

# TestingExpo 2000

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## European research at EMC system level

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# Contents

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1. Introduction
2. Number and complexity of electronics in vehicles
3. Cable harness issues in vehicles
4. Current situation : EM coupling on cables
  - 4.1 Theoretical models
  - 4.2 Present ESA test techniques
  - 4.3 Limitations of ESA EMC measurement techniques : example BCI test set-up
  - 4.4. Validation tests
5. Application of EMC automotive directive 95/54/EEC in Europe
6. Cabling issues and the authorities
7. GEMCAR project
8. Conclusion

# 1. Introduction

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- Safety issues of GSM in neighbourhood of fuel station (Malaysia)
- In general
  - Use of GSM not under control
- Little knowledge of coupling paths to cabling  
→ no system approach
- Important problem (product liability) for the smaller ESA/vehicle manufacturers

## 2. Number and complexity of electronics in vehicles

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- Now up to 15 % of vehicle cost, future 20-25 %
- Examples :  
Use of electronics in :  
ABS, motor adjustments, gearbox, consumer (audio, video) information technology (Internet), GPS, “Drive-by-wire”
- Frequency domain up to 80 GHz  
Examples of mobile communication applications :  
GSM : 890-960 MHz P from 3,7mW-20W (mostly 2 + 8W in some countries)  
DCS1800 : 1700-1900 MHz P from 250mW - 2W  
→ Use of the antenna may lead to dangerous coupling to sensitive cabling

### 3. Cable harness issues in vehicles

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In an “average” vehicle :

! Total length of all wires	: 2.500 m
Weight	: 40 kg
Number of contacts	: 2.300
! $\emptyset$ principal cable loom	: 70 mm
Costs	: 1.000 EURO
Development volume	: 4 man-year
! Average length of a connection	: 2,5 m

# 4. Current situation : EM coupling on cables

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## 4.1 Research on theoretical models

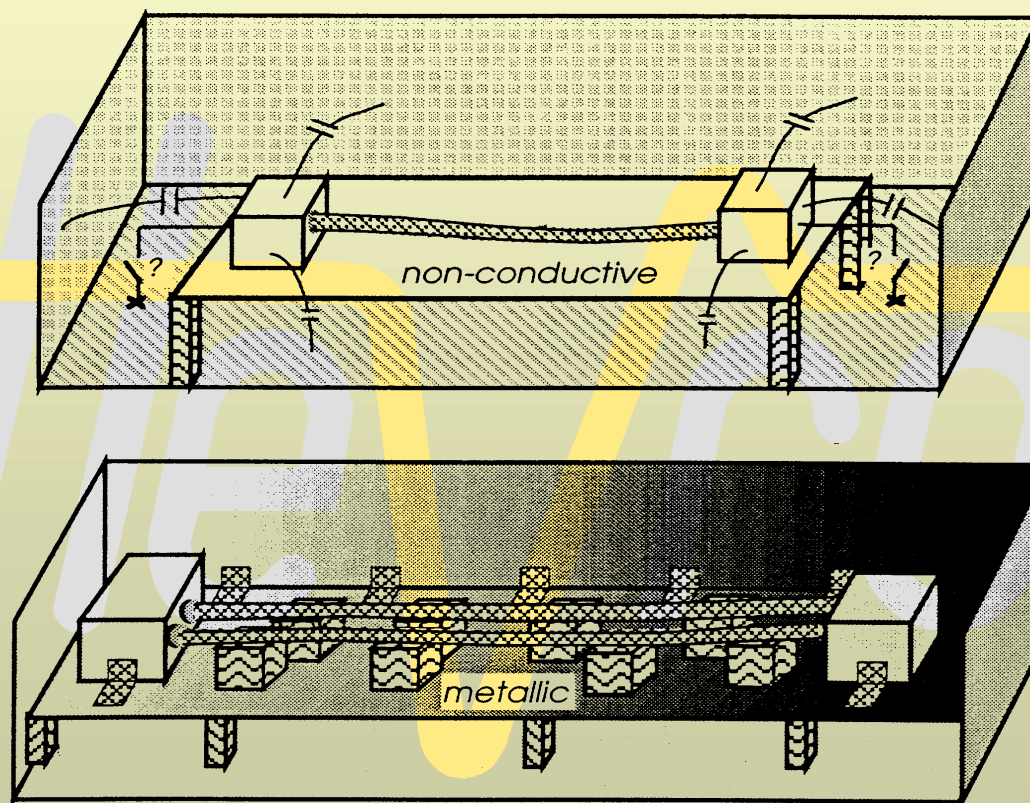
1. Simple model
  - box-to-box model
2. Choice of the modelling technique
  - MoM : Method of Moments
  - FE : Finite Elements
  - FDTD : Finite Difference Time Domain
  - TLM : Transmission Line Method
3. Validation of the modelling techniques
  - standard cases (generic models)
    - modelling
    - measuring

### **Conclusion :**

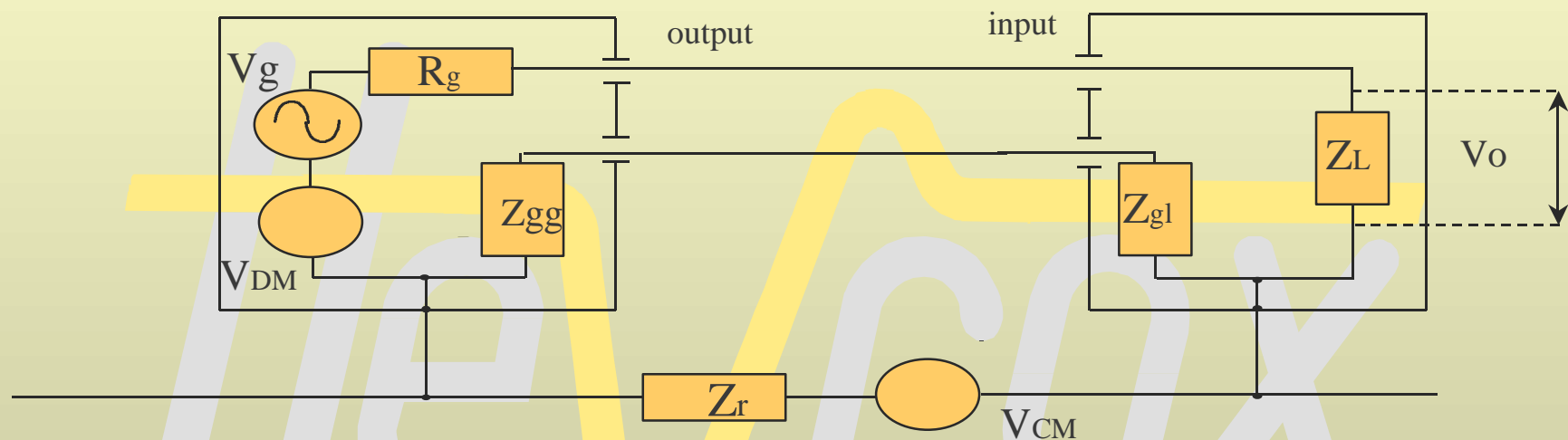
- Lack of theoretical models to analyse accurately the cable coupling issues
- Also lack of validation measurements in anechoic chambers and in vehicles

## 4.1 Research on theoretical models - continued

Examples (2) of the basic test set-ups for cable harness testing :



## 4.1 Research on theoretical models - continued



Box-to-box model

## 4.2 Present ESA test techniques (EMC)

### Draft ISO 11452 (1997)

Part 2 : Absorber lined chamber

Part 3 : TEM cell

Part 4 : BCI

Part 5 : Stripline

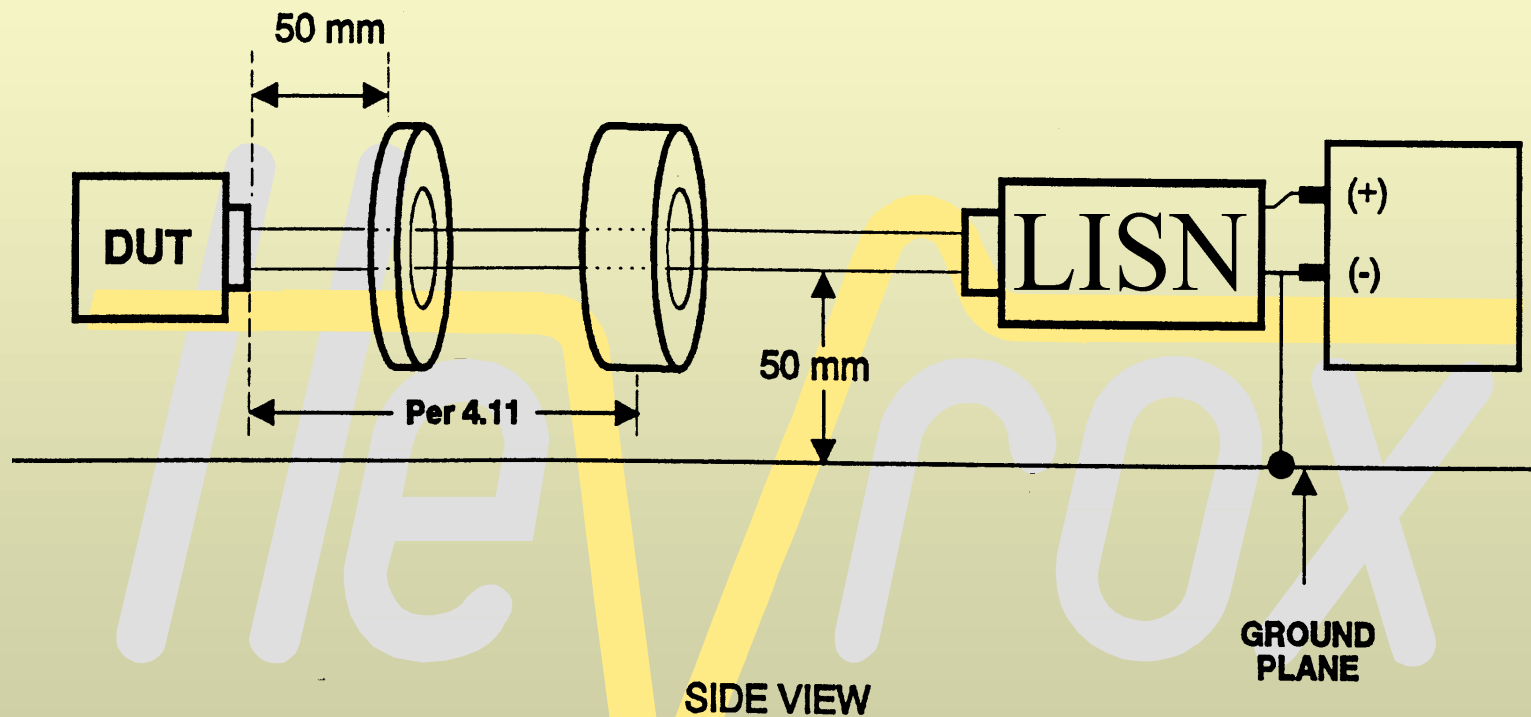
Part 6 : Parallel plate antenna

Part 7 : Direct RF power injection

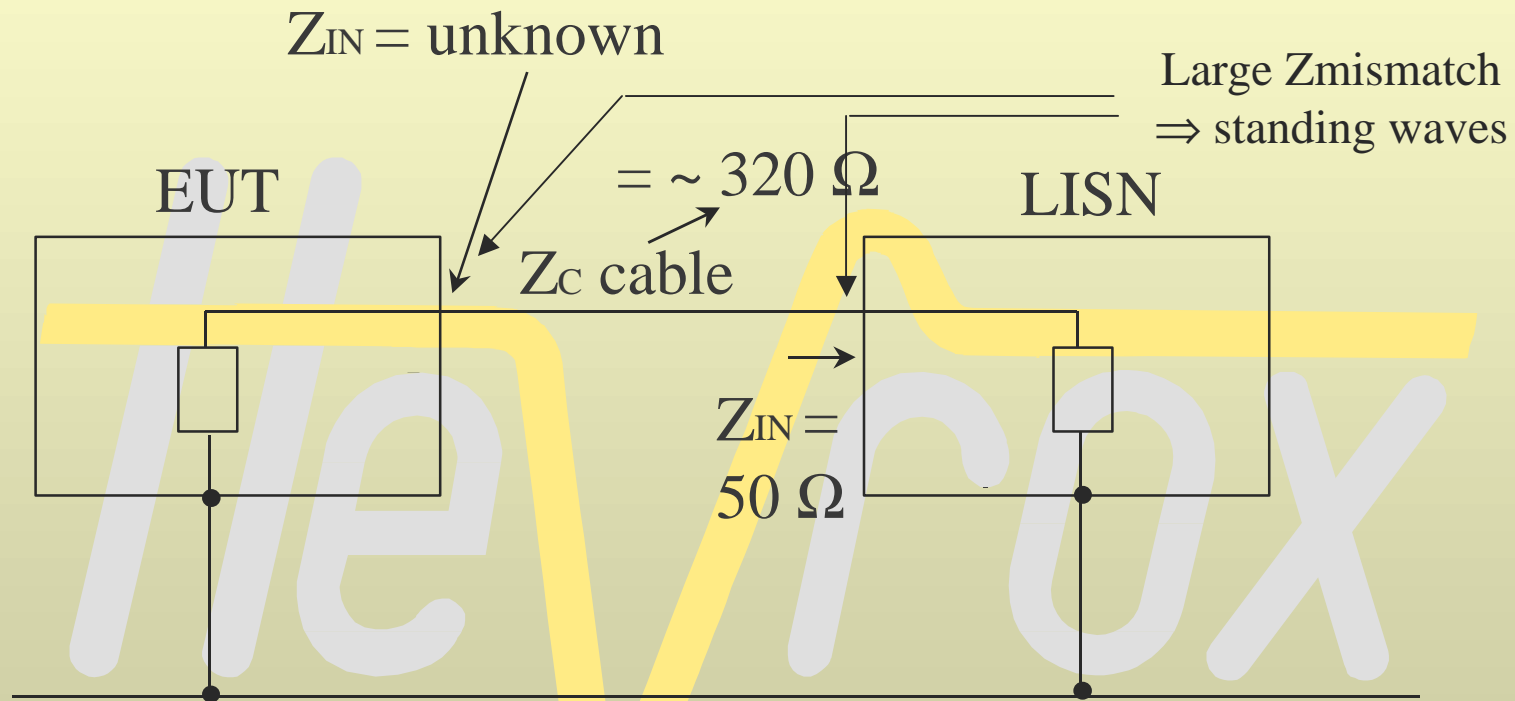
- No correlation between them
- No correlation ESA - vehicle test techniques

## 4.3 Limitations ESA EMC testing techniques

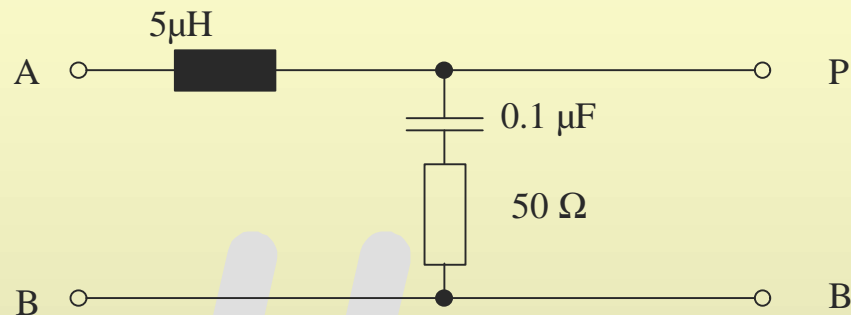
Example : BCI test method



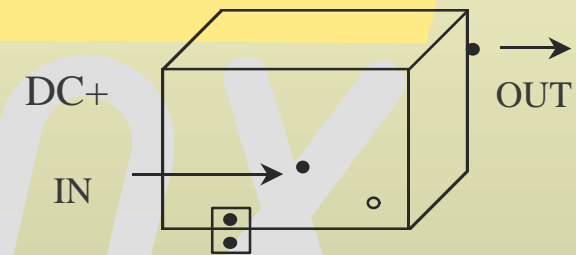
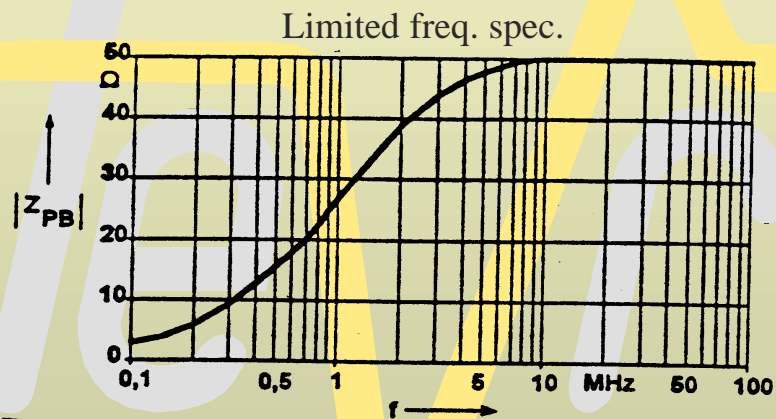
### 4.3 Limitations ESA EMC testing techniques : BCI test set-up - continued



## 4.3 Limitations ESA EMC measurement techniques : BCI test set-up - continued



A : power supply  
B : ground reference  
P : EUT

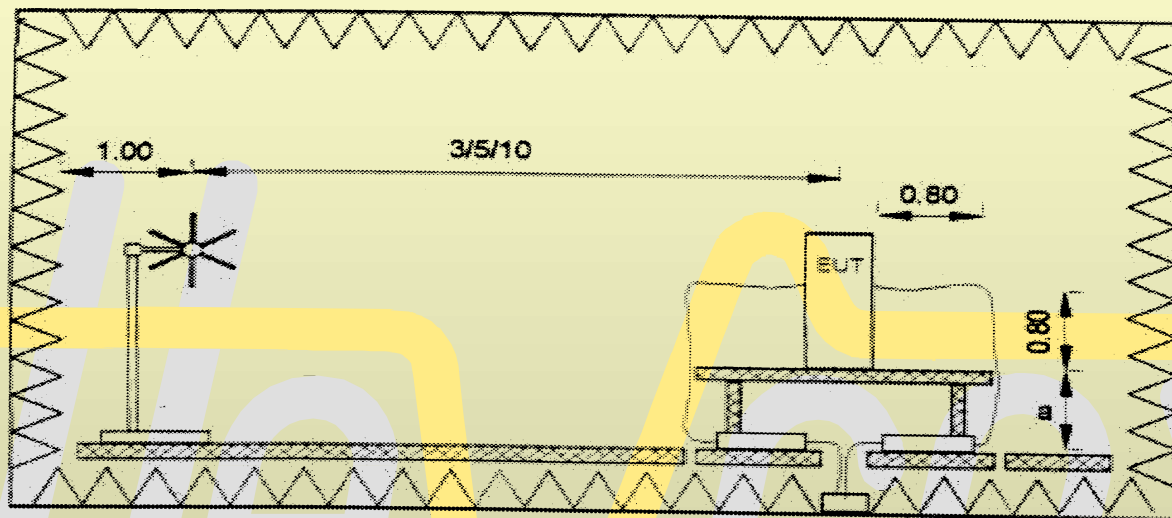


### Conclusion :

Frequency domain is only specified up to 100 MHz → in reality measurements must be performed up to 1 GHz and in the future up to at least 1,8 GHz !

## 4.4. Validation tests

Emission Measurements in Fully Anechoic Chamber (FAC)  
according to EN50147-3 (TC 210/WG4 : Feb. 98)



Typical test set up in fully anechoic chamber

Uncertainty 3 m OATS : + 4.2  
- 3.6 dB

Uncertainty 3 m FAC :  $\pm 3.7$  dB

$\Rightarrow$  FAC better than OATS !

But FAC test method still in progress

# 5. Application of EMC automotive directive 95/54/EEC in Europe

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## 1. Competent authorities

- 95/54 is vertical directive (includes specific test levels)  $\Rightarrow$  not correlated with 99/336
- issue of spot frequency immunity & emission testing still not resolved

## 2. Accredited test labs

- Technical services provide ESA/Vehicle EMC test reports
- Open issue ref. antenna factors for 1 m semi-anechoic emission testing

**95/54/EEC is fully applicable as of 1 October 2002**

but some essential test standards may not be available

## 6. Cabling issues and the authorities

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- Cable harness will become a sort of “ESA”, which should be type approved
- How to classify, to follow up
- Technical issues
  - signal integrity
  - crosstalk
  - impedance control
  - earthing
  - shielding
- Who has system responsibility ?
  - the ESA-manufacturer and/or the vehicle manufacturer ?
  - final system liability : should be with vehicle manufacturer

# 7. GEMCAR project

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*Gemcar stands for “Guidelines for ElectroMagnetic Compatibility modelling for Automotive Requirements”*

- European EMC research project within FW V of EC
- Consortium members from BE, FR, CH, UK.
- EMC modelling guidelines
- Details on <http://www.gemcar.org>
- Completed questionnaires required by (future) users ⇒ refer to MIRA BOOTH

# 8. Conclusion

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## *EMC Automotive issues :*

- high demands on ESA-suppliers  
→ reasons to group 1st Tier suppliers
- injected (V/m) levels and frequencies are high  
→ danger for interferences must be considered seriously (= responsibility of vehicle & ESA manufacturer)
- low correlation between EMC tests of :
  - ESA's
  - ESA/vehicles
- problem for the authorities to :
  - follow-up technical files
  - to determine who has the end responsibility in case of interference
- more fundamental and applied research as GEMCAR is necessary.