



Istwaan Knijff (istwaan@emcdemo.com)
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
-



Sensata Technologies

Sensata Technologies

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



Sensata Customers



Need for EMC in the automotive world?



- Number of sensor: 1 (?) > 100

Automotive, EMC... & Safety??

ANWB voor U AAN DE KANT
Het zwarte pad
Uit de binnenland-sectie van De Telegraaf-IV van 28 mei 1998
Steunzender mogelijk oorzaak defect aan auto Marco Bakker
door Martijn Koolhoven - AMSTERDAM, donderdag

Telefoons storen
De BOVAG afdeling tankstations laat een nieuwe sticker om de klanten verzocht om het telefoon uit te zetten.
Volgens...

Verzekeraars worstelen met 'schone' auto-inbraak
AMSTERDAM - Door nieuwe technologie laten auto-inbrekers steeds vaker geen spoor achter, waardoor verzekeraars de schade niet vergoeden. Dat schrijft het AD woensdag.
Criminelen gebruiken tegenwoordig autosleutel te stelen, waardoor de auto niet op slot gaat.
Bij oudere auto's kunnen ze de frequentie van de sleutel kopiëren. Ook kunnen ze het slot met zeer fijn gereedschap openen.

'Veel problemen met nieuwe motor Mercedes'
Londen - Bezitters van een Mercedes Diesel stuit een vloed van problemen. Het gaat om de zogenaamde OM 651 motor.
Dat schrijft de Britse krant The Independent op basis van bevindingen van garagehouders in Duitsland en Zweden.
Volgens de Mercedes-Benz website zou de motor problemen met de afgasbehandeling van de uitlaat in werking stellen.
De problemen zitten in het stelsel van de motor. Door verkeerde sproei van de motor wordt de afgasbehandeling van de uitlaat in werking gesteld.
De problemen worden veroorzaakt door de afgasbehandeling van de uitlaat in werking stellen.
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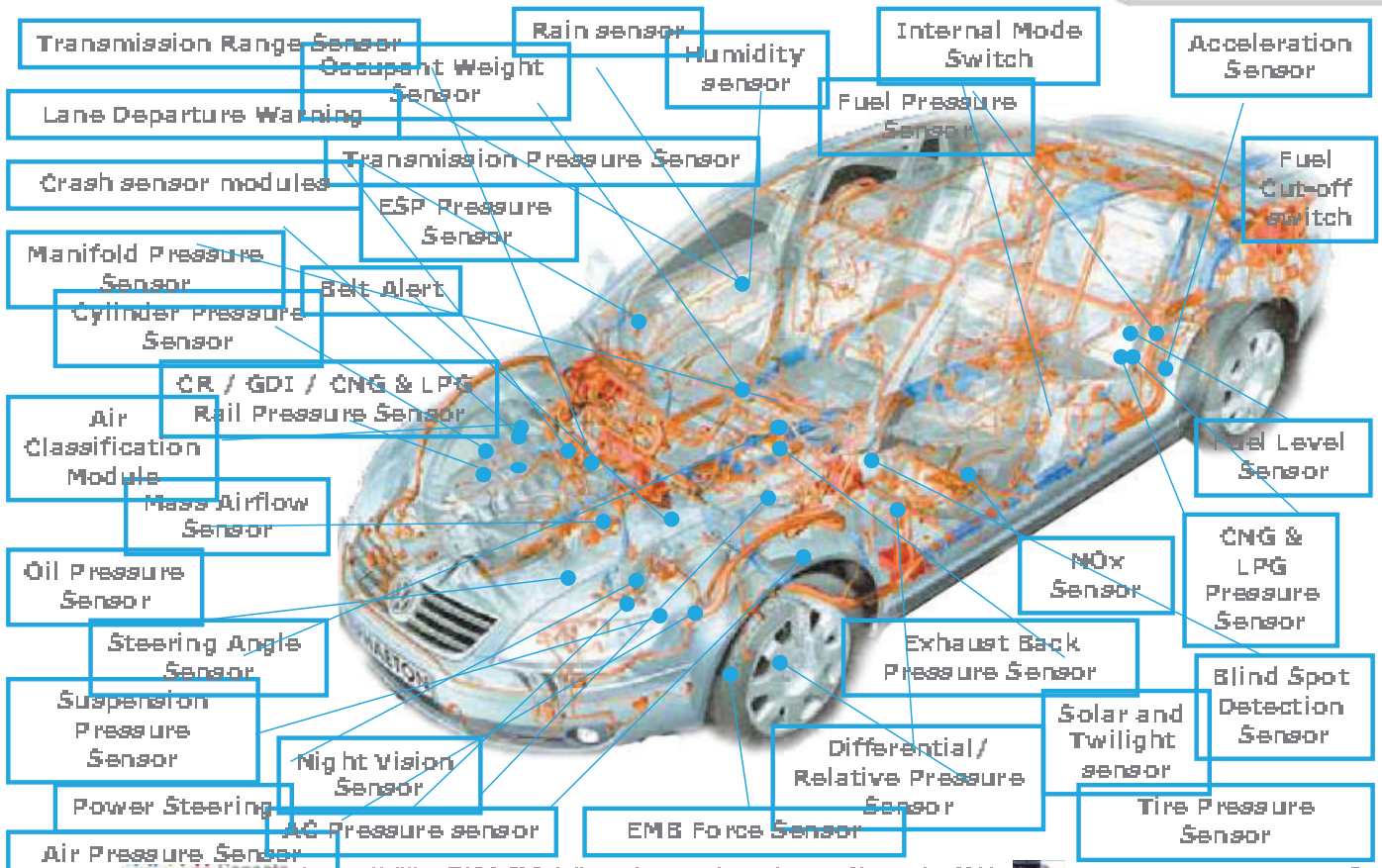
Gsm-verbod in stadsbus Maastricht
Maastricht - De stadsbus in Maastricht is nu gsm-verboden.
De problemen worden veroorzaakt door de afgasbehandeling van de uitlaat in werking stellen.

Tyota issues Vehicle Recall Due to Electrical I
Toyota has recalled more than 1 million vehicles worldwide due to a defect in the electrical system.
According to a "defect information" report from the National Highway Traffic Safety Administration (NHTSA), the problem involves a short circuit in the electrical system.
Toyota has confirmed 18 U.S. cases of abrasion-type inj accidents have also been reported by customers in Japan.

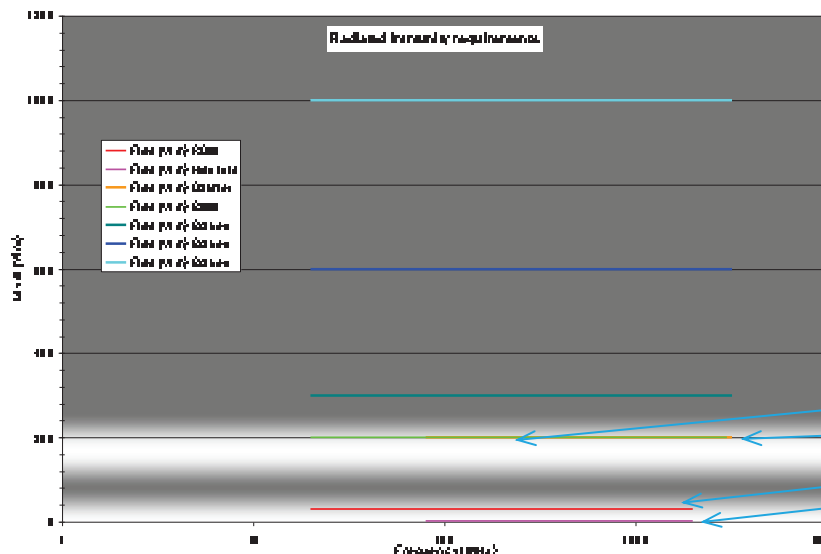
Airbag in Audi ploft spontaan
INGOLSTADT (DPA) - Audi, onderdeel van het Duitse Volkswagenconcern, roept ruim 900.000 auto's terug naar de garage voor verbeteringen aan de airbags.
add a filter to the airbag control module in...

Telefoon kan computer spookbus storen
Van onze correspondent
De Interim-strekkbus die eind september in Eindhoven op het sloeg en grote schade aanrichtte werd zeer waarschijnlijk 'bestuurd' door een auto-telefoon.
De problemen worden veroorzaakt door de afgasbehandeling van de uitlaat in werking stellen.

Automotive Sensors

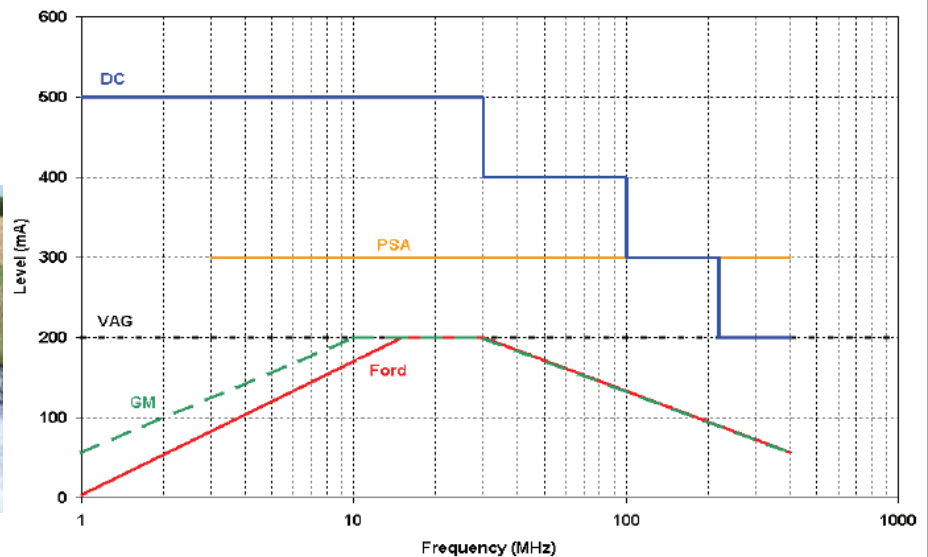


EMC Requirements – Radiated Immunity



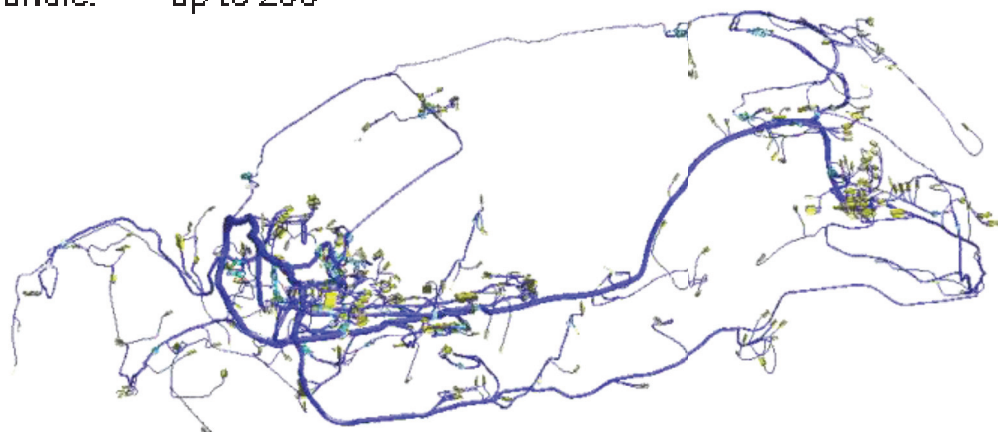
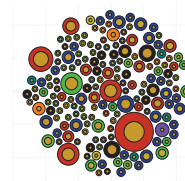
Other EMC Requirements

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



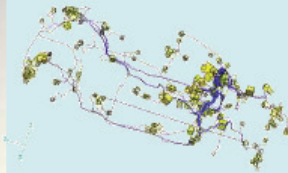
Simulations - Expert System for EMC Analysis

- 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

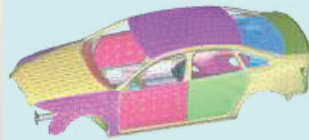


Simulations & Data sets for model generation

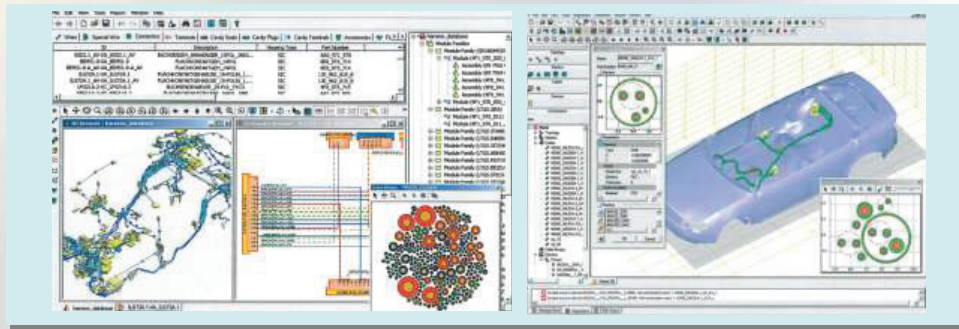
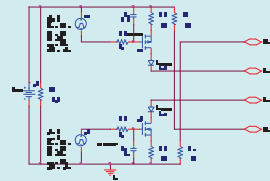
cable harness models



car body models



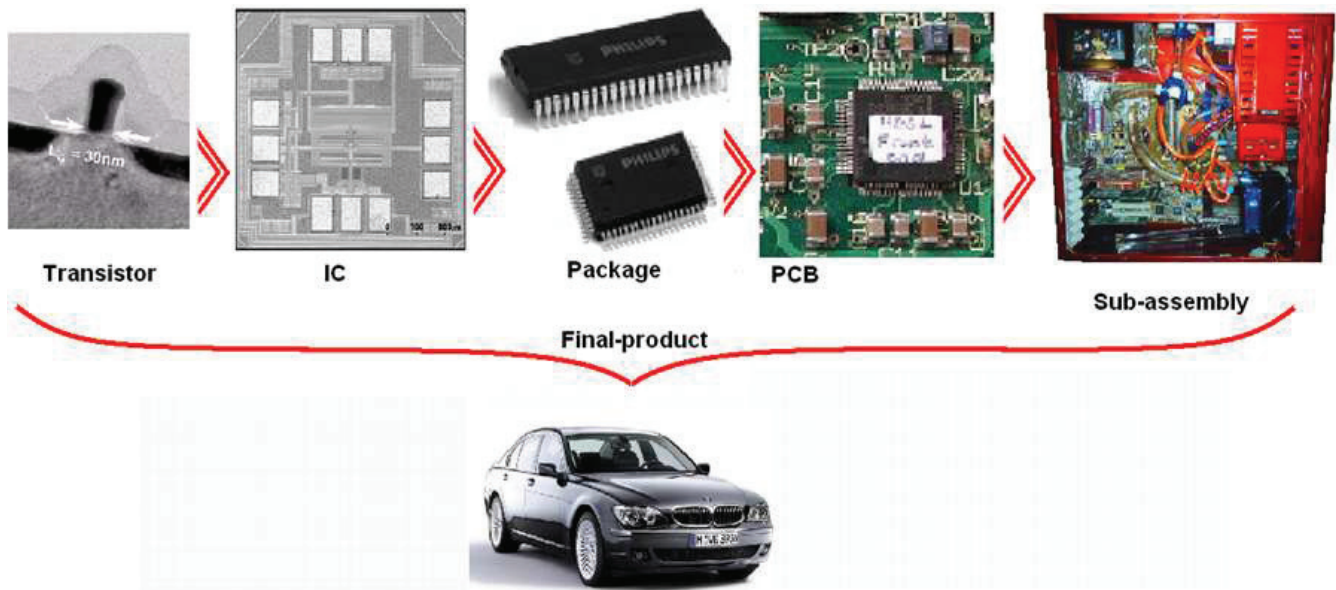
device models



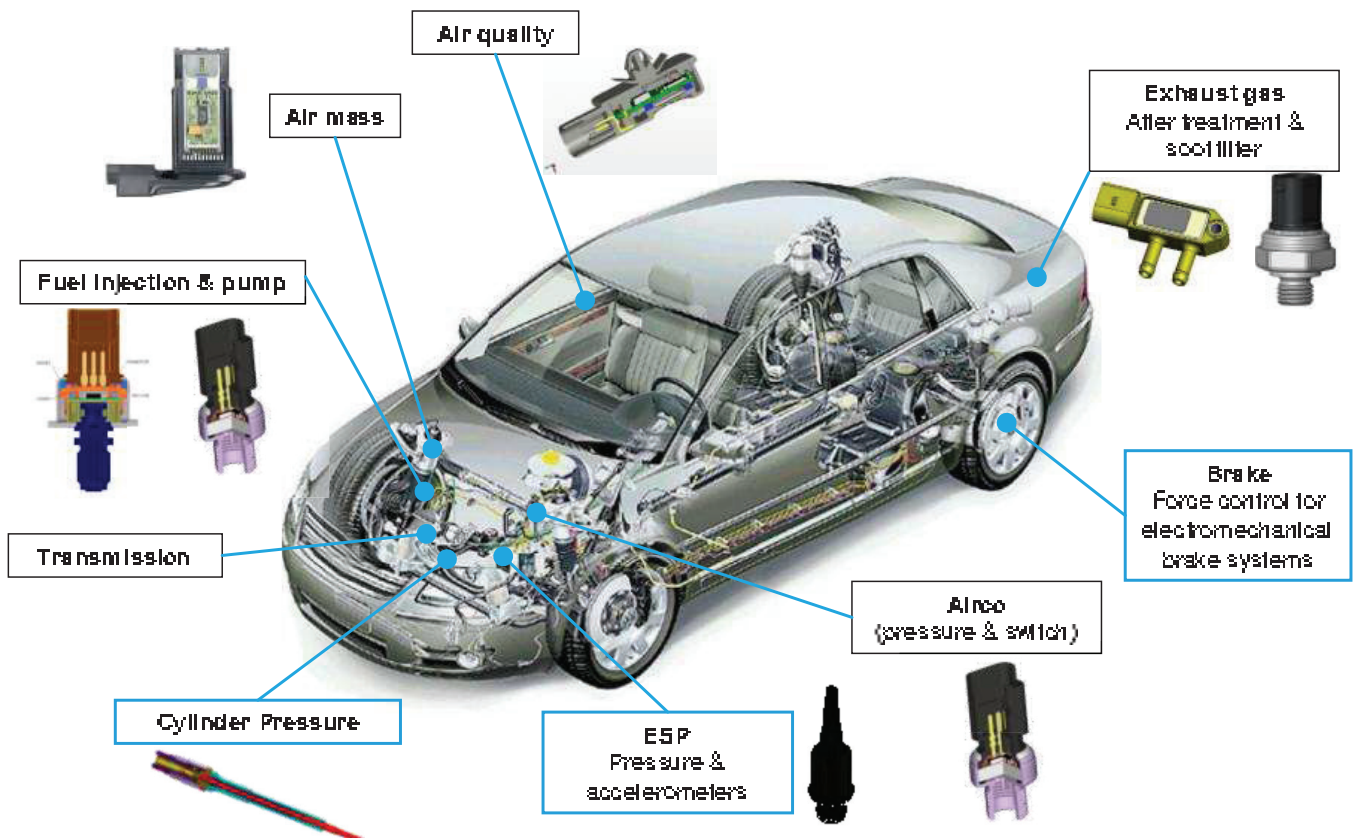
Reduction of vehicle tests



EMC & ESD on different levels

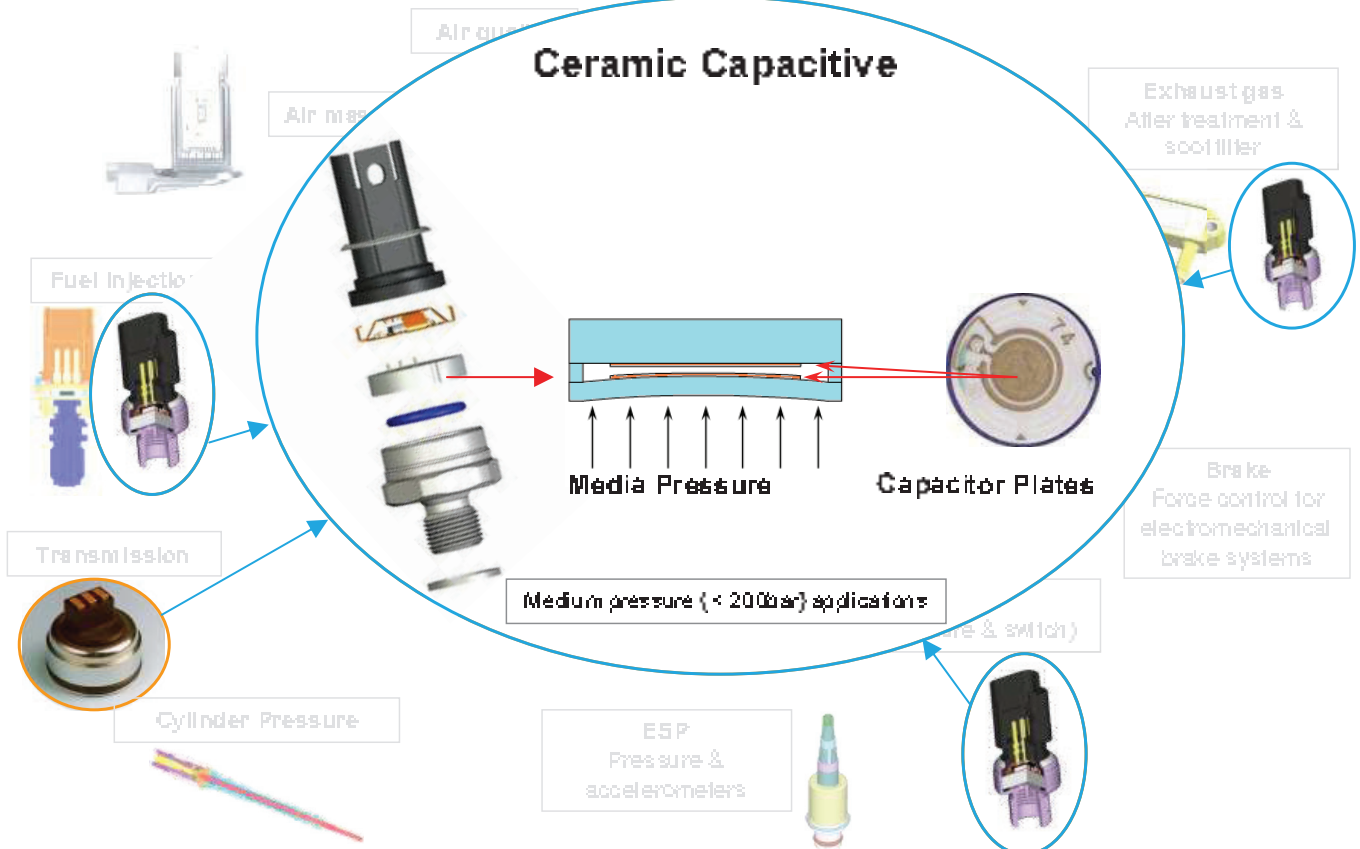


Automotive Sensors



Pressure Sensing Technologie

Ceramic Capacitive



ESD situations

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



Important to control ESD at Sensata

What is ESD?

ESD - ElectroStatic Discharge

= Discharge of static electricity or electrostatic induction



Airplane... Refueling... ESD risk?



Robustness against high voltage



ESD private life

ESD, who should know about it...

Everybody needs to understand ESD rules & requirements!

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

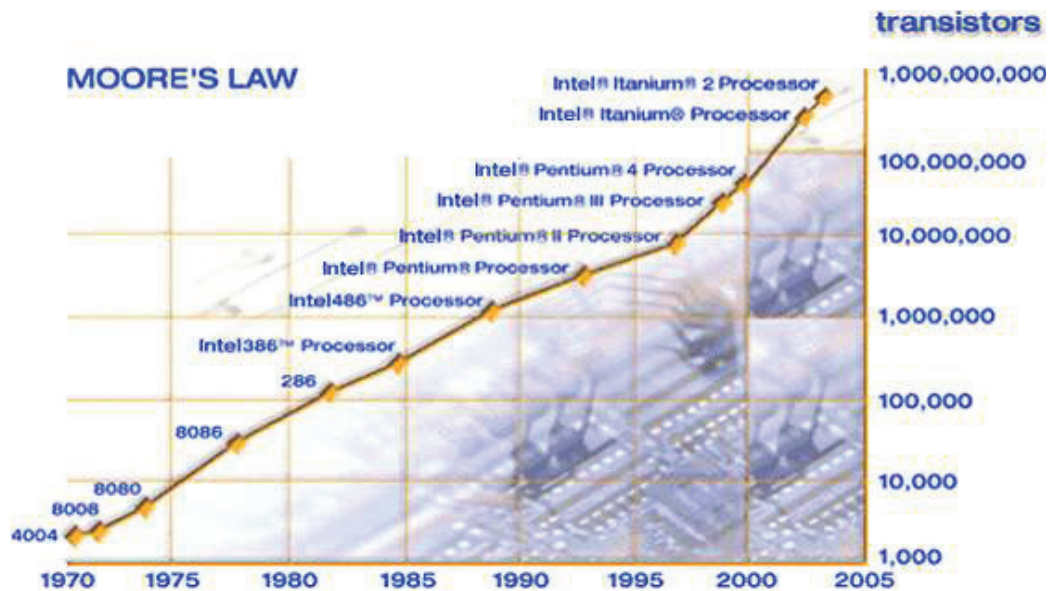
Why everybody?

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

Why ESD damage risk increases?

Open sensor products get more sensitive:

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

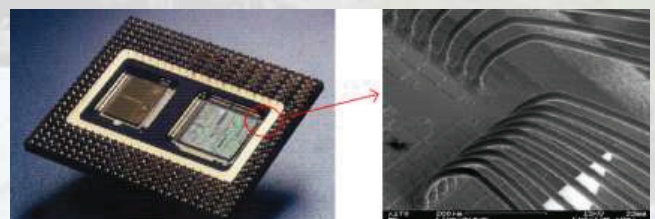


Why ESD damage risk increases?

Product ESD immunity: higher than 10volt → Damage risk

• Open sensors → Sensors ESD protection doesn't work

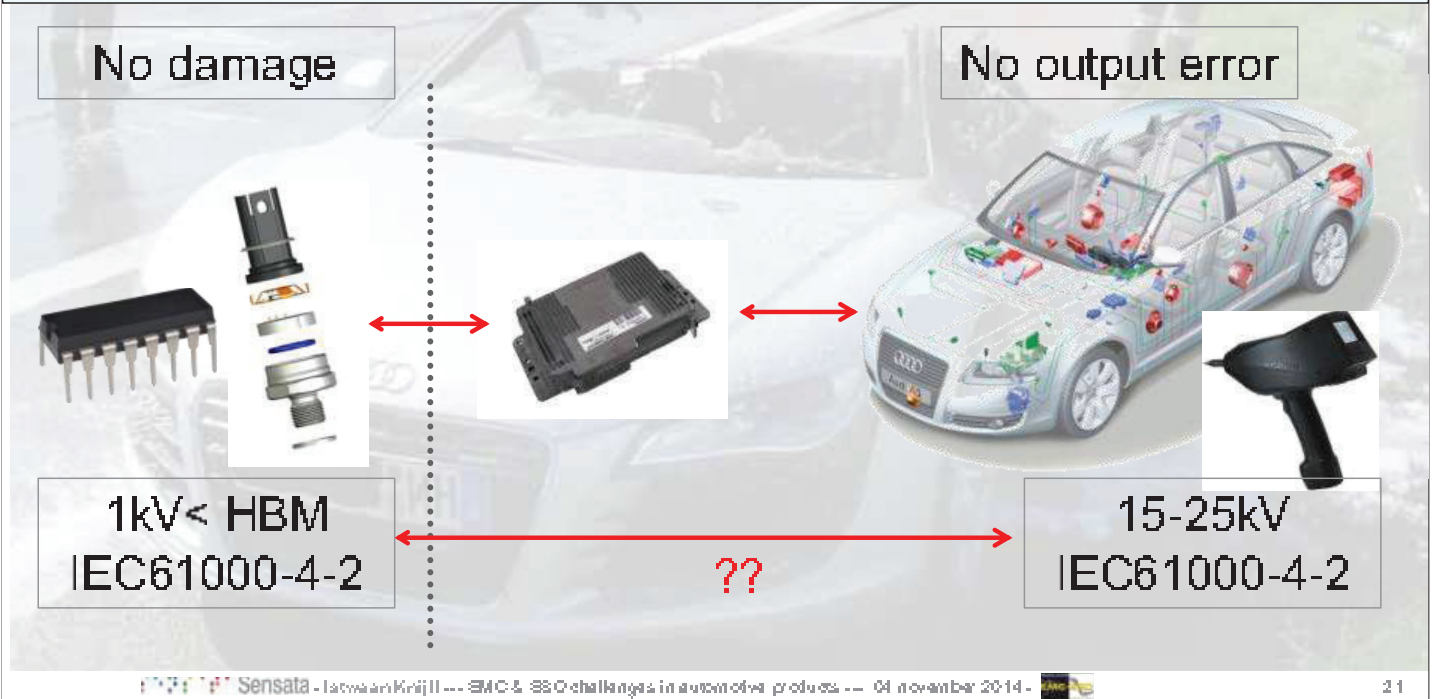
Device Type	Threshold Susceptivity (Volts)
* MOSFET	10-100
* VMOS	30-1800
* NMOS	60-100
* GaAsFET	60-2000
* EPROM	100+
* CMOS	200-3000
* GaAsFET	25-50
* JFET	140-7000
* SAW	150-500
* Op-AMP	190-2500
* Schottky Diodes	300-2500
* Film Resistors	300-3000
* Bipolar Resistors	300-7000
* ECL	500+
* SCR	500-1000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



ESD: not disturbance or destroyed?

Product ESD immunity: higher than 10volt → Damage risk

• Open sensors → Sensors ESD protection doesn't work



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

Other EMC Requirements

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Frequency [MHz]

Power Spectral Density [dBm/Hz]

ESD factory control in real life

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ESD Control steps

Eliminate & Reduce ESD generation (1/5)

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Basic ESD principles for ESD control

1. Immunity – Good sensor design – product specification/ requirement
2. Eliminate & Reduce generation of ESD
3. Dissipate & Neutralize
4. Protect products from ESD

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Eliminate & Reduce ESD generation (1/5)

NO Charge ↔ NO Discharge

- NO ESD risk materials allowed → Triboelectric
- Keep everything same potential → no discharge
- Good grounding procedure → Wrist straps / footwear

Good grounding available for all conductive items

Figure 3: How current flow through a conductive item is grounded.

Figure 4: The relationship between resistance (or safety ground) and earth ground.

Figure 5: Grounding strategy for electronics without AC power.

All items: 1.0 same potential = wrist strap, table, shoe, floor etc.

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Dissipate & Neutralize ESD

If static generation can't be eliminated:

- Proper grounding – Personnel, equipment, floor, etc..
- Dissipative materials – Production setup, materials in use, etc..
- If insulators required in production – Ionizers might be required

Wireless wriststrap... Do they work?

Personal grounding

Check our products How and Where to Order Search

WIRELESS WRIST STRAP

The Cordless Solution which enables free movement of personnel in factories, stock rooms, development laboratories, service areas and anywhere in transit protecting against static charge levels exceeding 500V.

It operates using a combination of several physics phenomena like "Ion Neutralization, Skin Effect, Point Discharge and Corona Discharge Effect" combined with the principle of differential potential to collect and dissipate static electricity.

It is a combination of bio-industrial and electronic technologies.

In effect, the wireless wrist strap slowly neutralizes static electricity on a human body and maintains the potential of a human body below 500V, which is a great improvement from 3 to 5 kV measured without the wrist strap.

The wireless wrist strap is not intended to replace conventional wrist straps. However, Model AML-301A, which is a cordless wrist strap "-", stocked with an additional coil cord for direct grounding, not only replaces conventional wrist straps, but provides additional protection when a person using it has to move away from the hard wired grounding point, (which is often a case in the electronics assembly, kitting, stock room, inspection, service or development working environments).

Practical Points, Benefits and Precautions:

- Please, do not touch electronics components immediately after installing the wireless wrist strap on your wrist. Allow minimum 60 seconds for the wrist strap to neutralize high levels of static electricity already existing on your body.
- Do not use wireless wrist strap as your primary grounding device (unless it is a 2 in 1, Model AML-301A and is used with the grounding cord).
- Since the wireless wrist strap decreases the positive electrical charge on a human body, it makes the person wearing it feel refreshed and energetic. This increases personnel awareness and productivity.
- You may have heard about negative effect of positive ions on humans or positive effect of negative ions which neutralize the negative ones. No matter what is the source of negative ions, their neutralization will help your productivity. You may find the information about the effect of ions on humans on the internet.
- If you use 2 in 1, Model 301A wrist straps, you will have conventional grounding and an additional positive ion neutralizer.

Independent product testing:

Our cordless wrist strap were tested independently by Sanyo Electronics of Japan and are widely used by this company.

The test was performed under the following conditions:

- Room Temperature: 25 deg. C
- Humidity: 40%RH



Fire suppression system EMI issue



Lightning on Car



Start @ 3min

