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Section: RF- and Microwaves, Radars

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EXPERT REPORT

Ordered by: **YSHIELD** EMR-Protection
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Germany

Devices under Test : (DUT) **RF- and Microwave Shielding Paint for interior and exterior 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: 27th 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
HSF54 # 1 7,5 m^2/l	39,2 dB	40,9 dB	38,6 dB
HSF54 # 2 10,0 m^2/l	34,5 dB	35,7 dB	31,5 dB

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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 %.

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

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:

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

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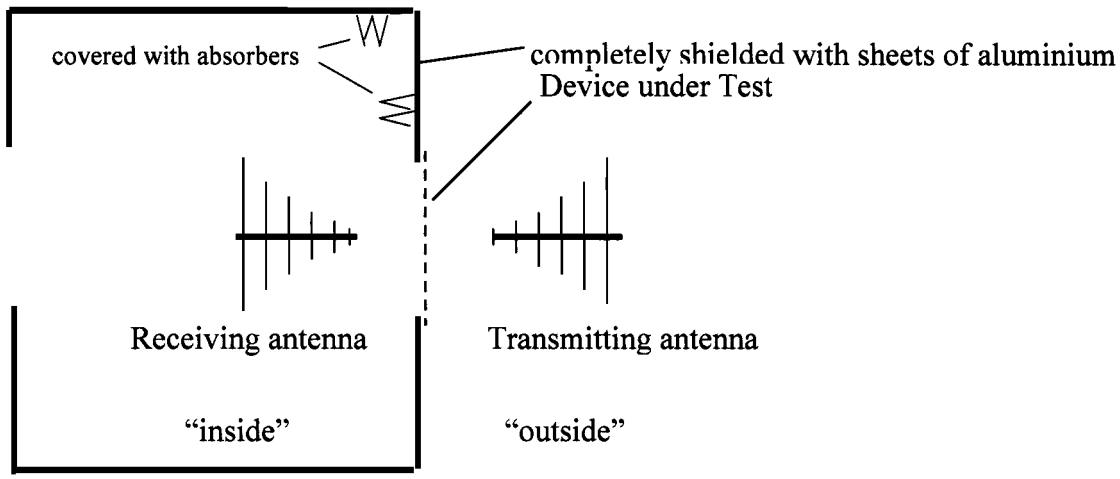
2.Measurement Set-up and Calibration Procedures

The measurements were performed according to MIL-Standard 285 on 27th 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.



Setup for Shielding Measurements (schematically)

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

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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
HSF54 # 1 7,5 m^2/l	39,2 dB	40,9 dB	38,6 dB
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For all measurements, the paint was applied to a thin panel of plaster with an even surface.

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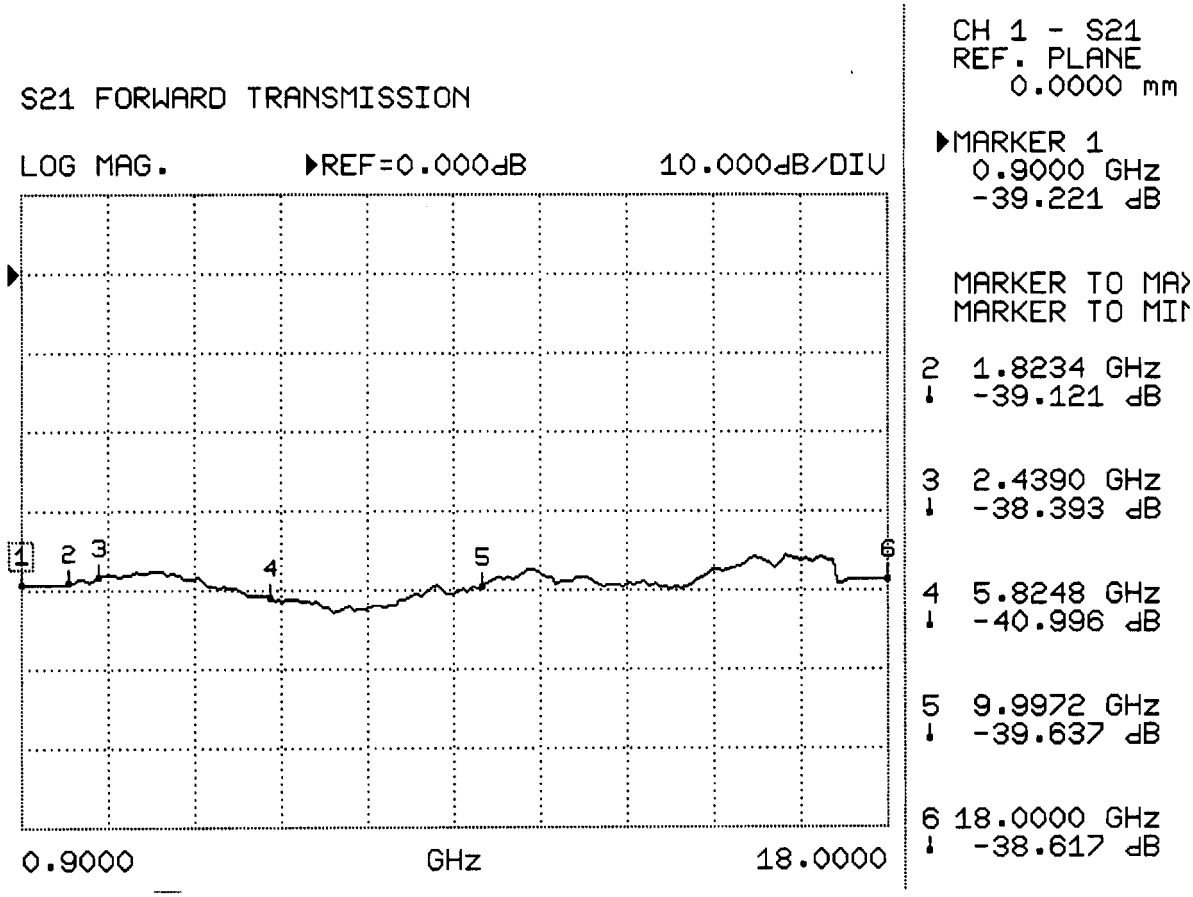
Appendix 1, 27th of February 2007
Polarisation **vertical**

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^2/l)



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Appendix 2, 27th of February 2007
Polarisation **vertical**

Device under test #2: **RF- and Microwave Shielding Paint HSF54**
for interior and exterior application
applied to an even panel of plaster (productiveness **10 m²/l**)