Mess-System CoMeT

Bernhard Mund, *bedea* Berkenhoff&Drebes GmbH, Herbornerstrasse 100, D-35614 Asslar, Germany, bmund@bedea.com

Measuring of EMC Characteristics on Communication Cables

- Author: Bernhard Mund,
  - *Radio&TV Technician, Radio Brand, Marburg, 1971*
  - *Dipl.-Ing. Nachrichten- & Mikroprozessortechnik, FH Giessen 1984*
- *bedea* Berkenhoff&Drebes GmbH, Asslar *since 1985*
  - *bedea* Manufacturer of Communication Cables, (CATV-Kabel)
- Responsible:
  - R&D Manager, RF- und EMC-Measurements,
  - **Standardisation:**
  - Chairman of UK 412.3, Koaxialkabel, (German NC)
  - Secretary of IEC SC 46X, Coaxial cables
  - Secretary of CENELEC SC 46XA, Coaxial cables

Bernhard Mund, *bedea* Berkenhoff&Drebes GmbH, Herbornerstrasse 100, D-35614 Asslar, Germany, bmund@bedea.com

Outline

- Physical Basics of Cable Screening
  - Definitions, elektrical length
  - Coupling Transfer Function
- Measuring of the Screening of Cables
  - Transferimpedance & Screening attenuation
  - Coupling attenuation
- Further Developments
  - Screening of Connectors & Connecting Hardware
- Conclusion & Discussion

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Definitions, electrical length

high frequencies: Screening attenuation

$$a_S = 10\ log\ (P_1/P_2) = 20log_{10}\ (U_1/U_2)\ [dB]$$

Ratio of two powers --> **length independent**

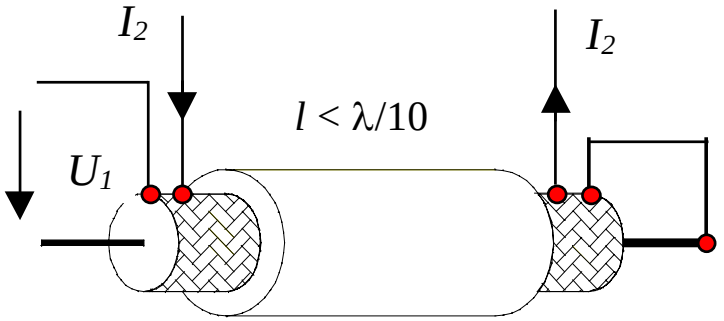
Wave length

$\lambda = (c_0 \bullet v_k) / f$

electrical long:

$$f > \frac{c_o}{2 \cdot l \cdot \left|\sqrt{\varepsilon_{r1}} - \sqrt{\varepsilon_{r2}}\right|}$$

low frequencies: Transferimpedance



$$Z_T = \frac{U_1}{I_2} \quad [m\Omega/m]$$

electrical short:

$$f < \frac{c_o}{10 \cdot l \cdot \sqrt{\varepsilon_{r1}}}$$

(EN 50289-1-6)

Ratio of **U/I = R** --> **length dependent (Ohms law)**

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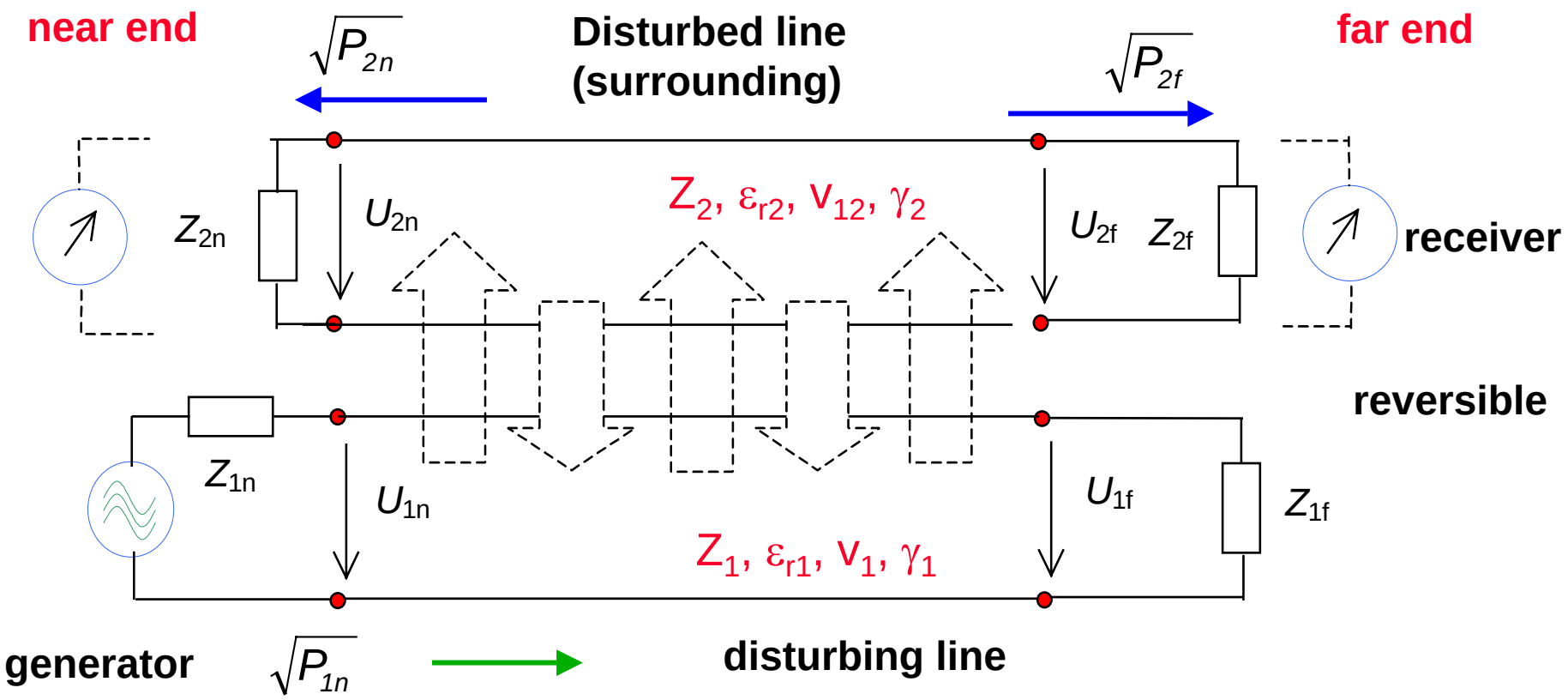
Coupling between two lines



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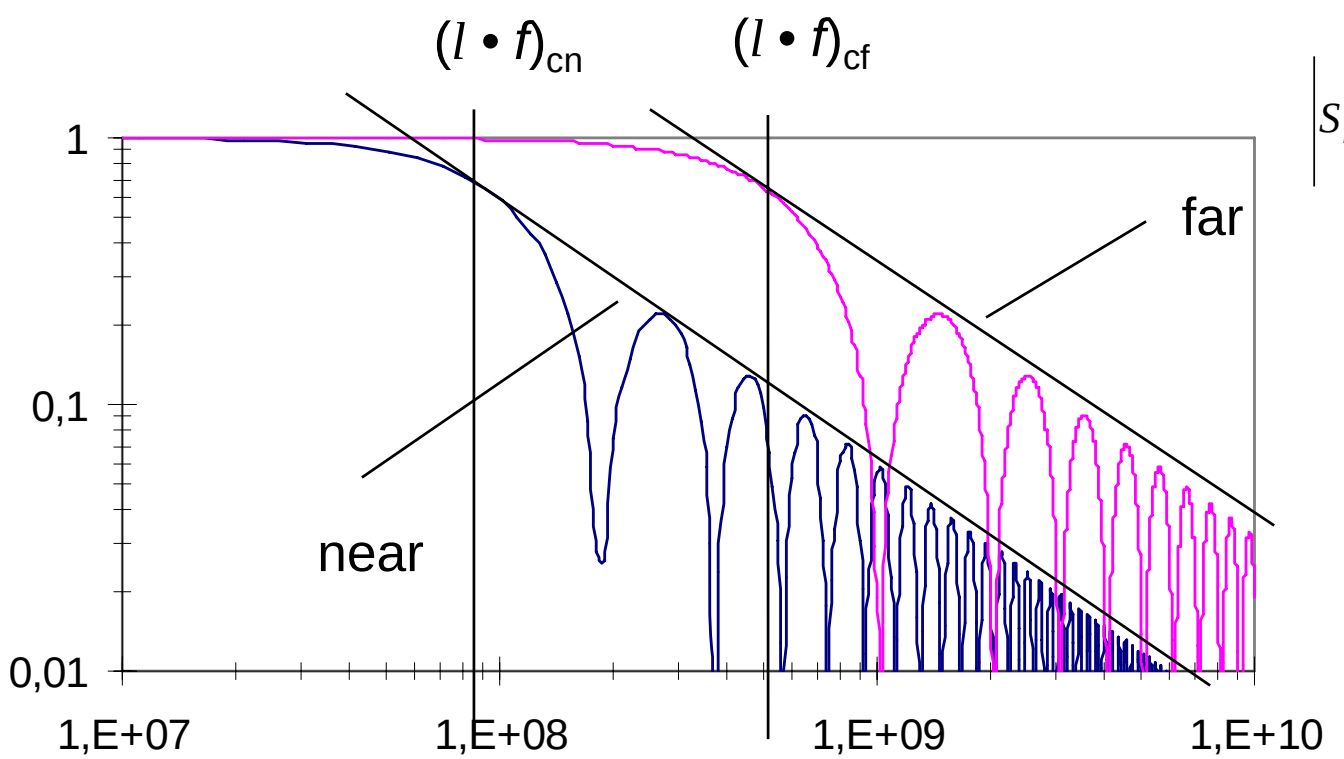
Summing function S_{nf}



$$\left|S_{n_f}\right| = \frac{\left|2\sin\left(\frac{(\beta_1 \pm \beta_2).L_c}{2}\right)\right|}{(\beta_1 \pm \beta_2).L_c}$$

≈ sin x/x

low frequencies

$$\left|S_{n_f}\right| \rightarrow 1$$

high frequencies

$$\left|S_{n_f}\right| \rightarrow \frac{2}{(\beta_1 \pm \beta_2)\cdot l}$$

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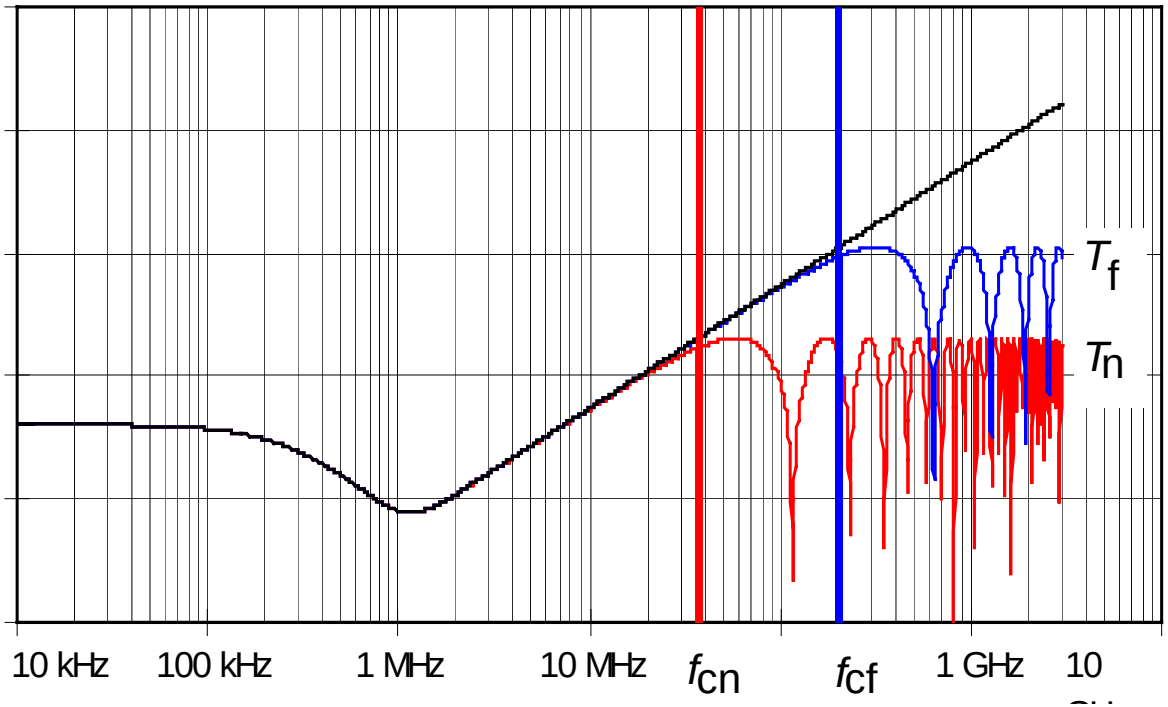
Calculated Coupling Transfer Function T_{nf}

a_s and Z_T vs frequency

$$T_{f}^{s,n} = (Z_F \pm Z_T) \cdot \frac{1}{\sqrt{Z_1 \cdot Z_2}} \cdot \frac{l}{2} \cdot S_f$$



n = near end

f = far end

L = 1 m

ε_{r1} = 2,3

ε_{r2} = 1,0

Z_F = 0

Transferimpedance

Screening attenuation

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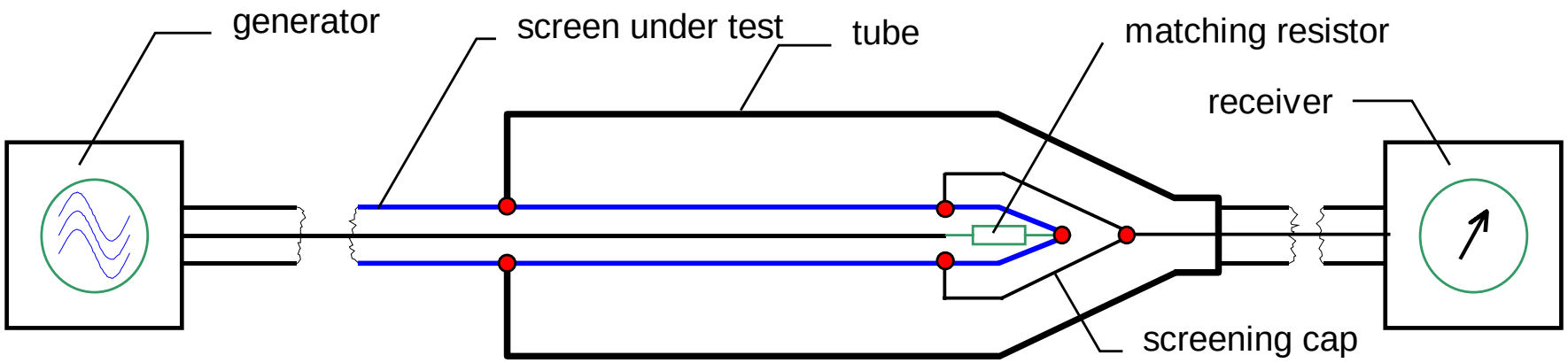
Measuring with the Triaxial test set-up *CoMeT*

Transferimpedance & Screening attenuation

few kHz up to and above 3 GHz with one test set-up



IEC 61196-1, A1 Generic for RF-Cables,
EN 50289-1-6, EMC on Communication cables

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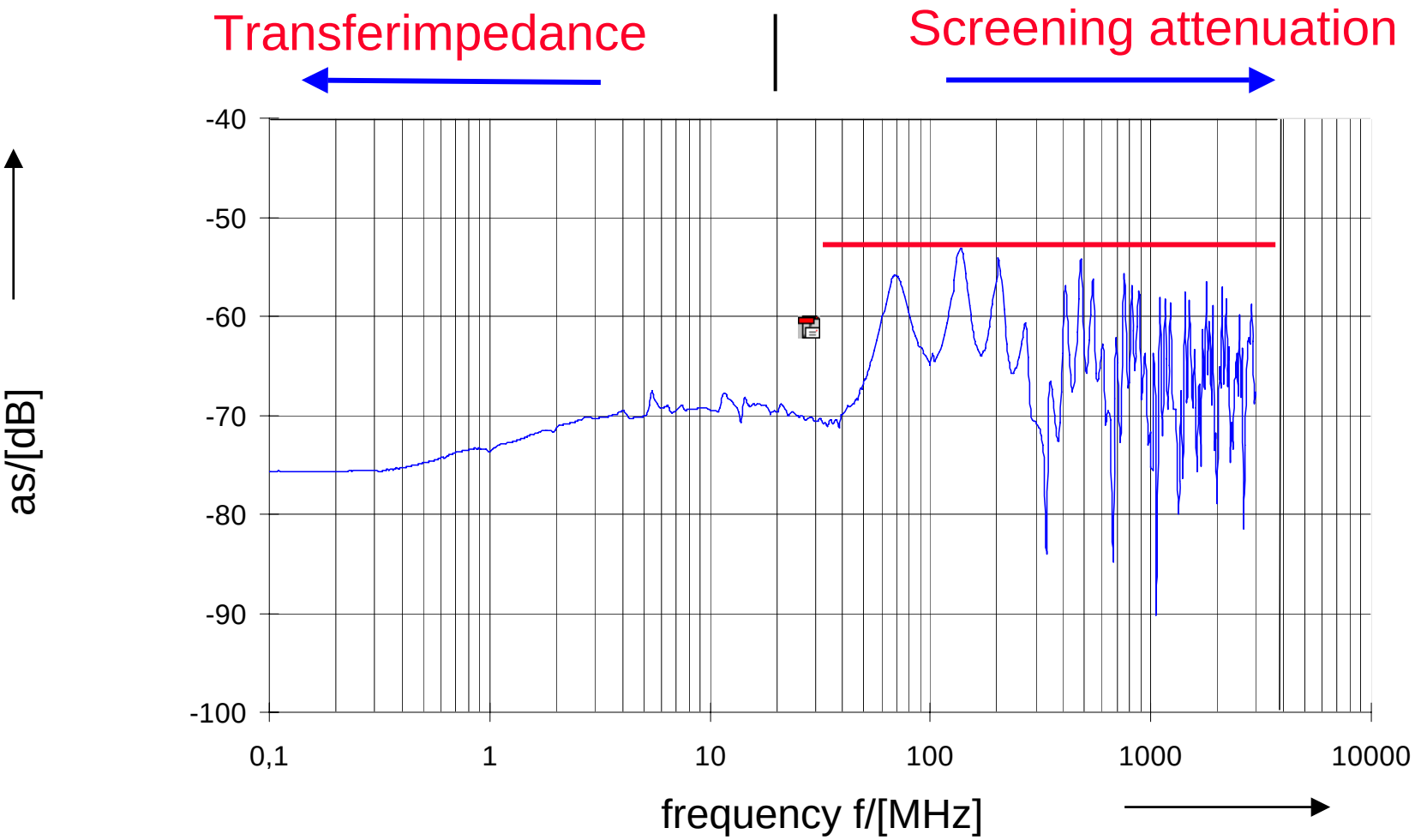
Measured Transfer function of RG 058



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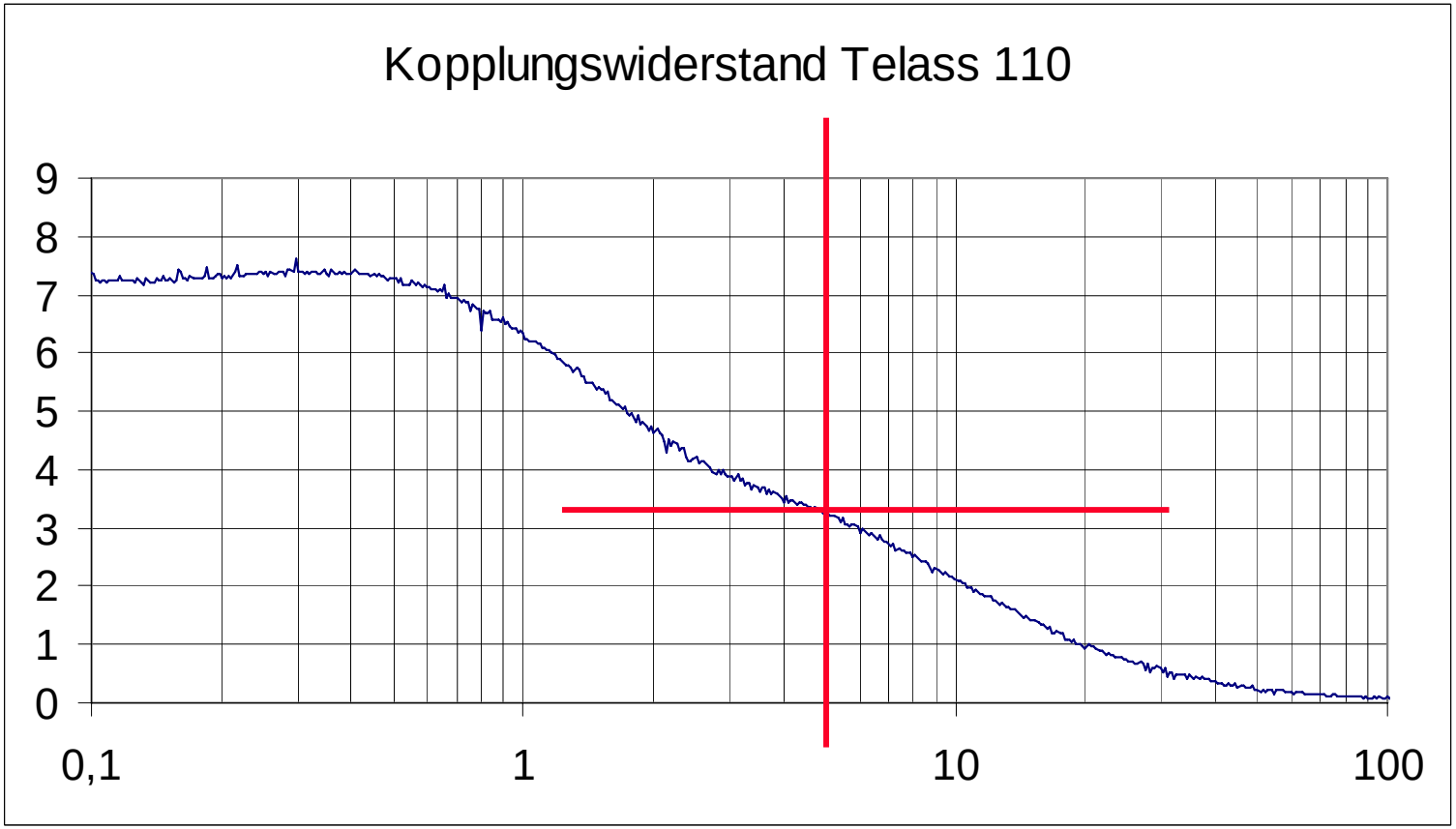
Transferimpedance Telass 110 in mOhm/m



3,5 mΩ/m @ 5 MHz

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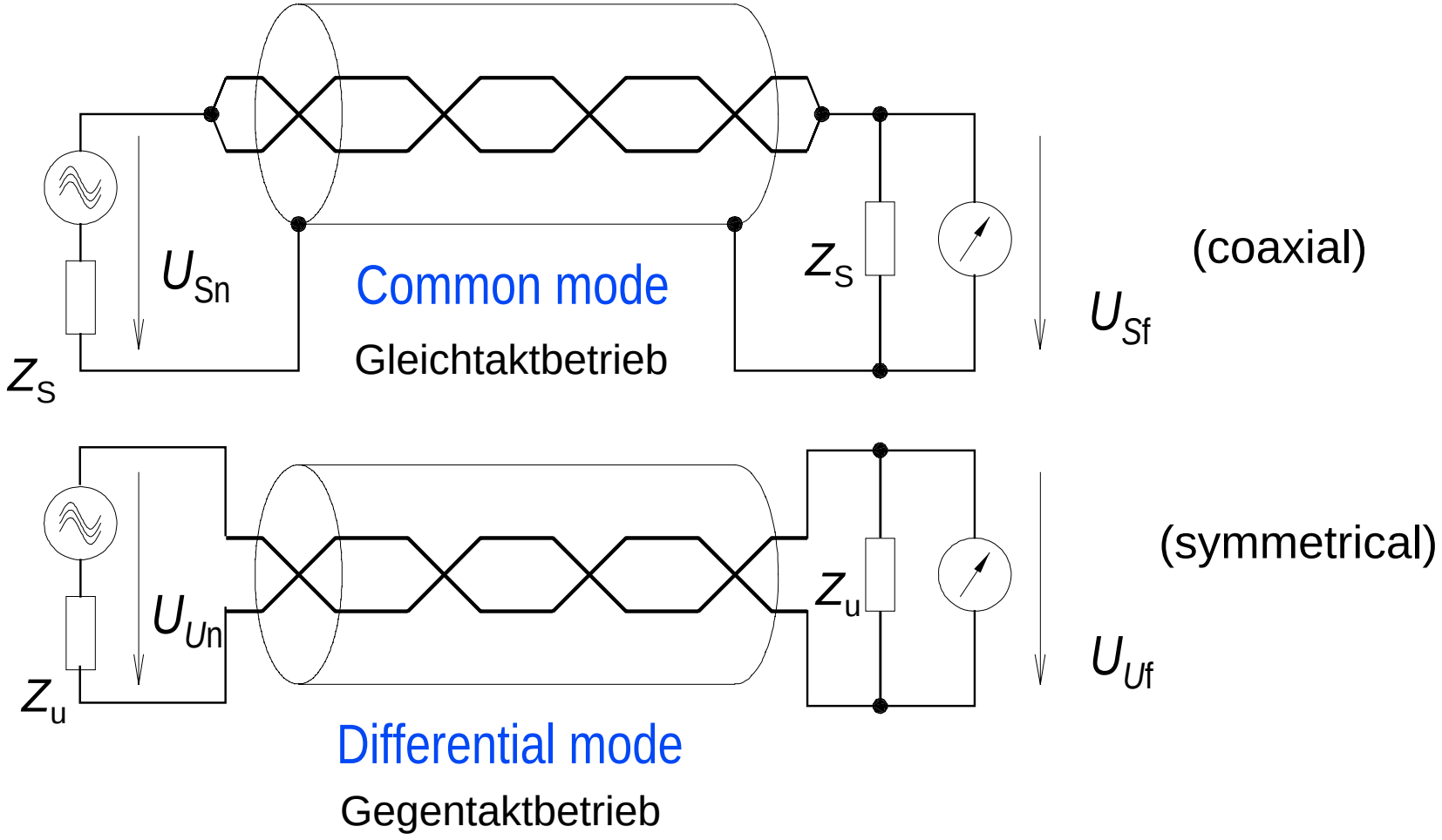
Diiferential & Common mode of a balanced pair



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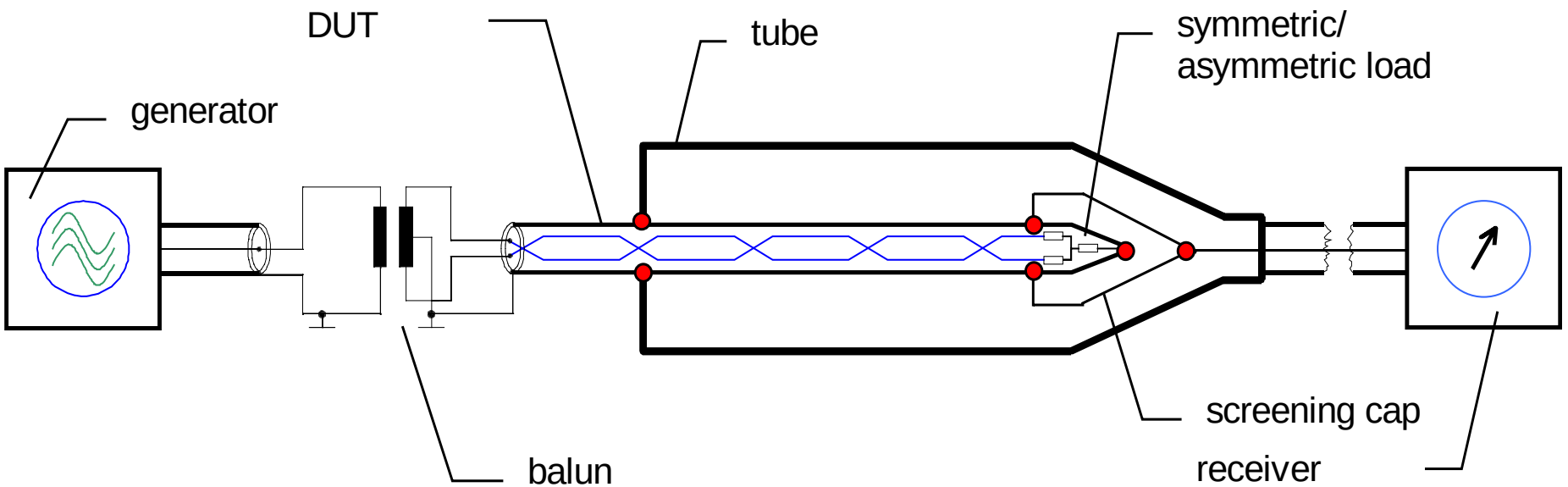
Measuring of Coupling attenuation

Coupling attenuation is the sum of Unbalance attenuation of the pair and the Screening attenuation of the screen



IEC/PAS 62338 Ed1, Coupling attenuation, triaxial method

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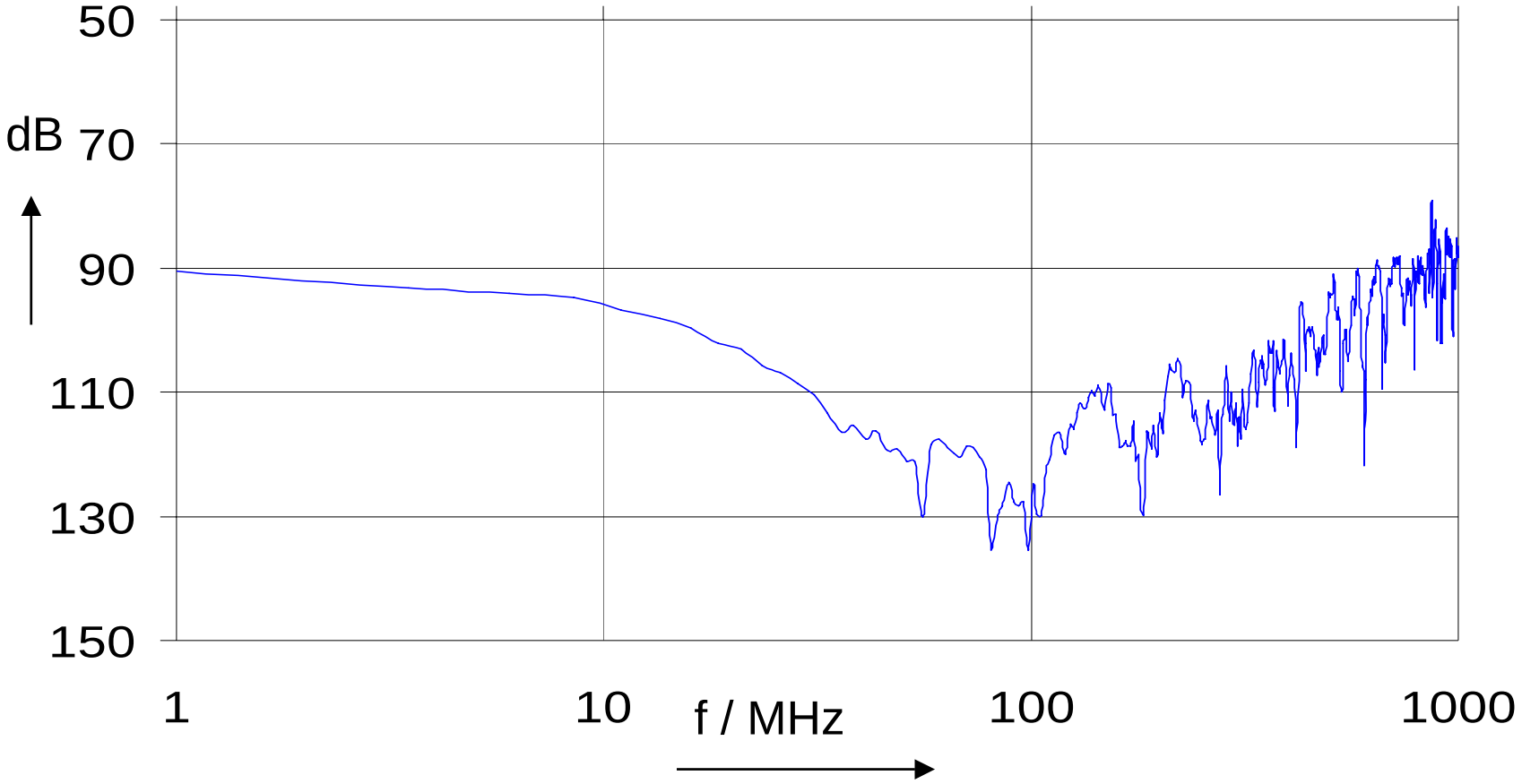
Coupling attenuation of a CAT 6 Cable, S/FTP, log scale, Triaxial set up



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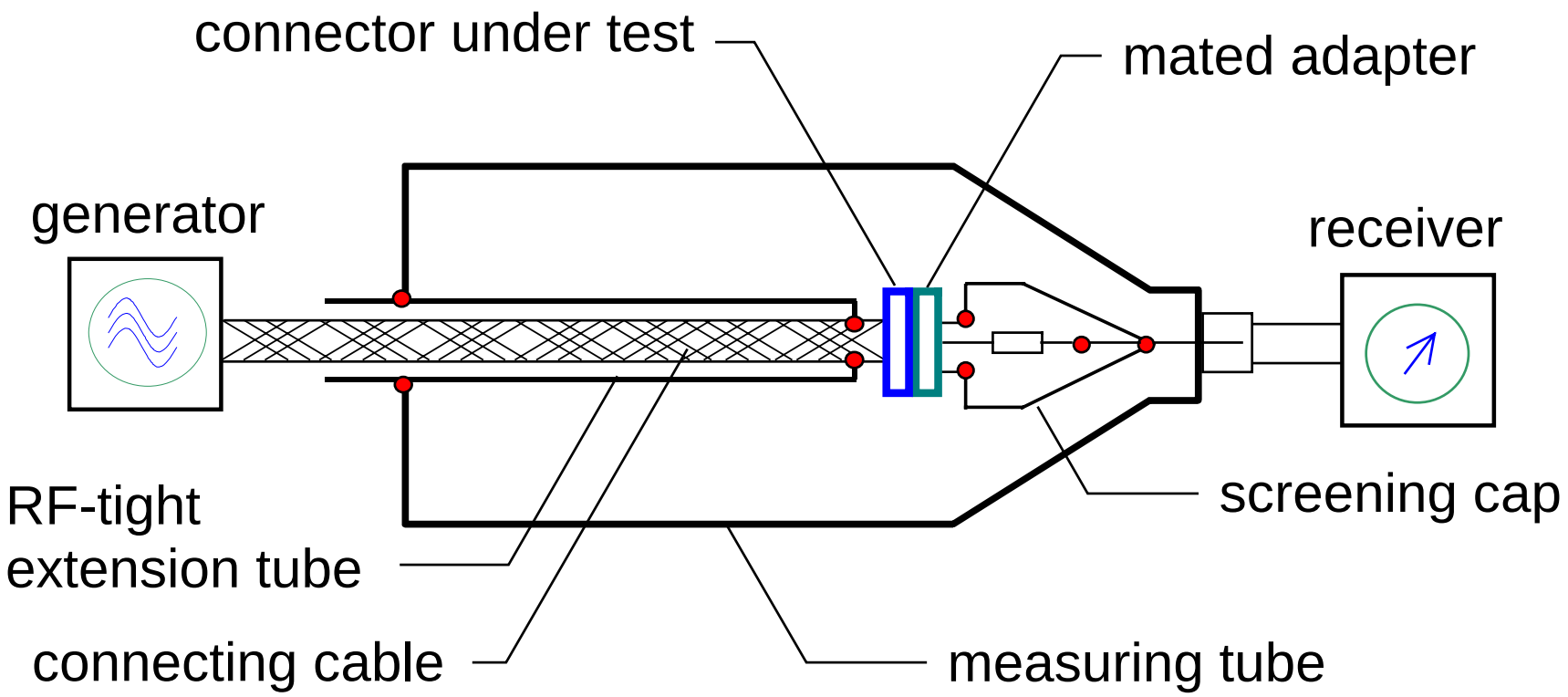
Triaxial set-up with “Tube in Tube“



Tube in Tube measurement of screening attenuation of connectors

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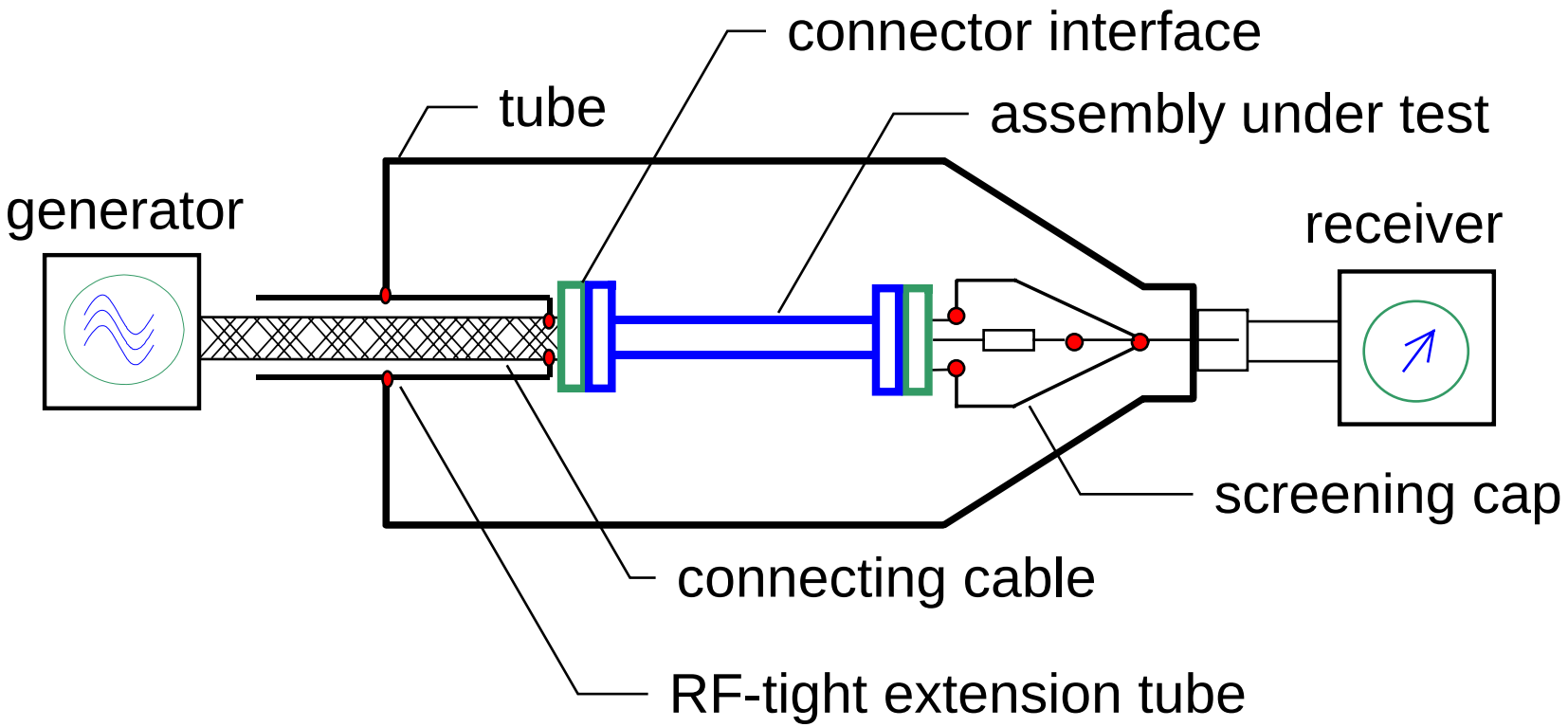
Measuring of cable assemblies



Measuring of the screening attenuation of a cable assemblies

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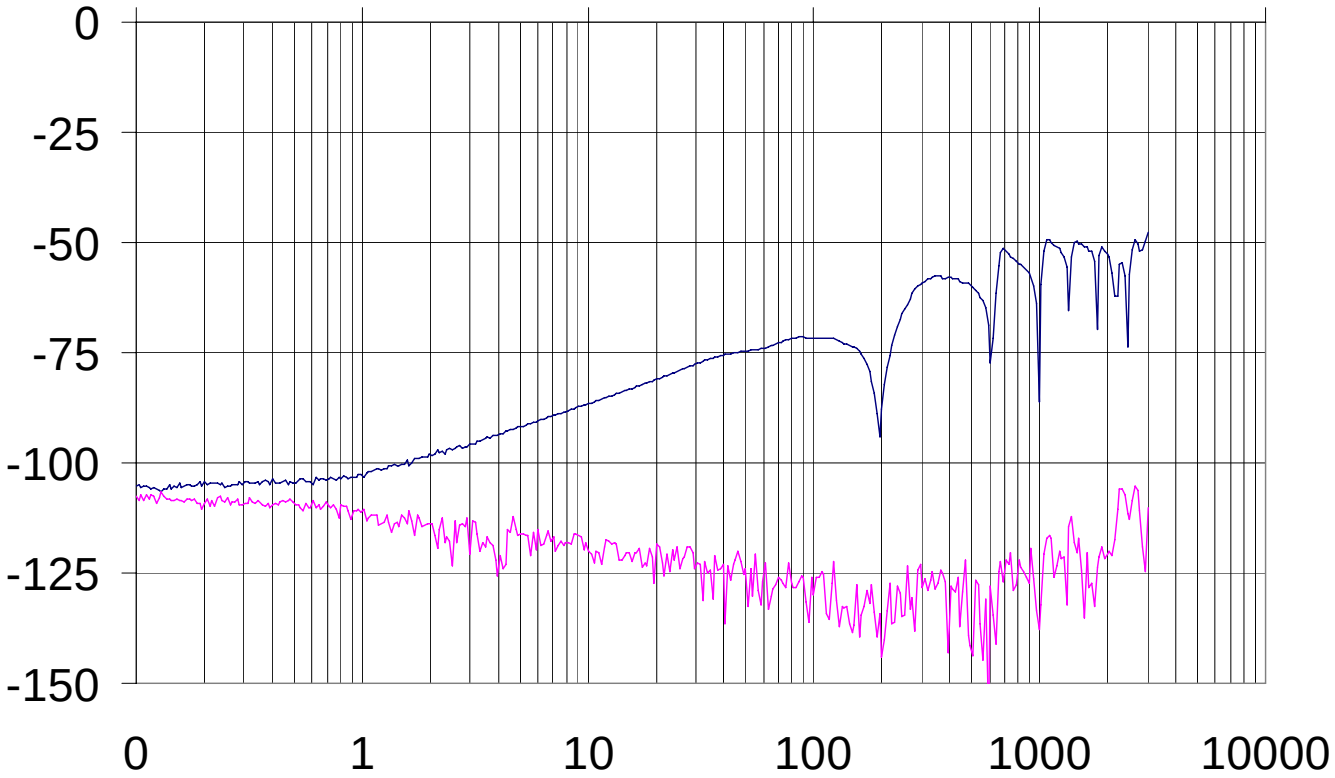
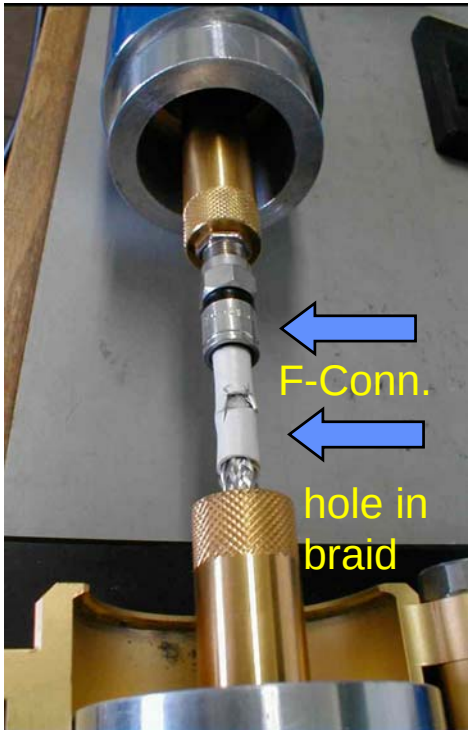
Cable with small hole, tube in tube, 0,5 m

Well screened CATV-Cable with F-Connector

Same cable with one small hole, 3 mm





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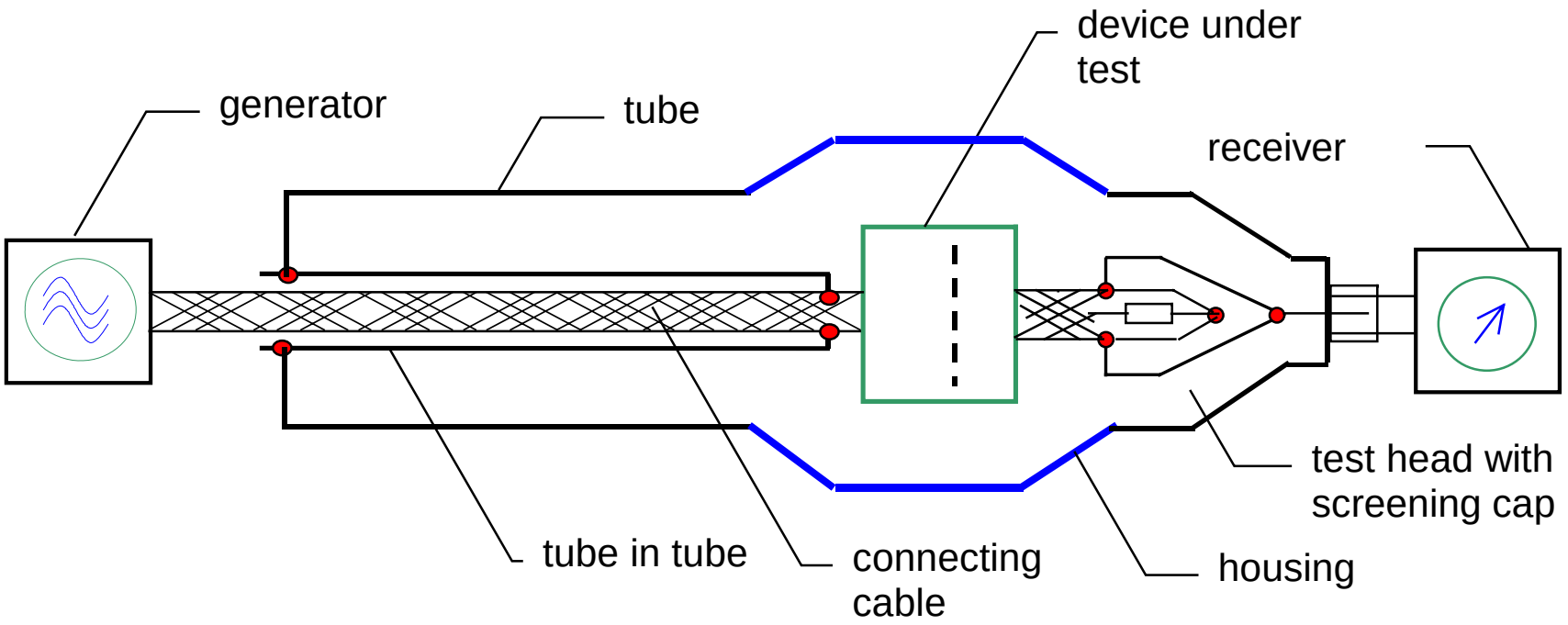
Test set-up for connecting hardware with tube in tube



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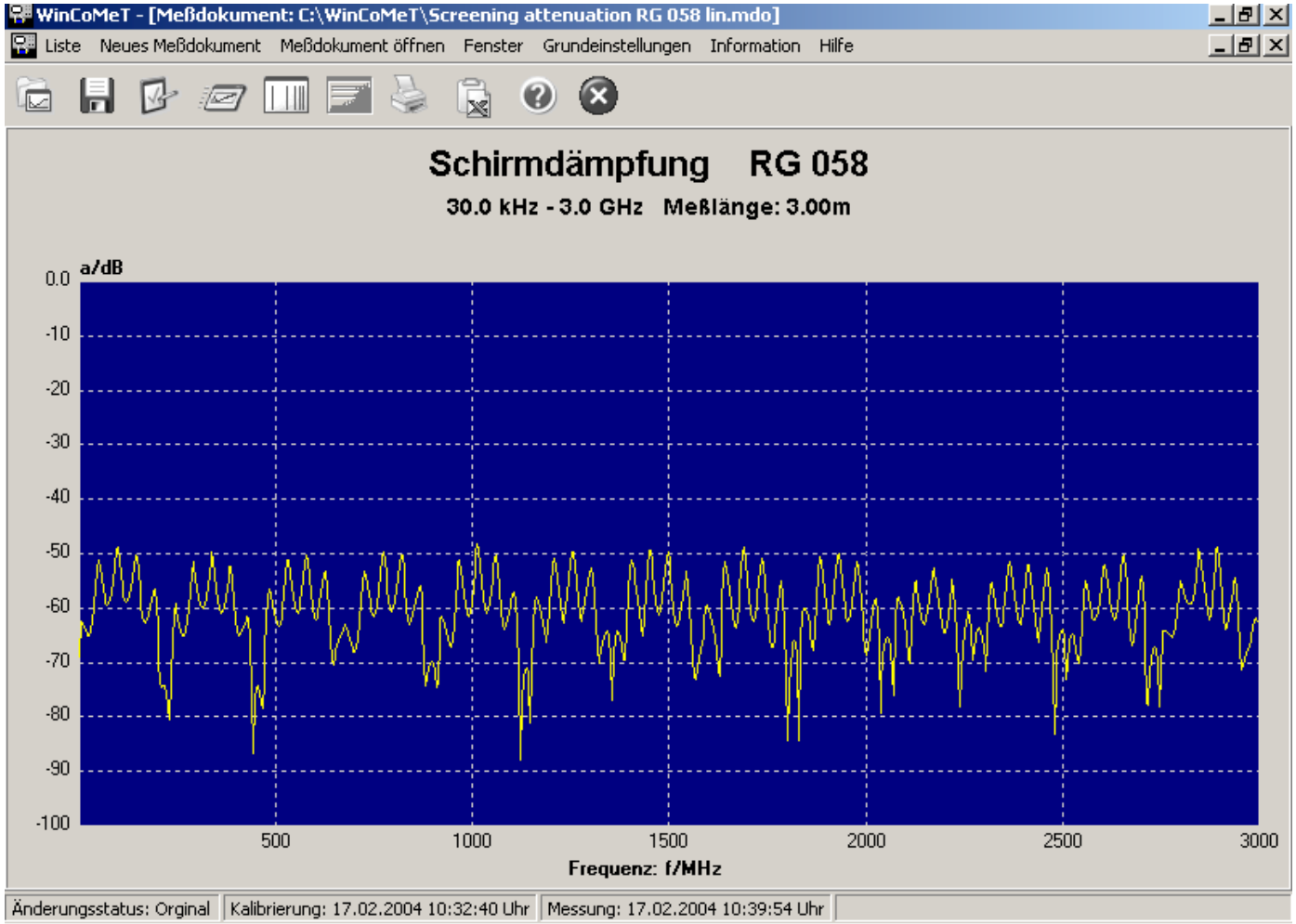
Control- and Evaluation Software



Delphi

C++

Control of network analyzers

Documentation

Further tests on communication cables

Bernhard Mund, *bedea* Berkenhoff&Drebes GmbH, Herbornerstrasse 100, D-35614 Asslar, Germany, bmund@bedea.com

Conclusion 1

- The Screening effectivenes of Communication cables is described in the lower frequency range by the **Transferimpedance Z_T** and in the upper frequency range by the **Screening attenuation a_S**.
- At screened balanced cables, the **Coupling attenuation a_C** is the measure of the screening effectiveness as the sum of the **Unbalance attenuation** of the Pair and the **Screening attenuation** of the screen.
- With the test system ***CoMeT*** of ***bedea*** one can measure the **Transferimpedance Z_T** as well as the **Screening attenuation a_S** in the frequency range from 100 kHz up to and above 3 GHz with one test set-up
- Furthermore, the **Coupling attenuation a_C** of screened balanced pairs may be measured.

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Conclusion 2

- **Advantages:**
  - **simple and easy sample preparation**
  - **only one test set up for Z_T, a_S & a_C**
  - **high sensitivity up to and above 125 dB**
  - **no radiation of electromagnetic energy**
  - **covers the whole frequencvy range**
  - **high reproducibility**

- Further information: *www.bedea.com*
- Contact person: *bmund@bedea.com*

Bernhard Mund, *bedea* Berkenhoff&Drebes GmbH, Herbornerstrasse 100, D-35614 Asslar, Germany, bmund@bedea.com

CoMeT

Coupling Measuring Tube

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