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Federal Communications Commission  
**Anechoic chamber registration no.: 90462 (FCC)**  
**Anechoic chamber registration no.: 3463 (IC)**  
TCB ID: DE 0001



Accredited by the  
German Accreditation Council  
DAR-Registration Number  
DAT-P-176/94-D1



Independent ETSI  
compliance test house



Accredited Bluetooth® Test Facility (BQTF)

**Test report no.: 2-4318-01-01/06**  
**FCC Part 15.407 / CANADA RSS-210**  
**FCC ID:LYHW700-1-V1 and LYHW700-2-V1**  
**IC:267AA-W700V1**

**SCALANCE W744-1PRO / SCALANCE W788-1PRO /**  
**SCALANCE W788-2PRO**

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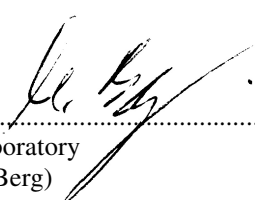
## ANNEX 1: ANTENNA MEASUREMENTS

## 1. Administrative data

### 1.1. Administrative data of the test facility

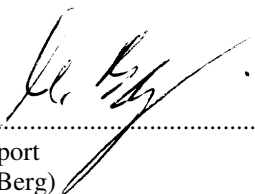
#### 1.1.1 Identification of the testing laboratory

|                                     |                                                                                                         |
|-------------------------------------|---------------------------------------------------------------------------------------------------------|
| Company name:                       | Cetecom ICT Services GmbH                                                                               |
| Address:                            | Untertürkheimerstr. 6-10<br>D-66117 Saarbruecken<br>Germany                                             |
| Laboratory accreditation:           | DAR-Registration No. DAT-P-176/94-D1<br>Bluetooth Qualification Test Facility (BQTF)                    |
| Responsible for testing laboratory: | Harro Ames, Michael Berg<br>Phone: +49 681 598 0<br>Fax: +49 681 598 9075<br>email: info@ict.cetecom.de |

 ,   
.....  
Responsible for testing laboratory  
(Harro Ames, Michael Berg)

#### 1.1.2 Organizational items

|                                                 |                          |
|-------------------------------------------------|--------------------------|
| Reference No.:                                  | 2-4318-01-01/06          |
| Order No.:                                      |                          |
| Responsible for test report and project leader: | Harro Ames, Michael Berg |
| Receipt of EUT:                                 | 2006-08-04               |
| Date(s) of test:                                | 2006-08-04 to 2006-08-29 |
| Date of report:                                 | 2006-08-30               |
| Number of report pages:                         | 66                       |
| Number of diagram pages (annex):                |                          |
| Version of template:                            | 1.2                      |

 ,   
.....  
Responsible for test report  
(Harro Ames, Michael Berg)

**Note:**

The test results of this test report relate exclusively to the item tested as specified in this report. The CETECOM ICT Services GmbH does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item.

The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of the CETECOM ICT Services GmbH.

During the test no hardware and software changes are allowed to be performed at the EUT.

### 1.1.3 Applicant's details

|                   |                                                                                                                            |
|-------------------|----------------------------------------------------------------------------------------------------------------------------|
| Applicant's name: | Siemens AG<br>A&D PT2                                                                                                      |
| Address:          | Gleiwitzer Strasse 555<br><br>D-90475 Nürnberg<br>Germany                                                                  |
| Contact person:   | Mr. Christoph Weiler<br>Phone: +49 (0) 721 595 4406<br>Fax: +49 (0) 721 595 2326<br>email: christoph.weiler@khe.siemens.de |

### 1.2 Administrative data of manufacturer / member

|                      |               |
|----------------------|---------------|
| Manufacturer's name: | - applicant - |
| Address:             |               |

## 1.3 Description of the Equipment under test (EUT)

### 1.3.1 EUT: Type, S/N etc.

| Product name         | Product ID         | Description        | Serial number      | HW hardware status | SW software status |
|----------------------|--------------------|--------------------|--------------------|--------------------|--------------------|
| SCALANCE W700        | W788-1(2)Pro       | WLAN AP            |                    |                    | T3.13              |
|                      | W744-1Pro          | WLAN Client        |                    |                    |                    |
| Frequency Band [GHz] | Type of Modulation | Number of channels | Antenna-connectors | Power Supply       | Temperature Range  |
| 5.15 – 5.25          | OFDM               | 4 / 4              | 2 external         | 24 V DC            | -20°C - +55°C      |

FCC ID: LYHW700-1-V1 and LYHW700-2-V1

IC: 267AA-W700-V1

### 1.3.2 If RF component testing only, description of additional used HW/SW

|   | Product name | Product ID | Description | S/N serial number | HW hardware status | SW software status |
|---|--------------|------------|-------------|-------------------|--------------------|--------------------|
| 1 |              |            |             |                   |                    |                    |
| 2 |              |            |             |                   |                    |                    |

### 1.3.3 Additional EUT information

The Siemens A&D PT2 Wireless LAN Product Family „SCALANCE W700 V1“ consists of three variants, namely

- SCALANCE W744-1PRO, 1 WLAN card inside
- SCALANCE W788-1PRO, 1 WLAN card inside
- SCALANCE W788-2PRO, 2 WLAN cards inside

The SCALANCE W788-2PRO is the superset of all variants and include the whole functionality of all three products.

This functionality can be divided into

- Simple WLAN client functionality, i.e. the device can bridge Ethernet traffic to a wireless LAN
- Single Access Point functionality
- Access Point functionality supporting two WLAN cells in parallel using two radio interfaces

The SCALANCE W744-1PRO only supports the client functionality. The SCALANCE W788-1PRO includes the single access point functionality and the client mode. The SCALANCE W788-2PRO additionally allows operating two WLAN cells in parallel, since it is fitted with two WLAN radio cards.

All variants are based on the same WLAN chipset (ATHEROS AR5212 + AR5112) and even on the same WLAN minipCI module from Alpha-Networks.

PCB-boards, layout, parts and housing are identical on all three variants, only the SCALANCE W788-2PRO has two additional antenna ports.

The radiated tests were performed with two different antennas.

The first antenna, here called antenna 1 is a dualband rod antenna for mounting directly on the housing.

The second antenna, here called antenna 2 is a „high gain“ dualband antenna to mount separately from the access point, connected with reverse sma connectors and a dedicated coax cable.

## 1.3.4 EUT operating modes

| EUT operating mode no. *) | Description of operating modes | Additional information                         |
|---------------------------|--------------------------------|------------------------------------------------|
| Op. 0                     | Normal mode                    | Normal temperature and power source conditions |
| Op. 1                     |                                | low temperature, low power source conditions   |
| Op. 3                     |                                | low temperature, high power source conditions  |
| Op. 4                     |                                | high temperature, low power source conditions  |
| Op. 5                     |                                | high temperature, high power source conditions |

\*) EUT operating mode no. is used to simplify the test report.

## 1.3.5 Extreme conditions testing values

| Description                    | Shortcut          | Unit   | Value  |
|--------------------------------|-------------------|--------|--------|
|                                |                   |        |        |
| Nominal Temperature / humidity | T <sub>nom</sub>  | °C / % | 22/ 33 |
| Low Temperature                | T <sub>low</sub>  | °C     | -20    |
| High Temperature               | T <sub>high</sub> | °C     | +55    |
|                                |                   |        |        |
| Nominal Power Source           | V <sub>nom</sub>  | V      | 24     |
| Low Power Source               | V <sub>low</sub>  | V      | 20     |
| High Power Source              | V <sub>high</sub> | V      | 28     |

Type of powersource: External DC power supply from our house

## 2 Test standard & summary list of all performed test cases

| TC identifier | Description                          | Verdict | Date       | Remark |
|---------------|--------------------------------------|---------|------------|--------|
| RF-Testing    | FCC Part 15 §15.407 - CANADA RSS-210 | PASS    | 2006-08-31 |        |

| Test Specification Clause | Test Case                             | Pass | Fail | Not applicable | Not performed |
|---------------------------|---------------------------------------|------|------|----------------|---------------|
|                           |                                       |      |      |                |               |
| None                      | Antenna Gain                          | Yes  |      |                |               |
| Range:                    | 5.150 to 5.250 GHz                    |      |      |                |               |
| §15.407a(1)               | Peak transmit power                   | Yes  |      |                |               |
| §15.407a(1)               | Occupied bandwidth                    | Yes  |      |                |               |
|                           |                                       |      |      |                |               |
| § 15.407a (6)             | Ratio of peak excursion               | Yes  |      |                |               |
|                           |                                       |      |      |                |               |
| §15.407a(5)               | Peak power spectral density conducted | Yes  |      |                |               |
|                           |                                       |      |      |                |               |
| § 15.407b (1)             | Undesirable emissions conducted       | Yes  |      |                |               |
|                           |                                       |      |      |                |               |
| § 15.209                  | Spurious Emission -radiated (TX)      | Yes  |      |                |               |
|                           |                                       |      |      |                |               |
| § 15.209                  | Spurious Emission -radiated (RX)      | Yes  |      |                |               |
|                           |                                       |      |      |                |               |
| § 15.107/207              | Conducted Emissions <30 MHz           | Yes  |      |                |               |

## 3 RF measurement testing

### 3.1 Description of test set-up

#### 3.1.1 Radiated measurements

The radiated measurements are performed in vertical and horizontal plane in the frequency range from 9 kHz to 25 GHz in semi-anechoic chambers. The EUT is positioned on a non-conductive support with a height of 0.80 m above a conductive ground plane that covers the whole chamber. The receiving antennas conform with specifications ANSI C63.2-1996 clause 15 and ANSI C63.4-2003 clause 4.1.5. These antennas can be moved over the height range between 1.0 m and 4.0 m in order to search for maximum field strength emitted from EUT. The measurement distances between EUT and receiving antennas are indicated in the test setups for the various frequency ranges. For each measurement, the EUT is rotated in all three axes until the maximum field strength is received. The wanted and unwanted emissions are received by spectrum analysers where the detector modes and resolution bandwidths over various frequency ranges are set according to requirement ANSI C63-4-2003 clause 4.2.

Antennas conform with ANSI C63.2-1996 item 15.

150 kHz - 30 MHz: Quasi Peak measurement, 9kHz Bandwidth, passive loop antenna.

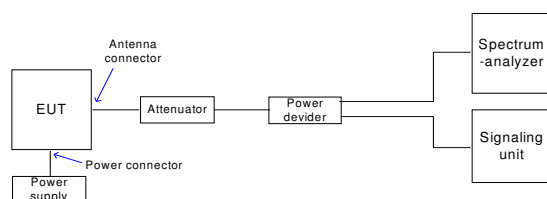
30 MHz - 200 MHz: Quasi Peak measurement, 120KHz Bandwidth, biconical antenna

200MHz - 1GHz: Quasi Peak measurement, 120KHz Bandwidth, log periodic antenna

>1GHz: Average, RBW 1MHz, VBW 10 MHz, waveguide horn with lownoise preamp

#### 3.1.2 Conducted measurements

The EUT's RF signal is coupled out by the antenna connector which is supplied by the manufacturer. The signal is connected to the spectrum analyzer. The specific losses for signal paths are first checked within a calibration. The measurement readings on the spectrum analyzer are corrected by the specific test set-up loss. The attenuator, power divider, signaling unit and the spectrum analyzer are impedance matched on 50 Ohm.



#### 3.1.3 AC-conducted measurements

As the product is sold without any power supply, we used a power supply from our company to show compliance with AC-conducted requirements.

## 3.2 Referenced Documents

none

## 3.3 Additional comments

Hardware / software changes during testing

| Setup revision | Description of change | Change referenced to setup revision | Already perf. testcases influenced yes (reaped ) / no |
|----------------|-----------------------|-------------------------------------|-------------------------------------------------------|
|                |                       |                                     |                                                       |
|                |                       |                                     |                                                       |
|                |                       |                                     |                                                       |
|                |                       |                                     |                                                       |
|                |                       |                                     |                                                       |
|                |                       |                                     |                                                       |

## 3.4 Antenna gain

The antenna gain for the three used antennas was measured in a so called “compact range” in our house (see results on annex 1)

Antenna 1: “Joymax” TMX 614RSXXX-403 (for direct connection at the housing)

-Max gain at 5.2 GHz = 1,7 dBi

Antenna 2: “Joymax” FG102 (delivered with a 5m fix mounted coax cable)

-Max gain at 5.2 GHz = 5,3 dBi (antenna itself) – 3.7 dB loss of the cable = 1.6 dBi.

## Frequency range of the sample : 5150 to 5250 MHz

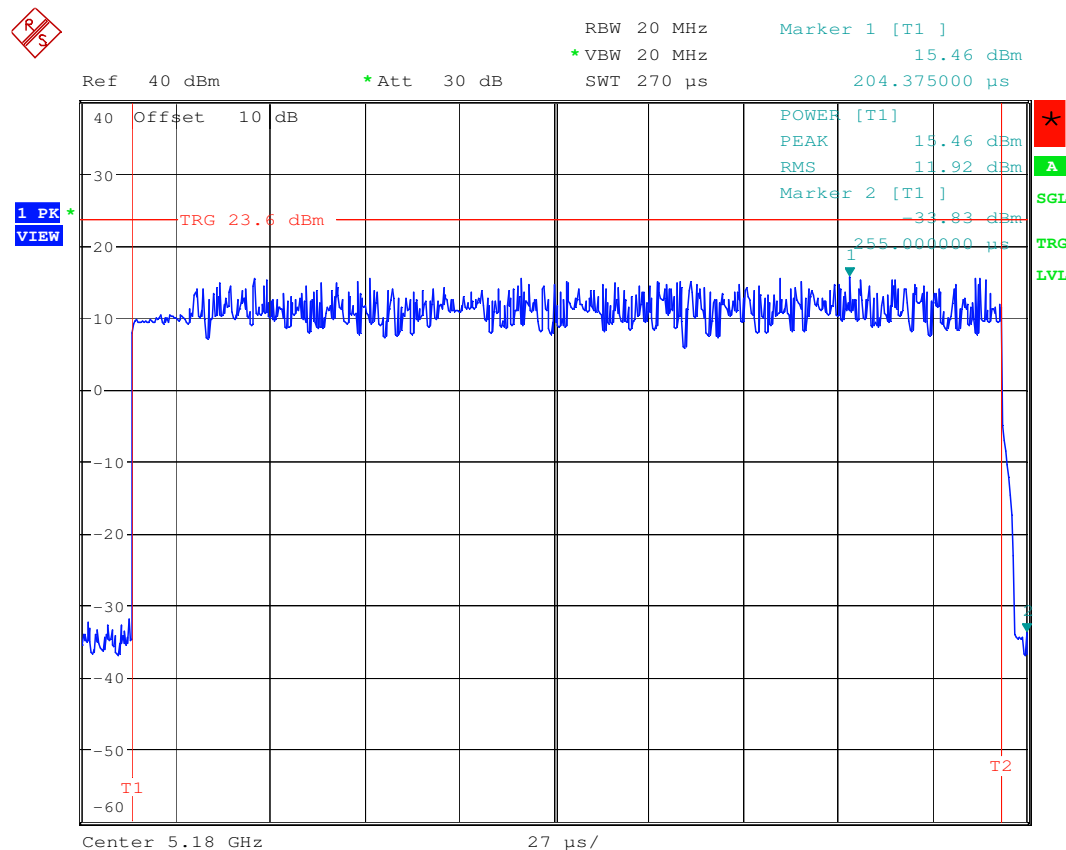
### 3.5 Peak Transmit Power

§15.407a(1)

#### 3.5.1 Measurement True RMS

Plot 1: 5180 MHz (result calculated by the FSU50 from Rohde & Schwarz with a true RMS filter)

here measured in time domain



Date: 29.AUG.2006 11:53:03

calculated result during time of continuous emissions, required in 15.407 (a)(4)

Peak value in this burst: 15.46 dBm

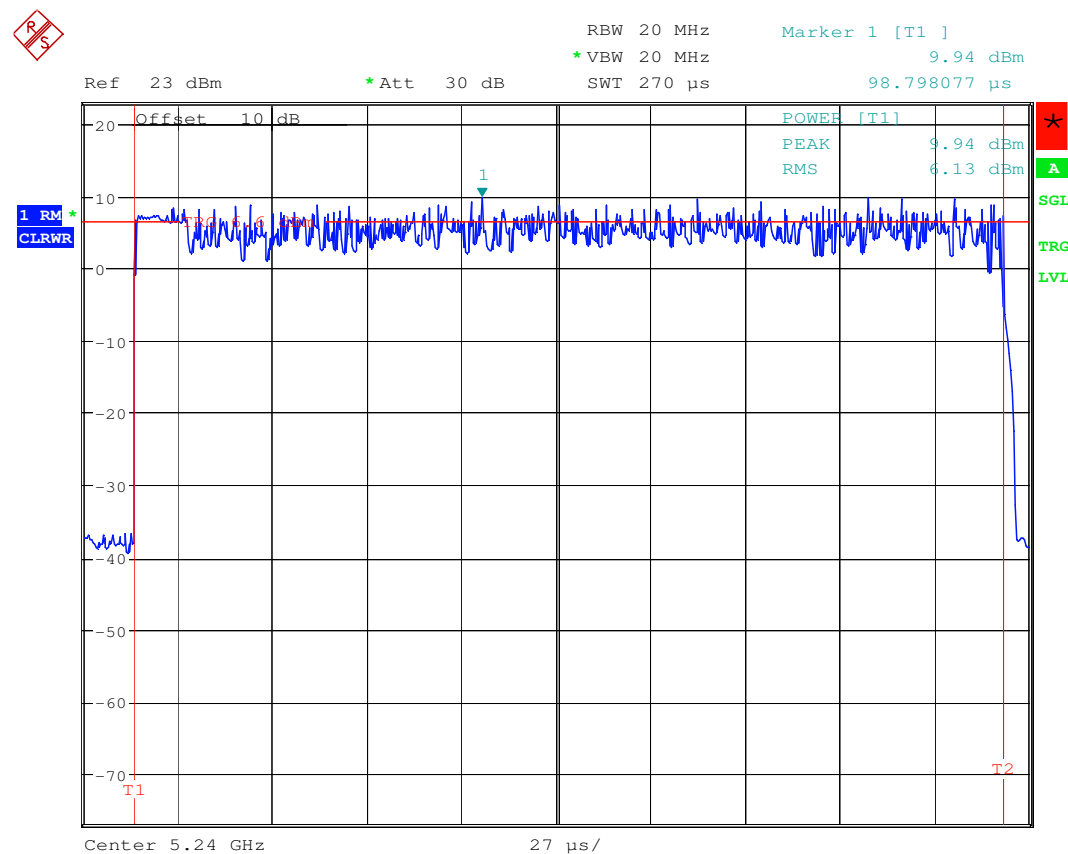
**RMS value in this burst: 11.92 dBm**

Delta dB = 3.54 dB

**Limit: 17 dBm RMS**

Plot 2: 5240 MHz (result calculated by the FSU50 from Rohde & Schwarz with a true RMS filter)

here measured in time domain



Date: 29.AUG.2006 10:08:42

calculated result during time of continuous emissions, required in 15.407 (a)(4)

Peak value in this burst: 9.94 dBm

**RMS value in this burst: 6.13 dBm**

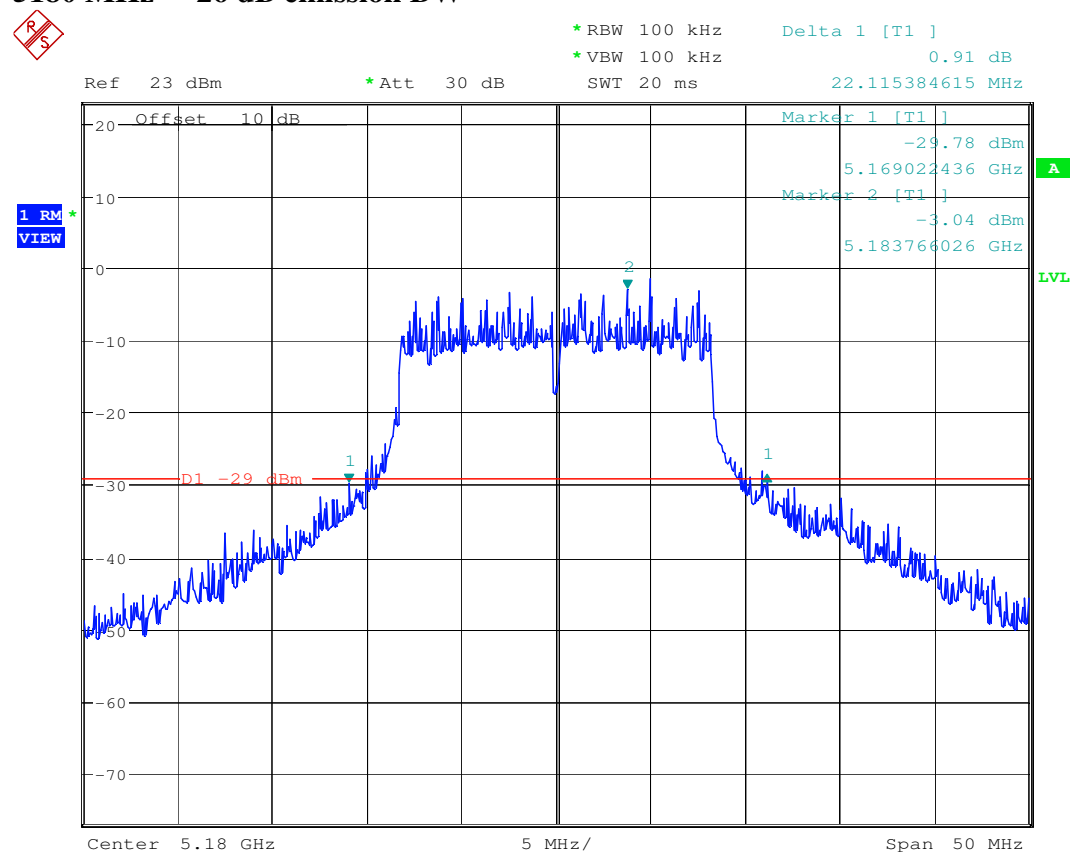
Delta dB = 3.81 dB

**Limit: 17 dBm RMS**

## 3.6 Occupied bandwidth (-26dB, -20 dB)

§15.407a(1)

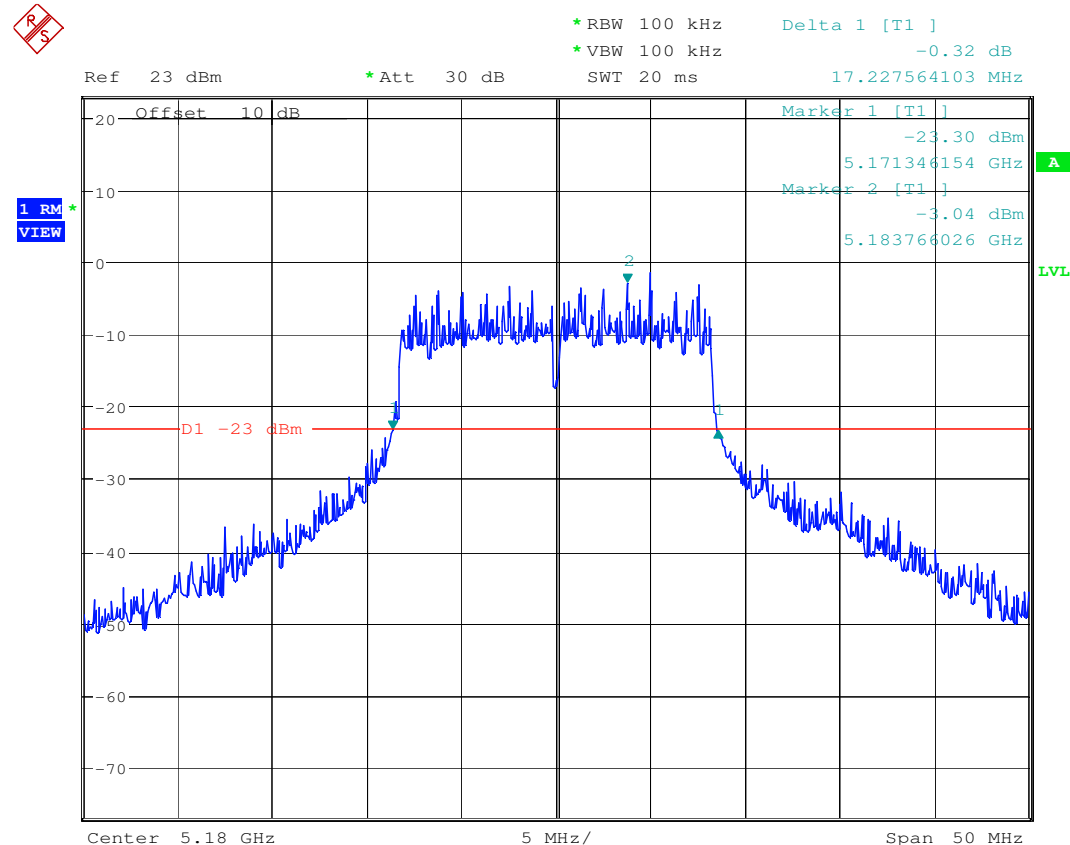
### 5180 MHz -26 dB emission BW



Date: 29.AUG.2006 11:45:27

The -26 dB-BW is 22.12 MHz

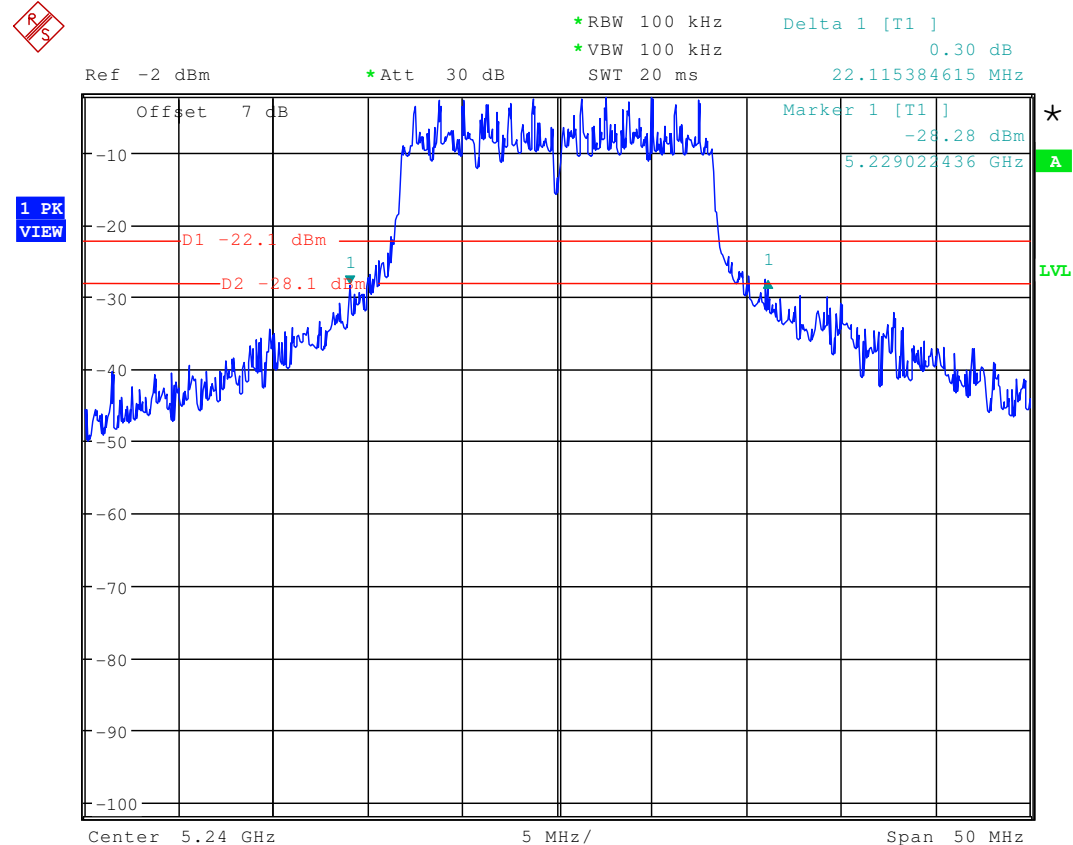
## 5180 MHz -20 dB emission BW



Date: 29.AUG.2006 11:44:44

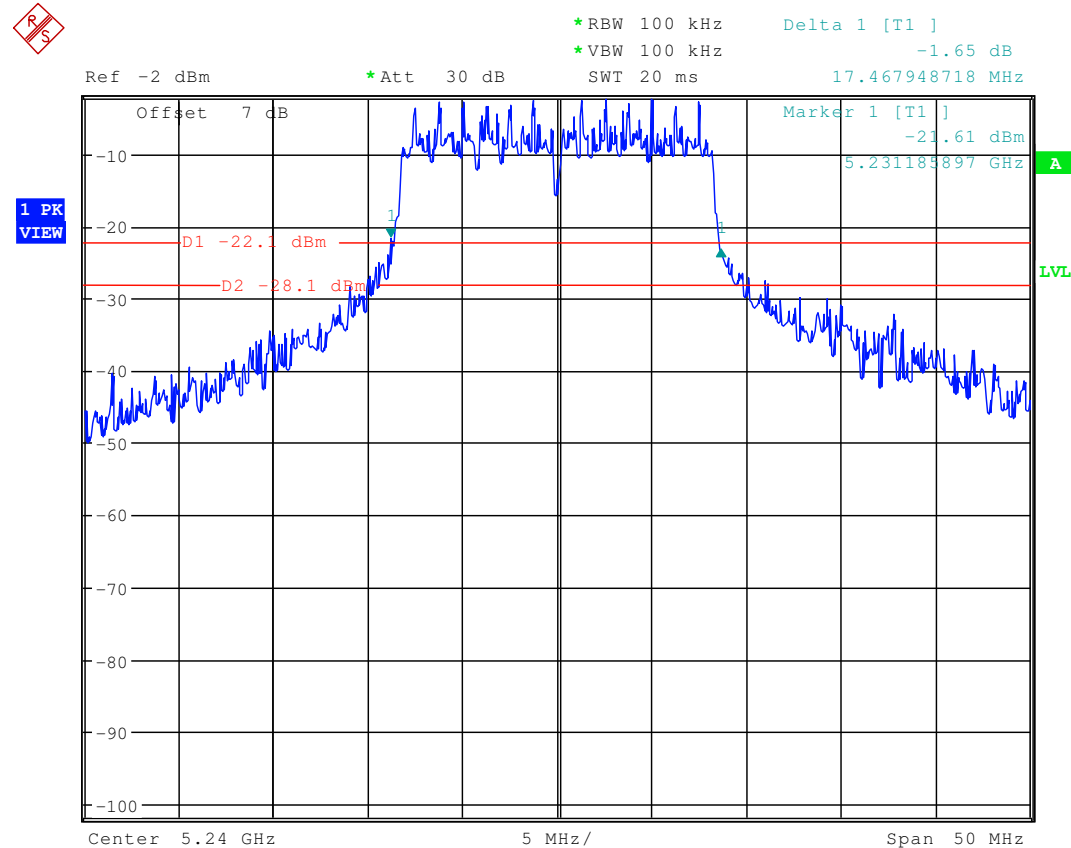
The -20 dB-BW is 17.23 MHz

## 5240 MHz -26 dB emission BW



The -26 dB-BW is 22.12 MHz

## 5240 MHz -20 dB emission BW



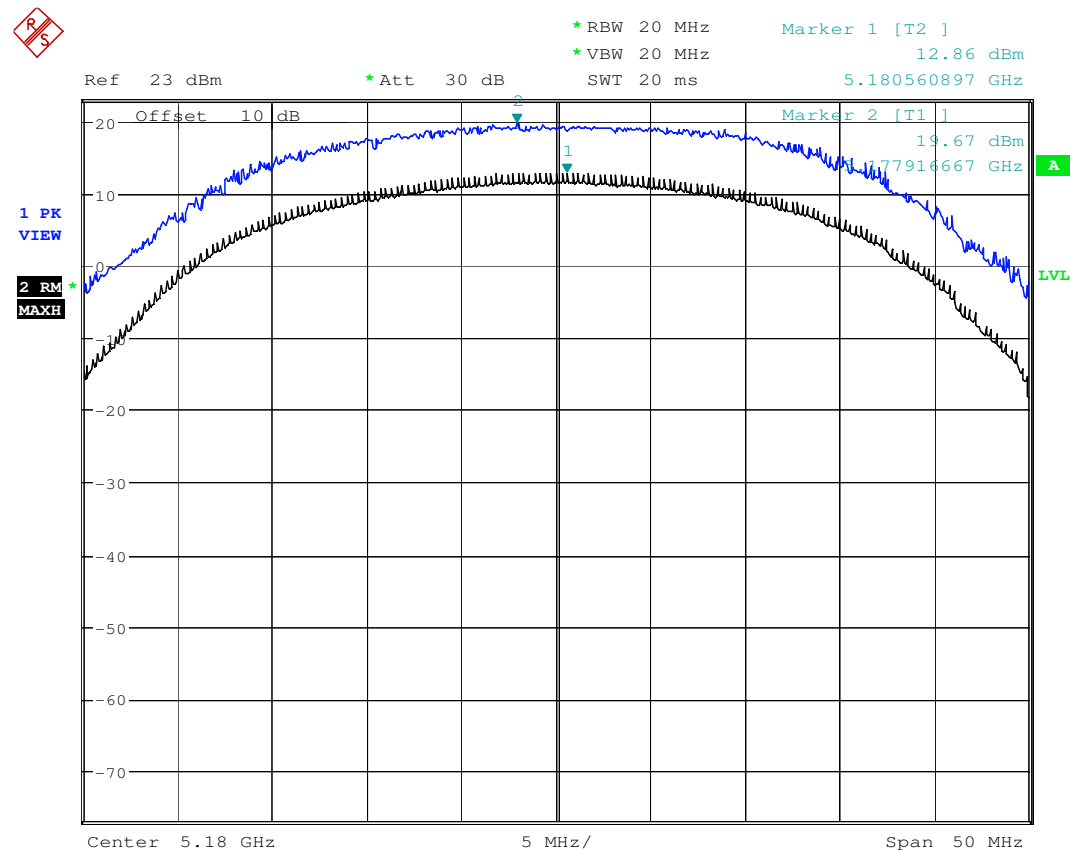
The -20 dB-BW is 17.47 MHz

## 3.7 Ratio of peak excursion

§15.407a(6)

here measured in the frequency domain

5180 MHz



Date: 29.AUG.2006 11:50:52

In this plot you see the difference between peak emissions and RMS emissions.  
The delta is 6.81 dB.

**LIMIT:**      Difference between the two values < 13 dB across any 1 MHz bandwidth

# SRD-Testreport

CETECOM ICT Services GmbH Saarbruecken, Germany



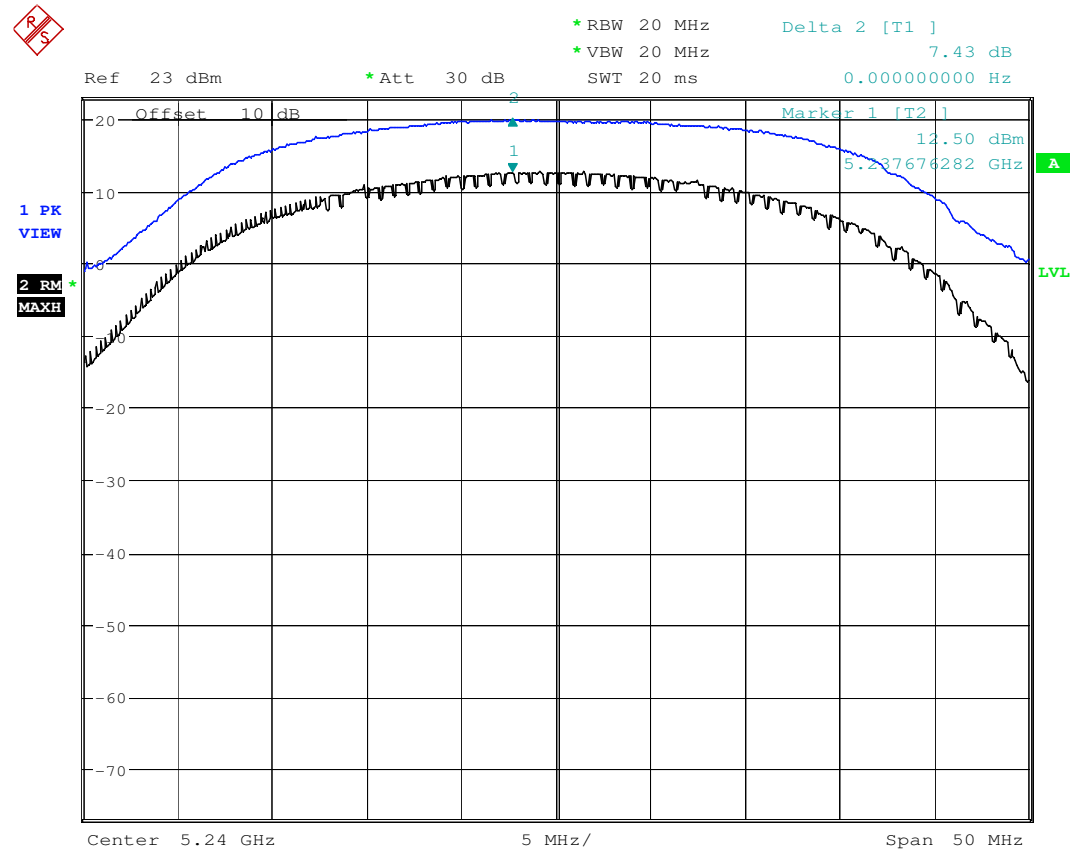
Test report No.: 2-4318-01-01/06

Date: 2006-08-30

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here measured in frequency domain

5240 MHz



Date: 29.AUG.2006 11:30:40

In this plot you see the difference between peak emissions and RMS emissions.  
The delta is 7.43 dB.

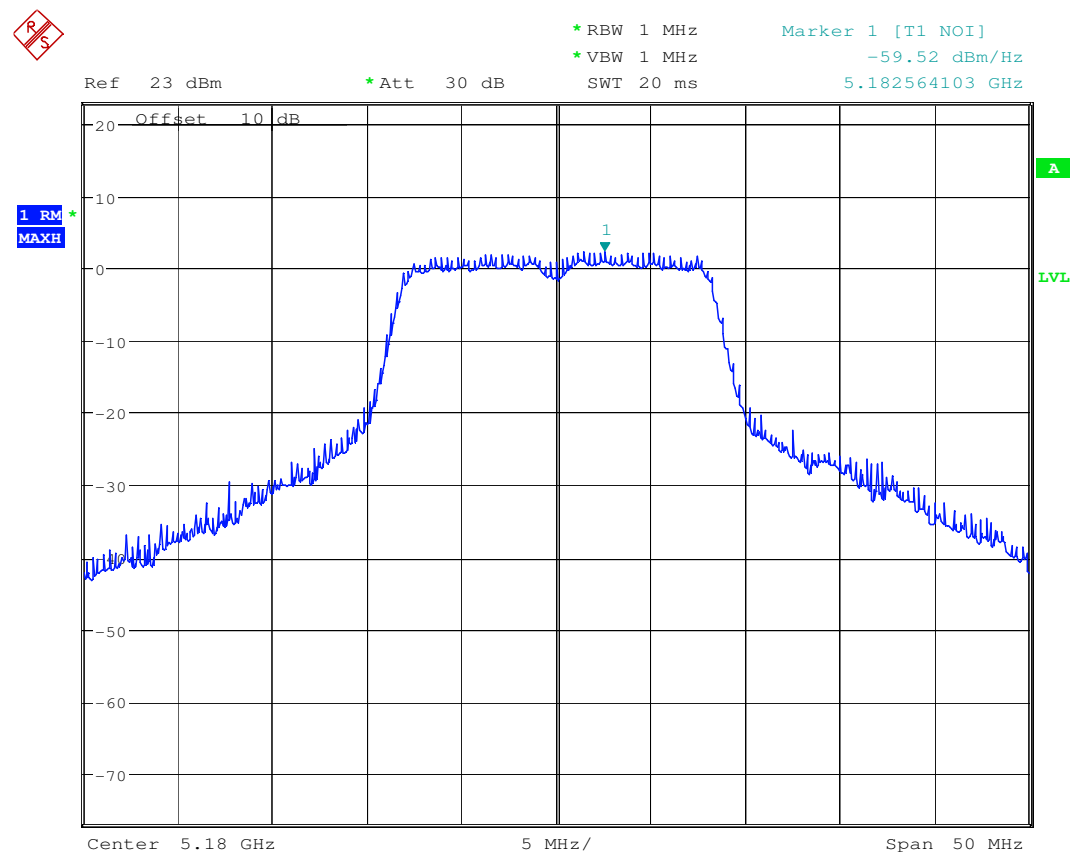
**LIMIT:** Difference between the two values < 13 dB across any 1 MHz bandwidth

## 3.8 Spectral Density Conducted

§15.407(a5)

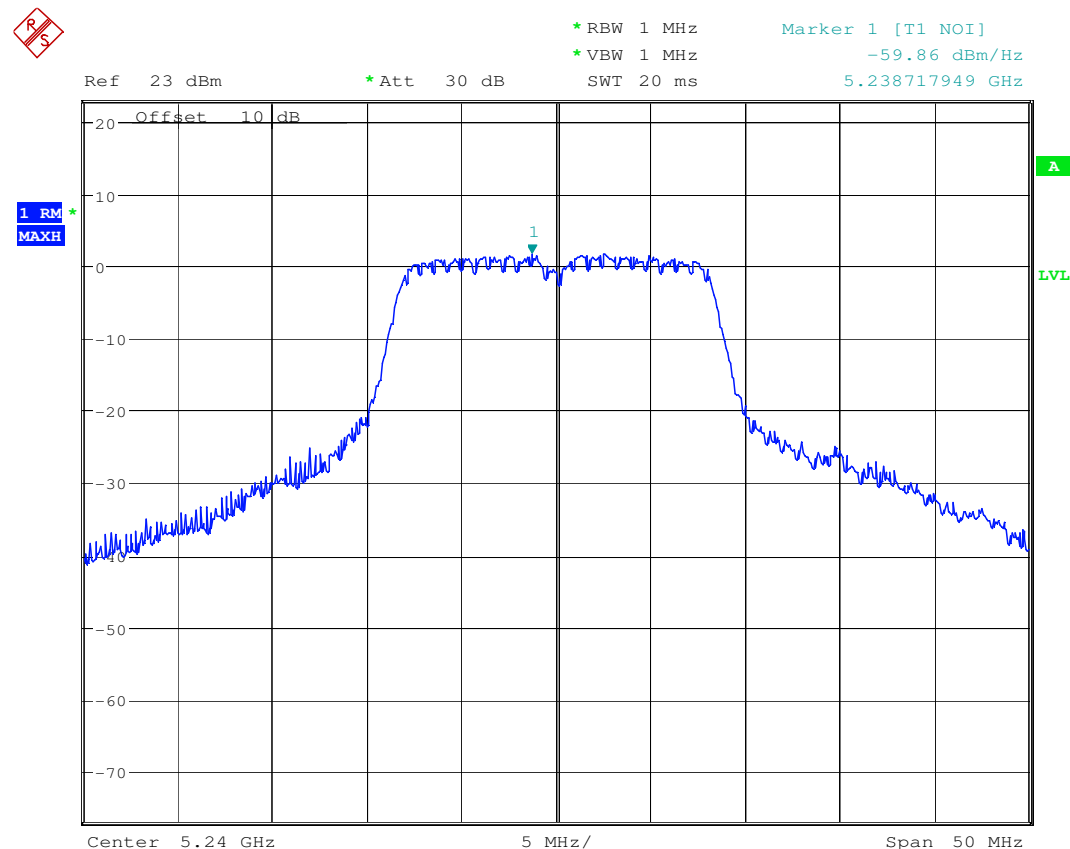
Plot 1 : 5180 MHz

Result is calculated to 1 Hz with the power density function of the analyzer FSU50. The get the result related to 1 MHz according to FCC you have to add 60 dB.



Date: 29.AUG.2006 11:42:22

Plot 2: 5240 MHz



Date: 29.AUG.2006 11:35:18

Results: with correction factors +60 dB regarding the BW from 1 Hz to 1 MHz.

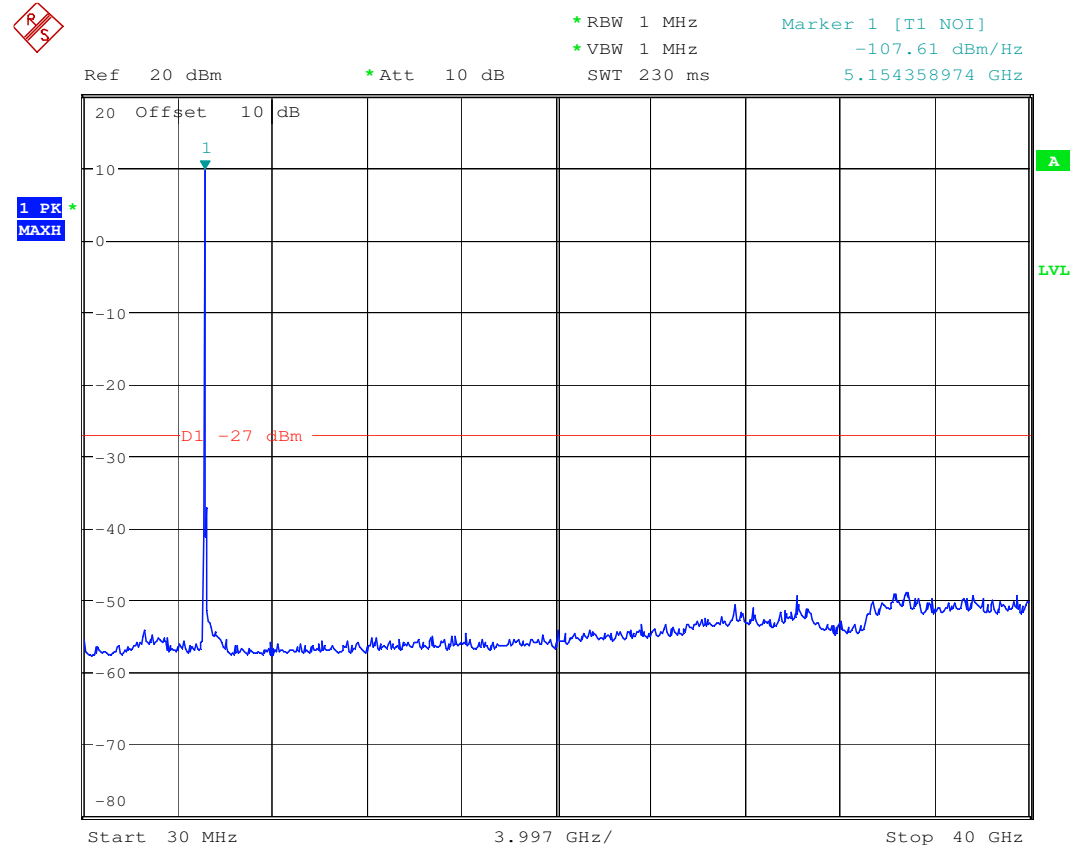
| Test conditions         |          | Spectral density<br>Including +60 dB correction factor |       |         |
|-------------------------|----------|--------------------------------------------------------|-------|---------|
| Frequency [MHz]         |          | Result                                                 | Limit | Verdict |
|                         | 5180 MHz | 0.5 dBm                                                | 4 dBm | Pass    |
|                         | 5240 MHz | 0.1 dBm                                                | 4 dBm | Pass    |
| Measurement uncertainty |          | ±1dB                                                   |       |         |

## 3.9 Undesirable emission limits conducted

15.407 (b)(1)

The measurement was performed up to 40 GHz.

Plot 1: 5180 MHz

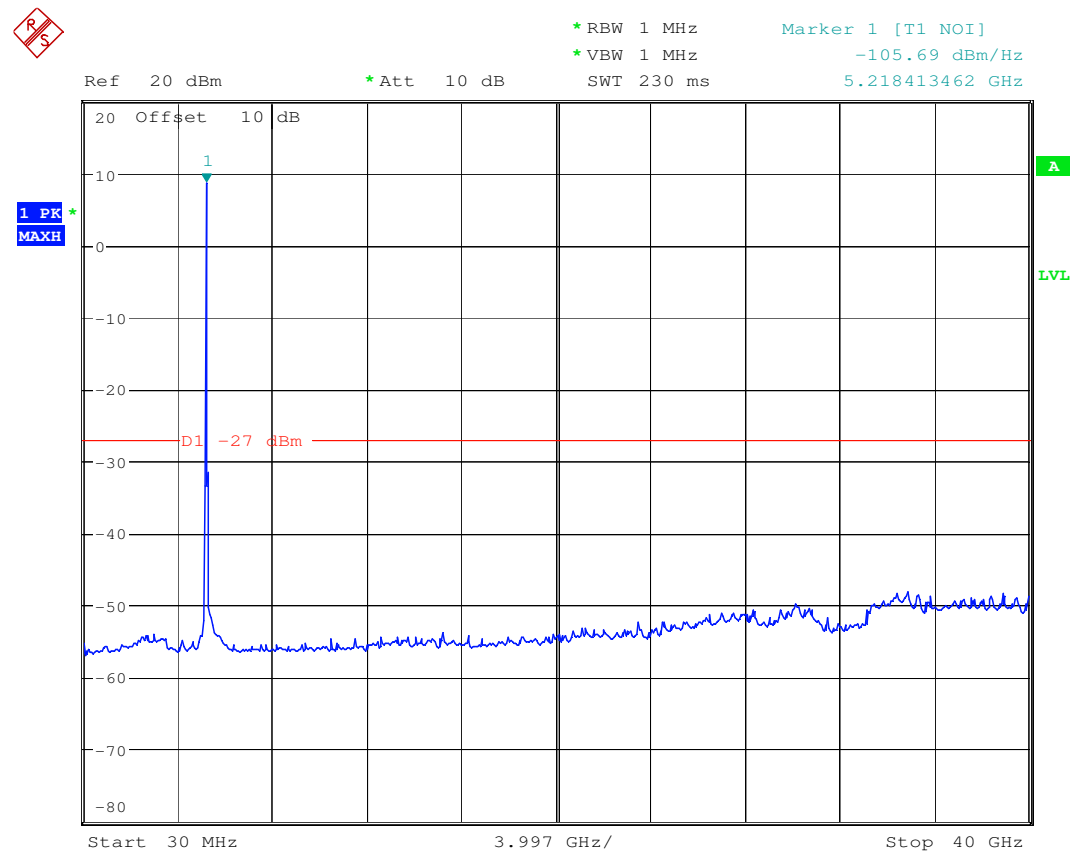


Date: 29.AUG.2006 12:52:22

RBW / VBW : 1 MHz

**LIMIT: -27 dBm/MHz outside the band 5150 to 5350 MHz.**

Plot 2: 5240 MHz



Date: 29.AUG.2006 13:30:46

RBW / VBW : 1 MHz

**LIMIT: -27 dBm/MHz outside the band 5150 to 5350 MHz.**

|                                   |                                                                                                                                                                                                                                                                       |
|-----------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Under normal test conditions only | In any 1 MHz bandwidth outside the frequency band at least -27 dBm/MHz.<br>In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)). |
|-----------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

## 3.10 MPE calculation

These equations are generally accurate in the far field of an antenna but will over predict power density in the near field, where they could be used for making a “worst case” prediction.

$$S = PG/4\pi R^2$$

where S = power density ( in appropriate units, e.g. mW/cm<sup>2</sup>)

P = power input to the antenna (in appropriate units e.g. mW)

G = power gain of the antenna in the direction of interest relative to the isotropic radiator

R = distance to the center of radiation of the antenna (appropriate units e.g. cm)

Or

$$S = EIRP/4\pi R^2$$

where EIRP = equivalent isotropically radiated power

### Calculation: (Antenna 1) (highest gain)

(Calculated for max. EIRP)

EIRP: 12.9 dBm + 1.7 dBi = 14.6 dBm = 28.8 mW

calculated at distance of 20 cm:

$$\text{power density} = 28.8 / 4\pi 20^2 = 0.006 \text{ mW/ cm}^2$$

Limit:

1mW/ cm<sup>2</sup> is the reference level for general public exposure according to the OET Bulletin 65,  
Edition 97-01 Table 1.

## 3.11 Max. peak output power (radiated) §15.247 (b) (1)

Results:

| Test conditions                                      |                  | Max. peak output power EIRP [dBm] |          |  |
|------------------------------------------------------|------------------|-----------------------------------|----------|--|
| <b>Antenna 1</b><br>(gain 1.7dBi)<br>Frequency [MHz] |                  | 5180 MHz                          | 5240 MHz |  |
| T <sub>nom</sub>                                     | V <sub>nom</sub> | 14.6                              | 14.2     |  |
| Measurement uncertainty                              |                  | ±3dB                              |          |  |

Measured with the channel power function of the analyzer

| Test conditions                                       |                  | Max. peak output power EIRP [dBm] |          |  |
|-------------------------------------------------------|------------------|-----------------------------------|----------|--|
| <b>Antenna 2</b><br>(gain 1.6 dBi)<br>Frequency [MHz] |                  | 5180 MHz                          | 5240 MHz |  |
| T <sub>nom</sub>                                      | V <sub>nom</sub> | 14.5                              | 14.1     |  |
| Measurement uncertainty                               |                  | ±3dB                              |          |  |

Limits:

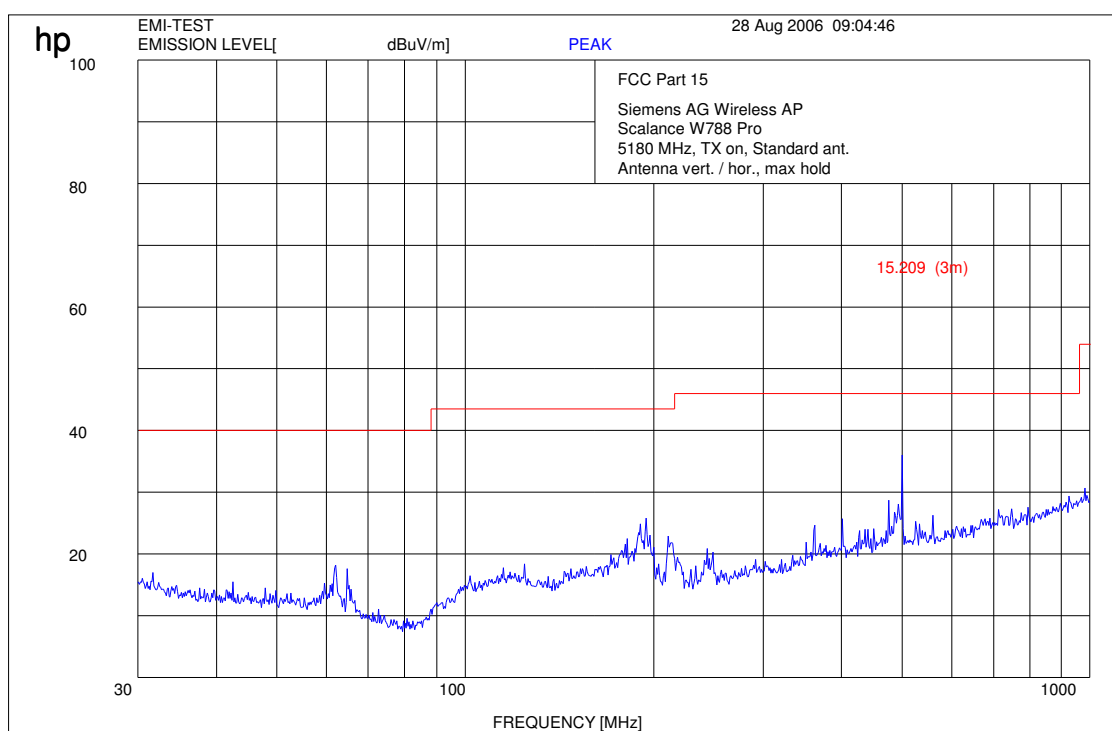
|                              |                                                                   |
|------------------------------|-------------------------------------------------------------------|
| Under normal test conditions | Max. 0.05 Watt / 13 dBm<br>As long as the antenna gain is < 6 dBi |
|------------------------------|-------------------------------------------------------------------|

## 3.12 Spurious Emissions - radiated (Transmitter)

§15.209

5180 MHz: Antenna 1:

Plot 1: 0.03 - 1 GHz (lowest channel)



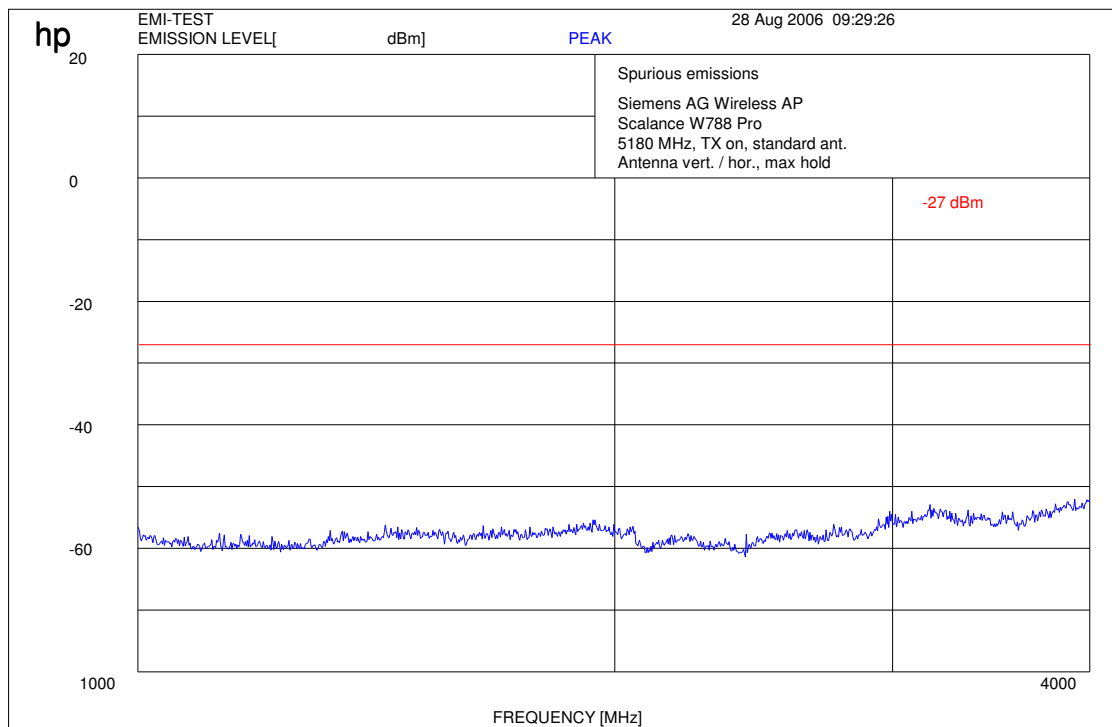
f < 1 GHz : RBW/VBW: 100 kHz

f ≥ 1GHz : RBW/VBW: 1 MHz

### Limits: § 15.209

| Frequency [MHz] | Field strength [ $\mu$ V/m] | Measurement distance (m) |
|-----------------|-----------------------------|--------------------------|
| 30 - 88         | 100 (40 dB $\mu$ V/m)       | 3                        |
| 88 - 216        | 150 (43.5 dB $\mu$ V/m)     | 3                        |
| 216 - 960       | 200 (46 dB $\mu$ V/m)       | 3                        |
| above 960       | 500 (54 dB $\mu$ V/m)       | 3                        |

Plot 2: 1 GHz – 4 GHz (lowest channel)

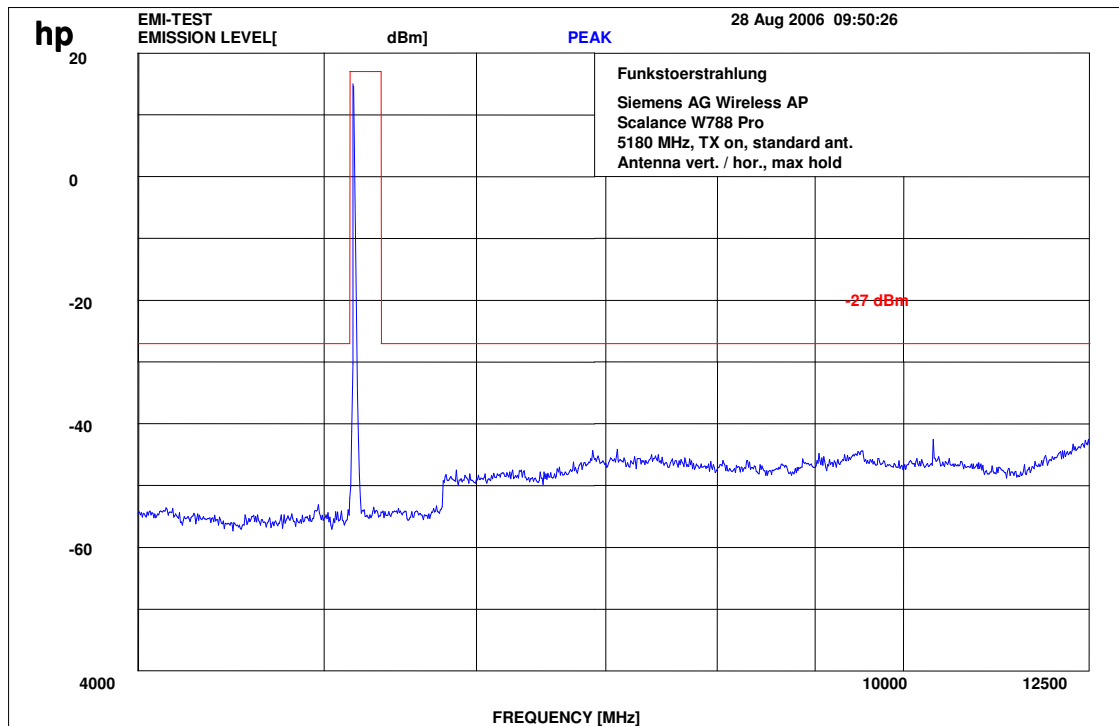


$f < 1 \text{ GHz}$  : RBW/VBW: 100 kHz

$f \geq 1 \text{ GHz}$  : RBW/VBW: 1 MHz

**LIMIT: -27 dBm/MHz above 1 GHz and outside the band 5150 to 5350 MHz**

Plot 3: 4 GHz - 12 GHz (lowest channel)

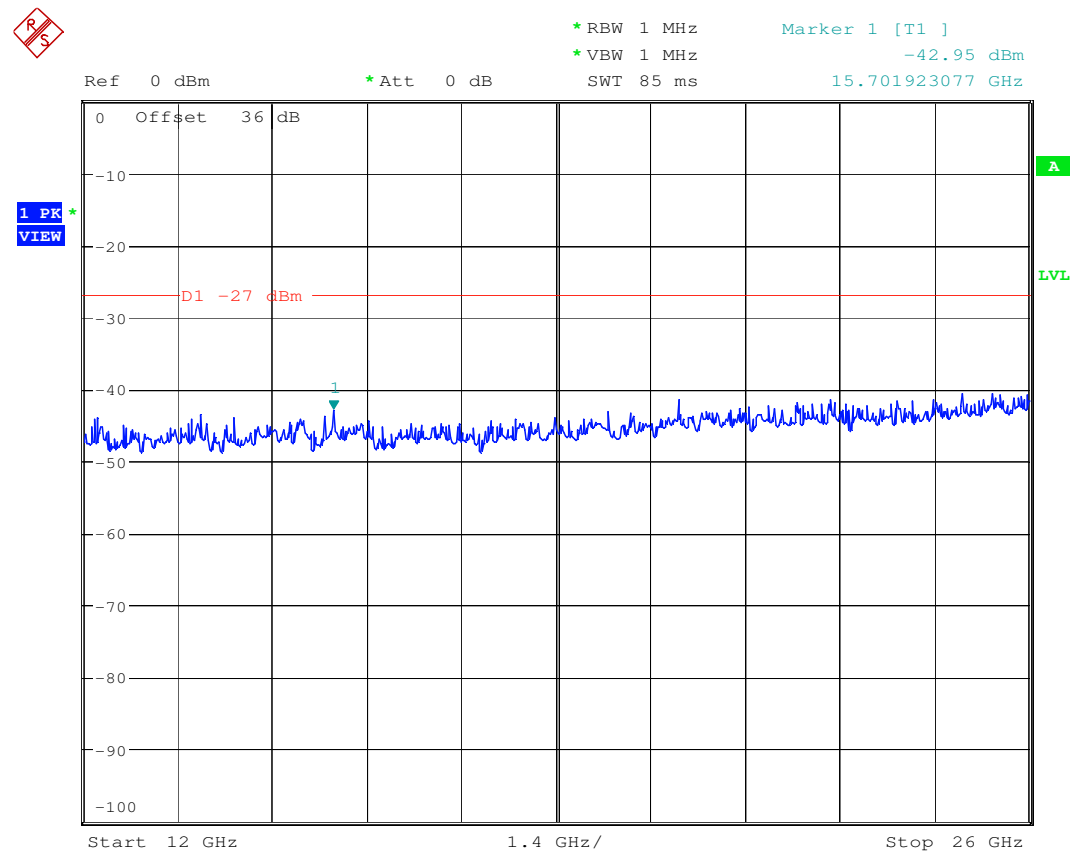


$f < 1 \text{ GHz}$  : RBW/VBW: 100 kHz

$f \geq 1 \text{ GHz}$  : RBW/VBW: 1 MHz

**LIMIT: -27 dBm/MHz above 1 GHz and outside the band 5150 to 5350 MHz**

Plot 4: 12 GHz - 26 GHz vertical (valid for all channels)



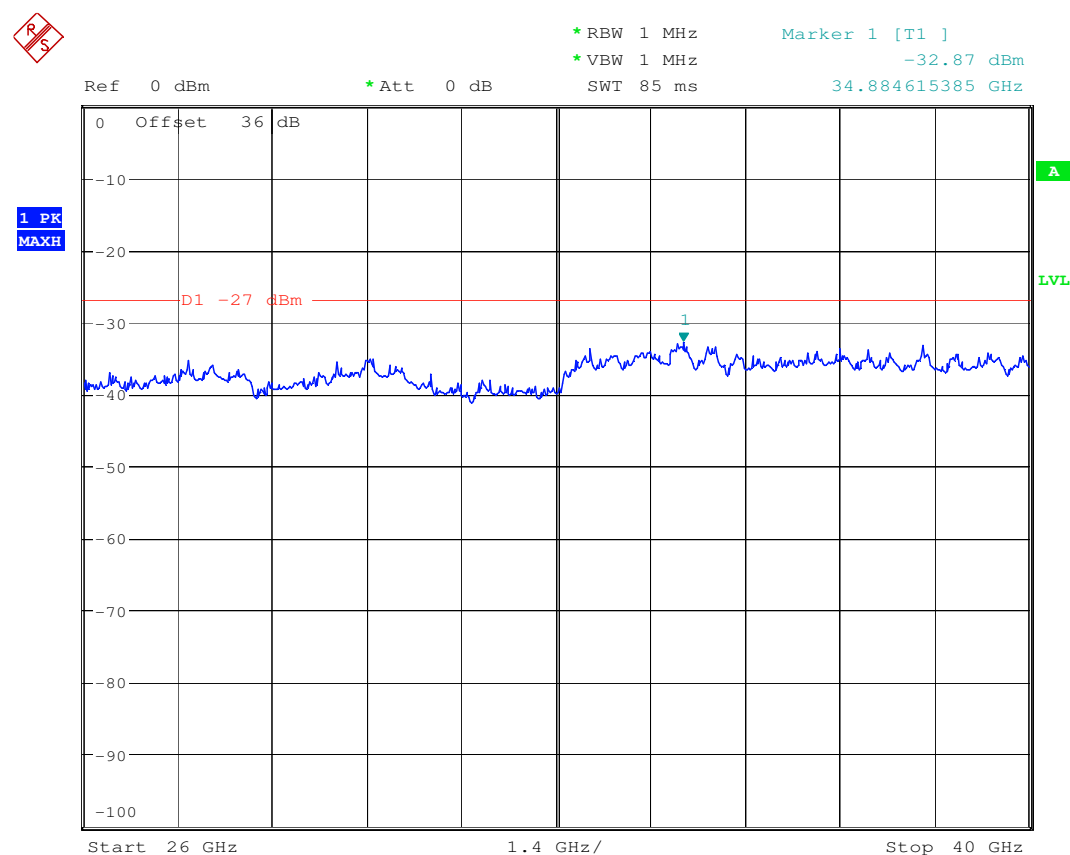
Date: 29.AUG.2006 13:42:55

$f < 1 \text{ GHz}$  : RBW/VBW: 100 kHz

$f \geq 1 \text{ GHz}$  : RBW/VBW: 1 MHz

**LIMIT: -27 dBm/MHz above 1 GHz and outside the band 5150 to 5350 MHz**

Plot 5: 26 GHz to 40 GHz vertical (valid for all channels)



Date: 29.AUG.2006 13:35:57

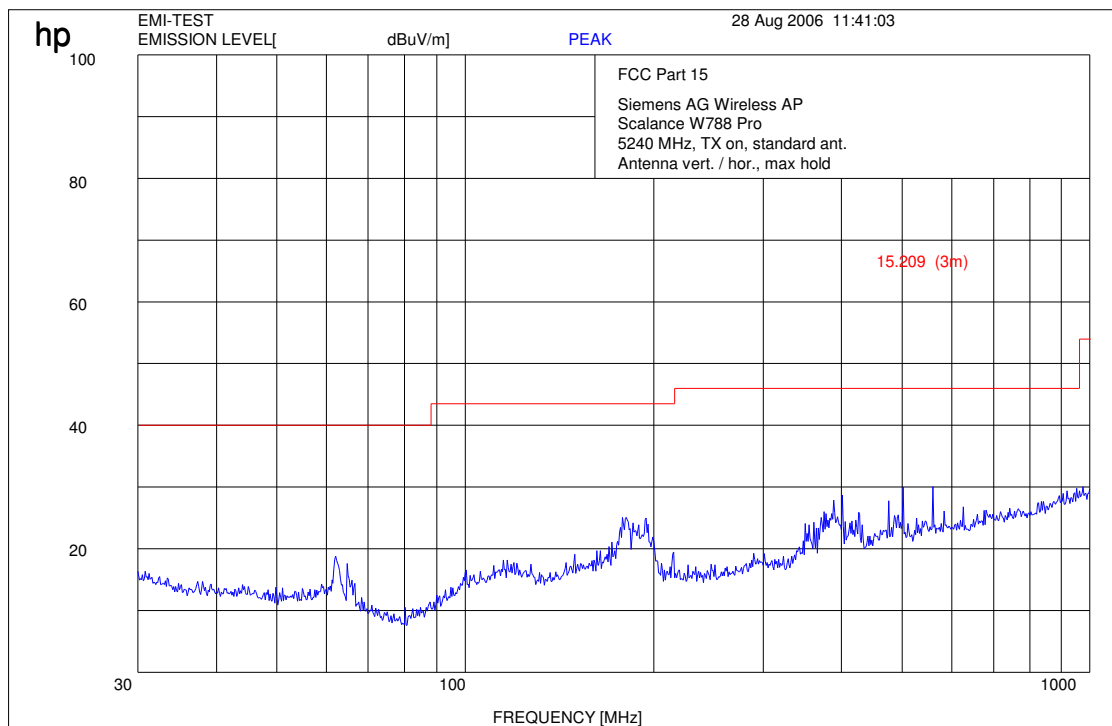
$f < 1 \text{ GHz}$  : RBW/VBW: 100 kHz

$f \geq 1 \text{ GHz}$  : RBW/VBW: 1 MHz

**LIMIT: -27 dBm/MHz above 1 GHz and outside the band 5150 to 5350 MHz**

5240 MHz: Antenna 1:

Plot 6: 30 MHz to 1 GHz (highest channel)



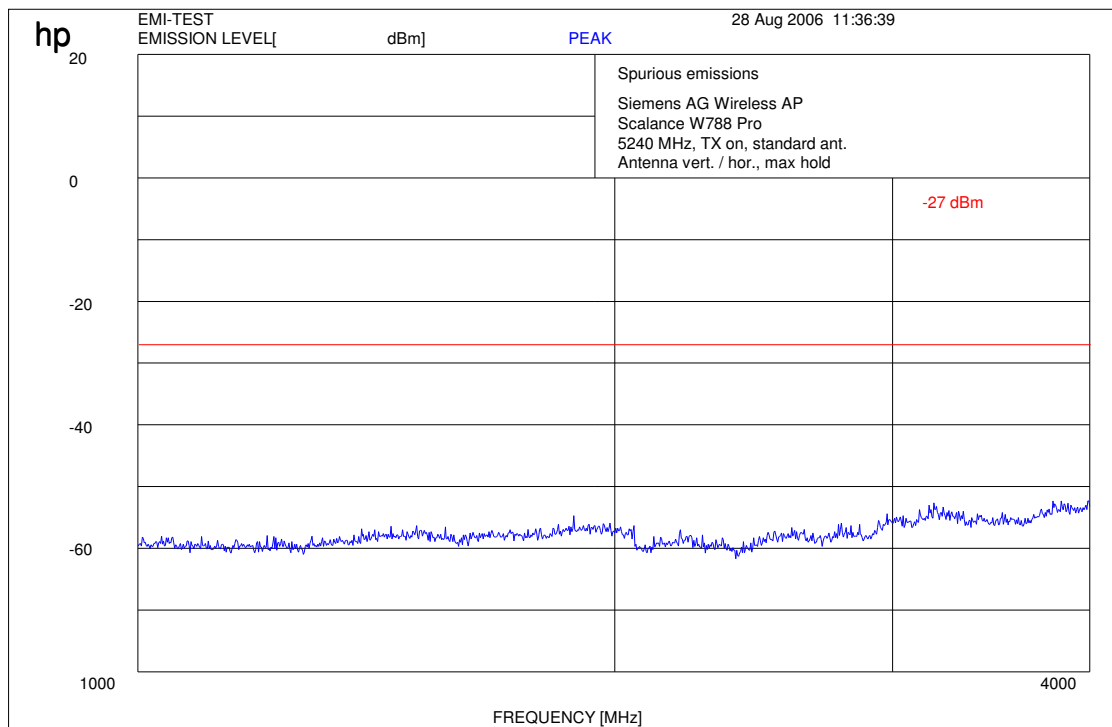
f < 1 GHz : RBW/VBW: 100 kHz

f ≥ 1GHz : RBW/VBW: 1 MHz

## Limits: § 15.209

| Frequency [MHz] | Field strength [ $\mu$ V/m] | Measurement distance (m) |
|-----------------|-----------------------------|--------------------------|
| 30 - 88         | 100 (40 dB $\mu$ V/m)       | 3                        |
| 88 - 216        | 150 (43.5 dB $\mu$ V/m)     | 3                        |
| 216 - 960       | 200 (46 dB $\mu$ V/m)       | 3                        |
| above 960       | 500 (54 dB $\mu$ V/m)       | 3                        |

Plot 7: 1 GHz to 4 GHz (highest channel)

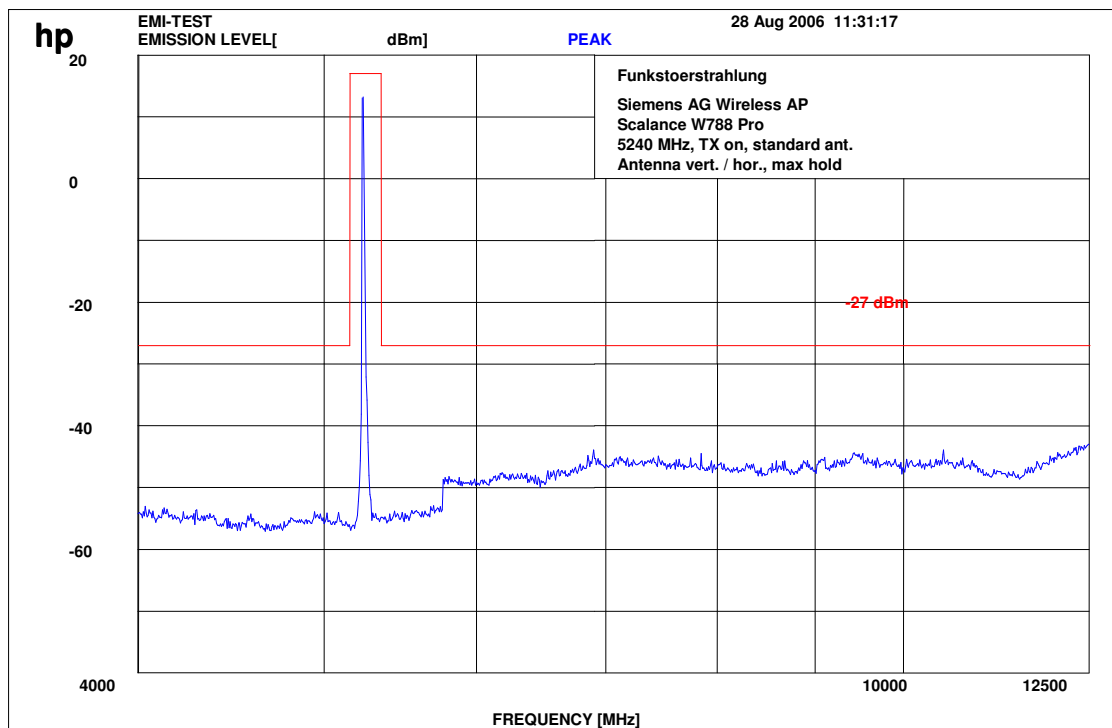


$f < 1 \text{ GHz}$  : RBW/VBW: 100 kHz

$f \geq 1 \text{ GHz}$  : RBW/VBW: 1 MHz

**LIMIT: -27 dBm/MHz above 1 GHz and outside the band 5150 to 5350 MHz**

Plot 8: 4 GHz to 12 GHz (highest channel)



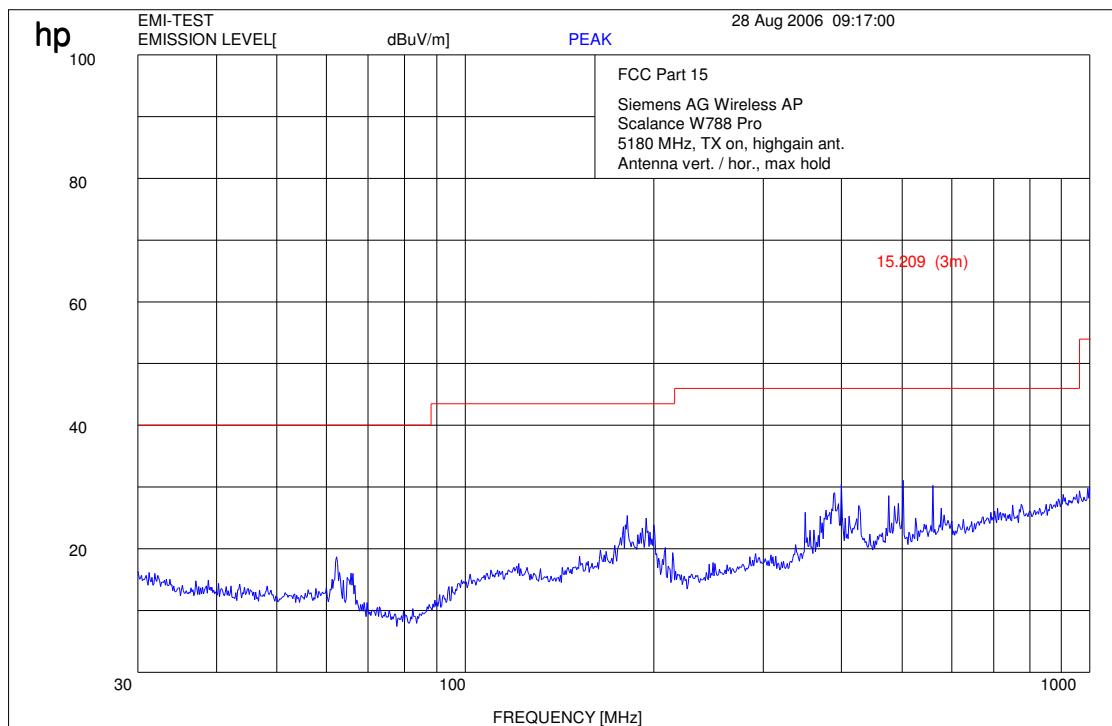
$f < 1 \text{ GHz}$  : RBW/VBW: 100 kHz

$f \geq 1 \text{ GHz}$  : RBW/VBW: 1 MHz

**LIMIT: -27 dBm/MHz above 1 GHz and outside the band 5150 to 5350 MHz**

5180 MHz: Antenna 2:

Plot 9: 30 MHz to 1 GHz (lowest channel)



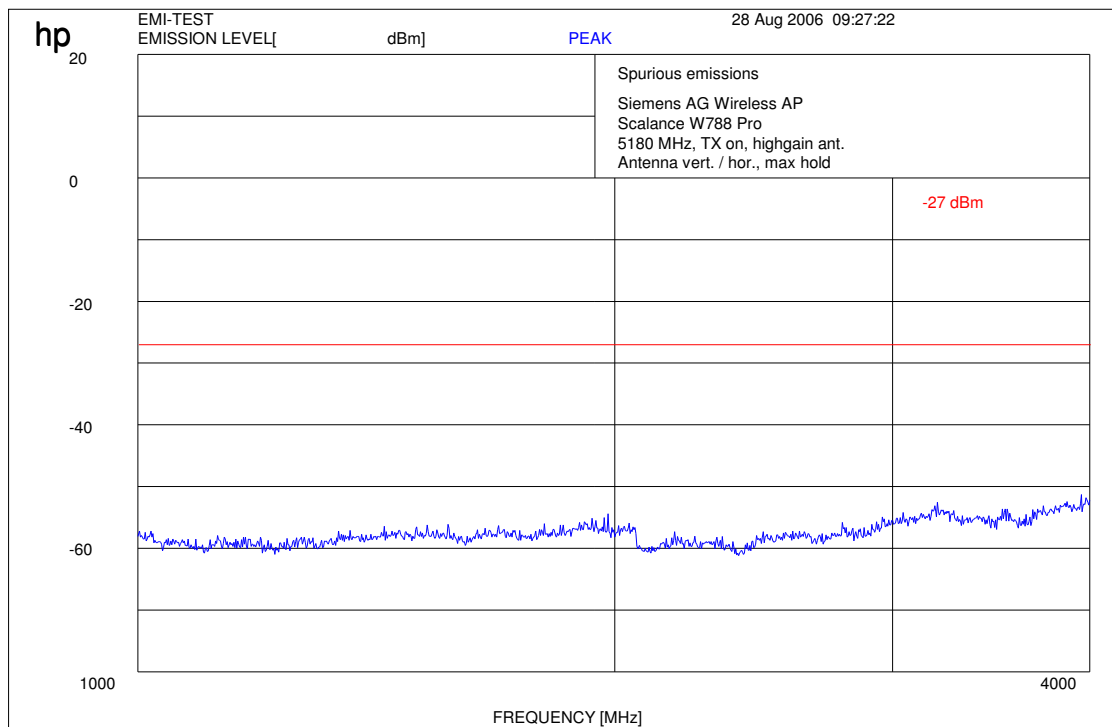
$f < 1 \text{ GHz}$  : RBW/VBW: 100 kHz

$f \geq 1 \text{ GHz}$  : RBW/VBW: 1 MHz

## Limits: § 15.209

| Frequency [MHz] | Field strength [ $\mu\text{V/m}$ ] | Measurement distance (m) |
|-----------------|------------------------------------|--------------------------|
| 30 - 88         | 100 (40 dB $\mu\text{V/m}$ )       | 3                        |
| 88 - 216        | 150 (43.5 dB $\mu\text{V/m}$ )     | 3                        |
| 216 - 960       | 200 (46 dB $\mu\text{V/m}$ )       | 3                        |
| above 960       | 500 (54 dB $\mu\text{V/m}$ )       | 3                        |

Plot 10: 1 GHz to 4 GHz (lowest channel)

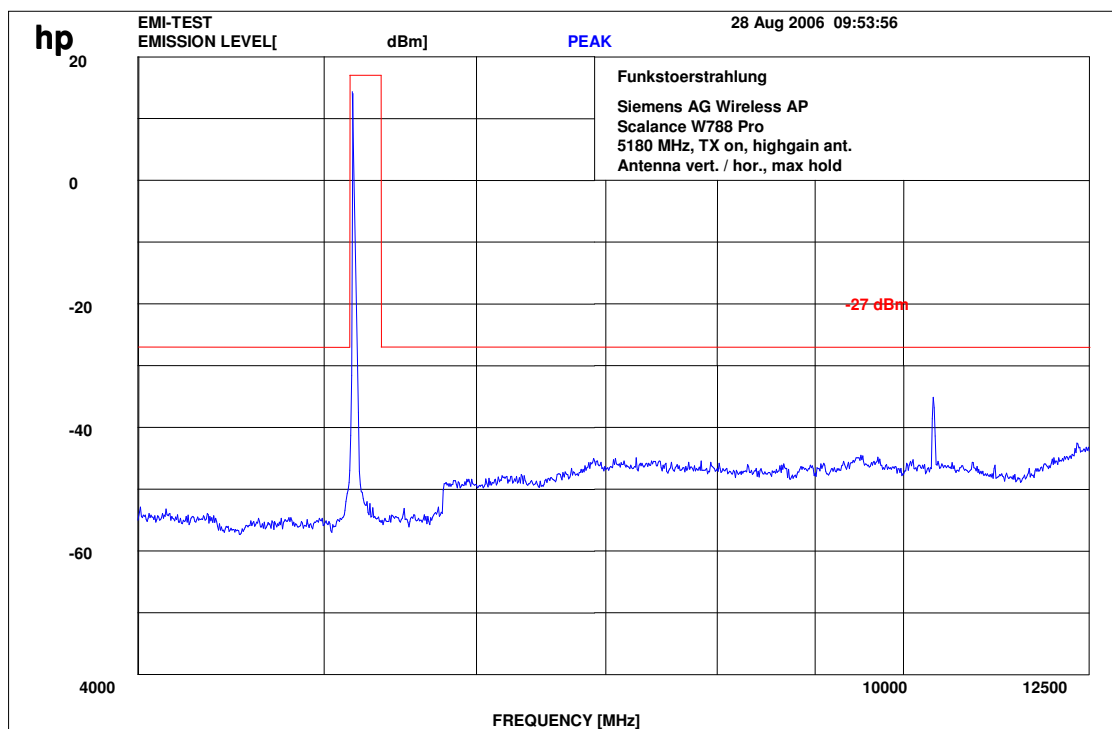


$f < 1 \text{ GHz}$  : RBW/VBW: 100 kHz

$f \geq 1 \text{ GHz}$  : RBW/VBW: 1 MHz

**LIMIT: -27 dBm/MHz above 1 GHz and outside the band 5150 to 5350 MHz**

Plot 11: 4 GHz to 12 GHz (lowest channel)



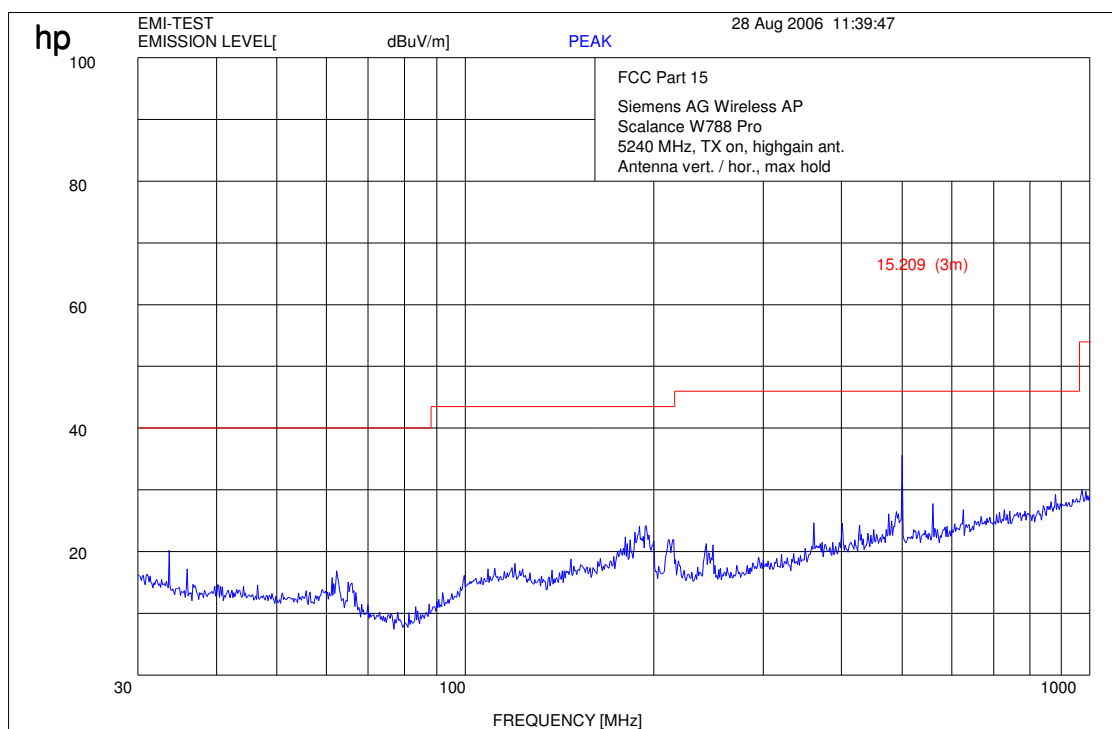
$f < 1 \text{ GHz}$  : RBW/VBW: 100 kHz

$f \geq 1 \text{ GHz}$  : RBW/VBW: 1 MHz

The unwanted emission at 10360 Mhz is -33.4 dBm/MHz

**LIMIT: -27 dBm/MHz above 1 GHz and outside the band 5150 to 5350 MHz**

Plot 12: 30 MHz to 1GHz (highest channel)



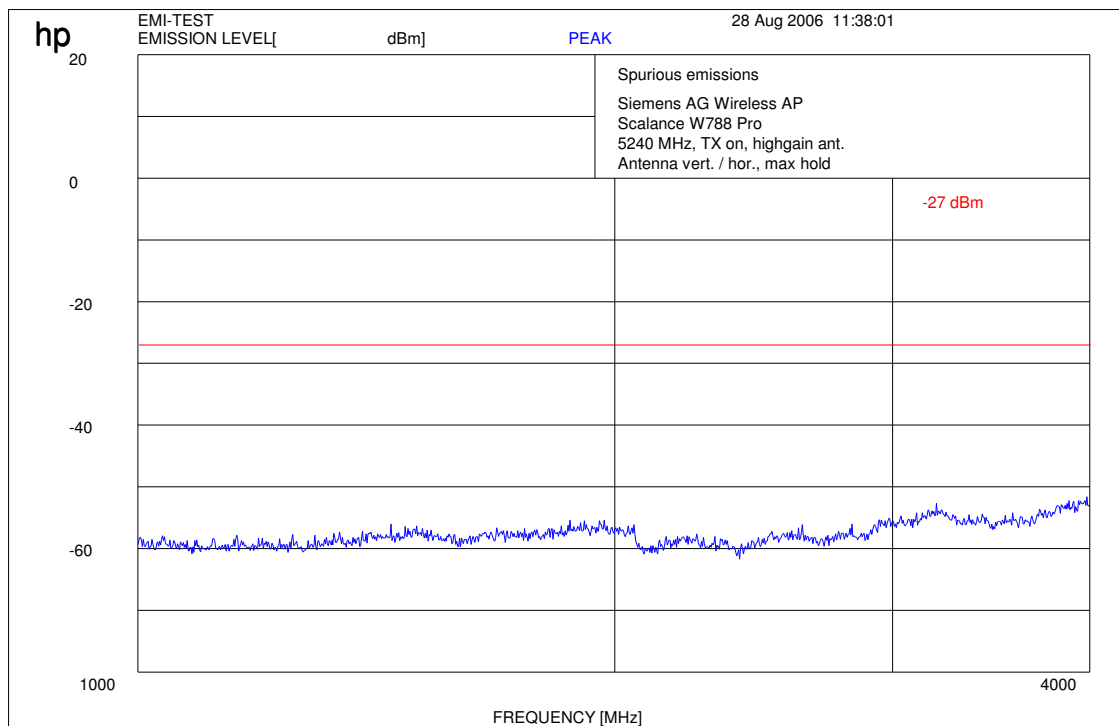
f < 1 GHz : RBW/VBW: 100 kHz

f ≥ 1GHz : RBW/VBW: 1 MHz

## Limits: § 15.209

| Frequency [MHz] | Field strength [ $\mu$ V/m] | Measurement distance (m) |
|-----------------|-----------------------------|--------------------------|
| 30 - 88         | 100 (40 dB $\mu$ V/m)       | 3                        |
| 88 - 216        | 150 (43.5 dB $\mu$ V/m)     | 3                        |
| 216 - 960       | 200 (46 dB $\mu$ V/m)       | 3                        |
| above 960       | 500 (54 dB $\mu$ V/m)       | 3                        |

Plot 13: 1- 4 GHz (highest channel)

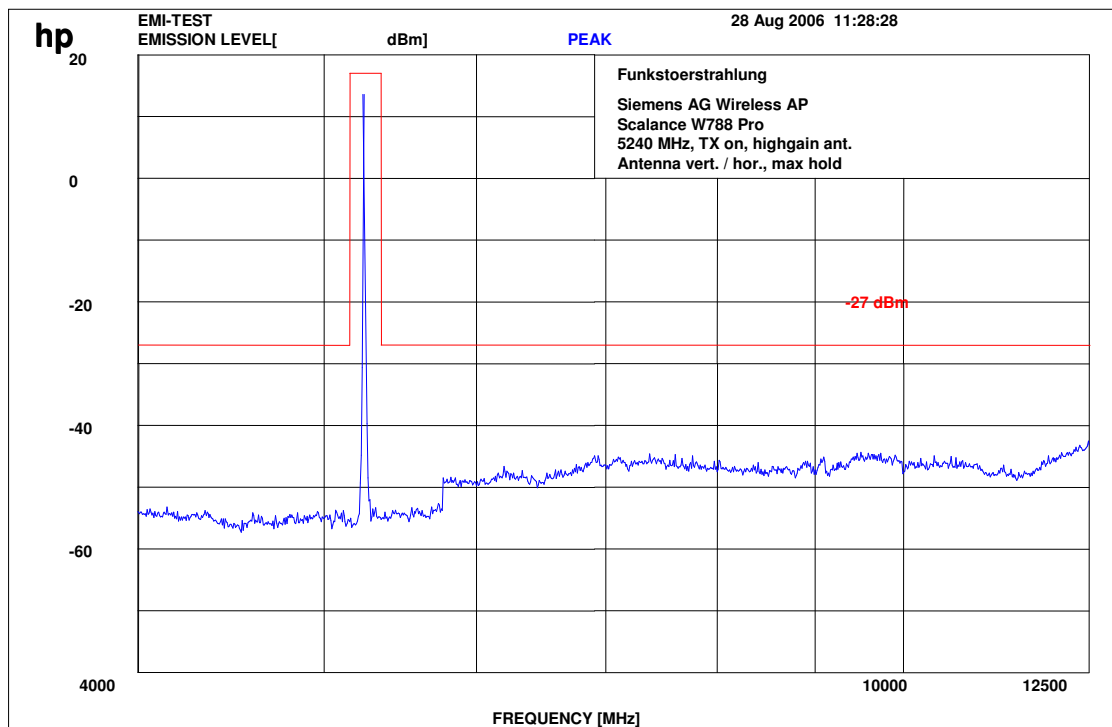


$f < 1 \text{ GHz}$  : RBW/VBW: 100 kHz

$f \geq 1 \text{ GHz}$  : RBW/VBW: 1 MHz

**LIMIT: -27 dBm/MHz above 1 GHz and outside the band 5150 to 5350 MHz**

Plot 14: 4- 12 GHz (highest channel)



$f < 1 \text{ GHz}$  : RBW/VBW: 100 kHz

$f \geq 1 \text{ GHz}$  : RBW/VBW: 1 MHz

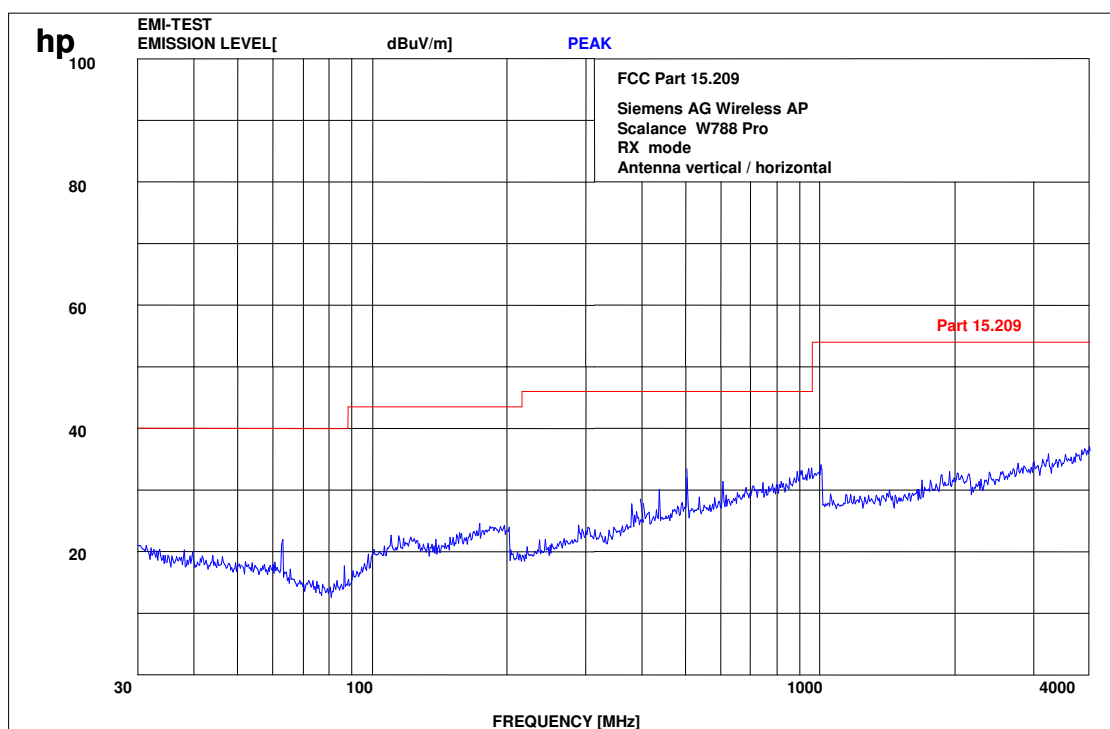
**LIMIT: -27 dBm/MHz above 1 GHz and outside the band 5150 to 5350 MHz**

## 3.13 Spurious emissions radiated (RX)

15.209

Valid for all antennas

Plot 1: 30 to 4000 MHz



f < 1 GHz : RBW/VBW: 100 kHz

f ≥ 1GHz : RBW/VBW: 1 MHz

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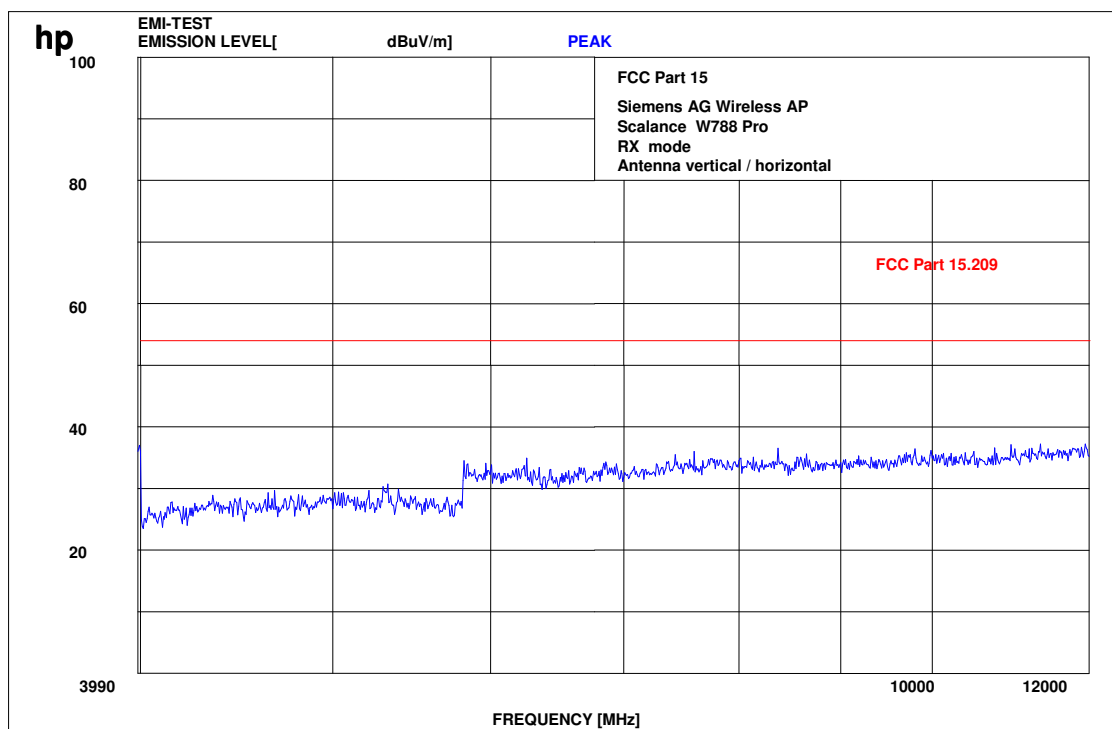


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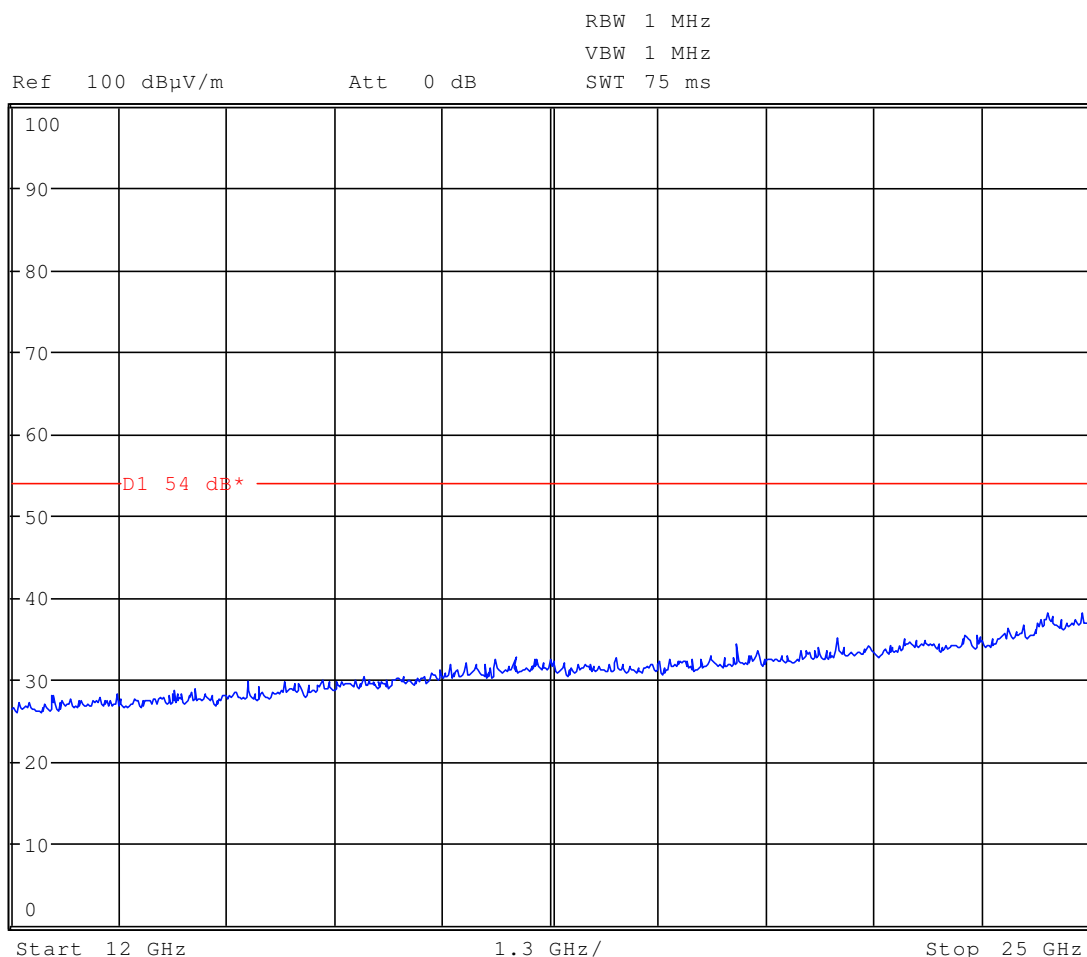
Plot 2: 4 GHz to 12 GHz



f < 1 GHz : RBW/VBW: 100 kHz

f ≥ 1GHz : RBW/VBW: 1 MHz

Plot 3: - 25 GHz



**The measurements were performed up to 60 GHz. There were no peaks found.**

$f < 1 \text{ GHz}$  : RBW/VBW: 100 kHz

$f \geq 1 \text{ GHz}$  : RBW/VBW: 1 MHz

## Limits: § 15.209

| Frequency [MHz] | Field strength [ $\mu\text{V/m}$ ] | Measurement distance (m) |
|-----------------|------------------------------------|--------------------------|
| 30 - 88         | 100 (40 dBμV/m)                    | 3                        |
| 88 - 216        | 150 (43.5 dBμV/m)                  | 3                        |
| 216 - 960       | 200 (46 dBμV/m)                    | 3                        |
| above 960       | 500 (54 dBμV/m)                    | 3                        |

## Results:

| Spurious Emissions level [ $\mu\text{V/m}$ ] |          |                           |                   |          |                           |        |          |                           |
|----------------------------------------------|----------|---------------------------|-------------------|----------|---------------------------|--------|----------|---------------------------|
| CH 1 / 2                                     |          |                           |                   |          |                           |        |          |                           |
| f[MHz]                                       | Detector | Level [ $\mu\text{V/m}$ ] | f[MHz]            | Detector | Level [ $\mu\text{V/m}$ ] | f[MHz] | Detector | Level [ $\mu\text{V/m}$ ] |
| no                                           | peaks    | found                     | < 15 dB           | below    | limit                     |        |          |                           |
|                                              |          |                           |                   |          |                           |        |          |                           |
|                                              |          |                           |                   |          |                           |        |          |                           |
|                                              |          |                           |                   |          |                           |        |          |                           |
|                                              |          |                           |                   |          |                           |        |          |                           |
|                                              |          |                           |                   |          |                           |        |          |                           |
|                                              |          |                           |                   |          |                           |        |          |                           |
|                                              |          |                           |                   |          |                           |        |          |                           |
|                                              |          |                           |                   |          |                           |        |          |                           |
|                                              |          |                           |                   |          |                           |        |          |                           |
|                                              |          |                           |                   |          |                           |        |          |                           |
|                                              |          |                           |                   |          |                           |        |          |                           |
| Measurement uncertainty                      |          |                           | $\pm 3\text{ dB}$ |          |                           |        |          |                           |

f < 1 GHz : RBW/VBW: 100 kHz  
see above plots

f  $\geq$  1GHz : RBW/VBW: 1 MHz

Measurement distance see table

Limits : § 15.109 / 209

| Frequency (MHz) | Field strength ( $\mu\text{V/m}$ ) | Measurement distance (m) |
|-----------------|------------------------------------|--------------------------|
| 30 - 88         | 100 (40 dB $\mu\text{V/m}$ )       | 3                        |
| 88 - 216        | 150 (43.5 dB $\mu\text{V/m}$ )     | 3                        |
| 216 - 960       | 200 (46 dB $\mu\text{V/m}$ )       | 3                        |
| above 960       | 500 (54 dB $\mu\text{V/m}$ )       | 3                        |

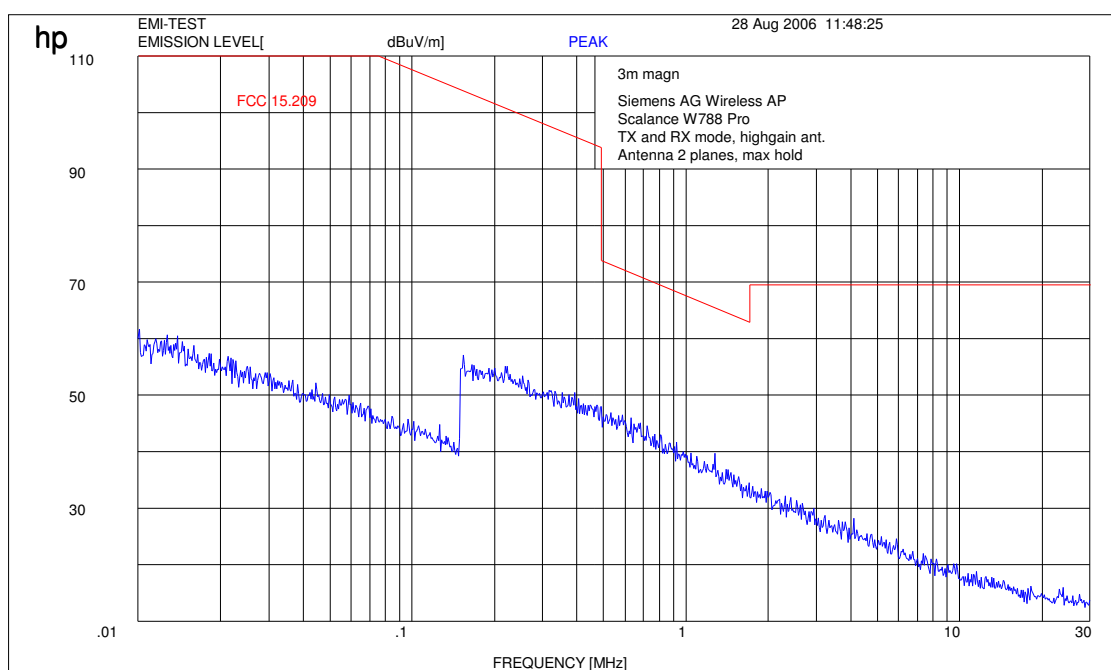
## 3.14 Spurious Emissions - radiated <30 MHz (valid for all antenna types)§15.109

(measured with a 110V AC power supply from our house as the product is delivered without any power supply.)

Measured at 3 m distance.

Values recalculated with 40 dB/decade according to FCC rules.

Plot 1:



Limits:

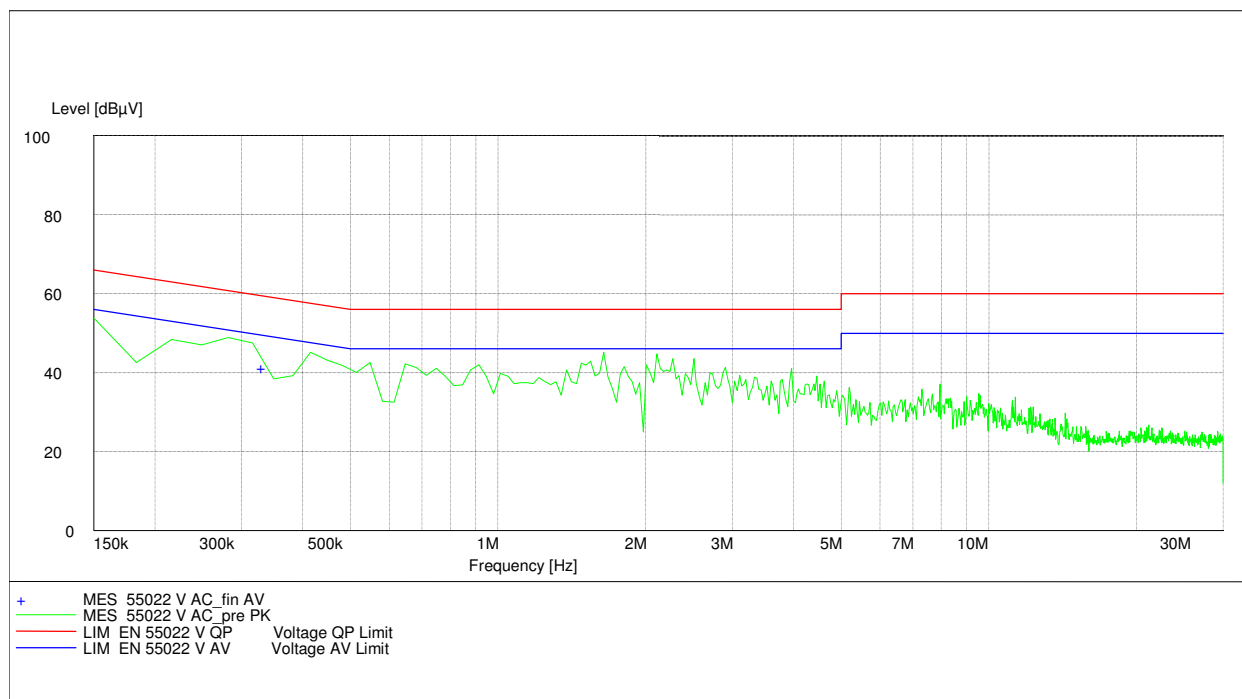
| Frequency (MHz) | Field strength ( $\mu\text{V/m}$ ) | Measurement distance (m) |
|-----------------|------------------------------------|--------------------------|
| 0.009 – 0.490   | 2400/F(kHz)                        | 300                      |
| 0.490 – 1.705   | 24000/F(kHz)                       | 30                       |
| 1.705 – 30.0    | 30 / 29.5 dB $\mu\text{V/m}$       | 30                       |
| 30 - 88         | 100 / 40 dB $\mu\text{V/m}$        | 3                        |
| 88 - 216        | 150 / 43.5 dB $\mu\text{V/m}$      | 3                        |
| 216 - 960       | 200 / 46 dB $\mu\text{V/m}$        | 3                        |
| above 960       | 54 dB $\mu\text{V/m}$              | 3                        |

## 3.15 Conducted Emissions <30 MHz

§15.107/207

(measured with a 110V AC power supply from our house as the product is delivered without any power supply.)

Plot 1: CISPR 22



We measured in TX and RX mode, L1 and N floating and grounded, max value was hold.

Limits :

|                                   |           |
|-----------------------------------|-----------|
| Under normal test conditions only | See plots |
|-----------------------------------|-----------|

## 3.16 Used Testequipment

### *Anechoic chamber C:*

| Device                    | Manufacturer | Type      | S/N Number | Inv. No. Cetecom |
|---------------------------|--------------|-----------|------------|------------------|
| Spectrum Analyzer         | HP           | 8566B     | 2747A05306 | 300001000        |
| Spectrum Analyzer Display | HP           | 85662A    | 2816A16541 | 300002297        |
| Quasi-Peak-Adapter        | HP           | 85650A    | 2811A01131 | 300000999        |
| Power Supply              | HP           | 6032A     | 2818A03450 | 300001040        |
| Power Attenuator          | Byrd         | 8325      | 1530       | 300001595        |
| Biconical Antenna         | EMCO         | 3104      | 3758       | 300001602        |
| Log. Period. Antenna      | EMCO         | 3146      | 2130       | 300001603        |
| Double Ridged Antenna     | EMCO         | HP 3115P  | 3088       | 300001032        |
| Active Loop Antenna       | EMCO         | 6502      | 2210       | 300001015        |
| Antenna VDE/FCC           |              | HP11965B  |            | 300002298        |
| SRM-Drive                 | HP           | 9144A     | 2823e46556 | 300001044        |
| Software                  | HP           | EMI       |            | 300000983        |
| Busisolator               | Kontron      |           |            | 300001056        |
| Absorberhalle             | MWB          |           | 87400/02   | 300000996        |
| Salzsäule                 | Kontron      |           |            | 300001055        |
| Antenna                   | R&S          | HMO20     | 832211/003 | 300002243        |
| Indukt. Tast Antenna      | R&S          | HFH 2 Z4  | 881468/026 | 300001464        |
| System-Rack               | HP I.V.      | 85900     | *          | 300000222        |
| Spectrum Analyzer         | HP           | 8566B     | 2747A05275 | 300000219        |
| Quasi-Peak-Adapter        | HP           | 85650A    | 2811A01135 | 300000216        |
| RF-Preselector            | HP           | 85685A    | 2837A00779 | 300000218        |
| Rahmen Antenne            | R&S          | HFH2-Z2   | 891847-35  | 300001169        |
| Leitungsteiler            | HP           | 11850C    |            | 300000997        |
| Breitband-Hornantenne EMI | HP           | 35155P    |            | 300002300        |
| PC                        | HP           | Vectra VL |            | 300001688        |
| VHF Meßantenne            | Schwarzbeck  | VHA 9103  |            | 300001778        |
| Spectrum Analyzer Display | HP           | 85662A    | 2816A16497 | 300001690        |
| VHF Meßantenna            | Schwarzbeck  | VHA 9103  |            | 300001780        |
| Biconical Antenna         | EMCO         | 3104 C    | 9909-4868  | 300002590        |

### *SRD Laboratory:*

| Device                          | Manufacturer | Type           | S/N Number | Inv. No. Cetecom |
|---------------------------------|--------------|----------------|------------|------------------|
| Spectrum Analyzer               | R&S          | FSU50          | 200012     | 300003443        |
| Spectrum Analyzer               | HP           | 71210A (70000) | 2731A02347 | 300000321        |
| Spectrum Analyzer Display       | HP           | 70206A         | 2840A01553 | 300002017        |
| Reference Frequency             | HP           | 70310A         | 2736A00707 | 300002018        |
| Local Oscillator                | HP           | 70900A         | 2842A02221 | 300002019        |
| ZF-Modul 10Hz-300 kHz           | HP           | 70902A         | 2840A02145 | 300002020        |
| ZF-Modul 100 kHz-3 MHz          | HP           | 70903A         | 2835A01069 | 300002021        |
| HF-Teil für 71210A 100Hz- 22GHz | HP           | 70908A         |            | 300002022        |
| Spectrum Analyzer 2             | HP           | 85660B         | 3138A07614 |                  |
| Spectrum Analyzer Display 2     | HP           | 85662A         | 3144A20627 |                  |

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|                                |                 |           |            |           |
|--------------------------------|-----------------|-----------|------------|-----------|
| Signal Generator DC-600 KHz    | HP              | 8904A     | 2822A01213 | 300001157 |
| Signal Generator DC-600 KHz    | HP              | 8904A     | 2822A01214 | 300001158 |
| Powersupply                    | HP              | 6038A     | 3122A11097 | 300001204 |
| Netznachbildung                | R&S             | ESH3-Z5   | 828576/020 | 300001210 |
| Amplituden Controller          | R&S             | SMDU-Z2   | 871829/051 | 300002309 |
| Trenntrafo                     | Erfi            | 913501    |            | 300001205 |
| Trenntrafo                     | Grundig         | RT5A      | 9242       | 300001627 |
| Relais Matrix                  | HP              | 3488A     | 2719A15013 | 300001156 |
| Multimeter                     | Siemens         | Multizet  |            | 300001102 |
| Peak Power Calibrator          | HP              | 8900B     |            | 300001084 |
| Schallgeber                    | Schomandl       | SG 1      | 10159      | 300001209 |
| Schallgeber                    | Schomandl       | SG 2      | 10176      | 300002473 |
| Filter                         | FSY Microwave   |           |            | 300001206 |
| Attenuatorer                   | Pro Nova        |           |            | 300002476 |
| Klimaschrank                   | Heraeus Voetsch | VUK04/500 |            | 300001012 |
| Spectrum Analyzer 3            | HP              | 8566A     | 1925A00257 | 300001098 |
| Spectrum Analyzer Display 3    | HP              | 85662     | 1925A00860 | 300002306 |
| Oszilloscope                   | Tektronix       | 2432      | 110261     | 300001165 |
| Radiocom. Analyzer             | R&S             | CMTA 54   | 894043/010 | 300001175 |
| Powersupply                    | HP              | 6038A     | 2848A07027 | 300001174 |
| Signal Generator 0.01-1280 MHz | HP              | 8662A     | 2224A01012 | 300001110 |
| Signal Generator (Funktionen)  | R&S             | AFGU      | 862490/032 | 300001201 |
| Trenntrafo                     | Erfi            | MPL       | 91350      | 300001155 |
| Relais Matrix                  | R&S             | PSU       | 893285/020 | 300001173 |
| Power Meter                    | HP              | 436A      | 2101A12378 | 300001136 |
| Powersensor                    | HP              | 8484A     | 2237A10156 | 300001140 |
| Powersensor                    | HP              | 8482A     | 2237A06016 | 300001139 |
| Relais Matrix                  | R&S             | PSU       | 282628/004 | 300001214 |
| Powersupply                    | Zentro          |           | 2007       | 300001109 |
| Oszilloscope                   | Tektronix       | 7633      |            | 300001111 |
| Klimaschrank                   | Heraeus Voetsch | VUK04/500 | 32926      | 300001500 |
| Quasi-Peak Adapter             | HP              | 85650A    | 2811A01204 | 300002308 |
| Radiocom. Analyzer             | R&S             | CMTA 84   | 894199/012 | 300001176 |
| Oszilloscope                   | HP              | 54510A    | 3022A02062 | 300001202 |
| Funkmeßplatz                   | Schomandl       | FD1000    | 34982      | 300001115 |
| Signal Generator               | R&S             | SMPC      | 882416/019 | 300001162 |
| Frequency counter              | HP              | 5340A     | 2116A08138 | 300001104 |
| Power Meter                    | HP              | 436A      | 2031U01461 | 300001105 |
| Powersensor                    | HP              | 8482A     |            | 300001106 |
| Powersensor                    | HP              | 8484A     |            | 300001107 |
| Powersensor                    | HP              | 8485A     |            | 300001108 |
| Powersupply                    | HP              | 6038A     | 2752A04866 | 300001161 |
| Reflectionsmeter               | R&S             | NAP       | 879191     | 300001132 |
| Signal Generator NF            | R&S             | SPN       | 880139/068 | 300001142 |
| Trenntrafo                     | Erfi            | MPL       | 91350      | 300001151 |
| Attenuator                     | JFW             | 30 db     | 1350h/104  | 300001703 |
| Attenuator                     | JFW             | 10 db     | 1350h/103  | 300001704 |
| Attenuator                     | JFW             | 20 db     | 1350h/106  | 300001705 |
| Attenuator                     | JFW             | 20 db     | 1350h/105  | 300001766 |
| Filter                         | Spinner         | 153755    |            | 300001791 |

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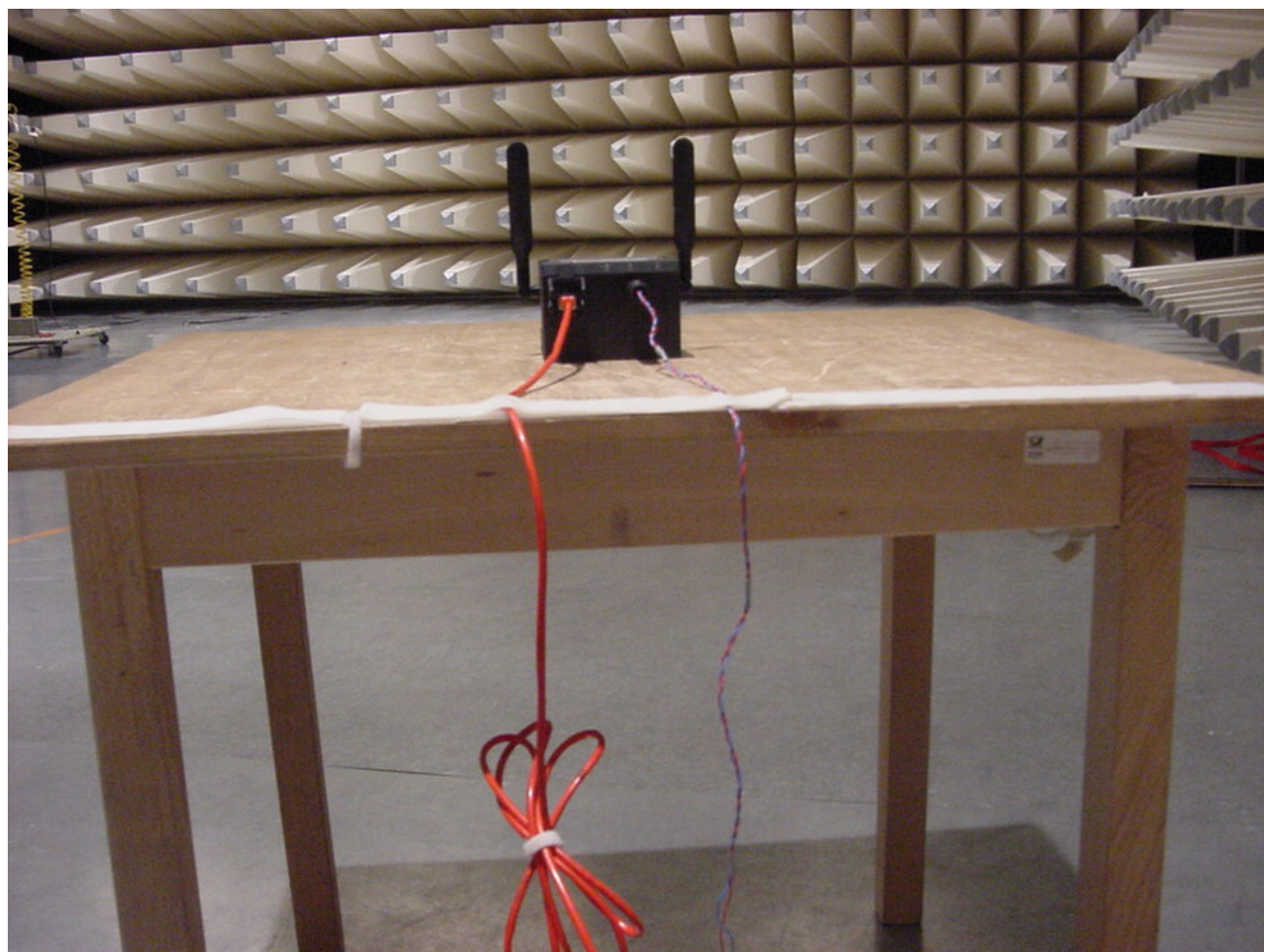
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|                                |                 |           |            |           |
|--------------------------------|-----------------|-----------|------------|-----------|
| Powersensor                    | HP              | 8484A     | 2237A10494 | 300001666 |
| Powersupply                    | HP              | 6038A     | 3122A11097 | 300001204 |
| Netznachbildung                | R&S             | ESH3-Z5   | 828576/020 | 300001210 |
| Amplituden Controller          | R&S             | SMDU-Z2   | 871829/051 | 300002309 |
| Trenntrafo                     | Erfi            | 913501    |            | 300001205 |
| Trenntrafo                     | Grundig         | RT5A      | 9242       | 300001627 |
| Relais Matrix                  | HP              | 3488A     | 2719A15013 | 300001156 |
| Multimeter                     | Siemens         | Multizet  |            | 300001102 |
| Peak Power Calibrator          | HP              | 8900B     |            | 300001084 |
| Schallgeber                    | Schomandl       | SG 1      | 10159      | 300001209 |
| Schallgeber                    | Schomandl       | SG 2      | 10176      | 300002473 |
| Filter                         | FSY Microwave   |           |            | 300001206 |
| Attenuatorer                   | Pro Nova        |           |            | 300002476 |
| Klimaschrank                   | Heraeus Voetsch | VUK04/500 |            | 300001012 |
| Spectrum Analyzer 3            | HP              | 8566A     | 1925A00257 | 300001098 |
| Spectrum Analyzer Display 3    | HP              | 85662     | 1925A00860 | 300002306 |
| Oszilloscope                   | Tektronix       | 2432      | 110261     | 300001165 |
| Radiocom. Analyzer             | R&S             | CMTA 54   | 894043/010 | 300001175 |
| Powersupply                    | HP              | 6038A     | 2848A07027 | 300001174 |
| Signal Generator 0.01-1280 MHz | HP              | 8662A     | 2224A01012 | 300001110 |
| Signal Generator (Funktionen)  | R&S             | AFGU      | 862490/032 | 300001201 |
| Trenntrafo                     | Erfi            | MPL       | 91350      | 300001155 |
| Relais Matrix                  | R&S             | PSU       | 893285/020 | 300001173 |
| Power Meter                    | HP              | 436A      | 2101A12378 | 300001136 |
| Powersensor                    | HP              | 8484A     | 2237A10156 | 300001140 |
| Powersensor                    | HP              | 8482A     | 2237A06016 | 300001139 |
| Relais Matrix                  | R&S             | PSU       | 282628/004 | 300001214 |
| Powersupply                    | Zentro          |           | 2007       | 300001109 |
| Oszilloscope                   | Tektronix       | 7633      |            | 300001111 |
| Klimaschrank                   | Heraeus Voetsch | VUK04/500 | 32926      | 300001500 |
| Quasi-Peak Adapter             | HP              | 85650A    | 2811A01204 | 300002308 |
| Radiocom. Analyzer             | R&S             | CMTA 84   | 894199/012 | 300001176 |
| Oszilloscope                   | HP              | 54510A    | 3022A02062 | 300001202 |
| Funkmeßplatz                   | Schomandl       | FD1000    | 34982      | 300001115 |
| Signal Generator               | R&S             | SMPC      | 882416/019 | 300001162 |
| Frequency counter              | HP              | 5340A     | 2116A08138 | 300001104 |
| Power Meter                    | HP              | 436A      | 2031U01461 | 300001105 |
| Powersensor                    | HP              | 8482A     |            | 300001106 |
| Powersensor                    | HP              | 8484A     |            | 300001107 |
| Powersensor                    | HP              | 8485A     |            | 300001108 |
| Powersupply                    | HP              | 6038A     | 2752A04866 | 300001161 |
| Reflectionsmeter               | R&S             | NAP       | 879191     | 300001132 |
| Signal Generator NF            | R&S             | SPN       | 880139/068 | 300001142 |
| Trenntrafo                     | Erfi            | MPL       | 91350      | 300001151 |
| Attenuator                     | JFW             | 30 db     | 1350h/104  | 300001703 |
| Attenuator                     | JFW             | 10 db     | 1350h/103  | 300001704 |
| Attenuator                     | JFW             | 20 db     | 1350h/106  | 300001705 |
| Attenuator                     | JFW             | 20 db     | 1350h/105  | 300001766 |
| Filter                         | Spinner         | 153755    |            | 300001791 |
| Powersensor                    | HP              | 8484A     | 2237A10494 | 300001666 |

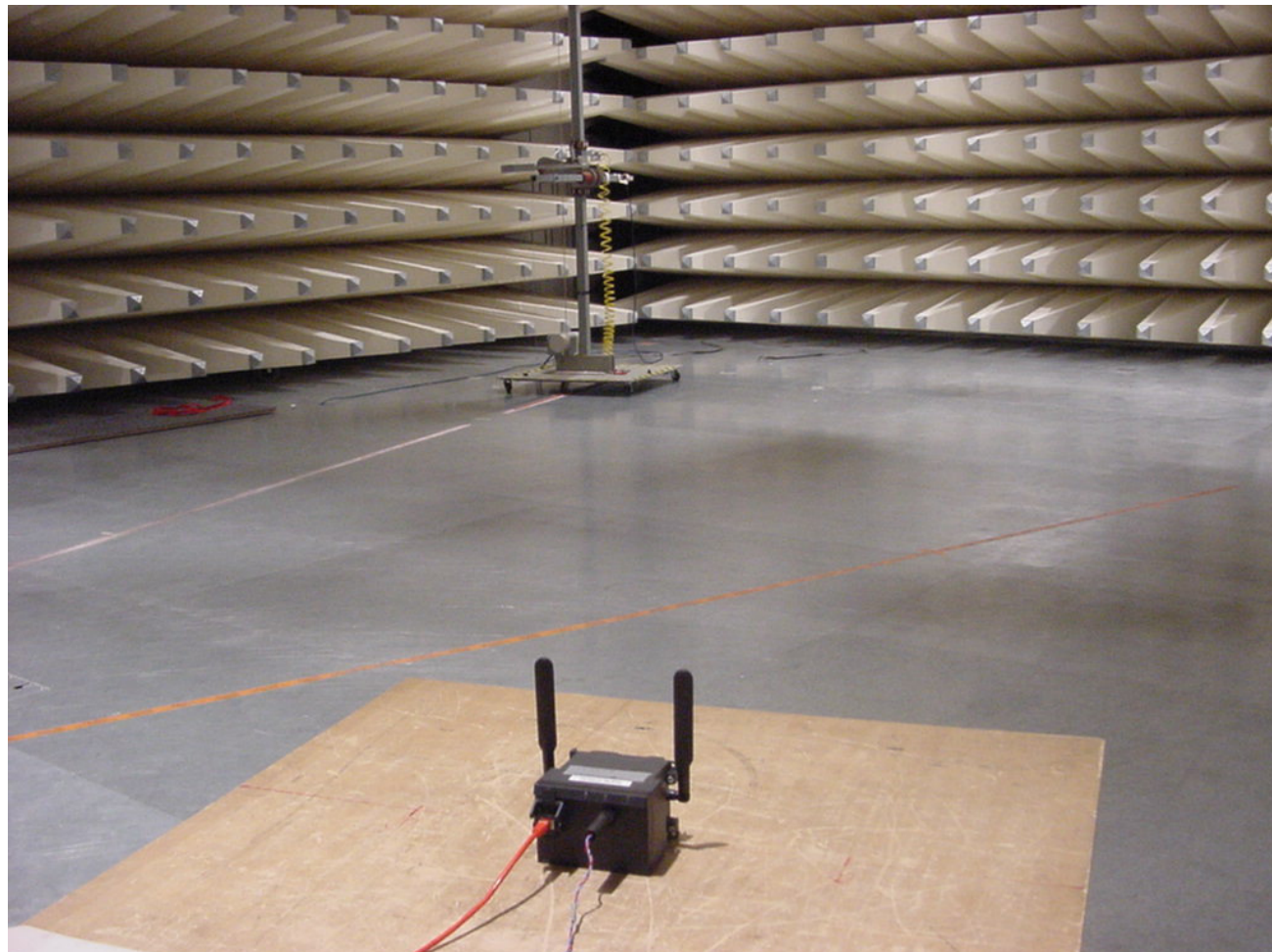
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|-------------------------------|--------------------|--------------------------|------------|-----------|
| Powersensor                   | HP                 | 8485A                    | 2238A00849 | 300001668 |
| Bandfilter                    | Telonic            | TTF7255EE                | 20293-11   | 300001300 |
| Bandfilter                    | Telonic            | TTF12555EE               | 20292-6    | 300001302 |
| Bandfilter                    | Telonic            | TTF25055EE               | 20291-8    | 300001304 |
| Bandfilter                    | Telonic            | TTF50055EE               | 20290-7    | 300001305 |
| Bandfilter                    | Telonic            | TTF100055EE              | 20289-7    | 300001307 |
| Bandfilter                    | Telonic            | TTA300055EESN            | 20370-2    | 300001312 |
| Bandstop                      | Telonic            | TTR3753EE1               | 30013-1    | 300001314 |
| Bandstop                      | Telonic            | TTR723EE                 | 20417-2    | 300001316 |
| Bandstop                      | Telonic            | TTR95-3EE                | 20372-4    | 300001318 |
| Bandstop                      | Telonic            | TTR1903EE                | 30036-4    | 300001320 |
| Bandstop                      | Telonic            | TTR3753EE                | 20369-5    | 300001321 |
| Bandstop                      | Telonic            | TTR750-3EE1              | 90177-1    | 300002387 |
| Highpass                      | Pro Nova           | HDP120-6GG               | ohne       | 300001348 |
| Highpass                      | Pro Nova           | HMC500-6AA               | HJ67-01?   | 300001350 |
| Highpass                      | Narda              | NHP 9000                 | 0004       | 300001362 |
| Highpass                      | Narda              | HDP16-6GH                | JV70-01    | 300001364 |
| Highpass                      | RSD                | HDP50-6GH,<br>HDP200-6GG |            | 300001371 |
| Highpass                      | RSD                | 2099-02-01               |            | 300000370 |
| Signal Generator 0.1-2060 MHz | HP                 | 8657A                    | 2838U00736 | 300001009 |
| Radio Code Analyzer           | Schlumberger       | SL4922                   |            | 300001038 |
| Signal Analyzer               | B&K                | 2033                     |            | 300001047 |
| Frequency counter             | HP                 | 5386A                    | 2704A01243 | 300000998 |
| Laufzeitelement               | WR-Elektronik      |                          |            | 300001036 |
| Powersupply Stromversorgung   | Syston             | M5P 40/15A               | 828233     | 300001291 |
| Powersupply                   | Heiden             | 1108-32                  | 1701       | 300001392 |
| Powersupply                   | Heiden             | 1108-32                  | 1802       | 300001383 |
| Powersupply                   | Heiden             | 1108-32                  | 003202     | 300001187 |
| Powersupply                   | Zentro             | LA 2x30/5GB1             | 2011       | 300001276 |
| Powersupply                   | Zentro             | LA 2x30/5GB2             | 2012       | 300001275 |
| Powersupply                   | Zentro             | LA 30/5GA                | 2041,2042  | 300001287 |
| Trenntrafo                    | Grundig            | RT5A                     | 8781       | 300001277 |
| Trenntrafo                    | Grundig            | RT5A                     | 9242       | 300001263 |
| Multimeter                    | Goerz Elektro      | Unigor 6e P              | 911 355    | 300001625 |
| Multimeter                    | Goerz Elektro      | Unigor 6e P              | 911 391    | 300001281 |
| Climatic Box                  | Heraeus Voetsch    | VUK04/500                | 32679      | 300000299 |
| Powersensor + Att.            | HP                 | 8482B                    | 2703A02586 | 300001492 |
| Attenuator 30 dB              | HP                 | 8498A                    | 1801A02445 | 300001475 |
| Signal Generator NF           | HP                 |                          | 2822A01203 | 300001004 |
| Attenuator                    | Spinner            | BN 534171 D              | 51881      | 300001516 |
| Attenuator coaxial            | Bird               | 8325                     | 2429       | 300001513 |
| Impulsbegrenzer               | R&S                | ESH 3 Z2                 |            | 300001460 |
| 4Port Box                     | R&S                | 4Port Box                | 860457/005 | 300001472 |
| Signal Generator 0.1-4200 MHz | HP                 | 8665A                    | 2833A0011  | 300002299 |
| NF-Spektrumanalyzer           | B&K                | 2033A                    |            | 300002301 |
| Swissphone Freifeld-Messbox   | Swissphone Schweiz |                          |            | 300002302 |
| Trenntrafo regelbar           | Grundig            | RT5H                     | 9242       | 300001628 |
| Signal Generator              | HP                 | 8111A                    | 2215G00867 | 300001117 |

## 3 Photographs

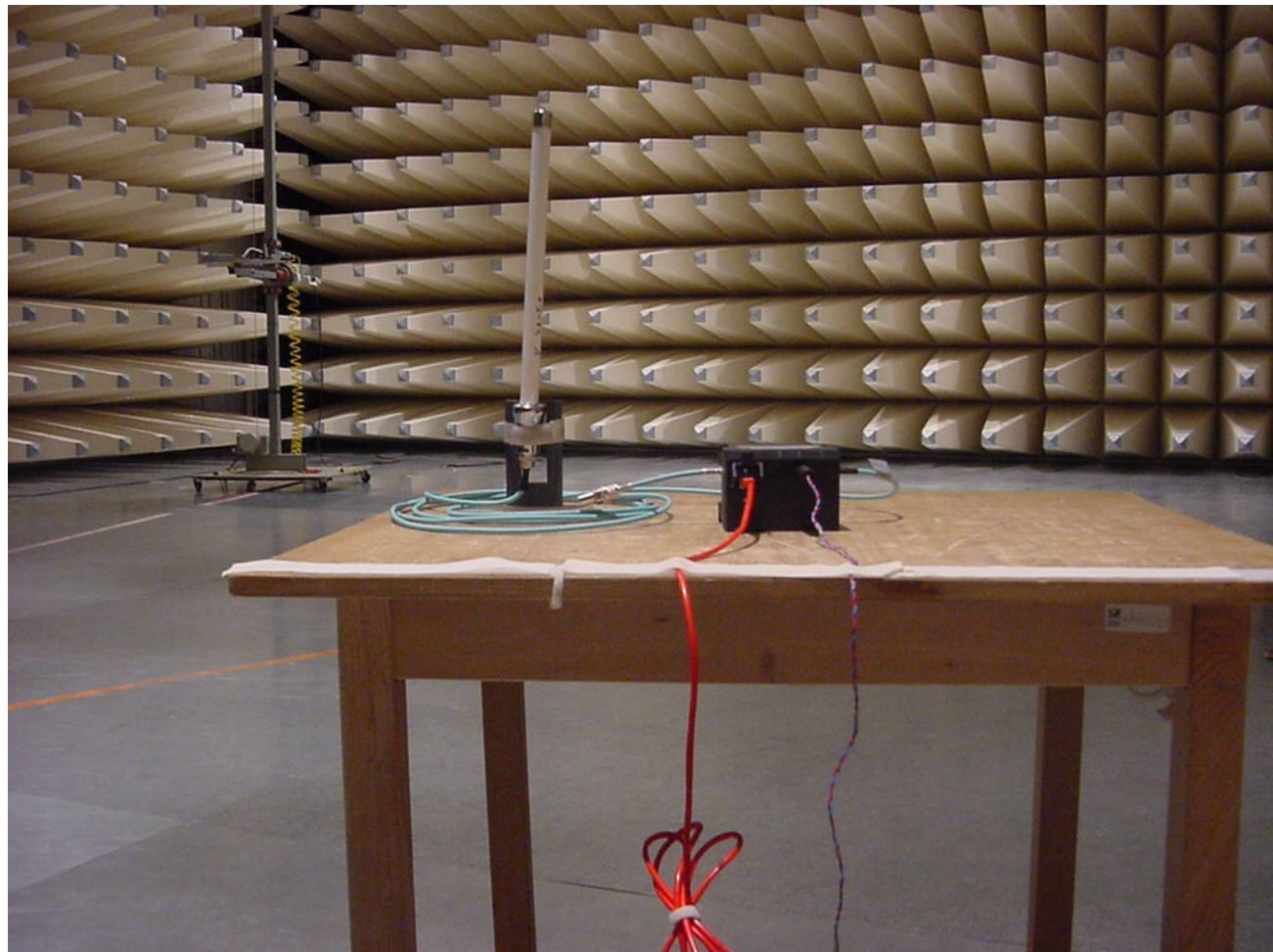
Test site: Antenna 1



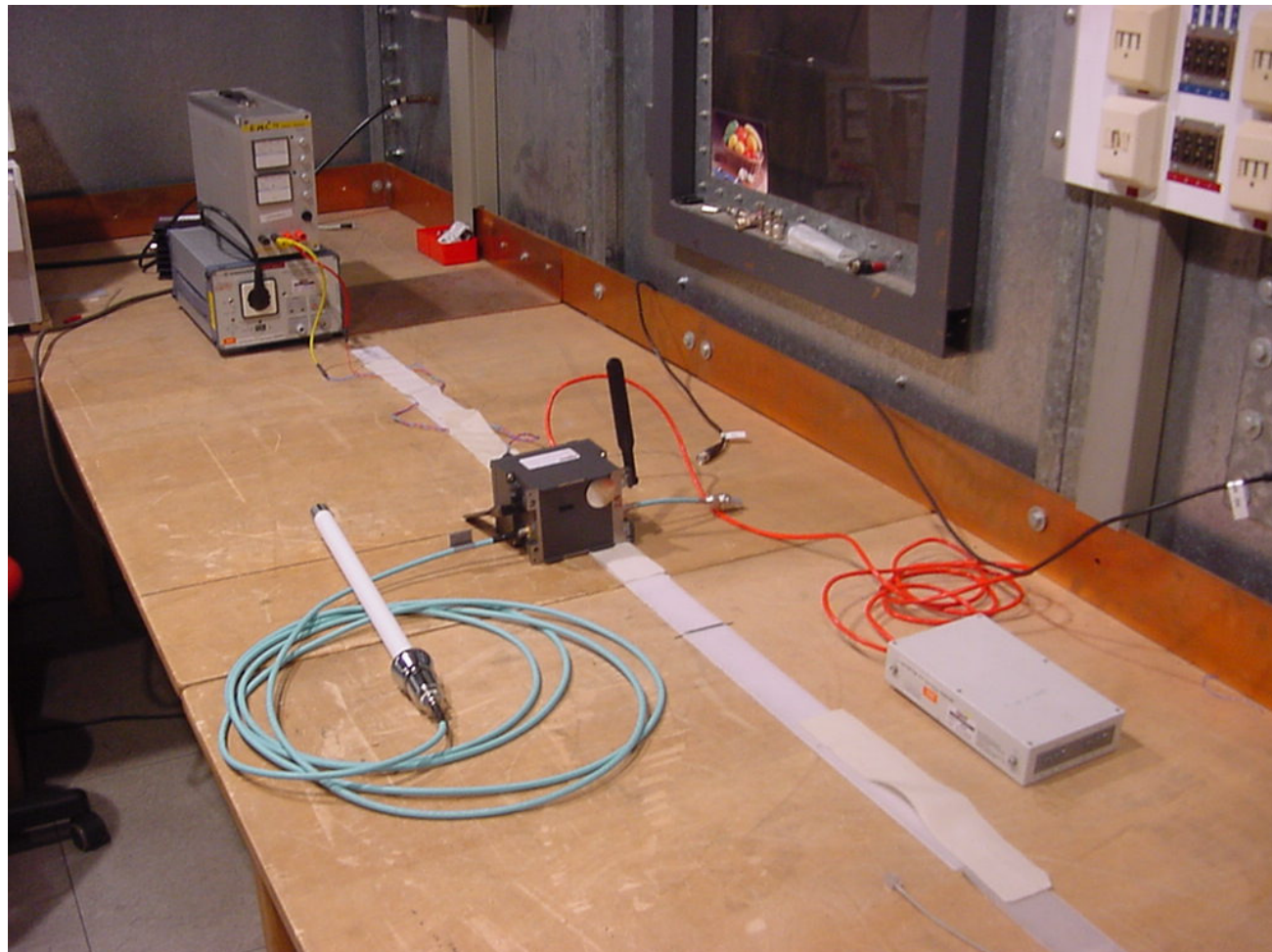
Test site: Antenna 1



Test site: Antenna 2



AC-conducted:



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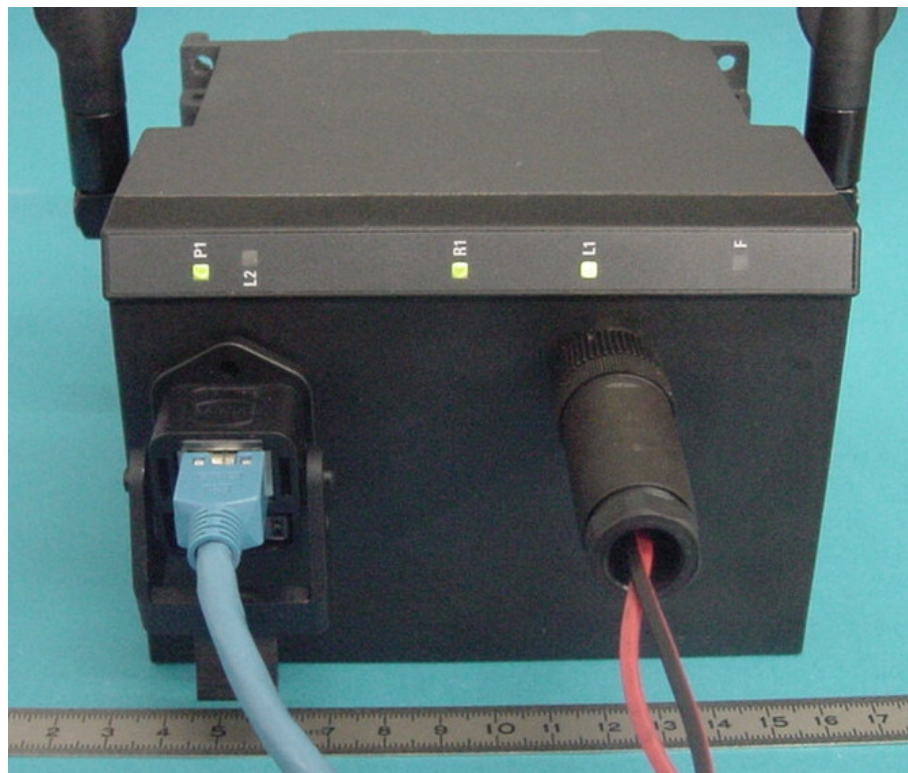


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Test sample:





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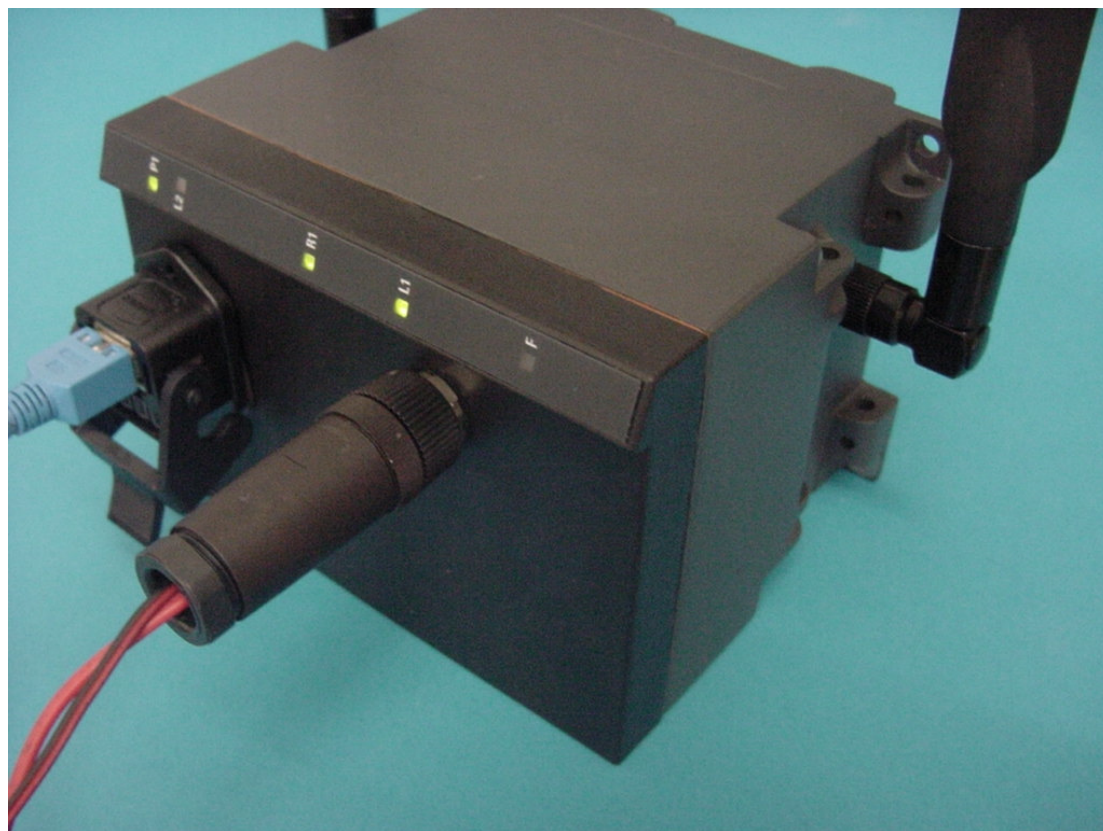
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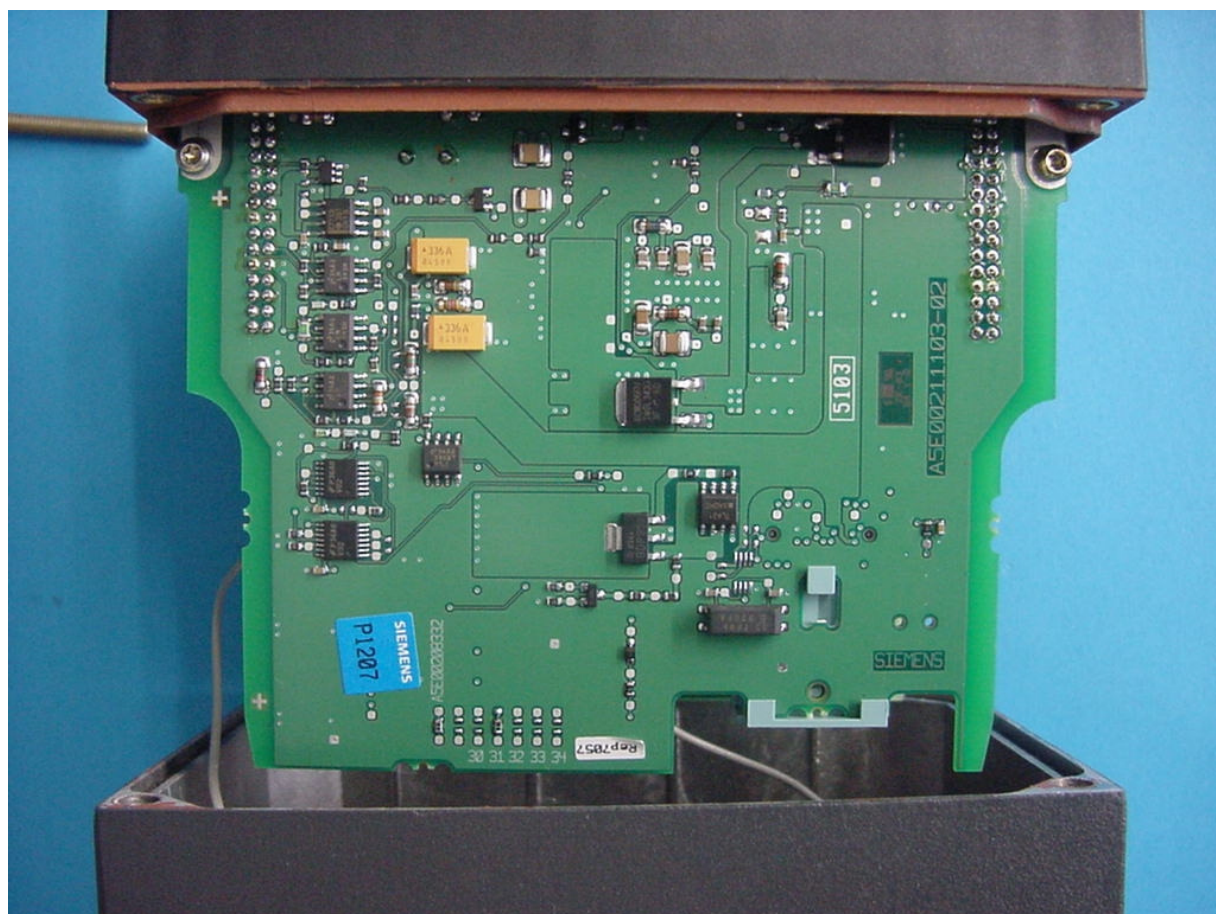
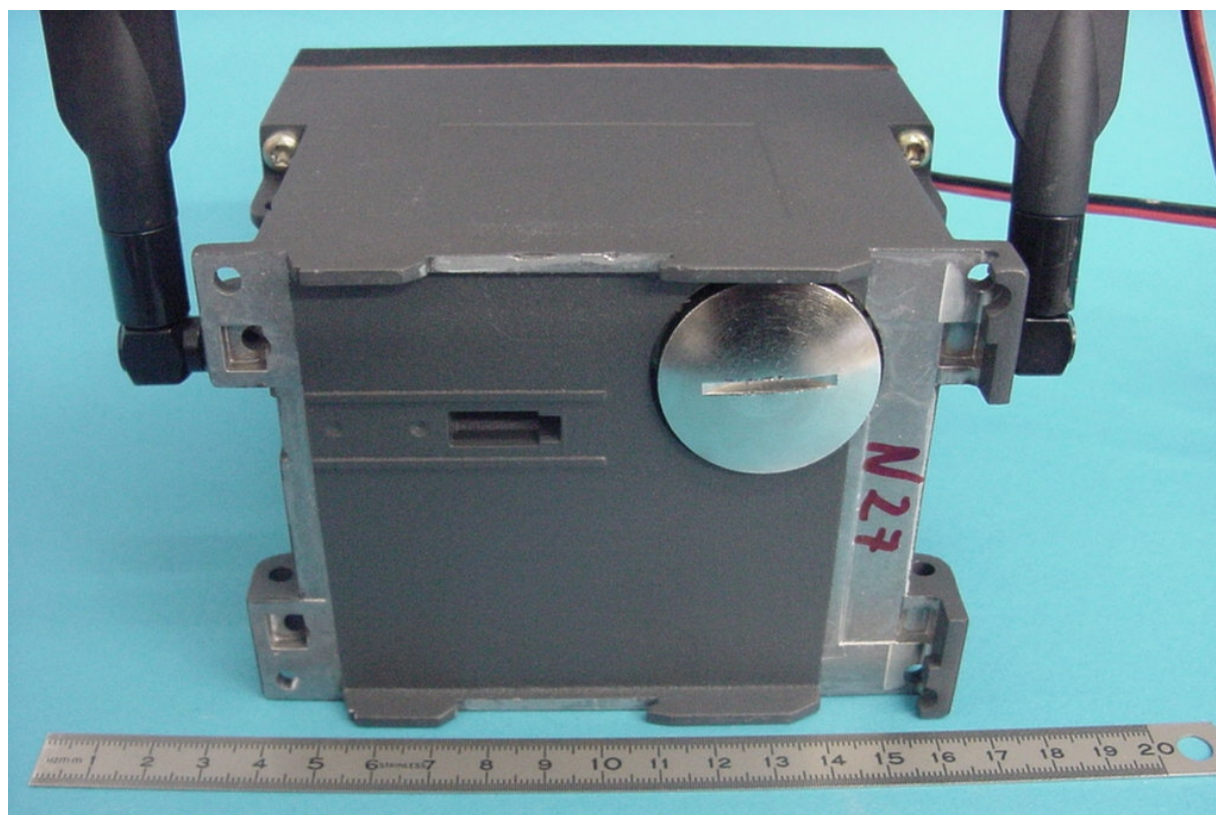
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