


REPORT: Radio Frequency (RF) test report

PRODUCT:

Test item description:	Suunto Movestick Mini
Trade Mark:	Suunto
Model/Type reference:	AD119
Serial number:	-
Customer:	Suunto Oy Valimotie 7 FI-01510 Vantaa FINLAND
Contact person:	Heikki Puuri
Manufacturer:	Suunto Oy Valimotie 7 FI-01510 Vantaa FINLAND

DATE: 2.3.2011

TESTED BY:



Simo Ojanen ;

Test engineer



APPROVED BY:

Tuomo Hahl ;

Test engineer



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Test results are valid for the tested unit only.

The report may be copied only in its entirety

1 LABORATORY INFORMATION

Test Laboratory	Intertek ETL Semko OY Koneenkatu 12 / K1 05801 Hyvinkää FINLAND
FCC registration number: IC file number:	910391 (January 27, 2003) IC 2042C-1 (May 14, 2003)
Quality and Environmental :	 

2 SUMMARY OF TEST RESULTS

The tests listed in this report have been done to demonstrate compliance to the FCC rules section §15.249, §15.209 and IC standard RSS-210.

Transmitter measurements

Section in CFR 47	Section in RSS-210	Test	Result
§ 15.249 (a)	A2.9 (1)	Field strength of fundamental	PASS
§ 15.249 (a) (d)	2.7, A2.9 (2)	Spurious radiated emissions	PASS
§ 15.215 (c)		20 dB bandwidth	PASS
	RSS-GEN 4.4.1	99% bandwidth	PASS
§ 15.215 (c)	RSS-GEN 7.2.4	Frequency stability	PASS

Receiver measurements

Section in CFR 47	Section in RSS-GEN	Section in ICES-003	Test	Result
§15.107	7.2.2	5.3	Conducted emissions to AC-power lines	PASS
§15.109	7.2.3	5.5	Radiated emissions	PASS

PASS Pass
 FAIL Fail
 X Measured, but there is no applicable performance criteria
 Na Not applicable

3 EUT INFORMATION

The EUT and accessories used in the tests are listed below. Later in this report only EUT numbers are used as reference.

	Device	Type	S/N	EUT number
EUT	Suunto Movestick Mini	AD119		1**
	Suunto Movestick Mini	AD119		2***
Accessories	HP Laptop	Compaq 6710b	CNU8071Z46	3
	HP AC adapter	PPP016H	F3-08010018480E	4
	Dell mouse	MOC5UO	H1607LMR	5

Notes:

** Modified to transmit continuously

*** Modified with antenna connector for conducted measurements

3.1 EUT description

EUT is USB powered transmitter / receiver that communicates with other Suunto devices. Radio link operates at 2,4 GHz frequency band and uses GFSK modulation.

The EUT was not modified during the tests.

3.2 EUT TEST SETUPS

For each test the EUT was exercised to find out the worst case of operation modes and device configuration.

Two different test setups were used: one for conducted measurements, another for radiated measurements. Conducted measurements EUT were equipped with an external antenna connector by customer.

The test setup photographs are in the document referenced in section 13.

4 APPLICABLE STANDARDS

The tests were performed in guidance of CFR 47 Part 15.249, 15.209, 15.107, 15.109 and Part 2, ANSI C63.4 (2003), ICES-003 and RSS-GEN / RSS-210

Deviations, modifications or clarifications (if any) to above mentioned documents are written in each section under "Test method" for each test case.

5 FIELD STRENGTH OF FUNDAMENTAL

EUT	1		
Accessories	3, 4		
Temp, Humidity, Air Pressure	19 °C	9 %RH	1024 hPa
Date of measurement	February 22, 2011		
FCC rule part	§15.249 (a)		
RSS-210 section	A2.9 (1)		
Measured by	Simo Ojanen		

5.1 Test setup and measurement method

The EUT was set on a non-conductive turntable in a semi-anechoic chamber. The EUT was set at 0.8m height. Measuring antenna was scanned 1 – 4 m in height.

The measurements were repeated in three EUT orientations and two antenna polarizations.

The measured signal was routed from the measuring antenna to the spectrum analyzer.

The measurement was made using 1 MHz resolution bandwidth and 1 MHz video bandwidth and maximum hold function to record the maximum peak output power.

5.2 EUT operation mode

EUT operation mode	Continuous transmission
EUT frequency	2465 MHz
EUT TX power level	0 dBm (Software configuration)

5.3 Limit

Table 1: Field strength of fundamental

Frequency (MHz)	mV/m (@3m)	dBµV/m (@3m)
2400-2483.5	50 (Avg)	94 (Avg) 114 (Peak)

5.4 Results

Table 2: Maximum field strength of fundamental (Peak value)

Freq MHz	Measured Value dB μ V	Correction Factor dB	Result dB μ V/m	EUT orientation	Antenna Pol.	Antenna height	Turntable angle
2465	72,2	31,1	103,4	Pos 1	Hor	1,0	156

Since the measurements are made with sample that is modified to continuous transmission, average results are calculated from peak results using duty cycle.

$$\text{Average level} \leq \text{Peak level} - 20 \log (\text{duty cycle}).$$

According to manufacturer the Duty cycle for this product is 150 μ s long transmission at 5Hz frequency (every 200ms).

Therefore,

$$\text{Average level} \leq \text{Peak level} - 20 \log ((100 \text{ ms} - 150 \mu\text{s}) / 150\mu\text{s})$$

$$\text{Average level} \leq \text{Peak level} - 56,5 \text{ dB}$$

$$\text{Average level} \leq 103,4 \text{ dB}\mu\text{V/m} - 56,5 \text{ dB} = \mathbf{46,9 \text{ dB}\mu\text{V/m}}$$

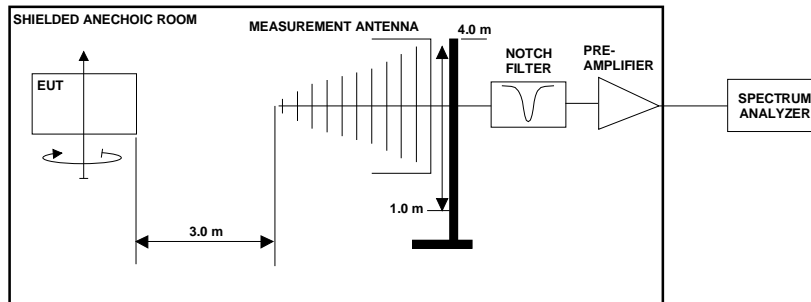
6 RADIATED SPURIOUS EMISSIONS

EUT	1		
Accessories	3, 4		
Temp, Humidity, Air Pressure	19 °C	9 %RH	1024 hPa
Date of measurement	February 21-22, 2011		
FCC rule part	§15.249 (a) (d)		
RSS-210 section	2.7, A2.9 (2)		
Measured by	Simo Ojanen		

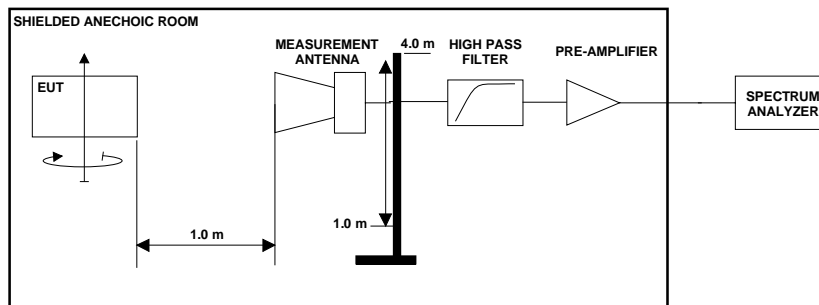
6.1 Test setup

EUT was modified to send constant carrier at nominal frequency.

The test was done using an automated test system, where a computer controlled the measurement equipments.



Picture 1: Test setup for radiated spurious emissions measurement
30 MHz - 3 GHz frequencies



Picture 2: Test setup for radiated spurious emissions measurement
3 GHz – 26 GHz frequencies

6.2 Test method

1. The emissions were searched and maximized by moving the turntable, changing the measuring antenna polarization and height and manipulating the EUT.
2. Levels of suspicious signals and levels of EUT transmitter harmonics were recorded.
3. The recorded levels were corrected in the automated test system with the measurement antenna factor, cable attenuations and filter attenuation.
4. The corrected values, giving the EUT radiated spurious emission levels as dB μ V/m at 3 m distance, are reported.

6.3 EUT operation mode

EUT operation mode	Continuous transmission
EUT frequency	2465 MHz
EUT TX power level	0 dBm (Software configuration)

6.4 Limit

Table 3: Radiated spurious emission limits at measurement distance of 3m

Frequency band (MHz)	3m Limit (μ V/m)	3m Limit (dB μ V/m)	Detector
30 – 88	100	40	QP
88 -216	150	43,5	QP
216 - 960	200	46	QP
960 - 1000	500	54,0	QP
1000 - 25000	500	54,0	AVG
1000 - 25000	5000	74,0	PEAK

As default, all emissions were compared against the general limits. If any emission exceeded that limit, it was further checked, that it complies with the -50dBc requirement.

6.5 Results

Measurement system noise level was least 20 dB below the spurious emission limit. Only levels of suspicious signals and transmitter harmonic frequencies, which were above the measurement system noise, are reported.

Table 4: Emission levels PEAK detector

Freq MHz	Measured Value dB μ V	Correction Factor dB	Result dB μ V/m	Marginal dB μ V/m	EUT Position	Ant Pol.	Ant height	TT angle
4930	16,5	31,4	47,9	26,1	1	Hor	1,0	85
7395	12,5	35,7	48,2	25,8	1	Hor	1,0	102

Since the measurements are made with sample that is modified to continuous transmission, average results are calculated from peak results using duty cycle.

$$\text{Average level} \leq \text{Peak level} - 20 \log(\text{duty cycle}).$$

According to manufacturer the Duty cycle for this product is 150 μ s long transmission at 5Hz frequency (every 200ms).

Therefore,

$$\begin{aligned} \text{Average level} &\leq \text{Peak level} - 20 \log((100 \text{ ms} - 150 \mu\text{s}) / 150\mu\text{s}) \\ \text{Average level} &\leq \text{Peak level} - 56,5 \text{ dB} \end{aligned}$$

7 20 dB BANDWIDTH

EUT	2		
Accessories	3, 4		
Temp, Humidity, Air Pressure	20 °C	8 %RH	1021 hPa
Date of measurement	February 18, 2011		
FCC rule part	§15.215 (c)		
RSS-210 section			
Measured by	Simo Ojanen		

7.1 Test setup and measurement method

The 20dB bandwidth was measured using 3 kHz resolution bandwidth and maximum hold function of the spectrum analyzer. 20dB bandwidth was defined by measuring the maximum level on the measured channel and by placing display line 20 dB below this value and by reading the bandwidth from the intersection of the measured trace and display line.

7.2 EUT operation mode

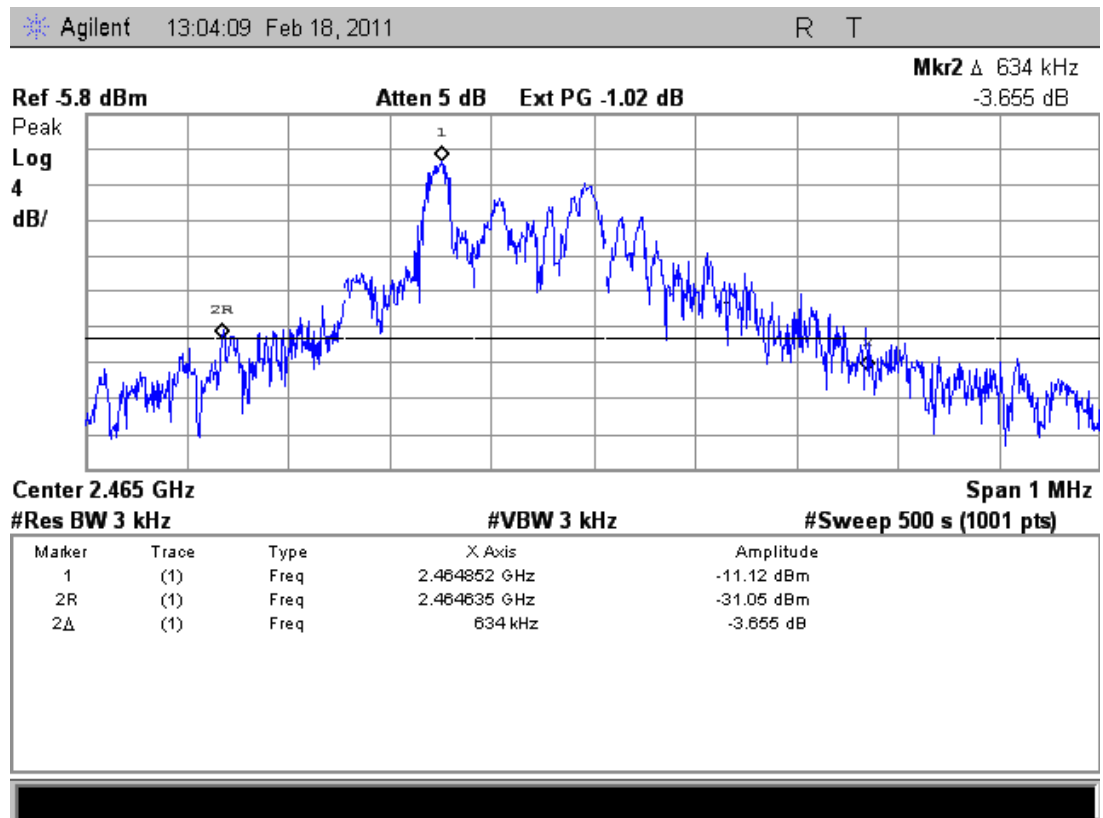
EUT operation mode	Normal modulation
EUT frequency	2465 MHz
EUT TX power level	0 dBm (Software configuration)

7.3 Results

Table 5: 20dB bandwidth measurement results

EUT Frequency MHz	Limit MHz	Measured value MHz
2465	-	0,634

7.4 Screen shots



Picture 3: 20dB Bandwidth measurement result

8 99 % BANDWIDTH

EUT	2		
Accessories	3, 4		
Temp, Humidity, Air Pressure	20 °C	8 %RH	1021 hPa
Date of measurement	February 18, 2011		
FCC rule part			
RSS-GEN section	4.4.1		
Measured by	Simo Ojanen		

8.1 Test setup and measurement method

The 99% occupied bandwidth was calculated from spectrum analyzer measurements.

The measurement data was read from the analyzer to computer.

Software in computer calculated the total power from the measurement data and defined the frequency band containing 99% of the total power.

Markers in the spectrum analyzer were then placed between the calculated frequencies to show the calculated 99% power band in the screenshots.

8.2 EUT operation mode

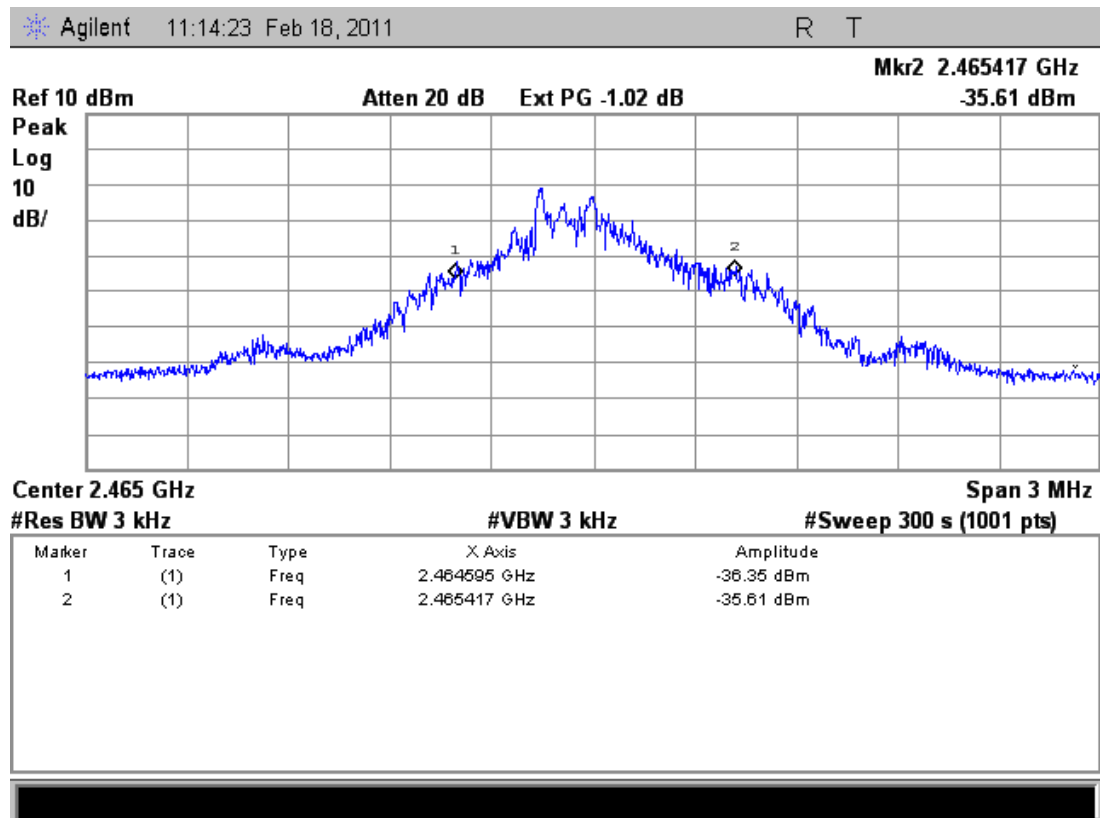
EUT operation mode	Normal modulation
EUT frequency	2465 MHz
EUT TX power level	0 dBm (Software configuration)

8.3 Results

Table 6: 99% bandwidth measurement results

EUT Frequency MHz	Limit MHz	Measured value MHz
2465	-	0,822

8.4 Screen shots

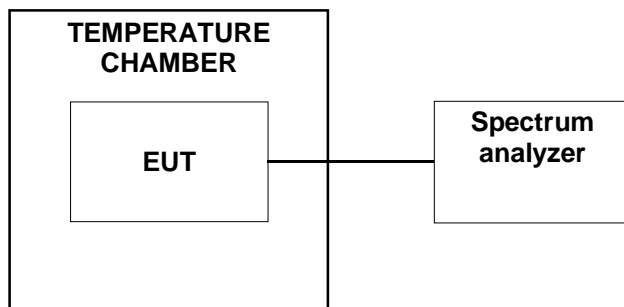


Picture 4: 99% Bandwidth measurement result

9 FREQUENCY STABILITY

EUT	2		
Accessories	3, 4		
Temp, Humidity, Air Pressure	21 °C	7 %RH	1021 hPa
Date of measurement	February 17, 2011		
FCC rule part	§15.215 (c)		
RSS-GEN section	7.2.4		
Measured by	Simo Ojanen		

9.1 Test setup and measurement method



1. The climate chamber temperature was set to the maximum value and the temperature was allowed to stabilize
2. The EUT was placed in the chamber power off
3. The EUT temperature was allowed to stabilize for 30 minutes
4. The EUT was turned on and set to transmit
5. Transmitter peak frequency was measured with spectrum analyzer
6. The steps 3 - 5 were repeated for each temperature

9.2 EUT operation mode

EUT operation mode	Continuous transmission
EUT channel	2465 MHz
EUT TX power level	0 dBm (Software configuration)

9.3 Results

Table 7: Frequency stability measurement Limits

Limit %	Limit MHz (2465MHz)
-0,001	2464,975350
+0,001	2465,024650

Table 8: Frequency stability measurement results

Temperature (°C)	Transmitter frequency (MHz)
-20	2464,995320
-10	2465,002160
0	2465,003860
10	2465,001880
20	2464,995280
30	2464,991685
40	2464,986365
50	2464,982905

10 CONDUCTED EMISSIONS TO AC-MAINS

EUT	1		
Accessories	3, 4, 5		
Temp, Humidity, Air Pressure	21 °C	9 %RH	1021 hPa
Date of measurement	February 22, 2011		
FCC rule part	§15.107		
RSS-GEN section	7.2.2		
ICES-003 section	5.3		
Measured by	Simo Ojanen		

10.1 Test setup

Charger was connected to line impedance stabilization network and conducted emissions to AC-mains were measured using measurement receiver.

10.2 EUT operation mode

EUT was connected to Laptop pc USB connector. Suunto Team Monitor program was used to set EUT to receiver active mode.

10.3 Limits

Frequency of emission [MHz]	FCC / IC	
	Limit [dBµV] Quasi peak	Limit [dBµV] Average
0,15 – 0,50	66 – 56*	56 – 46*
0,50 – 5	56	46
5 – 30	60	50

* The limit decreases linearly with the logarithm of the frequency

10.4 Results

The measured interference values using peak and average detectors are shown in the pictures 3 and 4 below.

All signals closer than 6 dB to the limit have been measured using quasi peak and average detectors and reported in the table 9 and 10.

Table 9: Quasi peak detector measurement results, AC live

Frequency [MHz]	Measured value [dB μ V]	Limit [dB μ V]	Margin to limit [dB]
N/A			

Table 10: Average detector measurement results, AC live

Frequency [MHz]	Measured value [dB μ V]	Limit [dB μ V]	Margin to limit [dB]
N/A			

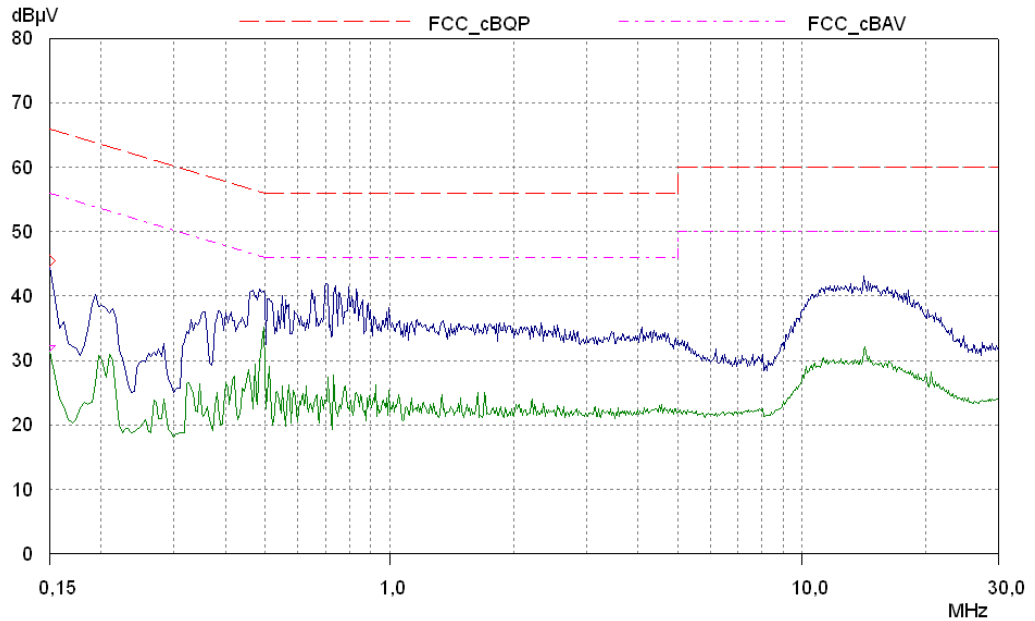
Table 11: Quasi peak detector measurement results, AC neutral

Frequency [MHz]	Measured value [dB μ V]	Limit [dB μ V]	Margin to limit [dB]
N/A			

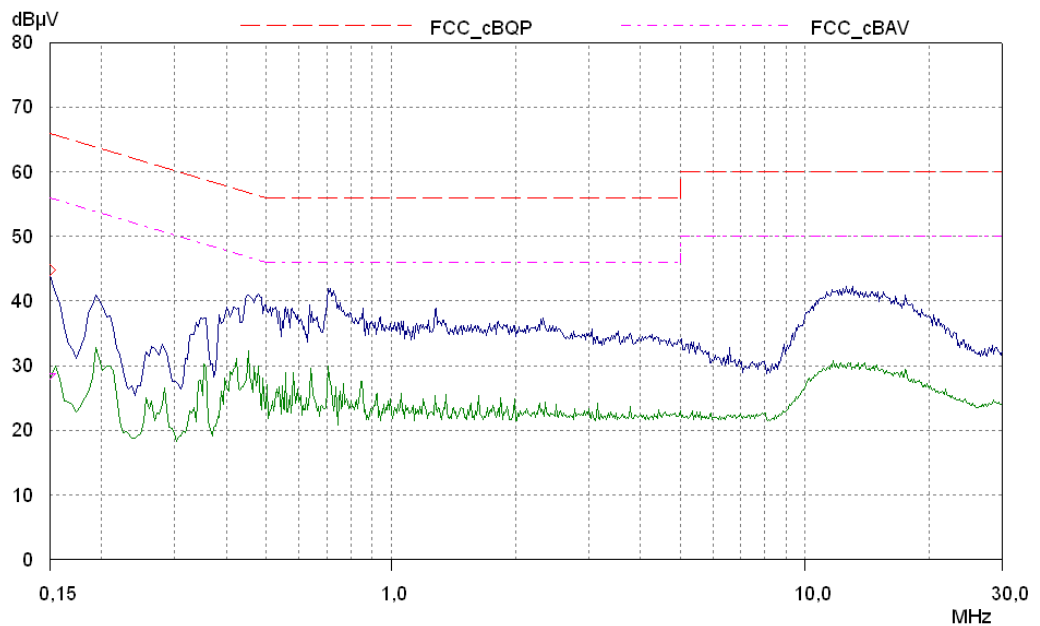
Table 12: Average detector measurement results, AC neutral

Frequency [MHz]	Measured value [dB μ V]	Limit [dB μ V]	Margin to limit [dB]
N/A			

10.5 Screen shots



Picture 5: AC-mains conducted emission measurement results, AC live



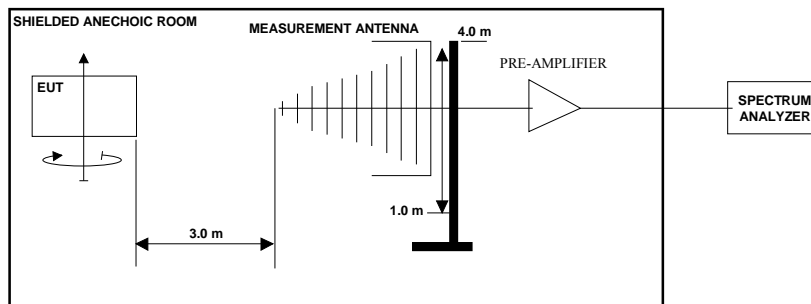
Picture 6: AC-mains conducted emission measurement results, AC neutral

11 RECEIVER RADIATED EMISSION

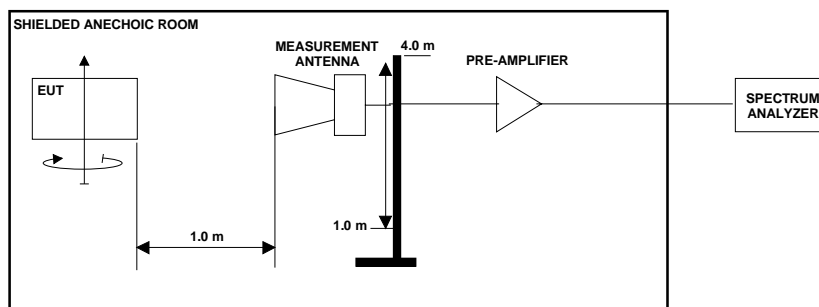
EUT	1		
Accessories	3, 4, 5		
Temp, Humidity, Air Pressure	19 °C	9 %RH	1024 hPa
Date of measurement	February 21, 2011		
FCC rule part	§15.109		
RSS-GEN section	7.2.3		
ICES-003 section	5.5		
Measured by	Simo Ojanen		

11.1 Test setup

The test was done using an automated test system, where a computer controlled the measurement equipments.



Picture 7: Test setup for radiated spurious emissions measurement
30 MHz - 1 GHz frequencies



Picture 8: Test setup for radiated spurious emissions measurement
1 GHz – 12,5 GHz frequencies

11.2 Test method

1. The emissions were searched and maximized by moving the turntable, changing the measuring antenna polarization and height and manipulating the EUT.
2. Levels of suspicious signals and levels of EUT transmitter harmonics were recorded.
3. The recorded levels were corrected in the automated test system with the measurement antenna factor, cable attenuations and filter attenuation.
4. The corrected values, giving the EUT radiated spurious emission levels as dB μ V/m at 3 m distance, are reported.

11.3 EUT operation mode

EUT was connected to Laptop pc USB connector. Suunto Team Monitor program was used to set EUT to receiver active mode.

EUT operation mode	Receiver mode
EUT frequency	2465 MHz
EUT TX power level	Na

11.4 Limit

Table 13: Radiated spurious emission limits at measurement distance 3m

Frequency band (MHz)	3m Limit (μV/m)	3m Limit (dBμV/m)	Detector
30 – 88	100	40	QP
88 -216	150	43,5	QP
216 - 960	200	46	QP
960 - 1000	500	54,0	QP
1000 - 12400	500	54,0	AVG
1000 - 12400	5000	74,0	PEAK

As default, all emissions were compared against the general limits. If any emission exceeded that limit, it was further checked, if it was outside the restricted band thus complying with the -20dBc requirement.

11.5 Results

The measured interference values using Quasi peak and average detectors are shown in the pictures below.

All signals closer than 6 dB to the limit below 1 GHz have been measured using quasi peak or average detector and reported in the table 14, 15 and 16.

Table 14: Radiated emissions using Quasi peak detector

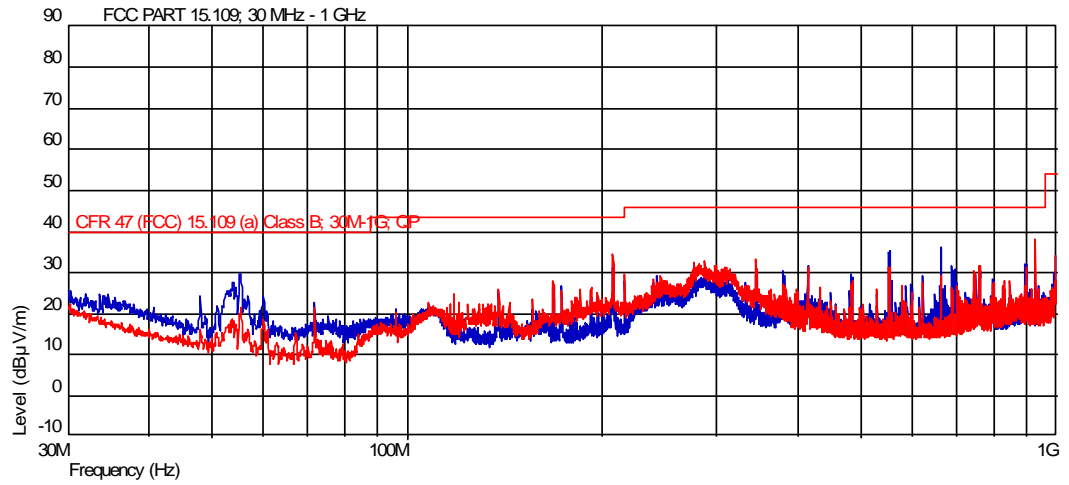
Freq MHz	Measured Value dBuV	Correction Factor dB	Result dBuV/m	Marginal dBuV/m	EUT Position	Ant Pol.	Ant height	TT angle
N/A								

Table 15: Radiated emissions using Peak detector

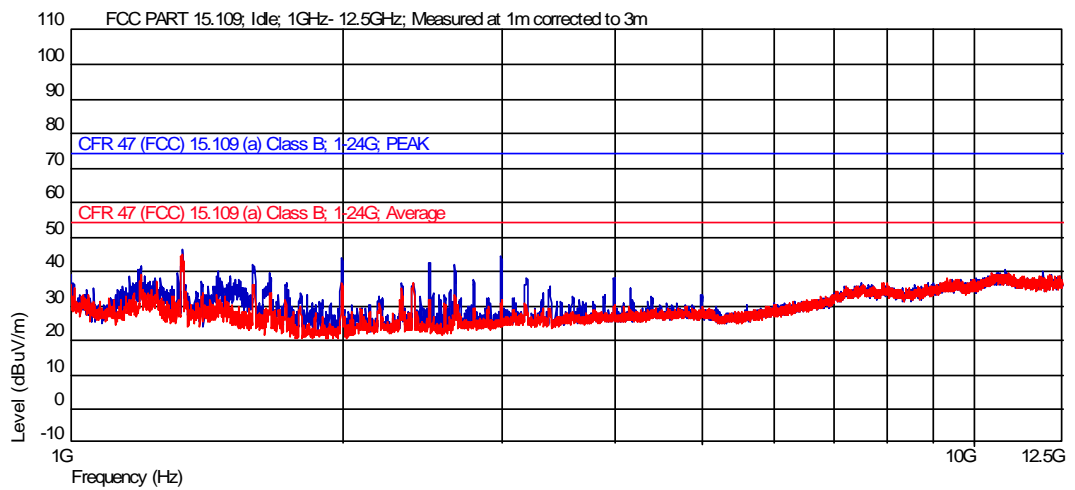
Freq MHz	Measured Value dBuV	Correction Factor dB	Result dBuV/m	Marginal dBuV/m	EUT Position	Ant Pol.	Ant height	TT angle
N/A								

Table 16: Radiated emissions using Average detector

Freq MHz	Measured Value dBuV	Correction Factor dB	Result dBuV/m	Marginal dBuV/m	EUT Position	Ant Pol.	Ant height	TT angle
N/A								



Picture 9: radiated emission results, 30 – 1000 MHz,
Red= horizontal polarization, blue = vertical polarization



Picture 10: radiated emission results, 1 – 12,5 GHz,
Red= horizontal polarization, blue = vertical polarization

12 TEST EQUIPMENT

All testing and measurement equipment has been calibrated once a year, except the antennas that are calibrated every two years.

12.1 Conducted measurements

DEVICE	MANUFACTURER	SPKTT	SERIAL
EMI test receiver	Rohde & Schwarz ESCS30	020	849650/0016
LISN	Rohde & Schwarz ESH3-Z5	049	833874/029
10dB trans.limiter	Teseq CFL9206A	222	26719
Measuring software	R&S ESxS-K1	-	Ver 2.20

DEVICE	MANUFACTURER	SPKTT	SERIAL
Spectrum analyser	Agilent E7405A	131	MY42000072
Temperature Chamber	Vötsch Industrietechnik GmbH, VC 7100-5	401	59566073010010

12.2 Radiated measurements

DEVICE	MANUFACTURER	SPKTT	SERIAL
Spectrum analyser	Agilent E7405A	131	MY42000072
Horn Antenna	Schwarzbeck BBHA9120D	138	365
X-wing BiLog antenna	Teseq CBL6143A	221	29611
Horn Antenna	Schwarzbeck BBHA9170	194	313
3 dB attenuator	Huber+Suhner 3dB/2W	214	-
Pre-amplifier	Agilent 87405B	143	MY39500154
Pre-amplifier	JCA 118-400	142	-
Pre-amplifier	Miteq AMF-6F-18002650-2	191	1128879
High pass filter	Wainwright Instruments WHK3.0/18GST	141	3
Band reject filter	Wainwright Instruments WRCT2400/2483	196	2
3m Semi-anechoic chamber	ETS Euroshield	081	-
Measuring software	Teseq Compliane3	-	Ver 4.01

13 TEST SETUP PHOTOGRAPHS

Test setup photograph can be found in a separate document

200385B-RF_PHOTOS.doc