



InterLab®

FCC Measurement/Technical Report on

WLAN transceiver in

Tablet Computer

INARI8-3GAN-1 and IRARI8-WLAN-1

Report Reference: MDE_AAVAM_1301_FCCg Rev 02

Test Laboratory:

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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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Table of Contents

| | | |
|----------|---|-----------|
| 0 | Applied Standards and Test Summary | 3 |
| 0.1 | Applied Standards | 3 |
| 0.2 | FCC and IC Correlation Table | 4 |
| 0.3 | Measurement Summary / Signatures | 5 |
| 0.4 | Report revision | 8 |
| 1 | Administrative Data | 9 |
| 1.1 | Testing Laboratory | 9 |
| 1.2 | Project Data | 9 |
| 1.3 | Applicant Data | 9 |
| 1.4 | Manufacturer Data | 9 |
| 2 | Test object Data | 10 |
| 2.1 | General EUT Description | 10 |
| 2.2 | EUT Main components | 11 |
| 2.3 | Ancillary Equipment | 11 |
| 2.4 | Auxiliary Equipment | 12 |
| 2.5 | EUT Setups | 12 |
| 2.6 | Operating Modes | 13 |
| 2.7 | Special software used for testing | 14 |
| 2.8 | Product labelling | 14 |
| 3 | Test Results | 15 |
| 3.1 | Conducted emissions (AC power line) | 15 |
| 3.2 | Occupied bandwidth | 18 |
| 3.3 | Peak power output | 28 |
| 3.4 | Spurious RF conducted emissions | 36 |
| 3.5 | Spurious radiated emissions | 40 |
| 3.6 | Band edge compliance | 46 |
| 3.7 | Power density | 58 |
| 4 | Test Equipment | 66 |
| 5 | Photo Report | 76 |
| 6 | Setup Drawings | 76 |



0 Applied Standards and Test Summary

0.1 Applied Standards

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 and 5725-5850 MHz

Notes:

The tests were selected and performed with reference to the FCC OET "Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 v03r0, April 9, 2013" and is hereinafter referred to as "DTS-Guideline".

Instead of applying ANSI C63.4–1992, the newer ANSI C63.4–2009 is applied.

Summary Test Results:

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



0.2 FCC and IC Correlation Table

Correlation of measurement requirements for DTS devices (e.g. WLAN 2.5/5 GHz) equipment

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.



0.3 Measurement Summary / Signatures

FCC Part 15, Subpart C

§ 15.207

Conducted emissions (AC power line)

The measurement was performed according to ANSI C63.4

| OP-Mode | Setup | Port | Final Result |
|-------------------------------------|------------|---------|--------------|
| n-Mode, CH 157, 20 MHz, 6.5 Mbps | Setup_ab01 | AC port | passed |

FCC Part 15, Subpart C

§ 15.247 (a) (1)

Occupied bandwidth

The measurement was performed according to FCC § 15.31

| OP-Mode | Setup | Port | Final Result |
|-------------------------|------------|--------------------|--------------|
| b-Mode, CH 1, 20 MHz | Setup_ac01 | Temp.ant.connector | passed |
| b-Mode, CH 6, 20 MHz | Setup_ac01 | Temp.ant.connector | passed |
| b-Mode, CH 11, 20 MHz | Setup_ac01 | Temp.ant.connector | passed |
| g-Mode, CH 1, 20 MHz | Setup_ac01 | Temp.ant.connector | passed |
| g-Mode, CH 6, 20 MHz | Setup_ac01 | Temp.ant.connector | passed |
| g-Mode, CH 11, 20 MHz | Setup_ac01 | Temp.ant.connector | passed |
| n-Mode, CH 1, 20 MHz | Setup_ac01 | Temp.ant.connector | passed |
| n-Mode, CH 6, 20 MHz | Setup_ac01 | Temp.ant.connector | passed |
| n-Mode, CH 11, 20 MHz | Setup_ac01 | Temp.ant.connector | passed |
| n-Mode, CH 3, 40 MHz* | Setup_ac01 | Temp.ant.connector | passed |
| n-Mode, CH 6, 40 MHz* | Setup_ac01 | Temp.ant.connector | passed |
| n-Mode, CH 11, 40 MHz* | Setup_ac01 | Temp.ant.connector | passed |
| a-Mode, CH 149, 20 MHz | Setup_ag01 | Temp.ant.connector | passed |
| a-Mode, CH 157, 20 MHz | Setup_ag01 | Temp.ant.connector | passed |
| a-Mode, CH 165, 20 MHz | Setup_ag01 | Temp.ant.connector | passed |
| n-Mode, CH 151, 40 MHz* | Setup_ag01 | Temp.ant.connector | passed |
| n-Mode, CH 159, 40 MHz* | Setup_ag01 | Temp.ant.connector | passed |

**FCC Part 15, Subpart C****§ 15.247 (b) (1)**

Peak power output

The measurement was performed according to FCC § 15.31

| OP-Mode | Setup | Port | Final Result |
|-------------------------|--------------|--------------------|---------------------|
| b-Mode, CH 1, 20 MHz | Setup_ac01 | Temp.ant.connector | passed |
| b-Mode, CH 6, 20 MHz | Setup_ac01 | Temp.ant.connector | passed |
| b-Mode, CH 11, 20 MHz | Setup_ac01 | Temp.ant.connector | passed |
| g-Mode, CH 1, 20 MHz | Setup_ac01 | Temp.ant.connector | passed |
| g-Mode, CH 6, 20 MHz | Setup_ac01 | Temp.ant.connector | passed |
| g-Mode, CH 11, 20 MHz | Setup_ac01 | Temp.ant.connector | passed |
| n-Mode, CH 1, 20 MHz | Setup_ac01 | Temp.ant.connector | passed |
| n-Mode, CH 6, 20 MHz | Setup_ac01 | Temp.ant.connector | passed |
| n-Mode, CH 11, 20 MHz | Setup_ac01 | Temp.ant.connector | passed |
| n-Mode, CH 3, 40 MHz* | Setup_ac01 | Temp.ant.connector | passed |
| n-Mode, CH 6, 40 MHz* | Setup_ac01 | Temp.ant.connector | passed |
| n-Mode, CH 11, 40 MHz* | Setup_ac01 | Temp.ant.connector | passed |
| a-Mode, CH 149, 20 MHz | Setup_ag01 | Temp.ant.connector | passed |
| a-Mode, CH 157, 20 MHz | Setup_ag01 | Temp.ant.connector | passed |
| a-Mode, CH 165, 20 MHz | Setup_ag01 | Temp.ant.connector | passed |
| n-Mode, CH 151, 40 MHz* | Setup_ag01 | Temp.ant.connector | passed |
| n-Mode, CH 159, 40 MHz* | Setup_ag01 | 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 C63.4

| OP-Mode | Setup | Port | Final Result |
|-------------------------|--------------|--------------------|---------------------|
| b-Mode, CH 1, 20 MHz | Setup_ac01 | Temp.ant.connector | passed |
| b-Mode, CH 6, 20 MHz | Setup_ac01 | Temp.ant.connector | passed |
| b-Mode, CH 11, 20 MHz | Setup_ac01 | Temp.ant.connector | passed |
| g-Mode, CH 1, 20 MHz | Setup_ac01 | Temp.ant.connector | passed |
| g-Mode, CH 6, 20 MHz | Setup_ac01 | Temp.ant.connector | passed |
| g-Mode, CH 11, 20 MHz | Setup_ac01 | Temp.ant.connector | passed |
| n-Mode, CH 1, 20 MHz | Setup_ac01 | Temp.ant.connector | passed |
| n-Mode, CH 6, 20 MHz | Setup_ac01 | Temp.ant.connector | passed |
| n-Mode, CH 11, 20 MHz | Setup_ac01 | Temp.ant.connector | passed |
| n-Mode, CH 3, 40 MHz* | Setup_ac01 | Temp.ant.connector | passed |
| n-Mode, CH 6, 40 MHz* | Setup_ac01 | Temp.ant.connector | passed |
| n-Mode, CH 11, 40 MHz* | Setup_ac01 | Temp.ant.connector | passed |
| a-Mode, CH 149, 20 MHz | Setup_ag01 | Temp.ant.connector | passed |
| a-Mode, CH 157, 20 MHz | Setup_ag01 | Temp.ant.connector | passed |
| a-Mode, CH 165, 20 MHz | Setup_ag01 | Temp.ant.connector | passed |
| n-Mode, CH 151, 40 MHz* | Setup_ag01 | Temp.ant.connector | passed |
| n-Mode, CH 159, 40 MHz* | Setup_ag01 | 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 C63.4

| OP-Mode | Setup | Port | Final Result |
|-------------------------|--------------|-------------|---------------------|
| b-Mode, CH 1, 20 MHz | Setup_ae01 | Enclosure | passed |
| b-Mode, CH 6, 20 MHz | Setup_ae01 | Enclosure | passed |
| b-Mode, CH 11, 20 MHz | Setup_ae01 | Enclosure | passed |
| g-Mode, CH 1, 20 MHz | Setup_ae01 | Enclosure | passed |
| g-Mode, CH 6, 20 MHz | Setup_ae01 | Enclosure | passed |
| g-Mode, CH 11, 20 MHz | Setup_ae01 | Enclosure | passed |
| a-Mode, CH 149, 20 MHz | Setup_ae01 | Enclosure | passed |
| a-Mode, CH 157, 20 MHz | Setup_ae01 | Enclosure | passed |
| a-Mode, CH 165, 20 MHz | Setup_ae01 | Enclosure | passed |
| n-Mode, CH 149, 20 MHz | Setup_ae01 | Enclosure | passed |
| n-Mode, CH 157, 20 MHz | Setup_ae01 | Enclosure | passed |
| n-Mode, CH 165, 20 MHz | Setup_ae01 | Enclosure | passed |
| n-Mode, CH 151, 40 MHz* | Setup_ae01 | Enclosure | passed |
| n-Mode, CH 159, 40 MHz* | Setup_ae01 | Enclosure | passed |

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

Band edge compliance

The measurement was performed according to FCC § 15.31 /

ANSI C63.4

| OP-Mode | Setup | Port | Final Result |
|-------------------------|--------------|--------------------|---------------------|
| b-Mode, CH 1, 20 MHz | Setup_ac01 | Temp.ant.connector | passed |
| b-Mode, CH 11, 20 MHz | Setup_ac01 | Temp.ant.connector | passed |
| g-Mode, CH 1, 20 MHz | Setup_ac01 | Temp.ant.connector | passed |
| g-Mode, CH 11, 20 MHz | Setup_ac01 | Temp.ant.connector | passed |
| n-Mode, CH 1, 20 MHz | Setup_ac01 | Temp.ant.connector | passed |
| n-Mode, CH 11, 20 MHz | Setup_ac01 | Temp.ant.connector | passed |
| n-Mode, CH 3, 40 MHz* | Setup_ac01 | Temp.ant.connector | passed |
| n-Mode, CH 11, 40 MHz* | Setup_ac01 | Temp.ant.connector | passed |
| a-Mode, CH 149, 20 MHz | Setup_ag01 | Temp.ant.connector | passed |
| a-Mode, CH 165, 20 MHz | Setup_ag01 | Temp.ant.connector | passed |
| n-Mode, CH 149, 20 MHz | Setup_ag01 | Temp.ant.connector | passed |
| n-Mode, CH 165, 20 MHz | Setup_ag01 | Temp.ant.connector | passed |
| n-Mode, CH 151, 40 MHz* | Setup_ag01 | Temp.ant.connector | passed |
| n-Mode, CH 159, 40 MHz* | Setup_ag01 | Temp.ant.connector | passed |
| b-Mode, CH 11, 20 MHz | Setup_ae01 | Enclosure | passed |
| g-Mode, CH 11, 20 MHz | Setup_ae01 | Enclosure | passed |
| n-Mode, CH 11, 20 MHz * | Setup_ae01 | Enclosure | passed |
| n-Mode, CH 11, 40 MHz* | Setup_ae01 | Enclosure | passed |

FCC Part 15, Subpart C

§ 15.247 (e)

Power density

The measurement was performed according to FCC § 15.31

| OP-Mode | Setup | Port | Final Result |
|-------------------------|------------|--------------------|--------------|
| b-Mode, CH 1, 20 MHz | Setup_ac01 | Temp.ant.connector | passed |
| b-Mode, CH 6, 20 MHz | Setup_ac01 | Temp.ant.connector | passed |
| b-Mode, CH 11, 20 MHz | Setup_ac01 | Temp.ant.connector | passed |
| g-Mode, CH 1, 20 MHz | Setup_ac01 | Temp.ant.connector | passed |
| g-Mode, CH 6, 20 MHz | Setup_ac01 | Temp.ant.connector | passed |
| g-Mode, CH 11, 20 MHz | Setup_ac01 | Temp.ant.connector | passed |
| n-Mode, CH 1, 20 MHz | Setup_ac01 | Temp.ant.connector | passed |
| n-Mode, CH 6, 20 MHz | Setup_ac01 | Temp.ant.connector | passed |
| n-Mode, CH 11, 20 MHz | Setup_ac01 | Temp.ant.connector | passed |
| n-Mode, CH 3, 40 MHz* | Setup_ag01 | Temp.ant.connector | passed |
| n-Mode, CH 6, 40 MHz* | Setup_ag01 | Temp.ant.connector | passed |
| n-Mode, CH 11, 40 MHz* | Setup_ag01 | Temp.ant.connector | passed |
| a-Mode, CH 149, 20 MHz | Setup_ag01 | Temp.ant.connector | passed |
| a-Mode, CH 157, 20 MHz | Setup_ag01 | Temp.ant.connector | passed |
| a-Mode, CH 165, 20 MHz | Setup_ag01 | Temp.ant.connector | passed |
| n-Mode, CH 151, 40 MHz* | Setup_ag01 | Temp.ant.connector | passed |
| n-Mode, CH 159, 40 MHz* | Setup_ag01 | Temp.ant.connector | passed |

N/A not applicable

* MIMO operating mode

0.4 Report revision

| Report version control | | | Previous version valid |
|------------------------|--------------|--|------------------------|
| Version | Release date | Changes | |
| 001 | 22.04.2014 | Initial version | |
| 002 | 29.04.2014 | Administrative changes in section 2.1 Added missing measurement plots | No |

Responsible for
Accreditation Scope:

M. Kullik
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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: 2014-04-16

1.2 Project Data

Responsible for testing and report: Dipl.-Ing. Andreas Petz

Date of Test(s): 2014-02-28 to 2014-04-17
Date of Report: 2014-04-29

1.3 Applicant Data

Company Name: Aava Mobile OY

Address: Nahkatehtaankatu 2
90130 Oulu
Finland

Contact Person: Mr. Kari Räisänen

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 802.11a/b/g/n WLAN transceiver |
| Type Designation: | INARI8-3GAN-1 and INARI8-WLAN-1 |
| Kind of Device: | Tablet Computer |
| (optional) | |
| Voltage Type: | DC |
| Voltage Level: | DC 4.8 V |
| Tested Modulation Type: | DBPSK; OFDM: BPSK; OFDM: 64-QAM |

General product description:

Please insert a general product description

Specific product description for the EUT:

The EUT is a dual band WLAN (802.11 a/b/g/n, 2.4 and 5 GHz) and Bluetooth module with two antennas. The main antenna is used for WLAN and Bluetooth, the auxiliary antenna for WLAN MIMO modes. 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 EUT also supports MIMO technology with a maximum data rate of 300 Mbit/s (MCS15).

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 and 5 GHz bands. In IEEE 802.11n mode, it was tested with 20 MHz and 40 MHz channel bandwidth.

The variants INARI8-3GAN-1 and INARI8-WLAN-1 are identical with the exception that the Huawei Cellular module used in the INARI8-3GAN-1 is depopulated in the INARI8-WLAN-1.

All testing was performed using the "worst case" variant, INARI8-3GAN-1.

The EUT provides the following ports:

Ports

Enclosure

AC-Port (at AE1)

DC Port (Micro-USB, only charging)

USB-Port

HDMI-Port

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: DE1004000a c01) | WLAN transceiver in Tablet Computer | INARI8-3GAN-1 | IN14060104 | Pre-production sample | Windows 8.1 |
| Remark: EUT equipped with a temporary antenna connector. | | | | | |
| EUT B (Code: DE1004000a g01) | WLAN transceiver in Tablet Computer | INARI8-3GAN-1 | IN14060102 | Pre-production sample | Windows 8.1 |
| Remark: EUT equipped with a temporary antenna connector. | | | | | |
| EUT C (Code: DE1004000a b01) | WLAN transceiver in Tablet Computer | INARI8-3GAN-1 | IN14060109 | Pre-production sample | Windows 8.1 |
| Remark: EUT equipped with integral antennas (2.4 GHz: 1.9 dBi gain / 5 GHz: 1.4 dBi gain) | | | | | |
| EUT D (Code: DE1004000a e01) | WLAN transceiver in Tablet Computer | INARI8-3GAN-1 | IN14060110 | Pre-production sample | Windows 8.1 |
| Remark: EUT equipped with integral antennas (2.4 GHz: 1.9 dBi gain / 5 GHz: 1.4 dBi gain) | | | | | |

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 |
|--------------------------------|----------------------|------------------------------------|------------------|-----------|-----------|
| AE1 (Code: DE104000ac dc03) | AC/DC power supply | Delta Electronics INC., ADP-10BW C | T01135100016 71A | REV.: 00 | — |



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 battery (for supply by external DC power source) | – (AAVAM self-built) | – | – | – |

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_ac01 | EUT A + AUX1 | setup for the conducted tests |
| Setup_ag01 | EUT B + AUX1 | setup for the conducted tests |
| Setup_ab01 | EUT C + AE1 | setup for conducted measurements, AC-Power Line |
| Setup_ae01 | EUT D + AE1 | 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

| | | | | | | | | |
|--|--------|-----|-------------------|--------|------|-----------------|--------|------|
| Band: | | | | | | | | |
| 900 MHz | | | 2.4 GHz ISM | | | 5 GHz ISM | | |
| 902 - 928 MHz | | | 2400 – 2483.5 MHz | | | 5725 – 5850 MHz | | |
| 20 MHz Test Channels: (Channel No./Frequency [MHz]): | | | | | | | | |
| Bottom | Middle | Top | Bottom | Middle | Top | Bottom | Middle | Top |
| - | - | - | 1 | 6 | 11 | 149 | 157 | 165 |
| - | - | - | 2412 | 2437 | 2462 | 5745 | 5785 | 5825 |
| 40 MHz Test Channels: (Channel No./Frequency [MHz]): | | | | | | | | |
| Bottom | Middle | Top | Bottom | Middle | Top | Bottom | Middle | Top |
| - | - | - | 3 | 6 | 11 | 151 | - | 159 |
| - | - | - | 2422 | 2437 | 2462 | 5755 | - | 5795 |

2.6.2 Datarates

SISO:

| |
|---|
| WLAN b-Mode; 20 MHz; 1 Mbit/s |
| WLAN g-Mode; 20 MHz; 6 Mbit/s |
| WLAN n-Mode; 20 MHz; 72.2 Mbit/s (MCS7, besides AC Mains emission test) |
| WLAN a-Mode, 20 MHz; 6 Mbit/s |

MIMO:

| |
|---|
| WLAN n-Mode; 40 MHz; 300 Mbit/s (MCS15) |
|---|



2.7 Special software used for testing

The applicant provided the prepared EUTs (i.e. pre-installed) where a software called "WLANCONTROLLER.EXE" can be started via an icon on the desktop.

All radiated tests have been performed while a power table was applied to reach a nominal RMS output power of approx. 12 dBm, all conducted tests have been performed with a changed power table reducing the nominal RMS by approx. 3 dB for the n-modes.

2.8 Product labelling

2.8.1 FCC ID label

Please refer to the documentation of the applicant.

Note: The requested FCC-ID is: 24BVH-INARI81
The requested IC number is: 11875A-INARI81
This test report remains valid independently from the FCC-ID/IC Number.

2.8.2 Location of the label on the EUT

Please refer to the documentation of the applicant.



3 Test Results

3.1 Conducted emissions (AC power line)

Standard FCC Part 15 Subpart C

The test was performed according to: ANSI C 63.4

3.1.1 Test Description

The test set-up was made in accordance to the general provisions of ANSI C 63.4. The Equipment Under Test (EUT) was setup in a shielded room to perform the conducted emissions measurements in a typical installation configuration. The EUT was powered from 50 μ H || 50 Ohm Line Impedance Stabilization Network (LISN). The LISN's unused connections were terminated with 50 Ohm loads.

The measurement procedure consists of two steps. It is implemented into the EMI test software ES-K1 from R&S.

Step 1: Preliminary scan

Intention of this step is, to determine the conducted EMI-profile of the EUT.

EMI receiver settings:

- Detector: Peak - Maxhold
- Frequency range: 150 kHz – 30 MHz
- Frequency steps: 5 kHz
- IF-Bandwidth: 9 kHz
- Measuring time / Frequency step: 20 ms
- Measurement on phase + neutral lines of the power cords

On basis of this preliminary scan the highest amplitudes and the corresponding frequencies relative to the limit are identified. Emissions above the limit and emissions which are in the 10 dB range below the limit are considered.

Step 2: Final measurement

Intention of this step is, to determine the highest emissions with the settings defined in the test specification for the frequencies identified in step 1.

EMI receiver settings:

- Detector: Quasi-Peak
- IF Bandwidth: 9 kHz
- Measuring time: 1 s / frequency

At each frequency determined in step 1, four measurements are performed in the following combinations:

- 1) Neutral lead - reference ground (PE grounded)
- 2) Phase lead - reference ground (PE grounded)
- 3) Neutral lead - reference ground (PE floating)
- 4) Phase lead - reference ground (PE floating)

The highest value is reported.

3.1.2 Test Requirements / Limits

FCC Part 15, Subpart C, §15.207

| Frequency Range (MHz) | QP Limit (dBμV) | AV Limit (dBμV) |
|-----------------------|-----------------|-----------------|
| 0.15 – 0.5 | 66 to 56 | 56 to 46 |
| 0.5 – 5 | 56 | 46 |
| 5 – 30 | 60 | 50 |

Used conversion factor: $\text{Limit (dBμV)} = 20 \log (\text{Limit (μV)} / 1\mu\text{V})$.

3.1.3 Test Protocol

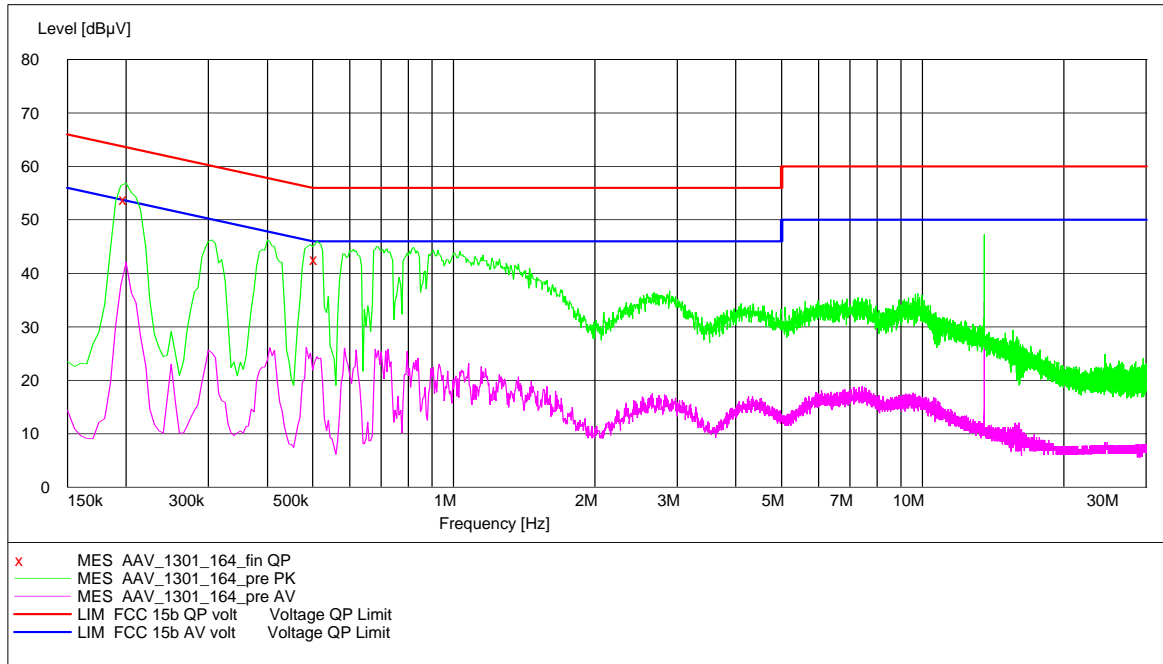
Temperature: 24 °C
Air Pressure: 1009 hPa
Humidity: 36 %

| Op. Mode | Setup | Port |
|----------------------------|------------|----------------|
| 5785 MHz, n-mode, 6.5 Mbps | Setup_ab01 | AC port of AE1 |

| Power line | Frequency MHz | Measured value QP dBμV | Measured value AV dBμV | QP Limit dBμV | AV Limit dBμV | Margin QP dB | Margin AV dB |
|------------|---------------|------------------------|------------------------|---------------|---------------|--------------|--------------|
| N | 0.20 | 53.9 | – | 63.6 | – | 9.7 | – |
| N | 0.51 | 42.6 | – | 56.0 | – | 13.4 | – |

Remark: The chosen operating mode is selected as representative mode to generate “worst-case” conditions, i.e. high power consumption.

3.1.4 Measurement Plot (showing the highest value, “worst case”)





3.2 Occupied bandwidth

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 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 results recorded were measured with the modulation which produce the worst-case (widest) occupied bandwidth.

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
- Detector: Peak
- Trace: Maxhold
- Sweeptime: auto (coupled)

Note:

The analyser settings are according to "DTS-Guideline" method "DTS bandwidth option 1".

3.2.2 Test Requirements / Limits

FCC Part 15, Subpart C, §15.247 (a) (2)

Systems using digital modulation techniques may operate in the 902-928 MHz, 2400-2483.5 MHz and 5725-5850 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)

3.2.3 Test Protocol

Temperature: 21–24 °C
 Air Pressure: 1005–1014 hPa
 Humidity: 32–43 %

SISO:

| 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 | 8.124 | 0.5 | 7.6 |
| | 6 | 2437 | 8.124 | 0.5 | 7.6 |
| | 11 | 2462 | 8.124 | 0.5 | 7.6 |

| 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 | 15.876 | 0.5 | 15.4 |
| | 6 | 2437 | 16.116 | 0.5 | 15.6 |
| | 11 | 2462 | 15.876 | 0.5 | 15.4 |

| 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 | 17.016 | 0.5 | 16.5 |
| | 6 | 2437 | 17.076 | 0.5 | 16.6 |
| | 11 | 2462 | 17.076 | 0.5 | 16.6 |
| 5 GHz ISM | 149 | 5745 | 17.548 | 0.5 | 17.0 |
| | 157 | 5785 | 17.500 | 0.5 | 17.0 |
| | 165 | 5825 | 17.500 | 0.5 | 17.0 |

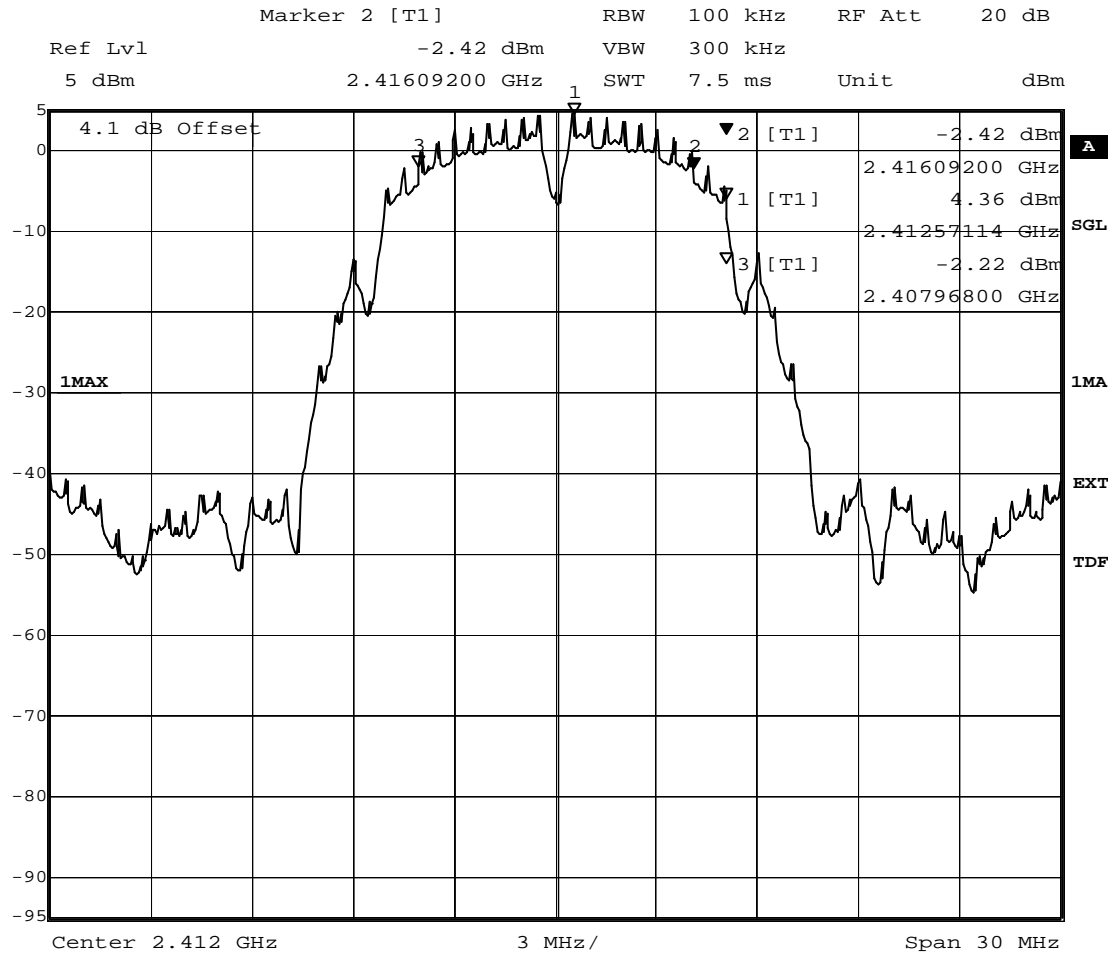


| WLAN a-Mode, 20 MHz; 6 Mbit/s | | | | | |
|-------------------------------|-------------|-----------------|----------------------|-------------|-----------------------|
| ISM-Band | Channel No. | Frequency [MHz] | 6 dB Bandwidth [MHz] | Limit [MHz] | Margin to Limit [MHz] |
| 5 GHz ISM | 149 | 5745 | 16.298 | 0.5 | 15.8 |
| | 157 | 5785 | 16.250 | 0.5 | 15.8 |
| | 165 | 5825 | 16.250 | 0.5 | 15.8 |

MIMO:

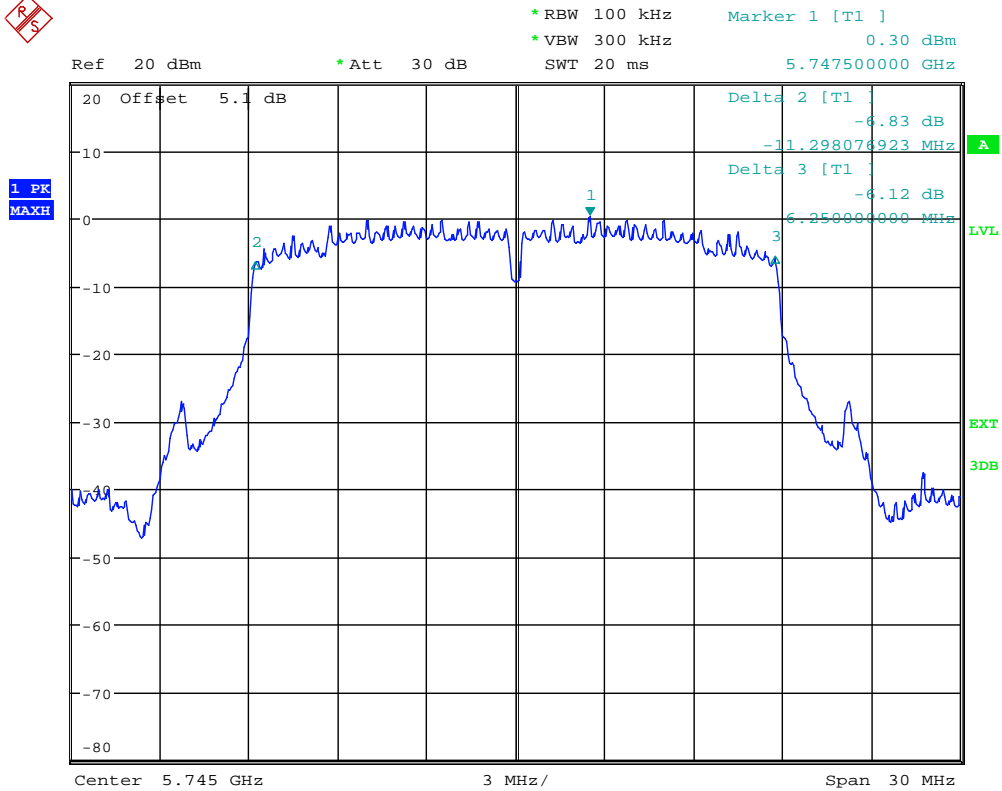
| WLAN n-Mode; 40 MHz; 300 Mbit/s | | | | | |
|---------------------------------|-------------|-----------------|----------------------|-------------|-----------------------|
| Band | Channel No. | Frequency [MHz] | 6 dB Bandwidth [MHz] | Limit [MHz] | Margin to Limit [MHz] |
| 2.4 GHz ISM | 3 | 2422 | 36.774 | 0.5 | 36.3 |
| | 6 | 2437 | 36.703 | 0.5 | 36.2 |
| | 11 | 2462 | 36.753 | 0.5 | 36.3 |
| 5 GHz ISM | 151 | 5755 | 36.699 | 0.5 | 36.2 |
| | 159 | 5795 | 36.619 | 0.5 | 36.1 |

3.2.4 Measurement Plots



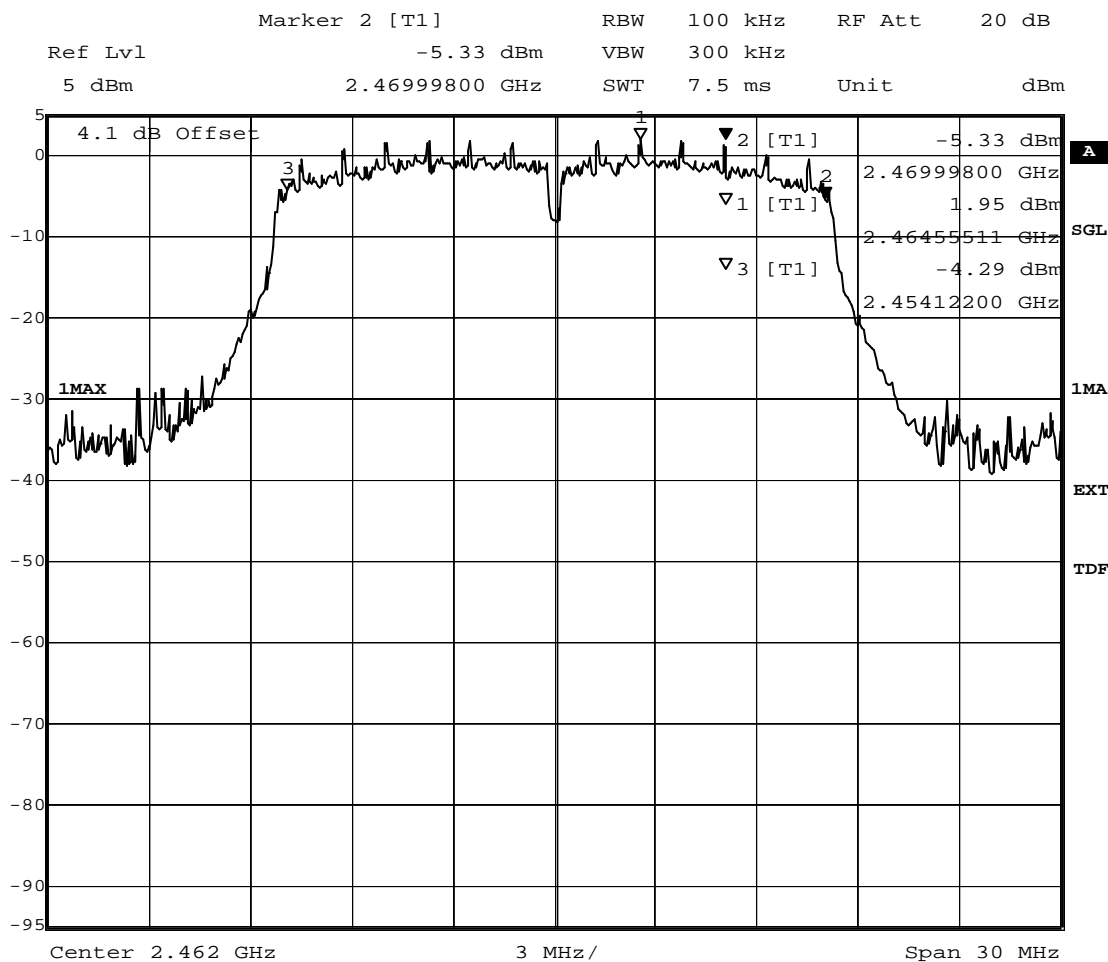
Title: 6dB Bandwidth
 Comment A: CH B: 2412 MHz; 6dB bandwidth (kHz):8124
 Date: 11.MAR.2014 10:10:39

6 dB bandwidth at 2412 MHz, WLAN b-Mode; 20 MHz; 1 Mbit/s



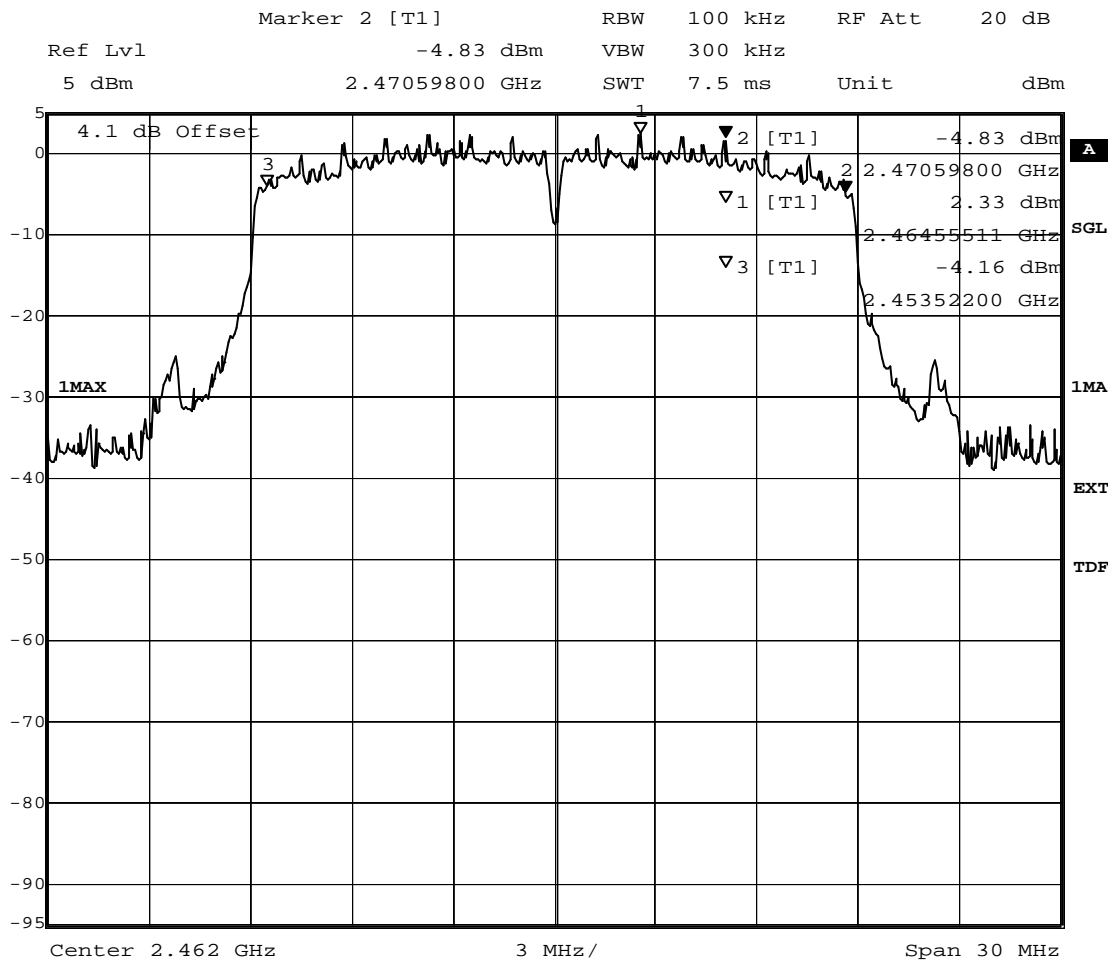
Date: 4.APR.2014 11:17:38

6 dB bandwidth at 5825 MHz, WLAN n-Mode; 20 MHz; 72.2 Mbit/s



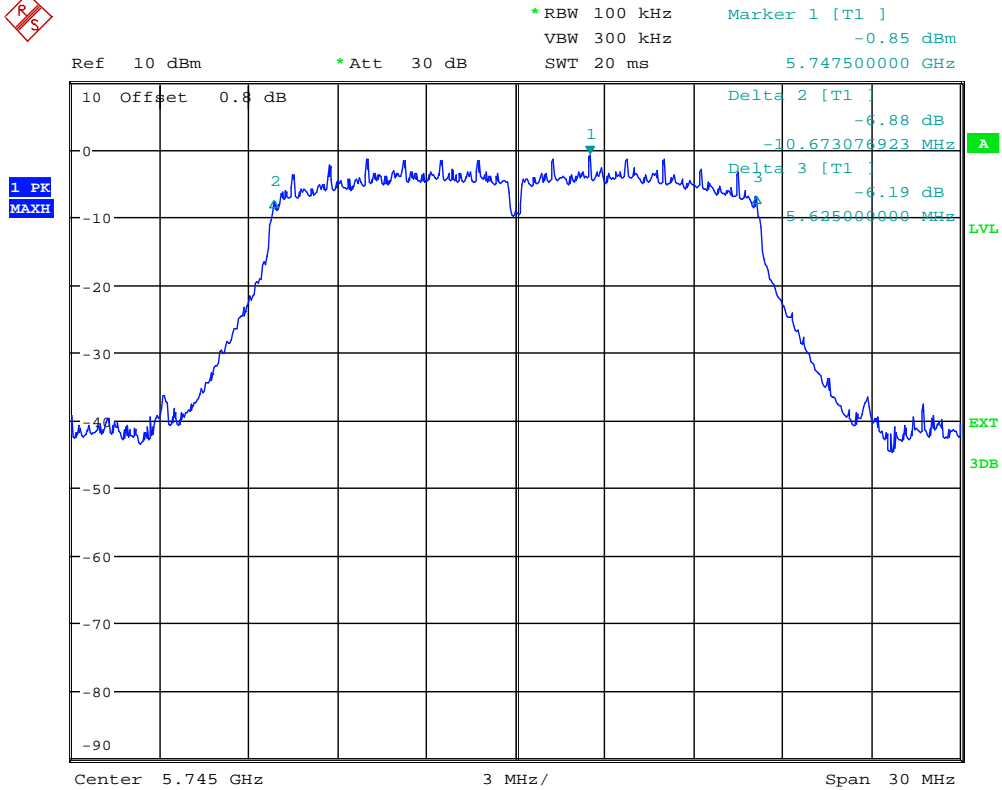
Title: 6dB Bandwidth
 Comment A: CH T: 2462 MHz; 6dB bandwidth (kHz):15876
 Date: 11.MAR.2014 13:26:00

6 dB bandwidth at 2462 MHz, WLAN g-Mode; 20 MHz; 6 Mbit/s



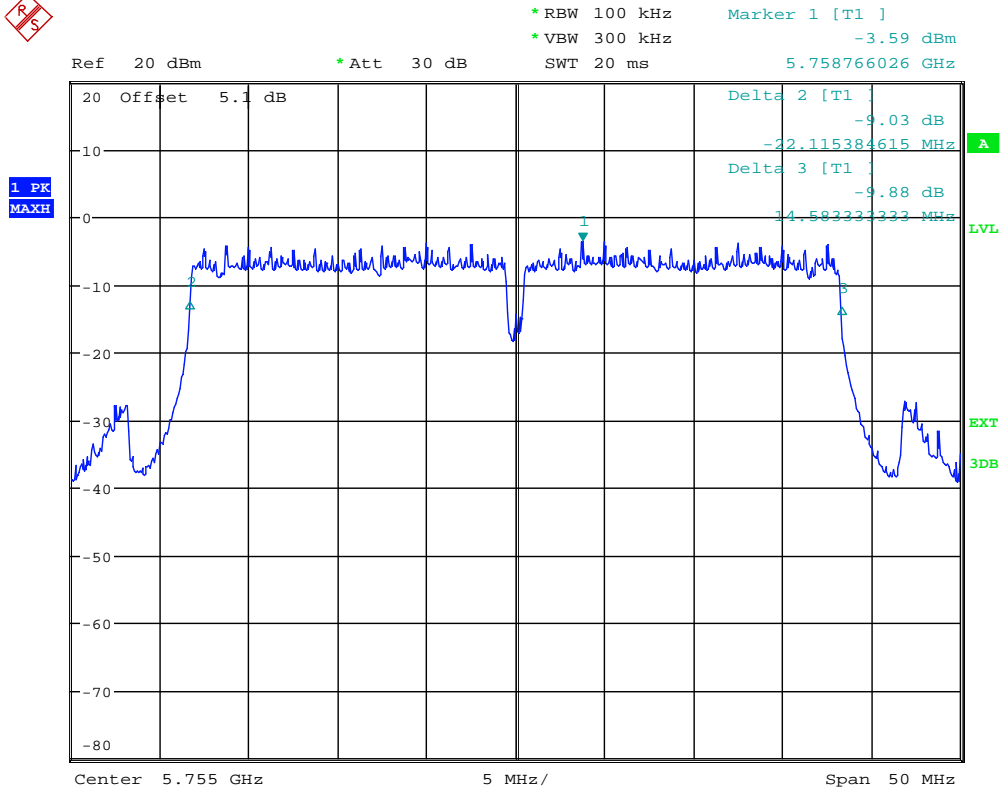
Title: 6dB Bandwidth
Comment A: CH T: 2462 MHz; 6dB bandwidth (kHz):17076
Date: 11.MAR.2014 15:02:33

6 dB bandwidth at 2462 MHz, WLAN n-Mode; 20 MHz; 72.2 Mbit/s



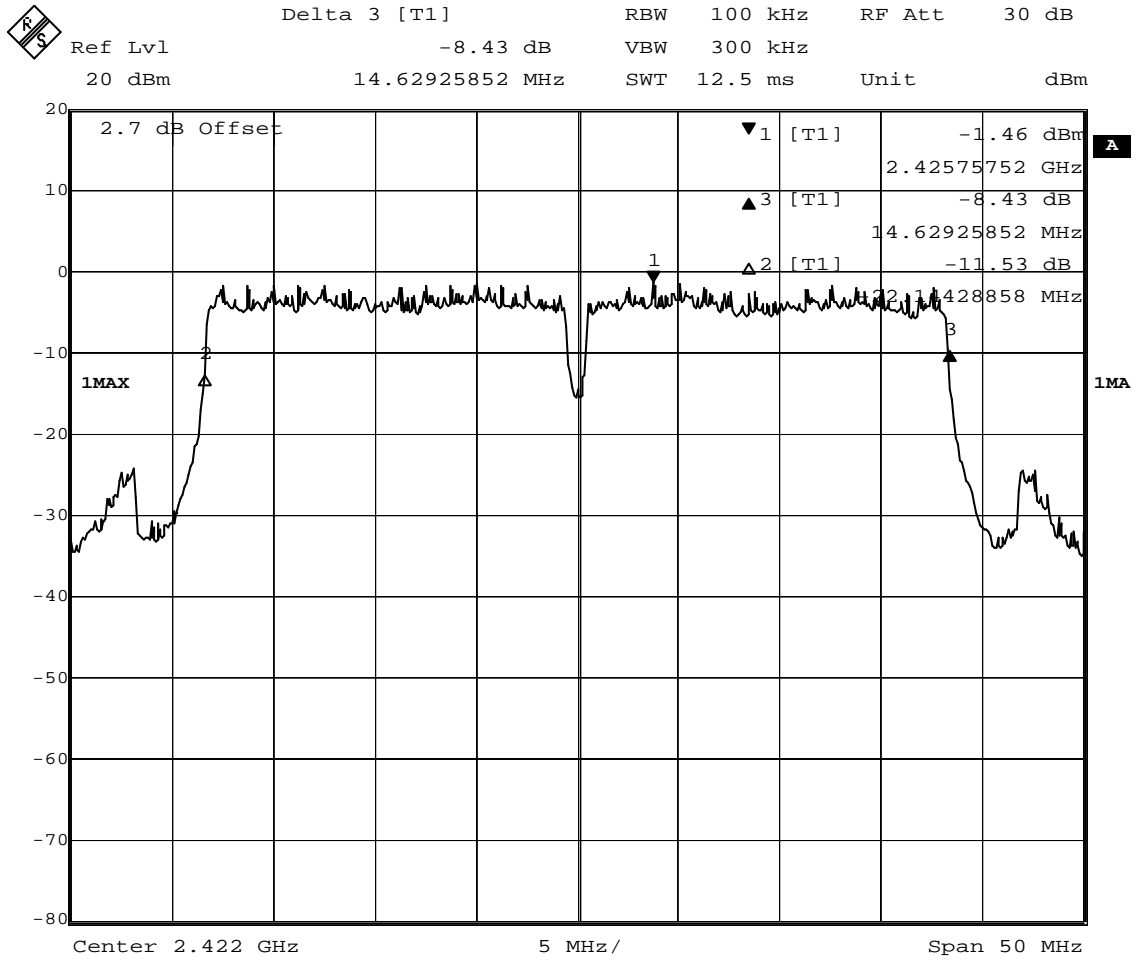
Date: 3.APR.2014 10:38:35

6 dB bandwidth at 5745 MHz, WLAN a-Mode; 20 MHz; 6 Mbit/s



Date: 4.APR.2014 11:27:41

6 dB bandwidth at 5755 MHz, WLAN n-Mode; 40 MHz; 300 Mbit/s



Date: 17.MAR.2014 10:06:29

6 dB bandwidth at 2412 MHz, WLAN n-Mode; 40 MHz; 300 Mbit/s



3.3 Peak power output

Standard FCC Part 15, Subpart C

The test was performed according to: FCC §15.31

3.3.1 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
- Trace: Maxhold
- Sweptime: 5 ms / sweep (greater than auto)

Note:

The analyser settings are according to "DTS-Guideline" method "Integrated band power method".

3.3.2 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: $\text{Limit (dBm)} = 10 \log (\text{Limit (W)}/1\text{mW})$

3.3.3 Test Protocol

Temperature: 21–24 °C
 Air Pressure: 1005–1014 hPa
 Humidity: 32–43 %

SISO:

| 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 | 13.0 | 30.0 | 17.0 | 14.9 |
| | 6 | 2437 | 13.4 | 30.0 | 16.6 | 15.3 |
| | 11 | 2462 | 13.4 | 30.0 | 16.7 | 15.3 |

| 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 | 18.5 | 30.0 | 11.5 | 20.4 |
| | 6 | 2437 | 18.6 | 30.0 | 11.4 | 20.5 |
| | 11 | 2462 | 18.8 | 30.0 | 11.2 | 20.7 |

| 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 | 18.7 | 30.0 | 11.4 | 20.6 |
| | 6 | 2437 | 19.1 | 30.0 | 10.9 | 21.0 |
| | 11 | 2462 | 19.2 | 30.0 | 10.8 | 21.1 |
| 5 GHz ISM | 149 | 5745 | 16.1 | 30.0 | 13.9 | 17.5 |
| | 157 | 5785 | 15.3 | 30.0 | 14.7 | 16.7 |
| | 165 | 5825 | 15.8 | 30.0 | 14.2 | 17.2 |

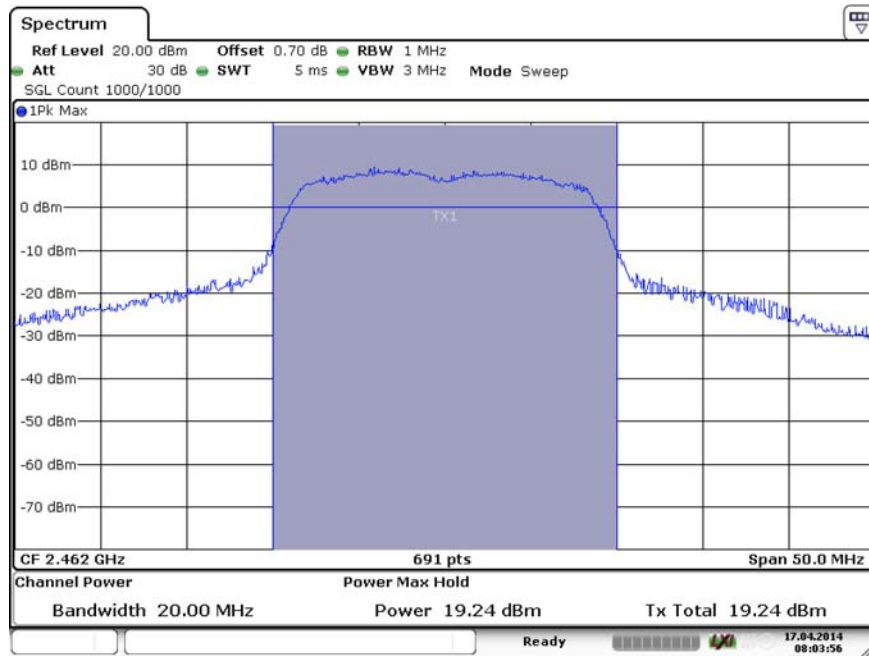
| WLAN a-Mode, 20 MHz; 6 Mbit/s | | | | | | |
|-------------------------------|-------------|-----------------|------------------|-------------|----------------------|----------------|
| ISM-Band | Channel No. | Frequency [MHz] | Peak Power [dBm] | Limit [dBm] | Margin to Limit [dB] | E.I.R.P. [dBm] |
| 5 GHz ISM | 149 | 5745 | 18.8 | 30.0 | 11.3 | 20.2 |
| | 157 | 5785 | 18.1 | 30.0 | 11.9 | 19.5 |
| | 165 | 5825 | 18.7 | 30.0 | 11.3 | 20.1 |

MIMO:

| WLAN n-Mode; 40 MHz; 300 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 | 2422 | 20.9 | 30.0 | 9.1 | 22.8 |
| | 6 | 2437 | 20.3 | 30.0 | 9.7 | 22.2 |
| | 11 | 2462 | 20.0 | 30.0 | 10.0 | 21.9 |
| 5 GHz ISM | 151 | 5755 | 17.2 | 30.0 | 12.8 | 18.6 |
| | 159 | 5795 | 18.0 | 30.0 | 12.0 | 19.4 |

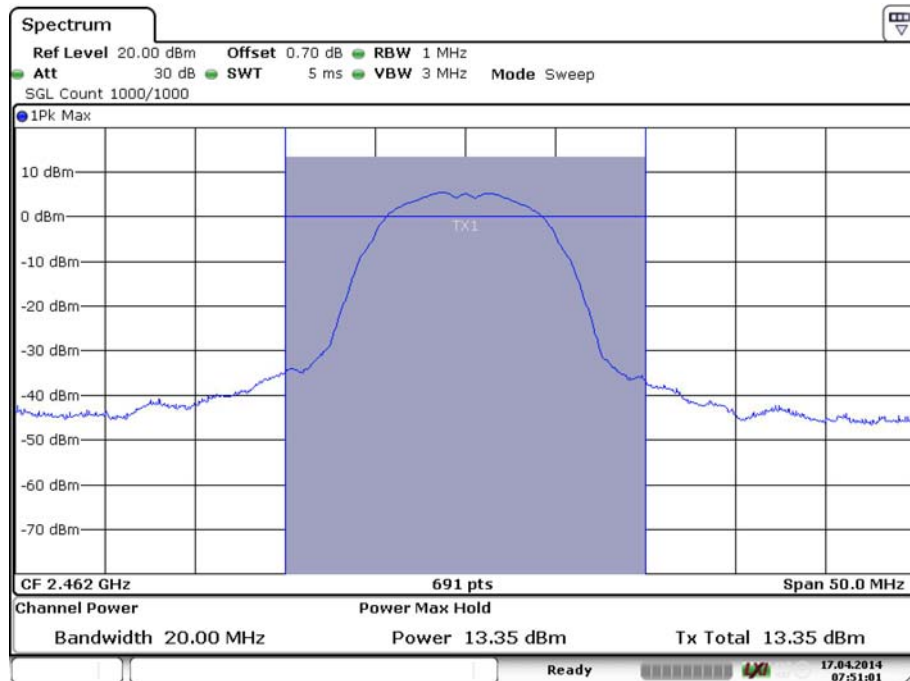
3.3.4 Measurement Plot (showing the highest value, "worst case")

SISO:



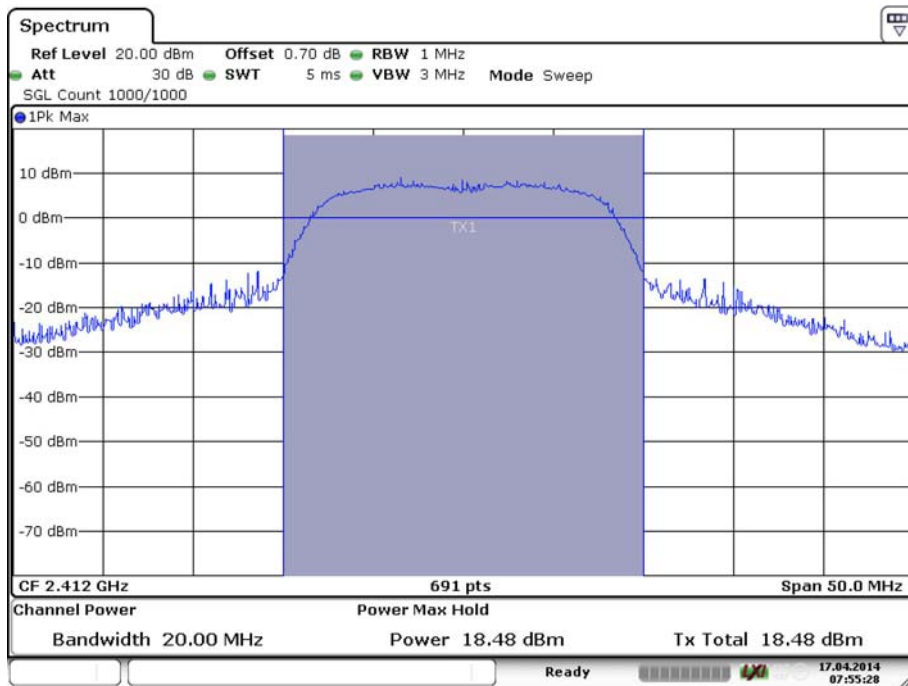
Date: 17.APR.2014 08:03:57

Peak output power, 2462 MHz, WLAN n-Mode; 20 MHz; 72.2 Mbit/s



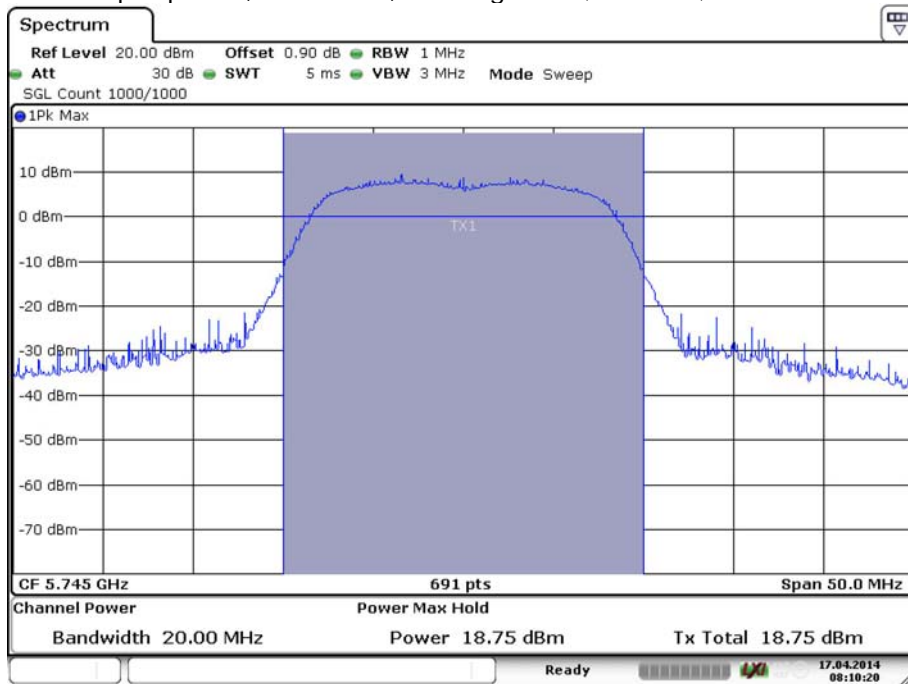
Date: 17.APR.2014 07:51:01

Peak output power, 2462 MHz, WLAN b-Mode; 20 MHz; 1 Mbit/s



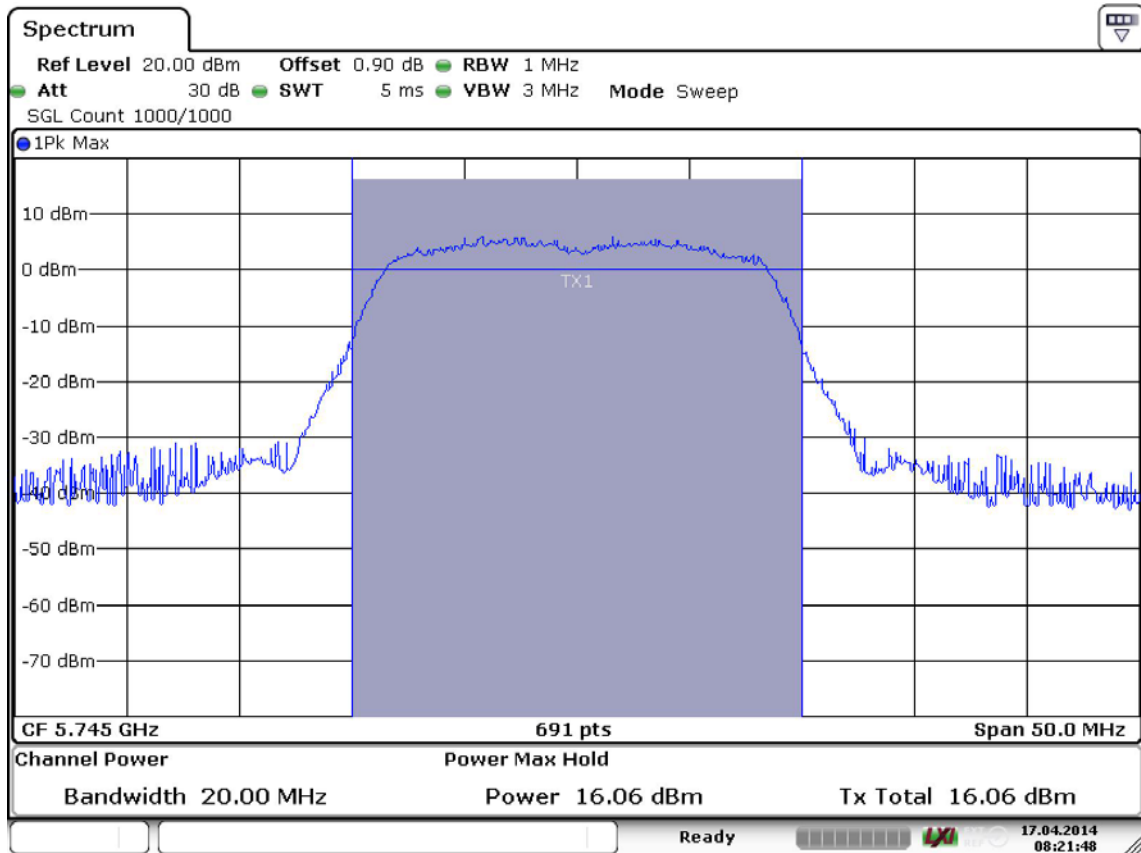
Date: 17.APR.2014 07:55:29

Peak output power, 2412 MHz, WLAN g-Mode; 20 MHz; 6 Mbit/s



Date: 17.APR.2014 08:10:20

Peak output power, 5745 MHz, WLAN a-Mode; 20 MHz; 72.2 Mbit/s



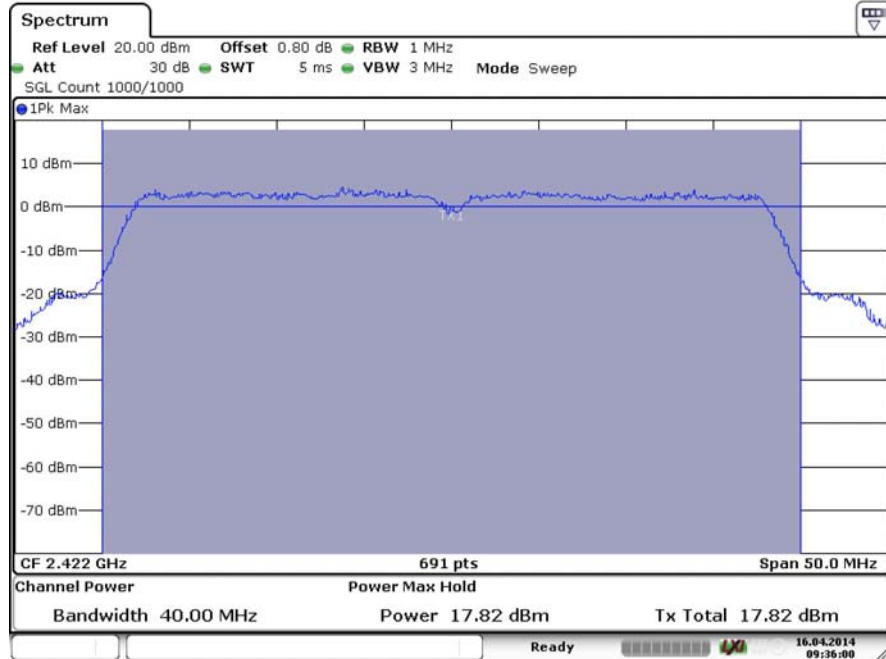
Date: 17.APR.2014 08:21:48

Peak output power, 5745 MHz, WLAN a-Mode; 20 MHz; 6 Mbit/s



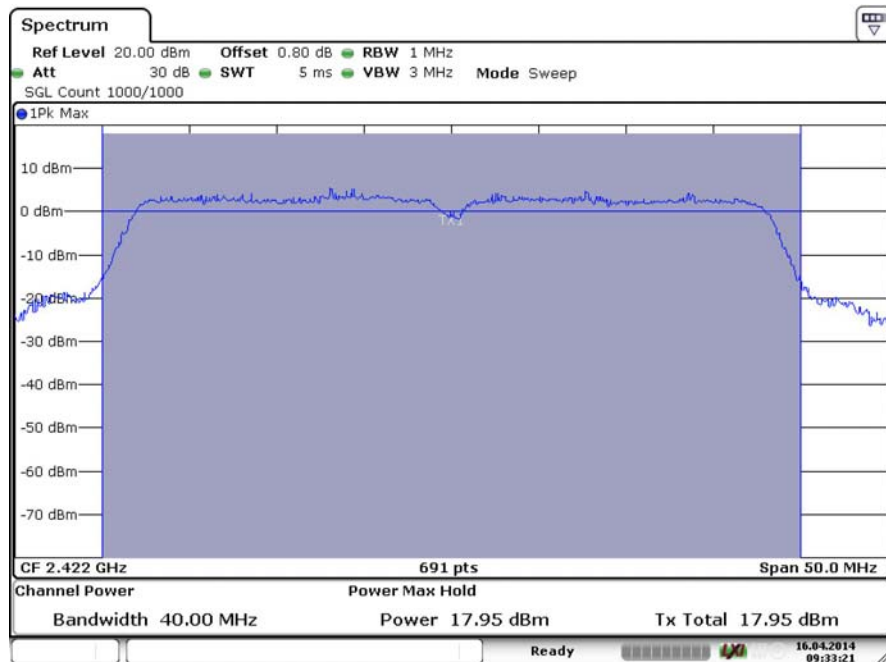
MIMO:

AUX Antenna Port:



Date: 16.APR.2014 09:36:01

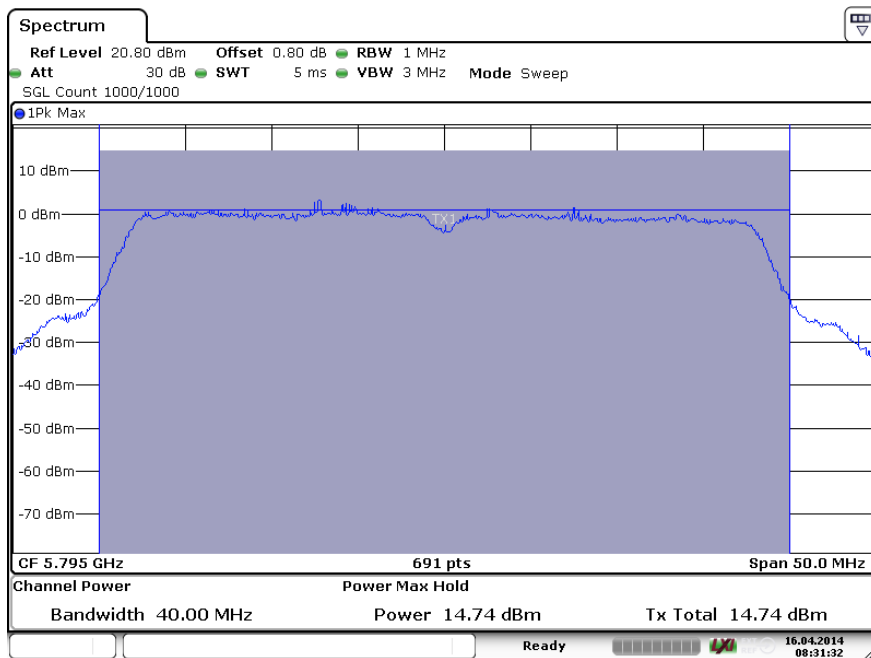
MAIN Antenna Port:



Date: 16.APR.2014 09:33:21

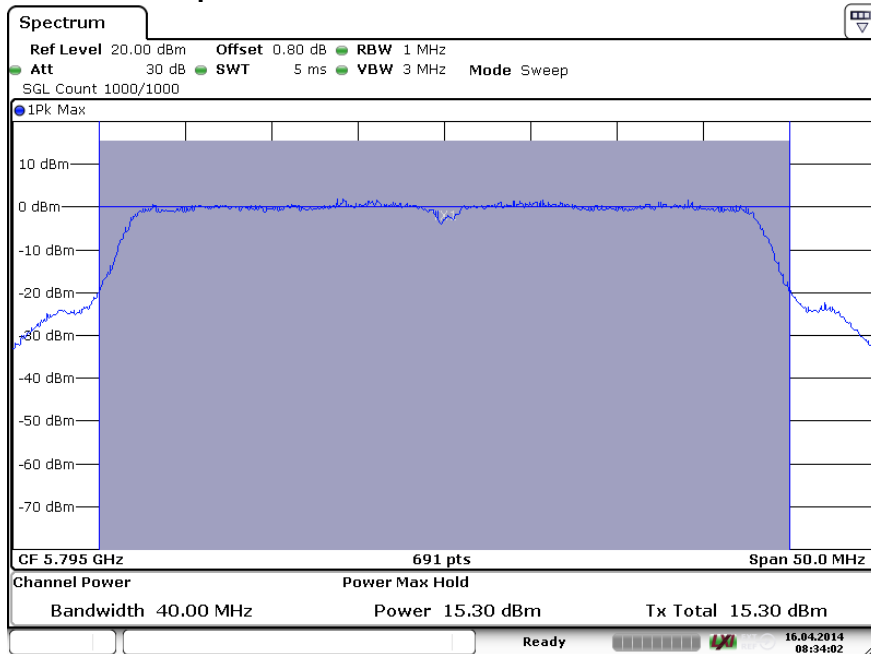
Peak output power, 2422 MHz, WLAN n-Mode; 40 MHz; 300 Mbit/s

Main antenna port:



Date: 16 APR 2014 08:31:31

Aux Antenna port:



Date: 16 APR 2014 08:34:02

Peak output power, 5795 MHz, WLAN n-Mode; 40 MHz; 300 Mbit/s

3.4 Spurious RF conducted emissions

Standard FCC Part 15, Subpart C

The test was performed according to: FCC §15.31

3.4.1 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
- Trace: Maxhold
- Frequency range: 30 – 25000 (2.4 GHz) / 40000 MHz (5 GHz)
- 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 3.6). This value is used to calculate the 20 dBc limit.

Note:

The analyser settings are according to “DTS-Guideline” method “Emission level measurement in non-restricted bands”.

3.4.2 Test Requirements / Limits

FCC Part 15, Subpart C, §15.247 (d)

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.

3.4.3 Test Protocol

Temperature: 21–24 °C
 Air Pressure: 1005–1014 hPa
 Humidity: 32–43 %

SISO

| WLAN a-Mode; 20 MHz; 6 Mbit/s | | | | | | | | |
|-------------------------------|-------------------------|--------------------------|----------------------|----------|-----------|------------------|-------------|----------------------|
| Channel No | Channel Frequency [MHz] | Spurious Frequency [MHz] | Spurious Level [dBm] | Detector | RBW [kHz] | Ref. Level [dBm] | Limit [dBm] | Margin to Limit [dB] |
| 149 | 5745 | – | – | PEAK | 100 | -0.9 | -20.9 | – |
| 157 | 5785 | – | – | PEAK | 100 | -0.9 | -20.9 | – |
| 165 | 5825 | – | – | PEAK | 100 | -1.3 | -21.3 | – |

| WLAN b-Mode; 20 MHz; 1 Mbit/s | | | | | | | | |
|-------------------------------|-------------------------|--------------------------|----------------------|----------|-----------|------------------|-------------|----------------------|
| Channel No | Channel Frequency [MHz] | Spurious Frequency [MHz] | Spurious Level [dBm] | Detector | RBW [kHz] | Ref. Level [dBm] | Limit [dBm] | Margin to Limit [dB] |
| 1 | 2412 | – | – | PEAK | 100 | 4.1 | -15.9 | – |
| 6 | 2437 | – | – | PEAK | 100 | 4.6 | -15.4 | – |
| 11 | 2462 | – | – | PEAK | 100 | 4.7 | -15.3 | – |

| WLAN g-Mode; 20 MHz; 6 Mbit/s | | | | | | | | |
|-------------------------------|-------------------------|--------------------------|----------------------|----------|-----------|------------------|-------------|----------------------|
| Channel No | Channel Frequency [MHz] | Spurious Frequency [MHz] | Spurious Level [dBm] | Detector | RBW [kHz] | Ref. Level [dBm] | Limit [dBm] | Margin to Limit [dB] |
| 1 | 2412 | – | – | PEAK | 100 | 1.9 | -18.1 | – |
| 6 | 2437 | – | – | PEAK | 100 | 1.7 | -18.3 | – |
| 11 | 2462 | – | – | PEAK | 100 | 1.8 | -18.2 | – |

| WLAN n-Mode; 20 MHz; 72.2 Mbit/s | | | | | | | | |
|----------------------------------|-------------------------|--------------------------|----------------------|----------|-----------|------------------|-------------|----------------------|
| Channel No | Channel Frequency [MHz] | Spurious Frequency [MHz] | Spurious Level [dBm] | Detector | RBW [kHz] | Ref. Level [dBm] | Limit [dBm] | Margin to Limit [dB] |
| 1 | 2412 | – | – | PEAK | 100 | 2.2 | -17.8 | – |
| 6 | 2437 | – | – | PEAK | 100 | 2.0 | -18.0 | – |
| 11 | 2462 | – | – | PEAK | 100 | 2.3 | -17.7 | – |
| 149 | 5745 | – | – | PEAK | 100 | -4.2 | -24.2 | – |
| 157 | 5785 | – | – | PEAK | 100 | -4.0 | -24.0 | – |
| 164 | 5820 | – | – | PEAK | 100 | -4.6 | -24.6 | – |



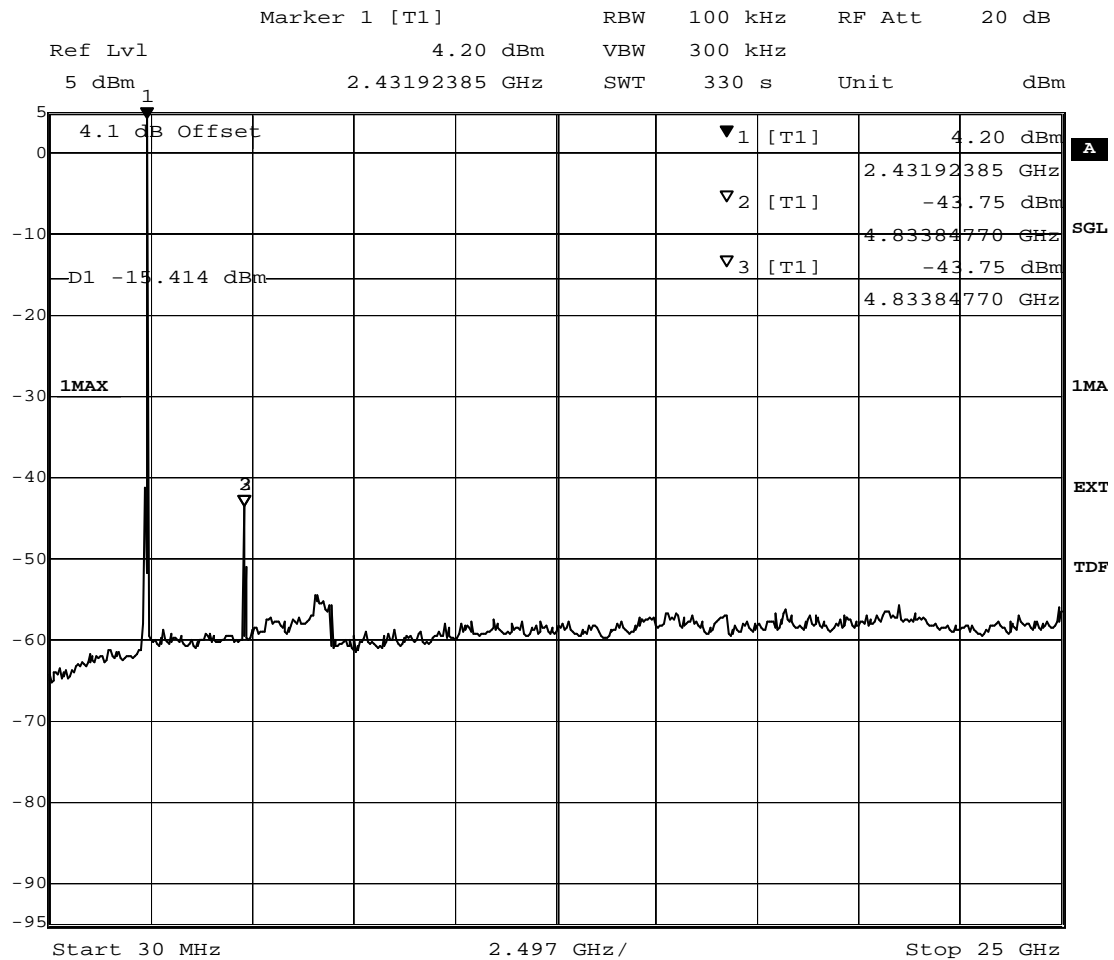
MIMO

| WLAN n-Mode; 40 MHz; 300 Mbit/s | | | | | | | | |
|---------------------------------|-------------------------|--------------------------|----------------------|----------|-----------|------------------|-------------|----------------------|
| Channel No | Channel Frequency [MHz] | Spurious Frequency [MHz] | Spurious Level [dBm] | Detector | RBW [kHz] | Ref. Level [dBm] | Limit [dBm] | Margin to Limit [dB] |
| 3 | 2422 | – | – | PEAK | 100 | -1.5 | -21.5 | – |
| 6 | 2437 | – | – | PEAK | 100 | -1.6 | -21.6 | – |
| 11 | 2462 | – | – | PEAK | 100 | -1.4 | -21.4 | – |
| 151 | 5755 | – | – | PEAK | 100 | -8.3 | -28.3 | – |
| 159 | 5795 | – | – | PEAK | 100 | -8.4 | -28.4 | – |

Notes:

- Only values closer than 20 dB to the limit will be reported.
- Such values have not been found.

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



Title: spurious emissions
 Comment A: CH M: 2437 MHz
 Date: 11.MAR.2014 10:41:09

3.5 Spurious radiated emissions

Standard FCC Part 15, Subpart C

The test was performed according to: ANSI C63.4

3.5.1 Test Description

The test set-up was made in accordance to the general provisions of ANSI C63.4 in a typical installation configuration.

The measurement procedure is implemented into the EMI test software ES-K1 from R&S.

1. Measurement up to 30 MHz

The Equipment Under Test (EUT) was set up on a non-conductive table in the anechoic chamber.

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

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.

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 μ s
- 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.

Settings for step 2:

- 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 $\pm 22.5^{\circ}$ 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.



Settings for step 3:

- Detector: Peak – Maxhold
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 120 kHz
- Measuring time: 100 ms
- Turntable angle range: $\pm 22.5^\circ$ 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 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

In the frequency range 25 – 40 GHz the measurement was performed conducted.

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 (to 15 GHz at 5 GHz) but it depends on the emissions found during the test for the modes b and g (mode n at 5 GHz). Please refer to the results for the used frequency range.

3.5.2 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) |
|------------------|--------------|--------------------------|--------------------------------------|
| 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: $\text{Limit (dBµV/m)} = 20 \log (\text{Limit (µV/m)}/1\mu\text{V/m})$

3.5.3 Test Protocol

Temperature: 21–24 °C
Air Pressure: 994–1014 hPa
Humidity: 34–43 %

SISO

| WLAN b-Mode; 20 MHz; 1 Mbit/s | | | | | | | |
|-------------------------------|-------------------------|--------------------------|-------------------------|------------|-----------|----------------|----------------------|
| Ch. No | Channel Frequency [MHz] | Spurious Frequency [MHz] | Spurious Level [dBμV/m] | Detec -tor | RBW [kHz] | Limit [dBμV/m] | Margin to Limit [dB] |
| 1 | 2412 | 4824.0 | 50.8 | PEAK | 1000 | 74.0 | 23.2 |
| 1 | 2412 | 4824.0 | 48.7 | AV | 1000 | 54.0 | 5.3 |
| 6 | 2437 | 4874.0 | 50.3 | PEAK | 1000 | 74.0 | 23.7 |
| 6 | 2437 | 4874.0 | 47.9 | AV | 1000 | 54.0 | 6.1 |
| 11 | 2462 | 4924.0 | 49.1 | PEAK | 1000 | 74.0 | 24.9 |
| 11 | 2462 | 4924.0 | 46.7 | AV | 1000 | 54.0 | 7.3 |

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

| WLAN g-Mode; 20 MHz; 6 Mbit/s | | | | | | | |
|-------------------------------|-------------------------|--------------------------|-------------------------|------------|-----------|----------------|----------------------|
| Ch. No | Channel Frequency [MHz] | Spurious Frequency [MHz] | Spurious Level [dBμV/m] | Detec -tor | RBW [kHz] | Limit [dBμV/m] | Margin to Limit [dB] |
| 1 | 2412 | 2390.0 | 64.2 | PEAK | 1000 | 74.0 | 9.8 |
| 1 | 2412 | 2390.0 | 41.8 | QP | 1000 | 54.0 | 12.2 |
| 1 | 2412 | 4826.0 | 49.4 | PEAK | 1000 | 74.0 | 24.6 |
| 1 | 2412 | 4826.0 | 36.2 | AV | 1000 | 54.0 | 17.8 |
| 6 | 2437 | 4878.0 | 48.6 | PEAK | 1000 | 74.0 | 25.4 |
| 6 | 2437 | 4878.0 | 35.2 | AV | 1000 | 54.0 | 18.8 |
| 11 | 2462 | - | | PEAK | 1000 | 74.0 | |
| 11 | 2462 | - | | AV | 1000 | 54.0 | |

Remark: No (further) spurious emissions in the range 20 dB below the limit found.
Tests were performed in the frequency range 1–8 GHz.

| WLAN a-Mode; 20 MHz; 6 Mbit/s | | | | | | | |
|-------------------------------|-------------------------|--------------------------|-------------------------|------------|-----------|----------------|----------------------|
| Ch. No | Channel Frequency [MHz] | Spurious Frequency [MHz] | Spurious Level [dBμV/m] | Detec -tor | RBW [kHz] | Limit [dBμV/m] | Margin to Limit [dB] |
| 149 | 5745 | - | | PEAK | 1000 | 74.0 | |
| 149 | 5745 | - | | AV | 1000 | 54.0 | |
| 157 | 5785 | 5357.0 | 47.8 | PEAK | 1000 | 74.0 | 26.2 |
| 157 | 5785 | 5357.0 | 37.5 | AV | 1000 | 54.0 | 16.5 |
| 165 | 5825 | 5394.0 | 47.5 | PEAK | 1000 | 74.0 | 26.5 |
| 165 | 5825 | 5394.0 | 37.4 | AV | 1000 | 54.0 | 16.6 |

Remark: No (further) spurious emissions in the range 20 dB below the limit found.
Tests were performed in the frequency range 1–25 GHz.

| WLAN n-Mode; 20 MHz; 72.2 Mbit/s | | | | | | | |
|----------------------------------|-------------------------|--------------------------|-------------------------|------------|-----------|----------------|----------------------|
| Ch. No | Channel Frequency [MHz] | Spurious Frequency [MHz] | Spurious Level [dBμV/m] | Detec -tor | RBW [kHz] | Limit [dBμV/m] | Margin to Limit [dB] |
| 149 | 5745 | - | | PEAK | 1000 | 74.0 | |
| 149 | 5745 | - | | AV | 1000 | 54.0 | |
| 157 | 5785 | - | | PEAK | 1000 | 74.0 | |
| 157 | 5785 | - | | AV | 1000 | 54.0 | |
| 165 | 5825 | - | | PEAK | 1000 | 74.0 | |
| 165 | 5825 | - | | AV | 1000 | 54.0 | |

Remark: No (further) spurious emissions in the range 20 dB below the limit found.
Tests were performed in the frequency range 1–15 GHz.

MIMO

| WLAN n-Mode; 40 MHz; 300 Mbit/s | | | | | | | |
|---------------------------------|-------------------------|--------------------------|-------------------------|------------|-----------|----------------|----------------------|
| Ch. No | Channel Frequency [MHz] | Spurious Frequency [MHz] | Spurious Level [dBμV/m] | Detec -tor | RBW [kHz] | Limit [dBμV/m] | Margin to Limit [dB] |
| 151 | 5755 | - | | PEAK | 1000 | 74.0 | |
| 151 | 5755 | - | | AV | 1000 | 54.0 | |
| 159 | 5795 | - | | PEAK | 1000 | 74.0 | |
| 159 | 5795 | - | | AV | 1000 | 54.0 | |

Remark: No (further) spurious emissions in the range 20 dB below the limit found.
Tests were performed in the frequency range 1–15 GHz.

3.6 Band edge compliance

Standard FCC Part 15, Subpart C

The test was performed according to: ANSI C63.4–2009, FCC §15.31

3.6.1 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 WLAN transmitter working in 2.4 GHz band:

- lowest channel - ch. 1 = 2412 MHz with channel bandwidth of 20 MHz.

For WLAN transmitter working in 5 GHz band:

- lowest U-NII-3 sub-band channel - ch. 149 = 5745 MHz with channel bandwidth of 20 MHz,

- lowest U-NII-3 sub-band channel - ch. 151 – 5755 MHz with channel bandwidth of 40 MHz.

The lower band edge is 2400 MHz for 2.4 GHz band transmitter and 5725 MHz for 5 GHz band transmitter.

For the higher band edge the EUT is set to transmit as follows:

For the WLAN transmitter working in 2.4 GHz band:

- highest channel - ch. 11 = 2462 MHz with channel bandwidth of 20 MHz.

For the WLAN transmitter working in 5 GHz,

- highest U-NII-3 sub-band channel - ch. 165 = 5825 MHz with channel bandwidth of 20 MHz,

- highest U-NII-3 sub-band channel - ch. 159 = 5795 MHz with channel bandwidth of 40 MHz.

The higher band edge is 2483.5 MHz for 2.4 GHz band transmitter and 5850 MHz for 5 GHz band transmitter.

Analyzer settings for conducted measurement:

- Detector: Peak
- RBW / VBW = 100 / 300 kHz
- Trace: Maxhold

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

Note:

The analyser settings are according to "DTS-Guideline" method "Reference level measurement in non-restricted bands". Standard methods are used for "Band-edge measurements".



3.6.2 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)".

3.6.3 Test Protocol

3.6.3.1 Conducted measurement

Temperature: 21–24 °C
 Air Pressure: 1005–1014 hPa
 Humidity: 32–43 %

SISO

| WLAN a-Mode; 20 MHz; 6 Mbit/s | | | | | | | | |
|-------------------------------|-------------------------|---------------------------|----------------------|----------|-----------|------------------|-------------|----------------------|
| Channel No | Channel Frequency [MHz] | Band Edge Frequency [MHz] | Spurious Level [dBm] | Detector | RBW [kHz] | Ref. Level [dBm] | Limit [dBm] | Margin to Limit [dB] |
| 149 | 5745 | 5725.0 | -46.4 | PEAK | 100 | -0.9 | -20.9 | 25.5 |
| 165 | 5825 | 5850.0 | -48.7 | PEAK | 100 | -1.3 | -21.3 | 27.4 |

| WLAN b-Mode; 20 MHz; 1 Mbit/s | | | | | | | | |
|-------------------------------|-------------------------|---------------------------|----------------------|----------|-----------|------------------|-------------|----------------------|
| Channel No | Channel Frequency [MHz] | Band Edge Frequency [MHz] | Spurious Level [dBm] | Detector | RBW [kHz] | Ref. Level [dBm] | Limit [dBm] | Margin to Limit [dB] |
| 1 | 2412 | 2400.0 | -44.0 | PEAK | 100 | 4.1 | -15.9 | 28.1 |
| 11 | 2462 | 2483.5 | -49.9 | PEAK | 100 | 4.7 | -15.3 | 34.6 |

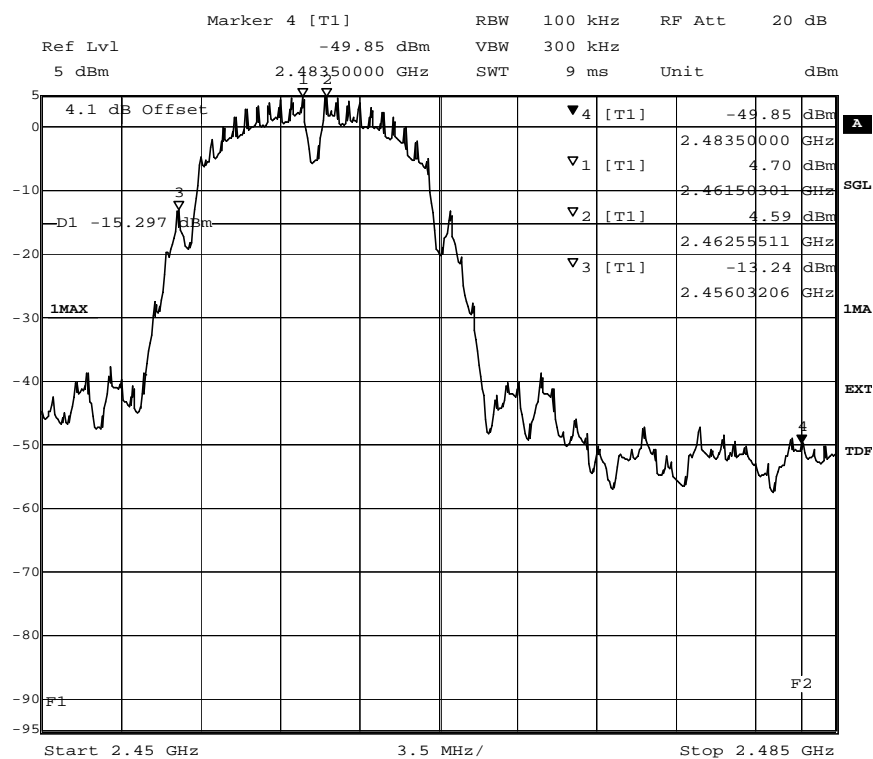
| WLAN g-Mode; 20 MHz; 6 Mbit/s | | | | | | | | |
|-------------------------------|-------------------------|---------------------------|----------------------|----------|-----------|------------------|-------------|----------------------|
| Channel No | Channel Frequency [MHz] | Band Edge Frequency [MHz] | Spurious Level [dBm] | Detector | RBW [kHz] | Ref. Level [dBm] | Limit [dBm] | Margin to Limit [dB] |
| 1 | 2412 | 2400.0 | -35.1 | PEAK | 100 | 1.9 | -18.1 | 17.0 |
| 11 | 2462 | 2483.5 | -38.6 | PEAK | 100 | 1.8 | -18.2 | 20.4 |

| WLAN n-Mode; 20 MHz; 72.2 Mbit/s | | | | | | | | |
|----------------------------------|-------------------------|---------------------------|----------------------|----------|-----------|------------------|-------------|----------------------|
| Channel No | Channel Frequency [MHz] | Band Edge Frequency [MHz] | Spurious Level [dBm] | Detector | RBW [kHz] | Ref. Level [dBm] | Limit [dBm] | Margin to Limit [dB] |
| 1 | 2412 | 2400.0 | -34.3 | PEAK | 100 | 2.2 | -17.8 | 16.5 |
| 11 | 2462 | 2483.5 | -47.0 | PEAK | 100 | 2.3 | -17.7 | 29.3 |
| 149 | 5745 | 5725.0 | -51.3 | PEAK | 100 | -4.2 | -24.2 | 27.1 |
| 165 | 5825 | 5850.0 | -52.0 | PEAK | 100 | -4.6 | -24.6 | 27.4 |

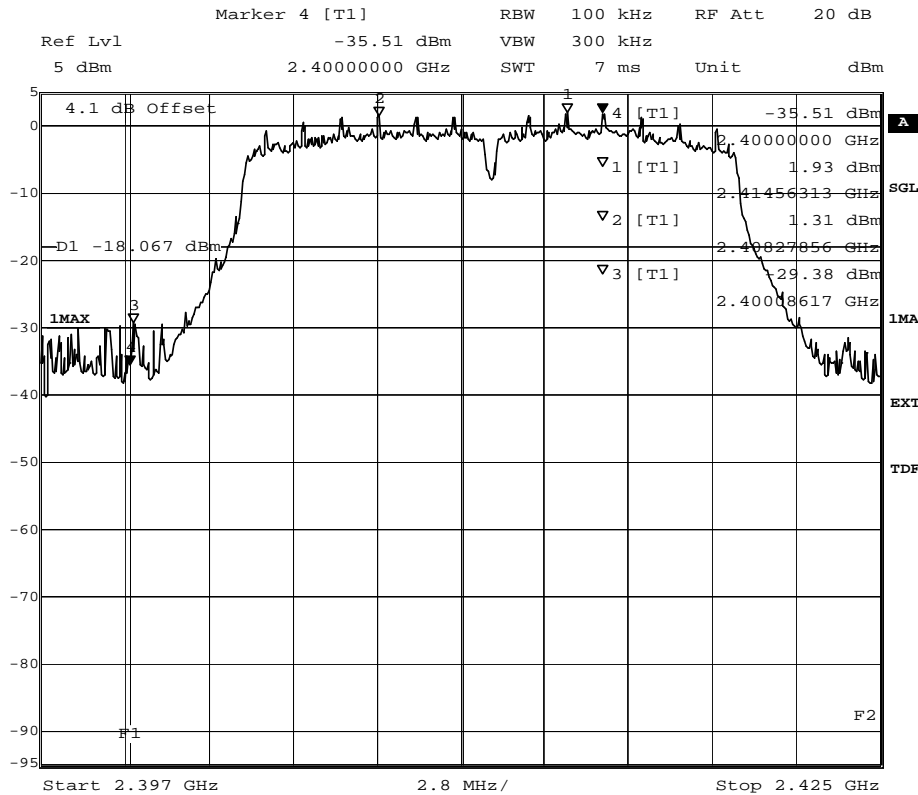
MIMO

| WLAN n-Mode; 40 MHz; 300 Mbit/s | | | | | | | | |
|---------------------------------|-------------------------|---------------------------|----------------------|----------|-----------|------------------|-------------|----------------------|
| Channel No | Channel Frequency [MHz] | Band Edge Frequency [MHz] | Spurious Level [dBm] | Detector | RBW [kHz] | Ref. Level [dBm] | Limit [dBm] | Margin to Limit [dB] |
| 3 | 2422 | 2400.0 | -24.5 | PEAK | 100 | -1.5 | -21.5 | 3.0 |
| 11 | 2462 | 2483.5 | -32.5 | PEAK | 100 | -1.4 | -21.4 | 11.1 |
| 151 | 5755 | 5725.0 | -51.2 | PEAK | 100 | -8.3 | -28.3 | 22.9 |
| 159 | 5795 | 5850.0 | -56.3 | PEAK | 100 | -8.4 | -28.4 | 27.9 |

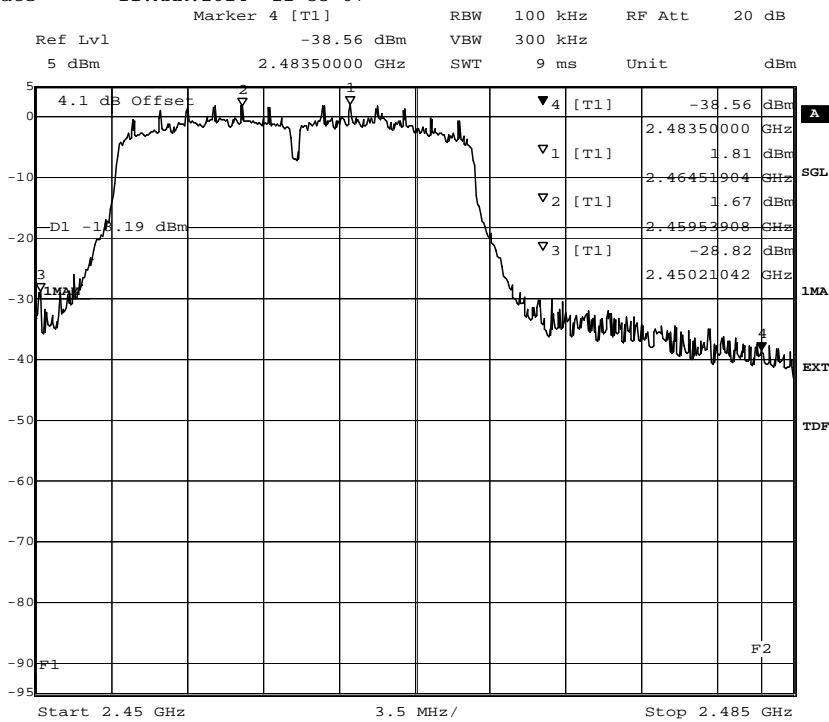
3.6.3.2 Measurement Plot (showing the highest value, "worst case")



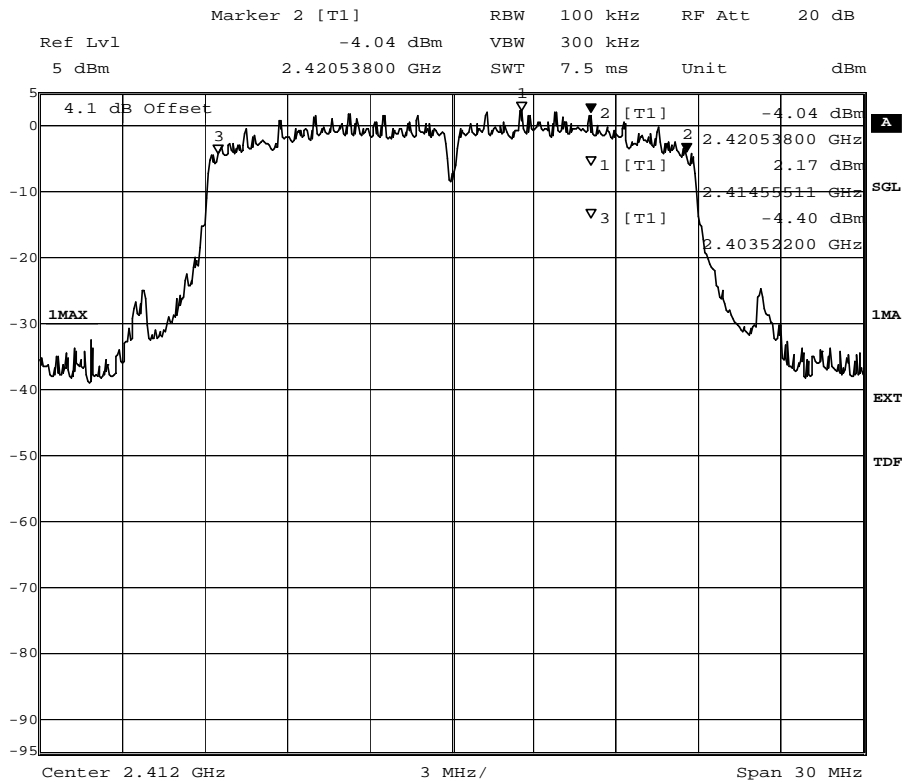
Title: Band Edge Compliance
 Comment A: CH T: 2462 MHz
 Date: 11.MAR.2014 11:02:47



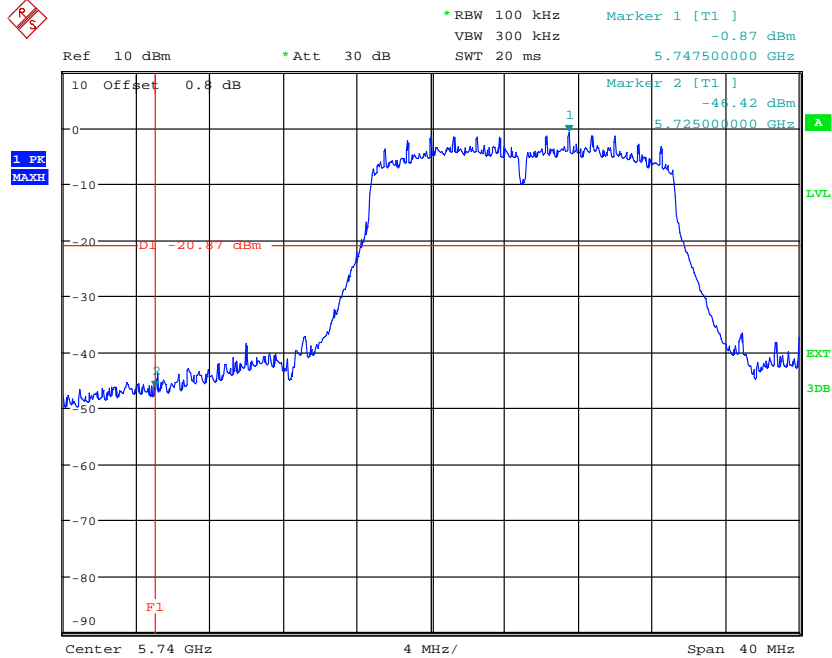
Title: Band Edge Compliance
 Comment A: CH B: 2412 MHz
 Date: 11.MAR.2014 11:35:07



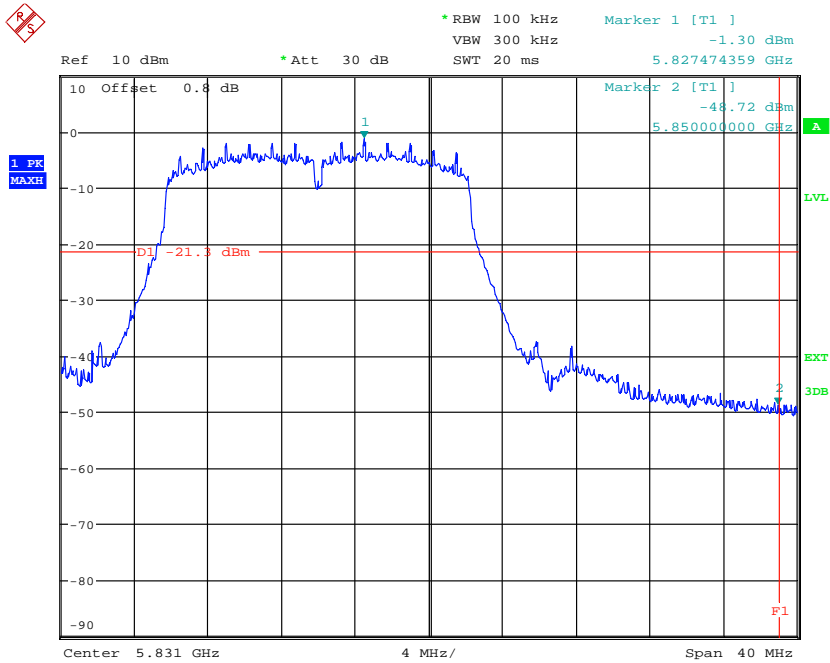
Title: Band Edge Compliance
 Comment A: CH T: 2462 MHz
 Date: 11.MAR.2014 13:12:23



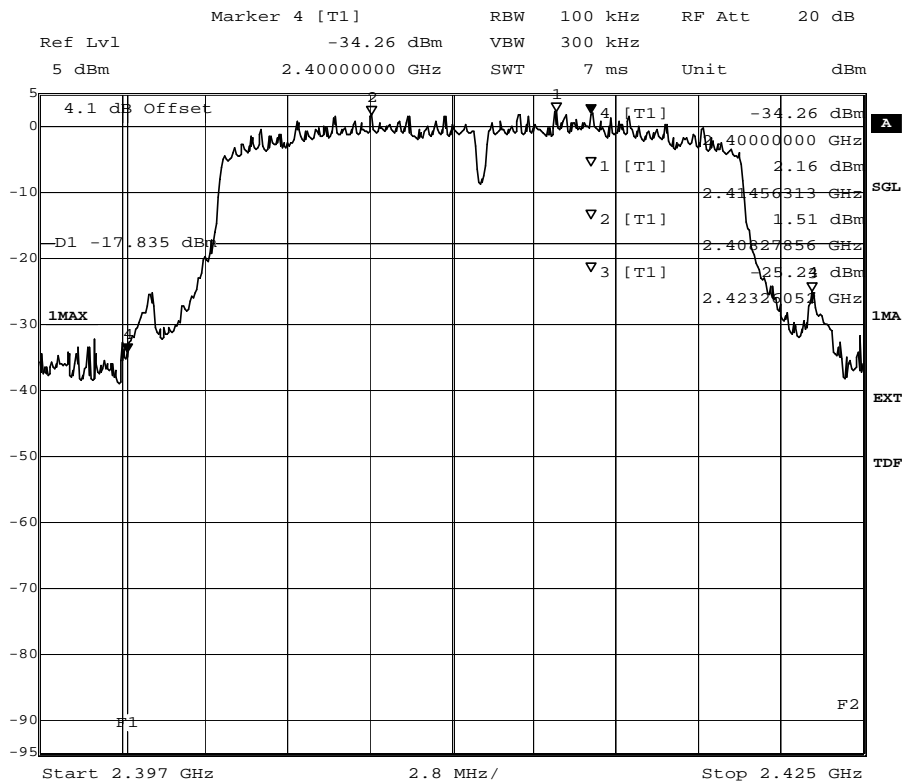
Title: 6dB Bandwidth
 Comment A: CH B: 2412 MHz; 6dB bandwidth (kHz):17016
 Date: 11.MAR.2014 13:59:31



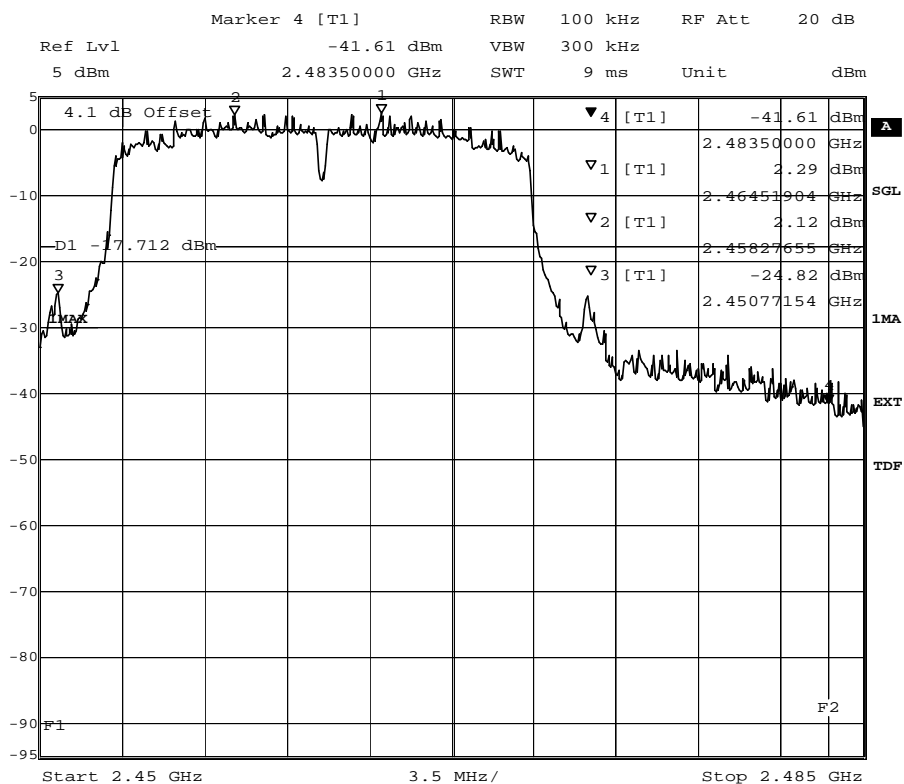
Date: 3.APR.2014 11:26:13



Date: 3.APR.2014 11:32:19

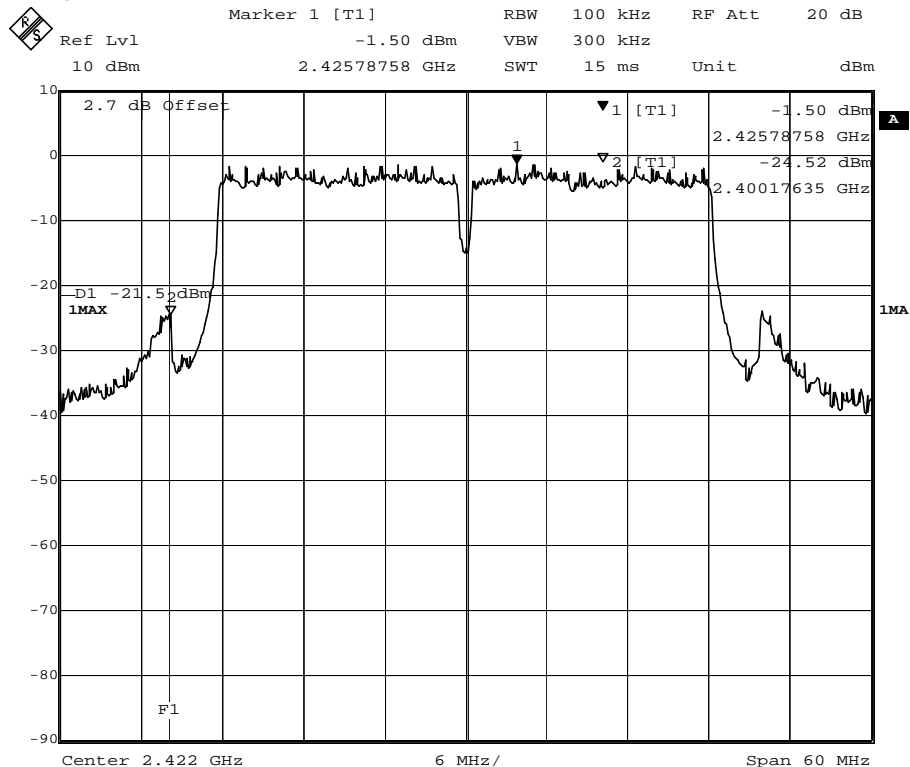


Title: Band Edge Compliance
Comment A: CH B: 2412 MHz
Date: 11.MAR.2014 13:46:00

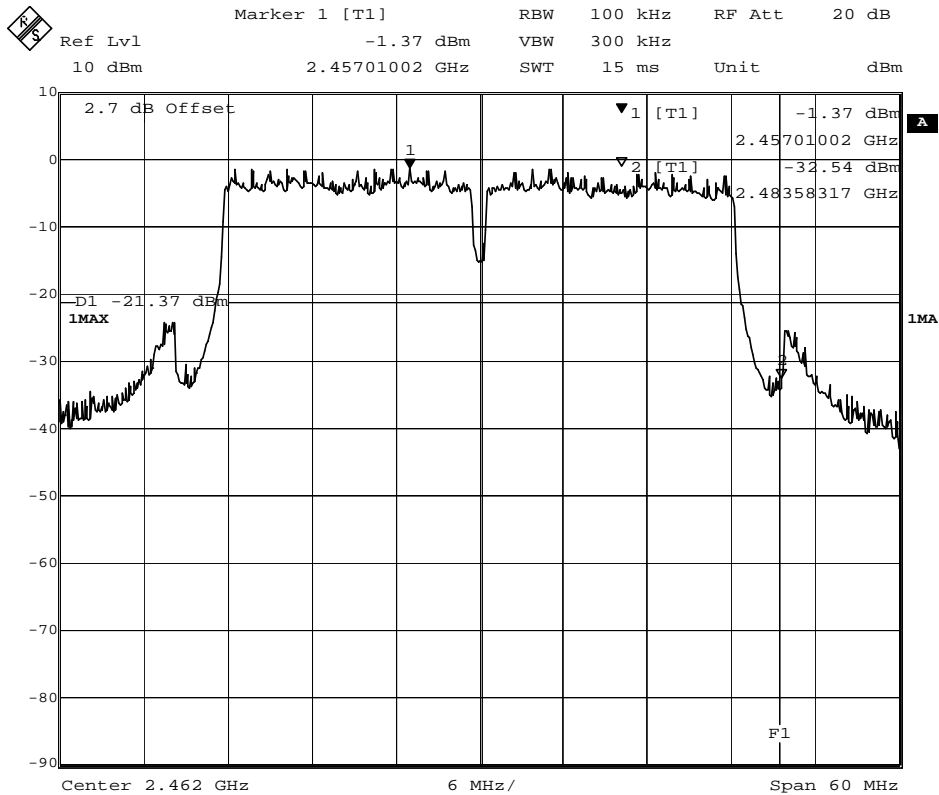


Title: Band Edge Compliance
 Comment A: CH T: 2462 MHz
 Date: 11.MAR.2014 14:49:03

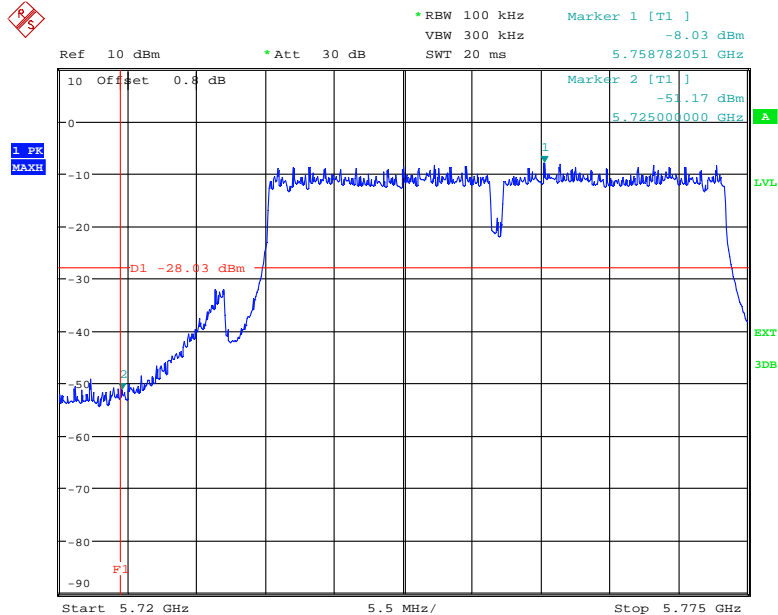
MIMO



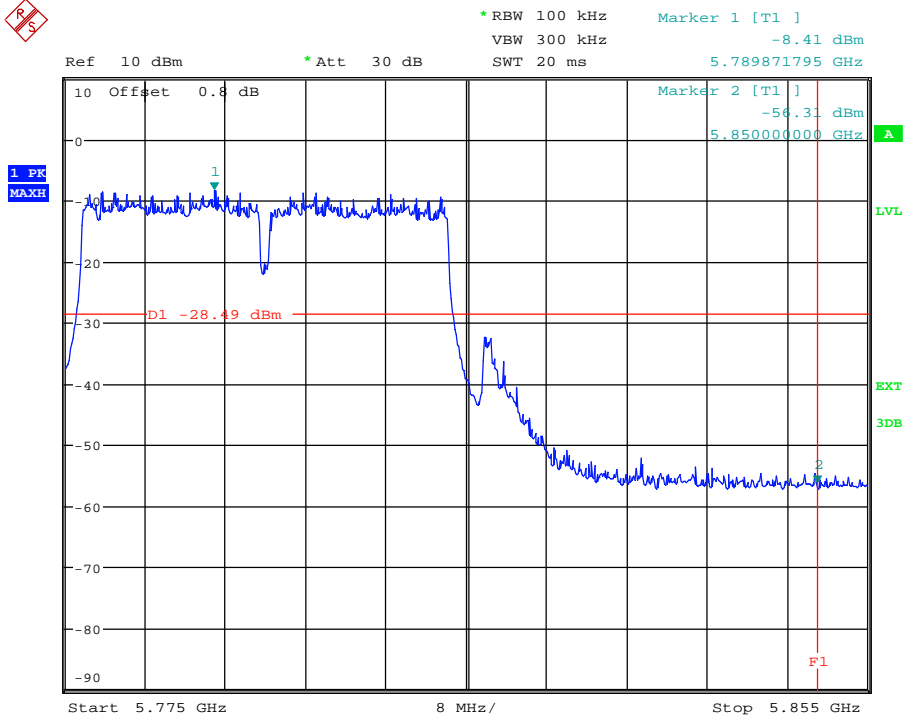
Date: 17.MAR.2014 08:58:29



Date: 17.MAR.2014 09:06:42



Date: 4.APR.2014 12:31:38



Date: 4.APR.2014 12:42:57

3.6.3.3 Radiated Measurement

Temperature: 21–24 °C
Air Pressure: 994–1014 hPa
Humidity: 34–43 %

SISO

| WLAN b-Mode; 20 MHz; 1 Mbit/s | | | | | | | |
|-------------------------------|-------------------------|---------------------------|-------------------------|------------|-----------|----------------|----------------------|
| Ch. No. | Channel Frequency [MHz] | Band Edge Frequency [MHz] | Spurious Level [dBμV/m] | Detec -tor | RBW [kHz] | Limit [dBμV/m] | Margin to Limit [dB] |
| 11 | 2462 | 2483.5 | 52.2 | PEAK | 1000 | 74.0 | 21.8 |
| 11 | 2462 | 2483.5 | 42.5 | AV | 1000 | 54.0 | 11.5 |

| WLAN g-Mode; 20 MHz; 6 Mbit/s | | | | | | | |
|-------------------------------|-------------------------|---------------------------|-------------------------|------------|-----------|----------------|----------------------|
| Ch. No. | Channel Frequency [MHz] | Band Edge Frequency [MHz] | Spurious Level [dBμV/m] | Detec -tor | RBW [kHz] | Limit [dBμV/m] | Margin to Limit [dB] |
| 11 | 2462 | 2483.5 | 62.4 | PEAK | 1000 | 74.0 | 11.6 |
| 11 | 2462 | 2483.5 | 43.9 | AV | 1000 | 54.0 | 10.1 |

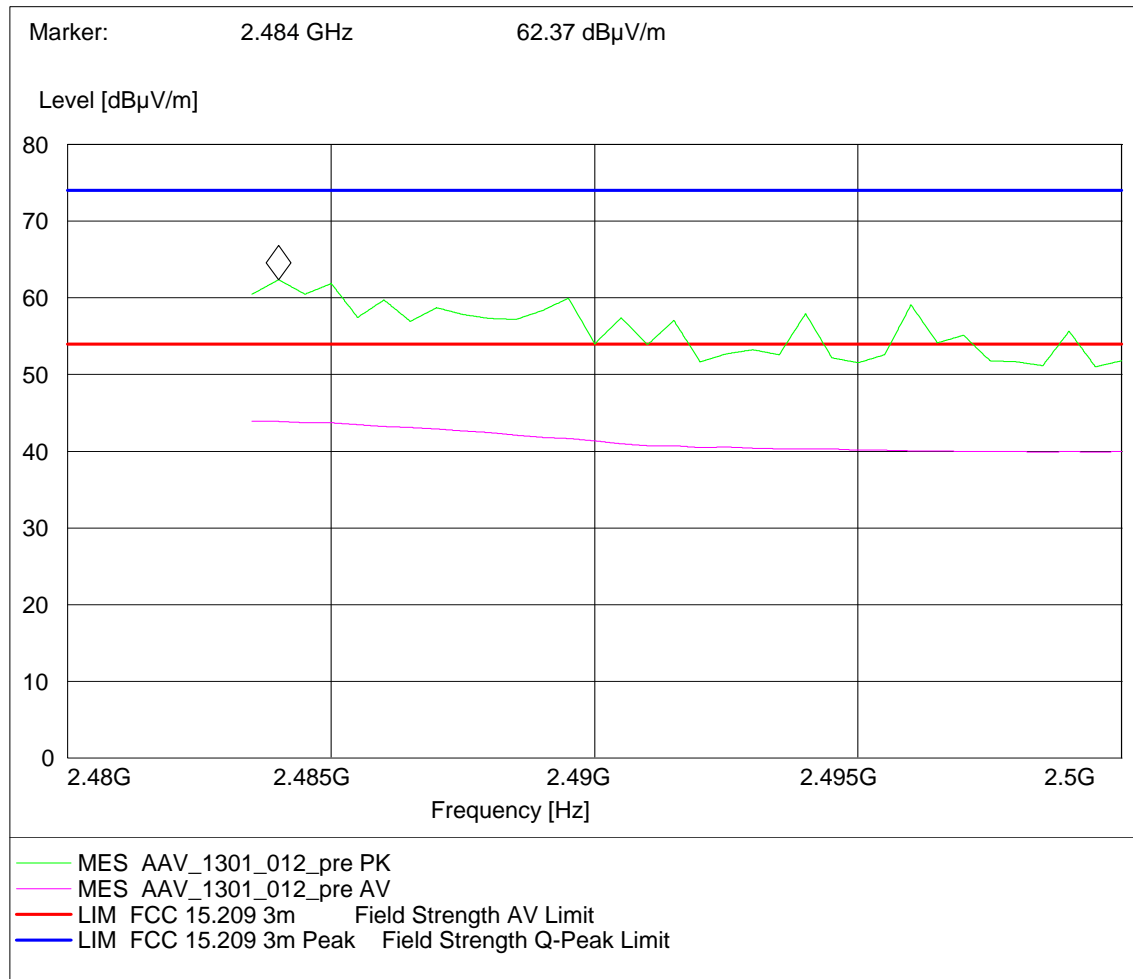
MIMO

| WLAN n-Mode; 20 MHz; 150 Mbit/s | | | | | | | |
|---------------------------------|-------------------------|---------------------------|-------------------------|------------|-----------|----------------|----------------------|
| Ch. No. | Channel Frequency [MHz] | Band Edge Frequency [MHz] | Spurious Level [dBμV/m] | Detec -tor | RBW [kHz] | Limit [dBμV/m] | Margin to Limit [dB] |
| 11 | 2462 | 2483.5 | 47.2 | PEAK | 1000 | 74.0 | 26.8 |
| 11 | 2462 | 2483.5 | 28.3 | AV | 1000 | 54.0 | 25.7 |

| WLAN n-Mode; 40 MHz; 300 Mbit/s | | | | | | | |
|---------------------------------|-------------------------|---------------------------|-------------------------|------------|-----------|----------------|----------------------|
| Ch. No. | Channel Frequency [MHz] | Band Edge Frequency [MHz] | Spurious Level [dBμV/m] | Detec -tor | RBW [kHz] | Limit [dBμV/m] | Margin to Limit [dB] |
| 11 | 2462 | 2483.5 | 57.8 | PEAK | 1000 | 74.0 | 16.2 |
| 11 | 2462 | 2483.5 | 41.4 | AV | 1000 | 54.0 | 12.6 |

Note:
Transmitters in UNII sub-band 3 do not operate adjacent to a restricted band.

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





3.7 Power density

Standard FCC Part 15, Subpart C

The test was performed according to: FCC §15.31

3.7.1 Test Description

The EUT was connected to spectrum analyzer via a short coax cable with a known loss.

Analyzer settings:

- Detector: Peak
- Trace: Maxhold
- Resolution Bandwidth (RBW): 3 kHz
- Video Bandwidth (VBW): 30 kHz
- Sweep Time: auto (coupled)

Note:

The analyser settings are according to "DTS-Guideline" method "Method PKPSD (peak PSD)".

3.7.2 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.

3.7.3 Test Protocol

Temperature: 21–24 °C
 Air Pressure: 1005–1018 hPa
 Humidity: 32–43 %

The values in the tables contain no antenna gain.

SISO:

| 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 | -9.7 | 8.0 | 17.7 |
| | 6 | 2437 | -10.1 | 8.0 | 18.1 |
| | 11 | 2462 | -9.3 | 8.0 | 17.3 |

| 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 | -13.0 | 8.0 | 21.0 |
| | 6 | 2437 | -12.8 | 8.0 | 20.8 |
| | 11 | 2462 | -12.9 | 8.0 | 20.9 |

| 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 | -13.5 | 8.0 | 21.5 |
| | 6 | 2437 | -13.7 | 8.0 | 21.7 |
| | 11 | 2462 | -13.4 | 8.0 | 21.4 |
| 5 GHz ISM | 149 | 5745 | -19.5 | 8.0 | 27.5 |
| | 157 | 5785 | -18.7 | 8.0 | 26.7 |
| | 165 | 5825 | -19.9 | 8.0 | 27.9 |



| WLAN a-Mode, 20 MHz; 6 Mbit/s | | | | | |
|-------------------------------|-------------|-----------------|--------------------------|------------------|----------------------|
| ISM-Band | Channel No. | Frequency [MHz] | Power Density [dBm/3kHz] | Limit [dBm/3kHz] | Margin to Limit [dB] |
| 5 GHz ISM | 149 | 5745 | -14.9 | 8.0 | 22.9 |
| | 157 | 5785 | -16.0 | 8.0 | 24.0 |
| | 165 | 5825 | -17.5 | 8.0 | 25.5 |

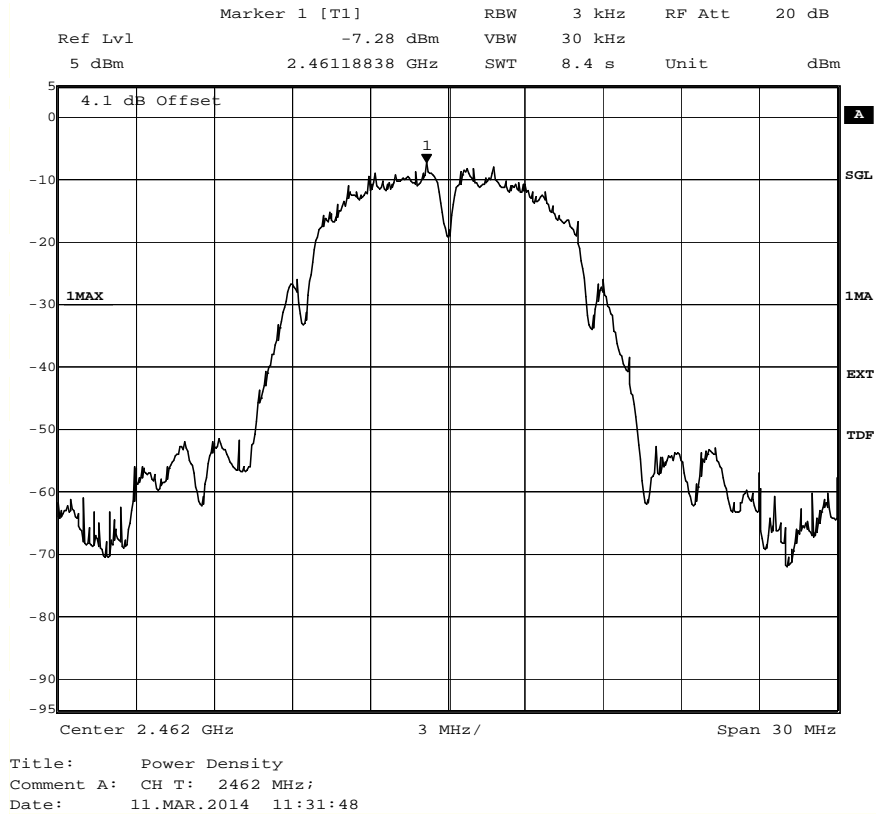
MIMO:

| WLAN n-Mode; 40 MHz; 300 Mbit/s | | | | | |
|---------------------------------|-------------|-----------------|--------------------------|------------------|----------------------|
| Band | Channel No. | Frequency [MHz] | Power Density [dBm/3kHz] | Limit [dBm/3kHz] | Margin to Limit [dB] |
| 2.4 GHz ISM | 3 | 2422 | 3.0 | 8.0 | 5.0 |
| | 6 | 2437 | 3.1 | 8.0 | 4.9 |
| | 11 | 2462 | 3.1 | 8.0 | 4.9 |
| 5 GHz ISM | 151 | 5755 | 3.0 | 8.0 | 5.0 |
| | 159 | 5795 | 3.0 | 8.0 | 5.0 |

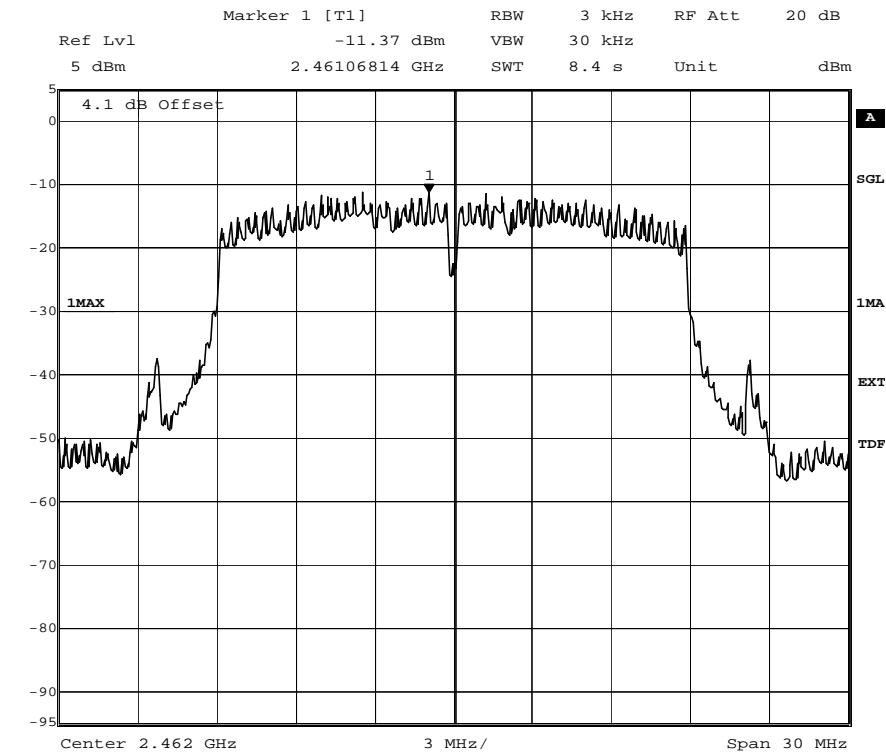
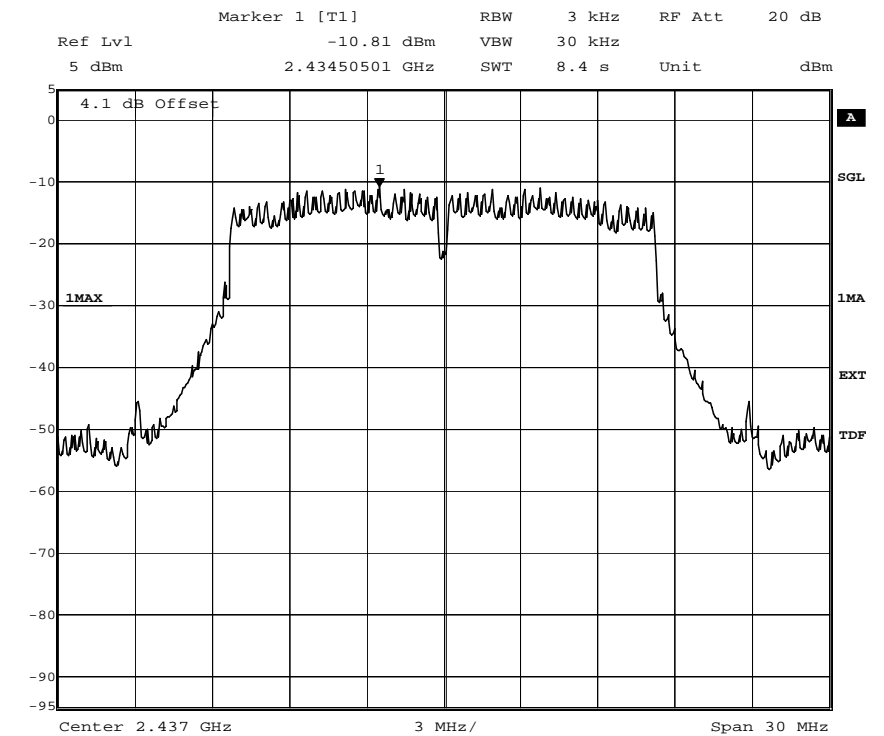


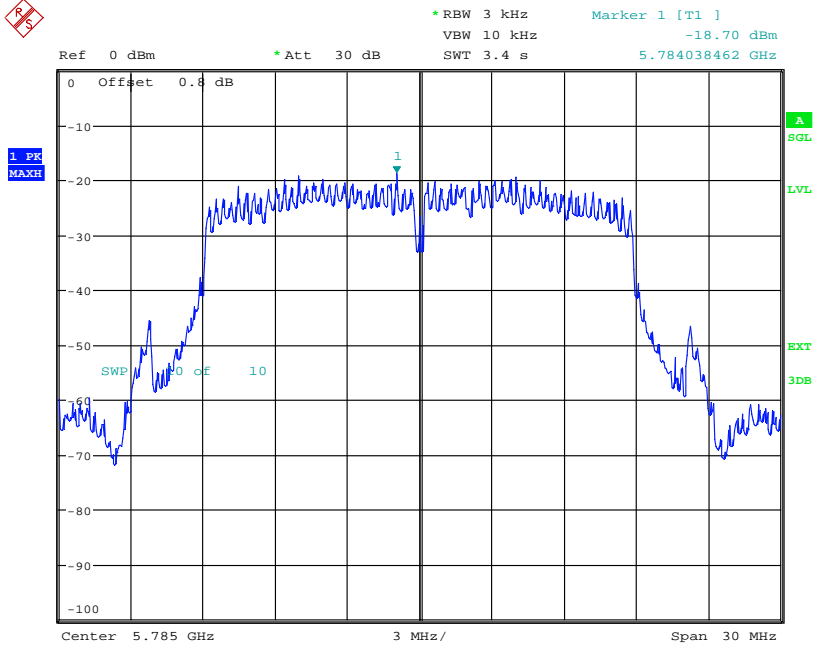
3.7.4 Measurement Plot (showing the highest value, “worst case”)

SISO:

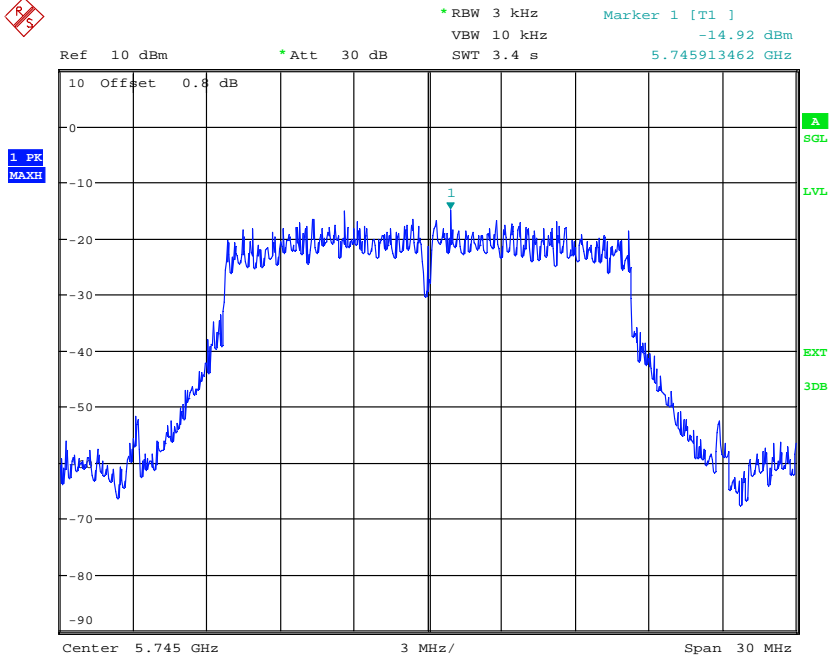


Remark: The plot contains the antenna gain





Date: 4.APR.2014 11:11:15

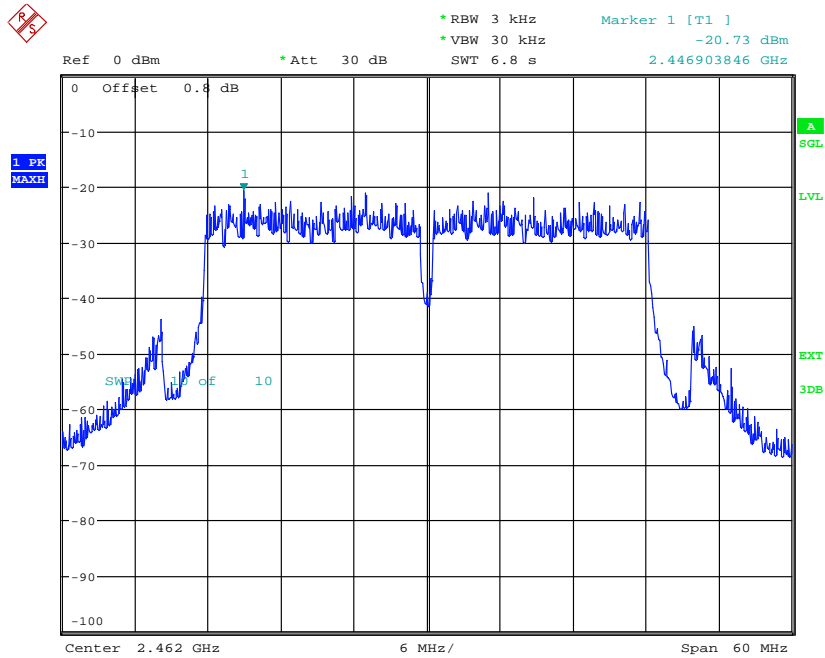


Date: 3.APR.2014 10:55:54

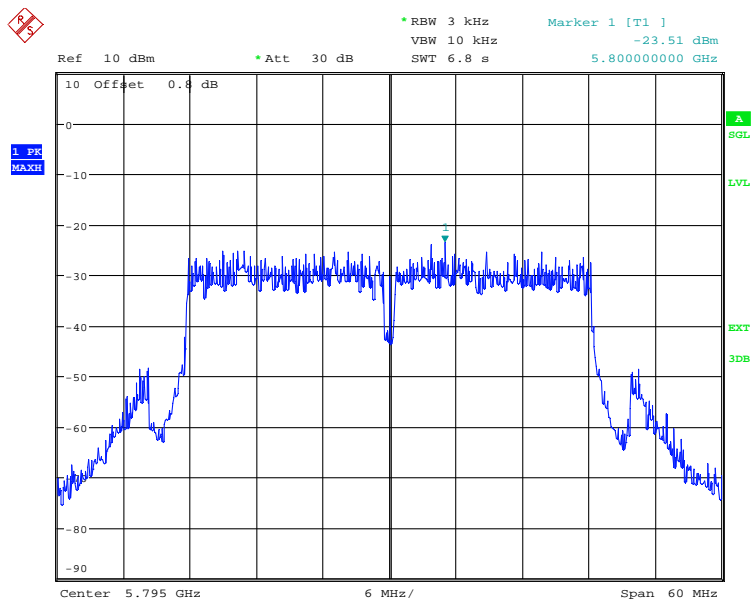


MIMO:

AUX Antenna Port:



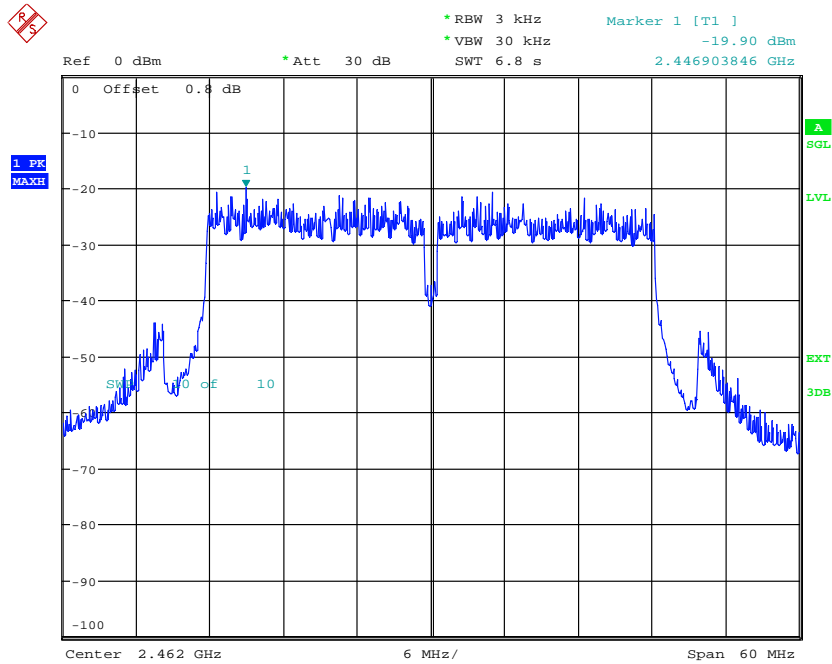
Date: 4.APR.2014 13:04:23



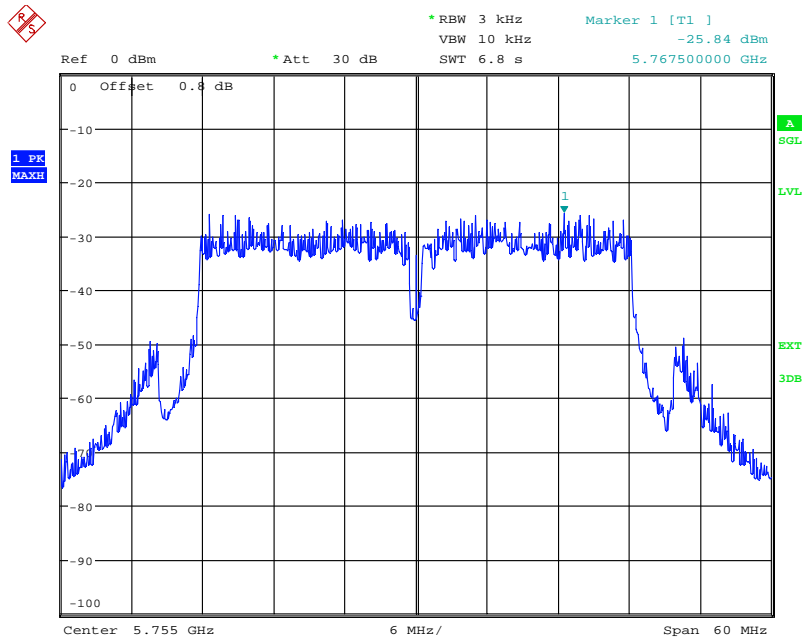
Date: 4.APR.2014 11:02:16



MAIN Antenna Port:



Date: 4.APR.2014 13:06:35



Date: 4.APR.2014 11:04:50

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 m ³ | | |
| | 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 m ³ 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 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 |
|--|----------------------------|---------------|---|
| AC Power Source | Chroma 6404 | 64040001304 | Chroma ATE INC. |
| Cable "LISN to ES1" | RG214 | W18.03+W48.03 | Huber&Suhner |
| Impedance Stabilization Network | ISN T800 | 36159 | Teseq GmbH |
| | <i>Calibration Details</i> | | <i>Last Execution</i> <i>Next Exec.</i> |
| | Standard Calibration | | 2014/02/06 2016/02/28 |
| Impedance Stabilization Network, Coupling Decoupling Network | ISN/CDN ENY41 | 100002 | Rohde & Schwarz GmbH & Co. KG |
| | <i>Calibration Details</i> | | <i>Last Execution</i> <i>Next Exec.</i> |
| | Standard calibration | | 2013/03/01 2015/03/31 |
| Impedance Stabilization Network, Coupling Decoupling Network | ISN/CDN ST08 | 36292 | Teseq GmbH |
| | <i>Calibration Details</i> | | <i>Last Execution</i> <i>Next Exec.</i> |
| | Standard calibration | | 2014/01/10 2016/01/31 |
| Impedance Stabilization Network, Coupling Decoupling Network | ISN/CDN T8-Cat6 | 32187 | Teseq GmbH |



Single Devices for Auxiliary Equipment for Conducted emissions (continued)

| <i>Single Device Name</i> | <i>Type</i> | <i>Serial Number</i> | <i>Manufacturer</i> | |
|----------------------------|-------------|----------------------|-------------------------------|-------------------|
| <i>Calibration Details</i> | | | <i>Last Execution</i> | <i>Next Exec.</i> |
| Standard Calibration | | | 2014/01/08 | 2016/01/31 |
| One-Line V-Network | ESH 3-Z6 | 100489 | Rohde & Schwarz GmbH & Co. KG | |
| One-Line V-Network | ESH 3-Z6 | 100570 | Rohde & Schwarz GmbH & Co. KG | |
| <i>Calibration Details</i> | | | <i>Last Execution</i> | <i>Next Exec.</i> |
| Standard Calibration | | | 2013/11/25 | 2016/11/24 |
| Two-Line V-Network | ESH 3-Z5 | 828304/029 | Rohde & Schwarz GmbH & Co. KG | |
| <i>Calibration Details</i> | | | <i>Last Execution</i> | <i>Next Exec.</i> |
| Standart Calibration | | | 2013/03/01 | 2015/02/28 |
| Two-Line V-Network | ESH 3-Z5 | 829996/002 | Rohde & Schwarz GmbH & Co. KG | |
| <i>Calibration Details</i> | | | <i>Last Execution</i> | <i>Next Exec.</i> |
| 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 | AM4.0/180/119205 13 | Maturo GmbH | | |
| Antenna mast | AS 620 P | 620/37 | HD GmbH | | |
| Biconical Broadband Antenna | SBA 9119 | 9119-005 | Schwarzbeck | | |
| | <i>Calibration Details</i> | | | <i>Last Execution</i> | <i>Next Exec.</i> |
| | Standard Calibration | | | 2009/06/04 | 2014/06/03 |
| Biconical dipole | VUBA 9117 | 9117-108 | Schwarzbeck | | |
| | <i>Calibration Details</i> | | | <i>Last Execution</i> | <i>Next Exec.</i> |
| | 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 | | |
| | <i>Calibration Details</i> | | | <i>Last Execution</i> | <i>Next Exec.</i> |
| | Standard Calibration | | | 2012/05/18 | 2015/05/17 |
| Double-ridged horn | HF 906 | 357357/002 | Rohde & Schwarz GmbH & Co. KG | | |
| | <i>Calibration Details</i> | | | <i>Last Execution</i> | <i>Next Exec.</i> |
| | 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 | | |
| | <i>Calibration Details</i> | | | <i>Last Execution</i> | <i>Next Exec.</i> |
| | 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 | | |
| | <i>Calibration Details</i> | | | <i>Last Execution</i> | <i>Next Exec.</i> |
| | Standard calibration | | | 2011/10/27 | 2014/10/26 |

Single Devices for Auxiliary Equipment for Radiated emissions (continued)

| Single Device Name | Type | Serial Number | Manufacturer |
|------------------------------------|--------------------|----------------------------|----------------------|
| Pyramidal Horn Antenna 26,5 GHz | 3160-09 | 00083069 | EMCO Elektronik GmbH |
| 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 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 |
|---------------------------------------|------------------|---------------|---|
| 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. |
| <i>Calibration Details</i> | | | <i>Last Execution</i> <i>Next Exec.</i> |
| 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 Transformatorwerke GmbH |
| Notch Filter Ultra Stable (Aux) | WRCA800/960-6EEK | 24 | Wainwright |
| Signal Analyzer | FSV30 | 103005 | Rohde & Schwarz GmbH & Co. KG |
| <i>Calibration Details</i> | | | <i>Last Execution</i> <i>Next Exec.</i> |
| Standard | | | 2014/02/10 2016/02/09 |
| Spectrum Analyser | FSP3 | 836722/011 | Rohde & Schwarz GmbH & Co. KG |
| <i>Calibration Details</i> | | | <i>Last Execution</i> <i>Next Exec.</i> |
| Standard | | | 2012/06/13 2015/06/12 |
| Spectrum Analyser | FSU26 | 200418 | Rohde & Schwarz GmbH & Co.KG |
| <i>Calibration Details</i> | | | <i>Last Execution</i> <i>Next Exec.</i> |
| Standard calibration | | | 2013/07/29 2014/07/28 |
| 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 | |
| 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: | | 2007/07/16 | |
| | 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 | | | |
| | --- | | | |
| 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: | | 2007/01/02 | |
| | 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 | | | |
| | --- | | | |
| | SW: | | 2008/11/03 | |
| | K62, K69 | | | |
| 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 | |
| | 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, Lab 5
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 DividerWA1515 SMA | | 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 Standard calibration | 828110/016 | Rohde & Schwarz GmbH & Co.KG 2013/05/03 2014/05/02 |
| RF Step Attenuator RSP | RSP | 833695/001 | Rohde & Schwarz GmbH & Co.KG |
| Rubidium Frequency Standard | Datum, Model: MFS Standard calibration | 5489/001 | Datum-Beverly 2013/06/24 2014/06/23 |
| Sensor Head A | NRV-Z1 Standard calibration | 827753/005 | Rohde & Schwarz GmbH & Co.KG 2013/04/30 2014/04/29 |
| Signal Generator SME | SME03 <i>Calibration Details</i> Standard calibration | 827460/016 | Rohde & Schwarz GmbH & Co.KG <i>Last Execution</i> <i>Next Exec.</i> 2011/11/25 2014/11/24 |
| Signal Generator SMP | SMP02 <i>Calibration Details</i> Standard calibration | 836402/008 | Rohde & Schwarz GmbH & Co. KG <i>Last Execution</i> <i>Next Exec.</i> 2013/05/06 2016/05/05 |
| Spectrum Analyser | FSIQ26 <i>Calibration Details</i> Standard Calibration | 840061/005 | Rohde & Schwarz GmbH & Co. KG <i>Last Execution</i> <i>Next Exec.</i> 2013/02/12 2015/02/11 |
| Temperature Chamber Vötsch 03 | VT 4002 <i>Calibration Details</i> Customized calibration Customized calibration | 58566002150010 | Vötsch <i>Last Execution</i> <i>Next Exec.</i> 2012/03/12 2014/03/11 2014/03/11 2016/03/10 |



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 | | 100302 | Rohde & Schwarz GmbH & Co.KG | |
| | Standard calibration | | 2013/08/28 | 2014/08/27 |
| Power Meter NRVD | NRVD | 832025/059 | 2013/08/26 2014/08/25 | |
| | Standard calibration | | | |
| Power Sensor NRV Z1 A | PROBE | 832279/013 | | |
| | Standard calibration | | 2013/08/28 | 2014/08/27 |
| Power Supply | NGSM 32/10 | 2725 | 2013/06/14 2015/06/13 | |
| | Standard calibration | | | |
| 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, Lab 5
Description: Shielded Room 4m x 6m

Test Equipment T/H Logger 04

Lab ID: Lab 4, Lab 5
Description: Lufft Opus10
Serial Number: 7481

Single Devices for T/H Logger 04

| Single Device Name | Type | Serial Number | Manufacturer | |
|---|------|---------------|-----------------------------------|--|
| ThermoHygro DataloggerOpus10 THI (8152.00) 04 (Environ) | | 7481 | Lufft Mess- und Regeltechnik GmbH | |



Test Equipment Temperature Chamber 01

Lab ID: Lab 4, Lab 5
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 |
| Customized calibration | | 2014/03/12 | 2016/03/11 |



Test Equipment WLAN RF Test Solution

Lab ID: Lab 5
Manufacturer: 7 layers AG
Description: Regulatory WLAN RF Tests
Type: WLAN RF
Serial Number: 001

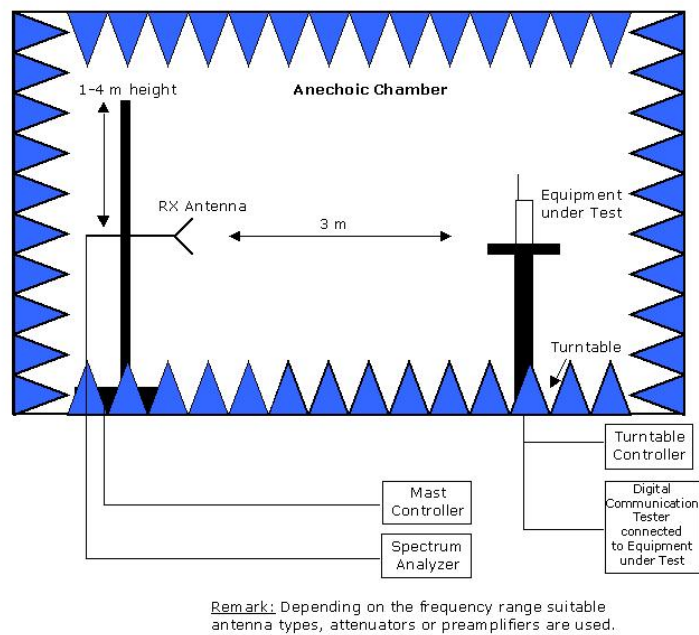
Single Devices for WLAN RF Test Solution

| Single Device Name | Type | Serial Number | Manufacturer | |
|---------------------------------|--|---------------|---|-----------------------|
| Arbitrary Waveform Generator | TGA12101 | 284482 | | |
| Power Meter NRVD | NRVD Standard calibration | 832025/059 | 2013/08/26 | 2014/08/25 |
| Power Sensor NRV Z1 A | PROBE Standard calibration | 832279/013 | 2013/08/28 | 2014/08/27 |
| Power Supply | NGSM 32/10 Standard calibration | 2725 | 2013/06/14 | 2015/06/13 |
| Rubidium Frequency Normal MFS | Datum MFS Standard calibration | 002 | Datum GmbH | 2013/08/27 2014/08/26 |
| Signal Analyser FSIQ26 | 1119.6001.26 | 832695/007 | Rohde & Schwarz GmbH & Co.KG | |
| Spectrum Analyser | FSU26 Standard Calibration Calibration HW/SW Status | 100136 | ROHDE & SCHWARZ GmbH & Co.KG 2014/01/06 2015/01/05 2013/11/14 2014/11/13 Date of Start Date of End | |
| | FSU FW Update to v4.61 SP3, K5 v4.60 and K73 v4.61 | | 2011/12/05 | |
| | FW 4.51 SP1 | | 2012/11/23 | |
| | Bios V5.1-22-1 | | | |
| | Specification Version 14.00 | | | |
| Spectrum Analyser | FSU3 Standard calibration HW/SW Status | 200046 | Rohde & Schwarz GmbH & Co.KG 2013/06/20 2014/06/19 Date of Start Date of End | |
| | Firmware Version 4.51 SP1 | | 2011/12/07 | |
| | Option FS-K72 4.50 SP1 | | | |
| | Option FS-K73 4.50 SP1 | | | |
| TOCT Switching Unit | Switching Unit | 040107 | 7 layers, Inc. | |
| Vector Signal Generator SMIQ03B | SMIQ03B Standard calibration | 832870/017 | 2013/06/21 | 2016/06/20 |

5 Photo Report

Please refer to external report.

6 Setup Drawings



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