Test set-up CoMeT
Coupling Measuring Tube

General:

Due to increasing electromagnetic disturbances of all kinds, the investigation of the electromagnetic behaviour of electric and electronic equipment becomes more and more important.

This is especially for cables concerning their electromagnetic performance and screening behaviour.
The measure of the screening behaviour of the screens of coaxial and symmetrical cable screens is the transfer impedance Z_T in the lower frequency range up to 50 MHz as well as the screening attenuation a_S in the upper frequency range from 30 MHz upwards.

The transfer impedance Z_T of an electrically short uniform cable is defined as the quotient of the longitudinal voltage induced in the outer circuit (environment) to the current in the inner circuit (cable) or vice versa, related to unit length.

Transfer impedance: $Z_T = \frac{U_2}{I_1 \cdot L}$

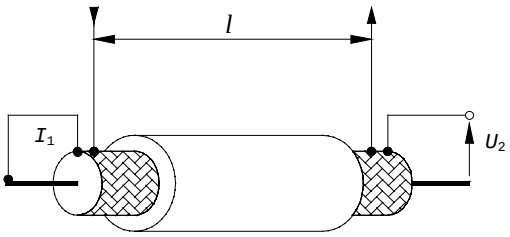


Fig. 1 - Definition of transfer impedance

The screening attenuation of electrically long cables is defined as the logarithmic ratio of the power fed into the cable and the radiated max. peak power:

screening attenuation: $a_S = 10 \log (P_1/P_2)$

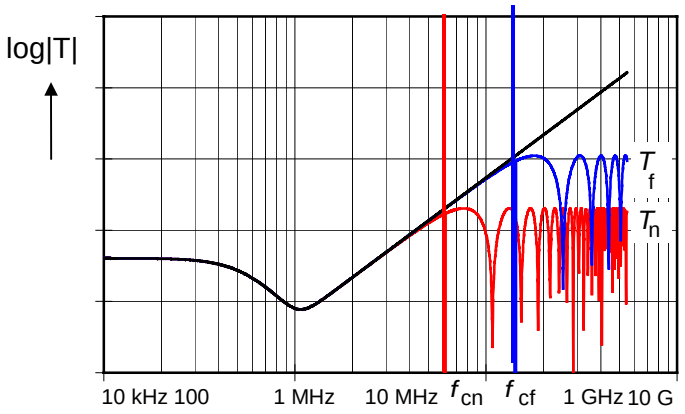


Fig. 2 - Calculated coupling transfer function $T_{n,f}$

The coupling transfer function $T_{n,f}$ gives the relation between the screening attenuation a_S and the transfer impedance Z_T of a cables screen. In the lower frequency range, where the cable samples are electrically short, the transfer impedance Z_T can be measured up to the cut off frequencies $f_{cn,f}$. Above these cut off frequencies $f_{cn,f}$ in the range of wave propagation, the screening attenuation a_S is the measure of screening effectiveness. With the variable tube length of the new test fixture the cut off frequencies $f_{cn,f}$ may be moved towards higher or lower frequencies.

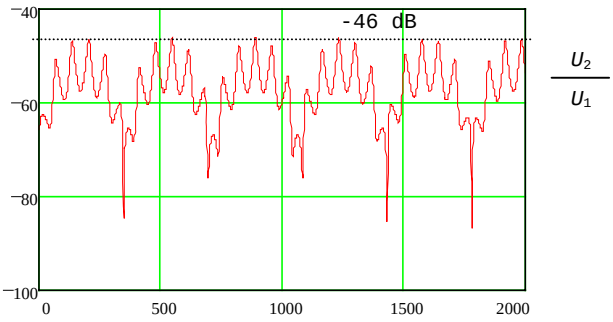


Fig. 3 - Calculated screening attenuation of a cable screen (RG 058)

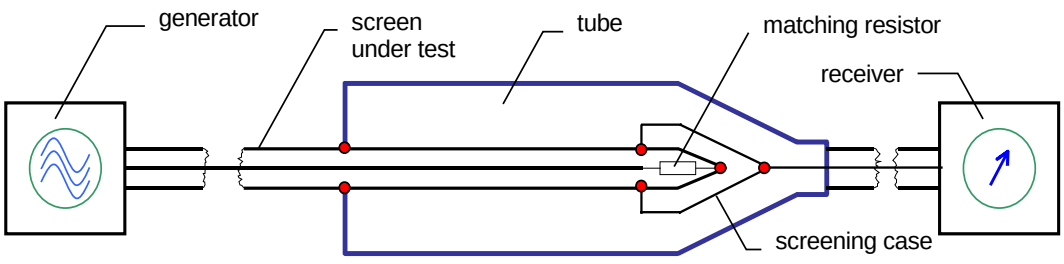


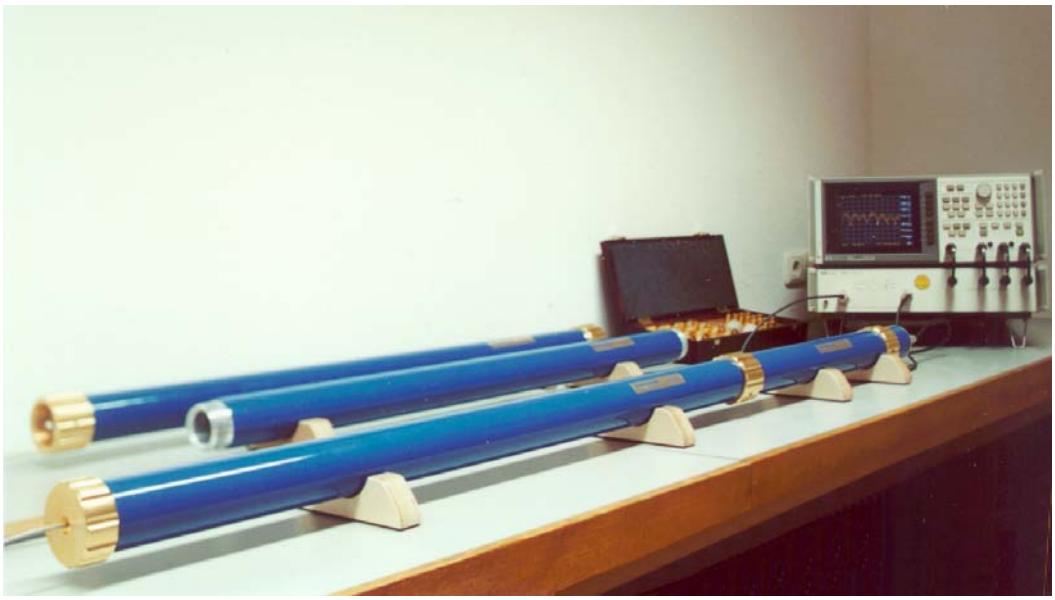
Fig. 4 - Test set-up to measure the Screening attenuation a_S and the Transfer impedance Z_T

Up to now, the measure of the transfer impedance Z_T and the screening attenuation a_s required two measuring set-ups, e.g. the triaxial test set up and the absorbing clamp set up.

With the new measuring tube *CoMeT* both, the transfer impedance Z_T in the lower frequency range as well as the screening attenuation a_S in the higher frequency range up to more than 8 GHz (12 GHz) can be measured. Furthermore, measurements of the coupling attenuation a_C of screened balanced cables which is the sum of unbalance attenuation of the pairs and the screening attenuation of the screen can be taken.

With the new measuring tube ***CoMeT*** and appropriate networkanalysers or discrete generator and receiver measuring arrangements in accordance with several national, regional and international standards may be realised.

Due to the shielded measuring fixture screening attenuation values of more than 125 dB respectively transfer impedances in the µ-Ohm range may be measured easily.



Measure of:

- Transfer impedance
- Screening attenuation
- Coupling attenuation

Advantages:

- insensitive against electromagnetic disturbances from outside
- no radiation of electromagnetic power
- high dynamic range > 125 dB
- high reproducibility
- simple measuring set-up
- fast preparing of the cable sample
- only one measurement required
- measure of the screening attenuation a_S and the transfer impedance Z_T with one test fixture.

Cut off frequencies:

The upper cut off frequency results from the definition of the wave propagation of transversal electromagnetic waves (TEM-waves) which is given by:

$$f_g = \frac{2 \cdot c_0}{\pi \cdot \sqrt{\varepsilon_{r2}} \cdot (D_2 + d_1)}$$

where d_1 is the outer diameter of the braid of the CUT, D_2 is the inner diameter of the measuring tube and ε_{r2} is the resulting dielectric permittivity of the outer system.
With an inner diameter of 40 mm of the tube and an outer diameter of about 3,5 mm of the braid, the cut off frequency of the system is about 4,2 GHz.

The lower cut off frequency to measure the screening attenuation a_S (electrical long cables) and the upper frequency limit to measure the transfer impedance Z_T (electrical short cables) are given by the definition of electrically long and electrically short by:

electrically long:

$$\lambda_o / l \leq 2 \cdot \left| \sqrt{\varepsilon_{r1}} - \sqrt{\varepsilon_{r2}} \right| \text{ or}$$

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

resp. electrically short:

$$\lambda_o / l > 10 \cdot \sqrt{\varepsilon_{r1}} \quad \text{or}$$

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

where

l	coupling length in the tube
λ_o	wave length of free space
ε_{r1}	dielectric permittivity of the CUT
ε_{r2}	dielectric permittivity of the outer system
f	frequency in Hz

Due to the variable length of the tube, the frequency limits may be varied in a wide range.

Standards:

With the coupling measuring tube ***CoMeT*** measurements of the screening attenuation a_S, the coupling attenuation a_C and the transfer impedance Z_T may be achieved according the following national, regional and international standards:

IEC 62153-4-x series: Metallic communication cable test methods - Part 4 -x: Electro Magnetic Compatibility (EMC)

- **IEC 62153-4-3:** Surface transfer impedance - Triaxial method
- **IEC 62153-4-4:** Shielded screening attenuation, test method for measuring of the screening attenuation "a_s" up to and above 3 GHz
- **IEC 62153-4-7:** Shielded screening attenuation, test method for measuring the Transfer impedance Z_T and the screening attenuation a_S of RF-Connectors and assemblies up to and above 3 GHz,Tube in Tube method
- **IEC 62153-4-9, (IEC/PAS 62338 Ed1):** Coupling attenuation (balanced cables), Triaxial method

regional: (Europa)
- **EN 50289-1-6:** Surface transfer impedance - Triaxial method
- **EN 50289-1-6:** Shielded screening attenuation, test method for measuring of the screening attenuation "a_s" up to and above 3 GHz

national: (Germany):
- **VG 95214-12:** Messverfahren für den Kopplungswiderstand und die Schirmdämpfung von geschirmten Bauelementen, Teil 12: Messverfahren KS 12 B, Kopplungswiderstand, Triaxialverfahren,
- **VG 95214-13:** Messverfahren für den Kopplungswiderstand und die Schirmdämpfung von geschirmten Bauelementen, Teil 13: Messverfahren KS 13 B, Schirmdämpfung, Triaxialverfahren.

A standard for measuring the screening effectiveness of larger connectors as well as of connecting hardware is under consideration at **IEC TC 46/WG 5**.

Coupling attenuation

The screening effectiveness respectively the electromagnetic performance of screened symmetrical pairs is given by the "coupling attenuation", which is the sum of the unbalance attenuation of the pair and the screening attenuation of the screen.

With the coupling measuring tube ***CoMeT*** the coupling attenuation a_C of screened symmetrical pairs can be measured when the pair is fed in the differential mode.

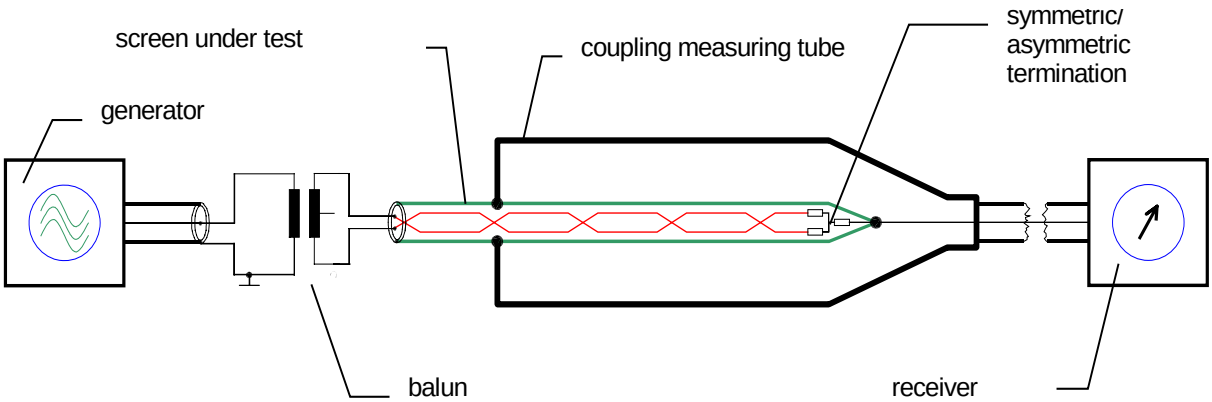
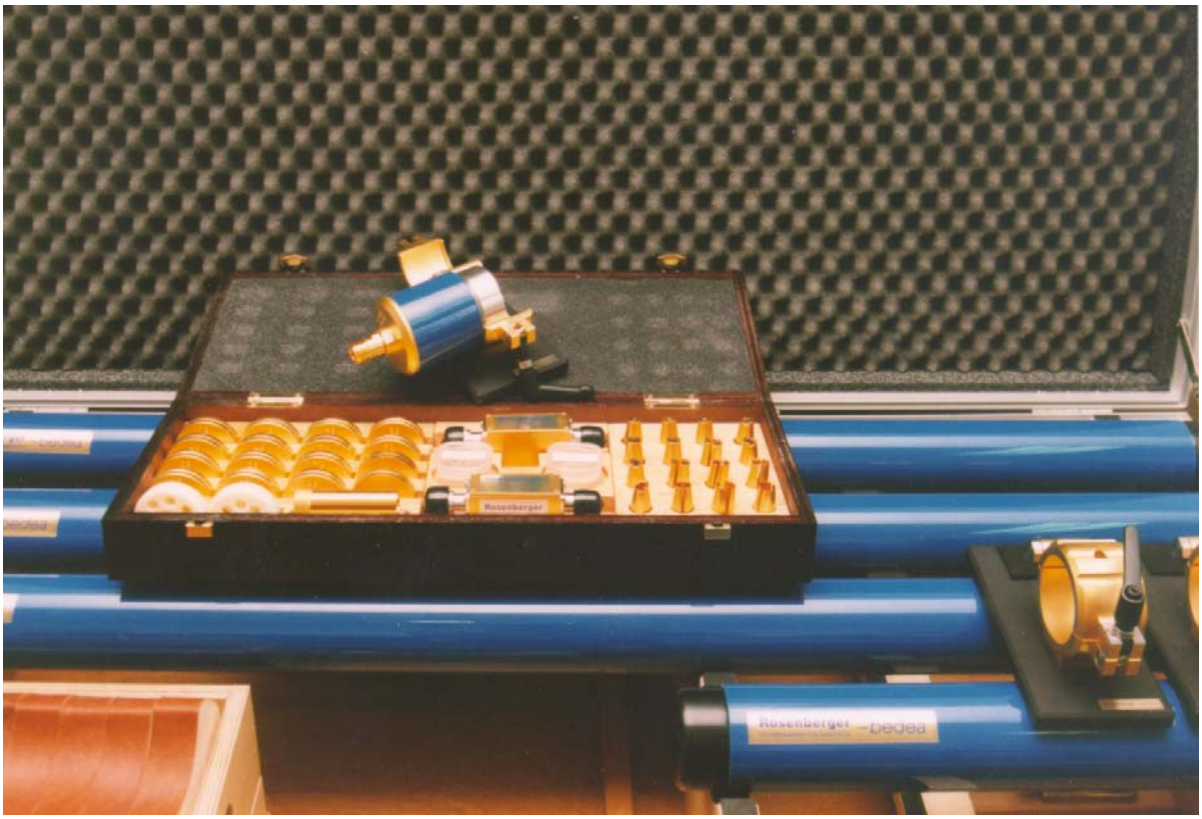


Fig. 5 - Set-up to measure the coupling attenuation a_C with the coupling measuring tube *CoMeT*



CoMeT 40

Mechanical Characteristics:

The test fixture consists of one part of a 0,5 m tube and three parts of a 3 m tube, which may be coupled together rf-tight by a quick release-fastener and the special designed measuring head (Gebrauchsmuster Nr. 297 12 882.5).

Integrated in the measuring head is a case to keep the matching resistor of the cable under test and to connect the cables screen to the tube.

Except of soldering the terminating resistor between inner and outer conductor of the cable under test there is no need for further soldering during the preparing of the sample.
Only the cables sheath has to be removed in the connecting ranges.

On the generator side, the screen is connected to the tube with contact slices.

The required accessories for connecting cable screens in the diameter range from 2.3 mm up to 9.8 mm is attached to the test fixture.

With this equipment, cable screens up to 9.8 mm diameter can easily be mounted.

All parts of the equipment are fixed in a robust case which allows shipment by any means of transportation.

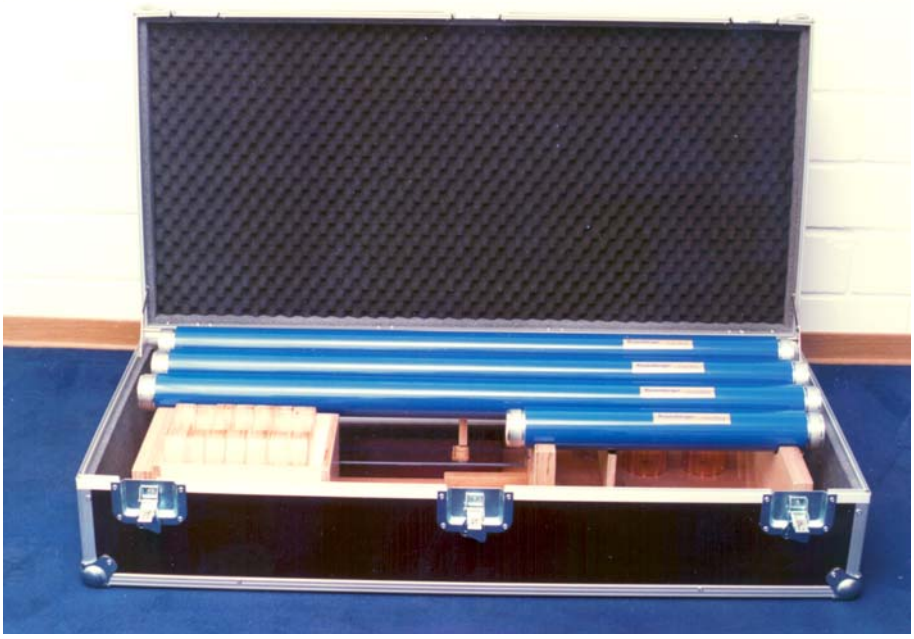
Supply schedule:

Matched measuring head with screening tube for the termination resistor, suitable for cable screens from 2.3 mm to ∅ 9.8 mm

Contact slices for the connection of the cable screens at the near end from 2.3 mm to ∅ 9.8 mm

Coupling measuring tube consisting of one tube of 0.5 m length and 3 tubes of 1.0 m length, including quick release-fastener.

Robust transportation case



CoMeT 90

For cables with larger diameters, e.g. screened power cables, a bigger test set is available. Following the same mechanical and electrical principles as the *CoMeT 40*, cables with screen diameters from 7,8 mm up to 22 mm can be tested. The tube length of 0,45 m (0,3 m active length) allows measurements of transfer impedance up to app. 100 MHz

Mechanical characteristics:

The test fixture consists of one part of a 0,3 m tube and two parts of a 0,6 m tube. The tubes can be coupled by a quick release-fastener and specially designed clamps.

The head can be removed for quick and easy sample mounting. A case is integrated into the head to keep the matching resistor and to contact the screen of the cable under test.

Soldering of the termination resistor between the inner and outer conductor is the only soldering necessary while preparing the test sample. On the generator side of the tube the cable screen is connected to the tube by contact slices. These slices as well as all other accessories needed to connect cables from 7,8 mm ∅ to 22,0 mm ∅ is part of the test fixture.

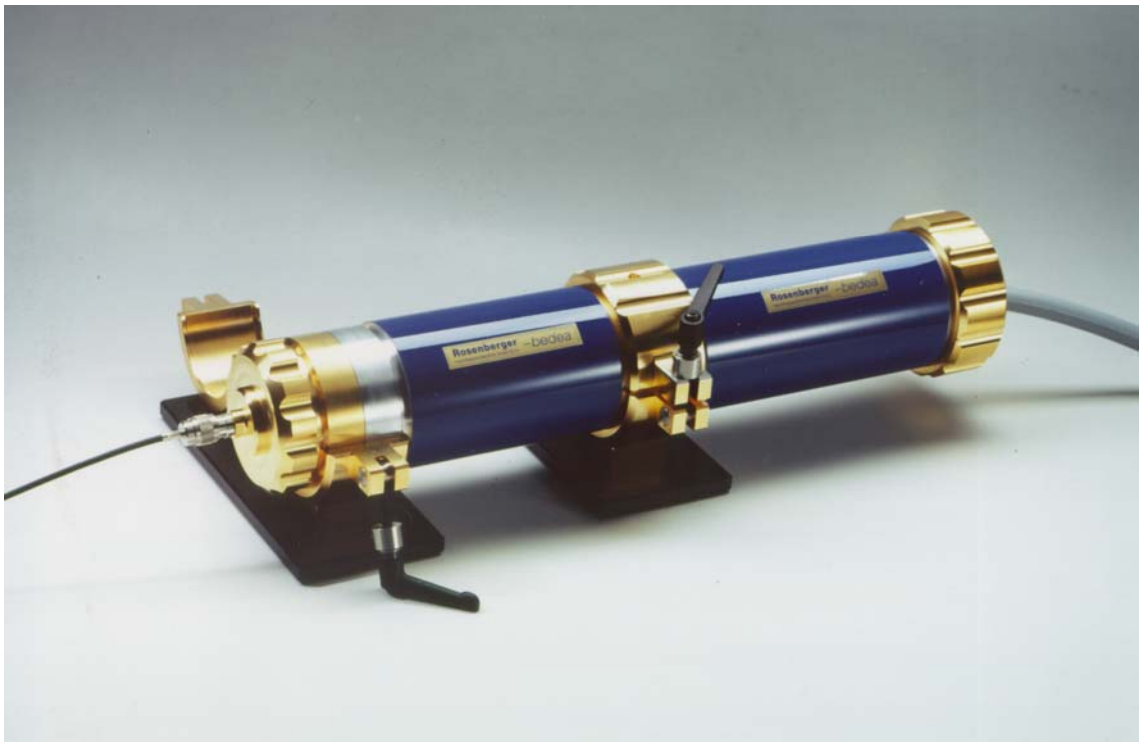
Supply schedule:

Matched measuring head with screening tube for the termination resistor.

Contact slices for cables in the range of 7,8 mm ∅ to 22,0 mm ∅.

Coupling measuring tube consisting of one tube of 0,45 m length and two tubes of 0,6 m length including quick release-fastener and caps.

Robust transportation case.



CoMeT accessories

Cable stretching device
Device for achieving defined tensions of the measuring objects inside the measuring device.
For *CoMeT*-Type: 40/2 and 40/1
For measuring objects: all

Open test head
Increased, optimised application of the procedure for measuring the coupling attenuation
For *CoMeT*-Type: 40/2 and 40/1
For measuring objects: screened, symmetrical cables (e.g.. Twisted Pairs)
Standards: IEC 62153-2-9

Baluns
For measuring the coupling attenuation of screened, symmetrical cables. Available for frequencies from 0,1 to 100 MHz and from 1 to 600 MHz.
For *CoMeT*-Type: all
For measuring objects: screened, symmetrical cables (e.g.. Twisted Pairs)
Standards: IEC 62153-2-9

Connectors adapter
To measure connectors and customised cables. Commonly used connectors can be adapted to the measuring device.
For *CoMeT*-Type: 40/1 and 40/2
For measuring objects: unsymmetrical cables (Coax)

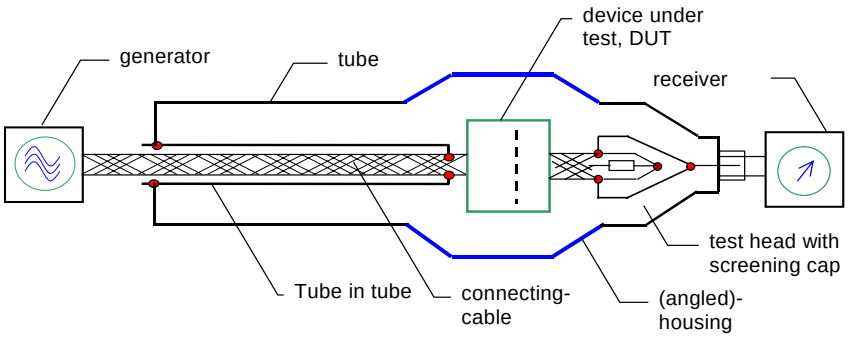
Housing V
To install a series resistor while measuring the transfer impedance.
N-Connector/ /N-Jack 50 Ohm
For *CoMeT*-Type: all
For measuring objects: unsymmetrical cables (Coax)
Standards: IEC 62153-4-3 /-4-4 and EN 50289-1-6

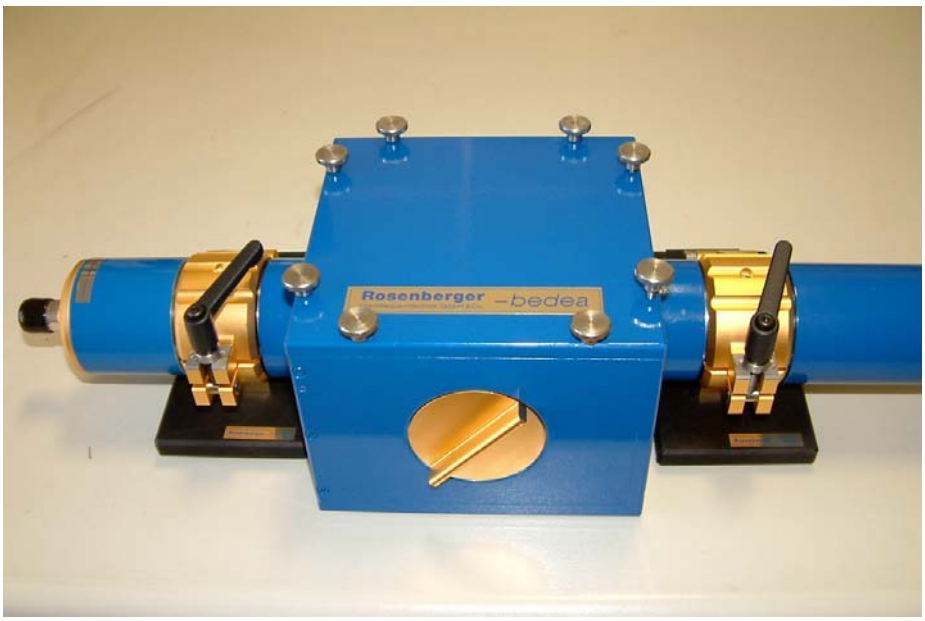
Housing N
To install a network while measuring the transfer impedance.
N-Connector/ /N-Jack 50 Ohm
For *CoMeT*-Type: all
For measuring objects: unsymmetrical cables (Coax)
Standards: IEC 62153-4-3 /-4-4 and EN 50289-1-6

Cable assembly for baluns
To connect a balun to a measuring instrument with N-jack 50 Ohm.
Consisting of a measuring cable of 0,3 m and an adapter Nf/BNCm)
For *CoMeT*-Type: all
For measuring objects: symmetrical cables (e.g. Twisted Pairs)

Cable assembly for *CoMeT*
To connect a measuring device *CoMeT* to a measuring instrument with N-jack 50 Ohm.
Consisting of a measuring cable of 1 m, a measuring cable of 3,5 m and an adapter Nf/Nf
For *CoMeT*-Type: all
For measuring objects: all

(angled)-Housing:
Measuring of Transfer impedance and Screening attenuation of connecting hardware, in combination with the "tube in tube" procedure.





Software WinCoMeT

Functions:

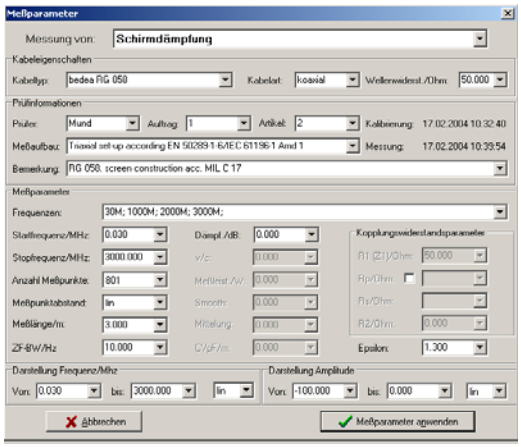
Controlling of network analysers to measure

- Transfer impedance acc. **IEC 62153-4-3** and **EN 50289-1-6**
- Screening attenuation acc. **IEC 62153-4-4** and **EN 50289-1-6**
- Transfer impedance, Coupling attenuation & Screening attenuation acc. to **IEC 62153-4-7,** Tube in tube method
- Coupling attenuation at balanced cables (data cables) according to **IEC 62153-4-9**

Description:

- Intuitive operating surface
- Ergonomic, effective user's guidance
- Operation by keyboard or mouse
- Menu controlled
- Input window with selecting windows
- Comprehensive helps
- Memorising of settings and parameters

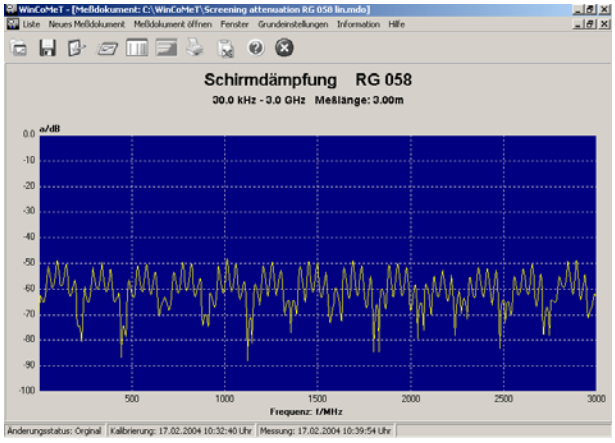
Input window:



Analysis, adaptation, monitoring, of the measurement resultsExtend of supply

- Software (run-time-licence),
- German or English manual

Measuring diagram of screening attenuation



Hardware requirements

- PC Pentium 90
- RAM min. 32 MB
- Operating system: Windows 9x/NT/2000/XP
- IEEE-Interface card:

NI 488.2 from Version 2.10,
It is possible to run the software without IEEE-Interface card for evaluation of measured datas, documentation e.t.a. Measurements can be achieved only via Interface card.

- Network analyser Rohde & Schwarz ZVR or Hewlett Packard 8753 B/D/E, others on request
- All printers

Production of all components:
Rosenberger Hochfrequenztechnik GmbH & Co.
Postfach 1260, D - 84526 Tittmoning, Germany
www.rosenberger.de

Sales and Service:
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