LANGER EMV-Technik

Electromagnetic Emission:
Measurement without an Anechoic Chamber

- Pre-compliance emission troubleshooting at the workstation -

Sven König, Dipl.-Ing. (BA)

Development Engineer

- New measurement tools
- Practical troubleshooting on electronic devices
- EMC/EMI/ESD tests on IC´s
- Teaching seminars and competent customer support

Langer EMV-Technik GmbH

LANGER EMV-Technik

EMC **seminars & workshops**
consultations
measurement tools

for devices, assemblies and integrated circuits



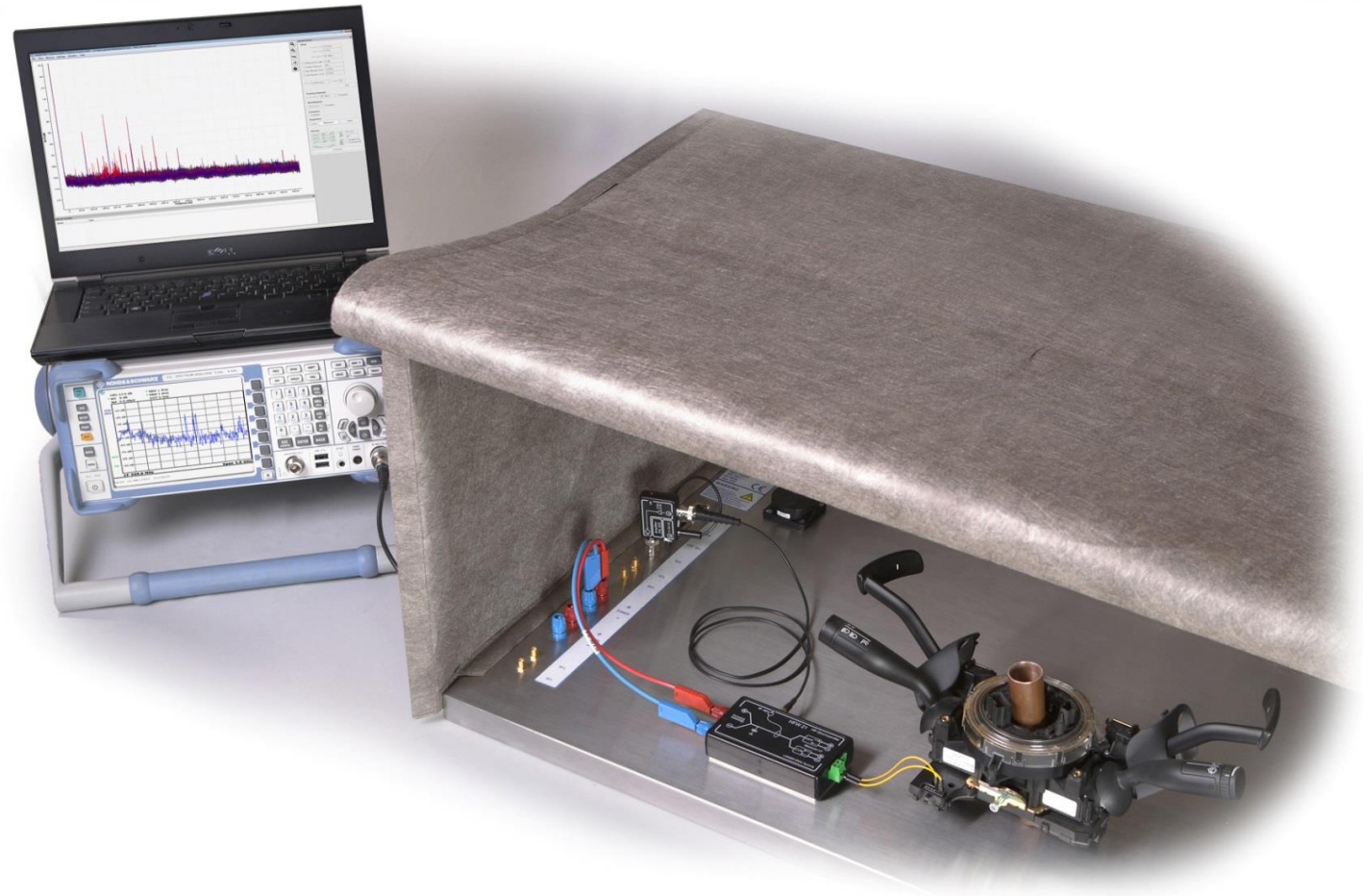


EMC LIVE 2016

Electromagnetic Emission:

Measurement without an anechoic chamber

- Pre-compliance emission troubleshooting at the workstation -



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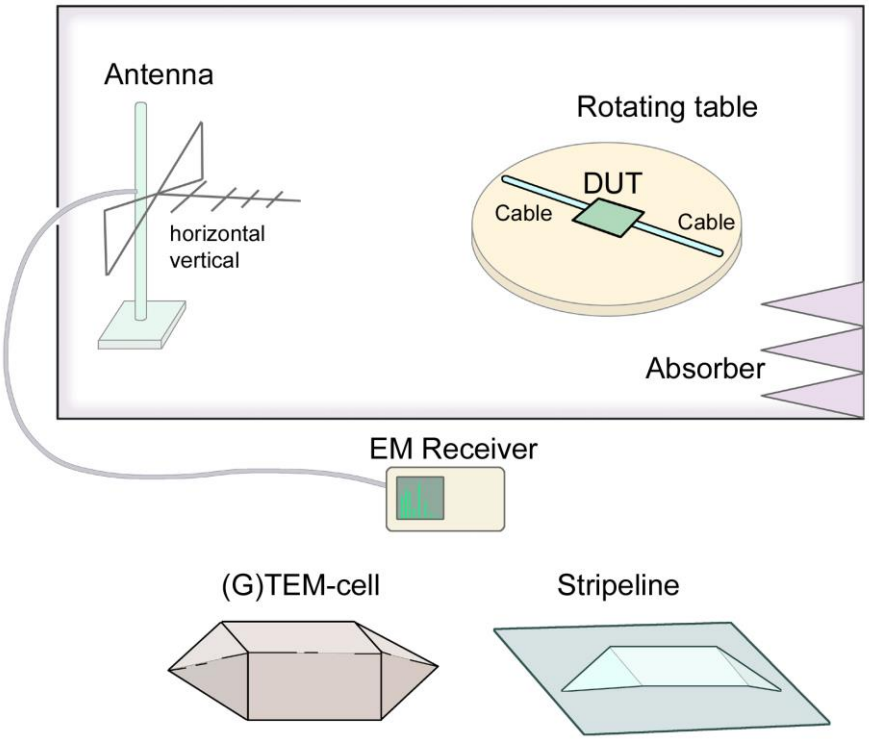
1. Theoretical part 1 – testing in anechoic chamber
2. Theoretical part 2 – source of radiated emission
3. ESA1 - measurement without an anechoic chamber
4. Troubleshooting strategies
5. Practical example

Testing in an Anechoic Chamber



- Necessary for certification
- Complex and expensive test procedure
- Anechoic chamber often only available in test labs

- Implementation of simpler methods is possible (GTEM, Stripeline)

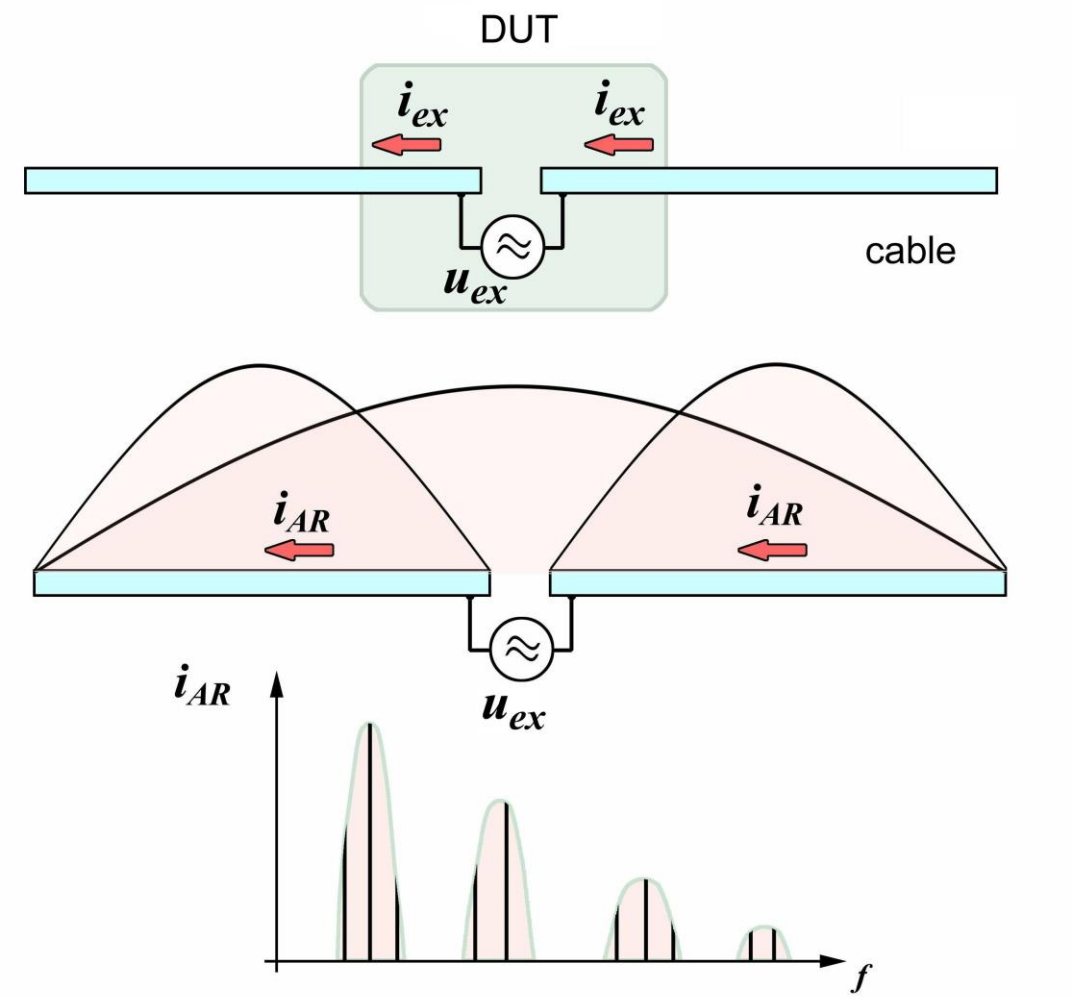
➢ How are they comparable to the antenna measurements?

Are these methods the best way to solve emission problems much earlier? during the initial design cycle

Are they the right tools for troubleshooting?

Source of Radiated Emission

Antenna excitation – DUT as a transmitting antenna:



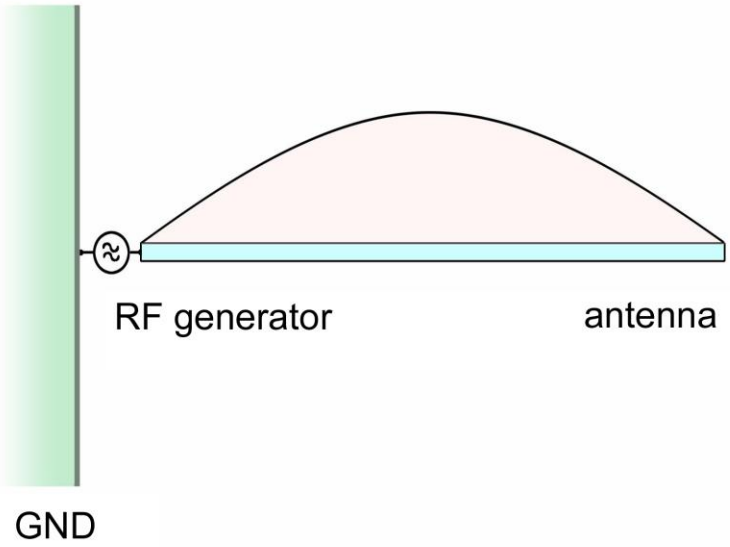
- Structures of DUT-PCB are too small to transmit emission directly
- Need for connected cables or nearby metal structures

➢ DUT is the source of antenna excitation

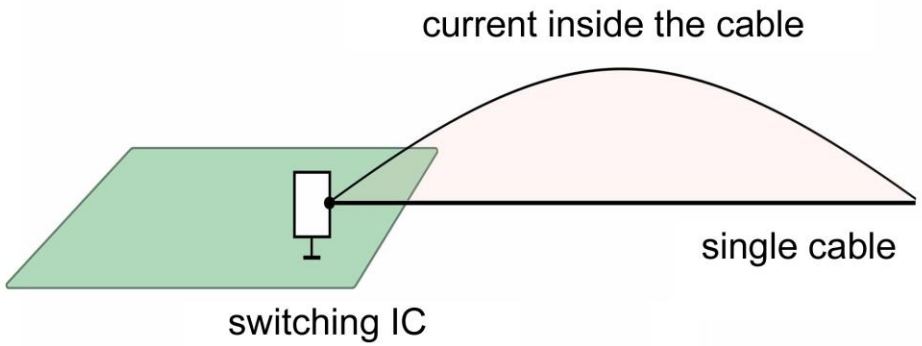
Source of Radiated Emission

galvanic antenna coupling

antenna coupling



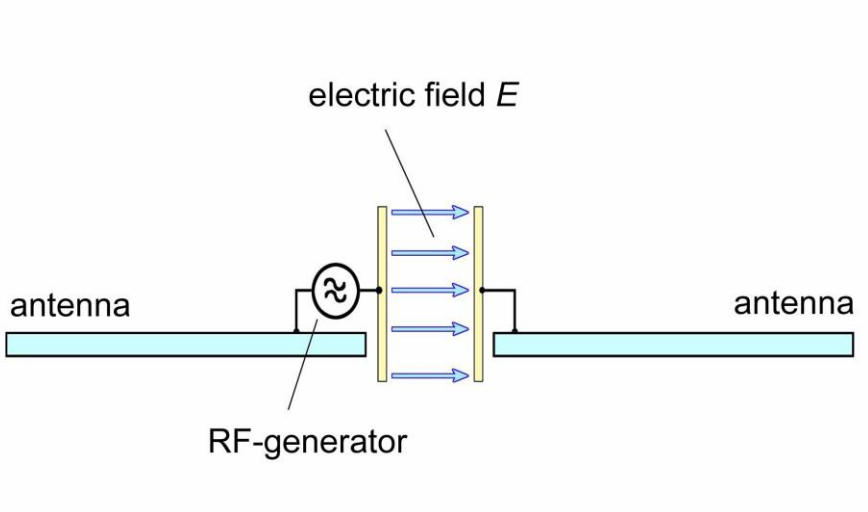
situation at PCB



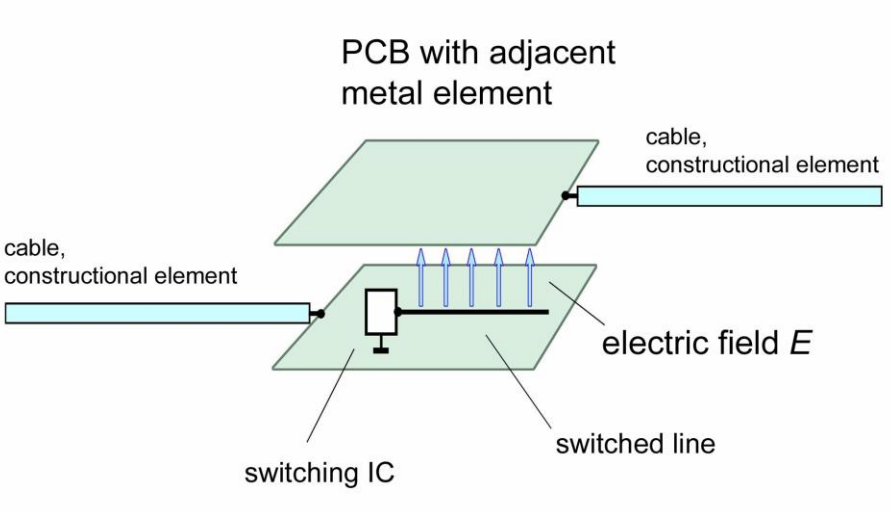
Source of Radiated Emission

antenna coupling by electric field

antenna coupling



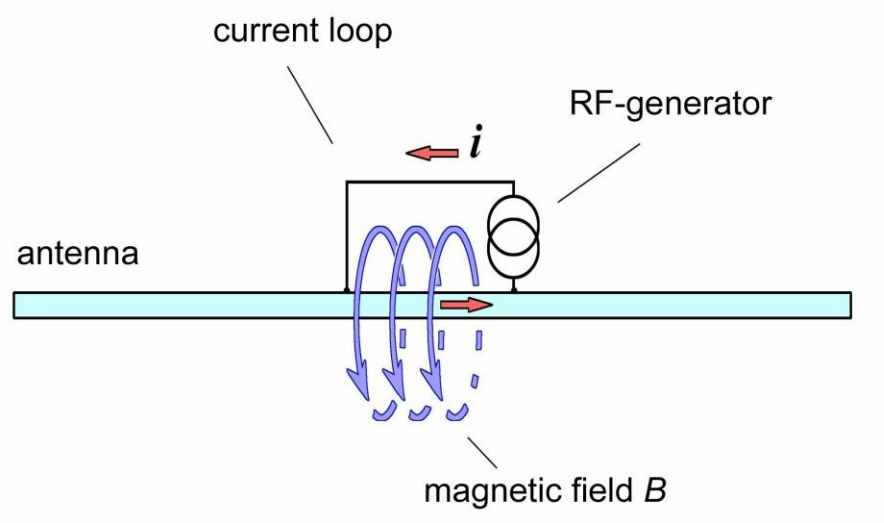
situation at PCB



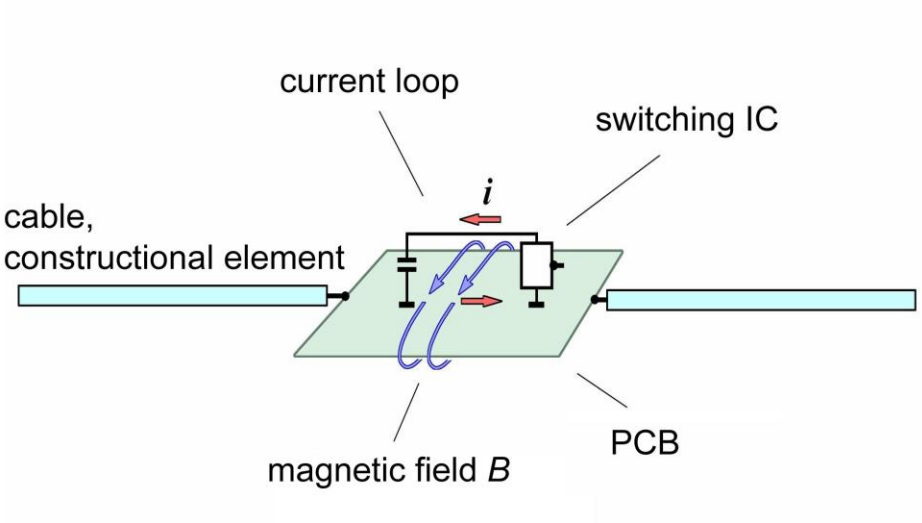
Source of Radiated Emission

antenna coupling by magnetic field

antenna coupling

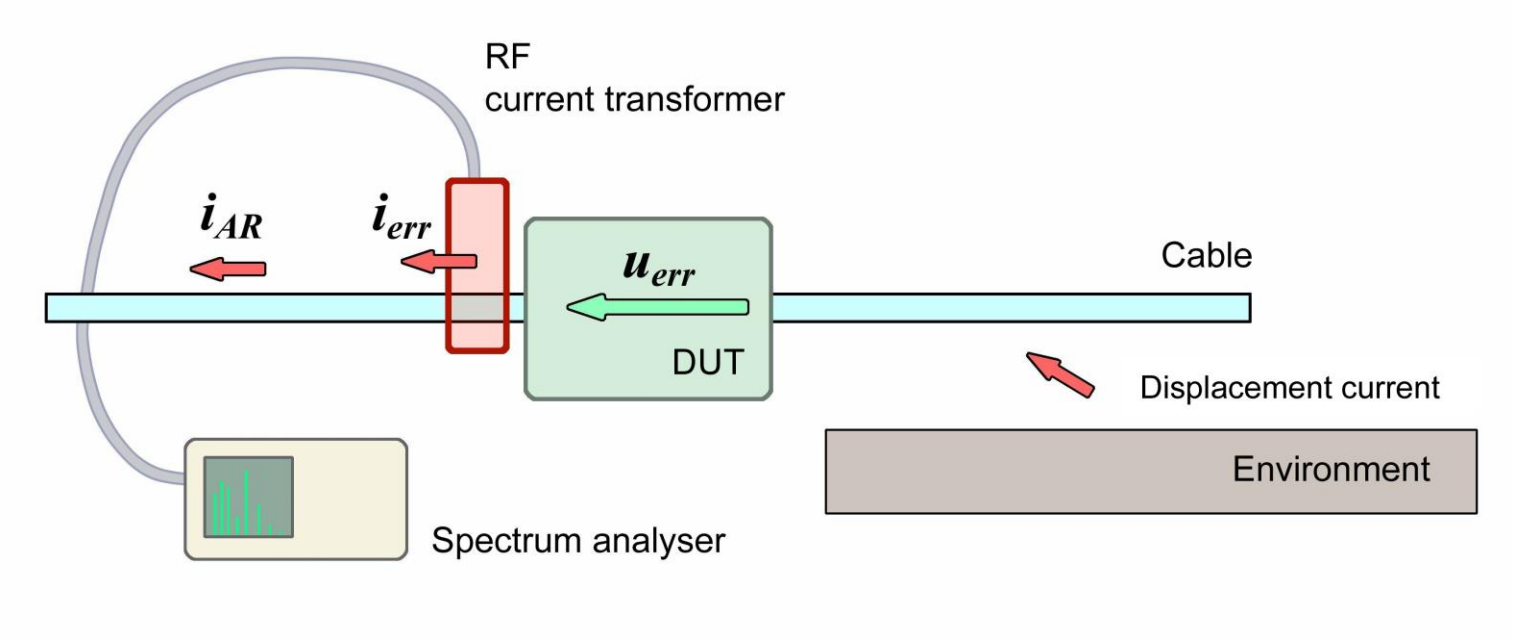


situation at PCB



Measurement without an Anechoic Chamber

RF current measurement:

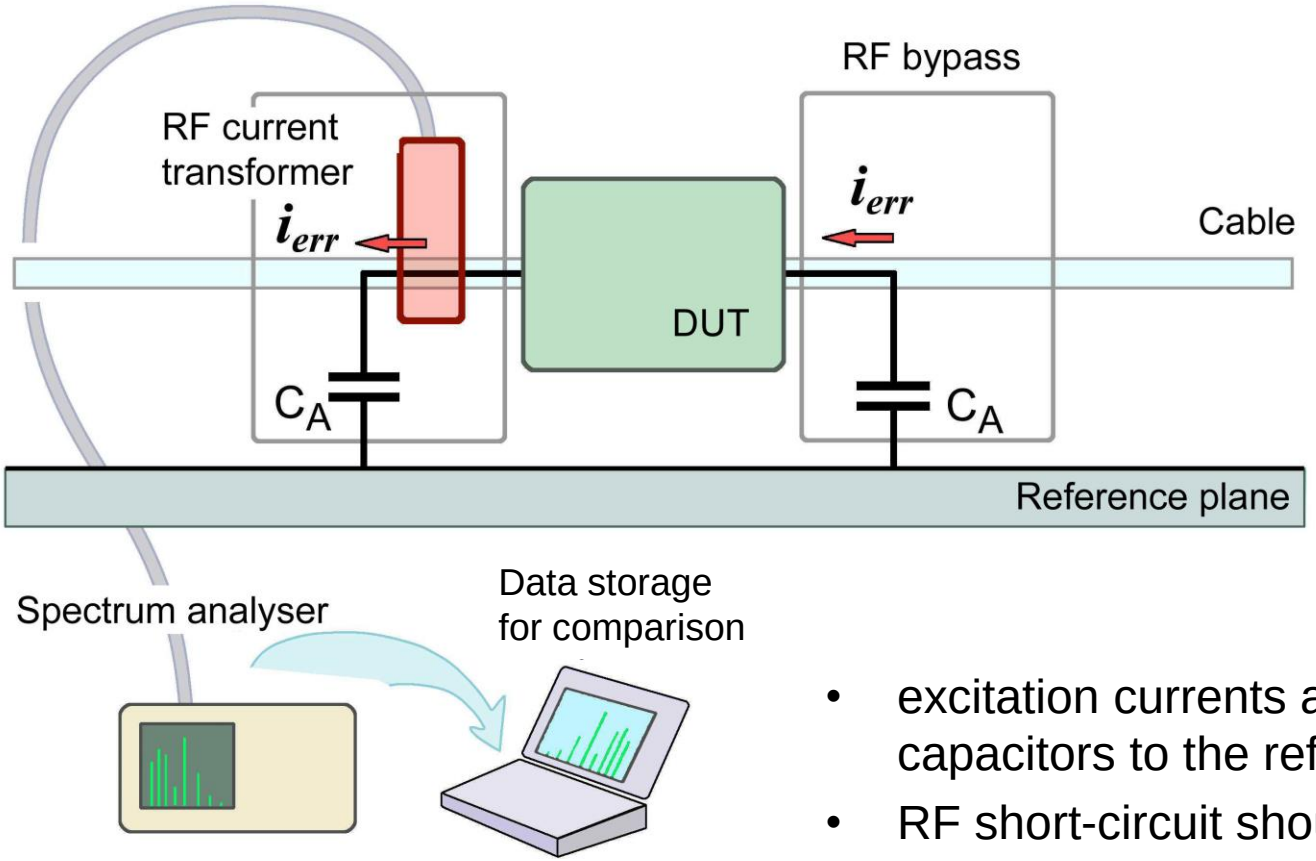


- Measurement of excitation current and antenna resonance current
- Small changes in the environment can cause big changes in current

➢ Uncertainties in measurement results

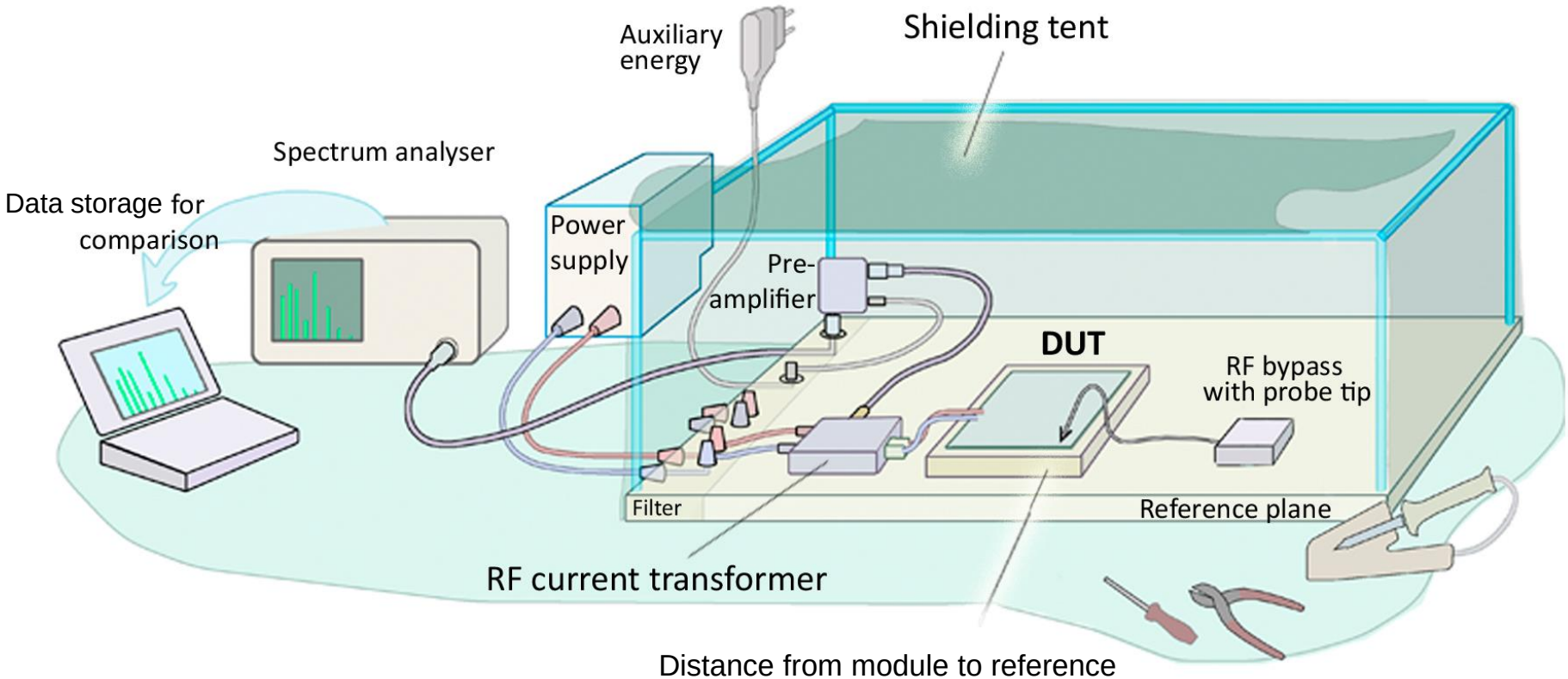
Measurement without an Anechoic Chamber

RF current measurement method with **ESA1**:

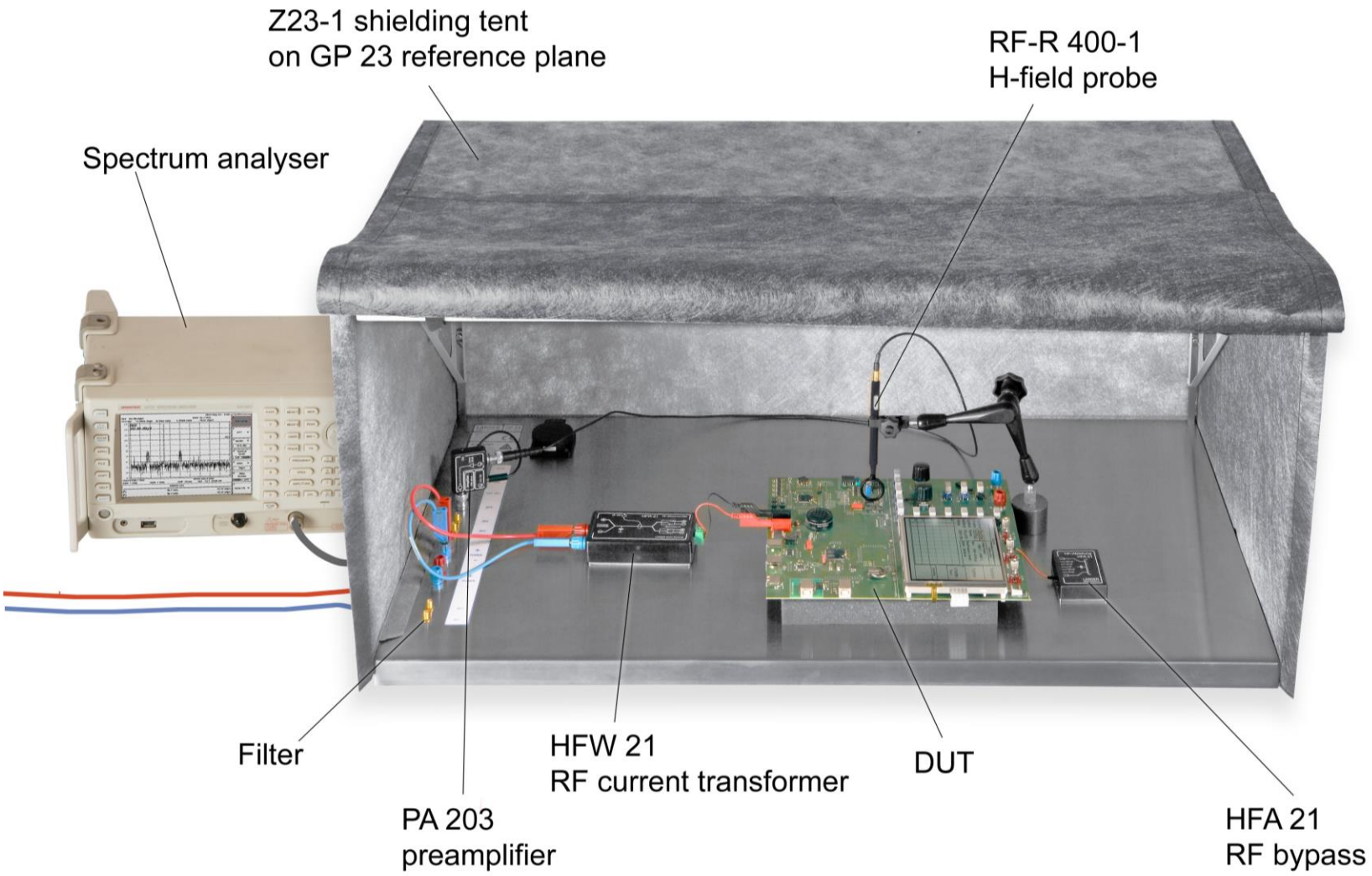


- excitation currents are shorted by capacitors to the reference plane
- RF short-circuit should not exceed ½ of the wavelength

ESA1 – Emission development system

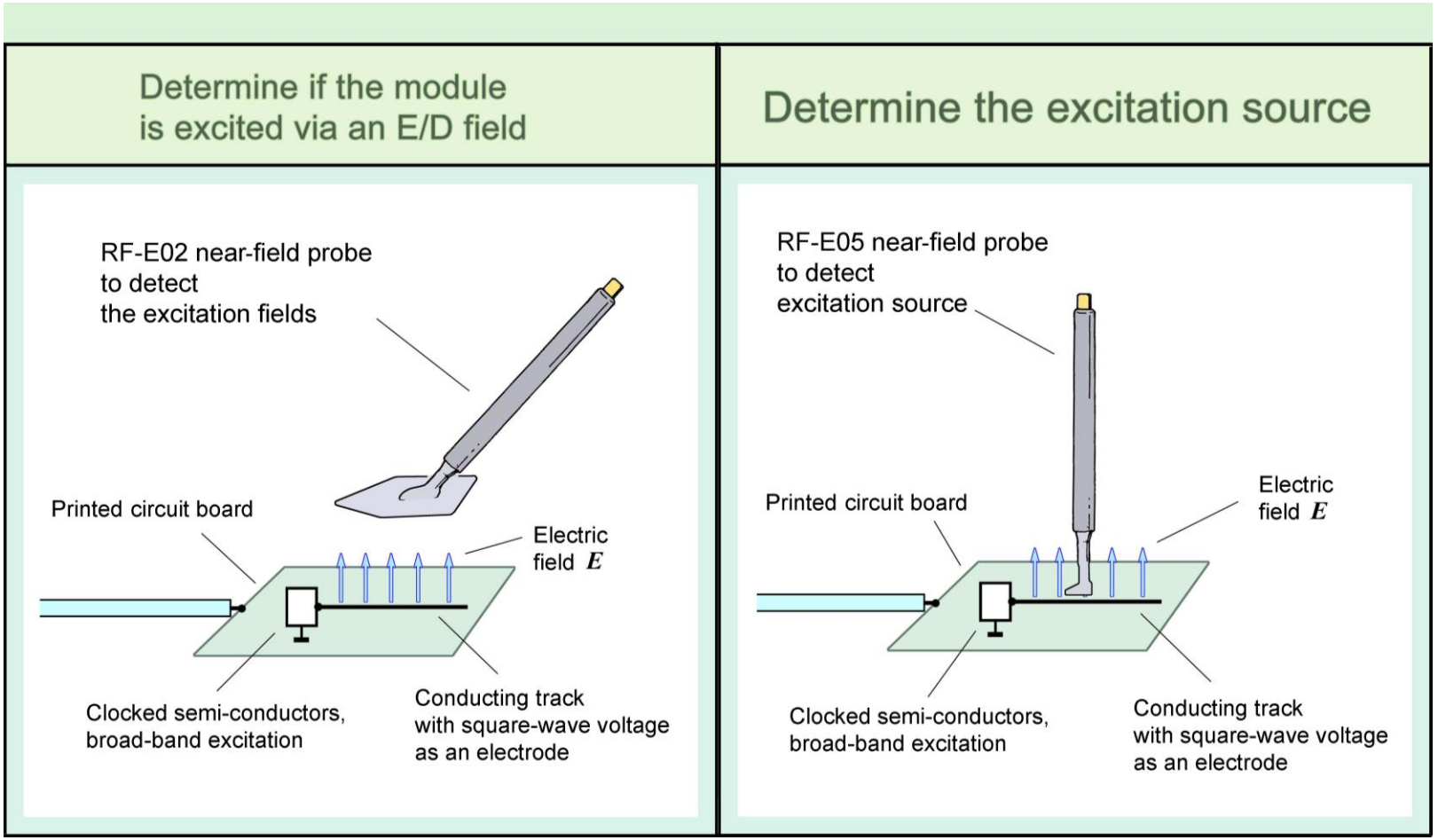


ESA1 – Emission development system



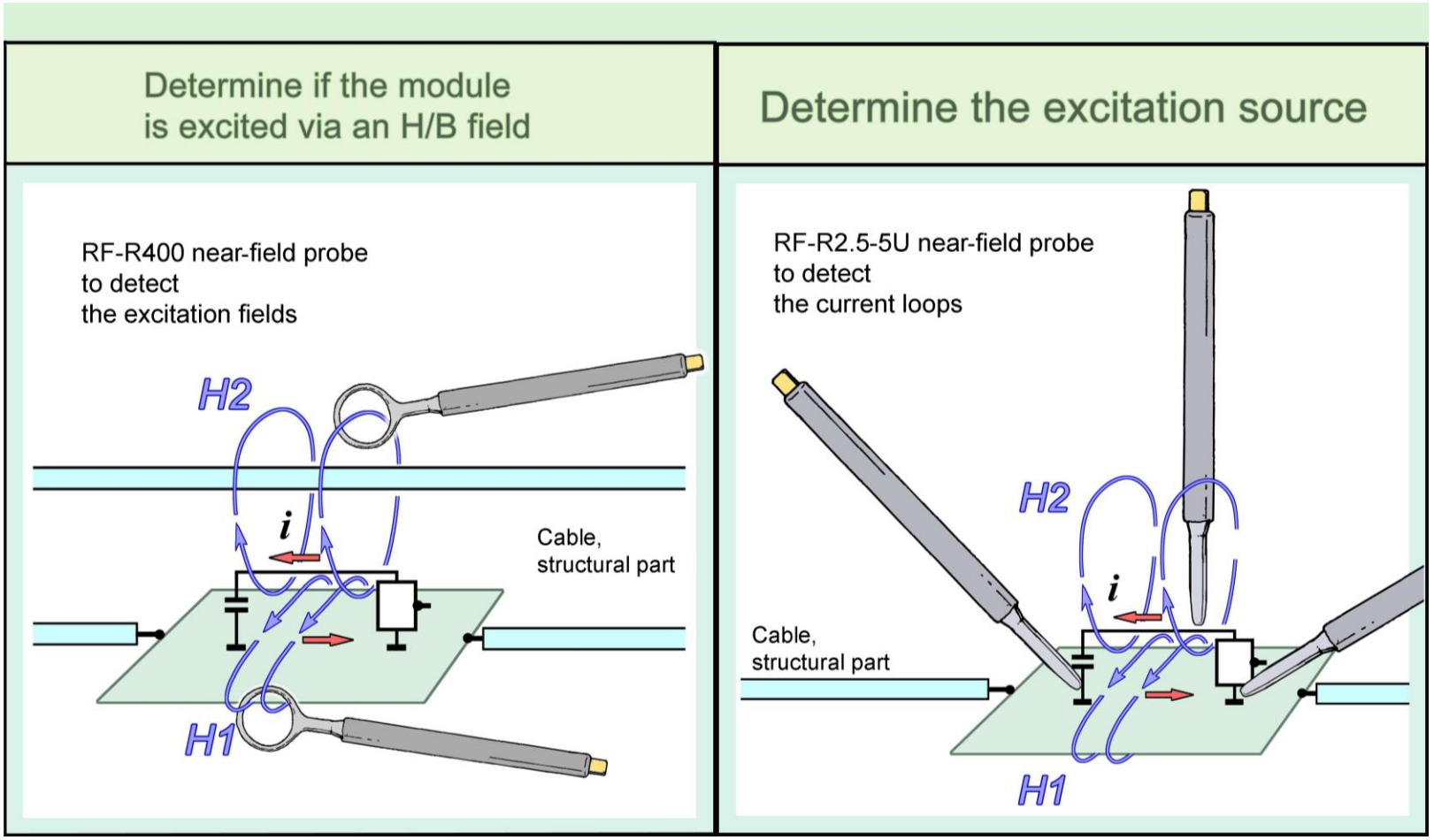
Research of emission sources

E/D Near-field search:

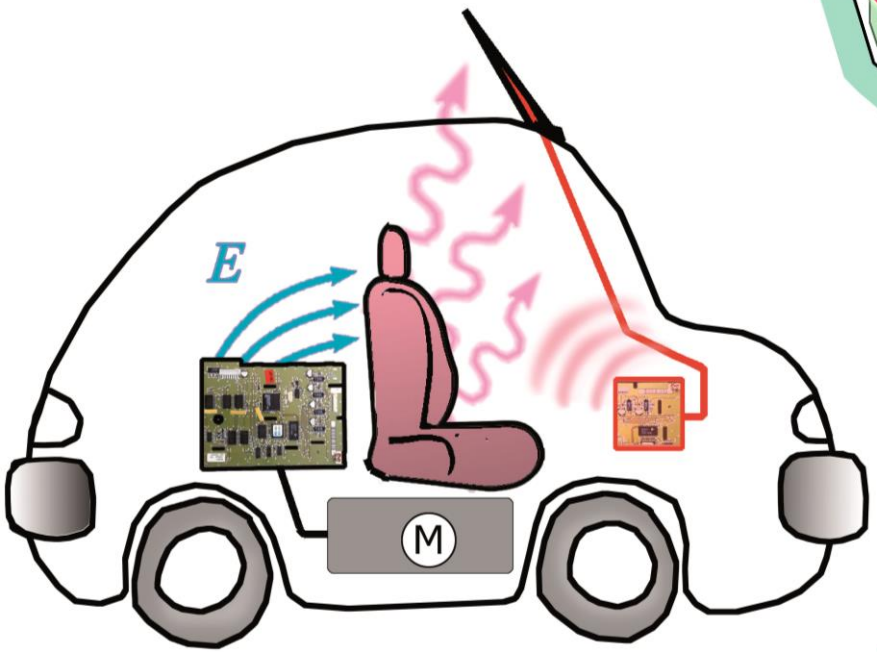


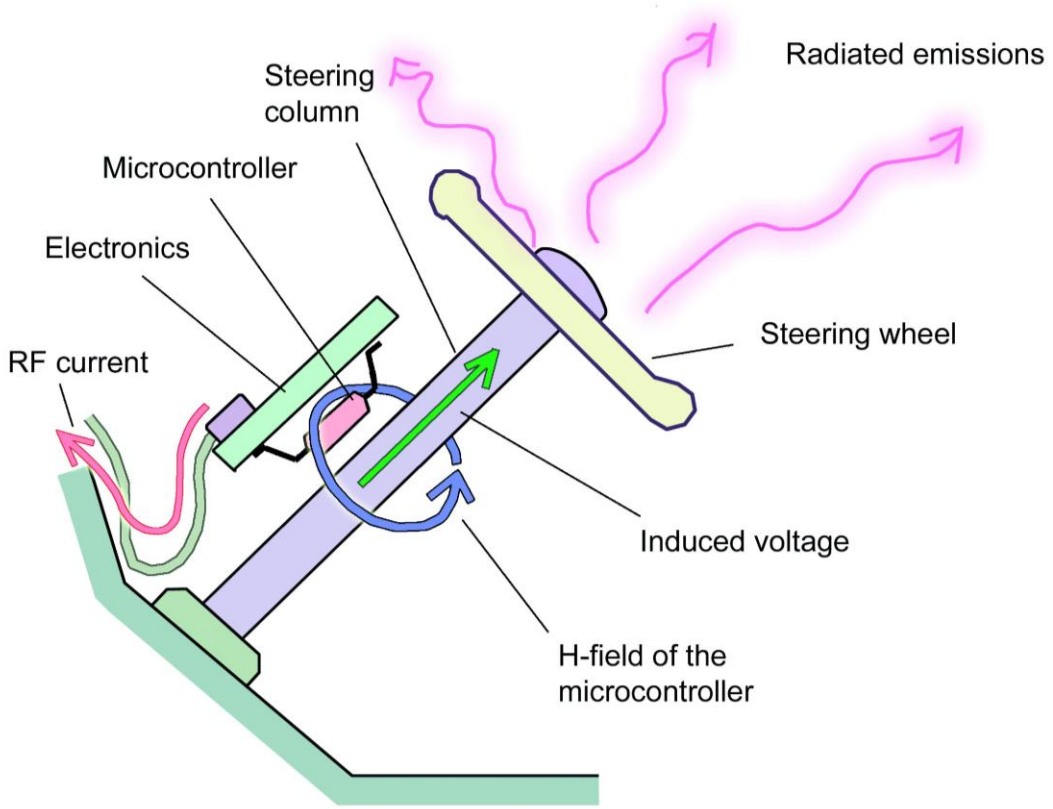
Research of emission sources

H/B Near-field search:

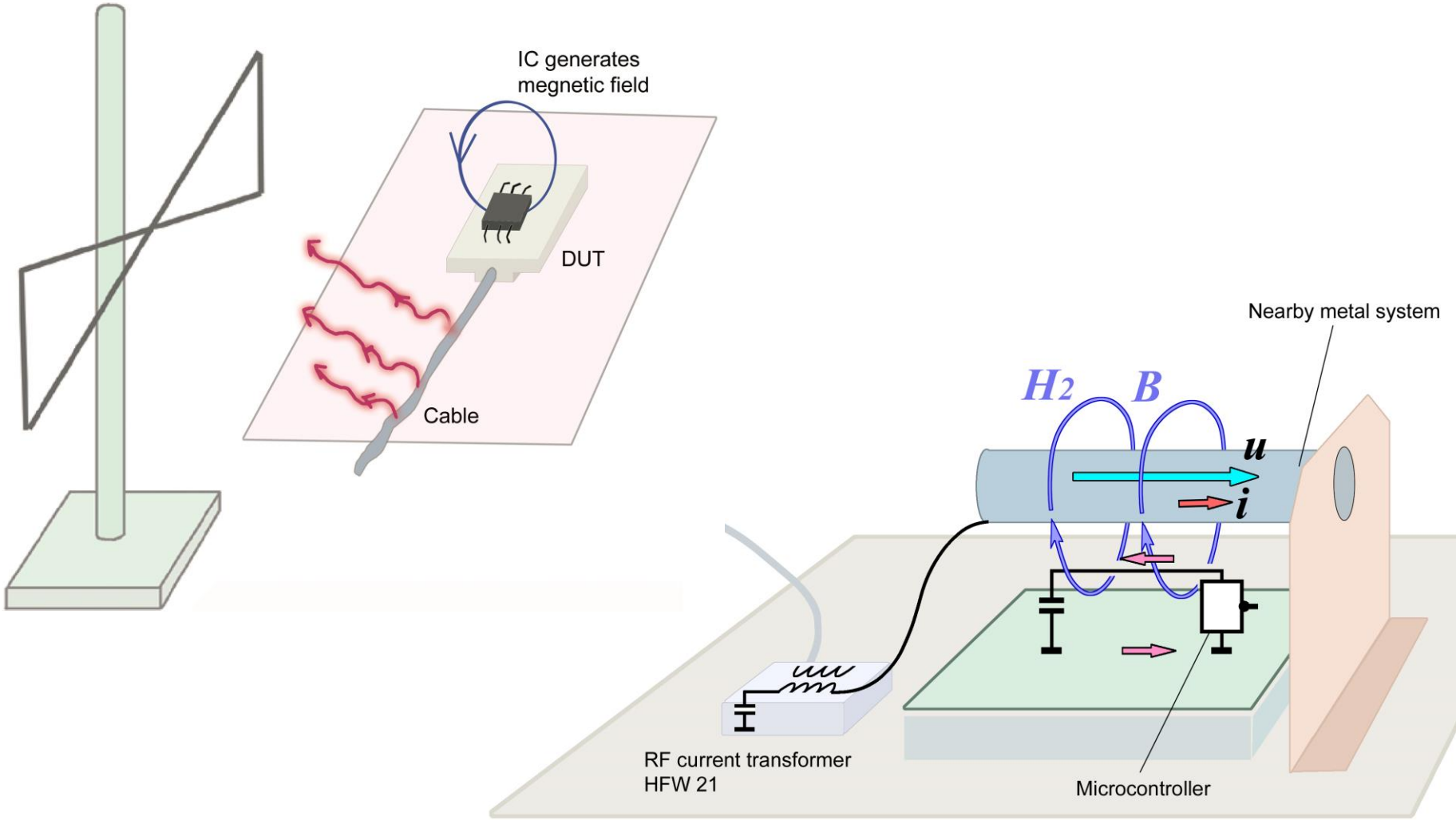


Troubleshooting Strategy



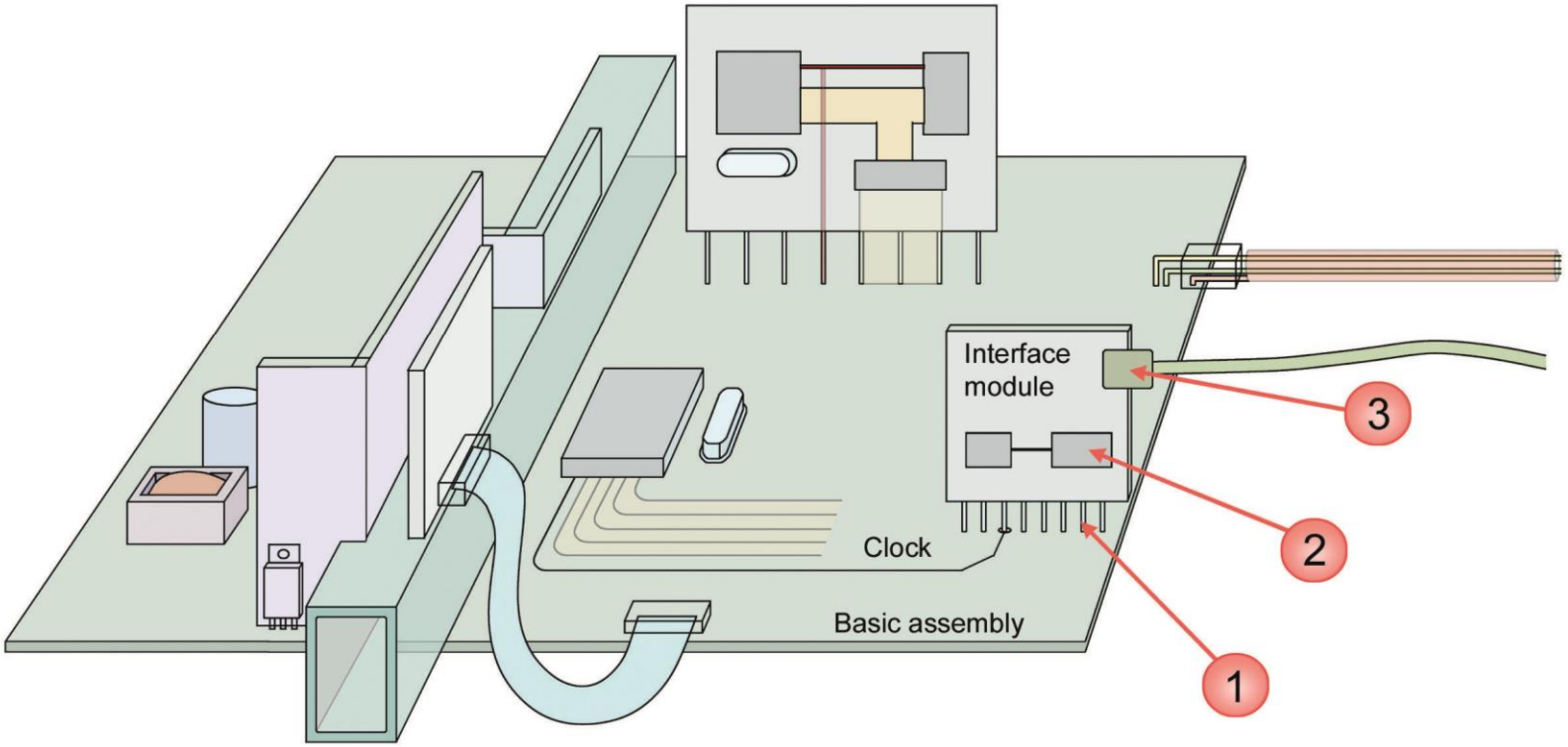


Troubleshooting Strategy



Troubleshooting Strategy

Test of complex devices – DUT with several potential emission sources:



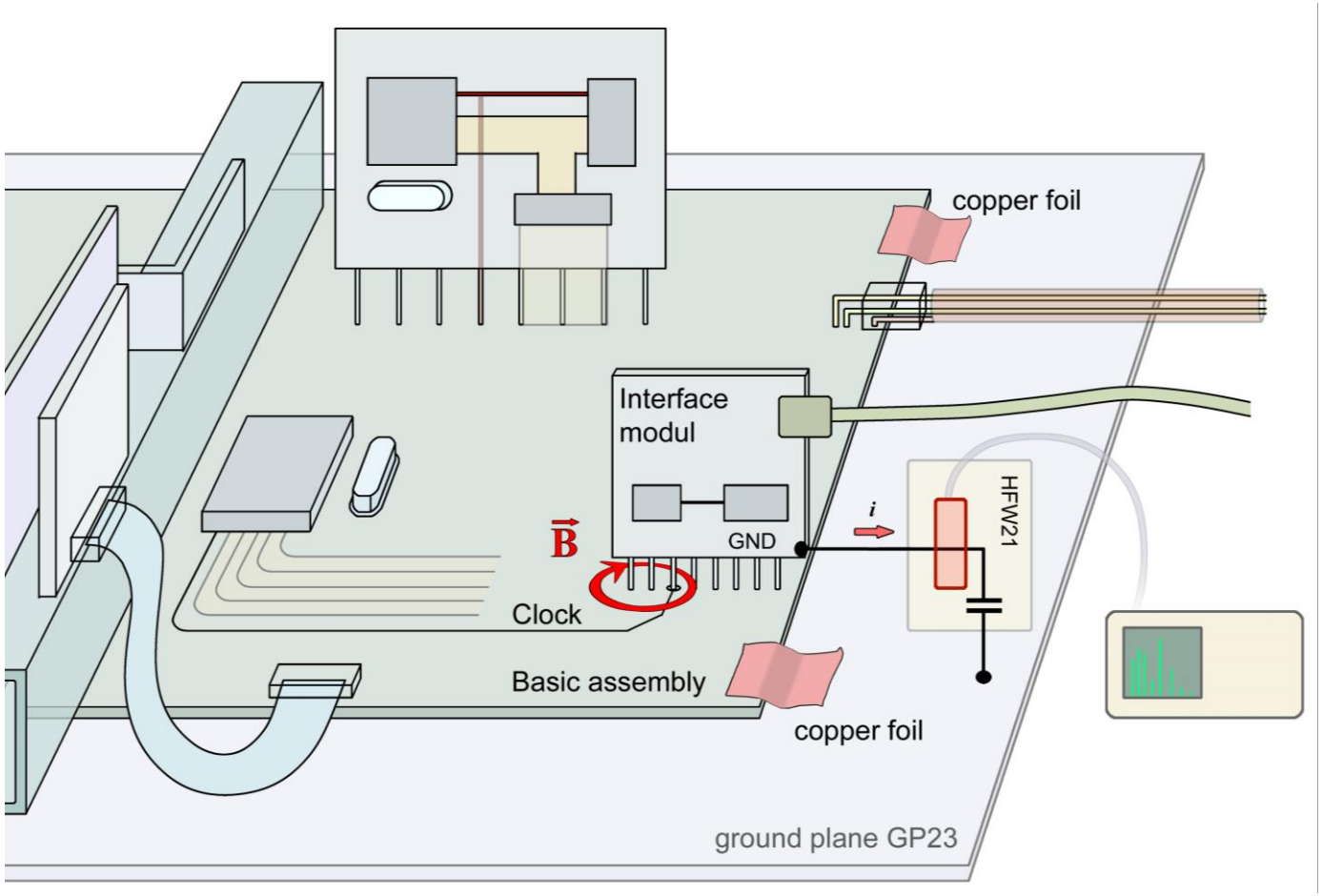
1 - connector between the basic assembly and the interface module

2 - electronics (PHY with a microprocessor) on the interface module

3 - connector of the interface cable

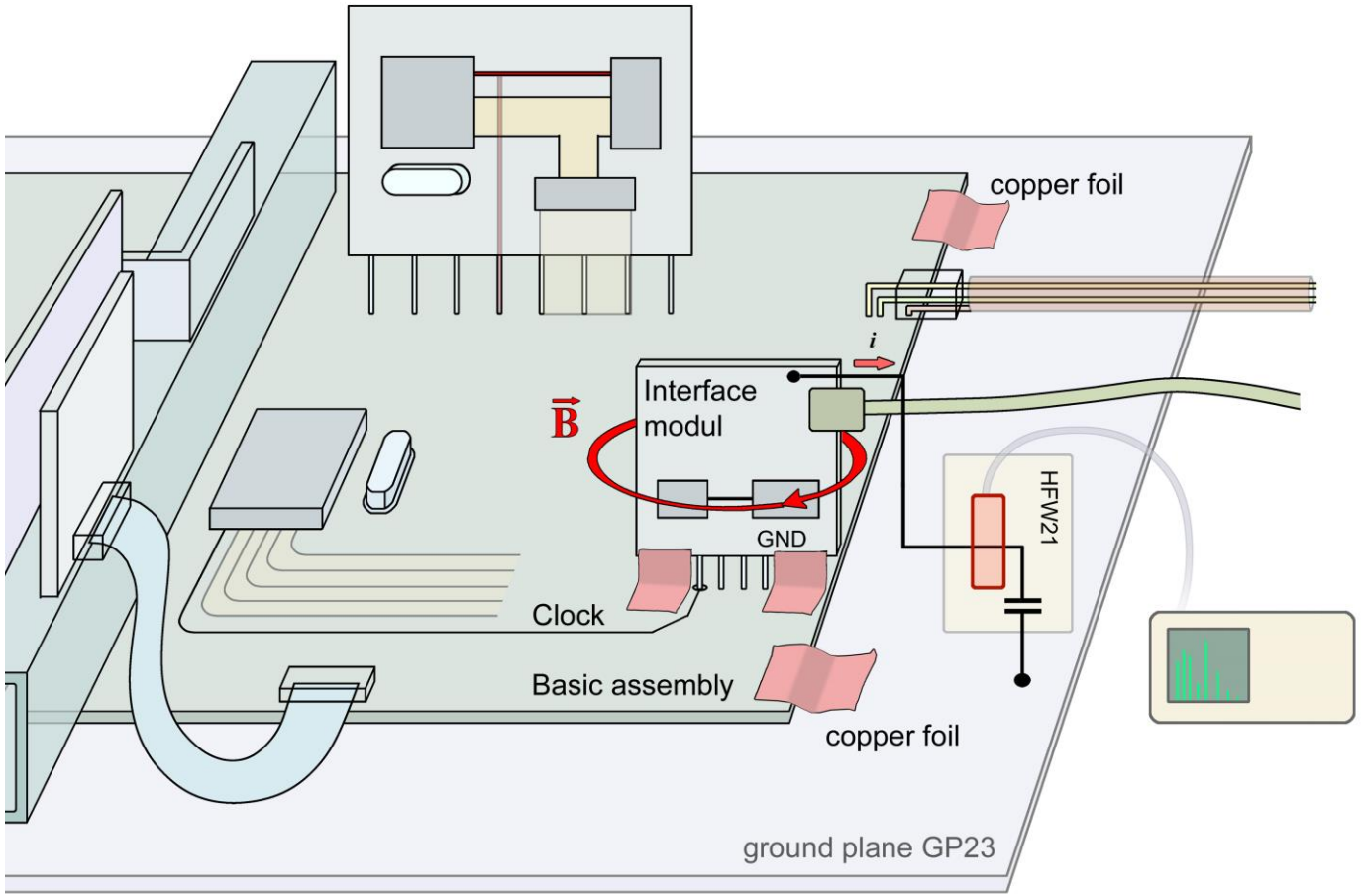
Troubleshooting Strategy

Test of complex devices – detect emission sources on the connector between the basic assembly and the interface module:



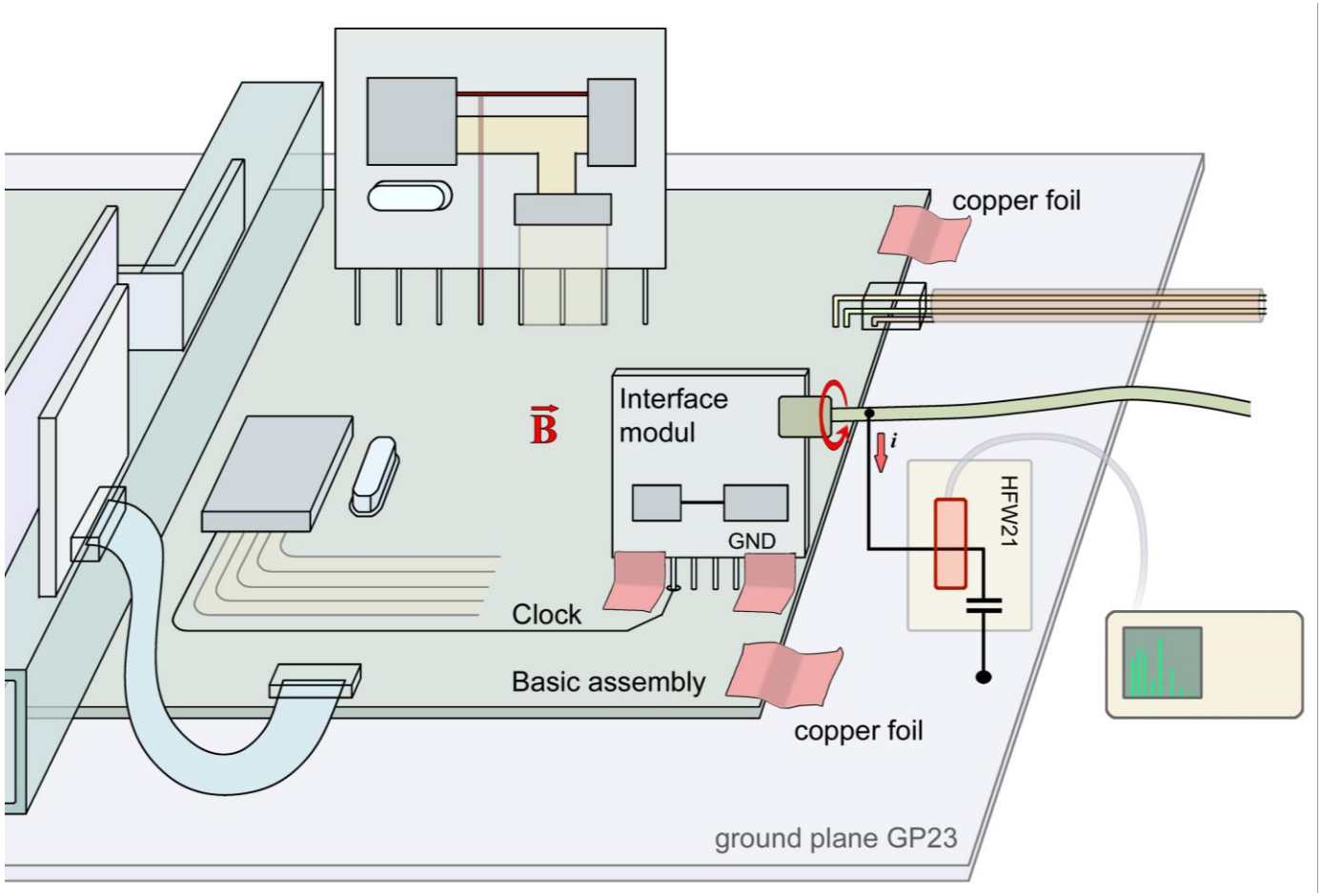
Troubleshooting Strategy

Test of complex devices – detect emission sources in the interface module:



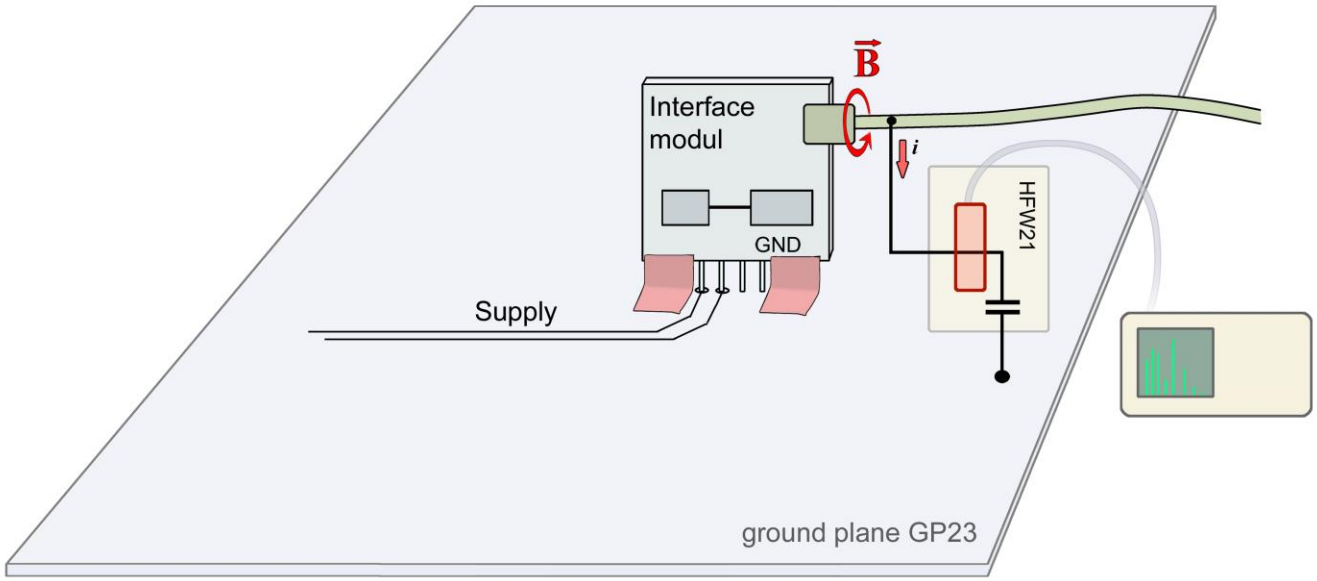
Troubleshooting Strategy

Test of complex devices – detect emission sources on the connector of the interface cable:



Troubleshooting Strategy

Test of complex devices – test the emission source of modules:



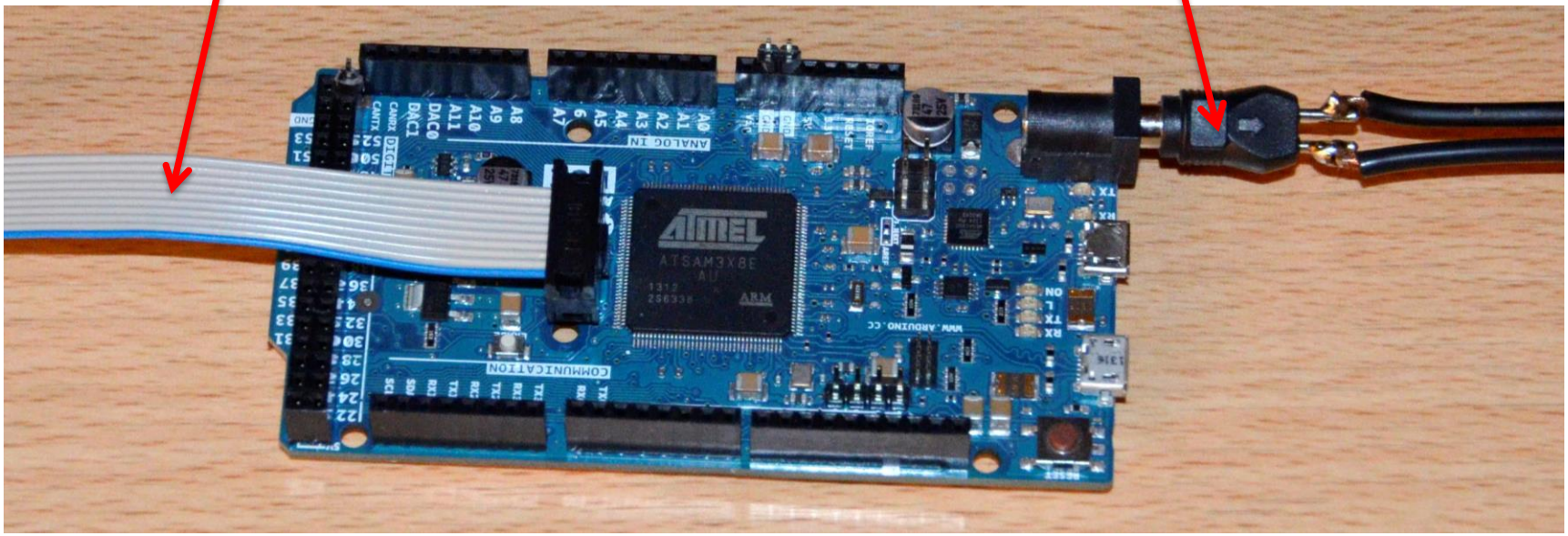
Practical Example

DUT: Arduino DUE
evaluation board with ATMEL microcontroller

Power supply: 12 V

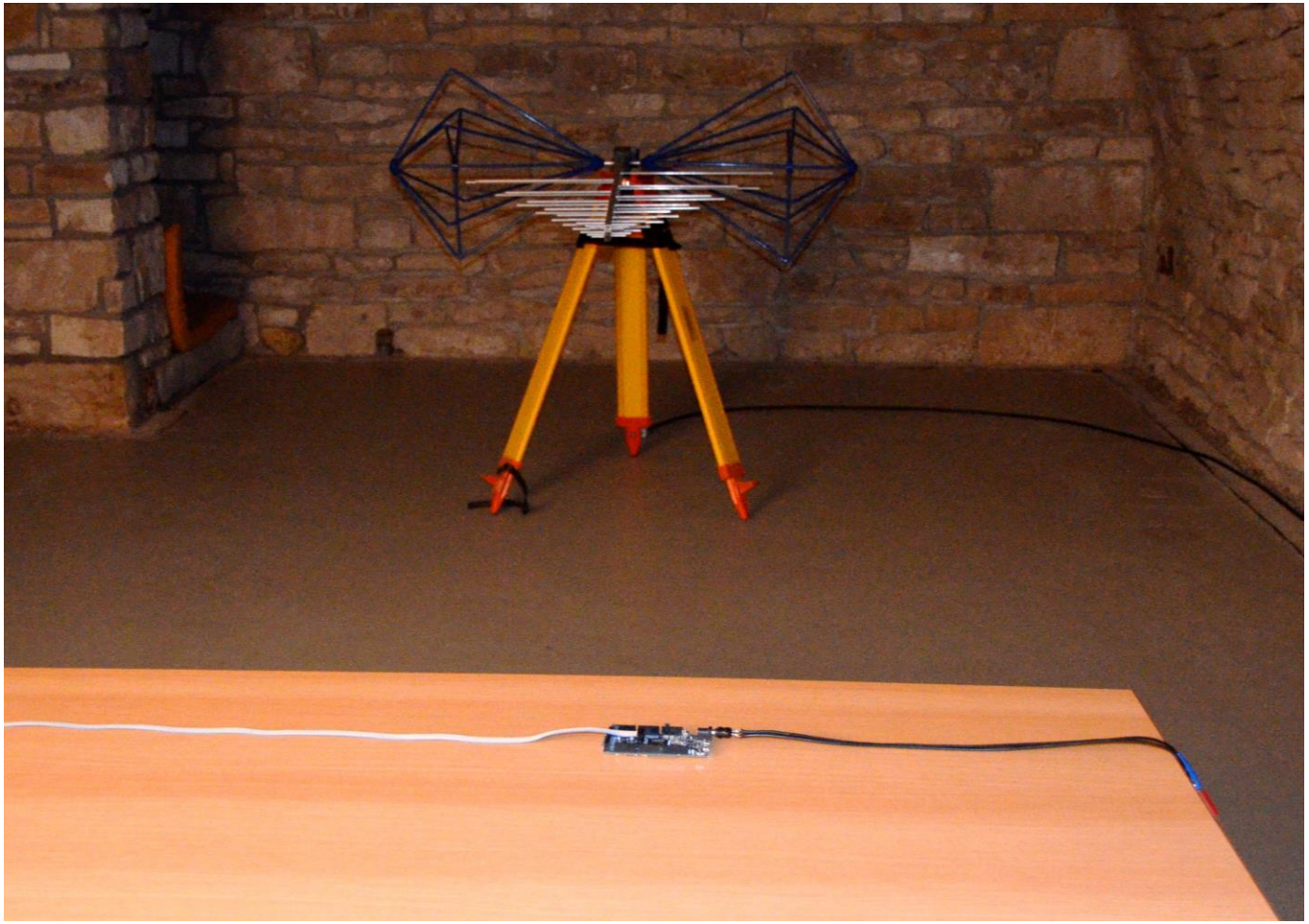
Ribbon cable with
Signals, clock, supply

Power supply 12 V



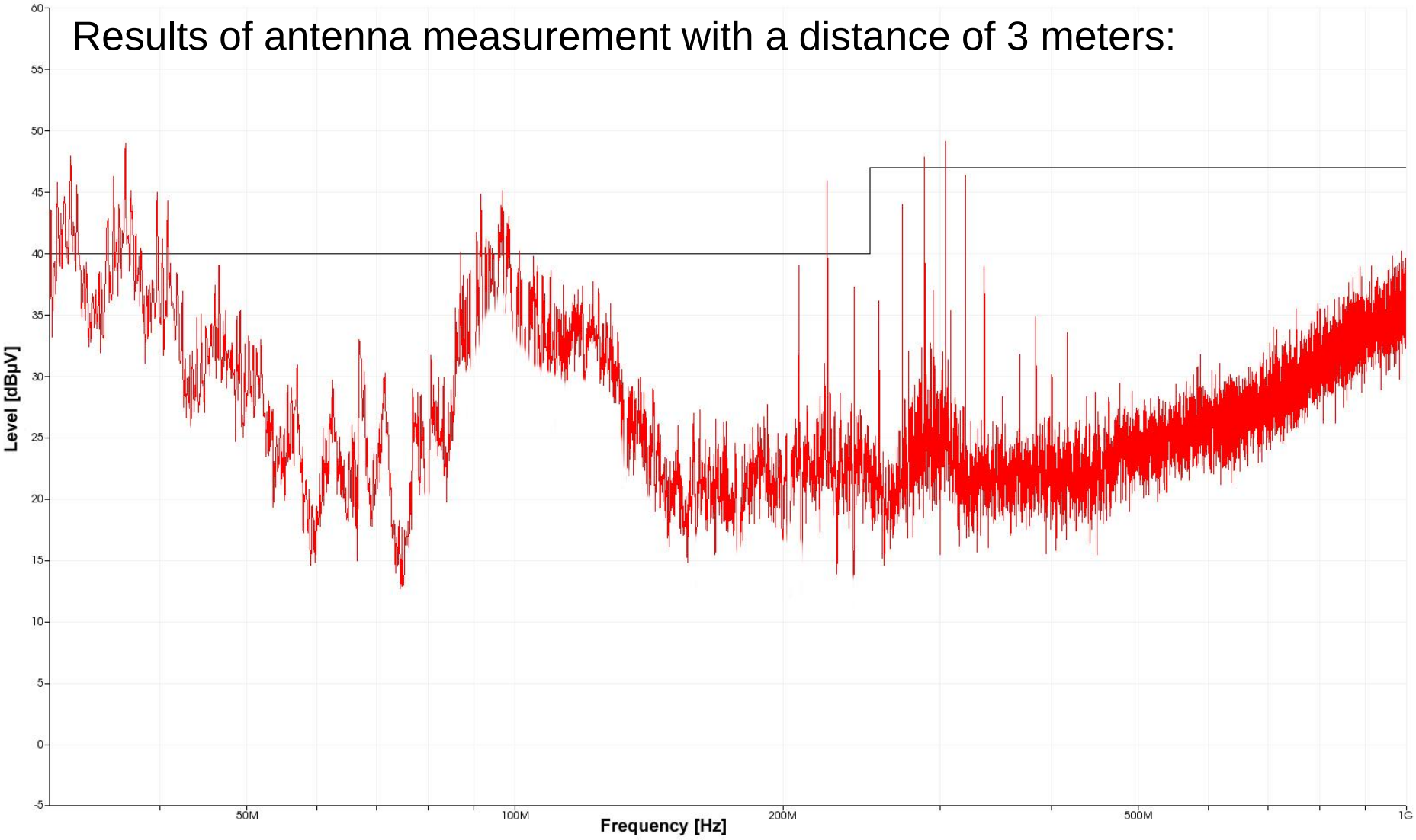
Practical Example

Antenna measurement with a distance of 3 meters:



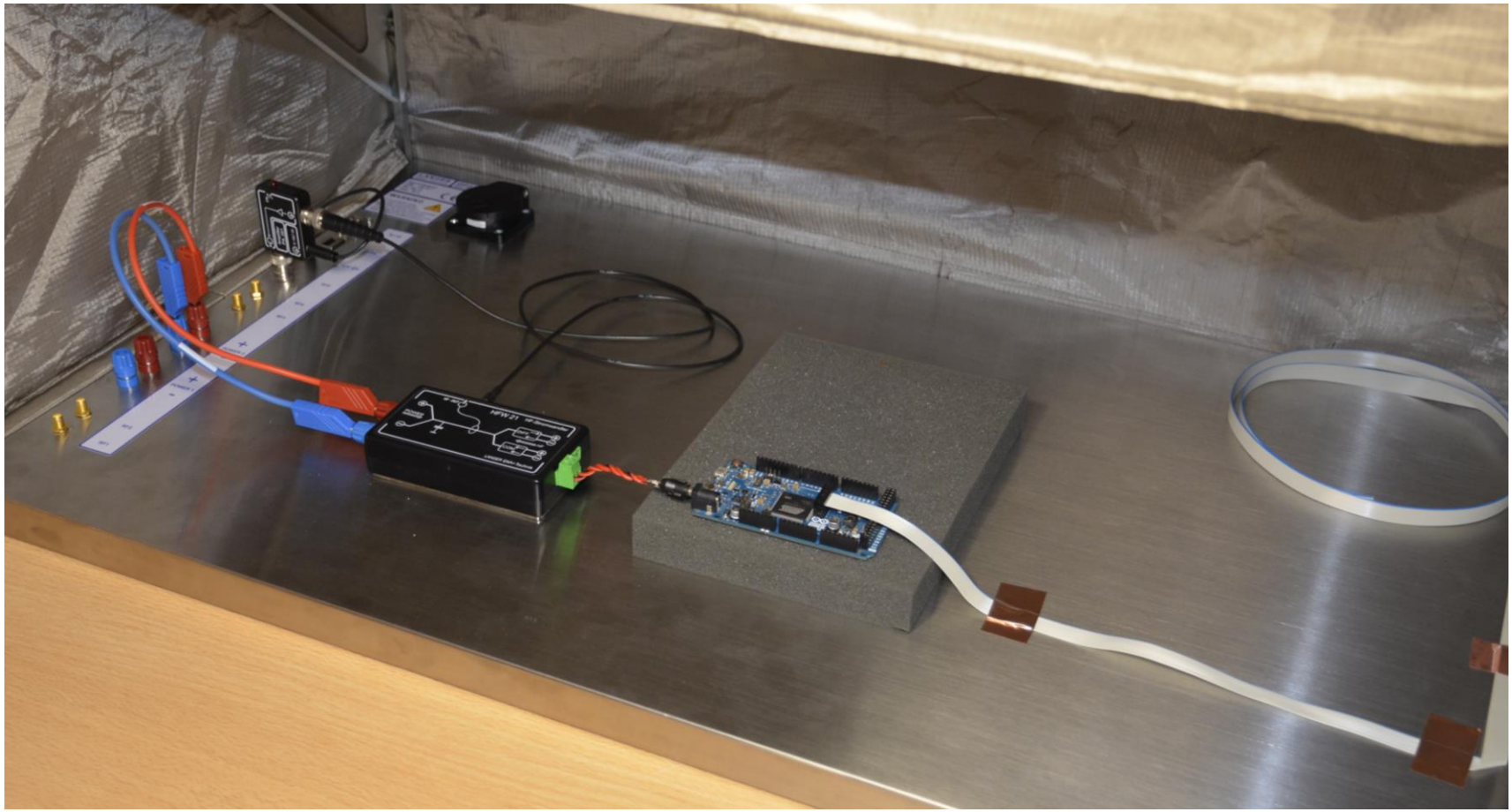
Practical Example

Results of antenna measurement with a distance of 3 meters:



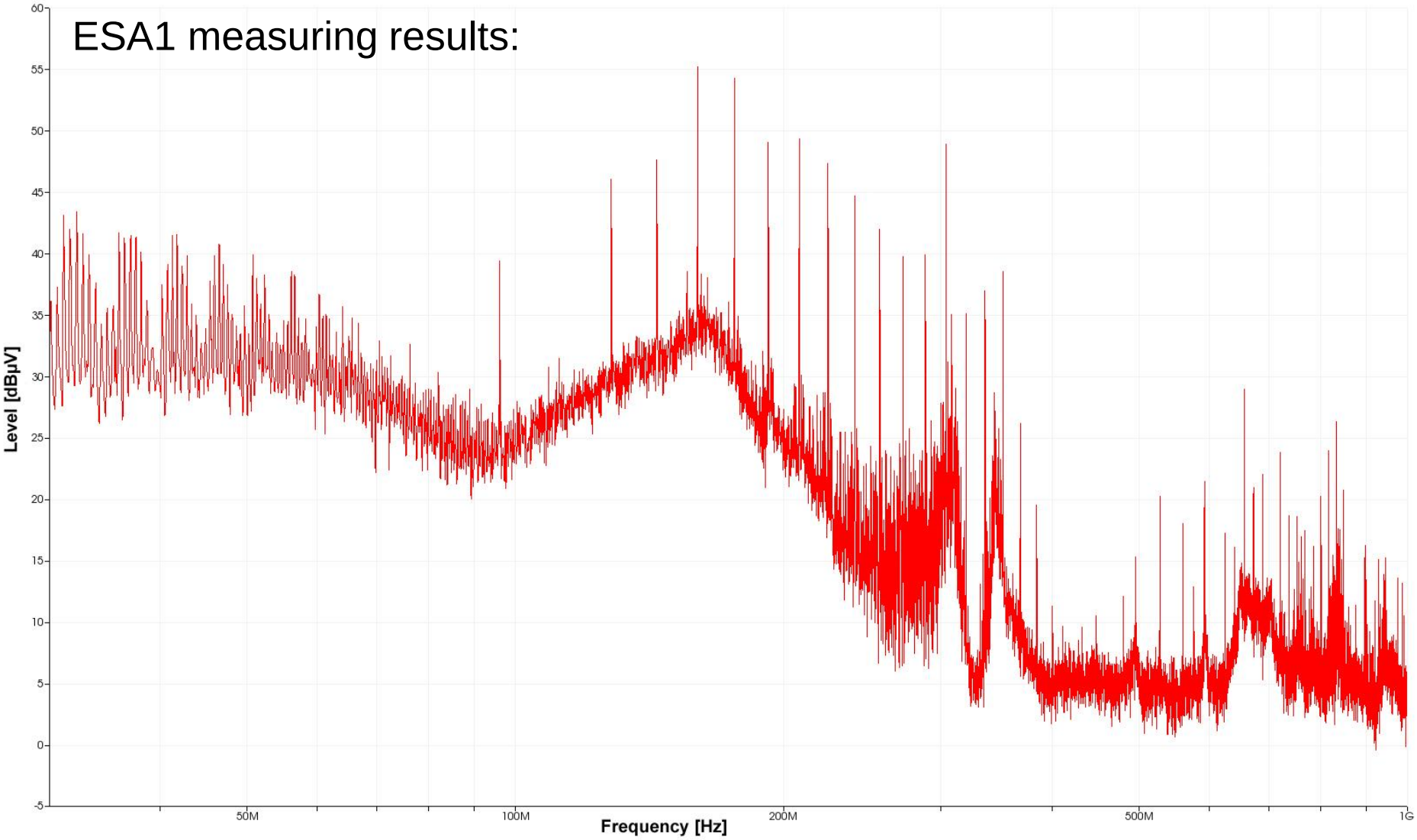
Practical Example

ESA1 measurement – test set-up:



Practical Example

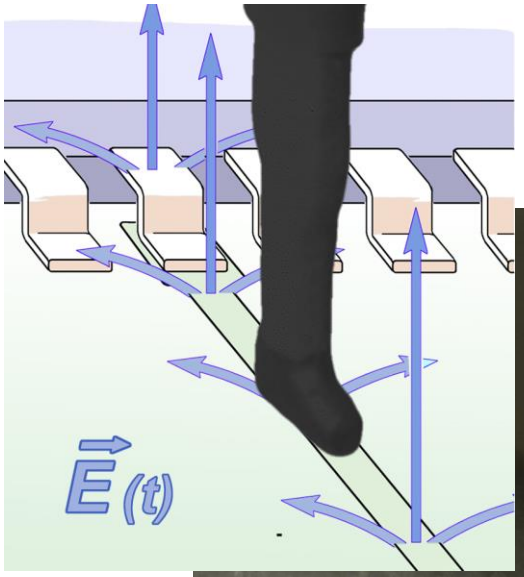
ESA1 measuring results:

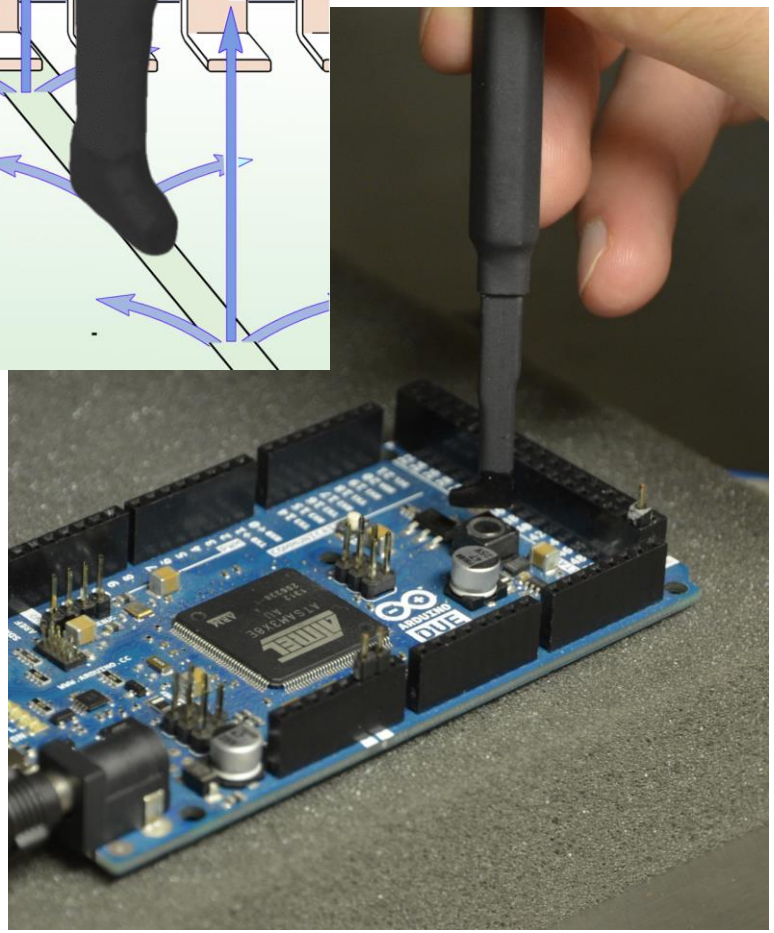


Practical Example

Search of emission sources

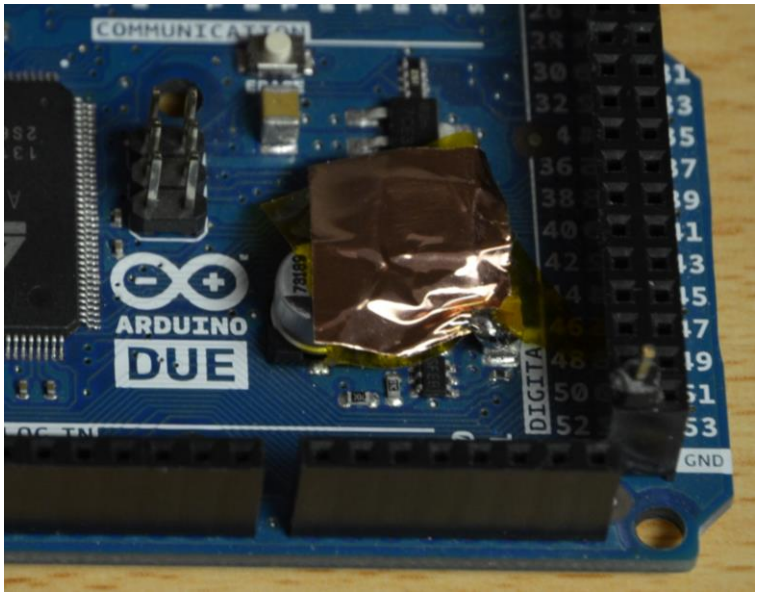
- E/D near-field from the DC/DC converter (500 kHz):





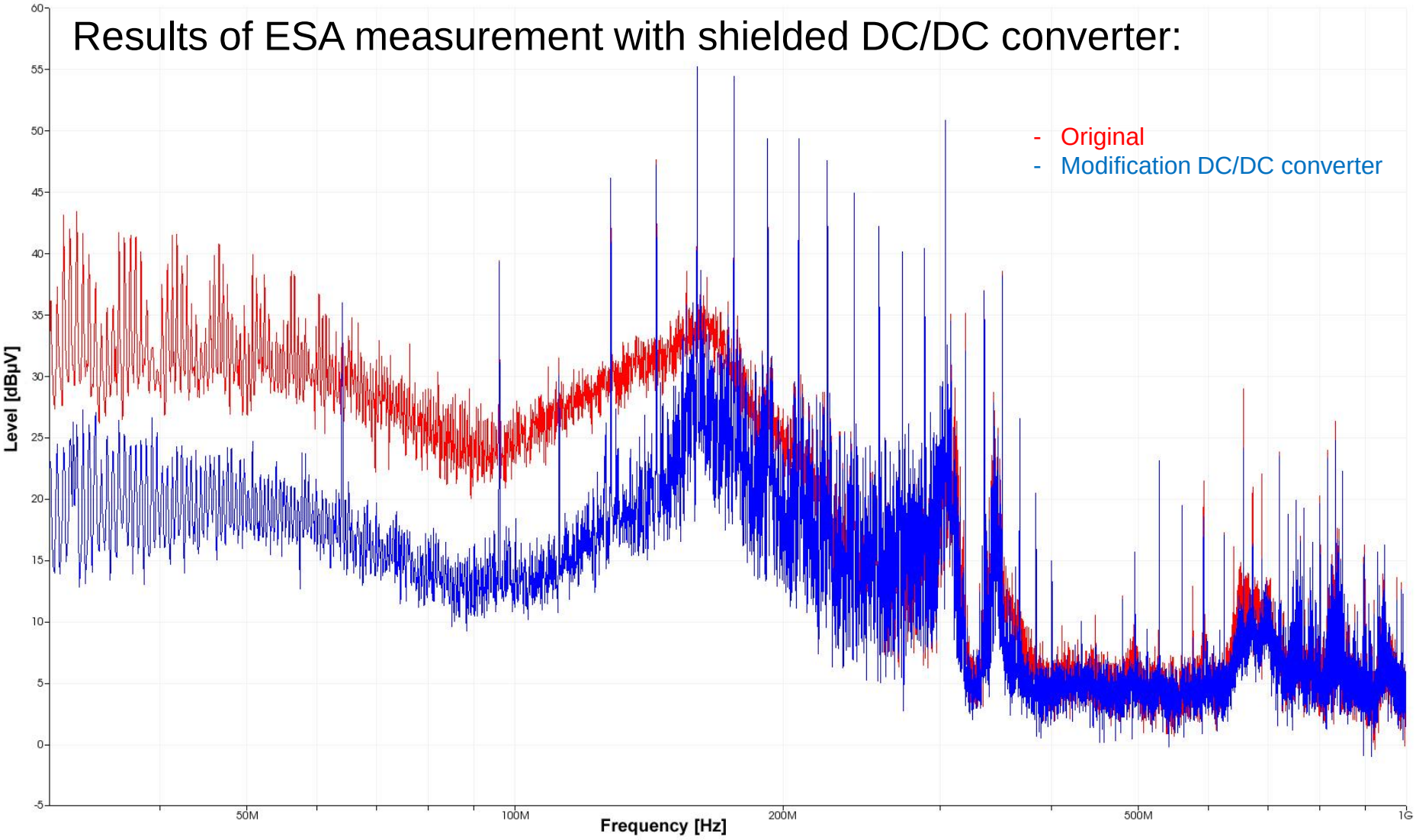
Modification:

Shielding DC/DC converter



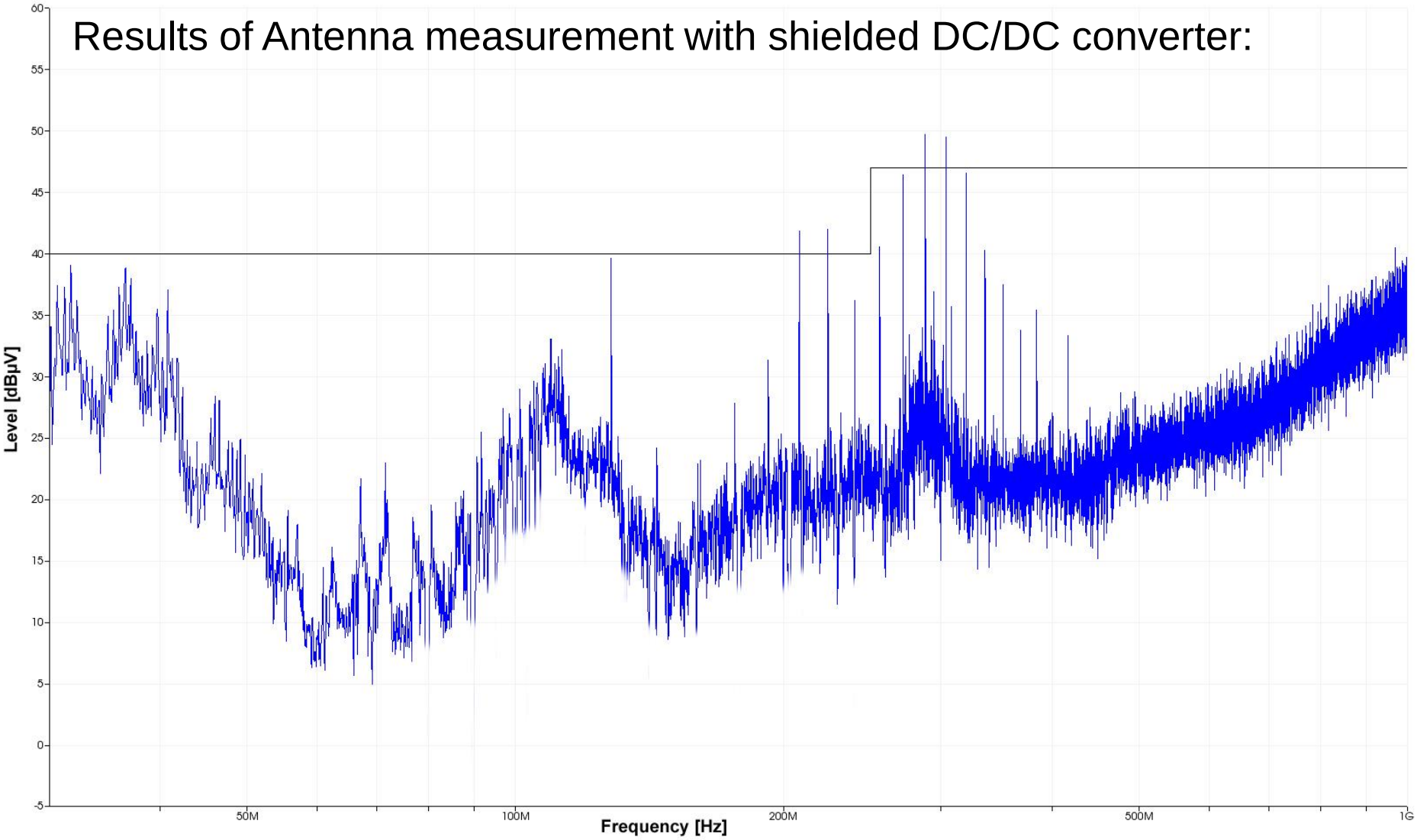
Practical Example

Results of ESA measurement with shielded DC/DC converter:



Practical Example

Results of Antenna measurement with shielded DC/DC converter:



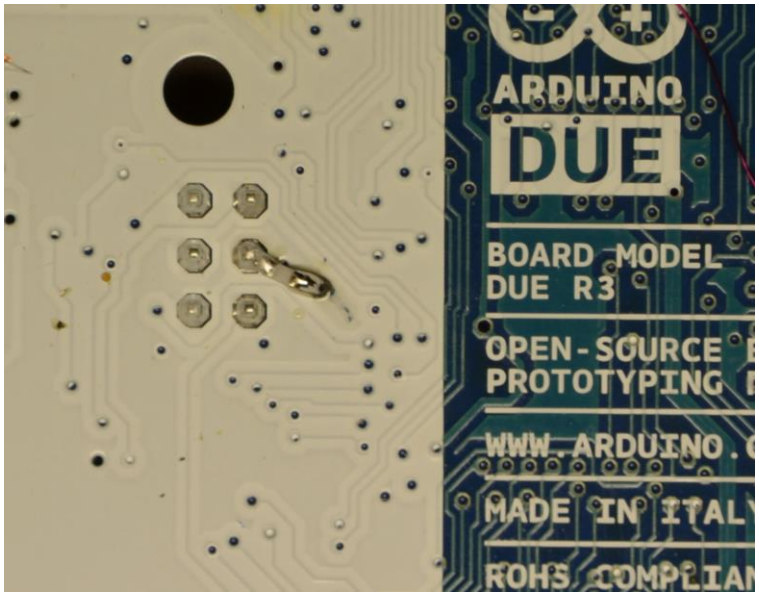
Practical Example

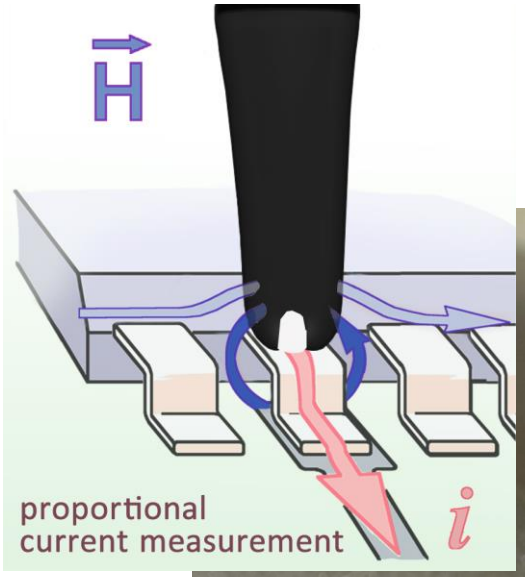
Search of emission sources

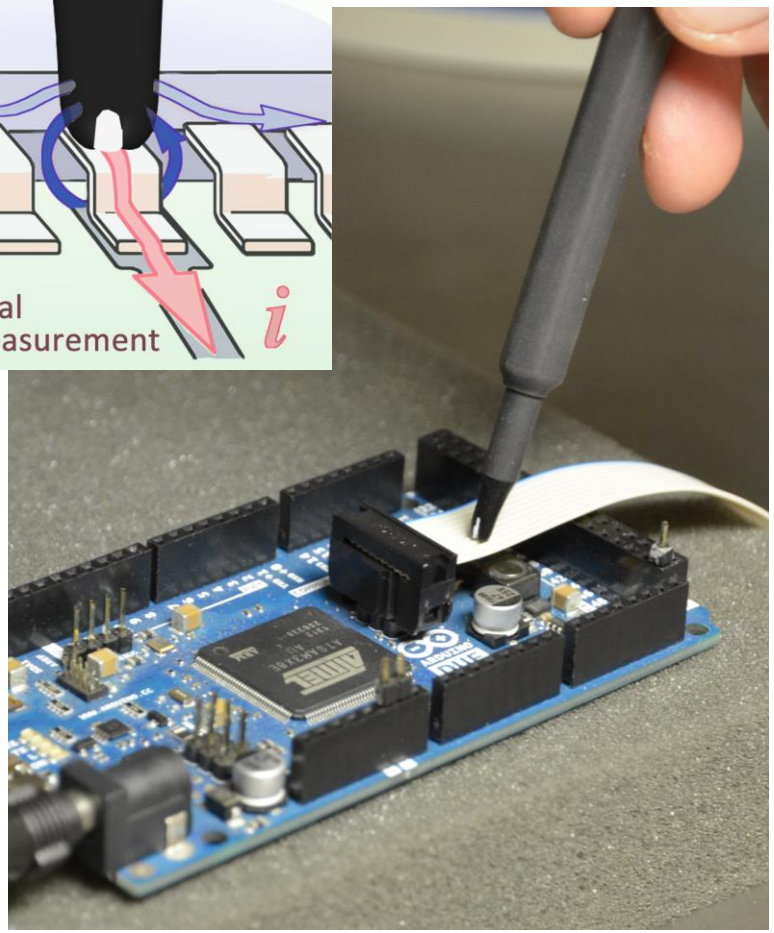
- H near-field from the Clock line (16 MHz):

Modification:

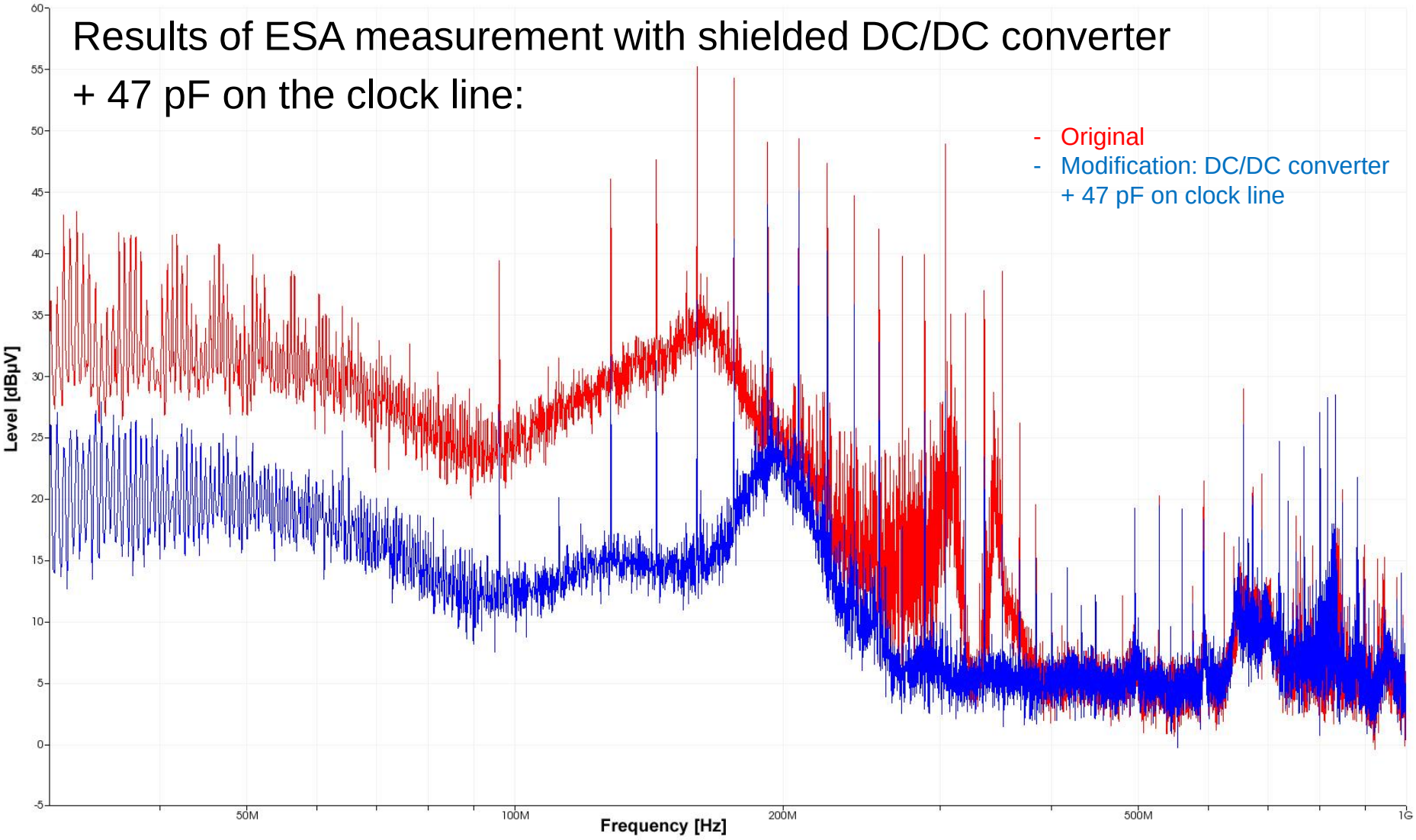
47 pF at clock line





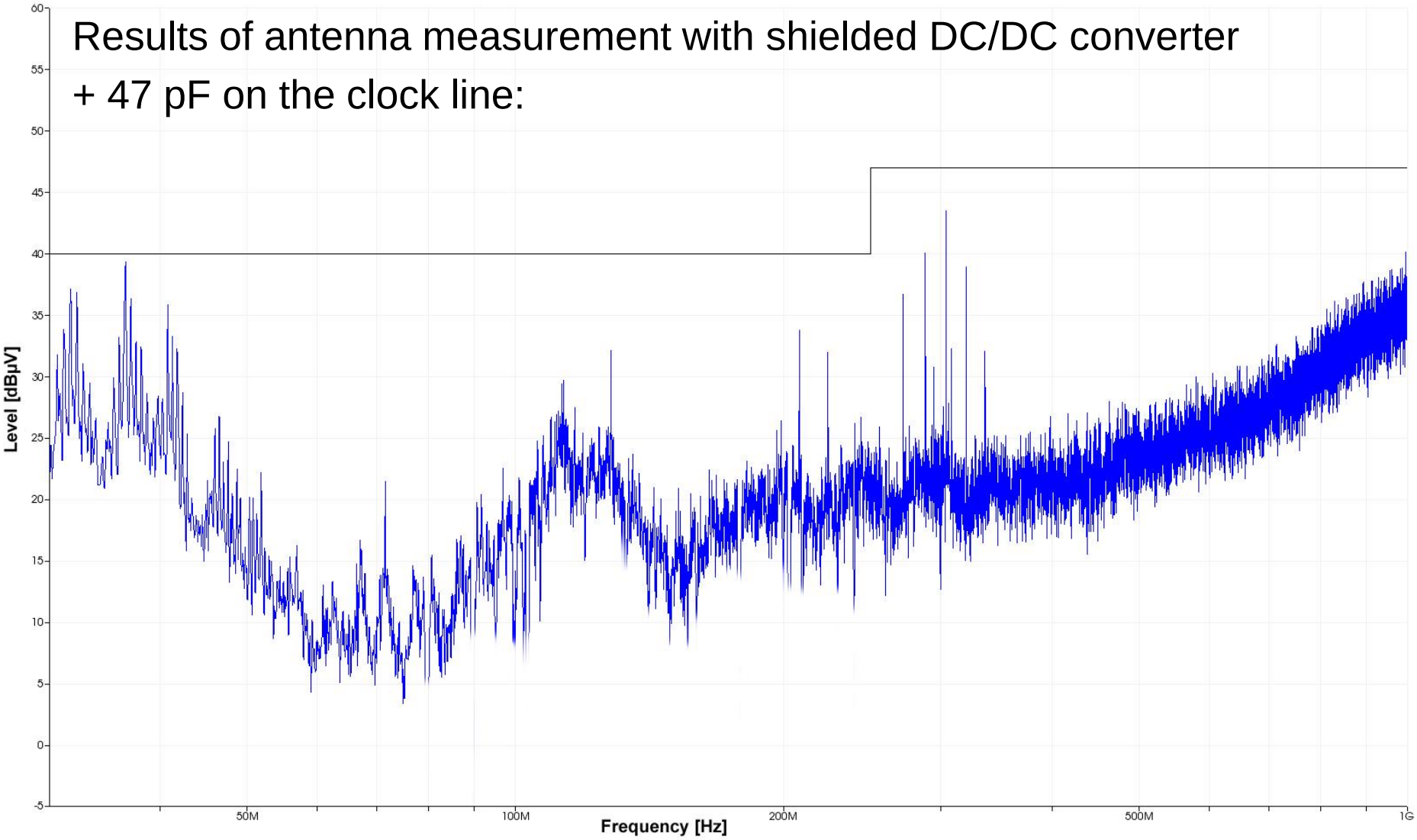


Practical Example



Practical Example

Results of antenna measurement with shielded DC/DC converter + 47 pF on the clock line:



Conclusion
ESA1 - Measurement without an Anechoic Chamber

- Easy way to solve emission problems in earlier development stage
- Useful tool for troubleshooting
- Evaluate the emission of electronics direct on your workplace
- Shielding tent is reducing the electromagnetic interference from the outside
- Good to discover and compare the effectiveness of modifications
- Saves time and costs

Next events

Langer will be exhibiting with a table top at the Michigan & Chicago IEEE EMC Chapter this spring:

- May 3rd, 2016 IEEE EMC Mini Symposium, Chicago (Itasca, IL)
- May 5th, 2016 IEEE EMC Fest, Detroit (Liviona, MI)

- July 25 - 29th, 2016 IEEE EMC, in Ottawa, Canada.

You will have the opportunity to see firsthand our various PCB and IC probes, as well as our software.

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Thanks for attending!

Don’t miss our Test Bootcamp!
November 16, 2016
www.emclive2016.com