REPORT: FCC/IC Radio Frequency (RF) test report

PRODUCT:

Test item description:	Suunto GPS receiver and 2,4 GHz transmitter
Trade Mark:	Suunto
Model/Type reference:	SUUNTO GPS TRACK POD
Serial number:	00122/00114
Customer:	Suunto Oy Valimotie 7 01510 Vantaa Finland
Contact person:	Heikki Puuri
Manufacturer:	Suunto Oy Valimotie 7 01510 Vantaa Finland

DATE: **5.9.2012**

TESTED BY:

Matti Virkki; Test engineer

APPROVED BY:

Tuomo Hahl; Test engineer

Intertek ETL Semko Oy Intertek FINLAND

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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)

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-GEN and RSS-210.

Transmitter measurements

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

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	Passed
§15.109	7.2.3	5.5	Radiated emissions	Passed

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

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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	S/N	EUT number
EUT	SUUNTO GPS TRACK POD	00122	1*
	SUUNTO GPS TRACK POD	00114	2**
	SUUNTO GPS TRACK POD	00090	3
AE	Compaq 6710b PC	Cnu823285C	4
	AC adapter HP PP012L-E	9859500802	5
	Mouse Logitech G3	-	6

Notes:
*Modified to transmit continuously
**Modified with antenna connector for conducted measurements

3.1 EUT description

EUT is transmitter that sends data to other devices.
Radio link operates at 2,465 GHz frequency band and uses GFSK modulation.

The EUT was not modified during the tests.

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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 12.

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.

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5 FIELD STRENGTH OF FUNDAMENTAL

EUT	1		
Accessories	-		
Temp, Humidity, Air Pressure	21 ºC	63 %RH	1009 hPa
Date of measurement	August 28th 2012		
FCC rule part	§15.249 (a)		
RSS-210 section	A2.9 (1)		
Measured by	Matti Virkki		

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 (Maximum power)

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)

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5.4 Results

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

Freq MHz	Measured Value dBµV	Correction Factor dB	Result dBµV/m	EUT orientation	Antenna Pol.	Antenna height	Turntable angle
2465	104,2	-14,3	89,9	Pos 1	Hor	1,0	95
2465	104,5	-14,3	90,2	Pos 2	Hor	1,0	45
2465	102,3	-14,3	88,0	Pos 3	Hor	1,0	199

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

Average level ≤ Peak level - 20 log (duty cycle).

Measured Duty cycle for this product is 200µs long transmission at every 200ms. Therefore,

Average level ≤ Peak level - 20 log ((100 ms – 200 µs) / 200µs)

Average level ≤ Peak level – 53,9 dB
Average level ≤ 90,2 dBµV/m – 53,9 dB = 36,3**dBµV/m**

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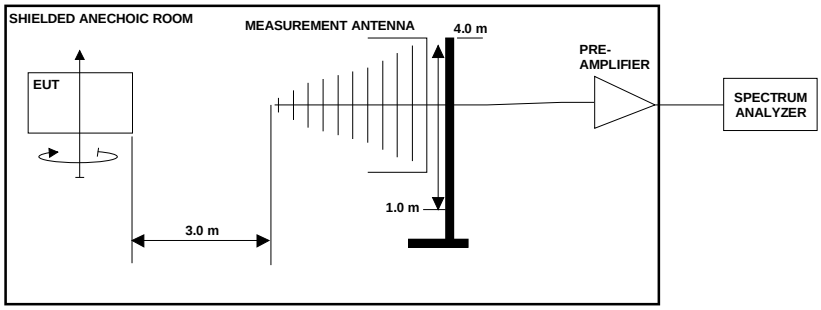
6 TRANSMITTER RADIATED SPURIOUS EMISSIONS

EUT	1		
Accessories	-		
Temp, Humidity, Air Pressure	21 ºC	63 %RH	1009 hPa
Date of measurement	August 28th 2012		
FCC rule part	§15.249 (a) (d)		
RSS-210 section	2.7, A2.9 (2)		
Measured by	Matti Virkki		

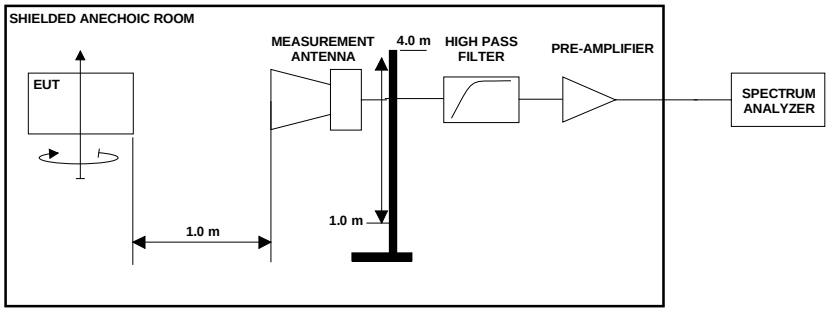
6.1 Test setup

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 - 1 GHz frequencies



Picture 2: Test setup for radiated spurious emissions measurement 1 GHz – 26 GHz frequencies

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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 dBµV/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 (Maximum power)

6.4 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.

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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

Frequency (MHz)	MaxPeak (dBµV/m)	EUT Pos.	Bandwidth (kHz)	Height (cm)	Pol.	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit Avg (dBµV/m)
4929,86	55,0	3	1000	100,0	H	204,0	-8,1	-1,1	53,9
7387,00	47,7	2	1000	269,0	H	334,0	0,5	6,2	53,9
9859,86	52,8	1	1000	190,0	H	2,0	1,8	1,1	53,9

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

Average level ≤ Peak level - 20 log (duty cycle).

Measured Duty cycle for this product is 200µs long transmission at every 200ms. Therefore,

Average level ≤ Peak level - 20 log ((100 ms – 200 µs) / 200µs)
Average level ≤ Peak level – 53,9 dB

Frequency (MHz)	Avg (dBµV/m)	Limit Avg (dBµV/m)	Margin (dB)
4929,86	1,1	53,9	52,8
7387,00	-6,2	53,9	60,1
9859,86	-1,1	53,9	55,0

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7 20 dB BANDWIDTH

EUT	2		
Accessories	-		
Temp, Humidity, Air Pressure	25 ºC	50 %RH	1011 hPa
Date of measurement	August 30th 2012		
FCC rule part	§15.215 (c)		
RSS-210 section	-		
Measured by	Matti Virkki		

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 (Maximum power)

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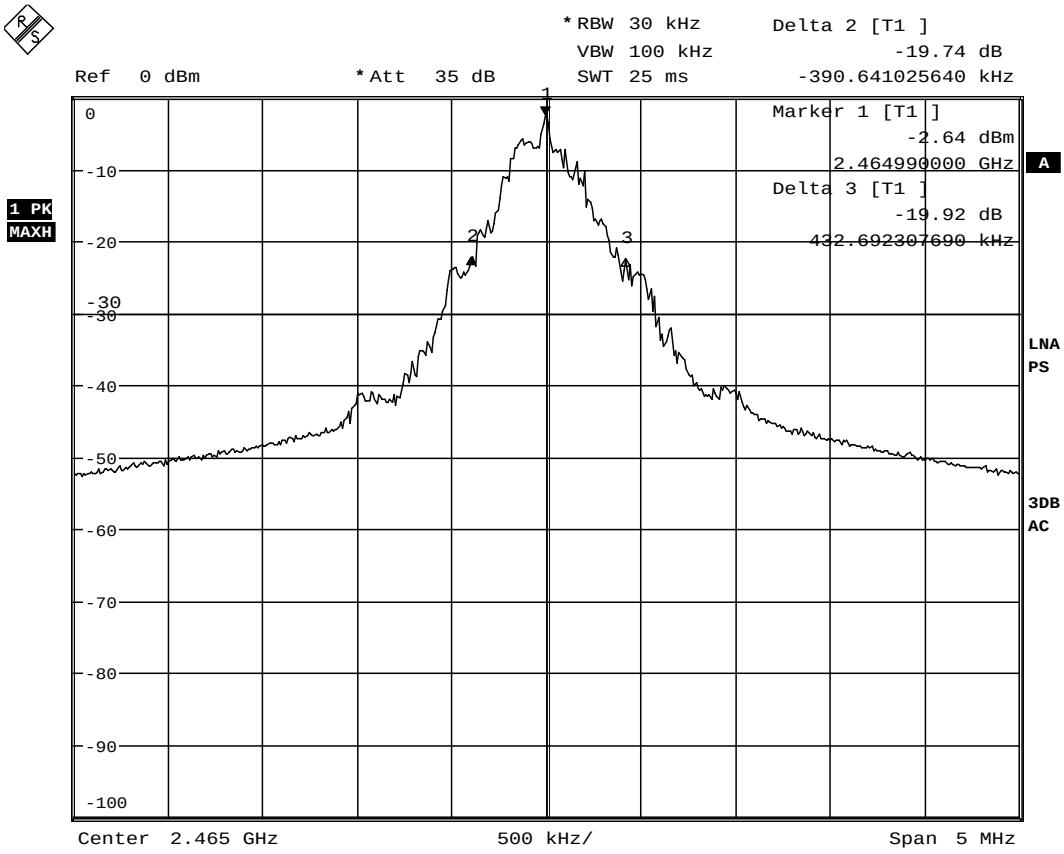
7.3 Results

Table 5: 20dB bandwidth measurement results

EUT Frequency MHz	Limit MHz	Measured value MHz
2465	-	0,823

7.4 Screen shots

Picture 3: 20dB Bandwidth measurement result



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8 99 % BANDWIDTH

EUT	2		
Accessories	-		
Temp, Humidity, Air Pressure	21 ºC	63 %RH	1009 hPa
Date of measurement	August 28th 2012		
FCC rule part			
RSS-GEN section	4.4.1		
Measured by	Matti Virkki		

8.1 Test setup and measurement method

The 99% occupied bandwidth was measured with spectrum analyzer occupied bandwidth measurement function.

8.2 EUT operation mode

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

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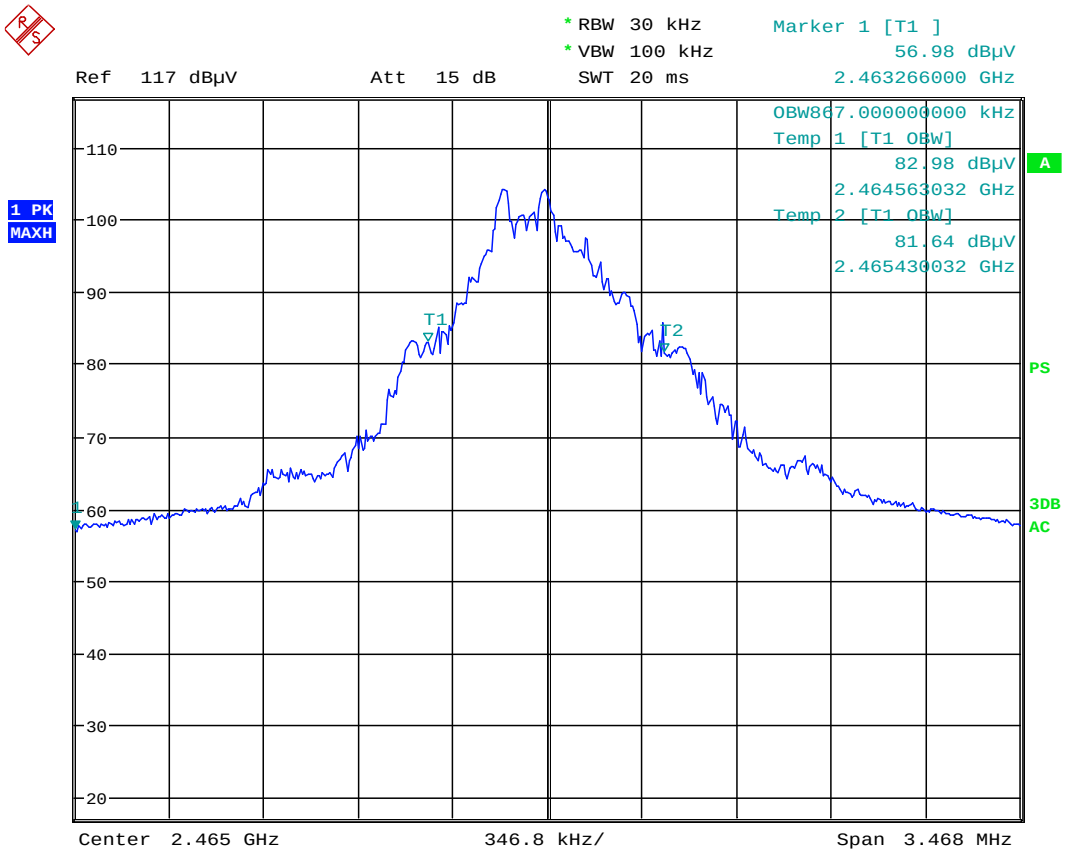
8.3 Results

Table 6: 99% bandwidth measurement results

EUT Frequency MHz	Limit MHz	Measured value MHz
2465	-	0,867

8.4 Screen shots

Picture 4: 99% Bandwidth measurement result



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9 CONDUCTED EMISSIONS TO AC-MAINS

EUT	3		
Accessories	4, 5, 6		
Temp, Humidity, Air Pressure	25 ºC	52 %RH	994 hPa
Date of measurement	September 3rd 2012.		
FCC rule part	§15.107		
RSS-GEN section	7.2.2		
ICES-003 section	5.3		
Measured by	Matti Virkki		

9.1 Test setup

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

9.2 EUT operation mode

EUT was connected to Laptop pc via USB cable.
EUT was charged via USB bus

9.3 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

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9.4 Results

The measured interference values using peak and average detectors are shown in the pictures 5 and 6 below. All signals have been measured using quasi peak and average detectors and reported in the table 7 and 8.

Table 7: Quasi peak detector measurement results, AC live

Frequency [MHz]	Measured value [dBµV]	Limit [dBµV]	Margin to limit [dB]
0,1578	42,4	65,5	23,0
0,1656	41,5	65,1	23,6
0,1968	37,5	63,7	26,1
0,4351	35,2	57,1	21,9
21,1773	32,8	60,0	27,1

Table 8: Average detector measurement results, AC live

Frequency [MHz]	Measured value [dBµV]	Limit [dBµV]	Margin to limit [dB]
0,1578	28,7	55,5	26,7
0,1656	27,3	55,1	27,8
0,1968	30,1	53,7	23,6
0,4351	32,2	47,1	14,8
21,1773	25,9	50,0	24,0

Table 9: Quasi peak detector measurement results, AC neutral

Frequency [MHz]	Measured value [dBµV]	Limit [dBµV]	Margin to limit [dB]
0,15	43,5	66,0	22,4
0,2437	36,6	61,9	25,3
0,40	38,0	57,8	19,8
1,5718	30,8	56,0	25,1

Table 10: Average detector measurement results, AC neutral

Frequency [MHz]	Measured value [dBµV]	Limit [dBµV]	Margin to limit [dB]
0,15	23,8	56,0	32,1
0,2437	31,3	51,9	20,6
0,40	36,1	47,8	11,6
1,5718	20,2	46,0	25,7

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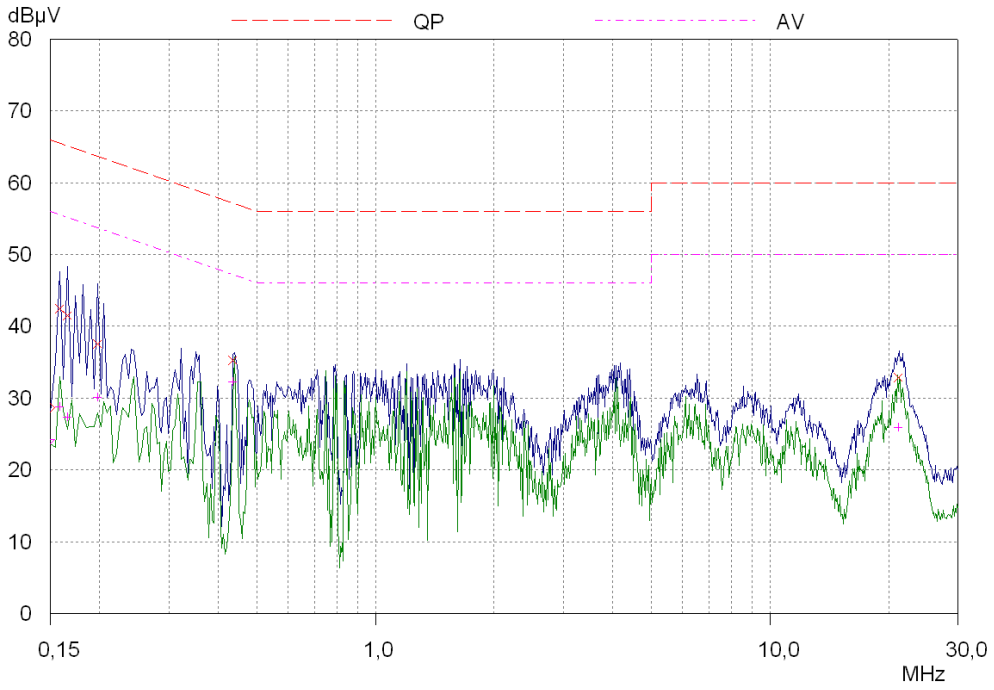
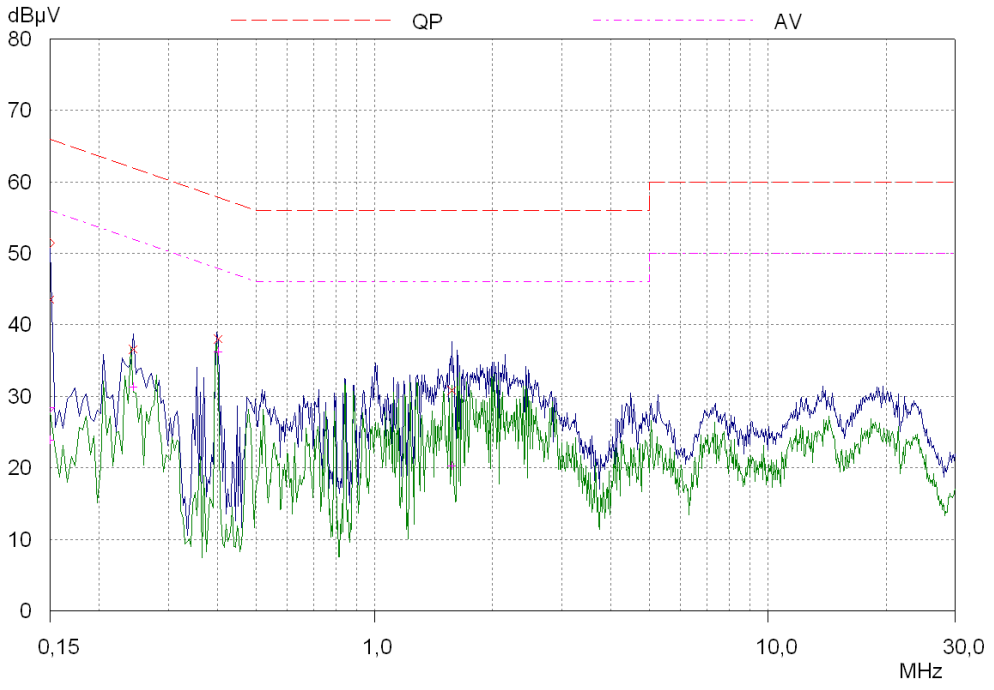
9.5 Screen shots

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



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



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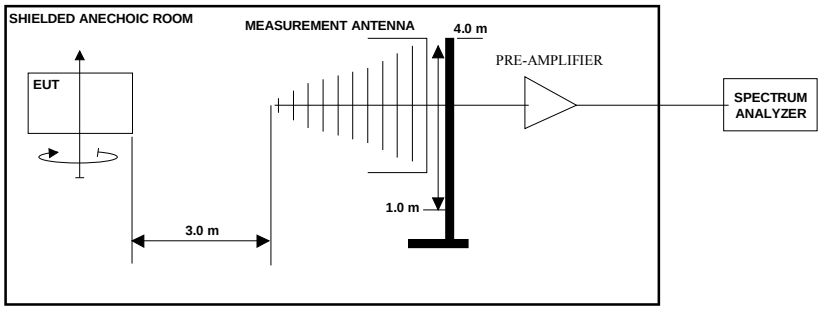
10 RADIATED EMISSION

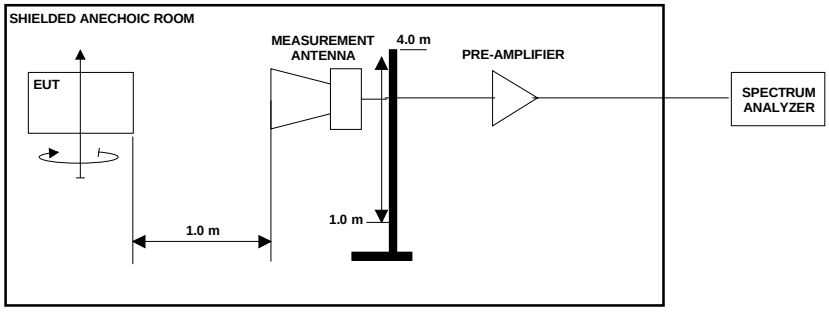
EUT	3		
Accessories	4, 5, 6		
Temp, Humidity, Air Pressure	25 ºC	50 %RH	1011 hPa
Date of measurement	August 30th 2012		
FCC rule part	§15.109		
RSS-GEN section	7.2.3		
ICES-003 section	5.5		
Measured by	Matti Virkki		

10.1 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

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10.2 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 dBµV/m at 3 m distance, are reported.

10.3 EUT operation mode

EUT was connected to Laptop pc via USB cable.
EUT was charged via USB bus

10.4 Limit

Table 11: 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

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10.5 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 12, 13 and 14.

Table 12: Radiated emissions using Quasi peak detector

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol.	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
72,00	28,8	5000,0	120	250,0	H	0,0	12,5	11,2	40,0
149,00	24,1	5000,0	120	275,0	H	336,0	15,3	19,4	43,5
180,92	31,5	5000,0	120	100,0	V	313,0	14,8	12,0	43,5
214,84	22,2	5000,0	120	225,0	H	5,0	15,7	21,3	43,5
421,96	19,2	5000,0	120	125,0	H	200,0	21,1	26,8	46,0
951,08	42,1	5000,0	120	175,0	H	213,0	26,4	3,9	46,0
952,32	33,3	5000,0	120	150,0	H	225,0	26,5	12,7	46,0
953,40	43,3	5000,0	120	152,0	H	249,0	26,5	2,7	46,0
954,68	40,0	5000,0	120	175,0	H	201,0	26,5	6,0	46,0

Table 13: Radiated emissions using Peak detector

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol.	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit dBµV/m)
1062,08	47,5	5000,0	1000	100,0	V	24,0	-15,7	26,4	73,9
1292,36	42,9	5000,0	1000	100,0	V	0,0	-16,2	31,0	73,9
1331,66	49,7	5000,0	1000	125,0	V	0,0	-16,3	24,2	73,9
1595,81	49,3	5000,0	1000	100,0	V	348,0	-18,0	24,6	73,9
1697,24	42,6	5000,0	1000	100,0	V	0,0	-18,4	31,3	73,9
2397,30	44,1	5000,0	1000	175,0	V	327,0	-15,1	29,8	73,9
2489,70	43,9	5000,0	1000	100,0	V	257,0	-15,1	30,0	73,9

Table 14: Radiated emissions using Average detector

N/A, all peak levels < AVG limit

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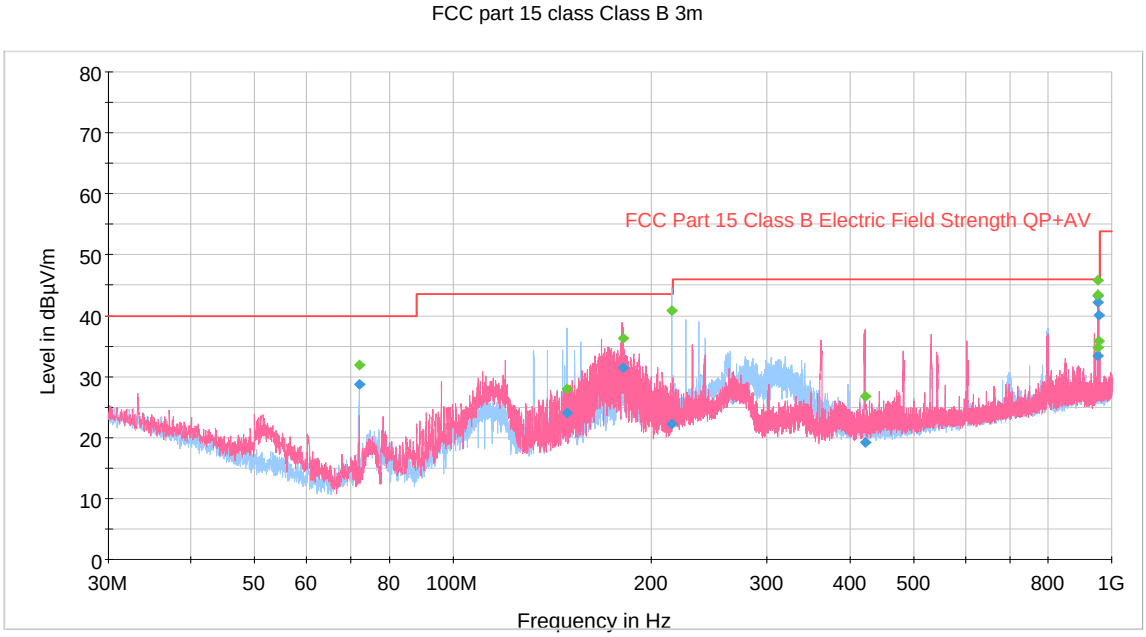
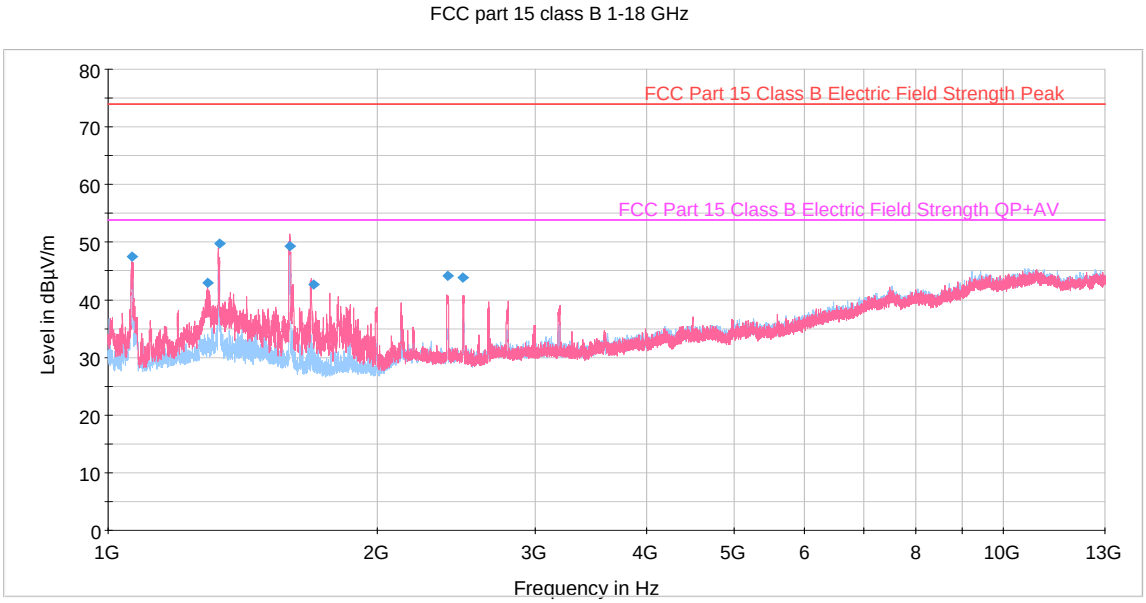


Picture 9: radiated emission results, 30 – 1000 MHz,
Red= horizontal polarization, blue = vertical polarization



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

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11 TEST EQUIPMENT

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

11.1 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
AC source	Schaffner NSG1007-5-400	93	54791

DEVICE	MANUFACTURER	SPKTT	SERIAL
Spectrum analyser	Rohde & Schwarz ESU 26	219	100173

11.2 Radiated measurements

DEVICE	MANUFACTURER	SPKTT	SERIAL
Spectrum analyser	Rohde & Schwarz ESU26	219	100173
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
3m Semi-anechoic chamber	ETS Euroshield	081	-
Measuring software	R&S EMC32	-	Ver 8.53.0

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12 TEST SETUP PHOTOGRAPHS

Test setup photograph can be found in a separate document

200700A-EMC_PHOTOS.doc

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