

## Equipment Authorization measurements on 926.5 MHz Handheld Transceiver Unit

### FCC ID: OG4-K3

(8 appendices)

Rev.1, 2012-05-31: Appendix 7 has been corrected, wrong limit has been used.

### Test object

Product name: Keyring  
Art. no: 946416-000  
Type: S800K3  
Serial number: No serial number  
The test object was powered with the internal batteries, 6.0 V DC

### Summary

See Appendix 1 for general information and Appendix 8 for photos.  
Emission measurements as specified below have been performed.

Standard	Compliant	Appendix	Remarks
<b>FCC 47 CFR Part 15 C (07-10-08)</b>			
15.249 Operation within the band 902-928 MHz	Yes		
<b>IC RSS-210 Issue 8, June 2010</b>	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	N/A	-	Note 1
2.1049 / RSS-Gen 4.6.1 Occupied bandwidth	Yes	5	
2.1049 / RSS-210 A2.9(b) Band Edge	Yes	6	
RF Safety / RSS-102 2.5.1 SAR Evaluation	Yes	7	

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.

Note 1: Test not applicable, not connected to the AC mains.



## REPORT

FCC ID: OG4-K3

Date

2012-04-18

Reference

FX205878-F15C1

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Rev.1: 2012-05-31 Rev. 1

### 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 Keyring 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:	Keyring
Antenna connector	Not applicable
Antenna:	Integral
Frequency range:	926.5 MHz
Frequencies used during test:	926.5 MHz
Modulation:	GFSK
Data rate:	9.6 kbps
Supply voltage:	6.0 V DC, internal batteries
Battery type:	Lithium, 2xCR2025

## Measurement equipment

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

### Operational test mode

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

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  $44.73/150.68 \text{ ms} = 0.297 = 29.7\%$ .

Duty cycle correction =  $20 \log 0.297 = -10.5 \text{ dB}$  (for determine the average level).

The PRF was calculated to  $\text{PRF} = 1/T = 1/150.68 \text{ ms} = 7 \text{ Hz}$ , thus QP-detector was used without any correction for pulse desensitization.

### 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

### Test engineers

Fredrik Isaksson and Azhar Abbas, SP

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

Date	Temperature	Humidity
2012-03-20	22 °C ± 3 °C	27 % ± 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 radiated maximum peak 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 8.

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

Field strength of fundamental measurements:  
RBW=120 kHz

		Max peak radiated output power Quasi-peak detector		
		926.5 MHz	926.5 MHz	926.5 MHz
	EUT axis	X	Y	Z
	Antenna height	1.00 m	1.00 m	1.13 m
	Azimuth	327 deg	200 deg	159 deg
	Polarization	Horizontal	Horizontal	Horizontal
T <sub>nom</sub> 22°C	V <sub>nom</sub> 6.0 V DC Note 1	92.7 dBμV/m	86.3 dBμV/m	89.5 dBμV/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
902-928 MHz	50 mV/m = 94 dBμV/m

Complies?	Yes
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Diagram 1

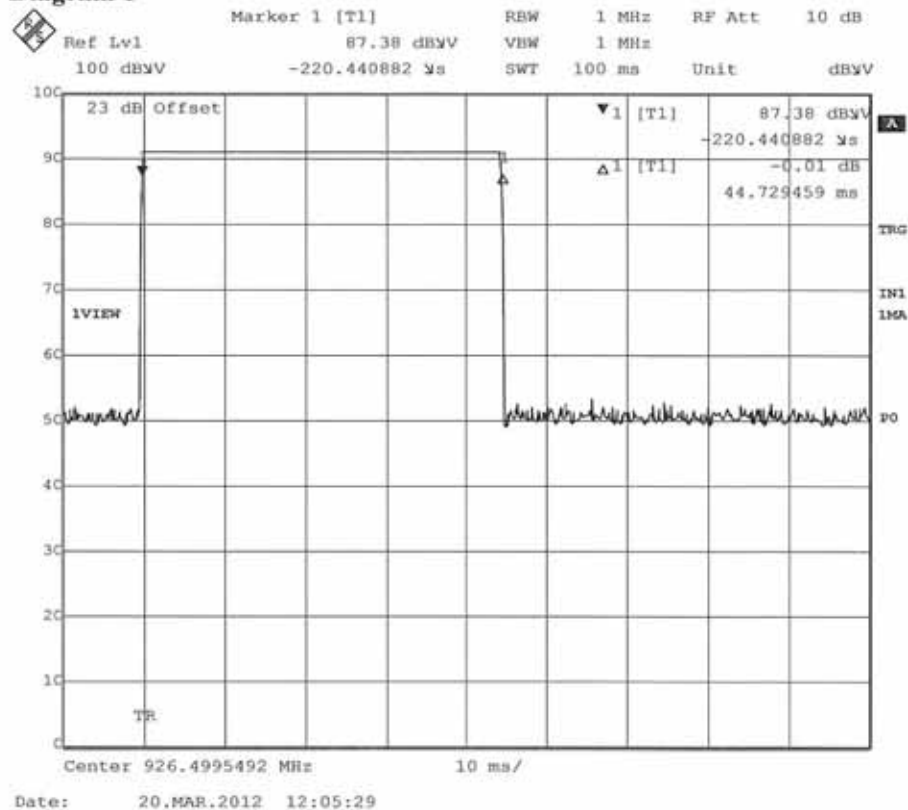
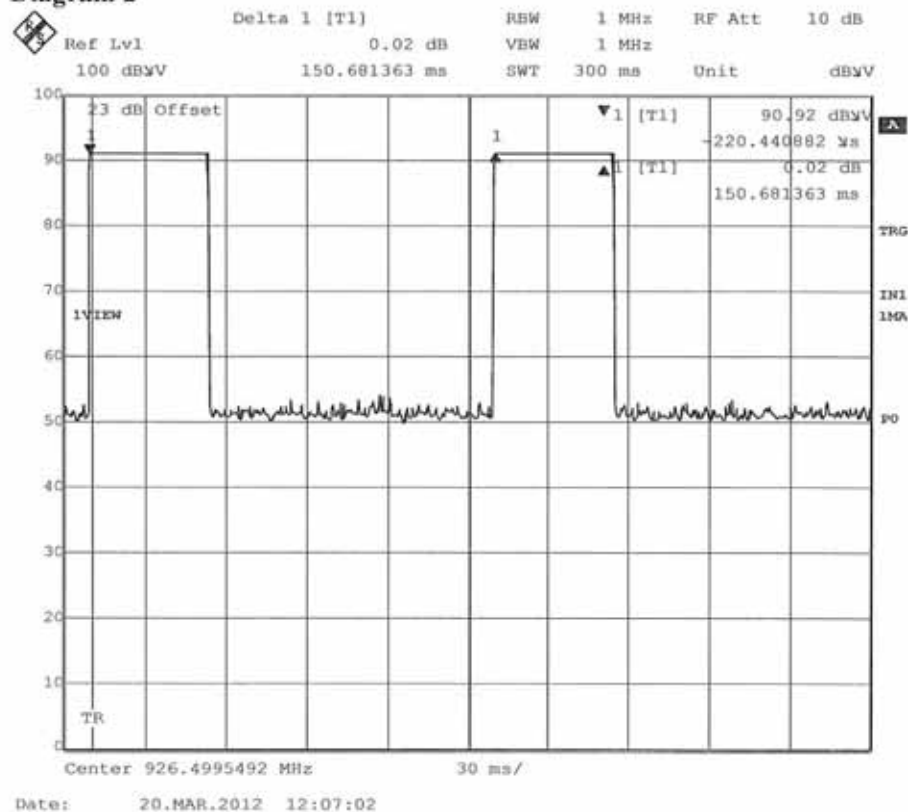


Diagram 2



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

Date	Temperature	Humidity
2012-03-16	22 °C ± 3 °C	33 % ± 5 %
2012-03-19	22 °C ± 3 °C	27 % ± 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 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 8.

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, X-axis, vertical and horizontal polarization
Diagram 3:	30-1000 MHz, Y-axis, vertical and horizontal polarization
Diagram 4:	30-1000 MHz, Z-axis, vertical and horizontal polarization
Diagram 5:	1-10 GHz, X-axis, vertical and horizontal polarization
Diagram 6:	1-10 GHz, Y-axis, vertical and horizontal polarization
Diagram 7:	1-10 GHz, Z-axis, vertical and horizontal polarization

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

X-axis:

Frequency (MHz)	QP level (dBμV/m)	CISPRAV level (dBμV/m)	Peak level (dBμV/m)	Corr (dB)	Limit (dBμV/m)	Height (m)	Azimuth (deg)	Polarization
45.9529	<b>18.4</b>	N/A	N/A	14.5	40	3.92	305	Vertical
1852.9960	N/A	<b>47.1 *</b>	<b>57.6</b>	-17.1	53.9 (AV)	1.22	263	Horizontal
2779.5491	N/A	<b>38.6 *</b>	<b>49.1</b>	-14.9	53.9 (AV)	1.22	263	Horizontal
3706.0220	N/A	<b>34.1 *</b>	<b>44.6</b>	-11.4	53.9 (AV)	1.08	134	Horizontal
4632.5351	N/A	<b>38.2 *</b>	<b>48.7</b>	-10.1	53.9 (AV)	1.15	22	Horizontal
5558.9880	N/A	<b>44.3 *</b>	<b>54.8</b>	-8.8	53.9 (AV)	1.00	205	Vertical
7411.8337	N/A	<b>40.1 *</b>	<b>50.6</b>	-2.1	53.9 (AV)	1.38	269	Horizontal
8338.4469	N/A	<b>41.8 *</b>	<b>52.3</b>	-2.5	53.9 (AV)	1.25	91	Horizontal

\*) The average level (with normal duty cycle 29.7%) 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 (10.5 dB).

Y-axis:

Frequency (MHz)	QP level (dBμV/m)	CISPRAV level (dBμV/m)	Peak level (dBμV/m)	Corr (dB)	Limit (dBμV/m)	Height (m)	Azimuth (deg)	Polarization
45.9168	<b>15.6</b>	N/A	N/A	14.5	40	3.19	319	Vertical
1853.0361	N/A	<b>49.9 *</b>	<b>60.4</b>	-17.1	53.9 (AV)	1.22	263	Vertical
2779.4689	N/A	<b>40.5 *</b>	<b>51.0</b>	-14.9	53.9 (AV)	1.22	263	Horizontal
3706.0020	N/A	<b>33.4 *</b>	<b>43.9</b>	-11.4	53.9 (AV)	1.08	134	Horizontal
4632.5351	N/A	<b>39.5 *</b>	<b>50.0</b>	-10.1	53.9 (AV)	1.15	22	Horizontal
5558.9278	N/A	<b>44.6 *</b>	<b>55.1</b>	-8.8	53.9 (AV)	1.00	205	Vertical
6485.6412	N/A	<b>36.3 *</b>	<b>46.8</b>	-6.5	53.9 (AV)	1.25	216	Vertical
7412.0140	N/A	<b>41.1 *</b>	<b>51.6</b>	-2.1	53.9 (AV)	1.38	269	Vertical
8338.5070	N/A	<b>40.6 *</b>	<b>51.1</b>	-2.5	53.9 (AV)	1.25	91	Vertical

\*) The average level (with normal duty cycle 29.7%) 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 (10.5 dB).

Z-axis:

Frequency (MHz)	QP level (dBμV/m)	CISPR AV level (dBμV/m)	Peak level (dBμV/m)	Corr (dB)	Limit (dBμV/m)	Height (m)	Azimuth (deg)	Polarization
45.9409	17.7	N/A	N/A	14.5	40	2.99	300	Vertical
1852.9960	N/A	47.1 *	44.6	-17.1	53.9 (AV)	1.22	263	Vertical
2779.5290	N/A	38.6 *	51.0	-14.9	53.9 (AV)	1.22	263	Vertical
3705.9218	N/A	35.1 *	45.6	-11.4	53.9 (AV)	1.08	134	Vertical
4632.4750	N/A	43.0 *	53.5	-10.1	53.9 (AV)	1.15	22	Vertical
5559.0280	N/A	45.9 *	56.4	-8.8	53.9 (AV)	1.00	205	Horizontal
7406.0281	N/A	38.3 *	50.6	-2.1	53.9 (AV)	1.38	269	Horizontal

\*) The average level (with normal duty cycle 29.7%) 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 (10.5 dB).

### 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 μV/m = 54 dBμV/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

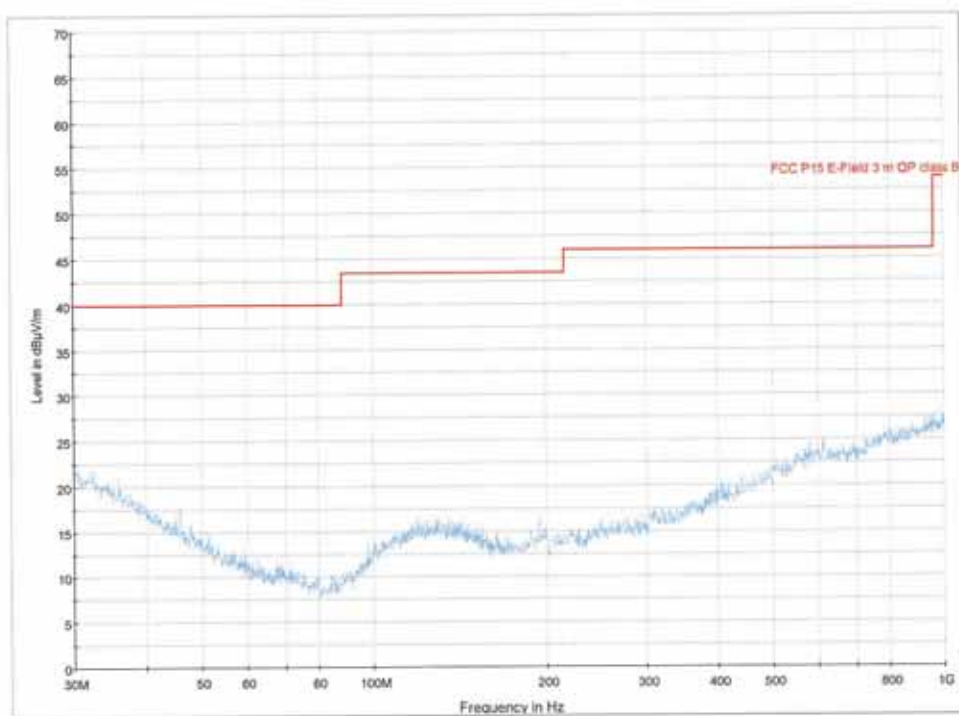


Diagram 2

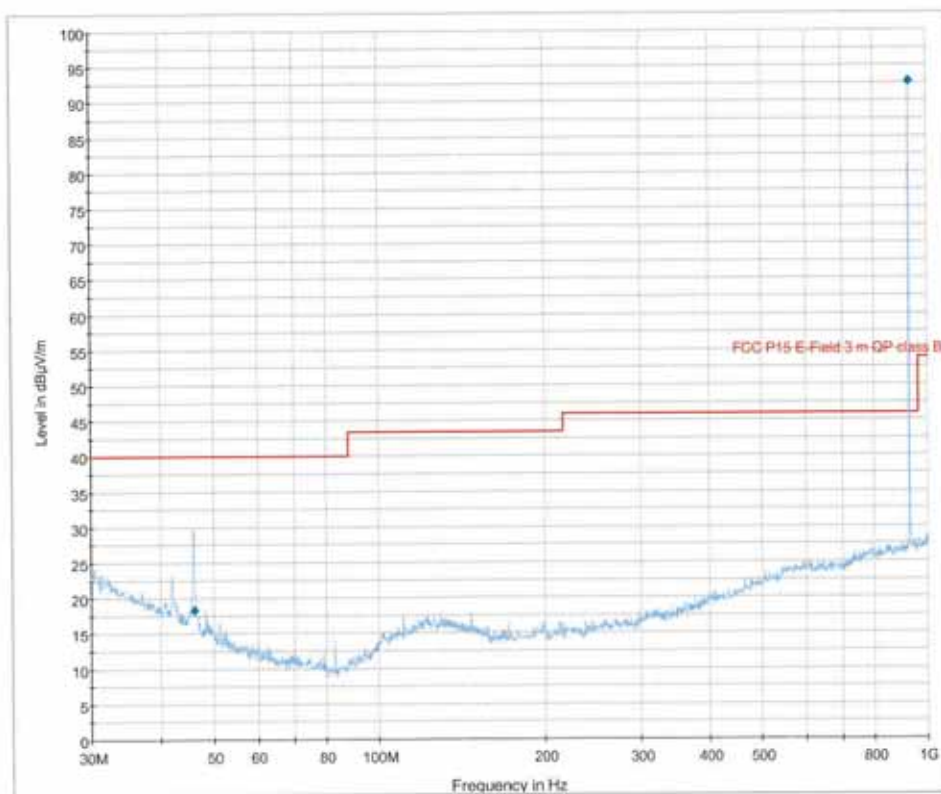




Diagram 3

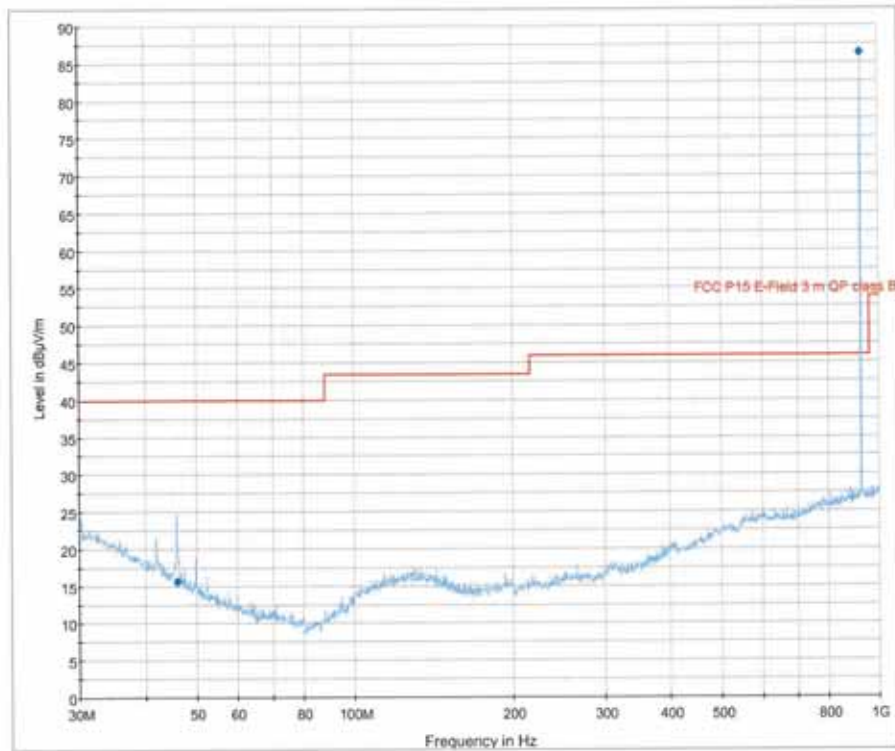


Diagram 4

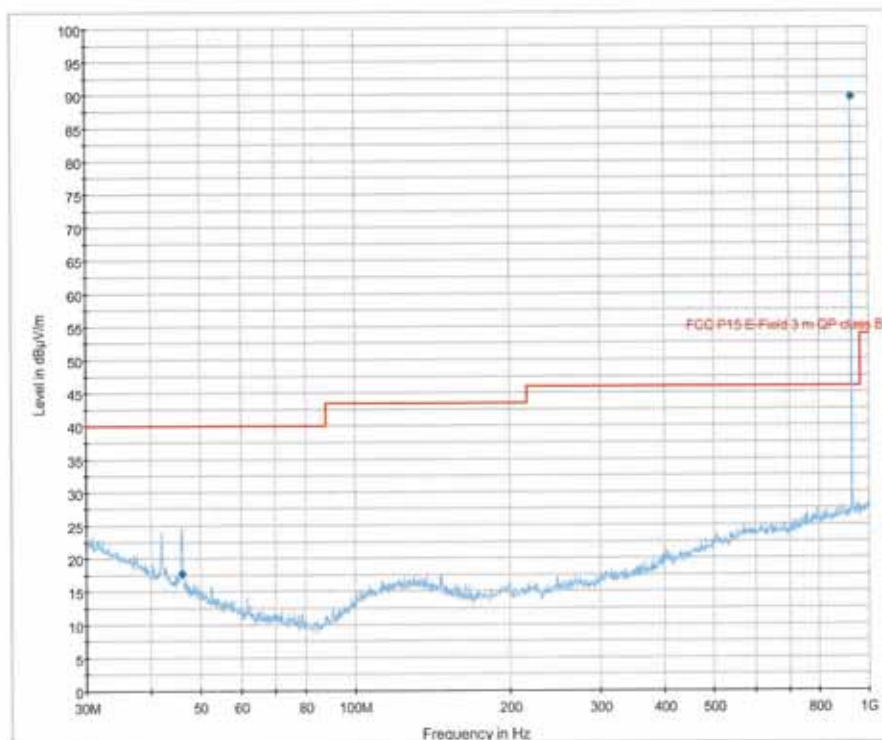




Diagram 5

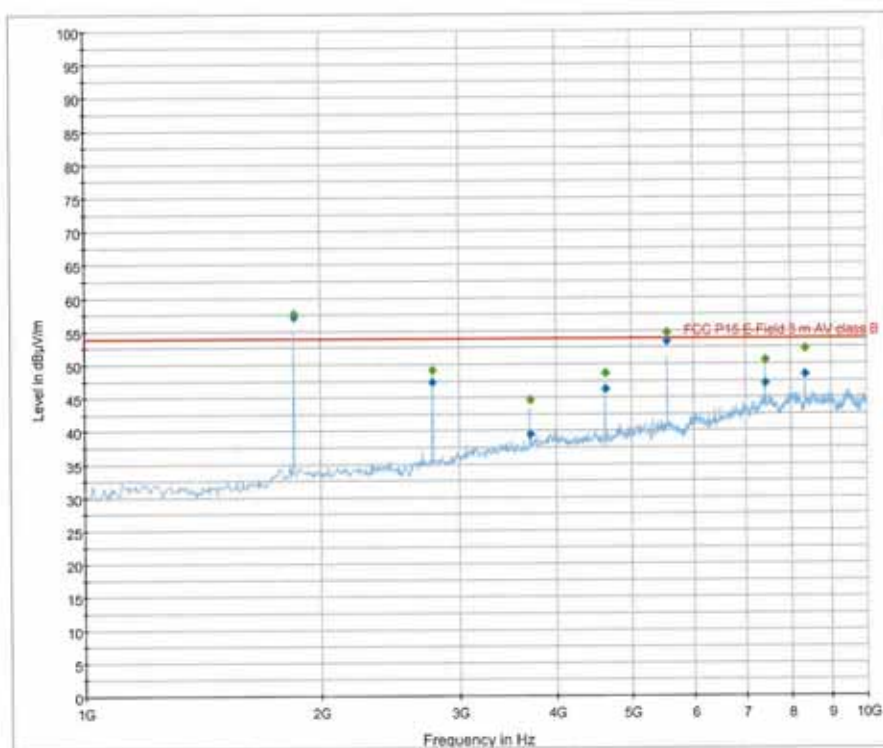
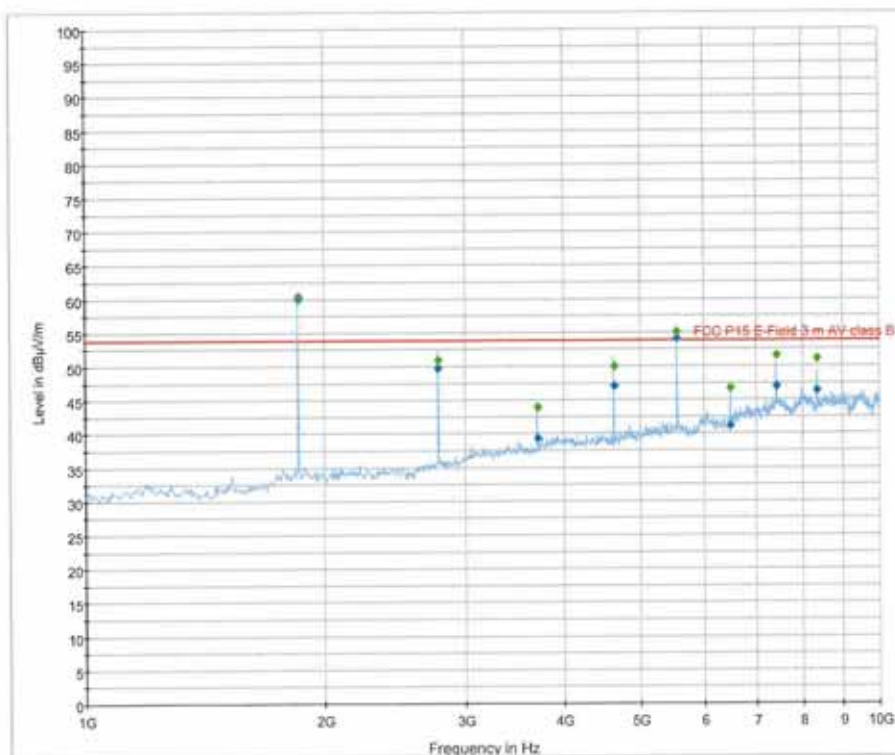
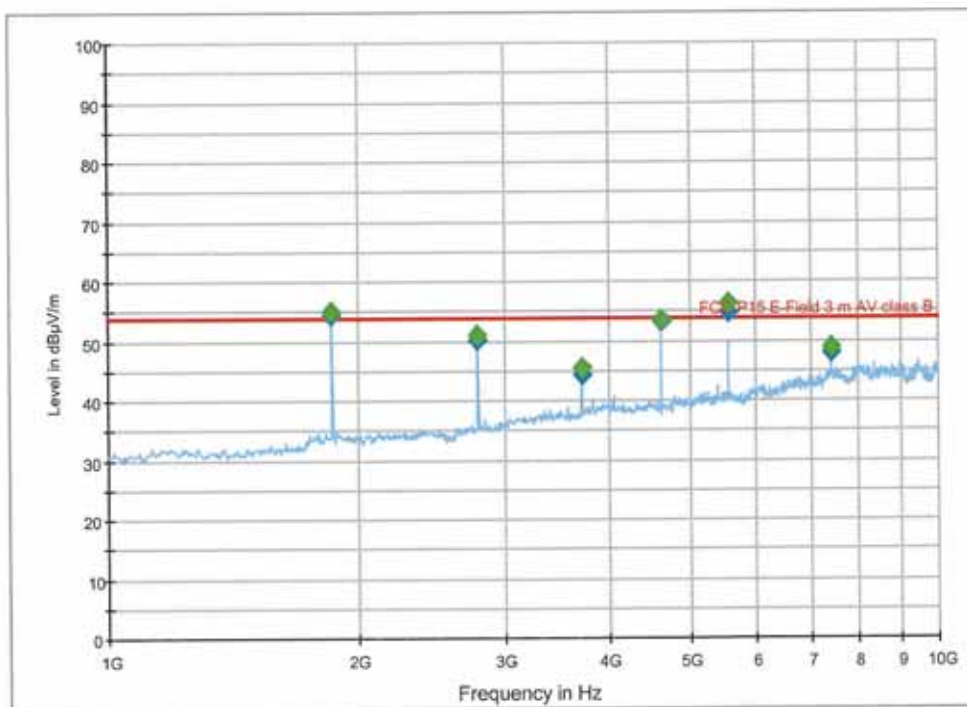


Diagram 6



**Diagram 7**



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

Date	Temperature	Humidity
2012-03-20	22 °C ± 3 °C	27 % ± 5 %

### Test set-up and procedure

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

The test was performed with continuous transmission with normal duty cycle (29.7%) and with normal modulation.

The radiated measurements were performed in the semi-anechoic chamber with the EUT in the axis with the highest fundamental power.

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 8, X-axis.

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

**Measurement uncertainty:** 2.6 %

### Results

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

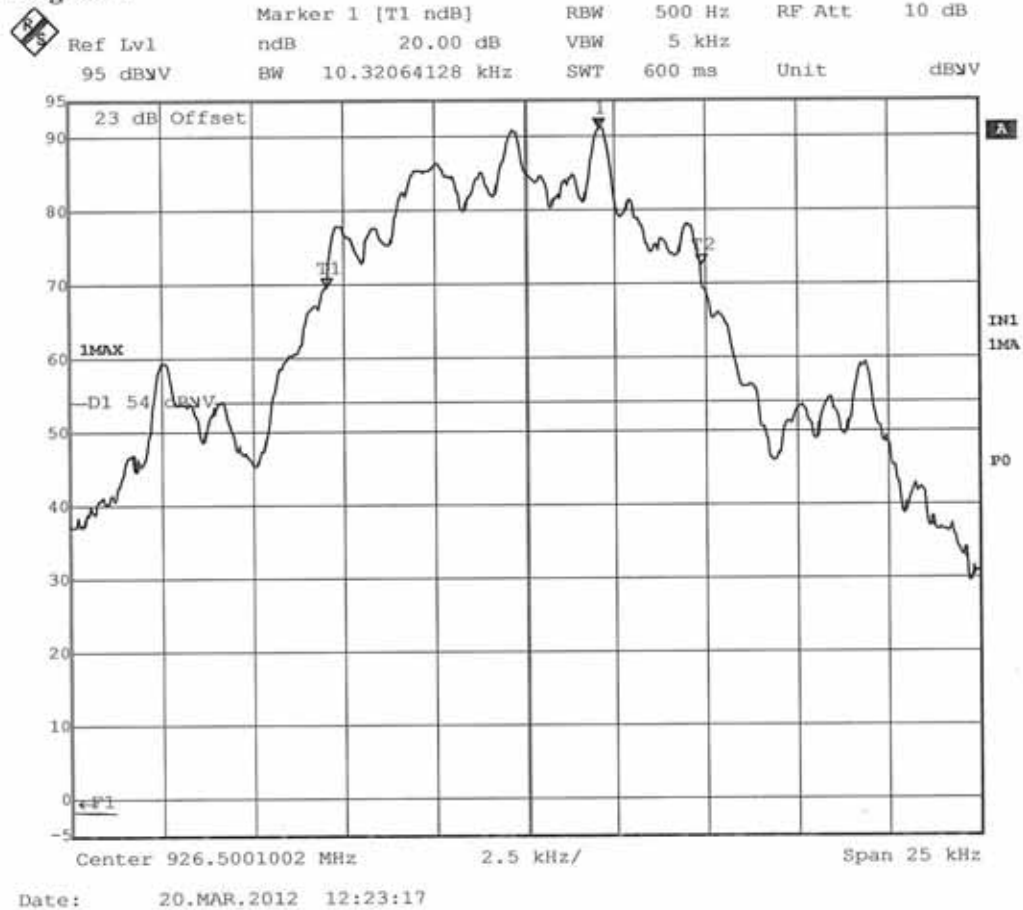
Diagram 1	926.5 MHz	20 dB BW = 10.32 kHz
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### Limits

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**





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

Date	Temperature	Humidity
2012-03-20	22 °C ± 3 °C	27 % ± 5 %

### Test set-up and procedure

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

The test was performed with continuous transmission with normal duty cycle (29.7%) and with normal modulation.

The radiated measurements were performed in the semi-anechoic chamber with the EUT in the axis with the highest fundamental power.

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 8, X-axis.

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

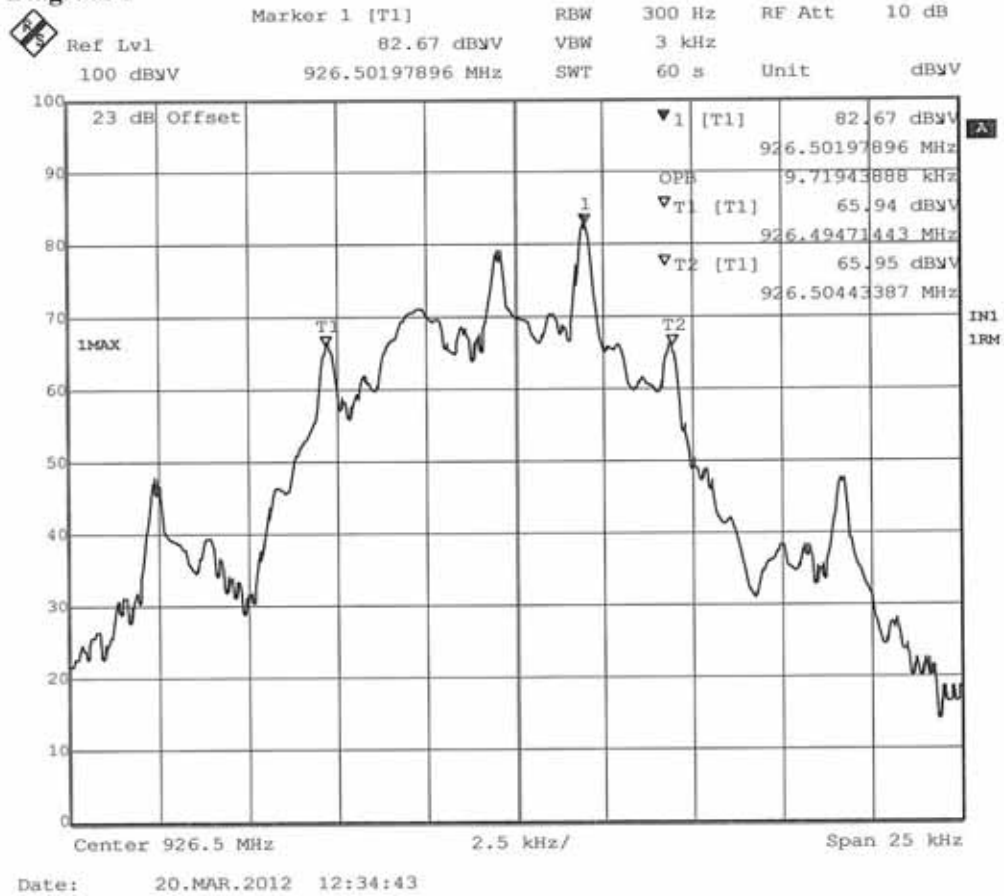
**Measurement uncertainty: 2.6 %**

### Results

The OBW measurements can be found in the diagram below:

Diagram 1	926.5 MHz	OBW = 9.92 kHz (99%)
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**Diagram 1**



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

Date	Temperature	Humidity
2012-03-20	22 °C ± 3 °C	27 % ± 5 %

### Test set-up and procedure

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

The test was performed with continuous transmission with normal duty cycle (29.7%) and with normal modulation.

The radiated measurements were performed in the semi-anechoic chamber with the EUT in the axis with the highest fundamental power.

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 8, X-axis.

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

Diagram 1	926.5 MHz	Band edge at 902 MHz
Diagram 2	926.5 MHz	Band edge at 928 MHz

Final measurements with QP detector:

926.5 MHz	QP level at band edge at 902 MHz: <b>21.1 dB<math>\mu</math>V/m</b>
926.5 MHz	QP level at band edge at 928 MHz: <b>24.3 dB<math>\mu</math>V/m</b>

## Limits

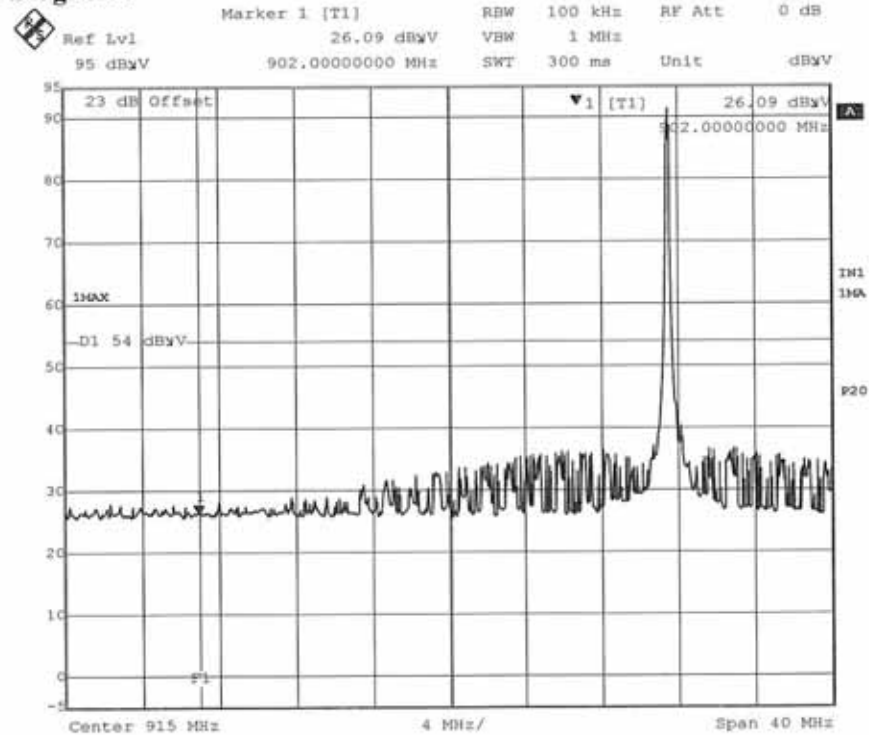
According to 47CFR 15.249(d), emission radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in section 15.209, whichever is the lesser attenuation.

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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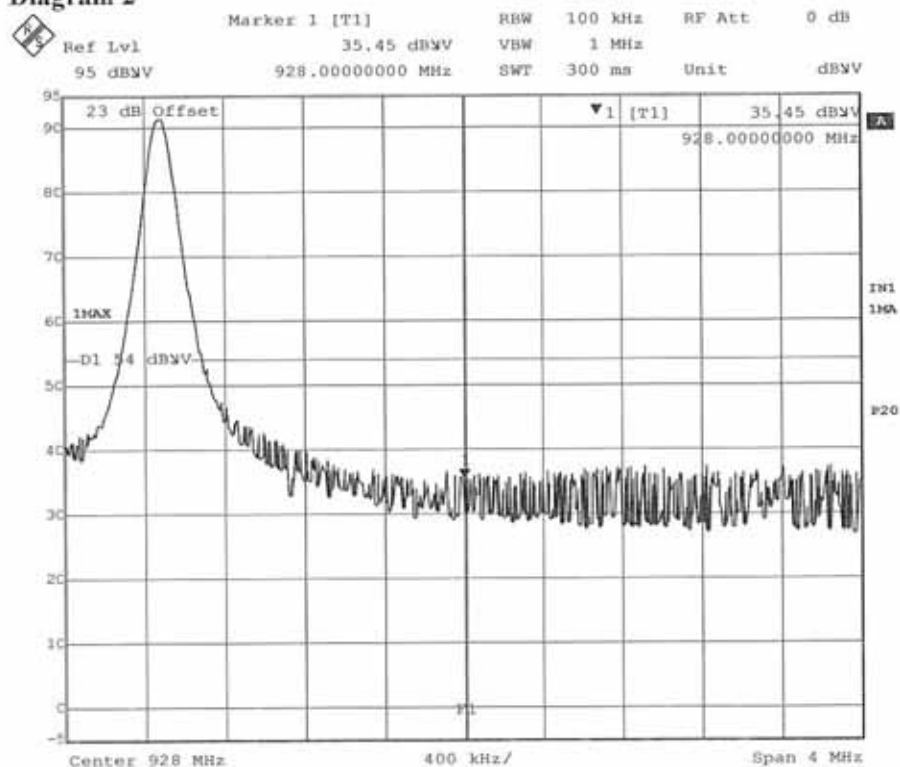
Diagram 1



Date: 20.MAR.2012 12:19:15

Note: The limit in the diagram is wrong, shall be 46 dBμV/m

Diagram 2



Date: 20.MAR.2012 12:11:52

Note: The limit in the diagram is wrong, shall be 46 dBμV/m

## RF exposure evaluation: Portable equipment / RSS-102 2.5.1

Date 2012-03-20	Temperature 22 °C ± 3 °C	Humidity 27 % ± 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 limits. In accordance with 47 CFR FCC Part 2 Subpart J, section 2.1093 this device has been defined as a portable device that is designed to be used so that the radiating structure(s) of the device is/are within 20 centimeters of the body of the user.

### Results

Portable transmitters shall fulfill the SAR requirements of 2.1093 if not excluded due to low output power.

ERP Peak output power (dBm)	Peak output power (mW)
-2.5 Note 1	0.562

Note 1: The measurements were performed in field strength in dB $\mu$ V/m. The ERP level was the calculated by the formula  $ERP = E(dB\mu V/m) - 90 + 20\log(d) - 10\log 30$ .

### Limits

According to FCC KDB 447498, D01 Mobile Portable RF exposure V04:  
A device may be used in portable exposure conditions with no restrictions on host platforms when the source-based time-averaged output power is  $\leq 60/f(\text{GHz}) \text{ mW}$

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.

In these cases, the information contained in the RF exposure technical brief may be limited to information that demonstrates how the e.i.r.p. was derived.

Complies?	Yes
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## Photos

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

EUT in X-axis, 30-1000 MHz:



EUT in X-axis, 30-1000 MHz:





EUT in Y-axis, 30-1000 MHz:



EUT in Y-axis, 30-1000 MHz:

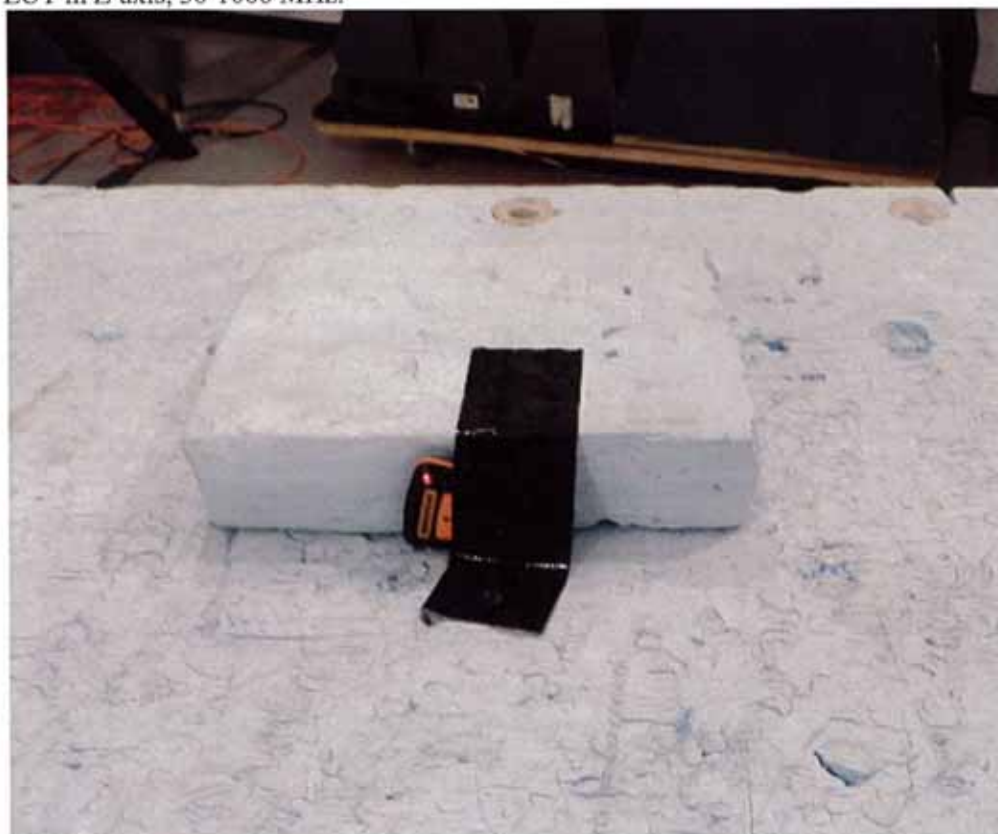




EUT in Z-axis, 30-1000 MHz:



EUT in Z-axis, 30-1000 MHz:



EUT in X-axis, 1-10 GHz:



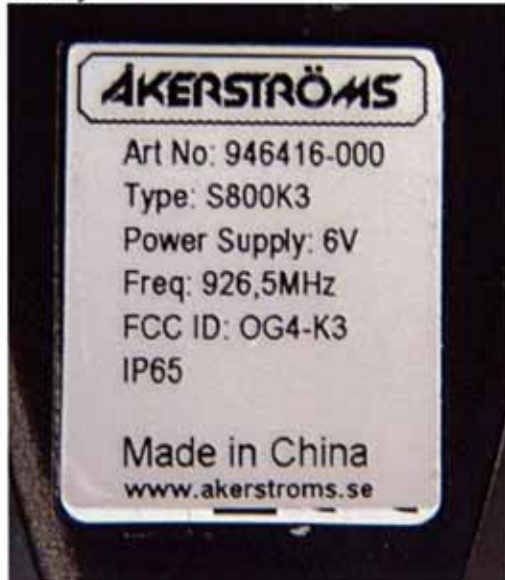
EUT in Z-axis, 1-10 GHz:



FCC ID: OG4-K3

Rev. 1  
Appendix 8

EUT  
Identity:



Top:





FCC ID: OG4-K3

Rev. 1  
Appendix 8

Rear:



Inside, top:





FCC ID: OG4-K3

Rev. 1  
Appendix 8

Inside, rear:

