Sensata
Technologies

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EMC & ESD challenges in automotive products

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The World Depends on Sensors and Controls

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Presentation Overview

- Sensata Technologies – Almelo
- What about EMC and ESD
- How is EMC controlled in automotive
- Pressure sensor technologies
- Is ESD a challenge?
- ESD factory issues

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- **Sensata Technologies**
  - Former Texas Instruments
  - 3 Business Centers + 7 Make sites
  - Worldwide 6,000 employees










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Sensata Customers

PSA PEUGEOT CITROËN
Audi
DELPHI
Driving Tomorrow's Technology
Mercedes-Benz
Miele
DeLonghi
Living innovation
RENAULT
Valeo
Continental TEVES
PHILIPS
FIAT
SIEMENS VDO
SAAB
VOLVO
Danfoss
BOSCH
arçelik

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Need for EMC in the automotive world?

- Number of sensor: 1 (?) > 100

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Automotive, EMC… & Safety??

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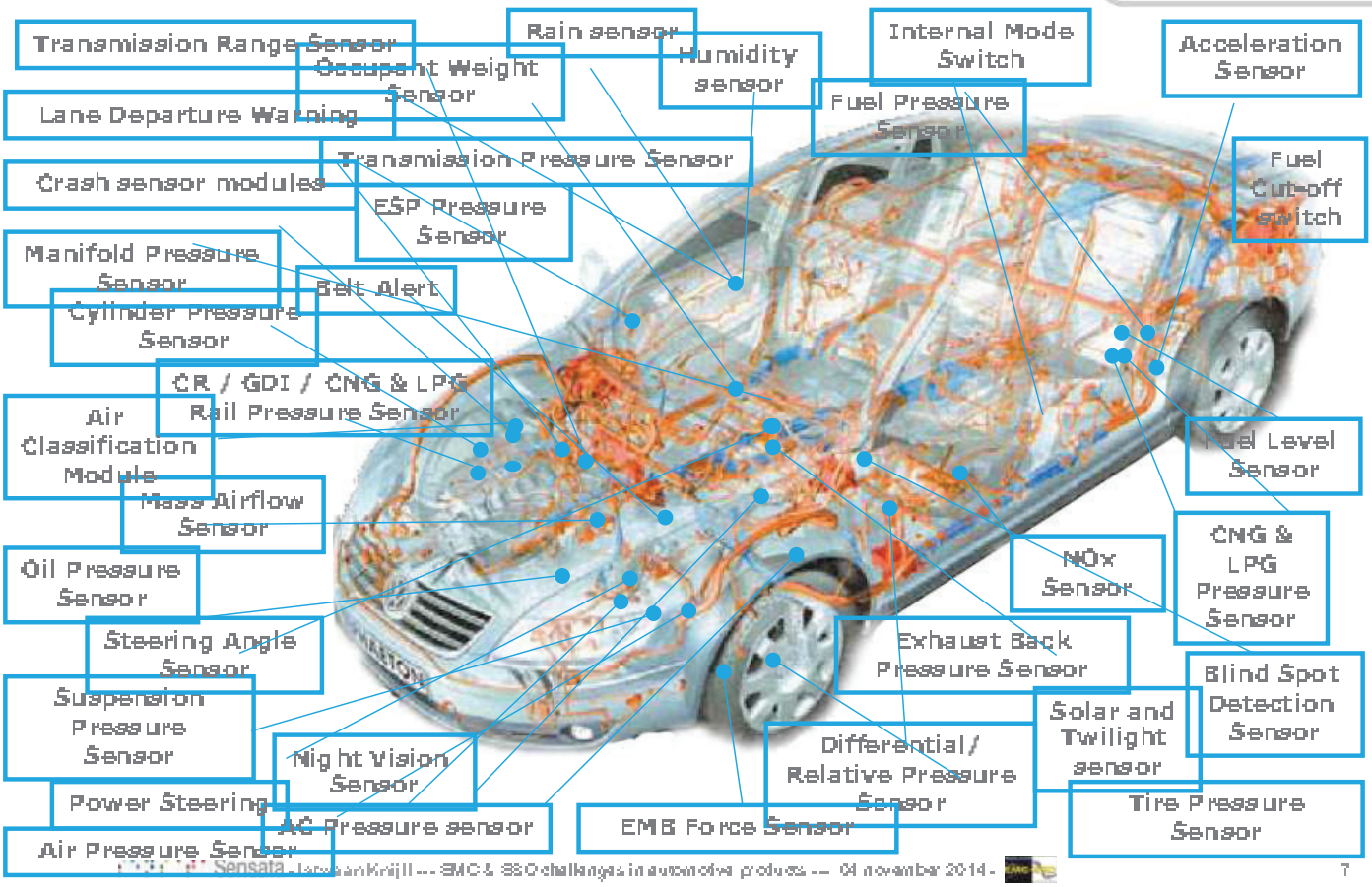
Automotive Sensors



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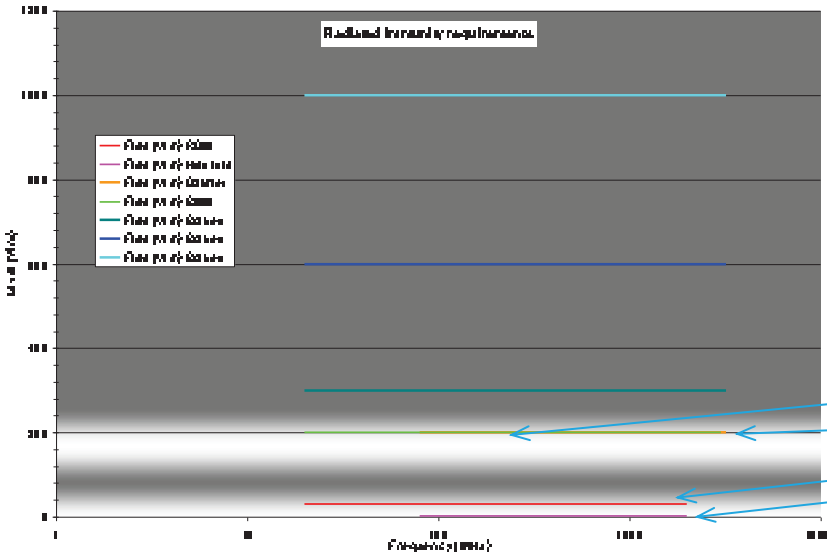
EMC Requirements – Radiated Immunity



Continental

GM

E4 KDW CE

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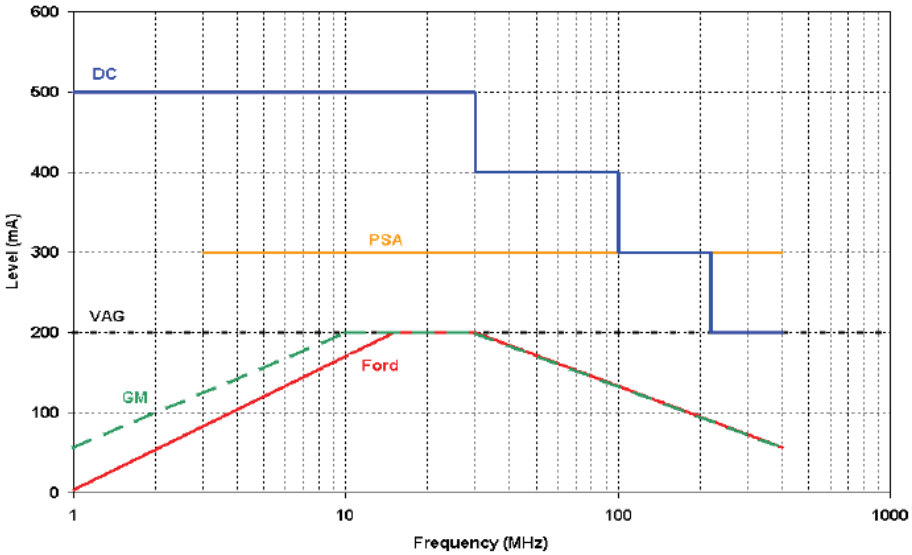
Other EMC Requirements

- Frequency range: 150kHz – 4 GHz / Radar bands
- Modulation: CW / AM / GSM...
- Antenna / DPI / GTEM / Stripline
- ESD: 2-25kV
- BCI: 60 - 500mA



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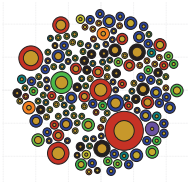
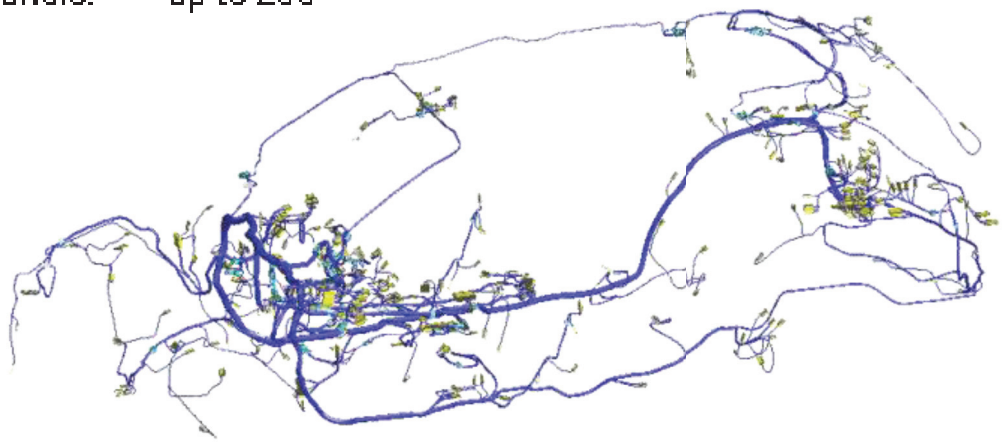
Simulations - Expert System for EMC Analysis

- Total length of cables: 1,7 – 2,8 km
- Number of sensor: 1 ... > 100
- Number of cables: 1100 - 1900
- Number of contacts: 1800 – 2500
- Cables per bundle: up to 200





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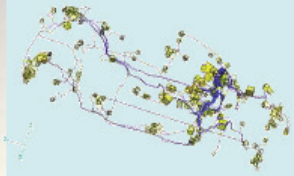
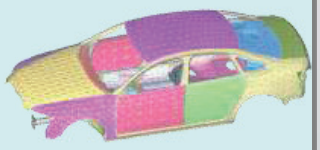
Simulations & Data sets for model generation

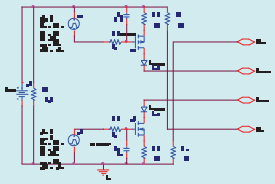
cable harness models

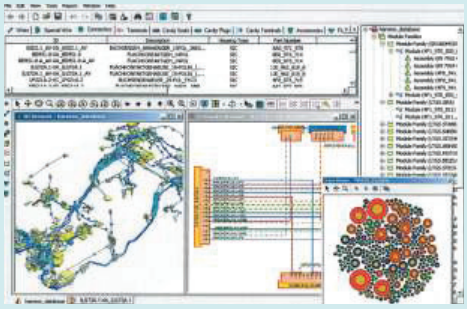


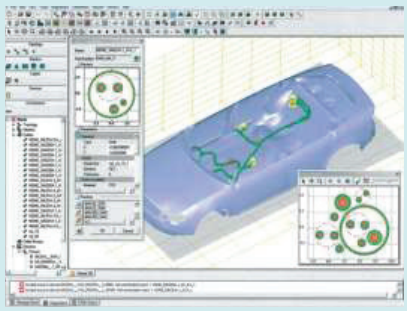
car body models



device models







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Reduction of vehicle tests

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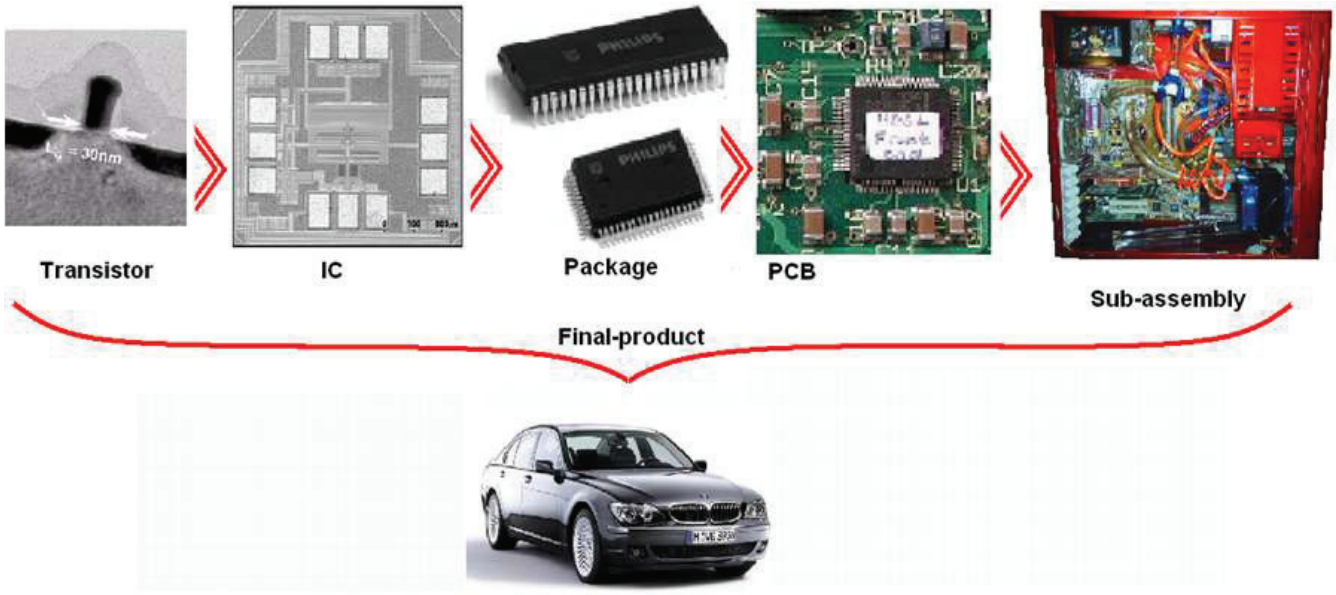
EMC & ESD on different levels



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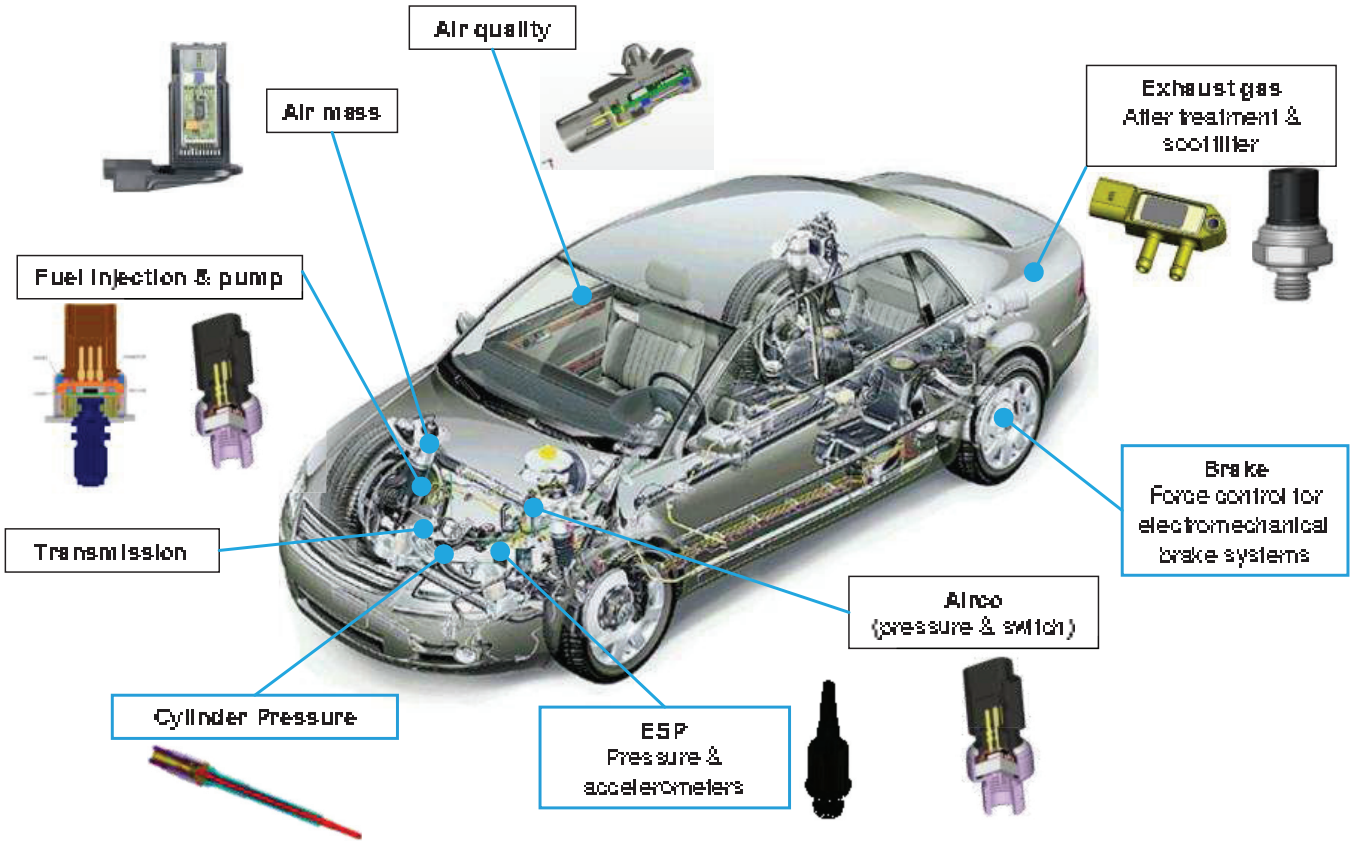
Automotive Sensors



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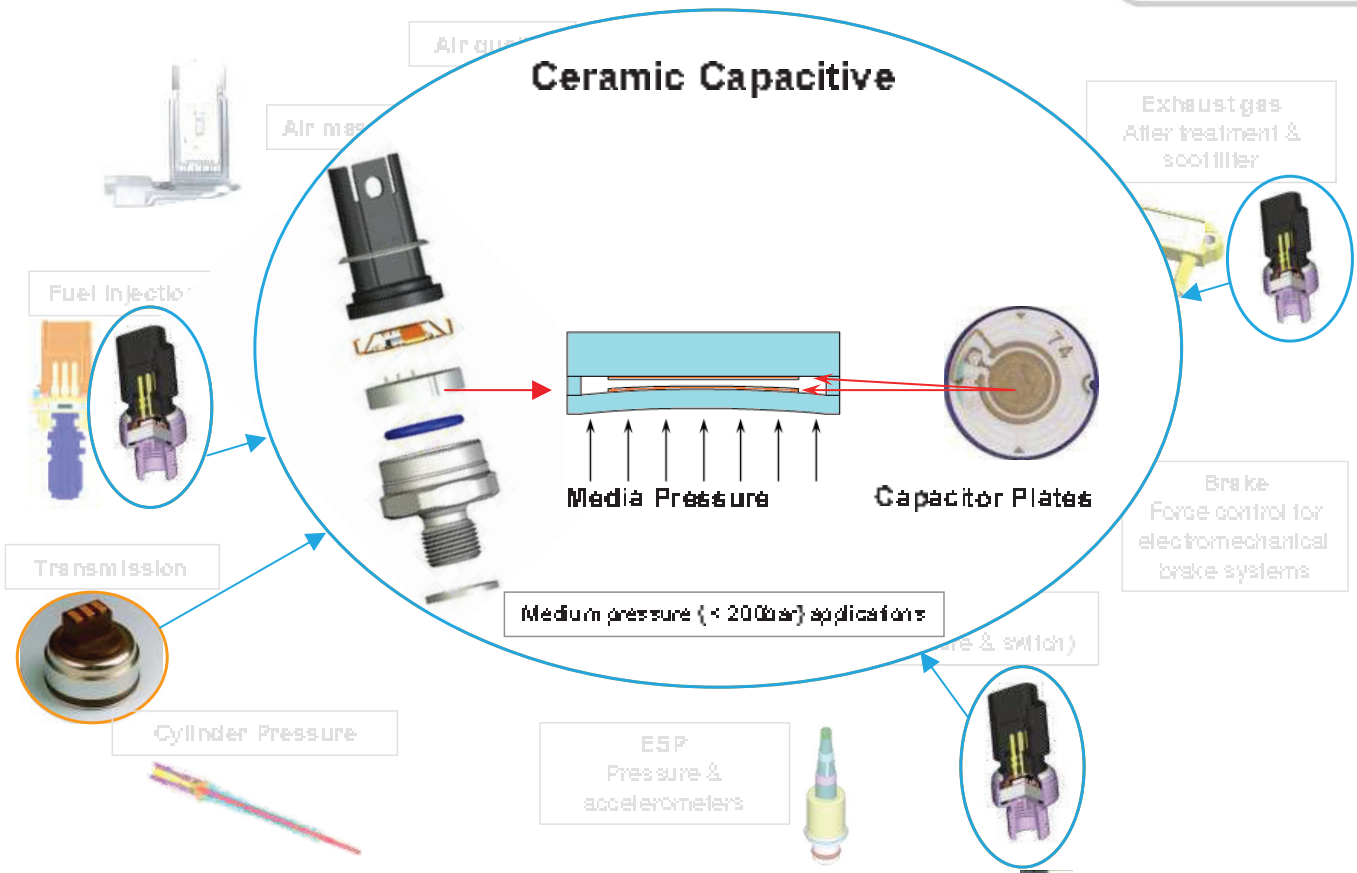
Pressure Sensing Technologie



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ESD situations

- Lightning
- Catastrophic
- Production line
  Personnel / equipment ESD
- Annoying
  Pain / Risk
- Damage component
  Latent / permanent

Important to control ESD at Sensata

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What is ESD?

ESD - ElectroStatic Discharge

= Discharge of static electricity or electrostatic induction

Airplane... Refueling... ESD risk?

Robustness against high voltage

ESD private life

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ESD, who should know about it...

Everybody needs to understand ESD rules & requirements!

- SQE
- DE / PE / QE
- ME / Equipment engineer / Technician
- Line operators
- CQE

Why everybody?

- ESD requires safe production facility / equipment
- Entering production site → follow ESD control plan
- Understanding product requirements supplier / customer

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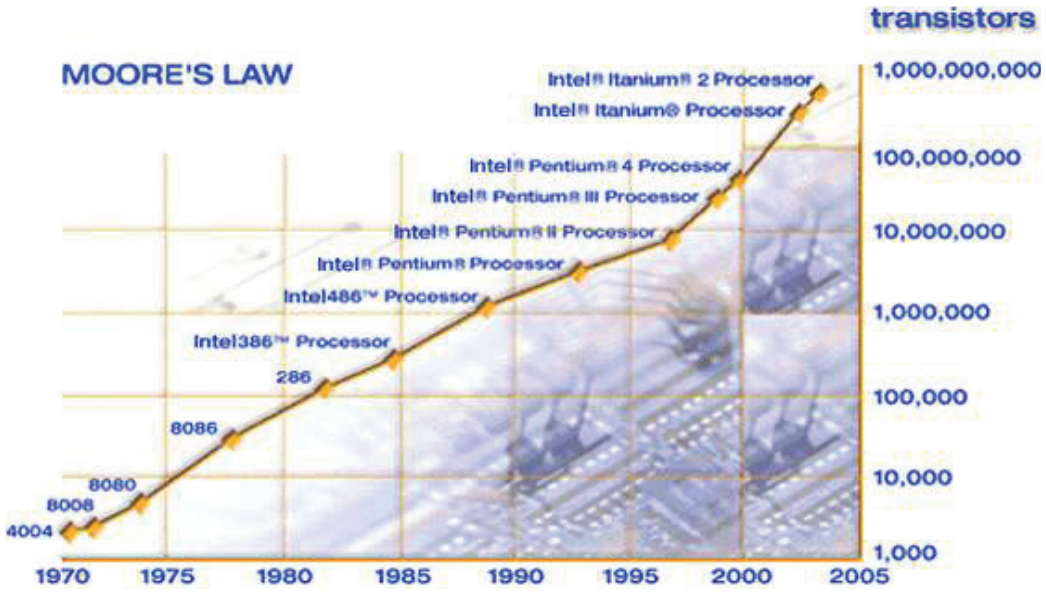
Why ESD damage risk increases?

Open sensor products get more sensitive:

- Small traces in IC → weaker
- Transistors smaller and smaller every year → weaker



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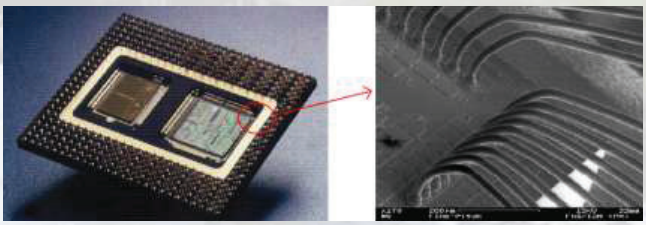
Why ESD damage risk increases?

Product ESD immunity: higher than 10volt → Damage risk

•Open sensors → Sensors ESD protection doesn't work

Device Type	Threshold Susceptivity (Volts)
* MOSFET	10-100
* VMOS	30-1800
* NMOS	60-100
* GaAsFET	60-2000
* EPROM	100+
* CMOS	200-3000
* GaAsFET	25-50
* JFET	140-7000
* SAW	150-500
* Op-AMP	190-2500
* Schottky Diodes	300-2500
* Film Resistors	300-3000
* Bipolar Resistors	300-7000
* ECL	500+
* SCR	500-1000
* Schottky TTL	500-2500



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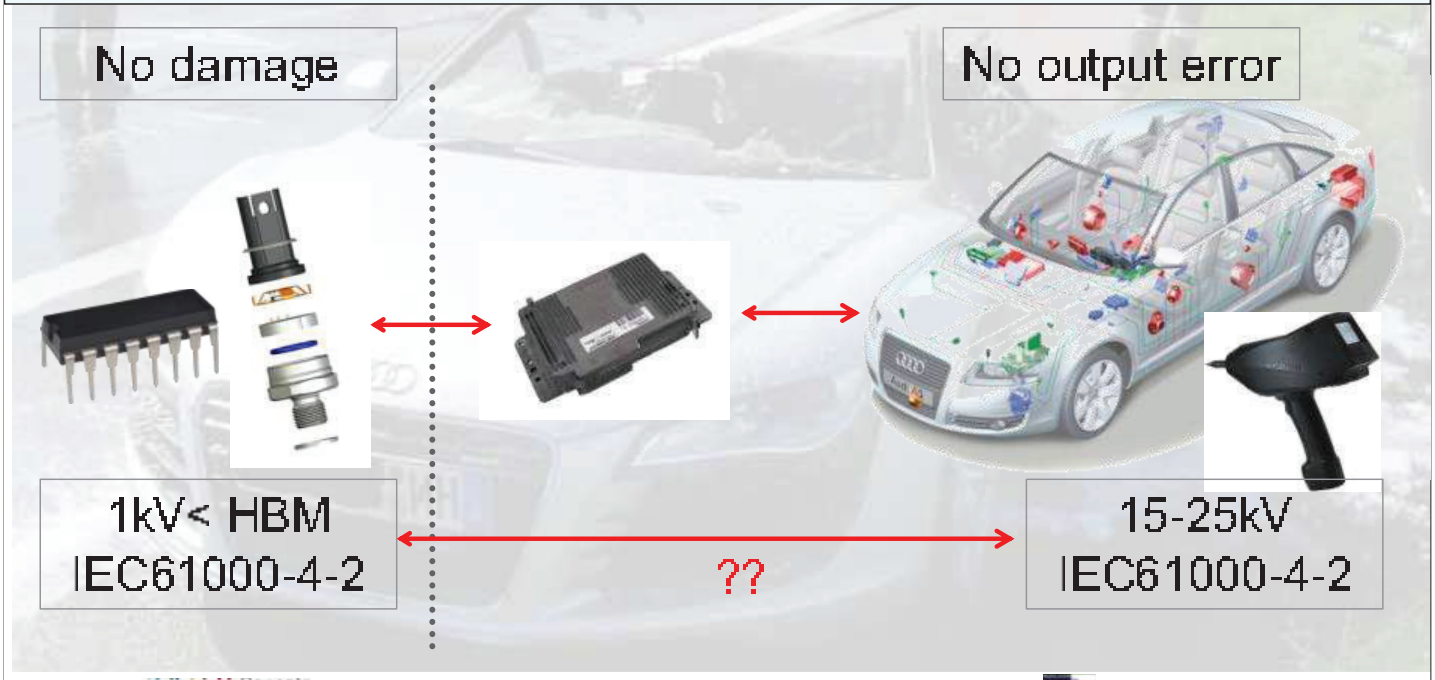
ESD: not disturbance or distroyed?

Product ESD immunity: higher than 10volt → Damage risk

- Open sensors → Sensors ESD protection doesn't work



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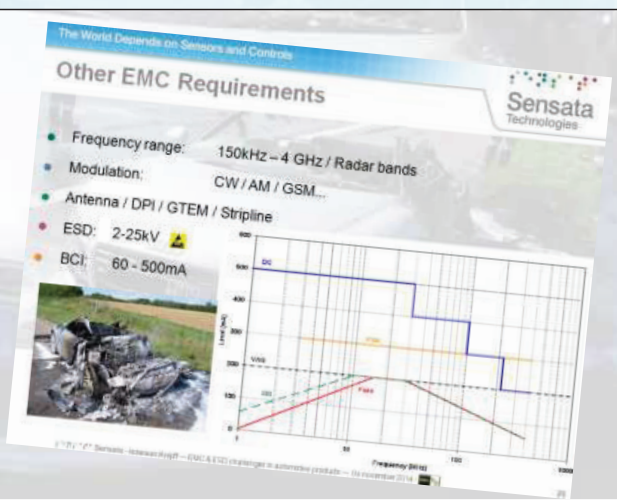
Immunity – Good sensor design

- Product robustness → ASIC requirement, specification:
  - ASIC robustness → specified by Sensata DE to supplier
  - Specified from Sensata DE to Make site – "What level to control"

    → Half product robustness, e.g. IC's, PCB, Closed sensor
- ESD Control make site



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ESD factory control in real life

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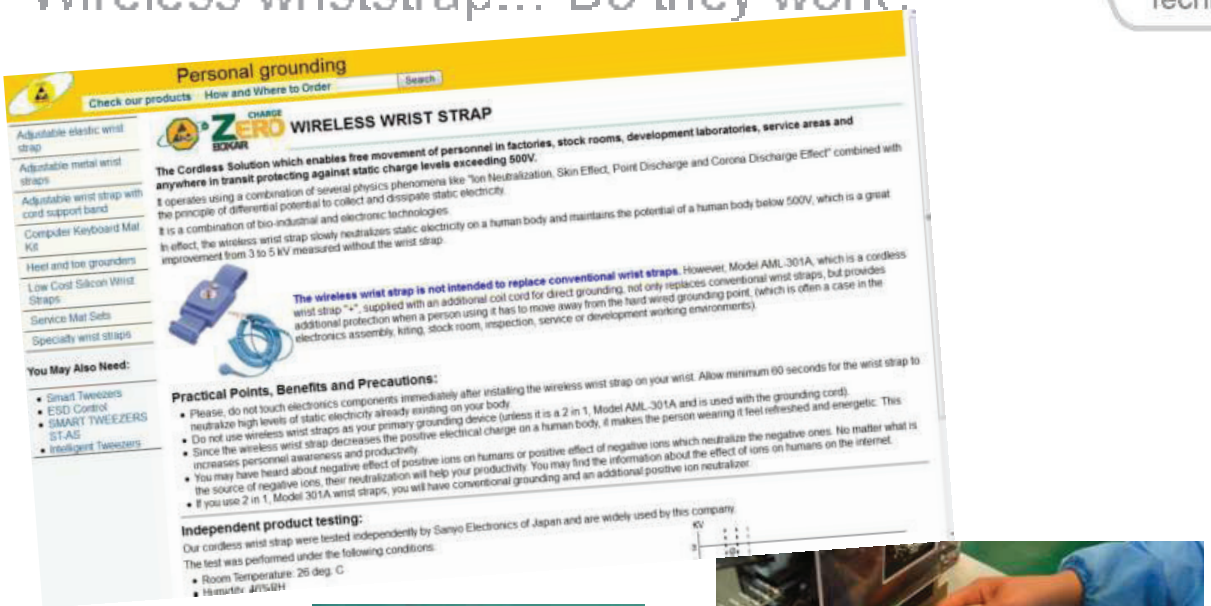
Wireless wriststrap… Do they work?



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Fire suppression system EMI issue

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Lightning on Car

Start @ 3min


QUESTIONS