TESTING CERT #3478.01

TEST REPORT

EUT Description	**WiGig, 2x2 PCIe M.2 adapter card**
Brand Name	**Intel® Wireless Gigabit 11000**
Model Name	**11000D2W , 11000D2W LC**
Serial Number	**TA : H82062-002** (see section 4)
FCC/IC ID	**FCC ID: PD911000D2** **IC ID: 1000M-11000D2**
Antenna type	**Intel ® Wireless Gigabit Antenna-M 10042R (Array Antenna Model No . 10042RRFW)**
Hardware/Software Version	**HW config: 26.4** **Test SW: DRTU version 1.8.3-02056 / DRTU version 1.8.3-02538** **Driver ver.: 2.2.0.15**
Date of Sample Receipt	**2015-12-08**
Date of Test Start/End	**2015-12-08 / 2016-01-19**
Features	**WiGig** (see section 5)

Applicant	**Intel Mobile Communications**
Address	**100 Center Point Circle, Suite 200** **Columbia, South Carolina 29210** **USA**
Contact Person	**Steven Hackett**
Telephone/Fax/ Email	**steven.c.hackett@intel.com**

Reference Standards	**FCC CFR Title 47 Part 15C, Part 2.1091** **IC RSS-210 Issue 8, IC RSS-Gen Issue 4, IC RSS-102** (see section 1)

Test Report number	**15120401.TR01**
Revision Control	**Rev. 00**

The test results relate only to the samples tested. The test report shall not be reproduced in full, without written approval of the laboratory.

Issued by

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Table of Contents

1. Standards, reference documents and applicable test methods

1. FCC 47 CFR Part 15 - Subpart C – §15.255 Operation within the band 57-64 GHz.
2. ANSI C63.10-2013, Clause 9 – Procedures for testing millimeter-wave systems.
3. IC RSS-Gen Issue 4 – General Requirements for Compliance of Radio Apparatus.
4. IC RSS-210 Issue 8 – Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment.
5. FCC 47 CFR Part 2 – Subpart J – §2.1091 Radiofrequency radiation exposure evaluation: mobile devices.
6. IC RSS-102 Issue 5 – Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands).

2. General conditions, competences and guarantees

- ✓ Intel Mobile Communications Wireless RF Lab (Intel WRF Lab) is a testing laboratory accredited by the American Association for Laboratory Accreditation (A2LA).
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- ✓ This report is only referred to the item that has undergone the test.
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3. Environmental Conditions

- ✓ At the site where the measurements were performed the following limits were not exceeded during the tests:

Temperature	24ºC ± 2ºC
Humidity	54% ± 5%

4. Test samples

Sample	Control #	Description	Model	Serial #	Date of reception	Note
#01	15120401.S04	RF Module	11000D2W	TA : H82062-002	2016-01-05	Used for RF detector tests and spurious tests below 40GHz
	15081801.S05	Extender board	PCB00469	ASS00469-001 4694213-526	2016-01-05	
	15032601.S44	WiGig Antenna	10042RRFW	-	2015-11-16	
	15120401.S06	Socket Card	11000D2W	-	2015-12-08	
	-	Laptop	Dell E55430	-	2015-08-17	
#02	15120401.S01	RF Module	11000D2W	TA : H82062-002	2015-12-08	Used for remaining tests
	15120401.S02	Extender board	PCB00469	ASS00469-001 4694213-524	2015-12-08	
	15032601.S42	WiGig Antenna	10042RRFW	-	2015-11-16	
	15120401.S02	Socket Card	11000D2W	-	2015-12-08	
	-	Laptop	Dell E55430	-	2015-08-17	

5. EUT Features

These are the detailed bands and modes supported by the equipment under Test:

WiGig	60GHz (57.24 – 63.72 GHz)

6. Remarks and comments

N/A

7. Test Verdicts summary

FCC part	RSS part	Test name	Verdict
15.255 (e) (1)	RSS-210 Annex A13.2.3	Emission & Occupied Bandwidth	P
15.255 (b) (1)	RSS-210 Annex A13.2.2 (1)	Peak and Average Power, RF detector	P
15.255 (e) (1)	RSS-210 Annex A13.2.3	Peak Output Power, RF detector	P
15.255 (c) (1) (2) (3) (4) 15.255 (d)	RSS-210 Annex A13.2.2	Spurious Emissions	P
15.255 (f)	RSS-210 Annex A13.2.5	Frequency Stability	P
15.255 (h)	RSS-210 Annex A13.2.6	Group Installation	P
-	RSS-210 Annex A13.2.7	Transmitter Identification	NA[1]
15.255 (g) 2.1091	RSS-102	RF Exposure	P

P: Pass
F: Fail
NM: Not Measured
NA: Not Applicable

8. Document Revision History

Revision #	Date	Modified by	Details
Rev. 00	2016-01-20	W. EL HAJJ	First Issue

[1] The EUT is used for indoor operation only. There are no outdoor units, therefore no transmissions are emitted outside the building

Annex A. Test & System Description

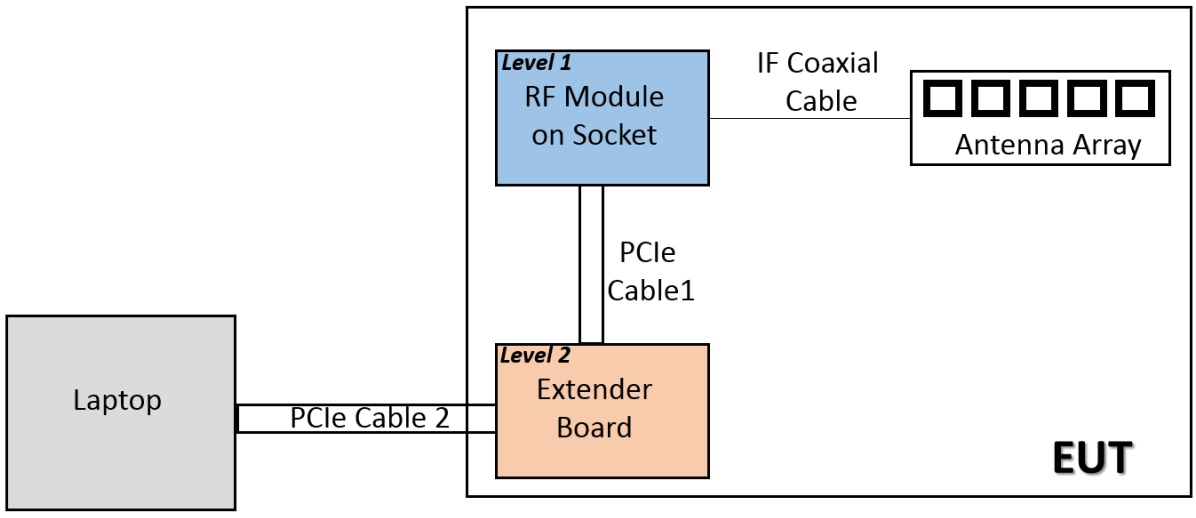
A.1 EUT Description

The EUT is a 60 GHz 802.11ac WiGig module adapter supporting one RFEM antenna array with typical application intended for portable platforms like Laptops, Tablets etc. :

Operation Frequencies	
Channel 1	58.32 GHz
Channel 2	60.48 GHz
Channel 3	62.64 GHz

Peak Antenna Gain	Channel 1: 15.3	Channel 2: 15.2	Channel 3 : 14.8	dBi
Highest EIRP	24.85			dBm
Highest Peak Output Power	11.2			mW

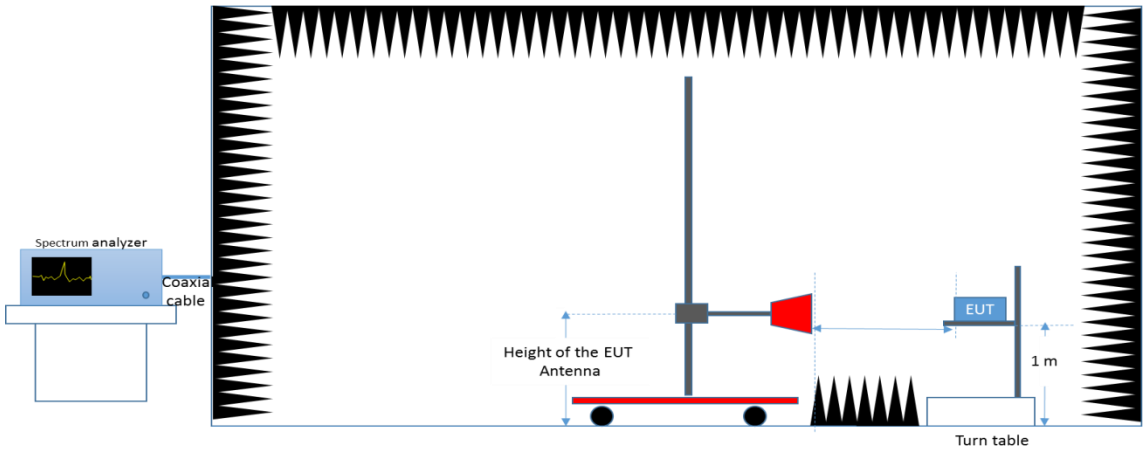
The EUT is built in two levels. In the first level the tested RF module is connected to an antenna array via an Intermediate Frequency (IF) coaxial cable and mounted on socket card. This socket card is connected to an extender board (second Level) via a PCIe cable. The group is connected to a laptop via a second PCIe cable.



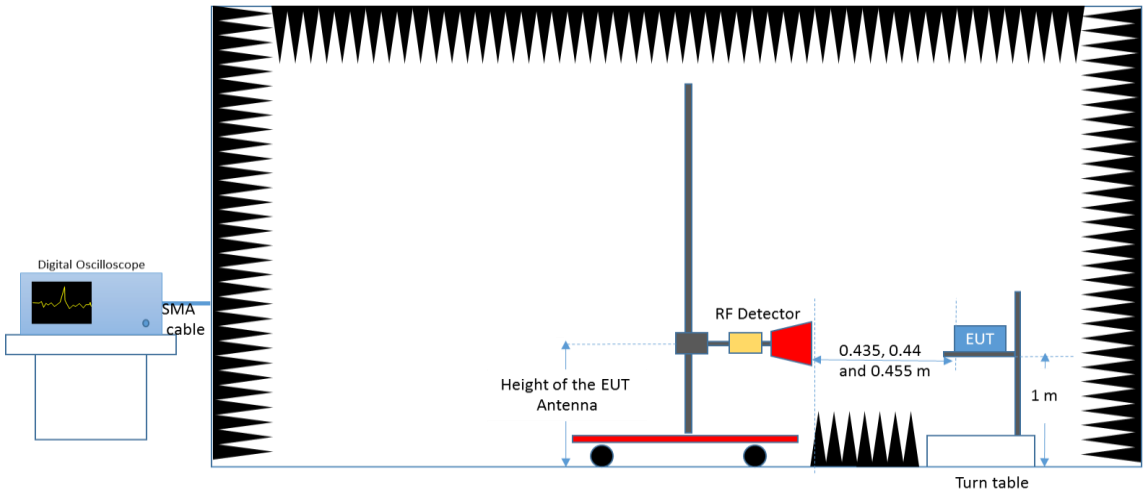
A.2 Measurement system

Measurements were performed using the following setups, made in accordance to the general provisions of ANSI C63.10-2013, Clause 9 – Procedures for testing millimeter-wave systems.

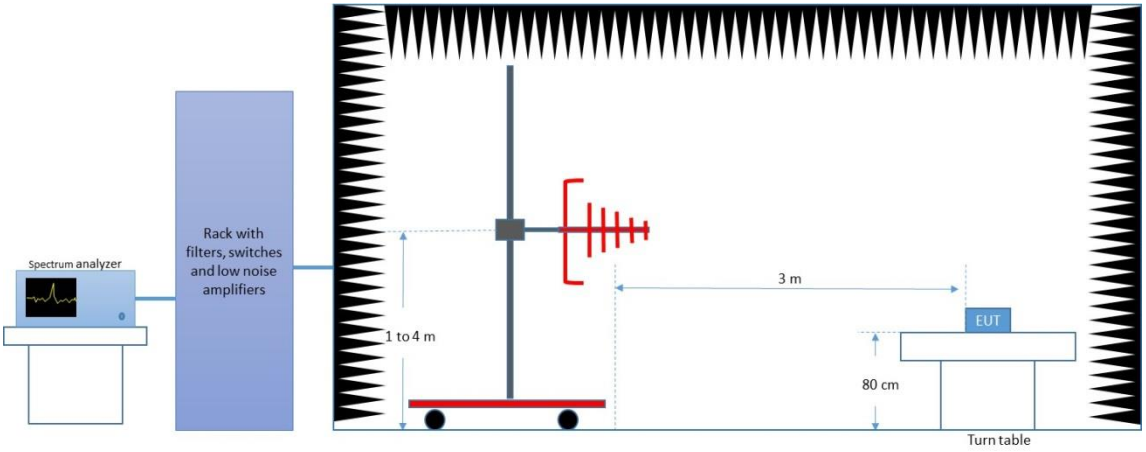
Emission Bandwidth Measurement Setup (57 – 64 GHz)



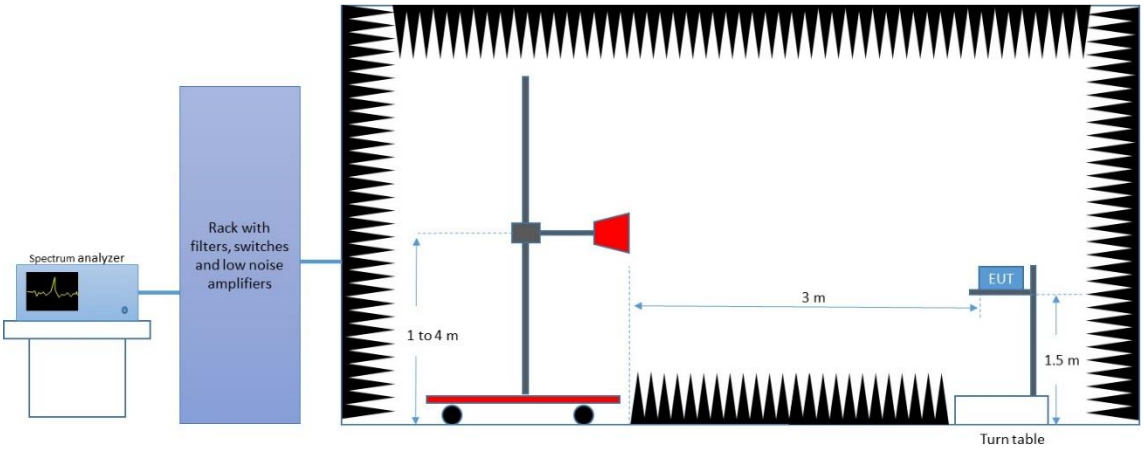
RF Detector Measurement Setup (57 – 64 GHz)



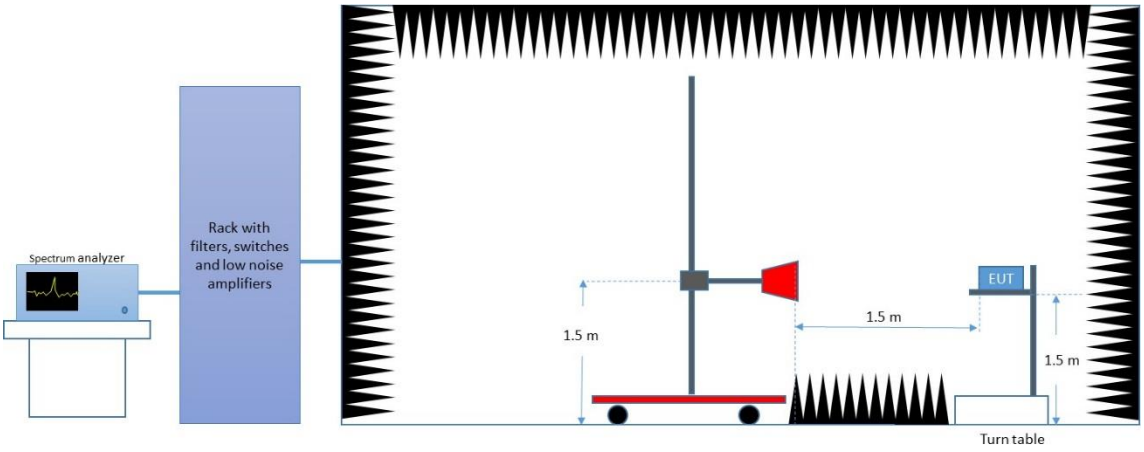
Radiated Setup (30 MHz – 1 GHz)



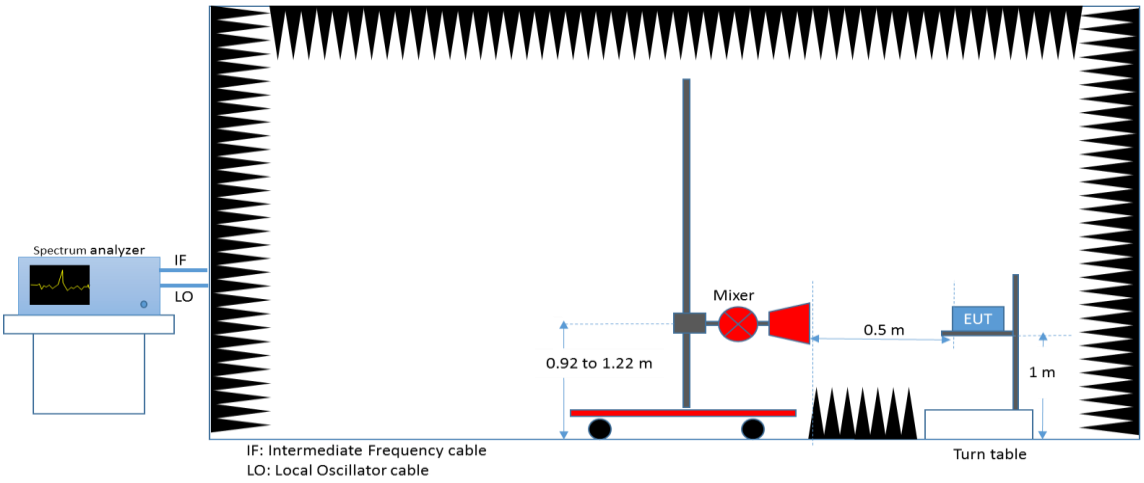
Radiated Setup (1 GHz – 18 GHz)



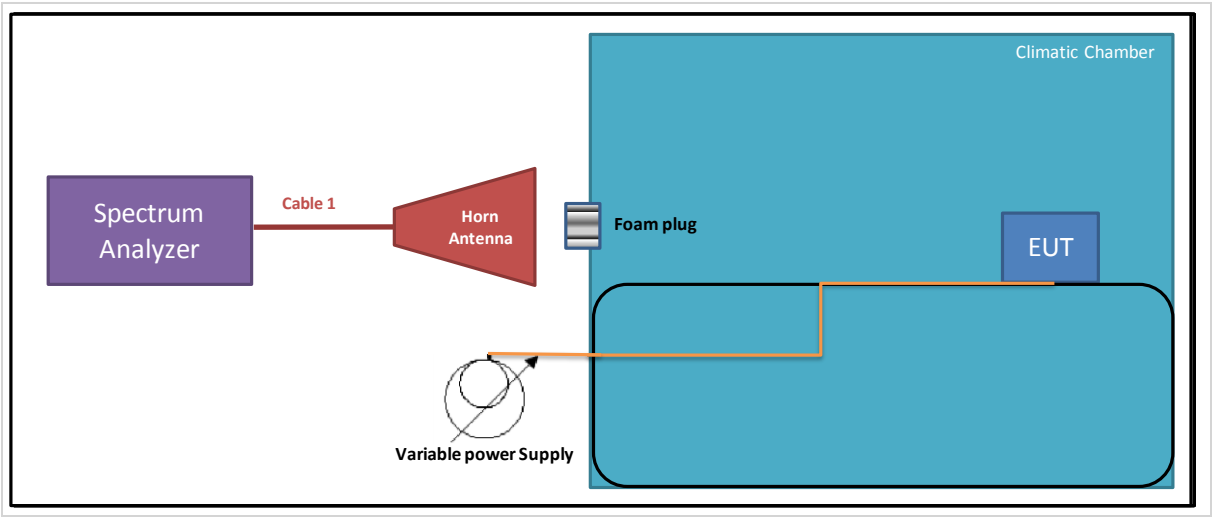
Radiated Setup (18 GHz – 40 GHz)



Radiated Setup (40 GHz – 200 GHz)



Frequency Stability Measurement Setup (57 – 64 GHz)



A.3 Test Equipment List

ID#	Device	Model Name	Manufacturer	S/N	Calibration Date	Calibration Due Date
0015	Spectrum Analyzer	FSU67	R&S	100092	2015-07-31	2017-07-31
0133	Spectrum Analyzer	FSV40	R&S	101072	2014-01-30	2016-01-30
0258	Spectrum Analyzer	FSV30	R&S	101318	2014-05-14	2016-05-14
0308	Signal Generator	SMB100A	R&S	178212	2015-03-16	2017-03-16
0014	Power Sensor	NRP-Z57	R&S	101280	2015-05-06	2017-05-06
0312	Digital Oscilloscope	RTE1052	R&S	101135	2015-03-25	2017-03-25
0251	RF Detector	DET-15	Millitech	-	N/A	N/A
0063	Multiplier Assembly (40-220 GHz)	AFM-40-220	RPG	394	N/A	N/A
0137	Measurement Antenna (30 MHz-1 GHz)	3142E	ETS Lindgren	00156946	2014-03-05	2016-03-05
0138	Measurement Antenna (1-6.4 GHz)	3117	ETS Lindgren	00152266	2014-03-04	2016-03-04
0141	Measurement Antenna (6.4-18 GHz)	3117-PA	ETS Lindgren	00157736	2014-06-03	2016-06-03
0139	Measurement Antenna (18-26.5GHz)	114514	ETS Lindgren	00167100	2014-04-25	2016-04-25
0140	Measurement Antenna (26.5-40 GHz)	120722	ETS Lindgren	120722	2014-08-14	2016-08-14
0064	Measurement Antenna (40-60 GHz)	FH-SG-060-25	RPG	20011	N/A	N/A
0066	Measurement Antenna (50-75 GHz)	FH-SG-075-25	RPG	20012	N/A	N/A
0068	Measurement Antenna (60-90 GHz)	FH-SG-090-25	RPG	-	N/A	N/A
0069	Measurement Antenna (75-110 GHz)	FH-SG-110-25	RPG	-	N/A	N/A
0070	Measurement Antenna (110-170 GHz)	FH-SG-170-25	RPG	-	N/A	N/A
0071	Measurement Antenna (140-220GHz)	FH-SG-220-25	RPG	-	N/A	N/A

ID#	Device	Model Name	Manufacturer	S/N	Calibration Date	Calibration Due Date
0057	MIXER 40-60GHz	FS-Z60	R&S	100130	2015-10-22	2017-10-22
0058	MIXER 60-90GHz	FS-Z90	R&S	100098	2015-06-04	2017-06-04
0059	MIXER 75-110GHz	FS-Z110	R&S	100069	2015-05-26	2017-05-26
0061	MIXER 110-170GHz	SAM-170	RPG	020000	2015-06-03	2017-06-03
0062	MIXER 140-220GHz	SAM-220	RPG	020012	2015-06-03	2017-06-03
0135	Anechoic chamber	FACT 3	ETS Lindgren	RFD_FA_100	2014-05-06	2016-05-06
0300	Climatic Chamber	SLT34/40	SECASI	56746020930010	2015-03-09	2017-03-09
0329	Measurement Software	EMC32	R&S	1300.7027.00 (100401)	N/A	N/A

NA: Not Applicable

A.4 Measurement Uncertainty Evaluation

The system uncertainty evaluation is shown in the below table:

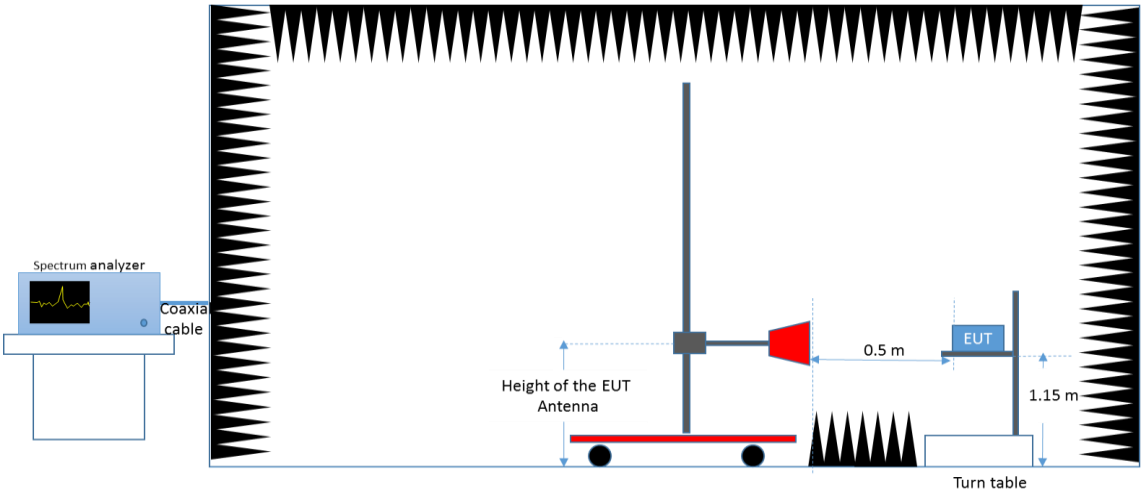
Measurement type	Uncertainty [±dB]
Radiated tests for power Measurement (57-66G)	±3.4
Radiated spurious tests < 1GHz	±3.8
Radiated Spurious tests 1 GHz - 40GHz	±4.7
Radiated Spurious tests 40GHz - 200GHz	±4.7

Annex B. Tests Results

B.1 Emission Bandwidth

Test procedure

The setup below was used to measure the 6dB & 99% Bandwidth. The measurement antenna covering the band (50-75G) is connected to the spectrum analyzer through a coaxial cable. The Spectrum analyzer is able to measure directly up to 67GHz. The EUT is configured to operate at the Modulation and Coding Scheme index (*MCS*) giving the maximum output power (MCS 3)[2].



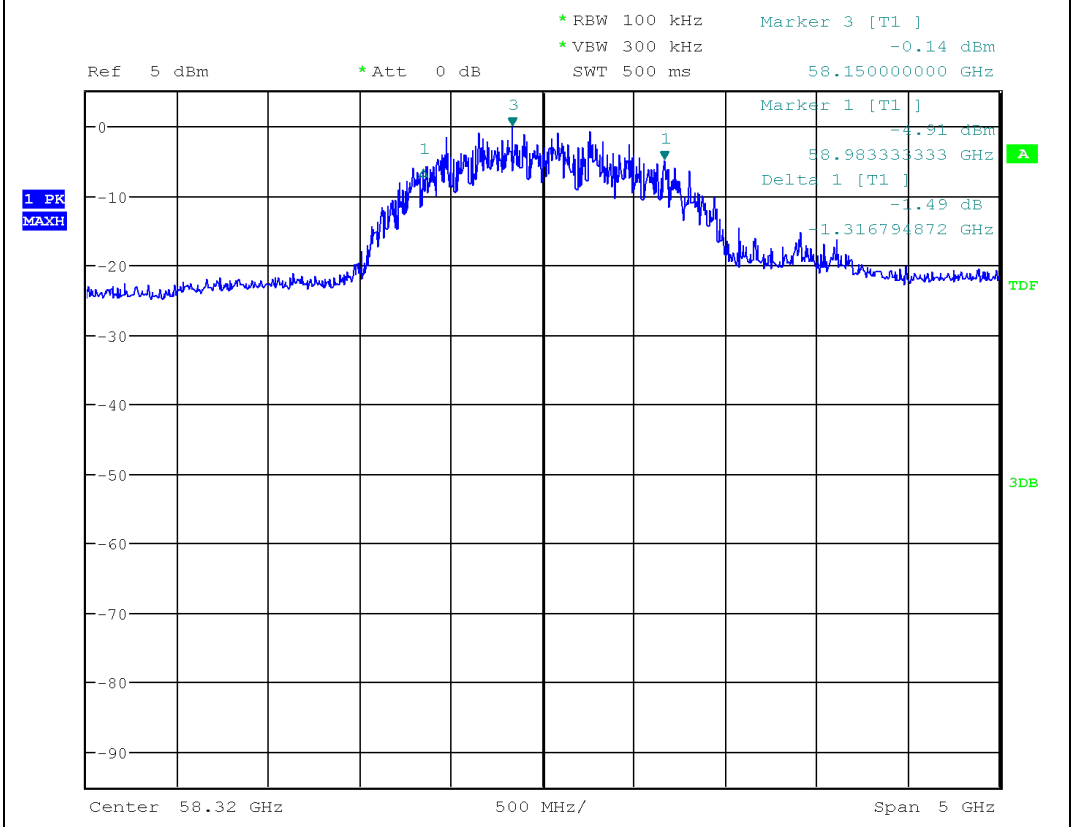
Results tables

Emission Bandwidths					
Mode	**MCS**	**Channel**	**Frequency (GHz)**	**6 dB Bandwidth (GHz)**	**99% Bandwidth (GHz)**
WiGig	3	1	58.32	1.317	1.923
WiGig	3	2	60.48	1.358	2.027
WiGig	3	3	62.64	1.204	2.043

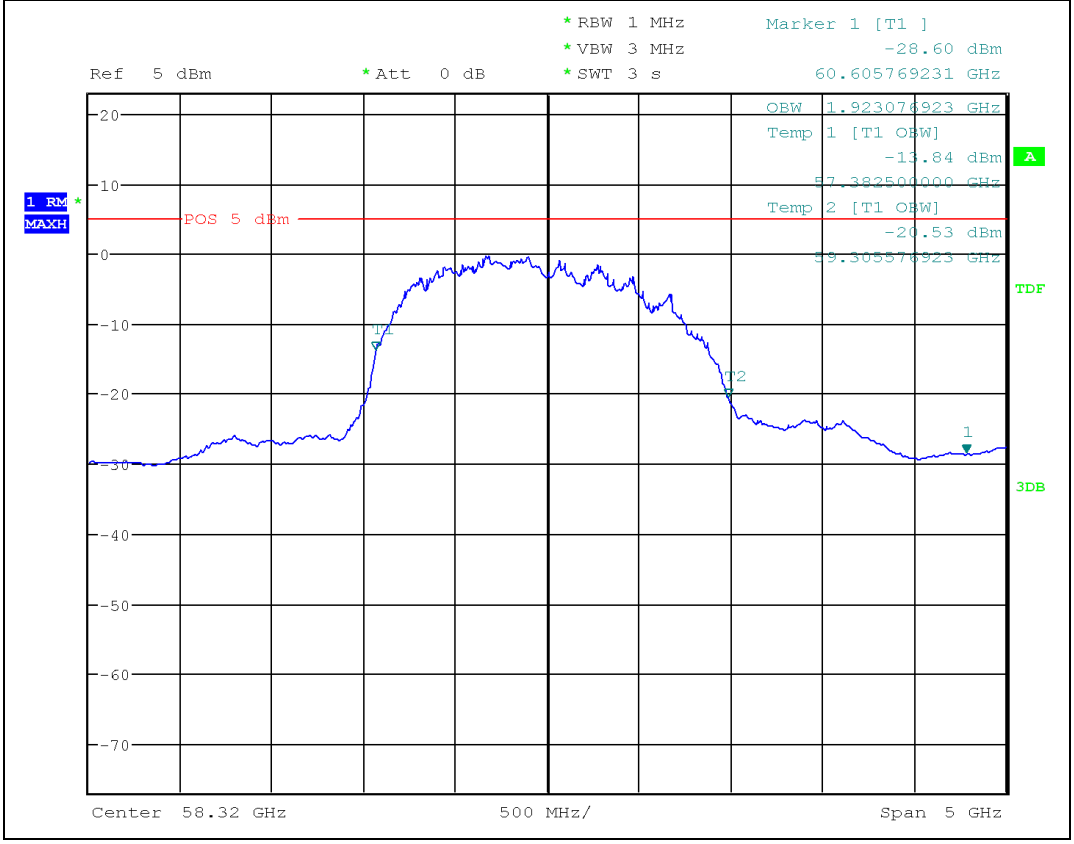
[2] *MSC 3 corresponds to π/2 BPSK Modulation type with a coding rate of (5/8)*

Results screenshots

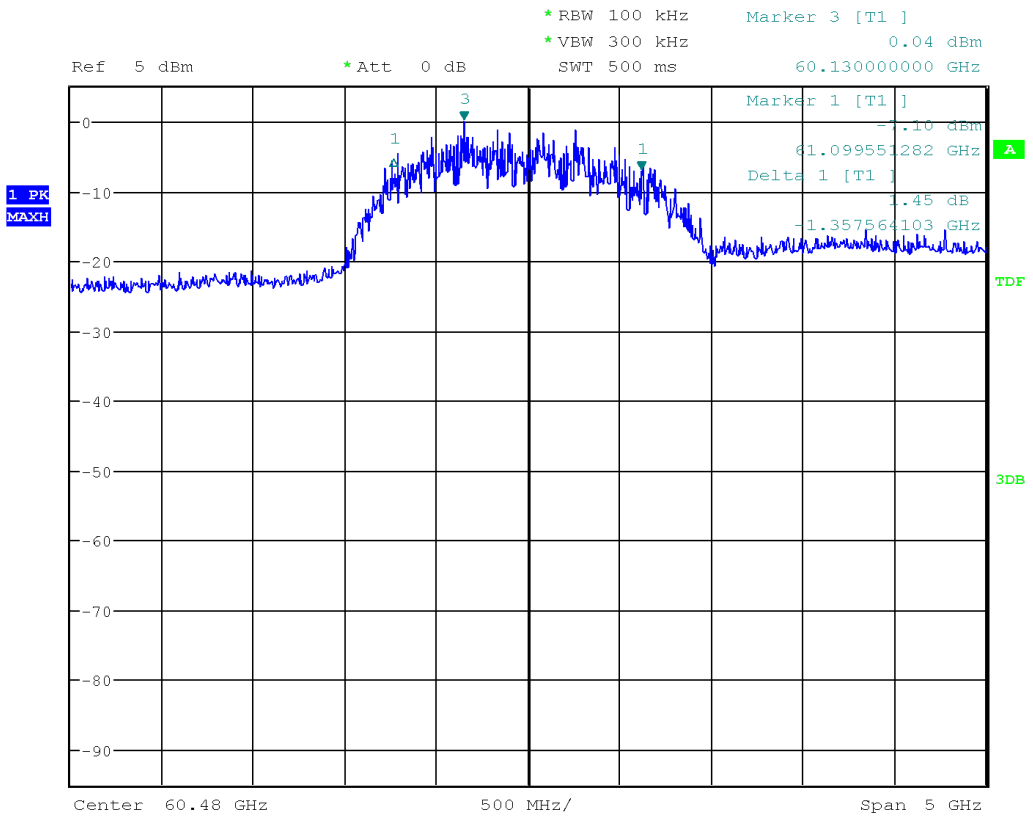
6dB BW - Channel 1 – MCS 3



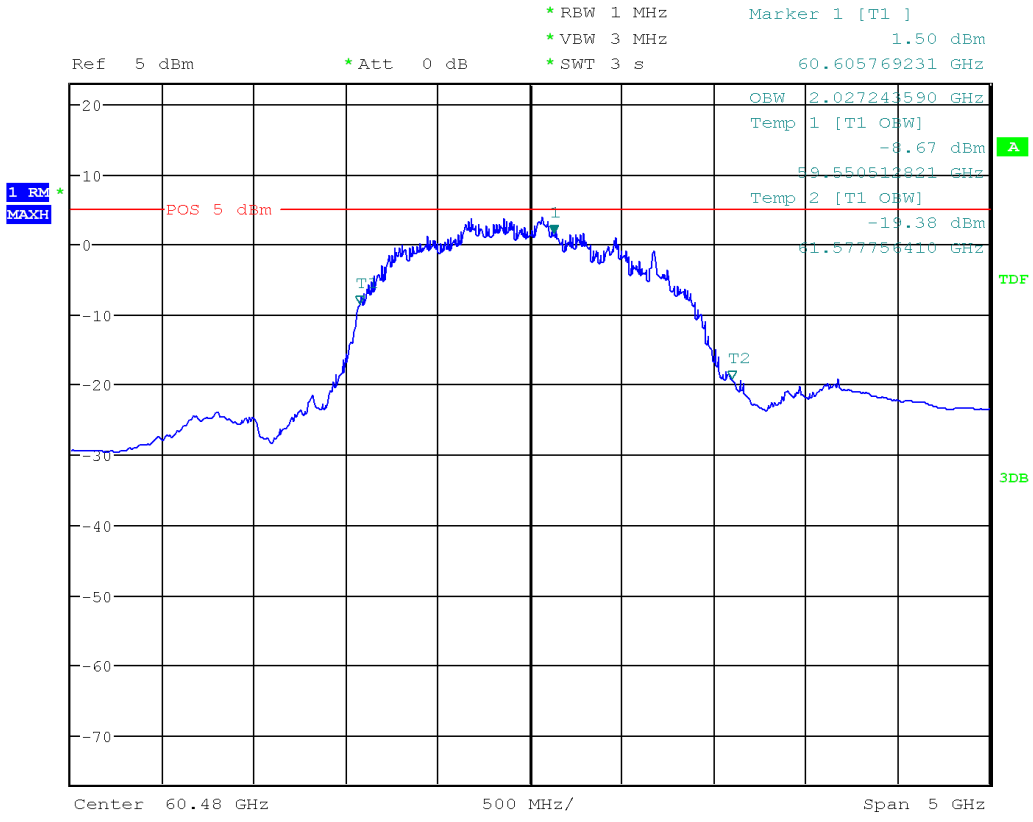
99 % BW - Channel 1 – MCS 3



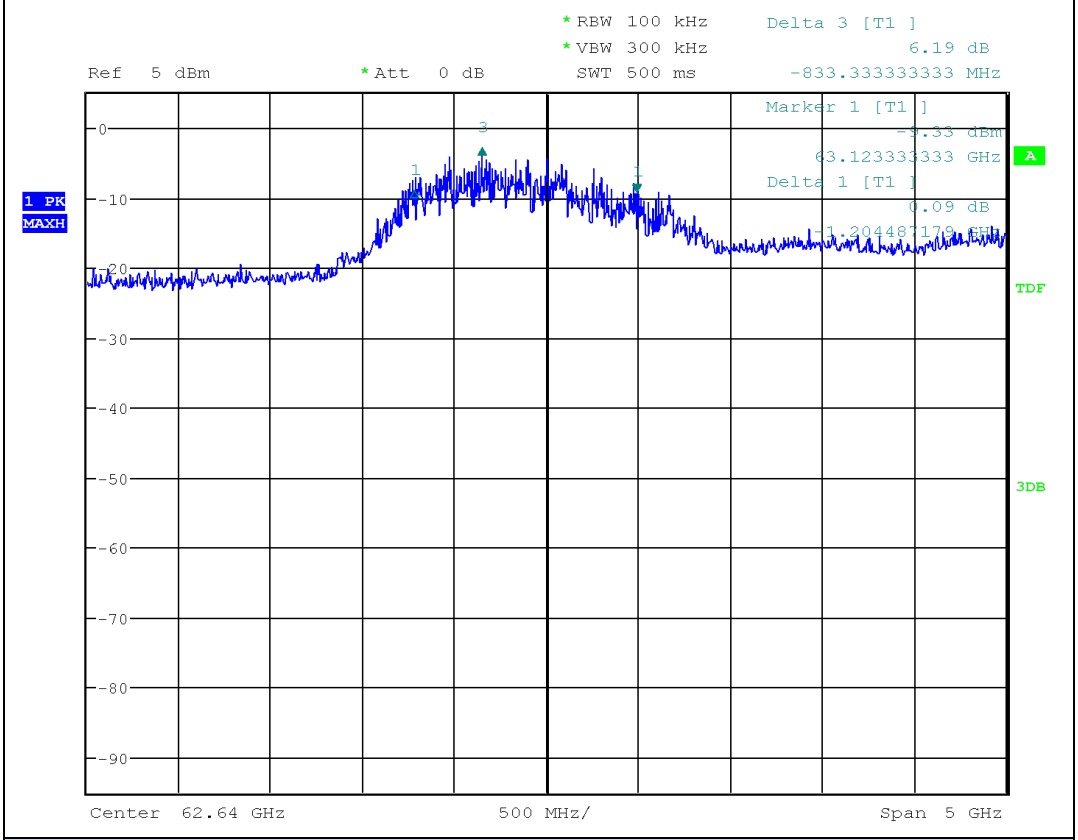
6dB BW - Channel 2 – MCS 3



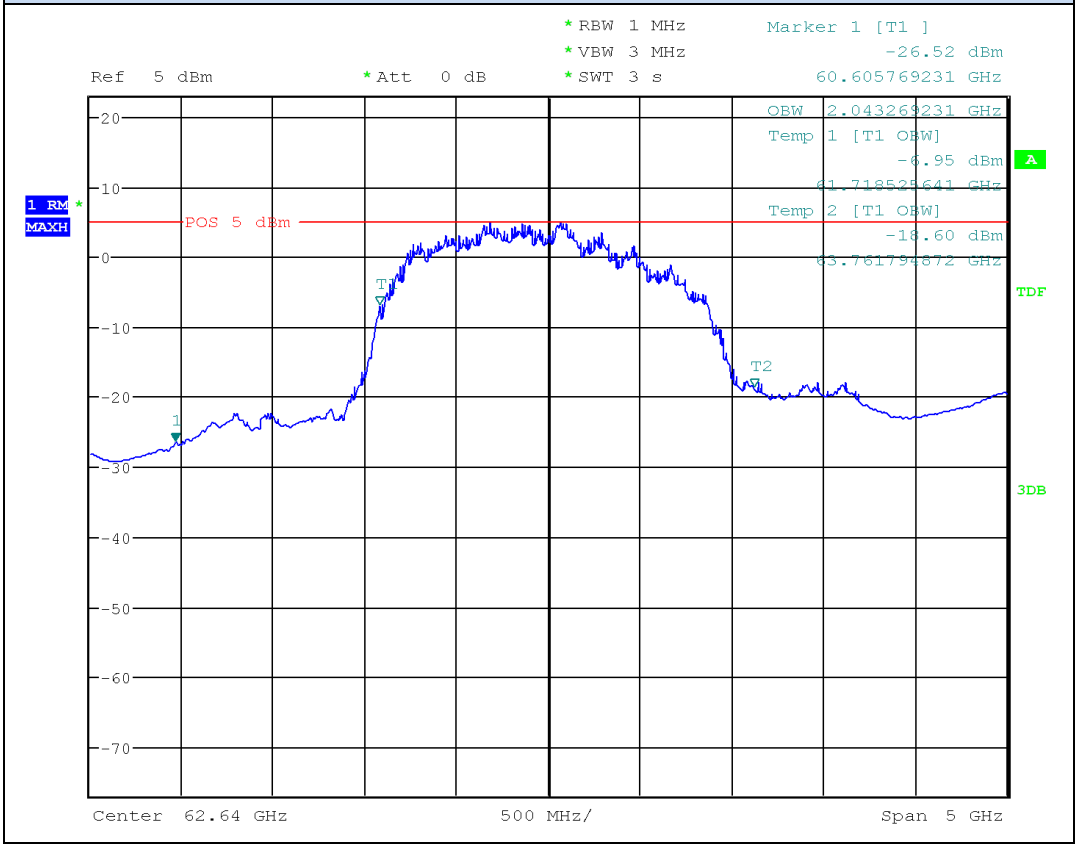
99 % BW - Channel 2 – MCS 3



6dB BW - Channel 3 – MCS 3



99 % BW - Channel 3 – MCS 3



B.2 Peak and Average Power, RF detector

Test limits

FCC part	RSS part	Limits
15.255 (b) (1)	RSS-210 Annex A13.2.2 (1)	Within the 57-64 GHz band, emission levels shall not exceed the following equivalent isotropically radiated power (EIRP): the average power of any emission shall not exceed 40 dBm (equivalent to 9 µW/cm^2 power density at 3m) and the peak power of any emission shall not exceed 43 dBm (equivalent to 18 µW/cm^2 power density at 3m)

Test procedure

1. According to ANSI C63.10-2013, Clause 9, the measurement should be performed at a distance greater than or equal to the far field boundary distance. This later is given by

$$R_{(Far\ Field)} = \frac{2L^2}{\lambda}$$

Where
L is the largest dimension of the transmit antenna in m
λ is the *w*avelength in m

Far field boundary calculation			
Frequency (GHz)	**Wavelength (λ) (m)**	**L (m)**	**R far field (m)**
58.32	0.0051	0.025	0.24
60.48	0.0050	0.025	0.25
62.64	0.0048	0.025	0.26

Our measurements are performed at a distance greater than **0.45m** > R far field. The measurement distances are 0.455 m for Channel 1, 0.44 m for Channels 2 and, 0.435 m for Channels 3.

2. The EUT is configured to operate at the Modulation and Coding Scheme index (MCS) giving the maximum output power (MCS 3).

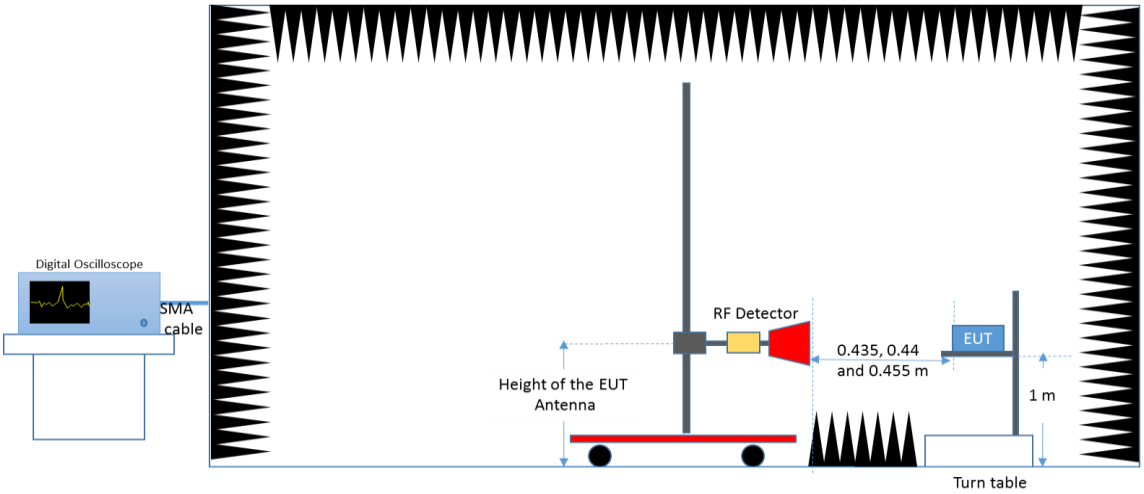
3. Referring to ANSI C63.10-2013, Clause 9, the equivalent Peak and Average Power obtained using the RF detector measured voltage* (see setup below) are converted to EIRP using Friis equation and then compared to the limits.

$$EIRP(W) = \frac{P_R}{G_R}.\left(\frac{4\pi D}{\lambda}\right)^2 \text{ and } EIRP(dBm) = 30 + 10\ Log_{10}\left(EIRP_{(W)}\right)$$

Where:

P_R is the equivalent power measured at the output of the test antenna, in W
λ is the wavelength of the emission under investigation in m
G_R is the linear gain of the test antenna
D is the measurement distance in m

** The conversion from the measured voltage to the equivalent power is done by a substitution measurement using the multiplier assembly generator (40-220G) and the power sensor (DC-67G) (see Test Equipment List in § A.3).*



The measurement antenna is aligned with the maximum radiation direction issued from the EUT antenna in order to receive the maximum available power.

Results tables:

Peak EIRP									
Mode	**MCS**	**Freq. (GHz)**	**D (m)**	**Measured Peak Voltage (mV)**	**P_R (dBm)**	**Rx Antenna Gain G_R (dBi)**	**EIRP (W)**	**EIRP (dBm)**	**Limit (dBm)**
WiGig	3	58.32	0.455	4.427	-12.48	24.37	0.255	24.07	43
WiGig	3	60.48	0.440	8.063	-10.54	24.71	0.371	25.69	43
WiGig	3	62.64	0.435	5.850	-11.78	25.00	0.273	24.37	43

Average EIRP									
Mode	**MCS**	**Freq. (GHz)**	**D (m)**	**Measured Peak Voltage (mV)**	**P_R (dBm)**	**Rx Antenna Gain G_R (dBi)**	**EIRP (W)**	**EIRP (dBm)**	**Limit (dBm)**
WiGig	3	58.32	0.455	2.982	-13.43	24.37	0.205	23.12	40
WiGig	3	60.48	0.440	5.831	-11.38	24.71	0.306	24.85	40
WiGig	3	62.64	0.435	3.834	-12.85	25.00	0.214	23.30	40

B.3 Conducted Peak Output Power, RF detector

Test limits

FCC part	RSS part	Limits
15.255 (e) (1)	RSS-210 Annex A13.2.3	The peak transmitter conducted output power shall not exceed 500 mW. Depending on the gain of the antenna, it may be necessary to operate the intentional radiator using a lower peak transmitter output power in order to comply with the EIRP limits specified in paragraph (b) of this section. Transmitters with an emission bandwidth of less than 100 MHz must limit their peak transmitter conducted output power to the product of 500 mW times their emission bandwidth divided by 100 MHz. For the purposes of this paragraph, emission bandwidth is defined as the instantaneous frequency range occupied by a steady state radiated signal with modulation, outside which the radiated power spectral density never exceeds 6 dB below the maximum radiated power spectral density in the band, as measured with a 100 kHz resolution bandwidth spectrum analyzer. The center frequency must be stationary during the measurement interval, even if not stationary during normal operation (e.g., for frequency hopping devices).

Test procedure

The peak output power in dBm is calculated by subtracting the DUT gain in dBi from the Peak EIRP in dBm found in section B.2.

Results tables:

Peak Output Power								
Mode	**MCS**	**Freq. (GHz)**	**EIRP (dBm)**	**EUT Antenna Gain (dBi)**	**Output Power (dBm)**	**Output Power (mW)**	**6 dB Bandwidth (MHz)**	**Limit (mW)**
WiGig	3	58.32	24.07	15.30	8.77	7.53	1317	500
WiGig	3	60.48	25.69	15.20	10.49	11.20	1358	500
WiGig	3	62.64	24.37	14.80	9.57	9.05	1204	500

B.4 Spurious Emissions

Test limits

<table>
<tr><th>FCC part</th><th>RSS part</th><th>Limits</th></tr>
<tr><td>15.255</td><td>RSS-210 Annex A13.2.2</td><td>(c) (1): The power density of any emissions outside the 57-64 GHz band shall consist solely of spurious emissions.

(c) (2): Radiated emissions below 40 GHz shall not exceed the general limits in §15.209.

(c) (3): Between 40 GHz and 200 GHz, the level of these emissions shall not exceed 90 pW/cm^2 at a distance of 3 meters.

(c) (4): The levels of the spurious emissions shall not exceed the level of the fundamental emission.

(d): Only spurious emissions and transmissions related to a publicly-accessible coordination channel, whose purpose is to coordinate operation between diverse transmitters with a view towards reducing the probability of interference throughout the 57-64 GHz band, are permitted in the 57-57.05 GHz band.

Note to paragraph (d): The 57-57.05 GHz is reserved exclusively for a publicly-accessible coordination channel. The development of standards for this channel shall be performed pursuant to authorizations issued under part 5 of this chapter.</td></tr>
<tr><td>15.209</td><td>RSS-Gen Clause 8.9</td><td>Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a):

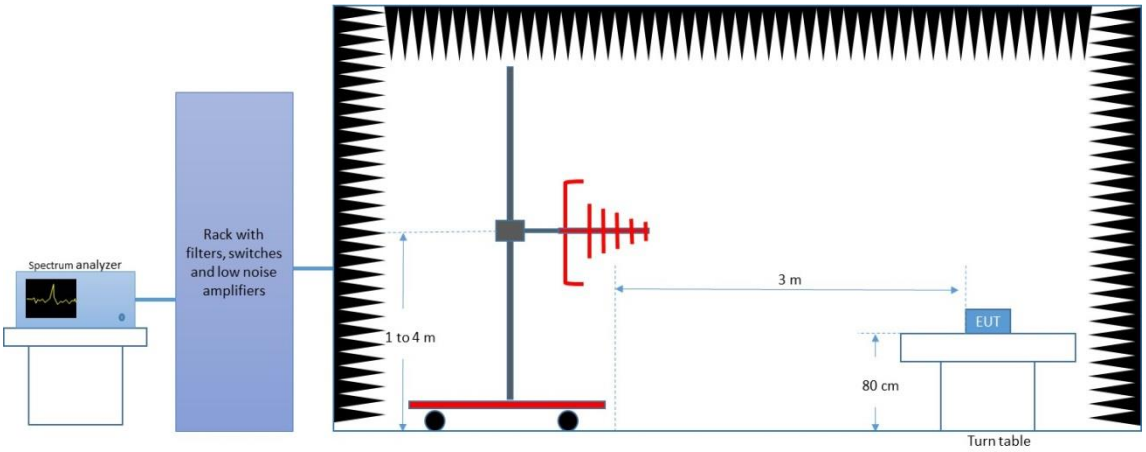
<table>
<tr><th>Freq Range (MHz)</th><th>Field Stregth (µV/m)</th><th>Field Stregth (dBµV/m)</th><th>Meas. Distance (m)</th></tr>
<tr><td>0.009-0.490</td><td>2400/f(kHz)</td><td>-</td><td>300</td></tr>
<tr><td>0.490-1.705</td><td>24000/f(kHz)</td><td>-</td><td>300</td></tr>
<tr><td>1.705-30.0</td><td>30</td><td>-</td><td>30</td></tr>
<tr><td>30-88</td><td>100</td><td>40</td><td>3</td></tr>
<tr><td>88-216</td><td>150</td><td>43.5</td><td>3</td></tr>
<tr><td>216-960</td><td>200</td><td>46</td><td>3</td></tr>
<tr><td>960-25000</td><td>500</td><td>54</td><td>3</td></tr>
</table>

The emission limits shown in the above table are based on measurements employing CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.
For average radiated emission measurements above 1000 MHz, there is also a limit specified when measuring with peak detector function, corresponding to 20 dB above the indicated values in the table.</td></tr>
</table>

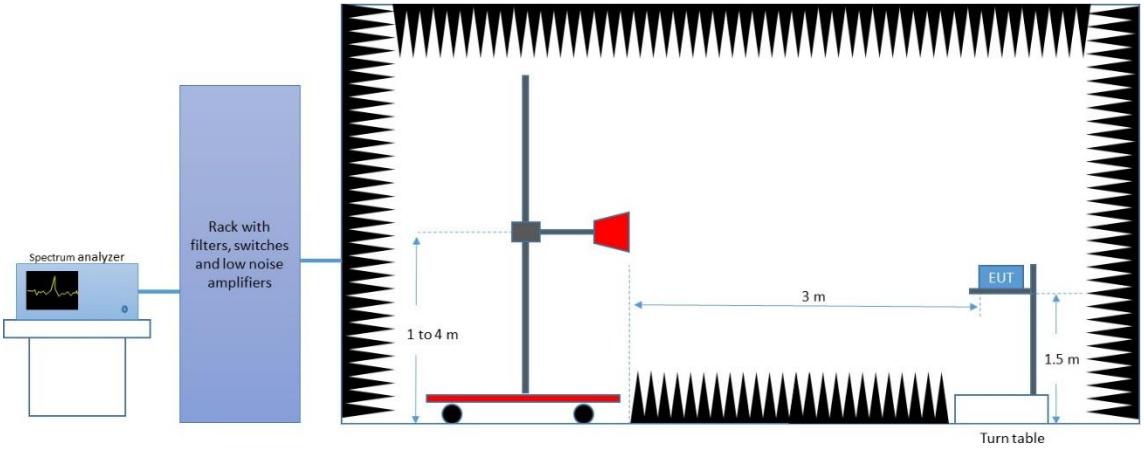
Test procedure

1. The spurious emissions are measured for the Modulation and Coding Scheme index (MCS) giving the maximum output power.
2. The setups presented below were used to measure the radiated spurious emissions.
    1. **From 30 MHz to 40 GHz**: Depending of the frequency range and bands being tested, different antennas and filters were used. The final measurement is done by varying the antenna height from 1 to 4 meters, the EUT azimuth over 360º and for both Vertical and Horizontal polarizations.
    2. **From 30MHz to 18GHz:** The measurements are done at the specification distance (3m) and the measured field strength is directly compared to the limit.
    3. **From 18GHz to 40GHz:** The measurements are done at a distance of (1.5m) then the measured field strength is extrapolated at the distance specified by the limit (3m) using an inverse distance correction factor (20 dB/decade of distance).
    4. **From 40 GHz to 200 GHz:** Depending of the frequency range and bands being tested, different antennas and mixers were used. The final measurement is done by varying the antenna height from 0.92 to 1.22 meters, the EUT azimuth over 360º and for both Vertical and Horizontal polarizations. The EIRP(dBm) is measured, then the power density at 3m is calculated and compared to the limit.

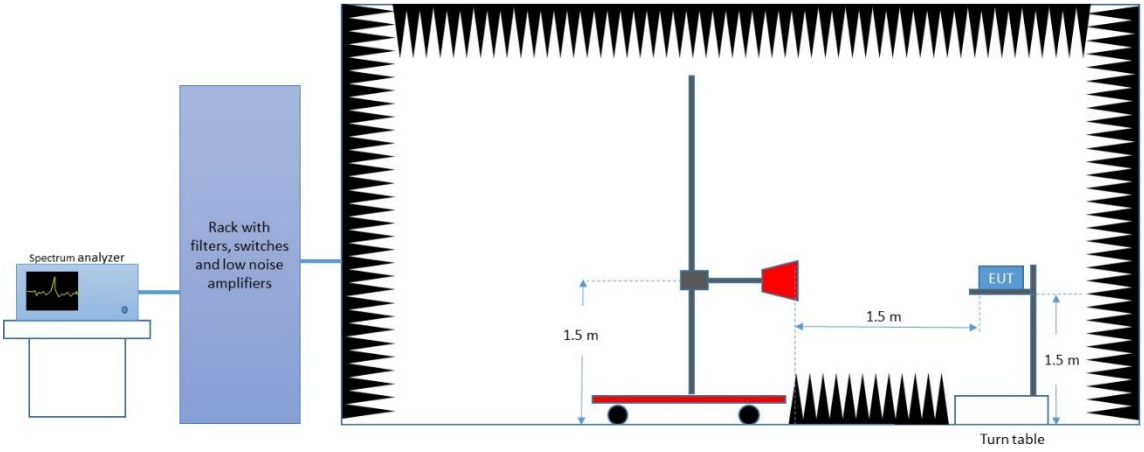
Radiated Setup (30 MHz – 1 GHz)



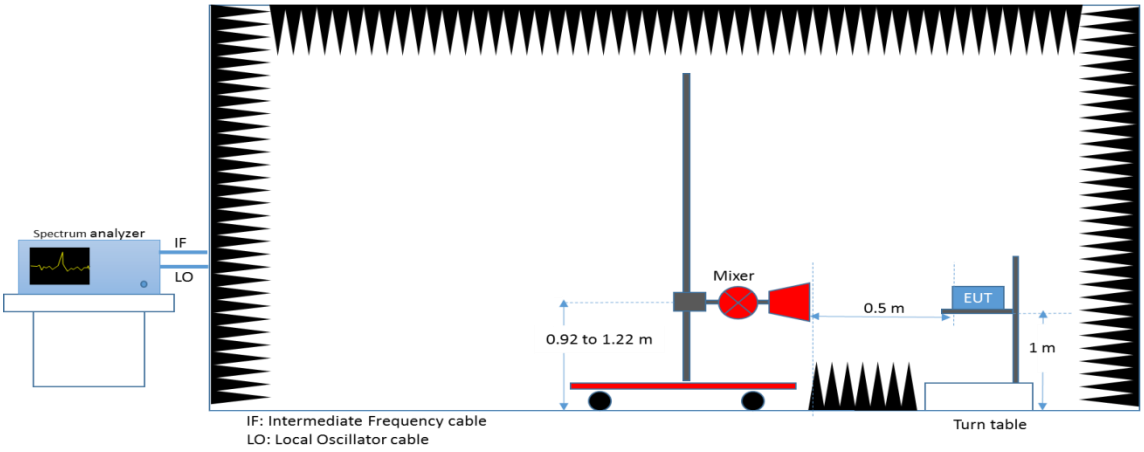
Radiated Setup (1 GHz – 18 GHz)



Radiated Setup (18 GHz – 40 GHz)



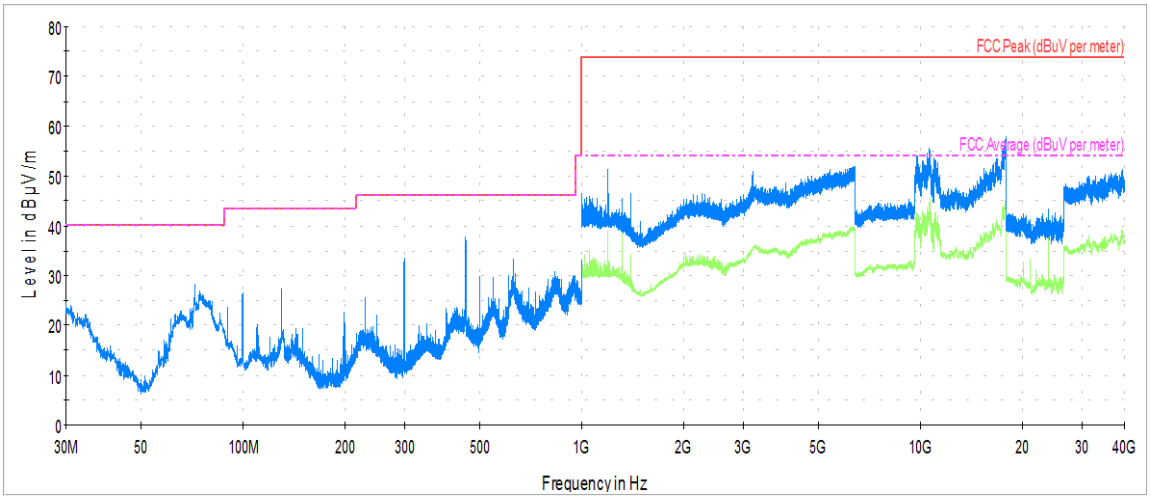
Radiated Setup (40 GHz – 200 GHz)



Tests Results

30 MHz – 40 GHz

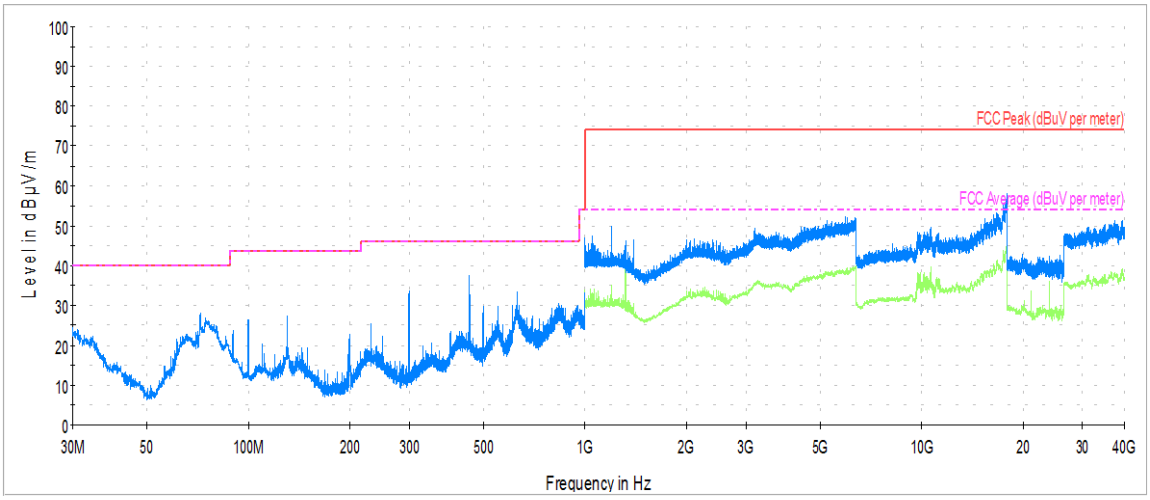
Channel 1 – 58.32 GHz



Frequency	MaxPeak	RMS	Limit	Margin
MHz	dBµV/m	dBµV/m	dBµV/m	dB
452.7	38.0	---	46.06	8.0
1195.3	51.2	---	74.06	22.8
1196.3	---	39.1	54.06	14.9
10652.4	55.6	---	74.06	18.3
10608.6		45.8	54.06	8.2
39645.2	51.2	---	74.06	22.8
39645.2	---	37.2	54.06	16.8

30 MHz – 40 GHz

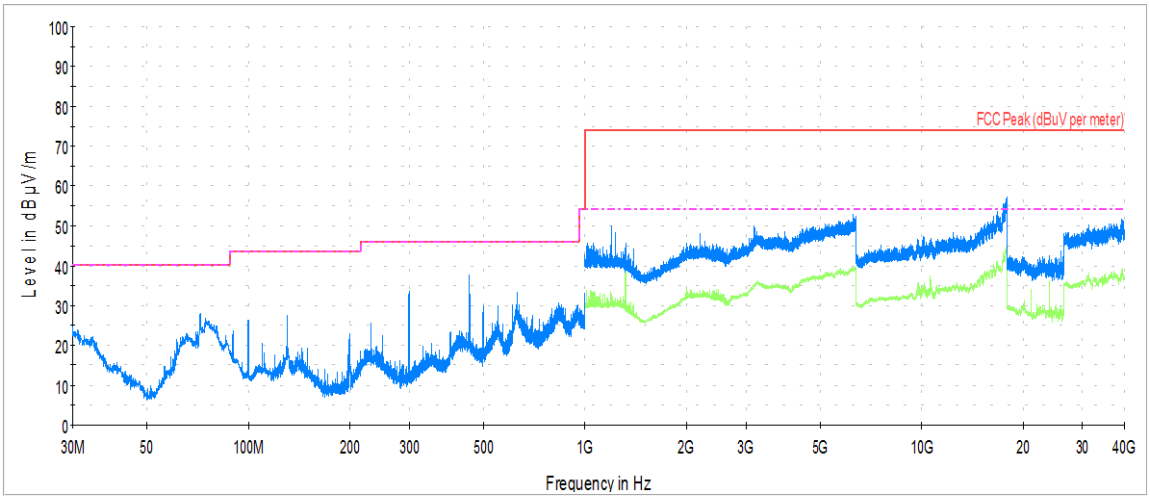
Channel 2 – 60.48 GHz



Frequency	MaxPeak	RMS	Limit	Margin
MHz	dBµV/m	dBµV/m	dBµV/m	dB
452.7	38.0	---	46.06	8.0
1319.5	41.6	---	74.06	32.4
1319.5	---	29.4	54.06	24.6
17987.0	57.8	---	74.06	16.2
17987.0	---	45.5	54.06	8.5
39664.3	49.9	---	74.06	24.0
39664.3	---	38.1	54.06	15.8

30 MHz – 40 GHz

Channel 3 – 62.64 GHz



Frequency	MaxPeak	RMS	Limit	Margin
MHz	dBµV/m	dBµV/m	dBµV/m	dB
452.7	38.0	---	46.06	8.0
1319.8	45.5	---	74.06	28.5
1319.8	---	41.5	54.06	12.5
17821.3	57.1	---	74.06	16.9
17821.3	---	44.6	54.06	9.4
39647.7	50.4	---	74.06	23.6
39647.7	---	38.2	54.06	15.8

40 GHz – 200 GHz

Channel 1 – 58.32 GHz

Spurious Emission 40 GHz- 200 GHz					
Freq. (GHz)	**EIRP (dBm)**	**Meas. Dist (m)**	**Spec. Dist (m)**	**Power Density @ 3m (pW/cm^2)**	**Limit (pW/cm^2)**
92.7692	-41.38	0.5	3	0.064	90
138.7650	-32.29	0.5	3	0.522	90

No other spurious emissions identified up to 200 GHz above the level reported in the table.

Channel 2 – 60.48 GHz

No Spurious emissions identified above the noise floor up to 200GHz

Channel 3 – 62.64 GHz

No Spurious emissions identified above the noise floor up to 200GHz

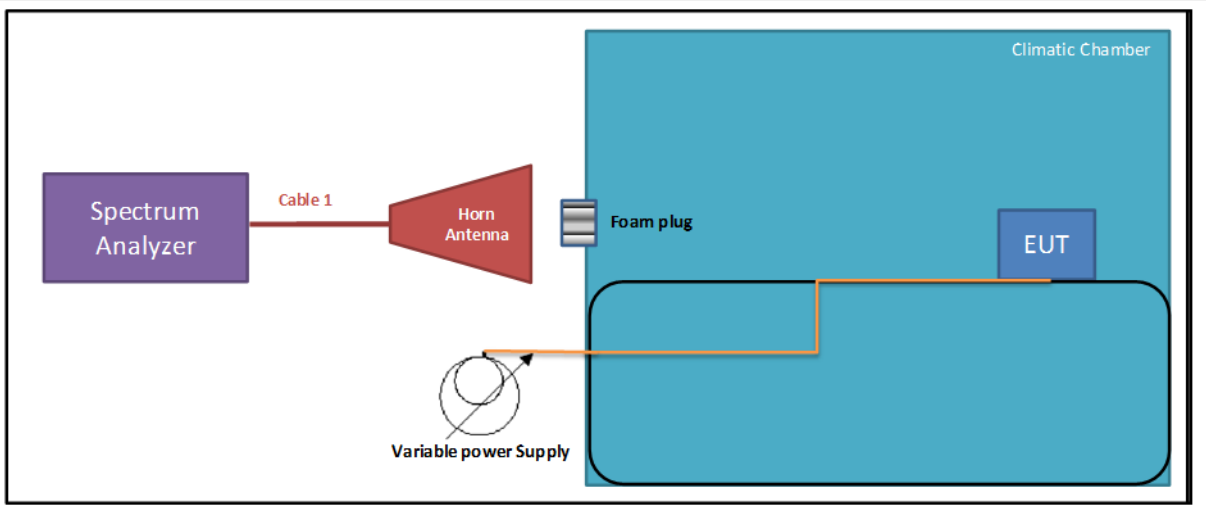
B.5 Frequency Stability

Test limits

FCC part	RSS part	Limits
15.255 (f)	RSS-210 Annex A13.2.5	Fundamental emissions must be contained within the frequency bands specified in this section during all conditions of operation. Equipment is presumed to operate over the temperature range −20 to + 50 degrees Celsius with an input voltage variation of 85% to 115% of rated input voltage, unless justification is presented to demonstrate otherwise.

Test procedure

1. Measurements are performed for the highest and lowest frequency of operation and with the modulation that produces the widest emission bandwidth (MCS3) according to the setup below.
2. These measurements are repeated for each step of temperature variation from (-20 to 50 ºC) at the nominal voltage.
3. These measurements are repeated for an input voltage variation of 85% to 110% at the reference temperature
4. The frequency excursion is recorded by checking at each time if the 20 dB bandwidth of the fundamental emission is contained within the frequency band over the temperature range -20 to +50 degrees Celsius with an input voltage variation of 85% to 115% of rated input voltage.



Results tables

Lowest frequency of operation (Channel 1)			
Power Supply (VDC)	**Environment Temperature (°C)**	**Min Frequency (GHz) @ 20dB BW**	**Limit**
3.3	50	57.3360	57 GHz
3.3	40	57.2815	57 GHz
3.3	30	57.2303	57 GHz
3.3	20	57.3085	57 GHz
3.3	10	57.3517	57 GHz
3.3	0	57.3229	57 GHz
3.3	-10	57.3277	57 GHz
3.3	-20	57.3362	57 GHz
2.805	20	57.3469	57 GHz
3.795	20	57.3325	57 GHz

Highest frequency of operation (Channel 3)			
Power Supply (VDC)	**Environment Temperature (°C)**	**Max Frequency (GHz) @ 20dB BW**	**Limit**
3.3	50	63.7955	64 GHz
3.3	40	63.8297	64 GHz
3.3	30	63.7810	64 GHz
3.3	20	63.7955	64 GHz
3.3	10	63.8243	64 GHz
3.3	0	63.7327	64 GHz
3.3	-10	63.8000	64 GHz
3.3	-20	63.7169	64 GHz
2.805	20	63.7762	64 GHz
3.795	20	63.7907	64 GHz

B.6 Group Installation

Test limits

FCC part	RSS part	Limits
15.255 (h)	RSS-210 Annex A13.2.6	Any transmitter that has received the necessary FCC equipment authorization under the rules of this chapter may be mounted in a group installation for simultaneous operation with one or more other transmitter(s) that have received the necessary FCC equipment authorization, without any additional equipment authorization. However, no transmitter operating under the provisions of this section may be equipped with external phase-locking inputs that permit beam-forming arrays to be realized.

Results

According to applicant's declaration, there is no external Phase-Locking input to realize a beamforming array.

B.7 RF Exposure

Limits

<table>
<tr><th>FCC part</th><th>Limits</th></tr>
<tr><td>15.255 (g)</td><td>Regardless of the power density levels permitted under this section, devices operating under the provisions of this section are subject to the radiofrequency radiation exposure requirements specified in §§1.1307(b), 2.1091 and 2.1093 of this chapter, as appropriate. Applications for equipment authorization of devices operating under this section must contain a statement confirming compliance with these requirements for both fundamental emissions and unwanted emissions. Technical information showing the basis for this statement must be submitted to the Commission upon request.</td></tr>
<tr><td>2.1091</td><td>(b) For purposes of this section, a mobile device is defined as a transmitting device designed to be used in other than fixed locations and to generally be used in such a way that a separation distance of at least 20 centimeters is normally maintained between the transmitter's radiating structure(s) and the body of the user or nearby persons. In this context, the term “fixed location” means that the device is physically secured at one location and is not able to be easily moved to another location. Transmitting devices designed to be used by consumers or workers that can be easily re-located, such as wireless devices associated with a personal computer, are considered to be mobile devices if they meet the 20 centimeter separation requirement.
(c)(2) Unlicensed personal communications service devices, unlicensed millimeter wave devices and unlicensed NII devices authorized under §§15.253(f), 15.255(g), 15.257(g), 15.319(i), and 15.407(f) of this chapter are also subject to routine environmental evaluation for RF exposure prior to equipment authorization or use if their ERP is 3 watts or more or if they meet the definition of a portable device as specified in §2.1093(b) requiring evaluation under the provisions of that section.</td></tr>
<tr><td>1.1310</td><td>(e) Table 1 below sets forth limits for Maximum Permissible Exposure (MPE) to radiofrequency electromagnetic fields.
TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)
<table>
<tr><th>Frequency range (MHz)</th><th>Electric field strength (V/m)</th><th>Magnetic field strength (A/m)</th><th>Power density (mW/cm^2)</th><th>Averaging time (minutes)</th></tr>
<tr><td colspan="5">(A) Limits for Occupational/Controlled Exposure</td></tr>
<tr><td>0.3-3.0</td><td>614</td><td>1.63</td><td>*100</td><td>6</td></tr>
<tr><td>3.0-30</td><td>1842/f</td><td>4.89/f</td><td>*900/f^2</td><td>6</td></tr>
<tr><td>30-300</td><td>61.4</td><td>0.163</td><td>1.0</td><td>6</td></tr>
<tr><td>300-1,500</td><td></td><td></td><td>f/300</td><td>6</td></tr>
<tr><td>1,500-100,000</td><td></td><td></td><td>5</td><td>6</td></tr>
<tr><td colspan="5">(B) Limits for General Population/Uncontrolled Exposure</td></tr>
<tr><td>0.3-1.34</td><td>614</td><td>1.63</td><td>*100</td><td>30</td></tr>
<tr><td>1.34-30</td><td>824/f</td><td>2.19/f</td><td>*180/f^2</td><td>30</td></tr>
<tr><td>30-300</td><td>27.5</td><td>0.073</td><td>0.2</td><td>30</td></tr>
<tr><td>300-1,500</td><td></td><td></td><td>f/1500</td><td>30</td></tr>
<tr><td>1,500-100,000</td><td></td><td></td><td>1.0</td><td>30</td></tr>
</table></td></tr>
</table>

<table>
<tr><th>RSS part</th><th>Limits</th></tr>
<tr><td>RSS-102</td><td>
3. Evaluation Methods
(…) Devices operating above 6 GHz regardless of the separation distance shall undergo an RF exposure evaluation.

4. Exposure Limits
For the purpose of this standard, Industry Canada has adopted the SAR and RF field strength limits established in Health Canada's RF exposure guideline, Safety Code 6.

Table 4: RF Field Strength Limits for Devices Used by the General Public (Uncontrolled Environment)
<table>
<tr><th>Frequency Range (MHz)</th><th>Electric Field (V/m rms)</th><th>Magnetic Field (A/m rms)</th><th>Power Density (W/m^2)</th><th>Reference Period (minutes)</th></tr>
<tr><td>0.003-10[21]</td><td>83</td><td>90</td><td>-</td><td>Instantaneous*</td></tr>
<tr><td>0.1-10</td><td>-</td><td>$0.73/f$</td><td>-</td><td>6**</td></tr>
<tr><td>1.1-10</td><td>$87/f^{0.5}$</td><td>-</td><td>-</td><td>6**</td></tr>
<tr><td>10-20</td><td>27.46</td><td>0.0728</td><td>2</td><td>6</td></tr>
<tr><td>20-48</td><td>$58.07/f^{0.25}$</td><td>$0.1540/f^{0.25}$</td><td>$8.944/f^{0.5}$</td><td>6</td></tr>
<tr><td>48-300</td><td>22.06</td><td>0.05852</td><td>1.291</td><td>6</td></tr>
<tr><td>300-6000</td><td>$3.142f^{0.3417}$</td><td>$0.008335f^{0.3417}$</td><td>$0.02619f^{0.6834}$</td><td>6</td></tr>
<tr><td>6000-15000</td><td>61.4</td><td>0.163</td><td>10</td><td>6</td></tr>
<tr><td>15000-150000</td><td>61.4</td><td>0.163</td><td>10</td><td>$616000/f^{1.2}$</td></tr>
<tr><td>150000-300000</td><td>$0.158f^{0.5}$</td><td>$4.21 \times 10^{-4} f^{0.5}$</td><td>$6.67 \times 10^{-5} f$</td><td>$616000/f^{1.2}$</td></tr>
<tr><td colspan="5">Note: f is frequency in MHz.
*Based on nerve stimulation (NS).
** Based on specific absorption rate (SAR).</td></tr>
</table>
</td></tr>
</table>

Test procedure

For the purpose of this evaluation, a minimum distance of 20cm was used to calculate the equivalent plan wave power density based on the Average EIRP values obtained in B.2, to be compared with the power density limit, according to following formula:

$$S_{eq} = \frac{P_{avg} \cdot G}{4 \cdot \pi \cdot R^2} \Rightarrow S_{eq} = \frac{EIRP}{4 \cdot \pi \cdot R^2}$$

Where:

S_{eq} = Equivalent Plane Wave Power Density, in Watts per square meter.

P_{avg} = Source-Based Average Power at antenna terminals, in Watts.

$EIRP$ = Equivalent Isotropically Radiated Power, in Watts.

G = Gain of the Transmitting Antenna.

R = Distance from the Transmitting Antenna, in meters.

Results

Power Density Calculation							
Mode	**MCS**	**Frequency (GHz)**	**Average EIRP (dBm)**	**Average EIRP (W)**	**Separation Distance (m)**	**Power Density (W/m^2)**	**Limit (W/m^2)**
WiGig	3	58.32	23.12	0.205	0.2	0.517	10
WiGig	3	60.48	24.85	0.305	0.2	0.626	10
WiGig	3	62.64	23.30	0.214	0.2	0.487	10