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Appendices -

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Tested by:



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SORT OF EQUIPMENT:

The transmitter of the heart rate monitoring system

MARKETING NAME:

SUUNTO

TYPE:

Suunto 2SKU

MANUFACTURER:

SUUNTO OY

CLIENT:

Suunto Oy

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TEST LABORATORY:

Nemko Oy

FCC REG. NO.

91087 August 27, 2001

SUMMARY:

In regard to the performed tests the equipment under test fulfils the requirements defined in the test specifications, see page 2 for details.

The test results are valid for the tested unit only. Without a written permission of Nemko Oy it is allowed to copy this report as a whole, but not partially.

Summary of performed tests and test results

<i>Section in CFR 47</i>		<i>Result</i>
15.249 (a)	Field Strength of Fundamental	PASS
15.249 (a)	Field Strength of Spurious Emissions	PASS

Explanations:

PASS The EUT passed that particular test.

FAIL The EUT failed that particular test.

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1. EUT and Accessory Information

1.1 EUT description

EUT is the transmitter of the heart rate monitoring system.
The highest internal frequency of the EUT was 2465 MHz.

For the facilitation of the spurious emissions tests (for finding of maximum value) the customer delivered also the sample, which transmitted continuously, because duty cycle of the production model is only 0.001 (200 μ s transmission every 200 ms). Therefore measuring results are peak values.
Average level \leq Peak level – 20 log (duty cycle). (Duty cycle = (200 ms + 200 μ s) / 200 μ s = 60 dB).
Average level \leq Peak level – 60 dB.

1.2 EUT and accessories

	<i>unit</i>	<i>type</i>	<i>S/N</i>
<i>EUT</i>	Transmitter of the heart rate monitoring system	Suunto 2SKU	-
<i>Power Supply</i>	Li-Mn Battery 3 V	Varta CR 2032	

2. Standards and measurement methods

The test were performed in guidance of the CFR 47 Part 15, Subpart B, Class B, ANSI C63.4 (2001) and EN 55022.

3. Test results

3.1 Field Strength of Fundamental

The test was performed as a compliance test. The test parameters concerned were as follows:

<i>Site name</i>	Nemko Oy / Perkaa
<i>Date of testing</i>	13.04.2004
<i>Test equipment</i>	350, 42, 82, 184, 403
<i>Test conditions</i>	22.3 °C, 32.5 % RH
<i>Test result</i>	PASS

3.1.1 Test method and limit

Vertical and horizontal polarizations in the frequency 2465 MHz was measured by using the peak detector. During the measurement the turntable was rotated from 0° to 360° and the antenna was raised from 1.0 m and 4.0 m.

Limit 15.249 (a)

<i>Fundamental Frequency</i>	<i>Field Strength of Fundamental</i>	
	<i>(millivolts/meter)</i>	<i>dBμV/m</i>
2465.0 <i>MHz</i>	50	94

3.1.2 EUT operation mode

<i>EUT operation mode</i>	TX ON
<i>EUT operation voltage</i>	3 VDC

3.1.3 Test data

The measurement results were obtained as described below.
(measurement distance: 3 m)

$$E [\mu\text{V}/\text{m}] = U_{RX} + A_{CABLE} + AF - G_{PREAMP}$$

Where

U_{RX} receiver reading

A_{CABLE} attenuation of the cable

AF antenna factor

G_{PREAMP} gain of the preamplifier

3.1.4 EUT test setup



Photograph 1. Radiated emissions test setup



Photograph 2. Radiated emissions test setup

3.1.5 Result

Frequency	Level (PK) Horizontal/	Level (PK) Vertical	Limit	Remarks
MHz	mV/m	mV/m	mV/m	
2465.0	29.7	27.7	50.00	

3.2 Field Strength of Spurious Emissions

<i>Site name</i>	Nemko Oy / Perkkaa
<i>Date of testing</i>	22.04.2004
<i>Test equipment</i>	350, 338, 42, 543, 544, K1, 319, 525, 83, 84, 85, 86, 87, 88, 508, 184, 403
<i>Test conditions</i>	23.1 °C. 35.0 % RH
<i>Test result</i>	PASS

3.2.1 Test method and limit

The test was performed in a semi-anechoic shielded room. The EUT was placed on a non-conductive 0.8 m high table standing on the turntable (photograph 1). During the test in the frequency range 30 - 4000 MHz the distance from the EUT to the measuring antenna was 3 m. During the test in the frequency range 4000-18000 MHz the distance from the EUT to the measuring antenna was 1.5 m.

Pre-scan: Vertical and horizontal polarizations in the frequency range 30 – 1000 MHz was measured by using the peak detector. During the peak detector scan the turntable was rotated from 0° to 360° with 30° step with the antenna heights 1.0 m and 3.0 m.

Final measurement: During the final measurement the turntable was rotated from 0° to 360° and the antenna was raised from 1.0 m and 4.0 m. The highest levels of the radiated interference field strength measured by using the quasi-peak detector were recorded.

Vertical and horizontal polarizations in the frequency range 1000 – 18000 MHz was measured by using the peak detector. During the measurement the turntable was rotated from 0° to 360° and the antenna was raised from 1.0 m and 4.0 m.

In the frequency range 18 – 25 GHz the harmonic frequencies are measured with the harmonic mixer using the substitution method. Measuring distance was 1.0 m. Measuring place was the shielded room.

EN 55022 Class B limit (3m measuring distance)

<i>Frequency band MHz</i>	<i>Quasi-peak dBμV/m</i>
30 - 230	40
230 - 1000	47

CFR 47 Part 15, Subpart B, Class B (3m measuring distance)

<i>Frequency band MHz</i>	<i>Average limit</i>		<i>Peak limit</i>	
	<i>dBμV/m</i>	<i>μV/m</i>	<i>dBμV/m</i>	<i>μV/m</i>
1000 - 25000	54	500	74	5000

3.2.2 EUT operation mode

<i>EUT operation mode</i>	Transmitter On
<i>EUT operation voltage</i>	3 VDC Li-Mn

3.2.3 Test data

The measurement results were obtained as described below.

30 – 4000 MHz (measurement distance: 3 m)

$$E [\mu V/m] = U_{RX} + A_{CABLE} + AF - G_{PREAMP}$$

Where

U_{RX} receiver reading

A_{CABLE} attenuation of the cable

AF antenna factor

G_{PREAMP} gain of the preamplifier

4000 – 18000 MHz (measurement distance 1.5 m)

$$E [\mu V/m] = U_{RX} + A_{CABLE} + AF - G_{PREAMP} - C_{1.5m}$$

Where

U_{RX} receiver reading

A_{CABLE} attenuation of the cable

AF antenna factor

G_{PREAMP} gain of the preamplifier

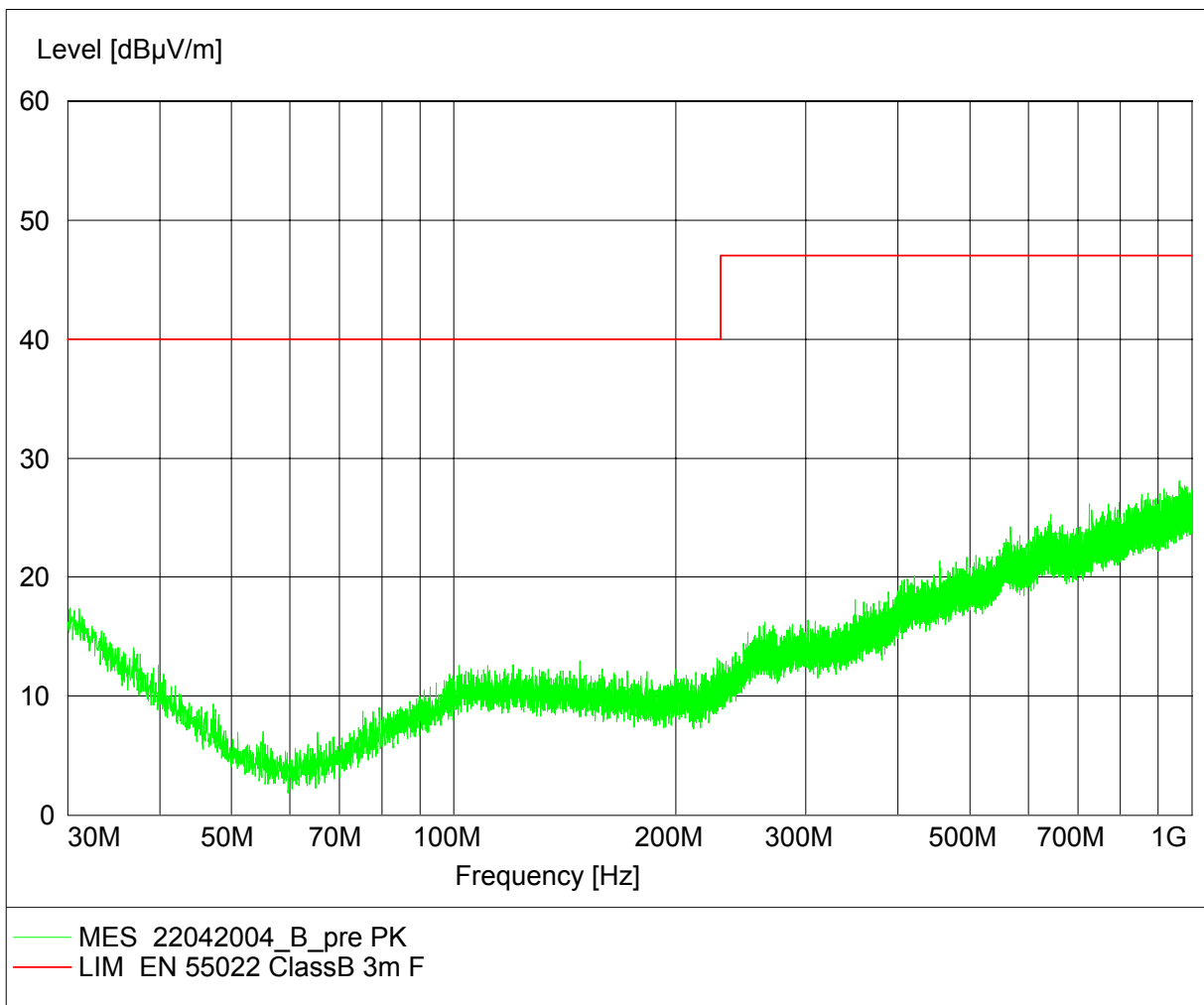
$C_{1.5m}$ correction factory due to 1.5 m measurement distance

3.2.4 EUT test setup

The same as on clause 3.1.4.

3.2.5 Spurious emissions results

Spurious emissions 30 MHz – 1 GHz

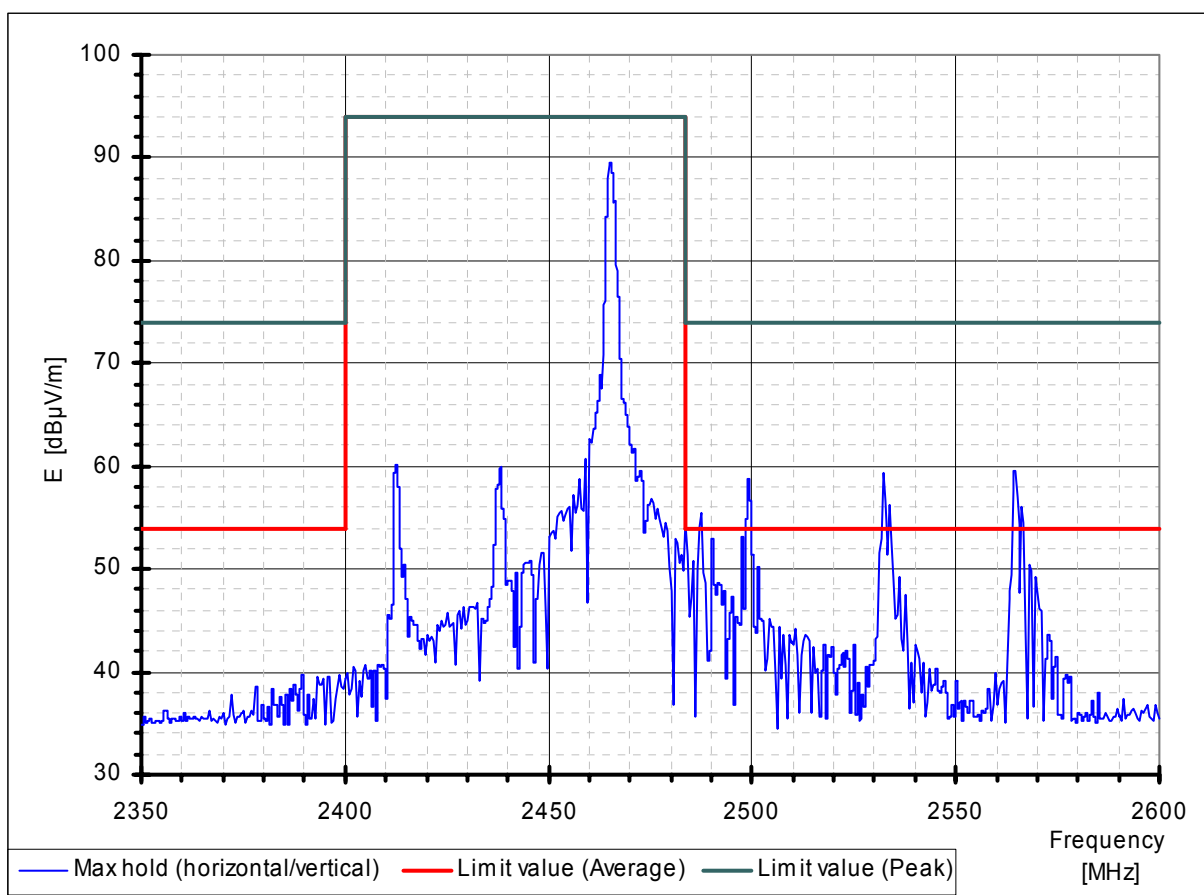


Highest emissions:

Frequency	Level	Limit	Height	Azimuth	Polarisation
MHz	dBµV/m	dBµV/m	cm	deg	
all 30 to 230	< 18.0	40.0			
all 230 to 1000	< 28.0	47.0			

Results 2350 MHz - 2600 MHz

Intermittent duty (Duty cycle: 0,001). TX on 200 ms and TX off 200µs
 Modulation: ON

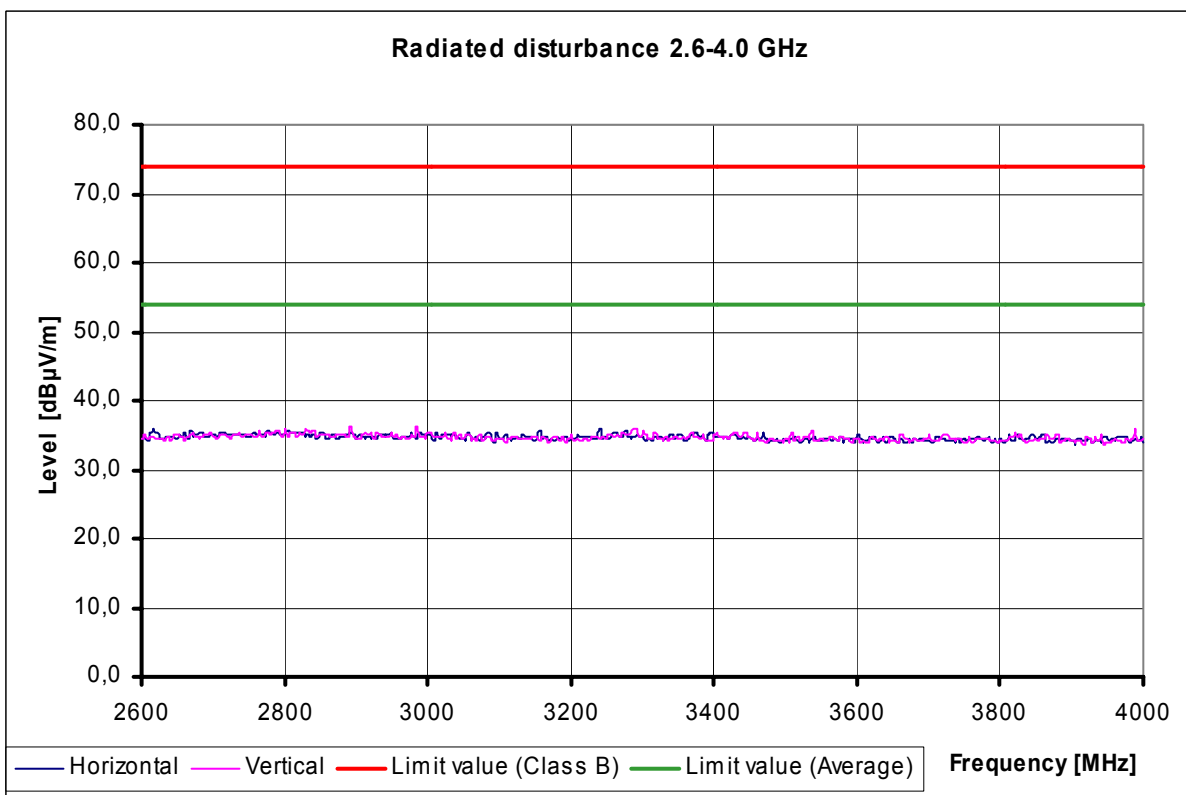
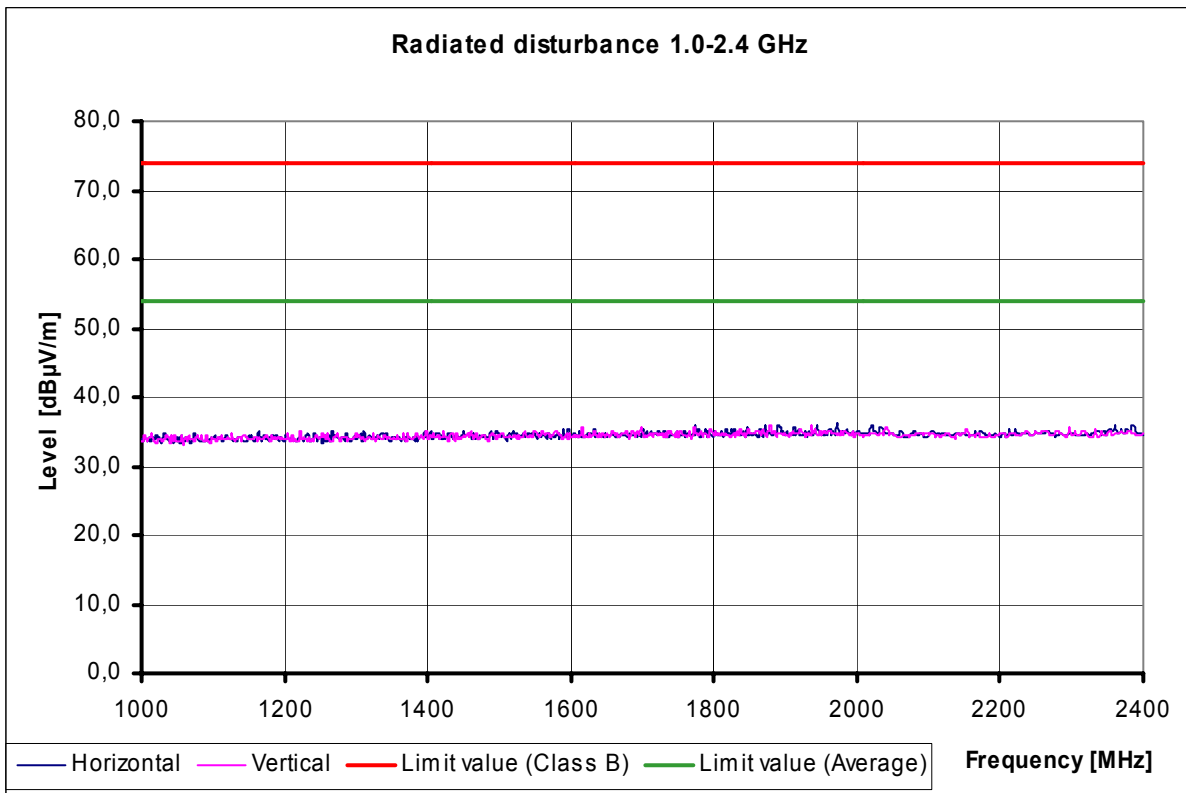


Frequency	Level (PK) Max hold Horizontal/ Vertical	Limit (PK)	Limit (AV)	Remarks
MHz	dBµV/m	dBµV/m	dBµV/m	
2412.5	57.1	94.0	94.0	
2438.5	56.8	94.0	94.0	
2499.0	55.8	74.0	54.0	
2532.5	56.4	74.0	54.0	
2564.5	56.6	74.0	54.0	

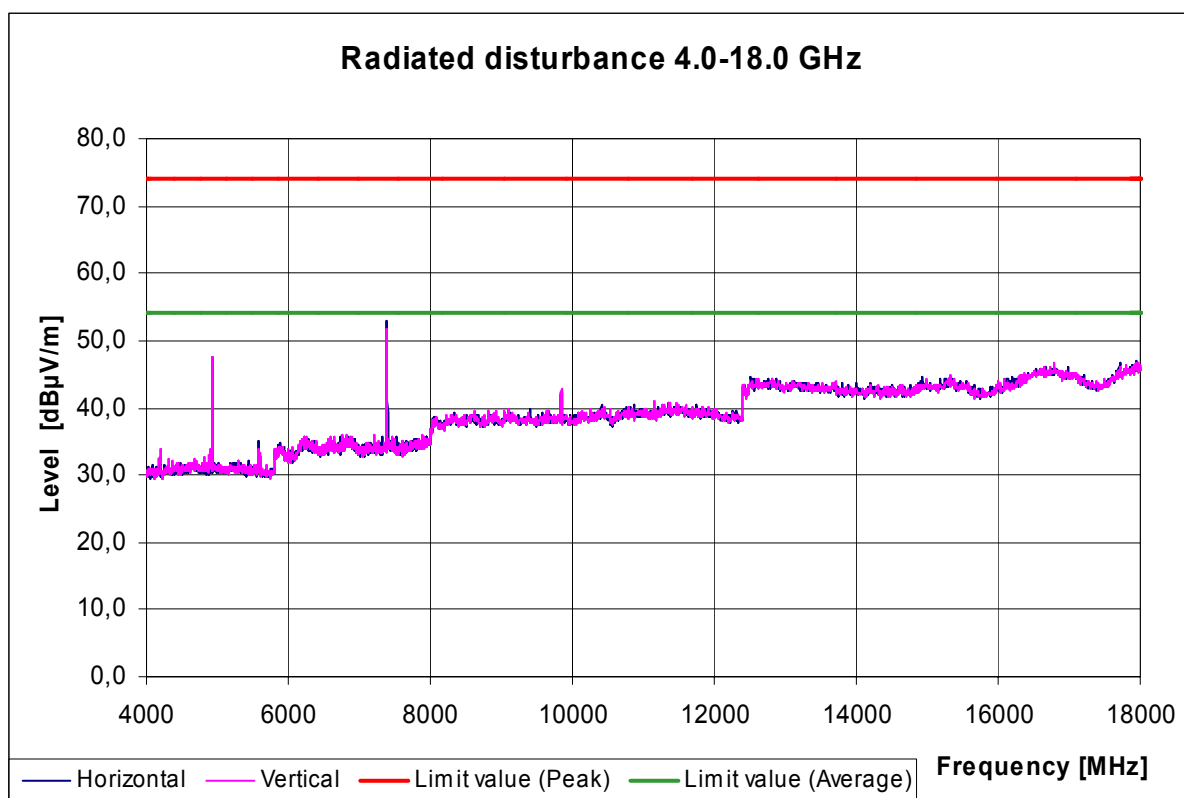
Note! Peak results!

Level (AV) ≤ Level Peak – 20 log (Duty Cycle)
 Level (AV) ≤ Level Peak – 60 dB

Duty Cycle: 0.001



Results of the harmonics

 Continuous duty (CW)
 Modulation off


Frequency	Level (PK) Horizontal	Level (PK) Vertical	Limit (PK)	Limit (AV)	Polarization (maximum)
MHz	dBµV/m	dBµV/m	dBµV/m	dBµV/m	
4930.0	47.7	47.5	74.0	54.0	HORIZONTAL
7395.0	53.1	47.1	74.0	54.0	HORIZONTAL
9860.0	42.3	42.7	74.0	54.0	
12325.0	< 48.	< 48	74.0	54.0	
14790.0	< 48	< 48	74.0	54.0	
17255.0	< 48	< 48	74.0	54.0	
19720.0	< 48	< 48	74.0	54.0	
22185.0	< 48	< 48	74.0	54.0	
24650.0	< 48	< 48	74.0	54.0	

Note! Peak results!

 $\text{Level (AV)} \leq \text{Level Peak} - 20 \log(\text{Duty Cycle})$

Duty Cycle: 0.001

 $\text{Level (AV)} \leq \text{Level Peak} - 60 \text{ dB}$

4. List of test equipment

Each active test equipment is calibrated once a year, antennas every 18 months and other passive equipments every 24 months.

Nr.	Equipment	Type	Manufacturer	Serial number
338	Test receiver	ESS	Rohde & Schwarz	847151/009
42	Spectrum analyzer	8566B	Hewlett Packard	2637A04102
543	RF amplifier	JCA018-501	Mini-Circuits	103
544	RF amplifier	ZFL-1000VH2	Mini-Circuits	D01080
82	Antenna	645	Narda	0811
83	Antenna	644	Narda	20072
84	Antenna	643	Narda	7911
85	Antenna	642	Narda	7912
86	Antenna	640	Narda	09
87	Antenna	639	Narda	7909
88	Antenna	638	Narda	8003
319	Antenna	CBL6112	Chase	2018
525	Antenna	3115	Emco	6691
508	Harmonic Mixer	11970K	Hewlett Packard	2332A01907
K1	Generator	8673D	Hewlett Packard	2645A00283
184	Temp. & humidity meter	H MI 32	Vaisala	63837
348	Shielded room	RFSD-100	Euroshield Oy	1320
403	Processmeter	787	Fluke	6975028
350	Semianechoic shielded room	RFD-F-100	Euroshield Oy	1327