DEKRA Testing and Certification (Suzhou) Co., Ltd.
No.99 Hongye Rd., Suzhou Industrial Park, Suzhou, 215006, Jiangsu, China
TEL: +86-512-6251-5088 / FAX: +86-512-6251-5098

Test report No:
2290469R-RF-US-P06V01

FCC TEST REPORT

Product Name	AFC-SW01
Trademark	HISINGY 星奇世界
Model and /or type reference	md010501
FCC ID	2BAIV-MD010501
Applicant´s name / address	Cockatoo & Friends Co., Ltd. Dongxiaojing Industrial Park, No. 205 Zone B, Unit 1277, Dongba Township, Chaoyang District, Beijing, China.
Test method requested, standard	CFR 47, FCC Part 15 C § 15.247 ANSI C63.10:2013
Verdict Summary	IN COMPLIANCE
Documented by (name / position & signature)	Jun Xu/ Project Manager
Approved by (name / position & signature)	Jack Zhang/ Manager
Date of issue	2023-10-12
Report Version	V1.1
Report template No	Template_FCC Part 15C-RF-V1.0

INDEX

page

General conditions 5
Environmental conditions 5
Possible test case verdicts 6
Abbreviations 6
Document History 7
Remarks and Comments 7
Used Equipment 8
Uncertainty 9
1 General Information 11
1.1 General Description of the Item(s) 11
1.2 Antenna Information 12
1.3 Channel List 13
2 Description of Test Setup 14
2.1 Operating mode(s) used for tests 14
2.2 Auxiliary equipment / Test software for the EUT 14
2.3 Test Configuration / Block diagram used for tests 15
2.4 Testing process 16
3 Verdict summary section 17
3.1 Standards 17
3.2 Deviation(s) from the Standard(s) / Test Specification(s) 17
3.3 Overview of results 18
3.4 Power setting in test 19
3.5 Test Matrix 19
3.6 Test Facility 20
4 Test Items Of Limit/Setup/Procedure 21
4.1 DTS Bandwidth 21
4.1.1 Limit 21
4.1.2 Test Setup 21
4.1.3 Test Procedure 21
4.2 Maximum Conducted Output Power 22
4.2.1 Limit 22
4.2.2 Test Setup 22
4.2.3 Test Procedure 23
4.3 Maximum Power Spectral Density 24

4.3.1 Limit 24
4.3.2 Test Setup 24
4.3.3 Test Procedure 24
4.4 Band Edge Measurements 25
4.4.1 Limit 25
4.4.2 Test Setup 25
4.4.3 Test Procedure 25
4.5 Conducted Spurious Emission 26
4.5.1 Limit 26
4.5.2 Test Setup 26
4.5.3 Test Procedure 26
4.6 Duty cycle 27
4.6.1 Limit 27
4.6.2 Test Setup 27
4.6.3 Test Procedure 27
4.7 Emissions in Restricted Bands 28
4.7.1 Limit 28
4.7.2 Test Setup 30
4.7.3 Test Procedure 31
4.8 AC Power Line Conducted Emission 32
4.8.1 Limit 32
4.8.2 Test Setup 32
4.9.3 Test Procedure 32
4.9 Antenna Requirement 33
4.9.1 Limit: 33
4.10.2 Antenna Connector Construction: 33
5 Test setup photo and EUT Photo 33
6 Test Result 34
Appendix A: DTS Bandwidth 34
Test Result 34
Test Graphs 35
Appendix B: Maximum conducted output power 36
Test Result Peak 36
Appendix C: Maximum power spectral density 37
Test Result 37
Test Graphs 38
Appendix D: Band edge measurements 39

Test Result 39
Appendix E: Conducted Spurious Emission 47
Test Graphs 47
Appendix G: Duty Cycle 49
Test Result 49
Test Graphs 50
Appendix H: Emissions in Restricted Bands 51
Test Result 51

COMPETENCES AND GUARANTEES

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

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

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

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

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GENERAL CONDITIONS

Test Location	No. 99, Hongye Road, Suzhou Industrial Park Suzhou, 215006, P.R. China
Date(receive sample)	Sept. 15, 2022
Date (start test)	Sept. 19, 2022
Date (finish test)	Feb. 15, 2023

1. This report is only referred to the item that has undergone the test.
2. This report does not constitute or imply on its own an approval of the product by the Certification Bodies or Competent Authorities.
3. This document is only valid if complete; no partial reproduction can be made without previous written permission of DEKRA.
4. This test report cannot be used partially or in full for publicity and/or promotional purposes without previous written permission of DEKRA.

ENVIRONMENTAL CONDITIONS

The climatic conditions during the tests are within the limits specified by the manufacturer for the operation of the EUT and the test equipment. The climatic conditions during the tests were within the following limits:

Ambient temperature	15 °C – 35 °C
Relative Humidity air	30% - 60%

If explicitly required in the basic standard or applied product / product family standard the climatic values are recorded and documented separately in this test report.

POSSIBLE TEST CASE VERDICTS

Test case does not apply to test object	N/A
Test object does meet requirement	P (Pass) / PASS
Test object does not meet requirement	F (Fail) / FAIL
Not measured	N/M

ABBREVIATIONS

For the purposes of the present document, the following abbreviations apply:

EUT	:	Equipment Under Test
QP	:	Quasi-Peak
CAV	:	CISPR Average
AV	:	Average
CDN	:	Coupling Decoupling Network
SAC	:	Semi-Anechoic Chamber
OATS	:	Open Area Test Site
BW	:	Bandwidth
AM	:	Amplitude Modulation
PM	:	Pulse Modulation
HCP	:	Horizontal Coupling Plane
VCP	:	Vertical Coupling Plane
U_N	:	Nominal voltage
*T*x	:	Transmitter
*R*x	:	Receiver
N/A	:	Not Applicable
N/M	:	Not Measured

DOCUMENT HISTORY

Report No.	Version	Description	Issued Date
2290469R-RF-US-P06V01	V1.0	Initial issue of report.	2023-07-25
2290469R-RF-US-P06V01	V1.1	Appendix H adds test data. (The test report No.: 2290469R-RF-US-P06V01 V1.1 is to replace the test report No.: 2290469R-RF-US-P06V01 V1.0, and test report 2290469R-RF-US-P06V01 V1.0 is obsoleted.)	2023-10-12

REMARKS AND COMMENTS

1. The equipment under test (EUT) does meet the essential requirements of the stated standard(s)/test(s).
2. These test results on a sample of the device are for the purpose of demonstrating Compliance with CFR 47, FCC Part 15 C,ANSI C63.10:2013.
3. The measurement result is considered in conformance with the requirement if it is within the prescribed limit, It is not necessary to account the uncertainty associated with the measurement result.
4. The test results presented in this report relate only to the object tested.
5. The test report shall not be reproduced without the written approval of DEKRA Testing and Certification (Suzhou) Co., Ltd.
6. This report will not be used for social proof function in China market.
7. DEKRA declines any responsibility with the following test data provided by customer that may affect the validity of result:

- Chapter 1.1 General Description of the Item(s);
- Chapter 1.2 Antenna Informaion;
- Chapter 1.3 Channel List.

USED EQUIPMENT

Conducted Test/ TR8

Instrument	Manufacturer	Model No.	Serial No.	Cal. Date	Next Cal. Date
Wireless Connectivity Tester	R&S	CMW 270	102593	2022.05.21	2023.05.20
Coaxial Cable	N/A	N/A	2187	2022.06.09	2023.06.08
High and low temperature and fast temperature change test box	ASTUOD	ASTD-FBT-225K	N/A	2022.07.13	2023.07.12
Temperature/Humidity Meter	RTS	RTS-8S	RF08	2022.07.07	2023.07.06
Test system					
4TX MIMO Power Sensor	Keysight	X8750A	MY59400102	2022.03.16	2023.03.15
MAX Signal Analyzer	Keysight	N9020B	MY59050482	2022.09.17	2023.09.16
Switch Box	Keysight	X8749A	N/A	N/A	N/A
High and low temperature and fast temperature change test box	ASTUOD	ASTD-FBT-225K	N/A	2022.07.13	2023.07.12
MXG-B RF Vector Signal Generator	Keysight	N5182B	MY61252529	2022.07.14	2023.07.13
Frequency extender for EXG or MXG	Keysight	N5182BX07	MY59362500	2022.07.14	2023.07.13
EXG-B MW Analog Signal Generator	Keysight	N5173B	MY61252566	2022.09.28	2023.09.27
High-Pass Filter	Wainwright	WHKX3.0/18G-12SS	81	2022.06.07	2023.06.06

Radiated Emission(9kHz-1GHz) / AC3

Instrument	Manufacturer	Model No.	Serial No.	Cal. Date	Next Cal. Date
EMI Test Receiver	R&S	ESCI	100573	2022.07.10	2023.07.09
Bilog Antenna	Teseq GmbH	CBL6112D	27611	2022.08.28	2023.08.27
Coaxial Cable	Huber+Suhner	RG 214	AC2-C	2022.03.30	2023.03.29
Loop Antenna	R&S	HFH2-Z2	833799/003	2022.04.15	2023.04.14
Temperature/Humidity Meter	RTS	RTS-8S	AC2-TH	2022.07.07	2023.07.06

Radiated Emission (1GHz-40GHz) / AC5

Instrument	Manufacturer	Model No.	Serial No.	Cal. Date	Next Cal. Date
MXA Signal Analyzer	Keysight	N9020B	MY60112218	2022.12.08	2023.12.07
Preamplifier	Chengyi	EMC184045SE	980263	2022.07.19	2023.07.18
Preamplifier	Chengyi	EMC184045SE	980263	2023.07.09	2024.07.08
Preamplifier	SKET	LNPA_0118G-45	SK2021041201	2022.04.15	2023.04.14
Preamplifier	SKET	LNPA_0118G-45	SK2021041201	2023.04.14	2024.04.13
DRG Horn	ETS-Lindgren	3117	00123988	2022.08.29	2023.08.28
DRG Horn	ETS-Lindgren	3117	00123988	2023.08.27	2024.08.26
Broad-Band Horn Antenna	SCHWARZBECK	BBHA 9170	01249	2022.09.22	2023.09.21
Broad-Band Horn Antenna	SCHWARZBECK	BBHA 9170	01249	2023.09.18	2024.09.17
Coaxial Cable	Huber+Suhner	SUCOFLEX 106	AC5-C2	2022.03.30	2023.03.29
Coaxial Cable	Huber+Suhner	SUCOFLEX 106	AC5-C2	2023.03.26	2024.03.25
Coaxial Cable	ROSENBERGER	LA1-C011-2000/3000	AC5-40G	2022.03.21	2023.03.20
Coaxial Cable	ROSENBERGER	LA1-C011-2000/3000	AC5-40G	2023.03.16	2024.03.15
Notch Filter	Micro-mve	MFN-2400.2485.S1	AN0003N	2022.07.18	2023.07.17
Notch Filter	Micro-mve	MFN-2400.2485.S1	AN0003N	2023.07.12	2024.07.11
High-Pass Filter	Wainwright	WHKX7.0/18G-8SS	27	2022.06.07	2023.06.06
High-Pass Filter	Wainwright	WHKX7.0/18G-8SS	27	2023.06.05	2024.06.04

UNCERTAINTY

Uncertainties have been calculated according to the DEKRA internal document. The reported expanded uncertainties are based on a standard uncertainty multiplied by a coverage factor of k=2, providing a level of confidence of approximately 95% .

Test item	Uncertainty
Peak Power Output	± 1.27 dB
Radiated Emission(30MHz~1GHz)	Horizontal: 30MHz~200MHz: 3.50 dB 300MHz~1GHz: 3.60 dB Vertical: 30MHz~200MHz: 3.60 dB 300MHz~1GHz: 3.50 dB
Radiated Emission(1GHz~26.5GHz)	Horizontal: 1GHz~18GHz: 5.00 dB Vertical: 1GHz~18GHz: 4.80 dB
RF antenna conducted test	± 1.27dB
Radiated Emission Band Edge	± 3.9 dB
DTS Bandwidth	±1kHz
Occupied Bandwidth	±1kHz
Power Density	±1.27dB

1 GENERAL INFORMATION

1.1 General Description of the Item(s)

Product Name .....:	AFC-SW01
Model No. .....:	md010501
Trademark .....:	HISINGY 星奇世界
FCC ID.....:	2BAIV-MD010501
Hardware Version.....:	5.0
Software Version .....:	1.59
Manufacturer .....:	Goertek Robotics Co,Ltd
Manufacturer address .....:	A218, Building A, No. 35, Lane 799, Jiasongzhong Road, Qingpu District, Shanghai
Factory.....:	Goertek Robotics Co,Ltd
address.....:	A218, Building A, No. 35, Lane 799, Jiasongzhong Road, Qingpu District, Shanghai

Wireless specifiction.....:	Bluetooth					
Operating frequency range(s)	2402~2480MHz					
Type of Modulation.....:	GFSK					
PHYs .....:	☒	LE 1M	☐	LE 2M	☐	LE Coded S=2/8
Data Rate .....:	☒	1Mbit/s	☐	2Mbit/s	☐	500/125 Kbit/s
Number of channel .....:	40					

Rated power supply..... :	Voltage and Frequency	
	☐	AC: 220 - 240 V, 50/60 Hz
	☐	AC: 100 - 240 V, 50/60 Hz
	☒	DC: 3.7 V
	☐	Battery: 3.8V, 2.28mw
	☐	Adapter: ……Input: Output:
Brand of adapter..... :	N/A	
Adapter model ..... :	N/A	
Mounting position ..... :	☐	Table top equipment
	☐	Wall/Ceiling mounted equipment
	☐	Floor standing equipment
	☐	Hand-held/Protable equipment
	☒	Other: RF Module

1.2 Antenna Information

Antenna model / type number .....:	N/A			
Antenna serial number .....:	N/A			
Antenna Delivery .....:	☒	1TX + 1RX		
	☐	2TX + 2RX		
	☐	Others:……		
Antenna technology.....:	☒	SISO		
	☐	MIMO	☐	CDD
			☐	Beam-forming
Antenna Type .....:	☐	External	☐	Dipole
			☐	Sectorized
	☒	Internal	☐	Ceramic Chip
			☐	PIFA
			☒	linear antenna
			☐	PCB
			☐	Others……..
Antenna Gain .....:	2.18 dBi			

1.3 Channel List

Bluetooth Working Frequency of Each Channel: (For LE)							
Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
00	2402 MHz	01	2404 MHz	02	2406 MHz	03	2408 MHz
04	2410 MHz	05	2412 MHz	06	2414 MHz	07	2416 MHz
08	2418 MHz	09	2420 MHz	10	2422 MHz	11	2424 MHz
12	2426 MHz	13	2428 MHz	14	2430 MHz	15	2432 MHz
16	2434 MHz	17	2436 MHz	18	2438 MHz	19	2440 MHz
20	2442 MHz	21	2444 MHz	22	2446 MHz	23	2448 MHz
24	2450 MHz	25	2452 MHz	26	2454 MHz	27	2456 MHz
28	2458 MHz	29	2460 MHz	30	2462 MHz	31	2464 MHz
32	2466 MHz	33	2468 MHz	34	2470 MHz	35	2472 MHz
36	2474 MHz	37	2476 MHz	38	2478 MHz	39	2480 MHz

Note: The General Description of the Item , antenna information and Channel List for the EUT in clause 1 are provided and confirmed by the client.

2 DESCRIPTION OF TEST SETUP

2.1 Operating mode(s) used for tests

During the tests the following operating mode(s) has(have) been used.

Test Mode For Bluetooth	Mode 1: Transmit by LE_1Mbps

Note 1: Regards to the frequency band operation: the lowest, middle and highest frequency channel were selected to perform the test, then shown on this report.

Note 2: For portable device, radiated tests was verified over X, Y, Z axis, and shown the worst case on this report.

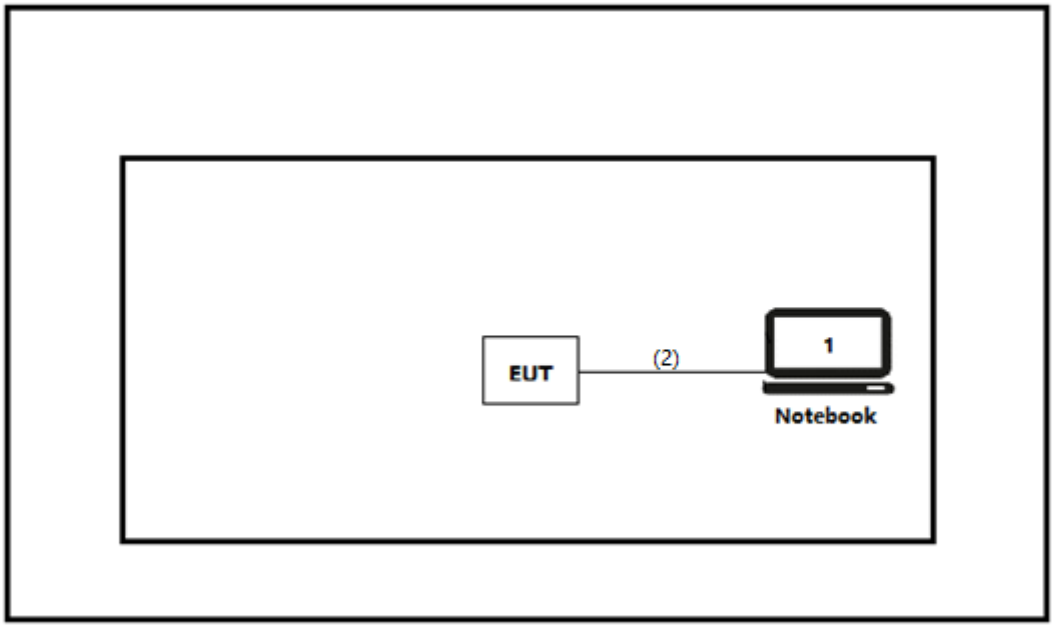
2.2 Auxiliary equipment / Test software for the EUT

Auxiliary equipment	Type / Version	Manufacturer	Supplied by
(1) Notebook	Think pad x220	Lenovo	Adapter
(2) USB Control Cable	N/A	N/A	N/A
(3) USB Control Cable	N/A	N/A	N/A
software	Type / Version	Manufacturer	Supplied by
EspRFTestTool	V2.6.2.6	N/A	N/A

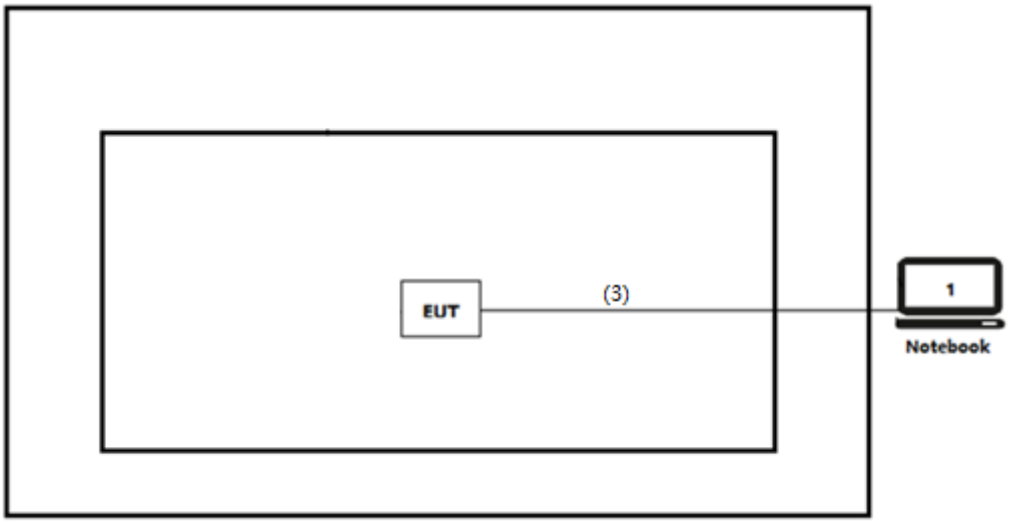
Accessories Information	Cable		
	Length used during test [m]	Attached during test	Shielded
(2)USB Control Cable	1	☒	☒
(3)USB Control Cable	8	☒	☒

2.3 Test Configuration / Block diagram used for tests

Test setup Diagram- Conducted test



Test setup Diagram- Ratiated test



2.4 Testing process

1	Setup the EUT shown in Section 2.3.
2	Execute the "EspRFTestTool" on the notebook.
3	Configure the test mode, the test channel, and the data rate.
4	Verify that the EUT works properly.

3 VERDICT SUMMARY SECTION

This chapter presents an overview of standards and results. Refer to the next chapters for details of measured test results and applied test levels.

3.1 Standards

Standard	Year	Description
FCC CFR Title 47 Part 15 Subpart C Section 15.247	2023	Operation within the bands 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz.
ANSI C63.10	2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
KDB558074	2019	guidance for compliance measurements on digital transmission system, frequency hopping spread spectrum system, and hybrid system devices operating under section 15.247 of the fcc rules

3.2 Deviation(s) from the Standard(s) / Test Specification(s)

The following deviation(s) was / were made from the published requirements of the listed standards: N/A.

(Please define the deviations from the standard(s) if applicable)

3.3 Overview of results

Requirement – Test Item of FCC	Standard(s)	Verdict	Remark
6dB Emission Bandwidth	FCC 15.247(a)(2)	PASS	Test data please refer to **Appendix A**
Maximum conducted output power	15.247 (b)(3)	PASS	Test data please refer to **Appendix B**
Maximum power spectral density	FCC 15.247(e)	PASS	Test data please refer to **Appendix C**
Band edge measurements	FCC 15.247(d) FCC 15.205 FCC 15.209	PASS	Test data please refer to **Appendix D**
Conducted Spurious Emission	FCC 15.247(d), FCC 15.209	PASS	Test data please refer to **Appendix E**
Duty cycle	ANSI C63.10:2013	PASS	Test data please refer to **Appendix F**
Emissions in Restricted Bands	FCC 15.205 FCC 15.209	PASS	Test data please refer to **Appendix G**
AC Power Line Conducted Emission	FCC 15.207	N/A	The equipment is powered by DC
Antenna Requirement	FCC 15.203	PASS	---

3.4 Power setting in test

Mode	Channel	Frequency (MHz)	Power setting
LE_1Mbps	00	2402	6
	19	2440	6
	39	2480	8

3.5 Test Matrix

Test item	md010501	
	1(#1)	2(#2)
DTS Bandwidth	☒	☐
Maximum conducted output power	☒	☐
Maximum power spectral density	☒	☐
Band edge measurements	☐	☒
Conducted Spurious Emission	☒	☐
Duty cycle	☒	☐
Emissions in Restricted Bands	☐	☒
Antenna Requirement	☐	☒

3.6 Test Facility

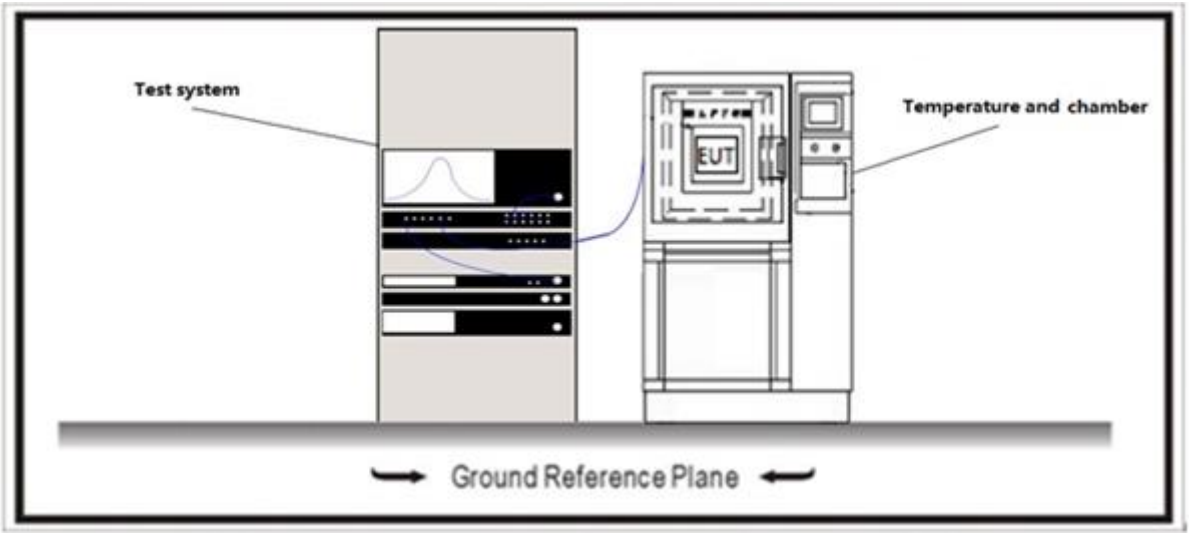
USA	**:**	**FCC Designation Number: CN1199**

4 TEST ITEMS OF LIMIT/SETUP/PROCEDURE

4.1 DTS Bandwidth	VERDICT: PASS

4.1.1 Limit	
Standard	FCC Part 15 Subpart C Paragraph 15.247 (a)(2);
Systems using digital modulation techniques operate in the2400-2483.5 MHz .The minimum 6 dB bandwidth shall be at least 500 kHz	

4.1.2 Test Setup



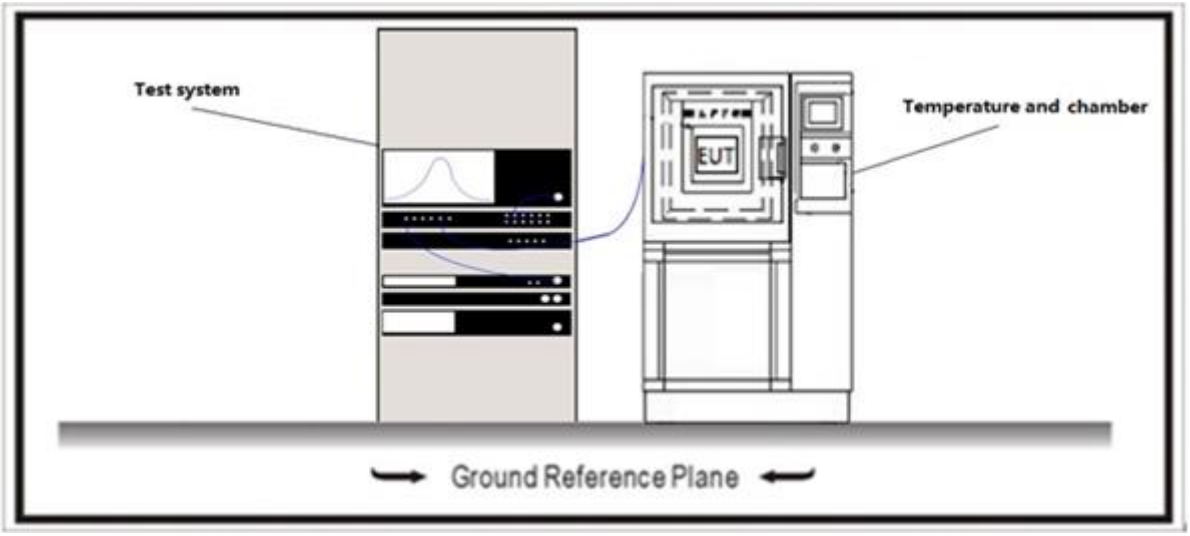
4.1.3 Test Procedure

	Reference Rule		Chapter	Description
☒	ANSI C63.10		11.8	DTS bandwidth
	☐	ANSI C63.10	11.8.1	Option 1
	☒	ANSI C63.10	11.8.2	Option 2

4.2 Maximum Conducted Output Power	VERDICT: PASS

4.2.1 Limit			
Standard		FCC Part 15 Subpart C Paragraph 15.247 (b)(3); RSS-247 Issue 2 Paragraph 5.4(d).	
☒	GTX ＜6dBi		Pout≤30dBm
☐	GTX ＞6dBi		
	☐	Non-Fix point-point	Pout≤30-(GTX -6)
	☐	Fix point-point	Pout≤30-[(GTX-6)]/3
	☐	Point-to-multipoint	Pout≤30-(GTX-6)
	☐	Overlap Beams	Pout≤30-[(GTX-6)]/3
	☐	Aggregate power transmitted simultaneously on all beams	Pout≤30-[(GTX-6)]/3
	☐	single directional beam	Pout≤30-[(GTX-6)]/3+8dB
Note 1 : GTX directional gain of transmitting antennas. Note 2 : Pout is maximum peak conducted output power .			

4.2.2 Test Setup

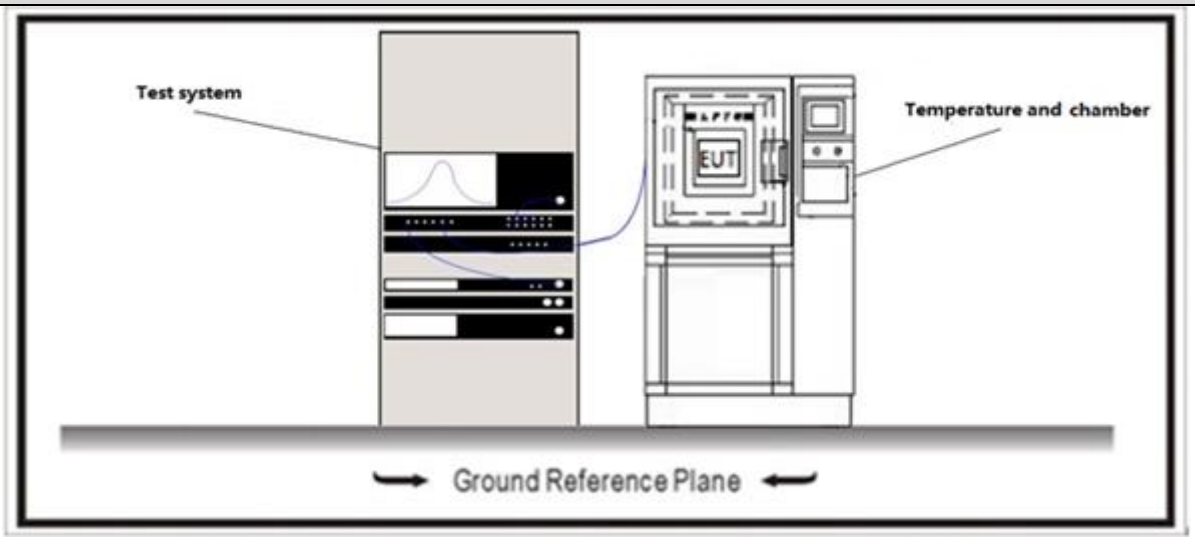


4.2.3 Test Procedure						
	References Rule				Chapter	Description
☒	ANSI C63.10				11.9	Fundamental emission output power
	☒	ANSI C63.10			11.9.1	Maximum peak conducted output power
		☒	ANSI C63.10		11.9.1.1	RBW ≥ DTS bandwidth
		☐	ANSI C63.10		11.9.1.2	Integrated band power method
		☐	ANSI C63.10		11.9.1.3	PKPM1 Peak power meter method
	☐	ANSI C63.10			11.9.2	Maximum conducted (average) output power
		☐	ANSI C63.10		11.9.2.2	Measurement using a spectrum analyzer (SA)
			☐	ANSI C63.10	11.9.2.2.2	Method AVGSA-1(Duty cycle ≥98%)
			☐	ANSI C63.10	11.9.2.2.3	Method AVGSA-1A(Duty cycle ≥98%)
			☐	ANSI C63.10	11.9.2.2.4	Method AVGSA-2(Duty cycle ≤98%)
			☐	ANSI C63.10	11.9.2.2.5	Method AVGSA-2A(Duty cycle ≤98%)
			☐	ANSI C63.10	11.9.2.2.4	Method AVGSA-3
			☐	ANSI C63.10	11.9.2.2.5	Method AVGSA-3A
		☐	ANSI C63.10		11.9.2.3	Measurement using a power meter (PM)
			☐	ANSI C63.10	11.9.2.3.1	Method AVGPM
			☐	ANSI C63.10	11.9.2.3.2	Method AVGPM-G

4.3 Maximum Power Spectral Density	VERDICT: PASS

4.3.1 Limit	
Standard	FCC Part 15 Subpart C Paragraph 15.247 (b)(3);
Power Spectral Density≤8dBm/3kHz	

4.3.2 Test Setup



4.3.3 Test Procedure

	References Rule		Chapter	Description
☒	ANSI C63.10		11.10	Maximum power spectral density level in the fundamental emission
	☒	ANSI C63.10	11.10.2	Method PKPSD (peak PSD)
	☐	ANSI C63.10	11.10.3	Method AVGPSD-1(Duty cycle≥98%)
	☐	ANSI C63.10	11.10.4	Method AVGPSD-1A(Duty cycle≥98%)
	☐	ANSI C63.10	11.10.5	Method AVGPSD-2(Duty cycle＜98%)
	☐	ANSI C63.10	11.10.6	Method AVGPSD-2A(Duty cycle＜98%)
	☐	ANSI C63.10	11.10.7	Method AVGPSD-3
	☐	ANSI C63.10	11.10.8	Method AVGPSD-3A

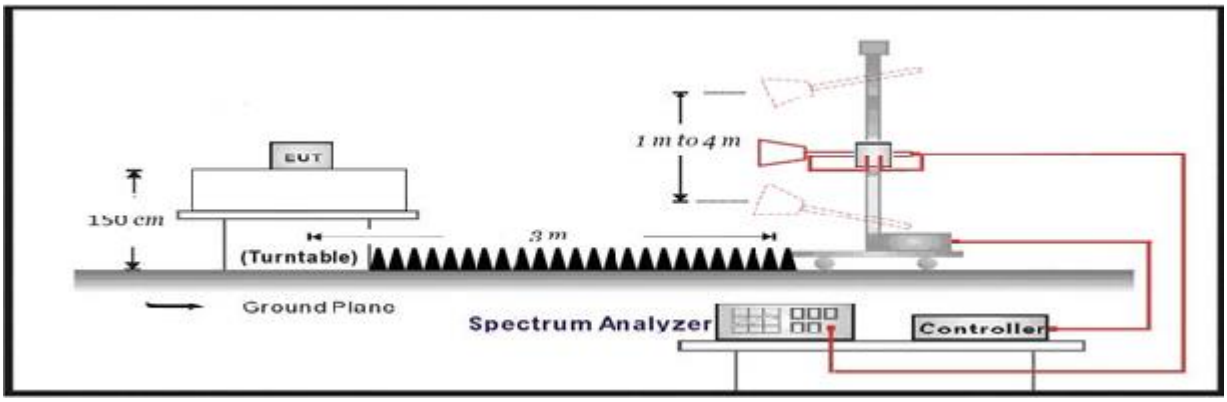
4.4 Band Edge Measurements	VERDICT: PASS

4.4.1 Limit

Standard	FCC Part 15 Subpart C Paragraph 15.247(d) , 15.209;			
Frequency bands (MHz)	Detector	Limit (dBμV/m)	RBW (MHz)	Distance (m)
2310-2390 2483.5-2500	PK	74	1	3
	AV	54	1	3
Note: The field strength of emissions appearing within these frequency bands shall not exceed the limits.				

4.4.2 Test Setup

Above 1GHz Test Setup:



4.4.3 Test Procedure

	References Rule		Chapter	Description
☒	ANSI C63.10		6.10	Band-edge testing
	☒	ANSI C63.10	6.10.5	Restricted-band band-edge measurements
	☐	ANSI C63.10	6.10.6	Marker-delta method
☒	ANSI C63.10		11.12	Emissions in restricted frequency bands
	☒	ANSI C63.10	11.12.1	Radiated emission measurements
	☒	ANSI C63.10	11.12.2.7	Radiated spurious emission test
☐	ANSI C63.10		6.4	Radiated emissions from unlicensed wireless devices below 30 MHz
☐	ANSI C63.10		6.5	Radiated emissions from unlicensed wireless devices in the frequency rangeof 30 MHz to 1000 MHz
☒	ANSI C63.10		6.6	Radiated emissions from unlicensed wireless devices above 1 GHz

4.5 Conducted Spurious Emission	VERDICT: PASS

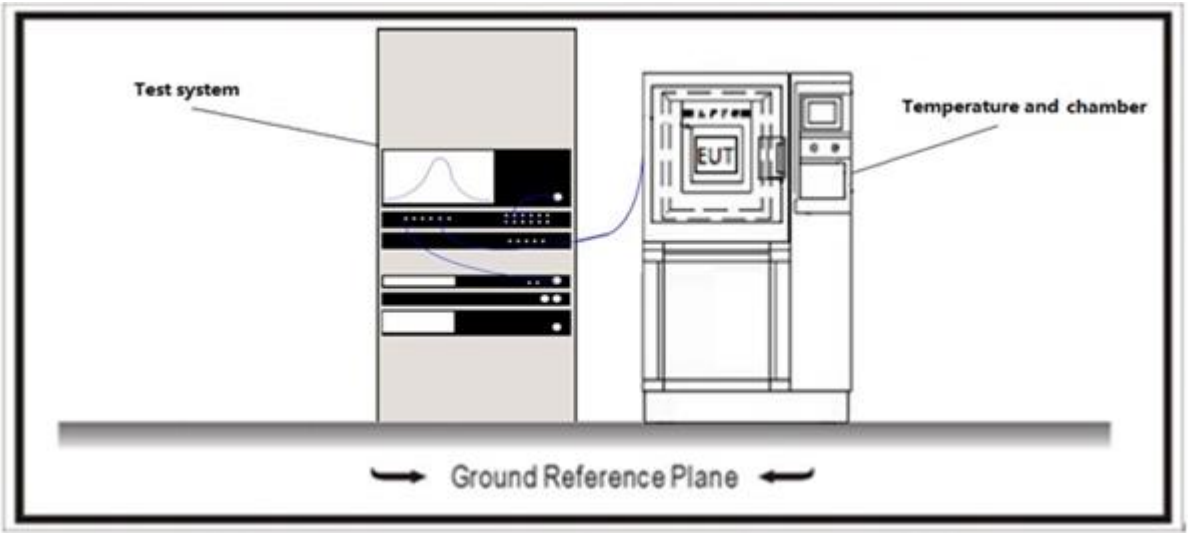
4.5.1 Limit

Standard	FCC Part 15 Subpart C Paragraph 15.247(d);
RF Output power (Detection methods)	Limit(dB)
RF Output power(Average detector)	30dBc(Note1)
RF Output power(PK detector)	20dBc(Note2)

Note 1: If maximum conducted (average) output power was used to demonstrate compliance as described in 9.2, then the peak power in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 30 dB relative to the maximum in-band peak PSD level in 100 kHz (i.e., 30 dBc).

Note 2: If the maximum peak conducted output power procedure was used, then the peak output power 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 (i.e., 20 dBc).

4.5.2 Test Setup



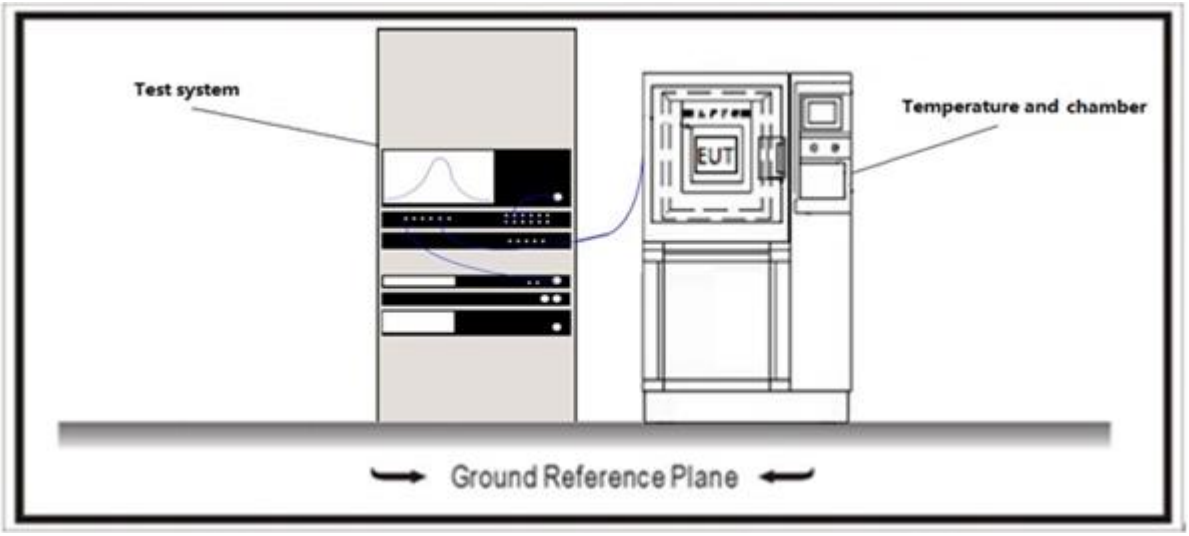
4.5.3 Test Procedure

References Rule			Chapter	Description
☒	ANSI C63.10		11.11	Emissions in non-restricted frequency bands
	☒	ANSI C63.10	11.11.1	General
	☒	ANSI C63.10	11.11.2	Reference level measurement
	☒	ANSI C63.10	11.11.3	Emission level measurement

4.6 Duty cycle	VERDICT: PASS

4.6.1 Limit
N/A

4.6.2 Test Setup



4.6.3 Test Procedure

References Rule		Chapter	Description
☒	ANSI C63.10	11.6	Duty cycle (D), transmission duration (T), and maximum power control level

4.7 Emissions in Restricted Bands — VERDICT: PASS

4.7.1 Limit

Standard	FCC Part 15 Subpart C Paragraph 15.205		
Restricted Bands of operation			
Frequency (MHz)	Frequency (MHz)	Frequency (MHz)	Frequency (GHz)
0.090 – 0.110	16.42 – 16.423	399.9 – 410	4.5 – 5.15
0.495 – 0.505	16.69475 –16.69525	608 – 614	5.35 – 5.46
2.1735 – 2.1905	16.80425 – 16.80475	960 – 1240	7.25 – 7.75
4.125 – 4.128	25.5 – 25.67	1300 – 1427	8.025 – 8.5
4.17725 – 4.17775	37.5 – 38.25	1435 – 1626.5	9.0 – 9.2
4.20725 – 4.20775	73 – 74.6	1645.5 – 1646.5	9.3 – 9.5
6.215 – 6.218	74.8 – 75.2	1660 – 1710	10.6 – 12.7
6.26775 – 6.26825	108 – 121.94	1718.8 – 1722.2	13.25 – 13.4
6.31175 – 6.31225	123 – 138	2200 – 2300	14.47 – 14.5
8.291 – 8.294	149.9 – 150.05	2310 – 2390	15.35 – 16.2
8.362 – 8.366	156.52475 – 156.52525	2483.5 – 2500	17.7 – 21.4
8.37625 – 8.38675	156.7 – 156.9	2690 – 2900	22.01 – 23.12
8.81425 – 8.81475	162.0125 – 167.17	3260 – 3267	23.6 – 24.0
12.29 – 12.293	167.72 – 173.2	3332 – 3339	31.2 – 31.8
12.51975–12.52025	240 – 285	3345.8 – 3358	36.43 – 36.5
12.57675–12.57725	322 – 335.4	3600 – 4400	
13.36 – 13.41			

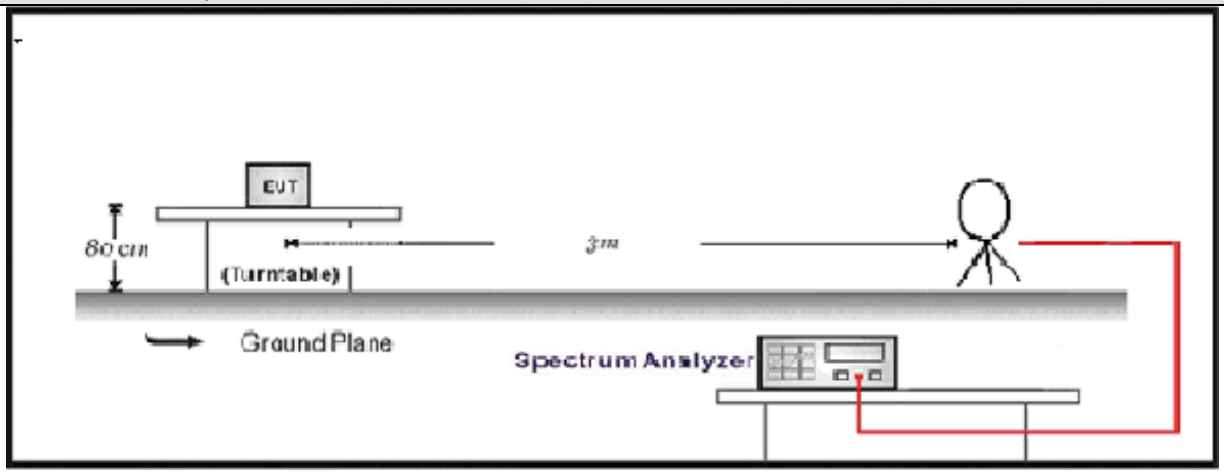
Restricted Band Emissions Limit			
FCC Part 15 Subpart C Paragraph 15.209			
Frequency (MHz)	Field strength (μV/m)	Field strength (dBμV/m)	Measurement distance (m)
0.009 - 0.49	2400/F(kHz)	48.5 – 13.8	300(Note 1)
0.49 - 1.705	24000/F(kHz)	33.8 - 23	30(Note 1)
1.705 - 30	30	29.5	30(Note 1)
30 - 88	100	40	3(Note 2)
88 - 216	150	43.5	3(Note 2)
216 - 960	200	46	3(Note 2)
Above 960	500	54	3(Note 2)

Note 1: At frequencies below 30 MHz, measurements may be performed at a distance closer than that specified in the regulations; however, an attempt should be made to avoid making measurements in the near field. Pending the development of an appropriate measurement procedure for measurements performed below 30 MHz, when performing measurements at a closer distance than specified, the results shall be extrapolated to the specified distance by either making measurements at a minimum of two distances on at least one radial to determine the proper extrapolation factor or by using the square of an inverse linear distance extrapolation factor (40 dB/decade).

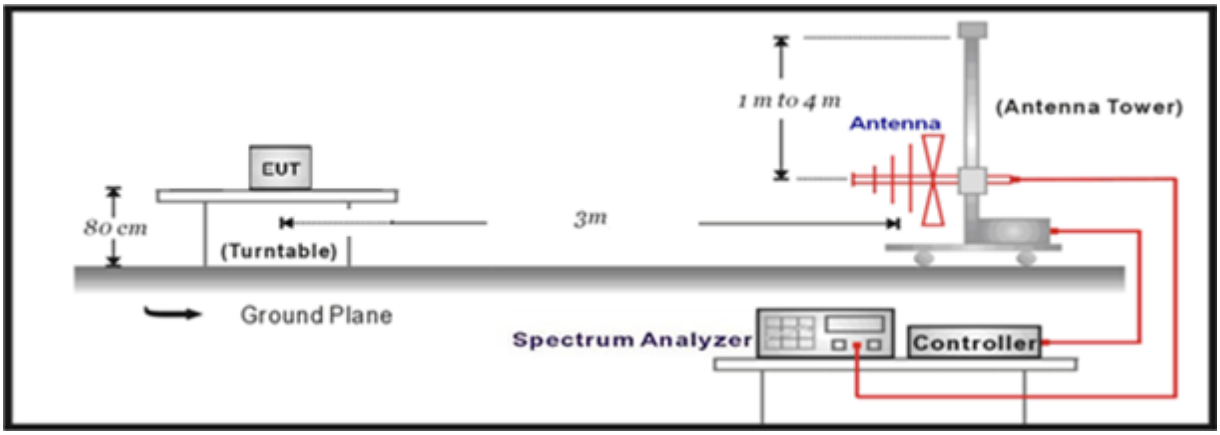
Note 2: At frequencies at or above 30 MHz, measurements may be performed at a distance other than what is specified provided: measurements are not made in the near field except where it can be shown that near field measurements are appropriate due to the characteristics of the device; and it can be demonstrated that the signal levels needed to be measured at the distance employed can be detected by the measurement equipment. Measurements shall not be performed at a distance greater than 30 meters unless it can be further demonstrated that measurements at a distance of 30 meters or less are impractical. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade (inverse linear-distance for field strength measurements; inverse-linear-distance-squared for power density measurements).

4.7.2 Test Setup

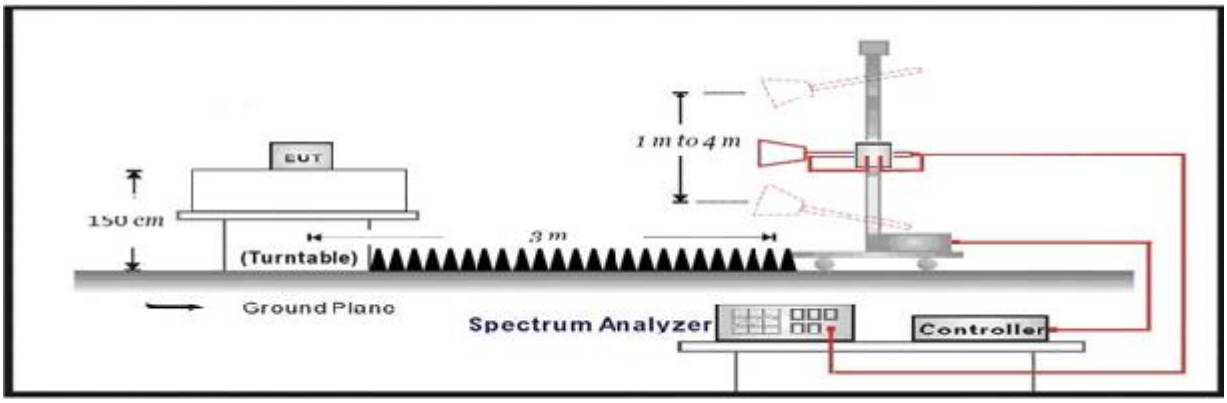
Below 30MHz Test Setup:



30MHz-1GHz Test Setup:



Above 1GHz Test Setup:



4.7.3 Test Procedure					
	References Rule			Chapter	Description
☒	ANSI C63.10			11.12	Emissions in restricted frequency bands
	☒	ANSI C63.10		11.12.1	Radiated emission measurements
	☒	ANSI C63.10		11.12.2.7	Radiated spurious emission test
		☒	ANSI C63.10	6.4	Radiated emissions from unlicensed wireless devices below 30 MHz
		☒	ANSI C63.10	6.5	Radiated emissions from unlicensed wireless devices in the frequency range of 30 MHz to 1000 MHz
		☒	ANSI C63.10	6.6	Radiated emissions from unlicensed wireless devices above 1 GHz

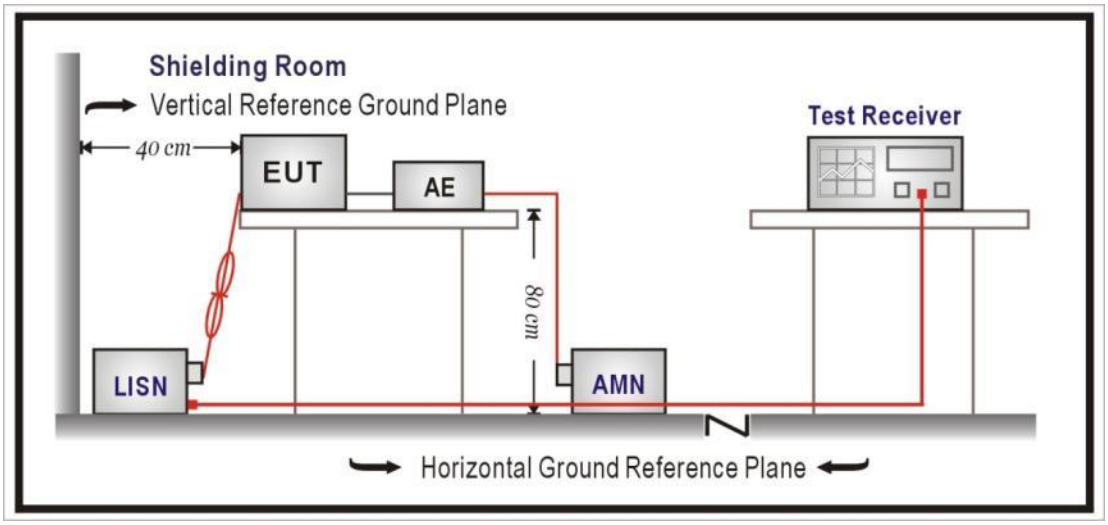
4.8 AC Power Line Conducted Emission	VERDICT: N/A

4.8.1 Limit

Standard	FCC Part 15 Subpart C Paragraph 15.207;	
Frequency range [MHz]	Limit: QP [dB(μV)[1)]]	Limit: AV [dB(μV) [1)]]
0,15 - 0,50	66 – 56 [2)]	56 - 46 [2)]
0,50 - 5,0	56	46
5,0 - 30	60	50

[1)] At the transition frequency, the lower limit applies.
[2)] The limit decreases linearly with the logarithm of the frequency.
NOTE 1: The exclusion band for transmitters shall be considered for transmitters operating at frequencies below 30 MHz.
NOTE 2: Where the AC output port is directly connected (or via a circuit breaker) to the AC power input port of the EUT the AC power output port need not to be tested.

4.8.2 Test Setup



4.9.3 Test Procedure

	References Rule	Chapter	Item
☒	ANSI C63.10-2013	6.2	Standard test method for ac power-line conducted emissions from unlicensed wireless devices

4.9 Antenna Requirement	VERDICT: PASS

4.9.1 Limit:	
Standard	FCC Part 15 Subpart C Paragraph 15.203;
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 shall be considered sufficient to comply with the provisions of this section. 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. This requirement does not apply to carrier current devices or to devices operated under the provisions of §15.211, §15.213, §15.217, §15.219, or §15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with §15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.	

4.10.2 Antenna Connector Construction:	
☒	The use of a permanently attached antenna
☐	The antenna use of a unique coupling to the intentional radiator
☐	The use of a nonstandard antenna jack or electrical connector
Please refer to the attached document “Internal Photograph” to show the antenna connector.	

5 TEST SETUP PHOTO AND EUT PHOTO

Remark: The test setup photo and EUT Photo please see appendix.

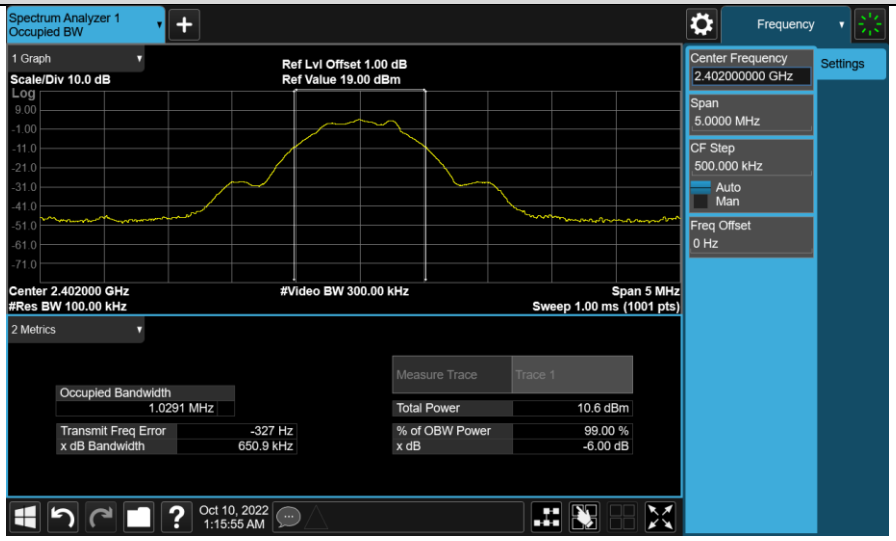
6 TEST RESULT

Appendix A: DTS Bandwidth
Test Result

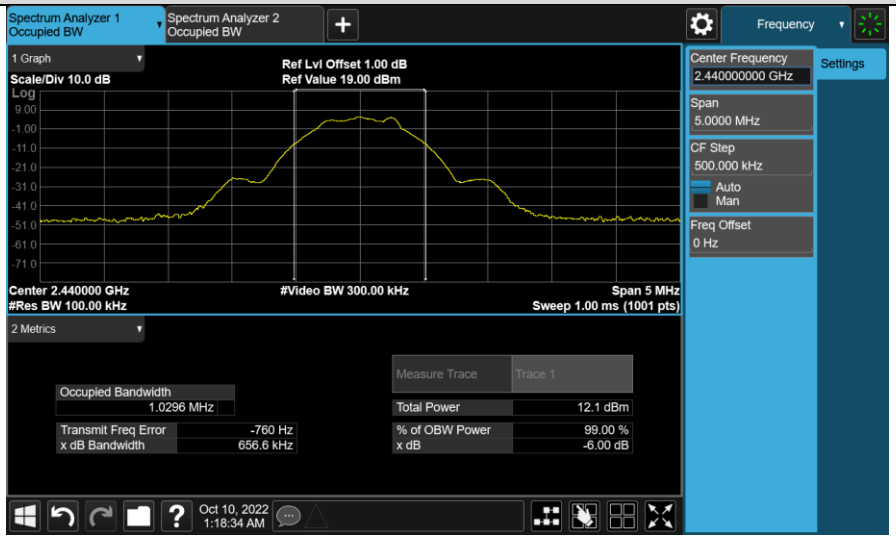
Mode	CH.	Test Freq. (MHz)	6dB Occupied Bandwidth (kHz)	Limit (kHz)	Result
1	00	2402	650.9	>500	Pass
	19	2440	656.6	>500	Pass
	39	2480	650.2	>500	Pass

Test Graphs

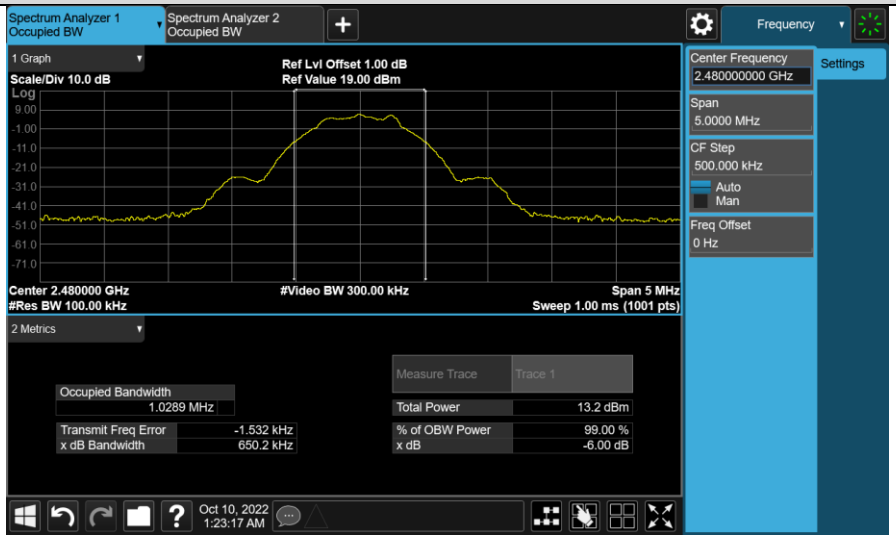
Mode 1 CH00 (2402MHz)



Mode 1 CH19 (2440MHz)



Mode 1 CH39 (2480MHz)



Appendix B: Maximum conducted output power
Test Result Peak

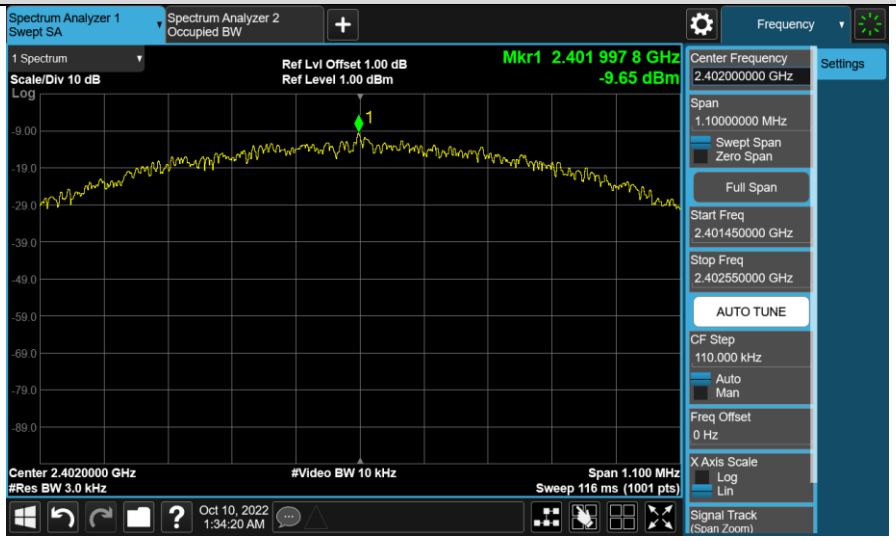
Mode	Channel	Test Frequency (MHz)	Conducted Power (dBm)	Conducted Power Limit (dBm)	Result
Mode 1	00	2402	7.46	≤30	Pass
	19	2440	8.63	≤30	Pass
	39	2480	9.89	≤30	Pass

Appendix C: Maximum power spectral density
Test Result

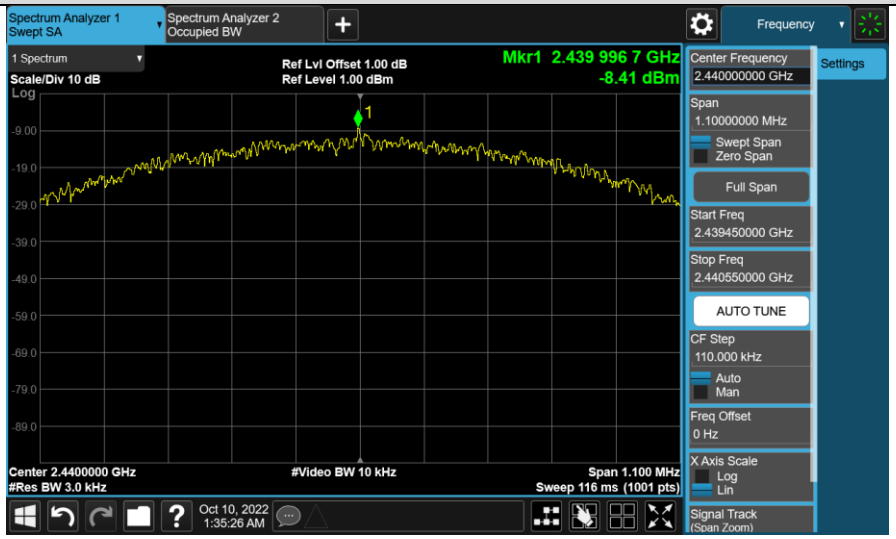
Mode	Channel	Test Frequency (MHz)	Measurement PSD (dBm/3kHz)	Limit (dBm/3kHz)	Result
Mode 1	00	2402	-9.65	≤8	Pass
	19	2440	-8.41	≤8	Pass
	39	2480	-6.78	≤8	Pass

Test Graphs

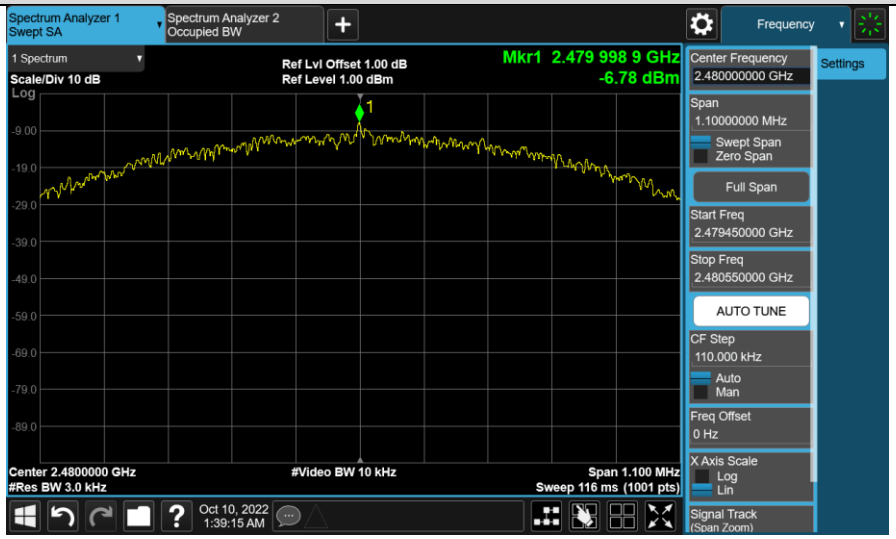
Mode 1 CH00 (2402MHz)



Mode 1 CH19 (2440MHz)

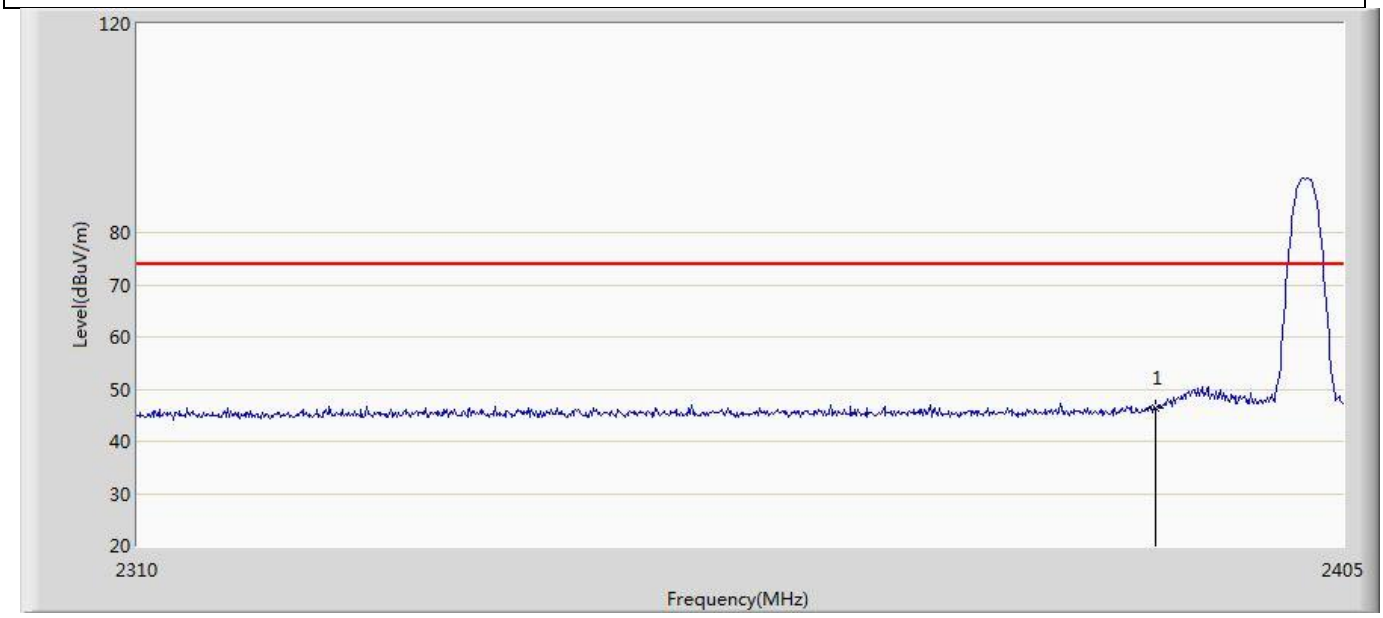


Mode 1 CH39 (2480MHz)



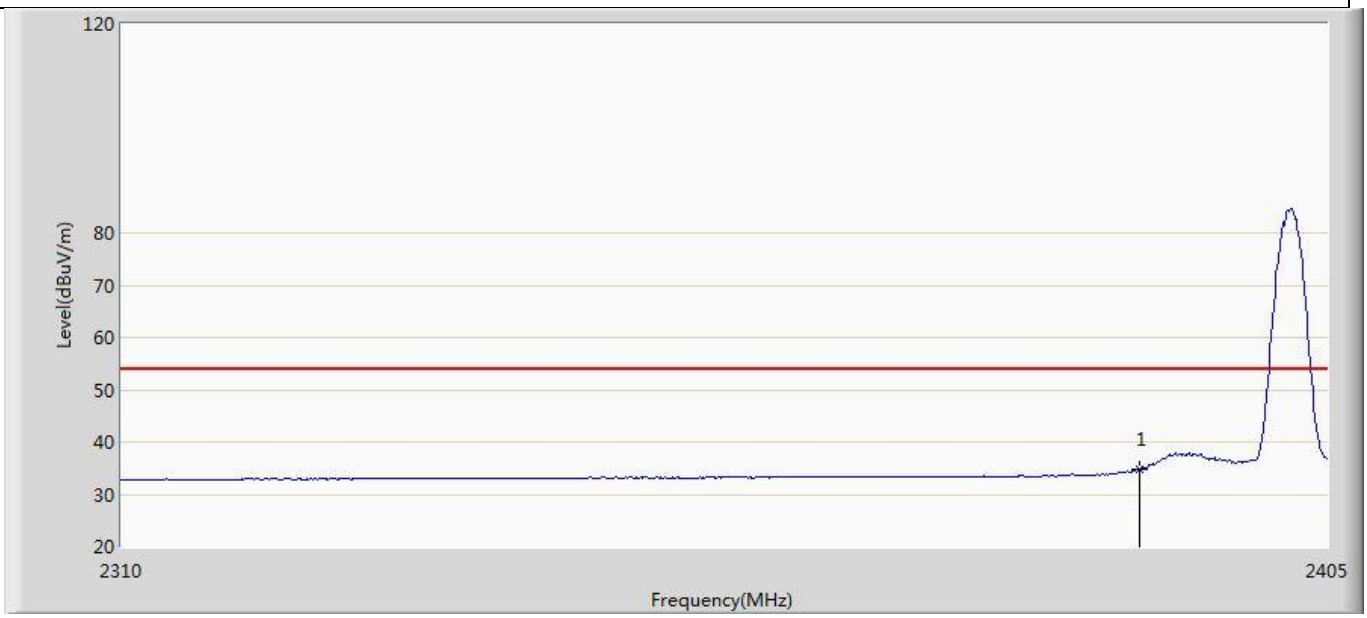
Appendix D: Band edge measurements
Test Result

Profile: 2290469R	Page No.: 7
Engineer: YuLiu	
Site: AC5	Time: 2022/11/15 - 19:38
Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: Horn_3117_00167055(1-18GHz)2022	Polarity: Horizontal
EUT: AFC-SW01	Power: DC 3.7V
Note: Mode 1:Transmit at 2402MHz by BLE_1Mbps	



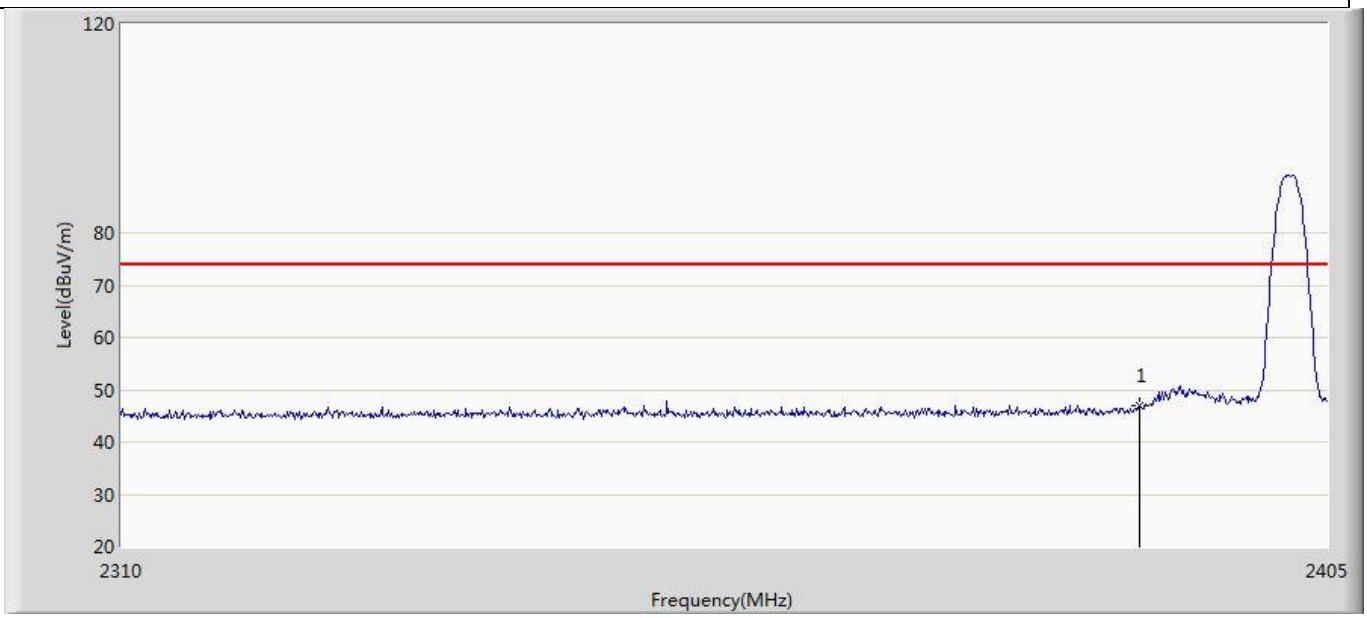
No	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1	*	2390.000	46.509	12.425	-27.491	74.000	34.084	PK

Profile: 2290469R	Page No.: 8
Engineer: YuLiu	
Site: AC5	Time: 2022/11/15 - 19:53
Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: Horn_3117_00167055(1-18GHz)2022	Polarity: Horizontal
EUT: AFC-SW01	Power: DC 3.7V
Note: Mode 1:Transmit at 2402MHz by BLE_1Mbps	



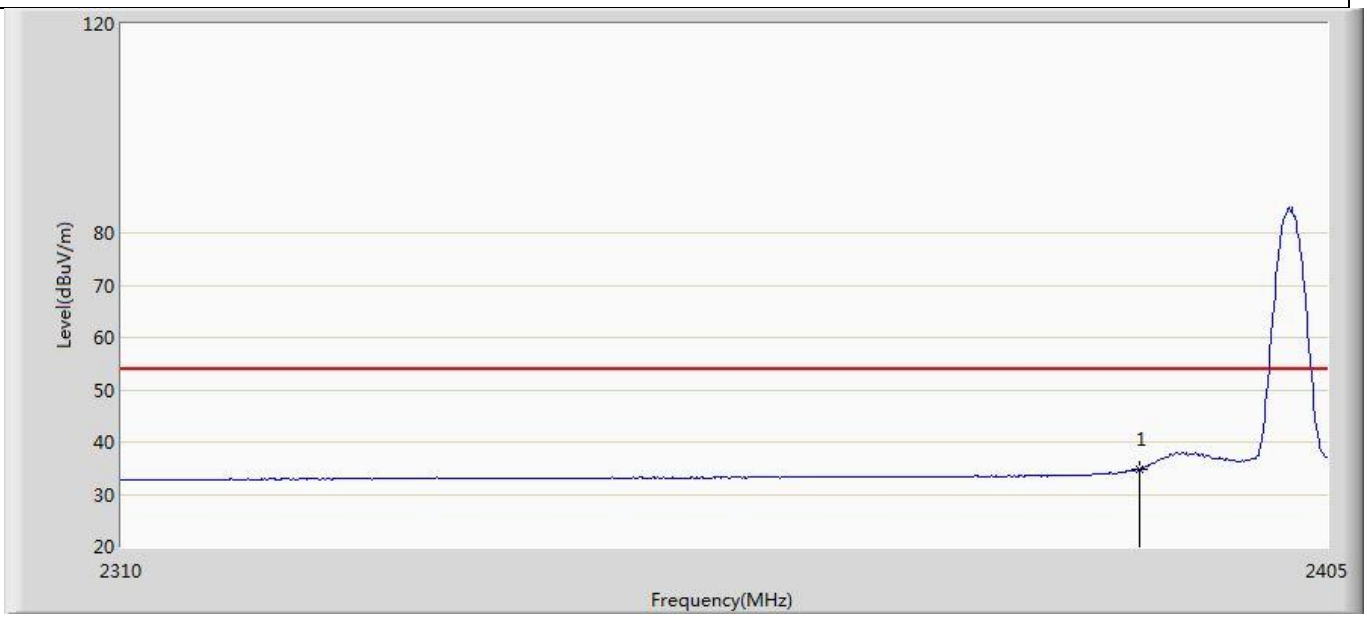
No	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1	*	2390.000	34.760	0.676	-19.240	54.000	34.084	AV

Profile: 2290469R	Page No.: 9
Engineer: YuLiu	
Site: AC5	Time: 2022/11/15 - 19:55
Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: Horn_3117_00167055(1-18GHz)2022	Polarity: Vertical
EUT: AFC-SW01	Power: DC 3.7V
Note: Mode 1:Transmit at 2402MHz by BLE_1Mbps	



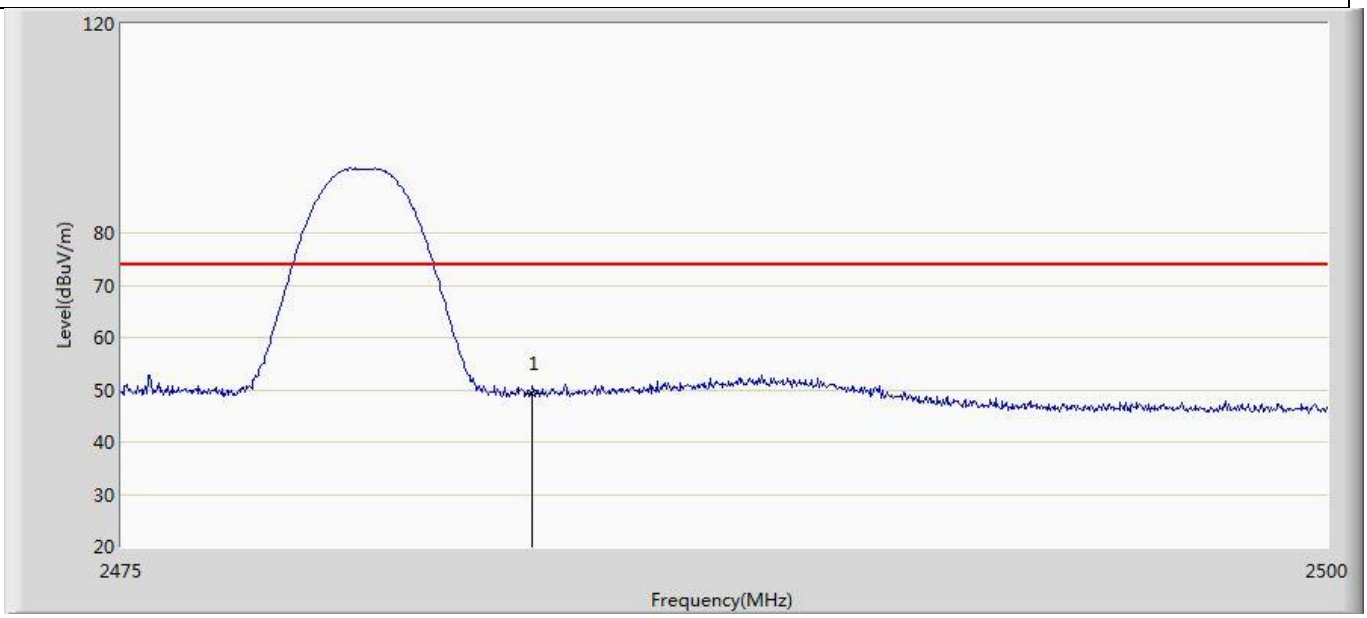
No	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1	*	2390.000	47.012	12.928	-26.988	74.000	34.084	PK

Profile: 2290469R	Page No.: 10
Engineer: YuLiu	
Site: AC5	Time: 2022/11/15 - 19:57
Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: Horn_3117_00167055(1-18GHz)2022	Polarity: Vertical
EUT: AFC-SW01	Power: DC 3.7V
Note: Mode 1:Transmit at 2402MHz by BLE_1Mbps	



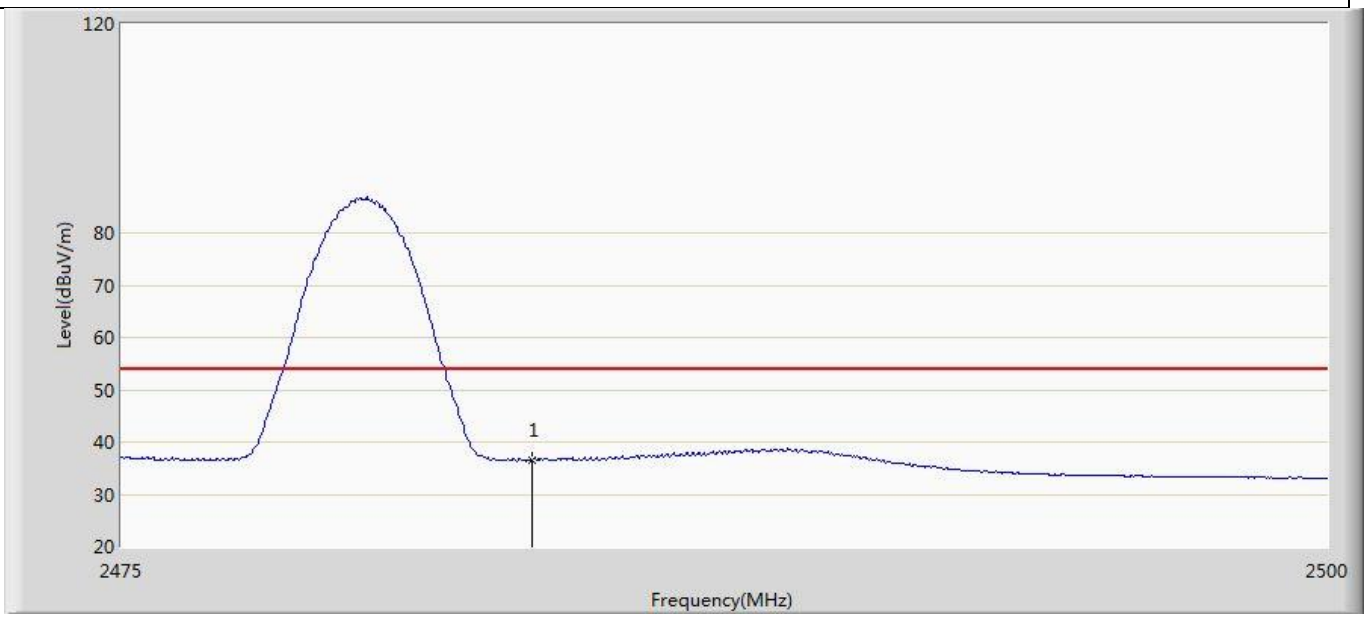
No	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1	*	2390.000	34.821	0.737	-19.179	54.000	34.084	AV

Profile: 2290469R	Page No.: 11
Engineer: YuLiu	
Site: AC5	Time: 2022/11/15 - 19:59
Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: Horn_3117_00167055(1-18GHz)2022	Polarity: Horizontal
EUT: AFC-SW01	Power: DC 3.7V
Note: Mode 1:Transmit at 2480MHz by BLE_1Mbps	



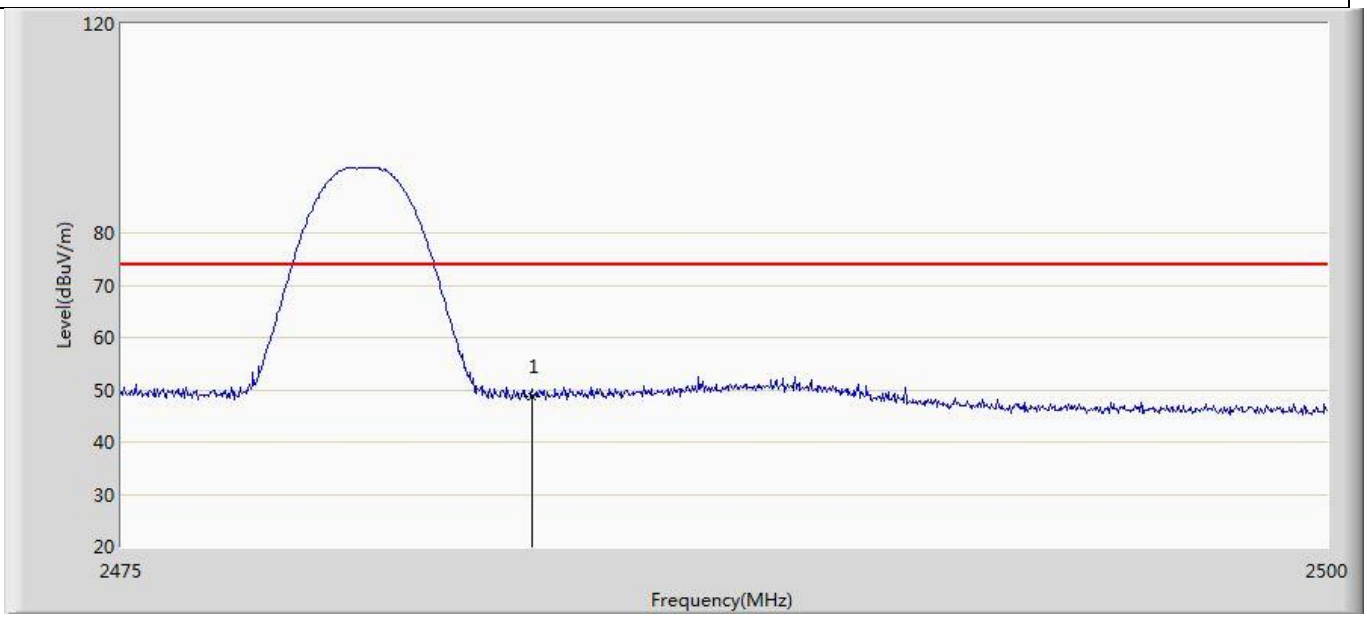
No	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1	*	2483.500	49.172	14.681	-24.828	74.000	34.491	PK

Profile: 2290469R	Page No.: 12
Engineer: YuLiu	
Site: AC5	Time: 2022/11/15 - 20:02
Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: Horn_3117_00167055(1-18GHz)2022	Polarity: Horizontal
EUT: AFC-SW01	Power: DC 3.7V
Note: Mode 1:Transmit at 2480MHz by BLE_1Mbps	



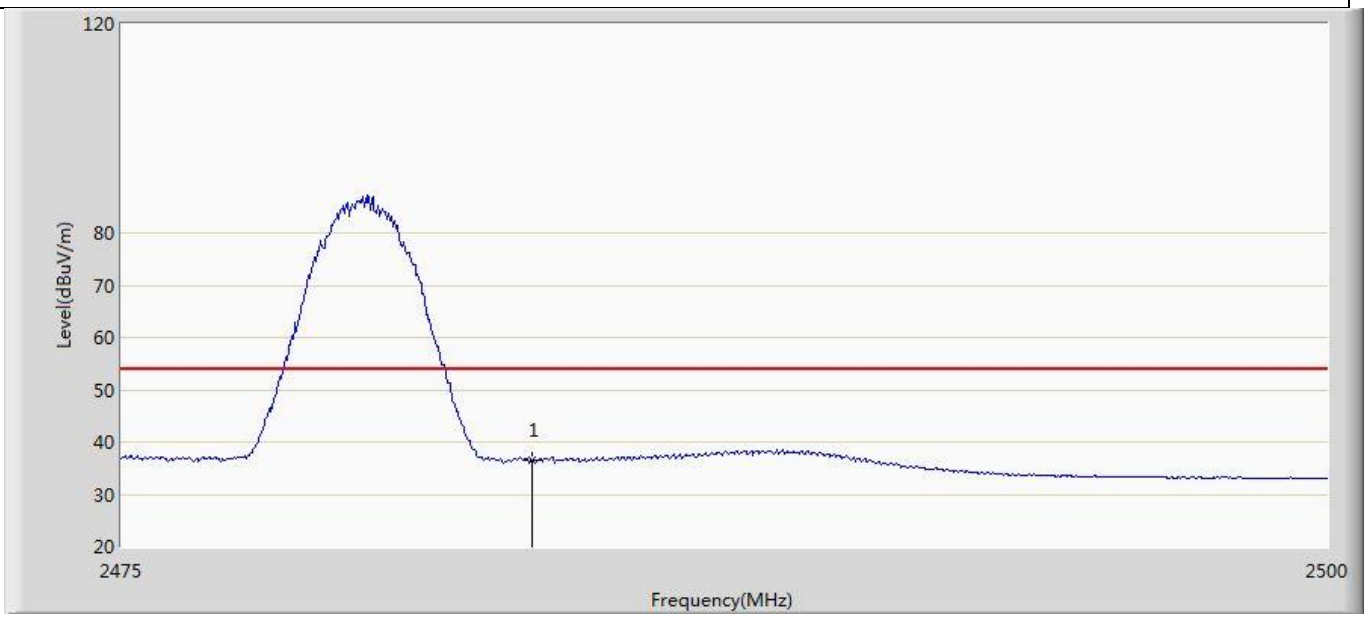
No	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1	*	2483.500	36.586	2.095	-17.414	54.000	34.491	AV

Profile: 2290469R	Page No.: 13
Engineer: YuLiu	
Site: AC5	Time: 2022/11/15 - 20:08
Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: Horn_3117_00167055(1-18GHz)2022	Polarity: Vertical
EUT: AFC-SW01	Power: DC 3.7V
Note: Mode 1:Transmit at 2480MHz by BLE_1Mbps	



No	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1	*	2483.500	48.837	14.346	-25.163	74.000	34.491	PK

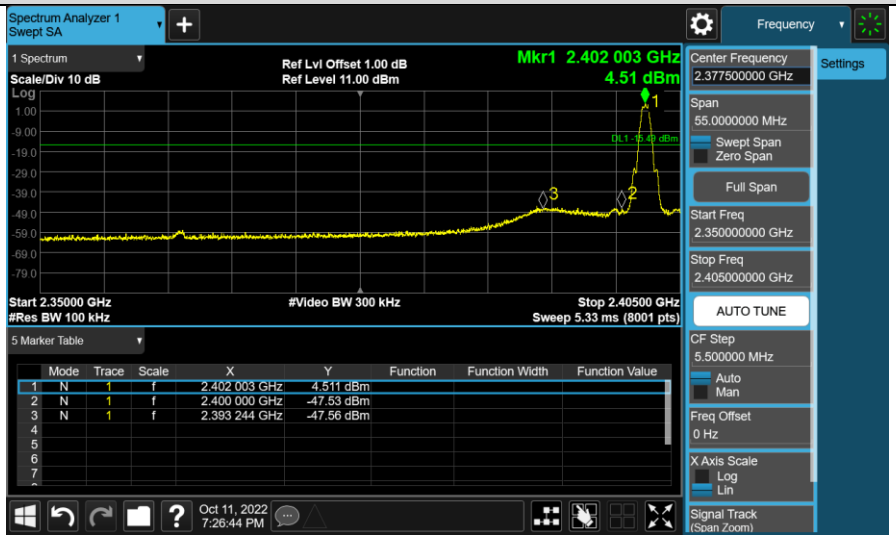
Profile: 2290469R	Page No.: 14
Engineer: YuLiu	
Site: AC5	Time: 2022/11/15 - 20:10
Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: Horn_3117_00167055(1-18GHz)2022	Polarity: Vertical
EUT: AFC-SW01	Power: DC 3.7V
Note: Mode 1:Transmit at 2480MHz by BLE_1Mbps	

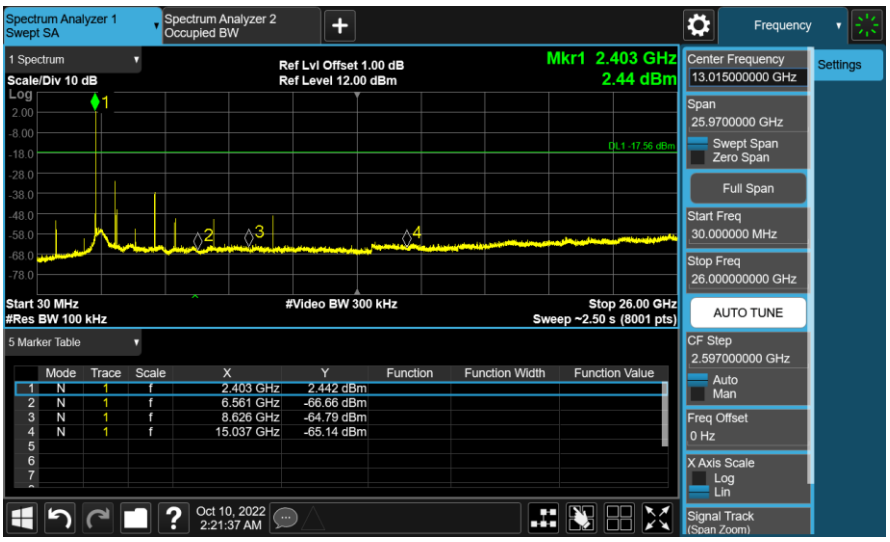


No	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1	*	2483.500	36.427	1.936	-17.573	54.000	34.491	AV

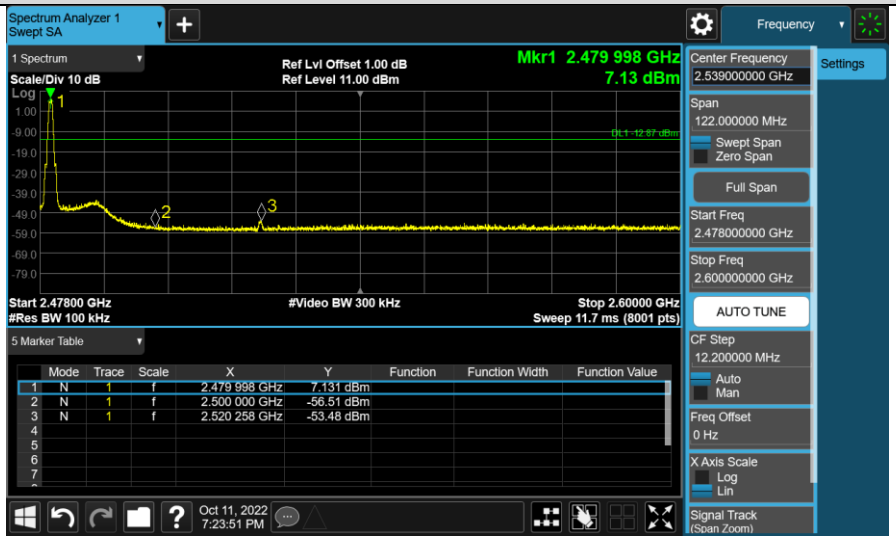
Appendix E: Conducted Spurious Emission Test Graphs

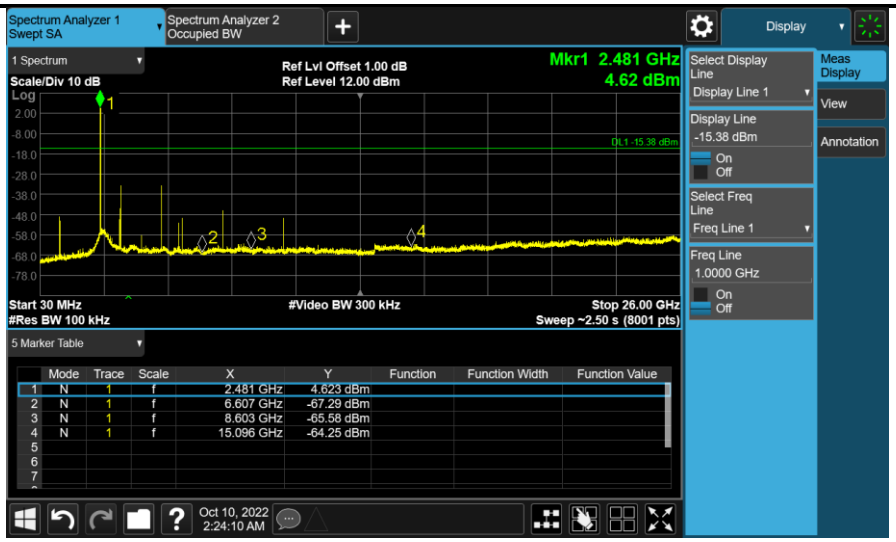
Mode 1 CH00 (2402MHz)





Mode 1 CH39 (2480MHz)




Spectrum Analyzer 1
Swept SA
Spectrum Analyzer 2
Occupied BW
Display
1 Spectrum
Scale/Div 10 dB
Ref Lvl Offset 1.00 dB
Ref Level 12.00 dBm
Mkr1 2.481 GHz
4.62 dBm
Log
2.00
-8.00
-18.0
-28.0
-38.0
-48.0
-58.0
-68.0
-78.0
DL1 -15.38 dBm
Start 30 MHz
#Res BW 100 kHz
#Video BW 300 kHz
Stop 26.00 GHz
Sweep ~2.50 s (8001 pts)
5 Marker Table
Mode Trace Scale X Y Function Function Width Function Value
1 N 1 f 2.481 GHz 4.623 dBm
2 N 1 f 6.607 GHz -67.29 dBm
3 N 1 f 8.603 GHz -65.58 dBm
4 N 1 f 15.096 GHz -64.25 dBm
5
6
7
Oct 10, 2022
2:24:10 AM
Select Display Line
Display Line 1
Display Line
-15.38 dBm
On
Off
Select Freq Line
Freq Line 1
Freq Line
1.0000 GHz
On
Off
Meas Display
View
Annotation

Appendix G: Duty Cycle
Test Result

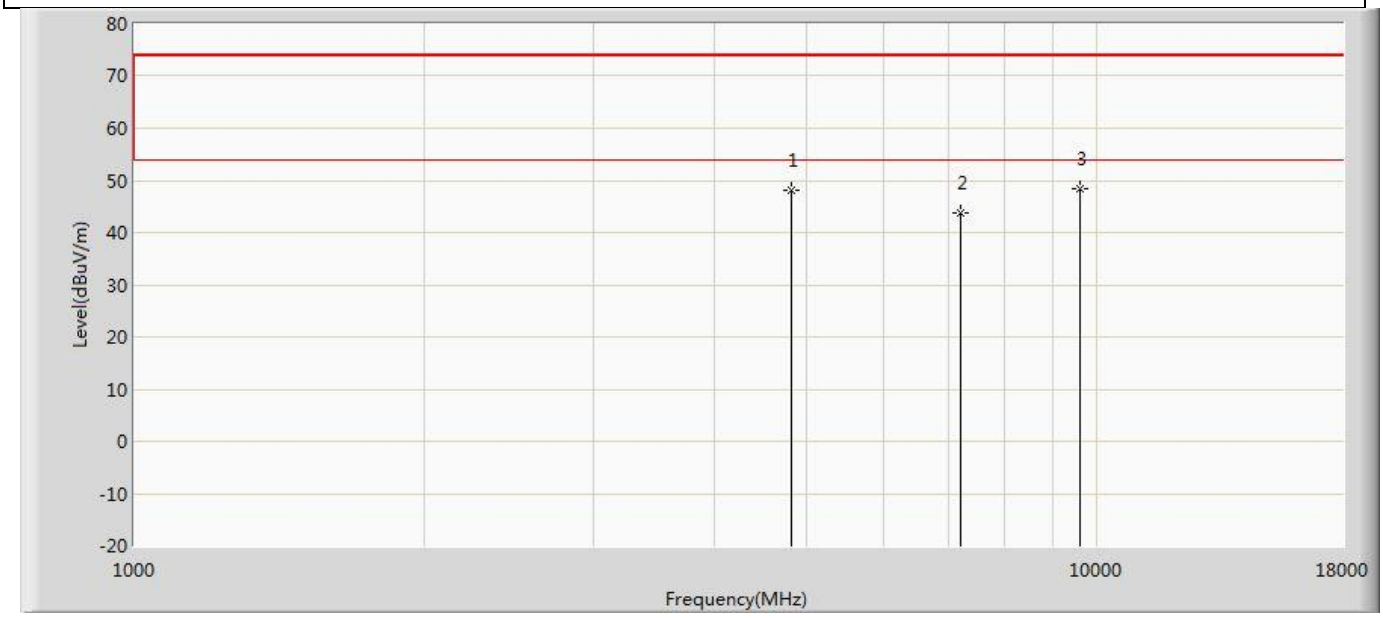
Test Mode	Tx On (ms)	Tx Off (ms)	Tx On + Tx Off (ms)	Duty Cycle (%)
Mode 1	9.54	1.08	10.62	89.83
Note : T means the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.				

Test Graphs

Mode 1 CH19 2440MHz

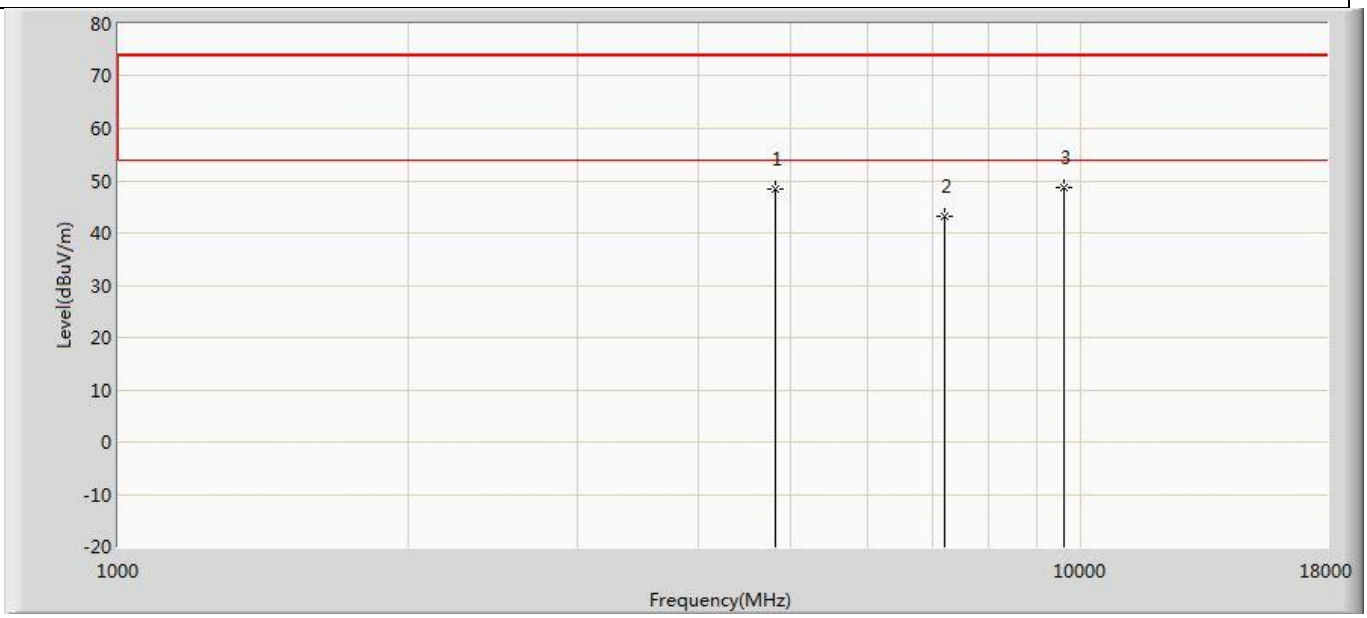
Appendix H: Emissions in Restricted Bands
Test Result

Profile: 2290469R	Page No.: 15
Engineer: YuLiu	
Site: AC5	Time: 2022/11/15 - 20:11
Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: Horn_3117_00167055(1-18GHz)2022	Polarity: Horizontal
EUT: AFC-SW01	Power: DC 3.7V
Note: Mode 1:Transmit at 2402MHz by BLE_1Mbps	



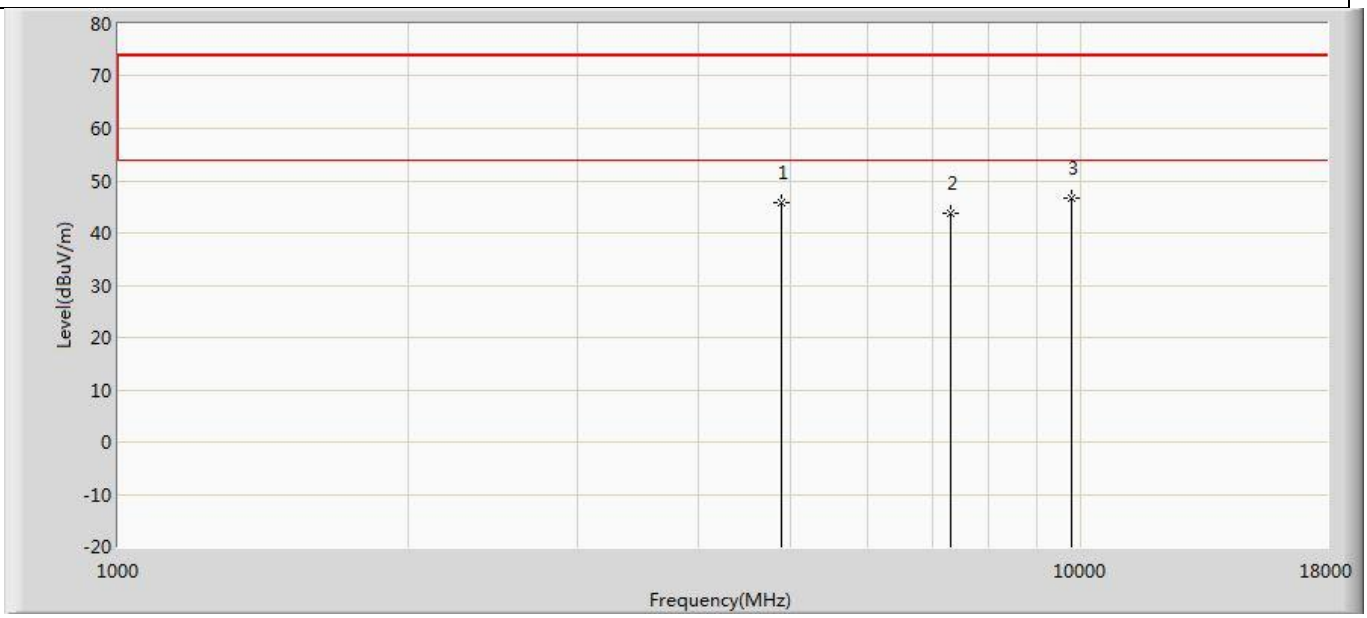
No	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1		4808.000	48.133	63.120	-25.867	74.000	-14.987	PK
2		7206.000	43.696	54.516	-30.304	74.000	-10.820	PK
3	*	9608.000	48.446	56.540	-25.554	74.000	-8.094	PK

Profile: 2290469R	Page No.: 16
Engineer: YuLiu	
Site: AC5	Time: 2022/11/15 - 20:11
Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: Horn_3117_00167055(1-18GHz)2022	Polarity: Vertical
EUT: AFC-SW01	Power: DC 3.7V
Note: Mode 1:Transmit at 2402MHz by BLE_1Mbps	



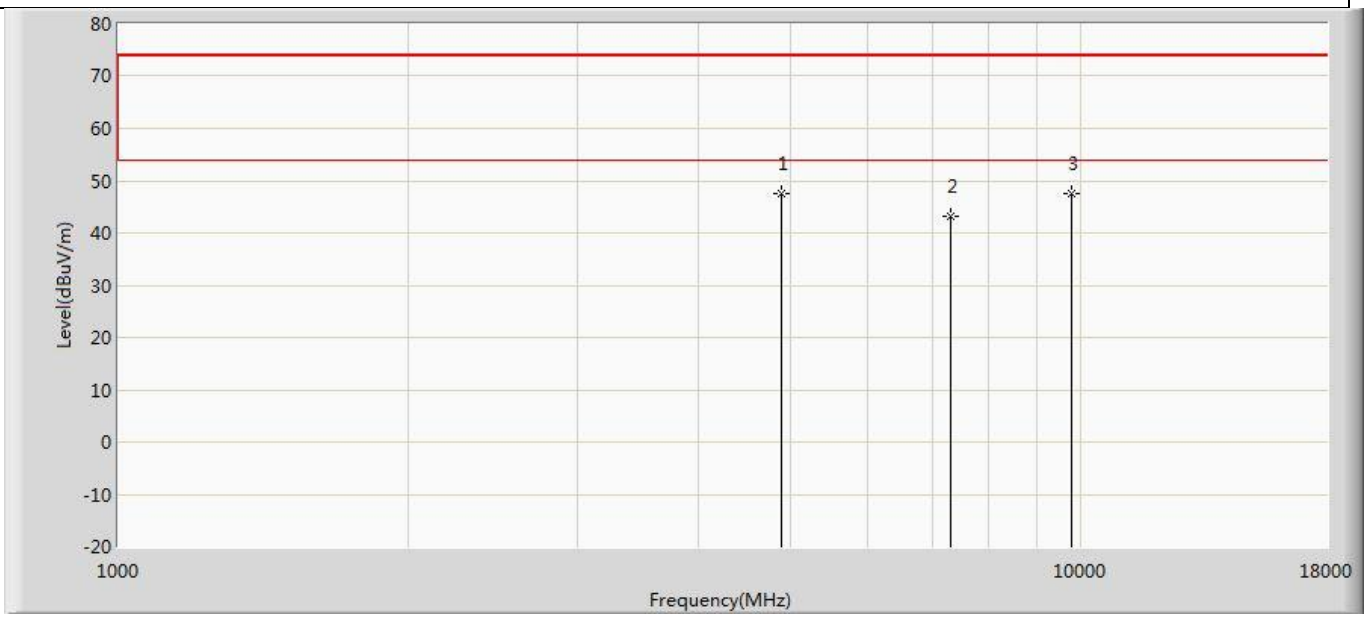
No	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1		4808.000	48.387	63.374	-25.613	74.000	-14.987	PK
2		7206.000	43.100	53.920	-30.900	74.000	-10.820	PK
3	*	9608.000	48.838	56.932	-25.162	74.000	-8.094	PK

Profile: 2290469R	Page No.: 17
Engineer: YuLiu	
Site: AC5	Time: 2022/11/15 - 20:12
Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: Horn_3117_00167055(1-18GHz)2022	Polarity: Horizontal
EUT: AFC-SW01	Power: DC 3.7V
Note: Mode 1:Transmit at 2440MHz by BLE_1Mbps	



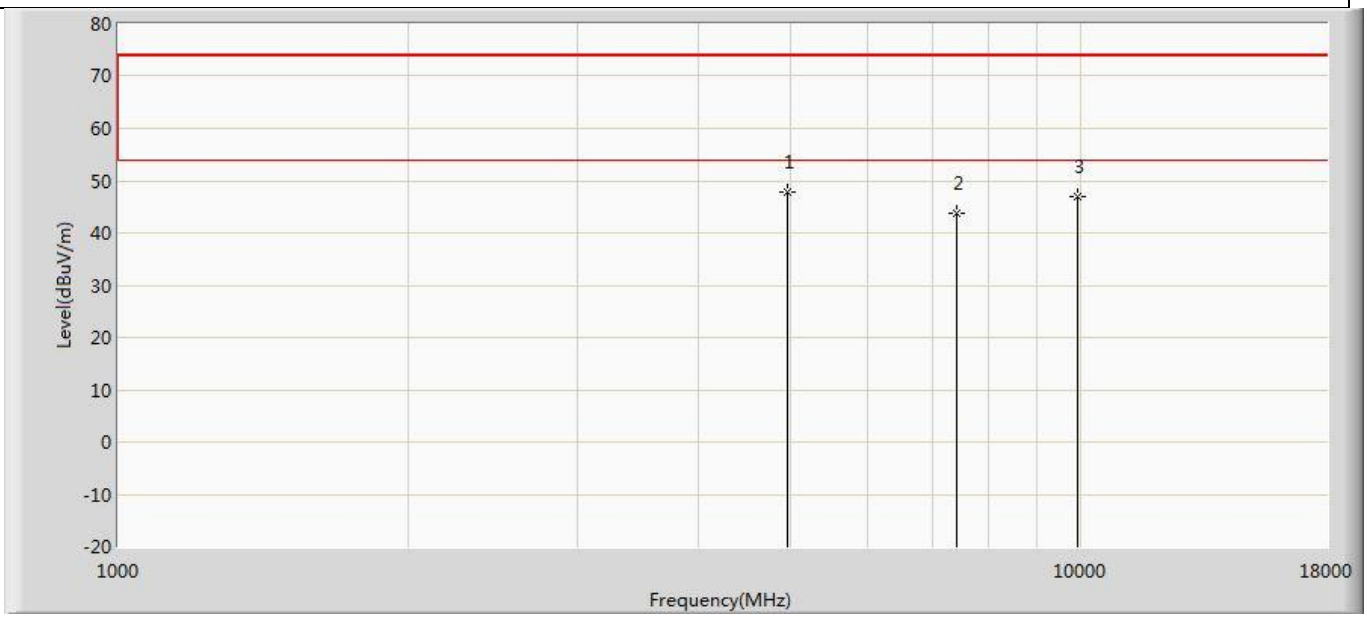
No	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1		4876.000	45.758	60.333	-28.242	74.000	-14.575	PK
2		7320.000	43.767	54.635	-30.233	74.000	-10.868	PK
3	*	9760.000	46.765	54.562	-27.235	74.000	-7.797	PK

Profile: 2290469R	Page No.: 18
Engineer: YuLiu	
Site: AC5	Time: 2022/11/15 - 20:12
Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: Horn_3117_00167055(1-18GHz)2022	Polarity: Vertical
EUT: AFC-SW01	Power: DC 3.7V
Note: Mode 1:Transmit at 2440MHz by BLE_1Mbps	



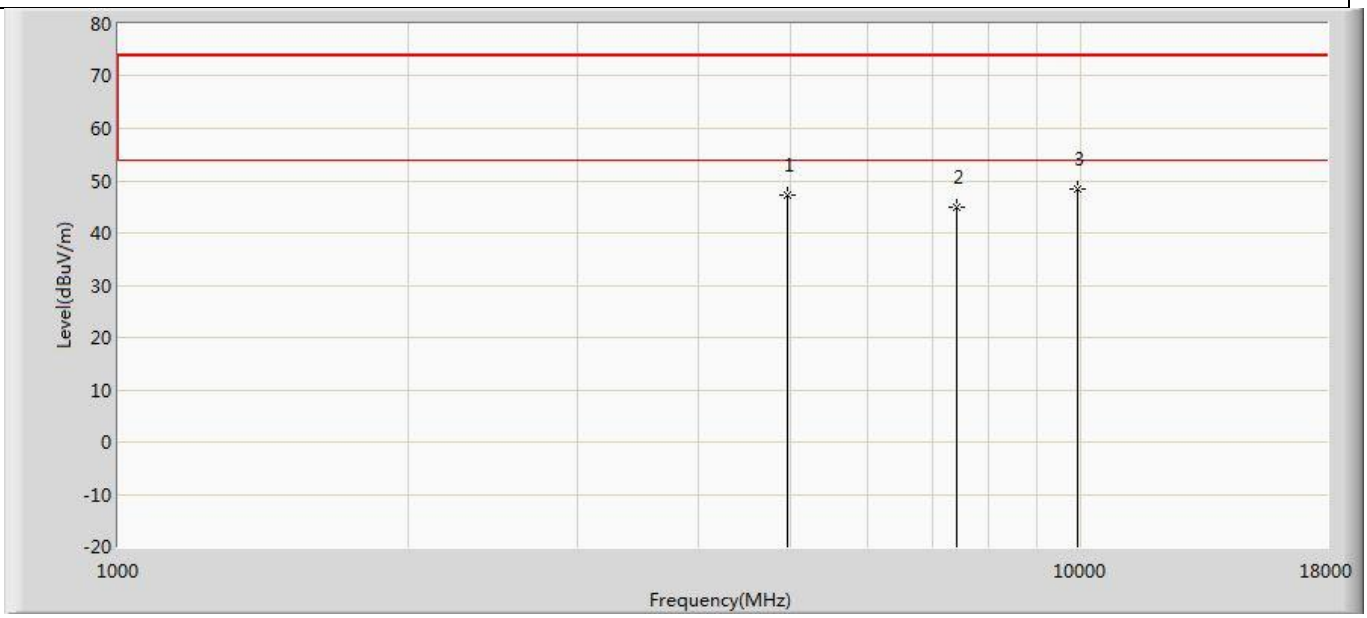
No	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1		4876.000	47.474	62.049	-26.526	74.000	-14.575	PK
2		7320.000	43.125	53.993	-30.875	74.000	-10.868	PK
3	*	9760.000	47.511	55.308	-26.489	74.000	-7.797	PK

Profile: 2290469R	Page No.: 19
Engineer: YuLiu	
Site: AC5	Time: 2022/11/15 - 20:12
Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: Horn_3117_00167055(1-18GHz)2022	Polarity: Horizontal
EUT: AFC-SW01	Power: DC 3.7V
Note: Mode 1:Transmit at 2480MHz by BLE_1Mbps	



No	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1	*	4961.000	47.890	62.449	-26.110	74.000	-14.560	PK
2		7440.000	43.899	54.630	-30.101	74.000	-10.731	PK
3		9920.000	46.883	54.460	-27.117	74.000	-7.578	PK

Profile: 2290469R	Page No.: 20
Engineer: YuLiu	
Site: AC5	Time: 2022/11/15 - 20:12
Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: Horn_3117_00167055(1-18GHz)2022	Polarity: Vertical
EUT: AFC-SW01	Power: DC 3.7V
Note: Mode 1:Transmit at 2480MHz by BLE_1Mbps	

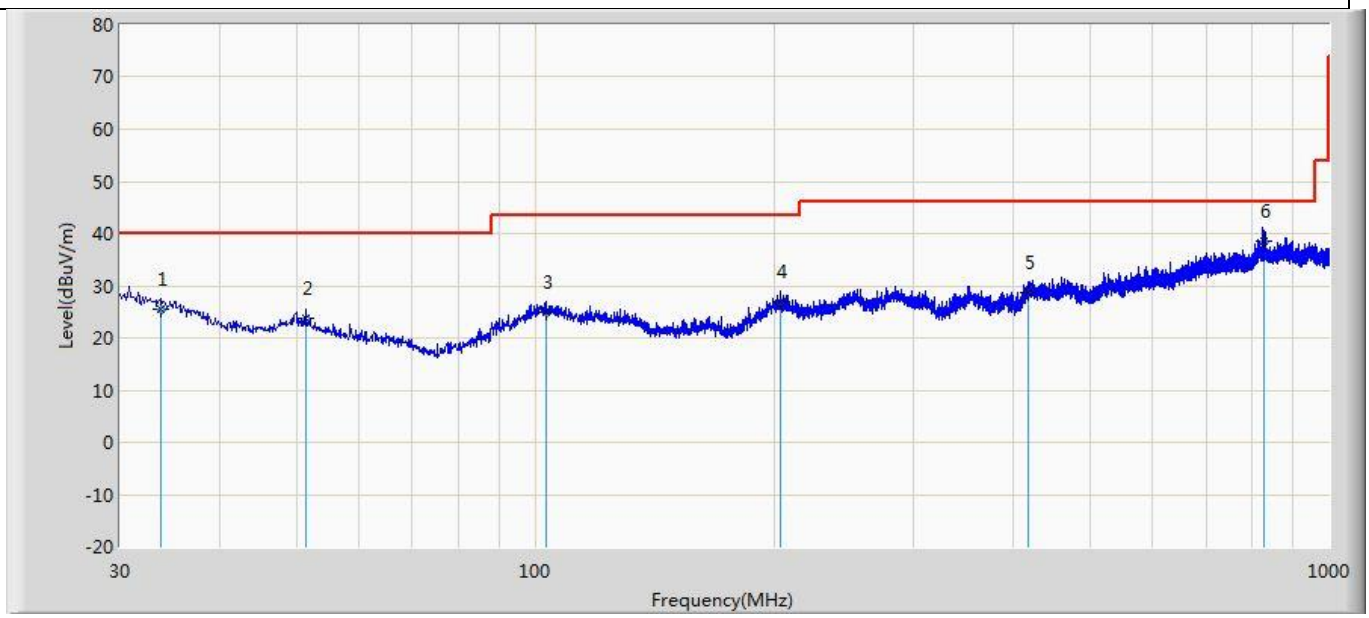


No	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1		4961.000	47.324	61.883	-26.676	74.000	-14.560	PK
2		7440.000	44.790	55.521	-29.210	74.000	-10.731	PK
3	*	9920.000	48.283	55.860	-25.717	74.000	-7.578	PK

Note:
1. Measured Level = Reading Level + Factor.
2. The test frequency range, 9kHz~30MHz, worst case are at least 20dB below the limits, therefore no data appear in the report.
3. The test frequency range, 18GHz~26GHz test result on peak is lower than average limit, all is the noise base, therefore no data appear in the report.
4. This limit applies for using average detector, if the test result on peak is lower than average limit, then average measurement needn't be performed.

The worst case of Radiated Emission below 1GHz:

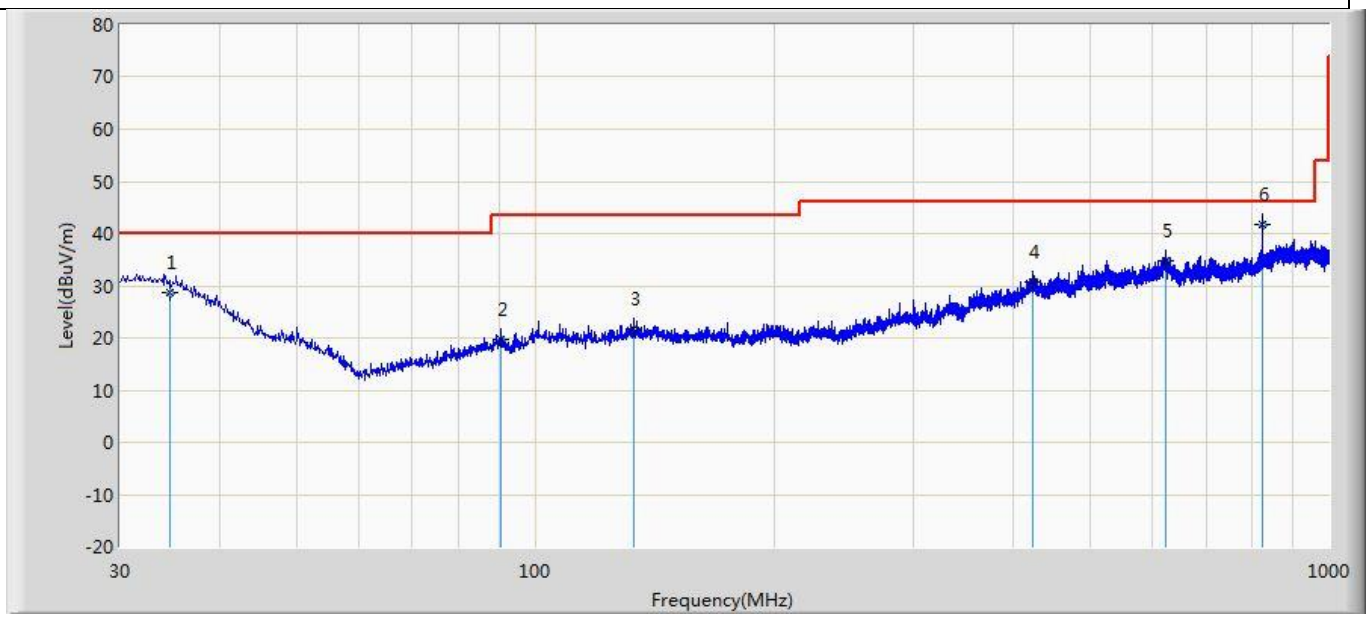
Profile: 2290469R	Page No.: 28
Engineer: Yuliu	
Site: AC3	Time: 2022/11/16 - 22:57
Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: AC3_3M(30-1000M)	Polarity: Vertical
EUT: AFC-SW01	Power: DC 3.7V
Note: Mode 1:Transmit at 2402MHz by BLE_1Mbps	



No	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1		33.759	25.425	2.500	-14.575	40.000	22.925	QP
2		51.340	23.643	4.614	-16.357	40.000	19.029	QP
3		103.356	24.818	2.621	-18.682	43.500	22.196	QP
4		203.387	26.901	3.421	-16.599	43.500	23.481	QP
5		418.728	28.835	2.203	-17.165	46.000	26.633	QP
6	*	830.008	38.689	5.933	-7.311	46.000	32.756	QP

1. " * ", means this data is the worst emission level.
2. Measurement Level = Reading Level + Factor(Probe+Cable-Amp)

Profile: 2290469R	Page No.: 29
Engineer: Yuliu	
Site: AC3	Time: 2022/11/16 - 23:01
Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: AC3_3M(30-1000M)	Polarity: Horizontal
EUT: AFC-SW01	Power: DC 3.7V
Note: Mode 1:Transmit at 2402MHz by BLE_1Mbps	

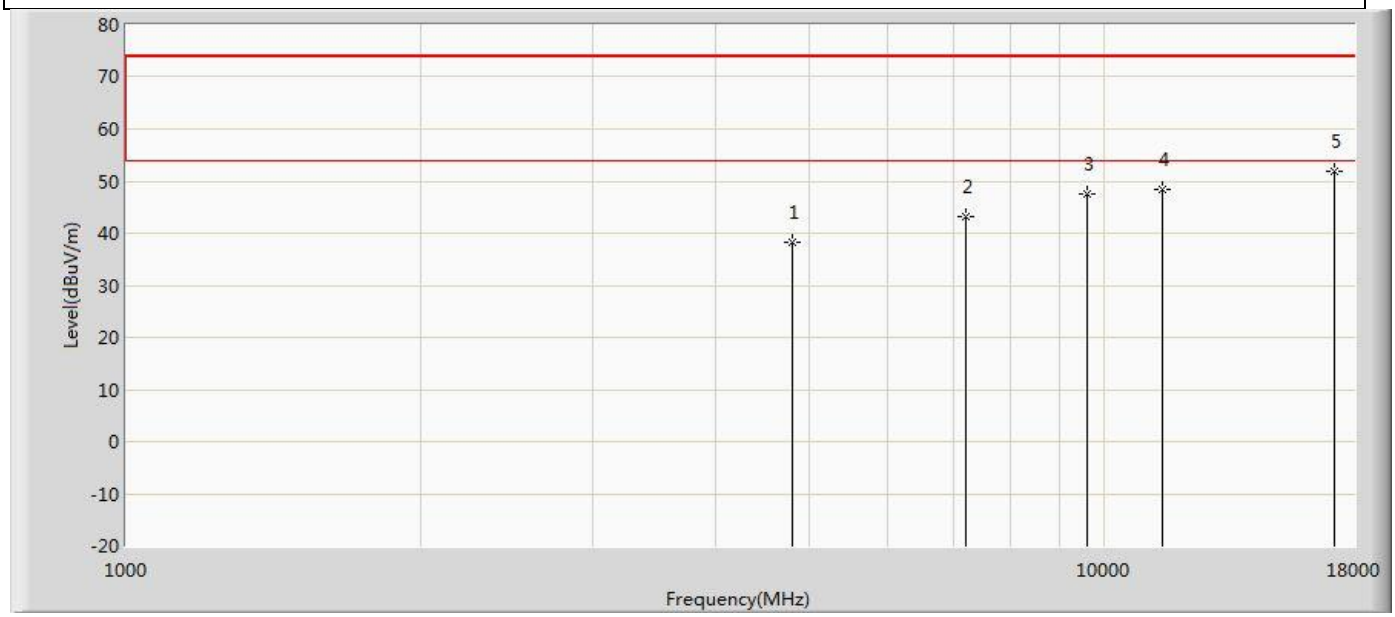


No	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1		34.729	28.792	1.745	-11.208	40.000	27.047	QP
2		90.504	19.633	5.977	-23.867	43.500	13.655	QP
3		133.184	21.633	3.924	-21.867	43.500	17.709	QP
4		424.305	30.689	3.390	-15.311	46.000	27.299	QP
5		624.246	34.799	4.122	-11.201	46.000	30.677	QP
6	*	825.885	41.678	10.029	-4.322	46.000	31.649	QP

1. " * ", means this data is the worst emission level.
2. Measurement Level = Reading Level + Factor(Probe+Cable-Amp)

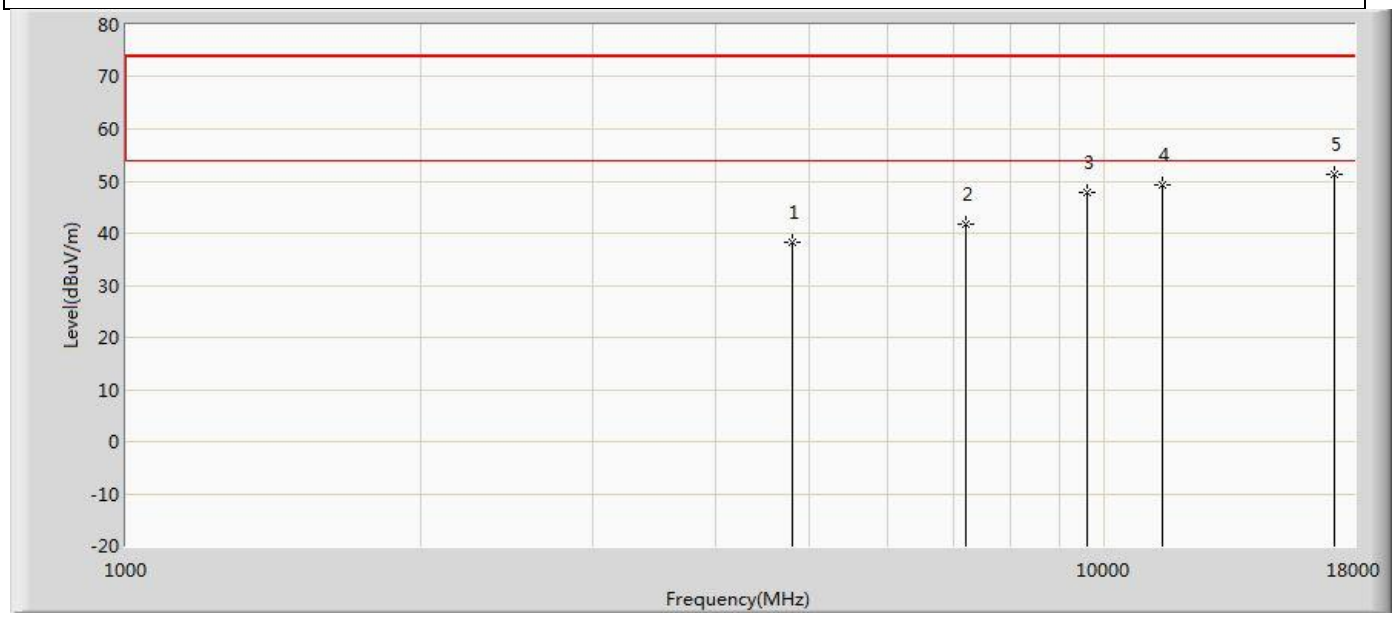
The worst case of Simultaneous Radiated Emission:

Profile: 2290469R	Page No.: 17
Engineer: Pengchengyang	
Site: AC5	Time: 2023/10/10 - 16:58
Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: Horn_3117_00167055(1-18GHz)	Polarity: Horizontal
EUT: AFC-SW01	Power: DC 3.7V
Note: Mode 1：Transmit at 2402MHz by LE_1Mbps & 5732MHz by SRD & 2402MHz by SRD	



No	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1		4804.000	38.141	52.233	-35.859	74.000	-14.092	PK
2		7206.000	43.277	51.546	-30.723	74.000	-8.269	PK
3		9608.000	47.471	50.952	-26.529	74.000	-3.481	PK
4		11464.000	48.395	49.443	-25.605	74.000	-1.049	PK
5	*	17196.000	51.789	49.003	-22.211	74.000	2.786	PK

Profile: 2290469R	Page No.: 18
Engineer: Pengchengyang	
Site: AC5	Time: 2023/10/10 - 16:58
Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: Horn_3117_00167055(1-18GHz)	Polarity: Vertical
EUT: AFC-SW01	Power: DC 3.7V
Note: Mode 1：Transmit at 2402MHz by LE_1Mbps & 5732MHz by SRD & 2402MHz by SRD	



No	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1		4804.000	38.298	52.390	-35.702	74.000	-14.092	PK
2		7206.000	41.859	50.128	-32.141	74.000	-8.269	PK
3		9608.000	47.723	51.204	-26.277	74.000	-3.481	PK
4		11464.000	49.328	50.376	-24.672	74.000	-1.049	PK
5	*	17196.000	51.206	48.420	-22.794	74.000	2.786	PK

The End