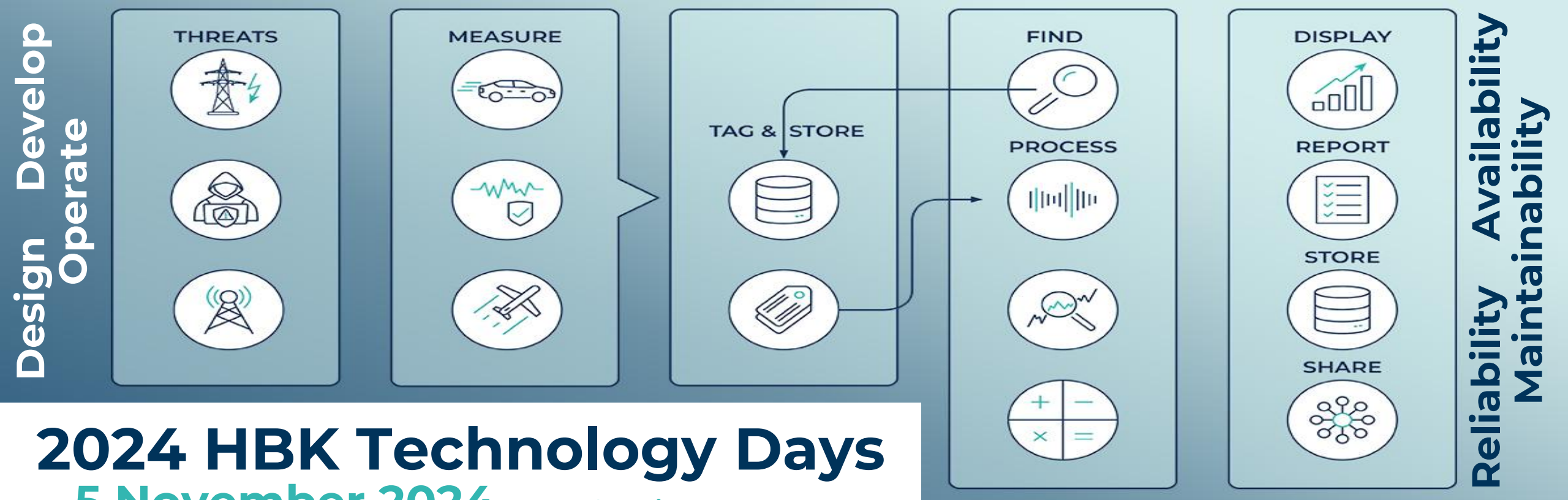
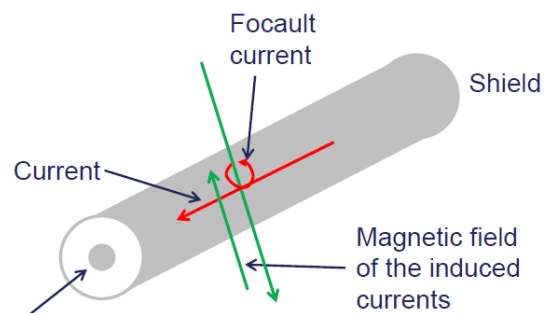




2024 HBK Technology Days

5 November 2024

Shield by inductive coupling



Session 1: Minimising Electromagnetic Interference to Measurements

- Electromagnetic interference, and how to avoid it when measuring with strain gauges

Patrik Ott,
HBK Academy

What is electromagnetic interference, and how to avoid it when measuring with strain gauges

Abstract

- Electromagnetic fields are present in all electrical measurements. This presentation introduces the basics of electromagnetic coupling, the types of coupling to expect, which protection methods work best, and demonstrates the importance of good electrical grounding.
- Electrical grounding during measurement is one of the most well-known but least well-understood causes of measurement error. Good electrical grounding significantly minimizes electromagnetic interference during measurement by providing a stable reference point and reducing noise, to ensure an accurate and reliable electrical measurement signal.

About the presenter, Patrik Ott

Trainer HBM Products and Applications, HBK Academy

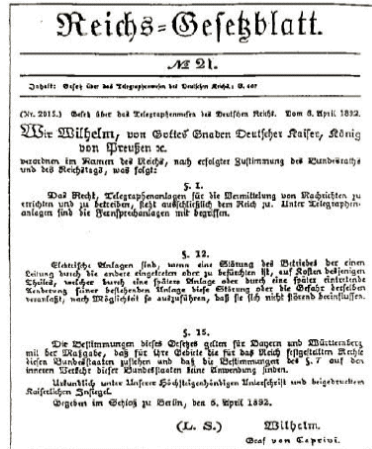
- Patrik Ott is a trainer in the HBK Academy, for HBM measurement products and applications. Patrik began his career as an energy electronics engineer in 1995, and then studied physics. His experience in electromagnetics and measurement technology comes from working and teaching for 12 years at the particle accelerator in the Institute for Nuclear Physics in Mainz. In 2016 he joined the HBM Academy, now HBK Academy, where their trainees can benefit from his measurement and teaching experience.

EMC-Fundamentals

KNOWLEDGE TO HANDLE YOUR MEASUREMENTS

Patrik Ott
Patrik.ott@hbkworld.com

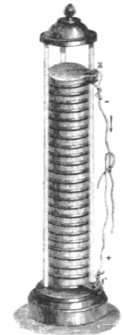




1892: First EMC-Law (Reichstelegraphengesetz)

1899: Second EMC-Law (Telegraphengesetz)

1800



Ca. 1800:
First Battery
(Alessandro
Volta)

1837: First telegraph circuit in Munich

1860: Philipp Reis
invents the telefon

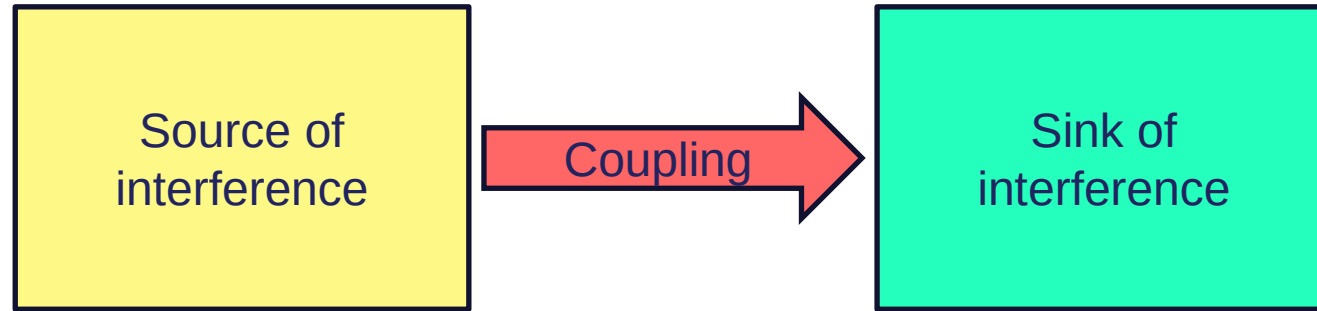
1866: Werner von Siemens invents the electric motor/generator

1897: First radio-communication (Alexander S. Popow)

~~1900~~



Common interference model



Couplings

- Galvanic
- Inductive
- Capacitive
- Radiation

Couplings

- Galvanic

- Inductive

- Capacitive

- Radiation

Acting over air
and distance

Couplings

- Galvanic

- Inductive

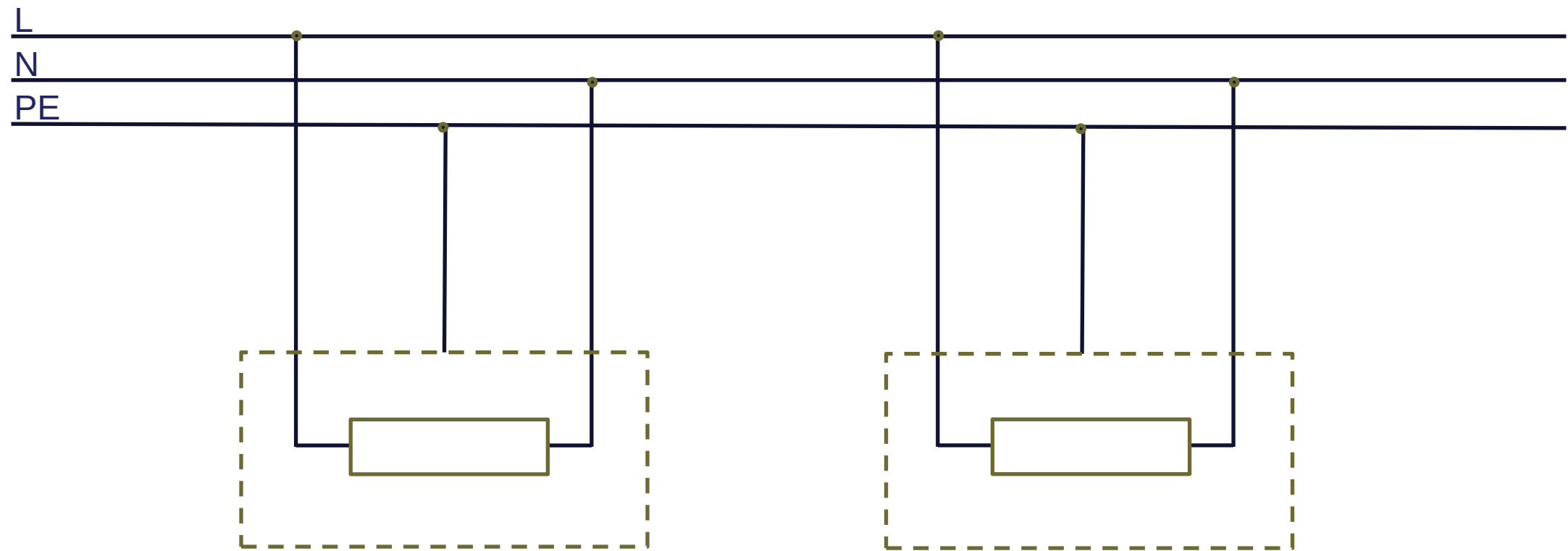
- Capacitive

- Radiation

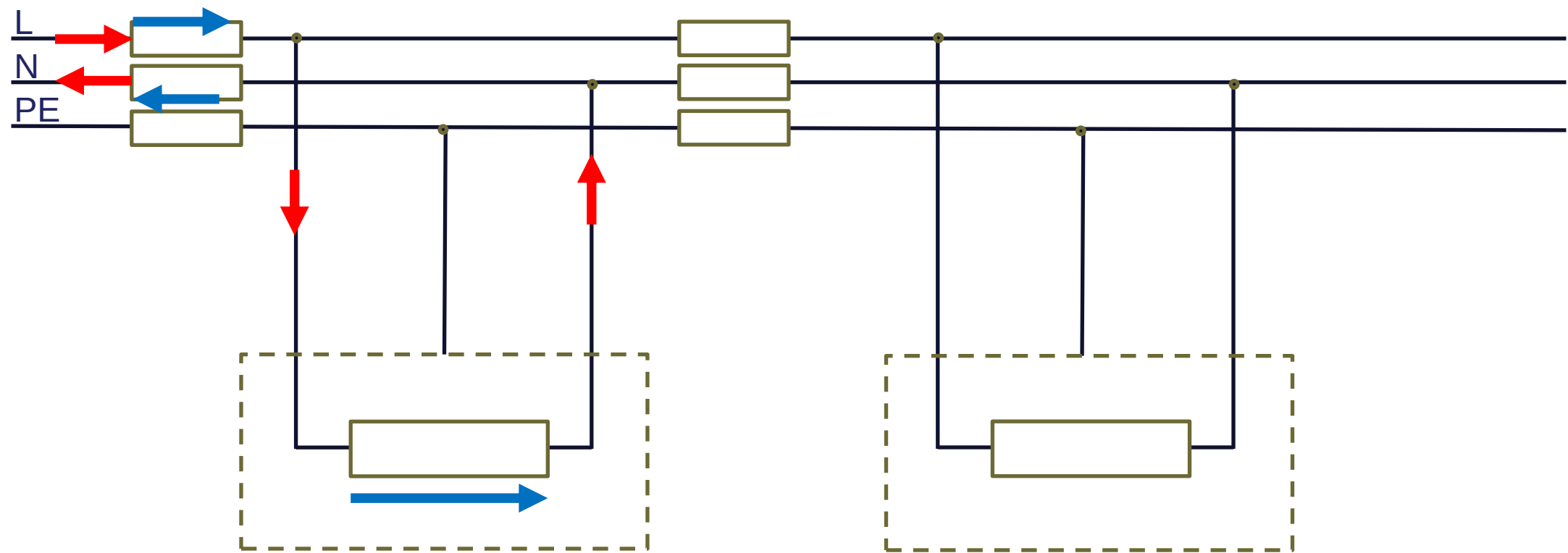
Acting over air
and distance

Can be neglected
under MHz

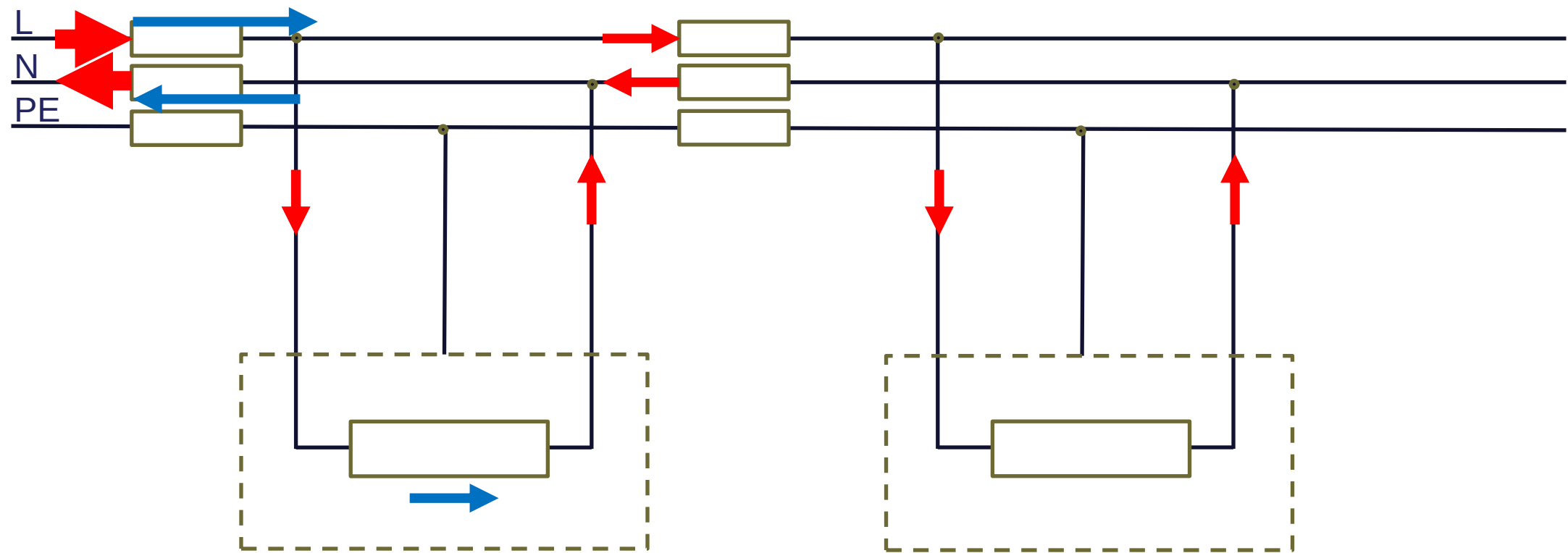
Galvanic Coupling - Idealisation



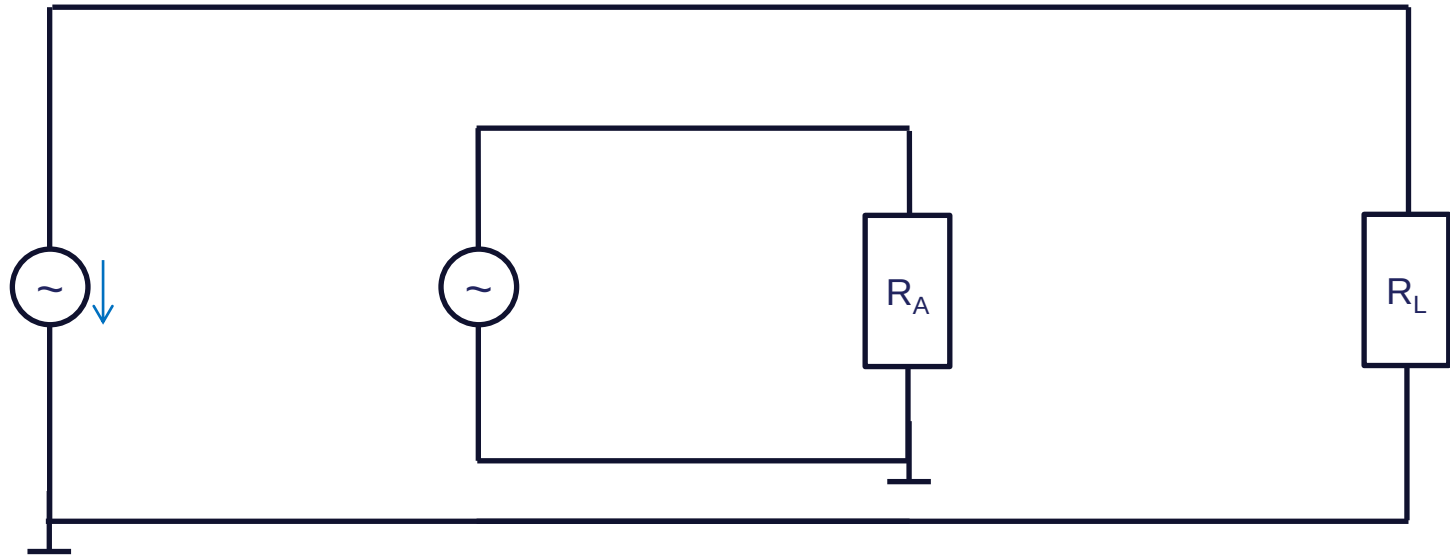
Galvanic Coupling - Reality



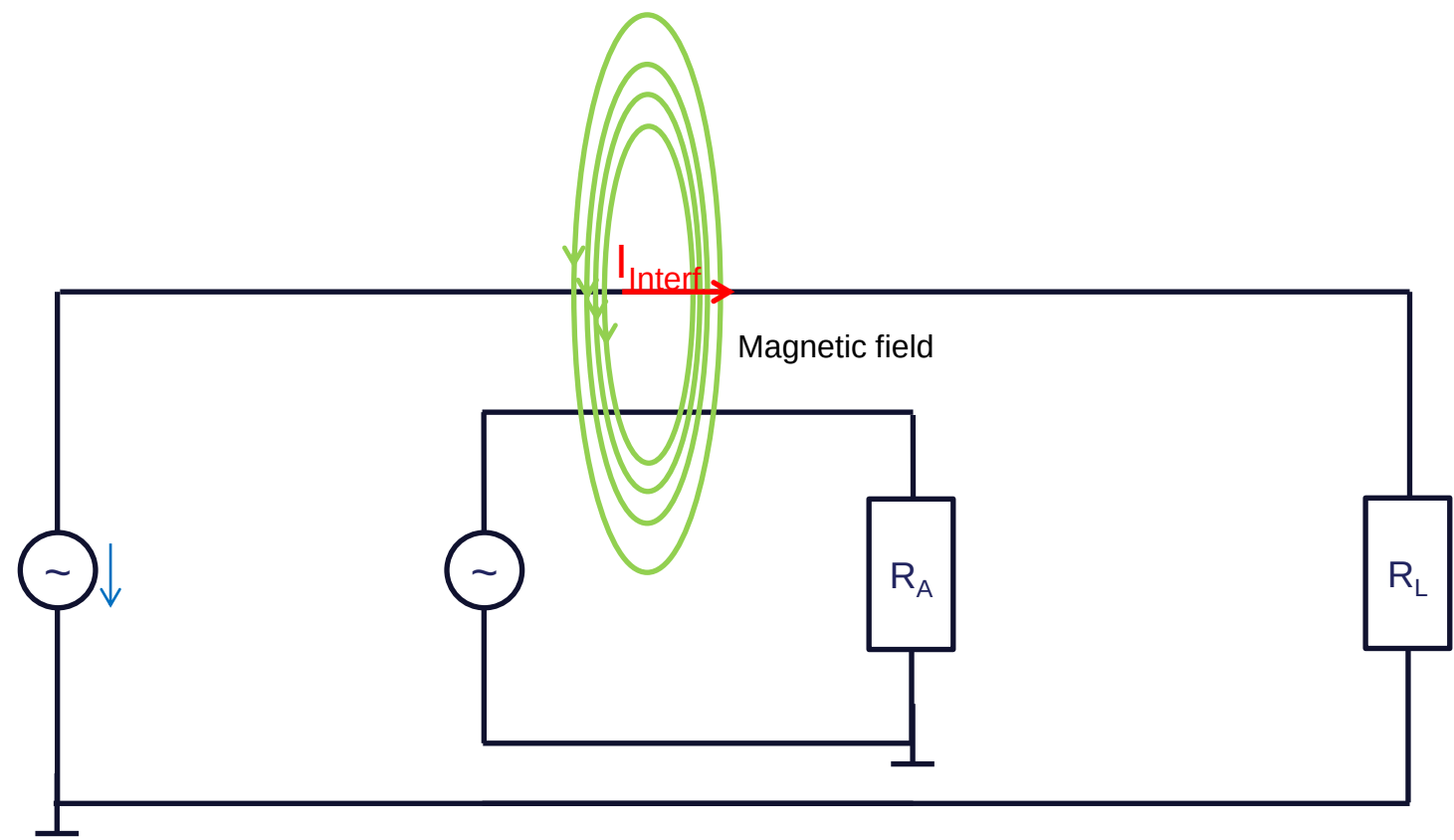
Galvanic Coupling - Reality



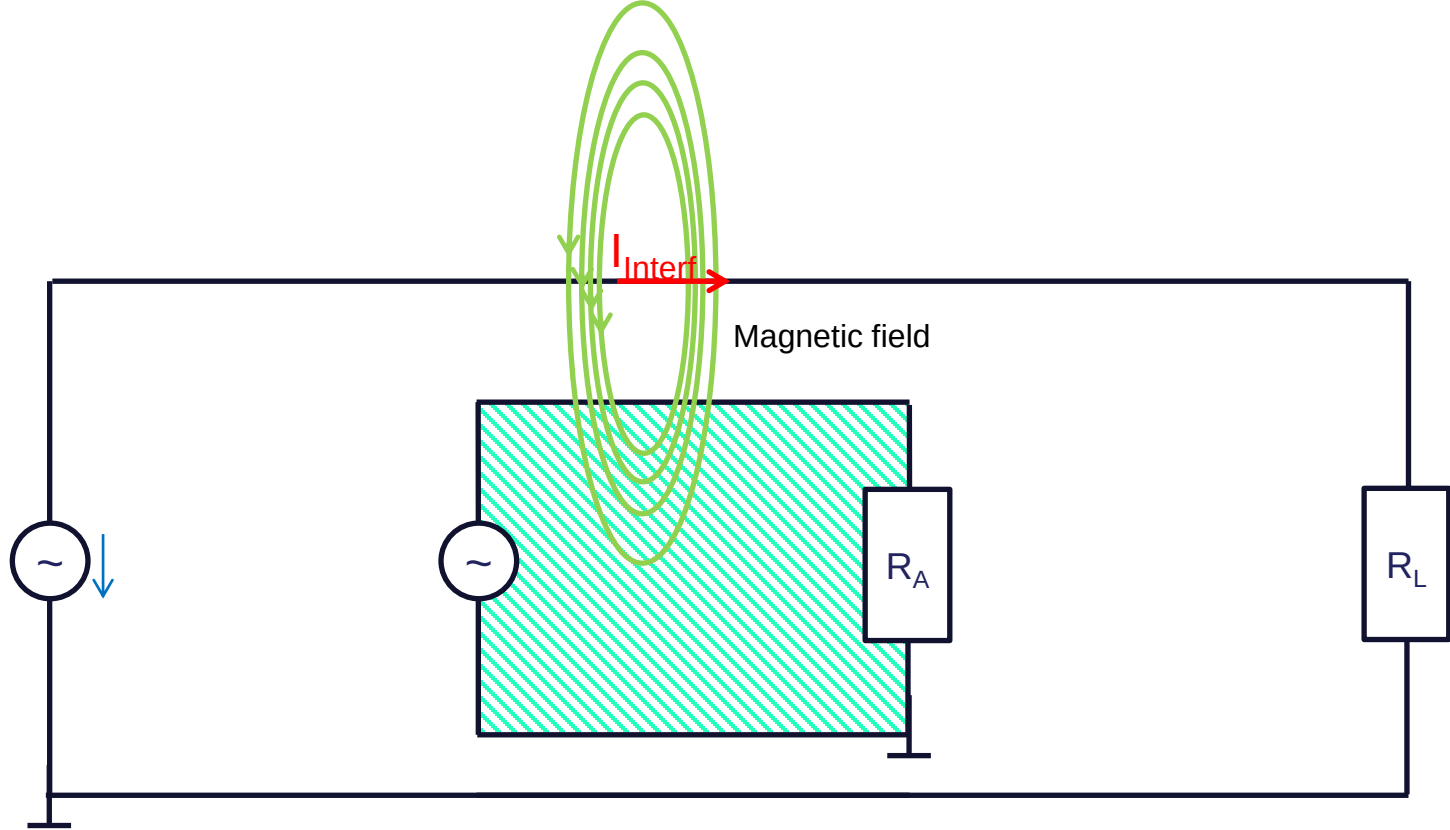
Signal circuit und load circuit for couplings acting on a distance



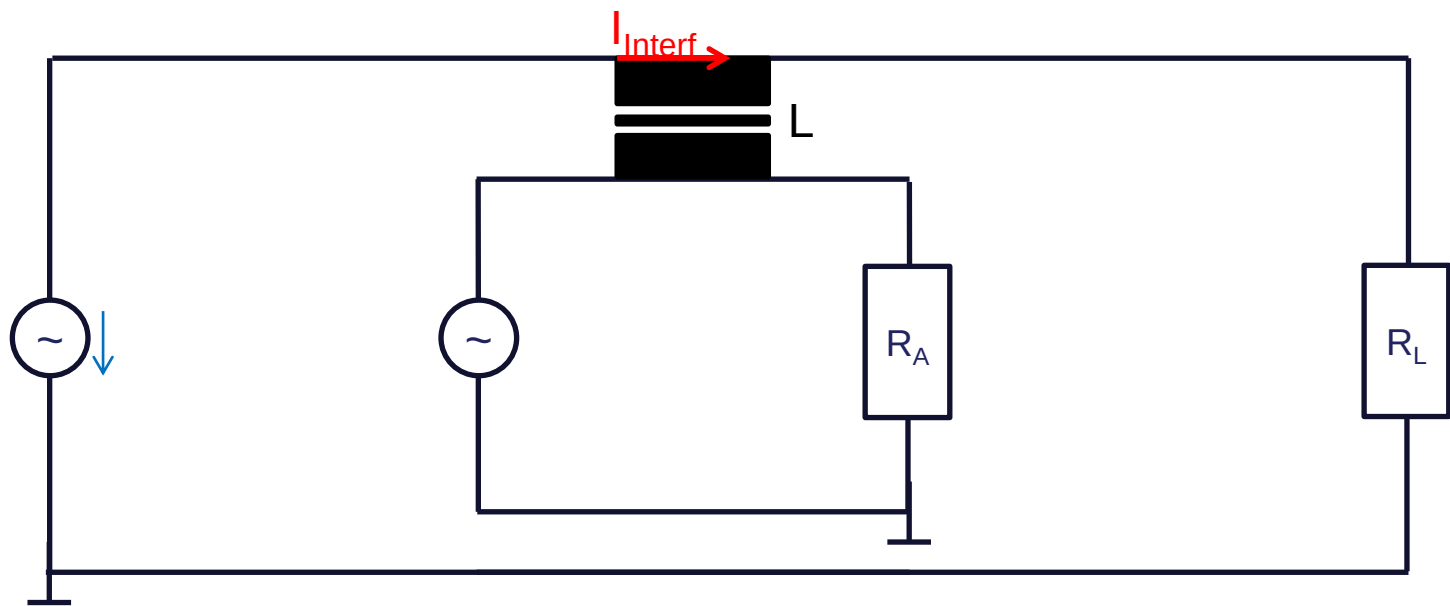
Inductive coupling



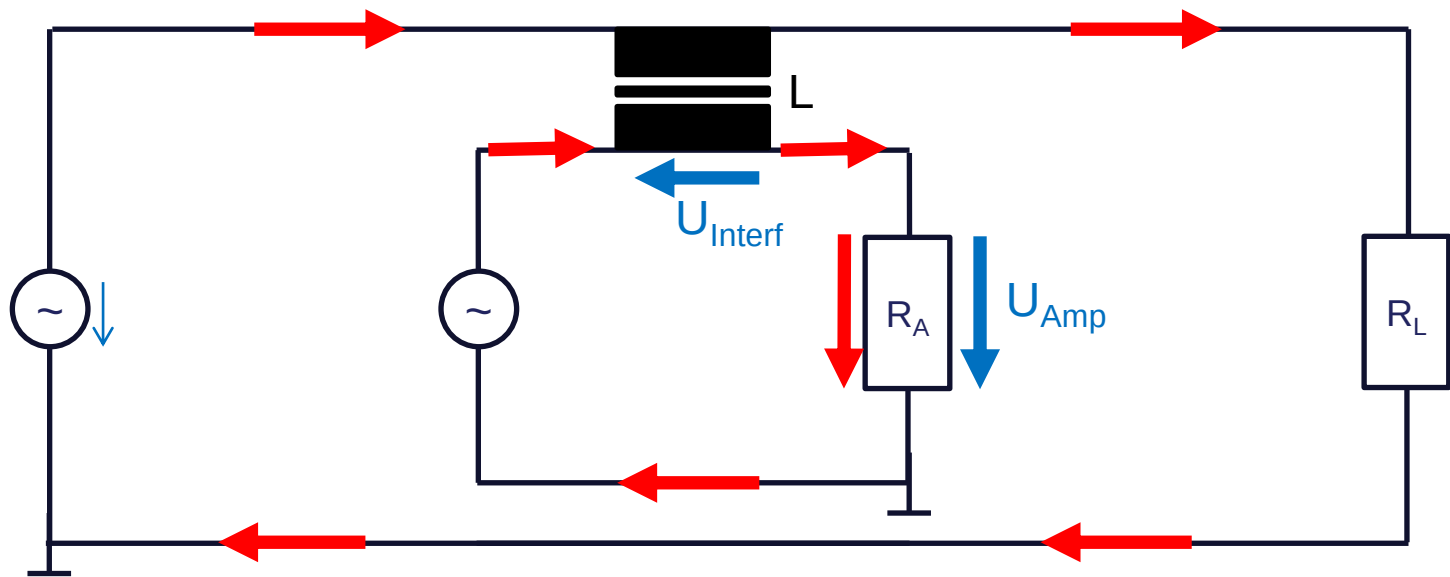
Inductive coupling - Fields



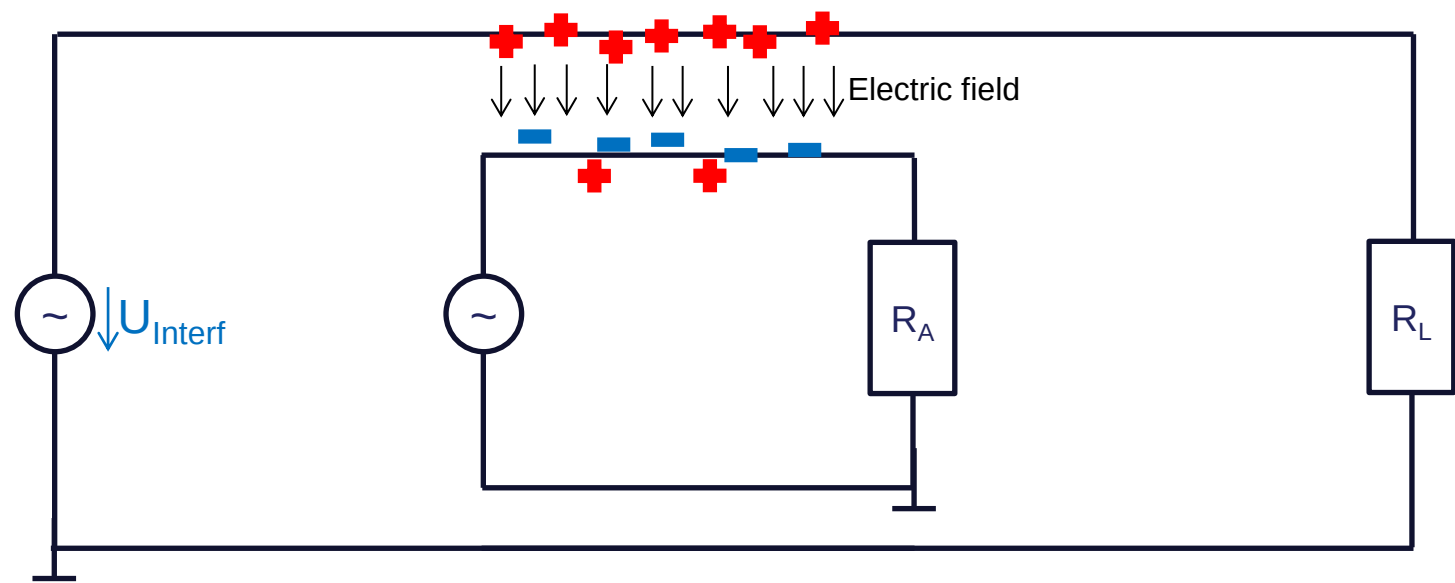
Inductive coupling – equivalent circuit



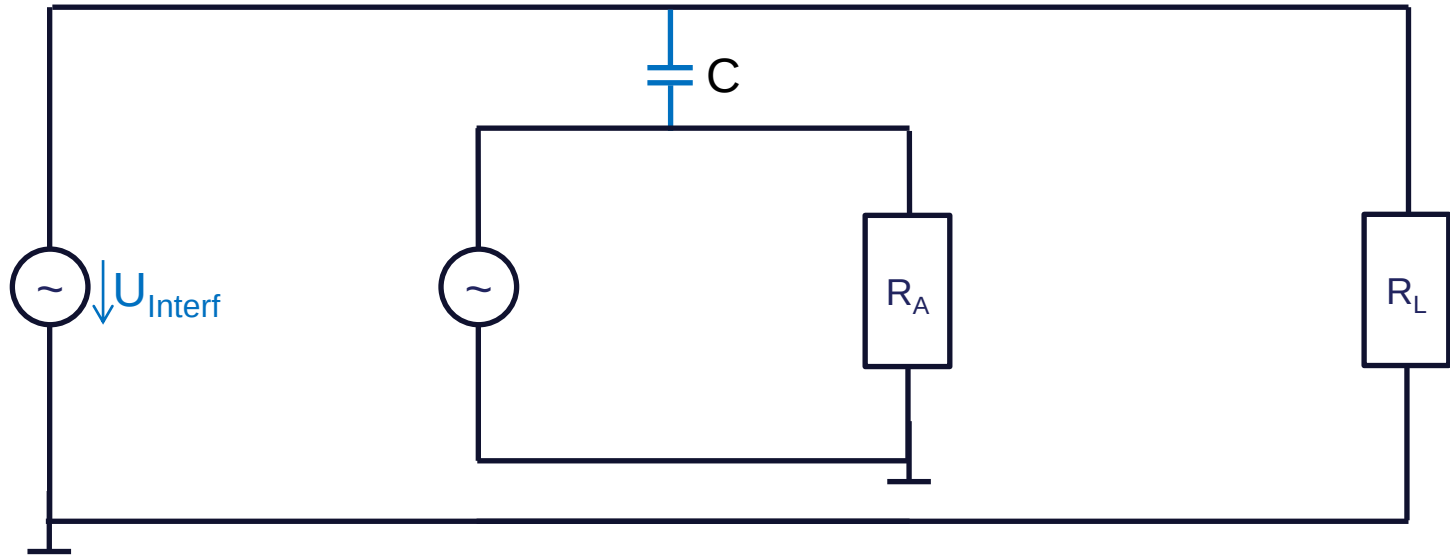
Inductive coupling – current flow



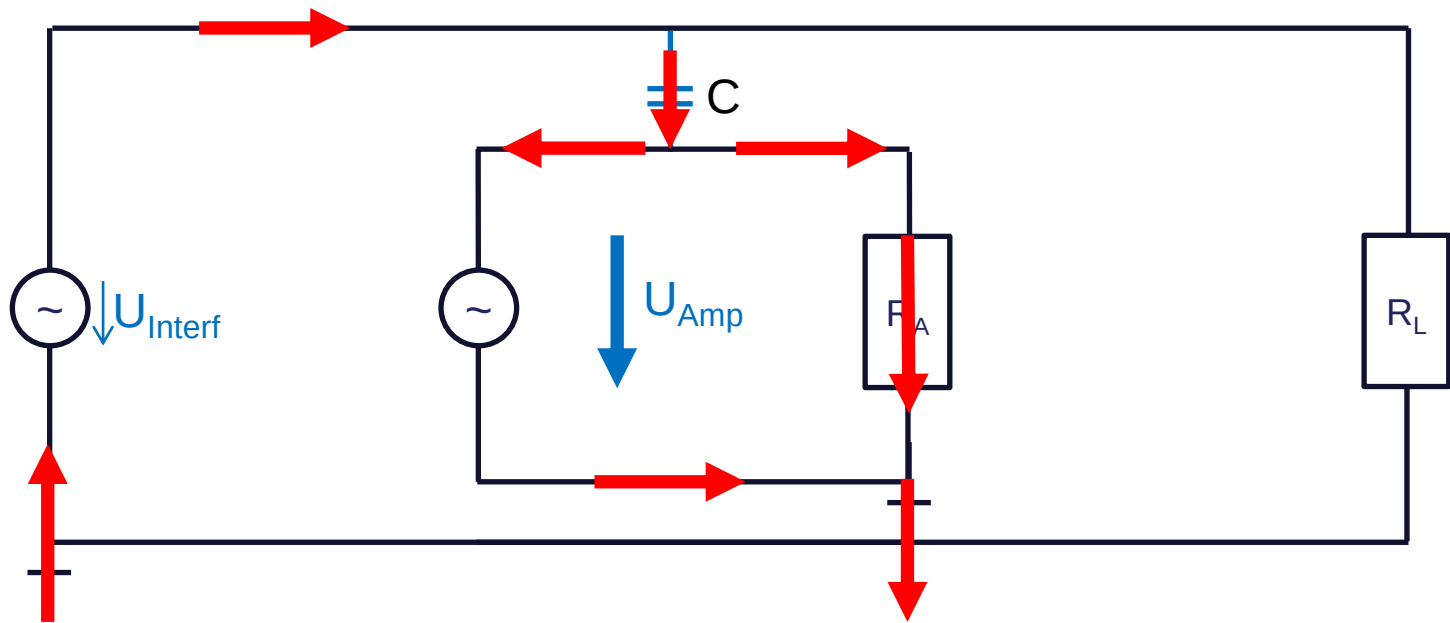
Capacitive coupling



Capacitive coupling – equivalent circuit

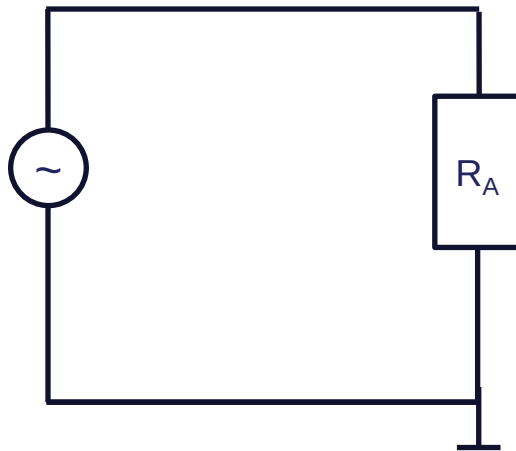


Capacitive coupling – current flow

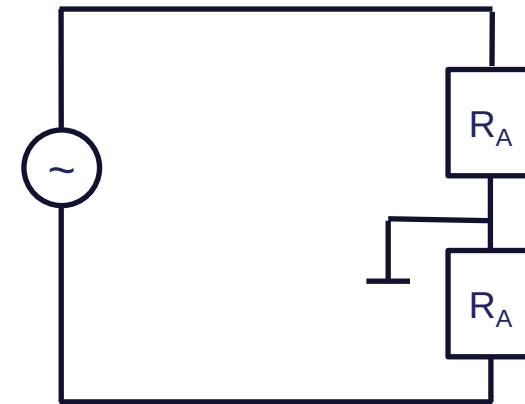


Full symmetric input – circuit

Unsymymmetric input
(single ended or
quasidifferential input)

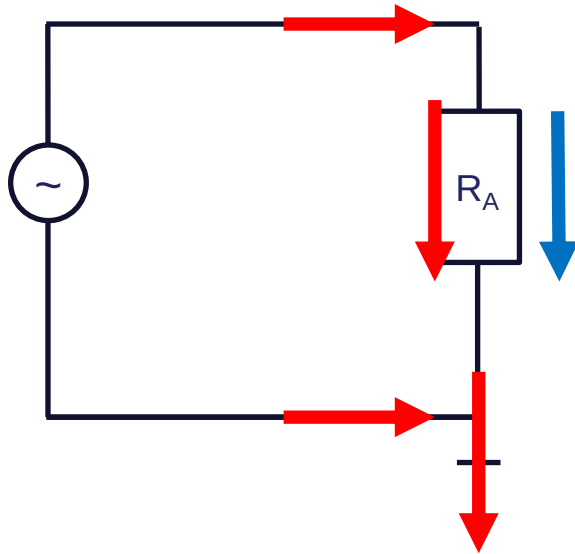


Symmetric input
(differential input)

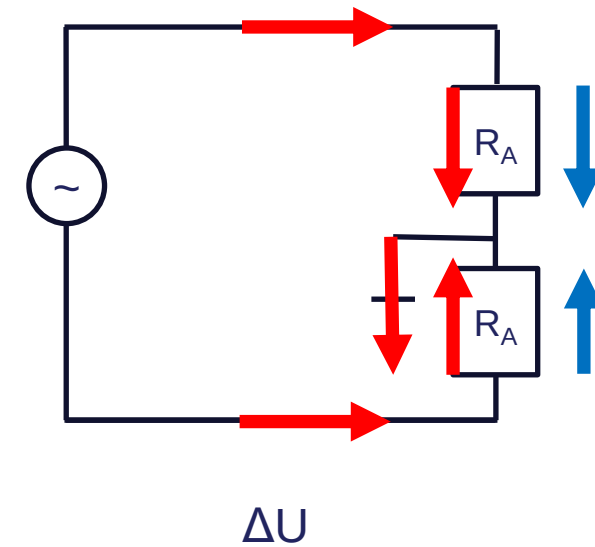


Full symmetric input – current flow

Unsymmetric input
(single ended or
quasidifferential input)



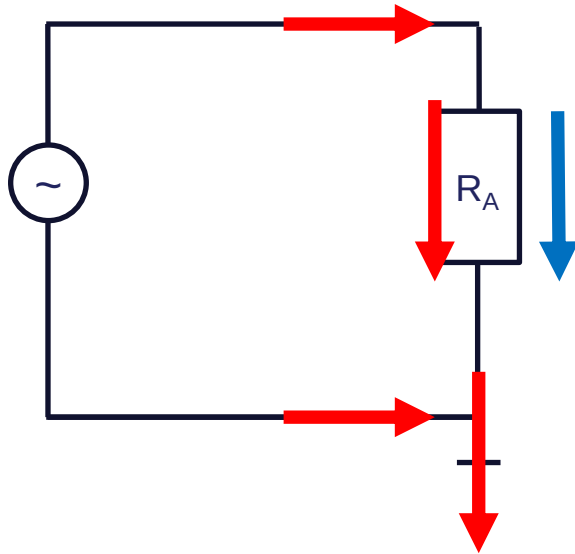
Symmetric input
(differential input)



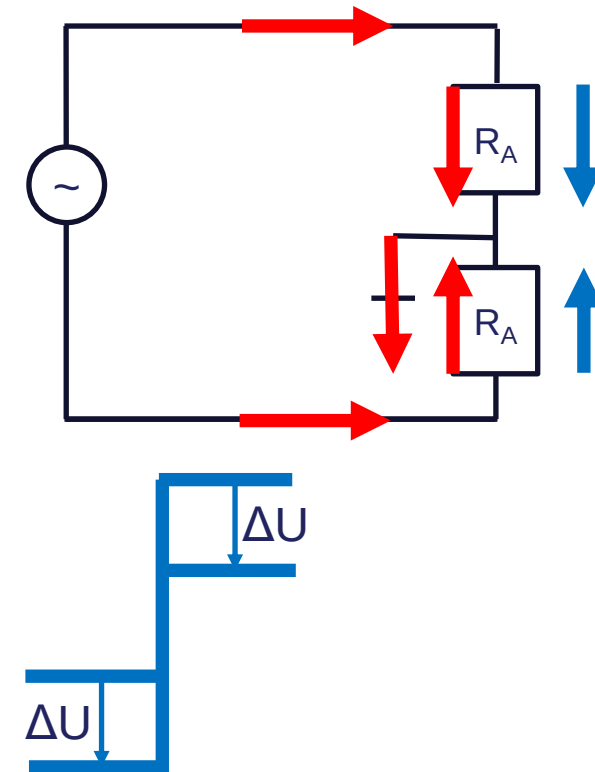
ΔU

Full symmetric input – common mode rejection

Unsymymmetric input
(single ended or
quasidifferential input)

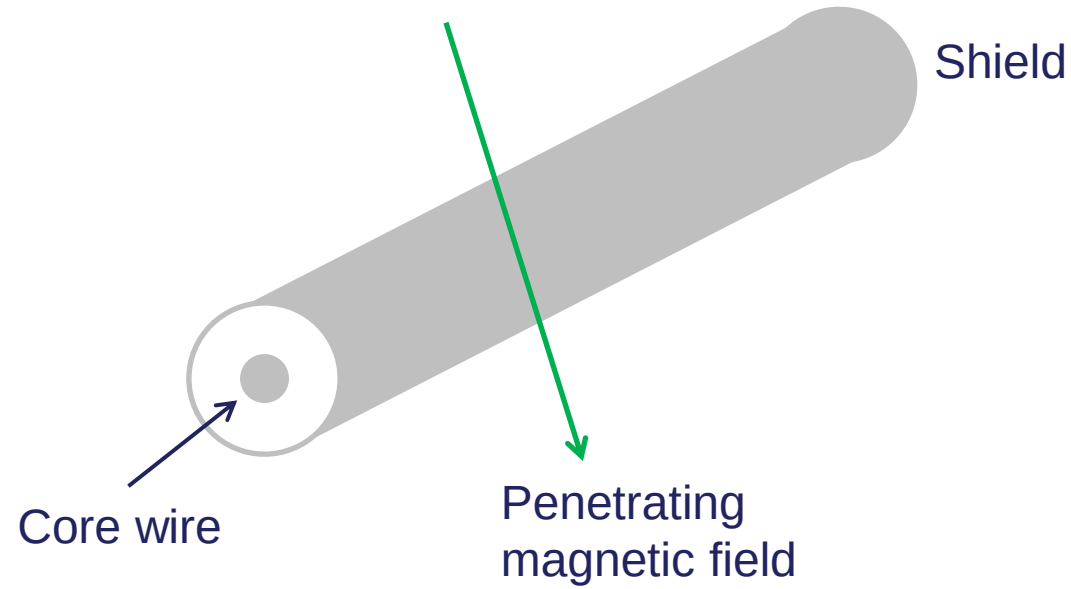


Symmetric input
(differential input)

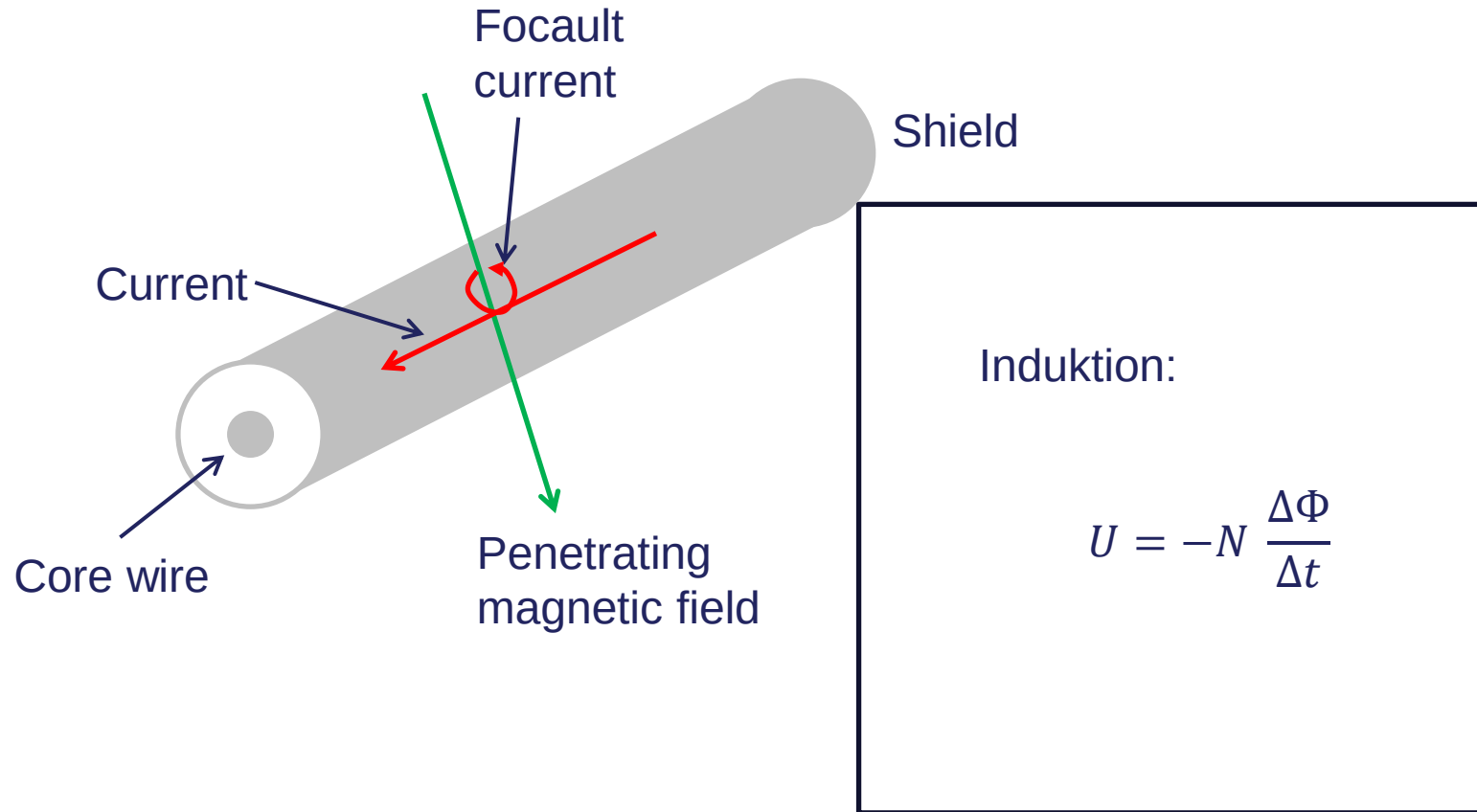


Shield

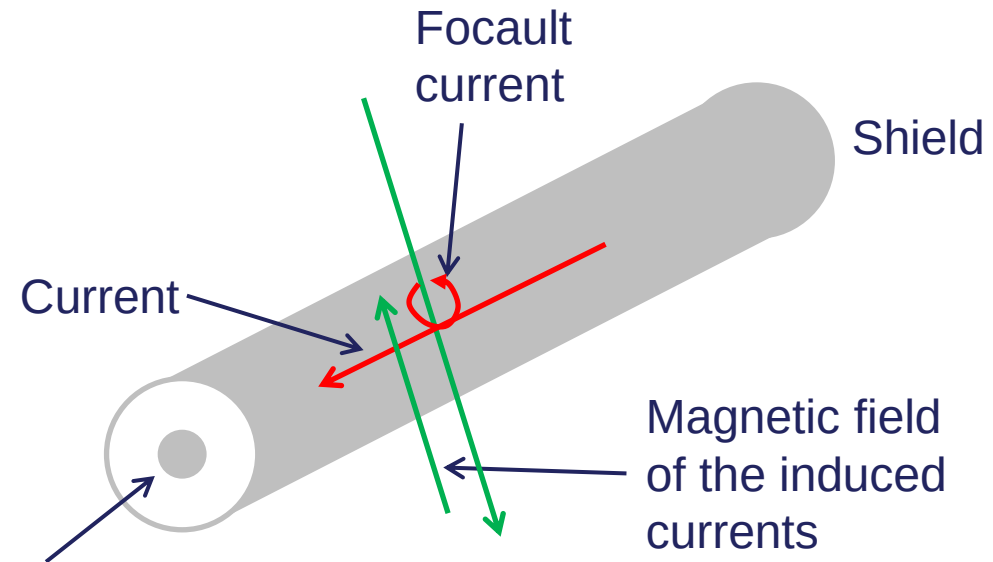
Shield by inductive coupling



Shield by inductive coupling



Shield by inductive coupling



How should a Shield be connected

- Never leave a shield unconnected
- If you have only capacitive coupling, one side is enough
- If you have also inductive coupling, both sides would be better
- Be careful if you connect on both sides. If there is a potential difference, you will get a lot of current on the shield

**GET THIS COURSE**

Data Acquisition without Electromagnetic Interference

Specifically for measurement engineers: A specialist training on how to avoid and shield against electromagnetic interference impacting the measurement result.

Do you see strange effects superimposed on your measurement signal? Presumably, this is electromagnetic interference. We have developed a seminar specifically for measurement engineers where you can learn more about many potential interference effects and strategies for avoiding and shielding against them. Many factors have to be considered to suppress interference. Profound knowledge and, above all, some experience is required to be able to take the right measures. Benefit from the opportunity to gain hands-on experience by implementing interference suppression at our practical workstations.

Benefit from the wealth of experience of our trainers in torque measurement technology: In the seminar there is enough time to answer your individual questions! HBK Academy ONLINE courses are delivered in real-time with an instructor available to answer questions.

Topics included

- Detecting interference sources and sinks
- Galvanic coupling and system perturbations
- Capacitive and inductive coupling
- Radiant coupling
- Shielding
- Grounding concepts
- Cable routing

<https://all-hbkacademy.talentlms.com/catalog/info/id:1940>

Target Group

Measurement engineers who perform measurements in environments with electromagnetic interference, e.g. industrial plants.

Thank You

HBK Academy
academy@hbkworld.com

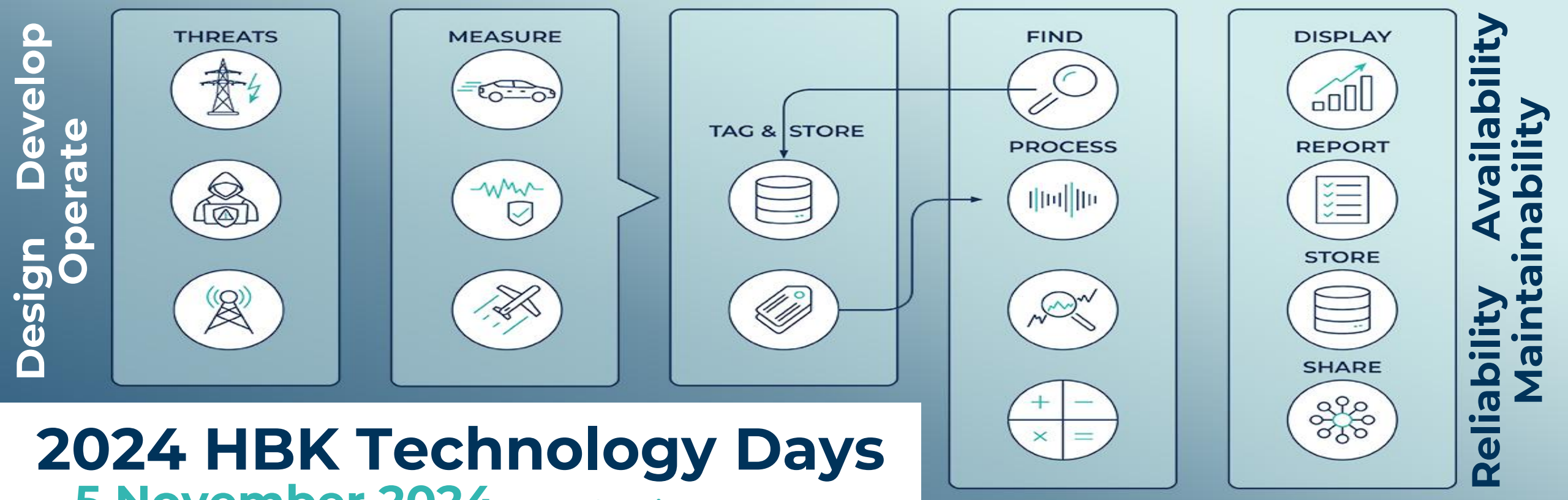


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Public

HBK: public

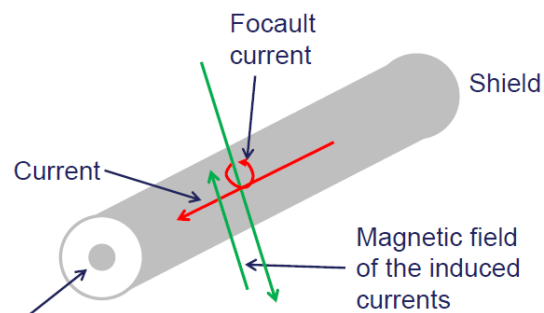




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