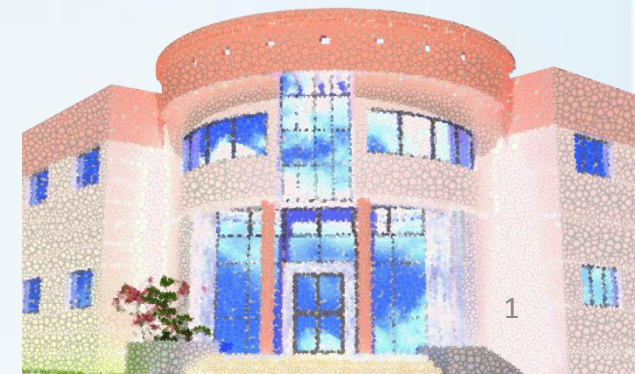





Radio compliance test

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Radio equipment

- An electrical or electronic product or an interface that intentionally emits or receives radio waves for the purpose of radio communication or radiodetermination and makes systematic use of radio spectrum.
-  In order to ensure an efficient use of radio spectrum so as to avoid harmful interference, all such equipment should fall within a scope of a radio directive.



DIRECTIVE 2014/53/EU



- On April 2014, new Radio Equipment Directive (RED) 2014/53/EU replaced the Radio Equipment and Telecommunications Terminal Equipment (R&TTE) Directive 1999/5/EC.
- ➔ New sets of rules are adopted for placing and putting into service radio equipments on the European market,.



What has changed since the R&TTE



- RED covers radio equipment which intentionally transmits or **receives** radio wave.
- Broadcast receivers are **included**
- Radar equipment are **included**
- Equipment operating below 9 KHz are **included**
- Equipment using radio as secondary function are **included**
- Wired terminal equipment are **excluded**
- Accessories are **excluded** (passive antennas, power supplies, ...)
- New essential requirement 3.2: increased emphasis on **efficient and effective** use of the spectrum. In particular radio equipment needs to demonstrate the performance of its receiver part, as well as its transmitter



General principles for product compliance



General principles for product compliance

- Article 3.1(a) Health and Safety
- Article 3.1(b) EMC
- Article 3.2 Radio essential requirements
- Article 3.3 additional requirements when invoked by the European Commission



Transmitter requirements



- The article 3.2 of the RED sets out the requirements for the efficient use of spectrum.
- These requirements are mandatory for the transmitter. The harmonized standards set specifications and test methods:
 - Power Radiated,
 - modulation bandwidth
 - spurious transmitter
 - Spurious emissions receiver
 - ...



Example WLAN equipments (ISM band 2.4 GHZ)

- **Radio : EN 300 328**
- **+ ERC 70-03 recommandation**
- **EMC: EN 301 489-17 & EN 301 489-01**
- **Safety: EN 60950**
- **Health: EN 50364**



Harmonized standard

EN 300 328



Essential radio test suites	Test specification reference
RF output power (EIRP)	5.3.2
Maximum spectral power density	5.3.3
Occupied Bandwidth	5.3.8
Unwanted emissions in out off band domain	5.3.9
Unwanted emissions in Spurious domain	5.3.10



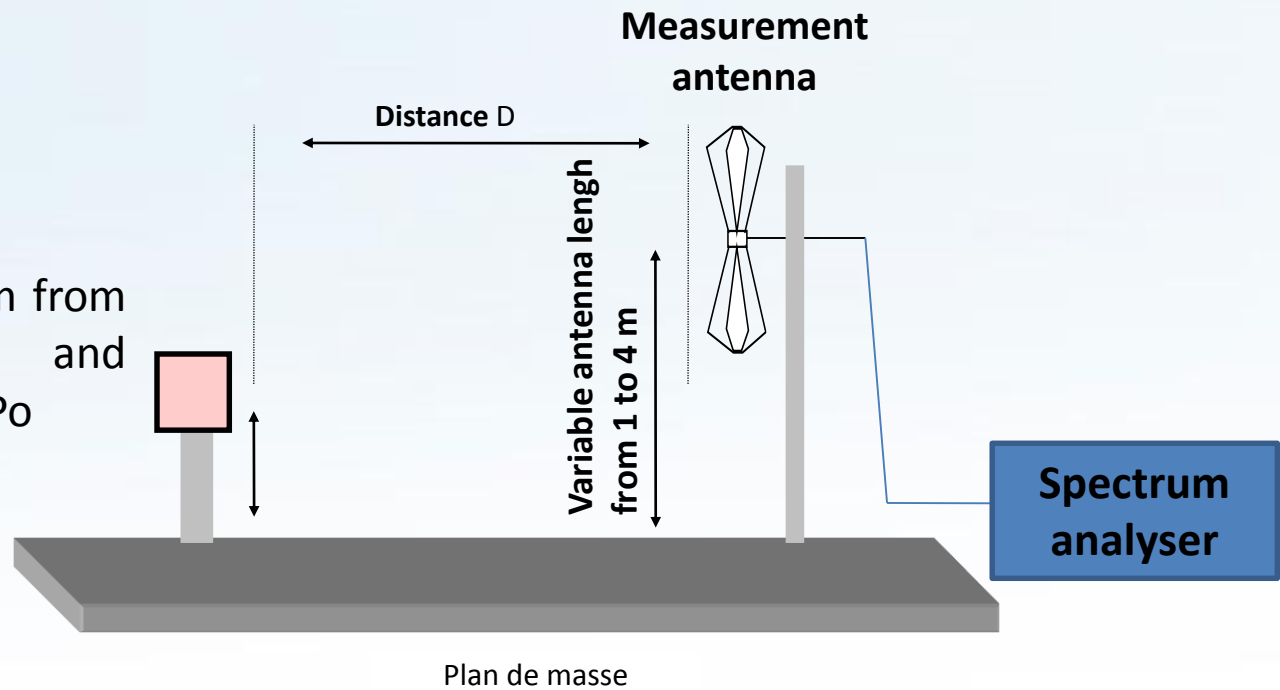
Equivalent isotropic radiated power (EIRP)



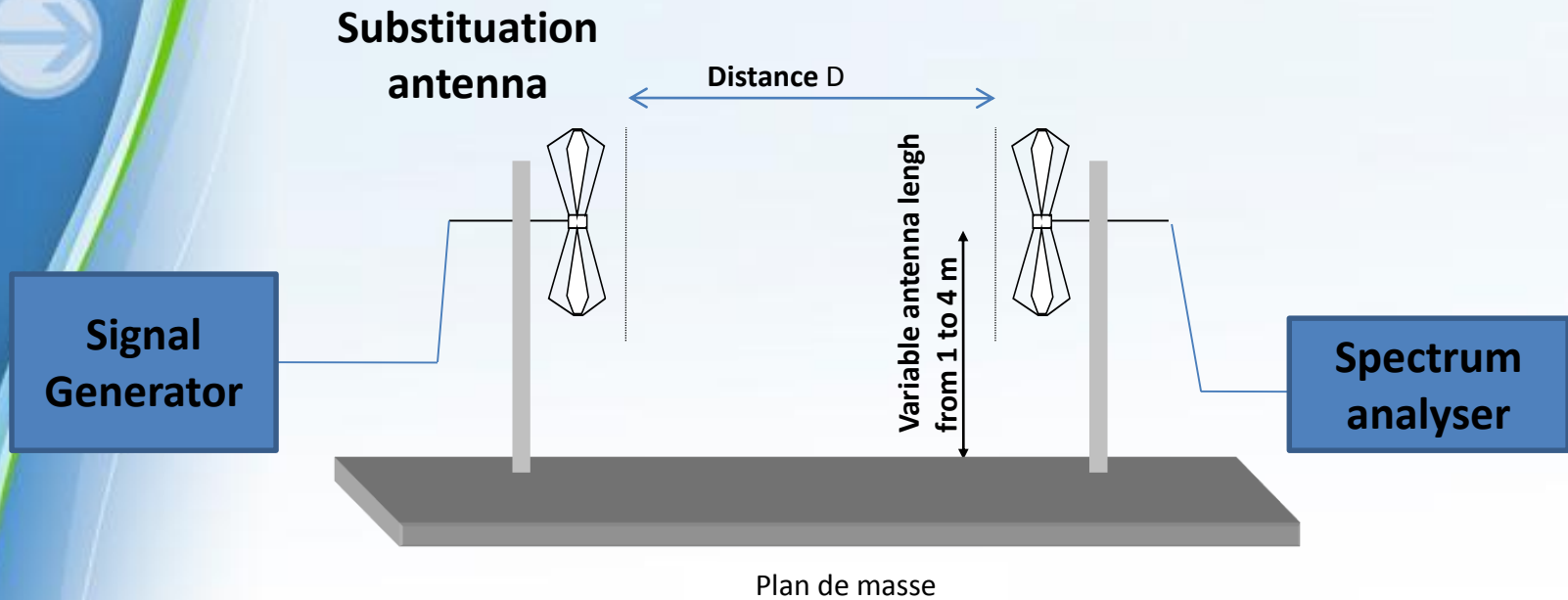
- Is also called the Effective Isotropic Radiated Power, and represents the amount of power that an ideal isotropic antenna could emit.
- The EIRP radiated measurement is based on the Substitution method which is defined through two steps.

Step 1

DUT at 1.5 m from the floor and radiated at P_0



Step 2






Substitution method



The substitution measurement is defined through the following steps:

- a) Measure each significant emission (where the total emitted power will exceed 20 mW) by maximising emission level (rotating turntable with EUT on it, moving receiving antenna 1m - 4m in
- b) Replace the EUT by an antenna with a known gain which had also be obtained in free space environment and adjust the signal generator output level to the same receiver level for each emission as previously determined


$$\mathbf{EIRP = SG - A_{tr} + G_{tr}}$$

Where

SG : Signal generator output level

A_{tr} : Attenuation of the cable between SG and transmit antenna

G_{tr} : Gain of the transmitting antenna
(isotropic antenna)



Occupied Channel Bandwidth



- Is the width of the frequency band which is just sufficient to ensure the transmission of information at the rate and with the quality required under specified conditions
- Applies to **FHSS** and **non-FHSS**
 - Based on 99% bandwidth
 - Must fall completely within band (band edge)
 - Partly replaces the old Frequency Range test
 - For non-Adaptive FHSS with >10 mW, e.i.r.p.
 - Limit: <5 MHz
 - For non-Adaptive non-FHSS with >10 mW, e.i.r.p.
 - Limit: <20 MHz



Unwanted emissions



- **It present** any emission outside the necessary bandwidth of the transmission

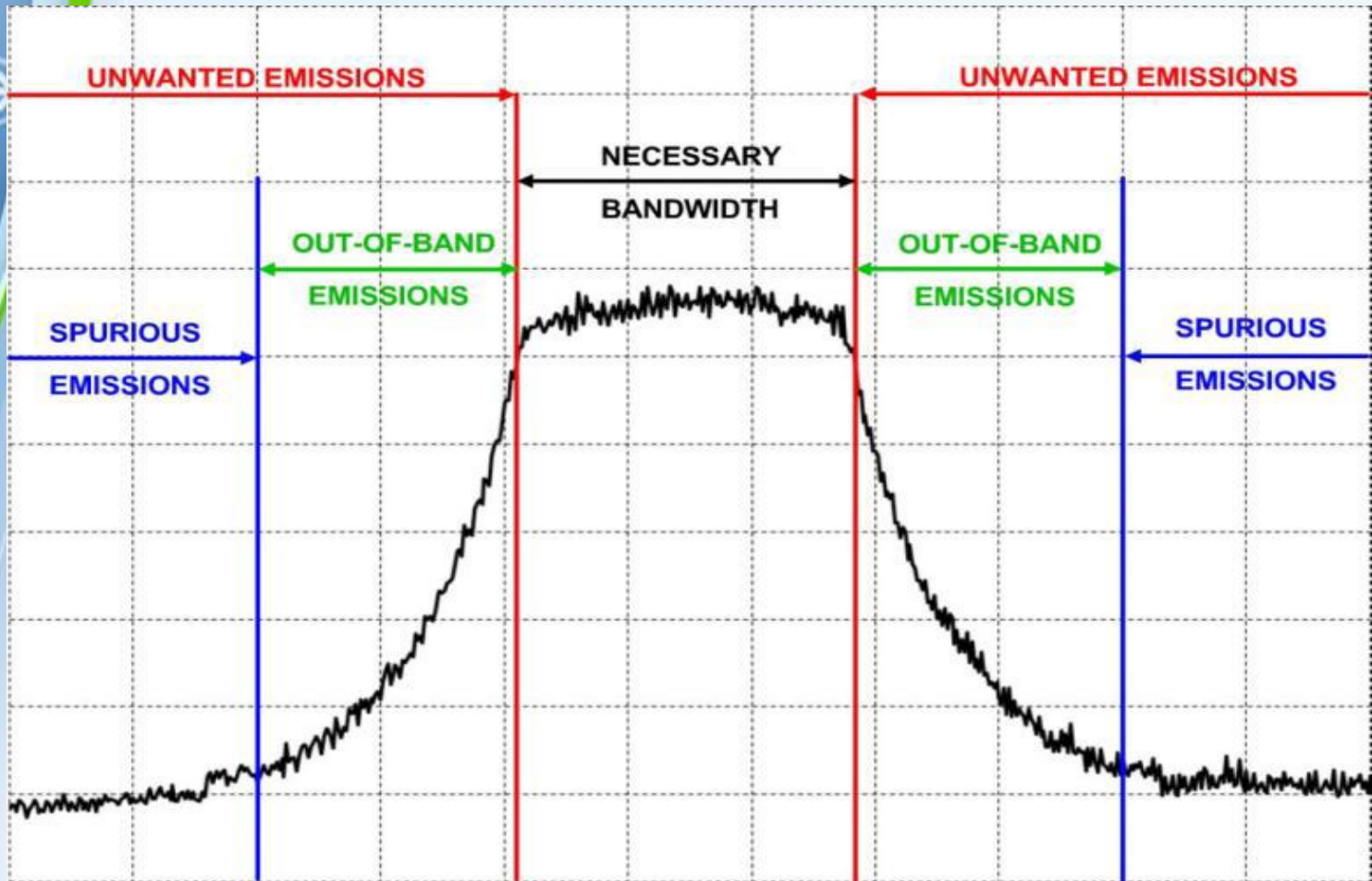


all emissions except the **fundamental**



Consist of *radiated spurious emissions* and *out-of-band emissions*.

Spurious Domain





Measurement method



- 1. Connect the equipment with an antenna in a horizontal orientation.
- 2. Adjust the settings of the Radio Communication Tester to set the EUT to its maximum power at the required channel.
- 3. Set the spectrum analyzer to measure peak hold.
- 4. Place the measurement antenna in a horizontal orientation. Raise the measurement from 1m up to 4 meters in steps and rotate the EUT 360 degrees at each height to maximize all emissions. Measure and record all spurious emissions (LVL) up to the tenth harmonic of the carrier frequency



Measurement method



- 5. Replace the EUT with a horizontally polarized half wave dipole or known gain antenna. The center of the antenna should be at the same location as the center of the EUT's antenna.
- 6. Connect the antenna to a signal generator with known output power and record the path loss in dB (LOSS).
- $LOSS = \text{Generator Output Power (dBm)} - \text{Analyzer reading (dBm)}$.



Measurement method



- 7. Determine the level of spurious emissions using the following equation:

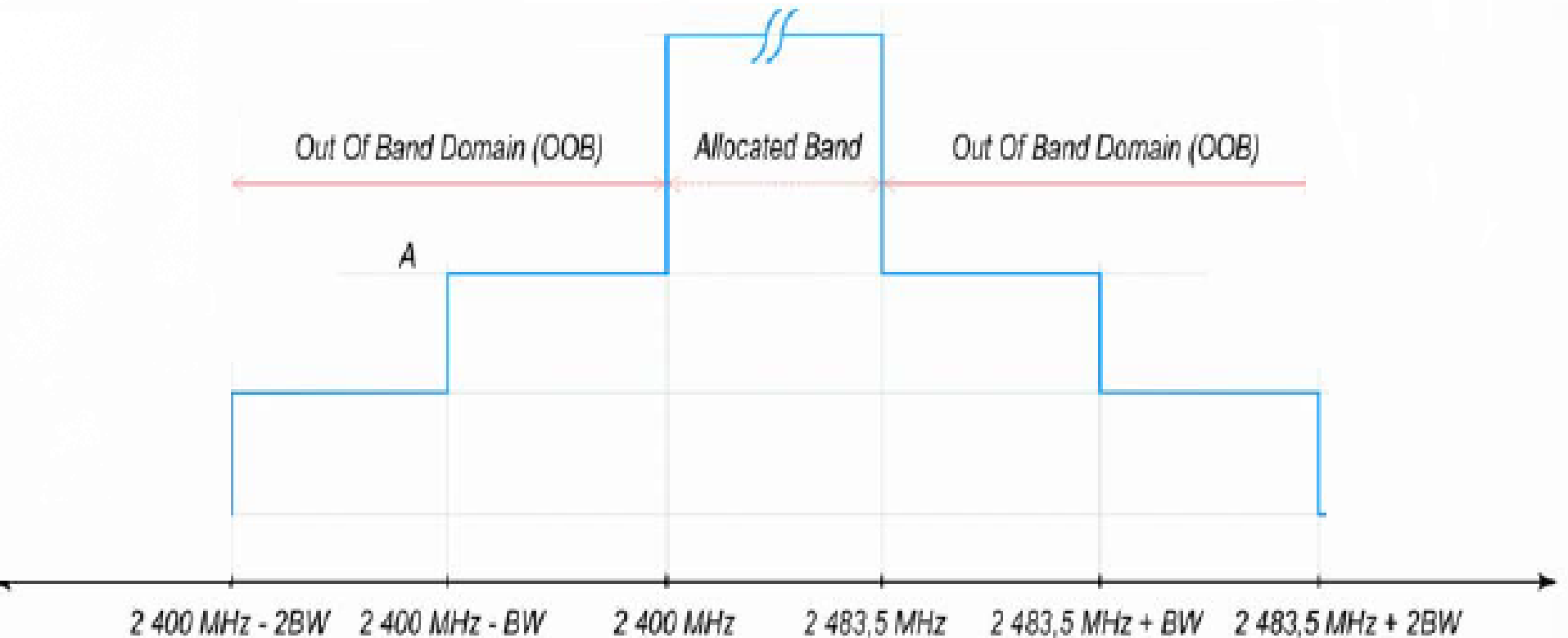
$$\text{Spurious (dBm)} = \text{LVL (dBm)} + \text{LOSS (dB)}$$

- 8. Repeat steps 4, 5 and 6 with all antennas vertically polarized.
- 9. Measurements are to be performed with the EUT set to the low, middle and high channel of each frequency band.

Out of band emissions

- Emission on a frequency or frequencies immediately outside the necessary bandwidth which results from the modulation process, but excluding spurious emissions
 - Applies to **FHSS** and **non-FHSS**

 This is really a “band edge” type of test



A: -10 dBm/MHz e.i.r.p.
 B: -20 dBm/MHz e.i.r.p.

BW = Occupied Channel Bandwidth in MHz or 1 MHz whichever is greater



Spurious emission



- Emission on a frequency or frequencies which are outside the necessary bandwidth and the level of which may be reduced without affecting the corresponding transmission of information.
- Spurious emissions include harmonic emissions, parasitic emissions, intermodulation products and frequency conversion products, but exclude out-of-band emissions



Tx Spurious Emissions limits



Table 1: Transmitter limits for spurious emissions

Frequency range	Maximum power, e.r.p. (≤ 1 GHz) e.i.r.p. (> 1 GHz)	Bandwidth
30 MHz to 47 MHz	-36 dBm	100 kHz
47 MHz to 74 MHz	-54 dBm	100 kHz
74 MHz to 87,5 MHz	-36 dBm	100 kHz
87,5 MHz to 118 MHz	-54 dBm	100 kHz
118 MHz to 174 MHz	-36 dBm	100 kHz
174 MHz to 230 MHz	-54 dBm	100 kHz
230 MHz to 470 MHz	-36 dBm	100 kHz
470 MHz to 862 MHz	-54 dBm	100 kHz
862 MHz to 1 GHz	-36 dBm	100 kHz
1 GHz to 12,75 GHz	-30 dBm	1 MHz



Thanks for your attention

