

# 10SPE

## Automotive PHY channel consideration - time domain simulation

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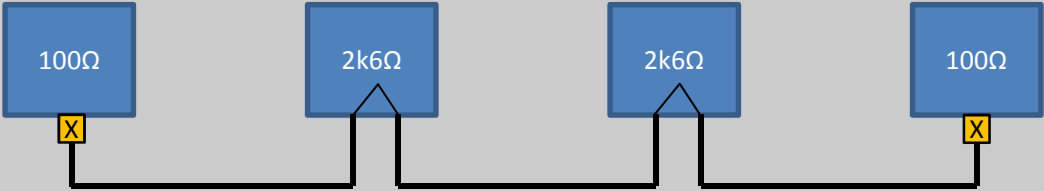
## Motivation

To show the gap between existing transceiver technologies and our ambitions for 10SPE@15m.

## Aspects:

- Choice of topologies (Based on Stefan Buntz presentation in the 10SPE adhoc on 29 March 2017)
- Transceiver technology:  
FlexRay (10MBit/s)

# General information: FlexRay

|                 | FlexRay                                                                                                                      |                                                                                                                             |
|-----------------|------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|
| Control mode    | Time triggered                                                                                                               |                                                                                                                             |
| Time response   | Deterministic                                                                                                                |                                                                                                                             |
| Bus access      | TDMA                                                                                                                         |                                                                                                                             |
| Error detection | CRC                                                                                                                          |                                                                                                                             |
| Bus level       | <u>Data 0:</u><br>$U_{\text{Bus\_p}} = 1.5\text{V}$<br>$U_{\text{Bus\_m}} = 3.5\text{V}$<br>$U_{\text{diff}} = -2.0\text{V}$ | <u>Data 1:</u><br>$U_{\text{Bus\_p}} = 3.5\text{V}$<br>$U_{\text{Bus\_m}} = 1.5\text{V}$<br>$U_{\text{diff}} = 2.0\text{V}$ |
| Medium          | Twisted pair                                                                                                                 |                                                                                                                             |
| Topology        | Linear (daisy-chain)                     |                                                                                                                             |

## Methodic: Time domain simulation

### Simulation environment:

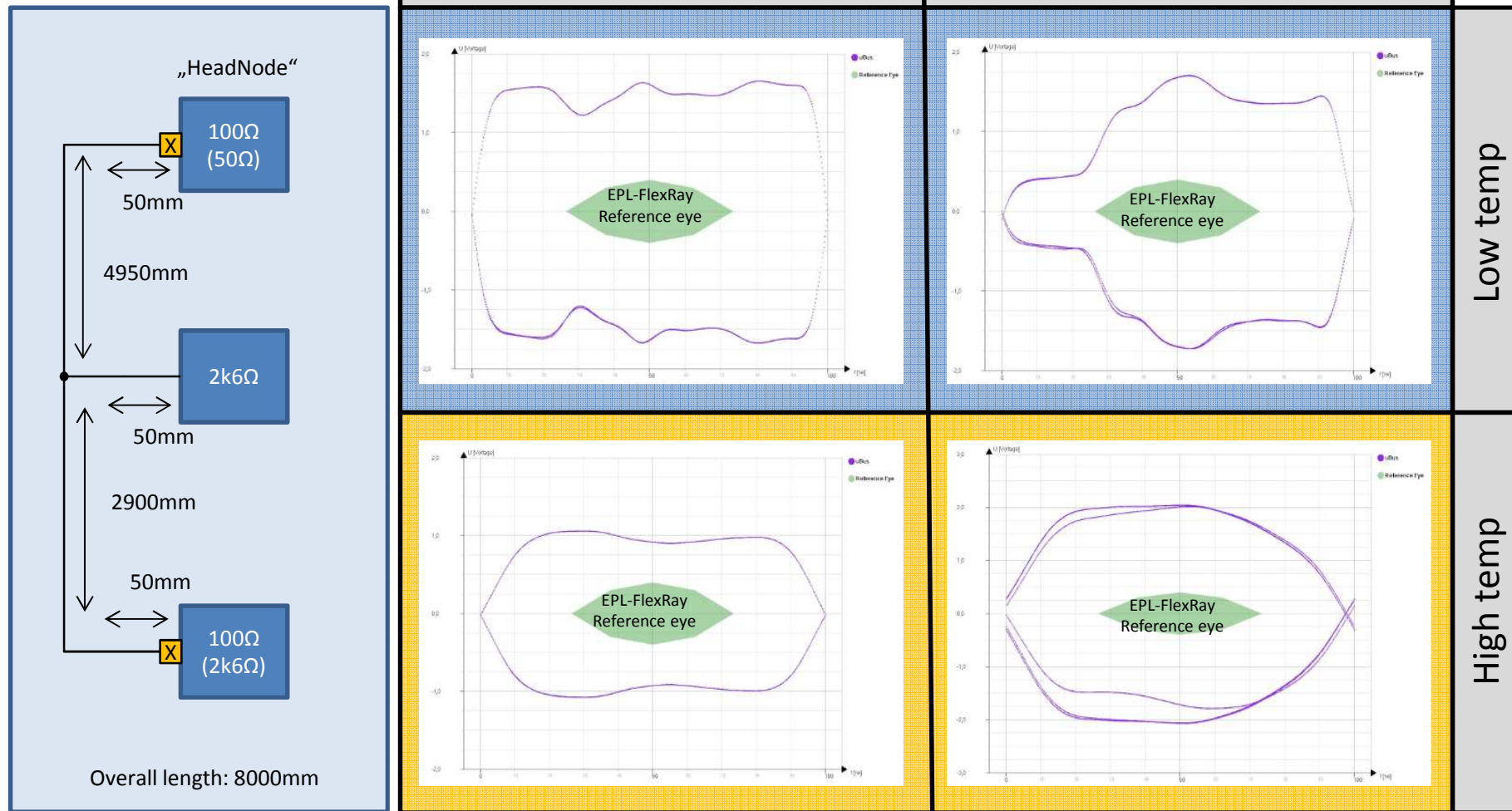
- VHDL-AMS Simulator
- Transceiver
  - FlexRay: TJA1081 (NXP)
- Cable model
  - FlexRay: FLR9Y (Coroplast)
- Temperature range
  - FlexRay: Low / Max

### Signal evaluation:

Eye diagram (Selection criteria: Shortest distance between signal and reference eye (Worst Case))

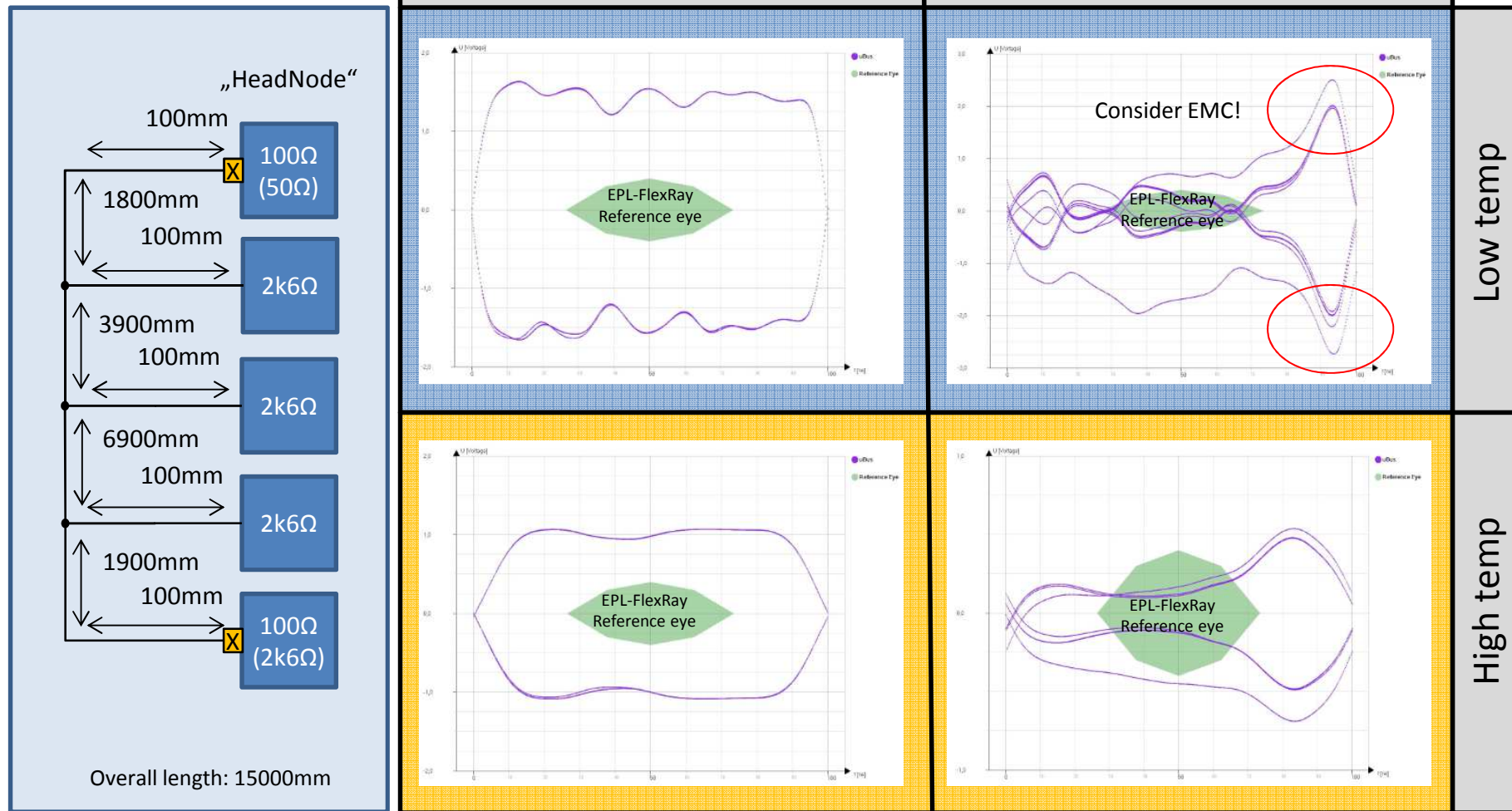
# -FlexRay-

## Passive linear topology – min. dimension



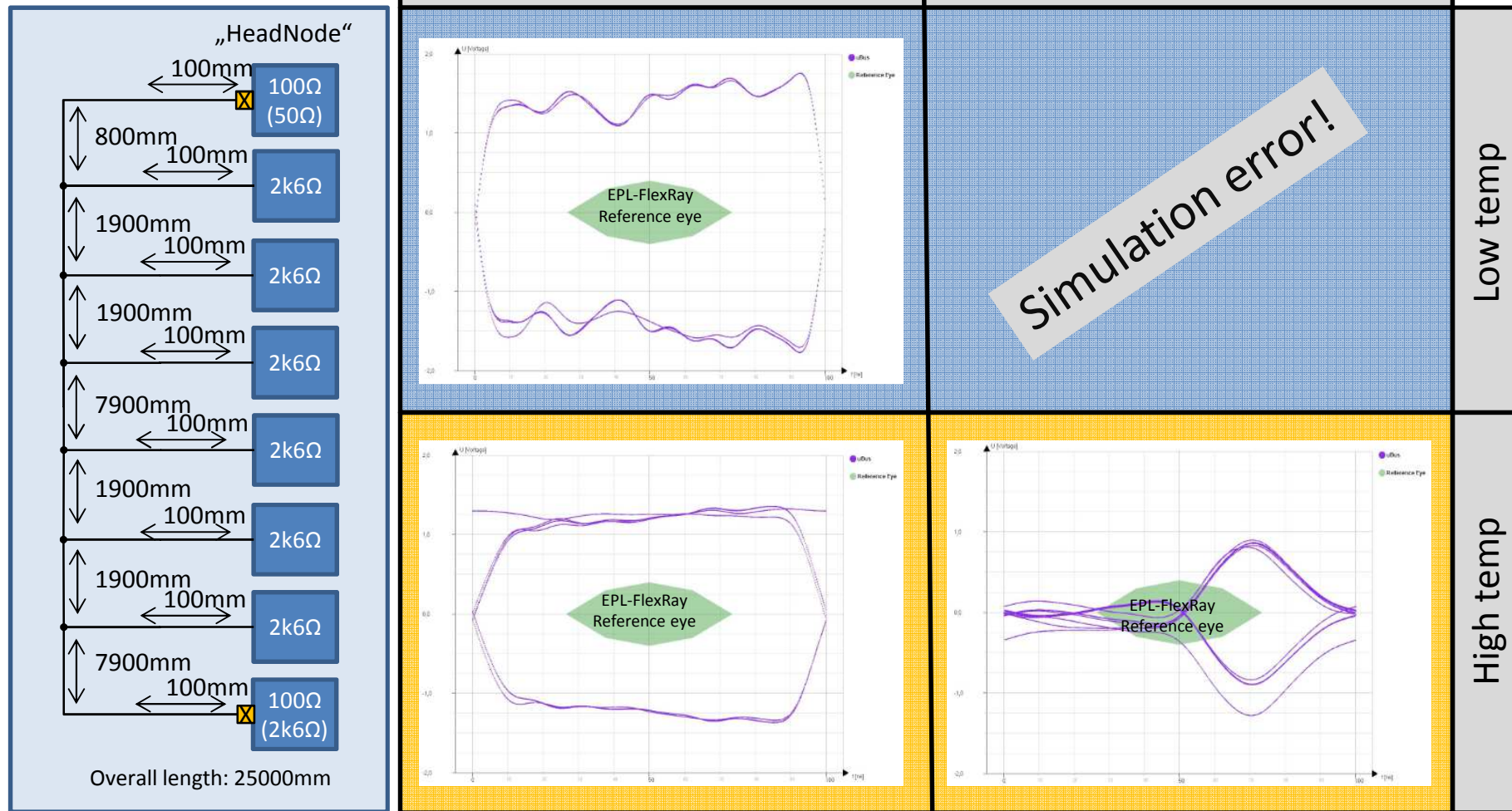
# -FlexRay-

## Passive linear topology – mid. dimension



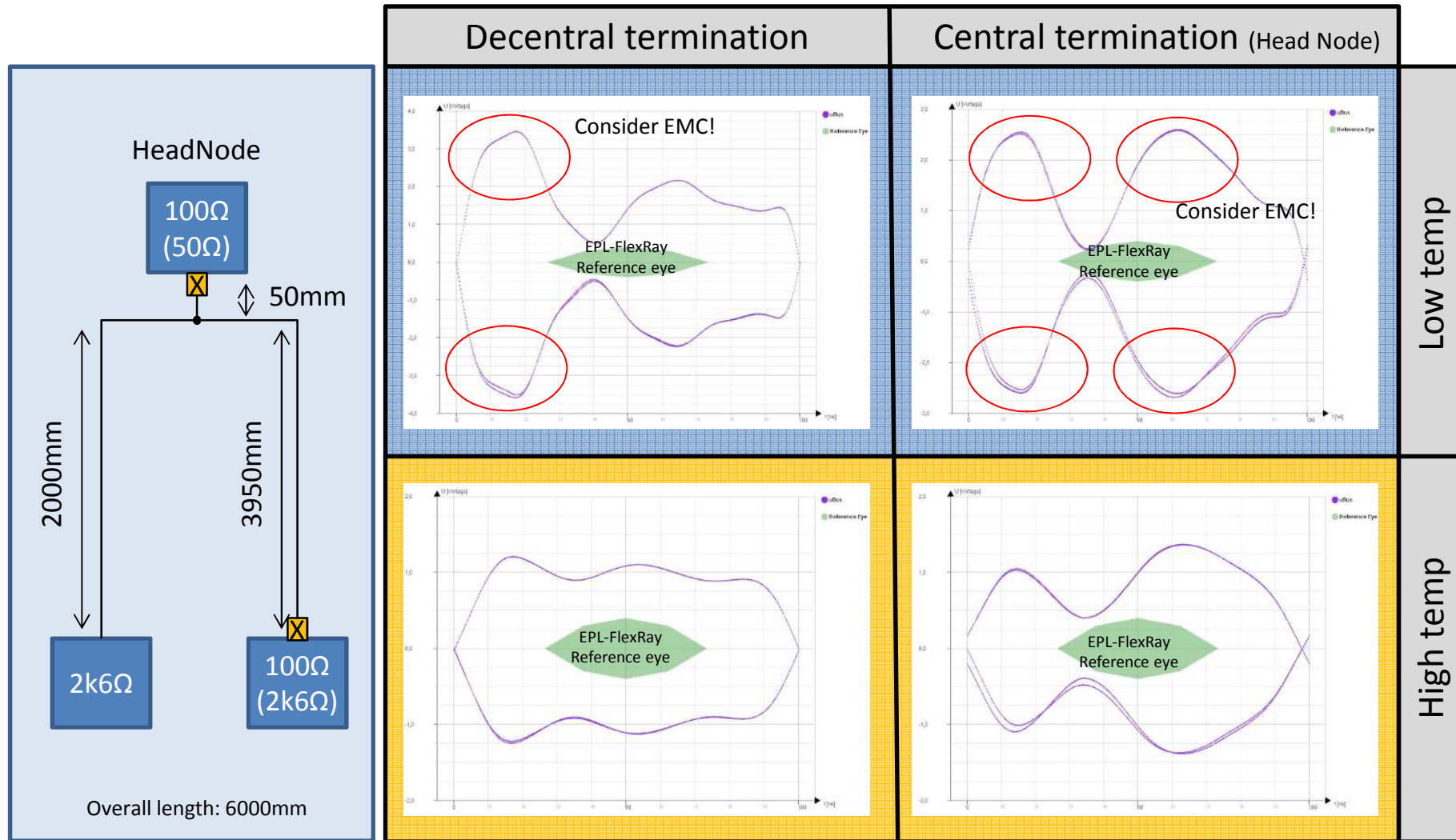
# -FlexRay-

## Passive linear topology – max. dimension



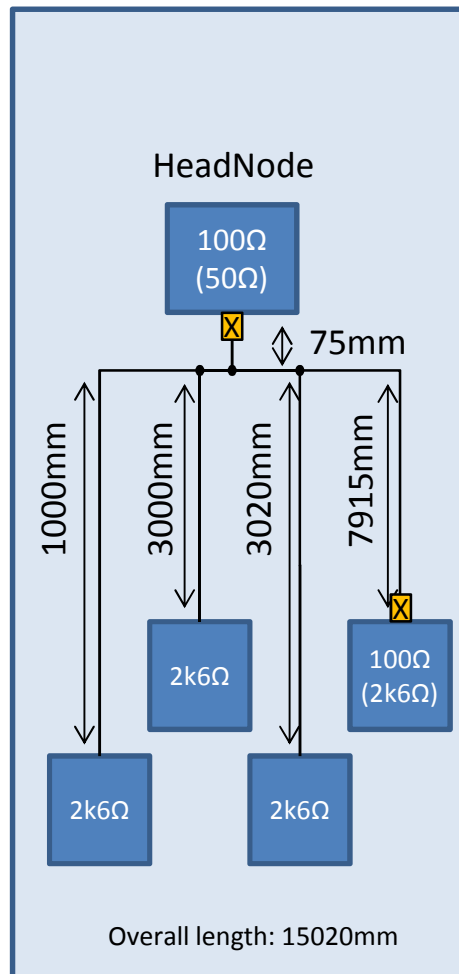
# -FlexRay-

## Passive star topology – min. dimension

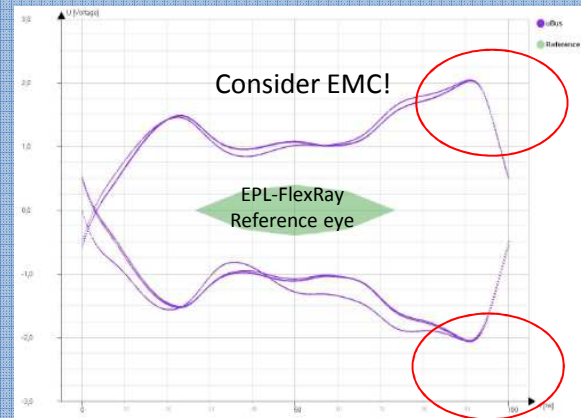


# -FlexRay-

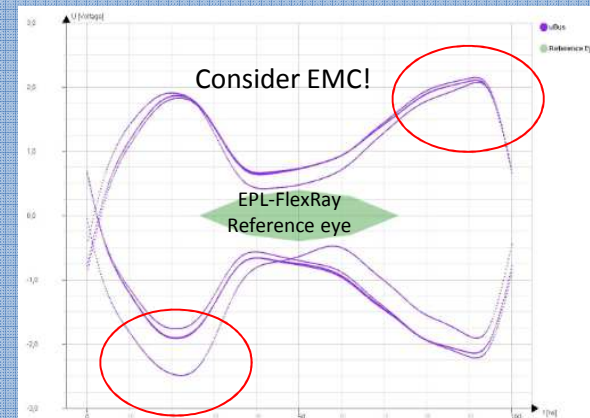
## Passive star topology – mid. dimension



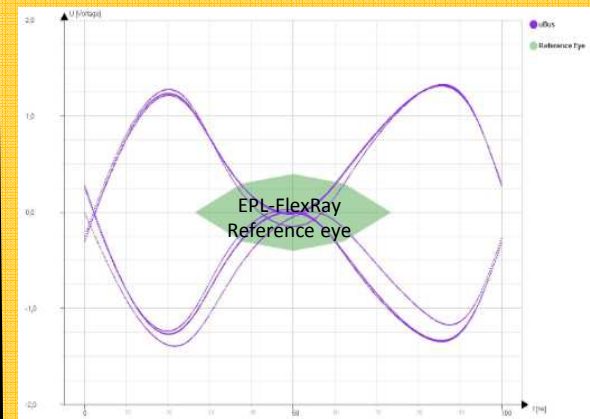
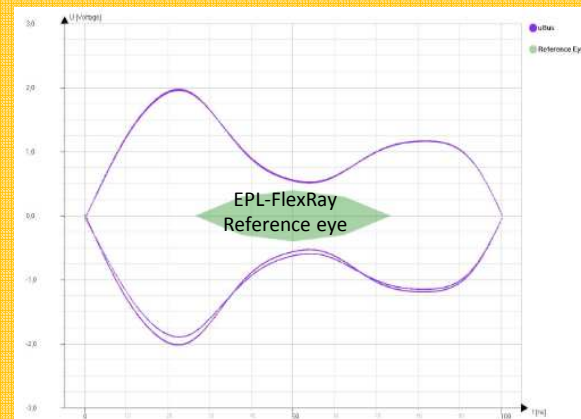
Decentral termination



Central termination (Head Node)



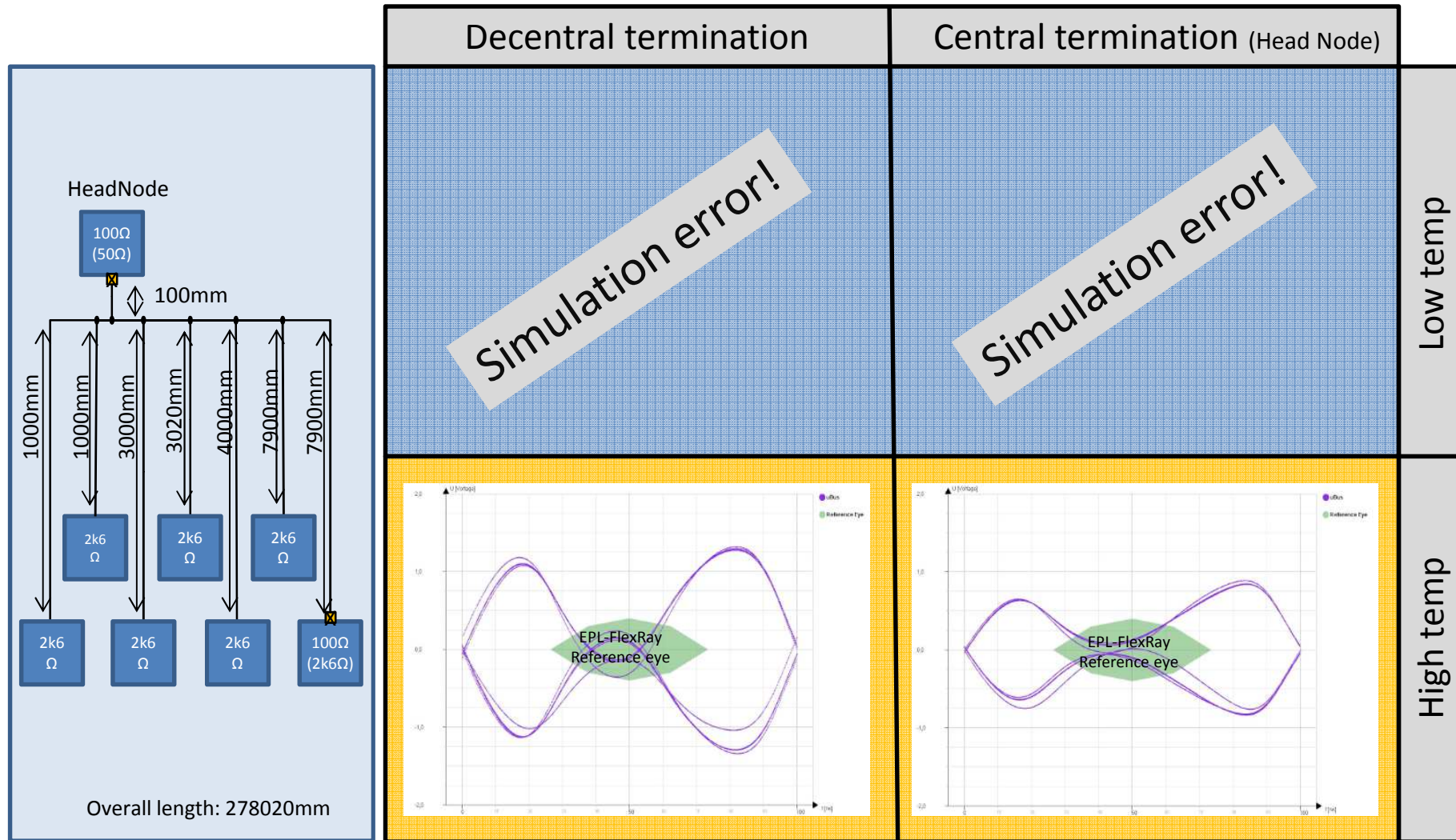
Low temp



High temp

# -FlexRay-

## Passive star topology – max. dimension



## Conclusion:

With the existing transceiver technology (FlexRay), it seems to be possible to meet the minimum requirements (passive linear topologies / decentral termination) for 10SPE@15m. However, they are not suitable for use in passive star topologies and/or central termination.

## Question to manufacturers:

Is it possible to develop a cost effective 10SPE@15m ETHERNET PHY that can handle the signal integrity in those cases?

## Ambition:

Passive topologies with:

- central termination
- total length: min. 15000mm
- amount of ECUs: min. 5
- passive star topology