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Test Report

Report Number:

F182223E2 2nd Version

Equipment under Test (EUT):

LBEE5HY1MW
Wi-Fi Communication Module

Applicant:

Xaptum, Inc.

Manufacturer:

Xaptum, Inc.

ilac-MRA
DAkkS 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] **RSS-247 Issue 2 (February 2017),** Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

[4] **RSS-Gen Issue 5 (March 2019)**, General Requirements for Compliance of Radio Apparatus

[5] **GUIDELINES FOR COMPLIANCE TESTING OF UNLICENSED NATIONAL INFORMATION INFRASTRUCTURE (U-NII) DEVICES PART 15, SUBPART E (December 2017)**, KDB 789033 D02 General U-NII test Procedures New Rules v02r01

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		16.12.2020
	Name	Signature	Date
Authorized reviewer:	Paul NEUFELD		16.12.2020
	Name	Signature	Date

This test report is only valid in its original form.

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1 Identification

1.1 Applicant

Name:	Xaptum, Inc.
Address:	541 N Fairbanks Ct Suite 2200 Chicago, IL 60611
Country:	USA
Name for contact purposes:	David Bild
Phone:	+1-505-818-7889
eMail Address:	david.bild@xaptum.com
Applicant represented during the test by the following person:	none

1.2 Manufacturer

Name:	Xaptum, Inc.
Address:	541 N Fairbanks Ct Suite 2200 Chicago, IL 60611
Country:	USA
Name for contact purposes:	David Bild
Phone:	+1-505-818-7889
eMail Address:	david.bild@xaptum.com
Applicant represented during the test by the following person:	none

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-17186-01-02 and D-PL-17186-01-05, FCC Test Firm Designation Number DE0004, FCC Test Firm Registration Number 469623, CAB Identifier DE0003 and ISED# 3469A.

1.4 EUT (Equipment Under Test)

EUT	
Test object: *	Stand-alone radio module
PMN / Model name: *	LBEE5HY1MW
FCC ID: *	2AQPLLBEE5HY1MW
ISED Certification number: * IC: *	24569-LBEE5HY1MW
HVIN: *	LBEE5HY1MW
HMN: *	n/a
FVIN: *	No information provided by the applicant
Serial number: *	n/a
PCB identifier: *	n/a
Hardware version: *	n/a
Software version: *	n/a

* Declared by the applicant

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

IEEE 802.11 a/ac/n20 frequencies (20 MHz channels)				
Channel 36	RX:	5180 MHz	TX:	5180 MHz
Channel 40	RX:	5200 MHz	TX:	5200 MHz
Channel 44	RX:	5220 MHz	TX:	5220 MHz
Channel 48	RX:	5240 MHz	TX:	5240 MHz
Channel 149	RX:	5745 MHz	TX:	5745 MHz
Channel 153	RX:	5765 MHz	TX:	5765 MHz
Channel 157	RX:	5785 MHz	TX:	5785 MHz
Channel 161	RX:	5805 MHz	TX:	5805 MHz
Channel 165	RX:	5825 MHz	TX:	5825 MHz

IEEE 802.11 ac40/n40 frequencies (40 MHz channels)				
Channel 38	RX:	5190 MHz	TX:	5190 MHz
Channel 46	RX:	5230 MHz	TX:	5230 MHz
Channel 151	RX:	5755 MHz	TX:	5755 MHz
Channel 159	RX:	5795 MHz	TX:	5795 MHz

Equipment used for testing	
Cables (connected to the EUT):	-USB 2.0 type A <-> USB 2.0 type B micro, ~0.2 m*1 +2 m USB extension* 2 -Laboratory cables for power supply
Fiber optic converter:	Opto USB2.0, MK Messtechnik (PM. No. 482617) *2
Laptop PC:	Fujitsu Lifebook S751 (PM No. 201036) *2
Eval-board:	xaprw001*1

*1 Provided by the applicant
*2 Provided by the laboratory

1.5 Technical Data of Equipment

General radio module						
Antenna type: *	Dipole antenna					
Antenna name: *	RD2458-5, Laird Technologies					
Antenna gain: *	5 dBi (max in the 5 GHz band)					
Antenna connector: *	SMA					
Evaluation board: *	xaprw001					
Power supply EUT: *	DC					
Supply voltage eval board: *	U_{nom} =	5.0 V	U_{min} =	5.0 V	U_{max} =	12.0 V
Supply voltage radio module: *	U_{nom} =	3.3	U_{min} =	1.7 V	U_{max} =	3.6 V
Temperature range: *	-40 °C to +85 °C					
Lowest / highest internal clock frequency: *	32 kHz to 498 MHz / 5825 MHz					

Radio module – radio modes		
IEEE 802.11 a	Type of modulation: *	OFDM
IEEE 802.11 a	Operating frequency range: *	5180 – 5240 MHz, 5745 – 5825 MHz
IEEE 802.11 a	Number of channels: *	9 (20 MHz channel spacing)
IEEE 802.11 n-HT20	Type of modulation: *	OFDM
IEEE 802.11 n-HT20	Operating frequency range: *	5180 – 5240 MHz; 5745 – 5825 MHz
IEEE 802.11 n-HT20	Number of channels: *	9 (20 MHz channel spacing)
IEEE 802.11 n-HT40	Type of modulation: *	OFDM
IEEE 802.11 n-HT40	Operating frequency range: *	5190 – 5230 MHz; 5755 – 5795 MHz
IEEE 802.11 n-HT40	Number of channels: *	4 (40 MHz channel spacing)
IEEE 802.11 ac (20 MHz)	Type of modulation: *	OFDM
IEEE 802.11 ac (20 MHz)	Operating frequency range: *	5180 – 5240 MHz; 5745 – 5825 MHz
IEEE 802.11 ac (20 MHz)	Number of channels: *	9 (20 MHz channel spacing)
IEEE 802.11 ac (40 MHz)	Type of modulation: *	OFDM
IEEE 802.11 ac (40 MHz)	Operating frequency range: *	5190 – 5230 MHz; 5755 – 5795 MHz
IEEE 802.11 ac (40 MHz)	Number of channels: *	4 (40 MHz channel spacing)

1.6 Dates

Date of receipt of test sample:	13.02.2019
Start of test:	13.06.2019
End of test:	03.09.2019

2 Operational States

The EUT is a communication module. The module is capable to use the following technologies:

- Wi-Fi 2.4 GHz (20 MHz)
- Wi-Fi 5 GHz (20/40/80 MHz)
  - UNII-1
  - UNII-2A
  - UNII-2C
  - UNII-3
- Bluetooth
- Bluetooth Low Energy

As declared by the applicant **only the following technologies were used**:

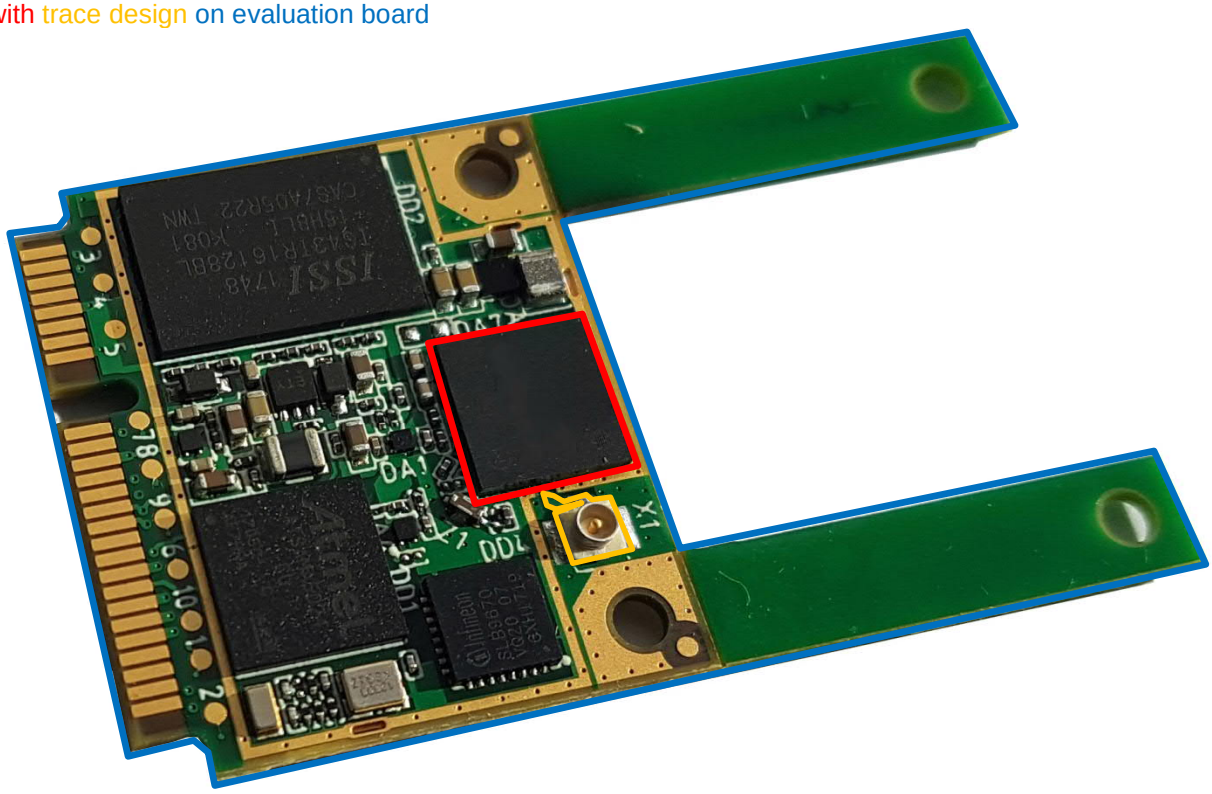
- Wi-Fi 2.4 GHz (20 MHz)
- Wi-Fi 5 GHz (20/40MHz)
  - UNII-1
  - UNII-3

As declared by the applicant the other technologies are deactivated by software.

The 2.4GHz and 5 GHz bands are not used simultaneously.

This test report incorporates only limited test-cases for the Wi-Fi 5 GHz (20/40 MHz).
Purpose of this report is to add a new antenna and trace design to the existing filing.

The EUT (photo provided by the applicant):
EUT with trace design on evaluation board



2.1 The following states were defined as the operating conditions

The EUT was placed on an evaluation board, the evaluation board and the EUT were powered with 3.3 V DC via laboratory power supply and the data connection was established via USB.

The USB data connection was converted to a fiber connection for remote control during the radiated tests.

2.1.1 Radio tests

For the radio tests the following settings were used:

A connection to the EUT was established via USB cable.
The USB connection was converted to a serial connection on the EUT.
The following COM port settings were used with “tera term”.
Baud rate: 115200
Data: 8 bit
Parity: None
Stop: 1 bit
Flow control: None

The EUT was set in a test-mode, the radio parameter was set with a Linux shell script (wifi_testmode.sh).

2.1.2 Operation Modes/Power settings

Worst cases (highest power / minimum margin to the limit / band edge) according to test report: 1802WSU008-U4 by MRT Technology (Suzhou) Co., Ltd, FCC ID: VPYLBEE5HY1MW.

Operation mode #	Radio technology	Frequency [MHz]	Channel	Modulation / Mode	Data rate	Power setting
1	WLAN	5180	36	a-mode	6 Mbit/s	40
2	WLAN	5240	48	a-mode	6 Mbit/s	60
3	WLAN	5745	149	a-mode	6 Mbit/s	48
4	WLAN	5785	157	a-mode	6 Mbit/s	60
5	WLAN	5825	165	a-mode	6 Mbit/s	48

3 Additional Information

This test report incorporates the limited tests with a further antenna (RD2458-5, Laird Technologies). It contains just limited test cases with the goal to add a new antenna to an existing filing.

The complete radio tests for 5 GHz Wi-Fi are documented in test report:
1802WSU008-U4 by MRT Technology (Suzhou) Co., Ltd, FCC ID: VPYLBEE5HY1MW.

4 Overview

Application	Frequency range [MHz]	FCC 47 CFR Part 15 section [2]	RSS-247 [3] or RSS-Gen, Issue 5 [4]	Status	Refer page
Maximum Output Power	5150 – 5250 5725 - 5850	15.407 (a)	6.2.1 (1)[3] 6.2.4 (1)[3]	Verified*	13 et seq
UNII Bandwidth	5150 – 5250 5725 - 5850	15.403 (i)	- 6.2.4 (1) [3]	not tested	---
Peak Power Spectral Density	5150 – 5250 5725 - 5850	15.407 (a)(5)	6.2.1 (1)[3] 6.2.4 (1)[3]	not tested	---
Frequency Stability	5150 – 5250	15.407 (g)	-	not tested	---
Band edge compliance	5150 – 5250 5725 - 5850	15.407 (b)	6.2.1 (2)[3] 6.2.4 (2)[3]	Passed	18 et seq.
Radiated emissions (transmitter)	1.000 - 40,000	15.407 (b) 15.205 (a) 15.209 (a)	8.9 [4], 6.2.1 (2)[3] 6.2.2 (2)[3] 6.2.3 (2)[3] 6.2.4 (2)[3]	Passed	18 et seq.
Conducted emissions on supply line	0.15 - 30	15.207 (a)	8.8 [4]	not tested	---

* Verification done conducted, result lies within the measurement uncertainty compared to the original report.

5 Results

5.1 Duty cycle

5.1.1 Method of measurement

The measurement was performed as a radiated measurement as described in 5.4.1.

Acceptable measurement configurations

The measurement procedures described herein are based on the use of radiated measurements.

The method described in chapter 12.2 b) 2) of document [1] was used to perform the following test.

The measurement was only performed on only one frequency, because the timing behavior was found to be independent of the selected channel.

The following measurement technique was used:

The zero-span mode on a spectrum analyzer or EMI receiver, if the response time and spacing between bins on the sweep are enough to permit accurate measurements of the ON and OFF times of the transmitted signal.

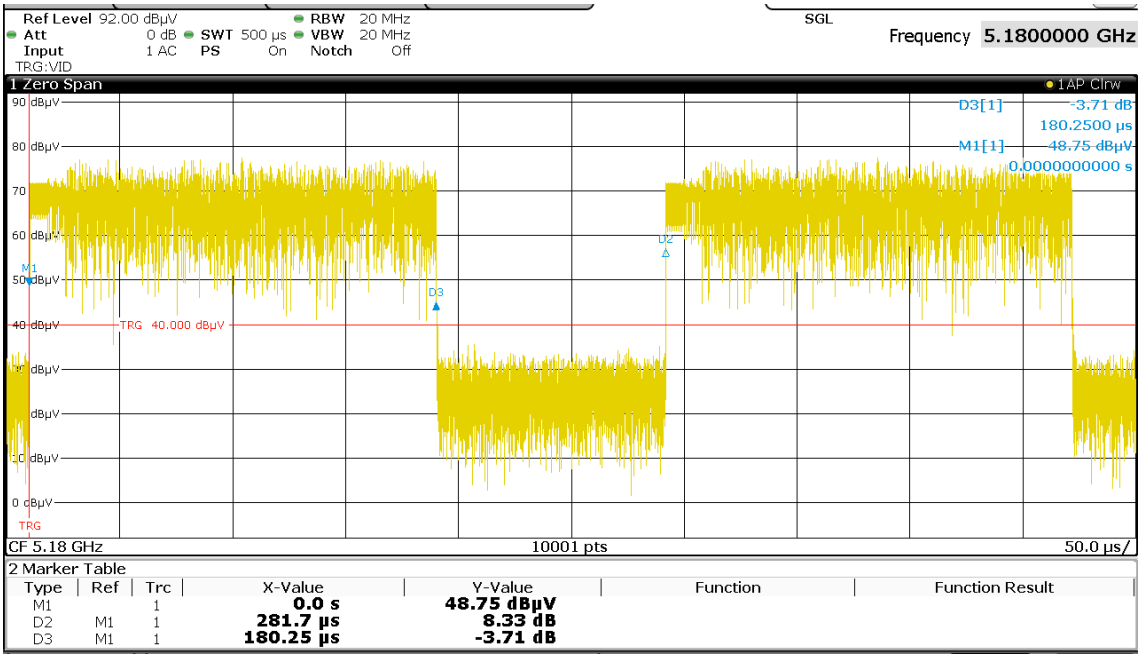
- Set the center frequency of the instrument to the center frequency of the transmission.
- Set RBW ≥ OBW if possible; otherwise, set RBW to the largest available value.
- Set VBW ≥ RBW.
- Set detector = peak or average.
- The zero-span measurement method shall not be used unless both RBW and VBW are > 50/T and the number of sweep points across duration T exceeds 100. (For example, if VBW and/or RBW are limited to 3 MHz, then the zero-span method of measuring duty cycle shall not be used if T ≤ 16.7 microseconds.)

5.1.2 Test results

Ambient temperature	22 °C
Relative humidity	40 %

Date	03.09.2019
Tested by	B. ROHDE

The plot below shows the duty cycle measurement for the worst documented case (802.11a 6 Mbps).



Operation mode	TX_on [µs]	TX_ges [µs]	RBW [MHz]	50/T [kHz]	50/T < RBW?
IEEE 802.11a	180	282	20	278	Yes

Operation mode	Sweep points	Sweep time [µs]	Meas points	Meas points >100?	Duty cycle %	DCCF [dB]
IEEE 802.11a	10001	500	5641	Yes	64	1.95

The DCCF (duty cycle correction factor) is calculated by:

$$DCCF = 10 * log_{10}\left(\frac{1}{Duty\ cycle}\right)$$

Therefore, for average measurements a correction factor of 1.95 dB is used for all tests in test modes.

Test equipment (please refer to chapter 6 for details)
1 - 2, 12 - 18

5.2 Maximum conducted output power

The Maximum Peak output power was verified (method II. E. 3. B of document [5] was used) and compared with the results from the original filing.
The results are like the original results within the measurement uncertainty.
For detailed results see test-reports 1802WSU008-U4 by MRT Technology (Suzhou) Co., Ltd,
FCC ID VPYLBEE5HY1MW.

5.3 Band-edge compliance

5.3.1 Method of measurement (band edges next to restricted bands (radiated))

For the measurement, the EUT was measured radiated in the anechoic chamber using the procedures described in 5.4.1.

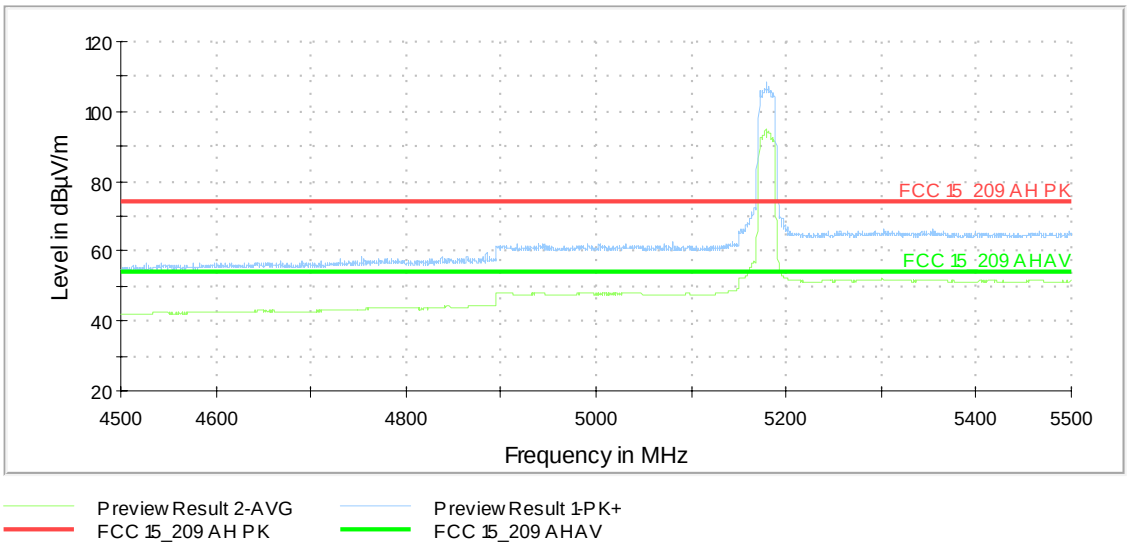
The relating measurements were carried out radiated. The measurement procedure refers to part II. G. 3.d) of document [5].

5.3.1.1 Test results (radiated)

Ambient temperature	22 °C
Relative humidity	42 %

Date	26.07.2019
Tested by	B. ROHDE

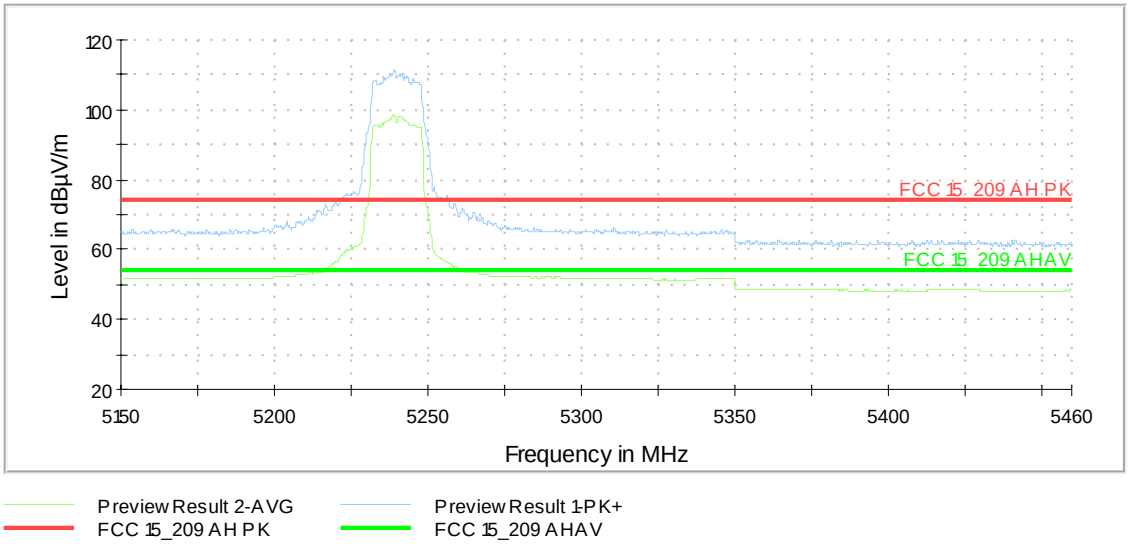
Operation mode 1



The variation of the peak and average amplitude @ 4.950 GHz is caused by the measuring system (preselect or); the variation @ 5.150 GHz is caused by an increased internal attenuation of the measuring receiver to prevent the equipment from overloading.

Lower band edge (U-NII-1)									
Operation mode 1			A duty cycle correction factor of 1.95 was applied to the Average reading						
Frequency	Max Peak	Average	Limit	Margin	Pol	Azimuth	Elevation	Correction	Result
[MHz]	[dBµV/m]	[dBµV/m]	[dBµV/m]	dB		[°]	[°]	[dB/m]	
5149.5	55.6	---	74	18.4	V	228	30	41.3	Passed
5149.5	---	44.4	54	9.6	V	228	30	43.3	Passed
5149.75	58.8	---	74	15.2	V	324	0	41.3	Passed
5149.75	---	46.1	54	7.9	V	324	0	43.3	Passed
Measurement uncertainty			+2.2 dB / -3.6 dB						

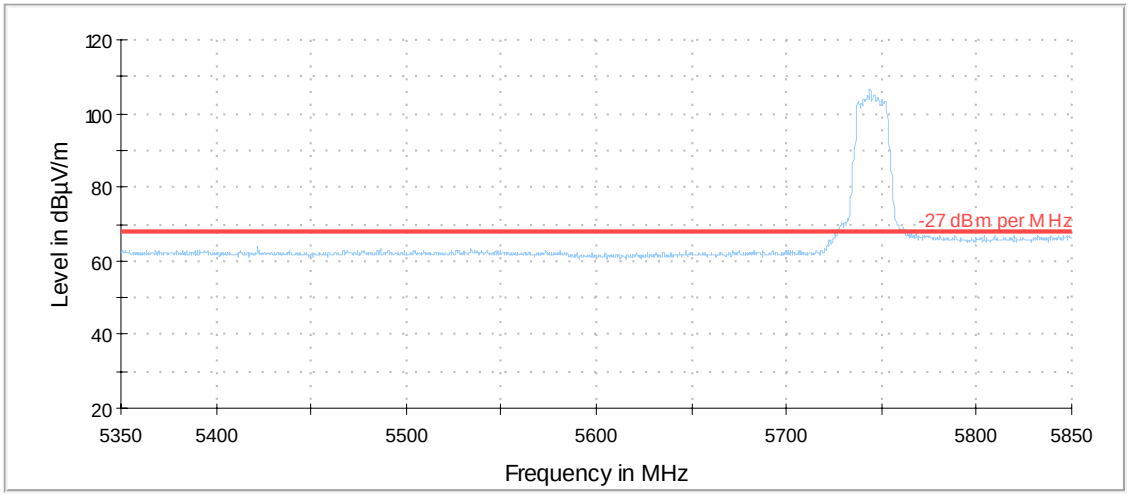
Operation mode 2



The variation of the peak and average amplitude @ 5.350 GHz is caused by an increased internal attenuation of the measuring receiver to prevent the equipment from overloading.

Upper band edge (U-NII-1)									
Operation mode 2			A duty cycle correction factor of 1.95 was applied to the Average reading						
Frequency	Max Peak	Average	Limit	Margin	Pol	Azimuth	Elevation	Correction	Result
[MHz]	[dBµV/m]	[dBµV/m]	[dBµV/m]	dB		[°]	[°]	[dB/m]	
5350.00	55.9	---	74	18.1	V	278	0	41.7	Passed
5149.75	---	45.5	54	8.5	V	278	0	43.7	Passed
Measurement uncertainty			+2.2 dB / -3.6 dB						

Operation mode 3



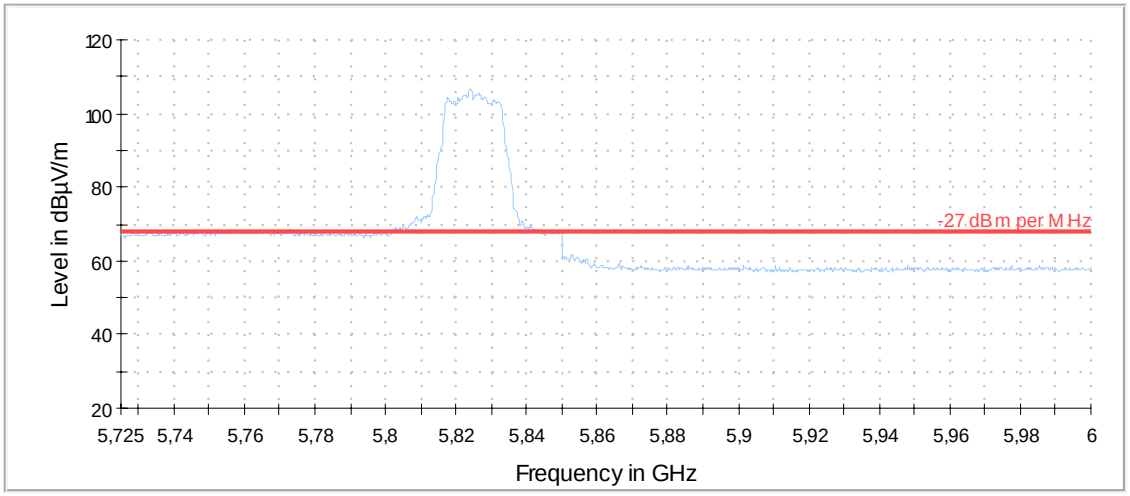
For comparison reasons the limit was converted to a field strength limit line

Lower band edge (U-NII-3)									
Frequency	Field strength @ 3m	Peak Emission	Limit	Margin	Pol	Azimuth	Elevation	Correction	Result
[MHz]	[dBµV/m]	[dBm]	[dBm / MHz]	dB		[°]	[°]	[dB]	
5725.00	63.8	-31.4	-27	4.4	V	359	0	95.2	Passed
Measurement uncertainty				+2.2 dB / -3.6 dB					

A field strength was measured and converted to an EIRP[dBm] with guidance of formula:

EIRP[dBm] = E[dBµV/m] - 95.2 (for 3 m measuring distance) according to II.G. 2.d) (iii) of document [5].

Operation mode 4



The variation of the peak and average amplitude @ 5.850 GHz is caused by an increased internal attenuation of the measuring receiver to prevent the equipment from overloading.

For comparison reasons the limit was converted to a field strength limit line.

Lower band edge (U-NII-3)									
Frequency	Field strength @ 3m	Peak Emission	Limit	Margin	Pol	Azimuth	Elevation	Correction	Result
[MHz]	[dBµV/m]	[dBm]	[dBm / MHz]	dB		[°]	[°]	[dB]	
5850.00	59.0	-36.2	-27	9.2	V	4	0	95.2	Passed
Measurement uncertainty				+2.2 dB / -3.6 dB					

A field strength was measured and converted to an EIRP[dBm] with guidance of formula:

EIRP[dBm] = E[dBµV/m] - 95.2 (for 3 m measuring distance) according to II.G. 2.d) (iii) of document [5].

Test equipment (please refer to chapter 6 for details)
1 - 2, 9, 10, 12 - 18

5.4 Maximum unwanted emissions

5.4.1 Method of measurement (radiated emissions)

Preliminary and final measurement (1 GHz to 40 GHz)

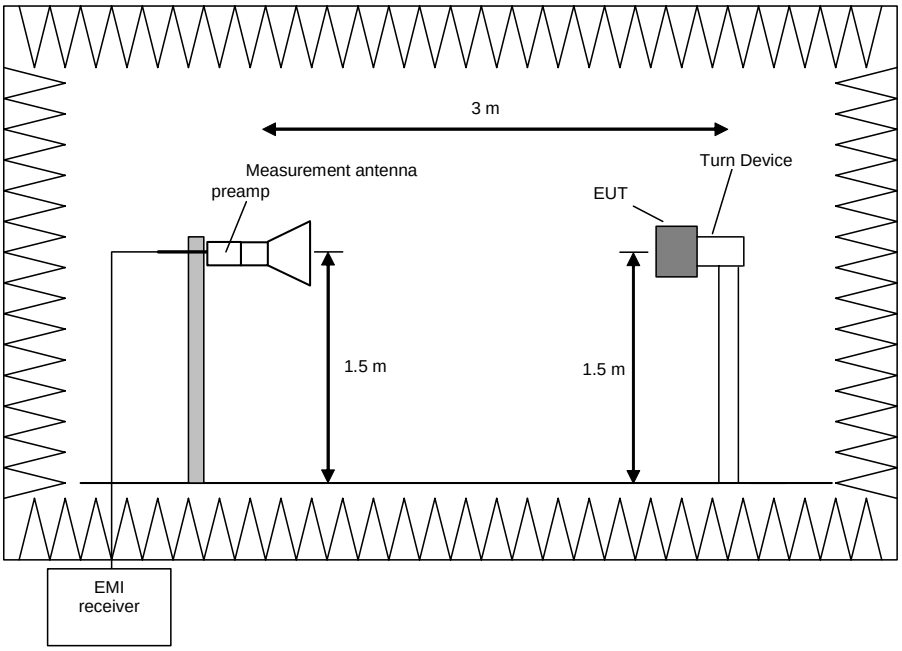
This measurement will be performed in a fully anechoic chamber. Table top devices will set up on a non-conducting turn device on the height of 1.5m. The set-up of the Equipment under test will be in accordance to [1].

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 analyzer set to MAX Hold mode and a resolution bandwidth of 100 kHz. The measurement will be performed in horizontal and vertical polarization 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:

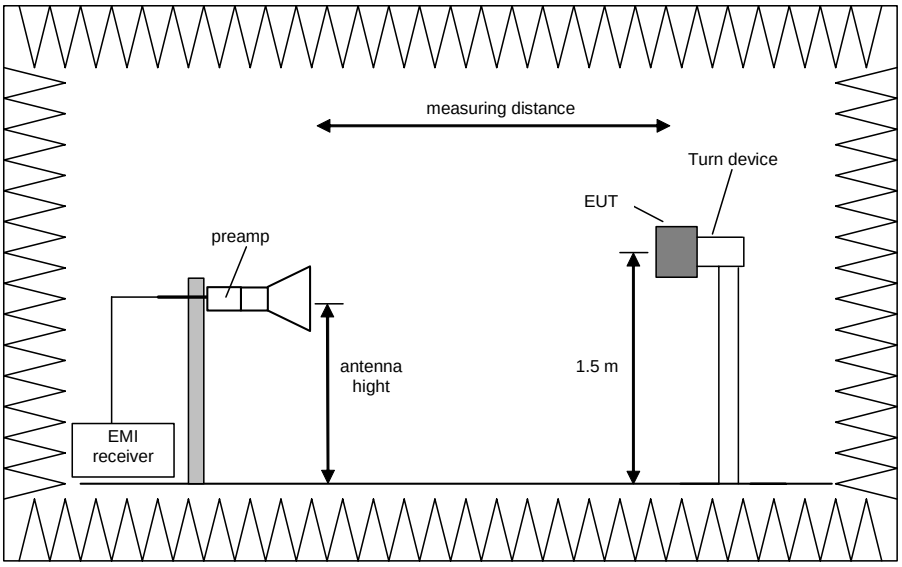
1. Monitor the frequency range at horizontal polarization and a EUT azimuth of 0 °.
2. Rotate the EUT by 360° to maximize the detected signals.
3. Repeat 1) to 2) with the vertical polarization of the measuring antenna.
4. Make a hardcopy of the spectrum.
5. Repeat 1) to 4) with the EUT raised by an 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 polarization, 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 horn 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 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 polarization to the orientation with the highest emission for the first frequency identified in the preliminary measurements.
3) Set the spectrum analyzer to EMI mode with peak and average detector activated.
4) Rotate the turntable from 0° to 360° to find the EUT angle 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.

5.4.2 Test results (radiated emissions)

5.4.2.1 Preliminary radiated emission measurement

5.4.2.1.1 Preliminary measurement (1 GHz to 26.5 GHz):

Ambient temperature	21° C	Date	13.06.2019 03.09.2019 26.07.2019
Relative humidity	29%	Tested by	B. ROHDE

Position of EUT: The EUT was set-up on an EUT turn device of a height of 1.5 m. The distance between EUT and antenna was 3 m.

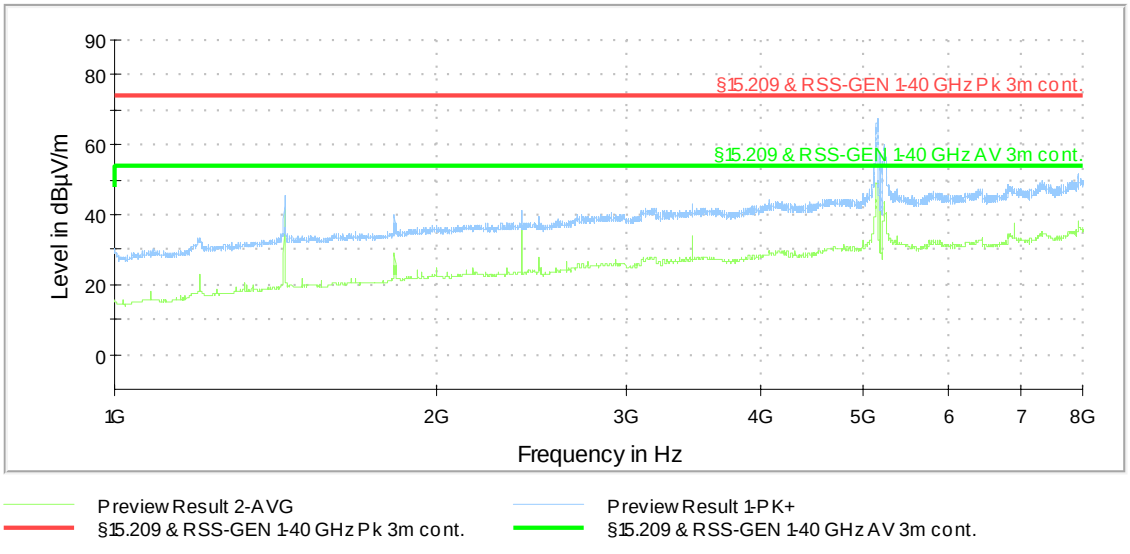
Cable guide: For detail information of test set-up and the cable guide refer to the pictures in Test setup Photo annex.

Test record: All results are shown in the following.

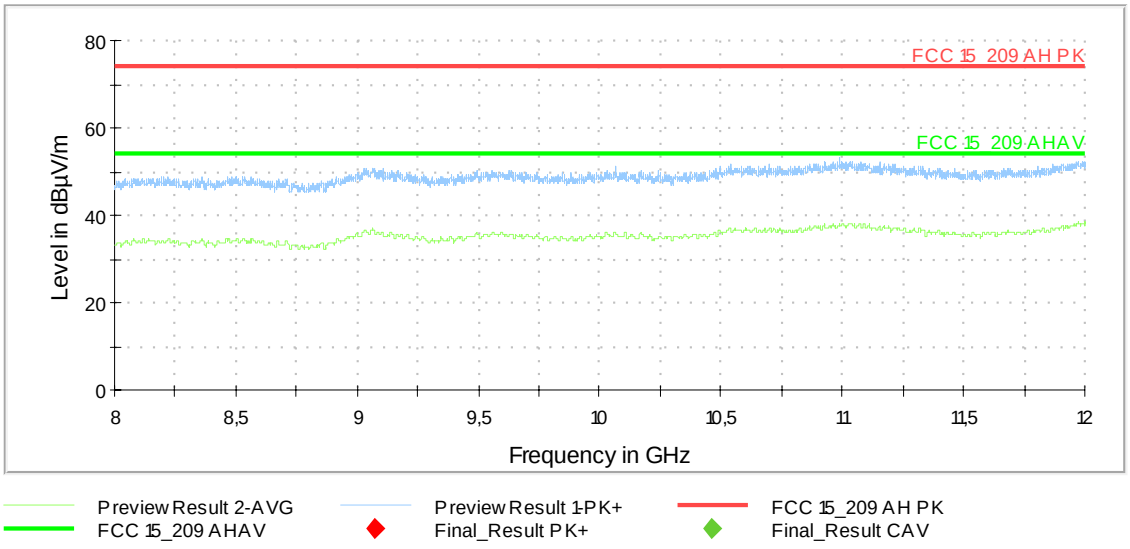
Supply voltage: During all measurements the host of the EUT was supplied with 5 V DC via an USB cable and 3.3 V DC via laboratory power supply.

Remark: Only the worst cases mode per U-NII band according to the original report was tested. No significant emissions below 1 GHz according to original report.

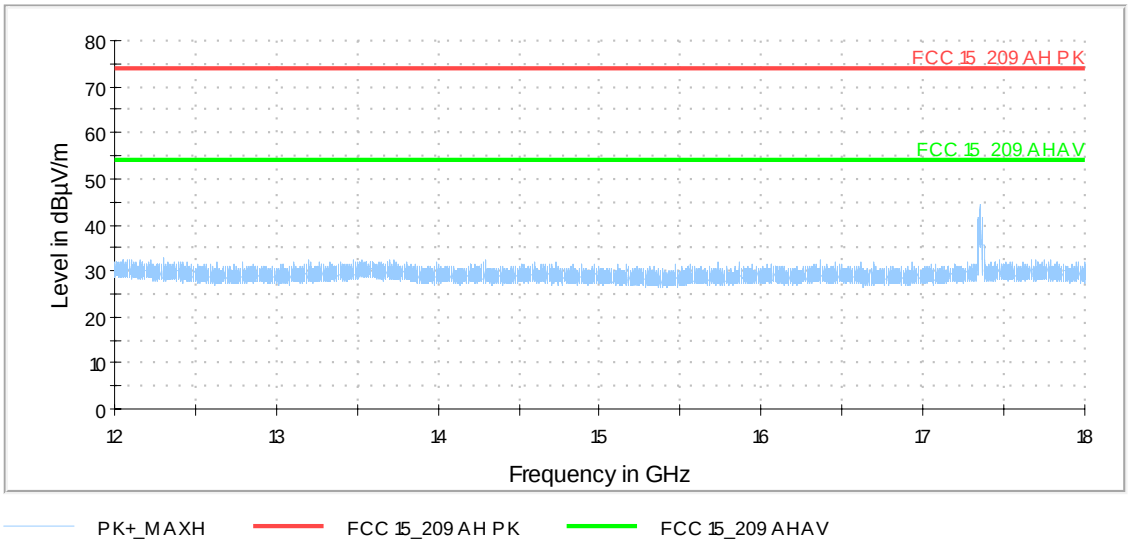
Operation mode 1: Spurious emissions from 1 – 8 GHz (carrier notched):
(Preliminary plot)



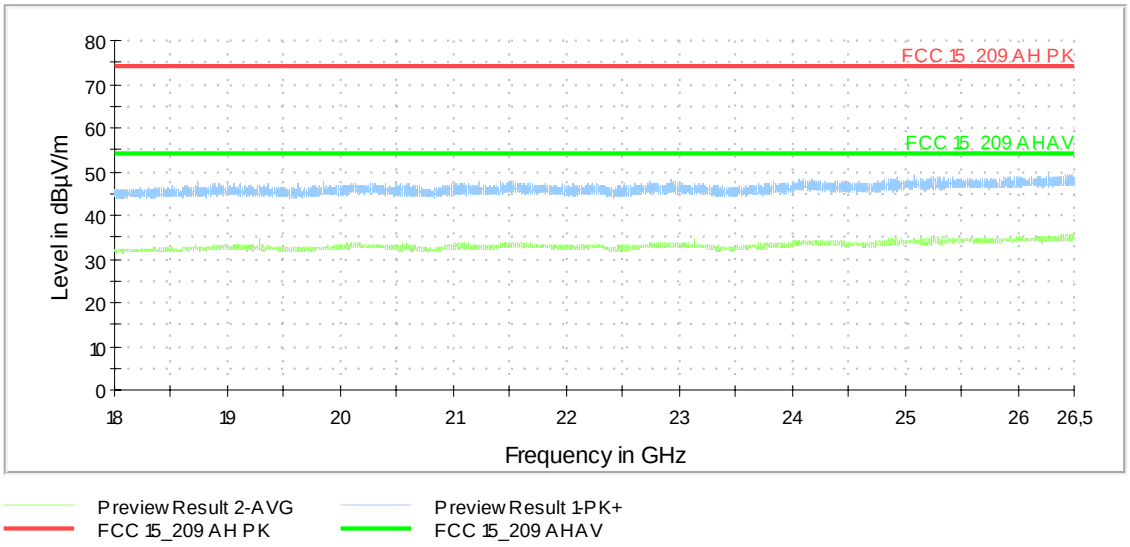
Operation mode 1: Spurious emissions from 8 - 12 GHz:
(Preliminary plot)



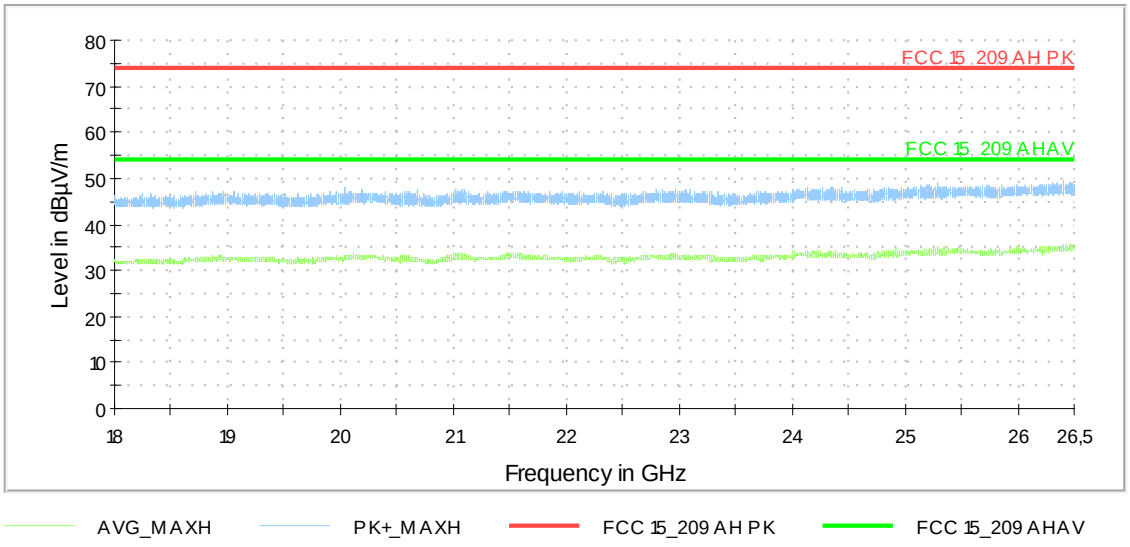
Operation mode 4: Spurious emissions from 12 - 18 GHz:
(Preliminary plot)



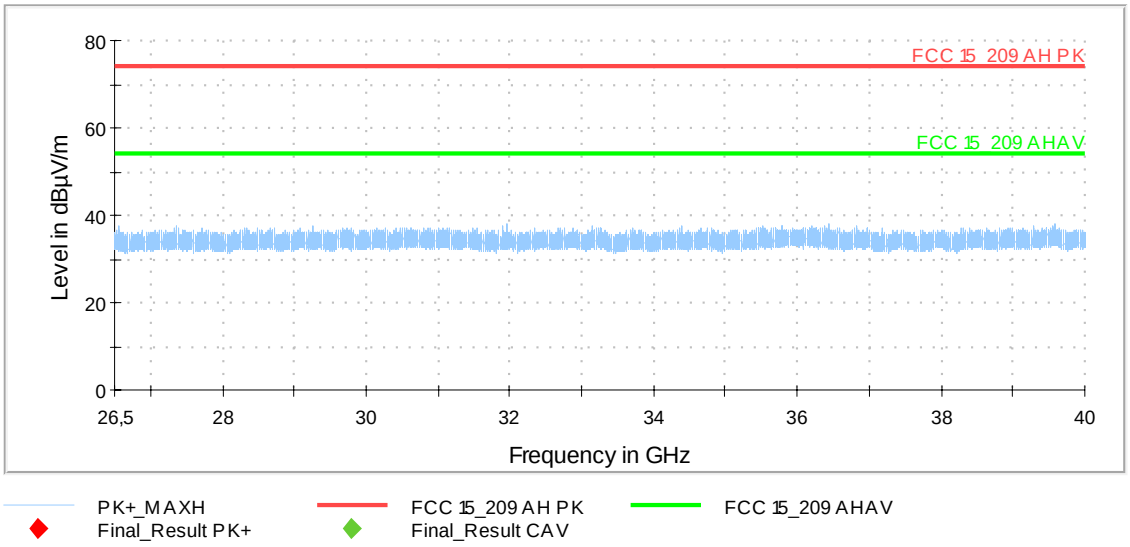
Operation mode 4: Spurious emissions from 18 – 26.5 GHz:
(Preliminary plot)



Operation mode 2: Spurious emissions from 18 - 26.5 GHz:
(Preliminary plot)



Operation mode 2: Spurious emissions from 26.5 - 40 GHz:
(Preliminary plot)



Test equipment (please refer to chapter 6 for details)
1 - 21

5.4.2.2 Results Final measurement (radiated emission)

5.4.2.2.1 Final measurement (1 GHz to 26.5 GHz):

Ambient temperature	21° C
Relative humidity	29%

Date	03.09.2019
Tested by	B.ROHDE

Position of EUT:	The EUT was set-up on an EUT turn device of a height of 1.5 m. 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 Test setup Photo annex.
Test record:	All results are shown in the following.
Supply voltage:	During all measurements the host of the EUT was supplied with 5 V DC via an USB cable and 3.3 V DC via laboratory power supply.
Resolution bandwidth:	For all measurements a resolution bandwidth of 1 MHz was used.
Additional information:	For simplification all average values were compared to the restricted band limit and all peak values were compared with the peak limit of -27 dBm / MHz or calculated according to II.G. 2.d) (iii) of document [5]. Therefor a peak limit of 68.2 dBµV/m was applied.

Operation mode 1

Spurious Emissions (Operation mode 1) 1 – 40 GHz									
No duty cycle correction factor was applied to the average reading									
Frequency [MHz]	Max Peak [dBµV/m]	Average [dBµV/m]	Limit [dBµV/m]	Margin dB	Pol	Azimuth [°]	Elevation [°]	Correction [dB]	Result
All emissions were more than 20 dB below the limit – no final emission measured									
Measurement uncertainty				+2.2 dB / -3.6 dB					

Operation mode 2

Spurious Emissions (Operation mode 2) 1 – 40 GHz									
No duty cycle correction factor was applied to the average reading									
Frequency [MHz]	Max Peak [dBµV/m]	Average [dBµV/m]	Limit [dBµV/m]	Margin dB	Pol	Azimuth [°]	Elevation [°]	Correction [dB]	Result
All emissions were more than 20 dB below the limit – no final emission measured									
Measurement uncertainty				+2.2 dB / -3.6 dB					

Operation mode 3

Spurious Emissions (Operation mode 3) 1 – 40 GHz									
No duty cycle correction factor was applied to the average reading									
Frequency [MHz]	Max Peak [dBµV/m]	Average [dBµV/m]	Limit [dBµV/m]	Margin dB	Pol	Azimuth [°]	Elevation [°]	Correction [dB]	Result
All emissions were more than 20 dB below the limit – no final emission measured									
Measurement uncertainty				+2.2 dB / -3.6 dB					

Operation mode 4

Spurious Emissions (Operation mode 4) 1 – 40 GHz									
No duty cycle correction factor was applied to the average reading									
Frequency [MHz]	Max Peak [dBµV/m]	Average [dBµV/m]	Limit* [dBµV/m]	Margin dB	Pol	Azimuth [°]	Elevation [°]	Correction [dB]	Result
17357.000	54.7	---	68.2	13.5	V	285	30	10.6	Passed
17357.000	---	42.8	54	11.2	V	285	30	12.6	Passed
Measurement uncertainty				+2.2 dB / -3.6 dB					

*

Operation mode 5

Spurious Emissions (Operation mode 5) 1 – 40 GHz									
No duty cycle correction factor was applied to the average reading									
Frequency [MHz]	Max Peak [dBµV/m]	Average [dBµV/m]	Limit [dBµV/m]	Margin dB	Pol	Azimuth [°]	Elevation [°]	Correction [dB]	Result
All emissions were more than 20 dB below the limit – no final emission measured									
Measurement uncertainty				+2.2 dB / -3.6 dB					

Test equipment (please refer to chapter 6 for details)
1 - 21

5.5 Conducted emissions on power supply lines (150 kHz to 30 MHz)

For detailed results see test-reports 1802WSU008-U1 by MRT Technology (Suzhou) Co., Ltd, FCC ID VPYLBEE5HY1MW.

6 Test Equipment

No.	Test equipment	Type	Manufacturer	Serial No.	PM. No.	Cal. Date	Cal Due
1	Antenna (Log. Per.)	HL050	Rohde & Schwarz	100438	481170	09.10.2017	10.2020
2	RF-Cable No. 40	Sucoflex 106B	Suhner	0708/6B / Kabel 40	481330	Calibration not necessary	
3	standard gain horn antenna	18240-20	Flann Microwave	483	480294	Calibration not necessary	
4	Preamplifier 12 GHz - 18 GHz	JS3-12001800-16-5A	MITEQ Hauppauge N.Y.	571667	480343	10.07.2018	07.2020
5	standard gain horn antenna	20240-20	Flann Microwave	411	480297	Calibration not necessary	
6	Preamplifier 18 GHz - 26 GHz	JS4-18002600-20-5A	MITEQ Hauppauge N.Y.	658697	480342	10.07.2018	07.2020
7	standard gain horn antenna	22240-20	Flann Microwave	469	480299	Calibration not necessary	
8	Preamplifier 26 GHz - 40 GHz	JS4-26004000-25-5A	MITEQ Hauppauge N.Y.	563593	480344	10.07.2018	07.2020
9	RF-cable No.3	Sucoflex 106B	Suhner	0563/6B / Kabel 3	480670	Calibration not necessary	
10	HF-Cable	Sucoflex 104	Huber+Suhner	517402	482392	Calibration not necessary	
11	Microwave cable 2m	Insulated Wire Inc.	Insulated Wire	KPS-1533-800-KPS	480302	Calibration not necessary	
12	Antenna mast	AS615P	Deisel	615/310	480187	Calibration not necessary	
13	Fully anechoic chamber M20	B83117-E2439-T232	Albatross Projects	103	480303	Calibration not necessary	
14	Turntable	DS420 HE	Deisel	420/620/00	480315	Calibration not necessary	
15	Multiple Control Unit	MCU	Maturo GmbH	MCU/043/971107	480832	Calibration not necessary	
16	Positioners	TDF 1.5- 10Kg	Maturo	15920215	482034	Calibration not necessary	
17	EMI Receiver / Spectrum Analyzer	ESW44	Rohde & Schwarz	101635	482467	29.03.2018	03.2020
18	Software	WMS32	Rohde & Schwarz		481800	Calibration not necessary	
19	Preamplifier 100 MHz - 16 GHz	AFS6-00101600-23-10P-6-R	Narda MITEQ	2011215	482333	10.07.2018	07.2020
20	High pass Filter	WHKX8.0/18G-8SS	Wainwright Instruments GmbH	4	480586	Calibration not necessary	
21	Tunable Band Reject	WRCJ5100/5850-20/50-8SSK	Wainwright Instruments GmbH	1	480681	Calibration not necessary	

7 Test Site Validation

Test Equipment	PM. No.	Frequency range	Type of validation	According to	Val. Date	Val Due
OATS M6	480085	30 – 1000 MHz	NSA	ANSI C63.4-2014	25.10.2018	24.10.2020
Fully anechoic chamber M20	480303	1 -18 GHz	SVSWR	CISPR 16-1-4 Amd. 1	13.07.2018	12.07.2020
Shielded chamber M4	480088	9 kHz – 30 MHz	GND-Plane	ANSI C63.4-2014	06.11.2018	05.11.2020

8 Report History

Report Number	Date	Comment
F182223E2	11.11.2019	Initial Test Report
F182223E2 2nd Version	16.12.2020	Reissuing requested by customer, due to delayed certification process

9 List of Annexes

Annex A Test Setup Photos 6 pages