

EXPERT REPORT

- Ordered by:** AURO Pflanzenchemie AG
Alte Frankfurter Str. 211
38122 Braunschweig
- Device under Test :** Conductive Paint *AURO Nr. 332 Safe Shield*
Painted as a double layer with 100ml/m² per coat
- Subject:** Shielding-measurements against electromagnetic waves from
100 MHz to 8 GHz
- Regulations:** ASTM D-4935-2010 (American Society of Testing and Materials)
- Date of Measurements:** 15th of March 2019
- Contents:** 4 pages of text, 1 page with 1 measured diagram
- Results:** The conductive paint *AURO Nr. 332 Safe Shield* presents the following shielding effectiveness at some interesting TV/DAB-, mobile phone and W-LAN-frequencies:

Measured in a coaxial TEM-Adapter according to ASTM D-4935-2010 with E-vectors in all directions	200 MHz VHF-TV DAB	450MHz TETRA	900 MHz GSM 900	1800 MHz GSM 1800	2.45 GHz UMTS / W-LAN	5.8GHz New WLAN
	30 dB	30 dB	30 dB	30 dB	31 dB	29 dB

A value of 30 dB means, that 99.9% of the incident power is removed by shielding. Only 0.1% of the Power will penetrate the shielding paint. This is a very good shielding effectiveness, provided the thickness of the paint layer is equal to that of the test specimen.

1 Introduction

To explain the measured diagrams, it is helpful to use the table at the bottom. You can easily calculate the relation between shielding in „dB“ and transmitted power in „%“.

The network analyzer presents the results of the shielding measurements in „Decibel“ (dB). The mode of measurement is a typical transmission measurement (S₂₁-measurement). This dB value describes, how much the level of an incident power or power flux density has decreased, passing the device under test.

It describes values of field-strengths as well. But the calculation of the percent-values in the table at the right refers to the **power-relationships**.

So it tells - for example - that 20 dB shielding reduces the penetrating power to 1%.

Conversion of Decibel to Percent of transmitted Power			
dB	Power Transmission in %	dB	Power Transmission in %
0	100,00		
1	81,00	21	0,78
2	62,80	22	0,63
3	50,00	23	0,50
4	40,00	24	0,39
5	31,60	25	0,31
6	25,00	26	0,25
7	20,00	27	0,20
8	16,00	28	0,18
9	12,50	29	0,12
10	10,00	30	0,10
11	7,90	31	0,08
12	6,25	32	0,06
13	5,00	33	0,05
14	4,00	34	0,04
15	3,13	35	0,03
16	2,50	36	0,02
17	2,00	37	0,02
18	1,56	38	0,02
19	1,20	39	0,02
20	1,00	40	0,01
		50	0,001

To calculate the dB-value from the incident power P₁ and the transmitted power P₂, one has to use the following equation:

$$a_{\text{Shield}} = 10 \cdot \log \frac{P_2}{P_1}$$

2 Test Set-up according to ASTM D- 4935-2010

This standard was published by the American Society of Testing and Materials (ASTM) for three reasons:

1. To measure the shielding effectiveness also at „low“ frequencies.
2. To measure extreme high shielding.
3. To measure also relatively small devices under test.

The basic measurement is presented in the figure below:

The DUT is installed between two coaxial TEM-Adapters. The test signal comes from port 1 of a Network analyzer. The transmitted signal was received by port 2 of the NWA. Due to the coaxial structure with a TEM-wave, the DUT is hit by E-field vectors in all directions. The consequence is: If the measured shielding is very good, you can assume, that the DUT will shield as well vertically as also horizontally polarized waves in the same quality.

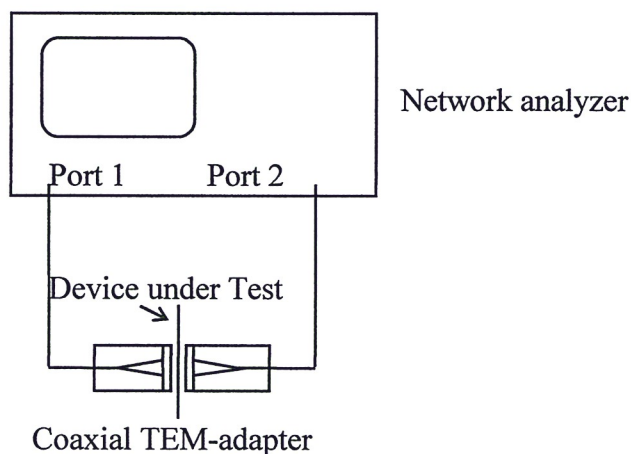


Fig. 1: Set-up to measure the shielding effectiveness in the MHz- und GHz-range

Test equipment:

Vector Network Analyzer type ZVRE (30 kHz – 8 GHz), Rohde & Schwarz
Coaxial TEM-Adapter, Wandel + Goltermann

3 Results of the measurements and comments

The diagram presents the transmission values in decibels as a function of frequency.

The vertical scale is: **10 dB/DIV**

The 0 dB-Reference line is the second **bold** line at the top of the diagram.

On the right top of the diagrams one can read the measured shielding values at different frequency markers.

To find out, how many percent of the incident power is shielded, the table on page 2 presents the conversion between **dB** and **%** (of power).

The shielding paint *AURO Nr. 332 Safe Shield* presents the following shielding effectiveness at some interesting frequencies, especially at the most important mobile phone and W-LAN-frequencies:

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Neubiberg, 15th of March 2019

Prof. Dipl.-Ing. P. Pauli

Device under test: Conductive paint *AURO Nr. 332 Safe Shield*
Frequency Range: 100 MHz to 8 GHz

