InterLab®

FCC Measurement/Technical Report on

WLAN transceiver

RSE III
FCC ID: Z3KRSE3
IC: 9930A-RSE3

And

RSE III C&G
FCC ID: Z3KRSE3CG
IC: 9930A-RSE3CG

Report Reference: MDE_NEXTB_1401_FCCa

Test Laboratory:
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40880 Ratingen
Germany

DAkkS Deutsche Akkreditierungsstelle D-PL-12140-01-01

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0 Applied Standards and Test 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 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

Note:
The tests were selected and performed with reference to the FCC Public Notice "Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS)Operating Under §15.247, 558074 D01 DTS Meas Guidance v03r03, 2015-06-09".

ANSI C63.10–2013 is applied.

Summary Test Results:

The EUT complied with all performed tests as listed in chapter 0.3 Measurement Summary.

0.2 FCC and IC Correlation Table

Correlation of measurement requirements for DTS (e.g. WLAN 2.4 GHz, BT LE) equipment from FCC and IC

DTS equipment

Measurement	FCC reference	IC reference
Conducted emissions on AC Mains	§ 15.207	RSS-Gen Issue 4: 8.8
Occupied bandwidth	§ 15.247 (a) (2)	RSS-247 Issue 1: 5.2 (1)
Peak conducted output power	§ 15.247 (b) (3), (4)	RSS-247 Issue 1: 5.4 (4)
Transmitter spurious RF conducted emissions	§ 15.247 (d)	RSS-Gen Issue 4: 6.13 / 8.9/8.10; RSS-247 Issue 1: 5.5
Transmitter spurious radiated emissions	§ 15.247 (d); § 15.209 (a)	RSS-Gen Issue 4: 6.13 / 8.9/8.10; RSS-247 Issue 1: 5.5
Band edge compliance	§ 15.247 (d)	RSS-247 Issue 1: 5.5
Power density	§ 15.247 (e)	RSS-247 Issue 1: 5.2 (2)
Antenna requirement	§ 15.203 / 15.204	RSS-Gen Issue 4: 8.3
Receiver spurious emissions	–	–

0.3 Measurement Summary

FCC Part 15, Subpart C	§ 15.207		
Conducted emissions (AC power line)			
The measurement was performed according to ANSI C63.10			
OP-Mode	**Setup**	**Port**	**Final Result**
-	-	AC port	N/P

FCC Part 15, Subpart C	§ 15.247 (a) (1)		
Occupied bandwidth			
The measurement was performed according to ANSI C63.10			
OP-Mode	**Setup**	**Port**	**Final Result**
op-mode 1b	Setup_01	Temp.ant.connector	Passed
op-mode 1g	Setup_01	Temp.ant.connector	Passed
op-mode 1n	Setup_01	Temp.ant.connector	Passed
op-mode 2b	Setup_01	Temp.ant.connector	Passed
op-mode 2g	Setup_01	Temp.ant.connector	Passed
op-mode 2n	Setup_01	Temp.ant.connector	Passed
op-mode 3b	Setup_01	Temp.ant.connector	Passed
op-mode 3g	Setup_01	Temp.ant.connector	Passed
op-mode 3n	Setup_01	Temp.ant.connector	Passed
op-mode 1n+	Setup_01	Temp.ant.connector	Passed
op-mode 2n+	Setup_01	Temp.ant.connector	Passed
op-mode 3n+	Setup_01	Temp.ant.connector	Passed

FCC Part 15, Subpart C	§ 15.247 (b) (1)		
Peak power output			
The measurement was performed according to ANSI C63.10			
OP-Mode	**Setup**	**Port**	**Final Result**
op-mode 1b	Setup_01	Temp.ant.connector	Passed
op-mode 1g	Setup_01	Temp.ant.connector	Passed
op-mode 1n	Setup_01	Temp.ant.connector	Passed
op-mode 2b	Setup_01	Temp.ant.connector	Passed
op-mode 2g	Setup_01	Temp.ant.connector	Passed
op-mode 2n	Setup_01	Temp.ant.connector	Passed
op-mode 3b	Setup_01	Temp.ant.connector	Passed
op-mode 3g	Setup_01	Temp.ant.connector	Passed
op-mode 3n	Setup_01	Temp.ant.connector	Passed
op-mode 1n+	Setup_01	Temp.ant.connector	Passed
op-mode 2n+	Setup_01	Temp.ant.connector	Passed
op-mode 3n+	Setup_01	Temp.ant.connector	Passed

FCC Part 15, Subpart C **§ 15.247 (d), § 15.35 (b), § 15.207**

Spurious conducted emissions

The measurement was performed according to ANSI C63.10

OP-Mode	Setup	Port	Final Result
op-mode 1b	Setup_01	Temp.ant.connector	Passed
op-mode 1g	Setup_01	Temp.ant.connector	Passed
op-mode 1n	Setup_01	Temp.ant.connector	Passed
op-mode 2b	Setup_01	Temp.ant.connector	Passed
op-mode 2g	Setup_01	Temp.ant.connector	Passed
op-mode 2n	Setup_01	Temp.ant.connector	Passed
op-mode 3b	Setup_01	Temp.ant.connector	Passed
op-mode 3g	Setup_01	Temp.ant.connector	Passed
op-mode 3n	Setup_01	Temp.ant.connector	Passed
op-mode 1n+	Setup_01	Temp.ant.connector	Passed
op-mode 2n+	Setup_01	Temp.ant.connector	Passed
op-mode 3n+	Setup_01	Temp.ant.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 C63.10

OP-Mode	Setup	Port	Final Result
op-mode 1b	Setup_02/03	Enclosure	Passed
op-mode 2b	Setup_02/03	Enclosure	Passed
op-mode 3b	Setup_02/03	Enclosure	Passed
op-mode 1g	Setup_02/03	Enclosure	Passed
op-mode 2g	Setup_02/03	Enclosure	Passed
op-mode 3g	Setup_02/03	Enclosure	Passed
op-mode 1b	Setup_04	Enclosure	Passed
op-mode 2b	Setup_04	Enclosure	Passed
op-mode 3b	Setup_04	Enclosure	Passed
op-mode 1g	Setup_04	Enclosure	Passed
op-mode 3g	Setup_04	Enclosure	Passed

FCC Part 15, Subpart C **§ 15.247 (d)**

Band edge compliance

The measurement was performed according to ANSI C63.10

OP-Mode	Setup	Port	Final Result
op-mode 1b	Setup_01	Temp.ant.connector	Passed
op-mode 1g	Setup_01	Temp.ant.connector	Passed
op-mode 1n	Setup_01	Temp.ant.connector	Passed
op-mode 3b	Setup_01	Temp.ant.connector	Passed
op-mode 3g	Setup_01	Temp.ant.connector	Passed
op-mode 3n	Setup_01	Temp.ant.connector	Passed
op-mode 1n+	Setup_01	Temp.ant.connector	Passed
op-mode 3n+	Setup_01	Temp.ant.connector	Passed
op-mode 3b	Setup_03	Enclosure	Passed
op-mode 3g	Setup_03	Enclosure	Passed
op-mode 3n	Setup_03	Enclosure	Passed
op-mode 3b	Setup_04	Enclosure	Passed
op-mode 3g	Setup_04	Enclosure	Passed
op-mode 3n	Setup_04	Enclosure	Passed

FCC Part 15, Subpart C **§ 15.247 (e)**

Power density

The measurement was performed according to ANSI C63.10

OP-Mode	Setup	Port	Final Result
op-mode 1b	Setup_01	Temp.ant.connector	Passed
op-mode 1g	Setup_01	Temp.ant.connector	Passed
op-mode 1n	Setup_01	Temp.ant.connector	Passed
op-mode 2b	Setup_01	Temp.ant.connector	Passed
op-mode 2g	Setup_01	Temp.ant.connector	Passed
op-mode 2n	Setup_01	Temp.ant.connector	Passed
op-mode 3b	Setup_01	Temp.ant.connector	Passed
op-mode 3g	Setup_01	Temp.ant.connector	Passed
op-mode 3n	Setup_01	Temp.ant.connector	Passed
op-mode 1n+	Setup_01	Temp.ant.connector	Passed
op-mode 2n+	Setup_01	Temp.ant.connector	Passed
op-mode 3n+	Setup_01	Temp.ant.connector	Passed

N/P not performed (the EUT is intended for automotive use)

The tested EUT is available in 2 different variants which, according to the applicant, are identical in hardware except for the housing. Because of that, testing at the temporary antenna connector has only been performed on one of the two variants.

Responsible for Accreditation Scope: _____ Responsible for Test Report: _____

7 layers GmbH, Borsigstr. 11
40880 Ratingen, Germany
Phone +49 (0)2102 749 0

1 Administrative Data

1.1 Testing Laboratory

Company Name:	7layers GmbH
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 .
This facility has been fully described in a report submitted to the IC and accepted under the registration number: Site# 3699A-1
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:	2015-09-28

1.2 Project Data

Responsible for testing and report:	Dipl.-Ing. Daniel Gall
Date of Test(s):	2015-10-01 to 2015-11-17
Date of Report:	2015-11-19

1.3 Applicant Data

Company Name:	JET Optoelectronics Co., Ltd.
Address:	3F., No.300, Yangguang St., Neihu Dist. 11491 Taipei City Taiwan R.O.C.
Contact Person:	Mrs. Angie Kang

1.4 Manufacturer Data

Company Name:	Please see applicant data
Address:	
Contact Person:	

2 Test object Data

2.1 General EUT Description

Equipment under Test:	IEEE 802.11b/g/n WLAN transceiver
Type Designation:	RSE III RSE III C&G
Kind of Device:	Rear Seat Entertainment computer
(optional)	
Voltage Type:	DC
Voltage Level:	DC 12.0 V
Tested Modulation Type:	DBPSK; OFDM:BPSK; OFDM:64-QAM

General product description:

The EUT is a tablet computer that can be mounted to the front seat of a car. It has build in Bluetooth and WLAN functionality.

Specific product description for the EUT:

The EUT is a single band WLAN (802.11 2.4 GHz b/g/n) 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 b/g/n modes, working in the 2.4 GHz band. In IEEE 802.11n mode, it was tested with 20 MHz and 40 MHz channel bandwidth.

The EUT provides the following ports:

Ports
Enclosure
12 V DC port
HDMI in
HDMI out
Micro USB Port
USB Port
3.5 mm Headset jack
SD card slot

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
EUT A (Code: DE1041000aa01)	WLAN transceiver	RSE III C&G	D150630GS00 0022	V02	0.9.4
Remark: EUT A is equipped with a temporary antenna connector.					
EUT B (Code: DE1041000ac01)	WLAN transceiver	RSE III C&G	D150630GS00 0025	V02	0.9.4
Remark: EUT B is equipped with an integral antenna with antenna gain = 2.6 dBi at 2.4 – 2.5 GHz frequency range.					
EUT C (Code: DE1041000ae01)	WLAN transceiver	RSE III C&G	D150630GS00 0023	V02	0.9.4
Remark: EUT C is equipped with an integral antenna with antenna gain = 2.6 dBi at 2.4 – 2.5 GHz frequency range.					
EUT D (Code: DE1041000ad02)	WLAN transceiver	RSE III	A150723SS00 0022	V02	0.9.4
Remark: EUT D is equipped with an integral antenna with antenna gain = 2.6 dBi at 2.4 – 2.5 GHz frequency range.					

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	Serial No.	HW Status	SW Status
-	–	–	–	–	–

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
AUX1	Dummy 12 V car adapter	–	–	–	–

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	Combination of EUTs	Description and Rationale
Setup_01	EUT A + AUX1	setup for conducted radio measurements
Setup_02	EUT B + AUX1	setup for radiated measurements
Setup_03	EUT C + AUX1	setup for radiated measurements
Setup_04	EUT D + AUX1	setup for radiated measurements

2.6 Operating Modes

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

2.6.1 Test Channels

	2.4 GHz ISM 2400 - 2483.5 MHz		
20 MHz Test Channels:	**Bottom**	**Middle**	**Top**
Channel:	1	6	11
Frequency [MHz]	2412	2437	2462

40 MHz Test Channels:	**Bottom**	**Middle**	**Top**
Channel:	3	6	11
Frequency [MHz]	2422	2437	2462

2.6.2 Datarates

Data rate / frequency	2412	2437	2462
b-mode, 1 Mbit/s	1b	2b	3b
g-mode, 6 Mbit/s	1g	2g	3g
n-Mode, 72.2 Mbit/s (MCS7, 20 MHz)	1n	2n	3n
	2422	2437	2462
n-Mode, 150 Mbit/s (MCS7, 40 MHz)	1n+	2n+	3n+

2.7 Special software used for testing

A windows software "SP META tool" was used to set the EUT into the necessary testmode.

2.8 Product labelling

2.8.1 FCC ID label

Please refer to the documentation of the applicant.

2.8.2 Location of the label on the EUT

Please refer to the documentation of the applicant.

3 Test Results

3.1 Occupied bandwidth

Standard FCC Part 15, Subpart C

The test was performed according to: ANSI C63.10

3.1.1 Test Description

The Equipment Under Test (EUT) was set up to perform the occupied bandwidth measurements.
The reference level is the level of the highest amplitude signal observed from the transmitter at either the fundamental frequency or first-order modulation products in all typical modes of operation, including the unmodulated carrier, even if atypical.
The EUT was connected to spectrum analyzer via a short coax cable with a known loss.
Analyzer settings:
- Resolution Bandwidth (RBW): 100 kHz
- Video Bandwidth (VBW): 300 kHz
- Span: 30 / 60 MHz (for 20 / 40 MHz nominal bandwidth)
- Detector: Peak / Sample (6 dB bandwidth / 99% bandwidth)

3.1.2 Test Requirements / Limits

FCC Part 15, Subpart C, §15.247 (a) (2)
Systems using digital modulation techniques may operate in the 902-928 MHz and 2400-2483.5 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

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

3.1.3 Test Protocol

Temperature: 23 °C
Air Pressure: 1008 hPa
Humidity: 37 %

3.1.3.1 6 dB bandwidth

WLAN b-Mode; 20 MHz; 1 Mbit/s					
Band	**Channel No.**	**Frequency [MHz]**	**6 dB Bandwidth [MHz]**	**Limit [MHz]**	**Margin to Limit [MHz]**
2.4 GHz ISM	1	2412	10.159	0.5	9.7
	6	2437	10.159	0.5	9.7
	11	2462	10.116	0.5	9.6

WLAN g-Mode; 20 MHz; 6 Mbit/s					
Band	**Channel No.**	**Frequency [MHz]**	**6 dB Bandwidth [MHz]**	**Limit [MHz]**	**Margin to Limit [MHz]**
2.4 GHz ISM	1	2412	16.021	0.5	15.5
	6	2437	16.238	0.5	15.7
	11	2462	15.716	0.5	15.2

WLAN n-Mode; 20 MHz; 72.2 Mbit/s					
Band	**Channel No.**	**Frequency [MHz]**	**6 dB Bandwidth [MHz]**	**Limit [MHz]**	**Margin to Limit [MHz]**
2.4 GHz ISM	1	2412	17.757	0.5	17.3
	6	2437	17.713	0.5	17.2
	11	2462	17.714	0.5	17.2

WLAN n-Mode; 40 MHz; 150 Mbit/s					
Band	**Channel No.**	**Frequency [MHz]**	**6 dB Bandwidth [MHz]**	**Limit [MHz]**	**Margin to Limit [MHz]**
2.4 GHz ISM	3	2412	35.752	0.5	35.3
	6	2437	36.057	0.5	35.6
	11	2462	36.064	0.5	35.6

3.1.3.2 99% bandwidth

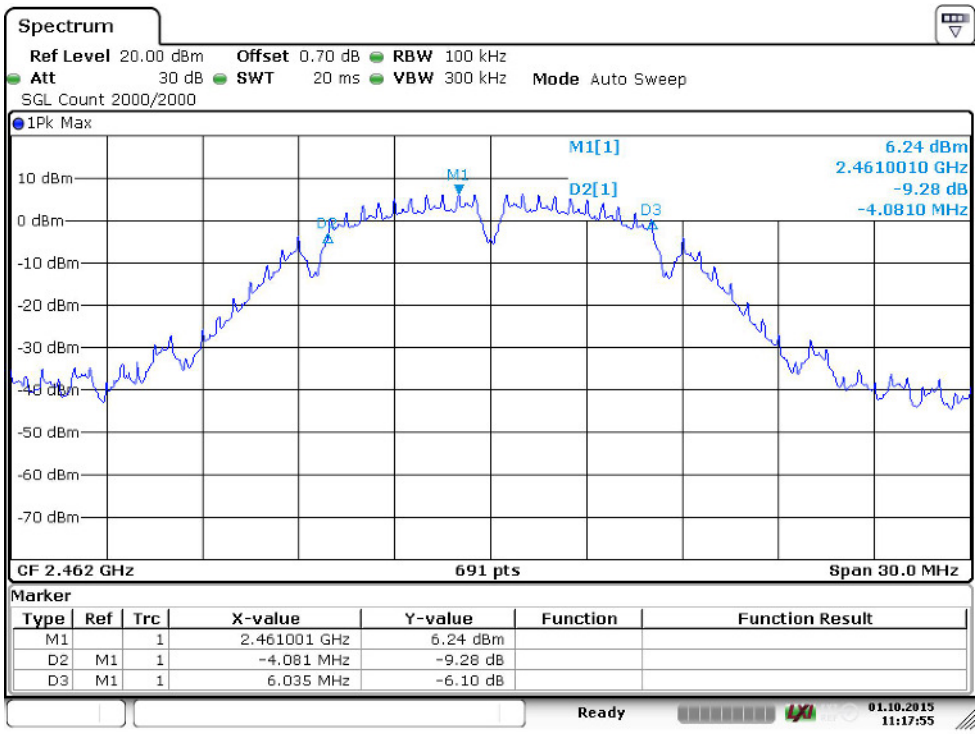
WLAN b-Mode; 20 MHz; 1 Mbit/s			
Band	**Channel No.**	**Frequency [MHz]**	**99 % Bandwidth [MHz]**
2.4 GHz ISM	1	2412	12.880
	6	2437	12.735
	11	2462	12.663

WLAN g-Mode; 20 MHz; 6 Mbit/s			
Band	**Channel No.**	**Frequency [MHz]**	**99 % Bandwidth [MHz]**
2.4 GHz ISM	1	2412	17.221
	6	2437	17.366
	11	2462	17.294

WLAN n-Mode; 20 MHz; 72.2 Mbit/s			
Band	**Channel No.**	**Frequency [MHz]**	**99 % Bandwidth [MHz]**
2.4 GHz ISM	1	2412	17.800
	6	2437	17.873
	11	2462	17.800

WLAN n-Mode; 40 MHz; 150 Mbit/s			
Band	**Channel No.**	**Frequency [MHz]**	**99 % Bandwidth [MHz]**
2.4 GHz ISM	3	2422	35.948
	6	2437	35.948
	11	2462	35.948

3.1.4 Measurement Plot (showing the lowest/highest value, "worst case")



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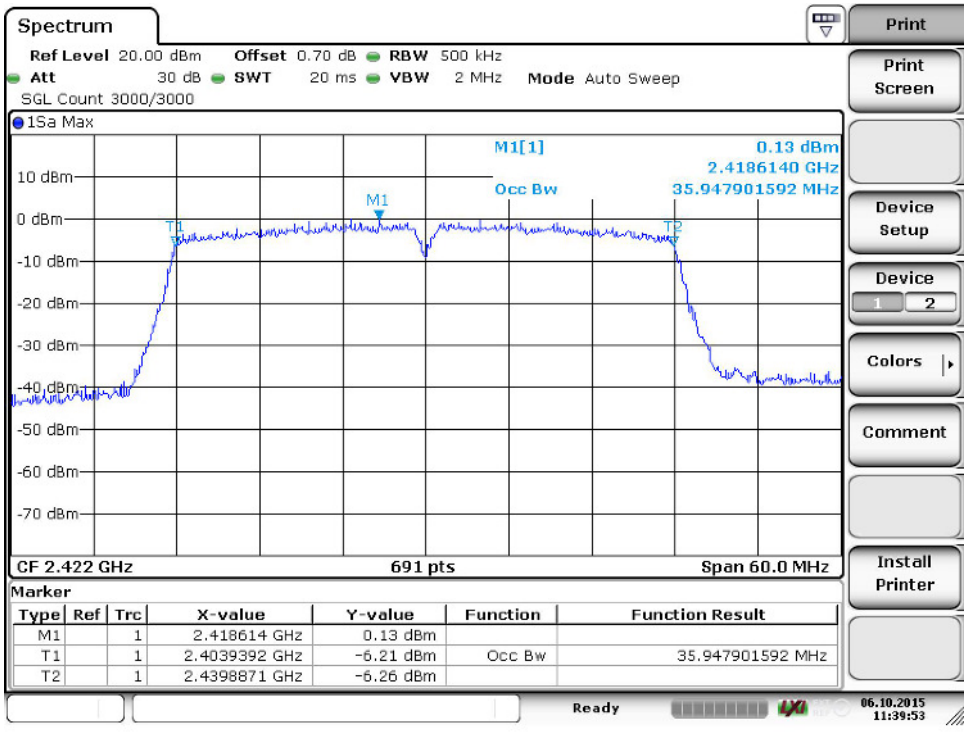
6 dB BW, WLAN mode b, Ch. 11



Date: 6.OCT.2015 11:39:52

99 % BW, WLAN mode n 40 MHz, Ch. 3

3.2 Peak power output

Standard FCC Part 15, Subpart C

The test was performed according to: ANSI C63.10

3.2.1 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: Peak

3.2.2 Test Requirements / Limits

FCC Part 15, Subpart C, §15.247 (b) (3)
For systems using digital modulation techniques in the 902-928 MHz and 2400-2483.5 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)

3.2.3 Test Protocol

Temperature: 23 °C
Air Pressure: 1008 hPa
Humidity: 37 %

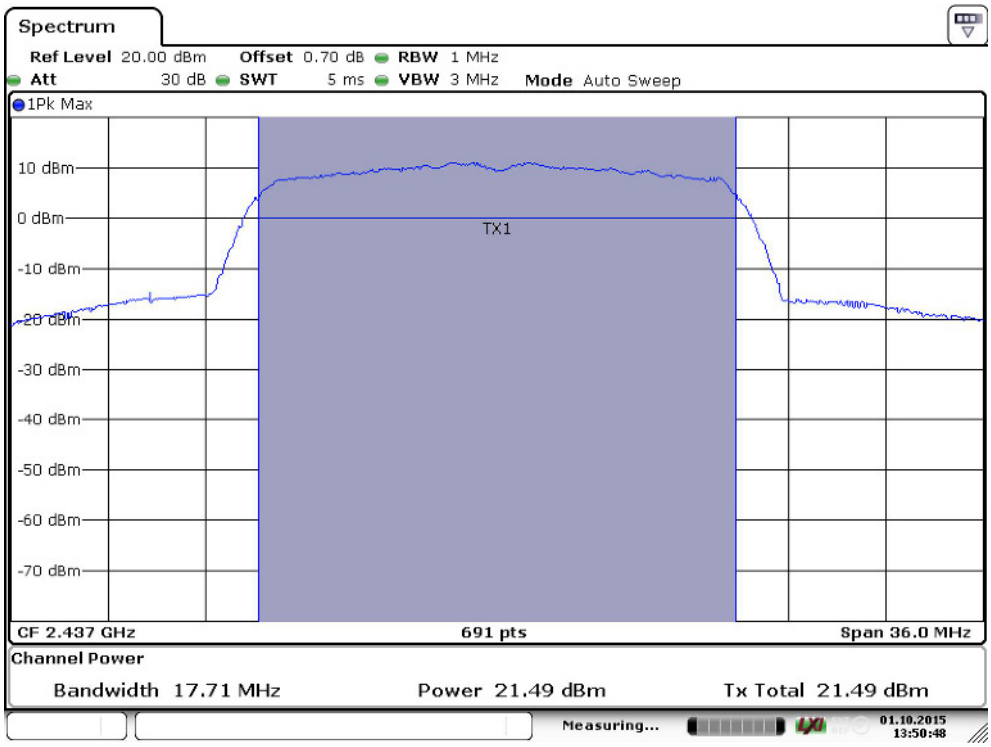
WLAN b-Mode; 20 MHz; 1 Mbit/s						
Band	**Channel No.**	**Frequency [MHz]**	**Peak Power [dBm]**	**Limit [dBm]**	**Margin to Limit [dB]**	**E.I.R.P [dBm]**
2.4 GHz ISM	1	2412	17.1	30.0	12.9	19.7
	6	2437	17.5	30.0	12.5	20.1
	11	2462	18.0	30.0	12.0	20.6

WLAN g-Mode; 20 MHz; 6 Mbit/s						
Band	**Channel No.**	**Frequency [MHz]**	**Peak Power [dBm]**	**Limit [dBm]**	**Margin to Limit [dB]**	**E.I.R.P [dBm]**
2.4 GHz ISM	1	2412	19.6	30.0	10.4	22.2
	6	2437	20.7	30.0	9.3	23.3
	11	2462	20.2	30.0	9.8	22.8

WLAN n-Mode; 20 MHz; 72.2 Mbit/s						
Band	**Channel No.**	**Frequency [MHz]**	**Peak Power [dBm]**	**Limit [dBm]**	**Margin to Limit [dB]**	**E.I.R.P [dBm]**
2.4 GHz ISM	1	2412	20.0	30.0	10.0	22.6
	6	2437	21.5	30.0	8.5	24.1
	11	2462	21.1	30.0	8.9	23.7

WLAN n-Mode; 40 MHz; 150 Mbit/s						
Band	**Channel No.**	**Frequency [MHz]**	**Peak Power [dBm]**	**Limit [dBm]**	**Margin to Limit [dB]**	**E.I.R.P [dBm]**
2.4 GHz ISM	3	2412	18.2	30.0	11.8	20.8
	6	2437	21.0	30.0	9.0	23.6
	11	2462	21.3	30.0	8.7	23.9

3.2.4 Measurement Plot (showing the highest value, "worst case")



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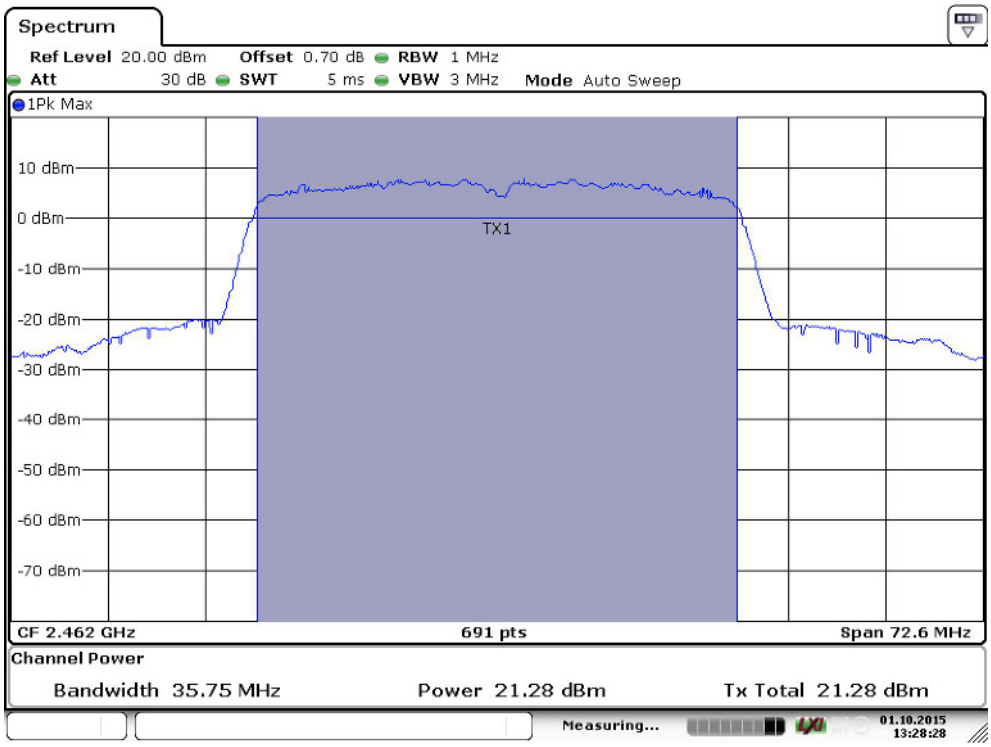
WLAN mode n 20 MHz, Ch. 6



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WLAN mode n 40 MHz, Ch. 11

3.3 Spurious RF conducted emissions

Standard FCC Part 15, Subpart C

The test was performed according to: ANSI C63.10

3.3.1 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 – 25000 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 3.5). This value is used to calculate the 20 dBc limit.

3.3.2 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.

3.3.3 Test Protocol

Temperature: 23 °C
Air Pressure: 1008 hPa
Humidity: 37 %

WLAN b-Mode; 20 MHz; 1 Mbit/s								
Channel No	Channel Center Freq. [MHz]	Spurious Freq. [MHz]	Spurious Level [dBm]	Detector	RBW [kHz]	Ref. Level [dBm]	Limit [dBm]	Margin to Limit [dB]
1	2412	-	-	PEAK	100	5.6	-14.4	-
6	2437	-	-	PEAK	100	5.9	-14.1	-
11	2462	-	-	PEAK	100	5.8	-14.2	-

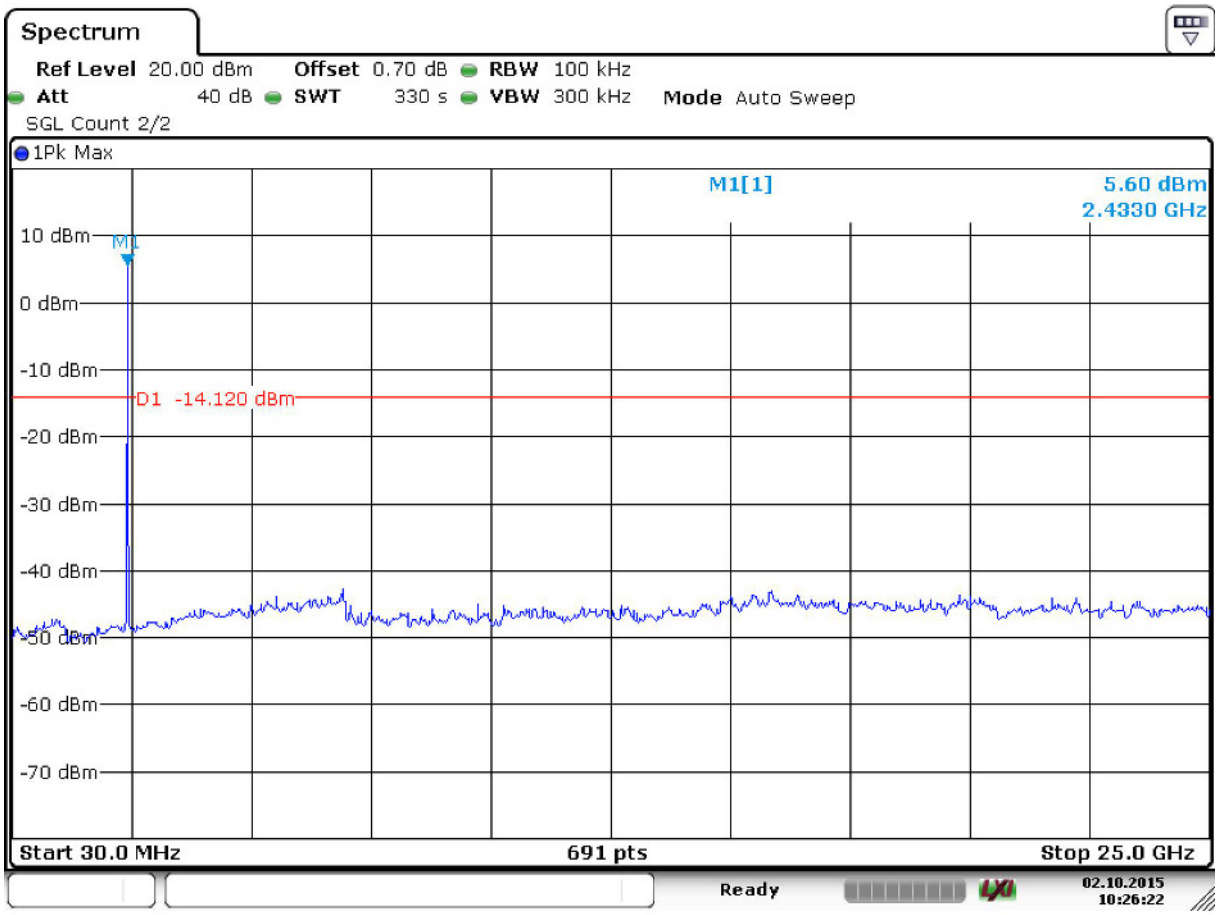
WLAN g-Mode; 20 MHz; 6 Mbit/s								
Channel No	Channel Center Freq. [MHz]	Spurious Freq. [MHz]	Spurious Level [dBm]	Detector	RBW [kHz]	Ref. Level [dBm]	Limit [dBm]	Margin to Limit [dB]
1	2412	-	-	PEAK	100	0.5	-19.5	-
6	2437	-	-	PEAK	100	1.6	-18.4	-
11	2462	-	-	PEAK	100	0.9	-19.1	-

WLAN n-Mode; 20 MHz; 72.2 Mbit/s								
Channel No	Channel Center Freq. [MHz]	Spurious Freq. [MHz]	Spurious Level [dBm]	Detector	RBW [kHz]	Ref. Level [dBm]	Limit [dBm]	Margin to Limit [dB]
1	2412	-	-	PEAK	100	0.0	-20.0	-
6	2437	-	-	PEAK	100	1.4	-18.6	-
11	2462	-	-	PEAK	100	0.7	-19.3	-

WLAN n-Mode; 40 MHz; 150 Mbit/s								
Channel No	Channel Center Freq. [MHz]	Spurious Freq. [MHz]	Spurious Level [dBm]	Detector	RBW [kHz]	Ref. Level [dBm]	Limit [dBm]	Margin to Limit [dB]
3	2422	-	-	PEAK	100	-5.1	-25.1	-
6	2437	-	-	PEAK	100	-2.6	-22.6	-
11	2462	-	-	PEAK	100	-2.3	-22.3	-

Note: No (further) spurious emissions in the range 20 dB below the limit found.

3.3.4 Measurement Plot (showing the highest value)



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3.4 Spurious radiated emissions

Standard FCC Part 15, Subpart C

The test was performed according to: ANSI C63.10

3.4.1 Test Description

The test set-up was made in accordance to the general provisions of ANSI C63.10 in 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 sourse.

1. Measurement up to 30 MHz
The Loop antenna HFH2-Z2 is used.
Step 1: pre measurement
- Anechoic chamber
- Antenna distance: 10 m
- Detector: Peak-Maxhold
- Frequency range: 0.009 - 0.15 MHz and 0.15 – 30 MHz
- Frequency steps: 0.1 kHz and 5 kHz
- IF–Bandwidth: 0.2 kHz and 10 kHz
- Measuring time / Frequency step: 100 ms

Intention of this step is, to determine the radiated EMI-profile of the EUT. Afterwards the relevant emissions for the final measurement are identified.
Step 2: final measurement
For the relevant emissions determined in step 1, an additional measurement with the following settings will be performed. Intention of this step is to find the maximum emission level.
- Open area test side
- Antenna distance: according to the Standard
- Detector: Quasi-Peak
- Frequency range: 0.009 – 30 MHz
- Frequency steps: measurement at frequencies detected in step 1
- IF–Bandwidth: 0.2 - 10 kHz
- Measuring time / Frequency step: 100 ms

2. Measurement above 30 MHz and up to 1 GHz

Step 1: Preliminary scan

This is a preliminary test to identify the highest amplitudes relative to the limit.

Settings for step 1:

- Antenna distance: 3 m
- Detector: Peak-Maxhold
- Frequency range: 30 – 1000 MHz
- Frequency steps: 60 kHz
- IF–Bandwidth: 120 kHz
- Measuring time / Frequency step: 100 µs
- Turntable angle range: –180° to 180°
- Turntable step size: 90°
- Height variation range: 1 – 3 m
- Height variation step size: 2 m
- Polarisation: Horizontal + Vertical

Intention of this step is, to determine the radiated EMI-profile of the EUT. Afterwards the relevant emissions for the final measurement are identified.

Step 2: second measurement

For the relevant emissions determined in step 1, an additional measurement with the following settings will be performed. Intention of this step is, to find out the approximate turntable angle and antenna height for each frequency.

- Detector: Peak – Maxhold
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 120 kHz
- Measuring time: 100 ms
- Turntable angle range: –180° to 180°
- Turntable step size: 45°
- Height variation range: 1 – 4 m
- Height variation step size: 0.5 m
- Polarisation: horizontal + vertical

After this step, the EMI test system has determined the following values for each frequency (of step 1):

- Frequency
- Azimuth value (of turntable)
- Antenna height

The last two values have now the following accuracy:

- Azimuth value (of turntable): 45°
- Antenna height: 0.5 m

Step 3: final measurement

In this step the accuracy of the turntable azimuth and antenna height will be improved. This is necessary to find out the maximum value of every frequency.

For each frequency, which was determined the turntable azimuth and antenna height will be adjusted. The turntable azimuth will slowly vary by ± 22.5° around this value. During this action, the value of emission is continuously measured. The turntable azimuth at the highest emission will be recorded and adjusted. In this position, the antenna height will also slowly vary by ± 25 cm around the antenna height determined. During this action, the value of emission is also continuously measured. The antenna height of the highest emission will also be recorded and adjusted.

- Detector: Peak – Maxhold
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 120 kHz
- Measuring time: 100 ms
- Turntable angle range: ± 22.5 ° around the determined value
- Height variation range: ± 25 cm around the determined value

Step 4: final measurement with QP detector
With the settings determined in step 3, the final measurement will be performed:
EMI receiver settings for step 4:
- Detector: Quasi-Peak (< 1 GHz)
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 120 kHz
- Measuring time: 1 s

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. Measurement above 1 GHz
The following modifications apply to the measurement procedure for the frequency range 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 was reduced to 1.5 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). Due to the fact, that in this frequency range a double-ridged wave guided horn antenna (up to 18 GHz) and a horn antenna (18–25 GHz) are used, the steps 2-4 are omitted. Step 1 was performed with one height of the receiving antenna only.
EMI receiver settings:
- Detector: Peak, Average
- IF Bandwidth = 1 MHz

For the data rate in mode n the test is performed as worst-case-check in order to verify that emissions have a comparable level as found at modes b and g. Typically, the measurement is performed in the frequency range 1 to 8 GHz but it depends on the emissions found during the test for the modes b and g. Please refer to the results for the used frequency range.

3.4.2 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 → 10	(48.5 – 13.8) + 59.1 dB	107.6 – 72.9
0.49 – 1.705	24000/F(kHz)	30 → 10	(33.8 – 23.0) + 19.1 dB	52.9 – 42.1
1.705 – 30	30	30 → 10	29.5 + 19.1 dB	48.6

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)

3.4.3 Test Protocol

Temperature: 20–25 °C
Air Pressure: 997–1020 hPa
Humidity: 26–46 %

Variant RSE III C&G

WLAN b-Mode; 20 MHz; 1 Mbit/s				Applied duty cycle correction (AV) [dB]:				0.0
Ch. No.	Ch. Center Freq. [MHz]	Spurious Freq. [MHz]	Spurious Level [dBµV/m]	Detec-tor	RBW [kHz]	Limit [dBµV/m]	Margin to Limit [dB]	Limit Type
1	2412	-	-	PEAK	1000	74.0	-	RB
6	2437	-	-	PEAK	1000	74.0	-	RB
11	2462	-	-	PEAK	1000	74.0	-	RB

WLAN g-Mode; 20 MHz; 6 Mbit/s				Applied duty cycle correction (AV) [dB]:				0.0
Ch. No.	Ch. Center Freq. [MHz]	Spurious Freq. [MHz]	Spurious Level [dBµV/m]	Detec-tor	RBW [kHz]	Limit [dBµV/m]	Margin to Limit [dB]	Limit Type
1	2412	2390.0	60.6	PEAK	1000	74.0	13.4	RB
1	2412	2390.0	40.5	AV	1000	54.0	13.5	RB
11	2462	-	-	PEAK	1000	74.0	-	RB

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

Since in pre checks no spurious emissions outside the restricted bands directly next to the 2.4 GHz band which are closer than 20 dB to the limit were found, only WLAN mode b was tested over the full frequency range. For mode g testing was only performed in the restricted bands directly below and above the 2.4 GHz band and in the restricted bands relevant for harmonics. For WLAN mode n only the upper band edge was performed.

VARIANT RSE III

WLAN b-Mode; 20 MHz; 1 Mbit/s				Applied duty cycle correction (AV) [dB]:				0.0
Ch. No.	Ch. Center Freq. [MHz]	Spurious Freq. [MHz]	Spurious Level [dBµV/m]	Detec-tor	RBW [kHz]	Limit [dBµV/m]	Margin to Limit [dB]	Limit Type
1	2412	-	-	PEAK	1000	74.0	-	RB
6	2437	-	-	PEAK	1000	74.0	-	RB
11	2462	-	-	PEAK	1000	74.0	-	RB

WLAN g-Mode; 20 MHz; 6 Mbit/s				Applied duty cycle correction (AV) [dB]:				0.0
Ch. No.	Ch. Center Freq. [MHz]	Spurious Freq. [MHz]	Spurious Level [dBµV/m]	Detec-tor	RBW [kHz]	Limit [dBµV/m]	Margin to Limit [dB]	Limit Type
1	2412	2390.0	67.7	PEAK	1000	74.0	6.3	RB
1	2412	2390.0	49.7	AV	1000	54.0	4.4	RB
11	2462	-	-	PEAK	1000	74.0	-	RB

Note: No (further) spurious emissions in the range 20 dB below the limit found.

Since in pre checks no spurious emissions outside the restricted bands directly next to the 2.4 GHz band which are closer than 20 dB to the limit were found, only WLAN mode b was tested over the full frequency range and on all three channels. For mode g testing was only performed in the restricted bands directly below (Ch. 1) and above (Ch.11) the 2.4 GHz band. For WLAN mode n only the upper band edge was performed.

3.5 Band edge compliance

Standard FCC Part 15, Subpart C

The test was performed according to: ANSI C63.10–2013, FCC §15.31

3.5.1 Test Description

The procedure to show compliance with the band edge requirement is divided into two measurements:

1. Show compliance of the lower and higher band edge by a conducted measurement.
For the conducted measurement, the Equipment Under Test (EUT) is placed in a shielded room.
For the lower band edge the EUT is set to transmit as follows:
For a WLAN transmitter working in the 2.4 GHz band on lowest channel:
CH1 = 2412 MHz / CH3 = 2422 MHz for a channel bandwidth of 20 / 40 MHz.
The lower band edge is 2400 MHz for 2.4 GHz band transmitter.
For the higher band edge the EUT is set to transmit as follows:
For a WLAN transmitter working in the 2.4 GHz band on highest channel:
CH11 = 2462 MHz or CH13 = 2472 MHz / CH11= 2462 MHz for a channel bandwidth of 20 / 40 MHz.
The higher band edge is 2483.5 MHz for a 2.4 GHz band transmitter.
Analyzer settings for conducted measurement:
- Detector: Peak
- RBW / VBW = 100 / 300 kHz

2. Showing compliance of the higher band edge falls in to restricted bands by a radiated measurement.
The radiated emissions measurements are performed in a typical installation configuration inside the fully anechoic chamber using a horn antenna at 1 m distance.
EMI receiver settings for radiated measurement:
- Detector: Peak, Average
- IF Bandwidth = 1 MHz

3.5.2 Test Requirements / Limits

FCC Part 15.247 (d)
"In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated 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. Attenuation below the general limits specified in Section 15.209(a) is not required. 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))."

For the conducted measurement the RF power at the band edge 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...”

For the radiated measurement of the higher band edge connected to a restricted band the limit is “specified in Section 15.209(a)”.

3.5.3 Test Protocol

3.5.3.1 Conducted measurement, lower and higher band edge

Temperature: 23 °C
Air Pressure: 1008 hPa
Humidity: 37 %

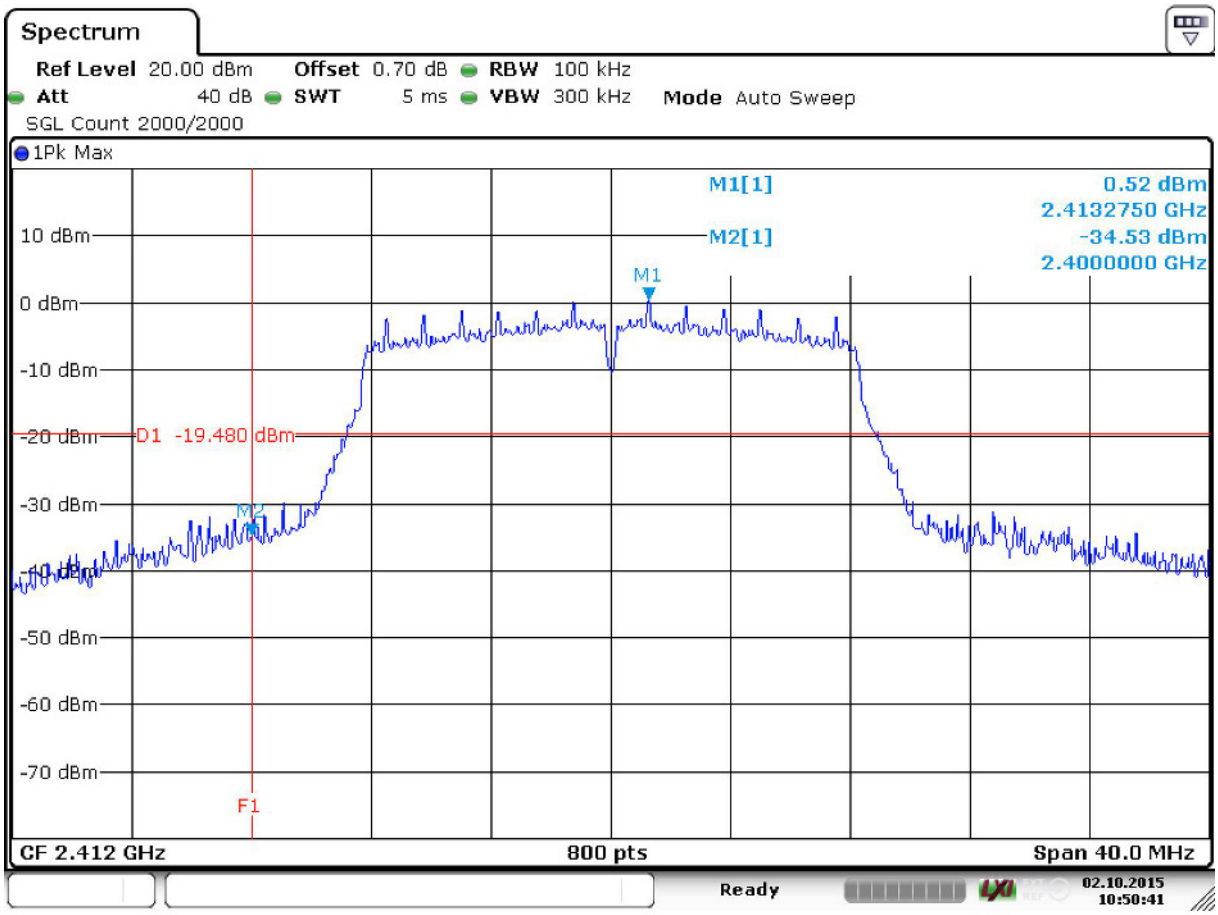
WLAN b-Mode; 20 MHz; 1 Mbit/s								
Channel No.	Channel Center Frequency [MHz]	Band Edge Freq. [MHz]	Spurious Level [dBm]	Detector	RBW [kHz]	Ref. Level [dBm]	Limit [dBµV/m]	Margin to Limit [dB]
1	2412	2400.0	-35.8	PEAK	100	5.6	-14.4	21.3
11	2462	2483.5	-47.0	PEAK	100	5.8	-14.2	32.8

WLAN g-Mode; 20 MHz; 6 Mbit/s								
Channel No.	Channel Center Frequency [MHz]	Band Edge Freq. [MHz]	Spurious Level [dBm]	Detector	RBW [kHz]	Ref. Level [dBm]	Limit [dBm]	Margin to Limit [dB]
1	2412	2400.0	-34.5	PEAK	100	0.5	-19.5	15.1
11	2462	2483.5	-41.4	PEAK	100	0.9	-19.1	22.3

WLAN n-Mode; 20 MHz; 72.2 Mbit/s								
Channel No.	Channel Center Frequency [MHz]	Band Edge Freq. [MHz]	Spurious Level [dBm]	Detector	RBW [kHz]	Ref. Level [dBm]	Limit [dBm]	Margin to Limit [dB]
1	2412	2400.0	-39.9	PEAK	100	0.0	-20.0	19.9
11	2462	2483.5	-45.0	PEAK	100	0.7	-19.3	25.7

WLAN n-Mode; 40 MHz; 150 Mbit/s								
Channel No.	Channel Center Frequency [MHz]	Band Edge Freq. [MHz]	Spurious Level [dBm]	Detector	RBW [kHz]	Ref. Level [dBm]	Limit [dBm]	Margin to Limit [dB]
3	2422	2400.0	-45.6	PEAK	100	-5.1	-25.1	20.6
11	2462	2483.5	-40.7	PEAK	100	-2.3	-22.3	18.4

3.5.3.2 Measurement Plot (showing the highest value, "worst case")



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3.5.3.3 Radiated measurement, higher band edge

Temperature: 20–25 °C
Air Pressure: 997–1020 hPa
Humidity: 26–46 %

Variant RSE III C&G

WLAN b-mode; 20 MHz; 1 Mbit/s				Applied duty cycle correction (AV) [dB]:				0.0
Ch. No.	Ch. Center Freq. [MHz]	Band Edge Freq. [MHz]	Spurious Level [dBµV/m]	Detec-tor	RBW [kHz]	Limit [dBµV/m]	Margin to Limit [dB]	Limit Type
11	2462	2483.5	45.5	PEAK	1000	74.0	28.5	BE
11	2462	2483.5	35.6	AV	1000	54.0	18.4	BE

WLAN g-Mode; 20 MHz; 6 Mbit/s				Applied duty cycle correction (AV) [dB]:				0.0
Ch. No.	Ch. Center Freq. [MHz]	Band Edge Freq. [MHz]	Spurious Level [dBµV/m]	Detec-tor	RBW [kHz]	Limit [dBµV/m]	Margin to Limit [dB]	Limit Type
11	2462	2483.5	60.4	PEAK	1000	74.0	13.6	BE
11	2462	2483.5	40.2	AV	1000	54.0	13.8	BE

WLAN n-Mode; 20 MHz; 72.2 Mbit/s				Applied duty cycle correction (AV) [dB]:				0.0
Ch. No.	Ch. Center Freq. [MHz]	Band Edge Freq. [MHz]	Spurious Level [dBµV/m]	Detec-tor	RBW [kHz]	Limit [dBµV/m]	Margin to Limit [dB]	Limit Type
11	2462	2483.5	57.5	PEAK	1000	74.0	16.5	BE
11	2462	2483.5	39.8	AV	1000	54.0	14.2	BE

WLAN n-Mode; 40 MHz; 150 Mbit/s				Applied duty cycle correction (AV) [dB]:				0.0
Ch. No.	Ch. Center Freq. [MHz]	Band Edge Freq. [MHz]	Spurious Level [dBµV/m]	Detec-tor	RBW [kHz]	Limit [dBµV/m]	Margin to Limit [dB]	Limit Type
11	2462	2483.5	54.0	PEAK	1000	74.0	20.0	BE
11	2462	2483.5	42.4	AV	1000	54.0	11.6	BE

Variant RSE III

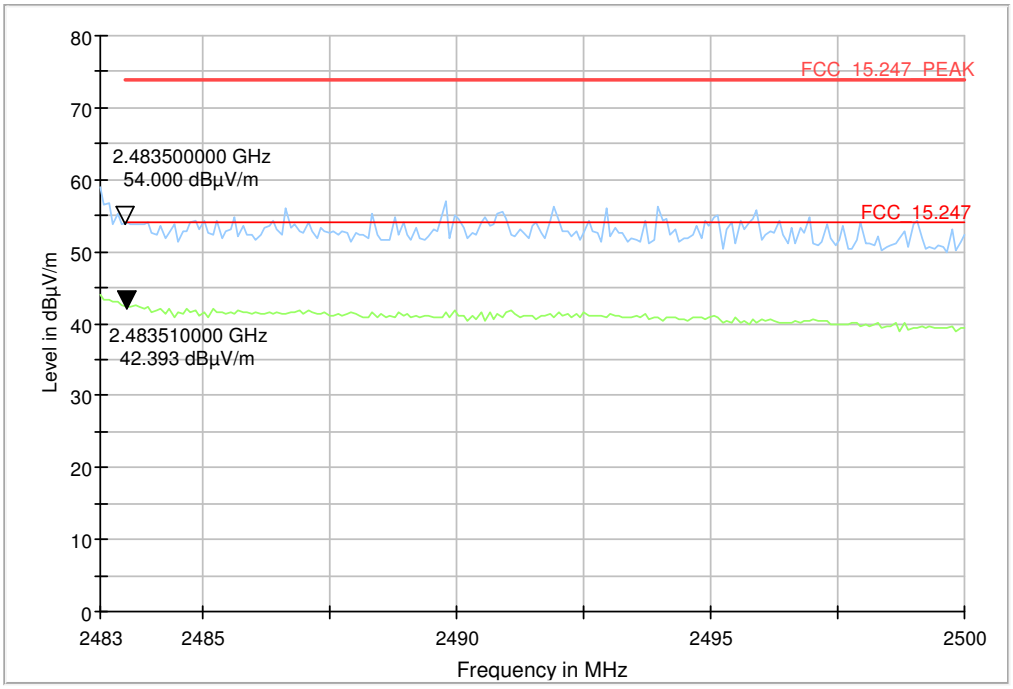
WLAN b-mode; 20 MHz; 1 Mbit/s				Applied duty cycle correction (AV) [dB]:				0.0
Ch. No.	Ch. Center Freq. [MHz]	Band Edge Freq. [MHz]	Spurious Level [dBµV/m]	Detec-tor	RBW [kHz]	Limit [dBµV/m]	Margin to Limit [dB]	Limit Type
11	2462	2483.5	51.1	PEAK	1000	74.0	22.9	BE
11	2462	2483.5	43.2	AV	1000	54.0	10.8	BE

WLAN g-Mode; 20 MHz; 6 Mbit/s				Applied duty cycle correction (AV) [dB]:				0.0
Ch. No.	Ch. Center Freq. [MHz]	Band Edge Freq. [MHz]	Spurious Level [dBµV/m]	Detec-tor	RBW [kHz]	Limit [dBµV/m]	Margin to Limit [dB]	Limit Type
11	2462	2483.5	70.2	PEAK	1000	74.0	3.8	BE
11	2462	2483.5	50.2	AV	1000	54.0	3.9	BE

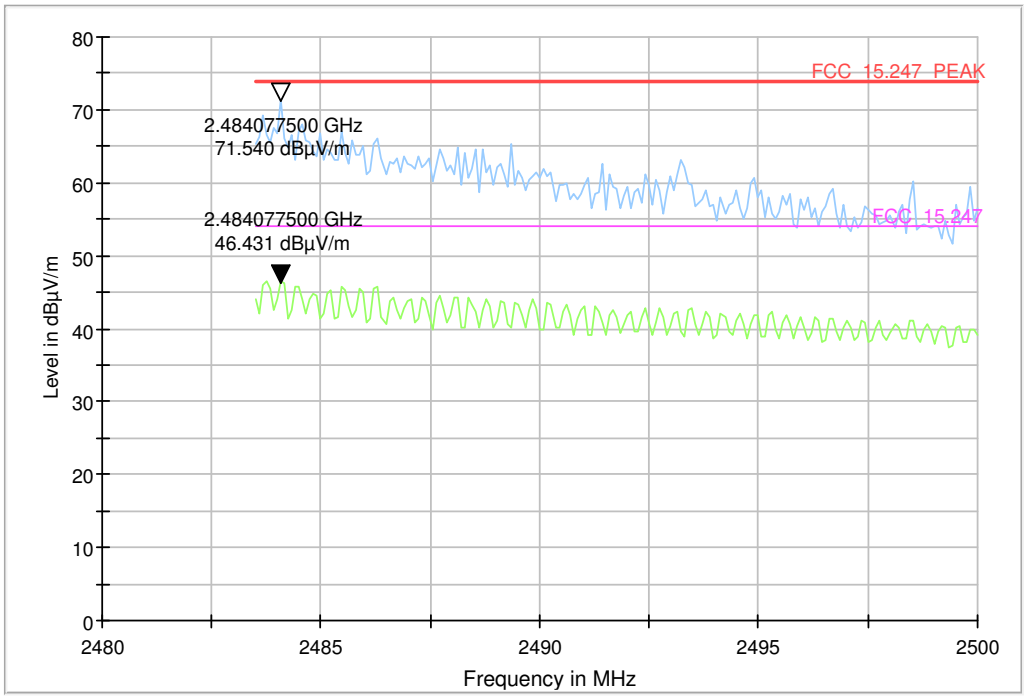
WLAN n-Mode; 20 MHz; 72.2 Mbit/s				Applied duty cycle correction (AV) [dB]:				0.0
Ch. No.	Ch. Center Freq. [MHz]	Band Edge Freq. [MHz]	Spurious Level [dBµV/m]	Detec-tor	RBW [kHz]	Limit [dBµV/m]	Margin to Limit [dB]	Limit Type
11	2462	2484.0	70.5	PEAK	1000	74.0	3.5	BE
11	2462	2483.5	47.7	AV	1000	54.0	6.3	BE

WLAN n-Mode; 40 MHz; 150 Mbit/s				Applied duty cycle correction (AV) [dB]:				0.0
Ch. No.	Ch. Center Freq. [MHz]	Band Edge Freq. [MHz]	Spurious Level [dBµV/m]	Detec-tor	RBW [kHz]	Limit [dBµV/m]	Margin to Limit [dB]	Limit Type
11	2462	2484.0	71.5	PEAK	1000	74.0	2.5	BE
11	2462	2484.0	46.4	AV	1000	54.0	7.6	BE

3.5.3.4 Measurement Plot (showing the highest value, "worst case")



Variant RSE III C&G, WLAN mode n 40 MHz



Variant RSE III, WLAN mode n 40 MHz

3.6 Power density

Standard FCC Part 15, Subpart C

The test was performed according to: ANSI C63.10

3.6.1 Test Description

The EUT was connected to spectrum analyzer via a short coax cable with a known loss.
Analyzer settings:
- Detector: Peak-Maxhold
- Resolution Bandwidth (RBW): 3 kHz
- Video Bandwidth (VBW): 30 kHz
- Sweep Time: Coupled

3.6.2 Test Requirements / Limits

FCC Part 15, Subpart C, §15.247 (e)

For digitally modulated systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.
…
The same method of determining the conducted output power shall be used to determine the power spectral density.

3.6.3 Test Protocol

Temperature: 23 °C
Air Pressure: 1008 hPa
Humidity: 37 %

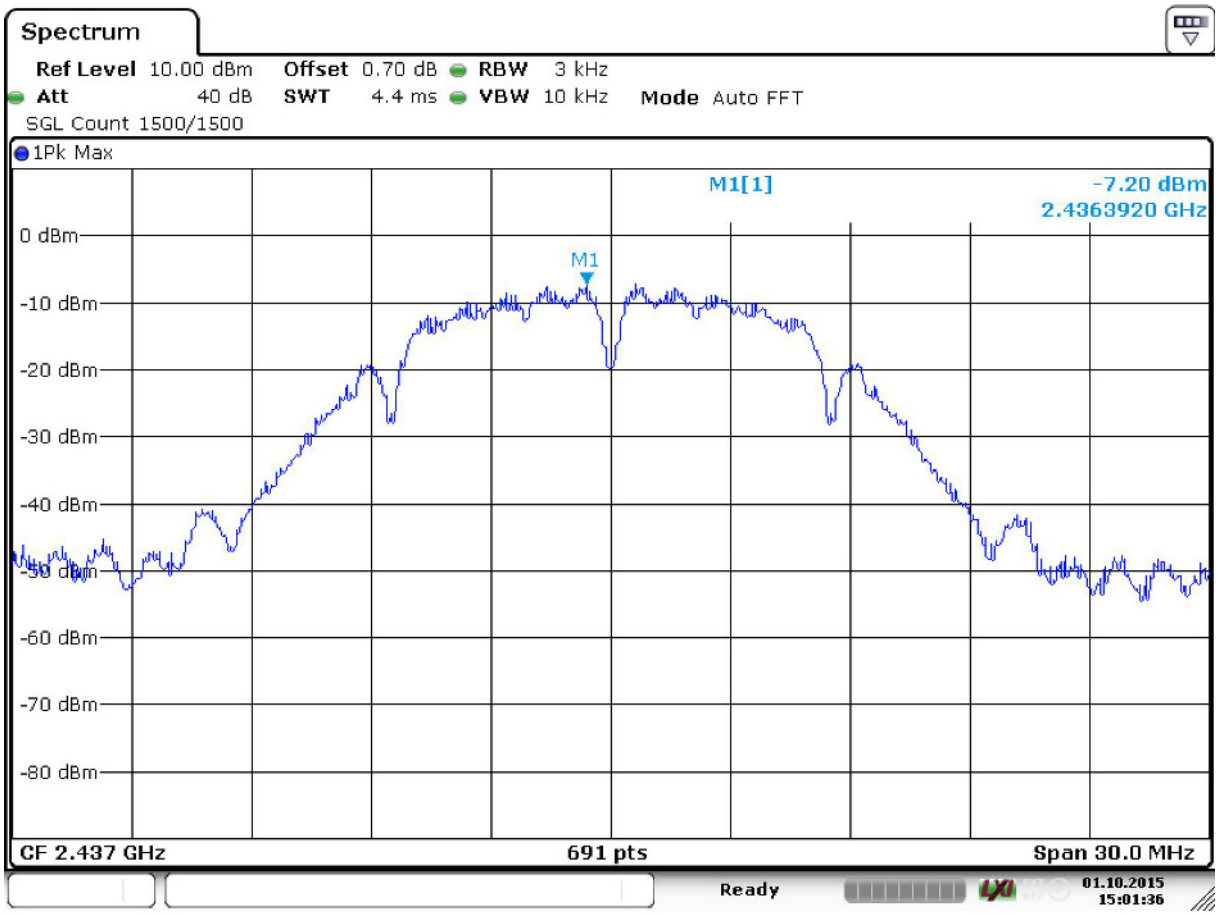
WLAN b-Mode; 20 MHz; 1 Mbit/s					
Band	**Channel No.**	**Frequency [MHz]**	**Power Density [dBm/3kHz]**	**Limit [dBm/3kHz]**	**Margin to Limit [dB]**
2.4 GHz ISM	1	2412	-7.8	8.0	15.8
	6	2437	-7.2	8.0	15.2
	11	2462	-7.5	8.0	15.5

WLAN g-Mode; 20 MHz; 6 Mbit/s					
Band	**Channel No.**	**Frequency [MHz]**	**Power Density [dBm/3kHz]**	**Limit [dBm/3kHz]**	**Margin to Limit [dB]**
2.4 GHz ISM	1	2412	-11.6	8.0	19.6
	6	2437	-11.2	8.0	19.2
	11	2462	-11.4	8.0	19.4

WLAN n-Mode; 20 MHz; 72.2 Mbit/s					
Band	**Channel No.**	**Frequency [MHz]**	**Power Density [dBm/3kHz]**	**Limit [dBm/3kHz]**	**Margin to Limit [dB]**
2.4 GHz ISM	1	2412	-14.5	8.0	22.5
	6	2437	-13.6	8.0	21.6
	11	2462	-13.6	8.0	21.6

WLAN n-Mode; 40 MHz; 150 Mbit/s					
Band	**Channel No.**	**Frequency [MHz]**	**Power Density [dBm/3kHz]**	**Limit [dBm/3kHz]**	**Margin to Limit [dB]**
2.4 GHz ISM	3	2412	-21.2	8.0	29.2
	6	2437	-18.9	8.0	26.9
	11	2462	-19.1	8.0	27.1

3.6.4 Measurement Plot (showing the highest value, "worst case")



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WLAN mode b, Ch. 6

4 Measurement Uncertainty

Test Case	Parameter	Uncertainty
AC Power Line	Power	± 3.4 dB
Field Strength of spurious radiation	Power	± 5.5 dB
6 dB / 26 dB / 99% Bandwidth	Power Frequency	± 2.9 dB ± 11.2 kHz
Conducted Output Power	Power	± 2.2 dB
Band Edge Compliance	Power Frequency	± 2.2 dB ± 11.2 kHz
Frequency Stability	Frequency	± 25 Hz
Power Spectral Density	Power	± 2.2 dB

5 Test Equipment

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

Test Equipment Anechoic Chamber

Lab ID:	**Lab 1**		
Manufacturer:	Frankonia		
Description:	Anechoic Chamber for radiated testing		
Type:	10.58x6.38x6.00 m³		
	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 FCC listing 96716 3m Part15/18	none	Frankonia 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 Radiated emissions

Lab ID:	**Lab 1**
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 Mess-Elektronik OHG
Biconical dipole	VUBA 9117	9117-108	Schwarzbeck Mess-Elektronik OHG
Broadband Amplifier 1 GHz - 4 GHz	AFS4-01000400-1Q-10P-4	-	Miteq
Broadband Amplifier 18 GHz - 26 GHz	JS4-18002600-32-5P	849785	Miteq
Broadband Amplifier 30 MHz - 18 GHz	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"	SucoFlex	W18.02-2+W38.02-2	HUBER+SUHNER
Cable "ESI to Horn Antenna"	UFB311A+UFB293C	W18.02-2+W38.02-2	Rosenberger Micro-Coax
Double-ridged horn	HF 906	357357/002	Rohde & Schwarz GmbH & Co. KG

Single Devices for Auxiliary Equipment for Radiated emissions (continued)

Single Device Name	*Type*	*Serial Number*	*Manufacturer*	
	Standard Calibration		2015/06/23	2018/06/22
Double-ridged horn	HF 907	102444	Rohde & Schwarz GmbH & Co. KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard Calibration		2015/05/11	2018/05/10
Double-ridged horn-duplicated 2015-07-15 10:47:55	HF 906	357357/001	Rohde & Schwarz GmbH & Co. KG	
High Pass Filter	4HC1600/12750-1.5-KK	9942011	Trilithic	
High Pass Filter	5HC2700/12750-1.5-KK	9942012	Trilithic	
High Pass Filter	5HC3500/18000-1.2-KK	200035008	Trilithic	
High Pass Filter	WHKX 7.0/18G-8SS	09	Wainwright	
Horn Antenna Schwarzbeck 15-26.5 GHz BBHA 9170	BBHA 9170	BBHA9170262	Schwarzbeck Mess-Elektronik OHG	
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 (upgraded)	HL 562 Ultralog new biconicals	830547/003	Rohde & Schwarz GmbH & Co. KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard Calibration		2015/06/30	2018/06/29
Loop Antenna	HFH2-Z2	829324/006	Rohde & Schwarz GmbH & Co. KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	DKD Calibration		2014/11/27	2017/11/27
Standard Gain / Pyramidal Horn Antenna 26.5 GHz	3160-09	00083069	EMCO Elektronik GmbH	
Standard Gain / Pyramidal Horn Antenna 40 GHz	3160-10	00086675	EMCO Elektronik GmbH	
Tilt device Maturo (Rohacell)	Antrieb TD1.5-10kg	TD1.5-10kg/024/3790709	Maturo GmbH	

Test Equipment Auxiliary Test Equipment

Lab ID:	**Lab 1, Lab 2**
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*	
AC Power Source	Chroma 6404	64040001304	Chroma ATE INC.	
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
Digital Multimeter 13 (Clamp Meter)	Fluke 325	31270091WS	FLUKE	
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	
Signal Analyzer	FSV30	103005	Rohde & Schwarz GmbH & Co. KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard		2014/02/10	2016/02/09
Spectrum Analyser	FSU26	200418	Rohde & Schwarz GmbH & Co.KG	
	Standard calibration		2015/10/20	2016/10/19
Spectrum Analyzer	FSP3	836722/011	Rohde & Schwarz GmbH & Co. KG	
	DKD calibration		2015/06/23	2018/06/22
Vector Signal Generator	SMIQ 03B	832492/061	Rohde & Schwarz GmbH & Co.KG	

Test Equipment Digital Signalling Devices

Lab ID:	**Lab 1, Lab 2**
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	
	Standart calibration		2015/01/21	2018/01/19
CMW500	CMW500	107500	Rohde & Schwarz GmbH & Co.KG	
	Standard calibration		2014/01/27	2016/01/26
Digital Radio Communication Tester	CMD 55	831050/020	Rohde & Schwarz GmbH & Co. KG	
	DKD calibration		2014/12/02	2017/12/01
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	
	DKD calibration		2014/12/03	2017/12/02
	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**
Description:	Equipment for emission measurements
Serial Number:	see single devices

Single Devices for Emission measurement devices

Single Device Name	*Type*	*Serial Number*	*Manufacturer*	
EMI Receiver / Spectrum Analyzer	ESR 7	101424	Rohde & Schwarz	
	Calibration Details		*Last Execution*	*Next Exec.*
	Initial Factory Calibration		2014/11/13	2016/11/12
Personal Computer	Dell	30304832059	Dell	
Power Meter	NRVD	828110/016	Rohde & Schwarz GmbH & Co.KG	
	Standard calibration		2015/05/11	2016/05/10
Sensor Head A	NRV-Z1	827753/005	Rohde & Schwarz GmbH & Co.KG	
	Standard calibration		2015/05/11	2016/05/10
Signal Generator	SMR 20	846834/008	Rohde & Schwarz GmbH & Co. KG	
	Standard Calibration		2014/06/24	2017/06/23
Spectrum Analyzer	ESIB 26	830482/004	Rohde & Schwarz GmbH & Co. KG	
	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	
Spectrum Analyzer	FSW 43	103779	Rohde & Schwarz	
	Calibration Details		*Last Execution*	*Next Exec.*
	Initial Factory Calibration		2014/11/17	2016/11/16

Test Equipment Multimeter 03

Lab ID:	**Lab 1, Lab 2**
Description:	Fluke 177
Serial Number:	86670383

Single Devices for Multimeter 03

Single Device Name	*Type*	*Serial Number*	*Manufacturer*	
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

Test Equipment Radio Lab Test Equipment

Lab ID: **Lab 2**
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		2015/05/11	2016/05/10
RF Step Attenuator RSP	RSP	833695/001	Rohde & Schwarz GmbH & Co.KG	
Rubidium Frequency Standard	Datum, Model: MFS	5489/001	Datum-Beverly	
	Standard calibration		2015/06/25	2016/06/24
Sensor Head A	NRV-Z1	827753/005	Rohde & Schwarz GmbH & Co.KG	
	Standard calibration		2015/05/11	2016/05/10
Signal Generator SME	SME03	827460/016	Rohde & Schwarz GmbH & Co.KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard calibration		2014/12/02	2017/12/01
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 Analyzer	FSIQ26	840061/005	Rohde & Schwarz GmbH & Co. KG	
	Calibration after reparation		2015/04/02	2017/04/01

Test Equipment T/A Logger 13

Lab ID:	**Lab 1, Lab 2**
Description:	Lufft Opus10 TPR
Type:	Opus10 TPR
Serial Number:	13936

Single Devices for T/A Logger 13

Single Device Name	*Type*	*Serial Number*	*Manufacturer*	
ThermoAirpressure Datalogger 13 (Environ)	Opus10 TPR (8253.00)	13936	Lufft Mess- und Regeltechnik GmbH	
	Customized calibration		2015/02/27	2017/02/26

Test Equipment T/H Logger 03

Lab ID:	**Lab 2**
Description:	Lufft Opus10
Serial Number:	7482

Single Devices for T/H Logger 03

Single Device Name	*Type*	*Serial Number*	*Manufacturer*	
ThermoHygro Datalogger 03 (Environ)	Opus10 THI (8152.00)	7482	Lufft Mess- und Regeltechnik GmbH	
	Customized calibration		2015/02/27	2017/02/26

Test Equipment T/H Logger 12

Lab ID:	**Lab 1**
Description:	Lufft Opus10
Serial Number:	12482

Single Devices for T/H Logger 12

Single Device Name	*Type*	*Serial Number*	*Manufacturer*	
ThermoHygro Datalogger 12 (Environ)	Opus10 THI (8152.00)	12482	Lufft Mess- und Regeltechnik GmbH	
	Customized calibration		2015/03/10	2017/03/09

Test Equipment Temperature Chamber 05

Lab ID:	**Lab 2**
Manufacturer:	see single devices
Description:	Temperature Chamber VT4002
Type:	Vötsch
Serial Number:	see single devices

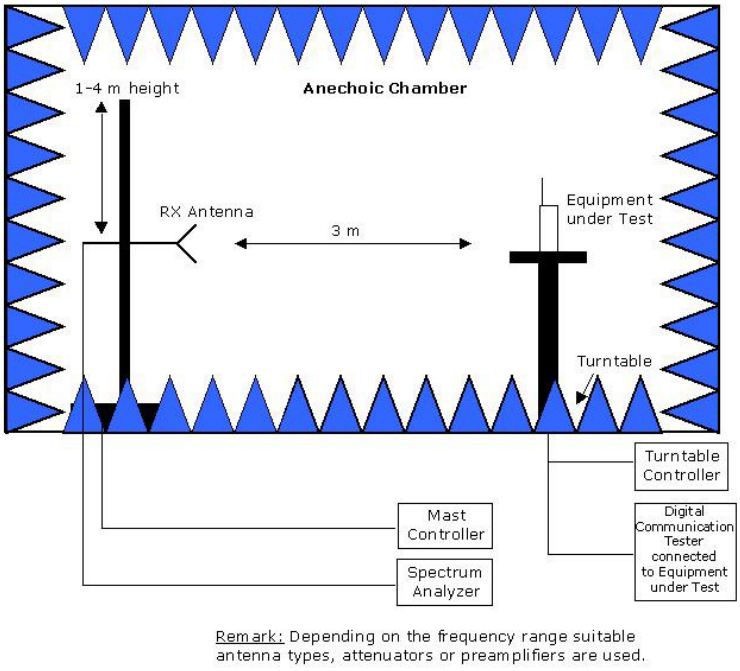
Single Devices for Temperature Chamber 05

Single Device Name	*Type*	*Serial Number*	*Manufacturer*	
Temperature Chamber Vötsch 05	VT 4002	58566080550010	Vötsch	
	Customized calibration		2014/03/11	2016/03/10

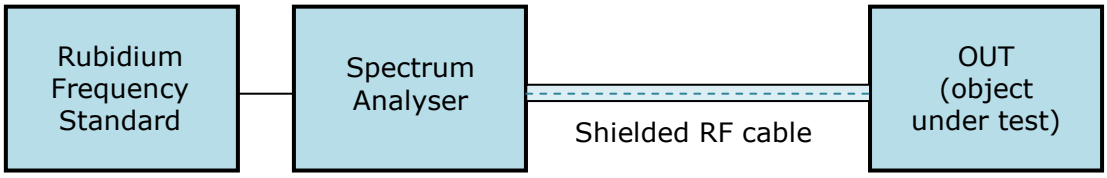
Additional Test Equipment Radiated emissions above 1 GHz

Instrument/Ancillary	Type	Manufacturer	Serial No.
Antenna Mast	PAS 2.5-10 kg	Maturo GmbH	-
Antenna Mast	ASP 1.2/1.8-10 kg	Maturo GmbH	-
Switching Unit	KRE-4056 KRE-4057	MTS Systemtechnik	018009-0010 018010-0010
Turn table	TT 1.5 WI	Maturo GmbH	-
Turn unit	TD 1.5-10 kg	Maturo GmbH	
Fully Anechoic Chamber	8,8x4,6x4,1 m³	Albatross Projects	–

6 Setup Drawings



Drawing 1: Setup in the Anechoic chamber. For measurements below 1 GHz the ground was replaced by a conducting groundplane.



Drawing 2: Setup for conducted radio tests.

7 Photo Report

Please refer to external report.