

## EXPERT REPORT

**Ordered by:** YSHIELD EMR-Protection  
Christian Danner  
Gewerbering 6  
D-94060 Pocking  
Germany

**Devices under Test :** RF- and Microwave Shielding Paint for interior and exterior  
(DUT) **application**  
Sample # 1: *HSF54* covering 7,5 squaremeter by 1 liter,  
applied to an even panel of plaster  
Sample # 2: *HSF54* covering 10 squaremeter by 1 liter  
applied to an even panel of plaster

**Subject:** Shielding-measurements of electromagnetic waves from  
900 MHz to 18 GHz

**Regulations:** According to MIL-Standard 285, IEEE-STD 299-1997 and  
VG-Standard 95 370-15, KS03

**Date of Measurements:** 27<sup>th</sup> of February 2007


**Contents:** 4 text pages, 2 measured diagrams in 2 appendices

**Results:** The measurements proved, that all measured items present a totally identical shielding effectiveness to vertically and horizontally polarised electromagnetic waves. Another remarkable fact is the very constant and almost frequency independent outstanding shielding of all samples across the entire measured frequency range.

The table at the bottom presents the shielding effectiveness of the RF- and Microwave Shielding Paint *HSF54* for interior and exterior application at some selected frequencies:

	at 900 MHz	at 5.8 GHz	at 18 GHz
<i>HSF54</i> # 1 7,5 m <sup>2</sup> /l	39,2 dB	40,9 dB	38,6 dB
<i>HSF54</i> # 2 10,0 m <sup>2</sup> /l	34,5 dB	35,7 dB	31,5 dB

Neubiberg, 27<sup>th</sup> of February 2007

  
Prof. Dipl.-Ing. P. Pauli

## 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 transmission in “%”.

The network analyzer presents the results of the shielding measurements in “Decibel” (dB). The mode of measurement is a typical transmission measurement (scalar  $S_{21}$ -measurement). A “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.

For example it tells that 20 dB shielding reduces the penetrating power to 1 %.

<b>Conversion of Decibel to Percent of transmitted Power</b>			
<b>dB</b>	<b>Power Transmission in %</b>	<b>dB</b>	<b>Power Transmission in %</b>
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
<b>20</b>	<b>1,00</b>	40	0,01

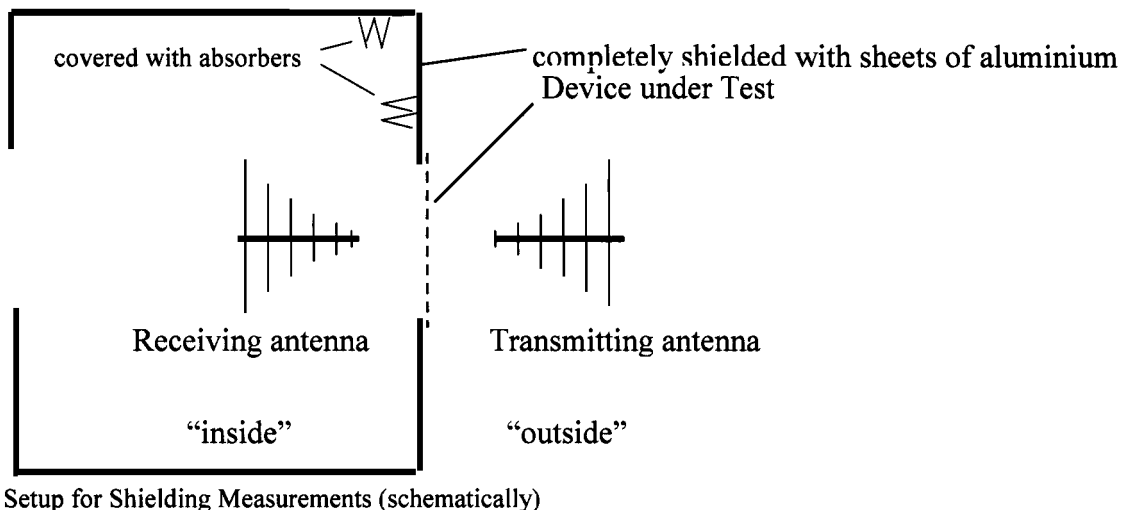
To calculate the dB-value from the incident power  $P_1$  respectively from the arriving electrical fieldstrength  $E_1$  and the transmitted power  $P_2$  or fieldstrength  $E_2$ , one has to use the following equation:

$$a_{Shield} = 10 \cdot \log \frac{P_2}{P_1} = 20 \cdot \log \frac{E_2}{E_1}$$

## 2. Measurement Set-up and Calibration Procedures

The measurements were performed according to MIL-Standard 285 on 27<sup>th</sup> of February 2007 in a shielded room of the Radar Laboratories at the German Armed Forces University Munich in Neubiberg at frequencies from 900 MHz to 18 GHz. Linear polarisation was radiated by logperiodic antennas. The devices under test were attached to a specific aperture as shown in the picture below (height 80 cm, width 60 cm) 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 in 90 degrees.



The test range was calibrated

1. without any object between the two antennas, to calibrate the zero-dB-transmission-value,
2. with a solid sheet of 2mm aluminium, to test the optimum shielding possible.

Measurement equipment:

Vector Networkanalyzer Type 360, (40 MHz to 18,6 GHz), Wiltron/Anritsu  
2 LogPer-Antennas, Typ HL 025 (1 GHz to 26 GHz), Rohde & Schwarz  
Printer: Kyocera Ecosys, FS – 1020D

### 3. Test Results and Comments

In all appendices the shielding effectiveness is presented in Decibel. The line of the zero-dB-value is marked by the black triangle ▶.


The measurements proved, that both measured items present a totally identical shielding effectiveness to vertically and horizontally polarised electromagnetic waves. Another remarkable fact is the very constant and almost frequency independent outstanding shielding of all samples across the entire frequency range.

The table at the bottom presents the shielding effectiveness of the RF- and Microwave Shielding Paint **HSF54** for interior and exterior application at some selected frequencies:

	at 900 MHz	at 5.8 GHz	at 18 GHz
<b>HSF54</b> # 1 7,5 m <sup>2</sup> /l	39,2 dB	40,9 dB	38,6 dB
<b>HSF54</b> # 2 10,0 m <sup>2</sup> /l	34,5 dB	35,7 dB	31,5 dB

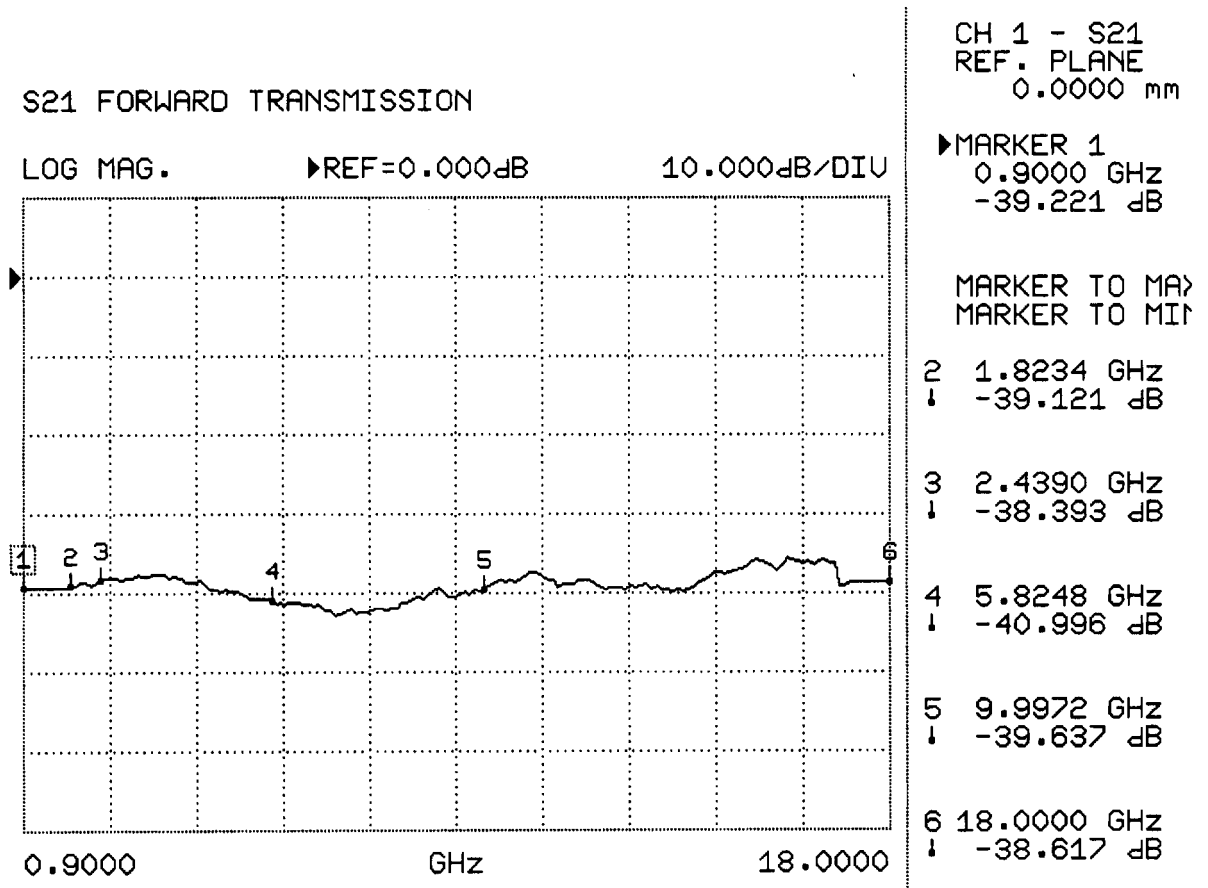
For all measurements, the paint was applied to a thin panel of plaster with an even surface.

Neubiberg, 27<sup>th</sup> of February 2007



Prof. Dipl.-Ing. P. Pauli

Device under test #1: **RF- and Microwave Shielding Paint HSF54**  
**for interior and exterior application**  
applied to an even panel of plaster (productiveness 7,5 m<sup>2</sup>/l)



Device under test #2: **RF- and Microwave Shielding Paint HSF54**  
**for interior and exterior application**  
applied to an even panel of plaster (productiveness **10 m<sup>2</sup>/l**)

