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Test Report

Report Number:

F210098E2

Equipment under Test (EUT):

LILY-W133

Applicant:

u-blox AG

Manufacturer:

u-blox AG



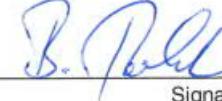
Deutsche
Akkreditierungsstelle
D-PL-17186-01-01
D-PL-17186-01-02
D-PL-17186-01-03

References

- [1] **ANSI C63.10-2013**, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
- [2] **FCC CFR 47 Part 15**, Radio Frequency Devices
- [3] **558074 D01 15.247 Meas Guidance v05r02 (April 2019)**, GUIDANCE FOR COMPLIANCE MEASUREMENTS ON DIGITAL TRANSMISSION SYSTEM, FREQUENCY HOPPING SPREAD SPECTRUM SYSTEM, AND HYBRID SYSTEM DEVICES OPERATING UNDER SECTION 15.247 OF THE FCC RULES
- [4] **RSS-247, Issue 2 (2017-02)** Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
- [5] **RSS-Gen, Issue 5 (2021-02)** General Requirements for Compliance of Radio Apparatus

Test Result

The requirements of the tests performed as shown in the overview (clause 4) were fulfilled by the equipment under test. The complete test results are presented in the following.

Tested and written by:	Bernward ROHDE		26.08.2021
	Name	Signature	Date
Reviewed and approved by:	Bernd STEINER		
	Name	Signature	

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1 Identification

1.1 Applicant

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Address:	Zürcherstraße 68 8800 Thalwil
Country:	Schwitzerland
Name for contact purposes:	Giulio Comar
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eMail Address:	giulio.comar@u-blox.com
Applicant represented during the test by the following person:	-

1.2 Manufacturer

Name:	u-blox AG
Address:	Zürcherstraße 68 8800 Thalwil
Country:	Schwitzerland
Name for contact purposes:	Giulio Comar
Phone:	+39 040 2603 757
Fax:	+39 040 2529 394
eMail Address:	giulio.comar@u-blox.com
Applicant represented during the test by the following person:	-

1.3 Test Laboratory

The tests were carried out by:

PHOENIX TESTLAB GmbH
Königswinkel 10
32825 Blomberg
Germany

Accredited by Deutsche Akkreditierungsstelle GmbH (DAkkS) in compliance with DIN EN ISO/IEC 17025 under Reg. No. D-PL-17186-01-05 and D-PL-17186-01-06, FCC Test Firm Accreditation designation number DE0004, FCC Test Firm Registration Number 469623, CAB Identifier DE0003 and ISED# 3469A.

1.4 EUT (Equipment under Test)

EUT	
Test object: *	WLAN IEE 802.11 g/b/n transceiver module
PMN / Model name: *	LILY-W1
FCC ID: *	XPYLILYW1
IC: * ISED Certification number: *	8595A-LILYW1

* Declared by the applicant

	EUT number		
	1	2	3
Serial number: *	K85D4CAEA9BC461100	K41D4CAEA91F381500	-
PCB identifier: *	K85	K41	-
Hardware version: * HVIN:*	LILY-W133	LILY-W133	-
Software version: * FVIN:*	n/a	n/a	-

Note: PHOENIX Testlab GmbH does not take samples. The samples used for the tests are provided exclusively by the applicant.

1.5 Technical Data of Equipment

EUT data				
Power supply EUT: *	DC			
Supply voltage EUT: *	U _{nom} = 3.3 V _{DC}	U _{min} = 3.0 V _{DC}	U _{max} = 3.6 V _{DC}	
Temperature range: *	-40 °C to +85 °C			
Lowest / highest internal clock frequency: *	26 MHz / 2462 MHz			

Ports / Connectors				
Identification			Length during test	Shielding (Yes / No)
	EUT	Ancillary		
USB	Micro USB	USB A	50 cm	Yes

IEEE 802.11 radio mode			
Fulfils radio specification: *	IEEE 802.11 b, g, n (HT20)		
Radio chip: *	Marvell 88W8801		
Antenna type: *	SMD PIFA		
Antenna name: *	u-blox LILY Antenna		
Antenna gain: *	Peak: -1 dBi (Typical)		
Antenna connector: *	-		
Type of modulation: *	IEEE 802.11 b	DSSS (DBPSK, DQPSK, CCK) (1/2/5.5/11 Mbit/s)	
	IEEE 802.11 g	OFDM (BPSK, QPSK, 16-QAM, 64-QAM) (6/9/12/18/24/36/48/54 Mbit/s)	
	IEEE 802.11 n20	OFDM (BPSK, QPSK, 16-QAM, 64-QAM) (up to 72.2 Mbit/s)	
Operating frequency range: *	IEEE 802.11 b	2412 – 2462 MHz	
	IEEE 802.11 g	2412 – 2462 MHz	
	IEEE 802.11 n20	2412 – 2462 MHz	
Number of channels: *	IEEE 802.11 b	11 (5 MHz channel spacing)	
	IEEE 802.11 g	11 (5 MHz channel spacing)	
	IEEE 802.11 n20	11 (5 MHz channel spacing)	

IEEE 802.11 b/g/n20 frequencies				
Channel 01	RX	2412 MHz	TX	2412 MHz
Channel 02	RX	2417 MHz	TX	2417 MHz
Channel 03	RX	2422 MHz	TX	2422 MHz
Channel 04	RX	2427 MHz	TX	2427 MHz
Channel 05	RX	2432 MHz	TX	2432 MHz
Channel 06	RX	2437 MHz	TX	2437 MHz
Channel 07	RX	2442 MHz	TX	2442 MHz
Channel 08	RX	2447 MHz	TX	2447 MHz
Channel 09	RX	2452 MHz	TX	2452 MHz
Channel 10	RX	2457 MHz	TX	2457 MHz
Channel 11	RX	2462 MHz	TX	2462 MHz

1.5.1 Ancillary Equipment / Equipment used for testing

Equipment used for testing	
Cables: ^{*1}	DC Power supply cable 3.3V USB to Micro-USB cable USB to Mini-USB cable
Laptop PC: ^{*1}	Lenovo ThinkPad L540
Eval board: ^{*1}	Odin-W260 AUX2 on EVB-W26 evaluation board, Serial number: 587000005340400
Linux development board: ^{*1}	EVK-W16

^{*1} Provided by the applicant

Ancillary equipment	
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1.6 Dates

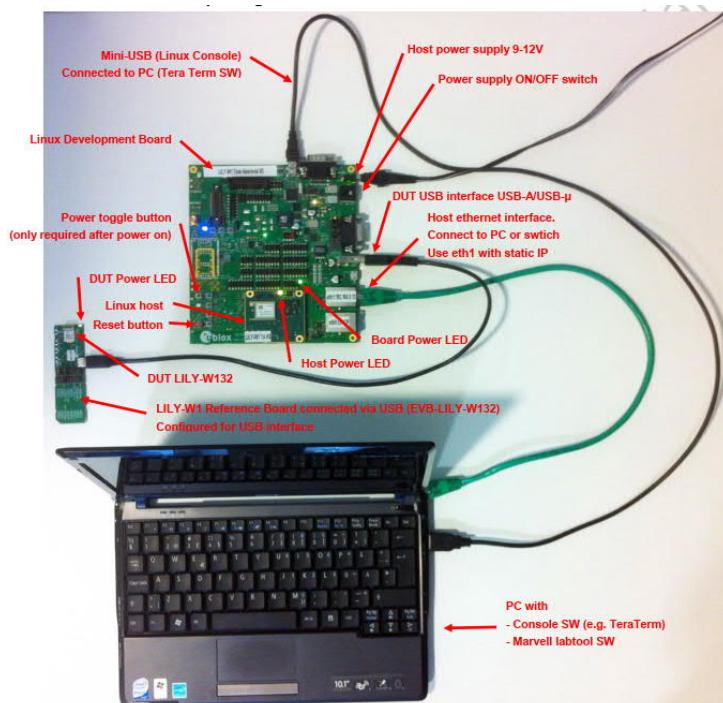
Date of receipt of test sample:	04.03.2021
Start of test:	23.03.2021
End of test:	24.03.2021

2 Operational States

2.1 Description of function of the EUT

The EUT is a WLAN module targeted for integration into different OEM products.

For the test the EUT was soldered on an EVB LILY-W1 Rev. B carrier-board. This carrier board is connected to a u-blox cB-0962-02-02-1 Linux development board via an USB-mini cable. The linux development board is connected to a laptop-PC via a micro-USB cable and an Ethernet cable. The module on the linux board is not part of this test report and was not active during any of the test, performed for this test report. The connection between Linux evaluation board and laptop is established by using Tera Term commands and the test cases are started by using a tool named "Labtool". All ancillary devices and the software were provided by the applicant.

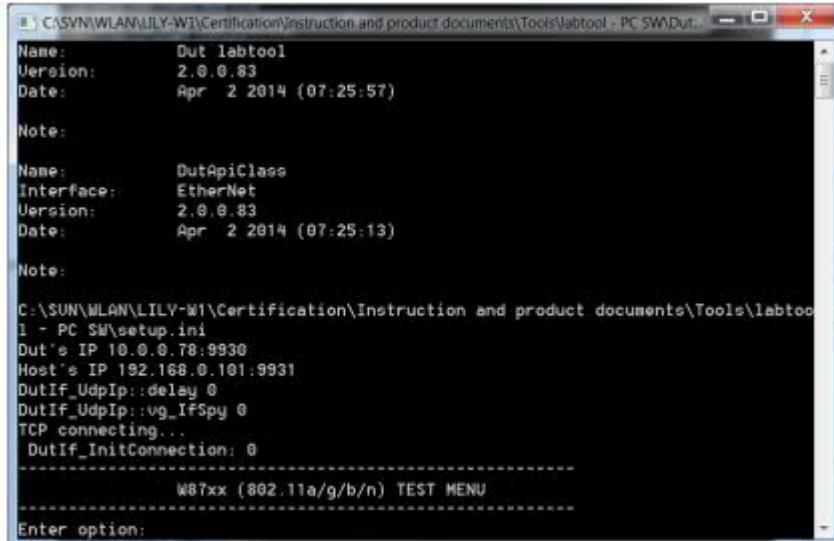


2.2 The following states were defined as the operating conditions

2.2.1 Radio test

During the "labtool" test mode following settings were used:

Command	Comment
30 0	Set 2.4 GHz band
22 a b c	a – channel 1 / 6 / 11 b – power setting in dBm c – modulation (0= b-rate, 1 = OFDM)
17 1 d	d – data rate (for details see objective specification)



The screenshot shows a command-line interface window titled "C:\SVN\WLAN\LL1Y-W1\Certification\Instruction and product documents\Tools\labtool - PC SW Dut". The window displays the following text:

```

Name: Dut_labtool
Version: 2.0.0.83
Date: Apr 2 2014 (07:25:57)

Note:

Name: DutApiClass
Interface: EtherNet
Version: 2.0.0.83
Date: Apr 2 2014 (07:25:13)

Note:

C:\SVN\WLAN\LL1Y-W1\Certification\Instruction and product documents\Tools\labtool - PC SW\setup.ini
Dut's IP 10.0.0.78:9930
Host's IP 192.168.0.101:9931
DutIf_UdpIp::delay 0
DutIf_UdpIp::wg_IFSpy 0
TCP connecting...
DutIf_InitConnection: 0
-----
W87xx (802.11a/g/b/n) TEST MENU
-----
Enter option:

```

2.2.2 Operation modes

Operation mode #	Radio technology	Frequency [MHz]	Channel / Band	Modulation / Mode	Data rate	Power setting
1	IEEE 802.11 b mode	2412	1	DSSS	1 Mbit/s	+16 dBm
2	IEEE 802.11 b-mode	2437	6	DSSS	1 Mbit/s	+16 dBm
3	IEEE 802.11 b-mode	2462	11	DSSS	1 Mbit/s	+16 dBm
4	IEEE 802.11 g-mode	2462	11	OFDM	6 Mbit/s	+16 dBm
5	IEEE 802.11 n-mode	2462	11	OFDM	MCS1	+16 dBm

3 Additional Information

none

4 Overview

Application	Frequency range [MHz]	FCC 47 CFR Part 15 section [2]	RSS-247 [4] RSS-Gen [5]	Status	EUT
Maximum peak conducted output power	2400.0 - 2483.5	15.247 (b) (3), (4)	5.4 (d) [4]	Verification done* ¹	2
Maximum conducted output power	2400.0 - 2483.5	15.247 (b) (3), (4)	5.4 (d) [4]	Not tested* ⁴	-
DTS Bandwidth / 99% Bandwidth	2400.0 - 2483.5	15.247 (a) (2)	5.2 (a) [4]	Not tested* ⁴	-
Peak Power Spectral Density	2400.0 - 2483.5	15.247 (e)	5.2 (b) [4]	Not tested* ⁴	-
Average Power Spectral Density	2400.0 - 2483.5	15.247 (e)	5.2 (b) [4]	Not tested* ⁴	-
Band edge compliance	2400.0 - 2483.5	15.247 (d) 15.205 (a) 15.209 (a)	5.5 [4]	Passed	1
Maximum unwanted emissions	1,000 – 26,500* ³	15.247 (d) 15.205 (a) 15.209 (a)	8.9 [5]	Passed* ³	1
Antenna Requirement	-	15.203 15.247 (b)	5.4 (f) (ii) [4]	Passed* ²	-

*¹ Maximum peak output power verification done; result lies within the measurement uncertainty.

*² Fixed Antenna, gain below 6 dBi, no power reduction necessary.

*³ Worst case emissions in the frequency range of 1 GHz to 10th harmonic

*⁴ not affected by this C2P change verified by output power verification

5 Results

5.1 Test setup

5.1.1 Test Setup (radiated)

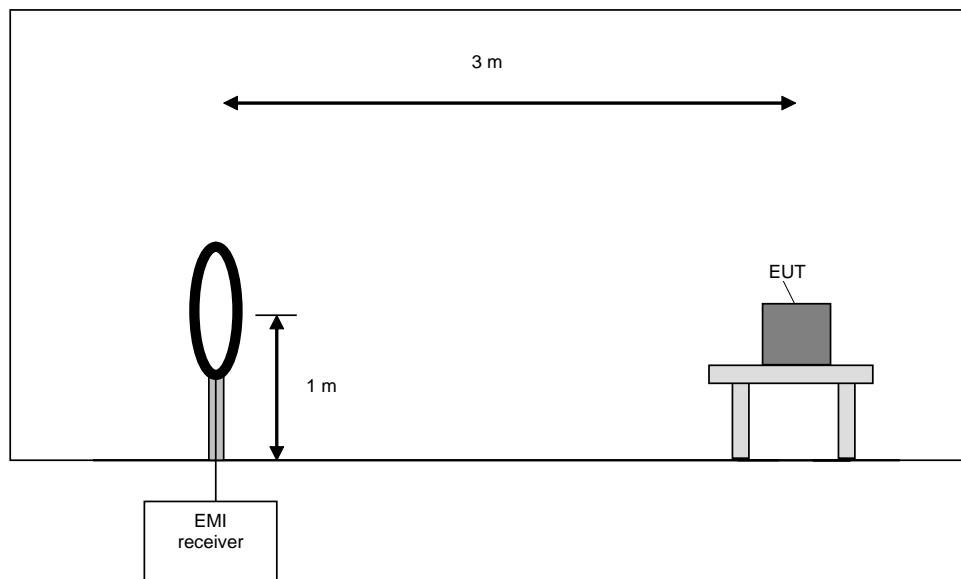
5.1.1.1 Preliminary measurement 9 kHz to 30 MHz

In the first stage a preliminary measurement is performed in an anechoic chamber with a measuring distance of 3 meters. Table-top devices are set up on a non-conducting support with a size of 1 m by 1.5 m and a height of 80 cm. Floor-standing devices are placed directly on the turntable / ground plane. The setup of the equipment under test is in accordance to [1].

The frequency range 9 kHz to 30 MHz is monitored with an EMI receiver while the system and its cables are manipulated to find out the configuration with the maximum emission levels if applicable. The EMI receiver is set to MAX hold mode. The EUT and the measuring antenna are rotated around their vertical axis to find the maximum emission levels.

The resolution bandwidth of the EMI receiver is set to the following values:

Frequency range	Resolution bandwidth
9 kHz to 150 kHz	200 Hz
150 kHz to 30 MHz	9 kHz



Procedure preliminary measurement:

Pre-scans are performed in the frequency range 9 kHz to 150 kHz and 150 kHz to 30 MHz. The following procedure is used:

- 1) Monitor the frequency range with the measuring antenna facing the EUT and an EUT / turntable azimuth of 0 °.
- 2) Manipulate the system cables to produce the maximum levels of emissions.
- 3) Rotate the EUT by 360 ° to maximize the detected signals.
- 4) Measure the frequencies of the highest detected emissions with a lower span and resolution bandwidth to increase the accuracy and note the frequency values.
- 5) If the EUT is portable or ceiling mounted, repeat steps 1 to 4 with other orientations (x,y,z) of the EUT.
- 6) Rotate the measuring antenna and repeat steps 1 to 5.

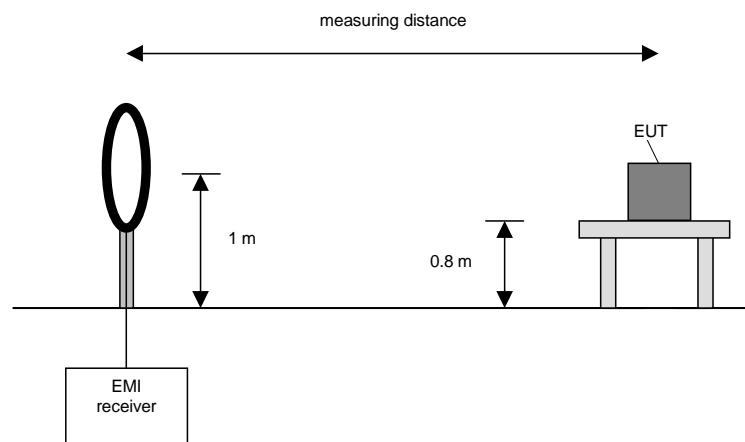
5.1.1.2 Final measurement 9 kHz to 30 MHz

In the second stage a final measurement is performed on an open area test site with no conducting ground plane in a measuring distances of 3 m, 10 m or 30 m. In the case where larger measuring distances are required the results are extrapolated based on the values measured on the closer distances according to section 15.31 (f) (2) [2]. The final measurement is performed with an EMI receiver set to Quasi-Peak detector, except for the frequency bands 9 kHz to 90 kHz and 110 kHz to 490 kHz where an Average detector is used according section 15.209 (d) [2].

At the frequencies, which were detected during the preliminary measurements, the final measurement is performed while rotating the EUT and the measuring antenna in the range of 0 ° to 360 ° around their vertical axis until the maximum level value is found.

The resolution bandwidth of the EMI receiver is set to the following values:

Frequency range	Resolution bandwidth
9 kHz to 150 kHz	200 Hz
150 kHz to 30 MHz	9 kHz



Procedure final measurement:

The following procedure is used:

- 1) Monitor the selected frequencies from the preliminary measurement with the measuring antenna facing the EUT and an EUT azimuth of 0 °.
- 2) Rotate the EUT by 360 ° to maximize the detected signals.
- 3) Rotate the measuring antenna and repeat steps 1 to 2 until the maximum value is found and note it.
- 4) If the EUT is portable or ceiling mounted, repeat steps 1 to 3 with other orientations (x,y,z) of the EUT.

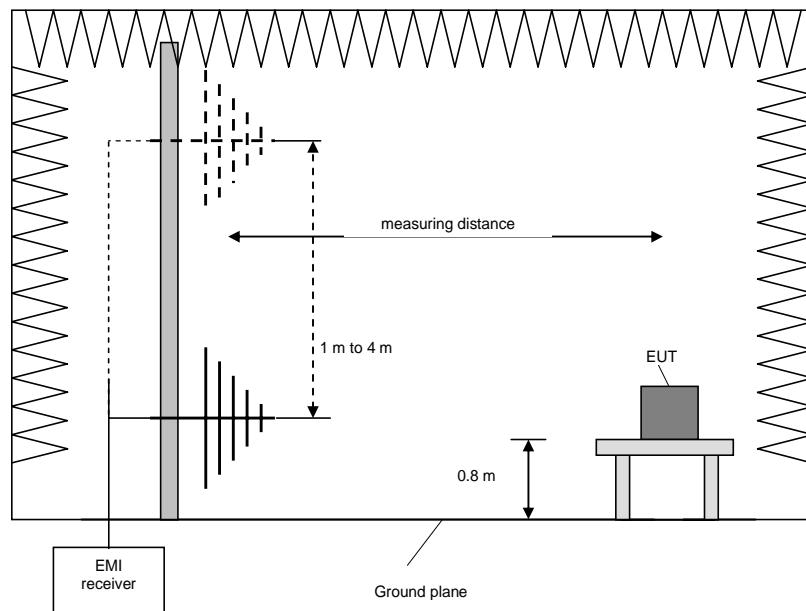
5.1.1.3 Preliminary and final measurement 30 MHz to 1 GHz

The preliminary and final measurements are performed in a semi-anechoic chamber with a metal ground plane in a 3 m distance.

During the tests the EUT is rotated in the range of 0 ° to 360 °, the measuring antenna is set to horizontal and vertical polarization and raised and lowered in the range from 1 m to 4 m to find the maximum level of emissions.

The resolution bandwidth of the EMI Receiver is set to the following values:

Test	Frequency range	Step-size	Resolution bandwidth	Detector
Preliminary measurement	30 MHz to 1 GHz	30 kHz	120 kHz	Peak Average
Frequency peak search	± 120 kHz	10 kHz	120 kHz	Peak
Final measurement	30 MHz to 1 GHz	-	120 kHz	QuasiPeak



Procedure preliminary measurement:

The following procedure is used:

- 1) Set the measuring antenna to 1 m height.
- 2) Monitor the frequency range at horizontal polarization of the measuring antenna and an EUT / turntable azimuth of 0 °.
- 3) Rotate the EUT by 360° to maximize the detected signals.
- 4) Repeat steps 2 to 3 with the vertical polarization of the measuring antenna.
- 5) Increase the height of the measuring antenna for 0.5 m and repeat steps 2 to 4 until the final height of 4 m is reached.
- 6) The highest values for each frequency are saved by the software, including the measuring antenna height and polarization and the turntable azimuth for that value.

Procedure final measurement:

The following procedure is used:

- 1) Select the highest frequency peaks (lowest margin to the limit) for the final measurement.
- 2) The software determines the exact peak frequencies by doing a partial scan with reduced step size of the pre-scan of the selected peaks.
- 3) If the EUT is portable or ceiling mounted, find the worst-case EUT orientation (x,y,z) for the final test.
- 4) The worst-case measuring antenna height is found via varying the height by +/- 0.5 m from the value obtained in the preliminary measurement while monitoring the emission level.
- 5) The worst-case turntable position is found via varying the turntable azimuth by +/- 30° from the value obtained in the preliminary measurement while monitoring the emission level.
- 6) The final measurement is performed at the worst-case measuring antenna height and the worst-case turntable azimuth.
- 7) Steps 2 to 6 are repeated for each frequency peak selected in step 1.

5.1.1.4 Preliminary and final measurement > 1 GHz

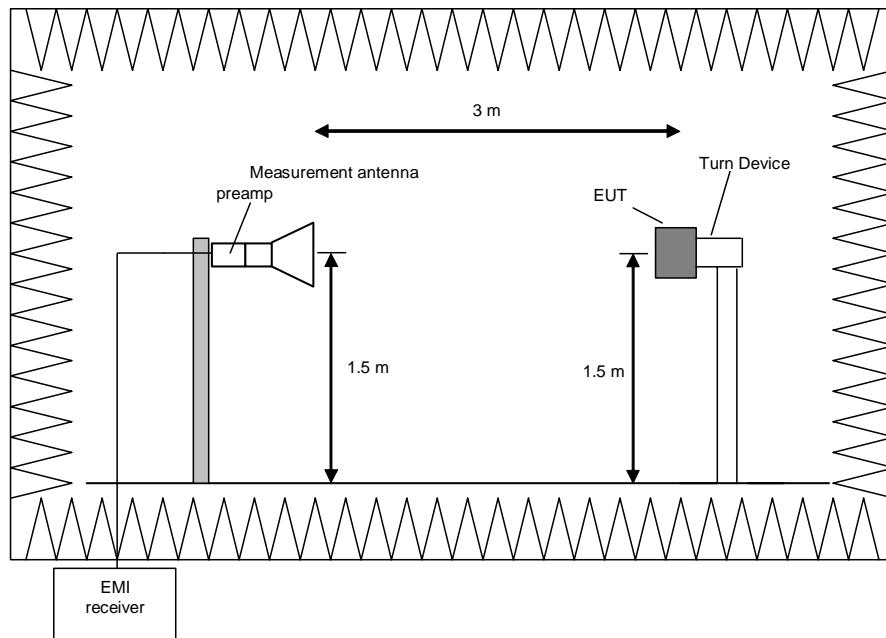
This measurement will be performed in a fully anechoic chamber. Tabletop devices will set up on a non-conducting turn device on the height of 1.5m. The set-up of the Equipment under test will be in accordance to [1].

Preliminary measurement (1 GHz to 40 GHz)

The frequency range will be divided into different sub ranges depending of the frequency range of the used horn antenna. The spectrum analyser set to MAX Hold mode and a resolution bandwidth of 1 MHz. The measurement will be performed in horizontal and vertical polarisation of the measuring antenna and while rotating the EUT in its vertical axis in the range of 0 ° to 360 °. This measurement is repeated after raising the EUT in 30° steps according 6.6.5.4 in [1].

The resolution bandwidth of the EMI Receiver will be set to the following values:

Frequency range	Resolution bandwidth
1 GHz to 4 GHz	1 MHz
4 GHz to 12 GHz	1 MHz
12 GHz to 18 GHz	1 MHz
18 GHz to 25 / 26.5 GHz	1 MHz
26.5 GHz to 40 GHz	1 MHz



Procedure preliminary measurement:

Pre-scans were performed in the frequency range 1 to 40 GHz.

The following procedure will be used:

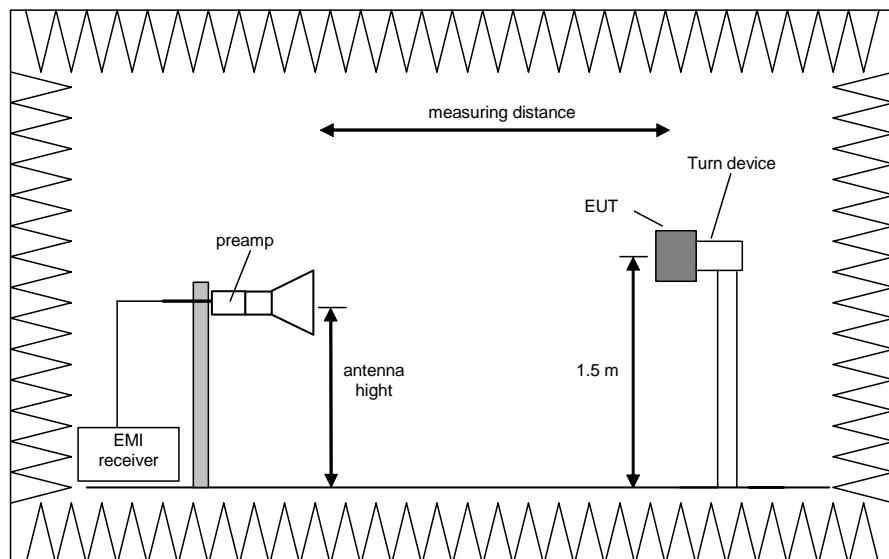
1. Monitor the frequency range at horizontal polarisation and a EUT azimuth of 0 °.
2. Rotate the EUT by 360° to maximize the detected signals.
3. Repeat 1) to 2) with the vertical polarisation of the measuring antenna.
4. Make a hardcopy of the spectrum.
5. Repeat 1) to 4) with the EUT raised by an angle of 30° (60°, 90°, 120° and 150°) according to 6.6.5.4 in [1].
6. Measure the frequency of the detected emissions with a lower span and resolution bandwidth to increase the accuracy and note the frequency value.
7. The measurement antenna polarisation, with the according EUT position (Turntable and Turn device) which produces the highest emission for each frequency will be used for the final measurement. The six closest values to the applicable limit will be used for the final measurement.

Final measurement (1 GHz to 40 GHz)

The frequency range will be divided into different sub ranges depending of the frequency range of the used antenna. The EMI Receiver set to peak and average mode and a resolution bandwidth of 1 MHz. The measurement will be performed by rotating the turntable through 0 to 360° in the worst-case EUT orientation which was obtained during the preliminary measurements.

The resolution bandwidth of the EMI Receiver will be set to the following values:

Frequency range	Resolution bandwidth
1 GHz to 4 GHz	1 MHz
4 GHz to 12 GHz	1 MHz
12 GHz to 18 GHz	1 MHz
18 GHz to 25 / 26.5 GHz	1 MHz
26.5 GHz to 40 GHz	1 MHz



Procedure of measurement:

The measurements were performed in the frequency ranges 1 GHz to 4 GHz, 4 GHz to 12 GHz, 12 GHz to 18 GHz, 18 GHz to 25 /26.5 GHz and 26.5 GHz to 40 GHz.

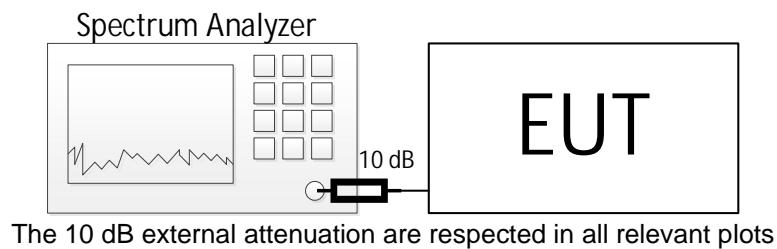
The following procedure will be used:

- 1) Set the turntable and the turn device to obtain the worst-case emission for the first frequency identified in the preliminary measurements.
- 2) Set the measurement antenna polarisation to the orientation with the highest emission for the first frequency identified in the preliminary measurements.
- 3) Set the spectrum analyser to EMI mode with peak and average detector activated.
- 4) Rotate the turntable from 0° to 360° to find the TT Pos. that produces the highest emissions.
- 5) Note the highest displayed peak and average values
- 6) Repeat the steps 1) to 5) for each frequency detected during the preliminary measurements.

5.1.2 Test setup (conducted)

The measurements were done conducted at the antenna connector.

Test setup (conducted)		
Used	Antenna connector	Comment
<input checked="" type="checkbox"/>	Temporary antenna connector	As provided by the applicant
<input type="checkbox"/>	Antenna port	

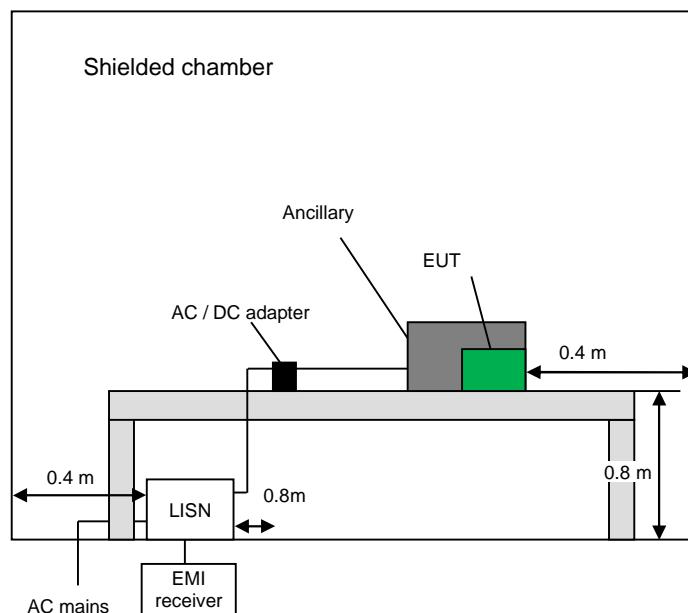


5.1.3 Test setup (AC powerline)

The test is carried out in a shielded chamber. Table-top devices are set up on a non-conducting support with a size of 1 m by 1.5 m and a height of 80 cm above the ground plane. Floor-standing devices are placed directly on the ground plane. In case of DC powered equipment, which is not exclusively powered by a battery, it is connected to the LISN via a suitable AC/DC adaptor. The setup of the equipment under test is in accordance to [1].

The frequency range 150 kHz to 30 MHz is measured with an EMI receiver set to MAX hold mode with Peak and Average detectors and a resolution bandwidth of 9 kHz. A scan is carried out on the phase and neutral line of the AC mains network. If emissions less than 10 dB below the appropriate limit are detected, these emissions are measured with an Average and Quasi-Peak detector on all lines.

Frequency range	Resolution bandwidth
150 kHz to 30 MHz	9 kHz



5.2 Duty cycle

5.2.1 Test setup (Duty cycle)

<input type="checkbox"/>	Test setup (radiated)	see sub-clause 5.1.1
<input checked="" type="checkbox"/>	Test setup (antenna port conducted)	see sub-clause 5.1.2

5.2.2 Test method (Duty cycle)

<input type="checkbox"/>	Diode detector	see 11.6. a) of ANSI C63.10
<input checked="" type="checkbox"/>	Zero span	see 6. a) of KDB 508074
		see 11.6. b) of ANSI C63.10
		see 6. b) of KDB 508074

5.2.3 Test results (Band edge – unrestricted bands)

The duty cycle of the IEEE 802.11 was set to 100 %, therefore no duty cycle correction factor (DCCF) needs to be calculated.

5.3 Band edge compliance

5.3.1 Test setup (Band edge – unrestricted bands)

<input checked="" type="checkbox"/>	Test setup (radiated)	see sub-clause 5.1.1
<input type="checkbox"/>	Test setup (antenna port conducted)	see sub-clause 5.1.2

5.3.2 Test method (Band edge – unrestricted bands)

<input checked="" type="checkbox"/>	20 dBc (Peak)	see 11.11.2 & 11.11.3
<input type="checkbox"/>	30 dBc (Average)	see 11.11.2 & 11.11.3

5.3.3 Test results (Band edge – unrestricted bands)

No emissions found, no tests were done at the unrestricted band edge

5.3.4 Test setup (Band edge – restricted bands)

<input checked="" type="checkbox"/>	Test setup (radiated)	see sub-clause 5.1.1
<input type="checkbox"/>	Test setup (antenna port conducted)	see sub-clause 5.1.2

5.3.5 Test method (Band edge – restricted bands)

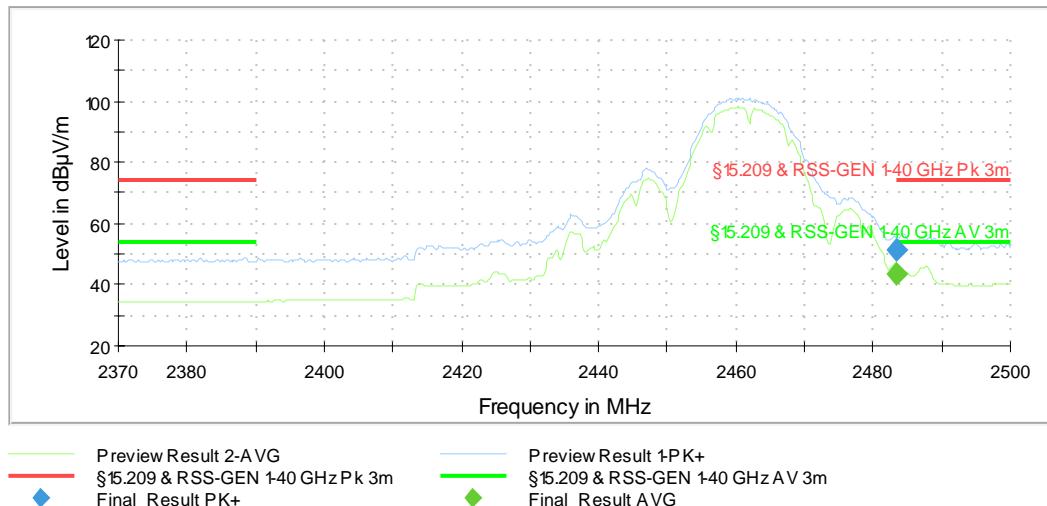
<input checked="" type="checkbox"/>	Standard method	see: 11.13.1 of ANSI C63.10 8.7.1. a) of KDB 508074
<input type="checkbox"/>	Marker-delta method	see: 11.13.2 of ANSI C63.10 8.7.2. a) of KDB 508074
<input type="checkbox"/>	Integration method	see: 11.13.3 of ANSI C63.10 8.7.3. a) of KDB 508074

5.3.6 Test results (Band edge – restricted bands)

Ambient temperature	22 °C
Relative humidity	30 %

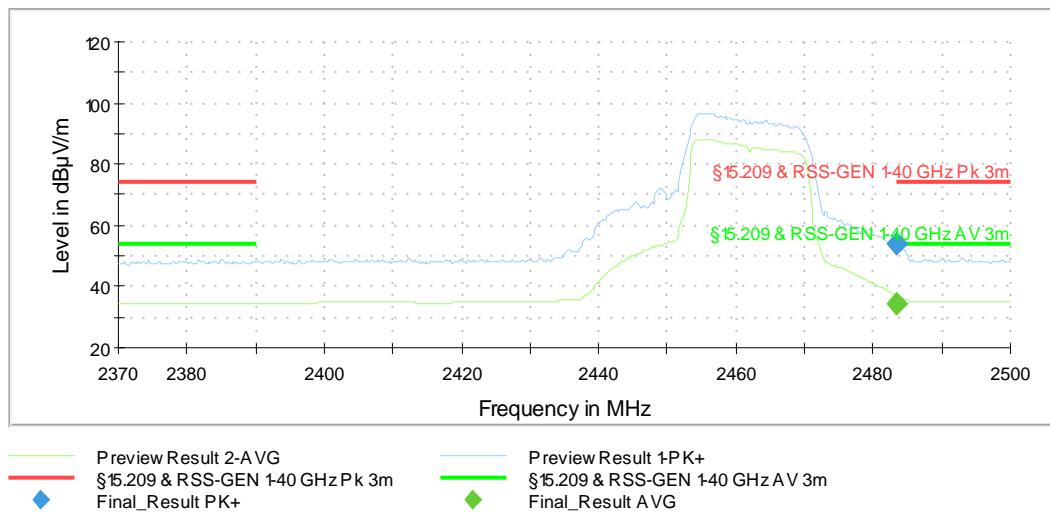
Date	23.03.2021
Tested by	B. ROHDE

Operation mode 3:



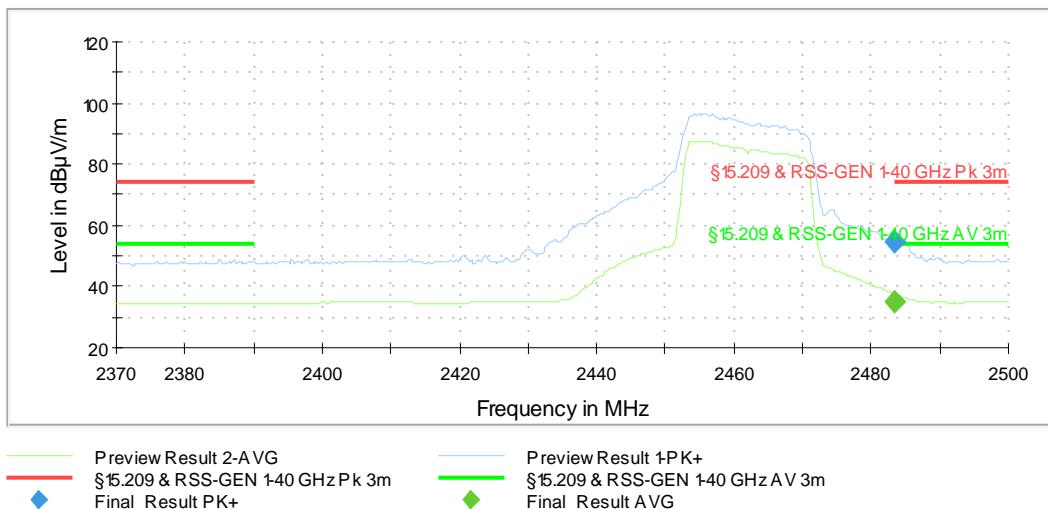
Frequency [MHz]	Result (Pk) [dBμV/m]	Result (Av) [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Readings [dBμV]	Correction [dB]	Elevation [deg]	Azimuth [deg]	Pol.	Result
2483.500000	51.5	---	74	22.5	10.2	33.6	90	219	H	Passed
2483.500000	---	43.8	54	10.2	17.9	33.6	90	219	H	Passed
Measurement uncertainty						±5.1 dB				

Operation mode 4:



Frequency [MHz]	Result (Pk) [dBµV/m]	Result (Av) [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Readings [dBµV]	Correction [dB]	Elevation [deg]	Azimuth [deg]	Pol.	Result
2483.500000	53.9	---	74	20.1	20.3	33.6	90	218	H	Passed
2483.500000	---	34.7	54	19.3	1.1	33.6	90	218	H	Passed
Measurement uncertainty					±5.1 dB					

Operation mode 5:



Frequency [MHz]	Result (Pk) [dB μ V/m]	Result (Av) [dB μ V/m]	Limit [dB μ V/m]	Margin [dB]	Readings [dB μ V]	Correction [dB]	Elevation [deg]	Azimuth [deg]	Pol.	Result
2483.500000	54.3	---	74	19.7	20.7	33.6	90	219	H	Passed
2483.500000	---	35.1	54	18.9	1.5	33.6	90	219	H	Passed
Measurement uncertainty					±5.1 dB					

Test equipment (please refer to chapter 6 for details)
1, 7 - 8, 10 - 16

5.4 Maximum unwanted emissions

5.4.1 Test setup (Maximum unwanted emissions)

- Test setup (radiated) see sub-clause 5.1.1
- Test setup (antenna port conducted) see sub-clause 5.1.2

5.4.2 Test method (Maximum unwanted emissions)

- Test method (radiated) see sub-clause 5.1.1 as described herein

5.4.3 Test results (Maximum unwanted emissions)

5.4.3.1 Test results (9 kHz – 30 MHz)

Not tested, because no relevant emission in the original report.

5.4.3.2 Test results (30 MHz – 1 GHz)

Not tested, because no relevant emission in the original report.

5.4.3.3 Test results (above 1 GHz)

Ambient temperature	22 °C
Relative humidity	29 %

Date	23.03.2021
Tested by	B. ROHDE

Position of EUT: For tests for f between 1 GHz and the 10th harmonic, the EUT was set-up on a positioning device at a height of 150 cm. The distance between EUT and antenna was 3 m.

Cable guide: For detail information of test set-up and the cable guide refer to the pictures in the annex A in the test report.

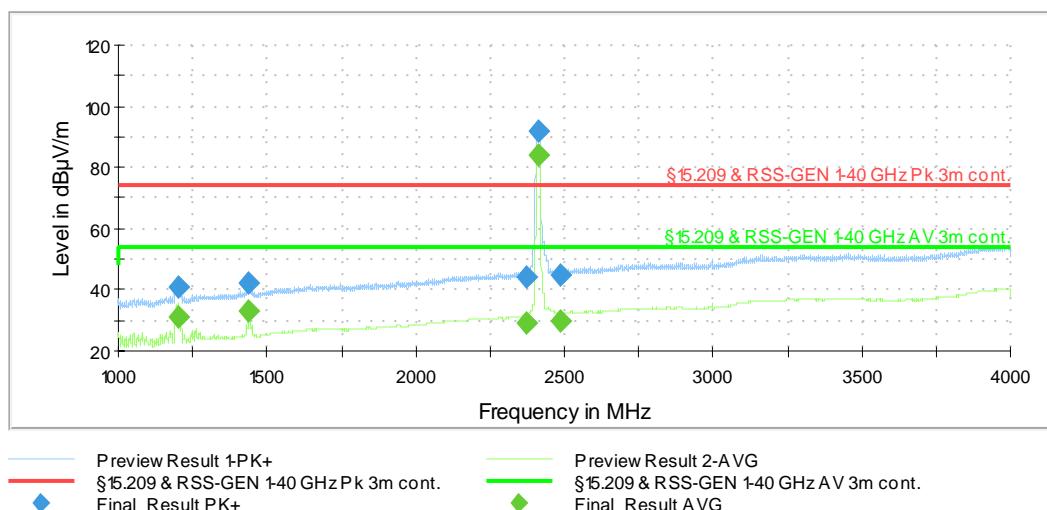
Test record: Plots for each frequency range are submitted below.

Remark: -

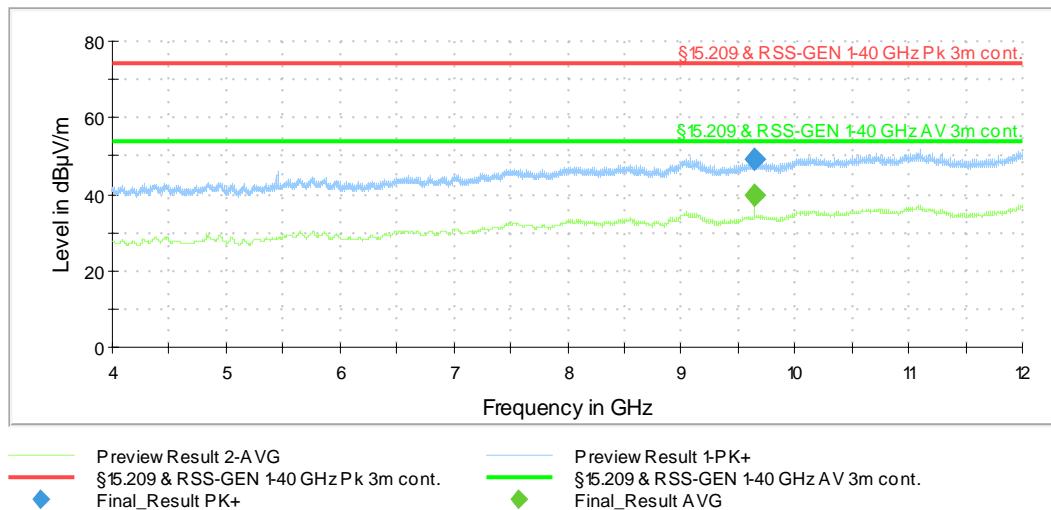
5.4.3.3.1 Plots

5.4.3.3.1.1 (operation mode 1):

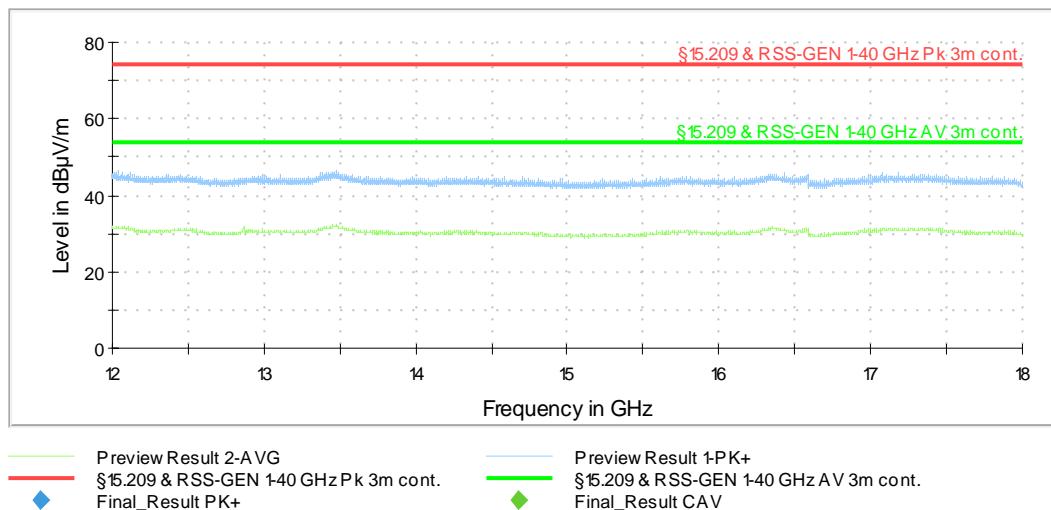
Spurious emissions from 1 GHz to 4 GHz (operation mode 1):



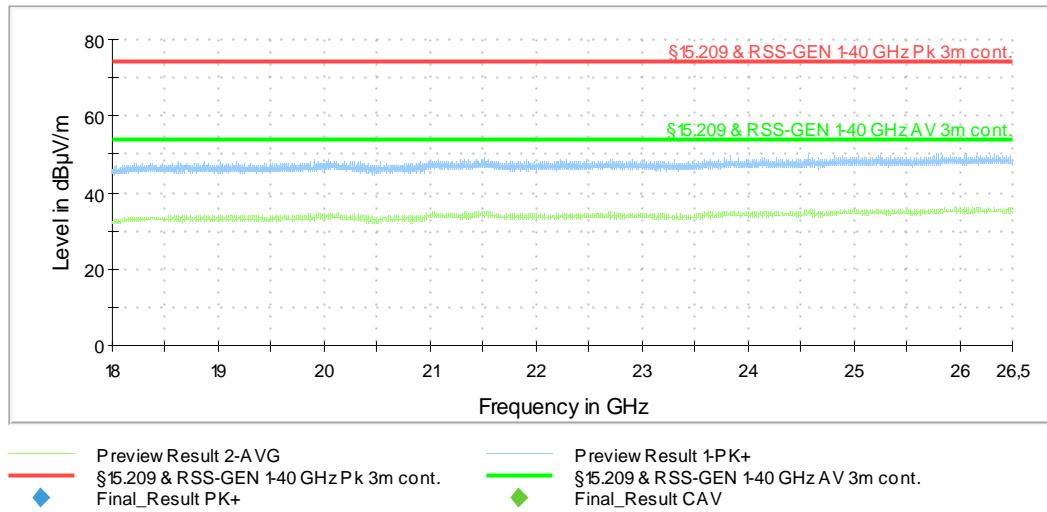
Spurious emissions from 4 GHz to 12 GHz:



Spurious emissions from 12 GHz to 18 GHz:

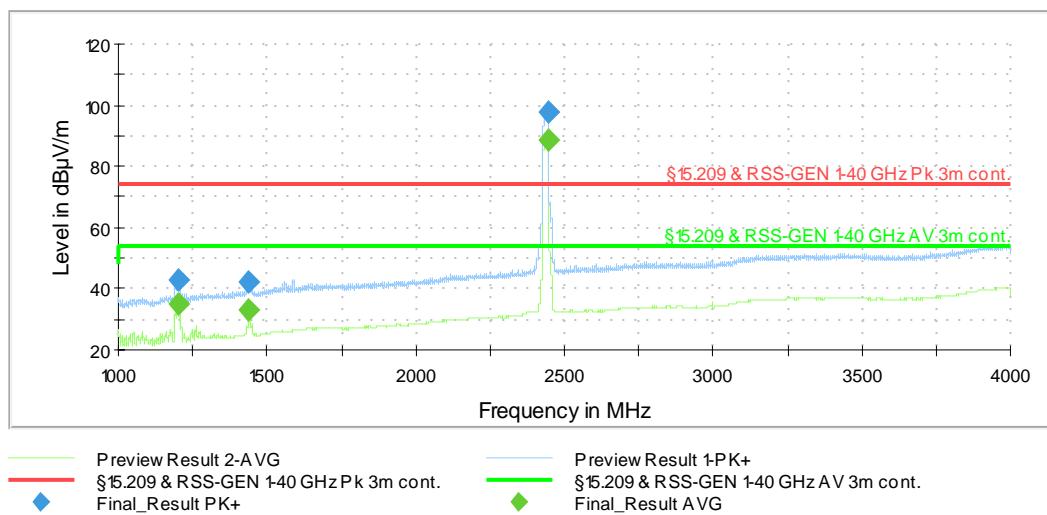


Spurious emissions from 18 GHz to 26.5 GHz:

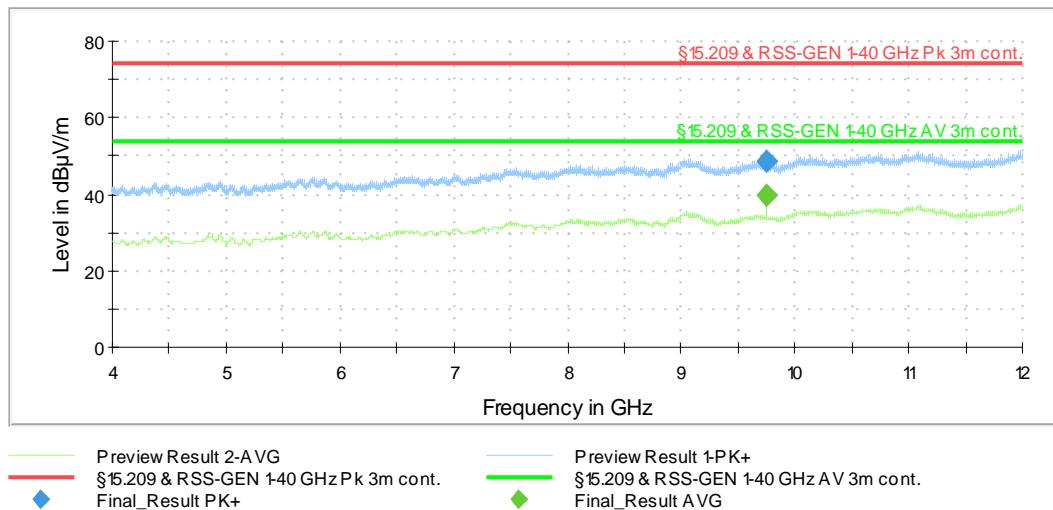


5.4.3.3.1.2 (operation mode 2):

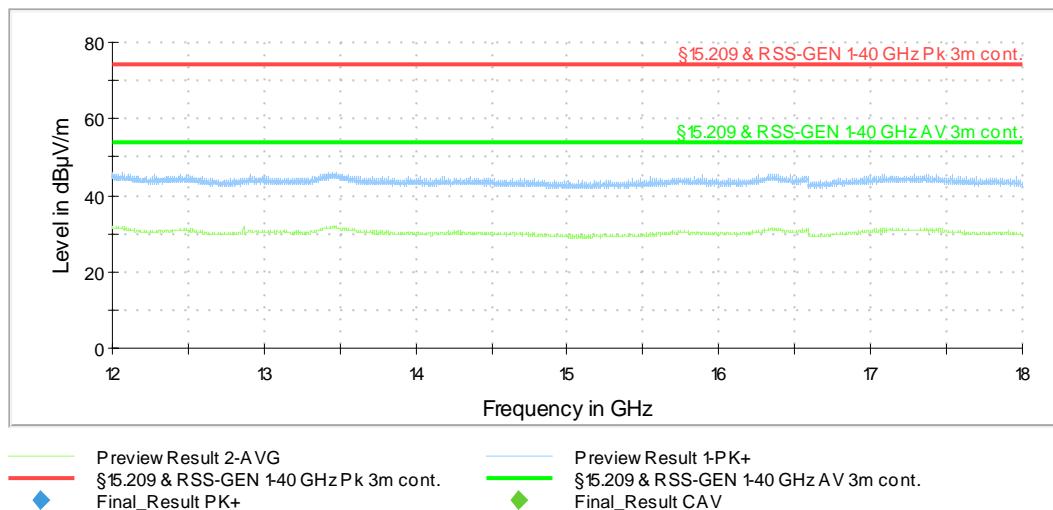
Spurious emissions from 1 GHz to 4 GHz:



Spurious emissions from 4 GHz to 12 GHz:

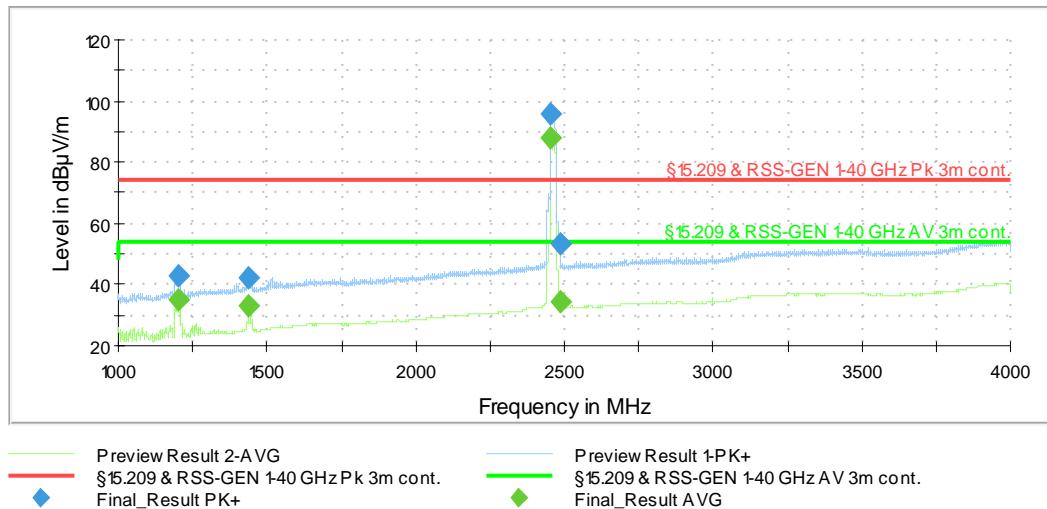


Spurious emissions from 12 GHz to 18 GHz:

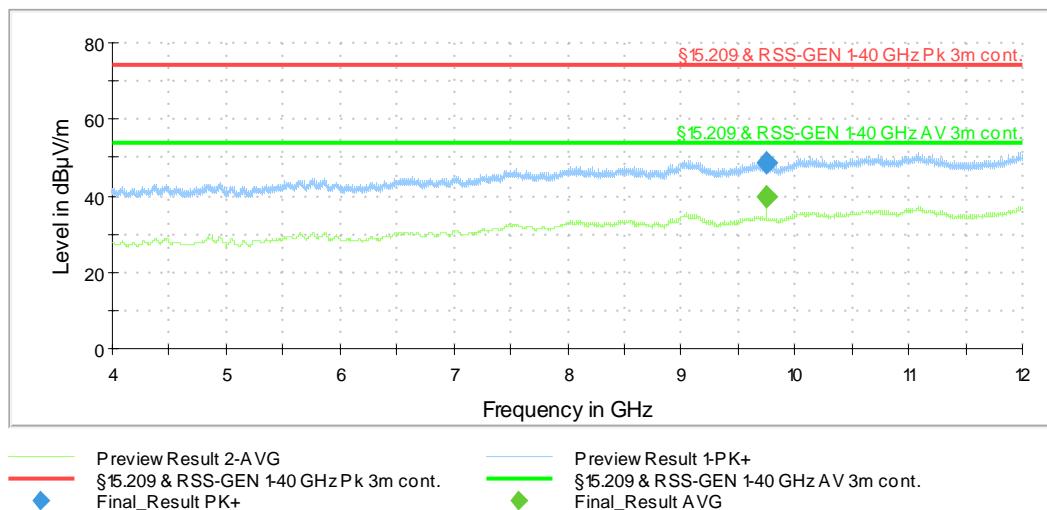


5.4.3.3.1.3 (operation mode 3):

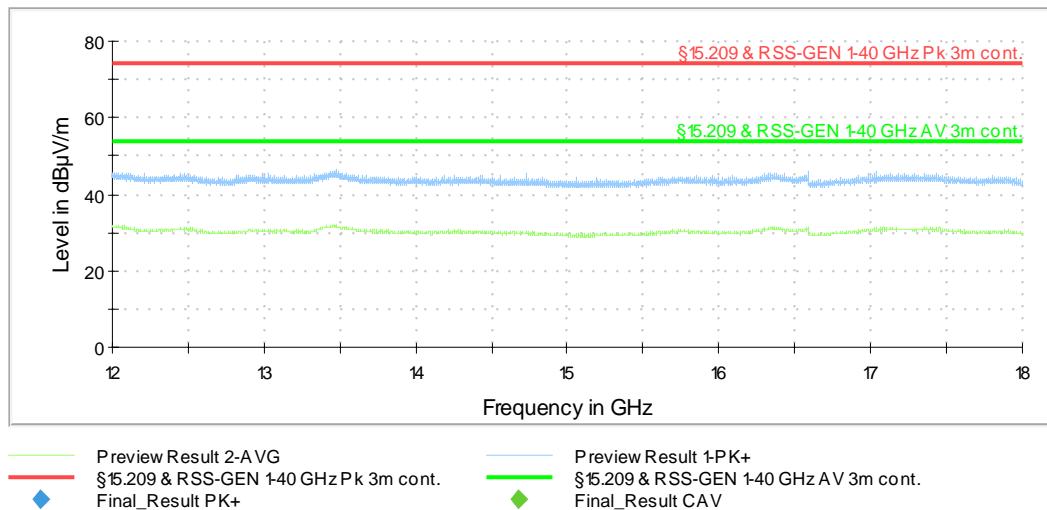
Spurious emissions from 1 GHz to 4 GHz:



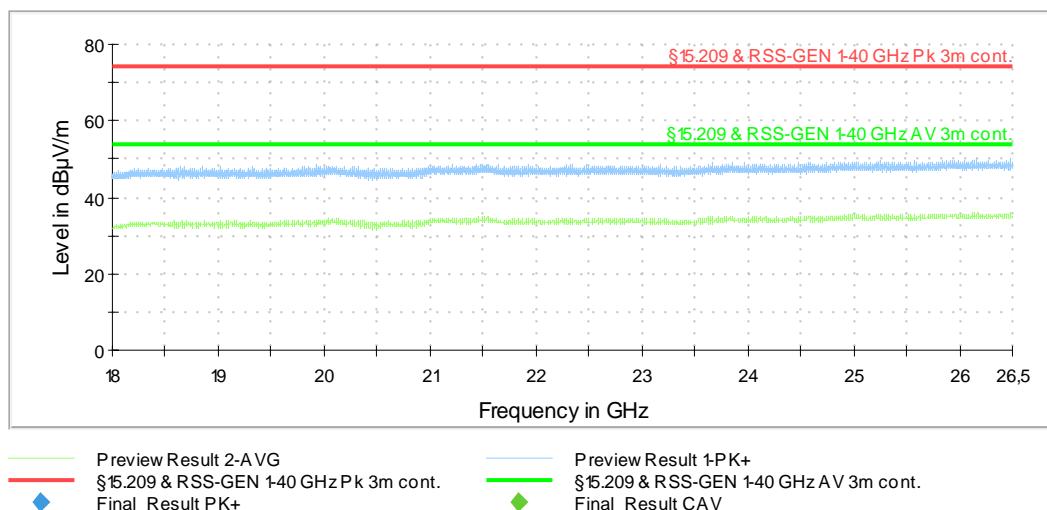
Spurious emissions from 4 GHz to 12 GHz:



Spurious emissions from 12 GHz to 18 GHz:



Spurious emissions from 18 GHz to 26.5 GHz:



5.4.3.3.2 Result tables

5.4.3.3.2.1 (operation mode 1):

Frequency [MHz]	MaxPeak [dB μ V/m]	Average [dB μ V/m]	Limit [dB μ V/m]	Margin (dB)	Corr. (dB/m)	Elevation (deg)	Azimuth (deg)	Pol	Result
1199.500000	40.7	---	74	33.3	26.2	60	230	H	Passed
1199.500000	---	31.1	54	22.9	26.2	60	230	H	Passed
1440.000000	42.3	---	74	31.7	28.0	60	166	H	Passed
1440.000000	---	32.9	54	21.1	28.0	60	166	H	Passed
2370.000000	43.9	---	74	30.1	33.2	150	24	H	Passed
2370.000000	---	29.2	54	24.8	33.2	150	24	H	Passed
2412.750000	---	83.9	Fund.	-	33.6	150	131	H	Fund.
2412.750000	92.1	---	Fund.	-	33.6	150	131	H	Fund.
2483.500000	45.1	---	74	28.9	33.6	120	196	H	Passed
2483.500000	---	30.0	54	24.0	33.6	120	196	H	Passed
9648.000000	---	40.0	54	14.0	7.2	120	253	V	Passed
9648.000000	49.2	---	74	24.8	7.2	120	253	V	Passed
Measurement uncertainty			+/- 5.4 dB						

5.4.3.3.2.2 (operation mode 2):

Frequency [MHz]	MaxPeak [dB μ V/m]	Average [dB μ V/m]	Limit [dB μ V/m]	Margin (dB)	Corr. (dB/m)	Elevation (deg)	Azimuth (deg)	Pol	Result
1200.000000	42.9	---	74	31.1	26.2	60	226	H	Passed
1200.000000	---	34.8	54	19.2	26.2	60	226	H	Passed
1440.000000	42.4	---	74	31.6	28.0	60	166	H	Passed
1440.000000	---	32.9	54	21.1	28.0	60	166	H	Passed
2444.000000	---	88.9	Fund.	-	33.8	90	220	H	Fund.
2444.000000	97.6	---	Fund.	-	33.8	90	220	H	Fund.
9748.000000	---	39.5	54	14.5	6.9	120	250	V	Passed
9748.000000	48.7	---	74	25.3	6.9	120	250	V	Passed
Measurement uncertainty			+/- 5.4 dB						

5.4.3.3.2.3 (operation mode 3):

Frequency [MHz]	MaxPeak [dB μ V/m]	Average [dB μ V/m]	Limit [dB μ V/m]	Margin (dB)	Corr. (dB/m)	Elevation (deg)	Azimuth (deg)	Pol	Result
1200.000000	42.6	---	74	31.4	26.2	60	226	H	Passed
1200.000000	---	34.8	54	19.2	26.2	60	226	H	Passed
1440.000000	42.1	---	74	31.9	28.0	60	167	H	Passed
1440.000000	---	32.9	54	21.1	28.0	60	167	H	Passed
2454.500000	---	88.1	Fund.	-	33.9	90	220	H	Fund.
2454.500000	96.1	---	Fund.	-	33.9	90	220	H	Fund.
2483.500000	---	34.5	54	19.5	33.6	90	220	H	Passed
2483.500000	53.4	---	74	20.6	33.6	90	220	H	Passed
9848.000000	---	39.5	54	14.5	6.6	120	267	V	Passed
9848.000000	47.6	---	74	26.4	6.6	120	267	V	Passed
Measurement uncertainty				+/- 5.4 dB					

Test equipment (please refer to chapter 6 for details)

1 - 17

6 Test Equipment used for Tests

No.	Test equipment	Type	Manufacturer	Serial No.	PM. No.	Cal. Date	Cal Due
1	Antenna (Log.Per.)	HL050	Rohde & Schwarz	100438	481170	Calibration not necessary	
2	Standard gain horn antenna	18240-20	Flann Microwave	483	480294	Calibration not necessary	
3	Preamplifier 12 GHz - 18 GHz	JS3-12001800-16-5A	MITEQ Hauppauge N.Y.	571667	480343	13.02.2020	02.2022
4	Standard gain horn antenna	20240-20	Flann Microwave	411	480297	Calibration not necessary	
5	Preamplifier 18 GHz - 26 GHz	JS4-18002600-20-5A	MITEQ Hauppauge N.Y.	658697	480342	13.02.2020	02.2022
6	High-pass Filter	WHD2.8/18G-10SS	Wainwright Instruments GmbH	1	480867	Calibration not necessary	
7	RF-cable No.38	Sucoflex 106B	Suhner	0709/6B / Kabel 38	481328	Calibration not necessary	
8	HF-Cable	Sucoflex 104	Huber+Suhner	517402	482392	Calibration not necessary	
9	Microwave cable 2m	Insulated Wire Inc.	Insulated Wire	KPS-1533-800-KPS	480302	Calibration not necessary	
10	Fully anechoic chamber M20	B83117-E2439-T232	Albatross Projects	103	480303	Calibration not necessary	
11	Turntable	DS420 HE	Deisel	420/620/00	480315	Calibration not necessary	
12	Antenna support	AS620P	Deisel	620/375	480325	Calibration not necessary	
13	Multiple Control Unit	MCU	Maturo GmbH	MCU/043/97110 7	480832	Calibration not necessary	
14	Positioners	TDF 1.5- 10Kg	Maturo	15920215	482034	Calibration not necessary	
15	EMI Receiver / Spectrum Analyser	ESW44	Rohde & Schwarz	101635	482467	18.02.2020	02.2022
16	Test software	EMC32	Rohde & Schwarz		483261	Calibration not necessary	
17	Preamplifier 100 MHz - 16 GHz	AFS6-00101600-23-10P-6-R	Narda MITEQ	2011215	482333	13.02.2020	02.2022

7 Test site Validation

Test equipment	PM. No.	Frequency range	Type of validation	According to	Val. Date	Val Due
Fully anechoic chamber M20	480303	1 -18 GHz	SVSWR	CISPR 16-1-4 + Cor1:2010 + A1:2012 +A2:2017	24.08.2020	23.08.2022

8 Report History

Report Number	Date	Comment
F210098E2	26.08.2021	Initial Test Report
-	-	-
-	-	-

9 List of Annexes

Annex A	Test Setup Photos	5 pages
Annex B	External Photos	3 pages
Annex C	Internal Photos	2 pages