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Report Template Version: V05
Report Template Revision Date: 2018-07-06

Test Report

Report No.:	CQASZ20230200180E-02
Applicant:	Shenzhen panlei Intelligent Technology Co., Ltd.
Address of Applicant:	501 Building A, Weihuada Industrial Park, No.5, Lirong Road, Dalang Street, Longhua District, Shenzhen, Guangdong, China
Equipment Under Test (EUT):	
Product:	Mini PC
Model No.:	HI-3
Teat Model No.:	HI-3
Brand Name:	N/A
FCC ID:	2BAGPHI-3
Standards:	47 CFR Part 15, Subpart E Section 15.407 KDB 789033 D02 General UNII Test Procedures New Rules v02 KDB 558074 D01 Meas Guidance v05
Date of Receipt:	2023-02-17
Date of Test:	2023-02-17 to 2023-03-10
Date of Issue:	2023-03-23
Test Result:	**PASS***

*In the configuration tested, the EUT complied with the standards specified above.

Tested By: lewis zhou

(Lewis Zhou)

Reviewed By: Timo Lei

(Timo Lei)

Approved By:

(Jack Ai)

The test report is effective only with both signature and specialized stamp, The result(s) shown in this report refer only to the sample(s) tested. Without written approval of CQA, this report can't be reproduced except in full.

1 Version

Revision History Of Report

Report No.	Version	Description	Issue Date
CQASZ20230200180E-02	Rev.01	Initial report	2023-03-23

2 Test Summary

Test Item	Test Requirement	Test method	Result
Antenna Requirement	47 CFR Part 15 Subpart C Section 15.203	ANSI C63.10-2013; KDB789033	PASS
AC Power Line Conducted Emission	47 CFR Part 15 Subpart E Section 15.207	ANSI C63.10-2013; KDB789033	PASS
Maximum Conducted Output Power	47 CFR Part 15 Subpart C Section 15.407 (a)	ANSI C63.10-2013; KDB789033	PASS
Emission Bandwidth	47 CFR Part 15 Subpart C Section 15.407 (a)(e)	ANSI C63.10-2013; KDB789033	PASS
Maximum Power Spectral Density	47 CFR Part 15 Subpart E Section 15.407 (a)	ANSI C63.10-2013; KDB789033	PASS
Band Edge Measurements	47 CFR Part 15 Subpart C Section 15.209 &15.407(b)	ANSI C63.10-2013; KDB789033	PASS
Frequency stability	47 CFR Part 15 Subpart E Section 15.407 (g)	ANSI C63.10-2013; KDB789033	PASS
Operation in the absence of information to the transmit	47 CFR Part 15 Subpart E Section 15.407 (c)	47 CFR Part 15 Subpart E	PASS
Radiated Spurious Emissions	47 CFR Part 15 Subpart E Section 15.407 (b)	ANSI C63.10-2013; KDB789033	PASS

Remark:
The tested sample(s) and the sample information are provided by the client.
Tx: In this whole report Tx (or tx) means Transmitter.
Rx: In this whole report Rx (or rx) means Receiver.
RF: In this whole report RF means Radiated Frequency.
CH: In this whole report CH means channel.
Volt: In this whole report Volt means Voltage.
Temp: In this whole report Temp means Temperature.
Humid: In this whole report Humid means humidity.
Press: In this whole report Press means Pressure.
N/A: In this whole report not application

3 Content

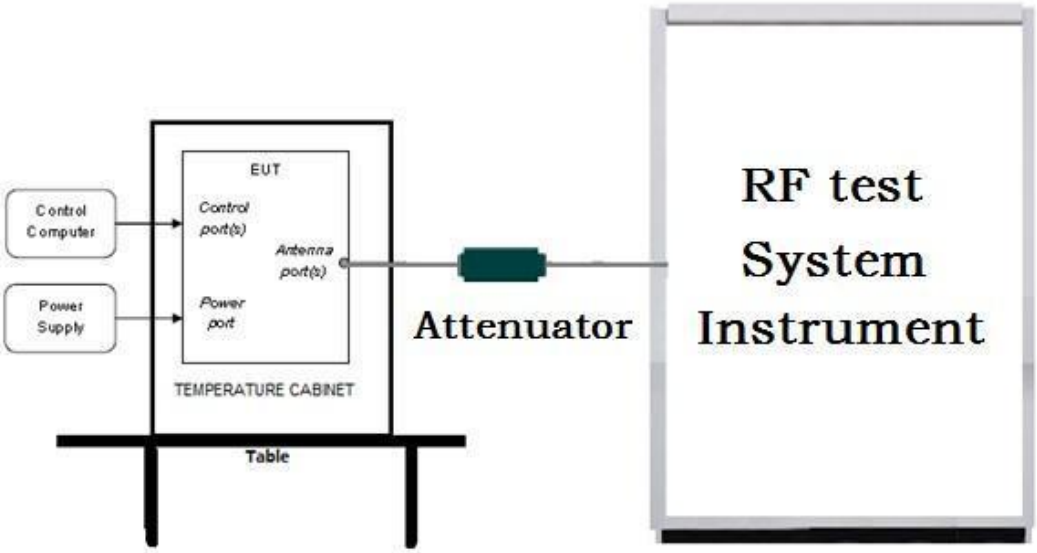
Page

1 VERSION 2
2 TEST SUMMARY 3
3 CONTENT 4
4 TEST REQUIREMENT 5
4.1 TEST SETUP 5
4.1.1 For Conducted test setup 5
4.1.2 For Radiated Emissions test setup 5
4.1.3 For Conducted Emissions test setup 6
4.2 TEST ENVIRONMENT 6
4.3 TEST CONDITION 7
5 GENERAL INFORMATION 9
5.1 CLIENT INFORMATION 9
5.2 GENERAL DESCRIPTION OF EUT 9
5.3 PRODUCT SPECIFICATION SUBJECTIVE TO THIS STANDARD 10
5.4 DESCRIPTION OF SUPPORT UNITS 11
5.5 TEST LOCATION 12
5.6 TEST FACILITY 12
5.7 DEVIATION FROM STANDARDS 12
5.8 ABNORMALITIES FROM STANDARD CONDITIONS 12
5.9 OTHER INFORMATION REQUESTED BY THE CUSTOMER 12
5.10 MEASUREMENT UNCERTAINTY (95% CONFIDENCE LEVELS, K=2) 12
6 EQUIPMENT LIST 13
7 RADIO TECHNICAL REQUIREMENTS SPECIFICATION 14
Appendix A): Emission Bandwidth 15
Appendix B): Maximum Conduct Output Power 20
Appendix C): Maximum Power Spectral Density 29
Appendix D): Band Edge Measurements 34
Appendix E): Frequency Stability 38
Appendix F): Antenna Requirement 41
Appendix G): Operation in the absence of information to the transmit 42
Appendix H): AC Power Line Conducted Emission 43
Appendix I): Restricted bands around fundamental frequency (Radiated Emission) 46
Appendix J): Radiated Spurious Emissions 48
8 PHOTOGRAPHS - EUT TEST SETUP 52
8.1 RADIATED SPURIOUS EMISSION 52
8.2 CONDUCTED EMISSION 53
9 PHOTOGRAPHS - EUT CONSTRUCTIONAL DETAILS 54

4 Test Requirement

4.1 Test setup

4.1.1 For Conducted test setup



4.1.2 For Radiated Emissions test setup

Radiated Emissions setup:

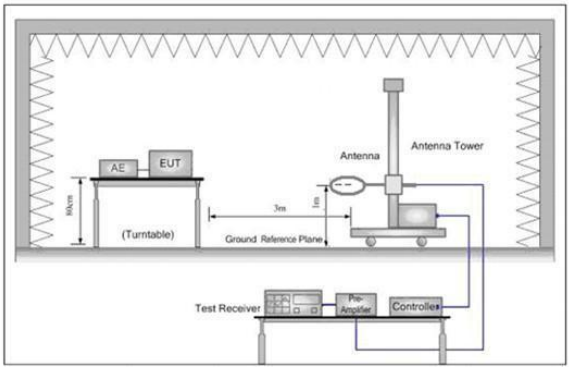


Figure 1. Below 30MHz

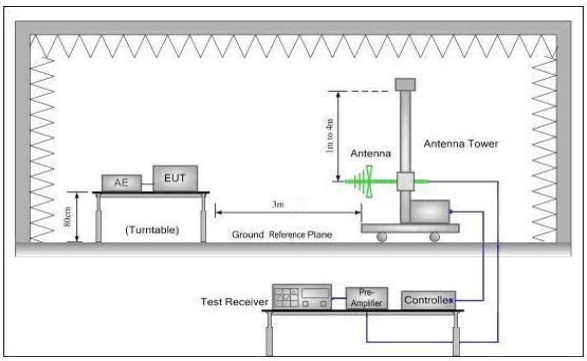


Figure 2. 30MHz to 1GHz

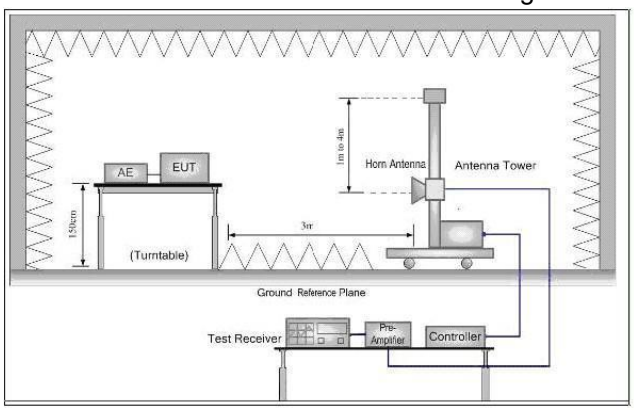
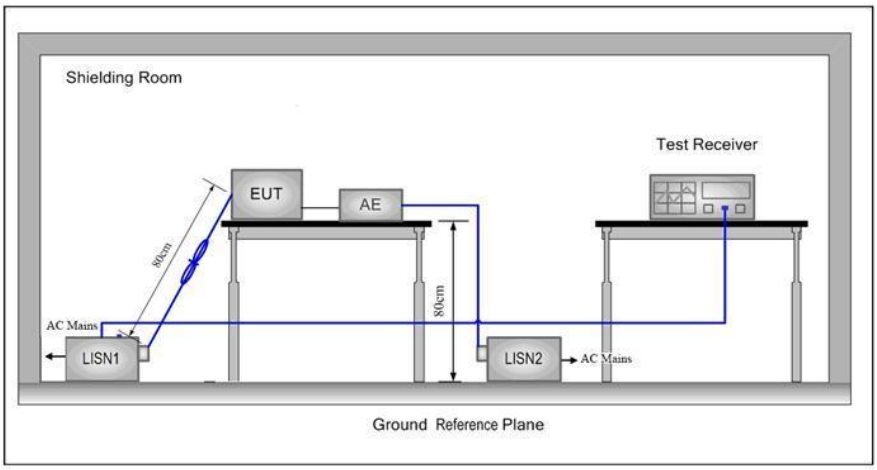


Figure 3. Above 1GHz

4.1.3 For Conducted Emissions test setup

Conducted Emissions setup



4.2 Test Environment

Operating Environment:		
Conducted Emissions:		
Temperature:	25.6 °C	
Humidity:	60 % RH	
Atmospheric Pressure:	1009 mbar	
Radiated Emissions:		
Temperature:	25.5 °C	
Humidity:	54 % RH	
Atmospheric Pressure:	1009mbar	
Radio conducted item test (RF Conducted test room):		
Temperature:	25.3 °C	
Humidity:	50 % RH	
Atmospheric Pressure:	1009 mbar	
Test Condition	Temperature (°C)	Voltage (V)
TN/VN	-10 to +50	7.6
TL/VL	-10	6.84
TH/VL	50	6.84
TL/VH	-10	8.36
TH/VH	50	8.36

Remark:

1)The EUT just work in such extreme temperature of -10 °C to 50 °C and the extreme voltage of 6.84V to 8.36V, so here the EUT is tested in the temperature of -10 °C to 50 °C and the voltage of 6.84V to 8.36V.

2)VN: Normal Voltage; TN: Normal Temperature;

TL: Low Extreme Test Temperature; TH: High Extreme Test Temperature;

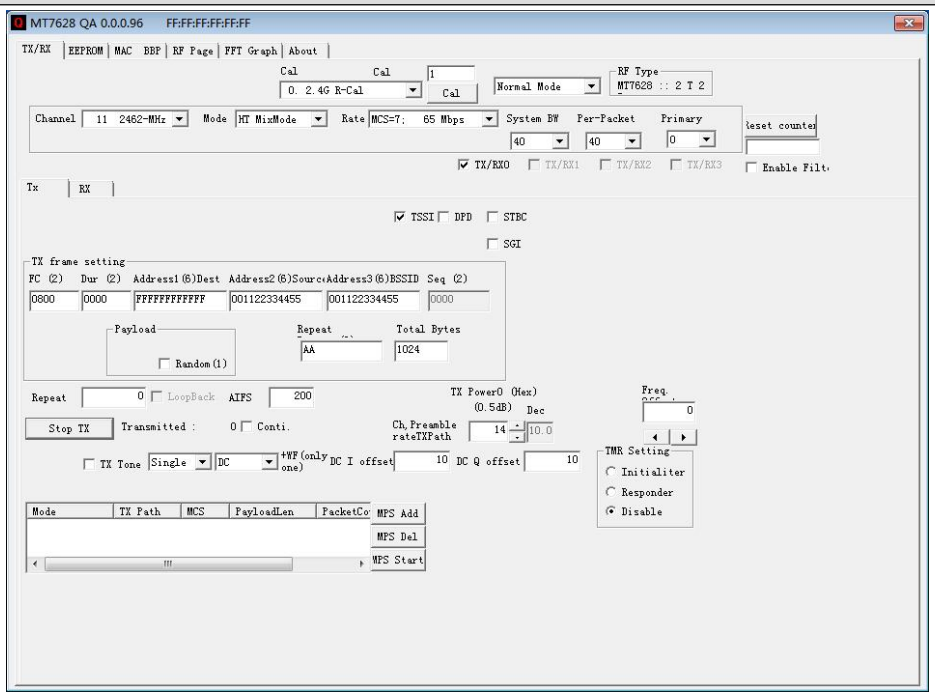
VL: Low Extreme Test Voltage; VH: High Extreme Test Voltage.

4.3 Test Condition

Test channel:

Test Mode	Tx/Rx	RF Channel		
		Low(L)	Middle(M)	High(H)
802.11a(20M)	5725MHz ~5850 MHz	Channel 149	Channel 157	Channel 165
		5745MHz	5785MHz	5825MHz

Run Software:



Test mode:

Pre-scan under all rate at lowest channel for Ant1

Through Pre-scan, 6Mbps is the worst case of 802.11a (20M)

5 General Information

5.1 Client Information

Applicant:	Shenzhen panlei Intelligent Technology Co., Ltd.
Address of Applicant:	501 Building A, Weihuada Industrial Park, No.5, Lirong Road, Dalang Street, Longhua District, Shenzhen, Guangdong, China
Manufacturer:	Shenzhen panlei Intelligent Technology Co., Ltd.
Address of Manufacturer:	501 Building A, Weihuada Industrial Park, No.5, Lirong Road, Dalang Street, Longhua District, Shenzhen, Guangdong, China
Factory:	Shenzhen Aierben Electronics Co.,Ltd.
Address of Factory:	South partition, 5th floor, building 2, No. 387, Huating Road, Langkou Community, Dalang street, Longhua District, Shenzhen

5.2 General Description of EUT

Product Name:	Mini PC
Model No.:	HI-3
Test Model No.:	HI-3
Trade Mark:	N/A
Software Version:	V1.0
Hardware Version:	V1.0
EUT Power Supply:	Power supply DC19V form adaptor
	Model No.:JC190472 Input:100-240V~50-60Hz 1.5A Output:19V 4.74A
EUT Supports Radios application:	2.4GHz: Wi-Fi: 802.11b/g/n(HT20): 2412MHz~2462MHz; 802.11n(HT40): 2422MHz~2452MHz 5GHz: Wi-Fi: U-NII-3: 5.725-5.850GHz
EUT Type:	Client devices

5.3 Product Specification subjective to this standard

Operation Frequency:	IEEE 802.11a(20M): 5725MHz ~5850 MHz
Channel Numbers:	IEEE 802.11a(20M): 5725MHz ~5850MHz/ 5 channel
Type of Modulation:	OFDM
Sample Type:	☒ Mobile ☐ Portable
Test Software of EUT:	MT7628 QA
Antenna Type:	FPC antenna
Antenna gain:	4.03dBi

Operation Frequency each of channel

For 802.11a(20M) Operation in the 5725MHz ~5850 MHz band			
Channel	Frequency	Channel	Frequency
149	5745MHz	161	5805MHz
153	5765MHz	165	5825MHz
157	5785MHz	NA	NA

5.4 Description of Support Units

The EUT has been tested with associated equipment below.

Description	Manufacturer	Model No.	Certification	Supplied by
/	/	/	/	/

5.5 Test Location

All tests were performed at:

Shenzhen Huaxia Testing Technology Co., Ltd.

1F., Block A of Tongsheng Technology Building, Huahui Road, Dalang Street, Longhua New District, Shenzhen, Guangdong, China

5.6 Test Facility

- **A2LA (Certificate No. 4742.01)**

Shenzhen Huaxia Testing Technology Co., Ltd., Shenzhen EMC Laboratory is accredited by the American Association for Laboratory Accreditation(A2LA). Certificate No. 4742.01.

- **FCC Registration No.: 522263**

Shenzhen Huaxia Testing Technology Co., Ltd., Shenzhen EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Registration No.:522263

5.7 Deviation from Standards

None.

5.8 Abnormalities from Standard Conditions

None.

5.9 Other Information Requested by the Customer

None.

5.10 Measurement Uncertainty (95% confidence levels, k=2)

No.	Item	Measurement Uncertainty
1	Radio Frequency	3×10^{-8}
2	RF power, conducted	0.86dB
3	Radiated Spurious emission test	5.12dB (Below 1GHz)
		4.6dB (Above 1GHz)
4	Conduction emission	3.5dB (9kHz to 150kHz)
		3.1dB (150kHz to 30MHz)
5	Temperature test	0.8°C
6	Humidity test	2.0%
7	DC power voltages	0.5%

6 Equipment List

Test Equipment	Manufacturer	Model No.	Instrument No.	Calibration Date	Calibration Due Date
EMI Test Receiver	R&S	ESR7	CQA-005	2022/09/09	2023/09/08
Spectrum analyzer	R&S	FSU26	CQA-038	2022/09/09	2023/09/08
Spectrum analyzer	R&S	FSU40	CQA-075	2022/09/09	2023/09/08
Preamplifier	MITEQ	AFS4-00010300-18-10P-4	CQA-035	2022/09/09	2023/09/08
Preamplifier	MITEQ	AMF-6D-02001800-29-20P	CQA-036	2022/09/09	2023/09/08
Preamplifier	EMCI	EMC184055SE	CQA-089	2022/09/09	2023/09/08
Loop antenna	Schwarzbeck	FMZB1516	CQA-060	2021/09/16	2024/09/15
Bilog Antenna	R&S	HL562	CQA-011	2021/09/16	2024/09/15
Horn Antenna	R&S	HF906	CQA-012	2021/09/16	2024/09/15
Horn Antenna	Schwarzbeck	BBHA 9170	CQA-088	2021/09/16	2024/09/15
Coaxial Cable (Above 1GHz)	CQA	N/A	C007	2022/09/09	2023/09/08
Coaxial Cable (Below 1GHz)	CQA	N/A	C013	2022/09/09	2023/09/08
RF cable(9KHz~40GHz)	CQA	RF-01	CQA-079	2022/09/09	2023/09/08
Antenna Connector	CQA	RFC-01	CQA-080	2022/09/09	2023/09/08
Power Sensor	KEYSIGHT	U2021XA	CQA-30	2022/09/09	2023/09/08
N1918A Power Analysis Manager Power Panel	Agilent	N1918A	CQA-074	2022/09/09	2023/09/08
Power meter	R&S	NRVD	CQA-029	2022/09/09	2023/09/08
Power divider	MIDWEST	PWD-2533-02-SMA-79	CQA-067	2022/09/09	2023/09/08
EMI Test Receiver	R&S	ESR7	CQA-005	2022/09/09	2023/09/08
LISN	R&S	ENV216	CQA-003	2022/09/09	2023/09/08
Coaxial cable	CQA	N/A	CQA-C009	2022/09/09	2023/09/08
DC power	KEYSIGHT	E3631A	CQA-028	2022/09/09	2023/09/08

Test software:

	Manufacturer	Software brand
Radiated Emissions test software	Tonscend	JS1120-3
Conducted Emissions test software	Audix	e3
RF Conducted test software	Audix	e3

7 Radio Technical Requirements Specification

Reference documents for testing:

No.	Identity	Document Title
1	FCC Part15E	Subpart C-Intentional Radiators
2	ANSI C63.10-2013	American National Standard for Testing Unlicesed Wireless Devices
3	KDB 789033 D02 General U-NII Test Procedures New Rules v02r01	Guidelines for compliance testing of unlicensed national information infrastructure (U-NII) device part 15, subpart E
4	KDB 662911 D01 Multiple Transmitter Output v02r01	Emissions Testing of Transmitters with Multiple Outputs in the Same Band

Appendix A): Emission Bandwidth

26dB Emission bandwidth

Test Requirement: 47 CFR Part 15, Subpart C 15.407 (a)

Test Method: KDB 789033 D02 II C 1

6 dB bandwidth (5.725-5.85 GHz band)

Test Requirement 47 CFR Part 15, Subpart C 15.407 (e)

Test Method: KDB 789033 D02 II C 2

Limit: ≥500 kHz

Test Procedure:

a) Set RBW = approximately 1% of the emission bandwidth.

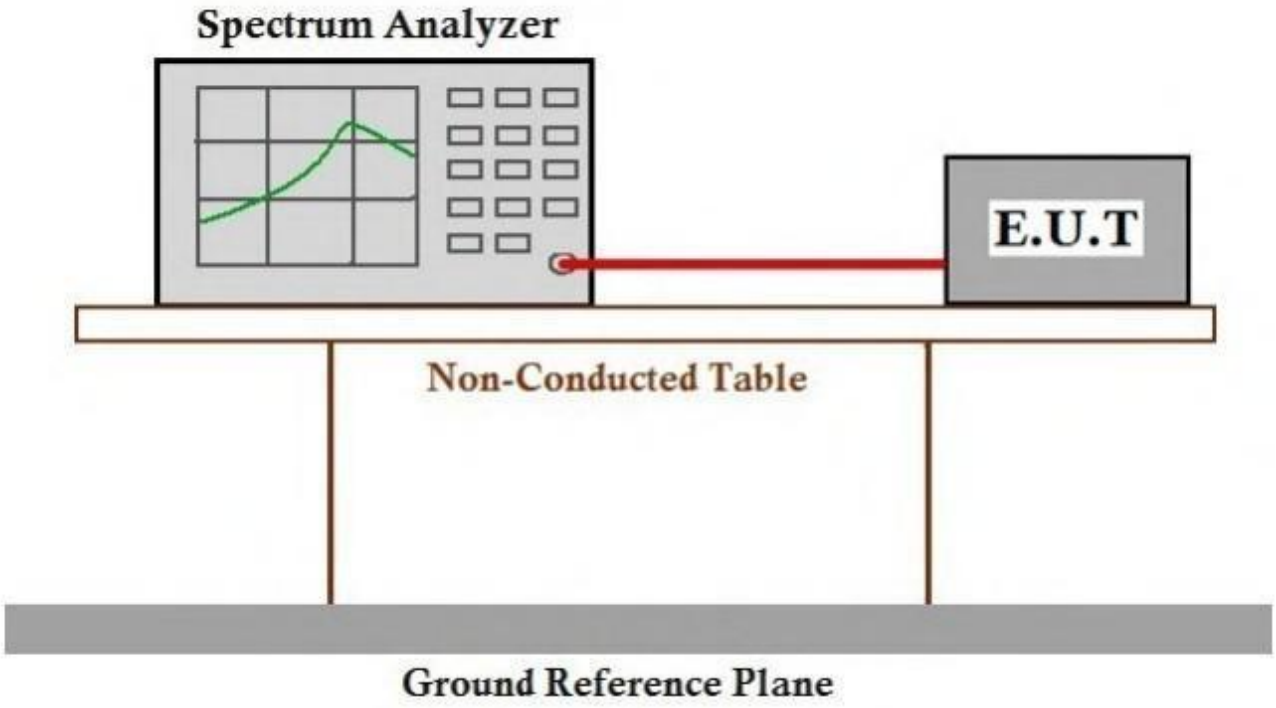
b) Set the VBW > RBW.

c) Detector = Peak.

d) Trace mode = max hold.

e) Measure the maximum width of the emission that is 26 dB down from the maximum of the emission. Compare this with the RBW setting of the analyzer. Readjust RBW and repeat measurement as needed until the RBW/EBW ratio is approximately 1%.

Test Setup Diagram



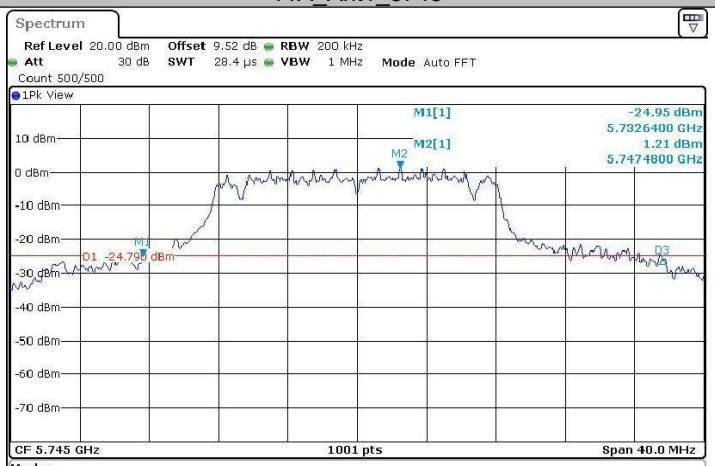
Result Table

TestMode	Antenna	Freq(MHz)	26db EBW [MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
11A	Ant1	5745	29.96	5732.64	5762.60	---	---
		5785	24.28	5773.36	5797.64	---	---
		5825	24.60	5813.04	5837.64	---	---

TestMode	Antenna	Channel	6db EBW [MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
11A	Ant1	5745	16.28	5736.84	5753.12	0.5	PASS
		5785	16.32	5776.80	5793.12	0.5	PASS
		5825	16.32	5816.80	5833.12	0.5	PASS

Test Graph

11A_Ant1_5745

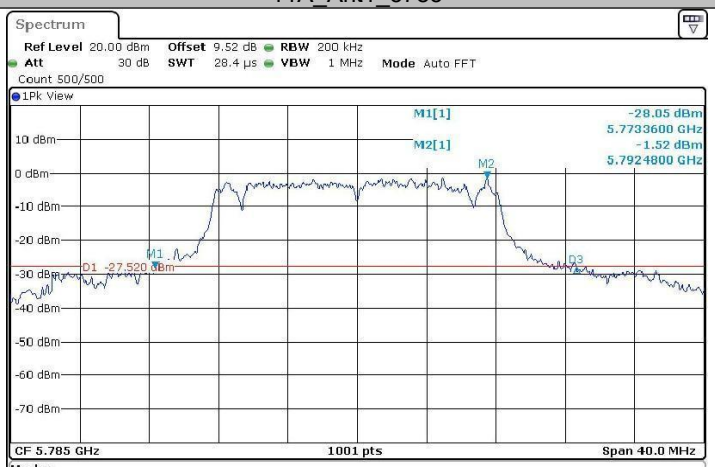


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	5.73264 GHz	-24.95 dBm		
M2		1	5.74748 GHz	1.21 dBm		
D3	M1	1	29.96 MHz	-0.48 dB		

Date: 27.FEB.2023 08:36:56

11A_Ant1_5785

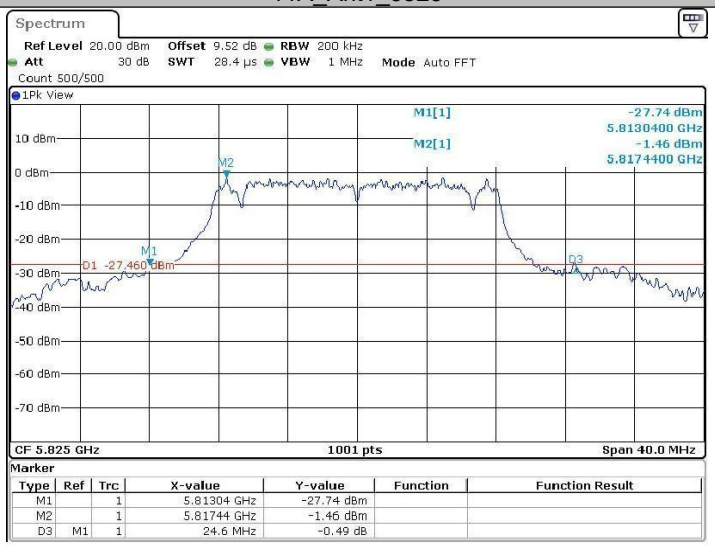


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	5.77336 GHz	-28.05 dBm		
M2		1	5.79248 GHz	-1.52 dBm		
D3	M1	1	24.28 MHz	0.08 dB		

Date: 27.FEB.2023 08:44:59

11A_Ant1_5825



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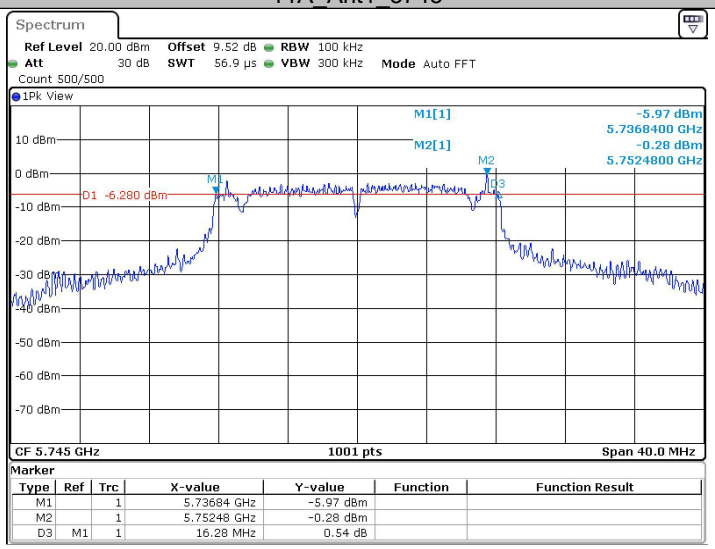
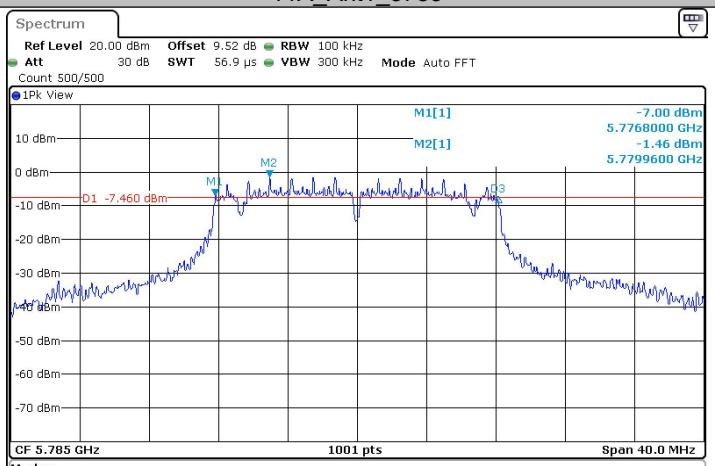


11A_Ant1_5785

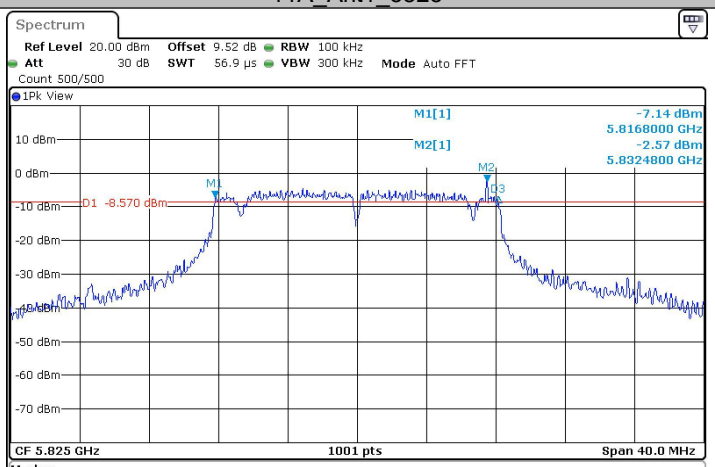


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	5.7768 GHz	-7.00 dBm		
M2		1	5.77996 GHz	-1.46 dBm		
D3	M1	1	16.32 MHz	-0.19 dB		

Date: 27.FEB.2023 08:45:06

11A_Ant1_5825



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	5.8168 GHz	-7.14 dBm		
M2		1	5.83248 GHz	-2.57 dBm		
D3	M1	1	16.32 MHz	0.06 dB		

Date: 27.FEB.2023 08:52:16

Appendix B): Maximum Conduct Output Power

1.Duty Cycle (x)

Test Requirement KDB 789033 D02 II B 1

Test Method: KDB 789033 II B 1

Test Procedure:

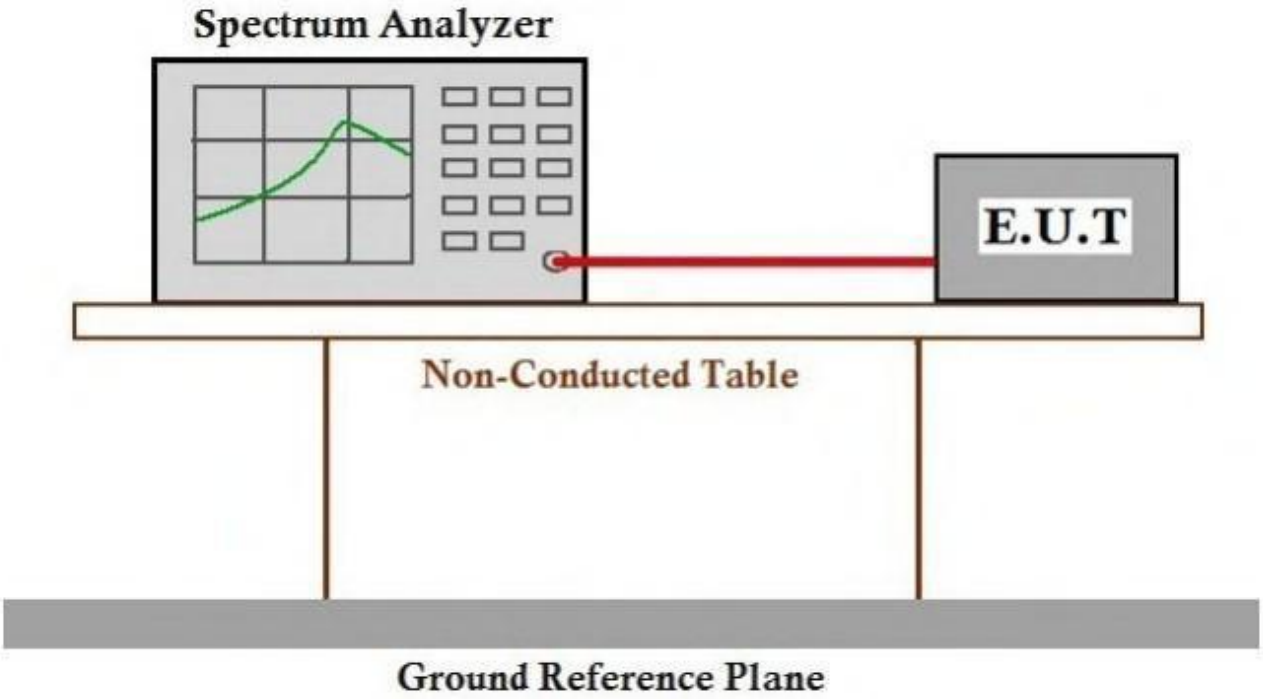
Set RBW = 20MHz

Set VBW = 40MHz

Set detector = peak.

Set span =0Hz

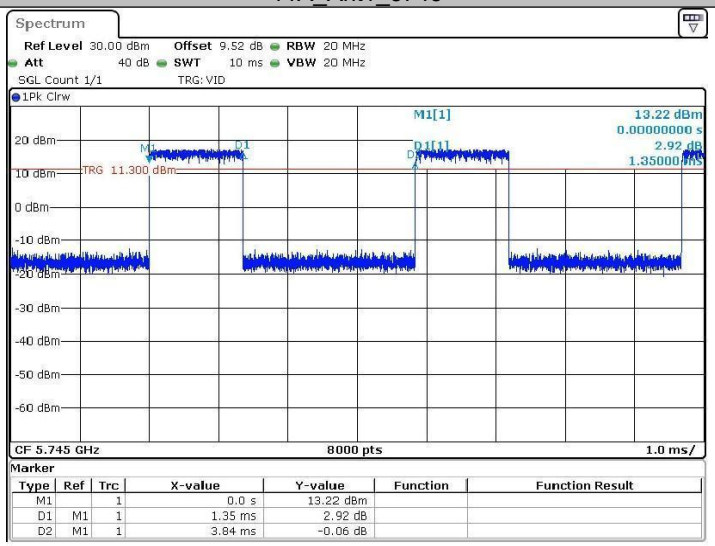
Test Setup Diagram



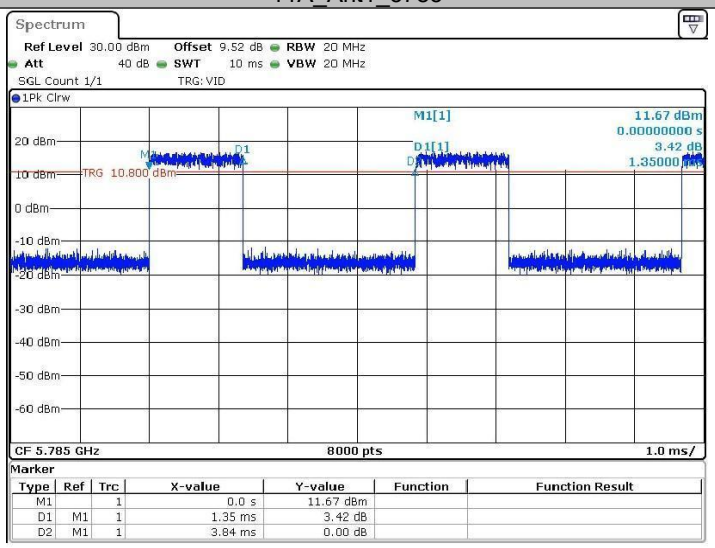
Measurement Data

TestMode	Freq(MHz)	Transmission Duration [ms]	Transmission Period [ms]	Duty Cycle [%]	Limit	Verdict
11A	5745	1.35	3.84	35.16	---	---
	5785	1.35	3.84	35.16	---	---
	5825	1.35	3.84	35.16	---	---

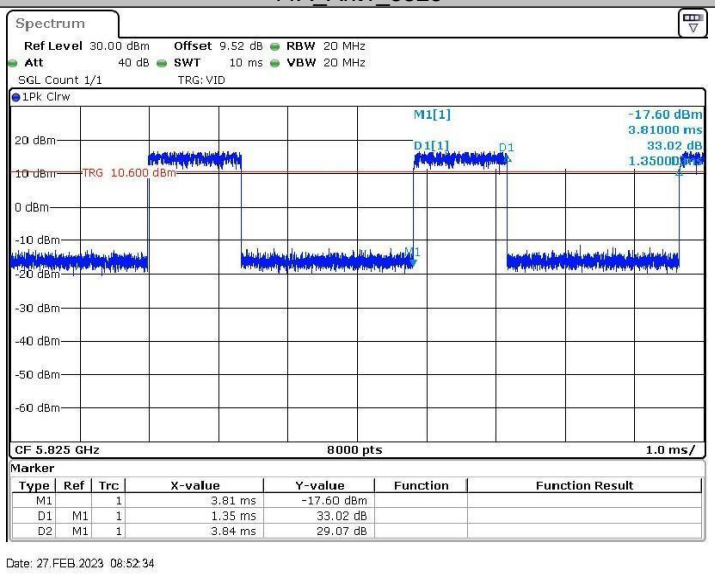
11A_Ant1_5745



11A_Ant1_5785



11A_Ant1_5825



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	3.81 ms	-17.60 dBm		
D1	M1	1	1.35 ms	33.02 dB		
D2	M1	1	3.84 ms	29.07 dB		

Date: 27.FEB.2023 08:52:34

2. Maximum Conducted Output Power

Test Requirement 47 CFR Part 15, Subpart C 15.407 (a)

Test Method: KDB 789033 D02 II E

Limit:

Frequency band(MHz)	Limit
5150-5250	≤1W(30dBm) for master device
	≤250mW(24dBm) for client device
5250-5350	≤250mW(24dBm) for client device or 11dBm+10logB*
5470-5725	≤250mW(24dBm) for client device or 11dBm+10logB*
5725-5850	≤1W(30dBm)
Remark:	* Where B is the 26dB emission bandwidth in MHz. The maximum conducted output power must be measured over any interval of continuous transmission using instrumentation calibrated in terms of an rms-equivalent voltage.

Test Procedure:

Method SA-2 (trace averaging across on and off times of the EUT transmissions, followed by duty cycle correction).

(1) Set RBW = 1 MHz.

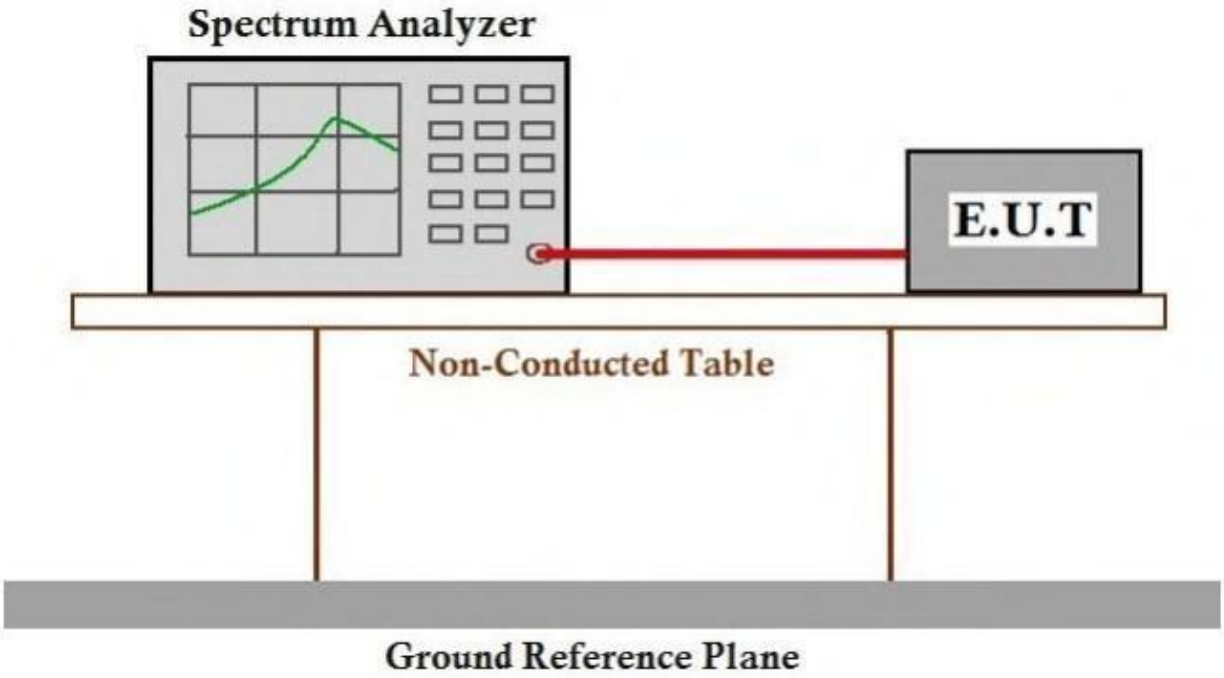
(2) Set VBW ≥ 3 MHz.

(3) Detector = power average

(4) Sweep time = auto.

(5) Add duty cycle to the measured average power.

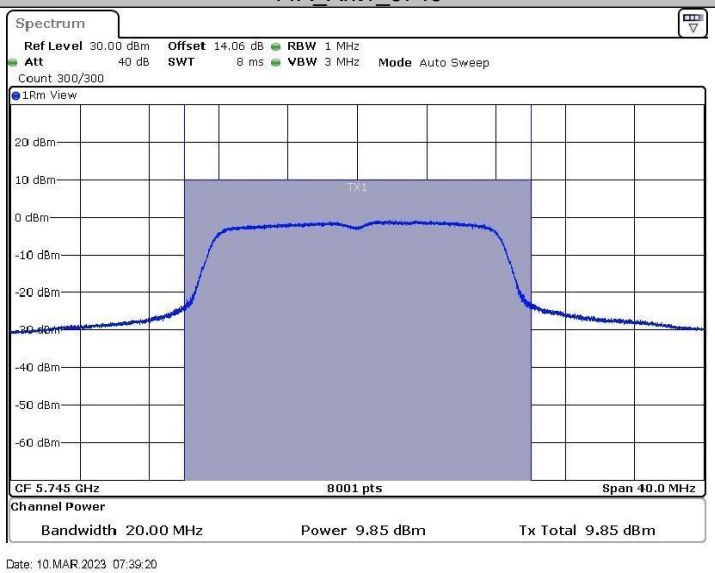
Test Setup Diagram



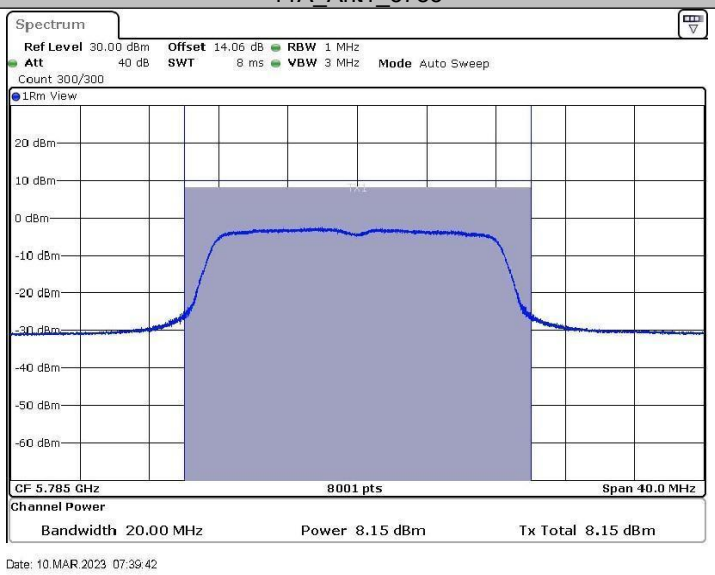
Measurement Data

TestMode	Antenna	Channel	Result[dBm]	Limit[dBm]	Verdict
11A	Ant1	5745	9.85	≤30.00	PASS
		5785	8.15	≤30.00	PASS
		5825	7.35	≤30.00	PASS

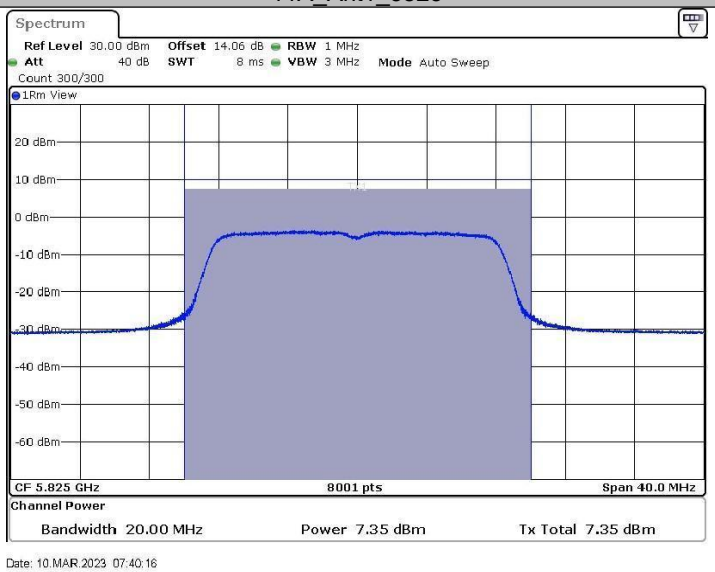
11A_Ant1_5745



11A_Ant1_5785



11A_Ant1_5825



Remark:
Av.Power=Meas.Level+10 log (1/duty cycle)
E.i.r.p=Av.Power+G,
G = antenna gain in dBi.

Appendix C): Maximum Power Spectral Density

Test Requirement 47 CFR Part 15, Subpart C 15.407 (a)

Test Method: KDB 789033 D02 II F

Test Procedure:

For 5150-5725MHz:

1. Connect EUT RF output port to the Spectrum Analyzer through an RF attenuator
2. Set the EUT Work on operation frequency individually.
3. Set RBW = 1MHz.
4. Set the VBW ≥3*RBW. Detector = Peak. Trace mode = max hold.

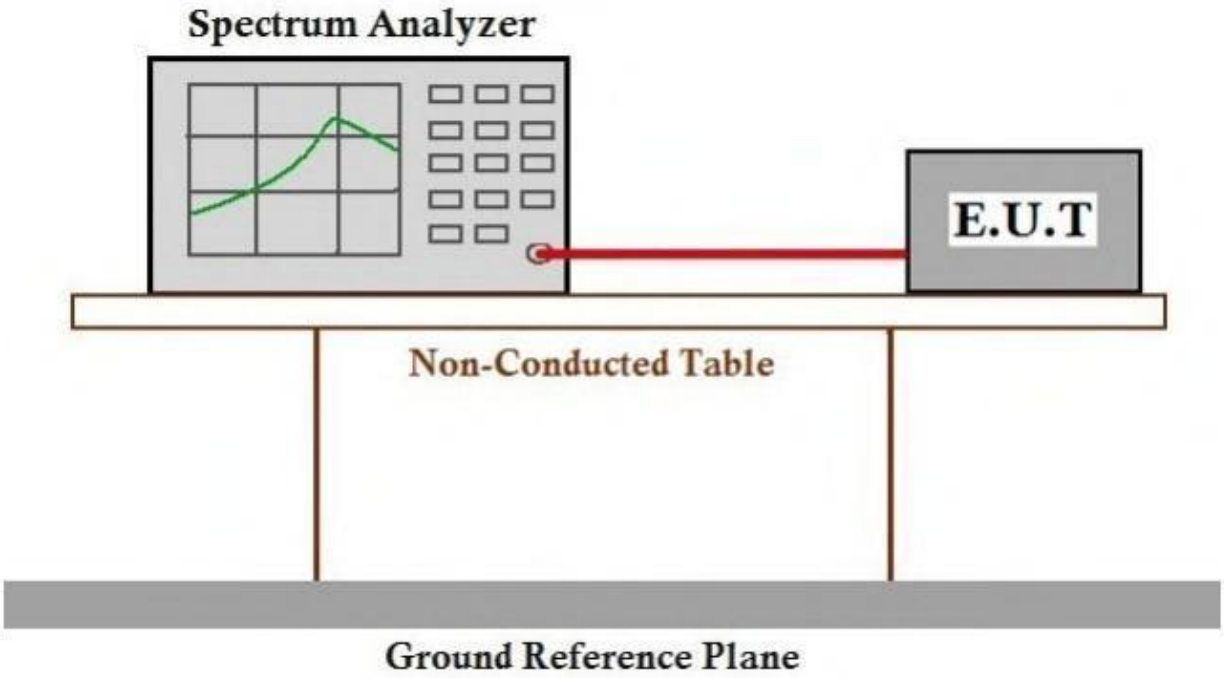
For 5725-5850MHz:

1. Connect EUT RF output port to the Spectrum Analyzer through an RF attenuator
2. Set the EUT Work on operation frequency individually.
3. Set RBW = 500KHz.
4. Set the VBW ≥3*RBW. Detector = Peak. Trace mode = max hold.

Limit:

Frequency band(MHz)	Limit
5150-5250	≤17dBm in 1MHz for master device
	≤11dBm in 1MHz for client device
5250-5350	≤11dBm in 1MHz for client device
5470-5725	≤11dBm in 1MHz for client device
5725-5850	≤30dBm in 500 kHz
Remark:	The maximum power spectral density is measured as a conducted emission by direct connection of a calibrated test instrument to the equipment under test.

Test Setup Diagram



Result Table

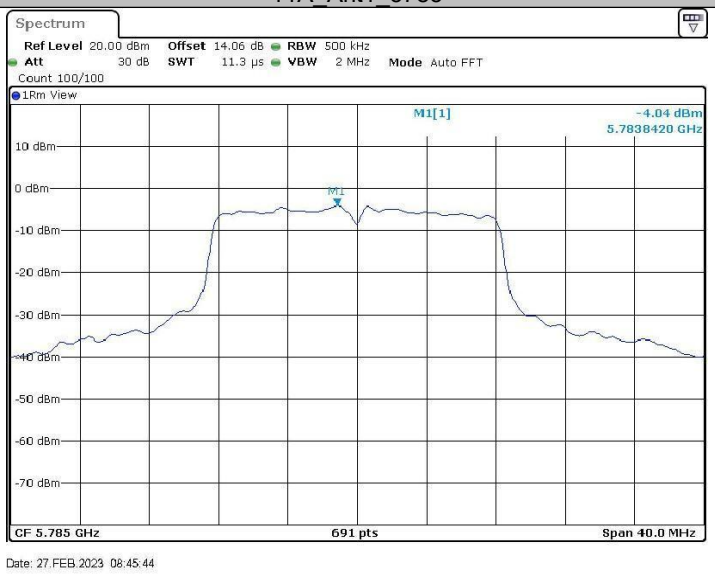
TestMode	Antenna	Freq(MHz)	Result [dBm/MHz]	Limit[dBm/MHz]	Verdict
11A	Ant1	5745	-3.21	≤30.00	PASS
		5785	-4.04	≤30.00	PASS
		5825	-4.35	≤30.00	PASS

Remark:

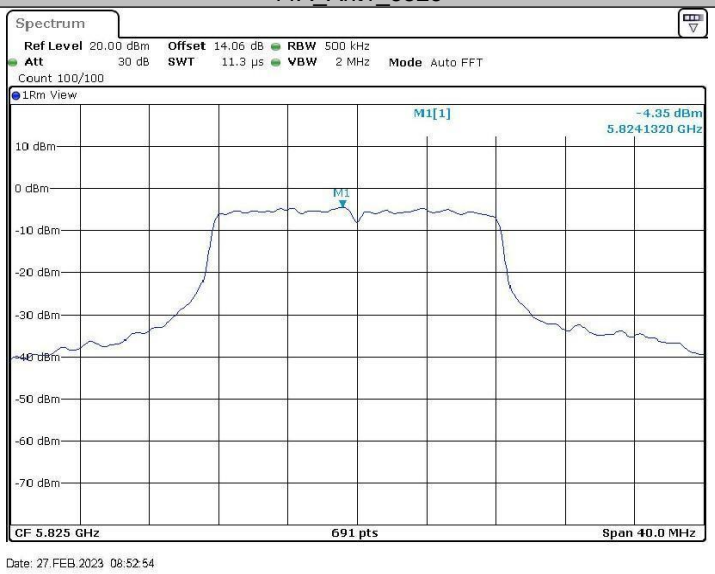
PSD = Meas PSD + Duty Cycle Factor

11A_Ant1_5745

11A_Ant1_5785



11A_Ant1_5825



Appendix D): Band Edge Measurements

Test Requirement 47 CFR Part 15, Subpart C 15.209 & 15.407(b)

Test Method: KDB 789033 D02 II G

Test Procedure:

1. The EUT operates at transmitting mode. The operate channel is tested to verify the largest transmission and spurious emissions power at the continuous transmission mode.

2. Set the spectrum analyzer in the following setting in order to capture the lower and upper band-edges of the emission:

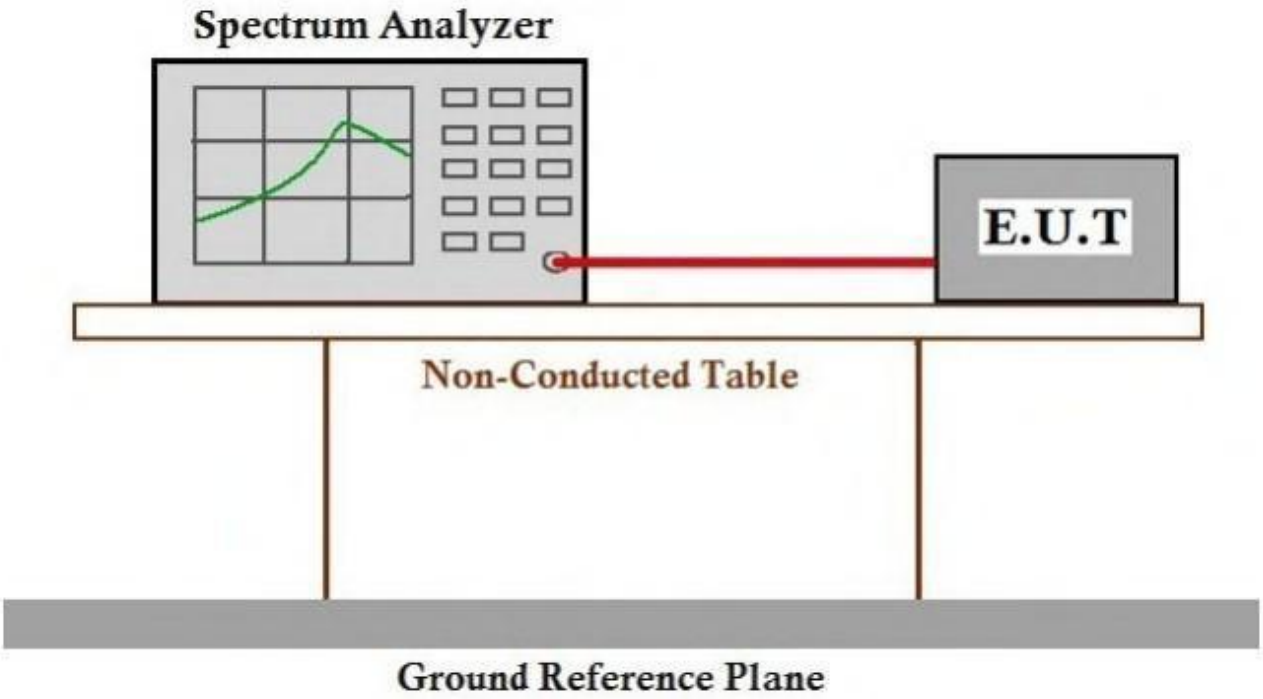
(a) PEAK: RBW=VBW=1MHz / Sweep=AUTO

(b) AVERAGE: RBW=1MHz ; VBW=1/on time(1KHz) / Sweep=AUTO

Limit:

For transmitters operating in the 5.15-5.25 GHz band:	All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of −27 dBm/MHz (68.2dBuV/m).
For transmitters operating in the 5.25-5.35 GHz band:	All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of −27 dBm/MHz (68.2dBuV/m).
For transmitters operating in the 5.47-5.725 GHz band:	All emissions outside of the 5.47-5.725 GHz band shall not exceed an e.i.r.p. of −27 dBm/MHz (68.2dBuV/m).
For transmitters operating in the 5.725-5.85 GHz band:	(i) All emissions shall be limited to a level of −27 dBm/MHz (68.2dBuV/m) at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz (105.2dBuV/m) at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz (110.8dBuV/m) at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz (122.2dBuV/m) at the band edge.

Test Setup Diagram



Test Result:

TestMode	Antenna	ChName	Freq(MHz)	FreqRange [MHz]	Result [dBm]	Limit [dBm]	Verdict
11A	Ant1	Low	5745	5650~5700	-41.75	≤-3.81	PASS
				5700~5720	-35.01	≤15.60	PASS
				5720~5725	-32.62	≤20.54	PASS
				5760~5650	-42.82	≤-27	PASS
		High	5825	5850~5855	-39.08	≤18.92	PASS
				5855~5875	-40.61	≤11.03	PASS
				5875~5925	-40.71	≤-3.45	PASS
				5925~5935	-41.41	≤-27	PASS

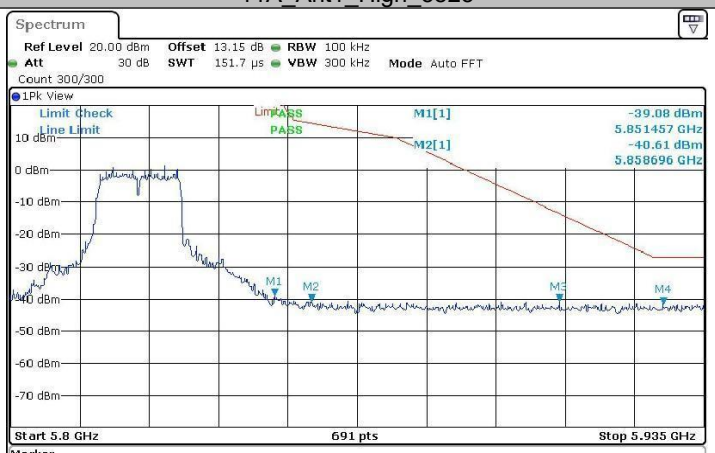
11A_Ant1_Low_5745

Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	5.722167 GHz	-32.62 dBm		
M2		1	5.72 GHz	-35.01 dBm		
M3		1	5.681333 GHz	-41.75 dBm		
M4		1	5.646333 GHz	-42.82 dBm		

Date: 27.FEB.2023 08:37:55

11A_Ant1_High_5825



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	5.851457 GHz	-39.08 dBm		
M2		1	5.858696 GHz	-40.61 dBm		
M3		1	5.906826 GHz	-40.71 dBm		
M4		1	5.926978 GHz	-41.41 dBm		

Date: 27.FEB.2023 08:53:08

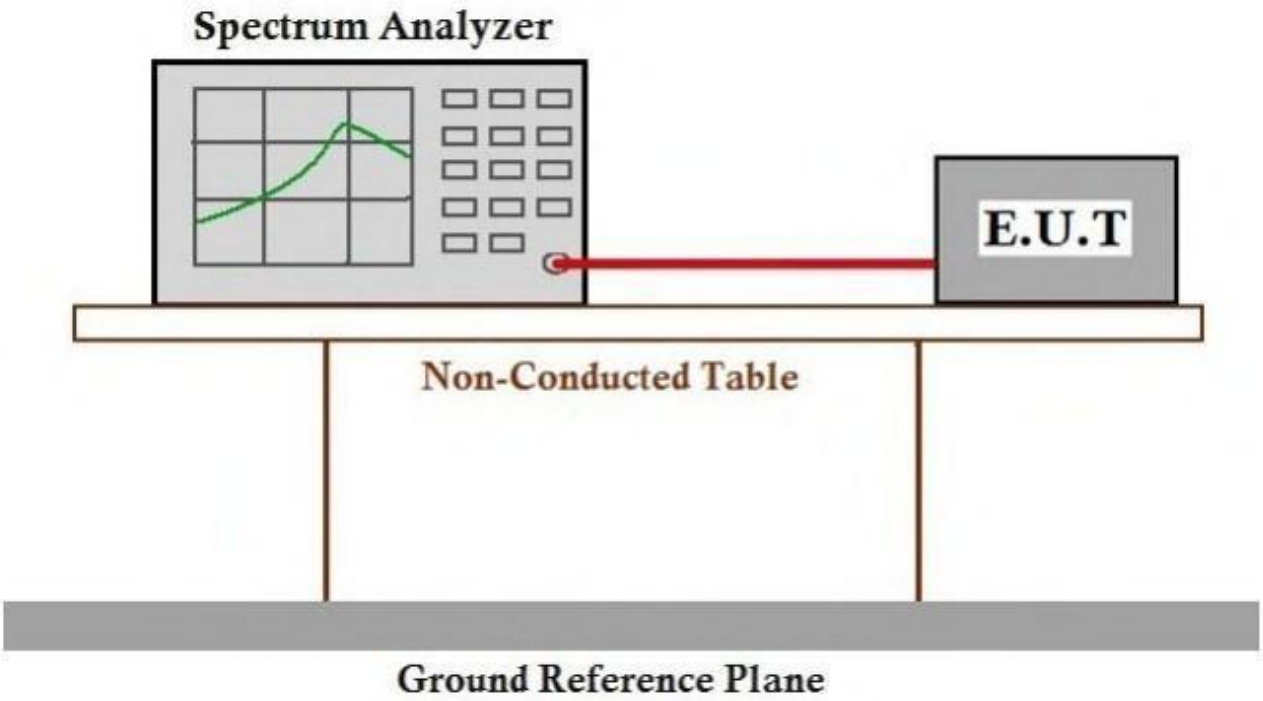
Appendix E): Frequency Stability

Test Requirement 47 CFR Part 15, Subpart C 15.407 (g)

Test Method: ANSI C63.10 (2013) Section 6.8

Limit:The frequency tolerance shall be maintained within the band of operation frequency over a temperature variation of 0 degrees to 35 degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C.

Test Setup Diagram



Measurement Data

Voltage								
TestMode	Antenna	Freq(MHz)	Voltage [Vdc]	Temperature (℃)	Deviation (Hz)	Deviation (ppm)	Limit (ppm)	Verdict
11A	Ant1	5745	NV	NT	-39000.00	-6.788512	20	PASS
			LV	NT	-38000.00	-6.614447	20	PASS
			HV	NT	-37000.00	-6.440383	20	PASS
		5785	NV	NT	-39000.00	-6.741573	20	PASS
			LV	NT	-39000.00	-6.741573	20	PASS
			HV	NT	-39000.00	-6.741573	20	PASS
		5825	NV	NT	-32000.00	-5.493562	20	PASS
			LV	NT	-32000.00	-5.493562	20	PASS
			HV	NT	-32000.00	-5.493562	20	PASS

Temperature								
TestMode	Antenna	Freq(MHz)	Voltage [Vdc]	Temperature (℃)	Deviation (Hz)	Deviation (ppm)	Limit (ppm)	Verdict
11A	Ant1	5745	NV	-10	-36000.00	-6.266319	20	PASS
			NV	0	-35000.00	-6.092254	20	PASS
			NV	10	-35000.00	-6.092254	20	PASS
			NV	20	-35000.00	-6.092254	20	PASS
			NV	30	-35000.00	-6.092254	20	PASS
			NV	40	-35000.00	-6.092254	20	PASS
			NV	50	-34000.00	-5.918190	20	PASS
		5785	NV	-10	-37000.00	-6.395851	20	PASS
			NV	0	-37000.00	-6.395851	20	PASS
			NV	10	-37000.00	-6.395851	20	PASS
			NV	20	-36000.00	-6.222990	20	PASS
			NV	30	-36000.00	-6.222990	20	PASS
			NV	40	-35000.00	-6.050130	20	PASS
			NV	50	-35000.00	-6.050130	20	PASS
		5825	NV	-10	-32000.00	-5.493562	20	PASS
			NV	0	-33000.00	-5.665236	20	PASS
			NV	10	-33000.00	-5.665236	20	PASS
			NV	20	-33000.00	-5.665236	20	PASS
			NV	30	-33000.00	-5.665236	20	PASS
			NV	40	-33000.00	-5.665236	20	PASS

			NV	50	-33000.00	-5.665236	20	PASS

Note: All the modulation and channels had been tested, but only the worst data recorded in the report.

Appendix F): Antenna Requirement

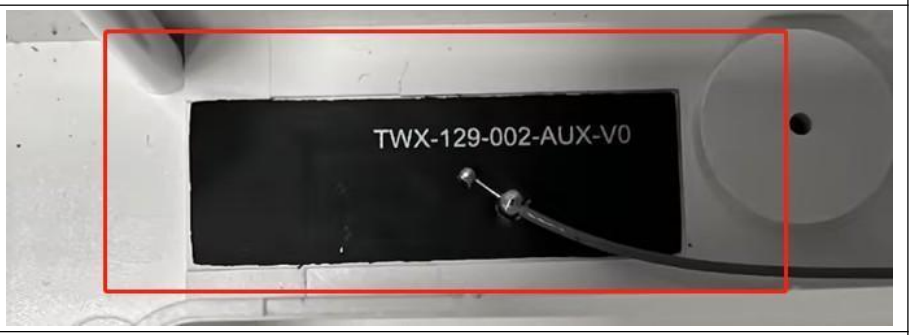
15.203 requirement:

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

15.407(a)(1) (2) requirement:

The conducted output power limit specified in paragraph (a) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (a) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power and the peak power spectral density shall be reduced by the by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

EUT Antenna:



The antenna is FPC antenna with ipex connector.The best case gain of the 5G WiFi antenna is 4.03dBi

Appendix G): Operation in the absence of information to the transmit

15.407(c) requirement: The device shall automatically discontinue transmission in case of either absence of information to transmit or operational failure. These provisions are not intended to preclude the transmission of control or signal ling information or the use of repetitive codes used by certain digital technologies to complete frame or burst intervals. Applicants shall include in their application for equipment authorization a description of how this requirement is met.
Operation in the absence of information to the transmit
While the EUT is not transmitting any information, the EUT can automatically discontinue transmission and become standby mode for power saving. The EUT can detect the controlling signal of ASK message transmitting from remote device and verify whether it shall resend or discontinue transmission. (manufacturer declare)

Appendix H): AC Power Line Conducted Emission

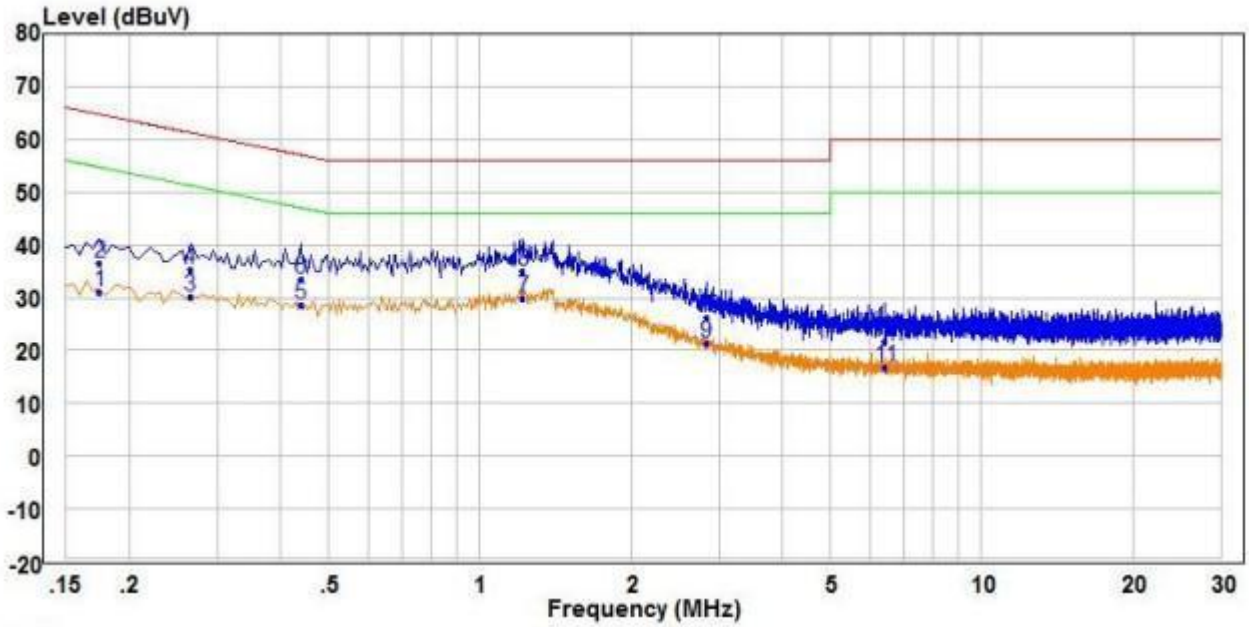
<table>
<tr><td>Test Procedure:</td><td>Test frequency range :150KHz-30MHz
1)The mains terminal disturbance voltage test was conducted in a shielded room.
2) The EUT was connected to AC power source through a LISN 1 (Line Impedance Stabilization Network) which provides a 50Ω/50μH + 5Ω linear impedance. The power cables of all other units of the EUT were connected to a second LISN 2, which was bonded to the ground reference plane in the same way as the LISN 1 for the unit being measured. A multiple socket outlet strip was used to connect multiple power cables to a single LISN provided the rating of the LISN was not exceeded.
3)The tabletop EUT was placed upon a non-metallic table 0.8m above the ground reference plane. And for floor-standing arrangement, the EUT was placed on the horizontal ground reference plane,
4) The test was performed with a vertical ground reference plane. The rear of the EUT shall be 0.4 m from the vertical ground reference plane. The vertical ground reference plane was bonded to the horizontal ground reference plane. The LISN 1 was placed 0.8 m from the boundary of the unit under test and bonded to a ground reference plane for LISNs mounted on top of the ground reference plane. This distance was between the closest points of the LISN 1 and the EUT. All other units of the EUT and associated equipment was at least 0.8 m from the LISN 2.
5) In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.10 on conducted measurement.</td></tr>
<tr><td>Limit:</td><td>
<table>
<tr><td rowspan="2">Frequency range (MHz)</td><td colspan="2">Limit (dBμV)</td></tr>
<tr><td>Quasi-peak</td><td>Average</td></tr>
<tr><td>0.15-0.5</td><td>66 to 56*</td><td>56 to 46*</td></tr>
<tr><td>0.5-5</td><td>56</td><td>46</td></tr>
<tr><td>5-30</td><td>60</td><td>50</td></tr>
</table>
* The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.
NOTE : The lower limit is applicable at the transition frequency</td></tr>
</table>

Measurement Data

An initial pre-scan was performed on the live and neutral lines with peak detector.

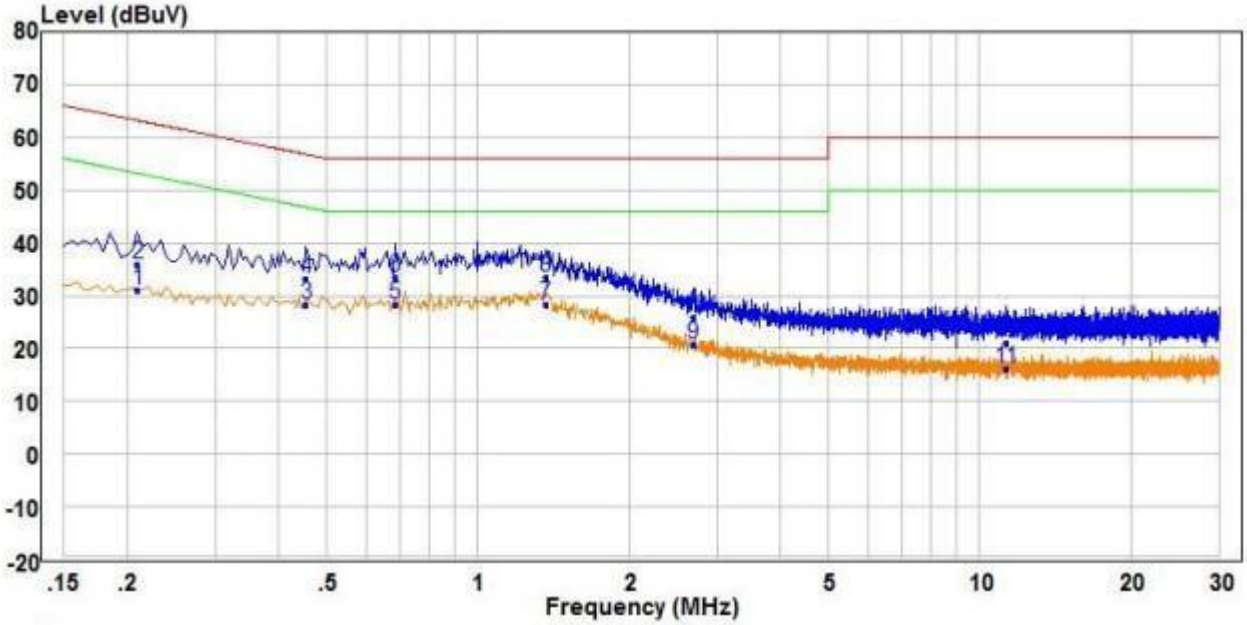
Quasi-Peak and Average measurement were performed at the frequencies with maximized peak emission were detected.

Live line:



		Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark	Pol/Phase
		MHz	dBuV	dB	dBuV	dBuV	dB		
1		0.175	21.44	9.65	31.09	54.72	-23.63	Average	Line
2		0.175	26.87	9.65	36.52	64.72	-28.20	QP	Line
3		0.265	20.67	9.53	30.20	51.27	-21.07	Average	Line
4		0.265	25.66	9.53	35.19	61.27	-26.08	QP	Line
5		0.440	18.93	9.65	28.58	47.06	-18.48	Average	Line
6		0.440	23.90	9.65	33.55	57.06	-23.51	QP	Line
7	PP	1.220	19.66	10.26	29.92	46.00	-16.08	Average	Line
8	QP	1.220	24.91	10.26	35.17	56.00	-20.83	QP	Line
9		2.830	10.41	10.91	21.32	46.00	-24.68	Average	Line
10		2.830	15.37	10.91	26.28	56.00	-29.72	QP	Line
11		6.435	7.11	9.79	16.90	50.00	-33.10	Average	Line
12		6.435	11.85	9.79	21.64	60.00	-38.36	QP	Line

Neutral line:



		Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark	Pol/Phase
		MHz	dBuV	dB	dBuV	dBuV	dB		
1		0.210	21.49	9.59	31.08	53.21	-22.13	Average	Neutral
2		0.210	26.38	9.59	35.97	63.21	-27.24	QP	Neutral
3		0.455	18.79	9.66	28.45	46.78	-18.33	Average	Neutral
4		0.455	23.66	9.66	33.32	56.78	-23.46	QP	Neutral
5		0.685	18.58	9.89	28.47	46.00	-17.53	Average	Neutral
6		0.685	23.56	9.89	33.45	56.00	-22.55	QP	Neutral
7	PP	1.365	18.77	9.72	28.49	46.00	-17.51	Average	Neutral
8	QP	1.365	23.80	9.72	33.52	56.00	-22.48	QP	Neutral
9		2.690	11.03	9.75	20.78	46.00	-25.22	Average	Neutral
10		2.690	16.15	9.75	25.90	56.00	-30.10	QP	Neutral
11		11.300	6.39	9.85	16.24	50.00	-33.76	Average	Neutral
12		11.300	11.23	9.85	21.08	60.00	-38.92	QP	Neutral

Notes:

1. The following Quasi-Peak and Average measurements were performed on the EUT:
2. Final Test Level =Receiver Reading + LISN Factor + Cable Loss.
3. The 6Mbps of rate of 802.11A_5240 is the worst case, only the worst data recorded in the report.

Appendix I): Restricted bands around fundamental frequency (Radiated Emission)

Receiver Setup:

Frequency	Detector	RBW	VBW	Remark
30MHz-1GHz	Quasi-peak	120kHz	300kHz	Quasi-peak
Above 1GHz	Peak	1MHz	3MHz	Peak
	Peak	1MHz	10Hz	Average

Test Procedure:

Below 1GHz test procedure as below:

a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter semi-anechoic camber. The table was rotated 360 degrees to determine the position of the highest radiation.
b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
c. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable was turned from 0 degrees to 360 degrees to find the maximum reading.
e. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
f. Place a marker at the end of the restricted band closest to the transmit frequency to show compliance. Also measure any emissions in the restricted bands. Save the spectrum analyzer plot. Repeat for each power and modulation for lowest and highest channel

Above 1GHz test procedure as below:

g. Different between above is the test site, change from Semi- Anechoic Chamber to fully Anechoic Chamber and change form table 0.8 metre to 1.5 metre(Above 18GHz the distance is 1 meter and table is 1.5 metre).
h. Test the EUT in the lowest channel , the Highest channel
i. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is worse case.
j. Repeat above procedures until all frequencies measured was complete.

Limit:

Frequency	Limit (dBμV/m @3cm)	Remark
30MHz-88MHz	40.0	Quasi-peak Value
88MHz-216MHz	43.5	Quasi-peak Value
216MHz-960MHz	46.0	Quasi-peak Value
960MHz-1GHz	54.0	Quasi-peak Value
Above 1GHz	54.0	Average Value
	74.0	Peak Value

Test plot as follows:

Worse case mode:		802.11a(6Mbps)		Test channel:		149	
Frequency	Meter Reading	Factor	Emission Level	Limits	Over	Detector Type	Ant. Pol.
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)		H/V
5725	57.38	-2.77	54.61	74	-19.39	peak	H
5725	44.30	-2.77	41.53	54	-12.47	AV	H
5725	58.30	-2.77	55.53	74	-18.47	peak	V
5725	43.25	-2.77	40.48	54	-13.52	AV	V

Worse case mode:		802.11a(6Mbps)		Test channel:		165	
Frequency	Meter Reading	Factor	Emission Level	Limits	Over	Detector Type	Ant. Pol.
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)		H/V
5850	49.70	-2.74	46.96	74	-27.04	peak	H
5850	39.73	-2.74	36.99	54	-17.01	AV	H
5850	50.50	-2.74	47.76	74	-26.24	peak	V
5850	38.28	-2.74	35.54	54	-18.46	AV	V

Note:
1) Through Pre-scan transmitting mode with all kind of modulation and data rate, Only the worst case is recorded in the report.
2) The field strength is calculated by adding the Antenna Factor, Cable Factor & Preamplifier. The basic equation with a sample calculation is as follows:
Final Test Level =Receiver Reading - Correct Factor
Correct Factor = Preamplifier Factor– Antenna Factor–Cable Factor

Appendix J): Radiated Spurious Emissions

Receiver Setup:

Frequency	Detector	RBW	VBW	Remark
0.009MHz-0.090MHz	Peak	10kHz	30kHz	Peak
0.009MHz-0.090MHz	Average	10kHz	30kHz	Average
0.090MHz-0.110MHz	Quasi-peak	10kHz	30kHz	Quasi-peak
0.110MHz-0.490MHz	Peak	10kHz	30kHz	Peak
0.110MHz-0.490MHz	Average	10kHz	30kHz	Average
0.490MHz -30MHz	Quasi-peak	10kHz	30kHz	Quasi-peak
30MHz-1GHz	Quasi-peak	120kHz	300kHz	Quasi-peak
Above 1GHz	Peak	1MHz	3MHz	Peak
	Peak	1MHz	10Hz	Average

Test Procedure:

Below 1GHz test procedure as below:

a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter semi-anechoic camber. The table was rotated 360 degrees to determine the position of the highest radiation.
b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
c. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rota table was turned from 0 degrees to 360 degrees to find the maximum reading.
e. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
f. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

Above 1GHz test procedure as below:

g. Different between above is the test site, change from Semi- Anechoic Chamber to fully Anechoic Chamber and change form table 0.8 metre to 1.5 metre(Above 18GHz the distance is 1 meter and table is 1.5 metre)
h. Test the EUT in the lowest channel ,the middle channel ,the Highest channel
i. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is worse case.
j. Repeat above procedures until all frequencies measured was complete.

Limit:

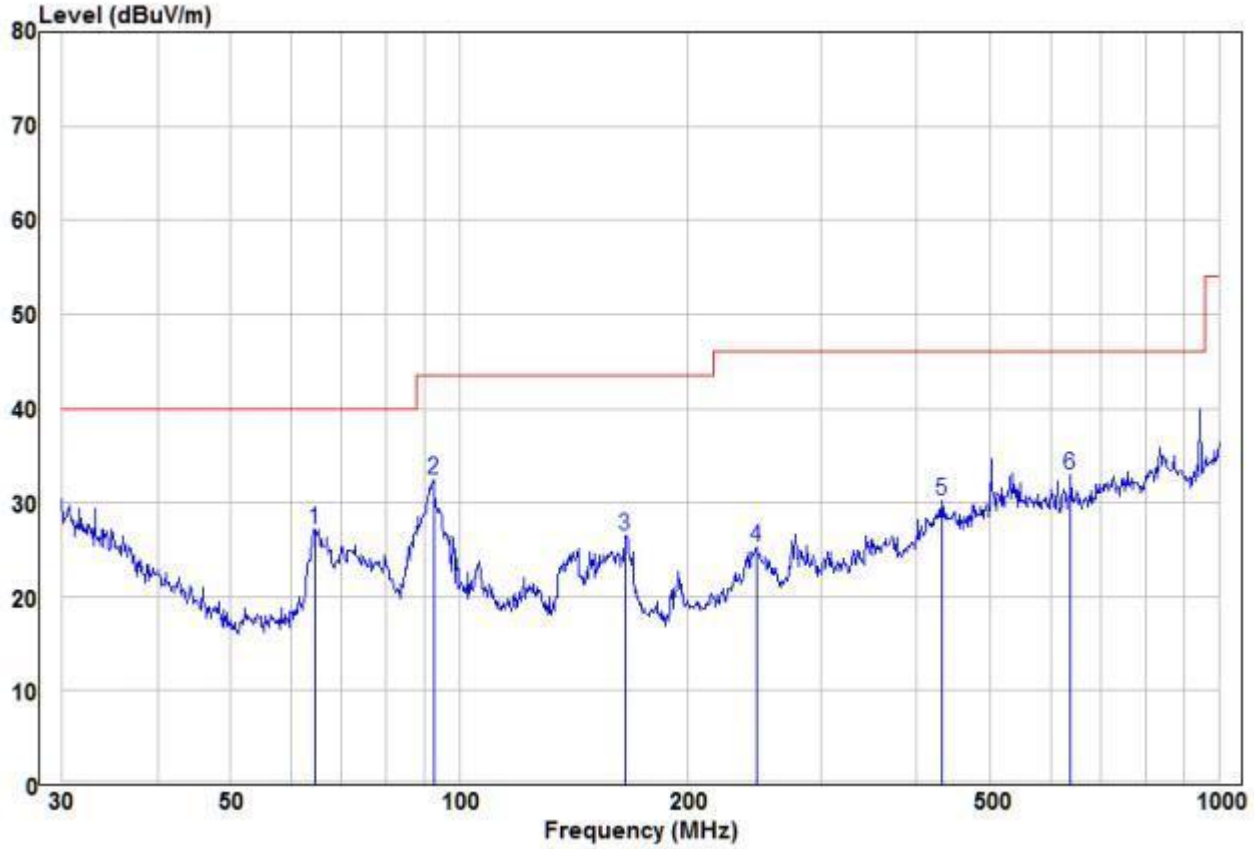
Frequency	Field strength (microvolt/meter)	Limit (dBμV/cm)	Remark	Measurement distance (cm)
0.009MHz-0.490MHz	2400/F(kHz)	-	-	300
0.490MHz-1.705MHz	24000/F(kHz)	-	-	30
1.705MHz-30MHz	30	-	-	30
30MHz-88MHz	100	40.0	Quasi-peak	3
88MHz-216MHz	150	43.5	Quasi-peak	3
216MHz-960MHz	200	46.0	Quasi-peak	3
960MHz-1GHz	500	54.0	Quasi-peak	3
Above 1GHz	500	54.0	Average	3

Note: 15.35(b), Unless otherwise specified, the limit on peak radio frequency emissions is 20dB above the maximum permitted average emission limit applicable to the equipment under test. This peak limit applies to the total peak emission level radiated by the device.

Test result: PASS

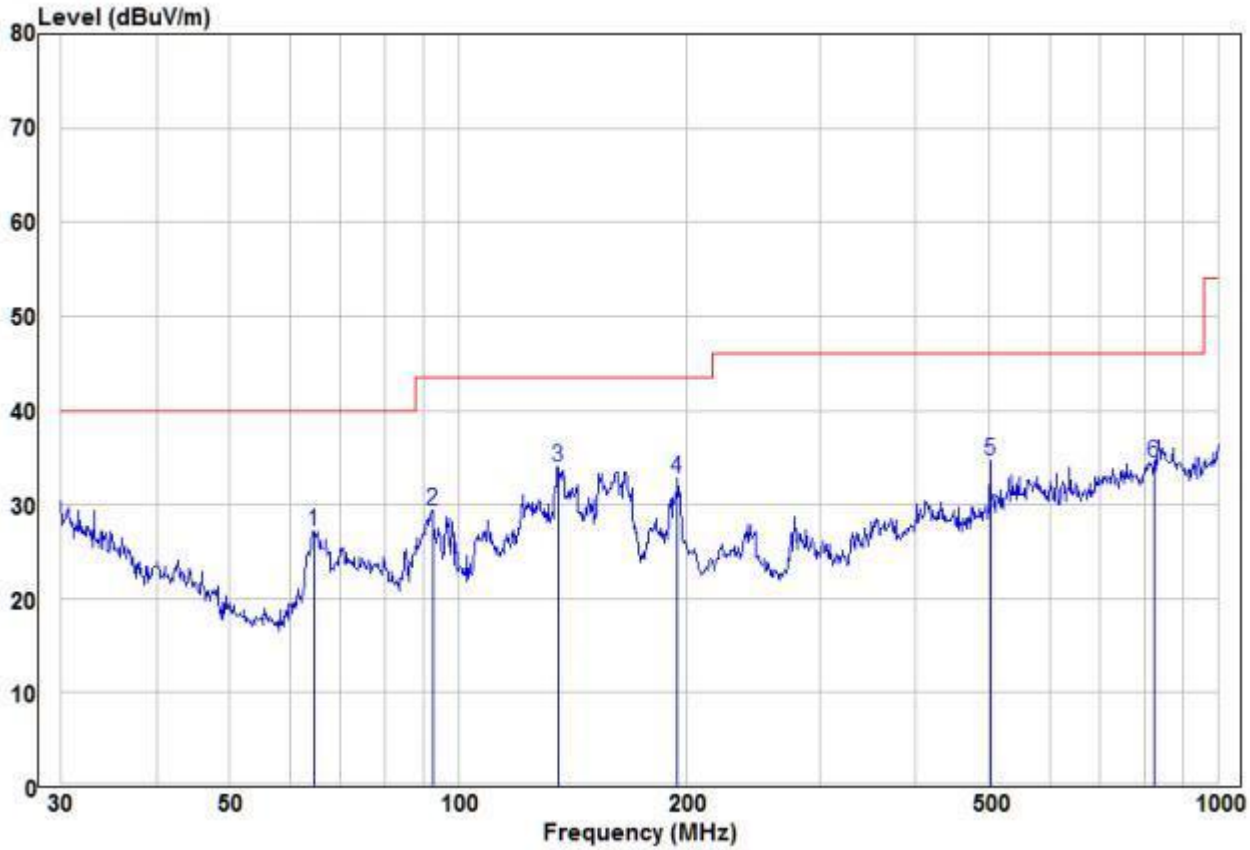
Test Data:
Radiated Emission below 1GHz

30MHz~1GHz		
Test mode:	Transmitting (802.11a 149CH)	Vertical



	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark	Pol/Phase
	MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB		
1	64.66	20.72	6.48	27.20	40.00	-12.80	Peak	VERTICAL
2 pp	92.46	22.16	10.18	32.34	43.50	-11.16	Peak	VERTICAL
3	165.49	18.77	7.70	26.47	43.50	-17.03	Peak	VERTICAL
4	245.95	13.25	11.95	25.20	46.00	-20.80	Peak	VERTICAL
5	431.03	14.09	16.13	30.22	46.00	-15.78	Peak	VERTICAL
6	638.37	13.41	19.47	32.88	46.00	-13.12	Peak	VERTICAL

Test mode:	Transmitting (802.11a 149CH)	Horizontal



	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark	Pol/Phase
	MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB		
1	64.66	20.72	6.48	27.20	40.00	-12.80	Peak	HORIZONTAL
2	92.46	19.16	10.18	29.34	43.50	-14.16	Peak	HORIZONTAL
3 pp	135.51	24.96	9.07	34.03	43.50	-9.47	Peak	HORIZONTAL
4	194.45	24.50	8.20	32.70	43.50	-10.80	Peak	HORIZONTAL
5	501.18	16.39	18.29	34.68	46.00	-11.32	Peak	HORIZONTAL
6	824.60	10.90	23.64	34.54	46.00	-11.46	Peak	HORIZONTAL

Transmitter Emission above 1GHz

Test mode:	802.11a(6Mbps)			Test channel:		149	
Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Over (dB)	Detector Type	Ant. Pol. H/V
11490	47.85	6.97	54.82	68.2	-13.38	peak	H
11490	36.20	6.97	43.17	54	-10.83	AVG	H
17235	41.21	15.71	56.92	68.2	-11.28	peak	H
17235	27.82	15.71	43.53	54	-10.47	AVG	H
11490	49.43	6.97	56.40	68.2	-11.80	peak	V
11490	38.06	6.97	45.03	54	-8.97	AVG	V
17235	42.50	15.71	58.21	68.2	-9.99	peak	V
17235	29.33	15.71	45.04	54	-8.96	AVG	V

Test mode:	802.11a(6Mbps)			Test channel:		165	
Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Over (dB)	Detector Type	Ant. Pol. H/V
11650	48.56	6.97	55.53	68.2	-12.67	peak	H
11650	36.05	6.97	43.02	54	-10.98	AVG	H
17475	43.31	15.71	59.02	68.2	-9.18	peak	H
17475	30.28	15.71	45.99	54	-8.01	AVG	H
11650	47.90	6.97	54.87	68.2	-13.33	peak	V
11650	37.72	6.97	44.69	54	-9.31	AVG	V
17475	42.21	15.71	57.92	68.2	-10.28	peak	V
17475	27.91	15.71	43.62	54	-10.38	AVG	V

Remark:

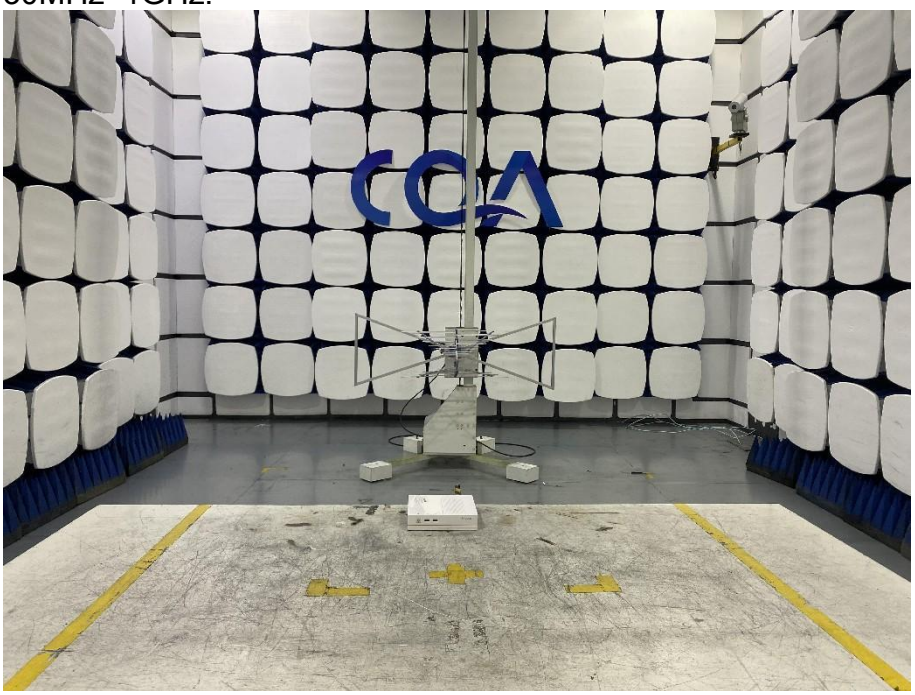
1) The 802.11a 6Mbps of rate is the worst case, only the worst data recorded in the report.
2) The field strength is calculated by adding the Antenna Factor, Cable Factor & Preamplifier. The basic equation with a sample calculation is as follows:
   Final Test Level =Receiver Reading + Antenna Factor + Cable Factor – Preamplifier Factor
3) Scan from 9kHz to 40GHz,The disturbance above 18GHz and below 30MHz was very low, and the above harmonics were the highest point could be found when testing, so only the above harmonics had been displayed. The amplitude of spurious emissions from the radiator which are attenuated more than 20dB below the limit need not be reported.

8 Photographs - EUT Test Setup

8.1 Radiated Spurious Emission

9kHz~30MHz:

30MHz~1GHz:



Above 1GHz:

8.2 Conducted Emission

9 Photographs - EUT Constructional Details

Refer to Photographs - EUT Constructional Details OF EUT for CQASZ20230200180E-01.

*** END OF REPORT ***