

**REPORT: FCC / IC Radio frequency (RF) test report**

This report replaces the old test report: T08-731D-RF.

**PRODUCT:**

Test item description:	Stride sensor
Trade Mark:	Polar
Model/Type reference:	S3 W.I.N.D.
Serial number:	C 827 9900 635 08 S DUT 1
	C 827 9900 635 03 S DUT 3
	C 827 9900 635 05 S DUT 5
Customer:	Polar Electro Oy. Professorintie 5 90440 Kempele FINLAND
Contact person:	Kari Parkkisenniemi
Manufacturer:	Polar Electro Oy. Professorintie 5 90440 Kempele FINLAND

**ORIGINAL DATE:** 6.11.2008

**CORRECTED DATE:** 4.6.2009

**CORRECTED DATE:** 15.6.2009



**TESTED BY:**

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**APPROVED BY:**

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## 1 LABORATORY INFORMATION

<b>Test Laboratory</b>	<p>INTERTEK ETL SEMKO OY EMC Laboratory Koneenkatu 12 / K17 05830 Hyvinkää FINLAND</p> <p>Tel: +358 10 424 6200 Fax: +358 10 424 6201 e-mail: firstname.surname@intertek.com</p>
<b>FCC registration number:</b> <b>IC file number:</b>	<p>910391 (January 27, 2003) IC 4616A-1 (May 14, 2003)</p>

## 2 CUSTOMER INFORMATION

<b>Client</b>	<p>Polar Elecktro Oy Professorintie 5 90440 Kempele Finland</p> <p>Tel. +358 8 520 2100 Fax +358 8 520 2200</p>
<b>Contact person:</b>	<p>Kari Parkkisenniemi Polar Electro Oy Professorintie 5 90440 Kempele Finland</p> <p>Tel: +358 8 520 2100 Fax: +358 8520 2200</p>
<b>Testing date:</b>	October 20, 2008- October 23, 2008
<b>Report date:</b>	October 24, 2008

The tests listed in this report have been done to demonstrate compliance to the FCC rules section §15.247, §15.207 and IC standard RSS-GEN / 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
§ 15.249 (d)		Band edge compliance	PASS
	RSS-GEN 4.4.1	99% bandwidth	PASS

#### Receiver measurements

Section in CFR 47	Section in RSS-GEN	Section in ICES-003	Test	Result
§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	Stride sensor	S3 W.I.N.D.	C 827 9900 635 08 S	DUT 1 *
	Stride sensor	S3 W.I.N.D.	C 827 9900 635 03 S	DUT 3 **
	Stride sensor	S3 W.I.N.D.	C 827 9900 635 05 S	DUT 5 ***
Accessories	-			

Notes:

- \* Modified with antenna + power connectors for conducted measurements
- \*\* Modified to receiving active only
- \*\*\* Modified to continuous carrier with modulation, max 0 dBm power.

### 4.1 EUT description

EUT is a running speed and distance monitor that is placed on a user's foot, or in a user's running shoe. The unit consists of a plastic enclosure housing the electronics and battery. When mounted on or in the user's shoe, it determines the speed at which the user is running, along with the distance that the user has traveled.

This device is powered from a 2430 Lithium coin cell operating at 3 volts. It is intended to be used with a disposable cell.

The unit contains a transceiver that transmits a data payload that is at most 150 microseconds in duration using a Gaussian-Frequency-Shift-Keyed modulation scheme. The 150 microsecond message occurs no more quickly than every 897/2048 seconds. The device uses a fixed carrier frequency of 2471 MHz, which is set at manufacturing time, and cannot be changed afterwards. This unit uses a printed strip antenna that can not be removed or interchanged; the antenna is internal to the unit and cannot be accessed.

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. One EUT was equipped with an external antenna connector for conductive measurements.

The test setup photographs are in the document referenced in section 12.

## 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

<b>EUT</b>	DUT 5		
<b>Accessories</b>	-		
<b>Temp, Humidity, Air Pressure</b>	22 °C	32 RH%	996 hPa
<b>Date of measurement</b>	21.10.2008		
<b>FCC rule part</b>	§15.249 (a)		
<b>RSS-210 section</b>	A2.9 (1)		
<b>Measured by</b>	Simo Ojanen		

### 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

<b>EUT operation mode</b>	Continuous transmission
<b>EUT frequency</b>	2471 MHz
<b>EUT TX power level</b>	Max. (Software configuration)

### 6.3 Limit

Table 1: Field strength of fundamental

Frequency (MHz)	mV/m ( @3m)	dBµV/m ( @3m)
2400-2483,5	50 (Avg)	94 (Avg) 114 (peak)

### 6.4 Results

Table 2: Maximum field strength of fundamental (Peak value) EUT orientation Pos2

Freq MHz	Measured Value dBµV	Correction Factor dB	Result dBµV/m	Marginal dB	Antenna Pol.	Antenna height	Turntable angle
2471	61,5	34	95,5	18,5	Hor	1,55	173

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 unit contains a transceiver that transmits a data payload that is at most 150 microseconds in duration using a Gaussian-Frequency-Shift-Keyed modulation scheme. The 150 microsecond message occurs no more quickly than every 897/2048 seconds.

Therefore,

$$\begin{aligned} \text{Average level} &\leq \text{Peak level} - 20 \log ((100 \text{ ms} - 150 \mu\text{s}) / 150\mu\text{s}) \\ \text{Average level} &\leq \text{Peak level} - \mathbf{56,5 \text{ dB}} \end{aligned}$$



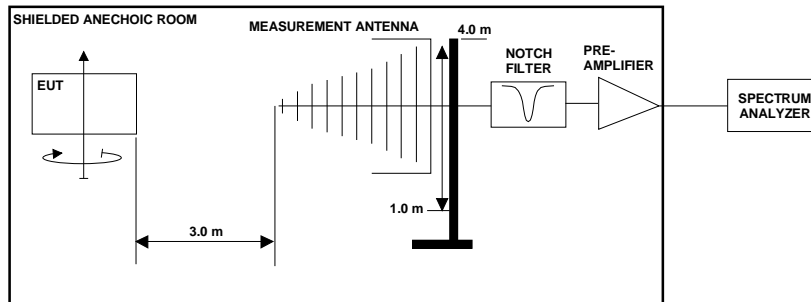
## 7 RADIATED SPURIOUS EMISSIONS

<b>EUT</b>	DUT1, DUT 5		
<b>Accessories</b>	-		
<b>Temp, Humidity, Air Pressure</b>	22 °C	32 RH%	996 hPa
<b>Date of measurement</b>	21.10.2008		
<b>FCC rule part</b>	§15.249 (a) (d)		
<b>RSS-210 section</b>	2.7, A2.9 (2)		
<b>Measured by</b>	Simo Ojanen		

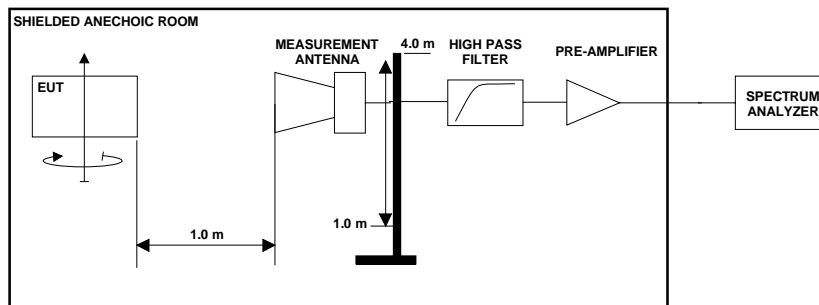
### 7.1 Test setup

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 $\mu$ V/m at 3 m distance, are reported.

## 7.3 EUT operation mode

<b>EUT operation mode</b>	Continuous transmission
<b>EUT frequency</b>	2471 MHz
<b>EUT TX power level</b>	Max. (Software configuration)

## 7.4 Limit

Table 3: Radiated spurious emission limits at measurement distance of 3m

<b>Frequency band (MHz)</b>	<b>3m Limit (<math>\mu</math>V/m)</b>	<b>3m Limit (dB<math>\mu</math>V/m)</b>	<b>Detector</b>
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 at 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 dB $\mu$ V	Correction Factor dB	Result dB $\mu$ V/m	Marginal dB	EUT Position	Ant Pol.	Ant height	TT angle
4942	91,4	-47,7	43,6	30,3	Pos 2	Hor	1,00	352
7412,5	114,3	-41,6	72,7	1,2	Pos 2	Ver	1,15	346
9883	88,6	-43,7	44,9	29,0	Pos 2	Ver	1,20	4

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 unit contains a transceiver that transmits a data payload that is at most 150 microseconds in duration using a Gaussian-Frequency-Shift-Keyed modulation scheme. The 150 microsecond message occurs no more quickly than every 897/2048 seconds.

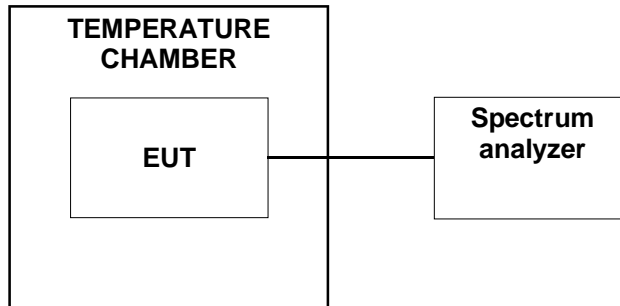
Therefore,

$$\begin{aligned} \text{Average level} &\leq \text{Peak level} - 20 \log ((100 \text{ ms} - 150 \mu\text{s}) / 150\mu\text{s}) \\ \text{Average level} &\leq \text{Peak level} - \mathbf{56,5 \text{ dB}} \end{aligned}$$

## 8 20 dB BANDWIDTH

<b>EUT</b>	DUT 1		
<b>Accessories</b>	-		
<b>Temp, Humidity, Air Pressure</b>	23 °C	27 RH%	993 hPa
<b>Date of measurement</b>	22.10.2008		
<b>FCC rule part</b>	§15.215 (c)		
<b>RSS-210 section</b>			
<b>Measured by</b>	Simo Ojanen		

### 8.1 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

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 delta markers 20 dB below this value.

## 8.2 EUT operation mode

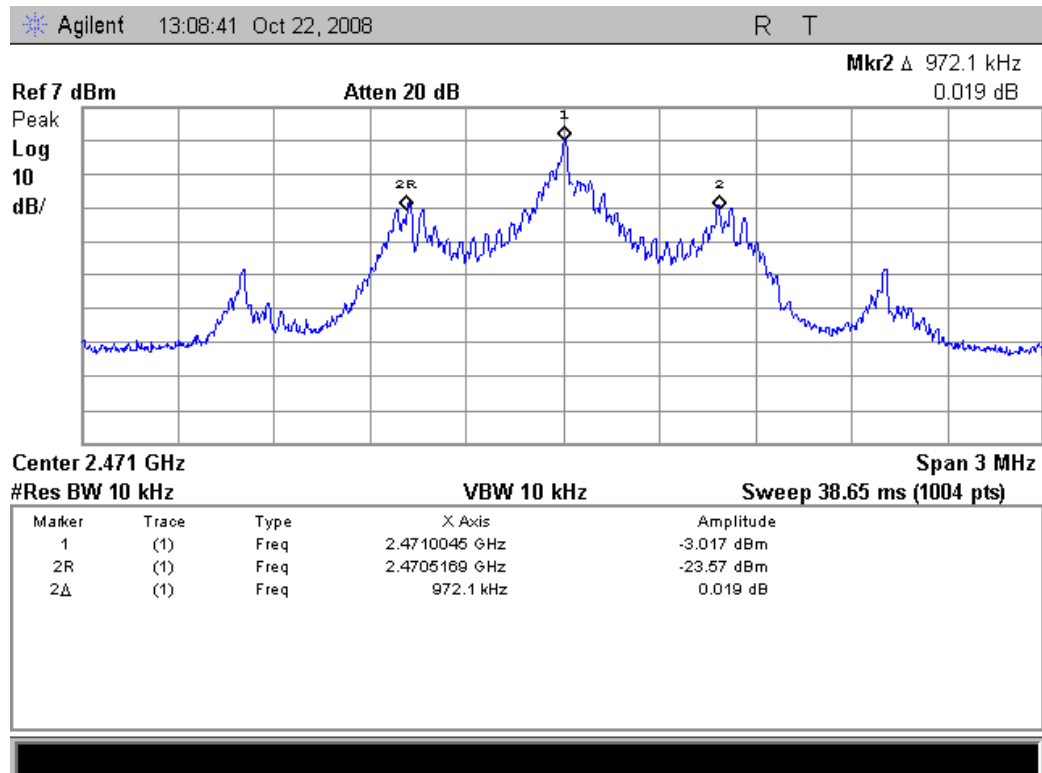
<b>EUT operation mode</b>	Continuous transmission
<b>EUT frequency</b>	2471 MHz
<b>EUT TX power level</b>	Max. (Software configuration)

## 8.3 Results

Table 5: 20dB bandwidth measurement results

EUT Frequency MHz	Temp °C	Operating voltage	Limit MHz	Measured value MHz
2471	23	Nominal	-	0,972

## 8.4 Screen shots



Picture 3: 20dB Bandwidth measurement result @ 23 °C and nominal operating voltage.

## 9 BAND EDGE COMPLIANCE

<b>EUT</b>	DUT 1		
<b>Accessories</b>	-		
<b>Temp, Humidity, Air Pressure</b>	23 °C	27 RH%	993 hPa
<b>Date of measurement</b>	October 22, 2008		
<b>FCC rule part</b>	§ 15.249 (d)		
<b>RSS-GEN section</b>			
<b>Measured by</b>	Simo Ojanen		

### 9.1 Test setup and measurement method

Band edge compliance of RF-conducted emissions was measured by setting the span of the spectrum analyzer so that band edge frequency and the carrier frequency can be seen in same display. The measured carrier power and power on the band edge frequency was then compared.

### 9.2 EUT operation mode

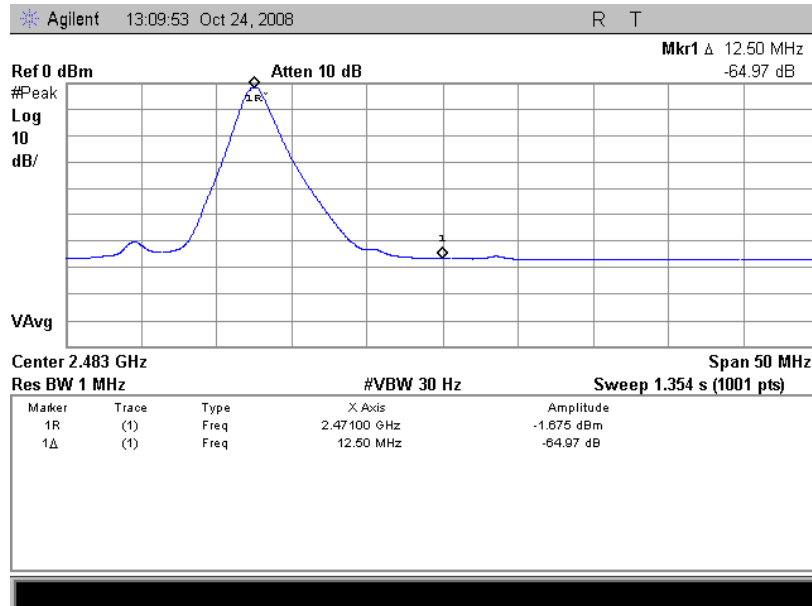
<b>EUT operation mode</b>	Continuous transmission
<b>EUT frequency</b>	2471 MHz
<b>EUT TX power level</b>	Max. (Software configuration)

### 9.3 Results

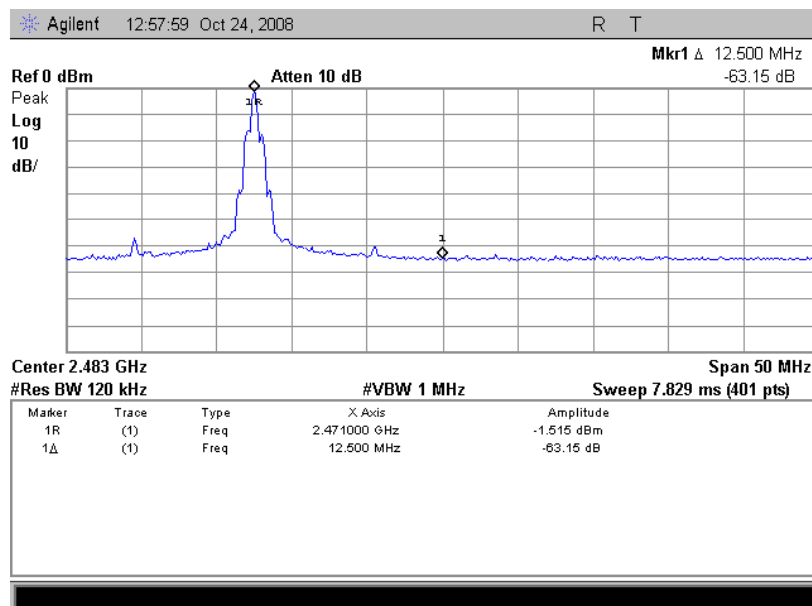
Table 6: Band edge compliance measurement results

Frequency MHz	Limit (dBc)	Test result (dBc peak)
2400	≤ -20	-70,8
2483,5		-63,1

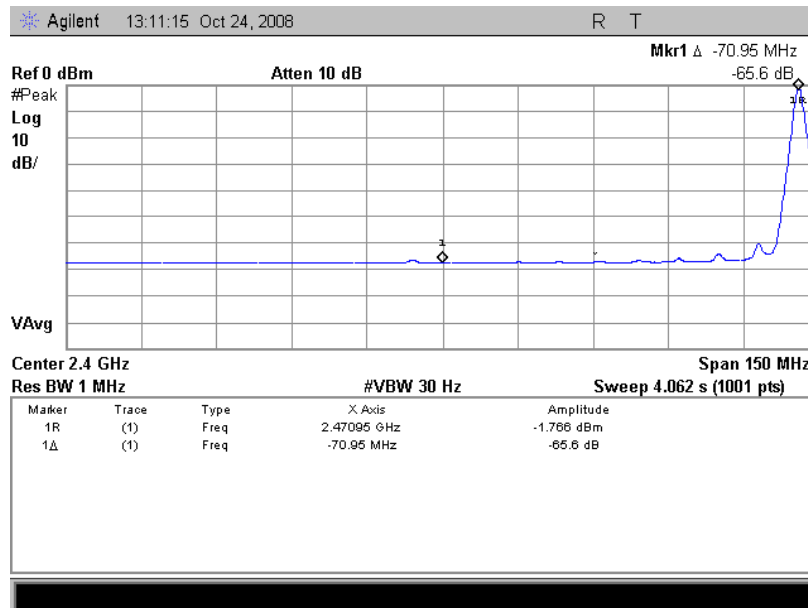
### 9.4 Screen shots



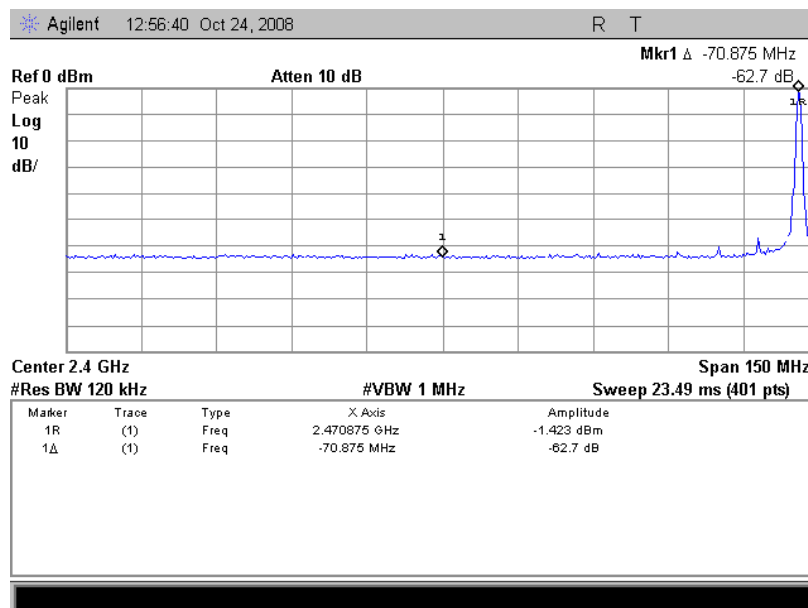
Picture 4: Band edge measurement, Average



Picture 5: Band edge measurement, Peak



Picture 6: Band edge measurement, Average



Picture 7: Band edge measurement, Peak



## 10 99 % BANDWIDTH

<b>EUT</b>	DUT 1		
<b>Accessories</b>	-		
<b>Temp, Humidity, Air Pressure</b>	23 °C	27 RH%	993 hPa
<b>Date of measurement</b>	22.10.2008		
<b>FCC rule part</b>			
<b>RSS-GEN section</b>	4.4.1		
<b>Measured by</b>	Simo Ojanen		

### 10.1 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.

### 10.2 EUT operation mode

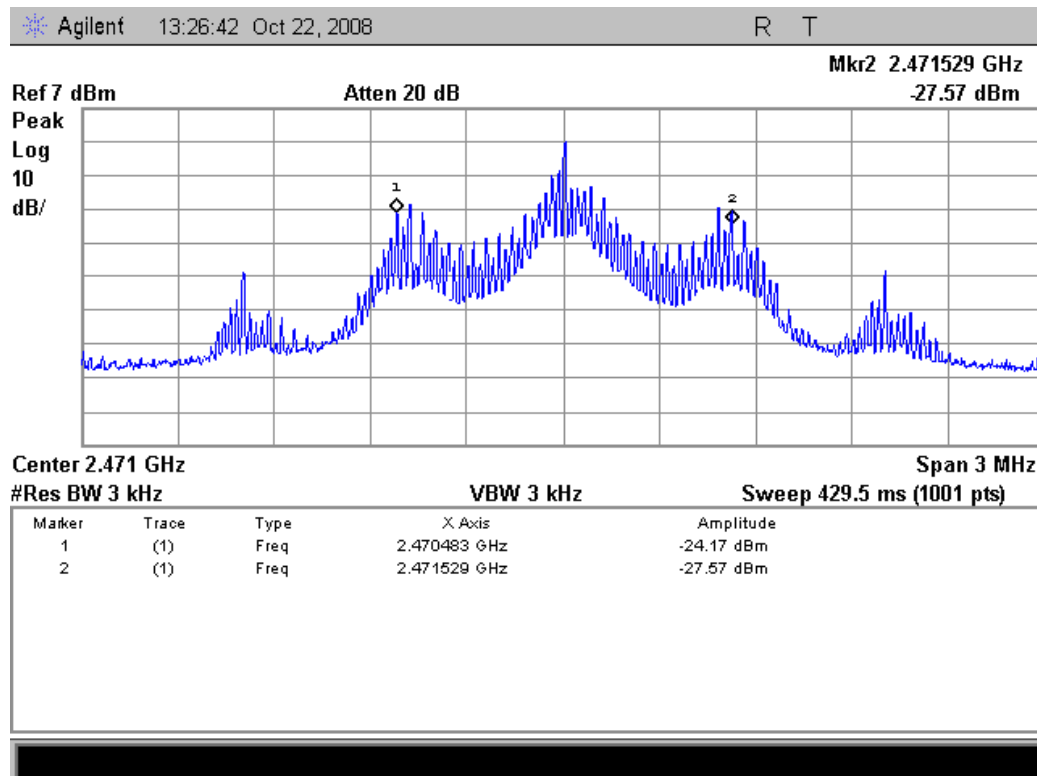
<b>EUT operation mode</b>	Continuous transmission
<b>EUT frequency</b>	2471 MHz
<b>EUT TX power level</b>	Max. (Software configuration)

### 10.3 Results

Table 7: 99% bandwidth measurement results

EUT Frequency MHz	Limit MHz	Measured value MHz
2471	-	1,046

### 10.4 Screen shots



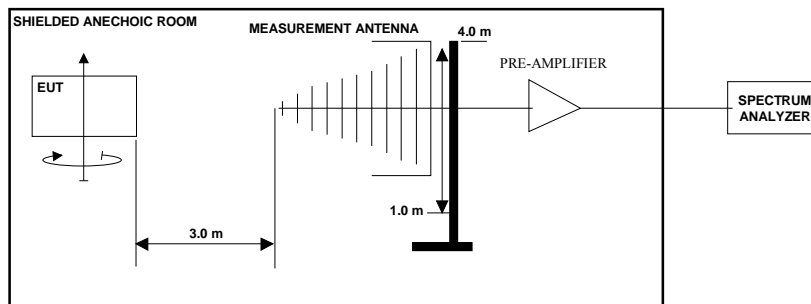
Picture 8: 99% Bandwidth measurement result

## 11 RECEIVER RADIATED EMISSION

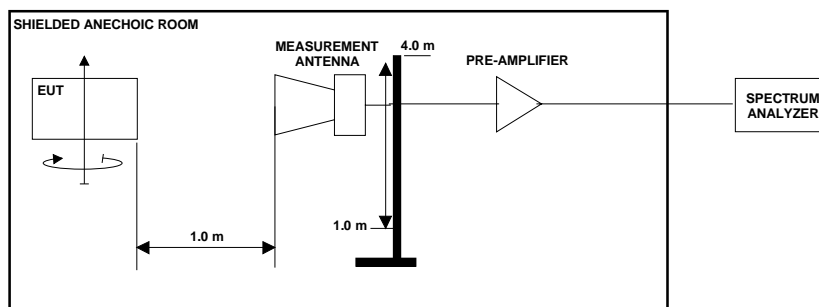
<b>EUT</b>	DUT 3		
<b>Accessories</b>	-		
<b>Temp, Humidity, Air Pressure</b>	22 °C	32 RH%	996 hPa
<b>Date of measurement</b>	21.10.2008		
<b>FCC rule part</b>	§15.109		
<b>RSS-GEN section</b>	7.2.3		
<b>ICES-003 section</b>	5.5		
<b>Measured by</b>	Simo Ojanen		

### 11.1 Test setup

The test was done using an automated test system, where a computer controlled the measurement equipments.



Picture 9: Test setup for radiated spurious emissions measurement  
30 MHz - 1 GHz frequencies



Picture 10: Test setup for radiated spurious emissions measurement  
1 GHz - 18 GHz frequencies

## 11.2 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 $\mu$ V/m at 3 m distance, are reported.

## 11.3 EUT operation mode

EUT was modified to receiver active mode by customer.

<b>EUT operation mode</b>	Receiver mode
<b>EUT frequency</b>	2471 MHz
<b>EUT TX power level</b>	Na

## 11.4 Limit

Table 8: Radiated spurious emission limits at measurement distance 3m

<b>Frequency band (MHz)</b>	<b>3m Limit (<math>\mu</math>V/m)</b>	<b>3m Limit (dB<math>\mu</math>V/m)</b>	<b>Detector</b>
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

As default, all emissions were compared against the general limits. If any emission exceeded that limit, it was further checked, if it was outside the restricted band thus complying with the -20dBc requirement.

## 11.5 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 9, 10 and 11.

Table 9: Radiated emissions using Quasi peak detector

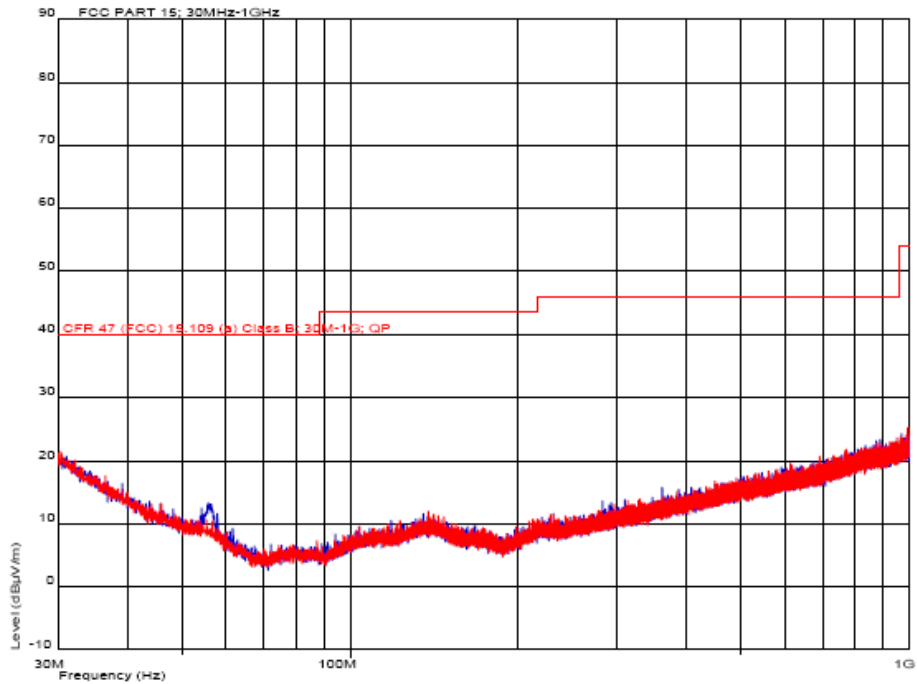
Freq MHz	Measured Value dBuV	Correction Factor dB	Result dBuV/m	Marginal dB	EUT Position	Ant Pol.	Ant height	TT angle
N/A								

Table 10: Radiated emissions using Peak detector

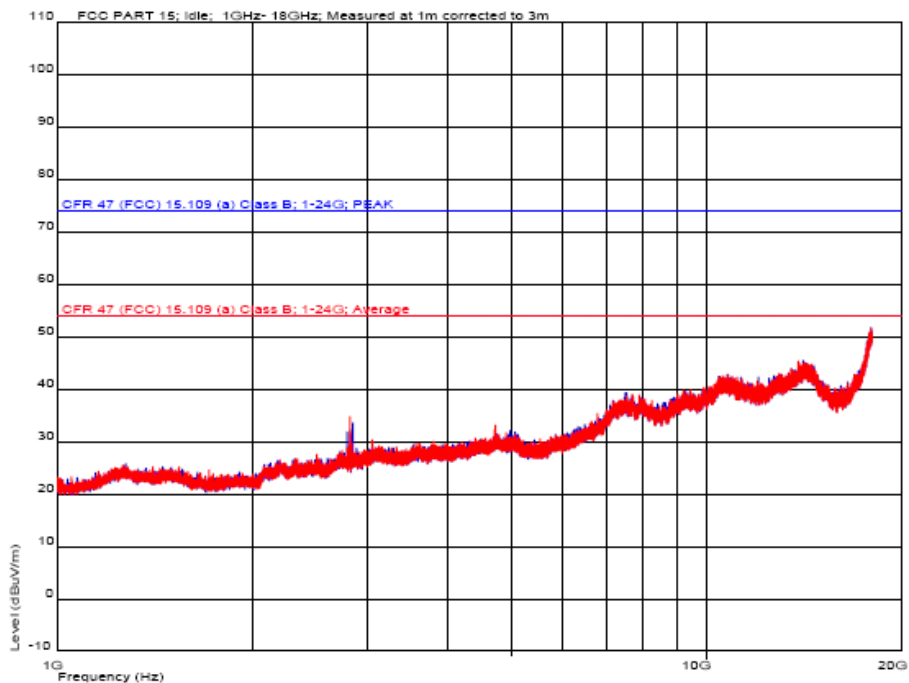
Freq MHz	Measured Value dBuV	Correction Factor dB	Result dBuV/m	Marginal dB	EUT Position	Ant Pol.	Ant height	TT angle
N/A								

Table 11: Radiated emissions using Average detector

Freq MHz	Measured Value dBuV	Correction Factor dB	Result dBuV/m	Marginal dB	EUT Position	Ant Pol.	Ant height	TT angle
N/A								



Picture 11: radiated emission results, 30 – 1000 MHz,  
Red= horizontal polarization, blue = vertical polarization



Picture 12: radiated emission results, 1 – 18 GHz,  
Red= horizontal polarization, blue = vertical polarization

## 12 TEST EQUIPMENT

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

### 12.1 Conducted measurements

Equipment	Manufacturer	Model
Spectrum Analyzer	Agilent	E7405A
Power supply	Delta Elektronika	SM120-13

### 12.2 Radiated measurements

Equipment	Manufacturer	Model
Spectrum Analyzer	Agilent	E7405A
Antenna	Chase	CBL 6141
Antenna	Schwarzbeck	BBHA 9120D
Antenna	Schwarzbeck	BBHA 9170
Band reject filter	Wainwright Instruments	WRCT2400/2483
High pass filter	Wainwright Instruments	WHK3.0/18GST
Pre-amplifier	Agilent	87405B
Pre-amplifier	JCA	118-400
Pre-amplifier	Miteq	AMF-6F-18002650-25-10P
Turn table / antenna mast controller	EMCO	2090

### 13 TEST SETUP PHOTOGRAPHS

Test setup photograph can be found in a separate document

T08-731E-RF\_PHOTOS.doc