



REPORT

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

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Date 2009-11-17 Reference F905629-F15C4

Page 1 (1)

Handled by, department

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Rev.1: 2009-12-28

Unfors Instruments AB

Att: Mats Quick

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Equipment Authorization measurements on 918 MHz Transceiver Unit

FCC ID: XWK8603021

(9 appendices)

Rev.1, 2009-12-28: Appendix 2, 3 and 3.1 has been revised. The limit of the harmonics was 50 μ V/m, it shall be 500 μ V/m instead. In the appendix 3.1 (diagram 2) the peak value has been used to calculate the final average level, average level shall be used instead.

Test object

Product name: Unfors Alert Base station

Part. number: 8603021

Serial number: 21000007

Software: 1.1b.42

Radio module f/w ver: 1.03.24.emc

The test object was powered with 120 V AC/60 Hz.

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		
§15.249 (a) Field strength of fundamental	Yes	2	
§15.249 (d) (e) Radiated emission	Yes	3	
§15.215 (c) 20 dB bandwidth	Yes	4	
§15.207 Conducted emission limits	Yes	5	
§2.1049 Occupied bandwidth	Yes	6	
§2.1049 Band Edge	Yes	7	
RF Safety	Yes	8	

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Performance test and requirements

The tests were performed to verify that the electromagnetic compatibility of Unfors Alert Base station meets the 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:	Unfors Alert Base station
Antenna:	Integral, AMD1103-ST01
Antenna gain, peak:	-0.5 dBd
Antenna gain, average:	-4.0 dBd
Frequency:	918.3 MHz
Frequency used during test:	918.3 MHz
Modulation:	GFSK
Data rate:	125 kbps
Supply voltage:	120 V AC / 60 Hz

The EUT was powered by an AC-DC-adapter Astec model: DPS53-M, primary: 120 V AC/60 Hz, secondary: 12 V DC/5A 60W.

Operational test mode

The EUT was set transmitting random data at 918.3 MHz (by selecting channel 52). The test was performed with continuous transmission (100% duty cycle) and with normal modulation.

For duty cycle measurements in normal operation see appendix 2.

According to the client the each base station can receive maximal 10 messages per second per each Unfors Alert Dosimeter. Maximal numbers of Unfors Alert Dosimeter connected to each base station at the same time are 10 Dosimeters, thus theoretical maximal duty cycle is, $1.182 \text{ ms} \times 10 \text{ messages} \times 10 \text{ Dosimeters per second} = 118.2 \text{ ms} \rightarrow \text{duty cycle} = 118.2/1000\text{ms} = 0.1182 = 11.82\%$.

Duty cycle correction factor: $20 \log 118.2/1000 = -18.5 \text{ dB}$

Cabling during emission test:

EUT port	Cable type	Termination / use
12 V DC	2-wire, unshielded, 2.0 m length., bundled to 1.2 m.	Astec AC-DC-adapter.
Ethernet	Unshielded twisted pair, UTP patch cable cat 5e, 0.5 m length.	Unterminated.

Uncertainties

Measurement and test instrument uncertainties are described in the quality assurance documentation "EL-QD 8.2". 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: 2009-10-16

Test engineer

Fredrik Isaksson



REPORT

FCC ID: XWK8603021

Date 2009-11-17 Reference F905629-F15C4 Page 1 (2)

Rev.1: 2009-12-28
Appendix 2

Field strength of fundamental measurements according to FCC 47 CFR part 15.249 (a)

Date	Temperature	Humidity
2009-10-19	22 °C ± 3 °C	34 % ± 5 %
2009-10-26	23 °C ± 3 °C	39 % ± 5 %

Test set-up and procedure

The measurements were performed according to ANSI C63.4-2003.

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	2010-01	504 114
Spectrum analyzer R&S ESI 26	2010-07	503 885
EMI measurement computer	-	-
Software: R&S EMC32, ver. 6.30.10	-	503 745
Antenna Schaffner Bilog CBL6143	2010-03	504 079
Multimeter Fluke 83	2010-01	501 522
Adjustable transformer	-	-
Temperature and humidity meter Testo 625	2010-04	504 117



REPORT

FCC ID: XWK8603021

Date

2009-11-17

Reference

F905629-F15C4

Page

2 (2)

Rev.1: 2009-12-28

Appendix 2

Results

Duty cycle measurements, normal operation (communication with an Unfors Alert Dosimeter) can be found appendix 2.1:

Diagram 1: Tx on at Base station

Diagram 2: Period time at Base station

Field strength of fundamental measurements:

RBW=120 kHz

		Max peak output power Quasi-peak detector (100% duty cycle)
		918.3 MHz
	Antenna height	1.10 m
	Azimuth	135 deg
	Polarization	Vertical
T _{nom} 22°C	V _{nom} 120V AC	93.8 dB μ V/m (=-1.4 dBm ERP) Note 1
T _{nom} 22°C	V _{min} 102 V AC Note 2	93.8 dB μ V/m (=-1.4 dBm ERP) Note 1
T _{nom} 22°C	V _{max} 138 V AC Note 2	93.8 dB μ V/m (=-1.4 dBm ERP) Note 1

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

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.

Limits

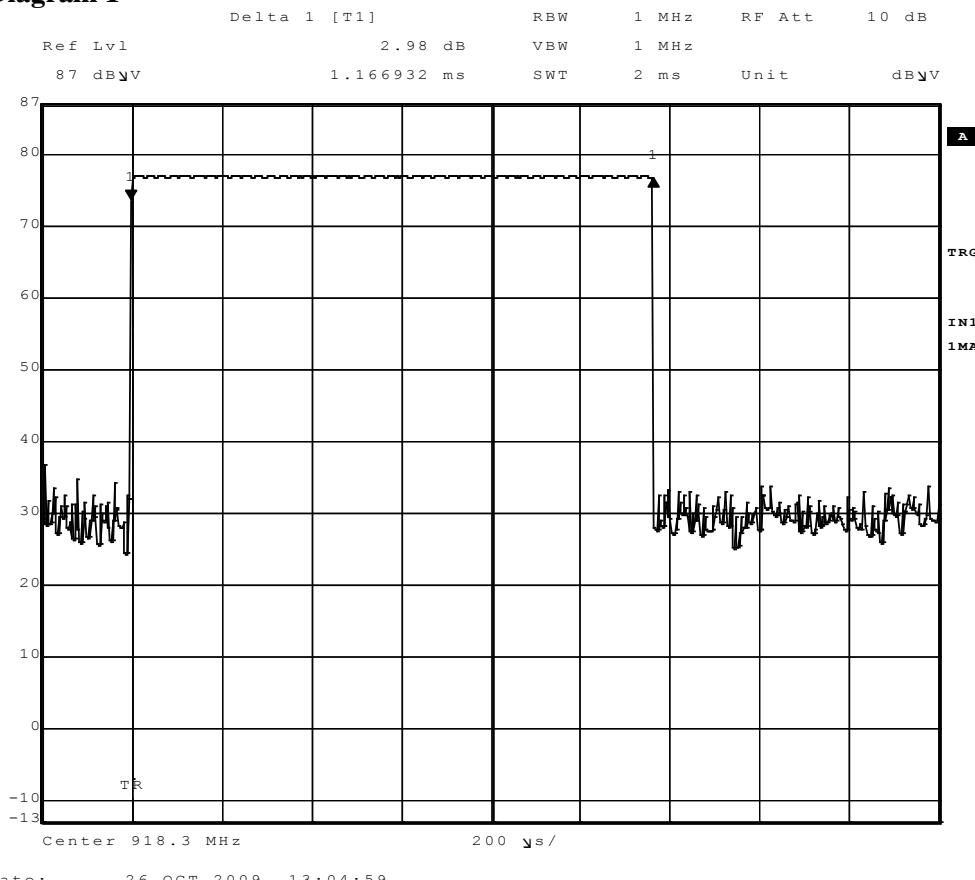
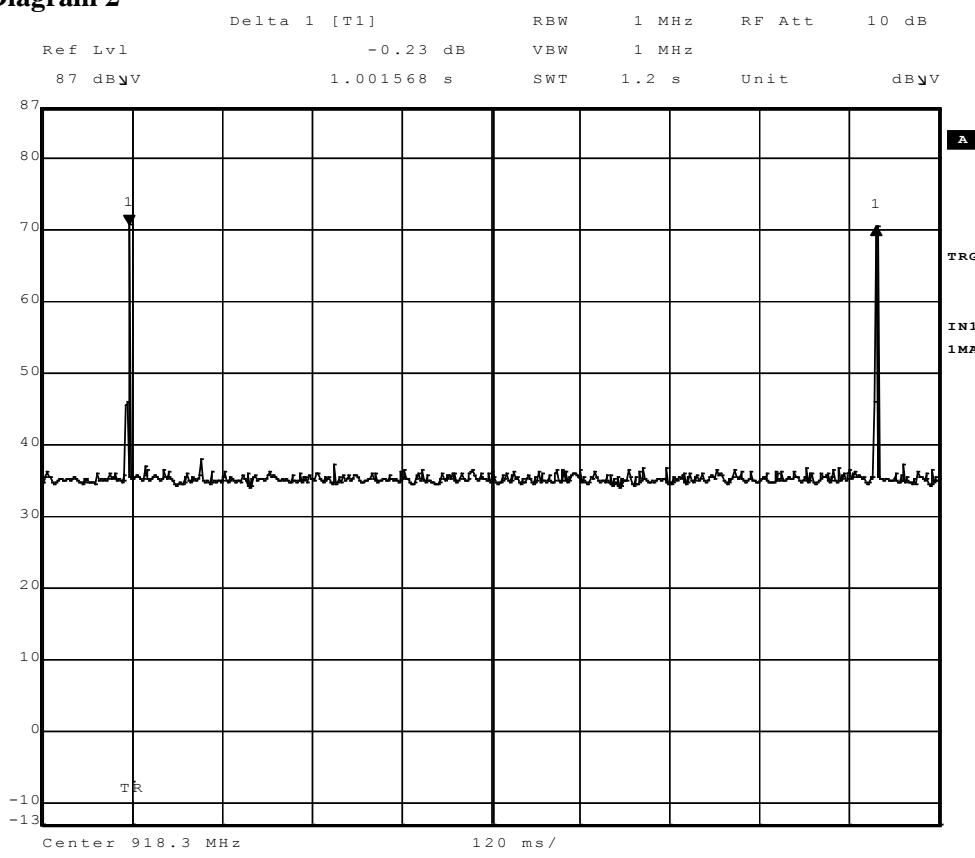
According to 47CFR 15.249(a), The field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Fundamental Frequency 902-928 MHz	Field strength of fundamental 50 mV/m = 94 dB μ V/m	Field strength of harmonics 500 μ V/m = 54 dB μ V/m
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Complies?	Yes
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FCC ID: XWK8603021

Appendix 2.1

Diagram 1**Diagram 2**

Radiated emission measurements according to FCC 47 CFR part 15.249 (d) (e)

Date	Temperature	Humidity
2009-10-16	22 °C ± 3 °C	25 % ± 5 %
2009-10-19	22 °C ± 3 °C	34 % ± 5 %

Test set-up and procedure

The measurements were performed according to ANSI C63.4-2003.

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 m.

The measurement procedure is as the following:

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

The 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	2010-01	504 114
Spectrum analyzer R&S ESI 26	2010-07	503 885
EMI measurement computer	-	-
Software: R&S EMC32, ver. 6.30.10	-	503 745
Antenna Schaffner Bilog CBL6143	2010-03	504 079
Horn antenna EMCO 3115	2011-10	501 548
Preamplifier Miteq, 1-18 GHz	2010-06	504 160
High pass filter Wainwright WHKY	2010-01	504 199
Temperature and humidity meter Testo 625	2010-04	504 117



REPORT

FCC ID: XWK8603021

Date

2009-11-17

Reference

F905629-F15C4

Page

2 (2)

Rev.1: 2009-12-28

Appendix 3

Results

The emission spectra can be found appendix 3.1:

918.3 MHz

Diagram 1: Radiated emission 30-1000 MHz, vertical and horizontal polarizations.

Diagram 2: Radiated emission 1-10 GHz, vertical and horizontal polarizations.

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:

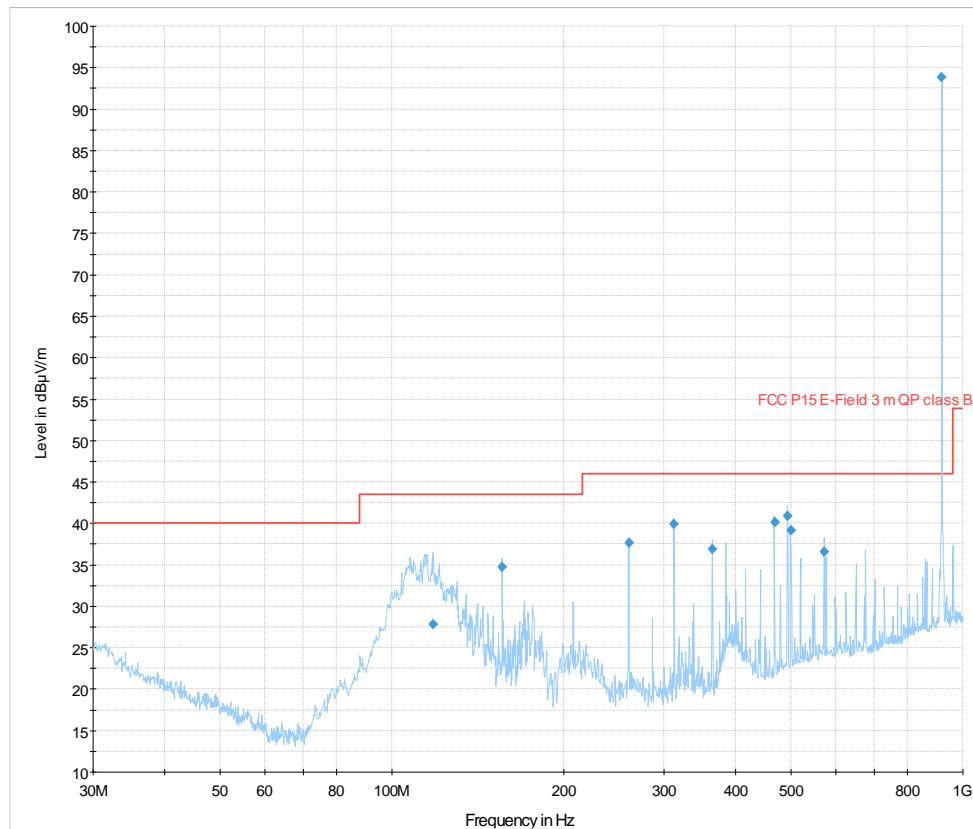
Fundamental Frequency	Field strength of harmonics
902-928 MHz	500 μ V/m = 54 dB μ V/m

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.

Complies?	Yes
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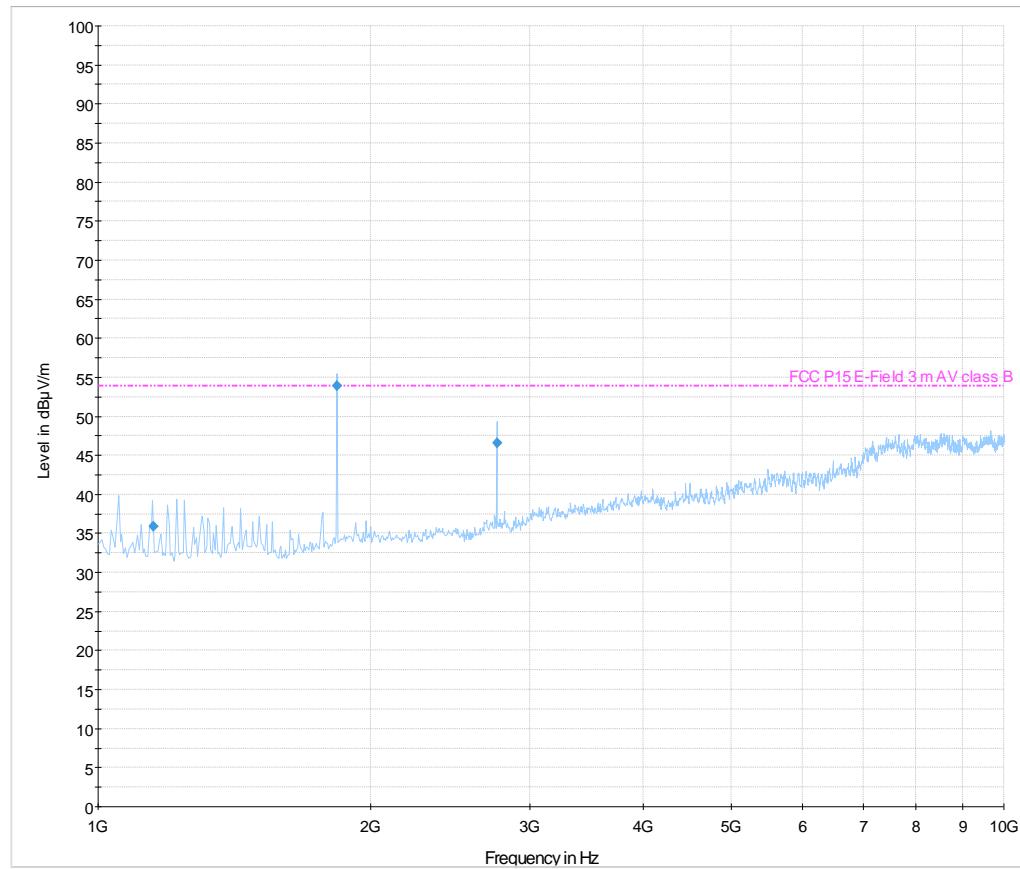
Diagram 1



Final Result 1 (with 100% duty cycle)

Frequency (MHz)	QuasiPeak (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Antenna height (cm)	Polarity	Turntable position (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
118.265531	27.8	1000.00	120.000	109.0	V	254.0	12.7	15.7	43.5
155.976954	34.8	1000.00	120.000	100.0	V	114.0	11.3	8.7	43.5
259.978958	37.7	1000.00	120.000	120.0	H	326.0	13.4	8.3	46.0
311.994990	39.9	1000.00	120.000	189.0	V	30.0	14.5	6.1	46.0
364.005010	36.9	1000.00	120.000	100.0	H	0.0	16.0	9.1	46.0
467.972946	40.1	1000.00	120.000	126.0	V	5.0	18.2	5.9	46.0
493.966934	40.9	1000.00	120.000	121.0	V	0.0	18.6	5.1	46.0
499.998998	39.2	1000.00	120.000	114.0	V	45.0	18.6	6.8	46.0
571.958918	36.6	1000.00	120.000	100.0	V	0.0	19.9	9.4	46.0
918.335671	93.8	1000.00	120.000	110.0	V	135.0	22.8	0.2	94.0

Diagram 2



Final Result 1 (with 100% duty cycle)

Frequency (MHz)	Average (dBµV/m)	Peak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Antenna height (cm)	Pol	Turntable position (deg)	Corr (dB)	Margin AV (dB)	Limit AV (dBµV /m)
1152.15430	35.9	-	1000.00	1000.000	149.0	V	318.0	-20.9	18.0	53.9
1836.74348	54.4	55.7	1000.00	1000.000	100.0	H	229.0	-18.4	+0.5 Note 1	53.9
2754.97996	46.6	49.5	1000.00	1000.000	100.0	V	226.0	-15.6	7.3	53.9

Note 1:

According to the duty cycle calculation in appendix 2, the maximal theoretical duty cycle is 11.82%, thus the duty cycle correction factor is -18.5 dB.

The correct Average level with normal duty cycle shall be: $54.4 \text{ dB}\mu\text{V/m} - 18.5 \text{ dB} = 35.9 \text{ dB}\mu\text{V/m}$, thus the result is compliant.



REPORT

Date 2009-11-17 Reference F905629-F15C4 Page 1 (1)

FCC ID: XWK8603021

Appendix 4

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

Date	Temperature	Humidity
2009-10-19	22 °C ± 3 °C	34 % ± 5 %

Test set-up and procedure

The measurements were performed according to ANSI C63.4-2003.

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	2010-01	504 114
Spectrum analyzer R&S ESI 26	2010-07	503 885
EMI measurement computer	-	-
Software: R&S EMC32, ver. 6.30.10	-	503 745
Antenna Schaffner Bilog CBL6143	2010-03	504 079
Temperature and humidity meter Testo 625	2010-04	504 117

Measurement uncertainty: 2.6 %

Results

The diagram can be found in the appendix 4.1.

Diagram 1 918.3 MHz 20 dB BW = 303.60 kHz

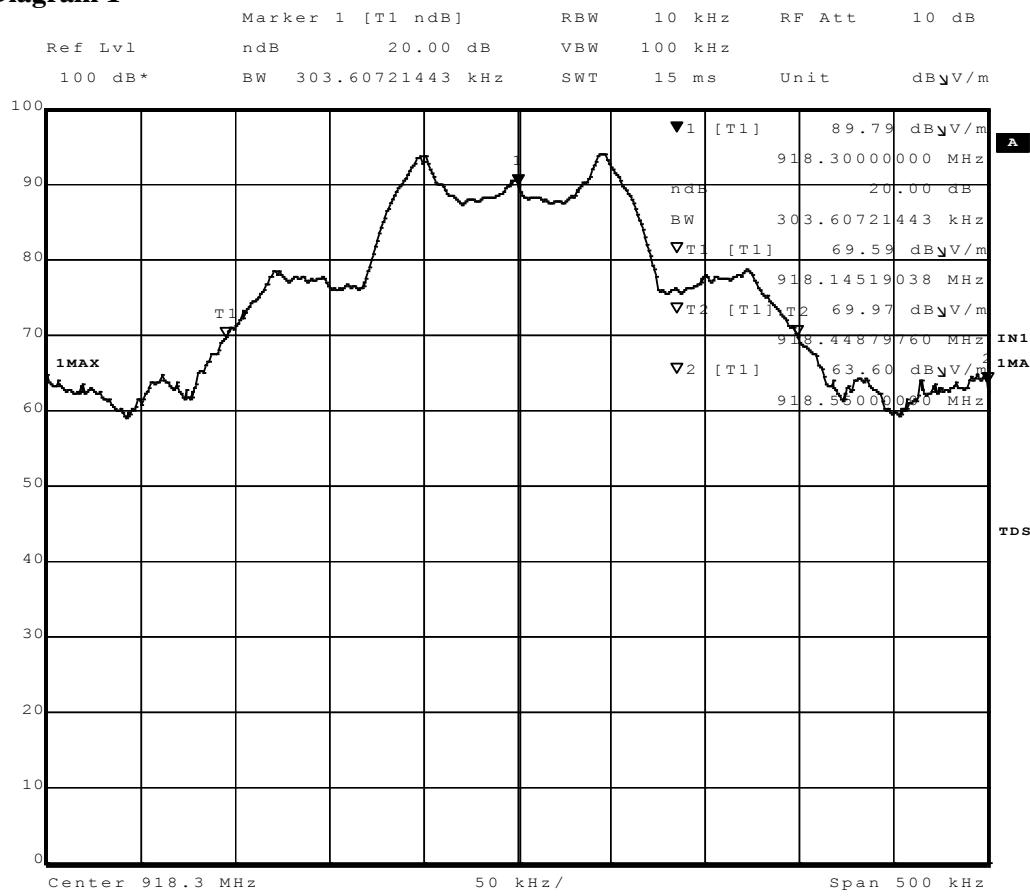
Limits

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: XWK8603021

Appendix 4.1

Diagram 1

Date: 19.OCT.2009 11:17:34

**Conducted emission measurements according to FCC 47 CFR part 15.207,
class B**

Date	Temperature	Humidity
2009-10-16	22 °C ± 3 °C	25 % ± 5 %

Test set-up and procedure

The measurements were performed according to ANSI C63.4-2003.

Measurements were performed on the 120 V AC/60 Hz, phase and neutral terminals.

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

Measurement equipment	Calibration Due	SP number
Semi anechoic chamber, Edison	2010-01	504 114
Spectrum analyzer R&S ESI 26	2010-07	503 885
EMI measurement computer	-	-
Software: R&S EMC32, ver. 6.30.10	-	503 745
LISN Schwartzbeck NNLA8120	2010-02	500 574
Temperature and humidity meter Testo 625	2010-04	504 117

Result

The conducted emission spectra can be found in appendix 5.1:

Diagram 1:	120 V AC, phase terminal
Diagram 2:	120 V AC, neutral terminal

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

Emission below limit?	Yes
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Test set-up, Conducted emission

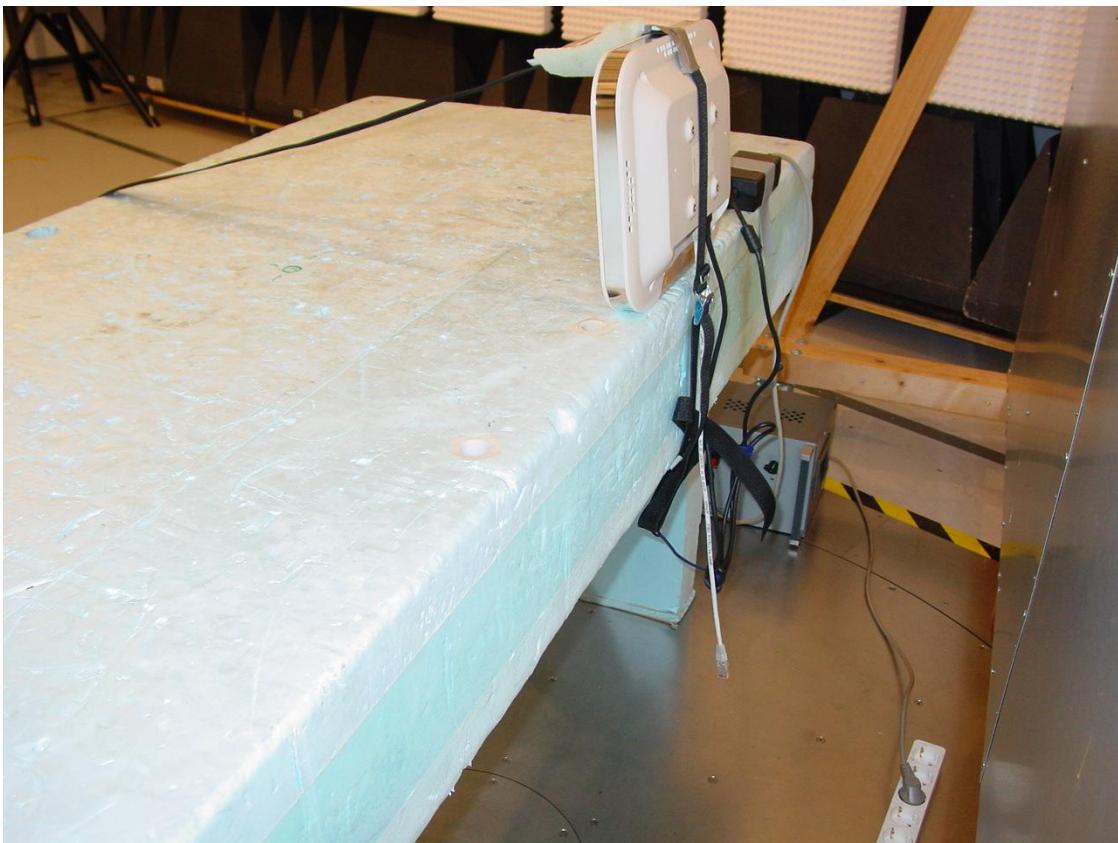
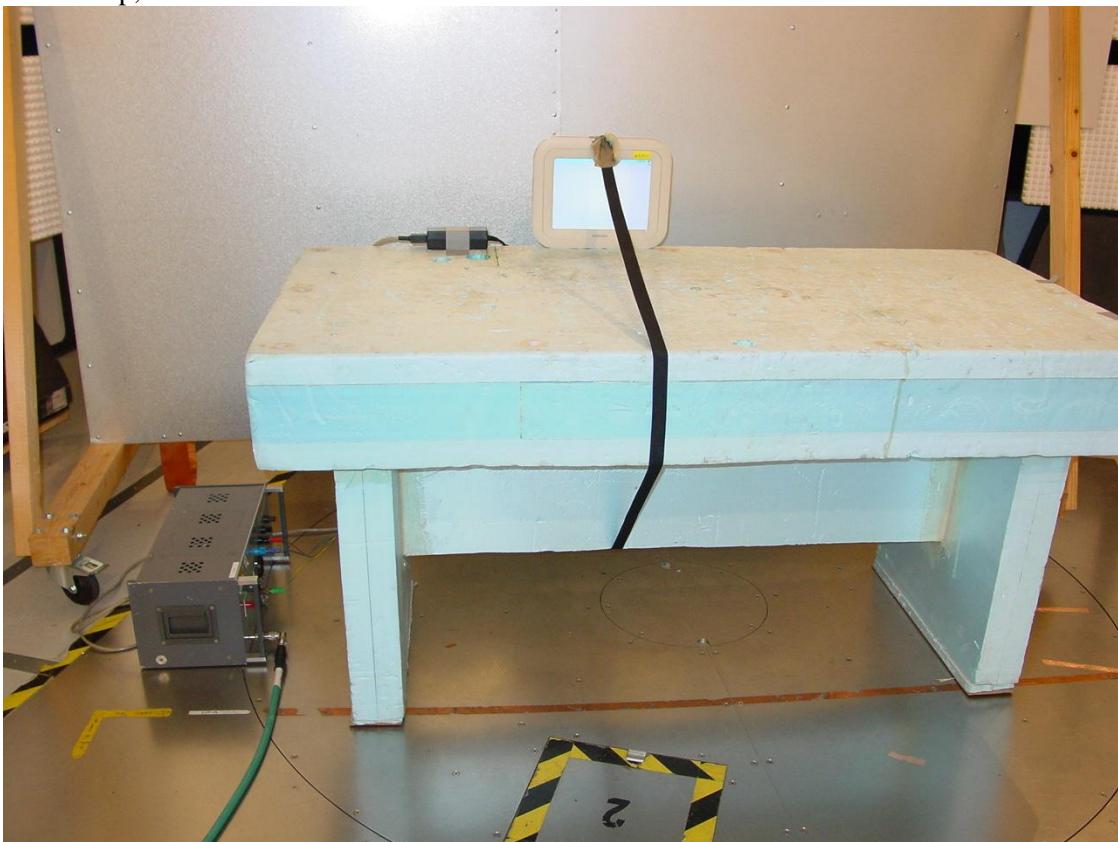
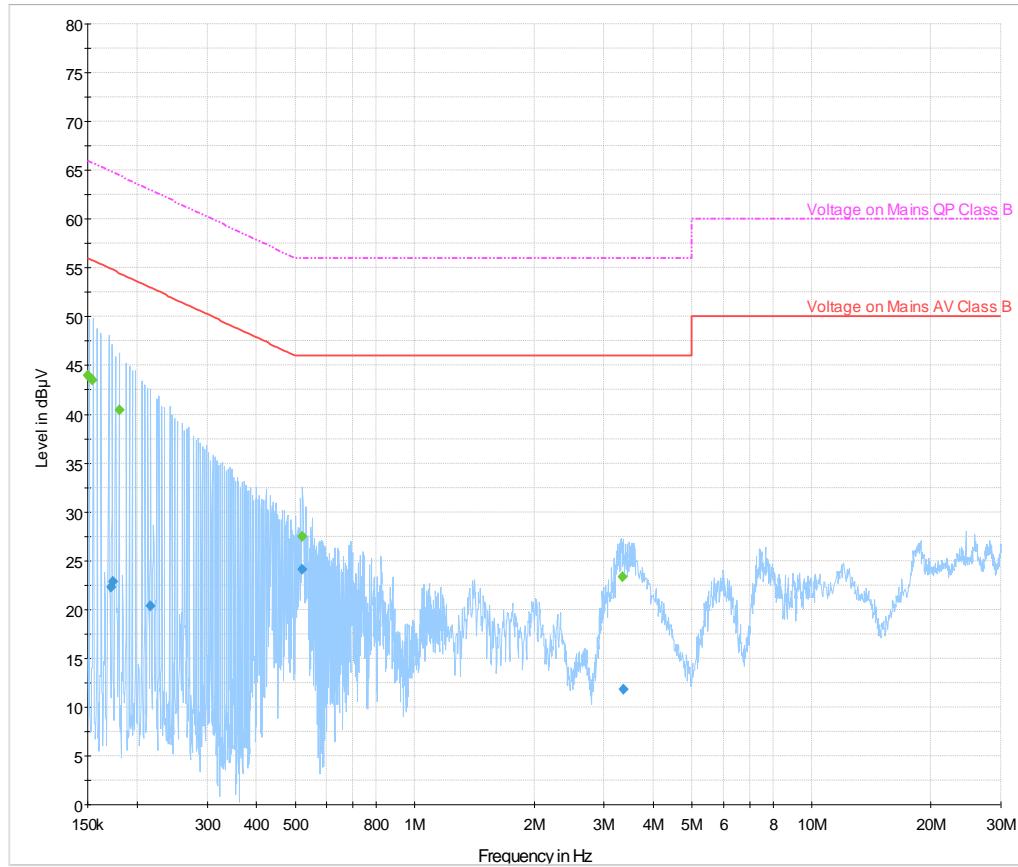


Diagram 1



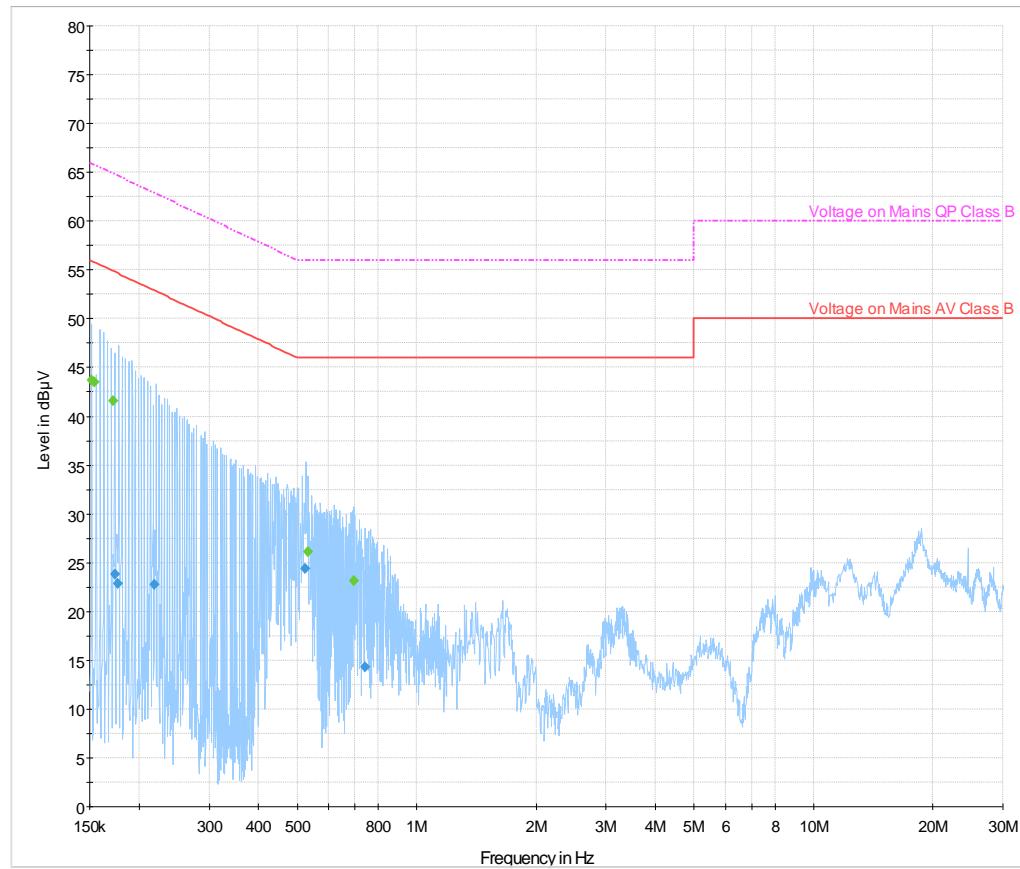
Final Result average

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	PE	Line	Corr (dB)	Margin (dB)	Limit (dBµV)
0.172000	22.3	1000.000	9.000	GND	L1	0.1	32.6	54.9
0.174000	22.9	1000.000	9.000	GND	L1	0.1	31.9	54.8
0.216240	20.4	1000.000	9.000	GND	L1	0.1	32.6	53.0
0.521844	24.1	1000.000	9.000	GND	L1	0.1	21.9	46.0
3.349042	11.8	1000.000	9.000	GND	L1	0.2	34.2	46.0

Final Result quasipeak

Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	PE	Line	Corr (dB)	Margin (dB)	Limit (dBµV)
0.150000	44.0	1000.000	9.000	GND	L1	0.1	22.0	66.0
0.152000	43.7	1000.000	9.000	GND	L1	0.1	22.2	65.9
0.154000	43.5	1000.000	9.000	GND	L1	0.1	22.3	65.8
0.180240	40.4	1000.000	9.000	GND	L1	0.1	24.1	64.5
0.519844	27.5	1000.000	9.000	GND	L1	0.1	28.5	56.0
3.345042	23.3	1000.000	9.000	GND	L1	0.2	32.7	56.0

Diagram 2



Final Result average

Frequency (MHz)	Average (dB μ V)	Meas. Time (ms)	Bandwidth (kHz)	PE	Line	Corr. (dB)	Margin (dB)	Limit (dB μ V)
0.174000	23.8	1000.000	9.000	GND	N	0.1	31.0	54.8
0.176220	22.8	1000.000	9.000	GND	N	0.1	31.9	54.7
0.218000	22.7	1000.000	9.000	GND	N	0.1	30.2	52.9
0.523050	24.4	1000.000	9.000	GND	N	0.1	21.6	46.0
0.741483	14.3	1000.000	9.000	GND	N	0.1	31.7	46.0

Final Result quasipeak

Frequency (MHz)	QuasiPeak (dB μ V)	Meas. Time (ms)	Bandwidth (kHz)	PE	Line	Corr. (dB)	Margin (dB)	Limit (dB μ V)
0.152000	43.7	1000.000	9.000	GND	N	0.1	22.2	65.9
0.154000	43.6	1000.000	9.000	GND	N	0.1	22.2	65.8
0.172220	41.6	1000.000	9.000	GND	N	0.1	23.3	64.9
0.531050	26.1	1000.000	9.000	GND	N	0.1	29.9	56.0
0.693483	23.1	1000.000	9.000	GND	N	0.1	32.9	56.0

Occupied bandwidth measurements according to 47CFR 2.1049

Date	Temperature	Humidity
2009-10-19	22 °C ± 3 °C	34 % ± 5 %

Test set-up and procedure

The measurements were performed according to ANSI C63.4-2003.

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	2010-01	504 114
Spectrum analyzer R&S FSIQ40	2010-07	503 738
EMI measurement computer	-	-
Software: R&S EMC32, ver. 6.30.10	-	503 745
Antenna Schaffner Bilog CBL6143	2010-03	504 079
Temperature and humidity meter Testo 625	2010-04	504 117

Measurement uncertainty: 2.6 %

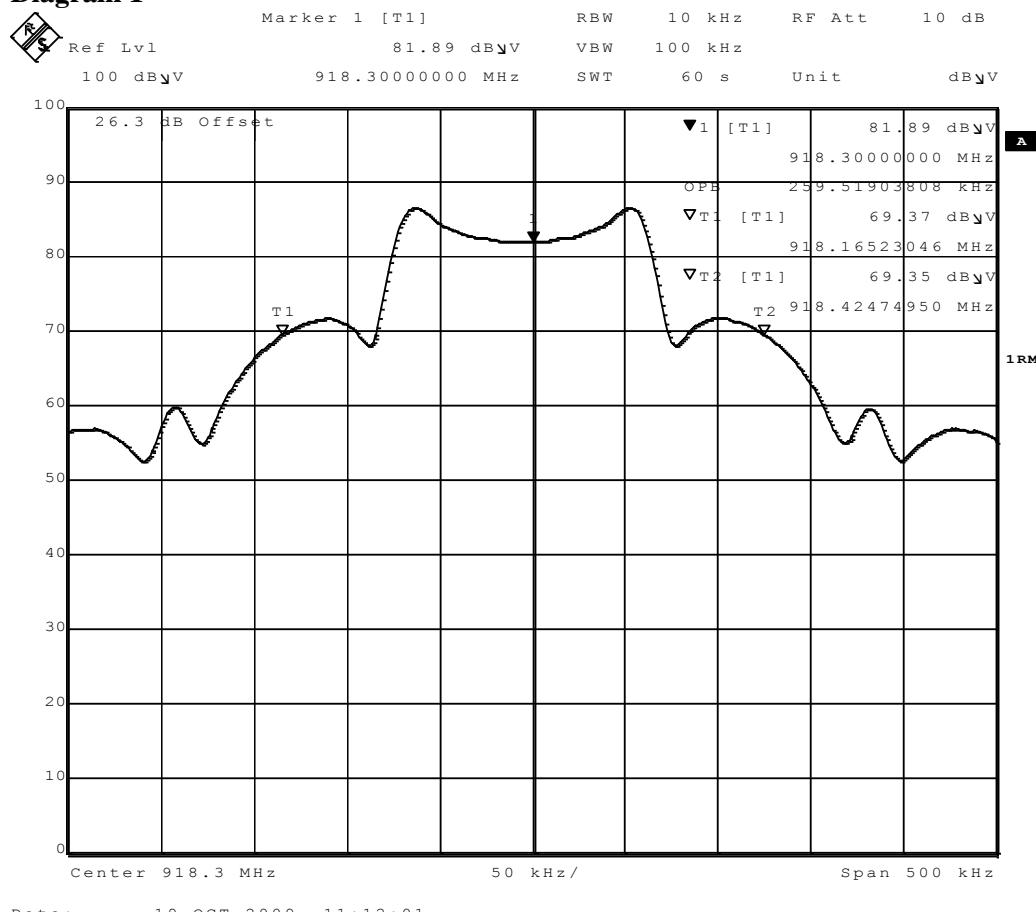
Results

The diagram can be found in the appendix 6.1.

Diagram 1 918.3 MHz OBW = 259.52 kHz (99%)

FCC ID: XWK8603021

Appendix 6.1

Diagram 1

**Band edge measurements according to 47CFR 2.1049**

Date	Temperature	Humidity
2009-10-19	22 °C ± 3 °C	34 % ± 5 %

Test set-up and procedure

The measurements were performed according to ANSI C63.4-2003.

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	2010-01	504 114
Spectrum analyzer R&S ESI 26	2010-07	503 885
EMI measurement computer	-	-
Software: R&S EMC32, ver. 6.30.10	-	503 745
Antenna Schaffner Bilog CBL6143	2010-03	504 079
Temperature and humidity meter Testo 625	2010-04	504 117

Results

Operation band 902-928 MHz

The diagram can be found in the appendix 7.1.

Diagram 1 918.3 MHz Band edge at 902 and 928 MHz

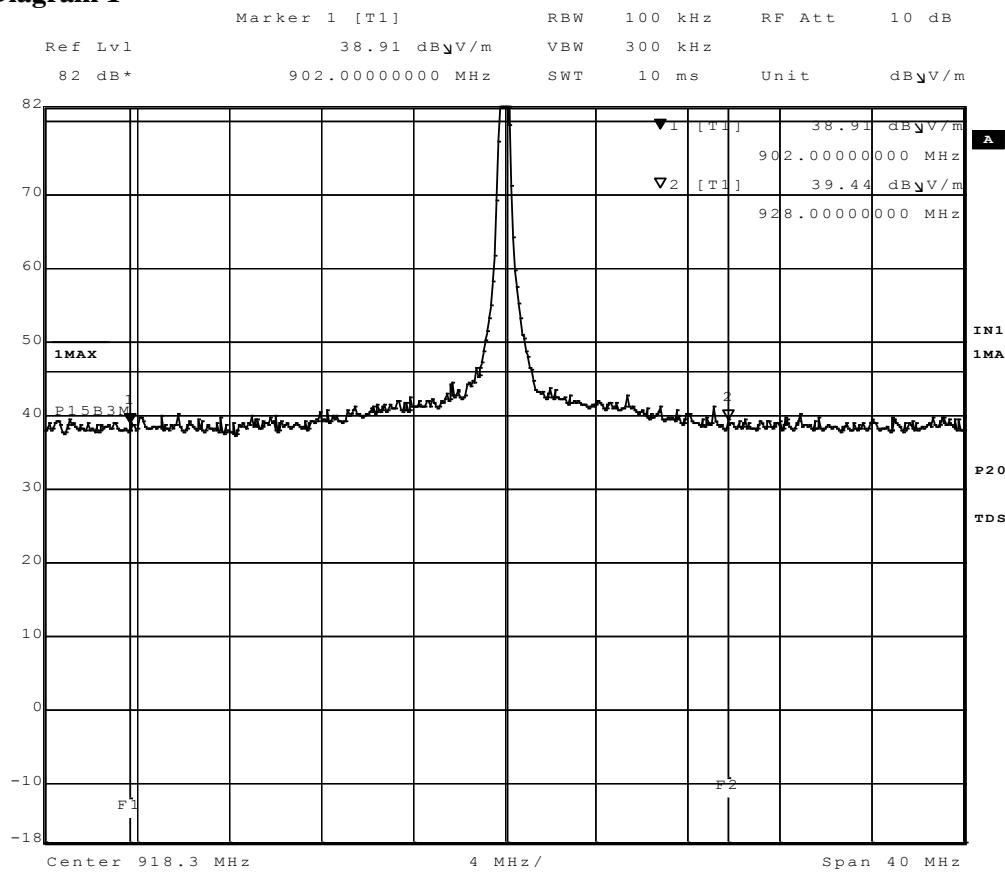
Limits

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.

Complies?	Yes
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FCC ID: XWK8603021

Appendix 7.1

Diagram 1

Date: 19.OCT.2009 10:55:33

**RF exposure evaluation: Mobile equipment**

Date	Temperature	Humidity
2009-10-19	22 °C ± 3 °C	34 % ± 5 %

Procedure

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

Results

The following formula was used to calculate the RF exposure,

$$Pd = Pout \times G / (4 \times \pi \times r_{cm}^2)$$

where,

Pd = power density in mW/cm^2

Pout = output power to antenna in mW

G = gain of antenna in linear scale

$\pi = 3.1416$

r = distance between observation and center of the radiator in cm

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

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

Antenna Gain (dBi)	Antenna Gain (numeric)	ERP Peak output power (dBm)	Peak output power (mW)	Power density, Pd [S] (mW/cm^2)	Limit of power density (mW/cm^2)
Note 1	Note 1	-1.4	0.724	0.00014	0.612

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



REPORT

Date 2009-11-17 Reference F905629-F15C4

Page 2 (2)

FCC ID: XWK8603021

Appendix 8

Limits

(A) Limits for Occupational/Controlled Exposure

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

(B) Limits for General Population/Uncontrolled Exposure

Frequency range (MHz)	Electric field strength [E] (V/m)	Magnetic filed strength [H] (A/m)	Power density [S] (mW/cm ²)	Averaging time E ² , H ² or S (minutes)
0.3-1.34	614	1.63	(100)*	30
1.34-30	824/f	2.19/f	(180/f)*	30
30-300	27.5	0.073	0.2	30
300-1500			F/1500 (=0.612 at 918.3 MHz)	30
1500-100,000			1.0	30

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

Complies?	Yes
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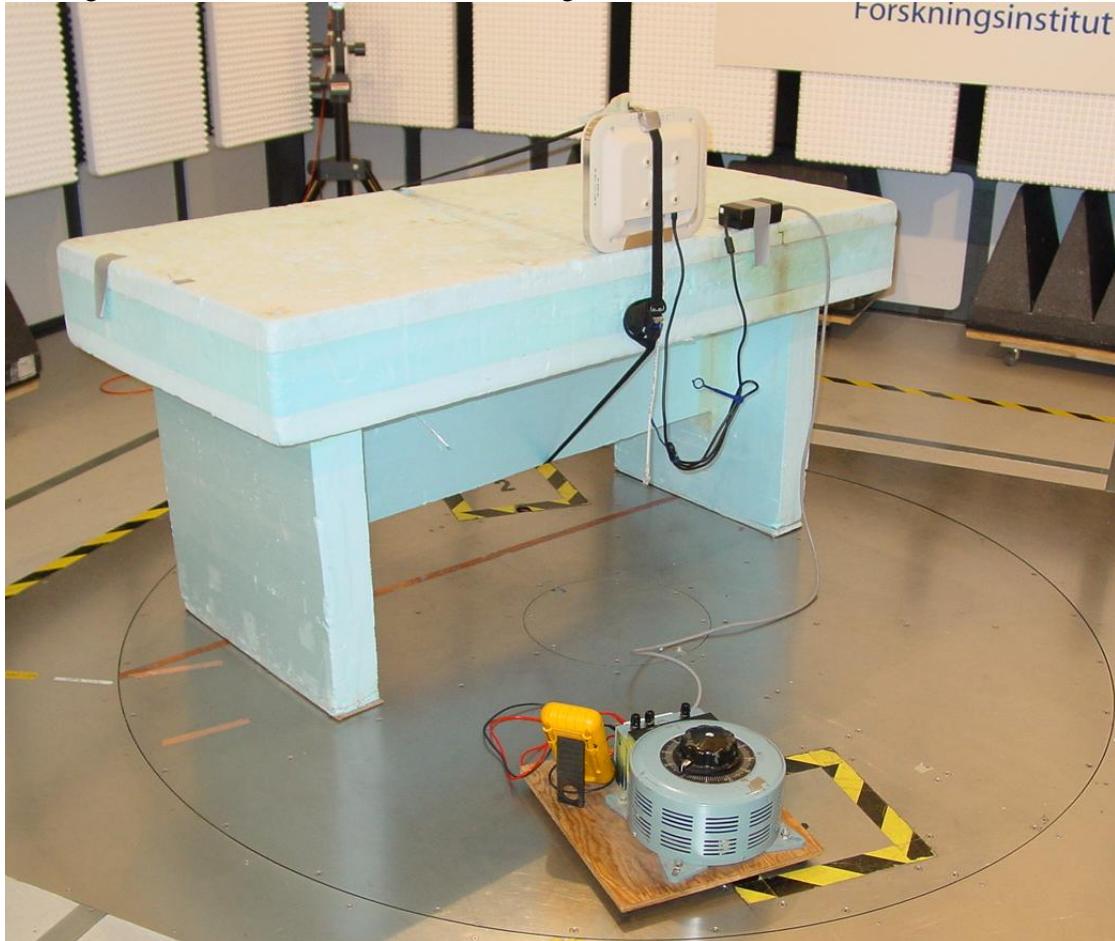
FCC ID: XWK8603021

Appendix 9

Photos

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

135 degree at TT (direction of the TT for the highest level of the fundamental)



Note: The adjustable transformer and the multimeter were only used during the test of the Field strength of fundamental.

FCC ID: XWK8603021

Appendix 9

EUT

Identity, base station



Identity, AC/DC-adapter



FCC ID: XWK8603021

Appendix 9

Front



Rear



FCC ID: XWK8603021

Appendix 9

Bottom



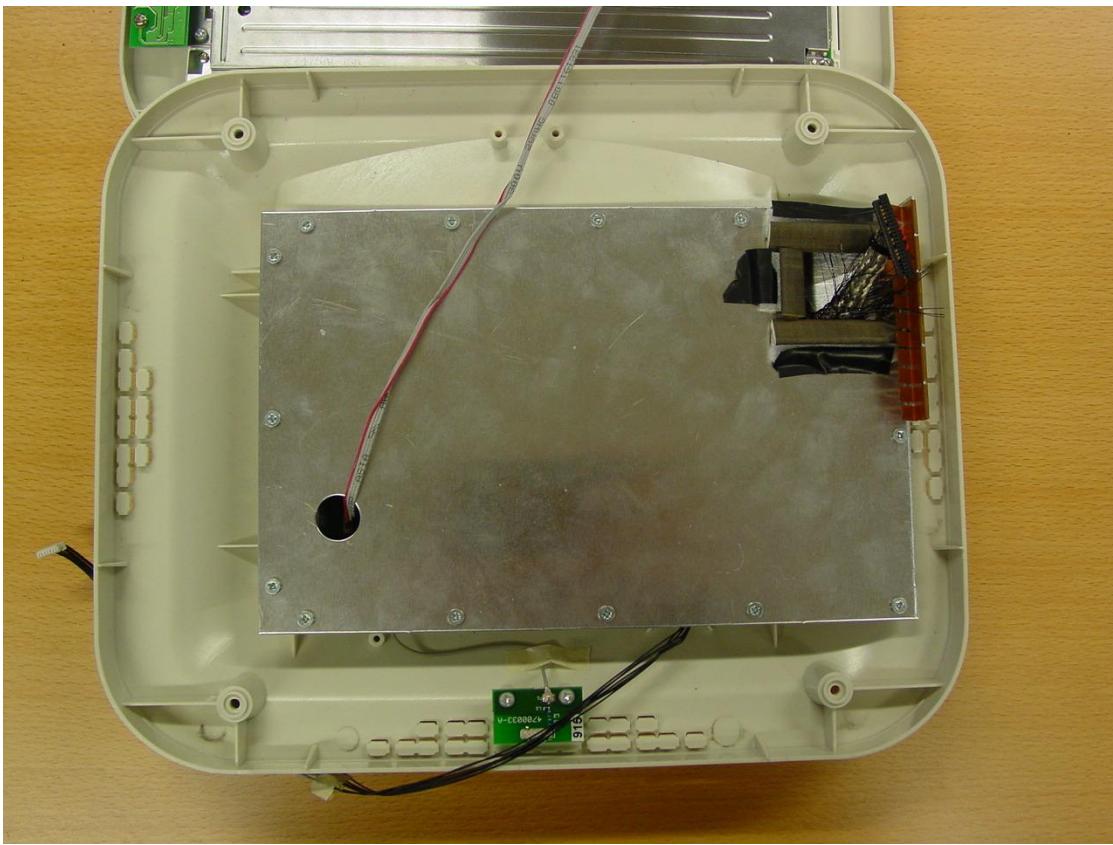
Inside view 1, over-view



FCC ID: XWK8603021

Appendix 9

Inside view 2



Inside view 3

