REPORT
issued by an FCC listed Laboratory Reg. no. 93866.
The test site complies with RSS-Gen, file no: IC 3482A-2

Date 2012-02-28 | Reference FX200703-15C | Page 1 (2)

1002
ISO/IEC 17025

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Rev.1: 2012-04-22

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Equipment Authorization measurements on 2405-2480 MHz Transceiver Unit
FCC ID: B7WACCESS

(11 appendices)

Rev.1, 2012-04-22: Appendices 4, 7 and 10 have been reviewed.
Appendix 1: Added information about used RBW. Added rows in result tables for low and high channel for the fundamental measurements with RBW=100 kHz.
Appendix 7: Measurement guideline for FHSS DA 00-705 deleted as measurement method.
Appendix 10: Values at low band edge with average values deleted, not relevant figures, the limit is in dBc.

Test object

Product name: MP access radio module
Product number: 8001231-2
Two different samples were used during the test:
Serial number: 12011183 (radiated sample)
Serial number: 12011197 (conducted sample, temporary antenna connector)

Summary

See Appendix 1 for general information and Appendix 11 for photos.
Emission measurements as specified below have been performed.

Standard	Compliant	Appendix	Remarks
FCC 47 CFR Part 15 C (07-10-08) 15.247 Operation within the band 2400-2483.5 MHz	**Yes**		
IC RSS-210 Issue 8, December 2010	**Yes**		
15.247 (a) (2) / RSS-210 A8.2(a) 6 dB bandwidth	Yes	2	
15.247 (b) (3) / RSS-210 A8.4(4) Maximum peak conducted power	Yes	3	
15.247 (d) / RSS-210 A8.5 20 dBc below fundamental	Yes	4	
15.247 (d) / RSS-210 A8.5 Restricted bands of operation	Yes	4	
15.247 (e) / RSS-210 A8.2(b) Power spectral density	Yes	5	
15.247 (i) / RSS-102 2.5.1 RF Safety	Yes	6	
15.215 (c) 20 dB bandwidth	Yes	7	
15.207 / RSS-Gen 7.2.4 Conducted emission limits	Yes	8	
2.1049 / RSS-Gen 4.6.1 Occupied bandwidth	Yes	9	
2.1049 / RSS-210 A8.5 Band Edge	Yes	10	

Note: Above RSS items are given as cross-reference only. Measurements were performed according to ANSI procedures referenced by FCC and covered by SP's accreditation.

SP Technical Research Institute of Sweden
Electronics - EMC

Performed by

Fredrik Isaksson

Examined by

Christer Karlsson

Performance test and requirements

The tests were performed to verify that MP access radio module meets the electromagnetic compatibility requirements of FCC 47 CFR part 15 C.

Test facility

The used anechoic chamber is compliant with the requirements of section 2.948 of the FCC rules and listed, registration number 96866, as a facility accepted for certification under parts 15 and 18. The site complies with RSS Gen, Issue 2 and is accepted by Industry Canada for the performance of radiated measurements, IC-file number 3482A-2.

Test object

Transceiver:	MP access radio module
Antenna:	Integral, PCB
Antenna gain:	Not declared
Frequency range:	2405-2480 MHz
Frequencies used during test:	2405 MHz 2440 MHz 2480 MHz
Modulation:	OQPSK
Data rate:	250 kbit/s (at 100 % duty cycle)
Supply voltage:	4.3-16 V DC via the host PCB Nominal: 10 V DC

The host PCB and the EUT was powered by an external DC power supply, Agilent E3631A SP503997. The DC power supply was powered by an AC Source HP 6813B SP503091.

Measurement equipment

Measurement equipment	Calibration Due	SP number
Test site Edison	2013-12	504 114
R&S FSIQ40 Signal Analyser	2012-07	503 738
EMI test receiver R&S ESIB 26	2012-07	503 885
LISN Schwarzbeck NNLA 8120	2012-04	504 129
Antenna Schaffner CBL 6143	2013-04	504 079
Horn antenna EMCO 3115	2014-01	501 548
Standard gain horn Flann 16240-25	-	503 939
Standard gain horn Flann 18240-25	-	503 900
Standard gain horn Flann 20240-20	-	503 674
Low Noise Amplifier Miteq	2012-08	503 277
Low Noise Amplifier Miteq	2012-08	504 160
High pass filter Wainwright WHKY	2012-08	503 739
Multimeter Fluke 83	2012-05	501 522
Temperature and humidity meter Testo 625	2012-05	504 117

Operational test mode

Justification measurements were performed with rotation of the EUT through three orthogonal axes to determine which orientation the radio module had the highest emission levels, see photos in Append ix 11.

The EUT was tested as a module powered by the host PCB.
The test was performed with continuous transmission (100% duty cycle), if not otherwise stated, and with normal modulation.
Settings of the EUT was performed with an external computer via Hyperterminal.
The following settings were used:
RF power: Max power, setting 12
100 % duty cycle: T-Continous Transmission, M-Modulated Transmission
7.7 % duty cycle: Range Test Transmitter

For duty cycle measurements see appendix 2.
At normal use the EUT has a duty cycle of maximum 7.7 %, according to the client.
With the setting Range Test Transmitter the duty cycle was measured to 0.673/8.77 ms = 0.0767 = 7.7 %.
The duty cycle correction factor was calculated to 20 log (0.673/8.77 ms) = -22.3 dB.
The PRF was calculated to PRF = 1/T = 1/8.77 ms = 114 Hz, thus QP-detector was used without any correction for pulse desensitization.

Cabling during emission test:

EUT port	Cable type	Termination / use
10 V DC	2 wire unshielded 1.5 m	Connected to the DC power supply
Control port	2 wire unshielded 0.3 m	Unterminated

Connected equipment during the test

Host PCB	Client equipment

Uncertainties

Measurement and test instrument uncertainties are described in the quality assurance documentation ”SP QD 10885”. The measurement uncertainties can be found in the table below. The uncertainties are calculated with a coverage factor k=2 (95% level of confidence). The measurement uncertainties can be found in the table below:

Method	**Uncertainty**
Radiated emission, 30 – 1000 MHz	4.8/5.6 dB (V/H-pol)
Radiated emission, 1 – 40 GHz	2.6 dB
Conducted emission	3.5 dB

Compliancy evaluation is based on a shared risk principle with respect to the measurement uncertainty.

Reservation

The test results in this report apply only to the particular test object as declared in the report.

Delivery of test object

The test object was delivered: 2012-01-18

Test participant

Henrik Magnuson, Micropower E.D Marketing AB

Test engineer

Fredrik Isaksson, SP

6 dB bandwidth measurements according to FCC 47 CFR part 15.247 (a) (2) / RSS-210 A8.2(a)

Date	Temperature	Humidity
2012-02-28	23 °C ± 3 °C	30 % ± 5 %

Test set-up and procedure

The measurements were performed according to ANSI C63.10-2009 and the guideline Measurement of Digital Transmission Systems Operating under Section 15.247, March 23, 2005.

The test was performed with continuous transmission (100% duty cycle) and with normal modulation.

The test was performed conducted at the antenna connector.
The test equipment was connected to an external 10 MHz reference standard during measurements.

Measurement equipment	SP number
Test site Marconi	15:120
R&S FSIQ40 Signal Analyser	503 738
Multimeter Fluke 83	501 522
Temperature and humidity meter Testo 625	504 117

Measurement uncertainty: 2.6 %

Results

6 dB measurements can be found in the diagrams below:

Diagram 1 2405 MHz 6 dBW = 1.50 MHz
Diagram 2 2445 MHz 6 dBW = 1.50 MHz
Diagram 3 2480 MHz 6 dBW = 1.51 MHz

Limits

According to 47CFR 15.247(a)(2), the minimum 6 dB bandwidth shall be at least 500 kHz.

According to RSS-210 A8.2(a), the minimum -6 dB bandwidth shall be at least 500 kHz.

Complies?	Yes

Diagram 1

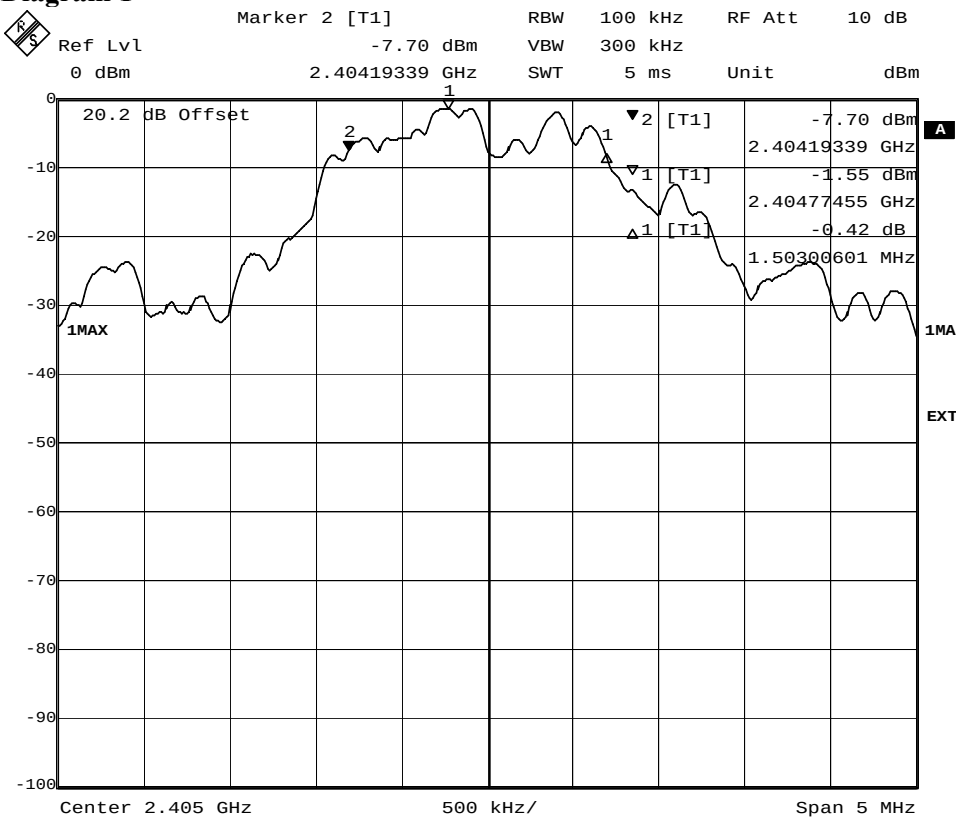


Diagram 2

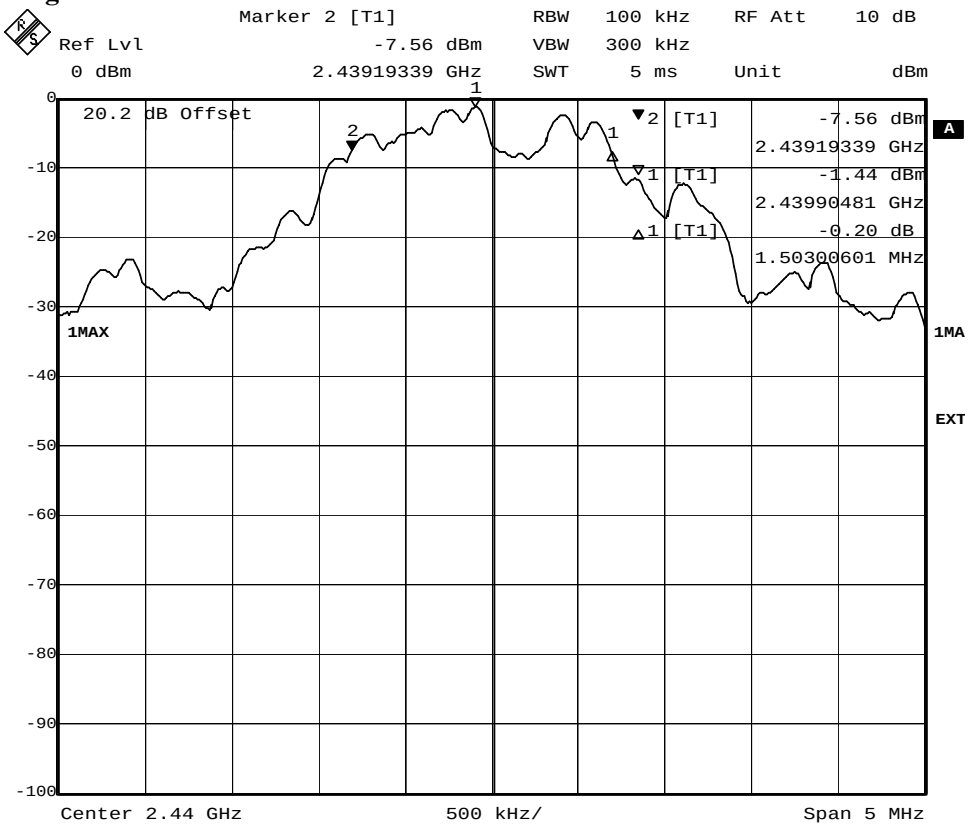
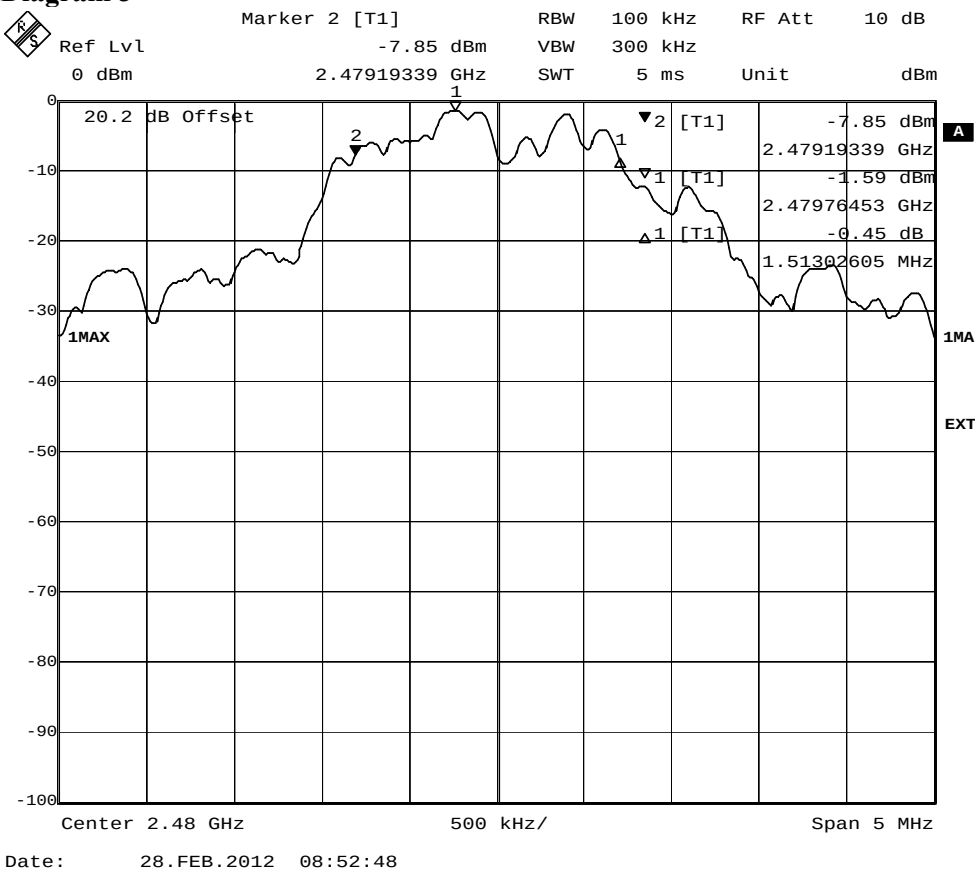


Diagram 3


Marker 2 [T1]
RBW 100 kHz
RF Att 10 dB
Ref Lvl
-7.85 dBm
VBW 300 kHz
0 dBm
2.47919339 GHz
SWT 5 ms
Unit dBm
20.2 dB Offset
2 [T1]
-7.85 dBm
2.47919339 GHz
1 [T1]
-1.59 dBm
2.47976453 GHz
1 [T1]
-0.45 dB
1.51302605 MHz
1MAX
1MA
A
EXT
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
Center 2.48 GHz
500 kHz/
Span 5 MHz
Date: 28.FEB.2012 08:52:48

Maximum peak radiated output power measurements according to FCC 47 CFR part 15.247 (b) (3) / RSS 210-210 A8.4(4)

Date	Temperature	Humidity
2012-01-18	22 °C ± 3 °C	25 % ± 5 %

Test set-up and procedure

The measurements were performed according to ANSI C63.10-2009.

The test was performed with continuous transmission (100% duty cycle) and with normal modulation.

The test of radiated emission was performed in a semi anechoic chamber. The measurements were performed with both horizontal and vertical polarizations of the antenna. The antenna distance was 3.0 m.
The fundamental was scanned with PEAK-detector with the antenna height was varied between 1-4 m and the turntable was rotated between 0-360 degrees for maximum response. The antenna distance during the measurements was 3.0 m

Test set-up photos during the tests can be found in Appendix 11.

Measurement equipment	SP number
Semi anechoic chamber, Edison	504 114
Spectrum analyzer R&S ESI 26	503 885
EMI measurement computer	-
Software: R&S EMC32, ver. 8.52.0	503 745
Horn antenna EMCO 3115	501 548
Multimeter Fluke 83	501 522
Temperature and humidity meter Testo 625	504 117

Results

The duty cycle measurements can be found in the diagrams below:

Diagram 1: Tx on with normal duty cycle.

Diagram 2: Period time with normal duty cycle.

RBW=5 MHz (greater than 6 dB BW)

		Max peak **radiated** output power Peak		
		2405 MHz	2440 MHz	2480 MHz
	EUT axes	Z	Z	Z
	Antenna height	2.48	2.42	2.42
	Azimuth	270	265	265
	Polarization	Horizontal	Horizontal	Horizontal
T_{nom} 22°C	V_{nom} 10 V DC Note 2	98.5 dBµV/m (=3.3 dBm ERP) Note 1	98.6 dBµV/m (=3.4 dBm ERP) Note 1	97.9 dBµV/m (=2.7 dBm ERP) Note 1
T_{nom} 22°C	V_{min} 4.3 V DC Note 2	96.7 dBµV/m (=1.5 dBm ERP) Note 1	95.8 dBµV/m (=0.6 dBm ERP) Note 1	97.5 dBµV/m (=2.3 dBm ERP) Note 1
T_{nom} 22°C	V_{max} 16.0 V DC Note 2	96.7 dBµV/m (=1.5 dBm ERP) Note 1	95.8 dBµV/m (=0.6 dBm ERP) Note 1	97.5 dBµV/m (=2.3 dBm ERP) Note 1
		Max peak **conducted** output power Peak		
		2405 MHz	2440 MHz	2480 MHz
T_{nom} 22°C	V_{nom} 10 V DC	4.0 dBm	3.9 dBm	3.9 dBm

Note 1: The measurements were performed in field strength in dBµV/m. The ERP level was the calculated by the formula ERP = E(dBµV/m)-90+20log(d)-10log30

Note 2: According 47CFR 15.31(e), for intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage.

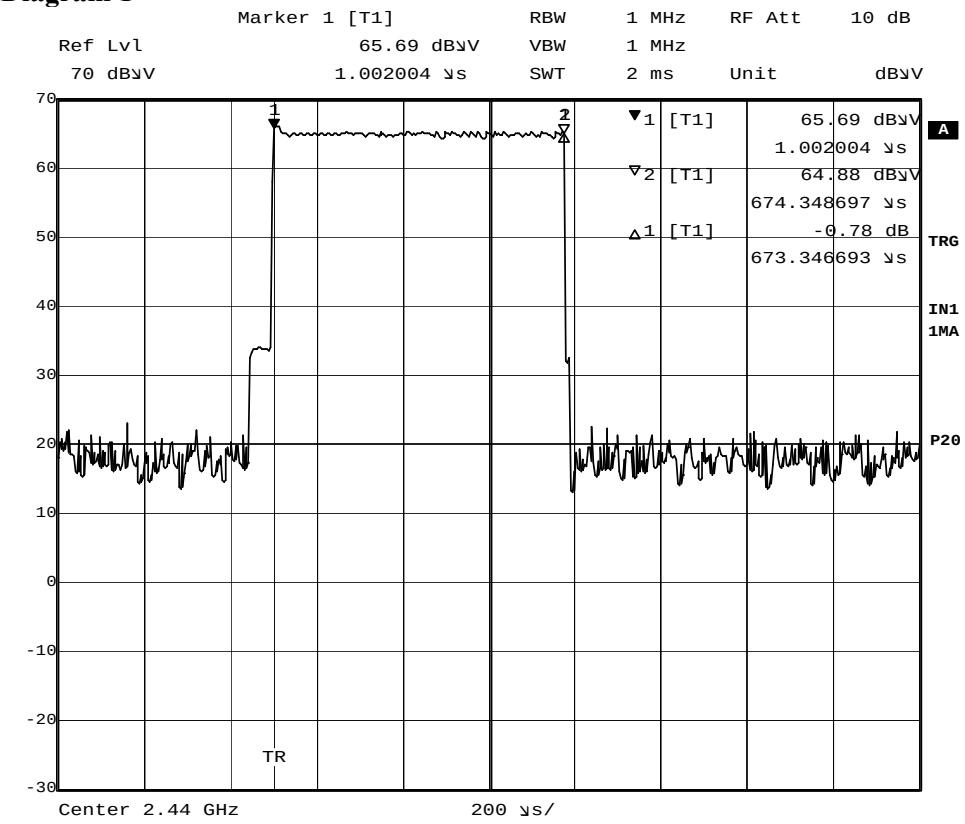
Limits

According to 47CFR 15.247(b)(3), for systems using digital modulation in the 2400-2483.5 MHz band: 1 Watt (30 dBm).

According to RSS-210 A8.4(4), for systems employing digital modulation techniques in the 2400-2483.5 MHz, the maximum peak conducted output power shall not 1 Watt (30 dBm).

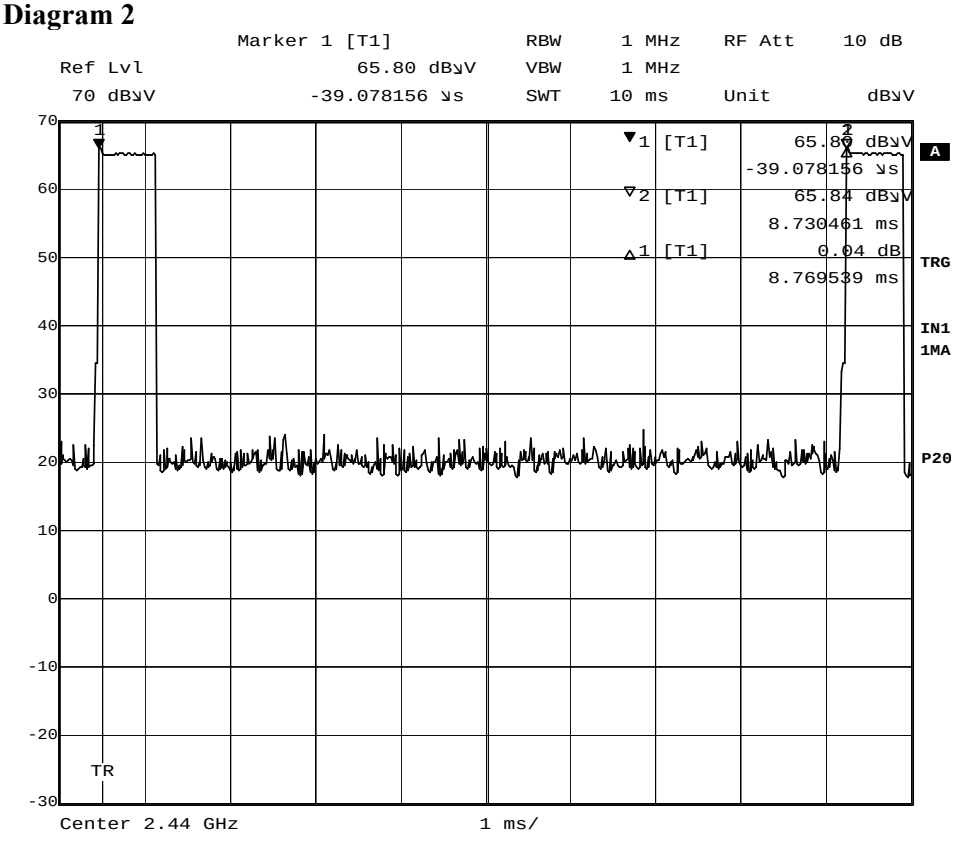
Complies?	Yes

Diagram 1



Date: 18.JAN.2012 12:16:39

Diagram 2



Date: 18.JAN.2012 12:17:55

20 dBc below fundamental and Restricted bands of operation measurements according to FCC 47 CFR part 15.247 (d) / RSS-210 A8.5

Date	Temperature	Humidity
2012-01-18	22 °C ± 3 °C	25 % ± 5 %
2012-01-19	22 °C ± 3 °C	26 % ± 5 %
2012-01-23	22 °C ± 3 °C	20 % ± 5 %

Test set-up and procedure

The measurements were performed according to ANSI C63.10-2009.

The test was performed with continuous transmission (100% duty cycle) and with normal modulation.

The test of radiated emission was performed in a semi anechoic chamber. The measurements were performed with both horizontal and vertical polarizations of the antenna. The antenna distance during the measurements was 3.0 m in the frequency range
30 MHz-18 GHz and 1.0 m in the frequency range 18-25 GHz.

The measurement procedure is as follows:

1. A pre-measurement is performed with peak detector. The test object is measured in eight directions with the antenna at three heights, 1.0 m, 1.5 m and 2.0 m.
2. If the emission is close or above the limit during the pre-measurement, the test object is scanned 360 degrees and the antenna height scanned from 1 to 4 m for maximum response. Then the emission is measured with the quasi-peak detector on frequencies below 1 GHz and with the average detector above 1 GHz.

The following RBW were used:
30 MHz-1 GHz: RBW=100 kHz
1-25 GHz: RBW=1 MHz
RBW=100 kHz were also used above 1 GHz at frequencies outside restricted bands.

Test set-up photos during the tests can be found in Appendix 11.

Measurement equipment	SP number
Semi anechoic chamber, Edison	504 114
Spectrum analyzer R&S ESI 26	503 885
EMI measurement computer	-
Software: R&S EMC32, ver. 8.52.0	503 745
Antenna Schaffner Bilog CBL6143	504 079
Horn antenna EMCO 3115	501 548
Low Noise Amplifier Miteq	504 160
Low Noise Amplifier Miteq	503 277
Standard gain horn Flann 16240-25	503 939
Standard gain horn Flann 18240-25	503 900
Standard gain horn Flann 20240-20	503 674
High pass filter Wainwright WHKY	503 939
Multimeter Fluke 83	501 522
Temperature and humidity meter Testo 625	504 117

Results

The pre-measurement emission spectra can be found in the diagrams below:

Diagram 1:	30-1000 MHz, Channel 18 (2440 MHz), vertical and horizontal polarization, X-axes
Diagram 2:	1-3 GHz, Channel 18 (2440 MHz), vertical and horizontal polarization, X-axes
Diagram 3:	3-8.2 GHz, Channel 18 (2440 MHz), vertical and horizontal polarization, X-axes
Diagram 4:	8.2-12 GHz, Channel 18 (2440 MHz), vertical and horizontal polarization, X-axes
Diagram 5:	12-18 GHz, Channel 18 (2440 MHz), vertical and horizontal polarization, X-axes
Diagram 6:	18-25 GHz, Channel 18 (2440 MHz), vertical polarization, X-axes
Diagram 7:	18-25 GHz, Channel 18 (2440 MHz), horizontal polarization, X-axes

Note: Worst-case plots are attached.

The highest detected levels during the final measurement in the frequency range 30 MHz-25 GHz are listed in the tables below.

2405 MHz

Frequency (MHz)	QP level (dBµV/m)	CISPRAV level (dBµV/m)	Peak level (dBµV/m)	Corr (dB)	Limit (dBµV/m)	Height (m)	Azimuth (deg)	Polarization
2333.457	N/A	**48.8**	**55.7**	31.4	53.9 (AV)	105	255	Vertical
2357.465	N/A	**51.1**	**58.3**	31.7	53.9 (AV)	100	254	Vertical
2381.473	N/A	**43.3 **)**	**63.7**	31.8	53.9 (AV)	100	258	Vertical
2404.262	N/A	N/A	**93.1 *)**	32.0	Carrier	100	251	Vertical
2500.311	N/A	50.5	**52.9**	32.0	73.1 (Pk)	100	232	Vertical
7213.413	N/A	39.1	**51.3**	-2.9	73.1 (Pk)	159	272	Vertical
9617.996	N/A	-	**41.3**	-15.4	73.1 (Pk)	100	23	Horizontal

*) With RBW 100 kHz the peak level was 93.1 dBµV/m.

**) The average level (with normal duty cycle 7.7%) was determined by calculation from the measured peak level (with 100% duty cycle) and the duty cycle correction factor, average level = measured peak level-duty cycle correction factor (22.3 dB).

2440 MHz

Frequency (MHz)	QP level (dBµV/m)	CISPRAV level (dBµV/m)	Peak level (dBµV/m)	Corr (dB)	Limit (dBµV/m)	Height (m)	Azimuth (deg)	Polarization
30.032	18.4	N/A	**28.2**	21.5	73.3 (Pk)	149	34	Vertical
48.887	13.4	N/A	**29.6**	14.5	73.3 (Pk)	368	326	Vertical
2368.547	N/A	**47.3**	**57.4**	31.7	53.9 (AV)	105	254	Vertical
2392.595	N/A	50.2	**59.5**	31.9	73.3 (Pk)	150	230	Vertical
2439.974	N/A	N/A	**93.3 *)**	32.0	Carrier	100	183	Vertical
2487.445	N/A	**39.5 **)**	**61.2**	32.1	53.9 (AV)	100	230	Vertical
2512.575	N/A	48.1	**56.0**	31.9	73.3 (Pk)	100	230	Vertical
7321.492	N/A	**42.8**	**52.3**	-2.5	53.9 (Av)	171	267	Vertical
9761.930	N/A	26.7	**39.0**	-15.2	73.3 (Pk)	100	22	Horizontal

*) With RBW 100 kHz the peak level was 93.3 dBµV/m.

**) The average level (with normal duty cycle 7.7%) was determined by calculation from the measured peak level (with 100% duty cycle) and the duty cycle correction factor, average level = measured peak level-duty cycle correction factor (22.3 dB).

2480 MHz

Frequency (MHz)	QP level (dBµV/m)	CISPRAV level (dBµV/m)	Peak level (dBµV/m)	Corr (dB)	Limit (dBµV/m)	Height (m)	Azimuth (deg)	Polarization
2479.647	N/A	N/A	**92.6 *)**	32.0	Carrier	100	221	Vertical
2503.457	N/A	59.3	**59.5**	32.0	72.6 (Pk)	100	229	Vertical
2527.425	N/A	53.8	**54.1**	31.9	72.6 (Pk)	100	228	Vertical
2551.473	N/A	49.6	**51.6**	31.7	72.6 (Pk)	100	228	Vertical
7441.459	N/A	**39.9**	**52.2**	-2.4	53.9 (AV)	156	270	Vertical
9922.004	N/A	-	**36.0**	-14.8	72.6 (Pk)	100	25	Horizontal

*) With RBW 100 kHz the peak level was 92.6 dBµV/m.

Limits

According to 47CFR 15.247(d), in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.
Radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section15.209(a).

According to RSS-210 A8.5, in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean square averaging over a time interval, as permitted under Section A8.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

Complies?	Yes

Diagram 1

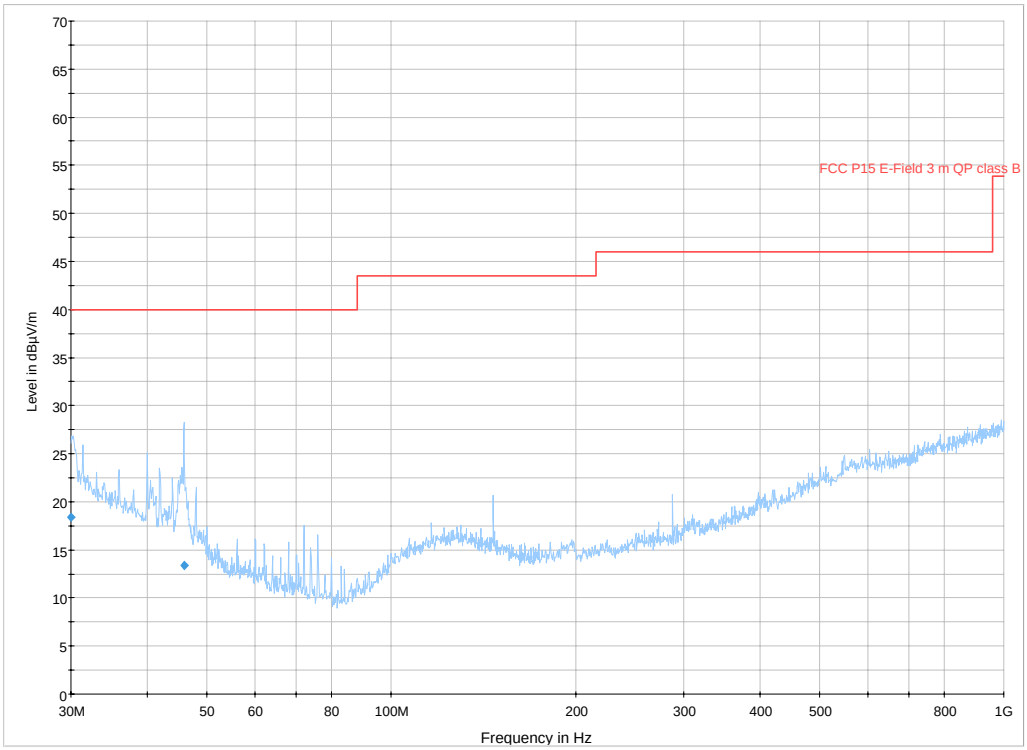


Diagram 2

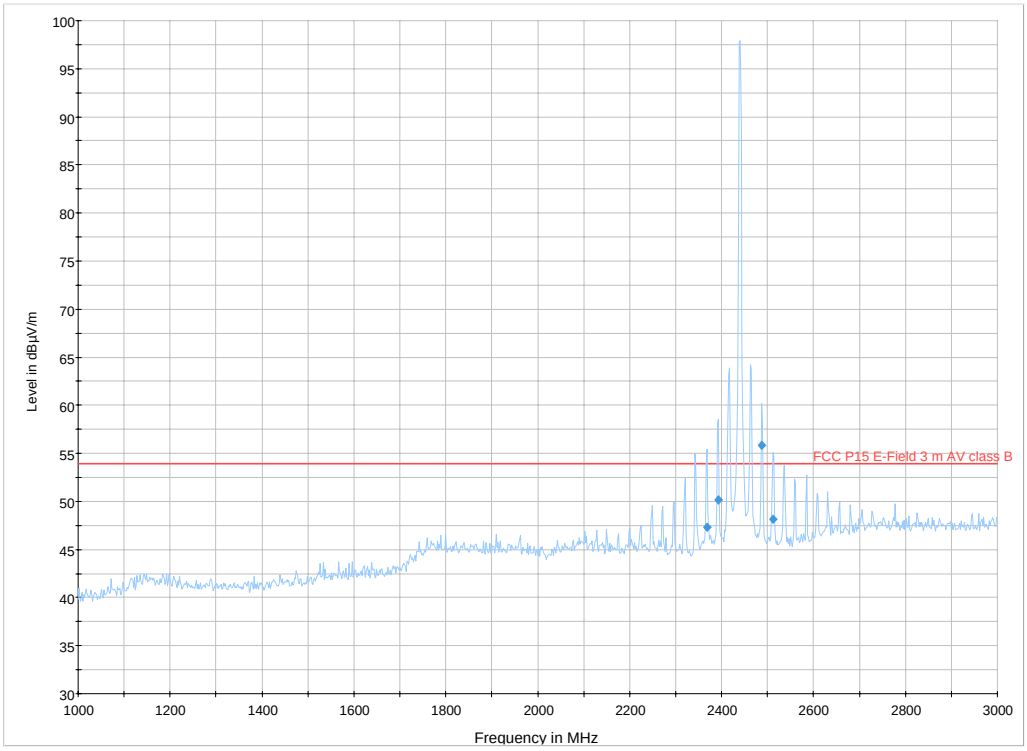


Diagram 3

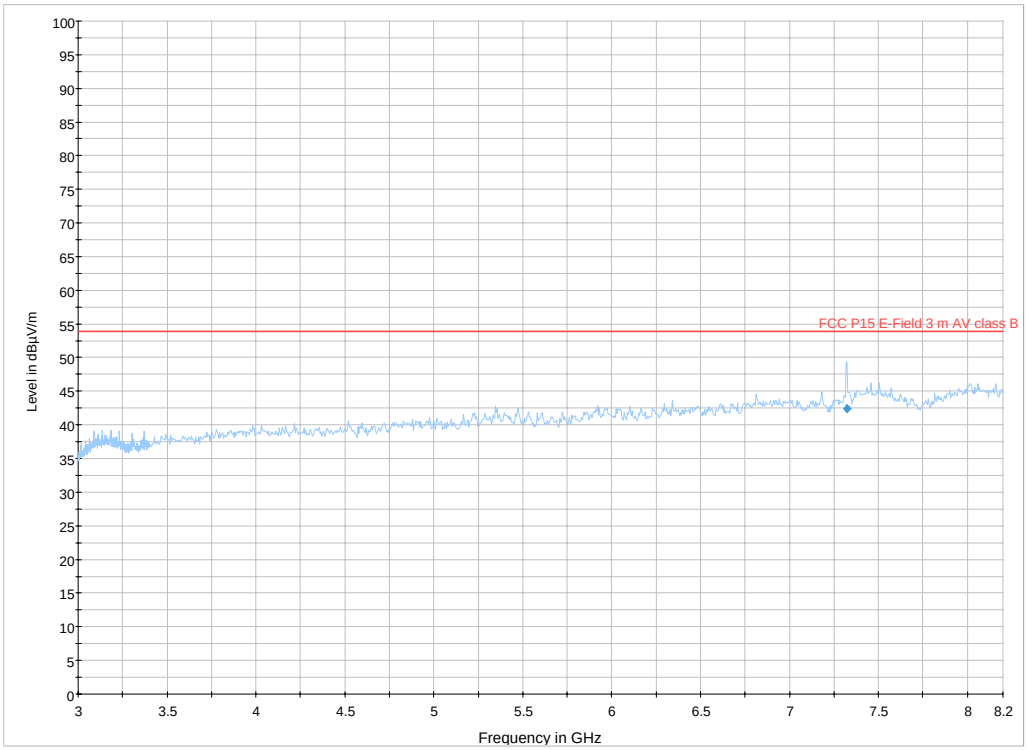


Diagram 4

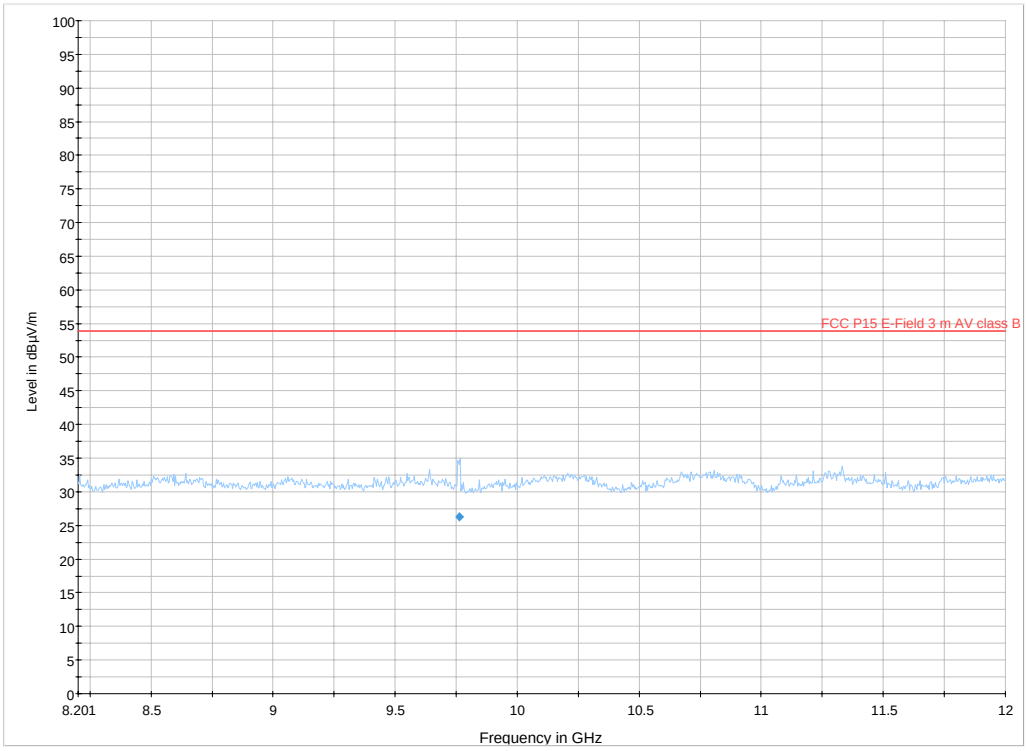


Diagram 5

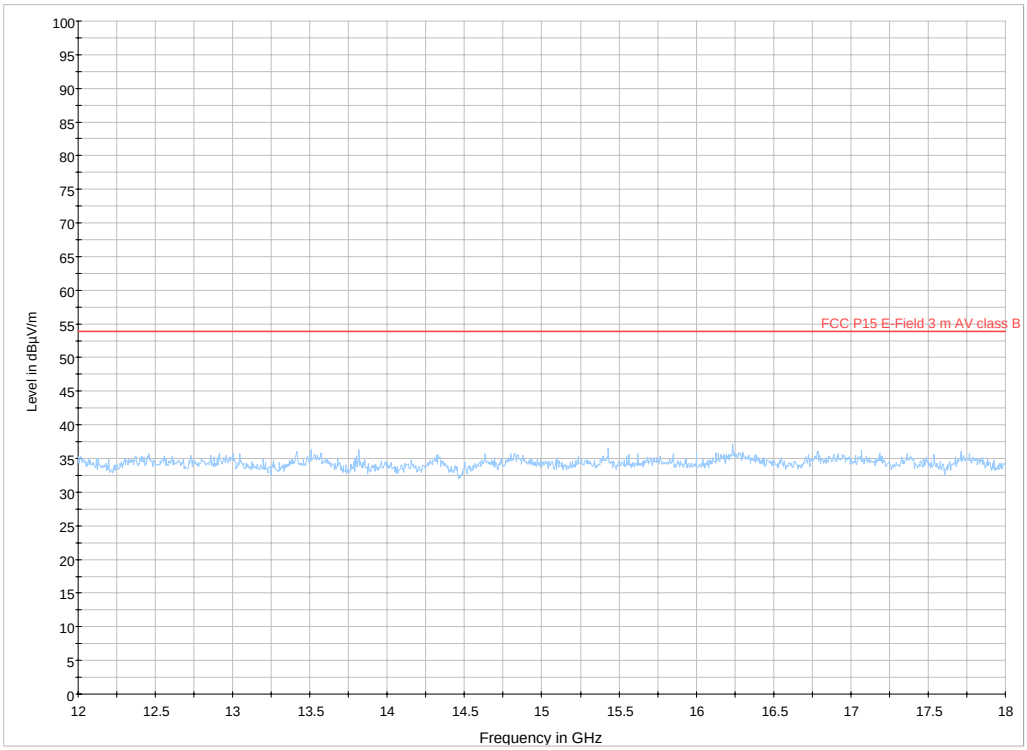


Diagram 6

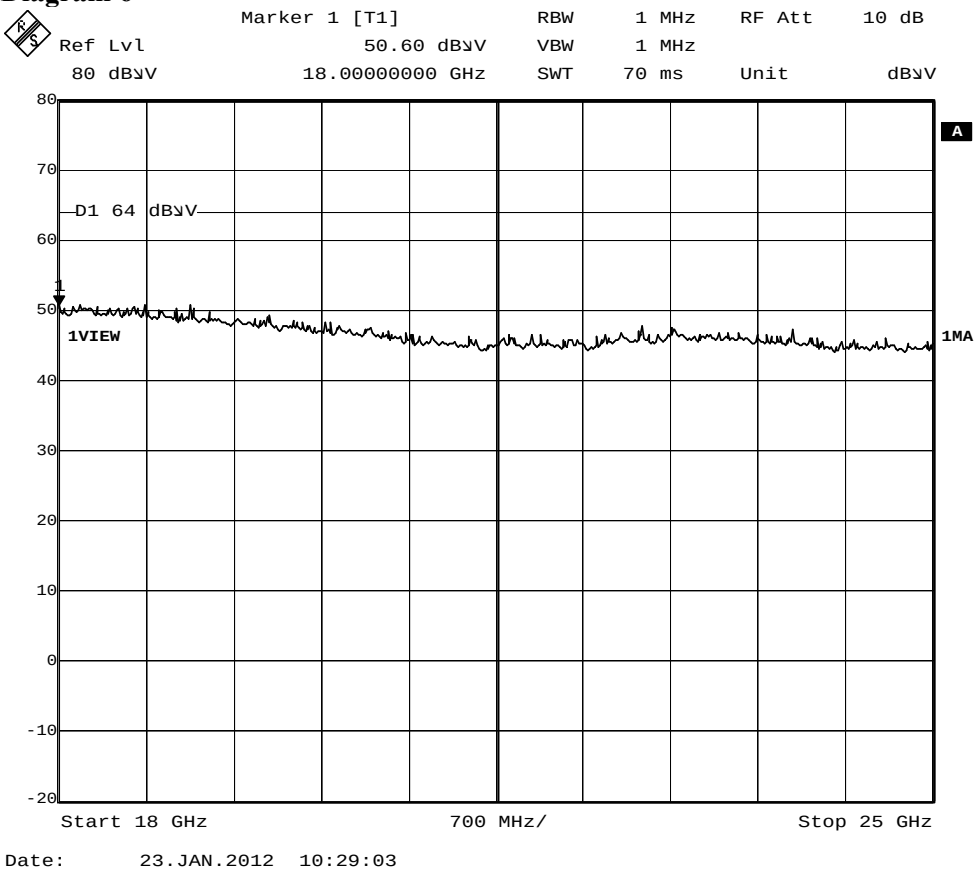
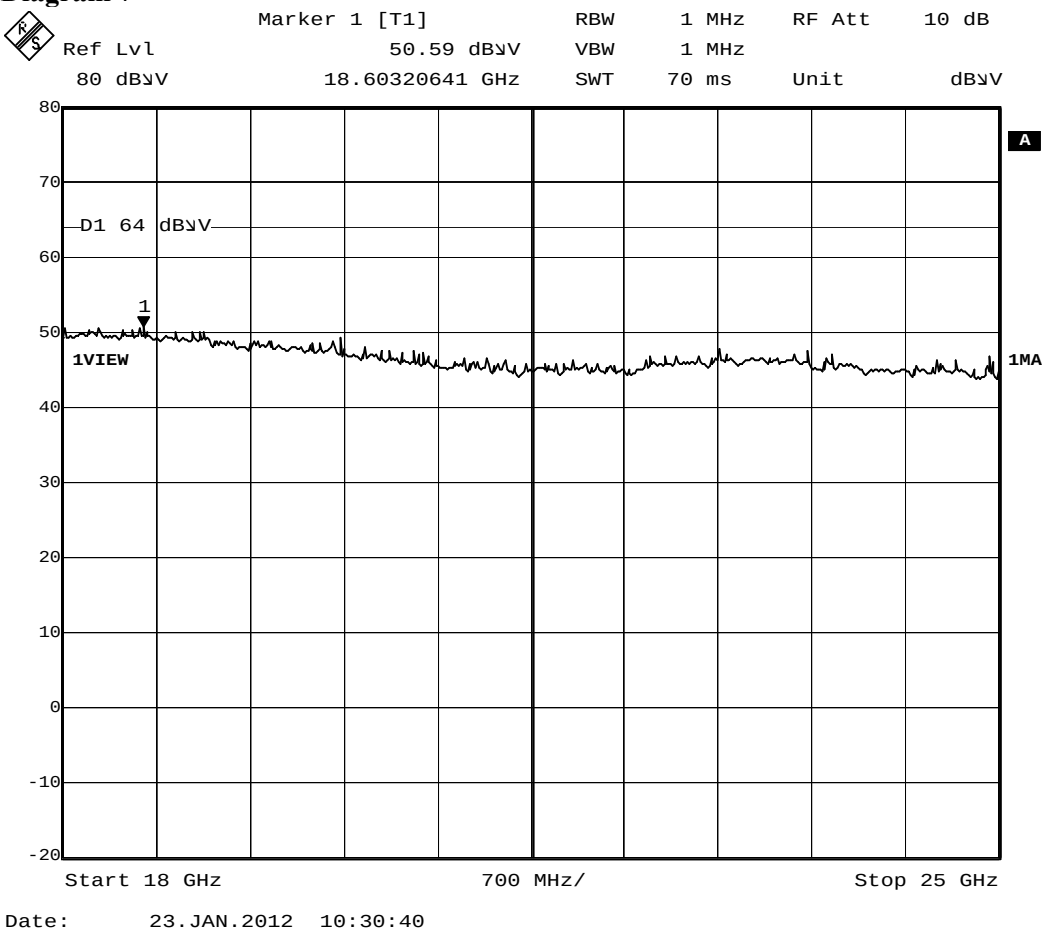


Diagram 7


Marker 1 [T1]
RBW 1 MHz
RF Att 10 dB
Ref Lvl
50.59 dBµV
VBW 1 MHz
80 dBµV
18.60320641 GHz
SWT 70 ms
Unit dBµV
80
70
60
50
40
30
20
10
0
-10
-20
A
D1 64 dBµV
1
1VIEW
1MA
Start 18 GHz
700 MHz/
Stop 25 GHz
Date: 23.JAN.2012 10:30:40

Power spectral density according to FCC 47 CFR part 15.247 (e) / RSS-210 A8.2 (b)

Date	Temperature	Humidity
2012-01-18	22 °C ± 3 °C	25 % ± 5 %

Test set-up and procedure

The measurements were performed according to ANSI C63.4-2009 and the guideline Measurement of Digital Transmission Systems Operating under Section 15.247, March 23, 2005.

The test was performed with continuous transmission (100% duty cycle) and with normal modulation.

The radiated measurements were performed in a semi anechoic chamber. The measurements were performed with the EUT-axes, antenna at the position and polarization and the turntable with the highest level of the fundamental. The antenna distance was 3.0 m.

Measurement equipment	SP number
Semi anechoic chamber, Edison	504 114
Spectrum analyzer R&S ESI 26	503 885
EMI measurement computer	-
Software: R&S EMC32, ver. 8.52.0	503 745
Horn antenna EMCO 3115	501 548
Multimeter Fluke 83	501 522
Temperature and humidity meter Testo 625	504 117

Results

The measurements can be found in the diagrams below:

Diagram 1	2405 MHz	Power spectral density (= 87.7 dBuV/m)= -7.5 dBm
Diagram 2	2440 MHz	Power spectral density (= 87.3 dBuV/m)= -7.9 dBm
Diagram 3	2480 MHz	Power spectral density (= 86.3 dBuV/m)= -8.9 dBm

Note : The measurements were performed in field strength in dBµV/m. The ERP level was the calculated by the formula ERP = E(dBµV/m)-90+20log(d)-10log30

Limits

According to 47CFR 15.247(e), for digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

According to RSS-210 A8.2(b), the transmitter power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of Section A8.4 (4),
(i.e. the power spectral density shall be determined using the same method as is used to determine the conducted output power).

Complies?	Yes

Diagram 1

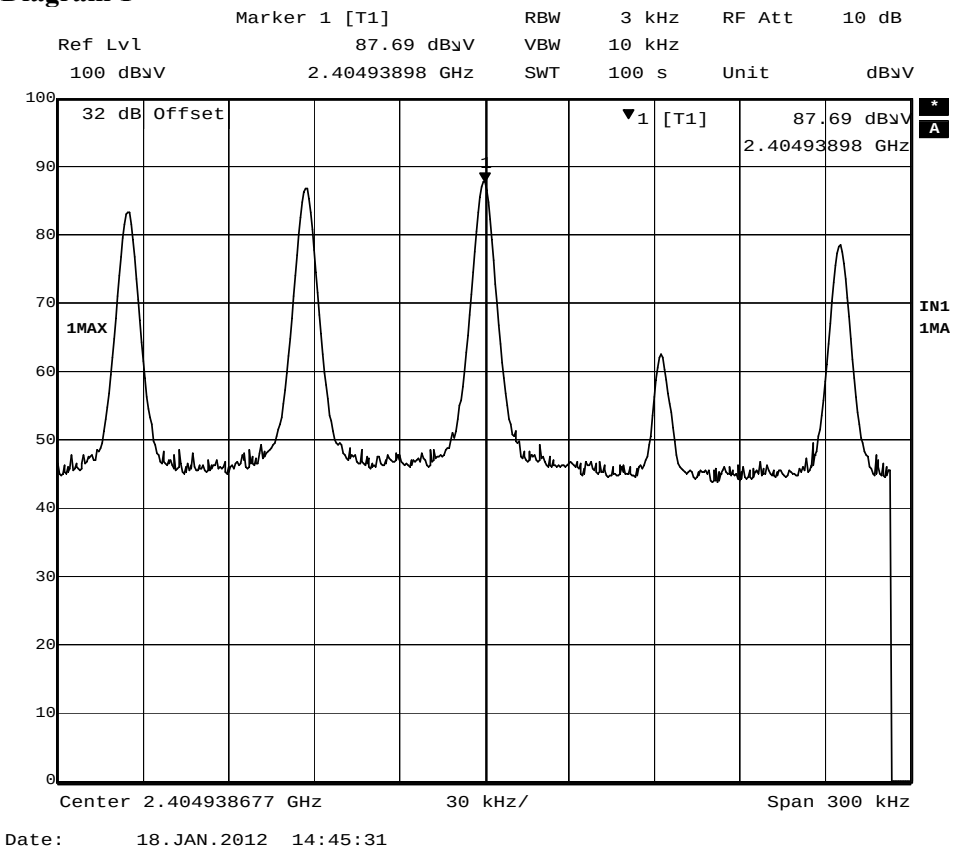


Diagram 2

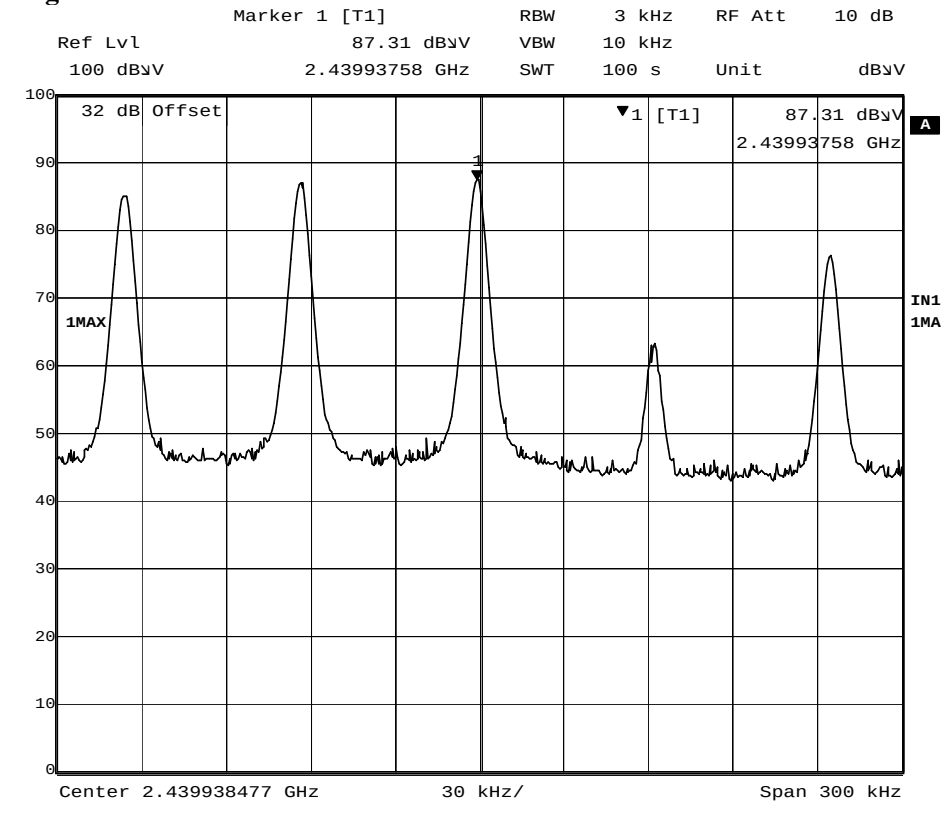
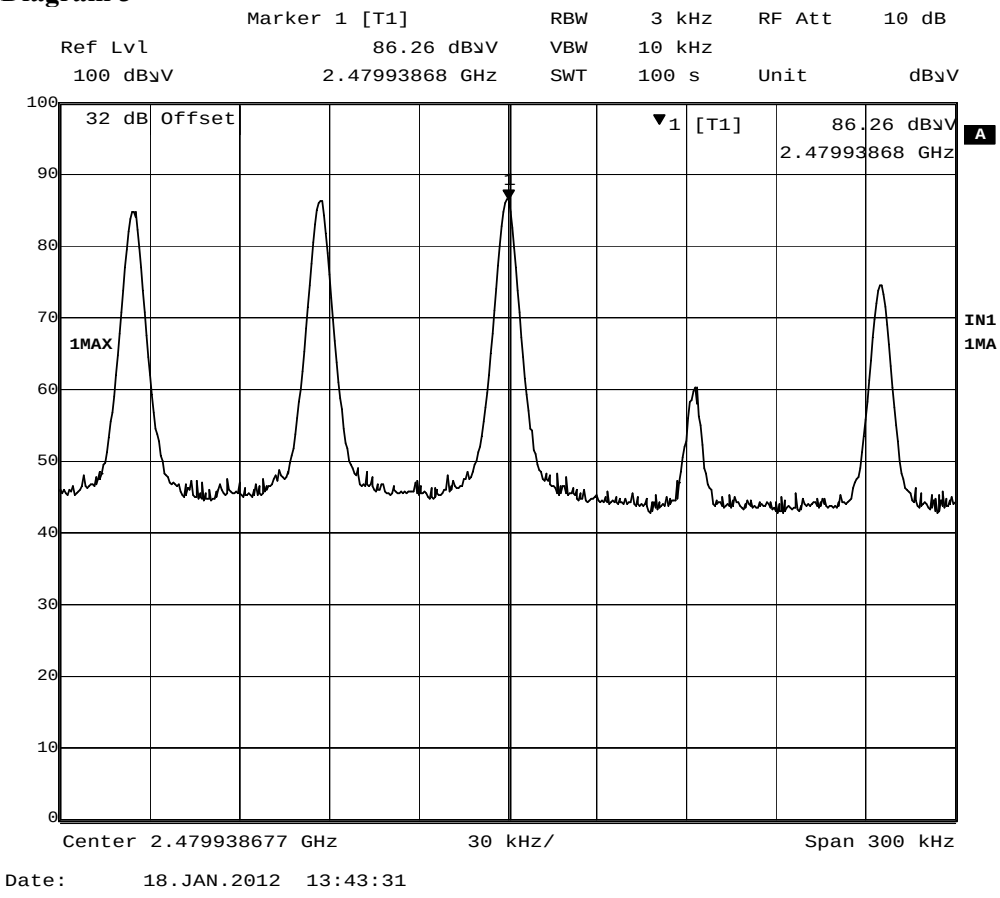


Diagram 3


Marker 1 [T1]
RBW 3 kHz
RF Att 10 dB
Ref Lvl 86.26 dBµV
VBW 10 kHz
100 dBµV 2.47993868 GHz
SWT 100 s
Unit dBµV
32 dB Offset
1 [T1] 86.26 dBµV
2.47993868 GHz
A
1MAX
IN1
1MA
100
90
80
70
60
50
40
30
20
10
0
Center 2.479938677 GHz
30 kHz/
Span 300 kHz
Date: 18.JAN.2012 13:43:31

RF exposure evaluation: Mobile equipment FCC 47 CFR part 15.247 (i) / RSS-102 2.5.1

Date	Temperature	Humidity
2012-01-18	22 °C ± 3 °C	25 % ± 5 %

Procedure

Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess limit for maximum permissible exposure. In accordance with 47 CFR FCC Part 2 Subpart J, section 2.1091 this device has been defined as a mobile device whereby a distance of 0.2 m normally can be maintained between the user and the device.

Results

The following formula was used to calculate the RF exposure,
$Pd = Pout \times G/(4 \times \pi \times r^2_{cm})$

where,
Pd = power density in mW/cm^2
Pout = output power to antenna in mW
G = gain of antenna in linear scale
$\pi = 3.1416$
r = distance between observation and center of the radiator in cm

From the peak EUT RF output power, the minimum mobile separation distance, r=20 cm, as well as the gain of the used antenna, the RF power density can be obtained.

The maximum radiated peak output power from appendix 2 was used for calculation of MPE.

Antenna Gain (dBi)	Antenna Gain (numeric)	ERP Peak output power (dBm)	Peak output power (mW)	Power density, Pd [S] (mW/cm^2)	Limit of power density (mW/cm^2)
Note 1	Note 1	3.4	2.1878	**0.00043**	1.0

Note 1: The antenna gain is not used in the MPE calculation as the ERP value (including the antenna) is used.

Limits

(A) Limits for Occupational/Controlled Exposure

Frequency range (MHz)	Electric field strength [E] (V/m)	Magnetic filed strength [H] (A/m)	Power density [S] (mW/cm^2)	Averaging time $|E|^2$, $|H|^2$ or S (minutes)
0.3-3.0	614	1.63	(100)*	6
3.0-30	1842/f	4.89/f	(900/f)*	6
30-300	61.4	0.163	1.0	6
300-1500			F/300	6
1500-100,000			5	6

(B) Limits for General Population/Uncontrolled Exposure

Frequency range (MHz)	Electric field strength [E] (V/m)	Magnetic filed strength [H] (A/m)	Power density [S] (mW/cm^2)	Averaging time $|E|^2$, $|H|^2$ or S (minutes)
0.3-1.34	614	1.63	(100)*	30
1.34-30	824/f	2.19/f	(180/f)*	30
30-300	27.5	0.073	0.2	30
300-1500			F/1500	30
1500-100,000			**1.0**	**30**

Note: f=frequency in MHz, *Plane-wave equivalent power density

According to RSS-102 2.5.1, SAR evaluation is required if the separation distance between the user and the radiating element of the device is less than or equal to 20 cm, except when the device operates as follows:

- above 2.2 GHz and up to 3 GHz inclusively, and with output power (i.e. the higher of the conducted or radiated (e.i.r.p.) source-based, time-averaged output power) that is less than or equal to 20 mW for general public use and 100 mW for controlled use;

Complies?	Yes

20 dB bandwidth measurements according to FCC 47 CFR part 15.215 (c)

Date	Temperature	Humidity
2012-02-23	24 °C ± 3 °C	20 % ± 5 %

Test set-up and procedure

The measurements were performed according to ANSI C63.10-2009.

The test was performed with continuous transmission (100% duty cycle) and with normal modulation.

The test was performed conducted at the antenna connector.
The test equipment was connected to an external 10 MHz reference standard during measurements.

Measurement equipment	SP number
Test site Marconi	15:120
R&S FSIQ40 Signal Analyser	503 738
Multimeter Fluke 83	501 522
Temperature and humidity meter Testo 625	504 117

Measurement uncertainty: 2.6 %

Results

The measurements can be found in the diagrams below:

Diagram 1: 2405 MHz 20 dB BW = **2.48 MHz**
Diagram 2: 2440 MHz 20 dB BW = **2.63 MHz**
Diagram 3: 2480 MHz 20 dB BW = **2.69 MHz**

Limits

According to 47CFR 15.215(c), intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§ 15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

Complies?	Yes

Diagram 1

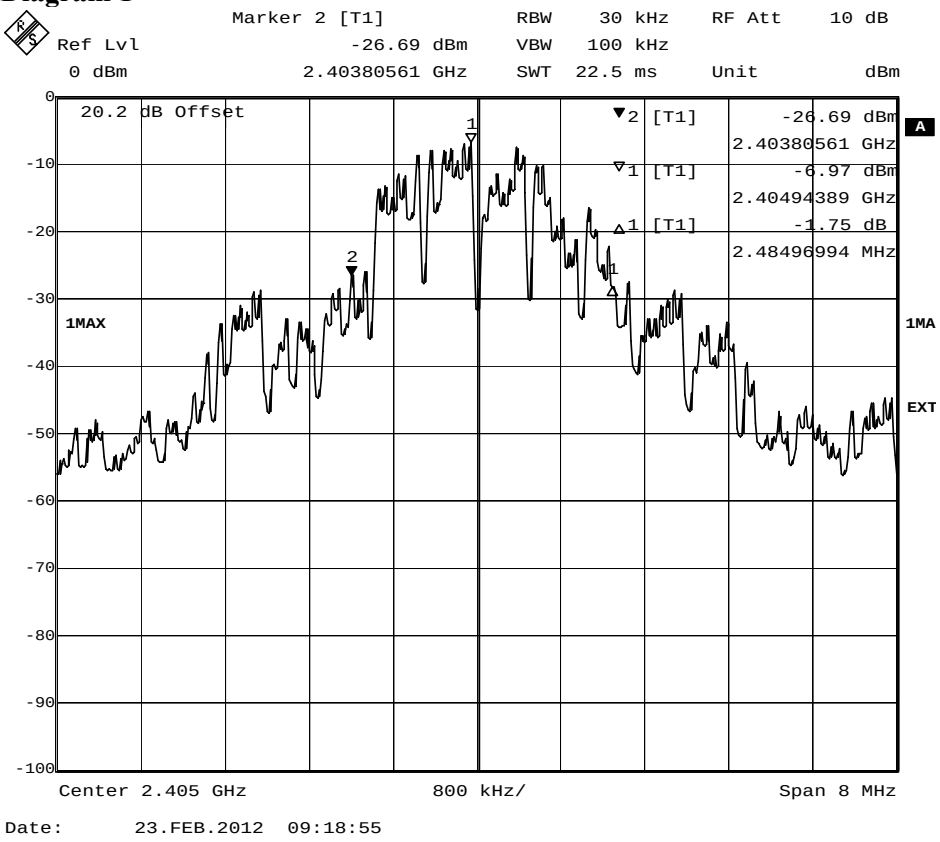


Diagram 2

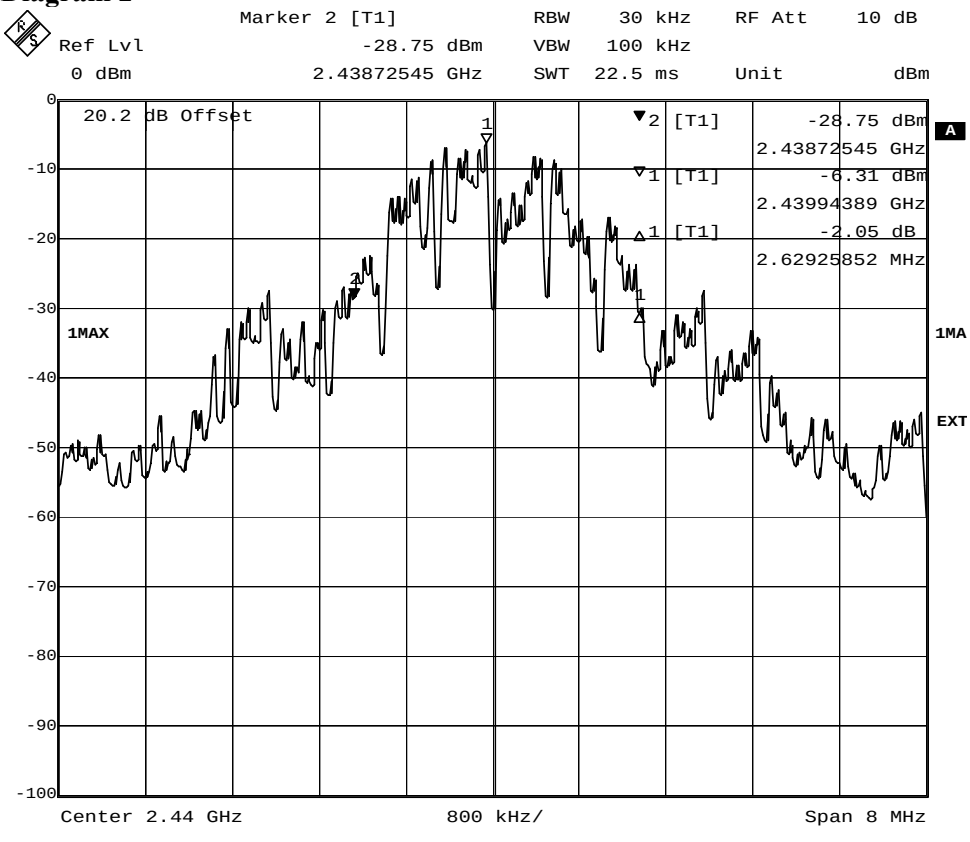
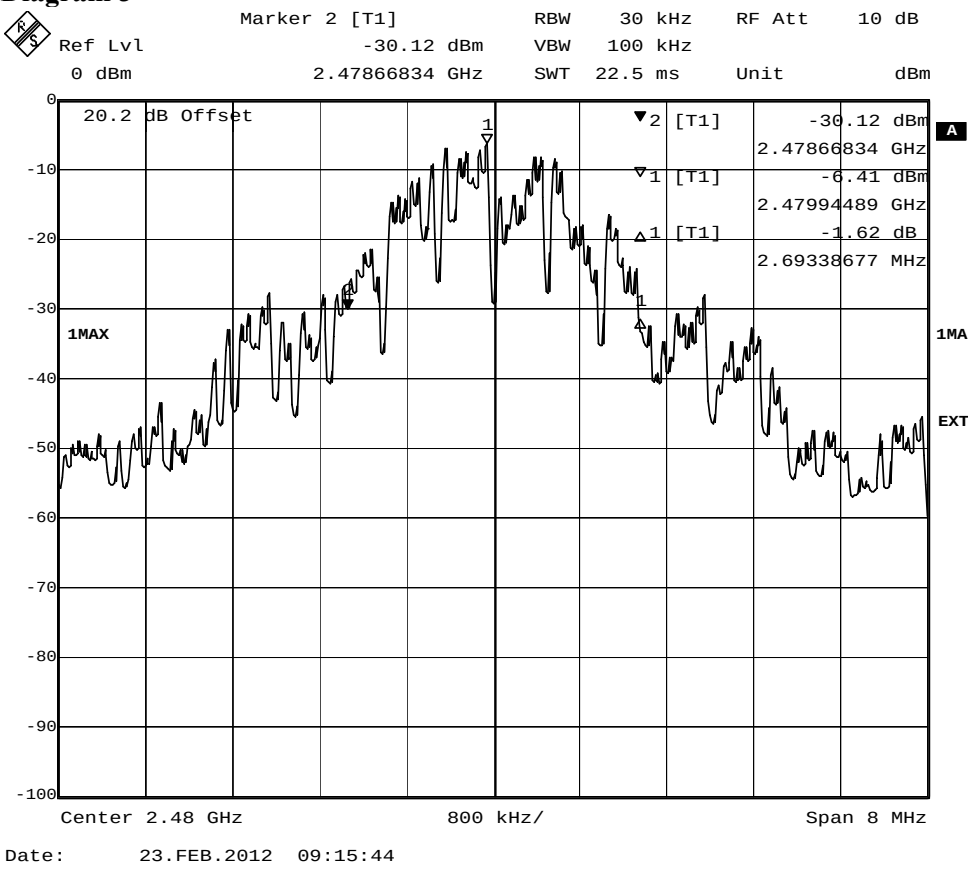


Diagram 3


Marker 2 [T1]
Ref Lvl
0 dBm
-30.12 dBm
2.47866834 GHz
RBW 30 kHz
VBW 100 kHz
SWT 22.5 ms
RF Att 10 dB
Unit dBm
20.2 dB Offset
2 [T1] -30.12 dBm
2.47866834 GHz
1 [T1] -6.41 dBm
2.47994489 GHz
1 [T1] -1.62 dB
2.69338677 MHz
1MAX
1MA
EXT
A
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
Center 2.48 GHz
800 kHz/
Span 8 MHz
Date: 23.FEB.2012 09:15:44

Conducted emission measurements according to FCC 47 CFR part 15.207, class B / RSS-Gen 7.2.4

Date	Temperature	Humidity
2012-01-23	22 °C ± 3 °C	20 % ± 5 %

Test set-up and procedure

The measurements were performed according to ANSI C63.10-2009.

The test was performed with continuous transmission (100% duty cycle) and with normal modulation.

Measurements were performed on the 120 V AC/60 Hz, phase and neutral terminals, at the AC-side of the external DC power supply, Agilent E3631A SP503997.

Test set-up photos during the tests can be found in Appendix 11.

Measurement equipment	SP number
Semi anechoic chamber, Edison	504 114
Spectrum analyzer R&S ESI 26	503 885
EMI measurement computer	-
Software: R&S EMC32, ver. 8.52.0	503 745
LISN Schwartzbeck NNLA20	504 129
Multimeter Fluke 83	501 522
Temperature and humidity meter Testo 625	504 117

Result

The conducted emission spectra can be found in the diagrams below:

Diagram 1:	Ambient, 120 V AC, phase terminal, DC output power off
Diagram 2:	Ambient, 120 V AC, phase terminal, AC output power off
Diagram 3:	120 V AC, phase terminal, 2440 MHz
Diagram 4:	120 V AC, neutral terminal, 2440 MHz

The limit lines indicated as Voltage on Mains in the diagrams are the same limit lines as of FCC part 15.

Limits

According to 47CFR 15.207 and according to RSS-Gen 7.2.4,

Frequency (MHz)	**Quasi-peak value (dBµV)**	**Average value (dBµV/m)**
0.15-0.5	66-56*	56-46*
0.5-5	56	46
5-30	60	50

*=Decreases with the logarithm of the frequency

Complies?	Yes

Diagram 1

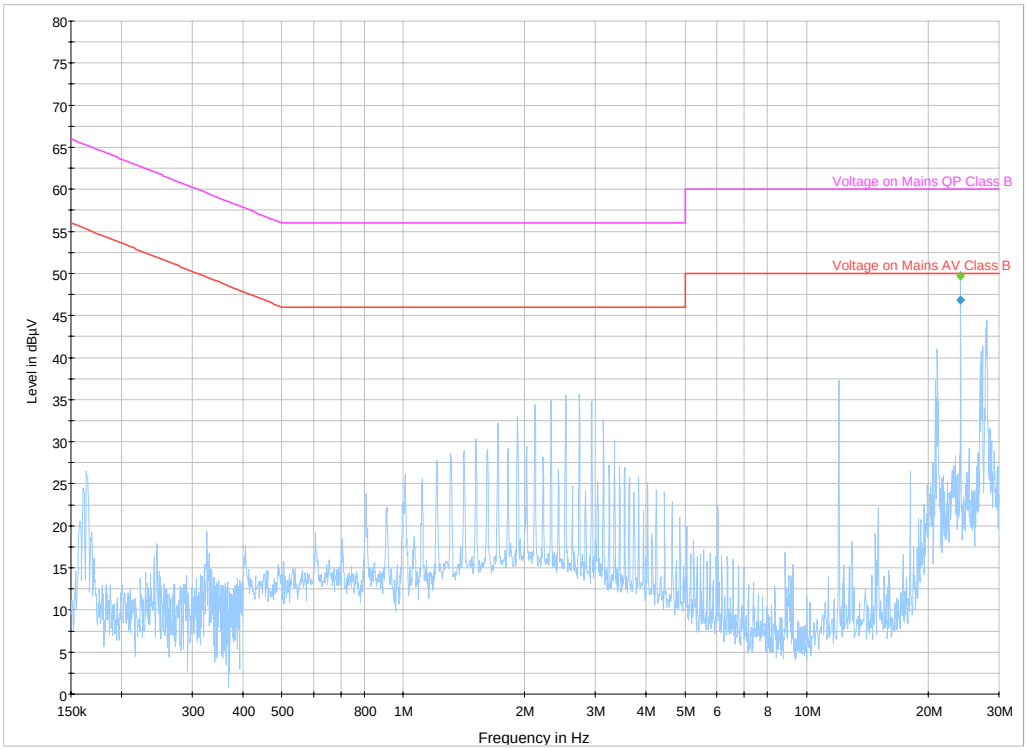


Diagram 2

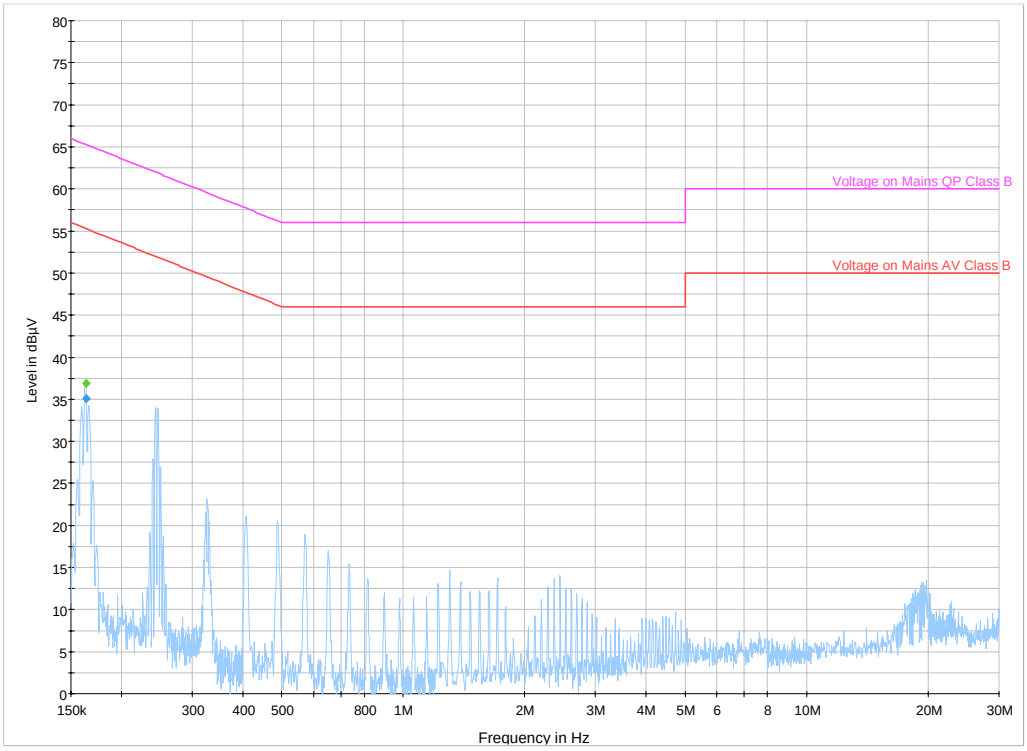
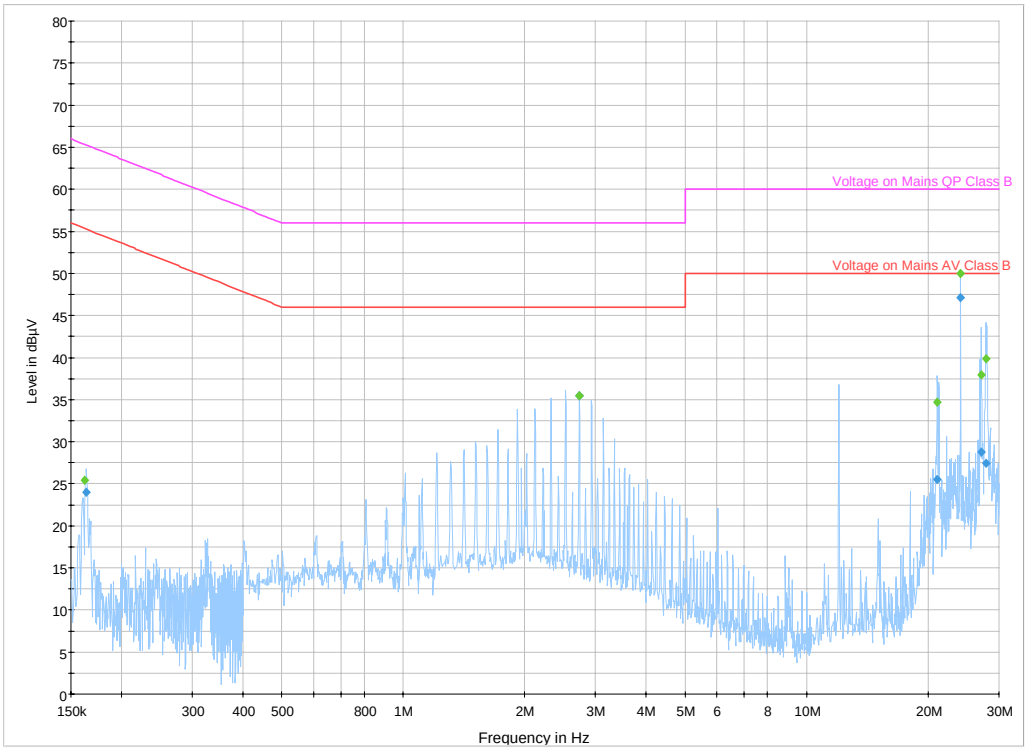


Diagram 3



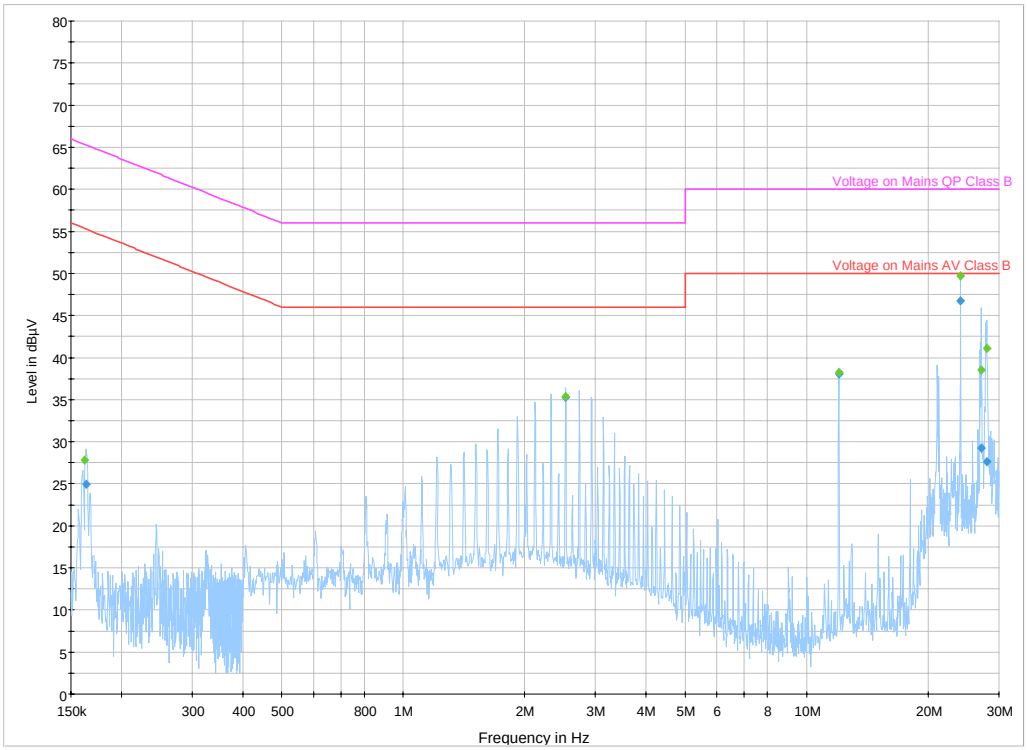
Final measurement: CISPR-Average detector

Frequency (MHz)	CAverage (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.164000	24.0	5000.0	9.000	0.1	31.3	55.3
2.731269	35.4	5000.0	9.000	0.2	10.6	46.0
21.084756	25.5	5000.0	9.000	1.1	24.5	50.0
24.096635	47.1	5000.0	9.000	1.3	2.9	50.0
27.109036	28.7	5000.0	9.000	1.5	21.3	50.0
27.861657	27.4	5000.0	9.000	1.5	22.6	50.0

Final measurement: QP detector

Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.162000	25.4	5000.0	9.000	0.1	40.0	65.4
2.731269	35.5	5000.0	9.000	0.2	20.5	56.0
21.084756	34.7	5000.0	9.000	1.1	25.3	60.0
24.096635	50.0	5000.0	9.000	1.3	10.0	60.0
27.111036	37.9	5000.0	9.000	1.5	22.1	60.0
27.865657	39.8	5000.0	9.000	1.5	20.2	60.0

Diagram 4



Final measurement: CISPR-Average detector

Frequency (MHz)	CAverage (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.164000	25.0	5000.0	9.000	0.1	30.3	55.3
2.529265	35.2	5000.0	9.000	0.2	10.8	46.0
12.048074	38.0	5000.0	9.000	0.6	12.0	50.0
24.096635	46.8	5000.0	9.000	1.3	3.2	50.0
27.113036	29.3	5000.0	9.000	1.5	20.7	50.0
27.993052	27.7	5000.0	9.000	1.5	22.3	50.0

Final measurement: QP detector

Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.162000	27.8	5000.0	9.000	0.1	37.5	65.4
2.529265	35.4	5000.0	9.000	0.2	20.6	56.0
12.048074	38.2	5000.0	9.000	0.6	21.8	60.0
24.096635	49.7	5000.0	9.000	1.3	10.3	60.0
27.107036	38.5	5000.0	9.000	1.5	21.5	60.0
27.993052	41.1	5000.0	9.000	1.5	18.9	60.0

Occupied bandwidth measurements according to 47CFR 2.1049 / RSS-Gen 4.6.1

Date	Temperature	Humidity
2012-02-23	24 °C ± 3 °C	20 % ± 5 %

Test set-up and procedure

The measurements were performed according to ANSI C63.10-2009.

The test was performed with continuous transmission (100% duty cycle) and with normal modulation.

The test was performed conducted at the antenna connector.
The used test equipment was connected to an external 10 MHz reference standard during measurements.

Measurement equipment	SP number
Test site Marconi	15:120
R&S FSIQ40 Signal Analyser	503 738
Multimeter Fluke 83	501 522
Temperature and humidity meter Testo 625	504 117

Measurement uncertainty: 2.6 %

Results

The measurements can be found in the diagrams below:

Diagram 1 2405 MHz OBW = 2.52 MHz (99%)
Diagram 2 2440 MHz OBW = 2.55 MHz (99%)
Diagram 3 2480 MHz OBW = 2.61 MHz (99%)

Diagram 1

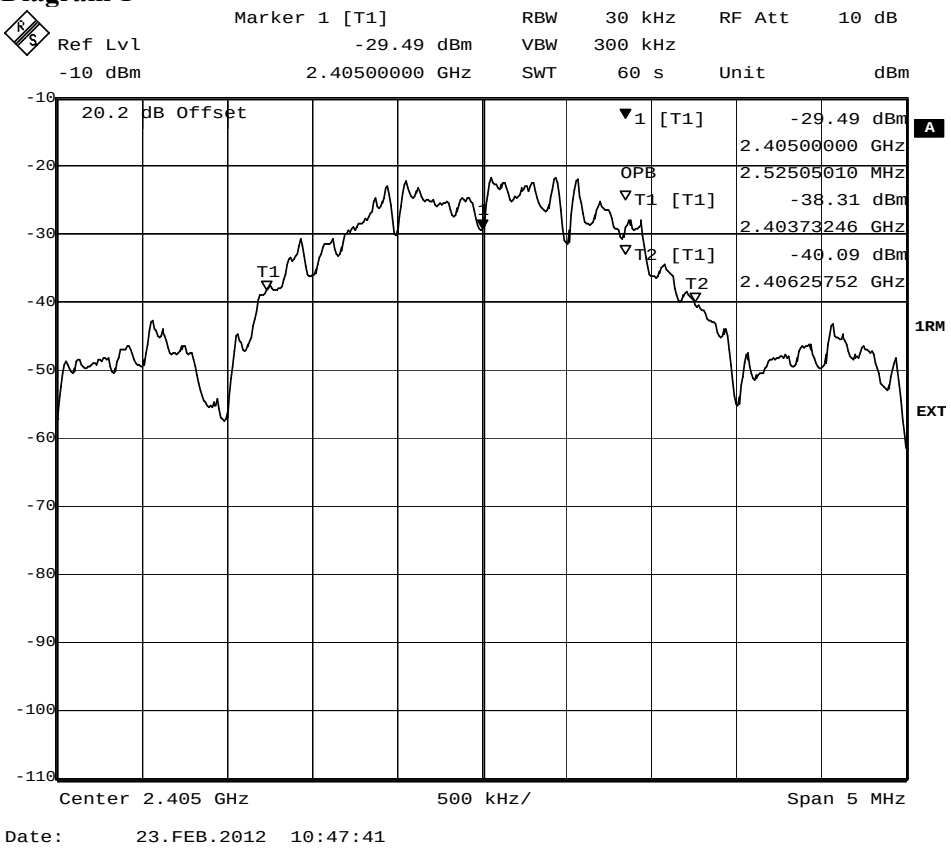


Diagram 2

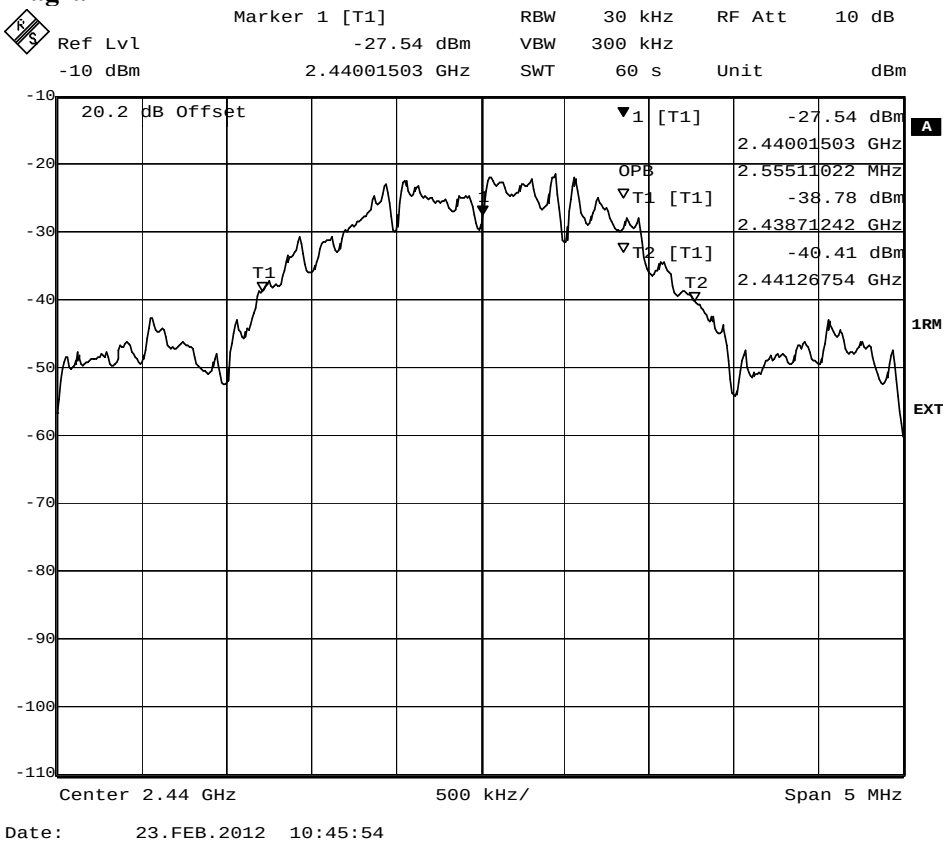
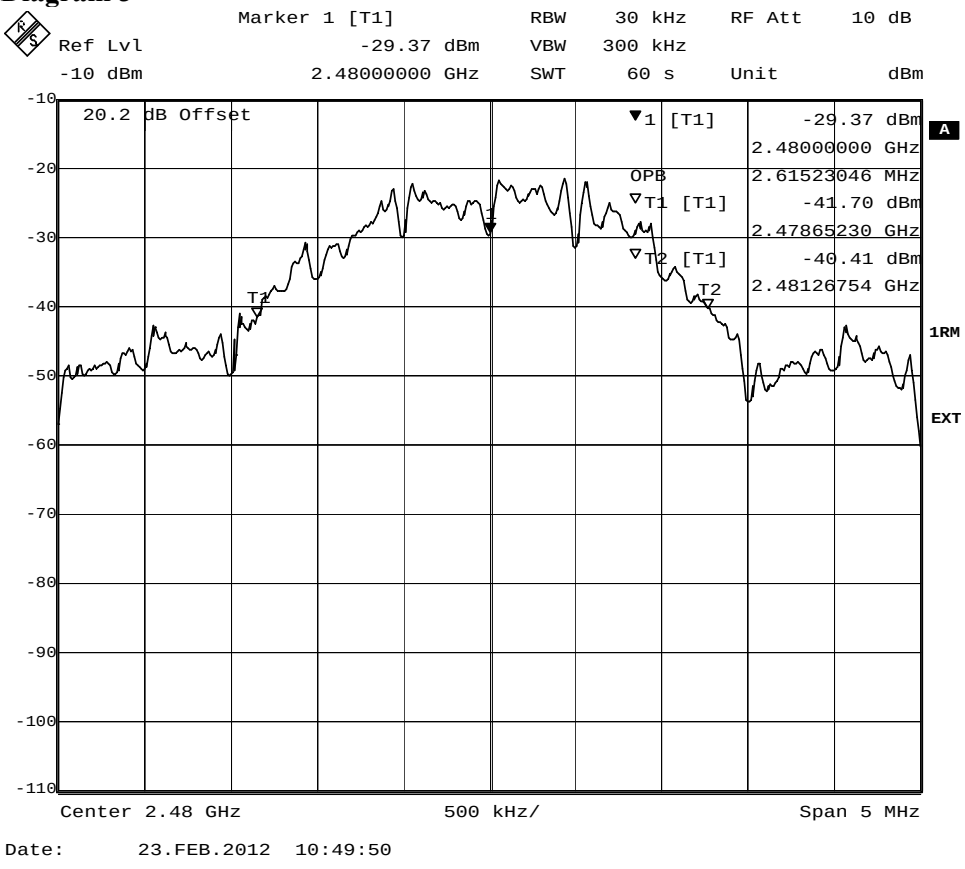


Diagram 3


Marker 1 [T1]
RBW 30 kHz
RF Att 10 dB
Ref Lvl
-29.37 dBm
VBW 300 kHz
-10 dBm
2.48000000 GHz
SWT 60 s
Unit dBm
20.2 dB Offset
1 [T1]
-29.37 dBm
2.48000000 GHz
OPB
2.61523046 MHz
T1 [T1]
-41.70 dBm
2.47865230 GHz
T2 [T1]
-40.41 dBm
2.48126754 GHz
T1
T2
A
1RM
EXT
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
Center 2.48 GHz
500 kHz/
Span 5 MHz
Date: 23.FEB.2012 10:49:50

Band edge measurements according to 47CFR 2.1049 / RSS-210 A8.5

Date	Temperature	Humidity
2012-02-18	22 °C ± 3 °C	25 % ± 5 %

Test set-up and procedure

The measurements were performed according to ANSI C63.10-2009.

The test was performed with continuous transmission (7.7% duty cycle) and with normal modulation.

The radiated maximum peak radiated output power measurements were performed in the semi-anechoic chamber.
The measurement was scanned with PEAK-detector with the antenna height 1-4 m and the turntable was varied between 0-360 degrees for maximum response, see Appendix 2. The antenna distance during the measurements was 3.0 m.

The radiated measurements were performed in a semi anechoic chamber. The measurements were performed with the EUT-axes, antenna at the position and polarization and the turntable with the highest level of the fundamental. The antenna distance was 3.0 m.

Test set-up photos during the tests can be found in Appendix 11.

Measurement equipment	SP number
Semi anechoic chamber, Edison	504 114
Spectrum analyzer R&S ESI 26	503 885
EMI measurement computer	-
Software: R&S EMC32, ver. 8.52.0	503 745
Horn antenna EMCO 3115	501 548
Multimeter Fluke 83	501 522
Temperature and humidity meter Testo 625	504 117

Results

Operation band 2400-2483.5 MHz

For duty cycle measurements see Appendix 2.
At normal use the EUT has a duty cycle of maximum 7.7 %, according to the client.
With the setting Range Test Transmitter the duty cycle was measured to 0.673/8.77 ms = 0.0767 = 7.7 %.
The duty cycle correction factor was calculated to 20 log (0.673/8.77 ms) = -22.3 dB.

		Band edge at 2400 MHz (20 dBc limit)
Diagram 1	2405 MHz	RBW=100 kHz dBc at 2400 MHz = **37.9 dBc**
		Band edge at 2483.5 MHz (=**32.2 dBµV/m** (Average)) (Restricted band)
	2480 MHz	Marker-delta method, step 1: Peak level at fundamental =97.9 dBµV/m
Diagram 2	2480 MHz	Marker-delta method. Step 2: Delta between fundamental and band edge = 43.3 dB. Step 3: Decrease the measured peak level in step 1: 97.9-43.3 = 54.6 dBµV/m =level at band edge. Average level at band edge due to the duty cycle: 54.6 dBµV/m-22.3 dB = **32.3 dBµV/m** (Average)

Limits

Band edge at 2400 MHz:
According to 47CFR 15.247(d), in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

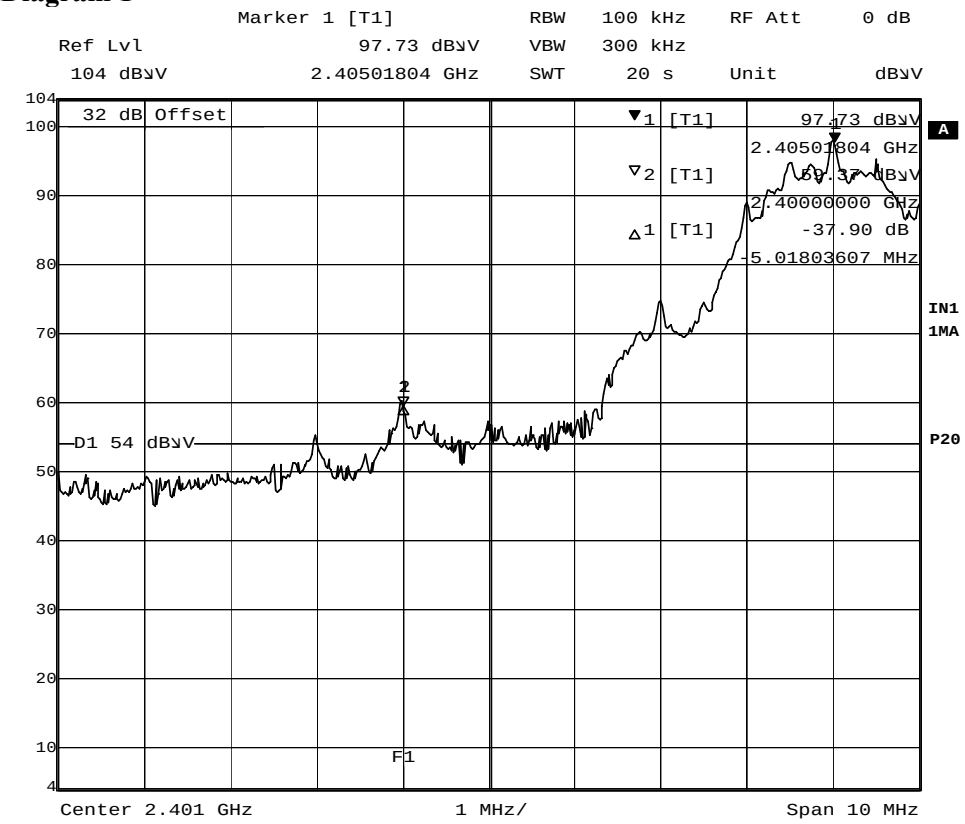
According to RSS-210 A8.5, in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean square averaging over a time interval, as permitted under Section A8.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

Band edge at 2483.5 MHz:
In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section15.209(a).

According to RSS-210 A8.5, in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean square averaging over a time interval, as permitted under Section A8.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

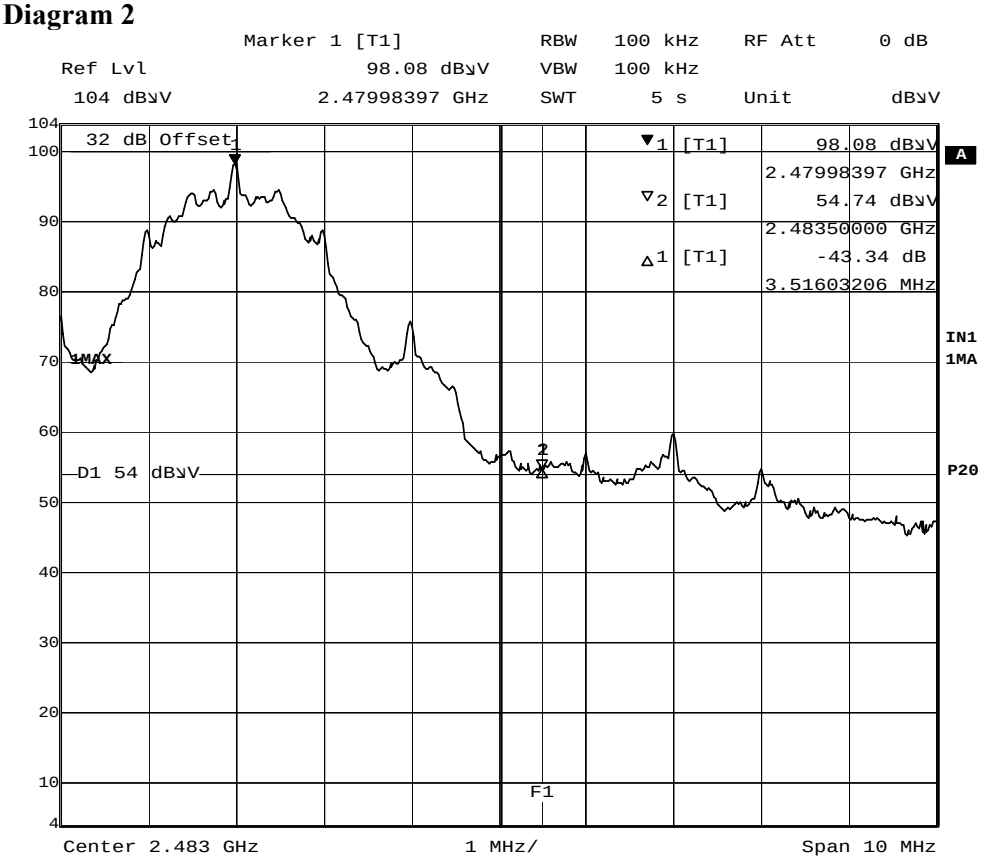
Complies?	Yes

Diagram 1



Date: 18.JAN.2012 15:09:00

Diagram 2

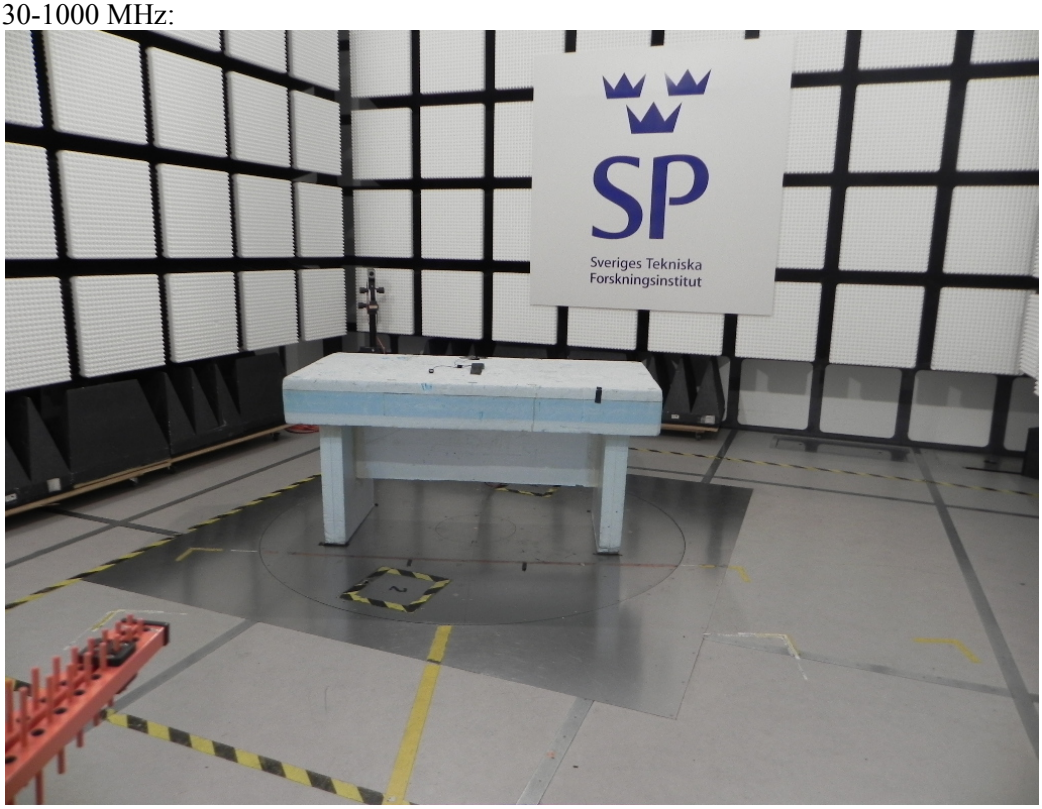


Date: 18.JAN.2012 14:12:54

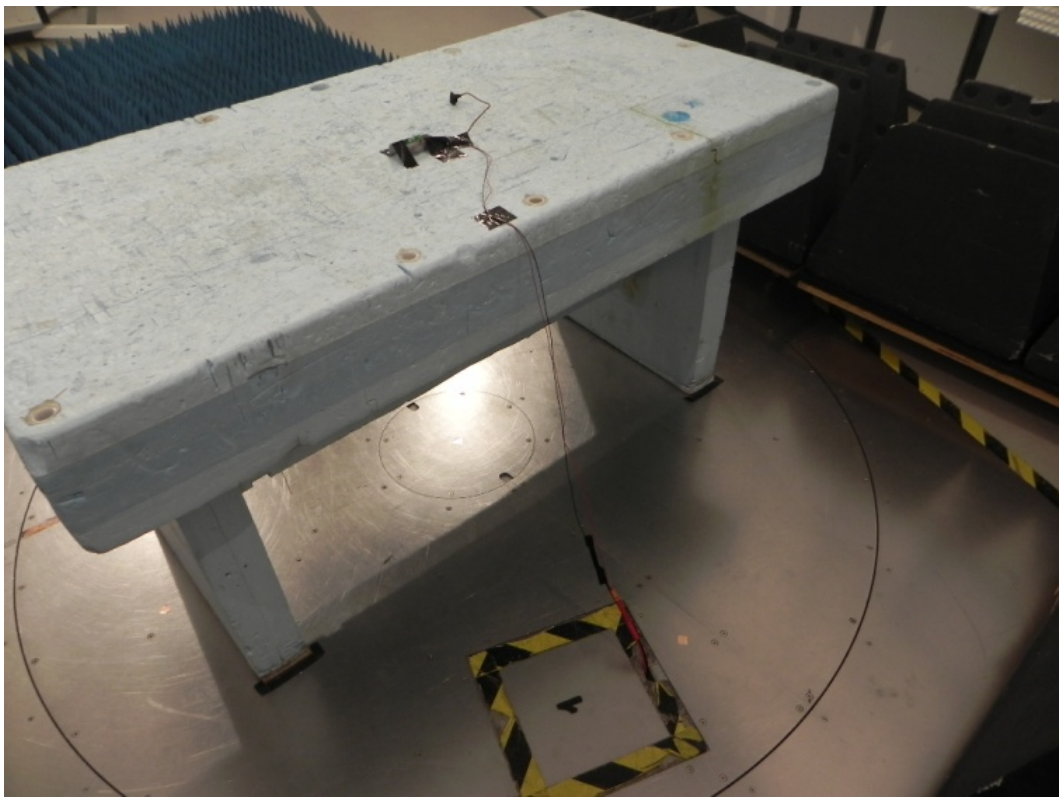
Photos

The test set-up during all the radiated tests can be seen in the pictures below.

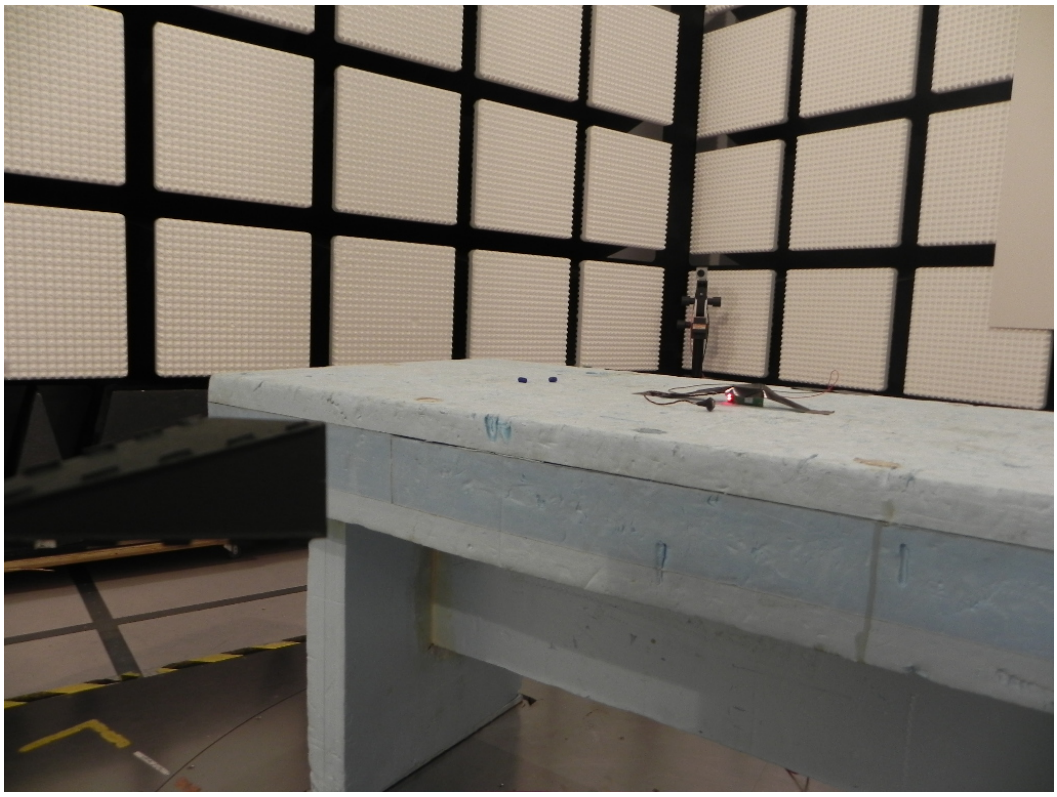
30-1000 MHz:



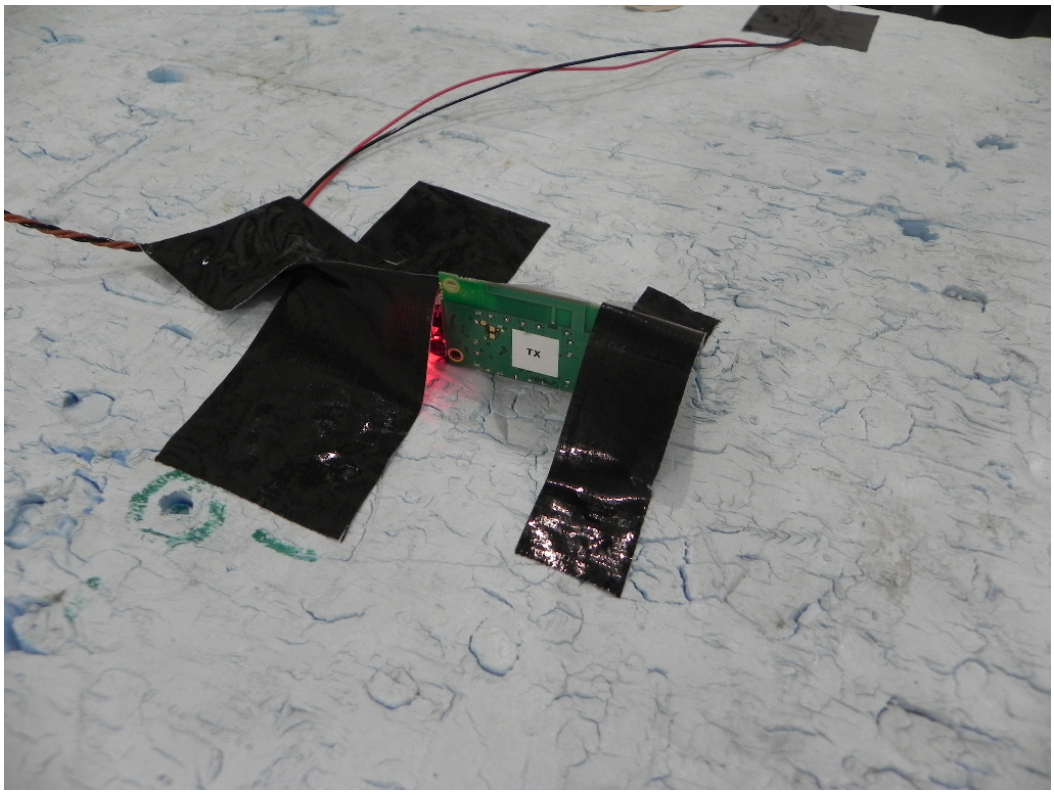
1-18 GHz:



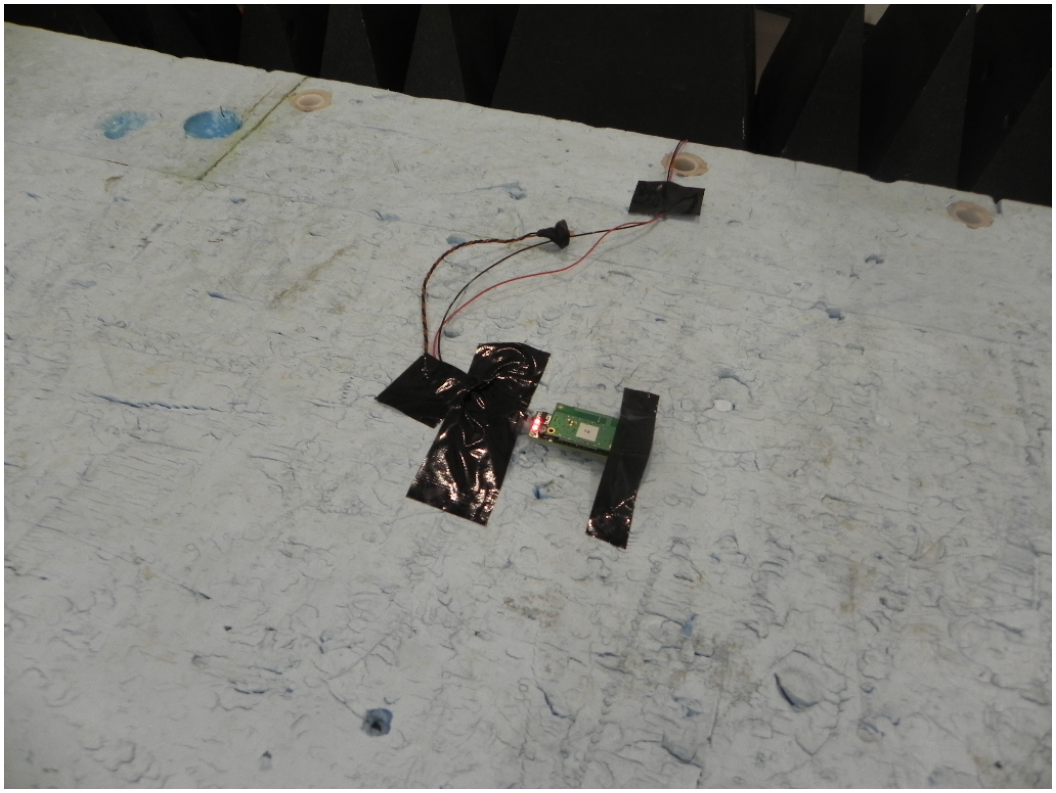
18-25 GHz:



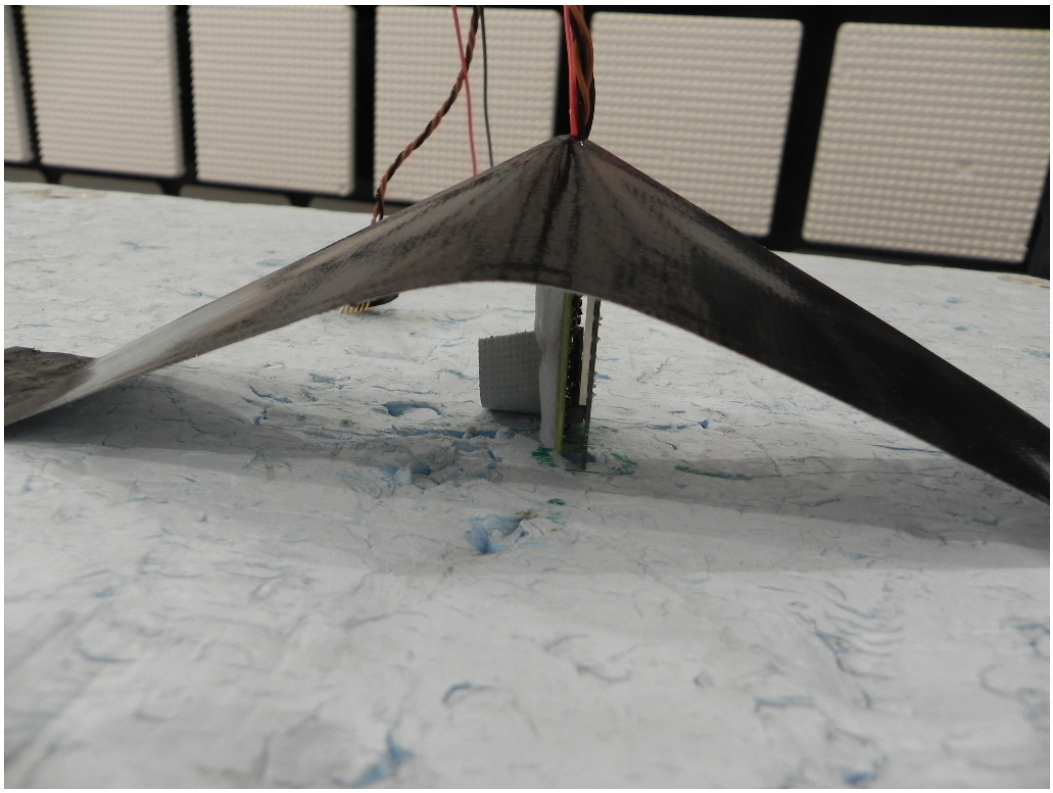
X-axes



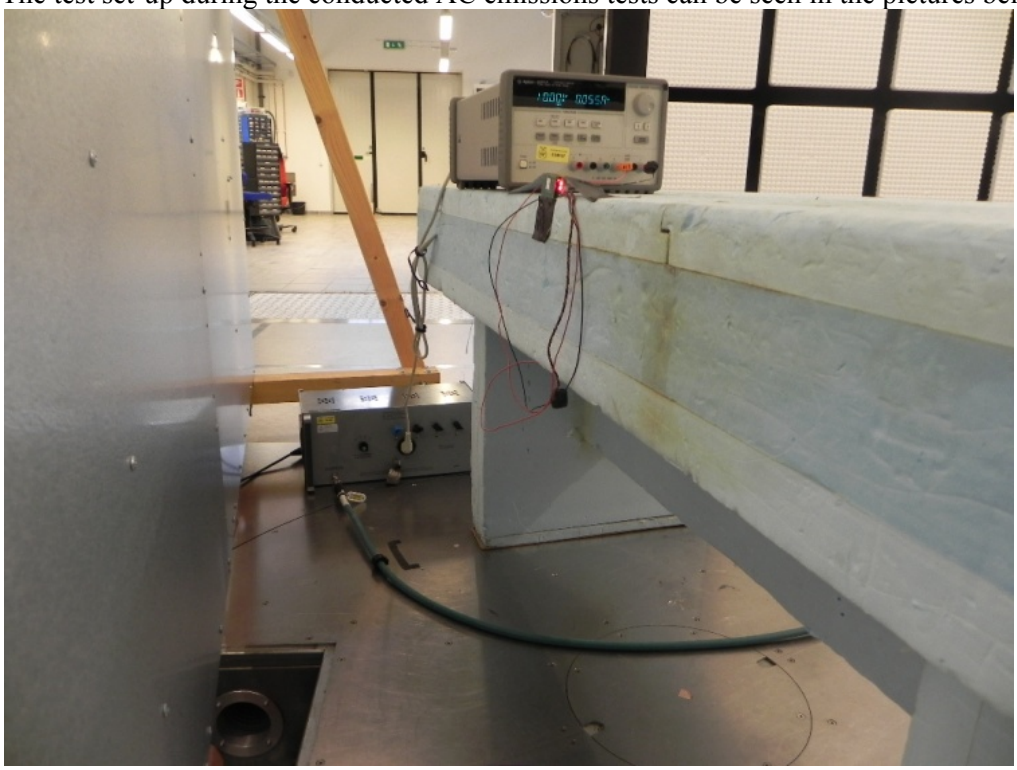
Y-axes

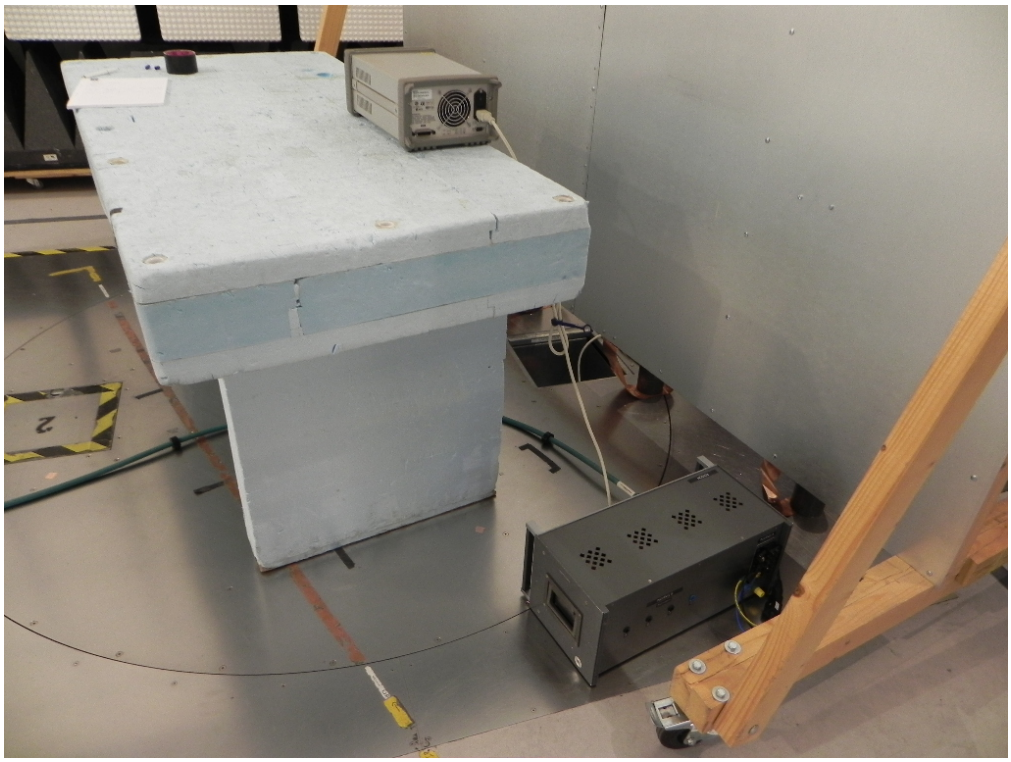


Z-axes



The test set-up during the conducted AC emissions tests can be seen in the pictures below.

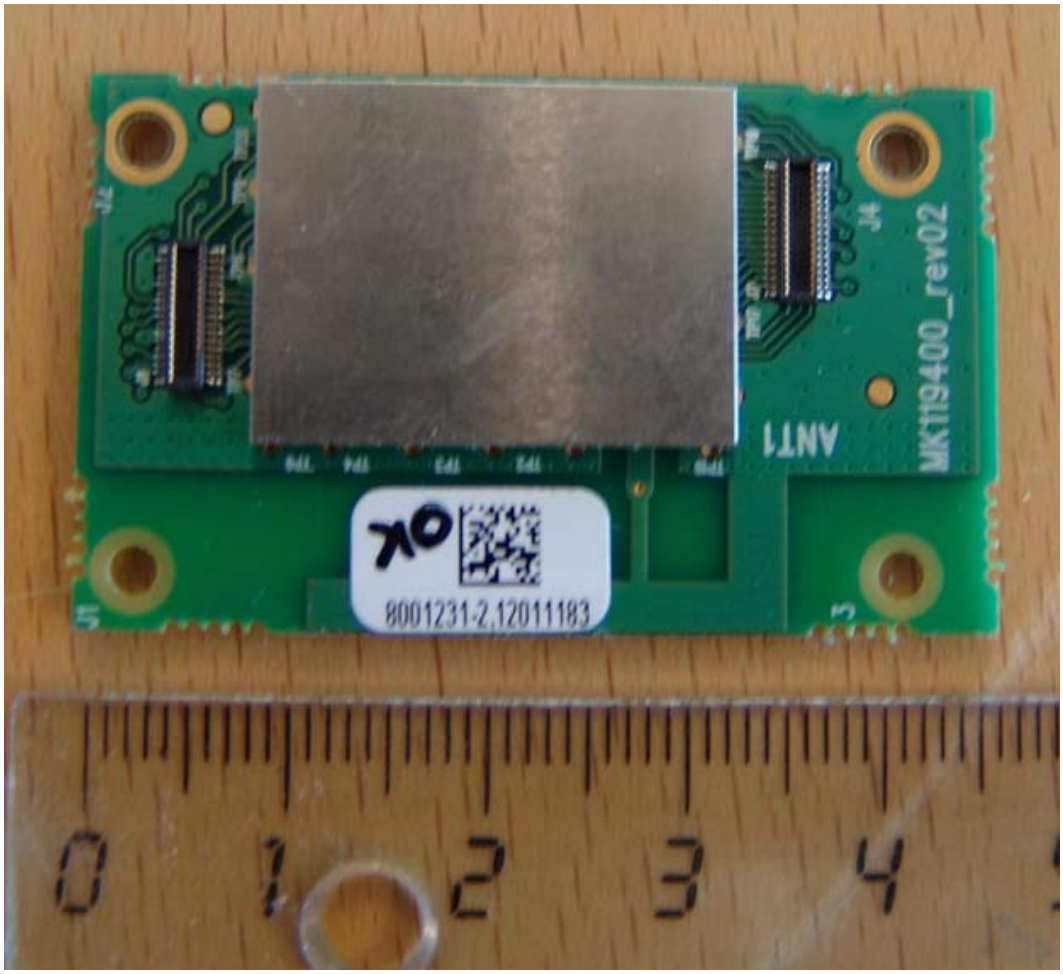




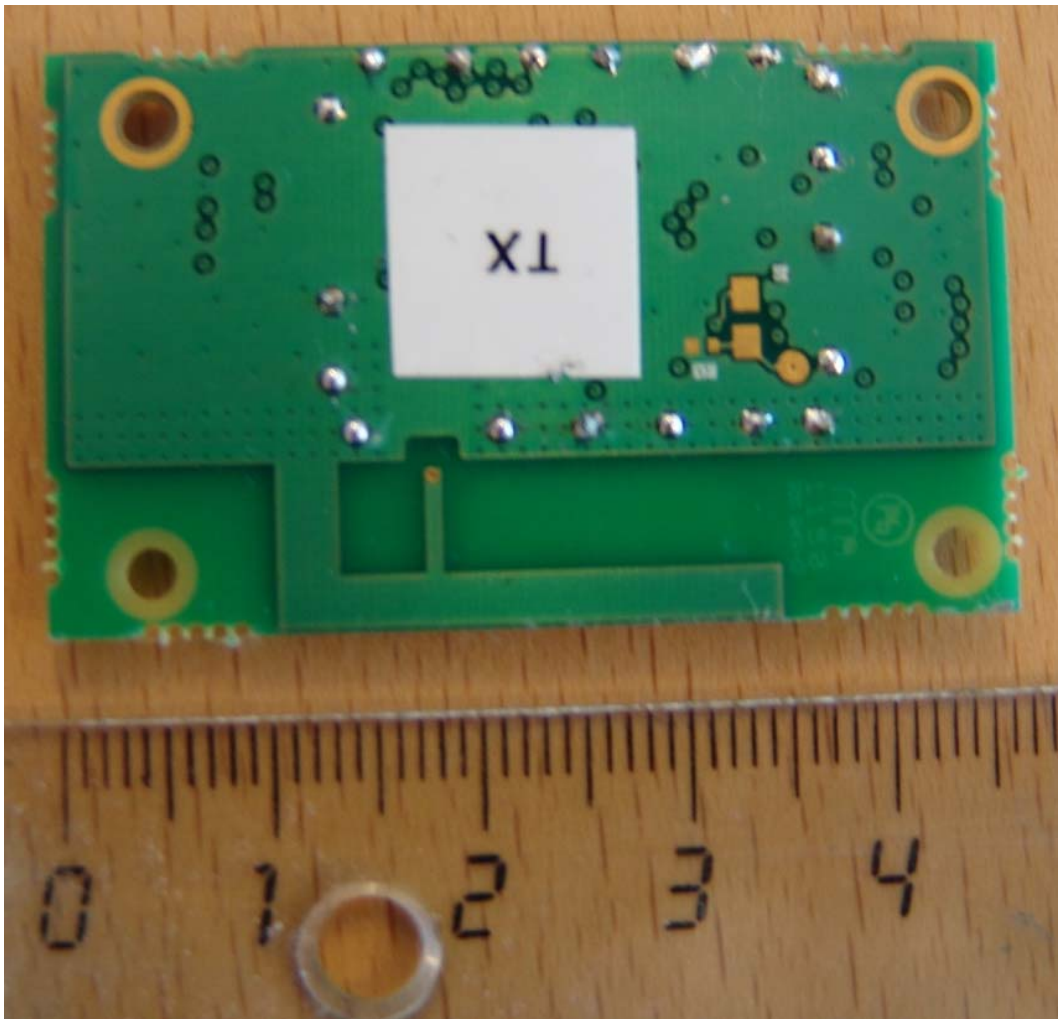
EUT, radiated sample

Identity

Front



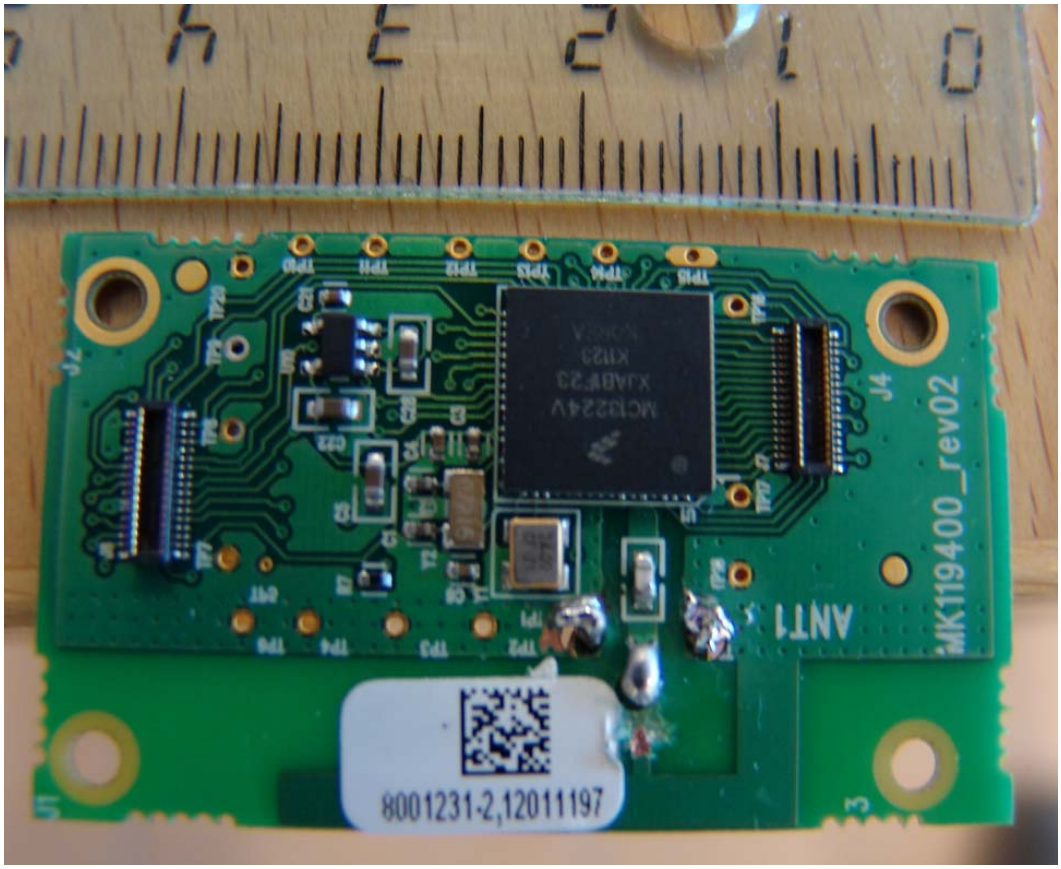
Rear



EUT, conducted sample

Identity

Front



Rear