InterLab

# FCC Measurement/Technical Report on

# WLAN transceiver
# INARI5-WLAN-1

# FCC ID: 2ABVH-INARI51
# IC: 11875A-INARI51

**Report Reference:** MDE_AAVAM_1408_FCCd_rev2


**Test Laboratory:**
7Layers AG
Borsigstrasse 11
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 v03r02, 2014-06-05" and are compliant to the new revision "Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS)Operating Under §15.247, 558074 D01 DTS Meas Guidance v03r03, 2015-06-09".

**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 devices (e.g. WLAN 2.4/5 GHz) equipment

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

**DTS equipment**

| Measurement | FCC reference | IC reference |
|---|---|---|
| Conducted emissions on AC Mains | § 15.207 | RSS-Gen Issue 4: 8.8 |
| Occupied bandwidth | § 15.247 (a) (2) | RSS-210 Issue 8: A8.2 (a) |
| Peak conducted output power | § 15.247 (b) (3), (4) | RSS-210 Issue 8: A8.4 (4) |
| Transmitter spurious RF conducted emissions | § 15.247 (d) | RSS-Gen Issue 4: 6.13 / 8.9/8.10;<br>RSS-210 Issue 8: A8.5 |
| Transmitter spurious radiated emissions | § 15.247 (d);<br>§ 15.209 (a) | RSS-Gen Issue 4: 6.13 / 8.9/8.10;<br>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 4: 8.3 |
| Receiver spurious emissions | – | RSS-210 Issue 8: 2.3<br>RSS Gen Issue 4: 5 / 7 *) |

*) Receivers are exempted from certification besides if operating in stand-alone mode in the frequency range 30–960 MHz or if these are scanner receivers.

## 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 | | | 2013 |
| **OP-Mode** | **Setup** | **Port** | **Final Result** |
| op-mode 2g | Setup_04 | AC port | Passed |

| FCC Part 15, Subpart C | § 15.247 (a) (1) | | |
|---|---|---|---|
| Occupied bandwidth | | | |
| The measurement was performed according to FCC § 15.31 / section 8 of KDB 558074 | | | 10-1-13 Edition / v03r02 |
| **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 FCC § 15.31 / section 9 of KDB 558074 | | | 10-1-13 Edition / v03r02 |
| **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 1n2 | 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 2n2 | 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 3n2 | Setup_01 | Temp.ant.connector | Passed |
| op-mode 1n+2 | Setup_01 | Temp.ant.connector | Passed |
| op-mode 2n+2 | Setup_01 | Temp.ant.connector | Passed |
| op-mode 3n+2 | 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 | | | 2013 |
| **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 | | | 2013 |
| **OP-Mode** | **Setup** | **Port** | **Final Result** |
| op-mode 1b | Setup_02 | Enclosure | Passed |
| op-mode 2b | Setup_02 | Enclosure | Passed |
| op-mode 3b | Setup_02 | Enclosure | Passed |
| op-mode 1g | Setup_02 | Enclosure | Passed |
| op-mode 2g | Setup_02 | Enclosure | Passed |
| op-mode 3g | Setup_02 | Enclosure | Passed |

| FCC Part 15, Subpart C | § 15.247 (d) | | |
|---|---|---|---|
| Band edge compliance | | | |
| The measurement was performed according to FCC § 15.31 / ANSI C63.10 / section 13 of KDB 558074 | | | 10-1-13 Edition / 2013 / v03r02 |
| **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_02 | Enclosure | Passed |
| op-mode 3g | Setup_02 | Enclosure | Passed |
| op-mode 3n | Setup_02 | Enclosure | Passed |
| op-mode 3n+ | Setup_02 | Enclosure | Passed |
| op-mode 3n2 | Setup_03 | Enclosure | Passed |
| op-mode 3n+2 | Setup_03 | Enclosure | Passed |

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

Power density

The measurement was performed according to FCC § 15.31 / section 10 of KDB 558074 10-1-13 Edition / v03r02

| 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 1n2 | 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 2n2 | 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 3n2 | Setup_01 | Temp.ant.connector | Passed |
| op-mode 1n+2 | Setup_01 | Temp.ant.connector | Passed |
| op-mode 2n+2 | Setup_01 | Temp.ant.connector | Passed |
| op-mode 3n+2 | Setup_01 | Temp.ant.connector | Passed |

Responsible for Accreditation Scope: MARCO KULLIK 2015.08.18 13:19:03 +02'00'

Responsible for Test Report: DANIEL GALL 2015.08.18 13:17:32 +02'00'

## Revision History

| Report version control | | | |
|---|---|---|---|
| **Version** | **Release date** | **Change Description** | **Version validity** |
| initial | 2015-07-15 | -- | invalid |
| rev1 | 2015-08-10 | Changed ANSI Reference, KDB Reference, corrected table 99% BW and testcase description, corrected measured range spurious emissions, deleted limit not belonging to spurious emissions testcase, added ch1 and 6 to spurious emissions radiated testcase table, added tested WLAN mode to plot AC mains conducted emissions, corrected channel number and/or frequency in some result tables. | invalid |
| rev2 | 2015-08-18 | Changed header of section 3.2.4 | valid |

# 1 Administrative Data

## 1.1 Testing Laboratory

| | |
|---|---|
| Company Name: | 7 Layers AG |
| Address | Borsigstr. 11<br>40880 Ratingen<br>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<br>Dipl.-Ing. Robert Machulec<br>Dipl.-Ing. Thomas Hoell<br>Dipl.-Ing. Andreas Petz<br>Dipl.-Ing. Marco Kullik |
| Report Template Version: | 2014-08-22 |

## 1.2 Project Data

| | |
|---|---|
| Responsible for testing and report: | Dipl.-Ing. Daniel Gall |
| Date of Test(s): | 2015-01-07 to 2015-02-15 |
| Date of Report: | 2015-08-18 |

## 1.3 Applicant Data

| | |
|---|---|
| Company Name: | Aava Mobile Oy |
| Address: | Nahkatehtaankatu 2<br>90130 Oulu<br>Finland |
| Contact Person: | Mr. Antti Aho |

## 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:** | Tablet computer |
| **Kind of Device:** | INARI5 |
| **(optional)** | |
| **Voltage Type:** | DC |
| **Voltage Level:** | DC 3.8 V |
| **Tested Modulation Type:** | DBPSK; OFDM:BPSK; OFDM:64-QAM |

**General product description:**

The product is a tablet computer with various transmitters.

**Specific product description for the EUT:**

The EUT supports dual band WLAN (802.11 2.4 GHz b/g/n and 5 GHz a/n) and Bluetooth as well as Bluetooth low energy with one joint antenna connector for WLAN and Bluetooth and an additional antenna for WLAN only allowing MIMO transmission.
In IEEE 802.11n mode it supports 20 MHz and 40 MHz bandwidth channels (both with MCS7 and 15), providing 65 Mbit/s, and 135 Mbit/s transfer data rates in SISO mode as well as 130 Mbit/s and 270 Mbit/s in MIMO 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 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
DC and Data port (USB)
Headset port (3.5mm jack)
System port
Temperature probe 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: DE1004006ac01) | WLAN transceiver | INARI5-WLAN-1 | EB44900066 | Preproduction | Android 4.4 |
| Remark: EUT A is equipped with a temporary antenna connector. | | | | | |
| EUT B (Code: DE1004006aa01) | WLAN transceiver | INARI5-WLAN-1 | EB44900043 | Preproduction | Android 4.4 |
| Remark: EUT B is equipped with a two dual-band integral antennas with the following antenna gain at 2.4 – 2.5 GHz frequency range: Antenna 1: -1.25 dBi, Antenna 2: -2.25 dBi. | | | | | |
| EUT C (Code: DE1004006ab01) | WLAN transceiver | INARI5-WLAN-1 | EB44900054 | Preproduction | Android 4.4 |
| Remark: EUT B is equipped with a two dual-band integral antennas with the following antenna gain at 2.4 – 2.5 GHz frequency range: Antenna 1: -1.25 dBi, Antenna 2: -2.25 dBi. | | | | | |
| EUT D (Code: DE1004006ad01) | WLAN transceiver | INARI5-WLAN-1 | EB44900002 | Preproduction | Android 4.4 |
| Remark: EUT B is equipped with a two dual-band integral antennas with the following antenna gain at 2.4 – 2.5 GHz frequency range: Antenna 1: -1.25 dBi, Antenna 2: -2.25 dBi. | | | | | |

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 | Headset | – | – | – | – |
| AUX2 | USB Cable | AmphenolUSB SHIELDED HIGH SPEED CABLE | – | Rev 2.0 | – |
| AUX3aa | Back panel for AAVAM INARI5 | AAVAM IN02051002.0 | GA44900044 | – | – |
| AUX4ab | Back panel for AAVAM INARI5 | AAVAM IN02051002.0 | GA44900030 | – | – |
| AUX5ad | Back panel for AAVAM INARI5 | AAVAM IN02051002.0 | GA44900048 | – | – |
| AUX6 | AC/DC converter with USB port | DELTA ELECTRONICS, INC. AC/DC ADAPTER ADP-10BW C | 053W41T00KM | Rev. 00 | – |

## 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 | setup for conducted radio measurements |
| Setup_02 | EUT B + AUX1 to AUX3 | setup for radiated measurements |
| Setup_03 | EUT C + AUX1 to AUX2 + AUX4 | setup for radiated measurements |
| Setup_04 | EUT C + AUX1 to AUX2 +AUX5 to AUX6 | setup for conducted emissions (AC power line) measurements |

## 2.6 Operating Modes

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

### 2.6.1 Test Channels

| | Band | | |
|---|---|---|---|
| | 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, 1Mbit/s | 1b | 2b | 3b |
| g-mode, 6 Mbit/s | 1g | 2g | 3g |
| n-Mode, 20 MHz, 65 Mbit/s (MCS7) | 1n | 2n | 3n |
| n-Mode, 40 MHz, 135 Mbit/s (MCS7) | 1n+ | 2n+ | 3n+ |
| n-mode, 20 MHz, MIMO, 130 Mbit/s (MCS15) | 1n2 | 2n2 | 3n2 |
| n-mode, 40 MHz, MIMO, 270 Mbit/s (MCS15) | 1n+2 | 2n+2 | 3n+2 |

## 2.7 Special software used for testing

For testing Bluetooth the ADB tool was used, the WLAN adapter was set into a special testmode that could be set using a laptop and a batch file provided by the applicant.

## 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 Conducted emissions (AC power line)

**Standard** FCC Part 15, Subpart C

**The test was performed according to:** ANSI C 63.10

### 3.1.1 Test Description

The test set-up was made in accordance to the general provisions of ANSI C 63.10
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 50µH || 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: Limit (dBµV) = 20 log (Limit (µV)/1µV).

### 3.1.3 Test Protocol

Temperature: 25 °C
Air Pressure: 1007 hPa
Humidity: 30 %

| 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 | 0.185 | 55.4 | – | 64 | – | 8.6 | – |
| L | – | – | – | – | – | – | – |

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

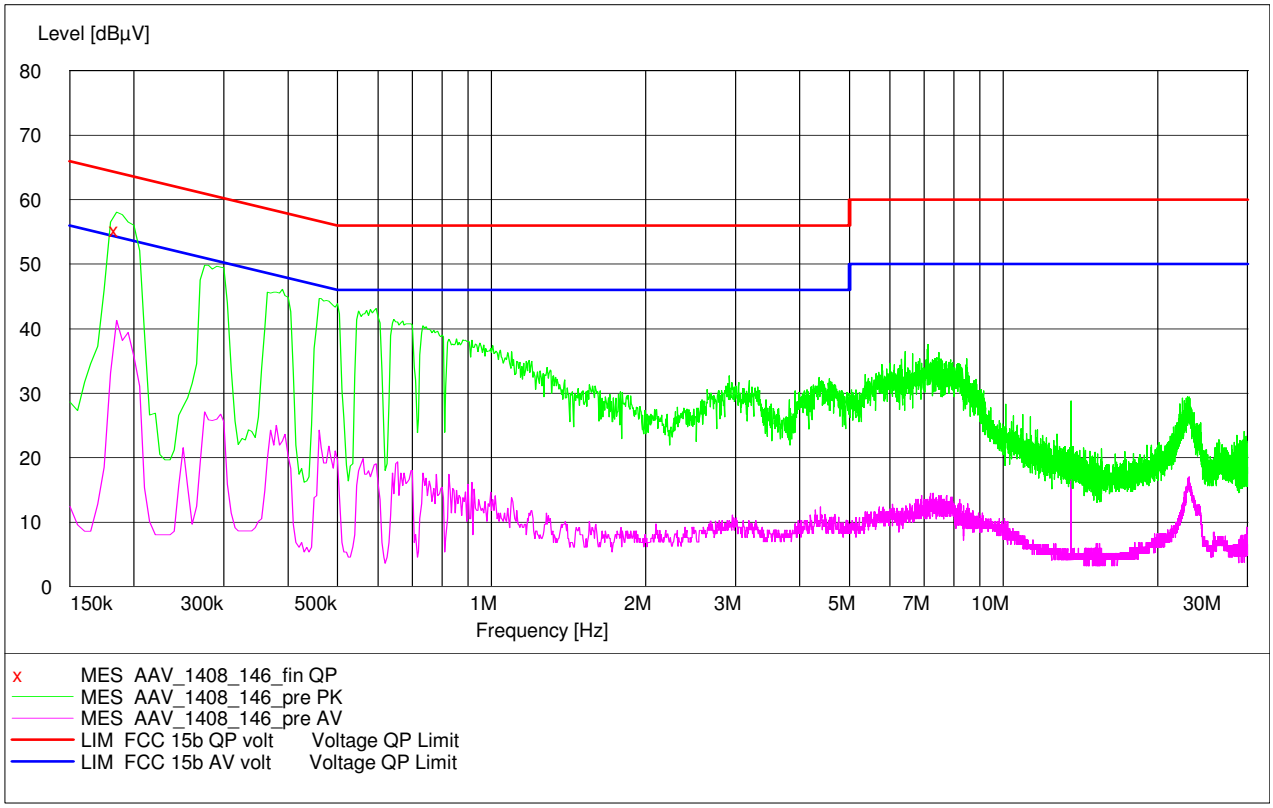
### 3.1.4 Measurement Plot (showing the highest value, "worst case")

***AC MAINS CONDUCTED***

```
EUT:                  (DE1004006ad01)
Manufacturer:         AAVAM
Operating Condition:  WLAN 6 Mbit/s Ch. 6, NFC on, video recording
Test Site:            7 layers Ratingen
Operator:             URO
Test Specification:   ANSI C63.10; FCC 15.107 / 15.207
Comment:              120 V / 60 Hz ; AC/DC adapter
Start of Test:        15.02.2015 / 21:19:36
```

***SCAN TABLE: "FCC Voltage"***

```
  Short Description:            FCC Voltage
  Start      Stop       Step      Detector   Meas.     IF       Transducer
  Frequency  Frequency  Width                Time      Bandw.
  150.0 kHz  30.0 MHz   5.0 kHz   MaxPeak    20.0 ms   9 kHz    ESH3-Z5
                                  Average
```




***MEASUREMENT RESULT: "AAV_1408_146_fin QP"***

```
15.02.2015  21:25
   Frequency     Level  Transd  Limit  Margin  Line   PE
         MHz      dBµV      dB   dBµV      dB

    0.185000     55.40    10.1     64     8.8  N      GND
```

## 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 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 / 50 MHz (for 20 / 40 MHz nominal bandwidth)
- Detector: Peak / Sample (6 dB bandwidth / 99% bandwidth)

### 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 band. 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: 24 °C
Air Pressure: 1018 hPa
Humidity: 34 %

#### 3.2.3.1 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 | 8.124 | 0.5 | 7.6 |
| | 6 | 2437 | 8.604 | 0.5 | 8.1 |
| | 11 | 2462 | 8.604 | 0.5 | 8.1 |

| 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 | 15.516 | 0.5 | 15.0 |
| | 6 | 2437 | 15.996 | 0.5 | 15.5 |
| | 11 | 2462 | 15.216 | 0.5 | 14.7 |

| WLAN n-Mode; 20 MHz; 65 Mbit/s | | | | | |
|---|---|---|---|---|---|
| **Band** | **Channel No.** | **Frequency [MHz]** | **6 dB Bandwidth [MHz]** | **Limit [MHz]** | **Margin to Limit [MHz]** |
| 2.4 GHz ISM | 1 | 2412 | 15.636 | 0.5 | 15.1 |
| | 6 | 2437 | 16.356 | 0.5 | 15.9 |
| | 11 | 2462 | 16.476 | 0.5 | 16.0 |

| WLAN n-Mode; 40 MHz; 135 Mbit/s | | | | | |
|---|---|---|---|---|---|
| **Band** | **Channel No.** | **Frequency [MHz]** | **6 dB Bandwidth [MHz]** | **Limit [MHz]** | **Margin to Limit [MHz]** |
| 2.4 GHz ISM | 3 | 2422 | 36.273 | 0.5 | 35.8 |
| | 6 | 2437 | 36.573 | 0.5 | 36.1 |
| | 11 | 2462 | 36.273 | 0.5 | 35.8 |

### 3.2.3.2 99% bandwidth

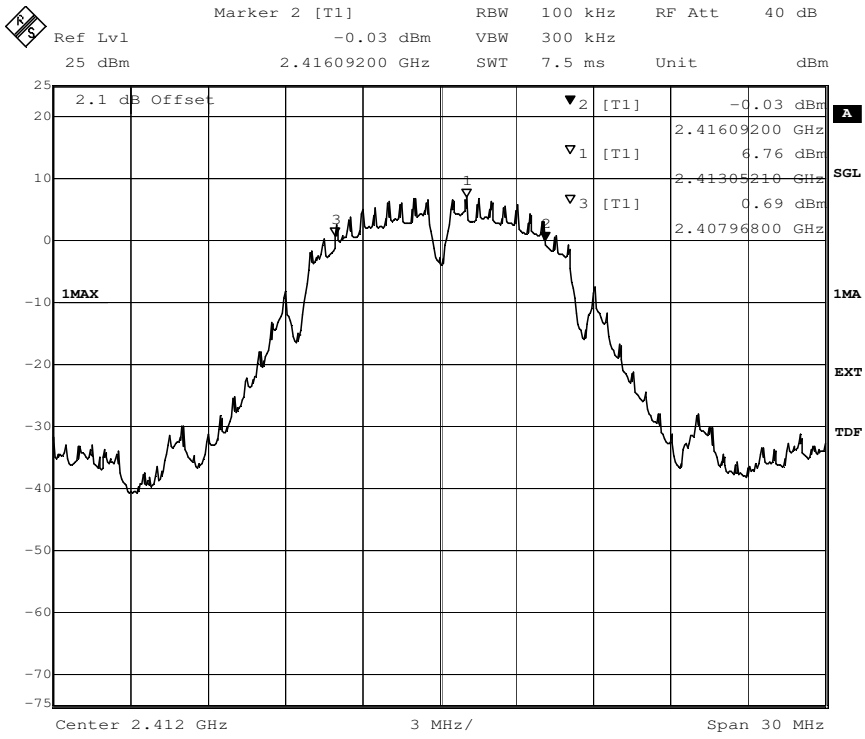
| WLAN b-Mode; 20 MHz; 1 Mbit/s | | | |
|---|---|---|---|
| **Band** | **Channel No.** | **Frequency [MHz]** | **99 % Bandwidth [MHz]** |
| 2.4 GHz ISM | 1 | 2412 | 11.138 |
| | 6 | 2437 | 11.138 |
| | 11 | 2462 | 11.218 |

| WLAN g-Mode; 20 MHz; 6 Mbit/s | | | |
|---|---|---|---|
| **Band** | **Channel No.** | **Frequency [MHz]** | **99 % Bandwidth [MHz]** |
| 2.4 GHz ISM | 1 | 2412 | 16.987 |
| | 6 | 2437 | 16.987 |
| | 11 | 2462 | 16.987 |

| WLAN n-Mode; 20 MHz; 65 Mbit/s | | | |
|---|---|---|---|
| **Band** | **Channel No.** | **Frequency [MHz]** | **99 % Bandwidth [MHz]** |
| 2.4 GHz ISM | 1 | 2412 | 17.628 |
| | 6 | 2437 | 17.628 |
| | 11 | 2462 | 17.628 |

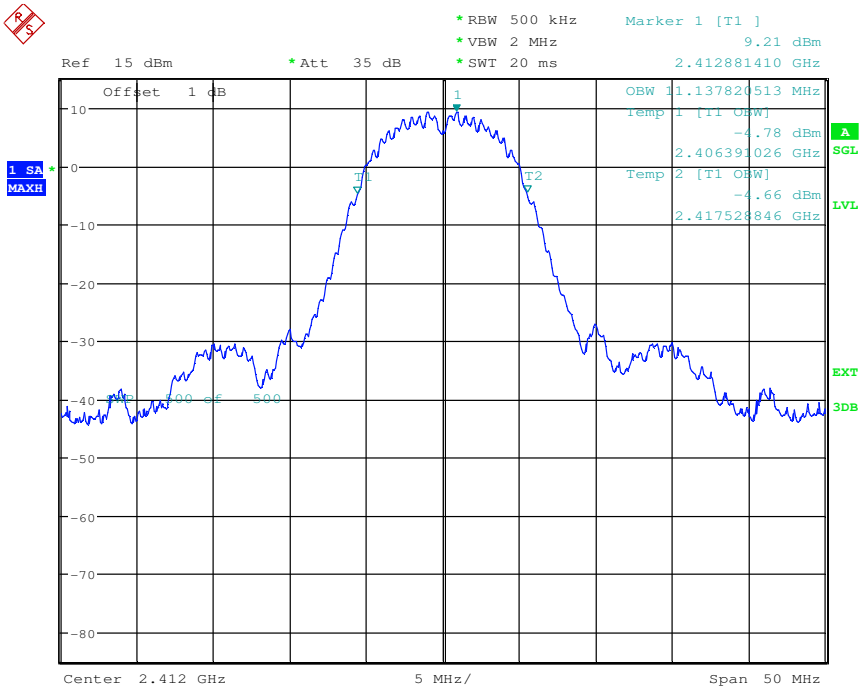
| WLAN n-Mode; 40 MHz; 135 Mbit/s | | | |
|---|---|---|---|
| **Band** | **Channel No.** | **Frequency [MHz]** | **99 % Bandwidth [MHz]** |
| 2.4 GHz ISM | 3 | 2422 | 36.458 |
| | 6 | 2437 | 36.538 |
| | 11 | 2462 | 36.458 |

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




Title: 6dB Bandwidth
Comment A: CH B: 2412 MHz; 6dB bandwidth (kHz):8124
Date: 12.JAN.2015 11:30:12

6dB Bandwidth b mode Ch. 1




Date: 16.JAN.2015 13:25:42

99% Bandwidth b mode Ch. 1

## 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

### 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 band: 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)

### 3.3.3 Test Protocol

Temperature: 24 °C
Air Pressure: 1018 hPa
Humidity: 36 %

The antenna gain is excluded in the table.

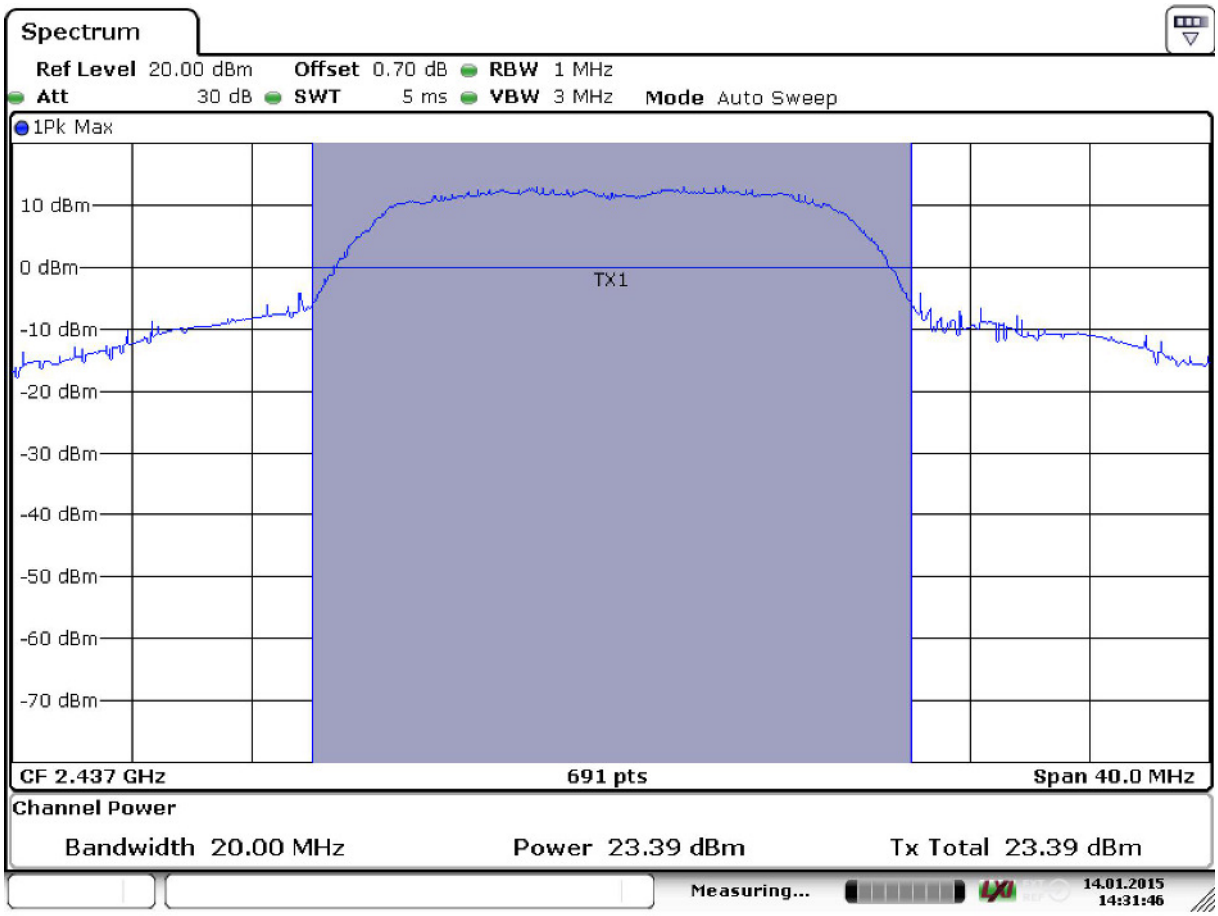
| WLAN b-Mode; 20 MHz; 1 Mbit/s | | | | | |
|---|---|---|---|---|---|
| **Band** | **Channel No.** | **Frequency [MHz]** | **Peak Power [dBm]** | **Limit [dBm]** | **Margin to Limit [dB]** |
| 2.4 GHz ISM | 1 | 2412 | 18.7 | 30.0 | 11.3 |
| | 6 | 2437 | 18.5 | 30.0 | 11.5 |
| | 11 | 2462 | 18.2 | 30.0 | 11.8 |

| WLAN g-Mode; 20 MHz; 6 Mbit/s | | | | | |
|---|---|---|---|---|---|
| **Band** | **Channel No.** | **Frequency [MHz]** | **Peak Power [dBm]** | **Limit [dBm]** | **Margin to Limit [dB]** |
| 2.4 GHz ISM | 1 | 2412 | 23.3 | 30.0 | 6.7 |
| | 6 | 2437 | 23.4 | 30.0 | 6.6 |
| | 11 | 2462 | 22.9 | 30.0 | 7.1 |

| WLAN n-Mode; 20 MHz; 130 Mbit/s | | | | | | TX1 | TX2 |
|---|---|---|---|---|---|---|---|
| **Band** | **Ch. No.** | **Freq. [MHz]** | **Peak Power [dBm]** | **Limit [dBm]** | **Margin to Limit [dB]** | ANT1 | ANT2 |
| 2.4 GHz ISM | 1 | 2412 | 24.1 | 30.0 | 5.9 | 21.7 | 20.4 |
| | 6 | 2437 | 24.0 | 30.0 | 6.0 | 21.5 | 20.4 |
| | 11 | 2462 | 24.0 | 30.0 | 6.0 | 21.3 | 20.6 |

| WLAN n-Mode; 40 MHz; 270 Mbit/s | | | | | | TX1 | TX2 |
|---|---|---|---|---|---|---|---|
| **Band** | **Ch. No.** | **Freq. [MHz]** | **Peak Power [dBm]** | **Limit [dBm]** | **Margin to Limit [dB]** | Ant 1 | Ant 2 |
| 2.4 GHz ISM | 3 | 2422 | 22.4 | 30.0 | 7.6 | 19.41 | 19.35 |
| | 6 | 2437 | 22.3 | 30.0 | 7.7 | 19.24 | 19.25 |
| | 11 | 2462 | 22.1 | 30.0 | 7.9 | 19.26 | 18.95 |

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




Date: 14.JAN.2015 14:31:46

## 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-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 3.6). This value is used to calculate the 20 dBc limit.

### 3.4.2 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.

### 3.4.3 Test Protocol

Temperature: 24 °C
Air Pressure: 1018 hPa
Humidity: 36 %

| 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 | 6.5 | -13.5 | - |
| 6 | 2437 | - | - | PEAK | 100 | 6.8 | -13.3 | - |
| 11 | 2462 | - | - | PEAK | 100 | 6.4 | -13.6 | - |

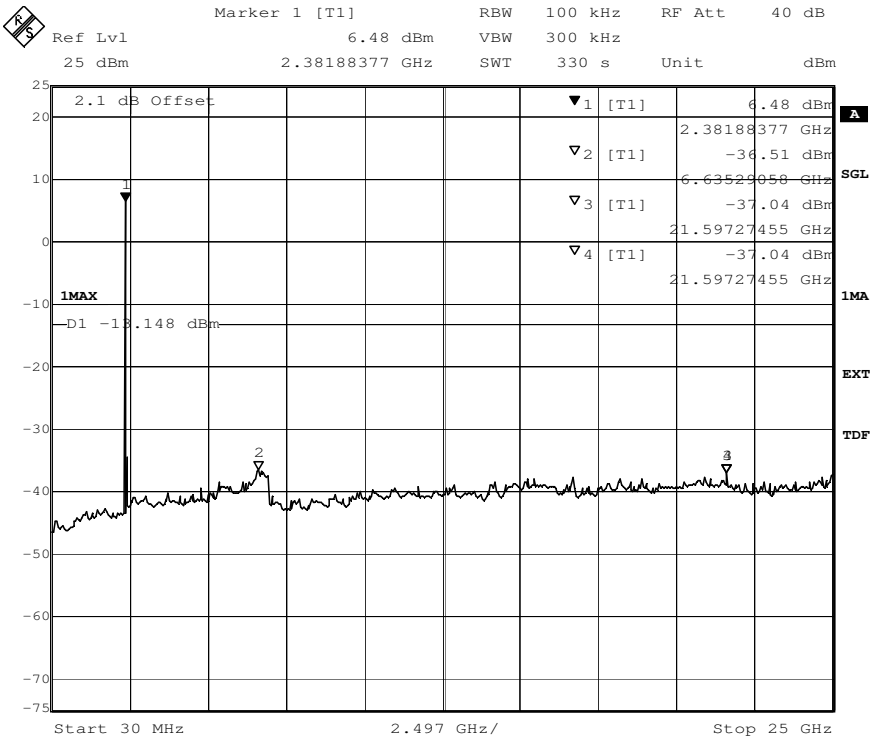
| WLAN g-Mode; 20 MHz; 6 Mbit/s | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Channel No | Channel Center Freq. [MHz] | Spurious Freq. [MHz] | Spurious Level [dBm] | Detector | RBW [kHz] | Ref. Level [dBm] | Limit [dBm] | Margin to Limit [dB] |
| 1 | 2412 | - | - | PEAK | 100 | 4.0 | -16.0 | - |
| 6 | 2437 | - | - | PEAK | 100 | 3.4 | -16.6 | - |
| 11 | 2462 | - | - | PEAK | 100 | 3.6 | -16.4 | - |

| WLAN n-Mode; 20 MHz; 65 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 | 9.8 | -10.2 | - |
| 6 | 2437 | - | - | PEAK | 100 | 1.5 | -18.5 | - |
| 11 | 2462 | - | - | PEAK | 100 | 1.5 | -18.5 | - |

| WLAN n-Mode; 40 MHz; 135 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 | -4.0 | -24.0 | - |
| 6 | 2437 | - | - | PEAK | 100 | -5.0 | -25.0 | - |
| 11 | 2462 | - | - | PEAK | 100 | -4.8 | -24.8 | - |

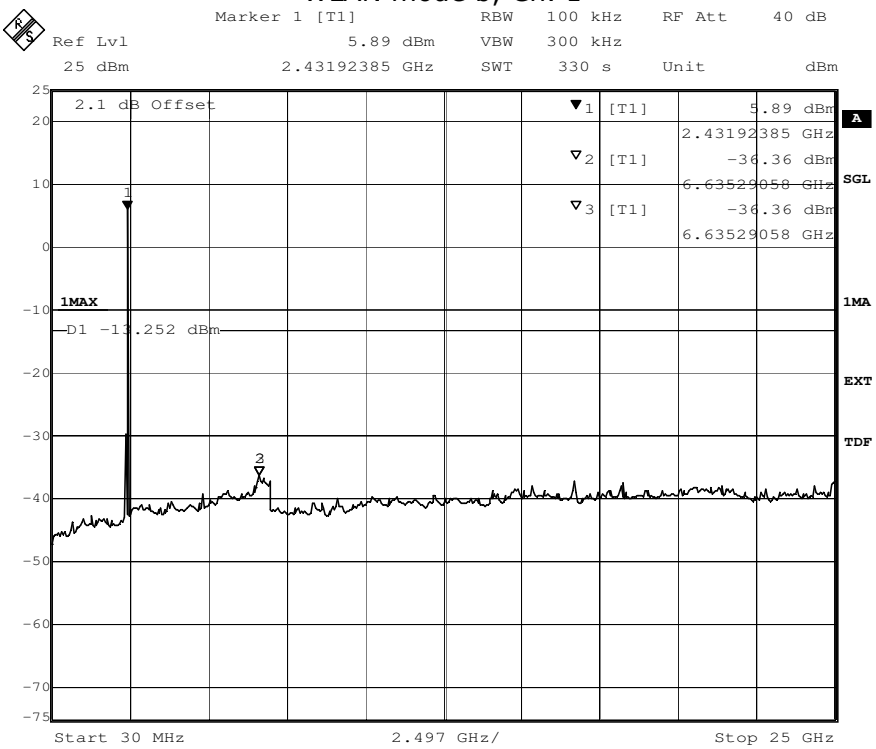
Note: No (further) spurious emissions in the range 20 dB below the limit found.

### 3.4.4 Measurement Plots



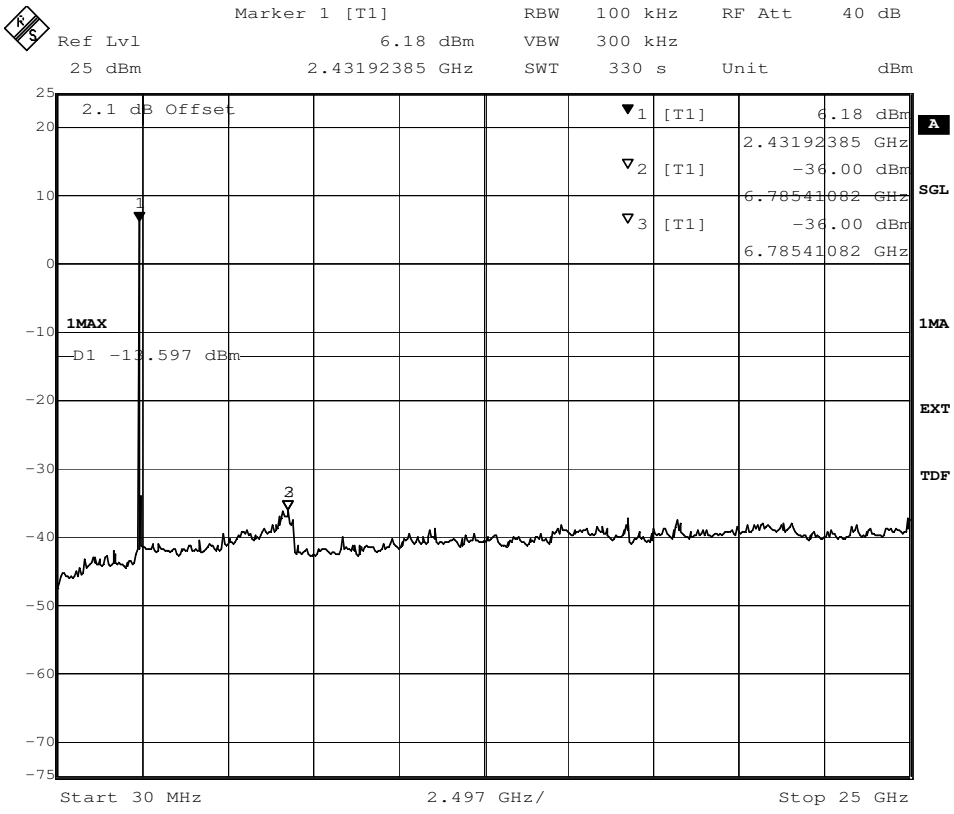

Title: spurious emissions
Comment A: CH B: 2412 MHz
Date: 12.JAN.2015 11:27:32

WLAN mode b, Ch. 1



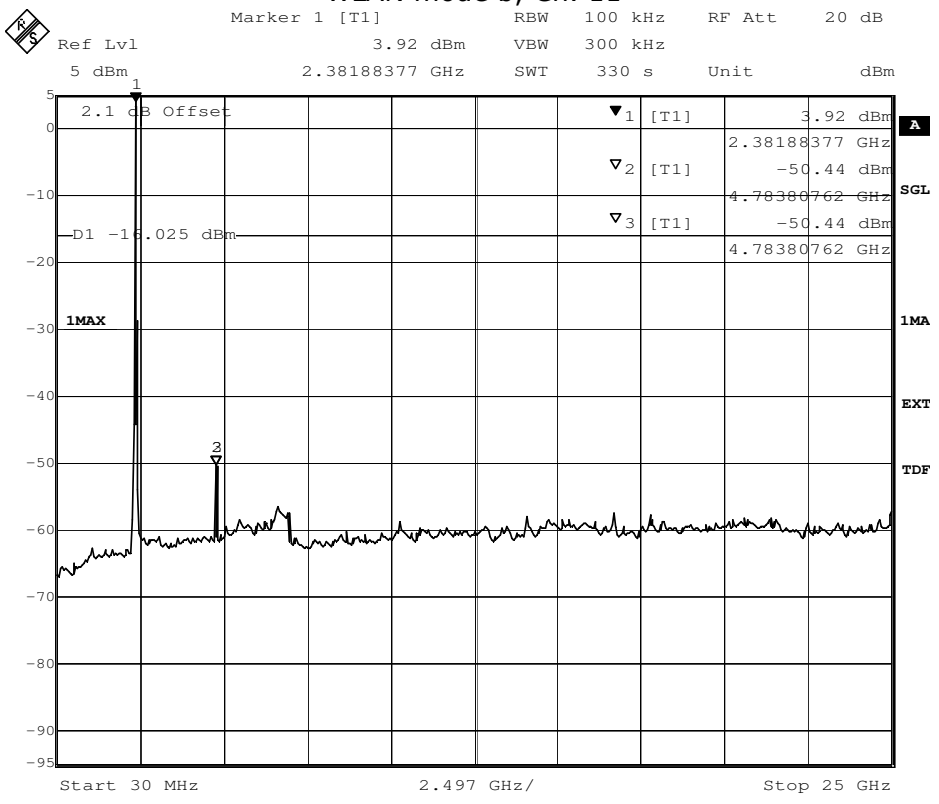

Title: spurious emissions
Comment A: CH M: 2437 MHz
Date: 12.JAN.2015 12:54:06

WLAN mode b, Ch. 6



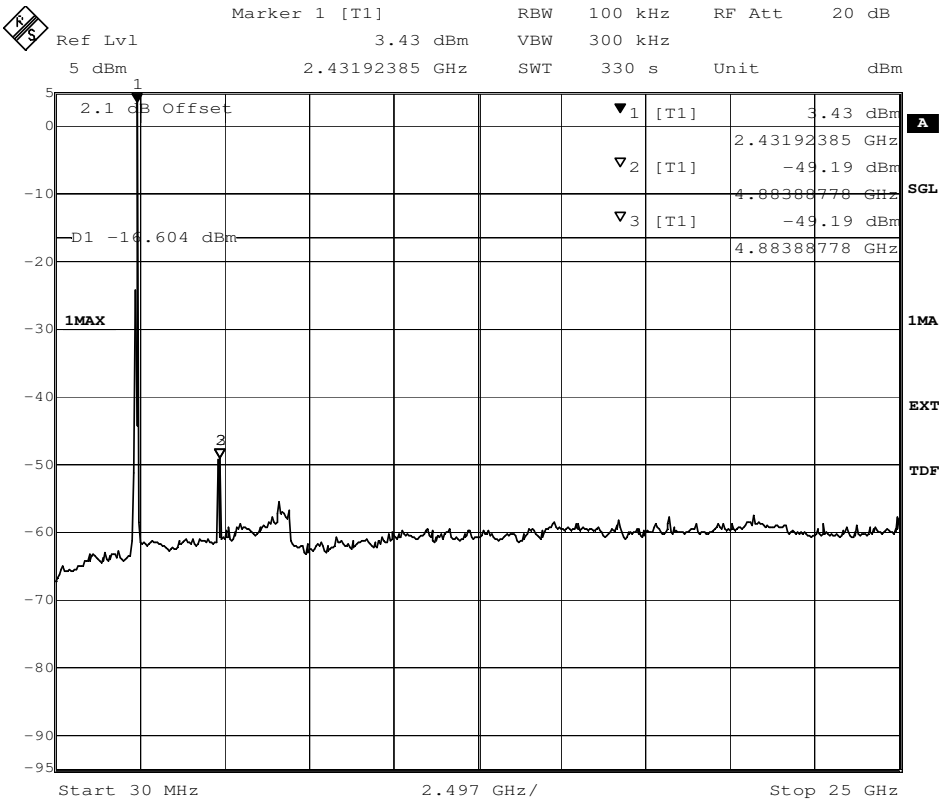

Title: spurious emissions
Comment A: CH T: 2462 MHz
Date: 12.JAN.2015 13:33:57

WLAN mode b, Ch. 11



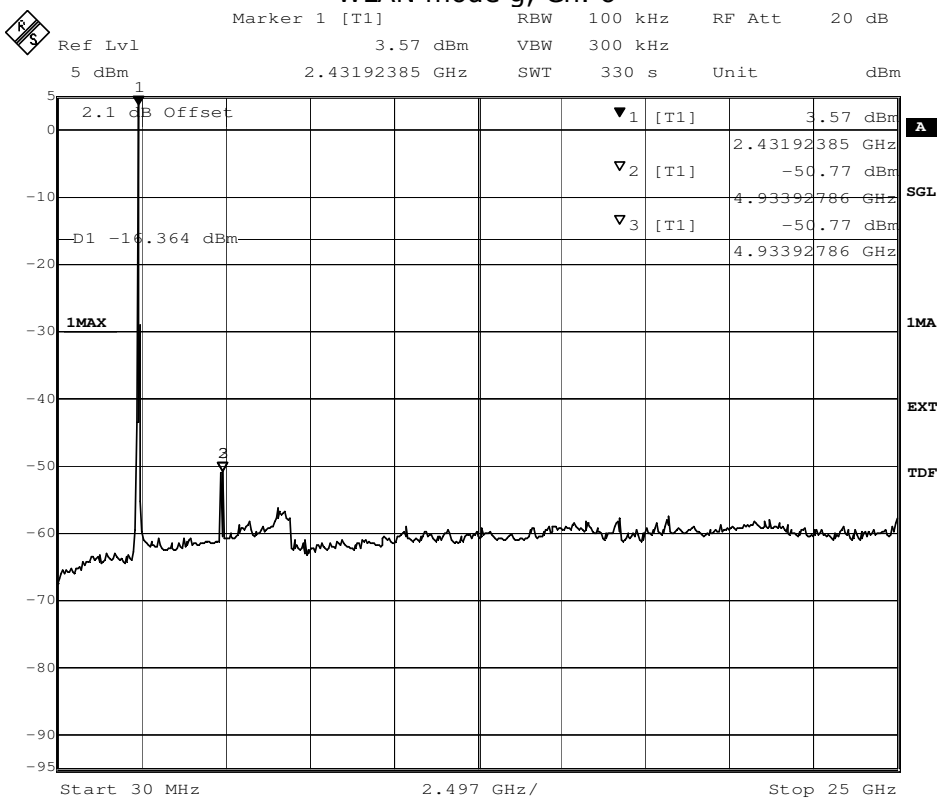

Title: spurious emissions
Comment A: CH B: 2412 MHz
Date: 12.JAN.2015 14:10:05

WLAN mode g, Ch. 1



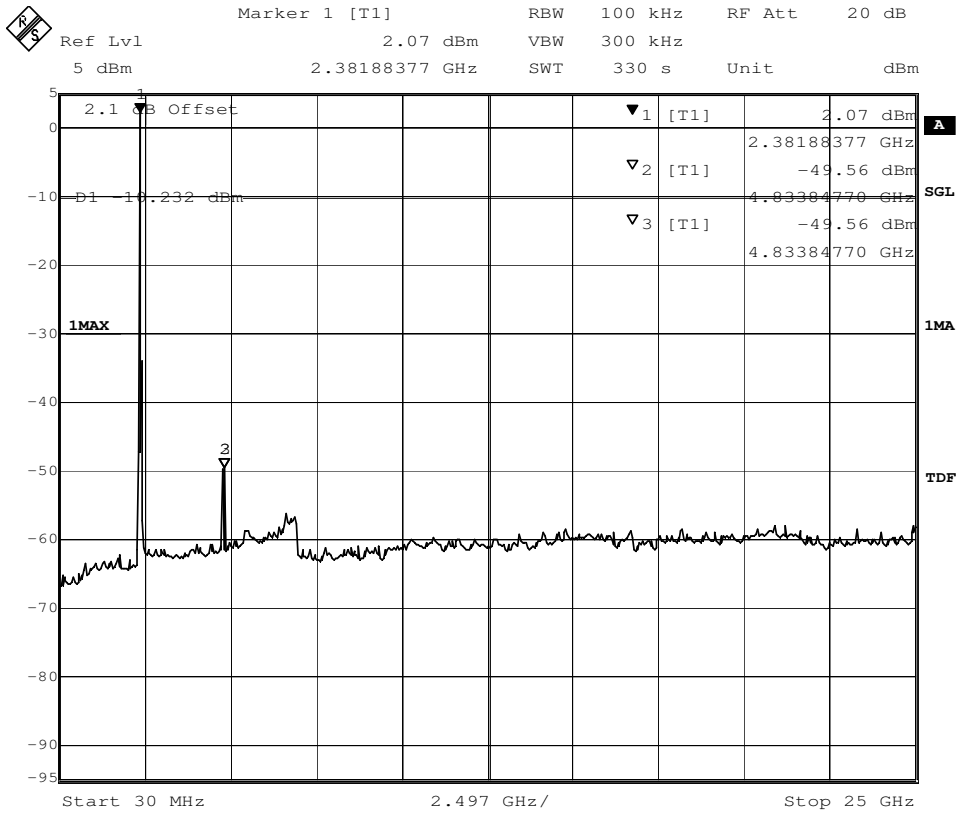

Title: spurious emissions
Comment A: CH M: 2437 MHz
Date: 12.JAN.2015 14:41:25

WLAN mode g, Ch. 6



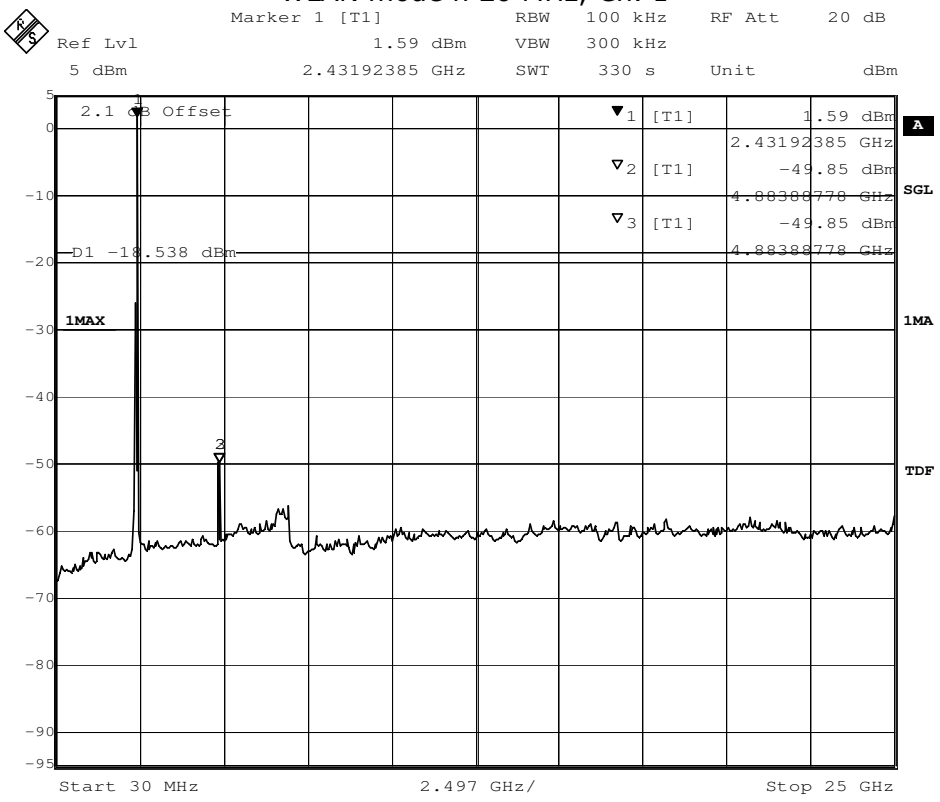

Title: spurious emissions
Comment A: CH T: 2462 MHz
Date: 12.JAN.2015 15:12:47

WLAN mode g, Ch. 11



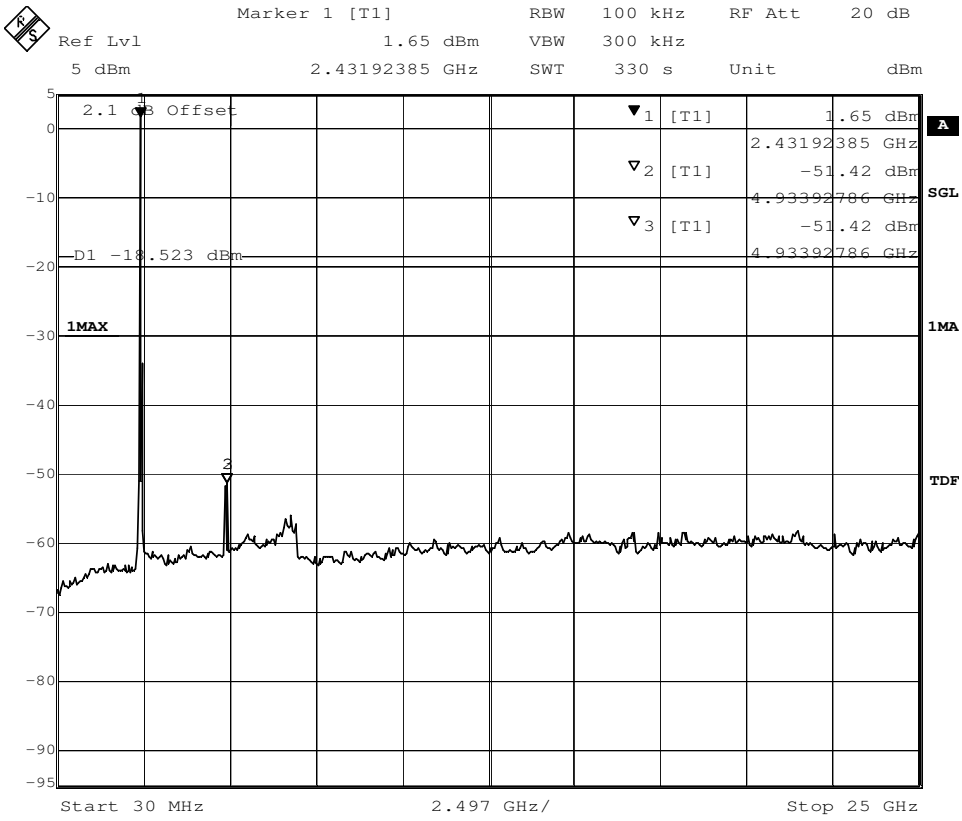

Title: spurious emissions
Comment A: CH B: 2412 MHz
Date: 13.JAN.2015 13:26:44

WLAN mode n 20 MHz, Ch. 1



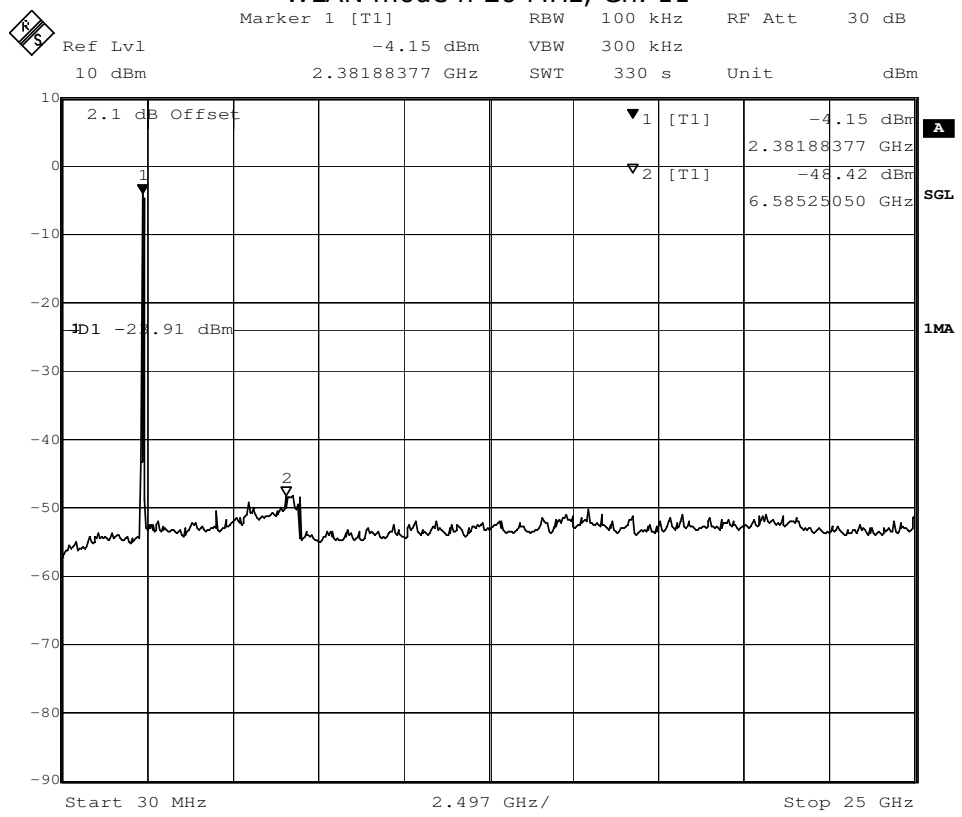

Title: spurious emissions
Comment A: CH M: 2437 MHz
Date: 13.JAN.2015 14:04:41

WLAN mode n 20 MHz, Ch. 6



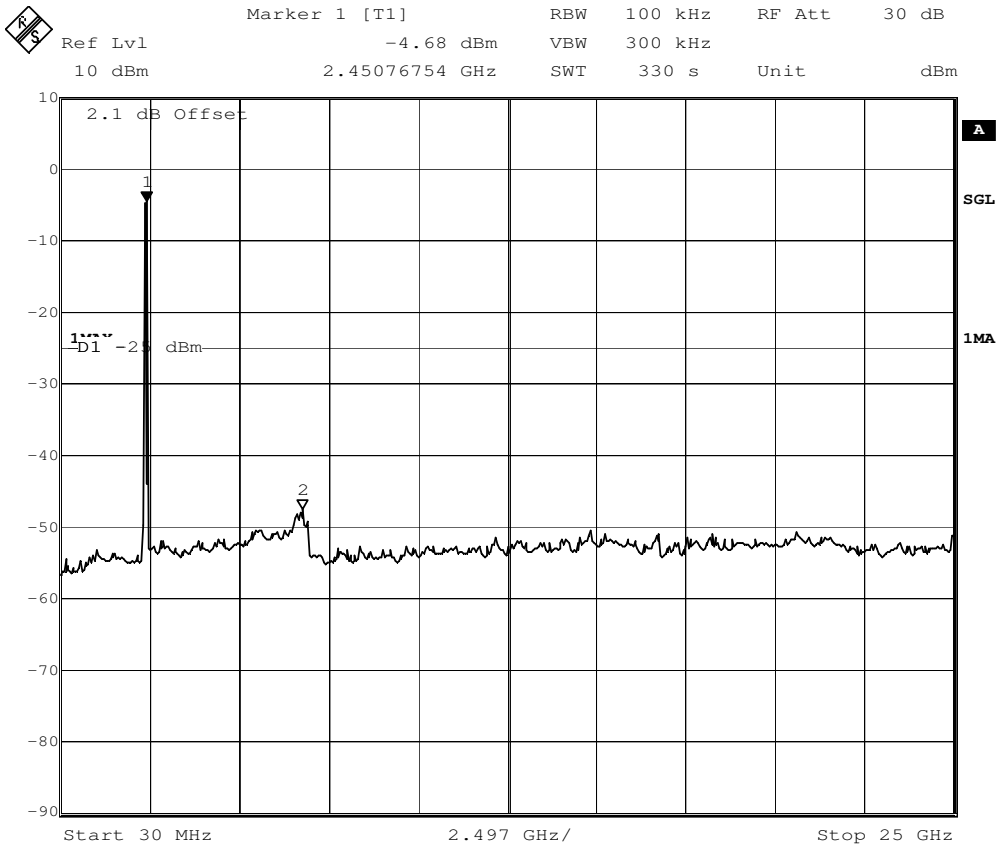

Title: spurious emissions
Comment A: CH T: 2462 MHz
Date: 13.JAN.2015 14:38:50

WLAN mode n 20 MHz, Ch. 11

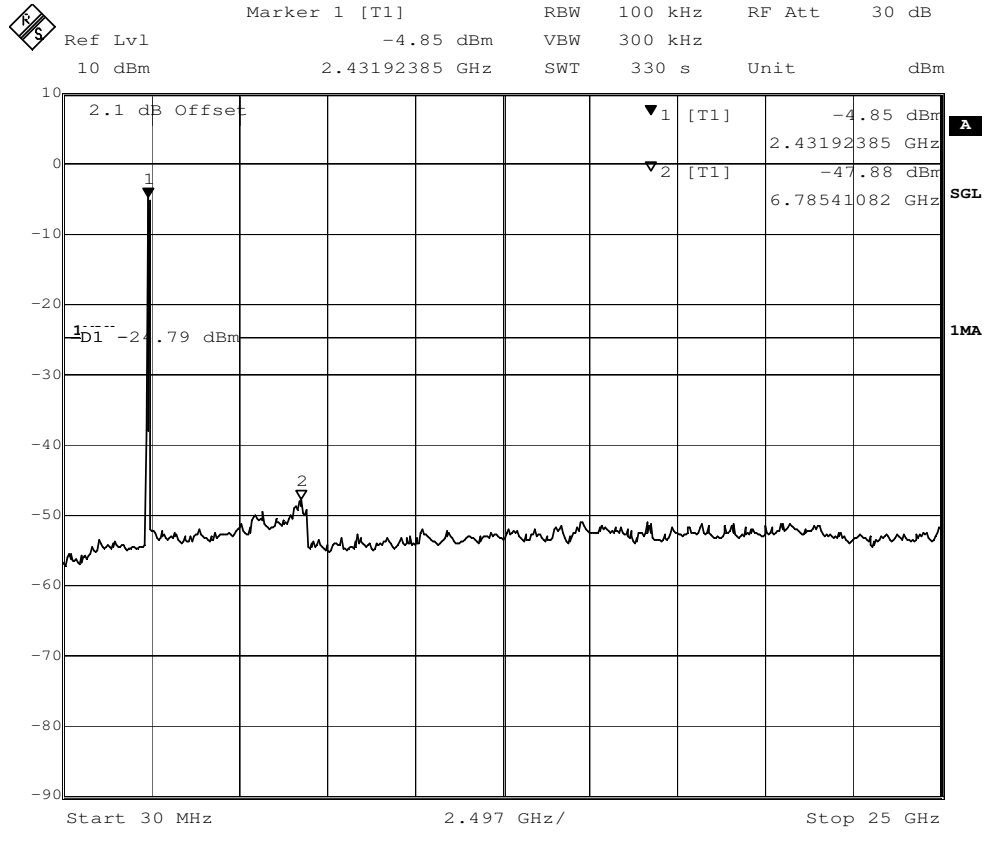



Date: 14.JAN.2015 09:05:08

WLAN mode n 40 MHz, Ch. 3




WLAN mode n 40 MHz, Ch. 6




WLAN mode n 40 MHz, Ch. 11

## 3.5 Spurious radiated emissions

**Standard** FCC Part 15, Subpart C

**The test was performed according to:** ANSI C63.10

### 3.5.1 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 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.

### 3.5.2 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) | 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)

### 3.5.3 Test Protocol

Temperature: 21–23 °C
Air Pressure: 1001–1016 hPa
Humidity: 31–35 %

| WLAN b-Mode; 20 MHz; 1 Mbit/s | | | | Applied duty cycle correction (AV) [dB]: | | | | 0.5 |
|---|---|---|---|---|---|---|---|---|
| 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 | - | - | - | - | - | >20 | - |
| 6 | 2437 | - | - | - | - | - | >20 | - |
| 11 | 2462 | 2483.5 | 55.0 | PEAK | 1000 | 74.0 | 19.0 | RB |
| 11 | 2462 | 2483.5 | 48.5 | AV | 1000 | 54.0 | 5.5 | RB |

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

| WLAN g-Mode; 20 MHz; 6 Mbit/s | | | | Applied duty cycle correction (AV) [dB]: | | | | 2.7 |
|---|---|---|---|---|---|---|---|---|
| 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 | 69.0 | PEAK | 1000 | 74.0 | 5.0 | RB |
| 1 | 2412 | 2390.0 | 48.9 | AV | 1000 | 54.0 | 5.1 | RB |
| 6 | 2437 | 2389.0 | 55.7 | PEAK | 1000 | 74.0 | 18.3 | RB |
| 6 | 2437 | 2389.0 | 40.2 | AV | 1000 | 54.0 | 13.8 | RB |
| 6 | 2437 | 2486.5 | 61.3 | PEAK | 1000 | 74.0 | 12.7 | RB |
| 6 | 2437 | 2486.5 | 41.2 | AV | 1000 | 54.0 | 12.8 | RB |
| 11 | 2462 | 2483.5 | 71.7 | PEAK | 1000 | 74.0 | 2.3 | RB |
| 11 | 2462 | 2483.5 | 49.9 | AV | 1000 | 54.0 | 4.1 | RB |

Note: No (further) spurious emissions in the range 20 dB below the limit found.
The measurement was performed from 1 GHz up to 8 GHz because at pre-measurements no significant spurious emissions have been found outside this frequency range.

## 3.6 Band edge compliance

**Standard** FCC Part 15, Subpart C

**The test was performed according to:** ANSI C63.10–2013, 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 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 / 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

### 3.6.2 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, lower and higher band edge

Temperature: 24 °C
Air Pressure: 1018 hPa
Humidity: 36 %

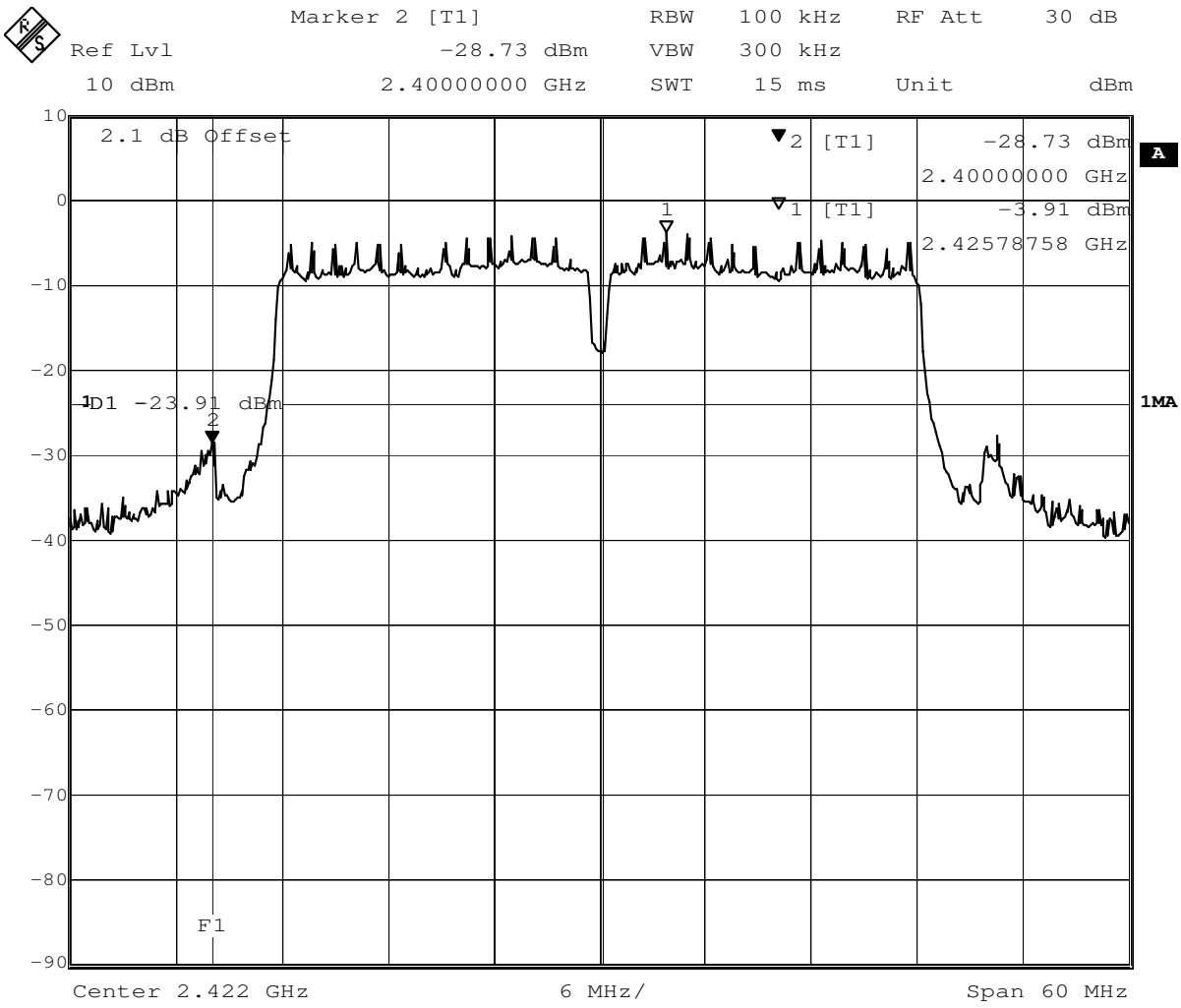
| WLAN b-Mode; 20 MHz; 1 Mbit/s | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Channel No. | Channel Center Frequency [MHz] | Band Edge Freq. [MHz] | Spurious Level [dBm] | Detector | RBW [kHz] | Ref. Level [dBm] | Limit [dBµV/m] | Margin to Limit [dB] |
| 1 | 2412 | 2400.0 | -29.8 | PEAK | 100 | 6.5 | -13.5 | 16.3 |
| 11 | 2462 | 2483.5 | -41.2 | PEAK | 100 | 6.4 | -13.6 | 27.6 |

| 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 | -28.8 | PEAK | 100 | 4.0 | -16.0 | 12.7 |
| 11 | 2462 | 2483.5 | -37.4 | PEAK | 100 | 3.6 | -16.4 | 21.0 |

| WLAN n-Mode; 20 MHz; 65 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 | -37.3 | PEAK | 100 | 9.8 | -10.2 | 27.1 |
| 11 | 2462 | 2483.5 | -43.6 | PEAK | 100 | 1.5 | -18.5 | 25.1 |

| WLAN n-Mode; 40 MHz; 135 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 | -28.7 | PEAK | 100 | -3.9 | -23.9 | 4.8 |
| 11 | 2462 | 2483.5 | -35.5 | PEAK | 100 | -4.8 | -24.8 | 10.7 |

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




WLAN mode n, 40 MHz, low channel

**Radiated measurement, higher band edge**

Temperature: 21 - 22 °C
Air Pressure: 1005 - 1011 hPa
Humidity: 31 - 36 %

| WLAN b-mode; 20 MHz; 1 Mbit/s | | | | Applied duty cycle correction (AV) [dB]: | | | | 0.5 |
|---|---|---|---|---|---|---|---|---|
| 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 | 55.0 | PEAK | 1000 | 74.0 | 19.0 | BE |
| 11 | 2462 | 2483.5 | 48.5 | AV | 1000 | 54.0 | 5.5 | BE |

| WLAN g-Mode; 20 MHz; 6 Mbit/s | | | | Applied duty cycle correction (AV) [dB]: | | | | 2.7 |
|---|---|---|---|---|---|---|---|---|
| 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 | 71.7 | PEAK | 1000 | 74.0 | 2.3 | BE |
| 11 | 2462 | 2483.5 | 49.9 | AV | 1000 | 54.0 | 4.1 | BE |

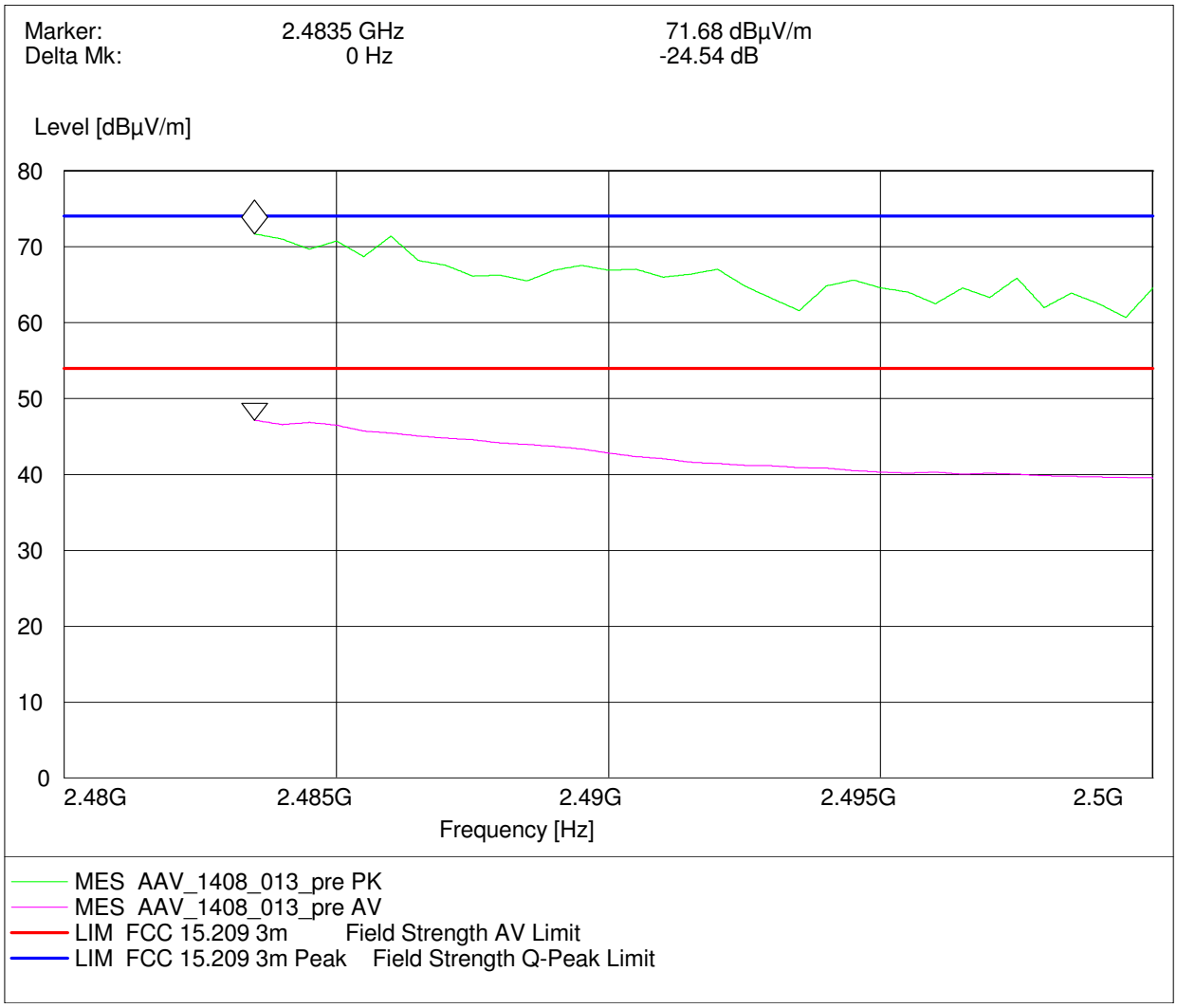
| WLAN n-Mode; 20 MHz; 13 Mbit/s | | | | Applied duty cycle correction (AV) [dB]: | | | | 5.9 |
|---|---|---|---|---|---|---|---|---|
| Ch. No. | Ch. Center Freq. [MHz] | Band Edge Freq. [MHz] | Spurious Level [dBµV/m] | Detec-tor | RBW [kHz] | Limit [dBµV/m] | Margin to Limit [dB] | Limit Type |
| 11 | 2462 | 2483.5 | 68.9 | PEAK | 1000 | 74.0 | 5.1 | BE |
| 11 | 2462 | 2483.5 | 48.4 | AV | 1000 | 54.0 | 5.6 | BE |

| WLAN n-Mode; 40 MHz; 130 Mbit/s | | | | Applied duty cycle correction (AV) [dB]: | | | | 5.9 |
|---|---|---|---|---|---|---|---|---|
| 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 | 65.1 | PEAK | 1000 | 74.0 | 8.9 | BE |
| 11 | 2462 | 2483.5 | 44.6 | AV | 1000 | 54.0 | 9.4 | BE |

| WLAN n-Mode; 20 MHz; 130 Mbit/s | | | | Applied duty cycle correction (AV) [dB]: | | | | 5.9 |
|---|---|---|---|---|---|---|---|---|
| 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 | 64.9 | PEAK | 1000 | 74.0 | 9.1 | BE |
| 11 | 2462 | 2483.5 | 45.6 | AV | 1000 | 54.0 | 8.4 | BE |

| WLAN n-Mode; 40 MHz; 270 Mbit/s | | | | Applied duty cycle correction (AV) [dB]: | | | | 5.9 |
|---|---|---|---|---|---|---|---|---|
| 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 | 64.6 | PEAK | 1000 | 74.0 | 9.4 | BE |
| 11 | 2462 | 2483.5 | 45.1 | AV | 1000 | 54.0 | 8.9 | BE |

### 3.6.3.3 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-Maxhold
- Resolution Bandwidth (RBW): 3 kHz
- Video Bandwidth (VBW): 30 kHz
- Sweep Time: Coupled

### 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: 24 °C
Air Pressure: 1018 hPa
Humidity: 34 %

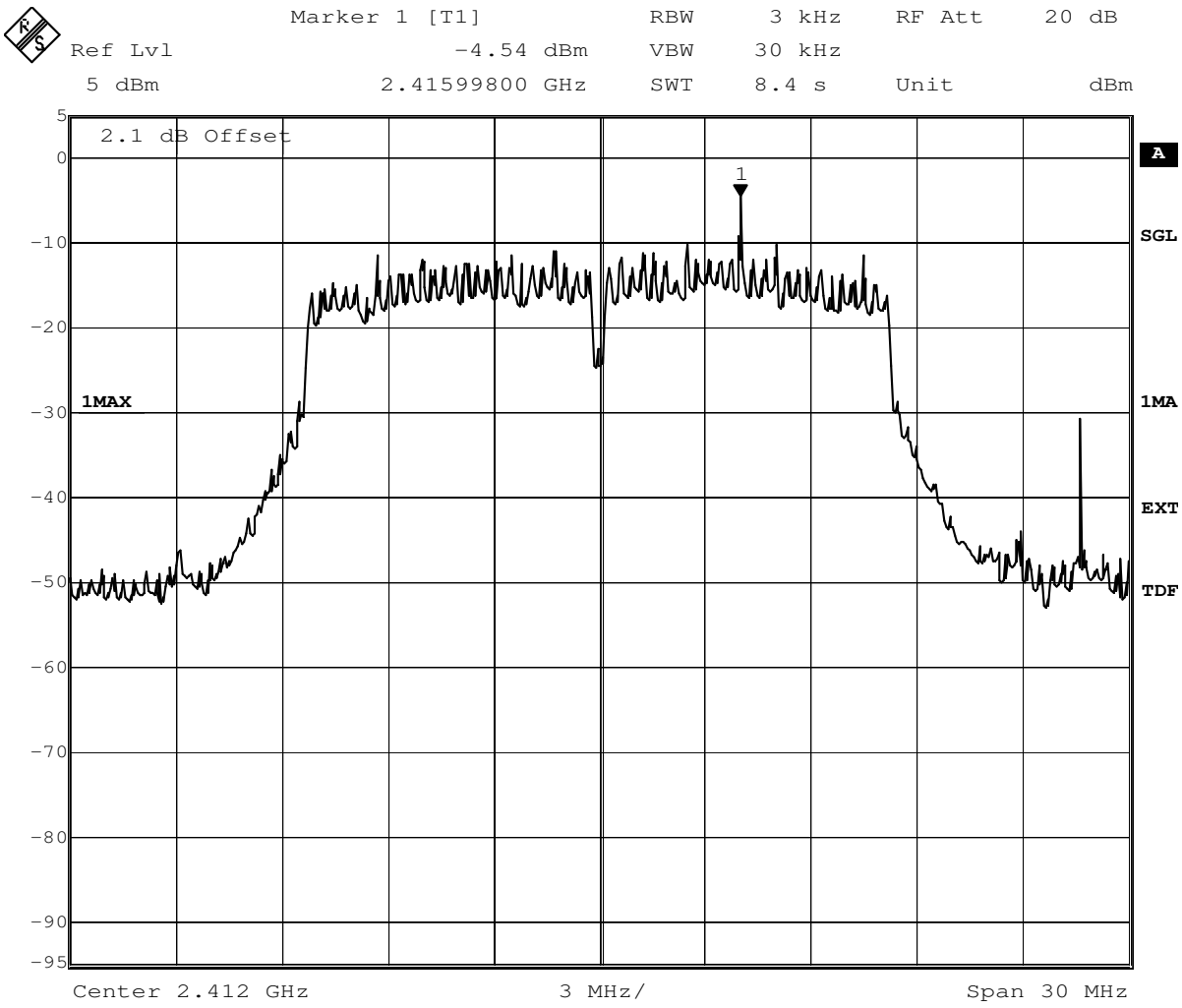
| WLAN b-Mode; 20 MHz; 1 Mbit/s | | | | | |
|---|---|---|---|---|---|
| **Band** | **Channel No.** | **Frequency [MHz]** | **Power Density [dBm/3kHz]** | **Limit [dBm/3kHz]** | **Margin to Limit [dB]** |
| 2.4 GHz ISM | 1 | 2412 | -6.9 | 8.0 | 14.9 |
| | 6 | 2437 | -6.2 | 8.0 | 14.2 |
| | 11 | 2462 | -6.4 | 8.0 | 14.4 |

| 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 | -4.5 | 8.0 | 12.5 |
| | 6 | 2437 | -9.7 | 8.0 | 17.7 |
| | 11 | 2462 | -10.1 | 8.0 | 18.1 |

| WLAN n-Mode; 20 MHz; 130 Mbit/s | | | | | |
|---|---|---|---|---|---|
| **Band** | **Ch. No.** | **Freq. [MHz]** | **Power Density [dBm/ 3kHz]** | **Limit [dBm/ 3kHz]** | **Margin to Limit [dB]** |
| 2.4 GHz ISM | 1 | 2412 | -12.3 | 8.0 | 20.3 |
| | 6 | 2437 | -12.3 | 8.0 | 20.3 |
| | 11 | 2462 | -12.6 | 8.0 | 20.6 |

| WLAN n-Mode; 40 MHz; 270 Mbit/s | | | | | |
|---|---|---|---|---|---|
| **Band** | **Ch. No.** | **Freq. [MHz]** | **Peak Power [dBm]** | **Limit [dBm/3k Hz]** | **Margin to Limit [dB]** |
| 2.4 GHz ISM | 3 | 2422 | -17.6 | 8.0 | 25.6 |
| | 6 | 2437 | -17.8 | 8.0 | 25.8 |
| | 11 | 2462 | -18.1 | 8.0 | 26.1 |

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




WLAN mode g low channel

# 4 Test Equipment

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

### Test Equipment Anechoic Chamber

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

| *Calibration Details* | *Last Execution* | *Next Exec.* |
|---|---|---|
| NSA (FCC) | 2014/01/09 | 2017/01/09 |

### Single Devices for Anechoic Chamber

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

| *Calibration Details* | *Last Execution* | *Next Exec.* |
|---|---|---|
| FCC listing 96716 3m Part15/18 | 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 ESI" | RG214 | W18.03+W48.03 | Huber&Suhner |
| Impedance Stabilization Network | ISN T800 | 36159 | Teseq GmbH |

| *Calibration Details* | *Last Execution* | *Next Exec.* |
|---|---|---|
| Standard Calibration | 2014/02/06 | 2016/02/28 |

| | | | |
|---|---|---|---|
| Impedance Stabilization Network, Coupling Decoupling Network | ISN/CDN ENY41 | 100002 | Rohde & Schwarz GmbH & Co. KG |

| *Calibration Details* | *Last Execution* | *Next Exec.* |
|---|---|---|
| Standard calibration | 2013/03/01 | 2015/03/31 |

| | | | |
|---|---|---|---|
| Impedance Stabilization Network, Coupling Decoupling Network | ISN/CDN ST08 | 36292 | Teseq GmbH |

| *Calibration Details* | *Last Execution* | *Next Exec.* |
|---|---|---|
| Standard calibration | 2014/01/10 | 2016/01/31 |

**Single Devices for Auxiliary Equipment for Conducted emissions (continued)**

| *Single Device Name* | *Type* | *Serial Number* | *Manufacturer* | |
|---|---|---|---|---|
| Impedance Stabilization Network, Coupling Decoupling Network | ISN/CDN T8-Cat6 | 32187 | Teseq GmbH | |
| | *Calibration Details* | | *Last Execution* | *Next Exec.* |
| | Standard Calibration | | 2014/01/08 | 2016/01/31 |
| One-Line V-Network | ESH 3-Z6 | 100489 | Rohde & Schwarz GmbH & Co. KG | |
| | *Calibration Details* | | *Last Execution* | *Next Exec.* |
| | standard calibration | | 2014/06/18 | 2017/11/30 |
| One-Line V-Network | ESH 3-Z6 | 100570 | Rohde & Schwarz GmbH & Co. KG | |
| | *Calibration Details* | | *Last Execution* | *Next Exec.* |
| | Standard Calibration | | 2013/11/25 | 2016/11/24 |
| Two-Line V-Network | ESH 3-Z5 | 828304/029 | Rohde & Schwarz GmbH & Co. KG | |
| | *Calibration Details* | | *Last Execution* | *Next Exec.* |
| | Standart Calibration | | 2013/03/01 | 2015/02/28 |
| Two-Line V-Network | ESH 3-Z5 | 829996/002 | Rohde & Schwarz GmbH & Co. KG | |
| | *Calibration Details* | | *Last Execution* | *Next Exec.* |
| | Standard Calibration | | 2013/03/01 | 2015/02/28 |

### Test Equipment Auxiliary Equipment for Radiated emissions

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

### Single Devices for Auxiliary Equipment for Radiated emissions

| *Single Device Name* | *Type* | *Serial Number* | *Manufacturer* | |
|---|---|---|---|---|
| Antenna mast | AM 4.0 | AM4.0/180/11920513 | Maturo GmbH | |
| Biconical Broadband Antenna | SBA 9119 | 9119-005 | Schwarzbeck | |
| Biconical dipole | VUBA 9117 | 9117-108 | Schwarzbeck | |
| | *Calibration Details* | | *Last Execution* | *Next Exec.* |
| | 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 | |
| | *Calibration Details* | | *Last Execution* | *Next Exec.* |
| | Standard Calibration | | 2012/05/18 | 2015/05/17 |
| Double-ridged horn | HF 906 | 357357/002 | Rohde & Schwarz GmbH & Co. KG | |
| | *Calibration Details* | | *Last Execution* | *Next Exec.* |
| | 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 | BBHA9170262 | | |
| Log.-per. Antenna | HL 562 Ultralog | 100609 | Rohde & Schwarz GmbH & Co. KG | |
| | *Calibration Details* | | *Last Execution* | *Next Exec.* |
| | Standard Calibration | | 2012/12/18 | 2015/12/17 |
| Log.-per. Antenna | HL 562 Ultralog | 830547/003 | Rohde & Schwarz GmbH & Co. KG | |
| Loop Antenna | HFH2-Z2 | 829324/006 | Rohde & Schwarz GmbH & Co. KG | |
| | *Calibration Details* | | *Last Execution* | *Next Exec.* |
| | DKD Calibration | | 2014/11/27 | 2017/11/27 |
| Standard Gain / Pyramidal Horn Antenna 26,5 GHz | 3160-09 | 00083069 | EMCO Elektronik GmbH | |

### Single Devices for Auxiliary Equipment for Radiated emissions (continued)

| *Single Device Name* | *Type* | *Serial Number* | *Manufacturer* |
|---|---|---|---|
| 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 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. | |
| | *Calibration Details* | | *Last Execution* | *Next Exec.* |
| | Customized calibration | | 2013/12/04 | 2015/12/03 |
| Fibre optic link Satellite (Aux) | FO RS232 Link | 181-018 | Pontis | |
| Fibre optic link Transceiver (Aux) | FO RS232 Link | 182-018 | Pontis | |
| Isolating Transformer | LTS 604 | 1888 | Thalheimer Transformatorenwerke GmbH | |
| Notch Filter Ultra Stable (Aux) | WRCA800/960-6EEK | 24 | Wainwright | |
| Signal Analyzer | FSV30 | 103005 | Rohde & Schwarz GmbH & Co. KG | |
| | *Calibration Details* | | *Last Execution* | *Next Exec.* |
| | Standard | | 2014/02/10 | 2016/02/09 |
| Spectrum Analyser | FSP3 | 836722/011 | Rohde & Schwarz GmbH & Co. KG | |
| | *Calibration Details* | | *Last Execution* | *Next Exec.* |
| | Standard | | 2012/06/13 | 2015/06/12 |
| | DKD calobration | | 2014/11/24 | 2017/11/23 |
| Spectrum Analyser | FSU26 | 200418 | Rohde & Schwarz GmbH & Co.KG | |
| | *Calibration Details* | | *Last Execution* | *Next Exec.* |
| | Standard calibration | | 2014/07/29 | 2015/07/28 |
| 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.* |
| | Standart calibration | | 2015/01/21 2018/01/19 |
| CMW500 | CMW500 | 107500 | Rohde & Schwarz GmbH & Co.KG |
| | *Calibration Details* | | *Last Execution* *Next Exec.* |
| | Standard calibration | | 2014/01/27 2016/01/26 |
| Digital Radio Communication Tester | CMD 55 | 831050/020 | Rohde & Schwarz GmbH & Co. KG |
| | *Calibration Details* | | *Last Execution* *Next Exec.* |
| | 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:<br>B11, B21V14, B21-2, B41, B52V14, B52-2, B53-2, B56V14, B68 3v04, PCMCIA, U65V04<br>Software:<br>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<br>Firmware:<br>µP1 8v50 02.05.06<br>--- | | 2007/07/16 |
| Universal Radio Communication Tester | CMU 200 | 837983/052 | Rohde & Schwarz GmbH & Co. KG |
| | *Calibration Details* | | *Last Execution* *Next Exec.* |
| | DKD calibration | | 2014/12/03 2017/12/02 |
| | *HW/SW Status* | | *Date of Start* *Date of End* |
| | HW options:<br>B11, B21V14, B21-2, B41, B52V14, B52-2, B53-2, B54V14, B56V14, B68 3v04, B95, PCMCIA, U65V02<br>SW options:<br>K21 4v11, K22 4v11, K23 4v11, K24 4v11, K27 4v10, K28 4v10, K42 4v11, K43 4v11, K53 4v10, K65 4v10, K66 4v10, K68 4v10,<br>Firmware:<br>µP1 8v40 01.12.05<br>--- | | 2007/01/02 |
| | SW:<br>K62, K69 | | 2008/11/03 |
| Vector Signal Generator | SMU200A | 100912 | Rohde & Schwarz GmbH & Co. KG |

### Test Equipment Emission measurement devices

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

### Single Devices for Emission measurement devices

| *Single Device Name* | *Type* | *Serial Number* | *Manufacturer* | |
|---|---|---|---|---|
| Personal Computer | Dell | 30304832059 | Dell | |
| Power Meter | NRVD | 828110/016 | Rohde & Schwarz GmbH & Co.KG | |
| | *Calibration Details* | | *Last Execution* | *Next Exec.* |
| | Standard calibration | | 2014/05/13 | 2015/05/12 |
| Sensor Head A | NRV-Z1 | 827753/005 | Rohde & Schwarz GmbH & Co.KG | |
| | *Calibration Details* | | *Last Execution* | *Next Exec.* |
| | Standard calibration | | 2014/05/13 | 2015/05/12 |
| Signal Generator | SMR 20 | 846834/008 | Rohde & Schwarz GmbH & Co. KG | |
| | *Calibration Details* | | *Last Execution* | *Next Exec.* |
| | Standard Calibration | | 2014/06/24 | 2017/06/23 |
| Spectrum Analyzer | ESIB 26 | 830482/004 | Rohde & Schwarz GmbH & Co. KG | |
| | *Calibration Details* | | *Last Execution* | *Next Exec.* |
| | 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 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 | |
| | *Calibration Details* | | *Last Execution* | *Next Exec.* |
| | Standard calibration | | 2014/05/13 | 2015/05/12 |
| RF Step Attenuator RSP | RSP | 833695/001 | Rohde & Schwarz GmbH & Co.KG | |
| Rubidium Frequency Standard | Datum, Model: MFS | 5489/001 | Datum-Beverly | |
| | *Calibration Details* | | *Last Execution* | *Next Exec.* |
| | Standard calibration | | 2014/07/03 | 2015/07/02 |
| Sensor Head A | NRV-Z1 | 827753/005 | Rohde & Schwarz GmbH & Co.KG | |
| | *Calibration Details* | | *Last Execution* | *Next Exec.* |
| | Standard calibration | | 2014/05/13 | 2015/05/12 |
| 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 Analyser | FSIQ26 | 840061/005 | Rohde & Schwarz GmbH & Co. KG | |
| | *Calibration Details* | | *Last Execution* | *Next Exec.* |
| | Standard Calibration | | 2013/02/12 | 2015/02/11 |

### Test Equipment Regulatory Bluetooth RF Test Solution

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

### Single Devices for Regulatory Bluetooth RF Test Solution

| *Single Device Name* | *Type* | *Serial Number* | *Manufacturer* | |
|---|---|---|---|---|
| ADU 200 Relay Box 7 | Relay Box | A04380 | Ontrak Control Systems Inc. | |
| Bluetooth Signalling Unit CBT | CBT | 100302 | Rohde & Schwarz GmbH & Co.KG | |
| | *Calibration Details* | | *Last Execution* | *Next Exec.* |
| | Standard calibration | | 2014/08/29 | 2015/08/28 |
| Power Meter NRVD | NRVD | 832025/059 | | |
| | *Calibration Details* | | *Last Execution* | *Next Exec.* |
| | Standard calibration | | 2014/08/29 | 2015/08/28 |
| Power Sensor NRV Z1 A | PROBE | 832279/013 | | |
| | *Calibration Details* | | *Last Execution* | *Next Exec.* |
| | Standard calibration | | 2014/08/28 | 2015/08/27 |
| Power Supply | NGSM 32/10 | 2725 | | |
| | *Calibration Details* | | *Last Execution* | *Next Exec.* |
| | Standard calibration | | 2013/06/20 | 2015/06/19 |
| Rubidium Frequency Normal MFS | Datum MFS | 002 | Datum GmbH | |
| | *Calibration Details* | | *Last Execution* | *Next Exec.* |
| | Standard calibration | | 2014/08/29 | 2015/08/28 |
| Signal Analyser FSIQ26 | 1119.6001.26 | 832695/007 | Rohde & Schwarz GmbH & Co.KG | |
| Vector Signal Generator SMIQ03B | SMIQ03B | 832870/017 | | |
| | *Calibration Details* | | *Last Execution* | *Next Exec.* |
| | 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/A Logger 13

| | |
|---|---|
| ***Lab ID:*** | **Lab 1, Lab 2, Lab 3** |
| *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 |

| *Calibration Details* | *Last Execution* | *Next Exec.* |
|---|---|---|
| Customized calibration | 2013/02/07 | 2015/02/06 |

### Test Equipment T/H Logger 02

| | |
|---|---|
| ***Lab ID:*** | **Lab 1** |
| *Description:* | Lufft Opus10 |
| *Serial Number:* | 7489 |

#### Single Devices for T/H Logger 02

| *Single Device Name* | *Type* | *Serial Number* | *Manufacturer* |
|---|---|---|---|
| ThermoHygro Datalogger 02 (Environ) | Opus10 THI (8152.00) | 7489 | Lufft Mess- und Regeltechnik GmbH |

| *Calibration Details* | *Last Execution* | *Next Exec.* |
|---|---|---|
| Customized calibration | 2013/02/07 | 2015/02/06 |

### Test Equipment T/H Logger 03

| | |
|---|---|
| ***Lab ID:*** | **Lab 3** |
| *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 |

| *Calibration Details* | *Last Execution* | *Next Exec.* |
|---|---|---|
| Customized calibration | 2013/02/07 | 2015/02/06 |

### Test Equipment T/H Logger 12

| | |
|---|---|
| ***Lab ID:*** | **Lab 2** |
| *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 |

| *Calibration Details* | *Last Execution* | *Next Exec.* |
|---|---|---|
| Customized calibration | 2013/01/07 | 2015/02/24 |

### Test Equipment T/H Logger 15

| | |
|---|---|
| ***Lab ID:*** | **Lab 4, Lab 5** |
| *Description:* | Lufft Opus10 |
| *Serial Number:* | 13985 |

### Single Devices for T/H Logger 15

| *Single Device Name* | *Type* | *Serial Number* | *Manufacturer* |
|---|---|---|---|
| ThermoHygro Datalogger 15 (Environ) | Opus10 THI (8152.00) | 13985 | Lufft Mess- und Regeltechnik GmbH |

| *Calibration Details* | *Last Execution* | *Next Exec.* |
|---|---|---|
| Customized calibration | 2013/01/07 | 2015/02/24 |

### 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 | 2014/03/12 | 2016/03/11 |

### Test Equipment Temperature Chamber 05

| | |
|---|---|
| ***Lab ID:*** | **Lab 3** |
| *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 |

| *Calibration Details* | *Last Execution* | *Next Exec.* |
|---|---|---|
| Customized calibration | 2014/03/11 | 2016/03/10 |

## 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 |

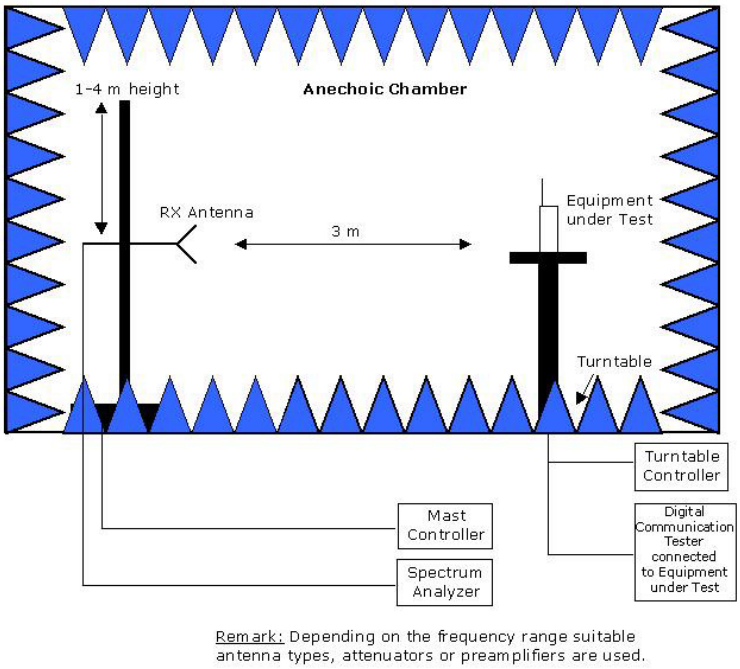
### Single Devices for WLAN RF Test Solution

| *Single Device Name* | *Type* | *Serial Number* | *Manufacturer* | |
|---|---|---|---|---|
| Arbitrary Waveform Generator | TGA12101 | 284482 | | |
| Power Meter NRVD | NRVD | 832025/059 | | |
| | *Calibration Details* | | *Last Execution* | *Next Exec.* |
| | Standard calibration | | 2014/08/29 | 2015/08/28 |
| Power Sensor NRV Z1 A | PROBE | 832279/013 | | |
| | *Calibration Details* | | *Last Execution* | *Next Exec.* |
| | Standard calibration | | 2014/08/28 | 2015/08/27 |
| Power Supply | NGSM 32/10 | 2725 | | |
| | *Calibration Details* | | *Last Execution* | *Next Exec.* |
| | Standard calibration | | 2013/06/20 | 2015/06/19 |
| Rubidium Frequency Normal MFS | Datum MFS | 002 | Datum GmbH | |
| | *Calibration Details* | | *Last Execution* | *Next Exec.* |
| | Standard calibration | | 2014/08/29 | 2015/08/28 |
| Signal Analyser FSIQ26 | 1119.6001.26 | 832695/007 | Rohde & Schwarz GmbH & Co.KG | |
| Spectrum Analyser | FSU26 | 100136 | Rohde & Schwarz GmbH & Co.KG | |
| | *Calibration Details* | | *Last Execution* | *Next Exec.* |
| | Standard Calibration | | 2014/01/06 | 2015/02/01 |
| | Standard Calibration | | 2015/02/02 | 2016/02/01 |
| | *HW/SW Status* | | *Date of Start* | *Date of End* |
| | FSU FW Update to v4.61 SP3, K5 v4.60 and K73 v4.61 | | 2011/12/05 | |
| Spectrum Analyser | FSU3 | 200046 | Rohde & Schwarz GmbH & Co.KG | |
| | *Calibration Details* | | *Last Execution* | *Next Exec.* |
| | Standard calibration | | 2014/07/01 | 2015/06/30 |
| | *HW/SW Status* | | *Date of Start* | *Date of End* |
| | Firmware Version 4.51 SP1<br>Option FS-K72 4.50 SP1<br>Option FS-K73 4.50 SP1 | | 2011/12/07 | |
| TOCT Switching Unit | Switching Unit | 040107 | 7 layers, Inc. | |
| Vector Signal Generator SMIQ03B | SMIQ03B | 832870/017 | | |
| | *Calibration Details* | | *Last Execution* | *Next Exec.* |
| | Standard calibration | | 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.