

Test report for WindLink

Report Date: July 2, 2008

Signatures:

Tested by:



Päivi Punta

Testing engineer



Contents approved:



Petri Lehtinen

Operational manager

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1 LABORATORY INFORMATION

| | |
|---|--|
| Test Laboratory | <p>INTERTEK ETL SEMKO OY EMC Laboratory Koneenkatu 12 / K17 05830 Hyvinkää FINLAND</p> <p>Tel: +358 10 424 6200 Fax: +358 10 424 6201 e-mail: firstname.surname@intertek.com</p> |
| FCC registration number: IC file number: | <p>910391 (January 27, 2003) IC 4616A-1 (May 14, 2003)</p> |

2 CUSTOMER INFORMATION

| | |
|------------------------|---|
| Client | <p>Polar Elektro Oy Professorintie 5 90440 Kempele Finland</p> <p>Tel. +358 8 520 2100 Fax +358 8 520 2200</p> |
| Contact person: | <p>Jouni savolainen Polar Elektro Oy Professorintie 5 90440 Kempele Finland</p> <p>Tel: +358 8 520 2100 Fax: +358 8520 2200</p> |
| Testing date: | April 23 – June 04, 2008 |
| Report date: | July 02, 2008 |

The tests listed in this report have been done to demonstrate compliance to the FCC rules section CFR47 §15.249, §15.209 and IC standard RSS-GEN, RSS-210.

3 SUMMARY OF TEST RESULTS

Transmitter measurements

| Section in CFR 47 | Section in RSS-210 | Test | Result |
|-------------------|--------------------|-------------------------------|--------|
| § 15.249 (a) | A2.9 | Field strength of fundamental | PASS |
| § 15.249 (a) (d) | 2.7, A2.9 | Spurious radiated emissions | PASS |
| § 15.215 (c) | | 20 dB bandwidth | PASS |
| | RSS-GEN 4.4.1 | 99% bandwidth | PASS |

Receiver measurements

| Section in CFR 47 | Section in RSS-GEN | Section in ICES-003 | Test | Result |
|-------------------|--------------------|---------------------|---------------------------------------|--------|
| §15.107 | 7.2.2 | 5.3 | Conducted emissions to AC-power lines | PASS |
| §15.109 | 7.2.3 | 5.5 | Radiated emissions | PASS |

PASS Pass
 FAIL Fail
 X Measured, but there is no applicable performance criteria
 Na Not applicable

4 EUT INFORMATION

The EUT and accessories used in the tests are listed below. Later in this report only EUT numbers are used as reference.

| | Device | Type | S/N | EUT number |
|-------------|------------------------------|----------|------------------|------------|
| EUT | W.I.N.D 2,4GHz USB-Dongle | WindLink | F821P70300034** | 60601 |
| | W.I.N.D 2,4GHz USB-Dongle | WindLink | F821P70300035*** | 60602 |
| | W.I.N.D 2,4GHz USB-Dongle | WindLink | F821P70300032*** | 60603 |
| Accessories | Portable computer | DELL | - | 60604 |
| | Printer | HP | - | 60605 |
| | Mouse | Compaq | - | 60606 |

Notes:

** Modified to transmit continuously

*** Modified with antenna connector for conducted measurements

4.1 EUT description

EUT is a USB dongle for transferring data between Polar wrist computers and PC. The data transfer is conducted using radio link operating in 2.4GHz frequency band.

The EUT was not modified during the tests.

4.2 EUT TEST SETUPS

For each test the EUT was exercised to find out the worst case of operation modes and device configuration.

Two different test setups were used: one for conducted measurements, another for radiated measurements. Two EUT were equipped with an external antenna connector for conductive measurements.

The test setup photographs are in the document referenced in section 13.

5 APPLICABLE STANDARDS

The tests were performed in guidance of:

CFR 47 part:

§15.107

§15.109

§15.209

§15.249

ANSI C63.4, 2003

IC standard:

RSS-GEN, Issue 1

RSS-210, Issue 7

ICES-003, Issue 4

CISPR 22, 2002

Deviations, modifications or clarifications (if any) to above mentioned documents are written in each section under "Test method" for each test case.

6 FIELD STRENGTH OF FUNDAMENTAL

| | | | |
|-------------------------------------|--------------|--------|----------|
| EUT | 60601 | | |
| Accessories | 60604 | | |
| Temp, Humidity, Air Pressure | 26 °C | 27 RH% | 1001 hPa |
| Date of measurement | May 29, 2008 | | |
| FCC rule part | §15.249 (a) | | |
| RSS-210 section | A2.9 (1) | | |
| Measured by | Päivi Punta | | |

6.1 Test setup and measurement method

The EUT was set on a non-conductive turntable in a semi-anechoic chamber. The EUT was set at 0.8m height. Measuring antenna was scanned 1 – 4 m in height.

The measurements were repeated in three EUT orientations and two antenna polarizations.

The measured signal was routed from the measuring antenna to the spectrum analyzer.

The measurement was made using 1 MHz resolution bandwidth and 1 MHz video bandwidth and maximum hold function to record the maximum peak output power.

6.2 EUT operation mode

| | |
|---------------------------|--------------------------------|
| EUT operation mode | Continuous transmission |
| EUT frequency | 2402, 2440, 2481 MHz |
| EUT TX power level | 0 dBm (Software configuration) |

6.3 Limit

Table 1: Field strength of fundamental

| Frequency (MHz) | mV/m (@3m) | dBuV/m (@3m) |
|-----------------|-------------|---------------------|
| 2400-2483.5 | 50 (Avg) | 94 (Avg) 114 (peak) |

6.4 Results

Table 2: Maximum field strength of fundamental (Peak value)

| Freq MHz | Measured Value dBuV | Correction Factor dB | Result dBuV/m | EUT orientation | Antenna Pol. | Antenna height m | Turntable angle deg |
|----------|---------------------|----------------------|---------------|-----------------|--------------|------------------|---------------------|
| 2401 | 59,1 | 33,7 | 92,8 | Pos 1 | Hor | 1,0 | 211 |
| 2440 | 60,1 | 33,9 | 94,0 | Pos 3 | Hor | 1,0 | 336 |
| 2481 | 58,3 | 34,1 | 92,4 | Pos 2 | Hor | 1,7 | 173 |

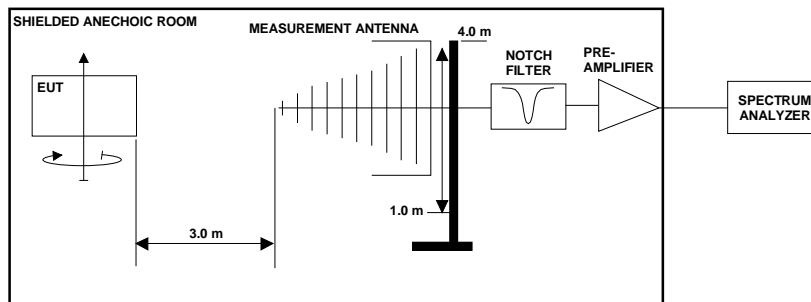
7 RADIATED SPURIOUS EMISSIONS

| | | | |
|-------------------------------------|-----------------|--------|----------|
| EUT | 60601 | | |
| Accessories | 60604 | | |
| Temp, Humidity, Air Pressure | 26 °C | 27 RH% | 1001 hPa |
| Date of measurement | May 29, 2008 | | |
| FCC rule part | §15.249 (a) (d) | | |
| RSS-210 section | 2.7, A2.9 (2) | | |
| Measured by | Päivi Punta | | |

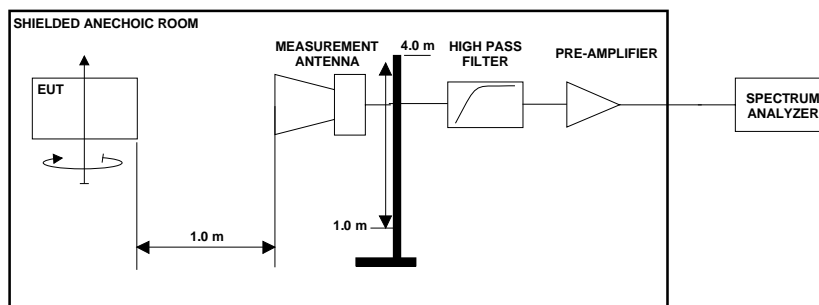
7.1 Test setup

EUT was modified to send constant carrier at nominal frequency.

The test was done using an automated test system, where a computer controlled the measurement equipments.



Picture 1: Test setup for radiated spurious emissions measurement
30 MHz - 3 GHz frequencies



Picture 2: Test setup for radiated spurious emissions measurement
3 GHz – 25 GHz frequencies

7.2 Test method

1. The emissions were searched and maximized by moving the turntable, changing the measuring antenna polarization and height and manipulating the EUT.
2. Levels of suspicious signals and levels of EUT transmitter harmonics were recorded.
3. The recorded levels were corrected in the automated test system with the measurement antenna factor, cable attenuations and filter attenuation.
4. The corrected values, giving the EUT radiated spurious emission levels as dB μ V/m at 3 m distance, are reported.

7.3 EUT operation mode

| | |
|---------------------------|--------------------------------|
| EUT operation mode | Continuous transmission |
| EUT frequency | 2402,2440, 2481 MHz |
| EUT TX power level | 0 dBm (Software configuration) |

7.4 Limit

Table 3: Radiated spurious emission limits at measurement distance of 3m

| Frequency band (MHz) | 3m Limit (μ V/m) | 3m Limit (dB μ V/m) | Detector |
|----------------------|-----------------------|-------------------------|----------|
| 30 – 88 | 100 | 40 | QP |
| 88 -216 | 150 | 43.5 | QP |
| 216 - 960 | 200 | 46 | QP |
| 960 - 1000 | 500 | 54.0 | QP |
| 1000 - 25000 | 500 | 54.0 | AVG |
| 1000 - 25000 | 5000 | 74.0 | PEAK |

As default, all emissions were compared against the general limits. If any emission exceeded that limit, it was further checked, that it complies with the -50dBc requirement.

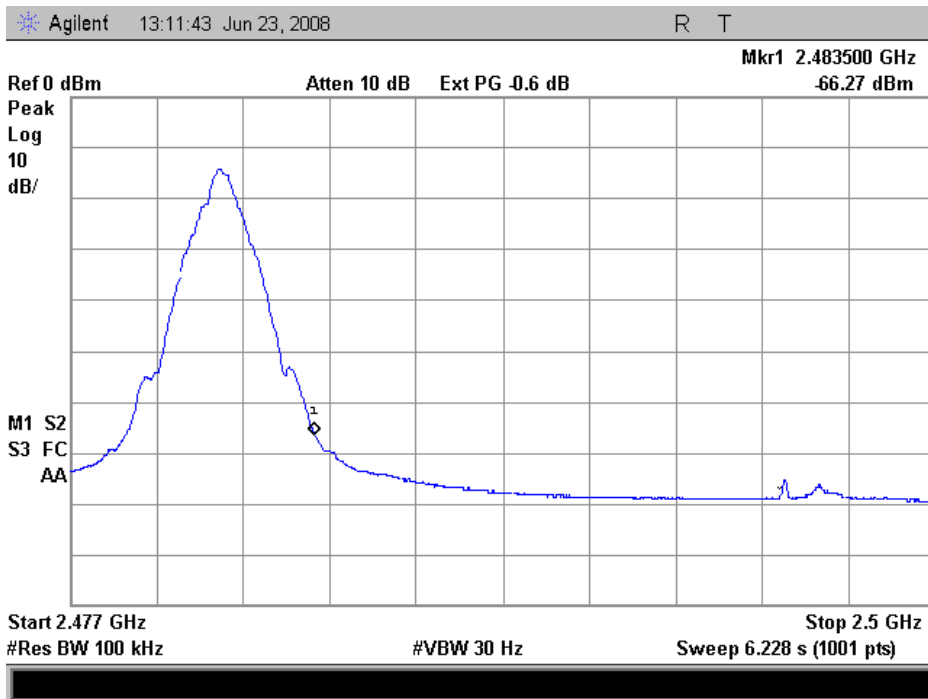
7.5 Results

Measurement system noise level was least 20 dB below the spurious emission limit. Only levels of suspicious signals and transmitter harmonic frequencies, which were above the measurement system noise, are reported.

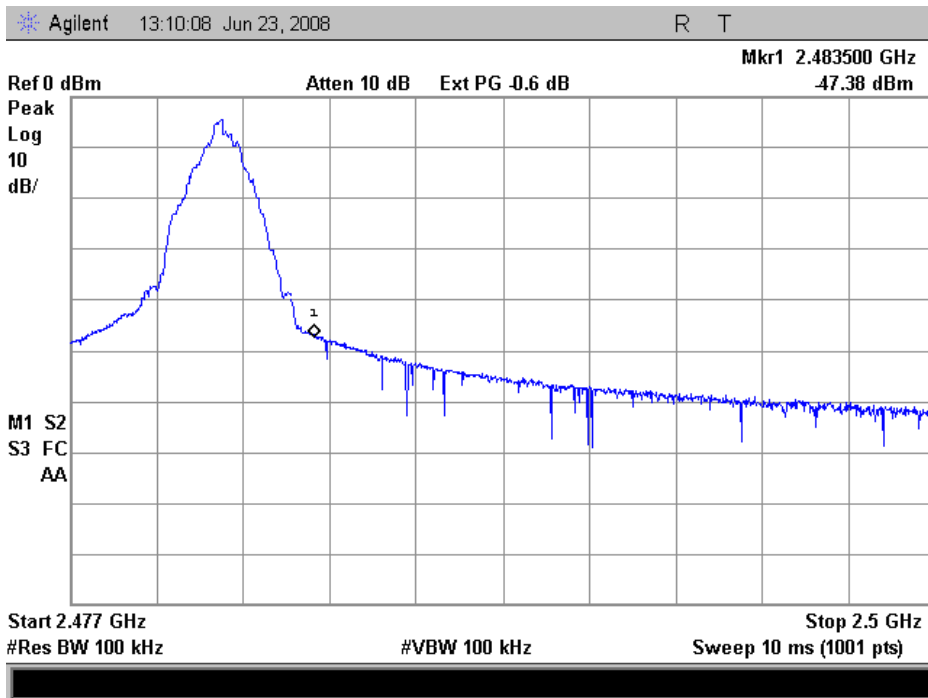
Table 4: Emission levels PEAK detector

| Freq MHz | Measured Value dBuV | Correction Factor dB | Result dBuV/m | Marginal dBuV/m | EUT Position | Ant Pol. | Ant height | TT angle |
|----------|---------------------|----------------------|---------------|-----------------|--------------|----------|------------|----------|
| 7206 | 51,5 | -3,8 | 47,7 | -26,3 | Pos 2 | Ver | 1.1 | 260 |

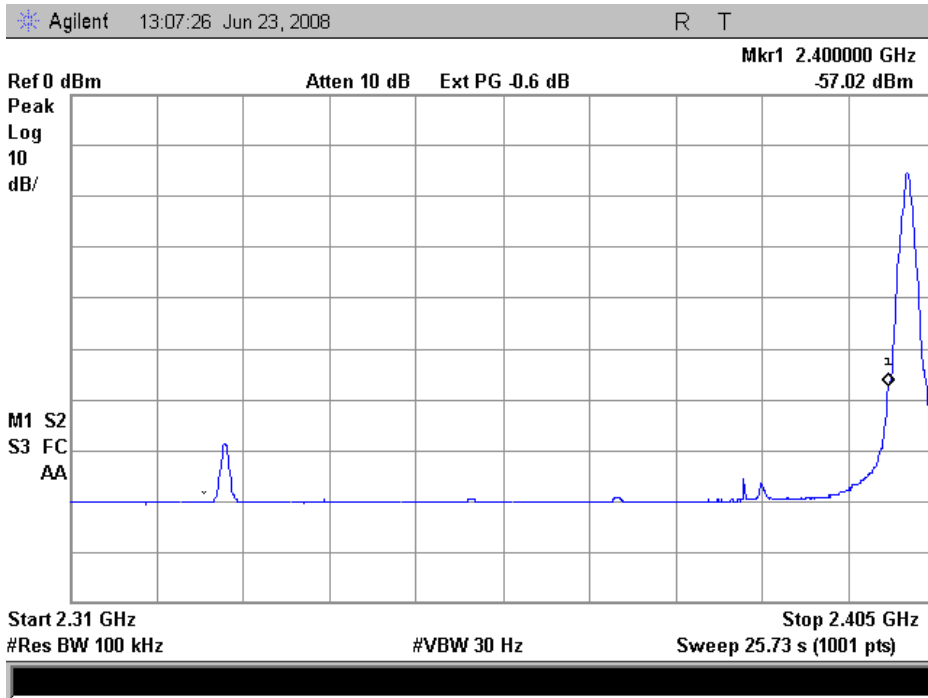
Spurious emissions on band edge restricted bands



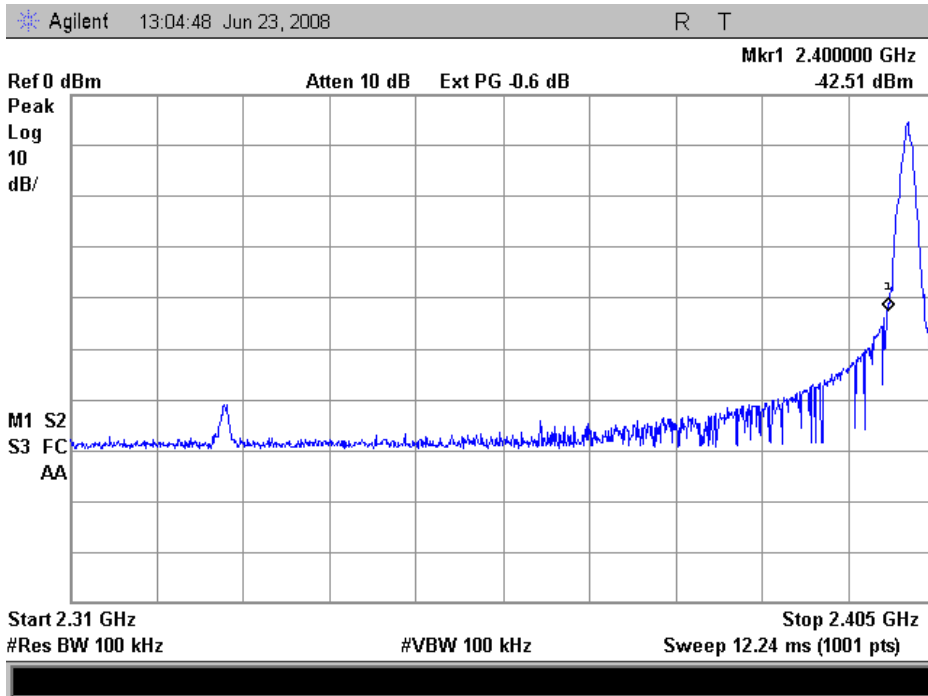
Picture 3: Band edge measurement, Average



Picture 4: Band edge measurement, Peak



Picture 5: Band edge measurement, Average



Picture 6: Band edge measurement, Peak

8 20 dB BANDWIDTH

| | | | |
|-------------------------------------|---------------|--------|---------|
| EUT | 60602 | | |
| Accessories | 60604 | | |
| Temp, Humidity, Air Pressure | 21 °C | 49 RH% | 992 hPa |
| Date of measurement | June 23, 2008 | | |
| FCC rule part | §15.215 (c) | | |
| RSS-210 section | | | |
| Measured by | Päivi Punta | | |

8.1 Test setup and measurement method

The 20dB bandwidth was measured using 10 kHz resolution bandwidth and maximum hold function of the spectrum analyzer. 20dB bandwidth was defined by measuring the maximum level on the measured channel and by placing display line 20 dB below this value and by reading the bandwidth from the intersection of the measured trace and display line.

8.2 EUT operation mode

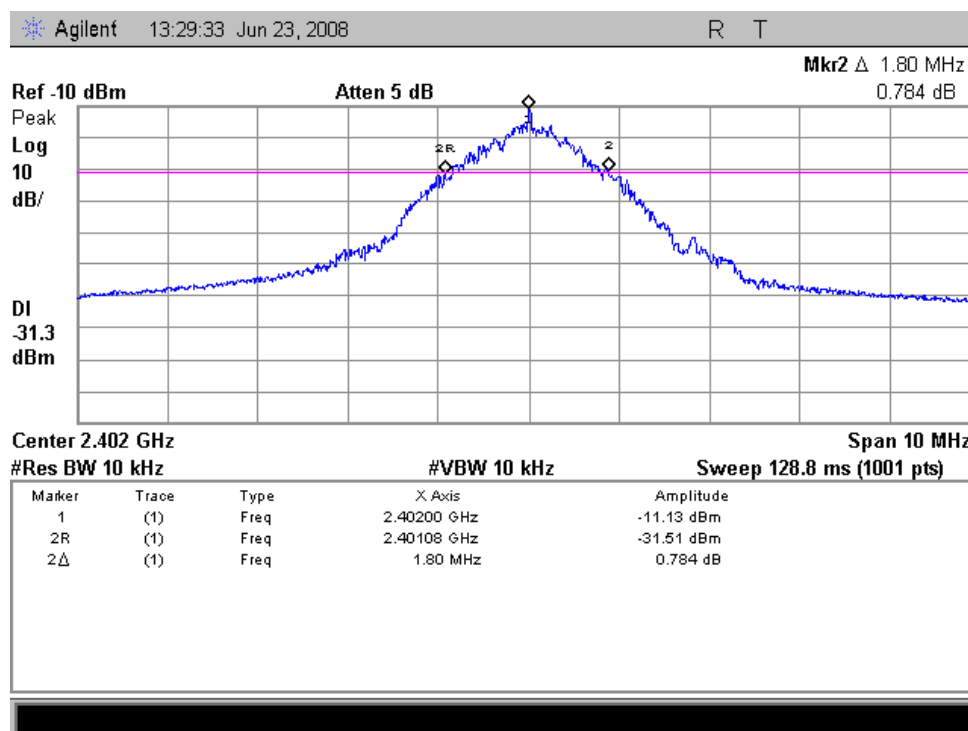
| | |
|---------------------------|--------------------------------|
| EUT operation mode | Normal modulation |
| EUT frequency | 2402, 2440, 2481 MHz |
| EUT TX power level | 0 dBm (Software configuration) |

8.3 Results

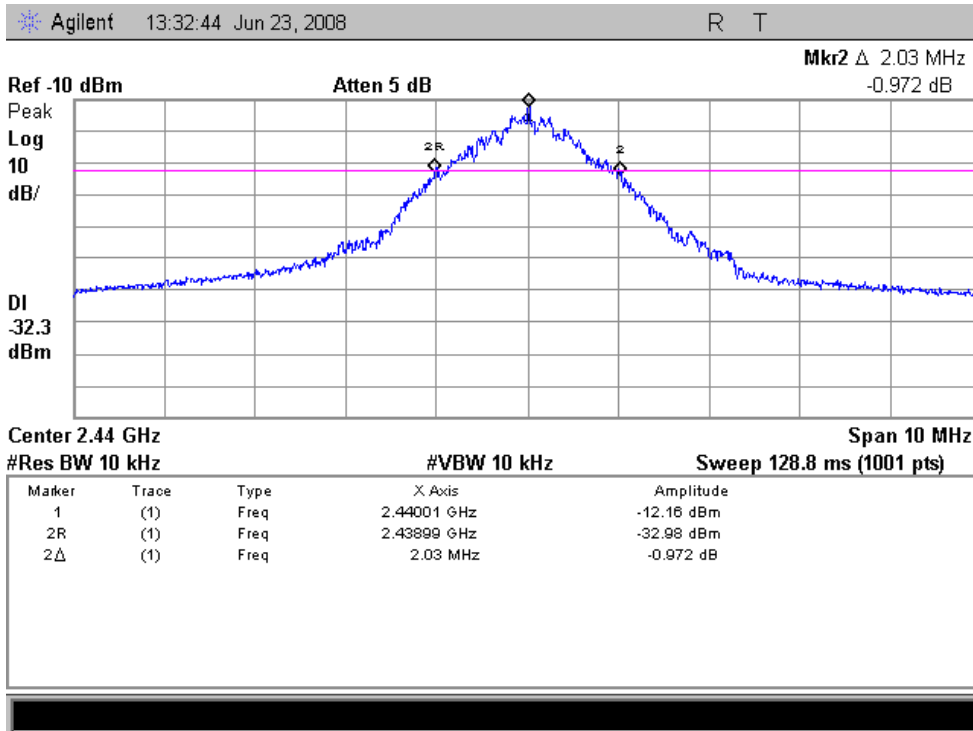
Table 5: 20dB bandwidth measurement results

| EUT Frequency MHz | Limit MHz | Measured value MHz |
|-------------------|-----------|--------------------|
| 2402 | - | 1.80 |
| 2440 | - | 2.03 |
| 2481 | - | 2.01 |

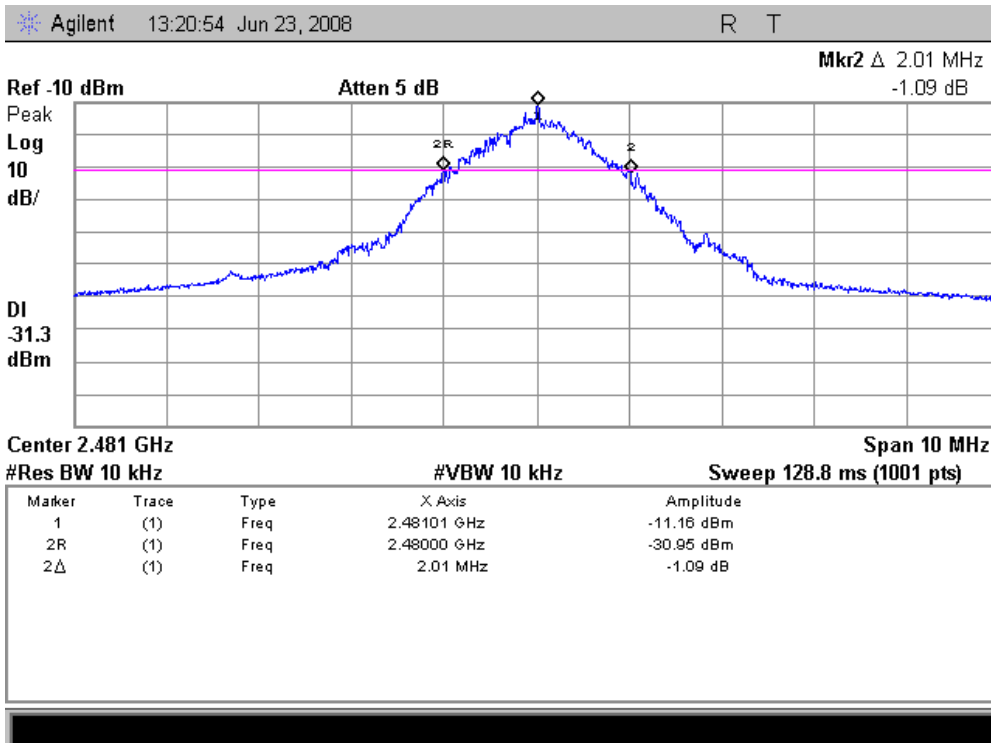
8.4 Screen shots



Picture 7: 20dB Bandwidth measurement result, 2402



Picture 8: 20dB Bandwidth measurement result, 2440



Picture 9: 20dB Bandwidth measurement result, 2481

9 99 % BANDWIDTH

| | | | |
|-------------------------------------|-----------------------------|--------|---------|
| EUT | 60602 | | |
| Accessories | 60604 | | |
| Temp, Humidity, Air Pressure | 21 °C | 49 RH% | 992 hPa |
| Date of measurement | June 23, 2008 | | |
| FCC rule part | | | |
| RSS-GEN section | 4.4.1 | | |
| Measured by | Marko Turkkila, Päivi Punta | | |

9.1 Test setup and measurement method

The 99% occupied bandwidth was calculated from spectrum analyzer measurements.

The measurement data was read from the analyzer to computer.

Software in computer calculated the total power from the measurement data and defined the frequency band containing 99% of the total power.

Markers in the spectrum analyzer were then placed between the calculated frequencies to show the calculated 99% power band in the screenshots.

9.2 EUT operation mode

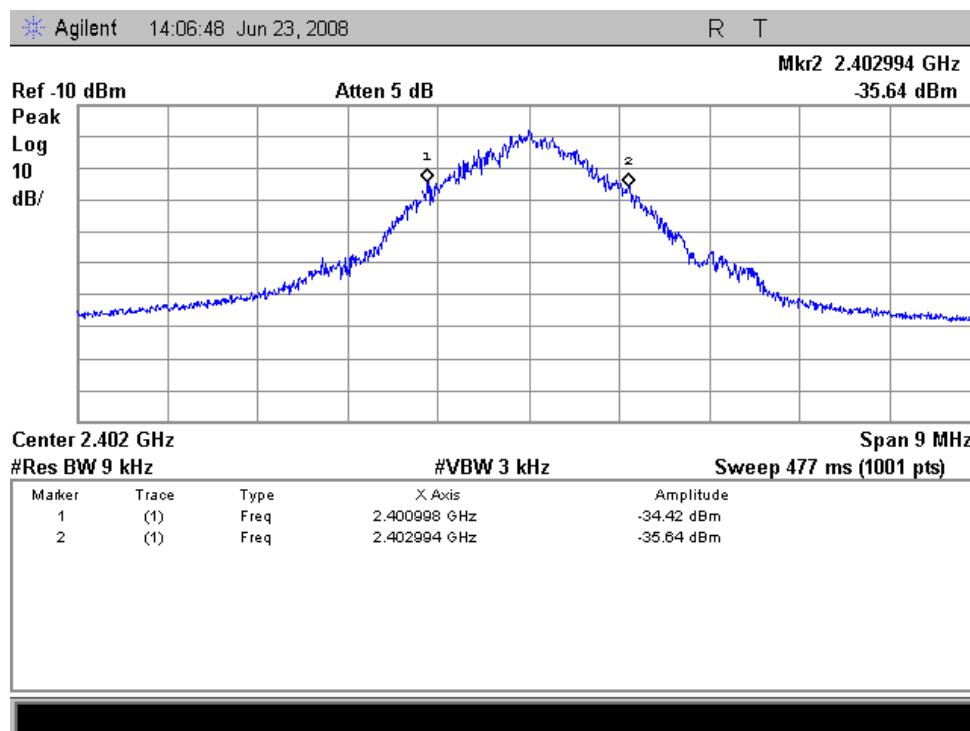
| | |
|---------------------------|--------------------------------|
| EUT operation mode | Normal modulation |
| EUT frequency | 2402, 2440, 2481 MHz |
| EUT TX power level | 0 dBm (Software configuration) |

9.3 Results

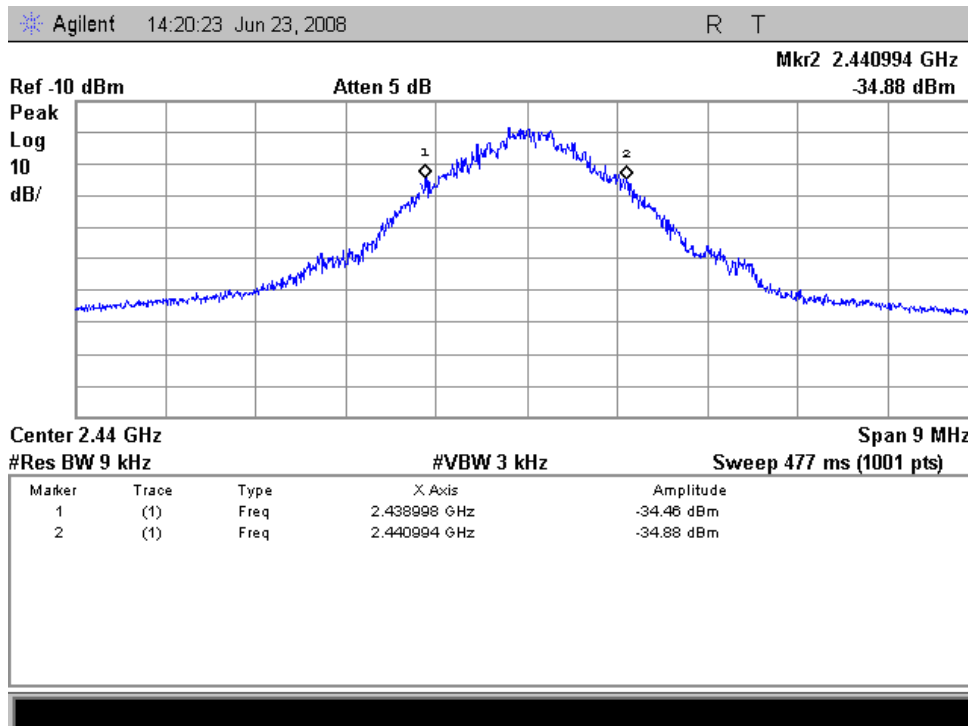
Table 6: 99% bandwidth measurement results

| EUT Frequency MHz | Limit MHz | Measured value MHz |
|-------------------|-----------|--------------------|
| 2402 | - | 1,996 |
| 2440 | - | 1,996 |
| 2481 | - | 1.987 |

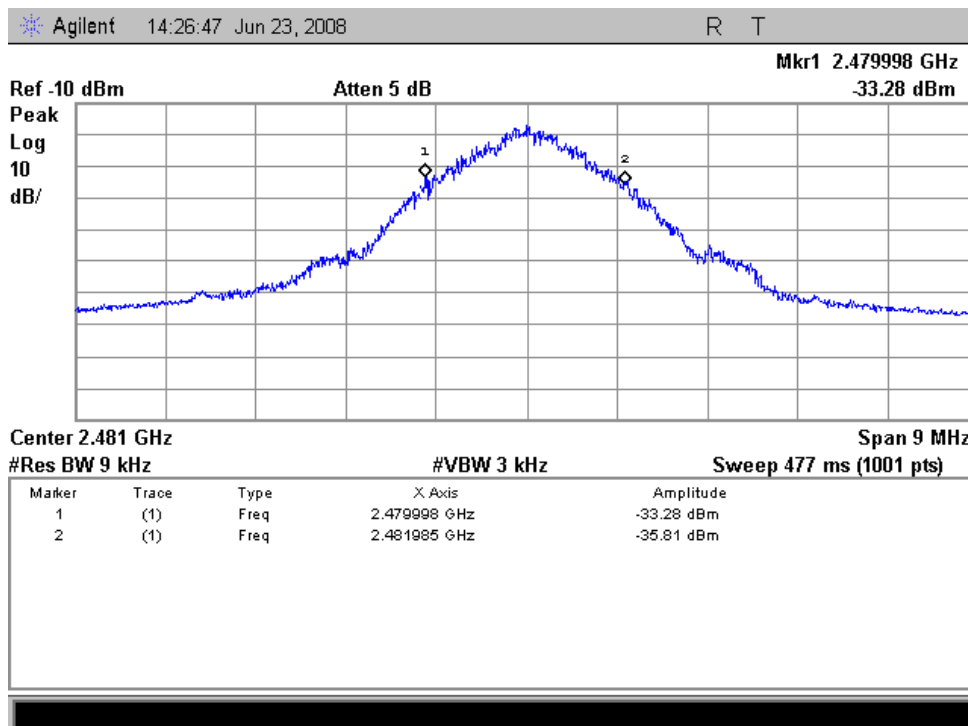
9.4 Screen shots



Picture 10: 99% Bandwidth measurement result 2402MHz



Picture 11: 99% Bandwidth measurement result, 2440MHz



Picture 12: 99% Bandwidth measurement result, 2481MHz

10 CONDUCTED EMISSIONS TO AC-MAINS

| | | | |
|-------------------------------------|---------------------|--------|---------|
| EUT | 60601 | | |
| Accessories | 60604, 60605, 60606 | | |
| Temp, Humidity, Air Pressure | 22 °C | 45 RH% | 997 hPa |
| Date of measurement | June 27, 2008 | | |
| FCC rule part | §15.107 | | |
| RSS-GEN section | 7.2.2 | | |
| ICES-003 section | 5.3 | | |
| Measured by | Päivi Punta | | |

10.1 Test setup

Charger was connected to line impedance stabilization network and conducted emissions to AC-mains were measured using measurement receiver.

10.2 EUT operation mode

EUT was connected to portable computer USB connector. Transmitter was set to receiver active mode.

10.3 Limits

| Frequency of emission [MHz] | FCC / IC | |
|-----------------------------|-------------------------|----------------------|
| | Limit [dBµV] Quasi peak | Limit [dBµV] Average |
| 0,15 – 0,50 | 66 – 56* | 56 – 46* |
| 0,50 – 5 | 56 | 46 |
| 5 – 30 | 60 | 50 |

* The limit decreases linearly with the logarithm of the frequency

10.4 Results

The measured interference values using peak and average detectors are shown in the pictures 3 and 4 below.

All signals closer than 6 dB to the limit have been measured using quasi peak and average detectors and reported in the table 7 and 8.

Table 7: Quasi peak detector measurement results, AC live

| Frequency [MHz] | Measured value [dB μ V] | Limit [dB μ V] | Margin to limit [dB] |
|-----------------|-----------------------------|--------------------|----------------------|
| N/A | | | |

Table 8: Average detector measurement results, AC live

| Frequency [MHz] | Measured value [dB μ V] | Limit [dB μ V] | Margin to limit [dB] |
|-----------------|-----------------------------|--------------------|----------------------|
| N/A | | | |

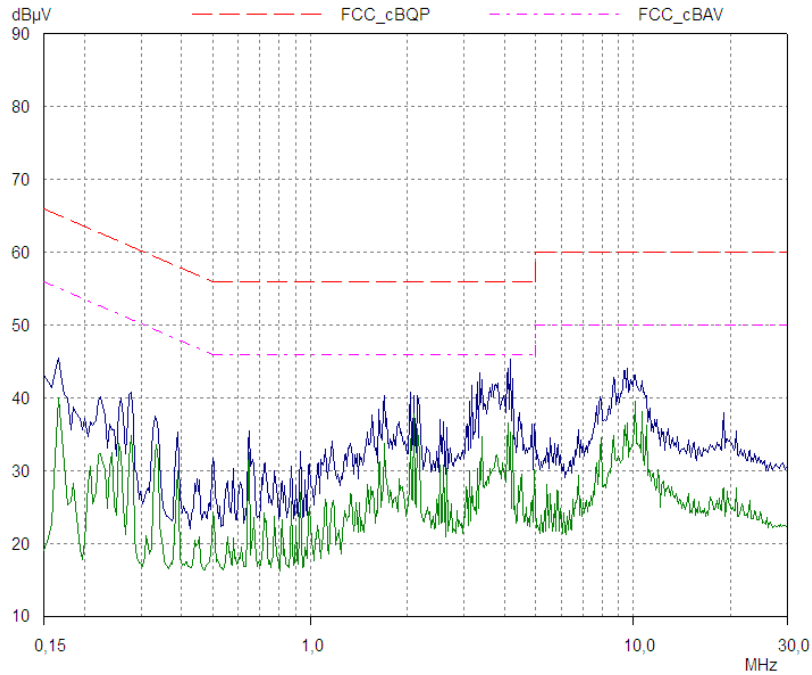
Table 9: Quasi peak detector measurement results, AC neutral

| Frequency [MHz] | Measured value [dB μ V] | Limit [dB μ V] | Margin to limit [dB] |
|-----------------|-----------------------------|--------------------|----------------------|
| N/A | | | |

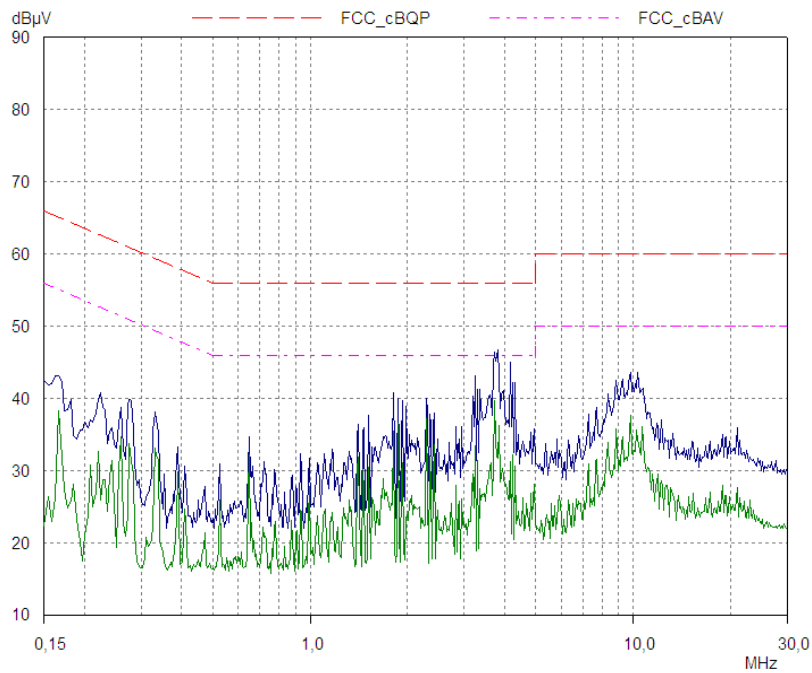
Table 10: Average detector measurement results, AC neutral

| Frequency [MHz] | Measured value [dB μ V] | Limit [dB μ V] | Margin to limit [dB] |
|-----------------|-----------------------------|--------------------|----------------------|
| N/A | | | |

10.5 Screen shots



Picture 13: AC-mains conducted emission measurement results, AC live



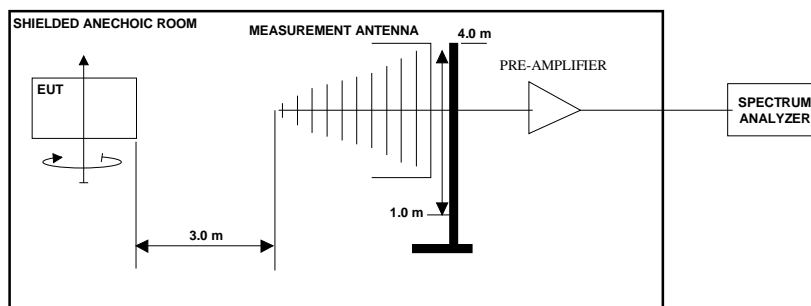
Picture 14: AC-mains conducted emission measurement results, AC neutral

11 RECEIVER RADIATED EMISSION

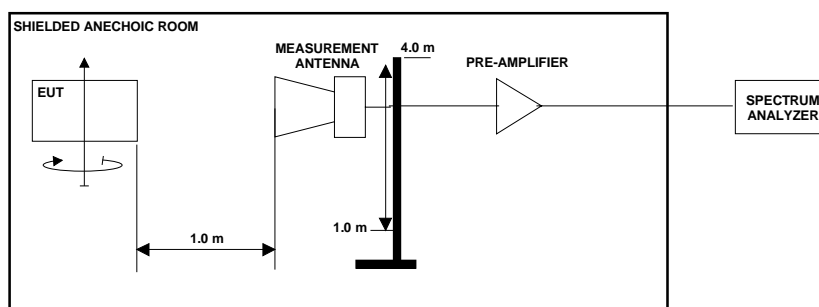
| | | | |
|-------------------------------------|---------------------|--------|----------|
| EUT | 60601 | | |
| Accessories | 60604, 60605, 60606 | | |
| Temp, Humidity, Air Pressure | 25 °C | 29 RH% | 1001 hPa |
| Date of measurement | June 2, 2008 | | |
| FCC rule part | §15.109 | | |
| RSS-GEN section | 7.2.3 | | |
| ICES-003 section | 5.5 | | |
| Measured by | Päivi Punta | | |

11.1 Test setup

The test was done using an automated test system, where a computer controlled the measurement equipments.



Picture 15: Test setup for radiated spurious emissions measurement
30 MHz - 1 GHz frequencies



Picture 16: Test setup for radiated spurious emissions measurement
1 GHz – 12.4 GHz frequencies

11.2 Test method

1. The emissions were searched and maximized by moving the turntable, changing the measuring antenna polarization and height and manipulating the EUT.
2. Levels of suspicious signals and levels of EUT transmitter harmonics were recorded.
3. The recorded levels were corrected in the automated test system with the measurement antenna factor, cable attenuations and filter attenuation.
4. The corrected values, giving the EUT radiated spurious emission levels as dB μ V/m at 3 m distance, are reported.

11.3 EUT operation mode

EUT was connected to portable computer USB connector. Transmitter was set to receiver active mode.

| | |
|---------------------------|---------------|
| EUT operation mode | Receiver mode |
| EUT frequency | 2402 MHz |
| EUT TX power level | Na |

11.4 Limit

Table 11: Radiated spurious emission limits at measurement distance 3m

| Frequency band (MHz) | 3m Limit (μV/m) | 3m Limit (dBμV/m) | Detector |
|-----------------------------|---------------------------------------|---|-----------------|
| 30 – 88 | 100 | 40 | QP |
| 88 -216 | 150 | 43.5 | QP |
| 216 - 960 | 200 | 46 | QP |
| 960 - 1000 | 500 | 54.0 | QP |
| 1000 - 12400 | 500 | 54.0 | AVG |
| 1000 - 12400 | 5000 | 74.0 | PEAK |

11.5 Results

The measured interference values using Quasi peak and average detectors are shown in the pictures below.

All signals closer than 6 dB to the limit below 1 GHz have been measured using quasi peak or average detector and reported in the table 12, 13 and 14.

Table 12: Radiated emissions using Quasi peak detector

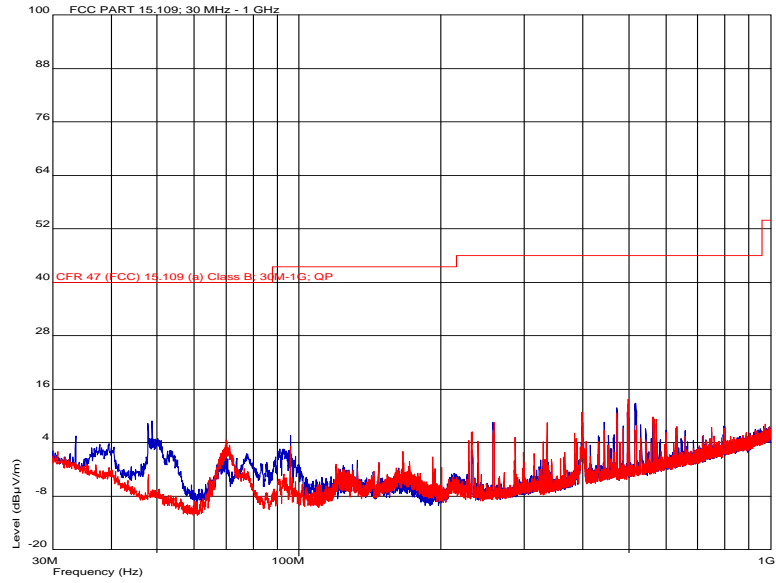
| Freq MHz | Measured Value dBuV | Correction Factor dB | Result dBuV/m | Marginal dBuV/m | EUT Position | Ant Pol. | Ant height | TT angle |
|----------|---------------------|----------------------|---------------|-----------------|--------------|----------|------------|----------|
| N/A | | | | | | | | |

Table 13: Radiated emissions using Peak detector

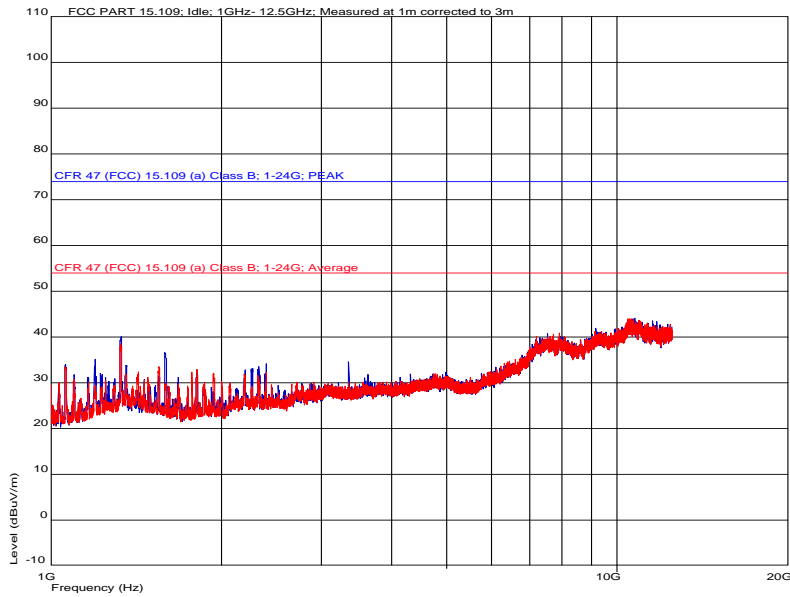
| Freq MHz | Measured Value dBuV | Correction Factor dB | Result dBuV/m | Marginal dBuV/m | EUT Position | Ant Pol. | Ant height | TT angle |
|----------|---------------------|----------------------|---------------|-----------------|--------------|----------|------------|----------|
| N/A | | | | | | | | |

Table 14: Radiated emissions using Average detector

| Freq MHz | Measured Value dBuV | Correction Factor dB | Result dBuV/m | Marginal dBuV/m | EUT Position | Ant Pol. | Ant height | TT angle |
|----------|---------------------|----------------------|---------------|-----------------|--------------|----------|------------|----------|
| N/A | | | | | | | | |



Picture 17: radiated emission results, 30 – 1000 MHz,
 Red= horizontal polarization, blue = vertical polarization



Picture 18: radiated emission results, 1 – 12,5 GHz,
 Red= horizontal polarization, blue = vertical polarization

12 TEST EQUIPMENT

All testing and measurement equipment has been calibrated once a year, except the antennas that are calibrated every two years.

12.1 Conducted measurements

| Equipment | Manufacturer | Model |
|-------------------|--------------|--------|
| Spectrum Analyzer | Agilent | E7405A |
| Attenuator 3 dB | Narda | 779-3 |

12.2 Radiated measurements

| Equipment | Manufacturer | Model |
|--------------------------------------|------------------------|------------------------|
| Spectrum Analyzer | Agilent | E7405A |
| Antenna | Chase | CBL 6141 |
| Antenna | Schwarzbeck | BBHA 9120D |
| Antenna | Schwarzbeck | BBHA 9170 |
| Band reject filter | Wainwright Instruments | WRCT2400/2483 |
| High pass filter | Wainwright Instruments | WHK3.0/18GST |
| Pre-amplifier | Agilent | 87405B |
| Pre-amplifier | JCA | 118-400 |
| Pre-amplifier | Miteq | AMF-6F-18002650-25-10P |
| Turn table / antenna mast controller | EMCO | 2090 |

13 TEST SETUP PHOTOGRAPHS

Test setup photograph can be found in a separate document

T08-606C-EMC_PHOTOS.doc