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Section: RF- and Microwaves, Radars

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Swiss Shield®: New Daylite™

EXPERT REPORT

Ordered by: Spoerry & Co AG
Spinning mill
Postfach 80
CH-8890 Flums / Switzerland

Device under Test : ***Swiss Shield New Daylite***

Subject: Shielding-measurements against electromagnetic waves from 30 MHz to 10 GHz

Regulations: According to IEE 299-1997 / MILSTD 285 and ASTM D-4935-89

Date of Measurements: 21st of December 2006

Contents: 4 pages of text, 5 pages with 7 measured diagrams

Results: The net curtain ***Swiss Shield New Daylite*** presents the following shielding effectiveness against popular mobile phone frequencies:

	450 MHz TETRA	900 MHz GSM 900	1800 MHz GSM 1800	2100 MHz UMTS
Exposed tovertically polarized waves	31 dB	24 dB	17 dB	17 dB
Exposed to horizontally polarized waves	42 dB	31 dB	24 dB	24 dB

A value of 17 dB means, that 98% of the incident power is removed by shielding.
At a shielding of 40 dB even 99,99% of the power is prevented, to get through the net curtain.
More details in the table at page 2 and the appendices No.1 and No. 2.

These results were confirmed by two additional measurements:

- > Individual measurements with vertically and horizontally polarized waves between the flanges of two rectangular waveguides from 1.1 GHz to 1.8 GHz (appendices No. 3 and 4)
- > Extra measurement between a pair of coaxial TEM-adapters with omnidirectional polarisation (appendix No. 5)

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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 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 (S_{21}-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

To calculate the dB-value from the incident power P_1 and the transmitted power P_2 , one has to use the following equation:

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

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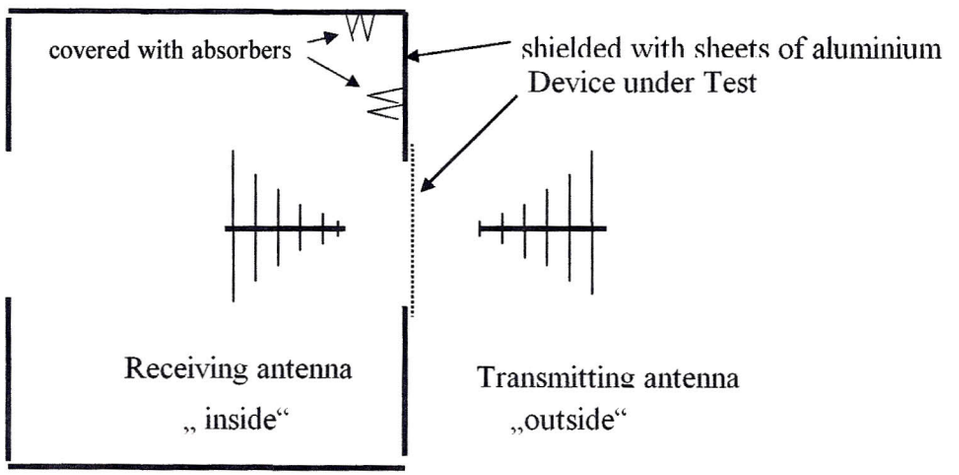
2 Measurement Setup

The measurements were performed according to IEEE-STD 299-1997 (which is close to the MIL-Standard 285) in a shielded room of the Radar Laboratories at the German Armed Forces University Munich in Neubiberg at frequencies from 200 MHz to 10 GHz. Linear polarisation was radiated by logperiodic antennas. The devices under test, the shielding net curtain, was attached to a specific window as shown in the picture below (height 80 cm, width 60 cm).
During the measurements neither interferences from external signals nor any creeping waves between DUT and cabin wall could be detected. To test the fabric in the different planes of linear polarisation (vertically and horizontally), the samples was rotated in 90 degrees.



Setup for Shielding Measurements

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 aluminium, to test the optimum shielding possible.

Due to the antenna specifications, measurements were performed in two frequency bands:

Range I: 200 MHz bis 2200 MHz, Range II: 1 GHz bis 10 GHz

According to IEEE 299, the transmitting antenna was positioned at a distance of 120 cm in front of the tested net curtain. The receiving antenna inside was 30 cm apart from the curtain.

Measurement equipment:

Vector Networkanalyzer Typ 360, (40 MHz to 18,6 GHz), Wiltron
2 Antennas (MHz): Bilog-Antennas , Typ CBL 6112A (30 MHz to 2000 MHz), CHASE
2 Antennas (GHz): LogPer-Antennas Typ HL 025 (1 GHz to 18 GHz) Rohde & Schwarz

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3 Results of the measurements and comments

All diagrams present the transmission values in decibels as a function of frequency.
Scale: 10dB/DIV. The 0 dB-Reference line is indicated by this marker► .
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 net curtain ***Swiss Shield New Daylite*** presents the following shielding effectiveness against the different mobile phone frequencies:

	450 MHz TETRA	900 MHz GSM 900	1800 MHz GSM 1800	2100 MHz UMTS
Exposed tovertically polarized waves	31 dB	24 dB	17 dB	17 dB
Exposed to horizontally polarized waves	42 dB	31 dB	24 dB	24 dB

At a shielding of 17 dB, 98% of the incident power is removed by the net curtain. At 40 dB even 99,99% of the power is prevented, to penetrate the net curtain.
More details in appendix No.1 and No. 2.

These results were confirmed by two other measurements:

> Individual measurements with vertically and horizontally polarized waves between the flanges of two rectangular waveguides from 1.1 GHz to 1.8 GHz (appendix No. 3 and No. 4).

> Between a pair of coaxial TEM-adapters with omnidirectional polarisation (appendix No. 5)
This measurement is according to the ASTM-SZD D 4935-89
(ASTM = American Society of Testing and Materials).

Neubiberg, 27th of December 2006

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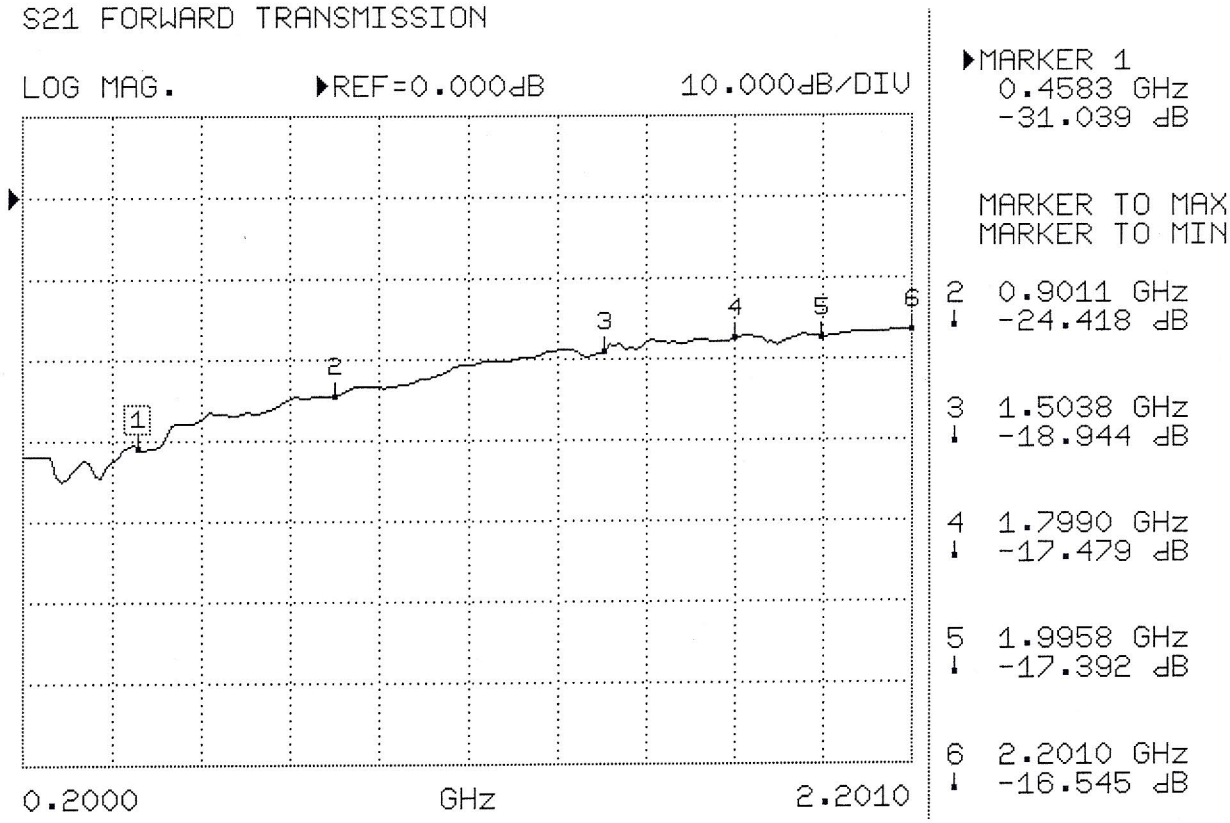
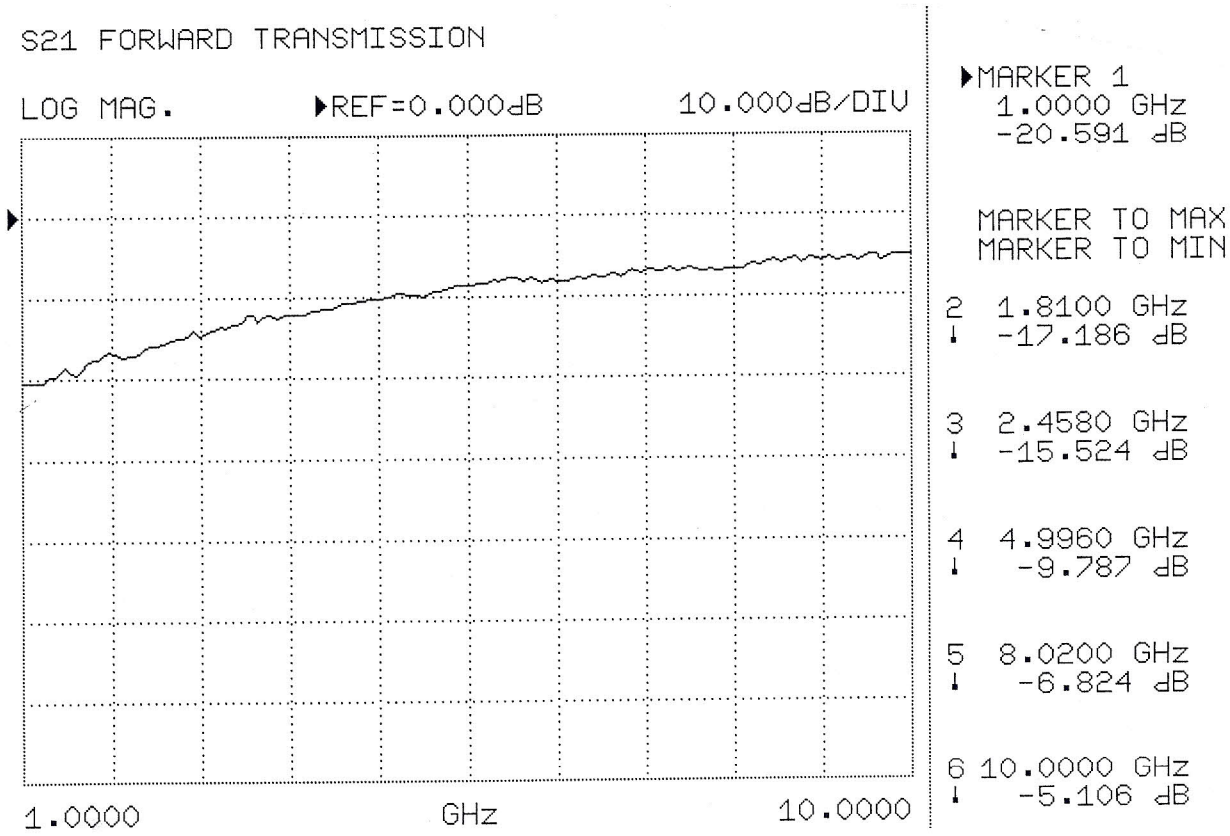
Appendix 1, 27th of December 2006
Polarisation vertical, this means E-field
parallel to the direction of production

Device under test: Net curtain **Swiss Shield New Daylite**
Upper trace: 200 MHz – 2200 MHz, trace at the bottom: 1 GHz – 10 GHz; set-up according to IEEE-STD 299





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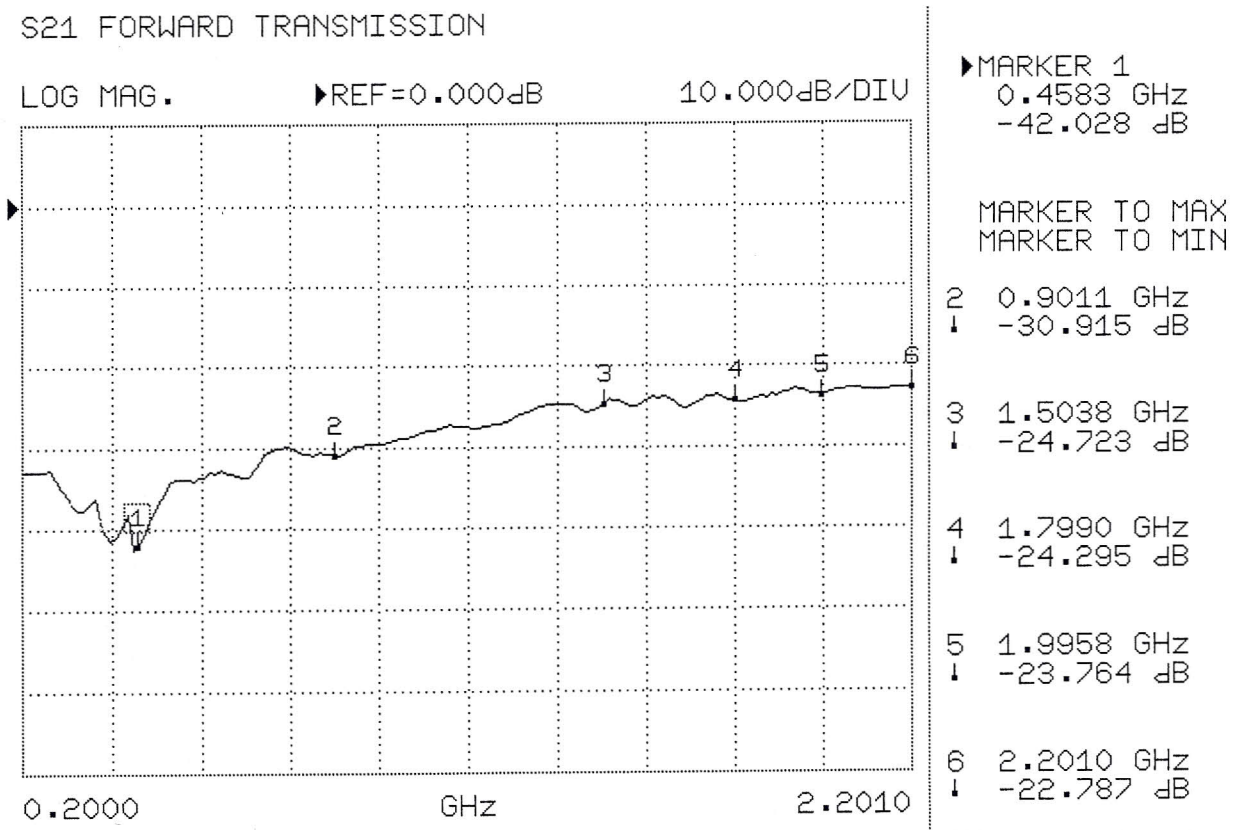
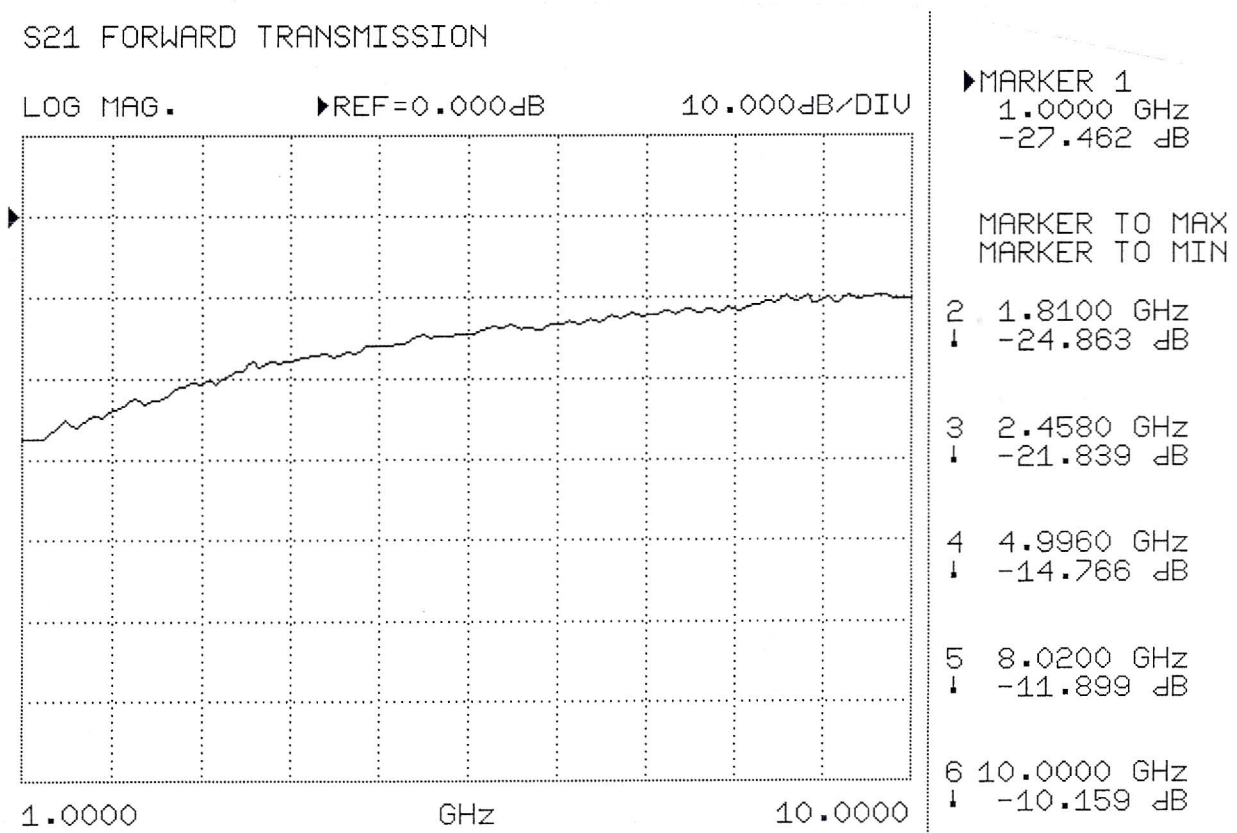
Appendix 2, 27th of December 2006
Polarisation horizontal, this means E-field
perpendicular to the direction of production

Device under test: Net curtain **Swiss Shield New Daylite**
Upper trace: 200 MHz – 2200 MHz, trace at the bottom: 1 GHz – 10 GHz; set-up according to IEEE-STD 299





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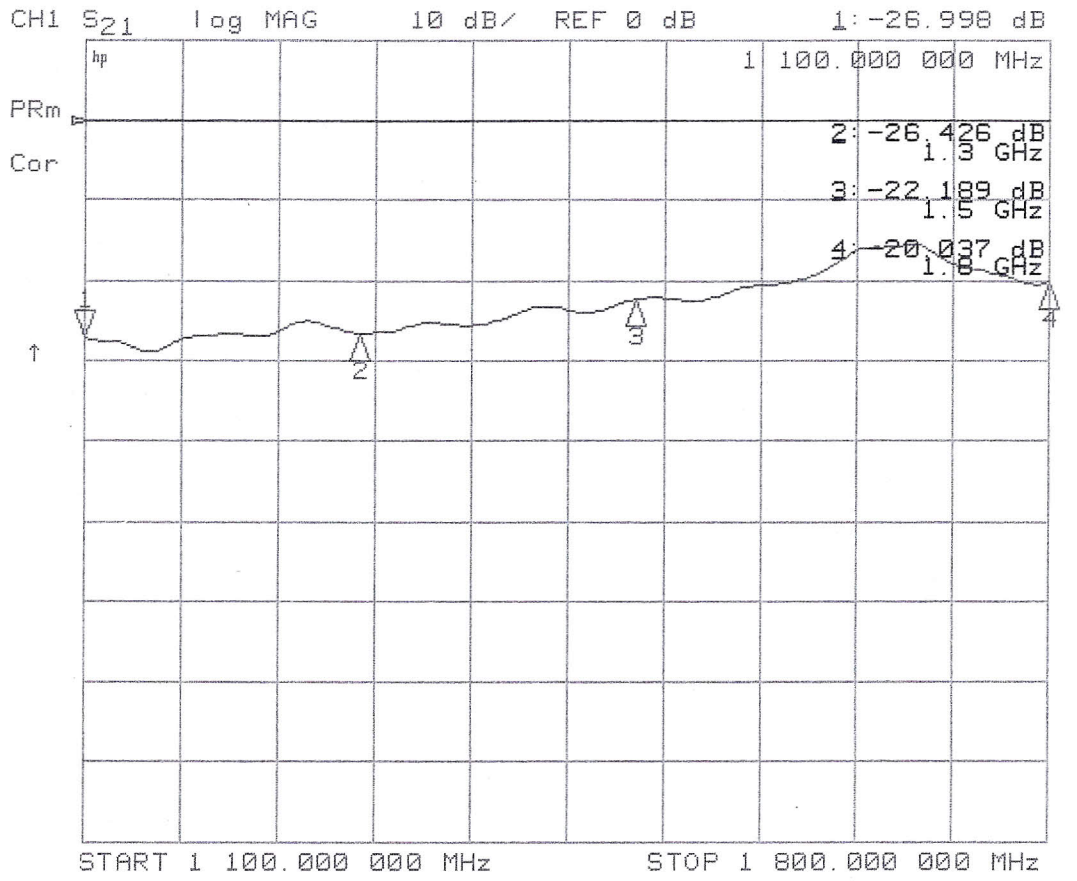
Appendix 3, 27th of December 2006
Polarisation vertical, this means E-field
parallel to the direction of production

Device under test: Net curtain **Swiss Shield New Daylite**
Measured between two L-band waveguide flanges from 1.1 GHz to 1.8 GHz



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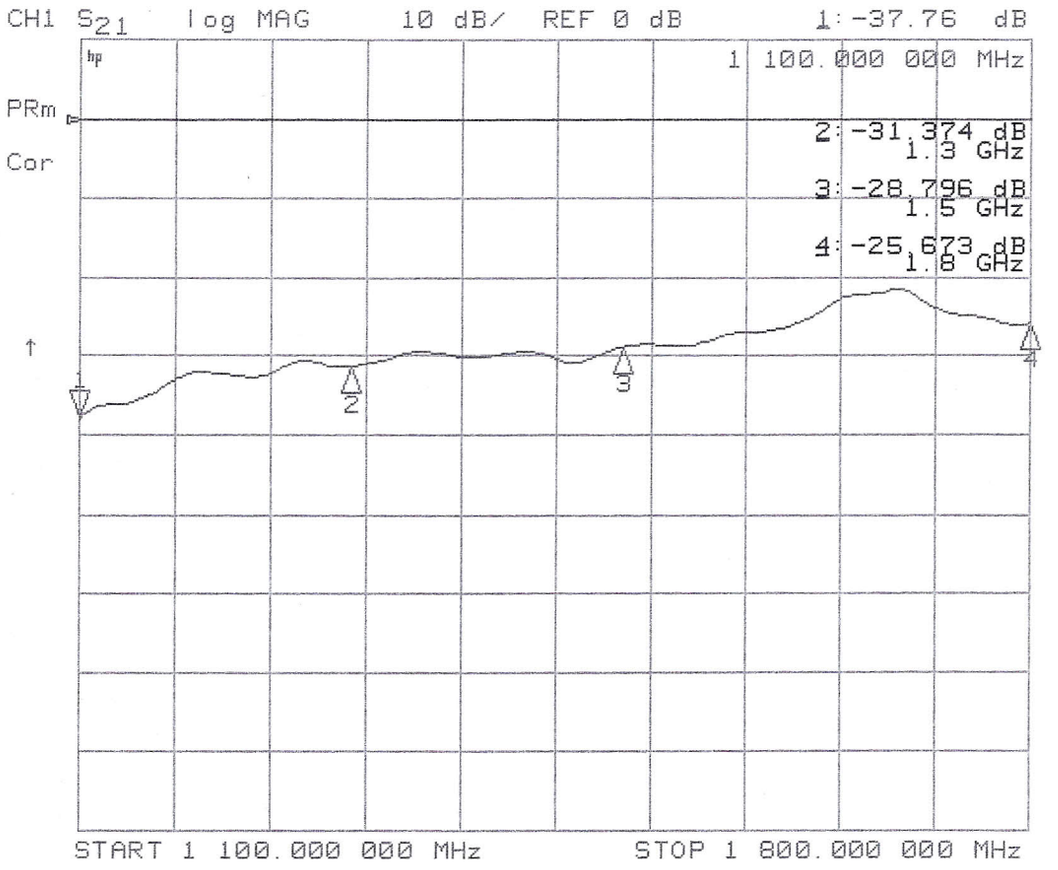
Appendix 4, 27th of December 2006
Polarisation horizontal, this means E-field
perpendicular to the direction of production

Device under test: Net curtain **Swiss Shield New Daylite**
Measured between two L-band waveguide flanges from 1.1 GHz to 1.8 GHz



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Appendix 5, 27th of December 2006
Polarization in all directions

Device under test: Net curtain **Swiss Shield New Daylite**
Measured between two coaxial TEM-adapters from 30 MHz to 4 GHz according t ASTM