

Date: ESPOO 31.10.2012Page: 1 (18)Appendices –Number:
No. 1 / 1**172279**

Date of handing in: 25.10.2012

Tested by:



Timo Hietala, Test Engineer

Reviewed by:



Janne Nyman, Compliance Specialist

SORT OF EQUIPMENT:

RF ID reader

MARKETING NAME:

FÖRSTER TECHNIK

TYPE:

Multi-FDX/HDX

MANUFACTURER:

Förster-Technik GmbH

CLIENT:

Förster Technik GmbH , Germany

ADDRESS:

Gerwigstrasse 25, Engen, D-78234, Germany

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TEST LABORATORY:

Nemko Oy

FCC REG. NO.

359859 October 20, 2011

IC FILE NO.

2040F-1 December 1, 2010**SUMMARY:**

In regard to the performed tests the equipment under test fulfils the requirements defined in the test specifications, see page 2 for details

The test results are valid for the tested unit only. Without a written permission of Nemko Oy it is allowed to copy this report as a whole, but not partially.

Summary of performed tests and test results

| <i>Section in CFR 47</i> | | <i>Result</i> |
|--------------------------|-----------------------------------|---------------|
| 15.209 | Peak output power | PASS |
| 15.209 | Spurious radiated emissions | PASS |
| 15.207 | AC power line conducted emissions | PASS |

| <i>Section in RSS Gen Issue 3</i> | | <i>Result</i> |
|-----------------------------------|-----------------------------------|---------------|
| 7.2.5 | Peak output power | PASS |
| 7.2.5 | Spurious radiated emissions | PASS |
| 7.2.4 | AC power line conducted emissions | PASS |

Explanations:

PASS The EUT passed that particular test.
FAIL The EUT failed that particular test.
X The measurement was done, but there is no applicable performance criteria.

Contents

| | |
|--|----|
| Summary of performed tests and test results | 2 |
| 1. EUT and Accessory Information | 4 |
| 1.1 EUT description | 4 |
| 1.2 EUT and accessories..... | 4 |
| 2. Test setups..... | 5 |
| 3. Standards and measurement methods..... | 6 |
| 4. Test results..... | 6 |
| 4.1 Fundamental output power | 6 |
| 4.1.1 EUT operation mode..... | 6 |
| 4.1.2 Test method and limit | 6 |
| 4.1.3 Test results | 7 |
| 4.2 Spurious radiated emission | 10 |
| 4.2.1 EUT operation mode..... | 10 |
| 4.2.2 Test method and limit | 10 |
| 4.2.3 Test results | 11 |
| 4.2.4 Conducted disturbance at mains ports emission test | 13 |
| 4.2.5 Test results | 14 |
| 5. List of test equipment..... | 16 |
| 6. Photographs..... | 17 |

1. EUT and Accessory Information

1.1 EUT description

The EUT is an RF ID reader for animal detection.

Alignment range: **120-133.9 kHz**

Channels: **3**

Operating Voltage: **12-24 VDC**

Antenna: loop antenna

1.2 EUT and accessories

Equipment under test (EUT):

- RF ID reader , type: Multi-FDX/HDX , S/N: -

Peripherals:

Main unit

Control unit

RFID tags: 120kHz, 130kHz and 133.9kHz

Cables:

| From | To | Type | Length [m] |
|----------------------|--------------|---------------------------|------------|
| Mains supply network | Main unit | Mains cable, unshielded | 1.2 |
| Main unit | EUT | Signal/DC cable, shielded | 3 |
| Main unit | Control unit | Signal cable, shielded | 2 |

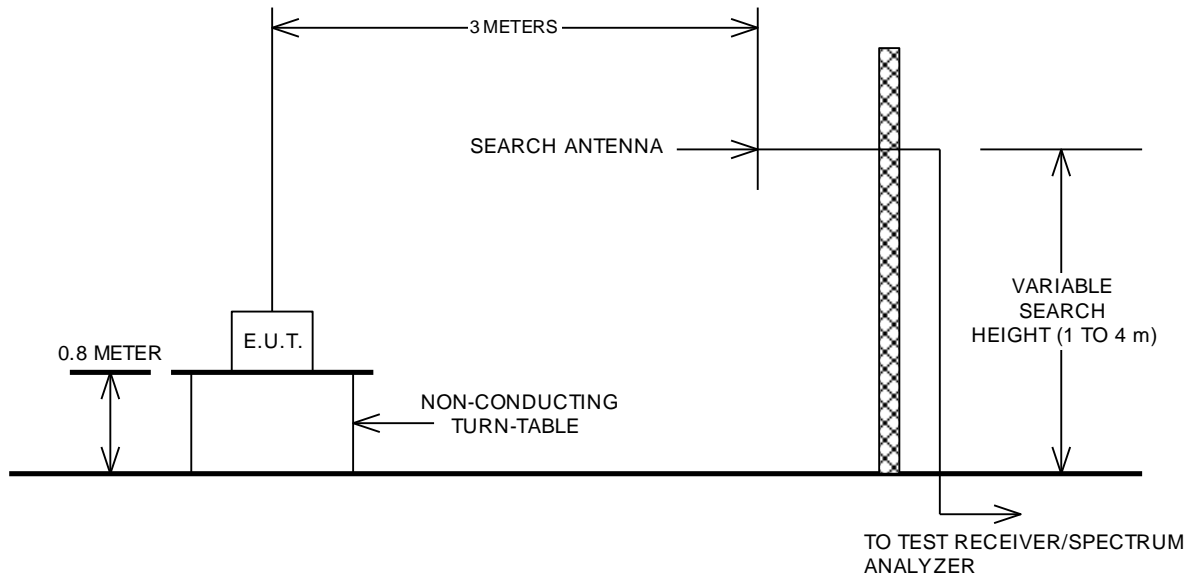
Operating voltage of the EUT during the tests:

- Main unit: 230 V AC, 50 Hz / 240 V AC, 60 Hz
- RF ID reader: 12V DC

2. Test setups

Setup 1 (Radiated measurements)

The test was performed inside a semi anechoic shielded room. For the duration of the test the EUT was placed on a non-conductive support 0.8 m high standing on the turntable. The tower and turn table were remotely controlled to turn the EUT and change the antenna polarization and height. The measured signal was routed from the measuring antenna to the spectrum analyzer.



3. Standards and measurement methods

The test were performed in guidance of the CFR 47 Part 15, SUBPART B, Paragraph 15.209 (2010), ANSI C63.4 (2003), CISPR 22, RSS-210 Issue 8 and RSS-Gen Issue 3.

4. Test results

4.1 Fundamental output power

The test was performed as a compliance test. The test parameters concerned were as follows:

| | |
|------------------------|--------------------|
| <i>Site name</i> | Nemko Oy / Perkkaa |
| <i>FCC rule part</i> | § 15.209 |
| <i>IC</i> | RSS Gen 7.2.5 |
| <i>Date of testing</i> | 29.10.2012 |
| <i>Test equipment</i> | 709, 98, 350 |
| <i>Test conditions</i> | 22 °C, 30 % RH |
| <i>Test result</i> | PASS |

4.1.1 EUT operation mode

| | |
|---------------------------|------------------------------|
| <i>EUT operation mode</i> | TX on with modulation |
| <i>EUT channel</i> | 120, 130.4, 133.9 kHz |
| <i>EUT TX power level</i> | Nominal |

4.1.2 Test method and limit

The test was performed in a semi-anechoic shielded room. The EUT was placed on a non-conductive 0.8 m high table standing on the turntable. During the test distance from the EUT to the measuring antenna was 3.0 m. Measurements were made using a magnetic loop antenna and a receiver with a peak detector and 200 Hz bandwidth (9 - 120kHz), 9 kHz bandwidth (0.150 - 30MHz). Measurements of this device were carried while it was transmitting continuously.

The CFR 47 Part 15.209 limit of (2400/F) has been calculated to correspond 26.0 dB(μV/m) as follows: $[dB(\mu V/m)] = 20 \log[\mu V/m]$.

The 300 meter limit (2400/F)@120kHz of 20.0 μV/m has been converted to 26.0 dB(μV/m) and this limit has been calculated to correspond 106 dB(μV/m) at 3 m measurement distance by using 40 dB per decade rule (2 decades).

As allowed by section 15.31(f)(2) measurements were made at 3 meter.

Limit (3m measuring distance)

| <i>Frequency band kHz</i> | <i>Peak dB(μV/m)</i> |
|-------------------------------|--------------------------|
| 120 | 106.0 |
| 130.4 | 105.3 |
| 133.9 | 105.1 |

4.1.3 Test results

The measurement results were obtained as described below.

$$E [\mu V/m] = U_{RX} + A_{CABLE} + AF$$

Where

U_{RX} receiver reading

A_{CABLE} attenuation of the cable

AF antenna factor

TX on low channel

| <i>Frequency kHz</i> | <i>Result PK dB(μV/m)</i> | <i>Limit dB(μV/m)</i> | <i>Margin dB</i> |
|--------------------------|-------------------------------|---------------------------|----------------------|
| 120 | 94.1 | 106.0 | 11.9 |

TX on middle channel

| <i>Frequency kHz</i> | <i>Result PK dB(μV/m)</i> | <i>Limit dB(μV/m)</i> | <i>Margin dB</i> |
|--------------------------|-------------------------------|---------------------------|----------------------|
| 130.4 | 93.7 | 105.3 | 11.6 |

TX on high channel

| <i>Frequency kHz</i> | <i>Result PK dB(μV/m)</i> | <i>Limit dB(μV/m)</i> | <i>Margin dB</i> |
|--------------------------|-------------------------------|---------------------------|----------------------|
| 133.9 | 93.7 | 105.1 | 11.4 |

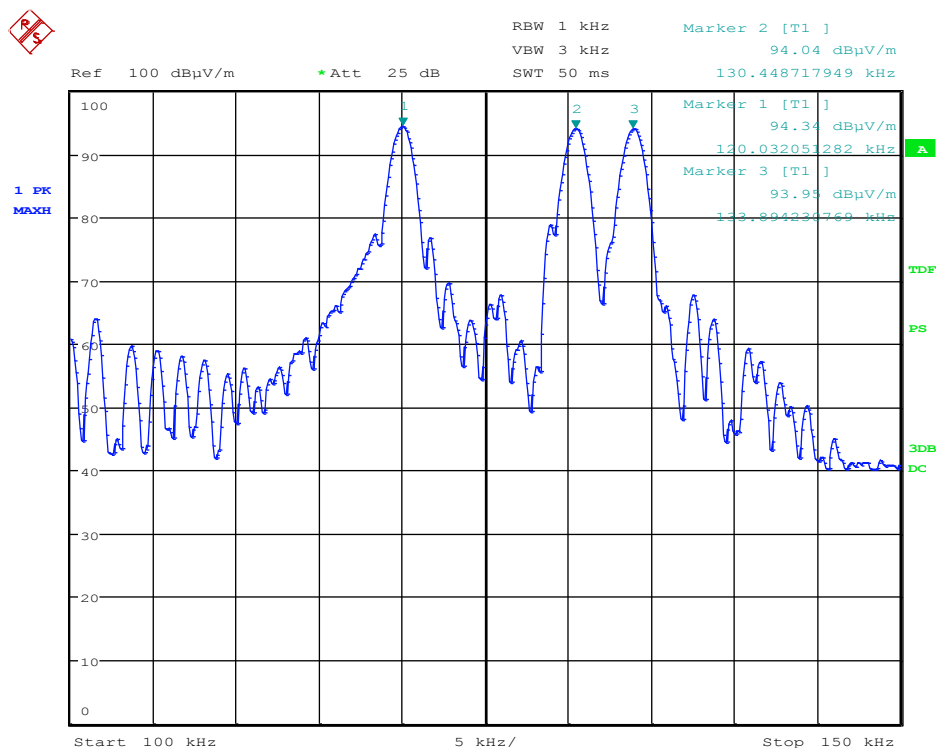


Figure 1. Fundamental output power, peak detector, channels 120-133.9 kHz

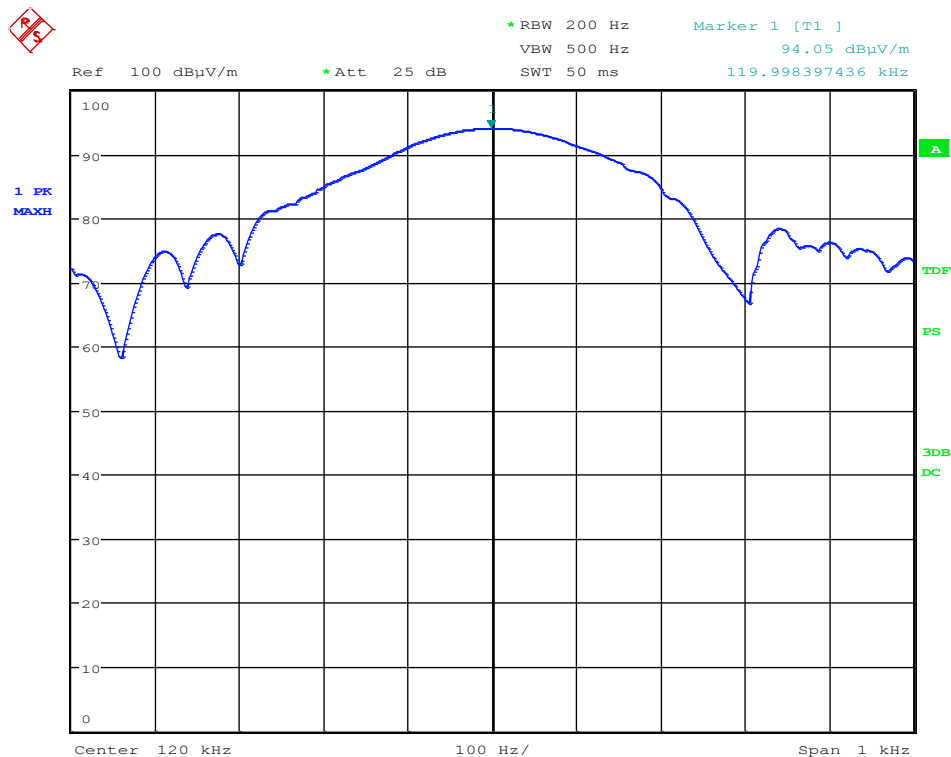


Figure 2. Fundamental output power, peak detector, channel 120 kHz

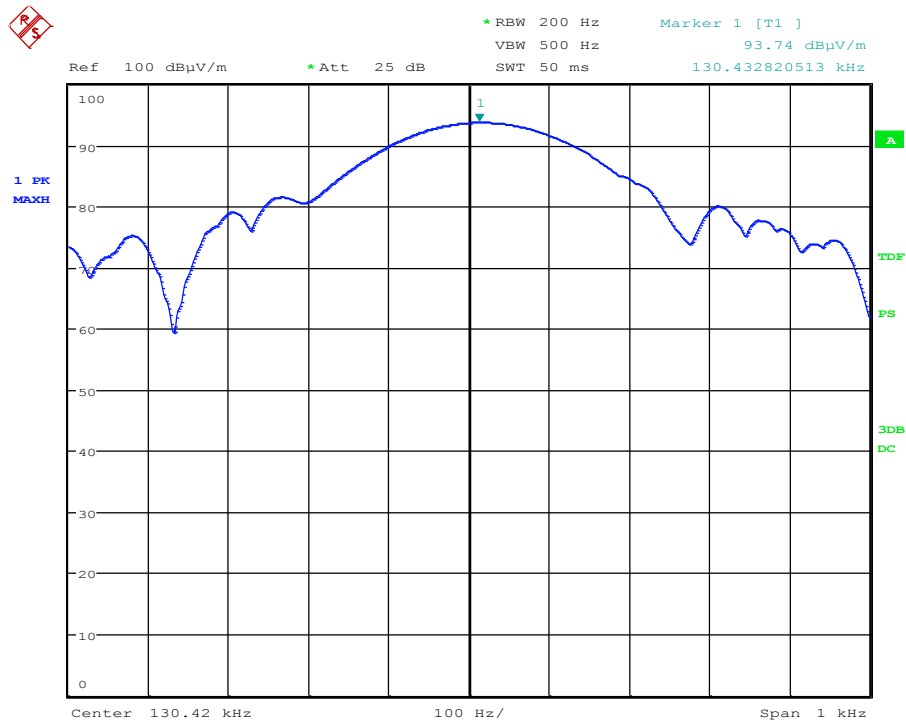


Figure 3. Fundamental output power, peak detector, channel 130.4 kHz

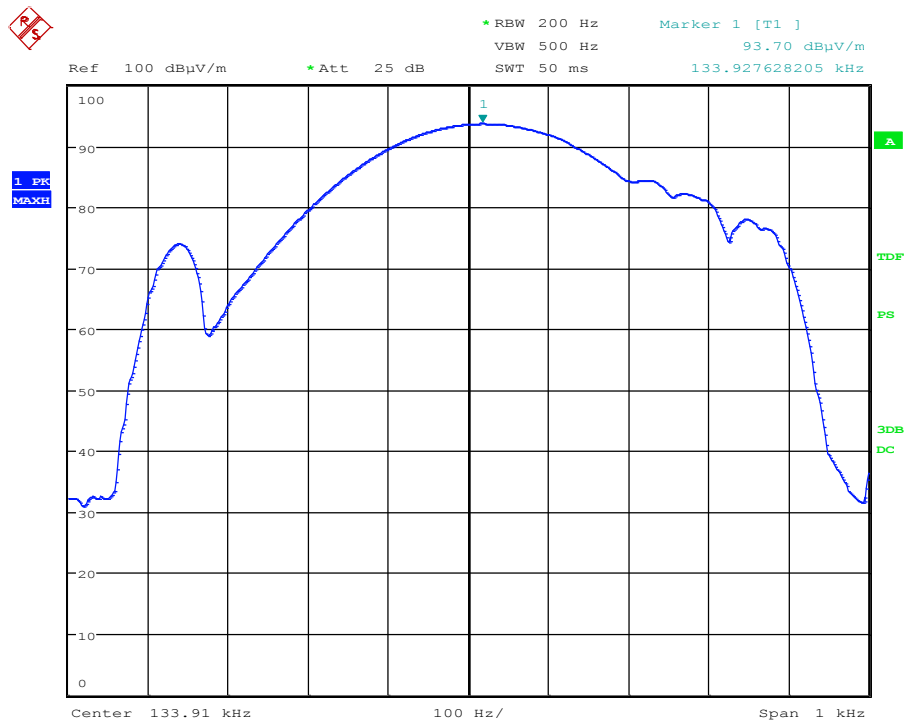


Figure 4. Fundamental output power, peak detector, channel 133.9 kHz

4.2 Spurious radiated emission

The test was performed as a compliance test. The test parameters concerned were as follows:

| | |
|-----------------|------------------------|
| Site name | Nemko Oy / Perkkää |
| FCC rule part | § 15.209 |
| IC | RSS Gen 7.2.5 |
| Date of testing | 29.10.2012 |
| Test equipment | 98, 319, 350, 544, 709 |
| Test conditions | 22 °C, 30 % RH |
| Test result | PASS |

4.2.1 EUT operation mode

| | |
|--------------------|------------------------------|
| EUT operation mode | TX on with modulation |
| EUT TX power level | Nominal |

4.2.2 Test method and limit

The test was performed in a semi-anechoic shielded room. The EUT was placed on a non-conductive 0.8 m high table standing on the turntable (photograph 2). During the test in the frequency range 9 kHz-30 MHz the distance from the EUT to the measuring antenna was 3 m and measurements were made using a magnetic loop antenna and a receiver with 200 Hz bandwidth (9 - 150 kHz) and 9 kHz bandwidth (0.15 – 30 MHz). During the test in the frequency range 30 - 1000 MHz the distance from the EUT to the measuring antenna was 10 m. In order to find the maximum levels of the disturbance radiation the angle of the turntable, the height of the measuring antenna and the lay-out of the EUT cables were varied during the tests. The test was performed separately with the measuring antenna being both in horizontal and vertical polarizations.

As allowed by section 15.31(f)(2) measurements were made at 3 meter with the 300 meter limit (2400/F)@(9 – 490 kHz) being extrapolated by a factor of 80 dB (40dB per decade) and (2400/F)@(0.490-1.705MHz) being extrapolated by a factor of 40 dB.

The CFR 47 Part 15.209 limit of 500 µV/m has been calculated to correspond 54 dB(µV/m) as follows: $[dB(\mu V/m)] = 20 \log[\mu V/m]$.

In the frequency range 30 – 1000 MHz the limit values defined for 3 m measuring distance have been converted to correspond limit values for 10 m measuring distance by using 20 dB per decade rule.

FCC Part 15.209 Limit values

| Frequency band MHz | Quasi-peak µV/m | Quasi-peak (3 m) dB(µV/m) | Quasi-peak (10 m) dB(µV/m) |
|-----------------------|--------------------------|------------------------------|-------------------------------|
| 0.009–0.490 | 2400/F (kHz)@300m | 128.5-93.8@3m | |
| 0.490–1.705 | 2400/F (kHz)@30m | 53.8-43@3m | |
| 1.705–30 | 30@30m | 69.5@3m | |
| 30 - 88 | 100@3m | 40.0@3m | 30.0@10m |
| 88 - 216 | 150@3m | 43.5@3m | 33.5@10m |
| 216-960 | 200@3m | 46.0@3m | 36.0@10m |
| 960-1000 | 500@3m | 54.0@3m | 44.0@10m |

For the frequency bands 9 – 90 kHz and 110 – 490 kHz the radiated emission limits are based on measurements employing an average detector.

4.2.3 Test results

The measurement results were obtained as described below.

$$E [\mu V/m] = U_{RX} + A_{CABLE} + AF - G_{PREAMP}$$

Where

U_{RX} receiver reading

A_{CABLE} attenuation of the cable

AF antenna factor

G_{PREAMP} gain of the preamplifier

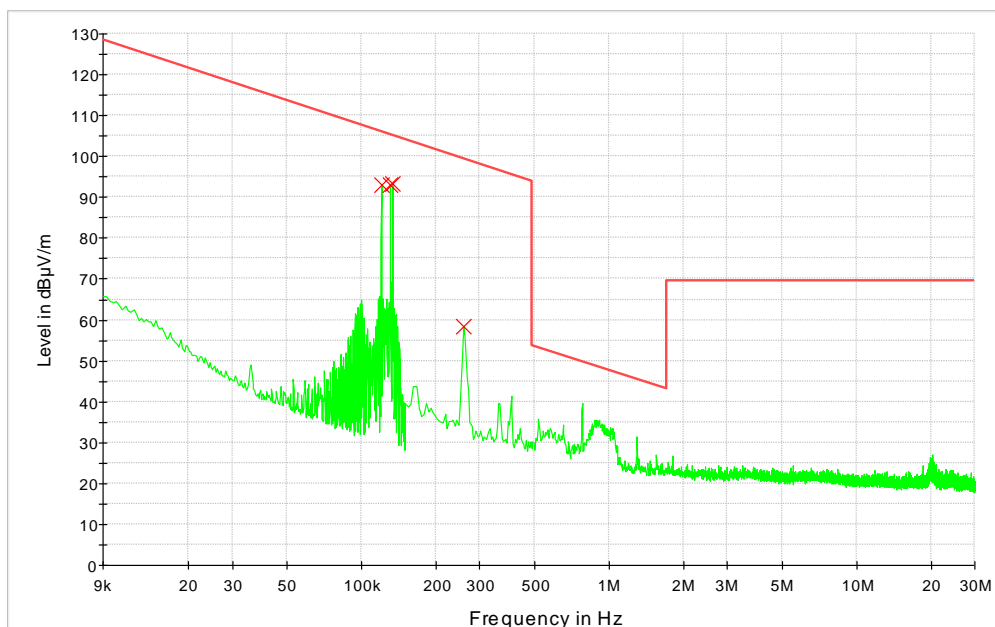


Figure 5. Spurious emissions, 9 kHz-30 MHz

| Frequency (MHz) | Average (dBμV/m) | Limit (dBμV/m) | Margin (dB) | Polarization | Azimuth (deg) |
|-----------------|------------------|----------------|-------------|--------------|---------------|
| 0.259 | 58.5 | 98.0 | 39.5 | H | 180 |

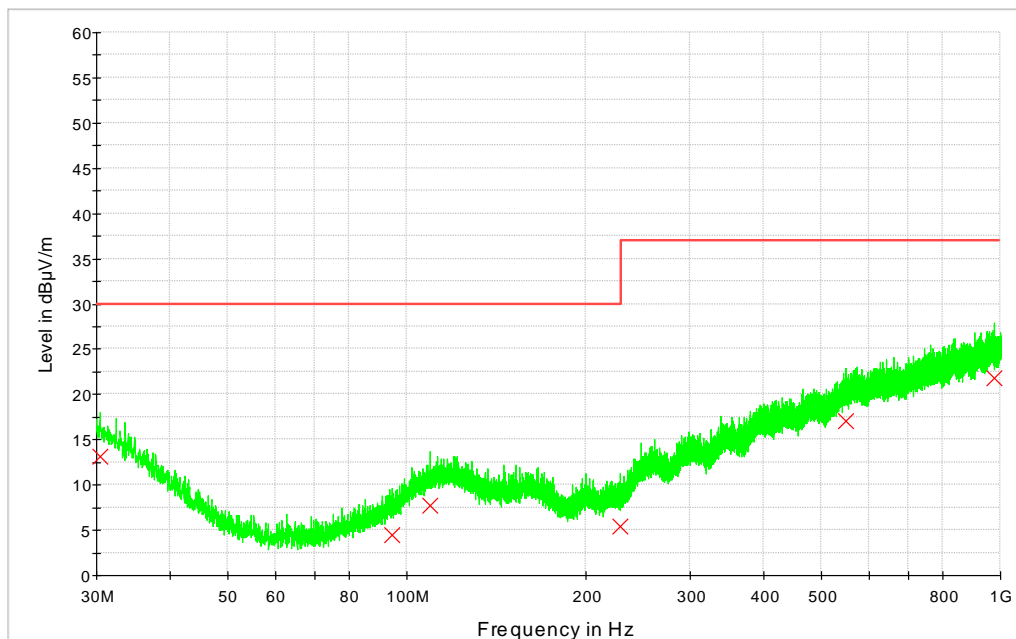


Figure 6. Spurious emissions, 30-1000 MHz, limit value as defined in CISPR 22 for 10 m measuring distance.

| Frequency (MHz) | QuasiPeak (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Height (cm) | Polarization | Azimuth (deg) |
|-----------------|--------------------|----------------|-------------|-------------|--------------|---------------|
| 30.400 | 13.1 | 30 | 16.9 | 238 | H | 315 |
| 94.480 | 4.5 | 30 | 25.5 | 174 | H | 23 |
| 109.320 | 7.7 | 30 | 22.3 | 386 | V | 79 |
| 228.920 | 5.4 | 30 | 24.6 | 186 | V | 0 |
| 548.480 | 17.1 | 37 | 19.9 | 100 | H | 257 |
| 974.480 | 21.8 | 37 | 15.2 | 326 | H | 248 |

4.2.4 Conducted disturbance at mains ports emission test

The test was performed as a compliance test. The test parameters concerned were as follows:

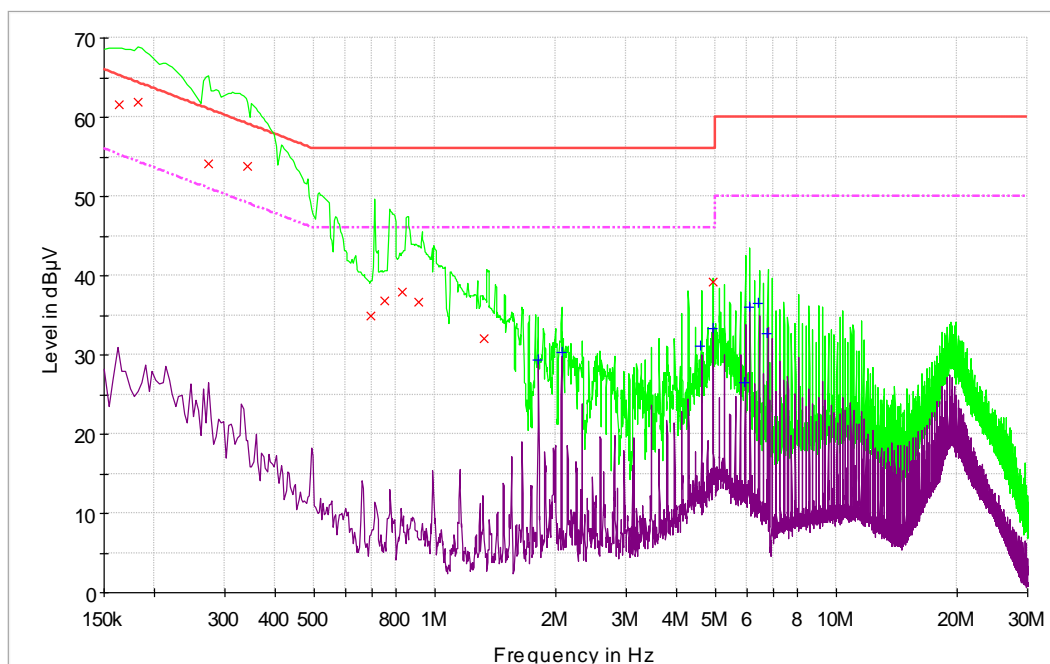
| Parameter | Specification |
|----------------------|--------------------|
| Frequency range | 0.150 – 30 MHz |
| Site name | Nemko Oy / Perkkää |
| FCC rule part | § 15.207 |
| IC | RSS Gen 7.2.4 |
| Date of testing | 30.10.2012 |
| Test equipment | 745, 338, 348 |
| Test uncertainty U95 | ±3.5dB |
| Test conditions | 24 °C, 45 % RH |

The test was performed inside a shielded room where the floor and one of the walls of the test site comprised the reference ground plane (RGP). For the duration of the test the EUT was placed on a non-conductive table 0.8 m high 0.4 m apart from the vertical RGP (see photograph 3). The excess lengths of the cables of the EUT were made into bundles 30-40 cm in length. The power input cable of the EUT was connected to an artificial mains network. The test was performed separately on each phase and also on the neutral wire.

The disturbances were first examined by performing a spectrum scan by using a peak detector. The general procedure in the conducted disturbance emission test is that no further measurements are necessary if the disturbance levels measured by using the peak detector are below the limit value defined for the measurement performed by using an average detector. If not, then at the test frequencies concerned the measurement is performed also by using a quasi-peak detector. If the disturbance levels measured by using the quasi-peak detector are below the limit value defined for the measurement performed by using an average detector, then measurements by using the average detector are not necessary.

4.2.5 Test results

Line L, Mains voltage 240VAC/60Hz



The graphs of the disturbances measured by using a peak and average detectors in the frequency range of 0.150 - 30 MHz.

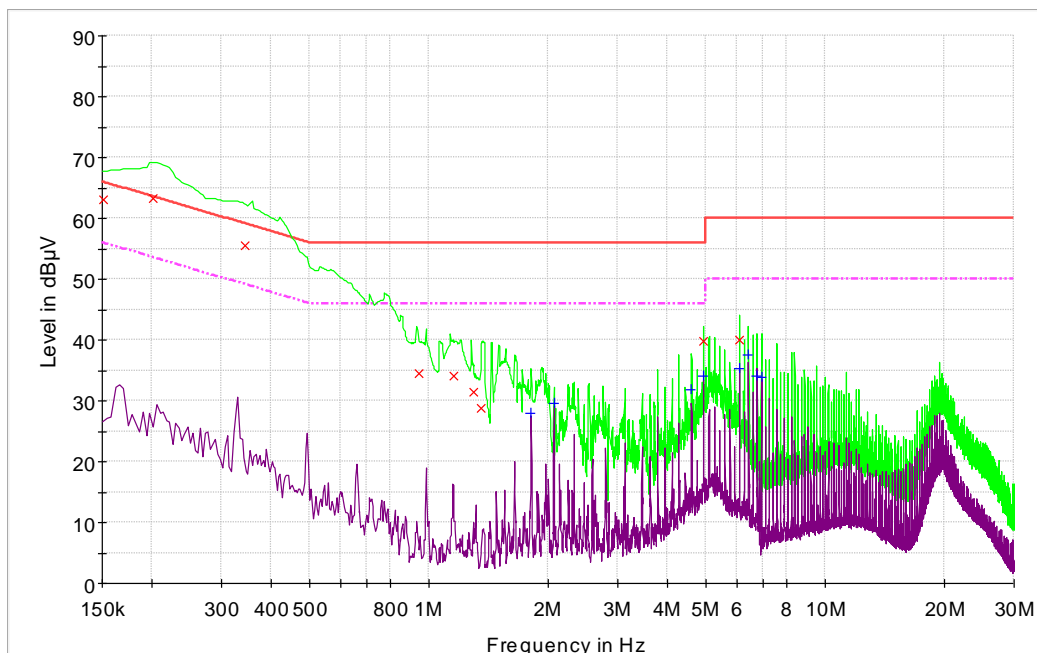
Measurement results (QP):

| Frequency MHz | Level dBμV | Limit dBμV | Margin dB | Line | Conclusion Pass/Fail |
|------------------|---------------|---------------|--------------|------|-------------------------|
| 0.164 | 61.6 | 65.3 | 3.6 | L | Pass |
| 0.182 | 61.8 | 64.4 | 2.6 | L | Pass |
| 0.274 | 54.1 | 61.0 | 6.9 | L | Pass |
| 0.341 | 53.7 | 59.2 | 5.4 | L | Pass |
| 0.693 | 34.9 | 56.0 | 21.1 | L | Pass |
| 0.748 | 36.9 | 56.0 | 19.1 | L | Pass |
| 0.831 | 37.9 | 56.0 | 18.1 | L | Pass |
| 0.910 | 36.7 | 56.0 | 19.3 | L | Pass |
| 1.330 | 32.0 | 56.0 | 24.0 | L | Pass |
| 4.937 | 39.2 | 56.0 | 16.8 | L | Pass |

Measurement results (Average):

| Frequency MHz | Level dBμV | Limit dBμV | Margin dB | Line | Conclusion Pass/Fail |
|------------------|---------------|---------------|--------------|------|-------------------------|
| 1.813 | 29.4 | 46.0 | 16.6 | L | Pass |
| 2.072 | 30.3 | 46.0 | 15.7 | L | Pass |
| 4.609 | 31.0 | 46.0 | 15.0 | L | Pass |
| 4.936 | 33.4 | 46.0 | 12.6 | L | Pass |
| 5.928 | 26.6 | 50.0 | 23.4 | L | Pass |
| 6.090 | 36.1 | 50.0 | 13.9 | L | Pass |
| 6.419 | 36.6 | 50.0 | 13.4 | L | Pass |
| 6.748 | 32.8 | 50.0 | 17.2 | L | Pass |

Line N, Mains voltage 240VAC/60Hz.



The graphs of the disturbances measured by using a peak and average detectors in the frequency range of 0.150 - 30 MHz.

Measurement results (QP):

| Frequency MHz | Level dBμV | Limit dBμV | Margin dB | Line | Conclusion Pass/Fail |
|------------------|---------------|---------------|--------------|------|-------------------------|
| 0.151 | 63.1 | 66.0 | 2.9 | N | Pass |
| 0.202 | 63.2 | 63.5 | 0.3 | N | Pass |
| 0.344 | 55.6 | 59.1 | 3.5 | N | Pass |
| 0.944 | 34.4 | 56.0 | 21.6 | N | Pass |
| 1.153 | 34.1 | 56.0 | 21.9 | N | Pass |
| 1.298 | 31.5 | 56.0 | 24.5 | N | Pass |
| 1.352 | 28.7 | 56.0 | 27.3 | N | Pass |
| 4.936 | 39.9 | 56.0 | 16.1 | N | Pass |
| 6.087 | 39.9 | 60.0 | 20.1 | N | Pass |

Measurement results (Average):

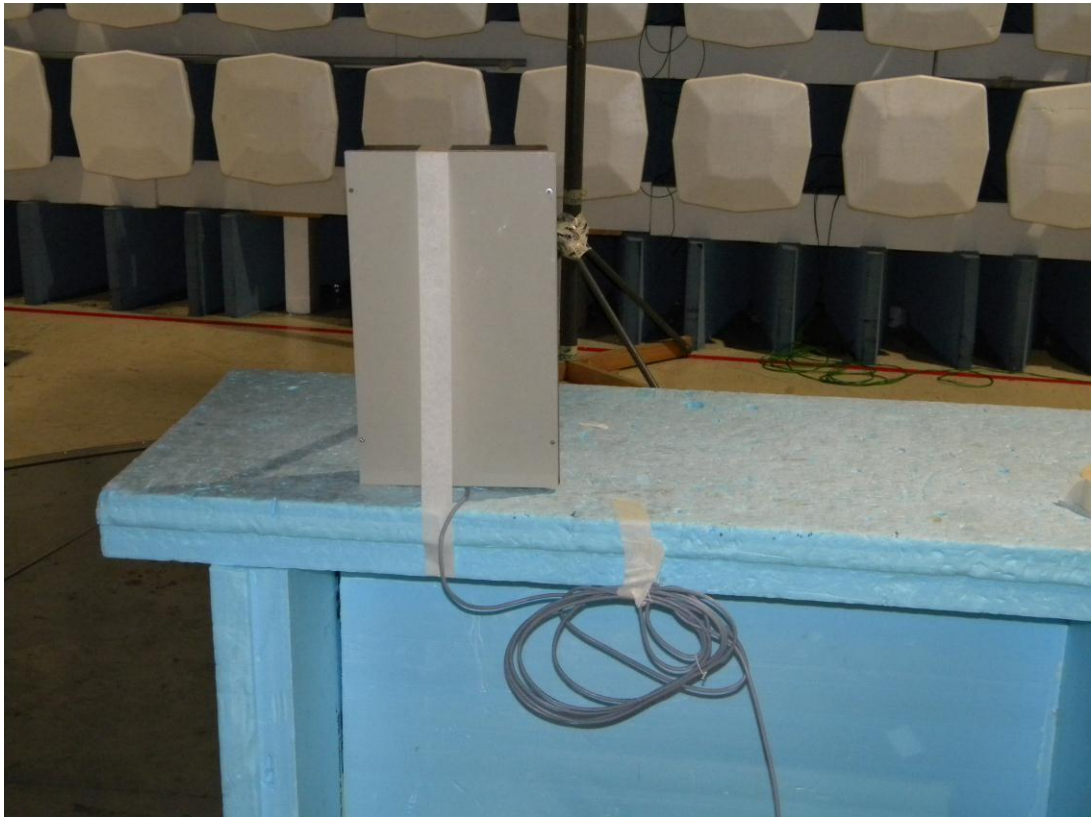
| Frequency MHz | Level dBμV | Limit dBμV | Margin dB | Line | Conclusion Pass/Fail |
|------------------|---------------|---------------|--------------|------|-------------------------|
| 1.813 | 28.0 | 46.0 | 18.0 | N | Pass |
| 2.072 | 29.7 | 46.0 | 16.3 | N | Pass |
| 4.606 | 31.8 | 46.0 | 14.2 | N | Pass |
| 4.934 | 34.0 | 46.0 | 12.0 | N | Pass |
| 6.088 | 35.2 | 50.0 | 14.8 | N | Pass |
| 6.416 | 37.6 | 50.0 | 12.4 | N | Pass |
| 6.745 | 34.0 | 50.0 | 16.0 | N | Pass |
| 6.908 | 33.8 | 50.0 | 16.2 | N | Pass |

5. List of test equipment

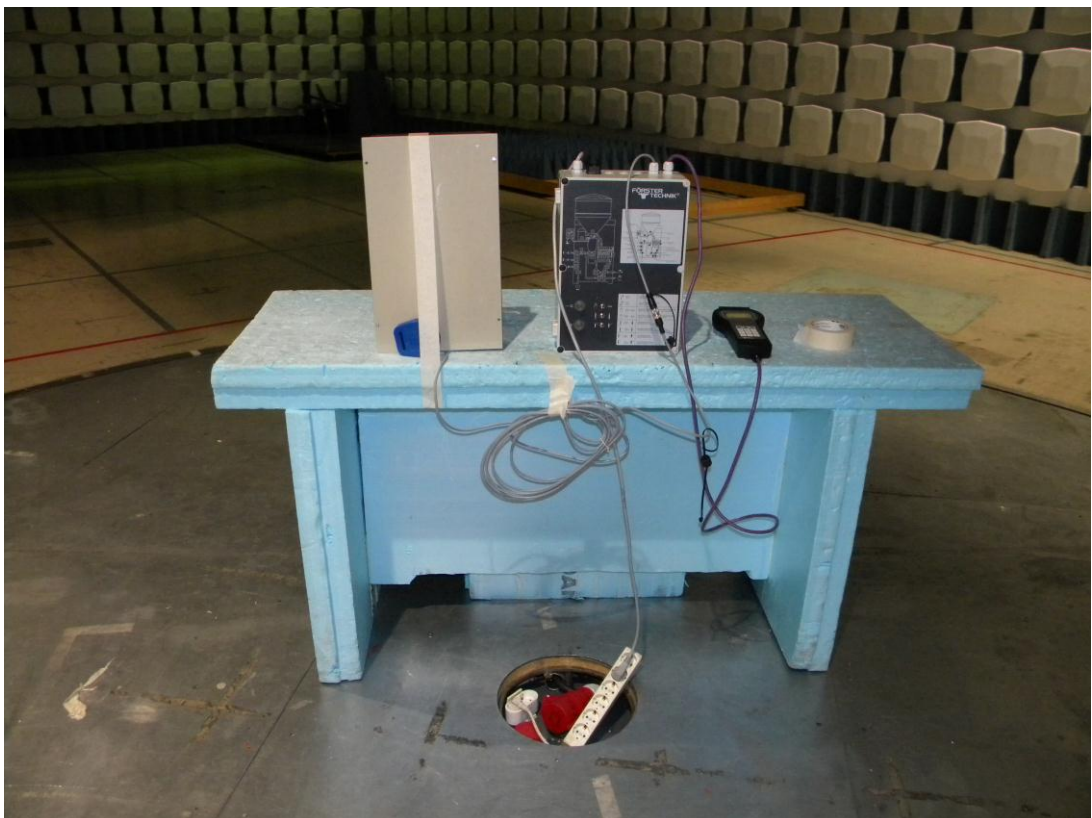
Each active test equipment is calibrated once a year, antennas every 18 months and other passive equipment every 24 months.

| Nr. | Equipment | Type | Manufacturer | Serial number |
|-----|----------------------------|------------------|------------------------|---------------|
| 338 | Test receiver | ESS | Rohde & Schwarz | 847151/009 |
| 98 | Antenna | HFH2 | Rohde & Schwarz | 871336/45 |
| 319 | Antenna | CBL6112 | Chase | 2018 |
| 348 | Shielded room | RFSD-100 | Euroshield Oy | 1320 |
| 350 | Semianechoic shielded room | RFD-F-100 | Euroshield Oy | 1327 |
| 542 | Double-Ridged Horn | 3115 | Emco | 00023905 |
| 544 | RF-amplifier | ZFL-2000VH2 | Mini-Circuits | QA0749010 |
| 559 | Highpass Filter | WHKX3.0/18G-10SS | Wainwright Instruments | 1 |
| 572 | High Pass Filter | WHKX1.5/15G-12SS | Wainwright Instruments | 4 |
| 564 | RF-amplifier | CA018-4010 | CIAO Wireless | 132 |
| 566 | Spectrum analyzer | E4448A | Agilent | US42510236 |
| 709 | EMI test receiver | ESU8 | Rohde & Schwarz | 100297 |
| 710 | RF amplifier | ALS1826-41-12 | ALC Microwave Inc. | 0011 |
| 745 | 2-Line V-Network | ENV216 | Rohde & Schwarz | 101466 |

6. Photographs



Photograph 1, Radiated power emission test



Photograph 2, Radiated emissions test



Photograph 3, AC mains conducted emissions test