

FCC ID: UTQ-W2400A

EMI -- TEST REPORT

Test Report No. :	T31291-00-00XF	November 27, 2006
<hr/>		Date of issue

Type / Model Name : 47BAWSB28AM3

Product Description : Industrial cordless assembly Tool with WLAN data transmission

Applicant : Cooper Power Tools GmbH & Co. OHG

Address : Industriestr. 1
73463 Westhausen

Manufacturer : Cooper Power Tools GmbH & Co. OHG

Address : Industriestr. 1
73463 Westhausen

Licence holder : Cooper Power Tools GmbH & Co. OHG

Address : Industriestr. 1
73463 Westhausen

Test Result according to the standards listed in clause 1 test standards:
Positive

Positive



The test report merely corresponds to the test sample.
It is not permitted to copy extracts of these test results without the written permission of the test laboratory.

FCC ID: UTQ-W2400A

Contents

1 TEST STANDARDS	3
2 SUMMARY	4
3 EQUIPMENT UNDER TEST	5
3.1 PHOTO DOCUMENTATION OF THE EUT	5
3.3 POWER SUPPLY SYSTEM UTILISED	9
3.4 SHORT DESCRIPTION OF THE EQUIPMENT UNDER TEST (EuT)	9
4 TEST ENVIRONMENT	10
4.1 ADDRESS OF THE TEST LABORATORY	10
4.2 ENVIRONMENTAL CONDITIONS	10
4.3 STATEMENT OF THE MEASUREMENT UNCERTAINTY	10
4.4 MEASUREMENT PROTOCOL FOR FCC, VCCI AND AUSTEL	10
5 TEST CONDITIONS AND RESULTS	12
5.1 CONDUCTED EMISSIONS	12
5.2 MAXIMUM PEAK OUTPUT POWER	13
5.3 RADIATED EMISSIONS 9 KHZ – 40 GHz	16
5.4 SPURIOUS RF CONDUCTED EMISSION	24
5.5 6 dB BANDWIDTH	27
5.6 BAND EDGE TEST	32
5.7 PEAK POWER DENSITY	36
5.9 ANTENNA APPLICATION	38
5.11 RECEIVER RADIATED EMISSIONS 9 KHZ - 40 GHz	39
6 USED TEST EQUIPMENT AND ACCESSORIES	44

1 TEST STANDARDS

The tests were performed according to following standards:

FCC Rules and Regulations Part 15 Subpart C - Intentional Radiators (October 01, 2005)

Part 15, Subpart C, Section 15.35(c)	Correction for Pulse Operation (Duty Cycle)
Part 15, Subpart C, Section 15.207(a)	AC Line conducted emissions
Part 15, Subpart C, Section 15.209(a)	Radiated emissions, general requirements
Part 15, Subpart C, Section 15.247(c)	Radiated emissions, outside the used frequency band
Part 15, Subpart C, Section 15.203	Antenna requirement
Part 15, Subpart C, Section 15.204	External radio frequency power amplifiers and antenna modifications
Part 15, Subpart C, Section 15.247(1)(iii)	Bandwidth requirement
Part 15, Subpart C, Section 15.247(b)(1)	Maximum Peak output Power of intentional radiator

FCC Rules and Regulations Part 15 Subpart B - Unintentional Radiators (October 01, 2005)

Part 15, Subpart B, Section 15.107(a)	AC Line conducted emissions
Part 15, Subpart B, Section 15.109(a)	Radiated emissions, general requirements

2 SUMMARY

GENERAL REMARKS:

The frequency range was scanned from 30 MHz to 25000 MHz. All emissions not reported in this test report were more than 10 dB below the specified limit.

FINAL ASSESSMENT:

The equipment under test **fulfills** the EMI requirements cited in clause 1 test standards.

Date of receipt of test sample : acc. to storage records

Testing commenced on : November 20, 2006

Testing concluded on : November 24, 2006

Checked by:

Tested by:

Klaus Gegenfurter
Dipl.-Ing.(FH)
Manager: Radio Group

Fischer Xaver

3 EQUIPMENT UNDER TEST

3.1 Photo documentation of the EuT

Industrial cordless assembly Tool with WLAN data transmission
T31291-00-00XF

External Photo
Top view



Industrial cordless assembly Tool with WLAN data transmission
T31291-00-00XF

Internal Photo
Top view of antenna



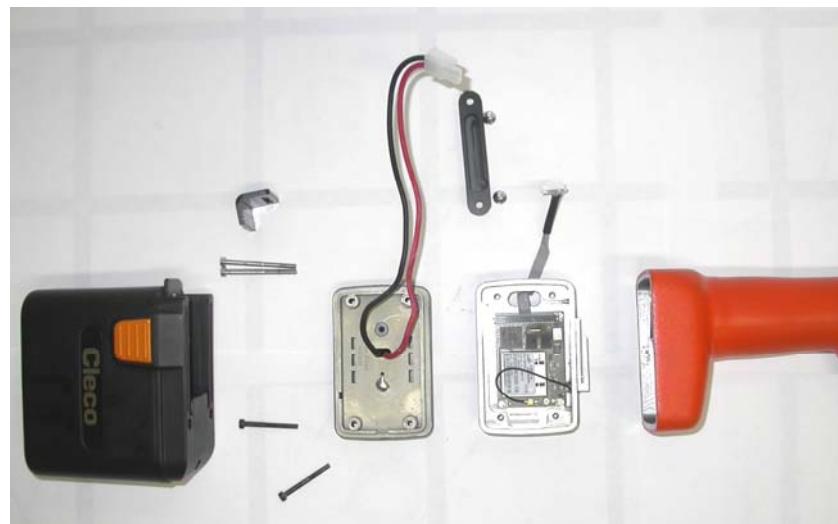
Industrial cordless assembly Tool with WLAN data transmission
T31291-00-00XF

Internal Photo
Open view



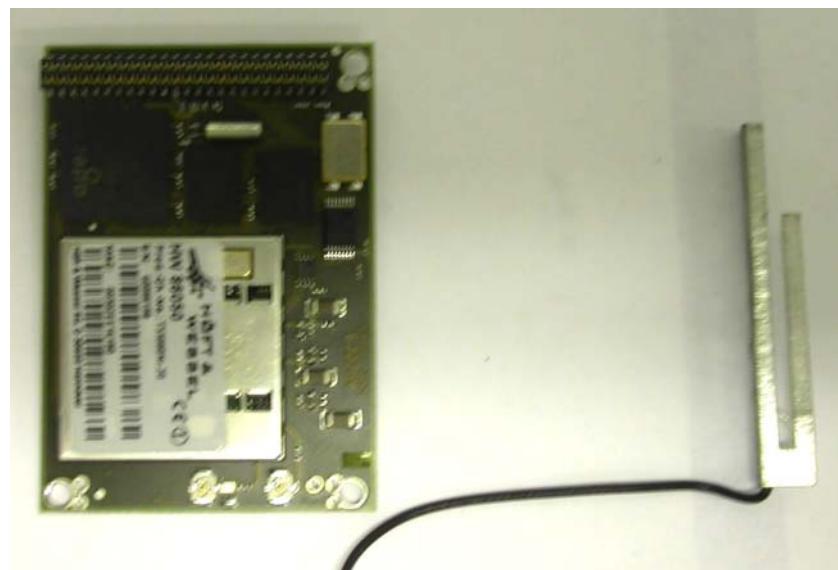
Industrial cordless assembly Tool with WLAN data transmission
T31291-00-00XF

Internal Photo
Open view



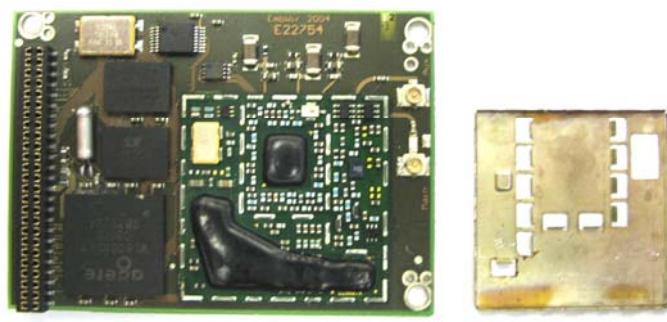
Industrial cordless assembly Tool with WLAN data transmission
T31291-00-00XF

Internal Photo
Front view of WLAN module and antenna with shielding



Industrial cordless assembly Tool with WLAN data transmission
T31291-00-00XF

Internal Photo
Front view of WLAN module without shielding



Industrial cordless assembly Tool with WLAN data transmission
T31291-00-00XF

External Photo
Rear view of WLAN module



Power supply system utilised

Power supply voltage : 26 V / DC

3.4 Short description of the Equipment under Test (EuT)

The wireless Tool is designed exclusively for fastening and releasing threaded fasteners. It's used in the automotive industry and whose suppliers. The WLAN data communication is used in order to define the set points and transmission of results.

Number of tested samples: 2
Serial number: Prototype

EuT operation mode:

The equipment under test was operated during the measurement under the following conditions:

- TX-mode with modulation

- RX-mode

EuT configuration:

(The CDF filled by the applicant can be viewed at the test laboratory.)

The following peripheral devices and interface cables were connected during the measurements:

- _____ Model : _____
- _____ Model : _____

4 TEST ENVIRONMENT

4.1 Address of the test laboratory

mikes-testingpartners gmbh
Ohmstrasse 2-4
94342 Strasskirchen
Germany

4.2 Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

Temperature: 15-35 ° C

Humidity: 30-60 %

Atmospheric pressure: 86-106 kPa

4.3 Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. to CISPR 16-4-2 /11.2003 „Uncertainties, statistics and limit modelling – Uncertainty in EMC measurements“ and is documented in the quality system acc. to DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

4.4 Measurement Protocol for FCC, VCCI and AUSTEL

4.4.1 GENERAL INFORMATION

4.4.1.1 Test Methodology

Conducted and radiated disturbance testing is performed according to the procedures in International Special Committee on Radio Interference (CISPR) Publication 22, European Standard EN 55022 as shown under section 1 of this report.

In compliance with 47 CFR Part 15 Subpart A Section 15.38 testing for FCC compliance may be done following the ANSI C63.4-2003 procedures and using the CISPR 22 Limits.

4.4.1.2 Justification

The Equipment Under Test (EUT) is configured in a typical user arrangement in accordance with the manufacturer's instructions. A cable is connected to each available port and either terminated with a peripheral using the appropriate impedance characteristic or left unterminated. Where appropriate, cables are manually manipulated with respect to each other thus obtaining maximum disturbances from the unit.

4.4.2 DETAILS OF TEST PROCEDURES

4.4.2.1 General Standard Information

The test methods used comply with CISPR Publication 22, EN 55022 - "Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement" and with ANSI C63.4-2003 - "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz."

TEST CONDITIONS AND RESULTS

5.1 Conducted emissions

For test instruments and accessories used see section 6 Part A 4.

5.1.1 Description of the test location

5.1.2 Photo documentation of the test set-up

5.1.3 Description of Measurement

The final level, expressed in dB μ V, is arrived at by taking the reading directly from the EMI receiver. This level is compared directly to the FCC Limit or to the CISPR limit.

To convert between dB μ V and μ V, the following conversions apply:

$$\text{dB}\mu\text{V} = 20(\log \mu\text{V})$$

$$\mu\text{V} = \text{Inverse log}(\text{dB}\mu\text{V}/20)$$

Conducted emissions on the 50 Hz and/or 60 Hz power interface of the EuT are measured in the frequency range of 150 kHz to 30 MHz. The measurements are performed using a receiver, which has CISPR characteristic bandwidth and quasi-peak detection and a Line Impedance Stabilization Network (LISN) with 50 Ω /50 μ H (CISPR 16) characteristics. Table top equipment is placed on a non-conducting table 80 centimeters above the floor and is positioned 40 centimeters from the vertical ground plane (wall) of the screen room. If the minimum limit margin appears to be less than 20 dB with a peak mode measurement, the emissions are remeasured using a tuned receiver with quasi-peak and average detection and recorded on the data sheets.

5.1.4 Test result

Remarks: The EuT is battery powered.

5.2 Maximum Peak Output Power

For test instruments and accessories used see section 6 Part **CPR 3**.

5.2.1 Description of the test location

Test location: Anechoic Chamber A2

5.2.2 Photo documentation of the test set-up



5.2.3 Description of Measurement

Conducted maximum peak output power:

A spectrum analyzer / EMI test receiver is connected to the output of the transmitter via a suitable attenuator while EuT was operating in transmit mode using the assigned frequency.

Analyzer Settings:

- Detector: Max hold
- RBW: greater than 20 dB Bandwidth
- VBW: \geq RBW
- Sweep Time: Coupled

Alternative test procedure:

If antenna conducted tests cannot be performed on the EuT, radiated tests to show compliance with the various conducted requirements of Section 15.247 are performed. A pre-amp have been used in making the following requirements.

Radiated maximum peak output power:

Radiated maximum peak output power from the EuT is measured in the frequency range of 30 MHz to 1000 MHz using a tuned receiver and appropriate broadband linearly polarized antennas. Measurements between 30 MHz and

1000 MHz are made with 120 kHz/6 dB bandwidth and quasi-peak detection. Table top equipment is placed on a 1.0 X 1.5 meter non-conducting table 80 centimetres above the ground plane. Floor standing equipment is placed directly on the turntable/ground plane. The set up of the Equipment under test will be in accordance to ANSI C63.4-2003.

The Interface cables that are closer than 40 centimetres to the ground plane are bundled in the center in a serpentine fashion so they are at least 40 centimetres from the ground plane. Cables to simulators/testers (if used in this test) are routed through the center of the table and to a screen room located outside the test area. The antenna was positioned 3, 10 or 30 meters horizontally from the EuT. To locate maximum emissions from the test sample the antenna is varied in height from 1 to 4 meters, measurement scans are made with both horizontal and vertical antenna polarization's and the EuT are rotated 360 degrees.

The final level, expressed in dB μ V/m, is arrived by taking the reading from the EMI receiver (Level dB μ V) and adding the correction factors and cable loss factor (Factor dB) to it. This is done automatically in the EMI receiver, where the correction factors are stored. This result then has the FCC or CISPR limit subtracted from it to provide the Delta which gives the tabular data as shown in the data sheets at page.

Radiated maximum peak output power from the EuT is measured above 1 GHz, using a tuned receiver (Spectrum Analyser) and appropriate linearly polarized antennas. Table top equipment is placed on a 1.0 X 1.5 meter non-conducting table 80 centimetres above the ground plane. Floor standing equipment is placed directly on the turntable/ground plane. The set up of the Equipment under test will be in accordance to ANSI C63.4-2003. The Interface cables that are closer than 40 centimetres to the ground plane are bundled in the center in a serpentine fashion so they are at least 40 centimetres from the ground plane. Cables to simulators/testers (if used in this test) are routed through the center of the table and to a screen room located outside the test area.

Measurement are made in both the horizontal and vertical planes of polarization in a fully anechoic room using a spectrum analyzer with the detector function set to peak and resolution as well as video bandwith set to 1 MHz. All tests are performed at a test-distance of 3 meters. Hand-held or body-worn devices are rotated through three orthogonal axes to determine which attitude and configuration procedure the highest emission relative the limit and therefore shall be used for final testing. During the tests the EUT is rotated all around to find the maximum levels of emissions. The cables and equipment were placed and moved within the range of position likely to find their maximum emissions. When the EuT is larger than the beamwidth of the measuring antenna, the measurement antenna will be moved over the surfaces for the four sides or the test distance will be reduced to demonstrate that emissions were at maximum at the limit distance.

Analyzer Settings:

- Detector: Max hold
- RBW: greater than 20 dB Bandwidth
- VBW: \geq RBW
- Sweep Time: Coupled

5.2.4 Test result

Channel	Frequency [MHz]	Peak Power Output (dBm)	Correct. [dB]	Corr. Peak Power Output (dBm)	Peak Power Limit (dBm)	Delta [dB]
1	2412	16,1	2,1	18,1	30	-11,9
6	2437	15,8	2,1	17,9	30	-12,2
11	2462	15,0	2,1	17,1	30	-12,9

Peak Power Limit according to FCC Subpart 15.247(b)(3)

Frequency (MHz)	Peak Power Limit	
	(dBm)	(Watt)
902-928	30	1,0
2400-2483.5	30	1,0
5725-5850	30	1,0

The requirements are **FULFILLED**.

Remarks: This test has been performed conducted at antenna jack on PCB.

5.3 Radiated emissions 9 kHz – 40 GHz

For test instruments and accessories used see section 6 Part **SER1, SER 2 and SER 3**.

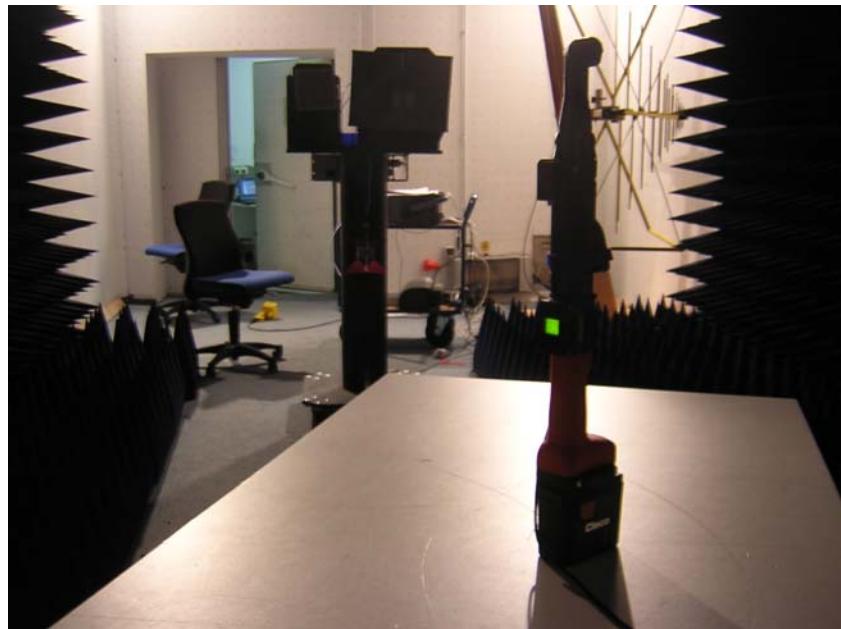
5.3.1 Description of the test location

Test location: OATS1
Anechoic Chamber A2

Test distance: 3 metres

5.3.2 Photo documentation of the test set-up





5.3.3 Description of Measurement

The spurious emissions from the EuT will be measured on an open area test site in the frequency range of 9 kHz to 30 MHz using a tuned receiver and a shielded loop antenna. The antenna was positioned 3, 10 or 30 meters horizontally from the EuT. Measurements have been made in all three orthogonal axes and the shielded loop antenna was rotated to locate the maximum of the emissions. In the case where larger measuring distances are required the results will be extrapolated based on the values measured on the closer distances according to Section 15.31 (f) (2) [2]. The final measurement will be performed with an EMI Receiver set to Quasi Peak detector except for the frequency bands 9 kHz to 90 kHz and 110 to 490 kHz where an average detector will be used according to Section 15.209 (d) [2].

The final level, expressed in $\text{dB}\mu\text{V}/\text{m}$, is arrived at by taking the reading from the EMI receiver (Level $\text{dB}\mu\text{V}$) and adding the antenna correction factor and cable loss factor (Factor dB) to it. This result then has to be compared with the relevant FCC limit.

The resolution bandwidth during the measurement is as follows:

9 kHz – 150 kHz: ResBW: 200 Hz

150 kHz – 30 MHz: ResBW: 9 kHz

Radiated spurious emissions from the EuT are measured in the frequency range of 30 MHz to 1000 MHz using a tuned receiver and appropriate broadband linearly polarized antennas. Measurements between 30 MHz and 1000 MHz are made with 120 kHz/6 dB bandwidth and quasi-peak detection. Table top equipment is placed on a 1.0 X 1.5 meter non-conducting table 80 centimetres above the ground plane. Floor standing equipment is placed directly on the turntable/ground plane. The set up of the Equipment under test will be in accordance to ANSI C63.4-2003. The Interface cables that are closer than 40 centimetres to the ground plane are bundled in the center in a serpentine fashion so they are at least 40 centimetres from the ground plane. Cables to simulators/testers (if used in this test) are routed through the center of the table and to a screen room located outside the test area. The antenna was positioned 3, 10 or 30 meters horizontally from the EuT. To locate maximum emissions from the test sample the antenna is varied in height from 1 to 4 meters, measurement scans are made with both horizontal and vertical antenna polarization's and the EuT are rotated 360 degrees.

The final level, expressed in $\text{dB}\mu\text{V}/\text{m}$, is arrived by taking the reading from the EMI receiver (Level $\text{dB}\mu\text{V}$) and adding the correction factors and cable loss factor (Factor dB) to it. This is done automatically in the EMI receiver, where the correction factors are stored. This result then has the FCC or CISPR limit subtracted from it to provide the Delta which gives the tabular data as shown in the data sheets at page.

The radiated emissions from the EuT are measured in the frequency range of 1 GHz to maximum frequency as specified in section 15.33, using a tuned receiver (Spectrum Analyser) and appropriate linearly polarized antennas. Table top equipment is placed on a 1.0 X 1.5 meter non-conducting table 80 centimetres above the ground plane. Floor standing equipment is placed directly on the turntable/ground plane. The set up of the Equipment under test will be in accordance to ANSI C63.4-2003.

The Interface cables that are closer than 40 centimetres to the ground plane are bundled in the center in a serpentine fashion so they are at least 40 centimetres from the ground plane. Cables to simulators/testers (if used in this test) are routed through the center of the table and to a screen room located outside the test area. The antenna was positioned 3m horizontally from the EuT.

Measurement are made in both the horizontal and vertical planes of polarization in a fully anechoic room using a spectrum analyzer with the detector function set to peak and resolution as well as video bandwidth set to 100 kHz and for any spurious emission or modulation product that falls in Restricted Band, as defined in Section 15.205, set the resolution and video bandwidth to 1 MHz.

All tests are performed at a test-distance of 3 meters. Hand-held or body-worn devices are rotated through three orthogonal axes to determine which attitude and configuration procedure the highest emission relative the limit and therefore shall be used for final testing. During the tests the EUT is rotated all around to find the maximum levels of emissions. The cables and equipment were placed and moved within the range of position likely to find their maximum emissions. When the EuT is larger than the beamwidth of the measuring antenna, the measurement antenna will be moved over the surfaces for the four sides or the test distance will be reduced to demonstrate that emissions were at maximum at the limit distance.

Analyzer Settings (EMI receiver) for spurious emissions which fall not in Restricted Band:

- Detector: Max hold
- RBW: 100 kHz for $f \geq 1\text{GHz}$, 120 kHz for $f \leq 1\text{GHz}$
- VBW: \geq RBW
- Sweep Time: Coupled
- Detector function: Peak

Analyzer Settings (EMI receiver) for spurious emissions which fall in Restricted Band:

- Detector: Max hold
- RBW: 1 MHz for $f \geq 1\text{GHz}$, 120 kHz for $f \leq 1\text{GHz}$
- VBW: \geq RBW
- Sweep Time: Coupled
- Detector function: Peak for $f \geq 1\text{GHz}$, Quasi Peak for $f \leq 1\text{GHz}$

5.3.4 Test result

Testresult in detail: (<1GHz)

Corrected field strength of fundamental wave as reference for radiated emissions:

100,8 dB μ V/m

Frequency [MHz]	Restricted Band	Reading Level QP [dB μ V]	Reading Level AV [dB μ V]	Reading Level PK [dB μ V]	Bandwidth [kHz]	Correct. factor [dB]	Corrected Level QP [dB μ V/m]	Corrected Level AV [dB μ V/m]	Corrected Level PK [dB μ V/m]	Limit [dB μ V/m]		Delta [dB]
										PK	QP	
0,009-0,15					0,2		< 30					
0,15 - 30					9		< 30					
30-1000					120				< 30	80,8		> -50,8
30-88	■				120		< 30				40	> -10,0
88-216	■				120		< 30				43,5	> -13,5
216-960	■				120		< 30				46	> -16,0
960-1000	■				120		< 30				54	> -24,0

Corrected field strength of fundamental wave as reference for radiated emissions:

100,7 dB μ V/m

Frequency [MHz]	Restricted Band	Reading Level QP [dB μ V]	Reading Level AV [dB μ V]	Reading Level PK [dB μ V]	Bandwidth [kHz]	Correct. factor [dB]	Corrected Level QP [dB μ V/m]	Corrected Level AV [dB μ V/m]	Corrected Level PK [dB μ V/m]	Limit [dB μ V/m]		Delta [dB]
										PK	QP	
0,009-0,15					0,2		< 30					
0,15 - 30					9		< 30					
30-1000					120				< 30	80,7		> -50,7
30-88	■				120		< 30				40	> -10,0
88-216	■				120		< 30				43,5	> -13,5
216-960	■				120		< 30				46	> -16,0
960-1000	■				120		< 30				54	> -24,0

Corrected field strength of fundamental wave as reference for radiated emissions:

101,3 dB μ V/m

Frequency [MHz]	Restricted Band	Reading Level QP [dB μ V]	Reading Level AV [dB μ V]	Reading Level PK [dB μ V]	Bandwidth [kHz]	Correct. factor [dB]	Corrected Level QP [dB μ V/m]	Corrected Level AV [dB μ V/m]	Corrected Level PK [dB μ V/m]	Limit [dB μ V/m]		Delta [dB]
										PK	QP	
0,009-0,15					0,2		< 30					
0,15 - 30					9		< 30					
30-1000					120				< 30	81,3		> -51,3
30-88	■				120		< 30				40	> -10,0
88-216	■				120		< 30				43,5	> -13,5
216-960	■				120		< 30				46	> -16,0
960-1000	■				120		< 30				54	> -24,0

Testresult in detail:(>1GHz)

Corrected field strength of fundamental wave as reference for radiated emissions:

100,8 dB μ V/m

Channel 1											
Frequency [MHz]	Restricted Band	Reading Level PK [dB μ V]	Corr. Duty Cycle [dB]	Level AV [dB μ V] *)	Band-width [kHz]	Correct. Factor [dB]	Corrected Level PK [dB μ V/m]	Corrected Level AV [dB μ V/m]	Limit PK [dB μ V/m]	Limit AV [dB μ V/m]	Delta [dB]
1876		47,5	----		100	-11,7	35,8		80,8		-45,0
7236		51,7	----		100	4,4	56,0		80,8		-24,8
9652		37,2	----		100	6,6	43,8		80,8		-37,0

Corrected field strength of fundamental wave as reference for radiated emissions:

100,7 dB μ V/m

Channel 6											
Frequency [MHz]	Restricted Band	Reading Level PK [dB μ V]	Corr. Duty Cycle [dB]	Level AV [dB μ V] *)	Band-width [kHz]	Correct. Factor [dB]	Corrected Level PK [dB μ V/m]	Corrected Level AV [dB μ V/m]	Limit PK [dB μ V/m]	Limit AV [dB μ V/m]	Delta [dB]
1918		55,6	----		100	-11,4	44,2		80,7		-36,5
7312	■	51,4	----	42,1	1000	4,3	55,7	45,4	74,0	54,0	-8,6
9742		33,0	----		100	6,6	39,6		80,7		-41,1

Corrected field strength of fundamental wave as reference for radiated emissions:

101,3 dB μ V/m

Channel 11											
Frequency [MHz]	Restricted Band	Reading Level PK [dB μ V]	Corr. Duty Cycle [dB]	Level AV [dB μ V] *)	Band-width [kHz]	Correct. Factor [dB]	Corrected Level PK [dB μ V/m]	Corrected Level AV [dB μ V/m]	Limit PK [dB μ V/m]	Limit AV [dB μ V/m]	Delta [dB]
7386	■	53,9	----	44,4	1000	4,3	58,2	48,7	74,0	54,0	-5,3

*) Average values were measured with spectrum analyzer by taking the following Settings

RBW: 1 MHz

VBW: 10 Hz

Sweep: Auto

Peak-Limit according to FCC Subpart 15.247(c)

In any 100 kHz bandwidth outside the frequency band 2400 – 2483.50 MHz, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in §15.209(a) is not required.

In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limit specified in §15.209(a) (see §15.205(c)).

Final radiated limits for spurious emissions which fall not in restricted band:

Frequency [MHz]	Limits acc. 15.209 [dB μ V/m]	Measure- ment dis- tance (meters)	Limits acc. 15.247(c) [dB μ V/m]			Final Radiated Limits [dB μ V/m]		
			Ch 1	Ch 6	Ch 11	Ch 1	Ch 6	Ch 11
0,009-0,490	2400/F(kHz)	300	80,8	80,7	81,3	80,8	80,7	81,3
0,490-1,705	24000/F(kHz)	30	80,8	80,7	81,3	80,8	80,7	81,3
1,705-30	30	30	80,8	80,7	81,3	80,8	80,7	81,3
30-88	40	3	80,8	80,7	81,3	80,8	80,7	81,3
88-216	43,5	3	80,8	80,7	81,3	80,8	80,7	81,3
216-960	46	3	80,8	80,7	81,3	80,8	80,7	81,3
Above 960	54	3	80,8	80,7	81,3	80,8	80,7	81,3

Radiated limits according to FCC Part 15 Subpart 15.209(a) for spurious emissions which fall in restricted band:

Frequency (MHz)	Field strength of spurious emissions		Measurement distance (meters)
	(μ V/m)	dB (μ V/m)	
0,009-0,490	2400/F(kHz)		300
0,490-1,705	24000/F(kHz)		30
1,705-30	30	29,5	30
30-88	100	40	3
88-216	150	43,5	3
216-960	200	46	3
Above 960	500	54	3

Restricted bands of operation:

The field strength of emissions appearing within these frequency bands shall not exceed the limits shown in §15.209

MHz	MHz	GHz
25.5 – 25.67	960 – 1240	4.5 – 5.15
37.5 – 38.25	1300 – 1427	5.35 – 5.46
73 – 74.6	1435 – 1626.5	7.25 – 7.75
74.8 – 75.2	1645.5 – 1646.5	8.025 – 8.5
108 – 121.94	1660 – 1710	9.0 – 9.2
123 – 138	1718.8 – 1722.2	9.3 – 9.5
149.9 – 150.05	2200 – 2300	10.6 – 12.7
156.52475 – 156.52525	2310 – 2390	13.25 – 13.4
156.7 – 156.9	2483.5 – 2500	14.47 – 14.5
162.0125 – 167.17	2655 – 2900	15.35 – 16.2
167.72 – 173.2	3260 – 3267	17.7 – 21.4
240 – 285	3332 – 3339	22.01 – 23.12
322 – 335.4	3345.8 – 3358	23.6 – 24.0
399.9 – 410	3600 – 4400	31.2 – 31.8
608 – 614		36.43 – 36.5

The requirements are **FULFILLED**.

Remarks: During the test, the Eut was set into normal modulation mode as intended for use.

The measurement was performed up to the 10th harmonic (25000MHz).

5.4 Spurious RF Conducted Emission

For test instruments and accessories used see section 6 Part **SEC1, SEC2 and SEC3**.

5.4.1 Description of the test location

Test location: AREA4

5.4.2 Description of Measurement

A Spectrum analyzer / EMI test receiver is connected to the output of the transmitter via a suitable attenuator while EuT was operating in transmit mode using the assigned frequency.

Analyzer Settings:

- Detector: Max Hold
- RBW: 100 kHz
- VBW: \geq RBW
- Sweep Time: Coupled
- Detector function: Peak

5.4.3 Photo documentation of the test set-up



5.4.4 Test result

Corrected field strength of fundamental wave as reference for conducted emissions:

109,8 dB μ V

Channel 1												
Frequency [MHz]	Restricted Band	Reading Level PK [dB μ V]	Corr. Duty Cycle [dB]	Level AV [dB μ V] *)	Band-width [kHz]	Correct. Factor [dB]	Corrected Level PK [dB μ V/m]	Corrected Level AV [dB μ V/m]	Limit PK [dB μ V/m]	Limit AV [dB μ V/m]	Delta [dB]	
0,009-0,15					0,2		< 30					
0,15-30					9		< 30					
674,4		53,60	----		100	0,9	54,5		89,8		-35,3	
7240		48,70	----		100	3,5	52,2		89,8		-37,7	
9652		60,37	----		100	3,7	64,1		89,8		-25,8	

Corrected field strength of fundamental wave as reference for conducted emissions:

107,9 dB μ V

Channel 6												
Frequency [MHz]	Restricted Band	Reading Level PK [dB μ V]	Corr. Duty Cycle [dB]	Level AV [dB μ V] *)	Band-width [kHz]	Correct. Factor [dB]	Corrected Level PK [dB μ V/m]	Corrected Level AV [dB μ V/m]	Limit PK [dB μ V/m]	Limit AV [dB μ V/m]	Delta [dB]	
0,009-0,15					0,2		< 30					
0,15-30					9		< 30					
699,7		52,80	----		100	0,9	53,7		87,9		-34,2	
9742		56,87	----		100	3,8	60,7		87,9		-27,2	

Corrected field strength of fundamental wave as reference for conducted emissions:

108,3 dB μ V

Channel 11												
Frequency [MHz]	Restricted Band	Reading Level PK [dB μ V]	Corr. Duty Cycle [dB]	Level AV [dB μ V] *)	Band-width [kHz]	Correct. Factor [dB]	Corrected Level PK [dB μ V/m]	Corrected Level AV [dB μ V/m]	Limit PK [dB μ V/m]	Limit AV [dB μ V/m]	Delta [dB]	
0,009-0,15					0,2		< 30					
0,15-30					9		< 30					
725,0		50,12	----		100	0,9	51,0		88,3		-37,3	
9850		53,18	----		100	3,9	57,1		88,3		-31,2	

Peak-Limit according to FCC Subpart 15.247(c)

In any 100 kHz bandwidth outside the frequency band 2400 – 2483.50 MHz, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.

Attenuation below the general limits specified in §15.209(a) is not required.

In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limit specified in §15.209(a) (see §15.205(c)).

Restricted bands of operation:

The field strength of emissions appearing within these frequency bands shall not exceed the limits shown in §15.209

MHz	MHz	GHz
25.5 – 25.67	960 – 1240	4.5 – 5.15
37.5 – 38.25	1300 – 1427	5.35 – 5.46
73 – 74.6	1435 – 1626.5	7.25 – 7.75
74.8 – 75.2	1645.5 – 1646.5	8.025 – 8.5
108 – 121.94	1660 – 1710	9.0 – 9.2
123 – 138	1718.8 – 1722.2	9.3 – 9.5
149.9 – 150.05	2200 – 2300	10.6 – 12.7
156.52475 – 156.52525	2310 – 2390	13.25 – 13.4
156.7 – 156.9	2483.5 – 2500	14.47 – 14.5
162.0125 – 167.17	2655 – 2900	15.35 – 16.2
167.72 – 173.2	3260 – 3267	17.7 – 21.4
240 – 285	3332 – 3339	22.01 – 23.12
322 – 335.4	3345.8 – 3358	23.6 – 24.0
399.9 – 410	3600 – 4400	31.2 – 31.8
608 – 614		36.43 – 36.5

The requirements are **FULFILLED**.

Remarks: Only spurious emissions which are falling not in restricted bands have been measured conducted.
Spurious emissions which are falling in restricted band have been measured radiated. Please
refer to „Radiated emissions 30 MHz – 40 GHz“ on page 20 – 27.
The measurement was performed up to the 10th harmonic (25000MHz).

5.5 6 dB Bandwidth

For test instruments and accessories used see section 6 Part **MB**.

5.5.1 Description of the test location

Test location: AREA4

5.5.2 Photo documentation of the test set-up



5.5.3 Description of Measurement

The bandwidth is measured at an amplitude level reduced from the reference level by a specified ratio of -6 dB. The reference level is the level of the highest amplitude signal observed from the transmitter at either the fundamental frequency or the first-order modulation products in all typical modes of operation, including the unmodulated carrier, even if atypical.

The resolution bandwidth of measuring instrument was set to a value as shown in the following table below according to ANSI C63.4-2003.

Fundamental frequency	Minimum resolution bandwidth
9 kHz to 30 MHz	1kHz
30 to 1000 MHz	10 kHz
1000 MHz to 40 GHz	100 kHz

5.5.4 Test result

Channel number	Fundamental Frequency [MHz]	6 dB BANDWIDTH (MHz)	MINIMUM LIMIT (MHz)
1	2412	11,60	0,5
6	2437	11,30	0,5
11	2462	11,20	0,5

Limit according to FCC Subpart 15.247 (a)(2)

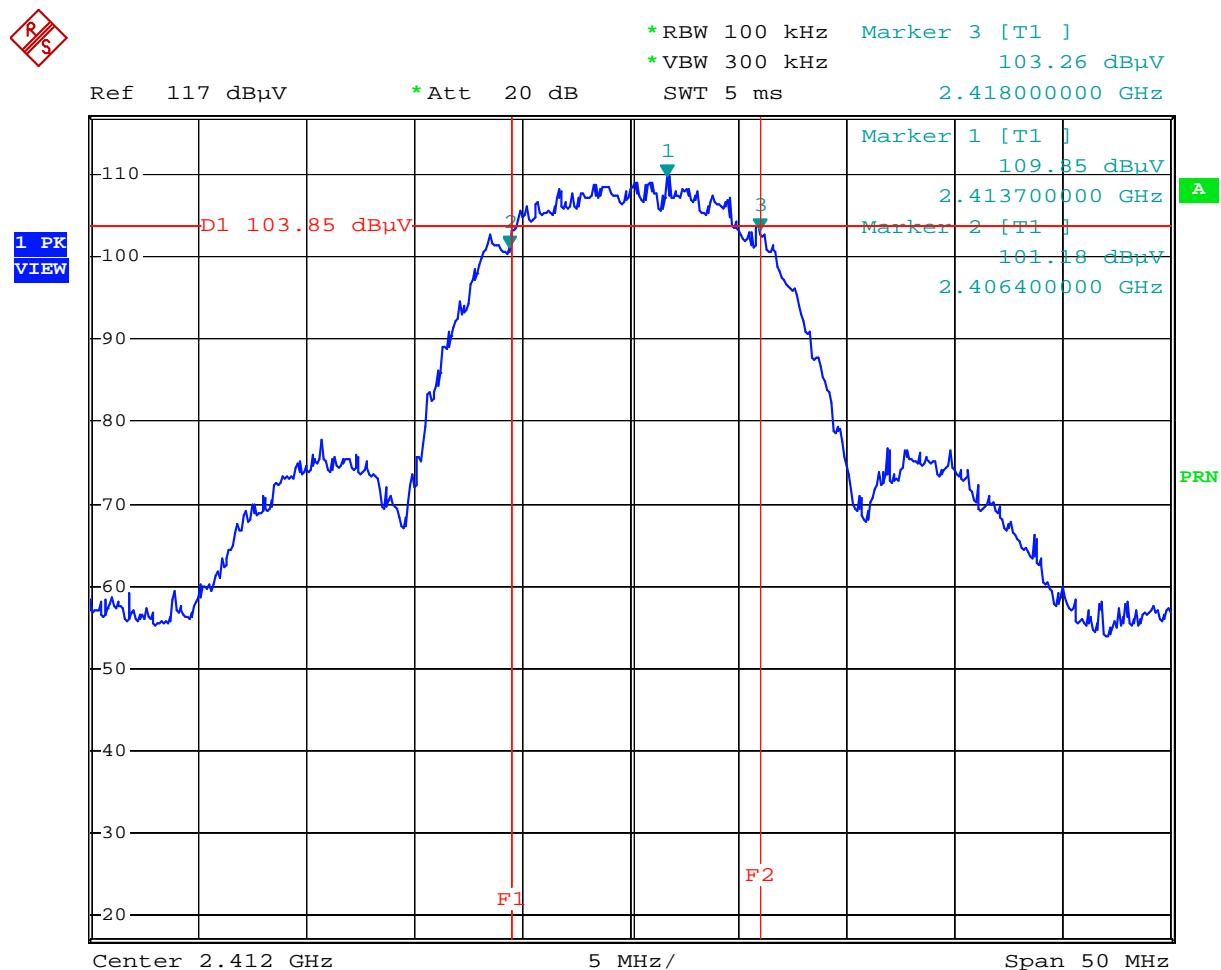
The minimum 6 dB bandwidth shall be at least 500 kHz

Remarks: For detailed test result please refer to following test protocol.

5.5.5 Test protocol

6dB Bandwidth Measurement FCC Part 15 Subpart 15.247(a)(2)

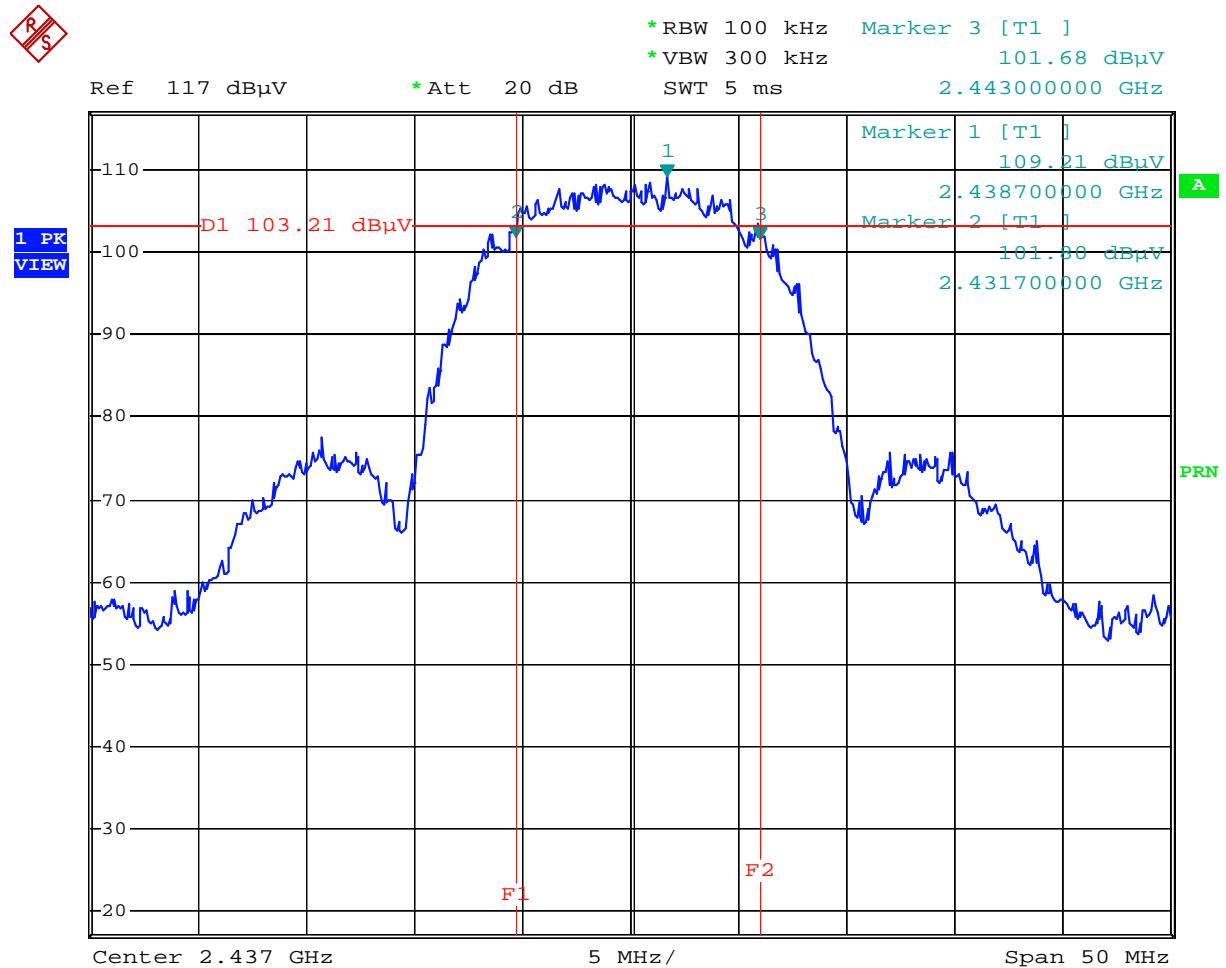
Channel 1



Date: 24.NOV.2006 16:57:06

6dB Bandwidth Measurement
FCC Part 15 Subpart 15.247(a)(2)

Channel 6

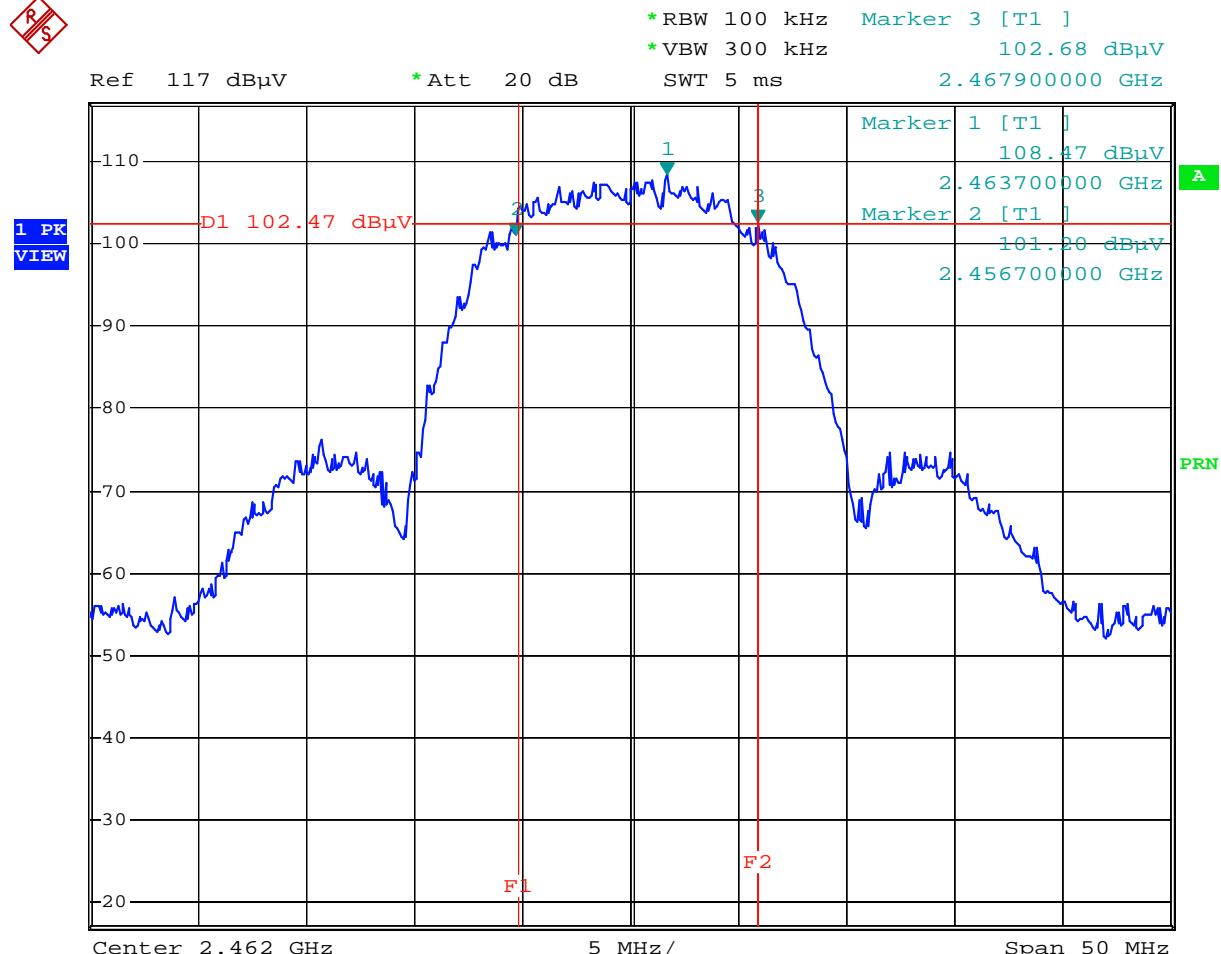


Date: 24.NOV.2006 17:29:23

6dB Bandwidth Measurement
FCC Part 15 Subpart 15.247(a)(2)

Channel 11

RF
S



Date: 24.NOV.2006 17:48:47

5.6 Band edge test

For test instruments and accessories used see section 6 Part **MB**.

5.6.1 Description of the test location

Test location: AREA4

5.6.2 Photo documentation of the test set-up



5.6.3 Description of Measurement

The EuT was connected to the spectrum analyzer with a suitable attenuator. The span of the spectrum analyzer was set wide enough to capture the peak level of the emission operating on the channel closest to the bandedge, as well as any modulation products which fall outside of the authorized band of operation. The highest amplitude appearing on spectral display was measured and it was set as the reference level for the emission mask. It was allowed the trace to stabilize and after then it was set the emission mask on the reference level to show the compliance with the bandedge requirements.

Further settings on the spectrum analyzer:

RBW: $\geq 1\%$ of the span

VBW: \geq RBW

Sweep: Auto

Detector function: Peak

5.6.4 Test result

Frequency [MHz]	Peak Power Output [dB μ V]	Spurious emission read value [dB μ V]	Result of Band edge [dBc]	Band edge LIMIT [dBc]
< 2400	109,54	77,56	31,98	≥ 20
> 2483,5	108,39	57,49	50,90	≥ 20

Peak-Limit according to FCC Subpart 15.247(c)

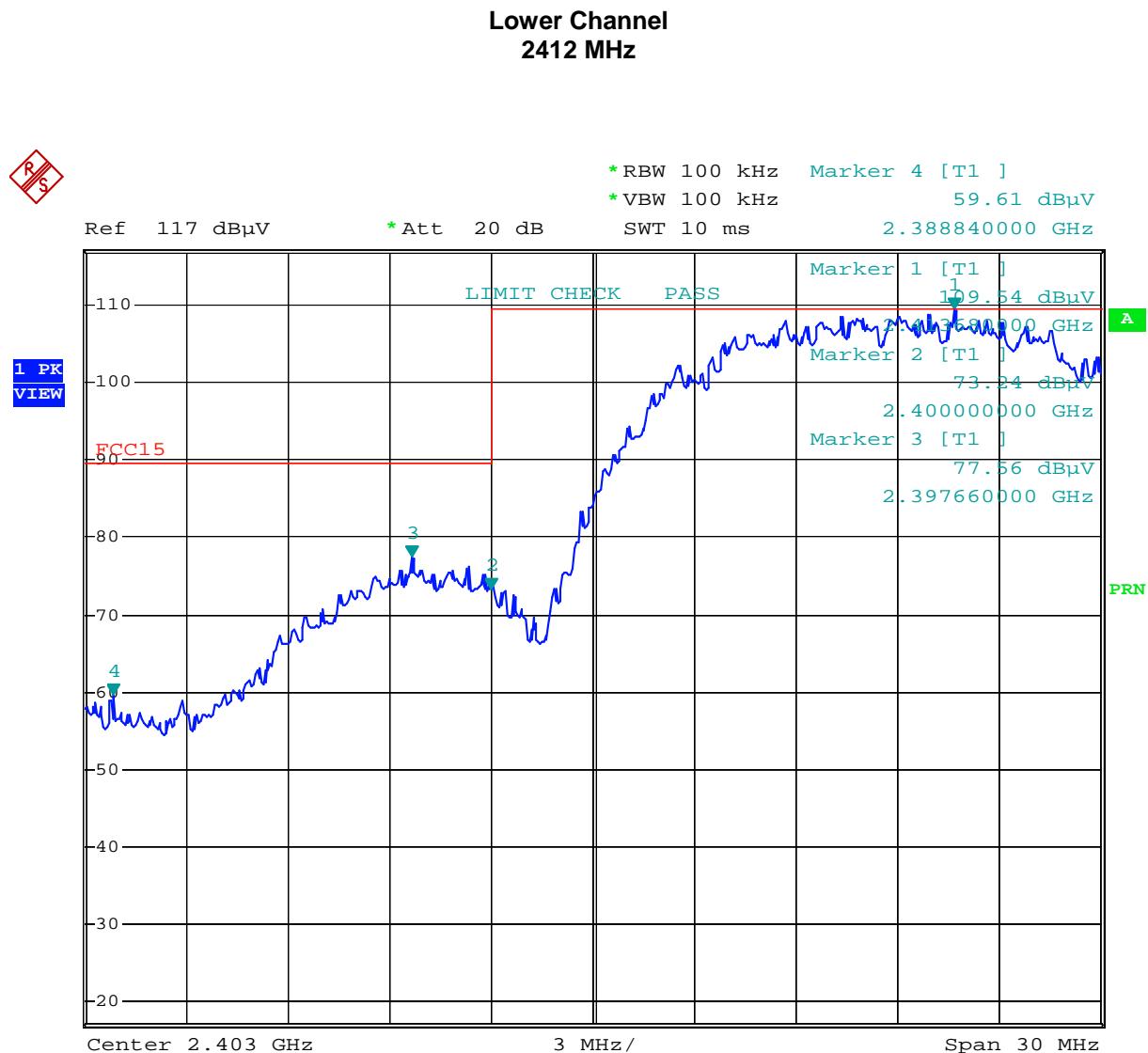
In any 100 kHz bandwidth outside the frequency band 2400 – 2483.50 MHz, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in §15.209(a) is not required.

In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limit specified in §15.209(a) (see §15.205(c)).

The requirements are **FULFILLED**.

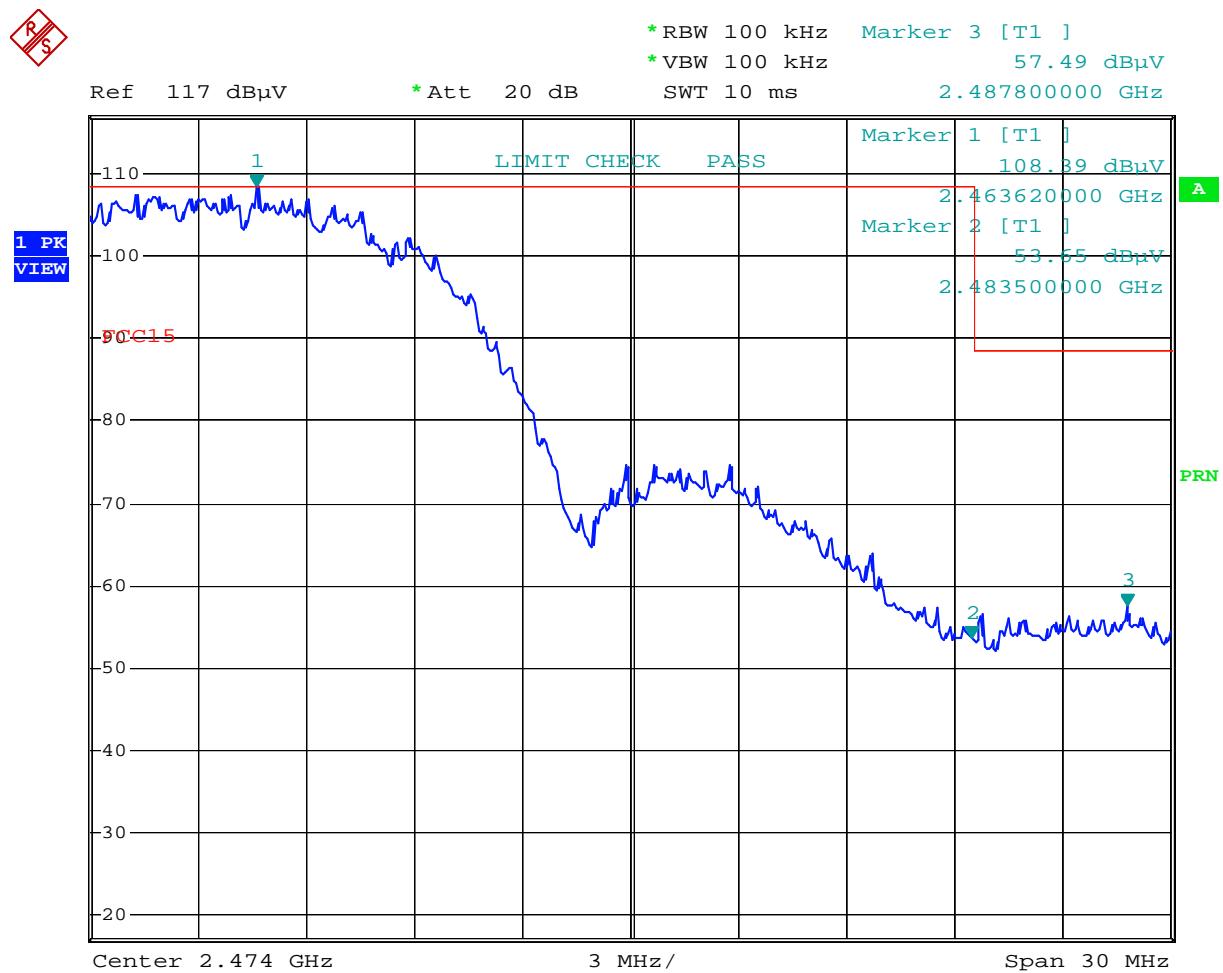
Remarks: For detailed test results please refer to following test protocol.

5.6.5 Test protocol



Date: 24.NOV.2006 17:09:27

Higher Channel 2462 MHz



Date: 24.NOV.2006 17:52:48

5.7 Peak Power Density

For test instruments and accessories used see section 6 Part CPC 3.

5.7.1 Description of the test location

Test location: Area 4

5.7.2 Photo documentation of the test set-up



5.7.3 Description of Measurement

The EuT was connected to the spectrum analyzer with a suitable attenuator. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using 3 kHz RBW and 30 kHz VBW, set sweep time equal to span/3 kHz. The power spectral density was measured and recorded.

Settings on the spectrum analyzer:

RBW: 3 kHz
VBW: 30 kHz
Sweep: auto
Detector function: Peak

5.7.4 Test result

Channel	Fundamental Frequency [MHz]	Peak Power density (dBm)
1	2412	-8,1
6	2437	-8,6
11	2462	-9,5

Limit according to FCC Subpart 15.247 (d)

The peak power spectral density shall not be greater than 8 dBm in any 3 kHz band.

The requirements are **FULFILLED**.

Remarks: _____

Antenna application

5.9.1 Antenna requirements

The EuT's antenna is met the requirement of FCC part 15C section 15.203 and 15.204.

FCC part 15C section 15.247 requirement:

Systems operating in the 2400-2483,5 MHz band that are used exclusively for fixed, point to point operations may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dbi.

5.9.2 Result

The EUT used a dipole antenna and is internal connected via RF cable to the WLAN module. The max. antenna gain is 2,0 dBi and meets the requirement.

Receiver radiated emissions 9 kHz - 40 GHz

For test instruments and accessories used see section 6 Part **SER1**, **SER2** and **SER3**.

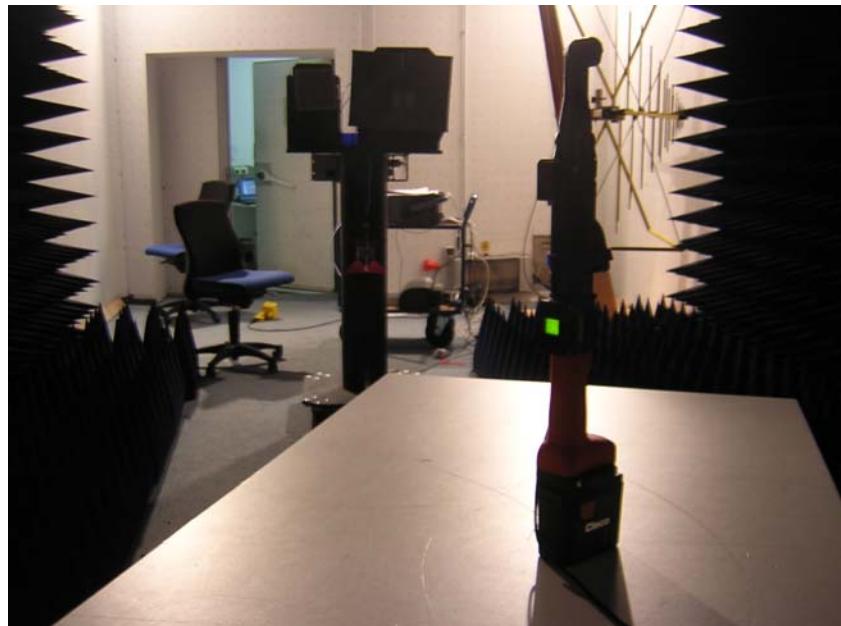
5.11.1 Description of the test location

Test location: OATS1
Anechoic Chamber A2

Test distance: 3 metres

5.11.2 Photo documentation of the test set-up





5.11.3 Description of Measurement

The spurious emissions from the EuT will be measured on an open area test site in the frequency range of 9 kHz to 30 MHz using a tuned receiver and a shielded loop antenna. The antenna was positioned 3, 10 or 30 meters horizontally from the EuT. Measurements have been made in all three orthogonal axes and the shielded loop antenna was rotated to locate the maximum of the emissions. In the case where larger measuring distances are required the results will be extrapolated based on the values measured on the closer distances according to Section 15.31 (f) (2) [2]. The final measurement will be performed with an EMI Receiver set to Quasi Peak detector except for the frequency bands 9 kHz to 90 kHz and 110 to 490 kHz where an average detector will be used according to Section 15.209 (d) [2].

The final level, expressed in $\text{dB}\mu\text{V}/\text{m}$, is arrived at by taking the reading from the EMI receiver (Level $\text{dB}\mu\text{V}$) and adding the antenna correction factor and cable loss factor (Factor dB) to it. This result then has to be compared with the relevant FCC limit.

The resolution bandwidth during the measurement is as follows:

9 kHz – 150 kHz: ResBW: 200 Hz

150 kHz – 30 MHz: ResBW: 9 kHz

Radiated spurious emissions from the EuT are measured in the frequency range of 30 MHz to 1000 MHz using a tuned receiver and appropriate broadband linearly polarized antennas. Measurements between 30 MHz and 1000 MHz are made with 120 kHz/6 dB bandwidth and quasi-peak detection. Table top equipment is placed on a 1.0 X 1.5 meter non-conducting table 80 centimetres above the ground plane. Floor standing equipment is placed directly on the turntable/ground plane. The set up of the Equipment under test will be in accordance to ANSI C63.4-2003. The Interface cables that are closer than 40 centimetres to the ground plane are bundled in the center in a serpentine fashion so they are at least 40 centimetres from the ground plane. Cables to simulators/testers (if used in this test) are routed through the center of the table and to a screen room located outside the test area. The antenna was positioned 3, 10 or 30 meters horizontally from the EuT. To locate maximum emissions from the test sample the antenna is varied in height from 1 to 4 meters, measurement scans are made with both horizontal and vertical antenna polarization's and the EuT are rotated 360 degrees.

The final level, expressed in $\text{dB}\mu\text{V}/\text{m}$, is arrived by taking the reading from the EMI receiver (Level $\text{dB}\mu\text{V}$) and adding the correction factors and cable loss factor (Factor dB) to it. This is done automatically in the EMI receiver, where the correction factors are stored. This result then has the FCC or CISPR limit subtracted from it to provide the Delta which gives the tabular data as shown in the data sheets at page.

The radiated emissions from the EuT are measured in the frequency range of 1 GHz to maximum frequency as specified in section 15.33, using a tuned receiver (Spectrum Analyser) and appropriate linearly polarized antennas. Table top equipment is placed on a 1.0 X 1.5 meter non-conducting table 80 centimetres above the ground plane. Floor standing equipment is placed directly on the turntable/ground plane. The set up of the Equipment under test will be in accordance to ANSI C63.4-2003.

The Interface cables that are closer than 40 centimetres to the ground plane are bundled in the center in a serpentine fashion so they are at least 40 centimetres from the ground plane. Cables to simulators/testers (if used in this test) are routed through the center of the table and to a screen room located outside the test area. The antenna was positioned 3m horizontally from the EuT.

Measurement are made in both the horizontal and vertical planes of polarization in a fully anechoic room using a spectrum analyzer with the detector function set to peak and resolution as well as video bandwidth set to 100 kHz and for any spurious emission or modulation product that falls in Restricted Band, as defined in Section 15.205, set the resolution and video bandwidth to 1 MHz.

All tests are performed at a test-distance of 3 meters. Hand-held or body-worn devices are rotated through three orthogonal axes to determine which attitude and configuration procedure the highest emission relative the limit and therefore shall be used for final testing. During the tests the EUT is rotated all around to find the maximum levels of emissions. The cables and equipment were placed and moved within the range of position likely to find their maximum emissions. When the EuT is larger than the beamwidth of the measuring antenna, the measurement antenna will be moved over the surfaces for the four sides or the test distance will be reduced to demonstrate that emissions were at maximum at the limit distance.

Analyzer Settings (EMI receiver) for spurious emissions which fall not in Restricted Band:

- Detector: Max hold
- RBW: 100 kHz for $f \geq 1\text{GHz}$, 120 kHz for $f \leq 1\text{GHz}$
- VBW: \geq RBW
- Sweep Time: Coupled
- Detector function: Peak

Analyzer Settings (EMI receiver) for spurious emissions which fall in Restricted Band:

- Detector: Max hold
- RBW: 1 MHz for $f \geq 1\text{GHz}$, 120 kHz for $f \leq 1\text{GHz}$
- VBW: \geq RBW
- Sweep Time: Coupled
- Detector function: Peak for $f \geq 1\text{GHz}$, Quasi Peak for $f \leq 1\text{GHz}$

5.11.4 Test result

Testresult in detail: (<1GHz)

Frequency [MHz]	Reading Level QP [dB μ V]	Reading Level AV [dB μ V]	Reading Level PK [dB μ V]	Bandwidth [kHz]	Correct. factor [dB]	Corrected Level QP [dB μ V/m]	Corrected Level AV [dB μ V/m]	[Corrected Level PK [dB μ V/m]	Limit [dB μ V/m]			Delta [dB]
									QP	AV	PK	
0,009-0,15				0,2		< 30						
0,15-30				9		< 30						
30-1000				120		< 30						

Frequency [MHz]	Reading Level QP [dB μ V]	Reading Level AV [dB μ V]	Reading Level PK [dB μ V]	Bandwidth [kHz]	Correct. factor [dB]	Corrected Level QP [dB μ V/m]	Corrected Level AV [dB μ V/m]	[Corrected Level PK [dB μ V/m]	Limit [dB μ V/m]			Delta [dB]
									QP	AV	PK	
0,009-0,15				0,2		< 30						
0,15-30				9		< 30						
30-1000				120		< 30						

Frequency [MHz]	Reading Level QP [dB μ V]	Reading Level AV [dB μ V]	Reading Level PK [dB μ V]	Bandwidth [kHz]	Correct. factor [dB]	Corrected Level QP [dB μ V/m]	Corrected Level AV [dB μ V/m]	[Corrected Level PK [dB μ V/m]	Limit [dB μ V/m]			Delta [dB]
									QP	AV	PK	
0,009-0,15				0,2		< 30						
0,15-30				9		< 30						
30-1000				120		< 30						

Test result >1GHz

Limit according to FCC Subpart 15.109(a)

Frequency of emission [MHz]	Field strength Limits [μ V/m]	Field strength Limits [dB μ V/m]
0,009-0,490	2400/F(kHz)	
0,490-1,705	24000/F(kHz)	
1,705-30	30	
30-88	100	40
88-216	150	44
216-960	200	46
Above 960	500	54

The requirements are **FULFILLED**.

Remarks: During the test, the Eut was set into continuous receiving mode.

The measurement was performed up to the 5th harmonic (13000 MHz).

6 USED TEST EQUIPMENT AND ACCESSORIES

All test instruments used, in addition to the test accessories, are calibrated and verified regularly.

The calibration intervals and the calibration history will be given out on request.

Test ID	Model / Type	Kind of Equipment	Manufacturer	Equipment No.
CPC 3	FSP 30	Spectrum Analyzer	Rohde & Schwarz München	02-02/11-05-001
	THS730A	Handheld Scope	Tektronix GmbH	02-02/13-05-001
	WK-340/40	Climatic Chamber	Weiss Umwelttechnik GmbH	02-02/45-05-001
CPR 3	FSP 30	Spectrum Analyzer	Rohde & Schwarz München	02-02/11-05-001
	AFS4-01000400-10-10P-4	RF Amplifier 1-4 GHz	PARZICH GMBH	02-02/17-05-003
	BBHA 9120 E 251	Broad-Band Horn Antenna	Schwarzbeck Mess-Elektronik	02-02/24-05-006
	Sucoflex N-2000-SMA	RF Cable	novotronik Signalverarbeitung	02-02/50-05-075
	Sucoflex N-2000-SMA	RF Cable	novotronik Signalverarbeitung	02-02/50-05-088
MB	FSP 30	Spectrum Analyzer	Rohde & Schwarz München	02-02/11-05-001
	THS730A	Handheld Scope	Tektronix GmbH	02-02/13-05-001
	WK-340/40	Climatic Chamber	Weiss Umwelttechnik GmbH	02-02/45-05-001
SEC 1-3	FSP 30	Spectrum Analyzer	Rohde & Schwarz München	02-02/11-05-001
	THS730A	Handheld Scope	Tektronix GmbH	02-02/13-05-001
	WK-340/40	Climatic Chamber	Weiss Umwelttechnik GmbH	02-02/45-05-001
SER 1	FMZB 1516	Magnetic Field Antenna	Schwarzbeck Mess-Elektronik	01-02/24-01-018
	ESHS 30	EMI Test Receiver	Rohde & Schwarz München	02-02/03-05-002
SER 2	ESVS 30	EMI Test Receiver	Rohde & Schwarz München	02-02/03-05-006
	VULB 9168	Trilog-Broadband Antenna	Schwarzbeck Mess-Elektronik	02-02/24-05-005
	S10162-B/+11N-50-10-5/+11N	RF Cable 33m	Huber + Suhner	02-02/50-05-031
	KK-EF393-21N-16	RF Cable 20m	Huber + Suhner	02-02/50-05-033
	NW-2000-NB	RF Cable	Huber + Suhner	02-02/50-05-113
SER 3	FSP 30	Spectrum Analyzer	Rohde & Schwarz München	02-02/11-05-001
	AFS4-01000400-10-10P-4	RF Amplifier 1-4 GHz	PARZICH GMBH	02-02/17-05-003
	AMF-4F-04001200-15-10P	RF Amplifier 4-12 GHz	PARZICH GMBH	02-02/17-05-004
	AFS5-12001800-18-10P-6	Amplifier	PARZICH GMBH	02-02/17-06-002
	3117	Horn Antenna 1-18 GHz	EMCO Elektronik GmbH	02-02/24-05-009
	Sucoflex N-1600-SMA	RF Cable	novotronik Signalverarbeitung	02-02/50-05-073
	Sucoflex N-2000-SMA	RF Cable	novotronik Signalverarbeitung	02-02/50-05-075