CETECOM ICT Services GmbH
Untertürkheimer Straße 6-10 D-66117 Saarbrücken Phone: +49 (0) 681-598-0 Fax: -9075
RSC-Laboratory

# Accredited testing-laboratory

**DAR registration number: DAT-P-176/94-D1**

**Federal Motor Transport Authority (KBA)**
**DAR registration number: KBA-P 00070-97**

**Recognized by the Federal Communications Commission**
**Anechoic chamber registration no.: 90462 (FCC)**
**Anechoic chamber registration no.: 3463C-1 (IC)**
**Certification ID: DE 0001**
**Accreditation ID: DE 0002**

**Accredited Bluetooth® Test Facility (BQTF)**

*The Bluetooth word mark and logos are owned by the Bluetooth SIG, Inc. and any use of such marks by Cetecom ICT is under license*

| | | |
|---|---|---|
| **Test report no.** | **:** | **1-0725-01-06/08** |
| **Type identification** | **:** | **TU-WHT1U** |
| **Applicant** | **:** | **Panasonic Corporation** |
| **FCC ID** | **:** | **ACJ-TUWHT1U** |
| **IC Certification No** | **:** | **216A-TUWHT1U** |
| **Test standards** | **:** | **FCC CFR 47 Part 15.255** |
| | | **RSS-210 Issue 7** |

# Table of contents

# 1 General information

## 1.1 Notes

The test results of this test report relate exclusively to the test item specified in 3.1.1. The CETECOM ICT Services GmbH does not assume responsibility for any conclusions and generalisations 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.

**Test laboratory manager:**

| **2009-03-27** | **Karsten Geraldy** | Geraldy Karsten |
|---|---|---|
| Date | Name | Signature |

**Technical responsibility for area of testing:**

| **2009-03-27** | **Nicolas Stamber** | N. Stamber |
|---|---|---|
| Date | Name | Signature |

## 1.2 Testing laboratory

**CETECOM ICT Services GmbH**

**Untertürkheimer Straße 6 - 10**
**66117 Saarbrücken**
**Germany**
**Phone: + 49 681 5 98 - 0**
**Fax: + 49 681 5 98 - 9075**
**e-mail: info@ICT.cetecom.de**
**Internet: http://www.cetecom-ict.de**

**State of accreditation:** **The test laboratory (area of testing) is accredited according to DIN EN ISO/IEC 17025**
**DAR registration number: DAT-P-176/94-D1**

**Accredited by:** **Federal Motor Transport Authority (KBA)**
**DAR registration number: KBA-P 00070-97**

**Testing location, if different from CETECOM ICT Services GmbH:**

**Name :**
**Street :**
**Town :**
**Country :**
**Phone :**
**Fax :**

## 1.3 Details of applicant

| | |
|---|---|
| **Name:** | **Panasonic Corporation**<br>**Visual Products and Display Devices Business Group** |
| **Street:** | **1-15 Matsuo-cho, Kadoma City** |
| **Town:** | **Osaka 571-8504** |
| **Country:** | **Japan** |
| **Telephone:** | **+81-6-6908-1551** |
| **Fax:** | **+81-6-6905-5983** |
| **Contact:** | **Mr. Masaya Koshimuta** |
| **E-mail:** | **-/-** |
| **Telephone:** | **+81-6-6905-5714** |

## 1.4 Application details

| | |
|---|---|
| **Date of receipt of order:** | **2008-10-24** |
| **Date of receipt of test item:** | **2009-01-22** |
| **Date of start test:** | **2009-01-22** |
| **Date of end test** | **2009-03-10** |
| **Persons(s) who have been present during the test:** | **-/-** |

## 2 Test standard/s

| | | |
|---|---|---|
| **FCC 47 CFR Part 15.255** | **2008-07** | **Radio Frequency Devices, Subpart C - Intentional Radiators, Operation within the band 57 - 64 GHz** |
| **RSS-210** | **2007-06** | **Low-power Licence-exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment** |

# 3 Technical tests

## 3.1 Details of manufacturer

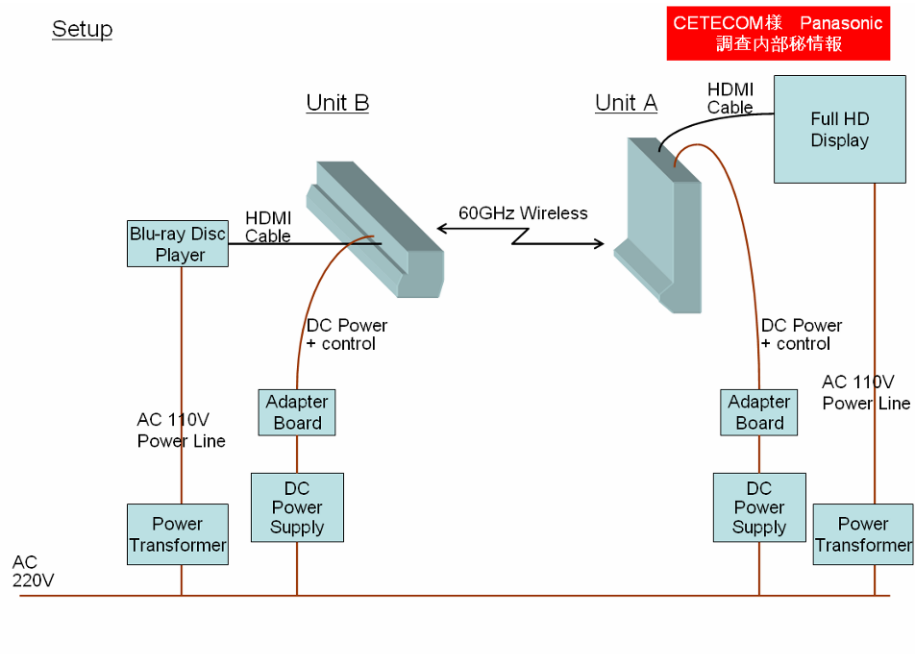
| | |
|---|---|
| Name: | **Panasonic Corporation**<br>**Visual Products and Display Devices Business Group** |
| Street: | **1-15 Matsuo-cho, Kadoma City** |
| Town: | **Osaka 571-8504** |
| Country: | **Japan** |

### 3.1.1 Test item

| | |
|---|---|
| Kind of test item: | **Wireless HDMI Transmission System** |
| Type identification: | **TU-WHT1U** |
| Model number / serial number: | **058** |
| Frequency: | **60.48 GHz** |
| Type of Modulation: | **OFDM** |
| Number of channels: | **1** |
| Antenna : | **integrated, non-replaceable patch antenna**<br>**nominal antenna gain: 12 dBi** |
| Power Supply: | **12.0 Vdc via external AC/DC adaptor** |
| Temperature Range: | **-20 °C to +55 °C** |

FCC ID: ACJ-TUWHT1U
IC: 216A-TUWHT1U

**Remark:**
**The wireless HDMI Transmission System consists of two units: TU-WHR1U and TU-WHT1U (also called Unit A and Unit B). The present test report documents testing of TU-WHT1U (Unit B) only.**
**The tests of TU-WHR1U (Unit A) are documented in a separate test report.**



### 3.1.2 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, nominal power source conditions |
| Op. 2 | | high temperature, nominal power source conditions |

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

### 3.1.3 Nominal conditions for testing

| Description | Shortcut | Unit | Value |
|---|---|---|---|
| Nominal Temperature | $T_{nom}$ | °C | **23** |
| Nominal Humidity | $H_{nom}$ | % | **45** |
| Nominal Power Source | $V_{nom}$ | Vac | **110** |

Type of power source: 100 - 250 V AC adaptor to 12 V DC.

Extreme conditions are reported in chapter 5.8.

# 4 Summary of Measurement Results and list of all performed test cases

☒ **No deviations from the technical specifications were ascertained**

☐ There were deviations from the technical specifications ascertained

| TC identifier | Description | Verdict | Date | Remark |
|---|---|---|---|---|
| RF-Testing | FCC CFR 47 Part 15.255<br>RSS-210, Annex 13 | PASS | 2009-03-27 | -/- |

| Test Specification / Clause | Test Case | Pass | Fail | N/A | N/P | Results |
|---|---|---|---|---|---|---|
| | | | | | | |
| §2.1049, §15.255<br>RSS-GEN 4.6 | Occupied Bandwidth (99%) and<br>6 dB Bandwidth | X | | | | max. 1381.4 MHz /<br>max. 956.7 MHz |
| | | | | | | |
| §15.255 (b)(1)<br>RSS-210 A13.2.2 | Power Density | X | | | | max. 0.12 nW/cm² |
| | | | | | | |
| §15.255 (c)<br>RSS-210 A13.2.2 | Spurious Emissions | X | | | | complies |
| | | | | | | |
| §15.255 (e)<br>RSS-210 A13.2.3 | Peak Transmitter Output Power | X | | | | max. 27 µW |
| | | | | | | |
| §15.255 (f)<br>RSS-210 A13.2.6 | Frequency Stability | X | | | | max. -82 ppm |
| | | | | | | |
| §15.255 (h)<br>RSS-210 A13.2.6 | Group Installations | | | X | | |
| | | | | | | |
| §15.255 (i)<br>RSS-210 A13.2.7 | Transmitter Self-Identification Transmission | | | X | | |
| | | | | | | |
| §15.207<br>RSS-GEN 7.2.2 | AC Conducted Emission Limits | X | | | | complies |
| | | | | | | |
| FCC OET<br>Bulletin 65 | MPE Calculation | X | | | | 0.027 µW/cm² |

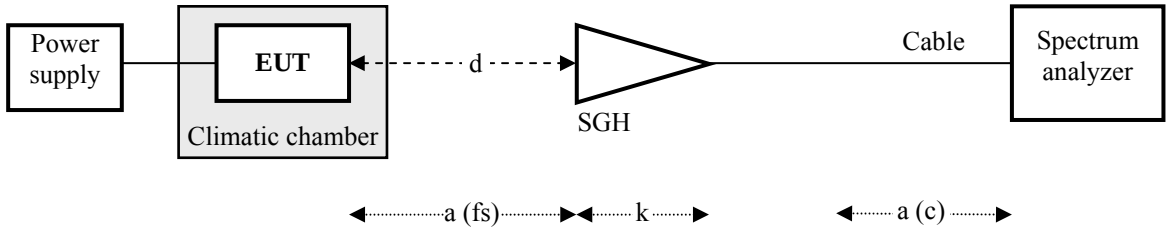
N/A: Not Applicable
N/P: Not Performed

# 5 RF measurement testing

## 5.1 Description of test set-up

### 5.1.1 Radiated measurements

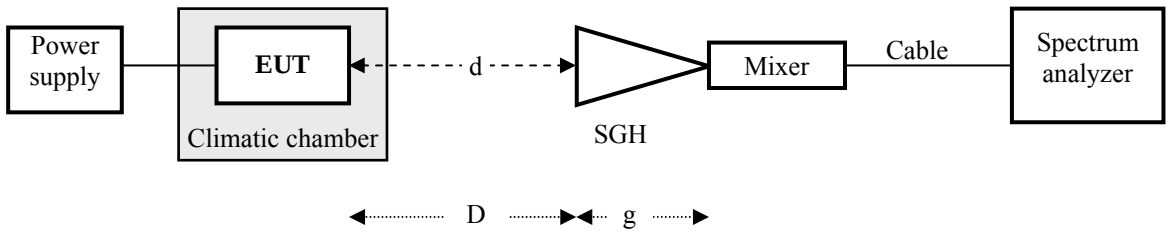
**Field strength of spurious radiation in the frequency range 12 GHz to 40 GHz**
**Frequency stability of wanted signals**




| Frequency f [GHz] | Distance d [m] | Standard gain Horn ant. (SGH) | Dist. correction. dc (3m/Xm) [dB] | Antenna factor k [dB 1/m] | Cable loss a [dB] | Amplifier gain g(amp)[dB] |
|---|---|---|---|---|---|---|
| 12 ... 18 | 0.5 | narda 639 | -15.6 | 34.0 | 3.1 | 35.0 |
| 18 ... 26 | 0.5 | narda 638 | -15.6 | 40.2 | 3.3 | 33.0 |
| 26 ... 40 | 0.5 | narda V637 | -15.6 | 44.0 | 4.2 | 19.0 |

**Calculation:** Field strength = Analyser reading + Cable loss + Antenna factor + Distance correction – Amp. gain
E = u + a + k + dc – g(amp)

**Frequency stability and power density of wanted signal**
**and spurious radiation in the frequency range 40 to 200 GHz**




| Frequency f [GHz] | Distance d [m] | Free space attenuation D [dB] | Antenna gain g [dBi] or antenna factor k [dB/m] | System Attenuation [dB] |
|---|---|---|---|---|
| 40 ... 60 | 0.5 | 58.5 … 62.0 | 20.0 (50 GHz) | 40.0 |
| 50 … 75 | 0.5 | 60.4 … 63.9 | 25.3 (62.5 GHz) | 36.8 |
| 60.48 | 0.5 | | k = 40.67 | |
| 60 ... 90 | 0.25 | 56.0 … 59.5 | 25.7 (75 GHz) | 32.1 |
| 90 ... 140 | 0.125 | 53.5 … 57.4 | 25.5 (115 GHz) | 30.1 |
| 140 ... 170 | 0.125 | 57.4 … 59.0 | 22.0 (155 GHz) | 36.2 |
| 170 ... 200 | 0.125 | 59.0 … 60.5 | 20.0 (185 GHz) | 39.7 |

A minimum test distance of 0.125 m was used for detecting of spurious radiations. 0.5 m was adjusted to measure the wanted signal levels in field strength or EIRP.

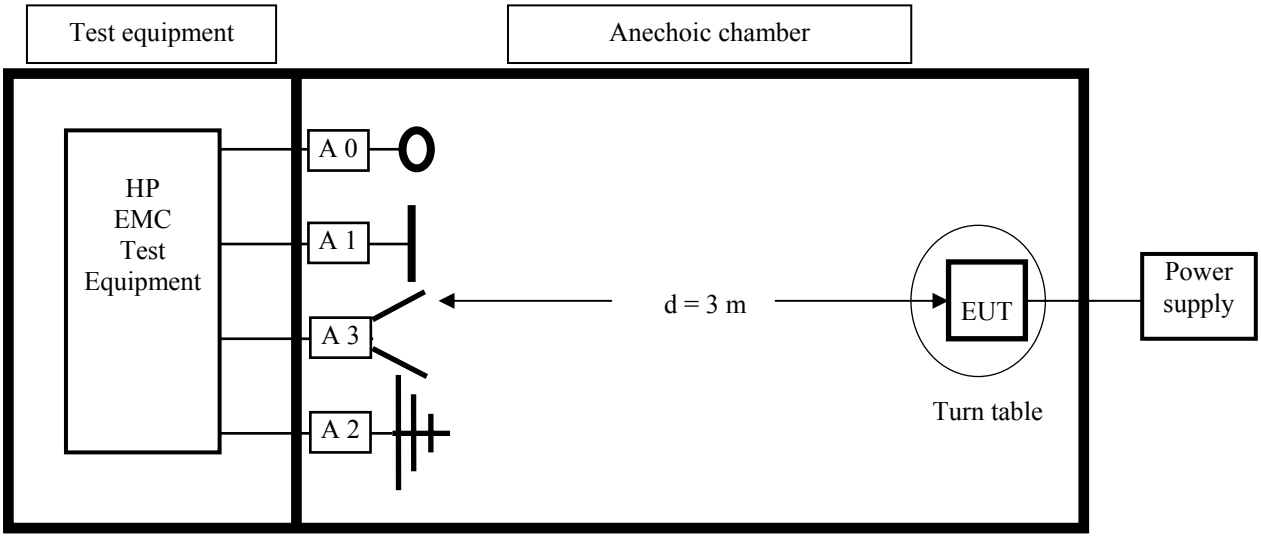
**Calculation :** Power density = EIRP /($4\pi d^2$) = EIRP / 1130973.4 $cm^2$ (for 3 m evaluation distance)

| No | Equipment/Type | Manuf. | Serial Nr. | Inv. No. Cetecom | Last Calibration | Frequency (months) | Next Calibration |
|---|---|---|---|---|---|---|---|
| 1 | Climatic box VUK 04/500 | Heraeus Vötsch | 32678 | 300000297 | 29.07.2008 | 24 | 27.07.2010 |
| 2 | Spectrum Analyser 8565E | HP | 3738A00773 | 300001665 | 08.01.2008 | 24 | 08.01.2010 |
| 3 | Spectrum Analyser FSU 50 | R&S | 200012 | 300003443 | 05.06.2008 | 24 | 05.06.2010 |
| 4 | Spectrum Analyzer 2782 | Tektronix | | 300001665 | 28.08.2008 | 24 | 28.08.2010 |
| 5 | Power Supply 6032A | | | 300002115 | 15.05.2007 | | |
| 6 | SGH 12 ... 18 GHz | narda | 01005 | 300000787 | cyclic verification | | |
| 7 | SGH 18 ... 27 GHz | narda | 01005 | 300000487 | cyclic verification | | |
| 8 | SGH 27 ... 40 GHz | narda | 82016 | 300000510 | cyclic verification | | |
| 9 | SGH 33 ....50 GHz | Thomson | | 300000812 | visual inspection | | |
| 10 | Adapter WG/SMA | narda | 64088 | -/- | cyclic verification | | |
| 11 | Adapter WG/SMA | flann | 213 | -/- | cyclic verification | | |
| 12 | Adapter WG/SMA | HP | 00231 | -/- | cyclic verification | | |
| 13 | SGH 50 ... 75GHz | Thomson | -/- | 300000813 | visual inspection | | |
| 14 | Mixer 50 ... 75 GHz | HP | -/- | 30000781m | 07.08.2007 | 24 | 07.08.2009 |
| 15 | SGH 75 ... 110 GHz | Thomson | -/- | 30000798b | visual inspection | | |
| 16 | Mixer 75 ... 110 GHz | HP | -/- | 30000781c | 07.08.2007 | 24 | 07.08.2009 |
| 17 | SGH 110 … 170 GHz | Flann | -/- | 300001999 | visual inspection | | |
| 18 | Mixer 110 … 170 GHz | Tektronix | B010186 | 300001685d | n.a. | | |
| 19 | SGH 170 … 325 GHz | Flann | -/- | 300002000 | visual inspection | | |
| 20 | Mixer 170 … 325 GHz | Tektronix | B010241 | 300001685j | n.a. | | |

Measurement uncertainties

| Test parameter | Measurement uncertainty |
|---|---|
| Power supply | ±0.1 VDC |
| Temperature | ±0.2 °C |
| Frequency | ±0.01 ppm |
| eirp | ±2.0 dB (up to 50 GHz) |
| eirp | ±3.0 dB (above 50 GHz) |

**Field strength of spurious radiation in the frequency ranges 9 kHz to 30 MHz and 1 to 12 GHz**
Set-up for radiated measurements (FAC "Chamber C")

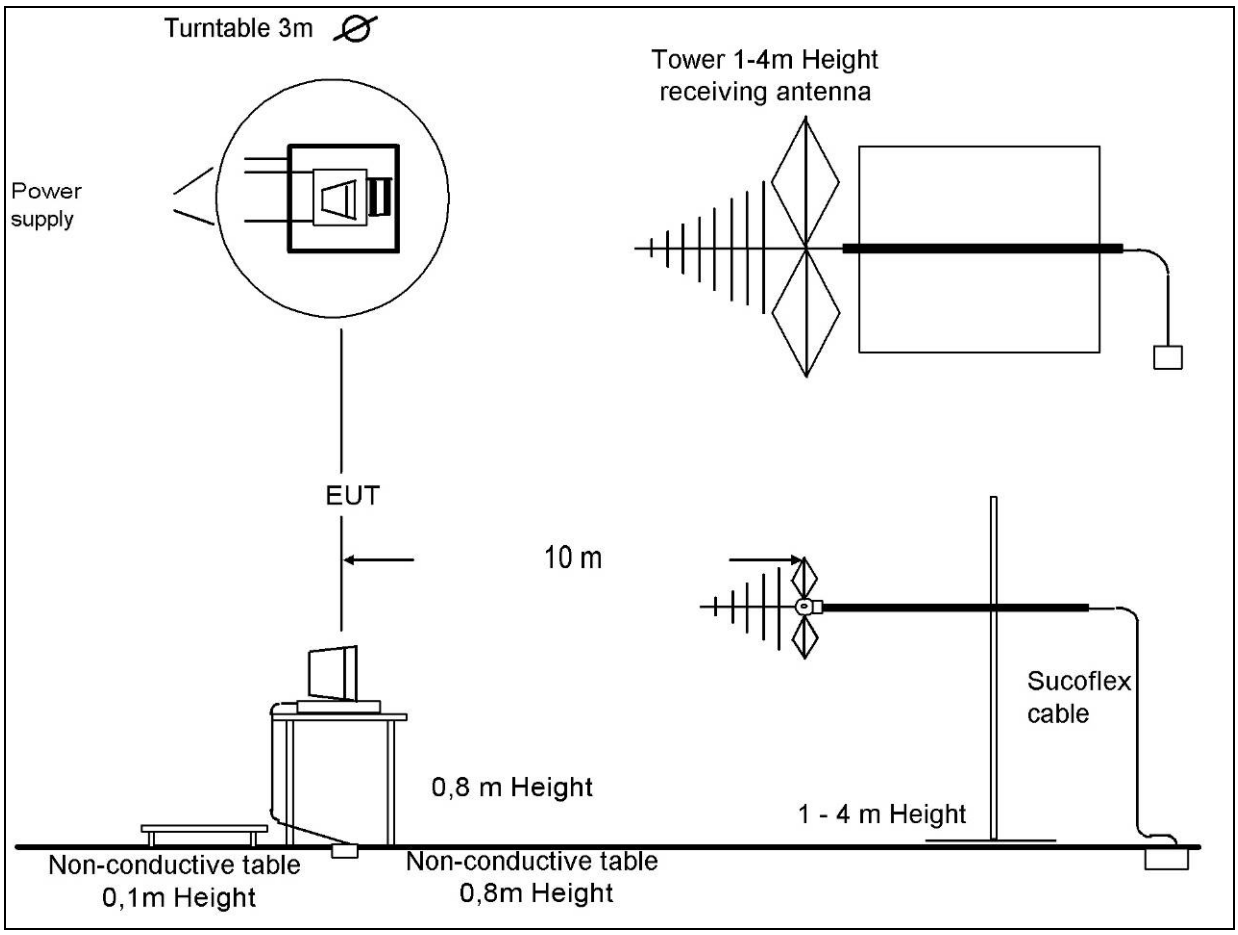



| No | Equipment/Type | Manuf. | Serial Nr. | Inv. No. Cetecom | Last Calibration | Frequency (months) | Next Calibration |
|---|---|---|---|---|---|---|---|
| 1 | Anechoic chamber | MWB | 87400/02 | 300000996 | Monthly verification | | |
| 2 | System-Rack 85900 | HP I.V. | * | 300000222 | n.a. | | |
| 3 | Measurement System 1 | | | | | | |
| 4 | Spektrum Analyzer 8566B | HP | 3138A07614 | 300001207 | 13.12.2007 | 24 | 13.12.2009 |
| 5 | Spektrum Analyzer Display 85662A | HP | 3144A28627 | 300001208 | 13.12.2007 | 24 | 13.12.2009 |
| 6 | Quasi-Peak-Adapter 85650A | HP | 2811A01204 | 300002308 | 13.12.2007 | 24 | 13.12.2009 |
| 7 | RF-Preselector 85685A | HP | 2837A00778 | 300002448 | 13.12.2007 | 24 | 13.12.2009 |
| 8 | PC Vectra VL | HP | | 300001688 | n.a. | | |
| 9 | Software EMI | HP | | 300000983 | n.a. | | |
| 10 | Measurement System 2 | | | | | | |
| 11 | FSP 30 | R&S | 100886 | 300003575 | 25.08.2008 | 24 | 25.08.2010 |
| 12 | PC | F+W | | | n.a. | | |
| 13 | TILE | TILE | | | n.a. | | |
| 14 | Biconical antenna | EMCO | S/N: 860 942/003 | | Monthly verification (System cal.) | | |
| 15 | Log. Period. Antenna 3146 | EMCO | 2130 | 300001603 | Monthly verification (System cal.) | | |
| 16 | Double Ridged Antenna HP 3115P | EMCO | 3088 | 300001032 | Monthly verification (System cal.) | | |
| 17 | Active Loop Antenna 6502 | EMCO | 2210 | 300001015 | Monthly verification (System cal.) | | |
| 18 | Power Supply 6032A | HP | 2818A03450 | 300001040 | 12.05.2007 | 36 | 12.05.2010 |
| 19 | Busisolator | Kontron | | 300001056 | n.a. | | |
| 20 | Leitungsteiler 11850C | HP | | 300000997 | Monthly verification (System cal.) | | |
| 21 | Power attenuator 8325 | Byrd | 1530 | 300001595 | Monthly verification (System cal.) | | |
| 22 | Band reject filter WRCG1855/1910 | Wainwright | 7 | 300003350 | Monthly verification (System cal.) | | |
| 23 | Band reject filter WRCG2000/2483 | Wainwright | 11 | 300003351 | Monthly verification (System cal.) | | |

Measurement uncertainties

| Test Parameter | Measurement uncertainty |
|---|---|
| Input power (DC) | ±0.1 V |
| Temperature | ±0.2 °C |
| Frequency | ±0.01 ppm |
| RF-power | ±2.0 dB |

**Field strength of spurious radiation in the frequency ranges 30 to 1000 MHz**
Set-up for radiated measurements at test distances 3m and 10m (SAC "Chamber F")




| No | Equipment/Type | Manuf. | Serial Nr. | Inv. No. Cetecom | Last Calibration | Frequency (months) | Next Calibration |
|---|---|---|---|---|---|---|---|
| 1 | Control Computer | F+W | FW0502032 | 300003303 | -/- | -/- | -/- |
| 2 | Trilog Antenna VULB 9163 | Schwarzbeck | 9163-295 | 300003787 | 30.04.2008 | 24 | 30.04.2010 |
| 3 | Amplifier - 0518C-138 | Veritech Micro-wave Inc. | -/- | -/- | -/- | -/- | -/- |
| 4 | Switch - 3488A | HP | | 300000368 | -/- | -/- | -/- |
| 5 | EMI Test receiver - ESCI | R&S | 100083 | 300003312 | 09.01.2009 | 24 | 31.01.2011 |
| 6 | Turntable Controller - 1061 3M | EMCO | 1218 | 300000661 | -/- | -/- | -/- |
| 7 | Tower Controller 1051 Controller | EMCO | 1262 | 300000625 | -/- | -/- | -/- |
| 8 | Tower - 1051 | EMCO | 1262 | 300000625 | -/- | -/- | -/- |
| 10 | Ultra Notch-Filter Rejected band Ch. 62 | WRCD | 9 | -/- | -/- | -/- | -/- |

Measurement uncertainties:
The uncertainty of the measurement equipment fulfils CISPR 16 and the related European and international standards.
The semi anechoic chamber fulfils the requirements of CISPR 16-1 (ANSI C63.4) for a test volume of 1.5m ∅.

**Remarks on methods of measurements**

1. General

The device under test is positioned on a non-conductive fixture and can be rotated and tilted relative to the measurement antenna.
The measurements of radiated emissions in the frequency range from 30 MHz to 1 GHz are performed in vertical and horizontal plane in a semi-anechoic chamber, compliant to CISPR 16-1 for test distances of 3m and 10m. The EUT is positioned on a non-conductive support at a height of 0.80 m above the conductive ground plane covering the whole chamber. The measuring antennas can be moved over a height range from 1.0 m to 4.0 m in order to detect the maximum field strength emitted from the EUT. These antennas are compliant with specifications ANSI C63.2-1996 clause 15 and ANSI C63.4-2003 clause 4.1.5.

Radiated emissions measurements in the frequency ranges from 9 kHz to 30 MHz and 1 GHz to 18 GHz are carried out in a fully-anechoic chamber, compliant to CISPR 16-1, providing test distances up to 5 m. EUT and receiving antennas are positioned 1.5 m above the tips of the absorbers.
Measurements between 18 GHz and 200 GHz are performed in certain test laboratory environments, where analyzers up to 50 GHz, without using external mixers, and harmonic mixer modules and standard gain horns are available up to 320 GHz.

The measurement distances between EUT and receiving antennas are indicated in the test set–ups for the various frequency ranges. For each measurement, the antenna was moved by hand in a defined distance around the EUT until the maximum field strength is received for both polarizations planes.

The wanted and unwanted emissions are received by spectrum analysers where the detector modes and resolution bandwidths (RBW) over various frequency ranges are set according to requirement ANSI C63-4-2003 clause 4.2.

Test equipment and ancillaries used for tests
Calibrations occur according to the EN/ISO/IEC 17025 standard. Calibrations are performed by an external accredited calibration laboratory. Additional to these calibrations, the laboratory performs comparison measurements with other calibrated systems and regular chamber inspections. All used devices are connected to an external 10 MHz reference.

2. Measurements of the EIRP and power density (PD) at fundamental frequency

The measurements are conducted according to FCC rules and, if appropriate to the guideline "Millimeter Wave Test Procedure" with a spectrum analyser (SA), harmonic mixer covering appropriate frequency range and a rectangular standard gain horn antenna (SGH) with matching wave guide dimensions. The conversion loss of the external mixer is taken into account in the SA power level reading automatically.

The radiated power measurements are performed with resolution bandwidth filter (RBW) of 1.0 MHz and a video filter of 1 MHz. Tests are repeated with different RBW, e.g. 2.0 MHz and Video bandwidth filter (VBW) 3.0 MHz in order to evaluate whether a calculated bandwidth correction may be performed.

The evaluation distance for fundamental power measurement is 3.0 m. If the far field condition is met, a smaller test distance (e.g. 1 m) is used and compliance with the 3 m requirement is proved by corresponding calculation. The SA level scale is set to the dimension dBm. With the appropriate antenna aperture area the power density can be calculated from the equation:

| | | | | | |
|---|---|---|---|---|---|
| Power Density | = | EIRP | / | Antenna aperture area | [mW/cm$^2$] |
| pd | = | eirp | – | a | [dB(mW/cm$^2$)] |

Field strength measurements in 3m distance are performed in the case of too large far field distances ($R=2*L^2/\lambda$, R = far field distance in meters, L = largest dimension of either measuring horn or transmitting EUT antenna).

3. Measurements of frequency stability

The frequency stability of the EUT under normal and extreme test conditions is normally measured in (unmodulated) CW-mode (if available).

For extreme test conditions the EUT is placed in a climatic chamber where the front door is made of stable polystyrene. The EUT can radiate through the front door without any additional path losses. The climatic chamber together with the EUT is cooled down to -20 ºC for at least 1 hour. Then frequency stability measurement is carried out with power supply set to nominal value.
The climatic chamber together with the EUT is warmed up in 10° steps and in a rate of +1ºC/minute. After reaching the next temperature step the temperature is kept for a certain time to be stabilized also within the EUT. The frequency stability measurement is done. These temperature steps are repeated until +50 °C is reached.

Frequency measurements are performed under extreme temperature / normal power supply voltage and under normal temperature / extreme power supply voltages.

4. Measurements of field strength and power density at spurious frequencies

Spurious frequencies are produced by transmitter and receiver when the EUT is active.
According to FCC requirements 15.209 and 15.255, spurious emissions have to be investigated as maximum field strength values in the frequency range from 9 kHz to 40 GHz, and as maximum power density in the frequency range above 40 GHz up to 200 GHz. Where possible, the measurement distance shall be 3 m.

In the low frequency range (9 kHz to 30 MHz), the receiving antenna is an active loop antenna which is positioned at 3 m distance in a shielded, anechoic chamber. In case of required measuring distances greater than 3 m, a distance correction factor is used to calculate the received field strength.

Spurious field strength measurements in the frequency range 1 to 12 GHz are carried out in shielded semi-anechoic test chambers. The measurement distance is 3 m.

In the frequency range 12 to 200 GHz, spurious field strength measurements are performed in a certain test laboratory environments with rectangular SGHs.

In the frequency range 40 to 200 GHz, spurious frequencies are measured as power densities. The EUT is operating with its specified modulation. The RBW and VBW are set to such a value that spurious power levels are clearly readable above the noise level of spectrum analyzer. The measurement distance chosen depends on the frequency range, EUT antenna size, test antenna size and test system noise floor for proper detecting spurious emission signals.

5. Measurements of maximum safe level for radiated power density

According to FCC § 1.1307, § 1.1310, § 2.1091 and § 2.1093 measurements are carried out in order to evaluate the impact of human exposure to RF radiation. For this test the EUT is in normal operation mode.

If there is a safety distance given in the manufacturer's document this distance is used for the calculation. The limit of maximum permissible exposure (MPE) for uncontrolled environment is:1.0 mW/cm². See FCC § 1.1310.

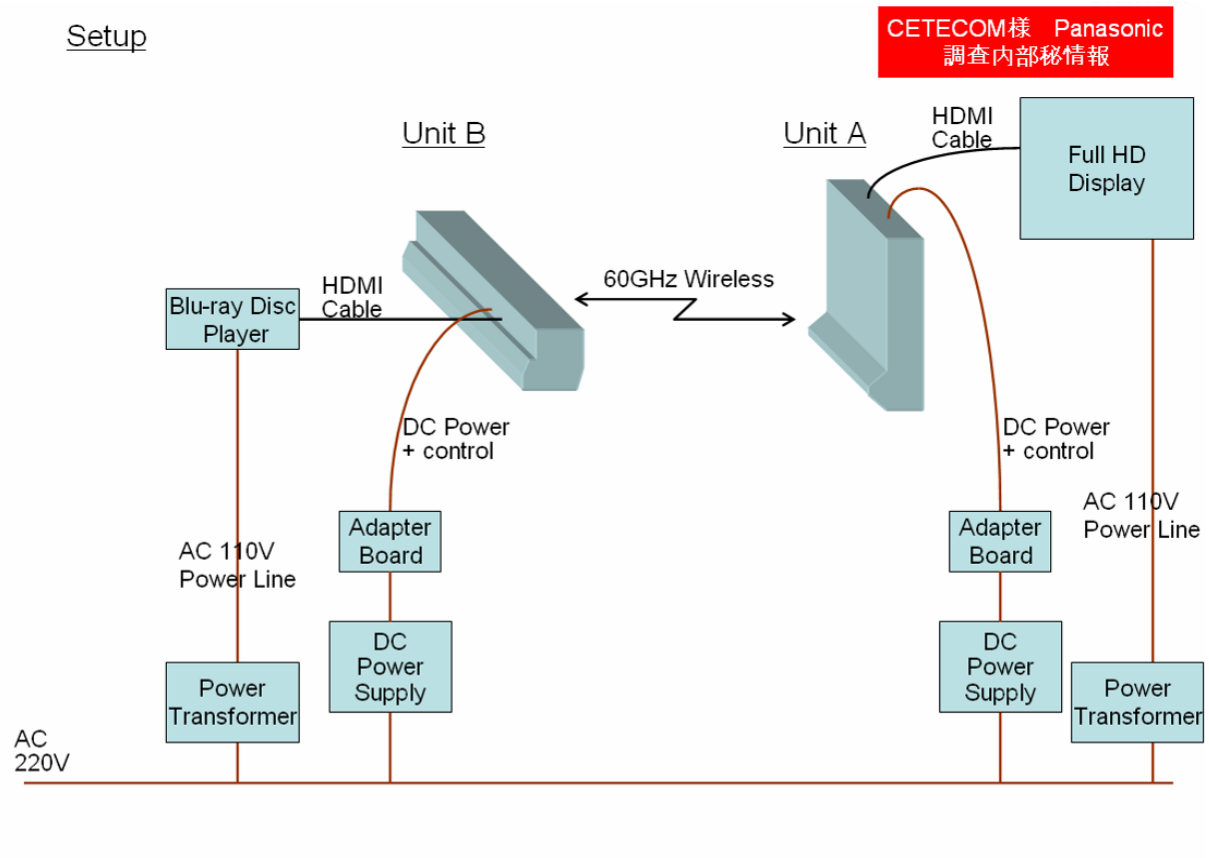
## 5.2 Referenced Documents

none

## 5.3 Additional comments

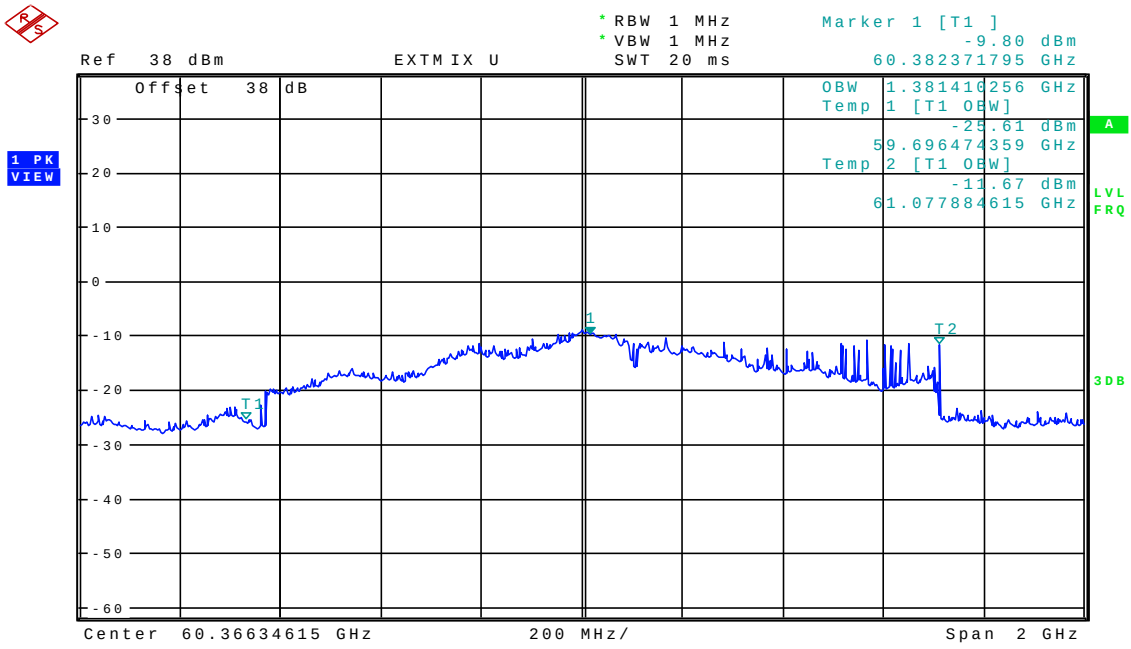
**FCC Inquiry (Tracking Number 813083)**
Dear FCC Experts, We have a device which falls under Part 15.255 Operation within the band 57-64 GHz. The device is a HDMI transmitter: One part is connected to the HDMI interface of a BlueRay/DVD-Player, the counterpart is connected to the HDMI interface of a TV. Transmission is done on 60.48 GHz (center frequency). The device's antenna is a patch antenna array with a beam steering function. The antenna can change the main beam direction e.g. if someone is standing in the line-of-sight between the two units to minimize disturbance of the transmission.
Test proposal: Based on the Millimeter Wave Test Procedure I would propose to setup both devices line-of-sight in a certain distance to make sure to have proper operation. Spectrum analyzer is placed apart from this line-of-sight. During the measurements the mixer is moved carefully by hand in a fixed distance to the transmitting device on a grid like on a chess board within the line-of-sight and completely around the unit. That means nothing except the mixer itself and my hand is within this line-of-sign to minimize disturbance between the two 60 GHz devices. Doing so, I think it should be possible to measure the maximum field strength / EIRP of the carrier and spurious levels even with activated beam steering functionality. Do you agree to this procedure? Best regards Karsten Geraldy

**Response:**
We agree with the proposed test procedure.



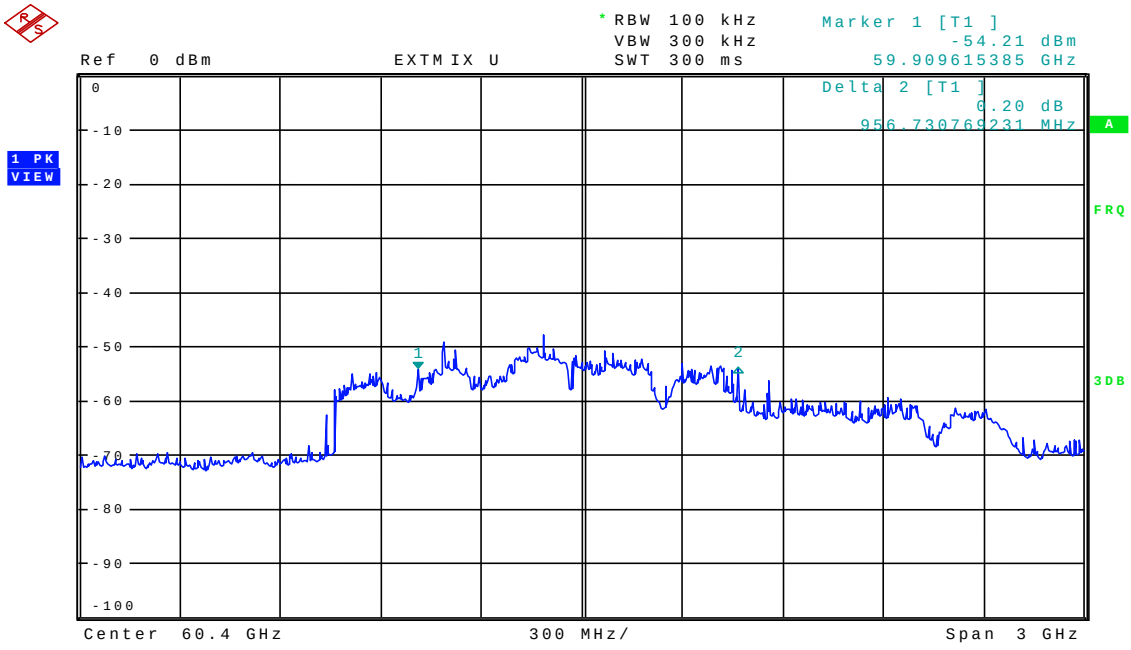
## 5.4 Occupied Bandwidth (99%) and 6 dB Bandwidth §2.1049 / RSS-GEN 4.6

Plot 1: Occupied bandwidth (99%)




Date: 23.JAN.2009 10:12:05

Plot 2: 6 dB bandwidth




Date: 23.JAN.2009 15:41:25

Remark:
The plots show two sets of tests:
- Occupied bandwidth (99%) according to FCC CFR 47 Part 2.1049 and RSS-GEN 4.6.1
- 6 dB bandwidth according to FCC CFR 47 Part 15.255(e)(1) and RSS-GEN 4.6.2

Results:

| **TEST CONDITIONS** | | **Occupied Bandwidth / 6 dB Bandwidth [MHz]** | | |
|---|---|---|---|---|
| **Frequency [GHz]** | | | **60.48** | |
| **$T_{nom}$ 23 °C** | **$V_{nom}$ 110 Vac** | | **1381.4 / 956.7** | |
| | | | | |

Description according to FCC §2.1049:

| | |
|---|---|
| Under normal test conditions only | The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission. |

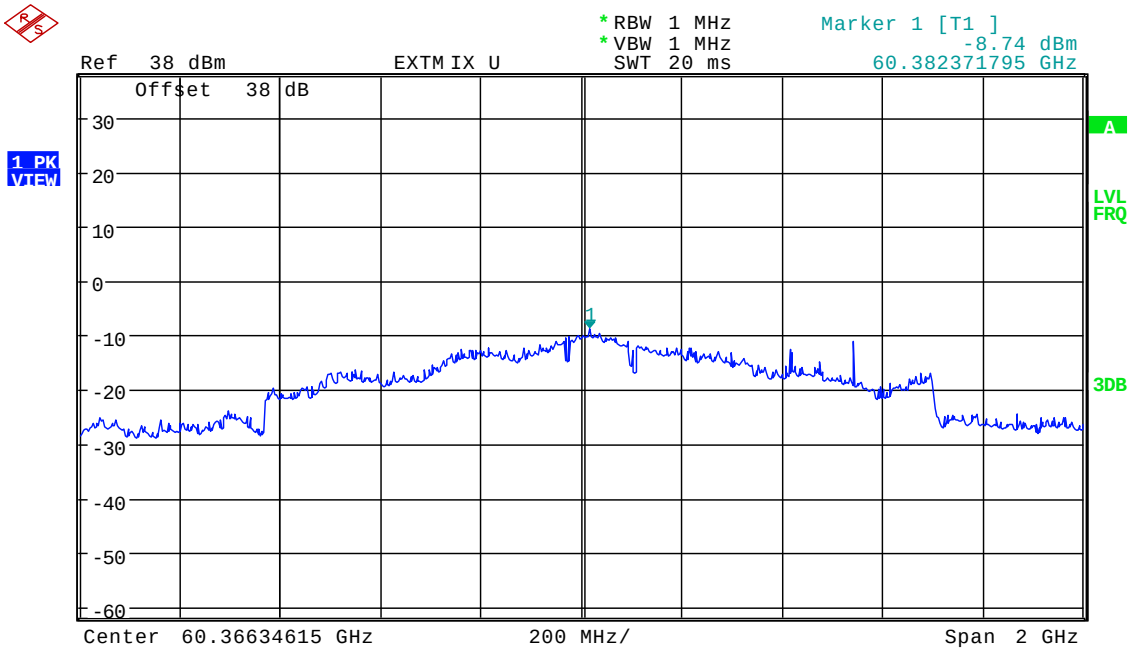
Description according to RSS-GEN 4.6.2:

| | |
|---|---|
| Under normal test conditions only | Where indicated, the 6 dB bandwidth is measured at the points when the spectral density of the signal is 6 dB down from the in-band spectral density of the modulated signal, with the transmitter modulated by a representative signal. Spectral density (power per unit bandwidth) is to be measured with a detector of resolution bandwidth equal to approximately 1.0% of the emission bandwidth. |

**Test Result: pass**

## 5.5 Power Density §15.255(b)(1) / RSS-210 A13.2.2

Plot 3:




The mark "R" in the plots indicates a reference level offset. This offset is calculated as follows:
System attenuation = free field attenuation - antenna gain = 62.1 dB - 24.1 dBi = 38.0 dB

Farfield conditions: $r = 2 * d^2/\lambda = 2 * d^2 * f / c = 2 * (0.023m)^2 * 60.48\ GHz / 3E8 = 0.21\ m$
Measurements were done on r = 0.5 m => farfield conditions are met.

Results:

| TEST CONDITIONS | | | MAXIMUM PEAK OUTPUT POWER / MAXIMUM PEAK POWER DENSITY | | |
|---|---|---|---|---|---|
| Frequency (GHz) | | | | 60.48 | |
| $T_{nom}$ 23 °C | $V_{nom}$ 110 Vac | Peak | | -8.7 dBm / 0.12 nW/cm² | |
| Measurement uncertainty | | | | ±3dB | |

If peak measured results meet the average limit, then the average calculation is not required.

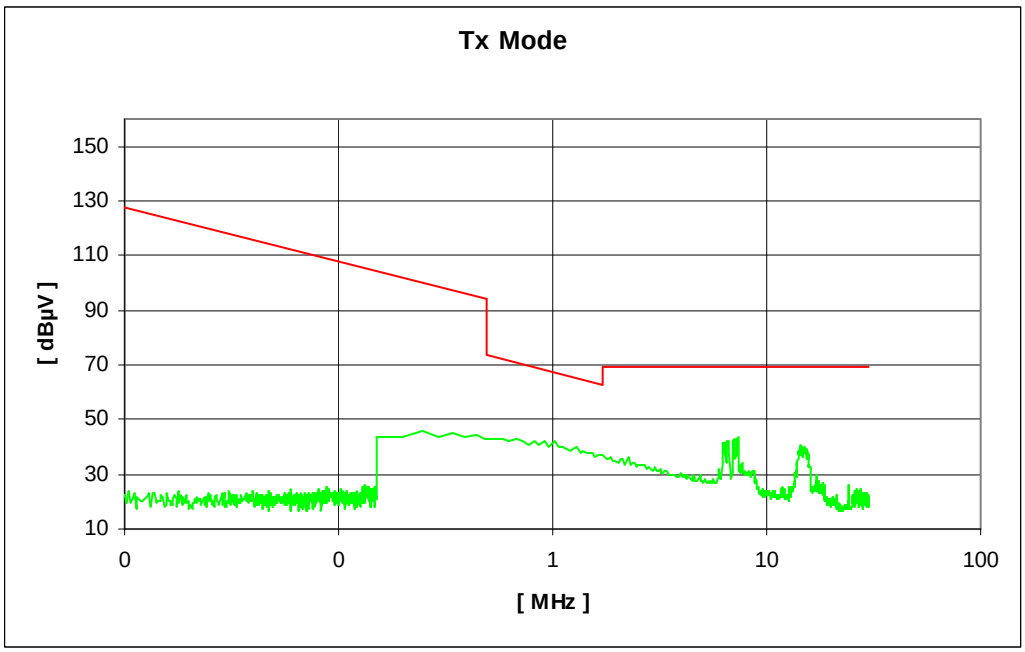
Limits according to §15.255(b)(1):

| | |
|---|---|
| Under normal test conditions only | For products other than fixed field disturbance sensors, the average power density of any emission, measured during the transmit interval, shall not exceed 9 µW/cm², as measured 3 meters from the radiating structure, and the peak power density of any emission shall not exceed 18 µW/cm², as measured 3 meters from the radiating structure. [9 µW/cm² is equivalent to an EIRP of 10.2 W; 18 µW/cm² is equivalent to an EIRP of 20.4 W.] |

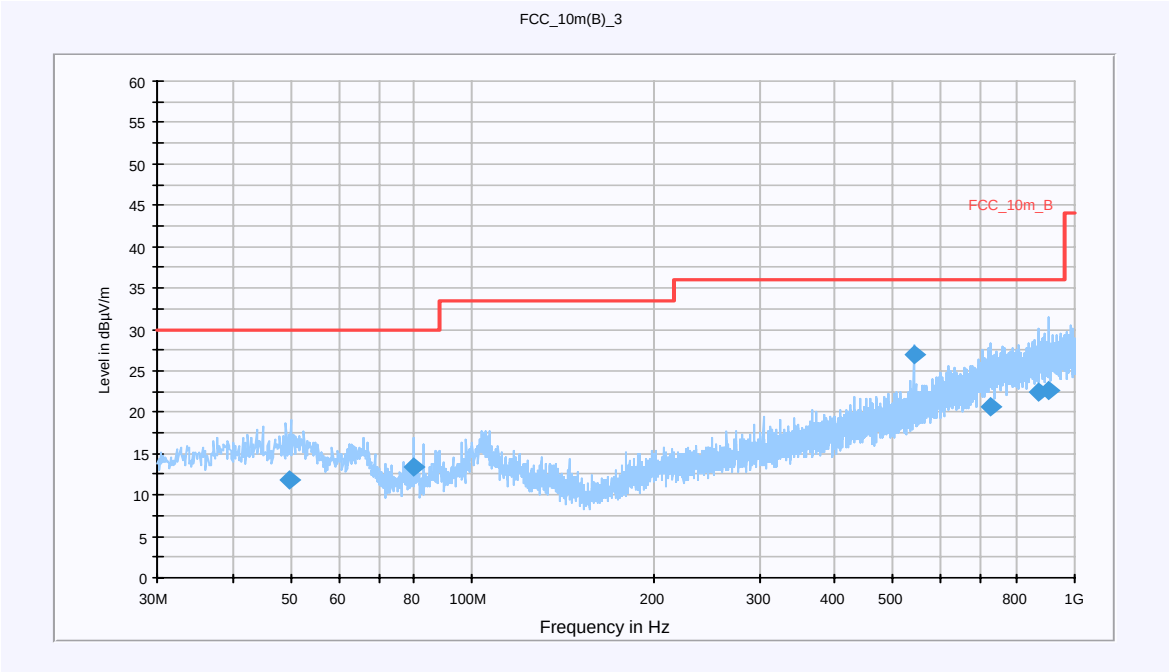
**Test Result: pass**

## 5.6 Radiated Spurious Emissions §15.255 (c) / RSS-210 A13.2.2

Plot 4: 9 kHz - 30 MHz

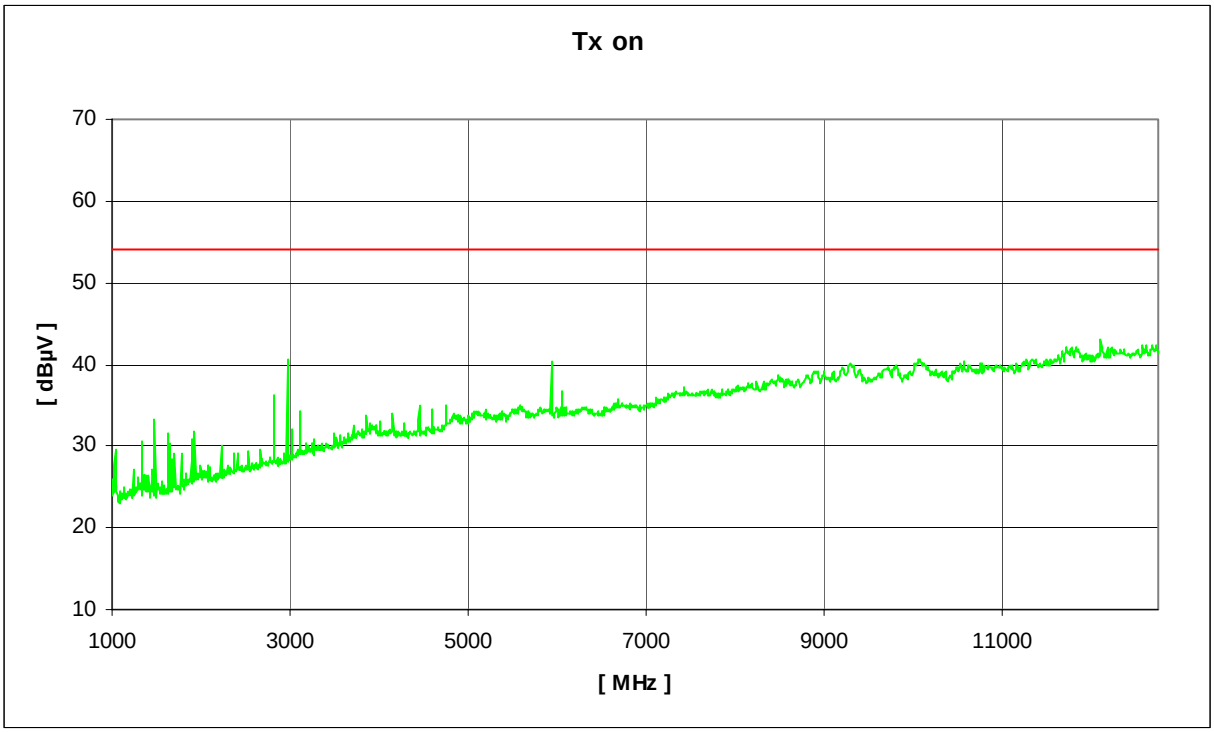



Plot 5: 30 MHz - 1 GHz

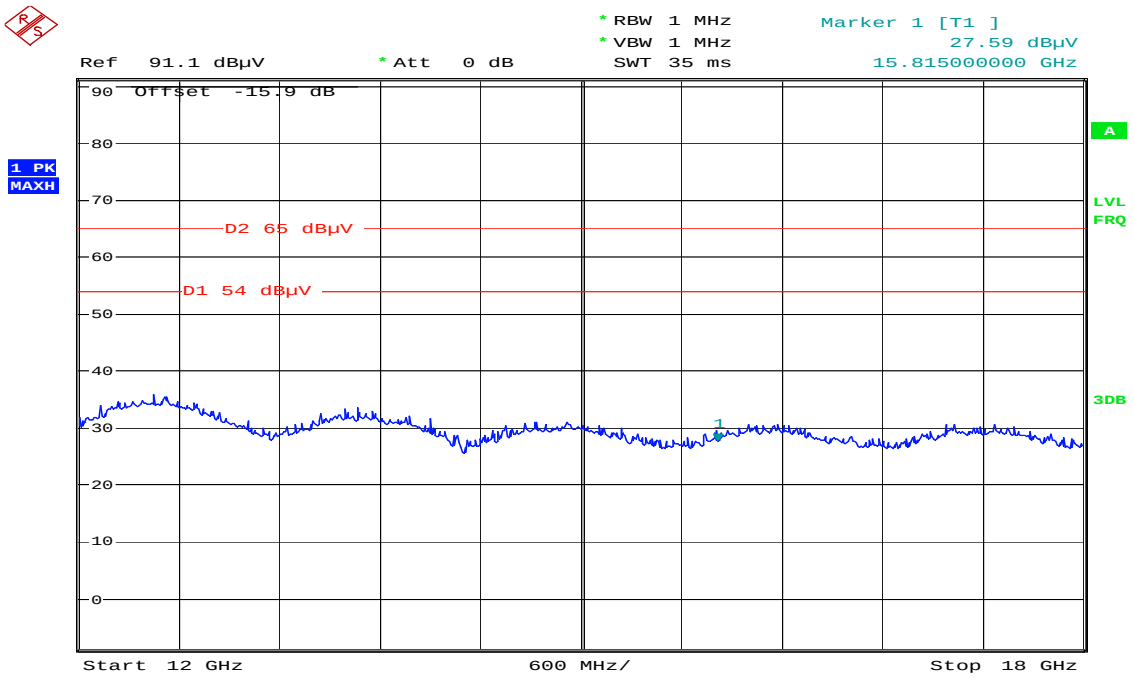



| Frequency (MHz) | QuasiPeak (dBµV/m) | Meas. Time (ms) | Bandwidth (kHz) | Antenna height (cm) | Polarity | Turntable position (deg) | Corr. (dB) | Margin (dB) | Limit (dBµV/m) |
|---|---|---|---|---|---|---|---|---|---|
| 49.549200 | 11.7 | 15000.000 | 120.000 | 189.0 | V | 268.0 | 13.5 | 18.3 | 30.0 |
| 80.007800 | 13.3 | 15000.000 | 120.000 | 171.0 | V | 233.0 | 9.4 | 16.7 | 30.0 |
| 540.003150 | 26.9 | 15000.000 | 120.000 | 98.0 | V | 215.0 | 19.7 | 9.1 | 36.0 |
| 727.654600 | 20.6 | 15000.000 | 120.000 | 215.0 | V | 323.0 | 23.6 | 15.4 | 36.0 |
| 870.831600 | 22.5 | 15000.000 | 120.000 | 224.0 | V | 20.0 | 25.3 | 13.5 | 36.0 |
| 907.603750 | 22.7 | 15000.000 | 120.000 | 224.0 | V | 28.0 | 25.7 | 13.3 | 36.0 |

Plot 6: 1 - 12.75 GHz

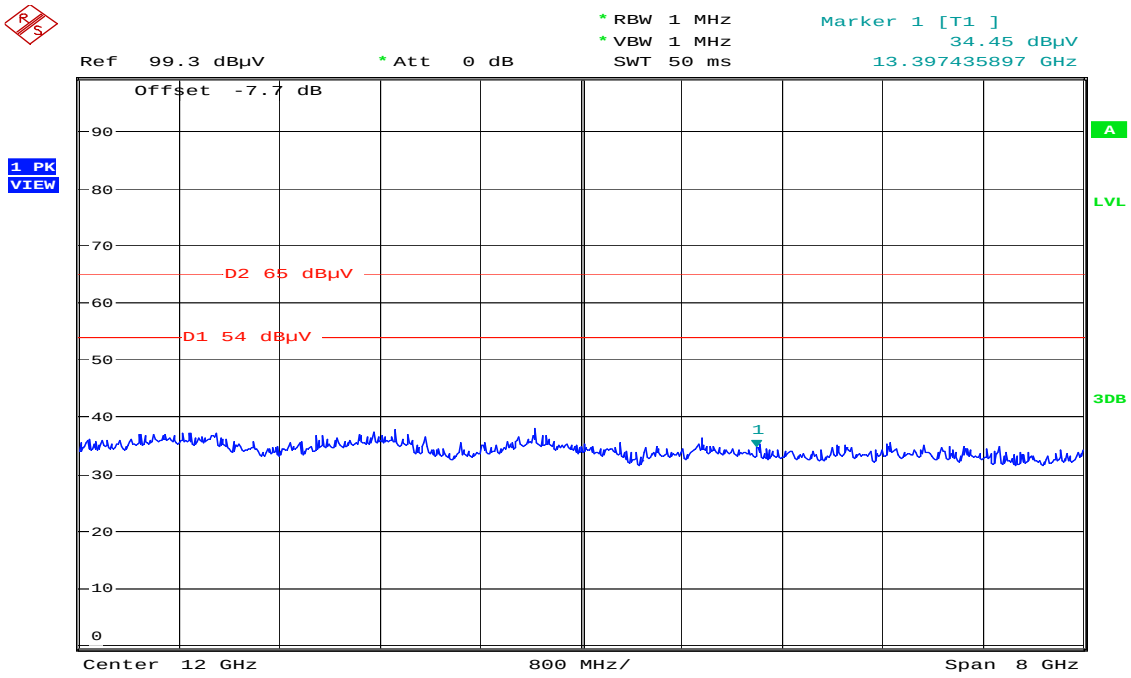



Plot 7: 12 - 18 GHz



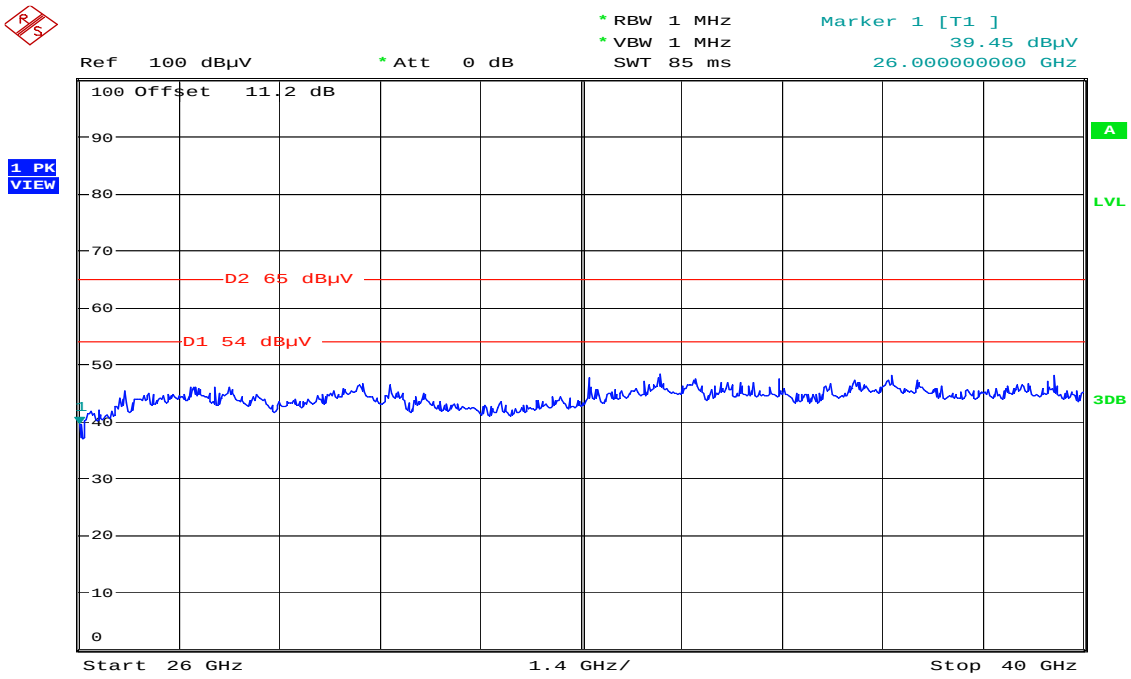

Date: 23.JAN.2009 10:24:06

Plot 8: 18 - 26 GHz



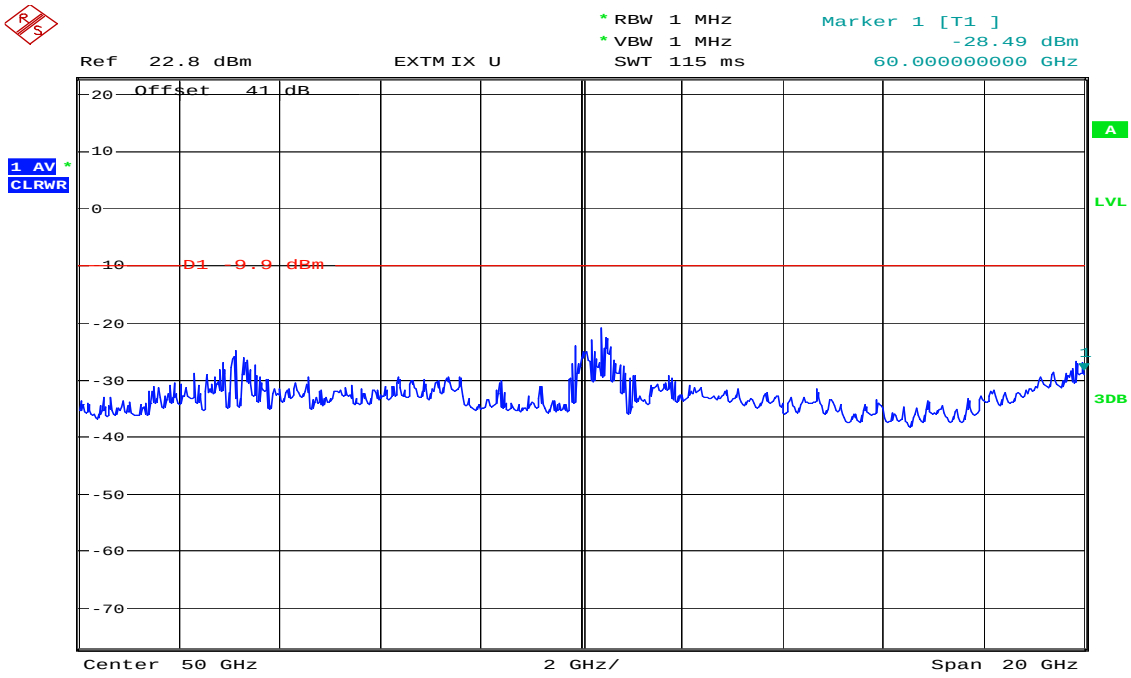

Date: 23.JAN.2009 10:26:39

Plot 9: 26 - 40 GHz



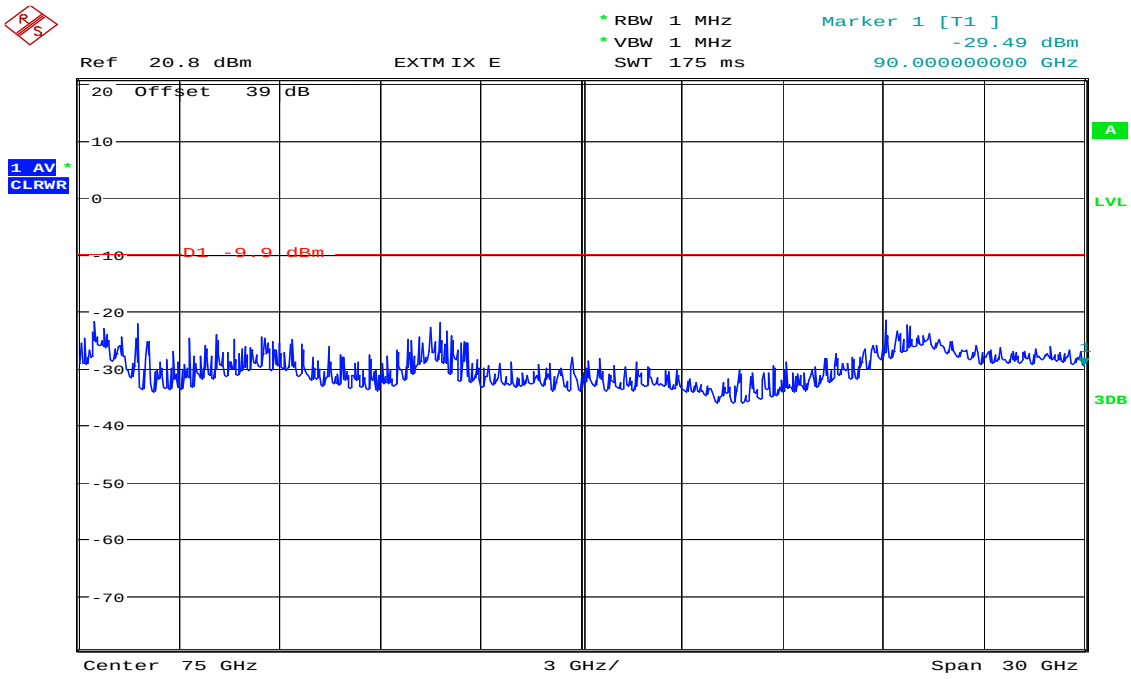

Date: 23.JAN.2009 10:28:52

Plot 10: 40 - 60 GHz



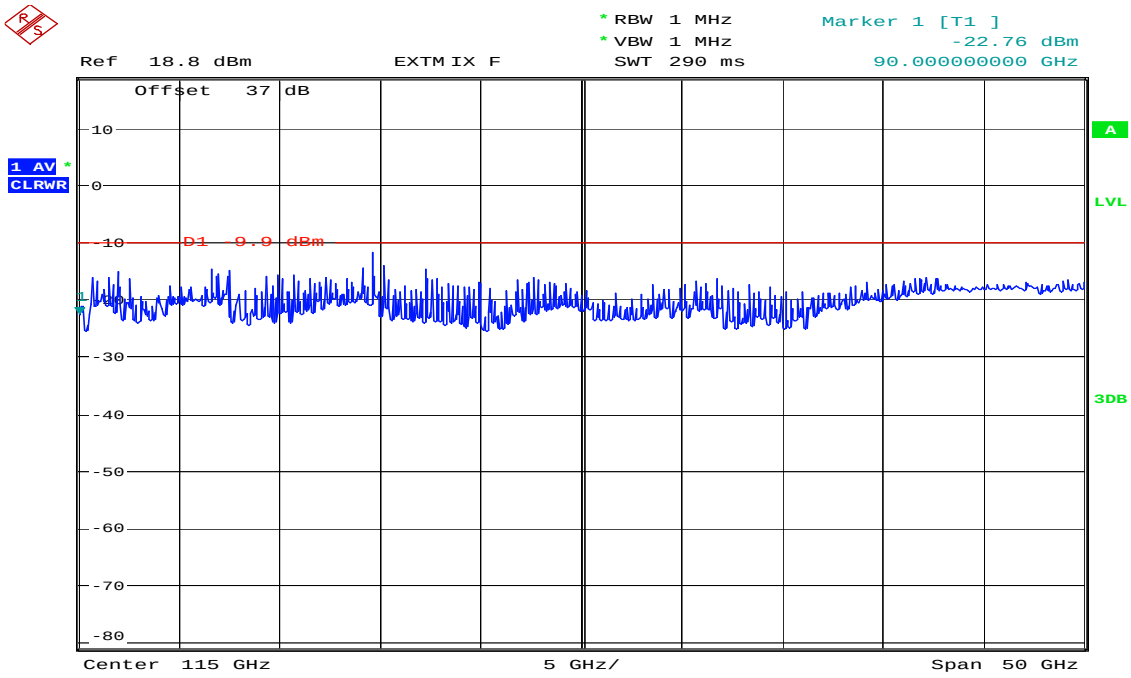

Date: 23.JAN.2009 11:07:15

Plot 11: 60 - 90 GHz



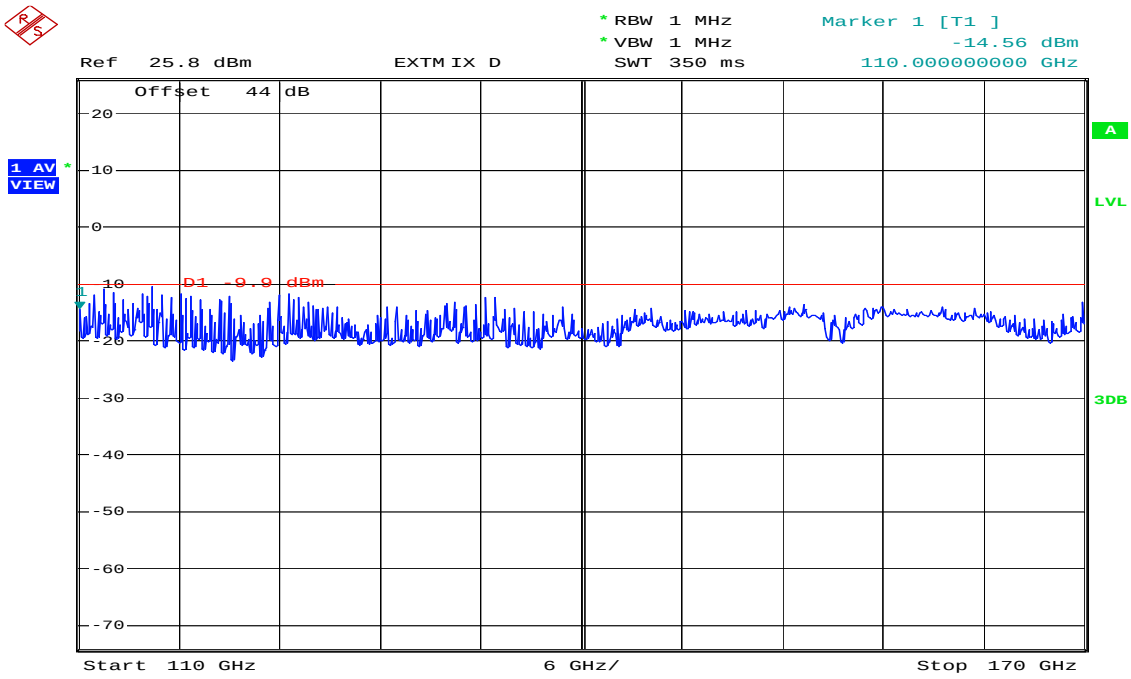

Date: 23.JAN.2009 11:05:11

Plot 12: 90 - 140 GHz



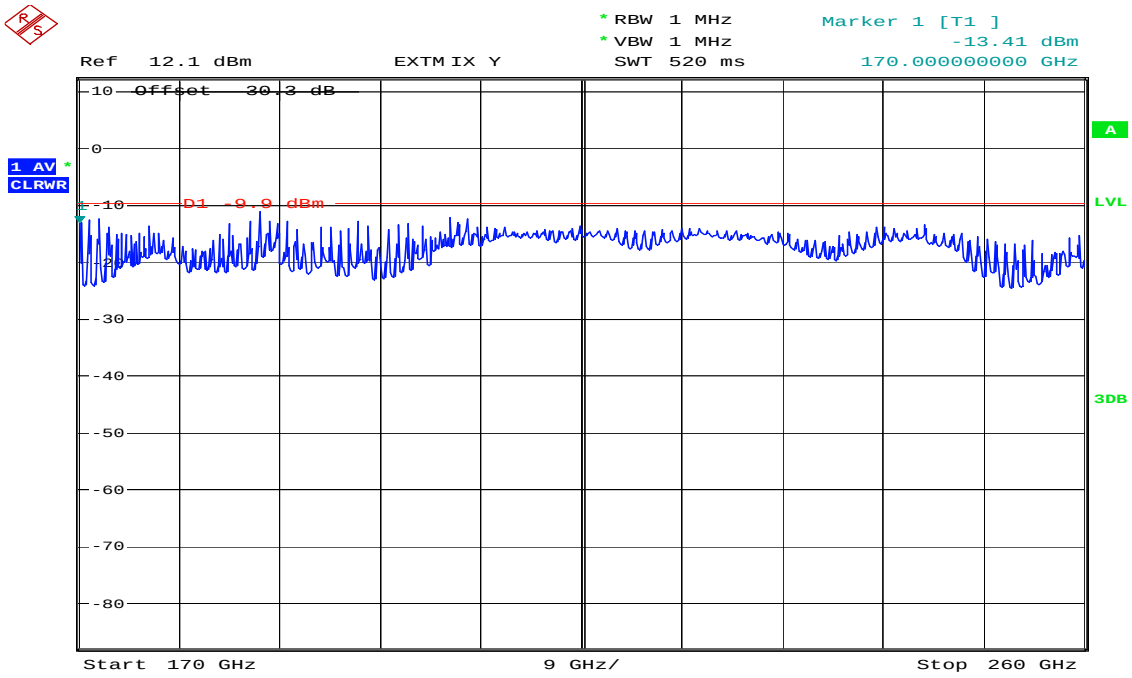

Date: 23.JAN.2009 10:54:04

Plot 13: 110 - 170 GHz




Date: 23.JAN.2009 10:58:04

Plot 14: 170 - 200 GHz




**All spurious emissions detected are lower in level than the fundamental signal.**

**Limit according to 15.255 (c):**

(c) Limits on spurious emissions:
(1) The power density of any emissions outside the 57-64 GHz band shall consist solely of spurious emissions.
(2) Radiated emissions below 40 GHz shall not exceed the general limits in Section 15.209 of this part.
(3) Between 40 GHz and 200 GHz, the level of these emissions shall not exceed 90 pW/cm$^2$ at a distance of 3 meters. [Equivalent to an EIRP of 102 µW.]
(4) The levels of the spurious emissions shall not exceed the level of the fundamental emission.

Limit line:

| Frequency (MHz) | Field strength (µV/m) | Measurement distance (m) |
|---|---|---|
| 0.009 - 0.490 | 2000/F(kHz) | 300 |
| 0.490 - 1.705 | 20000/F(kHz) | 30 |
| 1.705 - 30.0 | 30.0 µV/m / 29.5 dBµV/m | 30 |
| 30 - 88 | 100 µV/m / 40.0 dBµV/m | 3 |
| 88 - 216 | 150 µV/m / 43.5 dBµV/m | 3 |
| 216 - 960 | 200 µV/m / 46.0 dBµV/m | 3 |
| above 960 up to 40 GHz | 500 µV/m / 54.0 dBµV/m | 3 |
| 40 GHz - 200 GHz | 90 pW/cm$^2$ | 3 |

Remark:
90 pW/cm$^2$ measured at a distance of 3m corresponds to an EIRP of 102 µW / -9.9 dBm.

**Test Result: pass**

## 5.7 Peak Transmitter Output Power §15.255 (e) / RSS-210 A13.2.3

A maximum radiated peak power (EIRP) of -8.7 dBm was measured (see chapter 5.5 Power Density §15.255(b)(1))

Result:

| max. radiated power (EIRP) [dBm] | antenna gain (as specified by the manufacturer) [dBi] | conducted power [dBm] | conducted power [mW] |
|---|---|---|---|
| -8.7 | 17.0 | -25.7 | 0.027 |

Remark:
Antenna gain was specified by the manufacturer (see annex 1).

**Limit according to §15.255 (e):**

(e) Except as specified below, the total peak transmitter output power shall not exceed 500 mW.
(1) Transmitters with an emission bandwidth of less than 100 MHz must limit their peak transmitter output power to the product of 500 mW times their emission bandwidth divided by 100 MHz. For the purposes of this paragraph, emission bandwidth is defined as the instantaneous frequency range occupied by a steady state radiated signal with modulation, outside which the radiated power spectral density never exceeds 6 dB below the maximum radiated power spectral density in the band, as measured with a 100 kHz resolution bandwidth spectrum analyzer. The center frequency must be stationary during the measurement interval, even if not stationary during normal operation (e.g. for frequency hopping devices).

**Test Result: pass**

## 5.8 Frequency Stability §15.255 (f) / RSS-210 A13.2.6

| $U_{AC}$ [V] | Temperature [°C] | Carrier frequency [GHz] | Measured frequency [GHz] | Difference [MHz] | Difference [ppm] |
|---|---|---|---|---|---|
| 110 | +50.0 | 60.48 | 60.4800 | 0.0 | 0 |
| 110 | +40.0 | 60.48 | 60.4800 | 0.0 | 0 |
| 110 | +30.0 | 60.48 | 60.4750 | -5.0 | -82 |
| 94 | +20.0 | 60.48 | 60.4755 | -4.5 | -74 |
| 110 | +20.0 | 60.48 | 60.4750 | -5.0 | -82 |
| 126 | +20.0 | 60.48 | 60.4755 | -4.5 | -74 |
| 110 | +10.0 | 60.48 | 60.4800 | 0.0 | 0 |
| 110 | 0 | 60.48 | 60.4775 | -2.5 | -41 |
| 110 | -10.0 | 60.48 | 60.4775 | -2.5 | -41 |
| 110 | -20.0 | 60.48 | 60.4775 | -2.5 | -41 |
| 110 | -30.0 | 60.48 | 60.4775 | -2.5 | -41 |

**Limit according to §15.255 (f):**

(f) Fundamental emissions must be contained within the frequency bands specified in this section during all conditions of operation. Equipment is presumed to operate over the temperature range -20 to +50 degrees Celsius with an input voltage variation of 85% to 115% of rated input voltage, unless justification is presented to demonstrate otherwise.

**Test Result: pass**

## 5.9 Group Installations §15.255 (h) / RSS-210 A13.2.6

Declaration:
The units are not equipped with an interface for external control of Tx/Rx signals in frequency, amplitude or phase. The units do not provide any feature to combine several units together which allows building of beam-forming arrays.

**Limit according to §15.255 (h):**

(h) Any transmitter that has received the necessary FCC equipment authorization under the rules of this chapter may be mounted in a group installation for simultaneous operation with one or more other transmitter(s) that have received the necessary FCC equipment authorization, without any additional equipment authorization. However, no transmitter operating under the provisions of this section may be equipped with external phase-locking inputs that permit beam-forming arrays to be realized.

**Test Result: not applicable**

## 5.10 Transmitter Self-Identification Transmission §15.255 (i) / RSS-210 A13.2.7

Declaration:
The Wireless HDMI Transmission System is for indoor use only. There are no wanted transmissions directed to any outdoor unit outside of a building. Therefore this section is not applicable.

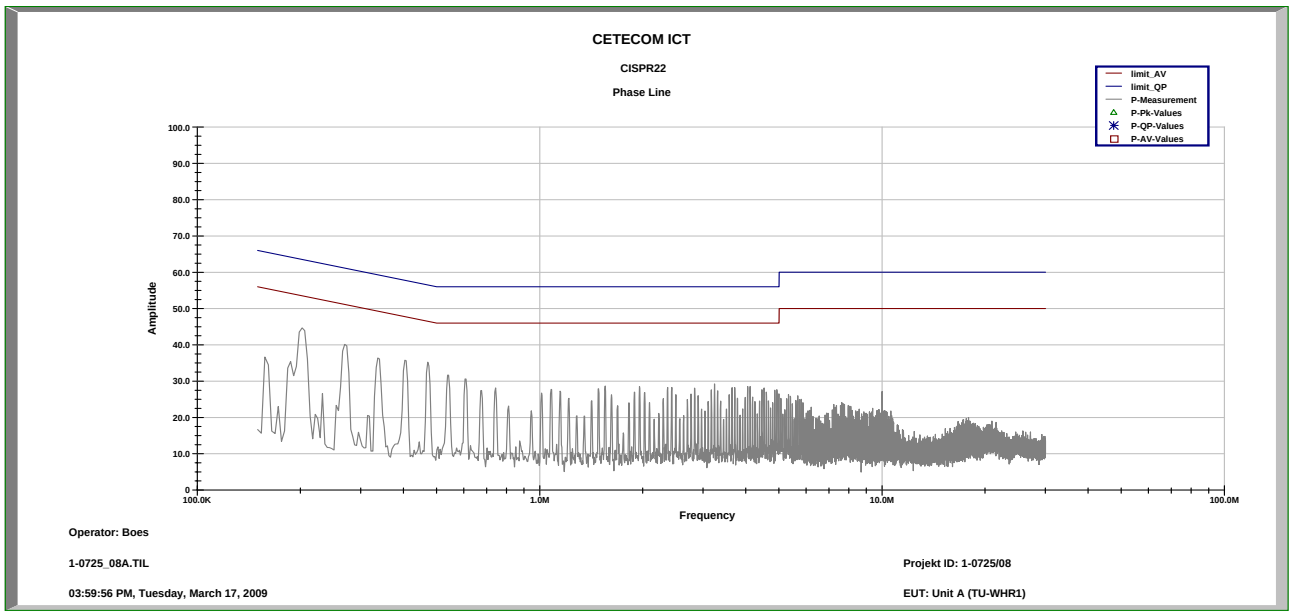
**Limit according to §15.255 (i):**

(i) For all transmissions that emanate from inside a building, within any one second interval of signal transmission, each transmitter with a peak output power equal to or greater than 0.1 mW or a peak power density equal to or greater than 3 nW/cm², as measured 3 meters from the radiating structure, must transmit a transmitter identification at least once. Each application for equipment authorization must declare that the equipment that will be used inside a building contains the required transmitter identification feature and must specify a method whereby interested parties can obtain sufficient information, at no cost, to enable them to fully detect and decode this transmitter identification information. Upon the completion of decoding, the transmitter identification data block must provide the following fields:
1. FCC Identifier, which shall be programmed at the factory.
2. Manufacturer's serial number, which shall be programmed at the factory.
3. Provision for at least 24 bytes of data relevant to the specific device, which shall be field programmable. The grantee must implement a method that makes it possible for users to specify and update this data. The recommended content of this field is information to assist in contacting the operator.

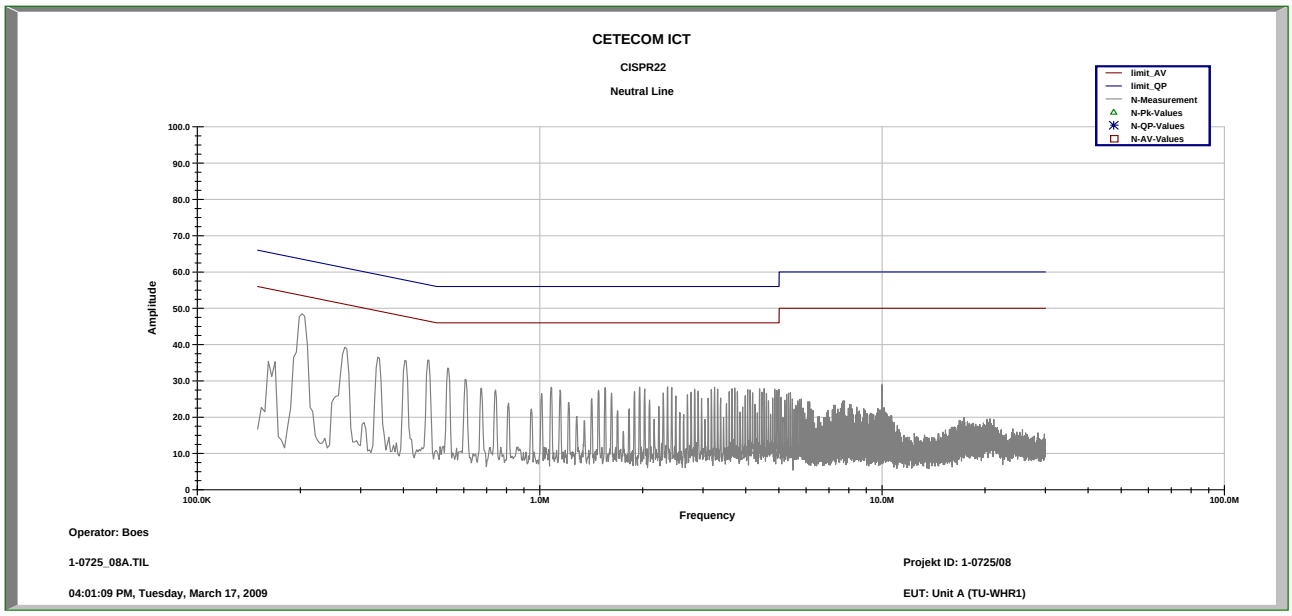
**Test Result: not applicable**

## 5.11 Conducted Spurious Emissions §15.207 / RSS-GEN 7.2.2

Plot 15: 150 kHz - 30 MHz




Plot 16: 150 kHz - 30 GHz




**Limits according to §15.207:**

| Frequency (MHz) | Conducted Emission (dBµV) Quasi-Peak | Conducted Emission (dBµV) Average |
|---|---|---|
| 0.15 -0.5 | 66 to 56 | 56 to 46 |
| 0.5 - 5 | 56 | 46 |
| 5 - 30 | 60 | 50 |

**Test Result: pass**

## 5.12 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. $mW/cm^2$)
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:

Calculated based on EIRP value

Max. EIRP: -8.7 dBm = 0.13 mW

calculated at distance of 20 cm:

Peak power density = 0.13 mW / $4\pi(20cm)^2$ = 0.027 µW/ $cm^2$

Limit:

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