

FCC Measurement/Technical Report on

50165

Bluetooth® / Bluetooth® Low Energy / WLAN Wireless Module

FCC ID: TXH-50165

IC: 6315A-50165

Test Report Reference: MDE_COGNEX_1803_FCC_06

Test Laboratory:

7layers GmbH
Borsigstrasse 11
40880 Ratingen
Germany



Deutsche
Akkreditierungsstelle
D-PL-12140-01-01
D-PL-12140-01-02
D-PL-12140-01-03

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.

7layers GmbH

Borsigstraße 11
40880 Ratingen, Germany
T +49 (0) 2102 749 0
F +49 (0) 2102 749 350

Geschäftsführer/

Managing Directors:

Frank Spiller
Bernhard Retka
Alexandre Norré-Oudard

Registergericht/registered:

Düsseldorf HRB 75554
USt-Id.-Nr./VAT-No. DE203159652
Steuer-Nr./TAX-No. 147/5869/0385

*a Bureau Veritas
Group Company*

www.7layers.com

Table of Contents

1	Applied Standards and Test Summary	3
1.1	Applied Standards	3
1.2	FCC-IC Correlation Table	4
1.3	Measurement Summary	5
2	Revision History / Signatures	15
3	Administrative Data	16
3.1	Testing Laboratory	16
3.2	Project Data	16
3.3	Applicant Data	16
3.4	Manufacturer Data	16
4	Test object Data	17
4.1	General EUT Description	17
4.2	EUT Main components	18
4.3	Ancillary Equipment	18
4.4	Auxiliary Equipment	19
4.5	EUT Setups	19
4.6	Operating Modes / Test Channels	20
4.7	Product labelling	20
4.8	Duty Cycle Plots	20
5	Test Results	22
5.1	AC Conducted Emissions	22
5.2	26 dB Bandwidth	26
5.3	6 dB Bandwidth	29
5.4	99 % Bandwidth	32
5.5	Maximum Conducted Output Power	35
5.6	Peak Power Spectral Density	40
5.7	Undesirable Emissions; General Field Strength Limits	44
5.8	Band Edge	54
6	Test Equipment	76
7	Antenna Factors, Cable Loss and Sample Calculations	79
7.1	LISN R&S ESH3-Z5 (150 kHz – 30 MHz)	79
7.2	Antenna R&S HFH2-Z2 (9 kHz – 30 MHz)	80
7.3	Antenna R&S HL562 (30 MHz – 1 GHz)	81
7.4	Antenna R&S HF907 (1 GHz – 18 GHz)	82
7.5	Antenna EMCO 3160-09 (18 GHz – 26.5 GHz)	83
7.6	Antenna EMCO 3160-10 (26.5 GHz – 40 GHz)	84
8	Photo Report	84
9	Measurement Uncertainties	85

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 and 15 (10-1-19 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 New Rules v02r01, 2017-12-14”.

ANSI C63.10-2013 is applied.

1.2 FCC-IC CORRELATION TABLE

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

UNII equipment

Measurement	FCC reference	IC reference
Conducted emissions on AC Mains	§ 15.207	RSS-Gen Issue 5+A1+A2: 8.8
Occupied bandwidth	§ 15.403 (i) (26 dB) / § 15.407 (e) (6 dB)	RSS-247 Issue 2: 6.2.1.1, 6.2.2.1, 6.2.3.1 (99%) RSS-247 Issue 2: 6.2.4.1 (6 dB)
Maximum conducted output power	§ 15.407 (a) (1),(2),(3),(4)	RSS-247 Issue 2: 6.2.1.1, 6.2.2.1, 6.2.3.1, 6.2.4.1
Maximum power spectral density	§ 15.407 (a) (1),(2),(3),(5)	RSS-247 Issue 2: 6.2.1.1, 6.2.2.1, 6.2.3.1, 6.2.4.1
Transmitter undesirable emissions; General Field Strength Limits, Restricted Bands	§ 15.407 (b) § 15.209 (a)	RSS-Gen Issue 5+A1+A2: 6.13/8.9/8.10; RSS-247 Issue 2: 3.3/6.2 6.2.1.2, 6.2.2.2, 6.2.3.2, 6.2.4.2
Frequency stability	§ 15.407 (g)	RSS-Gen Issue 5+A1+A2: 6.11/8.11
Transmit Power Control (TPC) and Dynamic Frequency Selection (DFS)	§ 15.407 (h)	RSS-247 Issue 2: 6.2.2.1, 6.2.3.1, 6.3
Antenna requirement	§ 15.203 / 15.204	RSS-Gen Issue 5+A1+A2: 6.8
Receiver spurious emissions	—	—

1.3 MEASUREMENT SUMMARY

47 CFR CHAPTER I FCC PART 15 Subpart E §15.407

FCC §15.207

AC Conducted Emissions

The measurement was performed according to ANSI C63.10

Final Result

OP-Mode

Operating mode

worst case

Remark: target power set to: 20 dBm

Setup

S02_AE02

Date

2020-03-12

FCC

Passed

IC

Passed

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

Radio Technology, Operating Frequency, Subband

WLAN a, high, U-NII-1

Remark: target power set to: 20 dBm

WLAN a, high, U-NII-2A

Remark: target power set to: 20 dBm

WLAN a, high, U-NII-2C

Remark: target power set to: 20 dBm

WLAN a, high, U-NII-3

Remark: target power set to: 20 dBm

WLAN a, low, U-NII-1

Remark: target power set to: 20 dBm

WLAN a, low, U-NII-2A

Remark: target power set to: 20 dBm

WLAN a, low, U-NII-2C

Remark: target power set to: 20 dBm

WLAN a, low, U-NII-3

Remark: target power set to: 20 dBm

WLAN a, mid, U-NII-1

Remark: target power set to: 20 dBm

WLAN a, mid, U-NII-2A

Remark: target power set to: 20 dBm

WLAN a, mid, U-NII-2C

Remark: target power set to: 20 dBm

WLAN a, mid, U-NII-3

Remark: target power set to: 20 dBm

WLAN ac 20 MHz, high, U-NII-1

Remark: target power set to: 20 dBm

WLAN ac 20 MHz, high, U-NII-2A

Remark: target power set to: 20 dBm

WLAN ac 20 MHz, high, U-NII-2C

Remark: target power set to: 20 dBm

WLAN ac 20 MHz, high, U-NII-3

Remark: target power set to: 20 dBm

WLAN ac 20 MHz, low, U-NII-1

Remark: target power set to: 20 dBm

WLAN ac 20 MHz, low, U-NII-2A

Remark: target power set to: 20 dBm

Setup

S01_AH02

S01_AH02

S01_AH02

S01_AH02

S01_AH02

S01_AH02

S01_AH02

S01_AH02

S01_AH02

S01_AH02

S01_AH02

S01_AH02

S01_AH02

S01_AH02

S01_AH02

S01_AH02

S01_AH02

S01_AH02

Date

2020-02-17

2020-02-17

2020-02-17

2020-02-17

2020-02-17

2020-02-17

2020-02-17

2020-02-17

2020-02-17

2020-02-17

2020-02-17

2020-02-17

2020-02-18

2020-02-18

2020-02-18

2020-02-18

2020-02-18

2020-02-18

FCC

Performed

Performed

Performed

Performed

Performed

Performed

Performed

Performed

Performed

Performed

Performed

Performed

Performed

Performed

Performed

Performed

Performed

Performed

IC

N/A

N/A

N/A

N/A

N/A

N/A

N/A

N/A

N/A

N/A

N/A

N/A

N/A

N/A

N/A

N/A

N/A

N/A

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 Radio Technology, Operating Frequency, Subband	Setup	Date	FCC	IC
WLAN ac 20 MHz, low, U-NII-2C Remark: target power set to: 20 dBm	S01_AH02	2020-02-18	Performed	N/A
WLAN ac 20 MHz, low, U-NII-3 Remark: target power set to: 20 dBm	S01_AH02	2020-02-18	Performed	N/A
WLAN ac 20 MHz, mid, U-NII-1 Remark: target power set to: 20 dBm	S01_AH02	2020-02-18	Performed	N/A
WLAN ac 20 MHz, mid, U-NII-2A Remark: target power set to: 20 dBm	S01_AH02	2020-02-18	Performed	N/A
WLAN ac 20 MHz, mid, U-NII-2C Remark: target power set to: 20 dBm	S01_AH02	2020-02-18	Performed	N/A
WLAN ac 20 MHz, mid, U-NII-3 Remark: target power set to: 20 dBm	S01_AH02	2020-02-18	Performed	N/A
WLAN n 20 MHz, high, U-NII-1 Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	Performed	N/A
WLAN n 20 MHz, high, U-NII-2A Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	Performed	N/A
WLAN n 20 MHz, high, U-NII-2C Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	Performed	N/A
WLAN n 20 MHz, high, U-NII-3 Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	Performed	N/A
WLAN n 20 MHz, low, U-NII-1 Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	Performed	N/A
WLAN n 20 MHz, low, U-NII-2A Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	Performed	N/A
WLAN n 20 MHz, low, U-NII-2C Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	Performed	N/A
WLAN n 20 MHz, low, U-NII-3 Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	Performed	N/A
WLAN n 20 MHz, mid, U-NII-1 Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	Performed	N/A
WLAN n 20 MHz, mid, U-NII-2A Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	Performed	N/A
WLAN n 20 MHz, mid, U-NII-2C Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	Performed	N/A
WLAN n 20 MHz, mid, U-NII-3 Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	Performed	N/A

47 CFR CHAPTER I FCC PART 15
Subpart E §15.407

FCC §15.31, §15.407 (e)

6 dB Bandwidth

The measurement was performed according to ANSI C63.10

Final Result

OP-Mode Radio Technology, Operating Frequency, Subband	Setup	Date	FCC	IC
WLAN a, high, U-NII-3 Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	Passed	Passed
WLAN a, low, U-NII-3 Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	Passed	Passed
WLAN a, mid, U-NII-3 Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	Passed	Passed

**47 CFR CHAPTER I FCC PART 15
Subpart E §15.407**

FCC §15.31, §15.407 (e)

6 dB Bandwidth

The measurement was performed according to ANSI C63.10

Final Result

OP-Mode Radio Technology, Operating Frequency, Subband	Setup	Date	FCC	IC
WLAN ac 20 MHz, high, U-NII-3 Remark: target power set to: 20 dBm	S01_AH02	2020-02-18	Passed	Passed
WLAN ac 20 MHz, low, U-NII-3 Remark: target power set to: 20 dBm	S01_AH02	2020-02-18	Passed	Passed
WLAN ac 20 MHz, mid, U-NII-3 Remark: target power set to: 20 dBm	S01_AH02	2020-02-18	Passed	Passed
WLAN n 20 MHz, high, U-NII-3 Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	Passed	Passed
WLAN n 20 MHz, low, U-NII-3 Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	Passed	Passed
WLAN n 20 MHz, mid, U-NII-3 Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	Passed	Passed

**47 CFR CHAPTER I FCC PART 15
Subpart E §15.407**

FCC §15.31, IC RSS 247 Ch. 6.2.x

99 % Bandwidth

The measurement was performed according to ANSI C63.10

Final Result

OP-Mode Radio Technology, Operating Frequency, Subband	Setup	Date	FCC	IC
WLAN a, high, U-NII-1 Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	N/A	Performed
WLAN a, high, U-NII-2A Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	N/A	Performed
WLAN a, high, U-NII-2C Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	N/A	Performed
WLAN a, high, U-NII-3 Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	N/A	Performed
WLAN a, low, U-NII-1 Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	N/A	Performed
WLAN a, low, U-NII-2A Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	N/A	Performed
WLAN a, low, U-NII-2C Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	N/A	Performed
WLAN a, low, U-NII-3 Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	N/A	Performed
WLAN a, mid, U-NII-1 Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	N/A	Performed
WLAN a, mid, U-NII-2A Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	N/A	Performed
WLAN a, mid, U-NII-2C Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	N/A	Performed
WLAN a, mid, U-NII-3 Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	N/A	Performed
WLAN ac 20 MHz, high, U-NII-1 Remark: target power set to: 20 dBm	S01_AH02	2020-02-18	N/A	Performed
WLAN ac 20 MHz, high, U-NII-2A Remark: target power set to: 20 dBm	S01_AH02	2020-02-18	N/A	Performed
WLAN ac 20 MHz, high, U-NII-2C Remark: target power set to: 20 dBm	S01_AH02	2020-02-18	N/A	Performed

**47 CFR CHAPTER I FCC PART 15
Subpart E §15.407**

FCC §15.31, IC RSS 247 Ch. 6.2.x

99 % Bandwidth

The measurement was performed according to ANSI C63.10

Final Result

OP-Mode Radio Technology, Operating Frequency, Subband	Setup	Date	FCC	IC
WLAN ac 20 MHz, high, U-NII-3 Remark: target power set to: 20 dBm	S01_AH02	2020-02-18	N/A	Performed
WLAN ac 20 MHz, low, U-NII-1 Remark: target power set to: 20 dBm	S01_AH02	2020-02-18	N/A	Performed
WLAN ac 20 MHz, low, U-NII-2A Remark: target power set to: 20 dBm	S01_AH02	2020-02-18	N/A	Performed
WLAN ac 20 MHz, low, U-NII-2C Remark: target power set to: 20 dBm	S01_AH02	2020-02-18	N/A	Performed
WLAN ac 20 MHz, low, U-NII-3 Remark: target power set to: 20 dBm	S01_AH02	2020-02-18	N/A	Performed
WLAN ac 20 MHz, mid, U-NII-1 Remark: target power set to: 20 dBm	S01_AH02	2020-02-18	N/A	Performed
WLAN ac 20 MHz, mid, U-NII-2A Remark: target power set to: 20 dBm	S01_AH02	2020-02-18	N/A	Performed
WLAN ac 20 MHz, mid, U-NII-2C Remark: target power set to: 20 dBm	S01_AH02	2020-02-18	N/A	Performed
WLAN ac 20 MHz, mid, U-NII-3 Remark: target power set to: 20 dBm	S01_AH02	2020-02-18	N/A	Performed
WLAN n 20 MHz, high, U-NII-1 Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	N/A	Performed
WLAN n 20 MHz, high, U-NII-2A Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	N/A	Performed
WLAN n 20 MHz, high, U-NII-2C Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	N/A	Performed
WLAN n 20 MHz, high, U-NII-3 Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	N/A	Performed
WLAN n 20 MHz, low, U-NII-1 Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	N/A	Performed
WLAN n 20 MHz, low, U-NII-2A Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	N/A	Performed
WLAN n 20 MHz, low, U-NII-2C Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	N/A	Performed
WLAN n 20 MHz, low, U-NII-3 Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	N/A	Performed
WLAN n 20 MHz, mid, U-NII-1 Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	N/A	Performed
WLAN n 20 MHz, mid, U-NII-2A Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	N/A	Performed
WLAN n 20 MHz, mid, U-NII-2C Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	N/A	Performed
WLAN n 20 MHz, mid, U-NII-3 Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	N/A	Performed

47 CFR CHAPTER I FCC PART 15
Subpart E §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 Radio Technology, Operating Frequency, Subband	Setup	Date	FCC	IC
WLAN a, high, U-NII-1 Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	Passed	Passed
WLAN a, high, U-NII-2A Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	Passed	Passed
WLAN a, high, U-NII-2C Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	Passed	Passed
WLAN a, high, U-NII-3 Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	Passed	Passed
WLAN a, low, U-NII-1 Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	Passed	Passed
WLAN a, low, U-NII-2A Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	Passed	Passed
WLAN a, low, U-NII-2C Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	Passed	Passed
WLAN a, low, U-NII-3 Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	Passed	Passed
WLAN a, mid, U-NII-1 Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	Passed	Passed
WLAN a, mid, U-NII-2A Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	Passed	Passed
WLAN a, mid, U-NII-2C Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	Passed	Passed
WLAN a, mid, U-NII-3 Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	Passed	Passed
WLAN ac 20 MHz, high, U-NII-1 Remark: target power set to: 20 dBm	S01_AH02	2020-02-18	Passed	Passed
WLAN ac 20 MHz, high, U-NII-2A Remark: target power set to: 20 dBm	S01_AH02	2020-02-18	Passed	Passed
WLAN ac 20 MHz, high, U-NII-2C Remark: target power set to: 20 dBm	S01_AH02	2020-02-18	Passed	Passed
WLAN ac 20 MHz, high, U-NII-3 Remark: target power set to: 20 dBm	S01_AH02	2020-02-18	Passed	Passed
WLAN ac 20 MHz, low, U-NII-1 Remark: target power set to: 20 dBm	S01_AH02	2020-02-18	Passed	Passed
WLAN ac 20 MHz, low, U-NII-2A Remark: target power set to: 20 dBm	S01_AH02	2020-02-18	Passed	Passed
WLAN ac 20 MHz, low, U-NII-2C Remark: target power set to: 20 dBm	S01_AH02	2020-02-18	Passed	Passed
WLAN ac 20 MHz, low, U-NII-3 Remark: target power set to: 20 dBm	S01_AH02	2020-02-18	Passed	Passed
WLAN ac 20 MHz, mid, U-NII-1 Remark: target power set to: 20 dBm	S01_AH02	2020-02-18	Passed	Passed
WLAN ac 20 MHz, mid, U-NII-2A Remark: target power set to: 20 dBm	S01_AH02	2020-02-18	Passed	Passed
WLAN ac 20 MHz, mid, U-NII-2C Remark: target power set to: 20 dBm	S01_AH02	2020-02-18	Passed	Passed
WLAN ac 20 MHz, mid, U-NII-3 Remark: target power set to: 20 dBm	S01_AH02	2020-02-18	Passed	Passed
WLAN n 20 MHz, high, U-NII-1 Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	Passed	Passed

47 CFR CHAPTER I FCC PART 15
Subpart E §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 Radio Technology, Operating Frequency, Subband	Setup	Date	FCC	IC
WLAN n 20 MHz, high, U-NII-2A Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	Passed	Passed
WLAN n 20 MHz, high, U-NII-2C Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	Passed	Passed
WLAN n 20 MHz, high, U-NII-3 Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	Passed	Passed
WLAN n 20 MHz, low, U-NII-1 Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	Passed	Passed
WLAN n 20 MHz, low, U-NII-2A Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	Passed	Passed
WLAN n 20 MHz, low, U-NII-2C Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	Passed	Passed
WLAN n 20 MHz, low, U-NII-3 Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	Passed	Passed
WLAN n 20 MHz, mid, U-NII-1 Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	Passed	Passed
WLAN n 20 MHz, mid, U-NII-2A Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	Passed	Passed
WLAN n 20 MHz, mid, U-NII-2C Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	Passed	Passed
WLAN n 20 MHz, mid, U-NII-3 Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	Passed	Passed

47 CFR CHAPTER I FCC PART 15
Subpart E §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	Date	FCC	IC
WLAN a, high, U-NII-1 Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	Passed	Passed
WLAN a, high, U-NII-2A Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	Passed	Passed
WLAN a, high, U-NII-2C Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	Passed	Passed
WLAN a, high, U-NII-3 Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	Passed	Passed
WLAN a, low, U-NII-1 Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	Passed	Passed
WLAN a, low, U-NII-2A Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	Passed	Passed
WLAN a, low, U-NII-2C Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	Passed	Passed
WLAN a, low, U-NII-3 Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	Passed	Passed
WLAN a, mid, U-NII-1 Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	Passed	Passed
WLAN a, mid, U-NII-2A Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	Passed	Passed

47 CFR CHAPTER I FCC PART 15
Subpart E §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	Setup	Date	FCC	IC
Radio Technology, Operating Frequency, Subband				
WLAN a, mid, U-NII-2C Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	Passed	Passed
WLAN a, mid, U-NII-3 Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	Passed	Passed
WLAN ac 20 MHz, high, U-NII-1 Remark: target power set to: 20 dBm	S01_AH02	2020-02-18	Passed	Passed
WLAN ac 20 MHz, high, U-NII-2A Remark: target power set to: 20 dBm	S01_AH02	2020-02-18	Passed	Passed
WLAN ac 20 MHz, high, U-NII-2C Remark: target power set to: 20 dBm	S01_AH02	2020-02-18	Passed	Passed
WLAN ac 20 MHz, high, U-NII-3 Remark: target power set to: 20 dBm	S01_AH02	2020-02-18	Passed	Passed
WLAN ac 20 MHz, low, U-NII-1 Remark: target power set to: 20 dBm	S01_AH02	2020-02-18	Passed	Passed
WLAN ac 20 MHz, low, U-NII-2A Remark: target power set to: 20 dBm	S01_AH02	2020-02-18	Passed	Passed
WLAN ac 20 MHz, low, U-NII-2C Remark: target power set to: 20 dBm	S01_AH02	2020-02-18	Passed	Passed
WLAN ac 20 MHz, low, U-NII-3 Remark: target power set to: 20 dBm	S01_AH02	2020-02-18	Passed	Passed
WLAN ac 20 MHz, mid, U-NII-1 Remark: target power set to: 20 dBm	S01_AH02	2020-02-18	Passed	Passed
WLAN ac 20 MHz, mid, U-NII-2A Remark: target power set to: 20 dBm	S01_AH02	2020-02-18	Passed	Passed
WLAN ac 20 MHz, mid, U-NII-2C Remark: target power set to: 20 dBm	S01_AH02	2020-02-18	Passed	Passed
WLAN ac 20 MHz, mid, U-NII-3 Remark: target power set to: 20 dBm	S01_AH02	2020-02-18	Passed	Passed
WLAN n 20 MHz, high, U-NII-1 Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	Passed	Passed
WLAN n 20 MHz, high, U-NII-2A Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	Passed	Passed
WLAN n 20 MHz, high, U-NII-2C Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	Passed	Passed
WLAN n 20 MHz, high, U-NII-3 Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	Passed	Passed
WLAN n 20 MHz, low, U-NII-1 Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	Passed	Passed
WLAN n 20 MHz, low, U-NII-2A Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	Passed	Passed
WLAN n 20 MHz, low, U-NII-2C Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	Passed	Passed
WLAN n 20 MHz, low, U-NII-3 Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	Passed	Passed
WLAN n 20 MHz, mid, U-NII-1 Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	Passed	Passed
WLAN n 20 MHz, mid, U-NII-2A Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	Passed	Passed
WLAN n 20 MHz, mid, U-NII-2C Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	Passed	Passed

**47 CFR CHAPTER I FCC PART 15
Subpart E §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	Date	FCC	IC
WLAN n 20 MHz, mid, U-NII-3 Remark: target power set to: 20 dBm	S01_AH02	2020-02-17	Passed	Passed

**47 CFR CHAPTER I FCC PART 15
Subpart E §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	Date	FCC	IC
WLAN a, high, 1GHz - 26GHz, U-NII-1 Remark: target power set to: 20 dBm	S01_AE02	2020-02-29	Passed	Passed
WLAN a, high, 1GHz - 26GHz, U-NII-2A Remark: target power set to: 20 dBm	S01_AE02	2020-03-01	Passed	Passed
WLAN a, high, 1GHz - 26GHz, U-NII-2C Remark: target power set to: 20 dBm	S01_AL02	2020-05-16	Passed	Passed
WLAN a, high, 1GHz - 26GHz, U-NII-3 Remark: target power set to: 20 dBm	S01_AE02	2020-03-02	Passed	Passed
WLAN a, low, 1GHz - 26GHz, U-NII-1 Remark: target power set to: 20 dBm	S01_AE02	2020-02-29	Passed	Passed
WLAN a, low, 1GHz - 26GHz, U-NII-2A Remark: target power set to: 20 dBm	S01_AE02	2020-03-01	Passed	Passed
WLAN a, low, 1GHz - 26GHz, U-NII-2C Remark: target power set to: 20 dBm	S01_AL02	2020-05-07	Passed	Passed
WLAN a, low, 1GHz - 26GHz, U-NII-3 Remark: target power set to: 20 dBm	S01_AL02	2020-04-17	Passed	Passed
WLAN a, mid, 1GHz - 26GHz, U-NII-1 Remark: target power set to: 20 dBm	S01_AE02	2020-02-29	Passed	Passed
WLAN a, mid, 1GHz - 26GHz, U-NII-2A Remark: target power set to: 20 dBm	S01_AE02	2020-03-01	Passed	Passed
WLAN a, mid, 1GHz - 26GHz, U-NII-2C Remark: target power set to: 20 dBm	S01_AL02	2020-05-19	Passed	Passed
WLAN a, mid, 1GHz - 26GHz, U-NII-3 Remark: target power set to: 20 dBm	S01_AE02	2020-03-02	Passed	Passed
WLAN a, mid, 26GHz - 40GHz, U-NII-1 Remark: target power set to: 20 dBm	S01_AL02	2020-05-14	Passed	Passed
WLAN a, mid, 26GHz - 40GHz, U-NII-2A Remark: target power set to: 20 dBm	S01_AL02	2020-05-14	Passed	Passed
WLAN a, mid, 26GHz - 40GHz, U-NII-2C Remark: target power set to: 20 dBm	S01_AL02	2020-05-14	Passed	Passed
WLAN a, mid, 26GHz - 40GHz, U-NII-3 Remark: target power set to: 20 dBm	S01_AL02	2020-05-14	Passed	Passed
WLAN a, mid, 30MHz - 1GHz, U-NII-1 Remark: target power set to: 20 dBm	S01_AE02	2020-03-11	Passed	Passed
WLAN a, mid, 30MHz - 1GHz, U-NII-2A Remark: target power set to: 20 dBm	S01_AE02	2020-03-11	Passed	Passed
WLAN a, mid, 30MHz - 1GHz, U-NII-2C Remark: target power set to: 20 dBm	S01_AE02	2020-03-01	Passed	Passed
WLAN a, mid, 30MHz - 1GHz, U-NII-3 Remark: target power set to: 20 dBm	S01_AE02	2020-03-11	Passed	Passed

**47 CFR CHAPTER I FCC PART 15
Subpart E §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	Setup	Date	FCC	IC
Radio Technology, Operating Frequency, Measurement range, Subband				
WLAN a, mid, 9kHz - 30MHz, U-NII-1 Remark: target power set to: 20 dBm	S01_AE02	2020-03-11	Passed	Passed
WLAN a, mid, 9kHz - 30MHz, U-NII-2C Remark: target power set to: 20 dBm	S01_AE02	2020-03-11	Passed	Passed
WLAN n 20 MHz, high, 1GHz - 26GHz, U-NII-1 Remark: target power set to: 20 dBm; measurement range: 1-18 GHz	S01_AE02	2020-03-01	Passed	Passed
WLAN n 20 MHz, high, 1GHz - 26GHz, U-NII-2A Remark: target power set to: 20 dBm; measurement range: 1-18 GHz	S01_AE02	2020-11-18	Passed	Passed
WLAN n 20 MHz, high, 1GHz - 26GHz, U-NII-2C Remark: target power set to: 20 dBm; measurement range: 1-18 GHz	S01_AL02	2020-05-19	Passed	Passed
WLAN n 20 MHz, high, 1GHz - 26GHz, U-NII-3 Remark: target power set to: 20 dBm; measurement range: 1-18 GHz	S01_AL02	2020-05-19	Passed	Passed
WLAN n 20 MHz, low, 1GHz - 26GHz, U-NII-1 Remark: target power set to: 20 dBm; measurement range: 1-18 GHz	S01_AE02	2020-03-01	Passed	Passed
WLAN n 20 MHz, low, 1GHz - 26GHz, U-NII-2A Remark: target power set to: 20 dBm; measurement range: 1-18 GHz	S01_AE02	2020-11-17	Passed	Passed
WLAN n 20 MHz, low, 1GHz - 26GHz, U-NII-2C Remark: target power set to: 20 dBm; measurement range: 1-18 GHz	S01_AL02	2020-05-16	Passed	Passed
WLAN n 20 MHz, low, 1GHz - 26GHz, U-NII-3 Remark: target power set to: 20 dBm; measurement range: 1-18 GHz	S01_AL02	2020-04-17	Passed	Passed
WLAN n 20 MHz, mid, 1GHz - 26GHz, U-NII-1 Remark: target power set to: 20 dBm; measurement range: 1-18 GHz	S01_AE02	2020-03-01	Passed	Passed
WLAN n 20 MHz, mid, 1GHz - 26GHz, U-NII-2A Remark: target power set to: 20 dBm; measurement range: 1-18 GHz	S01_AE02	2020-11-18	Passed	Passed
WLAN n 20 MHz, mid, 1GHz - 26GHz, U-NII-2C Remark: target power set to: 20 dBm; measurement range: 1-18 GHz	S01_AL02	2020-05-19	Passed	Passed
WLAN n 20 MHz, mid, 1GHz - 26GHz, U-NII-3 Remark: target power set to: 20 dBm; measurement range: 1-18 GHz	S01_AL02	2020-05-19	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	Date	FCC	IC
WLAN a, high, U-NII-2A Remark: target power set to: 20 dBm	S01_AE02	2020-02-29	Passed	Passed
WLAN a, high, U-NII-2C Remark: target power set to: 15 dBm	S01_AL02	2020-05-16	Passed	Passed
WLAN a, high, U-NII-3 Remark: target power set to: 20 dBm	S01_AE02	2020-03-02	Passed	Passed
WLAN a, low, U-NII-1 Remark: target power set to: 18 dBm	S01_AL02	2021-01-20	Passed	Passed
WLAN a, low, U-NII-2C Remark: target power set to: 15 dBm	S01_AL02	2020-05-07	Passed	Passed
WLAN a, low, U-NII-3 Remark: target power set to: 20 dBm	S01_AL02	2020-04-17	Passed	Passed
WLAN ac 20 MHz, high, U-NII-2A Remark: target power set to: 19 dBm	S01_AL02	2020-05-19	Passed	Passed
WLAN ac 20 MHz, high, U-NII-2C Remark: target power set to: 16 dBm	S01_AL02	2020-05-16	Passed	Passed
WLAN ac 20 MHz, high, U-NII-3 Remark: target power set to: 20 dBm	S01_AL02	2020-05-19	Passed	Passed
WLAN ac 20 MHz, low, U-NII-1 Remark: target power set to: 18 dBm	S01_AL02	2021-01-20	Passed	Passed
WLAN ac 20 MHz, low, U-NII-2C Remark: target power set to: 16 dBm	S01_AL02	2020-05-16	Passed	Passed
WLAN ac 20 MHz, low, U-NII-3 Remark: target power set to: 20 dBm	S01_AL02	2020-05-19	Passed	Passed
WLAN n 20 MHz, high, U-NII-2A Remark: target power set to: 20 dBm	S01_AL02	2020-05-16	Passed	Passed
WLAN n 20 MHz, high, U-NII-2C Remark: target power set to: 16 dBm	S01_AL02	2020-05-19	Passed	Passed
WLAN n 20 MHz, high, U-NII-3 Remark: target power set to: 20 dBm	S01_AL02	2020-05-19	Passed	Passed
WLAN n 20 MHz, low, U-NII-1 Remark: target power set to: 19 dBm	S01_AL02	2021-01-20	Passed	Passed
WLAN n 20 MHz, low, U-NII-2C Remark: target power set to: 15 dBm	S01_AL02	2020-05-19	Passed	Passed
WLAN n 20 MHz, low, U-NII-3 Remark: target power set to: 20 dBm	S01_AL02	2020-04-17	Passed	Passed

N/A: Not applicable

N/P: Not performed

2 REVISION HISTORY / SIGNATURES

Report version control			
Version	Release date	Change Description	Version validity
initial	2021-08-10	--	valid
--	--	--	--

COMMENT:

Test have been performed at different target power settings. Levels have been reduced due to band-edge requirements and have not been repeated for other tests because representing worst-cases.

A detailed survey on the chosen target power settings is provided by the applicant in a separate document.



(responsible for accreditation scope)
Dipl.-Ing. Daniel Gall



(responsible for testing and report)
Dipl.-Ing. Andreas Petz



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

3 ADMINISTRATIVE DATA

3.1 TESTING LABORATORY

Company Name: 7layers GmbH
Address: Borsigstr. 11
40880 Ratingen
Germany

The test facility is accredited by the following accreditation organisation:

Laboratory accreditation no: DAkkS D-PL-12140-01-01 | -02 | -03
FCC Designation Number: DE0015
FCC Test Firm Registration: 929146
ISED CAB Identifier DE0007; ISED#: 3699A

Responsible for accreditation scope: Dipl.-Ing. Daniel Gall

Report Template Version: 2021-01-13

3.2 PROJECT DATA

Responsible for testing and report: Dipl.-Ing. Andreas Petz
Employees who performed the tests: documented internally at 7Layers
Date of Report: 2021-08-10
Testing Period: 2020-02-17 to 2021-01-20

3.3 APPLICANT DATA

Company Name: Cognex Germany Aachen GmbH
Address: Krefelder Straße 218
52070 Aachen
Germany
Contact Person: Simon Juenger

3.4 MANUFACTURER DATA

Company Name: please see Applicant Data

4 TEST OBJECT DATA

4.1 GENERAL EUT DESCRIPTION

Kind of Device product description	Cognex wireless module 50165 for integration in Cognex 8700 series Handheld Readers and Base Stations
Product name	Bluetooth® / Bluetooth® Low Energy / WLAN Wireless Module
Type	50165
Declared EUT data by the supplier	
Voltage Type	DC
Voltage Level	5 V
General product description	wireless communication module for Cognex industrial vision systems
Specific product description	The EUT is a Bluetooth and WLAN module. It supports SISO Mode only. Supported WLAN modes are a, n and ac with 20 MHz nominal BW. The U-NII bands 1, 2A, 2C and 3 are supported. Channels falling into the frequency range 5600 to 5650 MHz are supported for the USA but not supported for Canada. The module supports both roles as access point and client.
Ports of the device	UART, SDIO, I2C, +5V, GND
Antenna (5 GHz bands)	3.5 dBi
Antenna Connector Impedance	50 Ohms (Temporary antenna connector, no permanent connector available on EUT)
Tested Modulation Type	mode a: OFDM, BPSK mode n: OFDM, BPSK mode ac: OFDM, 256-QAM
Tested data rates	mode a: 6 Mbps mode n: MCS0 mode ac: MCS8
Special software used for testing	the firmware accepts control commands which can be entered at a terminal emulation, test scripts are provided by the applicant
Transmit Power Control	Supported

4.2 EUT MAIN COMPONENTS

Sample Name	Sample Code	Description
#ae02	DE1408000ae02	
Sample Parameter	Value	
Serial No.	-	
HW Version	IDI88 RC	
SW Version	VERSION_ID: 9.9.9; SW 1.21 RC0.0 w10: May 2 2019 02:41:00 version 7.45.189 (r714228 CY WLTEST) FWID 01-fc9ee776	
Comment		

Sample Name	Sample Code	Description
#ah02	DE1408000ah02	
Sample Parameter	Value	
Serial No.	-	
HW Version	IDI88 RC	
SW Version	VERSION_ID: 9.9.9; SW 1.21 RC0.0 w10: May 2 2019 02:41:00 version 7.45.189 (r714228 CY WLTEST) FWID 01-fc9ee776	
Comment		

Sample Name	Sample Code	Description
#al02	DE1408000al02	
Sample Parameter	Value	
Serial No.	-	
HW Version	IDI88 RC	
SW Version	VERSION_ID: 6.1.7_m11-15-g58400c6; SW 1.21 RC0.0 w10: May 2 2019 02:41:00 version 7.45.189 (r714228 CY WLTEST) FWID 01-fc9ee776	
Comment		

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

4.3 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
-	-	-

4.4 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.

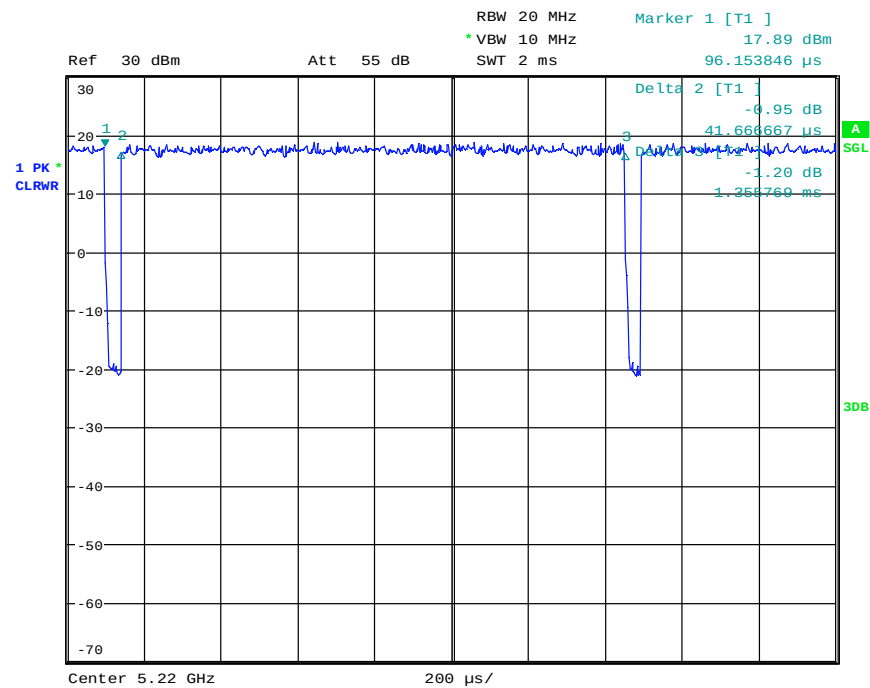
Device	Details (Manufacturer, Type Model, HW, SW, S/N)	Description
AC adapter (DE1408000ANC1)	GlobTek, GTM96060-0606-0.5, WR9QA1090EIAJ2CK5R6B, -, 786356123/19	Providing additional current to USB input of Base
Cradle CRA1 (DE1408000CRA1)	Cognex, DM8700 series Base Station R00087, IDB83-RE, Diags2 0.12, -	Part of Base Station modified to test modules
Cradle CRA3 (DE1408000CRA3)	Cognex, DM8700 series Base Station R00087, IDB83-RE, Diags2 0.12, -	Part of Base Station modified to test modules
Laptop RE06	Fujitsu Ltd., Laptop RE06:Lifebook U758, -, -, DSAL009842	Lifebook U758

4.5 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.

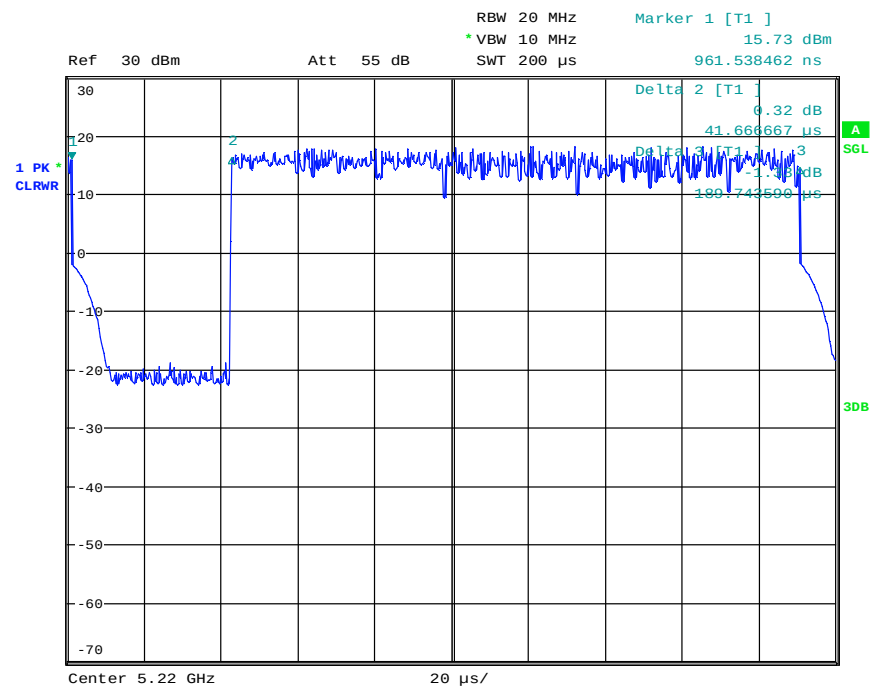
Setup	Combination of EUTs	Description and Rationale
S02_AE02	#ae02, AC adapter (DE1408000ANC1), Cradle CRA1, Laptop RE06,	Module in Cradle, supplied by USB and ext. AC adapter, Laptop
S01_AE02	#ae02, AC adapter (DE1408000ANC1), Cradle CRA1,	Module in Cradle, supplied by USB and ext. AC adapter (for radiated tests)
S01_AH02	#ah02, AC adapter (DE1408000ANC1), Cradle CRA3,	Module in Cradle, supplied by USB and ext. AC adapter (for conducted tests)
S01_AL02	#al02, AC adapter (DE1408000ANC1), CradleCRA1,	Module in Cradle, supplied by USB and ext. AC adapter (for radiated tests)

mode n



Date: 1.MAR.2021 20:07:53

mode ac



Date: 1.MAR.2021 20:13:26

5 TEST RESULTS

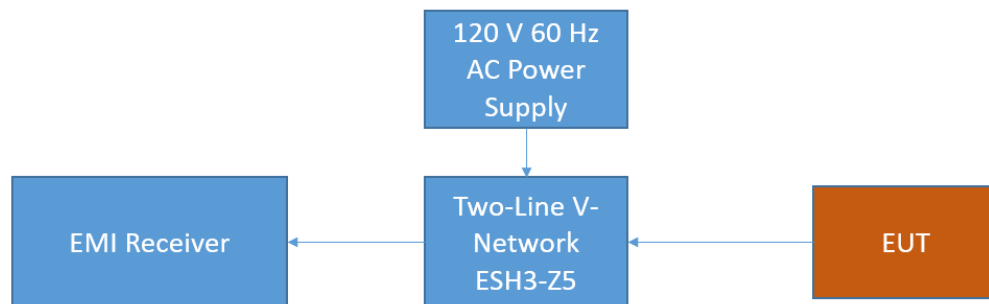
5.1 AC CONDUCTED EMISSIONS

Standard **FCC Part 15 Subpart E**

The test was performed according to:
ANSI C63.10

5.1.1 TEST DESCRIPTION

The test set-up was made in accordance to the general provisions of ANSI C 63.10. The Equipment Under Test (EUT) was setup in a shielded room to perform the conducted emissions measurements in a typical installation configuration. The EUT was powered from 50 μ H || 50 Ohm Line Impedance Stabilization Network (LISN). The LISN's unused connections were terminated with 50 Ohm loads.



FCC Conducted Emissions on AC

The measurement procedure consists of two steps. It is implemented into the EMI test software EMC-32 from R&S.

Step 1: Preliminary scan

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

EMI receiver settings:

- Detector: Peak – Maxhold & Average
- Frequency range: 150 kHz – 30 MHz
- Frequency steps: 2.5 kHz
- IF-Bandwidth: 9 kHz
- Measuring time / Frequency step: 100 ms (FFT-based)
- Measurement on phase + neutral lines of the power cords

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

Step 2: Final measurement

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

EMI receiver settings:

- Detector: Quasi-Peak & (CISPR) Average
- IF Bandwidth: 9 kHz
- Measuring time: 1 s / frequency

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

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

The highest value is reported.

5.1.2 TEST REQUIREMENTS / LIMITS

FCC Part 15, Subpart C, §15.207

Frequency (MHz)	QP Limits (dBμV)	AV Limits (dBμV)
0.15 – 0.5	66 - 56	56 - 46
0.5 - 5	56	46
5 - 30	60	50

5.1.3 TEST PROTOCOL

Temperature: 25 °C
Air Pressure: 1005 hPa
Humidity: 37 %

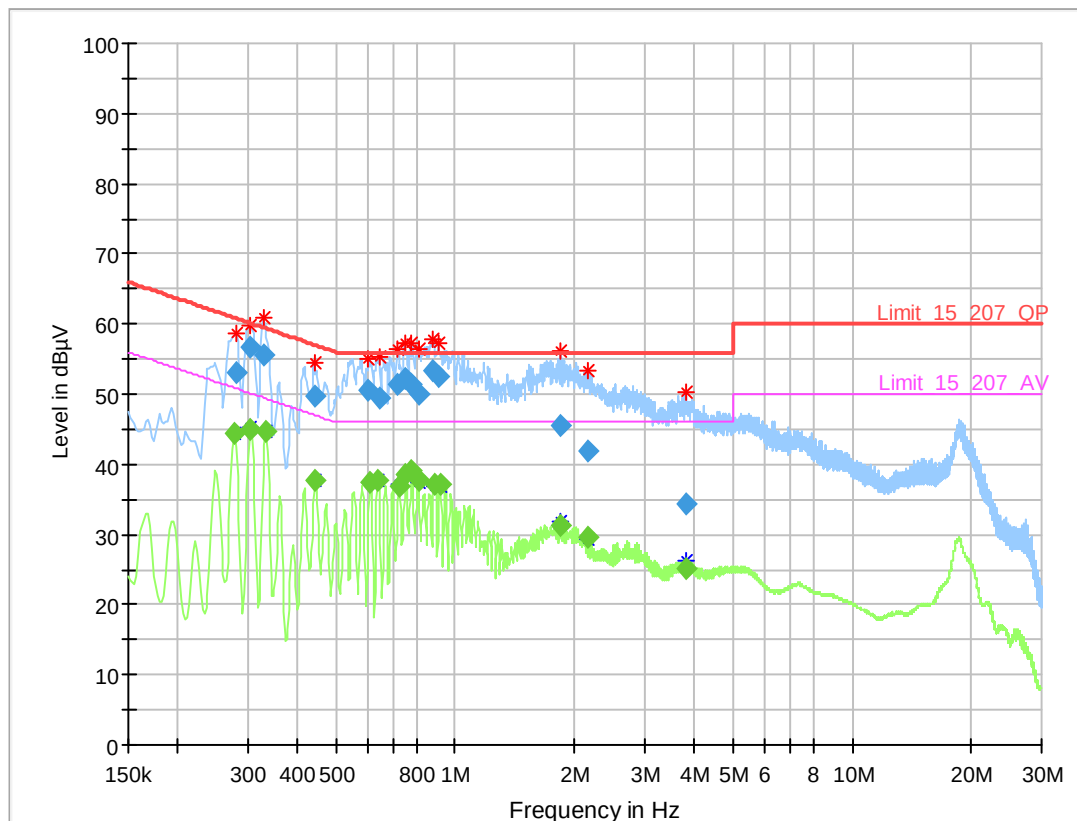
Power line	PE	Frequency [MHz]	Measured value QP [dBμV]	Measured value AV [dBμV]	Limit [dBμV]	Margin [dB]
L1	FLO	0.27825	---	44.32	50.9	6.6
L1	GND	0.2805	53.02	---	60.8	7.8
N	GND	0.303	56.69	---	60.2	3.5
L1	FLO	0.30525	---	45.05	50.1	5.1
N	GND	0.32775	55.72	---	59.5	3.8
L1	FLO	0.33225	---	44.66	49.4	4.7
N	GND	0.4425	49.62	---	57.0	7.4
L1	FLO	0.44475	---	37.78	47.0	9.2
N	GND	0.6045	50.64	---	56.0	5.4
L1	FLO	0.61125	---	37.38	46.0	8.6
L1	GND	0.63825	---	37.83	46.0	8.2
L1	FLO	0.64275	49.41	---	56.0	6.6
N	GND	0.71475	51.43	---	56.0	4.6
L1	FLO	0.7215	---	36.9	46.0	9.1
N	GND	0.744	52.28	---	56.0	3.7
L1	FLO	0.75075	---	38.62	46.0	7.4
N	GND	0.77325	51.28	---	56.0	4.7
L1	FLO	0.77775	---	38.98	46.0	7.0
L1	FLO	0.807	---	37.72	46.0	8.3
L1	FLO	0.80925	50.08	---	56.0	5.9
N	GND	0.879	53.23	---	56.0	2.8
L1	GND	0.888	---	37.09	46.0	8.9
N	GND	0.90825	52.54	---	56.0	3.5
L1	FLO	0.91725	---	37.2	46.0	8.8
L1	GND	1.842	---	31.41	46.0	14.6
N	GND	1.84425	45.4	---	56.0	10.6
L1	FLO	2.14575	---	29.5	46.0	16.5
N	GND	2.1525	41.86	---	56.0	14.1
N	GND	3.82425	34.41	---	56.0	21.6
L1	GND	3.831	---	25.04	46.0	21.0

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

5.1.4 MEASUREMENT PLOT (EXAMPLE PLOT, SHOWING WORST CASE, IF APPLICABLE)

Operating mode = worst case
(S02_AE02)

Test Description:	Conducted Emissions
Test Standard:	FCC §15.207, ANSI C63.10
EUT / Setup Code:	DE1408000 ae02 + AC adapter + Laptop + AC Adapter
Operating Conditions:	120 V / 60 Hz, Wifi 5 GHz (a-mode, CH:44 , 20dBm Power)
Comment:	-
Legend:	Trace: blue = PK, green = CISPR AV; Star: red or blue = critical frequency; Rhombus: blue = final QP, green = final CISPR AV
Tested Port / used LISN:	AC mains => ESH3-Z5
Termination of other ports:	AC of AUX => 2nd LISN ESH3-Z5 +50 Ohm



Frequency (MHz)	QuasiPeak (dBμV)	CAverage (dBμV)	Limit (dBμV)	Margin (dB)	Meas. Time	Bandwidth (kHz)	Line	PE	Corr. (dB)
0.278250	---	44.32	50.87	6.55	1000.0	9.000	L1	FLO	10.1
0.280500	53.02	---	60.80	7.78	1000.0	9.000	L1	GND	10.1
0.303000	56.69	---	60.16	3.47	1000.0	9.000	N	GND	10.1
0.305250	---	45.05	50.10	5.05	1000.0	9.000	L1	FLO	10.1
0.327750	55.72	---	59.51	3.79	1000.0	9.000	N	GND	10.1
0.332250	---	44.66	49.40	4.73	1000.0	9.000	L1	FLO	10.1
0.442500	49.62	---	57.02	7.40	1000.0	9.000	N	GND	10.1
0.444750	---	37.78	46.97	9.19	1000.0	9.000	L1	FLO	10.1
0.604500	50.64	---	56.00	5.36	1000.0	9.000	N	GND	10.1
0.611250	---	37.38	46.00	8.62	1000.0	9.000	L1	FLO	10.1
0.638250	---	37.83	46.00	8.17	1000.0	9.000	L1	GND	10.1
0.642750	49.41	---	56.00	6.59	1000.0	9.000	L1	FLO	10.1
0.714750	51.43	---	56.00	4.57	1000.0	9.000	N	GND	10.1
0.721500	---	36.90	46.00	9.10	1000.0	9.000	L1	FLO	10.1
0.744000	52.28	---	56.00	3.72	1000.0	9.000	N	GND	10.1
0.750750	---	38.62	46.00	7.38	1000.0	9.000	L1	FLO	10.1
0.773250	51.28	---	56.00	4.72	1000.0	9.000	N	GND	10.1
0.777750	---	38.98	46.00	7.02	1000.0	9.000	L1	FLO	10.1
0.807000	---	37.72	46.00	8.28	1000.0	9.000	L1	FLO	10.1
0.809250	50.08	---	56.00	5.92	1000.0	9.000	L1	FLO	10.1
0.879000	53.23	---	56.00	2.77	1000.0	9.000	N	GND	10.1
0.888000	---	37.09	46.00	8.91	1000.0	9.000	L1	GND	10.1
0.908250	52.54	---	56.00	3.46	1000.0	9.000	N	GND	10.1
0.917250	---	37.20	46.00	8.80	1000.0	9.000	L1	FLO	10.1
1.842000	---	31.41	46.00	14.59	1000.0	9.000	L1	GND	10.2
1.844250	45.40	---	56.00	10.60	1000.0	9.000	N	GND	10.2
2.145750	---	29.50	46.00	16.50	1000.0	9.000	L1	FLO	10.2
2.152500	41.86	---	56.00	14.14	1000.0	9.000	N	GND	10.2
3.824250	34.41	---	56.00	21.59	1000.0	9.000	N	GND	10.3
3.831000	---	25.04	46.00	20.96	1000.0	9.000	L1	GND	10.3

5.1.5 TEST EQUIPMENT USED

- Conducted Emissions FCC

5.2 26 DB BANDWIDTH

Standard **FCC Part 15 Subpart E**

The test was performed according to:
ANSI C63.10

5.2.1 TEST DESCRIPTION

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

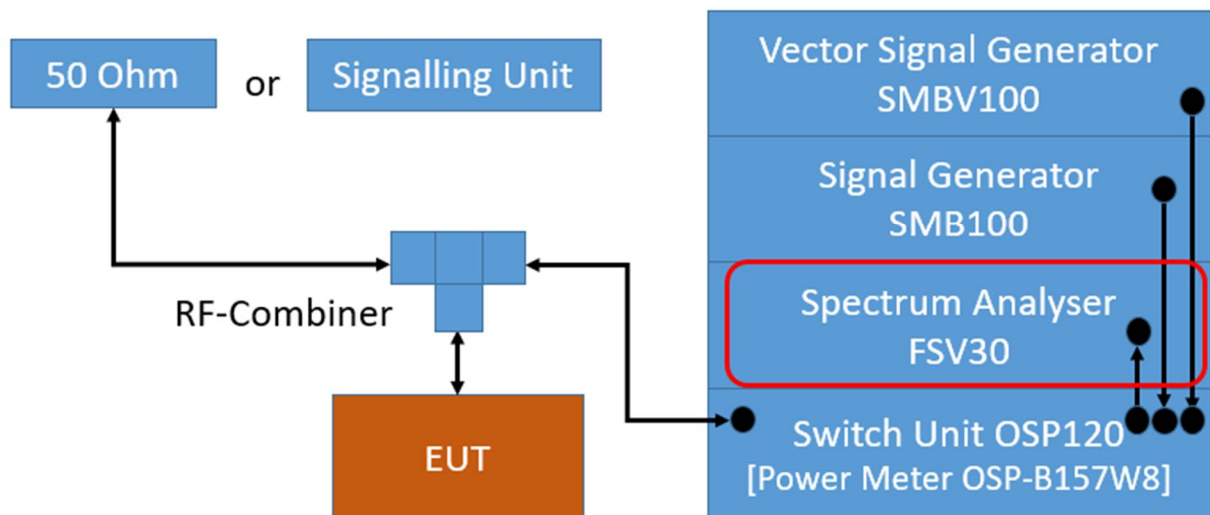
The reference level is the level of the highest amplitude signal observed from the transmitter at either the fundamental frequency or first-order modulation products in all typical modes of operation, including the unmodulated carrier, even if atypical.

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

The EUT was connected to the test system as described in the block diagram below. The complete attenuation of the measurement path is known and considered.

Analyzer settings:

- Resolution Bandwidth (RBW): initially approx. 1 % of nominal emission bandwidth
- Video Bandwidth (VBW): > RBW
- Span: 40 / 80 / 160 / 320 MHz (for 20 / 40 / 80 / 160 MHz nominal bandwidth)
- Trace: Maxhold
- Sweeps: Until the trace is stable
- Sweep time: Auto
- Detector: Peak



TS8997; Occupied Channel Bandwidth 6 dB / 26 dB / 99 %

5.2.2 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.

5.2.3 TEST PROTOCOL

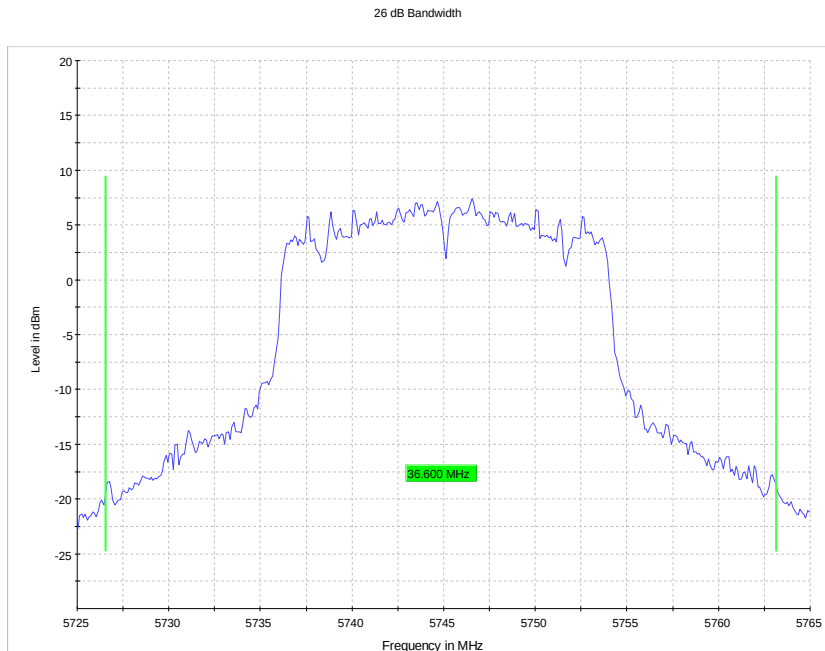
Ambient temperature: 26 °C
Air Pressure: 1010 hPa
Humidity: 32 %

Radio Technology	Operating Frequency	Subband	26 dB Bandwidth [MHz]
WLAN a	low	U-NII-1	34.1
WLAN a	mid	U-NII-1	31.2
WLAN a	high	U-NII-1	31.2
WLAN a	low	U-NII-2A	30.9
WLAN a	mid	U-NII-2A	29.6
WLAN a	high	U-NII-2A	31.7
WLAN a	low	U-NII-2C	29.0
WLAN a	mid	U-NII-2C	31.0
WLAN a	high	U-NII-2C	32.8
WLAN a	low	U-NII-3	30.6
WLAN a	mid	U-NII-3	31.0
WLAN a	high	U-NII-3	29.3
WLAN n 20 MHz	low	U-NII-1	29.6
WLAN n 20 MHz	mid	U-NII-1	31.0
WLAN n 20 MHz	high	U-NII-1	31.6
WLAN n 20 MHz	low	U-NII-2A	31.2
WLAN n 20 MHz	mid	U-NII-2A	30.9
WLAN n 20 MHz	high	U-NII-2A	32.0
WLAN n 20 MHz	low	U-NII-2C	30.4
WLAN n 20 MHz	mid	U-NII-2C	31.6
WLAN n 20 MHz	high	U-NII-2C	33.1
WLAN n 20 MHz	low	U-NII-3	31.3
WLAN n 20 MHz	mid	U-NII-3	32.0
WLAN n 20 MHz	high	U-NII-3	32.2
WLAN ac 20 MHz	low	U-NII-1	32.9
WLAN ac 20 MHz	mid	U-NII-1	33.4
WLAN ac 20 MHz	high	U-NII-1	32.5
WLAN ac 20 MHz	low	U-NII-2A	33.4
WLAN ac 20 MHz	mid	U-NII-2A	35.3
WLAN ac 20 MHz	high	U-NII-2A	33.1
WLAN ac 20 MHz	low	U-NII-2C	32.5
WLAN ac 20 MHz	mid	U-NII-2C	33.2
WLAN ac 20 MHz	high	U-NII-2C	34.4
WLAN ac 20 MHz	low	U-NII-3	36.6
WLAN ac 20 MHz	mid	U-NII-3	34.3
WLAN ac 20 MHz	high	U-NII-3	35.4

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

5.2.4 MEASUREMENT PLOT (EXAMPLE PLOT, SHOWING WORST CASE, IF APPLICABLE)

Radio Technology = WLAN ac 20 MHz, Operating Frequency = low, Subband = U-NII-3 (S01_AH02)



Settings of the spectrum analyser:

Measurement

Setting	Instrument Value	Target Value
Start Frequency	5.70000 GHz	5.70000 GHz
Stop Frequency	5.74000 GHz	5.74000 GHz
Span	40.000 MHz	40.000 MHz
RBW	200.000 kHz	≥ 200.000 kHz
VBW	1.000 MHz	≥ 600.000 kHz
SweepPoints	400	~ 400
SweepTime	28.477 μ s	AUTO
Reference Level	0.000 dBm	0.000 dBm
Attenuation	20.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	200	200
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
SweepType	FFT	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.30 dB	0.30 dB
Run	94 / max. 150	max. 150
Stable	5 / 5	5
Max Stable Difference	0.00 dB	0.30 dB

5.2.5 TEST EQUIPMENT USED

- R&S TS8997

5.3 6 DB BANDWIDTH

Standard **FCC Part 15 Subpart E**

The test was performed according to:
ANSI C63.10

5.3.1 TEST DESCRIPTION

The Equipment Under Test (EUT) was setup in a shielded room to perform the occupied bandwidth measurements.

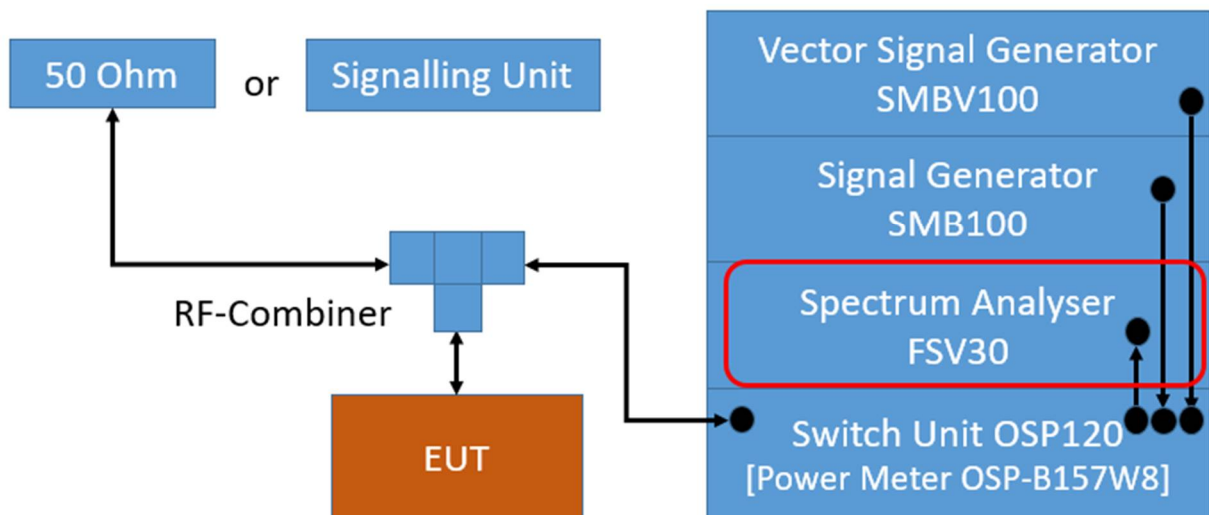
The reference level is the level of the highest amplitude signal observed from the transmitter at either the fundamental frequency or first-order modulation products in all typical modes of operation, including the unmodulated carrier, even if atypical.

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

The EUT was connected to the test system as described in the block diagram below. The complete attenuation of the measurement path is known and considered.

Analyzer settings:

- Resolution Bandwidth (RBW): 100 kHz
- Video Bandwidth (VBW): 300 kHz
- Span: 40 / 80 / 160 / 320 MHz (for 20 / 40 / 80 / 160 MHz nominal bandwidth))
- Trace: Maxhold
- Sweeps: Until the trace is stable
- Sweeptime: Auto
- Detector: Peak



TS8997; Occupied Channel Bandwidth 6 dB / 26 dB / 99 %

5.3.2 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.

5.3.3 TEST PROTOCOL

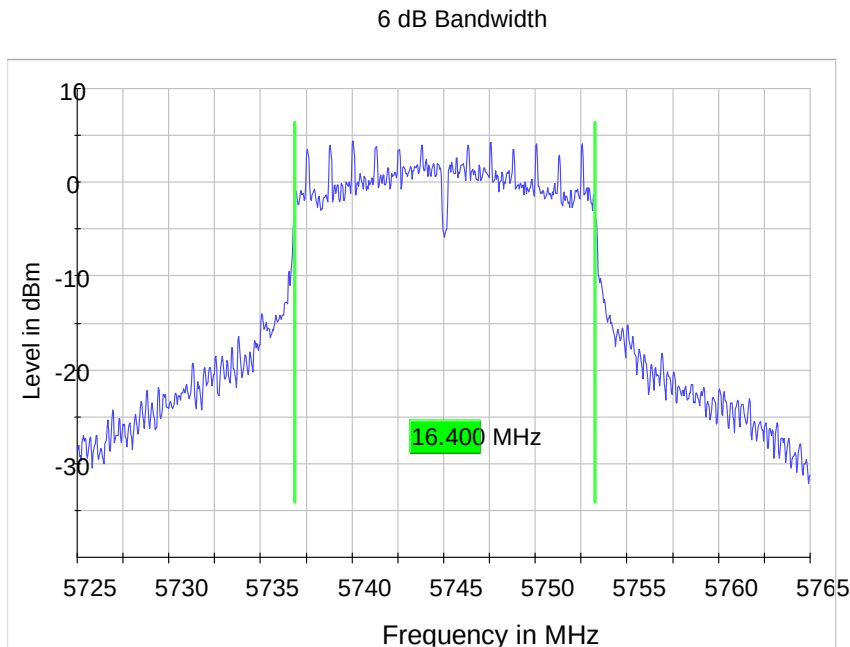
Ambient temperature: 26 °C
Air Pressure: 1010 hPa
Humidity: 32 %

Radio Technology	Operating Frequency	6 dB Bandwidth [MHz]	Limit [MHz]	Margin [MHz]	Min. 6 dB Frequency [MHz]	Max. 6 dB Frequency [MHz]
WLAN a	low	16.40	0.5	15.90	5736.88	5753.28
WLAN a	mid	16.40	0.5	15.90	5776.88	5793.28
WLAN a	high	16.40	0.5	15.90	5816.88	5833.28
WLAN n 20 MHz	low	17.60	0.5	17.10	5736.28	5753.88
WLAN n 20 MHz	mid	17.60	0.5	17.10	5776.28	5793.88
WLAN n 20 MHz	high	17.60	0.5	17.10	5816.28	5833.88
WLAN ac 20 MHz	low	17.75	0.5	17.25	5736.23	5753.98
WLAN ac 20 MHz	mid	17.75	0.5	17.25	5776.23	5793.98
WLAN ac 20 MHz	high	17.75	0.5	17.25	5816.23	5833.98

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

5.3.4 MEASUREMENT PLOT (EXAMPLE PLOT, SHOWING WORST CASE, IF APPLICABLE)

Radio Technology = WLAN a, Operating Frequency = low, Subband = U-NII-3 (S01_AH02)



Settings of the spectrum analyser:

Measurement

Setting	Instrument Value	Target Value
Start Frequency	5.72500 GHz	5.72500 GHz
Stop Frequency	5.76500 GHz	5.76500 GHz
Span	40.000 MHz	40.000 MHz
RBW	100.000 kHz	~ 100.000 kHz
VBW	300.000 kHz	~ 300.000 kHz
SweepPoints	800	~ 800
SweepTime	56.836 μ s	AUTO
Reference Level	0.000 dBm	0.000 dBm
Attenuation	20.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	200	200
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
SweepType	FFT	AUTO
Preamplifier	off	off
Stablemode	Trace	Trace
Stablevalue	0.30 dB	0.30 dB
Run	35 / max. 150	max. 150
Stable	5 / 5	5
Max Stable Difference	0.29 dB	0.30 dB

5.3.5 TEST EQUIPMENT USED

- R&S TS8997

5.4 99 % BANDWIDTH

Standard **FCC Part 15 Subpart E**

The test was performed according to:
ANSI C63.10

5.4.1 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.

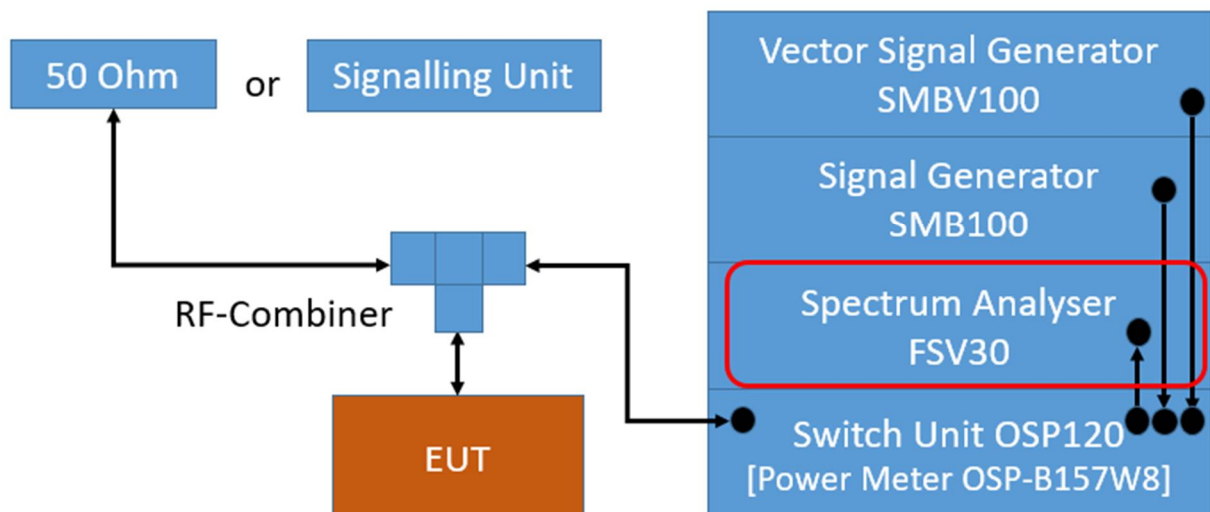
The results recorded were measured with the modulation which produce the worst-case (widest) emission bandwidth.

The EUT was connected to the test system as described in the block diagram below. The complete attenuation of the measurement path is known and considered.

Analyzer settings:

- Resolution Bandwidth (RBW): approx. ≥ 1 % of the span, but not below 5 %
- Video Bandwidth (VBW): ≥ 3 times the RBW
- Span: 40 / 80 / 160 / 320 MHz (for 20 / 40 / 80 / 160 MHz nominal bandwidth)
- Trace: Maxhold
- Sweeps: Until the trace is stable
- Sweep time: Auto
- Detector: Peak

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



TS8997; Occupied Channel Bandwidth 6 dB / 26 dB / 99 %

5.4.2 TEST REQUIREMENTS / LIMITS

No applicable limit.

5.4.3 TEST PROTOCOL

Ambient temperature: 26 °C
Air Pressure: 1010 hPa
Humidity: 32 %

Radio Technology	Operating Frequency	Subband	99 % Bandwidth [MHz]
WLAN a	low	U-NII-1	18.9
WLAN a	mid	U-NII-1	17.7
WLAN a	high	U-NII-1	17.9
WLAN a	low	U-NII-2A	17.9
WLAN a	mid	U-NII-2A	17.5
WLAN a	high	U-NII-2A	17.8
WLAN a	low	U-NII-2C	17.6
WLAN a	mid	U-NII-2C	17.7
WLAN a	high	U-NII-2C	17.8
WLAN a	low	U-NII-3	18.1
WLAN a	mid	U-NII-3	17.7
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	18.6
WLAN n 20 MHz	high	U-NII-1	18.8
WLAN n 20 MHz	low	U-NII-2A	18.8
WLAN n 20 MHz	mid	U-NII-2A	18.7
WLAN n 20 MHz	high	U-NII-2A	18.7
WLAN n 20 MHz	low	U-NII-2C	18.5
WLAN n 20 MHz	mid	U-NII-2C	18.6
WLAN n 20 MHz	high	U-NII-2C	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	18.5
WLAN ac 20 MHz	low	U-NII-1	18.9
WLAN ac 20 MHz	mid	U-NII-1	18.9
WLAN ac 20 MHz	high	U-NII-1	18.8
WLAN ac 20 MHz	low	U-NII-2A	18.7
WLAN ac 20 MHz	mid	U-NII-2A	18.9
WLAN ac 20 MHz	high	U-NII-2A	18.6
WLAN ac 20 MHz	low	U-NII-2C	18.7
WLAN ac 20 MHz	mid	U-NII-2C	18.6
WLAN ac 20 MHz	high	U-NII-2C	19.0
WLAN ac 20 MHz	low	U-NII-3	19.4
WLAN ac 20 MHz	mid	U-NII-3	19.1
WLAN ac 20 MHz	high	U-NII-3	19.7

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

5.4.4 MEASUREMENT PLOT (EXAMPLE PLOT, SHOWING WORST CASE, IF APPLICABLE)

Radio Technology = WLAN ac 20 MHz, Operating Frequency = high, Subband = U-NII-3 (S01_AH02)



Settings of the spectrum analyser:

Measurement

Setting	Instrument Value	Target Value
Start Frequency	5.80500 GHz	5.80500 GHz
Stop Frequency	5.84500 GHz	5.84500 GHz
Span	40.000 MHz	40.000 MHz
RBW	200.000 kHz	≥ 200.000 kHz
VBW	1.000 MHz	≥ 600.000 kHz
SweepPoints	400	~ 400
SweepTime	28.477 μ s	AUTO
Reference Level	0.000 dBm	0.000 dBm
Attenuation	20.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	200	200
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
SweepType	FFT	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.30 dB	0.30 dB
Run	92 / max. 150	max. 150
Stable	5 / 5	5
Max Stable Difference	0.00 dB	0.30 dB

5.4.5 TEST EQUIPMENT USED

- R&S TS8997

5.5 MAXIMUM CONDUCTED OUTPUT POWER

Standard **FCC Part 15 Subpart E**

The test was performed according to:
ANSI C63.10

5.5.1 TEST DESCRIPTION

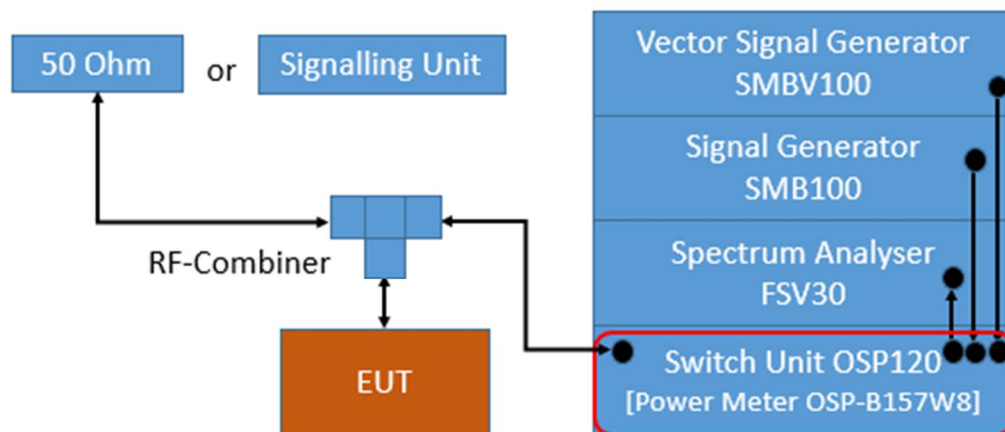
The Equipment Under Test (EUT) was set up to perform the output power measurements. The results recorded were measured with the modulation which produces the worst-case (highest) output power

The EUT was connected to the test system as described in the block diagram below. The complete attenuation of the measurement path is known and considered.

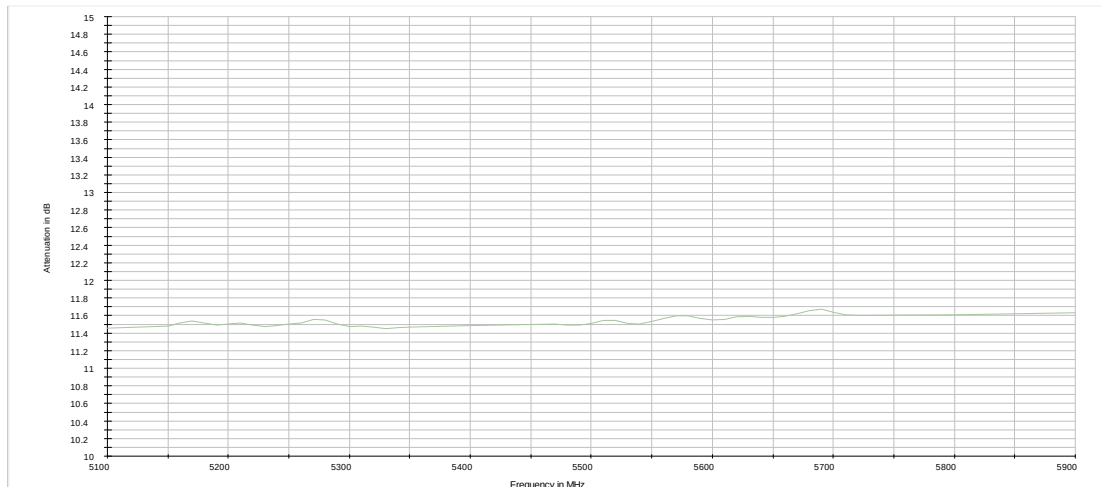
The OSP-B157W is a gated RF average power meter with a signal bandwidth > 300 MHz.

Note:

The measurement was performed according FCC Public Note "Guidelines for Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices - Part 15, Subpart E, 789033 D02", method **PM-G**.



TS8997; Maximum Conducted Output Power



Attenuation of measurement path

5.5.2 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 dBm + 10 log (26 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): Mobile and portable 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 dBm + 10 log (26 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 dBm + 10 log (26 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 $10 + 10 \log_{10} B$ [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 $11 + 10 \log_{10} B$ [dBm], whichever power is less.

e.i.r.p.: 1.0 W (30 dBm) or $17 + 10 \log_{10} B$ [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 $11 + 10 \log_{10} B$ [dBm], whichever power is less.

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

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

Limits:

Maximum conducted Power: 1W (30 dBm) or $17 + 10 \log_{10} B$ [dBm], whichever power is less.

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

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

5.5.3 TEST PROTOCOL

Ambient temperature: 26 °C
 Air Pressure: 1010 hPa
 Humidity: 32 %

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

U-NII-Subband	Ch. No.	Freq. [MHz]	Cond. Power [dBm]	EIRP [dBm]	FCC Cond. Limit [dBm]	Margin [dB]	IC Cond. Limit [dBm]	Margin [dB]	IC EIRP Limit [dBm]	Margin [dB]	
1	36	5180	13.1	16.6	30.0	16.9	N/A		22.8	6.1	1)
	44	5220	13.5	17.0	30.0	16.5	N/A		22.5	5.4	1)
	48	5240	13.6	17.1	30.0	16.4	N/A		22.5	5.4	1)
2A	52	5260	13.5	17.0	24.0	10.5	23.5	10.0	29.5	12.5	1)
	56	5280	13.8	17.3	24.0	10.2	23.4	9.6	29.4	12.1	1)
	64	5320	13.9	17.4	24.0	10.1	23.5	9.6	29.5	12.1	1)
2C	100	5500	14.9	18.4	24.0	9.1	23.5	8.5	29.5	11.0	
	116	5580	15.2	18.7	24.0	8.8	23.5	8.2	29.5	10.7	
	140	5700	15.5	19.0	24.0	8.5	23.5	8.0	29.5	10.5	
3	149	5745	15.5	19.0	30.0	14.5	30.0	14.5	36.0	17.0	
	157	5785	15.5	19.0	30.0	14.5	30.0	14.5	36.0	17.0	
	165	5825	15.4	18.9	30.0	14.6	30.0	14.6	36.0	17.1	

WLAN n-Mode; 20 MHz; MCS0; SISO

U-NII-Subband	Ch. No.	Freq. [MHz]	Cond. Power [dBm]	EIRP [dBm]	FCC Cond. Limit [dBm]	Margin [dB]	IC Cond. Limit [dBm]	Margin [dB]	IC EIRP Limit [dBm]	Margin [dB]	
1	36	5180	13.1	16.6	30.0	16.9	N/A		22.7	6.2	1)
	44	5220	13.2	16.7	30.0	16.8	N/A		22.7	6.0	1)
	48	5240	13.4	16.9	30.0	16.6	N/A		22.7	5.9	1)
2A	52	5260	13.3	16.8	24.0	10.7	23.7	10.5	29.7	13.0	1)
	56	5280	13.5	17.0	24.0	10.5	23.7	10.2	29.7	12.7	1)
	64	5320	13.7	17.2	24.0	10.3	23.7	10.1	29.7	12.6	1)
2C	100	5500	14.8	18.3	24.0	9.2	23.7	8.9	29.7	11.4	
	116	5580	15.0	18.5	24.0	9.0	23.7	8.7	29.7	11.2	
	140	5700	15.3	18.8	24.0	8.7	23.7	8.5	29.7	11.0	
3	149	5745	15.1	18.6	30.0	14.9	30.0	14.9	36.0	17.4	
	157	5785	15.2	18.7	30.0	14.8	30.0	14.8	36.0	17.3	
	165	5825	15.2	18.7	30.0	14.8	30.0	14.8	36.0	17.3	

WLAN n-Mode; 40 MHz; MCS8; SISO

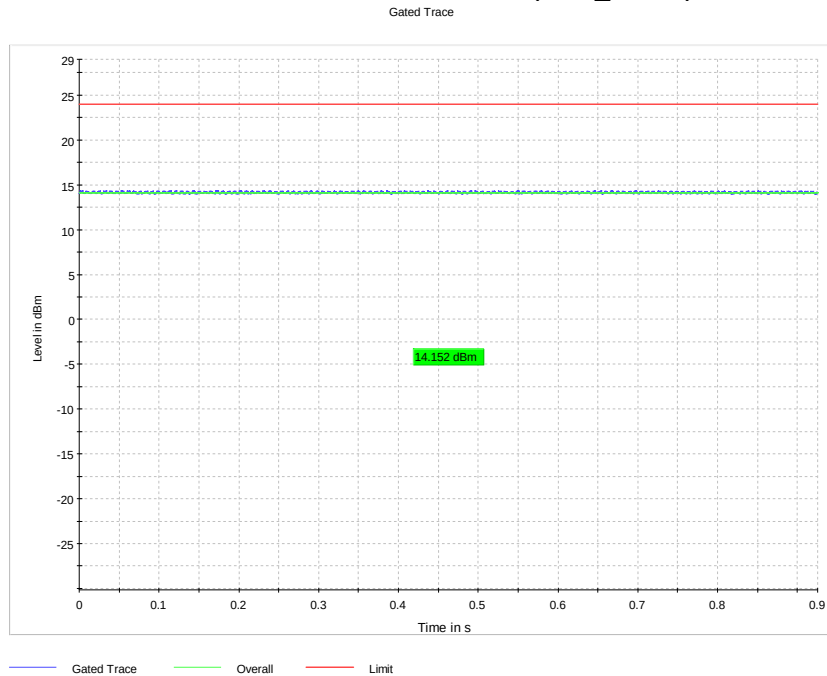
U-NII-Subband	Ch. No.	Freq. [MHz]	Cond. Power [dBm]	EIRP [dBm]	FCC Cond. Limit [dBm]	Margin [dB]	IC Cond. Limit [dBm]	Margin [dB]	IC EIRP Limit [dBm]	Margin [dB]	
1	36	5180	13.8	17.3	30.0	16.2	N/A		22.8	5.5	1)
	44	5220	14.0	17.5	30.0	16.0	N/A		22.8	5.2	1)
	48	5240	14.2	17.7	30.0	15.8	N/A		22.7	5.1	1)
2A	52	5260	14.1	17.6	24.0	9.9	23.7	9.6	29.7	12.1	1)
	56	5280	14.6	18.1	24.0	9.4	23.8	9.2	29.8	11.7	1)
	64	5320	14.3	17.8	24.0	9.7	23.7	9.4	29.7	11.9	1)
2C	100	5500	15.5	19.0	24.0	8.5	23.7	8.2	29.7	10.7	
	116	5580	15.8	19.3	24.0	8.2	23.7	7.9	29.7	10.4	
	140	5700	16.1	19.6	24.0	7.9	23.8	7.7	29.8	10.2	
3	149	5745	16.3	19.8	30.0	13.7	30.0	13.7	36.0	16.2	
	157	5785	16.1	19.6	30.0	13.9	30.0	13.9	36.0	16.4	
	165	5825	16.1	19.6	30.0	13.9	30.0	13.9	36.0	16.4	

1) = no additional limit applies related to the elevation.

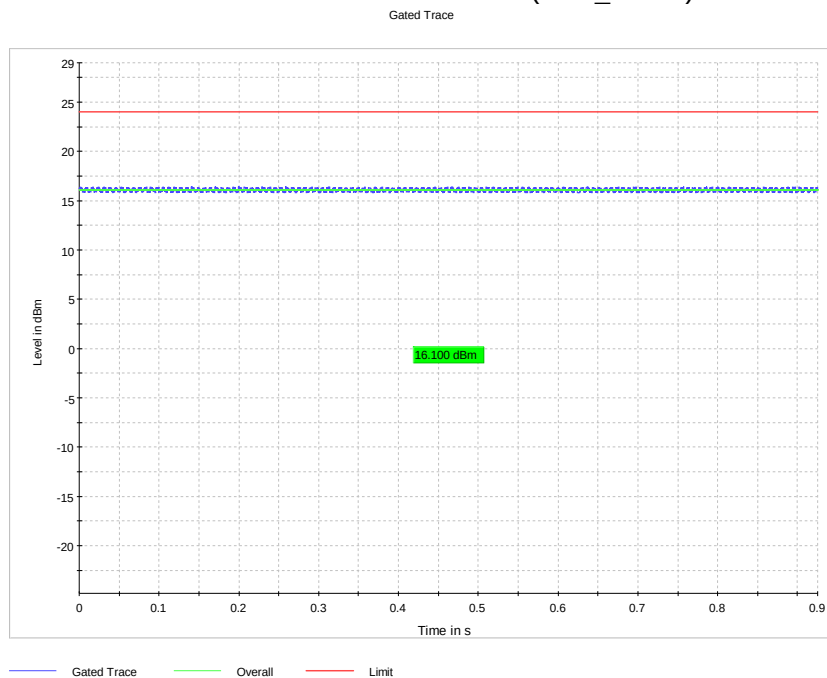
Remark: Please see next sub-clause for the measurement plot.

5.5.4 MEASUREMENT PLOT (EXAMPLE PLOT, SHOWING WORST CASE, IF APPLICABLE)

Radio Technology = WLAN ac 20 MHz, Operating Frequency = high, Subband = U-NII-1 (S01_AH02)



Radio Technology = WLAN ac 20 MHz, Operating Frequency = high, Subband = U-NII-2C (S01_AH02)



5.5.5 TEST EQUIPMENT USED

- R&S TS8997

5.6 PEAK POWER SPECTRAL DENSITY

Standard **FCC Part 15 Subpart E**

The test was performed according to:
ANSI C63.10

5.6.1 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.

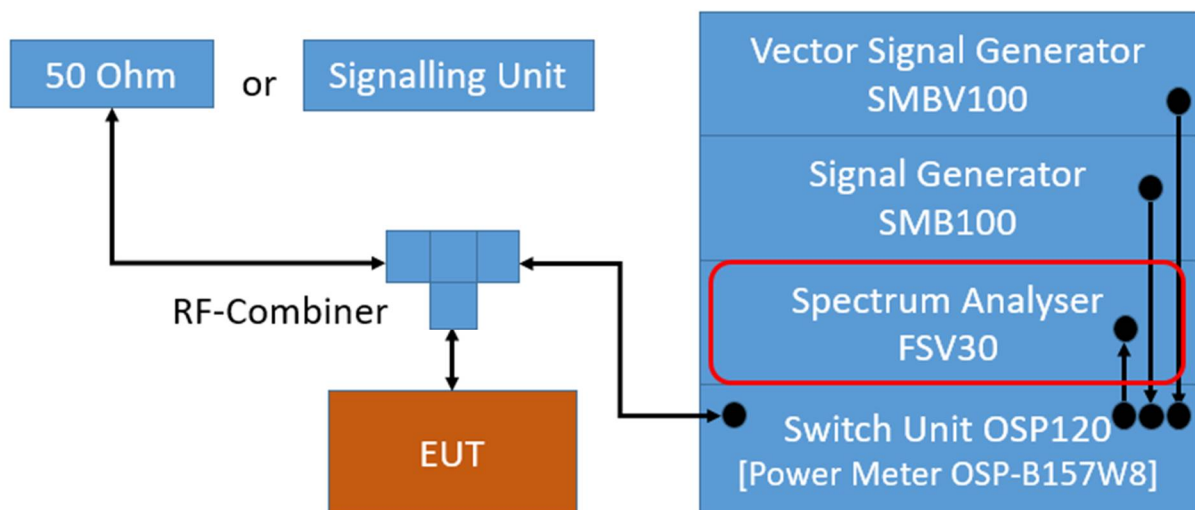
The EUT was connected to the test system as described in the block diagram below. The complete attenuation of the measurement path is known and considered.

Analyzer settings:

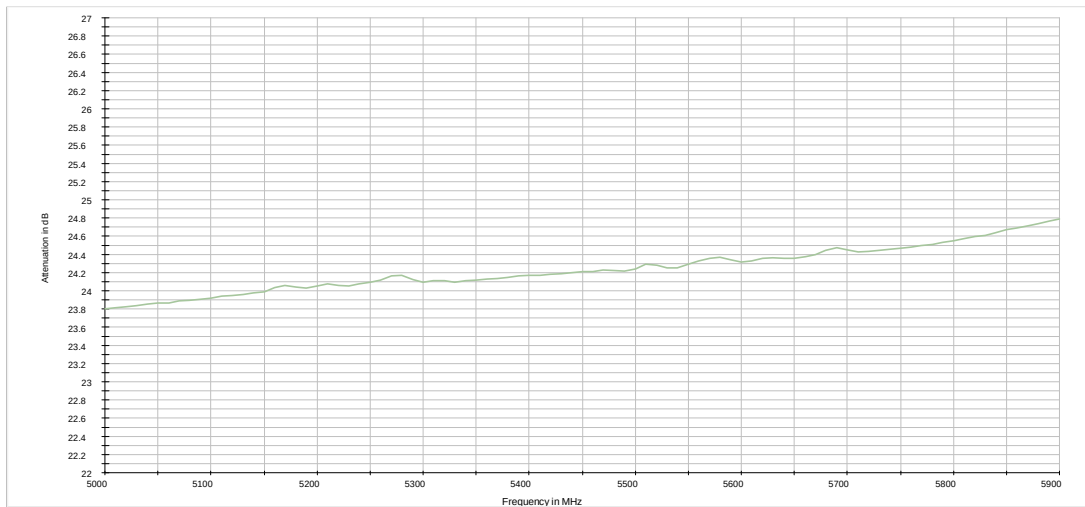
- Resolution Bandwidth (RBW): 1 MHz (for subband 3: 500 kHz)
- Video Bandwidth (VBW): 3 MHz (for subband 3: 2 MHz)
- Trace: Average, RMS power averaging mode
- Sweeps: 100
- Sweep time: 5 ms
- Detector: RMS
- Trigger: gated mode

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-3**.



TS8997; Maximum Power Spectral Density



Attenuation of the measurement path

5.6.2 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.

5.6.3 TEST PROTOCOL

Ambient temperature: 26 °C
 Air Pressure: 1010 hPa
 Humidity: 32 %
 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	2.7	17.0	14.3	10.0	3.8	6.2
	44	5220	3.0	17.0	14.0	10.0	3.5	6.5
	48	5240	3.0	17.0	14.0	10.0	3.5	6.5
2A	52	5260	3.0	11.0	8.0	11.0	8.0	unit:
	56	5280	3.1	11.0	7.9	11.0	7.9	dBm/
	64	5320	3.2	11.0	7.8	11.0	7.8	MHz
2C	100	5500	4.2	11.0	6.8	11.0	6.8	
	116	5580	4.7	11.0	6.3	11.0	6.3	
	140	5700	4.9	11.0	6.1	11.0	6.1	
3	149	5745	2.1	30.0	27.9	30.0	27.9	
	157	5785	1.9	30.0	28.1	30.0	28.1	
	165	5825	2.0	30.0	28.0	30.0	28.0	

WLAN n-Mode; 20 MHz; MCS0; SISO

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	2.6	17.0	14.4	10.0	3.9	6.1
	44	5220	2.6	17.0	14.4	10.0	3.9	6.1
	48	5240	2.5	17.0	14.5	10.0	4.0	6.0
2A	52	5260	2.5	11.0	8.5	11.0	8.5	unit:
	56	5280	2.8	11.0	8.2	11.0	8.2	dBm/
	64	5320	2.8	11.0	8.2	11.0	8.2	MHz
2C	100	5500	2.8	11.0	8.2	11.0	8.2	
	116	5580	4.2	11.0	6.8	11.0	6.8	
	140	5700	4.4	11.0	6.6	11.0	6.6	
3	149	5745	1.5	30.0	28.5	30.0	28.5	
	157	5785	1.3	30.0	28.7	30.0	28.7	
	165	5825	1.4	30.0	28.6	30.0	28.6	

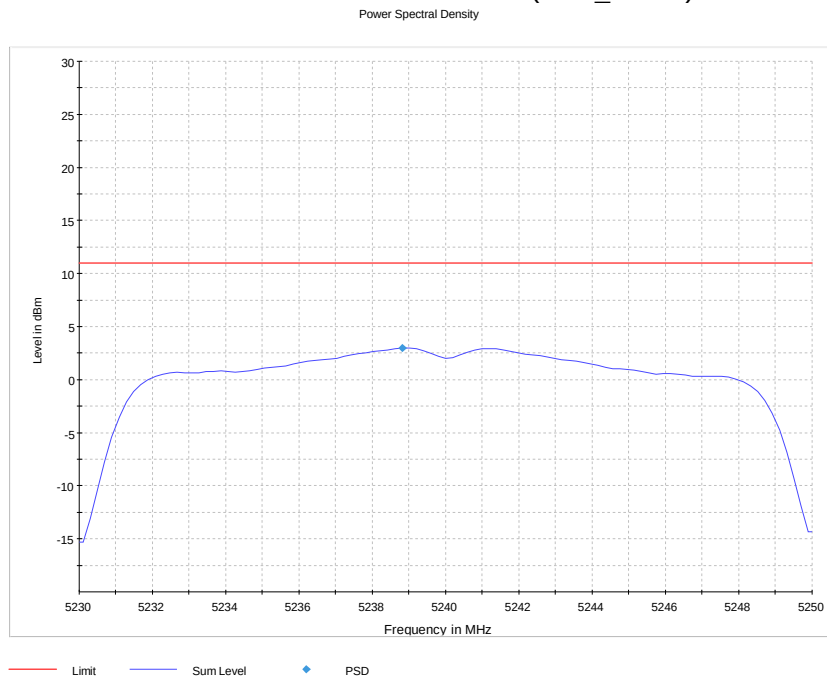
WLAN ac-Mode; 20 MHz; MCS8; SISO

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	2.7	17.0	14.3	10.0	3.8	6.2
	44	5220	2.8	17.0	14.2	10.0	3.7	6.3
	48	5240	3.0	17.0	14.0	10.0	3.5	6.5
2A	52	5260	2.9	11.0	8.1	11.0	8.1	unit:
	56	5280	3.3	11.0	7.7	11.0	7.7	dBm/
	64	5320	3.1	11.0	7.9	11.0	7.9	MHz
2C	100	5500	4.3	11.0	6.7	11.0	6.7	
	116	5580	4.4	11.0	6.6	11.0	6.6	
	140	5700	4.9	11.0	6.1	11.0	6.1	
3	149	5745	2.1	30.0	27.9	30.0	27.9	
	157	5785	1.8	30.0	28.2	30.0	28.2	
	165	5825	2.0	30.0	28.0	30.0	28.0	

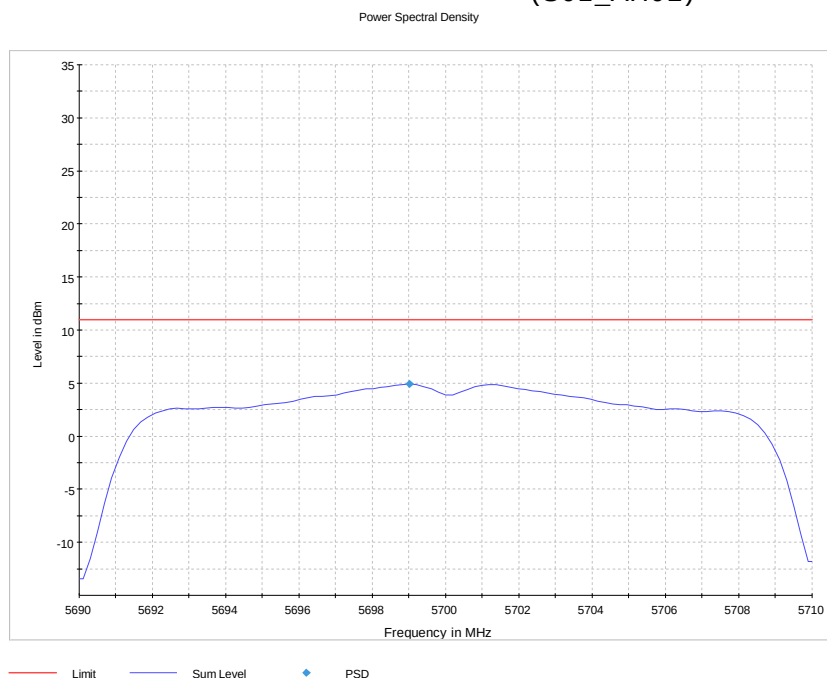
Remark: Please see next sub-clause for the measurement plot.

5.6.4 MEASUREMENT PLOT (EXAMPLE PLOT, SHOWING WORST CASE, IF APPLICABLE)

Radio Technology = WLAN ac 20 MHz, Operating Frequency = high, Subband = U-NII-1 (S01_AH02)



Radio Technology = WLAN ac 20 MHz, Operating Frequency = high, Subband = U-NII-2C (S01_AH02)



5.6.5 TEST EQUIPMENT USED

- R&S TS8997

5.7 UNDESIRABLE EMISSIONS; GENERAL FIELD STRENGTH LIMITS

Standard **FCC Part 15 Subpart E**

The test was performed according to:
ANSI C63.10

5.7.1 TEST DESCRIPTION

The test set-up was made in accordance to the general provisions of ANSI C63.10 in a typical installation configuration. The measurements were performed according the following sub-chapters of ANSI C63.10:

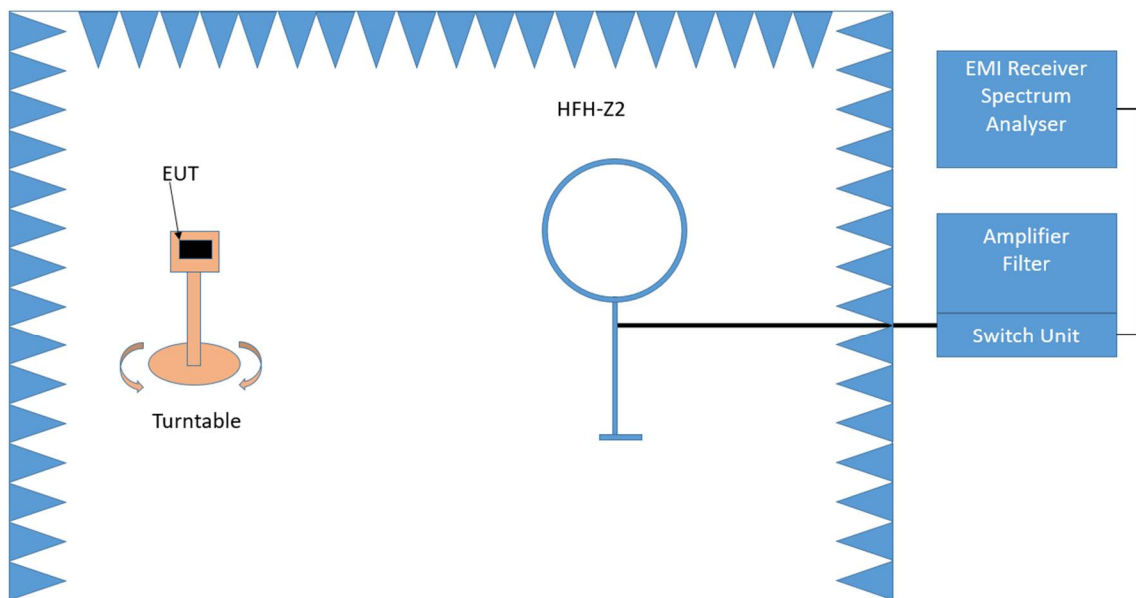
- < 30 MHz: Chapter 6.4
- 30 MHz – 1 GHz: Chapter 6.5
- > 1 GHz: Chapter 6.6 (procedure according 6.6.5 used)

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.

Below 1 GHz:

The Equipment Under Test (EUT) was set up on a non-conductive table in the semi-anechoic chamber. The influence of the EUT support table that is used between 30–1000 MHz was evaluated.

1. Measurement up to 30 MHz



Test Setup; Spurious Emission Radiated (SAC), 9 kHz – 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)

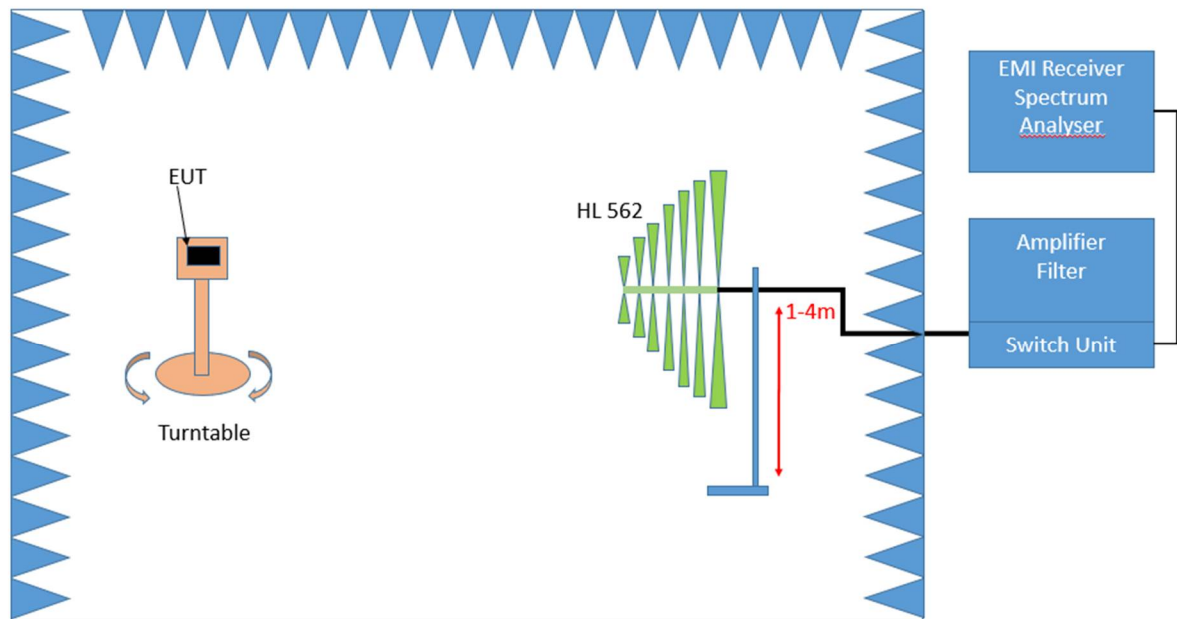
Intention of this step is, to determine the radiated EMI-profile of the EUT. Afterwards the relevant emissions for the final measurement are identified.

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 site
- 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



Test Setup; Spurious Emission Radiated (SAC), 30 MHz- 1GHz

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 – 4 m
- Height variation step size: 1.5 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 $\pm 45^\circ$ around this value. During this action, the value of emission is continuously measured. The turntable azimuth at the highest emission will be recorded and adjusted. In this position, the antenna height will also slowly vary by ± 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: 360°
- Height variation range: 1 – 4 m
- Antenna Polarisation: max. value determined in step 1

Step 3: Final measurement with QP detector

With the settings determined in step 2, the final measurement will be performed:

EMI receiver settings for step 3:

- Detector: Quasi-Peak (< 1 GHz)
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 120 kHz
- Measuring time: 1 s

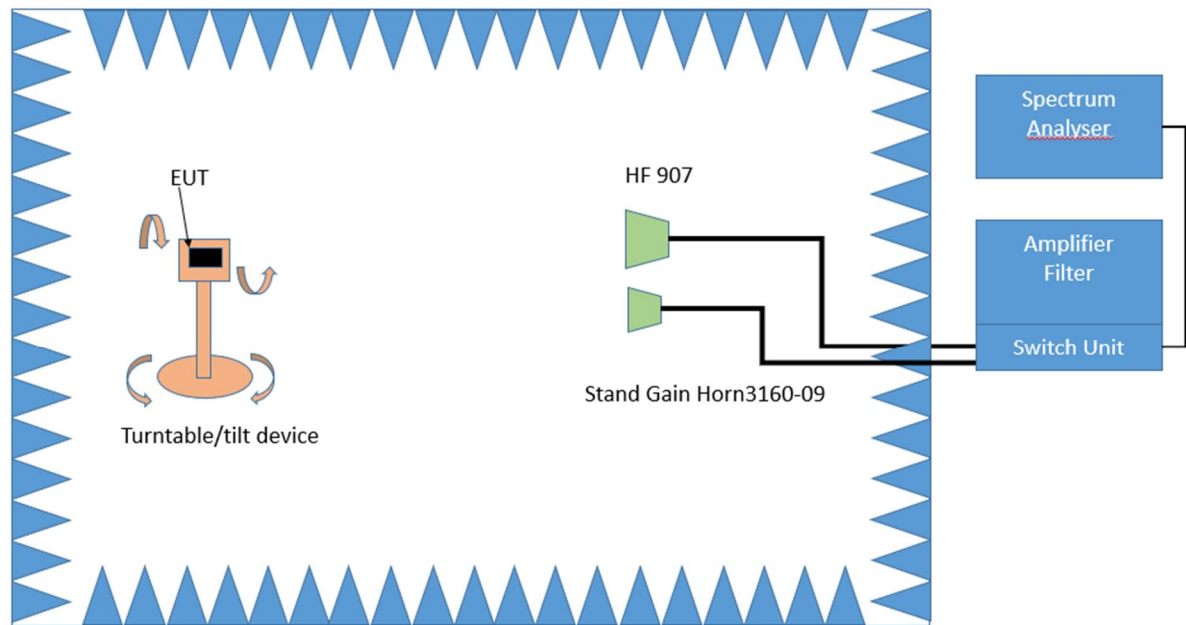
After the measurement a plot will be generated which contains a diagram with the results of the preliminary scan and a chart with the frequencies and values of the results of the final measurement.

Above 1 GHz:

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.

3. Measurement 1 GHz up to 26.5 GHz



Test Setup; Spurious Emission Radiated (FAC), 1 GHz-26.5 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 °.

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:

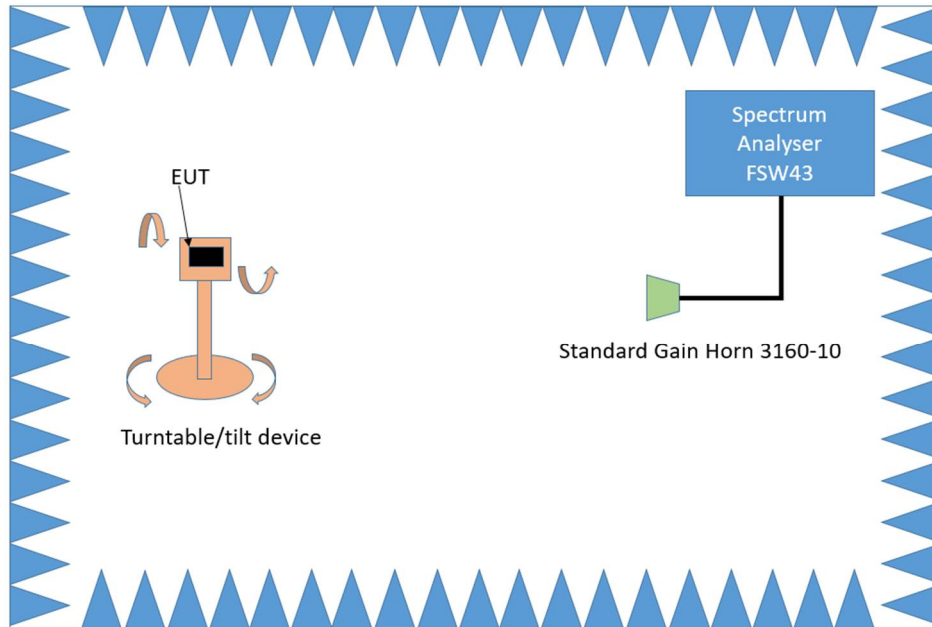
Spectrum analyser settings for step 3:

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

4. Measurement above 26.5 GHz up to 40 GHz

The following modifications, compared to the frequency range 1 GHz – 26.5 GHz, apply to the measurement procedure for the frequency range above 26.5 GHz:

- Measurement distance: 1m



Test Setup; Spurious Emission Radiated (FAC), 26.5 – 40 GHz

5.7.2 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 at 75 MHz or more above or below the band edge
 increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge
 increasing linearly to 15.6 dBm/MHz at 5 MHz above or below the band edge
 increasing linearly to 27 dBm/MHz at the band edge.

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.
However, devices with bandwidth overlapping the band edge of 5725 MHz can meet the emission limit of -27 dBm/MHz e.i.r.p. at 5850 MHz instead of 5725 MHz.
Note: No operation is permitted for the frequency range 5600-5650 MHz.

RSS-247, 6.2.4.2, Emissions outside the band 5725-5850 MHz:

- Limit: 27 dBm/MHz at frequencies from the band edges decreasing linearly to 15.6 dBm/MHz at 5 MHz above or below the band edges;
- Limit: 15.6 dBm/MHz at 5 MHz above or below the band edges decreasing linearly to 10 dBm/MHz at 25 MHz above or below the band edges;
- Limit: 10 dBm/MHz at 25 MHz above or below the band edges decreasing linearly to -27 dBm/MHz at 75 MHz above or below the band edges; and
- Limit: -27 dBm/MHz at frequencies more than 75 MHz above or below the band edges.

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 (µV/m)	Measurement distance (m)	Limits (dBµV/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 (µV/m)	Measurement distance (m)	Limits (dBµV/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 (dBµV/m) = 20 log (Limit (µV/m)/1µV/m)
- Limit (dBµV/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.

5.7.3 TEST PROTOCOL

Ambient temperature: 22–24 °C
Air Pressure: 980–1010 hPa
Humidity: 33–35 %

WLAN a-Mode; 20 MHz; 6 Mbit/s
Applied duty cycle correction (AV): 0.3 dB

Ch. No.	Ch. Center Freq. [MHz]	Spurious Freq. [MHz]	Spurious Level [dBµV / m]	Detector	RBW [kHz]	Limit [dBµV / m]	Margin [dB]	Limit Type
36	–	–	–	–	–	–	–	–
44	5220	150.0	27.0	QP	120	43.5	16.5	UE
44	5220	250.0	34.6	QP	120	46.0	11.4	UE
44	5220	350.0	36.0	QP	120	46.0	10.0	UE
44	5220	550.0	35.5	QP	120	46.0	10.5	UE
48	–	–	–	–	–	–	–	–
52	–	–	–	–	–	–	–	–
56	5280	150.0	31.7	QP	120	43.5	11.8	UE
56	5280	250.0	35.6	QP	120	46.0	10.4	UE
56	5280	350.0	36.5	QP	120	46.0	9.5	UE
56	5280	550.0	33.1	QP	120	46.0	12.9	UE
56	5280	800.0	34.9	QP	120	46.0	11.1	UE
56	5280	1746.7	49.8	PEAK	1000	68.2	18.4	UE
64	–	–	–	–	–	–	–	–
100	–	–	–	–	–	–	–	–
116	5580	50.0	27.8	QP	120	40.0	12.2	UE
116	5580	150.0	27.3	QP	120	43.5	16.2	UE
116	5580	250.0	36.9	QP	120	46.0	9.1	UE
116	5580	300.0	30.7	QP	120	46.0	15.3	UE
116	5580	350.0	36.4	QP	120	46.0	9.6	UE
116	5580	550.0	30.7	QP	120	46.0	15.3	UE
116	5580	800.0	31.2	QP	120	46.0	14.8	UE
140	–	–	–	–	–	–	–	–
149	–	–	–	–	–	–	–	–
157	5785	50.0	23.9	QP	120	40.0	16.1	UE
157	5785	132.9	23.8	QP	120	43.5	19.7	UE
157	5785	150.0	25.7	QP	120	43.5	17.8	UE
157	5785	250.0	40.9	QP	120	46.0	5.1	UE
157	5785	300.0	28.7	QP	120	46.0	17.3	UE
157	5785	350.0	35.0	QP	120	46.0	11.0	UE
157	5785	550.0	30.3	QP	120	46.0	15.7	UE
157	5785	800.0	31.3	QP	120	46.0	14.7	UE
165	–	–	–	–	–	–	–	–

WLAN n-Mode; 20 MHz; MCS0; SISO
Applied duty cycle correction (AV): 0.3 dB

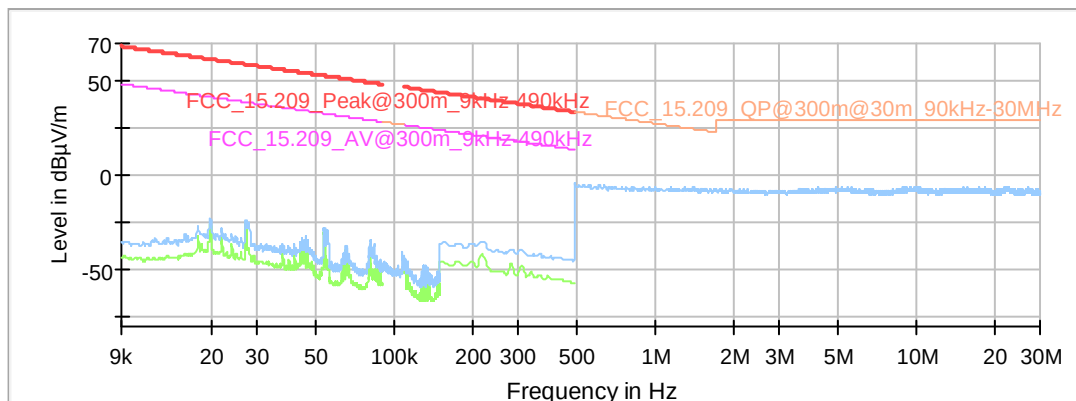
Ch. No.	Ch. Center Freq. [MHz]	Spurious Freq. [MHz]	Spurious Level [dBμV/m]	Detector	RBW [kHz]	Limit [dBμV/m]	Margin [dB]	Limit Type
116	5580	1149.0	47.3	PEAK	1000	74.0	26.7	RB
116	5580	1149.0	41.1	AV	1000	54.0	12.9	RB

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

5.7.4 MEASUREMENT PLOT (EXAMPLE PLOT, SHOWING WORST CASE, IF APPLICABLE)

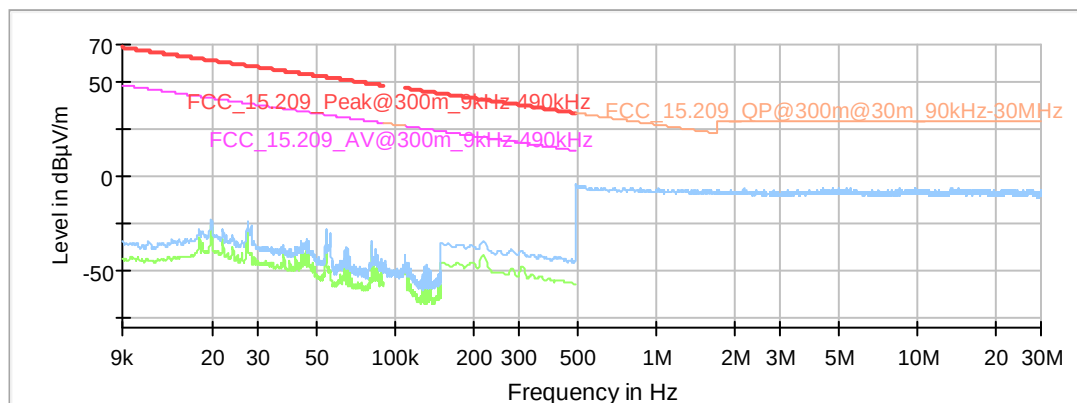
Radio Technology = WLAN a, Operating Frequency = mid, Measurement range = 9kHz - 30MHz, Subband = U-NII-1
(S01_AE02)

Test Description: Radiated Emissions, Test Site: Semi Anechoic Chamber @ 3 m
Test Standard: FCC15e407
Operating Conditions: DE1408000 ae02, WLAN5 a-Mode CH:44 20dBm
Operator Name: NEL
Comment: x-y Axis



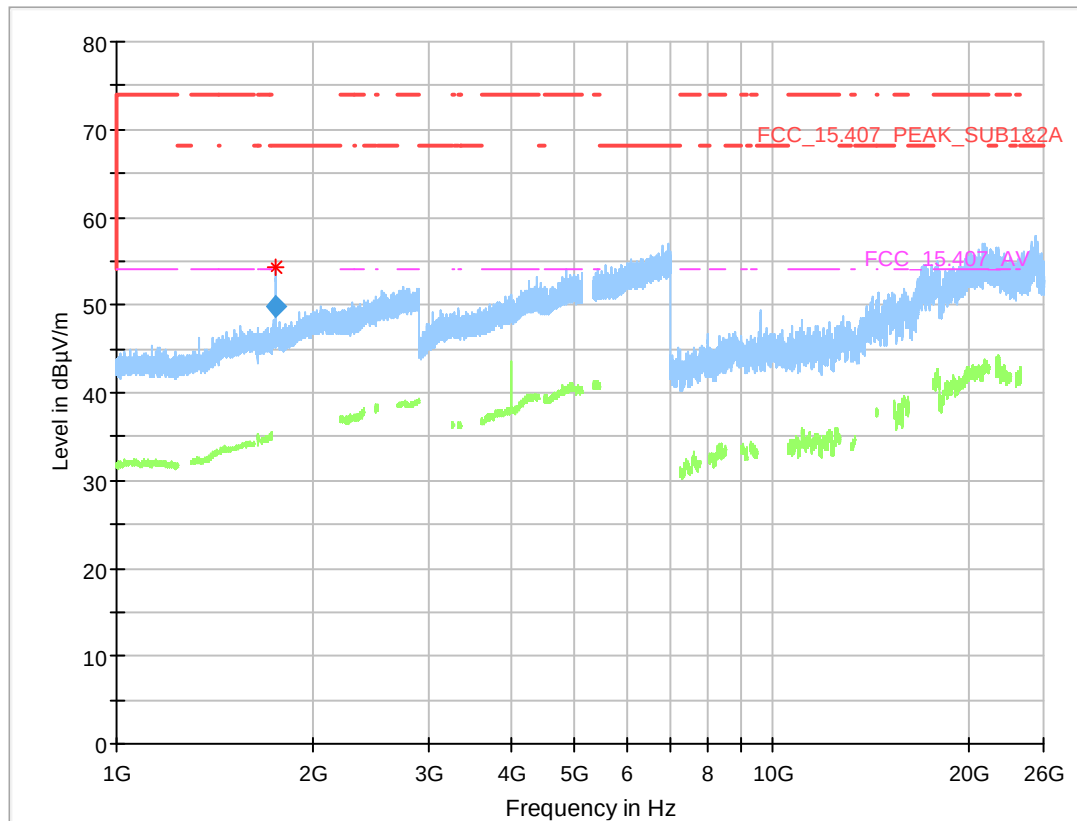
Frequency (MHz)	MaxPeak (dBμV/m)	Average (dBμV/m)	Limit (dBμV/m)	Margin	Meas. Time (ms)	Bandwidth (h)	Height	Pol	Azimuth (h)	Corr. (dB/m)
---	---	---	---	---	---	---	---	---	---	---

z Axis



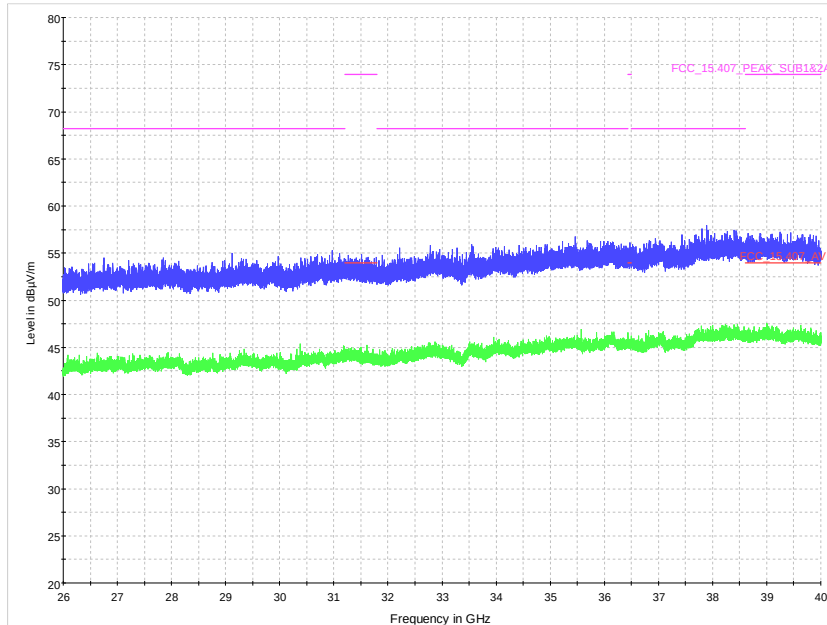
Frequency (MHz)	MaxPeak (dBμV/m)	Average (dBμV/m)	Limit (dBμV/m)	Margin	Meas. Time (ms)	Bandwidth (h)	Height	Pol	Azimuth (h)	Corr. (dB/m)
---	---	---	---	---	---	---	---	---	---	---

Radio Technology = WLAN a, Operating Frequency = mid, Measurement range = 1GHz - 26GHz, Subband = U-NII-2A
(S01_AE02)

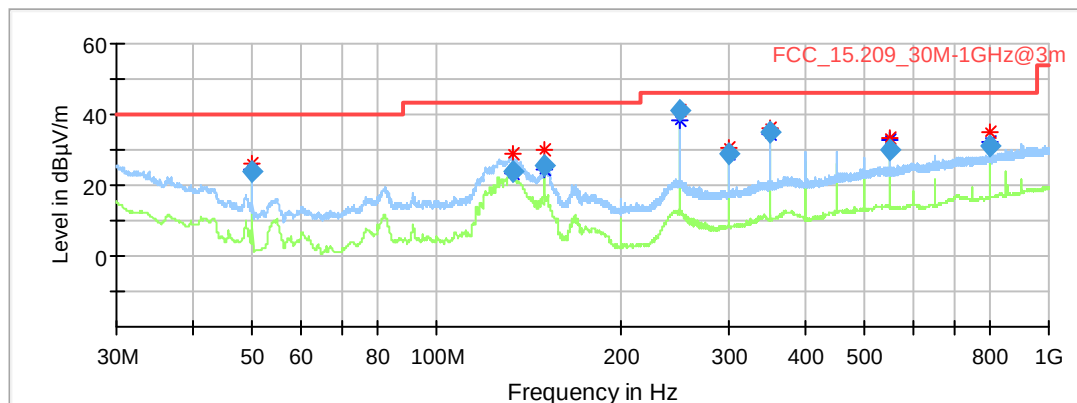


Frequency (MHz)	MaxPeak (dBμV/m)	CAverage (dBμV/m)	Limit (dBμV/m)	Margin	Meas. Time (ms)	Bandwidth (Hz)	Height	Pol	Azimuth	Elevation
1746.687	49.8	---	68.20	18.44	1000.0	1000.000	150.0	V	-4.0	-7.0

Radio Technology = WLAN a, Operating Frequency = mid, Measurement range = 26GHz - 40GHz, Subband = U-NII-2C (S01_AL02)



Radio Technology = WLAN a, Operating Frequency = mid, Measurement range = 30MHz - 1GHz, Subband = U-NII-3 (S01_AE02)



Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin	Meas. Time (ms)	Bandwidth (Hz)	Height	Pol	Azimuth	Corr. (dB/m)	Comment
50.010000	23.89	40.00	16.11	1000.0	120.000	100.0	V	-199.0	6.7	
132.870000	23.84	43.50	19.66	1000.0	120.000	108.0	V	129.0	10.3	
150.000000	25.74	43.50	17.76	1000.0	120.000	103.0	V	135.0	9.2	
249.990000	40.87	46.00	5.13	1000.0	120.000	105.0	H	55.0	11.3	
300.000000	28.74	46.00	17.26	1000.0	120.000	107.0	H	101.0	13.0	
349.980000	35.00	46.00	11.00	1000.0	120.000	100.0	H	-72.0	14.5	
549.990000	30.28	46.00	15.72	1000.0	120.000	168.0	V	5.0	19.0	
799.950000	31.29	46.00	14.71	1000.0	120.000	103.0	H	98.0	23.0	

5.7.5 TEST EQUIPMENT USED

- Radiated Emissions

5.8 BAND EDGE

Standard **FCC Part 15 Subpart E**

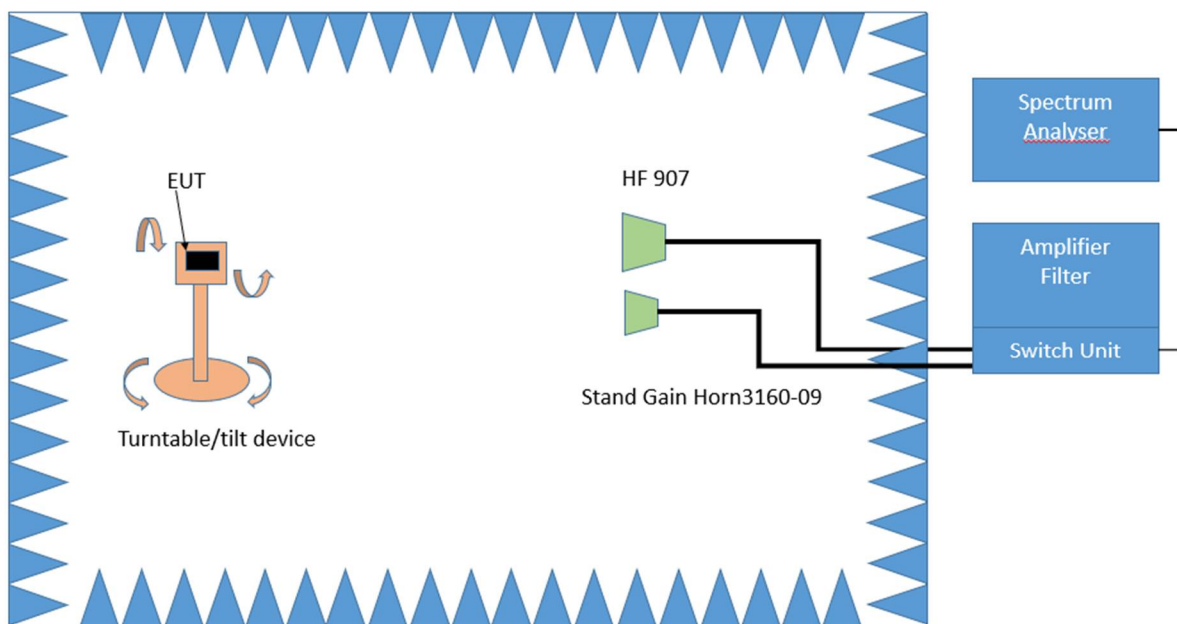
The test was performed according to:
ANSI C63.10

5.8.1 TEST DESCRIPTION

The test set-up was made in accordance to the general provisions of ANSI C63.10 in a typical installation configuration. The measurements were performed according the following sub-chapter of ANSI C63.10: 6.10.5

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 (procedure according ANSI C63.10, chapter 6.6.5).

3. Measurement above 1 GHz



Test Setup; Spurious Emission Radiated (FAC), 1 GHz-26.5 GHz

Step 1:

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 °.

Spectrum analyser settings:

- Detector: Peak, Average
- RBW = 1 MHz
- VBW = 3 MHz

Step 2:

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

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

Spectrum analyser settings:

- Detector: Peak

Step 3:

Spectrum analyser settings for step 3:

- Detector: Peak / CISPR Average
- Measured frequencies: in step 1 determined frequencies
- RBW = 1 MHz
- VBW = 3 MHz
- Measuring time: 1 s

5.8.2 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 (µV/m)	Measurement distance (m)	Limits (dBµV/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 (µV/m)	Measurement distance (m)	Limits (dBµV/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 (dBµV/m) = 20 log (Limit (µV/m)/1µV/m)

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.

5.8.3 TEST PROTOCOL

Ambient temperature: 22–24 °C
 Air Pressure: 980–1018 hPa
 Humidity: 28–35 %
 WLAN a-Mode; 20 MHz; 6 Mbit/s
 Applied duty cycle correction (AV): 0.3 dB

U-NII-Subband	Ch. No.	Ch. Center Freq. [MHz]	Band Edge Freq. [MHz]	Spurious Level [dBμV / m]	Detector	RBW [kHz]	Limit [dBμV / m]	Margin [dB]	Limit Type	FCC / IC?
1	36	5180	5150.0	65.6	PEAK	1000	74.0	8.4	BE-RB	FCC&IC
	36	5180	5150.0	51.2	AV	1000	54.0	2.8	BE-RB	FCC&IC
2A	64	5320	5350.0	67.3	PEAK	1000	74.0	6.7	BE-RB	FCC&IC
	64	5320	5350.0	52.9	AV	1000	54.0	1.1	BE-RB	FCC&IC
2C	100	5500	5460.0	62.0	PEAK	1000	74.0	12.0	BE-RB	FCC&IC
	100	5500	5460.0	46.3	AV	1000	54.0	7.7	BE-RB	FCC&IC
	100	5500	5470.0	67.4	PEAK	1000	68.2	0.8	BE-UE	FCC&IC
	140	5700	5725.0	65.7	PEAK	1000	68.2	2.5	BE-UE	FCC&IC
3	149	5745	5725.0	81.3	PEAK	1000	121.3	40.0	BE-UE	FCC&IC
	165	5825	5850.0	72.5	PEAK	1000	122.0	49.5	BE-UE	FCC&IC

WLAN n-Mode; 20 MHz; MCS0; SISO
 Applied duty cycle correction (AV): 0.3 dB

U-NII-Subband	Ch. No.	Ch. Center Freq. [MHz]	Band Edge Freq. [MHz]	Spurious Level [dBμV / m]	Detector	RBW [kHz]	Limit [dBμV / m]	Margin [dB]	Limit Type	FCC / IC?
1	36	5180	5150.0	66.6	PEAK	1000	74.0	7.4	BE-RB	FCC&IC
	36	5180	5150.0	52.0	AV	1000	54.0	2.0	BE-RB	FCC&IC
2A	64	5320	5350.0	72.2	PEAK	1000	74.0	1.8	BE-RB	FCC&IC
	64	5320	5350.0	53.3	AV	1000	54.0	0.7	BE-RB	FCC&IC
2C	100	5500	5460.0	60.0	PEAK	1000	74.0	14.0	BE-RB	FCC&IC
	100	5500	5460.0	46.2	AV	1000	54.0	7.8	BE-RB	FCC&IC
	100	5500	5470.0	67.0	PEAK	1000	68.2	1.2	BE-UE	FCC&IC
	140	5700	5725.0	64.9	PEAK	1000	68.2	3.3	BE-UE	FCC&IC
3	149	5745	5725.0	85.2	PEAK	1000	122.0	36.8	BE-UE	FCC&IC
	165	5825	5851.0	72.9	PEAK	1000	118.3	45.4	BE-UE	FCC&IC

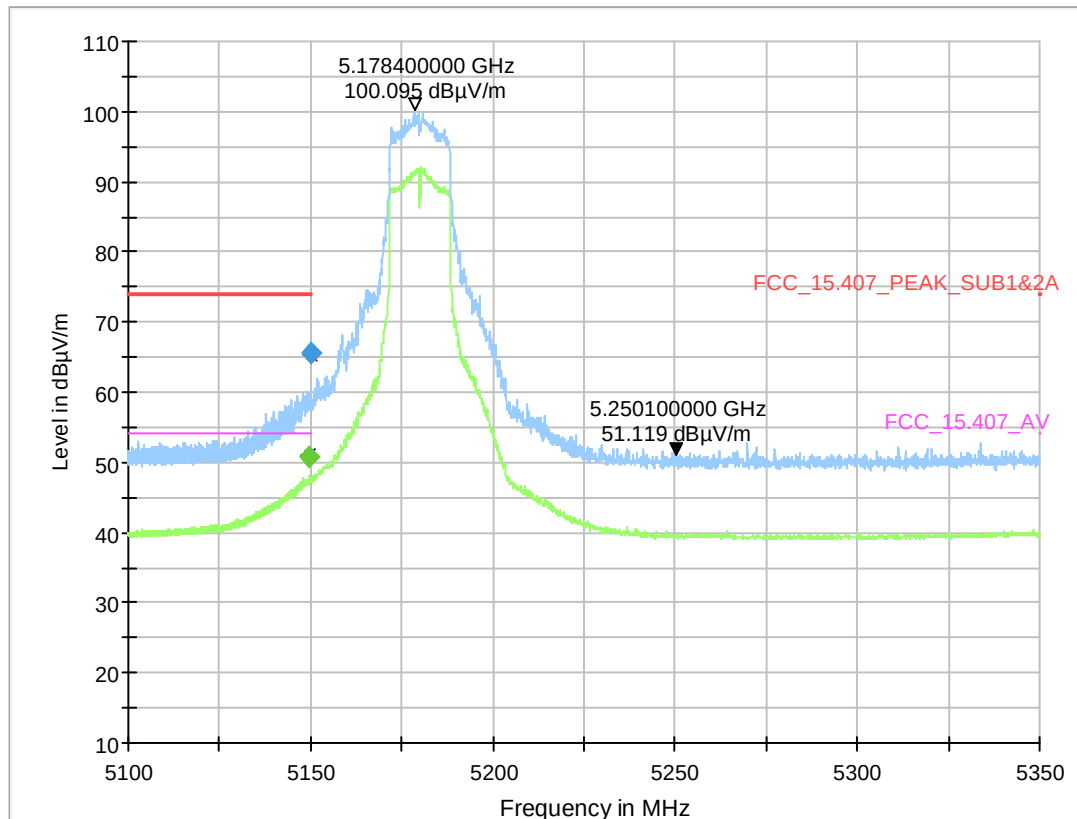
WLAN ac-Mode; 20 MHz; MCS8; SISO
Applied duty cycle correction (AV): 2.2 dB

U-NII-Subband	Ch. No.	Ch. Center Freq. [MHz]	Band Edge Freq. [MHz]	Spurious Level [dBμV / m]	Detector	RBW [kHz]	Limit [dBμV / m]	Margin [dB]	Limit Type	FCC / IC?
1	36	5180	5150.0	64.1	PEAK	1000	74.0	9.9	BE-RB	FCC&IC
	36	5180	5150.0	48.4	AV	1000	54.0	5.6	BE-RB	FCC&IC
2A	64	5320	5350.0	69.7	PEAK	1000	74.0	4.3	BE-RB	FCC&IC
	64	5320	5350.0	51.3	AV	1000	54.0	2.7	BE-RB	FCC&IC
2C	100	5500	5460.0	63.5	PEAK	1000	74.0	10.5	BE-RB	FCC&IC
	100	5500	5460.0	47.8	AV	1000	54.0	6.2	BE-RB	FCC&IC
	100	5500	5470.0	67.3	PEAK	1000	68.2	0.9	BE-UE	FCC&IC
	140	5700	5725.0	66.0	PEAK	1000	68.2	2.2	BE-UE	FCC&IC
3	149	5745	5725.0	84.4	PEAK	1000	122.2	37.8	BE-UE	FCC&IC
	165	5825	5850.0	77.3	PEAK	1000	122.2	44.9	BE-UE	FCC&IC

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

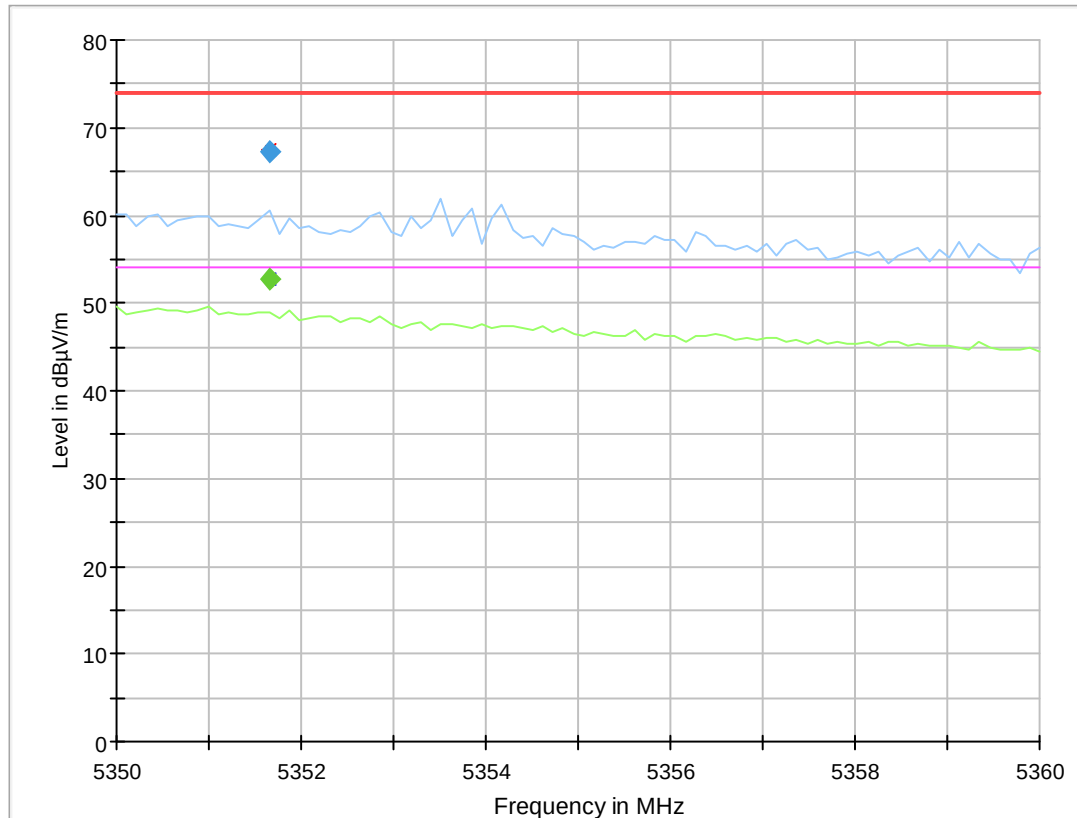
5.8.4 MEASUREMENT PLOT (EXAMPLE PLOT, SHOWING WORST CASE, IF APPLICABLE)

Radio Technology = WLAN a, Operating Frequency = low, Subband = U-NII-1 (S01_AL02)



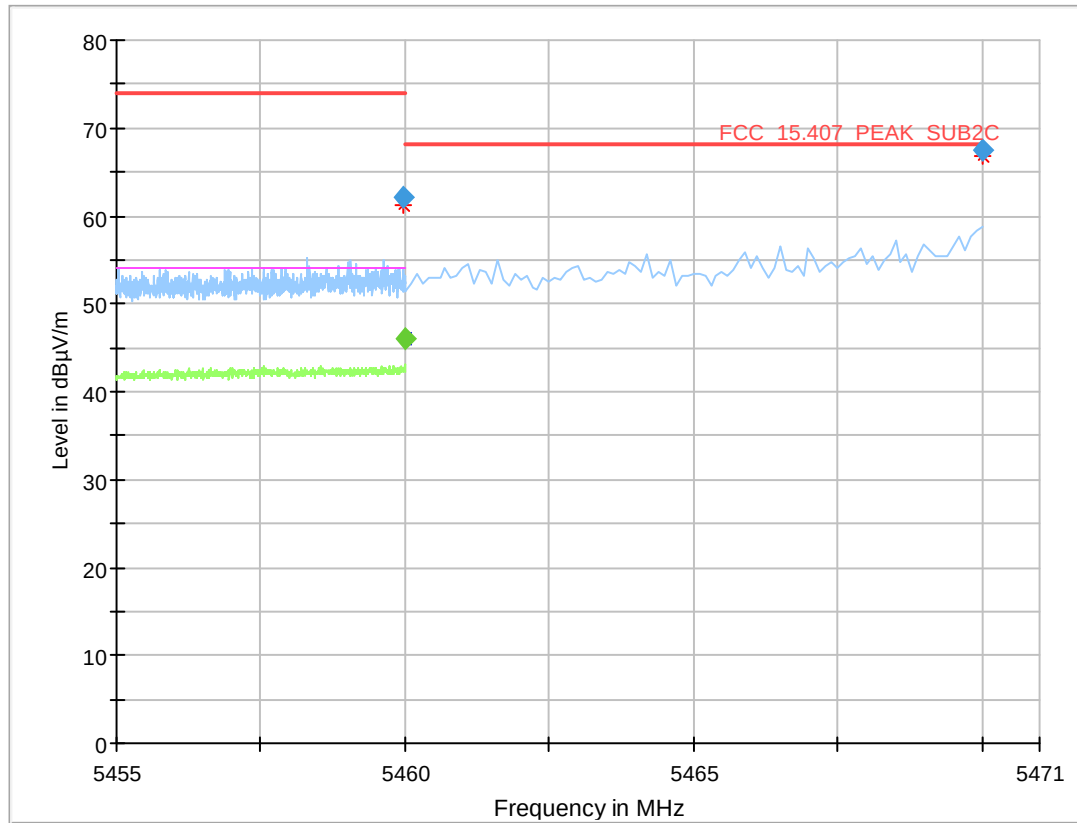
Frequency (MHz)	MaxPeak (dBμV/m)	CAverage (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Elevation (deg)
5149.500	---	50.9	54.00	3.08	1000.0	1000.000	150.0	V	45.0	102.0
5149.950	65.6	---	74.00	8.40	1000.0	1000.000	150.0	V	132.0	105.0

Radio Technology = WLAN a, Operating Frequency = high, Subband = U-NII-2A
(S01_AE02)



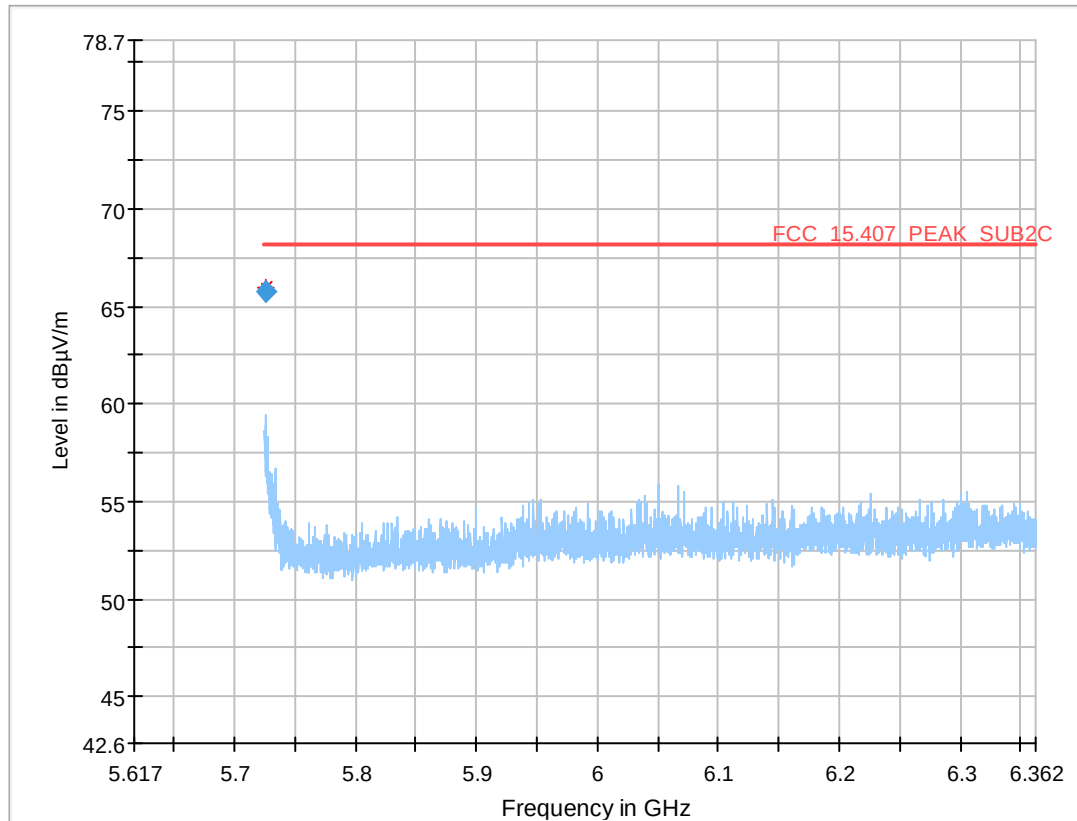
Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin	Meas. Time (ms)	Bandwidth (h)	Height	Pol	Azimuth	Elevation
5351.650	---	52.6	54.00	1.36	1000.0	1000.000	150.0	V	133.0	93.0
5351.650	67.3	---	74.00	6.71	1000.0	1000.000	150.0	V	136.0	86.0

Radio Technology = WLAN a, Operating Frequency = low, Subband = U-NII-2C
(S01_AL02)



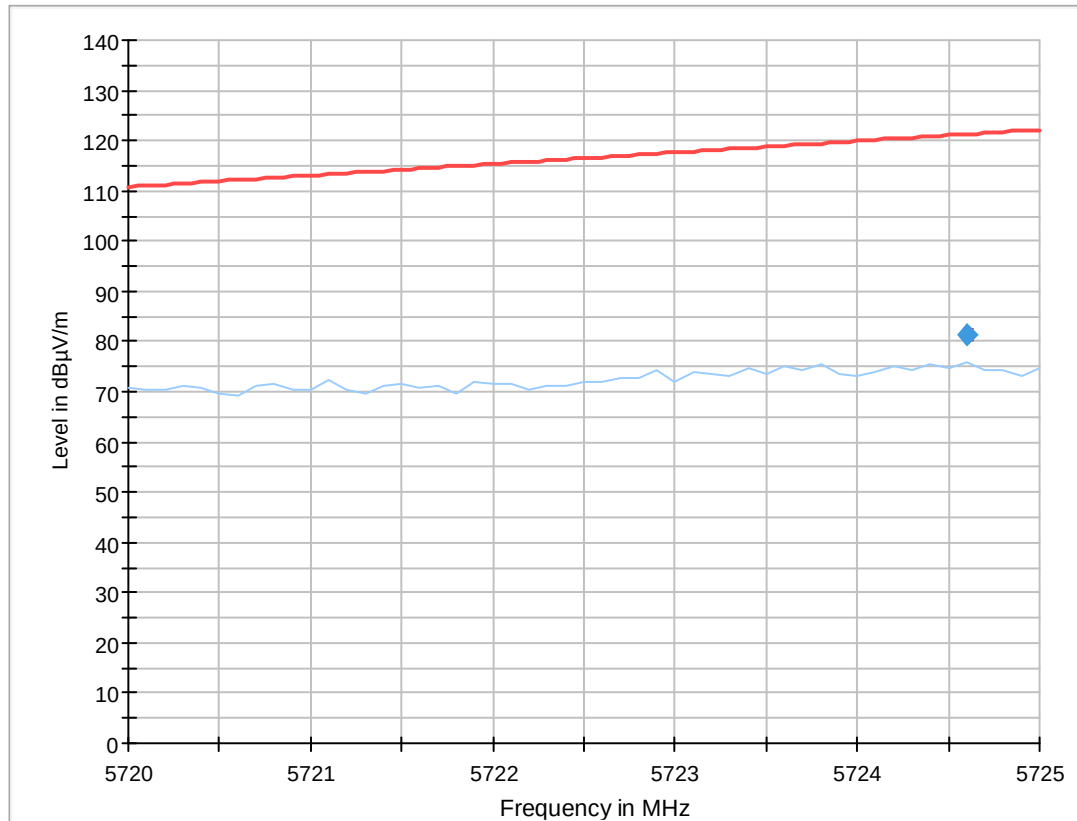
Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin	Meas. Time (ms)	Bandwidth (Hz)	Height	Pol	Azimuth	Elevation
5459.970	62.0	---	74.00	11.97	1000.0	1000.000	150.0	V	85.0	94.0
5459.990	---	46.0	54.00	7.98	1000.0	1000.000	150.0	V	137.0	86.0
5470.000	67.4	---	68.20	0.76	1000.0	1000.000	150.0	V	124.0	93.0

Radio Technology = WLAN a, Operating Frequency = high, Subband = U-NII-2C
(S01_AL02)



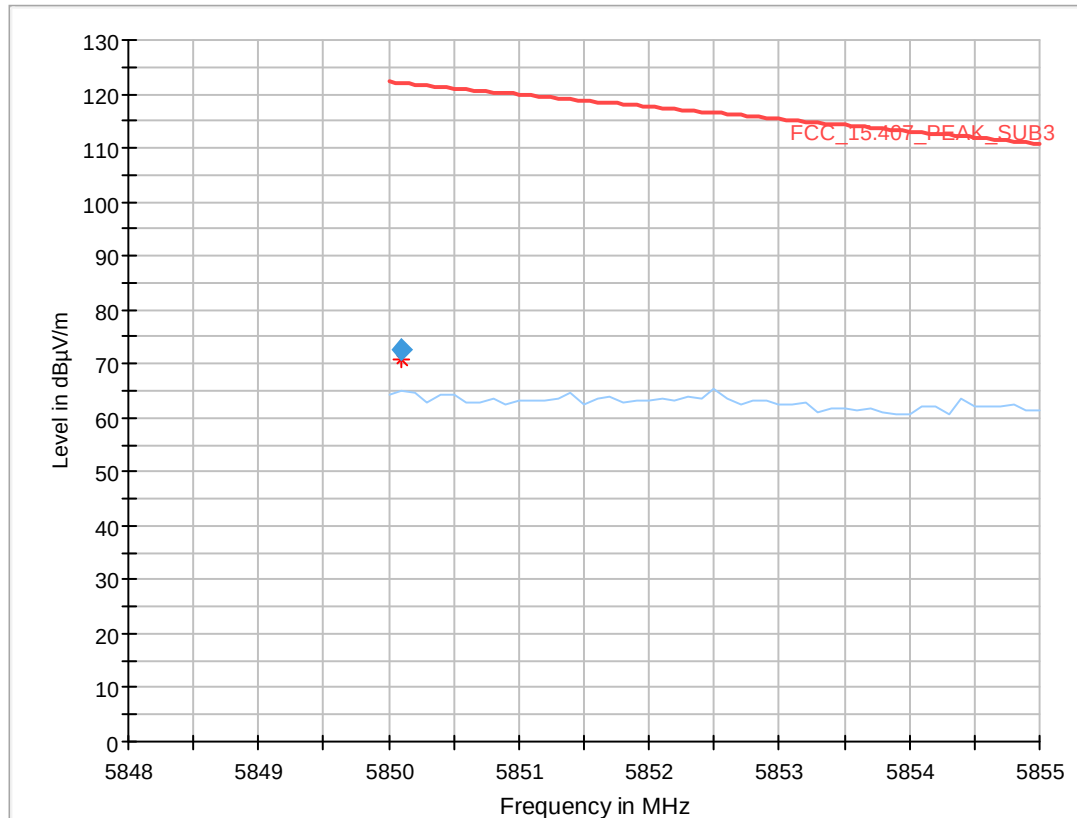
Frequency (MHz)	MaxPeak (dBμV/m)	CAverage (dBμV/m)	Limit (dBμV/m)	Margin	Meas. Time (ms)	Bandwidth	Height	Pol	Azimuth	Elevation
5725.510	65.7	---	68.20	2.45	1000.0	1000.000	150.0	H	92.0	-2.0

Radio Technology = WLAN a, Operating Frequency = low, Subband = U-NII-3
(S01_AL02)



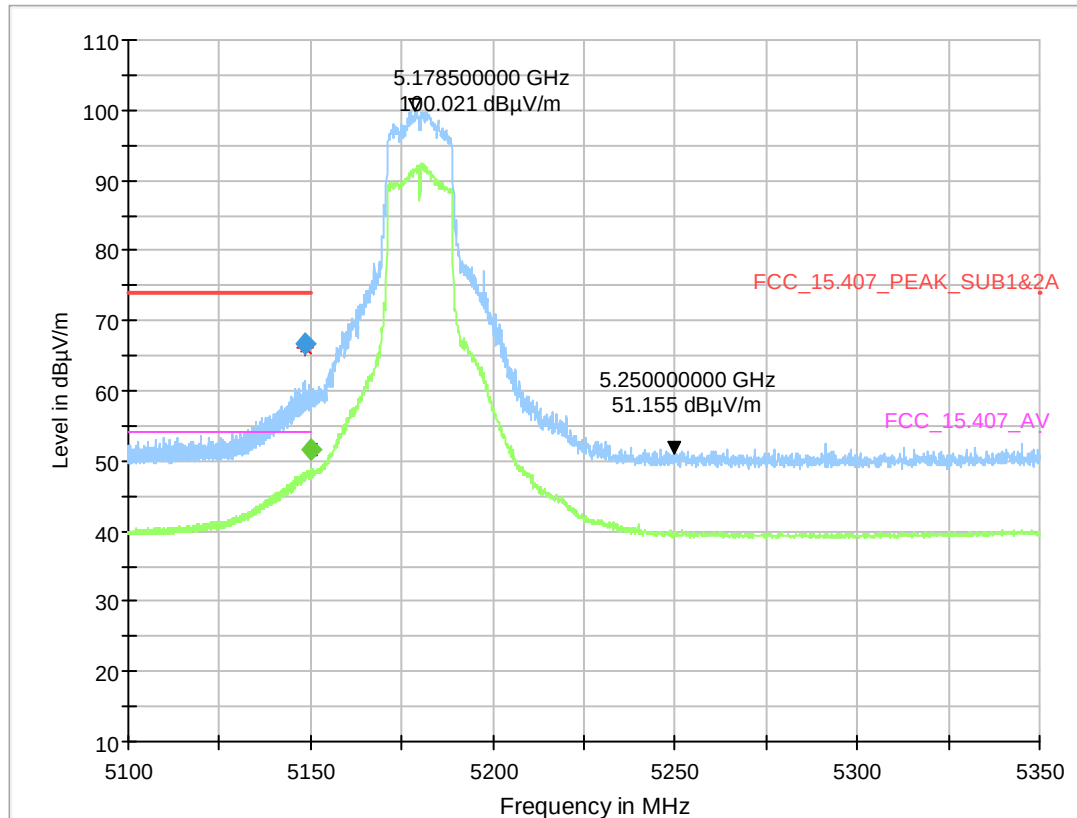
Frequency (MHz)	MaxPeak (dBμV/m)	CAverage (dBμV/m)	Limit (dBμV/m)	Margin	Meas. Time (ms)	Bandwidth (MHz)	Height	Pol	Azimuth	Elevation
5724.600	81.3	---	121.29	39.98	1000.0	1000.000	150.0	H	42.0	105.0

Radio Technology = WLAN a, Operating Frequency = high, Subband = U-NII-3
(S01_AE02)



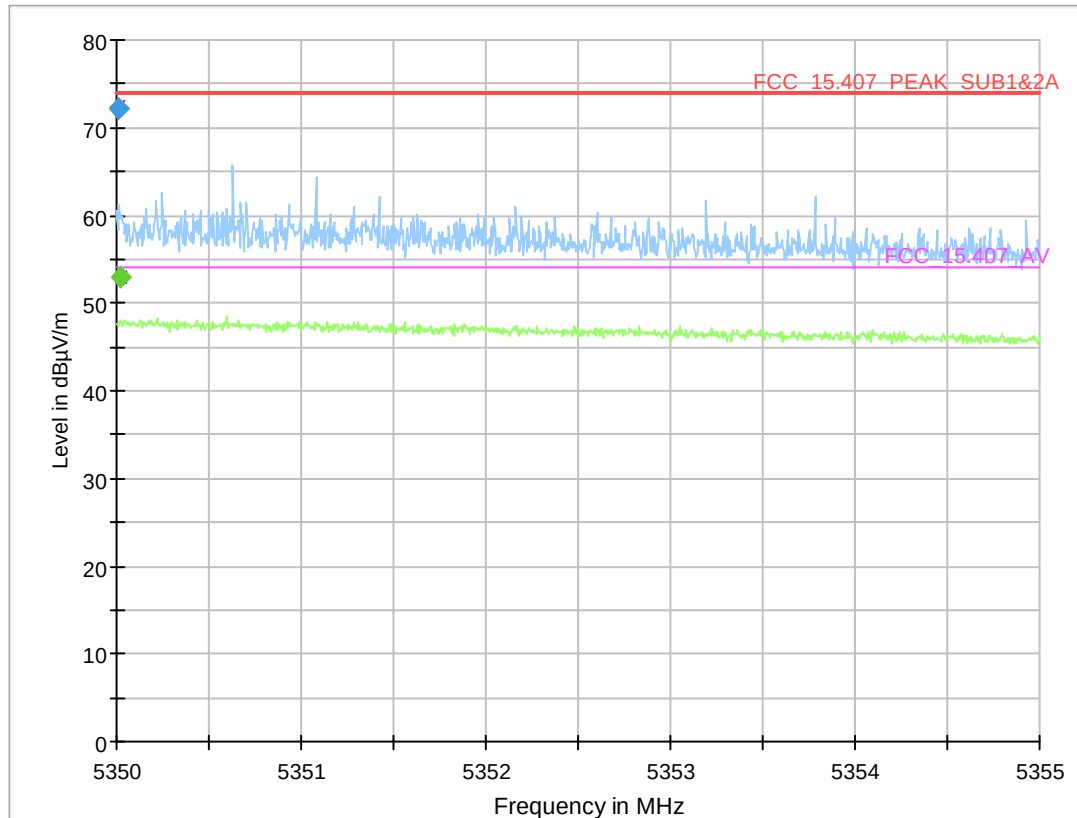
Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin	Meas. Time (ms)	Bandwidth (Hz)	Height	Pol	Azimuth	Elevation
5850.100	72.5	---	121.97	49.50	1000.0	1000.000	150.0	V	144.0	92.0

Radio Technology = WLAN n 20 MHz, Operating Frequency = low, Subband = U-NII-1
(S01_AL02)



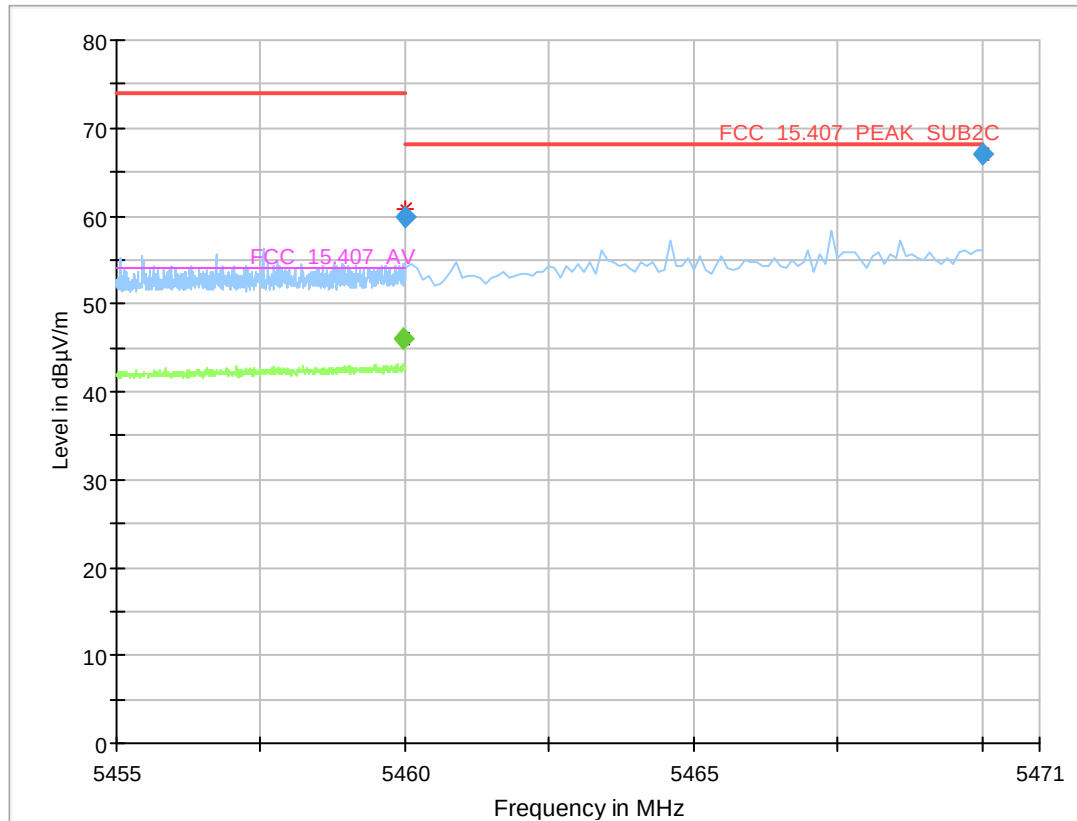
Frequency (MHz)	MaxPeak (dBμV/m)	CAverage (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Elevation (deg)
5148.500	66.6	---	74.00	7.40	1000.0	1000.000	150.0	V	90.0	86.0
5149.925	---	51.7	54.00	2.34	1000.0	1000.000	150.0	V	44.0	101.0

Radio Technology = WLAN n 20 MHz, Operating Frequency = high, Subband = U-NII-2A (S01_AL02)



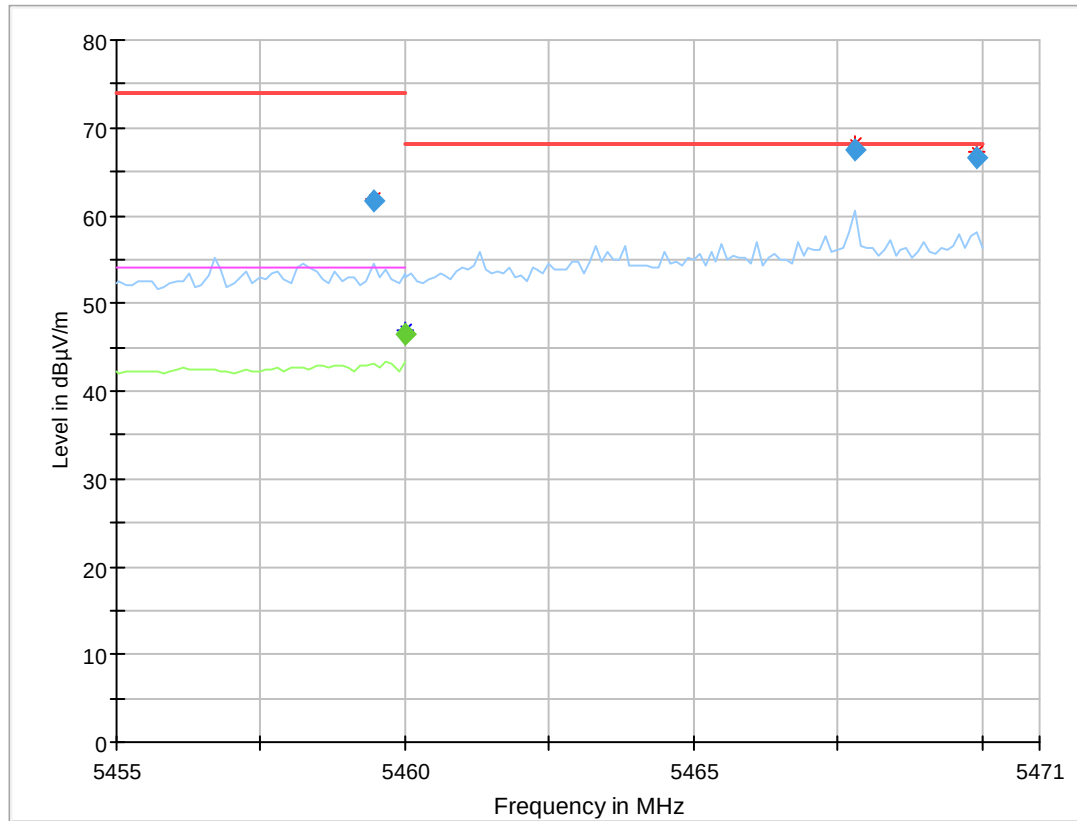
Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin	Meas. Time (ms)	Bandwidth	Height	Pol	Azimuth	Elevation
5350.015	72.2	---	74.00	1.78	1000.0	1000.000	150.0	V	140.0	92.0
5350.020	---	53.0	54.00	1.03	1000.0	1000.000	150.0	V	138.0	86.0

Radio Technology = WLAN n 20 MHz, Operating Frequency = low, Subband = U-NII-2C (S01_AL02)



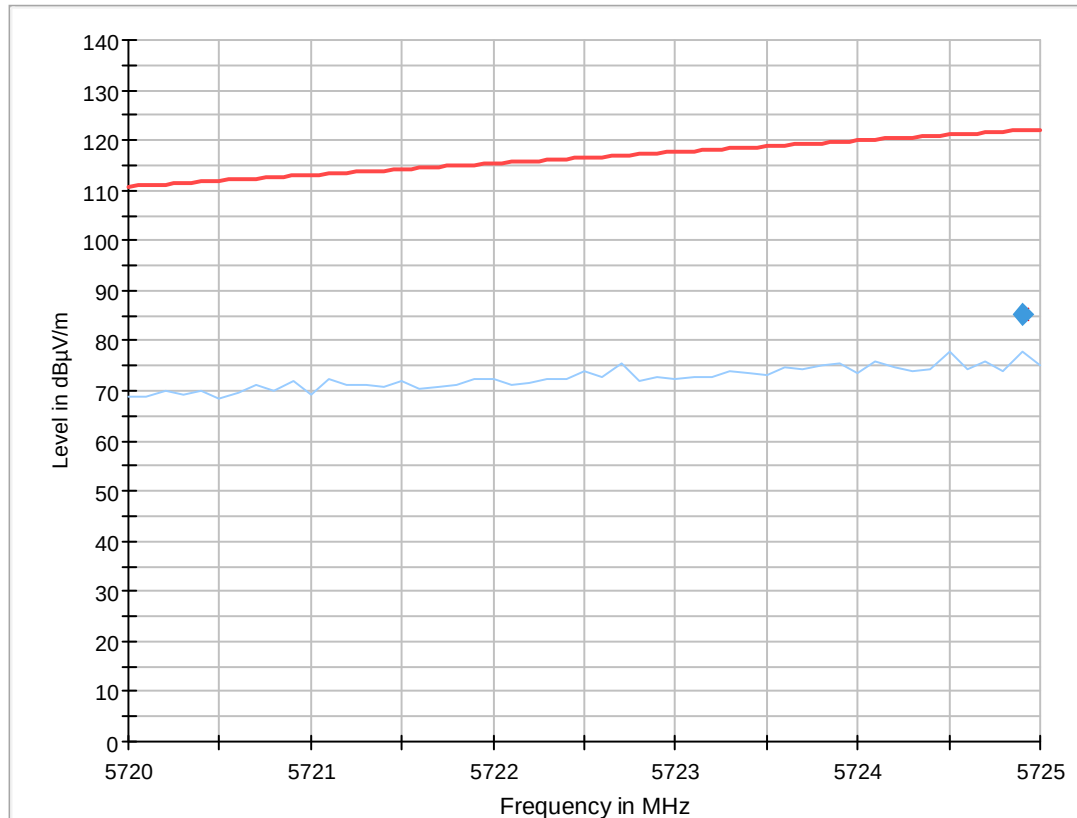
Frequency (MHz)	MaxPeak (dBμV/m)	CAverage (dBμV/m)	Limit (dBμV/m)	Margin	Meas. Time (ms)	Bandwidth (h)	Height	Pol	Azimuth (h)	Elevation (n)
5459.960	---	45.9	54.00	8.08	1000.0	1000.000	150.0	H	88.0	3.0
5459.995	60.0	---	74.00	14.02	1000.0	1000.000	150.0	V	137.0	75.0
5470.000	67.0	---	68.20	1.18	1000.0	1000.000	150.0	H	95.0	9.0

Radio Technology = WLAN n 20 MHz, Operating Frequency = high, Subband = U-NII-2C (S01_AL02)



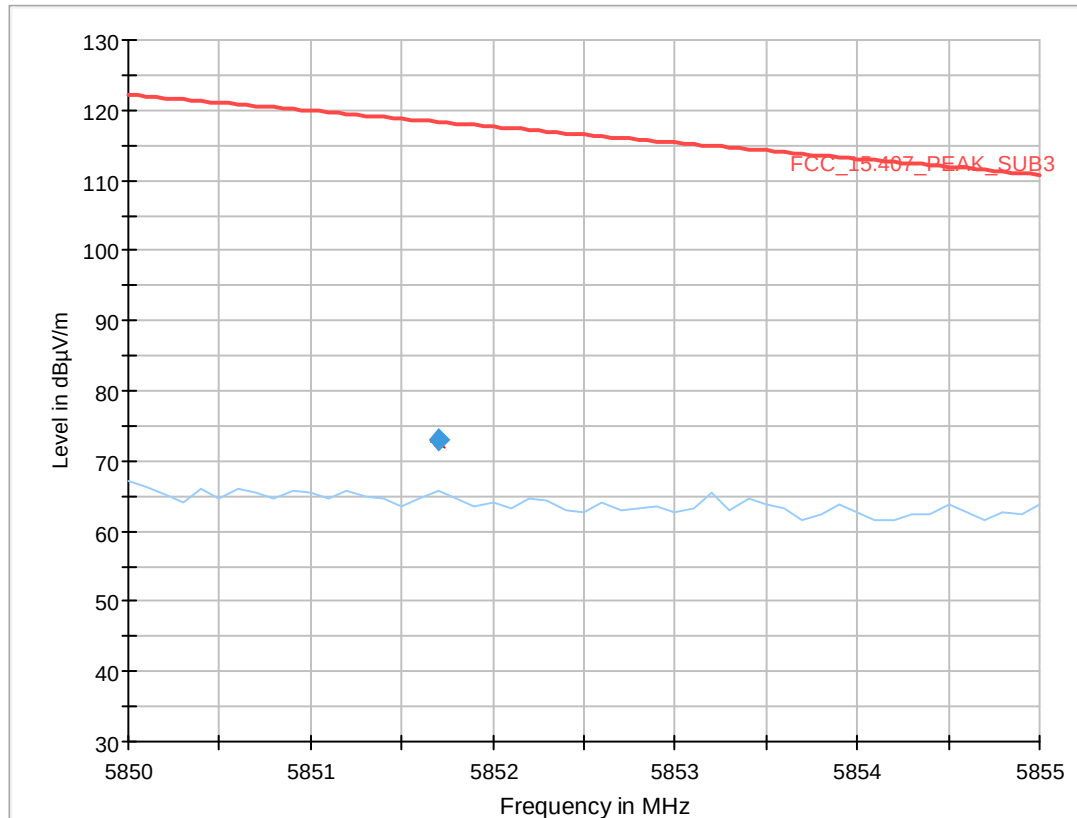
Frequency (MHz)	MaxPeak (dBμV/m)	CAverage (dBμV/m)	Limit (dBμV/m)	Margin	Meas. Time (ms)	Bandwidth (h)	Height	Pol	Azimuth (h)	Elevation (n)
5459.450	61.7	---	74.00	12.29	1000.0	1000.000	150.0	V	129.0	105.0
5460.000	---	46.5	54.00	7.46	1000.0	1000.000	150.0	V	130.0	88.0
5467.800	67.5	---	68.20	0.71	1000.0	1000.000	150.0	V	131.0	91.0
5469.900	66.6	---	68.20	1.65	1000.0	1000.000	150.0	H	98.0	15.0

Radio Technology = WLAN n 20 MHz, Operating Frequency = low, Subband = U-NII-3 (S01_AL02)



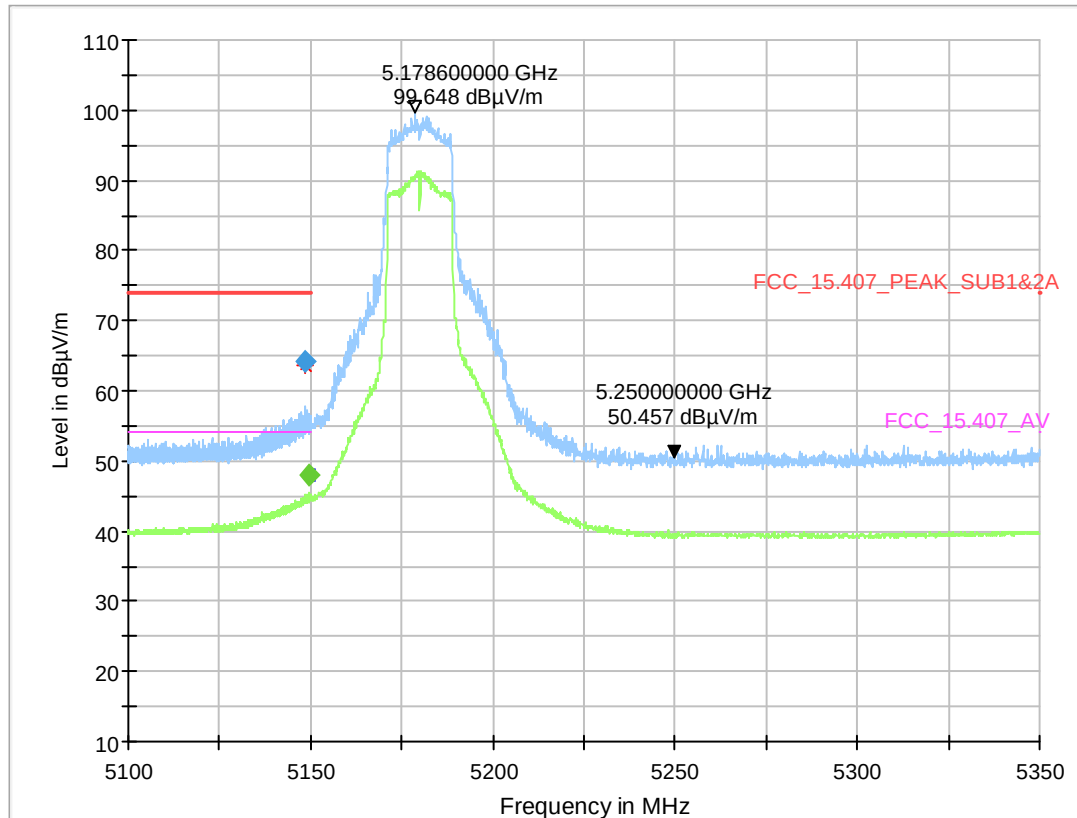
Frequency (MHz)	MaxPeak (dBμV/m)	CAverage (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Elevation (deg)
5724.900	85.2	---	121.97	36.75	1000.0	1000.000	150.0	H	34.0	105.0

Radio Technology = WLAN n 20 MHz, Operating Frequency = high, Subband = U-NII-3 (S01_AL02)



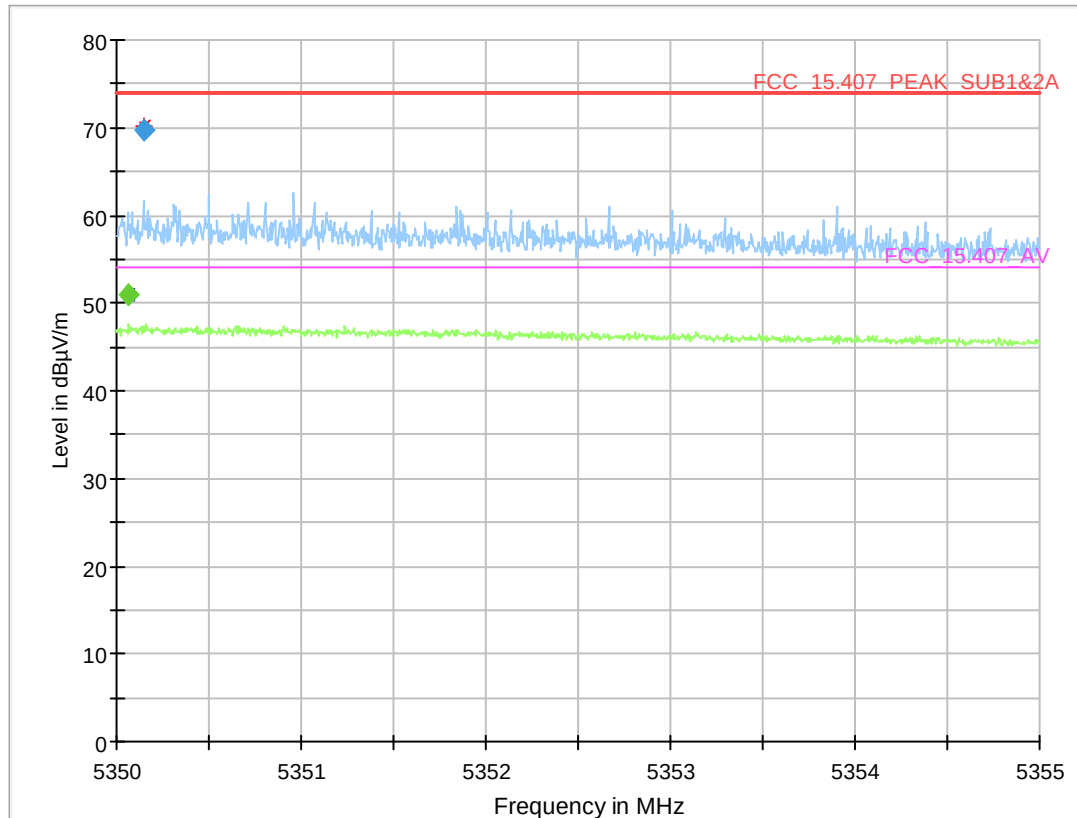
Frequency (MHz)	MaxPeak (dBμV/m)	CAverage (dBμV/m)	Limit (dBμV/m)	Margin	Meas. Time (ms)	Bandwidth (h)	Height	Pol	Azimuth	Elevation
5851.700	72.9	---	118.32	45.40	1000.0	1000.000	150.0	V	5.0	90.0

Radio Technology = WLAN ac 20 MHz, Operating Frequency = low, Subband = U-NII-1 (S01_AL02)



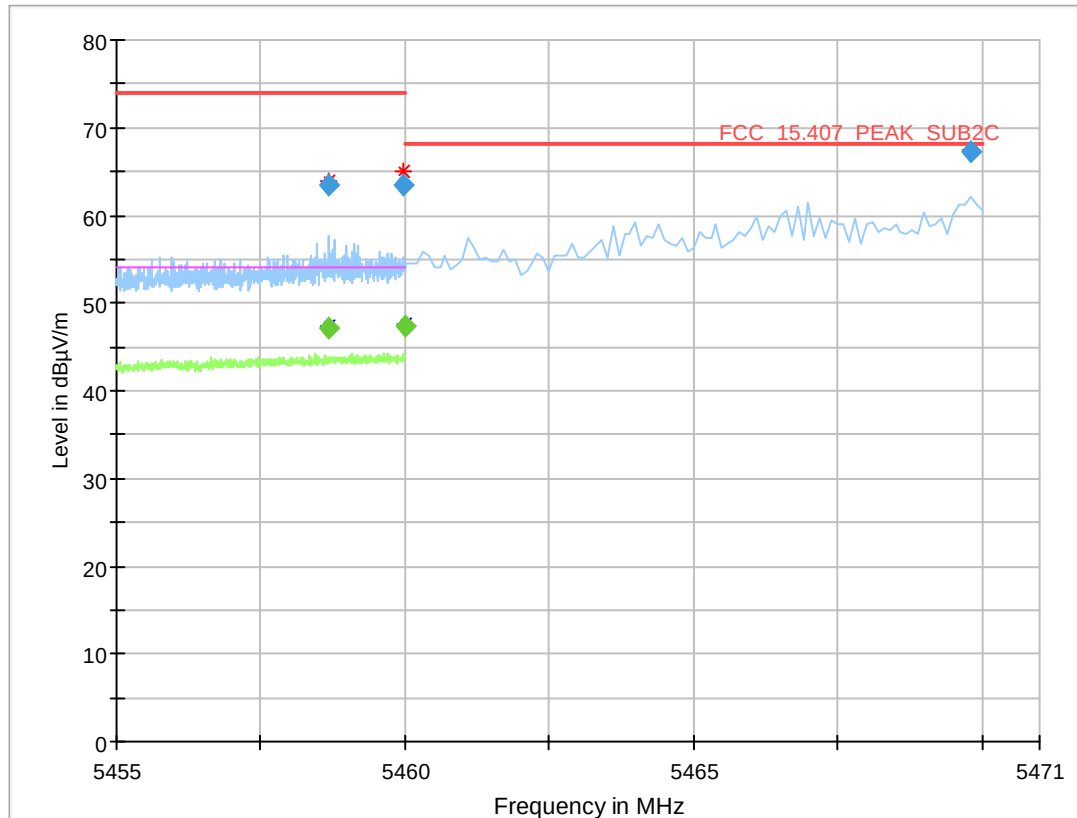
Frequency (MHz)	MaxPeak (dBμV/m)	CAverage (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Elevation (deg)
5148.638	64.1	---	74.00	9.95	1000.0	1000.000	150.0	V	134.0	90.0
5149.375	---	48.1	54.00	5.93	1000.0	1000.000	150.0	V	44.0	105.0

Radio Technology = WLAN ac 20 MHz, Operating Frequency = high, Subband = U-NII-2A (S01_AL02)



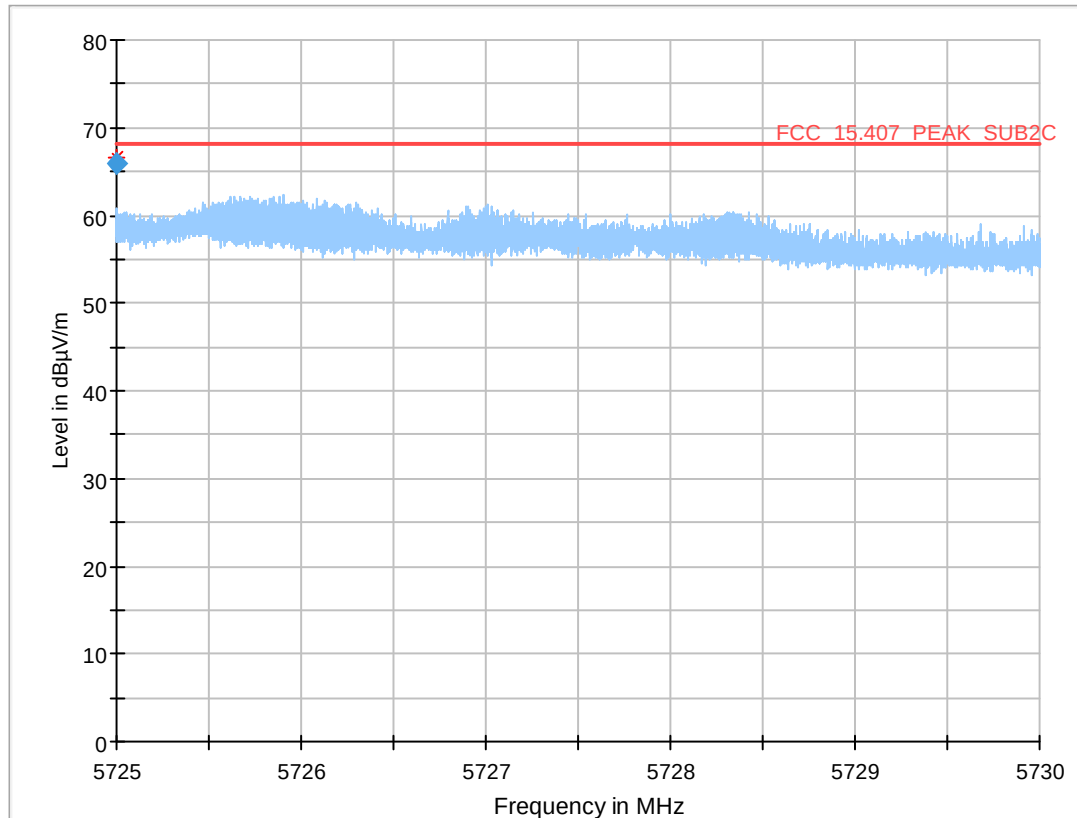
Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin	Meas. Time (ms)	Bandwidth	Height	Pol	Azimuth	Elevation
5350.065	---	51.0	54.00	3.00	1000.0	1000.000	150.0	V	79.0	85.0
5350.145	69.7	---	74.00	4.26	1000.0	1000.000	150.0	V	79.0	94.0

Radio Technology = WLAN ac 20 MHz, Operating Frequency = low, Subband = U-NII-2C (S01_AL02)



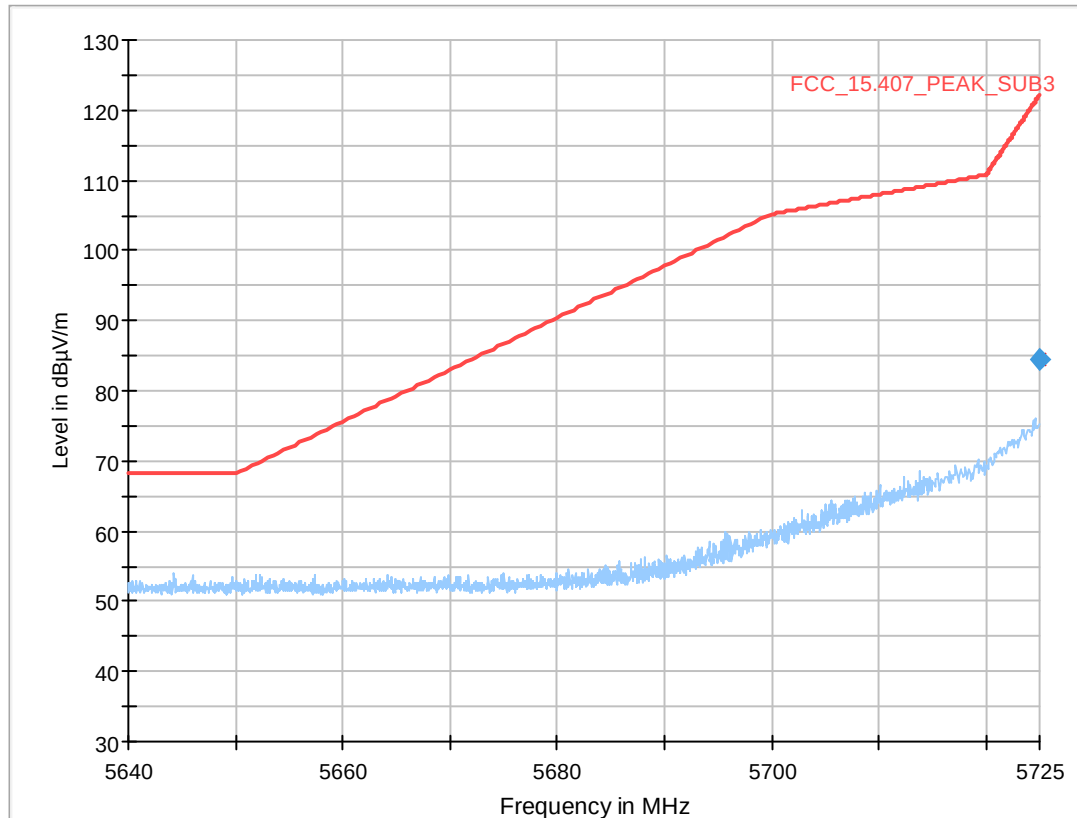
Frequency (MHz)	MaxPeak (dBμV/m)	CAverage (dBμV/m)	Limit (dBμV/m)	Margin	Meas. Time (ms)	Bandwidth (h)	Height	Pol	Azimuth	Elevation
5458.675	---	47.2	54.00	6.75	1000.0	1000.000	150.0	V	131.0	86.0
5458.680	63.4	---	74.00	10.60	1000.0	1000.000	150.0	V	79.0	105.0
5459.980	63.5	---	74.00	10.48	1000.0	1000.000	150.0	V	132.0	80.0
5459.995	---	47.5	54.00	6.53	1000.0	1000.000	150.0	V	131.0	86.0
5469.800	67.3	---	68.20	0.91	1000.0	1000.000	150.0	V	79.0	105.0

Radio Technology = WLAN ac 20 MHz, Operating Frequency = high, Subband = U-NII-2C (S01_AL02)



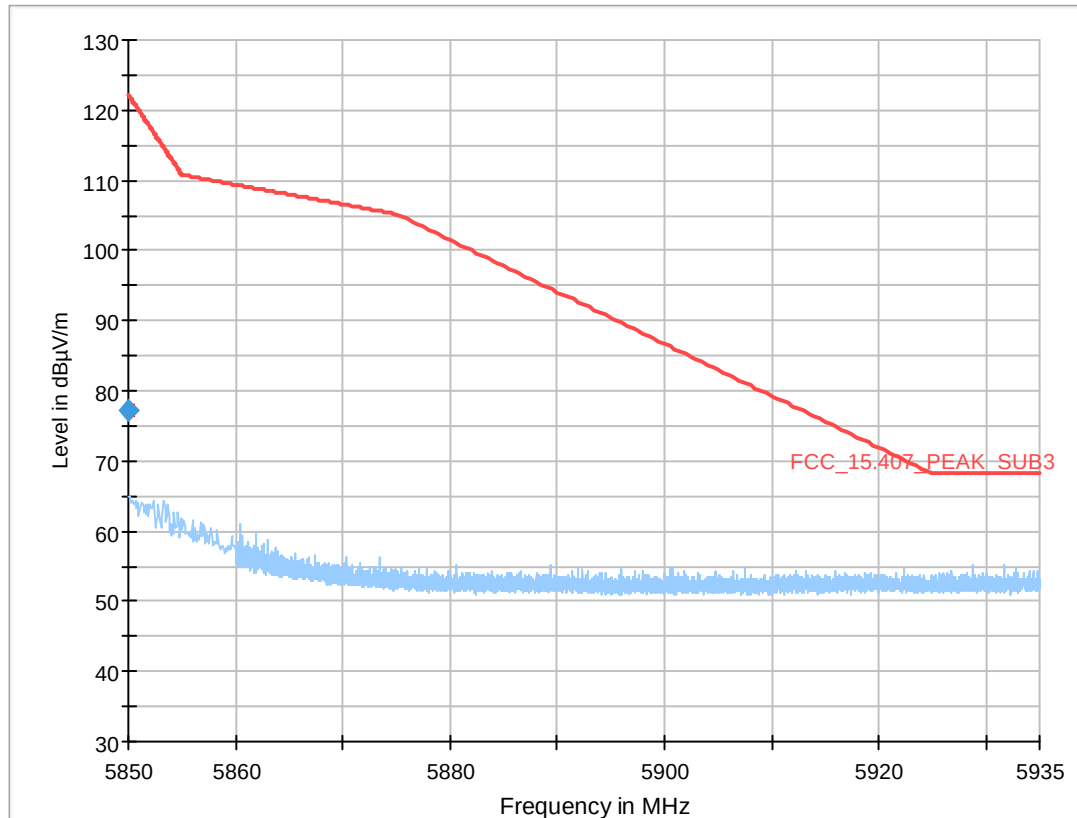
Frequency (MHz)	MaxPeak (dBμV/m)	CAverage (dBμV/m)	Limit (dBμV/m)	Margin	Meas. Time (ms)	Bandwidth (Hz)	Height	Pol	Azimuth	Elevation
5725.003	66.0	---	68.20	2.24	1000.0	1000.000	150.0	V	90.0	103.0

Radio Technology = WLAN ac 20 MHz, Operating Frequency = low, Subband = U-NII-3 (S01_AL02)



Frequency (MHz)	MaxPeak (dBμV/m)	CAverage (dBμV/m)	Limit (dBμV/m)	Margin	Meas. Time (ms)	Bandwidth (Hz)	Height	Pol	Azimuth	Elevation
5725.000	84.4	---	122.20	37.82	1000.0	1000.000	150.0	H	36.0	105.0

Radio Technology = WLAN ac 20 MHz, Operating Frequency = high, Subband = U-NII-3 (S01_AL02)



Frequency (MHz)	MaxPeak (dBμV/m)	CAverage (dBμV/m)	Limit (dBμV/m)	Margin	Meas. Time (ms)	Bandwidth (Hz)	Height	Pol	Azimuth	Elevation
5850.000	77.3	---	122.20	44.94	1000.0	1000.000	150.0	H	38.0	105.0

5.8.5 TEST EQUIPMENT USED

- Radiated Emissions

6 TEST EQUIPMENT

- 1 Conducted Emissions FCC
Conducted Emissions AC Mains for FCC standards

Ref.No.	Device Name	Description	Manufacturer	Serial Number	Last Calibration	Calibration Due
1.1	MFS	Rubidium Frequency Normal MFS	Datum GmbH	002	2019-10	2020-11
1.2	Opus10 TPR (8253.00)	T/P Logger 13	Lufft Mess- und Regeltechnik GmbH	13936	2019-05	2021-05
1.3	ESH3-Z5	Two-Line V-Network (AUX)	Rohde & Schwarz GmbH & Co. KG	828304/029	2019-06	2021-06
1.4	Chroma 6404	AC Source	Chroma ATE INC.	64040001304		
1.5	Shielded Room 02	Shielded Room 4m x 3m	Frankonia Germany EMC Solution GmbH	-		
1.6	ESH3-Z5	Two-Line V-Network (EUT)	Rohde & Schwarz GmbH & Co. KG	829996/002	2019-06	2021-06
1.7	ESR 7	EMI Receiver / Spectrum Analyzer	Rohde & Schwarz	101424	2019-01	2021-01
1.8	Opus10 THI (8152.00)	T/H Logger 02	Lufft Mess- und Regeltechnik GmbH	7489	2019-05	2021-05

- 2 R&S TS8997
2.4 and 5 GHz Bands Conducted Test Lab

Ref.No.	Device Name	Description	Manufacturer	Serial Number	Last Calibration	Calibration Due
2.1	FSV30	Signal Analyzer 10 Hz - 30 GHz	Rohde & Schwarz	103005	2018-04	2020-04
2.2	NGSM 32/10	Power Supply	Rohde & Schwarz GmbH & Co. KG	3456	2020-01	2022-01
2.3	Opus10 THI (8152.00)	T/H Logger 03	Lufft Mess- und Regeltechnik GmbH	7482	2019-06	2021-06
2.4	SMBV100A	Vector Signal Generator 9 kHz - 6 GHz	Rohde & Schwarz	259291	2019-11	2022-11
2.5	OSP120	Contains Power Meter and Switching Unit OSP-B157W8	Rohde & Schwarz	101158	2018-05	2021-05

- 3 Radiated Emissions
Lab to perform radiated emission tests

Ref.No.	Device Name	Description	Manufacturer	Serial Number	Last Calibration	Calibration Due
3.1	MFS	Rubidium Frequency Normal MFS	Datum GmbH	002	2019-10	2020-11
3.2	N5000/NP	Filter for EUT, 2 Lines, 250 V, 16 A	ETS-LINDGREN	241515		
3.3	Opus10 TPR (8253.00)	T/P Logger 13	Lufft Mess- und Regeltechnik GmbH	13936	2019-05	2021-05
3.4	ESW44	EMI Receiver / Spectrum Analyzer	Rohde & Schwarz GmbH & Co. KG	101603	2019-12	2021-12

Ref.No.	Device Name	Description	Manufacturer	Serial Number	Last Calibration	Calibration Due
3.5	Anechoic Chamber 01	SAC/FAR, 10.58 m x 6.38 m x 6.00 m	Frankonia	none	2018-06	2021-06
3.6	HL 562 ULTRALOG	Biconical-log-per antenna (30 MHz - 3 GHz) with HL 562E biconicals	Rohde & Schwarz GmbH & Co. KG	830547/003	2018-07	2021-07
3.7	AMF-7D00101800-30-10P-R	Broadband Amplifier 100 MHz - 18 GHz	Miteq			
3.8	ASP 1.2/1.8-10 kg	Antenna Mast	Maturo GmbH	-		
3.9	Anechoic Chamber 03	FAR, 8.80m x 4.60m x 4.05m (l x w x h)	Albatross Projects	P26971-647-001-PRB	2018-06	2020-06
3.10	Fluke 177	Digital Multimeter 03 (Multimeter)	Fluke Europe B.V.	86670383	2020-04	2022-04
3.11	Opus10 THI (8152.00)	T/H Logger 10	Lufft Mess- und Regeltechnik GmbH	12488	2019-06	2021-06
3.12	PONTIS Con4101	PONTIS Camera Controller		6061510370		
3.13	JS4-18002600-32-5P	Broadband Amplifier 18 GHz - 26 GHz	Miteq	849785		
3.14	3160-09	Standard Gain / Pyramidal Horn Antenna 26.5 GHz	EMCO Elektronik GmbH	00083069		
3.15	WHKX 7.0/18G-8SS	High Pass Filter	Wainwright Instruments GmbH	09		
3.16	DS 420S	Turn Table 2 m diameter	HD GmbH	420/573/99		
3.17	JS4-00102600-42-5A	Broadband Amplifier 30 MHz - 26 GHz	Miteq	619368		
3.18	TT 1.5 WI	Turn Table	Maturo GmbH	-		
3.19	HL 562 ULTRALOG	Biconical-log-per Antenna (30 MHz - 3 GHz)	Rohde & Schwarz GmbH & Co. KG	100609	2019-05	2022-05
3.20	3160-10	Standard Gain / Pyramidal Horn Antenna 40 GHz	EMCO Elektronik GmbH	00086675		
3.21	MA4985-XP-ET	Bore Sight Antenna Mast	innco systems GmbH	none		
3.22	JUN-AIR Mod. 6-15	Air Compressor	JUN-AIR Deutschland GmbH	612582		
3.23	HFH2-Z2	Loop Antenna + 3 Axis Tripod	Rohde & Schwarz GmbH & Co. KG	829324/006	2018-01	2021-01
3.24	Opus10 THI (8152.00)	T/H Logger 12	Lufft Mess- und Regeltechnik GmbH	12482	2019-06	2021-06

Ref.No.	Device Name	Description	Manufacturer	Serial Number	Last Calibration	Calibration Due
3.25	SB4-100.OLD20-3T/10 Airwin 2 x 1.5 kW	Air compressor (oil-free)	airWin Kompressoren UG	901/00503		
3.26	JS4-00101800-35-5P	Broadband Amplifier 30 MHz - 18 GHz	Miteq	896037		
3.27	AS 620 P	Antenna Mast (pneumatic polarisation)	HD GmbH	620/37		
3.28	6005D (30 V / 5 A)	Laboratory Power Supply 120 V 60 Hz	PeakTech	81062045		
3.29	TD1.5-10kg	EUT Tilt Device (Rohacell)	Maturo GmbH	TD1.5-10kg/024/3790709		
3.30	Innco Systems CO3000	Controller for bore sight mast SAC	innco systems GmbH	CO3000/967/39371016/L		
3.31	NRV-Z1	Sensor Head B	Rohde & Schwarz GmbH & Co. KG	827753/006	2019-08	2020-08
3.32	HF 907-2	Double-ridged horn	Rohde & Schwarz	102817	2019-04	2022-04
3.33	PAS 2.5 - 10 kg	Antenna Mast	Maturo GmbH	-		
3.34	AFS42-00101800-25-S-42	Broadband Amplifier 25 MHz - 18 GHz	Miteq	2035324		
3.35	AM 4.0	Antenna Mast 4 m	Maturo GmbH	AM4.0/180/11920513		
3.36	HF 907	Double-ridged horn	Rohde & Schwarz	102444	2018-07	2021-07

The calibration interval is the time interval between “Last Calibration” and “Calibration Due”

7 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.

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

Frequency		Corr.	LISN insertion loss ESH3- Z5	cable loss (incl. 10 dB atten- uator)
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.

7.2 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)
MHz	dB (1/m)	dB	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

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

U = Receiver reading

AF = Antenna factor

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

distance correction = $-40 * \text{LOG} (d_{\text{Limit}} / d_{\text{used}})$

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

Table shows an extract of values

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

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

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

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

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

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

U = Receiver reading

AF = Antenna factor

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

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

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

Tables show an extract of values.

7.4 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

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

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.

Tables show an extract of values.

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

Frequency	AF EMCO 3160-09	Corr.	cable loss 1 (inside chamber)	cable loss 2 (pre- amp)	cable loss 3 (inside chamber)	cable loss 4 (switch unit)	cable 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

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

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.

Table shows an extract of values.

7.6 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))
GHz	dB (1/m)	dB	dB	dB	dB	dB	dB	m	m
26.5	43.4	-11.2	4.4				-9.5	3	1.0
27.0	43.4	-11.2	4.4				-9.5	3	1.0
28.0	43.4	-11.1	4.5				-9.5	3	1.0
29.0	43.5	-11.0	4.6				-9.5	3	1.0
30.0	43.5	-10.9	4.7				-9.5	3	1.0
31.0	43.5	-10.8	4.7				-9.5	3	1.0
32.0	43.5	-10.7	4.8				-9.5	3	1.0
33.0	43.6	-10.7	4.9				-9.5	3	1.0
34.0	43.6	-10.6	5.0				-9.5	3	1.0
35.0	43.6	-10.5	5.1				-9.5	3	1.0
36.0	43.6	-10.4	5.1				-9.5	3	1.0
37.0	43.7	-10.3	5.2				-9.5	3	1.0
38.0	43.7	-10.2	5.3				-9.5	3	1.0
39.0	43.7	-10.2	5.4				-9.5	3	1.0
40.0	43.8	-10.1	5.5				-9.5	3	1.0

Sample calculation

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

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 = $-20 * \text{LOG} (d_{\text{Limit}} / d_{\text{used}})$

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

Table shows an extract of values.

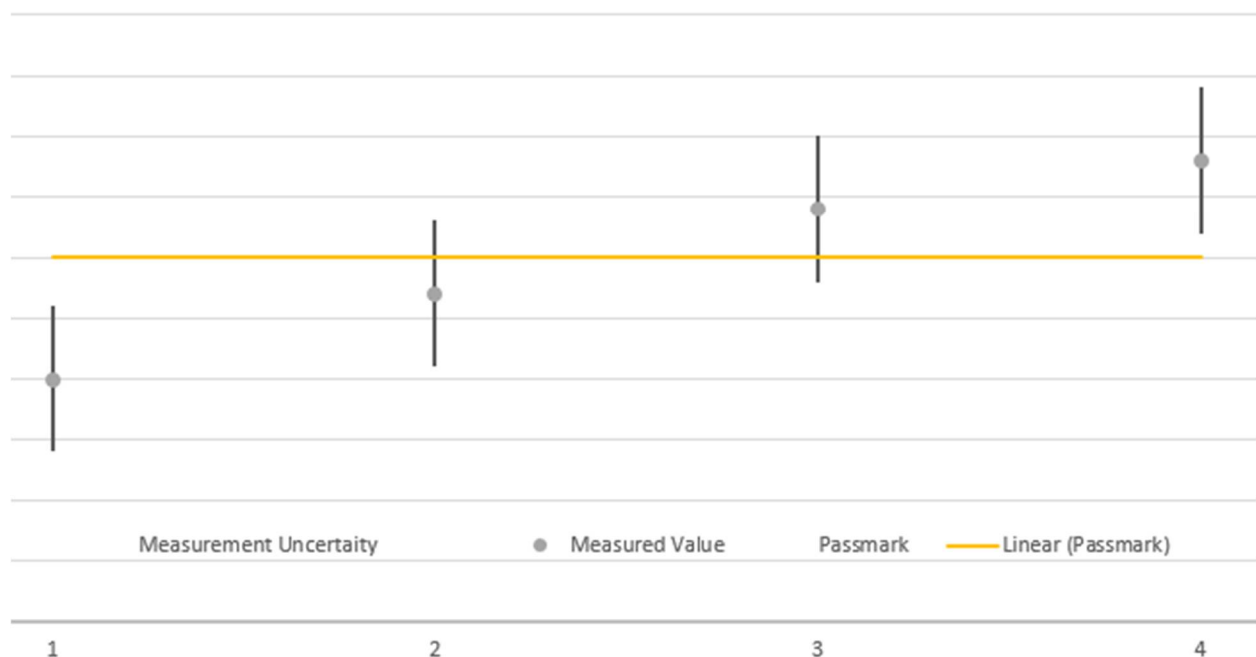
8 PHOTO REPORT

Please see separate photo report.

9 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

The measurement uncertainties for all parameters are calculated with an expansion factor (coverage factor) $k = 1.96$. This means, that the true value is in the corresponding interval with a probability of 95 %.



The verdicts in this test report are given according the above diagram:

Case	Measured Value	Uncertainty Range	Verdict
1	below pass mark	below pass mark	Passed
2	below pass mark	within pass mark	Passed
3	above pass mark	within pass mark	Failed
4	above pass mark	above pass mark	Failed

That means, the laboratory applies, as decision rule (see ISO/IEC 17025:2017), the so-called shared risk principle.