EMC on a system level

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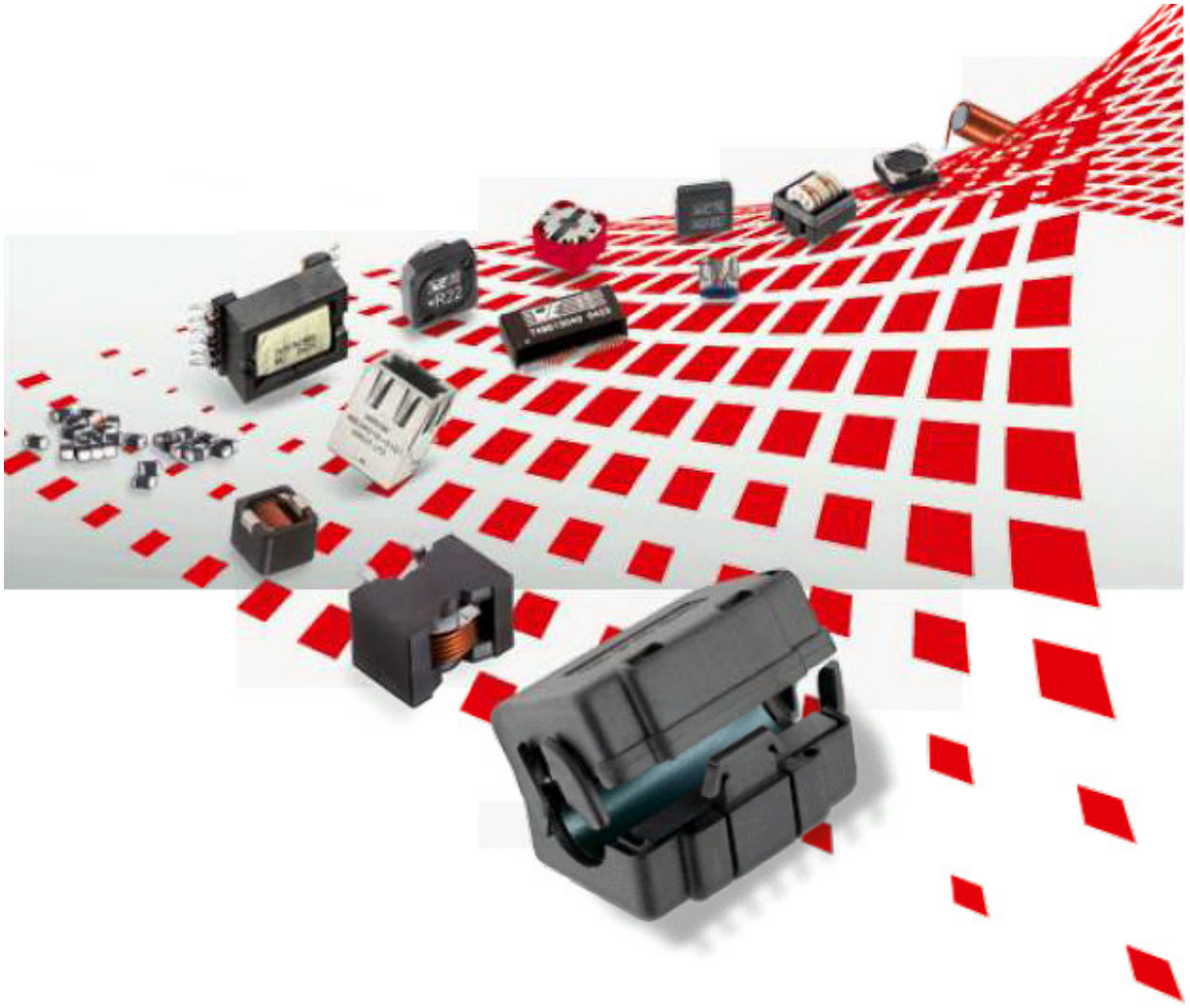
7. November 2016

Agenda

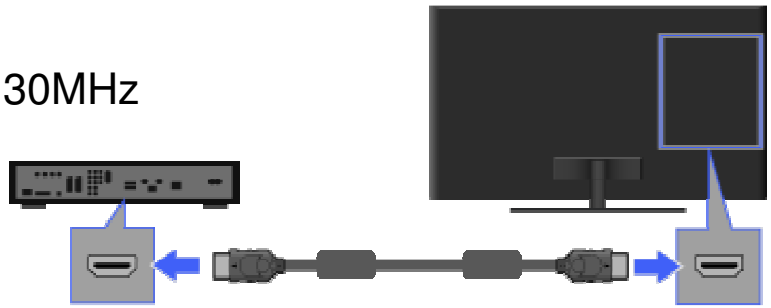


- Kinds of Interferences
- Core materials
- Cable Ferrites
- Schielding materials
- Conclusion
- Q & A

Kinds of Interferences

- **Origin of an Interference:**
  - Change of Voltage and Current in the disturbing source

- **Conductive Interferences:**
  - Standard definition: Test at EMC Lab from 150kHz – 30MHz
  - For Differential Mode disturbances

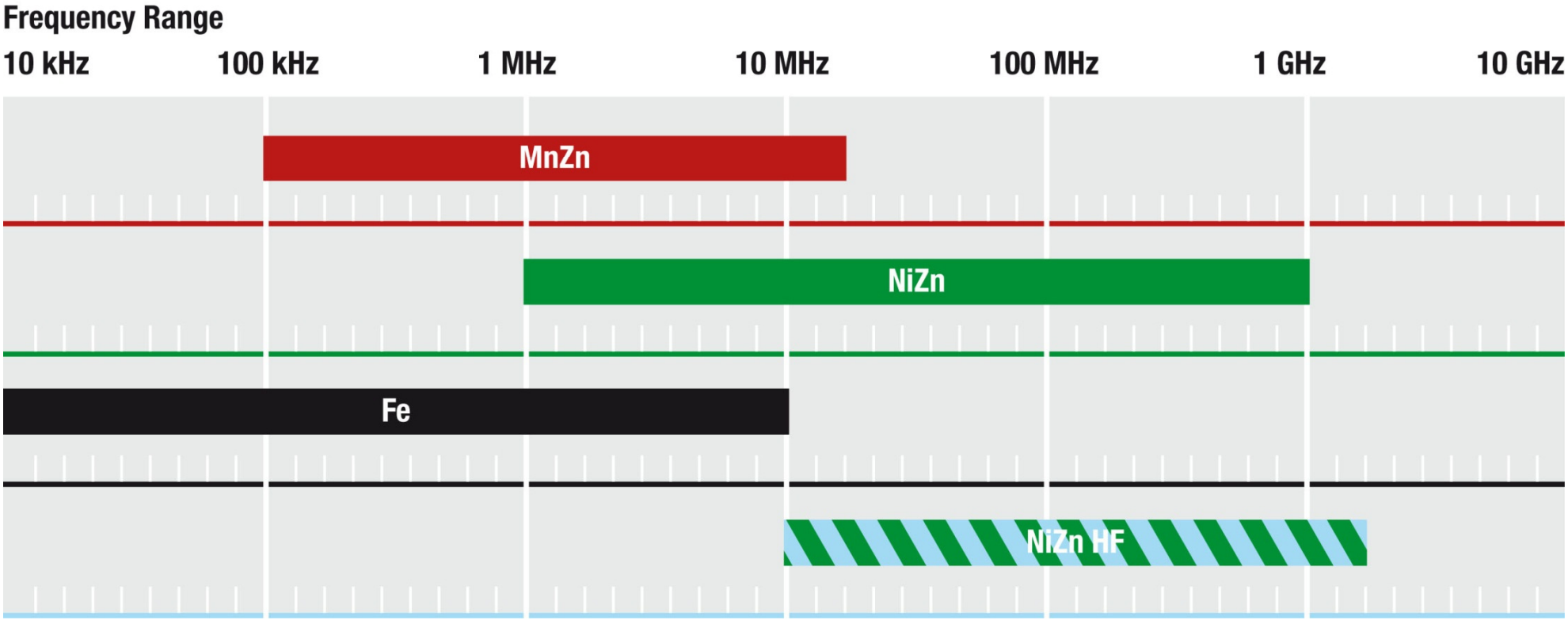


- **Radiated Interferences:**
  - Standard definition: Test at EMC Lab from 30MHz – 2GHz
  - For Common Mode disturbances

- **Conclusion:**
  - Depending on the frequency we have different kind of interferences

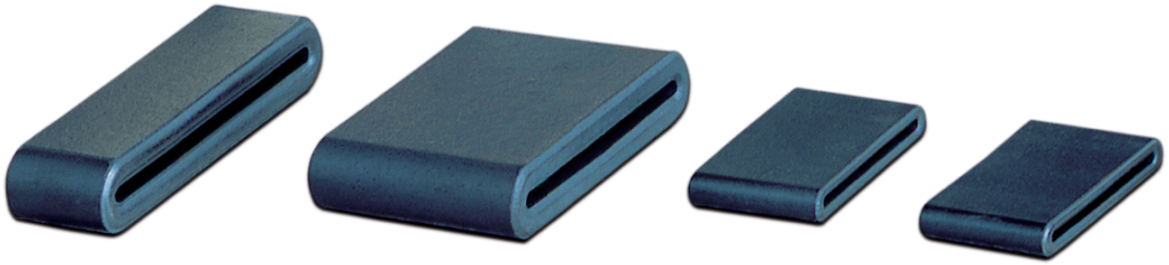
Different Core materials

Step 1: Check the frequency range



Solid Cores

- **Planned EMI Suppression**
- **Smaller Dimensions**
- **Cheaper**
- **No Rattling ☺**



WE-Flat

WE-AFB

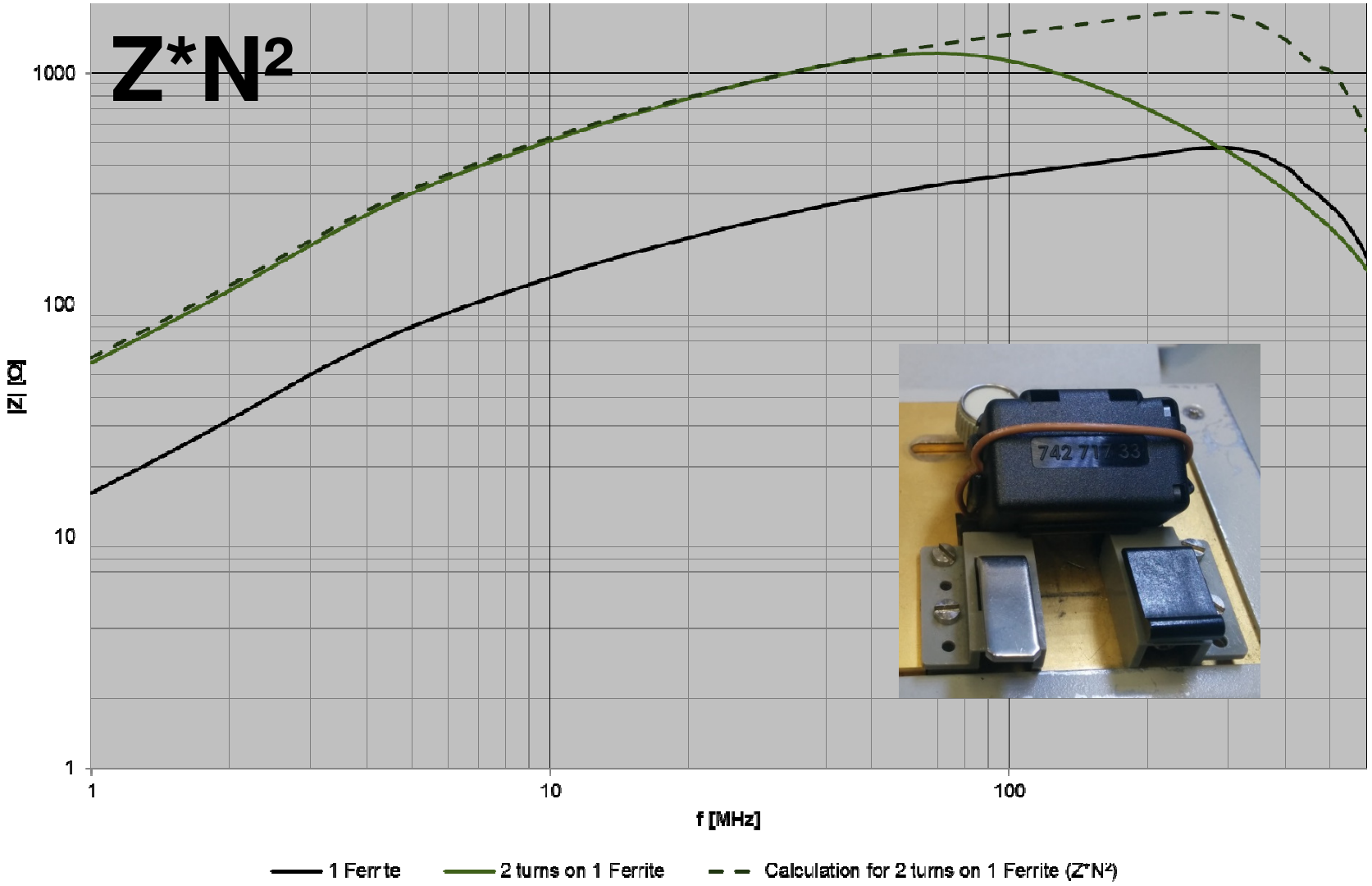
WE-TOF

Snap Ferrites (STAR-Series)

- **Subsequent EMI Suppression**
- **Key Technology**
  - Patented
  - Inner security lock
  - No unauthorized removing
- **Fixation of the cable**
- **Cable Clamping Protection**

Star-Ring Star-Bueno Star-Flat Star-Tec Star-Fix Star-Fix LFS Star-Gap Key

NiZn Ferrite 74271733 – 2 turns on 1 Ferrite



MnZn Ferrite 74272733 – 1 Ferrite 2 turns

Application of Cable Ferrites

- **Usage for:**
  - Interference suppression
  - Conductive and radiated emissions
  - Common and differential mode noise

- **Benefits:**
  - Fast and cheap solution to ensure delivery
  - No redesign of the printed circuit needed
  - No influence to the data signal

- **Application Areas:**
  - Computer, Industry, Consumer products, Telecommunication…

- **Conclusion:**
  - Cable ferrites are used to eliminate EMI-Problems!

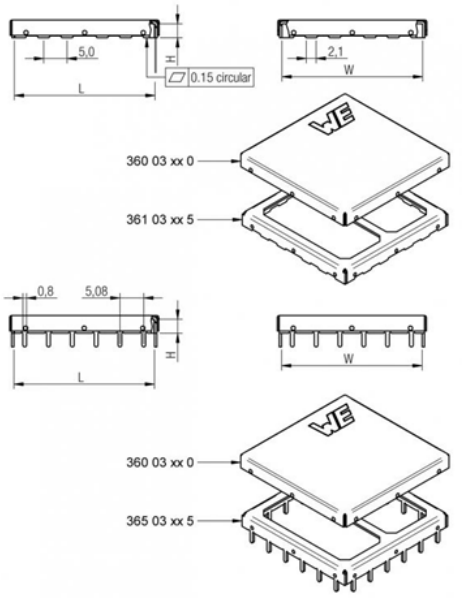
EMC SHIELDING

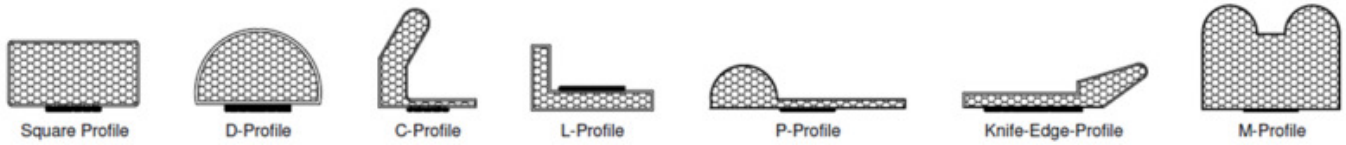
EMC Shielding

What is EMC shielding?

Designing:

- Material:
  - Conductivity
  - Permeability
  - Permittivity
  - Galvanic properties
- Shape
- Mechanical properties
  - Flexibility
  - Mechanical resistance



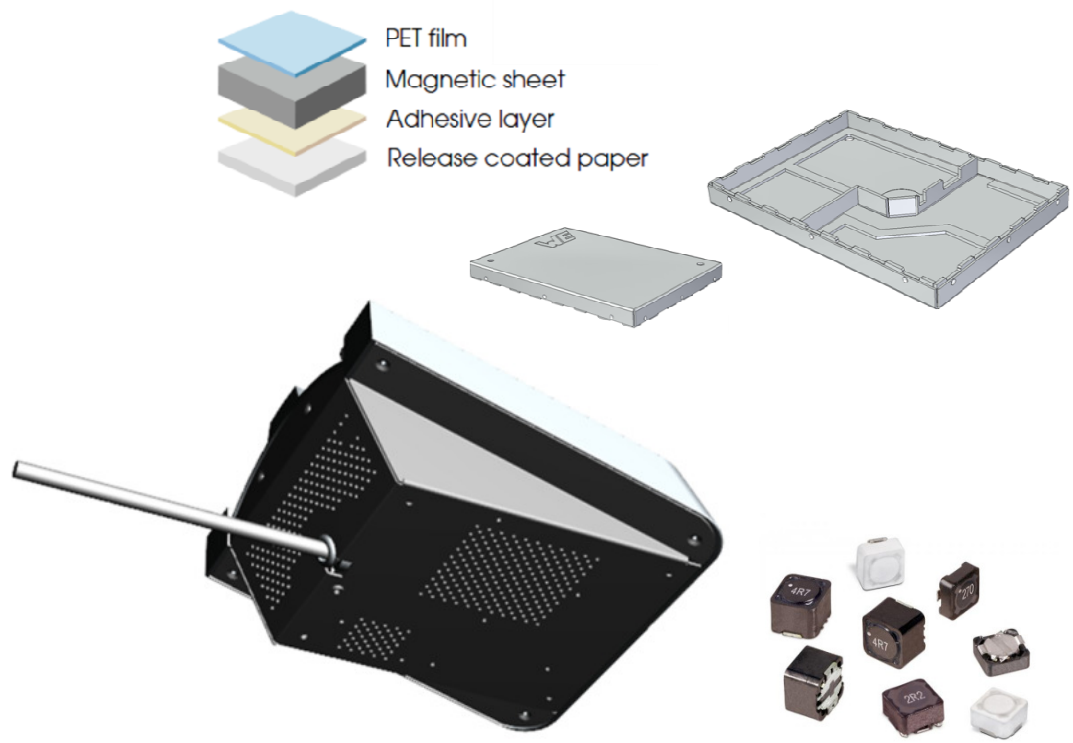


EMC Shielding

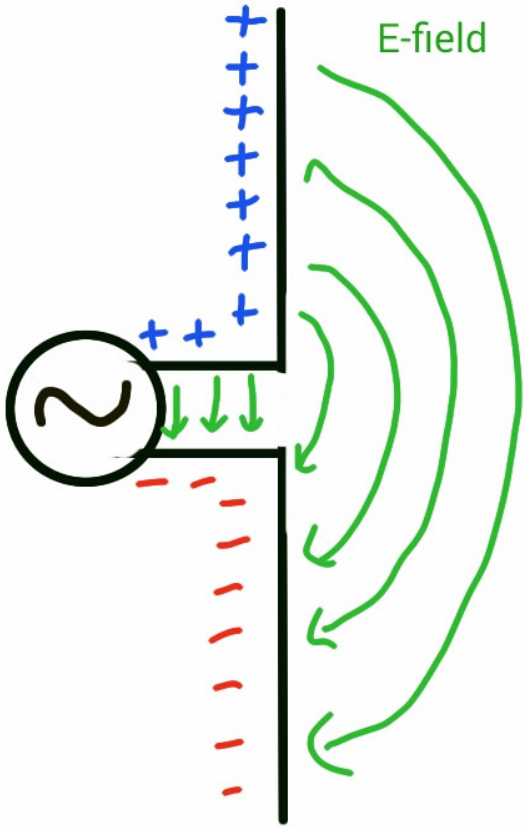
What is EMC shielding?

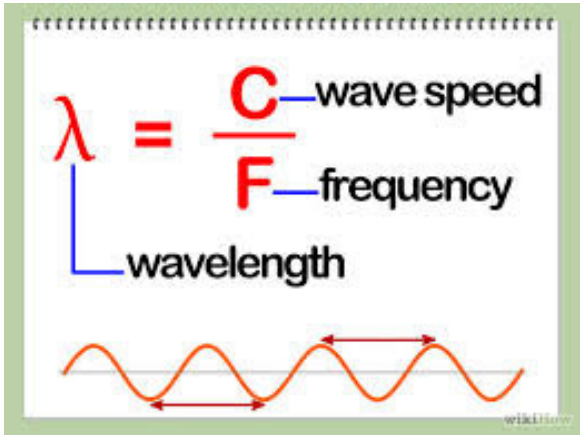
Placing:

- Fixing method:
  - Adhesive
  - Solder
  - Screw
  - Assembly
- Location:
  - Component
  - PCB
  - System
  - Building



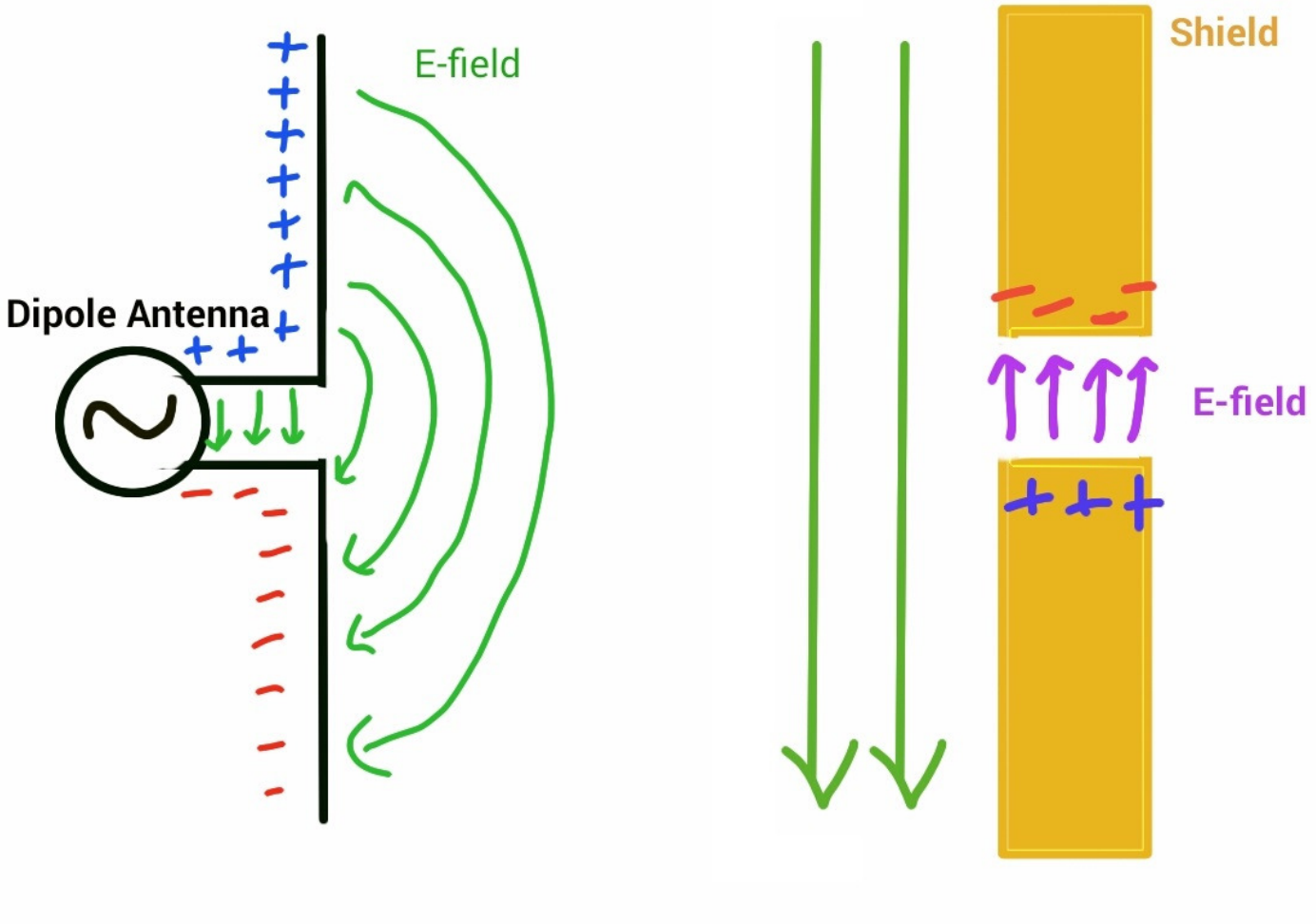
EMC Radiation



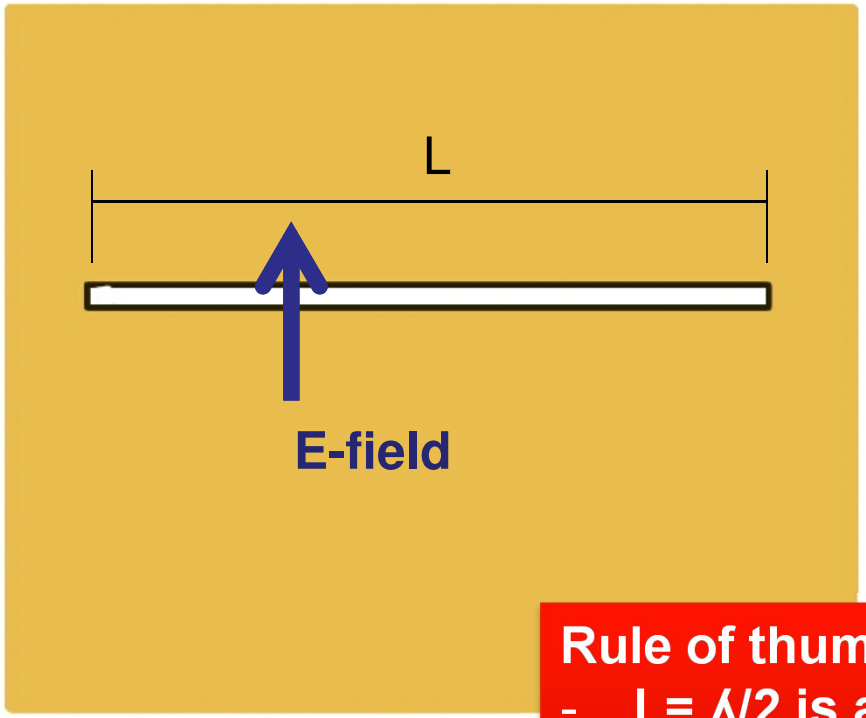


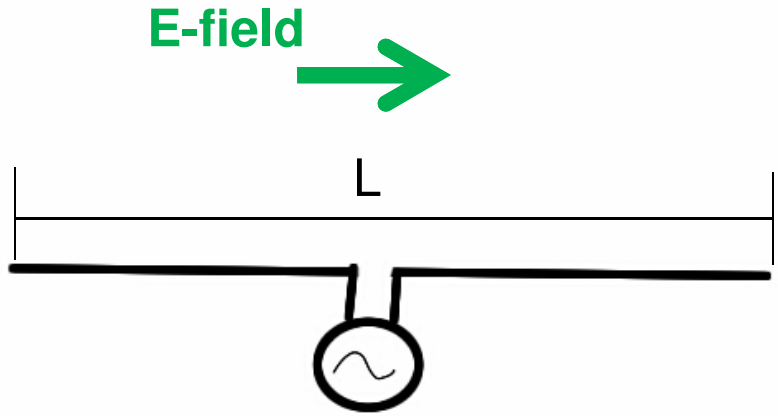
Rule of thumb :
- **L= λ/2 is a perfect dipole antenna**
- **L<λ/100 is a bad antenna**

EMC Radiation



EMC Radiation

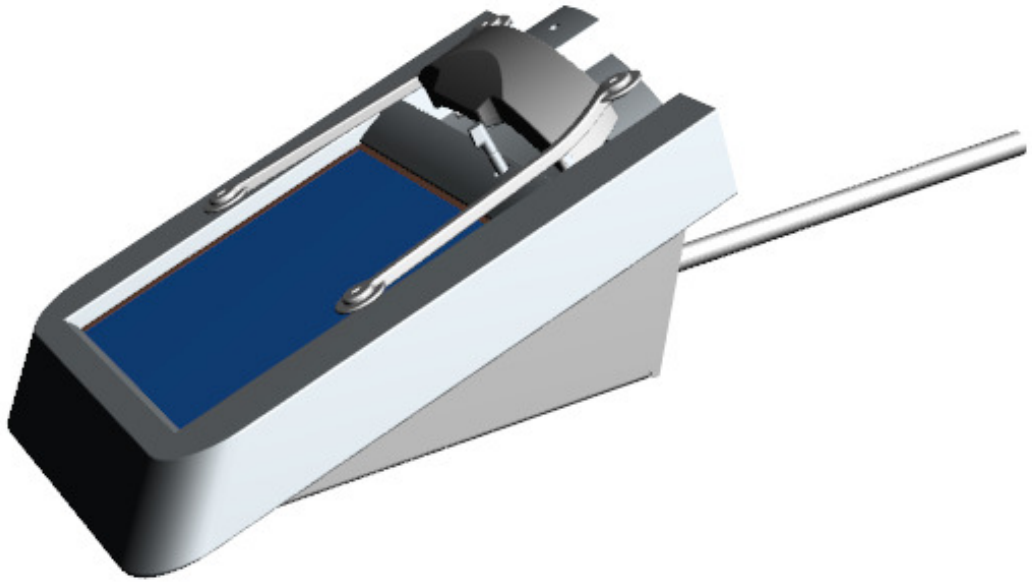


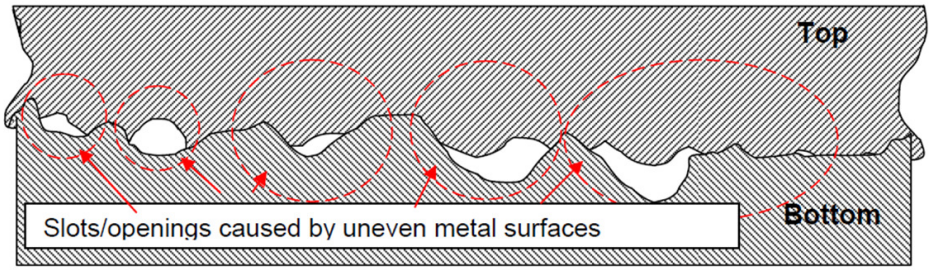


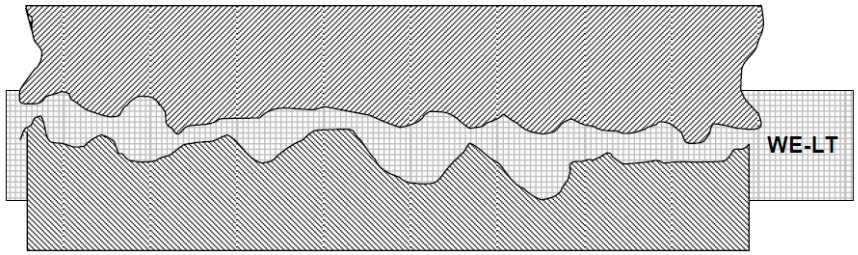
Rule of thumb :

- **L= λ/2 is a perfect dipole antenna**
- **L<λ/100 for a shielding effectiveness of 60dB**

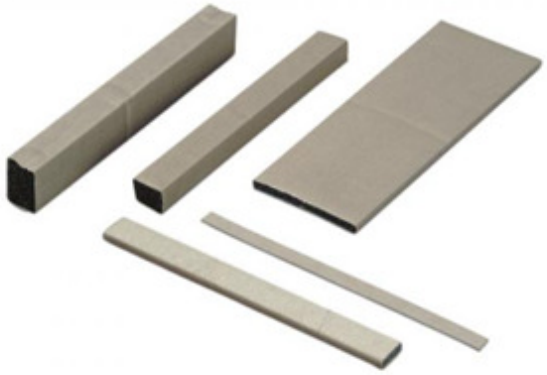
EMC Design of Electronic Devices: Joints and seams

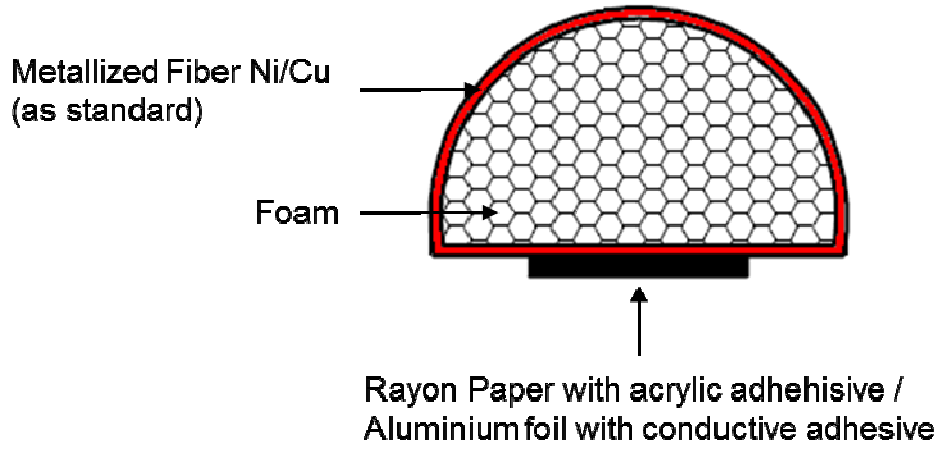


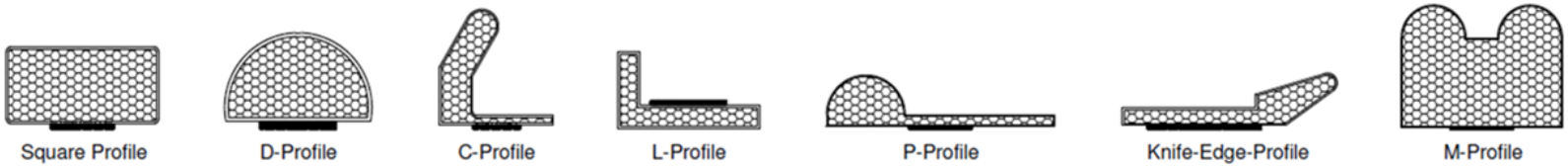




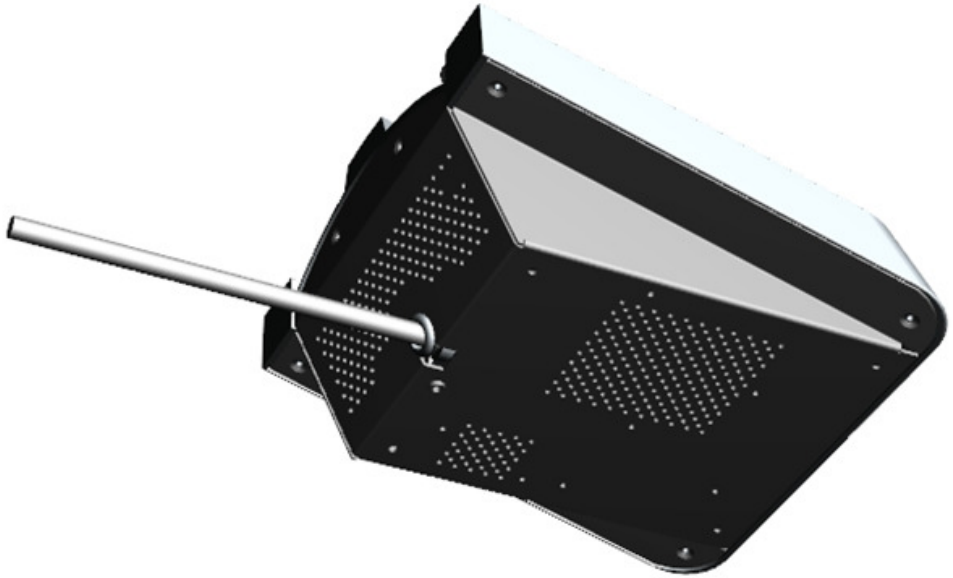
EMC Design of Electronic Devices: Joints and seams

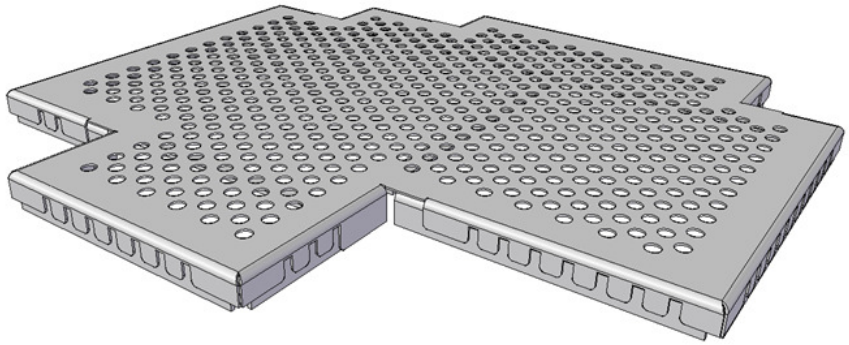




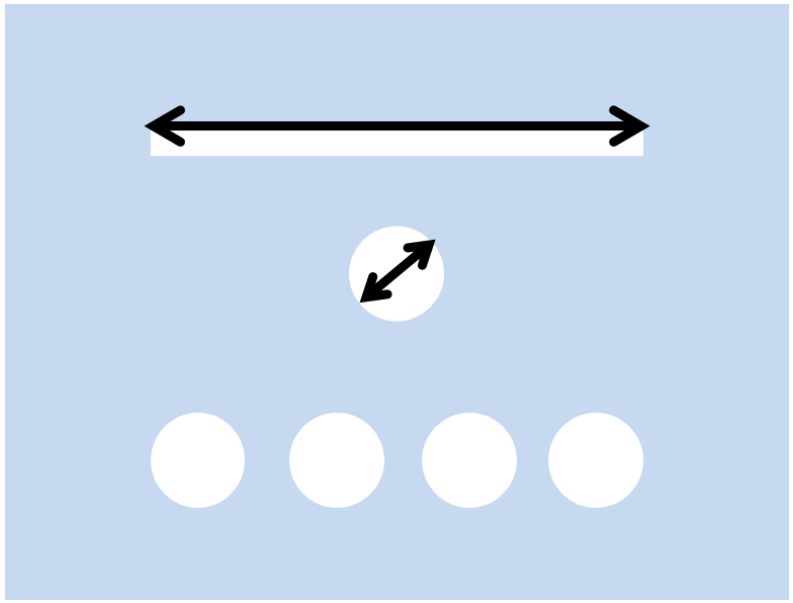


EMC Design of Electronic Devices: Ventilation





EMC Design of Electronic Devices: Ventilation

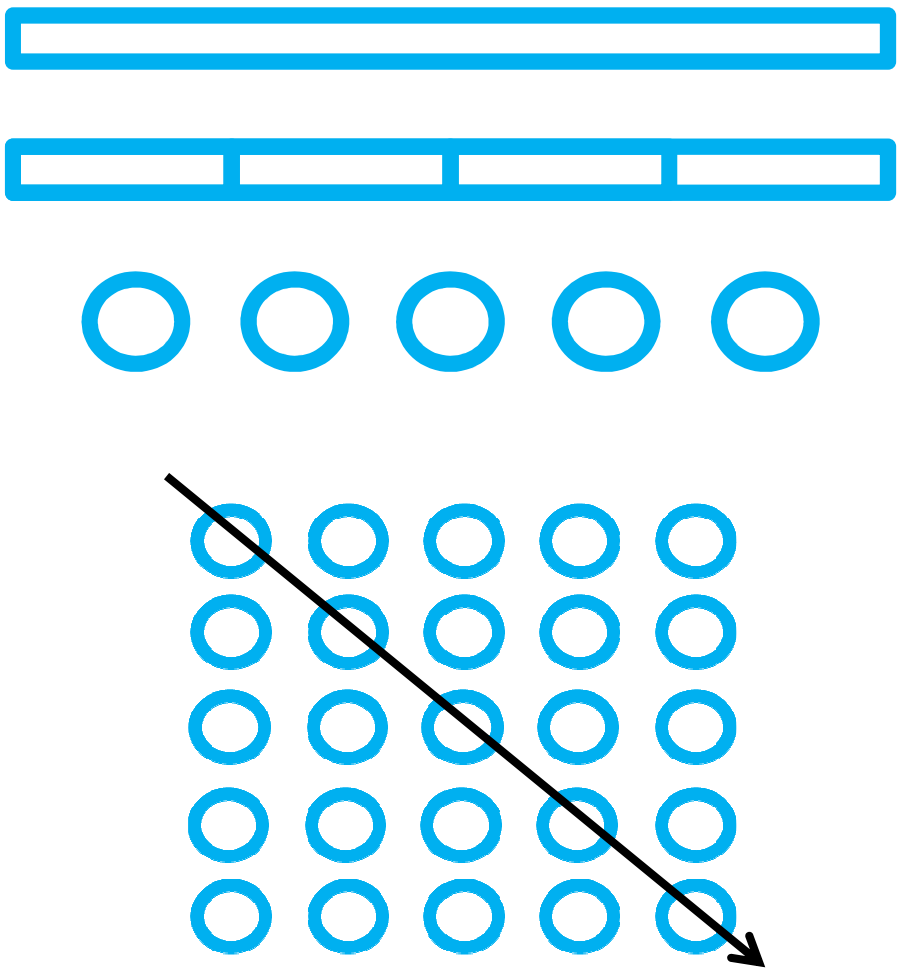


Maximum lenght for 20dB Shielding Effectiveness

Frequency (MHz)	Maximum length (cm)
30	46
50	30
100	15
300	5
500	3
1000	1.5
3000	0.2

Source: Electromagnetic Compatibility Engineering. Henry W. Ott

EMC Design of Electronic Devices: Ventilation

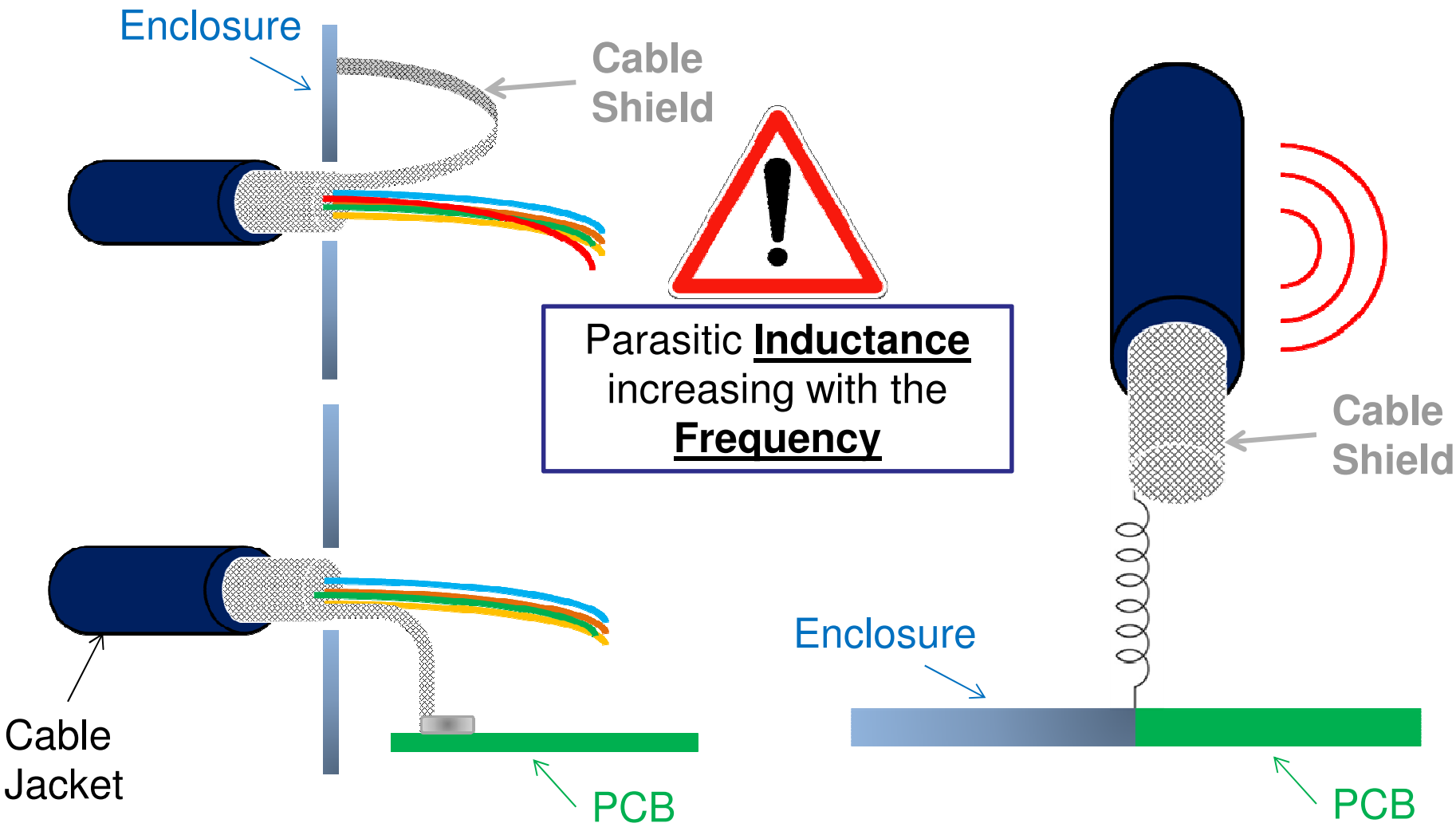


Reduction of Shielding Effectiveness versus the Number of Apertures

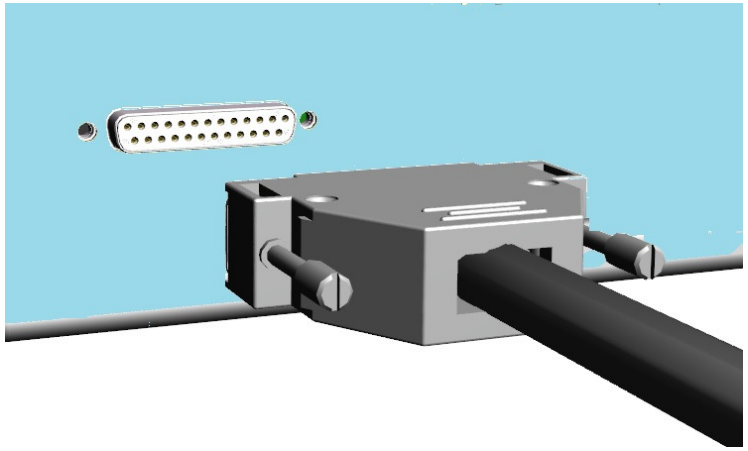
Number	Shielding Reduction
2	-3
4	-6
6	-8
8	-9
10	-10
20	-13
30	-15
40	-16
50	-17
100	-20

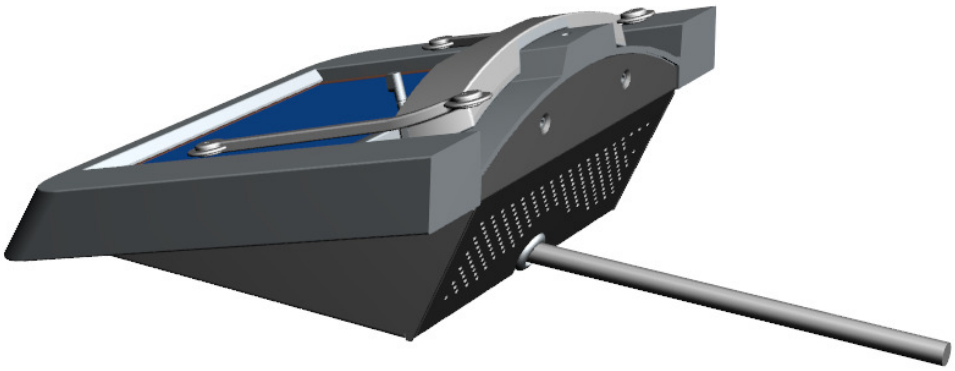
Source: Electromagnetic Compatibility Engineering. Henry W. Ott

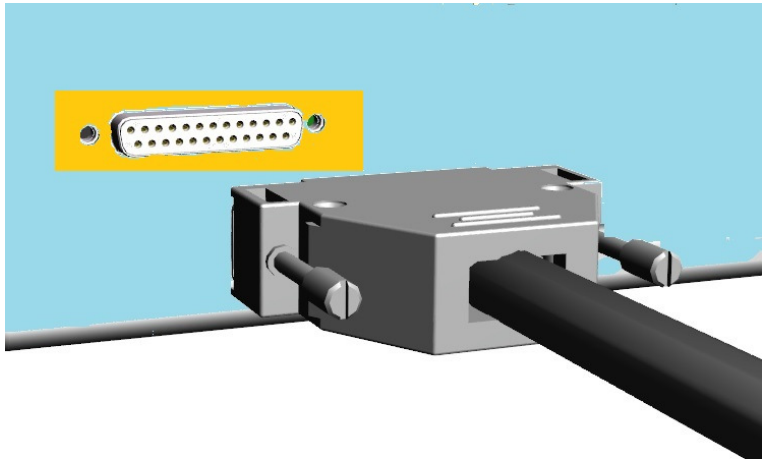
EMC Design of Electronic Devices: Cable entry

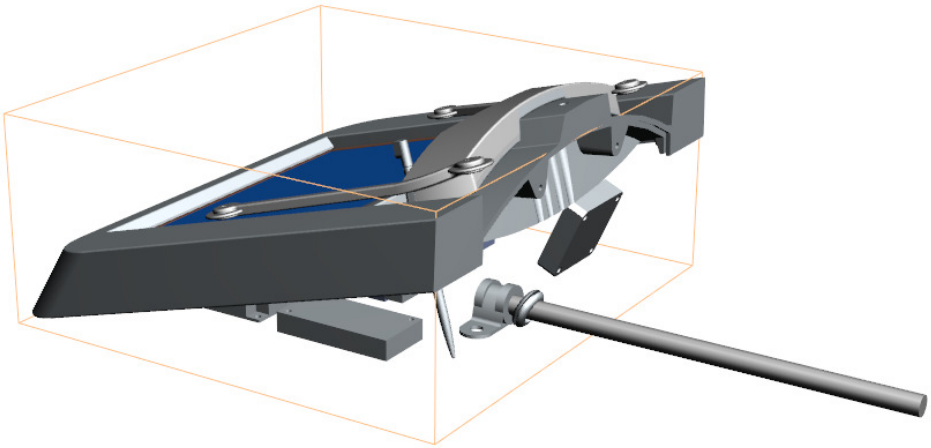


EMC Design of Electronic Devices: Cable entry

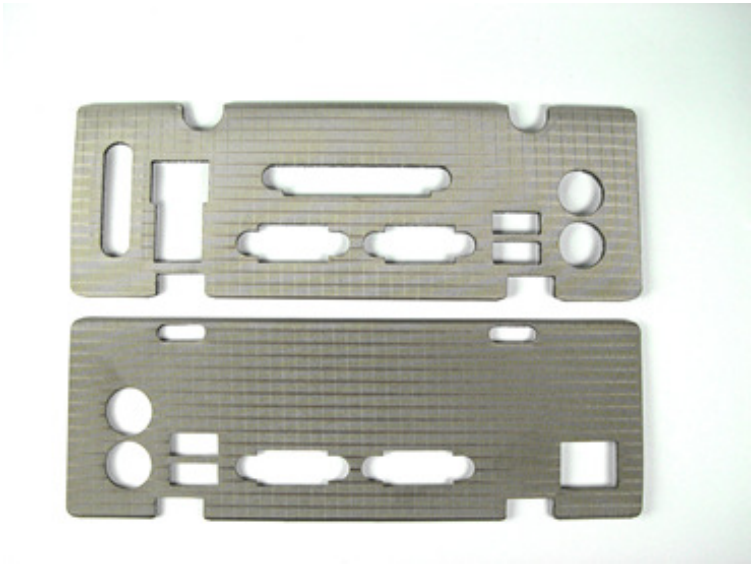




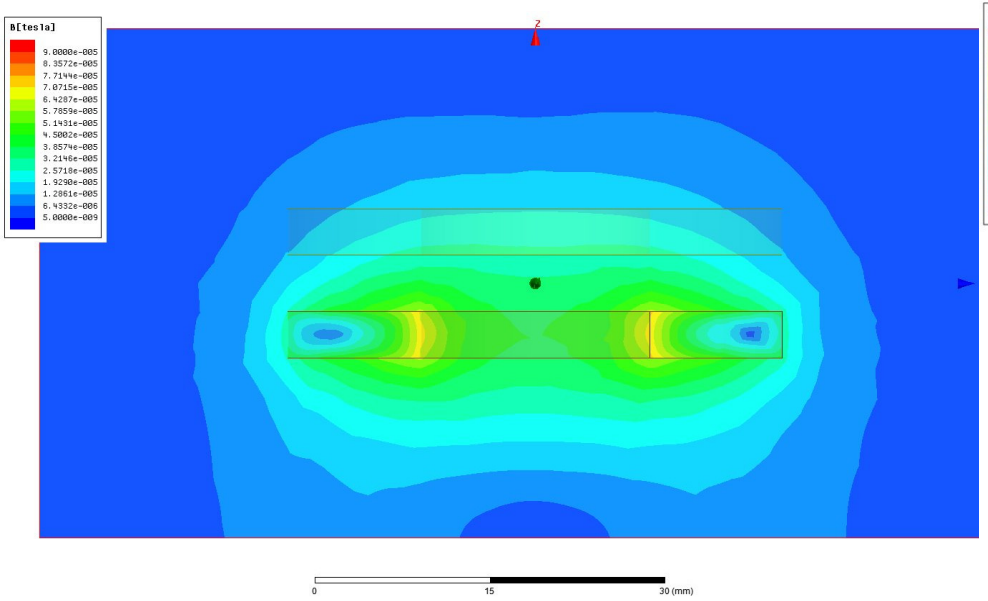


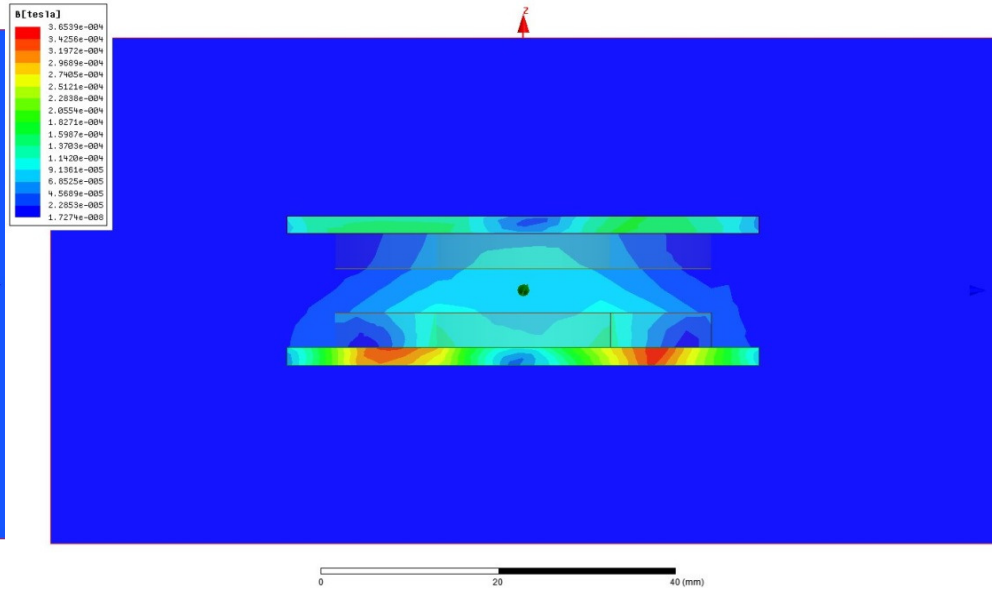


EMC Design of Electronic Devices: Cable entry



Magnetic field



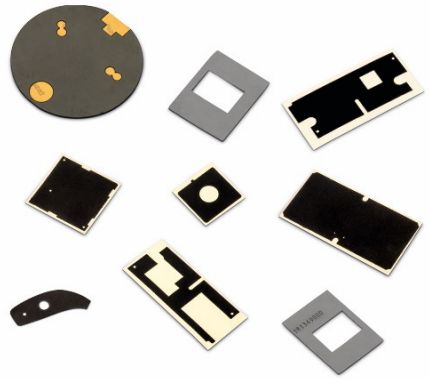


Without Shielding

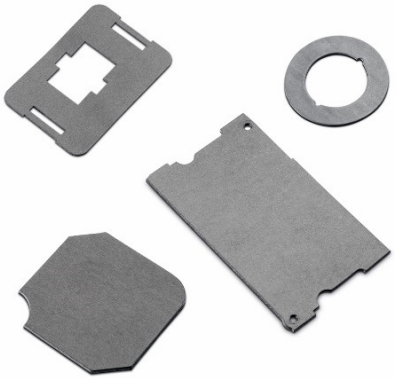
With Magnetic Shielding

Soft Magnetic Shielding

WE-FSFS Flexible Sintered Ferrite Sheet



WE-FAS Flexible Absorber Sheet



Application of schielding materials

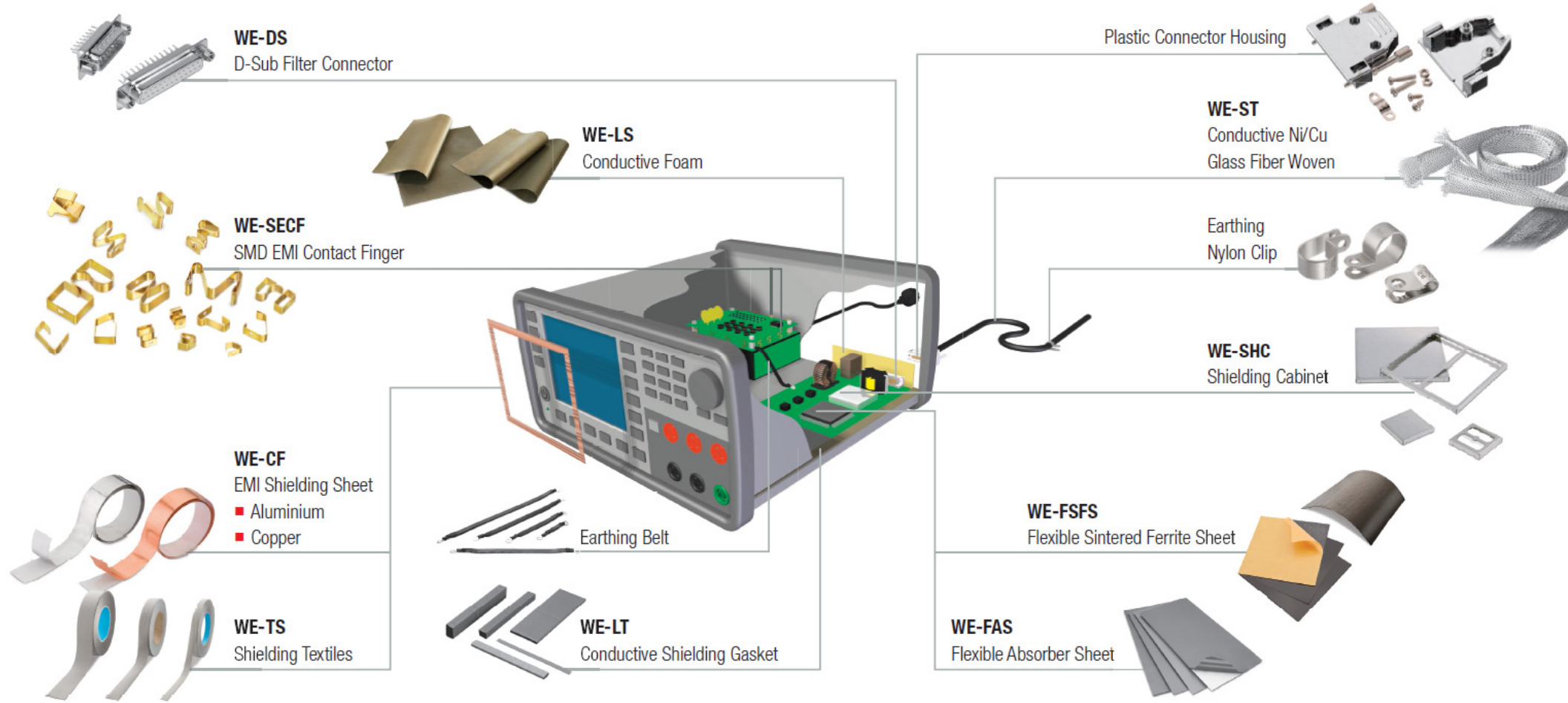
- **Usage for:**
  - Interference suppression
  - Only for radiated emissions

- **Benefits:**
  - Can be very effective up to 100 dB effectiveness.
  - No redesign of the printed circuit needed

- **Application Areas:**
  - Computer, Industry, Consumer products, Telecommunication…

- **Conclusion:**
  - Schielding materials are used to eliminate radiated EMI-Problems!

What WE have?



Thank you for your attention

WÜRTH ELEKTRONIK

EMC on a system level

Any questions?