

REPORT: Electromagnetic Compatibility (EMC) test report**PRODUCT:**

Test item description:	WLAN transceiver board
Trade Mark:	-
Model/Type reference:	DVT ConnectCore Wi-9P 9215-WLAN part
Serial number:	-
Customer:	Digi International GmbH Kueferstr- 8 DE-79206 Breisach Germany
Contact person:	Digi International GmbH Mr Sebastian Meyer
Manufacturer:	Digi International GmbH Kueferstr- 8 DE-79206 Breisach Germany

DATE: 31.10.2008**TESTED BY:**


Matti Virkki ; Test engineer

APPROVED BY:


Roland Dressler ; Test engineer

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1 LABORATORY INFORMATION

Test Laboratory	Intertek Deutschland GmbH Innovapark 20, D- 87600 Kaufbeuren
FCC registration number:	90714

2 CUSTOMER INFORMATION

Client	Digi International GmbH Kueferstr- 8 DE-79206 Breisach Germany
Contact person:	Sebastian Meyer
Testing date:	20-31.10.2008
Report date:	31.10.2008

The tests listed in this report have been done to demonstrate compliance to the FCC rules section §15.107, §15.109, §15.247 and IC standard RSS-GEN / RSS-210.

3 SUMMARY OF TEST RESULTS

Transmitter measurements

Section in CFR 47	Section in RSS-210	Test	Result
15.247, a 2	A8.1 (1)	6dB bandwidth	PASS
	RSS-GRN 4.4.1	99% bandwidth	
15.247, b 1	A8.4 (2)	Peak output power	PASS
15.247, d		Power spectral density	PASS
15.247, d	A8.5	Band-edge compliance of RF emissions	PASS
15.247, d	A8.5	Spurious RF conducted emissions	PASS
15.247, d	15.247, d	Spurious radiated emissions	PASS

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	PASS
§15.109	7.2.3	5.5	Radiated emissions	PASS

PASS Pass

FAIL Fail

X Measured, but there is no applicable performance criteria

- Not done

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	DVT ConnectCore Wi-9P 9215-WLAN part	WLAN transceiver board	Proto	1
Accessories	Laptop PC	Compaq nc 6320	CNU6483GYJ	2
	Mouse			3
	AC DC power supply Cincon electronics	TR10R120	(1P)24000056	4

4.1 EUT description

The EUT is dc powered Wlan board equipped with 2.4/5GHz rf transceivers
Transmitters are according to IEEE802.11b/g and IEEE802.11a.
This report consists 2,4 GHz transceiver results only.
EUT has 11 channels. Lowest, middle and highest were used in tests
Transceiver uses DSSS and OFDMA techniques

5 EUT TEST SETUPS

For each test the EUT was exercised to find out the worst case of operation modes and device configuration.

EUT was configured to operate at full power and use 11Mb/s and 54 Mb/s transmission rates.

The test setup photographs are in the document referenced in section 0.

6 APPLICABLE STANDARDS

The tests were performed in guidance of:

CFR 47 Part:

§15.107

§15.109

§15.209

§15.247

ANSI C63.4 (2003)

IC standard:

RSS-GEN, Issue 1

RSS-210, Issue 7

CISPR 22, 2002

Deviations, modifications or clarifications (if any) to above mentioned documents are written in each section under "Test method" for each test case.

7 6 dB BANDWIDTH

EUT	1		
Accessories	2		
Temp, Humidity, Air Pressure	23°C	30RH%	934hPa
Date of measurement	21.10.2008		
FCC rule part	15.247, c		
RSS-210 section	A8.1 (1)		
Measured by	Matti Virkki		

7.1 Test setup and measurement method

The 6dB bandwidth was measured using 100 kHz resolution bandwidth and maximum hold function of the spectrum analyzer. 6dB bandwidth was defined by measuring the maximum level on the measured channel and by placing display line 6 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	Transmitting continuously, DSSS 11Mb/s
EUT channel	0, 6 and 11
EUT TX power level	Full power

EUT operation mode	Transmitting continuously, OFDMA 54 Mb/s
EUT channel	0, 6 and 11
EUT TX power level	Full power

7.3 Results

Table 1: 6dB bandwidth measurement results DSSS

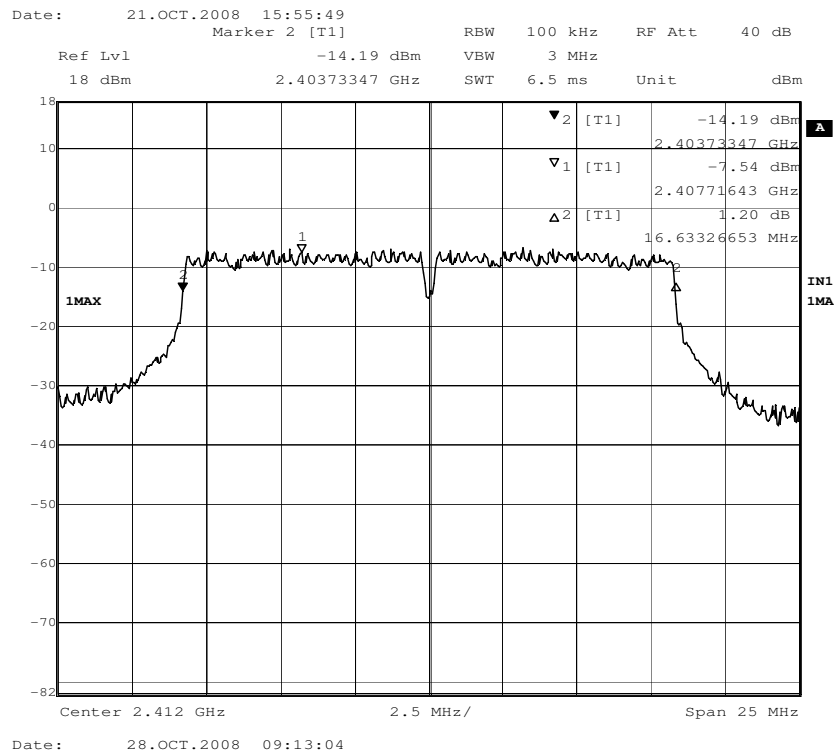
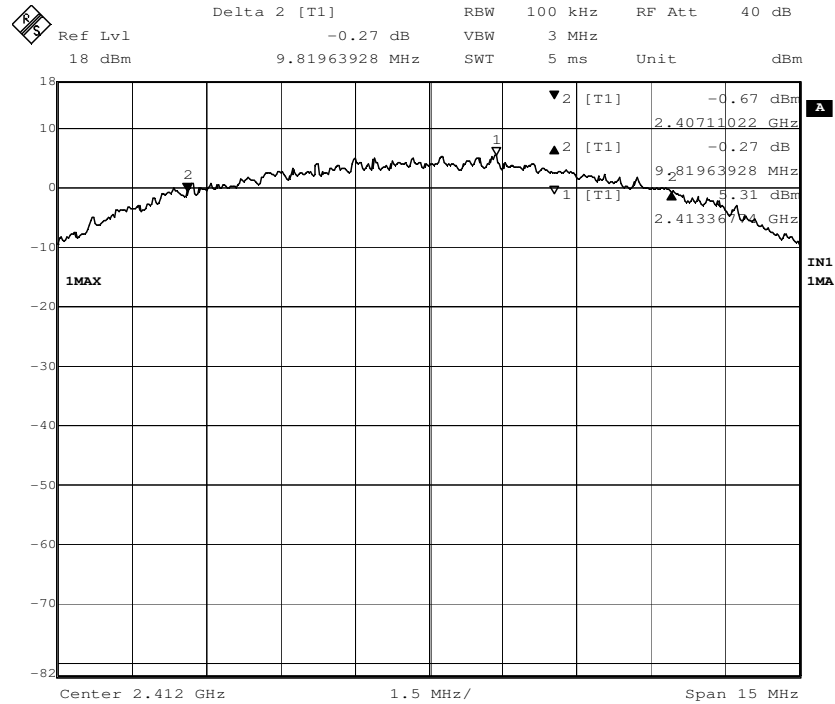
EUT Channel	Limit (MHz)	Measured value (MHz)
1	> 0,5	9,819
6		8,657
11		7,365

Table 2: 6dB bandwidth measurement results OFDMA

EUT Channel	Limit (MHz)	Measured value (MHz)
1	> 0,5	16,633
6		16,673
11		16,658

7.4 Screen shots

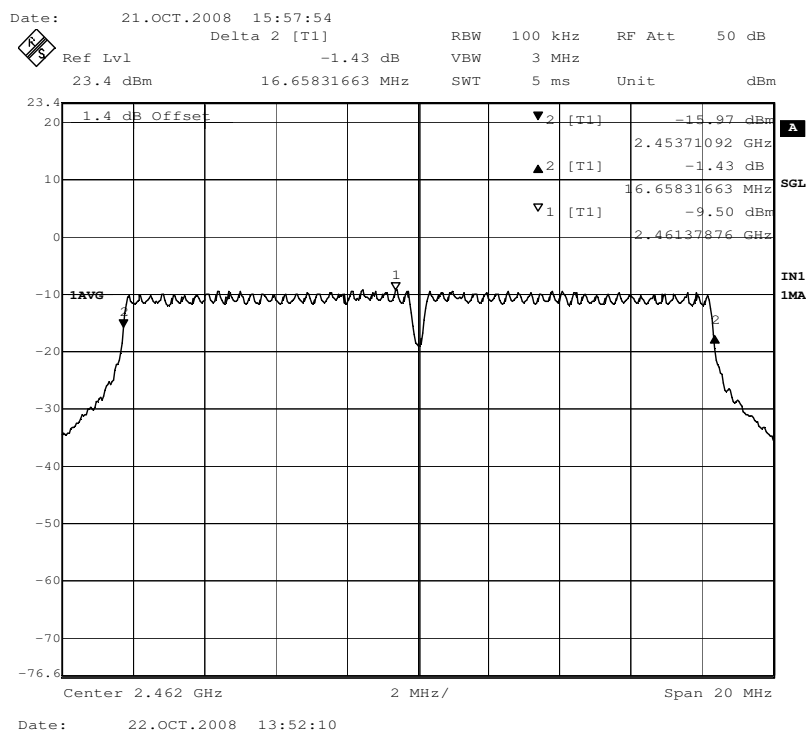
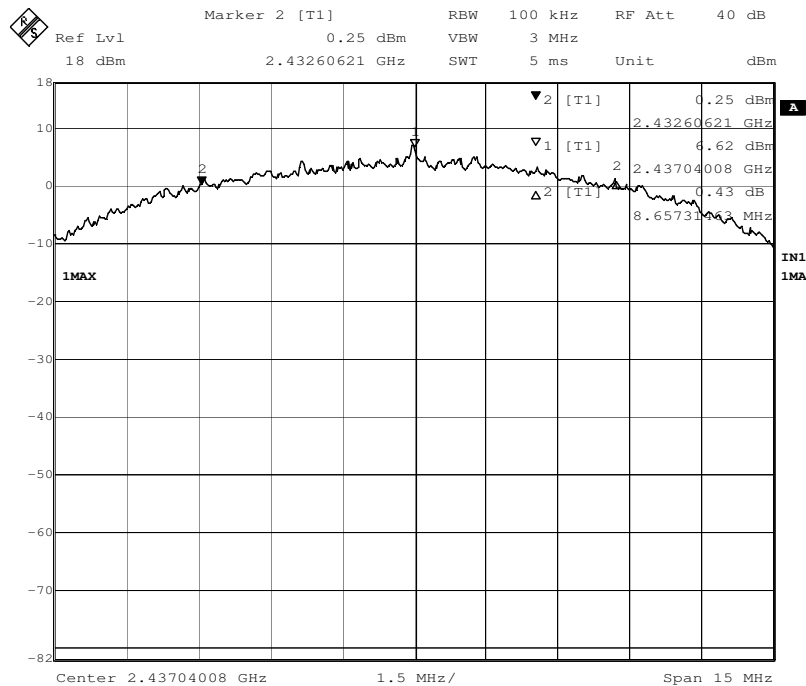
Pictures 1 and 2: 6dB Bandwidth measurement result, Channel 1



Test results are valid for the tested unit only.

The report may be copied only in its entirety

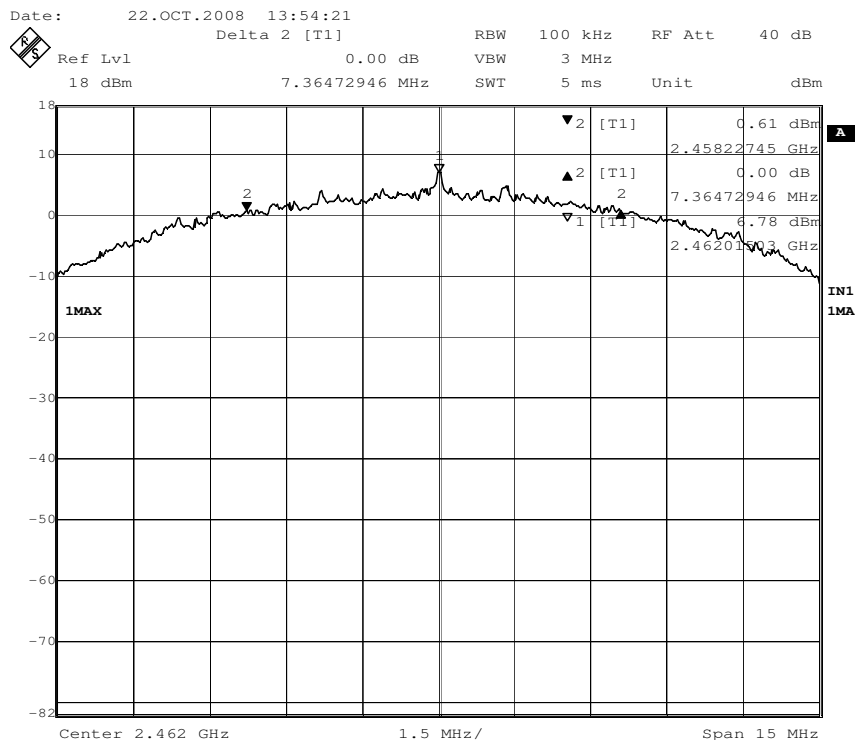
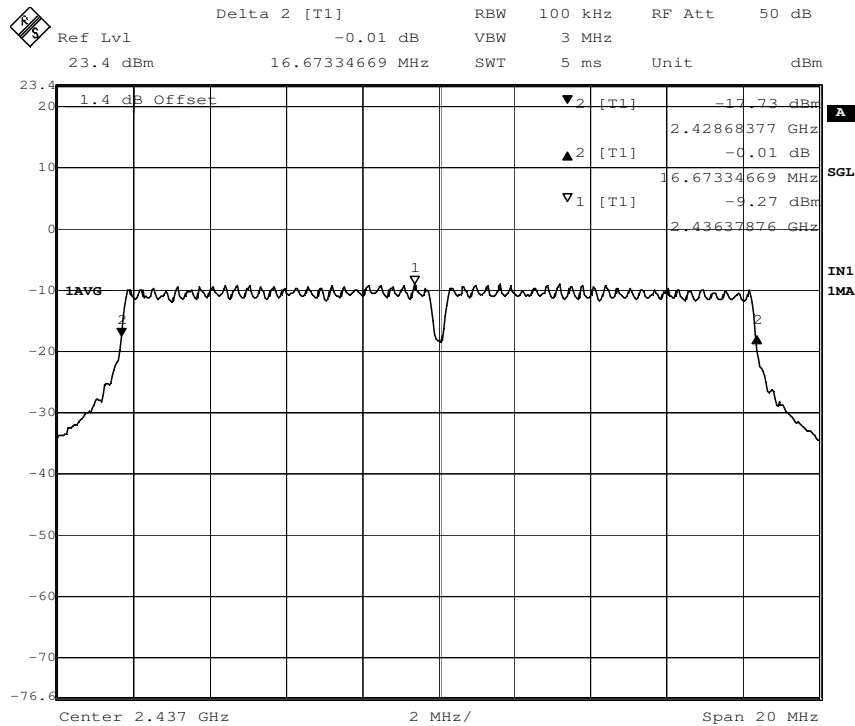
Pictures 3 and 4: 6dB Bandwidth measurement result, Channel 6



Test results are valid for the tested unit only.

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Pictures 5 and 6: 6dB Bandwidth measurement result, Channel 11



Date: 21.OCT.2008 16:01:42

Test results are valid for the tested unit only.

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8 99% BANDWIDTH

EUT	1		
Accessories	2		
Temp, Humidity, Air Pressure	23°C	30RH%	934hPa
Date of measurement	21.10.2008		
RSS-210 section	RSS-GRN 4.4.1		
Measured by	Matti Virkki		

8.1 Test setup and measurement method

The 99% bandwidth was measured using 100 kHz resolution bandwidth and maximum hold function of the spectrum analyzer. 99% bandwidth was defined by using spectrum analyzer's channel bandwidth measurement function.

8.2 EUT operation mode

EUT operation mode	Transmitting continuously, DSSS 11Mb/s
EUT channel	0, 6 and 11
EUT TX power level	Full power

EUT operation mode	Transmitting continuously, OFDMA 54 Mb/s
EUT channel	0, 6 and 11
EUT TX power level	Full power

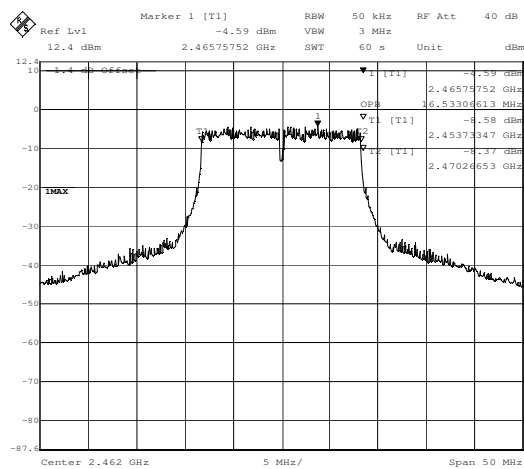
Table 3: 99% bandwidth measurement results DSSS

EUT Channel	Limit (MHz)	Measured value (MHz)
1	-	14,829
6		14,829
11		14,729

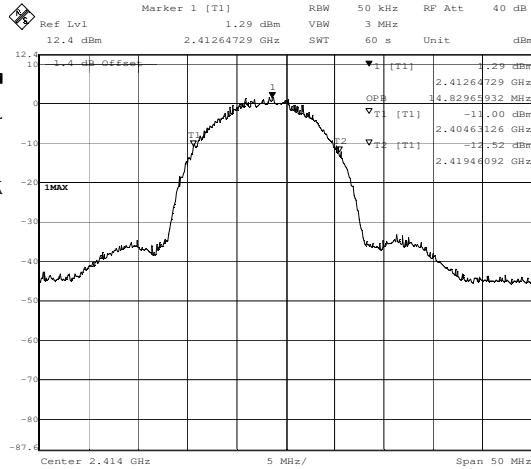
Table 4: 6dB bandwidth measurement results OFDMA

EUT Channel	Limit (MHz)	Measured value (MHz)
1	-	16,533
6		16,533
11		16,533

Pictures 7 and 8 99% bandwidth measurement channel 1

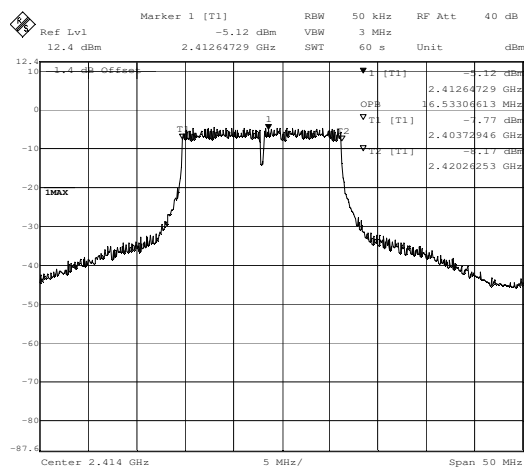


Date: 22.OCT.2008 16:43:22

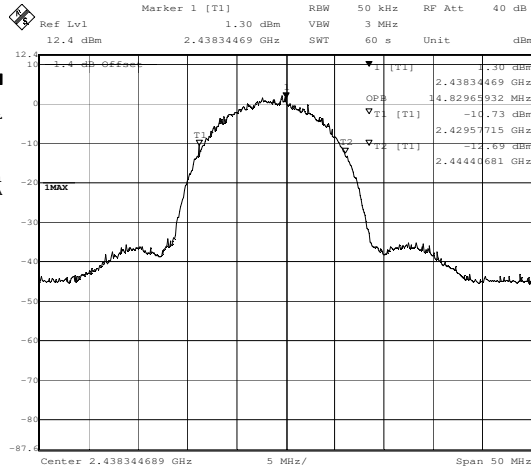


Date: 22.OCT.2008 16:18:52

Pictures 9 and 10 99% bandwidth measurement channel 6

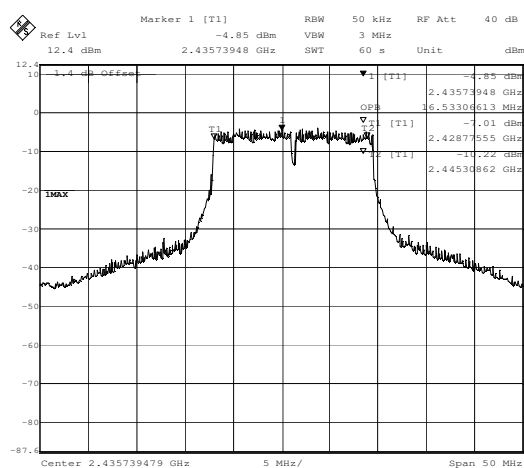


Date: 22.OCT.2008 16:25:43

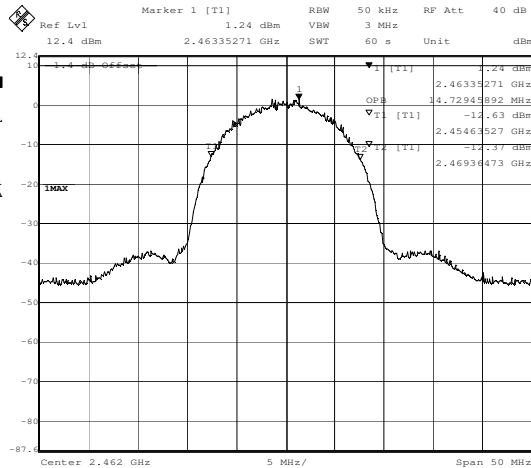


Date: 22.OCT.2008 16:15:19

Pictures 11 and 12 99% bandwidth measurement channel 11



Date: 22.OCT.2008 16:36:29



Date: 22.OCT.2008 16:09:57

Test results are valid for the tested unit only.

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9 PEAK OUTPUT POWER

EUT	1		
Accessories	2		
Temp, Humidity, Air Pressure	22°C	36RH%	928hPa
Date of measurement	29.10.2008		
FCC rule part	15.247, b 1		
RSS-210 section	A8.4 (2)		
Measured by	Matti Virkki		

9.1 Test setup and measurement method

In the peak output power measurement the cable attenuations were measured prior to the power measurement and set as parameter for cable loss in the spectrum analyzer to correct the reading of the peak output power. Spectrum analyzer subtracts the set attenuation value from the measured reading.

The measurement was made using 1 MHz resolution bandwidth and 3 MHz video bandwidth and spectrum analyzer's band power method to record the maximum peak output power.

9.2 EUT operation mode

EUT operation mode	Transmitting continuously, DSSS 11Mb/s
EUT channel	0, 6 and 11
EUT TX power level	Full power

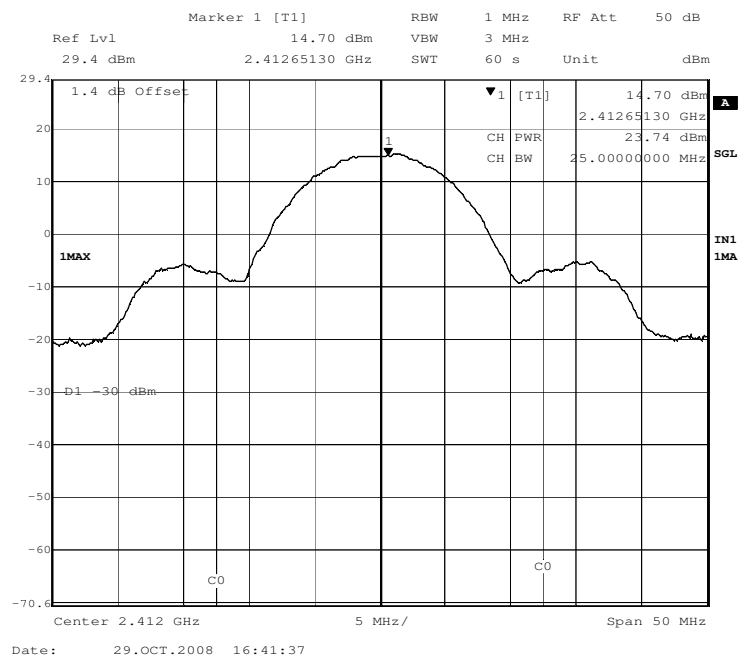
9.3 Results

Table 5: Peak output power measurement results DSSS

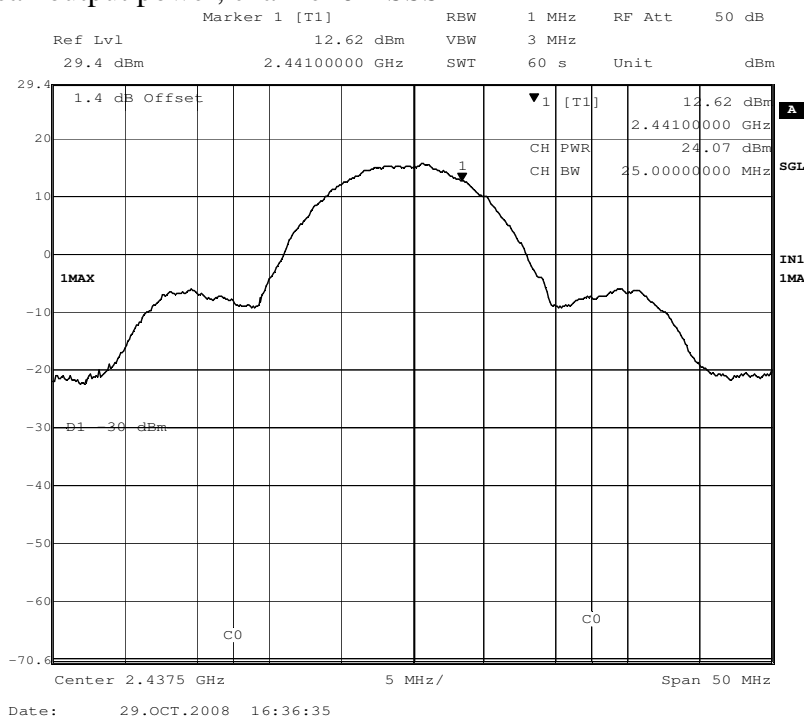
EUT Channel	Limit (W)	Test result (W)	Limit (dBm)	Test result (dBm)
0	≤ 1	0,234	≤ 30	23,7
6		0,257		24,1
11		0,269		24,3

9.4 Screen shots

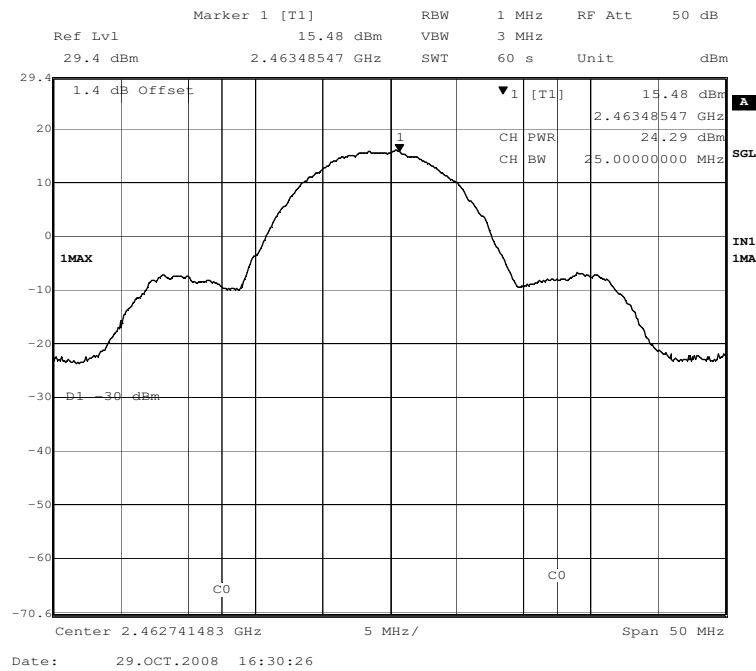
Picture 13 Peak output power, channel 1 DSSS



Picture 14 Peak output power, channel 6 DSSS



Picture 15 Peak output power, channel 11 DSSS



10 SPECTRAL POWER DENSITY OF RF CONDUCTED EMISSIONS

EUT	1		
Accessories	2		
Temp, Humidity, Air Pressure	23°C	34RH%	928hPa
Date of measurement	22.10.2008		
FCC rule part	15.247, d		
Measured by	Matti Virkki		

10.1 Test setup and measurement method

The transmitter output was connected to the spectrum analyzer, the bandwidth of the fundamental frequency was measured by the spectrum analyzer with 3 kHz RBW and 10 kHz VBW. The power spectral density was measured and recorded.

10.1.1 EUT operation mode

EUT operation mode	Connection continuous transmission
EUT channel	1, 6, 11
EUT TX power level	Full power

10.1.2 Results

Table 6: Power spectral density measurement results DSSS

EUT Channel	Limit (dBm)	Test result (dBm)
1	≤ 8	-10,5
6		-10,1
11		-9,6

11 BAND-EDGE COMPLIANCE OF RF CONDUCTED EMISSIONS

EUT	1		
Accessories	2		
Temp, Humidity, Air Pressure	23°C	45RH%	918hPa
Date of measurement	28.10.2008		
FCC rule part	15.247, d		
RSS-210 section	A8.5		
Measured by	Matti Virkki		

11.1 Test setup and measurement method

The transmitter output was connected to the spectrum analyzer

Band edge compliance of RF-conducted emissions was measured by setting the band edge as center frequency in the spectrum analyzer and measuring the power on the transmission on channels 1 and 11. The measured power and power on the band edge was then compared.

11.1.1 EUT operation mode

EUT operation mode	Connection continuous transmission
EUT channel	1, 11
EUT TX power level	Full power

11.1.2 Results

Table 7: Band edge compliance measurement results DSSM

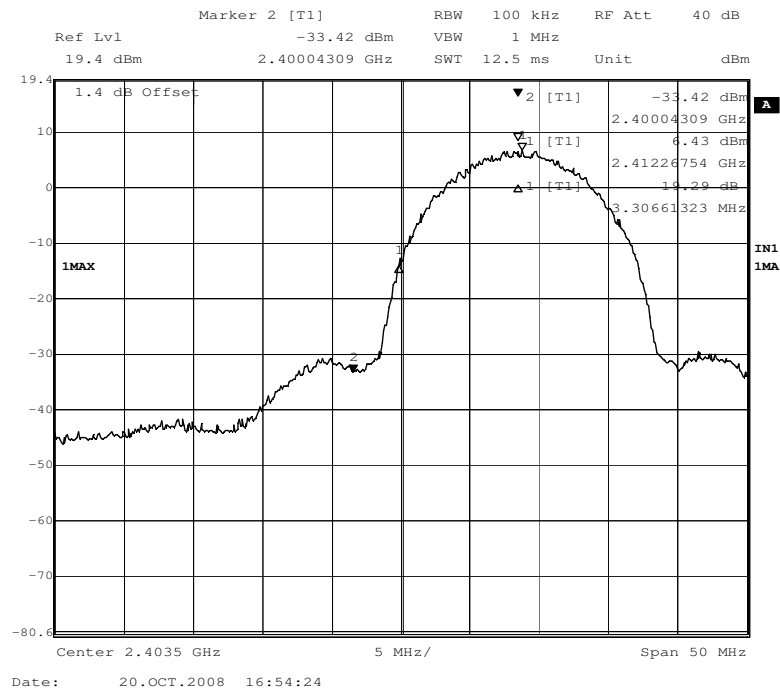
EUT Channel	Limit (dBc)	Test result (dBc)
1	≤ -20	-33,4
11		-45,6

Table 8: Band edge compliance measurement results OFDMA

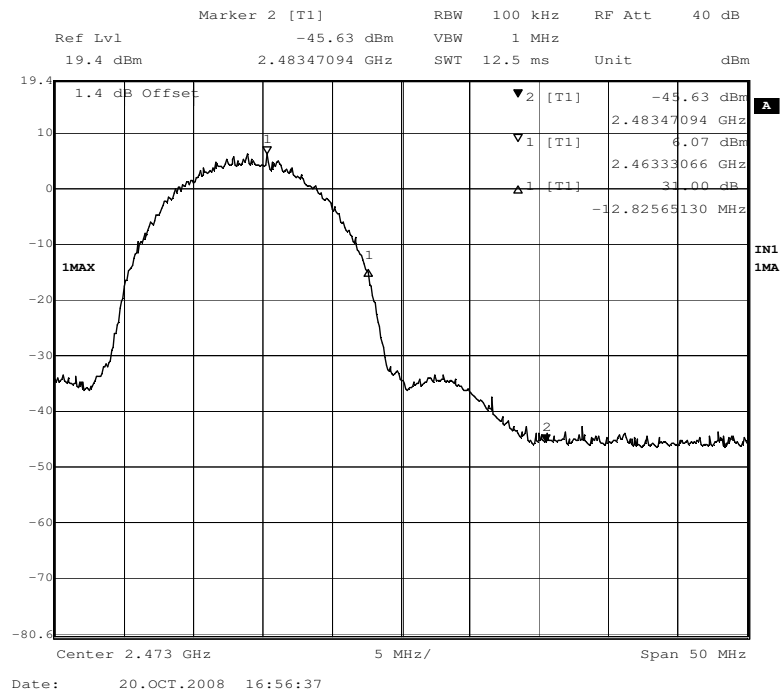
EUT Channel	Limit (dBc)	Test result (dBc)
1	≤ -20	-24,4
11		-29,9

11.1.3 Screen shots

Picture 16: Band edge compliance, channel 1.DSSS



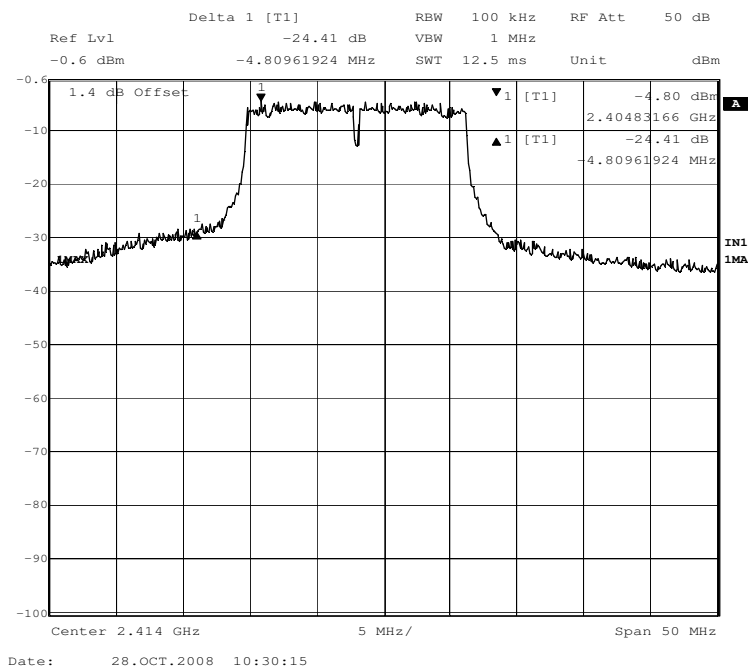
Picture 17: Band edge compliance, channel 11.DSSS



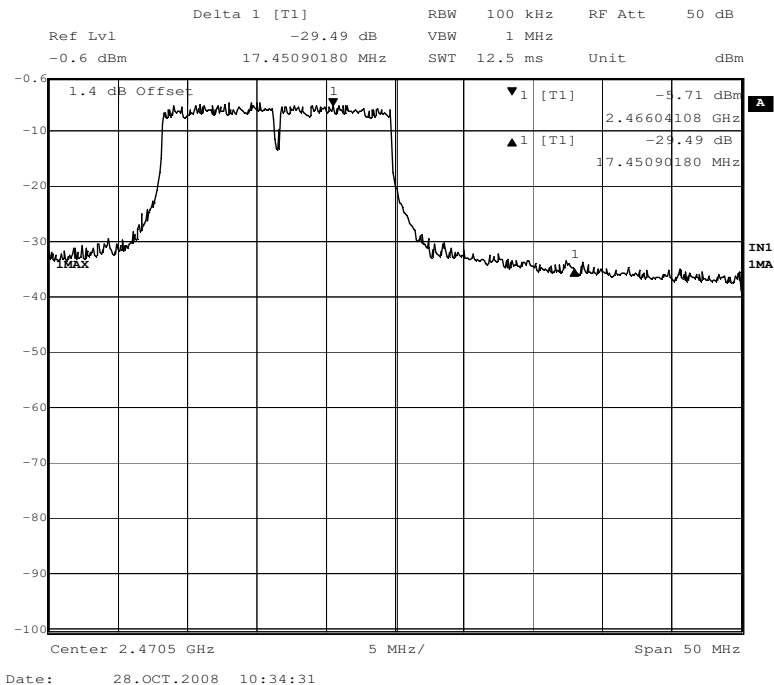
Test results are valid for the tested unit only.

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Picture 18: Band edge compliance, channel 1.OFDMA



Picture 19: Band edge compliance, channel 11.OFDMA



12 CONDUCTED EMISSIONS TO AC-MAINS

EUT	1		
Accessories	2		
Temp, Humidity, Air Pressure	23°C	43RH%	927hPa
Date of measurement	10.9.2008		
FCC rule part	§15.107		
RSS-GEN section	7.2.2		
ICES-003 section	5.3		
Measured by	Stefan Anderson		

12.1 Test setup

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

12.2 EUT operation mode

EUT was in idle mode.

12.3 Limits

Frequency of emission [MHz]	FCC / IC	
	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
-

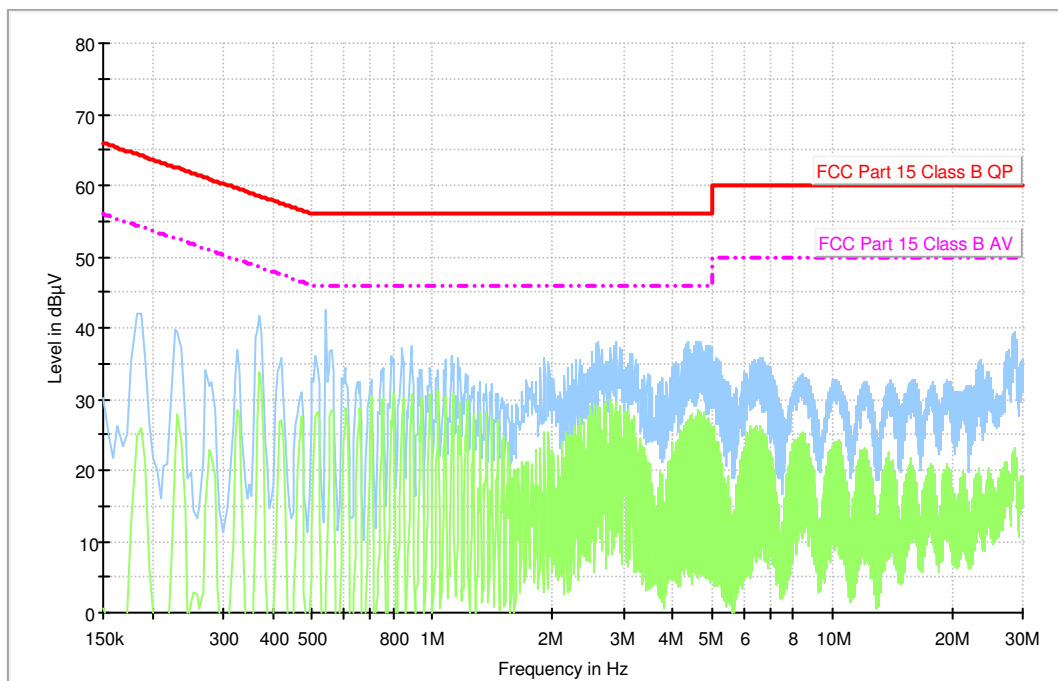
12.4 Results

The measured interference values using peak and average detectors are shown in the Picture 20 below.

All signals closer than 6 dB to the limit have been measured.

12.5 Screen shots

Picture 20: AC-mains conducted emission measurement results, AC live



13 SPURIOUS RF CONDUCTED EMISSIONS

EUT	1		
Accessories	2		
Temp, Humidity, Air Pressure	23°C	30RH%	928hPa
Date of measurement	28.10.2008		
RSS-210 section	A8.5		
FCC rule part	15.247, d		
Measured by	Matti Virkki		

13.1 Test setup and measurement method

Spectrum analyzer and automated software were used to record conducted spurious emissions on frequency range 30 MHz – 25 GHz. Frequency range was scanned using 100 kHz resolution bandwidth and 50 kHz steps. Spurious emissions levels relative to the carrier level were read from the measured results.

13.2 EUT operation mode

EUT operation mode	Transmitting continuously, DSSS 11Mb/s
EUT channel	0 (2402 MHz), 6 (2441 MHz) and 11 (2462 MHz)
EUT TX power level	Full power

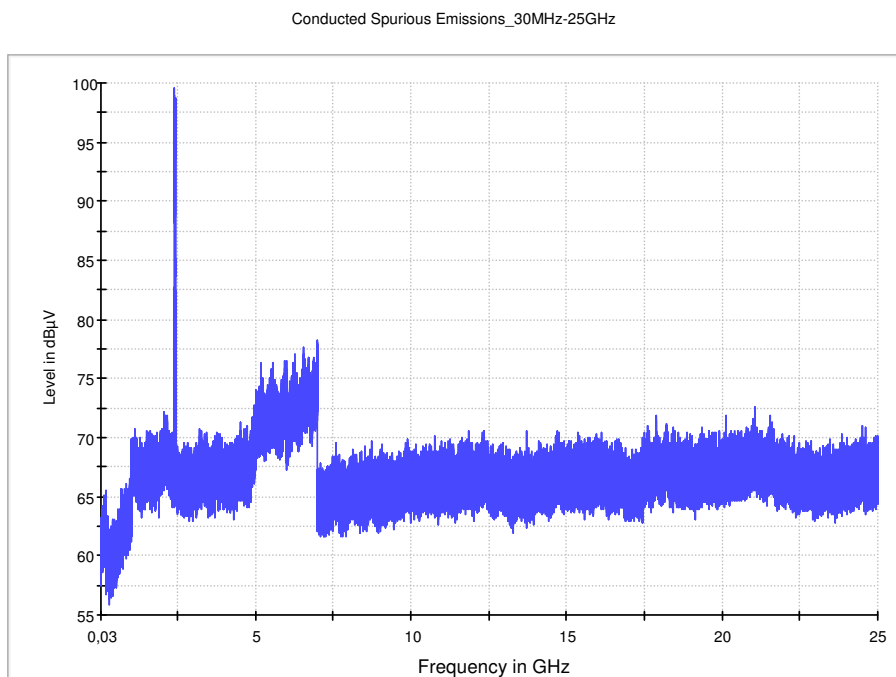
13.3 Limit

EUT Channel	Limit (dBc)
0	≤ -20
6	
11	

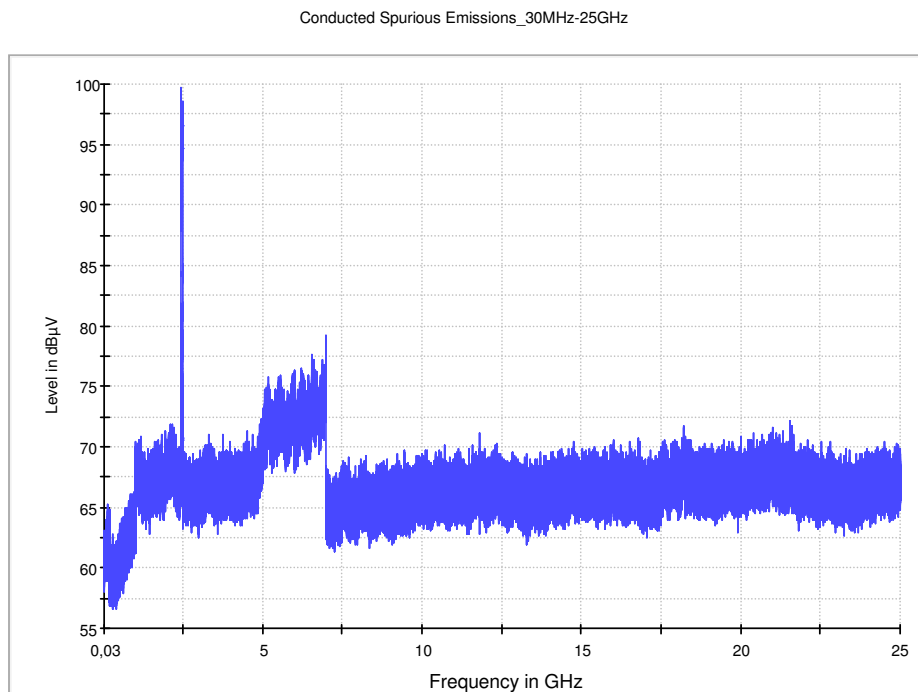
13.4 Results

All spurious emissions measured were least 20 dB below the carrier level.

Picture 21: Conducted spurious emissions on antenna port, Channel 1

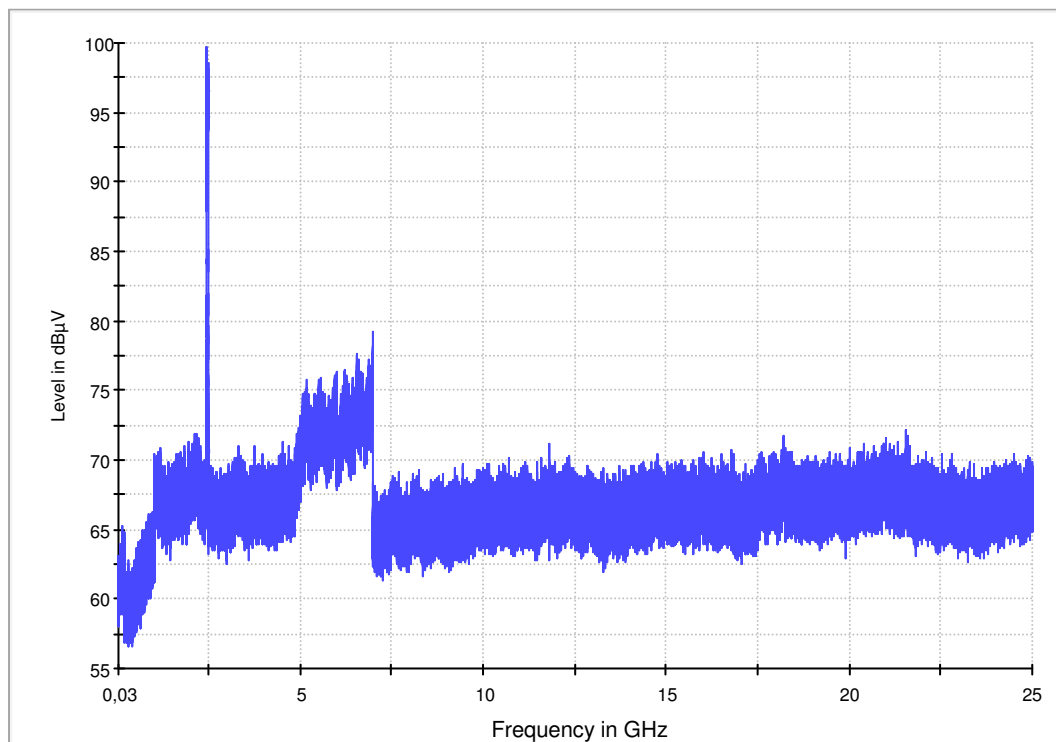


Picture 22: Conducted spurious emissions on antenna port, Channel 6



Picture 23: Conducted spurious emissions on antenna port, Channel 11

Conducted Spurious Emissions_30MHz-25GHz



14 RADIATED SPURIOUS EMISSIONS

EUT	1		
Accessories	2		
Temp, Humidity, Air Pressure	23°C	30RH%	928hPa
Date of measurement	31.10.2008		
FCC rule part	15.247, d		
RSS-210 section	A8.5		
Measured by	Matti Virkki		

14.1 Test setup

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

14.2 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 μ V/m at 3 m distance, are reported.

14.3 EUT operation mode

EUT operation mode	Transmitting continuously, DSSS 11Mb/s
EUT channel	1 (2414 MHz), 6 (2436 MHz) and 11 (2462 MHz)
EUT TX power level	Full power

14.4 Limit

Table 9: 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 - 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, if it was outside the restricted band thus complying with the -20dBc requirement.

14.5 Results

Measurement system noise level was least 15 dB below the spurious emission limit. Only levels of suspicious signals and transmitter harmonic frequencies, which were above the measurement system noise, are reported.

Only transmitter harmonics were found.

All spurious emissions measured were least 20 dB below the carrier level.

Table 10: Emission levels PEAK (QP) detector, channel 1

Freq MHz	Correction Factor dB	Result dBuV/m	Marginal dB	EUT Position	Ant Pol.	Ant height
2412	35	107,5	-	50	H	175
2412	35	114,3	-	50	V	159
4824,8	-11	54,2	>20 dBc	112	H	150
4824,8	-11	64,7	>20 dBc	115	V	73
7228	-7	57	>20 dBc	118	H	150
7228	-7	66,8	>20 dBc	145	V	90

Table 11: Emission levels PEAK (QP) detector, channel 6

Freq MHz	Correction Factor dB	Result dBuV/m	Marginal dB	EUT Position	Ant Pol.	Ant height
2438,4	34,6	117,6	-	232	V	130
2438,4	34,6	110,4	-	298	H	133
4873,6	-11	58,1	>20 dBc	331	H	140
4873,6	-11	51,3	>20 dBc	74	V	11
7308,8	-7	57,3	>20 dBc	180	H	155
7308,8	-7	53,7	>20 dBc	86	V	140
9748	-4	51,4	>20 dBc	125	H	140

Table 12: Emission levels PEAK (QP) detector, channel 11

Freq MHz	Correction Factor dB	Result dBuV/m	Marginal dB	EUT Position	Ant Pol.	Ant height
2463,2	34,8	118,1	-	236	V	127
2463,2	34,8	108,0	-	169	H	127
4924	-11,1	52,2	>20 dBc	176	H	150
4924	-11,1	52,8	>20 dBc	230	V	100
7388	-6,8	56,3	>20 dBc	74	H	150
7388	6,8	54,6	>20 dBc	41	V	110
9848,8	-3,9	51,0	>20 dBc	56	V	130

Table 13: Emission levels AVERAGE detector, channel 1

Freq MHz	Correction Factor dB	Result dBuV/m	Marginal dB	EUT Position	Ant Pol.	Ant height
2412	35	99,8	-	50	H	175
2412	35	106,7	-	50	V	159
4824,8	-11	43,62	>20 dBc	112	H	150
4824,8	-11	50,4	>20 dBc	115	V	73
7228	-7	45,7	>20 dBc	118	H	150
7228	-7	55,3	>20 dBc	145	V	90

Table 14: Emission levels AVERAGE detector, channel 6

Freq MHz	Correction Factor dB	Result dBuV/m	Marginal dB	EUT Position	Ant Pol.	Ant height
2438,4	34,6	108,9	-	232	V	130
2438,4	34,6	101,8		298	H	133
4873,6	-11	44,3	>20 dBc	331	H	140
4873,6	-11		>20 dBc			
7308,8	-7	46,2	>20 dBc	180	H	155
7308,8	-7		>20 dBc			
9748	-4	45,4	>20 dBc	125	H	140
9748	-4		>20 dBc			

Table 15: Emission levels AVERAGE detector, channel 11

Freq MHz	Correction Factor dB	Result dBuV/m	Marginal dB	EUT Position	Ant Pol.	Ant height
2463,2	34,8	109,3	-	236	V	127
2463,2	34,8	99,3	-	169	H	127
4924	-11,1	41,9	>20 dBc	176	H	150
4924	-11,1	52,8	>20 dBc	230	V	100
7388	-6,8	52,2	>20 dBc	74	H	150
7388	-6,8	46,1	>20 dBc	41	V	110
9848,8	-3,9	42,4	>20 dBc	56	V	130

15 RECEIVER RADIATED EMISSION

EUT	1		
Accessories	2,3,4		
Temp, Humidity, Air Pressure	23°C	30RH%	928hPa
Date of measurement	31.10.2008		
FCC rule part	§15.109		
RSS-GEN section	7.2.3		
ICES-003 section	5.5		
Measured by	Matti Virkki		

15.1 Test setup

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

15.2 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 μ V/m at 3 m distance, are reported.

15.3 EUT operation mode

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

15.4 Limit

Table 16: Radiated spurious emission limits at measurement distance 3m

Frequency band (MHz)	3m Limit ($\mu\text{V/m}$)	3m Limit ($\text{dB}\mu\text{V/m}$)	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

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.

15.5 Results

The measured interference values using Quasi peak and average detectors are shown in the pictures below.

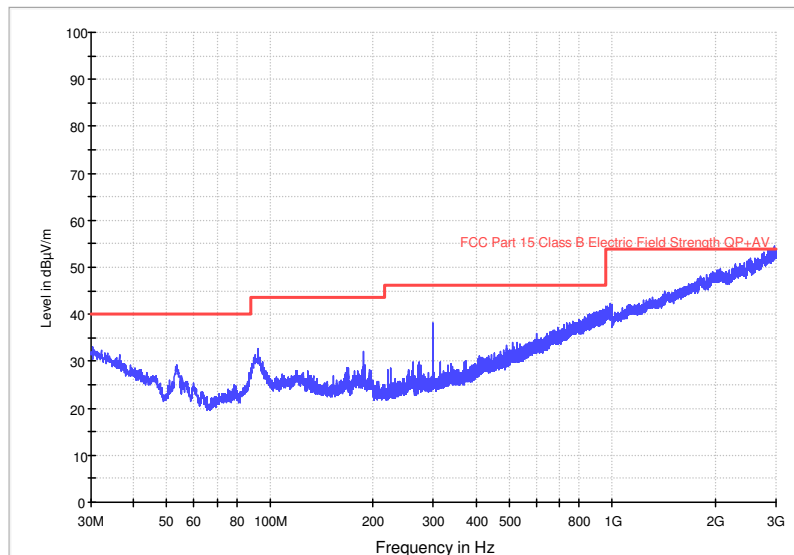
All signals closer than 6 dB to the limit below 1 GHz have been measured using quasi peak or average detector and reported in the table 17, **Fehler! Verweisquelle konnte nicht gefunden werden.** and **Fehler! Verweisquelle konnte nicht gefunden werden..**

Table 17: Radiated emissions

Frequency (MHz)	QuasiPeak ($\text{dB}\mu\text{V/m}$)	Bandwidth (kHz)	Antenna height (cm)	Polarity	Turntable position (deg)	Corr. (dB)
40.38	35.2	120	100.0	V	0.0	14.8
92.16	34.9	120	100.0	V	0.0	10.0
44.40	35.0	120	100.0	V	38.0	12.5

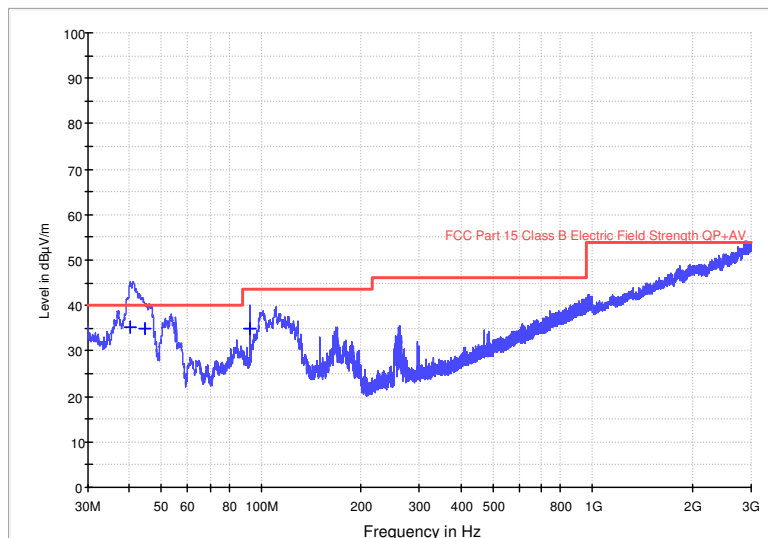
Picture 24: radiated emission results, 30 – 3000 MHz, Hor

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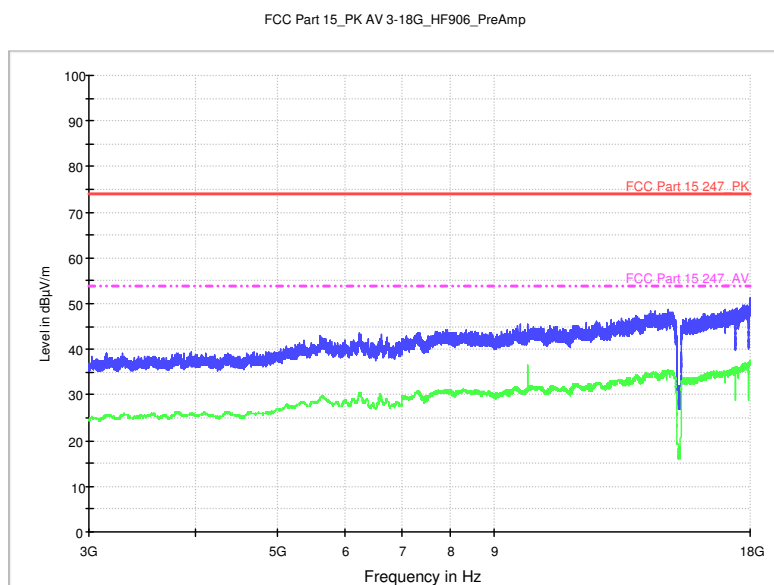


Picture 25: radiated emission results, 30 – 3000 MHz, Ver

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Picture 26: radiated emission results, 3 – 12,4 GHz,



16 TEST EQUIPMENT

16.1 Radiated measurement

Equipment	Type	Manufacturer	Ser. No.	Inventory-No.
☒ Test receiver, 20Hz-26.5GHz	ESIB26	Rohde & Schwarz	100150	PM KF 0948
☒ Antenna, 20-3000 MHz	HL562	Rohde & Schwarz	100354	PM KF 1123
☒ Horn antenna, 1-18 GHz	HF906	Rohde & Schwarz	100188	PM KF 0947
☒ Horn antenna, 18-26 GHz	BBHA 9170	Schwarzbeck	BBHA9170 361	PM KF 1204
☒ Preamplifier f. horn antenna	BLMA0118-4°	Bonn	35352	PM KF 0946
☒ Preamplifier f. horn antenna	BBV 9719	Schwarzbeck	9719-003	PM KF 1324

16.2 Conducted measurement

Equipment	Type	Manufacturer	Ser. No.	Inventory-No.
☒ Test receiver, 20Hz-26.5GHz	ESIB26	Rohde & Schwarz	100150	PM KF 0948
☒ Artificial mains network	ESH3-Z5	- Rohde & Schwarz	863367/018	PM KF 0142

17 TEST SETUP PHOTOGRAPHS

Test setup photograph can be found in a separate document
08KFE010163-C-01_PHOTOS