FCC RADIO TEST REPORT

FCC ID	:	**UZ7ET40AA**
Equipment	:	**Tablet**
Brand Name	:	**Zebra**
Model Name	:	**ET40AA**
Applicant	:	**Zebra Technologies Corporation 1 Zebra Plaza, Holtsville, NY 11742**
Manufacturer	:	**Zebra Technologies Corporation 1 Zebra Plaza, Holtsville, NY 11742**
Standard	:	**FCC PART 15 Subpart C §15.247**

The product was received on Mar. 18, 2022 and testing was performed from Mar. 23, 2022 to Jun. 06, 2022. We, Sporton International Inc. Wensan Laboratory, would like to declare that the tested sample has been evaluated in accordance with the test procedures and has been in compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval from Sporton International Inc. Wensan Laboratory, the test report shall not be reproduced except in full.

Louis Wu

Approved by: Louis Wu

Sporton International Inc. Wensan Laboratory
No.58, Aly. 75, Ln. 564, Wenhua 3rd, Rd., Guishan Dist., Taoyuan City 333010, Taiwan (R.O.C.)

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History of this test report

Report No.	Version	Description	Issue Date
FR222224C	01	Initial issue of report	May 17, 2022
FR222224C	02	1. Revise Appendix B and Appendix C 2. Revise Test Mode 3. Revise The Result of Output Power Measurement and Power Spectral Density Measurement	Jun. 06, 2022

Summary of Test Result

Report Clause	Ref Std. Clause	Test Items	Result (PASS/FAIL)	Remark
3.1	15.247(a)(2)	6dB Bandwidth	Pass	-
3.1	2.1049	99% Occupied Bandwidth	Reporting only	-
3.2	15.247(b)	Power Output Measurement	Pass	-
3.3	15.247(e)	Power Spectral Density	Pass	-
3.4	15.247(d)	Conducted Band Edges	Pass	-
		Conducted Spurious Emission	Pass	-
3.5	15.247(d)	Radiated Band Edges and Radiated Spurious Emission	Pass	1.03 dB under the limit at 2389.485 MHz
3.6	15.207	AC Conducted Emission	Pass	18.26 dB under the limit at 0.254 MHz
3.7	15.203 & 15.247(b)	Antenna Requirement	Pass	-

Declaration of Conformity:

1. The test results (PASS/FAIL) with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers.
   It's means measurement values may risk exceeding the limit of regulation standards, if measurement uncertainty is include in test results.
2. The measurement uncertainty please refer to this report "Uncertainty of Evaluation".

Comments and Explanations:

The product specifications of the EUT presented in the report are declared by the manufacturer who shall take full responsibility for the authenticity.

Reviewed by: Keven Cheng

Report Producer: Kaye Yang

1 General Description

1.1 Product Feature of Equipment Under Test

Product Feature	
Equipment	Tablet
Brand Name	Zebra
Model Name	ET40AA
FCC ID	UZ7ET40AA
EUT supports Radios application	NFC WLAN 11a/b/g/n HT20/HT40 WLAN 11ac VHT20/VHT40/VHT80 WLAN 11ax HE20/HE40/HE80 Bluetooth BR/EDR/LE
HW Version	EV2-1
SW Version	ET40-userdebug 11 11-07-10.00-RG-U00-PRD-GSE MX3 release-keys
MFD	28JAN22
EUT Stage	Identical Prototype

Remark: The above EUT's information was declared by manufacturer.

Specification of Accessories				
Battery	**Brand Name**	Zebra	**Model Name**	BT-000455

Supported Unit Used in Test Configuration and System				
AC Adapter	**Brand Name**	Zebra	**Part Number**	PWR-WUA5V12W0US
Earphone 1	**Brand Name**	Zebra	**Part Number**	HDST-35MM-PTVP-01
Earphone 2	**Brand Name**	Zebra	**Part Number**	HDST-USBC-PTT1-01
USB Cable (Type C to Type A)	**Brand Name**	Zebra	**Part Number**	CBL-TC5X-USBC2A-01
Type C-Audio Cable (Type C to 3.5mm)	**Brand Name**	Zebra	**Part Number**	ADP-USBC-35MM1-01

1.2 Product Specification of Equipment Under Test

Product Specification is subject to this standard	
Tx/Rx Channel Frequency Range	2412 MHz ~ 2462 MHz
Maximum Output Power to Antenna <CDD Modes>	**MIMO <Ant. 6+7>** 802.11b : 24.04 dBm / 0.2353 W 802.11g : 23.52 dBm / 0.2249 W 802.11n HT20 : 21.66 dBm / 0.1466 W 802.11ac VHT20: 21.66 dBm / 0.1466 W 802.11ax HE20: 21.76 dBm / 0.1500 W
Maximum Output Power <TXBF Modes>	**MIMO <Ant. 6+7>** 802.11ax HE20: 21.76 dBm / 0.1500 W
99% Occupied Bandwidth <CDD Mode>	**MIMO <Ant. 6>** 802.11b : 11.89 MHz 802.11g : 19.48 MHz 802.11ax HE20 : 19.73 MHz **MIMO <Ant. 7>** 802.11b : 11.74 MHz 802.11g : 19.53 MHz 802.11ax HE20 : 19.73 MHz
99% Occupied Bandwidth <TXBF Mode>	**MIMO <Ant. 6>** 802.11ax HE20 : 19.73 MHz **MIMO <Ant. 7>** 802.11ax HE20 : 19.73 MHz
Antenna Type / Gain	**<Ant. 6>:** IFA Antenna with gain 1.68 dBi **<Ant. 7>:** IFA Antenna with gain 1.27 dBi
Type of Modulation	802.11b : DSSS (DBPSK / DQPSK / CCK) 802.11g/n : OFDM (BPSK / QPSK / 16QAM / 64QAM) 802.11ac : OFDM (BPSK / QPSK / 16QAM / 64QAM / 256QAM) 802.11ax : OFDMA (BPSK / QPSK / 16QAM / 64QAM / 256QAM / 1024QAM)
Antenna Function Description	

	Ant. 6	Ant. 7
802.11 b/g/n/ac/ax MIMO	V	V
802.11ax TXBF	V	V

1.3 Modification of EUT

No modifications made to the EUT during the testing.

1.4 Testing Location

Test Site Location	No.58, Aly. 75, Ln. 564, Wenhua 3rd, Rd., Guishan Dist., Taoyuan City 333010, Taiwan (R.O.C.) TEL: +886-3-327-0868 FAX: +886-3-327-0855
Test Site No.	**Sporton Site No.**
	TH05-HY; 03CH13-HY; CO07-HY

Note: The test site complies with ANSI C63.4 2014 requirement.

FCC designation No.: TW3786

1.5 Applicable Standards

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

- FCC Part 15 Subpart C §15.247
- FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v05r02
- FCC KDB 414788 D01 Radiated Test Site v01r01.
- FCC KDB 662911 D01 Multiple Transmitter Output v02r01.
- ANSI C63.10-2013

Remark:

1. All the test items were validated and recorded in accordance with the standards without any modification during the testing.
2. The TAF code is not including all the FCC KDB listed without accreditation.

2 Test Configuration of Equipment Under Test

a. The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application. Frequency range investigated: conduction emission (150 kHz to 30 MHz), radiation emission (9 kHz to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower). For radiated measurement, the measured emission level of the EUT was maximized by rotating the EUT on a turntable, adjusting the orientation of the EUT and EUT antenna in three orthogonal axis (X: flat, Y: portrait, Z: landscape), and adjusting the measurement antenna orientation, following C63.10 exploratory test procedures and find X plane for CDD Modes; Z plane for TXBF Modes as worst plane.

b. AC power line Conducted Emission was tested under maximum output power.

2.1 Carrier Frequency and Channel

Frequency Band	Channel	Freq. (MHz)	Channel	Freq. (MHz)
2400-2483.5 MHz	1	2412	7	2442
	2	2417	8	2447
	3	2422	9	2452
	4	2427	10	2457
	5	2432	11	2462
	6	2437		

2.2 Test Mode

The 802.11ax mode is investigated among different tones, full resource units (RU), partial resource units. The partial RU has no higher power than full RU's, thus the full RU is chosen as main test configuration.

The CDD mode is chosen as worst case configuration for all test cases due to higher power than SISO mode.

The 802.11n/ac mode has no higher power mode, thus the 802.11ax mode is chosen as main test configuration, and the 802.11n/ac mode is verified the power.

The final test modes consider the modulation and the worst data rates as shown in the table below.

MIMO Mode

Modulation	Data Rate
802.11b	1 Mbps
802.11g	6 Mbps
802.11n HT20 (Covered by HE20)	MCS0
802.11ac VHT20 (Covered by HE20)	MCS0
802.11ax HE20	MCS0

TXBF Mode

Modulation	Data Rate
802.11ax HE20	MCS0

Test Cases	
AC Conducted Emission	Mode 1 :WLAN (2.4GHz) Link + Bluetooth Link + MPEG4 + USB Cable (Charging from Adapter)

<CDD Mode>

Ch. #	2400-2483.5 MHz				
	802.11b	802.11g		802.11ax HE20	
Low	01	01	02	01	02
Middle	06	06	09	06	09
High	11	10	11	10	11

<TXBF Mode>

Ch. #	2400-2483.5 MHz	
	802.11ax HE20	
Low	01	02
Middle	06	09
High	10	11

Remark: For radiation spurious emission, the modulation and the data rate picked for testing are determined by the Max. RF conducted power.

<CDD Mode>

802.11b RF Avg Output Power (dBm)						
Power vs. Channel			Power vs Data Rate			
Channel	Frequency (MHz)	Data Rate (bps)	Channel	Data Rate (bps)		
		1M		2M	5.5M	11M
CH 01	2412	**24.04**	CH 01	23.94	23.94	23.94
CH 06	2437	23.93				
CH 11	2462	22.84				

802.11g RF Avg Output Power (dBm)									
Power vs. Channel			Power vs Data Rate						
Channel	Frequency (MHz)	Data Rate (bps)	Channel	Data Rate (bps)					
		6M		9M	12M	18M	24M	36M	48M	54M
CH 01	2412	19.71	CH 06	23.42	23.42	23.32	23.32	23.27	23.22	23.22
CH 02	2417	20.81								
CH 06	2437	**23.52**								
CH 09	2452	21.93								
CH 10	2457	18.22								
CH 11	2462	16.56								

802.11n HT20 RF Avg Output Power (dBm)										
Power vs. Channel			Power vs Data Rate							
Channel	Frequency (MHz)	MCS Index	Channel	MCS Index						
		MCS0		MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
CH 01	2412	18.17	CH 06	21.56	21.56	21.51	21.51	21.51	21.51	21.46
CH 02	2417	21.26								
CH 06	2437	**21.66**								
CH 09	2452	20.37								
CH 10	2457	17.87								
CH 11	2462	16.11								

802.11ac VHT20 RF Avg Output Power (dBm)										
Power vs. Channel			Power vs Data Rate							
Channel	Frequency (MHz)	MCS Index	Channel	MCS Index						
		MCS0		MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7	MCS8
CH 01	2412	18.17	CH 06	21.56	21.56	21.51	21.51	21.51	21.51	21.46	21.46
CH 02	2417	21.26									
CH 06	2437	**21.66**									
CH 09	2452	20.37									
CH 10	2457	17.87									
CH 11	2462	16.11									

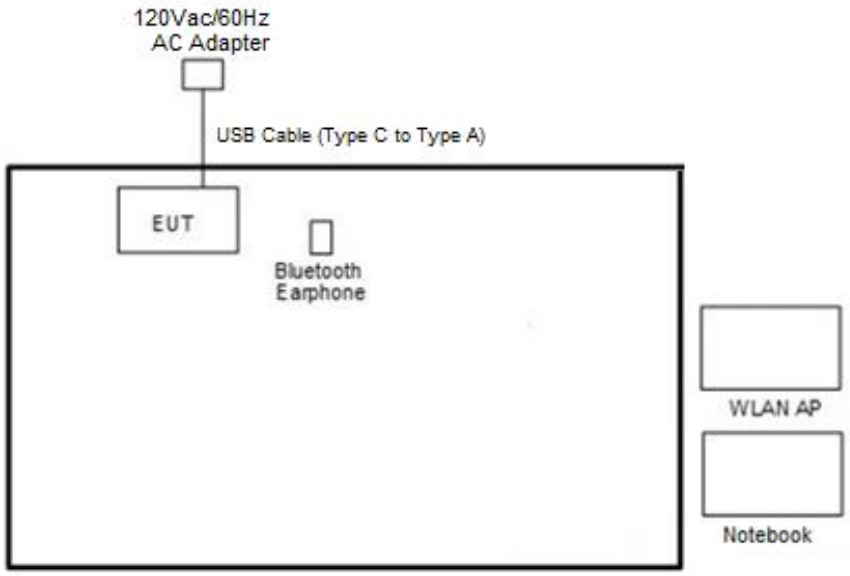
802.11ax HE20 RF Output Power (dBm)														
Power vs. Channel				Power vs Data Rate										
Channel	Frequency (MHz)	RU Config.	MCS Index	Channel	MCS Index									
			MCS0		MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7	MCS8	MCS9	MCS 10	MCS 11
CH 01	2412	Full	18.27	CH 06	21.66	21.66	21.61	21.51	21.51	21.61	21.51	21.51	21.51	21.41	21.41
CH 01	2412	26/0	11.61												
CH 01	2412	52/37	13.26												
CH 01	2412	106/53	15.56												
CH 02	2417	Full	21.36												
CH 06	2437	Full	**21.76**												
CH 06	2437	26/4	13.56												
CH 06	2437	52/39	16.26												
CH 06	2437	106/53	17.57												
CH 09	2452	Full	20.47												
CH 10	2457	Full	17.97												
CH 11	2462	Full	16.21												
CH 11	2462	26/8	9.06												
CH 11	2462	52/40	10.06												
CH 11	2462	106/54	13.72												

<TXBF Mode>

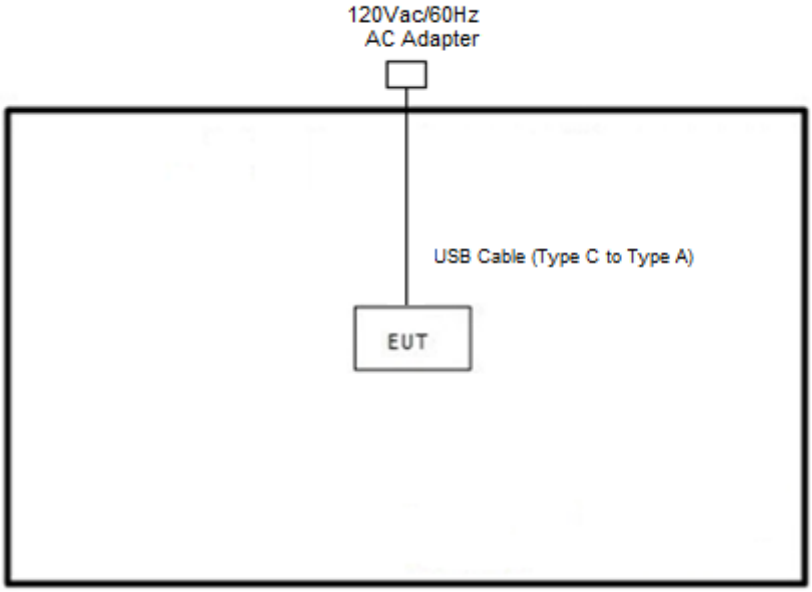
802.11ax HE20 RF Output Power (dBm)													
Power vs. Channel				Power vs Data Rate									
Channel	Frequency (MHz)	RU Config.	MCS Index	Channel	MCS Index								
			MCS0		MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7	MCS8	MCS9	MCS 10	MCS 11
CH 01	2412	Full	18.27	CH 06	21.71	21.71	21.67	21.61	21.61	21.67	21.61	21.61	21.56	21.56	21.56
CH 02	2417	Full	21.61												
CH 06	2437	Full	**21.76**												
CH 09	2452	Full	20.66												
CH 10	2457	Full	17.17												
CH 11	2462	Full	16.21												

2.3 Connection Diagram of Test System

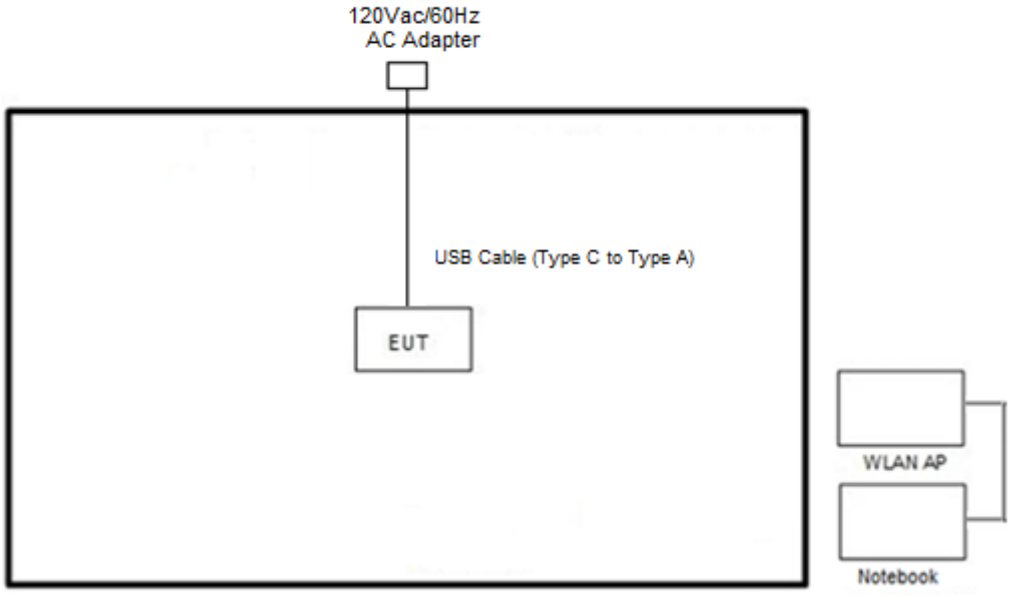
<AC Conducted Emission Mode>



<WLAN Tx Mode>



<WLAN TXBF Mode>



2.4 Support Unit used in test configuration and system

Item	Equipment	Brand Name	Model Name	FCC ID	Data Cable	Power Cord
1.	Bluetooth Earphone	Sony	SBH20	PY7-RD0010	N/A	N/A
2.	WLAN AP	ASUS	RT-AC52	MSQ-RTAC66U	N/A	Unshielded,1.8m
3.	WLAN AP	ASUS	RT-AX88U	LCITHP000236	N/A	Unshielded,1.8m
4.	Notebook	Dell	P74G	FCC DoC	N/A	AC I/P: Unshielded, 1.2 m DC O/P: Shielded, 1.8 m
5.	Notebook	Acer	N18Q13	PD9AX201NG	N/A	AC I/P: Unshielded, 1.2 m DC O/P: Shielded, 1.8 m

2.5 EUT Operation Test Setup

The RF test items, utility “cmd v10.0.17134.1304” was installed in Notebook which was programmed in order to make the EUT get into the engineering modes to provide channel selection, power level, data rate and the application type and for continuous transmitting signals.

For TXBF mode, the modulation modes and data rates manipulated by the command lines in the engineering program made the EUT link to another EUT by power under the normal operation. The “cmd v10.0.17134.1304” software tool was used to enable the EUT to transmit signals continuously.

2.6 Measurement Results Explanation Example

For all conducted test items:

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuator factor between EUT conducted output port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly the EUT RF output level.

Example:
The spectrum analyzer offset is derived from RF cable loss and attenuator factor.
Offset = RF cable loss + attenuator factor.
Following shows an offset computation example with cable loss 4.2 dB and 10 dB attenuator.

Offset(dB) = RF cable loss(dB) + attenuator factor(dB).
= 4.2 + 10 = 14.2 (dB)

3 Test Result

3.1 6dB and 99% Bandwidth Measurement

3.1.1 Limit of 6dB and 99% Bandwidth

The minimum 6 dB bandwidth shall be at least 500 kHz.

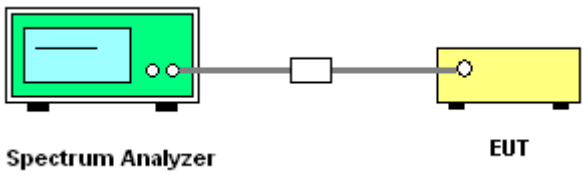
3.1.2 Measuring Instruments

Please refer to the measuring equipment list in this test report.

3.1.3 Test Procedures

1. The testing follows the ANSI C63.10 Section 6.9.3 (OBW) and 11.8.1 (6dB BW).
2. The RF output of EUT is connected to the spectrum analyzer by RF cable and attenuator. The path loss is compensated to the results for each measurement.
3. Set the maximum power setting and enable the EUT to transmit continuously.
4. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 100 kHz. Set the Video bandwidth (VBW) = 300 kHz. In order to make an accurate measurement. The 6 dB bandwidth must be greater than 500 kHz.
5. For 99% Bandwidth Measurement, the spectrum analyzer's resolution bandwidth (RBW) is set 1-5% of the emission bandwidth and set the Video bandwidth (VBW) ≥ 3 * RBW.
6. Measure and record the results in the test report.

3.1.4 Test Setup



3.1.5 Test Result of 6dB and 99% Occupied Bandwidth

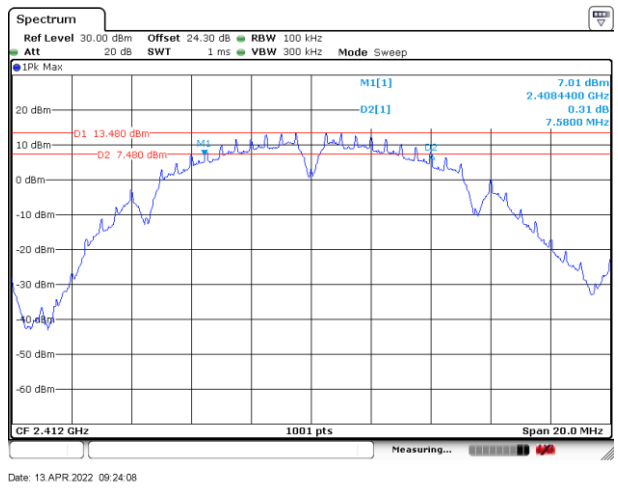
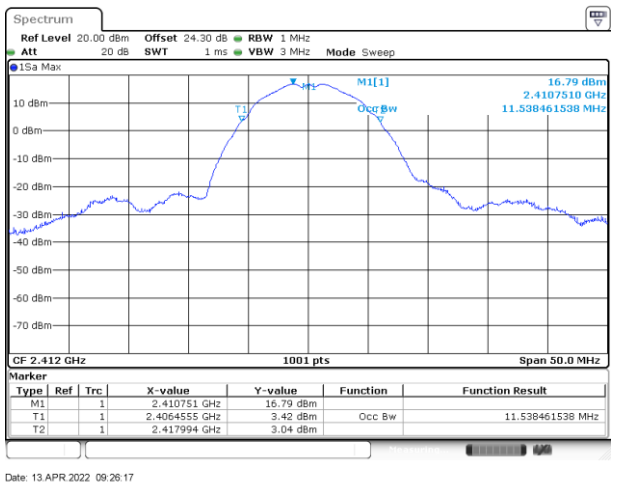
Test Engineer :	Benny Ku	Temperature :	21~25℃
		Relative Humidity :	51~54%

<CDD Mode>

2.4GHz Band MIMO											
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	99% Occupied BW (MHz)		6dB BW (MHz)		6dB BW Limit (MHz)	Pass/Fail
					Ant 6	Ant 7	Ant 6	Ant 7		
11b	1Mbps	2	1	2412	11.54	11.49	7.58	7.10	0.50	Pass
11b	1Mbps	2	6	2437	11.89	11.49	8.08	7.58	0.50	Pass
11b	1Mbps	2	11	2462	11.64	11.74	7.10	7.60	0.50	Pass
11g	6Mbps	2	1	2412	18.28	17.88	16.12	16.38	0.50	Pass
11g	6Mbps	2	6	2437	19.48	19.53	16.38	16.36	0.50	Pass
11g	6Mbps	2	11	2462	18.18	18.23	16.36	16.40	0.50	Pass

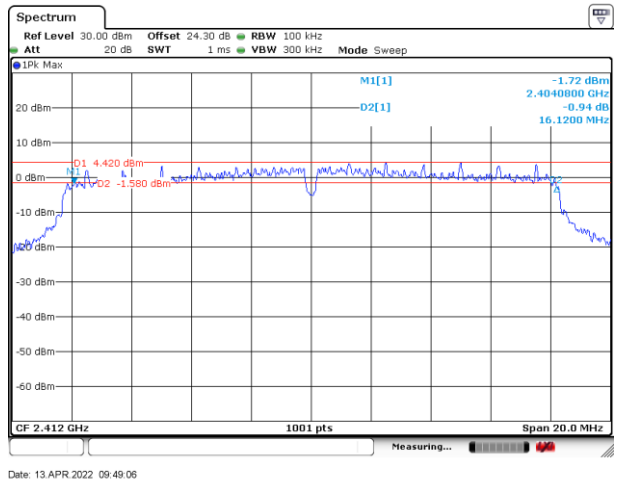
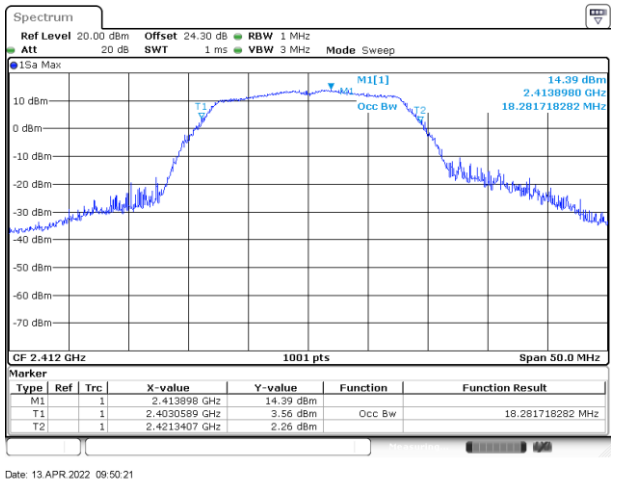
2.4GHz Band MIMO											
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	RU Config.	99% Occupied BW (MHz)		6dB BW (MHz)		6dB BW Limit (MHz)	Pass/Fail
						Ant6	Ant7	Ant6	Ant7		
HE20	MCS0	2	1	2412	Full	19.38	19.23	17.07	18.70	0.50	Pass
HE20	MCS0	2	6	2437	Full	19.73	19.73	18.90	18.97	0.50	Pass
HE20	MCS0	2	11	2462	Full	19.33	19.48	18.75	18.98	0.50	Pass

<802.11b>

6dB Bandwidth	99% Occupied Bandwidth
	

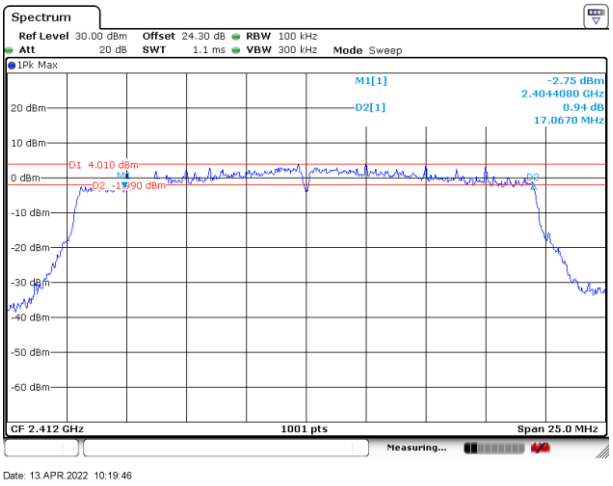
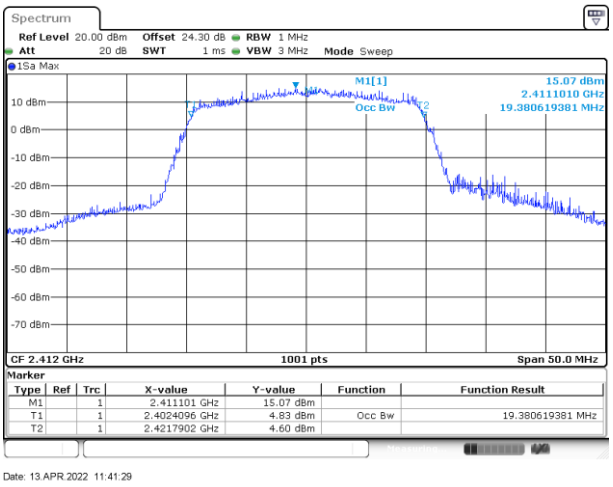
Note: The occupied channel bandwidth is maintained within the band of operation for all of the modulations.

<802.11g>

6dB Bandwidth	99% Occupied Bandwidth
	

Note: The occupied channel bandwidth is maintained within the band of operation for all of the modulations.

<802.11ax HE20>

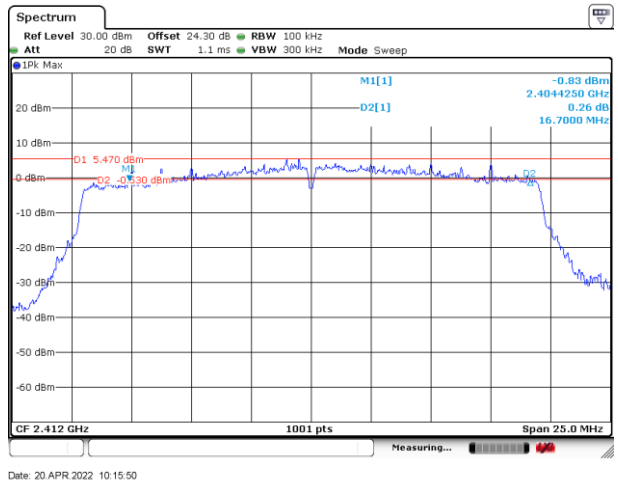
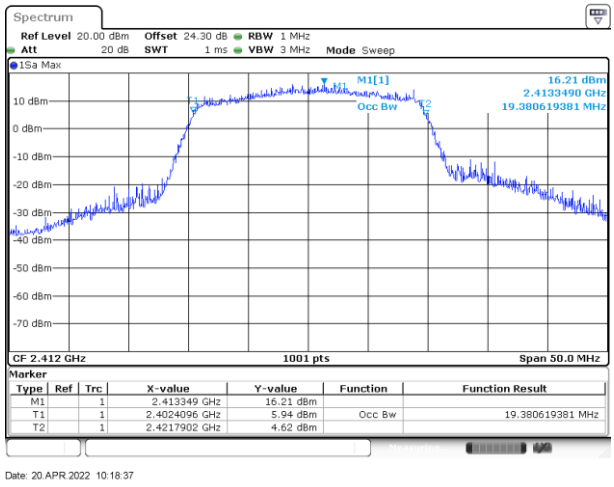
6dB Bandwidth	99% Occupied Bandwidth
	

Note: The occupied channel bandwidth is maintained within the band of operation for all of the modulations.

<TXBF Modes>

2.4GHz Band MIMO											
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	RU Config.	99% Occupied BW (MHz)		6dB BW (MHz)		6dB BW Limit (MHz)	Pass/Fail
						Ant6	Ant7	Ant6	Ant7		
HE20	MCS0	2	1	2412	Full	19.38	19.28	16.70	18.45	0.50	Pass
HE20	MCS0	2	6	2437	Full	19.73	19.73	18.90	18.97	0.50	Pass
HE20	MCS0	2	11	2462	Full	19.33	19.53	18.55	18.88	0.50	Pass

<802.11ax HE20>

6dB Bandwidth	99% Occupied Bandwidth
	

Note: The occupied channel bandwidth is maintained within the band of operation for all of the modulations.

3.2 Output Power Measurement

3.2.1 Limit of Output Power

For systems using digital modulation in the 2400-2483.5 MHz, the limit for output power is 30 dBm. If transmitting antenna with directional gain greater than 6 dBi is used, the output power from the intentional radiator shall be reduced below the above stated value by the amount in dB that the directional gain of the antenna exceeds 6 dBi. In case of point-to-point operation, the limit has to be reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

3.2.2 Measuring Instruments

Please refer to the measuring equipment list in this test report.

3.2.3 Test Procedures

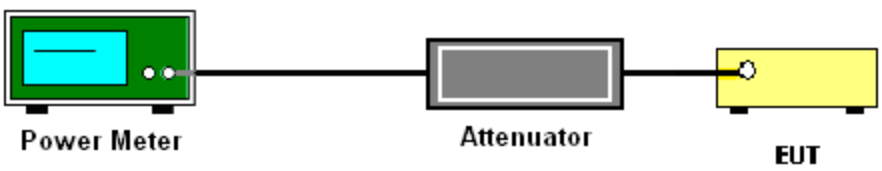
<CDD Modes>

1. For Average Power, the testing follows ANSI C63.10 Section 11.9.2.3.2 Method AVGPM-G
2. The RF output of EUT is connected to the power meter by RF cable and attenuator. The path loss is compensated to the results for each measurement.
3. Set the maximum power setting and enable the EUT to transmit continuously.
4. Measure the conducted output power and record the results in the test report.
5. For MIMO mode, calculation method follows FCC KDB 662911 D01 Multiple Transmitter Output v02r01.

<TXBF Modes>

1. For Average Power, the testing follows ANSI C63.10 Section 11.9.2.3.2 Method AVGPM-G
2. The RF output of EUT is connected to the power meter by RF cable and attenuator. The path loss is compensated to the results for each measurement.
3. Set the maximum power setting and enable the EUT to transmit continuously.
4. Measure the conducted output power and record the results in the test report.
5. For MIMO mode, calculation method follows FCC KDB 662911 D01 Multiple Transmitter Output v02r01.

3.2.4 Test Setup



3.2.5 Test Result of Average Output Power

Test Engineer :	Benny Ku	Temperature :	21~25℃
		Relative Humidity :	51~54%

<CDD Modes>

2.4GHz Band MIMO															
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Average Conducted Power (dBm)			Conducted Power Limit (dBm)		DG (dBi)		EIRP Power (dBm)		EIRP Power Limit (dBm)		Pass /Fail
					Ant 6	Ant 7	SUM	Ant 6	Ant 7	Ant 6	Ant 7	Ant 6	Ant 7	Ant 6	Ant 7	
11b	1Mbps	2	1	2412	21.50	20.50	24.04	30.00		1.68		25.72		36.00		Pass
11b	1Mbps	2	6	2437	21.40	20.40	23.94	30.00		1.68		25.62		36.00		Pass
11b	1Mbps	2	11	2462	20.30	19.30	22.84	30.00		1.68		24.52		36.00		Pass
11g	6Mbps	2	1	2412	16.90	16.50	19.71	30.00		1.68		21.39		36.00		Pass
11g	6Mbps	2	2	2417	17.90	17.70	20.81	30.00		1.68		22.49		36.00		Pass
11g	6Mbps	2	6	2437	20.80	20.20	23.52	30.00		1.68		25.20		36.00		Pass
11g	6Mbps	2	9	2452	19.30	18.50	21.93	30.00		1.68		23.61		36.00		Pass
11g	6Mbps	2	10	2457	15.50	14.90	18.22	30.00		1.68		19.90		36.00		Pass
11g	6Mbps	2	11	2462	13.60	13.50	16.56	30.00		1.68		18.24		36.00		Pass
HT20	MCS0	2	1	2412	15.50	14.80	18.17	30.00		1.68		19.85		36.00		Pass
HT20	MCS0	2	2	2417	18.40	18.10	21.26	30.00		1.68		22.94		36.00		Pass
HT20	MCS0	2	6	2437	18.80	18.50	21.66	30.00		1.68		23.34		36.00		Pass
HT20	MCS0	2	9	2452	17.70	17.00	20.37	30.00		1.68		22.05		36.00		Pass
HT20	MCS0	2	10	2457	15.10	14.60	17.87	30.00		1.68		19.55		36.00		Pass
HT20	MCS0	2	11	2462	12.90	13.30	16.11	30.00		1.68		17.79		36.00		Pass
VHT20	MCS0	2	1	2412	15.50	14.80	18.17	30.00		1.68		19.85		36.00		Pass
VHT20	MCS0	2	2	2417	18.40	18.10	21.26	30.00		1.68		22.94		36.00		Pass
VHT20	MCS0	2	6	2437	18.80	18.50	21.66	30.00		1.68		23.34		36.00		Pass
VHT20	MCS0	2	9	2452	17.70	17.00	20.37	30.00		1.68		22.05		36.00		Pass
VHT20	MCS0	2	10	2457	15.10	14.60	17.87	30.00		1.68		19.55		36.00		Pass
VHT20	MCS0	2	11	2462	12.90	13.30	16.11	30.00		1.68		17.79		36.00		Pass

2.4GHz Band MIMO																	
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	RU Config.	Average Conducted Power (dBm)			Conducted Power Limit (dBm)		DG (dBi)		EIRP Power (dBm)		EIRP Power Limit (dBm)		Pass /Fail
						Ant 6	Ant 7	SUM	Ant 6	Ant 7	Ant 6	Ant 7	Ant 6	Ant 7	Ant 6	Ant 7	
HE20	MCS0	2	1	2412	Full	15.60	14.90	18.27	30.00		1.68		19.95		36.00		Pass
HE20	MCS0	2	1	2412	26/0	8.70	8.50	11.61	30.00		1.68		13.29		36.00		Pass
HE20	MCS0	2	1	2412	52/37	10.10	10.40	13.26	30.00		1.68		14.94		36.00		Pass
HE20	MCS0	2	1	2412	106/53	12.40	12.70	15.56	30.00		1.68		17.24		36.00		Pass
HE20	MCS0	2	2	2417	Full	18.50	18.20	21.36	30.00		1.68		23.04		36.00		Pass
HE20	MCS0	2	6	2437	Full	18.90	18.60	21.76	30.00		1.68		23.44		36.00		Pass
HE20	MCS0	2	6	2437	26/4	10.40	10.70	13.56	30.00		1.68		15.24		36.00		Pass
HE20	MCS0	2	6	2437	52/39	13.20	13.30	16.26	30.00		1.68		17.94		36.00		Pass
HE20	MCS0	2	6	2437	106/53	14.90	14.20	17.57	30.00		1.68		19.25		36.00		Pass
HE20	MCS0	2	9	2452	Full	17.80	17.10	20.47	30.00		1.68		22.15		36.00		Pass
HE20	MCS0	2	10	2457	Full	15.20	14.70	17.97	30.00		1.68		19.65		36.00		Pass
HE20	MCS0	2	11	2462	Full	13.00	13.40	16.21	30.00		1.68		17.89		36.00		Pass
HE20	MCS0	2	11	2462	26/8	5.90	6.20	9.06	30.00		1.68		10.74		36.00		Pass
HE20	MCS0	2	11	2462	52/40	6.90	7.20	10.06	30.00		1.68		11.74		36.00		Pass
HE20	MCS0	2	11	2462	106/54	10.40	11.00	13.72	30.00		1.68		15.40		36.00		Pass

<TXBF Mode>

2.4GHz Band MIMO																	
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	RU Config.	Average Conducted Power (dBm)			Conducted Power Limit (dBm)		DG (dBi)		EIRP Power (dBm)		EIRP Power Limit (dBm)		Pass /Fail
						Ant 6	Ant 7	SUM	Ant 6	Ant 7	Ant 6	Ant 7	Ant 6	Ant 7	Ant 6	Ant 7	
HE20	MCS0	2	1	2412	Full	15.60	14.90	18.27	30.00		4.49		22.76		36.00		Pass
HE20	MCS0	2	2	2417	Full	18.70	18.50	21.61	30.00		4.49		26.10		36.00		Pass
HE20	MCS0	2	6	2437	Full	18.90	18.60	21.76	30.00		4.49		26.25		36.00		Pass
HE20	MCS0	2	9	2452	Full	17.80	17.50	20.66	30.00		4.49		25.15		36.00		Pass
HE20	MCS0	2	10	2457	Full	13.90	14.40	17.17	30.00		4.49		21.66		36.00		Pass
HE20	MCS0	2	11	2462	Full	13.00	13.40	16.21	30.00		4.49		20.70		36.00		Pass

3.3 Power Spectral Density Measurement

3.3.1 Limit of Power Spectral Density

The peak power spectral density shall not be greater than 8 dBm in any 3 kHz band at any time interval of continuous transmission.

3.3.2 Measuring Instruments

Please refer to the measuring equipment list in this test report.

3.3.3 Test Procedures

<CDD Modes>

1. The testing follows the ANSI C63.10 Section 11.10.5 Method AVGPSD-2.
2. The RF output of EUT is connected to the spectrum analyzer by RF cable and attenuator. The path loss is compensated to the results for each measurement.
3. Set the maximum power setting and enable the EUT to transmit continuously.
4. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 3 kHz. Video bandwidth VBW = 10 kHz In order to make an accurate measurement, set the span to 1.5 times DTS Channel Bandwidth. (6dB BW).
5. Number of points in sweep ≥ 2 Span / RBW. (This ensures that bin-to-bin spacing is ≤ RBW/2, so that narrowband signals are not lost between frequency bins).
6. Detector = RMS, Sweep time = auto couple.
7. Trace average at least 100 traces in power averaging mode.
8. Add 10 log(1/x), where x is the duty cycle, to the measured power in order to compute the average power during the actual transmission times. For example, add 10 log(1/0.25) = 6 dB if the duty cycle is 25 percent.
9. Measure and record the results in the test report.
10. For MIMO mode, calculation method follows FCC KDB 662911 D01 Multiple Transmitter Output v02r01.

    Method (c): Measure and add 10 log(N_{ANT}) dB.

    With this technique, spectrum measurements are performed at each output of the device, but rather than summing the spectra or the spectral peaks across the outputs, the quantity 10 log(N_{ANT}) dB is added to each spectrum value before comparing to the emission limit. The addition of 10 log(N_{ANT}) dB serves to apportion the emission limit among the N_{ANT} outputs so that each output is permitted to contribute no more than $1/N_{ANT}$ th of the PSD limit .

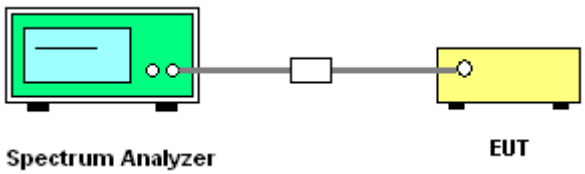
<TXBF Modes>

1. The testing follows the ANSI C63.10 Section 11.10.7 Method AVGPSD-3.
2. The RF output of EUT is connected to the spectrum analyzer by RF cable and attenuator. The path loss is compensated to the results for each measurement.
3. Set the maximum power setting and enable the EUT to transmit continuously.
4. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 3 kHz. Video bandwidth VBW = 10 kHz In order to make an accurate measurement, set the span to 1.5 times DTS Channel Bandwidth. (6dB BW).
5. Number of points in sweep ≥ 2 Span / RBW. (This ensures that bin-to-bin spacing is ≤ RBW/2, so that narrowband signals are not lost between frequency bins).
6. Detector = RMS, Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow max hold to run for at least 60 seconds, or longer as needed to allow the trace to stabilize.
9. Measure and record the results in the test report.
10. For MIMO mode, calculation method follows FCC KDB 662911 D01 Multiple Transmitter Output v02r01.

    Method (c): Measure and add 10 log(N_{ANT}) dB.

    With this technique, spectrum measurements are performed at each output of the device, but rather than summing the spectra or the spectral peaks across the outputs, the quantity 10 log(N_{ANT}) dB is added to each spectrum value before comparing to the emission limit. The addition of 10 log(N_{ANT}) dB serves to apportion the emission limit among the N_{ANT} outputs so that each output is permitted to contribute no more than $1/N_{ANT}$ th of the PSD limit .

3.3.4 Test Setup



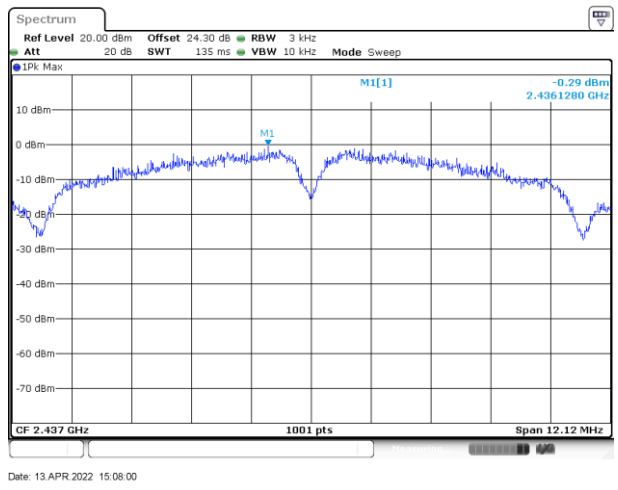
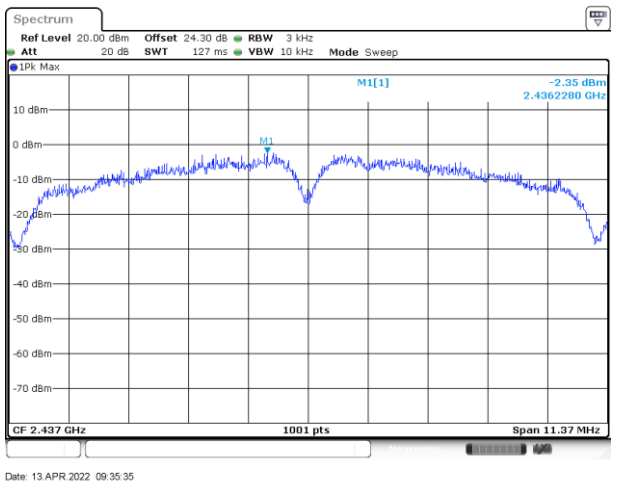
3.3.5 Test Result of Power Spectral Density

Test Engineer :	Benny Ku	Temperature :	21~25℃
		Relative Humidity :	51~54%

<CDD Modes>

2.4GHz Band MIMO												
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Peak PSD (dBm/3kHz)			DG (dBi)		Peak PSD Limit (dBm/3kHz)		Pass/Fail
					Ant6	Ant7	Worse + 3.01	Ant6	Ant7	Ant6	Ant7	
11b	1Mbps	2	1	2412	-1.06	-1.23	1.95	4.49		8.00		Pass
11b	1Mbps	2	6	2437	-0.29	-2.35	2.72	4.49		8.00		Pass
11b	1Mbps	2	11	2462	-1.31	-2.37	1.70	4.49		8.00		Pass
11g	6Mbps	2	1	2412	-7.89	-8.16	-4.88	4.49		8.00		Pass
11g	6Mbps	2	2	2417	-6.05	-7.46	-3.04	4.49		8.00		Pass
11g	6Mbps	2	6	2437	-4.54	-4.62	-1.53	4.49		8.00		Pass
11g	6Mbps	2	9	2452	-5.78	-6.36	-2.77	4.49		8.00		Pass
11g	6Mbps	2	10	2457	-8.28	-9.64	-5.27	4.49		8.00		Pass
11g	6Mbps	2	11	2462	-11.31	-11.67	-8.30	4.49		8.00		Pass

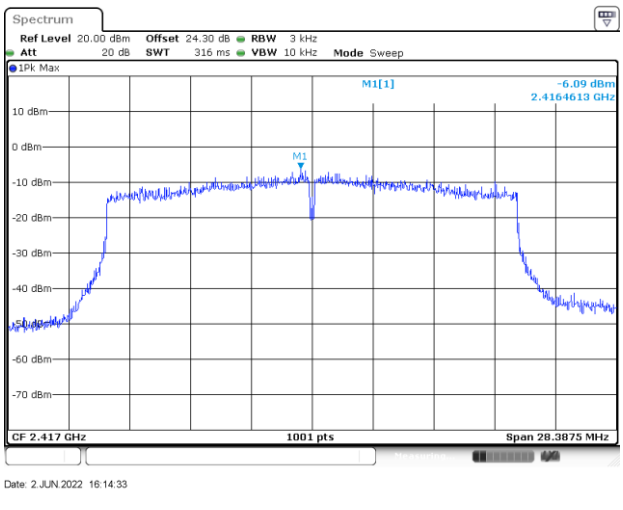
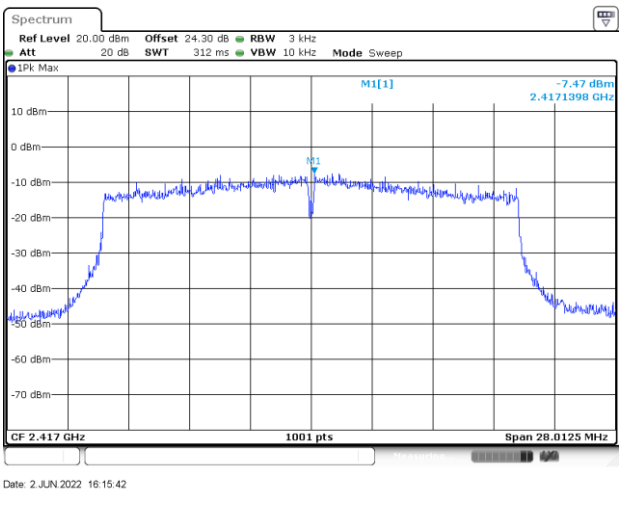
<802.11b>

Worst Case Power Density (dBm/3kHz)	
MIMO Ant. 6	MIMO Ant. 7
	

<802.11ax Mode>

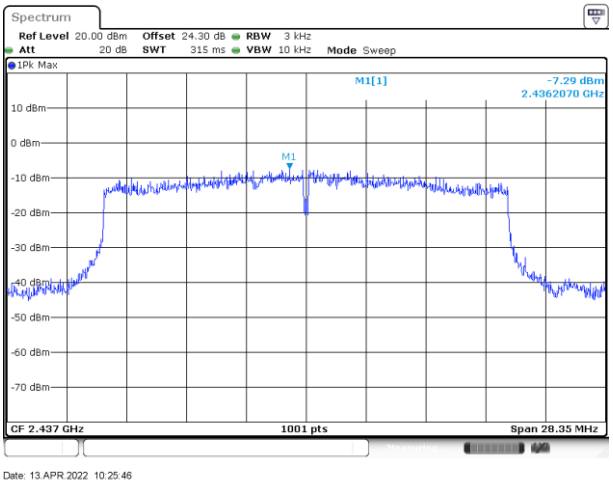
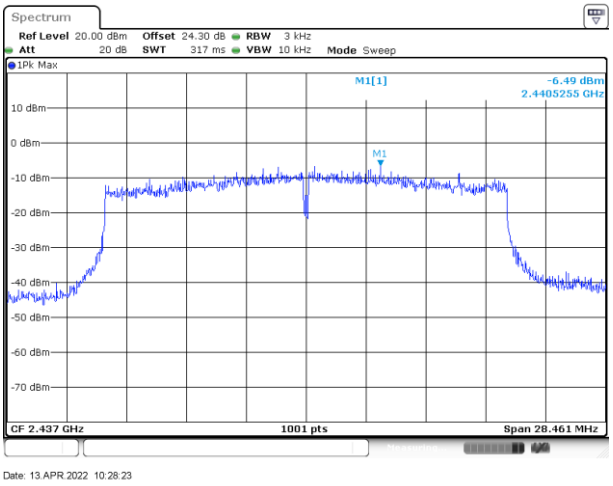
2.4GHz Band MIMO													
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	RU Config.	Peak PSD (dBm/3kHz)			DG (dBi)		Peak PSD Limit (dBm/3kHz)		Pass/Fail
						Ant6	Ant7	Worse + 3.01	Ant6	Ant7	Ant6	Ant7	
HE20	MCS0	2	1	2412	Full	-9.36	-9.93	-6.35	4.49		8.00		Pass
HE20	MCS0	2	1	2412	26/0	-9.54	-10.04	-6.53	4.49		8.00		Pass
HE20	MCS0	2	1	2412	52/37	-9.70	-10.41	-6.69	4.49		8.00		Pass
HE20	MCS0	2	1	2412	106/53	-9.79	-10.33	-6.78	4.49		8.00		Pass
HE20	MCS0	2	2	2417	Full	-6.09	-7.47	-3.08	4.49		8.00		Pass
HE20	MCS0	2	6	2437	Full	-7.29	-6.49	-3.48	4.49		8.00		Pass
HE20	MCS0	2	6	2437	26/4	-7.75	-6.60	-3.59	4.49		8.00		Pass
HE20	MCS0	2	6	2437	52/39	-7.55	-6.73	-3.72	4.49		8.00		Pass
HE20	MCS0	2	6	2437	106/53	-7.58	-6.85	-3.84	4.49		8.00		Pass
HE20	MCS0	2	9	2452	Full	-8.21	-8.83	-5.20	4.49		8.00		Pass
HE20	MCS0	2	10	2457	Full	-9.43	-10.09	-6.42	4.49		8.00		Pass
HE20	MCS0	2	11	2462	Full	-12.22	-12.41	-9.21	4.49		8.00		Pass
HE20	MCS0	2	11	2462	26/8	-12.59	-12.77	-9.58	4.49		8.00		Pass
HE20	MCS0	2	11	2462	52/40	-12.45	-12.57	-9.44	4.49		8.00		Pass
HE20	MCS0	2	11	2462	106/54	-12.79	-12.48	-9.47	4.49		8.00		Pass

<802.11ax HE20>

Maximum Power Density Plot (dBm/MHz)	
MIMO Ant. 6	MIMO Ant. 7
	

<TXBF Modes>

2.4GHz Band MIMO													
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	RU Config.	Peak PSD (dBm/3kHz)			DG (dBi)		Peak PSD Limit (dBm/3kHz)		Pass/Fail
						Ant 6	Ant 7	Worse + 3.01	Ant 6	Ant 7	Ant 6	Ant 7	
HE20	MCS0	2	1	2412	Full	-9.36	-9.93	-6.35	4.49		8.00		Pass
HE20	MCS0	2	2	2417	Full	-6.89	-6.96	-3.88	4.49		8.00		Pass
HE20	MCS0	2	6	2437	Full	-7.29	-6.49	-3.48	4.49		8.00		Pass
HE20	MCS0	2	9	2452	Full	-8.96	-9.81	-5.95	4.49		8.00		Pass
HE20	MCS0	2	10	2457	Full	-12.40	-12.66	-9.39	4.49		8.00		Pass
HE20	MCS0	2	11	2462	Full	-12.22	-12.41	-9.21	4.49		8.00		Pass

Worst Case Power Density (dBm/3kHz)	
MIMO Ant. 6	MIMO Ant. 7
	

3.4 Conducted Band Edges and Spurious Emission Measurement

3.4.1 Limit of Conducted Band Edges and Spurious Emission Measurement

In any 100 kHz bandwidth outside of the authorized frequency band, the emissions which fall in the non-restricted bands shall be attenuated at least 20 dB / 30dB relative to the maximum PSD level in 100 kHz by RF conducted measurement.

3.4.2 Measuring Instruments

Please refer to the measuring equipment list in this test report.

3.4.3 Test Procedures

1. The testing follows the ANSI C63.10 Section 11.11.3 Emission level measurement
2. The RF output of EUT is connected to the spectrum analyzer by RF cable and attenuator. The path loss is compensated to the results for each measurement.
3. Set the maximum power setting and enable the EUT to transmit continuously.
4. Set RBW = 100 kHz, VBW = 300 kHz, Peak Detector. Unwanted Emissions measured in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz when maximum peak conducted output power procedure is used. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB per 15.247(d).
5. Measure and record the results in the test report.
6. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.

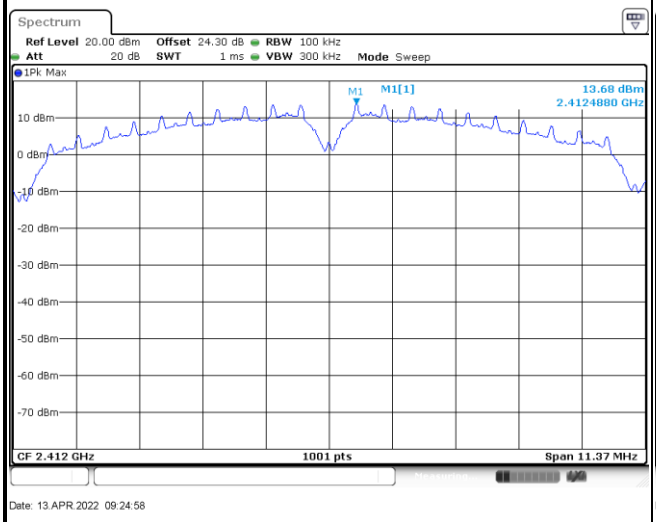
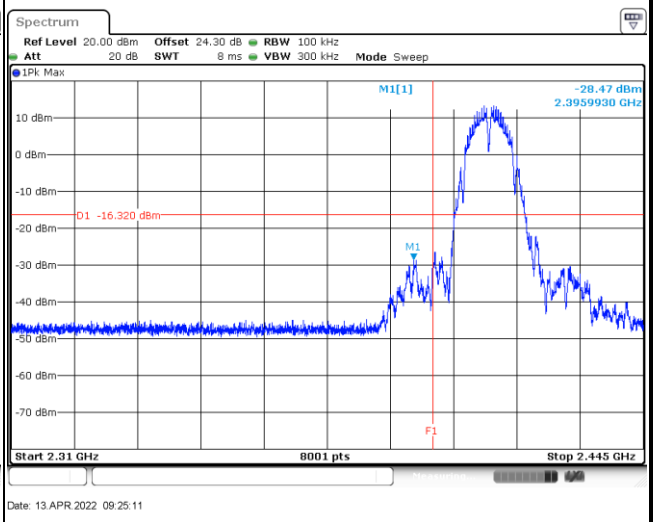
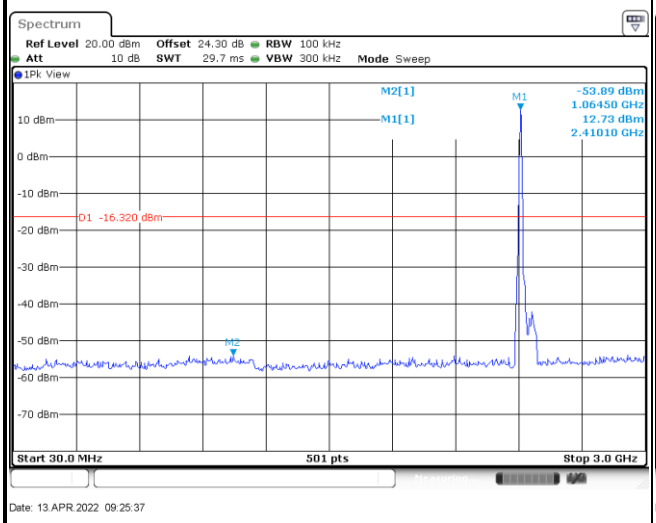
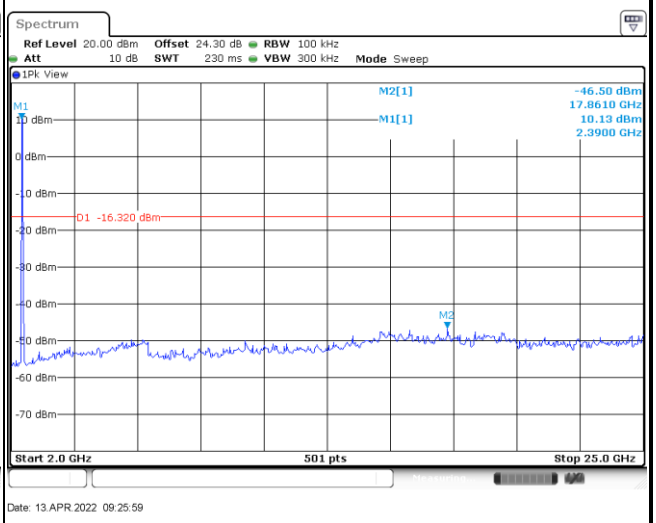
3.4.4 Test Setup

3.4.5 Test Result of Conducted Band Edges and Spurious Emission

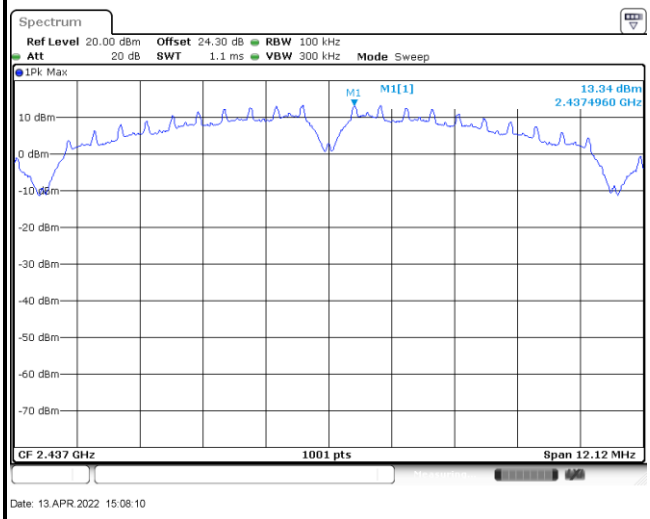
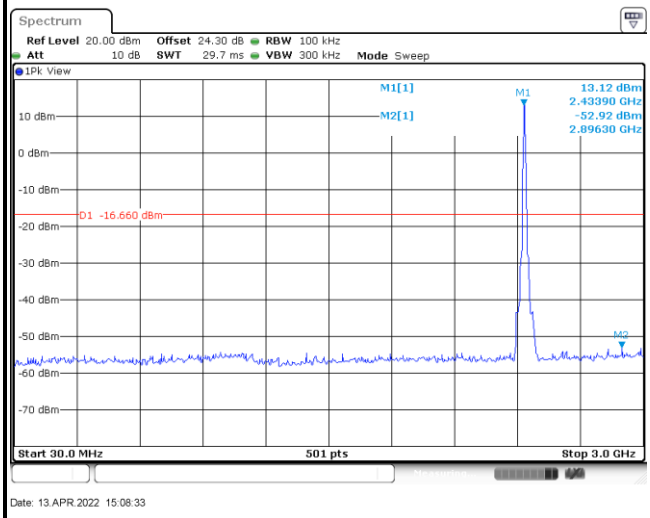
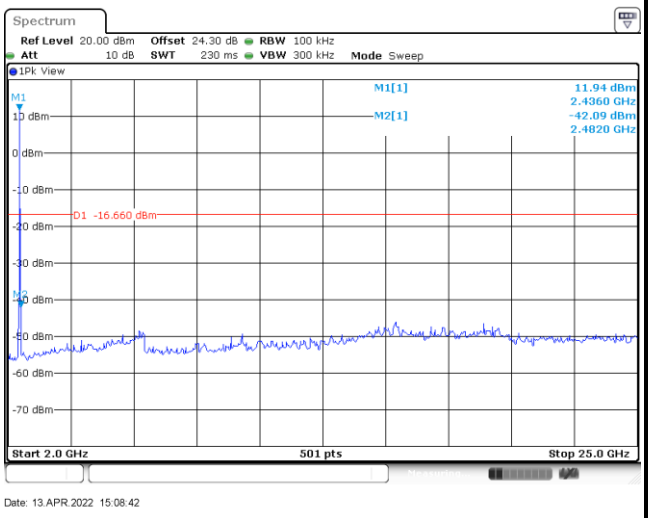
<CDD Modes>

Number of TX = 2, Ant. 6(Measured)

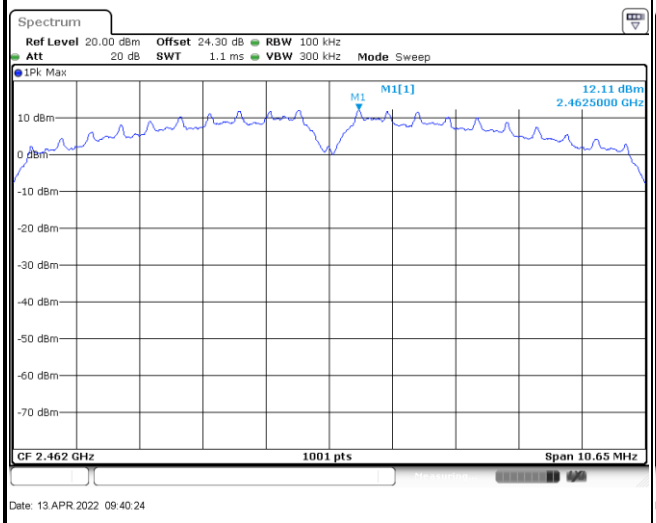
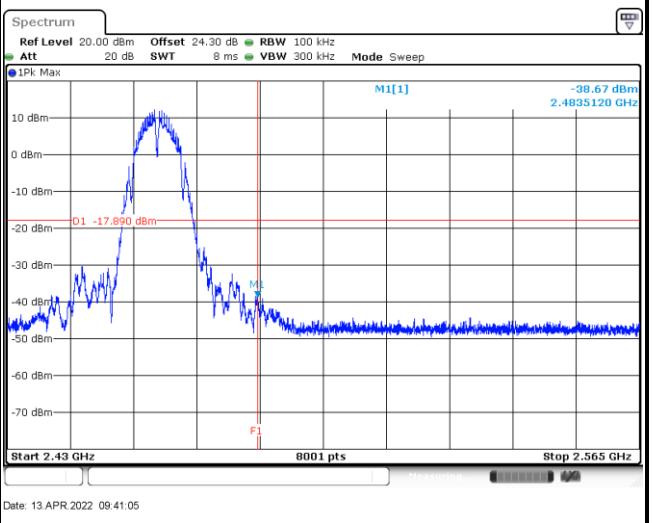
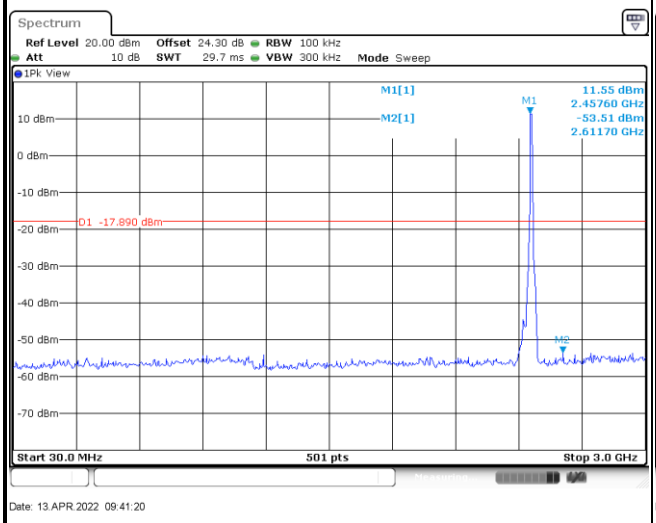
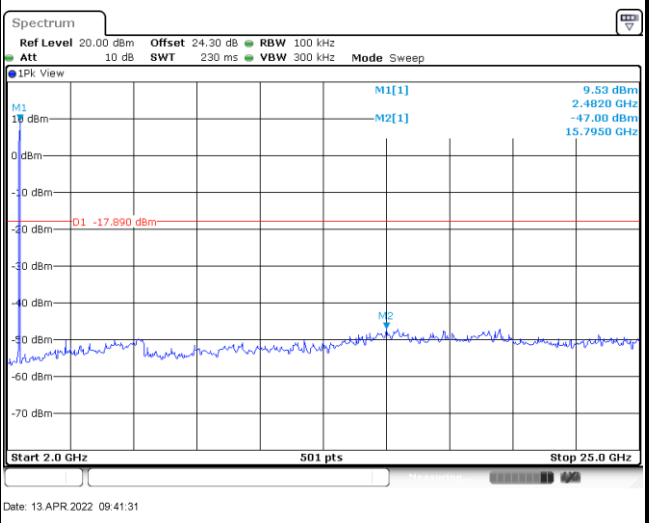
Test Mode :	802.11b	Test Channel :	01

100kHz PSD reference Level	Low Channel Plot
	
Spurious Emission 30MHz~3GHz	**Spurious Emission 2GHz~25GHz**
	

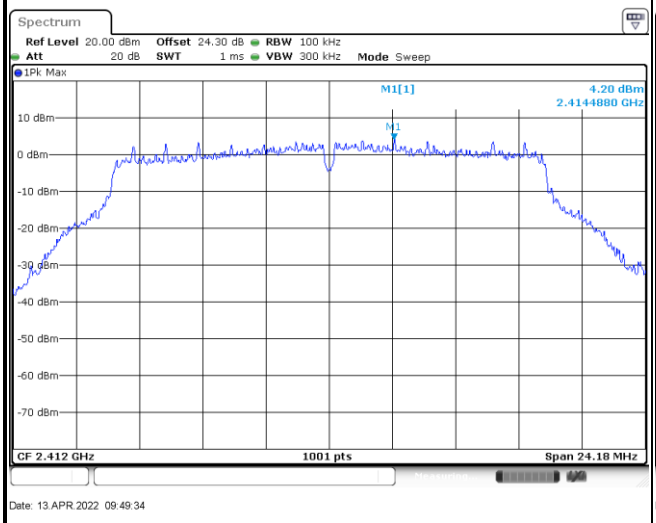
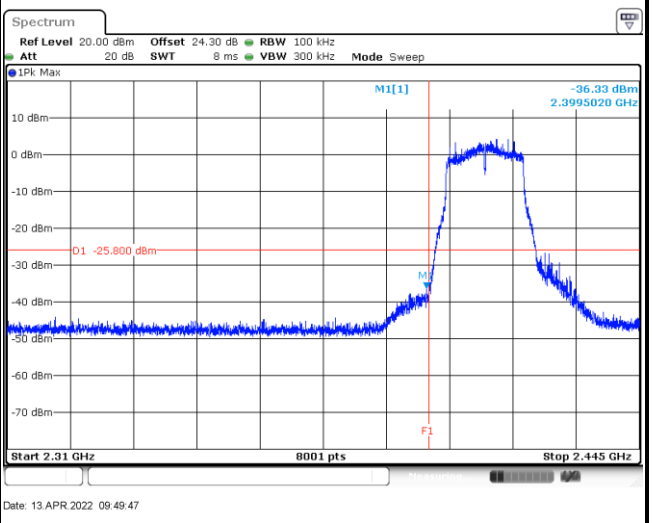
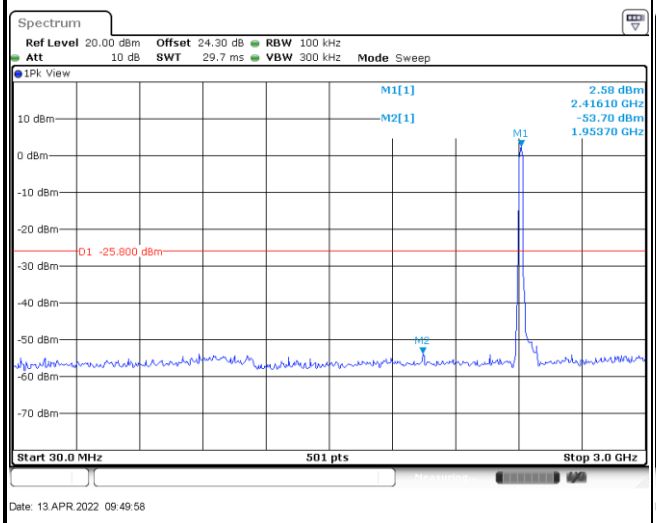
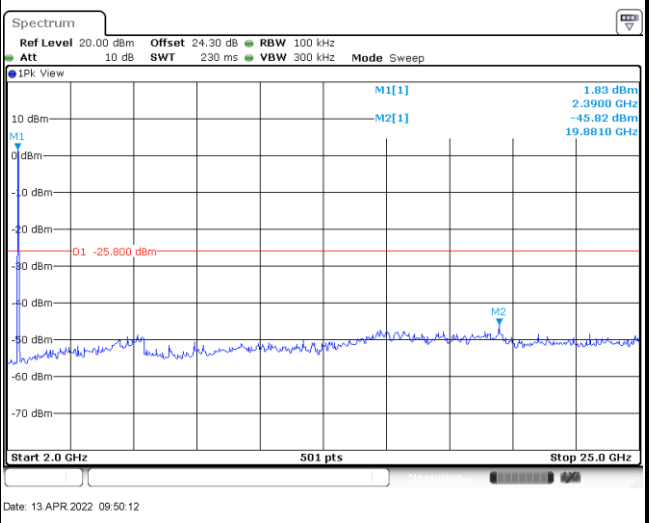
Test Mode :	802.11b	Test Channel :	06

100kHz PSD reference Level	Mid Channel Plot
	
Spurious Emission 30MHz~3GHz	**Spurious Emission 2GHz~25GHz**
	

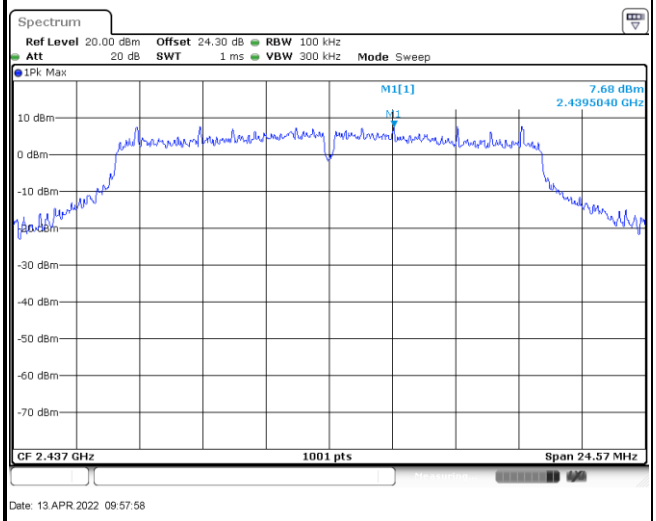
Test Mode :	802.11b	Test Channel :	11

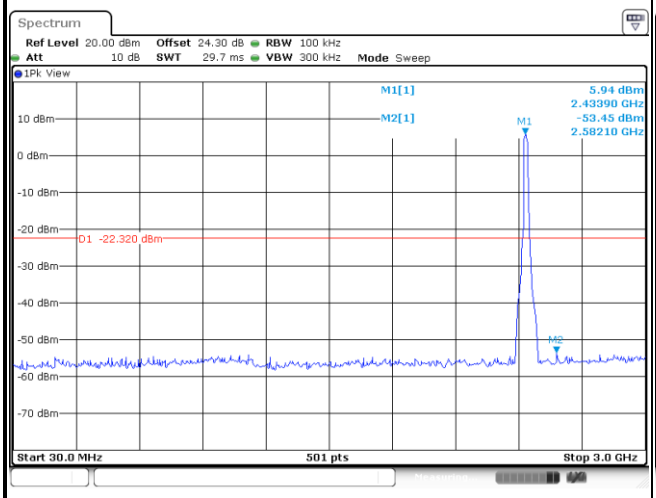
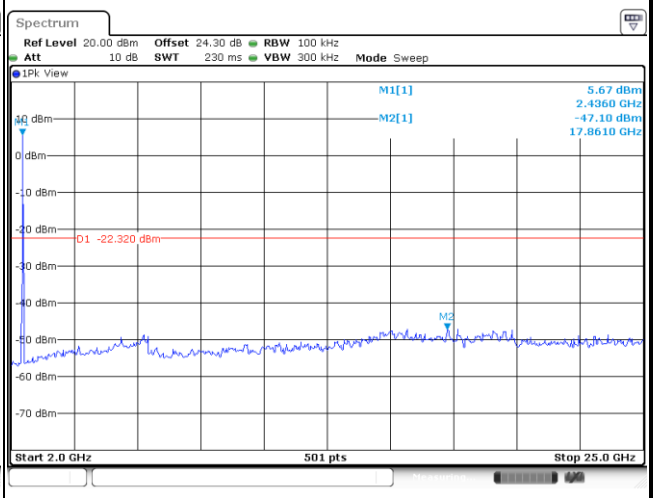
100kHz PSD reference Level	High Channel Plot
	
Spurious Emission 30MHz~3GHz	**Spurious Emission 2GHz~25GHz**
	

Test Mode :	802.11g	Test Channel :	01

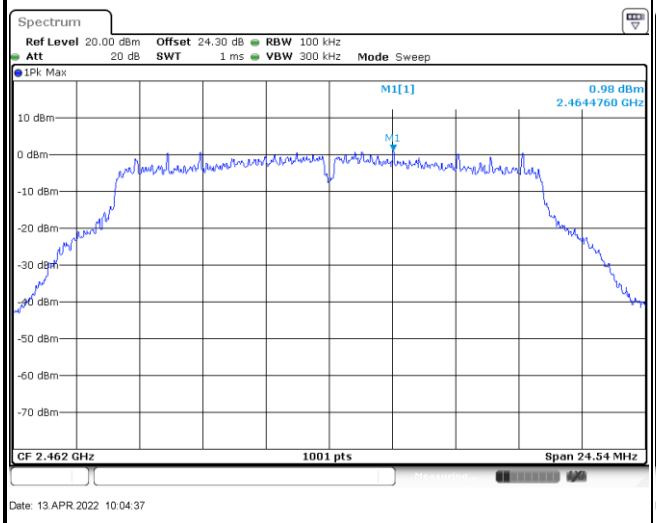
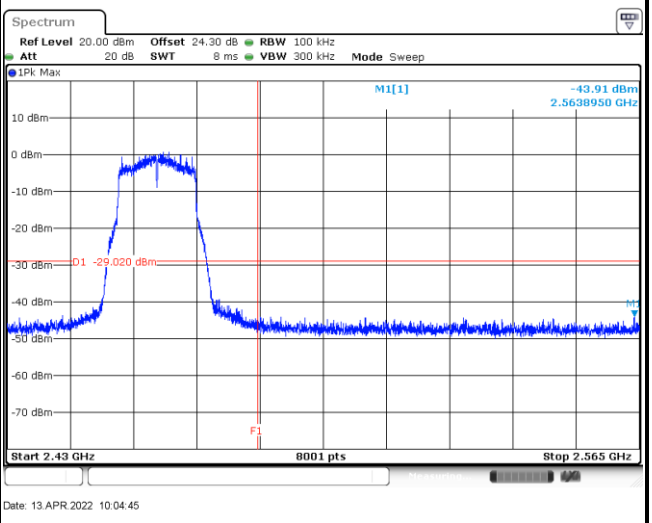
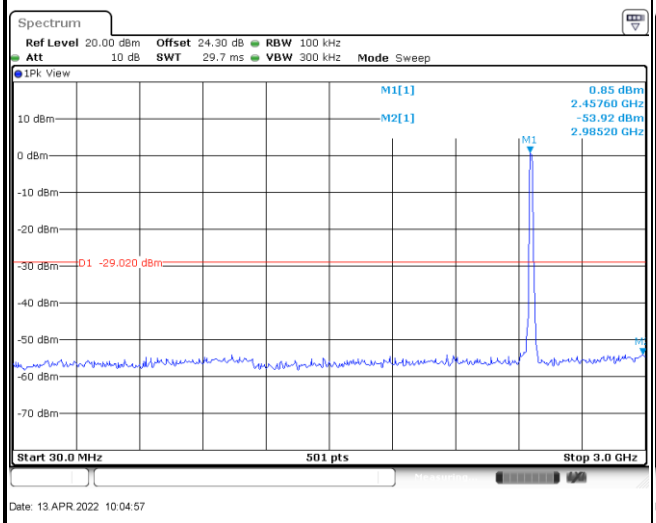
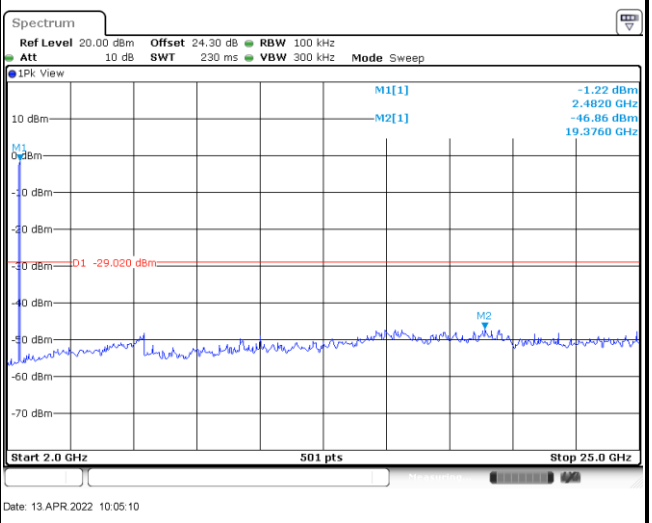
100kHz PSD reference Level	Low Channel Plot
	
Spurious Emission 30MHz~3GHz	**Spurious Emission 2GHz~25GHz**
	

Test Mode :	802.11g	Test Channel :	06

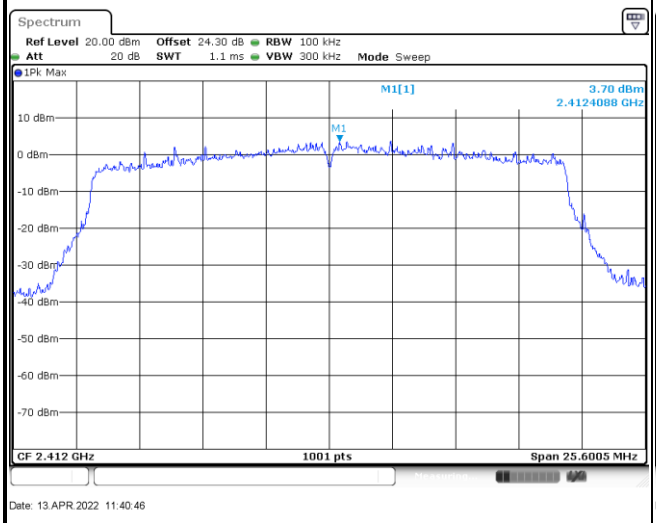
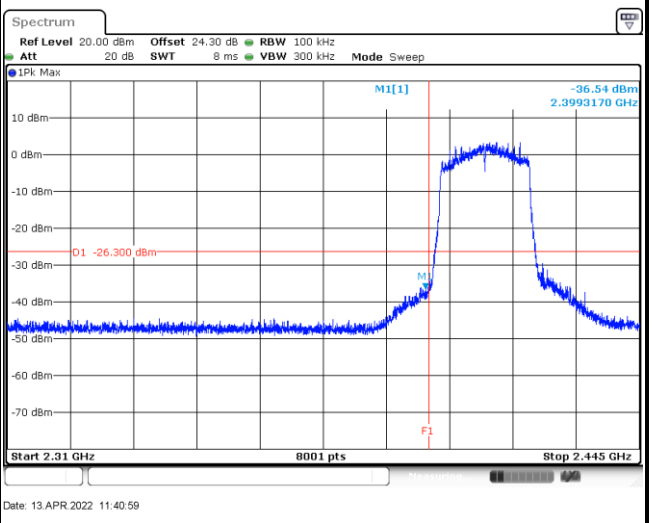
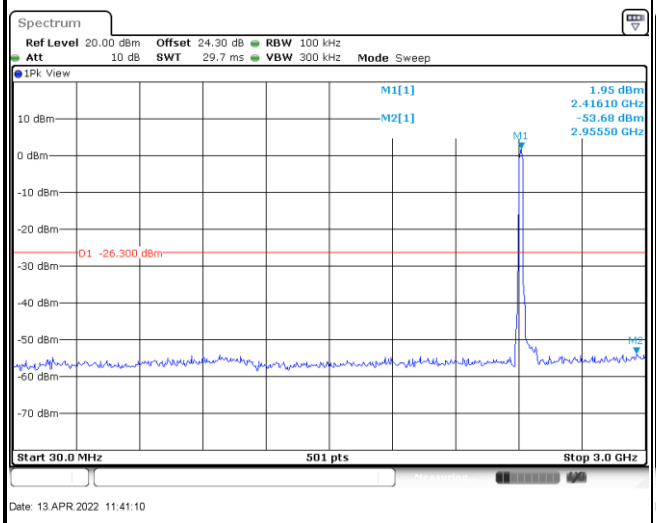
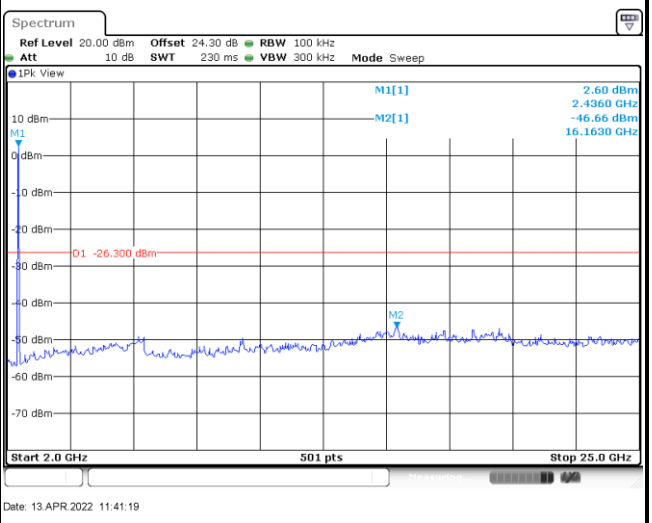
100kHz PSD reference Level	Mid Channel Plot
	

Spurious Emission 30MHz~3GHz	Spurious Emission 2GHz~25GHz
	

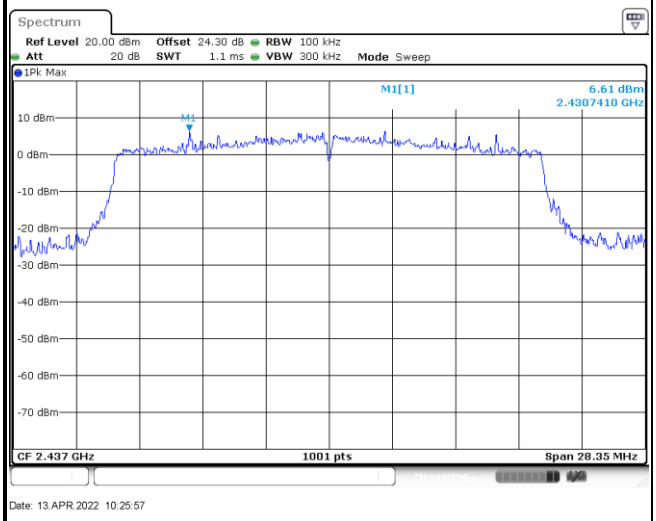
Test Mode :	802.11g	Test Channel :	11

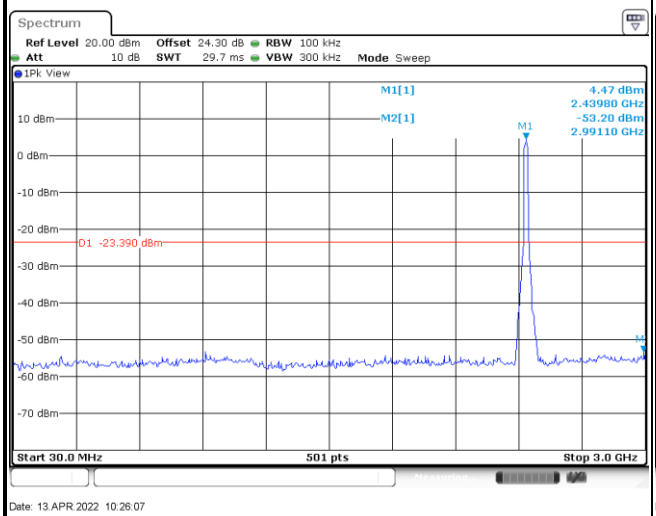
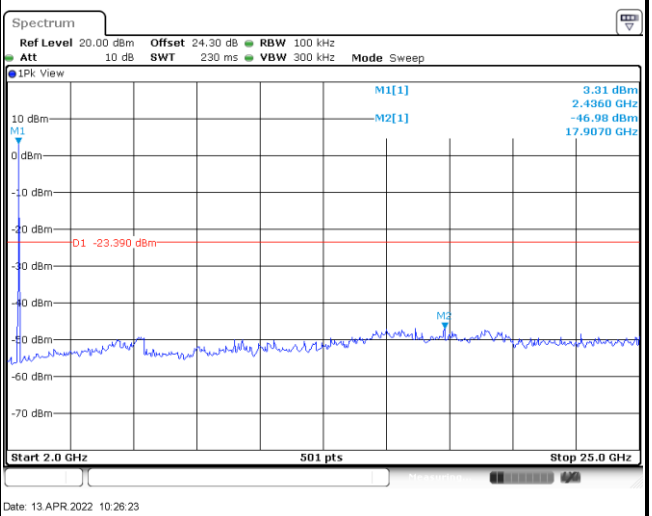
100kHz PSD reference Level	High Channel Plot
	
Spurious Emission 30MHz~3GHz	**Spurious Emission 2GHz~25GHz**
	

Test Mode :	802.11ax HE20	Test Channel :	01 Full RU

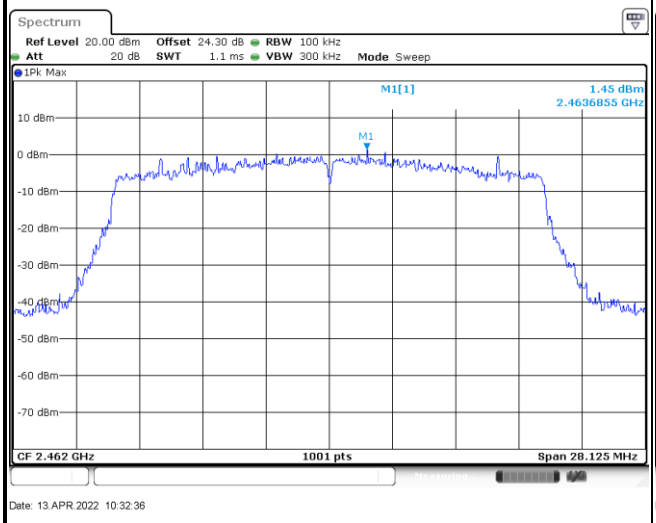
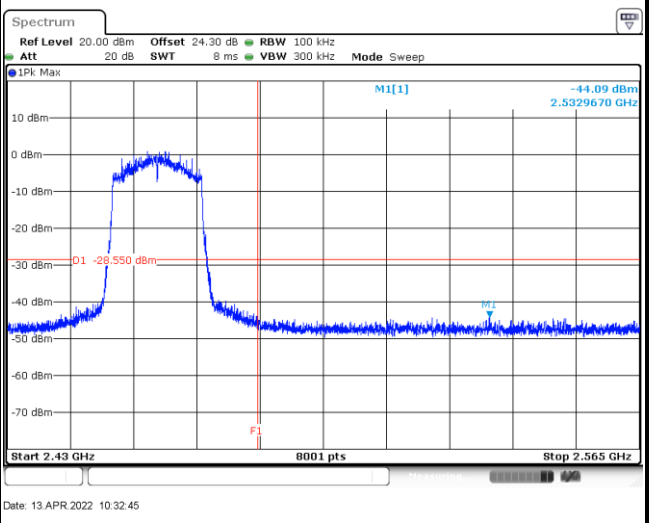
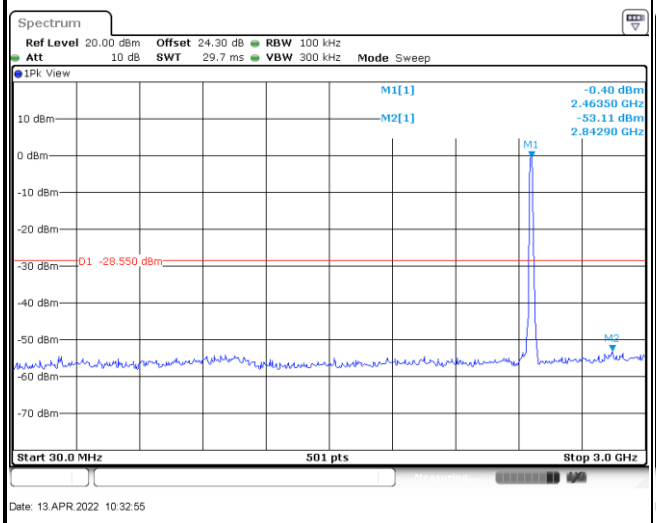
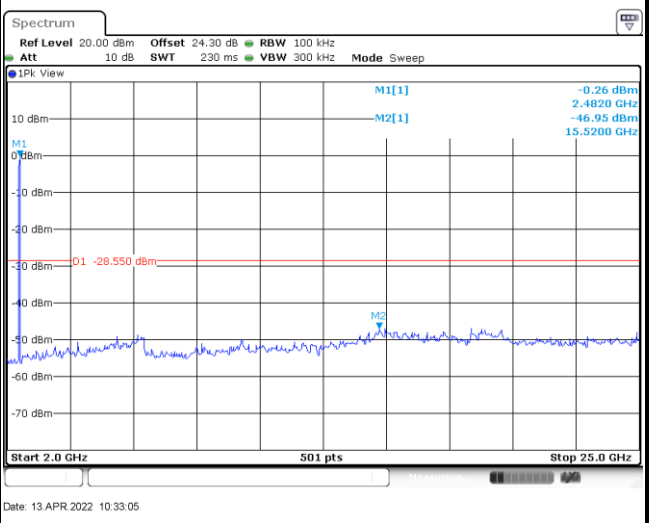
100kHz PSD reference Level	Low Channel Plot
	
Spurious Emission 30MHz~3GHz	**Spurious Emission 2GHz~25GHz**
	

Test Mode :	802.11ax HE20	Test Channel :	06 Full RU

100kHz PSD reference Level	Mid Channel Plot
	

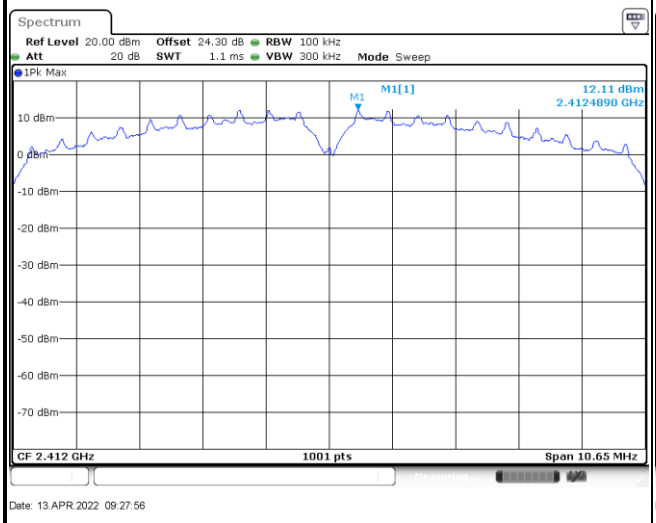
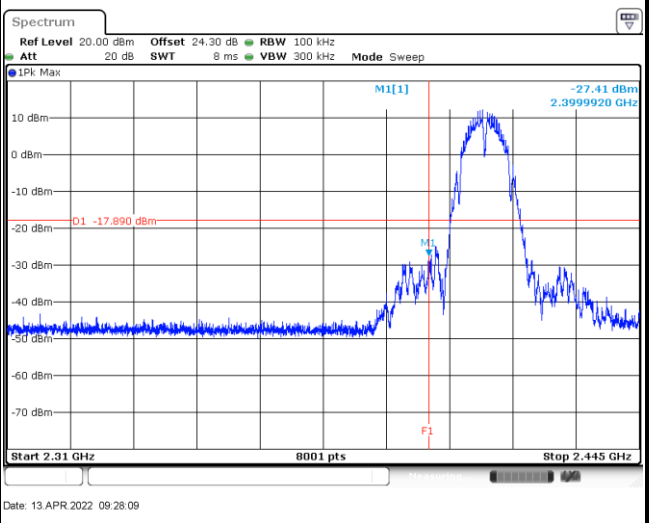
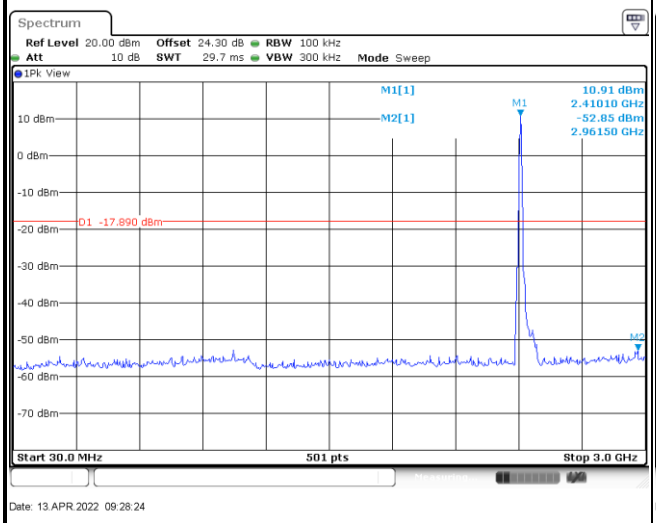
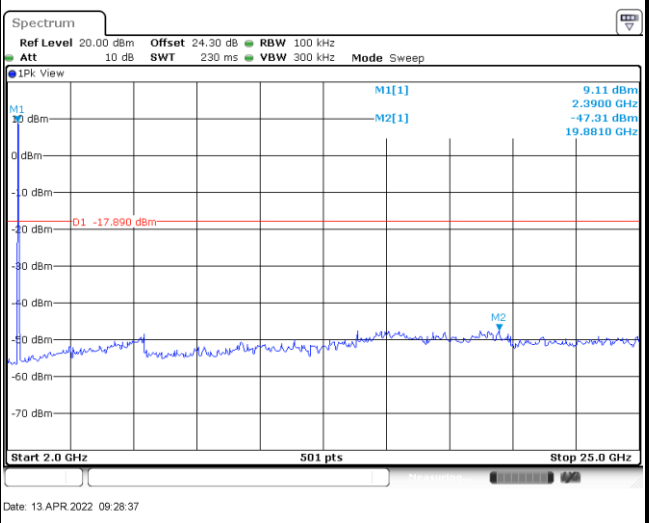
Spurious Emission 30MHz~3GHz	Spurious Emission 2GHz~25GHz
	

Test Mode :	802.11ax HE20	Test Channel :	11 Full RU

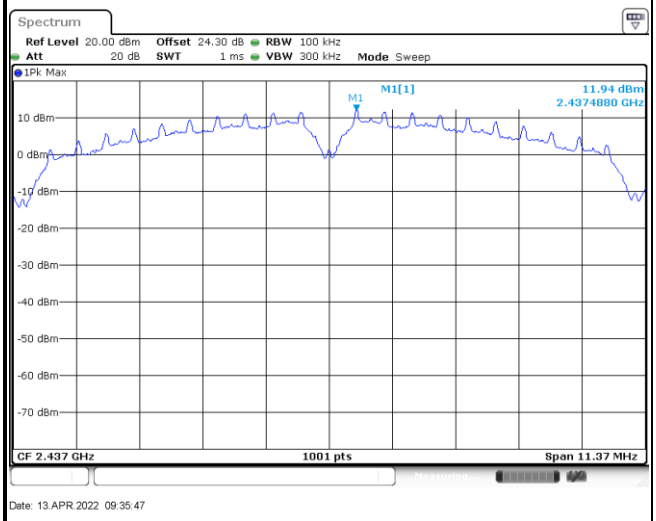
100kHz PSD reference Level	High Channel Plot
	
Spurious Emission 30MHz~3GHz	**Spurious Emission 2GHz~25GHz**
	

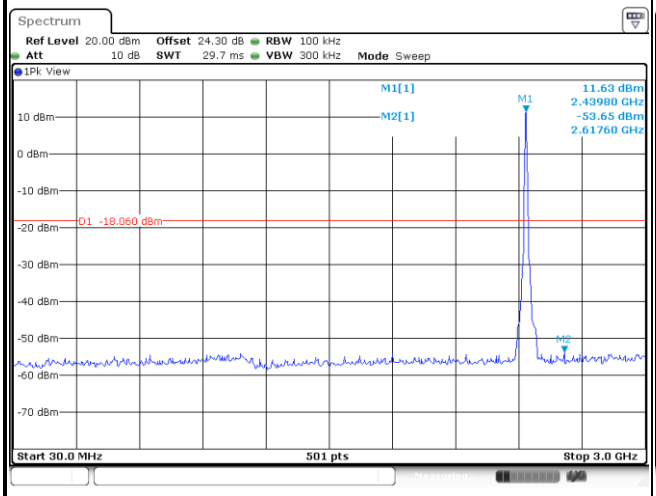
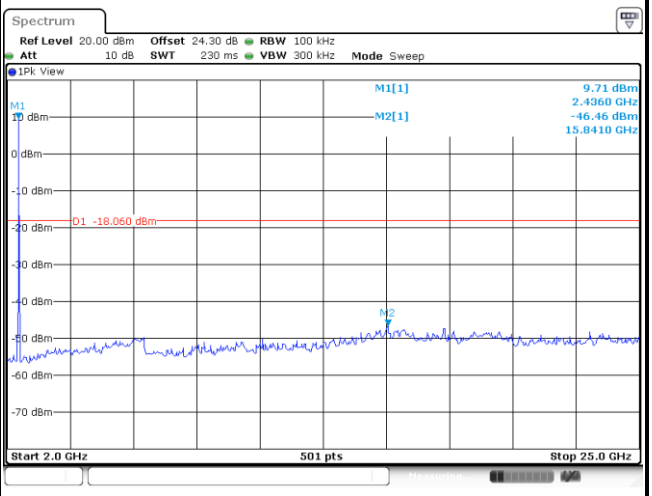
Number of TX = 2, Ant. 7 (Measured)

Test Mode :	802.11b	Test Channel :	01

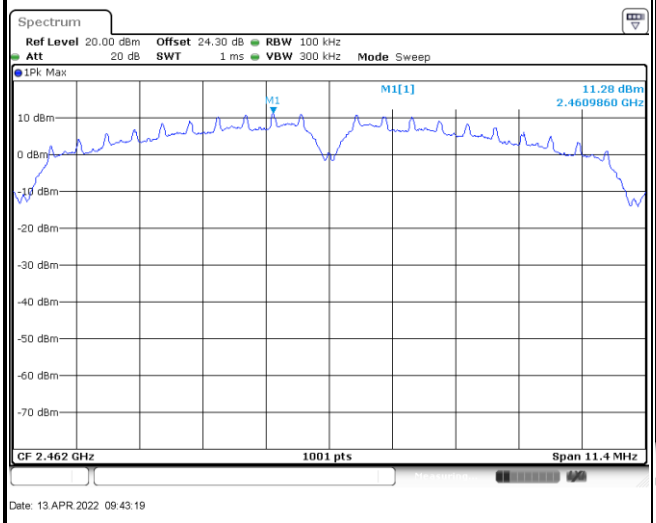
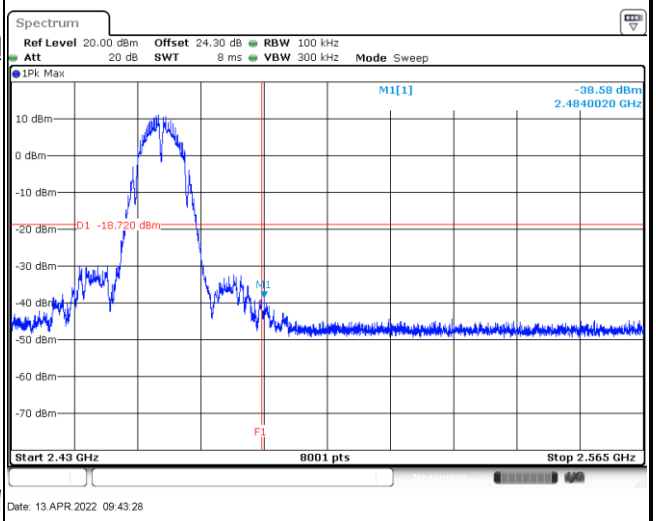
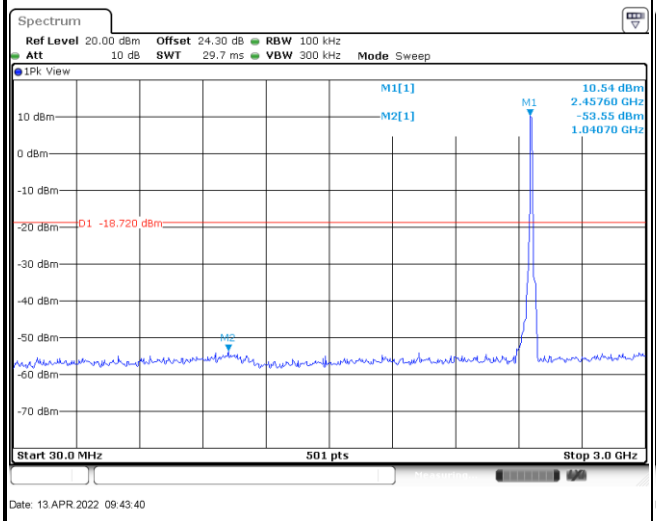
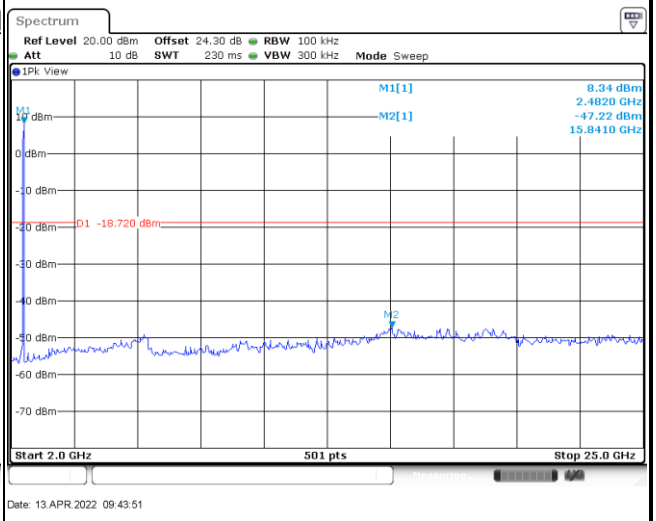
100kHz PSD reference Level	Low Channel Plot
	
Spurious Emission 30MHz~3GHz	**Spurious Emission 2GHz~25GHz**
	

Test Mode :	802.11b	Test Channel :	06

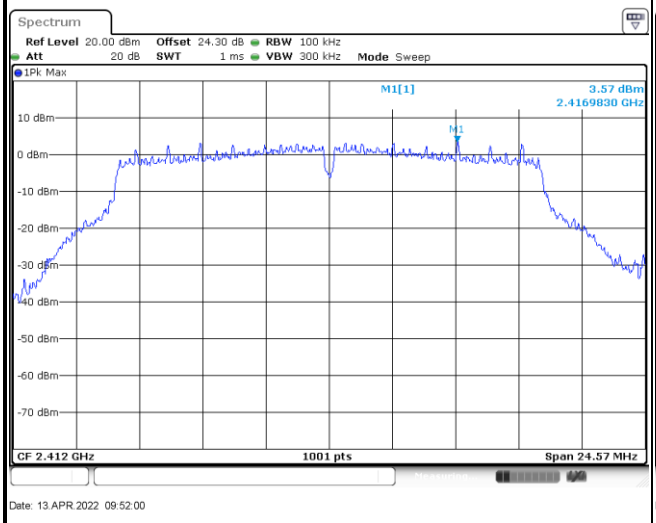
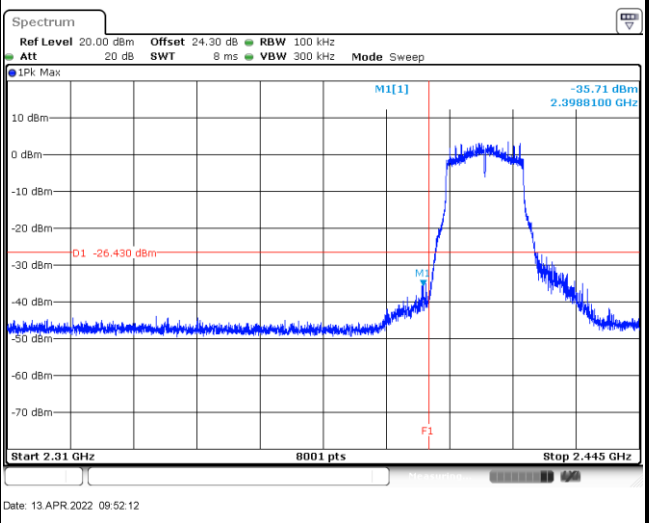
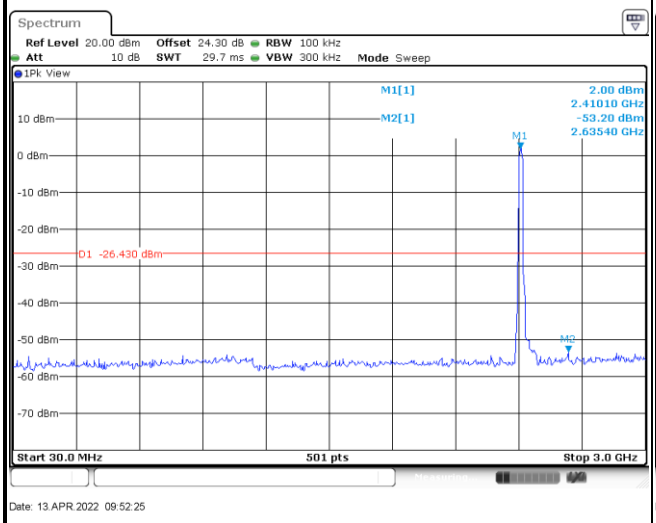
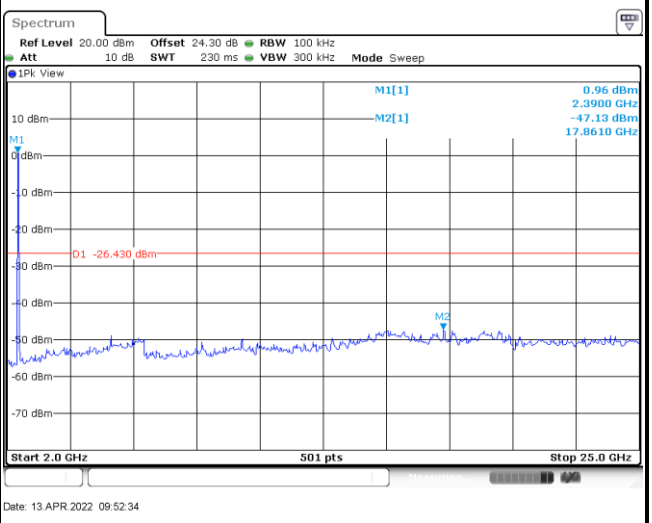
100kHz PSD reference Level	Mid Channel Plot
	

Spurious Emission 30MHz~3GHz	Spurious Emission 2GHz~25GHz
	

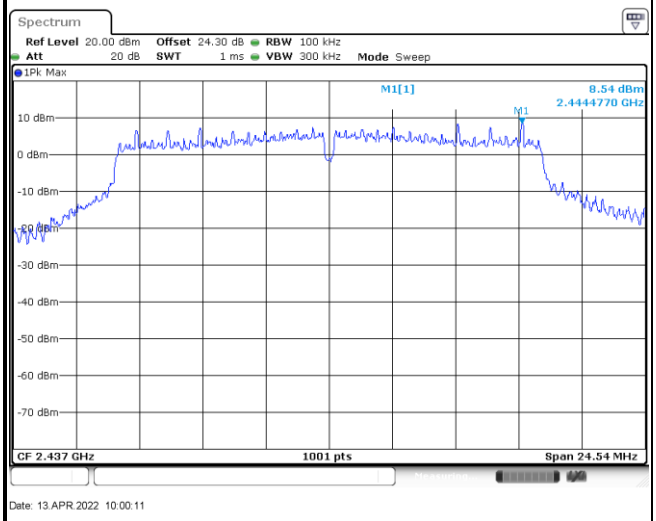
Test Mode :	802.11b	Test Channel :	11

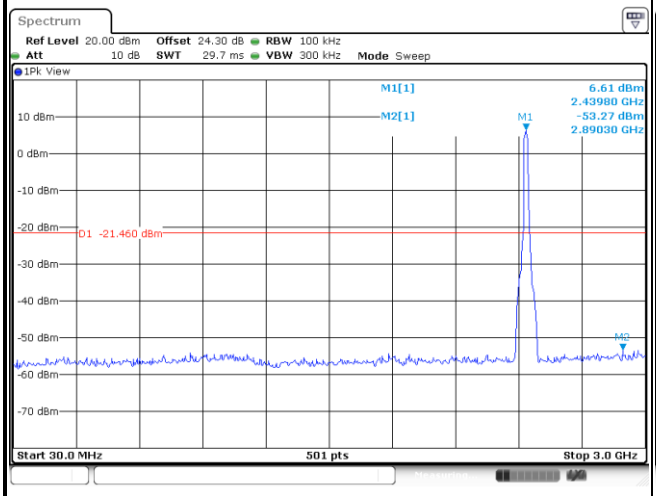
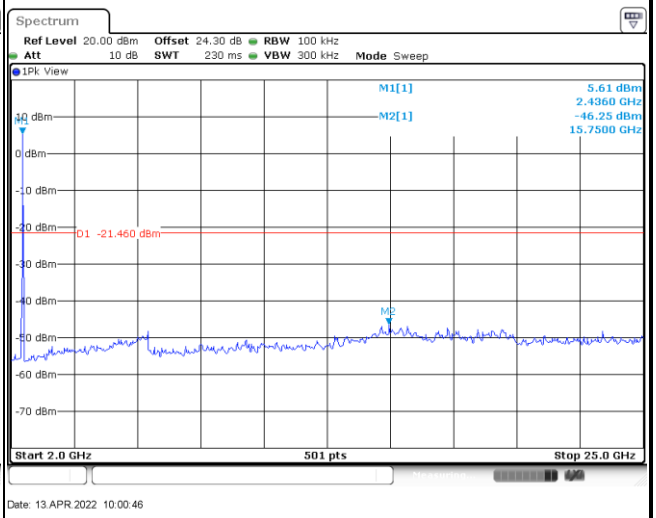
100kHz PSD reference Level	High Channel Plot
	
Spurious Emission 30MHz~3GHz	**Spurious Emission 2GHz~25GHz**
	

Test Mode :	802.11g	Test Channel :	01

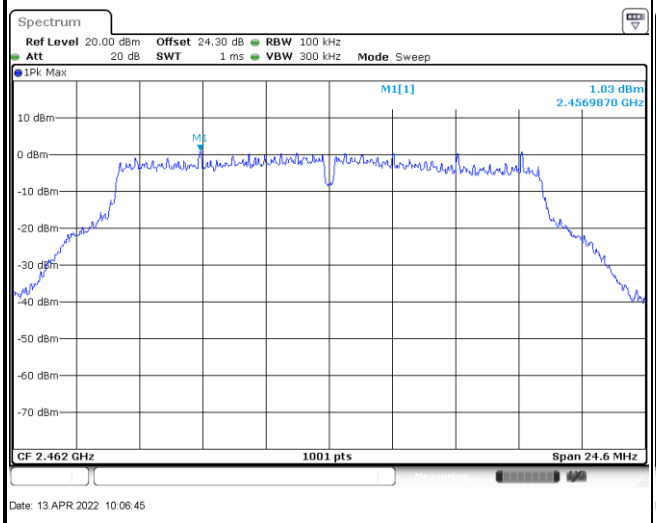
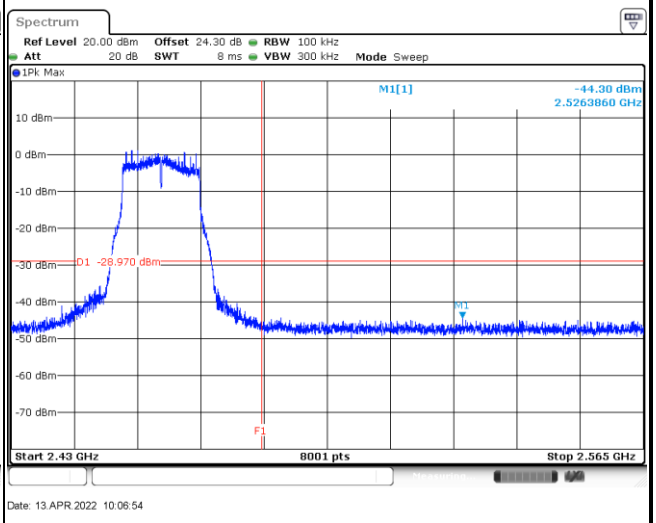
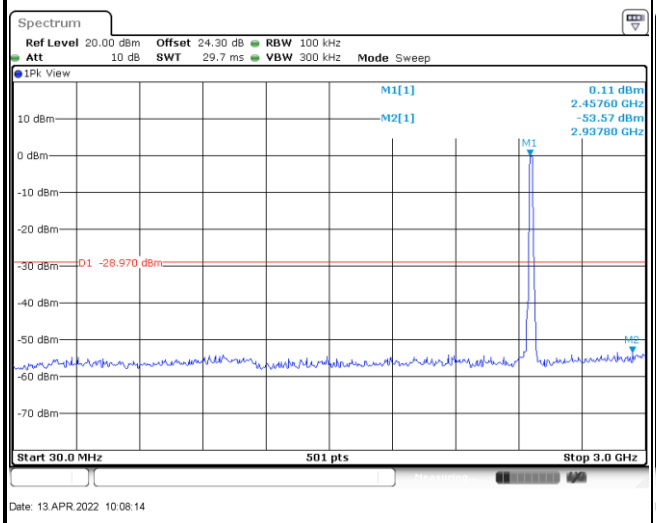
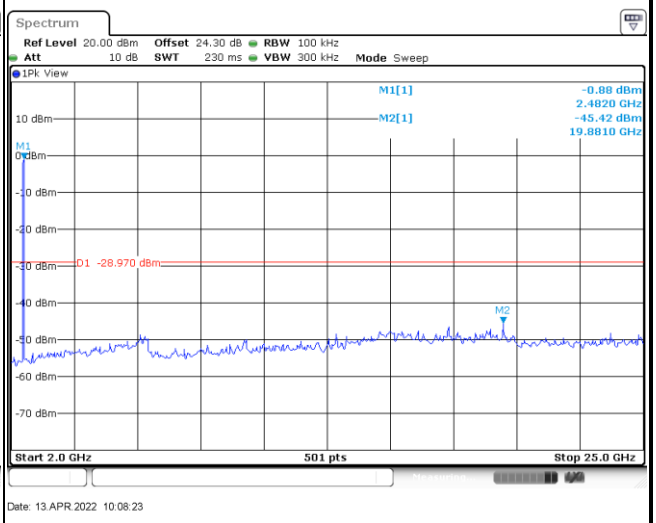
100kHz PSD reference Level	Low Channel Plot
	
Spurious Emission 30MHz~3GHz	**Spurious Emission 2GHz~25GHz**
	

Test Mode :	802.11g	Test Channel :	06

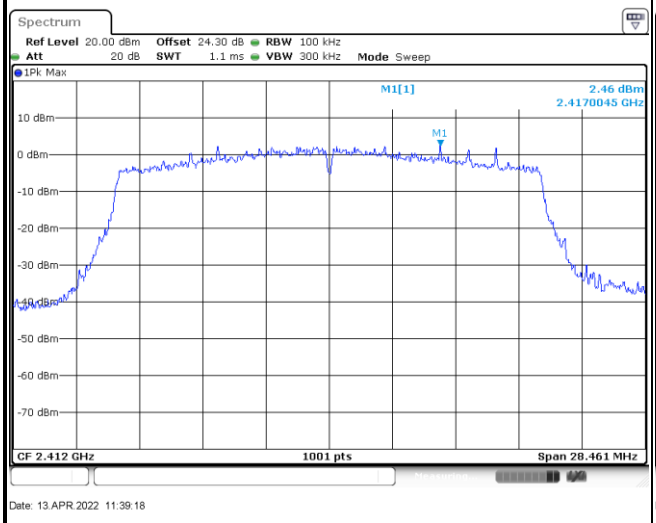
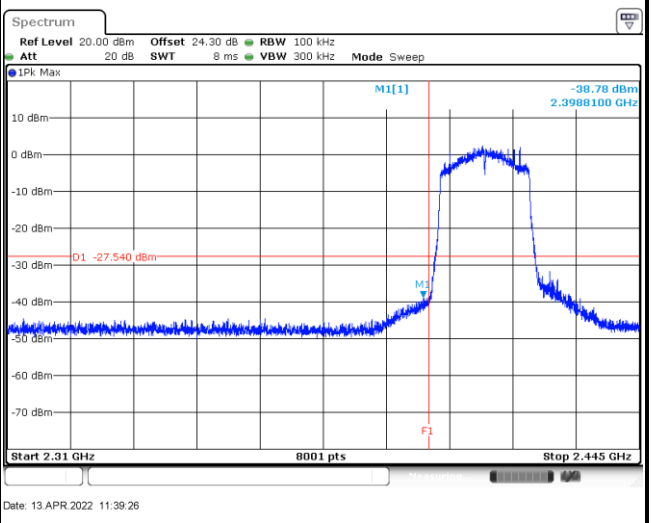
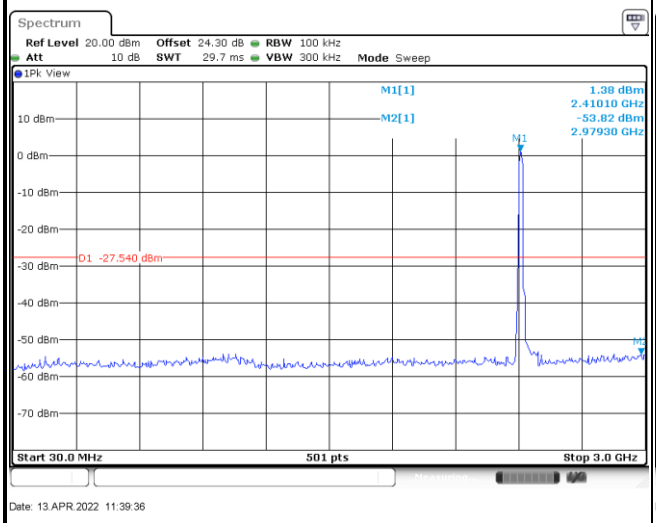
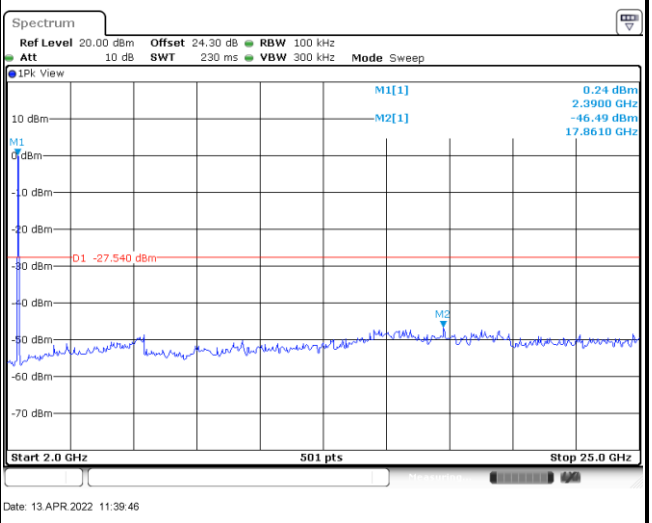
100kHz PSD reference Level	Mid Channel Plot
	

Spurious Emission 30MHz~3GHz	Spurious Emission 2GHz~25GHz
	

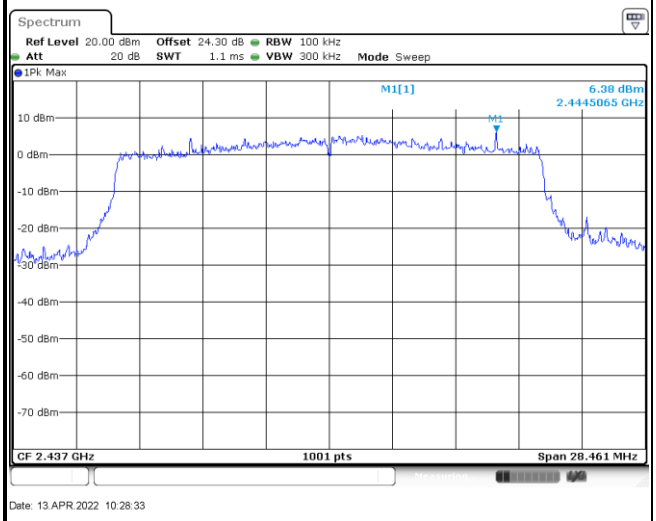
Test Mode :	802.11g	Test Channel :	11

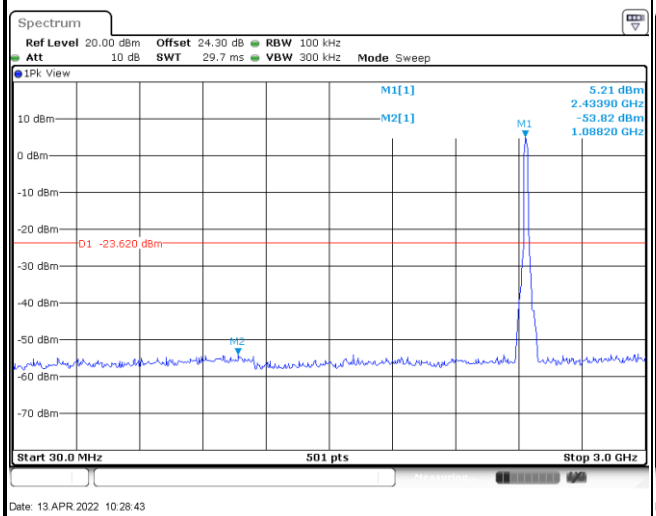
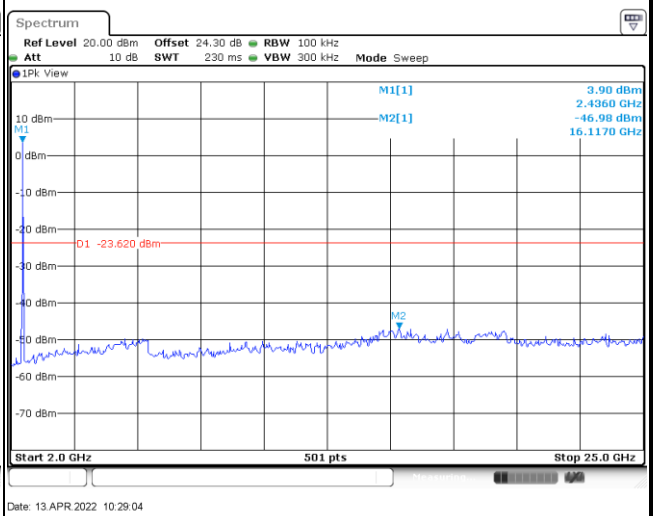
100kHz PSD reference Level	High Channel Plot
	
Spurious Emission 30MHz~3GHz	**Spurious Emission 2GHz~25GHz**
	

Test Mode :	802.11ax HE20	Test Channel :	01 Full RU

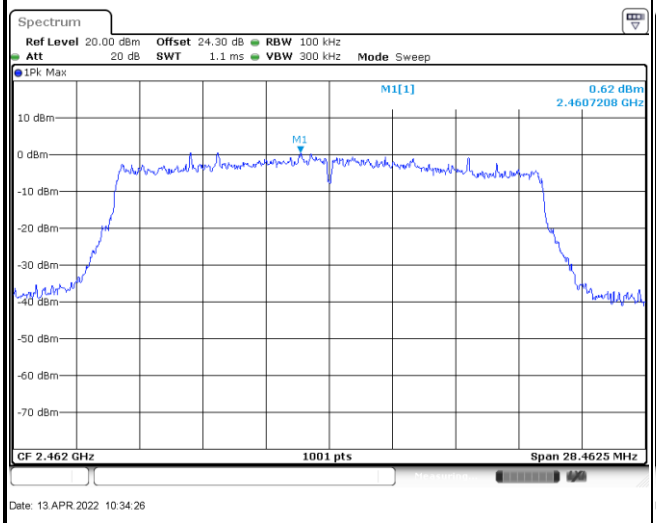
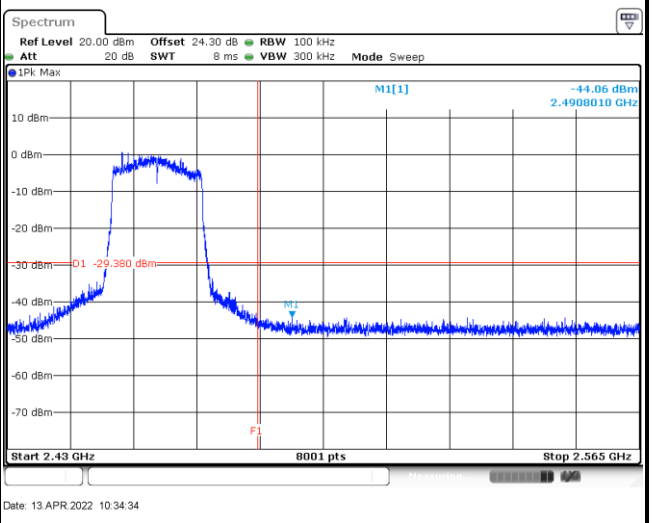
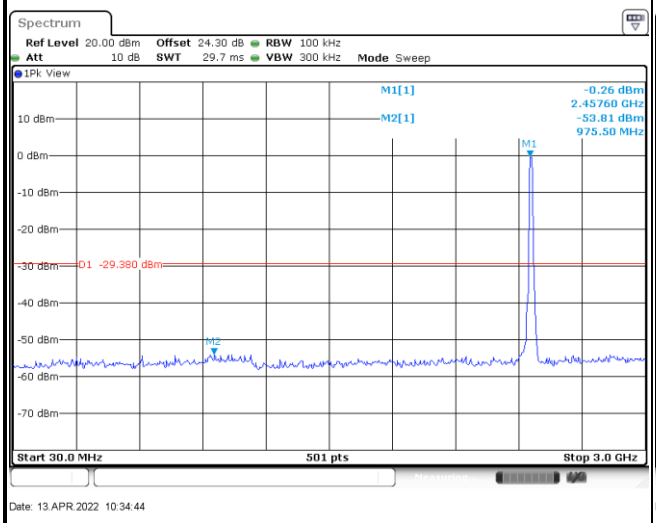
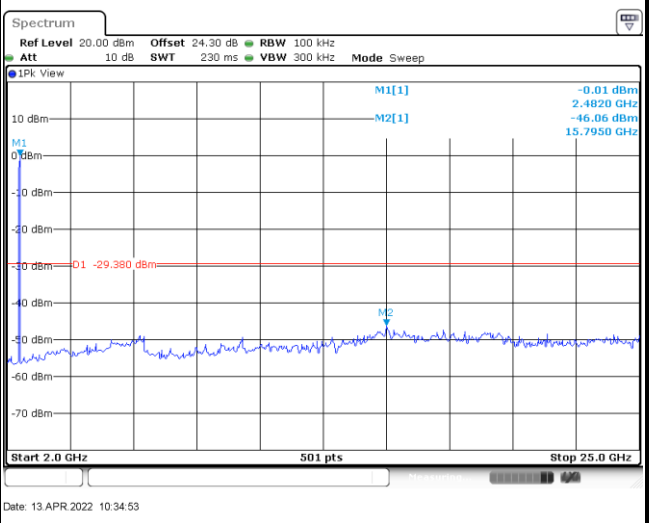
100kHz PSD reference Level	Low Channel Plot
	
Spurious Emission 30MHz~3GHz	**Spurious Emission 2GHz~25GHz**
	

Test Mode :	802.11ax HE20	Test Channel :	06 Full RU

100kHz PSD reference Level	Mid Channel Plot
	

Spurious Emission 30MHz~3GHz	Spurious Emission 2GHz~25GHz
	

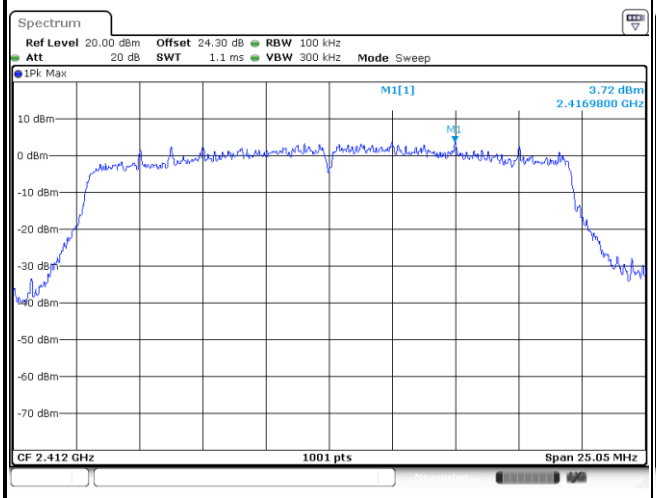
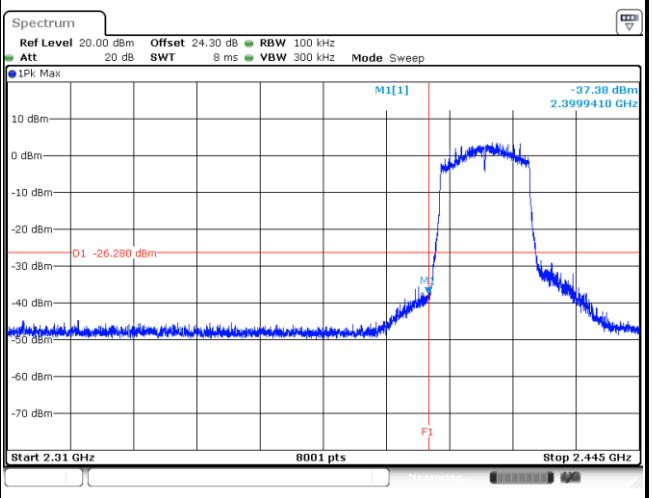
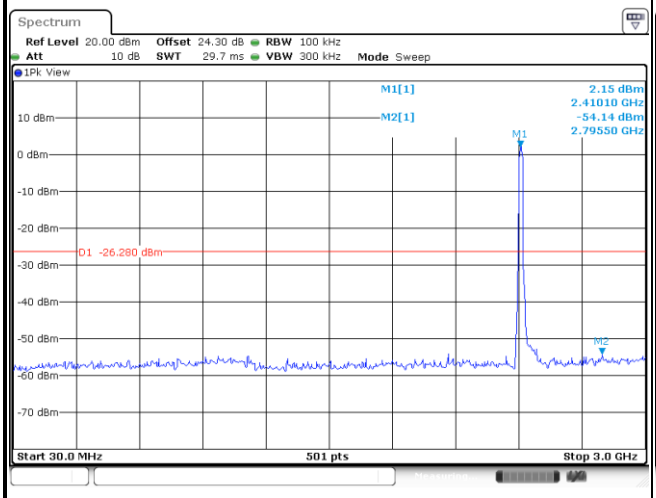
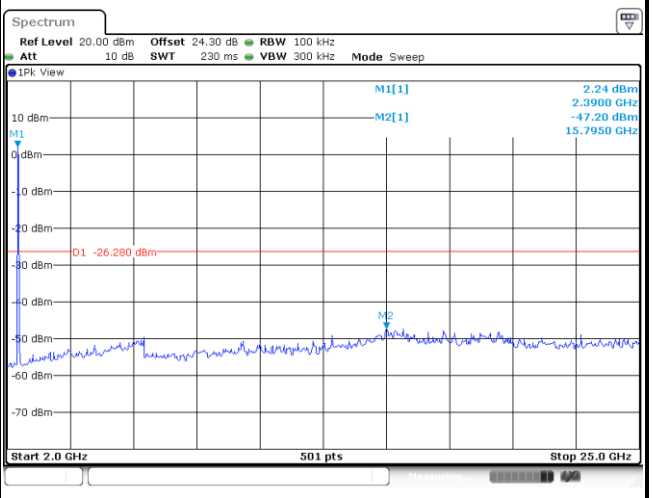
Test Mode :	802.11ax HE20	Test Channel :	11 Full RU

100kHz PSD reference Level	High Channel Plot
	
Spurious Emission 30MHz~3GHz	**Spurious Emission 2GHz~25GHz**
	

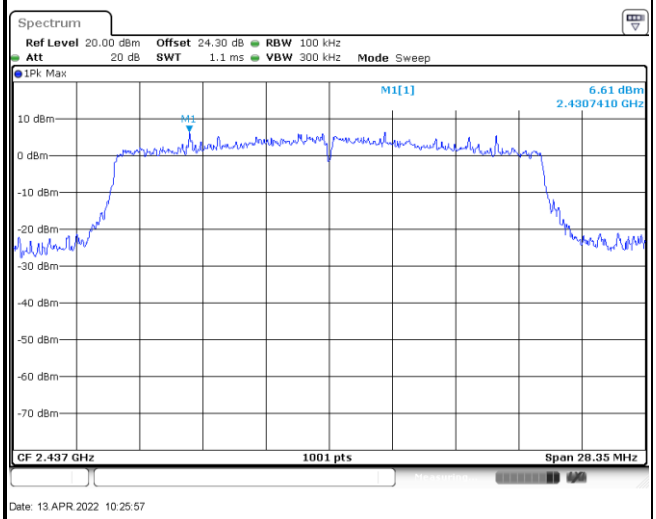
<TXBF Mode>

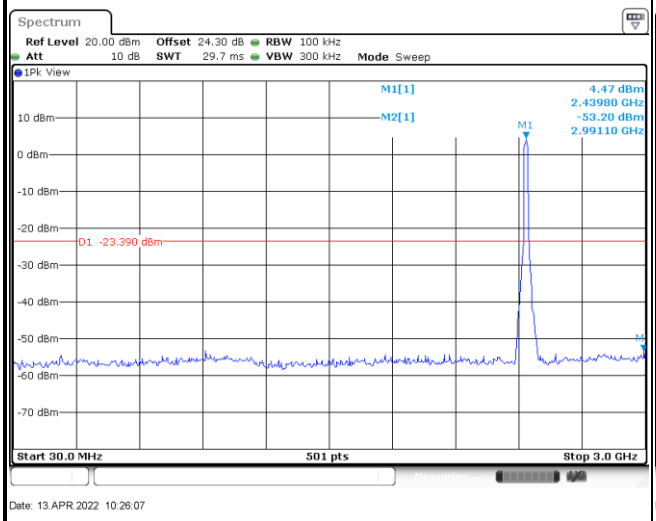
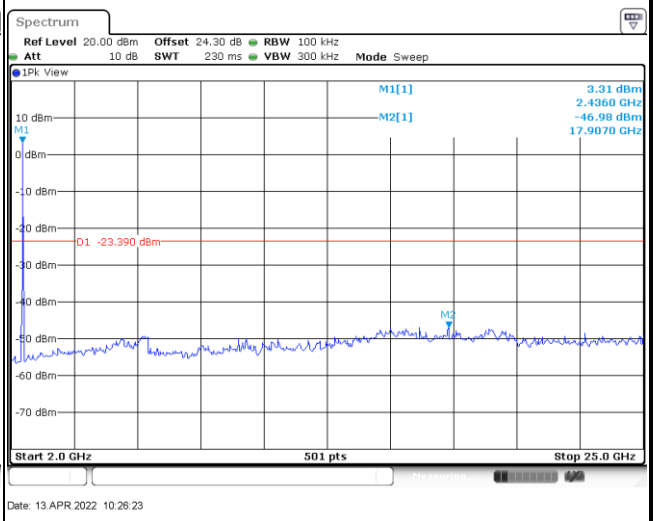
Number of TX = 2, Ant. 6 (Measured)

Test Mode :	802.11ax HE20	Test Channel :	01 Full RU

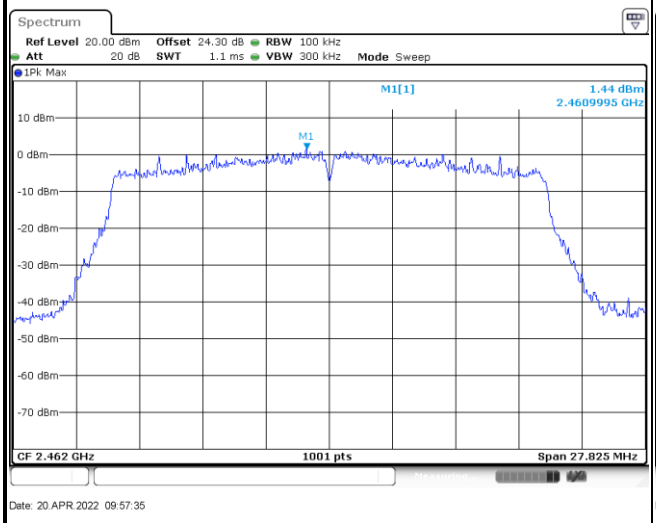
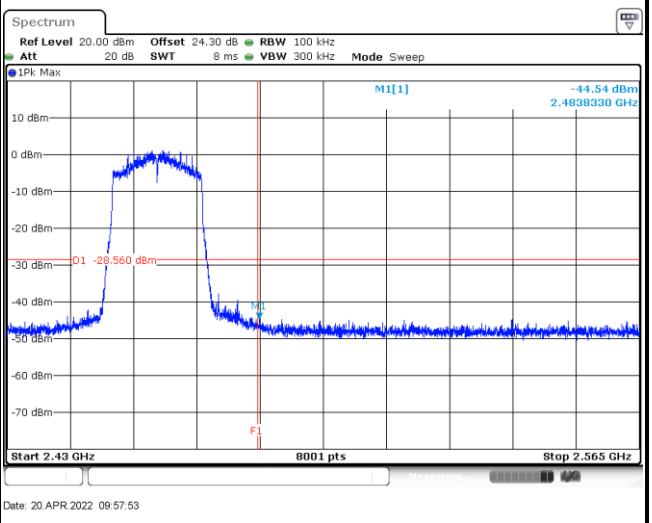
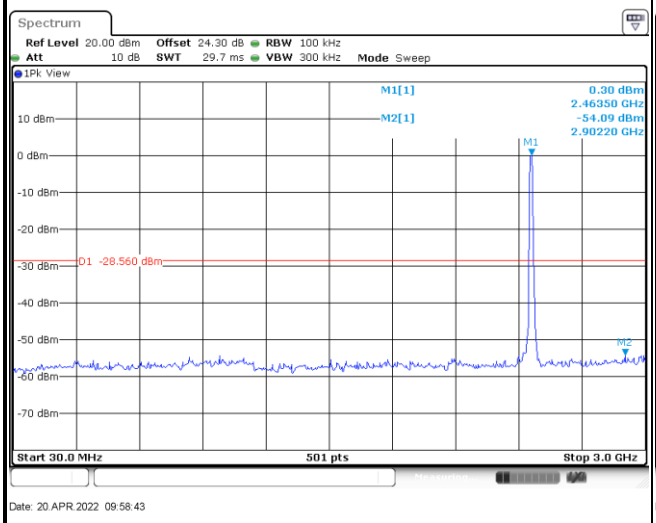
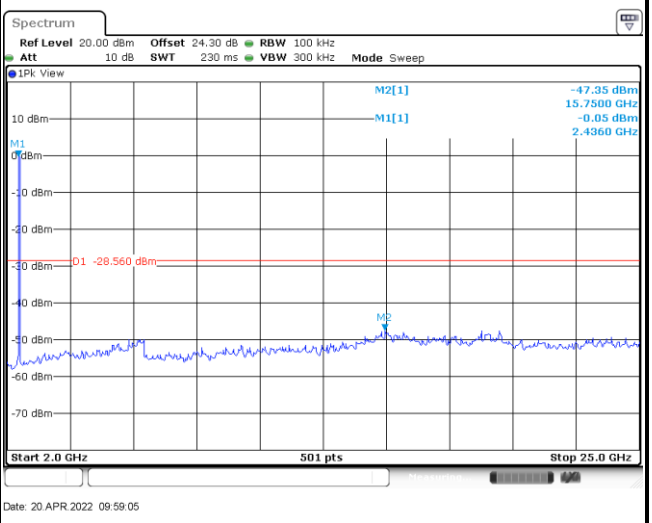
100kHz PSD reference Level	Low Channel Plot
	
Spurious Emission 30MHz~3GHz	**Spurious Emission 2GHz~25GHz**
	

Test Mode :	802.11ax HE20	Test Channel :	06 Full RU

100kHz PSD reference Level	Mid Channel Plot
	

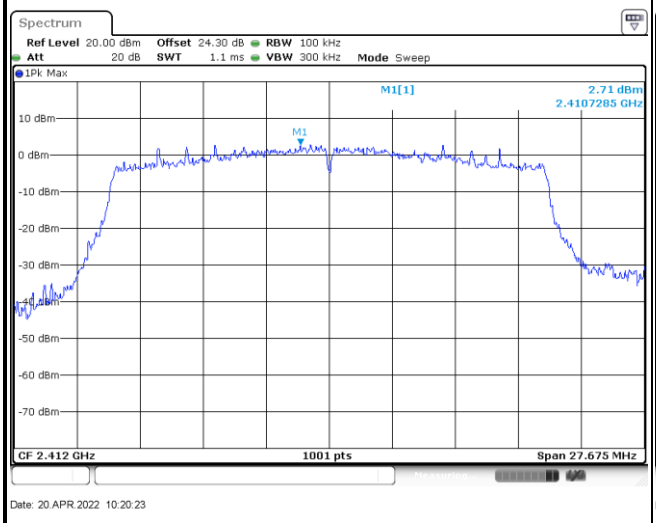
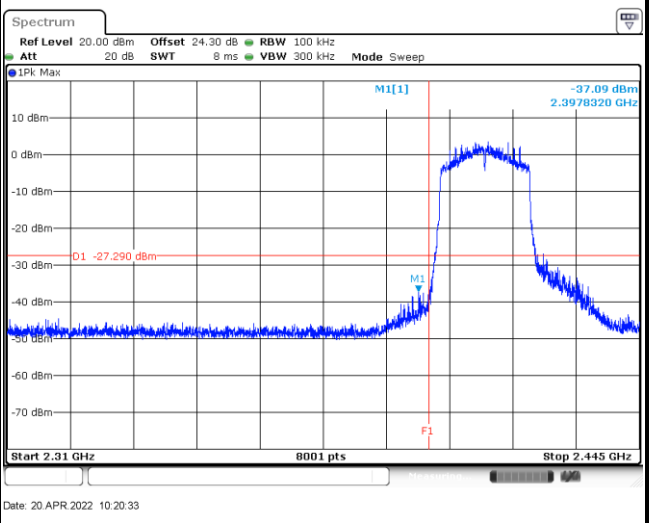
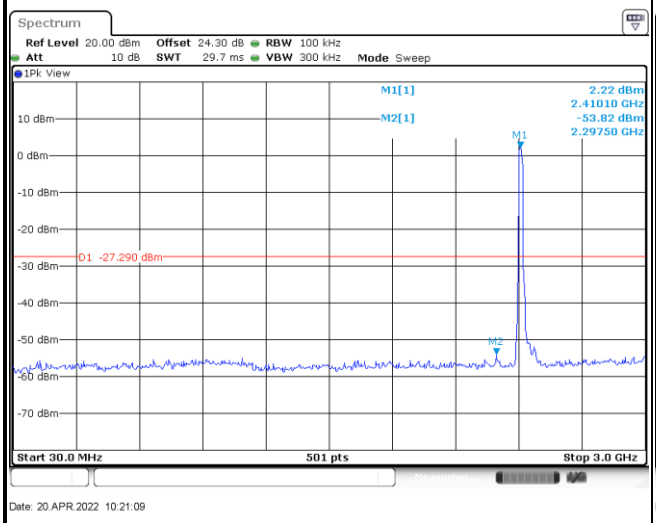
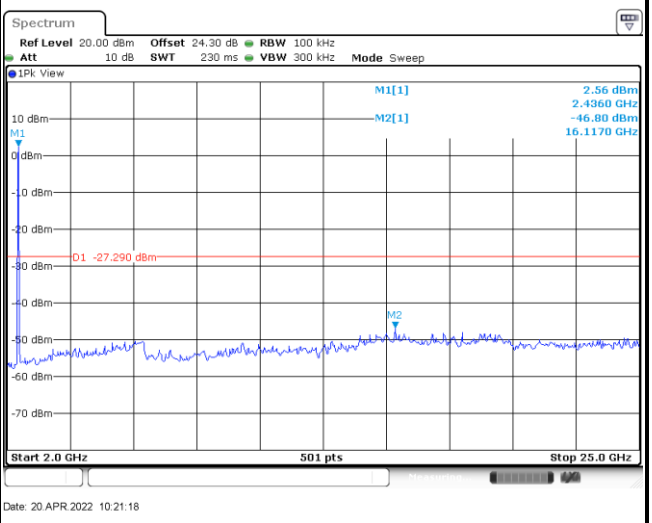
Spurious Emission 30MHz~3GHz	Spurious Emission 2GHz~25GHz
	

Test Mode :	802.11ax HE20	Test Channel :	11 Full RU

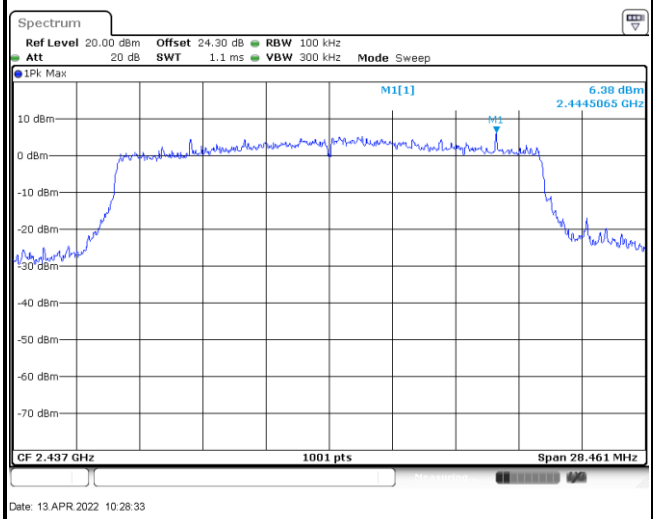
100kHz PSD reference Level	High Channel Plot
	
Spurious Emission 30MHz~3GHz	**Spurious Emission 2GHz~25GHz**
	

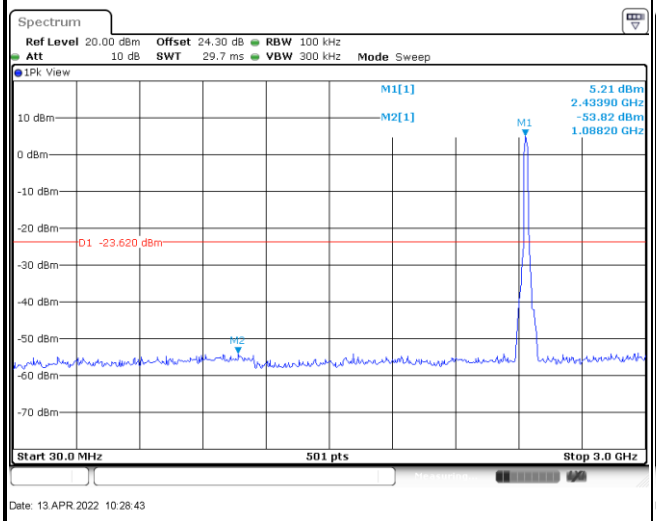
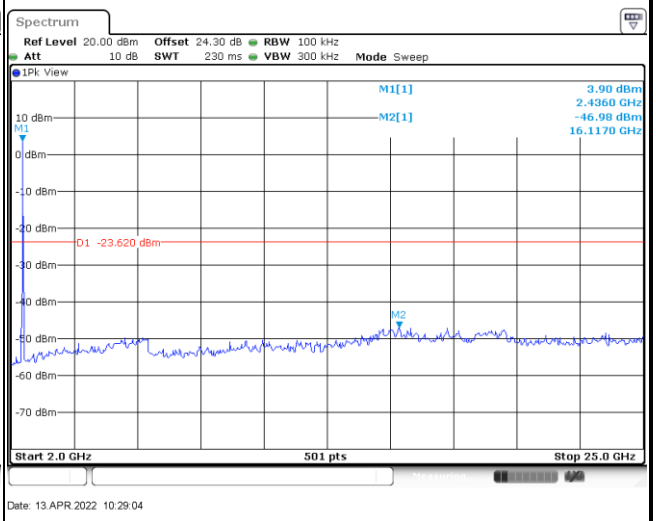
Number of TX = 2, Ant. 7 (Measured)

Test Mode :	802.11ax HE20	Test Channel :	01 Full RU

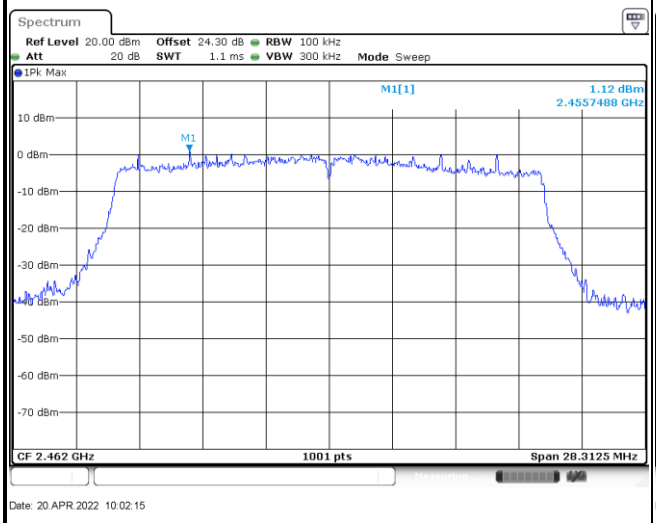
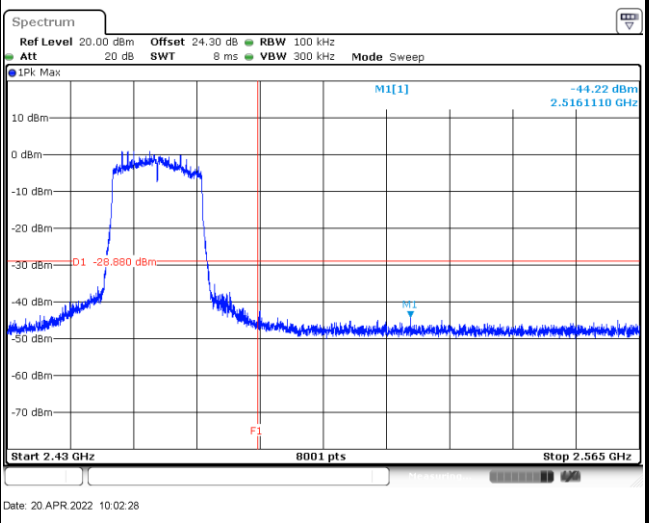
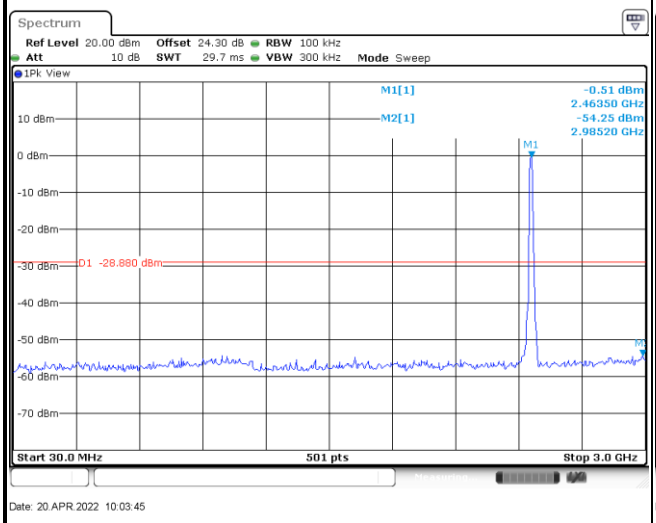
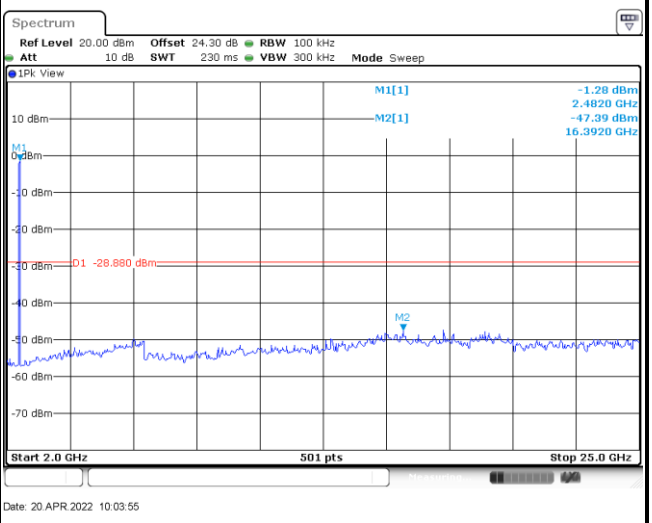
100kHz PSD reference Level	Low Channel Plot
	
Spurious Emission 30MHz~3GHz	**Spurious Emission 2GHz~25GHz**
	

Test Mode :	802.11ax HE20	Test Channel :	06 Full RU

100kHz PSD reference Level	Mid Channel Plot
	

Spurious Emission 30MHz~3GHz	Spurious Emission 2GHz~25GHz
	

Test Mode :	802.11ax HE20	Test Channel :	11 Full RU

100kHz PSD reference Level	High Channel Plot
	
Spurious Emission 30MHz~3GHz	**Spurious Emission 2GHz~25GHz**
	

3.5 Radiated Band Edges and Spurious Emission Measurement

3.5.1 Limit of Radiated band edge and Spurious Emission Measurement

In any 100 kHz bandwidth outside the intentional radiator frequency band, all harmonics/spurious must be at least 20 dB below the highest emission level within the authorized band. If the output power of this device is measured by spectrum analyzer, the attenuation under this paragraph shall be 30 dB instead of 20 dB. In addition, radiated emissions which fall in the restricted bands must also comply with the limits as below.

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30.0	30	30
30 – 88	100	3
88 – 216	150	3
216 - 960	200	3
Above 960	500	3

3.5.2 Measuring Instruments

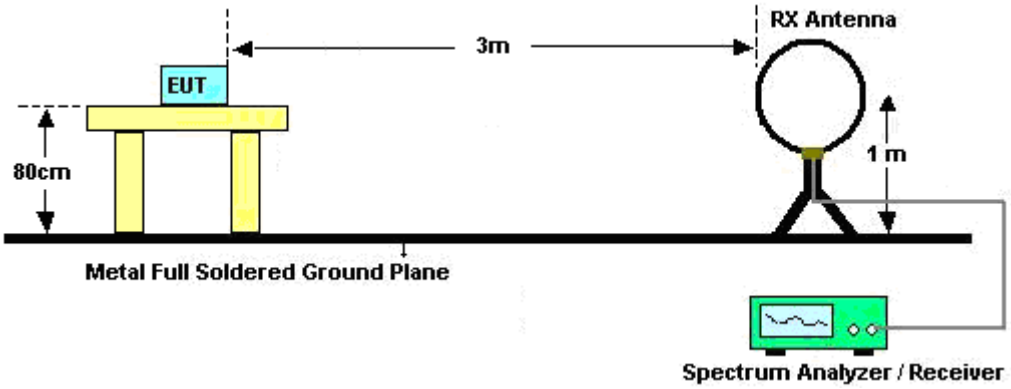
Please refer to the measuring equipment list in this test report.

3.5.3 Test Procedures

1. The testing follows the ANSI C63.10 Section 11.12.1 Radiated emission measurements
2. The EUT is arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level.
3. The EUT is placed on a turntable with 0.8 meter for frequency below 1 GHz and 1.5 meter for frequency above 1 GHz respectively above ground.
4. The EUT is set 3 meters away from the receiving antenna, which is mounted on the top of a variable height antenna tower.
5. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level
6. Radiated testing below 1 GHz is performed by adjusting the antenna tower from 1 m to 4 m and by rotating the turn table from 0 degree to 360 degrees to find the peak maximum hold reading. When there is no suspected emission found and the emission level is with at least 6 dB margin against QP limit line, the position is marked as "-".
7. Radiated testing above 1 GHz is performed by adjusting the antenna tower from 1 m to 4 m and by rotating the turn table from 0 degree to 360 degrees to find the peak maximum hold reading for scanning all frequencies. When there is no suspected emission found and the harmonic emission level is with at least 6 dB margin against average limit line, the position is marked as "-".
8. Use the following spectrum analyzer settings:
   (1) Span shall wide enough to fully capture the emission being measured;
   (2) Set RBW=100 kHz for f < 1 GHz; VBW ≥ RBW; Sweep = auto; Detector function = peak; Trace = max hold;
   (3) Set RBW = 1 MHz, VBW = 3 MHz for f ≥ 1 GHz for peak measurement.
   For average measurement:
   - VBW = 10 Hz, when duty cycle is no less than 98 percent.
   - VBW ≥ 1/T, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.

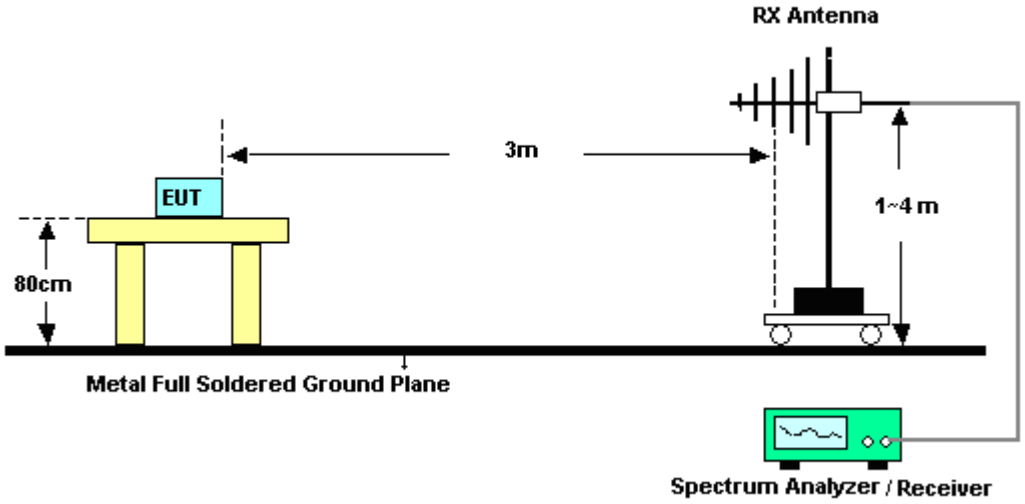
3.5.4 Test Setup

For radiated emissions below 30MHz

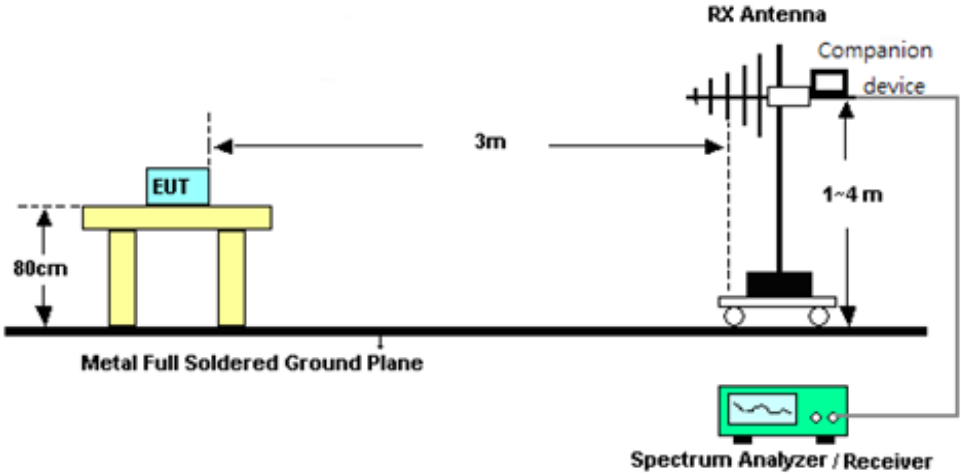


For radiated emissions from 30MHz to 1GHz

<CDD Mode>

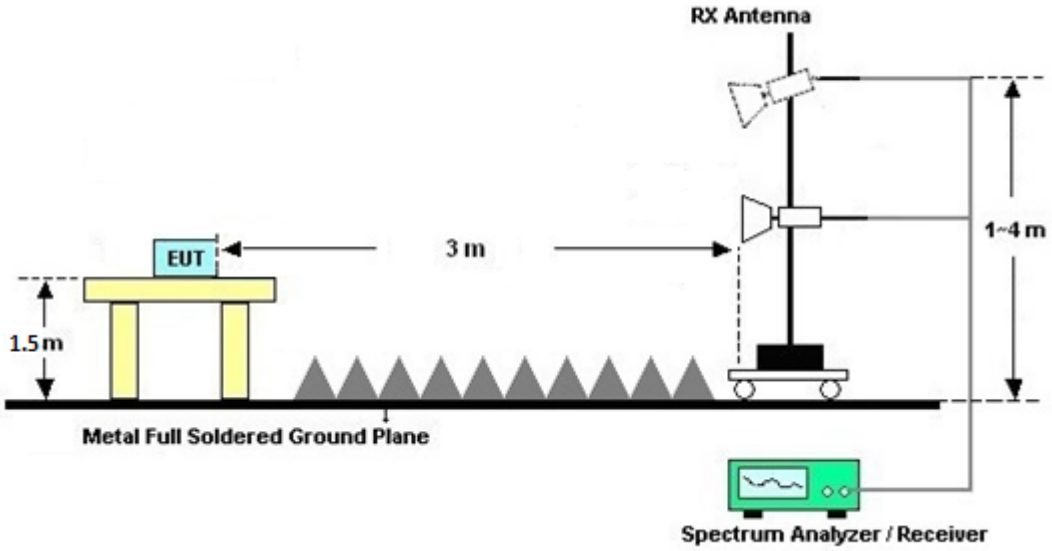


<TXBF Modes>



For radiated test from 1GHz to 18GHz

<CDD Mode>



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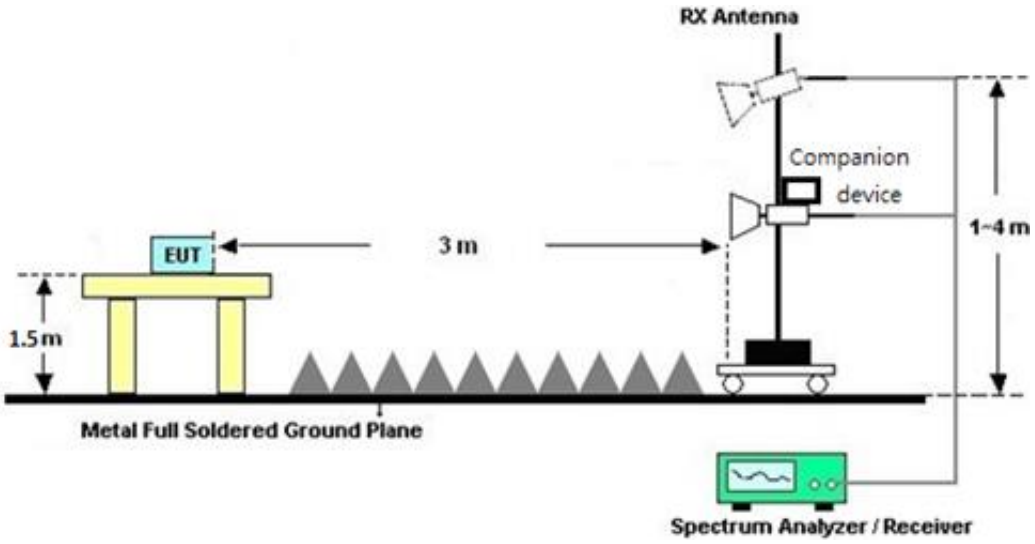
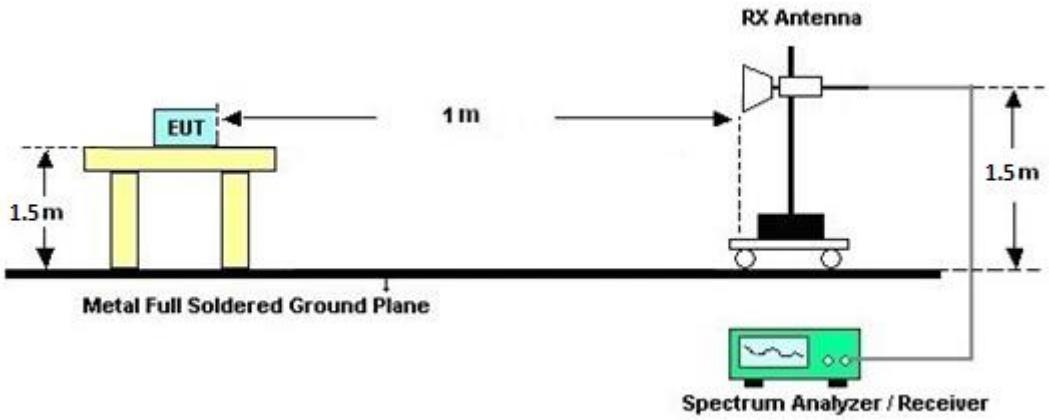


For radiated test above 18GHz

<CDD Mode>



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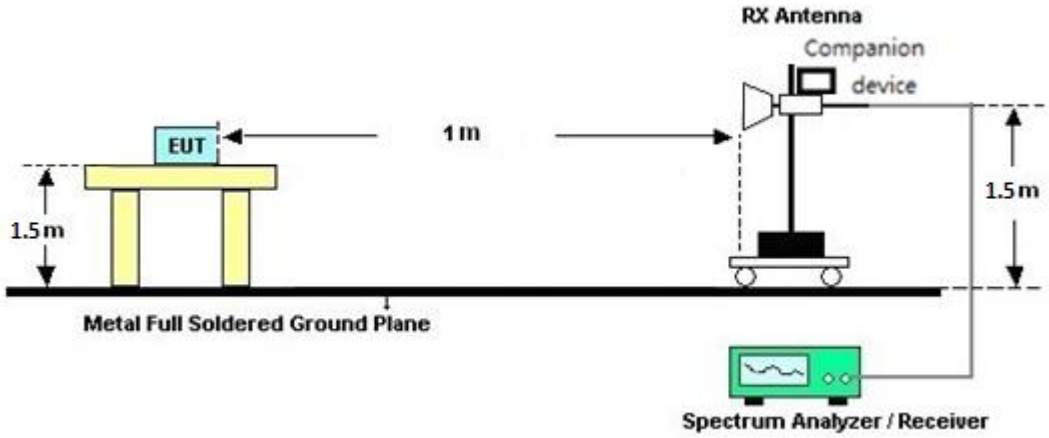


3.5.5 Test Results of Radiated Spurious Emissions (9 kHz ~ 30 MHz)

The low frequency, which starts from 9 kHz to 30 MHz, is pre-scanned and the result which is 20 dB lower than the limit line is not reported.

There is adequate comparison measurement of both open-field test site and alternative test site - semi-Anechoic chamber according to 414788 D01 Radiated Test Site v01r01, and the result comes out very similar.

3.5.6 Test Result of Radiated Spurious at Band Edges

Please refer to Appendix B and C.

3.5.7 Duty Cycle

Please refer to Appendix D.

3.5.8 Test Result of Radiated Spurious Emission (30 MHz ~ 10th Harmonic)

Please refer to Appendix B and C.

3.6 AC Conducted Emission Measurement

3.6.1 Limit of AC Conducted Emission

For equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table.

Frequency of Emission (MHz)	Conducted Limit (dBμV)	
	Quasi-Peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

*Decreases with the logarithm of the frequency.

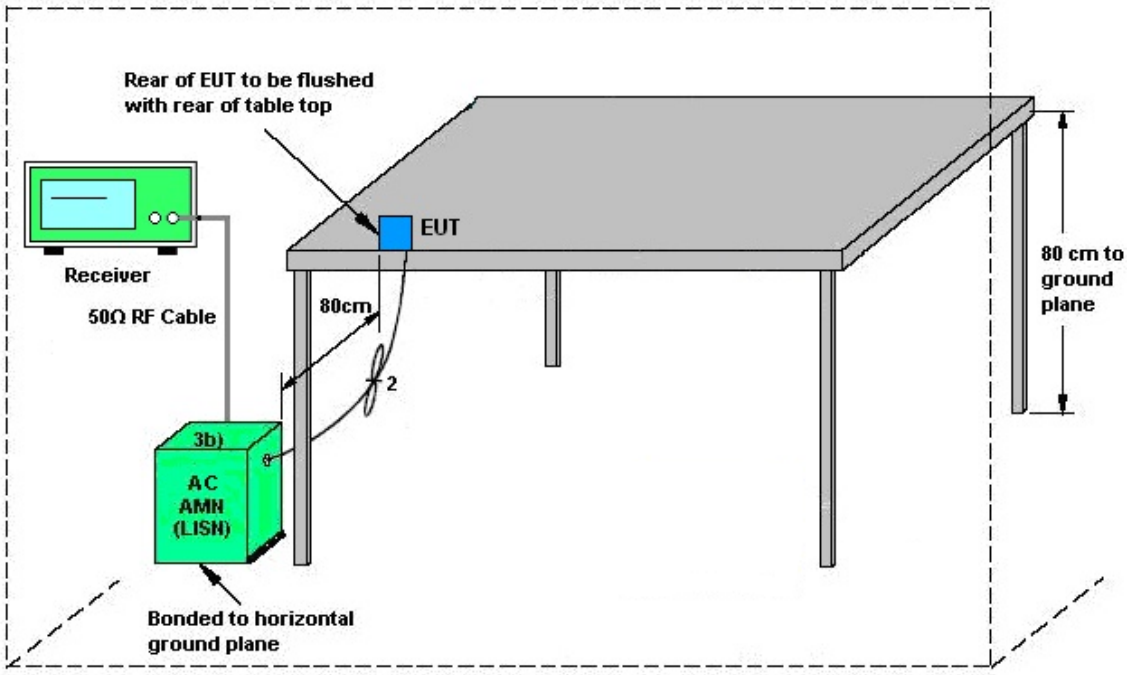
3.6.2 Measuring Instruments

Please refer to the measuring equipment list in this test report.

3.6.3 Test Procedures

1. The EUT is placed 0.4 meter away from the conducting wall of the shielding room, and is kept at least 80 centimeters from any other grounded conducting surface.
2. Connect EUT to the power mains through a line impedance stabilization network (LISN).
3. All the support units are connecting to the other LISN.
4. The LISN provides 50 ohm coupling impedance for the measuring instrument.
5. The FCC states that a 50 ohm, 50 microhenry LISN shall be used.
6. Both Line and Neutral shall be tested in order to find out the maximum conducted emission.
7. The frequency range from 150 kHz to 30 MHz is scanned.
8. Set the test-receiver system to Peak Detect Function and specified bandwidth (IF bandwidth = 9 kHz) with Maximum Hold Mode.

3.6.4 Test Setup



AMN = Artificial mains network (LISN)
AE = Associated equipment
EUT = Equipment under test
ISN = Impedance stabilization network

3.6.5 Test Result of AC Conducted Emission

Please refer to Appendix A.

3.7 Antenna Requirements

3.7.1 Standard Applicable

If directional gain of transmitting antennas is greater than 6 dBi, the power shall be reduced by the same level in dB comparing to gain minus 6 dBi. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the rule.

3.7.2 Antenna Anti-Replacement Construction

An embedded-in antenna design is used.

3.7.3 Antenna Gain

<CDD Modes >

FCC KDB 662911 D01 Multiple Transmitter Output v02r01

For power measurements on IEEE 802.11 devices,

Directional gain = G_{ANT} + Array Gain, where Array Gain is as follows:

Array Gain = 0 dB (i.e., no array gain) for $N_{ANT} \leq 4$.

G_{ANT} is set equal to the gain of the antenna having the highest gain.

For PSD measurements, the directional gain calculation follows F)2)f)ii) of KDB 662911 D01 v02r01.

$$DirectionalGain = 10 \cdot \log \left[\frac{\sum_{j=1}^{N_{SS}} \left\{ \sum_{k=1}^{N_{ANT}} g_{j,k} \right\}^2}{N_{ANT}} \right]$$

where

Each antenna is driven by no more than one spatial stream;

N_{SS} = the number of independent spatial streams of data;

N_{ANT} = the total number of antennas

$g_{j,k} = 10^{G_k / 20}$ if the kth antenna is being fed by spatial stream j, or zero if it is not;

G_k is the gain in dBi of the kth antenna.

As minimum N_{SS}=1 is supported by EUT, the formula can be simplified as:

Directional gain = $10*\log[(10^{G1/20} + 10^{G2/20} + \ldots + 10^{GN/20})^2 / N_{ANT}]$ dBi

Where G1, G2….GN denote single antenna gain.

For example: If a device has two antenna, G_{ANT1}= 3.6dBi; G_{ANT2}=4.2dBi

Directional gain of power measurement = max(3.6, 4.2) + 0 = 4.2 dBi

Directional gain of PSD measurement = 10 * log[($10^{3.6/20}$ + $10^{4.2/20}$)^2 / 2] = 6.92 dBi

The directional gain of EUT is listed in the following table.

<CDD Modes>

	Ant. 1 (dBi)	Ant. 2 (dBi)	DG for Power (dBi)	DG for PSD (dBi)	Power Limit Reduction (dB)	PSD Limit Reduction (dB)
2.4 GHz	1.68	1.27	1.68	4.49	0.00	0.00

Power Limit Reduction = DG(Power) – 6dBi, (min = 0)

PSD Limit Reduction = DG(PSD) – 6dBi, (min = 0)

Calculation example:

For the DG for PSD is derived from formula is

10 x log { { [10^ (1.68 dBi / 20) + 10^ (1.27 dBi / 20)] ^ 2 } / 2 }

= 4.49 dBi

TXBF modes

FCC KDB 662911 D01 Multiple Transmitter Output v02r01

For CDD transmissions, directional gain is calculated as

$$DirectionalGain = 10 \cdot \log \left[\frac{\sum_{j=1}^{N_{SS}} \left\{ \sum_{k=1}^{N_{ANT}} g_{j,k} \right\}^2}{N_{ANT}} \right]$$

where

Each antenna is driven by no more than one spatial stream;

N_{SS} = the number of independent spatial streams of data;

N_{ANT} = the total number of antennas

$g_{j,k} = 10^{G_k / 20}$ if the kth antenna is being fed by spatial stream j, or zero if it is not;

G_k is the gain in dBi of the kth antenna.

The EUT supports beamforming for 802.11ac modes.

The directional gain calculation is following F)2)e)ii) of KDB 662911 D01 v02r01.

The power and PSD limit should be modified if the directional gain of EUT is over 6 dBi,

The directional gain “DG” is calculated as following table.

			DG	DG	Power	PSD
			for	for	Limit	Limit
	Ant. 6	Ant. 7	Power	PSD	Reduction	Reduction
	(dBi)	(dBi)	(dBi)	(dBi)	(dB)	(dB)
2.4 GHz	1.68	1.27	4.49	4.49	0.00	0.00

Power Limit Reduction = DG(Power) – 6dBi, (min = 0)

PSD Limit Reduction = DG(PSD) – 6dBi, (min = 0)

Calculation example:

For the DG for PSD is derived from formula is

10 x log { { [10^ (1.68 dBi / 20) + 10^ (1.27 dBi / 20)] ^ 2 } / 2 }

= 4.49 dBi

4 List of Measuring Equipment

Instrument	Brand Name	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Hygrometer	TECPEL	DTM-303A	TP201996	N/A	Nov. 16, 2021	Mar. 23, 2022 Jun. 06, 2022	Nov. 15, 2022	Conducted (TH05-HY)
Power Sensor	DARE	RPR3006W	16I00054SNO12 (NO:113)	10MHz~6GHz	Dec. 16, 2021	Mar. 23, 2022 Jun. 06, 2022	Dec. 15, 2022	Conducted (TH05-HY)
Signal Analyzer	Rohde & Schwarz	FSV40	101566	10Hz~40GHz	Aug. 30, 2021	Mar. 23, 2022 Jun. 06, 2022	Aug. 29, 2022	Conducted (TH05-HY)
Switch Control Mainframe	E-IUSTRUMENT	ETF-1405-0	EC1900067 (BOX7)	N/A	Aug. 12, 2021	Mar. 23, 2022 Jun. 06, 2022	Aug. 11, 2022	Conducted (TH05-HY)
Loop Antenna	Rohde & Schwarz	HFH2-Z2	100488	9 kHz~30 MHz	Sep. 07, 2021	Apr. 09, 2022 ~ May 30, 2022	Sep. 06, 2022	Radiation (03CH13-HY)
Preamplifier	EMEC	EM18G40G	060715	18GHz~40GHz	Dec. 24, 2021	Apr. 09, 2022 ~ May 30, 2022	Dec. 23, 2022	Radiation (03CH13-HY)
SHF-EHF Horn Antenna	SCHWARZBECK	BBHA9170	00993	18GHz-40GHz	Nov. 30, 2021	Apr. 09, 2022 ~ May 30, 2022	Nov. 29, 2022	Radiation (03CH13-HY)
Amplifier	SONOMA	310N	187282	9kHz~1GHz	Dec. 15, 2021	Apr. 09, 2022 ~ May 30, 2022	Dec. 14, 2022	Radiation (03CH13-HY)
Bilog Antenna	TESEQ	BL 6111D & 00802N1D01N-06	47020 & 06	30MHz~1GHz	Oct. 09, 2021	Apr. 09, 2022 ~ May 30, 2022	Oct. 08, 2022	Radiation (03CH13-HY)
Horn Antenna	SCHWARZBECK	BBHA 9120 D	9120D-1241	1GHz~18GHz	Jul. 13, 2021	Apr. 09, 2022 ~ May 30, 2022	Jul. 12, 2022	Radiation (03CH13-HY)
Hygrometer	TECPEL	DTM-303B	TP200889	N/A	Sep. 30, 2021	Apr. 09, 2022 ~ May 30, 2022	Sep. 29, 2022	Radiation (03CH13-HY)
Preamplifier	MITEQ	AMF-7D-00101800-30-10P	1590074	1GHz~18GHz	May 18, 2021	Apr. 09, 2022 ~ May 16, 2022	May 17, 2022	Radiation (03CH13-HY)
Preamplifier	MITEQ	AMF-7D-00101800-30-10P	1590074	1GHz~18GHz	May 17, 2022	May 17, 2022~ May 30, 2022	May. 16, 2023	Radiation (03CH13-HY)
Preamplifier	Keysight	83017A	MY53270147	1GHz~26.5GHz	Oct. 26, 2021	Apr. 09, 2022 ~ May 30, 2022	Oct. 25, 2022	Radiation (03CH13-HY)
Spectrum Analyzer	Keysight	N9010A	MY55370526	10Hz~44GHz	Mar. 18, 2022	Apr. 09, 2022 ~ May 30, 2022	Mar. 17, 2023	Radiation (03CH13-HY)
Filter	Wainwright	WLK4-1000-1530-8000-40SS	SN12	1.53GHz Low Pass Filter	Sep. 14, 2021	Apr. 09, 2022 ~ May 30, 2022	Sep. 13, 2022	Radiation (03CH13-HY)
Filter	Wainwright	WHKX12-2700-3000-18000-60SS	SN2	3GHz High Pass Filter	Jul. 12, 2021	Apr. 09, 2022 ~ May 30, 2022	Jul. 11, 2022	Radiation (03CH13-HY)
Filter	Wainwright	WHKX8-5872.5-6750-18000-40ST	SN6	6.75GHz High Pass Filter	Jun. 30, 2021	Apr. 09, 2022 ~ May 30, 2022	Jun. 29, 2022	Radiation (03CH13-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 126E	0030/126E	30MHz~18GHz	Feb. 09, 2022	Apr. 09, 2022 ~ May 30, 2022	Feb. 08, 2023	Radiation (03CH13-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	804793/4	30MHz~18GHz	Feb. 09, 2022	Apr. 09, 2022 ~ May 30, 2022	Feb. 08, 2023	Radiation (03CH13-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	MY24961/4	30MHz~18GHz	Feb. 09, 2022	Apr. 09, 2022 ~ May 30, 2022	Feb. 08, 2023	Radiation (03CH13-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	MY9837/4PE	9kHz~30MHz	Mar. 10, 2022	Apr. 09, 2022 ~ May 30, 2022	Mar. 09, 2023	Radiation (03CH13-HY)

Instrument	Brand Name	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Controller	EMEC	EM1000	N/A	Control Turn table & Ant Mast	N/A	Apr. 09, 2022 ~ May 30, 2022	N/A	Radiation (03CH13-HY)
Antenna Mast	EMEC	AM-BS-4500-B	N/A	1m~4m	N/A	Apr. 09, 2022 ~ May 30, 2022	N/A	Radiation (03CH13-HY)
Turn Table	EMEC	TT2000	N/A	0~360 Degree	N/A	Apr. 09, 2022 ~ May 30, 2022	N/A	Radiation (03CH13-HY)
AC Power Source	ACPOWER	AFC-11003G	F317040033	N/A	N/A	Apr. 23, 2022	N/A	Conduction (CO07-HY)
Software	Rohde & Schwarz	EMC32 V10.30	N/A	N/A	N/A	Apr. 23, 2022	N/A	Conduction (CO07-HY)
Pulse Limiter	SCHWARZBECK	VTSD 9561-F N	9561-F N00373	9kHz-200MHz	Oct. 29, 2021	Apr. 23, 2022	Oct. 28, 2022	Conduction (CO07-HY)
RF Cable	HUBER + SUHNER	RG 214/U	1358175	9kHz~30MHz	Mar. 16, 2022	Apr. 23, 2022	Mar. 15, 2023	Conduction (CO07-HY)
Two-Line V-Network	TESEQ	NNB 51	45051	N/A	Feb. 16, 2022	Apr. 23, 2022	Feb. 15, 2023	Conduction (CO07-HY)
EMI Test Receiver	Rohde & Schwarz	ESCI7	100724	9kHz~7GHz	Feb. 24, 2022	Apr. 23, 2022	Feb. 23, 2023	Conduction (CO07-HY)

5 Uncertainty of Evaluation

Uncertainty of Conducted Emission Measurement (150kHz ~ 30MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**2.3 dB**

Uncertainty of Radiated Emission Measurement (30 MHz ~ 1000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**6.0 dB**

Uncertainty of Radiated Emission Measurement (1000 MHz ~ 18000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**5.2 dB**

Uncertainty of Radiated Emission Measurement (18000 MHz ~ 40000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**5.9 dB**

Appendix A. AC Conducted Emission Test Results

Test Engineer :	Louis Chung	**Temperature :**	28.6~29.5℃
		Relative Humidity :	43.9~46.7%