xVM
applied to automotive, mixed-mode products

Magdalena SIENKIEWICZ
PhD student
CNES/Freescale Semiconductor, Toulouse

Toulouse, 01/27/2009

cnes
CENTRE NATIONAL D'ÉTUDES SPATIALES

ims

freescale
semiconductor

Optical Localization Techniques Workshop

PLAN

❑ **Why xVM?**

❑ **Case study**

❑ **Discussion**

❑ **Conclusion**

PLAN

❑ **Why xVM?**

❑ **Case study**

❑ **Discussion**

❑ **Conclusion**

3

Why xVM?

Analog/mixed-mode

PVM result

❏ **High intrinsic sensitivity** to the environmental/electrical settings

❏ Laser mapping contains abnormal **& naturally sensitive regions**

❏ **Continuously variable** signal

❏ **The most sensitive device is not** **necessary the failing one**

❏ **Many** possible **parameters to** **extract**
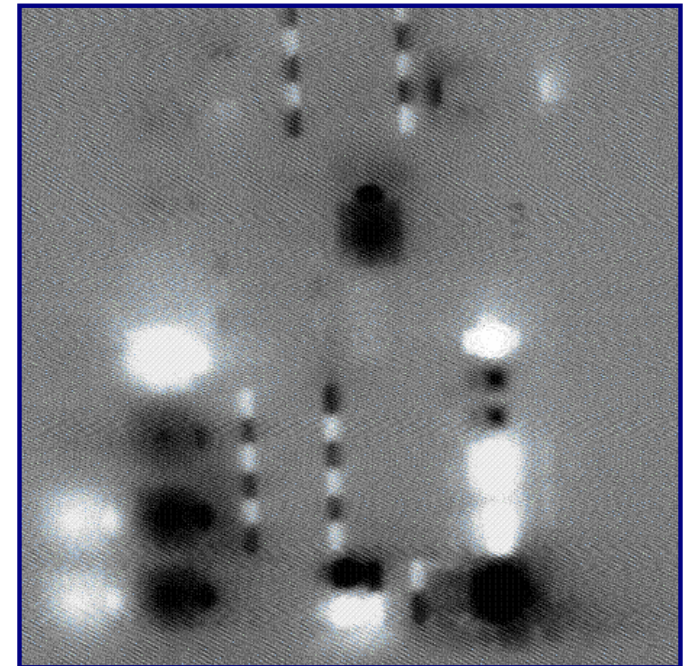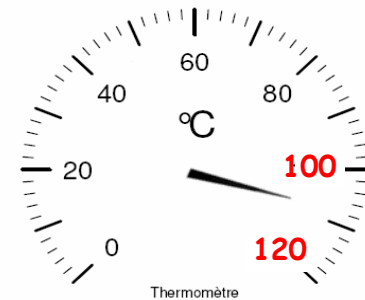
Block of a **mixed-mode «golden»** circuit

Parametric measurements need

4

PLAN

❑ **Why xVM?**

❑ **Case study**

❑ **Discussion**

❑ **Conclusion**

Case study

❑ **Mixed-mode, automotive IC under development**

❑ **0.25µm technology**

❑ **4 metal layers**

❑ **Functional, «soft» defect at high temperature**
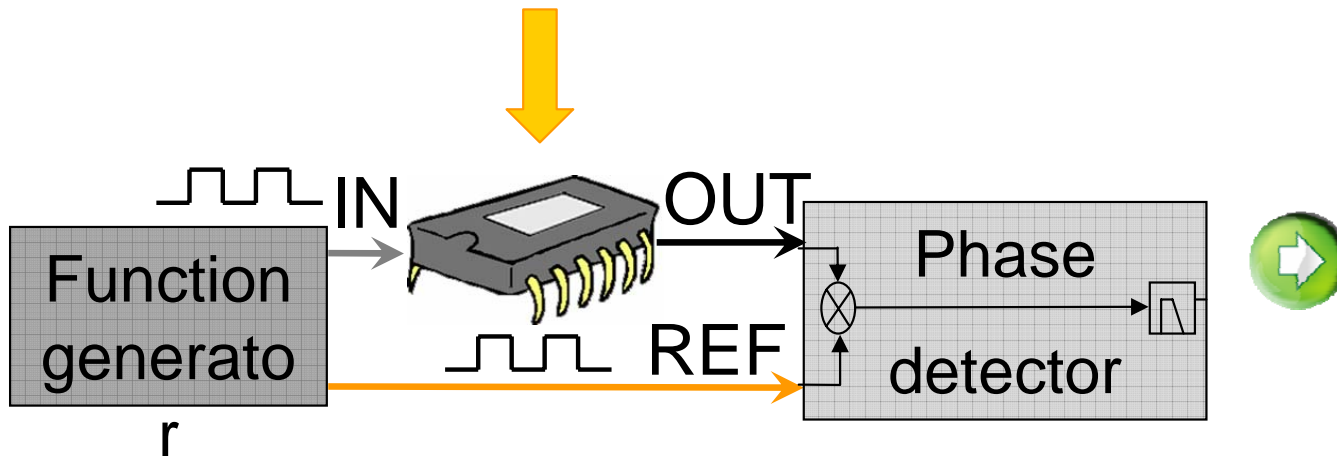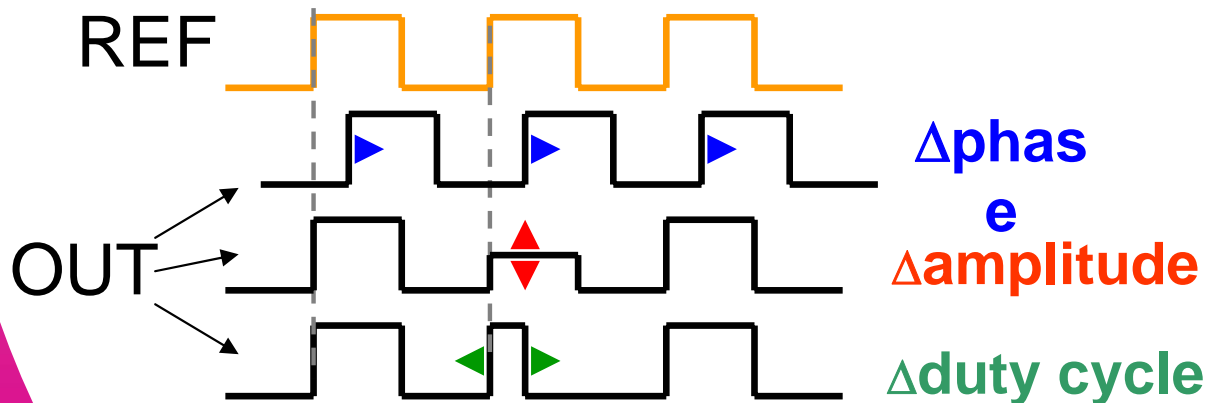
Phase Variation Mapping
analysis

6

Case study
Phase Variation Mapping technique

LSM

1.3µm laser beam

Function generator
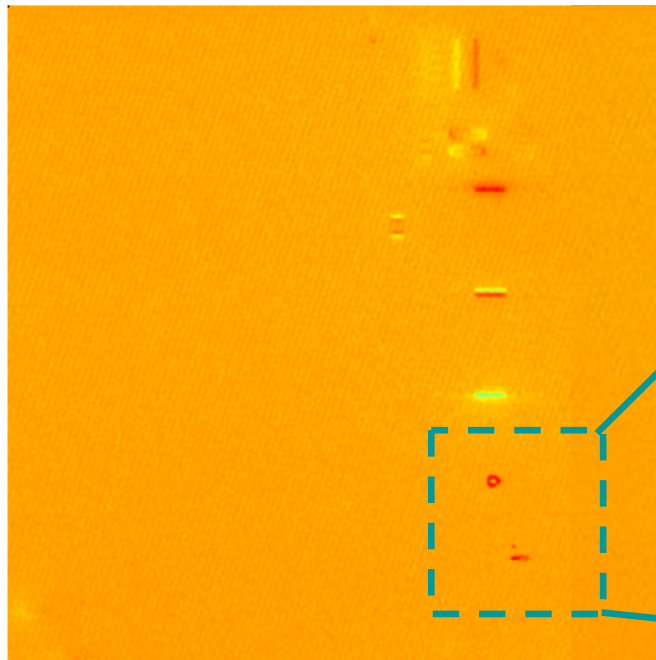
IN

OUT

REF

Phase detector

PVM image

REF

OUT

△phase

△amplitude

△duty cycle

Case study

- ❑ **PVM** results
  Dynamic **T**hermal **L**aser **S**timulation (1340nm)

PVM image

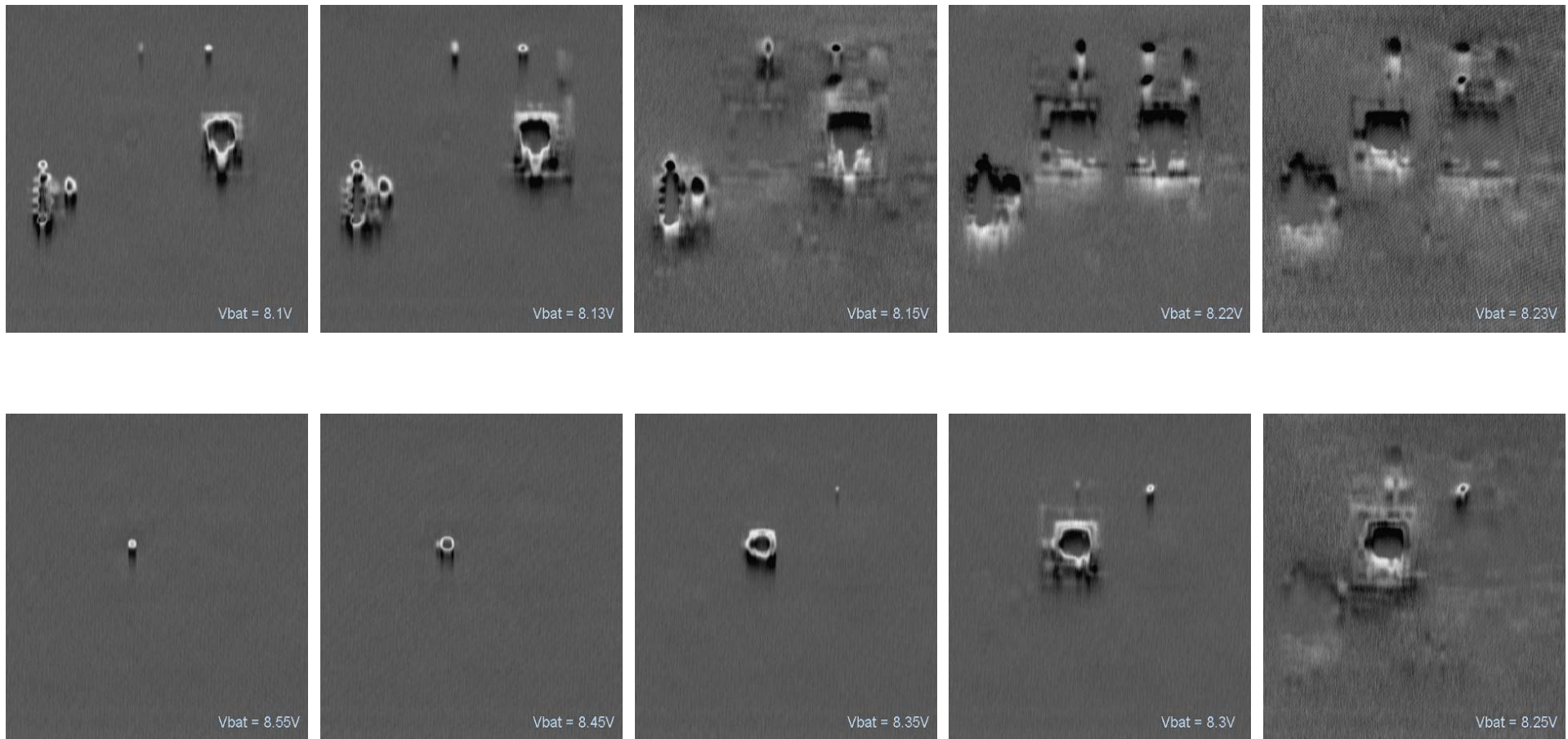**PVM + pattern** image
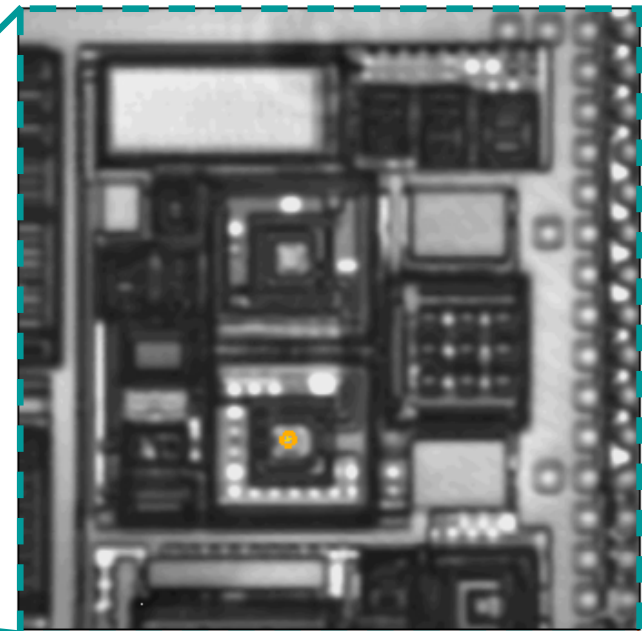
Each frame of movie saved for the **different** value of **Vbat**

8

Case study

PVM results

Case study

❑ **Sensitive area** was **delimited but** still **many devices** were **sensitive**

Vbat = 8.1V

Vbat = 8.22V

Vbat = 8.55V
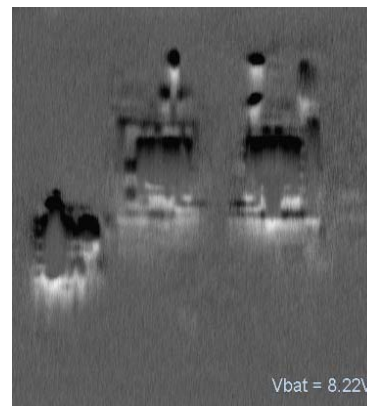
❑ **In function of Vbat the sensitive devices changed**

❑ **For all Vbat no common sensitivity was observed**

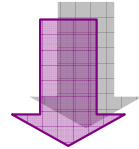**How can we extract the useful information?**

WHERE IS THE FAILURE?
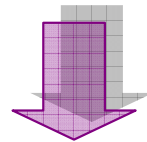
10

T O L S A

Case study

Backside DTLS localization

Layout & schematic analysis

Additional electrical simulation

Image PVM

Pattern+PVM

T=25°C vs T=100°C

T=100°C

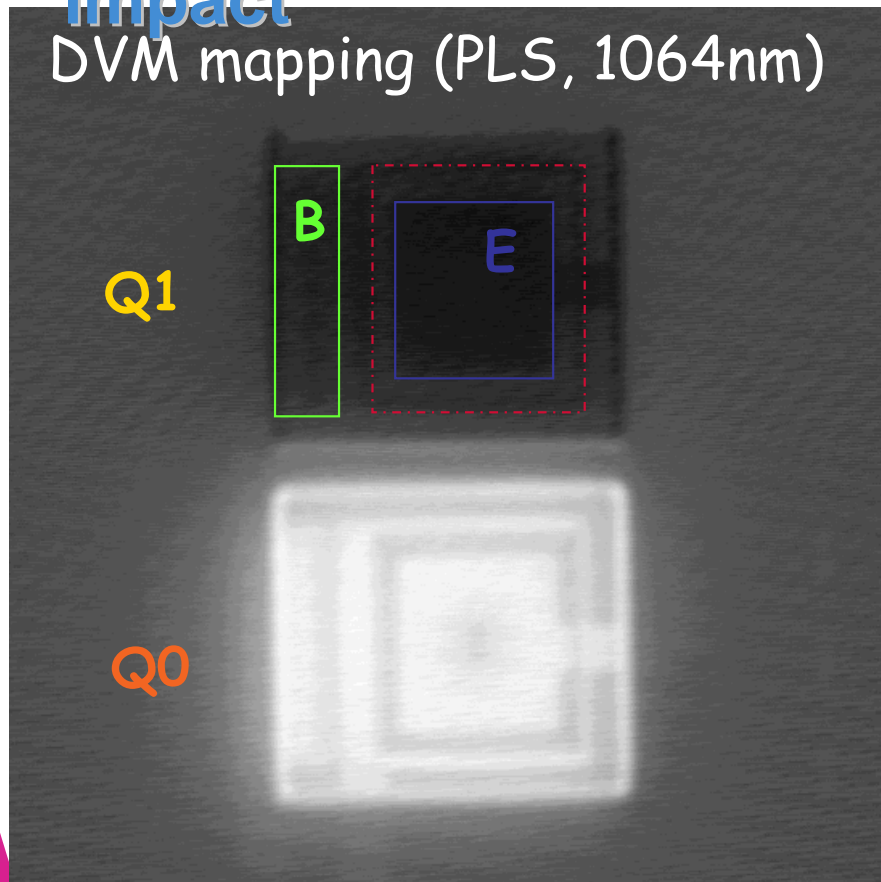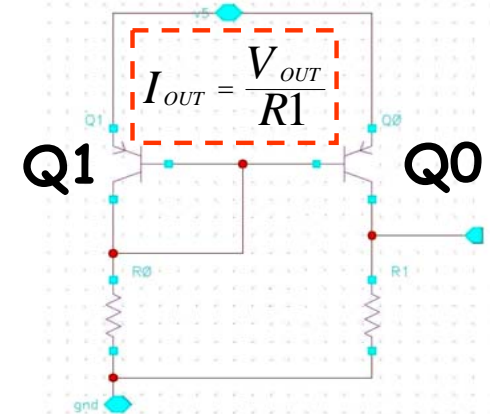**Design issue identified**

11

PLAN

❑ **Why xVM?**

❑ **Case study**

❑ **Discussion**

❑ **Conclusion**

12
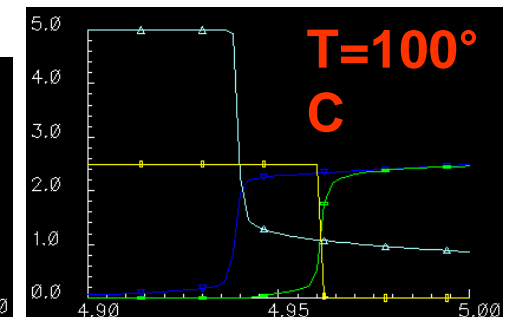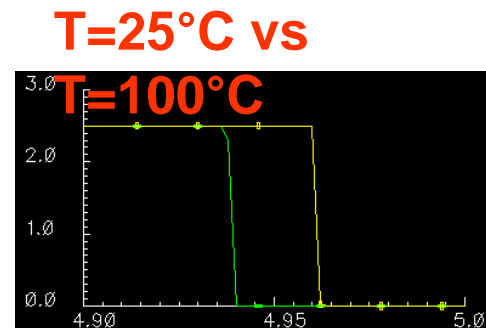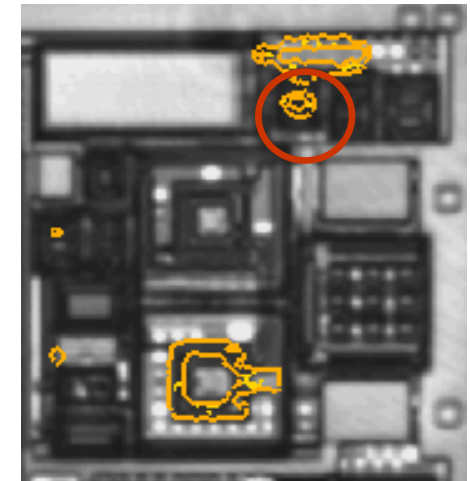
Discussion
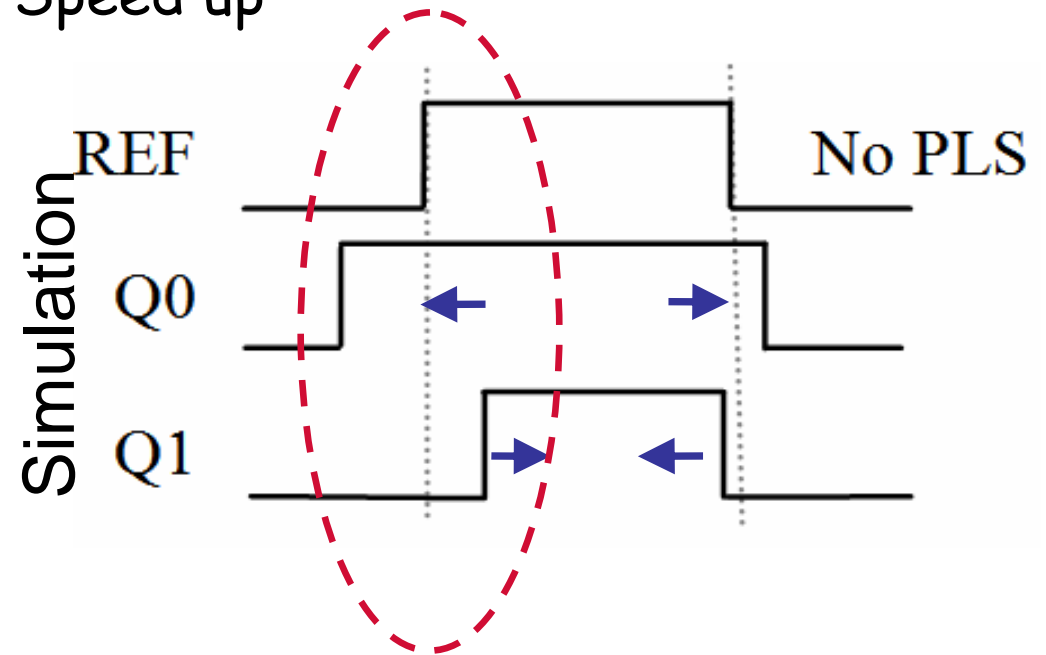
❑ How to proceed when the **sensitive devices** are **located in different blocks?**

🔘 **Study** of the **local** Laser Stimulation impact

T O L S A

$$I_{OUT} = \frac{V_{OUT}}{R1}$$

Q1   Q0

DVM mapping (PLS, 1064nm)

■ Slow down

☐ Speed up

B

E

Q1

Q0

Vsup = 2V

Simulation

REF

Q0

Q1

No PLS

❑ Good correlation between simulations and experimental results

13

PLAN

❑ **Why xVM?**

❑ **Case study**

❑ **Discussion**

❑ **Conclusion**

TOLSA

Conclusion

❑ **Example of xVM application (PVM technique) on mixed-mode, automotive circuit was presented**

❑ **Analog IC properties obstructing accurate failure localization were highlighted:**

   ❑ **High sensitivity** of the device under Laser Stimulation
   ❑ **Naturally** & abnormal **sensitive** regions
   ❑ **The most sensitive device is not necessary the failing one**

❑ **To localize accurately the fail-causing device, the electrical simulations (T) were run on the pre-localized block**

❑ **Promising simulations of the local TLS/PLS impact can help to analyze the mapping & faster focus on defective**

15

Thank you for your attention

Any questions?