

Test report for PC-Pod

Report Date: April 24, 2006
Editorial changes June 07, 2006

Signatures:

Tested by:



Marko Turkkila Test Engineer

Contents approved:



Tuomo Hahl Test Engineer

CONTENTS

1	LABORATORY INFORMATION	3
2	CUSTOMER INFORMATION	3
3	SUMMARY OF TEST RESULTS	4
4	EUT INFORMATION.....	5
4.1	EUT description	5
4.2	EUT TEST SETUPS	6
5	APPLICABLE STANDARDS.....	6
6	FIELD STRENGTH OF FUNDAMENTAL	7
6.1	Test setup and measurement method.....	7
6.2	EUT operation mode	7
6.3	Limit.....	7
6.4	Results.....	7
7	RADIATED SPURIOUS EMISSIONS	8
7.1	Test setup	8
7.2	Test method.....	9
7.3	EUT operation mode	9
7.4	Limit.....	9
7.5	Results.....	10
8	20 dB BANDWIDTH	11
8.1	Test setup and measurement method.....	11
8.2	EUT operation mode	11
8.3	Results.....	12
8.4	Screen shots.....	12
9	99 % BANDWIDTH	13
9.1	Test setup and measurement method.....	13
9.2	EUT operation mode	13
9.3	Results.....	14
9.4	Screen shots.....	14
10	FREQUENCY STABILITY.....	15
10.1	Test setup and measurement method.....	15
10.2	EUT operation mode	15
10.3	Results.....	16
11	CONDUCTED EMISSIONS TO AC-MAINS.....	17
11.1	Test setup	17
11.2	EUT operation mode	17
11.3	Limits	17
11.4	Results.....	18
11.5	Screen shots.....	19
12	RECEIVER RADIATED EMISSION.....	20
12.1	Test setup	20
12.2	Test method.....	21
12.3	EUT operation mode	21
12.4	Limit.....	21
12.5	Results.....	22
13	TEST EQUIPMENT.....	24
13.1	Conducted measurements.....	24
13.2	Radiated measurements.....	24
14	TEST SETUP PHOTOGRAPHS	25

1 LABORATORY INFORMATION

Test Laboratory	NATLABS OY EMC Laboratory Koneenkatu 12 / K17 05830 Hyvinkää FINLAND Tel: +358 20 475 2600 Fax: +358 20 475 2719 e-mail: firstname.surname@ette.com
FCC registration number: IC file number:	910391 (January 27, 2003) IC 4616 (May 14, 2003)

2 CUSTOMER INFORMATION

Client	Suunto Oy Valimotie 7 01510 Vantaa Finland Tel. +358 9 875 870 Fax +358 9 875 87301
Contact person:	Heikki Puuri Suunto Oy Valimotie 7 01510 Vantaa Finland Tel. +358 9 875 870 Fax: +358 9 875 87301
Receipt of EUT:	March 30, 2006
Testing date:	April 19 – 23, 2006
Report date:	April 24, 2006

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.

3 SUMMARY OF TEST RESULTS

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

4 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	USB connected transmitter / receiver	Pc-Pod	6046-0065 **	05001
	USB connected transmitter / receiver	Pc-Pod	6046-0046 **	05002 ***
	USB connected transmitter / receiver	Pc-Pod	6046-0052	05003 ***
	USB connected transmitter / receiver	Pc-Pod	6046-0084	05004
Accessories	Laptop computer	Toshiba T9000	Z1107330G ST900-0	05005
	Serial mouse	Logitech	LZB83902452	05006
	Printer	HP Deskjet 890C	SG78I19082	05007

Notes:

** Modified to transmit continuously

*** Modified with antenna connector for conducted measurements

4.1 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.

4.2 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. Two EUT were equipped with an external antenna connector for conductive measurements.

The test setup photographs are in the document referenced in section 14.

5 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.

6 FIELD STRENGTH OF FUNDAMENTAL

EUT	05001		
Accessories	05005		
Temp, Humidity, Air Pressure	22 °C	46 RH%	987 hPa
Date of measurement	April 05, 2006		
FCC rule part	§15.249 (a)		
RSS-210 section	A2.9 (1)		
Measured by	Tuomo Eloranta		

6.1 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.

6.2 EUT operation mode

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

6.3 Limit

Table 1: Field strength of fundamental

Frequency (MHz)	mV/m (@3m)	dBuV/m (@3m)
2400-2483.5	50	94

6.4 Results

Table 2: Maximum field strength of fundamental

Freq MHz	Measured Value dBuV	Correction Factor dB	Result dBuV/m	EUT orientation	Antenna Pol.	Antenna height	Turntable angle
2465	53.8	33.9	87.7	Pos 3	Ver	3	64

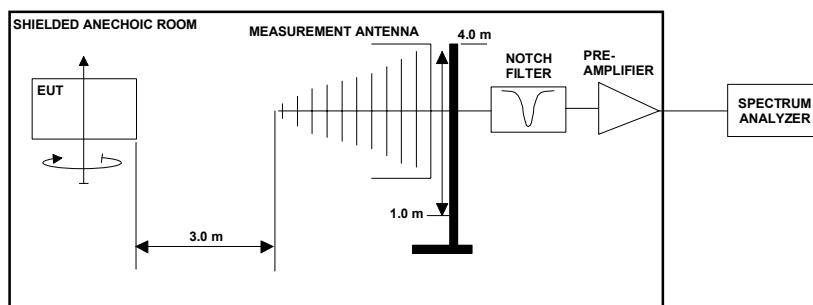
7 RADIATED SPURIOUS EMISSIONS

EUT	05001, 05002		
Accessories	05005		
Temp, Humidity, Air Pressure	22 °C	46 RH%	991 hPa
Date of measurement	April 07, 2005		
FCC rule part	§15.249 (a) (d)		
RSS-210 section	2.7, A2.9 (2)		
Measured by	Marko Turkkila		

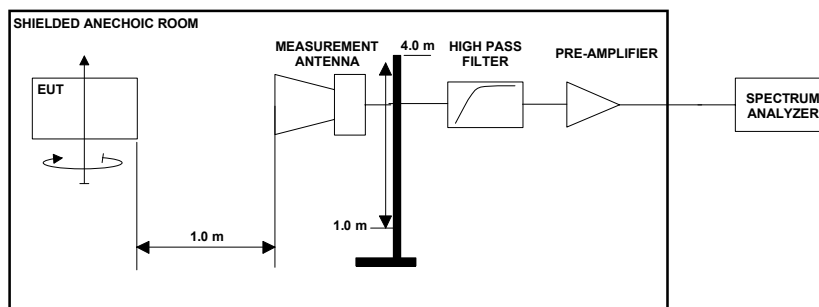
7.1 Test setup

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 – 25 GHz frequencies

7.2 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.

7.3 EUT operation mode

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

7.4 Limit

Table 3: Radiated spurious emission limits at measurement distance of 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 - 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.

7.5 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 dBuV	Correction Factor dB	Result dBuV/m	Marginal dBuV/m	EUT Position	Ant Pol.	Ant height	TT angle
3697.5	57.1	-18.6	38.5	-35.5	Pos 1	Hor	1	341
4930	74.4	-15.3	59.1	-14.9	Pos 1	Hor	1	346
7395	71.3	-3.1	68.2	-5.8	Pos 1	Hor	1.05	133
9860	59.9	-3.6	56.3	-17.7	Pos 1	Ver	1	121
12325	47.6	1.3	48.9	-25.1	Pos 1	Ver	1.05	139

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.

Therefore,

$$\begin{aligned} \text{Average level} &\leq \text{Peak level} - 20 \log((100 \text{ ms} - 150 \mu\text{s}) / 150\mu\text{s}) \\ \text{Average level} &\leq \text{Peak level} - \mathbf{56.5 \text{ dB}} \end{aligned}$$

8 20 dB BANDWIDTH

EUT	05003		
Accessories	05005		
Temp, Humidity, Air Pressure	22 °C	43 RH%	998 hPa
Date of measurement	April 06, 2006		
FCC rule part	§15.215 (c)		
RSS-210 section			
Measured by	Marko Turkkila		

8.1 Test setup and measurement method

The 20dB bandwidth was measured using 10 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.

8.2 EUT operation mode

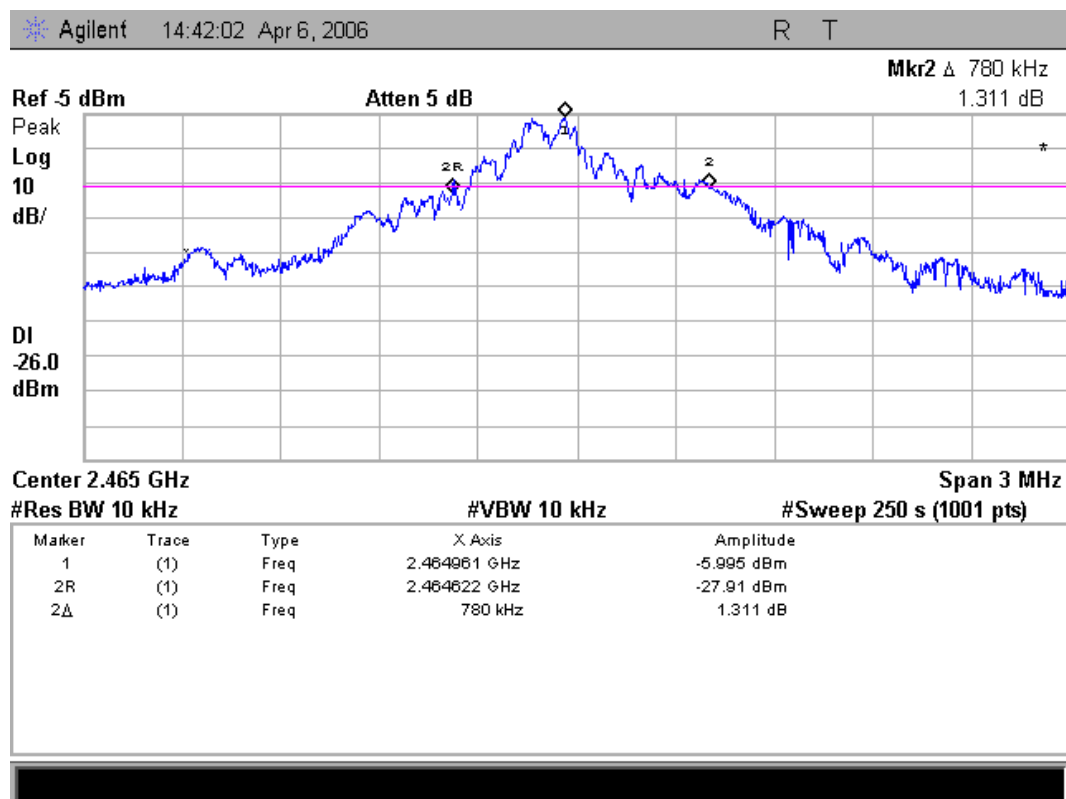
EUT operation mode	Normal modulation
EUT frequency	2465 MHz
EUT TX power level	0 dBm (Software configuration)

8.3 Results

Table 5: 20dB bandwidth measurement results

EUT Frequency MHz	Limit MHz	Measured value MHz
2465	-	0.780

8.4 Screen shots



Picture 3: 20dB Bandwidth measurement result

9 99 % BANDWIDTH

EUT	05003		
Accessories	05005		
Temp, Humidity, Air Pressure	22 °C	43 RH%	998 hPa
Date of measurement	April 06, 2006		
FCC rule part			
RSS-GEN section	4.4.1		
Measured by	Marko Turkkila		

9.1 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.

9.2 EUT operation mode

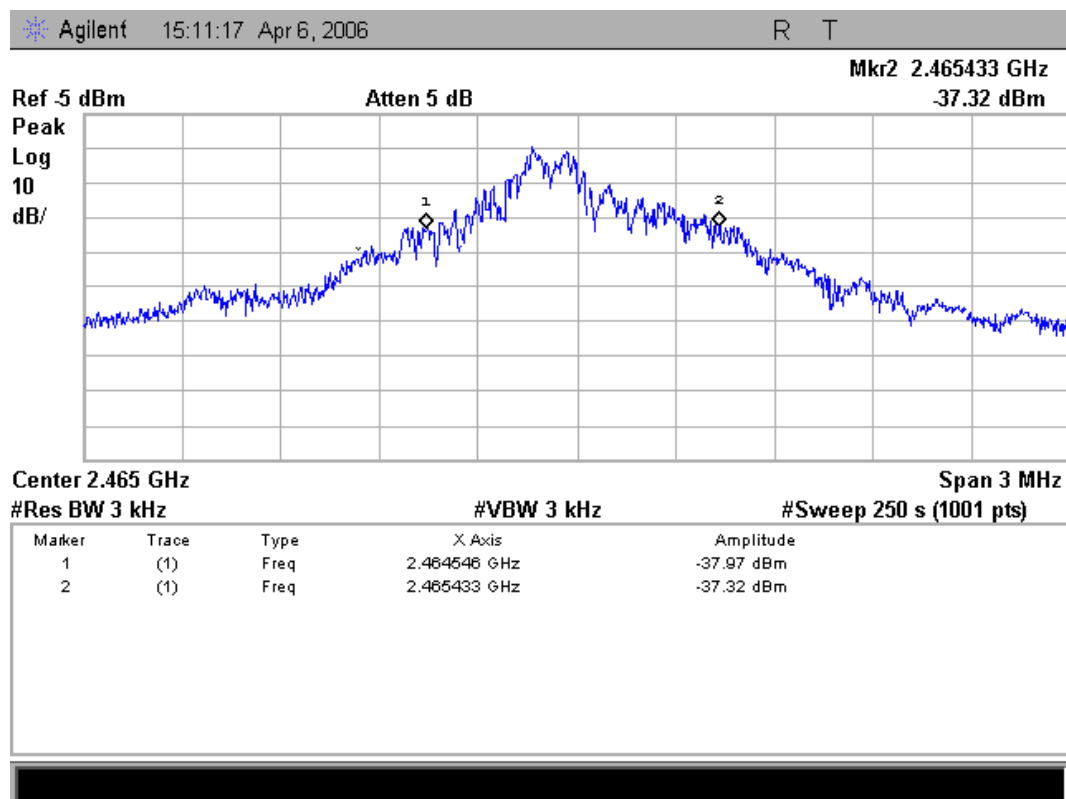
EUT operation mode	Normal modulation
EUT frequency	2465 MHz
EUT TX power level	0 dBm (Software configuration)

9.3 Results

Table 6: 99% bandwidth measurement results

EUT Frequency MHz	Limit MHz	Measured value MHz
2465	-	0.887

9.4 Screen shots

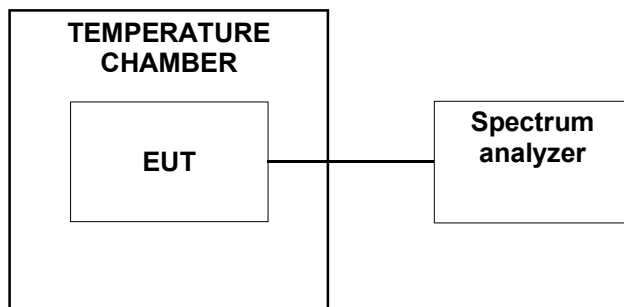


Picture 4: 99% Bandwidth measurement result

10 FREQUENCY STABILITY

EUT	05002		
Accessories	05005		
Temp, Humidity, Air Pressure	- °C	- RH%	- hPa
Date of measurement	April 06, 2006		
FCC rule part	§15.215 (c)		
RSS-GEN section	7.2.4		
Measured by	Marko Turkkila		

10.1 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

10.2 EUT operation mode

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

10.3 Results

Table 7: Frequency stability measurement results

Temperature (°C)	Transmitter frequency (MHz)
50	2464.975
40	2464.977
30	2464.981
20	2464.985
10	2464.987
0	2464.988
-10	2464.984
-20	2464.975
-30	2464.963

11 CONDUCTED EMISSIONS TO AC-MAINS

EUT	05004		
Accessories	05005, 05006, 05007		
Temp, Humidity, Air Pressure	22 °C	49 RH%	997 hPa
Date of measurement	April 20, 2006		
FCC rule part	§15.107		
RSS-GEN section	7.2.2		
ICES-003 section	5.3		
Measured by	Marko Turkkila		

11.1 Test setup

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

11.2 EUT operation mode

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

11.3 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

11.4 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 8 and 9.

Table 8: Quasi peak detector measurement results, AC live

Frequency [MHz]	Measured value [dB μ V]	Limit [dB μ V]	Margin to limit [dB]
0.20468	48.5	63.4	14.9
0.27109	41.8	61.1	19.3
0.3414	37.2	59.2	22.0

Table 9: Average detector measurement results, AC live

Frequency [MHz]	Measured value [dB μ V]	Limit [dB μ V]	Margin to limit [dB]
0.20468	42.7	53.4	10.7
0.27109	34.1	51.9	17.8
0.3414	29.9	49.1	19.2

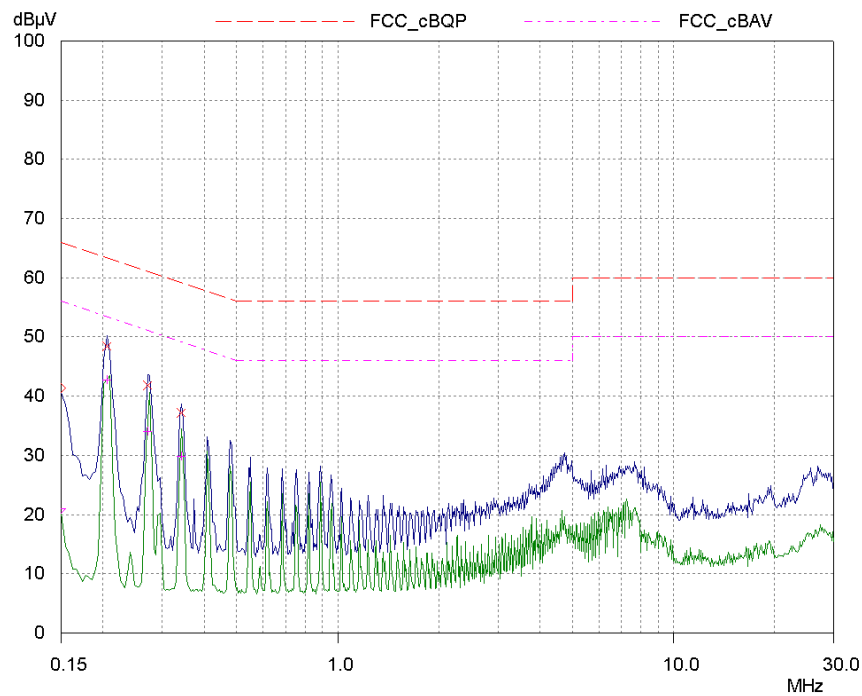
Table 10: Quasi peak detector measurement results, AC neutral

Frequency [MHz]	Measured value [dB μ V]	Limit [dB μ V]	Margin to limit [dB]
0.15	47.7	66.0	18.3
0.16171	44.7	65.4	20.7
0.16953	42.1	65.0	22.9
0.27109	37.3	61.1	23.8
0.3414	33.1	59.2	26.1

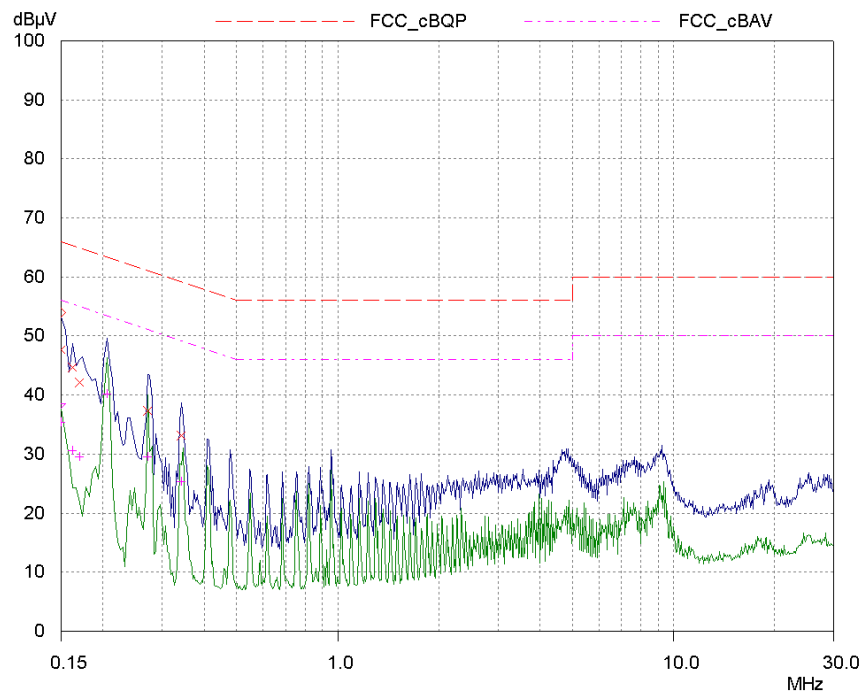
Table 11: Average detector measurement results, AC neutral

Frequency [MHz]	Measured value [dB μ V]	Limit [dB μ V]	Margin to limit [dB]
0.15	35.4	56.0	20.6
0.16171	30.5	55.4	24.9
0.16953	29.5	55.0	25.5
0.20468	40.1	53.4	13.3
0.27109	29.6	51.1	21.5
0.3414	25.3	49.2	23.9

11.5 Screen shots



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



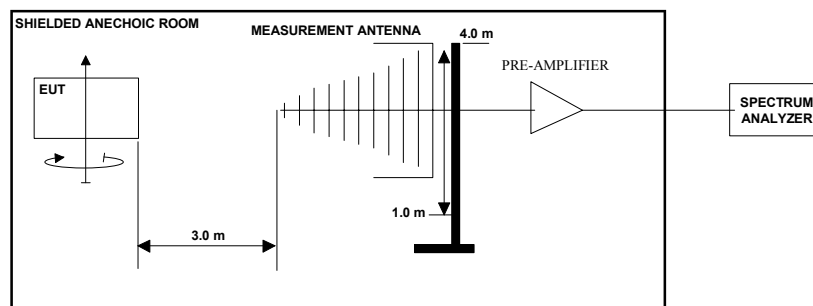
Picture 6: AC-mains conducted emission measurement results, AC neutral

12 RECEIVER RADIATED EMISSION

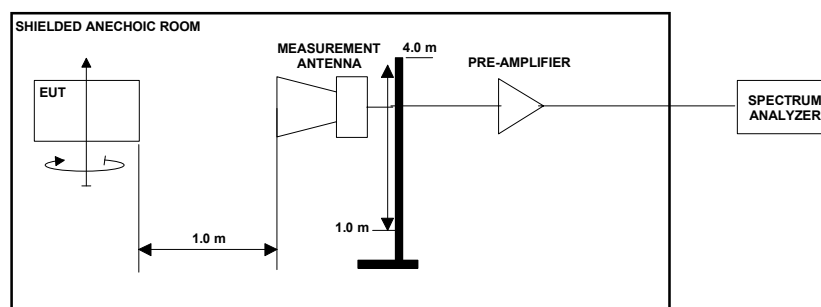
EUT	05004		
Accessories	05005, 05006, 05007		
Temp, Humidity, Air Pressure	22 °C	46 RH%	991 hPa
Date of measurement	April 07, 2006		
FCC rule part	§15.109		
RSS-GEN section	7.2.3		
ICES-003 section	5.5		
Measured by	Tuomo Eloranta		

12.1 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 – 12.4 GHz frequencies

12.2 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.

12.3 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

12.4 Limit

Table 12: 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

12.5 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 13, 14 and 15.

Table 13: Radiated emissions using Quasi peak detector

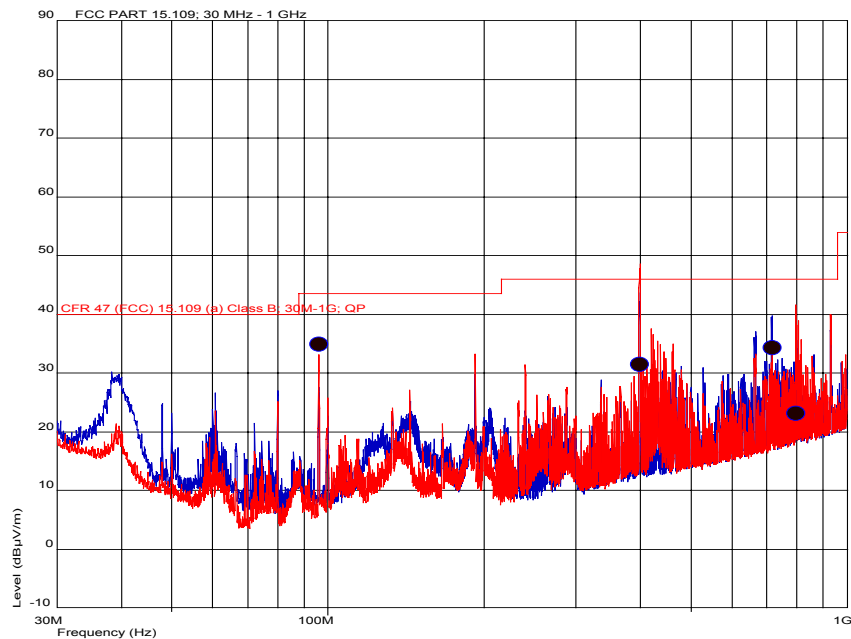
Freq MHz	Measured Value dBuV	Correction Factor dB	Result dBuV/m	Marginal dBuV/m	EUT Position	Ant Pol.	Ant height	TT angle
96	48.0	-13.0	35.0	-8.5	Pos 1	Hor	1.9	311
398.7	36.5	-5.0	31.5	-14.5	Pos 1	Hor	2.9	19
715.86	33.7	0.6	34.3	-11.7	Pos 1	Ver	2.2	136
796.98	21.1	2.0	23.1	-22.9	Pos 1	Hor	1.7	238

Table 14: Radiated emissions using Peak detector

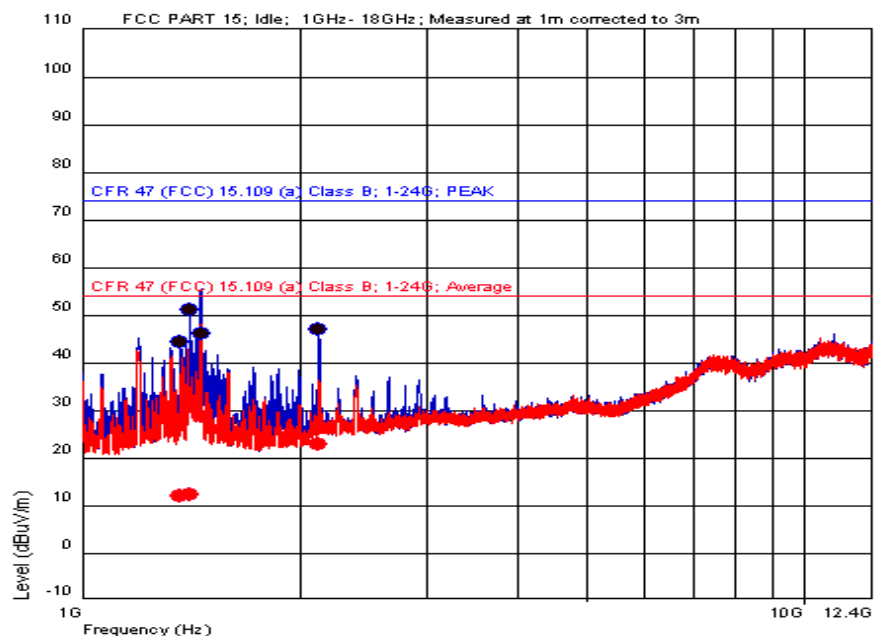
Freq MHz	Measured Value dBuV	Correction Factor dB	Result dBuV/m	Marginal dBuV/m	EUT Position	Ant Pol.	Ant height	TT angle
1367.5	69.1	-24.7	44.4	-29.6	Pos 1	Ver	1	308
1412	75.8	-24.9	51.0	-23.1	Pos 1	Ver	1	128
1460	71.2	-25.2	46.0	-28.0	Pos 1	Hor	1.2	44
2125	70.7	-23.8	46.9	-27.1	Pos 1	Ver	1	69

Table 15: 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
1367.5	36.6	-24.7	11.9	-42.1	Pos 1	Ver	1	308
1412	37.2	-24.9	12.3	-41.7	Pos 1	Ver	1	128
1460	53.9	-25.2	28.7	-25.3	Pos 1	Hor	1.2	44
2125	46.5	-23.8	22.7	-31.3	Pos 1	Ver	1	69



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



Picture 10: radiated emission results, 1 – 12.400 GHz,
 Red= horizontal polarization, blue = vertical polarization

13 TEST EQUIPMENT

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

13.1 Conducted measurements

Equipment	Manufacturer	Model
Measurement receiver	Rohde & Schwarz	ESCS 30
Transient limiter / 10 dB attenuator	Chase	CFL 9206
Line Impedance Stabilization Network (LISN)	Rohde & Schwarz	ESH 3-Z5
Line Impedance Stabilization Network (LISN)	Schwarzbeck	NNLK8121

13.2 Radiated measurements

Equipment	Manufacturer	Model
Spectrum Analyzer	Agilent	E7405A
Antenna	Chase	CBL 6141
Antenna	Schwarzbeck	BBHA 9120D
Band reject filter	Wainwright Instruments	WRCT2400/2483
High pass filter	Wainwright Instruments	WHK3.0/18GST
Pre-amplifier	Agilent	87405B
Pre-amplifier	JCA	118-400
Turn table / antenna mast controller	EMCO	2090

14 TEST SETUP PHOTOGRAPHS

Test setup photograph can be found in a separate document

T06-050D-EMC_PHOTOS.doc