FCC Measurement/Technical Report on

Host-based multiradio module with Wi-Fi, Bluetooth and NFC

EMMY-W163

in WLAN 5 GHz mode

FCC ID: XPYEMMYW163
IC: 8595A-EMMYW163

Test Report Reference: MDE_UBLOX_1551_FCCg_Rev_1

Test Laboratory:
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DAkkS Deutsche Akkreditierungsstelle D-PL-12140-01-01

1 APPLIED STANDARDS AND TEST SUMMARY

1.1 APPLIED STANDARDS

Type of Authorization
Certification for an Intentional Radiator (Digital Device / Spread Spectrum)

Applicable FCC Rules

Prepared in accordance with the requirements of FCC Rules and Regulations as listed in 47 CFR Ch.1 Parts 2 (10-1-15 Edition) and 15 (10-1-15 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 1:
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 v01r02, 2016-04-08".

ANSI C63.10-2013 is applied.

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

Note 2:
Not all possible operating modes were tested. Worst case operating modes were determined at the beginning of the test period.

Note 3:
According to applicant's description are the multiradio modules EMMY-W161 and EMMY-163 identical related to the 2.4 GHz WLAN and 5 GHz WLAN radio. Differences are only related to the Bluetooth radio: EMMY-W161 uses one single antenna port (pin) for WLAN and Bluetooth, EMMY-W163 uses a separate antenna ports for Bluetooth and one for WLAN. This report is focused on 5 GHz WLAN mode.

Note 4:
For 5 GHz WLAN mode were only "spot checks" performed to show evidence, that EMMY-W163 has the same RF-characteristic like EMMY-W161 (please refer to Test Report "MDE_UBLOX_1551_FCCf").

Note 5:
Unwanted emissions limits: Conducted measurements were performed at the antenna-port to cover different antennas.

Note 6:
The stricter limits were applied from the different device types: outdoor access point / indoor access point / mobile and portable client.

Note 7:
Transmit Power Control (TPC) and Dynamic Frequency Selection (DFS) is not part of this test report.

Summary Test Results:

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

1.2 FCC-IC CORRELATION TABLE

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

UNII equipment

Measurement	FCC reference	IC reference
Conducted emissions on AC Mains	§ 15.207	RSS-Gen Issue 4: 8.8
Occupied bandwidth	§ 15.403 (i) (26 dB) / § 15.407 (e) (6 dB)	RSS-247 Issue 1: 6.2.1 (1), 6.2.2 (1), 6.2.3 (1) (99%) RSS-247 Issue 1: 6.2.4 (1) (6 dB)
Maximum conducted output power	§ 15.407 (a) (1),(2),(3),(4)	RSS-247 Issue 1: : 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 1: : 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 4: 6.13/8.9/8.10; RSS-247 Issue 1: : 6.2.1 (2), 6.2.2 (2), 6.2.3 (2), 6.2.4 (2)
Frequency stability	§ 15.407 (g)	RSS-Gen Issue 4: 6.11/8.11
Transmit Power Control (TPC) and Dynamic Frequency Selection (DFS)	§ 15.407 (h)	RSS-247 Issue 1: 6.2.2 (1), 6.2.3 (1), 6.3
Antenna requirement	§ 15.203 / 15.204	RSS-Gen Issue 4: 8.3
Receiver spurious emissions	–	-

Note 1:
Industry Canada RSS-247 Issue 1
6.2.3 Frequency Bands 5470-5600 MHz and 5650-5725 MHz
Until further notice, devices subject to this section shall not be capable of transmitting in the band 5600-5650 MHz. This restriction is for the protection of Environment Canada's weather radars operating in this band.

1.3 MEASUREMENT SUMMARY / SIGNATURES

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	Setup	FCC	IC
Operating mode			
Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested

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

26 dB Bandwidth

The measurement was performed according to ANSI C63.10 **Final Result**

OP-Mode	Setup	FCC	IC
Radio Technology, Operating Frequency, Subband			
WLAN a Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	N/A
WLAN ac 20 MHz Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	N/A
WLAN ac 40 MHz Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	N/A
WLAN ac 80 MHz Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	N/A
WLAN n 20 MHz Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	N/A
WLAN n 40 MHz Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	N/A

Remark: No applicable limit. Measurement results for information purpose and to determine the limit for conducted output power.

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	FCC	IC
WLAN a Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested
WLAN ac 20 MHz Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested
WLAN ac 40 MHz Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested
WLAN ac 80 MHz Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested
WLAN n 20 MHz Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested
WLAN n 40 MHz Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested

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	FCC	IC
WLAN a Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	N/A	Not tested
WLAN ac 20 MHz Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	N/A	Not tested
WLAN ac 40 MHz Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	N/A	Not tested
WLAN ac 80 MHz Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	N/A	Not tested
WLAN n 20 MHz Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	N/A	Not tested
WLAN n 40 MHz Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	N/A	Not tested

Remark: No applicable limit. Measurement results for information purpose and to determine the limit for conducted output power.

Maximum Conducted Output Power
The measurement was performed according to ANSI C63.10 **Final Result**

OP-Mode Radio Technology, Operating Frequency, Subband	**Setup**	**FCC**	**IC**
WLAN a, high, U-NII-1 Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested
WLAN a, high, U-NII-2A Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested
WLAN a, high, U-NII-2C Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested
WLAN a, high, U-NII-3 Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested
WLAN a, low, U-NII-1 Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested
WLAN a, low, U-NII-2A Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested
WLAN a, low, U-NII-2C Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested
WLAN a, low, U-NII-3 Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested
WLAN a, mid, U-NII-1 Remark: set EUT target power 16	DE1015032 db01	Passed	Passed
WLAN a, mid, U-NII-2A Remark: set EUT target power 16	DE1015032 db01	Passed	Passed
WLAN a, mid, U-NII-2C Remark: set EUT target power 16	DE1015032 db01	Passed	Passed
WLAN a, mid, U-NII-3 Remark: set EUT target power 16	DE1015032 db01	Passed	Passed

WLAN ac 20 MHz, high, U-NII-1 Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested
WLAN ac 20 MHz, high, U-NII-2A Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested
WLAN ac 20 MHz, high, U-NII-2C Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested
WLAN ac 20 MHz, high, U-NII-3 Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested
WLAN ac 20 MHz, low, U-NII-1 Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested
WLAN ac 20 MHz, low, U-NII-2A Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested
WLAN ac 20 MHz, low, U-NII-2C Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested
WLAN ac 20 MHz, low, U-NII-3 Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested
WLAN ac 20 MHz, mid, U-NII-1 Remark: set EUT target power 16	DE1015032 db01	Passed	Passed
WLAN ac 20 MHz, mid, U-NII-2A Remark: set EUT target power 16	DE1015032 db01	Passed	Passed
WLAN ac 20 MHz, mid, U-NII-2C Remark: set EUT target power 16	DE1015032 db01	Passed	Passed
WLAN ac 20 MHz, mid, U-NII-3 Remark: set EUT target power 16	DE1015032 db01	Passed	Passed
WLAN ac 40 MHz, high, U-NII-1 Remark: set EUT target power 16	DE1015032 db01	Passed	Passed
WLAN ac 40 MHz, high, U-NII-2A Remark: set EUT target power 12	DE1015032 db01	Passed	Passed
WLAN ac 40 MHz, high, U-NII-2C Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested
WLAN ac 40 MHz, high, U-NII-3 Remark: set EUT target power 16	DE1015032 db01	Passed	Passed
WLAN ac 40 MHz, low, U-NII-1 Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested
WLAN ac 40 MHz, low, U-NII-2A Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested
WLAN ac 40 MHz, low, U-NII-2C Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested
WLAN ac 40 MHz, low, U-NII-3 Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested
WLAN ac 40 MHz, mid, U-NII-2C Remark: set EUT target power 16	DE1015032 db01	Passed	Passed

WLAN ac 80 MHz, high, U-NII-2C Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested
WLAN ac 80 MHz, low, U-NII-2C Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested
WLAN ac 80 MHz, mid, U-NII-1 Remark: set EUT target power 8	DE1015032 db01	Passed	Passed
WLAN ac 80 MHz, mid, U-NII-2A Remark: set EUT target power 8	DE1015032 db01	Passed	Passed
WLAN ac 80 MHz, mid, U-NII-2C Remark: set EUT target power 12	DE1015032 db01	Passed	Passed
WLAN ac 80 MHz, low, U-NII-3 Remark: set EUT target power 8	DE1015032 db01	Passed	Passed
WLAN n 20 MHz, high, U-NII-1 Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested
WLAN n 20 MHz, high, U-NII-2A Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested
WLAN n 20 MHz, high, U-NII-2C Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested
WLAN n 20 MHz, high, U-NII-3 Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested
WLAN n 20 MHz, low, U-NII-1 Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested
WLAN n 20 MHz, low, U-NII-2A Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested
WLAN n 20 MHz, low, U-NII-2C Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested
WLAN n 20 MHz, low, U-NII-3 Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested
WLAN n 20 MHz, mid, U-NII-1 Remark: set EUT target power 16	DE1015032 db01	Passed	Passed
WLAN n 20 MHz, mid, U-NII-2A Remark: set EUT target power 16	DE1015032 db01	Passed	Passed
WLAN n 20 MHz, mid, U-NII-2C Remark: set EUT target power 16	DE1015032 db01	Passed	Passed
WLAN n 20 MHz, mid, U-NII-3 Remark: set EUT target power 16	DE1015032 d01	Passed	Passed

WLAN n 40 MHz, high, U-NII-1 Remark: set EUT target power 16	DE1015032 db01	Passed	Passed
WLAN n 40 MHz, high, U-NII-2A Remark: set EUT target power 12	DE1015032 db01	Passed	Passed
WLAN n 40 MHz, high, U-NII-2C Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested
WLAN n 40 MHz, high, U-NII-3 Remark: set EUT target power 16	DE1015032 db01	Passed	Passed
WLAN n 40 MHz, low, U-NII-1 Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested
WLAN n 40 MHz, low, U-NII-2A Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested
WLAN n 40 MHz, low, U-NII-2C Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested
WLAN n 40 MHz, low, U-NII-3 Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested
WLAN n 40 MHz, mid, U-NII-2C Remark: set EUT target power 12	DE1015032 db01	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**	**FCC**	**IC**
WLAN a Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested
WLAN ac 20 MHz Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested
WLAN ac 40 MHz Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested
WLAN ac 80 MHz Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested
WLAN n 20 MHz Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested
WLAN n 40 MHz Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested

Undesirable Emissions; General Field Strength Limits
The measurement was performed according to ANSI C63.10

Final Result

OP-Mode Radio Technology, Operating Frequency, Measurement range, Subband	**Setup**	**FCC**	**IC**
WLAN a Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested
WLAN ac 20 MHz Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested
WLAN ac 40 MHz Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested
WLAN ac 80 MHz Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested
WLAN n 20 MHz Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested
WLAN n 40 MHz Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested

Spurious RF Conducted Emissions at Antenna Port
The measurement was performed according to ANSI C63.10

Final Result

OP-Mode Radio Technology, Operating Frequency, Subband	**Setup**	**FCC**	**IC**
WLAN a, additional channel, Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested
WLAN a, low, U-NII-1 Remark: 54Mbps	DE1015032 db01	Passed	Passed
WLAN a, low, U-NII-2C Remark: 54Mbps	DE1015032 db01	Passed	Passed
WLAN a, low, U-NII-3 Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested
WLAN a, high, U-NII-2A Remark: 54Mbps	DE1015032 db01	Passed	Passed
WLAN a, high, U-NII-2C Remark: 6Mbps	--	Not tested	Not tested
WLAN a, high, U-NII-2C Remark: 54Mbps	DE1015032 db01	Passed	Passed
WLAN a, high, U-NII-3 Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested
WLAN n 20 MHz, additional channel, U-NII-1 Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested
WLAN n 20 MHz, additional channel, U-NII-2A Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested
WLAN n 20 MHz, additional channel, U-NII-2C Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested
WLAN n 20 MHz, additional channel, U-NII-3 Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested
WLAN n 20 MHz, low, U-NII-1 Remark: MCS7	DE1015032 db01	Passed	Passed
WLAN n 20 MHz, low, U-NII-2C Remark: MCS7	DE1015032 db01	Passed	Passed
WLAN n 20 MHz, low, U-NII-3 Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested
WLAN n 20 MHz, high, U-NII-2A Remark: MCS7	DE1015032 db01	Passed	Passed
WLAN n 20 MHz, high, U-NII-2C Remark: MCS7	DE1015032 db01	Passed	Passed
WLAN n 20 MHz, high, U-NII-3 Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested

WLAN n 40 MHz, additional channel Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested
WLAN n 40 MHz, low, U-NII-1 Remark: MCS7	DE1015032 db01	Passed	Passed
WLAN n 40 MHz, low, U-NII-2A Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested
WLAN n 40 MHz, low, U-NII-2C Remark: MCS7	DE1015032 db01	Passed	Passed
WLAN n 40 MHz, low, U-NII-3 Remark: MCS0	DE1015032 da01	Passed	Passed
WLAN n 40 MHz, high, U-NII-1 Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested
WLAN n 40 MHz, high, U-NII-2A Remark: MCS7	DE1015032 db01	Passed	Passed
WLAN n 40 MHz, high, U-NII-2C Remark: MCS7	DE1015032 db01	Passed	Passed
WLAN n 40 MHz, high, U-NII-3 Remark: MCS0	DE1015032 da01	Passed	Passed
WLAN ac 20 MHz, additional channel Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested
WLAN ac 20 MHz, low, U-NII-1 Remark: MCS5	DE1015032 db01	Passed	Passed
WLAN ac 20 MHz, low, U-NII-2C Remark: MCS0	DE1015032 db01	Passed	Passed
WLAN ac 20 MHz, low, U-NII-3 Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested
WLAN ac 20 MHz, high, U-NII-2A Remark: MCS5	DE1015032 db01	Passed	Passed
WLAN ac 20 MHz, high, U-NII-3 Remark: MCS0	DE1015032 da01	Passed	Passed
WLAN ac 40 MHz, low, U-NII-1 Remark: MCS9	DE1015032 db01	Passed	Passed
WLAN ac 40 MHz, low, U-NII-2A Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested
WLAN ac 40 MHz, low, U-NII-2C Remark: MCS9	DE1015032 db01	Passed	Passed
WLAN ac 40 MHz, low, U-NII-3 Remark: MCS9	DE1015032 da01	Passed	Passed
WLAN ac 40 MHz, high, U-NII-1 Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested
WLAN ac 40 MHz, high, U-NII-2A Remark: MCS9	DE1015032 db01	Passed	Passed
WLAN ac 40 MHz, high, U-NII-3 Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested

WLAN ac 80 MHz, additional channel, U-NII-2C Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested
WLAN ac 80 MHz, low, U-NII-2C Remark: MCS9	DE1015032 db01	Passed	Passed
WLAN ac 80 MHz, mid, U-NII-1 Remark: MCS0	DE1015032 db01	Passed	Passed
WLAN ac 80 MHz, mid, U-NII-2A Remark: MCS0	DE1015032 db01	Passed	Passed
WLAN ac 80 MHz, low, U-NII-3 Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested

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

Band Edge

The measurement was performed according to ANSI C63.10 **Final Result**

OP-Mode Radio Technology, Operating Frequency, Subband	**Setup**	**FCC**	**IC**
WLAN a Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested
WLAN ac 20 MHz Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested
WLAN ac 40 MHz Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested
WLAN ac 80 MHz Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested
WLAN n 20 MHz Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested
WLAN n 40 MHz Remark: only spot check testing, please refer to test report MDE_UBLOX_1551_FCCf	--	Not tested	Not tested

Simultaneous Transmission - Spurious Radiated Emissions
The measurement was performed according to ANSI C63.10

Final Result

OP-Mode	**Setup**	**FCC**	**IC**
Active Transmitters			
NFC + Bluetooth BDR + WLAN 5 GHz	DE1015031 cb01	Passed	Passed

Digitally signed by MARCO KULLIK
Date: 2016.08.25 17:49:53 +02'00'

(responsible for accreditation scope)
Mr. Marco Kullik

WOLFGANG PETER RICHTER
2016.08.25 17:41:41 +02'00'

(responsible for testing and report)
Mr. Wolfgang Richter

1.4 REVISION HISTORY

Report version control			
Version	**Release date**	**Change Description**	**Version validity**
initial	2016-07-08	--	invalid
Rev_1	2016-08-25	1.3: Channel description for 5775 MHz corrected from "WLAN ac 80 MHz, mid, U-NII-3" to "WLAN ac 80 MHz, low, U-NII-3" (only low channel is used in this band) 3.1: EUT description changed for clarification from "test vehicle" to "evaluation board", 3.2: Sample cb01 added, 3.7.1: U-NII Subband 3, ac-mode 80 MHz nom. BW: only low channel at 5775 MHz is used in this band 4.1: Output power re-measured with lower declared output power, 4.3: Chapter Simultaneous Transmission added	valid

2 ADMINISTRATIVE DATA

2.1 TESTING LABORATORY

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

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

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

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

Laboratory accreditation no:	DAkkS D-PL-12140-01-01
Responsible for accreditation scope:	Mr. Marco Kullik
Report Template Version:	2016-06-07

2.2 PROJECT DATA

Responsible for testing and report:	Mr. Wolfgang Richter
Employees who performed the tests:	documented internally at 7Layers
Date of Report:	2016-08-25
Testing Period:	2016-01-06 to 2016-08-24

2.3 APPLICANT DATA

Company Name:	u-blox AG
Address:	Zürcherstrasse 68 8800 Thalwil Switzerland
Contact Person:	Mr. Giulio Comar

2.4 MANUFACTURER DATA

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

3 TEST OBJECT DATA

3.1 GENERAL EUT DESCRIPTION

Kind of Device product description	WLAN 2.4 GHz, 5 GHz, BT, NFC, SRD (5.8 GHz)
Product name	Host-based multiradio module with Wi-Fi, Bluetooth and NFC
Type	EMMY-W163
Declared EUT data by the supplier	
Voltage Type	DC
Voltage Level	normal: 3.3 V DC low: 3.0 V DC high: 3.6 V DC
Modulation Type for WLAN 5 GHz	OFDM, HT20 MCS0 – MCS7, HT40 MCS0 –MCS7, VHT20 MCS0 – MCS8, VHT40 MCS0 –MCS9, VHT80 MCS0 –MCS9 please see each test protocol
General product description	EMMY-W161 and EMMY-W163 are ultra-compact multi-radio modules providing Wi-Fi, Classic Bluetooth, Bluetooth low energy and NFC mode of operation. It is designed for both simultaneous and independent operations of: • Wi-Fi IEEE 802.11ac and a/b/g/n • Dual-mode Bluetooth 4.2 • NFC
Specific product description for the EUT	EMMY-W163: Shielded module, separate antenna pins for WLAN 802.11 ac/a/b/g/n and Bluetooth communication
The EUT provides the following ports:	- DC power supply - antenna ports - signal ports
Data rates	WLAN a: please see chapter "WLAN Power Table" WLAN n 20 MHz: please see chapter "WLAN Power Table" WLAN n 40 MHz: please see chapter "WLAN Power Table" WLAN ac 20: please see chapter "WLAN Power Table" WLAN ac 40: please see chapter "WLAN Power Table" WLAN ac 80: please see chapter "WLAN Power Table"
Access point use	Indoor or outdoor
Device type	Master or client, mobile and portable client
Special software used for testing	Special software used to setup EUT for testing: u-blox Labtool

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

3.2 EUT MAIN COMPONENTS

Sample Name	Sample Code	Description
DE1015032cb01	cb01	Radiated Sample "#3a"
Sample Parameter	**Value**	
Integral Antenna 1 (WLAN)	Antenna on evaluation board (target platform): Antenova, Type A10194, SMD chip antenna, 1.8 dBi Peak gain in 2.4 GHz band, 4.1 dBi Peak gain in 5 GHz band	
Integral Antenna 2 (Bluetooth)	Antenna on evaluation board (target platform): Johanson Technology, Type 2450AT45A100 [2], SMD chip antenna 9.5x2x1.2 [mm], 2.2 dBi Peak gain in 2.4 GHz band	
Serial No.	-	
HW Version	03	
SW Version	N/A	
Comment	-	

Sample Name	Sample Code	Description
DE1015032da01	da01	Conducted Sample "#4"
Sample Parameter	**Value**	
Antenna connector 1 (WLAN)	Antenna connector on evaluation board (target platform): The following antennas are designated for 2.4 and 5 GHz WLAN transmission on EMMY-W161, as well as Bluetooth on EMMY-W161. - Table 2 of Test Object Specification:	

				Peak gain [dBi]	
#	Manufacturer	Part number	Antenna type	2.4 GHz band	5 GHz band
W1	Antenova	A10194 [1]	SMD chip antenna 10x10x0.9 [mm]	1.8	4.1
W2	Linx	ANT-DB1-RAF-RPS [4]	Dual-band dipole antenna	2.5	**4.6**
W3	Taoglas	GW.40.2153	Dual-band dipole antenna	**3.74**	2.5
W4	Taoglas	GW.59.3153 [5]	Dual-band dipole antenna	2.37	2.93
W5	Walsin	RFDPA870900SBLB8G1	Dual-band dipole antenna	2	3
W6	Linx	ANT-2.4-CW-RCT-RP [3]	Single-band dipole antenna	2.2	N/A
W7	Delock	88395 [6]	Dual-band dipole antenna	1.5	2.1

Antenna connector 2 (Bluetooth)	Antenna connector on evaluation board (target platform) for Bluetooth antenna
Serial No.	-
HW Version	03
SW Version	N/A
Comment	-

Sample Name	Sample Code	Description
DE1015032db01	db01	Conducted Sample "#4a"

Sample Parameter	Value
Antenna connector 1 (WLAN)	Antenna connector on evaluation board (target platform): The following antennas are designated for 2.4 and 5 GHz WLAN transmission on EMMY-W161, as well as Bluetooth on EMMY-W161. - Table 2 of Test Object Specification:

				Peak gain [dBi]	
#	Manufacturer	Part number	Antenna type	2.4 GHz band	5 GHz band
W1	Antenova	A10194 [1]	SMD chip antenna 10x10x0.9 [mm]	1.8	4.1
W2	Linx	ANT-DB1-RAF-RPS [4]	Dual-band dipole antenna	2.5	**4.6**
W3	Taoglas	GW.40.2153	Dual-band dipole antenna	**3.74**	2.5
W4	Taoglas	GW.59.3153 [5]	Dual-band dipole antenna	2.37	2.93
W5	Walsin	RFDPA870900SBLB8G1	Dual-band dipole antenna	2	3
W6	Linx	ANT-2.4-CW-RCT-RP [3]	Single-band dipole antenna	2.2	N/A
W7	Delock	88395 [6]	Dual-band dipole antenna	1.5	2.1

Antenna connector 2 (Bluetooth)	Antenna connector on evaluation board (target platform) for Bluetooth antenna
Serial No.	-
HW Version	03
SW Version	N/A
Comment	-

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

3.3 WLAN POWER TABLE

Declared Power limits vs channel for FCC, U-NII-1 & 2A, 20 MHz BW

Modulation group	WLAN TX Power in dBm at frequency in MHz							
	5180	5200	5220	5240	5260	5280	5300	5320
OFDM 6, 9, 12, 18 Mbps	13	16	16	16	16	16	16	13
OFDM 24, 36 Mbps	13	16	16	16	16	16	16	13
OFDM 48, 54 Mbps	13	13	13	13	13	13	13	13
HT20 MCS0, MCS1, MCS2	13	16	16	16	16	16	16	13
HT20 MCS3, MCS4	13	16	16	16	16	16	16	13
HT20 MCS5, MCS6, MCS7	13	13	13	13	13	13	13	13
VHT20 MCS0, MCS1, MCS2	13	16	16	16	16	16	16	13
VHT20 MCS3, MCS4	13	16	16	16	16	16	16	13
VHT20 MCS5, MCS6, MCS7	13	13	13	13	13	13	13	13
VHT20 MCS8	13	13	13	13	13	13	13	13

Declared Power limits vs channel for FCC, U-NII-1 & 2A, 40 MHz BW

Modulation group	WLAN TX Power in dBm at frequency in MHz			
	5190	5230	5270	5310
HT40 MCS0, MCS1, MCS2	12	16	16	12
HT40 MCS3, MCS4	12	16	16	12
HT40 MCS5, MCS6, MCS7	12	12	12	11
VHT40 MCS0, MCS1, MCS2	12	16	16	12
VHT40 MCS3, MCS4	12	16	16	12
VHT40 MCS5, MCS6, MCS7	12	12	12	12
VHT40 MCS8, MCS9	10	10	10	10

Declared Power limits vs channel for FCC, U-NII-1 & 2A, 80 MHz BW

Modulation group	WLAN TX Power in dBm at frequency in MHz	
	5210	5290
VHT80 MCS0, MCS1, MCS2	8	8
VHT80 MCS3, MCS4	8	8
VHT80 MCS5, MCS6, MCS7	8	8
VHT80 MCS8, MCS9	8	8

Declared Power limits vs channel for FCC, U-NII-2C, 20 MHz BW

Modulation group	WLAN TX Power in dBm at frequency in MHz											
	5500	5520	5540	5560	5580	5600	5620	5640	5660	5680	5700	5720
OFDM 6, 9, 12, 18 Mbps	13	16	16	16	16	16	16	16	16	16	13	-
OFDM 24, 36 Mbps	13	16	16	16	16	16	16	16	16	16	13	-
OFDM 48, 54 Mbps	13	13	13	13	13	13	13	13	13	13	13	-
HT20 MCS0, MCS1, MCS2	13	16	16	16	16	16	16	16	16	16	13	-
HT20 MCS3, MCS4	13	16	16	16	16	16	16	16	16	16	13	-
HT20 MCS5, MCS6, MCS7	13	13	13	13	13	13	13	13	13	13	13	-
VHT20 MCS0, MCS1, MCS2	13	16	16	16	16	16	16	16	16	16	16	16
VHT20 MCS3, MCS4	13	16	16	16	16	16	16	16	16	16	16	16
VHT20 MCS5, MCS6, MCS7	13	13	13	13	13	13	13	13	13	13	13	13
VHT20 MCS8	13	13	13	13	13	13	13	13	13	13	13	13

Declared Power limits vs channel for FCC, U-NII-2C, 40 MHz BW

Modulation group	WLAN TX Power in dBm at frequency in MHz					
	5510	5550	5590	5630	5670	5710
HT40 MCS0, MCS1, MCS2	12	16	16	16	12	-
HT40 MCS3, MCS4	12	16	16	16	12	-
HT40 MCS5, MCS6, MCS7	12	12	12	12	12	-
VHT40 MCS0, MCS1, MCS2	12	16	16	16	16	16
VHT40 MCS3, MCS4	12	16	16	16	16	16
VHT40 MCS5, MCS6, MCS7	12	12	12	12	12	12
VHT40 MCS8, MCS9	10	10	10	10	10	10

Declared Power limits vs channel for FCC, U-NII-2C, 80 MHz BW

Modulation group	WLAN TX Power in dBm at frequency in MHz		
	5530	5610	5690
VHT80 MCS0, MCS1, MCS2	8	12	16
VHT80 MCS3, MCS4	8	13	13
VHT80 MCS5, MCS6, MCS7	8	10	10
VHT80 MCS8, MCS9	8	8	8

Note 1:
Industry Canada RSS-247 Issue 1
6.2.3 Frequency Bands 5470-5600 MHz and 5650-5725 MHz
Until further notice, devices subject to this section shall not be capable of transmitting in the band 5600-5650 MHz.
This restriction is for the protection of Environment Canada's weather radars operating in this band.

Declared Power limits vs channel for FCC, U-NII-3, 20 MHz BW

Modulation group	WLAN TX Power in dBm at frequency in MHz				
	5745	5765	5785	5805	5825
OFDM 6, 9, 12, 18 Mbps	14	16	16	16	14
OFDM 24, 36 Mbps	14	16	16	16	14
OFDM 48, 54 Mbps	13	13	13	13	13
HT20 MCS0, MCS1, MCS2	13	16	16	16	13
HT20 MCS3, MCS4	13	16	16	16	13
HT20 MCS5, MCS6, MCS7	13	13	13	13	13
VHT20 MCS0, MCS1, MCS2	13	16	16	16	16
VHT20 MCS3, MCS4	13	16	16	16	16
VHT20 MCS5, MCS6, MCS7	13	13	13	13	13
VHT20 MCS8	13	13	13	13	13

Declared Power limits vs channel for FCC, U-NII-3, 40 MHz BW

Modulation group	WLAN TX Power in dBm at frequency in MHz		
	5755	5795	
HT40 MCS0, MCS1, MCS2	12	16	
HT40 MCS3, MCS4	12	16	
HT40 MCS5, MCS6, MCS7	12	12	
VHT40 MCS0, MCS1, MCS2	12	12	
VHT40 MCS3, MCS4	12	12	
VHT40 MCS5, MCS6, MCS7	12	12	
VHT40 MCS8, MCS9	12	12	

Declared Power limits vs channel for FCC, U-NII-3, 80 MHz BW

Modulation group	WLAN TX Power in dBm at frequency in MHz	
	5775	
VHT80 MCS0, MCS1, MCS2	8	
VHT80 MCS3, MCS4	8	
VHT80 MCS5, MCS6, MCS7	8	
VHT80 MCS8, MCS9	8	

3.4 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**
Evaluation board / target platform	u-blox , 03, -, -	u-blox EVB-W16

3.5 AUXILIARY EQUIPMENT

For the purposes of this test report, auxiliary equipment is defined as equipment which is used temporarily to enable operational and control features especially used for the tests of the EUT which is not used during normal operation or equipment that is used during the tests in combination with the EUT but is not subject of this test report. It is necessary to configure the system in a typical fashion, as a customer would normally use it.
But nevertheless Auxiliary Equipment can influence the test results.

Device	**Details (Manufacturer, HW, SW, S/N)**	**Description**
AC/DC power supply (115 V 60 Hz)	PeakTech, -, -, 081062045	PeakTech 6005D

3.6 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
DE1015032cb01	DE1015032cb01, evaluation board, AC/DC power supply	Setup for radiated measurement
DE1015032da01	DE1015032da01, evaluation board, AC/DC power supply	Setup for conducted measurement
DE1015032db01	DE1015032db01, evaluation board, AC/DC power supply	Setup for conducted measurement

3.7 OPERATING MODES

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

3.7.1TEST CHANNELS

a-mode, n-mode

U-NII-Subband 1 5150 - 5250 MHz			**U-NII-Subband 2A 5250 - 5350 MHz**			**U-NII-Subband 2C 5470 - 5725 MHz**			**U-NII-Subband 3 5725 - 5850 MHz**			**Nom. BW**
low	**mid**	**high**	**low**	**mid**	**high**	**low**	**mid**	**high**	**low**	**mid**	**high**	**20 MHz**
36	44	48	52	56	64	100	116	140	149	157	165	**Ch.-No.**
5180	5220	5240	5260	5280	5320	5500	5580	5700	5745	5785	5825	**MHz**
low	**mid**	**high**	**low**	**mid**	**high**	**low**	**mid**	**high**	**low**	**mid**	**high**	**40 MHz**
38	N/A	46	54	N/A	62	102	110	134	151	N/A	159	**Ch.-No.**
5190	N/A	5230	5270	N/A	5310	5510	5550	5670	5755	N/A	5795	**MHz**

ac-mode

U-NII-Subband 1 5150 - 5250 MHz			**U-NII-Subband 2A 5250 - 5350 MHz**			**U-NII-Subband 2C 5470 - 5725 MHz**			**U-NII-Subband 3 5725 - 5850 MHz**			**Nom. BW**
low	**mid**	**high**	**low**	**mid**	**high**	**low**	**mid**	**high**	**low**	**mid**	**high**	**20 MHz**
36	44	48	52	56	64	100	116	144	149	157	165	**Ch.-No.**
5180	5220	5240	5260	5280	5320	5500	5580	5720	5745	5785	5825	**MHz**
low	**mid**	**high**	**low**	**mid**	**high**	**low**	**mid**	**high**	**low**	**mid**	**high**	**40 MHz**
38	N/A	46	54	N/A	62	102	110	142	151	N/A	159	**Ch.-No.**
5190	N/A	5230	5270	N/A	5310	5510	5550	5710	5755	N/A	5795	**MHz**
low	**mid**	**high**	**low**	**mid**	**high**	**low**	**mid**	**high**	**low**	**mid**	**high**	**80 MHz**
N/A	42	N/A	N/A	58	N/A	106	122	138	155	N/A	N/A	**Ch.-No.**
N/A	5210	N/A	N/A	5290	N/A	5530	5610	5690	5775	N/A	N/A	**MHz**

In case of testing another channel, the measurement summary state "additional channel" and the channel or centre frequency of the operating frequency is stated in the test protocol.

3.7.2TEST MODULATIONS

If not stated in the test protocols following operating modes are used:

WLAN a-Mode; 20 MHz; 6 Mbit/s; 100 % duty cycle
WLAN n-Mode; 20 MHz; 6,5 Mbit/s MCS0; 100 % duty cycle
WLAN n-Mode; 40 MHz;13,5 Mbit/s MCS0; 100 % duty cycle
WLAN ac-Mode; 20 MHz; 6,5 Mbit/s MCS0; 100 % duty cycle
WLAN ac-Mode; 40 MHz; 13,5Mbit/s MCS0; 100 % duty cycle
WLAN ac-Mode; 80 MHz; 433 Mbit/s MCS9; 100 % duty cycle

3.8 PRODUCT LABELLING

3.8.1FCC ID LABEL

Please refer to the documentation of the applicant.

3.8.2LOCATION OF THE LABEL ON THE EUT

Please refer to the documentation of the applicant.

4 TEST RESULTS

4.1 MAXIMUM CONDUCTED OUTPUT POWER

Standard **FCC Part 15 Subpart E**

The test was performed according to:
ANSI C63.10

4.1.1TEST DESCRIPTION

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

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

Analyzer settings:

- Resolution Bandwidth (RBW): 1 MHz
- Video Bandwidth (VBW): 3 MHz
- Trace: Average, RMS power averaging mode
- Sweeps: 1000
- Sweep time: 20 ms
- Detector: RMS

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

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

4.1.2TEST REQUIREMENTS / LIMITS

A) FCC
For systems using digital modulation techniques in the 5.15 – 5.25 GHz bands:
§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 log10 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 log10 B [dBm], whichever power is less.
e.i.r.p.: 1.0 W (30 dBm) or 17 + 10 log10 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 log10 B [dBm], whichever power is less.
e.i.r.p.: 1.0 W (30 dBm) or 17 + 10 log10 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 log10 B [dBm], whichever power is less.
e.i.r.p.: 4.0 W (36 dBm) or 23 + 10 log10 B [dBm], whichever power is less.

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

4.1.3TEST PROTOCOL

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

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

U-NII-Subband	Ch. No.	Freq. [MHz]	Cond. Power [dBm]	EIRP [dBm]	Cond. Limit FCC [dBm]	Margin [dB]	Cond. Limit IC [dBm]	Margin [dB]	EIRP Limit IC [dBm]	Margin [dB]	
1	36,0	5180,0	NT	NT	24,0	NT	N/A	N/A	22,4	NT	1)
	44,0	5220,0	16,5	21,1	24,0	7,5	N/A	N/A	22,4	**1,3**	1)
	48,0	5240,0	NT	NT	24,0	NT	N/A	N/A	22,4	NT	1)
2A	52,0	5260,0	NT	NT	24,0	NT	23,4	NT	29,4	NT	1)
	56,0	5280,0	15,9	20,5	24,0	8,1	23,4	7,5	29,4	8,9	1)
	64,0	5320,0	NT	NT	24,0	NT	23,3	NT	29,3	NT	1)
2C	100,0	5500,0	NT	NT	24,0	NT	23,3	NT	29,3	NT	
	116,0	5580,0	13,8	18,4	24,0	10,2	23,3	9,6	29,3	10,9	
	140,0	5700,0	NT	NT	24,0	NT	23,3	NT	29,3	NT	
3	149,0	5745,0	NT	NT	30,0	NT	29,4	NT	36,0	NT	
	157,0	5785,0	13,4	18,0	30,0	16,6	29,3	15,9	36,0	18,0	
	165,0	5825,0	NT	NT	30,0	NT	29,3	NT	36,0	NT	

WLAN n-Mode; 20 MHz; 6,5 Mbit/s MCS0

U-NII-Subband	Ch. No.	Freq. [MHz]	Cond. Power [dBm]	EIRP [dBm]	Cond. Limit FCC [dBm]	Margin [dB]	Cond. Limit IC [dBm]	Margin [dB]	EIRP Limit IC [dBm]	Margin [dB]	
1	36,0	5180,0	NT	NT	24,0	NT	N/A	N/A	22,6	NT	1)
	44,0	5220,0	16,5	21,1	24,0	7,5	N/A	N/A	22,6	**1,5**	1)
	48,0	5240,0	NT	NT	24,0	NT	N/A	N/A	22,6	NT	1)
2A	52,0	5260,0	NT	NT	24,0	NT	23,6	NT	29,6	NT	1)
	56,0	5280,0	16,3	20,5	24,0	8,1	23,6	7,7	29,6	9,1	1)
	64,0	5320,0	NT	NT	24,0	NT	23,5	NT	29,5	NT	1)
2C	100,0	5500,0	NT	NT	24,0	NT	23,5	NT	29,5	NT	
	116,0	5580,0	13,5	18,1	24,0	10,5	23,6	10,0	29,6	11,5	
	140,0	5700,0	NT	NT	24,0	NT	23,6	NT	29,6	NT	
3	149,0	5745,0	NT	NT	30,0	NT	29,6	NT	36,0	NT	
	157,0	5785,0	13,5	18,1	30,0	16,5	29,5	16,0	36,0	17,9	
	165,0	5825,0	NT	NT	30,0	NT	29,5	NT	36,0	NT	

WLAN n-Mode; 40 MHz;13,5 Mbit/s MCS0

U-NII-Subband	Ch. No.	Freq. [MHz]	Cond. Power [dBm]	EIRP [dBm]	Cond. Limit FCC [dBm]	Margin [dB]	Cond. Limit IC [dBm]	Margin [dB]	EIRP Limit IC [dBm]	Margin [dB]	
1	38,0	5190,0	NT	NT	24,0	NT	N/A	N/A	23,0	NT	1)
	46,0	5230,0	16,6	21,2	24,0	7,4	N/A	N/A	23,0	**1,8**	1)
2A	54,0	5270,0	NT	NT	24,0	NT	24,0	NT	30,0	NT	1)
	62,0	5310,0	11,6	16,2	24,0	12,4	24,0	12,4	30,0	13,8	1)
2C	102,0	5510,0	NT	NT	24,0	NT	24,0	NT	30,0	NT	
	110,0	5550,0	14,1	18,7	24,0	9,9	24,0	9,9	30,0	11,3	
	138,0	5670,0	NT	NT	24,0	NT	24,0	NT	30,0	NT	
3	151,0	5755,0	NT	NT	30,0	NT	30,0	NT	36,0	NT	
	159,0	5795,0	13,6	18,2	30,0	16,4	30,0	16,4	36,0	17,8	

Remark: 1) = no additional limit applies related to the elevation.
NT = not tested

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

WLAN ac-Mode; 20 MHz; 6,5 Mbit/s MCS0

U-NII-Subband	Ch. No.	Freq. [MHz]	Cond. Power [dBm]	EIRP [dBm]	Cond. Limit FCC [dBm]	Margin [dB]	Cond. Limit IC [dBm]	Margin [dB]	EIRP Limit IC [dBm]	Margin [dB]	
1	36,0	5180,0	NT	NT	24,0	NT	N/A	N/A	22,6	NT	1)
	44,0	5220,0	16,3	20,9	24,0	7,7	N/A	N/A	22,6	**1,7**	1)
	48,0	5240,0	NT	NT	24,0	NT	N/A	N/A	22,6	NT	1)
2A	52,0	5260,0	NT	NT	24,0	NT	23,6	NT	29,6	NT	1)
	56,0	5280,0	15,9	20,5	24,0	8,1	23,6	7,7	29,6	9,1	1)
	64,0	5320,0	NT	NT	24,0	NT	23,6	NT	29,5	NT	1)
2C	100,0	5500,0	NT	NT	24,0	NT	23,5	NT	29,5	NT	
	116,0	5580,0	13,8	18,4	24,0	10,2	23,5	9,7	29,5	11,1	
	140,0	5700,0	NT	NT	24,0	NT	23,5	NT	29,6	NT	
3	149,0	5745,0	NT	NT	30,0	NT	29,6	NT	36,0	NT	
	157,0	5785,0	13,4	18,0	30,0	16,6	29,5	16,1	36,0	18,0	
	165,0	5825,0	NT	NT	30,0	NT	29,5	NT	36,0	NT	

WLAN ac-Mode; 40 MHz; 13,5 Mbit/s MCS0

U-NII-Subband	Ch. No.	Freq. [MHz]	Cond. Power [dBm]	EIRP [dBm]	Cond. Limit FCC [dBm]	Margin [dB]	Cond. Limit IC [dBm]	Margin [dB]	EIRP Limit IC [dBm]	Margin [dB]	
1	38,0	5190,0	NT	NT	24,0	NT	N/A	N/A	23,0	NT	1)
	46,0	5230,0	16,6	21,2	24,0	7,4	N/A	N/A	23,0	**1,8**	1)
2A	54,0	5270,0	NT	NT	24,0	NT	24,0	NT	30,0	NT	1)
	62,0	5310,0	12,0	16,6	24,0	12,0	24,0	12,0	30,0	13,4	1)
2C	102,0	5510,0	NT	NT	24,0	NT	24,0	NT	30,0	NT	
	110,0	5550,0	13,9	18,5	24,0	10,1	24,0	10,1	30,0	11,5	
	138,0	5670,0	NT	NT	24,0	NT	24,0	NT	30,0	NT	
3	151,0	5755,0	NT	NT	30,0	NT	30,0	NT	36,0	NT	
	159,0	5795,0	13,4	18,0	30,0	16,6	30,0	16,6	36,0	18,0	

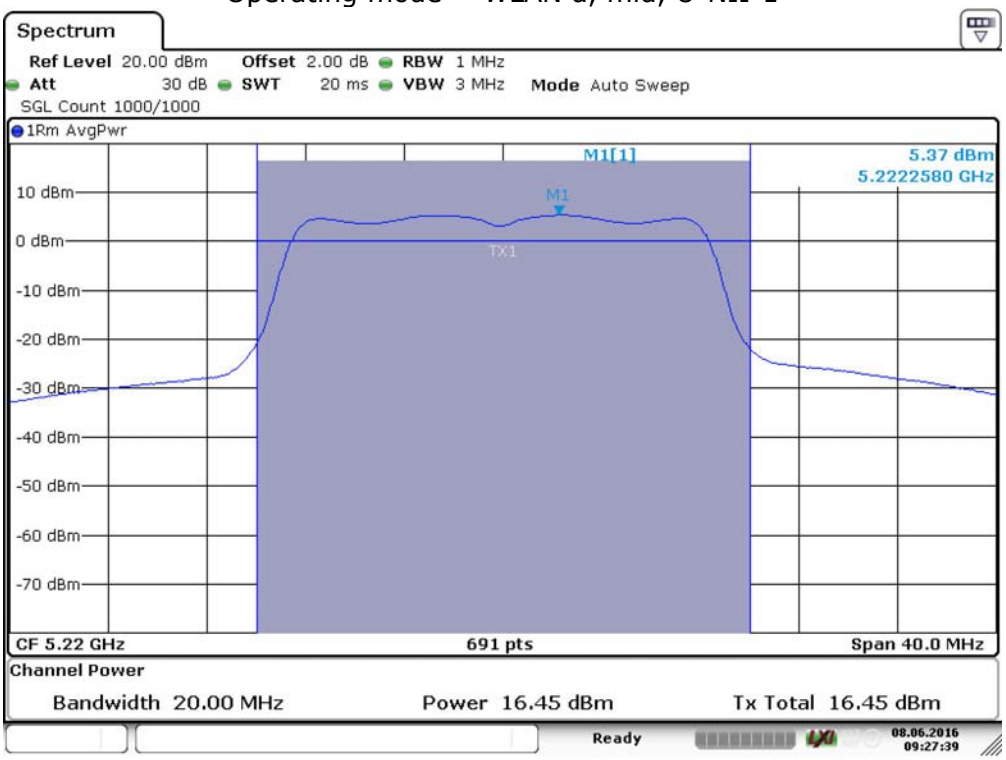
WLAN ac-Mode; 80 MHz; 433 Mbit/s MCS0

U-NII-Subband	Ch. No.	Freq. [MHz]	Cond. Power [dBm]	EIRP [dBm]	Cond. Limit FCC [dBm]	Margin [dB]	Cond. Limit IC [dBm]	Margin [dB]	EIRP Limit IC [dBm]	Margin [dB]	1)
1	42,0	5210,0	8,7	13,3	24,0	15,3	N/A	N/A	23,0	**9,7**	1)
2A	58,0	5290,0	7,9	12,5	24,0	16,1	24,0	13,2	30,0	17,5	1)
2C	106,0	5530,0	NT	NT	24,0	NT	24,0	NT	30,0	NT	
	122,0	5610,0	9,7	14,3	24,0	14,3	24,0	15,7	30,0	15,7	
	134,0	5690,0	NT	NT	24,0	NT	24,0	NT	30,0	NT	
3	155,0	5775,0	5,6	10,2	30,0	24,4	30,0	21,3	36,0	25,8	

Remark: 1) = no additional limit applies related to the elevation.
NT = not tested

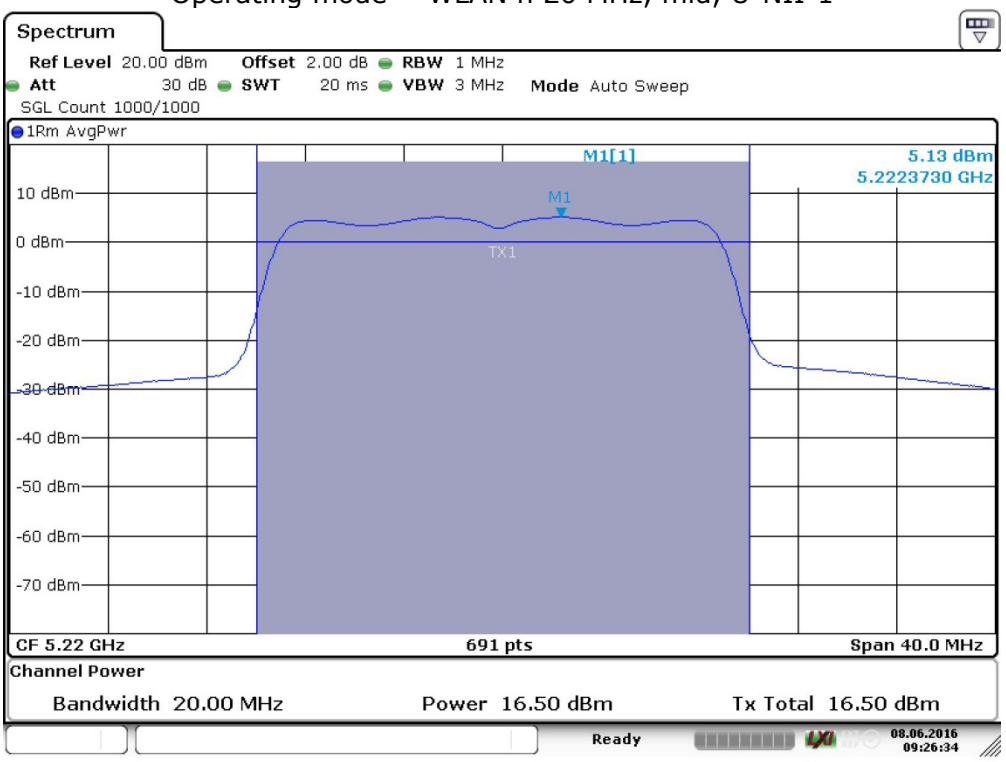
4.1.4MEASUREMENT PLOT (SHOWING THE HIGHEST VALUE, "WORST CASE")

Operating mode = WLAN a, mid, U-NII-1



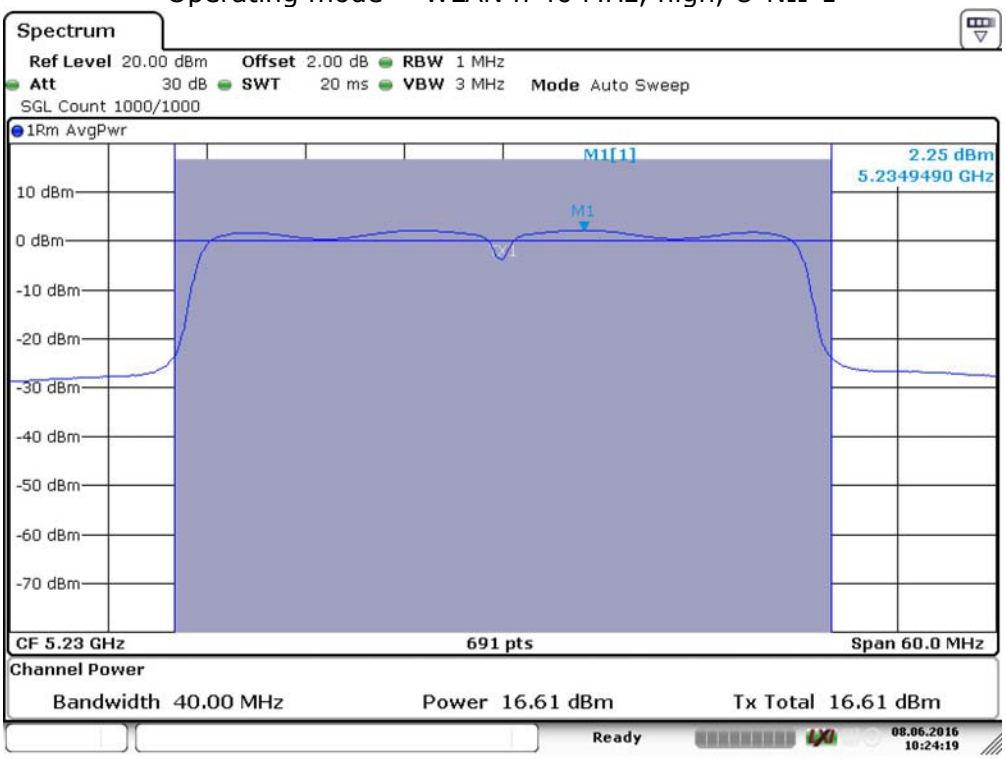
Date: 8.JUN.2016 09:27:39

Operating mode = WLAN n 20 MHz, mid, U-NII-1



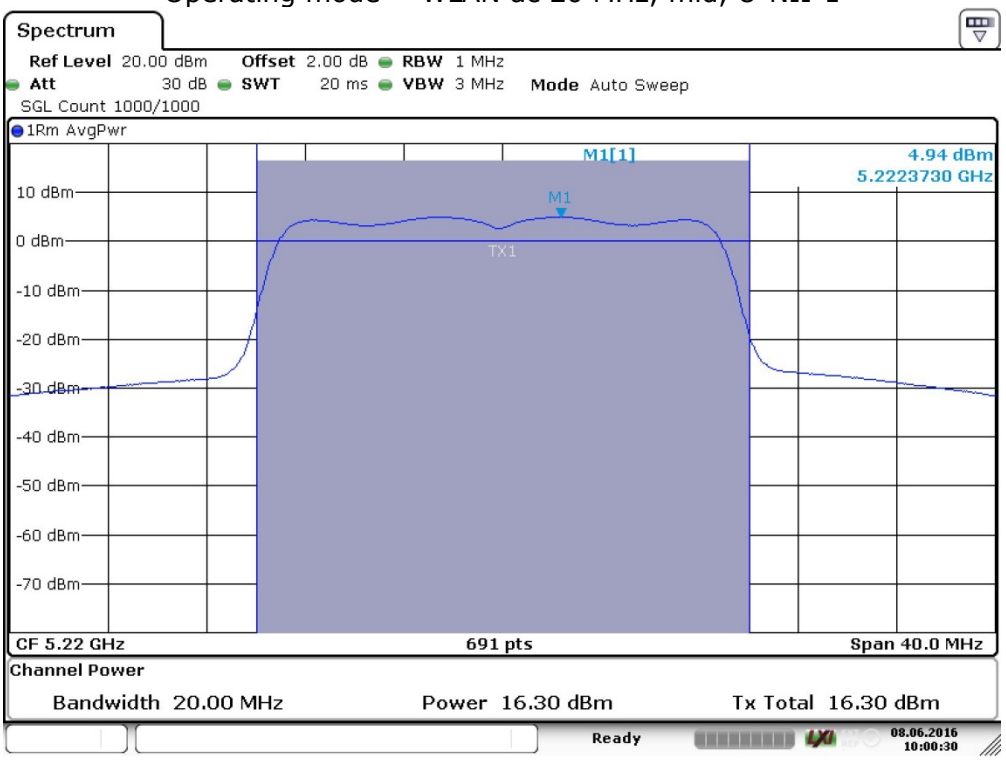
Date: 8.JUN.2016 09:26:35

Operating mode = WLAN n 40 MHz, high, U-NII-1



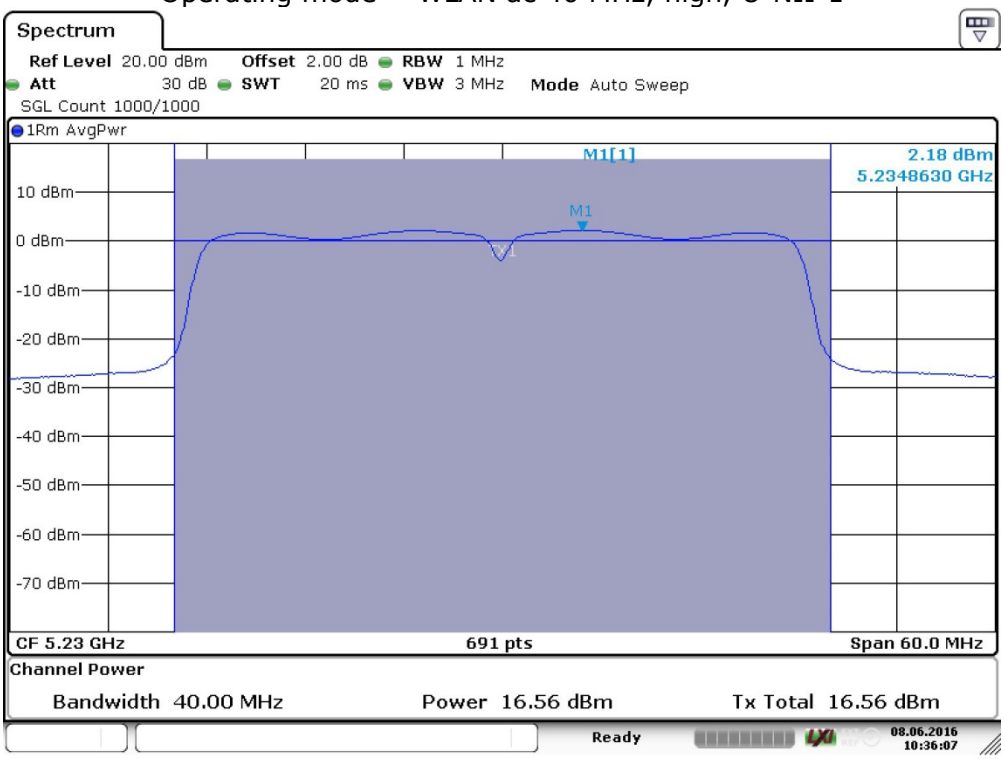
Date: 8.JUN.2016 10:24:19

Operating mode = WLAN ac 20 MHz, mid, U-NII-1



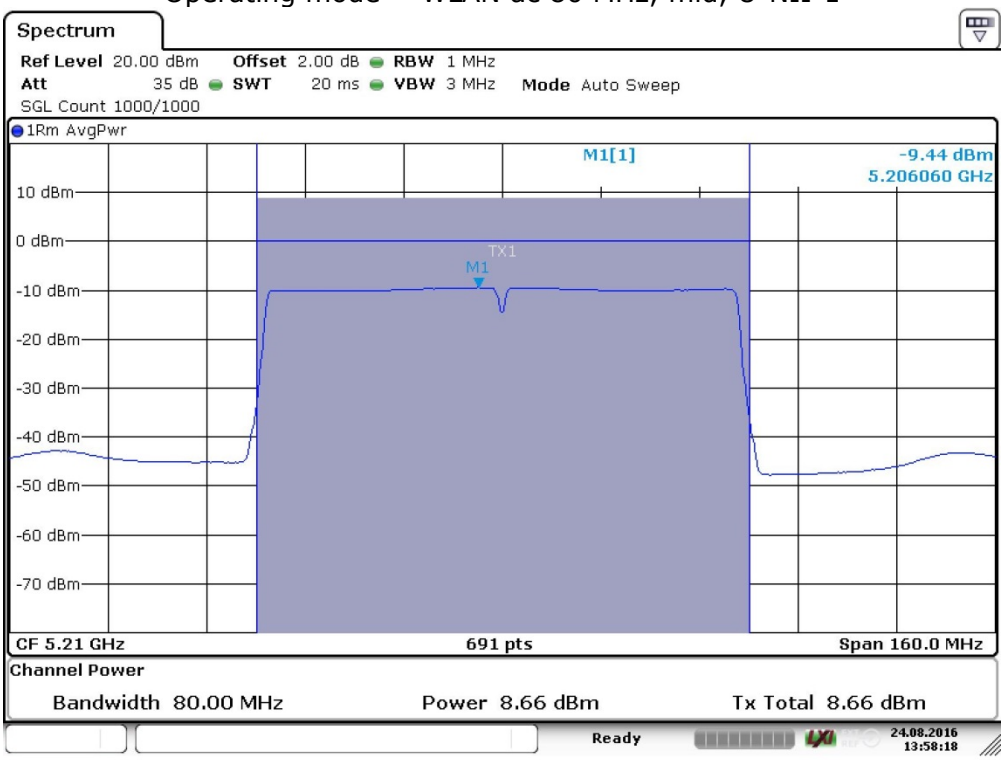
Date: 8.JUN.2016 10:00:31

Operating mode = WLAN ac 40 MHz, high, U-NII-1



Date: 8.JUN.2016 10:36:07

Operating mode = WLAN ac 80 MHz, mid, U-NII-1



Date: 24.AUG.2016 13:58:19

4.1.5TEST EQUIPMENT USED

R&S TS8997

4.2 SPURIOUS RF CONDUCTED EMISSIONS AT ANTENNA PORT

Standard **FCC Part 15 Subpart E**

The test was performed according to:
ANSI C63.10

4.2.1TEST DESCRIPTION

The Equipment Under Test (EUT) was set up to perform the conducted spurious emissions measurements. The antenna port of the EUT was connected to spectrum analyzer via a short coax cable with a known cable loss C_L. The measured voltage U_{meas} at the 50 Ohm input of the analyser was used to calculate the EUT output power at the antenna port:

$P = U_{meas} + C_L - 107$

where
P is the output power in dBm
U_{meas} is the measured voltage at the 50 Ohm input of the analyzer in dBµV
C_L is the cable loss of the used cable.

The maximum transmit isotropically antenna gain G_i (in dBi) was added to the measured output power P to determine the equivalent isotropically radiated power EIRP.

$EIRP = P + Gi$

where
P is the output power in dBm
G_i is maximum transmit antenna gain in dBi.

The resultant EIRP level was converted to an equivalent electric filed strength using the following relationship:

$E = EIRP - 20 \log d + 104.8$

where
E is the electric field strength in dBµV/m
EIRP is the equivalent isotropically radiated power in dBm
d is the specified measurement distance in m.

The appropriate maximum ground reflection factor was added to the EIRP:
6 dB for frequencies ≤ 30 MHz;
4.7 dB for frequencies between 30 MHz and 1000 MHz, inclusive; and
0 dB for frequencies > 1000 MHz).

Frequency range [MHz]	measurement distance d [m]	-20 log d [dB]	ground reflection factor [dB]
0,009 – 0,49	300	-49,54	6
0,49 – 30	30	-29,54	6
30 – 1000	3	-9,54	4,7
>1000	3	-9,54	0

1. Measurement up to 30 MHz

Step 1: pre measurement

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

- Detector: Peak-Maxhold/ Quasipeak (FFT-based)
- 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 EMI-profile of the EUT. Afterwards the relevant emissions for the final measurement are identified.

Step 2: final measurement

EMI receiver settings:

- Detector: Peak / Average / Quasi-Peak (depending on frequency)
- Frequency range: 0.009 – 30 MHz
- Frequency steps: measurement at frequencies detected in step 1
- IF–Bandwidth: 0.2 - 10 kHz (depending on frequency)
- Measuring time / Frequency step: 1 s

2. Measurement above 30 MHz and up to 1 GHz

Step 1: pre measurement

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

Settings:

- 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

Step 2: final measurement

EMI receiver settings:

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

3. Measurement above 1 GHz

Step 1: pre measurement

Ssettings:

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

Step 2: final measurement

Spectrum analyzer settings:

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

4.2.2TEST REQUIREMENTS / LIMITS

A) FCC

FCC Part 15 Subpart E, §15.407 (b)(1)
For transmitters operating in the 5150–5250 MHz band:
Limit: –27 dBm/MHz EIRP outside of the band 5150–5350 MHz.

FCC Part 15 Subpart E, §15.407 (b)(2)
For transmitters operating in the 5250–5350 MHz band:
Limit: –27 dBm/MHz EIRP outside of the band 5150–5350 MHz.

FCC Part 15 Subpart E, §15.407 (b)(3)
For transmitters operating in the 5470–5725 MHz band:
Limit: –27 dBm/MHz EIRP outside of the band 5470–5725 MHz.

FCC Part 15 Subpart E, §15.407 (b)(4)
For transmitters operating in the 5725–5850 MHz band:
Limit: –27 dBm/MHz EIRP outside of the band 5715–5860 MHz and additionally
Limit: –17 dBm/MHz EIRP within the frequency ranges 5715–5725 and 5850–5860 MHz.

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

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

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

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

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

C) FCC & IC

FCC Part 15 Subpart E, §15.405
The provisions of §§ 15.203 and 15.205 are included.

§15.407 (b)(6)
Unwanted emissions below 1 GHz must comply with the general field strength limits set forth in § 15.209.

§15.407 (b)(7)
The provisions of §15.205 apply to intentional radiators operating under this section

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

Frequency in MHz	Limit (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

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

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

4.2.3TEST PROTOCOL

Ambient temperature: 24–29 °C
Air Pressure: 1000–1009 hPa
Humidity: 33–49 %
Band U-NII-1 & 2A

Mode / Set EUT target power	Ch. Center Freq. [MHz]	Spurious Freq. [MHz]	Spurious Level [dBµV/m]	Detec-tor	RBW [kHz]	Limit [dBµV/m]	Margin [dB]	Limit Type
OFDM, 54Mbps / 13 dBm	5180,0	5149,812500 5149,812500	61,3 47,1	PEAK AV	1000,0	74 54	12,7 6,9	RB
OFDM, 54Mbps / 13 dBm	5320,0	5350,550000 5350,550000	61,0 43,8	PEAK AV	1000,0	74 54	13,0 10,2	RB
HT20, MCS7 / 13 dBm	5180,0	5149,887500 5149,887500	65,8 48,9	PEAK AV	1000,0	74 54	8,2 5,1	RB
HT20, MCS7 / 13 dBm	5320,0	5350,000000 5350,000000	63,9 45,4	PEAK AV	1000,0	74 54	10,1 8,6	RB
HT40, MCS7 / 12 dBm	5190,0	5148,762500 5149,925000	69,3 53,1	PEAK AV	1000,0	74 54	**4,7** **0,9**	RB
HT40, MCS7 / 11 dBm	5310,0	5350,110000 5350,110000	68,7 50,2	PEAK AV	1000,0	74 54	5,3 3,8	RB
VHT20, MCS5 / 13 dBm	5180,0	5149,175000 5149,925000	65,1 48,7	PEAK AV	1000,0	74 54	8,9 5,3	RB
VHT20, MCS5 / 13 dBm	5320,0	5350,330000 5350,330000	61,2 44,9	PEAK AV	1000,0	74 54	12,8 9,1	RB
VHT40, MCS9 / 10 dBm	5190,0	5144,937500 5150,000000	63,8 48,7	PEAK AV	1000,0	74 54	10,2 5,3	RB
VHT40, MCS9 / 10 dBm	5310,0	5350,000000 5350,000000	68,0 49,3	PEAK AV	1000,0	74 54	6,0 4,7	RB
VHT80, MCS0 / 8 dBm	5210,0	5137,925000 5137,700000	72,9 53,7	PEAK AV	1000,0	74 54	**1,1** **0,3**	RB
VHT80, MCS0 / 8 dBm	5290,0	5365,950000 5361.770000	69,1 50,8	PEAK AV	1000,0	74 54	4,9 3,2	RB

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

Ambient temperature: 24–29 °C
Air Pressure: 1000–1009 hPa
Humidity: 33–49 %
Band U-NII-2C

Mode / Set EUT target power	Ch. Center Freq. [MHz]	Spurious Freq. [MHz]	Spurious Level [dBµV/m]	Detec-tor	RBW [kHz]	Limit [dBµV/m]	Margin [dB]	Limit Type
OFDM, 54Mbps / 13 dBm	5500,0	5468,650000	58,8	PEAK	1000,0	68,2	9,4	UE
OFDM, 54Mbps / 13 dBm	5700,0	5725,000000	60,4	PEAK	1000,0	68,2	7,8	UE
HT20, MCS7 / 13 dBm	5500,0	5469,674000	57,1	PEAK	1000,0	68,2	11,1	UE
HT20, MCS7 / 13 dBm	5700,0	5725,000000	64,0	PEAK	1000,0	68,2	4,2	UE
HT40, MCS7 / 12 dBm	5510,0	5469,017000	64,8	PEAK	1000,0	68,2	**3,4**	UE
HT40, MCS7 / 12 dBm	5670,0	5725,0	57,5	PEAK	1000,0	68,2	10,7	UE
VHT20, MCS8 / 13 dBm	5500,0	5468,352000	59,4	PEAK	1000,0	68,2	8,8	UE
VHT20, MCS8 / 13 dBm	5500,0	5468,352000	59,4	PEAK	1000,0	68,2	8,8	UE
VHT40, MCS9 / 12 dBm	5510,0	5465,676000	64,1	PEAK	1000,0	68,2	4,1	UE
VHT80, MCS0 / 12 dBm	5610,0	5469,078000	61,2	PEAK	1000,0	68,2	7,0	UE
VHT80, MCS9 / 8 dBm	5530,0	5458,570000	62,2 47,0	PEAK AV	1000,0	75,0 54,0	11,8 7,0	RB

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

Ambient temperature: 24–29 °C
Air Pressure: 1000–1009 hPa
Humidity: 33–49 %

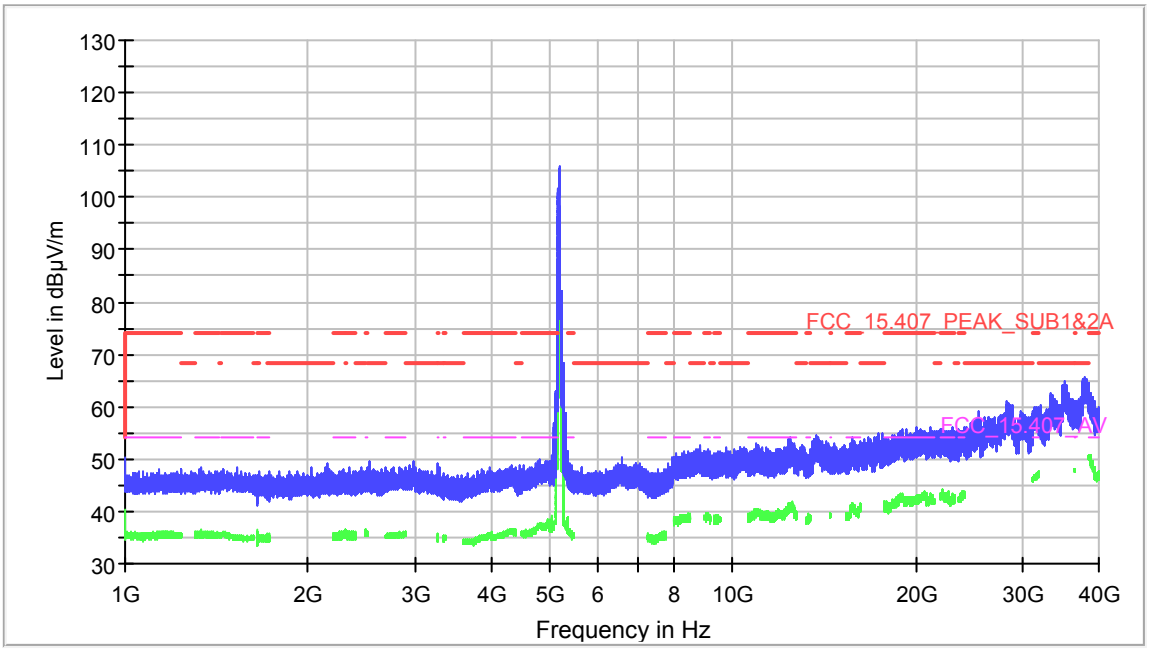
Band U-NII-3

Mode / Set EUT target power	Ch. Center Freq. [MHz]	Spurious Freq. [MHz]	Spurious Level [dBµV/m]	Detec-tor	RBW [kHz]	Limit [dBµV/m]	Margin [dB]	Limit Type
HT40, MCS0 / 12 dBm	5755,0	5713.684500	67,3	PEAK	1000,0	68,2	**0,9**	UE
HT40, MCS0 / 16 dBm	5795,0	5860,150000	66,7	PEAK	1000,0	68,2	1,5	UE
VHT20, MCS0 / 16 dBm	5825,0	5861,200000	64,5	PEAK	1000,0	68,2	3,7	UE
VHT40, MCS9 / 12 dBm	5755,0	5711,034500	64,6	PEAK	1000,0	68,2	3,6	UE

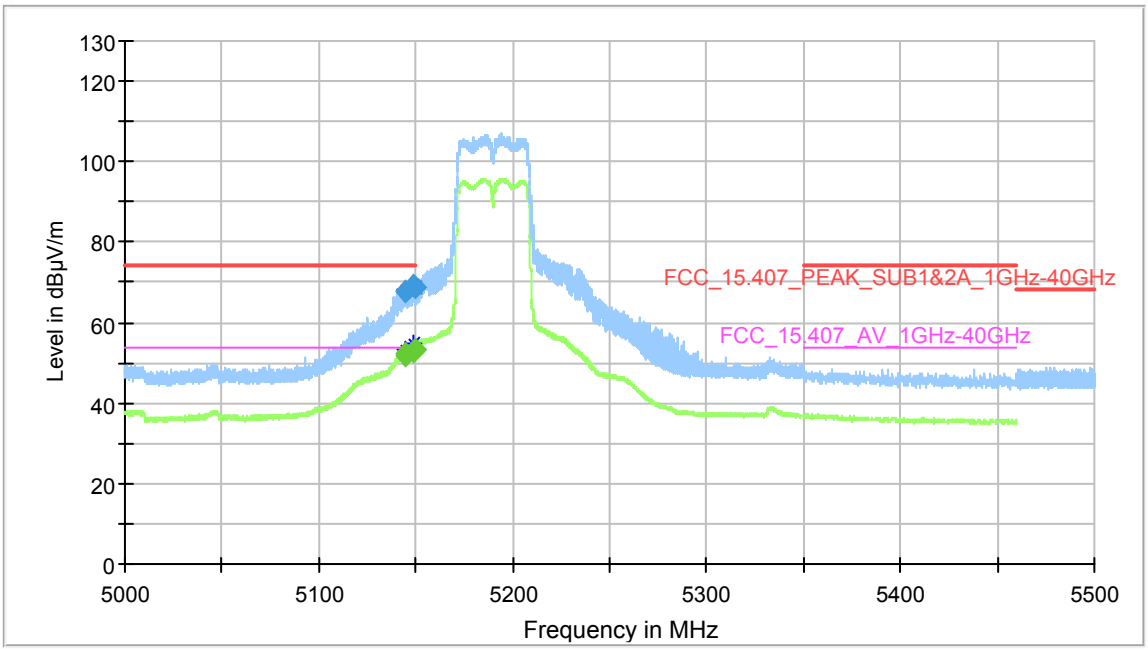
Remark: Please see next sub-clause for the measurement plot.

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

Operating mode = WLAN n 40 MHz (HT40, MCS7, 12 dBm), low, U-NII-1 & 2A



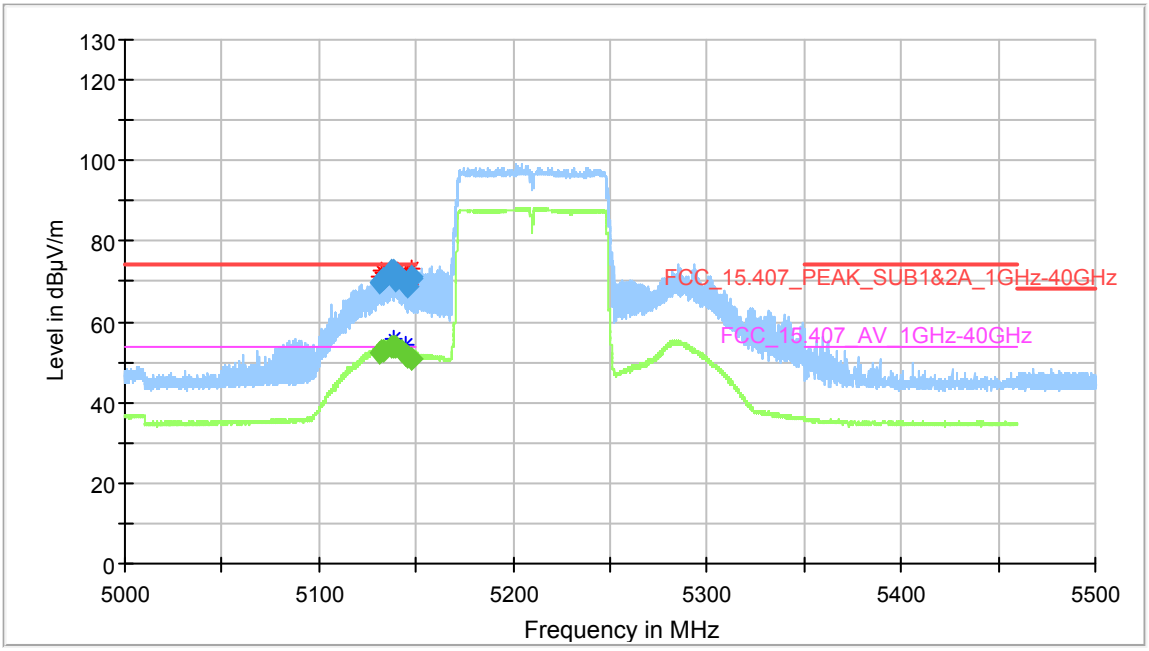
Plot zoomed



Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Corr. (dB)
5144,187500	---	51,86	54,00	2,14	1000,0	1000,000	-5,8
5144,187500	67,79	---	74,00	6,21	1000,0	1000,000	-5,8
5144,862500	---	52,24	54,00	1,76	1000,0	1000,000	-5,8
5144,862500	67,69	---	74,00	6,31	1000,0	1000,000	-5,8
5148,762500	---	53,00	54,00	1,00	1000,0	1000,000	-5,8
5148,762500	**69,25**	**---**	**74,00**	**4,75**	**1000,0**	**1000,000**	**-5,8**
5149,925000	**---**	**53,08**	**54,00**	**0,92**	**1000,0**	**1000,000**	**-5,8**
5149,925000	68,57	---	74,00	5,43	1000,0	1000,000	-5,8

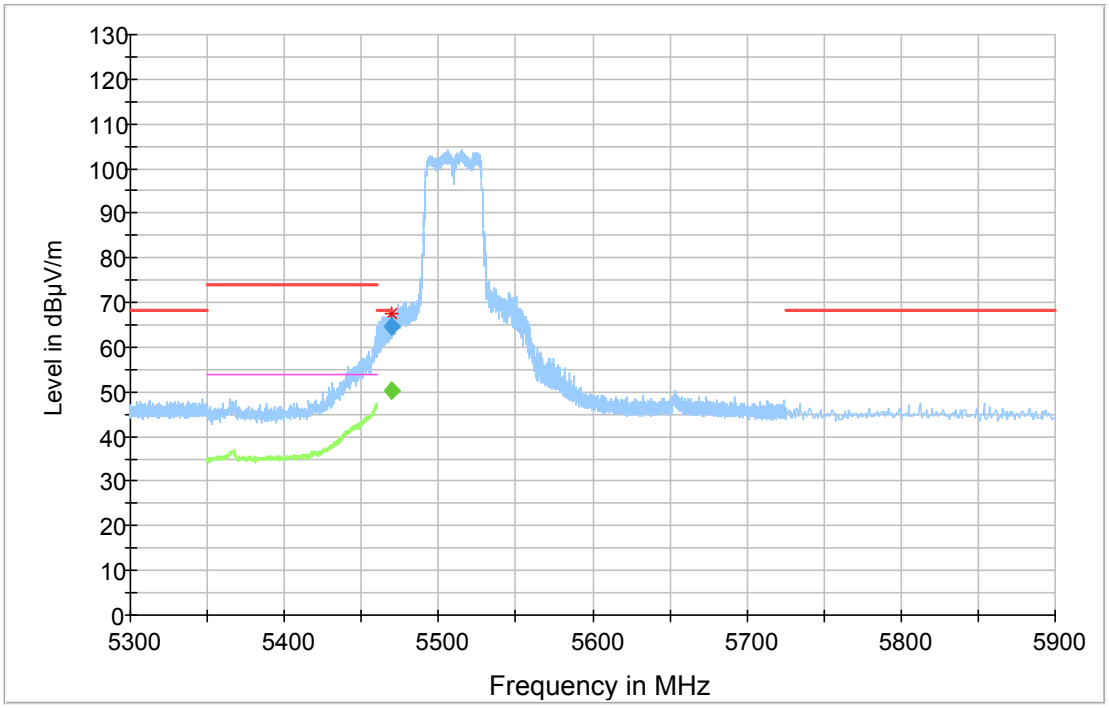
Operating mode = WLAN ac 80 MHz (VHT80, MCS0, 8 dBm), low, U-NII-1 & 2A



Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Corr. (dB)
5130,800000	---	52,20	54,00	1,80	1000,0	1000,000	-5,8
5130,800000	69,68	---	74,00	4,32	1000,0	1000,000	-5,8
5132,225000	---	52,56	54,00	1,44	1000,0	1000,000	-5,8
5132,225000	70,43	---	74,00	3,57	1000,0	1000,000	-5,8
5133,012500	---	52,87	54,00	1,13	1000,0	1000,000	-5,8
5133,012500	70,80	---	74,00	3,20	1000,0	1000,000	-5,8
5137,700000	**---**	**53,66**	**54,00**	**0,34**	**1000,0**	**1000,000**	**-5,8**
5137,700000	72,76	---	74,00	1,24	1000,0	1000,000	-5,8
5137,925000	---	53,63	54,00	0,37	1000,0	1000,000	-5,8
5137,925000	**72,93**	**---**	**74,00**	**1,07**	**1000,0**	**1000,000**	**-5,8**
5139,012500	---	53,63	54,00	0,37	1000,0	1000,000	-5,8
5139,012500	70,05	---	74,00	3,95	1000,0	1000,000	-5,8
5142,162500	---	52,86	54,00	1,14	1000,0	1000,000	-5,8
5142,162500	70,84	---	74,00	3,16	1000,0	1000,000	-5,8
5144,187500	---	51,98	54,00	2,02	1000,0	1000,000	-5,8
5144,187500	69,56	---	74,00	4,44	1000,0	1000,000	-5,8
5145,050000	---	51,68	54,00	2,32	1000,0	1000,000	-5,8
5145,050000	69,10	---	74,00	4,90	1000,0	1000,000	-5,8
5145,800000	---	51,46	54,00	2,54	1000,0	1000,000	-5,8
5145,800000	68,55	---	74,00	5,45	1000,0	1000,000	-5,8
5147,375000	---	51,05	54,00	2,95	1000,0	1000,000	-5,8
5147,375000	70,72	---	74,00	3,28	1000,0	1000,000	-5,8
5148,162500	---	50,72	54,00	3,28	1000,0	1000,000	-5,8
5148,162500	71,15	---	74,00	2,85	1000,0	1000,000	-5,8

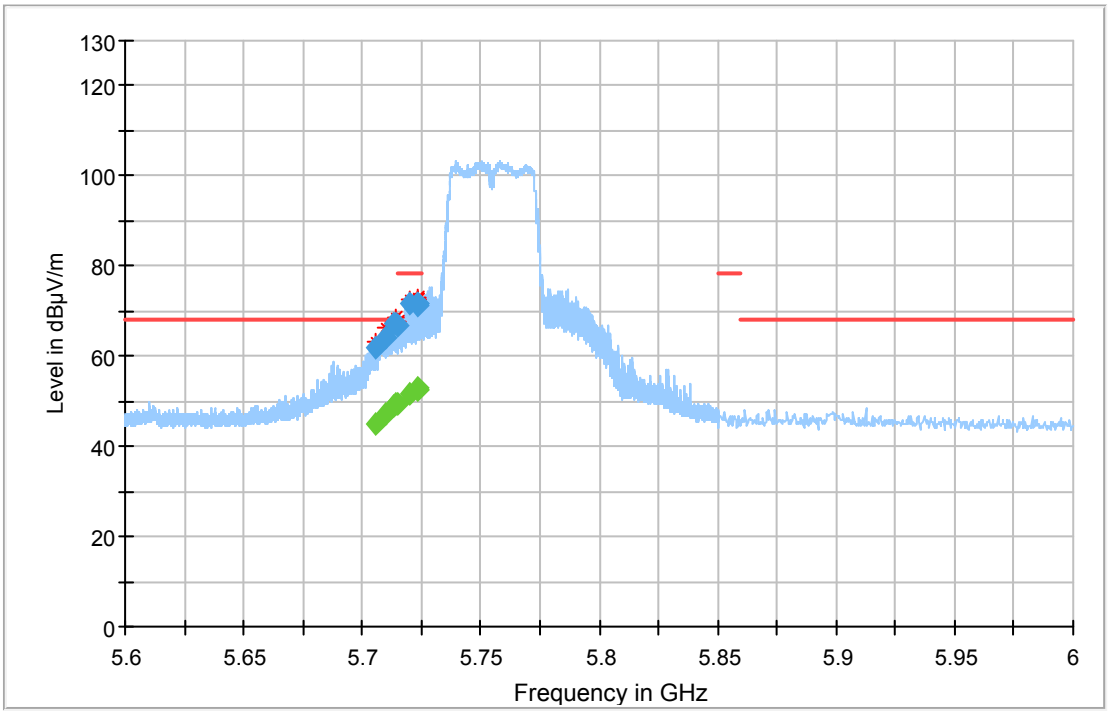
Operating mode = WLAN n 40 MHz (HT40, MCS7, 12 dBm, low, U-NII-2C



Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Corr, (dB)
5469,017000	---	50,11	---	---	1000,0	1000,000	-5,8
5469,017000	**64,79**	**---**	**68,20**	**3,41**	**1000,0**	**1000,000**	**-5,8**

Operating mode = WLAN n 40 MHz (HT40, MCS0, 12 dBm), low, U-NII-3



Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Corr. (dB)
5706,026000	---	45,13	---	---	1000,0	1000,000	-5,8
5706,026000	61,88	---	68,20	6,32	1000,0	1000,000	-5,8
5709,683000	---	47,24	---	---	1000,0	1000,000	-5,8
5709,683000	63,94	---	68,20	4,26	1000,0	1000,000	-5,8
5713,684500	---	49,11	---	---	1000,0	1000,000	-5,8
5713,684500	**67,26**	**---**	**68,20**	**0,94**	**1000,0**	**1000,000**	**-5,8**
5714,241000	---	49,41	---	---	1000,0	1000,000	-5,8
5714,241000	67,01	---	68,20	1,19	1000,0	1000,000	-5,8
5714,824000	---	49,62	---	---	1000,0	1000,000	-5,8
5714,824000	66,62	---	68,20	1,58	1000,0	1000,000	-5,8
5719,779500	---	51,49	---	---	1000,0	1000,000	-5,8
5719,779500	71,64	---	78,20	6,56	1000,0	1000,000	-5,8
5723,198000	---	52,83	---	---	1000,0	1000,000	-5,8
5723,198000	71,73	---	78,20	6,47	1000,0	1000,000	-5,8
5723,277500	---	52,51	---	---	1000,0	1000,000	-5,8
5723,277500	71,63	---	78,20	6,57	1000,0	1000,000	-5,8
5723,569000	---	52,71	---	---	1000,0	1000,000	-5,8
5723,569000	71,30	---	78,20	6,90	1000,0	1000,000	-5,8

4.2.5TEST EQUIPMENT USED

Radiated Emissions

4.3 SIMULTANEOUS TRANSMISSION – SPURIOUS RADIATED EMISSIONS

Standard **FCC Part 15 Subpart E**

The test was performed according to:
ANSI C63.10

4.3.1TEST DESCRIPTION

The test set-up was made in accordance to the general provisions of ANSI C63,10 in a typical installation configuration, The Equipment Under Test (EUT) was set up on a non-conductive table 1,0 x 2,0 m² in the semi-anechoic chamber, The influence of the EUT support table that is used between 30–1000 MHz was evaluated,
The measurement procedure is implemented into the EMI test software EMC32 from R&S. Exploratory tests are performed at 3 orthogonal axes to determine the worst-case orientation of a body-worn or handheld EUT. The final test on all kind of EUTs is also performed at 3 axes. A pre-check is performed while the EUT is powered from a DC power source.

1. Measurement up to 30 MHz
The Loop antenna HFH2-Z2 is used.

Step 1: pre measurement
- Anechoic chamber
- Antenna distance: 3 m
- Detector: Peak-Maxhold
- Frequency range: 0,009 - 0,15 MHz and 0,15 – 30 MHz
- Frequency steps: 0,05 kHz and 2,25 kHz
- IF–Bandwidth: 0,2 kHz and 9 kHz
- Measuring time / Frequency step: 100 ms (FFT-based)

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

Step 2: final measurement
For the relevant emissions determined in step 1, an additional measurement with the following settings will be performed. Intention of this step is to find the maximum emission level.
- Open area test side
- Antenna distance: according to the Standard
- Detector: Quasi-Peak
- Frequency range: 0,009 – 30 MHz
- Frequency steps: measurement at frequencies detected in step 1
- IF–Bandwidth: 0,2 - 10 kHz
- Measuring time / Frequency step: 1 s

2. Measurement above 30 MHz and up to 1 GHz

Step 1: Preliminary scan
This is a preliminary test to identify the highest amplitudes relative to the limit.
Settings for step 1:
- Antenna distance: 3 m
- Detector: Peak-Maxhold / Quasipeak (FFT-based)
- Frequency range: 30 – 1000 MHz
- Frequency steps: 30 kHz
- IF–Bandwidth: 120 kHz
- Measuring time / Frequency step: 100 ms
- Turntable angle range: –180° to 90°
- Turntable step size: 90°
- Height variation range: 1 – 3 m
- Height variation step size: 2 m
- Polarisation: Horizontal + Vertical

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

Step 2: Adjustment measurement
In this step the accuracy of the turntable azimuth and antenna height will be improved. This is necessary to find out the maximum value of every frequency.
For each frequency, which was determined the turntable azimuth and antenna height will be adjusted. The turntable azimuth will slowly vary by ± 45° around this value. During this action, the value of emission is continuously measured. The turntable azimuth at the highest emission will be recorded and adjusted. In this position, the antenna height will also slowly vary by ± 100 cm around the antenna height determined. During this action, the value of emission is also continuously measured. The antenna height of the highest emission will also be recorded and adjusted.
- Detector: Peak – Maxhold
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 120 kHz
- Measuring time: 100 ms
- Turntable angle range: ± 45 ° around the determined value
- Height variation range: ± 100 cm around the determined value
- Antenna Polarisation: max, value determined in step 1

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

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

3. Measurement above 1 GHz

The following modifications apply to the measurement procedure for the frequency range above 1 GHz:

Step 1:

The Equipment Under Test (EUT) was set up on a non-conductive support (tilt device) at 1,5 m height in the fully-anechoic chamber.

All steps were performed with one height (1,5 m) of the receiving antenna only.

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

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

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

Step 2:

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

The turn table azimuth will slowly vary by ± 22,5°.

The elevation angle will slowly vary by ± 45°.

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

4.3.2TEST REQUIREMENTS / LIMITS

WLAN 5 GHz
Please see "Test Requirements / Limits" for the test case "Spurious RF Conducted Emissions at Antenna Port"

Additional for NFC:
FCC §15.225 (d) The field strength of any emissions appearing outside of the 13,110-14,010 MHz band shall not exceed the general radiated emission limits in §15.209.

Additional for Bluetooth
FCC Part 15, Subpart C, §15.247 (d)
…In addition, radiated emissions which fall in the restricted bands, as defined in Section 15,205(a), must also comply with the radiated emission limits specified in Section 15,209(a) (see Section 15,205(c).

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

Frequency in MHz	Limit (µV/m)	Measurement distance (m)	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)

4.3.3TEST PROTOCOL

Possible simultaneous operating modes according to applicant's description	Remark
NFC + WLAN 2,4 GHz	Not part of this report
NFC + BT	covered from worst case mode: NFC + BT + WLAN 5 GHz
NFC + BT-LE	BT-LE covered from BT
NFC + WLAN 5 GHz	covered from worst case mode: NFC + BT + WLAN 5 GHz
NFC + BT + WLAN 5 GHz	Worst case operating mode, Selected worst case operating modes: channels and modes with highest output power

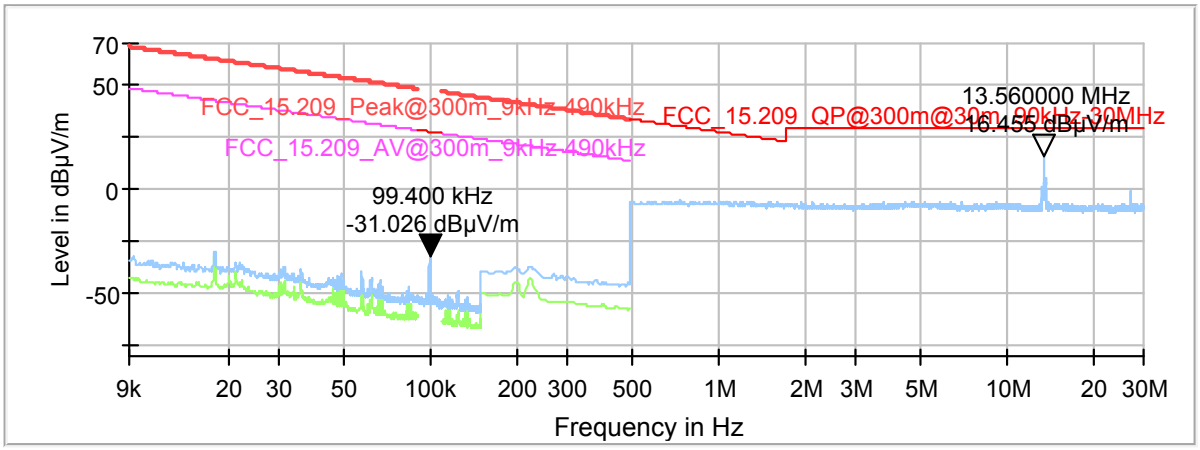
Ambient temperature: 21–25 °C
Air Pressure: 1002–1020 hPa
Humidity: 38–45 %
WLAN b-Mode; 20 MHz

Mode / Set EUT target power	**Ch. Center Freq, [MHz]**	**Spurious Freq, [MHz]**	**Spurious Level [dBµV/m]**	**Detec-tor**	**RBW [kHz]**	**Limit [dBµV/m]**	**Margin to Limit [dB]**
BT BDR (DH1, Ch.0) / max, power WLAN 5 GHz (a-Mode; 20 MHz; 6 Mbit/s) / 16 dBm NFC in continuous modulation mode	2402,0 5240,0 13,56	0,009 to 30	noise	Peak, AV	-	(13,56 MHz excluded)	> 20
BT BDR (DH1, Ch.0) / max, power WLAN 5 GHz (a-Mode; 20 MHz; 6 Mbit/s) / 16 dBm NFC in continuous modulation mode	2402,0 5240,0 13,56	40,68 352,56	33,1 32,8	QP	120	40 46	6,9 13,2
BT BDR (DH1, Ch.0) / max, power WLAN 5 GHz (a-Mode; 20 MHz; 6 Mbit/s) / 16 dBm NFC in continuous modulation mode	2402,0 5240,0 13,56	2834,90 15721,025	39,1 44,1 (100 % duty cycle, no duty cycle correction applicable)	AV	1000	54 54 (CF at 2402 MHz and 5240 MHz excluded)	14,9 9,9

Mode / Set EUT target power	Ch. Center Freq, [MHz]	Spurious Freq, [MHz]	Spurious Level [dBµV/m]	Detec-tor	RBW [kHz]	Limit [dBµV/m]	Margin to Limit [dB]
BT BDR (DH1, Ch.0) / max, power WLAN 5 GHz (a-Mode; 20 MHz; 6 Mbit/s) / 16 dBm NFC in continuous modulation mode	2402,0 5240,0 13,56	26000 to 40000	noise	Peak, AV	-	74 54	> 20

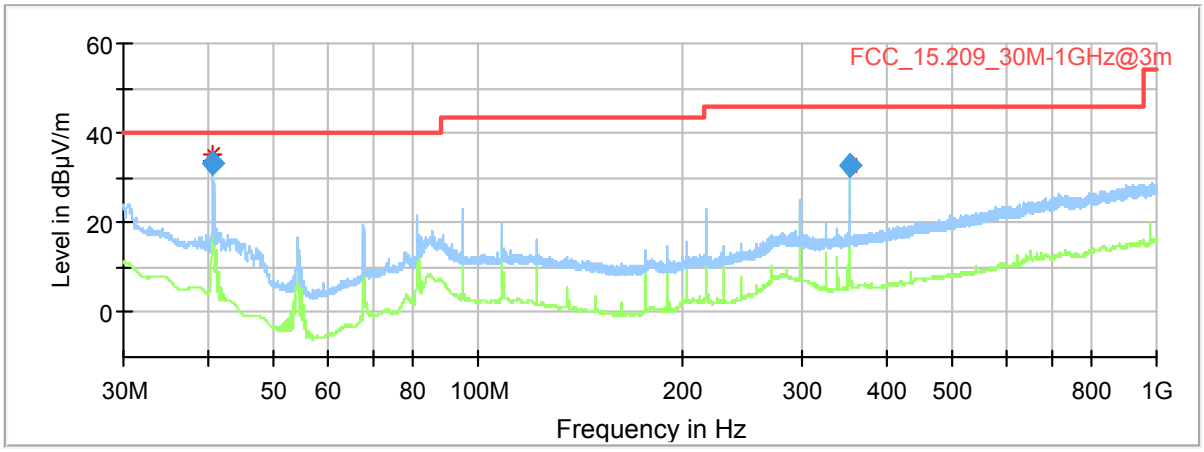
Remark: Please see next sub-clause for the measurement plot.

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



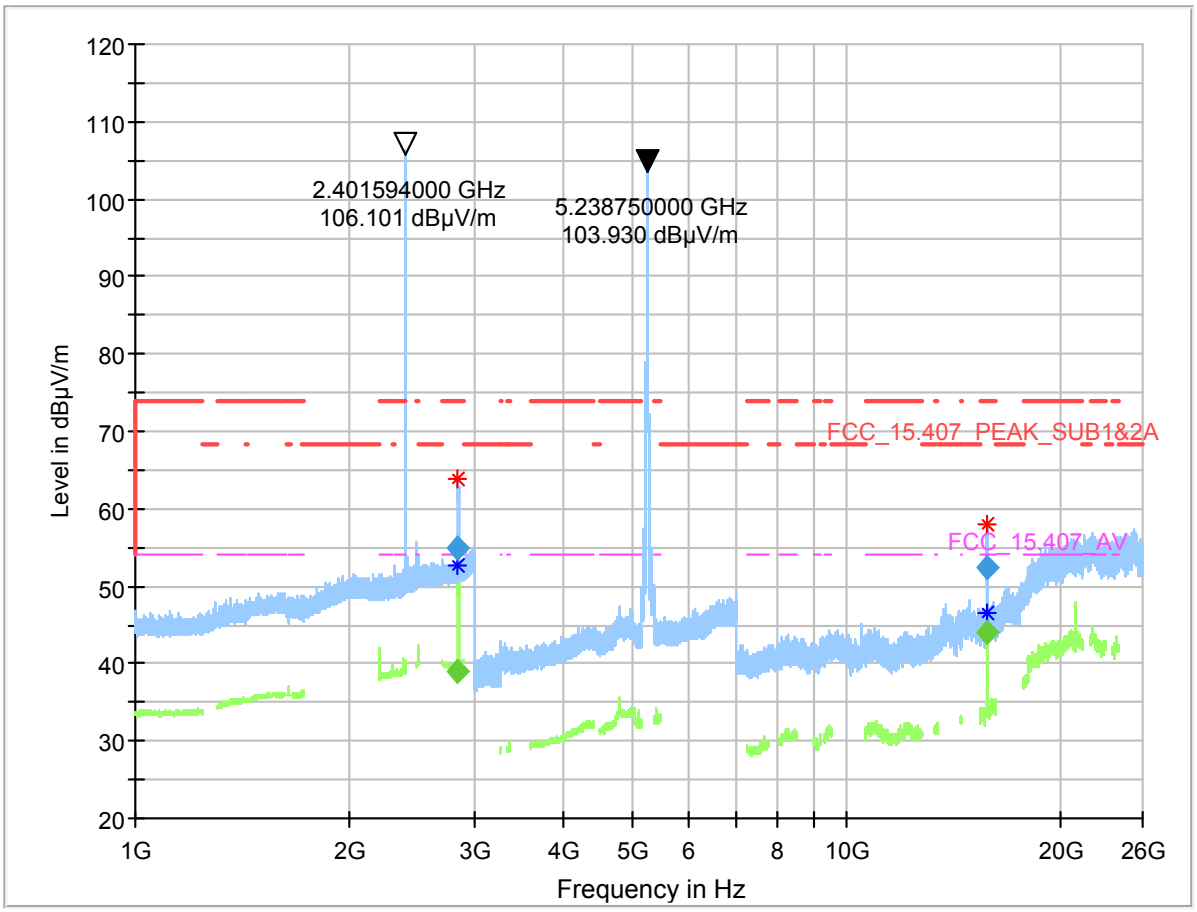
Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr, (dB)
-	-	-	-	-	-	-	-	-	-



Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr, (dB)
40,680000	33,09	40,00	6,91	1000,0	120,000	103,0	V	-162,0	13,3
352,560000	32,78	46,00	13,22	1000,0	120,000	103,0	H	-37,0	15,1

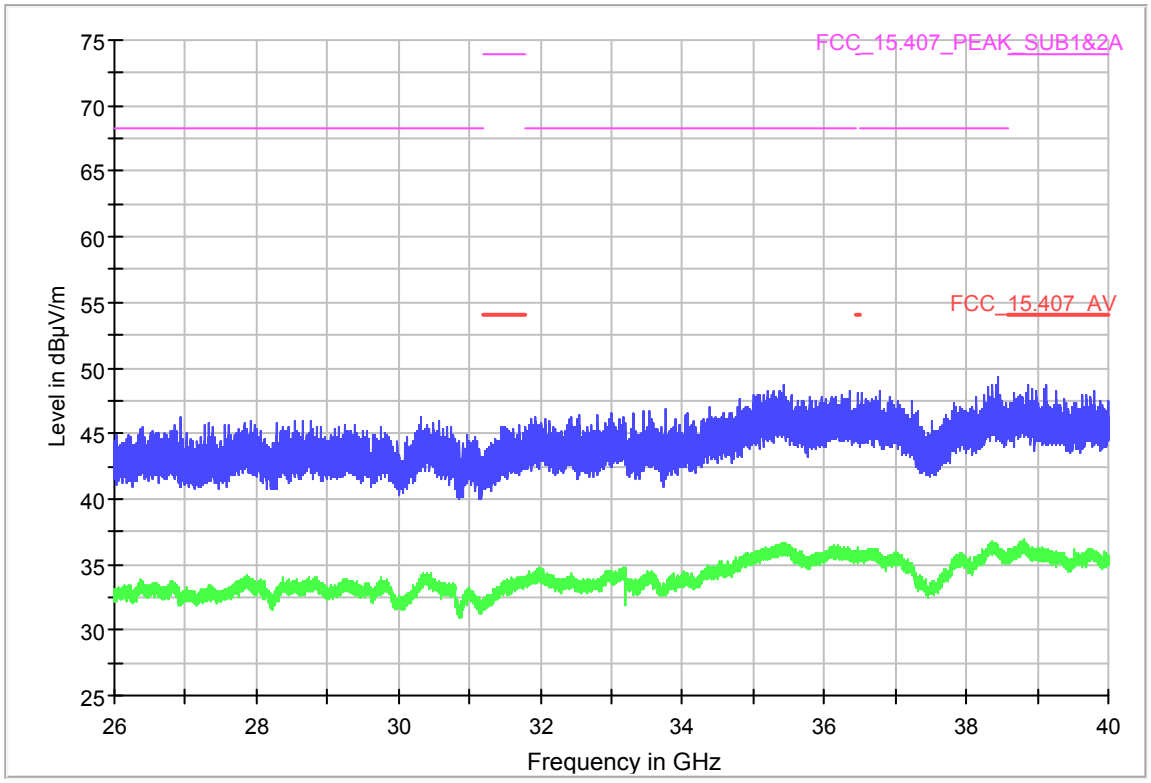


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Elevation (deg)
2834,900000	63,94	---	74,00	10,06	---	---	150,0	V	-125,0	74,8
2834,900000	---	52,77	54,00	1,23	---	---	150,0	V	-125,0	82,8
15721,025000	57,90	---	74,00	16,10	---	---	150,0	H	-8,0	74,8
15721,025000	---	46,48	54,00	7,52	---	---	150,0	H	6,0	95,8

Final_Result

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)
2834,900000	---	39,06	54,00	14,94	1000,0	1000,000	150,0	H	-124,0	82,9
2834,900000	55,01	---	74,00	18,99	1000,0	1000,000	150,0	V	-124,0	74,9
15721,025000	---	44,13	54,00	9,87	1000,0	1000,000	150,0	H	6,0	95,8
15721,025000	52,40	---	74,00	21,60	1000,0	1000,000	150,0	H	-8,0	74,8



Final_Result

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)
-	-	-	-	-	-	-	-	-	-	-

4.3.5TEST EQUIPMENT USED

Radiated Emissions

5 TEST EQUIPMENT

1 Conducted Emissions
Shielded Room 02

Ref,No,	Device Name	Description	Manufacturer	Serial Number	Last Calibration	Calibration Due
1.1	ESH 3-Z5	Two-Line V-Network	Rohde & Schwarz	828304/029	2015-03	2017-03
1.2	ESR 7	EMI Receiver / Spectrum Analyzer	Rohde & Schwarz	101424	2014-11	2016-11
1.3	ISN T800	Impedance Stabilization Network	Teseq	36159		
1.4	EP 1200/B, NA/B1	Amplifier with integrated variable Oscillator	Spitzenberger & Spieß	B6278	2015-07	2018-07
1.5	ESIB 26	Spectrum Analyzer	Rohde & Schwarz	830482/004	2015-12	2017-12
1.6	Opus10 THI (8152,00)	ThermoHygro Datalogger 02 (Environ)	Lufft Mess- und Regeltechnik GmbH	7489	2015-02	2017-02
1.7	ESH 3-Z5	Two-Line V-Network	Rohde & Schwarz	829996/002	2015-03	2017-03
1.8	CMU 200	Universal Radio Communication Tester	Rohde & Schwarz GmbH & Co, KG	102366	2016-06	2019-05
1.9	Opus10 TPR (8253,00)	ThermoAirpressure Datalogger 13 (Environ)	Lufft Mess- und Regeltechnik GmbH	13936	2015-02	2017-02
1.10	CMD 55	Digital Radio Communication Tester	Rohde & Schwarz	831050/020	2014-12	2017-12
1.11	ESH 3-Z6	One-Line V-Network	Rohde & Schwarz	100489	2014-06	2017-11
1.12	ESH 3-Z6	One-Line V-Network	Rohde & Schwarz	100570	2013-11	2016-11
1.13	Chroma 6404	AC Power Source	Chroma ATE INC,	64040001304		
1.14	CMW 500	CMW 500	Rohde & Schwarz	107500	2015-07	2017-07

2 Radiated Emissions

Lab to perform radiated emission tests

Ref,No,	Device Name	Description	Manufacturer	Serial Number	Last Calibration	Calibration Due
2.1	3160-09	Standard Gain / Pyramidal Horn Antenna 26,5 GHz	EMCO Elektronic GmbH	00083069		
2.2	WHKX 7,0/18G-8SS	High Pass Filter	Wainwright	09		
2.3	5HC3500/18000-1,2-KK	High Pass Filter	Trilithic	200035008		
2.4	Fully Anechoic Room	8,80m x 4,60m x 4,05m (l x w x h)	Albatross Projects	P26971-647-001-PRB		
2.5	AM 4,0	Antenna mast	Maturo GmbH	AM4,0/180/11920513		
2.6	ESR 7	EMI Receiver / Spectrum Analyzer	Rohde & Schwarz	101424	2014-11	2016-11
2.7	TT 1,5 WI	Turn Table	Maturo GmbH	-		
2.8	Anechoic Chamber	10,58 x 6,38 x 6,00 m³	Frankonia	none	2014-01	2017-01
2.9	Fluke 177	Digital Multimeter 03 (Multimeter)	Fluke Europe B,V,	86670383	2016-02	2018-02
2.10	ESIB 26	Spectrum Analyzer	Rohde & Schwarz	830482/004	2015-12	2017-12
2.11	Tilt device Maturo (Rohacell)	Antrieb TD1,5-10kg	Maturo GmbH	TD1,5-10kg/024/3790709		
2.12	5HC2700/12750-1,5-KK	High Pass Filter	Trilithic	9942012		
2.13	AS 620 P	Antenna mast	HD GmbH	620/37		
2.14	4HC1600/12750-1,5-KK	High Pass Filter	Trilithic	9942011		
2.15	ASP 1,2/1,8-10 kg	Antenna Mast	Maturo GmbH	-		
2.16	JS4-18002600-32-5P	Broadband Amplifier 18 GHz - 26 GHz	Miteq	849785		
2.17	JS4-00101800-35-5P	Broadband Amplifier 30 MHz - 18 GHz	Miteq	896037		
2.18	HL 562	Ultralog new biconicals	Rohde & Schwarz GmbH & Co, KG	830547/003	2015-06	2018-06

Ref,No,	Device Name	Description	Manufacturer	Serial Number	Last Calibration	Calibration Due
2.19	Opus10 THI (8152,00)	ThermoHygro Datalogger 12 (Environ)	Lufft Mess- und Regeltechnik GmbH	12482	2015-03	2017-03
2.20	JS4-00102600-42-5A	Broadband Amplifier 30 MHz - 26 GHz	Miteq	619368		
2.21	HFH2-Z2	Loop Antenna	Rohde & Schwarz GmbH & Co, KG	829324/006	2014-11	2017-11
2.22	FSW 43	Spectrum Analyzer	Rohde & Schwarz	103779	2014-11	2016-11
2.23	Opus10 TPR (8253,00)	ThermoAirpressure Datalogger 13 (Environ)	Lufft Mess- und Regeltechnik GmbH	13936	2015-02	2017-02
2.24	Chroma 6404	AC Power Source	Chroma ATE INC,	64040001304		
2.25	3160-10	Standard Gain / Pyramidal Horn Antenna 40 GHz	EMCO Elektronik GmbH	00086675		
2.26	HL 562 Ultralog	Log,-per, Antenna	Rohde & Schwarz GmbH & Co, KG	100609	2016-04	2019-04
2.27	PAS 2,5 - 10 kg	Antenna Mast	Maturo GmbH	-		
2.28	HF 907	Double-ridged horn	Rohde & Schwarz GmbH & Co, KG	102444	2015-05	2018-05

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Ref,No,	Device Name	Description	Manufacturer	Serial Number	Last Calibration	Calibration Due
3.1	OSP120	Switching Unit with integrated power meter	Rohde & Schwarz GmbH & Co, KG	101158	2015-08	2016-08
3.2	A8455-4	4 Way Power Divider (SMA)		-		
3.3	Fluke 177	Digital Multimeter 03 (Multimeter)	Fluke Europe B,V,	86670383	2016-02	2018-02
3.4	Opus10 THI (8152,00)	ThermoHygro Datalogger 03 (Environ)	Lufft Mess- und Regeltechnik GmbH	7482	2015-02	2017-02
3.5	SMB100A	Signal Generator 9 kHz - 6 GHz	Rohde & Schwarz GmbH & Co, KG	107695	2014-06	2017-06
3.6	VT 4002	Climatic Chamber	Vötsch	5856600215001 0	2016-03	2018-03
3.7	FSV30	Signal Analyzer 10 Hz - 30 GHz	Rohde & Schwarz	103005	2016-02	2018-02

Ref,No,	Device Name	Description	Manufacturer	Serial Number	Last Calibration	Calibration Due
3.8	SMBV100A	Vector Signal Generator 9 kHz - 6 GHz	Rohde & Schwarz GmbH & Co, KG	259291	2013-08	2016-08
3.9	1515 / 93459	Broadband Power Divider SMA (Aux)	Weinschel Associates	LN673		
3.10	Datum, Model: MFS	Rubidium Frequency Standard	Datum-Beverly	5489/001	2015-06 2016-06	2016-06 2017-06

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

6 ANTENNA FACTORS, CABLE LOSS AND SAMPLE CALCULATIONS

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

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

Frequency		Corr.	LISN insertion loss ESH3-Z5	cable loss (incl. 10 dB 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_{LISN} (dB µV) = U (dB µV) + Corr. (dB)
U = Receiver reading
LISN Insertion loss = Voltage Division Factor of LISN
Corr. = sum of single correction factors of used LISN, cables, switch units (if used)
Linear interpolation will be used for frequencies in between the values in the table.

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

Frequency	AF HFH-Z2)	Corr.	cable loss 1 (inside chamber)	cable loss 2 (outside chamber)	cable loss 3 (switch unit)	cable loss 4 (to receiver)	distance corr. (-40 dB/ decade)	d_{Limit} (meas. distance (limit)	d_{used} (meas. distance (used)
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 (dB µV/m) = U (dB µV) + AF (dB 1/m) + Corr. (dB)
U = Receiver reading
AF = Antenna factor
Corr. = sum of single correction factors of used cables, switch unit, distance correction, amplifier (if applicable)
distance correction = -40 * LOG (d_{Limit}/ d_{used})
Linear interpolation will be used for frequencies in between the values in the table.
Table shows an extract of values

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

(d_{Limit} = 3 m)

Frequency	AF R&S HL562	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)
MHz	dB (1/m)	dB	dB	dB	dB	dB	dB	m	m
30	18,6	0,6	0,29	0,04	0,23	0,02	0,0	3	3
50	6,0	0,9	0,39	0,09	0,32	0,08	0,0	3	3
100	9,7	1,2	0,56	0,14	0,47	0,08	0,0	3	3
150	7,9	1,6	0,73	0,20	0,59	0,12	0,0	3	3
200	7,6	1,9	0,84	0,21	0,70	0,11	0,0	3	3
250	9,5	2,1	0,98	0,24	0,80	0,13	0,0	3	3
300	11,0	2,3	1,04	0,26	0,89	0,15	0,0	3	3
350	12,4	2,6	1,18	0,31	0,96	0,13	0,0	3	3
400	13,6	2,9	1,28	0,35	1,03	0,19	0,0	3	3
450	14,7	3,1	1,39	0,38	1,11	0,22	0,0	3	3
500	15,6	3,2	1,44	0,39	1,20	0,19	0,0	3	3
550	16,3	3,5	1,55	0,46	1,24	0,23	0,0	3	3
600	17,2	3,5	1,59	0,43	1,29	0,23	0,0	3	3
650	18,1	3,6	1,67	0,34	1,35	0,22	0,0	3	3
700	18,5	3,6	1,67	0,42	1,41	0,15	0,0	3	3
750	19,1	4,1	1,87	0,54	1,46	0,25	0,0	3	3
800	19,6	4,1	1,90	0,46	1,51	0,25	0,0	3	3
850	20,1	4,4	1,99	0,60	1,56	0,27	0,0	3	3
900	20,8	4,7	2,14	0,60	1,63	0,29	0,0	3	3
950	21,1	4,8	2,22	0,60	1,66	0,33	0,0	3	3
1000	21,6	4,9	2,23	0,61	1,71	0,30	0,0	3	3

(d_{Limit} = 10 m)

30	18,6	-9,9	0,29	0,04	0,23	0,02	-10,5	10	3
50	6,0	-9,6	0,39	0,09	0,32	0,08	-10,5	10	3
100	9,7	-9,2	0,56	0,14	0,47	0,08	-10,5	10	3
150	7,9	-8,8	0,73	0,20	0,59	0,12	-10,5	10	3
200	7,6	-8,6	0,84	0,21	0,70	0,11	-10,5	10	3
250	9,5	-8,3	0,98	0,24	0,80	0,13	-10,5	10	3
300	11,0	-8,1	1,04	0,26	0,89	0,15	-10,5	10	3
350	12,4	-7,9	1,18	0,31	0,96	0,13	-10,5	10	3
400	13,6	-7,6	1,28	0,35	1,03	0,19	-10,5	10	3
450	14,7	-7,4	1,39	0,38	1,11	0,22	-10,5	10	3
500	15,6	-7,2	1,44	0,39	1,20	0,19	-10,5	10	3
550	16,3	-7,0	1,55	0,46	1,24	0,23	-10,5	10	3
600	17,2	-6,9	1,59	0,43	1,29	0,23	-10,5	10	3
650	18,1	-6,9	1,67	0,34	1,35	0,22	-10,5	10	3
700	18,5	-6,8	1,67	0,42	1,41	0,15	-10,5	10	3
750	19,1	-6,3	1,87	0,54	1,46	0,25	-10,5	10	3
800	19,6	-6,3	1,90	0,46	1,51	0,25	-10,5	10	3
850	20,1	-6,0	1,99	0,60	1,56	0,27	-10,5	10	3
900	20,8	-5,8	2,14	0,60	1,63	0,29	-10,5	10	3
950	21,1	-5,6	2,22	0,60	1,66	0,33	-10,5	10	3
1000	21,6	-5,6	2,23	0,61	1,71	0,30	-10,5	10	3

Sample calculation

E (dB µV/m) = U (dB µV) + AF (dB 1/m) + 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 * 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.

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

Frequency	AF R&S HF907	Corr.	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)		
MHz	dB (1/m)	dB	dB	dB	dB	dB		
1000	24,4	-19,4	0,99	0,31	-21,51	0,79		
2000	28,5	-17,4	1,44	0,44	-20,63	1,38		
3000	31,0	-16,1	1,87	0,53	-19,85	1,33		
4000	33,1	-14,7	2,41	0,67	-19,13	1,31		
5000	34,4	-13,7	2,78	0,86	-18,71	1,40		
6000	34,7	-12,7	2,74	0,90	-17,83	1,47		
7000	35,6	-11,0	2,82	0,86	-16,19	1,46		

Frequency	AF R&S HF907	Corr.	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
MHz	dB (1/m)	dB	dB	dB	dB	dB	dB	
3000	31,0	-23,4	0,47	1,87	0,53	-27,58	1,33	
4000	33,1	-23,3	0,56	2,41	0,67	-28,23	1,31	
5000	34,4	-21,7	0,61	2,78	0,86	-27,35	1,40	
6000	34,7	-21,2	0,58	2,74	0,90	-26,89	1,47	
7000	35,6	-19,8	0,66	2,82	0,86	-25,58	1,46	

Frequency	AF R&S HF907	Corr.	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)
MHz	dB (1/m)	dB	dB	dB	dB	dB	dB	dB
7000	35,6	-57,3	0,56	1,28	-62,72	2,66	0,94	1,46
8000	36,3	-56,3	0,69	0,71	-61,49	2,84	1,00	1,53
9000	37,1	-55,3	0,68	0,65	-60,80	3,06	1,09	1,60
10000	37,5	-56,2	0,70	0,54	-61,91	3,28	1,20	1,67
11000	37,5	-55,3	0,80	0,61	-61,40	3,43	1,27	1,70
12000	37,6	-53,7	0,84	0,42	-59,70	3,53	1,26	1,73
13000	38,2	-53,5	0,83	0,44	-59,81	3,75	1,32	1,83
14000	39,9	-56,3	0,91	0,53	-63,03	3,91	1,40	1,77
15000	40,9	-54,1	0,98	0,54	-61,05	4,02	1,44	1,83
16000	41,3	-54,1	1,23	0,49	-61,51	4,17	1,51	1,85
17000	42,8	-54,4	1,36	0,76	-62,36	4,34	1,53	2,00
18000	44,2	-54,7	1,70	0,53	-62,88	4,41	1,55	1,91

Sample calculation

E (dB µV/m) = U (dB µV) + AF (dB 1/m) + Corr. (dB)
U = Receiver reading
AF = Antenna factor
Corr. = sum of single correction factors of used cables, switch unit, distance correction, amplifier (if applicable)
Linear interpolation will be used for frequencies in between the values in the table.
Tables show an extract of values.

6.5 ANTENNA EMCO 3160-09 (18 GHZ – 26,5 GHZ)

Frequency	AF EMCO 3160-09	Corr.	cable 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 (dB µV/m) = U (dB µV) + AF (dB 1/m) + Corr. (dB)
U = Receiver reading
AF = Antenna factor
Corr. = sum of single correction factors of used cables, switch unit, distance correction, amplifier (if applicable)
Linear interpolation will be used for frequencies in between the values in the table.
Table shows an extract of values.

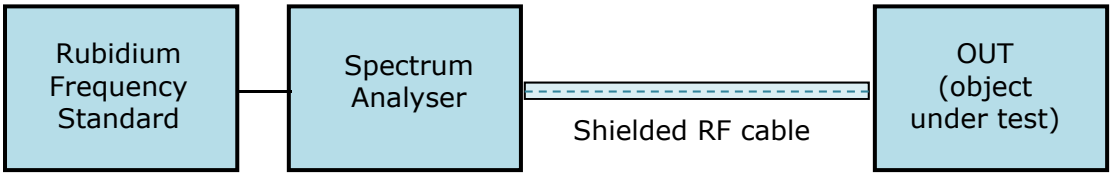
6.6 ANTENNA EMCO 3160-10 (26,5 GHZ – 40 GHZ)

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

Sample calculation

E (dB µV/m) = U (dB µV) + AF (dB 1/m) + Corr. (dB)
U = Receiver reading
AF = Antenna factor
Corr. = sum of single correction factors of used cables, switch unit, distance correction, amplifier (if applicable)
Linear interpolarisation will be used for frequencies in between the values in the table.
distance correction = -20 * LOG (d_{Limit}/ d_{used})
Linear interpolation will be used for frequencies in between the values in the table.
Table shows an extract of values.

7 SETUP DRAWINGS



Drawing 1: Setup for conducted radio tests.

8 MEASUREMENT UNCERTAINTIES

Test Case	Parameter	Uncertainty
AC Power Line	Power	± 3,4 dB
Field Strength of spurious radiation	Power	± 5,5 dB
6 dB / 26 dB / 99% Bandwidth	Power Frequency	± 2,9 dB ± 11,2 kHz
Conducted Output Power	Power	± 2,2 dB
Band Edge Compliance	Power Frequency	± 2,2 dB ± 11,2 kHz
Frequency Stability	Frequency	± 25 Hz
Power Spectral Density	Power	± 2,2 dB