Test report
for
CS600

Report Date: November 6, 2006

Signatures:

Tested by: 

Jani Kiiski Test Engineer

Contents approved: 

Tuomo Hahl Test Engineer

NATLABS Oy
Nordic Accredited Testing Laboratories
P.O. Box 1300, Koneenkatu 12
FIN-05801 Hyvinkää, Finland
VAT nr:
FI 1871439 4
Tel: +358 20 475 2600
Fax: +358 20 475 2719
Email: firstname.lastname@ette.com

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NATLABS Oy
Nordic Accredited Testing Laboratories
P.O. Box 1300, Koneenkatu 12
FIN-05801 Hyvinkää, Finland
VAT nr:
FI 1871439 4
Tel: +358 20 475 2600
Fax: +358 20 475 2719
Email: firstname.lastname@ette.com

1 LABORATORY INFORMATION

Test Laboratory	NATLABS OY EMC Laboratory Koneenkatu 12 / K17 05830 Hyvinkää FINLAND Tel: +358 20 475 2600 Fax: +358 20 475 2719 e-mail: firstname.surname@ette.com
FCC registration number: **IC file number:**	910391 (January 27, 2003) IC 4616 (May 14, 2003)

2 CUSTOMER INFORMATION

Client	Polar Electro Oy Professorintie 5 90440 Kempele Finland Tel. +358 9 875 870 Fax. +358 9 875 87301
Contact person:	Kari Parkkisenniemi Polar Electro Oy Proessorintie 5 90440 Kempele Finland Tel. +35840-574 0869 Fax. +3588- 520 2220
Receipt of EUT:	September 6, 2006
Testing date:	September 18 – 25, 2006
Report date:	November 1, 2006

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-210.

NATLABS Oy
Nordic Accredited Testing Laboratories
P.O. Box 1300, Koneenkatu 12
FIN-05801 Hyvinkää, Finland
VAT nr:
FI 1871439 4
Tel: +358 20 475 2600
Fax: +358 20 475 2719
Email: firstname.lastname@ette.com

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
	RSS-GEN 4.4.1	99% bandwidth	PASS
§ 15.215 (c)	RSS-GEN 7.2.4	Frequency stability	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

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P.O. Box 1300, Koneenkatu 12
FIN-05801 Hyvinkää, Finland
VAT nr:
FI 1871439 4
Tel: +358 20 475 2600
Fax: +358 20 475 2719
Email: firstname.lastname@ette.com

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	Cycling computer	CS 600	9.	14701 *1)
	Cycling computer	CS 600	3.	14702 *2)
	Cycling computer	CS 600	13.	14703 *3)
	Cycling computer	CS 600	12.	14704 *4)
Accessories	Battery (2 pcs)	LR03		14705

Notes:
*1) Continuous carrier wave
*2) EUT set to receiving mode
*3) Continuous modulated carrier, connector for conducted measurements
*4) Continuous carrier wave, connector for conducted measurements

4.1 EUT description

EUT is battery powered running computer that receives sensor data via radio link. EUT also includes transmitter for sending control data to the sensors. Radio link operates at 2.4GHz frequency band and uses GFSK modulation.

The EUT was not modified during the tests.

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P.O. Box 1300, Koneenkatu 12
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Fax: +358 20 475 2719
Email: firstname.lastname@ette.com

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

The test setup photographs are in the document referenced in section 13.

5 APPLICABLE STANDARDS

The tests were performed in guidance of CFR 47 Part 15.249, 15.209, 15.109 and Part 2, ANSI C63.4 (2003), 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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Email: firstname.lastname@ette.com

6 FIELD STRENGTH OF FUNDAMENTAL

EUT	14701		
Accessories	14705		
Temp, Humidity, Air Pressure	24 ºC	66 RH%	993 hPa
Date of measurement	September 20, 2006		
FCC rule part	§15.249 (a)		
RSS-210 section	A2.9 (1)		
Measured by	Jani Kiiski		

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

EUT operation mode	Continuous transmission
EUT frequency	2474 MHz
EUT TX power level	0 dBm (Software configuration)

6.3 Limit

Table 1: Field strength of fundamental (Measured with average detector)

Frequency (MHz)	mV/m (@3m)	dBµV/m (@3m)
2400-2483.5	50 (Avg)	94 (Avg) 114 (Peak)

NATLABS Oy
Nordic Accredited Testing Laboratories
P.O. Box 1300, Koneenkatu 12
FIN-05801 Hyvinkää, Finland
VAT nr:
FI 1871439 4
Tel: +358 20 475 2600
Fax: +358 20 475 2719
Email: firstname.lastname@ette.com

6.4 Results

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

Freq MHz	Measured Value dBuV	Correction Factor dB	Result dBuV/m	EUT orientation	Antenna Pol.	Antenna height	Turntable angle
2474	62.0	34.0	**96.0**	Pos 3	Ver	3.0	219

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).

According to manufacturer the Duty cycle for this product is 150µs long transmission at 5Hz frequency.

Therefore,

Average level ≤ Peak level – 20 log ((100 ms – 150 µs) / 150µs)
Average level ≤ Peak level – **56.5 dB**

NATLABS Oy
Nordic Accredited Testing Laboratories
P.O. Box 1300, Koneenkatu 12
FIN-05801 Hyvinkää, Finland
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Fax: +358 20 475 2719
Email: firstname.lastname@ette.com

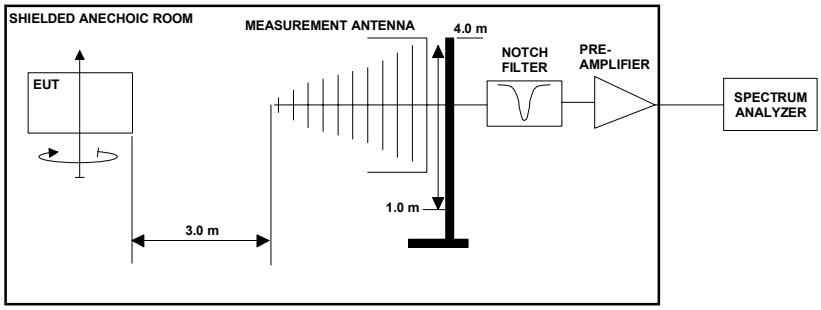
7 RADIATED SPURIOUS EMISSIONS

EUT	14701		
Accessories	14705		
Temp, Humidity, Air Pressure	21 ºC	55 RH%	1016 hPa
Date of measurement	September 18-19, 2006		
FCC rule part	§15.249 (a) (d)		
RSS-210 section	2.7, A2.9 (2)		
Measured by	Tuomo Eloranta		

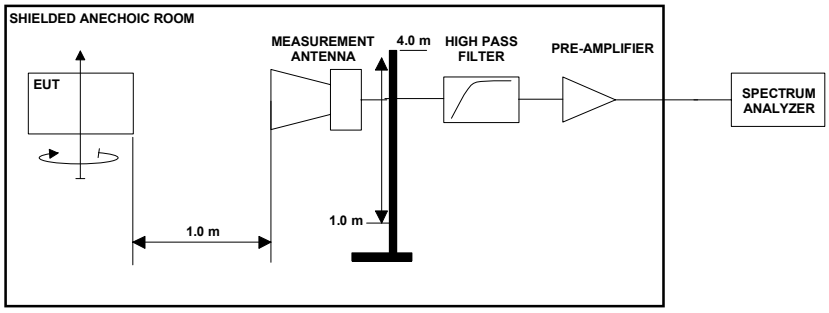
7.1 Test setup

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

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Nordic Accredited Testing Laboratories
P.O. Box 1300, Koneenkatu 12
FIN-05801 Hyvinkää, Finland
VAT nr:
FI 1871439 4
Tel: +358 20 475 2600
Fax: +358 20 475 2719
Email: firstname.lastname@ette.com

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 dBµV/m at 3 m distance, are reported.

7.3 EUT operation mode

EUT operation mode	Continuous transmission
EUT frequency	2474 MHz
EUT TX power level	0 dBm (Software configuration)

7.4 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.

NATLABS Oy
Nordic Accredited Testing Laboratories
P.O. Box 1300, Koneenkatu 12
FIN-05801 Hyvinkää, Finland
VAT nr:
FI 1871439 4
Tel: +358 20 475 2600
Fax: +358 20 475 2719
Email: firstname.lastname@ette.com

7.5 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

Freq MHz	Measured Value dBuV	Correction Factor dB	Result dBuV/m	Marginal dBuV/m	EUT Position	Ant Pol.	Ant height	TT angle
4948.5	71.3	-15.3	**56.0**	-18.0	Pos 3	|	1.3	26
6185.5	48.5	-11.3	**37.3**	-36.8	Pos 1	--	1.1	136
7422.5	56.9	-3.0	**53.9**	-20.1	Pos 1	--	1	207
9896.5	57.8	-3.5	**54.3**	-19.7	Pos 1	--	1.15	102
12370.5	47.8	1.3	**49.1**	-24.9	Pos 2	|	1.1	119
19793.0	50.7	1.7	**52.4**	-21.6	Pos 3	|	1	262

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).

According to manufacturer the Duty cycle for this product is 150µs long transmission at 5Hz frequency.

Therefore,

Average level ≤ Peak level – 20 log ((100 ms – 150 µs) / 150µs)
Average level ≤ Peak level – **56.5 dB**

NATLABS Oy
Nordic Accredited Testing Laboratories
P.O. Box 1300, Koneenkatu 12
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VAT nr:
FI 1871439 4
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Fax: +358 20 475 2719
Email: firstname.lastname@ette.com

8 20 dB BANDWIDTH

EUT	14703		
Accessories	14705		
Temp, Humidity, Air Pressure	22 ºC	55 RH%	1017 hPa
Date of measurement	September 25, 2006		
FCC rule part	§15.215 (c)		
RSS-210 section			
Measured by	Jani Kiiski		

8.1 Test setup and measurement method

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 display line 20 dB below this value and by reading the bandwidth from the intersection of the measured trace and display line.

8.2 EUT operation mode

EUT operation mode	Normal modulation
EUT frequency	2474 MHz
EUT TX power level	0 dBm (Software configuration)

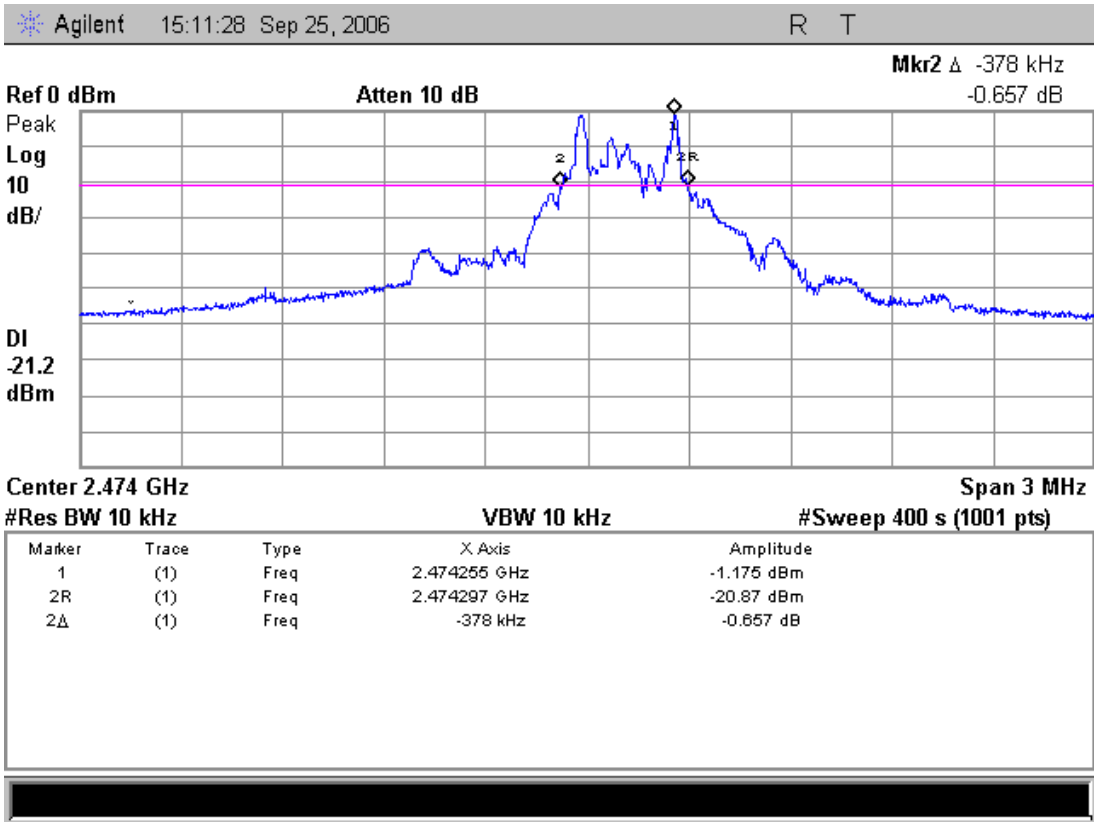
NATLABS Oy
Nordic Accredited Testing Laboratories
P.O. Box 1300, Koneenkatu 12
FIN-05801 Hyvinkää, Finland
VAT nr:
FI 1871439 4
Tel: +358 20 475 2600
Fax: +358 20 475 2719
Email: firstname.lastname@ette.com

8.3 Results

Table 5: 20dB bandwidth measurement results

EUT Frequency MHz	Limit MHz	Measured value MHz
2474	-	0.378

8.4 Screen shots



Picture 3: 20dB Bandwidth measurement result

NATLABS Oy
Nordic Accredited Testing Laboratories
P.O. Box 1300, Koneenkatu 12
FIN-05801 Hyvinkää, Finland
VAT nr:
FI 1871439 4
Tel: +358 20 475 2600
Fax: +358 20 475 2719
Email: firstname.lastname@ette.com

9 99 % BANDWIDTH

EUT	14703		
Accessories	14705		
Temp, Humidity, Air Pressure	22 ºC	55 RH%	1017 hPa
Date of measurement	September 25, 2006		
FCC rule part			
RSS-GEN section	4.4.1		
Measured by	Jani Kiiski		

9.1 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.

9.2 EUT operation mode

EUT operation mode	Normal modulation
EUT frequency	2474 MHz
EUT TX power level	0 dBm (Software configuration)

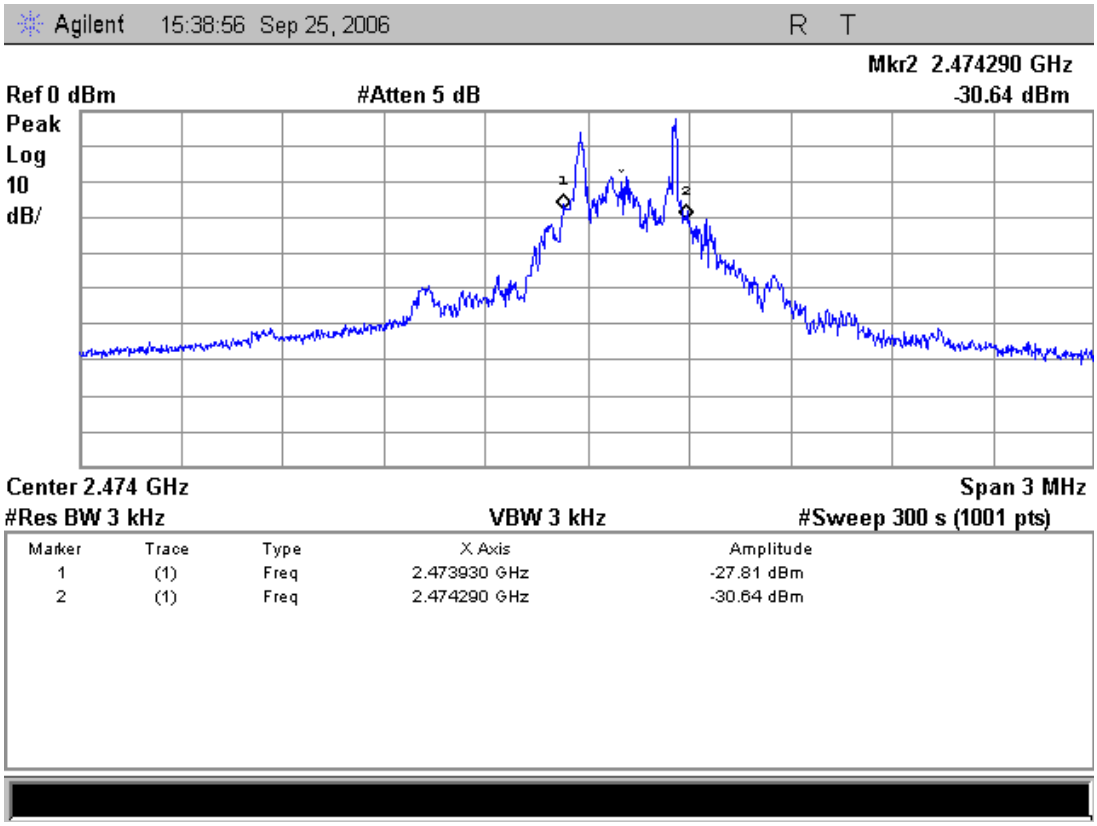
NATLABS Oy
Nordic Accredited Testing Laboratories
P.O. Box 1300, Koneenkatu 12
FIN-05801 Hyvinkää, Finland
VAT nr:
FI 1871439 4
Tel: +358 20 475 2600
Fax: +358 20 475 2719
Email: firstname.lastname@ette.com

9.3 Results

Table 6: 99% bandwidth measurement results

EUT Frequency MHz	Limit MHz	Measured value MHz
2474	-	0.360

9.4 Screen shots



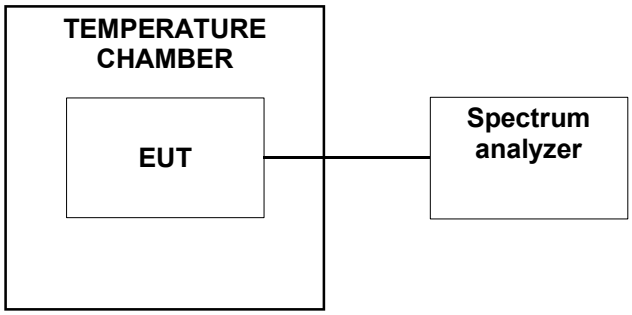
Picture 4: 99% Bandwidth measurement result

NATLABS Oy
Nordic Accredited Testing Laboratories
P.O. Box 1300, Koneenkatu 12
FIN-05801 Hyvinkää, Finland
VAT nr:
FI 1871439 4
Tel: +358 20 475 2600
Fax: +358 20 475 2719
Email: firstname.lastname@ette.com

10 FREQUENCY STABILITY

EUT	14704		
Accessories	-		
Temp, Humidity, Air Pressure	- ºC	- RH%	- hPa
Date of measurement	September 21, 2006		
FCC rule part	§15.215 (c)		
RSS-GEN section	7.2.4		
Measured by	Jani Kiiski		

10.1 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

10.2 EUT operation mode

EUT operation mode	Continuous transmission
EUT channel	2474 MHz
EUT TX power level	0 dBm (Software configuration)

NATLABS Oy
Nordic Accredited Testing Laboratories
P.O. Box 1300, Koneenkatu 12
FIN-05801 Hyvinkää, Finland
VAT nr:
FI 1871439 4
Tel: +358 20 475 2600
Fax: +358 20 475 2719
Email: firstname.lastname@ette.com

10.3 Results

Table 7: Frequency stability measurement results

Temperature (°/C)	Transmitter frequency (MHz)
50	2474.078
40	2474.079
30	2474.082
20	2474.087
10	2474.088
0	2474.090
-10	2474.086
-20	2474.077
-30	2474.062

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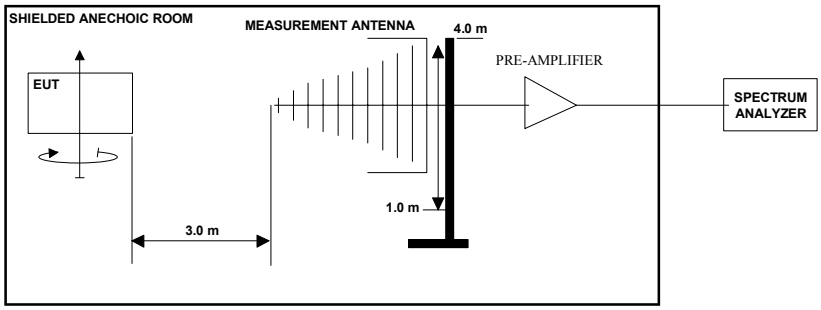
Nordic Accredited Testing Laboratories
P.O. Box 1300, Koneenkatu 12
FIN-05801 Hyvinkää, Finland
VAT nr:
FI 1871439 4
Tel: +358 20 475 2600
Fax: +358 20 475 2719
Email: firstname.lastname@ette.com

11 RECEIVER RADIATED EMISSION

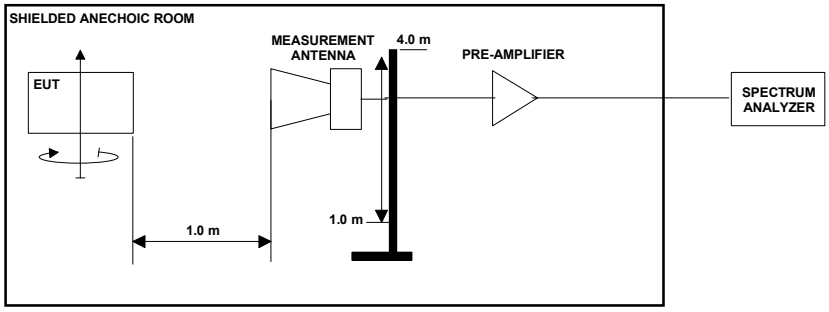
EUT	14702		
Accessories	14705		
Temp, Humidity, Air Pressure	25 ºC	72 RH%	1010 hPa
Date of measurement	September 22, 2006		
FCC rule part	§15.109		
RSS-GEN section	7.2.3		
ICES-003 section	5.5		
Measured by	Tuomo Eloranta		

11.1 Test setup

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



Picture 5: Test setup for radiated spurious emissions measurement 30 MHz - 1 GHz frequencies



Picture 6: Test setup for radiated spurious emissions measurement 1 GHz – 12.4 GHz frequencies

NATLABS Oy
Nordic Accredited Testing Laboratories
P.O. Box 1300, Koneenkatu 12
FIN-05801 Hyvinkää, Finland
VAT nr:
FI 1871439 4
Tel: +358 20 475 2600
Fax: +358 20 475 2719
Email: firstname.lastname@ette.com

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 dBµV/m at 3 m distance, are reported.

11.3 EUT operation mode

EUT operation mode	Receiver mode
EUT frequency	2474 MHz
EUT TX power level	Na

11.4 Limit

Table 8: 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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Nordic Accredited Testing Laboratories
P.O. Box 1300, Koneenkatu 12
FIN-05801 Hyvinkää, Finland
VAT nr:
FI 1871439 4
Tel: +358 20 475 2600
Fax: +358 20 475 2719
Email: firstname.lastname@ette.com

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 dBuV/m	EUT Position	Ant Pol.	Ant height	TT angle
-								

Table 10: Radiated emissions using Peak detector

Freq MHz	Measured Value dBuV	Correction Factor dB	Result dBuV/m	Marginal dBuV/m	EUT Position	Ant Pol.	Ant height	TT angle
2830	69.3	-21.7	**47.7**	-26.3	0	Hor	1	185
2859	67.8	-21.5	**46.3**	-27.7	0	Ver	1	277
3056	65.6	-20.6	**45.0**	-29.0	0	Ver	1	315

Table 11: Radiated emissions using Average detector

Freq MHz	Measured Value dBuV	Correction Factor dB	Result dBuV/m	Marginal dBuV/m	EUT Position	Ant Pol.	Ant height	TT angle
2830	59.9	-21.7	**38.2**	-15.8	0	Hor	1	185
2859	37.2	-21.5	**15.7**	-38.3	0	Ver	1	277
3056	36.4	-20.6	**15.9**	-38.2	0	Ver	1	315

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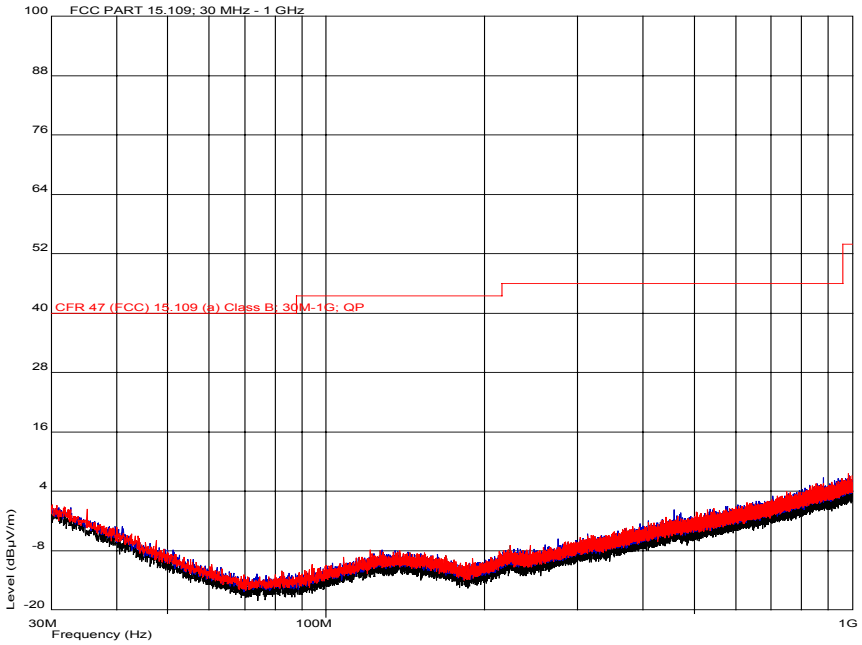
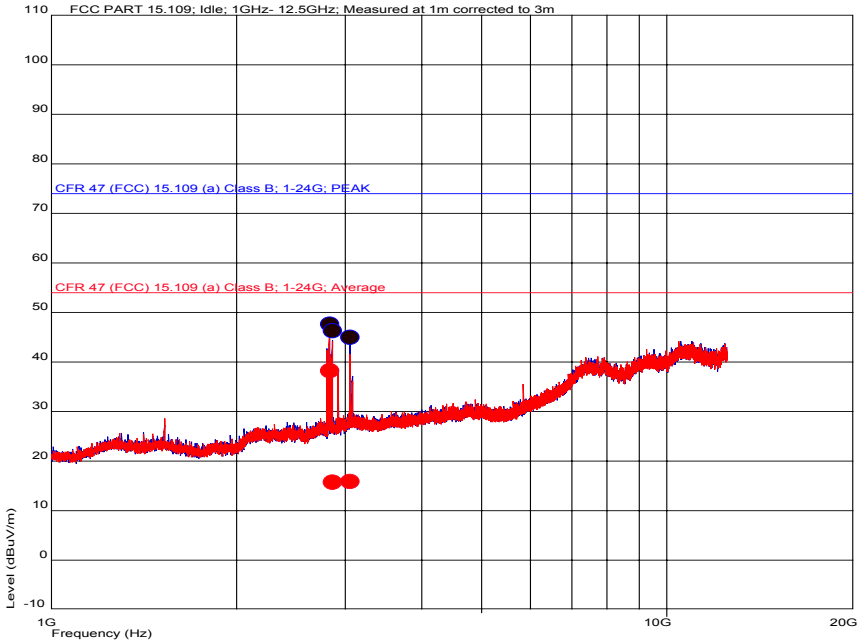
P.O. Box 1300, Koneenkatu 12
FIN-05801 Hyvinkää, Finland
VAT nr:
FI 1871439 4
Tel: +358 20 475 2600
Fax: +358 20 475 2719
Email: firstname.lastname@ette.com



Picture 7: radiated emission results, 30 – 1000 MHz,
Red= horizontal polarization, blue = vertical polarization



Picture 8: radiated emission results, 1 – 12.400 GHz,
Red= horizontal polarization, blue = vertical polarization

NATLABS Oy
Nordic Accredited Testing Laboratories
P.O. Box 1300, Koneenkatu 12
FIN-05801 Hyvinkää, Finland
VAT nr:
FI 1871439 4
Tel: +358 20 475 2600
Fax: +358 20 475 2719
Email: firstname.lastname@ette.com

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 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

T06-147C-EMC_PHOTOS.doc

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Nordic Accredited Testing Laboratories
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FIN-05801 Hyvinkää, Finland
VAT nr:
FI 1871439 4
Tel: +358 20 475 2600
Fax: +358 20 475 2719
Email: firstname.lastname@ette.com