REPORT: **FCC / IC Electromagnetic Compatibility (EMC) test report**
This report replaces the old test report: 200634B-EMC.

PRODUCT:

Test item description:	Wrist computer
Trade Mark:	Suunto
Model/Type reference:	Suunto Ambit
Serial number:	1147100077
Customer:	Suunto Oy Valimotie 7, FI-01510 Vantaa FINLAND
Contact person:	Heikki Puuri
Manufacturer:	Suunto Oy Valimotie 7, FI-01510 Vantaa FINLAND

ORIGINAL DATE: **24.1.2012**
CORRECED DATE: **12.3.2012**

TESTED BY:

Matti Virkki ; Test engineer

APPROVED BY:

Tuomo Hahl ; Test engineer

Intertek ETL Semko Oy Intertek FINLAND

CONTENTS

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1 LABORATORY INFORMATION

Test Laboratory	Intertek ETL Semko OY Koneenkatu 12 / K1 05801 Hyvinkää FINLAND
Laboratory accreditation:	FINAS Finnish Accreditation Service T199 (EN ISO/IEC 17025)
FCC registration number: **IC file number:**	910391 (January 27, 2003) IC 2042C-1 (May 14, 2003)

2 TEST SUMMARY

2.1 Test standards

The tests listed in this report have been done to demonstrate compliance to the FCC rules section §15.107, §15.109 and IC standard RSS-310. ICES-003

Test requirements:	CFR 47 §15.107	Conducted emissions to AC-mains
	CFR 47 §15.109	Radiated emissions
	ICES-003 Issue 4 Section 5.3	Conducted emissions to AC-mains
	ICES-003 Issue 4 Section 5.5	Radiated emissions
	RSS-GEN Issue 3	
	RSS-310 Issue 3	

2.2 Test results

Test method		**Page no**	**Result (Pass/Fail)**
ANSI C63.4 (2009)	Conducted emissions to AC-mains	6	**Passed** [1)]
ANSI C63.4 (2009)	Radiated emissions	11	**Passed** [1)]

1) If the measurement result is below the limit by a margin less than the measurement uncertainty, it is not possible to define compliance at a level of confidence of 95%.

PASSED Pass
FAILED Fail
X Measured, but there is no applicable performance criteria
Na Not applicable

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3 EUT INFORMATION

3.1 System configuration

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	Wrist computer	Suunto Ambit	1147100077	1
Accessories	Laptop PC	Dell	-	2
	AC DC adapter	Dell	-	3

Notes: -

3.2 Power specification

EUT power connection	Machine signboard	Tested
Voltage:	-	115 VAC, 1- phase
Current:	-	Not measured
Frequency:	50 – 60 Hz	60 Hz

3.3 Cable specification

Cable	Name	Type	Length /m	Shielded Yes/No
1	USB cable		1	No
2	AC power cable		1	No

4 OPERATIONAL CONDITION

4.1 Operation mode

Radiated emission was tested in two setups:

Setup 1: Stand alone in receiver mode searching for heart rate belt.
Setup 2: EUT is connected to PC via USB cable.

Conducted emission was tested in following setup:

EUT is connected to PC via USB cable.

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5 CONDUCTED EMISSIONS TO AC-MAINS

EUT:	1		
Accessories	-		
Testing method:	ANSI C63.4 (2009) Conducted emission part		
Measurement uncertainty:	0,15 – 30 MHz	± 2,2 dB	95% confidence expanded (k = 2)
Climatic condition:	19 ºC	19 %RH	1006 mbar
Site place:	Intertek ETL Semko EMC-laboratory of Hyvinkää		
FCC rule part	§15.107		
ICES-003 section	5.3		
Test date:	4.1.2012		
Tested by:	Matti Virkki		

5.1 Test setup

Test site is a shielded room. Size of the room is 5m x 4m x 3m.
The EUT is placed on a non-conductive table 0,8 m above the ground reference plane, 0,4 m distance from the vertical reference plane.

5.2 Measuring procedure

The measuring is carried out at 0,15 – 30 MHz frequency range. Frequency range is measured with peak and average detectors with 3,906 kHz steps. The resolution bandwidth of 9 kHz is used. For the peak frequency points closer than 6dB from the quasi-peak limit line, the quasi-peak measurement is carried out. All the phase lines and neutral are measured.

5.3 EUT operation mode

EUT was connected to PC via USB cable and was charging its battery.

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5.4 Limits

	FCC / IC	
Frequency of emission [MHz]	**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

5.5 Test results

Test results

Test	**Test result**
Conducted emission test	**Passed**

Note: If the measurement result is below the limit by a margin less than the measurement uncertainty, it is not possible to define compliance at a level of confidence of 95%.

The measured interference values using peak and average detectors are shown in the pictures 1 and 2 below.

Table 1: AC-mains conducted emission measurement results, AC live

Final Quasi Peak results from worst case frequencies.

Frequency (MHz)	**QP level (dBµV)**	**Limit (dBµV)**	**Margin (dB)**
N/A			

Final Average results from worst case frequencies.

Frequency (MHz)	**AV level (dBµV)**	**Limit (dBµV)**	**Margin (dB)**
N/A			

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Table 2: AC-mains conducted emission measurement results, AC neutral

Final Quasi Peak results from worst case frequencies.

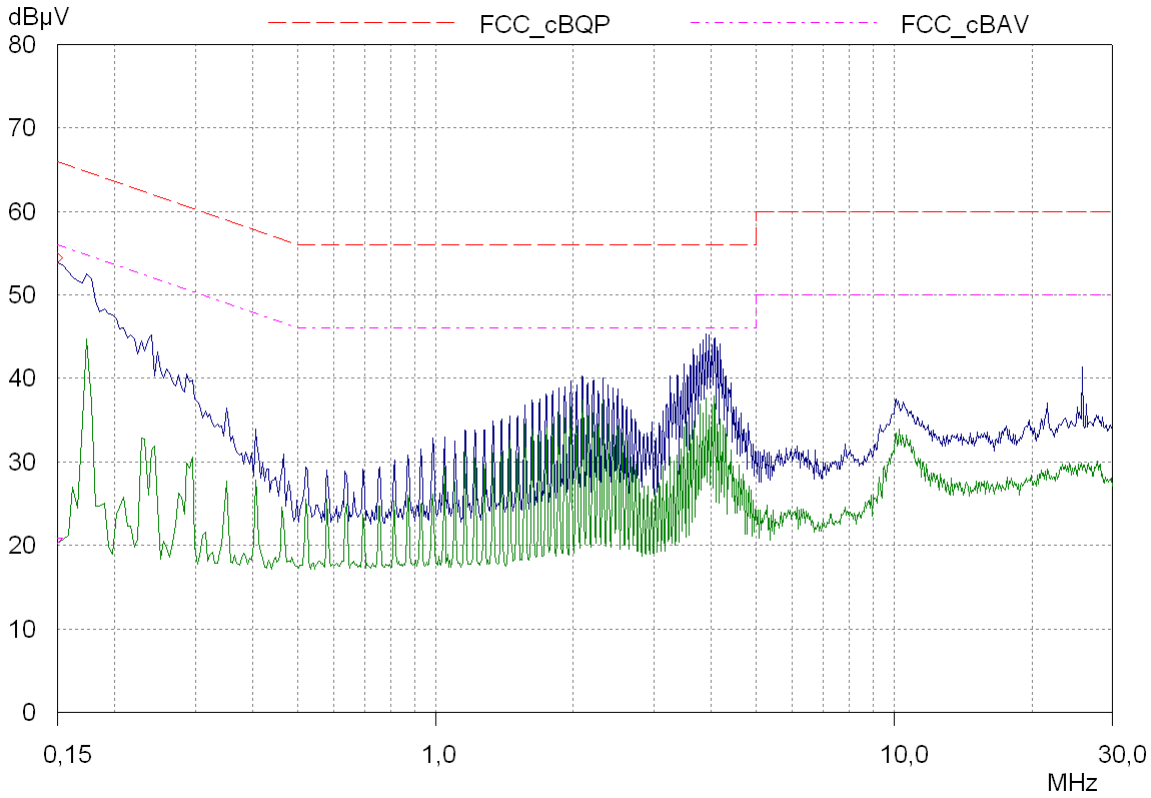
Frequency (MHz)	QP level (dBµV)	Limit (dBµV)	Margin (dB)
N/A			

Final Average results from worst case frequencies.

Frequency (MHz)	AV level (dBµV)	Limit (dBµV)	Margin (dB)
3,73	34,1	46,0	11,9
3,78	35,6	46,0	10,4
3,95	32,6	46,0	13,4
4,01	35,4	46,0	10,6

5.6 Screen shots

Picture 1: AC-mains conducted emission measurement results, AC live



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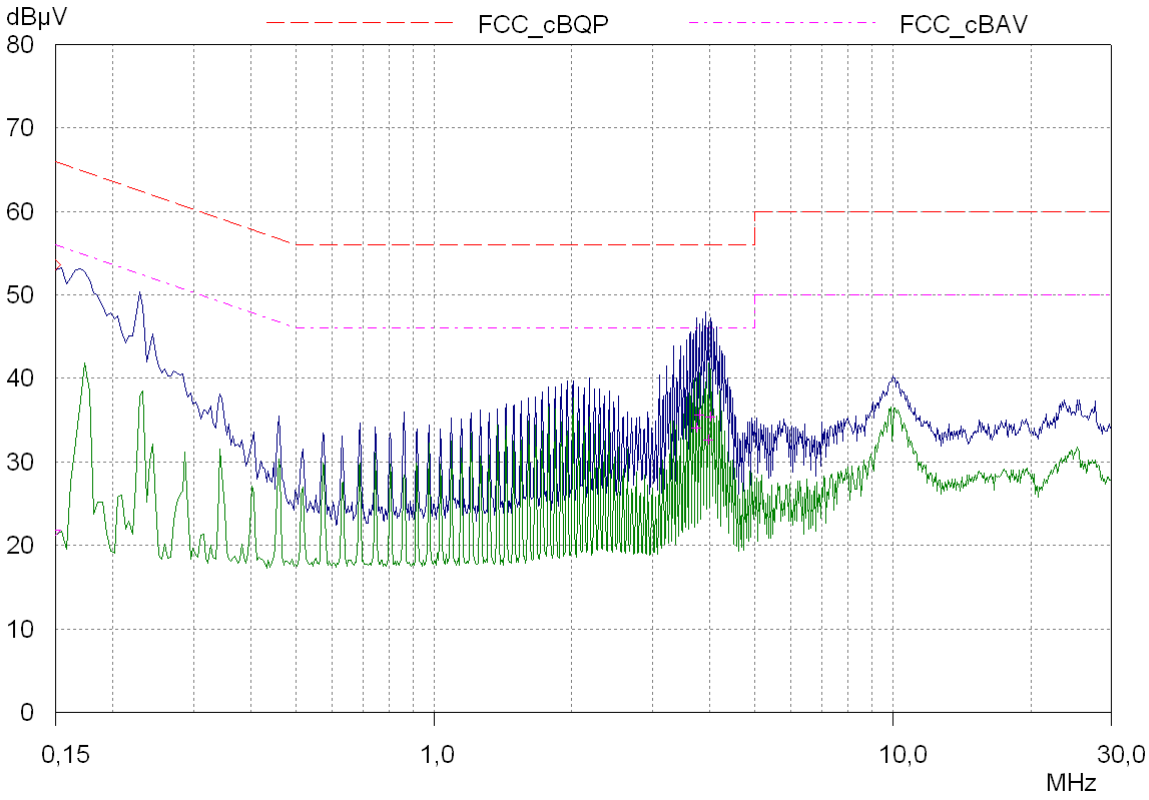
Picture 2: AC-mains conducted emission measurement results, AC neutral



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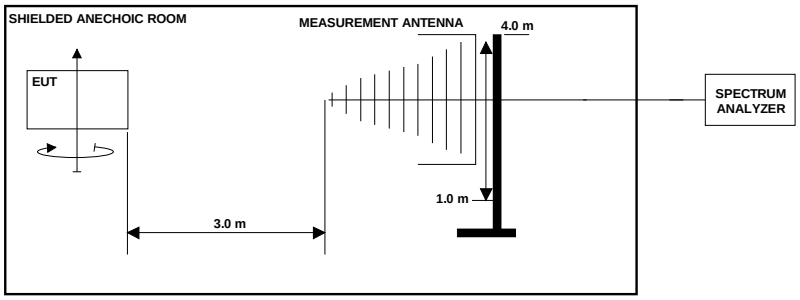
6 RADIATED EMISSIONS

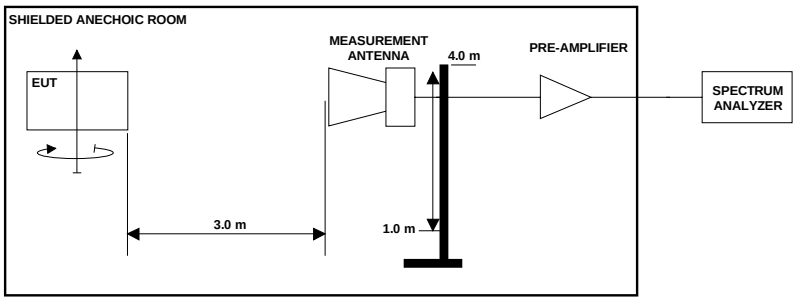
EUT	1		
Accessories	2, 3		
Testing method:	ANSI C63.4 (2009) Radiated emission part		
Measurement uncertainty:	30 – 1000 MHz 1 -6 GHz 6-18 GHz	± 4,2 dB ± 6,6 dB ± 7,0 dB	95% confidence expanded (k = 2)
Climatic condition:	19 ºC	19 %RH	1006 mbar
Test site:	Intertek ETL Semko EMC-laboratory of Hyvinkää		
FCC rule part	§15.109		
ICES-003 section	5.5		
Test date:	9.3.2012		
Tested by:	Matti Virkki		

6.1 Test setup

Test site is a semi-anechoic chamber. Size of the chamber is 9,1m x 6,9m x 6,6 (length, width, height). The EUT was set on a non-conductive turntable 0,80m height from reference ground plane.



Picture 3: Test setup for radiated emission measurement below 1 GHz



Picture 4: Test setup f

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6.2 Test method

The test system used is computer controlled. The measurement antenna calibrated antenna factors and connecting cable losses are added in a computer software to the measured results. The results corrected with antenna factors and cable losses are recorded.

Example calculation for measurement result.

$E_{dB\mu V/m} = V_{dB\mu V} + AF_{dB/m} + C_{dB} - G_{dB}$

Where:

E = Result as electrical field strength
V = measured voltage
AF = Antenna factor
C = cable and filter losses
G = pre-amplifier gain

Measurement procedure below 1 GHz frequencies:

The maximum emission levels were searched by rotating and manipulating the EUT and by scanning the measurement antenna in height from 1,0 to 4,0 m and by using peak detector.

All signal levels closer to 6 dB to the limit were measured using Quasi peak detector and recorded. Both

Measurement procedure above 1 GHz frequencies:

The maximum emission levels were searched by rotating and manipulating the EUT and by scanning the measurement antenna in height from 1,0 to 4,0 m and by using peak detector.

The maximum emission levels were searched by rotating and manipulating the EUT and by raising the antenna using peak detector and recorded.

6.3 EUT operation mode

EUT was tested in two setups:

setup 1 Stand alone receiver on searching for heart rate belt.
setup 2 EUT is connected to PC via USB cable.

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6.4 Limits

Table 3: Radiated emission limits for FCC class B and IC class B digital devices, measurement distance 3,0 m

FCC				
Frequency of emission [MHz]	**Limit [µV / m]**	**Limit [dBµV/m]**	**Resolution bandwidth [kHz]**	**Measurement detector type**
30 – 88	100	40	120	Quasi peak
88 – 216	150	43,5	120	Quasi peak
216 – 960	200	46	120	Quasi peak
960 – 1000	500	54	120	Quasi peak
Above 1000	500	54	1000	Average
Above 1000	5000	74	1000	Peak
IC				
30 - 230		40	120	Quasi peak
230 – 1000		47	120	Quasi peak

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6.5 Test results

Test	Test result
Radiated emission test	**Passed**

Note: If the measurement result is below the limit by a margin less than the measurement uncertainty, it is not possible to define compliance at a level of confidence of 95%.

The measured interference values using 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 detector and reported in the tables

Final Quasi Peak results from worst case frequencies after finding maximum of emissions from the EUT with antenna height scan (1-4m) and the turntable rotations (0-360°).

Receiver spurious emission

Frequency (MHz)	QuasiPeak (dBµV/m)	Bandwidth (kHz)	Height (cm)	Pol.ari zation	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
37,64	30,3	120	100	V	70,0	22,6	9,7	40,0

EUT connected to PC

Frequency (MHz)	QuasiPeak (dBµV/m)	Bandwidth (kHz)	Height (cm)	Pol.	Azimuth (deg)	Corr, (dB)	Margin (dB)	Limit (dBµV/m)
48,36	35,4	120	100	V	290,0	18,0	4,6	40,0
51,68	33,7	120	100	V	318,0	16,8	6,3	40,0
56,00	32,6	120	100	V	295,0	15,4	7,4	40,0
258,08	33,6	120	100	H	264,0	16,8	12,4	46,0
259,24	33,7	120	100	H	270,0	16,9	12,3	46,0
516,12	36,9	120	100	V	0,0	22,6	9,1	46,0
518,64	37,1	120	100	V	1,0	22,6	8,9	46,0

Frequency (MHz)	MaxPeak (dBµV/m)	Average- (dBµV/m)	BW (kHz)	Height (cm)	Pol.	Azimuth (deg)	Corr, (dB)	Margin (dB)	Limit dBµV/m
1047,61	51,3	22,7	1000	150,0	H	0,0	-15,6	2,6	53,9
1304,34	43,7	23,5	1000	125,0	V	58,0	-16,2	10,2	53,9
1660,51	45,7	26,8	1000	100,0	V	231,0	-18,4	8,2	53,9
1722,54	46,0	43,5	1000	100,0	V	120,0	-18,5	7,9	53,9
1997,25	41,9	22,3	1000	100,0	V	259,0	-17,3	12,0	53,9
2385,06	45,9	43,0	1000	100,0	V	0,0	-15,1	8,0	53,9

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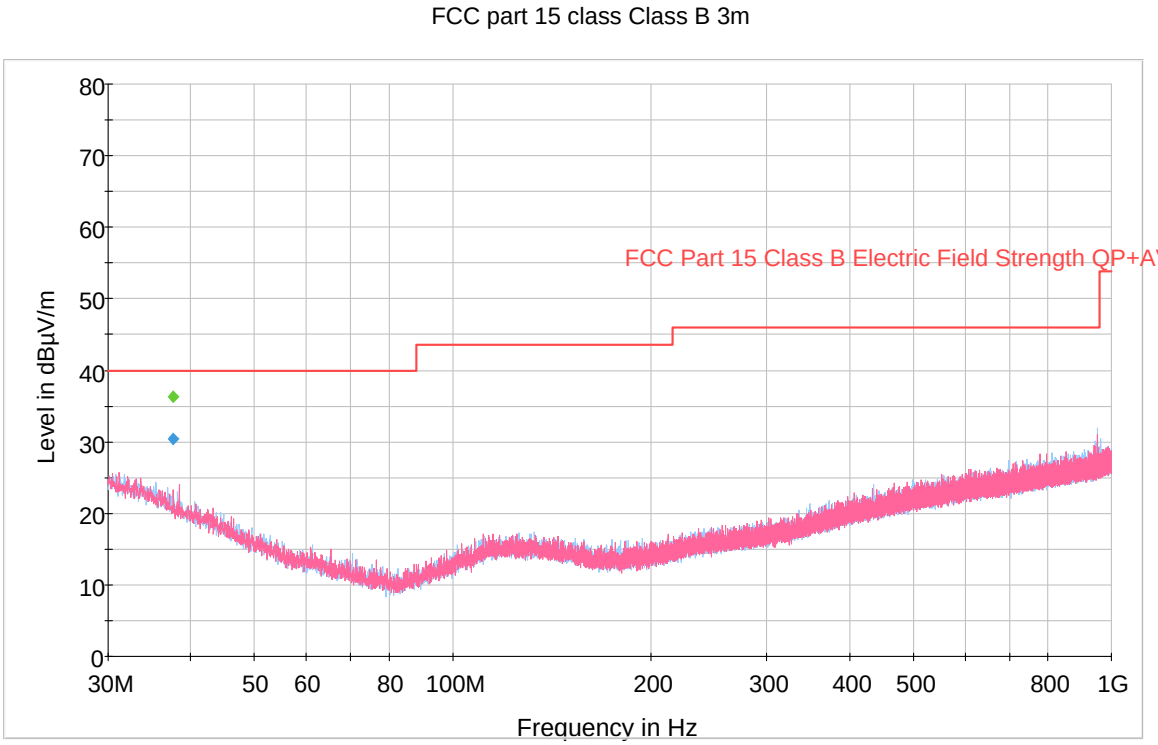
Picture 5: Receiver spurious emission results, 30 – 1000 MHz,
red = horizontal, blue = vertical



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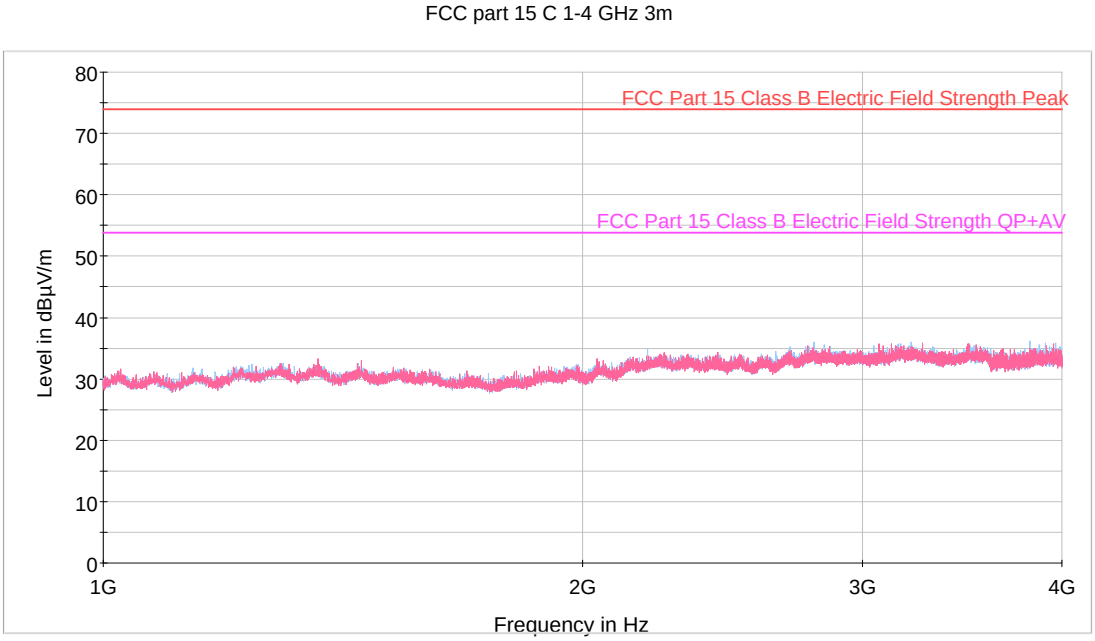
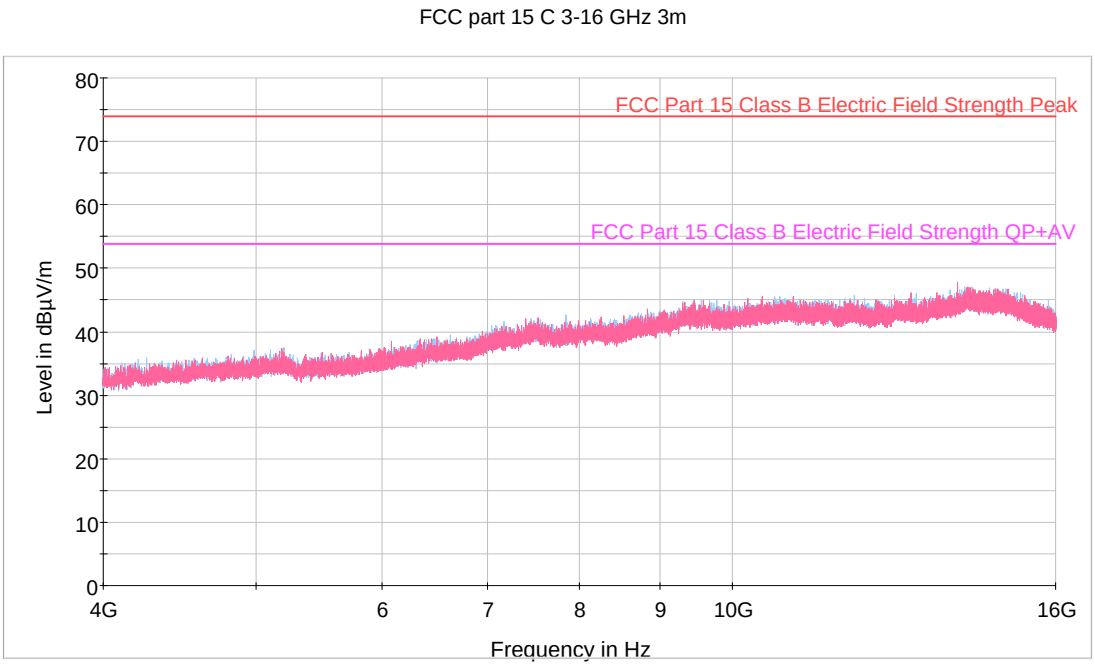
Picture 6: Receiver spurious emission results, 1 - 4 GHz, red = horizontal, blue = vertical



Picture 7: Receiver spurious emission results, 4 - 16 GHz, red = horizontal, blue = vertical



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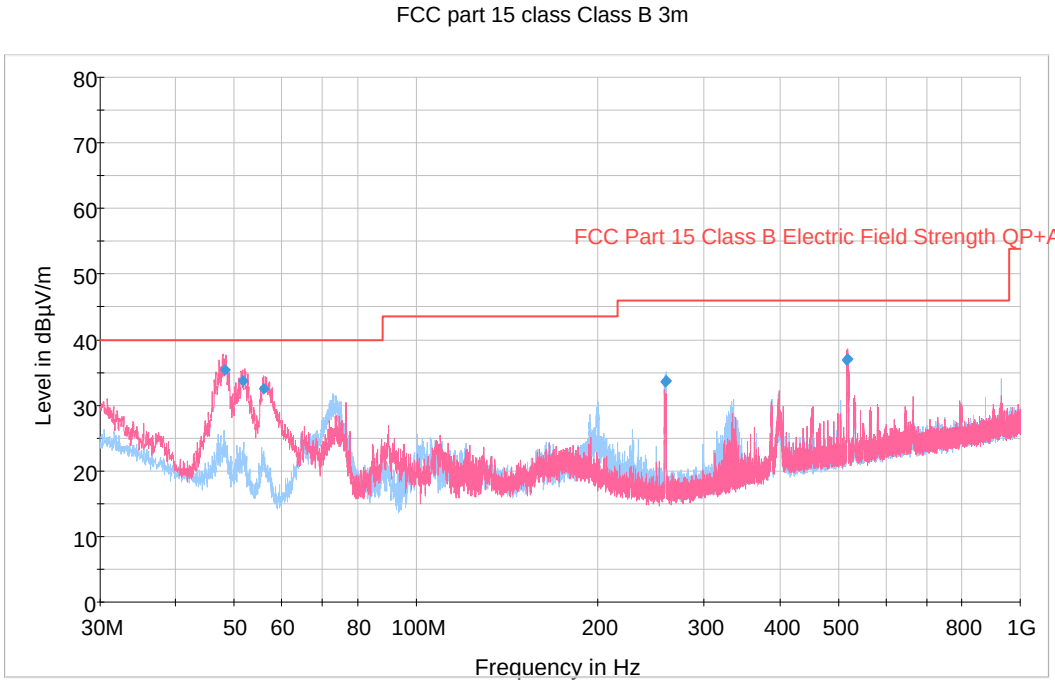
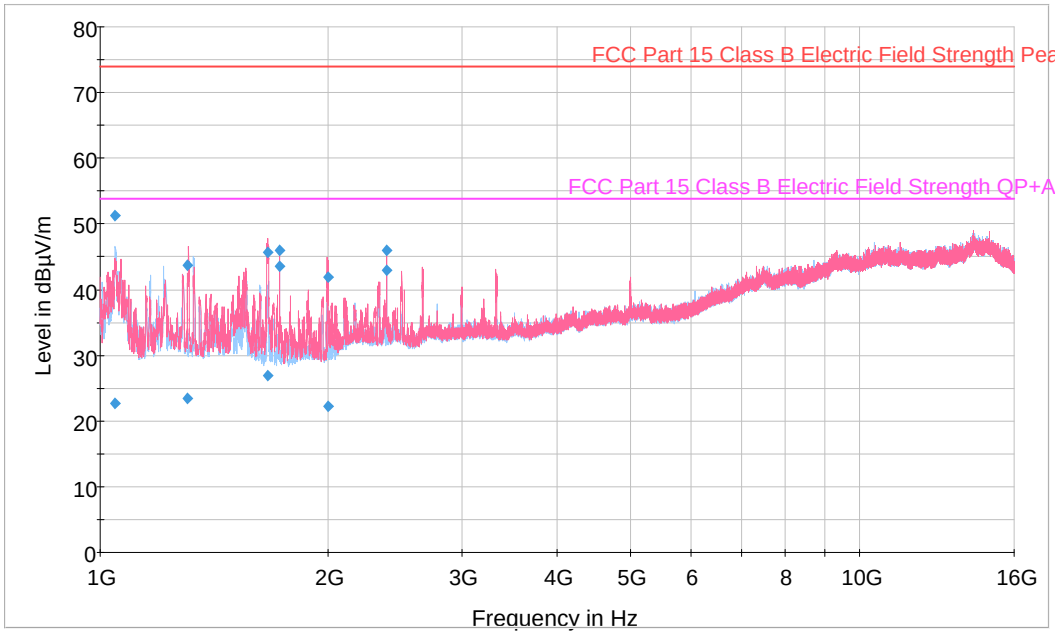
Picture 8: radiated emission results PC peripheral, 30 – 1000 MHz,
red = horizontal, blue = vertical



Picture 9: radiated emission results PC peripheral, 1 - 16 GHz, EUT horizontal
red = horizontal, blue = vertical



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7 TEST EQUIPMENT

Calibration period for all the equipment is 1 year except for antennas which are calibrated every 2 years.

Measurement equipment, conducted emission

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	227	30634
Measuring software	R&S ESxS-K1	-	Ver 2.20

Measurement equipment, radiated emission measurement

DEVICE	MANUFACTURER	SPKTT	SERIAL
EMI test receiver	Rohde & Schwarz ESU26	219	100173
Horn Antenna	Schwarzbeck BBHA9120D	138	365
X-wing BiLog antenna	Teseq CBL6143A	221	29611
3 dB attenuator	Huber+Suhner 3dB/2W	214	-
Pre-amplifier	JCA 118-400	142	-
High pass filter	Wainwright Instruments WHK3.0/18GST	141	3
3m Semi-anechoic chamber	ETS Euroshield	081	-
Measuring software	R&S EMC32	-	Ver 8.52.0

8 TEST SETUP PHOTOGRAPHS

Test setup photograph can be found in a separate document

200634B-EMC_PHOTOS.doc

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