

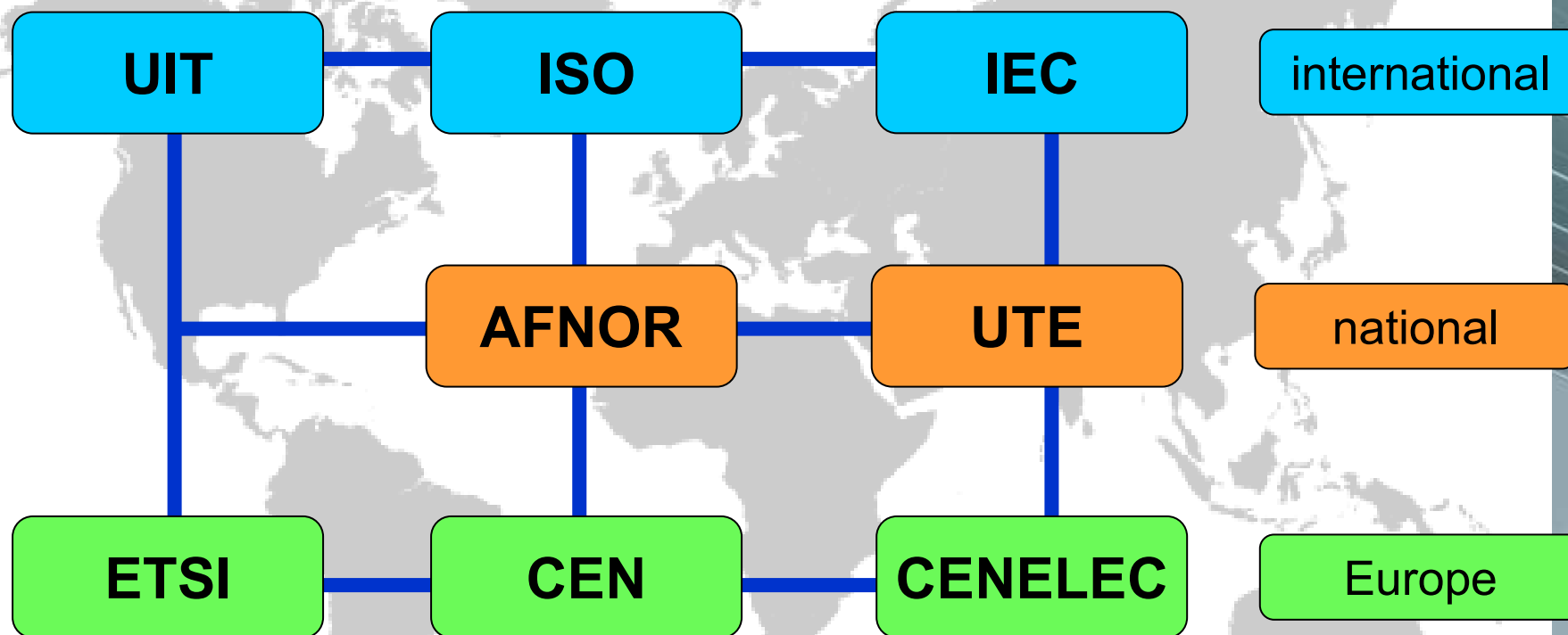


**Integrated Circuit level**

**EMC Measurement method**

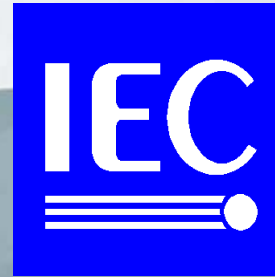
**EME / EMI modeling**

**MAROT Christian**  
**EMC Expert**  
**EADS IW**





**IEC SC 47A / WG 2, 2000  
EMC MODELLING  
Convenor : Japan, Mitani H,**



**IEC SC 47A / WG 9, 1996  
EMC measurement methods  
Convenor : France, Marot Ch**

**Prepare international standards for EMC measurement  
and modeling at integrated circuits level  
that are acceptable to the manufacturers and customers**

**National mirror committee**



France

US

UK

Japan

Nederland

Germany

Italy

Poland



**UTE : SC 47A / WG EMC , 1996**



## SC 47A UTE Members



### Animateur / UTE

**EADS-IW** : Christian Marot  
**UTE** : Adel Guerini

### IC manufacturers

**ST** : Philippe Dupre  
**ATMEL** : Jean-Luc Levant  
**T.I.** : Jean-Claude Perrin  
**Freescale** : John Shepherd

### IC users

**Continental** : Andre Durier  
**EADS – AIRBUS** : Alain Sauvage  
**Valeo** : Frederic Lafon  
**EADS-IW** : Marc Meyer

### University support

**ESIGELEC** : David Baudry  
**ESEO** : Mohamed Ramdani  
**LESIA** : Etienne Sicard



## SC 47A IEC WG2 , WG9 Members



### IC manufacturers / users

**FR:** Christian MAROT, EADS IW,  
Jean Luc LEVANT, Atmel  
Frederic LAFON, Valeo  
John SHEPHERD, Freescale

**NL :** Boris TRAA, Philips Applied

**CH :** Christian TERRIER, EM Microelectronic

**US :** Ross CARLTON, NI

**DE :** Frank KLOTZ, Infineon  
Guenther AUDERER, Freescale  
Hans-Werner LUETJENS, NXP

**JP:** Atsushi NAKAMURA, Renesas Technology  
Goichi YOKOMIZO, Renesas Technology y  
Kouji ICHIKAWA, Denso  
Norio MASUDA, NEC  
Shinichiro MITANI, Hitachi  
Yoshiyuki SAITO, Matsushita Electric Industrial

**KR :** Byoung Nam LEE , Soon Il YEO  
Electronic, Telecom research inst

### University support

**IT :** Francesco MUSOLINO, Politecnico di  
Torino  
Franco FIORI IT Politecnico di Torino

**PL :** Jerzy F. KOLODZIEJSKI, Institute of  
Electron

**JP :** Osami WADA, Kyoto university



## IEC 61967-1, Ed.1: Integrated circuits – Measurement of electromagnetic emissions, 150 kHz to 1 GHz -

- part 1 : General conditions and definitions → IS (International Standard)
- part 1-1: Near-Field Scan Data Exchange Format → TR (technical report)
- part 2 : TEM cell and wideband TEM cell method → IS
- part 3 : Surface scan method → TS (technical specification)
- part 4 : 1  $\Omega$ /150  $\Omega$  direct coupling method → IS
- part 4-1 : Application guidance to 1  $\Omega$ /150  $\Omega$  direct coupling method → TR
- part 5 : Workbench Faraday Cage method → IS
- part 6 : Mode Stirred Chamber method → IS
- part 7 : Mode Stirred Chamber method → DNP (draft new proposal)
- part 8 : IC Stripline method → CDV (committee draft for voting)

## IEC 62132-1, Ed 1: Integrated circuits – Measurement of electromagnetic immunity, 150 kHz to 1 GHz

- part 1 : General conditions and definitions → IS (International Standard)
- part 2 : TEM cell and wideband TEM cell method → IS
- part 3 : Bulk Current Injection (BCI) method → IS
- part 4 : Direct RF Power Injection method → IS
- part 5 : Workbench Faraday Cage method → IS
- part 6 : Local Injection Horn Antenna (LIHA) method → NP
- part 7 : Mode Stirred Chamber method → DNP (draft new proposal)
- part 8 : IC Stripline method → CD (committee draft for voting)
- Part 9 : Near Field scan immunity method → DNP



**IEC SC47A WG9**



## **IEC 62228, Ed1: Integrated circuits – IC family specific requirements**

part 1 : DPI on Can BUS → **TS**

## **IEC 62215,Ed1 : Integrated circuits – Measurement of impulse immunity**

part 1 : General conditions and definitions → **NP**

part 2 : Synchronous Transient Injection → **TS**

part 3 : Non-Synchronous Transient Injection → **NP**

part 4 : Surge → **DNP**

part 5 : Supply dips → **DNP**

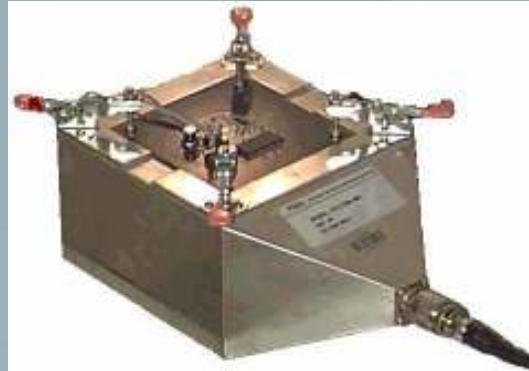
part 6 : Near Field scan immunity method → **DNP**



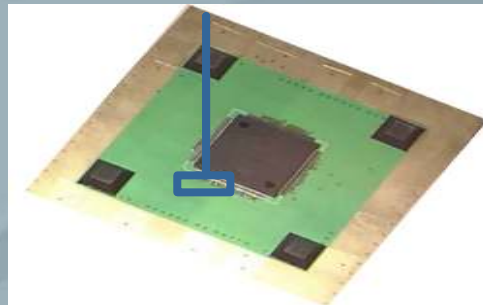
**IEC 62433, Ed. 1**  
**Models of Integrated Circuits for**  
**EMI behavioural simulation**

- part 1 : General modelling framework → CD
- part 2 : Integrated Circuit Emission Model, ICEM-CE → IS
- Part 2-1 : Theory of black box modelling for conducted emission → TS
- part 3 : Integrated Circuit Emission Model, ICEM-RE → DNP
- part 4 : Integrated Circuit Immunity Model, ICIM-CE → DNP
- part 5 : Integrated Circuit Immunity Model, ICIM-RE → DNP
- part 6 : Integrated Circuit Immunity Model, ICIM-PE → DNP

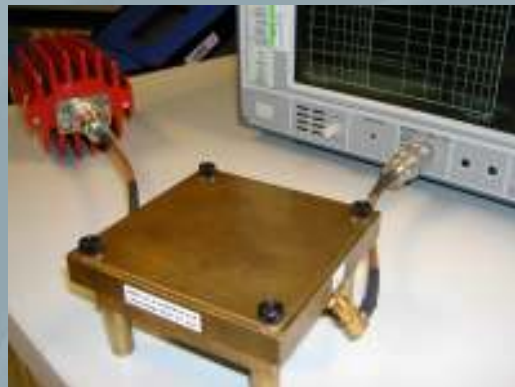
TEM cell



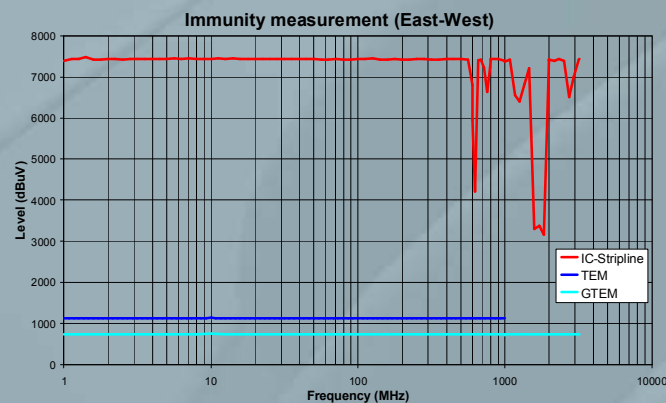
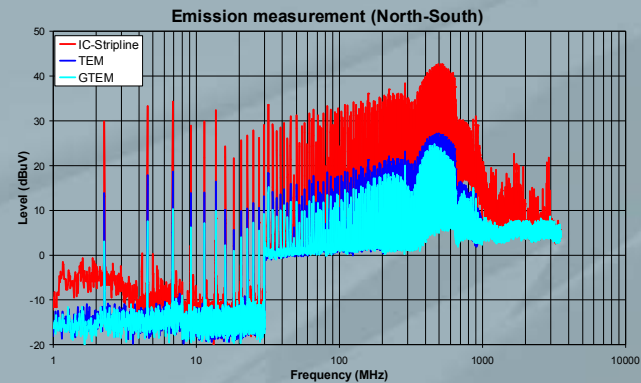
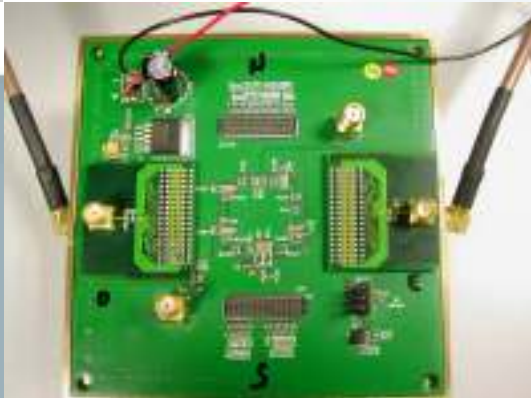
Near Field Scan



Stripline

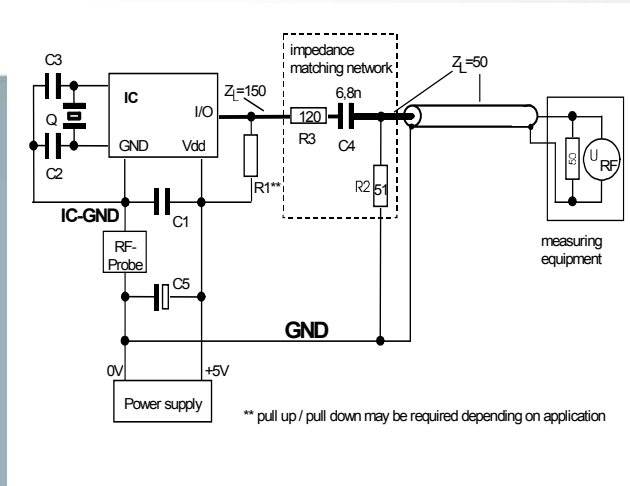


- Emission measurement with low sensibility
- Immunity tested up to 8kV/m
- Frequency range : 150kHz-3GHz
- Identification of hot spot in the IC design
- Need a specific test board
- Light test set-up



- No significant resonances
  - Usable up to 3.2GHz (and more)
- Improved sensitivity over TEM and GTEM
  - 16dB over TEM and 20dB over GTEM
- Considerably increased electric field
  - Up to 8000V/m
  - Detect previously TEM unseen defaults

1Ω /  
150Ω



- Emission measurement on Power and I/O lines

- Low sensitivity with AS or RS

- BCI immunity tested up to 200mA

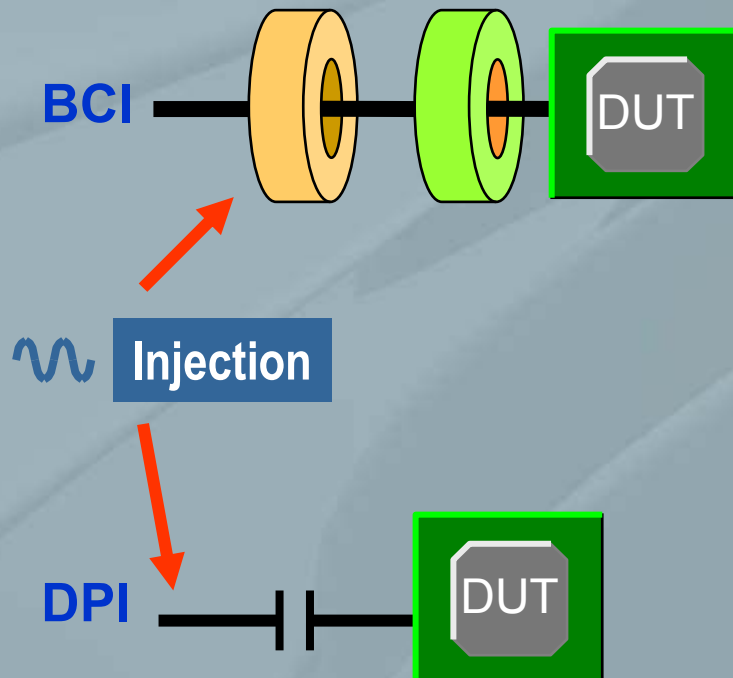
- DPI immunity tested up to 30dBm

- Frequency range :150kHz-3GHz

- Identification of internal crosstalk in the IC design

- Need a specific test board

- Heavy test set-up for multi IC I/O

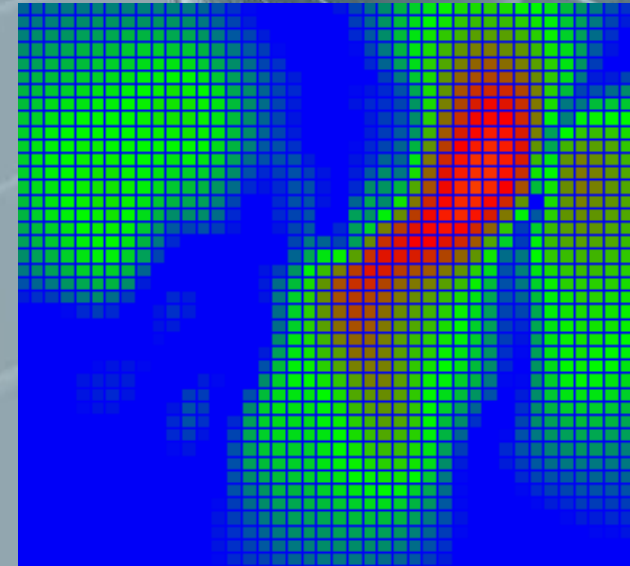




## Format for Near Field scan data exchange

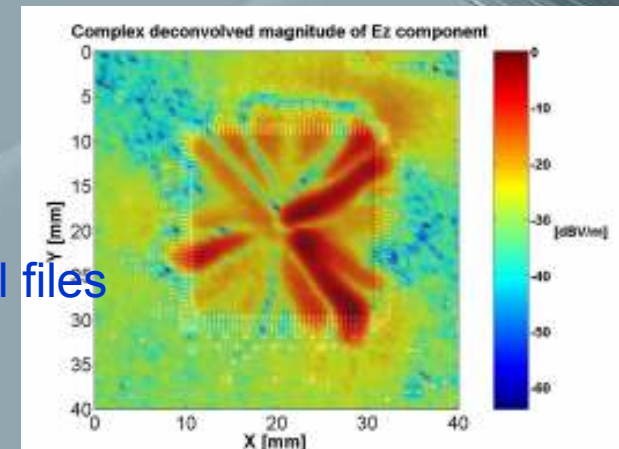


- Facilitate exchange and comparison of results between:
  - Industrials
  - Academics
  - Customers
- Avoid multiple file formats such as:
  - XML
  - Spreadsheets
  - Custom formats
- Flexible and evolutive:
  - Applicable to emission and immunity scans
  - Usable for scans and simulations
  - Easy addition of new functions
  - Adaptable to user requirements
  - Easily convertible to/from other formats



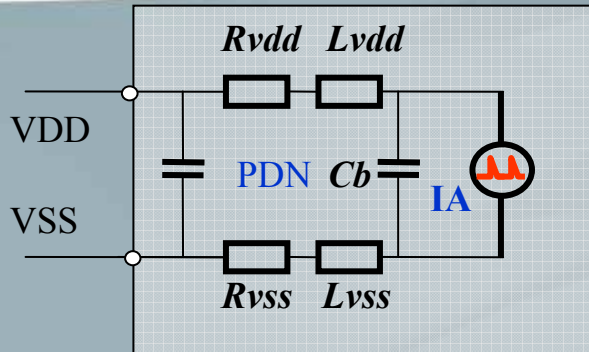
- Human and machine readable:
  - XML format
    - Simple keywords
    - Easily enhanced
    - Well structured
    - Easily parsable by viewers and post-processors
  
- Minimal constraints:
  - Most headers and keywords optional
  - Easily exportable, even between different operating systems
  - Simple file system structure
    - Information contained in a single file or several files
  - Applicable to emission and immunity scans
  - Not linked to a specific NFS setup
    - Scan table
    - Measurement equipment (Spectrum analyser, etc)

```
<?xml version="1.0" encoding="UTF-8"?>
<EmissionScan>
  <Nfs_ver>1</Nfs_ver>
  <Filename>scan_component_v7.xml</Filename>
  <File_ver>7</File_ver>
  <Date>9 October, 2008</Date>
  <Source>Freescale</Source>
  <Notes/>
  <Disclaimer>This file saves result of near field
  <Copyright>This document is the property of
  <Component>
    <Name>16-bit microcontroller</Name>
    <Manufacturer>Freescale SAS</Manufacturer>
    <Notes>Full speed mode</Notes>
    <Image>
      <Path>component_image.JPG</Path>
      <Unit>mm</Unit>
```





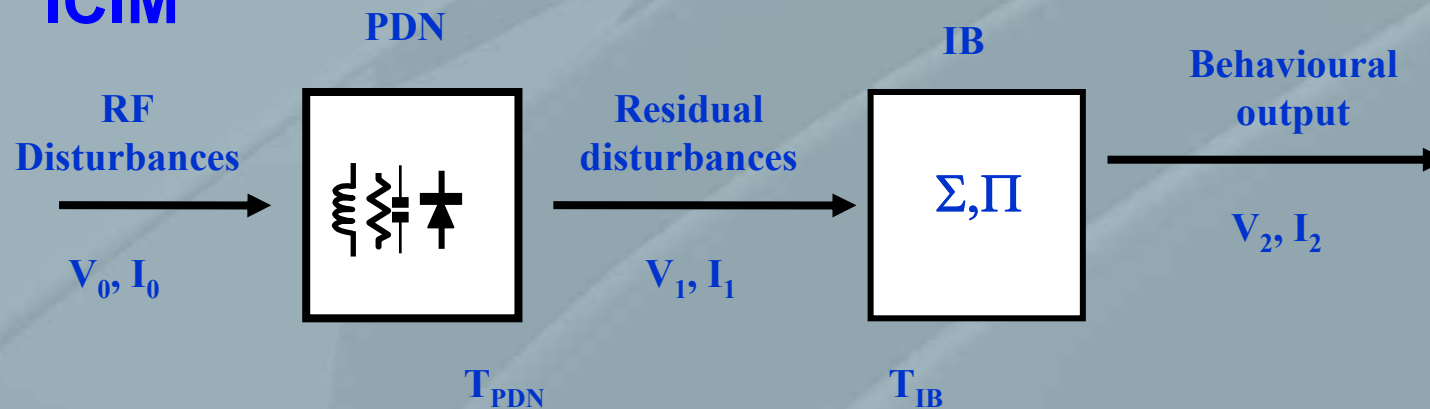
## ICEM



Integrated Circuit Emission Model

- Evaluation of the decoupling network
- Filtering optimization
- Starting to be supported by IC manufacturers
- ICIM is still in definition

## ICIM



Integrated Circuit Immunity Model

