

Complying with the radio equipment directive (RED) for wireless power transfer

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Short summary

- The Radio Equipment Directive (RED)
- Assessment procedures
- EN 301 489-1 and (-3)?
- EN 300 417
- Other EMC considerations

The Radio Equipment Directive (RED) 2014/53/EU

Radio equipment

DIRECTIVE 2014/53/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

of 16 April 2014

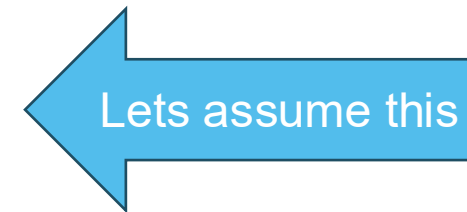
on the harmonisation of the laws of the Member States relating to the making available on the market of radio equipment and repealing Directive 1999/5/EC

- Lets agree on what is radio equipment is:

‘radio equipment’ means an electrical or electronic product, which intentionally emits and/or receives radio waves for the purpose of radio communication and/or radiodetermination, or an electrical or electronic product which must be completed with an accessory, such as antenna, so as to intentionally emit and/or receive radio waves for the purpose of radio communication and/or radiodetermination;

Are WPT radio devices?

- Yes?
 - It intentionally emits radio waves
 - There is communication
 - There exists specific WPT standards
- No?
 - There does not exist specific EMC for WPT under the RED
 - There is no communication?



The Radio Equipment Directive (RED) 2014/53/EU

Essential requirements

Essential

1. Radio equipment shall be constructed so as to ensure:

(a) the protection of health and safety of persons and of domestic animals and the protection of property, including the objectives with respect to safety requirements set out in Directive 2014/35/EU, but with no voltage limit applying;

(b) an adequate level of electromagnetic compatibility as set out in Directive 2014/30/EU.

2. Radio equipment shall be so constructed that it both effectively uses and supports the efficient use of radio spectrum in order to avoid harmful interference.

3. Radio equipment within certain categories or classes shall be so constructed that it complies with the following essential requirements:

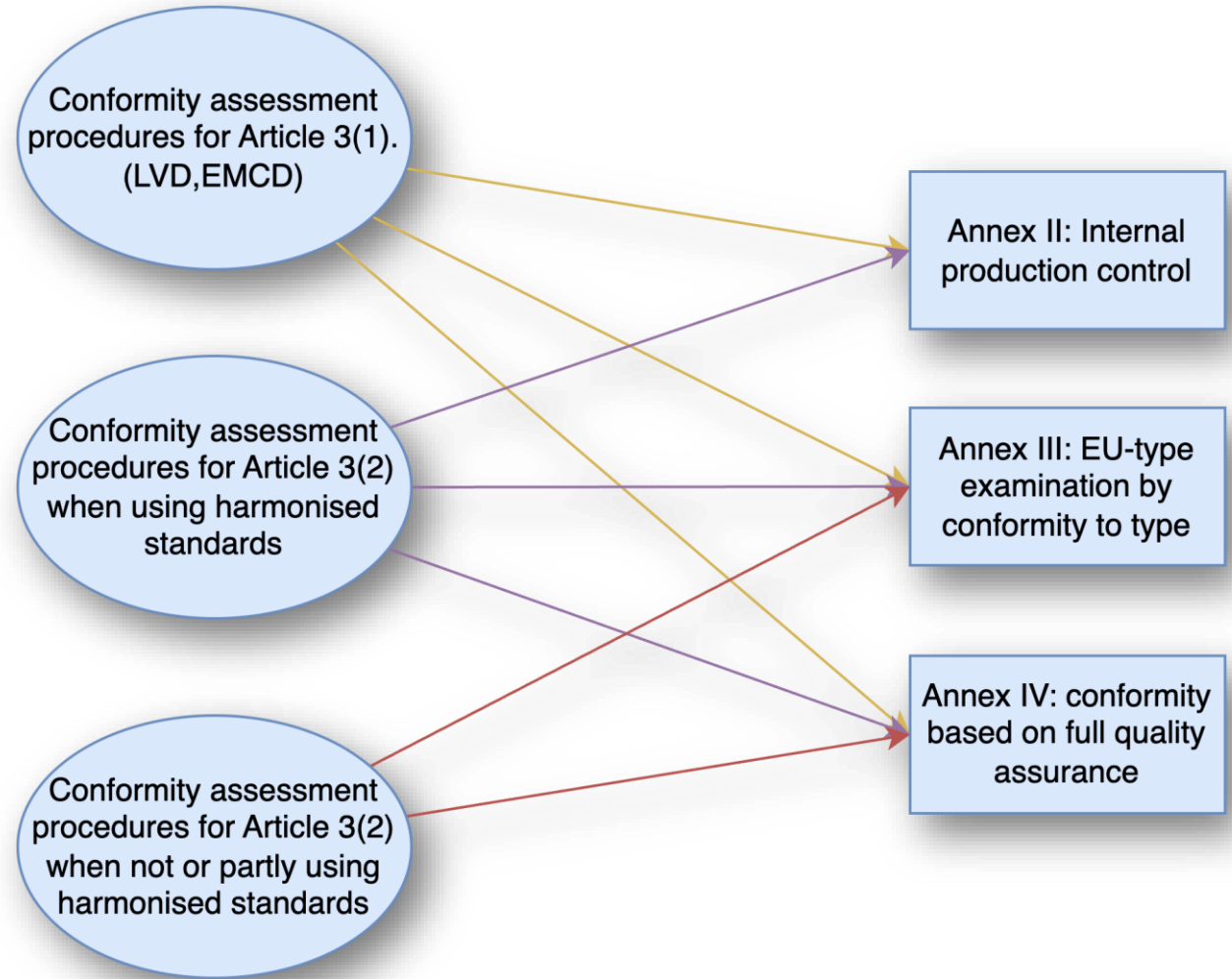
(a) radio equipment interworks with accessories, in particular with common chargers;

(r) 'harmful interference' means interference which endangers the functioning of a radio navigation service or of other safety services or which otherwise seriously degrades, obstructs or repeatedly interrupts a radio communications service operating in accordance with the applicable international, Community or national regulations;

The Radio Equipment Directive (RED) 2014/53/EU

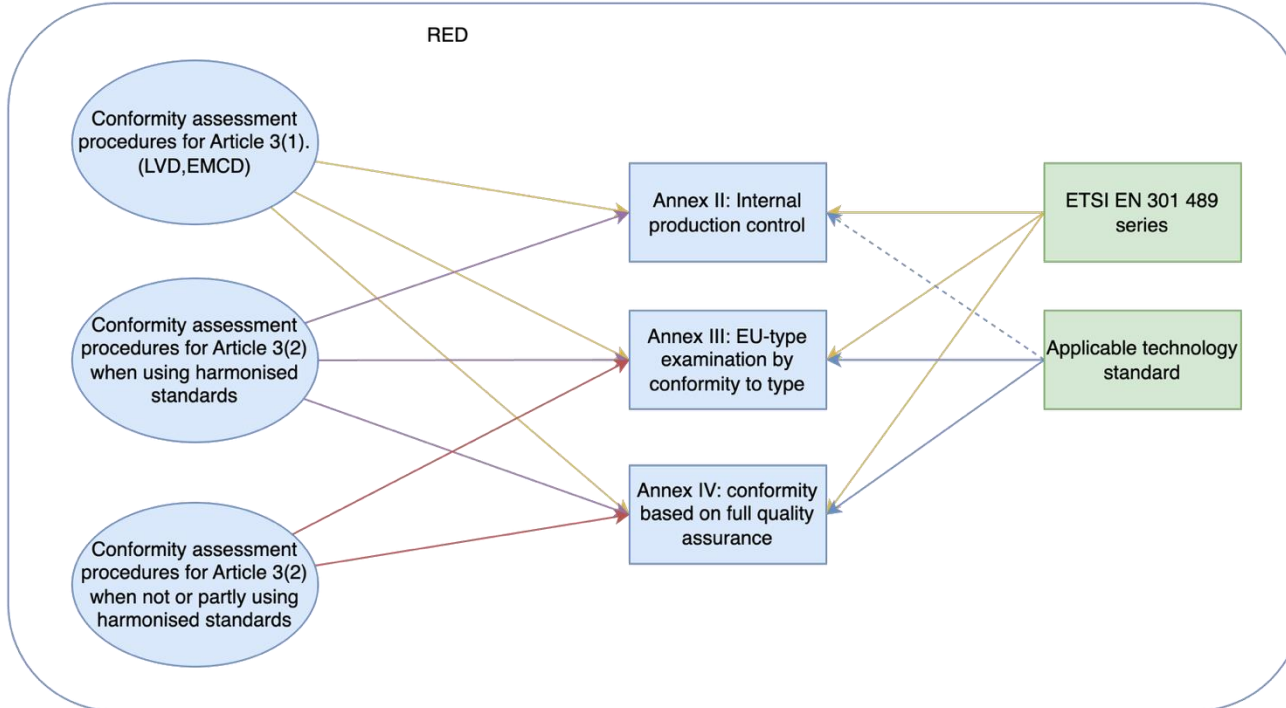
Conformity assessment procedure (CAP)

- Are you building radio equipment:
 - Wireless modules
 - ICs
 - Purely wireless device
- Follow Annex III or IV or (II)
- Are you using radio equipment in your equipment:
 - Follow Annex II or III
- Are you a large company and can you implement full quality assurance:
 - Follow Annex IV



Standards

- 3.1(b)
 - EN 301 489-1
 - EN 301 489-3



- 3.2
 - EN 303 417 (Harm)

3.1 (b) EMC

- 301 489-1: common technical requirements
 - No specific part for wireless power transfer
 - 301 489-3 Short range communication
 - (301 489-17) → If you added bluetooth communication
 - ... → if you added anything else
 - This is EMC with some modifications
 - Exclusion bands
 - Performance criteria for radios
 - Specific applicability
 - No radiated emissions are required (C
 - These are done in 303 417

If limit lines of EMC test are lower then 3.2 test, I suggest to do radiated emissions either way.

3.2 radio spectrum

EN 303 417

**Wireless power transmission systems, using technologies other than radio frequency beam in the 19 - 21 kHz, 59 - 61 kHz, 79 - 90 kHz, 100 - 300 kHz, 6 765 - 6 795 kHz ranges;
Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU**

- For all WPT in these frequency ranges and not using radio frequency beams
 - (Not yet for high power systems to charge vehicles CFR. ETSI TR 103 409)
- Operational modes

EN 303 417: Table 2

3.2 radio spectrum

EN 303 417

**Wireless power transmission systems, using technologies other than radio frequency beam in the 19 - 21 kHz, 59 - 61 kHz, 79 - 90 kHz, 100 - 300 kHz, 6 765 - 6 795 kHz ranges;
Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU**

- Transmitter tests
 - Operating frequency range(s) (OFR)

EN 303 417: Figure 2

EN 303 417: Figure 3

OBW = range of 99% power (0.5% below, 0.5% above)

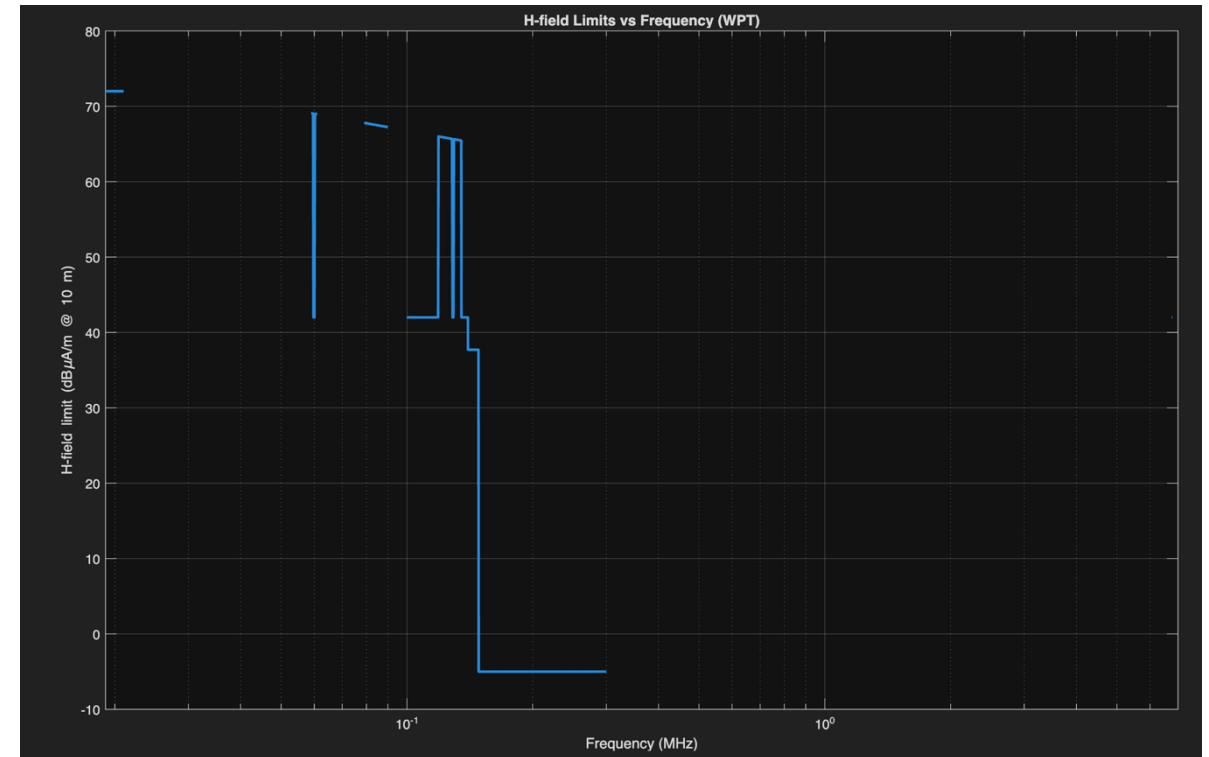
3.2 radio spectrum

EN 303 417

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- Transmitter tests
 - H-field requirements

EN 303 417: Table 3



3.2 radio spectrum

EN 303 417

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- Transmitter tests
 - Transmitter spurious emissions
 - Where are the spurious emissions?

EN 303 417: Figure 4

EN 303 417: Figure 5

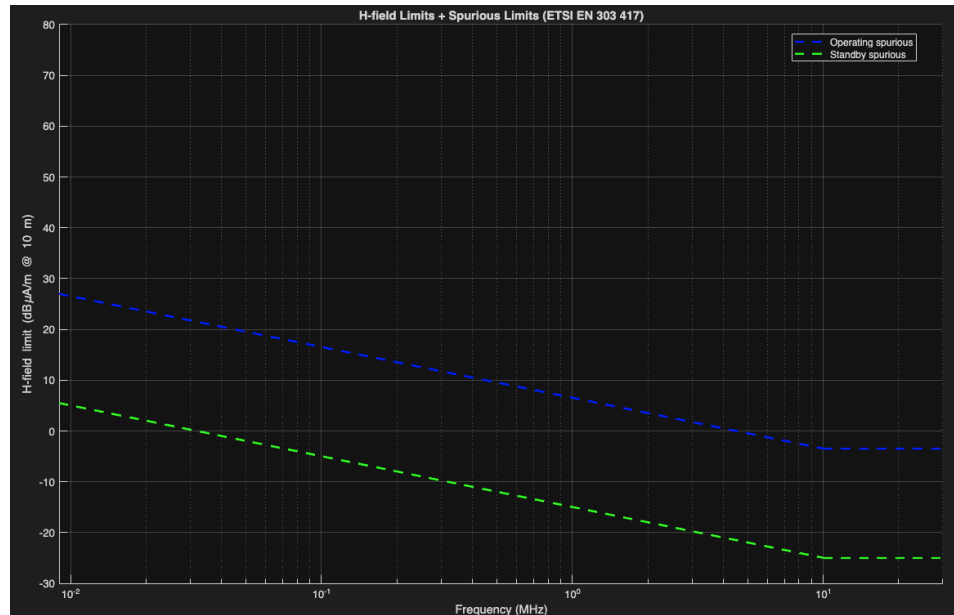
3.2 radio spectrum

EN 303 417

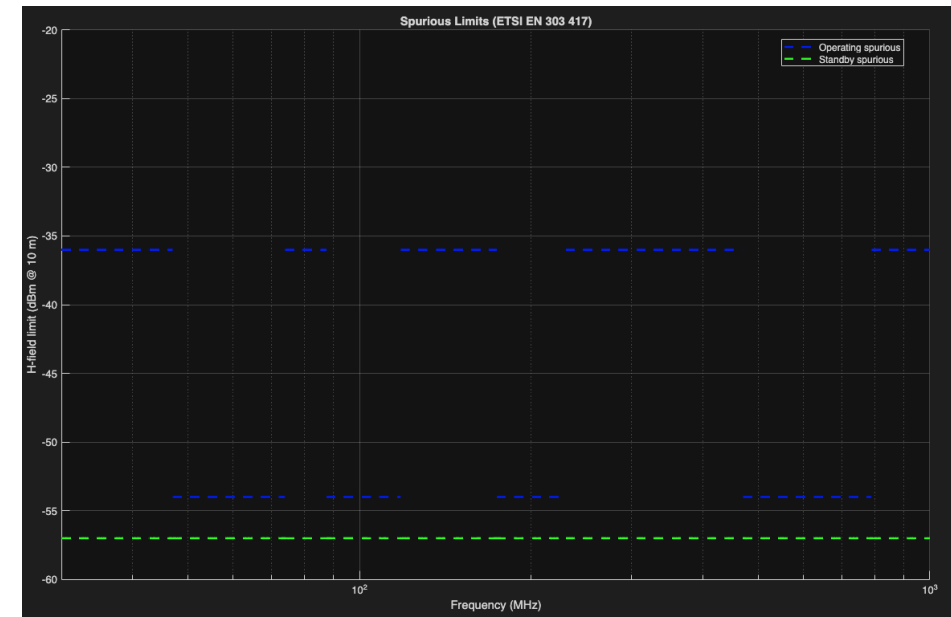
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- Transmitter tests
 - Transmitter spurious emissions

EN 303 417: Table 4



EN 303 417: Table 5



3.2 radio spectrum

EN 303 417

- Transmitter tests
 - Out of band emissions

EN 303 417: Figure 4

EN 303 417: Figure 5

3.2 radio spectrum

EN 303 417

- Transmitter tests
 - Unwanted conducted emissions
 - Where the cable to the primary coil exceeds 3m and where the cable is not installed in the ground or metallic structure

The common mode current (I_{CM}) between 1 MHz and 30 MHz shall not exceed the following limit:

$$I_{CM} = 47 - 8 \times \log(f) \text{ dB}\mu\text{A}$$

NOTE: f is the frequency in MHz.

3.2 radio spectrum

EN 303 417

- Receiver tests
 - RX blocking test
 - Susceptibility test of your device, replicating multiple WPT devices next to each other

EN 303 417: Figure 11

3.2 radio spectrum

EN 303 417

- How to measure?

Mode 1: Idle mode
No receiver

EN 303 417: Figure 6

Mode 2: Charging adjustment
D= max communication distance
Replace RX and TX for receiver
measurements

EN 303 417: Figure 6

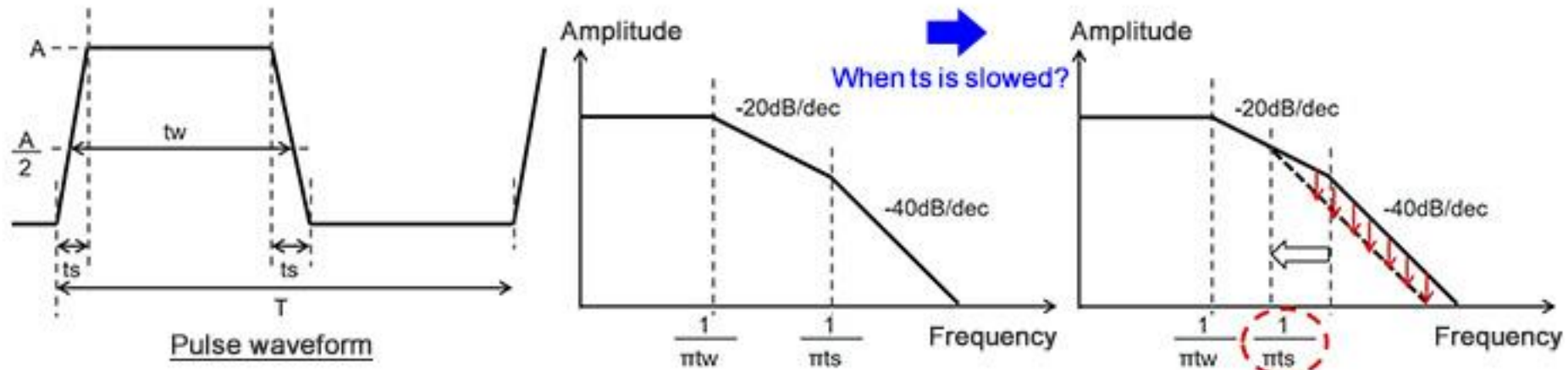
Mode 3,4 : power transmission
Worst case alignment!

EN 303 417: Figure 6

Other EMC considerations

Switching

- Most EMC problems are related to emissions
 - High power, high switching speed -> high frequency content



- Choose switching frequency as low as possible
- Choose rise and fall times as high as possible

Other EMC considerations

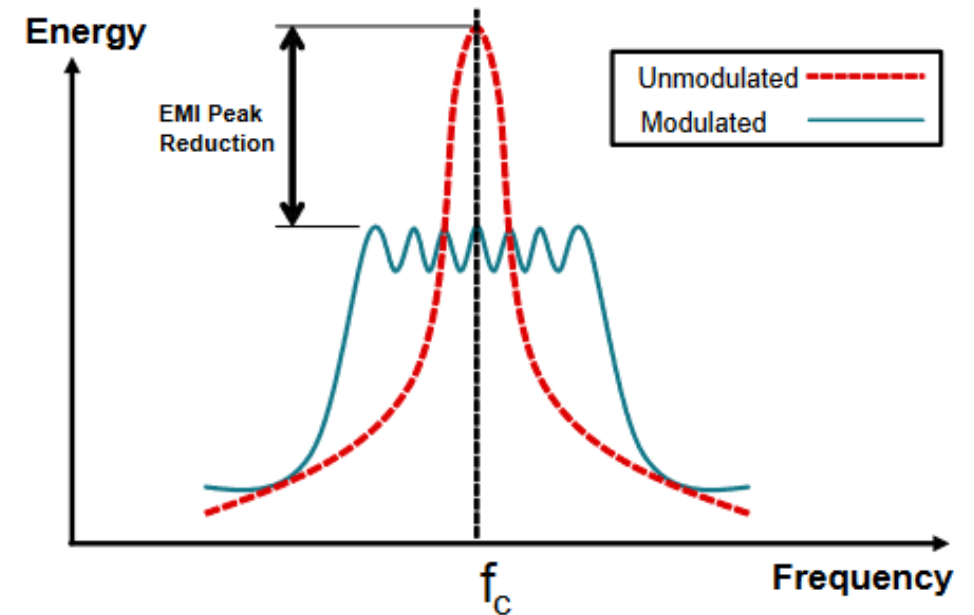
Filtering

- High frequency content will always be present.
 - Add filters
 - On WPT coils, might influence the WPT coil itself
 - On power supply and other ports
 - Improve coupling between coils
 - More power transferred between coils -> less power is leaking

Other EMC considerations

Spread Spectrum

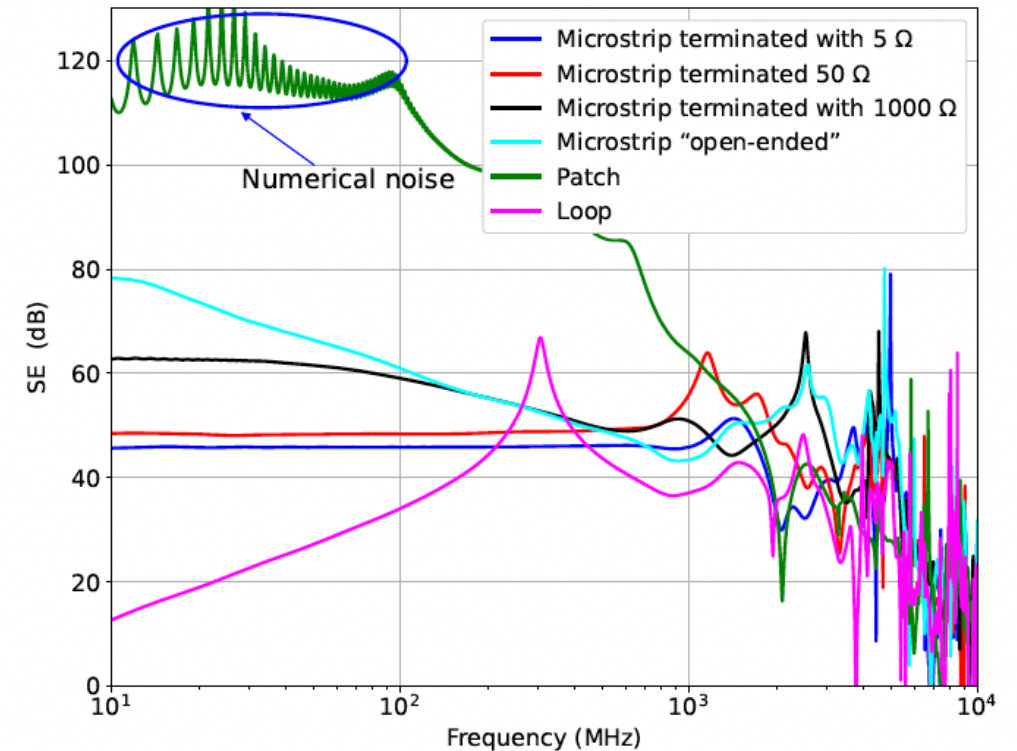
- Modulation of the switching frequency?
 - Change the switching frequency “fast”
 - Be careful!
 - Still the same power is being put in the EM environment
 - Possibility to increase emissions



Other EMC considerations

Shielding

- Shield specific parts to decrease leakage
 - Be carefull
 - Shielding changes depending on source
 - Magnetic \leftrightarrow electric



Other EMC considerations

Shielding

- Shield specific parts to decrease leakage
 - Be carefull
 - Shielding changes depending on source
 - Loop orientation

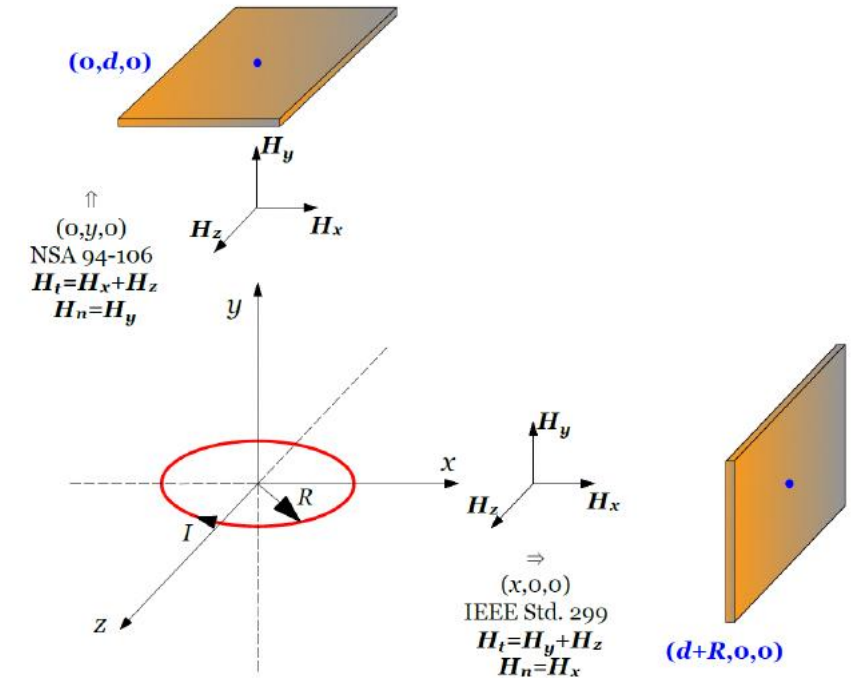
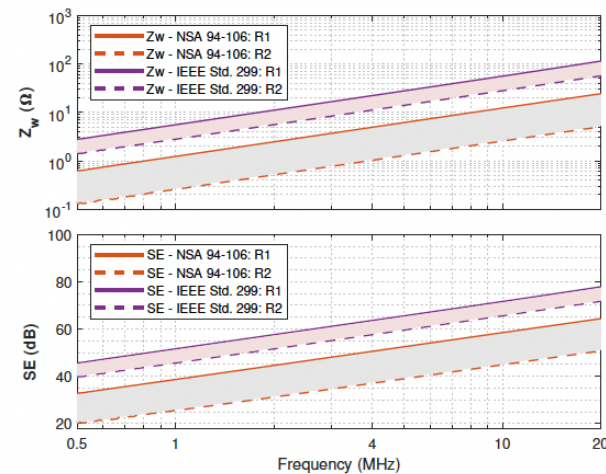
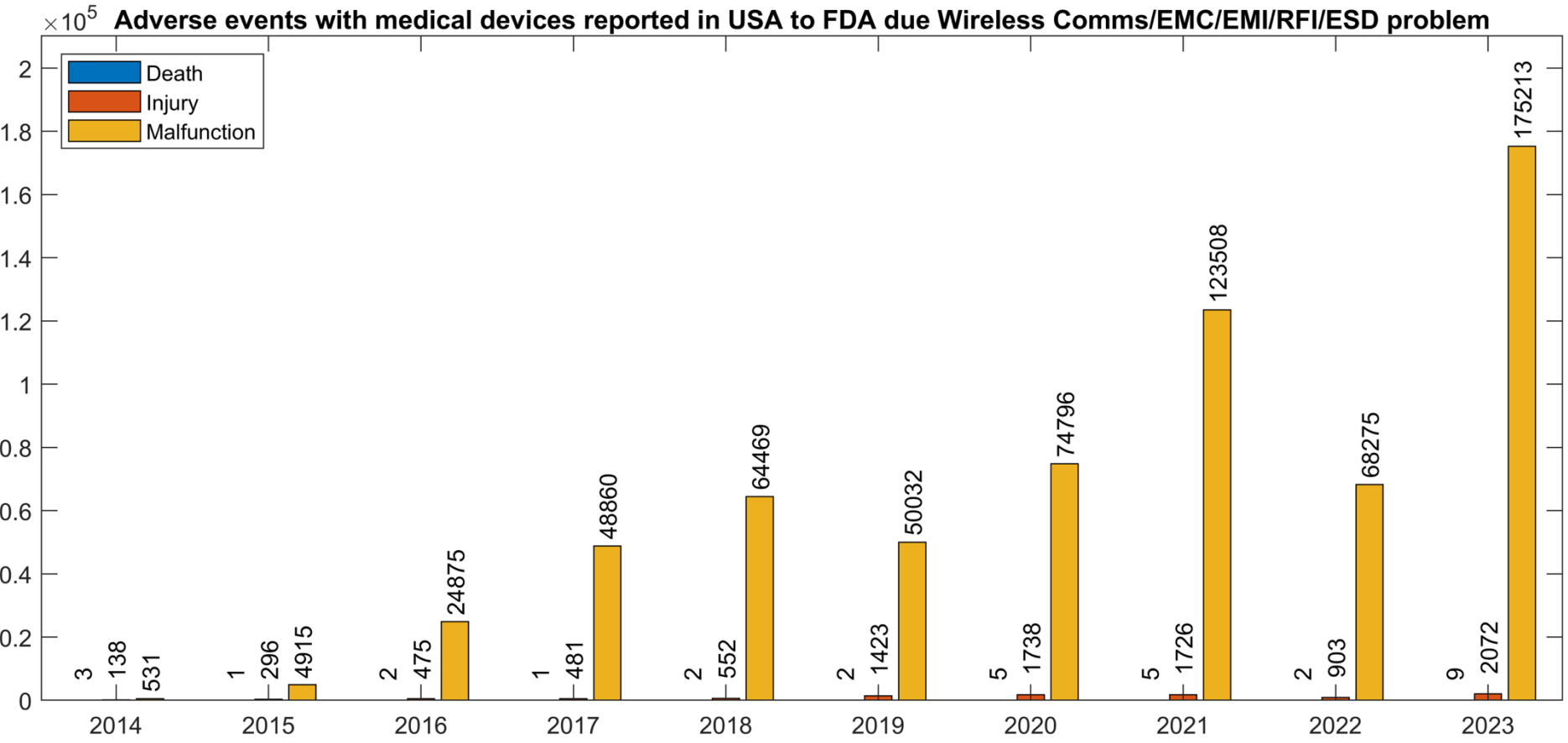


Fig. 5: NEC2 Simulation (MoM) setup.

Risk based RED?

- Rule
- F
- Risk
- C



Our services



Empowering innovation with reliable, compliant, and high-performance technology through expert pre-compliance EMC and RED testing, shielding effectiveness measurements, and reliability assessments — ensuring a seamless path from design to market.