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Hatteland Computer AS
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NORWAY

Equipment Authorization measurements on 903-927 MHz Transceiver Unit, modular device FCC ID: Y62-RobR-915-2 (9 appendices)

Test object

Product name: Autostore Robot radio
Model: Robot Radio 915 2.0
Serial number: 2010030001
Software: AS-99163-USA test program 10.10.2010 rev.2

Summary

See Appendix 1 for general information and Appendix 9 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, June 2010	Yes		
15.249 (a) / RSS-210 A2.9(a) Field strength of fundamental	Yes	2	
15.249 (d) (e) / RSS-210 A2.9(b) Radiated emission	Yes	3	
15.215 (c) 20 dB bandwidth	Yes	4	
15.207 / RSS-Gen 7.2.4 Conducted emission limits	Yes	5	
2.1049 / RSS-Gen 4.6.1 Occupied bandwidth	Yes	6	
2.1049 / RSS-210 A2.9(b) Band Edge	Yes	7	
RF Safety / RSS-102 2.5.1 SAR Evaluation	Yes	8	

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
2011-06-07

Reference
PX03821-RR1

Page
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FCC ID: Y62-RobR-915-2

SP Technical Research Institute of Sweden
Electronics - EMC

Fredrik Isaksson
Technical Officer

Christer Karlsson
Technical Manager

Performance test and requirements

The tests were performed to verify that Hatteland Computer Autostore Robot radio meets the electromagnetic compatibility requirements of FCC 47 CFR part 15 C.

Test facility

The used test site (SP 504 114) 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, file number: IC 3482A-2.

Test object

Transceiver:	Hatteland Computer Autostore Robot radio
Antenna:	Dedicated, RF solutions, Flexi-4BA-916
Antenna gain:	0 dBi
Frequency range:	903.0-927.0 MHz
Frequencies used during test:	903.0 MHz 915.0 MHz 927.0 MHz
Modulation:	GFSK
Data rate:	50 kbps
Supply voltage:	5.0 V DC

During the test the EUT was powered by a external DC power supply, Agilent E3620A SP 503 672, 5.0 V DC, if not otherwise stated.

Operational test mode

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.

Settings of the EUT was performed with an external computer. The external computer was not connected during the test.

For duty cycle measurements see appendix 2.

At normal use the EUT has a duty cycle of 1.37 %, burst transmissions.

With the setting CY (duty cycle at normal use) the duty cycle was measured to $2.75/199.82 \text{ ms} = 0.0138 = 1.38\%$.

The PRF was calculated to $\text{PRF} = 1/T = 1/199.82 \text{ ms} = 5 \text{ Hz}$.

The signal was a broad band signal (pulse spectrum) with the $\text{RBW} > 1/\tau > 1/2.75\text{ms} > 364$, thus no correction for pulse desensitization was necessary.

Cabling during emission test:

EUT port	Cable type	Termination / use
RS232/DC power	AS-11542-Rev#5 1m. Multi-wire, unshielded, 0.65 m length. The DC power was extended with 1.0 m cable.	RS232 unterminated. DC power, connected to the external 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
Conducted emission	3.5 dB

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: 2010-10-11 and 2010-12-06

Test participant

Geir Kõrge-Hårajuvet, Egesys OÜ (partly present)

Test engineer

Fredrik Isaksson

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

Date	Temperature	Humidity
2010-12-08	22 °C ± 3 °C	22 % ± 5 %
2010-12-09	22 °C ± 3 °C	21 % ± 5 %

Test set-up and procedure

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

The EUT had the following settings during the test:

Power: - 2 dBm (command P1)

Duty cycle: 1.38% (command CY)

During the voltage variation test the duty cycle was 100%.

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 9.

Measurement equipment	Calibration Due	SP number
Semi anechoic chamber, Edison	2011-12	504 114
Spectrum analyzer R&S ESI 26	2011-08	503 885
EMI measurement computer	-	-
Software: R&S EMC32, ver. 6.30.20	-	503 745
Antenna Schaffner Bilog CBL6143	2013-04	504 079
Multimeter Fluke 85 III	2011-04	503 418
Temperature and humidity meter Testo 625	2011-04	504 117

Results

Duty cycle measurements can be found in Appendix 2.1:

Diagram 1: Tx on at Robot radio with normal duty cycle, setting CY

Diagram 2: Period time at Robot radio with normal duty cycle, setting CY

Field strength of fundamental measurements:

RBW=120 kHz

		Max peak output power Quasi-peak detector		
		903.0 MHz	915.0 MHz	927.0 MHz
	Antenna height	1.15 m	1.15 m	1.15 m
	Azimuth	54 deg	54 deg	54 deg
	Polarization	Vertical	Vertical	Vertical
T_{nom} 23°C	V_{nom} 5.0 V DC	92.8 dBμV/m (=-2.4 dBm ERP) Note 1	92.7 dBμV/m (=-2.5 dBm ERP) Note 1	90.4 dBμV/m (=-4.8 dBm ERP) Note 1
T_{nom} 23°C	V_{nom} 4.25 V DC Note 2	92.8 dBμV/m (=-2.4 dBm ERP) Note 1	92.7 dBμV/m (=-2.5 dBm ERP) Note 1	90.4 dBμV/m (=-4.8 dBm ERP) Note 1
T_{nom} 23°C	V_{nom} 5.50 V DC Note 2	92.8 dBμV/m (=-2.4 dBm ERP) Note 1	92.7 dBμV/m (=-2.5 dBm ERP) Note 1	90.4 dBμV/m (=-4.8 dBm ERP) Note 1

Note 1: The measurements were performed in field strength in dBμV/m. The ERP level was then calculated by the formula $ERP = E(dBμV/m) - 90 + 20\log(d) - 10\log(30)$, (d=antenna dist, =3 m).

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

According to the client the maximal upper voltage limit for the EUT was 5.50 V DC, thus 5.50 V DC was used instead of 5.75 V DC.

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 902-928 MHz	Field strength of fundamental 50 mV/m = 94 dBμV/m	Field strength of harmonics 500 μV/m = 54 dBμV/m
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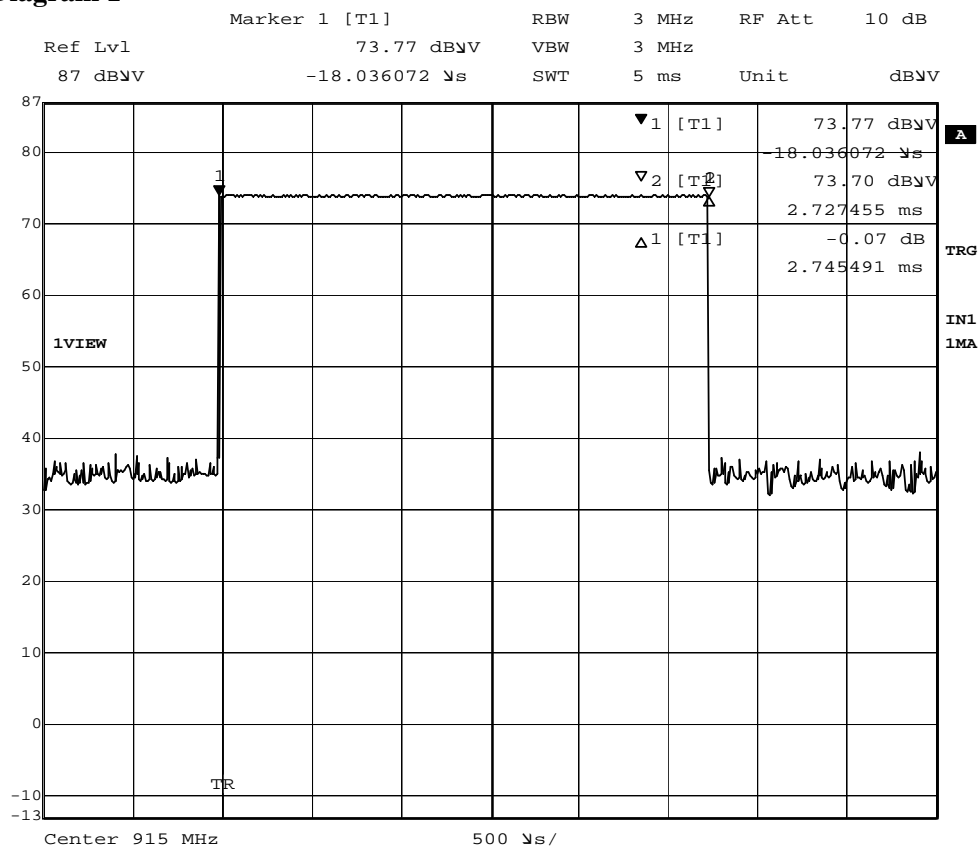
Complies?	Yes
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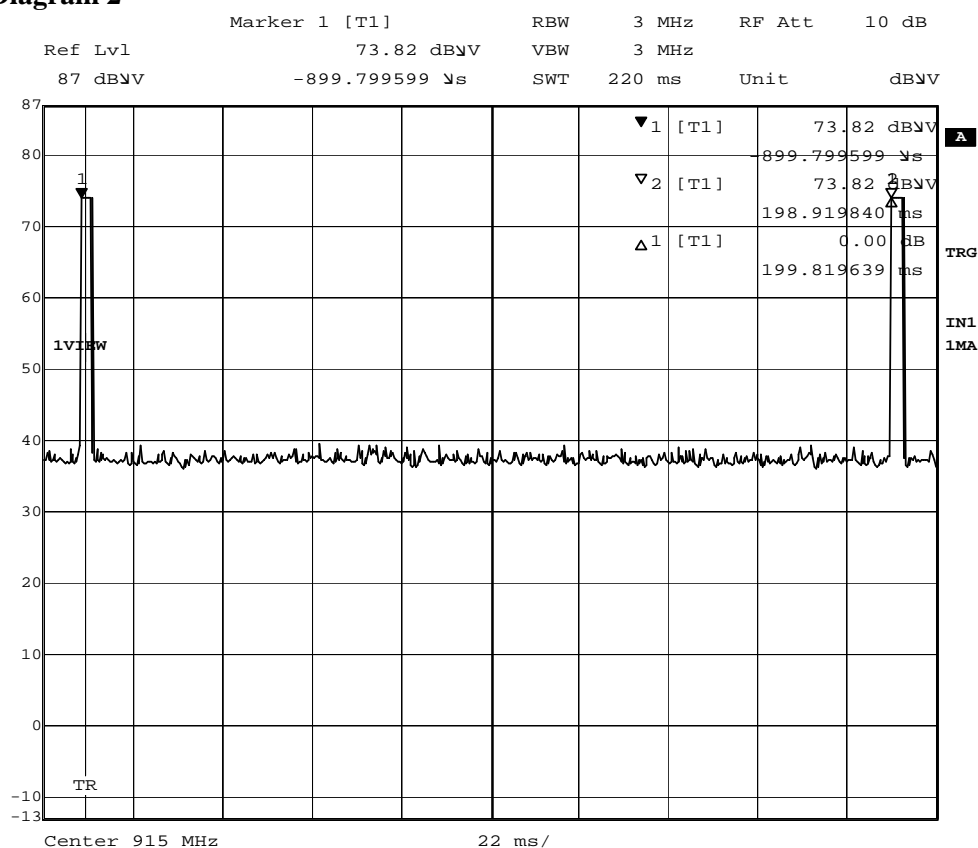
Appendix 2.1

Diagram 1



Date: 8.DEC.2010 15:39:00

Diagram 2



Date: 8.DEC.2010 15:41:02

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

Date	Temperature	Humidity
2010-12-09	22 °C ± 3 °C	21 % ± 5 %
2010-12-17	22 °C ± 3 °C	12 % ± 5 %

Test set-up and procedure

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

The EUT had the following settings during the test:

Power: - 2 dBm (command P1)

Duty cycle: 100% (command C1)

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 test was also performed with rotation of the EUT through three orthogonal axes to determine the position that produces the highest emission relative to the limit.

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 9.

Measurement equipment	Calibration Due	SP number
Semi anechoic chamber, Edison	2011-12	504 114
Spectrum analyzer R&S ESI 26	2011-08	503 885
EMI measurement computer	-	-
Software: R&S EMC32, ver. 6.30.10	-	503 745
Antenna Schaffner Bilog CBL6143	2013-04	504 079
Horn antenna EMCO 3115	2011-02	501 548
Preamplifier Miteq, 1 18 GHz	2011-07	504 160
High pass filter Wainwright WHKY	2011-07	504 199
Temperature and humidity meter Testo 625	2011-04	504 117

Results

The pre-measurement emission spectra can be found appendix 3.1:

Diagram 1: Radiated emission 30-1000 MHz, vertical polarization, ambient.

Diagram 2: Radiated emission 30-1000 MHz, horizontal polarization, ambient.

Diagram 3: Radiated emission 30-1000 MHz, 915.0 MHz, vertical and horizontal polarizations.

Diagram 4: Radiated emission 1-10 GHz, 915.0 MHz, vertical and horizontal polarizations.

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

903.0 MHz

Frequency (MHz)	QP level (dB μ V/m)	AV level (dB μ V/m)	Peak level (dB μ V/m)	Corr (dB)	Limit (dB μ V/m)	Height (m)	Azimuth (deg)	Polarization
54.090	32.1	N/A	-	11.6	40.0 (QP)	2.08	316	Vertical
607.999	36.1	N/A	-	20.8	46 (QP)	1.91	158	Vertical
677.275	40.8	N/A	-	21.1	46 (QP)	1.00	238	Vertical
1806.230	N/A	45.1	47.8	-18.1	53.9 (Av)	1.60	177	Vertical

915.0 MHz

Frequency (MHz)	QP level (dB μ V/m)	AV level (dB μ V/m)	Peak level (dB μ V/m)	Corr (dB)	Limit (dB μ V/m)	Height (m)	Azimuth (deg)	Polarization
54.069	32.1	N/A	-	11.6	40.0 (QP)	2.08	316	Vertical
55.728	31.7	N/A	-	11.2	40.0 (QP)	1.09	219	Vertical
96.007	30.8	N/A	-	10.0	43.5 (QP)	1.00	162	Vertical
128.009	29.3	N/A	-	13.8	43.5 (QP)	1.00	158	Vertical
175.997	28.8	N/A	-	11.4	43.5 (QP)	1.33	247	Horizontal
607.999	36.4	N/A	-	20.8	46 (QP)	1.91	158	Vertical
686.267	38.8	N/A	-	21.1	46 (QP)	1.00	238	Vertical
1830.170	N/A	45.8	48.3	-18.3	53.9 (Av)	1.60	177	Vertical

927.0 MHz

Frequency (MHz)	QP level (dB μ V/m)	AV level (dB μ V/m)	Peak level (dB μ V/m)	Corr (dB)	Limit (dB μ V/m)	Height (m)	Azimuth (deg)	Polarization
54.069	31.9	N/A	-	11.6	40.0 (QP)	2.08	316	Vertical
695.209	37.0	N/A	-	21.1	46 (QP)	1.00	238	Vertical
1854.110	N/A	43.8	46.1	-18.1	53.9 (Av)	1.45	181	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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FCC ID: Y62-RobR-915-2

Appendix 3.1

Diagram 1

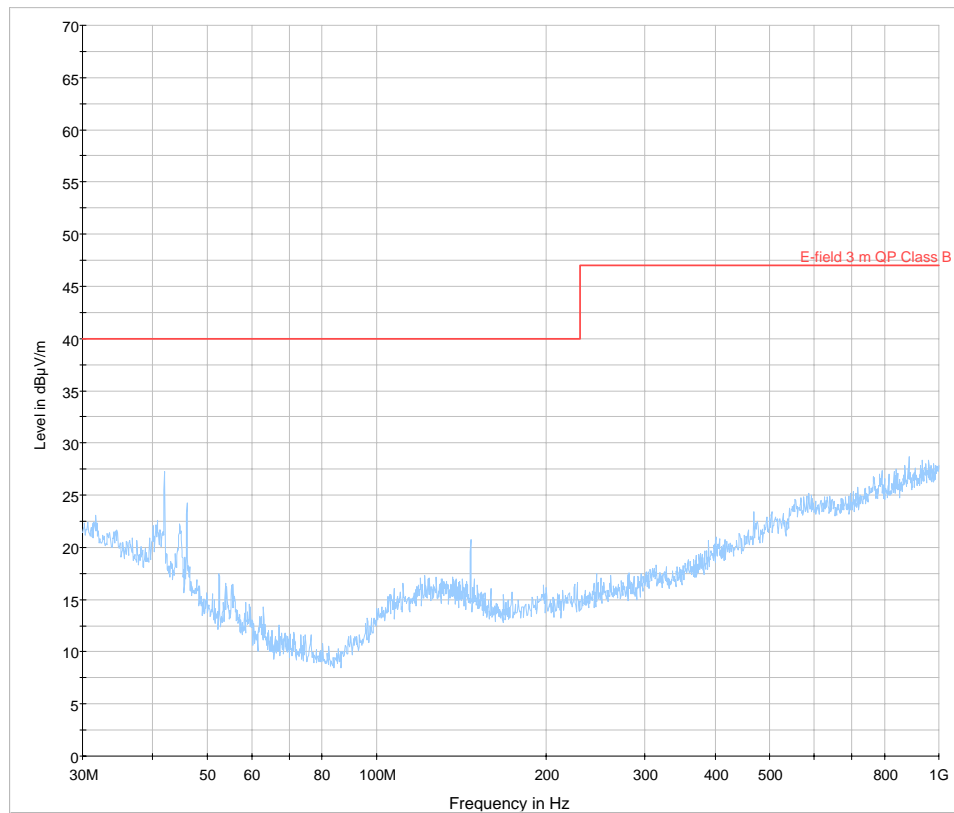
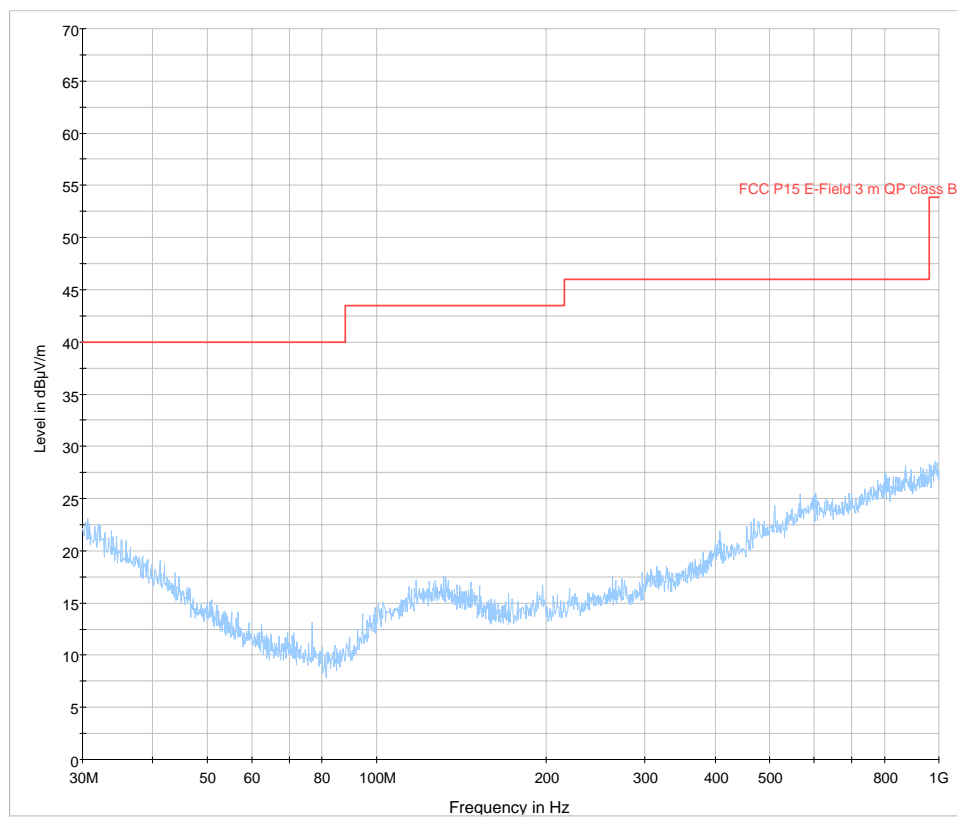


Diagram 2



FCC ID: Y62-RobR-915-2

Appendix 3.1

Diagram 3

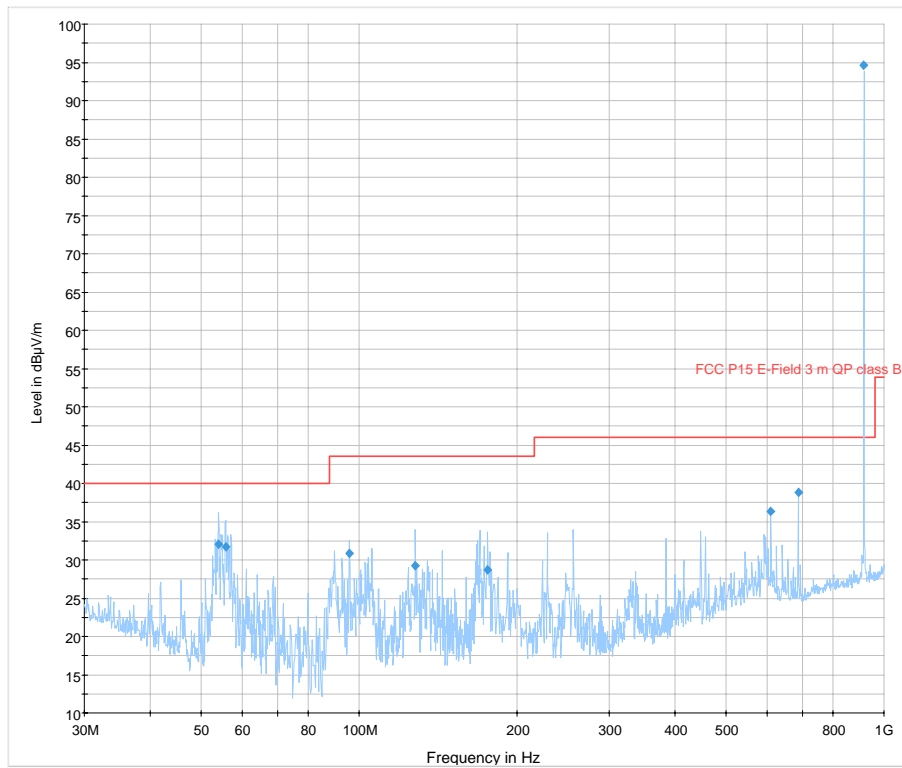
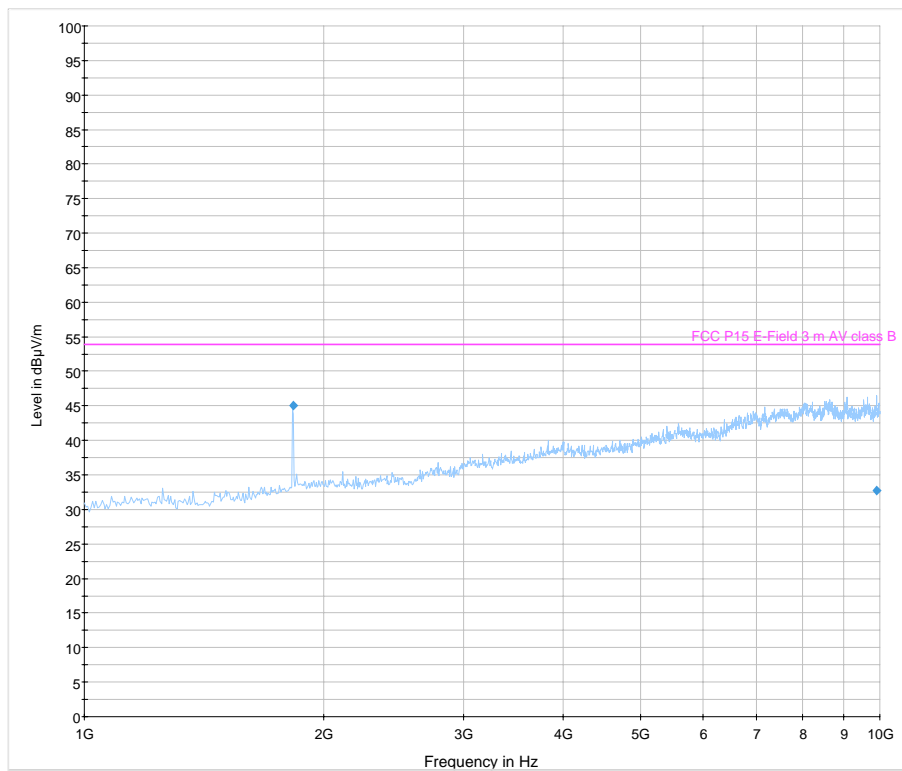


Diagram 4



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Appendix 4

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

Date 2010-12-09	Temperature 22 °C ± 3 °C	Humidity 21 % ± 5 %
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Test set-up and procedure

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

The EUT had the following settings during the test:

Power: - 2 dBm (command P1)

Duty cycle: 1.38% (command CY)

The radiated 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, 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 9.

Measurement equipment	Calibration Due	SP number
Semi anechoic chamber, Edison	2011-12	504 114
Spectrum analyzer R&S ESI 26	2011-08	503 885
EMI measurement computer	-	-
Software: R&S EMC32, ver. 6.30.10	-	503 745
Antenna Schaffner Bilog CBL6143	2013-04	504 079
Temperature and humidity meter Testo 625	2011-04	504 117

Measurement uncertainty: 2.6 %

Results

The diagram can be found in Appendix 4.1.

Diagram 1 903.0 MHz 20 dB BW = **173.35 kHz**

Diagram 2 915.0 MHz 20 dB BW = **173.35 kHz**

Diagram 3 927.0 MHz 20 dB BW = **174.35 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.

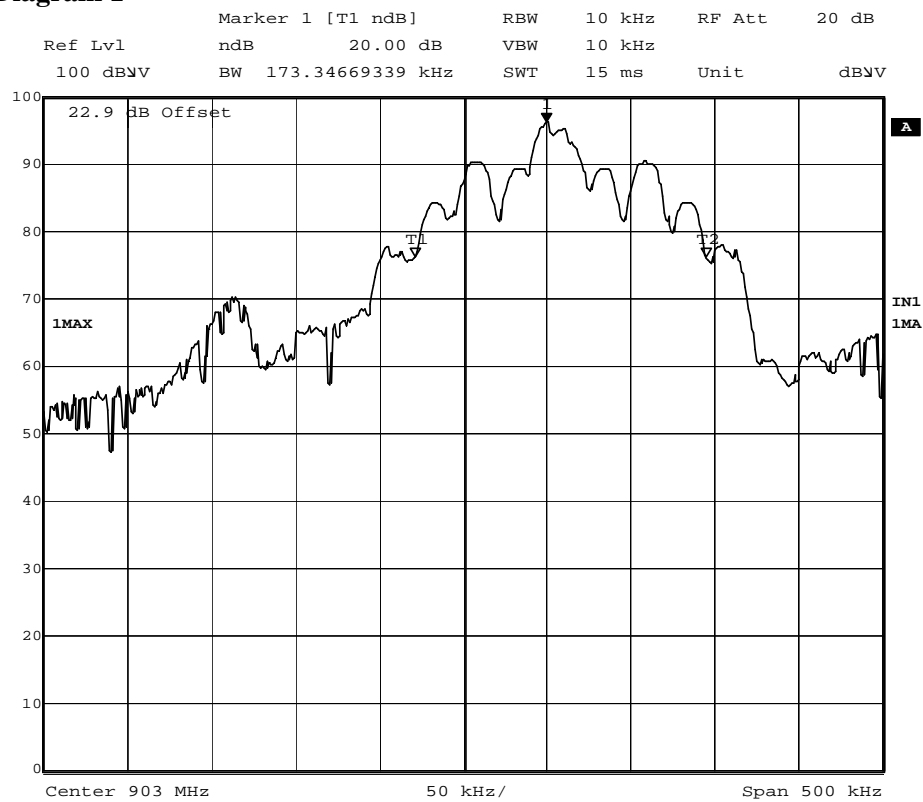
Complies?	Yes
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FCC ID: Y62-RobR-915-2

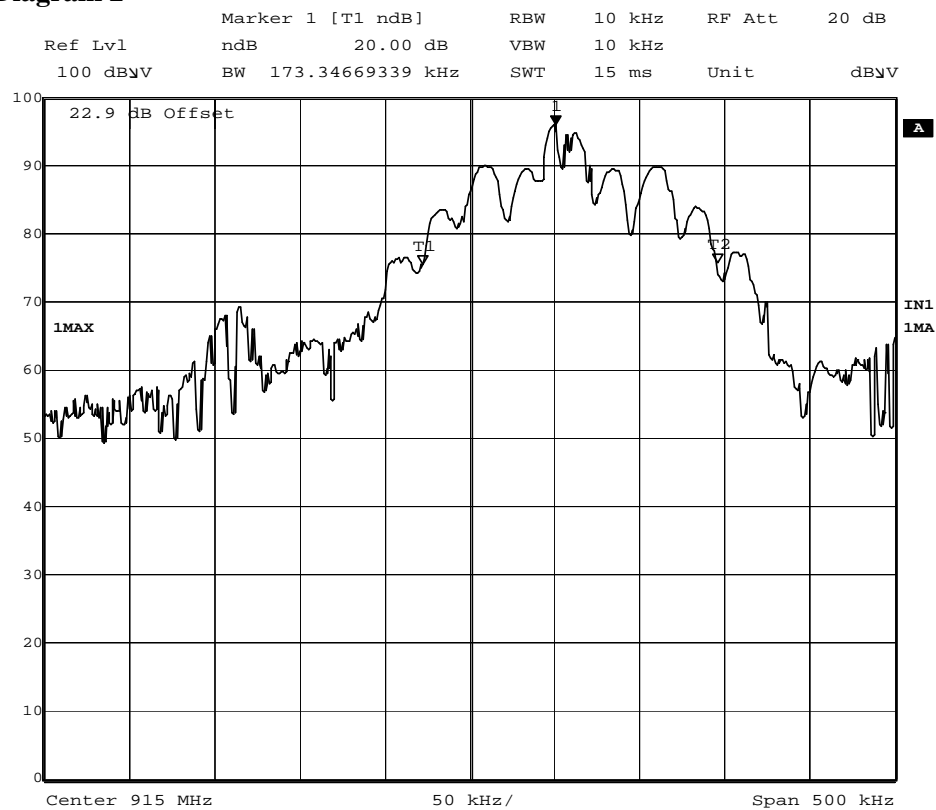
Appendix 4.1

Diagram 1



Date: 9.DEC.2010 15:33:02

Diagram 2



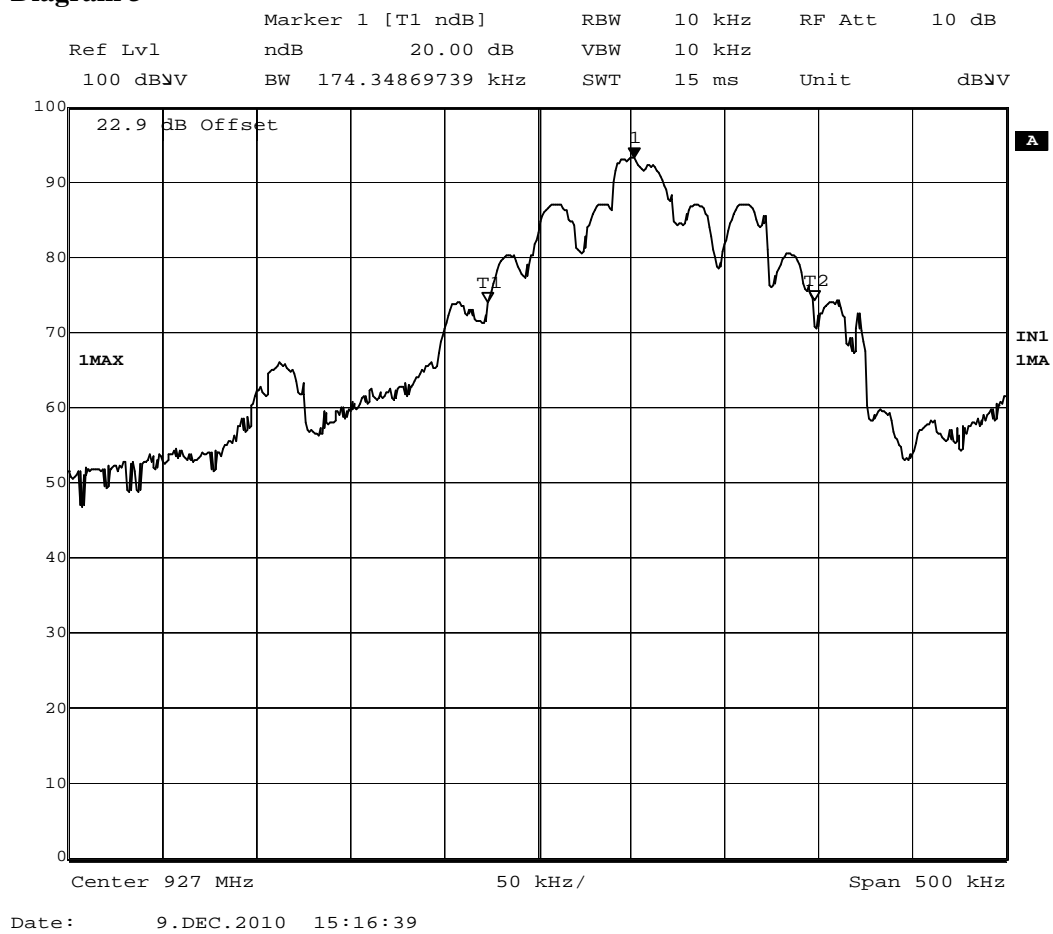
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FCC ID: Y62-RobR-915-2

Appendix 4.1

Diagram 3



FCC ID: Y62-RobR-915-2

Appendix 5

Conducted emission measurements according to FCC 47 CFR part 15.207, class B / RSS-Gen 7.2.2

Date 2010-11-03	Temperature 23 °C ± 3 °C	Humidity 36 % ± 5 %
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Test set-up and procedure

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

The EUT had the following settings during the test:

Power: - 2 dBm (command P1)

Duty cycle: 100% (command C1)

Measurements were performed on the 120 V AC/60 Hz, phase and neutral terminals, at the external DC power supply, Agilent E3632A, SP 503 170, 5.0 V DC.

Test set-up photos during the tests can be found on page 2.

Measurement equipment	Calibration Due	SP number
Test site Hertz	2011-12	15:116
Spectrum analyzer R&S ESI 40	2011-07	503 125
EMI measurement computer	-	-
Software: R&S EMC32, ver. 8.20.1	-	503 899
LISN Schwartzbeck NSLK 8126	2012-04	503 114
Temperature and humidity meter Testo 616	2012-04	503 498

Result

The conducted emission spectra can be found in Appendix 5.1:

Diagram 1:	120 V AC, neutral terminal, ambient, voltage off at DC power supply
Diagram 2:	120 V AC, neutral terminal, ambient, power off at DC power supply
Diagram 3:	120 V AC, phase terminal, 903.0 MHz
Diagram 4:	120 V AC, neutral terminal, 903.0 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, 927.0 MHz
Diagram 8:	120 V AC, neutral terminal, 927.0 MHz

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



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Appendix 5

Limits

According to 47CFR 15.207 and according to RSS-Gen 7.2.2,

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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Test set-up:



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Appendix 5.1

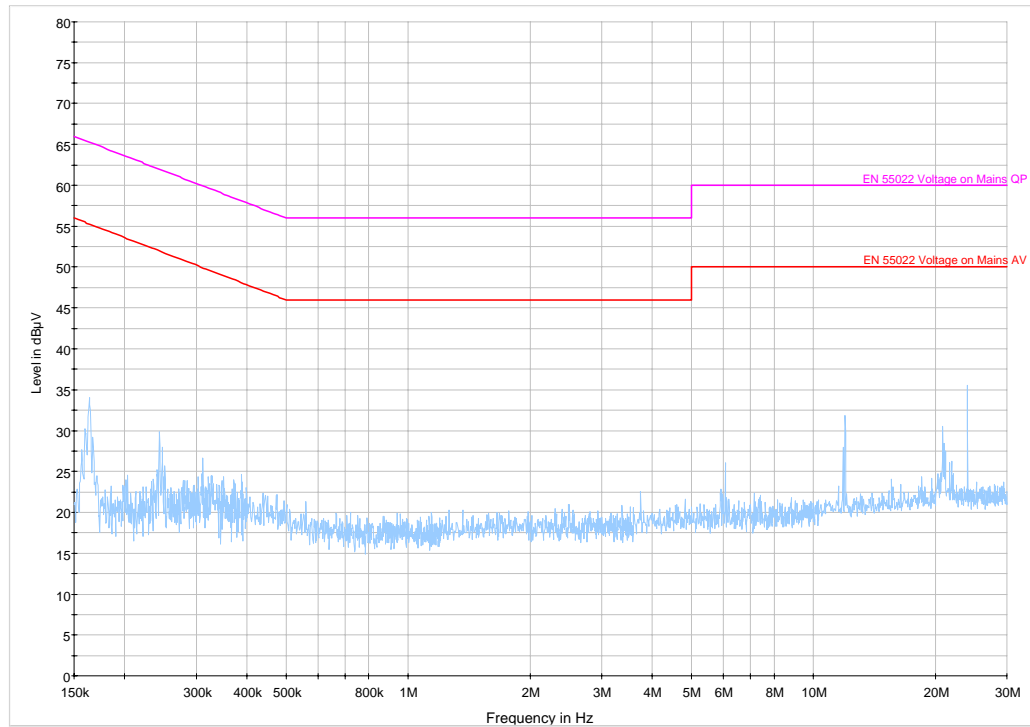
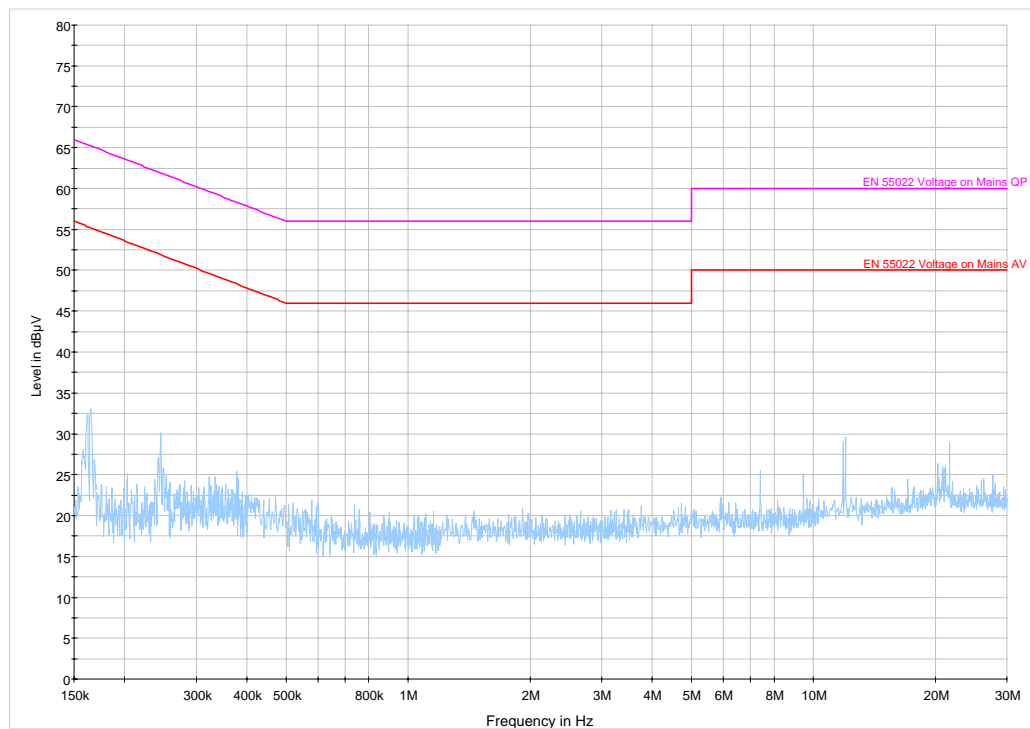
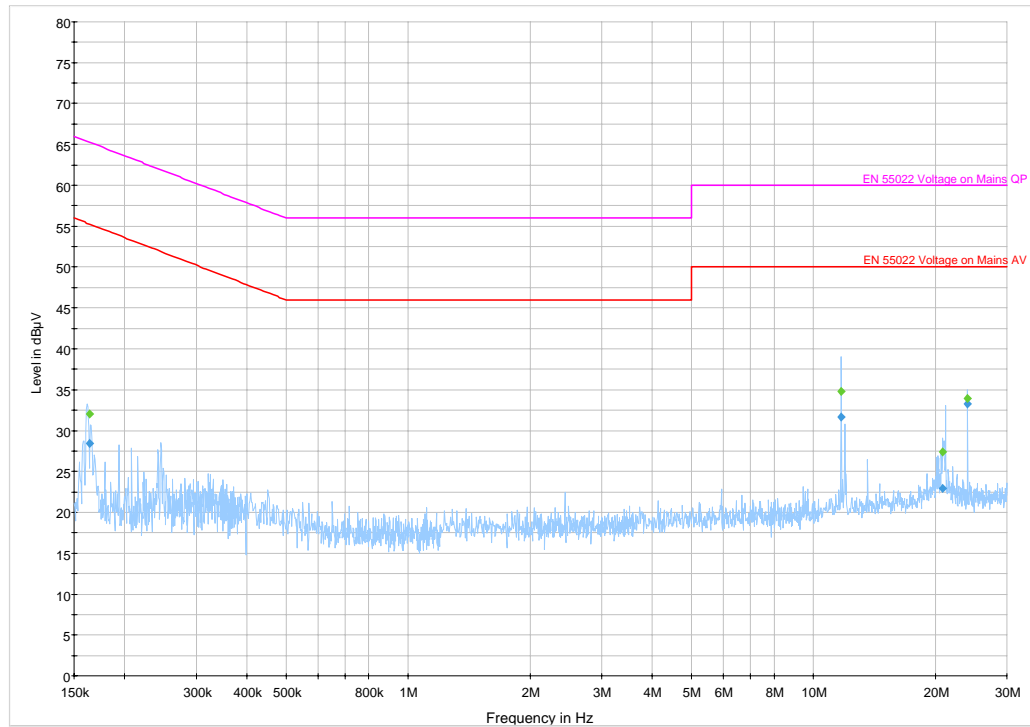
Diagram 1**Diagram 2**

Diagram 3



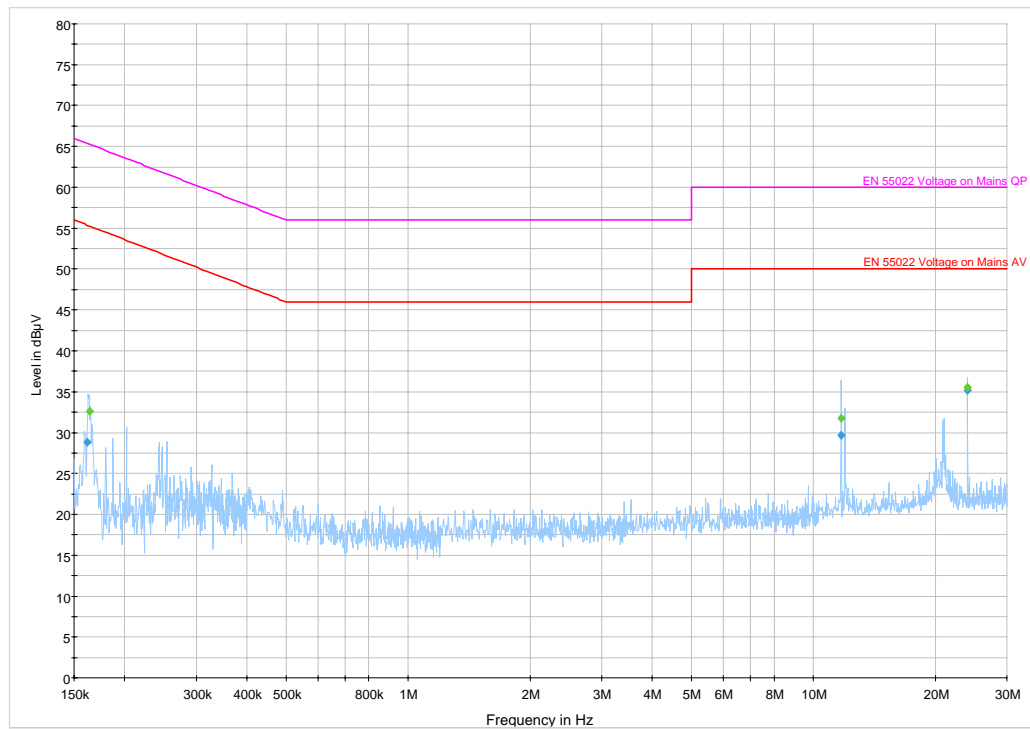
Final Average

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	PE	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.164000	28.5	5000.0	9.000	GN	0.5	26.8	55.3
11.719243	31.7	5000.0	9.000	GN	2.1	18.3	50.0
20.822882	22.9	5000.0	9.000	GN	2.6	27.1	50.0
23.961198	33.2	5000.0	9.000	GN	2.6	16.8	50.0

Final QuasiPeak

Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	PE	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.164000	32.0	5000.0	9.000	GN	0.5	33.3	65.3
11.719243	34.8	5000.0	9.000	GN	2.1	25.2	60.0
20.826882	27.4	5000.0	9.000	GN	2.6	32.6	60.0
23.961198	34.0	5000.0	9.000	GN	2.6	26.0	60.0

Diagram 4

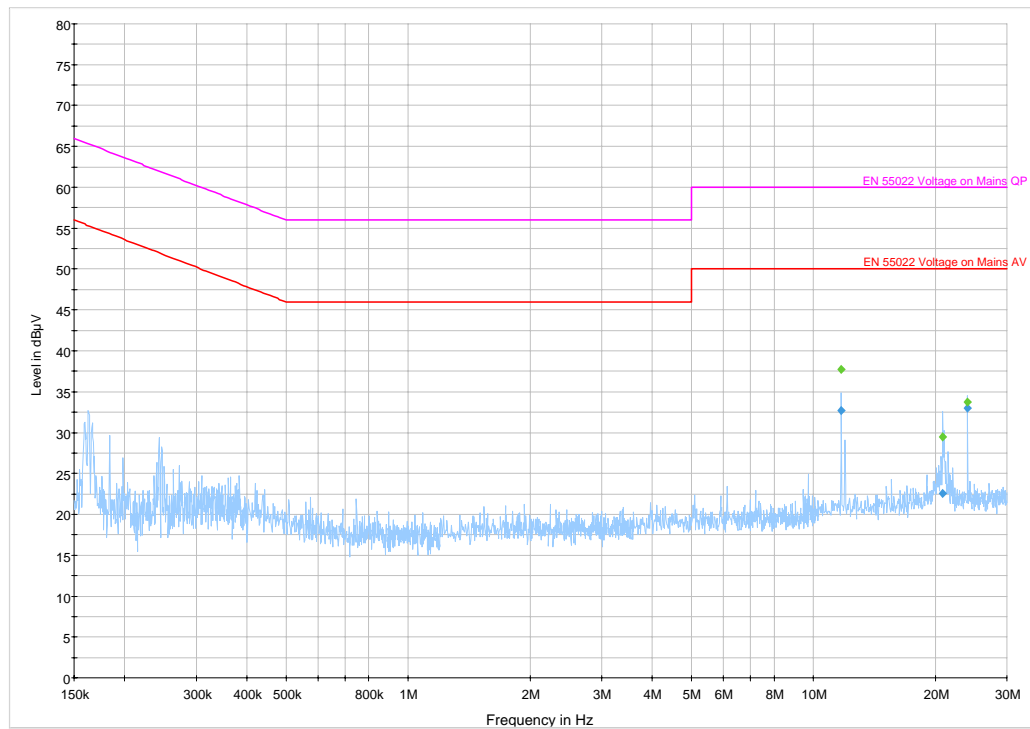


Final Average

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	PE	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.162000	28.9	5000.0	9.000	GN	0.5	26.5	55.4
11.721243	29.6	5000.0	9.000	GN	2.1	20.4	50.0
23.959719	35.2	5000.0	9.000	GN	2.6	14.8	50.0

Final QuasiPeak

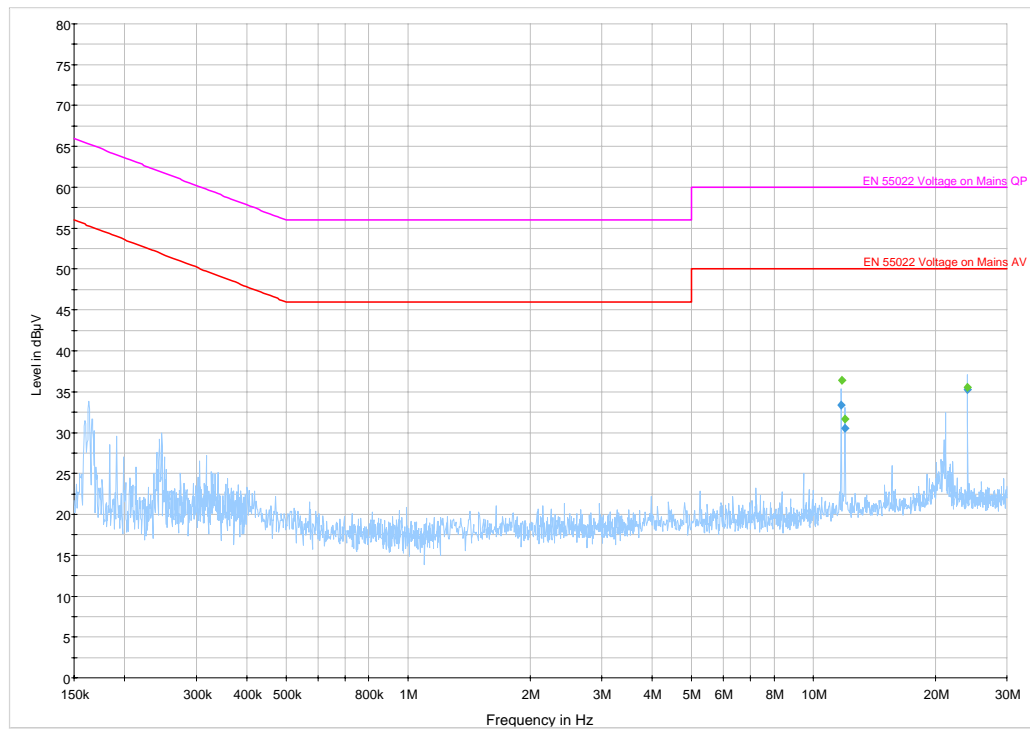
Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	PE	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.164000	32.6	5000.0	9.000	GN	0.5	32.7	65.3
11.719243	31.7	5000.0	9.000	GN	2.1	28.3	60.0
23.959719	35.5	5000.0	9.000	GN	2.6	24.5	60.0

Diagram 5

Final Average

Frequency (MHz)	Average (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	PE	Corr. (dB)	Margin (dB)	Limit (dBμV)
11.721243	32.7	5000.0	9.000	GN	2.1	17.3	50.0
20.822882	22.5	5000.0	9.000	GN	2.6	27.5	50.0
23.959719	33.0	5000.0	9.000	GN	2.6	17.0	50.0

Final QuasiPeak

Frequency (MHz)	QuasiPeak (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	PE	Corr. (dB)	Margin (dB)	Limit (dBμV)
11.719243	37.7	5000.0	9.000	GN	2.1	22.3	60.0
20.824882	29.5	5000.0	9.000	GN	2.6	30.5	60.0
23.959719	33.7	5000.0	9.000	GN	2.6	26.3	60.0

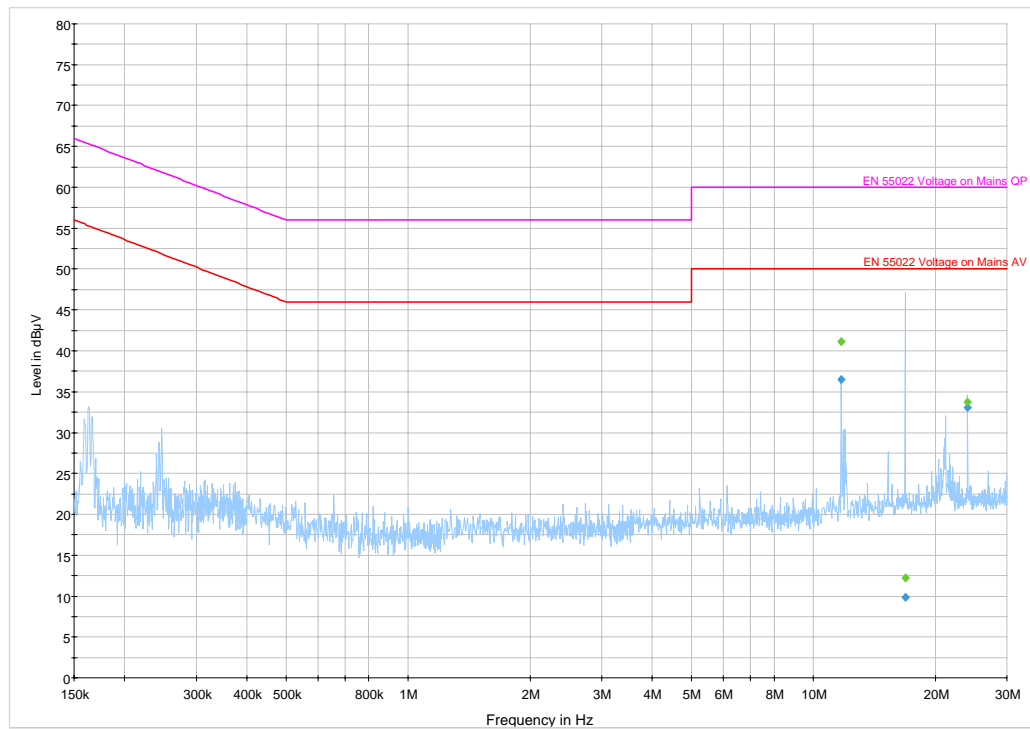
Diagram 6

Final Average

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	PE	Corr. (dB)	Margin (dB)	Limit (dBµV)
11.719243	33.4	5000.0	9.000	GN	2.1	16.6	50.0
11.980116	30.6	5000.0	9.000	GN	2.1	19.4	50.0
23.959719	35.2	5000.0	9.000	GN	2.6	14.8	50.0

Final QuasiPeak

Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	PE	Corr. (dB)	Margin (dB)	Limit (dBµV)
11.729243	36.4	5000.0	9.000	GN	2.1	23.6	60.0
11.980116	31.7	5000.0	9.000	GN	2.1	28.3	60.0
23.959719	35.6	5000.0	9.000	GN	2.6	24.4	60.0

Diagram 7

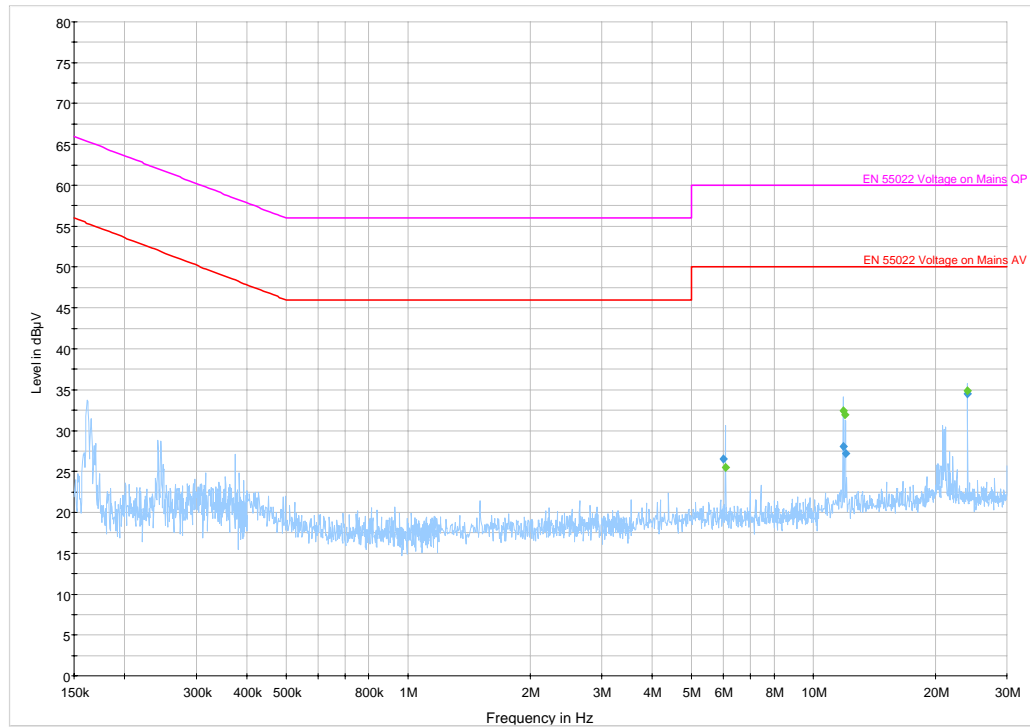


Final Average

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	PE	Corr. (dB)	Margin (dB)	Limit (dBµV)
11.719243	36.5	5000.0	9.000	GN	2.1	13.5	50.0
16.825507	9.9	5000.0	9.000	GN	2.3	40.1	50.0
23.959719	33.1	5000.0	9.000	GN	2.6	16.9	50.0

Final QuasiPeak

Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	PE	Corr. (dB)	Margin (dB)	Limit (dBµV)
11.719243	41.1	5000.0	9.000	GN	2.1	18.9	60.0
16.827507	12.2	5000.0	9.000	GN	2.3	47.8	60.0
23.959719	33.8	5000.0	9.000	GN	2.6	26.2	60.0

Diagram 8

Final Average

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	PE	Corr. (dB)	Margin (dB)	Limit (dBµV)
5.990541	26.5	5000.0	9.000	GN	1.4	23.5	50.0
11.863679	28.0	5000.0	9.000	GN	2.1	22.0	50.0
12.004116	27.2	5000.0	9.000	GN	2.1	22.8	50.0
23.959719	34.5	5000.0	9.000	GN	2.6	15.5	50.0

Final QuasiPeak

Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	PE	Corr. (dB)	Margin (dB)	Limit (dBµV)
6.074541	25.5	5000.0	9.000	GN	1.4	34.5	60.0
11.865679	32.4	5000.0	9.000	GN	2.1	27.6	60.0
11.980116	31.9	5000.0	9.000	GN	2.1	28.1	60.0
23.959719	34.9	5000.0	9.000	GN	2.6	25.1	60.0

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

Date 2010-12-09	Temperature 22 °C ± 3 °C	Humidity 21 % ± 5 %
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Test set-up and procedure

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

The EUT had the following settings during the test:

Power: - 2 dBm (command P1)

Duty cycle: 1.38% (command CY)

The radiated 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, 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 9.

Measurement equipment	Calibration Due	SP number
Semi anechoic chamber, Edison	2011-12	504 114
Spectrum analyzer R&S ESI 26	2011-08	503 885
EMI measurement computer	-	-
Software: R&S EMC32, ver. 6.30.10	-	503 745
Antenna Schaffner Bilog CBL6143	2013-04	504 079
Temperature and humidity meter Testo 625	2011-04	504 117

Measurement uncertainty: 2.6 %

Results

The diagram can be found in Appendix 6.1.

Diagram 1 903.0 MHz OBW = **161.36 kHz** (99%)

Diagram 2 915.0 MHz OBW = **173.35 kHz** (99%)

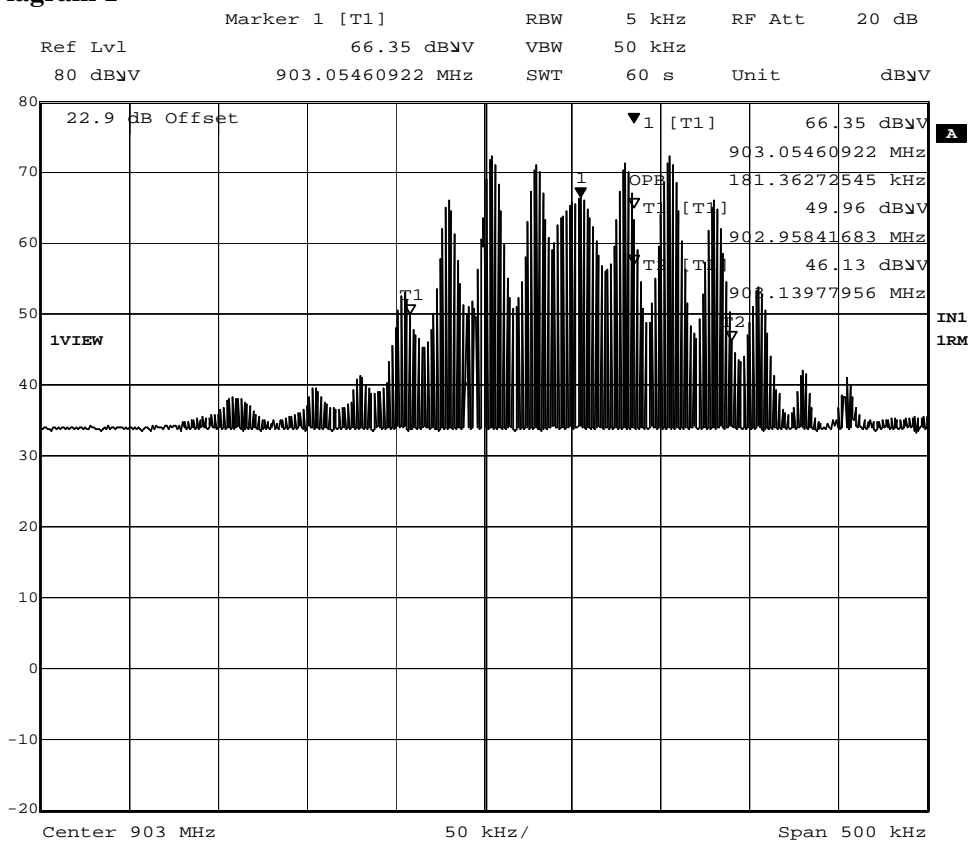
Diagram 2 927.0 MHz OBW = **163.37 kHz** (99%)



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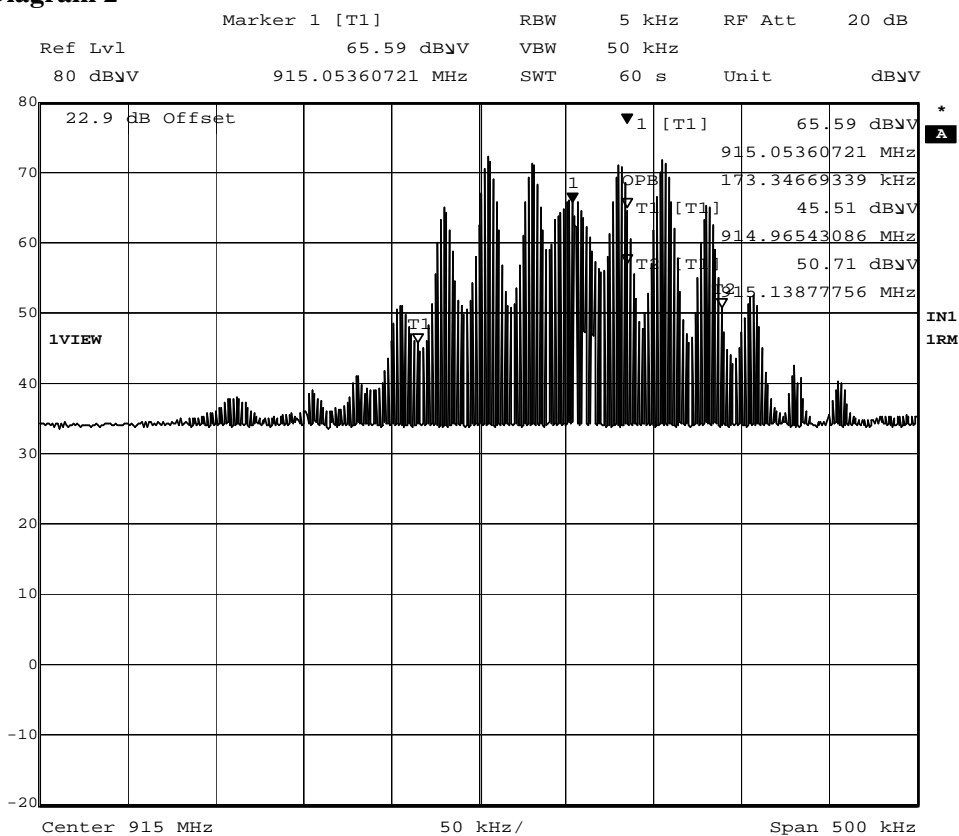
Appendix 6.1

Diagram 1



Date: 9.DEC.2010 15:26:39

Diagram 2



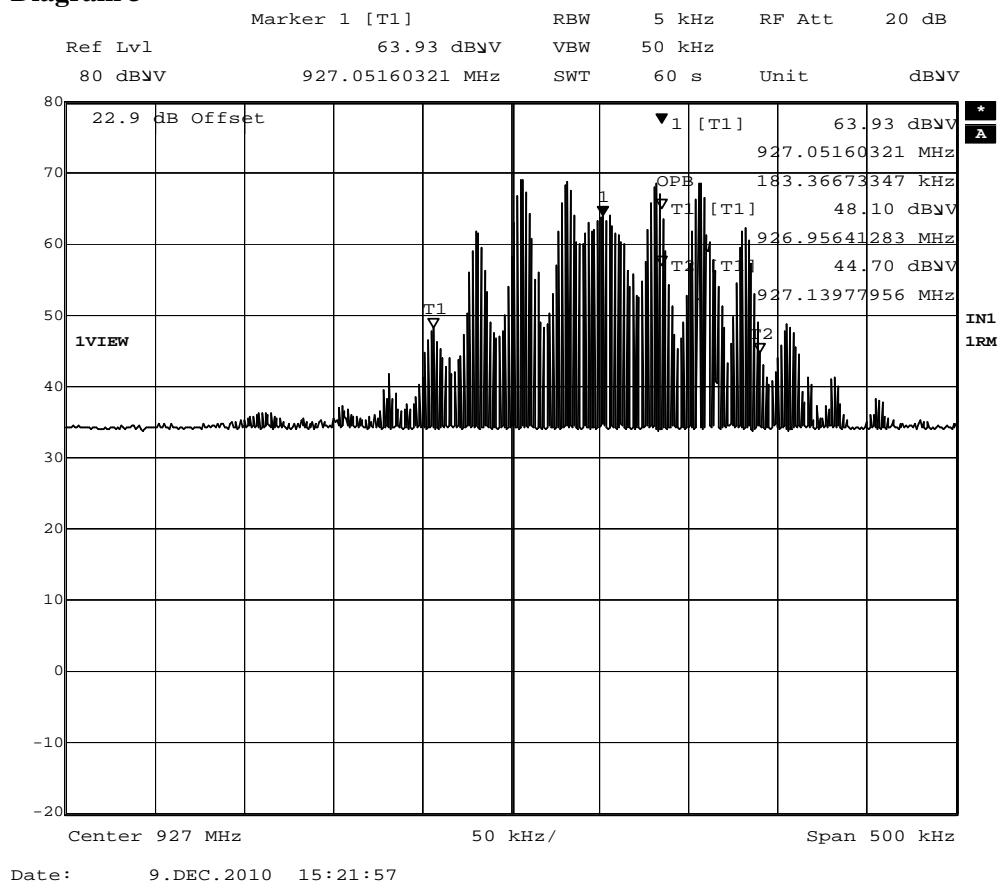
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Appendix 6.1

Diagram 3



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

Date 2010-12-09	Temperature 22 °C ± 3 °C	Humidity 21 % ± 5 %
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Test set-up and procedure

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

The EUT had the following settings during the test:

Power: - 2 dBm (command P1)

Duty cycle: 1.38% (command CY)

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 9.

Measurement equipment	Calibration Due	SP number
Semi anechoic chamber, Edison	2011-12	504 114
Spectrum analyzer R&S ESI 26	2011-08	503 885
EMI measurement computer	-	-
Software: R&S EMC32, ver. 6.30.10	-	503 745
Antenna Schaffner Bilog CBL6143	2013-04	504 079
Temperature and humidity meter Testo 625	2011-04	504 117

Results

Operation band 902-928 MHz

The pre-measurement diagrams with peak detector can be found in Appendix 7.1.

Diagram 1 903.0 MHz

Diagram 2 927.0 MHz

Final measurements with QP detector:

903.0 MHz QP level at band edge at 902 MHz: **33.9 dBµV/m**

927.0 MHz QP level at band edge at 928 MHz: **33.4 dBµV/m**

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 table 2 limits, whichever is the less stringent.

Complies?	Yes
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Appendix 7.1

Diagram 1

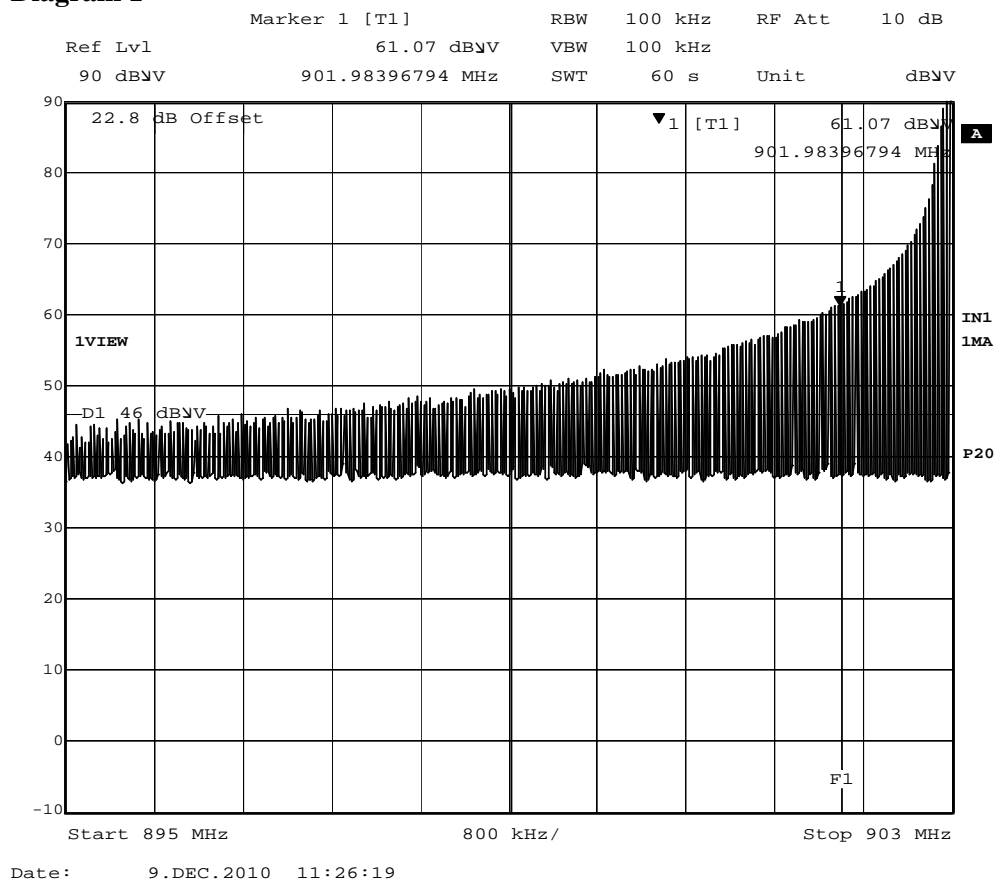
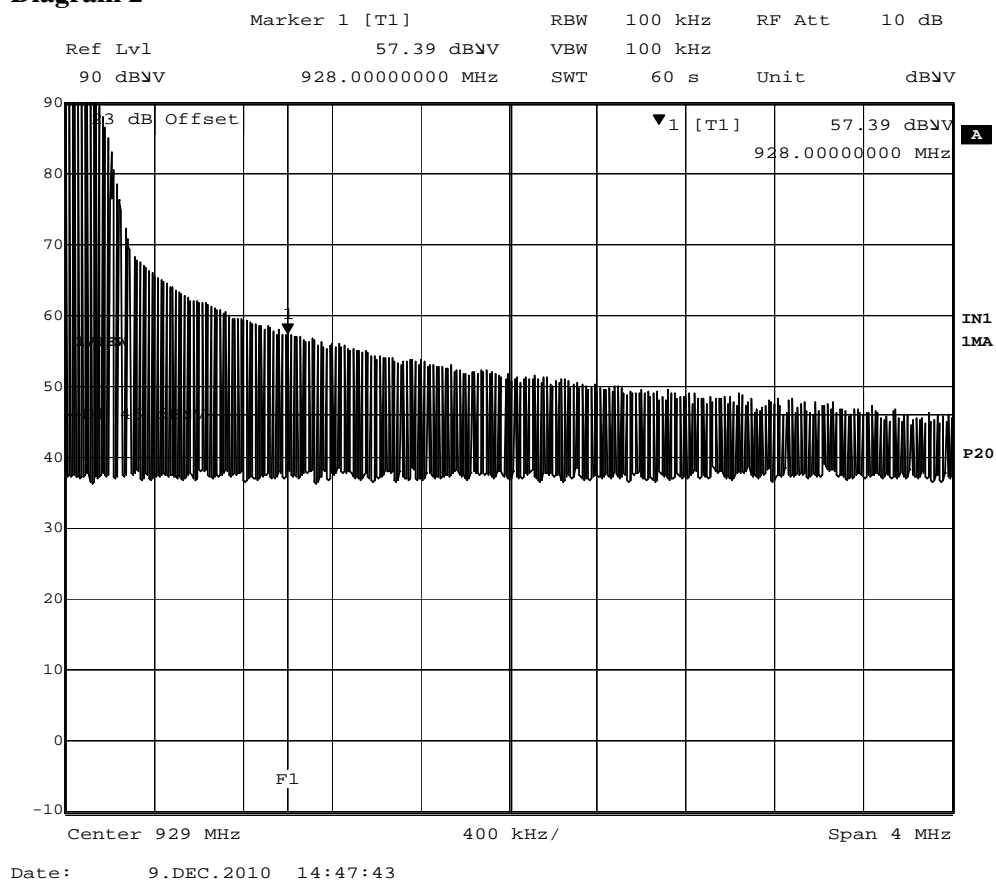


Diagram 2



**RF exposure evaluation: Mobile equipment / RSS-102 2.5.1**

Date 2010-12-09	Temperature 22 °C ± 3 °C	Humidity 21 % ± 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 2 was used for calculation of MPE.

Antenna Gain (dBi)	Antenna Gain (numeric)	ERP 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	-2.4	0.575	0.00011	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 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:

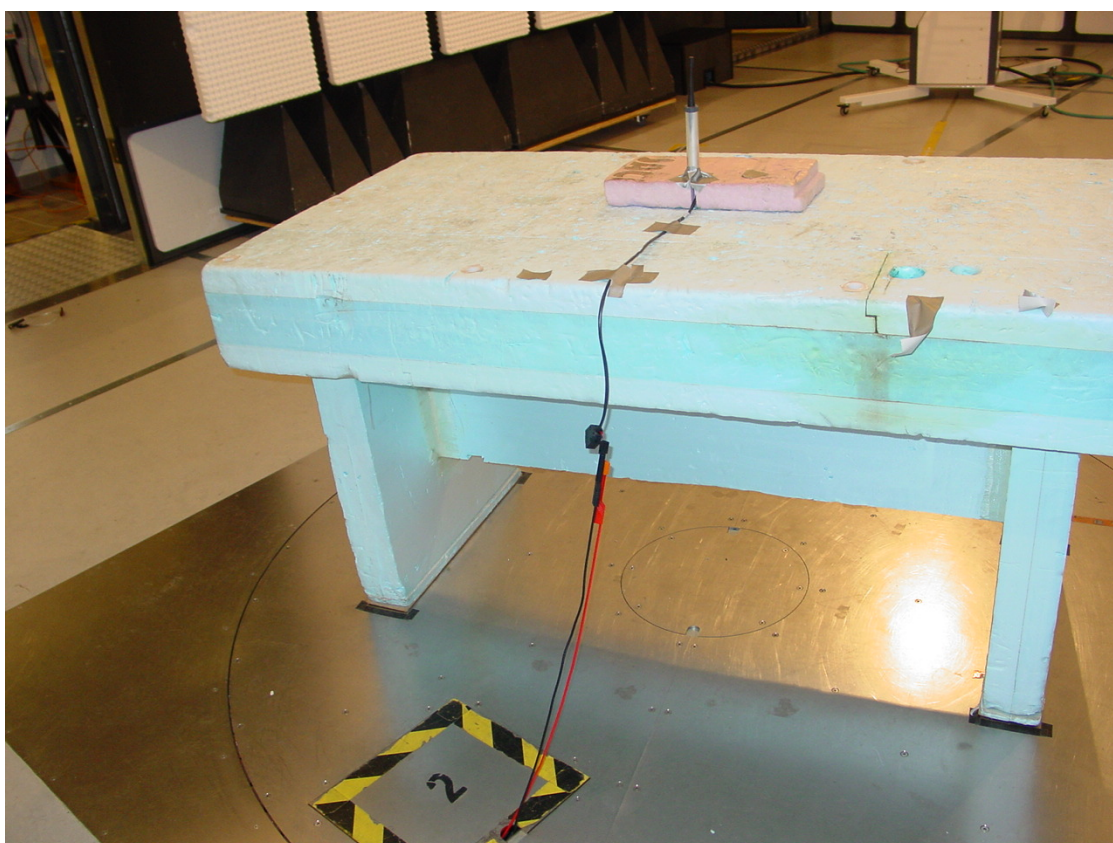
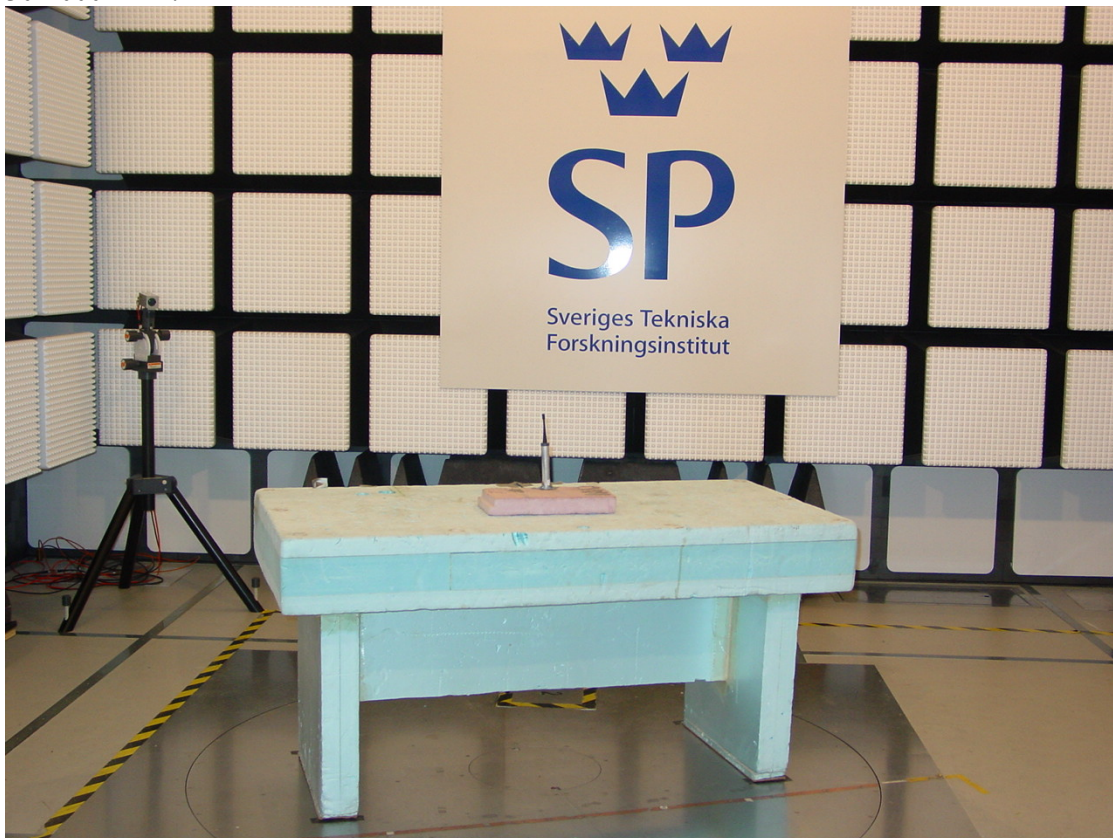
- From 3 kHz up to 1 GHz inclusively, and with output power (i.e. the higher of the conducted or equivalent isotropically radiated power (e.i.r.p) source-base, time-averaged output power) that is less than or equal to 200 mW for general use and 1000 mW for controlled use.

Complies?	Yes
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Photos

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

30-1000 MHz:



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Appendix 9

1-10 GHz:

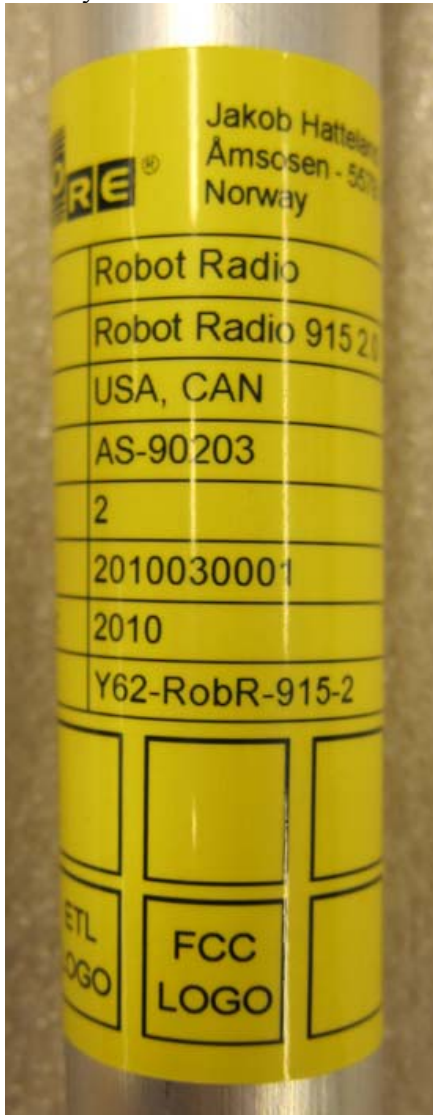


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Appendix 9

EUT

Identity



Over-view



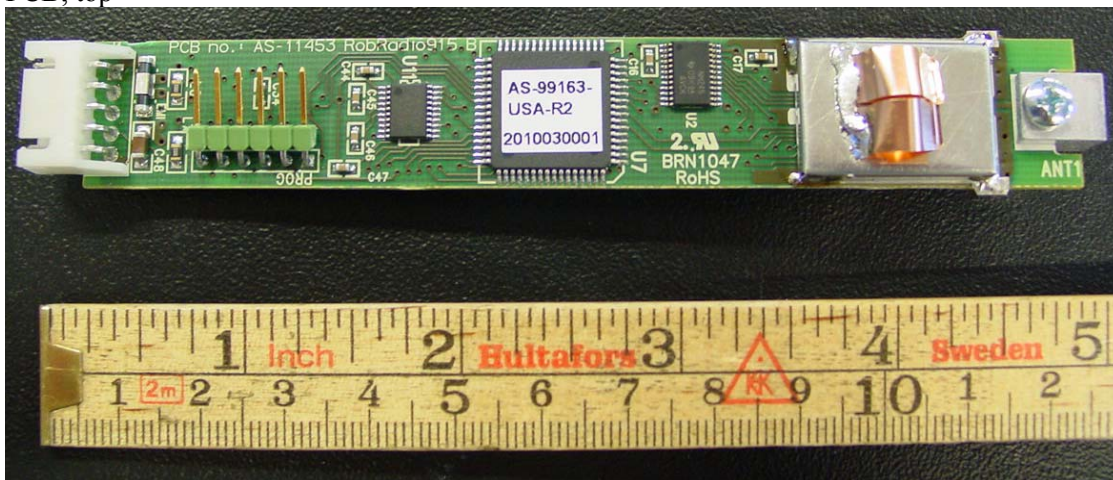
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Appendix 9

Antenna



PCB, top



PCB, rear

