Test Report No:
2470803R-RFUSV15S-A

TEST REPORT
FCC Rules&Regulations

Product Name	WiFi USB Adapter
Brand Name	msi
Model No.	GUBE65
FCC ID	I4L-GUBE65
Applicant´s Name / Address	Micro-Star Int'l Co.,Ltd. No.69, Lide St., Zhonghe Dist., New Taipei City 235, Taiwan
Manufacturer's Name / Address	Micro-Star Int'l Co.,Ltd. No.69, Lide St., Zhonghe Dist., New Taipei City 235, Taiwan
Test Method Requested, Standard	FCC CFR Title 47 Part 15 Subpart E Section 15.407 ANSI C63.10: 2013
Verdict Summary	IN COMPLIANCE
Documented By	Amelia Wu
Approved By	Allen Lin
Date of Receipt	Jul. 26, 2024
Date of Issue	Feb. 14, 2025
Report Version	V1.0

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Competences and Guarantees

DEKRA is a testing laboratory competent to carry out the tests described in this report.
In order to assure the traceability to other national and international laboratories, DEKRA has a calibration and maintenance program for its measurement equipment.

DEKRA guarantees the reliability of the data presented in this report, which is the result of the measurements and the tests performed to the item under test on the date and under the conditions stated in the report and it is based on the knowledge and technical facilities available at DEKRA at the time of performance of the test.

DEKRA is liable to the client for the maintenance of the confidentiality of all information related to the item under test and the results of the test.

The results presented in this Test Report apply only to the particular item under test established in this document.

General Conditions

1. The test results relate only to the samples tested.
2. The test results shown in the test report are traceable to the national/international standard through the calibration report of the equipment and evaluated measurement uncertainty herein.
3. This report must not be used to claim product endorsement by TAF or any agency of the government.
4. The test report shall not be reproduced without the written approval of DEKRA Testing and Certification Co., Ltd.
5. Measurement uncertainties evaluated for each testing system and associated connections are given here to provide the system information for reference. Compliance determinations do not take into account measurement uncertainties for each testing system, but are based on the results of the compliance measurement.

Revision History

Version	Description	Issued Date
V1.0	Initial issue of report	Feb. 14, 2025

Summary of Test Result

Report Clause	Test Items	Result (PASS/FAIL)	Remark
3	AC Power Line Conducted Emission	PASS	-
4	Emission Bandwidth	PASS	-
5	Maximum E.I.R.P. Power	PASS	-
6	Maximum E.I.R.P. Power Spectral Density	PASS	-
7	Transmitter Radiated Spurious Emission	PASS	-
8	In-Ban Emission (Mask)	PASS	-
9	Contention-Based Protocol	PASS	-

Comments and Explanations
The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.

Comments and Remarks

The product specification and testing instructions for the EUT declared in the report are provided by the manufacturer who will take all responsibilities for the accuracy.

1. General Information

1.1. EUT Description

Frequency Range	5925 ~ 6425 MHz 6425 ~ 6525 MHz 6525 ~ 6875 MHz 6875 ~ 7125 MHz	
Operating Frequency / Channel Number	IEEE 802.11 ax/be (20 MHz)	U-NII-5: 5955 ~ 6415 MHz / 24 Channels U-NII-6: 6435 ~ 6515 MHz / 5 Channels U-NII-7: 6535 ~ 6875 MHz / 18 Channels U-NII-8: 6895 ~ 7115 MHz / 12 Channels
	IEEE 802.11 ax/be (40 MHz)	U-NII-5: 5965 ~ 6405 MHz / 12 Channels U-NII-6: 6445 ~ 6525 MHz / 3 Channels U-NII-7: 6525 ~ 6885 MHz / 10 Channels U-NII-8: 6885 ~ 7085 MHz / 6 Channels
	IEEE 802.11 ax/be (80 MHz)	U-NII-5: 5985 ~ 6385 MHz / 6 Channels U-NII-6: 6465 ~ 6545 MHz / 2 Channels U-NII-7: 6545 ~ 6865 MHz / 5 Channels U-NII-8: 6865 ~ 7025 MHz / 3 Channels
	IEEE 802.11 ax/be (160 MHz)	U-NII-5: 6025 ~ 6345 MHz / 3 Channels U-NII-6: 6505 MHz / 1 Channels U-NII-7: 6505 ~ 6825 MHz / 3 Channels U-NII-8: 6825 ~ 6985 MHz / 2 Channels
Type of Modulation	IEEE 802.11ax	OFDMA-BPSK, QPSK, 16QAM, 64QAM, 256QAM, 1024QAM
	IEEE 802.11be	OFDMA-BPSK, QPSK, 16QAM, 64QAM, 256QAM, 1024QAM, 4096QAM

Accessories Information				
No.	Equipment Name	Brand Name	Model No.	Remark
1	Cradle	msi	GUBE65 Cradle	With cable: Shielded, 0.9m

Antenna Information							
Ant.	Brand Name	Model No.	Type	Antenna Gain (dBi)			
				U-NII 5	U-NII 6	U-NII 7	U-NII 8
1	WHA YU	C059-510503-A	PCB	2.80	2.69	2.69	2.64
2	WHA YU	C059-510504-A	PCB	2.76	2.45	2.45	1.84

For IEEE 802.11ax/be Mode: (2TX, 2RX)

Both Ant. 1 and Ant. 2 can be used as transmitting/receiving antennas, and they can transmit/receive signal simultaneously.

1.2. EUT Information

EUT Power Type	From Host system			
Product Type	☐	Low-power Indoor Access Point	☐	Indoor Subordinate
	☒	Low-power Indoor Client	☐	Standard Power Access Point
	☐	Dual Client	☐	Standard Client
	☐	Fixed Client		
Beamforming Function	☐	With beamforming	☒	Without beamforming
Resource Unit of 802.11ax/be	☒	Full RU	☐	Partial RU
Channel Puncturing	☐	Support	☒	Not Support

1.3. Applicable Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- 47 CFR FCC Part 15
- ANSI C63.10-2013
- KDB 789033 D02 v02r01

The following reference test guidance is not within the scope of accreditation of TAF.

- Draft KDB 987594 D02
- KDB 662911 D01 v02r01
- KDB 412172 D01 v01r01

1.4. Testing Location Information

Testing Location Information		
Test Laboratory：DEKRA Testing and Certification Co., Ltd.		
	1 (TAF: 3024)	ADD: No.372-2, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County 31061, Taiwan, R.O.C. TEL: +886-3-582-8001 FAX: +886-3-582-8958 Test site Designation No. TW3024 with FCC. Conformity Assessment Body Identifier (CABID) TW3024 with ISED.
	2 (TAF: 3024)	ADD: No.372, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County 31061, Taiwan, R.O.C. TEL: +886-3-582-8001 FAX: +886-3-582-8958 Test site Designation No. TW3024 with FCC. Conformity Assessment Body Identifier (CABID) TW3024 with ISED.
Test site number for address 1 includes HC-SR02. Test site number for address 2 includes HC-CB02, HC-CB03, HC-CB04, HC-SR10 and HC-SR12.		

Test Condition	Test Site No.	Test Engineer	Test Environment (°C / %)	Test Date
AC Conduction Emission	HC-SR02	Gary Liao	19~21 / 60~61.5	2024/11/21~2024/11/22
RF Conducted Emission	HC-SR12	Kevin Teng	22.8~24.2 / 49.2~52.1	2024/10/01~2024/11/22
Radiated Emission	HC-CB04	Ling Chen Brook Cheng	22.9~24.6 / 47.6~51.1	2024/10/14-2024/10/24
Contention-Based Protocol	HC-SR10	Neil Yeh Igor Tseng	22 / 54	2025/02/13~2025/02/14

1.5. Measurement Uncertainty

Uncertainties have been calculated according to the DEKRA internal document with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level (based on a coverage factor (k=2).

Test Item	Uncertainty
AC Power Line Conducted Emission	± 2.34 dB
Emission Bandwidth	± 636.54 Hz
Maximum E.I.R.P. Power	± 1.16 dB
Maximum E.I.R.P. Power Spectral Density	± 2.47 dB
Transmitter Radiated Spurious Emission	± 3.52 dB below 1 GHz ± 3.56 dB above 1 GHz
In-Ban Emission (Mask)	± 2.47 dB
Contention-Based Protocol	± 2.47 dB

1.6. List of Test Equipment

HC-SR02

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Cal. Date	Next Cal. Date
Artificial Mains Network	R&S	ENV4200	848411/010	9kHz-30MHz, 4line/100A	2023/12/15	2024/12/14
EMI Test Receiver	R&S	ESR3	102608	9 kHz - 3.6 GHz	2024/09/11	2025/09/10
Two-Line V-Network	R&S	ENV216	100096	9kHz-30MHz	2024/06/03	2025/06/02
Coaxial Cable(9 m)	Harbour	RG-400	HC-SR02	9 kHz–2500 MHz	2024/08/15	2025/08/14
EMI Testing System	Audix	e3 210616 dekra V9	HC-SR02	N/A	N/A	N/A

HC-SR12

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Cal. Date	Next Cal. Date
High Speed Peak Power Meter Dual Input	Anritsu	ML2496A	1947001	0.3-40 GHz	2024/01/09	2025/01/08
Pulse Power Sensor	Anritsu	MA2411B	1911082	0.3-40 GHz	2024/01/09	2025/01/08
Pulse Power Sensor	Anritsu	MA2411B	1911083	0.3-40 GHz	2024/01/09	2025/01/08
Signal & Spectrum Analyzer	R&S	FSV40	101869	10Hz-40GHz	2024/06/20	2025/06/19

HC-CB04

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Cal. Date	Next Cal. Date
Signal and Spectrum Analyzer	R&S	FSVA40	101435	10 Hz-40 GHz	2024/05/17	2025/05/16
Trilog Broadband Antenna	Schwarzbeck	VULB 9168	1209	30 MHz-2 GHz	2024/06/11	2025/06/10
Double Ridged Horn Antenna	RF SPIN	DRH18-E	211212A18EN	1G-18GHz	2023/11/17	2024/11/16
Horn Antenna	Schwarzbeck	BBHA 9170	203	18G-40GHz	2024/02/02	2025/02/01
Pre-Amplifier	EMCI	EMC01820I	980364	30M-8 GHz,20 dB	2024/06/04	2025/06/03
Pre-Amplifier	EMEC	EM01G18GA	060835	1-18 GHz,50 dB	2024/07/16	2025/07/15
Pre-Amplifier	SGH	SGH184	20230411-2	18G-40 GHz,54 dB	2024/04/23	2025/04/22
EMI Test Receiver	R&S	ESR7	102260	10 Hz-7 GHz	2023/11/27	2024/11/26
Magnetic Loop Antenna	Teseq	HLA 6121	49611	0.01-30 MHz	2024/02/23	2025/02/22
Coaxial Cable	Huber+Suhner	SF104	HC-CB04	30 MHz-18 GHz, 11m	2024/08/07	2025/08/06
Coaxial Cable	Huber+Suhner,Rosnol	SF102_UP0264	HC-CB04-1	18-40 GHz, 3m	2024/08/13	2025/08/12
Radiated Software	Audix	e3 V9	HC-CB04_1	N/A	N/A	N/A

HC-SR10

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Cal. Date	Next Cal. Date
Spectrum Analyzer	Keysight	N9010B	MY57110159	10 Hz-7 GHz	2024/03/01	2025/02/28
MXG Vector Signal Generator	Keysight	N5182B	MY53052548	9 kHz-6 GHz	2025/01/06	2026/01/05
Frequency Extender	Keysight	N5182BX07	MY61500162	9 kHz- 7.2 GHz and 160 MHz modulation bandwidth	2025/01/10	2026/01/09

Note: All equipment upon which need to calibrated are with calibration period of 1 year.

2. Test Configuration of EUT

2.1. Test Condition

EUT Operational Condition	
Testing Voltage	AC 120V/60Hz

2.2. Test Frequency Mode

Test Software	AX Series MP Toolkit

<2TX, NSS 1>

Modulation	Frequency (MHz)	Power Setting
802.11be (20 MHz)	5955	8.75
	6195	8.75
	6415	8.75
	6435	8.25
	6475	8.25
	6515	7.75
	6535	8.75
	6695	9.00
	6855	9.50
	6875	9.25
	6895	9.75
	7015	10.50
	7115	10.50
802.11be (40 MHz)	5965	11.25
	6205	10.75
	6405	11.00
	6445	11.50

	6485	11.50
	6525	10.50
	6565	11.00
	6725	11.00
	6845	12.50
	6885	12.00
	6925	12.50
	7005	13.00
	7085	12.00

Modulation	Frequency (MHz)	Power Setting
802.11be (80 MHz)	5985	12.50
	6225	12.50
	6385	12.50
	6465	12.50
	6545	12.50
	6625	12.50
	6705	12.50
	6785	12.50
	6865	12.50
	6945	13.00
	7025	13.00
802.11be (160 MHz)	6025	12.50
	6185	12.50
	6345	12.50
	6505	12.50
	6665	12.50
	6825	12.50
	6985	13.00

<2TX, NSS 2>

Modulation	Frequency (MHz)	Power Setting
802.11be (20 MHz)	5955	9.75
	6195	9.25
	6415	9.50
	6435	8.25
	6475	8.75
	6515	8.25
	6535	7.50
	6695	8.00
	6855	9.00
	6875	9.50
	6895	9.75
	7015	9.75
	7115	10.25
802.11be (40 MHz)	5965	12.00
	6205	11.50
	6405	11.75
	6445	11.00
	6485	11.00
	6525	10.50
	6565	11.00
	6725	11.00
	6845	12.50
	6885	12.00
	6925	13.00
	7005	13.00
	7085	11.50

Modulation	Frequency (MHz)	Power Setting
802.11be (80 MHz)	5985	12.50
	6225	12.50
	6385	12.50
	6465	12.50
	6545	12.50
	6625	12.50
	6705	12.50
	6785	12.50
	6865	12.50
	6945	13.00
	7025	13.00
802.11be (160 MHz)	6025	12.50
	6185	12.50
	6345	12.50
	6505	12.50
	6665	12.50
	6825	12.50
	6985	13.00

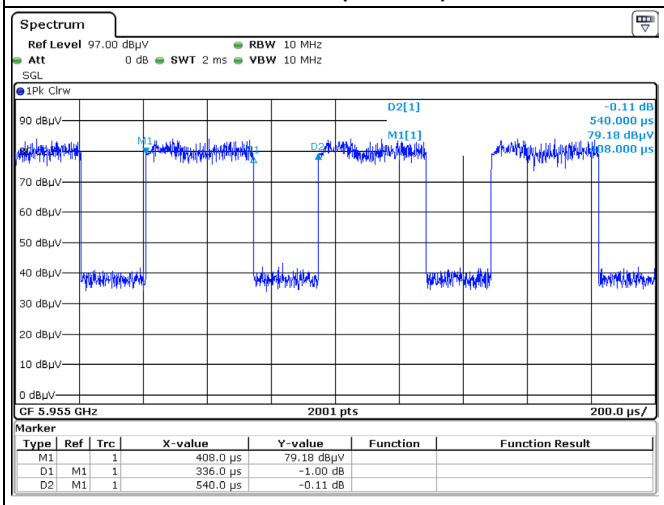
2.3. Duty Cycle

<2TX, NSS 1>

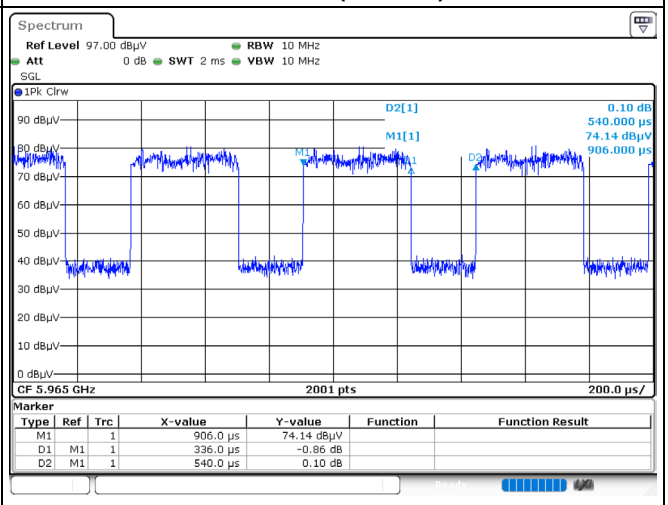
Modulation	On Time (ms)	On+Off Time (ms)	Duty Cycle (%)	Duty Factor (dB)	1/T Minimum VBW (kHz)
802.11be (20 MHz)	0.336	0.540	62.28	2.06	2.976
802.11be (40 MHz)	0.336	0.540	62.28	2.06	2.976
802.11be (80 MHz)	0.336	0.540	62.28	2.06	2.976
802.11be (160 MHz)	0.336	0.540	62.28	2.06	2.976

Note: The duty factor will compensate for the total power and power spectral density.

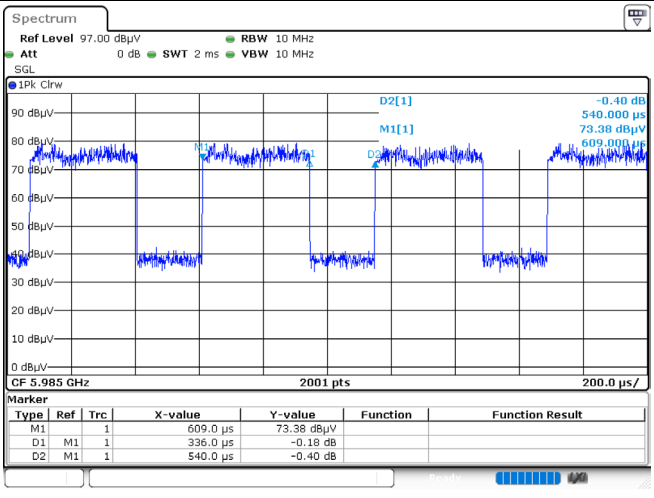
802.11be (20 MHz)



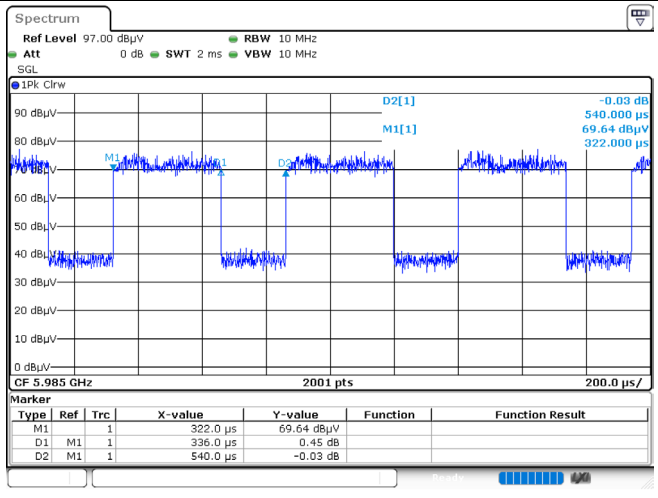
802.11be (40 MHz)



802.11be (80 MHz)



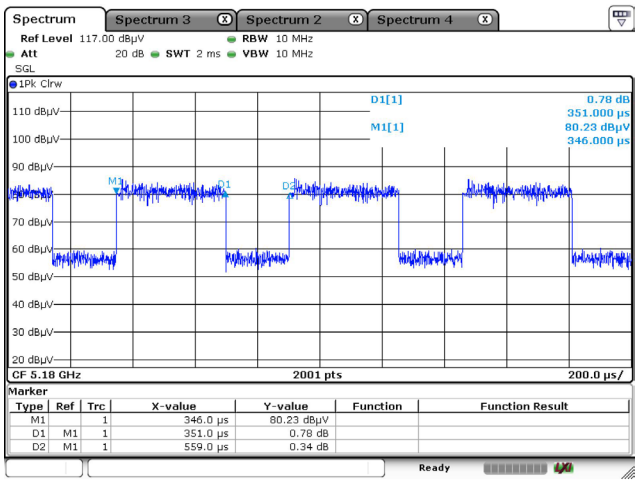
802.11be (160 MHz)



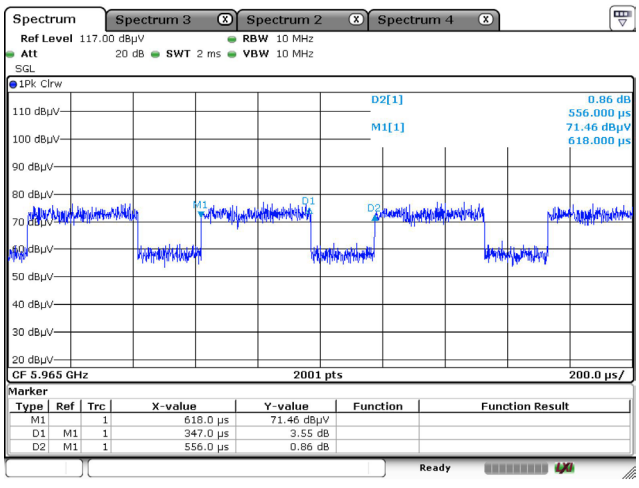
<2TX, NSS 2>

Modulation	On Time (ms)	On+Off Time (ms)	Duty Cycle (%)	Duty Factor (dB)	1/T Minimum VBW (kHz)
802.11be (20 MHz)	0.351	0.559	62.79	2.02	2.849
802.11be (40 MHz)	0.347	0.556	62.41	2.05	2.882
802.11be (80 MHz)	0.350	0.557	62.84	2.02	2.857
802.11be (160 MHz)	0.349	0.556	62.77	2.02	2.865

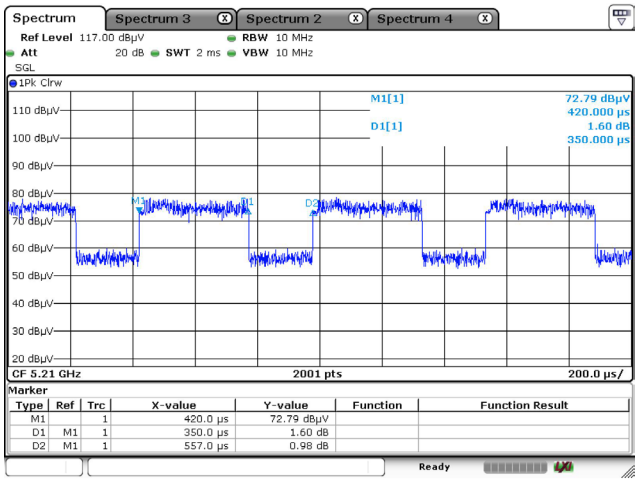
802.11be (20 MHz)



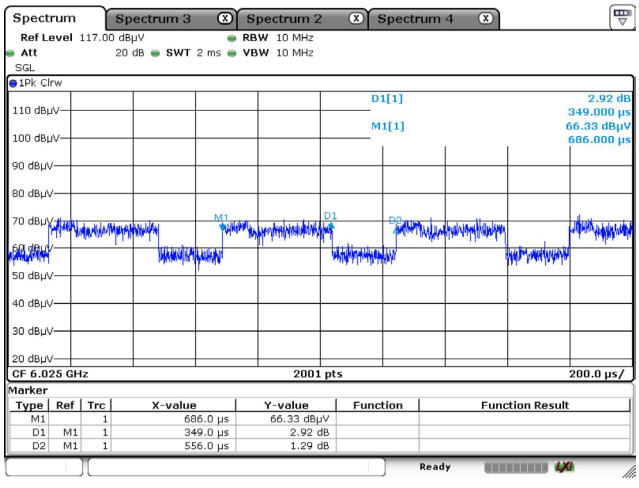
802.11be (40 MHz)



802.11be (80 MHz)



802.11be (160 MHz)



2.4. The Worst Case Measurement Configuration

Tests Item	AC Power Line Conducted Emission
Test Condition	AC power line conducted measurement for line and neutral
Operating Mode	Transmit

Tests Item	Maximum E.I.R.P. Power Maximum E.I.R.P. Power Spectral Density
Test Condition	Radiated measurement at transmit chains

Tests Item	Emission Bandwidth In-Band Emission (Mask) Contention Based Protocol
Test Condition	Conducted measurement at transmit chains

Tests Item	Transmitter Radiated Spurious Emission
Test Condition	Radiated measurement If EUT consist of multiple antenna assembly (multiple antenna are used in EUT regardless of spatial multiplexing MIMO configuration), the radiated test should be performed with highest antenna gain of each antenna type.
Operating Mode < 1GHz	Transmit
Operating Mode > 1GHz	Transmit
The EUT was performed at X axis, Y axis and Z axis position for radiated spurious emission test. The worst case was found at Z axis, so the measurement will follow this same test configuration.	

Note:

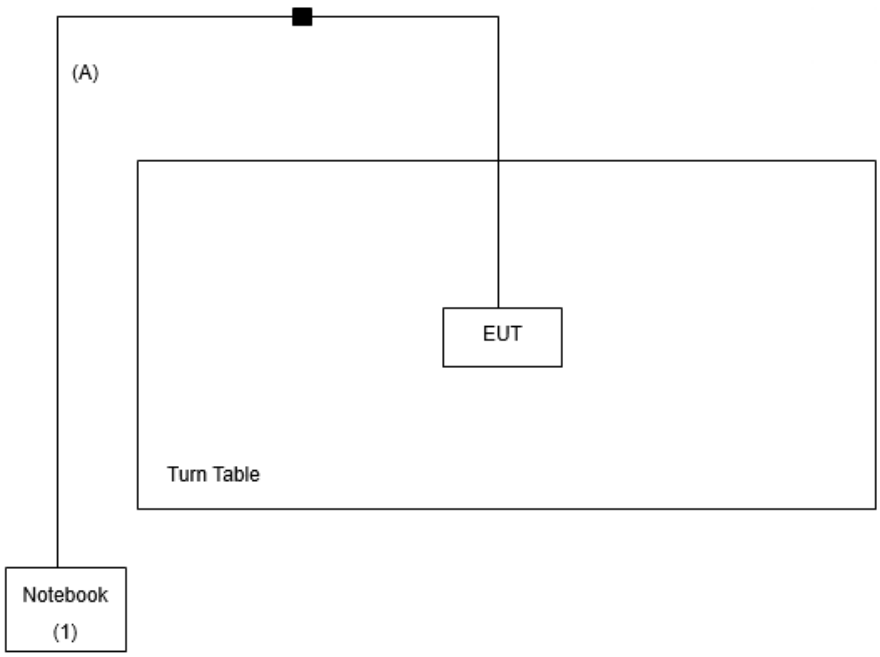
1. Determining compliance shall be based on the results of the compliance measurement, not taking into account measurement instrumentation uncertainty.
2. For radiated spurious emission below 1 GHz and AC power line conducted emission have performed all modes of operation were investigated and the worst-case emissions are reported.
3. The modulation and bandwidth are similar for 802.11ax mode for HEW20/HEW40/HEW80/HEW160 and 802.11be mode for EHT20/EHT40/EHT80/EHT160, therefore investigated worst case to representative mode in test report.

2.5. Tested System Details

No.	Equipment	Brand Name	Model No.	Serial No.
1	Notebook	ASUS	BX310U	J5N0CV04S32319B

2.6. Configuration of tested System

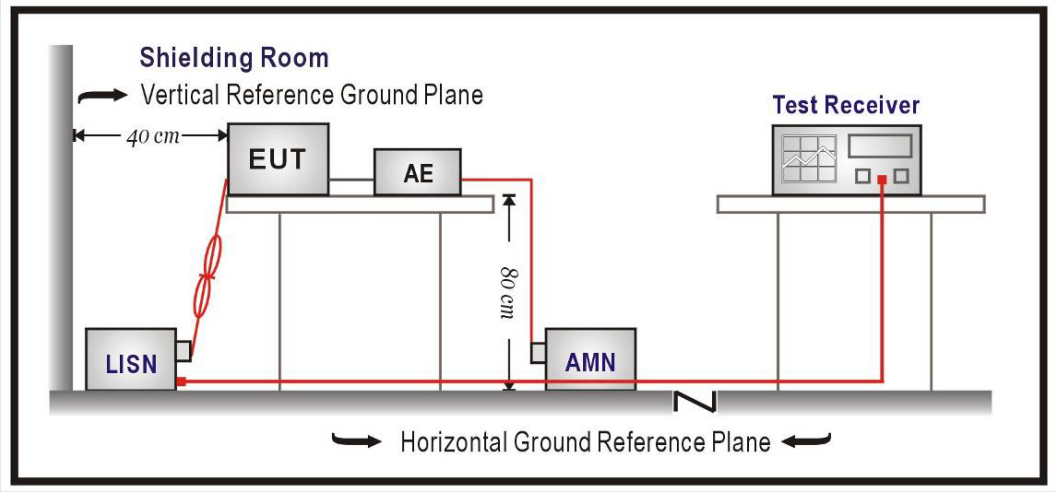
Connection Diagram



Signal Cable Type		Signal cable Description
A	USB Cable	Non-Shielded, 10m

3. AC Power Line Conducted Emission

3.1. Test Setup



3.2. Test Limit

Frequency (MHz)	QP (dBuV)	AV (dBuV)
0.15 - 0.50	66 - 56	56 - 46
0.50 - 5.0	56	46
5.0 - 30	60	50

Remark: In the above table, the tighter limit applies at the band edges.

3.3. Test Procedure

The EUT was setup according to ANSI C63.10: 2013. The EUT was placed on a platform of nominal size, 1 m by 1.5 m, raised 80 cm above the conducting ground plane. The vertical conducting plane was located 40 cm to the rear of the EUT. All other surfaces of EUT were at least 80 cm from any other grounded conducting surface. The EUT and simulators are connected to the main power through a line impedance stabilization network (LISN). The LISN provides a 50 ohm /50uH coupling impedance for the measuring equipment. The peripheral devices are also connected to the main power through a LISN. (Please refer to the block diagram of the test setup and photographs.)

Each current-carrying conductor of the EUT power cord, except the ground (safety) conductor, was individually connected through a LISN to the input power source.

The excess length of the power cord between the EUT and the LISN receptacle were folded back and forth at the center of the lead to form a bundle not exceeding 40 cm in length.

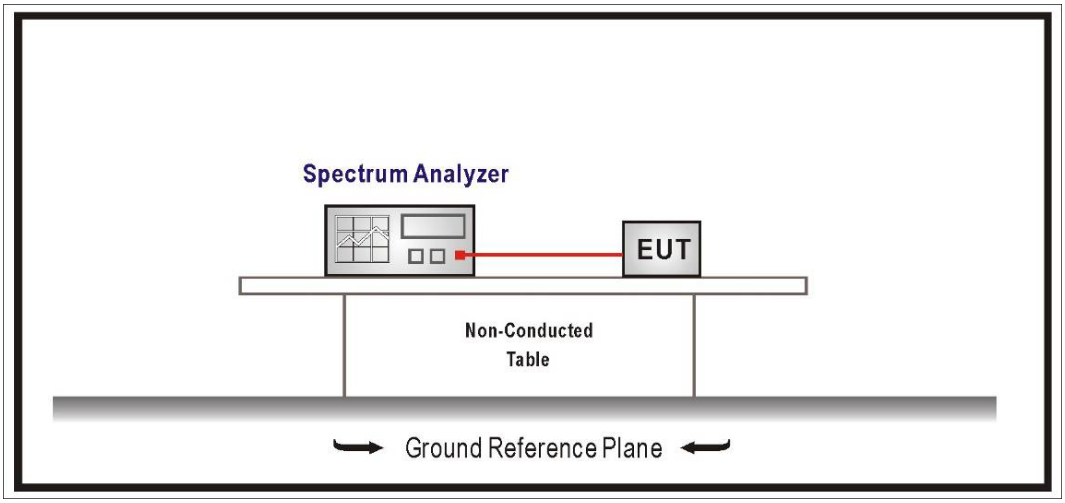
Conducted emissions were investigated over the frequency range from 0.15MHz to 30MHz using a receiver bandwidth of 9 kHz.

3.4. Test Result of AC Power Line Conducted Emission

Refer as Appendix A

4. Emission Bandwidth

4.1. Test Setup



4.2. Test Limit

No Required

4.3. Test Procedure

The EUT was tested according to U-NII test procedure of KDB 789033.

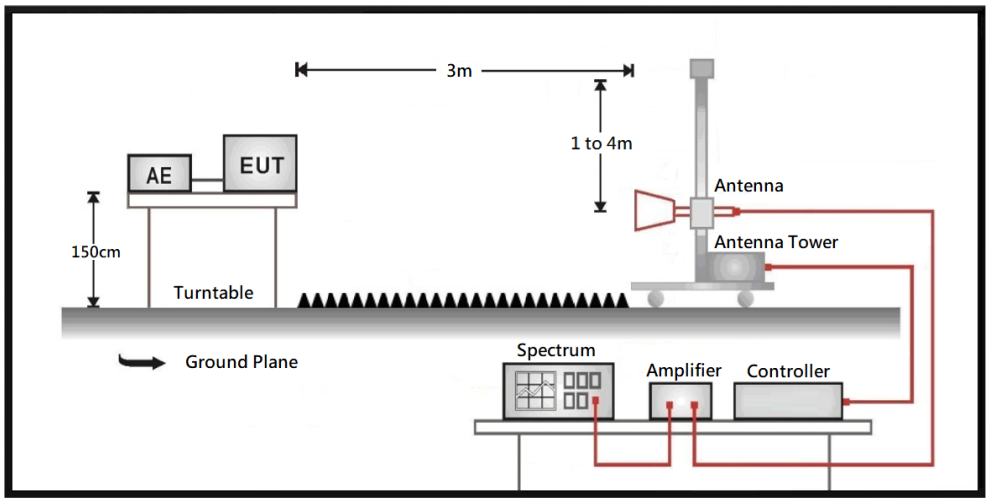
Set RBW 1% of the emission bandwidth, VBW equal to 3 times the RBW.

4.4. Test Result of Emission Bandwidth

Refer as Appendix B

5. Maximum E.I.R.P. Power

5.1. Test Setup



5.2. Test Limit

1. For the 5.925 ~ 6.425 GHz band:

   For standard power access point and fixed client device : e.i.r.p < 36 dBm , For outdoor devices, the maximum e.i.r.p. at any elevation angle above 30 degrees not exceed 125 mW (21 dBm).

   For indoor access point : e.i.r.p < 30 dBm.

   For subordinate device control of an indoor access point : e.i.r.p < 30 dBm.

   For client device control of a standard power access point : e.i.r.p < 30 dBm.

   For client device control of an indoor access point : e.i.r.p < 24 dBm.

2. For the 6.425 ~ 6.525 GHz band:

   For indoor access point : e.i.r.p < 30 dBm.

   For client device control of an indoor access point : e.i.r.p < 24 dBm.

3. For the 6.525 ~ 6.875 GHz band:

   For standard power access point and fixed client device : e.i.r.p < 36 dBm , For outdoor devices, the maximum e.i.r.p. at any elevation angle above 30 degrees not exceed 125 mW (21 dBm).

   For indoor access point : e.i.r.p < 30 dBm.

   For subordinate device control of an indoor access point : e.i.r.p < 30 dBm.

   For client device control of a standard power access point : e.i.r.p < 30 dBm.

   For client device control of an indoor access point : e.i.r.p < 24 dBm.

4. For the 6.87 ~ 7.125 GHz band:

   For indoor access point : e.i.r.p < 30 dBm.

   For client device control of an indoor access point : e.i.r.p < 24 dBm.

5.3. Test Procedure

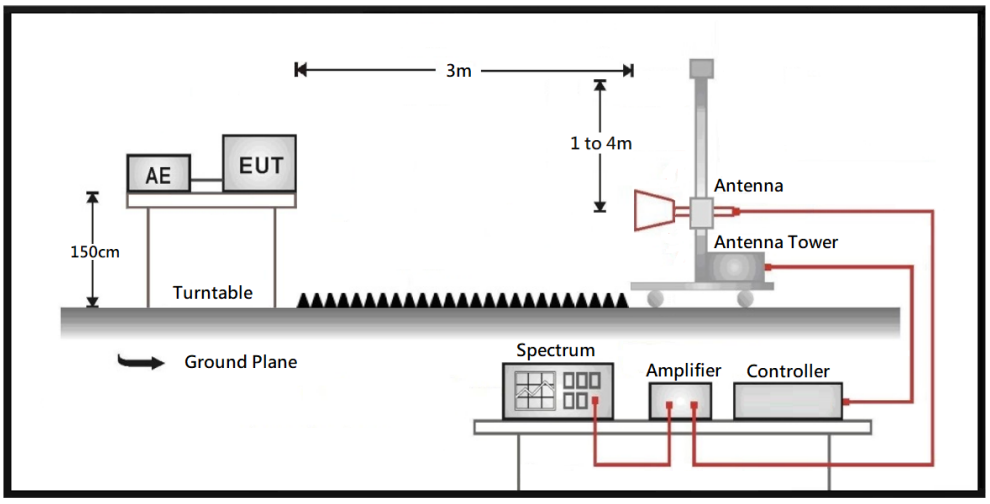
The EUT and its simulators are placed on a turn table which is 0.8 or 1.5 meter above ground. The turn table can rotate 360 degrees to determine the position of the maximum emission level. The EUT was positioned such that the distance from antenna to the EUT was 3 meters.
The antenna can move up and down between 1 meter and 4 meters to find out the maximum emission level. Both horizontal and vertical polarization of the antenna are set on measurement. In order to find the maximum emission, all of the interface cables must be manipulated according to ANSI C63.10: 2013 on radiated measurement.
The bandwidth above 1 GHz setting on the field strength meter are 1 MHz.
The frequency range from 30 MHz to 10th harmonics and included The frequency range from the lowest oscillator frequency generated within the device up to the 10th harmonic was checked is checked.

5.4. Test Result of Maximum E.I.R.P. Power

Refer as Appendix C

6. Maximum E.I.R.P. Power Spectral Density

6.1. Test Setup



6.2. Test Limit

1. For the 5.925 ~ 6.425 GHz band:

   For standard power access point and fixed client device : e.i.r.p PSD < 23 dBm/MHz.

   For indoor access point : e.i.r.p PSD < 5 dBm/MHz.

   For subordinate device control of an indoor access point : e.i.r.p PSD < 5 dBm/MHz.

   For client device control of a standard power access point : e.i.r.p PSD < 17 dBm/MHz.

   For client device control of an indoor access point : e.i.r.p PSD < -1 dBm/MHz.

2. For the 6.425 ~ 6.525 GHz band:

   For indoor access point : e.i.r.p PSD < 5 dBm/MHz.

   For client device control of an indoor access point : e.i.r.p PSD < -1 dBm/MHz.

3. For the 6.525 ~ 6.875 GHz band:

   For standard power access point and fixed client device : e.i.r.p PSD < 23 dBm/MHz.

   For indoor access point : e.i.r.p PSD < 5 dBm/MHz.

   For subordinate device control of an indoor access point : e.i.r.p PSD < 5 dBm/MHz.

   For client device control of a standard power access point : e.i.r.p PSD < 17 dBm/MHz.

   For client device control of an indoor access point : e.i.r.p PSD < -1 dBm/MHz.

4. For the 6.875 ~ 7.125 GHz band:

   For indoor access point : e.i.r.p PSD < 5 dBm/MHz.

   For client device control of an indoor access point : e.i.r.p PSD < -1 dBm/MHz.

6.3. Test Procedure

The EUT and its simulators are placed on a turn table which is 0.8 or 1.5 meter above ground. The turn table can rotate 360 degrees to determine the position of the maximum emission level. The EUT was positioned such that the distance from antenna to the EUT was 3 meters.

The antenna can move up and down between 1 meter and 4 meters to find out the maximum emission level. Both horizontal and vertical polarization of the antenna are set on measurement. In order to find the maximum emission, all of the interface cables must be manipulated according to ANSI C63.10: 2013 on radiated measurement.

The bandwidth above 1 GHz setting on the field strength meter are 1 MHz.

The frequency range from 30 MHz to 10th harmonics and included The frequency range from the lowest oscillator frequency generated within the device up to the 10th harmonic was checked is checked.

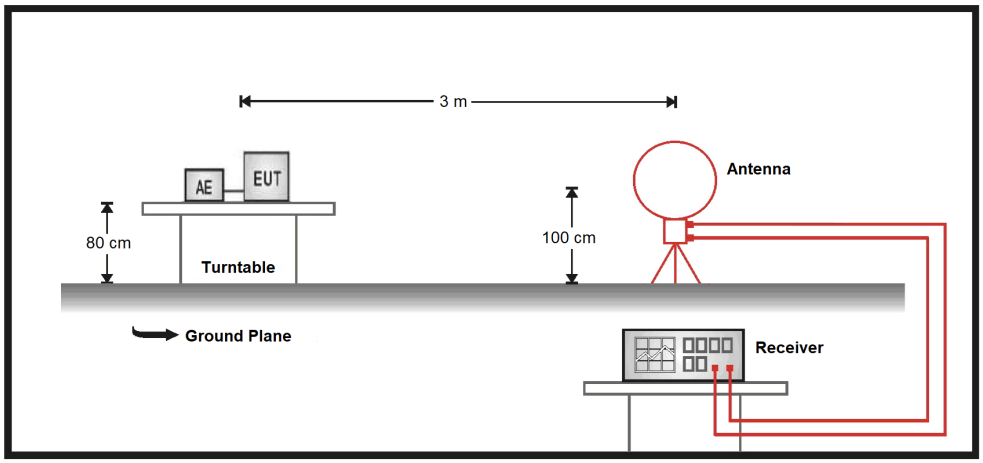
6.4. Test Result of Maximum E.I.R.P. Power Spectral Density

Refer as Appendix D

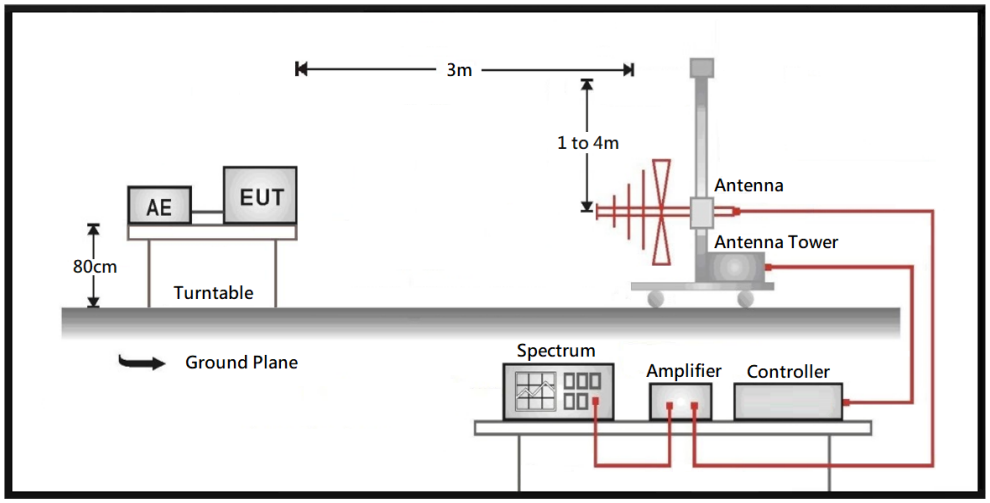
7. Transmitter Radiated Spurious Emission

7.1. Test Setup

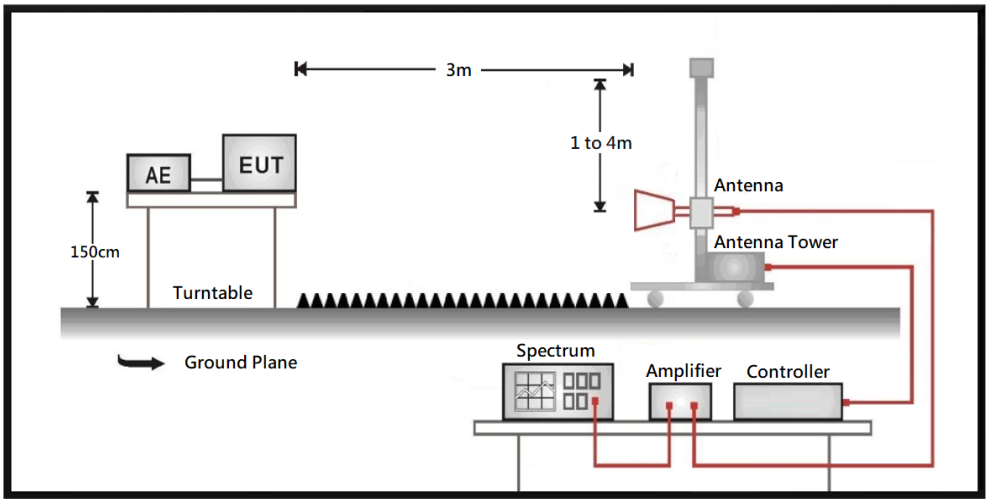
9kHz~30MHz



30MHz~1GHz



Above 1GHz



7.2. Test Limit

General Radiated Emission Test Limit

The provisions of Section 15.205 of this part apply to intentional radiators operating under this section. Radiated emissions which fall in the restricted bands, as defined in Section 15.205, must also comply with the radiated emission limit specified in Section 15.209:

Frequency (MHz)	Field strength (uV/m)	Field strength (dBuV/m)	Measurement distance (m)
0.009 – 0.490	2400/F(kHz)	20 log (2400/F(kHz))	300
0.490 – 1.705	24000/F(kHz)	20 log (24000/F(kHz))	30
1.705 - 30	30	29.5	30
30 - 88	100	40	3
88 - 216	150	43.5	3
216 - 960	200	46	3
Above 960	500	54	3

Remarks:

1. Field strength (dBuV/m) = 20 log Field strength (uV/m)
2. In the Above Table, the tighter limit applies at the band edges.
2. Distance refers to the distance in meters between the measuring instrument antenna and the closed point of any part of the device or system

Unwanted Emission out of the restricted bands Test Limit

Frequency (MHz)	EIRP Limit (dBm/MHz)	Equivalent Field Strength (dBuV/m@3m)
5925 MHz > F 7125 MHz	Peak: -7	88.2
	Average: -27	68.2

Remark:

The following for mula is used to convert the equipment isotropic radiated power (eirp) to field strength:

E = $\frac{1000000\sqrt{30P}}{3}$ uV/m, where P is the eirp (Watts).

7.3. Test Procedure

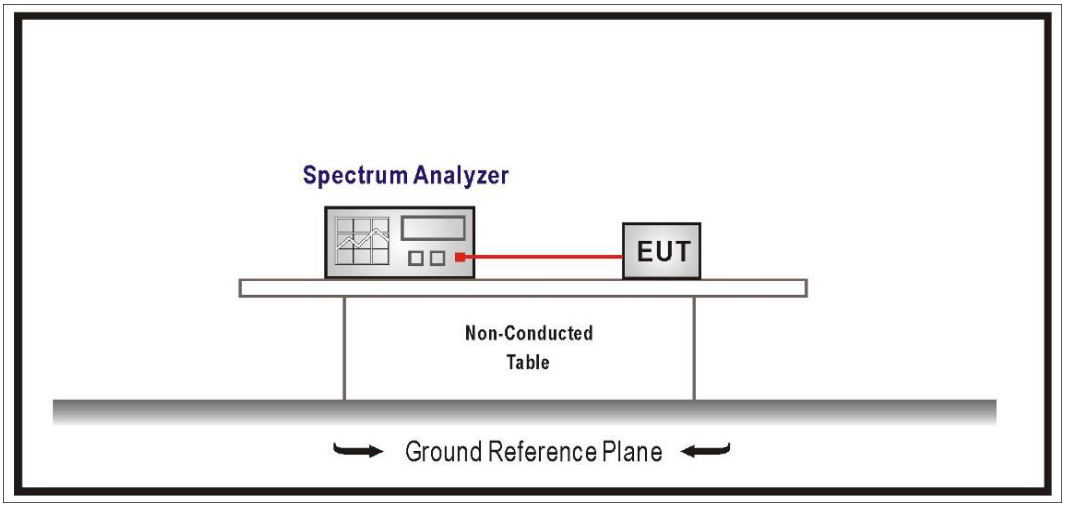
The EUT and its simulators are placed on a turn table which is 0.8 or 1.5 meter above ground. The turn table can rotate 360 degrees to determine the position of the maximum emission level. The EUT was positioned such that the distance from antenna to the EUT was 3 meters.
The antenna can move up and down between 1 meter and 4 meters to find out the maximum emission level. Both horizontal and vertical polarization of the antenna are set on measurement. In order to find the maximum emission, all of the interface cables must be manipulated according to ANSI C63.10: 2013 on radiated measurement.
The additional latch filter below 1 GHz was used to measure the level of harmonics radiated emission during field dtrength of harmonics measurement.
The bandwidth below 1 GHz setting on the field strength meter is 120 kHz, above 1 GHz are 1 MHz.
The frequency range from 30 MHz to 10th harmonics and included The frequency range from the lowest oscillator frequency generated within the device up to the 10^{th} harmonic was checked is checked.

7.4. Test Result of Transmitter Radiated Spurious Emission

Refer as Appendix E

8. In-Band Emission (Mask)

8.1. Test Setup



8.2. Test Limit

Test Items	Frequencies (MHz)	(X) dBc*1
Emission Mask	At 1MHz outside of channel ege	20
	At one channel bandwidth from the channel center*2	28
	At one- and one-half times the channel bandwidth away from channek center*3	40
	More than one- and one-half times the channel bandwidth	40

Remark:

1. The power spectral density must be suppressed by “x” dB.
2. At frequencies between one megahertz outside an unlicensed device’s channek edge and one channel bandwidth from the center of the cannel, the limit must be linearly interpolated between 20 dB and 28 dB suppression.
3. At frequencies between one and one- and one-half times an unlicensed device’s channel bandwidth, the limit must be linearly interpolated between 28 dB and 40 dB suppression.

8.3. Test Procedure

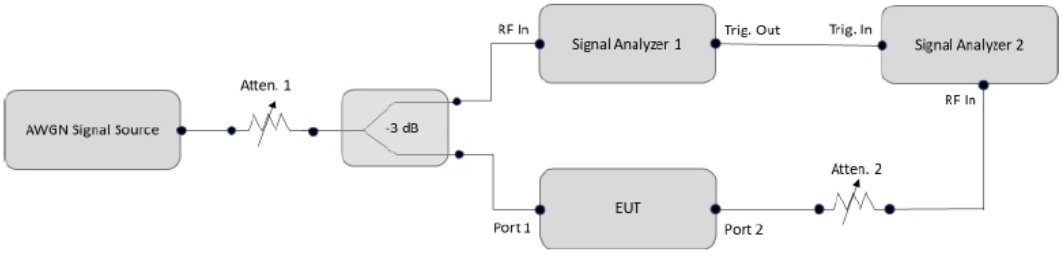
1. Connect output of the antenna port to a spectrum analyzer and adjust appropriate attenuation.
2. Measure the 26 dB EBW using the test procedure 12.4.1 of ANSI C63.10-2013. (Determine the channel edge.)
3. Measure the power spectral density (for emissions mask reference) using the following procedure:
   (1) Set the span to encompass the entire 26 dB EBW of the signal.
   (2) Set RBW = same RBW used for 26 dB EBW measurement.
   (3) Set VBW ≥ 3 X RBW
   (4) Number of points in sweep ≥ [2 X span / RBW].
   (5) Sweep time = auto.
   (6) Detector = RMS (i.e., power averaging)
   (7) Trace average at least 100 traces in power averaging (rms) mode.
   (8) Use the peak search function on the instrument to find the peak of the spectrum.
4. Using the measuring equipment limit line function, develop the emissions mask based on the following requirements. The emissions power spectral density must be reduced below the peak power spectral density (in dB) as follows:
   (1) Suppressed by 20 dB at 1 MHz outside of the channel edge. (The channel edge is defined as the 26-dB point on either side of the carrier center frequency.)
   (2) Suppressed by 28 dB at one channel bandwidth from the channel center.
   (3) Suppressed by 40 dB at one- and one-half times the channel bandwidth from the channel center.
5. Adjust the span to encompass the entire mask as necessary and clear trace.
6. Trace average at least 100 traces in power averaging (rms) mode.
7. Adjust the reference level as necessary so that the crest of the channel touches the top of the emission mask

8.4. Test Result of In-Band Emission (Mask)

Refer as Appendix F

9. Contention Based Protocol

9.1. Test Setup



9.2. Test Limit

Unlicensed indoor low-power devices must detect co-channe radio frequency power that is at least -62 dBm (The threshold is referenced to a 0dBi antenna gain.) or lower. Additionally, indoor low-power devices must detect co-channek energy with 90% or greater certainty.

9.3. Test Procedure

1. Set the signal analyzer center frequency to the nominal EUT channel center frequency. The span range of the signal analyzer shall be between two times and five times the OBW of the EUT. Connect the output port of the EUT to the signal analyzer 2. Ensure that the attenuator 2 provides enough attenuation to not overload the signal analyzer 2 receiver.
2. Monitoring the signal analyzer 2, verify the EUT is operating and transmitting with the parameters (set as following section 4.7.5 EUT operating condition).
3. Determine number of times detection threshold test as following table:

Test Items	Number of Tests	Placement of Incumbent Transmission
$BW_{EUT} \leqq BW_{Inc}$	Once	Same as EUT transmission
$BW_{Inc} < BW_{EUT} \leqq 2xBW_{Inc}$	Once	Contained within BWEUT
$2xBW_{Inc} < BW_{EUT} \leqq 4xBW_{Inc}$	Twice. (Incumbent transmission is contained within BWEUT)	Closely to the lower edge and upper edge of the EUT Channel
$BW_{EUT} > 4xBW_{Inc}$	Three times	Closely to the lower edge ,in the middle and upper edge of the EUT Channel

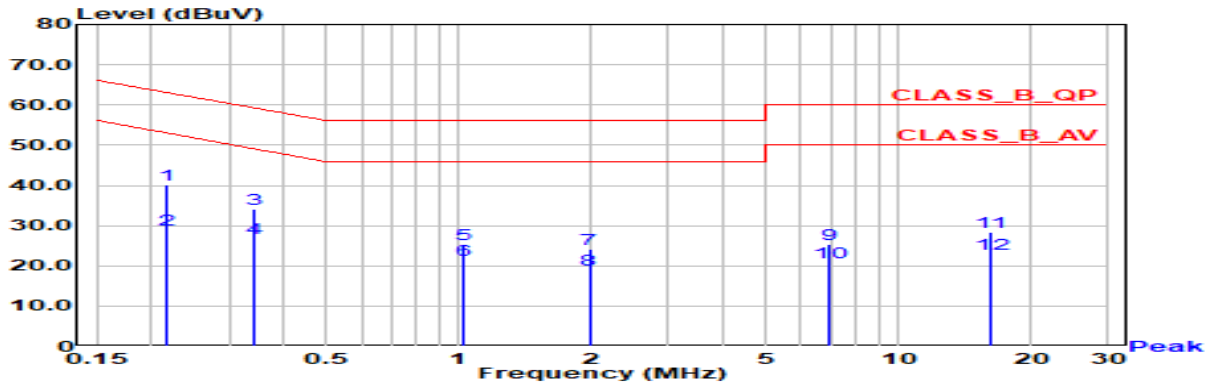
4. Using an AWGN signal source, generate (but do not transmit, i.e., RF OFF) a 10 MHz-wide AWGN signal. Use step c table to determine the center frequency of the 10 MHz AWGN signal relative to the EUT's channel bandwidth and center frequency.
5. Set the AWGN signal power to an extremely low level (more than 20 dB below the -62 dBm threshold). Connect the AWGN signal source, via a 3-dB splitter, to the signal analyzer 1 and the EUT.
6. Transmit the AWGN signal (RF ON) and verify its characteristics on the signal analyzer 1.
7. Monitor the signal analyzer 2 to verify if the AWGN signal has been detected and the EUT has ceased transmission. If the EUT continues to transmit, then incrementally increase the AWGN signal power level until the EUT stops transmitting.
8. (Including all losses in the RF paths) Determine and record the AWGN signal power level (at the EUT's antenna port) at which the EUT ceased transmission. Repeat the procedure at least 10 times to verify the EUT can detect an AWGN signal with 90% (or better) level of certainty.
9. Refer to step c table to determine number of times the detection threshold testing needs to be repeated. If testing is required more than once, then go back to step d, choose a different center frequency for the AWGN signal and repeat the process.

9.4. Test Result of Contention Based Protocol

Refer as Appendix G

Appendix A. Test Result of AC Power Line Conducted Emission

Test Mode	Transmit	Phase	Line
Test Condition	802.11be (160MHz) / Ant. 1 + Ant. 2 / 6185 MHz		

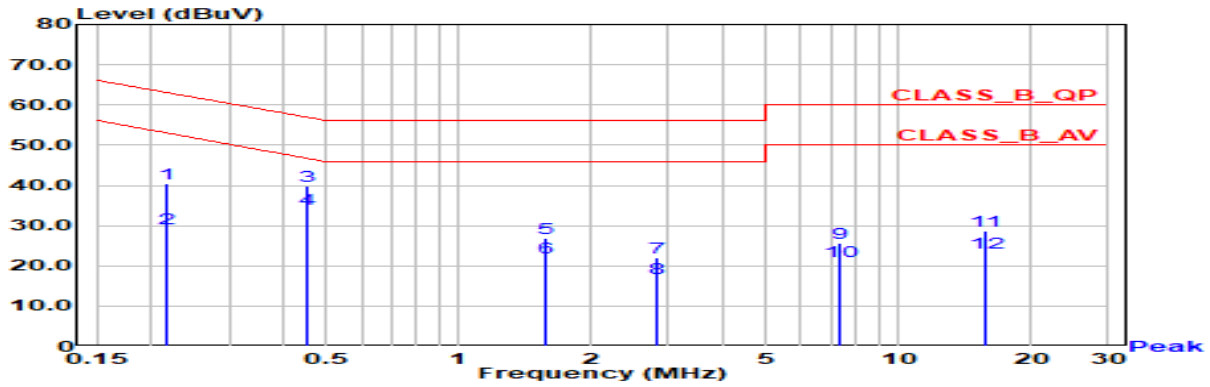


No	Frequency (MHz)	Emission Level (dBuV)	Limit (dBuV)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB)	Detector Type
1	0.217	40.30	62.93	-22.63	30.63	9.67	QP
2	0.217	29.08	52.93	-23.84	19.41	9.67	AV
3	0.342	34.02	59.16	-25.14	24.35	9.67	QP
*4	0.342	26.93	49.16	-22.23	17.26	9.67	AV
5	1.028	25.44	56.00	-30.56	15.73	9.70	QP
6	1.028	21.33	46.00	-24.67	11.62	9.70	AV
7	1.980	24.21	56.00	-31.79	14.34	9.87	QP
8	1.980	19.09	46.00	-26.91	9.22	9.87	AV
9	6.937	25.40	60.00	-34.60	15.39	10.01	QP
10	6.937	20.94	50.00	-29.06	10.93	10.01	AV
11	16.140	28.29	60.00	-31.71	18.08	10.21	QP
12	16.140	22.96	50.00	-27.04	12.75	10.21	AV

Remark:

1. "*" means this data is the worst emission level.
2. Emission Level = Reading Level + Correct Factor (Correct Factor = LISN Insertion Loss + Cable Loss).
3. Margin = Emission Level - Limit.

Test Mode	Transmit	Phase	Neutral
Test Condition	802.11be (160MHz) / Ant. 1 + Ant. 2 / 6185 MHz		



No	Frequency (MHz)	Emission Level (dBuV)	Limit (dBuV)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB)	Detector Type
1	0.216	40.51	62.98	-22.47	30.84	9.67	QP
2	0.216	29.36	52.98	-23.62	19.69	9.67	AV
3	0.452	39.89	56.83	-16.93	30.22	9.67	QP
*4	0.452	34.19	46.83	-12.64	24.52	9.67	AV
5	1.575	26.76	56.00	-29.24	16.96	9.80	QP
6	1.575	22.17	46.00	-23.83	12.38	9.80	AV
7	2.813	21.96	56.00	-34.04	12.06	9.89	QP
8	2.813	16.81	46.00	-29.19	6.92	9.89	AV
9	7.359	25.65	60.00	-34.35	15.63	10.02	QP
10	7.359	21.10	50.00	-28.90	11.08	10.02	AV
11	15.686	28.53	60.00	-31.47	18.33	10.20	QP
12	15.686	23.31	50.00	-26.69	13.11	10.20	AV

Remark:

1. "*" means this data is the worst emission level.

2. Emission Level = Reading Level + Correct Factor (Correct Factor = LISN Insertion Loss + Cable Loss).

3. Margin = Emission Level - Limit.

Appendix B. Test Result of Emission Bandwidth

<2TX, NSS 1>

802.11be (20 MHz)

Frequency (MHz)	99% dB Bandwidth (MHz)		26dB Occupied Bandwidth (MHz)		Limit (MHz)
	Ant. 1	Ant. 2	Ant. 1	Ant. 2	
5955	21.34	21.34	20.80	20.44	-
6195	21.30	21.34	20.60	20.60	-
6415	21.50	21.30	20.60	20.76	-
6435	21.30	21.34	20.76	20.68	-
6475	21.06	21.50	20.68	20.60	-
6515	21.46	21.26	20.60	20.52	-
6535	21.18	21.30	20.80	20.88	-
6695	21.42	21.54	20.68	20.760	-
6855	21.22	21.42	20.76	20.60	-
6875 (U-NII 7~8)	21.18	21.38	20.64	20.60	-
6895	21.54	21.30	20.80	20.64	-
7015	20.98	21.38	20.80	20.92	-
7115	21.46	21.46	20.88	20.88	-

802.11be (40 MHz)

Frequency (MHz)	99% dB Bandwidth (MHz)		26dB Occupied Bandwidth (MHz)		Limit (MHz)
	Ant. 1	Ant. 2	Ant. 1	Ant. 2	
5965	39.80	39.96	39.68	39.68	-
6205	39.96	40.04	40.32	40.00	-
6405	39.88	39.88	39.92	39.92	-
6445	39.88	39.88	40.16	40.00	-
6485	39.88	39.96	39.68	39.76	-
6525 (U-NII-6~7)	39.88	39.80	39.84	39.84	-
6565	39.56	39.56	39.92	40.08	-
6725	39.80	39.72	40.08	39.84	-
6845	39.64	39.64	40.24	39.84	-
6885 (U-NII-7~8)	39.64	39.72	39.92	40.08	-
6925	39.56	39.64	39.92	39.84	-
7005	39.88	39.80	40.00	39.92	-
7085	39.72	39.64	40.16	39.84	-

802.11be (80 MHz)

Frequency (MHz)	99% dB Bandwidth (MHz)		26dB Occupied Bandwidth (MHz)		Limit (MHz)
	Ant. 1	Ant. 2	Ant. 1	Ant. 2	
5985	77.20	77.04	80.32	79.84	-
6225	77.04	77.04	80.48	80.00	-
6385	77.20	77.20	80.00	80.00	-
6465	77.20	77.04	80.00	80.00	-
6545 (U-NII-6~7)	77.04	77.36	80.00	80.00	-
6625	76.88	77.04	80.00	80.00	-
6705	77.04	77.20	80.48	80.00	-
6785	77.20	77.04	80.00	80.00	-
6865 (U-NII-7~8)	77.04	76.88	80.00	79.84	-
6945	77.20	77.20	80.32	80.00	-
7025	76.56	76.88	80.16	80.00	-

802.11be (160 MHz)

Frequency (MHz)	99% dB Bandwidth (MHz)		26dB Occupied Bandwidth (MHz)		Limit (MHz)
	Ant. 1	Ant. 2	Ant. 1	Ant. 2	
6025	157.60	157.60	301.92	298.08	-
6185	157.28	157.28	293.76	290.40	-
6345	156.96	157.28	162.56	162.24	-
6505 (U-NII-6~7)	157.60	157.60	162.24	162.56	-
6665	157.28	156.96	162.24	162.56	-
6825 (U-NII-7~8)	156.96	157.28	162.56	162.24	-
6985	158.24	158.24	238.08	238.56	-

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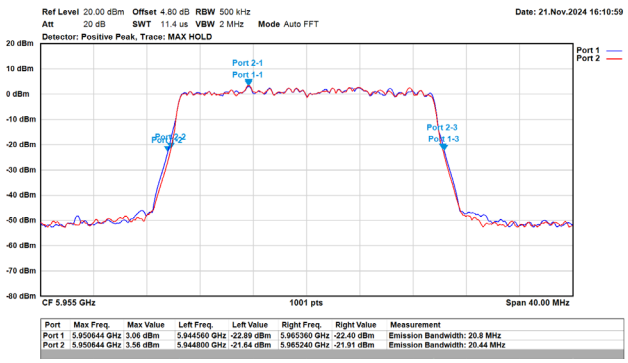	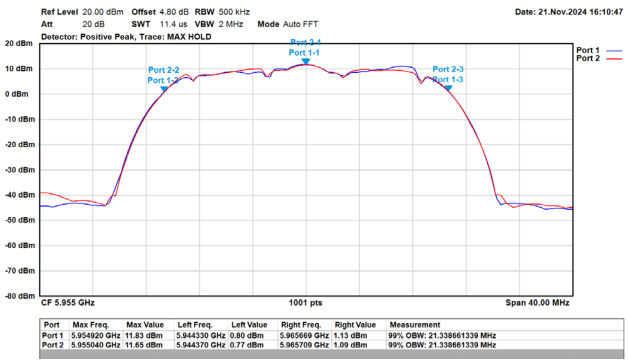
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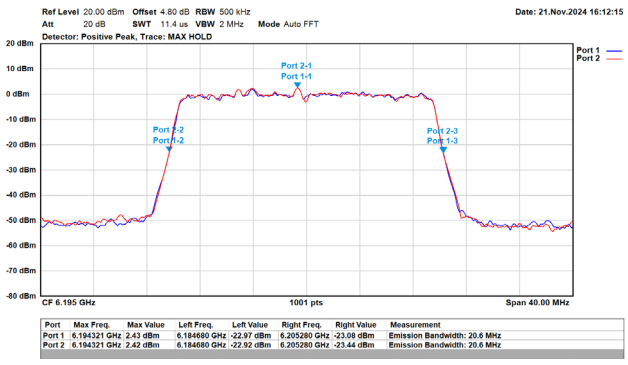	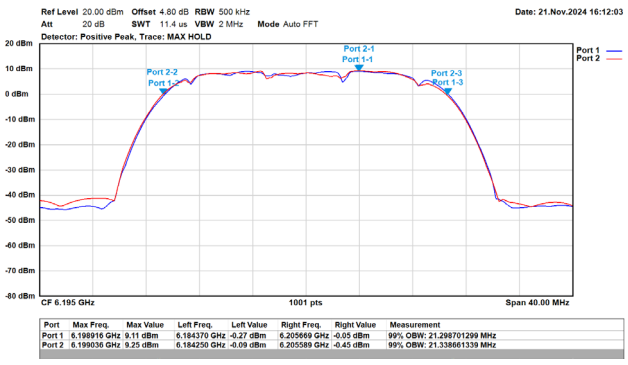
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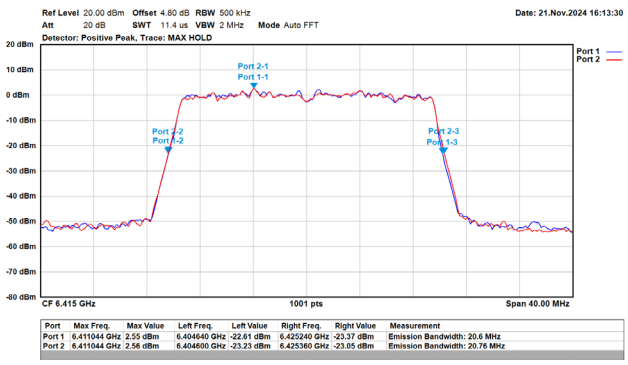	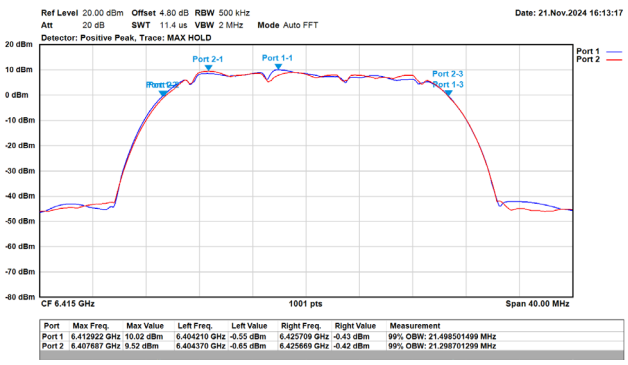

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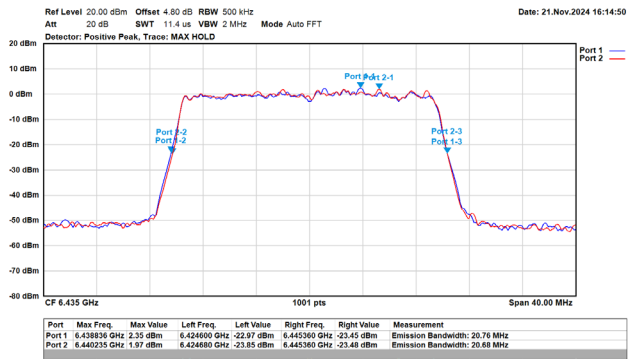	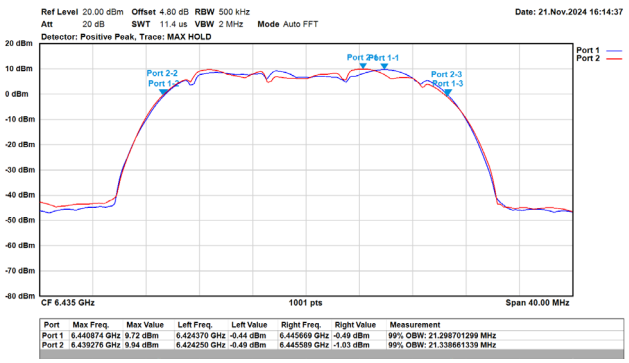
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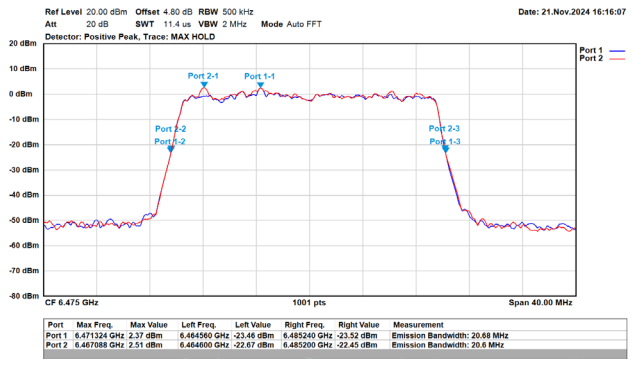
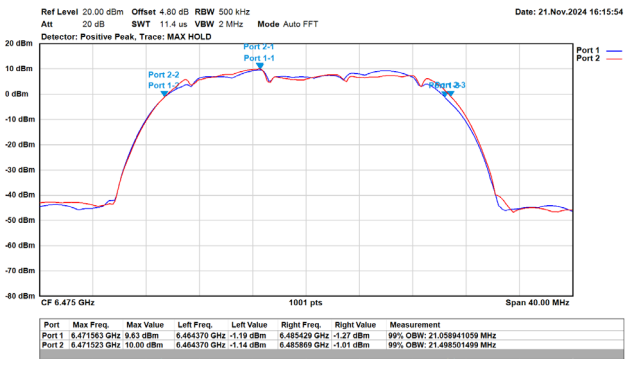
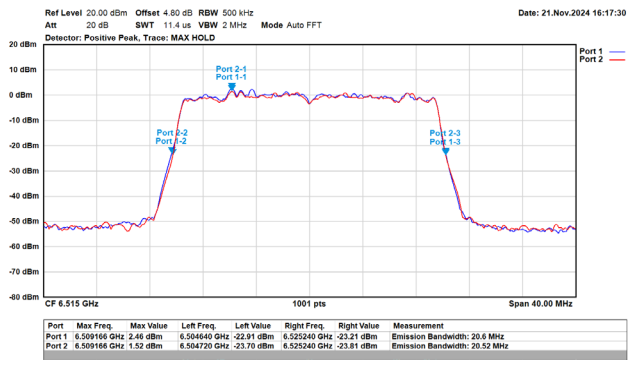
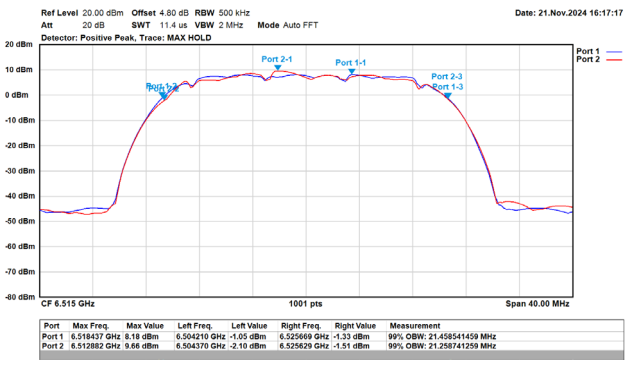
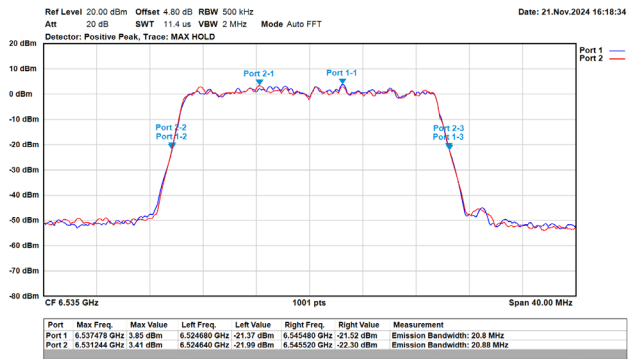
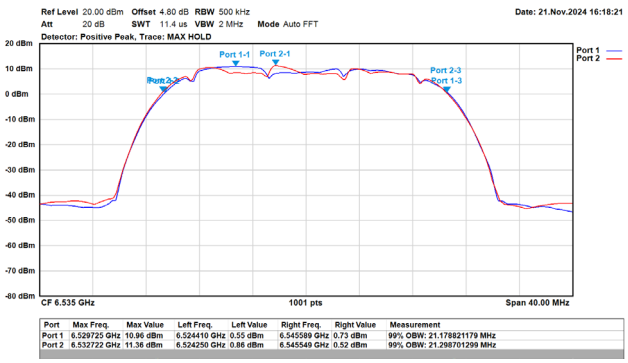
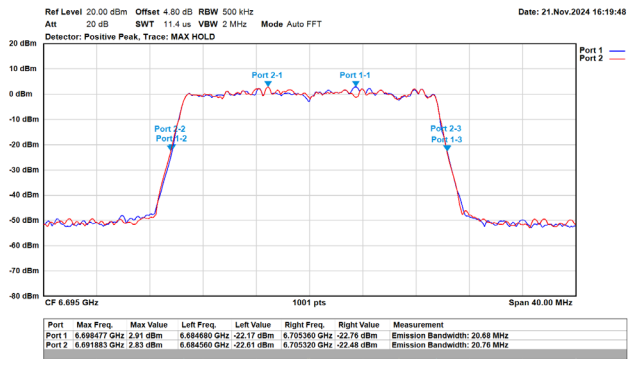
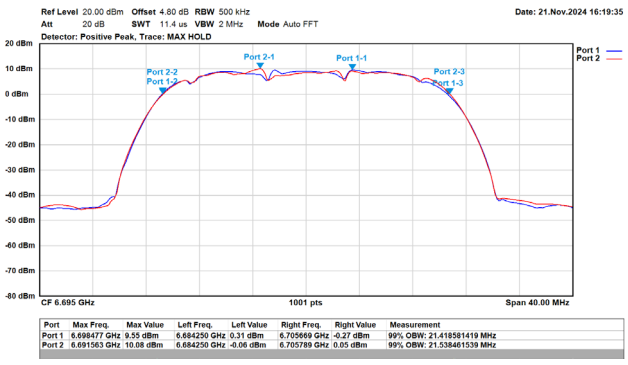
	
802.11be / 20MHz / MCS0 / 6515MHz / Ch113 (EBW)	802.11be / 20MHz / MCS0 / 6515MHz / Ch113 (OBW)
	

802.11be / 20MHz / MCS0 / 6535MHz / Ch117 (EBW)	802.11be / 20MHz / MCS0 / 6535MHz / Ch117 (OBW)
	
802.11be / 20MHz / MCS0 / 6695MHz / Ch149 (EBW)	802.11be / 20MHz / MCS0 / 6695MHz / Ch149 (OBW)
	
802.11be / 20MHz / MCS0 / 6855MHz / Ch181 (EBW)	802.11be / 20MHz / MCS0 / 6855MHz / Ch181 (OBW)