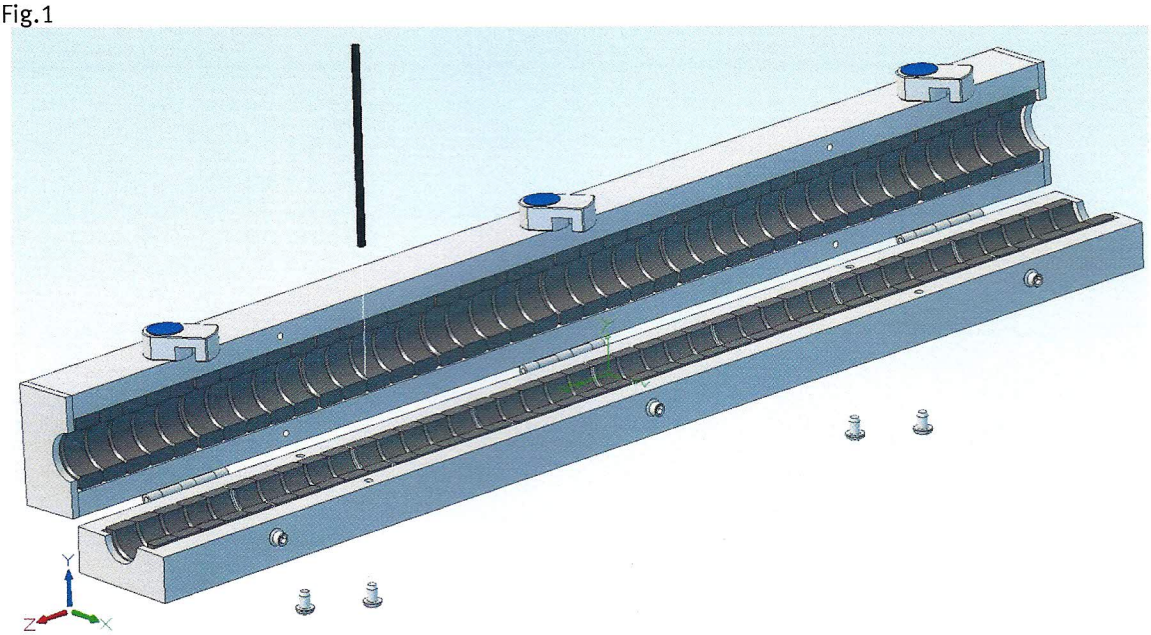
Montageanweisung / Assembly instruction FTC 101

Die FTC 101 wird von Werk aus ohne montierte Unterlegeteile für die Kalibration ausgeliefert.
Wenn Sie die Unterlegeteile montieren wollen, gehen Sie folgendermassen vor:
Öffnen Sie die Zange. Stossen Sie von oben mit einem Durchschlag oder Stab mit max. 4mm Durchmesser die Gummifüsse aus dem Unterteil der Zange.

Factory-provided the base parts for the FTC 101, which are required for calibration, are not mounted.
To mount the base parts, please follow the instruction below:
Open the clamp as illustrated in figure 1 Use a drift punch or slat (max. 4mm diameter) to bounce out the rubber buffer from the clamp bottom.

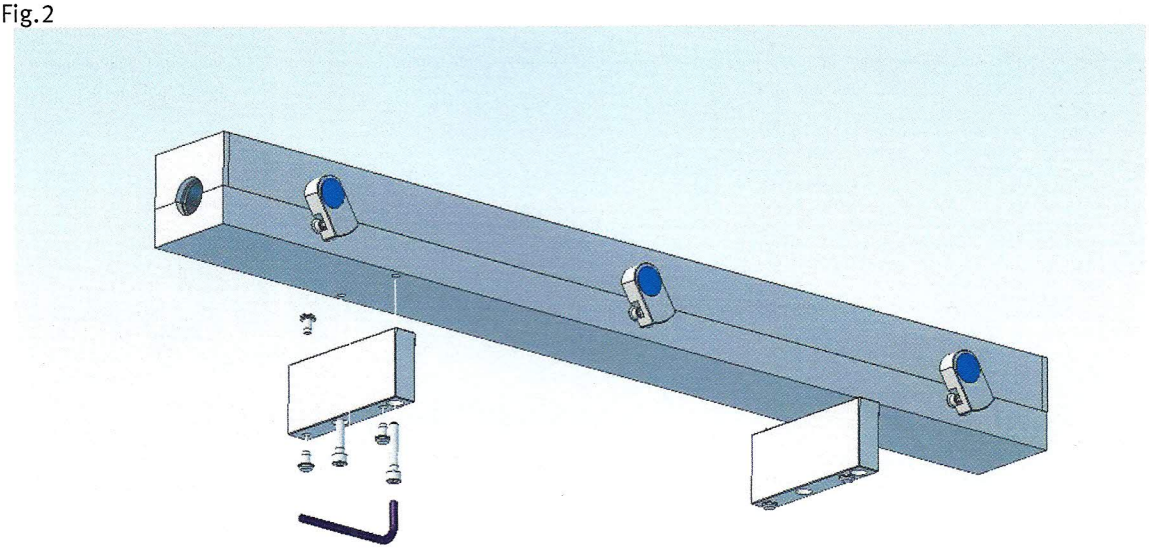
Fig.1



Montieren Sie die Unterlegeteile gemäss nachfolgendem Bild.

Mount the base parts as shown in figure 2

Fig.2

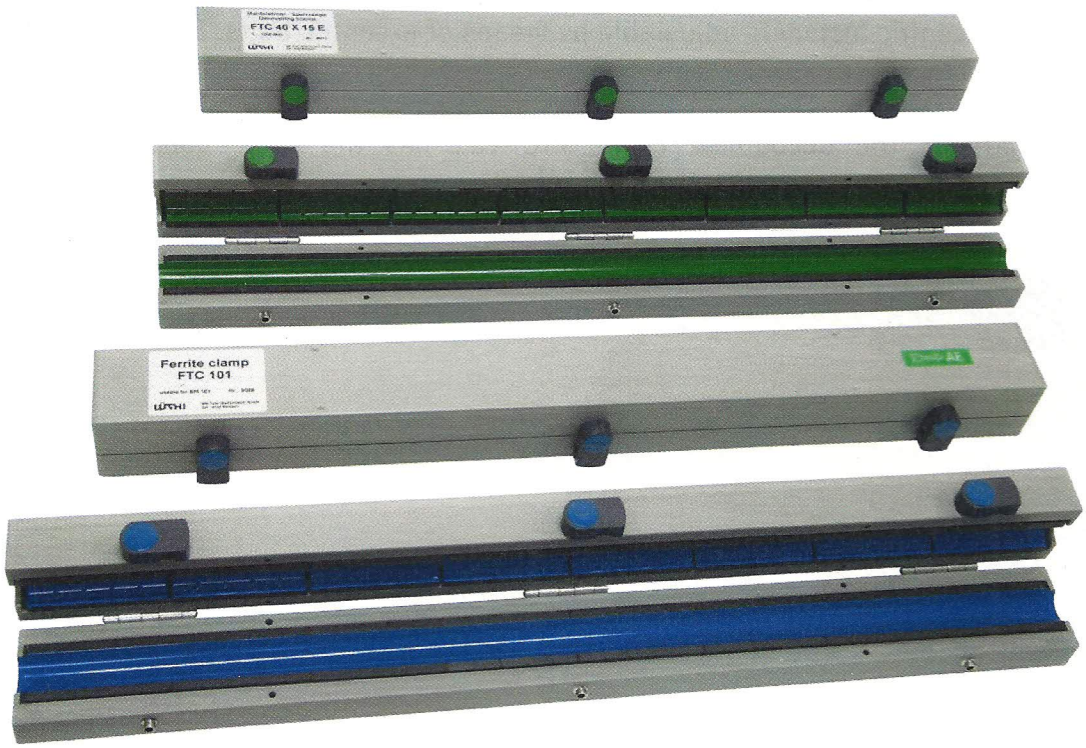


a brand of em test group

RF CURRENT ABSORBER CLAMP **FTC 40X15E**

DECOUPLING CLAMP **FTC 101**
IN ORDER TO IEC 61000-4-6

RF CURRENT ABSORBERS **FT**



When using laboratory test set-ups in the VHF and UHF range, the screenings of usual coaxial cables make a connection between the housings of the measuring components. The thus developing coupling loops, together with induced currents originating in radiated fields, engender indistinct couplings between and within the components. If the housings are earthed the earth loops create especially indefinable conditions. Very often, the surface currents flowing in the screening coats cause incorrect measurements, instabilities and readings not reproducible.
A remedy in a wide frequency range are the so-called „linear losses" i.e. long coatings of the cables with ferrite toroids.

The surface current absorbers FT and FTC have proved an appropriate solution for practical use in the laboratory.

Of course the FT and FTC can also be used for protecting a test set-up with non screened cables against HF influences.

EM TEST (Switzerland) GmbH, CH-4153 Reinach

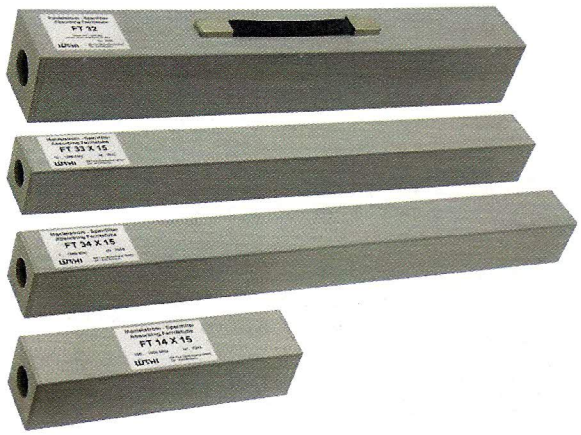
LÜTHI
a brand of em test group

In a PVC case a great number of ferrite toroids are arranged. Their material is well-chosen and optimal for the particular frequency range. Effective suppression sets in at 1, 10 or 100 MHz respectively and ranges up to 2 GHz.

The types FT are composed of toroids trough which the conductors are to be passed. The opening is 23 mm in diameter.

The types FTC come in the form of „clamps" with the toroids cut into halves and grinded contact surfaces. The conductors are places into the open clamp and the clamp is locked by excentric fasteners adjustable by means of excentric bolts. Springs press the ferrite halves together.

IEC 61000-4-6: The decoupling clamp FTC 101 has the same construction and Dimensions but is only used together with EM 101.



RF-Current-Absorbers Type FT

Type	Opening mm	Frequency range MHz	Insertion loss dB	Dimension mm	Weight kg
FTC 40X15 E	22	1 ... 1000	10 ... 30	58x53x615	3,4
FTC 101	22	to EM 101		58x53x615	3,4
FT 14X15	23	100 ... 1000	6 ... 30	50x50x215	1,2
FT 33X15	23	10 ... 1000	6 ... 40	50x50x515	2,4
FT 34X15	23	1 ... 1000	10 ... 25	50x50x515	2,4
FT 32	32	0,01 ... 1000	> 6 dB above 0.5 MHz	70x70x520	6,0

SC 65A/WG4 (CH-Bersier, Szentkuti)2
CISPR/A/WG1 (Bersier)18
CISPR/G/WG3 (Bersier, Ryser)6

March 1991

Practical application of the EM clamp:

New test setup yielding better reproducibility of the tests and better decoupling of the auxiliary equipment

Investigations performed at the Swiss PTT show that a ferrite tube of high permeability, placed directly at the rear side of the EM clamp, improves the reproducibility of the immunity tests and efficiently decouples the auxiliary equipment (AE). This setup is shown in figures 1 and 1a.

However, the application of this tube increases the impedance of the injection setup in the frequency range 0.5...5 MHz, i.e. the injected current will be decreased in this frequency band. Therefore the whole "combination" [EM clamp + ferrite tube] must be considered as the injection system , rather than the EM clamp alone, when calibrating for the correction-factor; see fig. 2.

With the setup of fig. 1 the influence of the rear circuit (AE impedance, length and lay-out of the cable) on the injection to the EUT-side does usually not exeede ± 3 dB, with respect to the values during calibration, in the frequency range 1 MHz...400 MHz (see fig. 3 and 4). Consequently in this frequency range the setup of fig. 1 may be used for any type of AE and cabling.

In the frequency range 150 kHz...1 MHz the strongest influence from the rear circuit is obtained, whenever the cable is short and the common mode impedance of the AE is high. This is the situation when the AE input-circuits are insulated from the AE-earth.

For the tests in the frequency range 150 kHz...1 MHz the reproducibility may be improved through the following measures:

- Connect a 150 Ω resistor between the ground point of the AE input-circuits (generally the ground pin of the input connector) and the GRP.
- If this is not feasible than increase the capacitance between the cable and the GRP at the rear side of the injection system, as much as possible (10 m cable placed in zig-zag on the GRP or capacitive winding on a metallic plate).

Fig. 5a shows the decoupling obtained for the AE using the setup of fig. 1 in the case of a short cable. This decoupling may be increased by using a long cable and, if necessary, an additional ferrite tube, directly at the AE (fig. 5b).

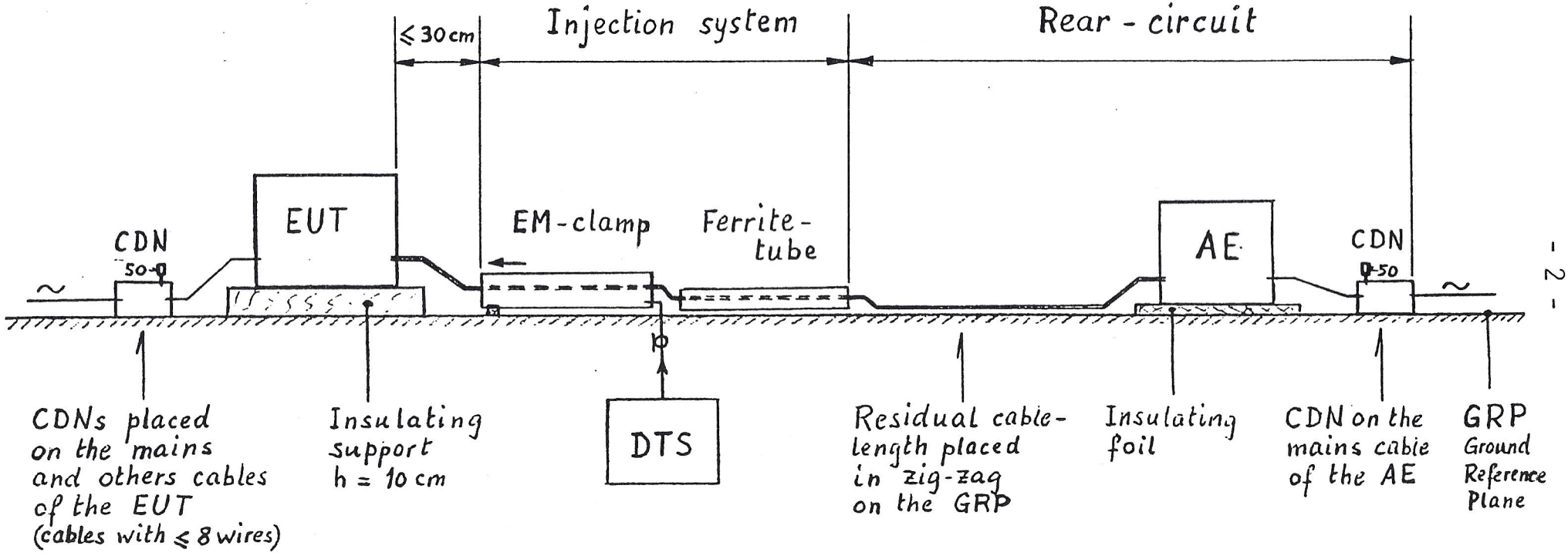


Fig. 1: Test set-up applicable for all immunity tests using the EM-clamp, in the frequency range 1 MHz to 400 MHz.

For the tests in the frequency-range 0,15...1 MHz it is recommended to stabilise the common-mode inpedance of the AE to 150 Ω, in order to provide reproducible test-conditions.

The correction factor k_{cf} of the whole injection system comprising the EM-clamp and the ferrite tube shall be taken into account.

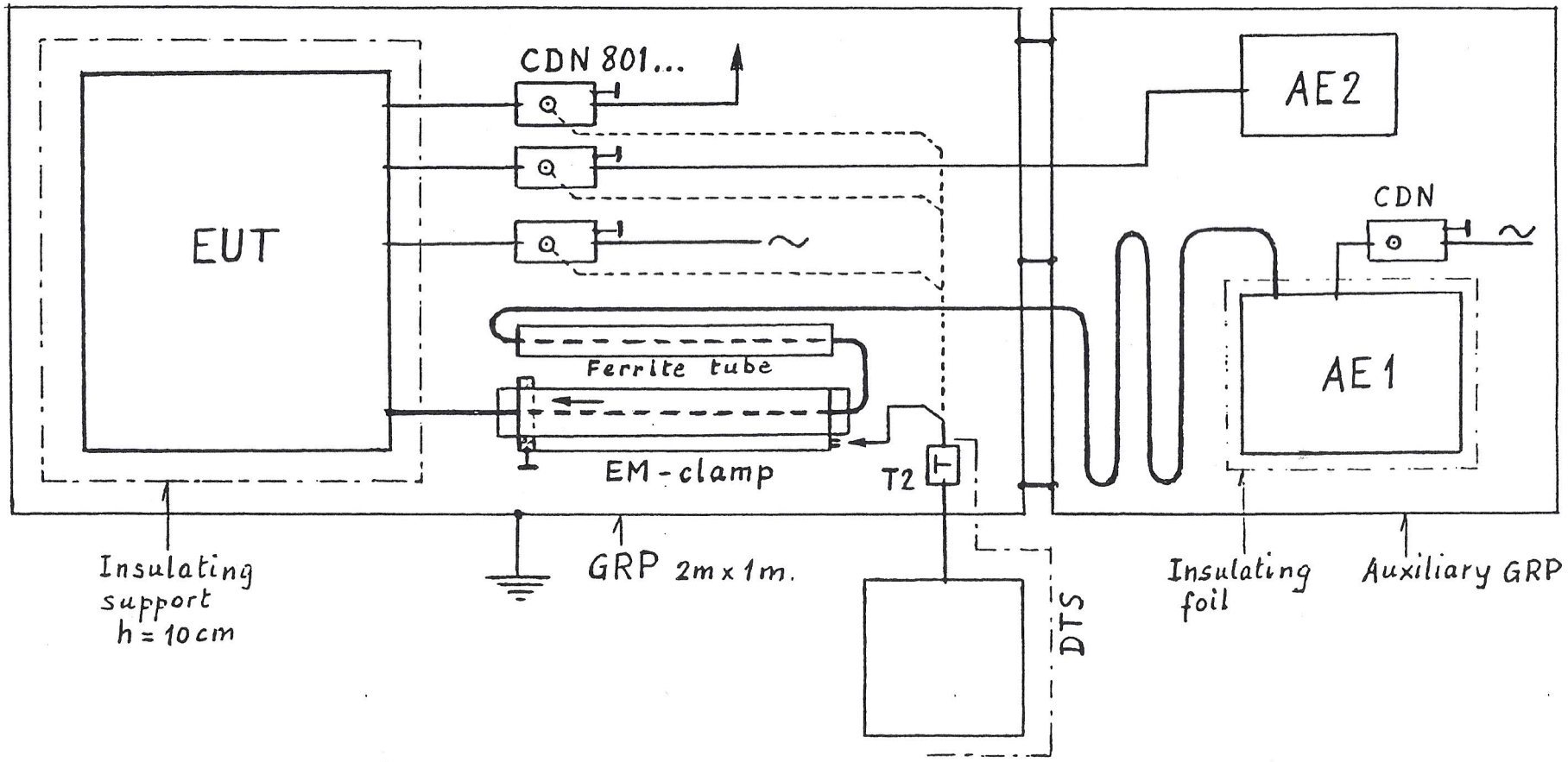
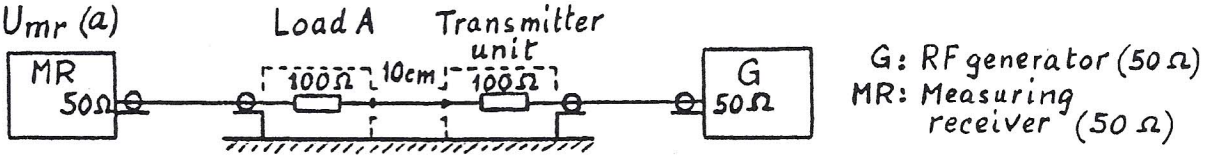


Fig. 1a: Example of test unit locations on the ground plane (upper viewl)

Fig. 2: Calibration of the injection system

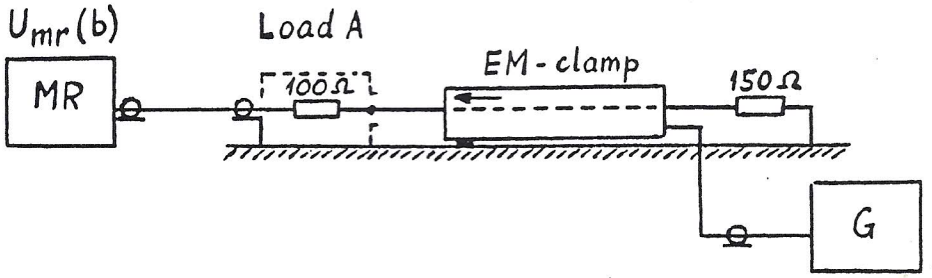
a) Reference set - up with two 150 Ω coupling units



b) The transmitter unit is replaced by the EM - clamp

Correction factor of the EM - clamp:

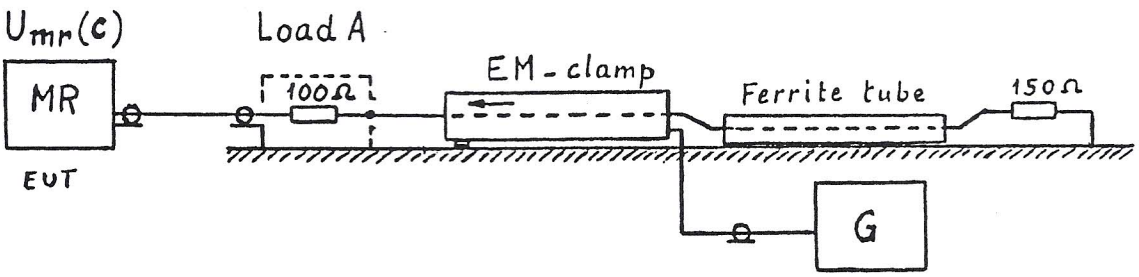
$$k_{dB} = U_{mr}(b)_{dB(\mu V)} - U_{mr}(a)_{dB(\mu V)}$$ for the same e.m.f. of G

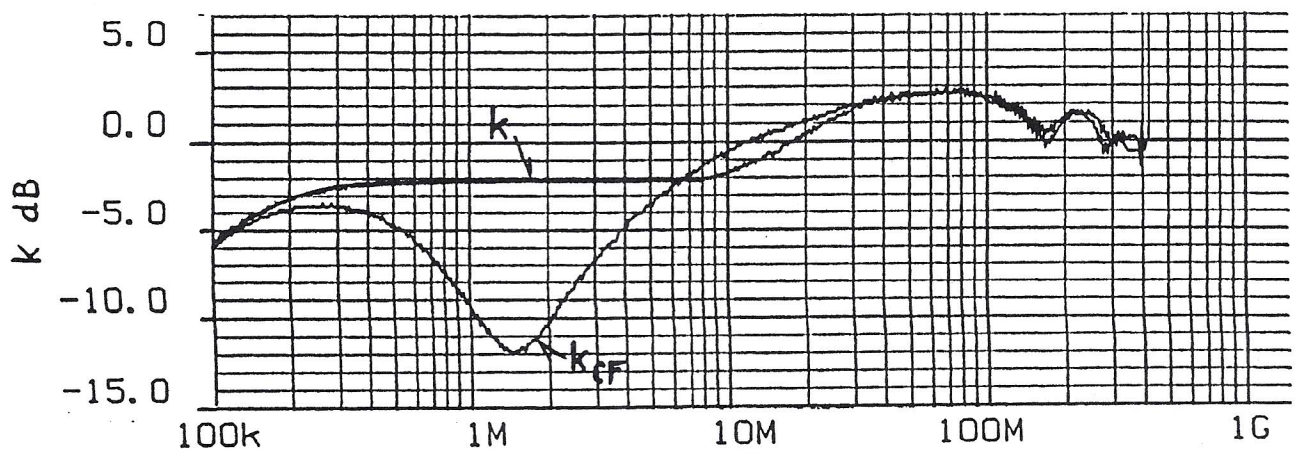


c) The transmitter unit is replaced by the injection system [EM - clamp + ferrite tube]

Correction factor of the injection system:

$$k_{CF\,dB} = U_{mr}(c)_{dB(\mu V)} - U_{mr}(a)_{dB(\mu V)}$$ for the same e.m.f. of G





k = correction factor for the clamp EM 101

k_{cf} = correction factor for the injection system EM 101 + ferrite tube

Fig. 3 + 4: Influence of the AE - impedance and cable layout on the injected level to the EUT.
EUT simulated by typical impedance 150 Ω.
Injection system: EM - clamp + ferrite tube

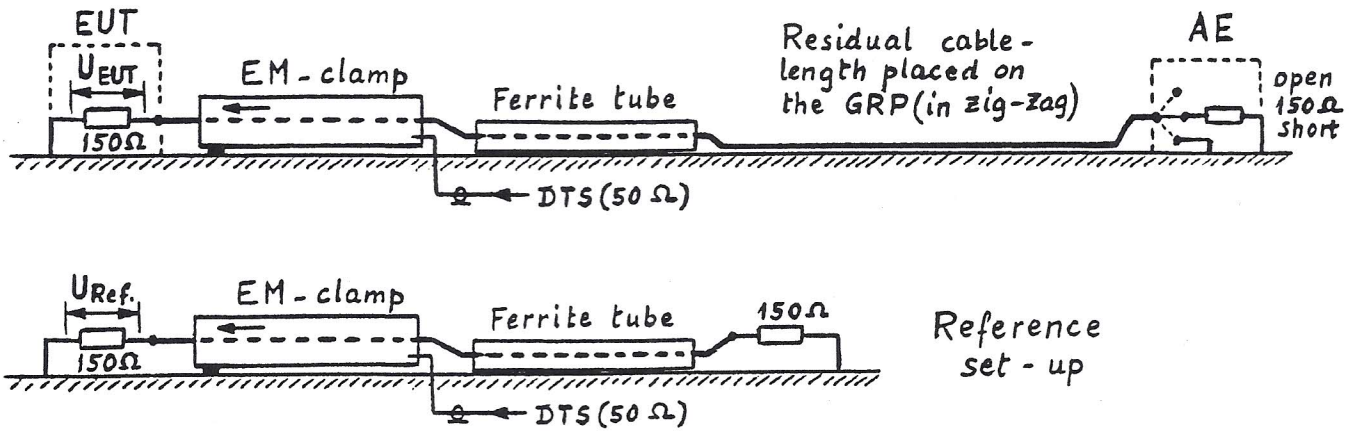


Fig. 3: Total cable - length: 12 m (~ 10,4 m in zig - zag on the GRP)

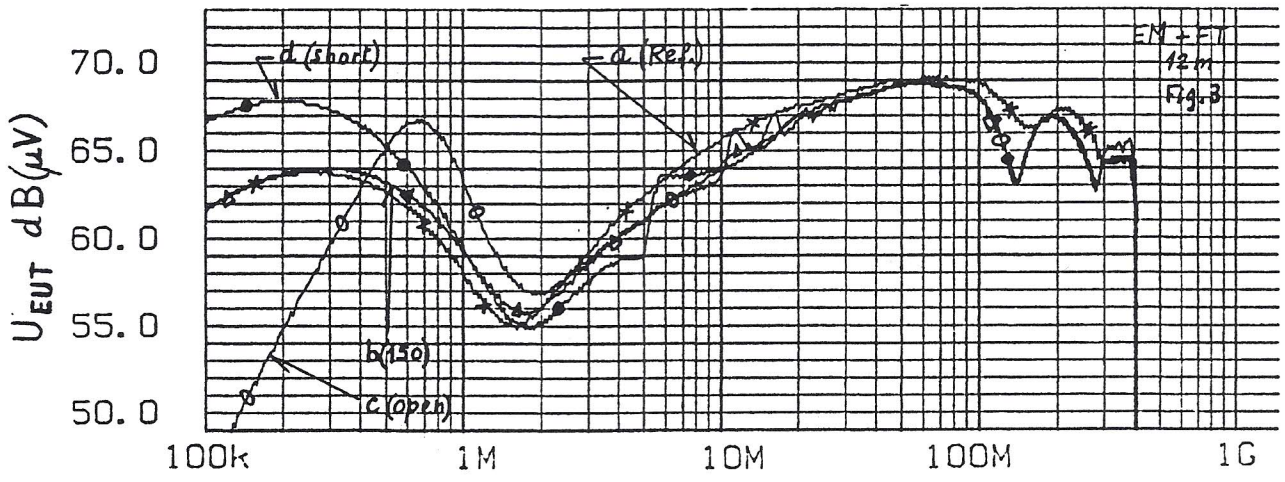


Fig. 4: Total cable - length: 2,4 m (~ 0,8 m on the GRP)

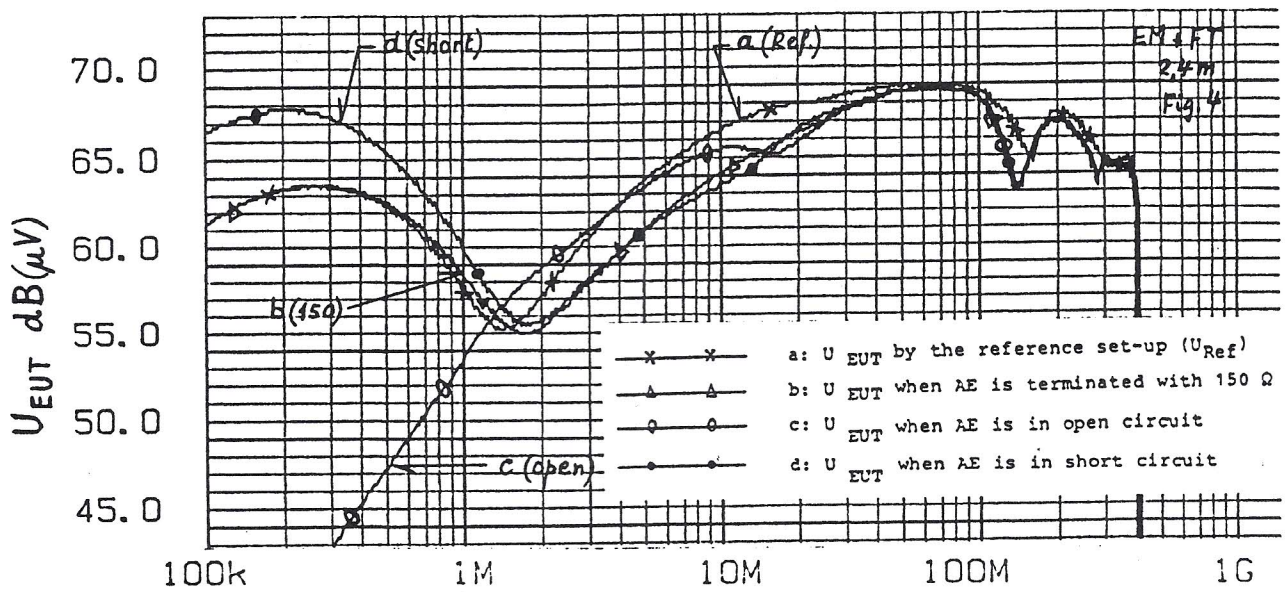


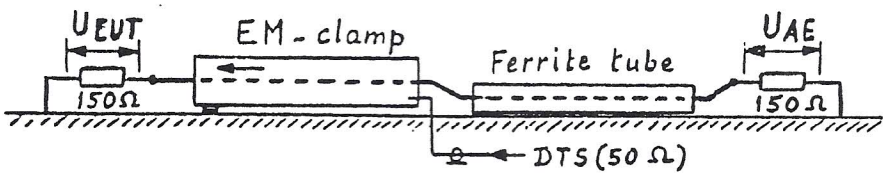
Fig. 5: Protection of the auxiliary equipment (AE)

Injection system: EM - clamp + ferrite tube

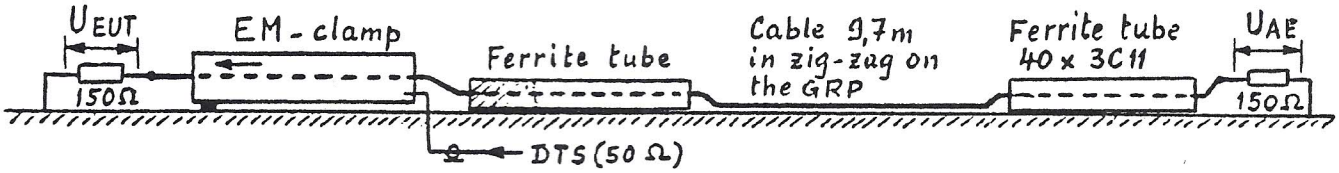
EUT = 150 Ω ; AE = 150 Ω

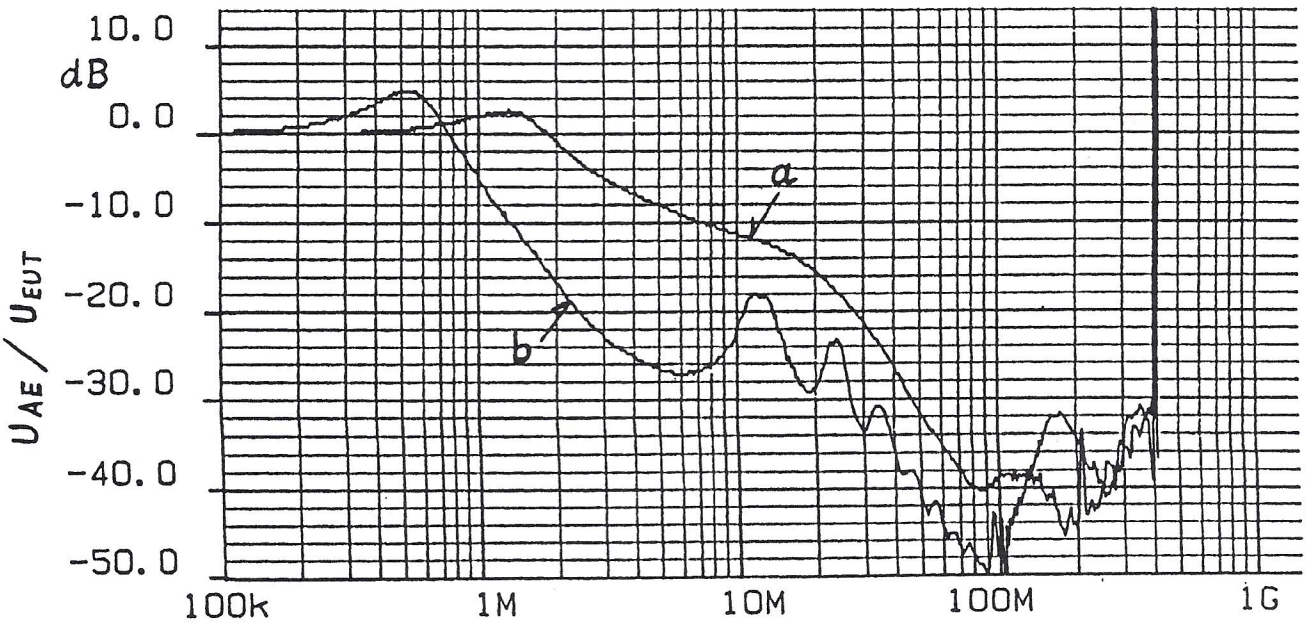
Protection of the AE = U_{AE} − U_{EUT}
dB dB(µV) dB(µV)

a) Total cable length: 1,8 m



b) Total cable length: 12 m (~9,7 m in zig - zag on the GRP)





Reference level and required HF power of the power amplifier PA in the frequency range 0.15 ... 230 MHz

Table 1 Test levels

The prescribed voltage test levels are shown in item 5, table 1.

Frequency range	.15 MHz - 80 MHz	
Level	Voltage level (e.m.f.) U_0 [dBuV]	U_0 [V]
1	120	1
2	130	3
3	140	10
X(1)	special	

This is the not direct measurable EMF at the exit of T2.

For HF current injection either a CDN or a **Current Injection Clamp (EM 101** or Current Clamp 5:1) can be used, depending on the number of leads.

The decoupling against the AE is contained in both the CDN and the EM 101. In order to obtain a well reproducible result below 20 MHz, it is advisable to use an additional decoupling **(FTC Clamp)**. In this connection please note that the Current Clamp 5:1 without decoupling does not produce reproducible results.

The required output power of the PA for testing at level 3 (10 $V_{e.m.f.}$) and 80 % amplitude modulation depth is shown in table D.1.

The available output power of the power amplifier PA, figure 3 can be determined by taking into account the attenuator T_2 (6 dB), the amplitude modulation depth (80 %), see figure 4 and the minimum coupling factor of the used CDN or clamp.

Table D.1 Required power amplifier output power to obtain a test level of 10 $V_{e.m.f.}$

Injection device	Minimum coupling factor ± 1.5 [dB]	Required power at output of PA [Watt]
CDN	0	7
Current clamp winding ratio 5:1	-14	176
EM-clamp	-6	28

Determination of the power required for measuring by means of the EM 101:
At 150 Hz k equals -5 dB; the ratio is 3.16 (see table in annex 2)
P_{PA} = 3.16 * 7 = 22 W.

If the FTC 101 is used as an additional decoupling in order to guarantee reproducibility below 20 MHz, more power is required in the hatched frequency range. At the most unfavourable frequency of 1.5 MHz k equals -12 dB; the ratio is 15.85
P_{PA} = 15.85 * 7 = 111 W.
If the range between 1 and 1.5 MHz is not relevant, 90 W are sufficient, etc.

Annex 1 coupling factor of EM 101 + FTC 101
2 table dB / Watt
3 measuring of the reference
4 substitute circuit diagram with CDN
5 substitute circuit diagram with EM 101

Verification of the system EM101 + FTC101
in the frequency range 150 kHz - 1000 MHz
with reference to a 150Ω source / load system

Swisscom CT-EEC Ry

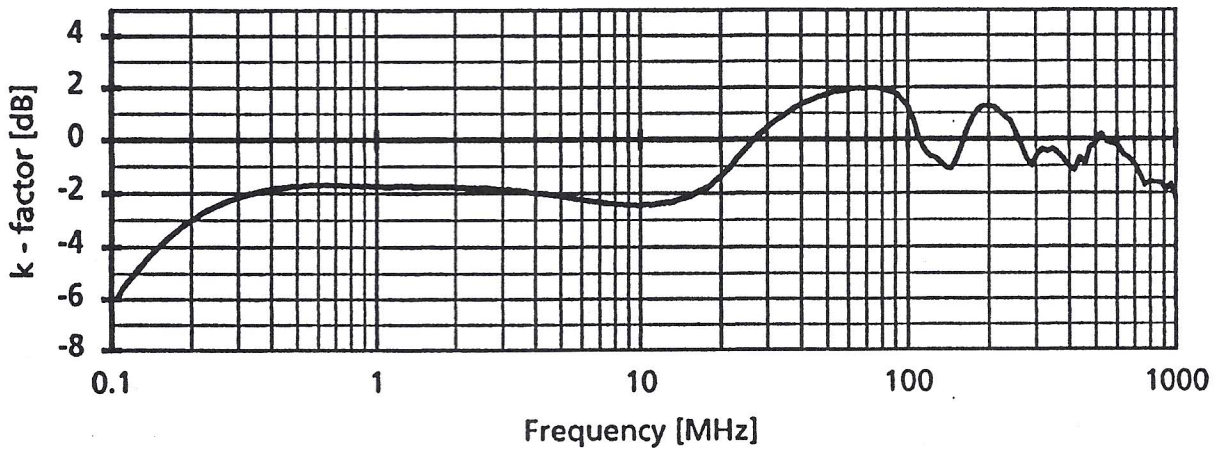
Date 07.04.1999

EM101 Ser. Nr.: 35555

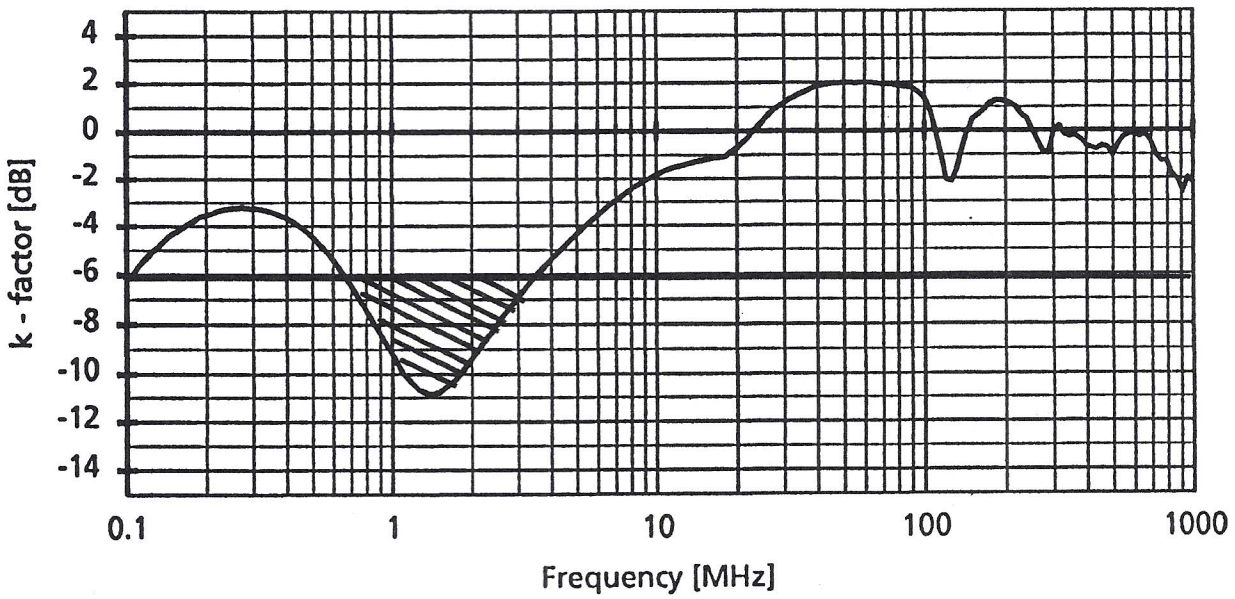
FTC 101 Ser. Nr.: 4631

Made by: Lüthi Elektronik-Feinmechanik AG
CH 4402 Frenkendorf

EM101 (without FTC)



System EM101 + FTC 101

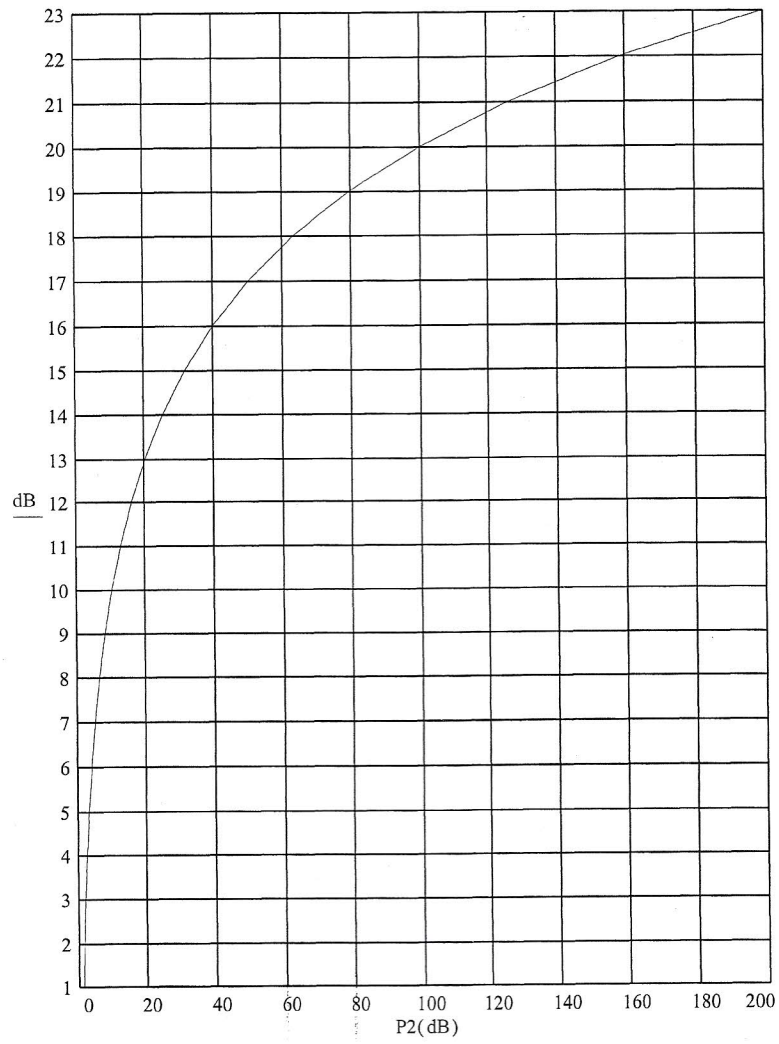


Prüfleistung des PA
Output power of the PA

$dB := 1, 2 .. 23 \qquad P1 := 1$

$$dB := 10 \cdot \log\left(\frac{P2}{P1}\right)$$

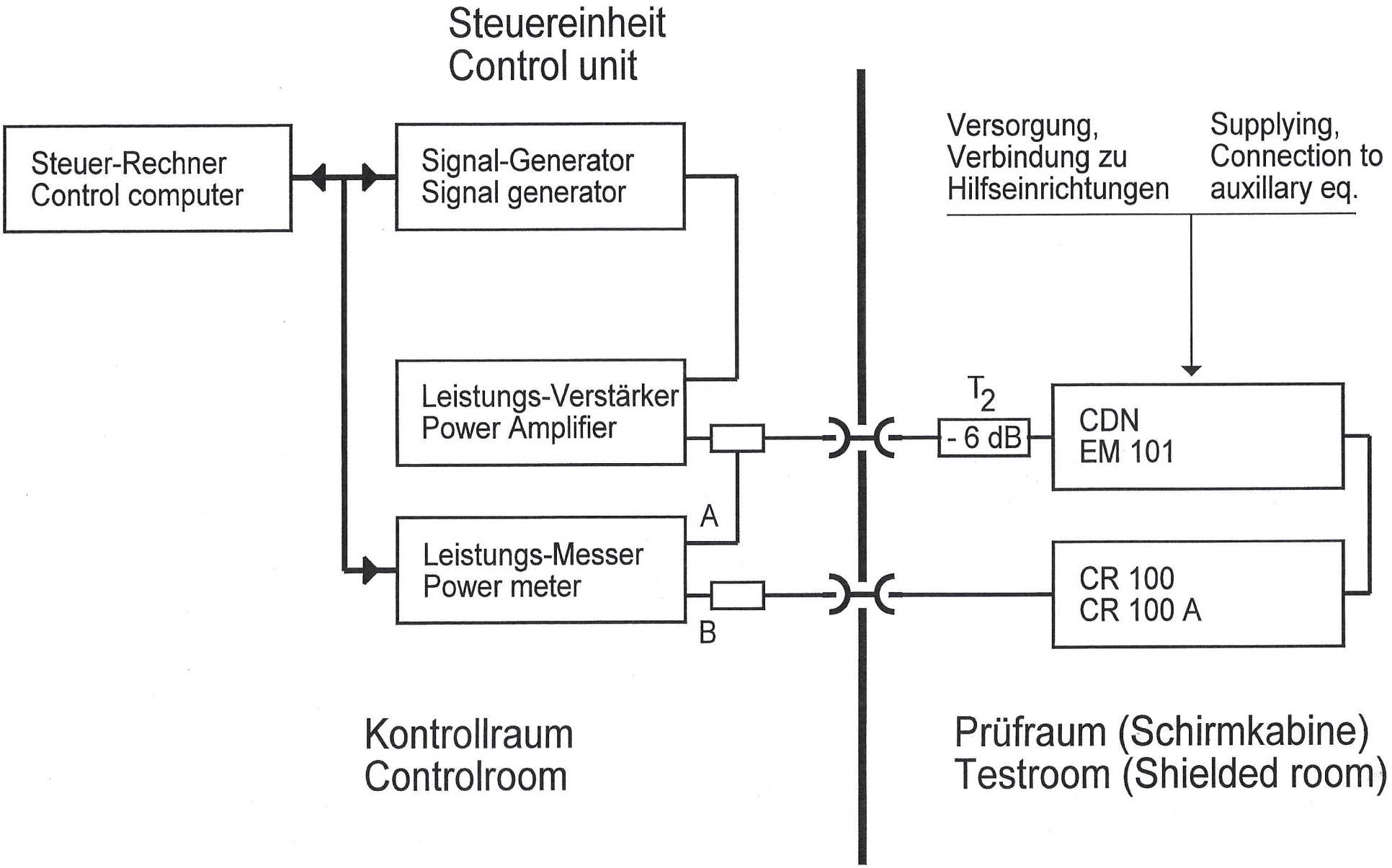
$$P2(dB) := \exp\left(\frac{1}{10} \cdot dB \cdot \ln(10)\right) \cdot P1$$



dB	P2(dB)
1	1.259
2	1.585
3	1.995
4	2.512
5	3.162
6	3.981
7	5.012
8	6.31
9	7.943
10	10
11	12.589
12	15.849
13	19.953
14	25.119
15	31.623
16	39.811
17	50.119
18	63.096
19	79.433
20	100
21	125.893
22	158.489
23	199.526

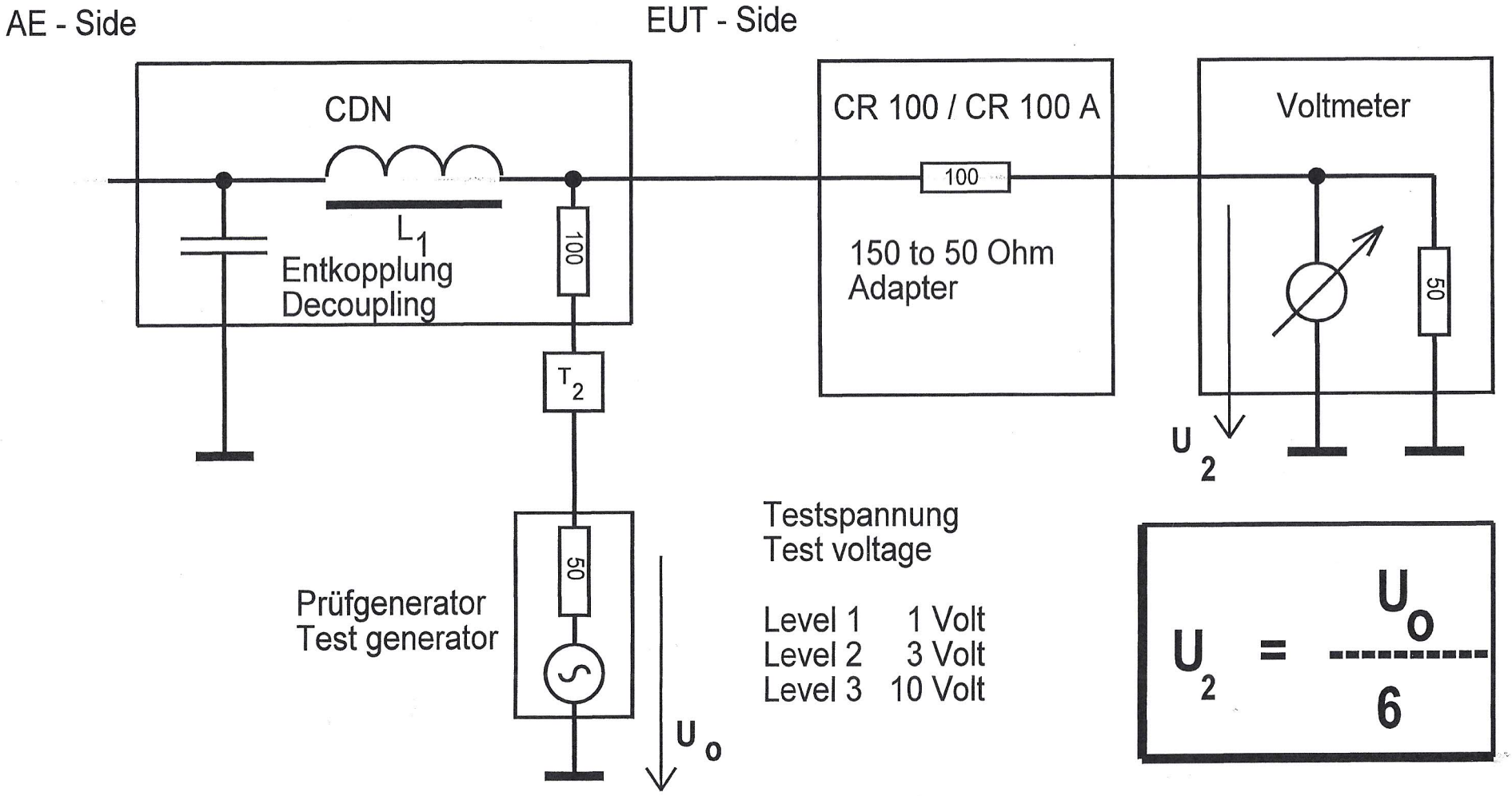
P2 [W]

Referenzmessung / Reference measurement



IEC 1000-4-6

Referenzmessung : Ersatzschaltbild CDN
Reference measurement : Basic circuit CDN



Referenzmessung : Ersatzschaltbild EM 101
Reference measurement : Basic circuit EM 101