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Rev.1: 2009-12-28  
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## Equipment Authorization measurements on 918 MHz Transceiver Unit

**FCC ID: XWK8601015**

(8 appendices)

Rev.1, 2009-12-28: Appendix 2 and 3 has been revised, the limit of the harmonics was 50  $\mu$ V/m, it shall be 500  $\mu$ V/m instead.

### Test object

Product name: Unfors Alert Dosimeter (PDM, Personal DosiMeter)  
Part. number: 1601021  
Serial number: 11000138  
Software: 1.04.62

### Summary

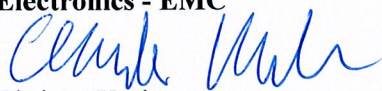
See appendix 1 for general information and appendix 8 for photos.  
Emission measurements as specified below have been performed.

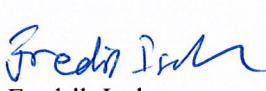
Standard	Compliant	Appendix	Remarks
<b>FCC 47 CFR Part 15 C (07-10-08)</b>			
§15.249 Operation within the band 902-928 MHz	Yes		
§15.249 (a) Field strength of fundamental	Yes	2	
§15.249 (d) (e) Radiated emission	Yes	3	
§15.215 (c) 20 dB bandwidth	Yes	4	
§15.207 Conducted emission limits	N/A	-	Note 1
§2.1049 Occupied bandwidth	Yes	5	
§2.1049 Band Edge	Yes	6	
RF Safety	Yes	7	

Note 1: Test not applicable, battery powered.

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## Performance test and requirements

The tests were performed to verify that the electromagnetic compatibility of Unfors Alert Dosimeter (PDM, Personal DosiMeter) 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 Dosimeter
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:	3.0 V DC, internal battery Lithium

## Operational test mode

To simplify the measurements a modified test sample was used to be able to transmit continuous with modulation.

The EUT was tested stand alone.

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

The EUT was set in desired mode with a PC via the s/w Terminal.exe v1.9b 20041226 with the EUT in the Unfors Alert Cradle.

The used commando was:

rtest 2: Transmit random modulated carrier

**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: 2009-09-14

**Test engineer**

Fredrik Isaksson

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

Date 2009-09-14	Temperature 23 °C ± 3 °C	Humidity 41 % ± 5 %
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### 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 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 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	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**

RBW=120 kHz

		Max peak output power Quasi-peak detector		
		918.3 MHz	918.3 MHz	918.3 MHz
	EUT axes	X-axes	Y-axes	Z-axes
	Antenna height	1.00 m	1.00	1.33 m
	Azimuth	0 deg	14 deg	25 deg
	Polarization	Horizontal	Horizontal	Vertical
$T_{nom}$ 23°C	$V_{nom}$ 3.0 V DC	88.0 dBμV/m (=-7.2 dBm ERP) Note 1	89.2 dBμV/m (=-6.0 dBm ERP) Note 1	83.6 dBμV/m (=-11.6 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  $ERP = E(dBμV/m) - 90 + 20\log(d) - 10\log(30)$

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 dBμV/m	Field strength of harmonics 500 μV/m = 54 dBμV/m
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Complies?	Yes
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## Radiated emission measurements according to FCC 47 CFR part 15.249 (d) (e)

Date	Temperature	Humidity
2009-09-14	23 °C ± 3 °C	41 % ± 5 %
2009-09-15	23 °C ± 3 °C	33 % ± 5 %
2009-09-16	23 °C ± 3 °C	40 % ± 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 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 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 8.

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

**Results**

The emission spectra can be found appendix 3.1:

918.3 MHz

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

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

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

Diagram 4: Radiated emission 1-10 GHz, Y-axes, vertical and horizontal polarizations.

Diagram 5: Radiated emission 30-1000 MHz, Z-axes, vertical and horizontal polarizations.

Diagram 6: Radiated emission 1-10 GHz, Z-axes, 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:

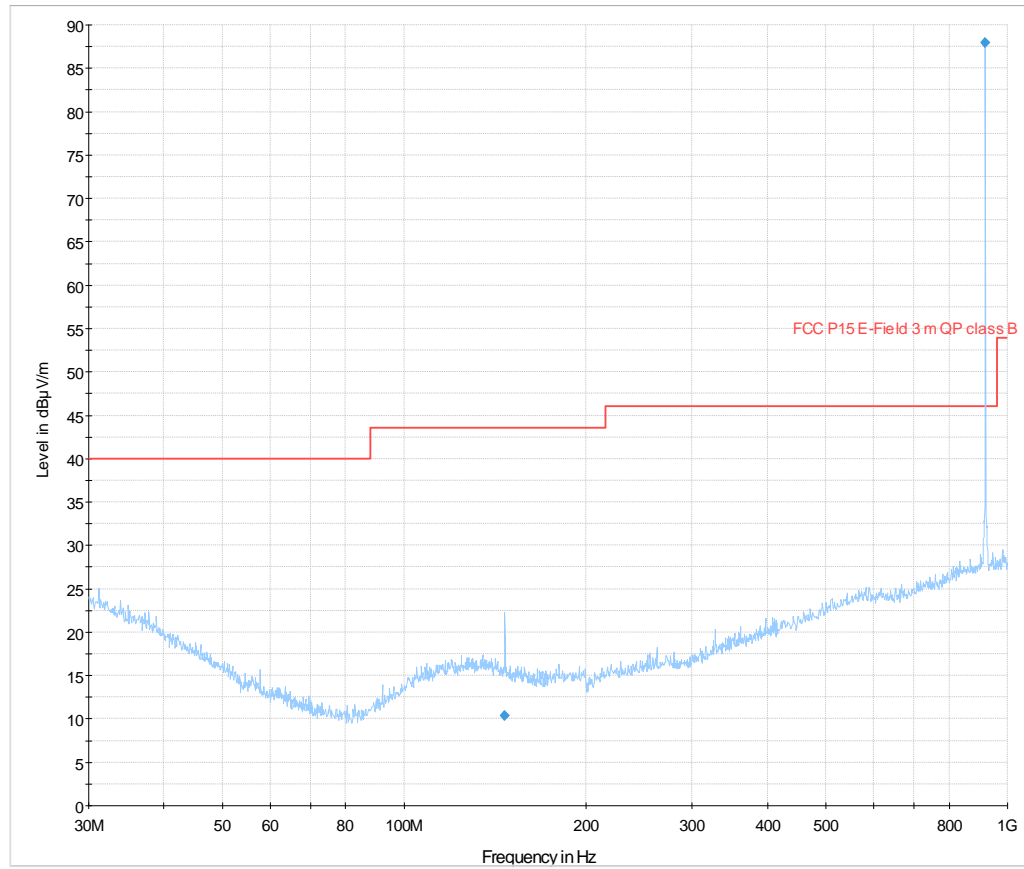
Fundamental Frequency	Field strength of harmonics
902-928 MHz	500 $\mu$ V/m = 54 dB $\mu$ V/m

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**

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Antenna height (cm)	Polarity	Turntable position (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
146.916834	10.3	1000.00	120.000	195.0	V	20.0	11.9	33.2	43.5
918.329659	88.0	1000.00	120.000	100.0	H	0.0	22.8	6.0	94.0

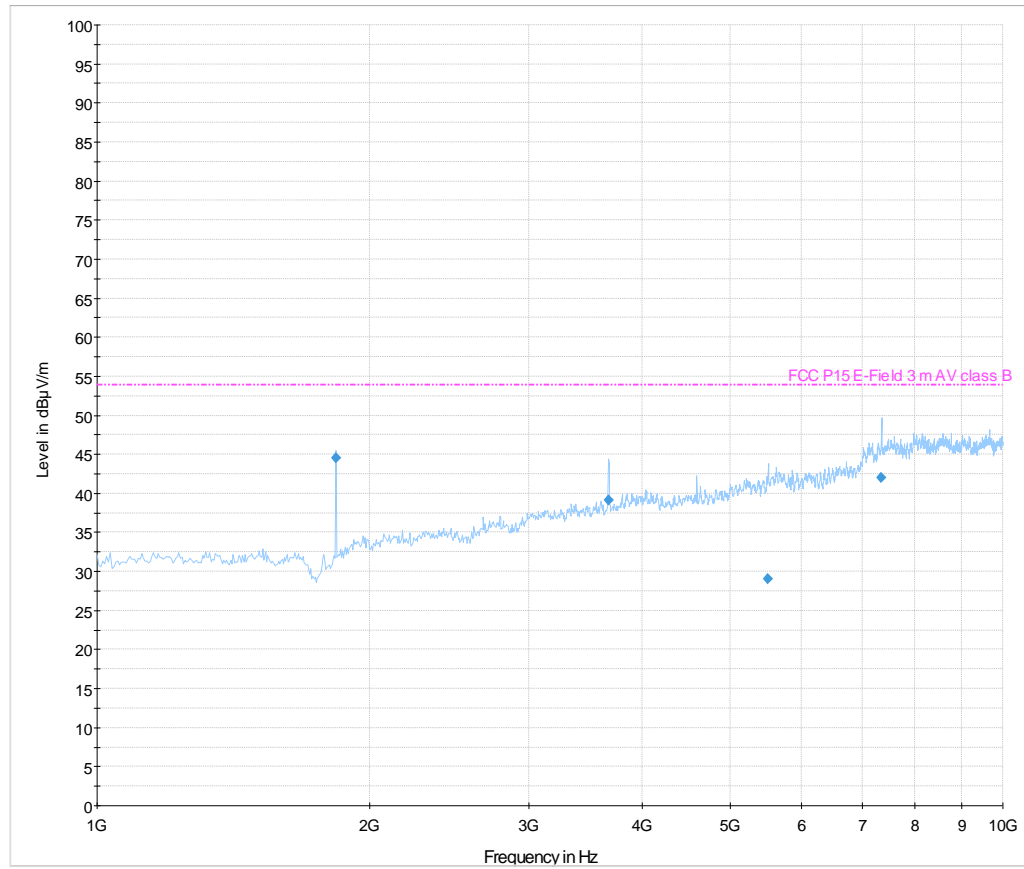




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Appendix 3.1

Diagram 2

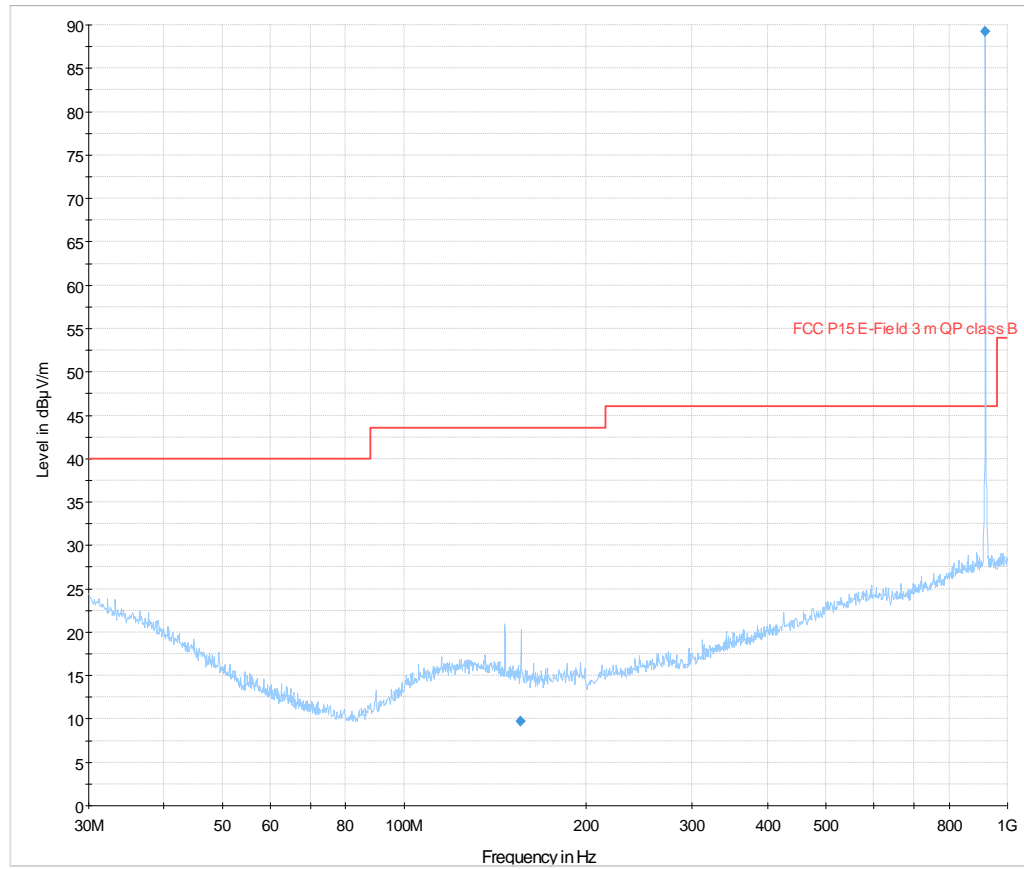


Final Result 1

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)	AV-Limit (dBμV)
1836.68336	46.5	49.0	1000.0	1000.000	109.0	V	0.0	-18.4	7.4	53.9
3673.07615	42.7	47.7	1000.0	1000.000	100.0	H	328.0	-12.5	11.2	53.9
5504.31863	29.1	-	1000.0	1000.000	137.0	V	284.0	-9.3	24.8	53.9
7345.98196	42.0	50.1	1000.0	1000.000	114.0	H	19.0	-3.7	11.9	53.9



Diagram 3



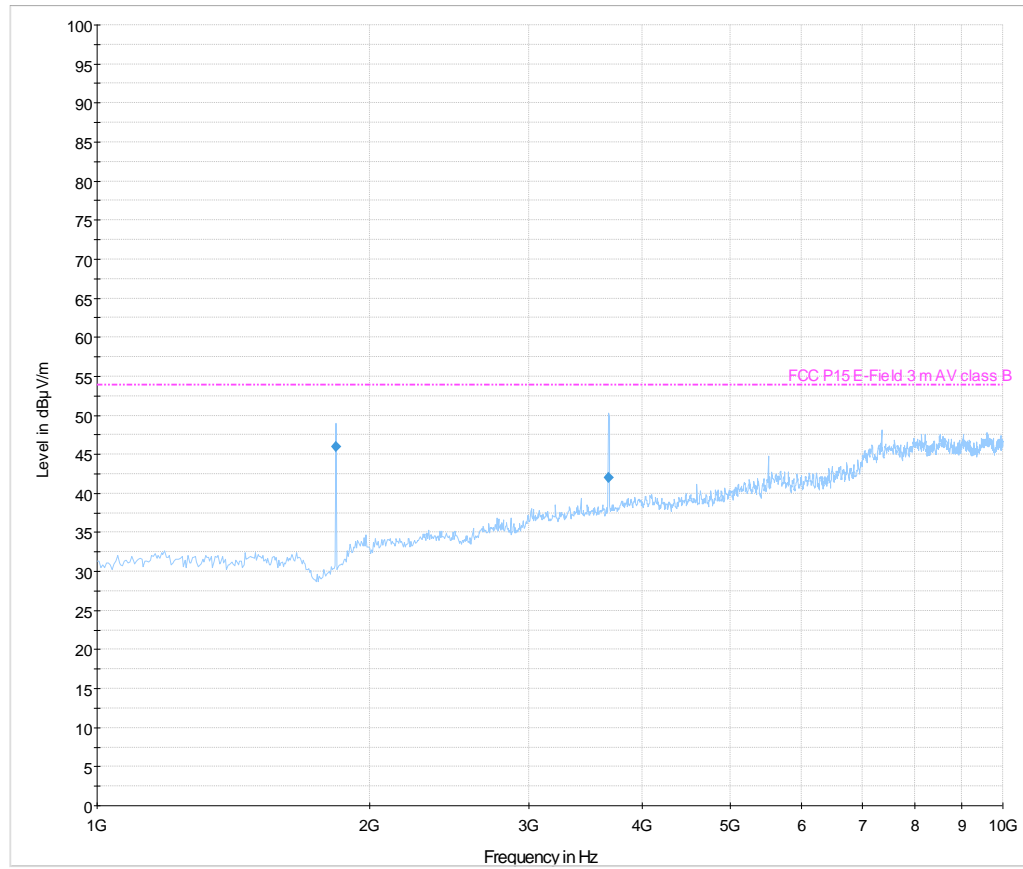
Final Result 1

Frequency (MHz)	QuasiPeak (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Antenna height (cm)	Polarity	Turntable position (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
156.125251	9.7	1000.00	120.000	144.0	V	0.0	11.3	33.8	43.5
918.329659	89.2	1000.00	120.000	100.0	H	14.0	22.8	5.8	94.0

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Appendix 3.1

**Diagram 4**

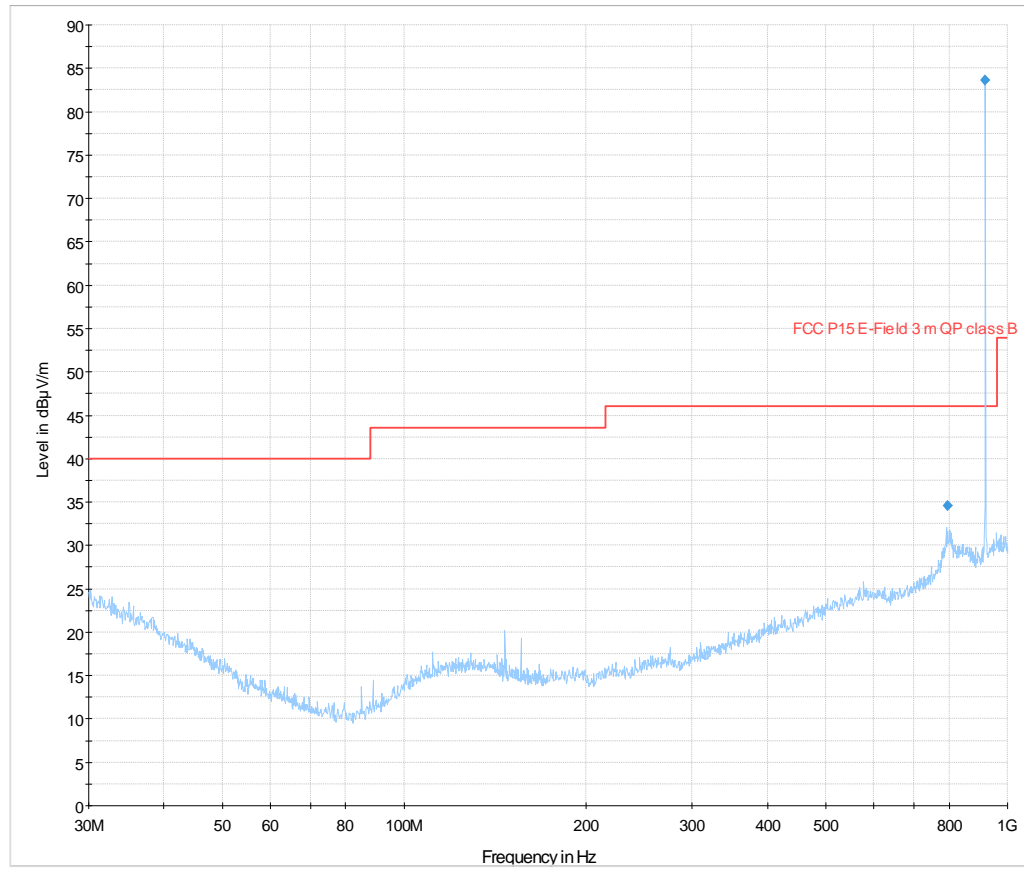


**Final Result 1**

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)	AV-Limit (dBμV)
1836.68336	46.0	48.6	1000.0	1000.000	100.0	H	228.0	-18.4	7.9	53.9
3673.33667	42.0	46.9	1000.0	1000.000	100.0	H	90.0	-12.5	11.9	53.9



Diagram 5

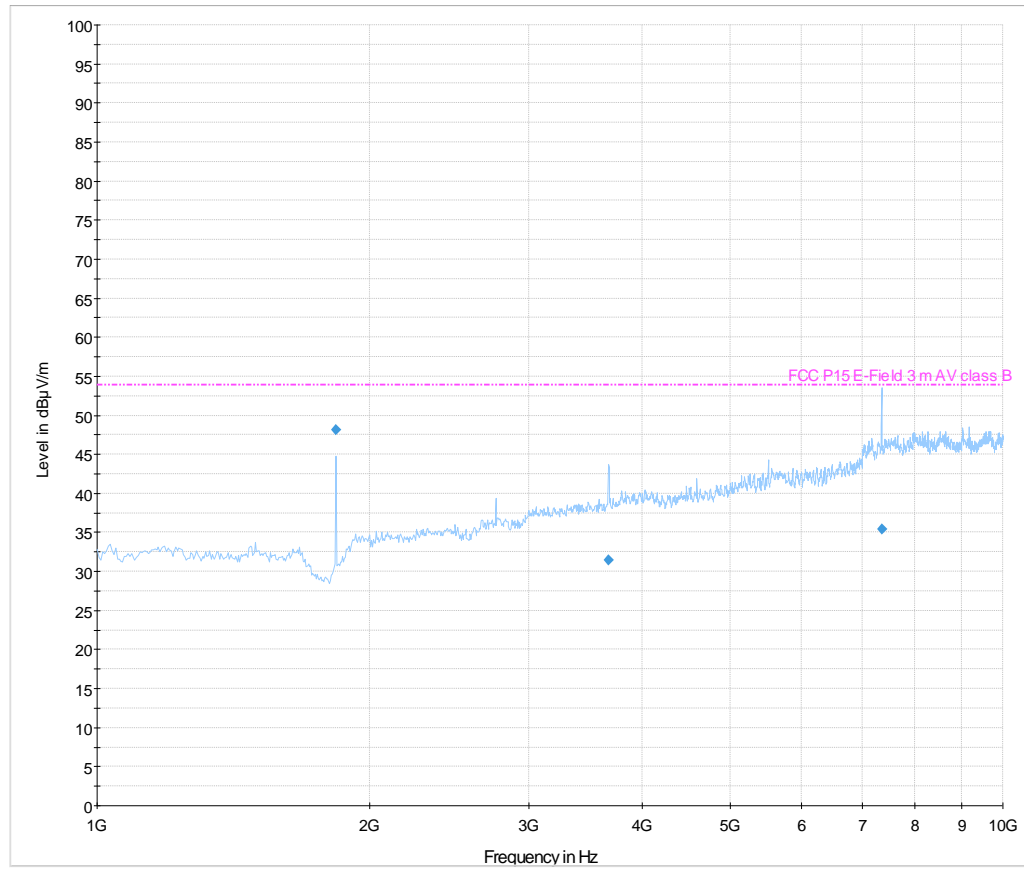


Final Result 1

Frequency (MHz)	QuasiPeak (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Antenna height (cm)	Polarity	Turntable position (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
796.449900	34.6	1000.00	120.000	161.0	V	30.0	21.5	11.4	46.0
918.329659	83.6	1000.00	120.000	133.0	V	25.0	22.8	10.4	94.0



Diagram 6



Final Result 1

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)	AV-Limit (dBμV)
1836.66332	48.1	50.0	1000.0	1000.000	125.0	H	58.0	-18.4	5.8	53.9
3673.37675	36.5	44.4	1000.0	1000.000	244.0	H	265.0	-12.5	17.4	53.9
7346.70340	43.6	51.8	1000.0	1000.000	142.0	V	118.0	-3.7	10.3	53.9



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Appendix 4

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

Date 2009-09-17	Temperature 22 °C ± 3 °C	Humidity 37 % ± 5 %
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**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 test was also performed with the position of the EUT in the orthogonal axis that produces the highest emission relative to the limit.

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.

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 = 300.60 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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## Occupied bandwidth measurements according to 47CFR 2.1049

Date 2009-09-17	Temperature 22 °C ± 3 °C	Humidity 37 % ± 5 %
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### 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 test was also performed with the position of the EUT in the orthogonal axis that produces the highest emission relative to the limit.

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.

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 5.1.

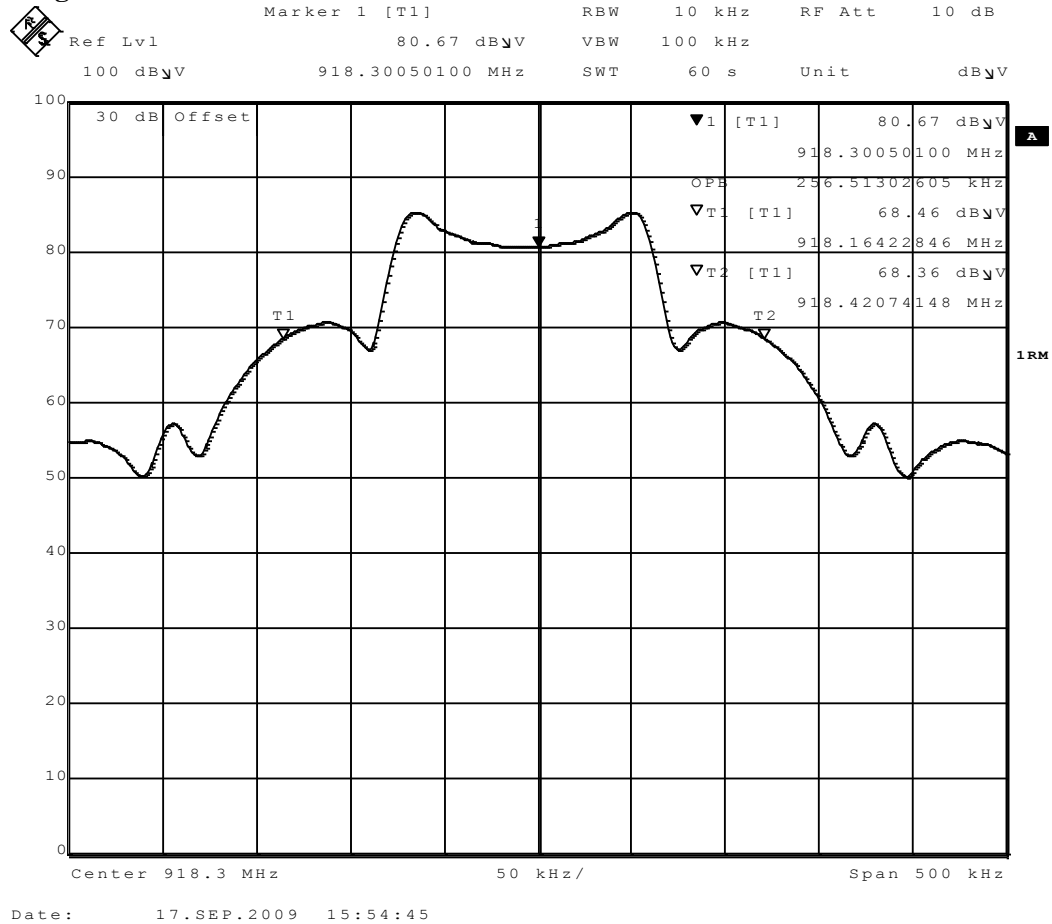
Diagram 1    918.3 MHz            OBW = 256.51 kHz (99%)



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Appendix 5.1

Diagram 1



### Band edge measurements according to 47CFR 2.1049

Date 2009-09-16	Temperature 23 °C ± 3 °C	Humidity 40 % ± 5 %
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#### 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 test was also performed with the position of the EUT in the orthogonal axis that produces the highest emission relative to the limit.

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 8.

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 6.1.

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.

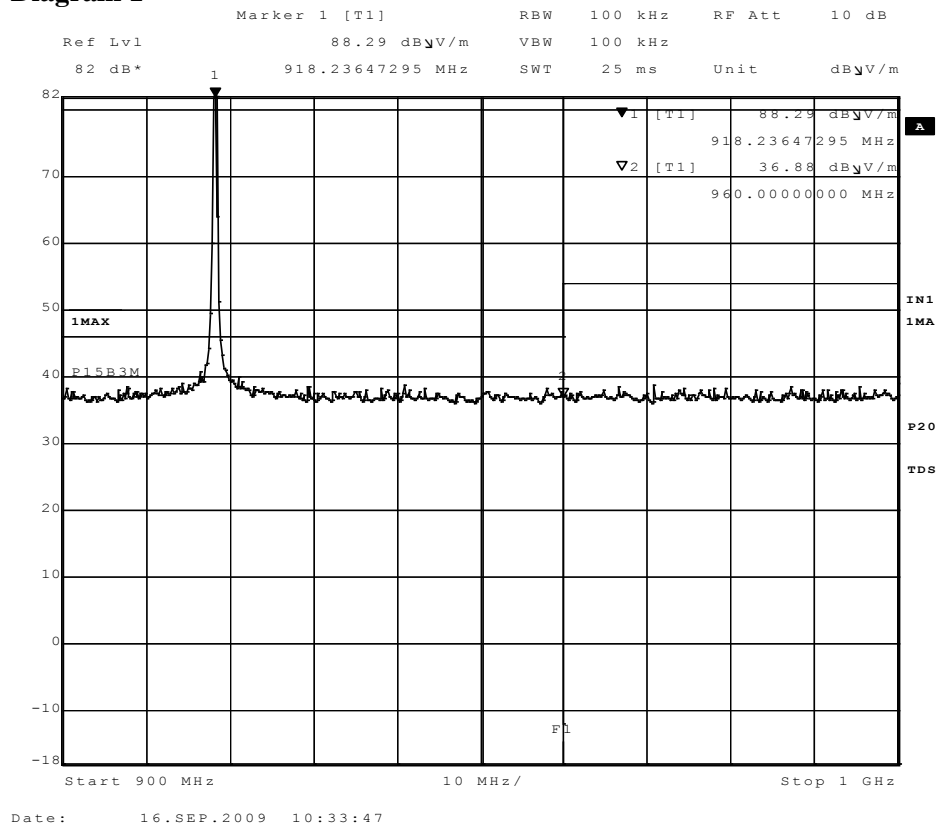
Complies?	Yes
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FCC ID: XWK8601015

Appendix 6.1

Diagram 1



**RF exposure evaluation: Portable equipment**

Date 2009-09-14	Temperature 23 °C ± 3 °C	Humidity 41 % ± 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 2.1093 this device has been defined as a portable 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/cm<sup>2</sup>

$P_{out}$  = 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

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

Antenna Gain (dBi)	Antenna Gain (numeric)	ERP Peak output power (dBm)	Peak output power (mW)	Power density, $P_d$ [S] (mW/cm <sup>2</sup> )	Limit of power density (mW/cm <sup>2</sup> )
Note 1	Note 1	-6.0	0.2512	N/A, Note 2	N/A, Note 2

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

Note 2: Not applicable as the EUT is a portable device and the peak output power is  
 $< 60/f_{GHz} = 60/0.9183 = 65.3$  mW

Complies?	Yes
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Appendix 8

**Photos**

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

Over-view, 0 degree at TT



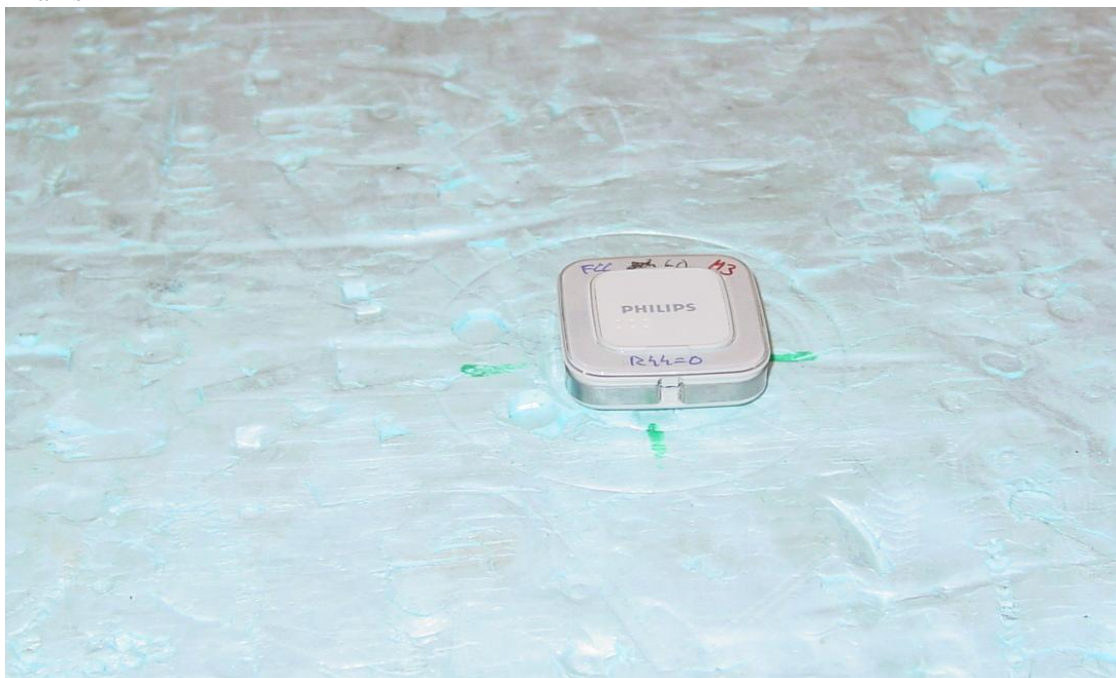
X-axis



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Appendix 8

Y-axis



Z-axis



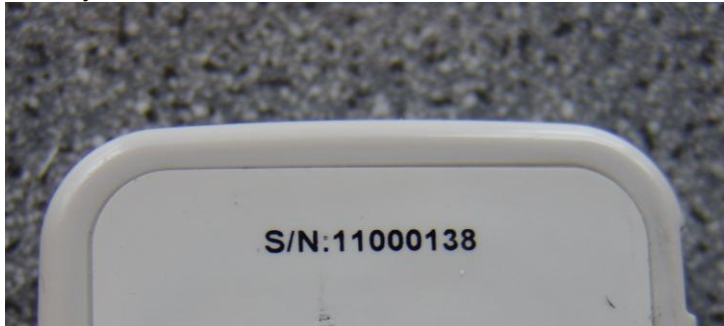


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Appendix 8

EUT

Identity



Top



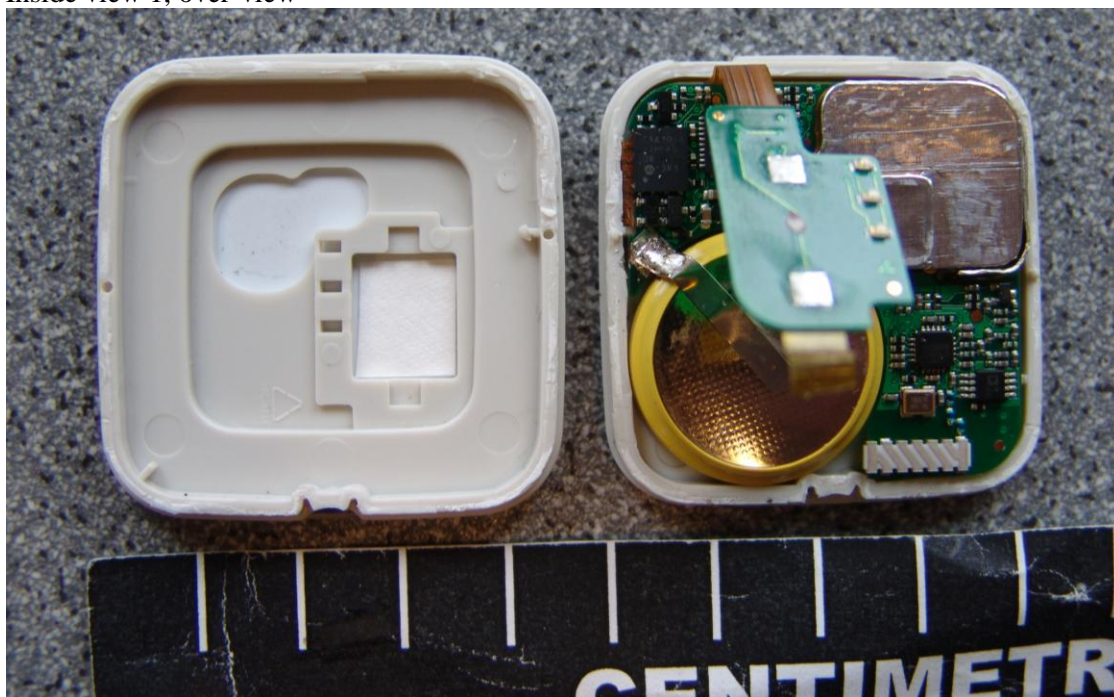
FCC ID: XWK8601015

Appendix 8

Rear



Inside view 1, over-view

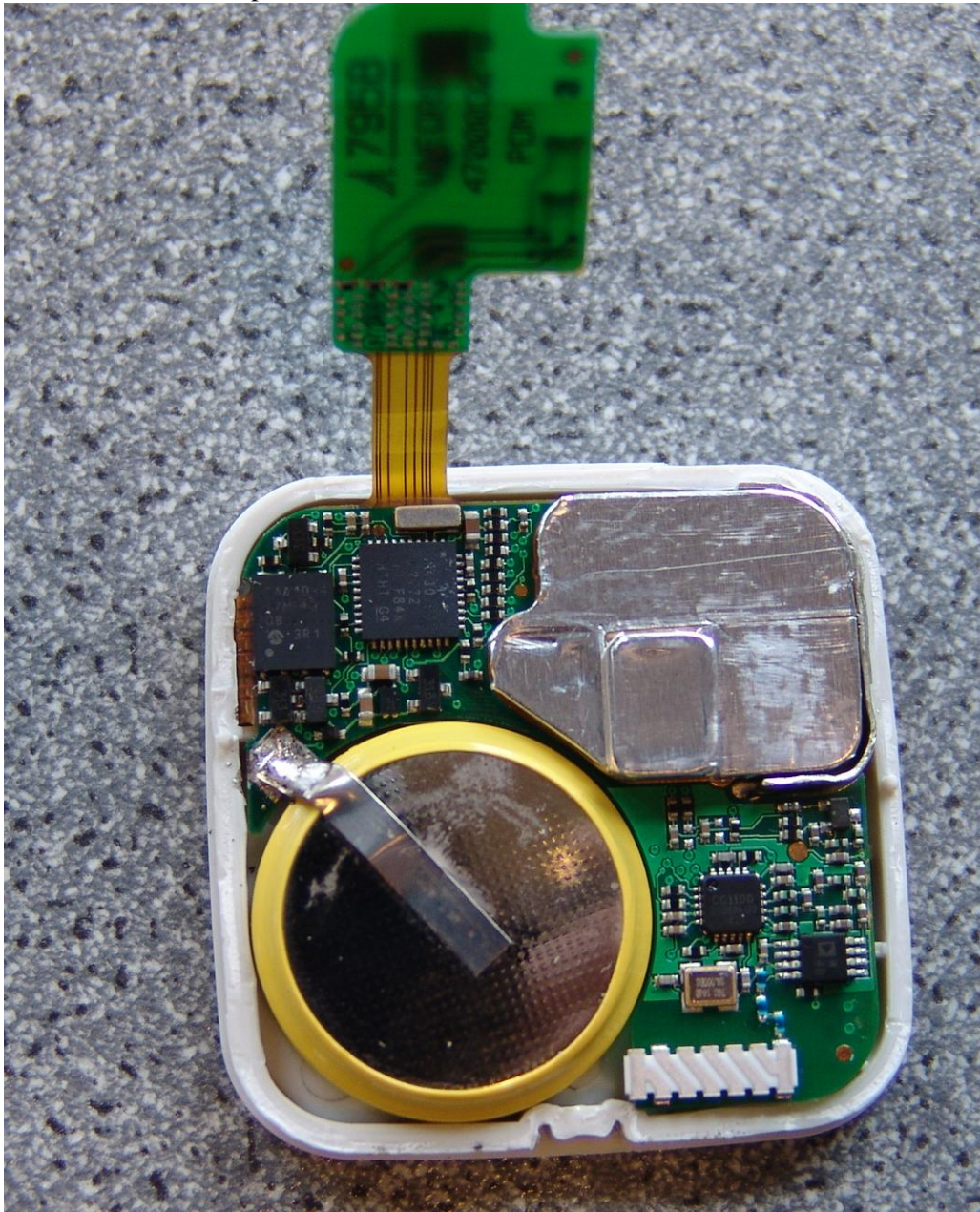




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Appendix 8

Inside view 2, PCB top



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Appendix 8

Inside view 2, PCB rear

