TEST REPORT

Date:	**ESPOO 03.01.2014**	Page:	**1 (33)**
		Appendices	–

Number: **250332**
No. 1 / 1

Date of handing in: 18.12.2013

Tested by:

Pekka Kälviäinen, Test Engineer

Reviewed by:

Timo Hietala, Test Specialist

SORT OF EQUIPMENT: **2.4 GHz Transceiver**

TRADE MARK: ***SCANRECO***
TYPE: ***TR05***
MANUFACTURER: ***Scanreco Industrielektronik AB***

CLIENT: **Scanreco Industrielektronik AB**
ADDRESS: **Årsta Skolgränd 22, S – 100 74 Stockholm, Sweden**

TEST LABORATORY: **Nemko Oy**
FCC REG. NO. **359859 October 25, 2013**
IC FILE NO. **2040F-1 November 22, 2012**

SUMMARY:

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

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Summary of performed tests and test results

Section in CFR 47	*Section in RSS-GEN or RSS-210*		*Result*
15.247 (b)(1)	A8.4 (2)	Conducted peak output power	PASS
15.247 (d)	A8.5	Band-edge compliance of RF emissions	PASS
15.247 (d) 15.209	A8.5	Spurious radiated emissions	PASS
15.207	7.2.2	AC power line conducted emissions	PASS
15.247 (a)(1)	A8.1 (a)	20 dB bandwidth	X
15.247 (a)(1)	A8.1 (b)	Carrier frequency separation	PASS
15.247 (a)(1)(iii)	A8.1 (d)	Number of hopping frequencies	PASS
15.247 (a)/1)(iii)	A8.1 (d)	Time of occupancy	PASS

Explanations:

PASS The EUT passed that particular test.
FAIL The EUT failed that particular test.
N.A. The test not applicable, battery operated equipment
X The measurement was done, but there is no applicable performance criteria.

Contents

1. EUT and Accessory Information

1.1 EUT description

2.4 GHz transceiver, Frequency hopping system, 16 channels

1.2 EUT and accessories

	unit	*type*	*s/n*
Setup1	**Transceiver1 + removable antenna, gain 2.1dBi**	**TR05**	**-**
Setup2	**Trancseiver2, integral antenna, gain 3.3dBi**	**TR05**	**-**
Setup3	**Transceiver3, integral antenna, gain 1dBi**	**TR05**	**-**
Setup4	**Transceiver1 + external antenna, gain 4dBi, cable between transceiver and antenna 0.55m**	**TR05**	**-**
Setup5	**Transceiver1, without antenna**	**TR05**	**-**

Ancillary equipments:
- DC power supply for transceiver: Mascot AC/DC Adaptor, Type 5015, output cable l = 1.7m

Operating voltages

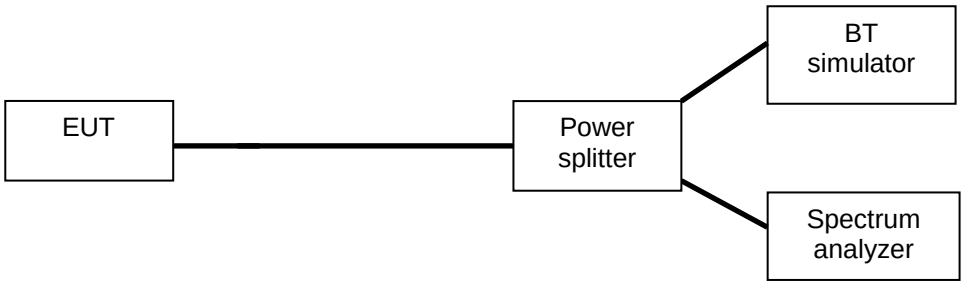
Transceiver: 6.0V DC
AC/DC power supply: 115V 60Hz AC

1.3 Additional information related to testing

Tested Technology:	**Frequency Hopping System, 16 channels**	
Type of Unit	**Transmitter**	
Modulation:	**FHSS**	
Power Supply Requirement:	**Nominal**	**6.0V**
Transmit Frequency Range	**2400 MHz to 2483.5 MHz**	
Transmit Channels Tested:	**Channel Number**	**Channel Frequency (MHz)**
	0	**2405**
	7	**2440**
	15	**2480**

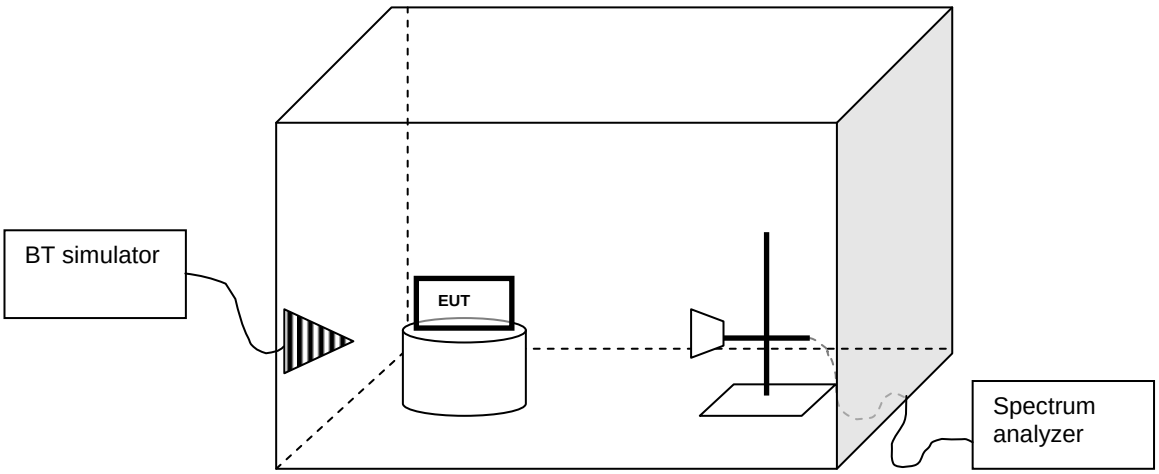
2. Test setups

Setup 5 (Conducted measurements)
The test was performed inside a shielded room. A BT simulator was not used.



Setups 1 - 4 (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. The measured signal was routed from the measuring antenna to the spectrum analyzer. A BT simulator was not used.



3. Standards and measurement methods

The test were performed in guidance of the CFR 47, FCC Rules Part 15 Subpart C, ANSI C63.4 (2003), CISPR 22 Ed. 6.0, Public notice DA 00-705, ANSI C63.10 (2009), IC standards RSS-GEN (Issue 3, December 2010) and RSS-210 (Issue 8, December 2010).

4. Test results

4.1 Conducted peak output power

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

EUT	**setup5**
Site name	**Nemko Oy / Perkkaa**
FCC rule part	**§ 15.247 (b)(1)**
Section in RSS-210	**A8.4 (2)**
Date of testing	**18.12.2013**
Test equipment	**566, 375**
Test conditions	**22 °C, 31 % RH**

4.1.1 EUT operation mode

EUT channel	**0, 7 and 15**

4.1.2 Test method and limit

The measurement is made according to Public notice DA 00-705 and IC standard RSS-210.

Frequency range (MHz)	*Limit (W)*	*Limit (dBm)*
2400 – 2483.5	**≤ 1.0**	**≤ 30**

4.1.3 Test results

Channel / f (MHz)	*P (dBm)*	*Result*
0 / 2405	**18.04**	**PASS**
7 / 2440	**17.59**	**PASS**
15 / 2480	**16.71**	**PASS**

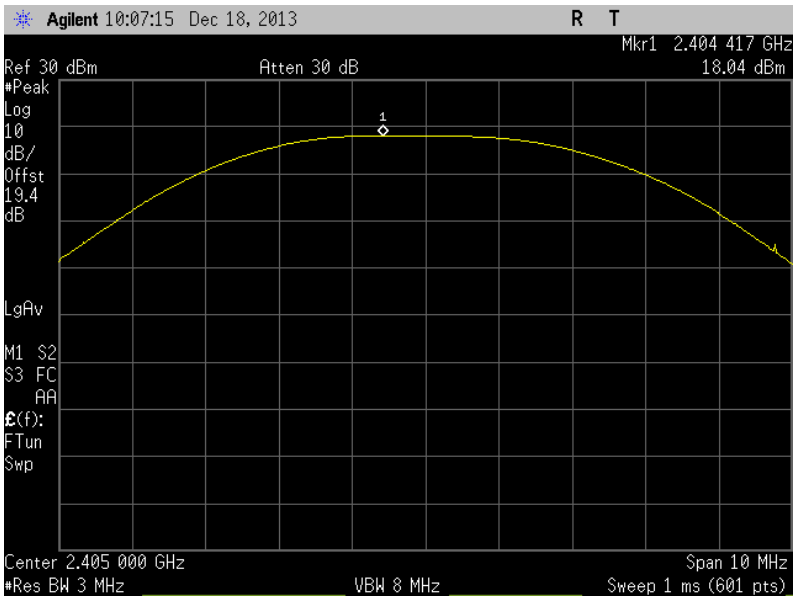


Figure 1. channel 0, conducted peak output power

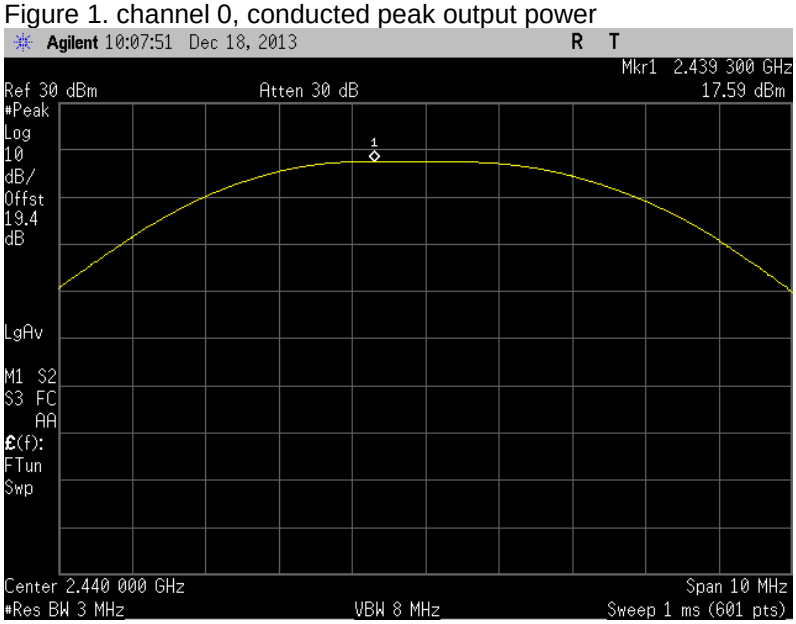


Figure 2. channel 7, conducted peak output power

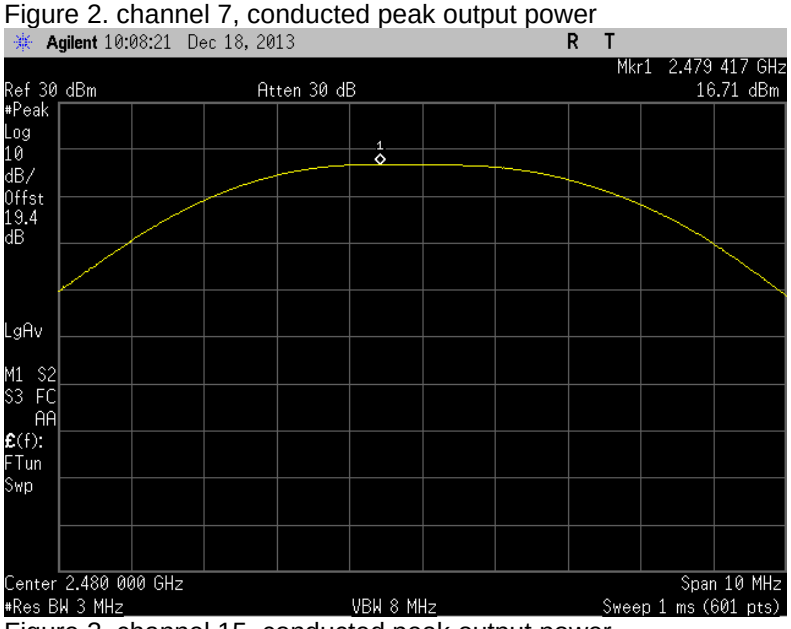


Figure 3. channel 15, conducted peak output power

4.2 Band-edge compliance of RF emissions

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

EUT	**setup1, setup2, setup3, setup4**
Site name	**Nemko Oy / Perkkaa**
FCC rule part	**§ 15.247 (d)**
Section in RSS-210	**A8.5**
Date of testing	**18-19.12.2013**
Test equipment	**566, 564, 525, 350**
Test conditions	**22 °C, 30 % RH**
Test result	**PASS**

4.2.1 EUT operation mode

EUT channel	**Hopping** **0 and 15**

4.2.2 Test method and limit

The measurement is made according to Public notice DA 00-705 and IC standard RSS-210.

3m measurement distance

Frequency range (MHz)	*Limit Average (dBµV/m)*	*Limit Peak (dBµV/m)*
Below 2390 and above 2483.5	**≤ 54**	**≤ 74**

3m measurement distance

Frequency range (MHz)	*Limit Peak (dBc)*
2390 - 2400	**≤ -20**

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

Duty Cycle correction factor(dB) -21.60 dB was used.

4.2.3 Test results

Setup1:

Hopping:

Below 2390 MHz:

Detector (RBW: 1MHz)	*E (dBµV/m)*	*Result*
Peak	**48.68**	**PASS**
Average	**27.08**	**PASS**

2390 – 2400 MHz:

Detector (RBW: 100kHz)	*dBc*	*Result*
Peak	**-53.03**	**PASS**

Above 2483.5 MHz:

Detector (RBW: 1MHz)	*E (dBµV/m)*	*Result*
Peak	**71.36**	**PASS**
Average	**49.76**	**PASS**

Channel 0:

Below 2390 MHz:

Detector (RBW: 1MHz)	*E (dBµV/m)*	*Result*
Peak	**51.93**	**PASS**
Average	**30.33**	**PASS**

2390 – 2400 MHz:

Detector (RBW: 100kHz)	*dBc*	*Result*
Peak	**-53.34**	**PASS**

Channel 15:

Above 2483.5 MHz:

Detector (RBW: 1MHz)	*E (dBµV/m)*	*Result*
Peak	**73.35**	**PASS**
Average	**51.75**	**PASS**

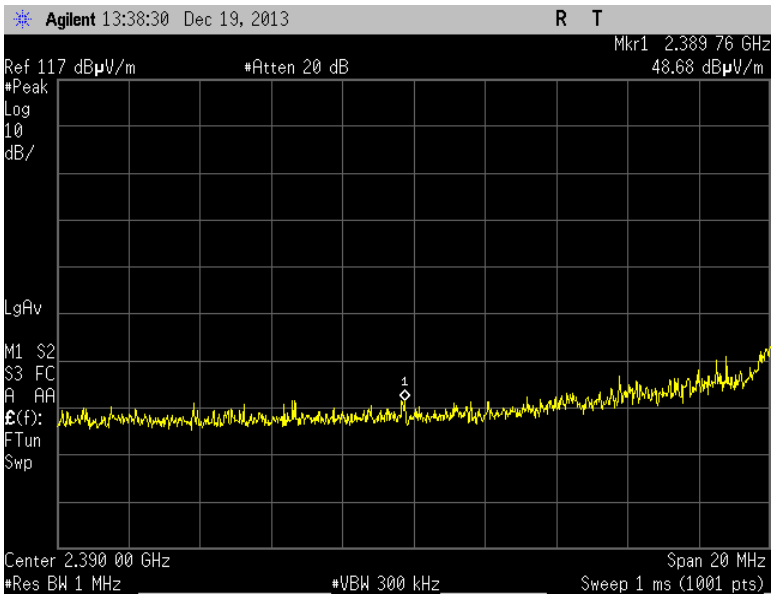


Figure 4. Hopping on, Band-edge compliance, low end, below 2390MHz

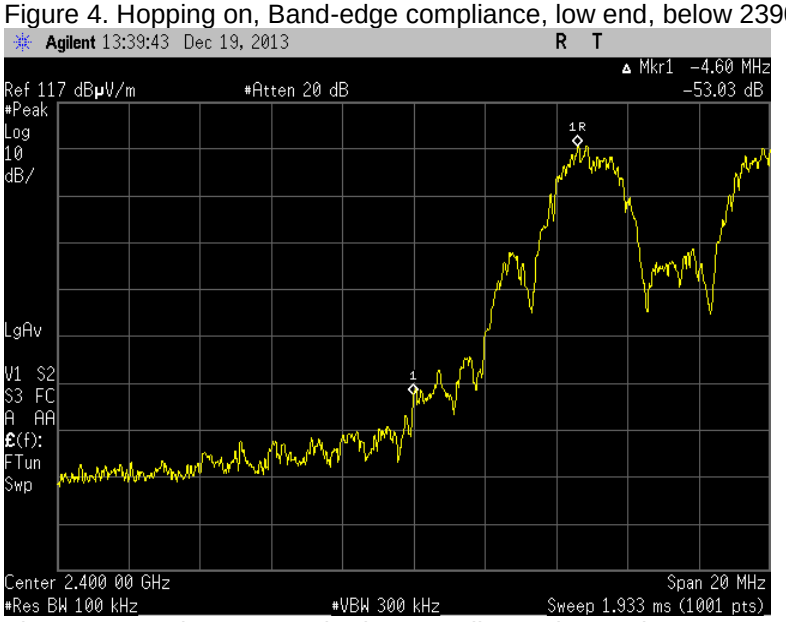


Figure 5. Hopping on, Band-edge compliance, low end, 2390-2400MHz

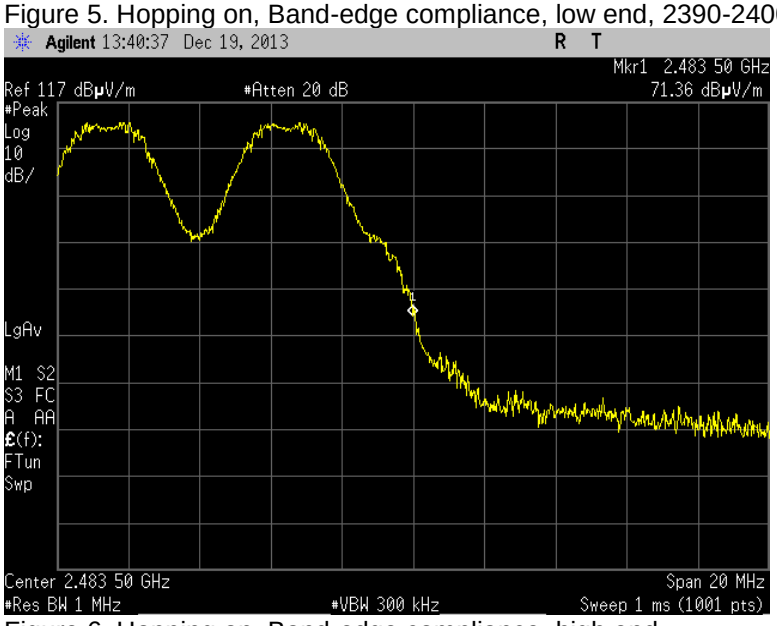


Figure 6. Hopping on, Band-edge compliance, high end

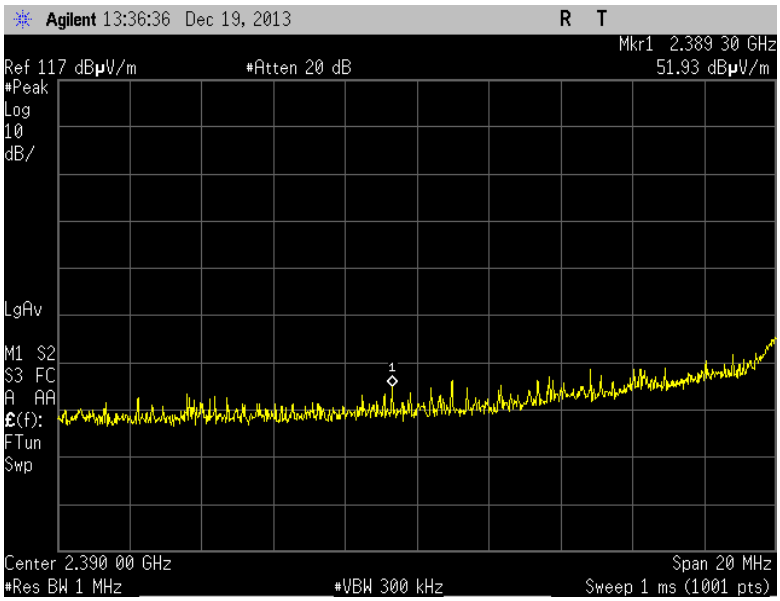


Figure 7. Hopping off, Channel 0, Band-edge compliance, low end

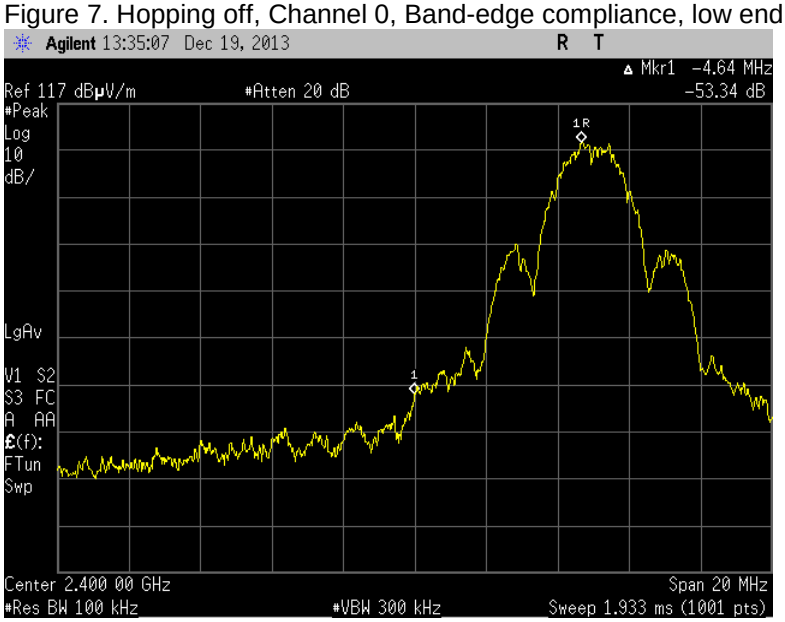


Figure 8. Hopping off, Band-edge compliance, low end, 2390-2400MHz

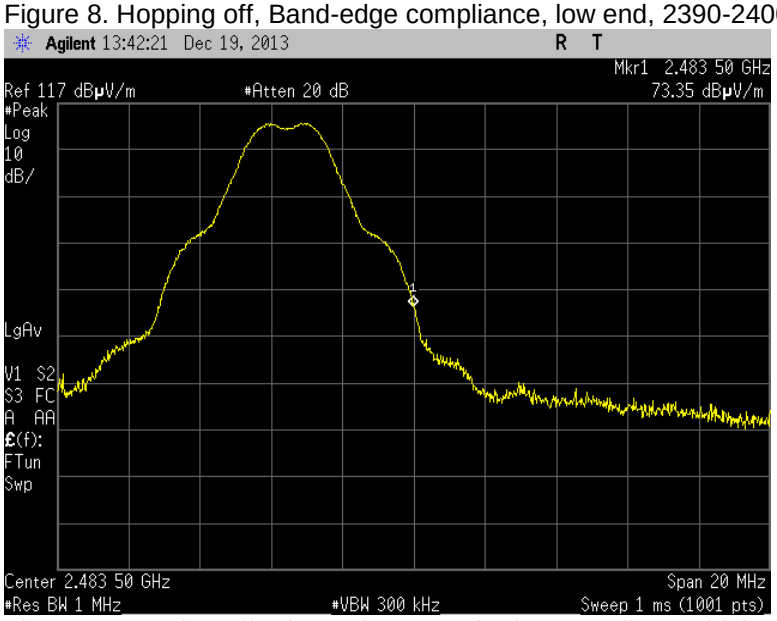


Figure 9. Hopping off, Channel 15, Band-edge compliance, high end

Setup2:

Hopping:

Below 2390 MHz:

Detector (RBW: 1MHz)	*E (dBµV/m)*	*Result*
Peak	**57.43**	**PASS**
Average	**35.83**	**PASS**

2390 – 2400 MHz:

Detector (RBW: 100kHz)	*dBc*	*Result*
Peak	**-53.35**	**PASS**

Above 2483.5 MHz:

Detector (RBW: 1MHz)	*E (dBµV/m)*	*Result*
Peak	**72.91**	**PASS**
Average	**51.31**	**PASS**

Channel 0:

Below 2390 MHz:

Detector (RBW: 1MHz)	*E (dBµV/m)*	*Result*
Peak	**59.54**	**PASS**
Average	**37.94**	**PASS**

2390 – 2400 MHz:

Detector (RBW: 100kHz)	*dBc*	*Result*
Peak	**-53.80**	**PASS**

Channel 15:

Above 2483.5 MHz:

Detector (RBW: 1MHz)	*E (dBµV/m)*	*Result*
Peak	**73.33**	**PASS**
Average	**51.73**	**PASS**

Setup3:

Hopping:

Below 2390 MHz:

Detector (RBW: 1MHz)	*E (dBµV/m)*	*Result*
Peak	**57.39**	**PASS**
Average	**35.79**	**PASS**

2390 – 2400 MHz:

Detector (RBW: 100kHz)	*dBc*	*Result*
Peak	**-54.15**	**PASS**

Above 2483.5 MHz:

Detector (RBW: 1MHz)	*E (dBµV/m)*	*Result*
Peak	**72.74**	**PASS**
Average	**51.14**	**PASS**

Channel 0:

Below 2390 MHz:

Detector (RBW: 1MHz)	*E (dBµV/m)*	*Result*
Peak	**59.54**	**PASS**
Average	**37.94**	**PASS**

2390 – 2400 MHz:

Detector (RBW: 100kHz)	*dBc*	*Result*
Peak	**-53.28**	**PASS**

Channel 15:

Above 2483.5 MHz:

Detector (RBW: 1MHz)	*E (dBµV/m)*	*Result*
Peak	**72.38**	**PASS**
Average	**50.78**	**PASS**

Setup4:

Hopping:

Below 2390 MHz:

Detector (RBW: 1MHz)	*E (dBµV/m)*	*Result*
Peak	**58.42**	**PASS**
Average	**36.82**	**PASS**

2390 – 2400 MHz:

Detector (RBW: 100kHz)	*dBc*	*Result*
Peak	**-53.39**	**PASS**

Above 2483.5 MHz:

Detector (RBW: 1MHz)	*E (dBµV/m)*	*Result*
Peak	**71.12**	**PASS**
Average	**49.52**	**PASS**

Channel 0:

Below 2390 MHz:

Detector (RBW: 1MHz)	*E (dBµV/m)*	*Result*
Peak	**60.37**	**PASS**
Average	**38.77**	**PASS**

2390 – 2400 MHz:

Detector (RBW: 100kHz)	*dBc*	*Result*
Peak	**-52.99**	**PASS**

Channel 15:

Above 2483.5 MHz:

Detector (RBW: 1MHz)	*E (dBµV/m)*	*Result*
Peak	**71.34**	**PASS**
Average	**49.74**	**PASS**

4.3 Spurious radiated emission

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

EUT	**setup1, setup2, setup3, setup4**
Site name	**Nemko Oy / Perkkaa**
FCC rule part	**§ 15.247 (d), § 15.209**
Section in RSS-210	**A8.5**
Date of testing	**18.-19.12.2013**
Test equipment	**566, 709, 564, 559, 525, 319, 544, 350, 88, 710**
Test conditions	**22 °C, 31 % RH**

4.3.1 EUT operation mode

EUT channel	**Channel 0, 7 and 15**

4.3.2 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 the distance from the EUT to the measuring antenna was 3 m. The excess length of the cables of the EUT were made into bundles 30-40 cm in length (see photograph 1). 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 with the measuring antenna being both in horizontal and vertical polarizations.

Vertical and horizontal polarizations in the frequency range 30 – 1000 MHz was measured by using the peak detector. During the peak detector scan. the turntable was rotated from 0° to 360° with 30° step with the antenna heights 1.0 m and 3.0 m. The highest levels of the radiated interference field strength measured by using the quasi-peak detector were recorded.

Vertical and horizontal polarizations in the frequency range 1000 – 25000 MHz was measured by using the peak detector. During the peak detector scan. the turntable was rotated from 0° to 360° with 15° step with the antenna heights 1.0 m, 1,5m, 2.0m, 2,5m and 3.0 m. The highest levels of the radiated interference field strength measured by using the average and peak detectors were recorded.

Minimum Standard: In any 100kHz bandwidth outside the frequency band in which the transmitter is operating, emissions shall be at least 20 dB below the fundamental emission or shall not exceed the following field strength limits:

Emissions falling in the restricted bands of 15.205 shall not exceed the limits shown in §15.209.
At frequencies equal to or less than 1000 MHz, compliance with the limits in §15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in §15.209 shall be demonstrated based on the average value of the measured emissions.

3m measuring distance, FCC Part 15.209

Frequency band MHz	*limit, Quasi peak detector dB(µV/m)*
30 - 88	**40**
88 - 216	**43.5**
216 - 960	**46**
960 - 1000	**54**

Frequency band MHz	*limit, average detector dB(µV/m)*	*limit, peak detector dB(µV/m)*
1000 - 25000	**54**	**74**

The EUT was tested on three orthogonal axis.
The device was tested from 30 MHz to the tenth harmonic of the highest fundamental frequency per 15.33.
The device was tested on three channels per 15.31(l).

The CFR 47 Part 15. Subpart B. Class B limit of 500 µV/m has been calculated to correspond 54 dB(µV/m) as follows: [dB(µV/m)]=20log[µV/m].

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

Duty Cycle correction factor(dB) -21.60 dB was used.

4.3.3 Test results

Setup1

Channel 0, (RBW 100kHz, VBW 300 kHz)

Frequency MHz	*Peak dBc*	*Limit dBc*	*Margin dB*
7215	**-41.6**	**-20.0**	**21.6**
9620	**-54.9**	**-20.0**	**34.9**

Above 1GHz. Channel 7, (RBW 100kHz, VBW 300 kHz)

Frequency MHz	*Peak dBc*	*Limit dBc*	*Margin dB*
9760	**-55.9**	**-20.0**	**35.9**

Above 1GHz. Channel 15, (RBW 100kHz, VBW 300 kHz)

Frequency MHz	*Peak dBc*	*Limit dBc*	*Margin dB*
9920	**-55.7**	**-20.0**	**35.7**

Radiated emissions in restricted bands 30 MHz – 25 GHz

Spurious emissions above 1 GHz

TX on channel 0 (RBW 1MHz, VBW 3MHz)

Frequency MHz	*Peak*			*Average*		
	Result dB(µV/m)	*Limit dB(µV/m)*	*Margin dB*	*Result dB(µV/m)*	*Limit dB(µV/m)*	*Margin dB*
4810	**48.5**	**74**	**25.5**	**26.9**	**54**	**27.1**
12025	**53.6**	**74**	**20.4**	**32.0**	**54**	**22.0**

TX on channel 7 (RBW 1MHz, VBW 3MHz)

Frequency MHz	*Peak*			*Average*		
	Result dB(µV/m)	*Limit dB(µV/m)*	*Margin dB*	*Result dB(µV/m)*	*Limit dB(µV/m)*	*Margin dB*
4880	**49.5**	**74**	**24.5**	**27.9**	**54**	**26.1**
7320	**69.5**	**74**	**4.5**	**47.9**	**54**	**6.1**
12200	**55.2**	**74**	**18.8**	**33.6**	**54**	**20.4**

TX on channel 15 (RBW 1MHz, VBW 3MHz)

Frequency MHz	*Peak*			*Average*		
	Result dB(µV/m)	*Limit dB(µV/m)*	*Margin dB*	*Result dB(µV/m)*	*Limit dB(µV/m)*	*Margin dB*
4960	**51.9**	**74**	**22.1**	**30.3**	**54**	**23.7**
7440	**69.8**	**74**	**4.2**	**48.2**	**54**	**5.8**
12400	**55.6**	**74**	**18.4**	**34.0**	**54**	**20.0**

The average was obtained from the peak using the duty cycle correction factor. The peak was measured using a peak detector.

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Setup2

Channel 0, (RBW 100kHz, VBW 300 kHz)

Frequency MHz	*Peak dBc*	*Limit dBc*	*Margin dB*
7215	**-42.6**	**-20.0**	**22.6**
9620	**-53.9**	**-20.0**	**33.9**

Above 1GHz. Channel 7, (RBW 100kHz, VBW 300 kHz)

Frequency MHz	*Peak dBc*	*Limit dBc*	*Margin dB*
9760	**-56.7**	**-20.0**	**36.7**

Above 1GHz. Channel 15, (RBW 100kHz, VBW 300 kHz)

Frequency MHz	*Peak dBc*	*Limit dBc*	*Margin dB*
9920	**-54.0**	**-20.0**	**34.0**

Radiated emissions in restricted bands 30 MHz – 25 GHz

Spurious emissions above 1 GHz

TX on channel 0 (RBW 1MHz, VBW 3MHz)

Frequency MHz	*Peak*			*Average*		
	Result dB(µV/m)	*Limit dB(µV/m)*	*Margin dB*	*Result dB(µV/m)*	*Limit dB(µV/m)*	*Margin dB*
4810	**58.0**	**74**	**16.0**	**36.4**	**54**	**17.6**
12025	**60.8**	**74**	**13.2**	**39.2**	**54**	**14.8**

TX on channel 7 (RBW 1MHz, VBW 3MHz)

Frequency MHz	*Peak*			*Average*		
	Result dB(µV/m)	*Limit dB(µV/m)*	*Margin dB*	*Result dB(µV/m)*	*Limit dB(µV/m)*	*Margin dB*
4880	**55.8**	**74**	**18.2**	**34.2**	**54**	**19.8**
7320	**67.7**	**74**	**6.3**	**46.0**	**54**	**8.0**
12200	**58.7**	**74**	**15.3**	**37.1**	**54**	**16.7**

TX on channel 15 (RBW 1MHz, VBW 3MHz)

Frequency MHz	*Peak*			*Average*		
	Result dB(µV/m)	*Limit dB(µV/m)*	*Margin dB*	*Result dB(µV/m)*	*Limit dB(µV/m)*	*Margin dB*
4960	**56.2**	**74**	**17.8**	**34.6**	**54**	**19.4**
7440	**68.9**	**74**	**5.1**	**47.3**	**54**	**6.7**
12400	**57.9**	**74**	**16.1**	**36.3**	**54**	**17.7**

The average was obtained from the peak using the duty cycle correction factor. The peak was measured using a peak detector.

Setup3

Channel 0, (RBW 100kHz, VBW 300 kHz)

Frequency MHz	*Peak dBc*	*Limit dBc*	*Margin dB*
7215	**-41.3**	**-20.0**	**21.3**
9620	**-54.9**	**-20.0**	**34.9**

Above 1GHz. Channel 7, (RBW 100kHz, VBW 300 kHz)

Frequency MHz	*Peak dBc*	*Limit dBc*	*Margin dB*
9760	**-54.8**	**-20.0**	**34.8**

Above 1GHz. Channel 15, (RBW 100kHz, VBW 300 kHz)

Frequency MHz	*Peak dBc*	*Limit dBc*	*Margin dB*
9920	**-54.2**	**-20.0**	**32.2**

Radiated emissions in restricted bands 30 MHz – 25 GHz

Spurious emissions above 1 GHz

TX on channel 0 (RBW 1MHz, VBW 3MHz)

Frequency MHz	*Peak*			*Average*		
	Result dB(µV/m)	*Limit dB(µV/m)*	*Margin dB*	*Result dB(µV/m)*	*Limit dB(µV/m)*	*Margin dB*
4810	**54.7**	**74**	**19.3**	**33.1**	**54**	**20.9**
12025	**57.4**	**74**	**16.6**	**35.8**	**54**	**18.2**

TX on channel 7 (RBW 1MHz, VBW 3MHz)

Frequency MHz	*Peak*			*Average*		
	Result dB(µV/m)	*Limit dB(µV/m)*	*Margin dB*	*Result dB(µV/m)*	*Limit dB(µV/m)*	*Margin dB*
4880	**53.0**	**74**	**18.8**	**31.4**	**54**	**22.6**
7320	**66.4**	**74**	**7.6**	**44.8**	**54**	**9.2**
12200	**55.3**	**74**	**18.7**	**33.7**	**54**	**20.3**

TX on channel 15 (RBW 1MHz, VBW 3MHz)

Frequency MHz	*Peak*			*Average*		
	Result dB(µV/m)	*Limit dB(µV/m)*	*Margin dB*	*Result dB(µV/m)*	*Limit dB(µV/m)*	*Margin dB*
4960	**52.7**	**74**	**21.3**	**31.1**	**54**	**22.9**
7440	**68.3**	**74**	**5.7**	**46.7**	**54**	**7.3**
12400	**56.0**	**74**	**18**	**34.4**	**54**	**19.6**

The average was obtained from the peak using the duty cycle correction factor. The peak was measured using a peak detector.

Setup4

Channel 0, (RBW 100kHz, VBW 300 kHz)

Frequency MHz	*Peak dBc*	*Limit dBc*	*Margin dB*
7215	**-40.2**	**-20.0**	**20.2**
9620	**-54.3**	**-20.0**	**34.3**

Above 1GHz. Channel 7, (RBW 100kHz, VBW 300 kHz)

Frequency MHz	*Peak dBc*	*Limit dBc*	*Margin dB*
9760	**-54.0**	**-20.0**	**34.0**

Above 1GHz. Channel 15, (RBW 100kHz, VBW 300 kHz)

Frequency MHz	*Peak dBc*	*Limit dBc*	*Margin dB*
9920	**-51.4**	**-20.0**	**31.4**

Radiated emissions in restricted bands 30 MHz – 25 GHz

Spurious emissions, 30-1000 MHz

Channel 7 (RBW120kHz)

Frequency MHz	*Quasi peak dB(µV/m)*	*Limit dB(µV/m)*	*Margin dB*
34.11	**26.0**	**40**	**14.0**
54.90	**14.6**	**40**	**25.4**
932.64	**21.2**	**46**	**24.8**

Spurious emissions above 1 GHz

TX on channel 0 (RBW 1MHz, VBW 3MHz)

Frequency MHz	*Peak*			*Average*		
	Result dB(µV/m)	*Limit dB(µV/m)*	*Margin dB*	*Result dB(µV/m)*	*Limit dB(µV/m)*	*Margin dB*
4810	**49.1**	**74**	**24.9**	**27.5**	**54**	**26.5**
12025	**61.1**	**74**	**12.9**	**39.5**	**54**	**14.5**

TX on channel 7 (RBW 1MHz, VBW 3MHz)

Frequency MHz	*Peak*			*Average*		
	Result dB(µV/m)	*Limit dB(µV/m)*	*Margin dB*	*Result dB(µV/m)*	*Limit dB(µV/m)*	*Margin dB*
4880	**47.0**	**74**	**27.0**	**25.4**	**54**	**28.6**
7320	**68.0**	**74**	**6.0**	**46.4**	**54**	**7.6**
12200	**60.1**	**74**	**13.9**	**38.5**	**54**	**15.5**

TX on channel 15 (RBW 1MHz, VBW 3MHz)

Frequency MHz	*Peak*			*Average*		
	Result dB(µV/m)	*Limit dB(µV/m)*	*Margin dB*	*Result dB(µV/m)*	*Limit dB(µV/m)*	*Margin dB*
4960	**51.7**	**74**	**22.3**	**30.1**	**54**	**23.9**
7440	**68.3**	**74**	**5.7**	**46.7**	**54**	**7.3**
12400	**57.0**	**74**	**17.0**	**35.4**	**54**	**18.6**

The average was obtained from the peak using the duty cycle correction factor. The peak was measured using a peak detector.

4.4 20 dB bandwidth

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

EUT	**setup5**
Site name	**Nemko Oy / Perkkaa**
FCC rule part	**§ 15.247 (a)(1)**
Section in RSS-210	**A8.1 (a)**
Date of testing	**18.12.2013**
Test equipment	**566, 375**
Test conditions	**22 °C, 31 % RH**

4.4.1 EUT operation mode

EUT channel	**0, 7 and 15**

4.4.2 Test method and limit

The measurement is made according to Public notice DA 00-705 and IC standard RSS-210.

Limit (MHz)
N/A

4.4.3 Test results

EUT Channel / f (MHz)	*20 dB bandwidth (MHz)*
0 / 2405	**2.826**
7/ 2440	**2.826**
15 /2480	**2.787**

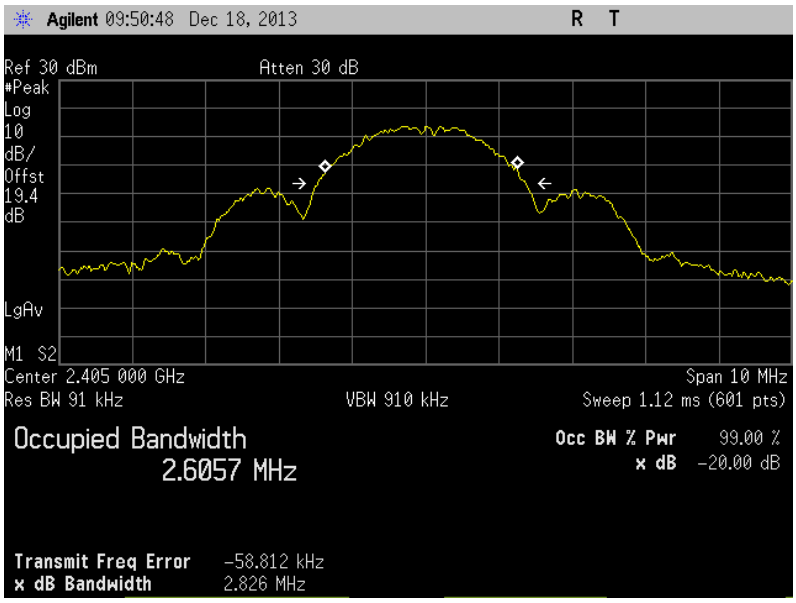

Figure 10. channel 0, 20 dB bandwidth

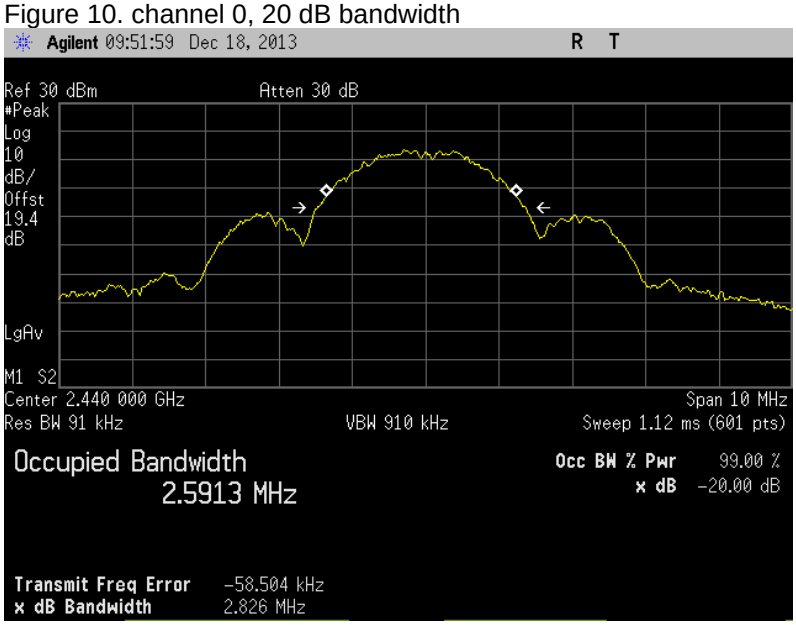

Figure 11.channel 7, 20 dB bandwidth

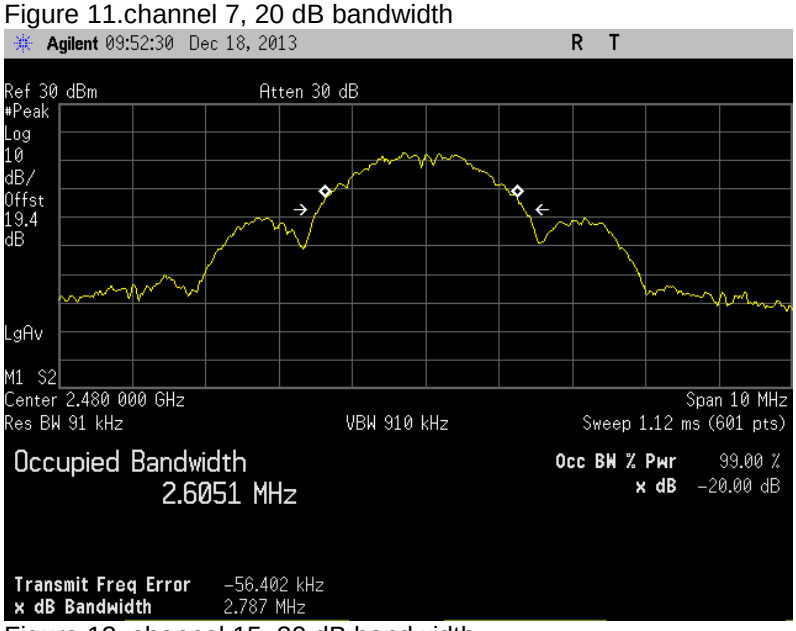

Figure 12. channel 15, 20 dB bandwidth

4.5 Carrier frequency separation

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

EUT	**setup5**
Site name	**Nemko Oy / Perkkaa**
FCC rule part	**§ 15.247 (a)(1)**
Section in RSS-210	**A8.1 (b)**
Date of testing	**18.12.2013**
Test equipment	**566, 375**
Test conditions	**22 °C, 31 % RH**

4.5.1 EUT operation mode

EUT channel	**Hopping**

4.5.2 Test method and limit and test results

The measurement is made according to Public notice DA 00-705 and IC standard RSS-210.

Limit (MHz)
≥ 0.025 or 2/3 of the 20 dB BW

4.5.3 Test results

Carrier frequency separation (MHz)	*Result*
5.000	**PASS**

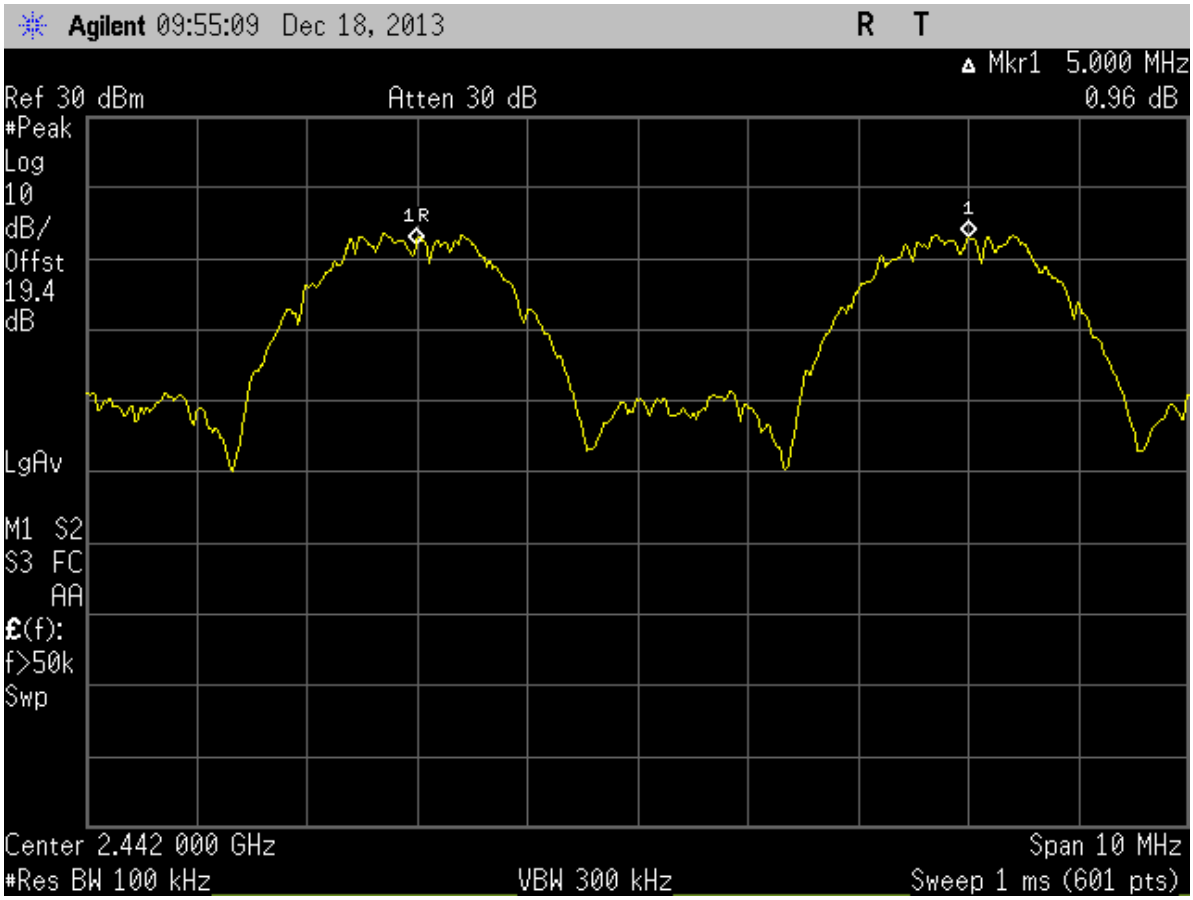

Figure 13. Hopping on, carrier frequency separation of channels 7 / 2440MHz and 8 / 2445MHz

4.6 Number of hopping frequencies

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

EUT	**setup5**
Site name	**Nemko Oy / Perkkaa**
FCC rule part	**§ 15.247, (a)(1)(iii)**
Section in RSS-210	**A8.1 (d)**
Date of testing	**18.12.2013**
Test equipment	**566, 375**
Test conditions	**22 °C,31 % RH**

4.6.1 EUT operation mode

EUT channel	**Hopping**

4.6.2 Test method and limit

The measurement is made according to Public notice DA 00-705 and IC standard RSS-210.

limit (Number)
≥ 15

4.6.3 Test results

Number of hopping frequencies	*Result*
16	**PASS**

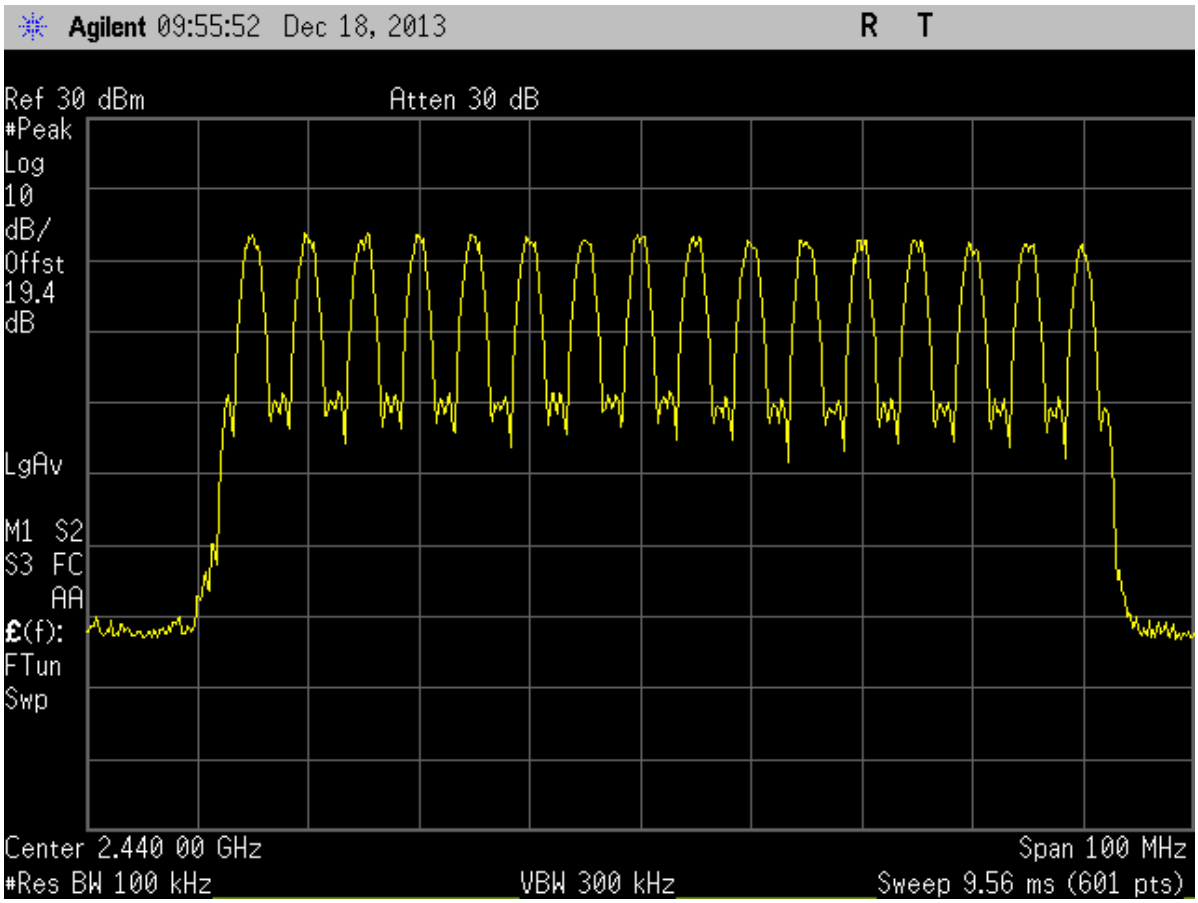

Figure 14. Hopping on, number of hopping frequencies

4.7 Time of occupancy

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

EUT	**setup5**
Site name	**Nemko Oy / Perkkaa**
FCC rule part	**§ 15.247 (a)(1)(iii)**
Section in RSS-210	**A8.1 (d)**
Date of testing	**18.12.2013**
Test equipment	**566, 375**
Test conditions	**22 °C, 31 % RH**

4.7.1 EUT operation mode

EUT channel	**Hopping**

4.7.2 Test method and limit

The measurement is made according to Public notice DA 00-705 and IC standard RSS-210 as follows:

The total time of occupancy is obtained by multiplying the measured number of transmissions occurred during 6.4 second period with the duration of one transmission.

Limit (s)
≤ 0.4

4.7.3 Test results

Time of occupancy, t (s)	*Result*
0.279	**PASS**

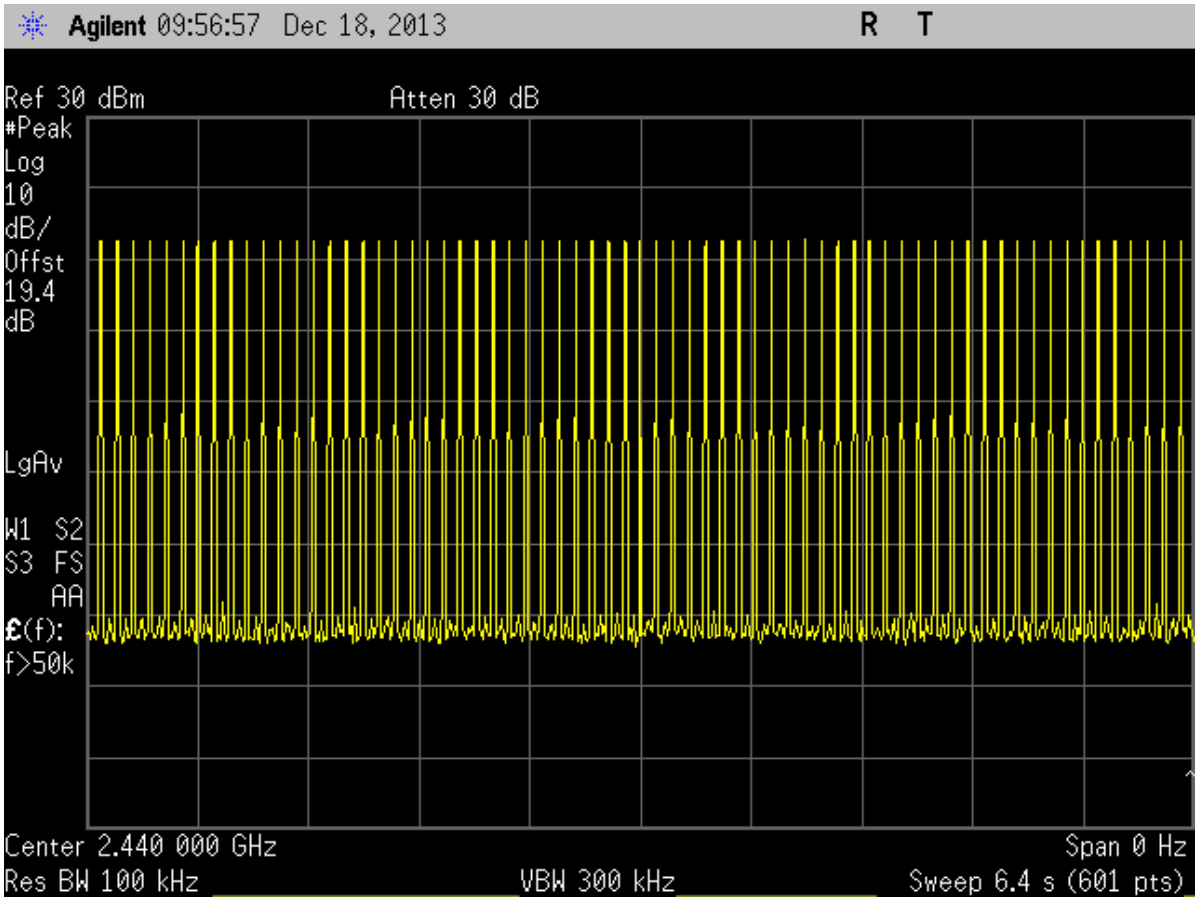

Figure 15. Hopping on, number of transmissions, channel 7 / 2440MHz, 67 transmissions

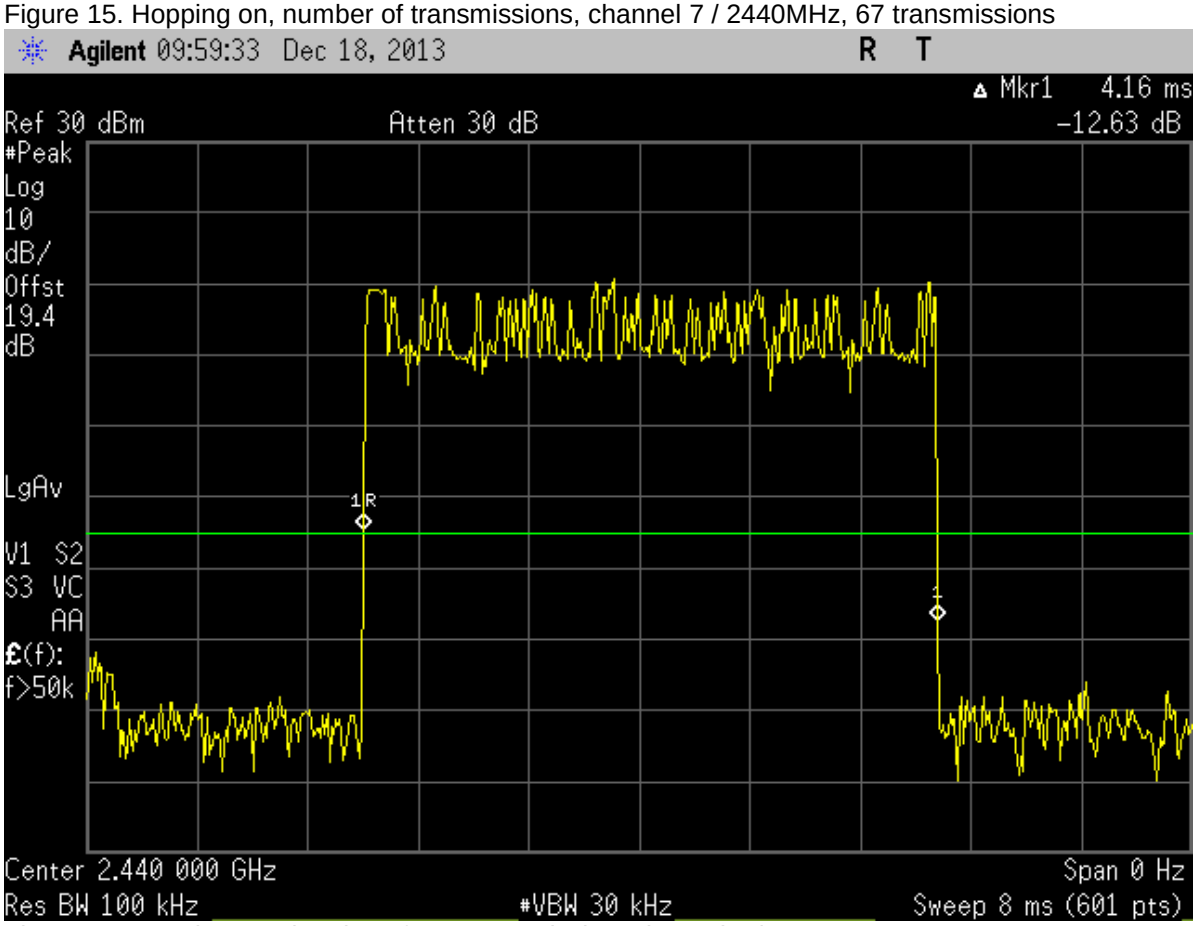

Figure 16. Hopping on, duration of one transmission, channel 7 / 2440Hz

4.8 Duty cycle correction factor, Transmit time in 100 ms

Spectrum analyzer with zero span was used to investigate spectrum.

15.35(c) Unless otherwise specified, e.g.§ 15.255(b), when the radiated emission limits are expressed in terms of the average value of the emission, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value. The exact method of calculating the average field strength shall be submitted with any application for certification or shall be retained in the measurement data file for equipment subject to notification or verification.

4.8.1 Test data

Pulse period (T) = 6.4s/67=95.5ms
Pulses/100ms=2
Length of one pulse = 4.16ms

*DutyCycleCorrectionFactor=20*log(Tocc/100)=20*log(2*4.16/100)=-21.60dB*

4.9 AC power line conducted emissions

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

EUT	**setup4**
Site name	**Nemko / Perkkaa**
FCC rule part	**§ 15.207**
Test method	**CISPR 22 /ANSI C63.4-2003**
Date of testing	**27.12.2013**
Test equipment	**348, 745, 694**
Test conditions	**22 °C, 30 % RH**

4.9.1 Test method and limit

The measurement is made according to ANSI C63.4-2003. 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 standing on the reference ground plane (see photograph 2). The excess length 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 the 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.

CISPR 22, class B limits

Frequency band MHz	*Quasi-peak dB(µV)*	*Average limit dB(µV)*
0.15 – 0.5	**66 – 56**	**56 – 46**
0.5 – 5	**56**	**46**
5 - 30	**60**	**50**

4.9.2 EUT operation mode

EUT channel	**7**

4.9.3 Test results

Line N

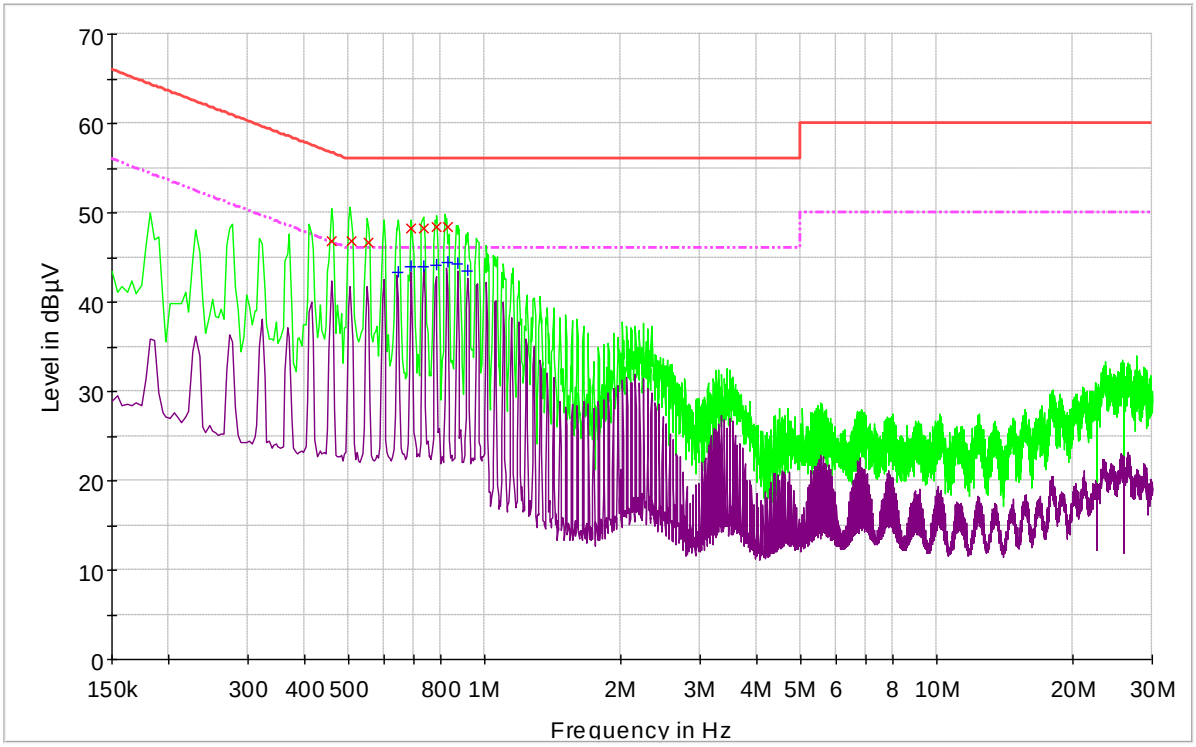

Figure 17. AC powerline emissions, Line N

Highest emissions (BW 10kHz):

Frequency MHz	*Quasi-peak dB(µV)*	*Limit value dB(µV)*	*Margin dB*
0.458	**46.8**	**56.7**	**10.0**
0.507	**46.9**	**56.0**	**9.1**
0.553	**46.7**	**56.0**	**9.3**
0.690	**48.2**	**56.0**	**7.8**
0.736	**48.2**	**56.0**	**7.8**
0.782	**48.5**	**56.0**	**7.5**
0.828	**48.5**	**56.0**	**7.5**

Frequency MHz	*Average dB(µV)*	*Limit value dB(µV)*	*Margin dB*
0.643	**43.4**	**46.0**	**2.6**
0.690	**43.9**	**46.0**	**2.1**
0.736	**44.0**	**46.0**	**2.0**
0.782	**44.1**	**46.0**	**1.9**
0.829	**44.4**	**46.0**	**1.6**
0.875	**44.2**	**46.0**	**1.8**
0.921	**43.4**	**46.0**	**2.6**

Line L

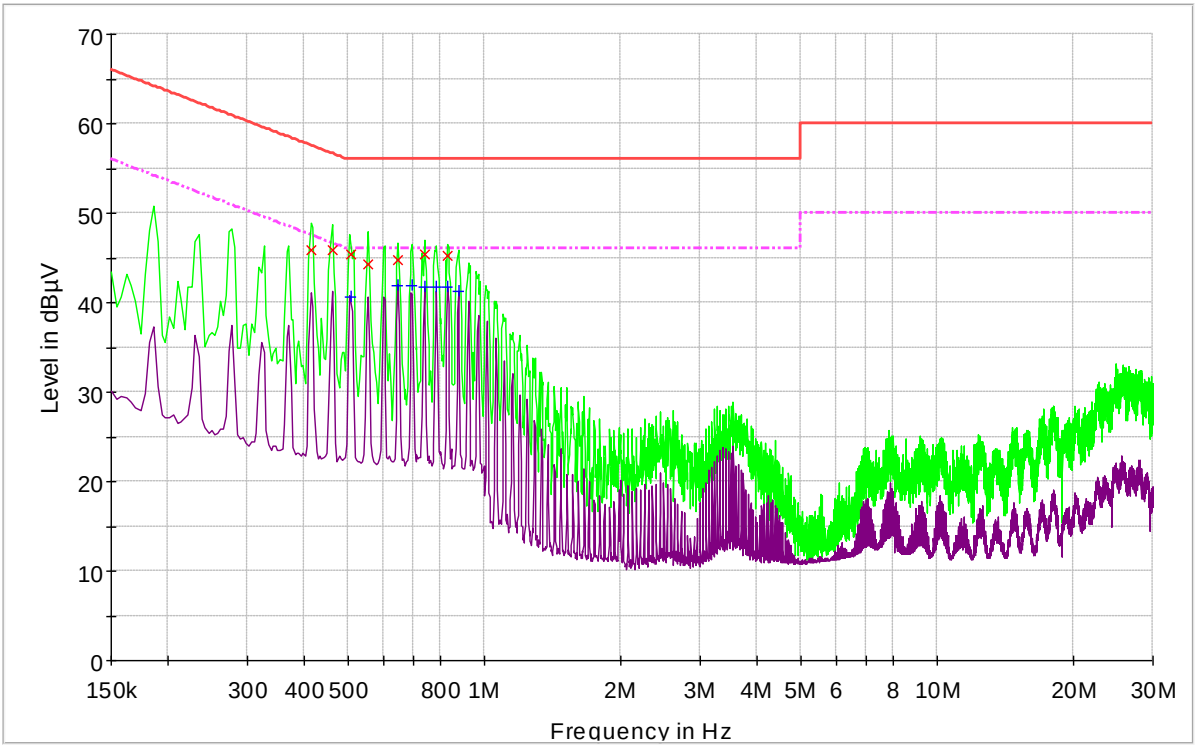

Figure 18. AC powerline emissions, Line L

Highest emissions (BW 10kHz):

Frequency MHz	*Quasi-peak dB(µV)*	*Limit value dB(µV)*	*Margin dB*
0.415	**45.9**	**57.5**	**11.6**
0.461	**45.9**	**56.7**	**10.8**
0.508	**45.3**	**56.0**	**10.7**
0.556	**44.2**	**56.0**	**11.8**
0.646	**44.8**	**56.0**	**11.2**
0.740	**45.4**	**56.0**	**10.6**
0.832	**45.3**	**56.0**	**10.7**

Frequency MHz	*Average dB(µV)*	*Limit value dB(µV)*	*Margin dB*
0.508	**40.7**	**46.0**	**5.3**
0.647	**41.8**	**46.0**	**4.2**
0.693	**41.9**	**46.0**	**4.1**
0.740	**41.7**	**46.0**	**4.3**
0.786	**41.7**	**46.0**	**4.3**
0.832	**41.8**	**46.0**	**4.2**
0.878	**41.3**	**46.0**	**4.7**

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	Cal date	Cal due
375	RF attenuator PAD	757 C - 20 dB	Narda	-	10.12.2011	12.2013
390	RF attenuator PAD	WA2-10	Weinschel	3784	10.12.2011	12.2013
694	EMI Test Receiver	ESPC	Rohde & Schwarz	842888/023	11.12.2012	12.2013
566	Spectrum analyzer	E4448A	Agilent	US42510236	17.4.2013	4.2014
709	EMI test receiver	ESU8	Rohde & Schwarz	100297	24.07.2013	7.2014
567	RF generator	E8257C	Agilent	MY43320736	25.2.2013	2.2014
544	RF-amplifier	ZFL-2000VH2	Mini-Circuits	QA0749010	9.1.2013	1.2014
564	RF amplifier	CA018-4010	CIAO Wireless	132	9.1.2013	1.2014
710	RF-amplifier	ALS 1826-41-12	ALC Microwave Inc.	0011	28.10.2011	10.2013
745	2-Line V-Network	ENV216	Rohde & Schwarz	101466	11.6.2013	06.2014
319	Antenna	CBL6112	Chase	2018	12.7.2012	1.2014
525	Double-Ridged Horn	3115	Emco	6691	10.10.2012	4.2014
542	Double-Ridged Horn	3115	Emco	00023905	10.10.2012	4.2014
559	Highpass Filter	WHKX3.0/18G-10SS	Wainwright Instruments	1	7.12.2011	12.2013
88	Waveguide horn	638	Narda	8003	10.10.2012	4.2014
350	Semianechoic shielded room	RFD-F-100	Euroshield Oy	1327	26.10.2012	10.2014
157	Temp. test chamber	VMT 04/240	Vötch	31884	-	-

6. Photographs

See "250332_test_setup_photographs"