



Basics of EMC

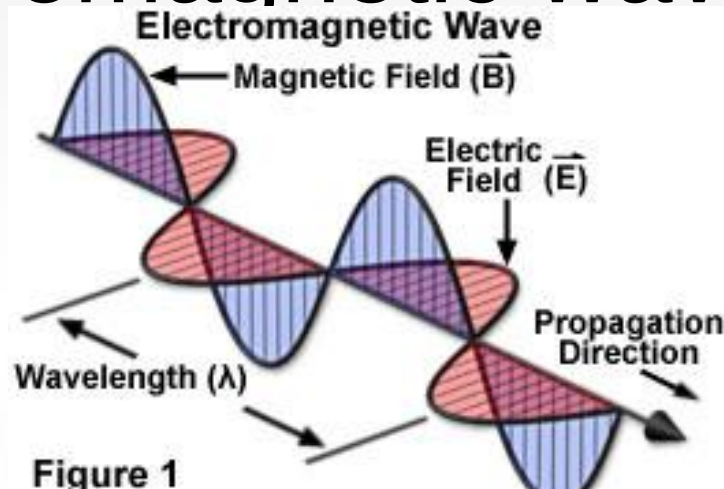
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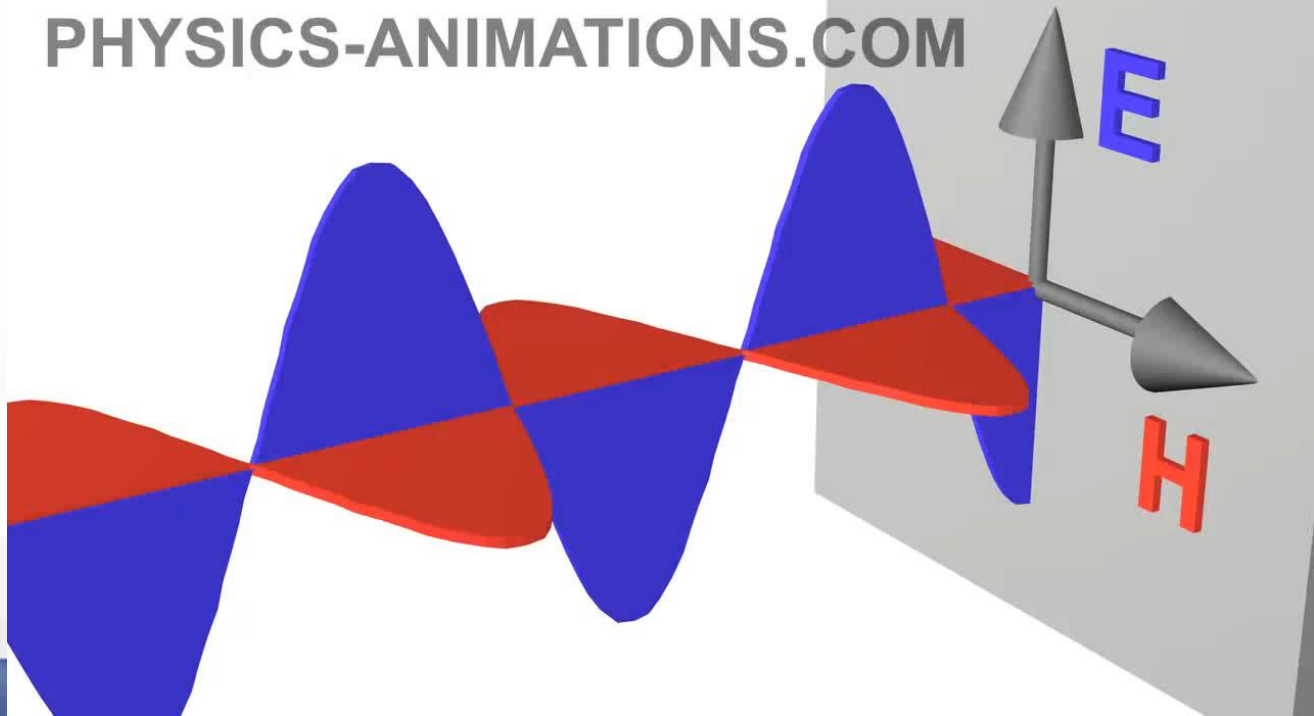
Kais.siala@cert.mincom.tn

Basics of electromagnetics

Electromagnetic waves (3)

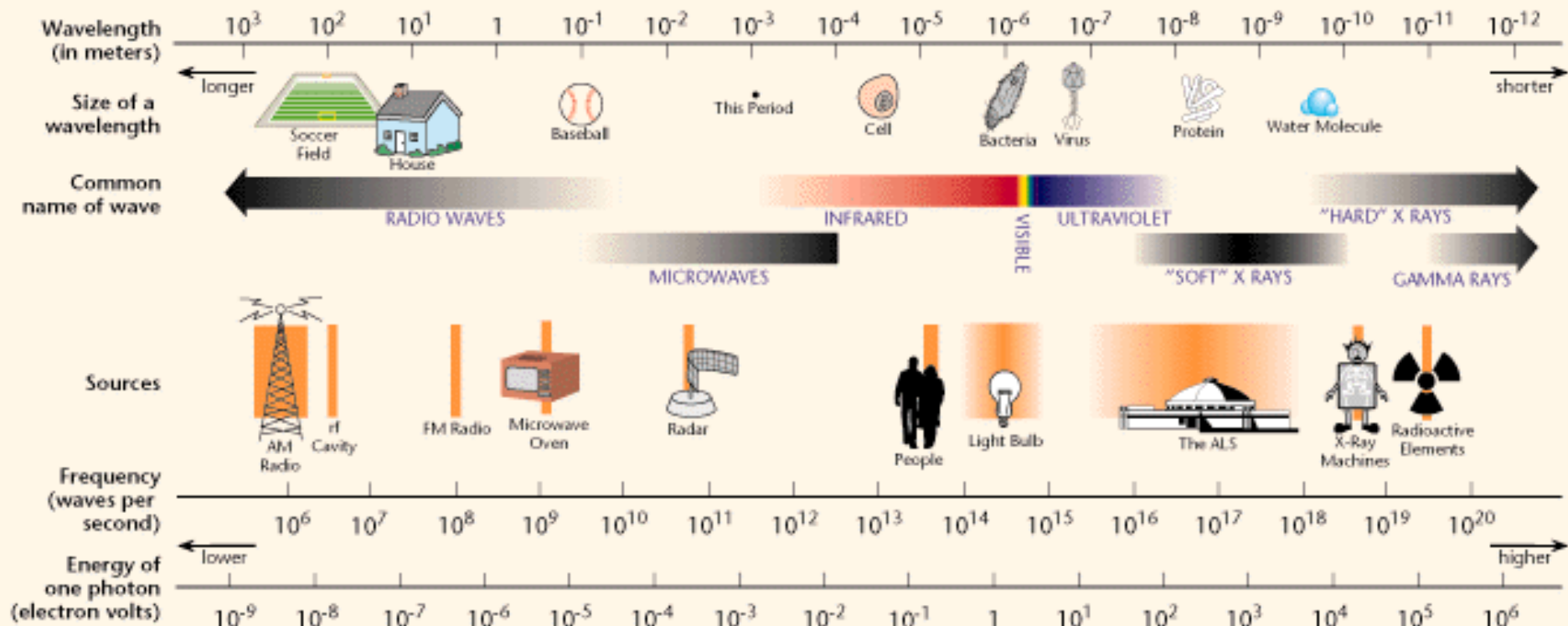


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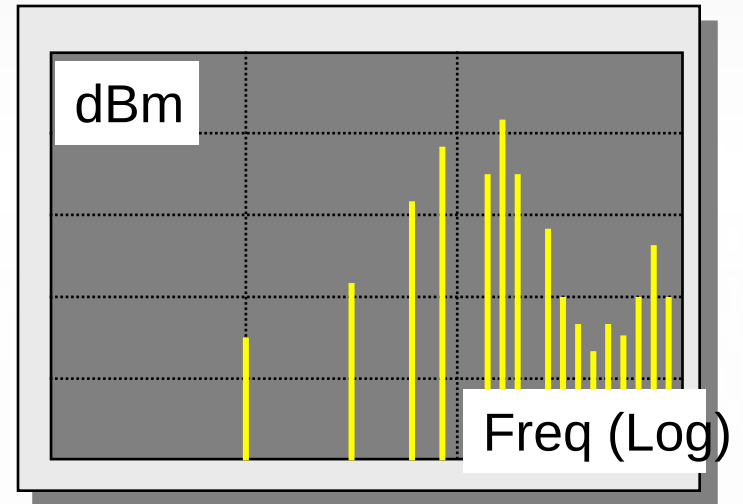
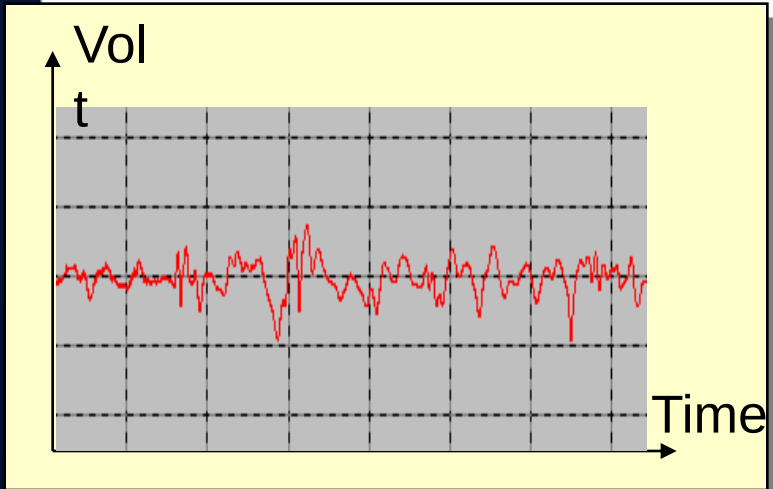


Electromagnetic spectrum

THE ELECTROMAGNETIC SPECTRUM



Specific units

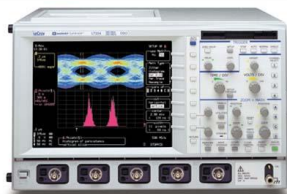


Time-domain measurement



Frequency-domain measurement

Inverse Fourier transform



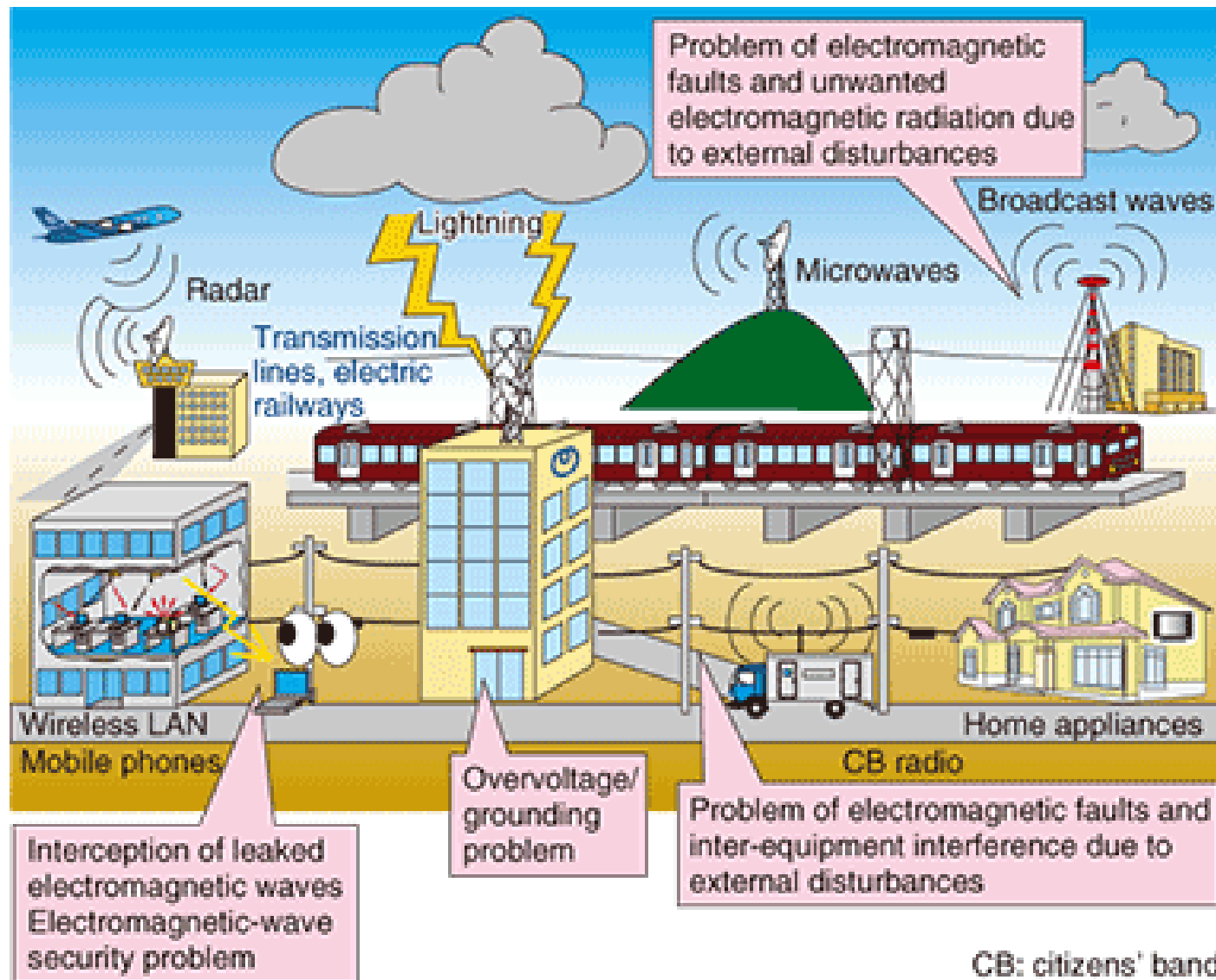
Oscilloscope



Spectrum analyser

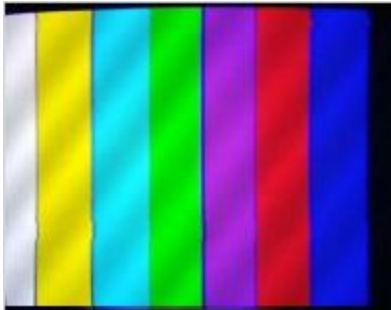
Electromagnetic compatibility

What is EMC?



Example of perturbation

Analogue video signal



- ✓ Moiré
- ✓ loss of luminance, contrast
- ✓ loss of color
- ✓ loss of synchronization

Digital video signal



- ✓ block effect
- ✓ cessation of movement
- ✓ black screen



EMC (1)

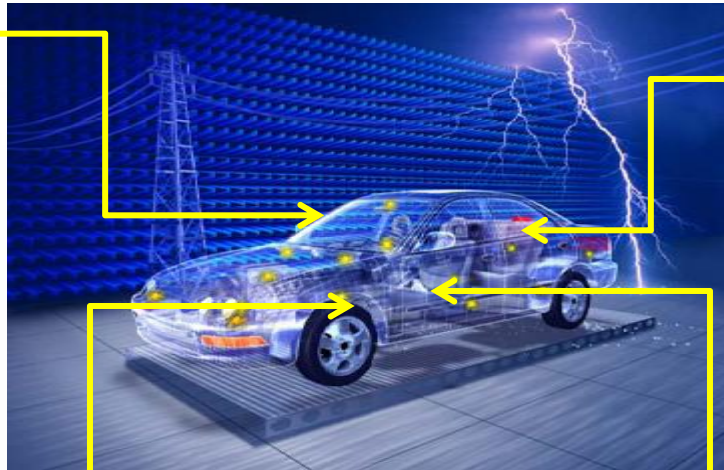
Electric equipment:

1. Victim of its environment:
 - ✓ Malfunction
 - ✓ Temporary malfunction or permanent
2. Source of disturbance in its environment

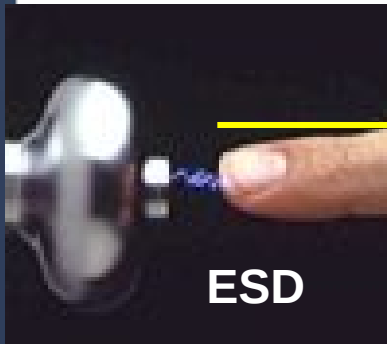
Sources of perturbation



RF tra



Human impacts



ESD

- External Impacts
- Internal Impacts
- Human Impacts



Oragons

Les questions essentielles qui se posent au stade conception

Quelle
réglementation
applicable ?

Étude et développement d'un
équipement

Quel impact de la
réglementation sur les
choix en matière de
conception ?

Existence de
limitations ou
restrictions

Spécification de besoin

Conception du produit

Certification ou
qualification différente
selon les marchés ciblés ?

Nouvelle norme en
préparation ?

Prototype, série

Plan de qualification
défini ?

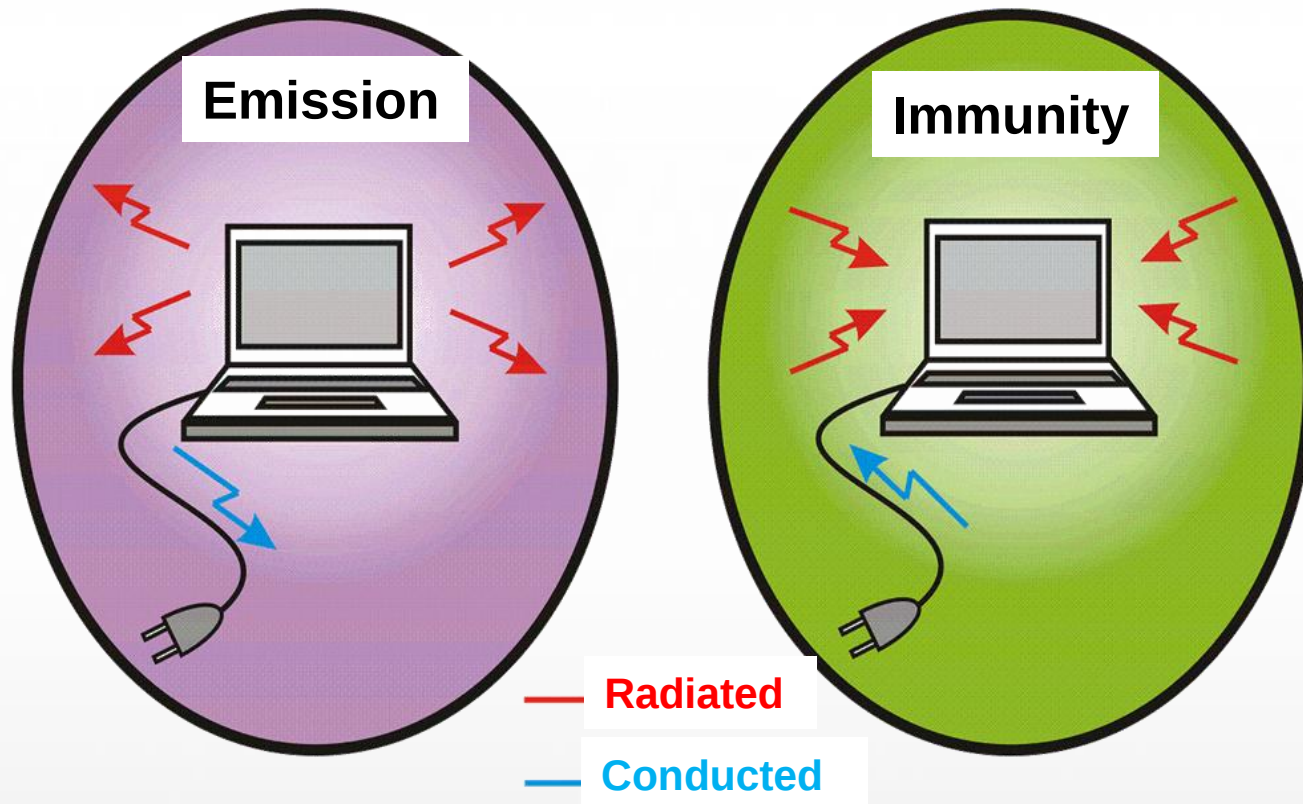
Qualification

Mise sur le marché

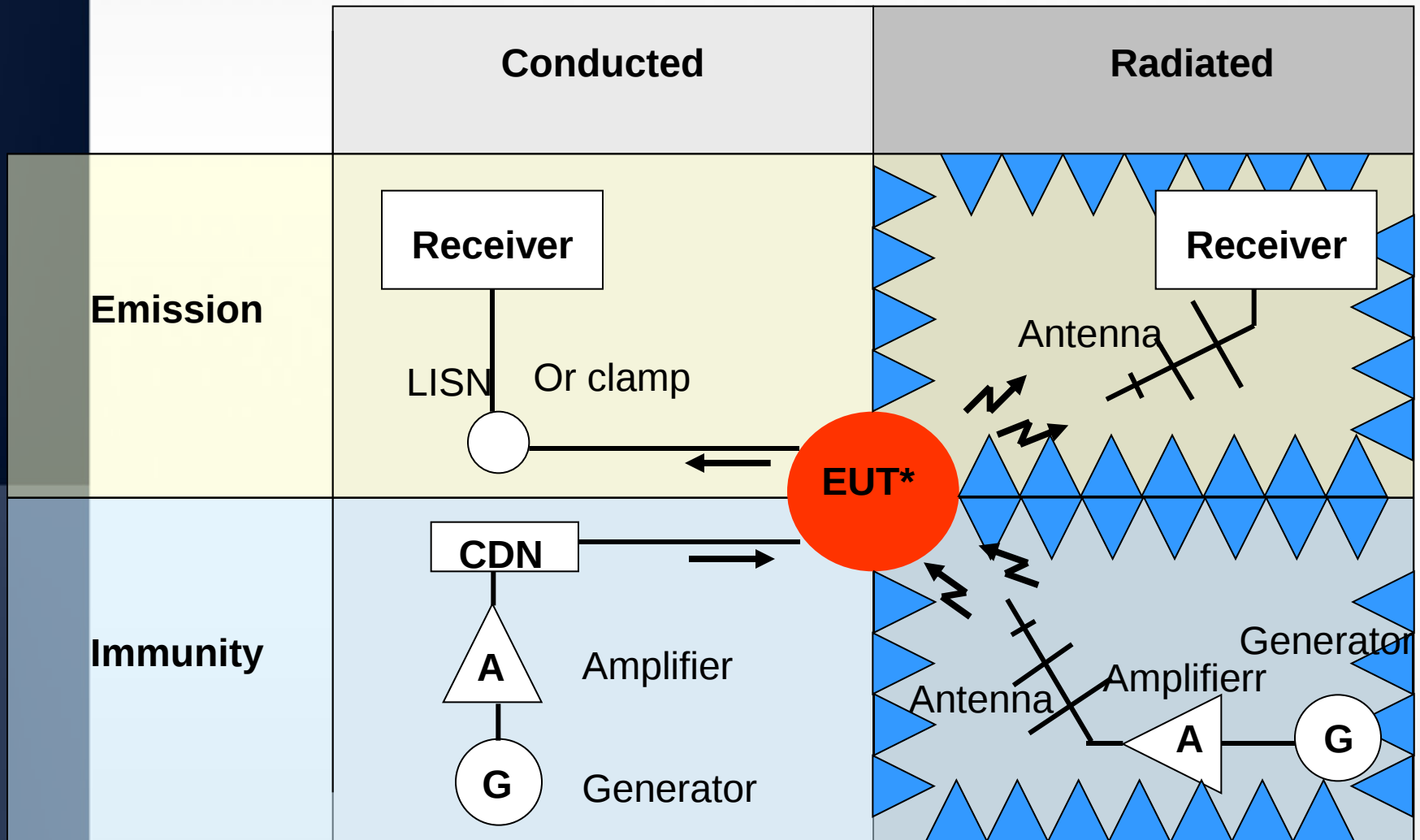
Que nécessite le
maintien de la
certification ou
qualification dans le
processus de
fabrication ?

Types of EMC measures

Mesures CEM



EMC (3)

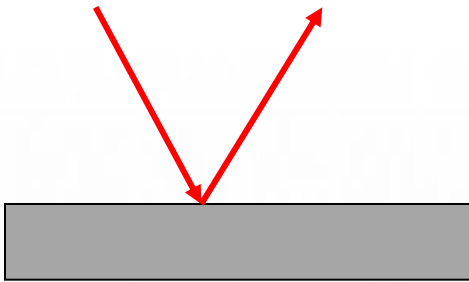


*EUT = Equipement Under Test

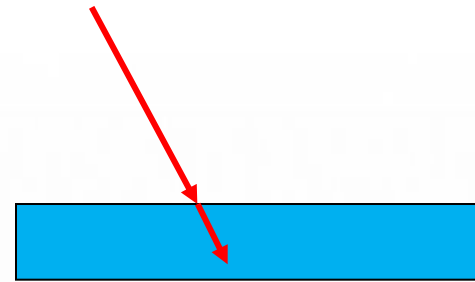
Test sites

Reflectivity

Electromagnetic wave

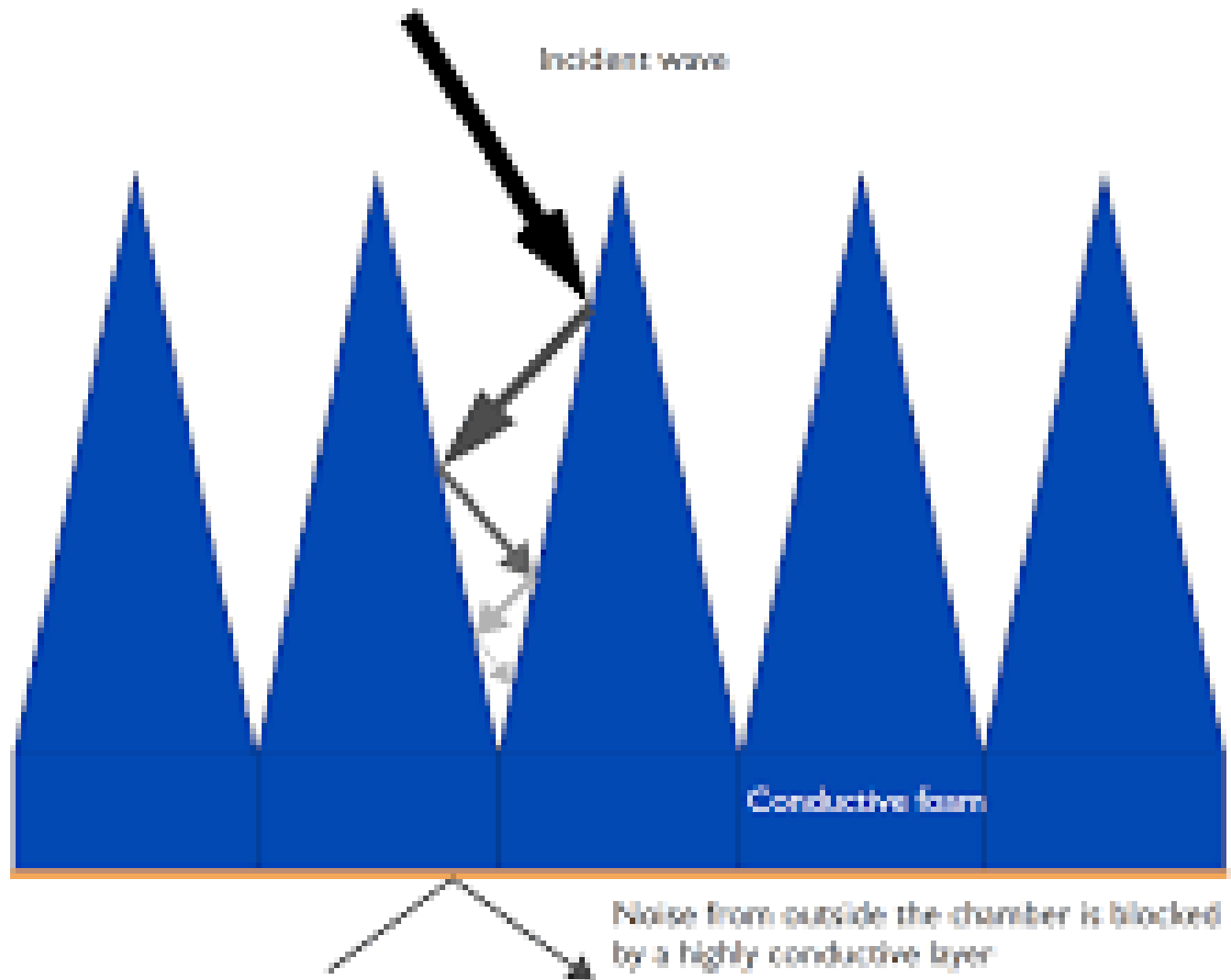


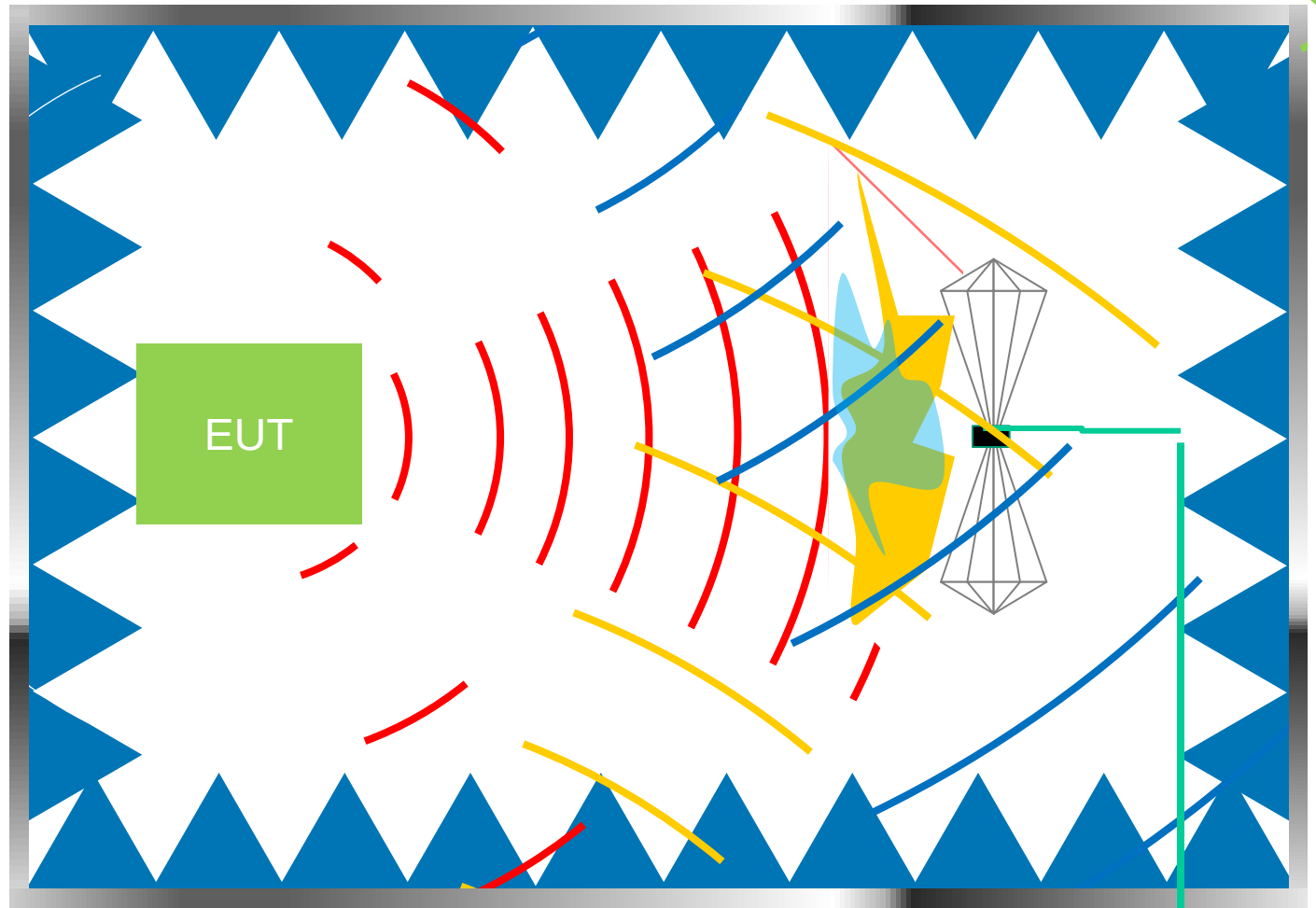
Metal



Absorber

Pyramid absorber





EMI receiver

Semi anechoic chamber SAC (1)



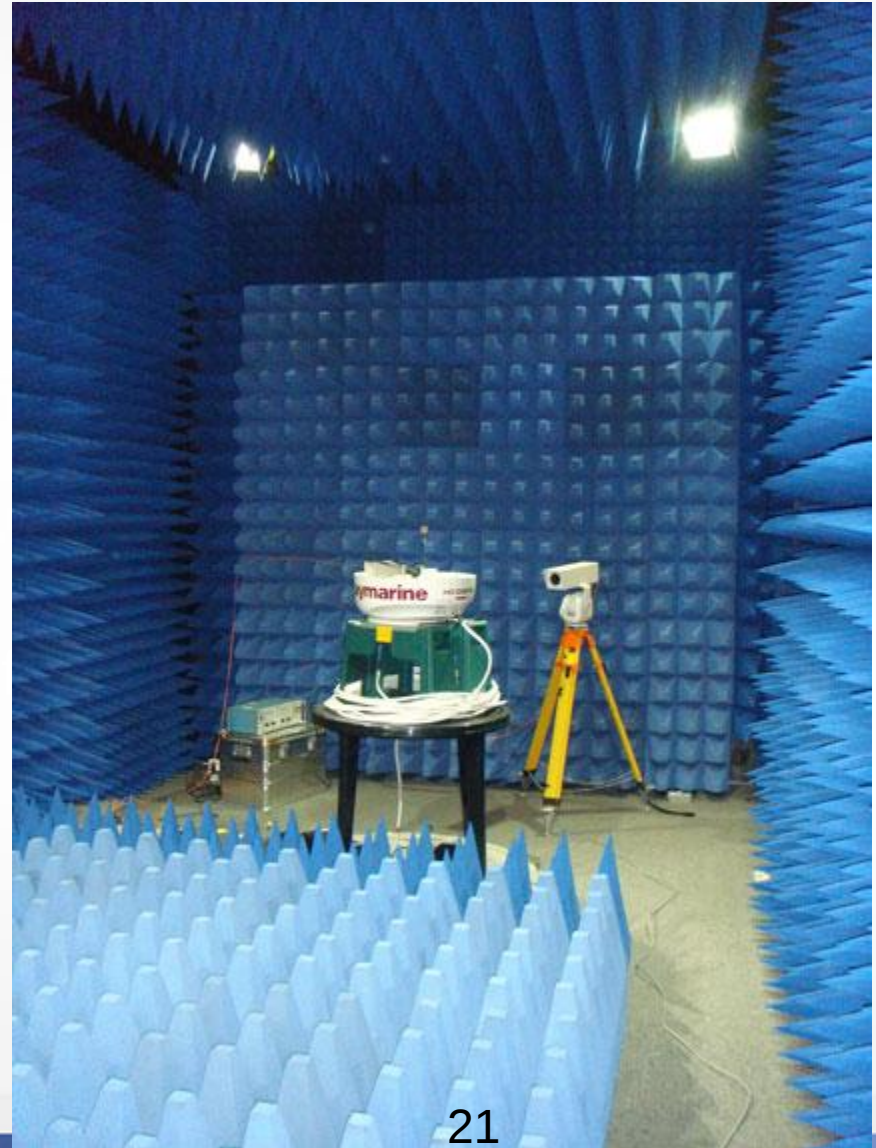
Semi anechoic chamber SAC (2)



Fully anechoic chamber (FAC)

- Fully anechoic shielded enclosure
- Electromagnetic interference (EMI) frequency absorption (its entire inner surface)
- Emission measurements of direct radiation of radio frequency transmitters.
- Complies with ETSI

standards

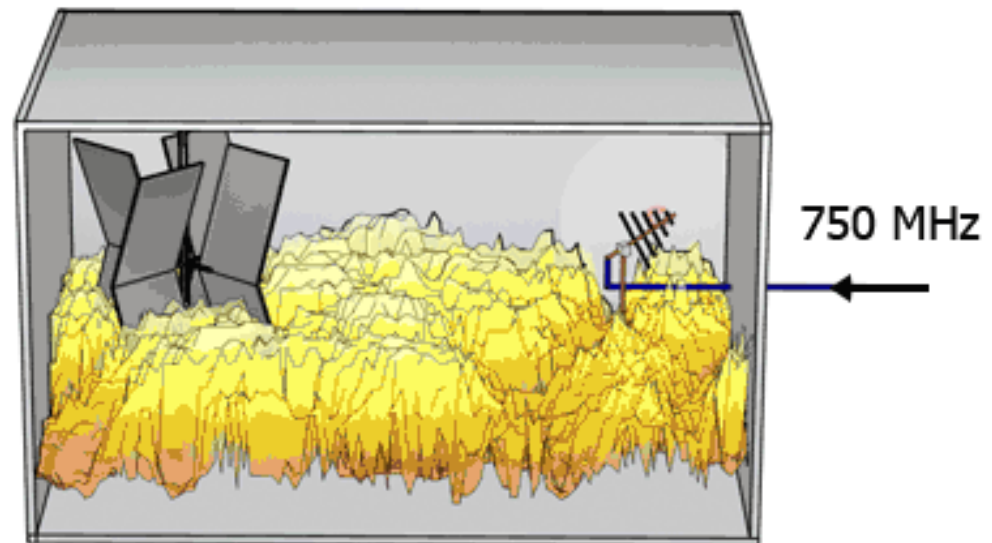
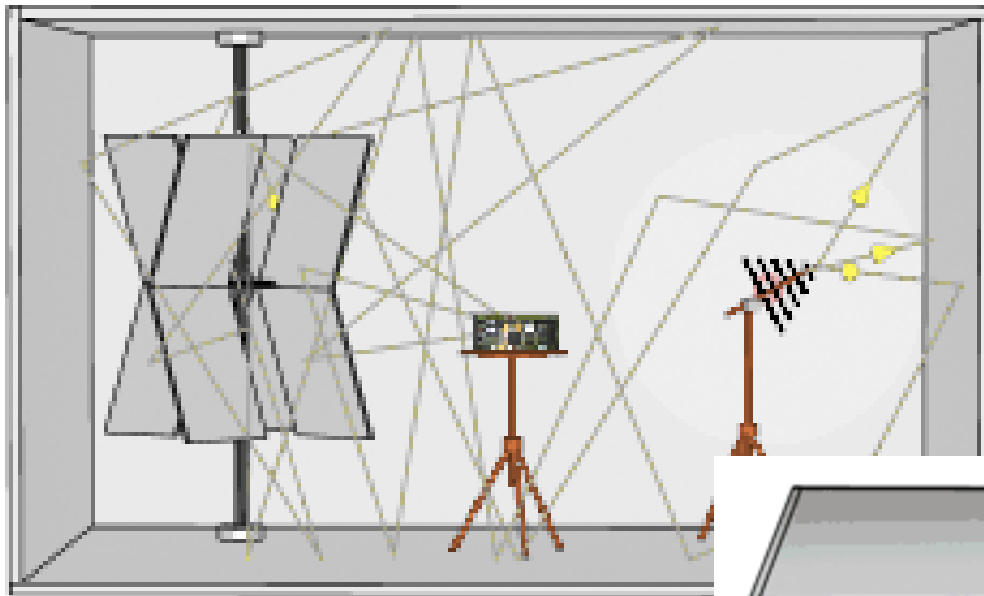


Mode stirred reverberation chambers

- Electromagnetic chamber
- Constructed out of double wall with metal stirrer
- Measures of radiated immunity and emission
- EN 61000-4-21.

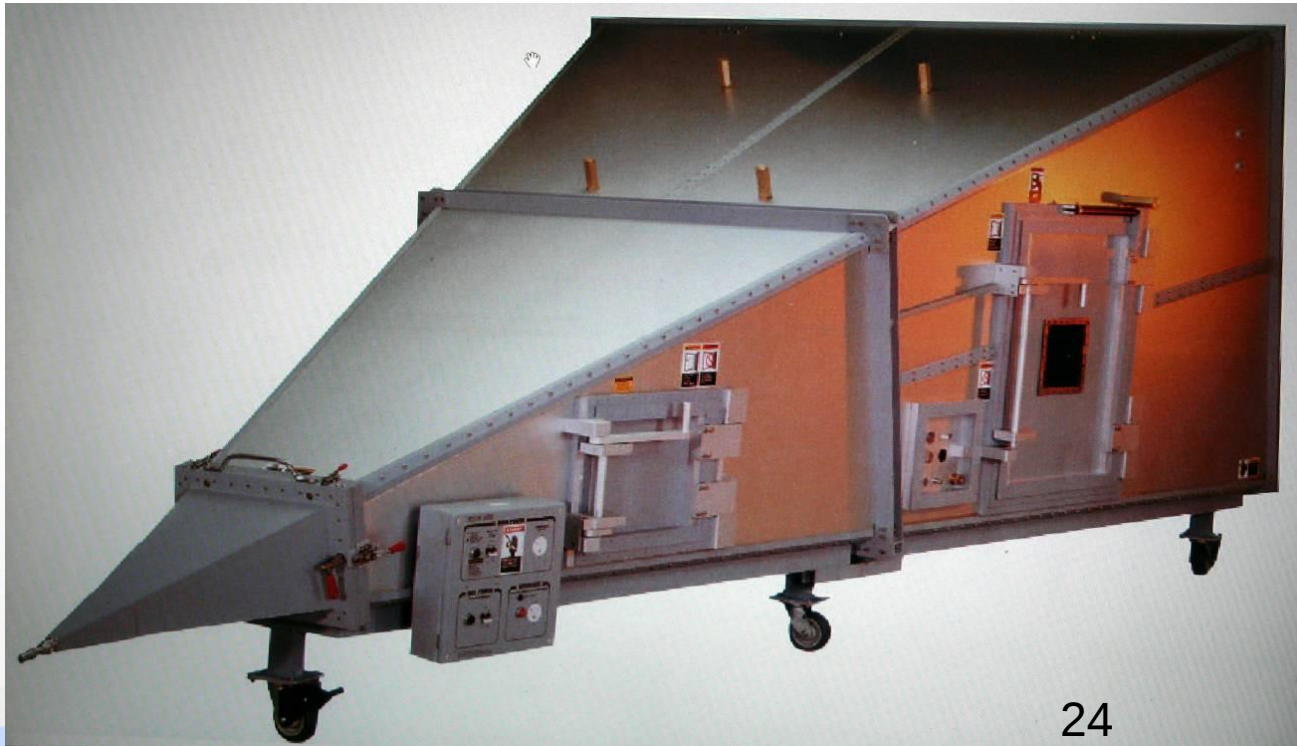


Mode stirred reverberation chambers



TEM Cells

- Closed cell loaded onto a characteristic impedance
- Measures radiated emission and immunity
- Can be used for EMC testing



Open Area test sites

- The reference CISPR test site
- Radiated fields measures
- Great distance measures (10m – 30m).



Open Area test sites



Performance of measure sites

	Low distance faraday cage	Open area test site	Semi or fully anechoic chamber
Advantages	Isolating EUT from external EM noise	Correct field measurements	Correct field measurements
drawbacks	• Walls reflections • Near field measure	Electromagnetic noise	• Degradation of absorbers performance • high cost

EMC standards

Fundamental standards

EN 61000.4.2	Electrostatic discharge immunity test
EN 61000.4.3	Radiated, radio-frequency, electromagnetic field immunity test
EN 61000.4.4	Electrical fast transient/burst immunity test
EN 61000.4.5	Surge immunity test
EN 61000.4.6	Immunity to conducted disturbances, induced by radio-frequency fields
EN 61000.4.8	Power frequency magnetic field immunity test
EN 61000.4.9	Pulse magnetic field immunity test
EN 61000.4.11	Voltage dips, short interruptions and voltage variations immunity tests
EN 61000-3-2 et EN 61000-3-3	Limits for harmonic current / flicker emissions (equipment input current ≤ 16 A per phase)

Product standards

EN 55011	Industrial, scientific and medical (ISM) radio-frequency equipment - Electromagnetic disturbance characteristics - Limits and methods of measurement
EN 55014	Requirements for household appliances, electric tools and similar apparatus Part 1: Emission. Part 2: Immunity
EN 55022	Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement
EN 55024	Information technology equipment - Immunity characteristics - Limits and methods of measurement.
ETSI EN 300-330	Electromagnetic compatibility and Radio spectrum Matters (ERM); Short Range Devices (SRD); Radio equipment in the frequency range 9 kHz to 25 MHz and inductive loop systems in the frequency range 9 kHz to 30 MHz;

Generic standards

EN 61000-6-1:	Immunity for residential, commercial and light-industrial environments
EN 61000-6-2	Immunity for industrial environments
EN 61000-6-3:	Emission standard for residential, commercial and light-industrial environments
EN 61000-6-4:	Emission standard for industrial environments

CISPR 16 standards

OLD CISPR 16

CISPR 16-1	Radio disturbance and immunity measuring apparatus
CISPR 16-2	Methods of measurement of disturbances and immunity
CISPR 16-3	Reports and recommendations of CISPR
CISPR 16-4	Uncertainty in EMC measurements

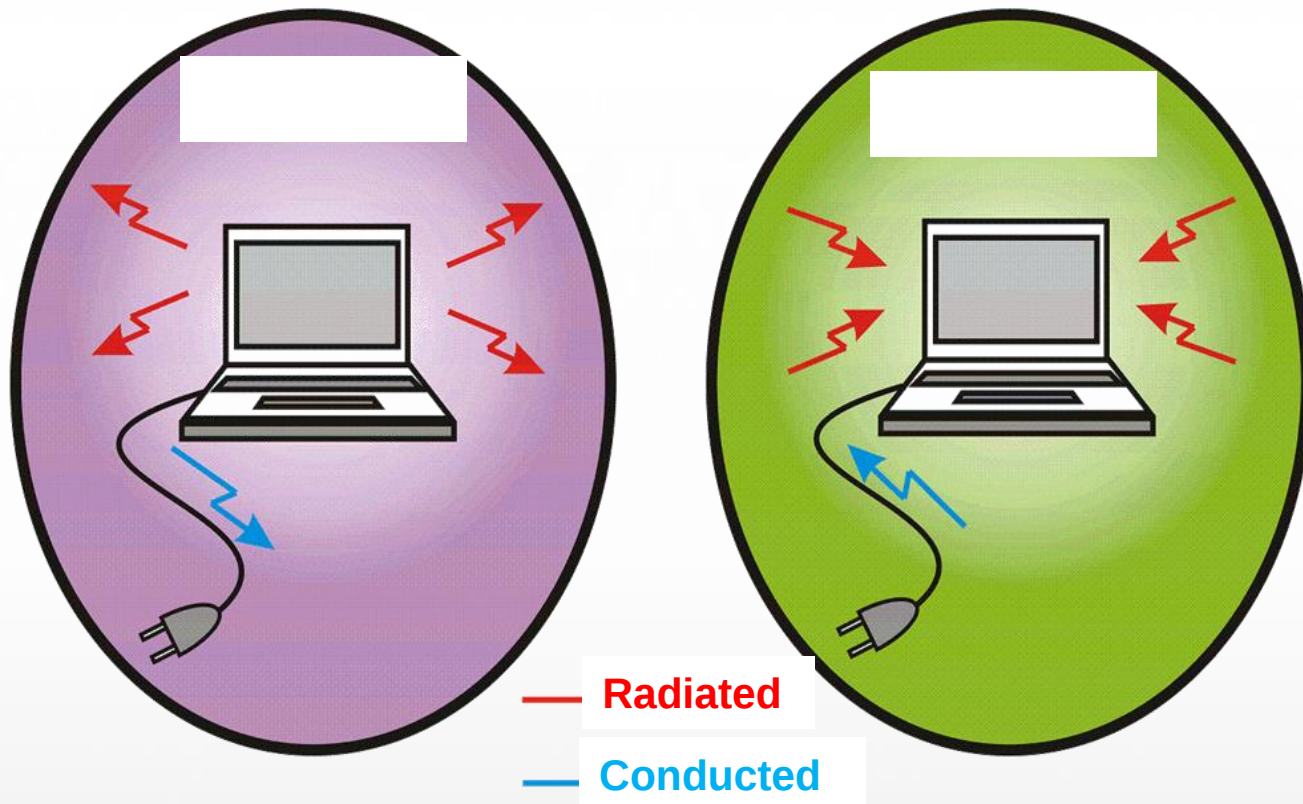
NEW CISPR 16

CISPR 16-1-1	Measuring apparatus
CISPR 16-1-2	Ancillary eqpt – conducted disturbances
CISPR 16-1-3	Ancillary eqpt – Disturbance power
CISPR 16-1-4	Ancillary eqpt – Radiated disturbances
CISPR 16-1-5	Antenna calibration test sites 30MHz - 1000MHz
CISPR 16-2-1	Conducted disturbance power
CISPR 16-2-2	Measurement of disturbance power
CISPR 16-2-3	Radiated disturbance measurements
CISPR 16-2-4	Immunity measurements
CISPR 16-3	CISPR technical reports
CISPR 16-4-1	Uncertainties in standardised EMC tests
CISPR 16-4-2	Measurement instrumentation uncertainty
CISPR 16-4-3	Statistical considerations in the determination of EMC compliance of mass –produce products
CISPR 16-4-4	Statistics of complaints and a model for the calculation of limits



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