

FCC Measurement/Technical Report on

INFO3 CSM MID & INFO3 CSM HIGH

FCC ID: 2AHPN-BE2817
IC: 6434C-BE2817

Test Report Reference: MDE_HARMAN_1606_FCCC

Test Laboratory:

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Germany



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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1 APPLIED STANDARDS AND TEST SUMMARY

1.1 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 (10-1-14 Edition) and 15 (10-1-14 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

Part 15, Subpart E – Unlicensed National Information Infrastructure Devices

§ 15.403 Definitions

§ 15.407 General technical requirements

Note:

The tests were selected and performed with reference to the FCC Public Notice "Guidelines for Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices - Part 15, Subpart E, 789033 D02 General U-NII Test Procedures v01r03, 2016-08-22".

ANSI C63.10-2013 is applied.

FCC ET Docket No. 13-49, FIRST REPORT AND ORDER, April 1, 2014 ("new rules") is applied.

Summary Test Results:

The EUT complied with all performed tests as listed in chapter 1.3 Measurement Summary / Signatures.

1.2 FCC-IC CORRELATION TABLE

Correlation of measurement requirements for UNII / LE-LAN (e.g. WLAN 5 GHz) equipment

UNII equipment

| Measurement | FCC reference | IC reference |
|--|---|--|
| Conducted emissions on AC Mains | § 15.207 | RSS-Gen Issue 4: 8.8 |
| Occupied bandwidth | § 15.403 (i) (26 dB) / § 15.407 (e) (6 dB) | RSS-210 Issue 8: A9.2, 9.4 (99%) |
| Maximum conducted output power | § 15.407 (a) (1),(2),(3),(4) | RSS-210 Issue 8: A9.2, 9.4 |
| Maximum power spectral density | § 15.407 (a) (1),(2),(3),(5) | RSS-210 Issue 8: A9.2, 9.4 |
| Transmitter undesirable emissions; General Field Strength Limits, Restricted Bands | 15.407 (b) § 15.209 (a) | RSS-Gen Issue4: 6.13/8.9/8.10; RSS-210 Issue 8: A9.2, 9.4 |
| Frequency stability | § 15.407 (g) | RSS-Gen Issue 4: 6.11/8.11 |
| Transmit Power Control (TPC) and Dynamic Frequency Selection (DFS) | § 15.407 (h) | RSS-210 Issue 8: A9.2, 9.4 |
| Antenna requirement | § 15.203 / 15.204 | RSS-Gen Issue 4: 8.3 |
| Receiver spurious emissions | – | RSS-210 Issue 8: 2.3; 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.

1.3 MEASUREMENT SUMMARY / SIGNATURES

47 CFR CHAPTER I FCC PART 15 Subpart E
§15.407

FCC §15.31, §15.403 (i)

26 dB Bandwidth

The measurement was performed according to ANSI C63.10

Final Result

| OP-Mode | Setup | FCC | IC |
|--|--------------|------------|-----------|
| Radio Technology, Operating Frequency, Subband | | | |
| WLAN a, high, U-NII-1 | Setup_AI02 | Tested | Tested |
| WLAN a, high, U-NII-3 | Setup_AI02 | Tested | Tested |
| WLAN a, low, U-NII-1 | Setup_AI02 | Tested | Tested |
| WLAN a, low, U-NII-3 | Setup_AI02 | Tested | Tested |
| WLAN a, mid, U-NII-1 | Setup_AI02 | Tested | Tested |
| WLAN a, mid, U-NII-3 | Setup_AI02 | Tested | Tested |
| WLAN ac 20 MHz, high, U-NII-1 | Setup_AI02 | Tested | Tested |
| WLAN ac 20 MHz, high, U-NII-3 | Setup_AI02 | Tested | Tested |
| WLAN ac 20 MHz, low, U-NII-1 | Setup_AI02 | Tested | Tested |
| WLAN ac 20 MHz, low, U-NII-3 | Setup_AI02 | Tested | Tested |
| WLAN ac 20 MHz, mid, U-NII-1 | Setup_AI02 | Tested | Tested |
| WLAN ac 20 MHz, mid, U-NII-3 | Setup_AI02 | Tested | Tested |
| WLAN ac 40 MHz, high, U-NII-1 | Setup_AI02 | Tested | Tested |
| WLAN ac 40 MHz, high, U-NII-3 | Setup_AI02 | Tested | Tested |
| WLAN ac 40 MHz, low, U-NII-1 | Setup_AI02 | Tested | Tested |
| WLAN ac 40 MHz, low, U-NII-3 | Setup_AI02 | Tested | Tested |
| WLAN ac 80 MHz, mid, U-NII-1 | Setup_AI02 | Tested | Tested |
| WLAN ac 80 MHz, mid, U-NII-3 | Setup_AI02 | Tested | Tested |
| WLAN n 20 MHz, high, U-NII-1 | Setup_AI02 | Tested | Tested |
| WLAN n 20 MHz, high, U-NII-3 | Setup_AI02 | Tested | Tested |
| WLAN n 20 MHz, low, U-NII-1 | Setup_AI02 | Tested | Tested |
| WLAN n 20 MHz, low, U-NII-3 | Setup_AI02 | Tested | Tested |
| WLAN n 20 MHz, mid, U-NII-1 | Setup_AI02 | Tested | Tested |
| WLAN n 20 MHz, mid, U-NII-3 | Setup_AI02 | Tested | Tested |
| WLAN n 40 MHz, high, U-NII-1 | Setup_AI02 | Tested | Tested |
| WLAN n 40 MHz, high, U-NII-3 | Setup_AI02 | Tested | Tested |
| WLAN n 40 MHz, low, U-NII-1 | Setup_AI02 | Tested | Tested |
| WLAN n 40 MHz, low, U-NII-3 | Setup_AI02 | Tested | Tested |

**47 CFR CHAPTER I FCC PART 15 Subpart E
§15.407**
FCC §15.31, §15.403 (i)

6 dB Bandwidth

The measurement was performed according to ANSI C63.10

Final Result
OP-Mode

Radio Technology, Operating Frequency, Subband

| | Setup | FCC | IC |
|-------------------------------|--------------|------------|-----------|
| WLAN a, high, U-NII-3 | Setup_AI02 | Passed | Passed |
| WLAN a, low, U-NII-3 | Setup_AI02 | Passed | Passed |
| WLAN a, mid, U-NII-3 | Setup_AI02 | Passed | Passed |
| WLAN ac 20 MHz, high, U-NII-3 | Setup_AI02 | Passed | Passed |
| WLAN ac 20 MHz, low, U-NII-3 | Setup_AI02 | Passed | Passed |
| WLAN ac 20 MHz, mid, U-NII-3 | Setup_AI02 | Passed | Passed |
| WLAN ac 40 MHz, high, U-NII-3 | Setup_AI02 | Passed | Passed |
| WLAN ac 40 MHz, low, U-NII-3 | Setup_AI02 | Passed | Passed |
| WLAN ac 80 MHz, mid, U-NII-3 | Setup_AI02 | Passed | Passed |
| WLAN n 20 MHz, high, U-NII-3 | Setup_AI02 | Passed | Passed |
| WLAN n 20 MHz, low, U-NII-3 | Setup_AI02 | Passed | Passed |
| WLAN n 20 MHz, mid, U-NII-3 | Setup_AI02 | Passed | Passed |
| WLAN n 40 MHz, high, U-NII-3 | Setup_AI02 | Passed | Passed |
| WLAN n 40 MHz, low, U-NII-3 | Setup_AI02 | Passed | Passed |

**47 CFR CHAPTER I FCC PART 15 Subpart E
§15.407**
FCC §15.31, §15.403 (i)

99 % Bandwidth

The measurement was performed according to ANSI C63.10

Final Result
OP-Mode

Radio Technology, Operating Frequency, Subband

| | Setup | FCC | IC |
|-------------------------------|--------------|------------|-----------|
| WLAN a, high, U-NII-1 | Setup_AI02 | N/A | N/A |
| WLAN a, high, U-NII-3 | Setup_AI02 | N/A | N/A |
| WLAN a, low, U-NII-1 | Setup_AI02 | N/A | N/A |
| WLAN a, low, U-NII-3 | Setup_AI02 | N/A | N/A |
| WLAN a, mid, U-NII-1 | Setup_AI02 | N/A | N/A |
| WLAN a, mid, U-NII-3 | Setup_AI02 | N/A | N/A |
| WLAN ac 20 MHz, high, U-NII-1 | Setup_AI02 | N/A | N/A |
| WLAN ac 20 MHz, high, U-NII-3 | Setup_AI02 | N/A | N/A |
| WLAN ac 20 MHz, low, U-NII-1 | Setup_AI02 | N/A | N/A |
| WLAN ac 20 MHz, low, U-NII-3 | Setup_AI02 | N/A | N/A |
| WLAN ac 20 MHz, mid, U-NII-1 | Setup_AI02 | N/A | N/A |
| WLAN ac 20 MHz, mid, U-NII-3 | Setup_AI02 | N/A | N/A |
| WLAN ac 40 MHz, high, U-NII-1 | Setup_AI02 | N/A | N/A |
| WLAN ac 40 MHz, high, U-NII-3 | Setup_AI02 | N/A | N/A |
| WLAN ac 40 MHz, low, U-NII-1 | Setup_AI02 | N/A | N/A |
| WLAN ac 40 MHz, low, U-NII-3 | Setup_AI02 | N/A | N/A |
| WLAN ac 80 MHz, mid, U-NII-1 | Setup_AI02 | N/A | N/A |
| WLAN ac 80 MHz, mid, U-NII-3 | Setup_AI02 | N/A | N/A |

| | | | |
|------------------------------|------------|-----|-----|
| WLAN n 20 MHz, high, U-NII-1 | Setup_AI02 | N/A | N/A |
| WLAN n 20 MHz, high, U-NII-3 | Setup_AI02 | N/A | N/A |
| WLAN n 20 MHz, low, U-NII-1 | Setup_AI02 | N/A | N/A |
| WLAN n 20 MHz, low, U-NII-3 | Setup_AI02 | N/A | N/A |
| WLAN n 20 MHz, mid, U-NII-1 | Setup_AI02 | N/A | N/A |
| WLAN n 20 MHz, mid, U-NII-3 | Setup_AI02 | N/A | N/A |
| WLAN n 40 MHz, high, U-NII-1 | Setup_AI02 | N/A | N/A |
| WLAN n 40 MHz, high, U-NII-3 | Setup_AI02 | N/A | N/A |
| WLAN n 40 MHz, low, U-NII-1 | Setup_AI02 | N/A | N/A |
| WLAN n 40 MHz, low, U-NII-3 | Setup_AI02 | N/A | N/A |

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§15.407**

FCC §15.31, §15.407 (a)(1)

Maximum Conducted Output Power

The measurement was performed according to ANSI C63.10

Final Result

| OP-Mode | Setup | FCC | IC |
|--|--------------|------------|-----------|
| Radio Technology, Operating Frequency, Subband | | | |
| WLAN a, high, U-NII-1 | Setup_AI02 | Passed | Passed |
| WLAN a, high, U-NII-3 | Setup_AI02 | Passed | Passed |
| WLAN a, low, U-NII-1 | Setup_AI02 | Passed | Passed |
| WLAN a, low, U-NII-3 | Setup_AI02 | Passed | Passed |
| WLAN a, mid, U-NII-1 | Setup_AI02 | Passed | Passed |
| WLAN a, mid, U-NII-3 | Setup_AI02 | Passed | Passed |
| WLAN ac 20 MHz, high, U-NII-1 | Setup_AI02 | Passed | Passed |
| WLAN ac 20 MHz, high, U-NII-3 | Setup_AI02 | Passed | Passed |
| WLAN ac 20 MHz, low, U-NII-1 | Setup_AI02 | Passed | Passed |
| WLAN ac 20 MHz, low, U-NII-3 | Setup_AI02 | Passed | Passed |
| WLAN ac 20 MHz, mid, U-NII-1 | Setup_AI02 | Passed | Passed |
| WLAN ac 20 MHz, mid, U-NII-3 | Setup_AI02 | Passed | Passed |
| WLAN ac 40 MHz, high, U-NII-1 | Setup_AI02 | Passed | Passed |
| WLAN ac 40 MHz, high, U-NII-3 | Setup_AI02 | Passed | Passed |
| WLAN ac 40 MHz, low, U-NII-1 | Setup_AI02 | Passed | Passed |
| WLAN ac 40 MHz, low, U-NII-3 | Setup_AI02 | Passed | Passed |
| WLAN ac 80 MHz, mid, U-NII-1 | Setup_AI02 | Passed | Passed |
| WLAN ac 80 MHz, mid, U-NII-3 | Setup_AI02 | Passed | Passed |
| WLAN n 20 MHz, high, U-NII-1 | Setup_AI02 | Passed | Passed |
| WLAN n 20 MHz, high, U-NII-3 | Setup_AI02 | Passed | Passed |
| WLAN n 20 MHz, low, U-NII-1 | Setup_AI02 | Passed | Passed |
| WLAN n 20 MHz, low, U-NII-3 | Setup_AI02 | Passed | Passed |
| WLAN n 20 MHz, mid, U-NII-1 | Setup_AI02 | Passed | Passed |
| WLAN n 20 MHz, mid, U-NII-3 | Setup_AI02 | Passed | Passed |
| WLAN n 40 MHz, high, U-NII-1 | Setup_AI02 | Passed | Passed |
| WLAN n 40 MHz, high, U-NII-3 | Setup_AI02 | Passed | Passed |
| WLAN n 40 MHz, low, U-NII-1 | Setup_AI02 | Passed | Passed |
| WLAN n 40 MHz, low, U-NII-3 | Setup_AI02 | Passed | Passed |

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§15.407
FCC §15.31, §15.407 (a)
(1),(5)

Peak Power Spectral Density

The measurement was performed according to ANSI C63.10

Final Result
OP-Mode

Radio Technology, Operating Frequency, Subband

| | Setup | FCC | IC |
|-------------------------------|--------------|------------|-----------|
| WLAN a, high, U-NII-1 | Setup_AI02 | Passed | Passed |
| WLAN a, high, U-NII-3 | Setup_AI02 | Passed | Passed |
| WLAN a, low, U-NII-1 | Setup_AI02 | Passed | Passed |
| WLAN a, low, U-NII-3 | Setup_AI02 | Passed | Passed |
| WLAN a, mid, U-NII-1 | Setup_AI02 | Passed | Passed |
| WLAN a, mid, U-NII-3 | Setup_AI02 | Passed | Passed |
| WLAN ac 20 MHz, high, U-NII-1 | Setup_AI02 | Passed | Passed |
| WLAN ac 20 MHz, high, U-NII-3 | Setup_AI02 | Passed | Passed |
| WLAN ac 20 MHz, low, U-NII-1 | Setup_AI02 | Passed | Passed |
| WLAN ac 20 MHz, low, U-NII-3 | Setup_AI02 | Passed | Passed |
| WLAN ac 20 MHz, mid, U-NII-1 | Setup_AI02 | Passed | Passed |
| WLAN ac 20 MHz, mid, U-NII-3 | Setup_AI02 | Passed | Passed |
| WLAN ac 40 MHz, high, U-NII-1 | Setup_AI02 | Passed | Passed |
| WLAN ac 40 MHz, high, U-NII-3 | Setup_AI02 | Passed | Passed |
| WLAN ac 40 MHz, low, U-NII-1 | Setup_AI02 | Passed | Passed |
| WLAN ac 40 MHz, low, U-NII-3 | Setup_AI02 | Passed | Passed |
| WLAN ac 80 MHz, mid, U-NII-1 | Setup_AI02 | Passed | Passed |
| WLAN ac 80 MHz, mid, U-NII-3 | Setup_AI02 | Passed | Passed |
| WLAN n 20 MHz, high, U-NII-1 | Setup_AI02 | Passed | Passed |
| WLAN n 20 MHz, high, U-NII-3 | Setup_AI02 | Passed | Passed |
| WLAN n 20 MHz, low, U-NII-1 | Setup_AI02 | Passed | Passed |
| WLAN n 20 MHz, low, U-NII-3 | Setup_AI02 | Passed | Passed |
| WLAN n 20 MHz, mid, U-NII-1 | Setup_AI02 | Passed | Passed |
| WLAN n 20 MHz, mid, U-NII-3 | Setup_AI02 | Passed | Passed |
| WLAN n 40 MHz, high, U-NII-1 | Setup_AI02 | Passed | Passed |
| WLAN n 40 MHz, high, U-NII-3 | Setup_AI02 | Passed | Passed |
| WLAN n 40 MHz, low, U-NII-1 | Setup_AI02 | Passed | Passed |
| WLAN n 40 MHz, low, U-NII-3 | Setup_AI02 | Passed | Passed |

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§15.407
**FCC §15.407 (b),
(1),(2),(3),(4); FCC §15.205,
§15.209, §15.407 (b) (5),(6)**

Undesirable Emissions; General Field Strength Limits

The measurement was performed according to ANSI C63.10

Final Result**OP-Mode**

Radio Technology, Operating Frequency, Measurement range, Subband

| | Setup | FCC | IC |
|---|--------------|------------|-----------|
| WLAN a, high, 1GHz - 18GHz, U-NII-1 | Setup_AC02 | Passed | Passed |
| WLAN a, high, 1GHz - 18GHz, U-NII-3 | Setup_AC02 | Passed | Passed |
| WLAN a, low, 1GHz - 18GHz, U-NII-1 | Setup_AC02 | Passed | Passed |
| WLAN a, low, 1GHz - 18GHz, U-NII-3 | Setup_AC02 | Passed | Passed |
| WLAN a, mid, 1GHz - 18GHz, U-NII-1 | Setup_AC02 | Passed | Passed |
| WLAN a, mid, 1GHz - 18GHz, U-NII-3 | Setup_AC02 | Passed | Passed |
| WLAN ac 20 MHz, high, 1GHz - 26GHz, U-NII-1 | Setup_AC02 | Passed | Passed |
| WLAN ac 20 MHz, high, 1GHz - 26GHz, U-NII-3 | Setup_AC02 | Passed | Passed |
| WLAN ac 20 MHz, low, 1GHz - 26GHz, U-NII-1 | Setup_AC02 | Passed | Passed |
| WLAN ac 20 MHz, low, 1GHz - 26GHz, U-NII-3 | Setup_AC02 | Passed | Passed |
| WLAN ac 20 MHz, mid, 1GHz - 26GHz, U-NII-1 | Setup_AC02 | Passed | Passed |
| WLAN ac 20 MHz, mid, 1GHz - 26GHz, U-NII-3 | Setup_AC02 | Passed | Passed |
| WLAN ac 20 MHz, mid, 26GHz - 40GHz, U-NII-1 | Setup_AC02 | Passed | Passed |
| WLAN ac 20 MHz, mid, 26GHz - 40GHz, U-NII-3 | Setup_AC02 | Passed | Passed |
| WLAN ac 20 MHz, mid, 30MHz - 1GHz, U-NII-1 | Setup_AC02 | Passed | Passed |
| WLAN ac 20 MHz, mid, 30MHz - 1GHz, U-NII-3 | Setup_AC02 | Passed | Passed |
| WLAN ac 20 MHz, mid, 9kHz - 30MHz, U-NII-1 | Setup_AC02 | Passed | Passed |
| WLAN ac 20 MHz, mid, 9kHz - 30MHz, U-NII-3 | Setup_AC02 | Passed | Passed |

47 CFR CHAPTER I FCC PART 15 Subpart E
§15.407
**FCC §15.407 (b),
(1),(2),(3),(4)**

Band Edge

The measurement was performed according to ANSI C63.10

Final Result**OP-Mode**

Radio Technology, Operating Frequency, Subband

| | Setup | FCC | IC |
|-------------------------------|--------------|------------|-----------|
| WLAN a, high, U-NII-3 | Setup_AC02 | Passed | Passed |
| WLAN a, low, U-NII-1 | Setup_AC02 | Passed | Passed |
| WLAN a, low, U-NII-3 | Setup_AC02 | Passed | Passed |
| WLAN ac 20 MHz, high, U-NII-3 | Setup_AC02 | Passed | Passed |
| WLAN ac 20 MHz, low, U-NII-1 | Setup_AC02 | Passed | Passed |
| WLAN ac 20 MHz, low, U-NII-3 | Setup_AC02 | Passed | Passed |
| WLAN ac 40 MHz, high, U-NII-3 | Setup_AC02 | Passed | Passed |
| WLAN ac 40 MHz, low, U-NII-1 | Setup_AC02 | Passed | Passed |
| WLAN ac 40 MHz, low, U-NII-3 | Setup_AC02 | Passed | Passed |
| WLAN ac 80 MHz, mid, U-NII-1 | Setup_AC02 | Passed | Passed |
| WLAN ac 80 MHz, mid, U-NII-3 | Setup_AC02 | Passed | Passed |
| WLAN n 20 MHz, high, U-NII-3 | Setup_AC02 | Passed | Passed |

| | | | |
|------------------------------|------------|--------|--------|
| WLAN n 20 MHz, low, U-NII-1 | Setup_AC02 | Passed | Passed |
| WLAN n 20 MHz, low, U-NII-3 | Setup_AC02 | Passed | Passed |
| WLAN n 40 MHz, high, U-NII-3 | Setup_AC02 | Passed | Passed |
| WLAN n 40 MHz, low, U-NII-1 | Setup_AC02 | Passed | Passed |
| WLAN n 40 MHz, low, U-NII-3 | Setup_AC02 | Passed | Passed |

N/A: Not applicable

N/P: Not performed

COMMENT:

This Test Report applies to the variant GM Info MID & GM Info HIGH. By customer declaration these variants differ only in their memory size and not in the radio technology part.
The EUT supports only Subband 1 and Subband 3.

(responsible for accreditation scope)
Dipl.-Ing. Marco Kullik

(responsible for testing and report)
Dipl.-Ing Daniel Gall

2 ADMINISTRATIVE DATA

2.1 TESTING LABORATORY

Company Name: 7layers GmbH

Address: Borsigstr. 11
40880 Ratingen
Germany

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

This facility has been fully described in a report submitted to the IC and accepted under the registration number: Site# 3699A-1.

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

Laboratory accreditation no: DAKKS D-PL-12140-01-01

Responsible for accreditation scope: Dipl.-Ing. Marco Kullik

Report Template Version: 2016-06-07

2.2 PROJECT DATA

Responsible for testing and report: Dipl.-Ing Daniel Gall

Employees who performed the tests: documented internally at 7Layers

Date of Report: 2016-09-02

Testing Period: 2016-07-28 to 2016-08-24

2.3 APPLICANT DATA

Company Name: Harman International Industries, Inc.

Address: 30001 Cabot Drive
Novi, MI 48377
USA

Contact Person:

2.4 MANUFACTURER DATA

Company Name: please see applicant data

Address:

Contact Person:

3 TEST OBJECT DATA

3.1 GENERAL EUT DESCRIPTION

| | |
|--|---|
| Kind of Device product description | Automotive Infotainment Unit w/ Bluetooth & WLAN |
| Product name | INFO3 CSM MID & INFO3 CSM HIGH |
| Type | - |
| Declared EUT data by the supplier | |
| Voltage Type | DC |
| Voltage Level | 13.2 V |
| Tested Modulation Type | DBPSK; OFDM; BPSK; OFDM; 64-QAM |
| General product description | The EUT is a car radio infotainment system. |
| Specific product description | <p>The EUT is a car radio infotainment system, it is using Bluetooth and WLAN radio technology in the 2.4 GHz ISM band and WLAN radio technology in the 5 GHz ISM band.</p> <p>In the 5 GHz ISM band the EUT supports the U-NII-1 and U-NII-3 band with the modes:</p> <ul style="list-style-type: none"> WLAN a-mode, 20 MHz WLAN n-mode, 20, 40 MHz WLAN ac-mode, 20, 40, 80 MHz <p>The U-NII-2A and U-NII-2C bands are not supported.</p> |
| Ports of the device | DC USB AM/FM, SDARS GPS Rear camera Display |
| Antenna 1 | integral / 5.0 dBi for Subband U-NII-1 integral / 4.6 dBi for Subband U-NII-3 |
| Tested Datarates | WLAN a-mode; 6 Mbit/s WLAN n-20-mode; MCS 7 WLAN n-40-mode; MCS 7 WLAN ac-20-mode; MCS 8 WLAN ac-40-mode; MCS 9 WLAN ac-80-mode; MCS 9 |
| Special software used for testing | The EUT can be prepared for WLAN test mode by using an adb-shell. |

| | |
|------------|--|
| Duty Cycle | WLAN a-mode: 98% WLAN n-20-mode: 99% WLAN n-40-mode: 96% WLAN ac-20-mode: 98% WLAN ac-40-mode: 96% WLAN ac-80-mode: 93% |
|------------|--|

The main components of the EUT are listed and described in chapter 3.2 EUT Main components.

3.2 EUT MAIN COMPONENTS

| Sample Name | Sample Code | Description |
|---------------------------|---------------|---|
| FCC Conducted sample HIGH | DE1009009ai02 | sample with temporary antenna connector |
| Sample Parameter | Value | |
| Integral Antenna | deactivated | |
| Serial No. | SN027 | |
| HW Version | 160120 | |
| SW Version | 160412 | |
| Comment | - | |

| Sample Name | Sample Code | Description |
|--------------------------|----------------------------------|------------------------------|
| FCC Radiated sample HIGH | DE1009014ac02 | sample with integral antenna |
| Sample Parameter | Value | |
| Integral Antenna | Gain see general EUT description | |
| Serial No. | SN041 | |
| HW Version | 160120 | |
| SW Version | 160412 | |
| Comment | - | |

3.3 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.

| Device | Details (Manufacturer, Type Model, OUT Code) | Description |
|--------|---|-------------|
| - | - | - |

3.4 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.

| Device | Details (Manufacturer, HW, SW, S/N) | Description |
|--------|--|-------------|
| - | - | - |

3.5 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_AC02 | FCC Radiated sample HIGH | Setup for radiated measurements |
| Setup_AI02 | FCC Conducted sample HIGH | FCC Setup for Conducted measurement |

3.6 INTERCONNECTING CABLES

This chapter describes the used cables. The rationale for selecting the ports and interconnecting cables is to test a representative configuration meeting the requirements of the referenced standards.

| Port and interconnecting cables | Cable length | Cable shielded | Connected during test |
|---------------------------------|--------------|----------------|-----------------------|
| DC cable harness | 110 cm | No | Yes |
| USB | 130 cm | Yes | Yes |
| AM/FM, SDARS | 150 cm | Yes | Yes |
| GPS | 100 cm | Yes | Yes |
| rear camera | 110 cm | No | Yes |
| display | 150 cm | No | Yes |

3.7 OPERATING MODES

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

3.7.1 TEST CHANNELS

| | U-NII-Subband 1 5150 - 5250 MHz | | | U-NII-Subband 2A 5250 - 5350 MHz | | | U-NII-Subband 2C 5470 - 5725 MHz | | | U-NII-Subband 3 5725 - 5850 MHz | | | Nom. BW |
|-----------------------------|------------------------------------|------|------|-------------------------------------|-----|------|-------------------------------------|-----|------|------------------------------------|------|------|------------|
| 20 MHz Test Channels: | low | mid | high | low | mid | high | low | mid | high | low | mid | high | 20 MHz |
| Channel: Frequency [MHz] | 36 | 44 | 48 | - | - | - | - | - | - | 149 | 157 | 165 | Ch.- No. |
| | 5180 | 5220 | 5240 | - | - | - | - | - | - | 5745 | 5785 | 5825 | MHz |

| 40 MHz Test Channels: | low | mid | high | low | mid | high | low | mid | high | low | mid | high | 40 MHz |
|------------------------------|------|-----|------|-----|-----|------|-----|-----|------|------|-----|------|----------|
| Channels: Frequency [MHz] | 38 | - | 46 | - | - | - | - | - | - | 151 | - | 159 | Ch.- No. |
| | 5190 | - | 5230 | - | - | - | - | - | - | 5755 | - | 5795 | MHz |

| 80 MHz Test Channels: | low | mid | high | low | mid | high | low | mid | high | low | mid | high | 80 MHz |
|------------------------------|-----|------|------|-----|-----|------|-----|-----|------|-----|------|------|----------|
| Channels: Frequency [MHz] | - | 42 | - | - | - | - | - | - | - | - | 155 | - | Ch.- No. |
| | - | 5210 | - | - | - | - | - | - | - | - | 5775 | - | MHz |

3.8 PRODUCT LABELLING

3.8.1 FCC ID LABEL

Please refer to the documentation of the applicant.

3.8.2 LOCATION OF THE LABEL ON THE EUT

Please refer to the documentation of the applicant.

4 TEST RESULTS

4.1 26 DB BANDWIDTH

Standard FCC Part 15 Subpart E

The test was performed according to:

ANSI C63.10

4.1.1 TEST DESCRIPTION

The Equipment Under Test (EUT) was set up to perform the occupied bandwidth measurements.

The reference level is the level of the highest amplitude signal observed from the transmitter at either the fundamental frequency or first-order modulation products in all typical modes of operation, including the unmodulated carrier, even if atypical.

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

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

Analyzer settings:

- Resolution Bandwidth (RBW): initially approx. 1 % of nominal emission bandwidth
- Video Bandwidth (VBW): > RBW
- Span: 40 / 80 / 140 MHz (for 20 / 40 / 80 MHz nominal bandwidth)
- Trace: Maxhold
- Sweeps: 2000
- Sweptime: 20 ms
- Detector: Sample

4.1.2 TEST REQUIREMENTS / LIMITS

FCC Part 15, Subpart E, §15.403 (i)

There exist no applicable limits for the U-NII subbands 1, 2A and 2C. The test was performed to determine the limits for the "Maximum Conducted Output Power" test case. Therefore no result was applied.

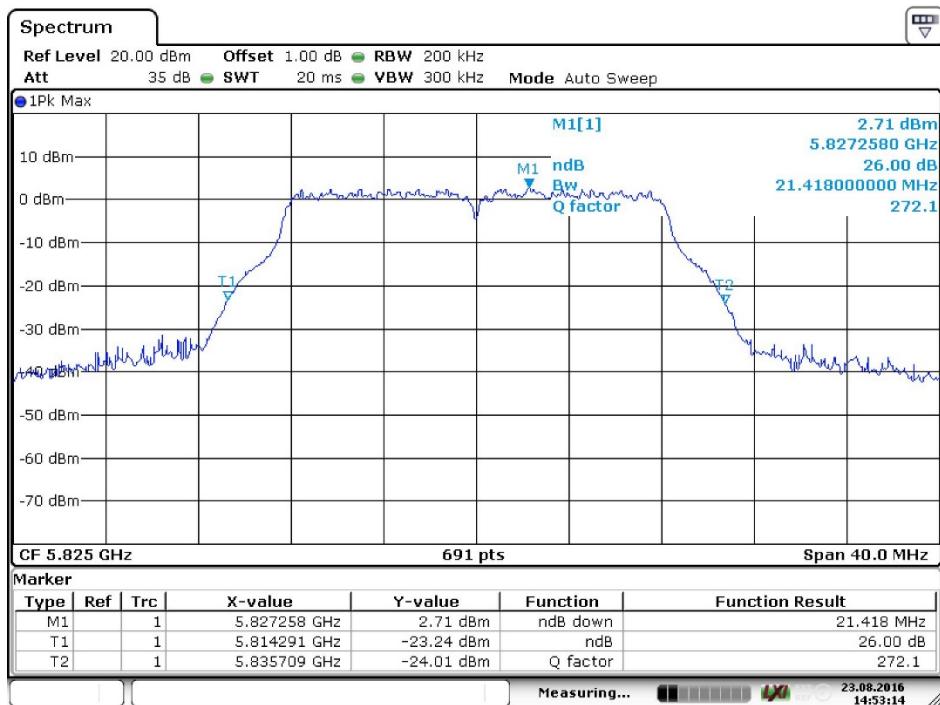
4.1.3 TEST PROTOCOL

Ambient temperature: 23 °C
Air Pressure: 1010 hPa
Humidity: 40 %

| Radio Technology | Operating Frequency | Subband | 26 dB Bandwidth [MHz] |
|-------------------------|----------------------------|----------------|------------------------------|
| WLAN a | low | U-NII-1 | 21.3 |
| WLAN a | mid | U-NII-1 | 21.4 |
| WLAN a | high | U-NII-1 | 21.4 |
| WLAN a | low | U-NII-3 | 21.4 |
| WLAN a | mid | U-NII-3 | 21.3 |
| WLAN a | high | U-NII-3 | 21.4 |
| WLAN n 20 MHz | low | U-NII-1 | 21.8 |
| WLAN n 20 MHz | mid | U-NII-1 | 21.8 |
| WLAN n 20 MHz | high | U-NII-1 | 21.8 |
| WLAN n 20 MHz | low | U-NII-3 | 21.9 |
| WLAN n 20 MHz | mid | U-NII-3 | 21.8 |
| WLAN n 20 MHz | high | U-NII-3 | 21.9 |
| WLAN n 40 MHz | low | U-NII-1 | 40.6 |
| WLAN n 40 MHz | high | U-NII-1 | 40.6 |
| WLAN n 40 MHz | low | U-NII-3 | 40.6 |
| WLAN n 40 MHz | high | U-NII-3 | 40.6 |
| WLAN ac 20 MHz | low | U-NII-1 | 21.9 |
| WLAN ac 20 MHz | mid | U-NII-1 | 21.9 |
| WLAN ac 20 MHz | high | U-NII-1 | 21.8 |
| WLAN ac 20 MHz | low | U-NII-3 | 21.8 |
| WLAN ac 20 MHz | mid | U-NII-3 | 21.9 |
| WLAN ac 20 MHz | high | U-NII-3 | 21.8 |
| WLAN ac 40 MHz | low | U-NII-1 | 40.5 |
| WLAN ac 40 MHz | high | U-NII-1 | 40.6 |
| WLAN ac 40 MHz | low | U-NII-3 | 40.5 |
| WLAN ac 40 MHz | high | U-NII-3 | 40.5 |
| WLAN ac 80 MHz | mid | U-NII-1 | 82.9 |
| WLAN ac 80 MHz | mid | U-NII-3 | 82.7 |

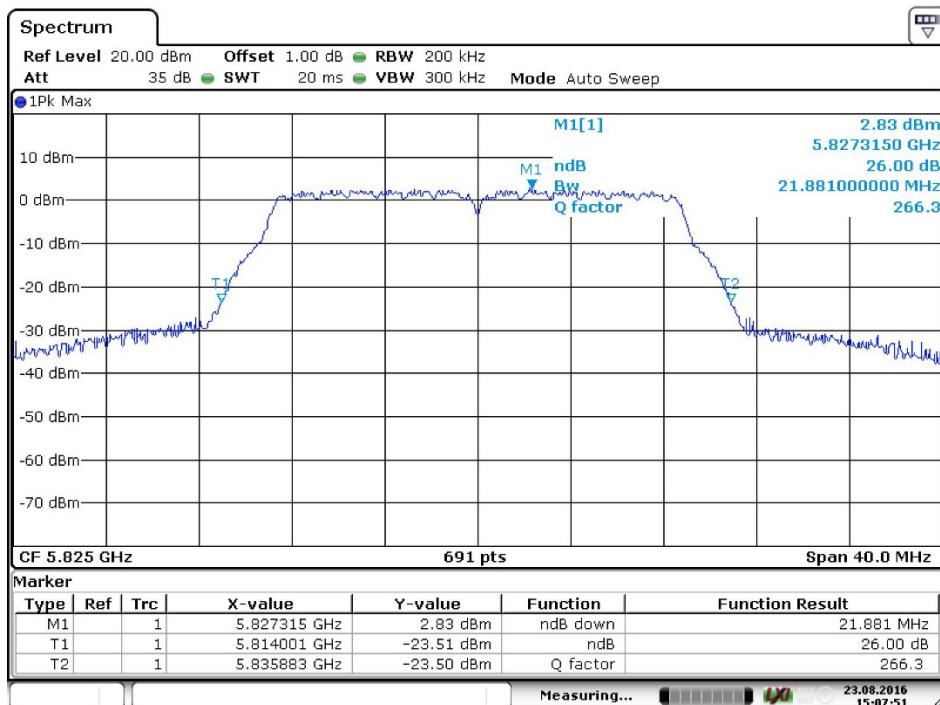
Remark: Please see next sub-clause for the measurement plot.

4.1.4 MEASUREMENT PLOT (SHOWING THE HIGHEST VALUE, "WORST CASE")



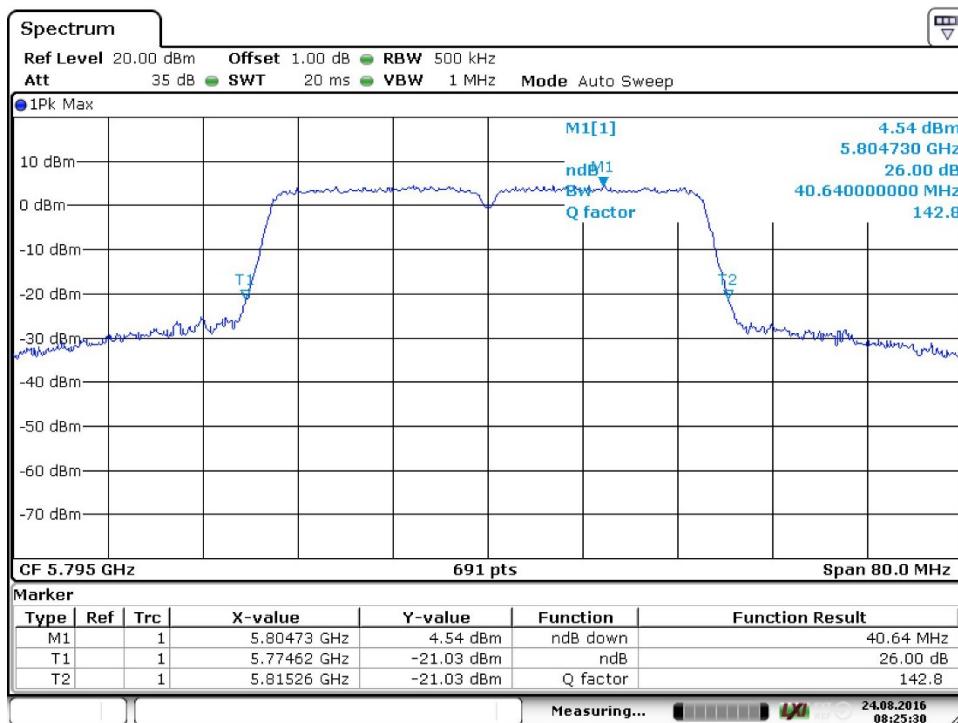
Date: 23.AUG.2016 14:53:14

WLAN a-mode, CH 165



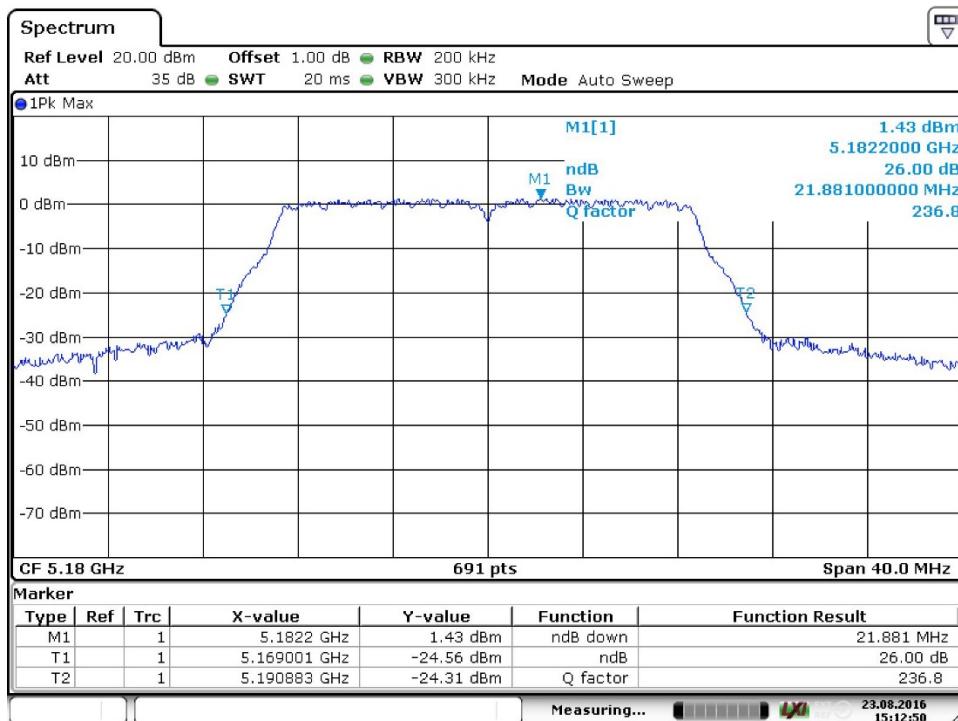
Date: 23.AUG.2016 15:07:51

WLAN n-mode, 20 MHz, CH 165



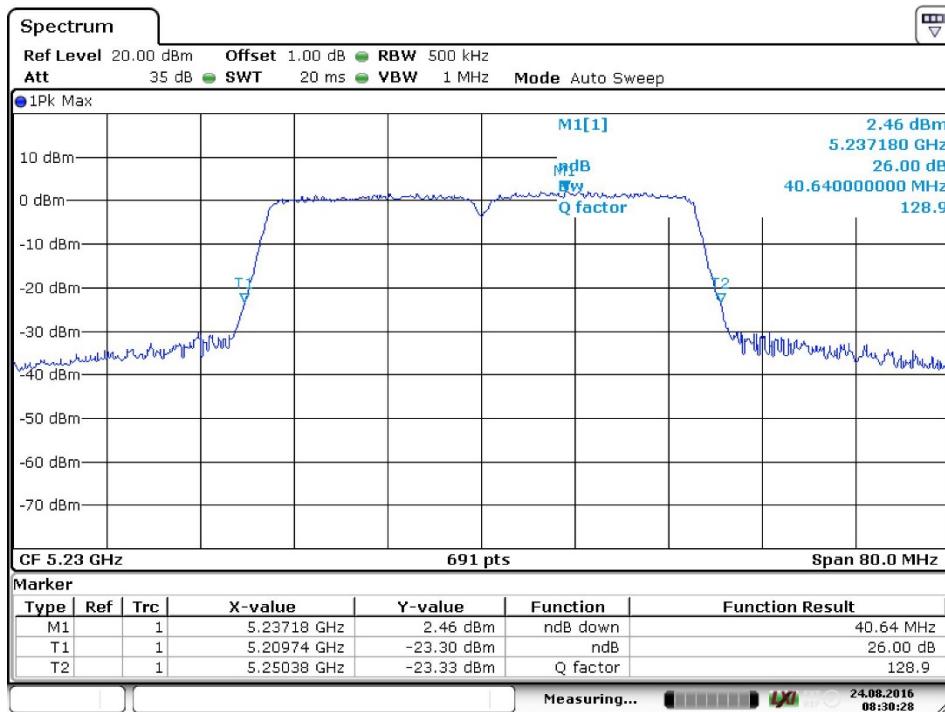
Date: 24.AUG.2016 08:25:30

WLAN n-mode, 40 MHz, CH 159



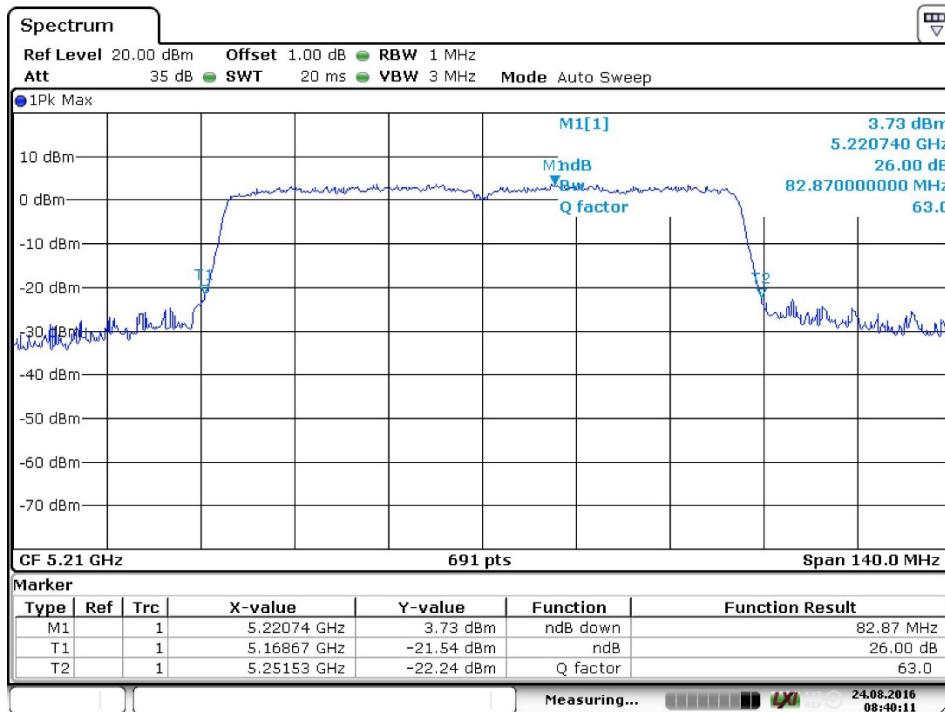
Date: 23.AUG.2016 15:12:50

WLAN ac-mode, 20 MHz, CH 38



Date: 24.AUG.2016 08:30:29

WLAN ac-mode, 40 MHz, CH 46



Date: 24.AUG.2016 08:40:12

WLAN ac-mode, 80 MHz, CH 42

4.1.5 TEST EQUIPMENT USED

R&S TS8997

4.2 6 DB BANDWIDTH

Standard FCC Part 15 Subpart E

The test was performed according to:
ANSI C63.10

4.2.1 TEST DESCRIPTION

The Equipment Under Test (EUT) was setup in a shielded room 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 (smallest) emission 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
- Span: 40 / 80 MHz (for 20 / 40 MHz nominal bandwidth)
- Trace: Maxhold
- Sweeps: 2000
- Sweptime: coupled
- Detector: Peak

4.2.2 TEST REQUIREMENTS / LIMITS

FCC Part 15, Subpart E, §15.407 (e)

Within the 5.725-5.850 GHz band, the minimum 6 dB bandwidth of U-NII devices shall be at least 500 kHz.

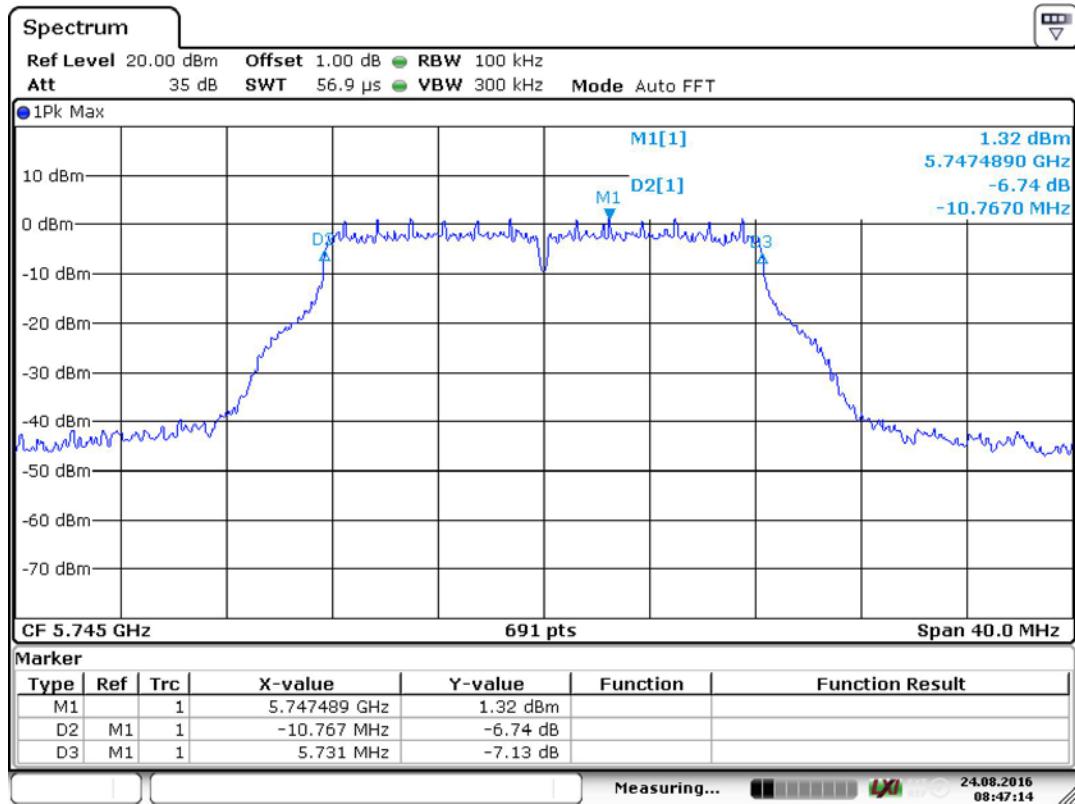
4.2.3 TEST PROTOCOL

Ambient temperature: 23 °C
Air Pressure: 1010 hPa
Humidity: 40 %

| Radio Technology | Operating Frequency | 6 dB Bandwidth [MHz] | Limit [MHz] | Margin [MHz] |
|------------------|---------------------|----------------------|-------------|--------------|
| WLAN a | low | 16.5 | 0.5 | 16.0 |
| WLAN a | mid | 16.4 | 0.5 | 15.9 |
| WLAN a | high | 16.5 | 0.5 | 16.0 |
| WLAN n 20 MHz | low | 17.7 | 0.5 | 17.2 |
| WLAN n 20 MHz | mid | 17.7 | 0.5 | 17.2 |
| WLAN n 20 MHz | high | 17.7 | 0.5 | 17.2 |
| WLAN n 40 MHz | low | 36.6 | 0.5 | 36.1 |
| WLAN n 40 MHz | high | 36.6 | 0.5 | 36.1 |
| WLAN ac 20 MHz | low | 17.7 | 0.5 | 17.2 |
| WLAN ac 20 MHz | mid | 17.7 | 0.5 | 17.2 |
| WLAN ac 20 MHz | high | 17.7 | 0.5 | 17.2 |
| WLAN ac 40 MHz | low | 36.6 | 0.5 | 36.1 |
| WLAN ac 40 MHz | high | 36.6 | 0.5 | 36.1 |
| WLAN ac 80 MHz | low | 76.1 | 0.5 | 75.6 |

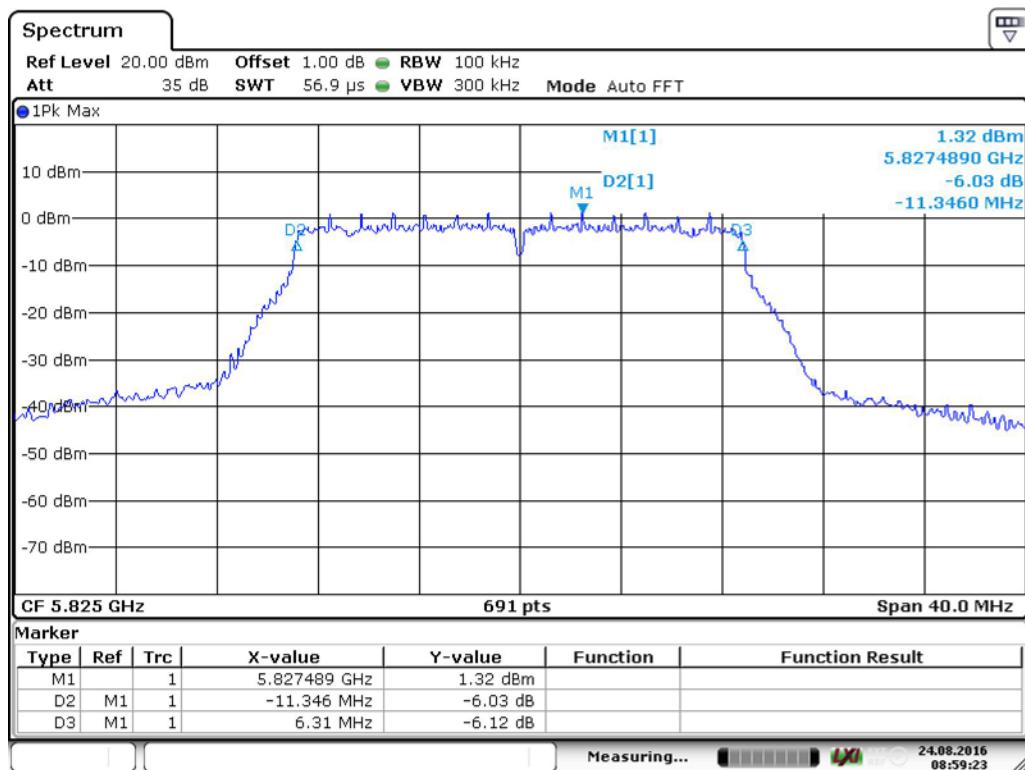
Remark: Please see next sub-clause for the measurement plot.

4.2.4 MEASUREMENT PLOT (SHOWING THE HIGHEST VALUE, "WORST CASE")



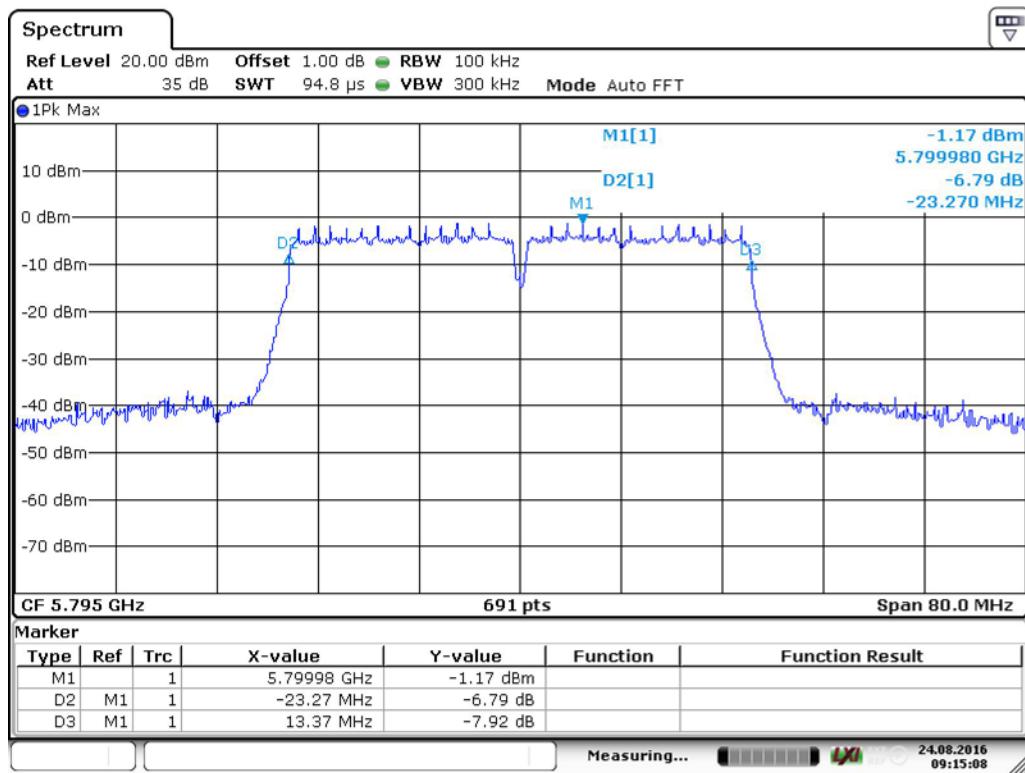
Date: 24.AUG.2016 08:47:15

WLAN a-mode, CH 149



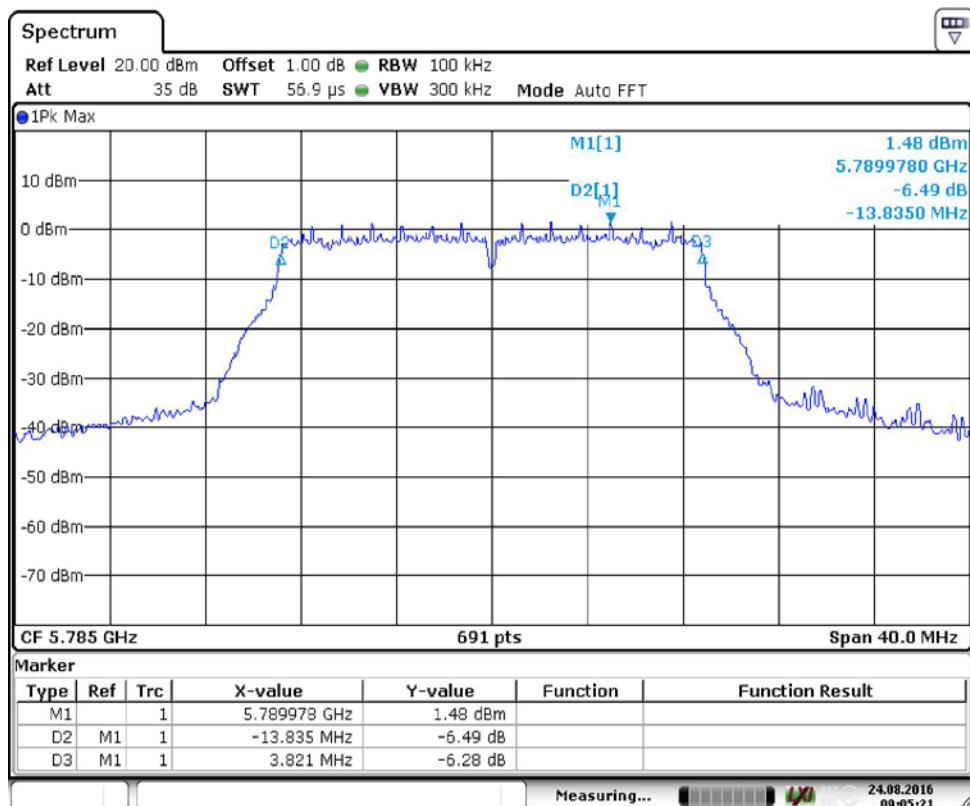
Date: 24.AUG.2016 08:59:24

WLAN n-mode, 20 MHz, CH 165



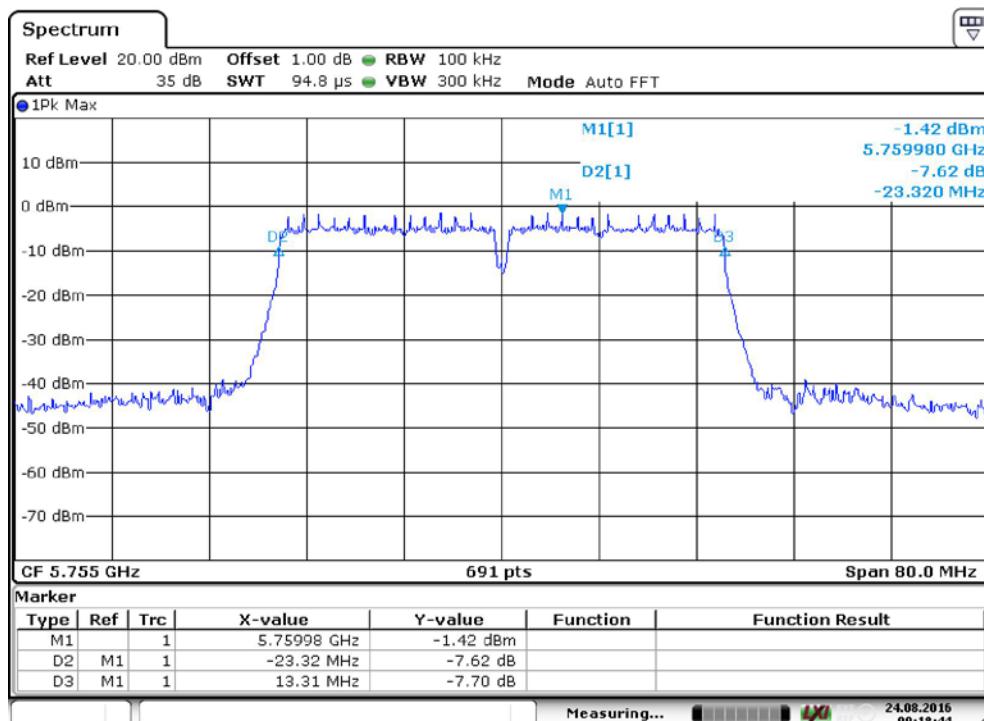
Date: 24.AUG.2016 09:15:08

WLAN n-mode, 40 MHz, CH 159



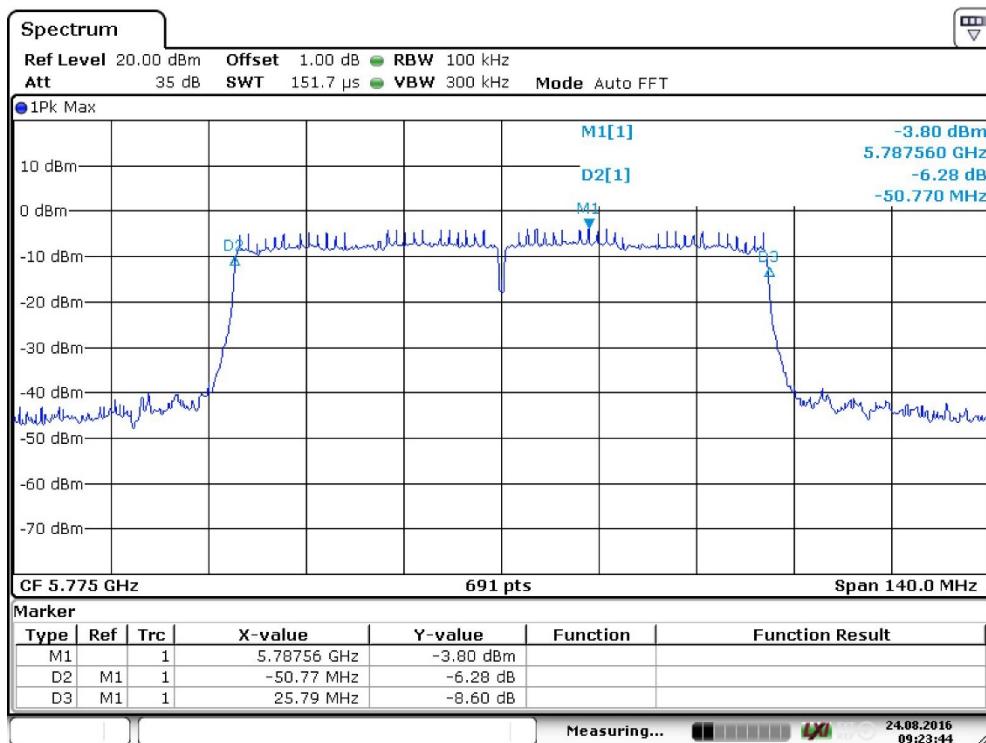
Date: 24.AUG.2016 09:05:21

WLAN ac-mode, 20 MHz, CH 157



Date: 24.AUG.2016 09:18:45

WLAN ac-mode, 40 MHz, CH 151



Date: 24.AUG.2016 09:23:45

WLAN ac-mode, 80 MHz, CH 155

4.2.5 TEST EQUIPMENT USED

R&S TS8997

4.3 99 % BANDWIDTH

Standard RSS-247

The test was performed according to:
ANSI C63.10

4.3.1 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) emission bandwidth.

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

Analyzer settings:

- Resolution Bandwidth (RBW): approx. $\geq 1\%$ of the span, but not below
- Video Bandwidth (VBW): ≥ 3 times the RBW
- Span: 40 / 80 / 160 MHz (for 20 / 40 / 80 MHz nominal bandwidth)
- Trace: Maxhold
- Sweeps: 2000
- Sweptime: 20 ms
- Detector: Sample

The 99 % measurement function of the spectrum analyser function was used to determine the 99 % bandwidth.

4.3.2 TEST REQUIREMENTS / LIMITS

No applicable limit:

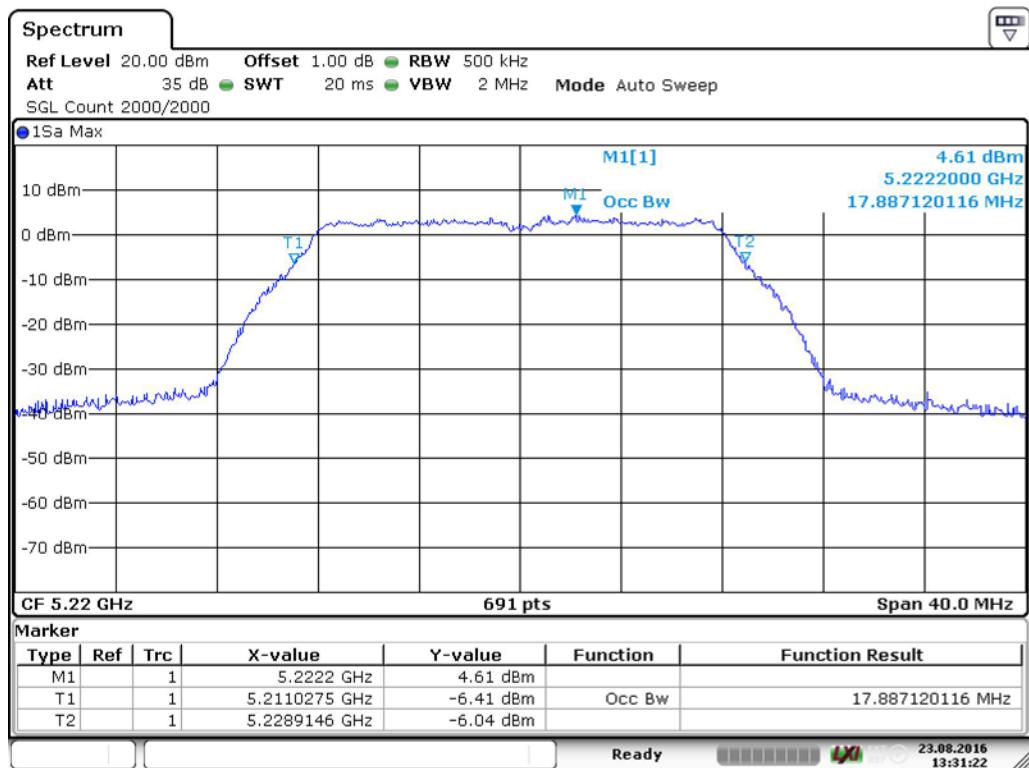
4.3.3 TEST PROTOCOL

Ambient temperature: 23 °C
Air Pressure: 1010 hPa
Humidity: 40 %

| Radio Technology | Operating Frequency | Subband | 99% Bandwidth [MHz] |
|------------------|---------------------|---------|---------------------|
| WLAN a | low | U-NII-1 | 17.8 |
| WLAN a | mid | U-NII-1 | 17.9 |
| WLAN a | high | U-NII-1 | 17.8 |
| WLAN a | low | U-NII-3 | 17.8 |
| WLAN a | mid | U-NII-3 | 17.9 |
| WLAN a | high | U-NII-3 | 17.8 |
| WLAN n 20 MHz | low | U-NII-1 | 18.8 |
| WLAN n 20 MHz | mid | U-NII-1 | 18.8 |
| WLAN n 20 MHz | high | U-NII-1 | 18.7 |
| WLAN n 20 MHz | low | U-NII-3 | 18.7 |
| WLAN n 20 MHz | mid | U-NII-3 | 18.6 |
| WLAN n 20 MHz | high | U-NII-3 | 18.6 |
| WLAN n 40 MHz | low | U-NII-1 | 36.7 |
| WLAN n 40 MHz | high | U-NII-1 | 36.8 |
| WLAN n 40 MHz | low | U-NII-3 | 36.7 |
| WLAN n 40 MHz | high | U-NII-3 | 36.7 |
| WLAN ac 20 MHz | low | U-NII-1 | 18.8 |
| WLAN ac 20 MHz | mid | U-NII-1 | 18.8 |
| WLAN ac 20 MHz | high | U-NII-1 | 18.7 |
| WLAN ac 20 MHz | low | U-NII-3 | 18.8 |
| WLAN ac 20 MHz | mid | U-NII-3 | 18.8 |
| WLAN ac 20 MHz | high | U-NII-3 | 18.7 |
| WLAN ac 40 MHz | low | U-NII-1 | 36.7 |
| WLAN ac 40 MHz | high | U-NII-1 | 36.8 |
| WLAN ac 40 MHz | low | U-NII-3 | 36.8 |
| WLAN ac 40 MHz | high | U-NII-3 | 36.8 |
| WLAN ac 80 MHz | mid | U-NII-1 | 76.2 |
| WLAN ac 80 MHz | mid | U-NII-3 | 76.2 |

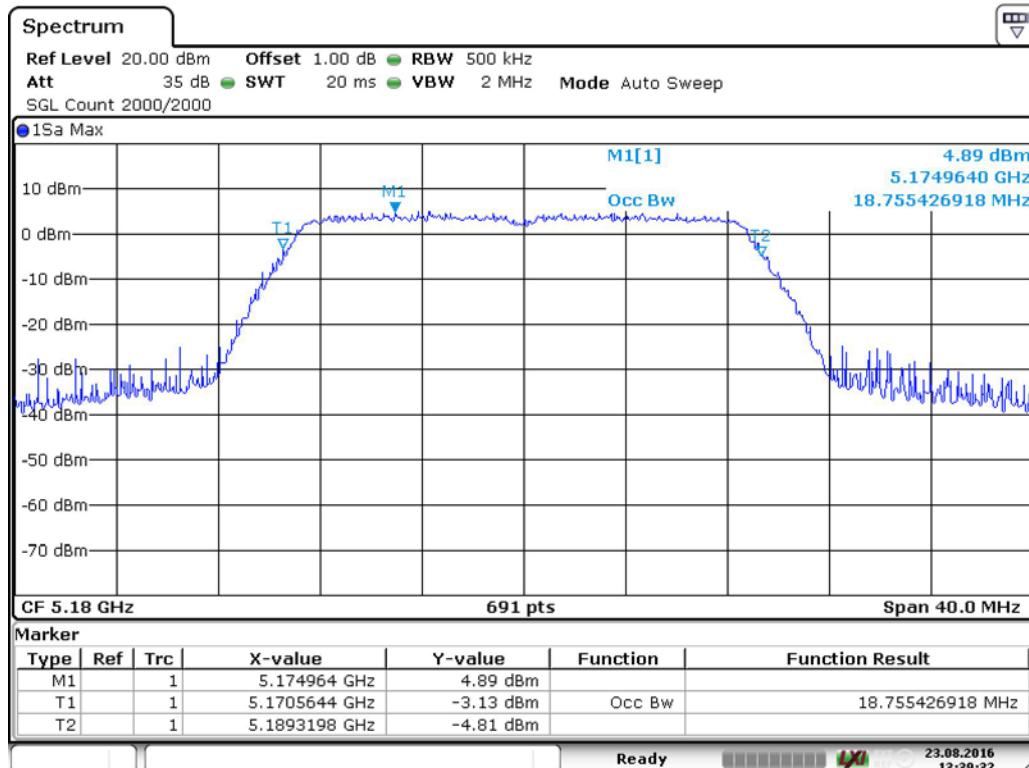
Remark: Please see next sub-clause for the measurement plot.

4.3.4 MEASUREMENT PLOT (SHOWING THE HIGHEST VALUE, "WORST CASE")



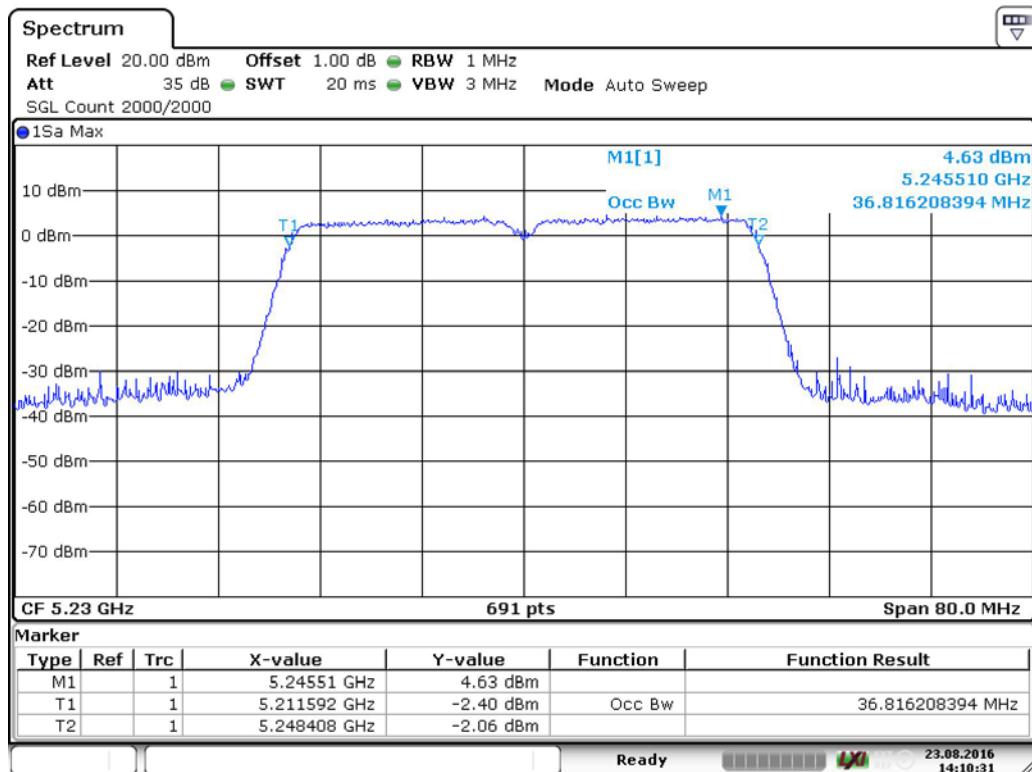
Date: 23.AUG.2016 13:31:22

WLAN a-mode, CH 44



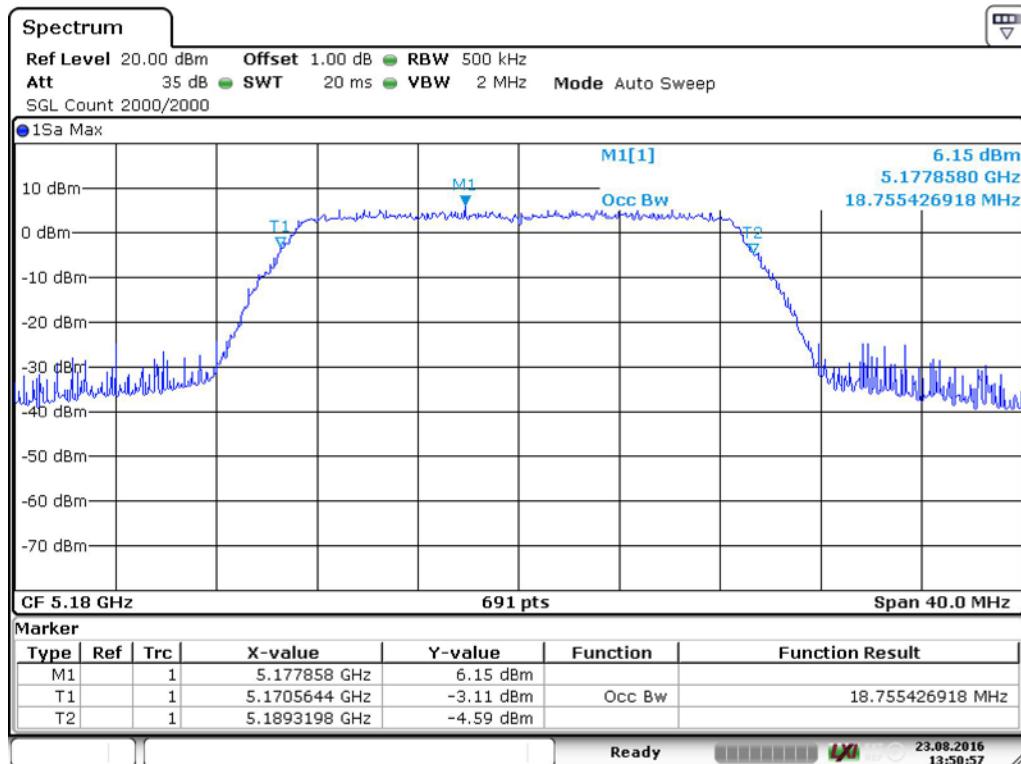
Date: 23.AUG.2016 13:39:31

WLAN n-mode, 20 MHz, CH 36



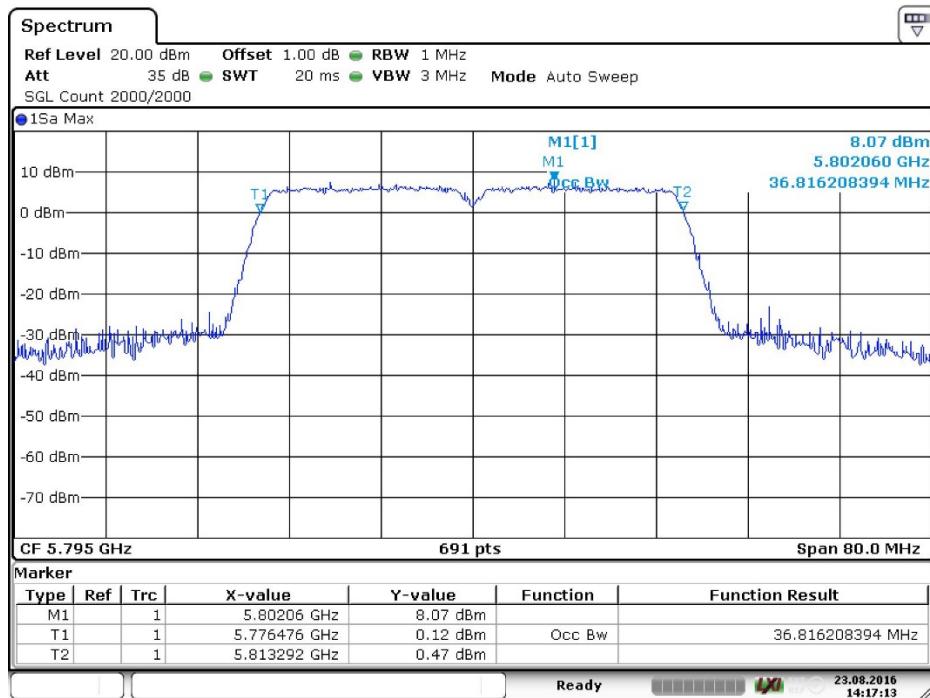
Date: 23.AUG.2016 14:10:32

WLAN n-mode, 40 MHz, CH 46



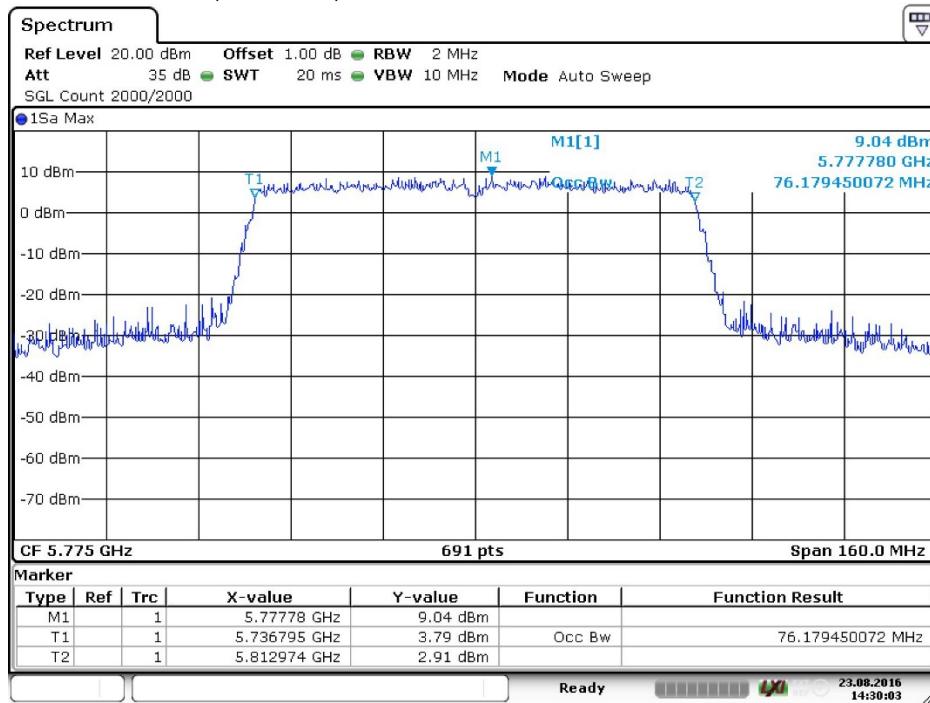
Date: 23.AUG.2016 13:50:57

WLAN ac-mode, 20 MHz, CH 36



Date: 23.AUG.2016 14:17:13

WLAN ac-mode, 40 MHz, CH 159



Date: 23.AUG.2016 14:30:03

WLAN ac-mode, 80 MHz, CH 155

4.3.5 TEST EQUIPMENT USED

R&S TS8997

4.4 MAXIMUM CONDUCTED OUTPUT POWER

Standard FCC Part 15 Subpart E

The test was performed according to:
ANSI C63.10

4.4.1 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:

- Resolution Bandwidth (RBW): 1 MHz
- Video Bandwidth (VBW): 3 MHz
- Trace: Average, RMS power averaging mode
- Sweeps: 500
- Sweptime: 20 ms
- Detector: RMS
- Trigger: gated mode

The channel power function of the spectrum analyser was used (Used channel bandwidth = nominal bandwidth)

Note:

The analyser settings are according FCC Public Note "Guidelines for Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices - Part 15, Subpart E, 789033 D02", method **SA-1**.

4.4.2 TEST REQUIREMENTS / LIMITS

A) FCC

For systems using digital modulation techniques in the 5.15 – 5.25 GHz bands:

§15.407 (a) (1)

Limit: 50 mW (17 dBm) or $4 \text{ dBm} + 10 \log(26 \text{ dB bandwidth/MHz})$ whatever is the lesser.

FCC ET Docket No. 13-49, FIRST REPORT AND ORDER, April 1, 2014 ("new rules"):

§15.407 (a) (1) (i): Outdoor access point:

Limit: 1 W (30 dBm) provided the maximum antenna gain does not exceed 6 dBi.

The maximum e.i.r.p. at any elevation angle above 30 degrees as measured from the horizon must not exceed 125 mW (21 dBm).

§15.407 (a) (1) (ii): Indoor access point:

Limit: 1 W (30 dBm) provided the maximum antenna gain does not exceed 6 dBi.

§15.407 (a) (1) (iv): Client devices:

Limit: 250 mW (24 dBm) provided the maximum antenna gain does not exceed 6 dBi.

For systems using digital modulation techniques in the 5.25 – 5.35 GHz and 5.47 – 5.725 GHz bands:

§15.407 (a) (2)

Limit: 250 mW (24 dBm) or $11 \text{ dBm} + 10 \log(26 \text{ dB bandwidth/MHz})$ whatever is the lesser.

For systems using digital modulation techniques in the 5.725 – 5.850 GHz bands:

§15.407 (a) (3)

Limit: 1 W (30 dBm) or $17 \text{ dBm} + 10 \log(26 \text{ dB bandwidth/MHz})$ whatever is the lesser.

FCC ET Docket No. 13-49, FIRST REPORT AND ORDER, April 1, 2014 ("new rules"):

§15.407 (a) (3):

Limit: 1 W (30 dBm).

§15.407 (a) (4):

The maximum conducted output power must be measured over any interval of continuous transmission using instrumentation calibrated in terms of an rms-equivalent voltage.

B) IC

Different frequency bands and limits apply, as compared to the FCC requirements.

RSS-247, 6.2.1 (1), Band 5150-5250 MHz, indoor operation only:

Limit (e.i.r.p.): 200 mW (23 dBm) or $10 + 10 \log_{10} B [\text{dBm}]$, whichever power is less.
B is the 99% emission bandwidth in MHz.

RSS-247, 6.2.2 (1), Band 5250-5350 MHz:

Limits:

Maximum conducted Power: 250 mW (24 dBm) or $11 + 10 \log_{10} B [\text{dBm}]$, whichever power is less.

e.i.r.p.: 1.0 W (30 dBm) or $17 + 10 \log_{10} B [\text{dBm}]$, whichever power is less.

Note: For EUTs operating at a higher e.i.r.p. than 200 mW (23 dBm), compliance with the e.i.r.p. elevation mask is required.

RSS-247, 6.2.3 (1), Bands 5470-5600 MHz and 5650-5725 MHz:

Limits:

Maximum conducted Power: 250 mW (24 dBm) or $11 + 10 \log_{10} B [\text{dBm}]$, whichever power is less.

e.i.r.p.: 1.0 W (30 dBm) or $17 + 10 \log_{10} B [\text{dBm}]$, whichever power is less.

RSS-247, 6.2.4 (1), Band 5725-5825 MHz:

Limits:

Maximum conducted Power: 1W (30 dBm) or $17 + 10 \log_{10} B [\text{dBm}]$, whichever power is less.
e.i.r.p.: 4.0 W (36 dBm) or $23 + 10 \log_{10} B [\text{dBm}]$, whichever power is less.

All frequency bands: B is the 99% emission bandwidth in MHz.

4.4.3 TEST PROTOCOL

Ambient temperature: 23 °C

Air Pressure: 1010 hPa

Humidity: 40 %

| WLAN a-Mode; 20 MHz; 6 Mbit/s | | | | | FCC | | IC | | | |
|-------------------------------|--------|-------------|-------------------|------------|-------------------|-------------|-------------------|-------------|------------------|-------------|
| | Ch. No | Freq. [MHz] | Cond. Power [dBm] | EIRP [dBm] | Cond. Limit [dBm] | Margin [dB] | Cond. Limit [dBm] | Margin [dB] | EIRP Limit [dBm] | Margin [dB] |
| 1 | 36 | 5180.0 | 11.4 | 16.4 | 24.0 | 12.6 | N/A | | 22.5 | 6.1 |
| | 44 | 5220.0 | 11.9 | 16.9 | 24.0 | 12.1 | N/A | | 22.5 | 5.6 |
| | 48 | 5240.0 | 11.8 | 16.8 | 24.0 | 12.2 | N/A | | 22.5 | 5.7 |
| 3 | 149 | 5745.0 | 13.3 | 18.1 | 30.0 | 16.7 | 30.0 | 16.7 | 36.0 | 17.9 |
| | 157 | 5785.0 | 13.0 | 17.8 | 30.0 | 17.0 | 30.0 | 17.0 | 36.0 | 18.2 |
| | 165 | 5825.0 | 12.8 | 17.6 | 30.0 | 17.2 | 30.0 | 17.2 | 36.0 | 18.4 |

| WLAN n-Mode; 20 MHz; 72.2 Mbit/s MCS7 | | | | | FCC | | IC | | | |
|---------------------------------------|--------|-------------|-------------------|------------|-------------------|-------------|-------------------|-------------|------------------|-------------|
| | Ch. No | Freq. [MHz] | Cond. Power [dBm] | EIRP [dBm] | Cond. Limit [dBm] | Margin [dB] | Cond. Limit [dBm] | Margin [dB] | EIRP Limit [dBm] | Margin [dB] |
| 1 | 36 | 5180.0 | 11.3 | 16.3 | 24.0 | 12.7 | N/A | | 22.7 | 6.4 |
| | 44 | 5220.0 | 12.0 | 17.0 | 24.0 | 12.1 | N/A | | 22.7 | 5.8 |
| | 48 | 5240.0 | 11.6 | 16.6 | 24.0 | 12.4 | N/A | | 22.7 | 6.1 |
| 3 | 149 | 5745.0 | 13.3 | 18.1 | 30.0 | 16.7 | 30.0 | 16.7 | 36.0 | 17.9 |
| | 157 | 5785.0 | 12.9 | 17.7 | 30.0 | 17.1 | 30.0 | 17.1 | 36.0 | 18.3 |
| | 165 | 5825.0 | 12.8 | 17.6 | 30.0 | 17.2 | 30.0 | 17.2 | 36.0 | 18.4 |

| WLAN n-Mode; 40 MHz; 150 Mbit/s MCS7 | | | | | FCC | | IC | | | |
|--------------------------------------|--------|-------------|-------------------|------------|-------------------|-------------|-------------------|-------------|------------------|-------------|
| | Ch. No | Freq. [MHz] | Cond. Power [dBm] | EIRP [dBm] | Cond. Limit [dBm] | Margin [dB] | Cond. Limit [dBm] | Margin [dB] | EIRP Limit [dBm] | Margin [dB] |
| 1 | 38 | 5190.0 | 10.9 | 15.9 | 24.0 | 13.1 | N/A | | 23.0 | 12.1 |
| | 46 | 5230.0 | 11.2 | 16.2 | 24.0 | 12.8 | N/A | | 23.0 | 11.8 |
| 3 | 151 | 5755.0 | 13.3 | 18.1 | 30.0 | 16.7 | 30.0 | 16.7 | 36.0 | 22.7 |
| | 159 | 5795.0 | 12.9 | 17.7 | 30.0 | 17.2 | 30.0 | 17.2 | 36.0 | 23.2 |

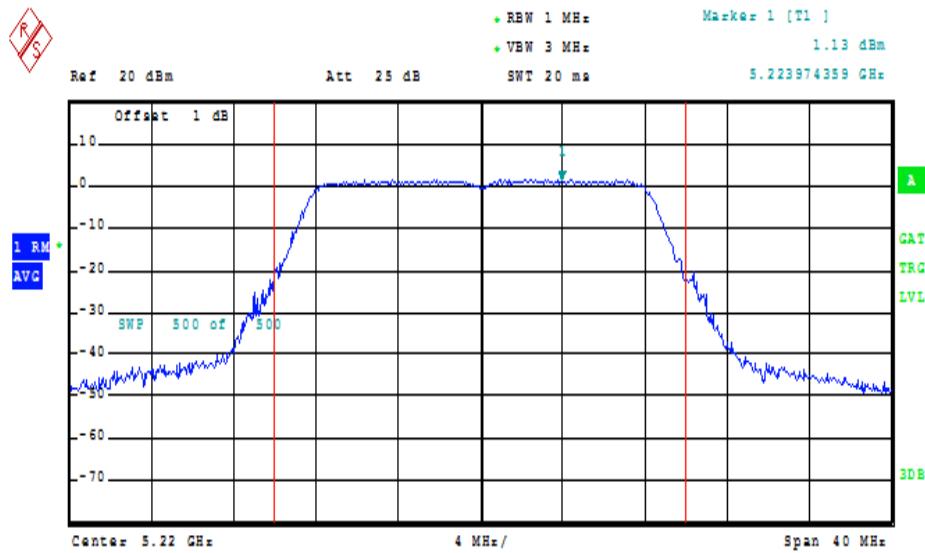
| WLAN ac-Mode; 20 MHz; 86.7 Mbit/s MCS8 | | | | | FCC | | IC | | | |
|--|--------|-------------|-------------------|------------|-------------------|-------------|-------------------|-------------|------------------|-------------|
| | Ch. No | Freq. [MHz] | Cond. Power [dBm] | EIRP [dBm] | Cond. Limit [dBm] | Margin [dB] | Cond. Limit [dBm] | Margin [dB] | EIRP Limit [dBm] | Margin [dB] |
| 1 | 36 | 5180.0 | 9.8 | 14.8 | 24.0 | 14.2 | N/A | | 22.7 | 7.9 |
| | 44 | 5220.0 | 9.6 | 14.6 | 24.0 | 14.4 | N/A | | 22.7 | 8.1 |
| | 48 | 5240.0 | 10.1 | 15.1 | 24.0 | 13.9 | N/A | | 22.7 | 7.6 |
| 3 | 149 | 5745.0 | 11.9 | 16.7 | 30.0 | 18.1 | 30.0 | 18.1 | 36.0 | 19.3 |
| | 157 | 5785.0 | 12.1 | 16.9 | 30.0 | 18.0 | 30.0 | 18.0 | 36.0 | 19.2 |
| | 165 | 5825.0 | 11.9 | 16.7 | 30.0 | 18.1 | 30.0 | 18.1 | 36.0 | 19.3 |

| WLAN ac-Mode; 40 MHz; 200 Mbit/s MCS9 | | | | | FCC | | IC | | | |
|---------------------------------------|--------|-------------|-------------------|------------|-------------------|-------------|-------------------|-------------|------------------|-------------|
| | Ch. No | Freq. [MHz] | Cond. Power [dBm] | EIRP [dBm] | Cond. Limit [dBm] | Margin [dB] | Cond. Limit [dBm] | Margin [dB] | EIRP Limit [dBm] | Margin [dB] |
| 1 | 38 | 5190.0 | 10.8 | 15.8 | 24.0 | 13.2 | N/A | | 23.0 | 7.2 |
| | 46 | 5230.0 | 11.1 | 16.1 | 24.0 | 12.9 | N/A | | 23.0 | 6.9 |
| 3 | 151 | 5755.0 | 13.3 | 18.1 | 30.0 | 16.7 | 30.0 | 16.7 | 36.0 | 17.9 |
| | 159 | 5795.0 | 12.9 | 17.7 | 30.0 | 17.1 | 30.0 | 17.1 | 36.0 | 18.3 |

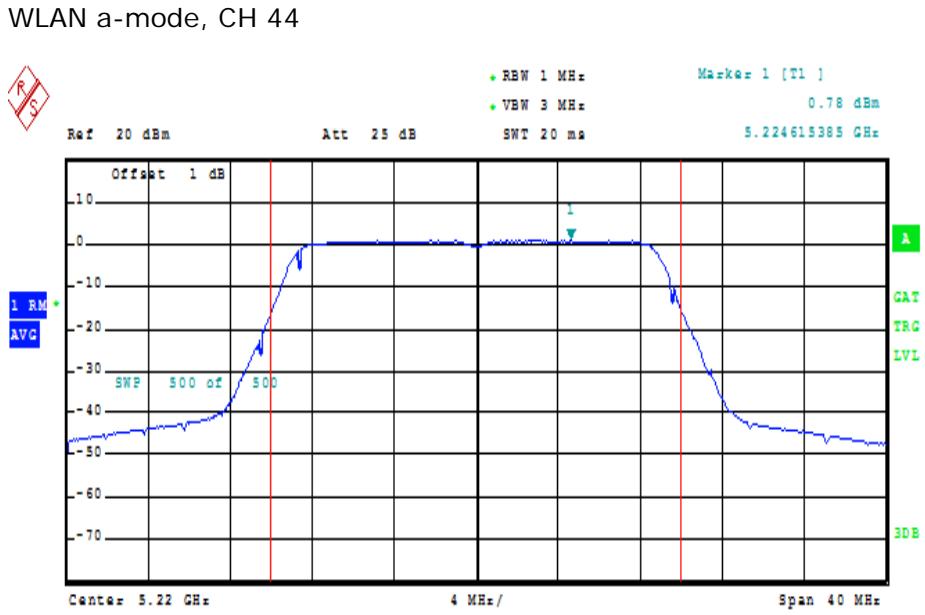
| WLAN ac-Mode; 80 MHz; 433.3 Mbit/s MCS9 | | | | | FCC | | IC | | | |
|--|--------|-------------|-------------------|------------|-------------------|-------------|-------------------|-------------|------------------|-------------|
| | Ch. No | Freq. [MHz] | Cond. Power [dBm] | EIRP [dBm] | Cond. Limit [dBm] | Margin [dB] | Cond. Limit [dBm] | Margin [dB] | EIRP Limit [dBm] | Margin [dB] |
| 1 | 42 | 5210.0 | 11.6 | 16.6 | 24.0 | 12.4 | N/A | | 23.0 | 6.4 |
| 3 | 155 | 5775 | 13.3 | 18.1 | 30.0 | 16.7 | 30.0 | 16.7 | 36.0 | 17.9 |

Remark: Please see next sub-clause for the measurement plot.

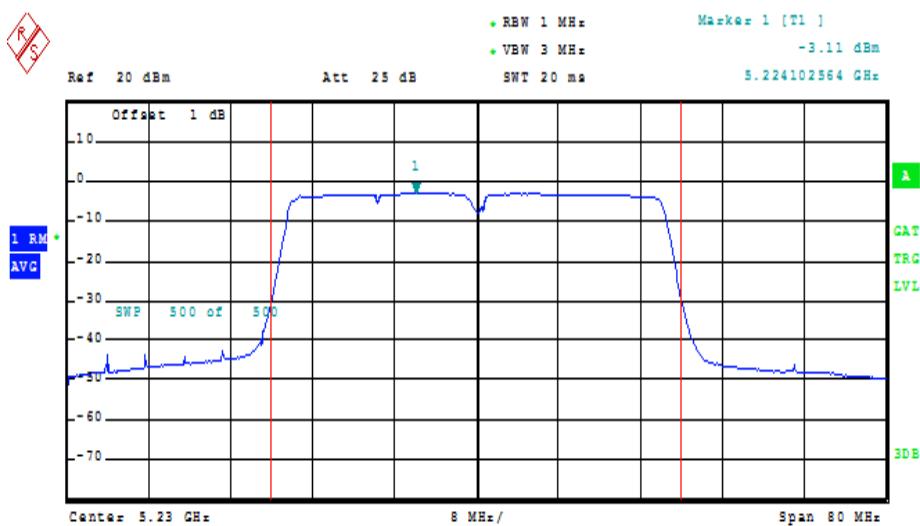
4.4.4 MEASUREMENT PLOT (SHOWING THE HIGHEST VALUE, "WORST CASE")



WLAN a-mode, CH 44

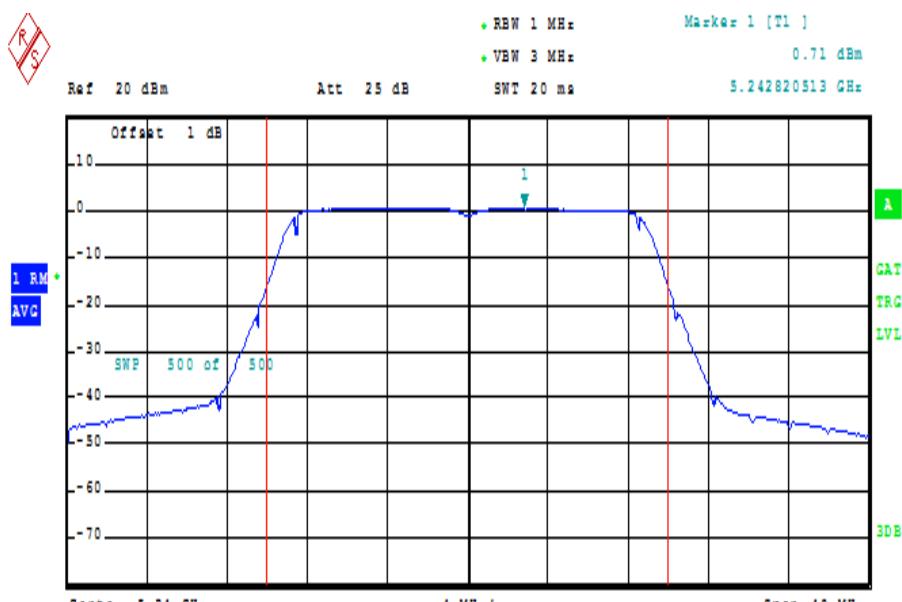


WLAN n-mode, 20 MHz, CH 44

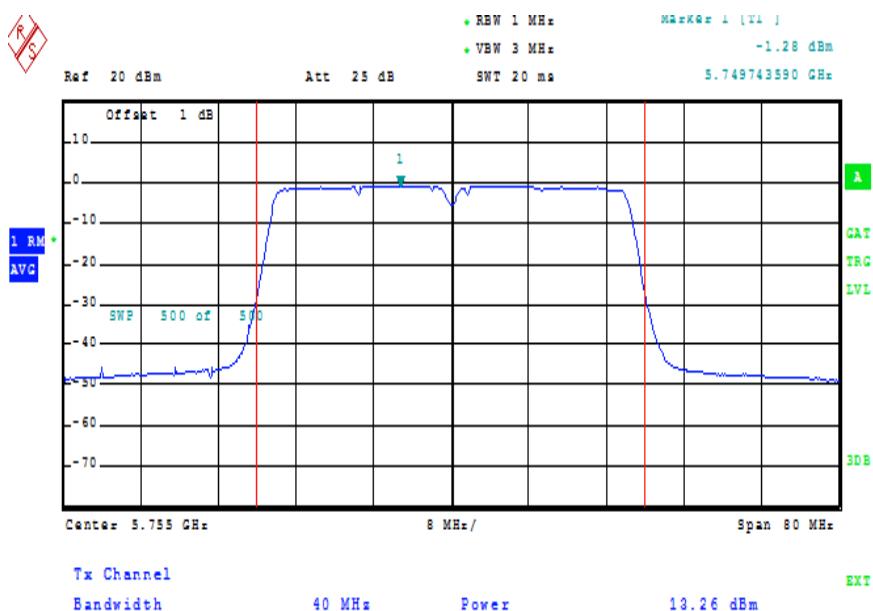
Tx Channel EXT
Bandwidth 40 MHz Power 11.19 dBm

WLAN n-mode, 40 MHz, CH 46

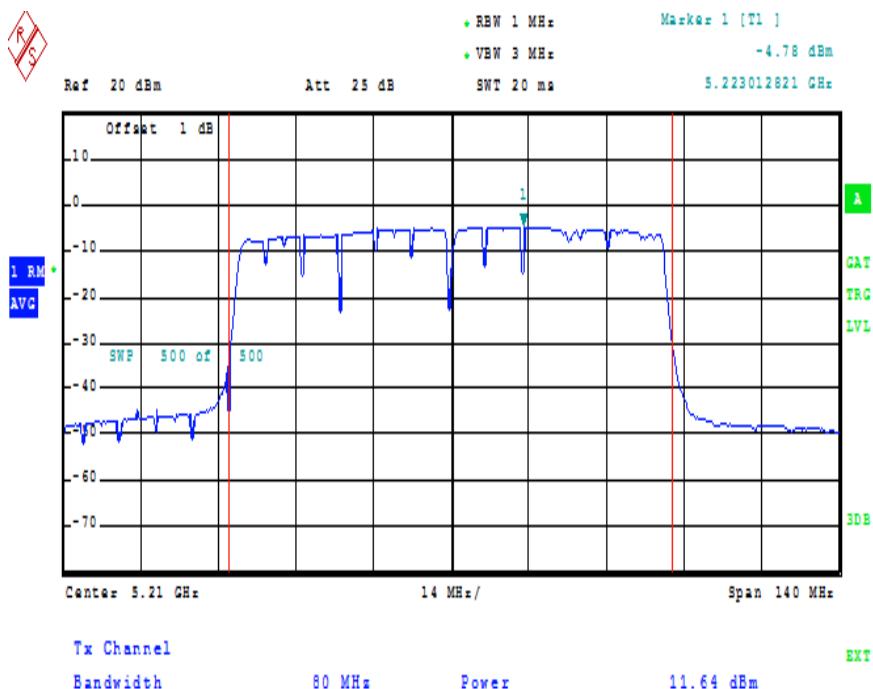



Tx Channel EXT
Bandwidth 20 MHz Power 11.68 dBm

WLAN ac-mode, 20 MHz, CH 48

WLAN ac-mode, 40 MHz, CH 151



WLAN ac-mode, 80 MHz, CH 42

4.4.5 TEST EQUIPMENT USED

R&S TS8997

4.5 PEAK POWER SPECTRAL DENSITY

Standard FCC Part 15 Subpart E

The test was performed according to:
ANSI C63.10

4.5.1 TEST DESCRIPTION

The Equipment Under Test (EUT) was set up in a shielded room to perform the Maximum Power Spectral Density measurements.

The results recorded were measured with the modulation which produces the worst-case (highest) output power.

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

Analyzer settings:

- Resolution Bandwidth (RBW): 1 MHz
- Video Bandwidth (VBW): 3 MHz
- Trace: Average, RMS power averaging mode
- Sweeps: 500
- Sweeptime: 20 ms
- Detector: RMS
- Trigger: gated mode

Note:

The analyser settings are according FCC Public Note "Guidelines for Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices - Part 15, Subpart E, 789033 D02", method **SA-1**.

4.5.2 TEST REQUIREMENTS / LIMITS

A) FCC

FCC Part 15, Subpart E, §15.407 (a) (1)

For systems using digital modulation techniques in the 5.15 – 5.25 GHz bands:

- (i) and (ii), outdoor and indoor access points: Limit: 17 dBm/MHz.
- (iv), mobile and portable client devices: Limit: 11 dBm/MHz.

FCC Part 15, Subpart E, §15.407 (a) (2)

For systems using digital modulation techniques in the 5.25 – 5.35 GHz and 5.47 – 5.725 GHz bands:

Limit: 11 dBm/MHz.

FCC Part 15, Subpart E, §15.407 (a) (3)

For systems using digital modulation techniques in the 5.725 – 5.850 GHz bands:

Limit: 30 dBm/500 kHz.

Note: The limit will be also fulfilled when measuring at any bandwidth greater than 500 kHz.
This applies to signals where the maximum conducted output power was measured at a bandwidth exceeding 500 kHz and which fulfil that limit of 30 dBm.

B) IC

Different frequency bands and limits apply, as compared to the FCC requirements.

RSS-247, 6.2.1 (1), Band 5150-5250 MHz, indoor operation only:

Limit (e.i.r.p.): 10 dBm/MHz.

RSS-247, 6.2.2 (1), Band 5250-5350 MHz:

Limit: 11 dBm/MHz.

RSS-247, 6.2.3 (1), Bands 5470-5600 MHz and 5650-5725 MHz:

Limit: 11 dBm/MHz.

RSS-247, 6.2.4 (1), Band 5725-5850 MHz:

Limit: 30 dBm/500 kHz.

4.5.3 TEST PROTOCOL

Ambient temperature: 32 °C

Air Pressure: 1010 hPa

Humidity: 40 %

WLAN a-Mode; 20 MHz; 6 Mbit/s

| U-NII-Subband | Ch. No. | Freq. [MHz] | MPSD [dBm/MHz] | FCC Limit [dBm/MHz] | Margin [dB] | IC Limit [dBm/MHz] | Margin [dB] | IC EIRP MPSD |
|----------------------|----------------|--------------------|-----------------------|----------------------------|--------------------|---------------------------|--------------------|---------------------|
| 1 | 36 | 5180.0 | 1.1 | 11.0 | 9.9 | 10.0 | 3.9 | 6.1 |
| | 44 | 5220.0 | 1.1 | 11.0 | 9.9 | 10.0 | 3.9 | 6.1 |
| | 48 | 5240.0 | 0.9 | 11.0 | 10.2 | 10.0 | 4.2 | 5.9 |
| 3 | 149 | 5745.0 | 2.6 | 30.0 | 27.4 | 30.0 | 27.4 | |
| | 157 | 5785.0 | 2.2 | 30.0 | 27.8 | 30.0 | 27.8 | |
| | 165 | 5825.0 | 1.9 | 30.0 | 28.1 | 30.0 | 28.1 | |

WLAN n-Mode; 20 MHz; 72.2 Mbit/s MCS7

| U-NII-Subband | Ch. No. | Freq. [MHz] | MPSD [dBm/MHz] | FCC Limit [dBm/MHz] | Margin [dB] | IC Limit [dBm/MHz] | Margin [dB] | IC EIRP MPSD |
|----------------------|----------------|--------------------|-----------------------|----------------------------|--------------------|---------------------------|--------------------|---------------------|
| 1 | 36 | 5180.0 | 0.1 | 11.0 | 11.0 | 10.0 | 5.0 | 5.1 |
| | 44 | 5220.0 | 0.8 | 11.0 | 10.2 | 10.0 | 4.2 | 5.8 |
| | 48 | 5240.0 | 0.3 | 11.0 | 10.7 | 10.0 | 4.7 | 5.3 |
| 3 | 149 | 5745.0 | 2.1 | 30.0 | 27.9 | 30.0 | 27.9 | |
| | 157 | 5785.0 | 1.6 | 30.0 | 28.4 | 30.0 | 28.4 | |
| | 165 | 5825.0 | 1.7 | 30.0 | 28.3 | 30.0 | 28.3 | |

WLAN n-Mode; 40 MHz; 150 Mbit/s MCS7

| U-NII-Subband | Ch. No. | Freq. [MHz] | MPSD [dBm/MHz] | FCC Limit [dBm/MHz] | Margin [dB] | IC Limit [dBm/MHz] | Margin [dB] | IC EIRP MPSD |
|----------------------|----------------|--------------------|-----------------------|----------------------------|--------------------|---------------------------|--------------------|---------------------|
| 1 | 38 | 5190.0 | -3.3 | 11.0 | 14.3 | 10.0 | 8.3 | 1.7 |
| | 46 | 5230.0 | -3.1 | 11.0 | 14.1 | 10.0 | 8.1 | 1.9 |
| | 3 | 151 | 5755.0 | -1.2 | 30.0 | 31.2 | 30.0 | 31.2 |
| 3 | 159 | 5795.0 | -1.6 | 30.0 | 31.6 | 30.0 | 31.6 | |

WLAN ac-Mode; 20 MHz; 86.7 Mbit/s MCS8

| U-NII-Subband | Ch. No. | Freq. [MHz] | MPSD [dBm/MHz] | FCC Limit [dBm/MHz] | Margin [dB] | IC Limit [dBm/MHz] | Margin [dB] | IC EIRP MPSD |
|----------------------|----------------|--------------------|-----------------------|----------------------------|--------------------|---------------------------|--------------------|---------------------|
| 1 | 36 | 5180.0 | -2.2 | 11.0 | 13.2 | 10.0 | 7.2 | 2.8 |
| | 44 | 5220.0 | -2.3 | 11.0 | 13.3 | 10.0 | 7.3 | 2.7 |
| | 48 | 5240.0 | -1.9 | 11.0 | 12.9 | 10.0 | 6.9 | 3.1 |
| 3 | 149 | 5745.0 | -0.1 | 30.0 | 30.1 | 30.0 | 30.1 | |
| | 157 | 5785.0 | 0.0 | 30.0 | 30.0 | 30.0 | 30.0 | |
| | 165 | 5825.0 | -0.1 | 30.0 | 30.1 | 30.0 | 30.1 | |

WLAN ac-Mode; 40 MHz; 200 Mbit/s MCS9

| U-NII-Subband | Ch. No. | Freq. [MHz] | MPSD [dBm/MHz] | FCC Limit [dBm/MHz] | Margin [dB] | IC Limit [dBm/MHz] | Margin [dB] | IC EIRP MPSD |
|----------------------|----------------|--------------------|-----------------------|----------------------------|--------------------|---------------------------|--------------------|---------------------|
| 1 | 38 | 5190.0 | -3.3 | 11.0 | 14.3 | 10.0 | 8.3 | 1.7 |
| | 46 | 5230.0 | -3.4 | 11.0 | 14.4 | 10.0 | 8.4 | 1.6 |
| 3 | 151 | 5755.0 | -1.3 | 30.0 | 31.3 | 30.0 | 31.3 | |
| | 159 | 5795.0 | -1.7 | 30.0 | 31.7 | 30.0 | 31.7 | |

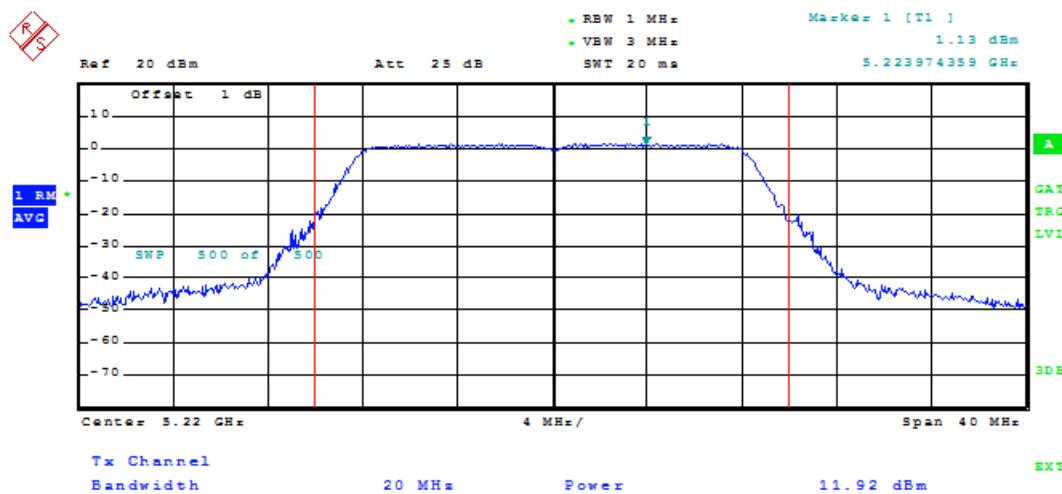
WLAN ac-Mode; 80 MHz; 433.3 Mbit/s MCS9

| U-NII-Subband | Ch. No. | Freq. [MHz] | MPSD [dBm/MHz] | FCC Limit [dBm/MHz] | Margin [dB] | IC Limit [dBm/MHz] | Margin [dB] | IC EIRP MPSD |
|----------------------|----------------|--------------------|-----------------------|----------------------------|--------------------|---------------------------|--------------------|---------------------|
| 1 | 42 | 5210.0 | -4.8 | 17.0 | 15.8 | 10.0 | 9.8 | 0.2 |
| | 155 | 5775.0 | -3.5 | 30.0 | 33.5 | 30.0 | 33.5 | |

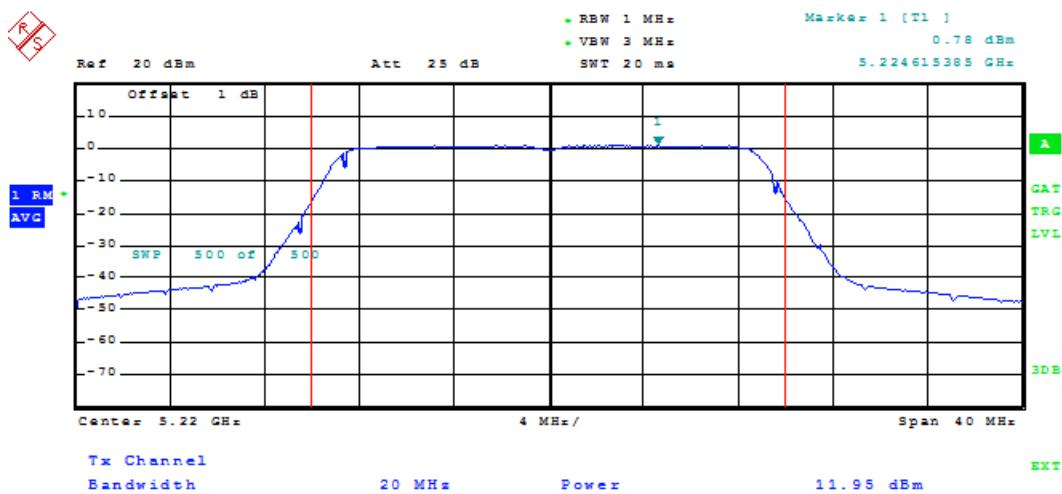
Remark: Please see next sub-clause for the measurement plot.

4.5.4 MEASUREMENT PLOT (SHOWING THE HIGHEST VALUE, "WORST CASE")

4.5.5

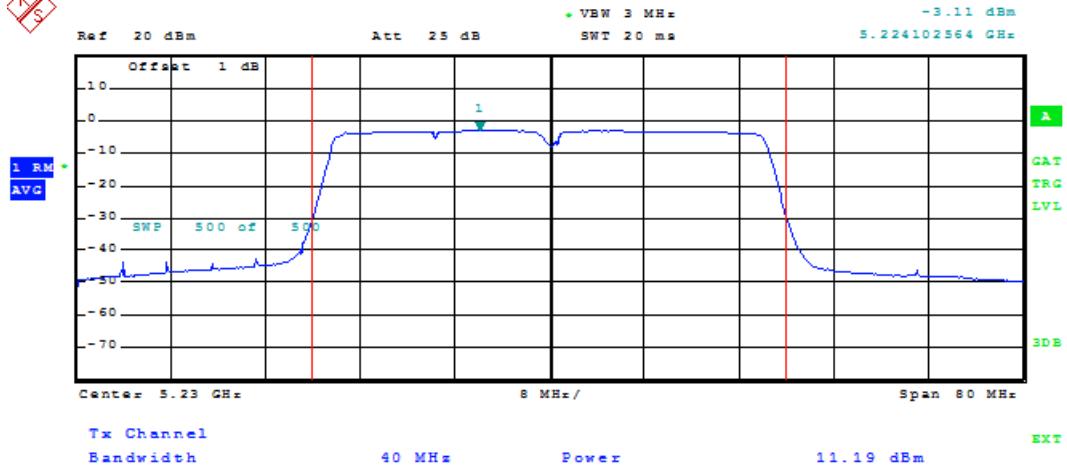


WLAN a-mode, CH 44



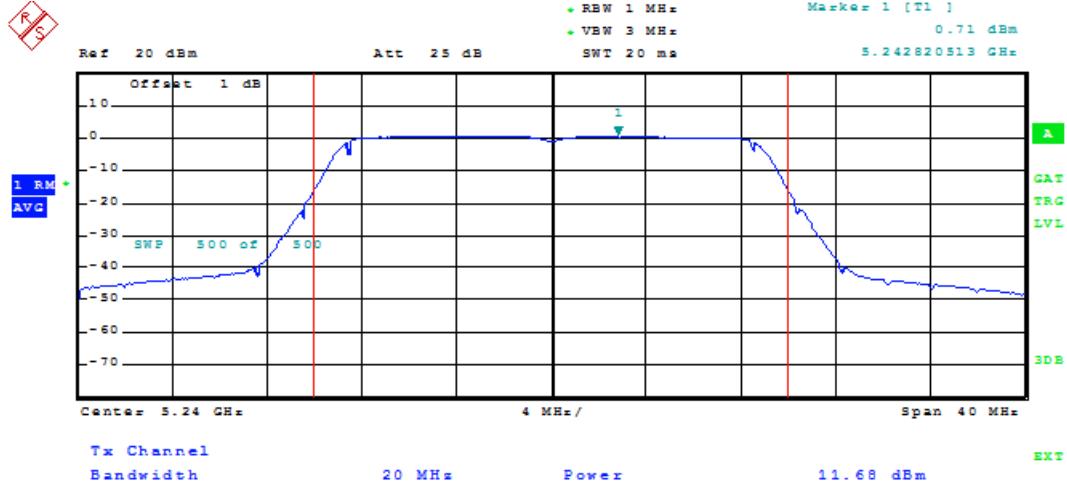
WLAN n-mode, 20 MHz, CH 44

R/S



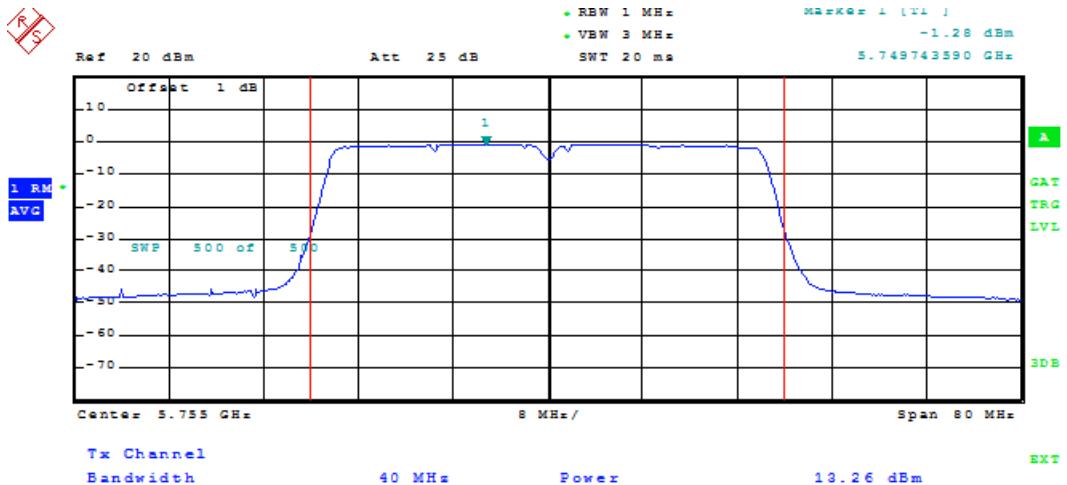
WLAN n-mode, 40 MHz, CH 46

R/S

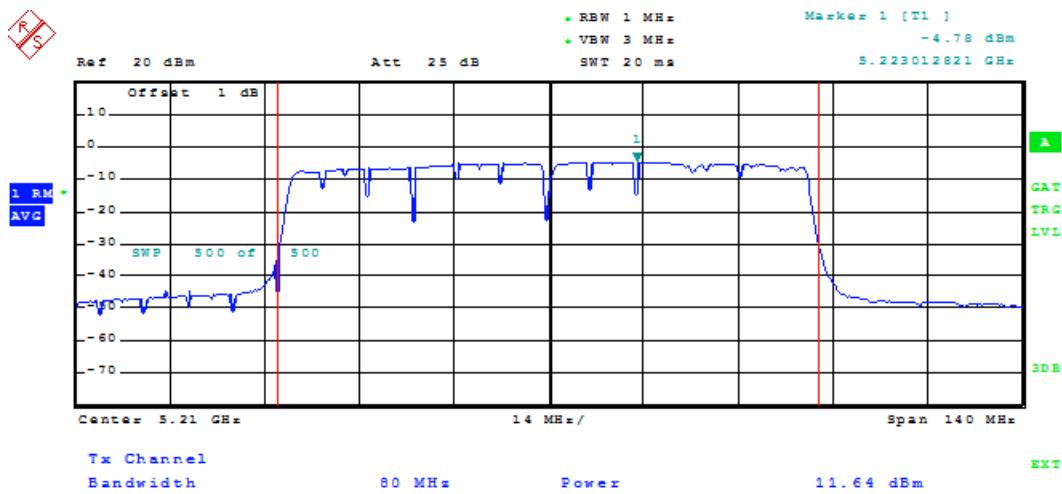


WLAN ac-mode, 20 MHz, CH 48

R/S



WLAN ac-mode, 40 MHz, CH 151



WLAN ac-mode, 80 MHz, CH 42

4.5.6 TEST EQUIPMENT USED

R&S TS8997

4.6 UNDESIRABLE EMISSIONS; GENERAL FIELD STRENGTH LIMITS

Standard FCC Part 15 Subpart E

The test was performed according to:

ANSI C63.10

4.6.1 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 EMC32 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 also performed at 3 axes. A pre-check is performed while the EUT is powered from a DC power source.

1. Measurement up to 30 MHz

The Loop antenna HFH2-Z2 is used.

Step 1: pre measurement

- Anechoic chamber
- Antenna distance: 3 m
- Detector: Peak-Maxhold
- Frequency range: 0.009 - 0.15 MHz and 0.15 – 30 MHz
- Frequency steps: 0.05 kHz and 2.25 kHz
- IF-Bandwidth: 0.2 kHz and 9 kHz
- Measuring time / Frequency step: 100 ms (FFT-based)

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: 1 s

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 / Quasipeak (FFT-based)
- Frequency range: 30 – 1000 MHz
- Frequency steps: 30 kHz
- IF-Bandwidth: 120 kHz
- Measuring time / Frequency step: 100 ms
- Turntable angle range: -180° to 90°
- 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: Adjustment 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 ± 45° 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 ± 100 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: ± 45 ° around the determined value
- Height variation range: ± 100 cm around the determined value
- Antenna Polarisation: max. value determined in step 1

Step 3: 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:

Step 1:

The Equipment Under Test (EUT) was set up on a non-conductive support (tilt device) at 1.5 m height in the fully-anechoic chamber.

All steps were performed with one height (1.5 m) of the receiving antenna only.

The EUT is turned during the preliminary measurement across the elevation axis, with a step size of 90 °.

The turn table step size (azimuth angle) for the preliminary measurement is 45 °.

Above 26 GHz the measurement distance is reduced to 1 m.

Step 2:

Due to the fact, that in this frequency range the test is performed in a fully anechoic room, the height scan of the receiving antenna instep 2 is omitted. Instead of this, a maximum search with a step size $\pm 45^\circ$ for the elevation axis is performed.

The turn table azimuth will slowly vary by $\pm 22.5^\circ$.

The elevation angle will slowly vary by $\pm 45^\circ$.

EMI receiver settings (for all steps):

- Detector: Peak, Average
- IF Bandwidth = 1 MHz

Step 3:

Spectrum analyser settings for step 3:

- Detector: Peak / Average
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 1 MHz
- Measuring time: 1 s

4.6.2 TEST REQUIREMENTS / LIMITS

A) FCC

FCC Part 15 Subpart E, §15.407 (b)(1)

For transmitters operating in the 5150–5250 MHz band:

Limit: -27 dBm/MHz EIRP outside of the band 5150–5350 MHz.

FCC Part 15 Subpart E, §15.407 (b)(2)

For transmitters operating in the 5250–5350 MHz band:

Limit: -27 dBm/MHz EIRP outside of the band 5150–5350 MHz.

FCC Part 15 Subpart E, §15.407 (b)(3)

For transmitters operating in the 5470–5725 MHz band:

Limit: -27 dBm/MHz EIRP outside of the band 5470–5725 MHz.

FCC Part 15 Subpart E, §15.407 (b)(4)

For transmitters operating in the 5725–5850 MHz band:

Limit: -27 dBm/MHz EIRP outside of the band 5715–5860 MHz and additionally

Limit: -17 dBm/MHz EIRP within the frequency ranges 5715–5725 and 5850–5860 MHz.

B) IC

Different frequency bands and limits apply, as compared to the FCC requirements.

RSS-247, 6.2.1 (2), Emissions outside the band 5150-5250 MHz, indoor operation only:
Limit: -27 dBm/MHz EIRP outside of the band 5150–5250 MHz.

RSS-247, 6.2.2 (2), Emissions outside the band 5250-5350 MHz:
Limit: -27 dBm/MHz EIRP outside of the band 5250–5350 MHz.

RSS-247, 6.2.3 (2), Emissions outside the bands 5470-5600 MHz and 5650-5725 MHz:
Limit: -27 dBm/MHz EIRP outside of the band 5470–5725 MHz.
Note: No operation is permitted for the frequency range 5600–5650 MHz.

RSS-247, 6.2.4 (2), Emissions outside the band 5725-5825 MHz:
Limit: -27 dBm/MHz EIRP outside of the band 5715–5835 MHz and additionally
Limit: -17 dBm/MHz EIRP within the frequency ranges 5715–5725 and 5825–5835 MHz.

C) FCC & IC

FCC Part 15 Subpart E, §15.405

The provisions of §§ 15.203 and 15.205 are included.

§15.407 (b)(6)

Unwanted emissions below 1 GHz must comply with the general field strength limits set forth in § 15.209.

§15.407 (b)(7)

The provisions of §15.205 apply to intentional radiators operating under this section

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

| Frequency in MHz | Limit (μ V/m) | Measurement distance (m) | Limits (dB μ V/m) |
|------------------|--------------------|--------------------------|-----------------------|
| 0.009 – 0.49 | 2400/F(kHz)@300m | 3 | (48.5 – 13.8)@300m |
| 0.49 – 1.705 | 24000/F(kHz)@30m | 3 | (33.8 – 23.0)@30m |
| 1.705 – 30 | 30@30m | 3 | 29.5@30m |

The measured values are corrected with an inverse linear distance extrapolation factor (40 dB/decade) according FCC 15.31 (2).

| Frequency in MHz | Limit (μ V/m) | Measurement distance (m) | Limits (dB μ V/m) |
|------------------|--------------------|--------------------------|-----------------------|
| 30 – 88 | 100@3m | 3 | 40.0@3m |
| 88 – 216 | 150@3m | 3 | 43.5@3m |
| 216 – 960 | 200@3m | 3 | 46.0@3m |
| 960 - 26000 | 500@3m | 3 | 54.0@3m |
| 26000 - 40000 | 500@3m | 1 | 54.0@3m |

The measured values above 26 GHz are corrected with an inverse linear distance extrapolation factor (20 dB/decade).

§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 (dB μ V/m) = 20 log (Limit (μ V/m)/1 μ V/m)
- Limit (dB μ V/m) = EIRP [dBm] – 20 log (d [m]) + 104.8

Limit types (in result tables on next page):

RB – Emissions falls into a “Restricted Band” according FCC §§15.205 and 15.209 *)

UE – “Undesirable Emission Limit” according FCC §15.407

BE-RB – Band Edge Limit basing on “Restricted Band Limits”

BE-UE – Band Edge Limit basing on “Undesirable Emission Limit”

*) Below 1 GHz the limits of §15.209 are applied for all frequencies.

4.6.3 TEST PROTOCOL

Ambient temperature: 24–29 °C

Air Pressure: 1000–1009 hPa

Humidity: 33–49 %

| WLAN a-Mode; 20 MHz; 6 Mbit/s | | | | Applied duty cycle correction (AV) [dB]: 0.2 | | | | |
|-------------------------------|------------------------|----------------------|-------------------------------|--|-----------|----------------------|-------------|-----------|
| Ch. No. | Ch. Center Freq. [MHz] | Spurious Freq. [MHz] | Spurious Level [dB μ V/m] | Detector | RBW [kHz] | Limit [dB μ V/m] | Margin [dB] | LimitType |
| 36 | 5180.0 | - | - | - | - | - | - | - |
| 44 | 5220.0 | - | - | - | - | - | - | - |
| 48 | 5240.0 | - | - | - | - | - | - | - |
| 149 | 5745.0 | 3830.0 | 44.8 | AV | 1000.0 | 54.0 | 9.2 | RB |
| 157 | 5785.0 | 3856.0 | 45.9 | AV | 1000.0 | 54.0 | 8.1 | RB |
| 165 | 5825.0 | 3883.4 | 57.2 | PEAK | 1000.0 | 74.0 | 16.8 | RB |
| 165 | 5825.0 | 3883.4 | 49.2 | AV | 1000.0 | 54.0 | 4.8 | RB |

| WLAN ac-Mode; 20 MHz; 86.7 Mbit/s MCS8 | | | | Applied duty cycle correction (AV) [dB]: 0.2 | | | | |
|--|------------------------|----------------------|-------------------------------|--|-----------|----------------------|-------------|-----------|
| Ch. No. | Ch. Center Freq. [MHz] | Spurious Freq. [MHz] | Spurious Level [dB μ V/m] | Detector | RBW [kHz] | Limit [dB μ V/m] | Margin [dB] | LimitType |
| 36 | 5180.0 | 4845.0 | 56.8 | PEAK | 1000.0 | 74.0 | 17.2 | RB |
| 36 | 5180.0 | 4845.0 | 43.6 | AV | 1000.0 | 54.0 | 10.4 | RB |
| 36 | 5180.0 | 22107.5 | 56.4 | PEAK | 1000.0 | 74.0 | 17.7 | RB |
| 36 | 5180.0 | 22107.5 | 42.4 | AV | 1000.0 | 54.0 | 11.6 | RB |
| 44 | 5220.0 | 31.5 | 26.1 | QP | 100.0 | 40.0 | 13.9 | RB |
| 44 | 5220.0 | 48.2 | 32.3 | QP | 100.0 | 40.0 | 7.7 | RB |
| 44 | 5220.0 | 83.5 | 28.3 | QP | 100.0 | 40.0 | 11.7 | RB |
| 44 | 5220.0 | 91.4 | 30.3 | QP | 100.0 | 43.5 | 13.2 | RB |
| 44 | 5220.0 | 120.0 | 31.3 | QP | 100.0 | 43.5 | 12.2 | RB |
| 44 | 5220.0 | 161.9 | 27.0 | QP | 100.0 | 43.5 | 16.5 | RB |
| 44 | 5220.0 | 173.8 | 24.6 | QP | 100.0 | 43.5 | 18.9 | RB |
| 44 | 5220.0 | 289.8 | 23.6 | QP | 100.0 | 46.0 | 22.4 | RB |
| 44 | 5220.0 | 480.0 | 37.2 | QP | 100.0 | 46.0 | 8.8 | RB |
| 44 | 5220.0 | 511.1 | 27.1 | QP | 100.0 | 46.0 | 18.9 | RB |
| 44 | 5220.0 | 540.0 | 39.4 | QP | 100.0 | 46.0 | 6.6 | RB |
| 44 | 5220.0 | 607.3 | 31.7 | QP | 100.0 | 46.0 | 14.3 | RB |
| 44 | 5220.0 | 840.0 | 30.8 | QP | 100.0 | 46.0 | 15.2 | RB |

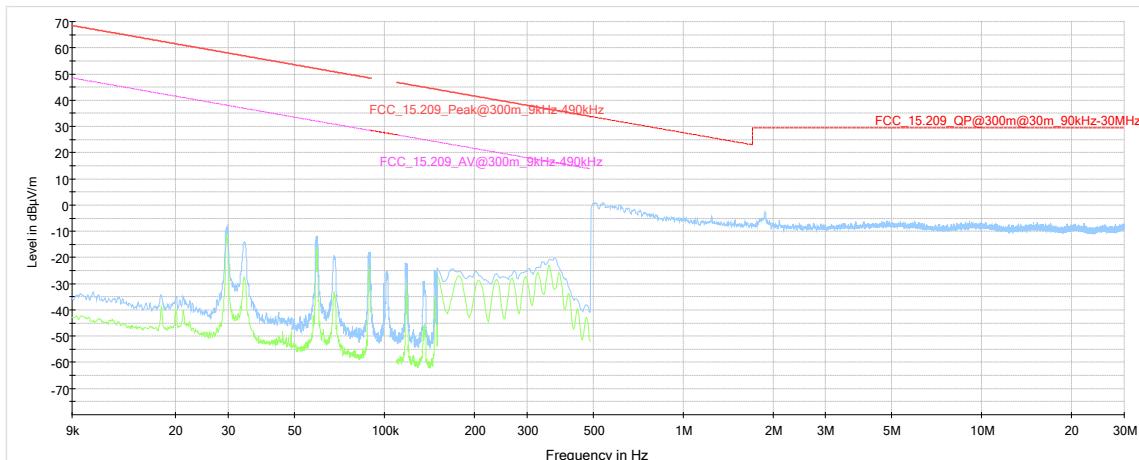
| | | | | | | | | |
|-----|--------|--------|------|------|--------|------|------|----|
| 44 | 5220.0 | 4821.1 | 56.2 | PEAK | 1000.0 | 74.0 | 17.8 | RB |
| 44 | 5220.0 | 4821.1 | 43.7 | AV | 1000.0 | 54.0 | 10.3 | RB |
| 149 | 5745.0 | 5724.8 | 61.0 | PEAK | 1000.0 | 74.0 | 13.1 | RB |
| 157 | 5785.0 | 39.2 | 34.1 | QP | 100.0 | 40.0 | 5.9 | RB |
| 157 | 5785.0 | 48.7 | 29.0 | QP | 100.0 | 40.0 | 11.1 | RB |
| 157 | 5785.0 | 85.9 | 27.6 | QP | 100.0 | 40.0 | 12.4 | RB |
| 157 | 5785.0 | 87.5 | 37.8 | QP | 100.0 | 40.0 | 2.2 | RB |
| 157 | 5785.0 | 120.1 | 32.5 | QP | 100.0 | 43.5 | 11.0 | RB |
| 157 | 5785.0 | 480.0 | 41.1 | QP | 100.0 | 46.0 | 4.9 | RB |
| 157 | 5785.0 | 511.2 | 32.1 | QP | 100.0 | 46.0 | 13.9 | RB |
| 157 | 5785.0 | 540.0 | 38.4 | QP | 100.0 | 46.0 | 7.6 | RB |
| 157 | 5785.0 | 607.1 | 30.3 | QP | 100.0 | 46.0 | 15.8 | RB |
| 165 | 5825.0 | 3883.2 | 56.2 | PEAK | 1000.0 | 74.0 | 17.8 | RB |
| 165 | 5825.0 | 3883.2 | 43.2 | AV | 1000.0 | 54.0 | 10.8 | RB |

Remark: Please see next sub-clause for the measurement plot.

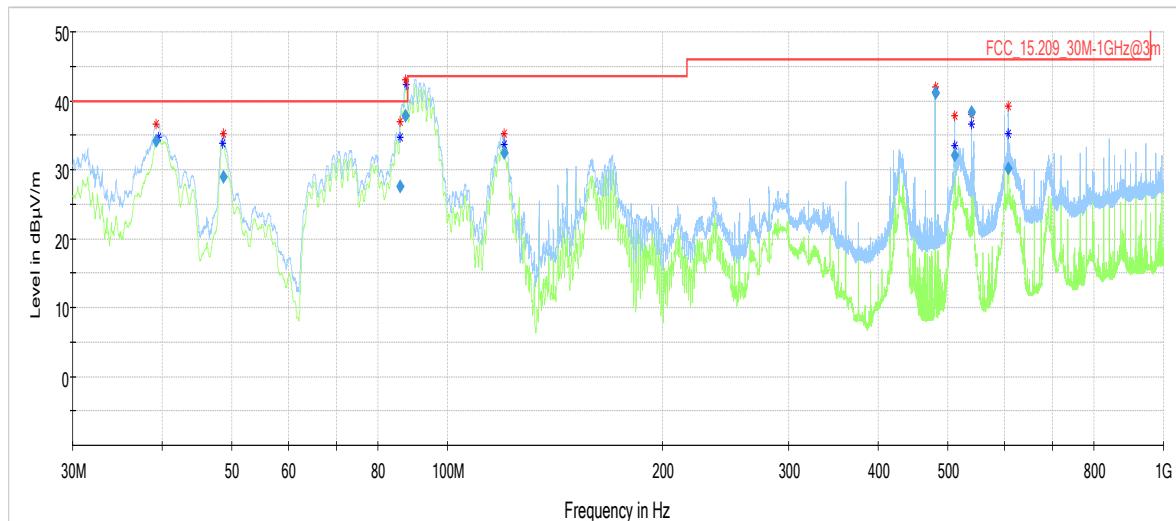
COMMENT:

No (further) spurious emissions in the range 20 dB below the limit found. Because no significant spurious emissions have been found, the measurement range for WLAN a-mode was reduced up to 18 GHz and the measurements for WLAN n-mode were not repeated.

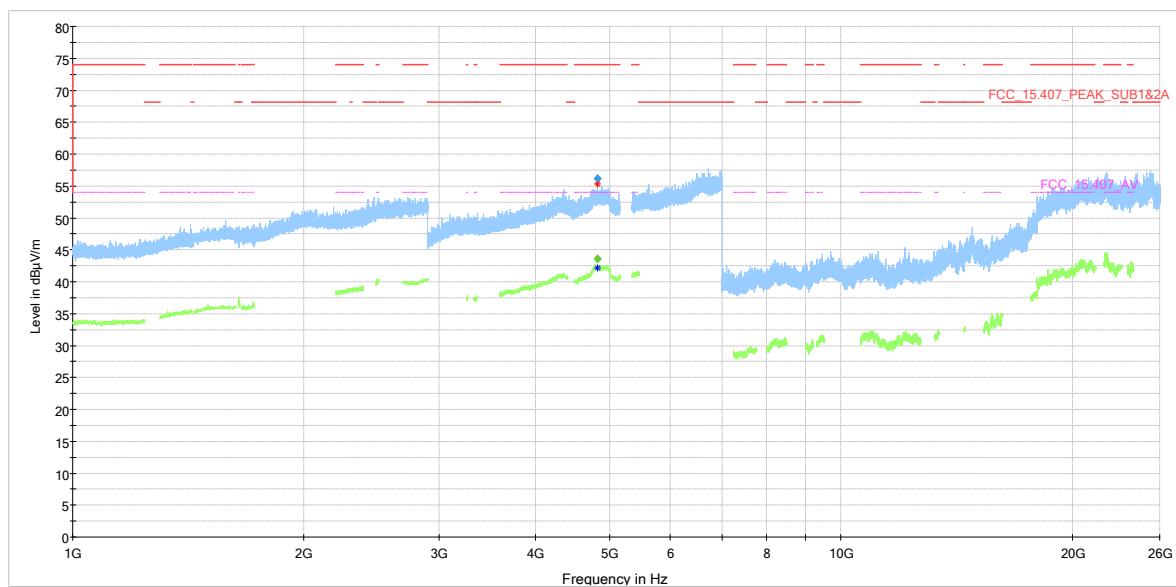
4.6.4 MEASUREMENT PLOT (SHOWING THE HIGHEST VALUE, "WORST CASE")



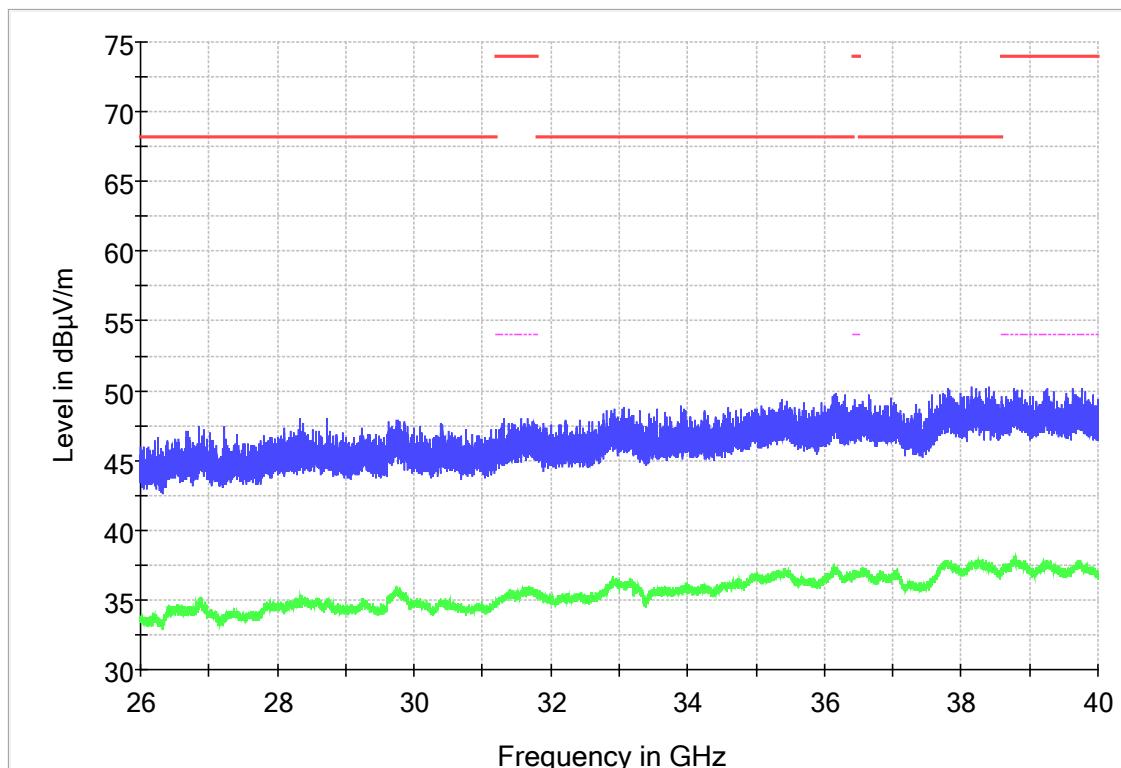
WLAN ac-mode, 20 MHz, CH 36



WLAN ac-mode, 20 MHz, CH 157



WLAN ac-mode, 20 MHz, CH 44



WLAN ac-mode, 20 MHz, CH 44

4.6.5 TEST EQUIPMENT USED

Radiated Emissions

4.7 BAND EDGE

Standard FCC Part 15 Subpart E

The test was performed according to:
ANSI C63.10

4.7.1 TEST DESCRIPTION

Please see test description for the test case "Spurious Radiated Emissions"

4.7.2 TEST REQUIREMENTS / LIMITS

For band edges connected to a restricted band, the limits are specified in Section 15.209(a)

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

| Frequency in MHz | Limit (μ V/m) | Measurement distance (m) | Limits (dB μ V/m) |
|------------------|--------------------|--------------------------|-----------------------|
| 0.009 – 0.49 | 2400/F(kHz)@300m | 3 | (48.5 – 13.8)@300m |
| 0.49 – 1.705 | 24000/F(kHz)@30m | 3 | (33.8 – 23.0)@30m |
| 1.705 – 30 | 30@30m | 3 | 29.5@30m |

The measured values are corrected with an inverse linear distance extrapolation factor (40 dB/decade) according FCC 15.31 (2).

| Frequency in MHz | Limit (μ V/m) | Measurement distance (m) | Limits (dB μ V/m) |
|------------------|--------------------|--------------------------|-----------------------|
| 30 – 88 | 100@3m | 3 | 40.0@3m |
| 88 – 216 | 150@3m | 3 | 43.5@3m |
| 216 – 960 | 200@3m | 3 | 46.0@3m |
| 960 - 26000 | 500@3m | 3 | 54.0@3m |
| 26000 - 40000 | 500@3m | 1 | 54.0@3m |

The measured values above 26 GHz are corrected with an inverse linear distance extrapolation factor (20 dB/decade).

§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 (dB μ V/m) = 20 log (Limit (μ V/m)/1 μ V/m)

4.7.3 TEST PROTOCOL

Ambient temperature: 24–29 °C

Air Pressure: 1000–1009 hPa

Humidity: 33–49 %

| WLAN a-Mode; 20 MHz; 6 Mbit/s | | | | | Applied duty cycle correction (AV) [dB]: 0.2 | | | |
|-------------------------------|--------|-------------|-----------------------|-------------------------|--|-----------|----------------|-------------|
| U-NII-Subband | Ch. No | Freq. [MHz] | Band Edge Freq. [MHz] | Spurious Level [dByV/m] | Detector | RBW [kHz] | Limit [dBμV/m] | Margin [dB] |
| 1 | 36 | 5180.0 | 5150.0 | 55.8 | PEAK | 1000.0 | 74.0 | 18.2 |
| | 36 | 5180.0 | 5150.0 | 43.3 | AV | 1000.0 | 54.0 | 10.7 |
| 3 | 149 | 5745.0 | 5725.0 | 55.1 | PEAK | 1000.0 | 78.0 | 22.9 |
| | 165 | 5825.0 | 5850.0 | 53.1 | PEAK | 1000.0 | 78.0 | 24.9 |

| WLAN n-Mode; 20 MHz; 72.2 Mbit/s MCS7 | | | | | Applied duty cycle correction (AV) [dB]: 0.1 | | | |
|---------------------------------------|--------|-------------|-----------------------|-------------------------|--|-----------|----------------|-------------|
| U-NII-Subband | Ch. No | Freq. [MHz] | Band Edge Freq. [MHz] | Spurious Level [dByV/m] | Detector | RBW [kHz] | Limit [dBμV/m] | Margin [dB] |
| 1 | 36 | 5180.0 | 5150.0 | 56.4 | PEAK | 1000.0 | 74.0 | 17.6 |
| | 36 | 5180.0 | 5150.0 | 43.2 | AV | 1000.0 | 54.0 | 10.8 |
| 3 | 149 | 5745.0 | 5725.0 | 59.6 | PEAK | 1000.0 | 78.0 | 18.4 |
| | 165 | 5825.0 | 5850.0 | 53.8 | PEAK | 1000.0 | 78.0 | 24.2 |

| WLAN n-Mode; 40 MHz; 150 Mbit/s MCS7 | | | | | Applied duty cycle correction (AV) [dB]: 0.3 | | | |
|--------------------------------------|--------|-------------|-----------------------|-------------------------|--|-----------|----------------|-------------|
| U-NII-Subband | Ch. No | Freq. [MHz] | Band Edge Freq. [MHz] | Spurious Level [dByV/m] | Detector | RBW [kHz] | Limit [dBμV/m] | Margin [dB] |
| 1 | 38 | 5190.0 | 5150.0 | 59.0 | PEAK | 1000.0 | 74.0 | 15.0 |
| | 38 | 5190.0 | 5150.0 | 44.5 | AV | 1000.0 | 54.0 | 9.5 |
| 3 | 151 | 5755.0 | 5725.0 | 58.0 | PEAK | 1000.0 | 78.0 | 20.0 |
| | 159 | 5795.0 | 5850.0 | 53.5 | PEAK | 1000.0 | 78.0 | 24.5 |

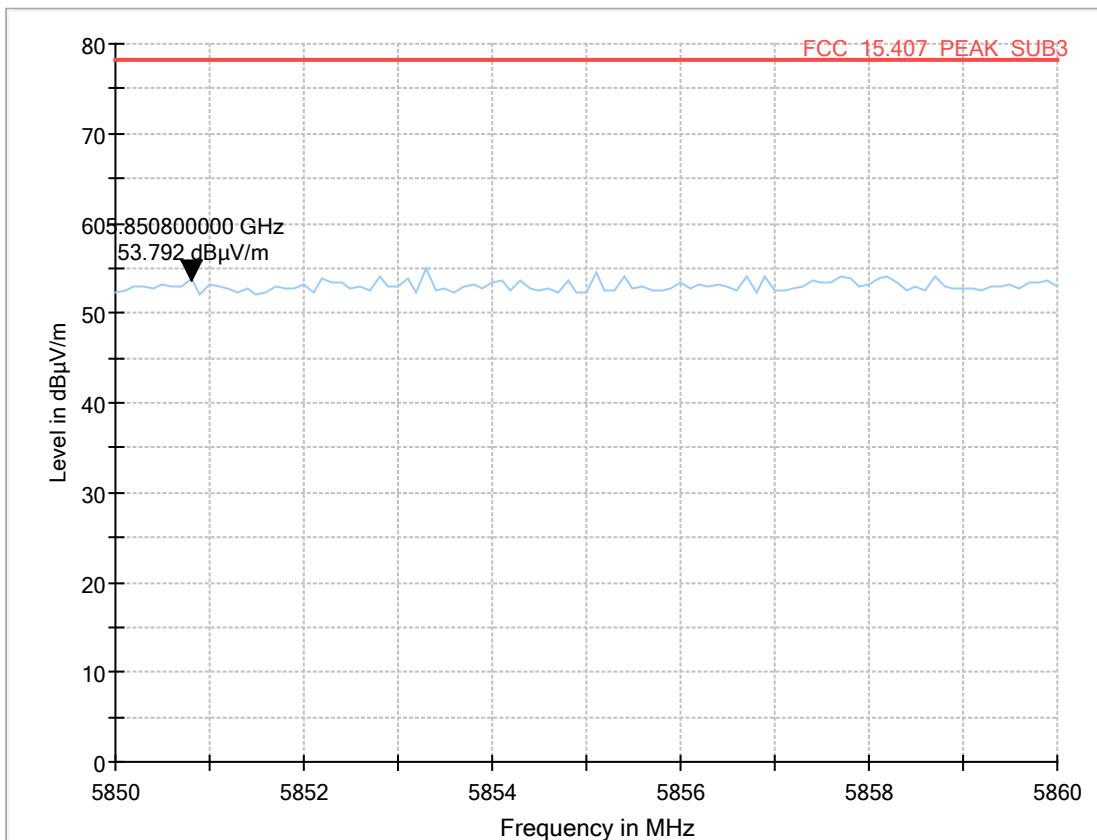
| WLAN ac-Mode; 20 MHz; 86.7 Mbit/s MCS8 | | | | | Applied duty cycle correction (AV) [dB]: 0.2 | | | |
|--|--------|-------------|-----------------------|-------------------------|--|-----------|----------------|-------------|
| U-NII-Subband | Ch. No | Freq. [MHz] | Band Edge Freq. [MHz] | Spurious Level [dByV/m] | Detector | RBW [kHz] | Limit [dBμV/m] | Margin [dB] |
| 1 | 36 | 5180.0 | 5150.0 | 56.4 | PEAK | 1000.0 | 74.0 | 17.7 |
| | 36 | 5180.0 | 5150.0 | 43.3 | AV | 1000.0 | 54.0 | 10.7 |
| 3 | 149 | 5745.0 | 5725.0 | 69.5 | PEAK | 1000.0 | 78.0 | 8.5 |
| | 165 | 5825.0 | 5850.0 | 57.1 | PEAK | 1000.0 | 78.0 | 20.9 |

| WLAN ac-Mode; 40 MHz; 200 Mbit/s MCS9 | | | | | Applied duty cycle correction (AV) [dB]: 0.4 | | | |
|---------------------------------------|--------|-------------|-----------------------|-------------------------|--|-----------|----------------|-------------|
| U-NII-Subband | Ch. No | Freq. [MHz] | Band Edge Freq. [MHz] | Spurious Level [dByV/m] | Detector | RBW [kHz] | Limit [dBμV/m] | Margin [dB] |
| 1 | 38 | 5190.0 | 5150.0 | 56.3 | PEAK | 1000.0 | 74.0 | 17.7 |
| | 38 | 5190.0 | 5150.0 | 44.3 | AV | 1000.0 | 54.0 | 9.7 |
| 3 | 151 | 5755.0 | 5725.0 | 66.1 | PEAK | 1000.0 | 78.0 | 11.9 |
| | 159 | 5795.0 | 5850.0 | 53.5 | PEAK | 1000.0 | 78.0 | 24.5 |

| WLAN ac-Mode; 80 MHz; 433.3 Mbit/s MCS9 | | | | | Applied duty cycle correction (AV) [dB]: 0.7 | | | |
|---|--------|-------------|-----------------------|-------------------------|--|-----------|----------------|-------------|
| U-NII-Subband | Ch. No | Freq. [MHz] | Band Edge Freq. [MHz] | Spurious Level [dByV/m] | Detector | RBW [kHz] | Limit [dBμV/m] | Margin [dB] |
| 1 | 42 | 5210.0 | 5150.0 | 62.6 | PEAK | 1000.0 | 74.0 | 11.4 |
| | 42 | 5210.0 | 5150.0 | 46.3 | AV | 1000.0 | 54.0 | 7.7 |
| 3 | 155 | 5775.0 | 5725.0 | 53.8 | PEAK | 1000.0 | 78.0 | 24.2 |

Remark: Please see next sub-clause for the measurement plot.

4.7.4 MEASUREMENT PLOT (SHOWING THE HIGHEST VALUE, "WORST CASE")



WLAN ac-mode, 80 MHz, CH 155

4.7.5 TEST EQUIPMENT USED

Radiated Emissions

5 TEST EQUIPMENT

1 Radiated Emissions

Lab to perform radiated emission tests

| Ref.No. | Device Name | Description | Manufacturer | Serial Number | Last Calibration | Calibration Due |
|---------|-------------------------------|---|----------------------|-------------------------|------------------|-----------------|
| 1.1 | 3160-09 | Standard Gain / Pyramidal Horn Antenna 26.5 GHz | EMCO Elektronic GmbH | 00083069 | | |
| 1.2 | WHKX 7.0/18G-8SS | High Pass Filter | Wainwright | 09 | | |
| 1.3 | 5HC3500/1800 0-1.2-KK | High Pass Filter | Trilithic | 200035008 | | |
| 1.4 | Datum MFS | Rubidium Frequency Normal MFS | Datum GmbH | 002 | 2015-08 | 2016-08 |
| 1.5 | Fully Anechoic Room | 8.80m x 4.60m x 4.05m (l x w x h) | Albatross Projects | P26971-647-001-PRB | | |
| 1.6 | AM 4.0 | Antenna mast | Maturo GmbH | AM4.0/180/1192 0513 | | |
| 1.7 | ESR 7 | EMI Receiver / Spectrum Analyzer | Rohde & Schwarz | 101424 | 2014-11 | 2016-11 |
| 1.8 | TT 1.5 WI | Turn Table | Maturo GmbH | - | | |
| 1.9 | Anechoic Chamber | 10.58 x 6.38 x 6.00 m ³ | Frankonia | none | 2014-01 | 2017-01 |
| 1.10 | Fluke 177 | Digital Multimeter 03 (Multimeter) | Fluke Europe B.V. | 86670383 | 2016-02 | 2018-02 |
| 1.11 | ESIB 26 | Spectrum Analyzer | Rohde & Schwarz | 830482/004 | 2015-12 | 2017-12 |
| 1.12 | Tilt device Maturo (Rohacell) | Antrieb TD1.5-10kg | Maturo GmbH | TD1.5-10kg/024/37907 09 | | |
| 1.13 | 5HC2700/1275 0-1.5-KK | High Pass Filter | Trilithic | 9942012 | | |
| 1.14 | AS 620 P | Antenna mast | HD GmbH | 620/37 | | |
| 1.15 | NRV-Z1 | Sensor Head A | Rohde & Schwarz | 827753/005 | 2016-05 | 2017-05 |
| 1.16 | 4HC1600/1275 0-1.5-KK | High Pass Filter | Trilithic | 9942011 | | |
| 1.17 | ASP 1.2/1.8-10 kg | Antenna Mast | Maturo GmbH | - | | |

| Ref.No. | Device Name | Description | Manufacturer | Serial Number | Last Calibration | Calibration Due |
|---------|----------------------|---|-----------------------------------|---------------|------------------|-----------------|
| 1.18 | JS4-18002600-32-5P | Broadband Amplifier 18 GHz - 26 GHz | Miteq | 849785 | | |
| 1.19 | JS4-00101800-35-5P | Broadband Amplifier 30 MHz - 18 GHz | Miteq | 896037 | | |
| 1.20 | HL 562 | Ultralog new biconicals | Rohde & Schwarz | 830547/003 | 2015-06 | 2018-06 |
| 1.21 | Opus10 THI (8152.00) | ThermoHygro Datalogger 12 (Environ) | Lufft Mess- und Regeltechnik GmbH | 12482 | 2015-03 | 2017-03 |
| 1.22 | JS4-00102600-42-5A | Broadband Amplifier 30 MHz - 26 GHz | Miteq | 619368 | | |
| 1.23 | HFH2-Z2 | Loop Antenna | Rohde & Schwarz | 829324/006 | 2014-11 | 2017-11 |
| 1.24 | FSW 43 | Spectrum Analyzer | Rohde & Schwarz | 103779 | 2014-11 | 2016-11 |
| 1.25 | Opus10 TPR (8253.00) | ThermoAirpressure Datalogger 13 (Environ) | Lufft Mess- und Regeltechnik GmbH | 13936 | 2015-02 | 2017-02 |
| 1.26 | Chroma 6404 | AC Power Source | Chroma ATE INC. | 64040001304 | | |
| 1.27 | 3160-10 | Standard Gain / Pyramidal Horn Antenna 40 GHz | EMCO Elektronik GmbH | 00086675 | | |
| 1.28 | HL 562 Ultralog | Log.-per. Antenna | Rohde & Schwarz | 100609 | 2016-04 | 2019-04 |
| 1.29 | PAS 2.5 - 10 kg | Antenna Mast | Maturo GmbH | - | | |
| 1.30 | HF 907 | Double-ridged horn | Rohde & Schwarz | 102444 | 2015-05 | 2018-05 |

2 R&S TS8997
EN300328/301893 Test Lab

| Ref.No. | Device Name | Description | Manufacturer | Serial Number | Last Calibration | Calibration Due |
|---------|----------------------|--|-----------------------------------|----------------|------------------|-----------------|
| 2.1 | OSP120 | Switching Unit with integrated power meter | Rohde & Schwarz | 101158 | 2015-08 | 2016-08 |
| 2.2 | A8455-4 | 4 Way Power Divider (SMA) | | - | | |
| 2.3 | Fluke 177 | Digital Multimeter 03 (Multimeter) | Fluke Europe B.V. | 86670383 | 2016-02 | 2018-02 |
| 2.4 | Opus10 THI (8152.00) | ThermoHygro Datalogger 03 (Environ) | Lufft Mess- und Regeltechnik GmbH | 7482 | 2015-02 | 2017-02 |
| 2.5 | SMB100A | Signal Generator 9 kHz - 6 GHz | Rohde & Schwarz | 107695 | 2014-06 | 2017-06 |
| 2.6 | VT 4002 | Climatic Chamber | Vötsch | 58566002150010 | 2016-03 | 2018-03 |
| 2.7 | FSV30 | Signal Analyzer 10 Hz - 30 GHz | Rohde & Schwarz | 103005 | 2016-02 | 2018-02 |
| 2.8 | SMBV100A | Vector Signal Generator 9 kHz - 6 GHz | Rohde & Schwarz | 259291 | 2013-08 | 2016-08 |
| 2.9 | 1515 / 93459 | Broadband Power Divider SMA (Aux) | Weinschel Associates | LN673 | | |
| 2.10 | Datum, Model: MFS | Rubidium Frequency Standard | Datum-Beverly | 5489/001 | 2016-06 | 2017-06 |

The calibration interval is the time interval between "Last Calibration" and "Calibration Due"

6 ANTENNA FACTORS, CABLE LOSS AND SAMPLE CALCULATIONS

This chapter contains the antenna factors with their corresponding path loss of the used measurement path for all antennas as well as the insertion loss of the LISN.

6.1 LISN R&S ESH3-Z5 (150 KHZ – 30 MHZ)

| Frequency | | Corr. | LISN insertion loss ESH3-Z5 | cable loss (incl. 10 dB attenuator) |
|-----------|--|-------|-----------------------------|-------------------------------------|
| MHz | | dB | dB | dB |
| 0,15 | | 10,1 | 0,1 | 10,0 |
| 5 | | 10,3 | 0,1 | 10,2 |
| 7 | | 10,5 | 0,2 | 10,3 |
| 10 | | 10,5 | 0,2 | 10,3 |
| 12 | | 10,7 | 0,3 | 10,4 |
| 14 | | 10,7 | 0,3 | 10,4 |
| 16 | | 10,8 | 0,4 | 10,4 |
| 18 | | 10,9 | 0,4 | 10,5 |
| 20 | | 10,9 | 0,4 | 10,5 |
| 22 | | 11,1 | 0,5 | 10,6 |
| 24 | | 11,1 | 0,5 | 10,6 |
| 26 | | 11,2 | 0,5 | 10,7 |
| 28 | | 11,2 | 0,5 | 10,7 |
| 30 | | 11,3 | 0,5 | 10,8 |

Sample calculation

$$U_{\text{LISN}} (\text{dB } \mu\text{V}) = U (\text{dB } \mu\text{V}) + \text{Corr. (dB)}$$

U = Receiver reading

LISN Insertion loss = Voltage Division Factor of LISN

Corr. = sum of single correction factors of used LISN, cables, switch units (if used)

Linear interpolation will be used for frequencies in between the values in the table.

6.2 ANTENNA R&S HFH2-Z2 (9 KHZ – 30 MHZ)

| Frequency | AF HFH-Z2) | Corr. | cable loss 1 (inside chamber) | cable loss 2 (outside chamber) | cable loss 3 (switch unit) | cable loss 4 (to receiver) | distance corr. (-40 dB/ decade) | d _{limit} (meas. distance (limit)) | d _{used} (meas. distance (used)) |
|-----------|---------------|-------|--|---|-------------------------------------|-------------------------------------|--|--|--|
| | | | dB | dB | dB | dB | dB | m | m |
| 0,009 | 20,50 | -79,6 | 0,1 | 0,1 | 0,1 | 0,1 | -80 | 300 | 3 |
| 0,01 | 20,45 | -79,6 | 0,1 | 0,1 | 0,1 | 0,1 | -80 | 300 | 3 |
| 0,015 | 20,37 | -79,6 | 0,1 | 0,1 | 0,1 | 0,1 | -80 | 300 | 3 |
| 0,02 | 20,36 | -79,6 | 0,1 | 0,1 | 0,1 | 0,1 | -80 | 300 | 3 |
| 0,025 | 20,38 | -79,6 | 0,1 | 0,1 | 0,1 | 0,1 | -80 | 300 | 3 |
| 0,03 | 20,32 | -79,6 | 0,1 | 0,1 | 0,1 | 0,1 | -80 | 300 | 3 |
| 0,05 | 20,35 | -79,6 | 0,1 | 0,1 | 0,1 | 0,1 | -80 | 300 | 3 |
| 0,08 | 20,30 | -79,6 | 0,1 | 0,1 | 0,1 | 0,1 | -80 | 300 | 3 |
| 0,1 | 20,20 | -79,6 | 0,1 | 0,1 | 0,1 | 0,1 | -80 | 300 | 3 |
| 0,2 | 20,17 | -79,6 | 0,1 | 0,1 | 0,1 | 0,1 | -80 | 300 | 3 |
| 0,3 | 20,14 | -79,6 | 0,1 | 0,1 | 0,1 | 0,1 | -80 | 300 | 3 |
| 0,49 | 20,12 | -79,6 | 0,1 | 0,1 | 0,1 | 0,1 | -80 | 300 | 3 |
| 0,490001 | 20,12 | -39,6 | 0,1 | 0,1 | 0,1 | 0,1 | -40 | 30 | 3 |
| 0,5 | 20,11 | -39,6 | 0,1 | 0,1 | 0,1 | 0,1 | -40 | 30 | 3 |
| 0,8 | 20,10 | -39,6 | 0,1 | 0,1 | 0,1 | 0,1 | -40 | 30 | 3 |
| 1 | 20,09 | -39,6 | 0,1 | 0,1 | 0,1 | 0,1 | -40 | 30 | 3 |
| 2 | 20,08 | -39,6 | 0,1 | 0,1 | 0,1 | 0,1 | -40 | 30 | 3 |
| 3 | 20,06 | -39,6 | 0,1 | 0,1 | 0,1 | 0,1 | -40 | 30 | 3 |
| 4 | 20,05 | -39,5 | 0,2 | 0,1 | 0,1 | 0,1 | -40 | 30 | 3 |
| 5 | 20,05 | -39,5 | 0,2 | 0,1 | 0,1 | 0,1 | -40 | 30 | 3 |
| 6 | 20,02 | -39,5 | 0,2 | 0,1 | 0,1 | 0,1 | -40 | 30 | 3 |
| 8 | 19,95 | -39,5 | 0,2 | 0,1 | 0,1 | 0,1 | -40 | 30 | 3 |
| 10 | 19,83 | -39,4 | 0,2 | 0,1 | 0,2 | 0,1 | -40 | 30 | 3 |
| 12 | 19,71 | -39,4 | 0,2 | 0,1 | 0,2 | 0,1 | -40 | 30 | 3 |
| 14 | 19,54 | -39,4 | 0,2 | 0,1 | 0,2 | 0,1 | -40 | 30 | 3 |
| 16 | 19,53 | -39,3 | 0,3 | 0,1 | 0,2 | 0,1 | -40 | 30 | 3 |
| 18 | 19,50 | -39,3 | 0,3 | 0,1 | 0,2 | 0,1 | -40 | 30 | 3 |
| 20 | 19,57 | -39,3 | 0,3 | 0,1 | 0,2 | 0,1 | -40 | 30 | 3 |
| 22 | 19,61 | -39,3 | 0,3 | 0,1 | 0,2 | 0,1 | -40 | 30 | 3 |
| 24 | 19,61 | -39,3 | 0,3 | 0,1 | 0,2 | 0,1 | -40 | 30 | 3 |
| 26 | 19,54 | -39,3 | 0,3 | 0,1 | 0,2 | 0,1 | -40 | 30 | 3 |
| 28 | 19,46 | -39,2 | 0,3 | 0,1 | 0,3 | 0,1 | -40 | 30 | 3 |
| 30 | 19,73 | -39,1 | 0,4 | 0,1 | 0,3 | 0,1 | -40 | 30 | 3 |

Sample calculation

$$E \text{ (dB } \mu\text{V/m)} = U \text{ (dB } \mu\text{V)} + AF \text{ (dB } 1/\text{m)} + \text{Corr. (dB)}$$

U = Receiver reading

AF = Antenna factor

Corr. = sum of single correction factors of used cables, switch unit, distance correction, amplifier (if applicable)
distance correction = $-40 * \log(d_{\text{limit}}/d_{\text{used}})$

Linear interpolation will be used for frequencies in between the values in the table.

Table shows an extract of values

6.3 ANTENNA R&S HL562 (30 MHZ – 1 GHZ)

($d_{\text{Limit}} = 3 \text{ m}$)

| Frequency | AF R&S HL562 | Corr. |
|-----------|--------------------|-------|
| MHz | dB (1/m) | dB |
| 30 | 18,6 | 0,6 |
| 50 | 6,0 | 0,9 |
| 100 | 9,7 | 1,2 |
| 150 | 7,9 | 1,6 |
| 200 | 7,6 | 1,9 |
| 250 | 9,5 | 2,1 |
| 300 | 11,0 | 2,3 |
| 350 | 12,4 | 2,6 |
| 400 | 13,6 | 2,9 |
| 450 | 14,7 | 3,1 |
| 500 | 15,6 | 3,2 |
| 550 | 16,3 | 3,5 |
| 600 | 17,2 | 3,5 |
| 650 | 18,1 | 3,6 |
| 700 | 18,5 | 3,6 |
| 750 | 19,1 | 4,1 |
| 800 | 19,6 | 4,1 |
| 850 | 20,1 | 4,4 |
| 900 | 20,8 | 4,7 |
| 950 | 21,1 | 4,8 |
| 1000 | 21,6 | 4,9 |

| cable loss 1 (inside chamber) | cable loss 2 (outside chamber) | cable loss 3 (switch unit) | cable loss 4 (to receiver) | distance corr. (-20 dB/ decade) | d_{Limit} (meas. distance (limit)) | d_{used} (meas. distance (used)) |
|--|---|-------------------------------------|-------------------------------------|--|--|--|
| dB | dB | dB | dB | dB | m | m |
| 0,29 | 0,04 | 0,23 | 0,02 | 0,0 | 3 | 3 |
| 0,39 | 0,09 | 0,32 | 0,08 | 0,0 | 3 | 3 |
| 0,56 | 0,14 | 0,47 | 0,08 | 0,0 | 3 | 3 |
| 0,73 | 0,20 | 0,59 | 0,12 | 0,0 | 3 | 3 |
| 0,84 | 0,21 | 0,70 | 0,11 | 0,0 | 3 | 3 |
| 0,98 | 0,24 | 0,80 | 0,13 | 0,0 | 3 | 3 |
| 1,04 | 0,26 | 0,89 | 0,15 | 0,0 | 3 | 3 |
| 1,18 | 0,31 | 0,96 | 0,13 | 0,0 | 3 | 3 |
| 1,28 | 0,35 | 1,03 | 0,19 | 0,0 | 3 | 3 |
| 1,39 | 0,38 | 1,11 | 0,22 | 0,0 | 3 | 3 |
| 1,44 | 0,39 | 1,20 | 0,19 | 0,0 | 3 | 3 |
| 1,55 | 0,46 | 1,24 | 0,23 | 0,0 | 3 | 3 |
| 1,59 | 0,43 | 1,29 | 0,23 | 0,0 | 3 | 3 |
| 1,67 | 0,34 | 1,35 | 0,22 | 0,0 | 3 | 3 |
| 1,67 | 0,42 | 1,41 | 0,15 | 0,0 | 3 | 3 |
| 1,87 | 0,54 | 1,46 | 0,25 | 0,0 | 3 | 3 |
| 1,90 | 0,46 | 1,51 | 0,25 | 0,0 | 3 | 3 |
| 1,99 | 0,60 | 1,56 | 0,27 | 0,0 | 3 | 3 |
| 2,14 | 0,60 | 1,63 | 0,29 | 0,0 | 3 | 3 |
| 2,22 | 0,60 | 1,66 | 0,33 | 0,0 | 3 | 3 |
| 2,23 | 0,61 | 1,71 | 0,30 | 0,0 | 3 | 3 |

($d_{\text{Limit}} = 10 \text{ m}$)

| | | |
|------|------|------|
| 30 | 18,6 | -9,9 |
| 50 | 6,0 | -9,6 |
| 100 | 9,7 | -9,2 |
| 150 | 7,9 | -8,8 |
| 200 | 7,6 | -8,6 |
| 250 | 9,5 | -8,3 |
| 300 | 11,0 | -8,1 |
| 350 | 12,4 | -7,9 |
| 400 | 13,6 | -7,6 |
| 450 | 14,7 | -7,4 |
| 500 | 15,6 | -7,2 |
| 550 | 16,3 | -7,0 |
| 600 | 17,2 | -6,9 |
| 650 | 18,1 | -6,9 |
| 700 | 18,5 | -6,8 |
| 750 | 19,1 | -6,3 |
| 800 | 19,6 | -6,3 |
| 850 | 20,1 | -6,0 |
| 900 | 20,8 | -5,8 |
| 950 | 21,1 | -5,6 |
| 1000 | 21,6 | -5,6 |

| | | | | | | |
|------|------|------|------|-------|----|---|
| 0,29 | 0,04 | 0,23 | 0,02 | -10,5 | 10 | 3 |
| 0,39 | 0,09 | 0,32 | 0,08 | -10,5 | 10 | 3 |
| 0,56 | 0,14 | 0,47 | 0,08 | -10,5 | 10 | 3 |
| 0,73 | 0,20 | 0,59 | 0,12 | -10,5 | 10 | 3 |
| 0,84 | 0,21 | 0,70 | 0,11 | -10,5 | 10 | 3 |
| 0,98 | 0,24 | 0,80 | 0,13 | -10,5 | 10 | 3 |
| 1,04 | 0,26 | 0,89 | 0,15 | -10,5 | 10 | 3 |
| 1,18 | 0,31 | 0,96 | 0,13 | -10,5 | 10 | 3 |
| 1,28 | 0,35 | 1,03 | 0,19 | -10,5 | 10 | 3 |
| 1,39 | 0,38 | 1,11 | 0,22 | -10,5 | 10 | 3 |
| 1,44 | 0,39 | 1,20 | 0,19 | -10,5 | 10 | 3 |
| 1,55 | 0,46 | 1,24 | 0,23 | -10,5 | 10 | 3 |
| 1,59 | 0,43 | 1,29 | 0,23 | -10,5 | 10 | 3 |
| 1,67 | 0,34 | 1,35 | 0,22 | -10,5 | 10 | 3 |
| 1,67 | 0,42 | 1,41 | 0,15 | -10,5 | 10 | 3 |
| 1,87 | 0,54 | 1,46 | 0,25 | -10,5 | 10 | 3 |
| 1,90 | 0,46 | 1,51 | 0,25 | -10,5 | 10 | 3 |
| 1,99 | 0,60 | 1,56 | 0,27 | -10,5 | 10 | 3 |
| 2,14 | 0,60 | 1,63 | 0,29 | -10,5 | 10 | 3 |
| 2,22 | 0,60 | 1,66 | 0,33 | -10,5 | 10 | 3 |
| 2,23 | 0,61 | 1,71 | 0,30 | -10,5 | 10 | 3 |

Sample calculation

$$E (\text{dB } \mu\text{V}/\text{m}) = U (\text{dB } \mu\text{V}) + AF (\text{dB } 1/\text{m}) + \text{Corr. (dB)}$$

U = Receiver reading

AF = Antenna factor

Corr. = sum of single correction factors of used cables, switch unit, distance correction, amplifier (if applicable)
distance correction = $-20 * \text{LOG} (d_{\text{Limit}} / d_{\text{used}})$

Linear interpolation will be used for frequencies in between the values in the table.

Tables show an extract of values.

6.4 ANTENNA R&S HF907 (1 GHZ – 18 GHZ)

| Frequency | AF R&S HF907 | Corr. |
|-----------|--------------------|-------|
| MHz | dB (1/m) | dB |
| 1000 | 24,4 | -19,4 |
| 2000 | 28,5 | -17,4 |
| 3000 | 31,0 | -16,1 |
| 4000 | 33,1 | -14,7 |
| 5000 | 34,4 | -13,7 |
| 6000 | 34,7 | -12,7 |
| 7000 | 35,6 | -11,0 |

| cable loss 1 (relay + cable inside chamber) | cable loss 2 (outside chamber) | cable loss 3 (switch unit, atten- uator & pre-amp) | cable loss 4 (to receiver) | | |
|--|---|--|----------------------------------|--|--|
| dB | dB | dB | dB | | |
| 0,99 | 0,31 | -21,51 | 0,79 | | |
| 1,44 | 0,44 | -20,63 | 1,38 | | |
| 1,87 | 0,53 | -19,85 | 1,33 | | |
| 2,41 | 0,67 | -19,13 | 1,31 | | |
| 2,78 | 0,86 | -18,71 | 1,40 | | |
| 2,74 | 0,90 | -17,83 | 1,47 | | |
| 2,82 | 0,86 | -16,19 | 1,46 | | |

| Frequency | AF R&S HF907 | Corr. |
|-----------|--------------------|-------|
| MHz | dB (1/m) | dB |
| 3000 | 31,0 | -23,4 |
| 4000 | 33,1 | -23,3 |
| 5000 | 34,4 | -21,7 |
| 6000 | 34,7 | -21,2 |
| 7000 | 35,6 | -19,8 |

| cable loss 1 (relay inside chamber) | cable loss 2 (inside chamber) | cable loss 3 (outside chamber) | cable loss 4 (switch unit, atten- uator & pre-amp) | cable loss 5 (to receiver) | used for FCC 15.247 |
|---|--|---|--|----------------------------------|------------------------------|
| dB | dB | dB | dB | dB | |
| 0,47 | 1,87 | 0,53 | -27,58 | 1,33 | |
| 0,56 | 2,41 | 0,67 | -28,23 | 1,31 | |
| 0,61 | 2,78 | 0,86 | -27,35 | 1,40 | |
| 0,58 | 2,74 | 0,90 | -26,89 | 1,47 | |
| 0,66 | 2,82 | 0,86 | -25,58 | 1,46 | |

| Frequency | AF R&S HF907 | Corr. |
|-----------|--------------------|-------|
| MHz | dB (1/m) | dB |
| 7000 | 35,6 | -57,3 |
| 8000 | 36,3 | -56,3 |
| 9000 | 37,1 | -55,3 |
| 10000 | 37,5 | -56,2 |
| 11000 | 37,5 | -55,3 |
| 12000 | 37,6 | -53,7 |
| 13000 | 38,2 | -53,5 |
| 14000 | 39,9 | -56,3 |
| 15000 | 40,9 | -54,1 |
| 16000 | 41,3 | -54,1 |
| 17000 | 42,8 | -54,4 |
| 18000 | 44,2 | -54,7 |

| cable loss 1 (relay inside chamber) | cable loss 2 (High Pass) | cable loss 3 (pre- amp) | cable loss 4 (inside chamber) | cable loss 5 (outside chamber) | cable loss 6 (to receiver) |
|---|-----------------------------------|----------------------------------|--|---|-------------------------------------|
| dB | dB | dB | dB | dB | dB |
| 0,56 | 1,28 | -62,72 | 2,66 | 0,94 | 1,46 |
| 0,69 | 0,71 | -61,49 | 2,84 | 1,00 | 1,53 |
| 0,68 | 0,65 | -60,80 | 3,06 | 1,09 | 1,60 |
| 0,70 | 0,54 | -61,91 | 3,28 | 1,20 | 1,67 |
| 0,80 | 0,61 | -61,40 | 3,43 | 1,27 | 1,70 |
| 0,84 | 0,42 | -59,70 | 3,53 | 1,26 | 1,73 |
| 0,83 | 0,44 | -59,81 | 3,75 | 1,32 | 1,83 |
| 0,91 | 0,53 | -63,03 | 3,91 | 1,40 | 1,77 |
| 0,98 | 0,54 | -61,05 | 4,02 | 1,44 | 1,83 |
| 1,23 | 0,49 | -61,51 | 4,17 | 1,51 | 1,85 |
| 1,36 | 0,76 | -62,36 | 4,34 | 1,53 | 2,00 |
| 1,70 | 0,53 | -62,88 | 4,41 | 1,55 | 1,91 |

Sample calculation

$$E \text{ (dB } \mu\text{V/m)} = U \text{ (dB } \mu\text{V)} + AF \text{ (dB 1/m)} + \text{Corr. (dB)}$$

U = Receiver reading

AF = Antenna factor

Corr. = sum of single correction factors of used cables, switch unit, distance correction, amplifier (if applicable)
Linear interpolation will be used for frequencies in between the values in the table.

Tables show an extract of values.

6.5 ANTENNA EMCO 3160-09 (18 GHZ – 26.5 GHZ)

| Frequency | AF EMCO 3160-09 | Corr. | cable | cable | cable | cable | cable |
|-----------|-----------------------|-------|-------------------------------|-------------------------|-------------------------------|----------------------------|----------------------------|
| | | | loss 1 (inside chamber) | loss 2 (pre- amp) | loss 3 (inside chamber) | loss 4 (switch unit) | loss 5 (to receiver) |
| MHz | dB (1/m) | dB | dB | dB | dB | dB | dB |
| 18000 | 40,2 | -23,5 | 0,72 | -35,85 | 6,20 | 2,81 | 2,65 |
| 18500 | 40,2 | -23,2 | 0,69 | -35,71 | 6,46 | 2,76 | 2,59 |
| 19000 | 40,2 | -22,0 | 0,76 | -35,44 | 6,69 | 3,15 | 2,79 |
| 19500 | 40,3 | -21,3 | 0,74 | -35,07 | 7,04 | 3,11 | 2,91 |
| 20000 | 40,3 | -20,3 | 0,72 | -34,49 | 7,30 | 3,07 | 3,05 |
| 20500 | 40,3 | -19,9 | 0,78 | -34,46 | 7,48 | 3,12 | 3,15 |
| 21000 | 40,3 | -19,1 | 0,87 | -34,07 | 7,61 | 3,20 | 3,33 |
| 21500 | 40,3 | -19,1 | 0,90 | -33,96 | 7,47 | 3,28 | 3,19 |
| 22000 | 40,3 | -18,7 | 0,89 | -33,57 | 7,34 | 3,35 | 3,28 |
| 22500 | 40,4 | -19,0 | 0,87 | -33,66 | 7,06 | 3,75 | 2,94 |
| 23000 | 40,4 | -19,5 | 0,88 | -33,75 | 6,92 | 3,77 | 2,70 |
| 23500 | 40,4 | -19,3 | 0,90 | -33,35 | 6,99 | 3,52 | 2,66 |
| 24000 | 40,4 | -19,8 | 0,88 | -33,99 | 6,88 | 3,88 | 2,58 |
| 24500 | 40,4 | -19,5 | 0,91 | -33,89 | 7,01 | 3,93 | 2,51 |
| 25000 | 40,4 | -19,3 | 0,88 | -33,00 | 6,72 | 3,96 | 2,14 |
| 25500 | 40,5 | -20,4 | 0,89 | -34,07 | 6,90 | 3,66 | 2,22 |
| 26000 | 40,5 | -21,3 | 0,86 | -35,11 | 7,02 | 3,69 | 2,28 |
| 26500 | 40,5 | -21,1 | 0,90 | -35,20 | 7,15 | 3,91 | 2,36 |

Sample calculation

$$E \text{ (dB } \mu\text{V/m)} = U \text{ (dB } \mu\text{V)} + AF \text{ (dB } 1/\text{m)} + \text{Corr. (dB)}$$

U = Receiver reading

AF = Antenna factor

Corr. = sum of single correction factors of used cables, switch unit, distance correction, amplifier (if applicable)

Linear interpolation will be used for frequencies in between the values in the table.

Table shows an extract of values.

6.6 ANTENNA EMCO 3160-10 (26.5 GHZ – 40 GHZ)

| Frequency | AF EMCO 3160-10 | Corr. | cable loss 1 (inside chamber) | cable loss 2 (outside chamber) | cable loss 3 (switch unit) | cable loss 4 (to receiver) | distance corr. (-20 dB/ decade) | d _{limit} (meas. distance (limit)) | d _{used} (meas. distance (used)) |
|-----------|-----------------------|-------|--|---|-------------------------------------|-------------------------------------|--|--|--|
| | | | dB | dB | dB | dB | m | m | |
| 26,5 | 43,4 | -11,2 | 4,4 | | | | -15,6 | 3 | 0,5 |
| 27,0 | 43,4 | -11,2 | 4,4 | | | | -15,6 | 3 | 0,5 |
| 28,0 | 43,4 | -11,1 | 4,5 | | | | -15,6 | 3 | 0,5 |
| 29,0 | 43,5 | -11,0 | 4,6 | | | | -15,6 | 3 | 0,5 |
| 30,0 | 43,5 | -10,9 | 4,7 | | | | -15,6 | 3 | 0,5 |
| 31,0 | 43,5 | -10,8 | 4,7 | | | | -15,6 | 3 | 0,5 |
| 32,0 | 43,5 | -10,7 | 4,8 | | | | -15,6 | 3 | 0,5 |
| 33,0 | 43,6 | -10,7 | 4,9 | | | | -15,6 | 3 | 0,5 |
| 34,0 | 43,6 | -10,6 | 5,0 | | | | -15,6 | 3 | 0,5 |
| 35,0 | 43,6 | -10,5 | 5,1 | | | | -15,6 | 3 | 0,5 |
| 36,0 | 43,6 | -10,4 | 5,1 | | | | -15,6 | 3 | 0,5 |
| 37,0 | 43,7 | -10,3 | 5,2 | | | | -15,6 | 3 | 0,5 |
| 38,0 | 43,7 | -10,2 | 5,3 | | | | -15,6 | 3 | 0,5 |
| 39,0 | 43,7 | -10,2 | 5,4 | | | | -15,6 | 3 | 0,5 |
| 40,0 | 43,8 | -10,1 | 5,5 | | | | -15,6 | 3 | 0,5 |

Sample calculation

$$E \text{ (dB } \mu\text{V/m)} = U \text{ (dB } \mu\text{V)} + AF \text{ (dB } 1/\text{m)} + Corr. \text{ (dB)}$$

U = Receiver reading

AF = Antenna factor

Corr. = sum of single correction factors of used cables, switch unit, distance correction, amplifier (if applicable)

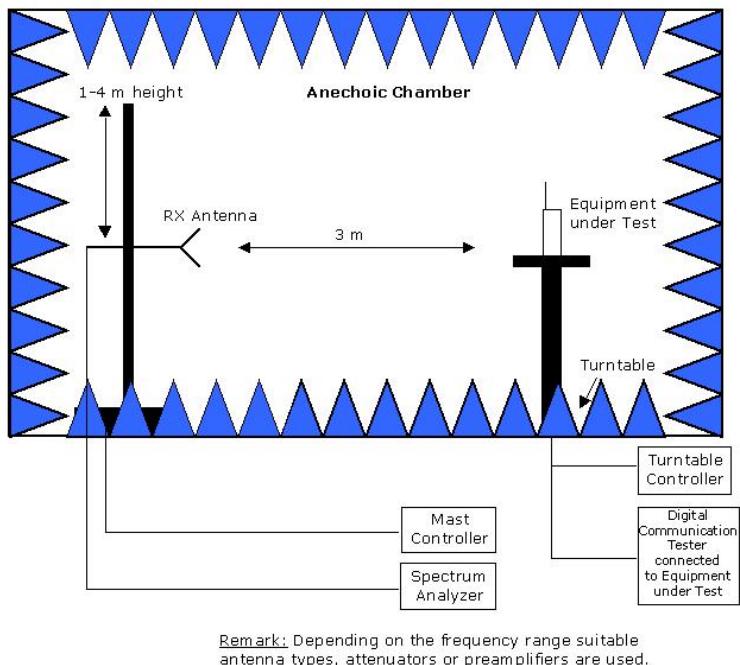
Linear interpolation will be used for frequencies in between the values in the table.

distance correction = $-20 * \log(d_{\text{limit}} / d_{\text{used}})$

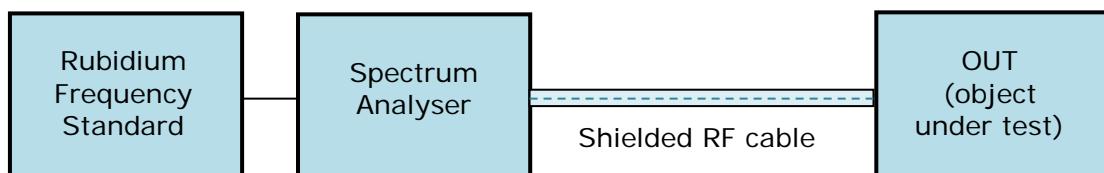
Linear interpolation will be used for frequencies in between the values in the table.

Table shows an extract of values.

7 SETUP DRAWINGS



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



Drawing 2: Setup for conducted radio tests.

8 MEASUREMENT UNCERTAINTIES

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

9 PHOTO REPORT

Please see separate photo report.