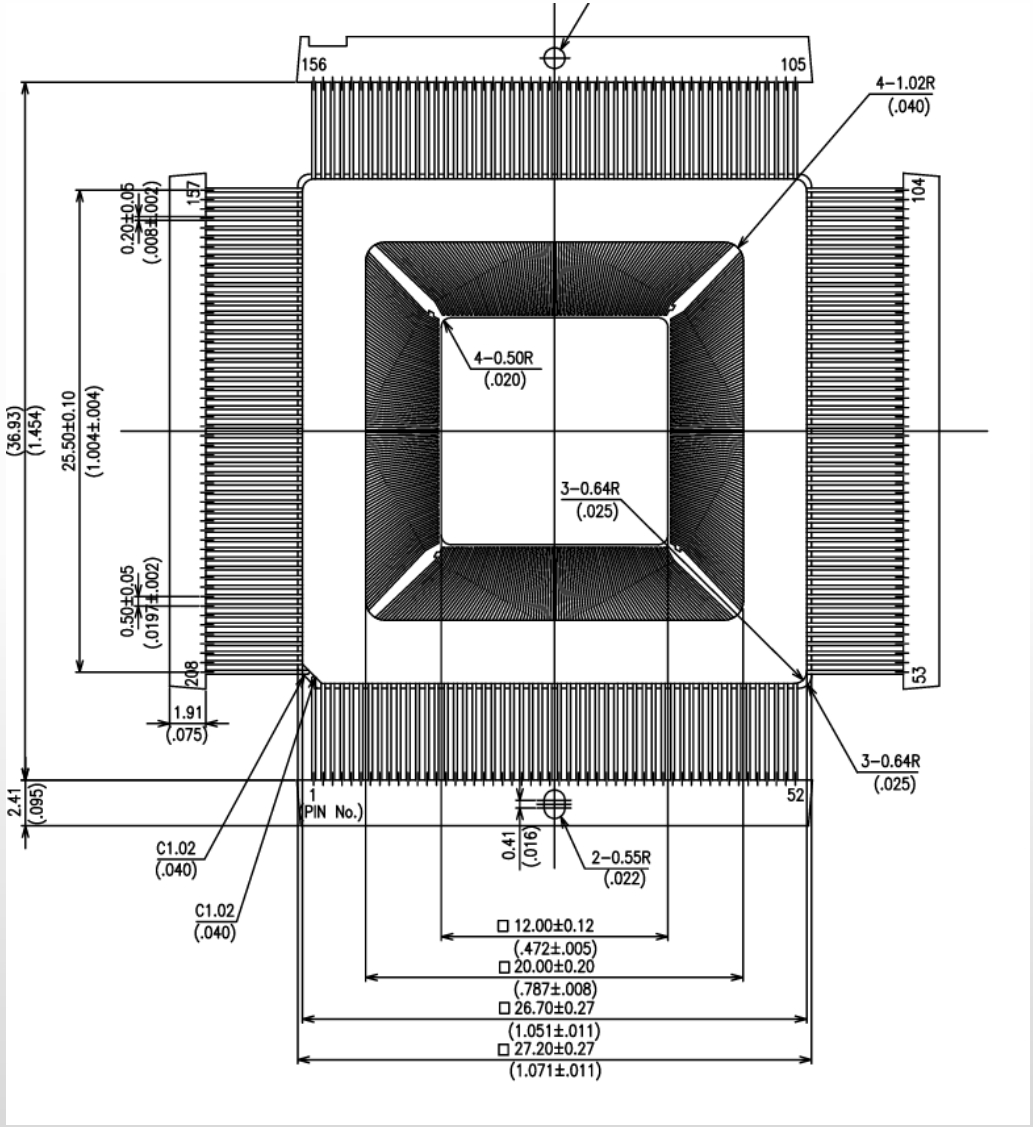
PBGA 256


2.000 SQ±.020
.920 SQ±.009
.800 SQ±.008
.790 SQ±.008
.709 SQ±.008
.630 SQ±.008
.020R TYP.
.003
.129 ±.013
.020 ±.002
.020 ±.002
.029 ±.003
.060 ±.006
.180
PIN
Fe-Ni-Co ALLOY
MP-1
MP-2
MP-3
MP-4
MP-5
MP-6
MP-7
BRAZED
Ag-Cu ALLOY
.005R TYP.
CERAMIC
KYOCERA A440
(BLACK)
.018DIA
±.002 TYP.
.050DIA TYP.
.050
INDEX MARK
PLATING OPTION
1.900 ±.018
.100 TYP
EXTRA PIN
STAND OFF PIN
ALUMINA COAT
.070DIA TYP.

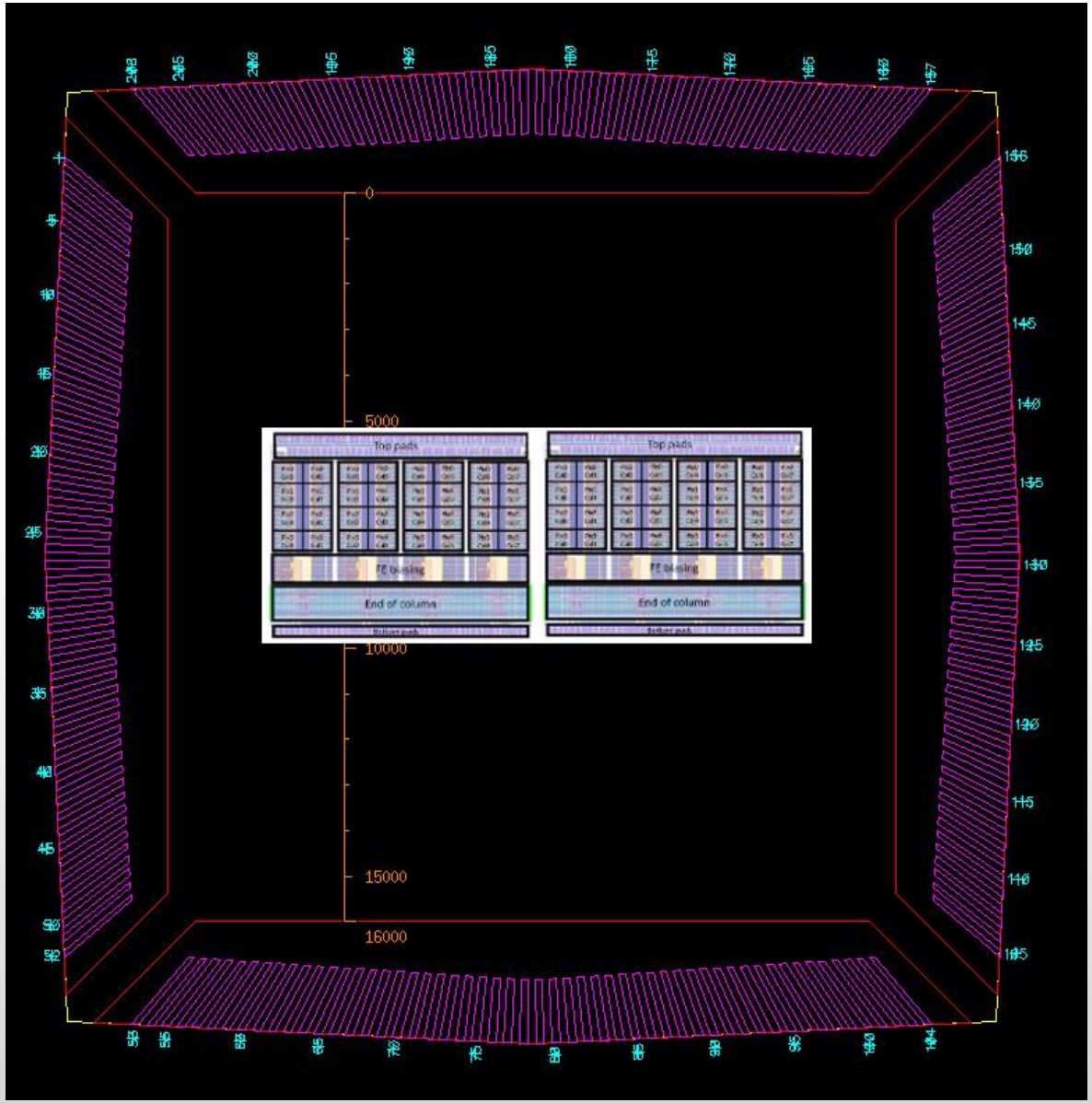
PBGA 256



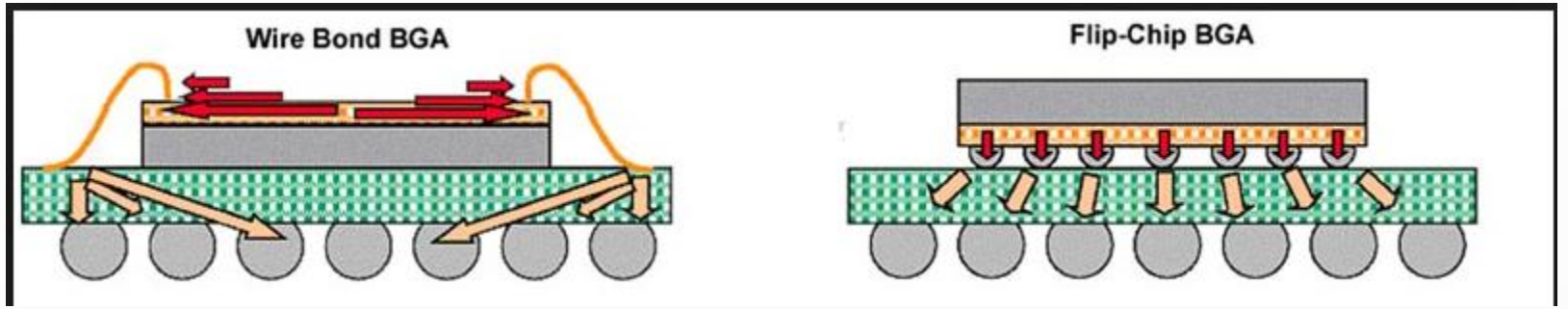
QFP 208


156
105
4–1.02R
(.040)
0.20±0.05
(.008±.002)
157
104
4–0.50R
(.020)
(36.93)
(1.454)
25.50±0.10
(1.004±.004)
3–0.64R
(.025)
0.50±0.05
(.0197±.002)
208
53
1.91
(.075)
3–0.64R
(.025)
2.41
(.095)
1
(PIN No.)
52
0.41
(.016)
2–0.55R
(.022)
C1.02
(.040)
C1.02
(.040)
□ 12.00±0.12
(.472±.005)
□ 20.00±0.20
(.787±.008)
□ 26.70±0.27
(1.051±.011)
□ 27.20±0.27
(1.071±.011)

QFP 208


0
5000
10000
15000
16000
Top pads
Top pads
End of column
End of column

Flip chip or wire bond to BGA



- BGA: Higher costs, best implementation
- A totally new layout for both solutions (BGA vs standard)

Packaging costs

PRICE STRUCTURE

All packages require a setup cost of **€440 per bonding diagram**.

The prices below are valid for all packages and bonding of designs with the following requirements:

- Pad pitch of min. 90 microns
- Wire bonding length up to 6mm. If wirebond length is more than 6mm, 30% additional charge applies based on unit price
- Passivation openings of 76µm x 76µm or larger. Additional charges apply for designs with passivation openings less than 76µm x 76µm:
  - passivation openings 61µm to 75µm: 325 EUR
  - passivation openings 51µm to 60µm: 470 EUR
  - passivation openings 40µm to 50µm: 585 EUR

Minimum package order depends on the EUROPRACTICE partner you work with.

- **Fraunhofer** and **imec**: minimum quantity is **10** packages per design.
- **CMP**: minimum quantity is **5** packages per design.

Fixed set-up cost for glass sealing for up to 30 pieces: 820 EUR.

Standard

BGA

Dear Giulio,

A BGA package is always to be considered as a customized package requiring a dedicated substrate with solder balls at the bottom and to which the die is flip-chipped or wire bonded to the top side.
A BGA involves the design and manufacturing of the substrate prior to the subsequent assembly steps.
For small quantities the design and NRE costs are the dominant ones.
As ballpark numbers:
Cost for designing a BGA substrate typically is in the 20K to 50K EUR range
NRE costs related to substrate manufacturing and assembly setup are in the 50K to 200K EUR range depending on size and complexity (number of layers, ball pitch, bump pitch, signal requirements)

I'll be happy to elaborate this further.