

EXPERT REPORT

- Ordered by:** GEOVITAL
Akademie für Geobiologie und Strahlenschutz
Unterwolfbühl 430
A-6934 Sulzberg
- Device under Test:** **GEOVITAL T98 Alpha – Shielding Paint**
① Applied as a single layer to an even wooden surface
(Productivity: 8 m²/liter)
② Applied as a double layer to an even wooden surface
(Productivity: 4 m²/liter)
- Subject:** Measuring the shielding efficiency against electromagnetic waves from 100 MHz to 20 GHz
- Regulations:** IEEE 299-1997 and ASTM D-4935-89
(ASTM = American Society of Testing and Materials)
- Date of Measurements:** 18th of March 2010

Results: The shielding paint GEOVITAL T98 Alpha has been tested with electromagnetic waves showing polarizations in all directions. As the paint has been applied very homogeneously to the wooden structure (thickness 6mm), the results are valid as well for vertically as also for horizontally polarized waves. This fact was confirmed by the results, presented in appendix 1. Table 1 presents the values of shielding efficiency (SE), measured at some interesting frequencies:

Communication services:	Shielding efficiency of the two specimen in dB	
	① Single paint layer with a productivity of 8 m ² /liter	② Double layer with a productivity of 4 m ² /liter
C-Netz, TETRA, 450 MHz	43 dB	50 dB
D-Netz, 900 MHz	41 dB *)	47 dB *)
E-Netz, 1800 MHz	40 dB *)	48 dB *)
Blue-Tooth, WLAN 2450 MHz	40 dB	50 dB
W-LAN new generation at 5,8 GHz	38 dB	50 dB *)
10 GHz	42 dB	50 dB
14 GHz	42 dB	46 dB
16 GHz	42 dB	44 dB
20 GHz	41 dB	41 dB

Table 1: Shielding Efficiencies at different frequencies

*) Average values, calculated from the results of the IEEE- and ASTM-measurements

2. Measurement Set-up

2.1 Shielding measurements according to IEEE 299-1997 from 0.8 to 20 GHz

The measurements were performed according to IEEE 299 on 18th of March 2010 at the EMC-test site of the Radar Laboratories at the German Armed Forces University Munich in Neubiberg at frequencies from 800 MHz to 20 GHz. Linear polarisation was radiated by double ridged exponential horn antennas. The devices under test were attached to a specific aperture (height 40 cm, width 40 cm) as shown in the picture below in a metallic shelter wall with the dimensions of 210cm x 200cm. During the measurements neither interferences from external signals nor any creeping waves between DUT and cabin wall could be detected. To test the device in the different planes of linear polarisation (vertically and horizontally), the sample was rotated by 90 degrees.

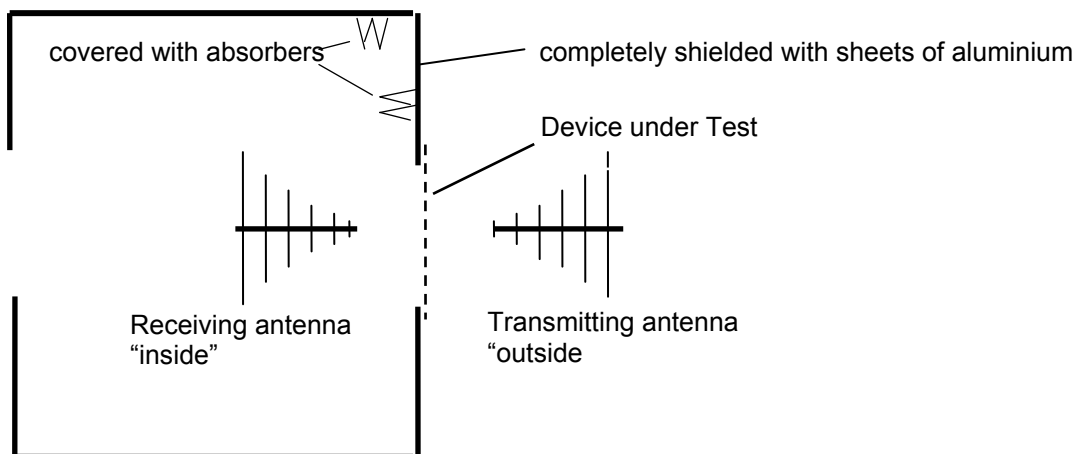


Fig. 1 Setup for Shielding Measurements (schematically)

The test range was calibrated without any object between the two antennas, to adjust the zero-dB-transmission-value and with a solid sheet of 2mm aluminium, to test the optimum shielding possible. The horn antennas were positioned at a distance of 80cm in front of the DUT and 30cm behind it.

Test equipment:

Vector Networkanalyzer type ZVRE, 20 kHz – 8 GHz, Rohde & Schwarz
Scalar Networkanalyzer Type 5300, (40 MHz to 40 GHz), Wiltron/Anritsu
2 Double-ridged exponential horn antennas type HF 906, (1 – 18 GHz) R & S
Printer: Kyocera Ecosys, FS – 1020D

2.2 Measurement Setup according to ASTM D 4935-89 from 100 MHz to 2 GHz

This standard was published by the American Society of Testing and Materials (ASTM).

The DUT (Device Under Test) is installed between two coaxial TEM-adapters. The test signal was emitted from the port 1 of a network analyzer. The transmitted signal was received by port 2 of the NWA. During a S_{21} -calibration without DUT but with a neutral distance holder of the same thickness as the DUT, the transmission value was set to "0" dB.

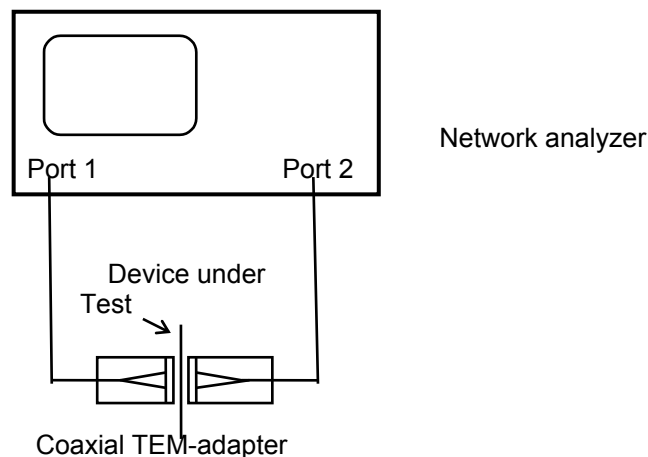


Fig. 2 Set-up to measure the shielding effectiveness by means of TEM-adapters

Test equipment:

Vector Network Analyzer, type 8753D, (30 kHz to 6 GHz), Hewlett & Packard
A pair of coaxial TEM-Adapters, (100kHz – 4 GHz) Wandel + Goltermann
Documentation: OfficeJet 500, H & P

Due to the coaxial structure transmitting a TEM-wave, the DUT is hit by E-field vectors in all transverse 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.

Then the results directly can be compared to an IEEE-299-measurement, performed with linear polarization.

3. Results of the Measurements

The diagrams in the appendices present the transmission values i.e. shielding effectiveness of the shielding paint **GEOVITAL T98 Alpha** in decibels as a function of frequency.

The 0 dB-Reference line is indicated by this marker ►.

The following table presents the **shielding efficiency** at some interesting frequencies:

Communication services:	Shielding efficiency of the two specimen in dB	
	① Single paint layer with a productivity of 8 m ² /liter	② Double layer with a productivity of 4 m ² /liter
C-Netz, TETRA, 450 MHz	43 dB	50 dB
D-Netz, 900 MHz	41 dB *)	47 dB *)
E-Netz, 1800 MHz	40 dB *)	48 dB *)
Blue-Tooth, WLAN 2450 MHz	40 dB	50 dB
W-LAN new generation at 5,8 GHz	38 dB	50 dB *)
10 GHz	42 dB	50 dB
12 GHz	42 dB	48 dB
14 GHz	42 dB	46 dB
16 GHz	42 dB	44 dB
18 GHz	42 dB	42 dB
20 GHz	42 dB	41 dB

Table 3: Shielding Efficiencies at different frequencies

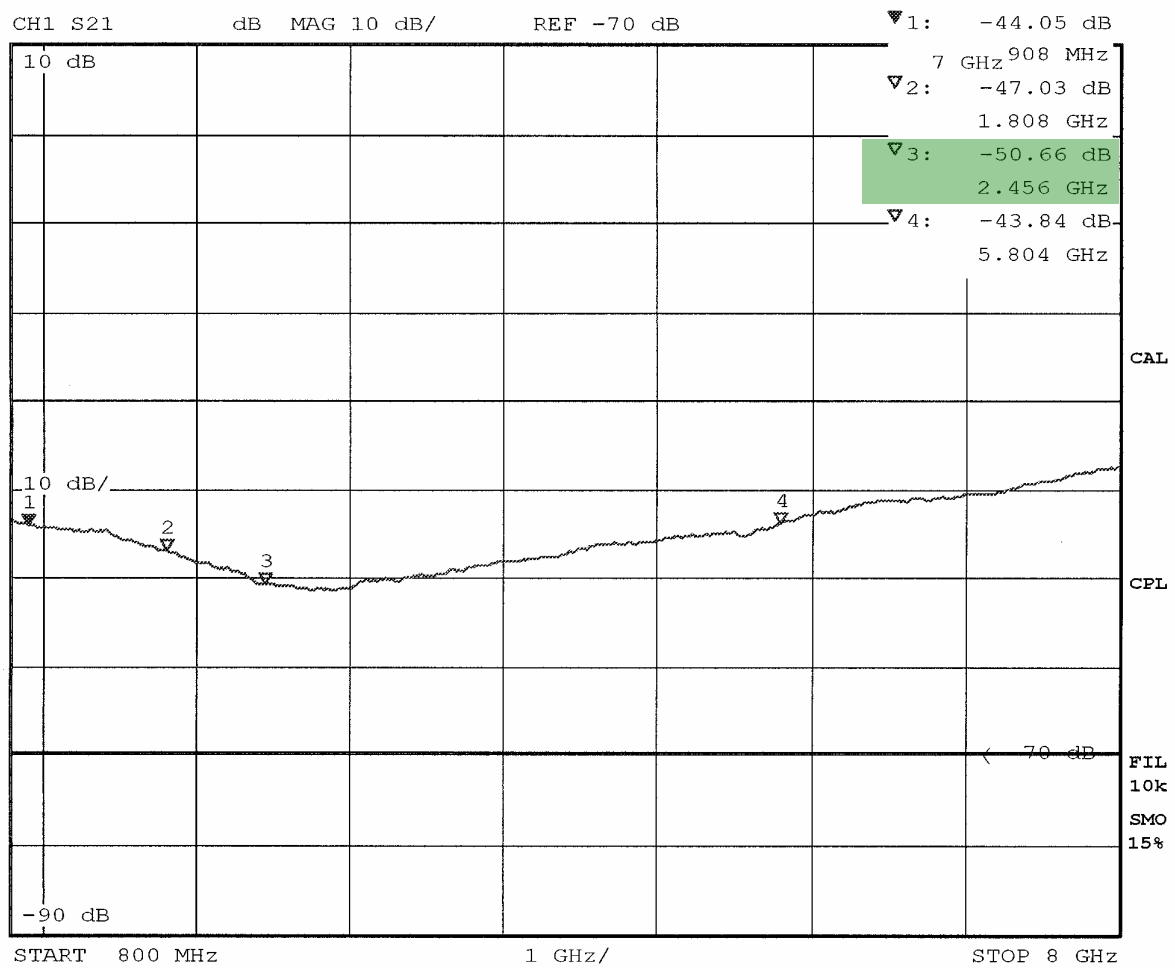
*) Average values, calculated from the results of the IEEE- and ASTM-measurements

4. Final conclusions

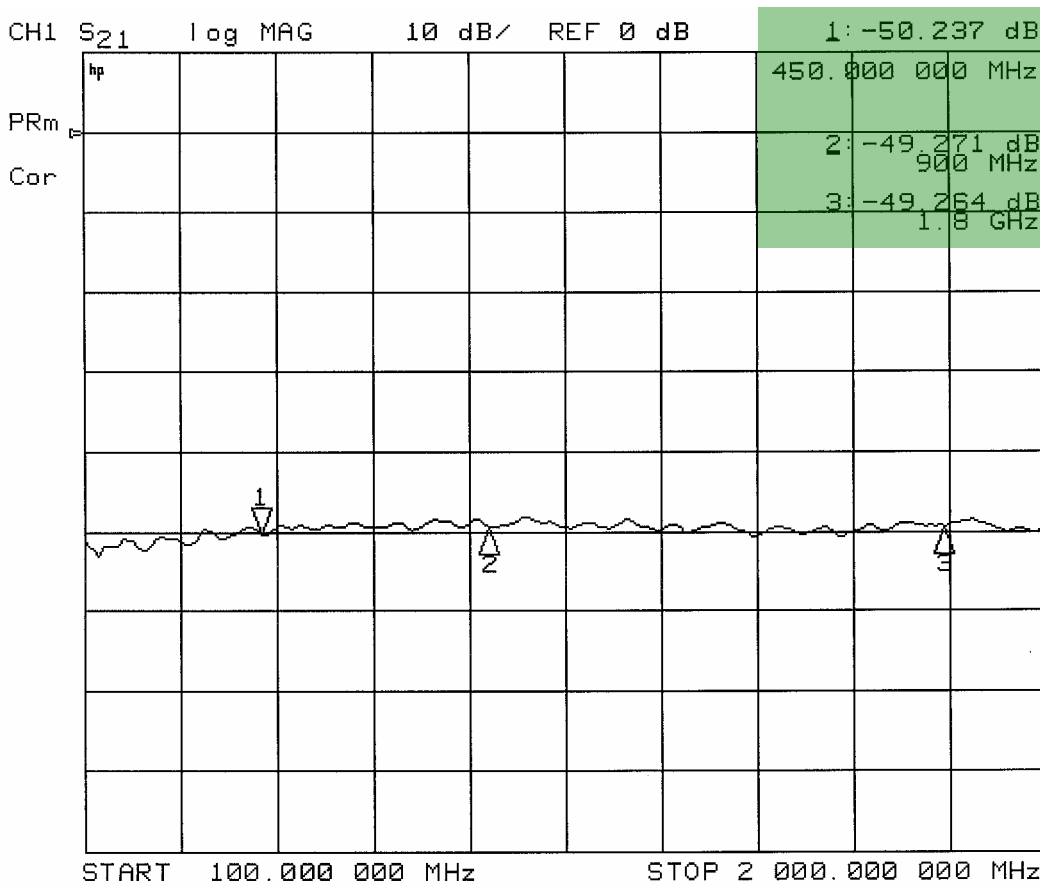
The shielding paint GEOVITAL T98 Alpha presents an excellent shielding efficiency even in a single layer application. 40dB shielding means a reduction of the transmitted power down to a factor of 1:10 000. This promises an outstanding good shielding, assuming, the ground is prepared with a proper isolation to limit the absorbcency of the wood.

In the double-layer application, the shielding climbs to almost 50dB. In this case, the relation of penetrating to incident power is 1:100 000.

Device under test ©: Shielding Paint **GEOVITAL T98 Alpha**
Double layer application on a flat wooden panel; productivity: **4 m²/liter**
Frequency Range: 800 MHz to 8 GHz



Device under test ©: Shielding Paint **GEOVITAL T98 Alpha**
 Double layer application on a flat wooden panel; productivity: **4 m²/liter**
 Frequency Range: 100 MHz to 2 GHz



Device under test ©: Shielding Paint **GEOVITAL T98 Alpha**
Double layer application on a flat wooden panel; productivity: **4 m²/liter**
Frequency Range: 10 GHz to 20 GHz

Additional Measurements to 20 GHz according to IEEE 299-1997

Measurement equipment: Skalarer Netzwerkanalysator, Typ 5300,
Fa. Wiltron, 10 MHz – 40 GHz

Results:

Frequency	10 GHz	12 GHz	14 GHz	16 GHz	18 GHz	20 GHz
Geovital T98 Alpha 4 m ² /liter	50 dB	48 dB	46 dB	44 dB	42 B	41 dB