

**Nemko**

TEST REPORT

Date: ESPOO 12.1.2009Page: 1 (11)Appendices -Number:
No. 1 / 1**112915A**

Date of handing in: 8.9.2008

Tested by:

Timo Leismala, Product Manager

Reviewed by:

Janne Nyman, Product Manager, EMC

SORT OF EQUIPMENT:

Heart rate sensor

MARKETING NAME:

Suunto Dual Belt

TYPE:

Suunto Dual Belt

MANUFACTURER:

Suunto Oy, Finland

CLIENT:

Suunto Oy

ADDRESS:

Valimotie 7, FI-01510 Vantaa, FINLAND

TELEPHONE:

+358 9 875 870 / Heikki Puuri

TEST LABORATORY:

Nemko Oy

FCC REG. NO.

90569 August 13, 2008

IC FILE NO.

IC 4627-1 October 10, 2006**SUMMARY:**

This test report is a revised test report replacing the former version dated on 13.10.2008.

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.

Nemko Oy • P.O.Box 19, FI-02601 Espoo, Finland

Street address: Perkkaantie 11, FI-02600 Espoo

Telephone +358 (0)424 5454 1 • Telefax +358 (0)9 5489 6371

Summary of performed tests and test results

<i>Section in CFR 47</i>	<i>Section in RSS-210, Issue 7</i>	<i>Measurement</i>	<i>Result</i>
15.249 (a)	A2.9 (a)	Field strength of fundamental	PASS
15.249 (a), (d)	2.7, table 2	Spurious radiated emissions	PASS
15.215 (c)		20 dB bandwidth	PASS
	RSS-GEN, Issue 2: 4.6.1	99% bandwidth	PASS
15.215 (c)	RSS-GEN, Issue 2: 4.7	Frequency stability	PASS

Explanations:

- PASS The EUT passed that particular test.
FAIL The EUT failed that particular test.
X The measurement was done, but there is no applicable performance criteria.

Contents

Summary of performed tests and test results	2
1. General	4
2. System Configuration.....	4
2.1 Test set-up.....	4
2.2 Operating conditions of the EUT	4
2.3 Channels of the EUT	4
3. Test results.....	5
3.1 Field Strength of Fundamental	5
3.2 Radiated spurious emissions.....	7
3.3 20 dB Bandwidth.....	9
3.4 99 % Bandwidth.....	10
3.5 Frequency stability.....	10
4. List of test equipment.....	11

1. General

The equipment under test (EUT) was a heart rate sensor. The purpose of the performed tests was to see if in regard to these tests the EUT fulfils the requirements defined in the FCC 47 CFR PART 15, SUBPART C (2005). The tests were performed according to the test specifications CISPR 22 (2005), ANSI C63.4 – 2003, FCC 47 CFR PART 15, SUBPART C (2005) and RSS-210 (Issue 7, June 2007)

2. System Configuration

2.1 Test set-up

Equipment under test (EUT):

- Heart rate sensor Suunto Dual Belt measures weak electrical heart rate impulses on users chest. There are both inductive 5.3 kHz transmitter and 2.465GHz transmitter in the belt's electronic module
 - Type: Suunto Dual Belt
 - battery powered (Li-Mn, 3 VDC):
 - Fixed transmitting frequency of 2465.0 MHz
 - Modulation GFSK (deviation ± 156 kHz)
 - maximum transmitter peak power 0 dBm
 - one pulse train consists of 5 equal 150 μ s frames and lasts 1 second (duty cycle 0.00075)
 - S/N:---

Operating voltage of the EUT during the tests:

- battery 3 VDC.

2.2 Operating conditions of the EUT

Emission tests:

For the duration of the tests the EUT was set to a transmitting mode of operation. The device was powered on with a fresh battery during the tests.

2.3 Channels of the EUT

<i>EUT Channel</i>	<i>Frequency (MHz)</i>
1	2465.0

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>FCC rule part</i>	§ 15.249 (a)
<i>Section in RSS-210, Issue 7</i>	A2.9 (a)
<i>Date of testing</i>	08.09.2008 and 29.12.2008
<i>Test equipment</i>	177, 350, 525, 566
<i>Test conditions</i>	23 °C, 40 % RH
<i>Test result</i>	PASS

3.1.1 EUT operation mode

<i>EUT operation mode</i>	Transmitting
<i>EUT channel</i>	1
<i>EUT TX power level</i>	Nominal (0 dBm peak power)

3.1.2 Test method and limit

The test was performed in a semi-anechoic shielded room (IC 4627-1) and Open Area Test Site (FCC Reg. No. 90569). 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 30-25000 MHz the distance from the EUT to the measuring antenna was 3 m. In order to find the maximum levels of the disturbance radiation the angle of the turntable and the height of the measuring antenna were varied during the tests. The test was performed with the measuring antenna being both in horizontal and vertical polarizations. The measurements were performed with the EUT at all three orthogonal planes to determine the worst case emissions from the device. The worst case emissions are shown in this test report.

Vertical and horizontal polarizations in the frequency range 1000 – 25000 MHz were 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, 2.0 and 3.0 m. During the final measurement the turntable was rotated from 0° to 360° and the antenna was raised from 1.0 m to 4.0 m. The highest levels of the radiated interference field strength measured by using the peak detector were recorded. For measurements above 1 GHz the resolution bandwidth is set to 1 MHz, and the video bandwidth is set to 1 MHz for peak measurements.

The CFR 47 Part 15, Subpart C, limit of 50 mV/m has been calculated to correspond 94 dB(µV/m) as follows: $[dB(\mu V/m)] = 20 \log[\mu V/m]$.

CFR 47 Part 15, Subpart C, section 15.249 (a) limit (3m measuring distance)

<i>Frequency MHz</i>	<i>Peak limit dB(µV/m)</i>	<i>Average limit dB(µV/m)</i>
2465	114	94

3.1.3 Test results

Frequency MHz	Measured value dBμV	Correction factor dB	Result dBμV/m	Antenna Polarization	Antenna height m	Turntable angle °
2465	104.0 (PK)	-8.0	96.0 (PK)	VER	1.3	219

Average results are calculated from peak results using duty cycle. According to the manufacturers duty cycle description one pulse train consists of 5 equal 150μs frames and lasts 1 second. The duty cycle was verified, see figures 1 and 2. This yields:

$$\begin{aligned} \text{Average result} &= \text{PK level} - 20\log(\text{duty cycle over } 100 \text{ ms}) \\ &= 96.0 \text{ dB}\mu\text{V/m} - 20\log(0.15/100) = 39.5 \text{ dB}\mu\text{V/m} \end{aligned}$$

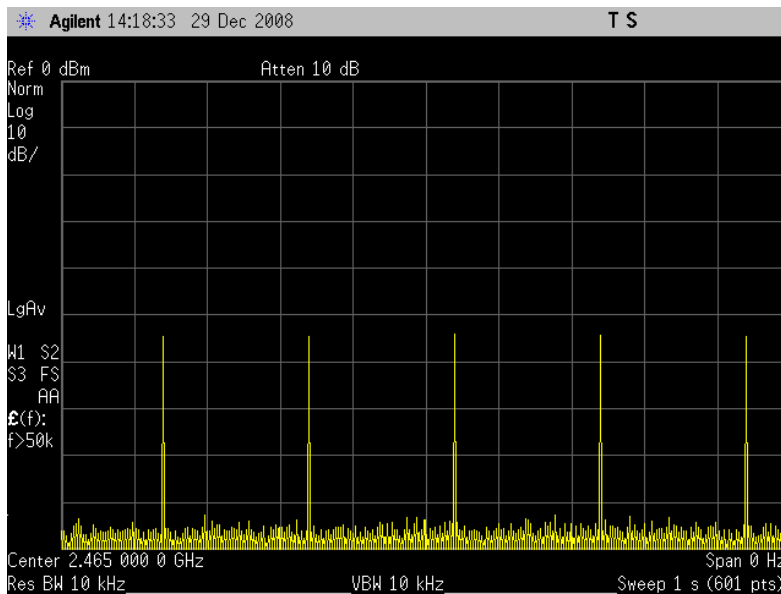


Figure 1: Pulse train

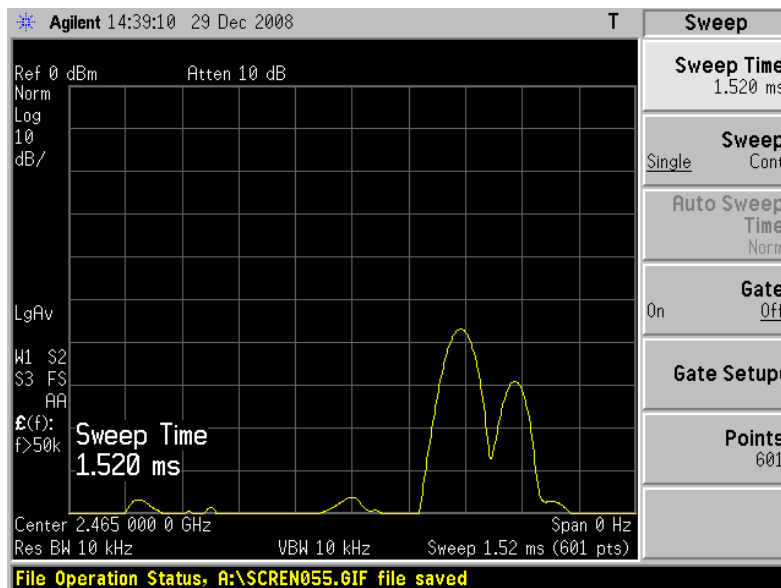


Figure 2: One 150μs frame.

3.2 Radiated spurious emissions

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

<i>Site name</i>	Nemko Oy / Perkkaa
<i>FCC rule part</i>	§ 15.249 (a), (d)
<i>Section in RSS-210, Issue 7</i>	A2.9 (a), (b); 2.7: Table 2
<i>Date of testing</i>	08.09.2008
<i>Test equipment</i>	177, 184, 319, 338, 350, 525, 544, 566
<i>Test conditions</i>	23 °C, 40 % RH
<i>Test result</i>	PASS

3.2.1 EUT operation mode

<i>EUT operation mode</i>	Transmitting
<i>EUT channel</i>	1
<i>EUT TX power level</i>	Nominal (0 dBm peak power)

3.2.2 Test method and limit

The test was performed in a semi-anechoic shielded room and Open Area Test Site. The EUT was placed on a non-conductive 0.8 m high table standing on the turntable (photographs 1-6). During the test in the frequency range 30-25000 MHz the distance from the EUT to the measuring antenna was 3 m. In order to find the maximum levels of the disturbance radiation the angle of the turntable and the height of the measuring antenna were varied during the tests. The test was performed with the measuring antenna being both in horizontal and vertical polarizations. The measurements were performed with the EUT at all three orthogonal planes to determine the worst case emissions from the device. The worst case emissions are shown in this test report.

Vertical and horizontal polarizations in the frequency range 30 – 1 000 MHz were 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. The highest levels of the radiated interference field strength measured by using the quasi-peak detector were recorded.

For measurements below 1 GHz the resolution bandwidth is set to 120 kHz for peak and quasi-peak detection measurements.

Vertical and horizontal polarizations in the frequency range 1000 – 25000 MHz were 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, 2.0 and 3.0 m. During the final measurement the turntable was rotated from 0° to 360° and the antenna was raised from 1.0 m to 4.0 m. The highest levels of the radiated interference field strength measured by using the peak detector were recorded.

For measurements above 1 GHz the resolution bandwidth is set to 1 MHz, and the video bandwidth is set to 1 MHz for peak measurements.

Limit values

<i>Frequency MHz</i>	<i>3m limit μV/m</i>	<i>3m limit dB(μV/m)</i>	<i>Detector</i>
30-88	100	40	QP
88-216	150	43.5	QP
216-960	200	46	QP
960-1000	500	54	QP
1000-25000	500	54	AVG
1000-25000	5000	74	Peak

3.2.1 Test results

The measurement results were obtained as described below.

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

Where

U_{RX} receiver reading
 A_{CABLE} attenuation of the cable
 AF antenna factor
 G_{PREAMP} gain of the preamplifier

Example of the calculation of the measurement result (4931 MHz):

$$43.1 \text{ (dB}\mu\text{V}/\text{m)} = 46.7 \text{ (dB}\mu\text{V)} + 2.6 + 33.0 - 39.2$$

Measurements were performed by using measurement distance of 3 m and peak detector.

Frequency MHz	Measured value dB μ V	Correction factor dB	Result dB μ V/m	Antenna Polarization	Antenna height m	Turntable angle °
4931	46.7 (PK)	-3.6	43.1 (PK)	HOR	2.0	195
7395	44.9 (PK)	1.1	46.0 (PK)	HOR	2.5	240
9861	43.3 (PK)	2.9	46.2 (PK)	HOR	2.5	135

3.3 20 dB Bandwidth

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

Site name	Nemko Oy / Perkkaa
FCC rule part	§ 15.215 (c)
Section in RSS-210, Issue 7	
Date of testing	29.12.2008
Test equipment	184, 350, 525, 566
Test conditions	22 °C, 42 % RH
Test result	PASS

3.3.1 EUT operation mode

EUT operation mode	Transmitting
EUT channel	1
EUT TX power level	Nominal (0 dBm peak power)

3.3.2 Test data

EUT Channel	No. Of pulse trains	Measured value (kHz)
1	1 (fig 3)	1.68

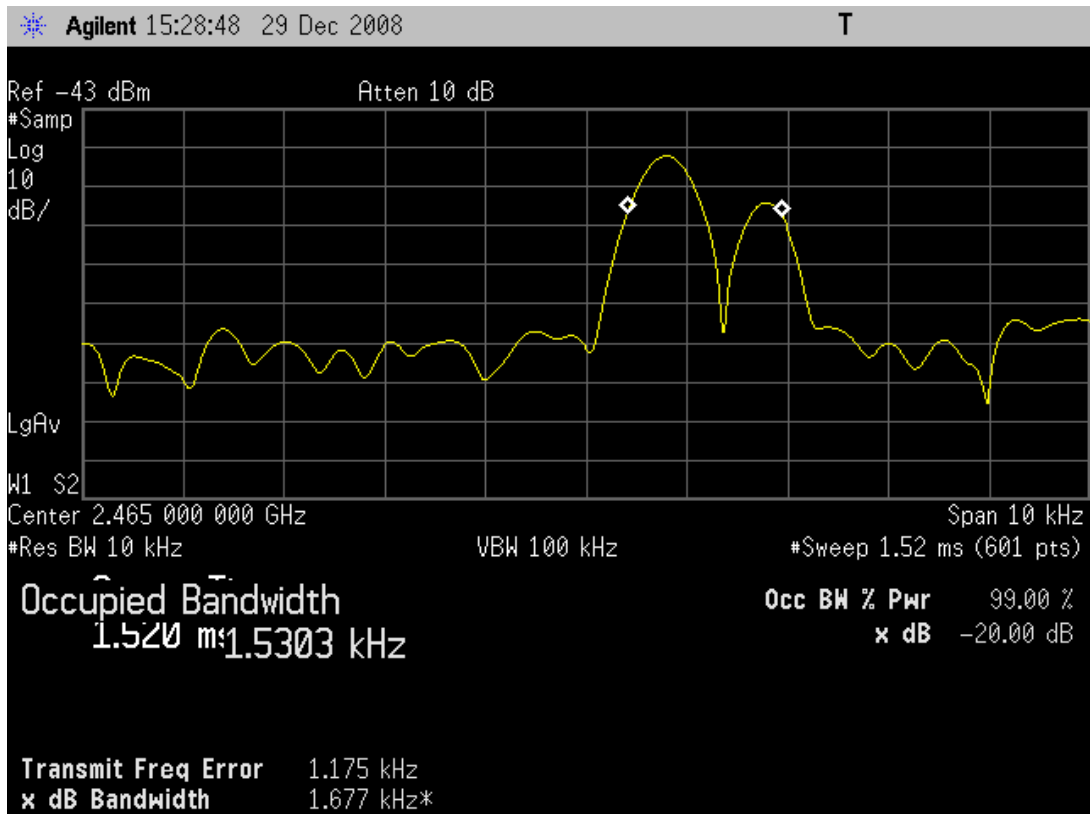


Figure 3: 20 dB bandwidth and 99 % occupied bandwidth (one pulse train)

3.4 99 % Bandwidth

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

Site name	Nemko Oy / Perkkaa
FCC rule part	
RSS-GEN, Issue 2:	4.6.1
Date of testing	29.12.2008
Test equipment	184, 350, 525, 566
Test conditions	22 °C, 42 % RH
Test result	PASS

3.4.1 EUT operation mode

EUT operation mode	Transmitting
EUT channel	1
EUT TX power level	Nominal (0 dBm peak power)

3.4.2 Test data

EUT Channel	No. Of pulse trains	Measured value (kHz)
1	1 (fig 3)	1.53

3.5 Frequency stability

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

Site name	Nemko Oy / Perkkaa
FCC rule part	§ 15.215 (c)
RSS-GEN, Issue 2:	4.7
Date of testing	30.09.2008
Test equipment	53, 157, 563
Test conditions	23 °C, 41 % RH
Test result	PASS

3.5.1 EUT operation mode

EUT operation mode	Transmitting
EUT channel	2465 MHz
EUT TX power level	Nominal (0 dBm peak power)

3.5.2 Test data

Temperature (°C)	Transmitter Frequency (GHz)	Difference (kHz)
+20	2,464.992.7	Ref
-30	2,464.963.7	-29 kHz
+50	2,464.983.3	-9,4 kHz

4. List of test equipment

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

Nr.	Equipment	Type	Manufacturer	Serial number
5	Test receiver	ESH-3	Rohde & Schwarz	894718/015
338	Test receiver	ESS	Rohde & Schwarz	847151/009
10	Oscilloscope	9400A	LeCroy	8878
53	Counter	1999	Racal-Dana	1321
157	Temp. test chamber	VMT 04/240	Vötsch	31884
42	Spectrum analyzer	8566B	Hewlett Packard	2637A04102
168	Artificial Mains	NSLK 8127	Schwartzbeck	8127162
177	Keimola	Open area radiation measurement site		
184	Temp. & humidity meter	H MI 32	Vaisala	63837
188	Antenna	CBL6111	Chase	1028
319	Antenna	CBL6112	Chase	2018
348	Shielded room	RFSD-100	Euroshield Oy	1320
350	Semianechoic shielded room	RFD-F-100	Euroshield Oy	1327
351	RF generator	SMT 06	Rohde & Schwarz	845715/001
371	AC Power source	500i-400	California Instr.	HK 52064
519	RF High-Power Attenuator	765-20	Narda	
525	Double-Ridged Horn	3115	Emco	6691
542	Double-Ridged Horn	3115	Emco	00023905
544	RF-amplifier	ZFL-2000VH2	Mini-Circuits	D01080
559	Highpass Filter	WHKX3.0/18G-10SS	Wainwright Instruments	1
550	Notch Filter	WRCD1800/2000-0.2/40-5SSSD	Wainwright Instruments	1
563	Thermometer	52 II	Fluke	81210080
564	RF-amplifier	CA018-4010	CIAO Wireless	101
566	Spectrum analyzer	E4448A	Agilent	US42510236
572	Highpass Filter	WHKX1.5/15G-12SS	Wainwright Instruments	4