InterLab®

FCC Measurement/Technical Report on

WLAN transceiver
WiBear11n-DF2

FCC ID PV7-WIBEAR11N-DF2
IC: 7738A-WB11NDF2

Report Reference: MDE_LESSW_1302_FCCc

Test Laboratory:
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7Layers AG
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DAkkS
Deutsche
Akkreditierungsstelle
D-PL-12140-01-01

Note:
The following test results relate only to the devices specified in this document. This report shall not be reproduced in parts without the written approval of the test laboratory.

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0 Summary

0.1 Technical Report Summary

Type of Authorization
Certification for an Intentional Radiator (Digital Device / Spread Spectrum).

Applicable FCC Rules

Prepared in accordance with the requirements of FCC Rules and Regulations as listed in 47 CFR Ch.1 Parts 2 (10-1-13 Edition) and 15 (10-1-13 Edition). The following subparts are applicable to the results in this test report.

Part 2, Subpart J - Equipment Authorization Procedures, Certification

Part 15, Subpart C – Intentional Radiators

§ 15.201 Equipment authorization requirement

§ 15.207 Conducted limits

§ 15.209 Radiated emission limits; general requirements

§ 15.247 Operation within the bands 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz

Note:
The tests were selected and performed with reference to the FCC measurement guide line "Measurement of Digital Transmission Systems Operating under Section 15.247 March 23, 2005"
Instead of applying ANSI C63.4–1992 which is referenced in the FCC Public Note, the newer ANSI C63.4–2009 is applied.

Summary Test Results:

The EUT complied with all performed tests as listed in chapter 0.2 Measurement Summary.

0.2 Measurement Summary

FCC Part 15, Subpart C	§ 15.247 (b) (1)		
Peak power output			
The measurement was performed according to FCC § 15.31			10-1-13 Edition
OP-Mode	**Setup**	**Port**	**Final Result**
op-mode 1b	Setup_02	Antenna connector	passed
op-mode 1g	Setup_02	Antenna connector	passed
op-mode 1n	Setup_02	Antenna connector	passed
op-mode 2b	Setup_02	Antenna connector	passed
op-mode 2g	Setup_02	Antenna connector	passed
op-mode 2n	Setup_02	Antenna connector	passed
op-mode 3b	Setup_02	Antenna connector	passed
op-mode 3g	Setup_02	Antenna connector	passed
op-mode 3n	Setup_02	Antenna connector	passed
op-mode 1n+	Setup_02	Antenna connector	passed
op-mode 2n+	Setup_02	Antenna connector	passed
op-mode 3n+	Setup_02	Antenna connector	passed
op-mode 1a	Setup_02	Antenna connector	passed
op-mode 2a	Setup_02	Antenna connector	passed
op-mode 3a	Setup_02	Antenna connector	passed
op-mode 1n5	Setup_02	Antenna connector	passed
op-mode 2n5	Setup_02	Antenna connector	passed
op-mode 3n5	Setup_02	Antenna connector	passed
op-mode 2n5+	Setup_02	Antenna connector	passed
op-mode 3n5+	Setup_02	Antenna connector	passed

FCC Part 15, Subpart C	§ 15.247 (d), § 15.35 (b), § 15.209		
Spurious radiated emissions			
The measurement was performed according to ANSI C63.4			2009
OP-Mode	**Setup**	**Port**	**Final Result**
op-mode 1b	Setup_01	Enclosure	passed
op-mode 2b	Setup_01	Enclosure	passed
op-mode 3b	Setup_01	Enclosure	passed
op-mode 1g	Setup_01	Enclosure	passed
op-mode 2g	Setup_01	Enclosure	passed
op-mode 3g	Setup_01	Enclosure	passed
op-mode 1n	Setup_01	Enclosure	passed
op-mode 2n	Setup_01	Enclosure	passed
op-mode 3n	Setup_01	Enclosure	passed
op-mode 1a	Setup_01	Enclosure	passed
op-mode 2a	Setup_01	Enclosure	passed
op-mode 3a	Setup_01	Enclosure	passed

Responsible for Accreditation Scope: B. Rott

Responsible for Test Report: M. Jullich

1 Administrative Data

1.1 Testing Laboratory

Company Name:	7 Layers AG
Address	Borsigstr. 11 40880 Ratingen Germany

This facility has been fully described in a report submitted to the FCC and accepted under the registration number 96716 .

The test facility is also accredited by the following accreditation organisation:

Laboratory accreditation no.:	DAkkS D-PL-12140-01-01
Responsible for Accreditation Scope:	Dipl.-Ing. Bernhard Retka Dipl.-Ing. Robert Machulec Dipl.-Ing. Thomas Hoell Dipl.-Ing. Andreas Petz Dipl.-Ing. Marco Kullik
Report Template Version:	2012-08-27

1.2 Project Data

Responsible for testing and report:	Dipl.-Ing. Marco Kullik
Date of Test(s):	2013-12-10 to 2014-02-26
Date of Report:	2014-03-07

1.3 Applicant Data

Company Name:	Lesswire AG
Address:	Rudower Chaussee 30 12489 Berlin Germany
Contact Person:	Dr. Daniel Dietterle

1.4 Manufacturer Data

Company Name:	PRETTL Electronics AG
Address:	Robert-Bosch-Straße 10, 01454 Radeberg, Germany
Contact Person:	Kerstin Sauer

2 Test object Data

2.1 General EUT Description

Equipment under Test:	IEEE 802.11a/b/g/n WLAN transceiver
Type Designation:	WiBear11n – DF2
Kind of Device: (optional)	Transceiver module
Voltage Type:	DC
Voltage Level:	1.8 V and 3.3 V
Tested Modulation Type:	DBPSK; OFDM:BPSK; OFDM:64-QAM

General product description:

The EUT is industrial universal module, targeted for integration into different Original Equipment Manufacturer products. The module is designed for both - simultaneous and independent operation of the following:
IEEE 802.11a/b/g/n payload data rates for Wireless Local Area Network (WLAN), Bluetooth 3.0+High Speed (HS) and Bluetooth 2.1+EDR. It provides a complete end-to-end solution for low power applications. It includes an integrated MAC/Baseband processor and RF front-end components, and can connect to a host processor via SDIO interface.

Specific product description for the EUT:

The EUT is a dual band WLAN (802.11 a/b/g/n, 2.5 and 5 GHz) and Bluetooth module with one joint antenna connector for WLAN and Bluetooth. In IEEE 802.11n mode it supports 20 MHz and 40 MHz bandwidth channels (both with MCS7), providing 72.2 Mbit/s, and 150 Mbit/s transfer data rates respectively.

The object of this test report is the WLAN transceiver, consequently switched on the IEEE 802.11 a/b/g/n modes, working in 2.4 MHz and 5 MHz bands. In IEEE 802.11n mode, it was tested with 20 MHz and 40 MHz channel bandwidth.

The EUT provides the following ports:

Ports

- Antenna connector
- DC port
- Data port
- Enclosure

The main components of the EUT are listed and described in Chapter 2.2

2.2 EUT Main components

Type, S/N, Short Descriptions etc. used in this Test Report

Short Description	Equipment under Test	Type Designation	Serial No.	HW Status	SW Status	Date of Receipt
EUT A (Code: LS003r01)	WLAN transceiver	WiBear11n-DF2	AN00J93176 C432 1001 1341	mounted on evaluation board #23 Ver. C4	14.44.35.p200	–
Remark: EUT A is equipped with a dual band integral antenna A10194 (with antenna gain = 1.8 dBi at 2.4 – 2.5 GHz frequency range and 4.1 dBi in 4.9 – 5.9 MHz frequency range).						
EUT B (Code: LS003w01)	WLAN transceiver	WiBear11n-DF2	AN00J93176 C432 1001 1395	mounted on evaluation board #12 Ver. C4	14.44.35.p200	–
Remark: EUTB A is equipped with a joint antena connector						

NOTE: The short description used to simplify the identification of the EUT in this test report.

2.3 Ancillary Equipment

For the purposes of this test report, ancillary equipment is defined as equipment, which is used in conjunction with the EUT to provide operational and control features to the EUT. It is necessary to configure the system in a typical fashion, as a customer would normally use it. But nevertheless Ancillary Equipment can influence the test results.

Short Description	Equipment under Test	Type Designation	HW Status	SW Status	Serial no.	FCC ID
–	–	–	–	–	–	–

2.4 Auxiliary Equipment

For the purposes of this test report, auxiliary equipment is defined as equipment, which is used temporarily to enable operational and control features especially used for the tests of the EUT, which is not used during normal operation or equipment that is used during the tests in combination with the EUT but is not subject of this test report. It is necessary to configure the system in a typical fashion, as a customer would normally use it. But nevertheless Auxiliary Equipment can influence the test results.

Short Description	Equipment under Test	Type Designation	Serial no.	HW Status	SW Status	FCC ID
AUX1	Laptop Acer TravelMate 5720	Model: 2205	LXTK20603274 4008D6A2000	–	WinXP Prof.EN	–
AUX2	AC/DC Adapter for AUX1 Acer/LITEON	Model PA-1900-24	870923010AR	Rev A06	–	–
AUX3	cable & adapter board & SDIO connector to the host PC	Lesswire AG HOST SDIO	SDIO 1	–	–	–
AUX4	evaluation board with antenna (gain = 4.1 dBi) enabled and antenna connector (open).	EB1 & Antenova A10194 dual-band WLAN/BT antenna	#23	–	–	–
AUX5	evaluation board with antenna (gain = 4.1 dBi) enabled and antenna connector (open).	EB1 & Antenova A10194 dual-band WLAN/BT antenna	#12	–	–	–

2.5 EUT Setups

This chapter describes the combination of EUTs and equipment used for testing. The rationale for selecting the EUTs, ancillary and auxiliary equipment and interconnecting cables, is to test a representative configuration meeting the requirements of the referenced standards.

Setup No.	Combination of EUTs	Description and Rationale
Setup_01	EUT A + AUX1 to AUX4	setup for radiated measurements into the anechoic chamber
Setup_02	EUT B + AUX1 to AUX3 + AUX 5	setup for conducted measurements

2.6 Operating Modes

This chapter describes the operating modes of the EUTs used for testing.

Op. Mode	Description of Operating Modes	Remarks
op-mode 1b	TX-mode, the EUT transmits on the lowest channel (2412 MHz)	Worst case data rate 1 Mbps (channel 1) 20 MHz channel bandwidth
op-mode 1g	TX-mode, the EUT transmits on the lowest channel (2412 MHz)	Worst case data rate 6 Mbps (channel 1) 20 MHz channel bandwidth
op-mode 1n	TX-mode, the EUT transmits on the lowest channel (2412 MHz)	Worst case data rate 72.2 Mbps (channel 1) 20 MHz channel bandwidth
op-mode 2b	TX-mode, the EUT transmits on the mid channel (2437 MHz)	Worst case data rate 1 Mbps (channel 6) 20 MHz channel bandwidth
op-mode 2g	TX-mode, the EUT transmits on the mid channel (2437 MHz)	Worst case data rate 6 Mbps (channel 6) 20 MHz channel bandwidth
op-mode 2n	TX-mode, the EUT transmits on the mid channel (2437 MHz)	Worst case data rate 72.2 Mbps (channel 6) 20 MHz channel bandwidth
op-mode 3b	TX-mode, the EUT transmits on the highest channel (2462 MHz)	Worst case data rate 1 Mbps (channel 11) 20 MHz channel bandwidth
op-mode 3g	TX-mode, the EUT transmits on the highest channel (2462 MHz)	Worst case data rate 6 Mbps (channel 11) 20 MHz channel bandwidth
op-mode 3n	TX-mode, the EUT transmits on the highest channel (2462 MHz)	Worst case data rate 72.2 Mbps (channel 11) 20 MHz channel bandwidth
op-mode 1n+	TX-mode, the EUT transmits on the channel 3 (2422 MHz)	Worst case data rate 150 Mbps (channel 3) 40 MHz channel bandwidth
op-mode 2n+	TX-mode, the EUT transmits on the mid channel (2437 MHz)	Worst case data rate 150 Mbps (channel 6) 40 MHz channel bandwidth
op-mode 3n+	TX-mode, the EUT transmits on the highest channel (2462 MHz)	Worst case data rate 150 Mbps (channel 11) 40 MHz channel bandwidth
op-mode 1a	TX-mode, the EUT transmits on the lowest channel (5745 MHz)	Worst case data rate 6 Mbps (channel 149) 20 MHz channel bandwidth
op-mode 2a	TX-mode, the EUT transmits on the mid channel (5785 MHz)	Worst case data rate 6 Mbps (channel 157) 20 MHz channel bandwidth
op-mode 3a	TX-mode, the EUT transmits on the highest channel (5825 MHz)	Worst case data rate 6 Mbps (channel 165) 20 MHz channel bandwidth
op-mode 4a	TX-mode, the EUT transmits on the channel 52 of U-NII-2A band (5260 MHz)	Worst case data rate 6 Mbps (channel 52) 20 MHz channel bandwidth
op-mode 1n5	TX-mode, the EUT transmits on the lowest channel (5745 MHz)	Worst case data rate 72.2 Mbps (channel 149) 20 MHz channel bandwidth
op-mode 2n5	TX-mode, the EUT transmits on the mid channel (5785 MHz)	Worst case data rate 72.2 Mbps (channel 157) 20 MHz channel bandwidth
op-mode 3n5	TX-mode, the EUT transmits on the highest channel (5825 MHz)	Worst case data rate 72.2 Mbps (channel 165) 20 MHz channel bandwidth
op-mode 2n5+	TX-mode, the EUT transmits on the lowest channel (5755 MHz)	Worst case data rate 150 Mbps (channel 151) 40 MHz channel bandwidth
op-mode 3n5+	TX-mode, the EUT transmits on the highest channel (5795 MHz)	Worst case data rate 150 Mbps (channel 159) 40 MHz channel bandwidth

2.6.1 Special software used for testing

Marvell Labtool SW is used to set the EUT at different operating modes.

2.7 Product labelling

Please refer to the documentation of the applicant.

2.7.1 FCC ID label

Please refer to the documentation of the applicant.

2.7.2 Location of the label on the EUT

Please refer to the documentation of the applicant.

3 Test Results

3.1 Peak power output

Standard FCC Part 15, Subpart C

The test was performed according to: FCC §15.31

3.1.1 Test Description

The Equipment Under Test (EUT) was set up to perform the output power measurements. The results recorded were measured with the modulation which produces the worst-case (highest) output power. The reference level of the spectrum analyzer was set higher than the output power of the EUT. The EUT was connected to the spectrum analyzer via a short coax cable with a known loss.
Analyzer settings:
- Detector: RMS

3.1.2 Test Requirements / Limits

FCC Part 15, Subpart C, §15.247 (b) (3)
For systems using digital modulation techniques in the 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz bands: 1 Watt.

==> Maximum conducted peak output power: 30 dBm (excluding antenna gain, if antennas with directional gains that do not exceed 6 dBi are used).

Used conversion factor: Limit (dBm) = 10 log (Limit (W)/1mW)

3.1.3 Test Protocol

Temperature: 23.5°C
Air Pressure: 1018hPa
Humidity: 39%

Op. Mode	Setup	Port
op-mode 1b	Setup_02	Antenna connector

Output power (dBm)	Remarks
23.1	A maximum antenna gain of 3 dBi shall be used according to the applicant. Considering the measuring cable attenuation of 1 dB this leads to a maximum EIRP of 23.1 dBm.

Remark: Please see annex for the measurement plot.

Op. Mode	Setup	Port
op-mode 1g	Setup_02	Antenna connector

Output power (dBm)	Remarks
25.5	A maximum antenna gain of 3 dBi shall be used according to the applicant. Considering the measuring cable attenuation of 1 dB this leads to a maximum EIRP of 25.5 dBm

Op. Mode	Setup	Port
op-mode 1n	Setup_02	Antenna connector

Output power (dBm)	Remarks
25.1	A maximum antenna gain of 3 dBi shall be used according to the applicant. Considering the measuring cable attenuation of 1 dB this leads to a maximum EIRP of 25.1 dBm

Op. Mode	Setup	Port
op-mode 2b	Setup_02	Antenna connector

Output power (dBm)	Remarks
23.0	A maximum antenna gain of 3 dBi shall be used according to the applicant. Considering the measuring cable attenuation of 1 dB this leads to a maximum EIRP of 23.0 dBm

Op. Mode	Setup	Port
op-mode 2g	Setup_02	Antenna connector

Output power (dBm)	Remarks
25.5	A maximum antenna gain of 3 dBi shall be used according to the applicant. Considering the measuring cable attenuation of 1 dB this leads to a maximum EIRP of 25.5 dBm

Remark: Please see annex for the measurement plot.

Op. Mode	Setup	Port
op-mode 2n	Setup_02	Antenna connector

Output power (dBm)	Remarks
25.3	A maximum antenna gain of 3 dBi shall be used according to the applicant. Considering the measuring cable attenuation of 1 dB this leads to a maximum EIRP of 25.3 dBm

Remark: Please see annex for the measurement plot.

Op. Mode	Setup	Port
op-mode 3b	Setup_02	Antenna connector

Output power (dBm)	Remarks
22.7	According to the applicant a maximum antenna gain of 3 dBi shall be used. Considering the measuring cable attenuation of 1 dB this leads to a maximum EIRP of 22.7 dBm

Op. Mode	Setup	Port
op-mode 3g	Setup_02	Antenna connector

Output power (dBm)	Remarks
24.3	According to the applicant a maximum antenna gain of 3 dBi shall be used. Considering the measuring cable attenuation of 1 dB this leads to a maximum EIRP of 24.3 dBm

Remark: Please see annex for the measurement plot.

Op. Mode	Setup	Port
op-mode 3n	Setup_02	Antenna connector

Output power (dBm)	Remarks
24.8	According to the applicant a maximum antenna gain of 3 dBi shall be used. Considering the measuring cable attenuation of 1 dB this leads to a maximum EIRP of 24.8 dBm

Op. Mode	Setup	Port
op-mode 1n+	Setup_02	Antenna connector

Output power (dBm)	Remarks
24.8	According to the applicant a maximum antenna gain of 3 dBi shall be used. Considering the measuring cable attenuation of 1 dB this leads to a maximum EIRP of 24.8 dBm

Op. Mode	Setup	Port
op-mode 2n+	Setup_02	Antenna connector

Output power (dBm)	Remarks
24.5	According to the applicant a maximum antenna gain of 3 dBi shall be used. Considering the measuring cable attenuation of 1 dB this leads to a maximum EIRP of 24.5 dBm

Op. Mode	Setup	Port
op-mode 3n+	Setup_02	Antenna connector

Output power (dBm)	Remarks
24.6	According to the applicant a maximum antenna gain of 3 dBi shall be used. Considering the measuring cable attenuation of 1 dB this leads to a maximum EIRP of 24.6 dBm

Remark: Please see annex for the measurement plot.

Op. Mode	Setup	Port
op-mode 1a	Setup_02	Antenna connector

Output power (dBm)	Remarks
25.5	According to the applicant antenna gain is 4.1 dBi. Considering the measuring cable attenuation of 1 dB this leads to EIRP of 25.5 dBm

Op. Mode	Setup	Port
op-mode 2a	Setup_02	Antenna connector

Output power (dBm)	Remarks
25.4	According to the applicant antenna gain is 4.1 dBi. Considering the measuring cable attenuation of 1 dB this leads to EIRP of 25.4 dBm

Op. Mode	Setup	Port
op-mode 3a	Setup_02	Antenna connector

Output power (dBm)	Remarks
25.1	According to the applicant antenna gain is 4.1 dBi. Considering the measuring cable attenuation of 1 dB this leads to EIRP of 25.1 dBm

Op. Mode	Setup	Port
op-mode 1n5	Setup_02	Antenna connector

Output power (dBm)	Remarks
25.5	According to the applicant antenna gain is 4.1 dBi. Considering the measuring cable attenuation of 1 dB this leads to EIRP of 25.5 dBm

Op. Mode	Setup	Port
op-mode 2n5	Setup_02	Antenna connector

Output power (dBm)	Remarks
25.6	According to the applicant antenna gain is 4.1 dBi. Considering the measuring cable attenuation of 1 dB this leads to EIRP of 25.6 dBm

Remark: Please see annex for the measurement plot.

Op. Mode	Setup	Port
op-mode 3n5	Setup_02	Antenna connector

Output power (dBm)	Remarks
25.1	According to the applicant antenna gain is 4.1 dBi. Considering the measuring cable attenuation of 1 dB this leads to EIRP of 25.1 dBm

Op. Mode	Setup	Port
op-mode 2n5+	Setup_02	Antenna connector

Output power (dBm)	Remarks
24.3	According to the applicant antenna gain is 4.1 dBi. Considering the measuring cable attenuation of 1 dB this leads to EIRP of 24.3 dBm

Remark: Please see annex for the measurement plot.

Op. Mode	Setup	Port
op-mode 3n5+	Setup_02	Antenna connector

Output power (dBm)	Remarks
23.8	According to the applicant antenna gain is 4.1 dBi. Considering the measuring cable attenuation of 1 dB this leads to EIRP of 23.8 dBm

3.1.4 Test result: Peak power output

FCC Part 15, Subpart C	Op. Mode	Result
	op-mode 1b	passed
	op-mode 1g	passed
	op-mode 1n	passed
	op-mode 2b	passed
	op-mode 2g	passed
	op-mode 2n	passed
	op-mode 3b	passed
	op-mode 3g	passed
	op-mode 3n	passed
	op-mode 1n+	passed
	op-mode 2n+	passed
	op-mode 3n+	passed
	op-mode 1a	passed
	op-mode 2a	passed
	op-mode 3a	passed
	op-mode 1n5	passed
	op-mode 2n5	passed
	op-mode 3n5	passed
	op-mode 2n5+	passed
	op-mode 3n5+	passed

3.2 Spurious RF conducted emissions

Standard FCC Part 15, Subpart C

The test was performed according to: FCC §15.31

3.2.1 Test Description

The Equipment Under Test (EUT) was set up to perform the spurious emissions measurements.
The EUT was connected to spectrum analyzer via a short coax cable with a known loss.
Analyzer settings:

- Detector: Peak-Maxhold
- Frequency range: 30 – 40000 MHz
- Resolution Bandwidth (RBW): 100 kHz
- Video Bandwidth (VBW): 300 kHz
- Sweep Time: 330 s

The reference value for the measurement of the spurious RF conducted emissions is determined during the test "band edge compliance" (cf. chapter **Error! Reference source not found.**). This value is used to calculate the 20 dBc limit.

3.2.2 Test Requirements / Limits

FCC Part 15, Subpart C, §15.247 (c)
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, 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, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

3.2.3 Test Protocol

Temperature: 23.5°C
Air Pressure: 1018hPa
Humidity: 38%

Op. Mode	Setup	Port
op-mode 4a	Setup_02	Antenna connector

Frequency MHz	Corrected measurement value dBm	Reference value dBm	Limit dBm	Margin dB
-	-	-	-	-

Remark: No spurious emisions in the range 20 dB below the limit found.
Please see annex for the measurement plot.

3.3 Spurious radiated emissions

Standard FCC Part 15, Subpart C

The test was performed according to: ANSI C63.4

3.3.1 Test Description

The test set-up was made in accordance to the general provisions of ANSI C63.4in a typical installation configuration. The Equipment Under Test (EUT) was set up on a non-conductive table 1.0 x 2.0 m² in the semi-anechoic chamber. The influence of the EUT support table that is used between 30–1000 MHz was evaluated.
The measurement procedure is implemented into the EMI test software ES-K1 from R&S. Exploratory tests are performed at 3 orthogonal axes to determine the worst-case orientation of a body-worn or handheld EUT. The final test on all kind of EUTs is performed at 2 axes. A pre-check is performed while the EUT is powered from a DC power source.

Measurement above 1 GHz
The Equipment Under Test (EUT) was set up on a non-conductive support at 1.4 m height in the fully-anechoic chamber. The measurement distance is 1 m. The results were extrapolated by the extrapolation factor of 20 dB/decade (inverse linear-distance for field strength measurements, inverse linear-distance squared for the power reference level measurements). In this frequency range a double-ridged wave guided horn antenna (up to 18 GHz) and a horn antenna (18–25 GHz) are used.
EMI receiver settings:
- Detector: Peak, Average
- IF Bandwidth = 1 MHz

After the measurement a plot will be generated which contains a diagram with the results of the preliminary scan and a chart with the frequencies and values of the results of the final measurement.

3.3.2 Test Requirements / Limits

FCC Part 15, Subpart C, §15.247 (d)
... In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

FCC Part 15, Subpart C, §15.209, Radiated Emission Limits

Frequency in MHz	Limit (µV/m)	Measurement distance (m)		Calculated Limits(dBµV/m @10m)	Limits(dBµV/m @10m)
0.009 – 0.49	2400/F(kHz)	300	59.1 dB	(48.5 – 13.8) + 30 dB	78.5 – 43.8
0.49 – 1.705	24000/F(kHz)	30	19.1 dB	(48.9 – 23.0) + 10 dB	58.9 – 33.0
1.705 – 30	30	30	19.1 dB	29.5 + 10 dB	39.5

Frequency in MHz	Limit (µV/m)	Measurement distance (m)	Limit (dBµV/m)
30 – 88	100	3	40.0
88 – 216	150	3	43.5
216 – 960	200	3	46.0
above 960	500	3	54.0

§15.35(b) ..., there is also a limit on the radio frequency emissions, as measured using instrumentation with a peak detector function, corresponding to 20 dB above the maximum permitted average limit....
Used conversion factor: Limit (dBµV/m) = 20 log (Limit (µV/m)/1µV/m)

3.3.3 Test Protocol

Temperature: 23 °C
Air Pressure: 1019 hPa
Humidity: 42 %

3.3.3.1 ***Measurement above 1 GHz***

Op. Mode	Setup	Port
op-mode 4a	Setup_01	Enclosure

Polari-sation	Frequency MHz	Corrected value dBµV/m			Limit dBµV/m			Margin dB	
		QP	PK	AV	QP	PK	AV	QP/PK	AV
Hor. + Vert.	–	–	–	–	–	74.0	54.0	–	–

Remark: No spurious emissions in the range 20 dB below the limit found.

Op. Mode	Setup	Port
op-mode 1b	Setup_01	Enclosure

Polari-sation	Frequency MHz	Corrected value dBµV/m			Limit dBµV/m			Margin dB	
		QP	PK	AV	QP	PK	AV	QP/PK	AV
Hor. + Vert.	2386	–	51.6	42.6	–	74.0	54.0	22.4	11.4
Hor. + Vert.	4824	–	48.0	45.7	–	74.0	54.0	26.0	8.3
Hor. + Vert.	4960	–	46.0	34.5	–	74.0	54.0	28.0	19.5
Hor. + Vert.	12401	–	53.0	37.7	–	74.0	54.0	21.0	16.3

Remark: No further spurious emissions in the range 20 dB below the limit found.

3.3.4 Test result: Spurious radiated emissions

FCC Part 15, Subpart C	Op. Mode	Result
	op-mode 2a	passed
	op-mode 1b	passed

4 Test Equipment

The calibration, hardware and software states are shown for the testing period.

Test Equipment Anechoic Chamber

Lab ID:	**Lab 2**
Manufacturer:	Frankonia
Description:	Anechoic Chamber for radiated testing
Type:	10.58x6.38x6.00 m³

Calibration Details	*Last Execution*	*Next Exec.*
NSA (FCC, IC)	2011/01/10	2014/01/10
NSA (FCC)	2014/01/09	2017/01/09

Single Devices for Anechoic Chamber

Single Device Name	*Type*	*Serial Number*	*Manufacturer*
Air compressor	none	-	Atlas Copco
Anechoic Chamber	10.58 x 6.38 x 6.00 m³	none	Frankonia

Calibration Details	*Last Execution*	*Next Exec.*
FCC listing 96716 3m Part15/18	2011/01/11	2014/01/10
IC listing 3699A-1 3m	2011/02/07	2014/02/06
FCC listing 96716 3m Part15/18	2014/01/09	2017/01/08

Controller Maturo	MCU	961208	Maturo GmbH
EMC camera	CE-CAM/1	-	CE-SYS
EMC camera Nr.2	CCD-400E	0005033	Mitsubishi
Filter ISDN	B84312-C110-E1		Siemens&Matsushita
Filter Universal 1A	BB4312-C30-H3	-	Siemens&Matsushita

Test Equipment Auxiliary Equipment for Conducted emissions

Lab ID:	**Lab 1**
Manufacturer:	Rohde & Schwarz GmbH & Co.KG
Description:	EMI Conducted Auxiliary Equipment

Single Devices for Auxiliary Equipment for Conducted emissions

Single Device Name	*Type*	*Serial Number*	*Manufacturer*	
Cable "LISN to ESI"	RG214	W18.03+W48.03	Huber&Suhner	
Impedance Stabilization Network	ISN T800	36159	Teseq GmbH	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard Calibration		2014/02/06	2016/02/28
Impedance Stabilization Network, Coupling Decoupling Network	ISN/CDN ENY41	100002	Rohde & Schwarz GmbH & Co. KG	
	Standard calibration		2013/03/01	2015/03/31
Impedance Stabilization Network, Coupling Decoupling Network	ISN/CDN ST08	36292	Teseq GmbH	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard calibration		2014/01/10	2016/01/31
Impedance Stabilization Network, Coupling Decoupling Network	ISN/CDN T8-Cat6	32187	Teseq GmbH	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard Calibration		2014/01/08	2016/01/31
One-Line V-Network	ESH 3-Z6	100489	Rohde & Schwarz GmbH & Co. KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard calibration		2011/02/08	2014/02/07
One-Line V-Network	ESH 3-Z6	100570	Rohde & Schwarz GmbH & Co. KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard Calibration		2013/11/25	2016/11/24
Two-Line V-Network	ESH 3-Z5	828304/029	Rohde & Schwarz GmbH & Co. KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standart Calibration		2013/03/01	2015/02/28
Two-Line V-Network	ESH 3-Z5	829996/002	Rohde & Schwarz GmbH & Co. KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard Calibration		2013/03/01	2015/02/28

Test Equipment Auxiliary Equipment for Radiated emissions

Lab ID:	**Lab 2**
Description:	Equipment for emission measurements
Serial Number:	see single devices

Single Devices for Auxiliary Equipment for Radiated emissions

Single Device Name	*Type*	*Serial Number*	*Manufacturer*	
Antenna mast	AM 4.0	AM4.0/180/11920513	Maturo GmbH	
Antenna mast	AS 620 P	620/37	HD GmbH	
Biconical Broadband Antenna	SBA 9119	9119-005	Schwarzbeck	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard Calibration		2009/06/04	2014/06/03
Biconical dipole	VUBA 9117	9117-108	Schwarzbeck	
	Standard Calibration		2012/01/18	2015/01/17
Broadband Amplifier 18MHz-26GHz	JS4-18002600-32-5P	849785	Miteq	
Broadband Amplifier 1GHz-4GHz	AFS4-01000400-1Q-10P-4	-	Miteq	
Broadband Amplifier 30MHz-18GHz	JS4-00101800-35-5P	896037	Miteq	
Cable "ESI to EMI Antenna"	EcoFlex10	W18.01-2+W38.01-2	Kabel Kusch	
Cable "ESI to Horn Antenna"	UFB311A+UFB293C	W18.02-2+W38.02-2	Rosenberger Micro-Coax	
Double-ridged horn	HF 906	357357/001	Rohde & Schwarz GmbH & Co. KG	
	Standard Calibration		2012/05/18	2015/05/17
Double-ridged horn	HF 906	357357/002	Rohde & Schwarz GmbH & Co. KG	
	Standard Calibration		2012/06/26	2015/06/25
High Pass Filter	4HC1600/12750-1.5-KK	9942011	Trilithic	
High Pass Filter	5HC2700/12750-1.5-KK	9942012	Trilithic	
High Pass Filter	5HC3500/12750-1.2-KK	200035008	Trilithic	
High Pass Filter	WHKX 7.0/18G-8SS	09	Wainwright	
Horn Antenna Schwarzbeck 15-26 GHz BBHA 9170	BBHA 9170			
Log.-per. Antenna	HL 562 Ultralog	100609	Rohde & Schwarz GmbH & Co. KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard Calibration		2012/12/18	2015/12/17
Log.-per. Antenna	HL 562 Ultralog	830547/003	Rohde & Schwarz GmbH & Co. KG	
Loop Antenna	HFH2-Z2	829324/006	Rohde & Schwarz GmbH & Co. KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard calibration		2011/10/27	2014/10/26
Pyramidal Horn Antenna 26,5 GHz	3160-09	00083069	EMCO Elektronik GmbH	
Pyramidal Horn Antenna 40 GHz	3160-10	00086675	EMCO Elektronik GmbH	

Single Devices for Auxiliary Equipment for Radiated emissions (continued)

Single Device Name	*Type*	*Serial Number*	*Manufacturer*
Tilt device Maturo (Rohacell)	Antrieb TD1.5-10kg	TD1.5-10kg/024/3790709	Maturo GmbH

Test Equipment Auxiliary Test Equipment

Lab ID:	**Lab 2, Lab 3**
Manufacturer:	see single devices
Description:	Single Devices for various Test Equipment
Type:	various
Serial Number:	none

Single Devices for Auxiliary Test Equipment

Single Device Name	*Type*	*Serial Number*	*Manufacturer*	
Broadband Power Divider N (Aux)	1506A / 93459	LM390	Weinschel Associates	
Broadband Power Divider SMA	WA1515	A855	Weinschel Associates	
Digital Multimeter 03 (Multimeter)	Fluke 177	86670383	Fluke Europe B.V.	
	Calibration Details		*Last Execution*	*Next Exec.*
	Customized calibration		2013/12/04	2015/12/03
Fibre optic link Satellite (Aux)	FO RS232 Link	181-018	Pontis	
Fibre optic link Transceiver (Aux)	FO RS232 Link	182-018	Pontis	
Isolating Transformer	LTS 604	1888	Thalheimer Transformatorenwerke GmbH	
Notch Filter Ultra Stable (Aux)	WRCA800/960-6EEK	24	Wainwright	
Spectrum Analyser	FSP3	836722/011	Rohde & Schwarz GmbH & Co. KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard		2012/06/13	2015/06/12
Vector Signal Generator	SMIQ 03B	832492/061	Rohde & Schwarz GmbH & Co.KG	

Test Equipment Digital Signalling Devices

Lab ID:	**Lab 1, Lab 2, Lab 3**
Description:	Signalling equipment for various wireless technologies.

Single Devices for Digital Signalling Devices

Single Device Name	*Type*	*Serial Number*	*Manufacturer*	
Bluetooth Signalling Unit CBT	CBT	100589	Rohde & Schwarz GmbH & Co. KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard calibration		2011/11/24	2014/11/23
CMW500	CMW500	107500	Rohde & Schwarz GmbH & Co.KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	Initial factory calibration		2012/01/26	2014/01/25
Digital Radio Communication Tester	CMD 55	831050/020	Rohde & Schwarz GmbH & Co. KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard calibration		2011/11/28	2014/11/27
Universal Radio Communication Tester	CMU 200	102366	Rohde & Schwarz GmbH & Co. KG	
	HW/SW Status		*Date of Start*	*Date of End*
	Hardware: B11, B21V14, B21-2, B41, B52V14, B52-2, B53-2, B56V14, B68 3v04, PCMCIA, U65V04 Software: K21 4v21, K22 4v21, K23 4v21, K24 4v21, K42 4v21, K43 4v21, K53 4v21, K56 4v22, K57 4v22, K58 4v22, K59 4v22, K61 4v22, K62 4v22, K63 4v22, K64 4v22, K65 4v22, K66 4v22, K67 4v22, K68 4v22, K69 4v22 Firmware: µP1 8v50 02.05.06 ---		2007/07/16	
Universal Radio Communication Tester	CMU 200	837983/052	Rohde & Schwarz GmbH & Co. KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard calibration		2011/12/07	2014/12/06
	HW/SW Status		*Date of Start*	*Date of End*
	HW options: B11, B21V14, B21-2, B41, B52V14, B52-2, B53-2, B54V14, B56V14, B68 3v04, B95, PCMCIA, U65V02 SW options: K21 4v11, K22 4v11, K23 4v11, K24 4v11, K27 4v10, K28 4v10, K42 4v11, K43 4v11, K53 4v10, K65 4v10, K66 4v10, K68 4v10, Firmware: µP1 8v40 01.12.05 ---		2007/01/02	
	SW: K62, K69		2008/11/03	
Vector Signal Generator	SMU200A	100912	Rohde & Schwarz GmbH & Co. KG	

Test Equipment Emission measurement devices

Lab ID:	**Lab 1, Lab 2**
Description:	Equipment for emission measurements
Serial Number:	see single devices

Single Devices for Emission measurement devices

Single Device Name	*Type*	*Serial Number*	*Manufacturer*	
Personal Computer	Dell	30304832059	Dell	
Power Meter	NRVD	828110/016	Rohde & Schwarz GmbH & Co.KG	
	Standard calibration		2013/05/03	2014/05/02
Sensor Head A	NRV-Z1	827753/005	Rohde & Schwarz GmbH & Co.KG	
	Standard calibration		2013/04/30	2014/04/29
Signal Generator	SMR 20	846834/008	Rohde & Schwarz GmbH & Co. KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	standard calibration		2011/05/12	2014/05/11
Spectrum Analyzer	ESIB 26	830482/004	Rohde & Schwarz GmbH & Co. KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard Calibration		2011/12/05	2013/12/31
	Standard Calibration		2014/01/07	2016/01/31
	HW/SW Status		*Date of Start*	*Date of End*
	Firmware-Update 4.34.4 from 3.45 during calibration		2009/12/03	

Test Equipment Multimeter 12

Lab ID:	**Lab 4**
Description:	Ex-Tech 520
Serial Number:	05157876

Single Devices for Multimeter 12

Single Device Name	*Type*	*Serial Number*	*Manufacturer*	
Digital Multimeter 12 (Multimeter)	EX520	05157876	Extech Instruments Corp.	
	Calibration Details		*Last Execution*	*Next Exec.*
	Customized calibration		2013/12/04	2015/12/03

Test Equipment Radio Lab Test Equipment

Lab ID: **Lab 3**
Description: Radio Lab Test Equipment

Single Devices for Radio Lab Test Equipment

Single Device Name	*Type*	*Serial Number*	*Manufacturer*	
Broadband Power Divider SMA	WA1515	A856	Weinschel Associates	
Coax Attenuator 10dB SMA 2W	4T-10	F9401	Weinschel Associates	
Coax Attenuator 10dB SMA 2W	56-10	W3702	Weinschel Associates	
Coax Attenuator 10dB SMA 2W	56-10	W3711	Weinschel Associates	
Coax Cable Huber&Suhner	Sucotest 2,0m		Huber&Suhner	
Coax Cable Rosenberger Micro Coax FA210A0010003030 SMA/SMA 1,0m	FA210A0010003030	54491-2	Rosenberger Micro-Coax	
Power Meter	NRVD	828110/016	Rohde & Schwarz GmbH & Co.KG	
	Standard calibration		2013/05/03	2014/05/02
RF Step Attenuator RSP	RSP	833695/001	Rohde & Schwarz GmbH & Co.KG	
Rubidium Frequency Standard	Datum, Model: MFS	5489/001	Datum-Beverly	
	Standard calibration		2013/06/24	2014/06/23
Sensor Head A	NRV-Z1	827753/005	Rohde & Schwarz GmbH & Co.KG	
	Standard calibration		2013/04/30	2014/04/29
Signal Generator SME	SME03	827460/016	Rohde & Schwarz GmbH & Co.KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard calibration		2011/11/25	2014/11/24
Signal Generator SMP	SMP02	836402/008	Rohde & Schwarz GmbH & Co. KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard calibration		2013/05/06	2016/05/05
Spectrum Analyser	FSIQ26	840061/005	Rohde & Schwarz GmbH & Co. KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard Calibration		2013/02/12	2015/02/11
Temperature Chamber Vötsch 03	VT 4002	58566002150010	Vötsch	
	Calibration Details		*Last Execution*	*Next Exec.*
	Customized calibration		2012/03/12	2014/03/11

Test Equipment Regulatory Bluetooth RF Test Solution

Lab ID:	**Lab 4**
Description:	Regulatory Bluetooth RF Tests
Type:	Bluetooth RF
Serial Number:	001

Single Devices for Regulatory Bluetooth RF Test Solution

Single Device Name	*Type*	*Serial Number*	*Manufacturer*	
ADU 200 Relay Box 7	Relay Box	A04380	Ontrak Control Systems Inc.	
Bluetooth Signalling Unit CBT	CBT	100302	Rohde & Schwarz GmbH & Co.KG	
	Standard calibration		2013/08/28	2014/08/27
Power Meter NRVD	NRVD	832025/059		
	Standard calibration		2013/08/26	2014/08/25
Power Sensor NRV Z1 A	PROBE	832279/013		
	Standard calibration		2013/08/28	2014/08/27
Power Supply	NGSM 32/10	2725		
	Standard calibration		2013/06/14	2015/06/13
Rubidium Frequency Normal MFS	Datum MFS	002	Datum GmbH	
	Standard calibration		2013/08/27	2014/08/26
Signal Analyser FSIQ26	1119.6001.26	832695/007	Rohde & Schwarz GmbH & Co.KG	
Vector Signal Generator SMIQ03B	SMIQ03B	832870/017		
	Standard calibration		2013/06/21	2016/06/20

Test Equipment Shielded Room 02

Lab ID:	**Lab 1**
Manufacturer:	Frankonia
Description:	Shielded Room for conducted testing
Type:	12 qm
Serial Number:	none

Test Equipment Shielded Room 07

Lab ID:	**Lab 4**
Description:	Shielded Room 4m x 6m

Test Equipment T/H Logger 04

Lab ID:	**Lab 4**
Description:	Lufft Opus10
Serial Number:	7481

Single Devices for T/H Logger 04

Single Device Name	*Type*	*Serial Number*	*Manufacturer*
ThermoHygro Datalogger 04 (Environ)	Opus10 THI (8152.00)	7481	Lufft Mess- und Regeltechnik GmbH

Test Equipment Temperature Chamber 01

Lab ID:	**Lab 4**
Manufacturer:	see single devices
Description:	Temperature Chamber KWP 120/70
Type:	Weiss
Serial Number:	see single devices

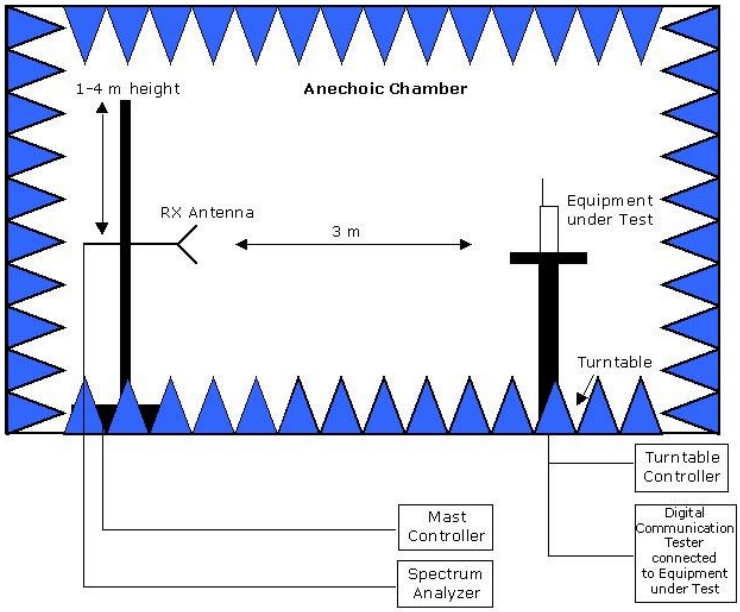
Single Devices for Temperature Chamber 01

Single Device Name	*Type*	*Serial Number*	*Manufacturer*	
Temperature Chamber Weiss 01	KWP 120/70	59226012190010	Weiss Umwelttechnik GmbH	
	Calibration Details		*Last Execution*	*Next Exec.*
	Customized calibration		2012/03/12	2014/03/11

5 Photo Report

Photos are included in an external report.

6 Setup Drawings



Remark: Depending on the frequency range suitable antenna types, attenuators or preamplifiers are used.

Drawing 1: Setup in the Anechoic chamber:
Measurements below 1 GHz: Semi-anechoic, conducting ground plane.
Measurements above 1 GHz: Fully-anechoic, absorbers on all surfaces.

7 FCC and IC Correlation of measurement requirements

The following tables show the correlation of measurement requirements for DTS (e.g. WLAN) equipment and Information Technology Equipment (ITE) from FCC and IC standards.

DTS equipment

Measurement	FCC reference	IC reference
Conducted emissions on AC Mains	§ 15.207	RSS-Gen Issue 3: 7.2.4
Occupied bandwidth	§ 15.247 (a) (2)	RSS-210 Issue 8: A8.2 (a)
Peak power output	§ 15.247 (b) (3), (4)	RSS-210 Issue 8: A8.4 (4)
Spurious RF conducted emissions	§ 15.247 (d)	RSS-Gen Issue 3: 6; RSS-210 Issue 8: A8.5
Spurious radiated emissions	§ 15.247 (d); § 15.209 (a)	RSS-Gen Issue 3: 6; RSS-210 Issue 8: A8.5
Band edge compliance	§ 15.247 (d)	RSS-210 Issue 8: A8.5
Power density	§ 15.247 (e)	RSS-210 Issue 8: A8.2 (b)
Antenna requirement	§ 15.203 / 15.204	RSS-Gen Issue 3: 7.1.2
Receiver spurious emissions	–	RSS-210 Issue 8: 2.3 RSS Gen Issue 3: 6 *)

*) Receivers which are part of Transceivers are exempted with respect to Notice 2012-DRS0126.

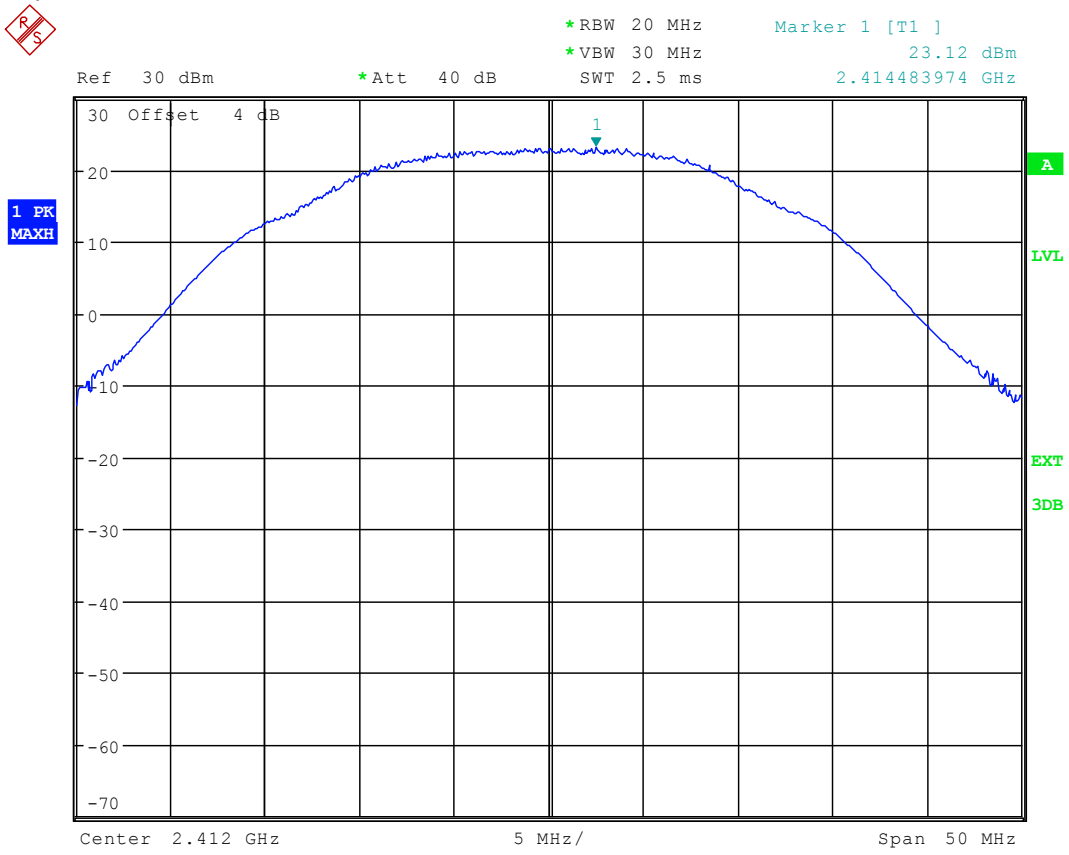
Information Technology Equipment (ITE)

Measurement	FCC reference	IC reference
Conducted emissions on AC Mains	§ 15.107	ICES-003 Issue 5: 6.1
Spurious Radiated Emissions	§ 15.109	ICES-003 Issue 5: 6.2

8 Annex measurement plots

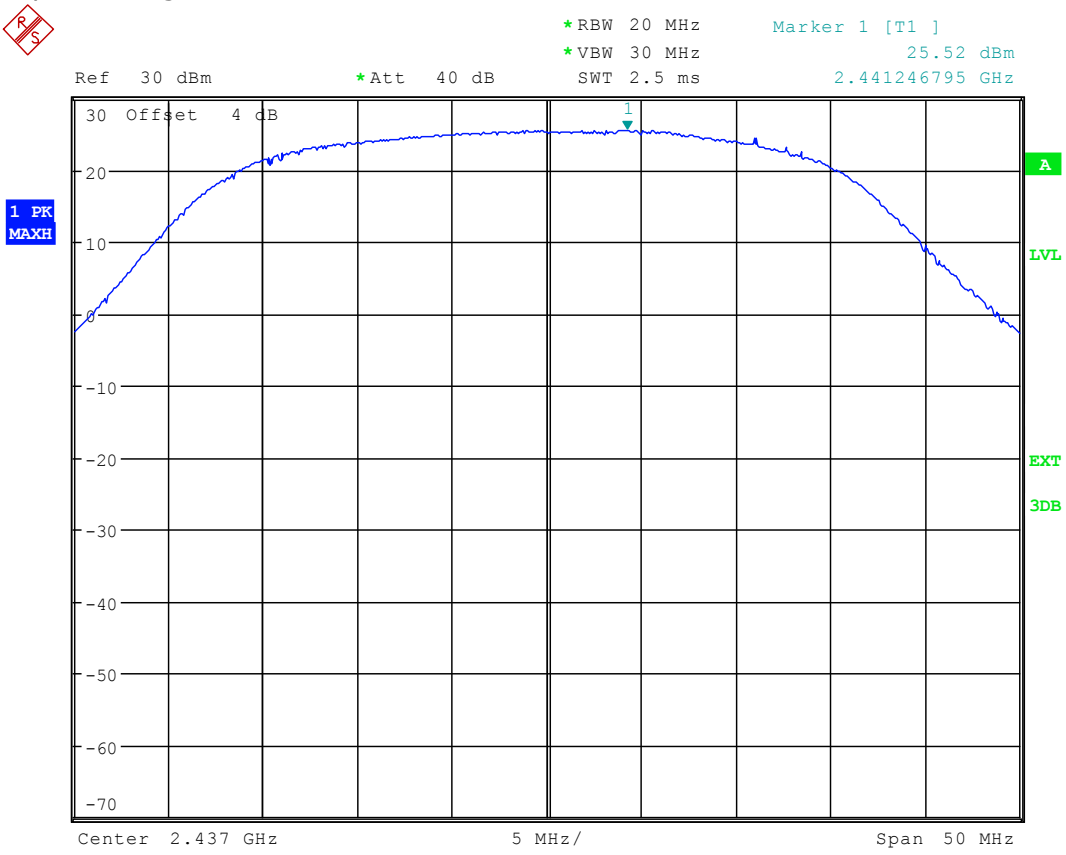
8.1 Peak power output

Op. Mode	lowest channel
op-mode 1b	ch. bandwidth = 20 MHz



Op. Mode **mid channel**

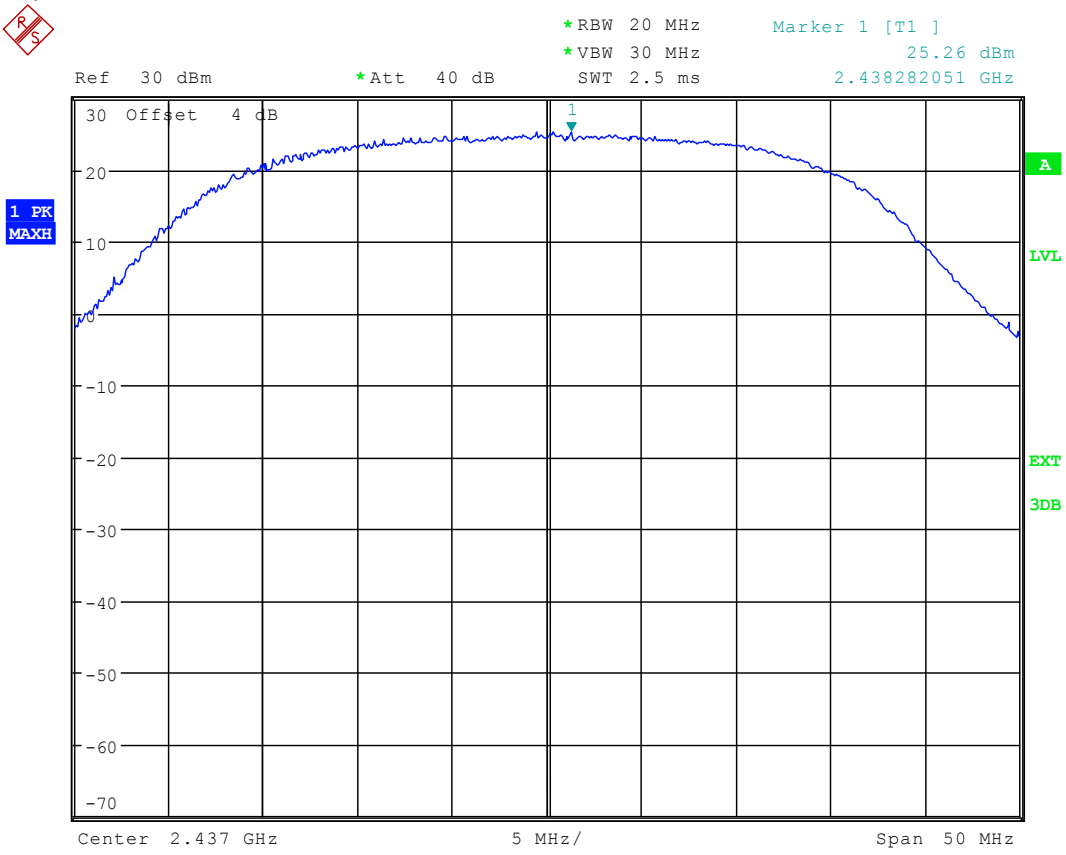
op-mode 2g ch. bandwidth = 20 MHz



Date: 27.FEB.2014 11:28:27

Op. Mode **mid channel**

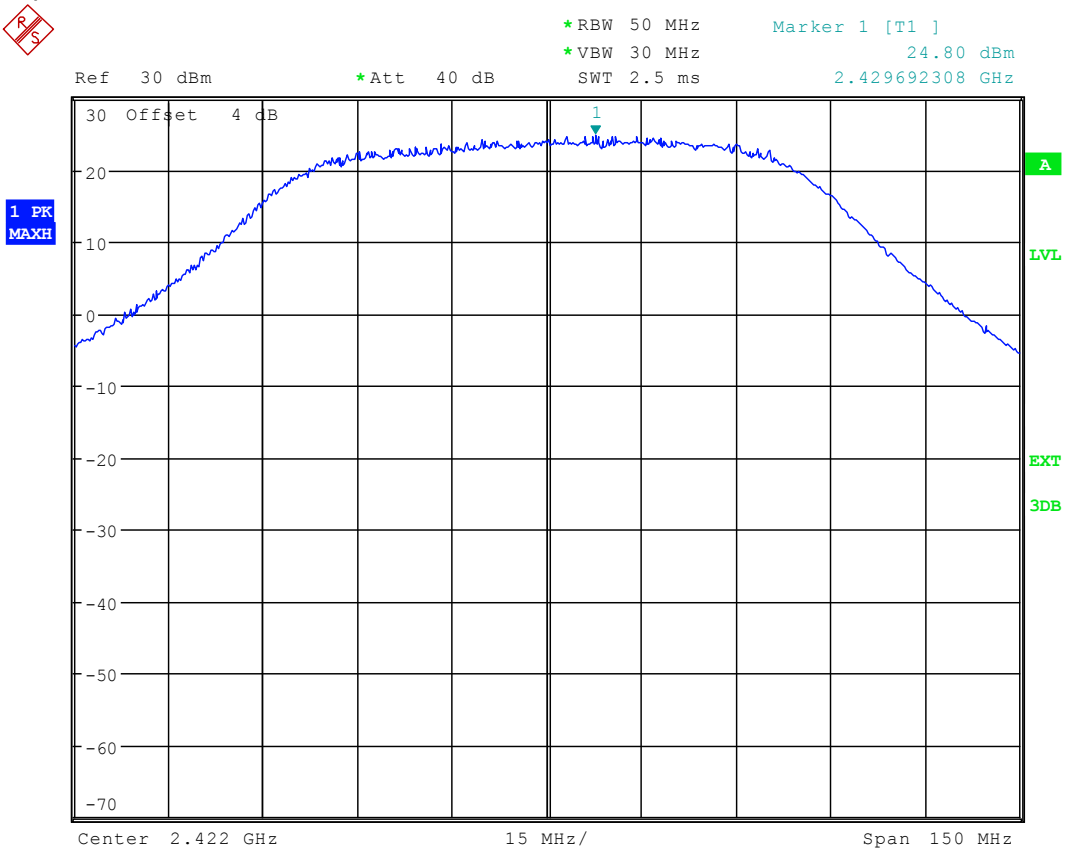
op-mode 2n ch. bandwidth = 20 MHz



Date: 27.FEB.2014 11:41:15

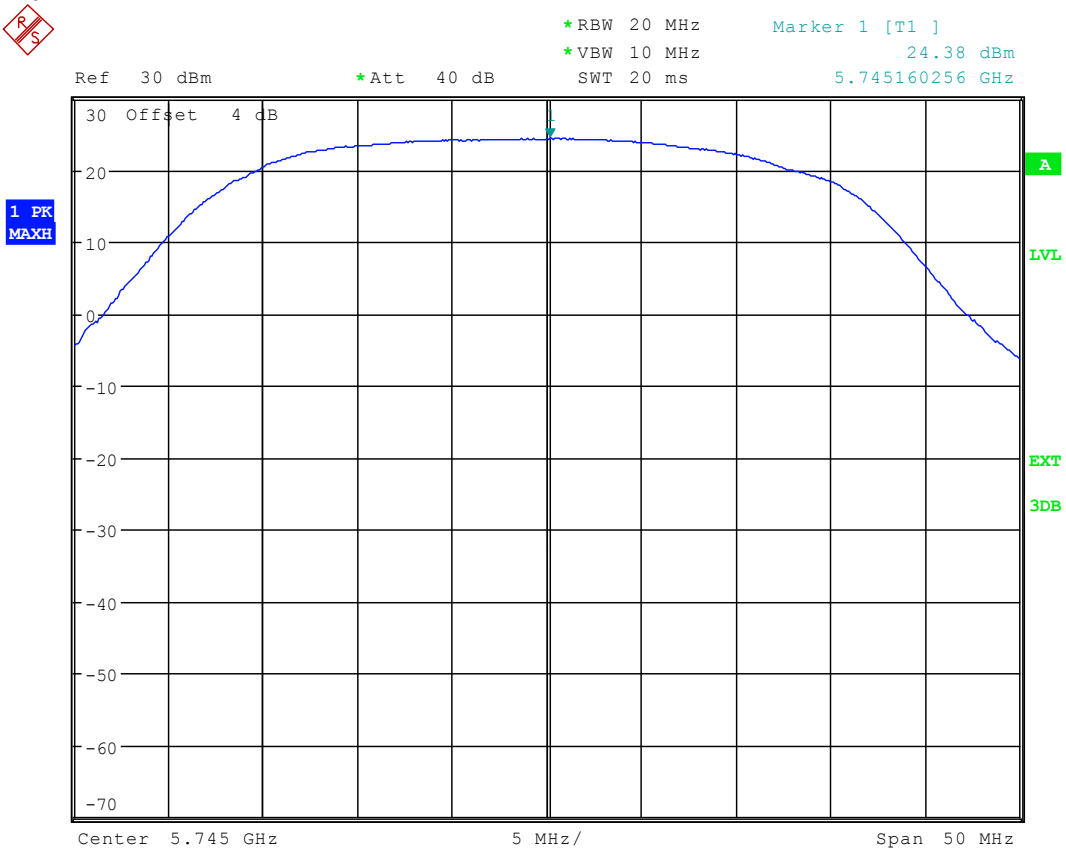
Op. Mode **channel 3**

op-mode 1n+ ch. bandwidth = 40 MHz



Date: 27.FEB.2014 13:18:29

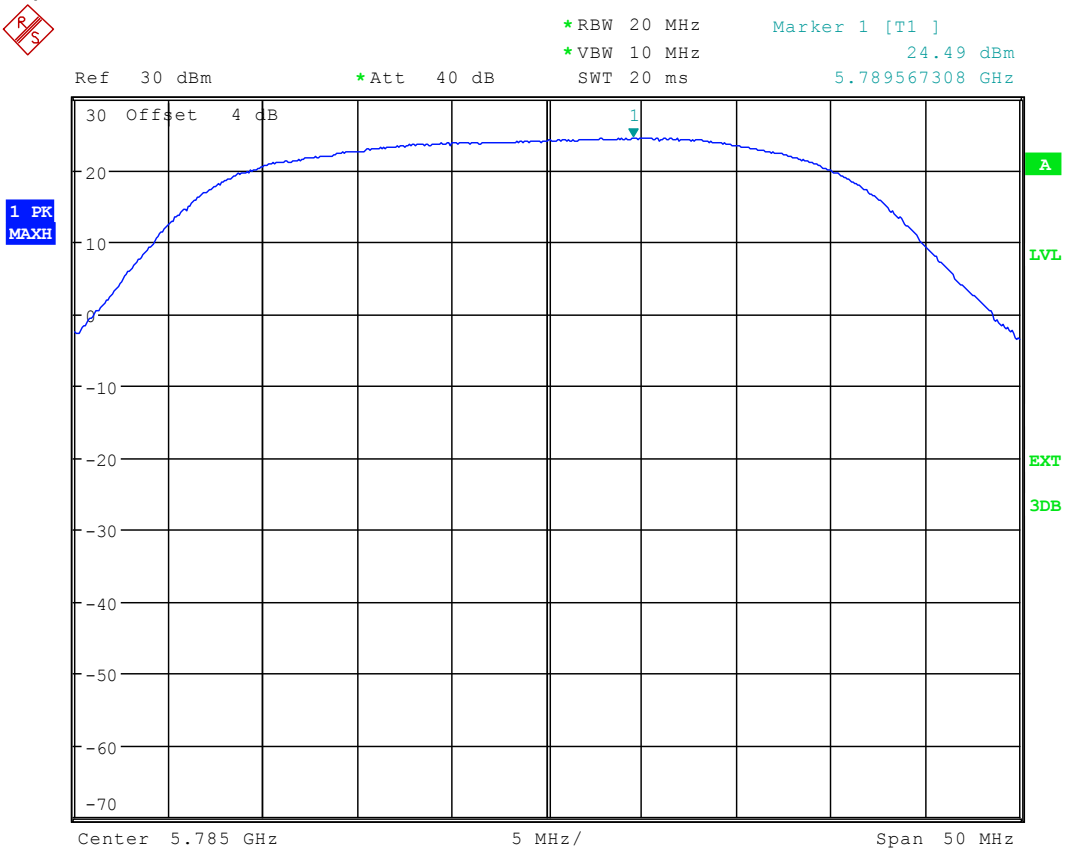
Op. Mode	**lowest channel**
op-mode 1a	ch. bandwidth = 20 MHz



Date: 27.FEB.2014 15:14:32

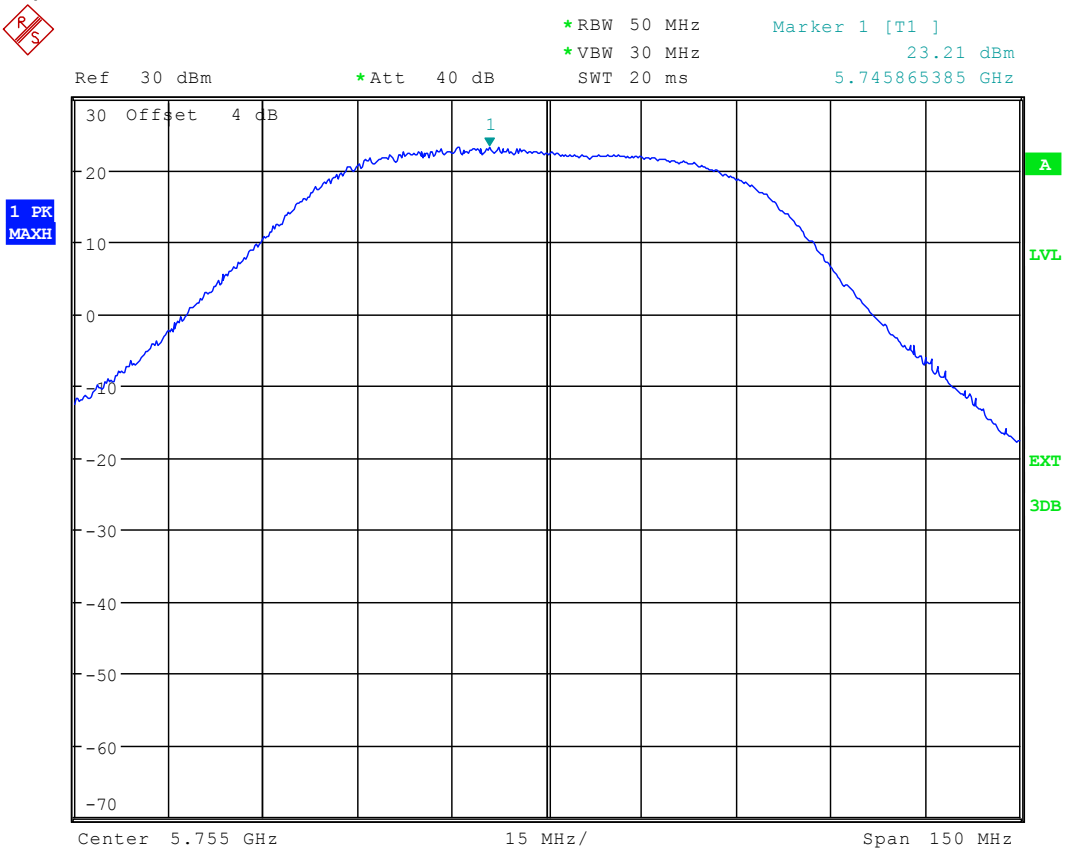
Op. Mode **mid channel**

op-mode 2n5 ch. bandwidth = 20 MHz



Date: 27.FEB.2014 15:21:40

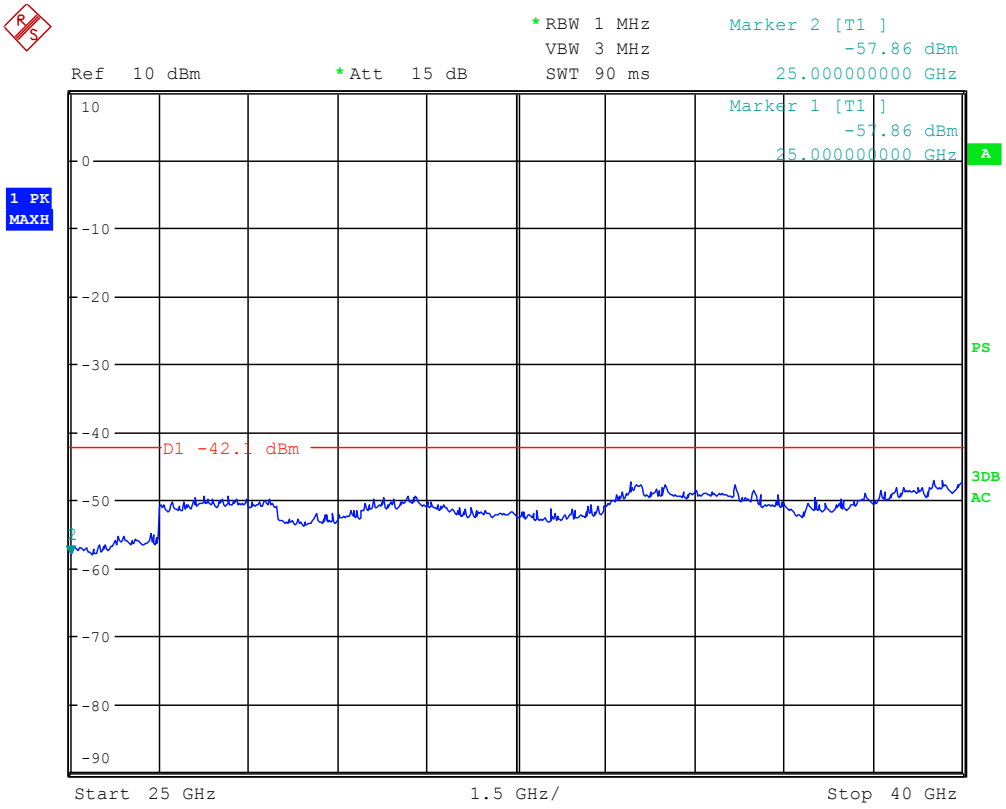
Op. Mode	**lowest channel**
op-mode 2n5+	ch. bandwidth = 20 MHz



Date: 27.FEB.2014 15:09:31

8.2 Spurious RF conducted emissions.

Op. Mode	lowest channel of U-NII-2A sub-band
op-mode 4a	ch. bandwidth = 20 MHz



Date: 28.FEB.2014 16:49:58

8.3 Spurious radiated emissions

Op. Mode	lowest channel of U-NII-2A sub-band
op-mode 4a	ch. bandwidth = 20 MHz

```
EUT:                    (LS003r01)
Manufacturer:           Lesswire
Operating Condition:    Wlan a-mode CH52, 6Mbps
Test Site:              7 Layers Ratingen
Test Specification:     FCC 15.247 (15.35b, 15.209)
Comment:                vertical + horizontal antenna polarisation
Start of Test:          24.02.2014 / 21:37:21
```