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No. 1 / 1**169001**

Date of handing in: 20.03.2012

Tested by:



Timo Hietala, Test Engineer

Reviewed by:



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SORT OF EQUIPMENT:

RF ID reader

MARKETING NAME:

TYPE:

MANUFACTURER:

Multi-FDX/HDX**Förster-Technik GmbH**

CLIENT:

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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</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.

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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

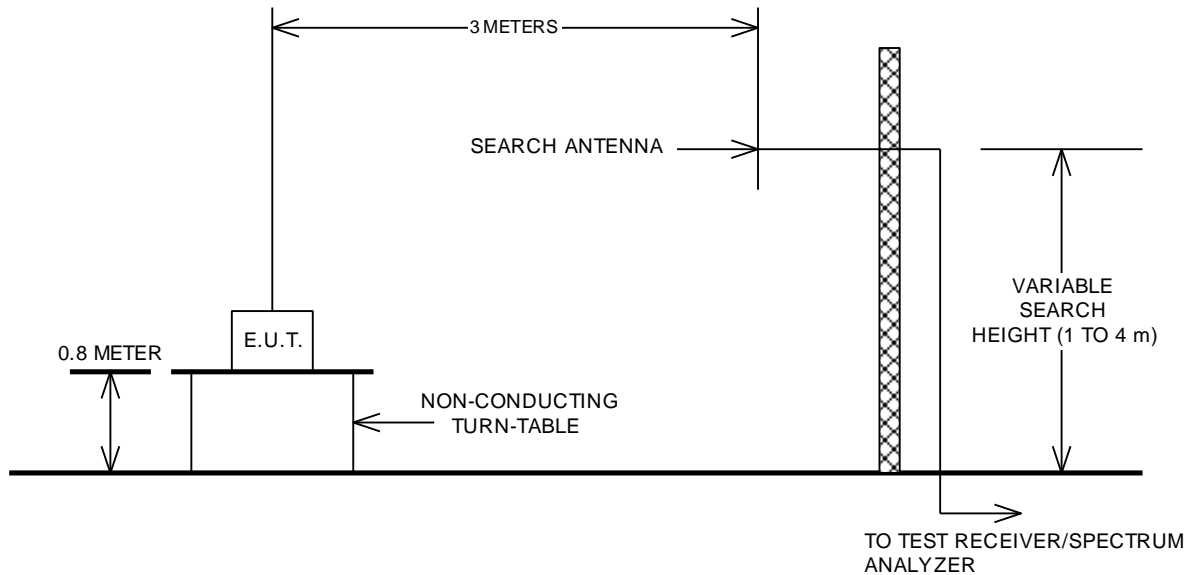
Operating voltage of the EUT during the tests:

- Main unit: 230 V AC, 50 Hz/240V AC 60Hz
- 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 / Perkkää
<i>FCC rule part</i>	§ 15.209
<i>IC</i>	RSS Gen 7.25
<i>Date of testing</i>	26.03.2012
<i>Test equipment</i>	709, 98
<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 an peak detector and a 9 kHz bandwidth. Measurements on 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 uV/m has been converted to 26.0 dBuV/m and this limit has been extrapolated by 80 dB's as 300 meter to 3 meter is 2 decades.

As allowed by section 15.31(f)(2) measurements were made at 3 meter with the 300 meter limit being extrapolated by a factor of 40 dB per decade.

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	97.3	106.0	8.7

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	97.1	105.3	8.2

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	97.1	105.1	8.0

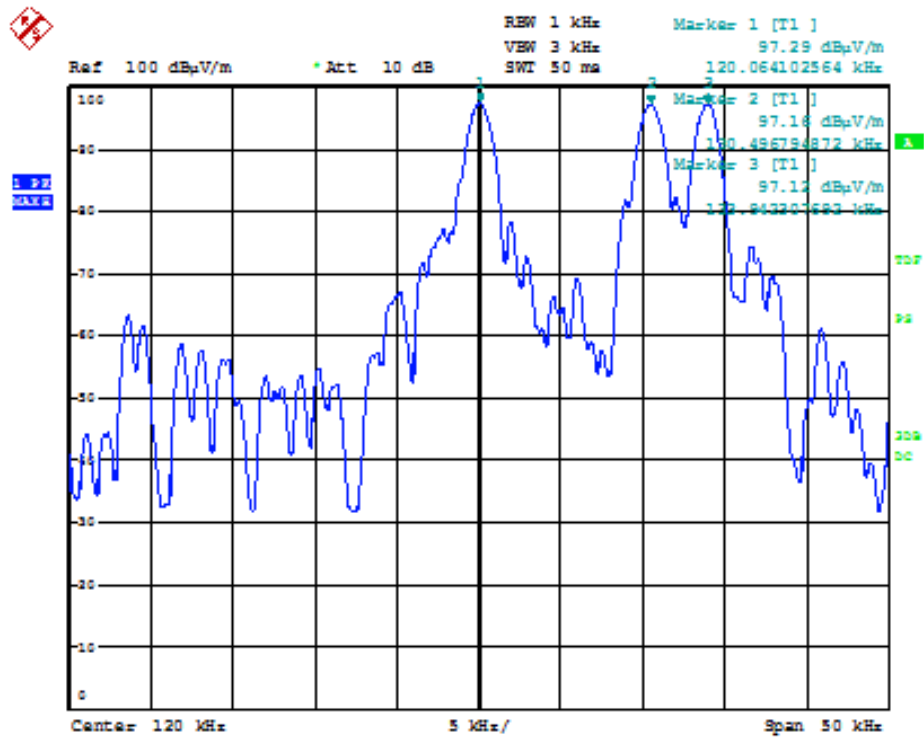


Figure 1. Fundamental output power, peak detector, channels 120-133.9kHz

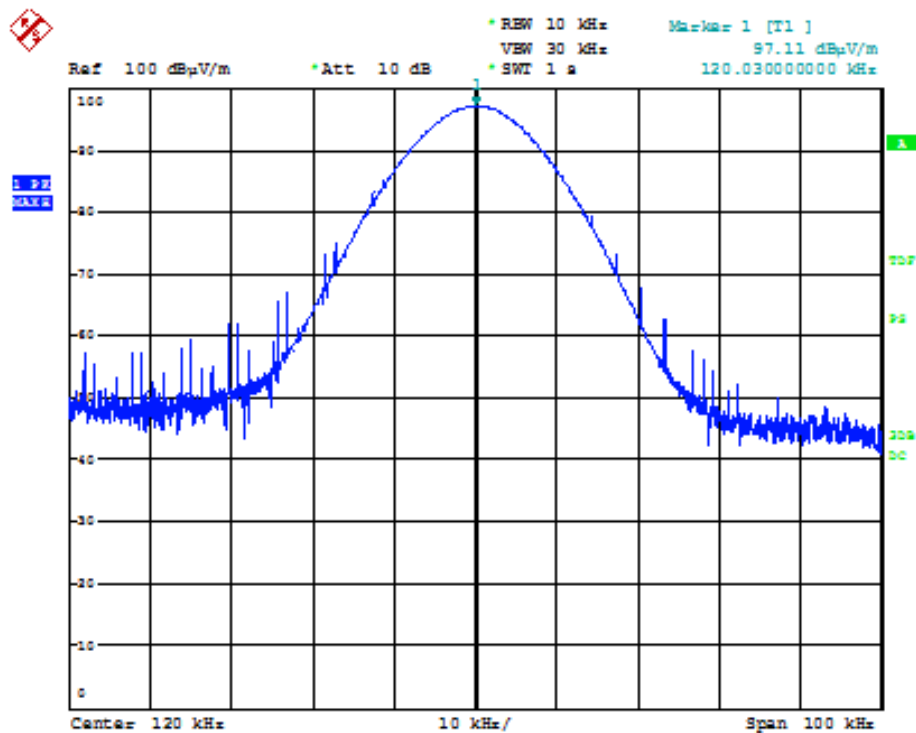


Figure 2. Fundamental output power, peak detector, channel 120 kHz

4.2 Spurious radiated emission

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

<i>Site name</i>	Nemko Oy / Perkkää
<i>FCC rule part</i>	§ 15.209
<i>IC</i>	RSS Gen 7.25
<i>Date of testing</i>	26.03.2012
<i>Test equipment</i>	319, 544, 709
<i>Test conditions</i>	22 °C, 30 % RH
<i>Test result</i>	PASS

4.2.1 EUT operation mode

<i>EUT operation mode</i>	TX on with modulation
<i>EUT TX power level</i>	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 0.01-1000 MHz the distance from the EUT to the measuring antenna was 3 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 and the EUT being in three different orthogonal positions.

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

FCC Part 15.209 Limit values (3m measuring distance)

<i>Frequency band MHz</i>	<i>Quasi-peak $\mu\text{V/m}$</i>	<i>Quasi-peak dB($\mu\text{V/m}$)</i>
30 - 88	100	40.0
88 - 216	150	43.5
216-960	200	46.0
960-1000	500	54.0

4.2.3 Test results

The measurement results were obtained as described below.

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

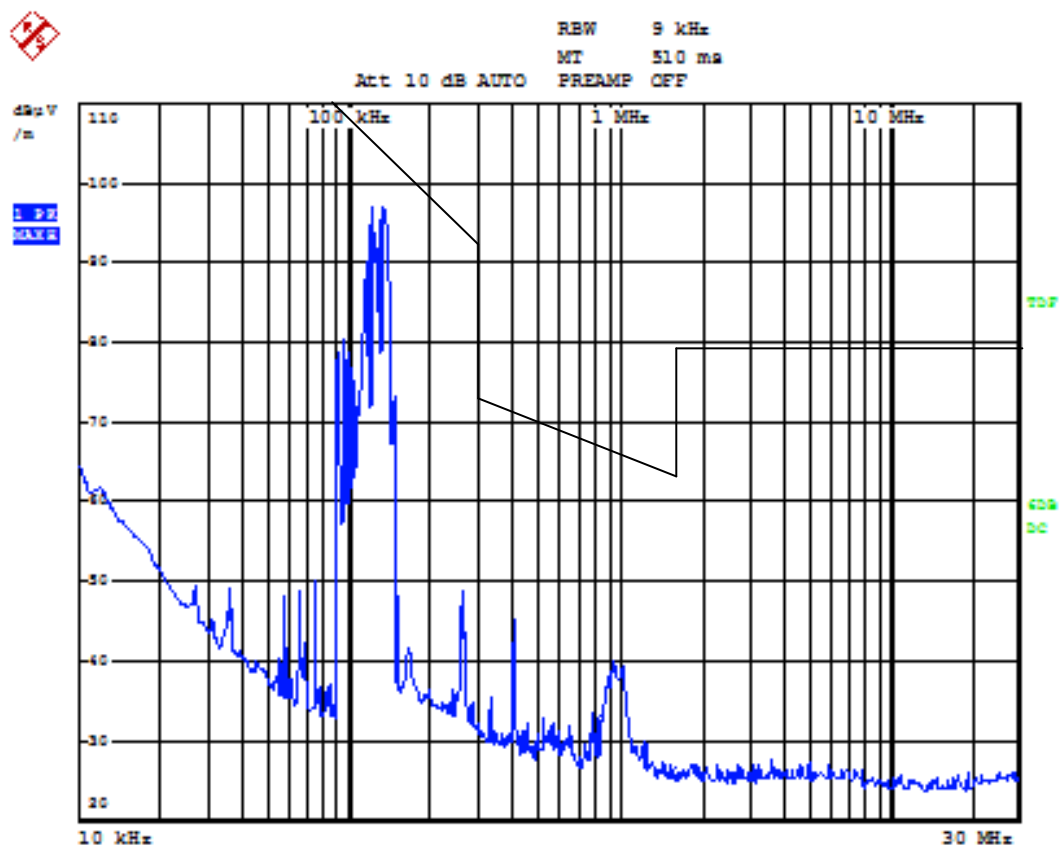
Where

U_{RX} receiver reading

A_{CABLE} attenuation of the cable

AF antenna factor

G_{PREAMP} gain of the preamplifier



10 kHz -30MHz

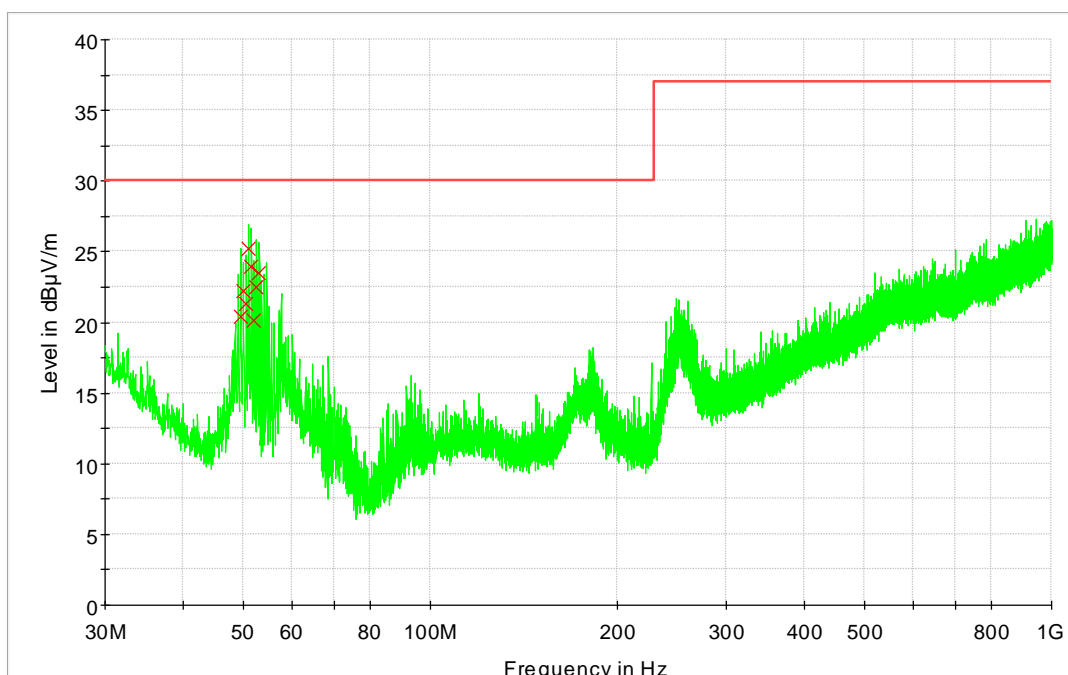


Figure 3. Spurious emissions, 30-1000 MHz

Final Result 1

Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Polarization	Azimuth (deg)
49.645	20.4	30.0	9.6	116	V	350
50.130	22.2	30.0	7.8	100	V	107
50.570	21.3	30.0	8.7	229	V	347
51.089	25.2	30.0	4.8	100	V	336
51.570	24.0	30.0	6.0	116	V	357
52.070	20.2	30.0	9.8	395	V	355
52.640	22.5	30.0	7.5	138	V	356
53.010	23.5	30.0	6.5	100.0	V	331

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:

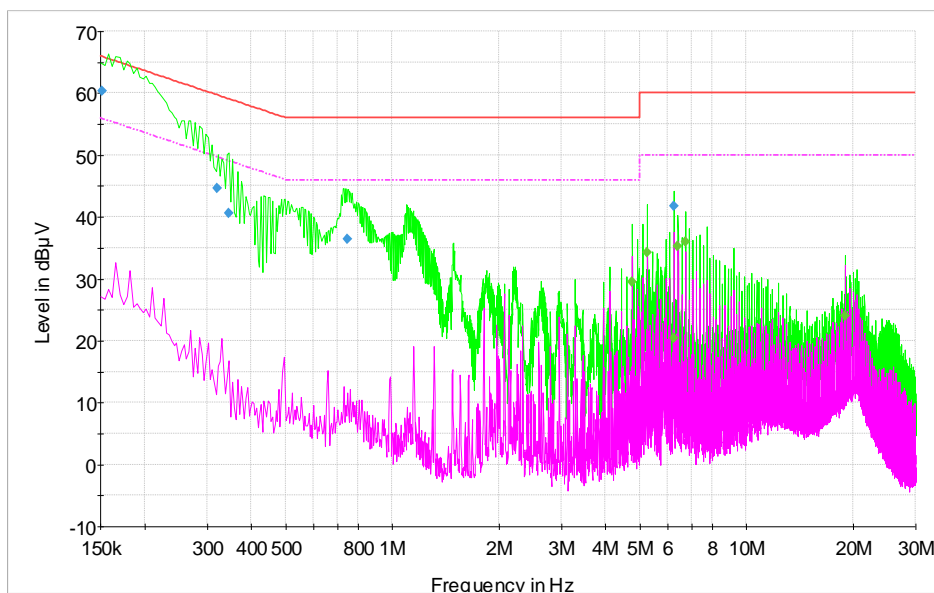
Parameter	Specification
Frequency range	0.150 – 30 MHz
Site name	Nemko Oy / Perkkää
FCC rule part	§ 15.207
IC	RSS Gen 7.25
Date of testing	16.07.2012
Test equipment	745, 709, 349
Test uncertainty U95	±3.5dB
Test conditions	24 °C, 45 % RH

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.

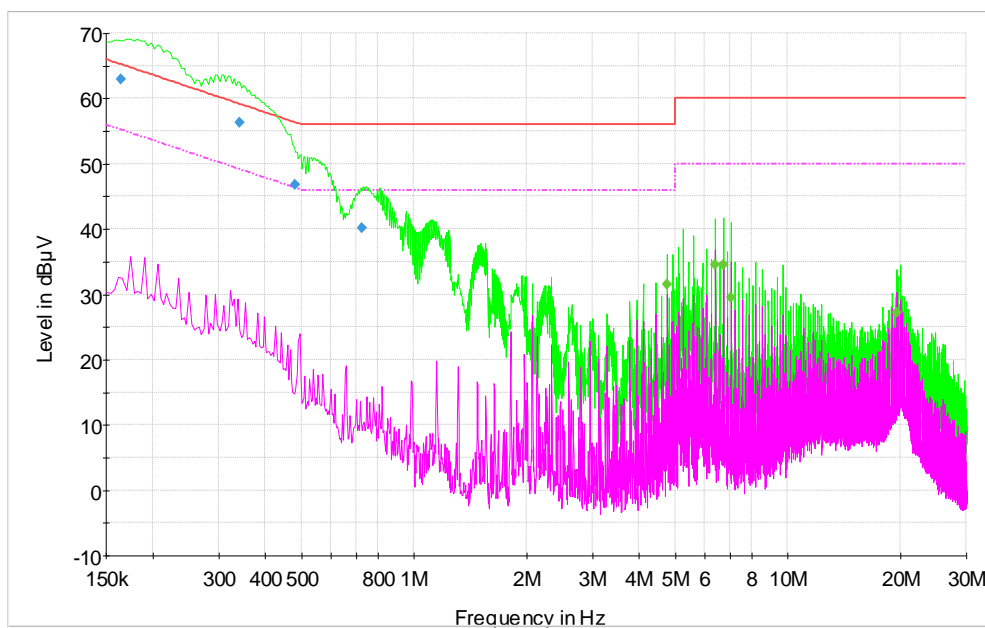
Measurement results (QP):

Frequency MHz	Level dB μ V/m	Limit dB μ V/m	Margin dB	Line	Conclusion Pass/Fail
0.152	60.3	65.9	5.6	L	Pass
0.321	44.6	59.7	15.1	L	Pass
0.346	40.5	59.1	18.5	L	Pass
0.749	36.4	56	19.6	L	Pass
6.233	41.8	60	18.2	L	Pass

Measurement results (Average):

Frequency MHz	Level dB μ V/m	Limit dB μ V/m	Margin dB	Line	Conclusion Pass/Fail
4.759	29.5	46	16.5	L	Pass
5.248	34.3	50	15.7	L	Pass
6.239	20.4	50	29.6	L	Pass
6.396	35.3	50	14.7	L	Pass
6.725	35.9	50	14.1	L	Pass
19.011	24.0	50	26.0	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 dB μ V/m	Limit dB μ V/m	Margin dB	Line	Conclusion Pass/Fail
0.165	62.9	65.2	2.3	N	Pass
0.341	56.4	59.2	2.8	N	Pass
0.482	46.7	56.3	9.6	N	Pass
0.724	40.2	56	15.8	N	Pass

Measurement results (Average):

Frequency MHz	Level dB μ V/m	Limit dB μ V/m	Margin dB	Line	Conclusion Pass/Fail
4.757	31.4	46	14.6	N	Pass
6.398	34.5	50	15.5	N	Pass
6.725	34.5	50	15.5	N	Pass
7.05	29.4	50	20.6	N	Pass
19.512	27.2	50	22.8	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
88	Standard Gain Horn	638	Narda	8003
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	D01080
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 2, AC mains conducted emissions test