

Equipment Authorization measurements on 902-928 MHz Transceiver Unit, Modular device FCC ID: OG4-TRXBQ900 (10 appendices)

Rev.1, 2012-12-11: Added appendix 2 (was implemented in Appendix 3 before) and Appendix 6 (measurements has been performed and added).

Appendix 9: Corrected output power to EIRP instead of ERP and calculated by the formula $P = (Exd)2/30xG$.

Test objects

Product name: TRXBQ900

Art. no: 943058-000

Serial number: No serial numbers

The test object was powered with 3.5 V DC (nominal)

Eight different samples were used during the test:

- one for sample for each tested frequency
- different samples for the RP-SMA antennas and for the samples with the wire antenna

Summary

See Appendix 1 for general information and Appendix 10 for photos.

Emission measurements as specified below have been performed.

Standard	Compliant	Appendix	Remarks
FCC 47 CFR Part 15 C (07-10-08)			
15.249 Operation within the band 902-928 MHz	Yes		
IC RSS-210 Issue 8, December 2010	Yes		
Duty cycle measurements	N/A	2	
15.249 (a) / RSS-210 A2.9(a) Field strength of fundamental	Yes	3	
15.249 (d) (e) / RSS-210 A2.9(b) Radiated emission	Yes	4	
15.215 (c) 20 dB bandwidth	Yes	5	
15.207 / RSS-Gen 7.2.4 Conducted emission limits	Yes	6	
2.1049 / RSS-Gen 4.6.1 Occupied bandwidth	Yes	7	
2.1049 / RSS-210 A2.9(b) Band Edge	Yes	8	
RF Safety / RSS-102 2.5.1 SAR Evaluation	Yes	9	

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.

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REPORT

Date
2012-04-04

Reference
FX200738-F15C

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FCC ID: OG4-TRXBQ900

Rev.1: 2012-12-11

SP Technical Research Institute of Sweden

Electronics - EMC

Performed by

Fredrik Isaksson

Examined by

Bengt Andersson

Performance test and requirements

The tests were performed to verify that TRXBQ900 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 and is accepted by Industry Canada for the performance of radiated measurements, IC-file number 3482A-2.

Test object

Transceiver:	TRXBQ900
Antenna connector	MMCX
Antenna 1:	Ex-it GSM/868, RP-SMA straight angle
Antenna 2:	Ex-it GSM/868, RP-SMA right angle
Antenna 3:	Wire antenna 40 mm, AWG23, 0.6 mm diameter
Nominal power setting:	41D792
Antenna 1 gain:	Max 3.0 dBi
Antenna 2 gain:	Max 3.0 dBi
Antenna 3 gain:	Not declared
Frequency range:	902.0875-927.9125 MHz
Frequencies used during test:	902.0875 MHz 915.0 MHz 927.9125 MHz
Modulation:	GFSK
Data rate:	9.6 kbps
Supply voltage:	3.5V DC, nominal

During the test the EUT was powered by a external DC power supply, Topward 6303DS SP 502 754, 3.5 V DC except for the conducted emission test on the AC mains where the HP E3632A SP 503 170 was used.

Measurement equipment

Tests performed 2012-03-12--14

Measurement equipment	Calibration Due	SP number
Test site Edison	2013-12	504 114
EMI test receiver R&S ESIB 26	2012-07	503 885
Antenna Schaffner CBL 6143	2013-04	504 079
Horn antenna EMCO 3115	2014-01	502 175
Low Noise Amplifier Miteq	2012-08	504 160
High pass filter Wainwright WHKY	2012-08	504 199
Multimeter Fluke 85 III 625	2012-05	503 418
Temperature and humidity meter Testo 625	2012-05	504 117

Tests performed 2012-12-05

Measurement equipment	Calibration Due	SP number
Test site Edison	2013-12	504 114
EMI test receiver R&S ESIB 26	2013-07	503 885
Antenna Schaffner CBL 6143	2013-04	504 079
Horn antenna EMCO 3115	2014-01	502 175
Low Noise Amplifier Miteq	2013-08	504 160
High pass filter Wainwright WHKY	2013-07	504 199
Multimeter Fluke 85 III 625	2012-08	503 418
Temperature and humidity meter Testo 625	2013-03	504 117

Operational test mode

Justification measurements were performed with rotation of the EUT through three orthogonal axes determine which orientation the radio module had the highest emission levels, see photos in Appendix 8.

The EUT was tested stand alone, as a modular device.

The test was performed with continuously transmission (100% duty cycle), if not otherwise stated, and with normal modulation.

For duty cycle measurements see appendix 2.

With the normal duty cycle the duty cycle was measured to $28.06/100.2 \text{ ms} = 0.121 = 28.0\%$.

The PRF was calculated to $PRF = 1/T = 1/100.2 \text{ ms} = 10 \text{ Hz}$, thus QP-detector was used without any correction for pulse desensitization.

Cabling during emission test:

EUT port	Cable type	Termination / use
DC power port	2-wire, unshielded, 3.0 m length	Connected to the DC power supply

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

Compliance 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: 2012-03-12 and 2012-12-03

Test participants

Björn Quickers and Jan Forsgren, Åkerström Björbo AB (partly present)

Test engineers

Fredrik Isaksson, Azhar Abbas and Mattias Engström (2012-12-05), SP

Duty cycle measurements

Date 2012-03-12	Temperature 22 °C ± 3 °C	Humidity 30 % ± 5 %
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Test set-up and procedure

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

The test was performed with normal 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.

Test set-up photos during the tests can be found in Appendix 10.

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. 6.30.20	503 745
Antenna Schaffner Bilog CBL6143	504 079
Multimeter Fluke 85 III	503 418
Temperature and humidity meter Testo 625	504 117

Results

Duty cycle measurements can be found in the diagrams below:

Diagram 1:	Normal duty cycle, Tx on
Diagram 2:	Normal duty cycle, Period time

Complies?	N/A
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Diagram 1

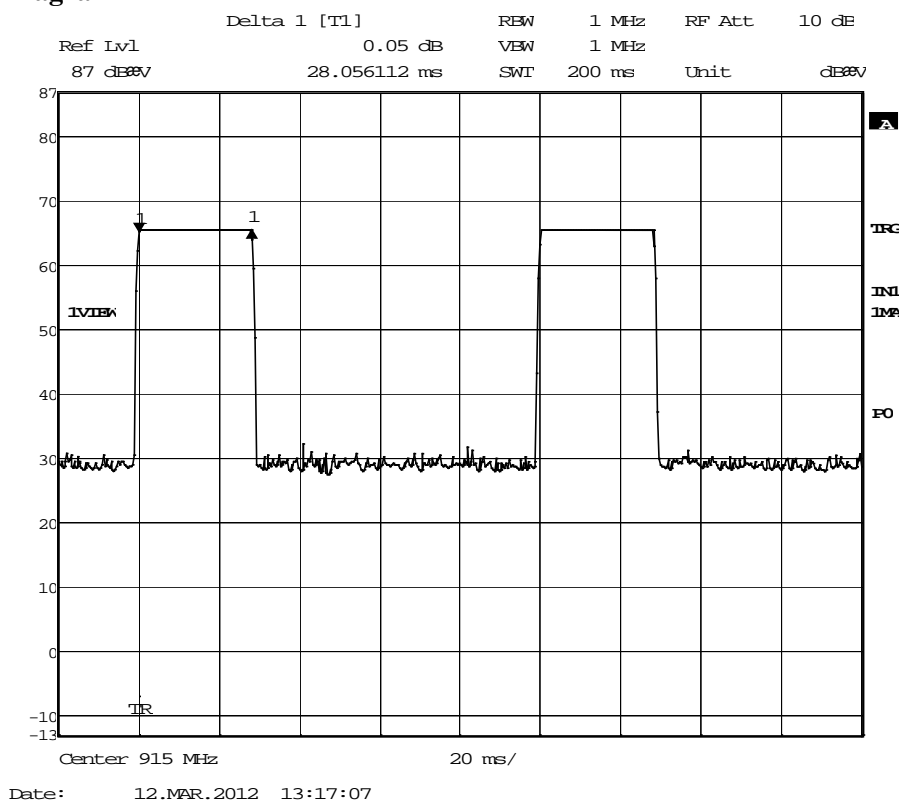
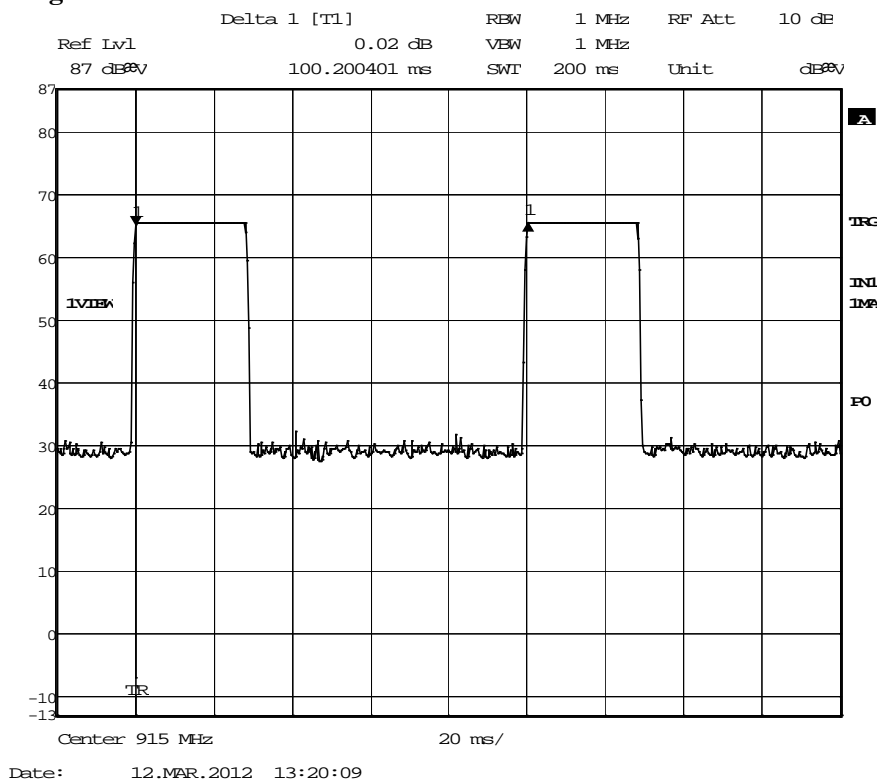


Diagram 2



Field strength of fundamental measurements according to FCC 47 CFR part 15.249 (a) / RSS-210 A2.9(a)

Date	Temperature	Humidity
2012-03-12	22 °C ± 3 °C	30 % ± 5 %
2012-03-13	22 °C ± 3 °C	28 % ± 5 %
2012-03-14	22 °C ± 3 °C	28 % ± 5 %

Test set-up and procedure

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

The test was performed with the power setting: 41D792 (nominal) and with continuous transmission (100% duty cycle) and with normal modulation.

The radiated maximum peak radiated output power measurements were performed in the semi-anechoic chamber.

The fundamental was scanned with peak-detector with the antenna height 1-4 m and the turntable was varied between 0-360 degrees for maximum response. The antenna distance during the measurements was 3.0 m.

Final measurement was performed with detector according to the FCC rules.

Test set-up photos during the tests can be found in Appendix 10.

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. 6.30.20	503 745
Antenna Schaffner Bilog CBL6143	504 079
Multimeter Fluke 85 III	503 418
Temperature and humidity meter Testo 625	504 117

Results

Field strength of fundamental measurements:
RBW=120 kHz

Antenna: RP-SMA straight, power setting: 41D792 (nominal), test set-up according to picture 2 in Appendix 10:

		Max peak radiated output power Quasi-peak detector		
		902.0875 MHz	915.0 MHz	927.9125 MHz
	Antenna height	1.00 m	1.12 m	1.13 m
	Azimuth	328 deg	182 deg	190 deg
	Polarization	Horizontal	Horizontal	Horizontal
T_{nom} 22°C	V_{nom} 3.5 V DC	88.8 dB μ V/m	90.4 dB μ V/m	91.8 dB μ V/m
T_{nom} 22°C	V_{min} 2.975 V DC Note 1	88.7 dB μ V/m	90.3 dB μ V/m	91.6 dB μ V/m
T_{nom} 22°C	V_{max} 5.5 V DC Note 1	88.8 dB μ V/m	90.4 dB μ V/m	91.8 dB μ V/m

Antenna: RP-SMA right, power setting: 41D792 (nominal), test set-up according to picture 6 in Appendix 10:

		Max peak radiated output power Quasi-peak detector		
		902.0875 MHz	915.0 MHz	927.9125 MHz
	Antenna height	1.00 m	1.00 m	1.07 m
	Azimuth	43 deg	180 deg	100 deg
	Polarization	Horizontal	Horizontal	Horizontal
T_{nom} 22°C	V_{nom} 3.5 V DC	87.2 dB μ V/m	87.2 dB μ V/m	89.5 dB μ V/m
T_{nom} 22°C	V_{min} 2.975 V DC Note 1	87.1 dB μ V/m	87.1 dB μ V/m	89.3 dB μ V/m
T_{nom} 22°C	V_{max} 5.5 V DC Note 1	87.2 dB μ V/m	87.2 dB μ V/m	89.5 dB μ V/m

Antenna: Wire antenna 40 mm, power setting: 41D792 (nominal), test set-up according to picture 10 in Appendix 10:

		Max peak radiated output power Quasi-peak detector		
		902.0875 MHz	915.0 MHz	927.9125 MHz
	Antenna height	1.44 m	1.43 m	1.38 m
	Azimuth	183 deg	6 deg	6 deg
	Polarization	Vertical	Vertical	Vertical
T_{nom} 22°C	V_{nom} 3.5 V DC	82.1 dB μ V/m	77.4 dB μ V/m	76.7 dB μ V/m
T_{nom} 22°C	V_{min} 2.975 V DC Note 1	82.0 dB μ V/m	77.3 dB μ V/m	76.5 dB μ V/m
T_{nom} 22°C	V_{max} 5.5 V DC Note 1	82.1 dB μ V/m	77.4 dB μ V/m	76.7 dB μ V/m

Note 1: 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. For battery operated equipment, the equipment tests shall be performed using a new battery.

Limits

According to 47CFR 15.249(a), the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

According to RSS-210 A2.9(a), the field strength measured at 3 meter shall not exceed the following:

Fundamental Frequency	Field strength of fundamental	Field strength of harmonics
902-928 MHz	50 mV/m = 94 dB μ V/m	500 μ V/m = 54 dB μ V/m

Complies?	Yes
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Radiated emission measurements according to FCC 47 CFR part 15.249 (d) (e) / RSS 210-210 A2.9(b)

Date	Temperature	Humidity
2012-03-12	22 °C ± 3 °C	30 % ± 5 %
2012-03-13	22 °C ± 3 °C	28 % ± 5 %
2012-03-14	22 °C ± 3 °C	28 % ± 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.

Two different power settings were used during the test, 41D792 (nominal) and 429692 (nominal+3 dB), see the results.

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 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 (above 1 GHz pre-measurement was only performed at 1.0 m due to the small EUT size).
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 measurement was first performed with peak detector.

The following RBW were used:

30 MHz-1 GHz: RBW=120 kHz

1-10 GHz: RBW=1 MHz

Test set-up photos during the tests can be found in Appendix 10.

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. 6.30.10	503 745
Antenna Schaffner Bilog CBL6143	504 079
Horn antenna EMCO 3115	501 548
Preamplifier Miteq, 1 18 GHz	504 160
High pass filter Wainwright WHKY	504 199
Temperature and humidity meter Testo 625	504 117

Results

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

Diagram 1:	Ambient, 30-1000 MHz vertical and horizontal polarization
Diagram 2:	30-1000 MHz, EUT set to 915.0 MHz, RP-SMA straight antenna, power setting: 429692 (nominal+3 dB), test set-up according to picture 2 in Appendix 8, vertical and horizontal polarization
Diagram 3:	30-1000 MHz, EUT set to 915.0 MHz, RP-SMA right antenna, power setting: 429692 (nominal+3 dB), test set-up according to picture 6 in Appendix 8, vertical and horizontal polarization
Diagram 4:	30-1000 MHz, EUT set to 915.0 MHz, Wire antenna 40 mm, power setting: 429692 (nominal+3 dB), test set-up according to picture 10 in Appendix 8, vertical and horizontal polarization
Diagram 5:	1-10 GHz, EUT set to 915.0 MHz, RP-SMA straight antenna, power setting: 41D792 (nominal), test set-up according to picture 4 in Appendix 8, vertical and horizontal polarization
Diagram 6:	1-10 GHz, EUT set to 927.9125 MHz, RP-SMA right antenna, power setting: 41D792 (nominal), test set-up according to picture 8 in Appendix 8, vertical and horizontal polarization
Diagram 7:	1-10 GHz, EUT set to 902.0875 MHz, Wire antenna 40 mm, power setting: 41D792 (nominal), test set-up according to picture 12 in Appendix 8, vertical and horizontal polarization

Note: Worst-case plots are attached.

The highest detected levels during the final measurement in the frequency range 30 MHz-10 GHz are listed in the tables below.

All other emission in the frequency range 30 MHz-10 GHz in all the different set-ups with all the three antennas and with rotation of the EUT through three orthogonal axes and at the three frequencies, bottom, mid and top, where > 20 dB below limit.

915.0 MHz: RP-SMA straight antenna, power setting: 429692 (nominal+3 dB), test set-up according to picture 2 in Appendix 10:

Frequency (MHz)	QP level (dBμV/m)	AV level (dBμV/m)	Peak level (dBμV/m)	Corr (dB)	Limit (dBμV/m)	Height (m)	Azimuth (deg)	Polarization
41.8912	21.0	N/A	N/A	17.0	40	1.29	310	Vertical
45.9043	29.3	N/A	N/A	14.5	40	1.00	95	Vertical

915.0 MHz: RP-SMA right antenna, power setting: 429692 (nominal+3 dB), test set-up according to picture 6 in Appendix 10:

Frequency (MHz)	QP level (dBμV/m)	AV level (dBμV/m)	Peak level (dBμV/m)	Corr (dB)	Limit (dBμV/m)	Height (m)	Azimuth (deg)	Polarization
41.8910	20.9	N/A	N/A	17.0	40	1.31	304	Vertical
45.9044	29.6	N/A	N/A	14.5	40	1.00	88	Vertical

915.0 MHz: Wire antenna 40 mm, power setting: 429692 (nominal+3 dB), test set-up according to picture 10 in Appendix 10:

Frequency (MHz)	QP level (dBμV/m)	AV level (dBμV/m)	Peak level (dBμV/m)	Corr (dB)	Limit (dBμV/m)	Height (m)	Azimuth (deg)	Polarization
45.9288	22.1	N/A	N/A	14.5	40	2.46	316	Vertical

Limits

According to 47CFR 15.249(a), the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Fundamental Frequency	Field strength of harmonics
902-928 MHz	500 μ V/m = 54 dB μ V/m

According to 47CFR 15.249(d), emission radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in section 15.209, whichever is the lesser attenuation.

According to 47CFR 15.249(e), the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.

According to RSS-210 A2.9(b), emissions radiated the outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to table 2 limits, whichever is the less stringent.

Complies?	Yes
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Diagram 1

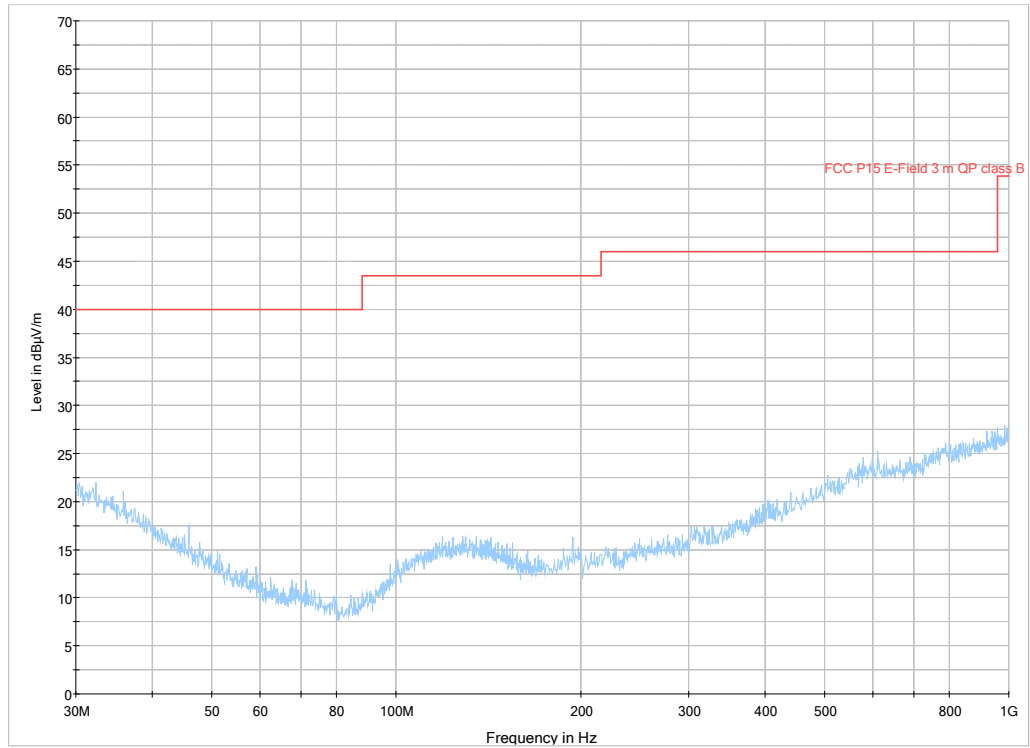


Diagram 2

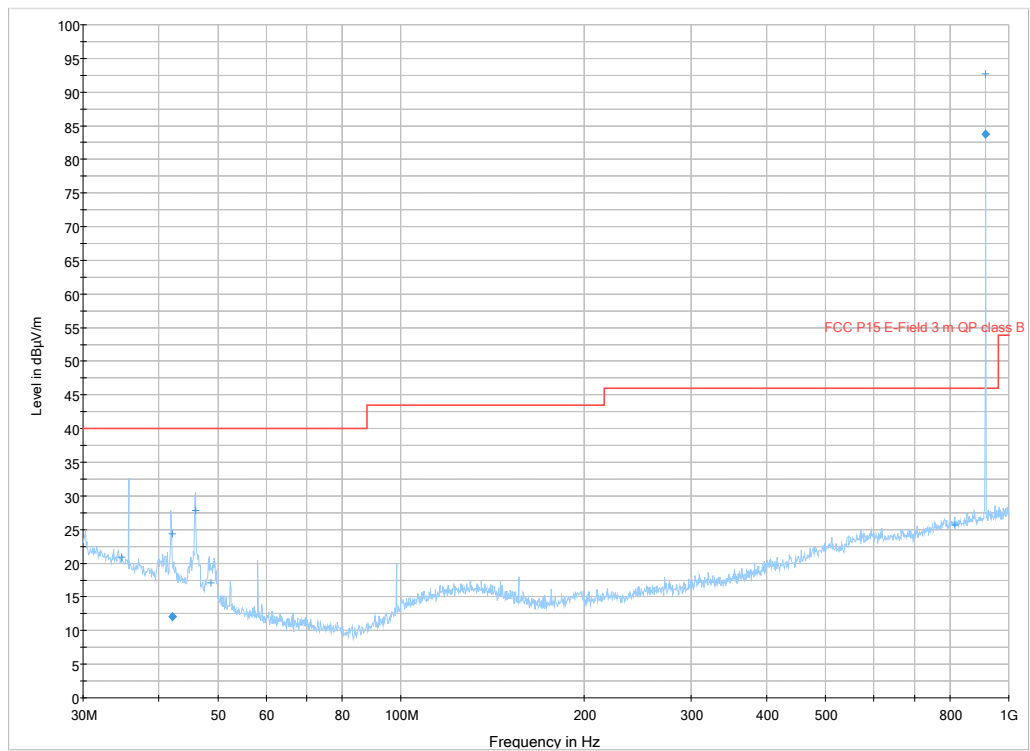


Diagram 3

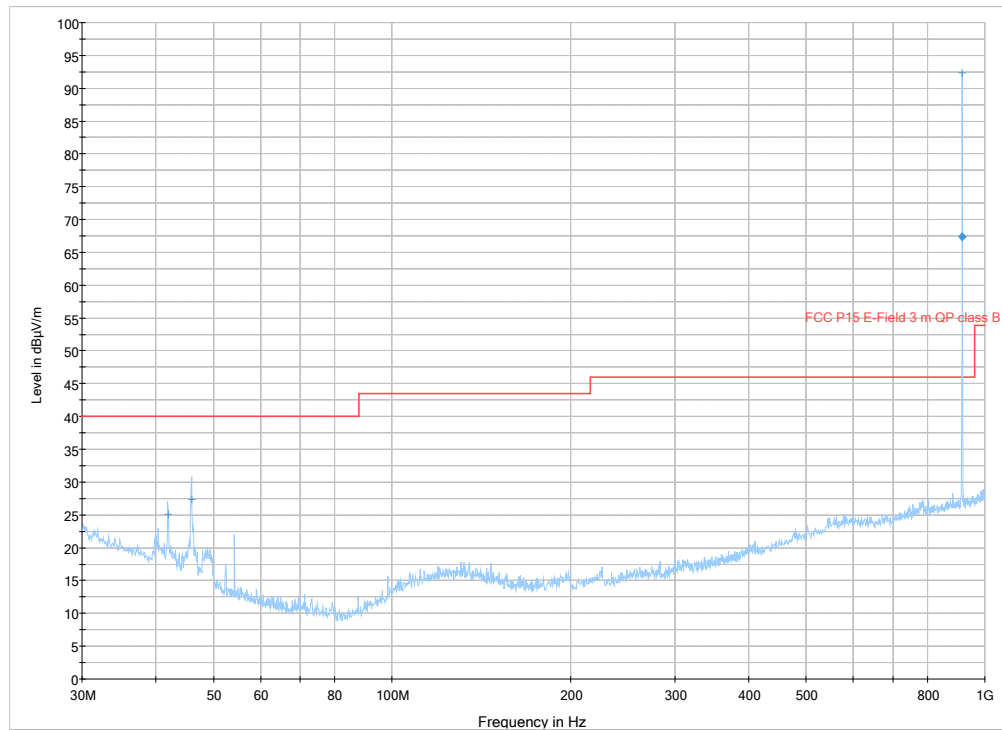


Diagram 4

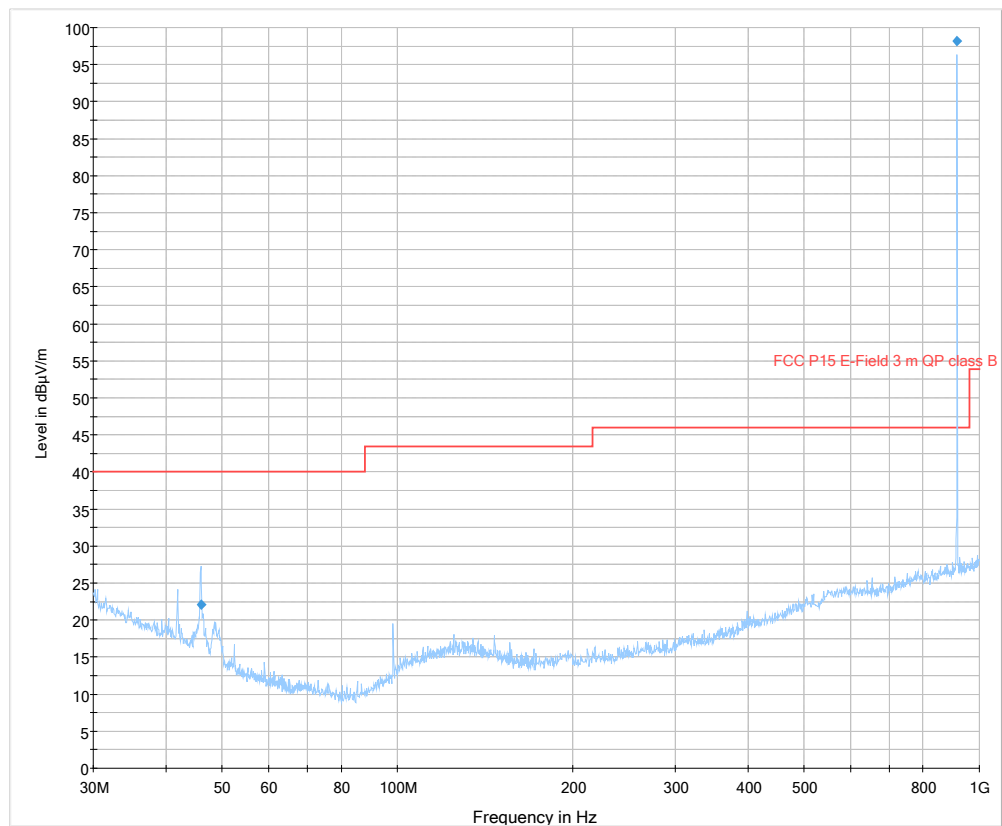


Diagram 5

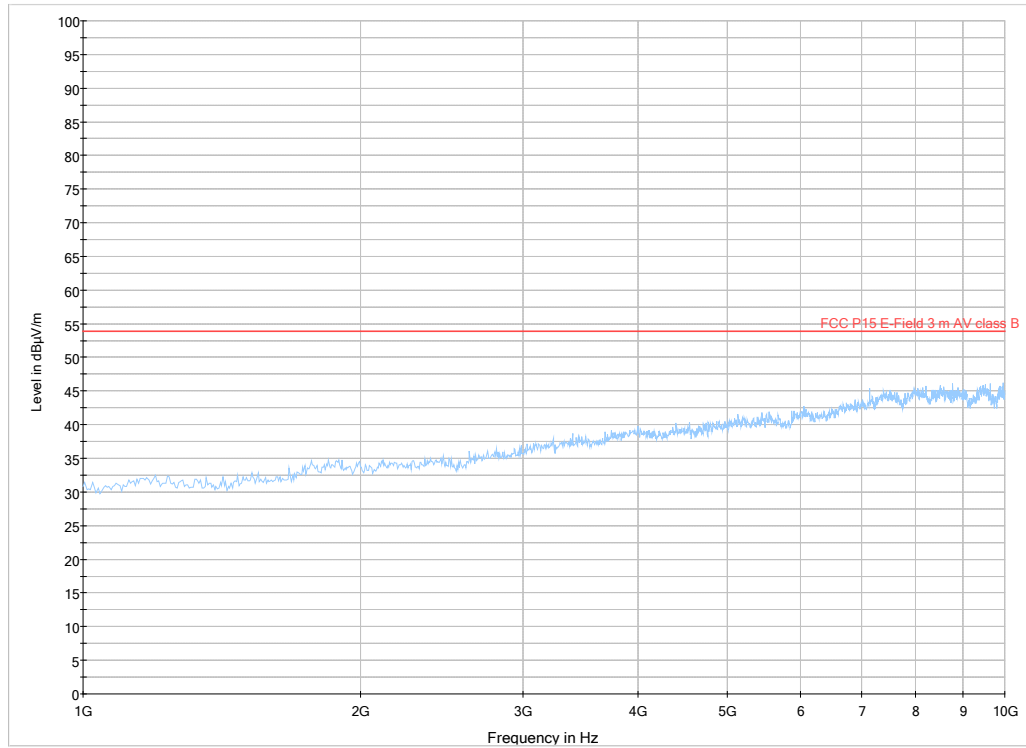


Diagram 6

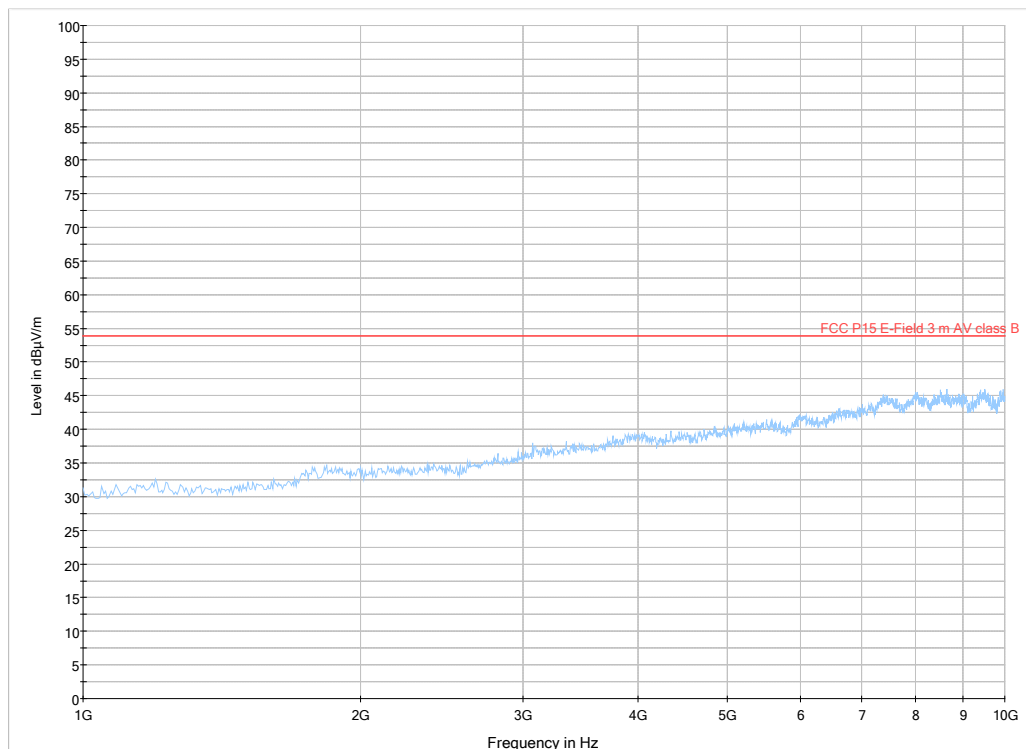
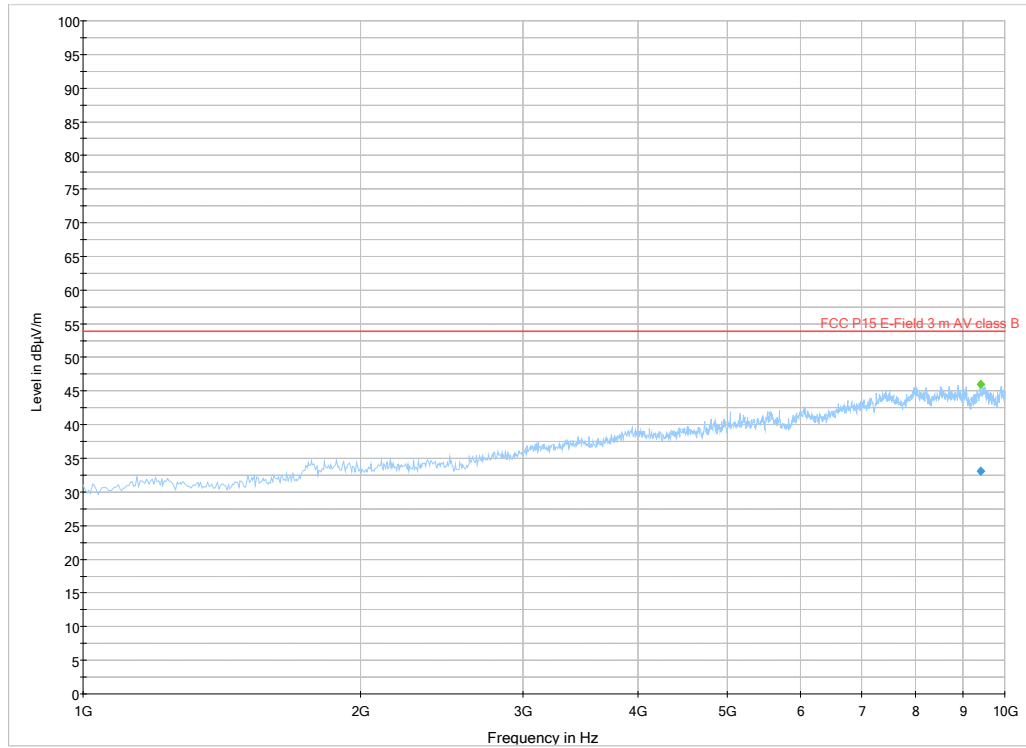


Diagram 7



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

Date 2012-03-14	Temperature 22 °C ± 3 °C	Humidity 28 % ± 5 %
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Test set-up and procedure

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

The test was performed with the power setting: 41D792 (nominal) and with continuous transmission with normal duty cycle (28%) and with normal modulation.
The test was performed conducted at the antenna connector.

Measurement equipment	SP number
Test site, Edison	504 114
Spectrum analyzer R&S ESI 26	503 885
Multimeter Fluke 85 III	503 418
Temperature and humidity meter Testo 625	504 117

Measurement uncertainty: 2.6 %

Results

The 20 dB BW measurements can be found in the diagrams below:

Diagram 1	902.0875 MHz	20 dB BW = 11.62 kHz
Diagram 2	915.0 MHz	20 dB BW = 11.52 kHz
Diagram 3	927.9125 MHz	20 dB BW = 11.22 kHz

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
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Diagram 1

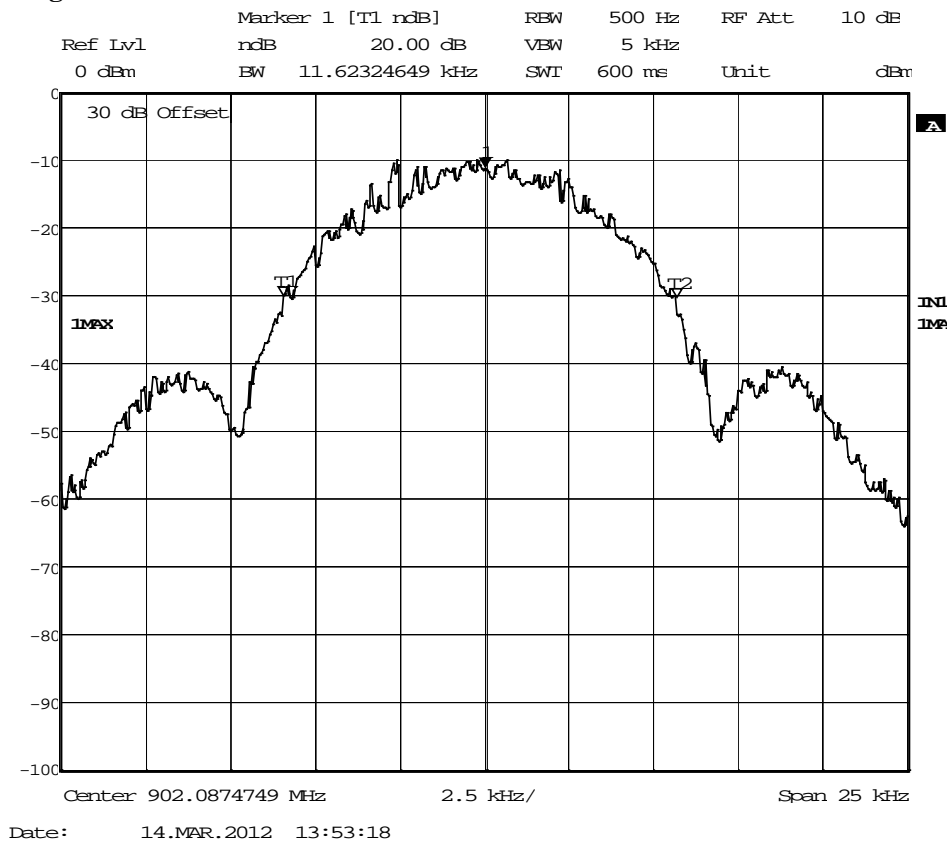


Diagram 2

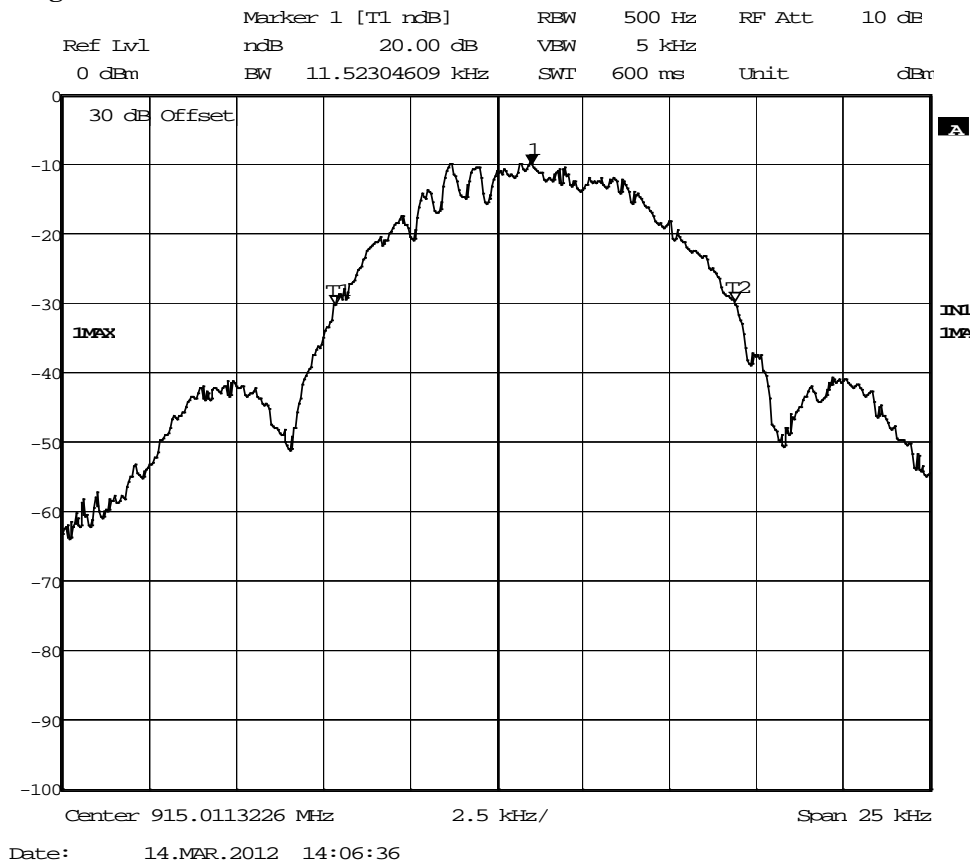
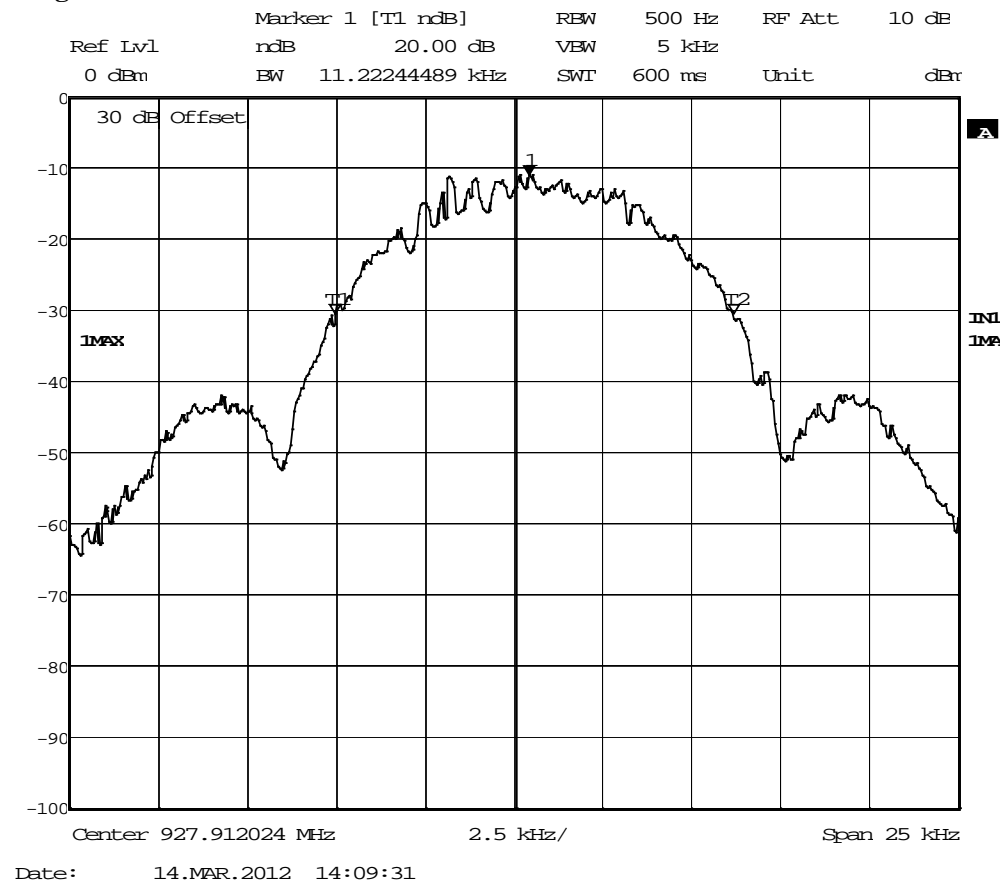


Diagram 3



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

Date 2012-12-05	Temperature 22 °C ± 3 °C	Humidity 17 % ± 5 %
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Test set-up and procedure

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

The test was performed with the power setting: 41D792 (nominal) and 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, HP E3632A SP 503 170 was used.

Test set-up photos during the tests can be found in Appendix 12.

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
Diagram 2:	Ambient, 120 V AC, neutral terminal
Diagram 3:	120 V AC, phase terminal, 902.0875 MHz
Diagram 4:	120 V AC, neutral terminal, 902.0875 MHz
Diagram 5:	120 V AC, phase terminal, 915.0 MHz
Diagram 6:	120 V AC, neutral terminal, 915.0 MHz
Diagram 7:	120 V AC, phase terminal, 927.9125 MHz
Diagram 8:	120 V AC, neutral terminal, 927.9125 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 (dB μ V)	Average value (dB μ V/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
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Diagram 1

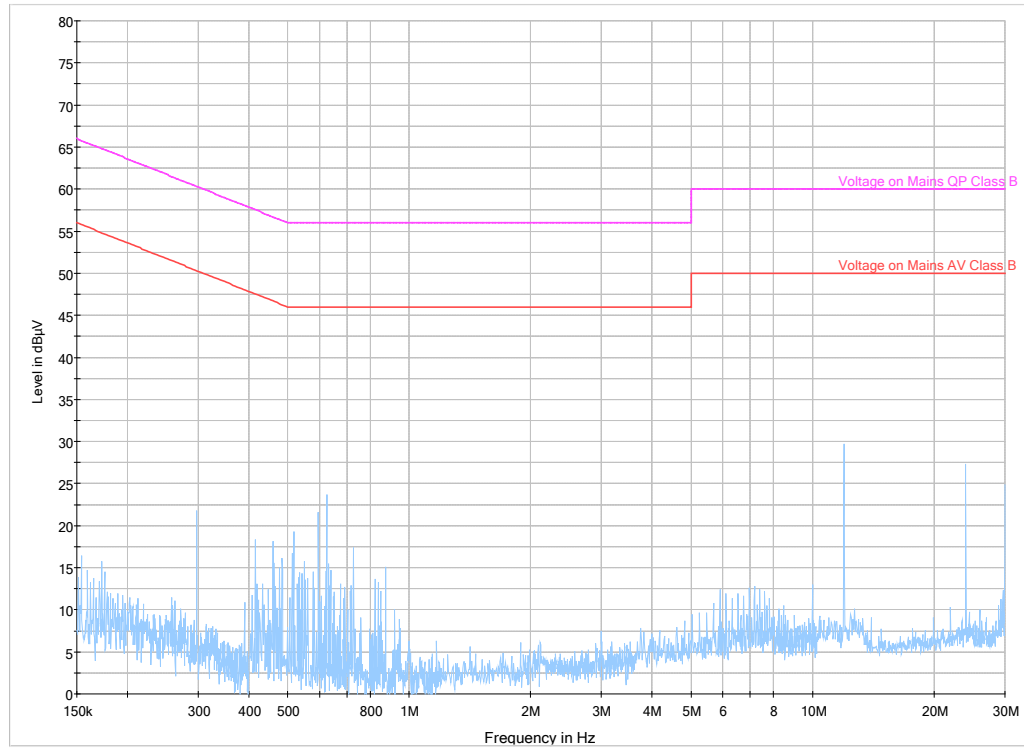


Diagram 2

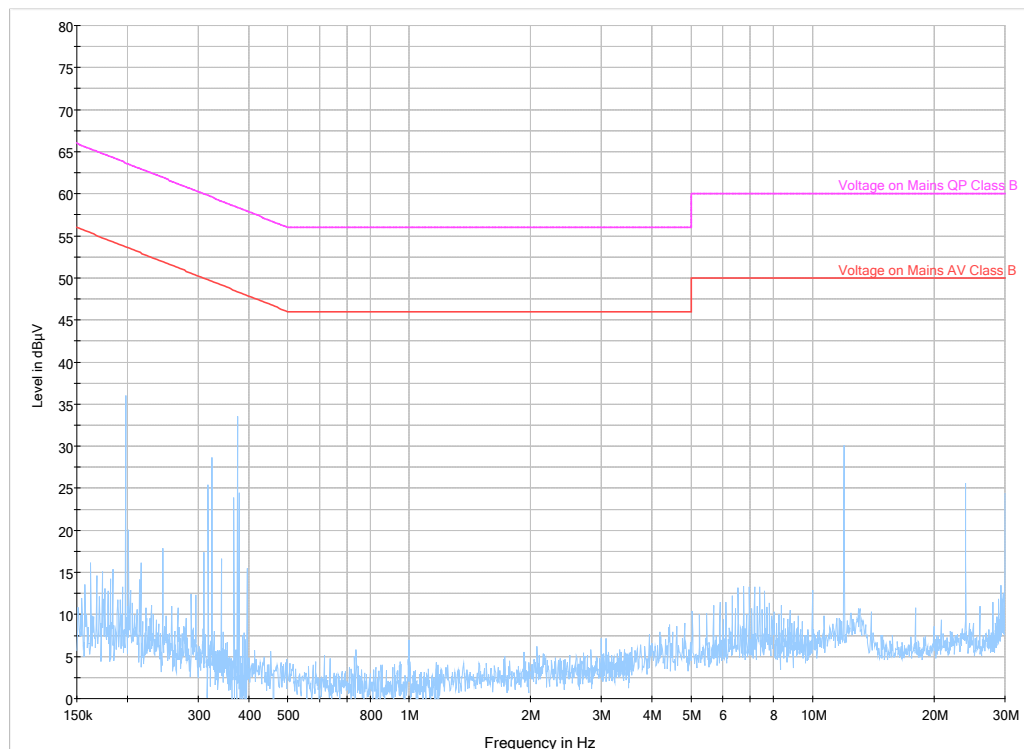


Diagram 3

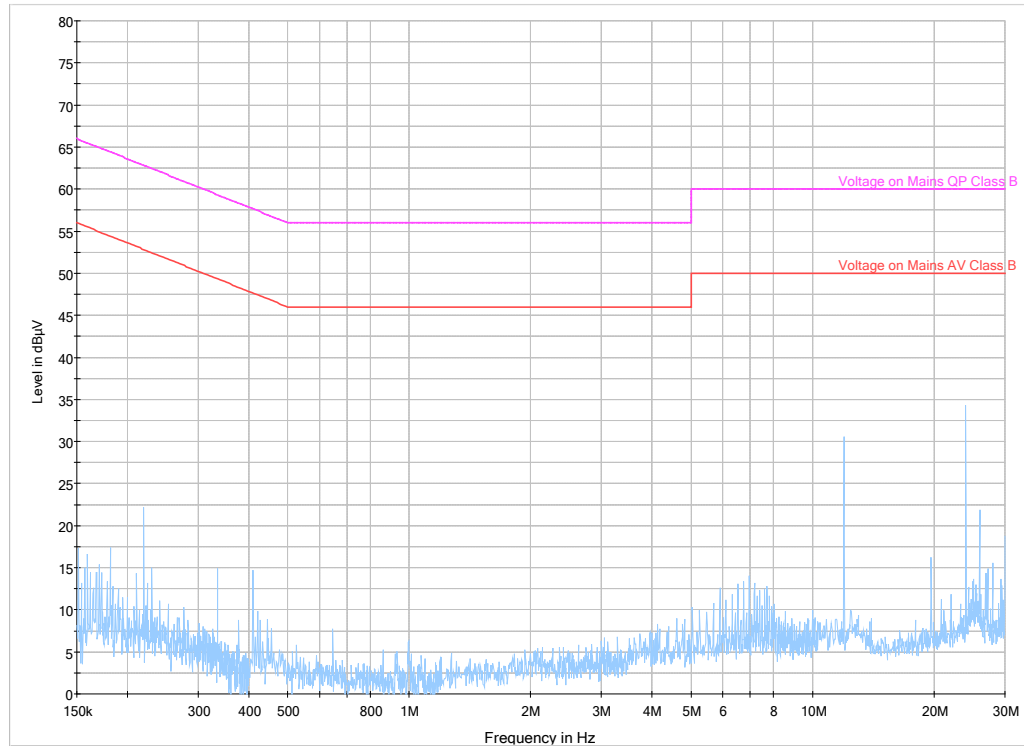


Diagram 4

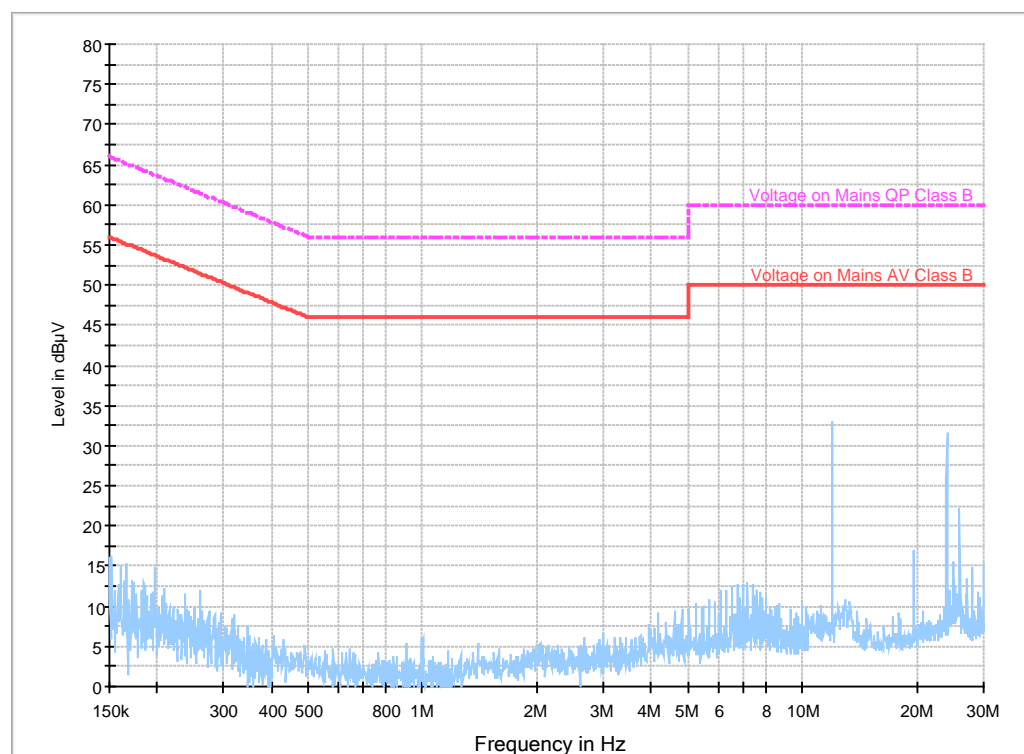


Diagram 5

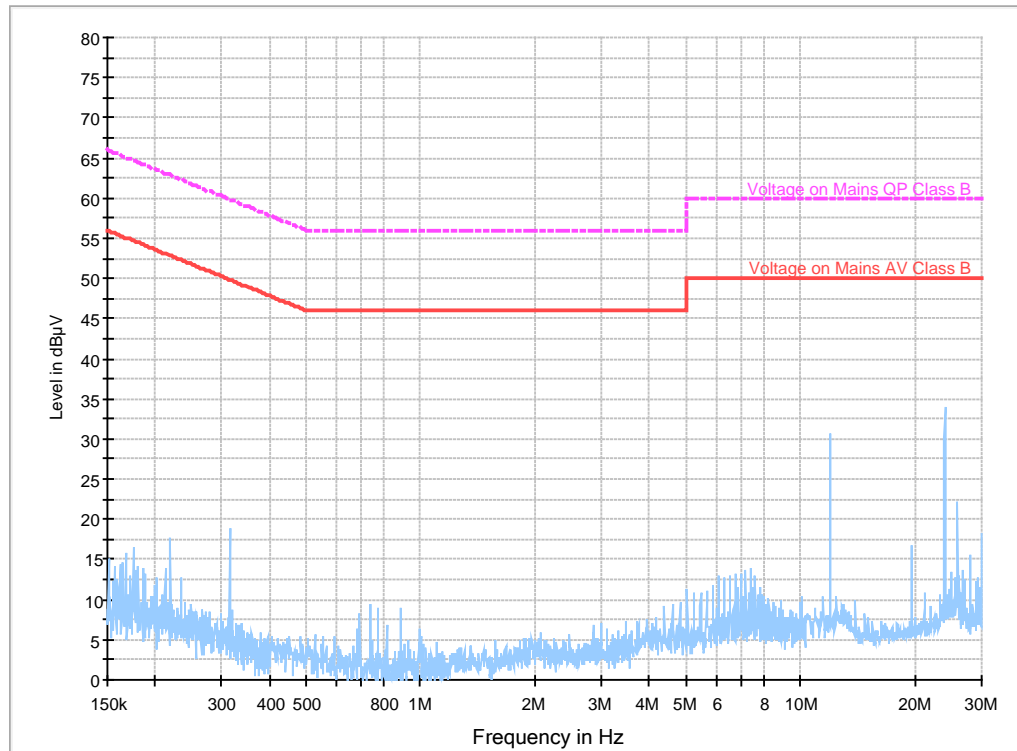
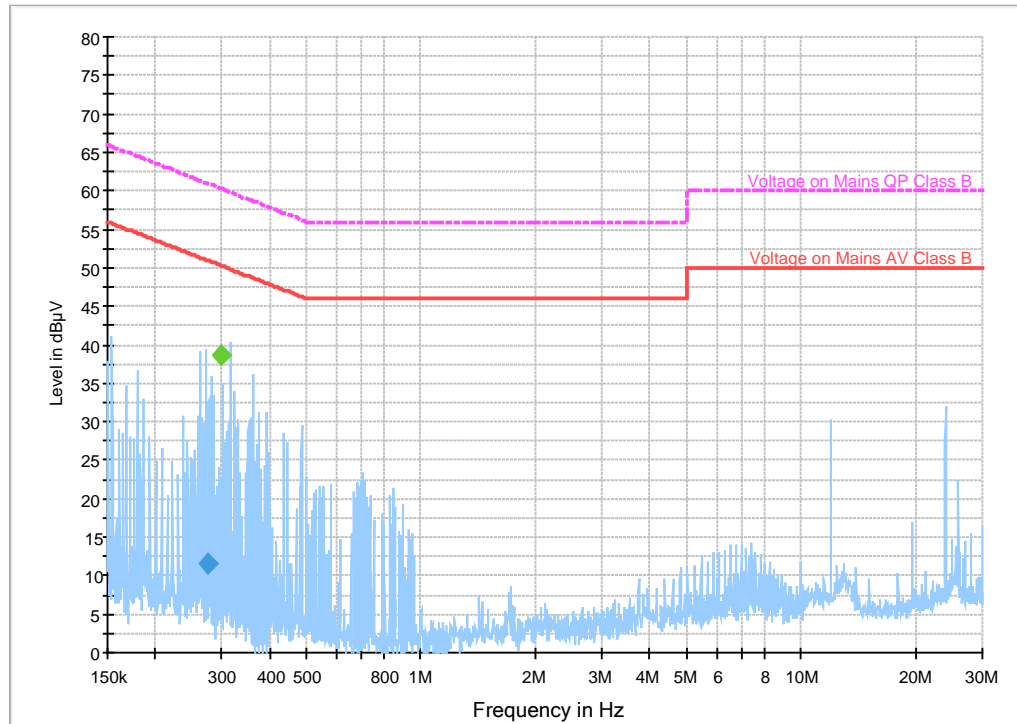


Diagram 6

_E_EN-FCC_V_CI B_504129_N_150K-30M



Final Result

Frequency (MHz)	CAverage (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	PE	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.275834	11.5	5000.0	9.000	GN	N	0.1	39.5	50.9

Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	PE	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.299834	38.6	5000.0	9.000	GN	N	0.1	21.7	60.2

Diagram 7

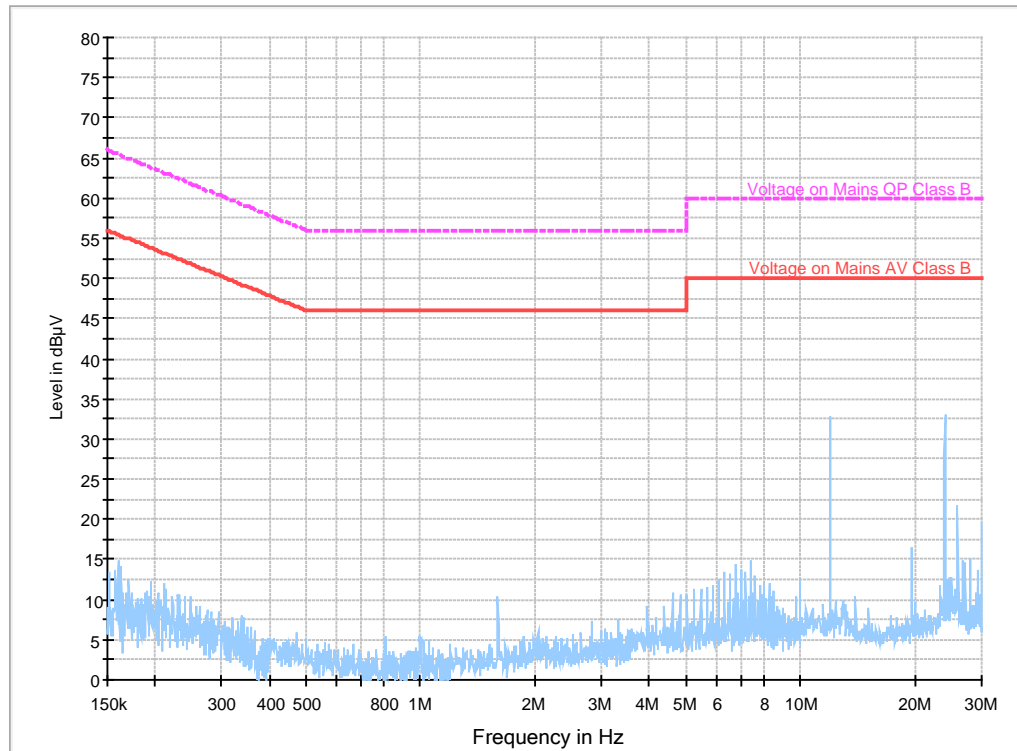
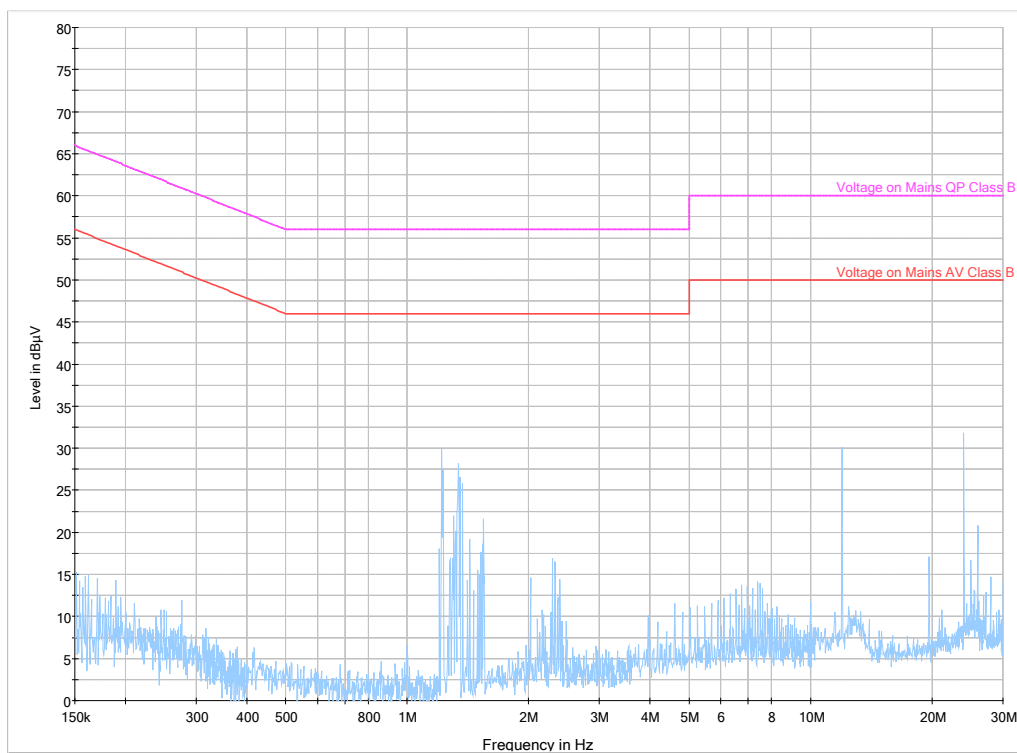


Diagram 8



Occupied bandwidth measurements according to 47CFR 2.1049 / RSS-Gen 7.2.2

Date 2012-03-14	Temperature 22 °C ± 3 °C	Humidity 28 % ± 5 %
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Test set-up and procedure

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

The test was performed with the power setting: 41D792 (nominal) and with continuous transmission with normal duty cycle (28%) and with normal modulation.

The test was performed conducted at the antenna connector.

Measurement equipment	SP number
Test site, Edison	504 114
Spectrum analyzer R&S ESI 26	503 885
Multimeter Fluke 85 III	503 418
Temperature and humidity meter Testo 625	504 117

Measurement uncertainty: 2.6 %

Results

The OBW measurements can be found in the diagrams below:

Diagram 1	902.0875 MHz	OBW = 9.92 kHz (99%)
Diagram 2	915.0 MHz	OBW = 9.97 kHz (99%)
Diagram 2	927.9125 MHz	OBW = 9.92 kHz (99%)

Diagram 1

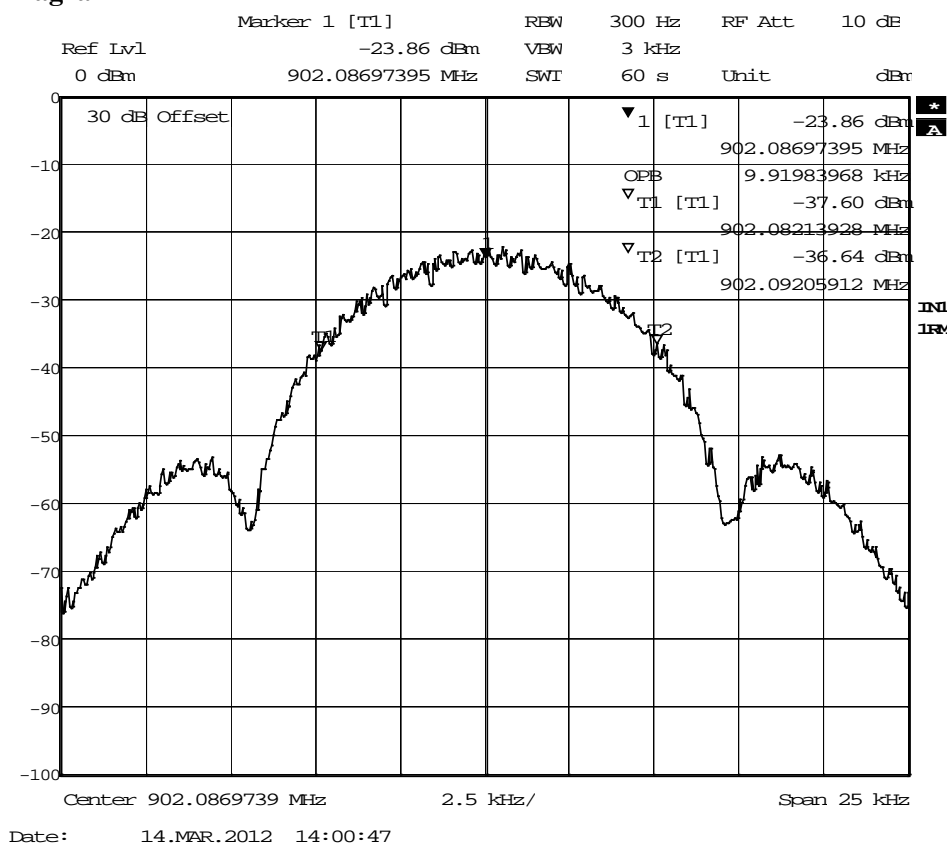


Diagram 2

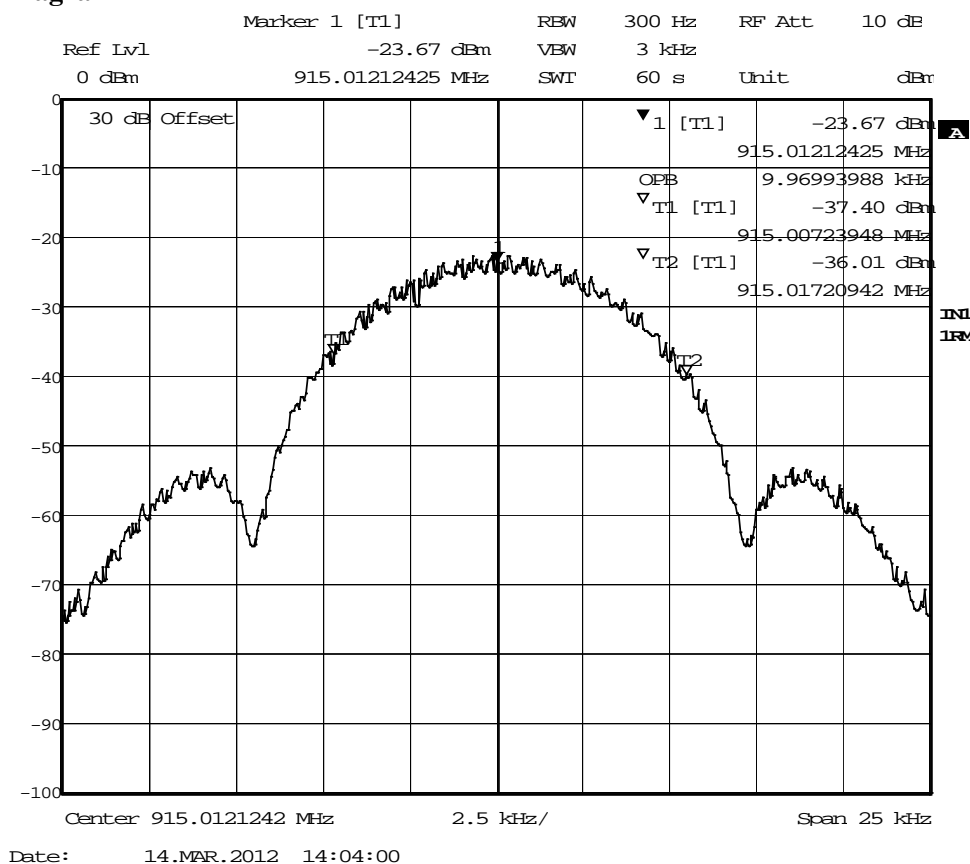
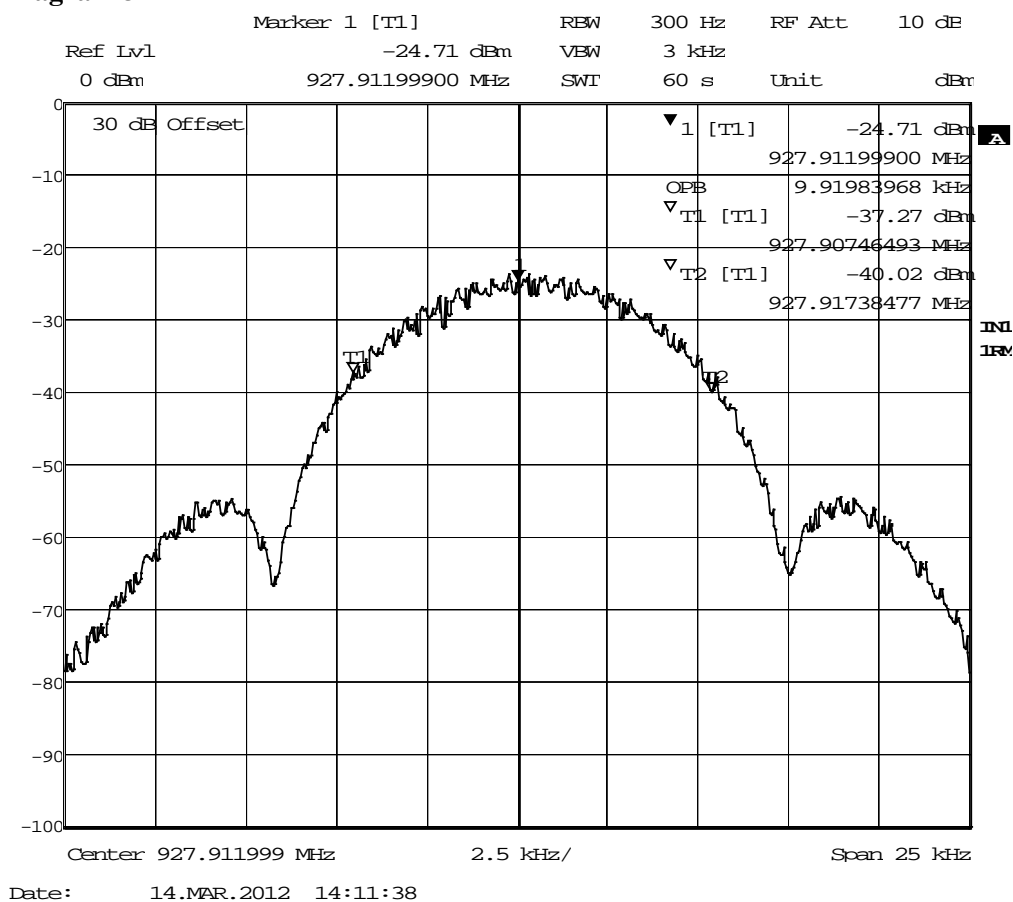


Diagram 3



Band edge measurements according to 47CFR 2.1049 / RSS-210 A2.9(b)

Date 2012-03-14	Temperature 22 °C ± 3 °C	Humidity 28 % ± 5 %
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Test set-up and procedure

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

The test was performed with the configuration with the highest fundamental power, with the RP-SMA straight antenna.

The test was performed with the power setting: 41D792 (nominal) and with continuous transmission with normal duty cycle (28%) 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.

Test set-up photos during the tests can be found in Appendix 10, picture 2.

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. 6.30.10	503 745
Antenna Schaffner Bilog CBL6143	504 079
Temperature and humidity meter Testo 625	504 117

Results

Operation band 902-928 MHz

The pre-measurement diagrams with peak detector can be found in the diagrams below

	<u>f of EUT</u>	<u>Band edge at 902 MHz</u>
	902.0875 MHz	QP level at 902 MHz =42.7 dBμV/m Marker-delta method, step 1: QP level at fundamental = 88.8 dB μ V/m (according to Appendix 2)
Diagram 1	902.0875 MHz	Marker-delta method. Step 2: Delta between fundamental and 902 MHz = 46.1 dB. Step 3: Decrease the measured peak level in step 1: 88.8-46.1 = 42.7 dB μ V/m=level at band edge (limit=46.0 dB μ V/m) QP level at 901.76 MHz =45.6 dBμV/m (2x standard RBW (120 kHz) from band edge)
		<u>Band edge at 928 MHz</u>
	927.9125 MHz	QP level at 928 MHz =44.3 dBμV/m Marker-delta method, step 1: QP level at fundamental = 91.8 dB μ V/m (according to Appendix 2)
Diagram 2	927.9125 MHz	Marker-delta method. Step 2: Delta between fundamental and 928 MHz = 47.5 dB. Step 3: Decrease the measured peak level in step 1: 91.8-47.5 = 44.3 dB μ V/m=level at band edge (limit=46.0 dB μ V/m) QP level at 928.24 MHz =43.6 dBμV/m (2x standard RBW (120 kHz) from band edge)

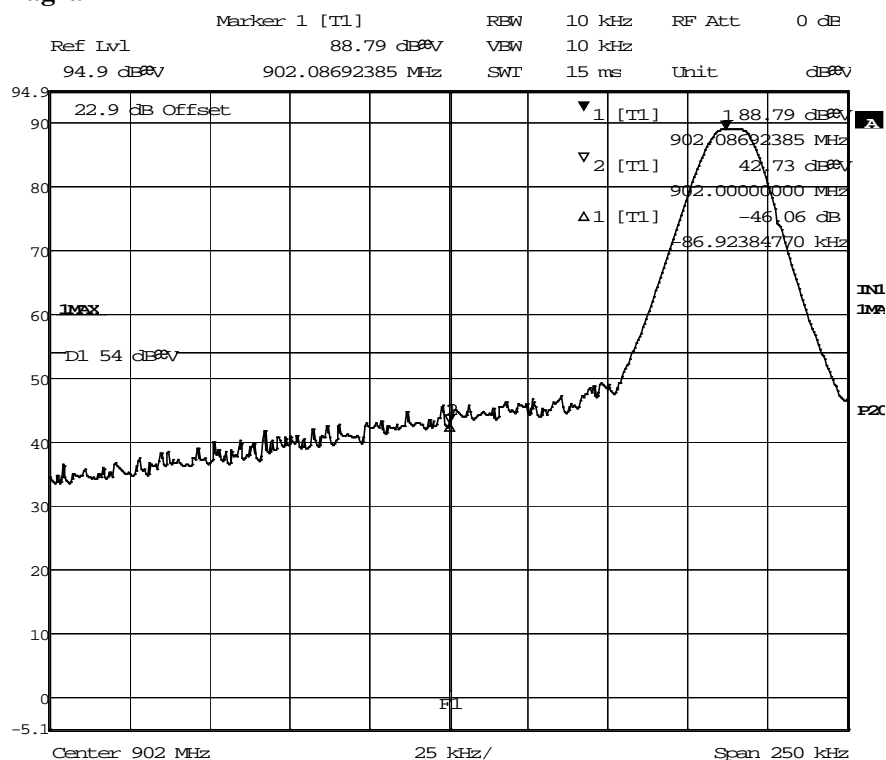
Limits

According to 47CFR 15.249(d), emission radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in section 15.209, whichever is the lesser attenuation.

According to RSS-210 A2.9(b), emissions radiated the outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general field strength limits listed in RSS-Gen, whichever is the less stringent.

Complies?	Yes
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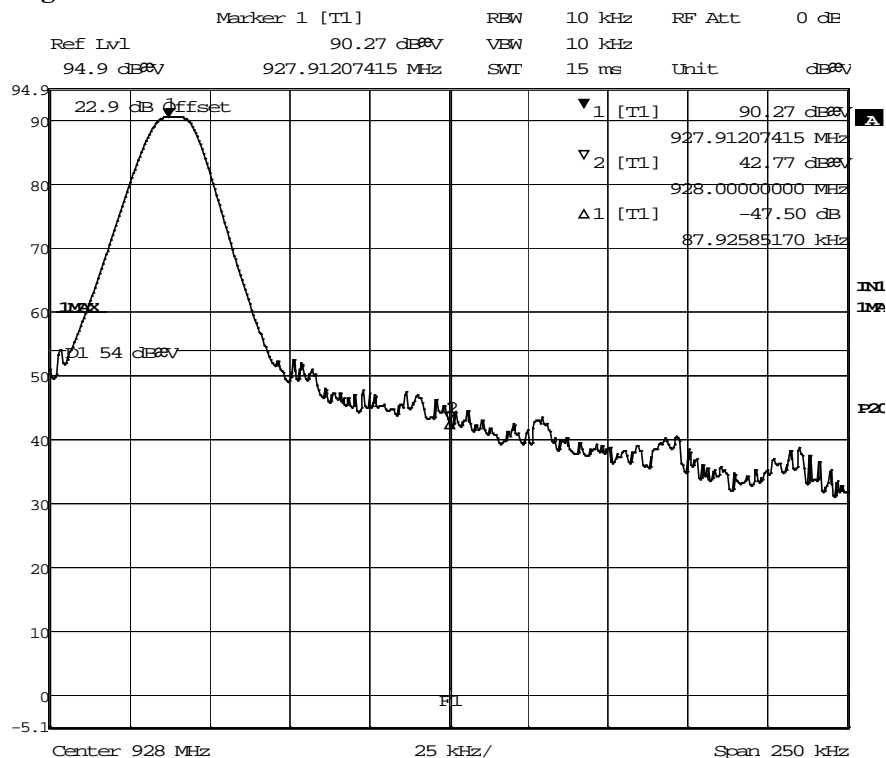
Diagram 1



Date: 14.MAR.2012 08:25:58

Note: The limit in the diagram is wrong, shall be 46 dB μ V/m

Diagram 2



Date: 14.MAR.2012 09:27:39

Note: The limit in the diagram is wrong, shall be 46 dB μ V/m

RF exposure evaluation: Mobile equipment / RSS-102 2.5.1

Date 2012-03-14	Temperature 22 °C ± 3 °C	Humidity 28 % ± 5 %
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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,

$$P_d = P_{out} \times G / (4 \times \pi \times r^2_{cm})$$

where,

P_d = power density in mW/cm²

P_{out} = output power to antenna in mW

G = gain of antenna in linear scale

π = 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 3 was used for calculation of MPE.

Antenna Gain (dBi)	Antenna Gain (numeric)	EIRP Peak output power (dBm)	Peak output power (mW)	Power density, P_d [S] (mW/cm ²)	Limit of power density (mW/cm ²)
Note 1	Note 1	-3.4 Note 2	0.457	0.00009	0.62

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

Note 2: The measurements were performed in field strength in dBμV/m. The EIRP level was then calculated by the formula $P = (E_{fd})^2 / 30 \times G$, with G as unity gain of 1.

Limits

(A) Limits for Occupational/Controlled Exposure

Frequency range (MHz)	Electric field strength [E] (V/m)	Magnetic field 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 field 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:

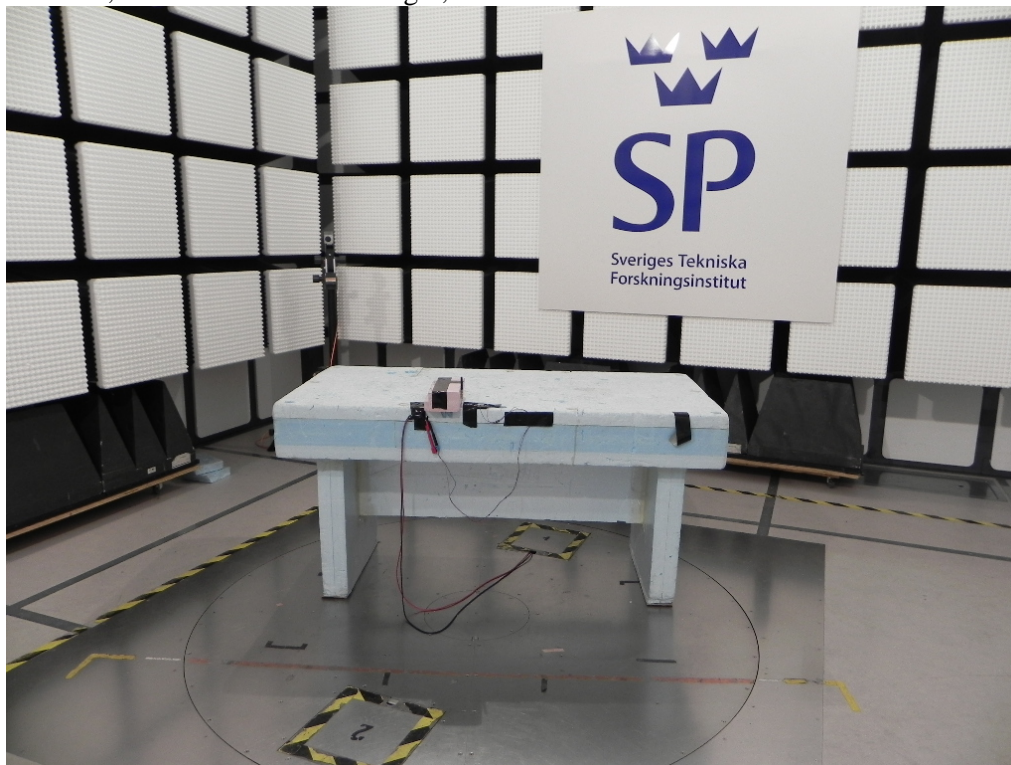
- From 3 kHz up to 1 GHz inclusively, and with output power (i.e. the higher of the conducted or equivalent isotropically radiated power (e.i.r.p) source-base, time-averaged output power) that is less than or equal to 200 mW for general use and 1000 mW for controlled use.

Complies?	Yes
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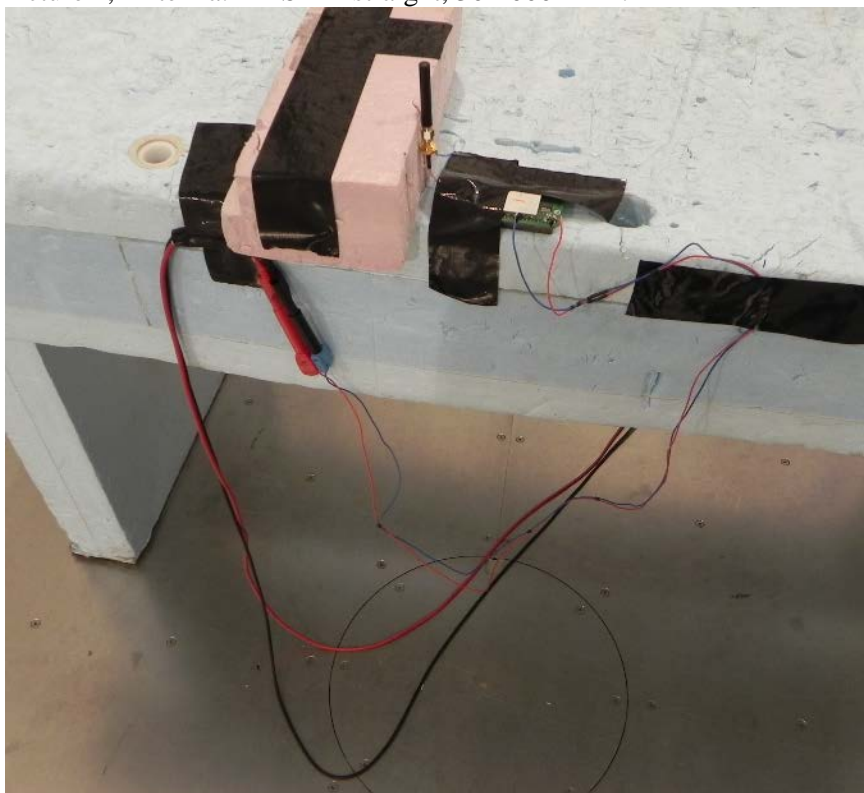
Photos

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

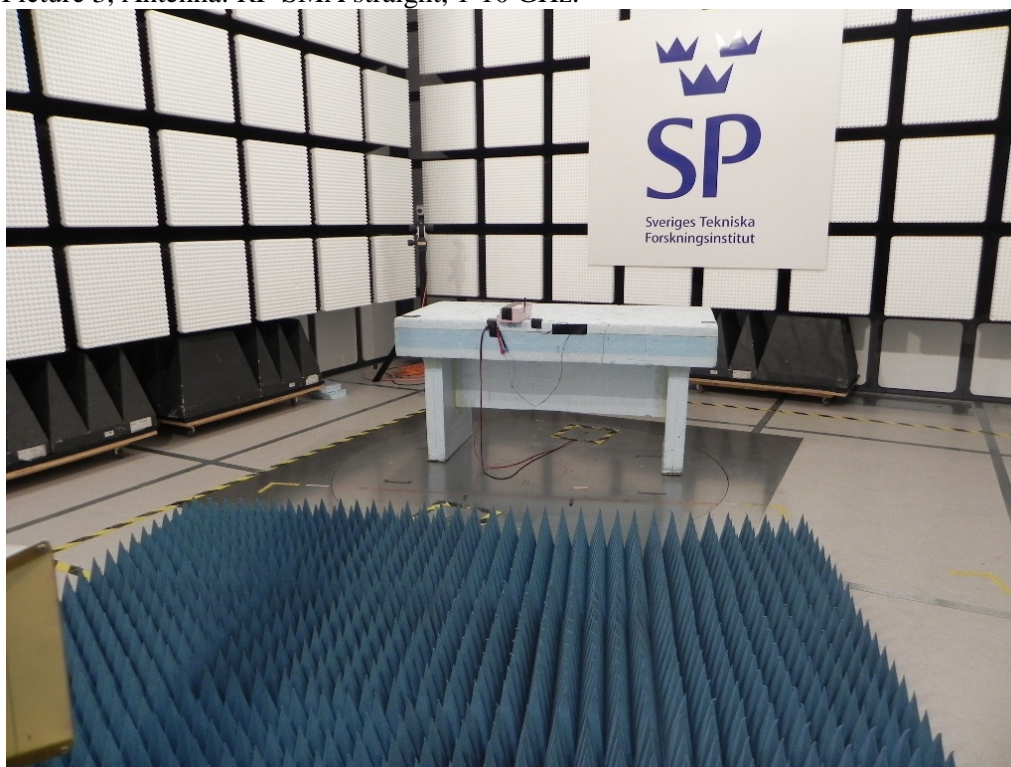
Picture 1, Antenna: RP-SMA straight, 30-1000 MHz:



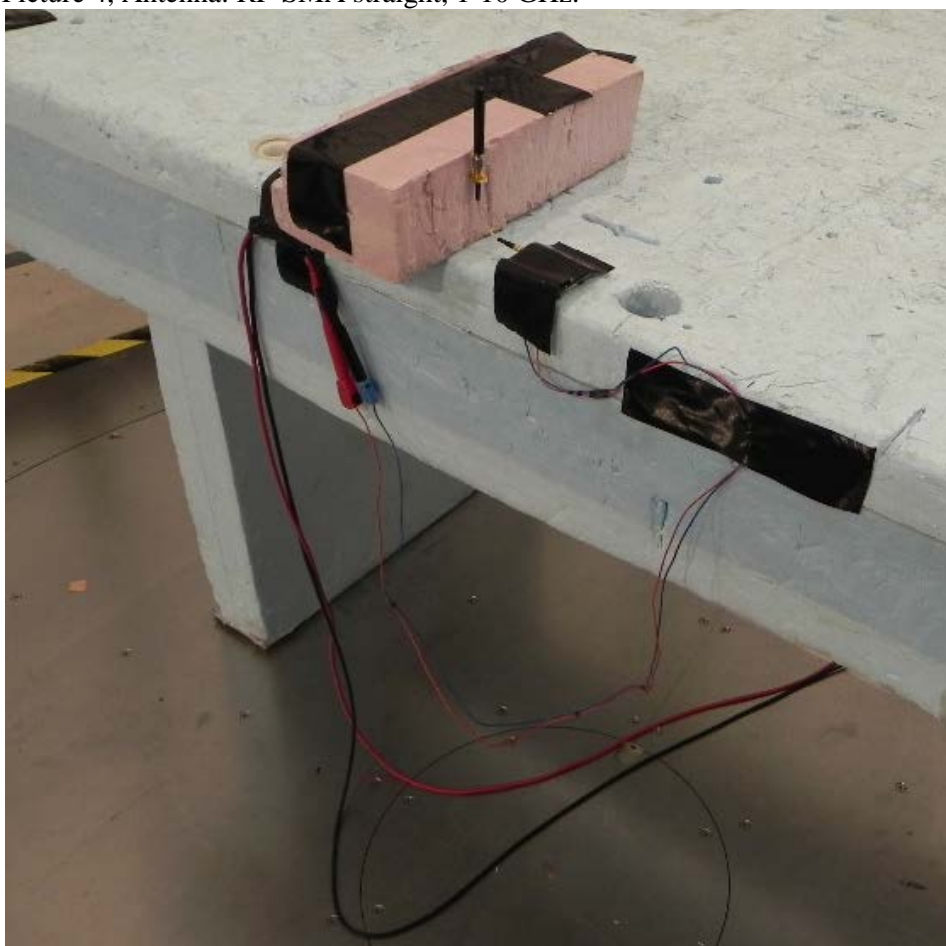
Picture 2, Antenna: RP-SMA straight, 30-1000 MHz:



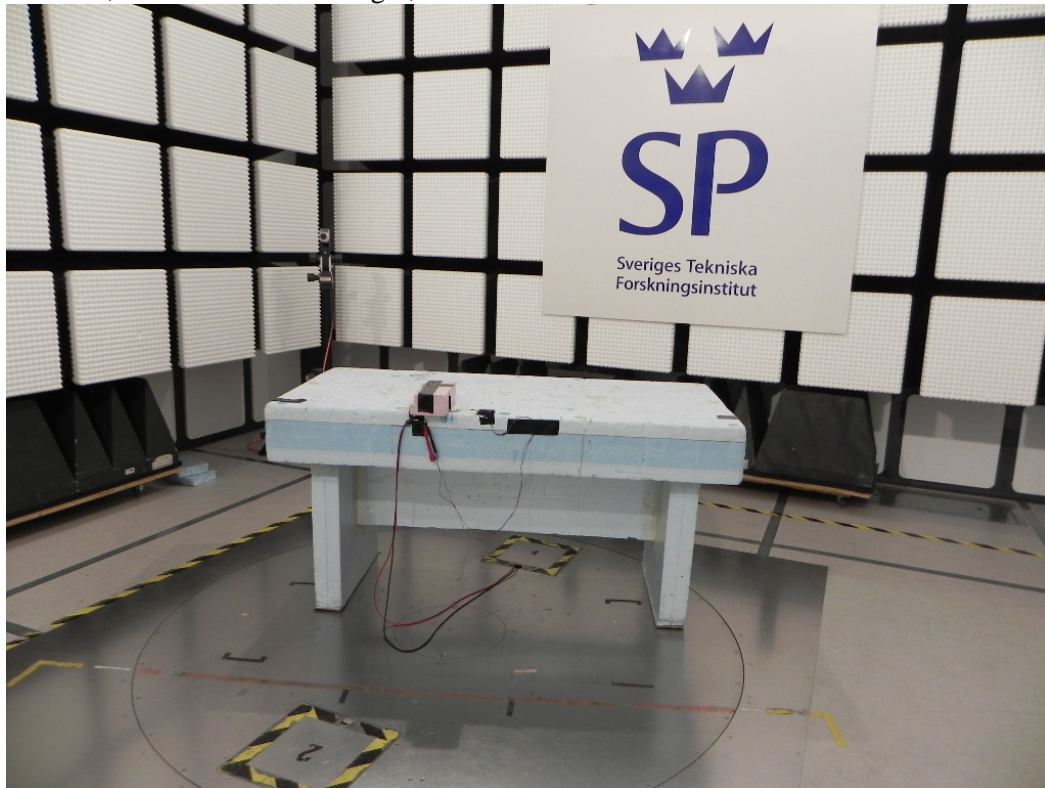
Picture 3, Antenna: RP-SMA straight, 1-10 GHz:



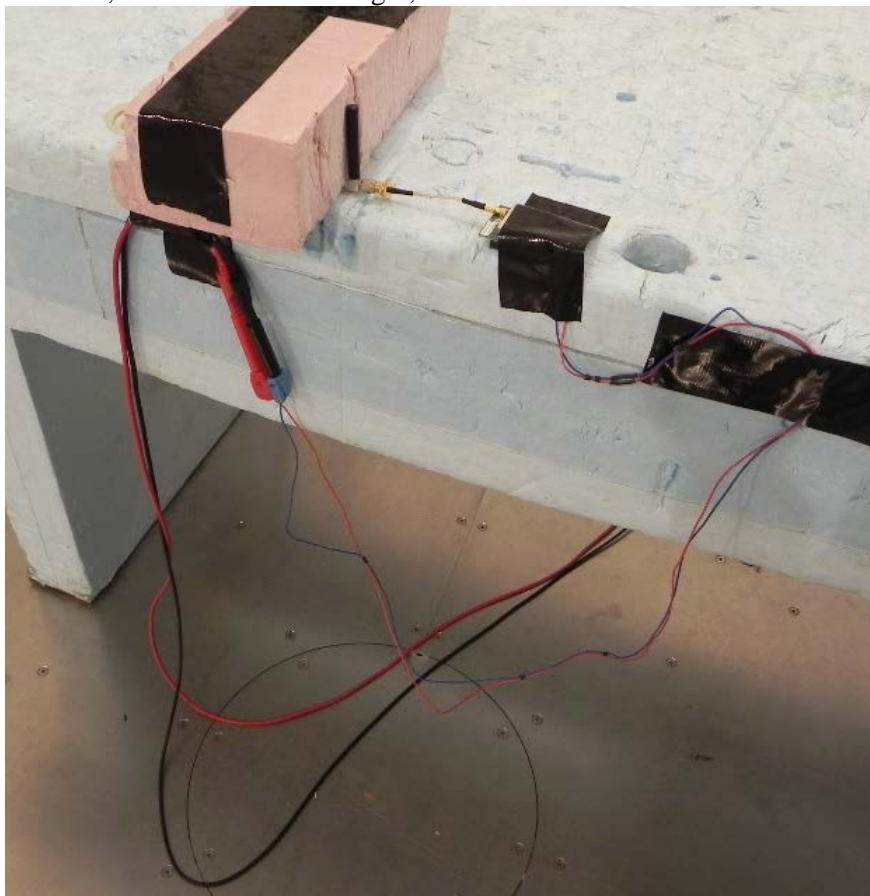
Picture 4, Antenna: RP-SMA straight, 1-10 GHz:



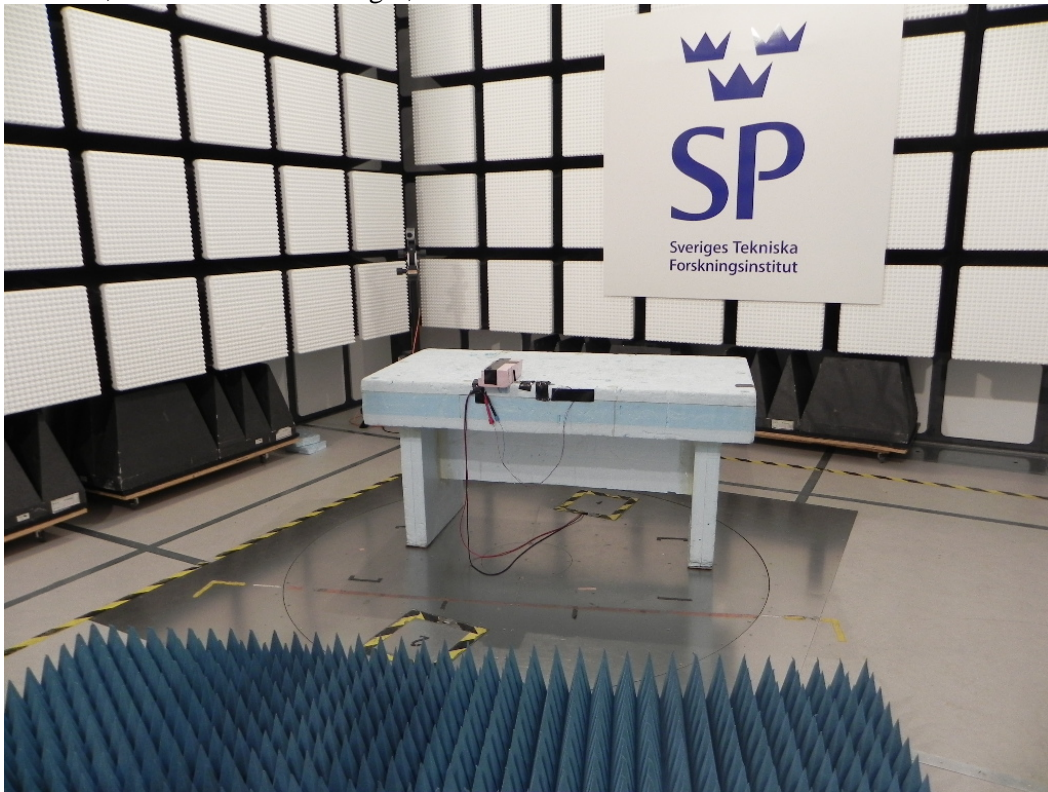
Picture 5, Antenna: RP-SMA right, 30-1000 MHz:



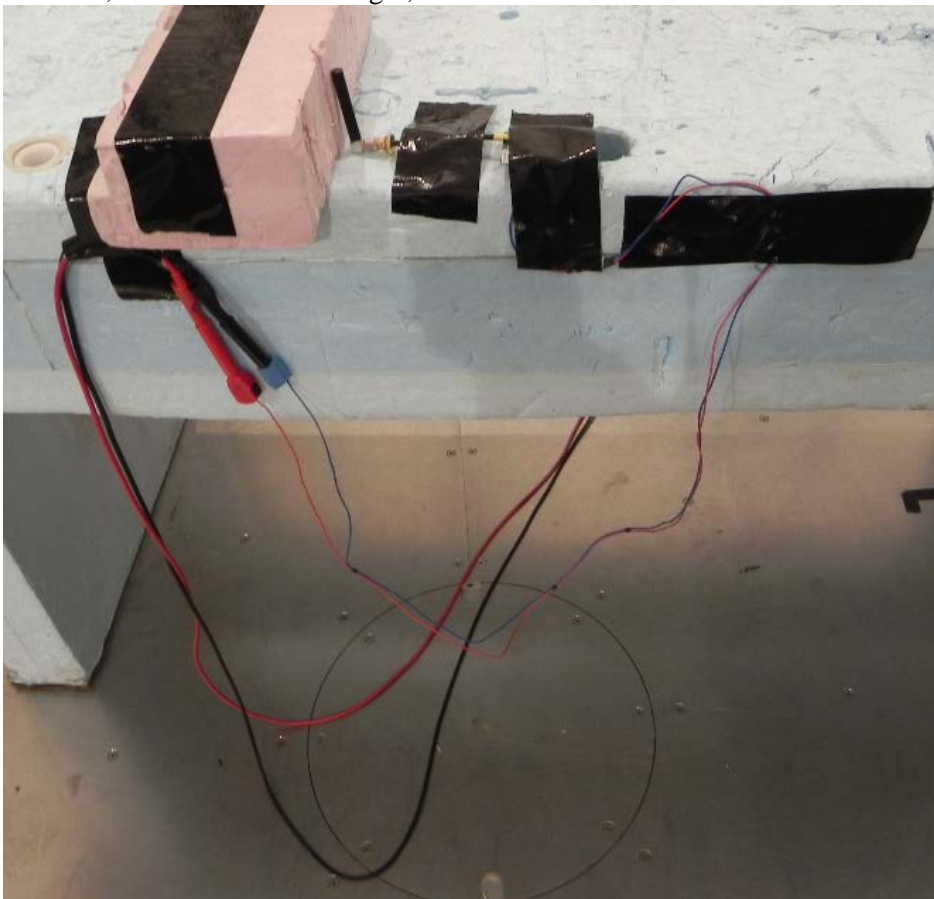
Picture 6, Antenna: RP-SMA right, 30-1000 MHz:



Picture 7, Antenna: RP-SMA right, 1-10 GHz:



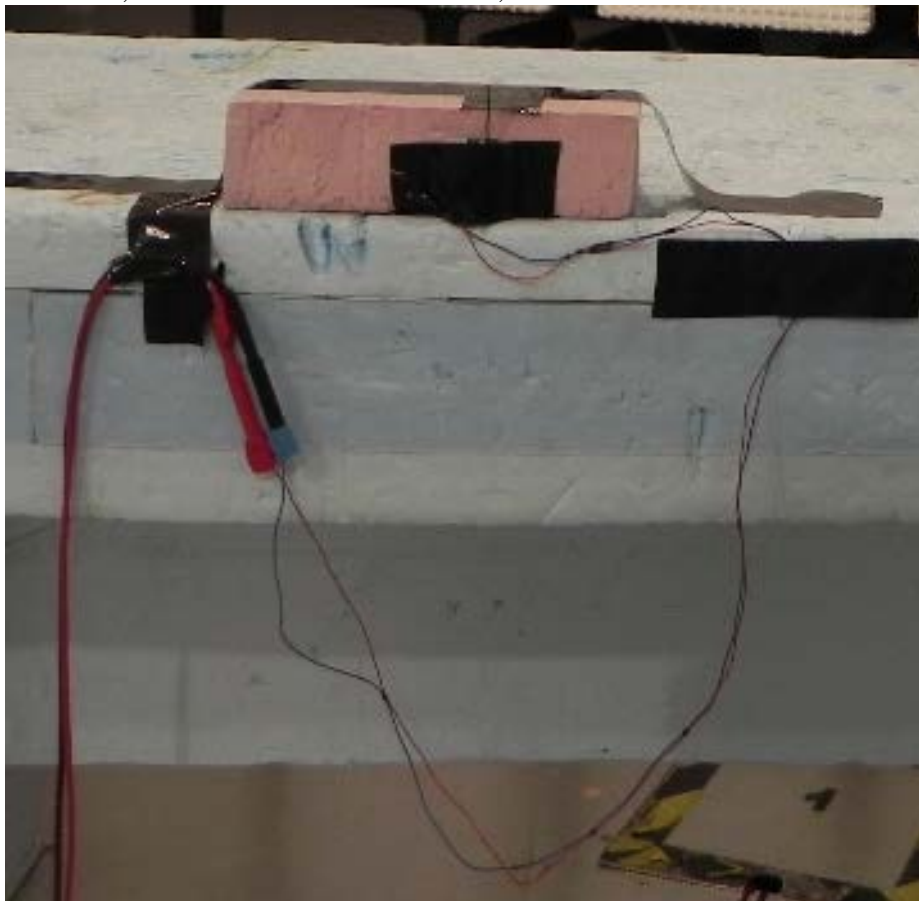
Picture 8, Antenna: RP-SMA right, 1-10 GHz:



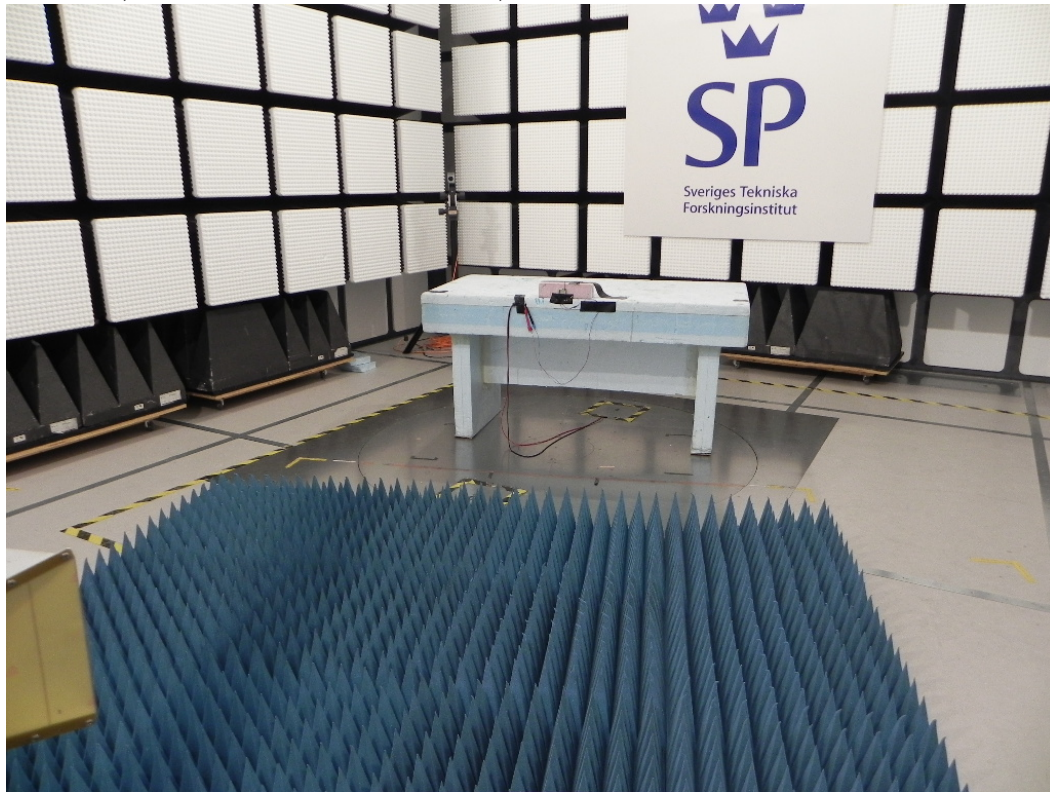
Picture 9, Antenna: Wire antenna 40 mm, 30-1000 MHz:



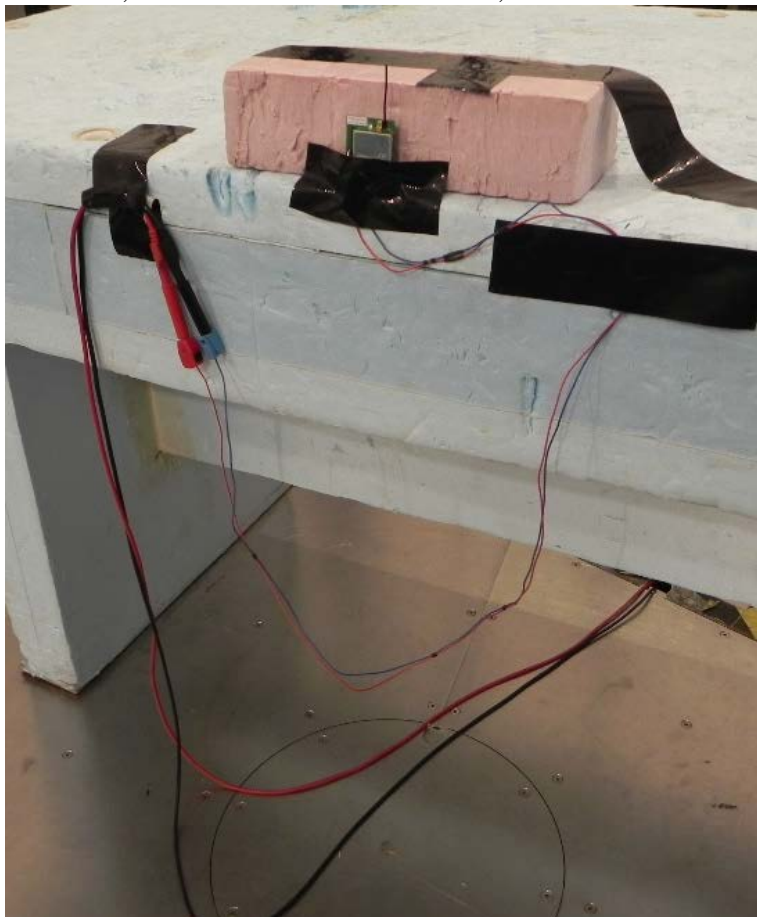
Picture 10, Antenna: Wire antenna 40 mm, 30-1000 MHz:



Picture 11, Antenna: Wire antenna 40 mm, 1-10 GHz:

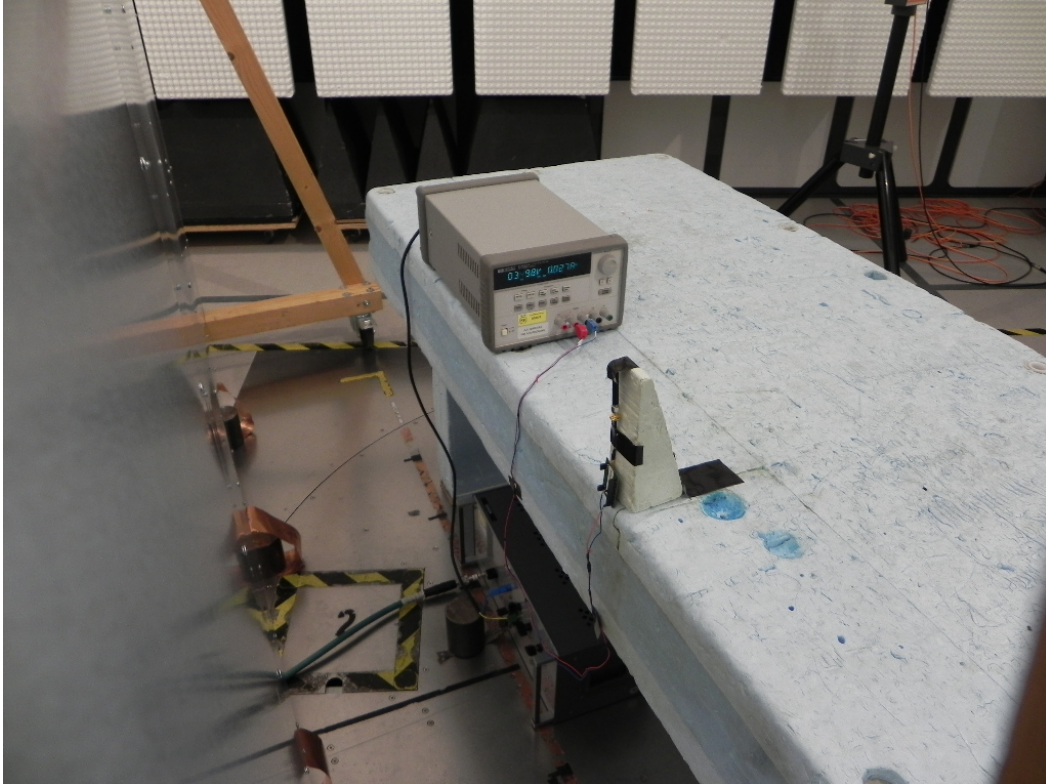


Picture 12, Antenna: Wire antenna 40 mm, 1-10 GHz:



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

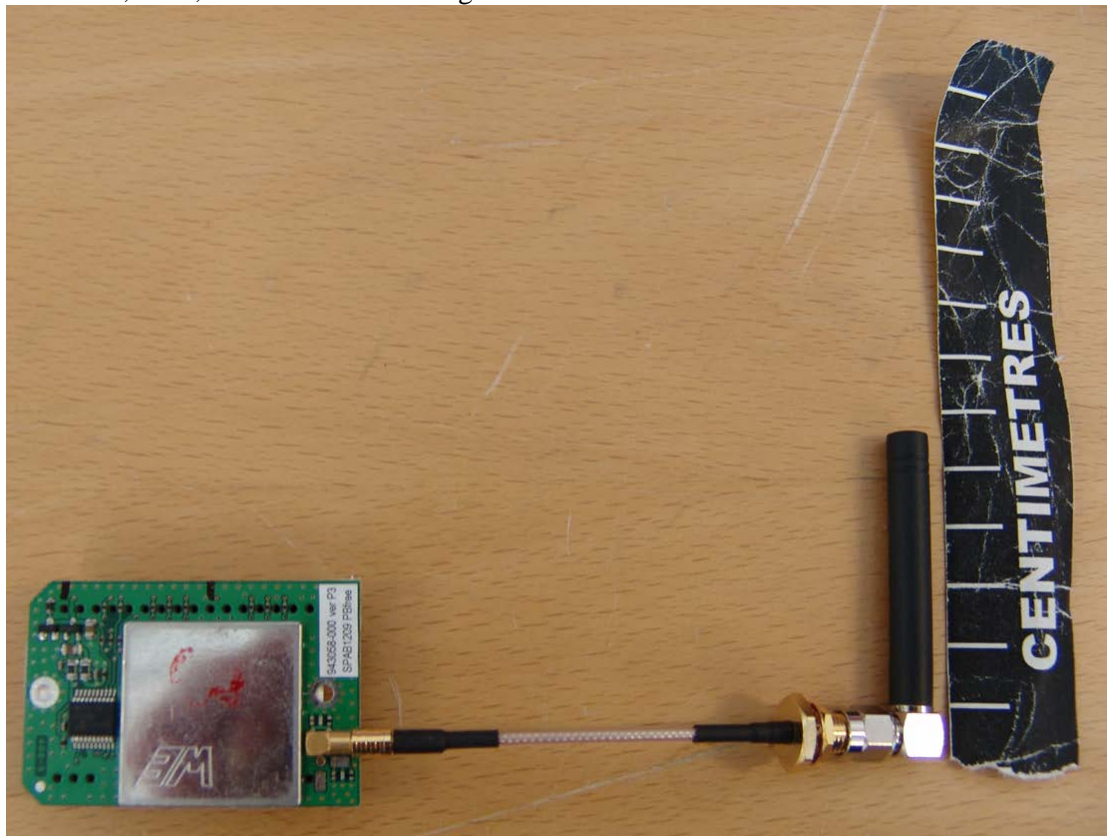
Picture 13:



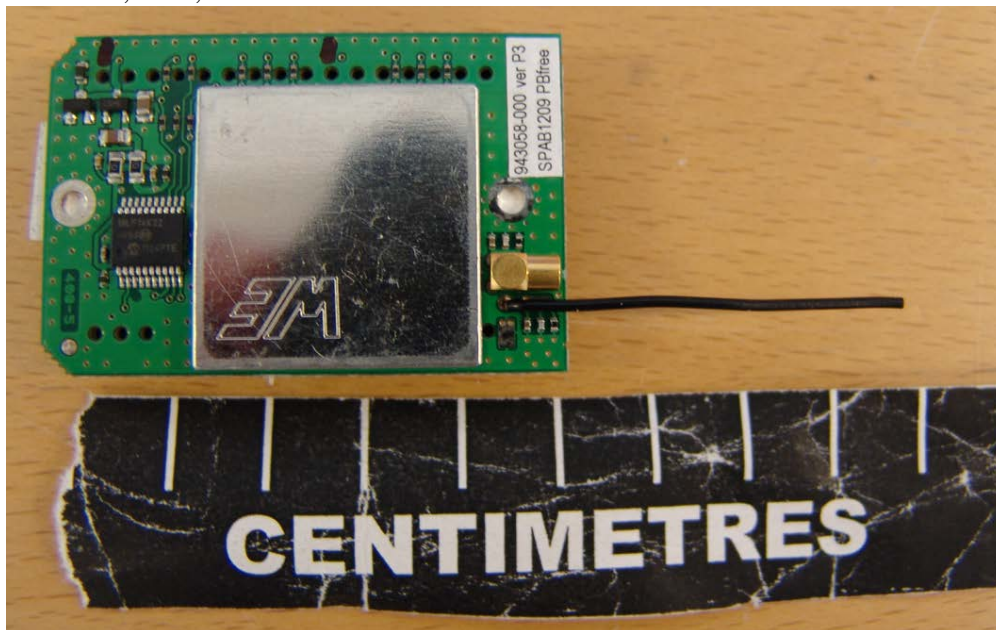
Picture 14, EUT, Antenna: RP-SMA straight:



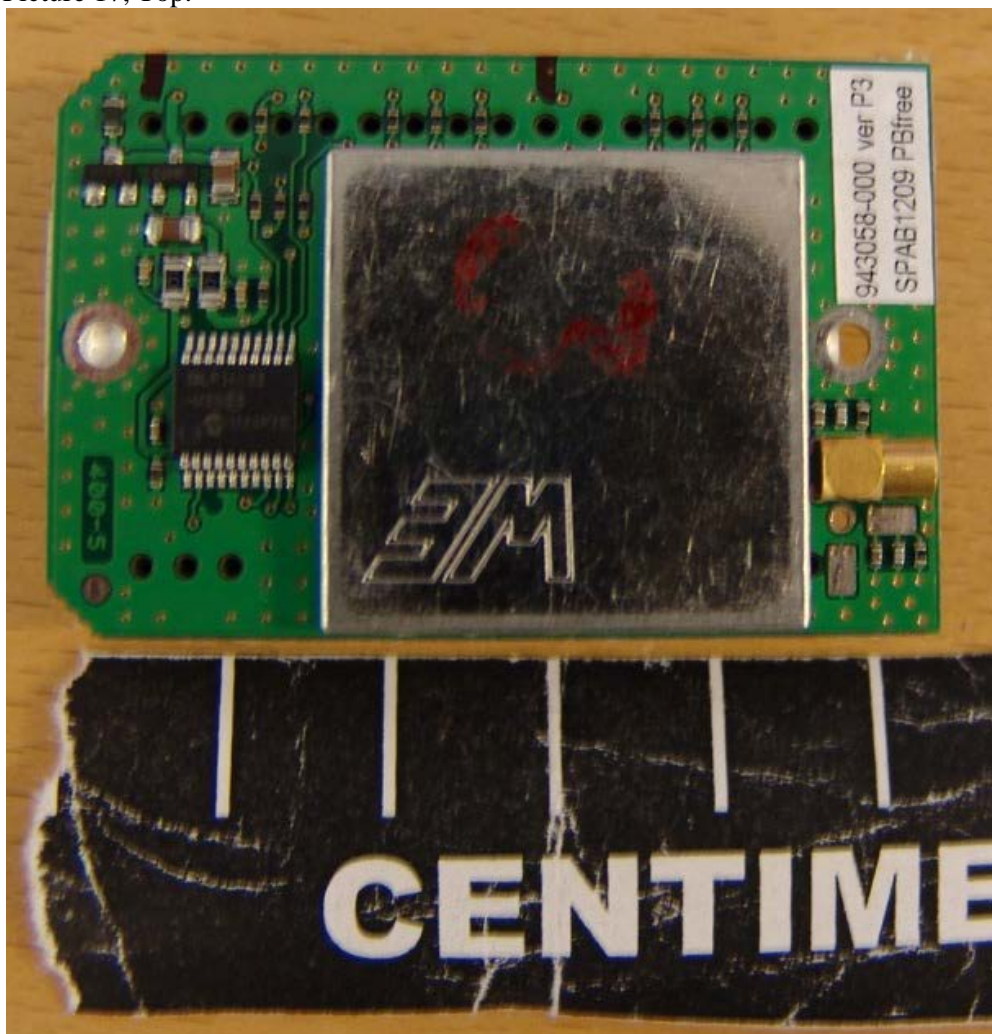
Picture 15, EUT, Antenna: RP-SMA right:



Picture 16, EUT, Antenna: Wire antenna 40 mm:



Picture 17, Top:



Picture 18, Rear:

