RF Test Report

For

Applicant Name:	**Shenzhen hualei Innovation Technology Co.,Ltd**
Address:	3F, Building 2, No. 33, Jixiang 2nd Road, Xiangyuan New Village, Pingxi, Pingdi Street, Longgang District, Shenzhen, China
EUT Name:	TWS Bluetooth earphone
Brand Name:	N/A
Model Number:	Y12
Series Model Number:	Refer to section 2

Issued By

Company Name:	**BTF Testing Lab (Shenzhen) Co., Ltd.**
Address:	F101, 201 and 301, Building 1, Block 2, Tantou Industrial Park, Tantou Community, Songgang Street, Bao'an District, Shenzhen, China
Report Number:	BTF230725R01201
Test Standards:	47 CFR Part 15.247
Test Conclusion:	Pass
FCC ID:	2BCA7-Y12
Test Date:	2023-07-25 to 2023-08-11
Date of Issue:	2023-08-15

Prepared By: Elma.Yang

elma.yang / Project Engineer

Date: 2023-08-15

Approved By: Ryan.CJ

Ryan.CJ / EMC Manager

Date: 2023-08-15

BTF Testing Lab (Shenzhen) Co., Ltd.

Note: All the test results in this report only related to the testing samples. Which can be duplicated completely for the legal use with approval of applicant; it shall not be reproduced except in full without the written approval of BTF Testing Lab (Shenzhen) Co., Ltd., All the objections should be raised within thirty days from the date of issue. To validate the report, you can contact us.

Revision History		
Version	Issue Date	Revisions Content
R_V0	2023-08-15	Original
Note: Once the revision has been made, then previous versions reports are invalid.		

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BTF Testing Lab (Shenzhen) Co., Ltd.
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1 Introduction

1.1 Identification of Testing Laboratory

Company Name:	BTF Testing Lab (Shenzhen) Co., Ltd.
Address:	F101, 201 and 301, Building 1, Block 2, Tantou Industrial Park, Tantou Community, Songgang Street, Bao'an District, Shenzhen, China
Phone Number:	+86-0755-23146130
Fax Number:	+86-0755-23146130

1.2 Identification of the Responsible Testing Location

Company Name:	BTF Testing Lab (Shenzhen) Co., Ltd.
Address:	F101, 201 and 301, Building 1, Block 2, Tantou Industrial Park, Tantou Community, Songgang Street, Bao'an District, Shenzhen, China
Phone Number:	+86-0755-23146130
Fax Number:	+86-0755-23146130
FCC Registration Number:	518915
Designation Number:	CN1330

1.3 Announcement

(1) The test report reference to the report template version v0.
(2) The test report is invalid if not marked with the signatures of the persons responsible for preparing, reviewing and approving the test report.
(3) The test report is invalid if there is any evidence and/or falsification.
(4) This document may not be altered or revised in any way unless done so by BTF and all revisions are duly noted in the revisions section.
(5) Content of the test report, in part or in full, cannot be used for publicity and/or promotional purposes without prior written approval from the laboratory.
(6) The laboratory is only responsible for the data released by the laboratory, except for the part provided by the applicant.

2 Product Information

2.1 Application Information

Company Name:	Shenzhen hualei Innovation Technology Co.,Ltd
Address:	3F, Building 2, No. 33, Jixiang 2nd Road, Xiangyuan New Village, Pingxi, Pingdi Street, Longgang District, Shenzhen, China

2.2 Manufacturer Information

Company Name:	Shenzhen hualei Innovation Technology Co.,Ltd
Address:	3F, Building 2, No. 33, Jixiang 2nd Road, Xiangyuan New Village, Pingxi, Pingdi Street, Longgang District, Shenzhen, China

2.3 Factory Information

Company Name:	Shenzhen hualei Innovation Technology Co.,Ltd
Address:	3F, Building 2, No. 33, Jixiang 2nd Road, Xiangyuan New Village, Pingxi, Pingdi Street, Longgang District, Shenzhen, China

2.4 General Description of Equipment under Test (EUT)

EUT Name:	TWS Bluetooth earphone
Test Model Number:	Y12
Series Model Number:	Y17, Y18, Y22
Description of Model name differentiation:	Only the model name is different, the others are the same.

2.5 Technical Information

Power Supply:	3.7V from Battery
Operation Frequency:	2402MHz to 2480MHz
Number of Channels:	79
Modulation Type:	GFSK, π/4 DQPSK, 8DPSK
Antenna Type:	ceramic antenna
Antenna Gain#:	3 dBi
Note: #: The antenna gain provided by the applicant, and the laboratory will not be responsible for the accumulated calculation results which covers the information provided by the applicant.	

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3 Summary of Test Results

3.1 Test Standards

The tests were performed according to following standards:
47 CFR Part 15.247: Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz

3.2 Uncertainty of Test

Item	Measurement Uncertainty
Conducted Emission (150 kHz-30 MHz)	±2.64dB
The following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.	

3.3 Summary of Test Result

Item	Standard	Requirement	Result
Antenna requirement	47 CFR Part 15.247	47 CFR 15.203	Pass
Conducted Emission at AC power line	47 CFR Part 15.247	47 CFR 15.207(a)	Pass
Occupied Bandwidth	47 CFR Part 15.247	47 CFR 15.215(c)	Pass
Maximum Conducted Output Power	47 CFR Part 15.247	47 CFR 15.247(b)(1)	Pass
Channel Separation	47 CFR Part 15.247	47 CFR 15.247(a)(1)	Pass
Number of Hopping Frequencies	47 CFR Part 15.247	47 CFR 15.247(a)(1)(iii)	Pass
Dwell Time	47 CFR Part 15.247	47 CFR 15.247(a)(1)(iii)	Pass
Emissions in non-restricted frequency bands	47 CFR Part 15.247	47 CFR 15.247(d)	Pass
Band edge emissions (Radiated)	47 CFR Part 15.247	47 CFR 15.247(d)	Pass
Emissions in restricted frequency bands (below 1GHz)	47 CFR Part 15.247	47 CFR 15.247(d)	Pass
Emissions in restricted frequency bands (above 1GHz)	47 CFR Part 15.247	47 CFR 15.247(d)	Pass

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4 Test Configuration

4.1 Test Equipment List

Conducted Emission at AC power line					
Equipment	**Manufacturer**	**Model No**	**Inventory No**	**Cal Date**	**Cal Due Date**
Pulse Limiter	SCHWARZBECK	VTSD 9561-F	00953	2022-11-24	2023-11-23
Coaxial Switcher	SCHWARZBECK	CX210	CX210	2022-11-24	2023-11-23
V-LISN	SCHWARZBECK	NSLK 8127	01073	2022-11-24	2023-11-23
LISN	AFJ	LS16/110VAC	16010020076	2023-02-23	2024-02-22
EMI Receiver	ROHDE&SCHWARZ	ESCI3	101422	2022-11-24	2023-11-23

Occupied Bandwidth **Maximum Conducted Output Power** **Channel Separation** **Number of Hopping Frequencies** **Dwell Time** **Emissions in non-restricted frequency bands**					
Equipment	**Manufacturer**	**Model No**	**Inventory No**	**Cal Date**	**Cal Due Date**
RFTest software	/	V1.00	/	/	/
RF Control Unit	Techy	TR1029-1	/	2022-11-24	2023-11-23
RF Sensor Unit	Techy	TR1029-2	/	2022-11-24	2023-11-23
Programmable constant temperature and humidity box	ZZCKONG	ZZ-K02A	20210928007	2022-11-24	2023-11-23
Adjustable Direct Current Regulated Power Supply	Dongguan Tongmen Electronic Technology Co., LTD	etm-6050c	20211026123	2022-11-24	2023-11-23
WIDEBAND RADIO COMMNUNICATION TESTER	Rohde & Schwarz	CMW500	161997	2022-11-24	2023-11-23
MXA Signal Analyzer	KEYSIGHT	N9020A	MY50410020	2022-11-24	2023-11-23

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Emissions in restricted frequency bands (above 1GHz) Band edge emissions (Radiated) Emissions in restricted frequency bands (below 1GHz)					
Equipment	**Manufacturer**	**Model No**	**Inventory No**	**Cal Date**	**Cal Due Date**
Coaxial cable Multiflex 141	Schwarzbeck	N/SMA 0.5m	517386	2023-03-24	2024-03-23
Preamplifier	SCHWARZBECK	BBV9744	00246	2022-11-24	2023-11-23
RE Cable	REBES Talent	UF1-SMASMAM-10m	21101566	2022-11-24	2023-11-23
RE Cable	REBES Talent	UF2-NMNM-10m	21101570	2022-11-24	2023-11-23
RE Cable	REBES Talent	UF1-SMASMAM-1m	21101568	2022-11-24	2023-11-23
RE Cable	REBES Talent	UF2-NMNM-1m	21101576	2022-11-24	2023-11-23
RE Cable	REBES Talent	UF2-NMNM-2.5m	21101573	2022-11-24	2023-11-23
POSITIONAL CONTROLLER	SKET	PCI-GPIB	/	/	/
Horn Antenna	SCHWARZBECK	BBHA9170	01157	2021-11-28	2023-11-27
EMI TEST RECEIVER	ROHDE&SCHWARZ	ESCI7	101032	2022-11-24	2023-11-23
SIGNAL ANALYZER	ROHDE&SCHWARZ	FSQ40	100010	2022-11-24	2023-11-23
POSITIONAL CONTROLLER	SKET	PCI-GPIB	/	/	/
Broadband Preamplilifier	SCHWARZBECK	BBV9718D	00008	2023-03-24	2024-03-23
Horn Antenna	SCHWARZBECK	BBHA9120D	2597	2022-05-22	2024-05-21
EZ_EMC	Frad	FA-03A2 RE+	/	/	/
POSITIONAL CONTROLLER	SKET	PCI-GPIB	/	/	/
Log periodic antenna	SCHWARZBECK	VULB 9168	01328	2021-11-28	2023-11-27

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4.2 Test Auxiliary Equipment

The EUT was tested as an independent device.

4.3 Test Modes

No.	Test Modes	Description
TM1	TX-GFSK (Non-Hopping)	Keep the EUT in continuously transmitting mode (non-hopping) with GFSK modulation.
TM2	TX-Pi/4DQPSK (Non-Hopping)	Keep the EUT in continuously transmitting mode (non-hopping) with Pi/4DQPSK modulation.
TM3	TX-8DPSK (Non-Hopping)	Keep the EUT in continuously transmitting mode (non-hopping) with 8DPSK modulation.
TM4	TX-GFSK (Hopping)	Keep the EUT in continuously transmitting mode (hopping) with GFSK modulation,.
TM5	TX-Pi/4DQPSK (Hopping)	Keep the EUT in continuously transmitting mode (hopping) with Pi/4DQPSK modulation.
TM6	TX-8DPSK (Hopping)	Keep the EUT in continuously transmitting mode (hopping) with 8DPSK modulation.

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5 Evaluation Results (Evaluation)

5.1 Antenna requirement

Test 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 shall be considered sufficient to comply with the provisions of this section.

6 Radio Spectrum Matter Test Results (RF)

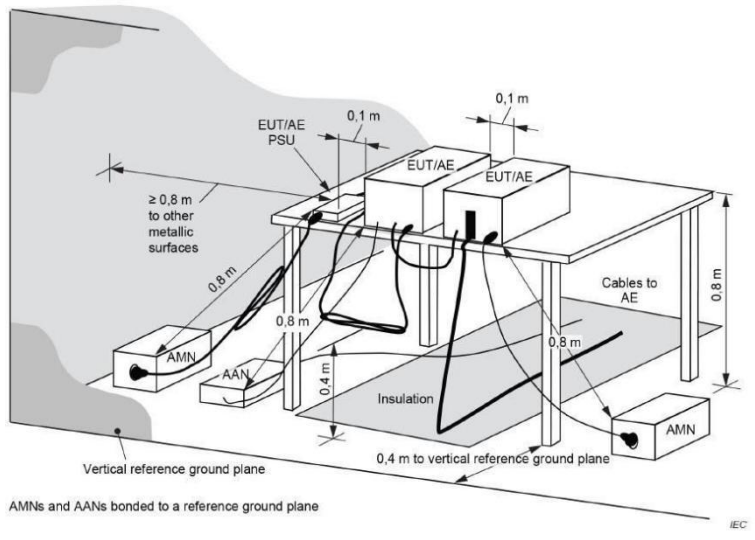
6.1 Conducted Emission at AC power line

Test Requirement:	Refer to 47 CFR 15.207(a), Except as shown in paragraphs (b)and (c)of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μH/50 ohms line impedance stabilization network (LISN).
Test Method:	ANSI C63.10-2020 section 6.2
Test Limit:	Frequency of emission (MHz) / Conducted limit (dBμV): Quasi-peak / Average 0.15-0.5: 66 to 56* / 56 to 46* 0.5-5: 56 / 46 5-30: 60 / 50 *Decreases with the logarithm of the frequency.
Procedure:	Refer to ANSI C63.10-2020 section 6.2, standard test method for ac power-line conducted emissions from unlicensed wireless devices

6.1.1 E.U.T. Operation:

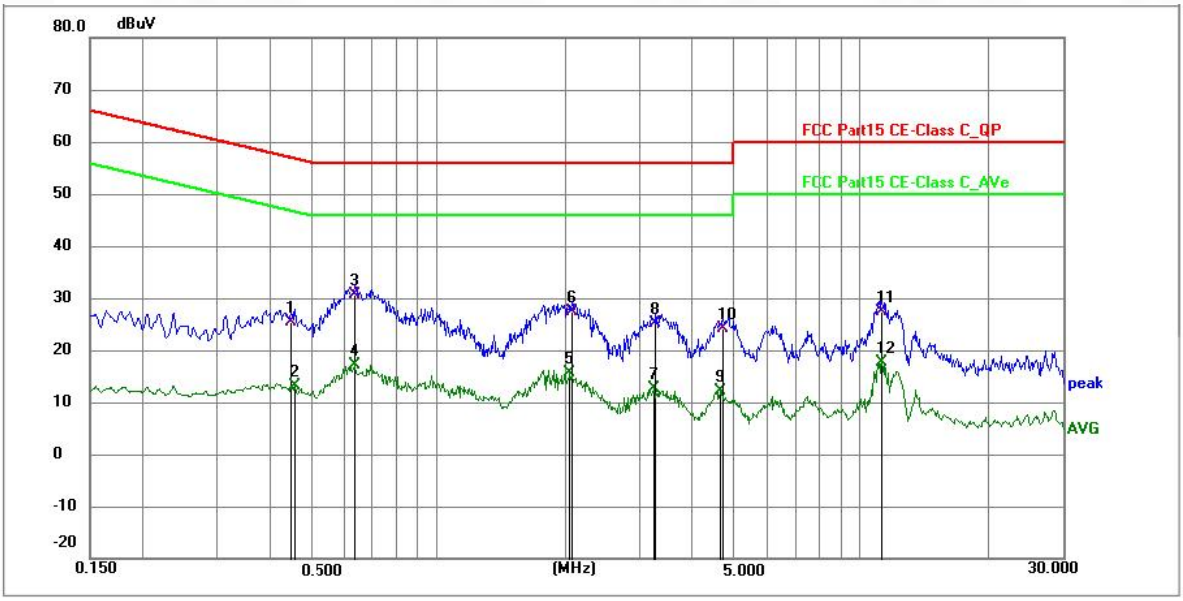
Operating Environment:	
Temperature:	23 °C
Humidity:	47.9 %
Atmospheric Pressure:	1010 mbar

6.1.2 Test Setup Diagram:



6.1.3 Test Data:

TM1 / Line: Line / Band: 2.4G / BW: 1 / CH: M



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	P/F	Remark
1	0.4470	14.69	10.61	25.30	56.93	-31.63	QP	P	
2	0.4560	2.50	10.61	13.11	46.77	-33.66	AVG	P	
3 *	0.6360	19.91	10.69	30.60	56.00	-25.40	QP	P	
4	0.6360	6.56	10.69	17.25	46.00	-28.75	AVG	P	
5	2.0445	4.85	10.69	15.54	46.00	-30.46	AVG	P	
6	2.0714	16.71	10.69	27.40	56.00	-28.60	QP	P	
7	3.2370	1.89	10.71	12.60	46.00	-33.40	AVG	P	
8	3.2640	14.38	10.72	25.10	56.00	-30.90	QP	P	
9	4.6455	1.33	10.79	12.12	46.00	-33.88	AVG	P	
10	4.7130	13.41	10.79	24.20	56.00	-31.80	QP	P	
11	11.2470	16.46	10.94	27.40	60.00	-32.60	QP	P	
12	11.2470	6.74	10.94	17.68	50.00	-32.32	AVG	P	

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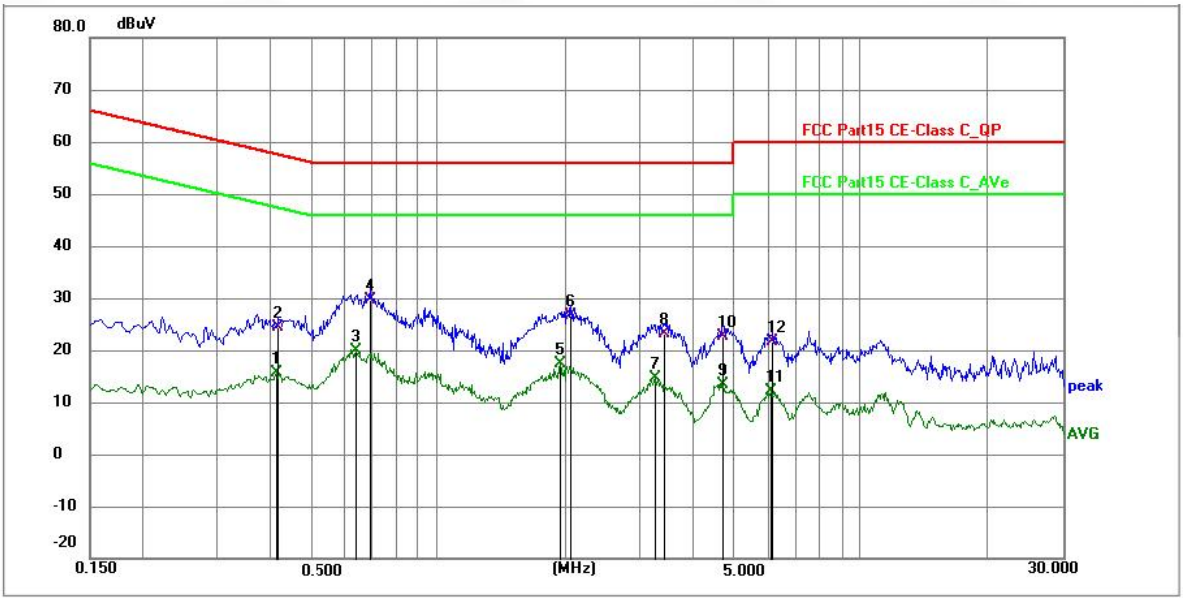
TM1 / Line: Neutral / Band: 2.4G / BW: 1 / CH: M



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	P/F	Remark
1	0.4110	4.91	10.60	15.51	47.63	-32.12	AVG	P	
2	0.4154	13.70	10.60	24.30	57.54	-33.24	QP	P	
3 *	0.6404	9.14	10.69	19.83	46.00	-26.17	AVG	P	
4	0.6900	18.98	10.72	29.70	56.00	-26.30	QP	P	
5	1.9455	6.60	10.69	17.29	46.00	-28.71	AVG	P	
6	2.0625	15.91	10.69	26.60	56.00	-29.40	QP	P	
7	3.2550	3.83	10.72	14.55	46.00	-31.45	AVG	P	
8	3.4304	12.38	10.72	23.10	56.00	-32.90	QP	P	
9	4.6994	2.69	10.79	13.48	46.00	-32.52	AVG	P	
10	4.7399	11.90	10.80	22.70	56.00	-33.30	QP	P	
11	6.1170	1.23	10.78	12.01	50.00	-37.99	AVG	P	
12	6.1574	10.83	10.77	21.60	60.00	-38.40	QP	P	

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6.2 Occupied Bandwidth

Test Requirement:	47 CFR 15.215(c)
Test Method:	ANSI C63.10-2020, section 7.8.6, For occupied bandwidth measurements, use the procedure in 6.9.3. Frequency hopping shall be disabled for this test. KDB 558074 D01 15.247 Meas Guidance v05r02
Test Limit:	Refer to 47 CFR 15.215(c), intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§ 15.217 through 15.257 and in subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.
Procedure:	The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission. The following procedure shall be used for measuring 99% power bandwidth: a) The instrument center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be between 1.5 times and 5.0 times the OBW. b) The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW, and VBW shall be at least three times the RBW, unless otherwise specified by the applicable requirement. c) Set the reference level of the instrument as required, keeping the signal from exceeding the maximum input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than [10 log (OBW/RBW)] below the reference level. Specific guidance is given in 4.1.6.2. d) Step a) through step c) might require iteration to adjust within the specified range. e) Video averaging is not permitted. Where practical, a sample detection and single sweep mode shall be used. Otherwise, peak detection and max-hold mode (until the trace stabilizes) shall be used. f) Use the 99% power bandwidth function of the instrument (if available) and report the measured bandwidth. g) If the instrument does not have a 99% power bandwidth function, then the trace data points are recovered and directly summed in linear power terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached; that frequency is recorded as the lower frequency. The process is repeated until 99.5% of the total is reached; that frequency is recorded as the upper frequency. The 99% power bandwidth is the difference between these two frequencies. h) The occupied bandwidth shall be reported by providing spectral plot(s) of the measuring instrument display; the plot axes and the scale units per division shall be clearly labeled. Tabular data may be reported in addition to the plot(s).

6.2.1 E.U.T. Operation:

Operating Environment:	
Temperature:	23 °C
Humidity:	47.9 %
Atmospheric Pressure:	1010 mbar

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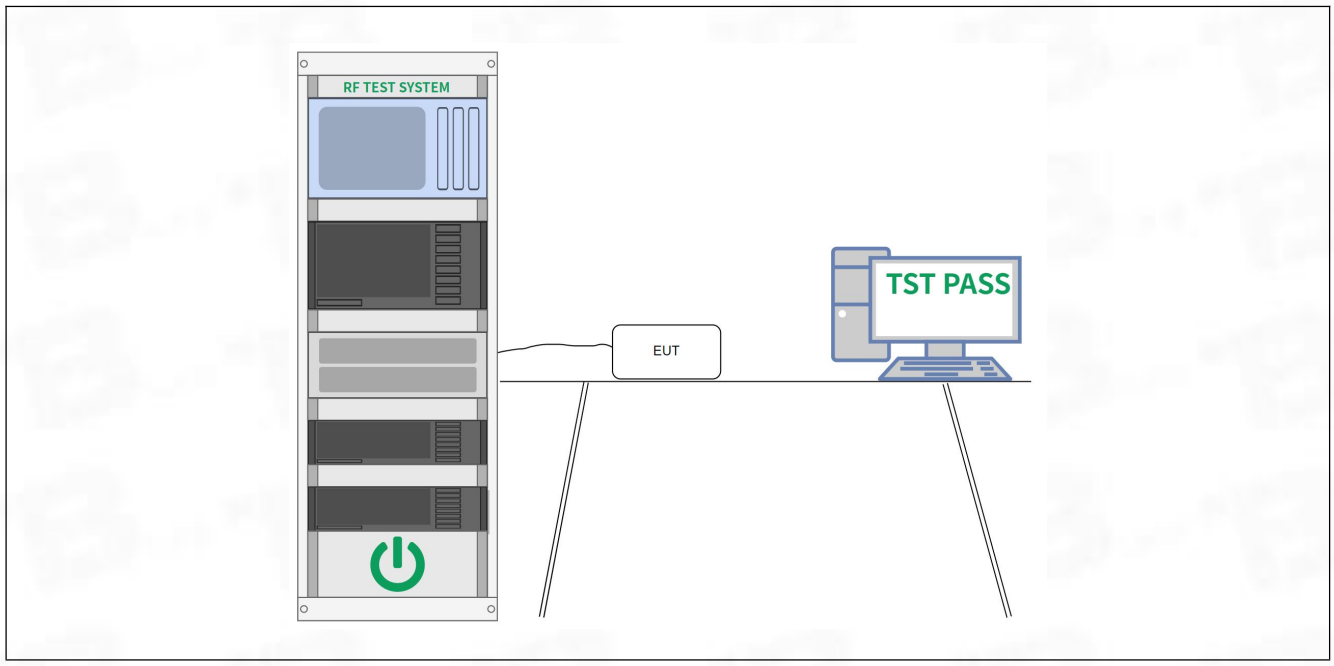
6.2.2 Test Setup Diagram:



6.2.3 Test Data:

Please Refer to Appendix for Details.

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6.3 Maximum Conducted Output Power

Test Requirement:	47 CFR 15.247(b)(1)
Test Method:	ANSI C63.10-2020, section 7.8.5 KDB 558074 D01 15.247 Meas Guidance v05r02
Test Limit:	Refer to 47 CFR 15.247(b)(1), For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.
Procedure:	This is an RF-conducted test to evaluate maximum peak output power. Use a direct connection between the antenna port of the unlicensed wireless device and the spectrum analyzer, through suitable attenuation. Frequency hopping shall be disabled for this test. Use the following spectrum analyzer settings: a) Span: Approximately five times the 20 dB bandwidth, centered on a hopping channel. b) RBW > 20 dB bandwidth of the emission being measured. c) VBW ≥ RBW. d) Sweep: No faster than coupled (auto) time. e) Detector function: Peak. f) Trace: Max-hold. g) Allow trace to stabilize. h) Use the marker-to-peak function to set the marker to the peak of the emission. i) The indicated level is the peak output power, after any corrections for external attenuators and cables. j) A spectral plot of the test results and setup description shall be included in the test report. NOTE—A peak responding power meter may be used, where the power meter and sensor system video bandwidth is greater than the occupied bandwidth of the unlicensed wireless device, rather than a spectrum analyzer.

6.3.1 E.U.T. Operation:

Operating Environment:	
Temperature:	23 °C
Humidity:	47.9 %
Atmospheric Pressure:	1010 mbar

BTF Testing Lab (Shenzhen) Co., Ltd.
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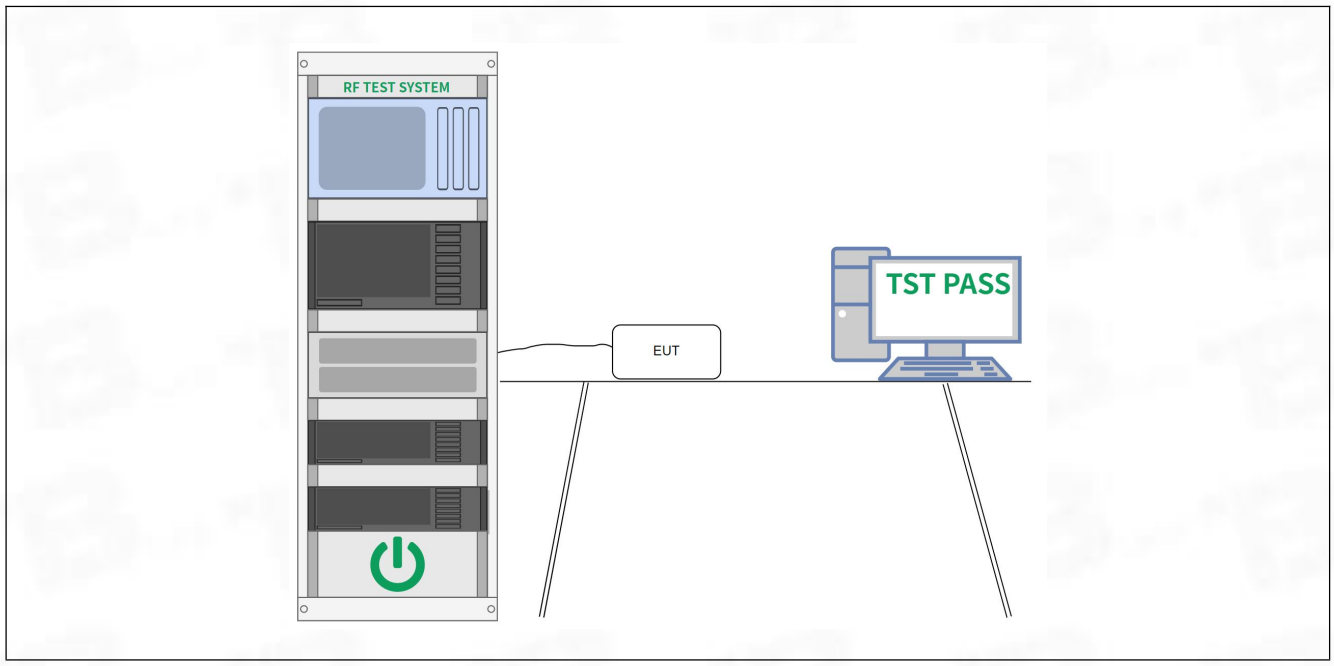
6.3.2 Test Setup Diagram:



6.3.3 Test Data:

Please Refer to Appendix for Details.

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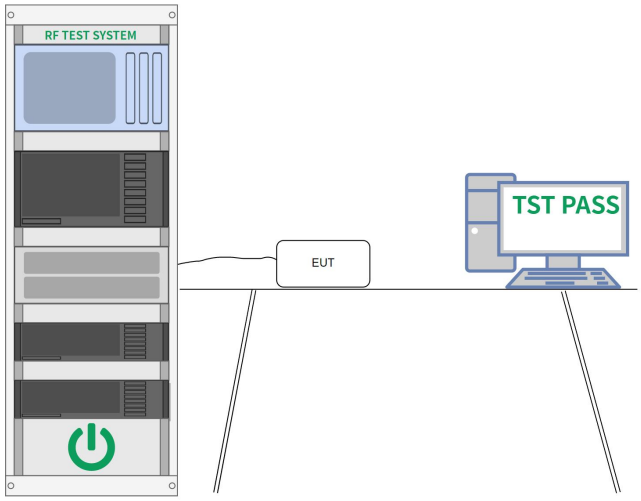
6.4 Channel Separation

Test Requirement:	47 CFR 15.247(a)(1)
Test Method:	ANSI C63.10-2020, section 7.8.2 KDB 558074 D01 15.247 Meas Guidance v05r02
Test Limit:	Refer to 47 CFR 15.247(a)(1), Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.
Procedure:	The EUT shall have its hopping function enabled. Use the following spectrum analyzer settings: a) Span: Wide enough to capture the peaks of two adjacent channels. b) RBW: Start with the RBW set to approximately 30% of the channel spacing; adjust as necessary to best identify the center of each individual channel. c) Video (or average) bandwidth (VBW) ≥ RBW. d) Sweep: No faster than coupled (auto) time. e) Detector function: Peak. f) Trace: Max-hold. g) Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels. Compliance of an EUT with the appropriate regulatory limit shall be determined. A spectral plot of the data shall be included in the test report.

6.4.1 E.U.T. Operation:

Operating Environment:	
Temperature:	23 °C
Humidity:	47.9 %
Atmospheric Pressure:	1010 mbar

6.4.2 Test Setup Diagram:



6.4.3 Test Data:

Please Refer to Appendix for Details.

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6.5 Number of Hopping Frequencies

Test Requirement:	47 CFR 15.247(a)(1)(iii)
Test Method:	ANSI C63.10-2020, section 7.8.3 KDB 558074 D01 15.247 Meas Guidance v05r02
Test Limit:	Refer to 47 CFR 15.247(a)(1)(iii), Fequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.
Procedure:	The EUT shall have its hopping function enabled. Use the following spectrum analyzer settings: a) Span: The frequency band of operation. Depending on the number of channels the device supports, it could be necessary to divide the frequency range of operation across multiple spans, to allow the individual channels to be clearly seen. b) RBW: To identify clearly the individual channels, set the RBW to less than 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller. c) VBW ≥ RBW. d) Sweep: No faster than coupled (auto) time. e) Detector function: Peak. f) Trace: Max-hold. g) Allow the trace to stabilize. It might prove necessary to break the span up into subranges to show clearly all of the hopping frequencies. Compliance of an EUT with the appropriate regulatory limit shall be determined for the number of hopping channels. A spectral plot of the data shall be included in the test report.

6.5.1 E.U.T. Operation:

Operating Environment:	
Temperature:	23 °C
Humidity:	47.9 %
Atmospheric Pressure:	1010 mbar

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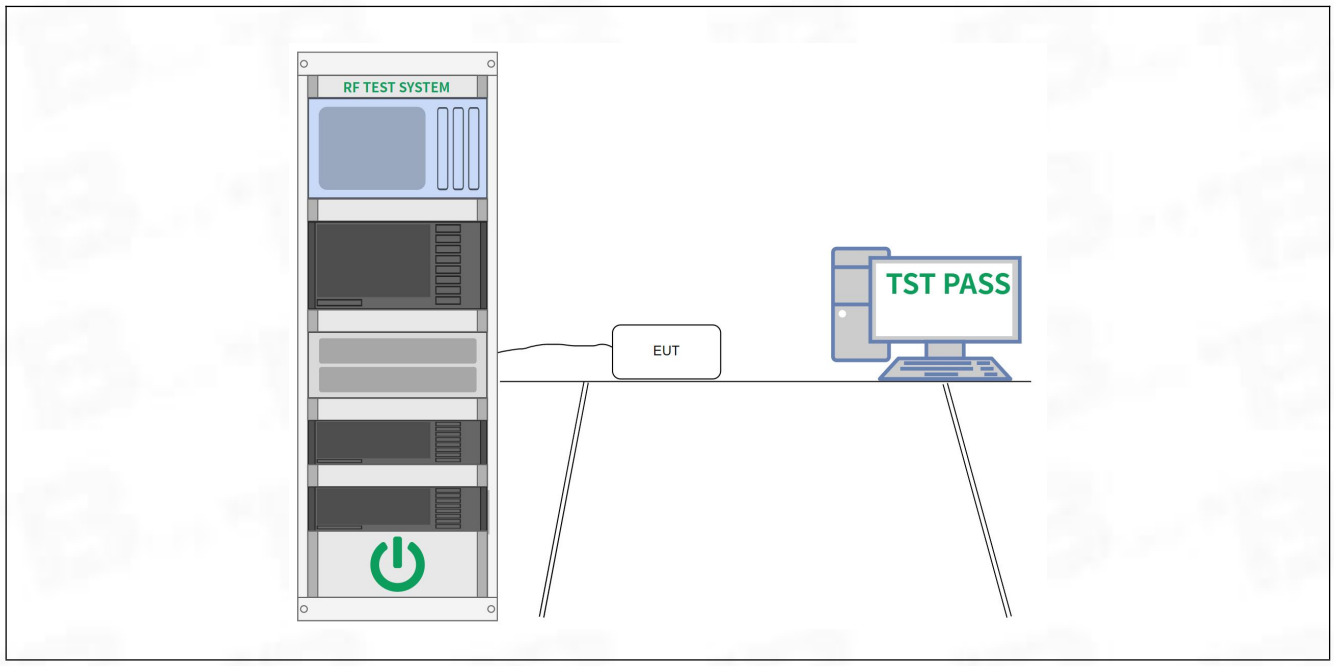
6.5.2 Test Setup Diagram:



6.5.3 Test Data:

Please Refer to Appendix for Details.

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6.6 Dwell Time

Test Requirement:	47 CFR 15.247(a)(1)(iii)
Test Method:	ANSI C63.10-2020, section 7.8.4 KDB 558074 D01 15.247 Meas Guidance v05r02
Test Limit:	Refer to 47 CFR 15.247(a)(1)(iii), Fequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.
Procedure:	The dwell time per hop on a channel is the time from the start of the first transmission to the end of the last transmission for that hop. If the device has a single transmission per hop then the dwell time is the duration of that transmission. If the device has a multiple transmissions per hop then the dwell time is measured from the start of the first transmission to the end of the last transmission. The time of occupancy is the total time that the device dwells on a channel over an observation period specified in the regulatory requirement. To determine the time of occupancy the spectrum analyzer will be configured to measure both the dwell time per hop and the number of times the device transmits on a specific channel in a given period. The EUT shall have its hopping function enabled. Compliance with the requirements shall be made with the minimum and with the maximum number of channels enabled. If the dwell time per channel does not vary with the number of channels than compliance with the requirements may be based on the minimum number of channels. If the device supports different dwell times per channel (example Bluetooth devices can dwell on a channel for 1, 3 or 5 time slots) then measurements can be limited to the longest dwell time with the minimum number of channels. Use the following spectrum analyzer settings to determine the dwell time per hop: a) Span: Zero span, centered on a hopping channel. b) RBW shall be ≤ channel spacing and where possible RBW should be set >> 1 / T, where T is the expected transmission time per hop. c) Sweep time: Set so that the start of the first transmission and end of the last transmission for the hop are clearly captured. Setting the sweep time to be slightly longer than the hopping period per channel (hopping period = 1/hopping rate) should achieve this. d) Use a video trigger, where possible with a trigger delay, so that the start of the transmission is clearly observed. The trigger level might need adjustment to reduce the chance of triggering when the system hops on an adjacent channel. e) Detector function: Peak. f) Trace: Clear-write, single sweep. g) Place markers at the start of the first transmission on the channel and at the end of the last transmission. The dwell time per hop is the time between these two markers. To determine the number of hops on a channel in the regulatory observation period repeat the measurement using a longer sweep time. When the device uses a single hopping sequence the period of measurement should be sufficient to capture at least 2 hops. When the device uses a dynamic hopping sequence, or the sequence varies, the period of measurement may need to capture multiple hops to better determine the average time of occupancy. Count the number of

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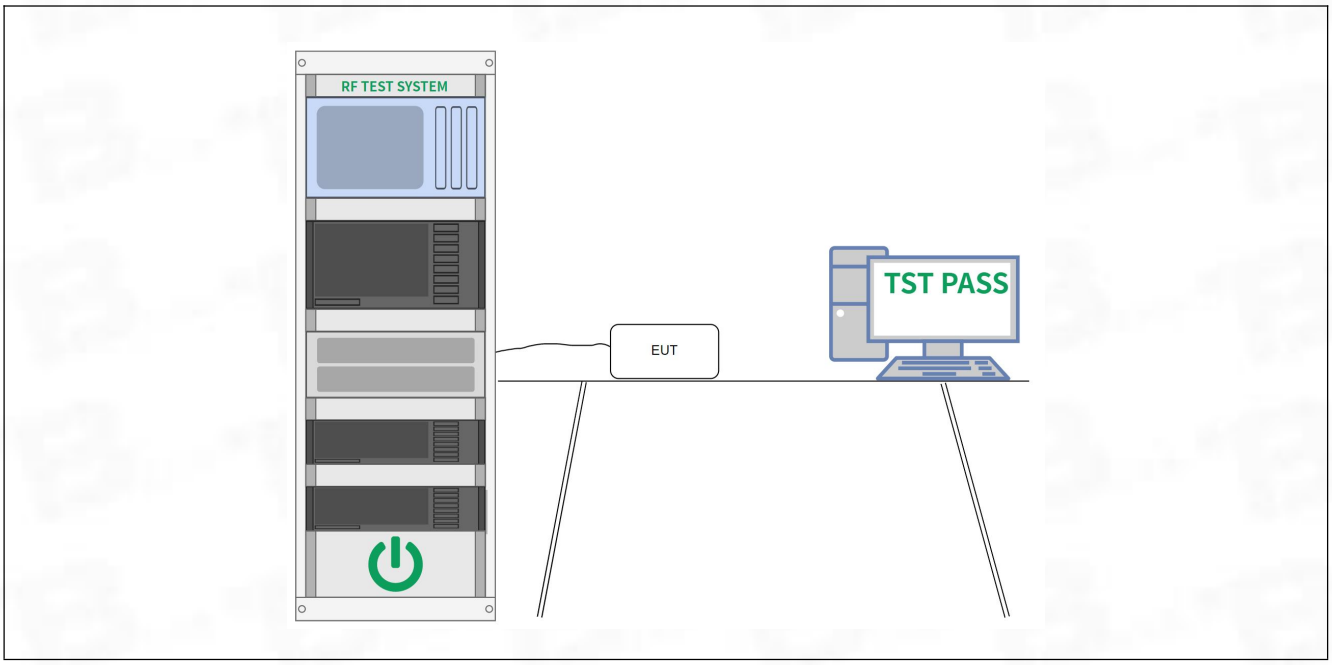
	hops on the channel across the sweep time. The average number of hops on the same channel within the regulatory observation period is calculated from the number of hops on the channel divided by the spectrum analyzer sweep time multiplied by the regulatory observation period. For example, if three hops are counted with an analyzer sweep time of 500 ms and the regulatory observation period is 10 s, then the number of hops in that ten seconds is 3 / 0.5 × 10, or 60 hops. The average time of occupancy is calculated by multiplying the dwell time per hop by the number of hops in the observation period.

6.6.1 E.U.T. Operation:

Operating Environment:	
Temperature:	23 °C
Humidity:	47.9 %
Atmospheric Pressure:	1010 mbar

6.6.2 Test Setup Diagram:



6.6.3 Test Data:

Please Refer to Appendix for Details.

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6.7 Emissions in non-restricted frequency bands

Test Requirement:	47 CFR 15.247(d)
Test Method:	ANSI C63.10-2020 section 7.8.7 KDB 558074 D01 15.247 Meas Guidance v05r02
Test Limit:	Refer to 47 CFR 15.247(d), In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in § 15.209(a) is not required.
Procedure:	7.8.7.1 General considerations To demonstrate compliance with the relative out-of-band emissions requirements conducted spurious emissions shall be measured for the transmit frequencies, per 5.5 and 5.6, and at the maximum transmit powers. Frequency hopping shall be disabled for this test with the exception of measurements at the allocated band-edges which shall be repeated with hopping enabled. Connect the primary antenna port through an attenuator to the spectrum analyzer input; in the results, account for all losses between the unlicensed wireless device output and the spectrum analyzer. The frequency range of testing shall span 30 MHz to 10 times the operating frequency and this may be done in a single sweep or, to aid resolution, across a number of sweeps. The resolution bandwidth shall be 100 kHz, video bandwidth 300 kHz, and a coupled sweep time with a peak detector. The limit is based on the highest in-band level across all channels measured using the same instrument settings (resolution bandwidth of 100 kHz, video bandwidth of 300 kHz, and a coupled sweep time with a peak detector). To help clearly demonstrate compliance a display line may be set at the required offset (typically 20 dB) below the highest in-band level. Where the highest in-band level is not clearly identified in the out-of-band measurements a separate spectral plot showing the in-band level shall be provided. When conducted measurements cannot be made (for example a device with integrated, non-removable antenna) radiated measurements shall be used. The reference level for determining the limit shall be established by maximizing the field strength from the highest power channel and measuring using the resolution and video bandwidth settings and peak detector as described above. The field strength limit for spurious emissions outside of restricted-bands shall then be set at the required offset (typically 20 dB) below the highest in-band level. Radiated measurements will follow the standards measurement procedures described in Clause 6 with the exception that the resolution bandwidth shall be 100 kHz, video bandwidth 300 kHz, and a coupled sweep time with a peak detector. Note that use of wider measurement bandwidths are acceptable for measuring the spurious emissions provided that the peak detector is used and that the measured value of spurious emissions are compared to the highest in-band level measured with the 100 kHz / 300 kHz bandwidth settings to determine compliance. 7.8.7.2 Band-edges Compliance with a relative limit at the band-edges (e.g., −20 dBc) shall be made on

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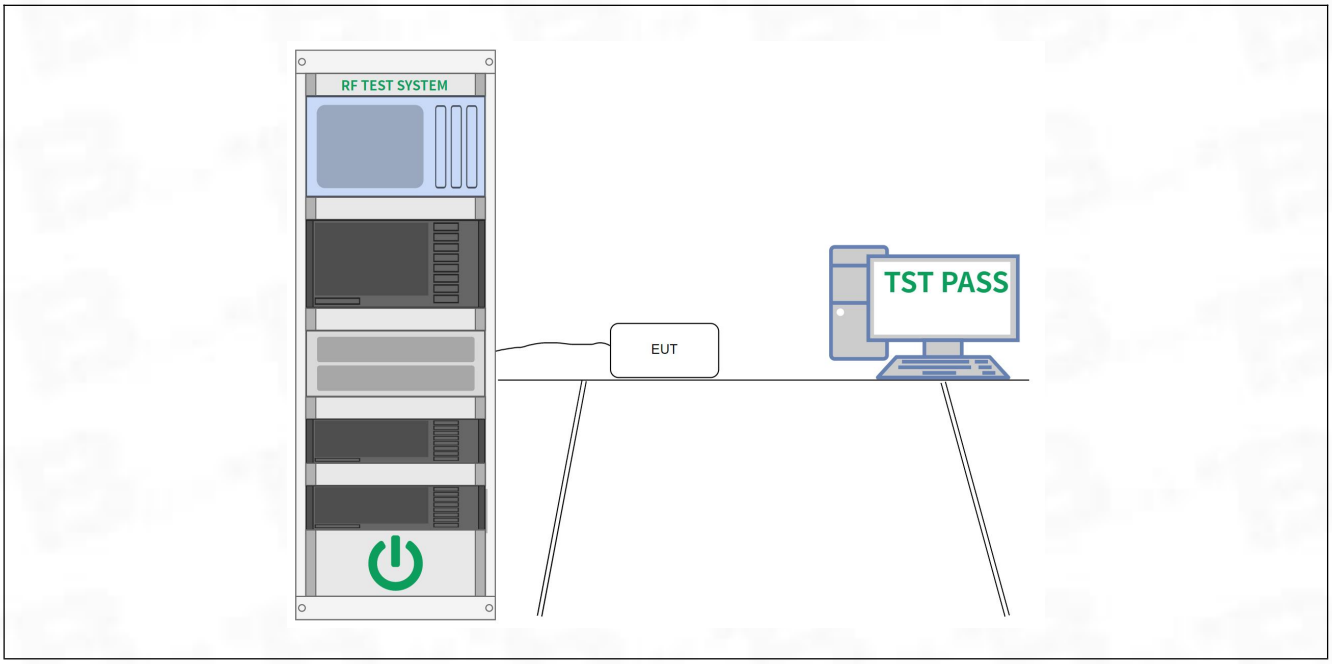
	the lowest and on the highest channels with frequency hopping disabled and repeated with frequency hopping enabled. For the latter test the hopping sequence shall include the lowest and highest channels. For measurements with the hopping disabled the analyzer screen shall clearly show compliance with the requirement within 10 MHz of the allocated band-edge. For measurements with the hopping enabled the analyzer screen shall clearly show compliance with the requirement within 10 MHz of both of the allocated band-edges. This could require separate spectral plots for each band-edge.

6.7.1 E.U.T. Operation:

Operating Environment:	
Temperature:	23 °C
Humidity:	47.9 %
Atmospheric Pressure:	1010 mbar

6.7.2 Test Setup Diagram:



6.7.3 Test Data:

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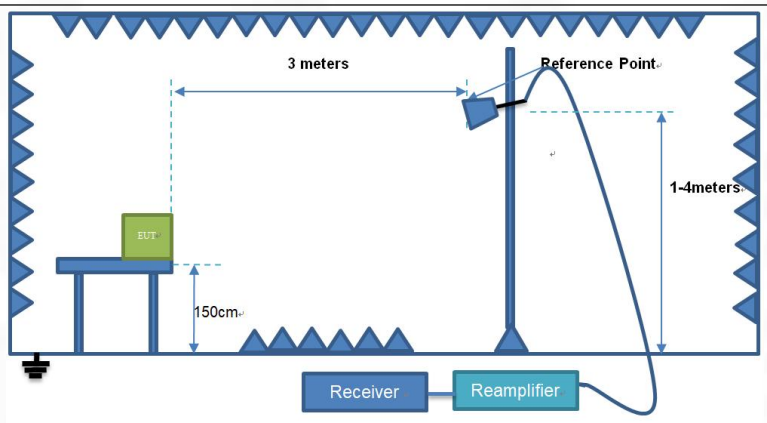
6.8 Band edge emissions (Radiated)

Test Requirement:	Refer to 47 CFR 15.247(d), In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a)(see § 15.205(c)).`
Test Method:	ANSI C63.10-2020 section 6.10 KDB 558074 D01 15.247 Meas Guidance v05r02
Test Limit:	Frequency (MHz) / Field strength (microvolts/meter) / Measurement distance (meters) 0.009-0.490 / 2400/F(kHz) / 300 0.490-1.705 / 24000/F(kHz) / 30 1.705-30.0 / 30 / 30 30-88 / 100 ** / 3 88-216 / 150 ** / 3 216-960 / 200 ** / 3 Above 960 / 500 / 3 ** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g., §§ 15.231 and 15.241.
Procedure:	ANSI C63.10-2020 section 6.10.5.2

6.8.1 E.U.T. Operation:

Operating Environment:	
Temperature:	23 °C
Humidity:	47.9 %
Atmospheric Pressure:	1010 mbar

6.8.2 Test Setup Diagram:



6.8.3 Test Data:

TM1 / Polarization: Horizontal / Band: 2.4G / BW: 1 / CH: L

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	P/F
1	2310.000	72.07	-30.59	41.48	74.00	-32.52	peak	P
2	2390.000	72.38	-30.49	41.89	74.00	-32.11	peak	P
3 *	2400.000	80.78	-30.48	50.30	74.00	-23.70	peak	P

TM1 / Polarization: Vertical / Band: 2.4G / BW: 1 / CH: L

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	P/F
1	2310.000	72.08	-30.59	41.48	74.00	-32.52	peak	P
2	2390.000	72.40	-30.49	41.89	74.00	-32.11	peak	P
3 *	2400.000	75.28	-30.48	44.80	74.00	-29.20	peak	P

TM1 / Polarization: Horizontal / Band: 2.4G / BW: 1 / CH: H

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	P/F
1 *	2483.500	70.03	-30.39	39.64	74.00	-34.36	peak	P
2	2500.000	68.65	-30.37	38.28	74.00	-35.72	peak	P

TM1 / Polarization: Vertical / Band: 2.4G / BW: 1 / CH: H

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	P/F
1 *	2483.500	71.53	-30.39	41.14	74.00	-32.86	peak	P
2	2500.000	70.15	-30.37	39.78	74.00	-34.22	peak	P

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TM2 / Polarization: Horizontal / Band: 2.4G / BW: 1 / CH: L

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	P/F
1	2310.000	67.01	-30.59	36.42	74.00	-37.58	peak	P
2	2390.000	70.53	-30.49	40.04	74.00	-33.96	peak	P
3 *	2400.000	75.64	-30.48	45.16	74.00	-28.84	peak	P

TM2 / Polarization: Vertical / Band: 2.4G / BW: 1 / CH: L

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	P/F
1	2310.000	69.51	-30.59	38.92	74.00	-35.08	peak	P
2	2390.000	68.53	-30.49	38.04	74.00	-35.96	peak	P
3 *	2400.000	74.14	-30.48	43.66	74.00	-30.34	peak	P

TM2 / Polarization: Horizontal / Band: 2.4G / BW: 1 / CH: H

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	P/F
1 *	2483.500	77.28	-30.39	46.89	74.00	-27.11	peak	P
2	2500.000	72.39	-30.37	42.02	74.00	-31.98	peak	P

TM2 / Polarization: Vertical / Band: 2.4G / BW: 1 / CH: H

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	P/F
1 *	2483.500	75.28	-30.39	44.89	74.00	-29.11	peak	P
2	2500.000	71.08	-30.37	40.71	74.00	-33.29	peak	P

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TM3 / Polarization: Horizontal / Band: 2.4G / BW: 1 / CH: L

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	P/F
1	2310.000	71.42	-30.59	40.83	74.00	-33.17	peak	P
2	2390.000	70.49	-30.49	40.00	74.00	-34.00	peak	P
3 *	2400.000	74.01	-30.48	43.53	74.00	-30.47	peak	P

TM3 / Polarization: Vertical / Band: 2.4G / BW: 1 / CH: L

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	P/F
1	2310.000	68.92	-30.59	38.33	74.00	-35.67	peak	P
2	2390.000	70.99	-30.49	40.50	74.00	-33.50	peak	P
3 *	2400.000	74.01	-30.48	43.53	74.00	-30.47	peak	P

TM3 / Polarization: Horizontal / Band: 2.4G / BW: 1 / CH: H

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	P/F
1 *	2483.500	76.95	-30.39	46.56	74.00	-27.44	peak	P
2	2500.000	70.35	-30.37	39.98	74.00	-34.02	peak	P

TM3 / Polarization: Vertical / Band: 2.4G / BW: 1 / CH: H

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	P/F
1 *	2483.500	76.45	-30.39	46.06	74.00	-27.94	peak	P
2	2500.000	72.35	-30.37	41.98	74.00	-32.02	peak	P

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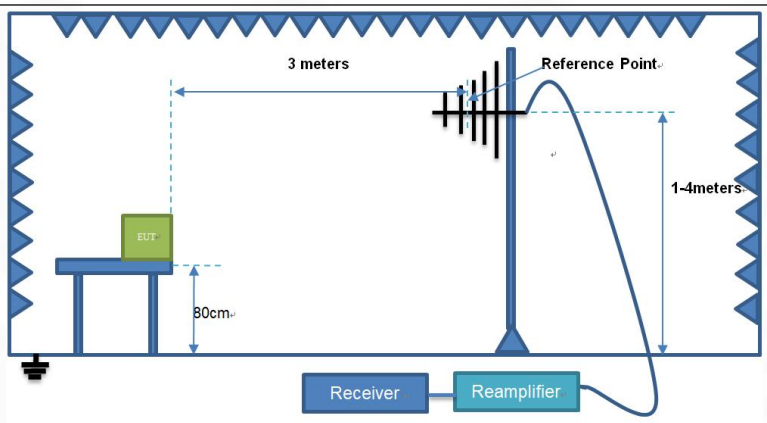
6.9 Emissions in restricted frequency bands (below 1GHz)

Test Requirement:	Refer to 47 CFR 15.247(d), In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a)(see § 15.205(c)).`
Test Method:	ANSI C63.10-2020 section 6.6.4 KDB 558074 D01 15.247 Meas Guidance v05r02
Test Limit:	Frequency (MHz) / Field strength (microvolts/meter) / Measurement distance (meters) 0.009-0.490 / 2400/F(kHz) / 300 0.490-1.705 / 24000/F(kHz) / 30 1.705-30.0 / 30 / 30 30-88 / 100 ** / 3 88-216 / 150 ** / 3 216-960 / 200 ** / 3 Above 960 / 500 / 3 ** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g., §§ 15.231 and 15.241.
Procedure:	ANSI C63.10-2020 section 6.6.4

6.9.1 E.U.T. Operation:

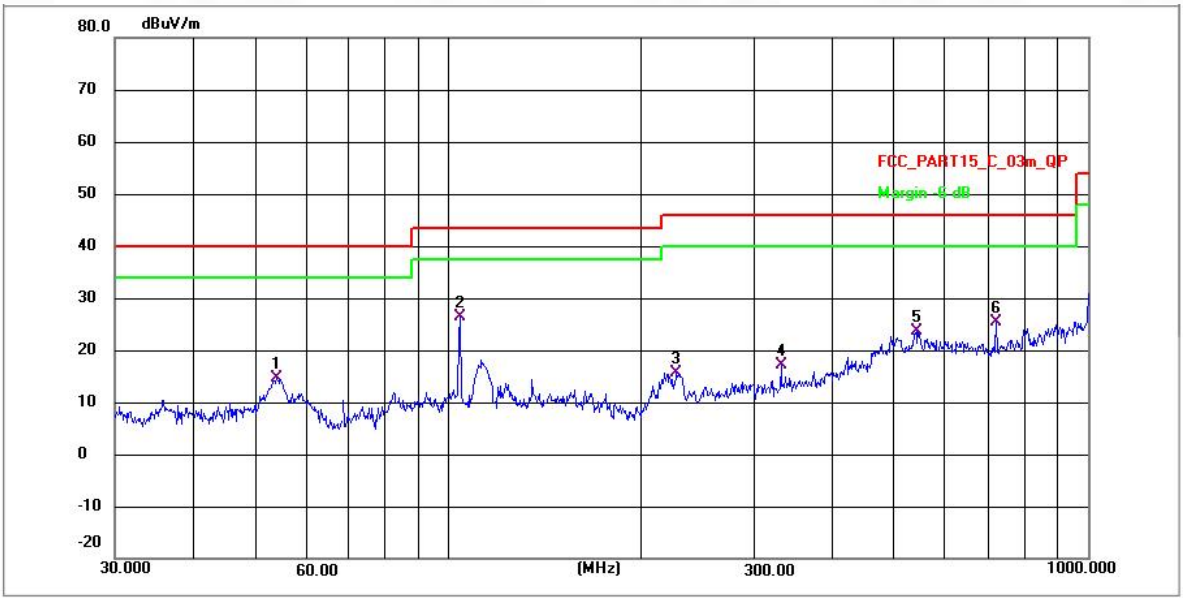
Operating Environment:	
Temperature:	23 °C
Humidity:	47.9 %
Atmospheric Pressure:	1010 mbar

6.9.2 Test Setup Diagram:



6.9.3 Test Data:

TM1 / Polarization: Horizontal / Band: 2.4G / BW: 1 / CH: L



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	P/F
1	53.8818	34.93	-20.25	14.68	40.00	-25.32	QP	P
2 *	104.1701	54.58	-28.19	26.39	43.50	-17.11	QP	P
3	227.6906	41.67	-26.12	15.55	46.00	-30.45	QP	P
4	331.3546	42.41	-25.18	17.23	46.00	-28.77	QP	P
5	539.4775	45.19	-21.55	23.64	46.00	-22.36	QP	P
6	720.4616	48.99	-23.66	25.33	46.00	-20.67	QP	P

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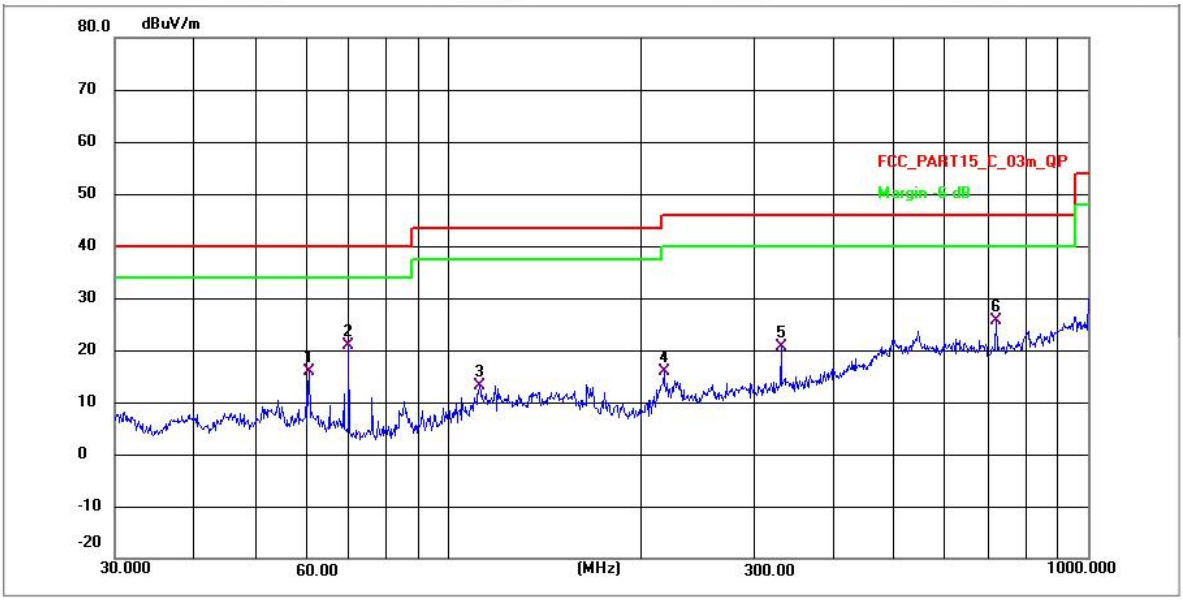
TM1 / Polarization: Vertical / Band: 2.4G / BW: 1 / CH: L



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	P/F
1	60.2801	34.05	-18.19	15.86	40.00	-24.14	QP	P
2 *	69.9675	38.89	-18.10	20.79	40.00	-19.21	QP	P
3	112.1305	41.30	-28.13	13.17	43.50	-30.33	QP	P
4	217.1632	42.54	-26.58	15.96	46.00	-30.04	QP	P
5	330.7742	45.84	-25.18	20.66	46.00	-25.34	QP	P
6	720.4616	49.18	-23.66	25.52	46.00	-20.48	QP	P

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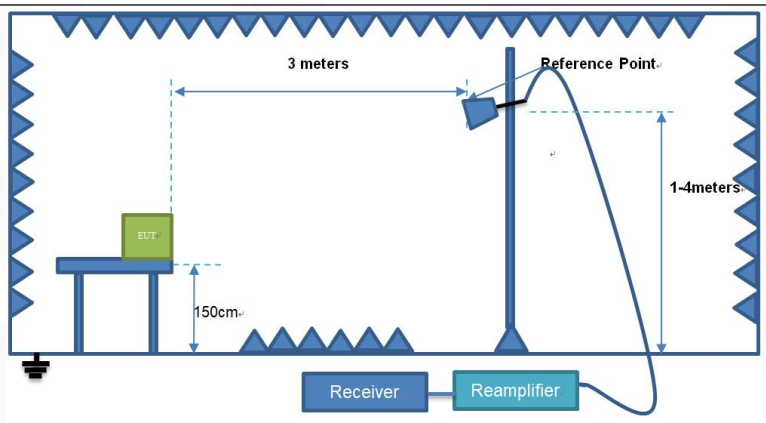
6.10 Emissions in restricted frequency bands (above 1GHz)

Test Requirement:	In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a)(see § 15.205(c)).`
Test Method:	ANSI C63.10-2020 section 6.6.4 KDB 558074 D01 15.247 Meas Guidance v05r02
Test Limit:	Frequency (MHz) / Field strength (microvolts/meter) / Measurement distance (meters) 0.009-0.490 / 2400/F(kHz) / 300 0.490-1.705 / 24000/F(kHz) / 30 1.705-30.0 / 30 / 30 30-88 / 100 ** / 3 88-216 / 150 ** / 3 216-960 / 200 ** / 3 Above 960 / 500 / 3 ** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g., §§ 15.231 and 15.241.
Procedure:	ANSI C63.10-2020 section 6.6.4

6.10.1 E.U.T. Operation:

Operating Environment:	
Temperature:	23.5 °C
Humidity:	51.9 %
Atmospheric Pressure:	1010 mbar

6.10.2 Test Setup Diagram:



6.10.3 Test Data:

TM1 / Polarization: Horizontal / Band: 2.4G / BW: 1 / CH: L

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	P/F
1	4375.903	68.64	-28.84	39.80	74.00	-34.20	peak	P
2	5738.683	69.60	-26.18	43.42	74.00	-30.58	peak	P
3	6566.106	70.84	-25.32	45.52	74.00	-28.48	peak	P
4	8556.396	73.07	-25.21	47.86	74.00	-26.14	peak	P
5 *	12248.142	71.84	-21.90	49.94	74.00	-24.06	peak	P
6	15147.213	69.88	-20.72	49.16	74.00	-24.84	peak	P

TM1 / Polarization: Vertical / Band: 2.4G / BW: 1 / CH: L

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	P/F
1	4029.883	62.77	-28.99	33.78	74.00	-40.22	peak	P
2	5488.846	62.44	-26.96	35.48	74.00	-38.52	peak	P
3	6972.967	66.94	-24.96	41.98	74.00	-32.02	peak	P
4	8920.040	68.18	-24.47	43.71	74.00	-30.29	peak	P
5	9815.588	68.24	-23.89	44.35	74.00	-29.65	peak	P
6 *	13583.415	67.59	-20.98	46.61	74.00	-27.39	peak	P

TM1 / Polarization: Horizontal / Band: 2.4G / BW: 1 / CH: M

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	P/F
1	4419.118	60.05	-28.82	31.23	74.00	-42.77	peak	P
2	5671.078	62.82	-26.40	36.42	74.00	-37.58	peak	P
3	7041.830	65.32	-24.92	40.40	74.00	-33.60	peak	P
4	8445.827	70.02	-25.34	44.68	74.00	-29.32	peak	P
5	10420.786	73.86	-24.48	49.38	74.00	-24.62	peak	P
6 *	13334.453	72.34	-21.09	51.25	74.00	-22.75	peak	P

TM1 / Polarization: Vertical / Band: 2.4G / BW: 1 / CH: M

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	P/F
1	4207.227	63.43	-28.91	34.52	74.00	-39.48	peak	P
2	5480.919	61.17	-26.96	34.21	74.00	-39.79	peak	P
3	6902.782	64.85	-25.02	39.83	74.00	-34.17	peak	P
4	8556.396	67.07	-25.21	41.86	74.00	-32.14	peak	P
5	11140.310	68.90	-23.33	45.57	74.00	-28.43	peak	P
6 *	15727.195	69.55	-21.54	48.01	74.00	-25.99	peak	P

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TM1 / Polarization: Horizontal / Band: 2.4G / BW: 1 / CH: H

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	P/F
1	5050.440	59.56	-27.33	32.23	74.00	-41.77	peak	P
2	6475.639	66.23	-25.38	40.85	74.00	-33.15	peak	P
3	7959.927	67.03	-25.47	41.56	74.00	-32.44	peak	P
4	10438.873	68.11	-24.49	43.62	74.00	-30.38	peak	P
5	10782.332	68.59	-23.91	44.68	74.00	-29.32	peak	P
6 *	16476.356	68.83	-19.29	49.54	74.00	-24.46	peak	P

TM1 / Polarization: Vertical / Band: 2.4G / BW: 1 / CH: H

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	P/F
1	3398.062	63.54	-29.15	34.39	74.00	-39.61	peak	P
2	3996.245	64.00	-29.00	35.00	74.00	-39.00	peak	P
3	5097.369	62.60	-27.29	35.31	74.00	-38.69	peak	P
4	6902.782	62.85	-25.02	37.83	74.00	-36.17	peak	P
5	10381.703	66.47	-24.46	42.01	74.00	-31.99	peak	P
6 *	16338.827	68.40	-19.96	48.44	74.00	-25.56	peak	P

TM2 / Polarization: Horizontal / Band: 2.4G / BW: 1 / CH: L

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	P/F
1	5592.942	65.60	-26.65	38.95	74.00	-35.05	peak	P
2	7443.664	66.85	-24.80	42.05	74.00	-31.95	peak	P
3	7443.664	66.85	-24.80	42.05	74.00	-31.95	peak	P
4	9566.309	72.33	-23.34	48.99	74.00	-25.01	peak	P
5 *	11610.413	72.18	-22.87	49.31	74.00	-24.69	peak	P
6	15704.483	66.88	-21.53	45.35	74.00	-28.65	peak	P

TM2 / Polarization: Vertical / Band: 2.4G / BW: 1 / CH: L

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	P/F
1	3586.781	64.78	-29.04	35.74	74.00	-38.26	peak	P
2	4920.755	64.66	-27.59	37.07	74.00	-36.93	peak	P
3	6218.832	64.06	-25.35	38.71	74.00	-35.29	peak	P
4	9984.411	67.45	-24.26	43.19	74.00	-30.81	peak	P
5 *	11906.073	70.41	-22.35	48.06	74.00	-25.94	peak	P
6	15147.213	66.38	-20.72	45.66	74.00	-28.34	peak	P

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TM2 / Polarization: Horizontal / Band: 2.4G / BW: 1 / CH: M

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	P/F
1	4089.727	64.81	-28.96	35.85	74.00	-38.15	peak	P
2	5265.082	67.16	-27.15	40.01	74.00	-33.99	peak	P
3	6902.782	69.35	-25.02	44.33	74.00	-29.67	peak	P
4	9632.900	72.47	-23.49	48.98	74.00	-25.02	peak	P
5 *	12361.953	72.10	-21.78	50.32	74.00	-23.68	peak	P
6	14609.718	70.31	-21.02	49.29	74.00	-24.71	peak	P

TM2 / Polarization: Vertical / Band: 2.4G / BW: 1 / CH: M

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	P/F
1	4273.408	63.53	-28.88	34.65	74.00	-39.35	peak	P
2	4988.058	66.15	-27.41	38.74	74.00	-35.26	peak	P
3	5758.622	67.92	-26.11	41.81	74.00	-32.19	peak	P
4	6715.820	72.03	-25.19	46.84	74.00	-27.16	peak	P
5	9123.426	71.13	-24.04	47.09	74.00	-26.91	peak	P
6 *	12491.255	70.96	-21.63	49.33	74.00	-24.67	peak	P

TM2 / Polarization: Horizontal / Band: 2.4G / BW: 1 / CH: H

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	P/F
1	3885.760	64.31	-29.01	35.30	74.00	-38.70	peak	P
2	5414.785	66.22	-27.02	39.20	74.00	-34.80	peak	P
3	6851.102	70.55	-25.06	45.49	74.00	-28.51	peak	P
4	8812.409	70.86	-24.69	46.17	74.00	-27.83	peak	P
5	10695.422	72.40	-24.10	48.30	74.00	-25.70	peak	P
6 *	13709.633	69.39	-21.01	48.38	74.00	-25.62	peak	P

TM2 / Polarization: Vertical / Band: 2.4G / BW: 1 / CH: H

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	P/F
1	4724.245	68.69	-28.15	40.54	74.00	-33.46	peak	P
2	6005.097	68.88	-25.33	43.55	74.00	-30.45	peak	P
3	8620.940	73.38	-25.08	48.30	74.00	-25.70	peak	P
4 *	11992.417	73.75	-22.20	51.55	74.00	-22.45	peak	P
5	13067.374	71.82	-21.29	50.53	74.00	-23.47	peak	P
6	14762.531	71.28	-20.77	50.51	74.00	-23.49	peak	P

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TM3 / Polarization: Horizontal / Band: 2.4G / BW: 1 / CH: L

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	P/F
1	4082.640	67.88	-28.97	38.91	74.00	-35.09	peak	P
2	4345.653	67.74	-28.85	38.89	74.00	-35.11	peak	P
3	6475.639	70.73	-25.38	45.35	74.00	-28.65	peak	P
4	8250.389	73.54	-25.43	48.11	74.00	-25.89	peak	P
5	10713.986	71.80	-24.06	47.74	74.00	-26.26	peak	P
6 *	14164.799	71.23	-21.13	50.10	74.00	-23.90	peak	P

TM3 / Polarization: Vertical / Band: 2.4G / BW: 1 / CH: L

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	P/F
1	4029.883	64.77	-28.99	35.78	74.00	-38.22	peak	P
2	5027.137	67.88	-27.34	40.54	74.00	-33.46	peak	P
3	6962.897	70.64	-24.96	45.68	74.00	-28.32	peak	P
4	8327.053	73.23	-25.39	47.84	74.00	-26.16	peak	P
5 *	10212.065	74.35	-24.38	49.97	74.00	-24.03	peak	P
6	14597.055	69.34	-21.04	48.30	74.00	-25.70	peak	P

TM3 / Polarization: Horizontal / Band: 2.4G / BW: 1 / CH: M

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	P/F
1	3853.325	62.80	-29.01	33.79	74.00	-40.21	peak	P
2	4585.673	63.09	-28.54	34.55	74.00	-39.45	peak	P
3	5768.617	66.64	-26.08	40.56	74.00	-33.44	peak	P
4	7823.074	69.43	-25.26	44.17	74.00	-29.83	peak	P
5	9795.749	69.00	-23.85	45.15	74.00	-28.85	peak	P
6 *	11731.854	72.45	-22.66	49.79	74.00	-24.21	peak	P

TM3 / Polarization: Vertical / Band: 2.4G / BW: 1 / CH: M

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	P/F
1	4519.878	65.00	-28.73	36.27	74.00	-37.73	peak	P
2	5850.898	63.70	-25.82	37.88	74.00	-36.12	peak	P
3	6549.048	67.83	-25.34	42.49	74.00	-31.51	peak	P
4	7786.979	69.90	-25.21	44.69	74.00	-29.31	peak	P
5	12437.215	65.97	-21.68	44.29	74.00	-29.71	peak	P
6 *	15564.397	71.15	-21.51	49.64	74.00	-24.36	peak	P

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TM3 / Polarization: Horizontal / Band: 2.4G / BW: 1 / CH: H

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	P/F
1	4779.181	62.45	-28.00	34.45	74.00	-39.55	peak	P
2	5265.082	66.16	-27.15	39.01	74.00	-34.99	peak	P
3	6650.145	70.57	-25.25	45.32	74.00	-28.68	peak	P
4	8663.404	71.39	-24.99	46.40	74.00	-27.60	peak	P
5 *	9663.576	70.44	-23.56	46.88	74.00	-27.12	peak	P
6	15164.736	67.13	-20.76	46.37	74.00	-27.63	peak	P

TM3 / Polarization: Vertical / Band: 2.4G / BW: 1 / CH: H

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	P/F
1	5179.049	65.50	-27.22	38.28	74.00	-35.72	peak	P
2	6355.114	69.02	-25.36	43.66	74.00	-30.34	peak	P
3	7506.319	69.20	-24.79	44.41	74.00	-29.59	peak	P
4	9065.595	71.49	-24.16	47.33	74.00	-26.67	peak	P
5	10624.556	69.05	-24.25	44.80	74.00	-29.20	peak	P
6 *	14690.171	71.34	-20.89	50.45	74.00	-23.55	peak	P

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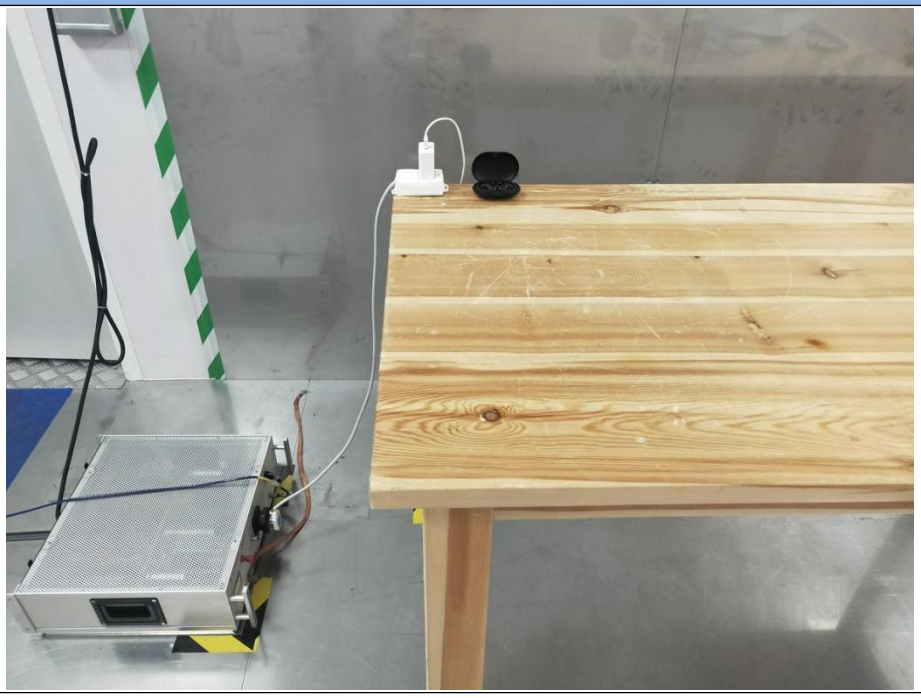
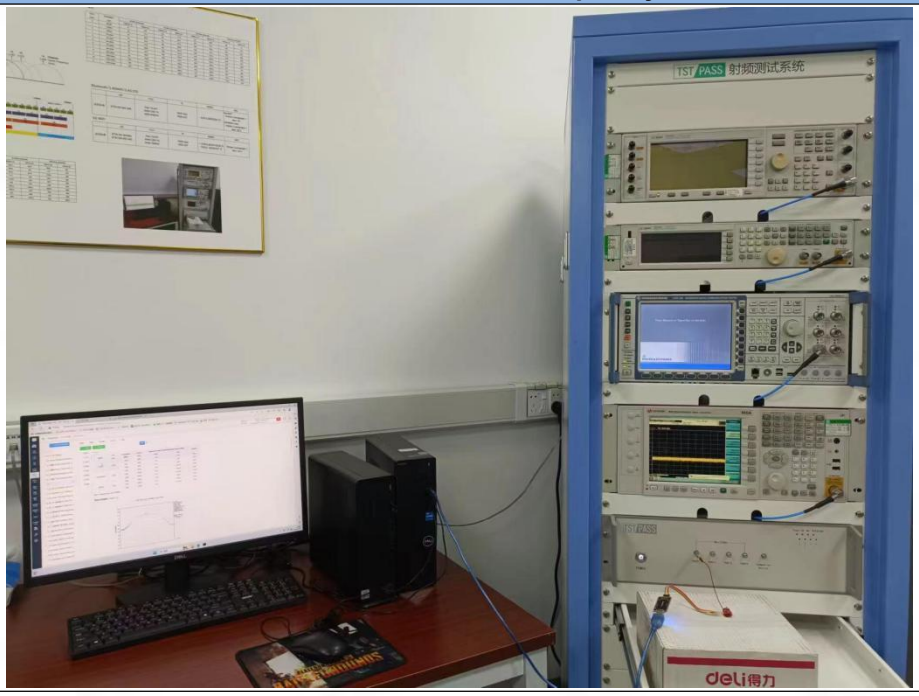
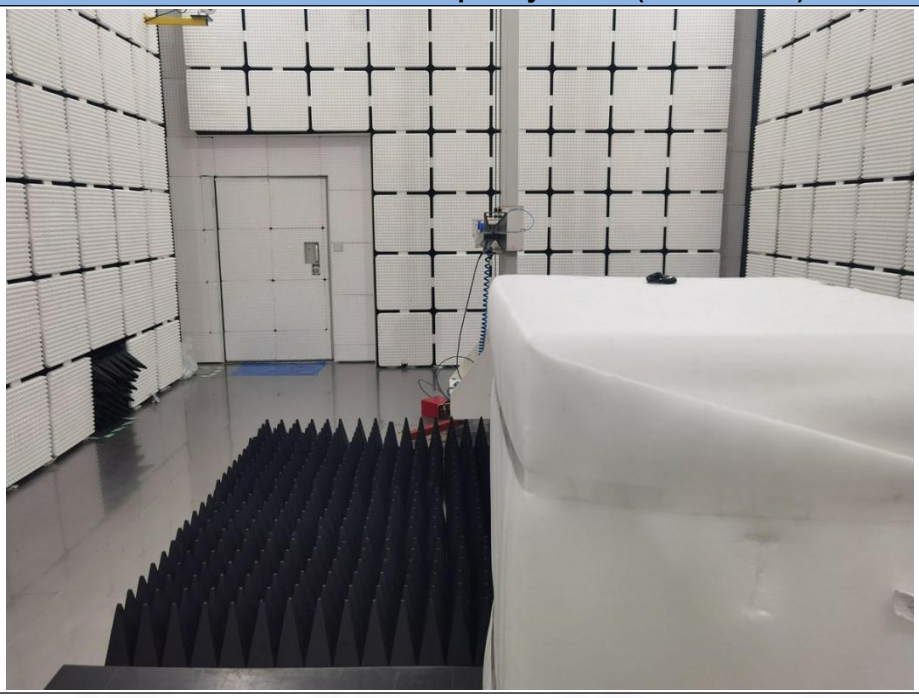
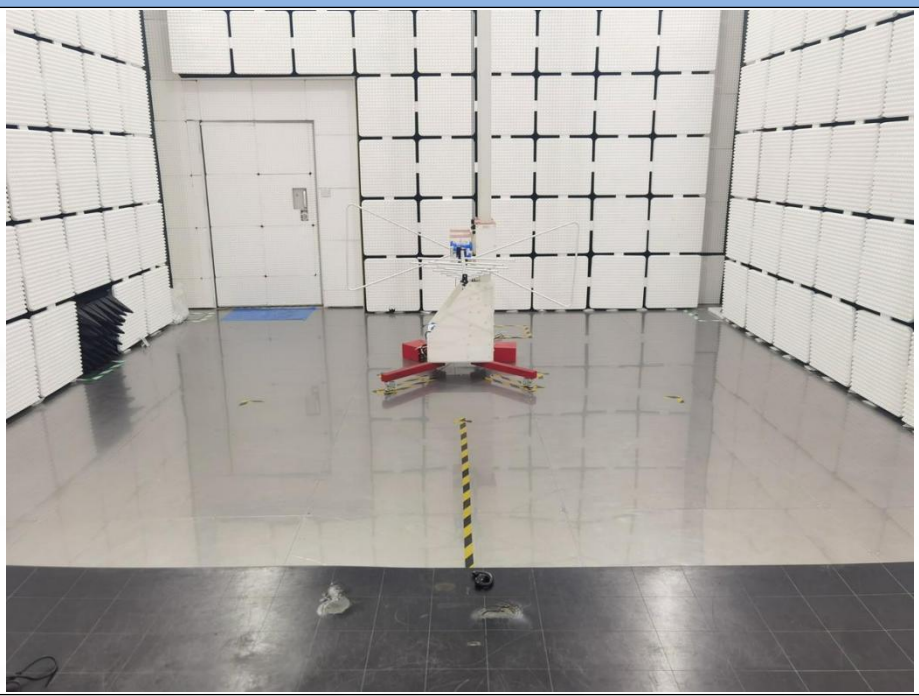
7 Test Setup Photos

Conducted Emission at AC power line


Occupied Bandwidth Maximum Conducted Output Power Channel Separation Number of Hopping Frequencies Dwell Time Emissions in non-restricted frequency bands


Band edge emissions (Radiated) Emissions in restricted frequency bands (above 1GHz)


Emissions in restricted frequency bands (below 1GHz)


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8 EUT Constructional Details (EUT Photos)

External

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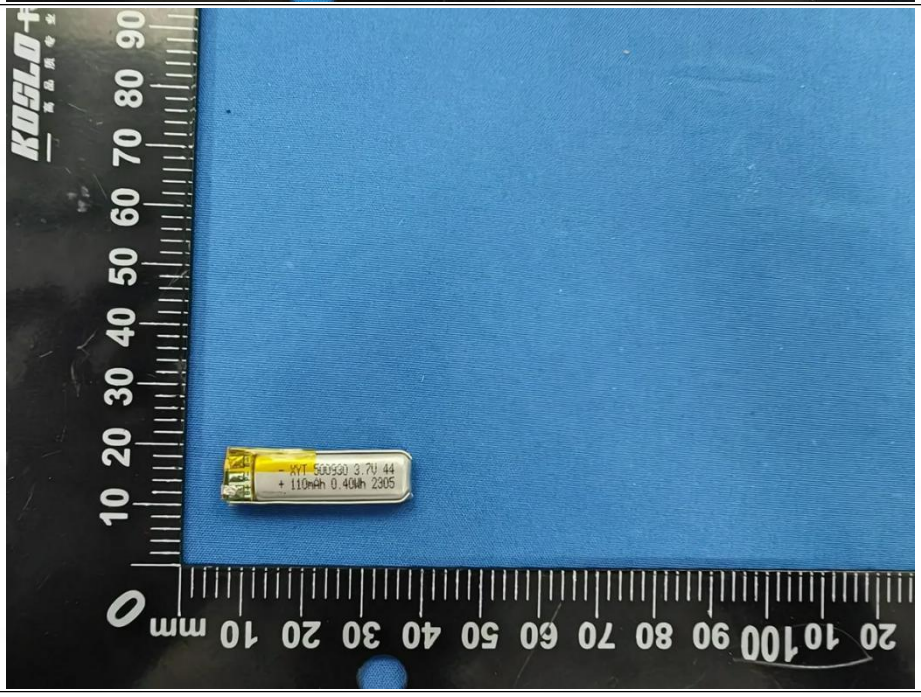
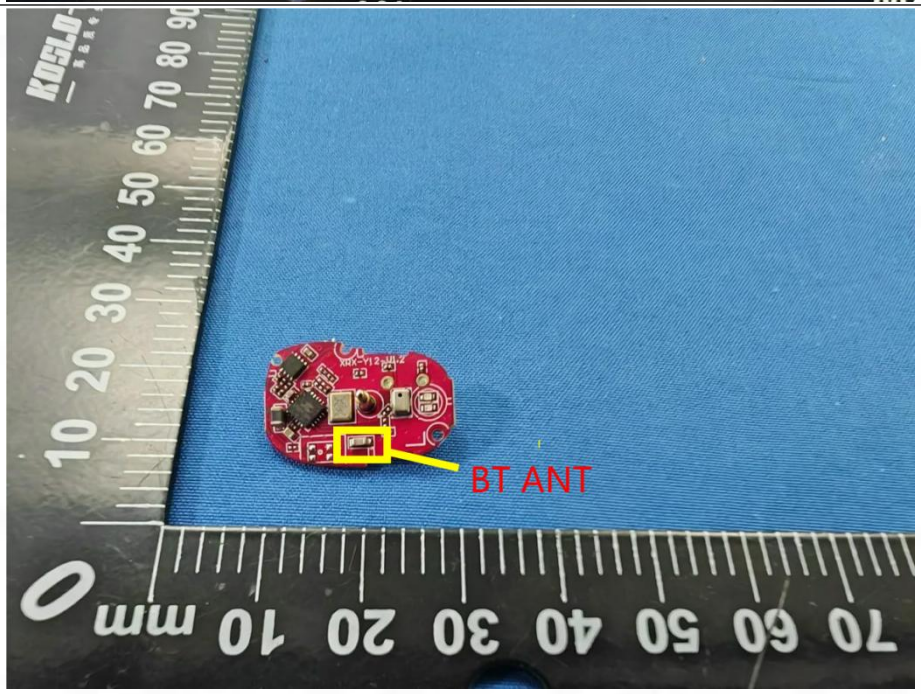
Internal





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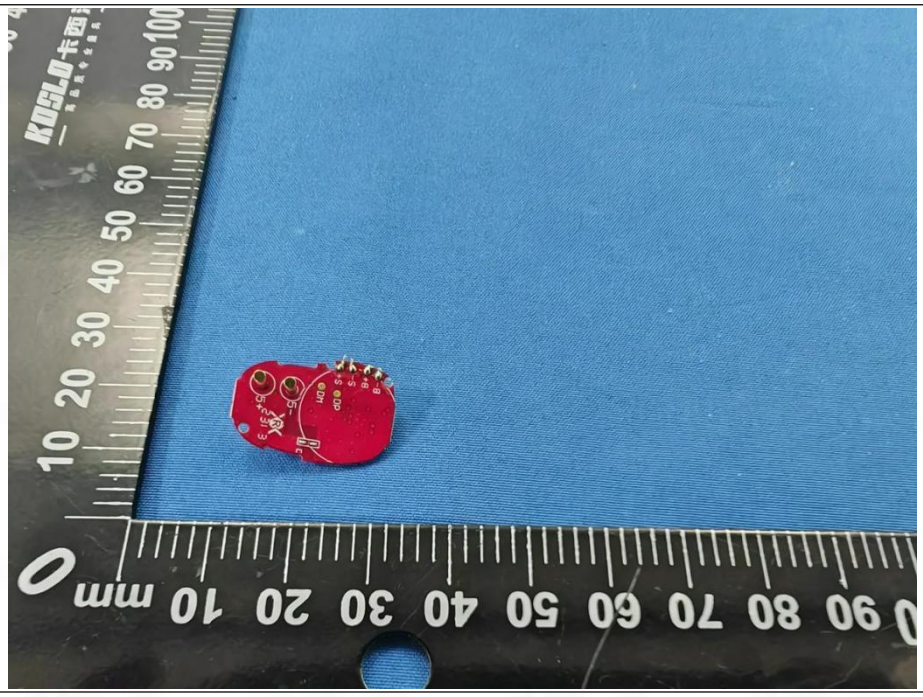

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Appendix

BTF Testing Lab (Shenzhen) Co., Ltd.
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1. Bandwidth

1.1 OBW

1.1.1 Test Result

Mode	TX Type	Frequency (MHz)	Packet Type	ANT	99% Occupied Bandwidth (MHz) Result	Verdict
GFSK	SISO	2402	DH5	1	0.853	Pass
		2441	DH5	1	0.853	Pass
		2480	DH5	1	0.852	Pass
Pi/4DQPSK	SISO	2402	2DH5	1	1.167	Pass
		2441	2DH5	1	1.171	Pass
		2480	2DH5	1	1.178	Pass
8DPSK	SISO	2402	3DH5	1	1.164	Pass
		2441	3DH5	1	1.167	Pass
		2480	3DH5	1	1.172	Pass

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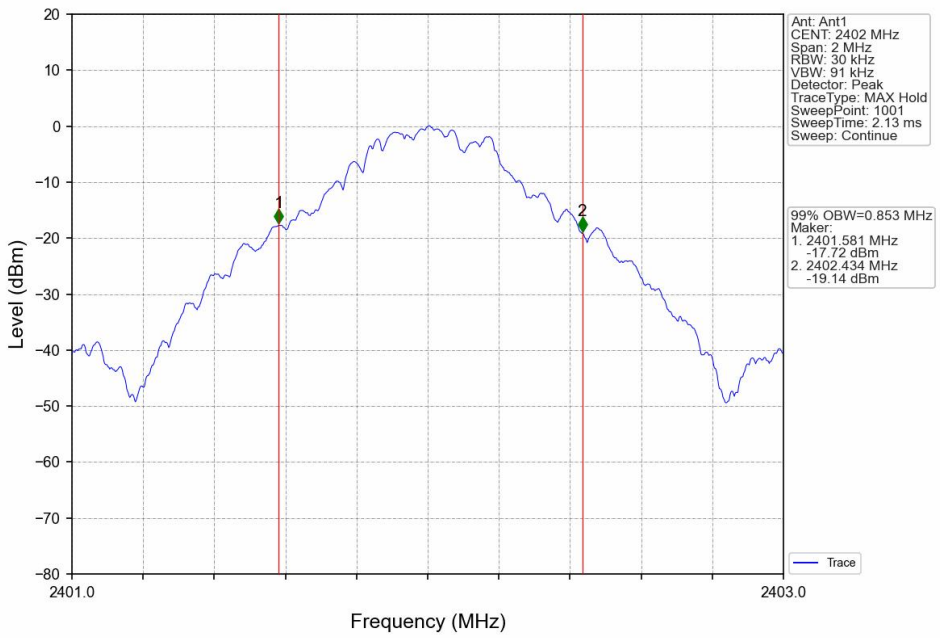
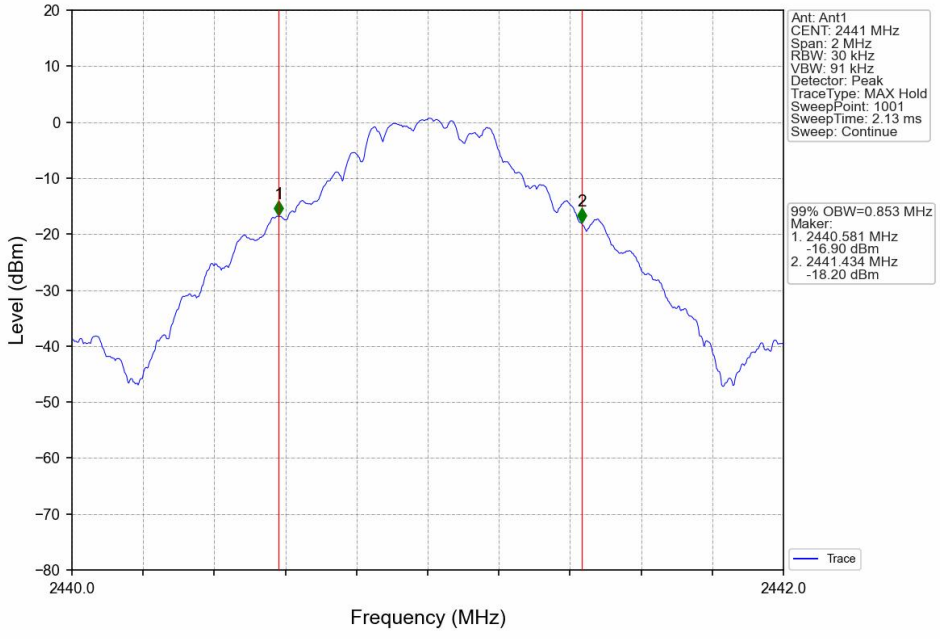
1.1.2 Test Graph

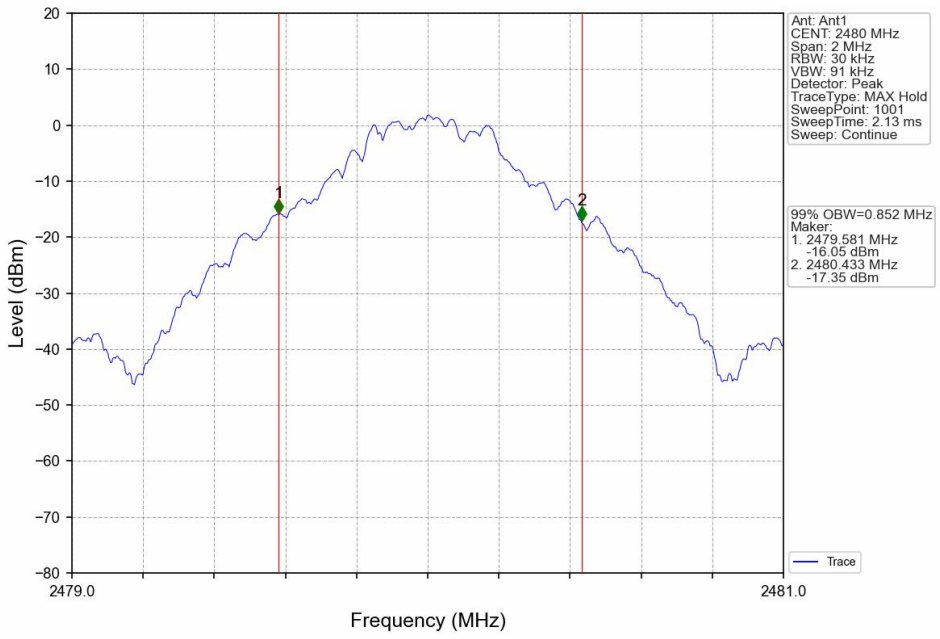
GFSK_DH5_LCH_2402MHz_Ant1_NTNV



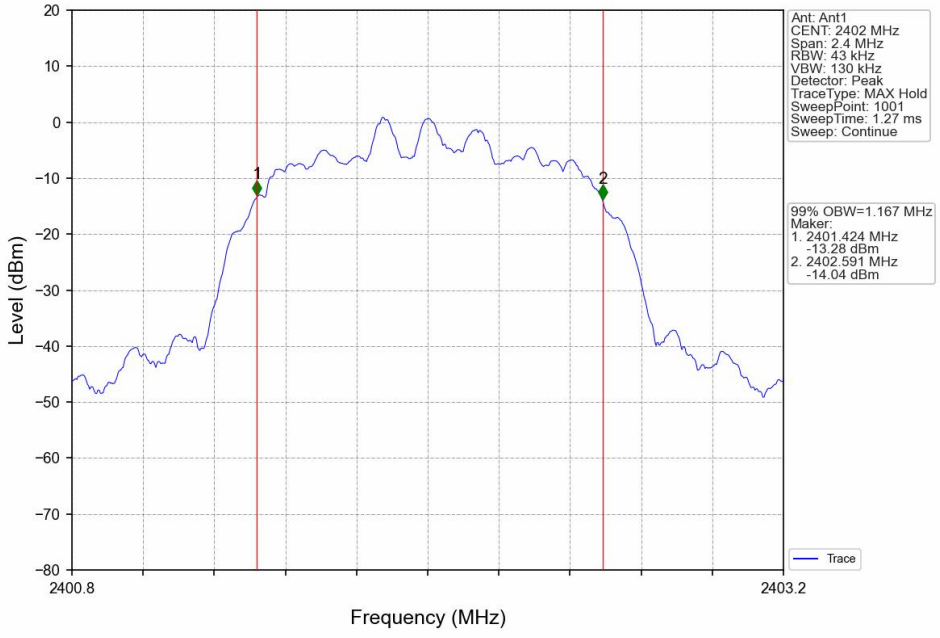
GFSK_DH5_MCH_2441MHz_Ant1_NTNV



GFSK_DH5_HCH_2480MHz_Ant1_NTNV



Pi/4DQPSK_2DH5_LCH_2402MHz_Ant1_NTNV



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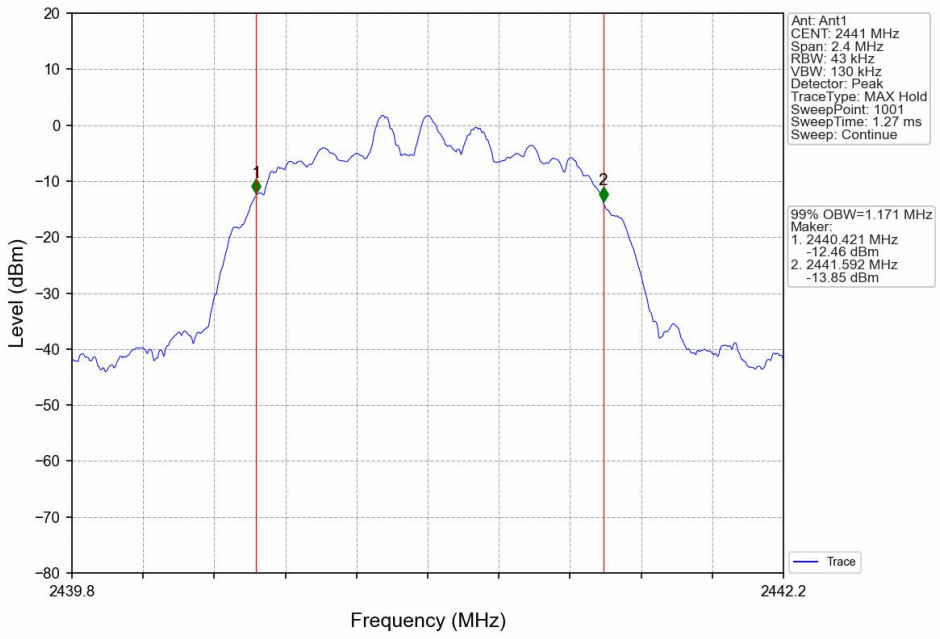
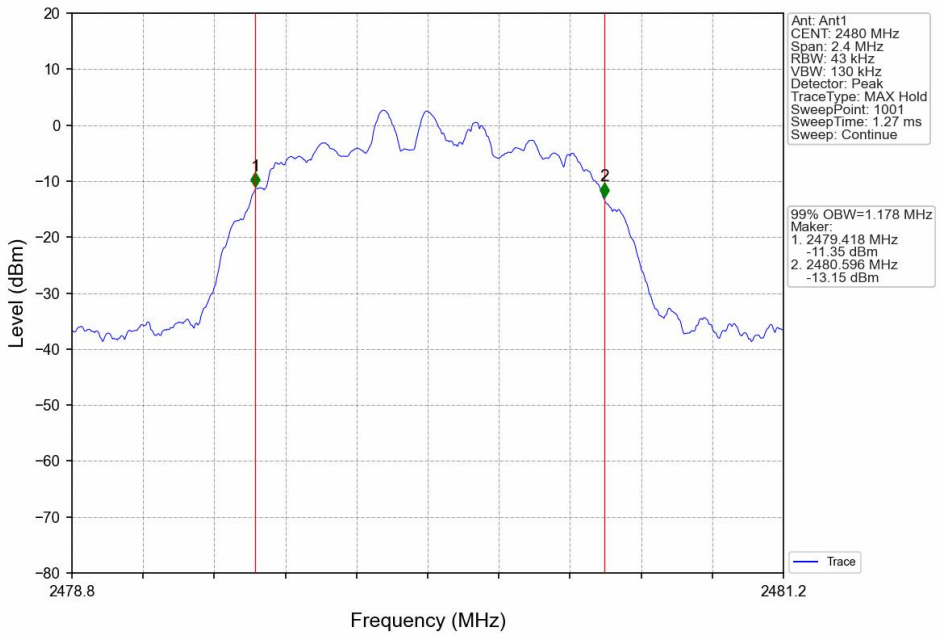
Pi/4DQPSK_2DH5_MCH_2441MHz_Ant1_NTNV



Pi/4DQPSK_2DH5_HCH_2480MHz_Ant1_NTNV



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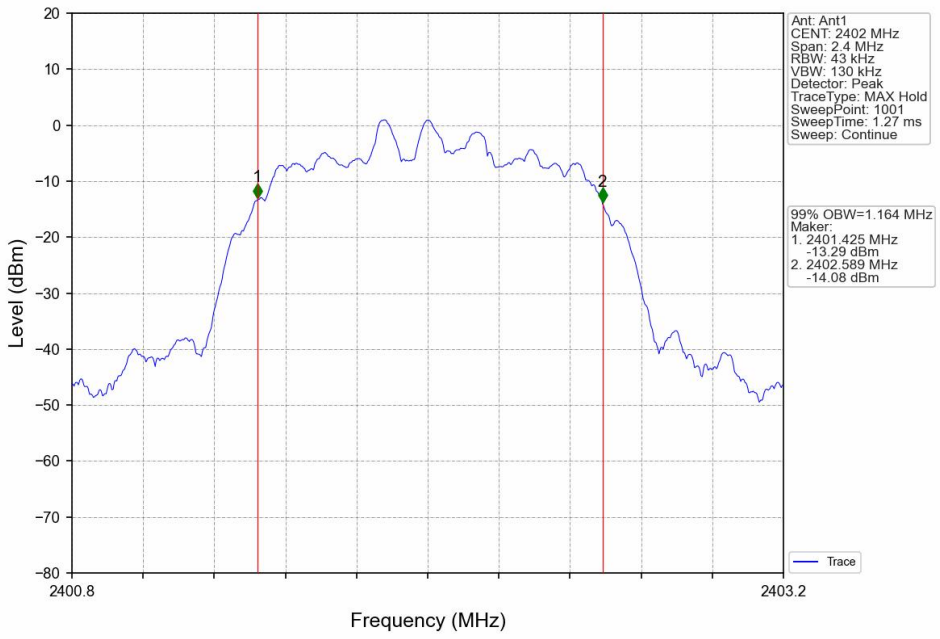
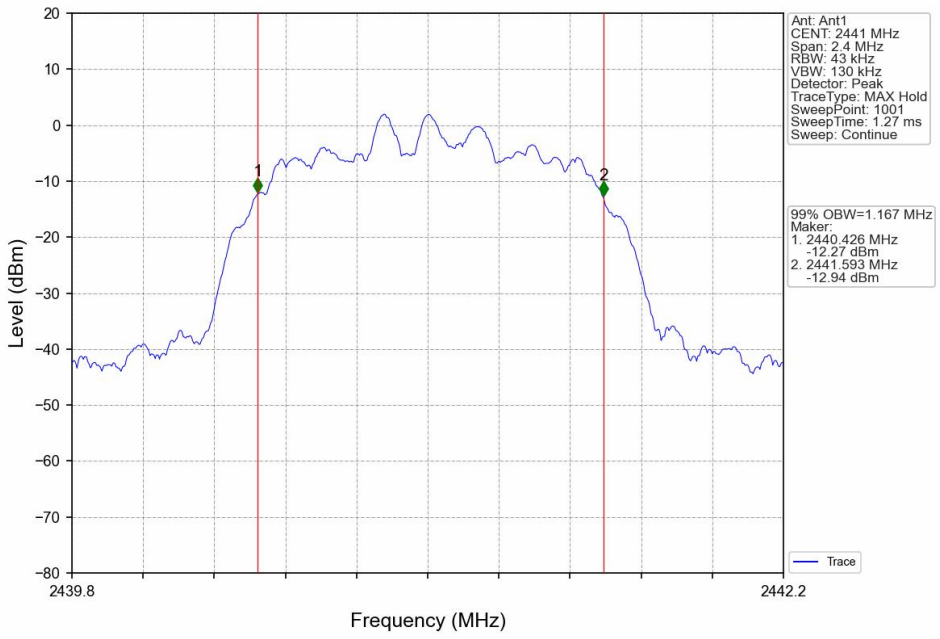
8DPSK_3DH5_LCH_2402MHz_Ant1_NTNV



8DPSK_3DH5_MCH_2441MHz_Ant1_NTNV



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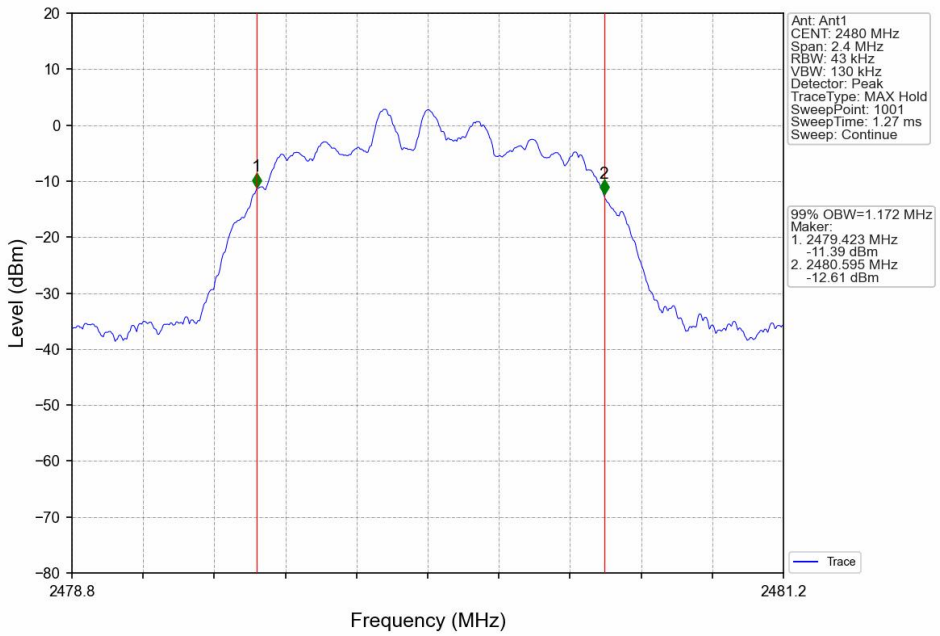
8DPSK_3DH5_HCH_2480MHz_Ant1_NTNV



1.2 20dB BW

1.2.1 Test Result

Mode	TX Type	Frequency (MHz)	Packet Type	ANT	20dB Bandwidth (MHz) Result	Verdict
GFSK	SISO	2402	DH5	1	0.950	Pass
		2441	DH5	1	0.949	Pass
		2480	DH5	1	0.956	Pass
Pi/4DQPSK	SISO	2402	2DH5	1	1.298	Pass
		2441	2DH5	1	1.300	Pass
		2480	2DH5	1	1.319	Pass
8DPSK	SISO	2402	3DH5	1	1.294	Pass
		2441	3DH5	1	1.303	Pass
		2480	3DH5	1	1.302	Pass

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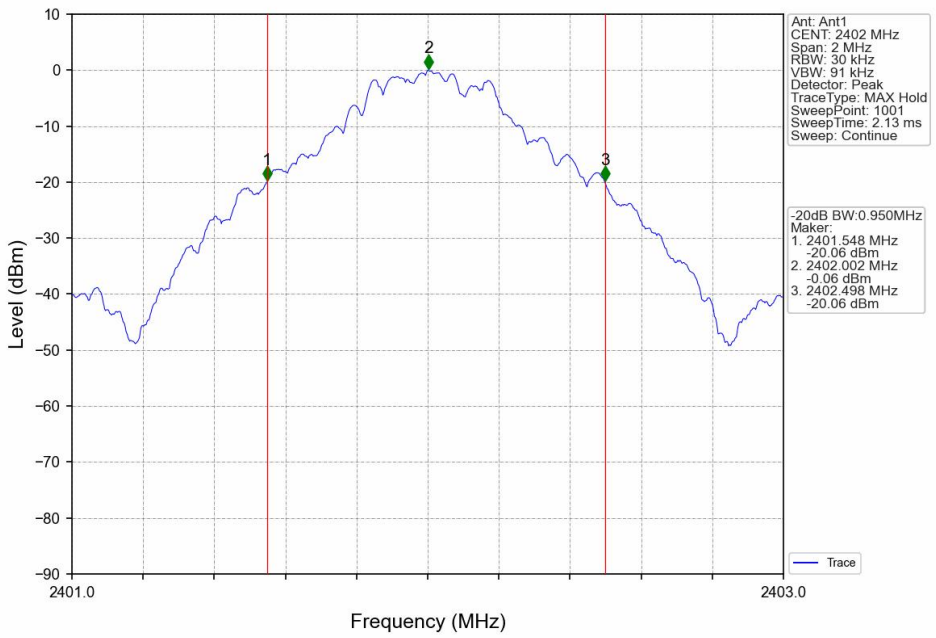
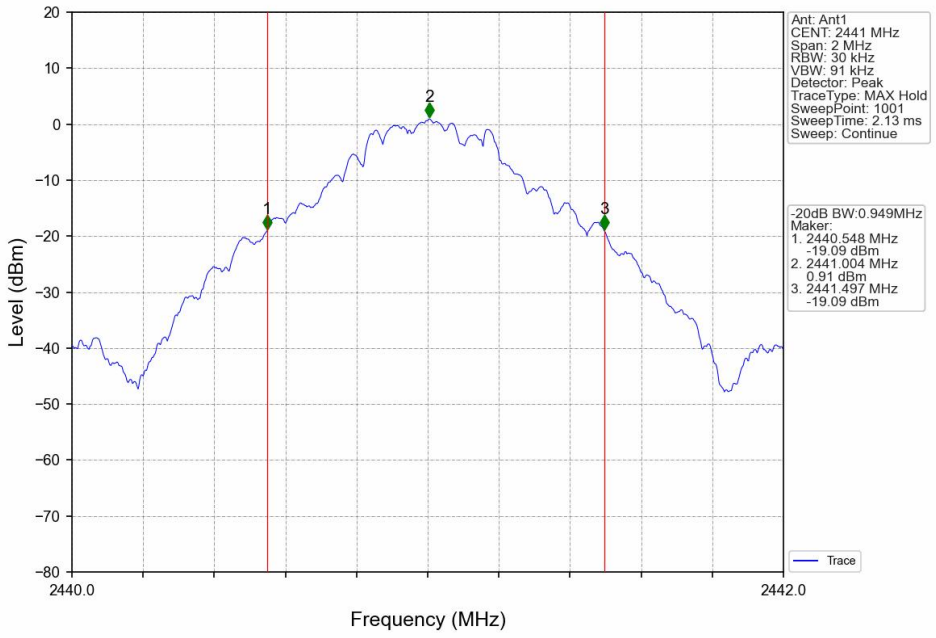
1.2.2 Test Graph

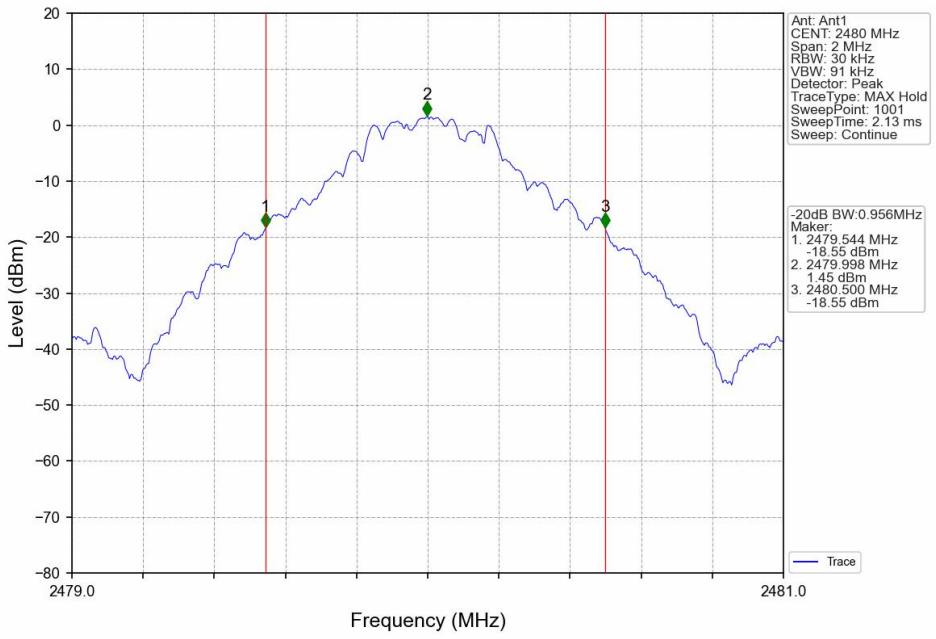
GFSK_DH5_LCH_2402MHz_Ant1_NTNV



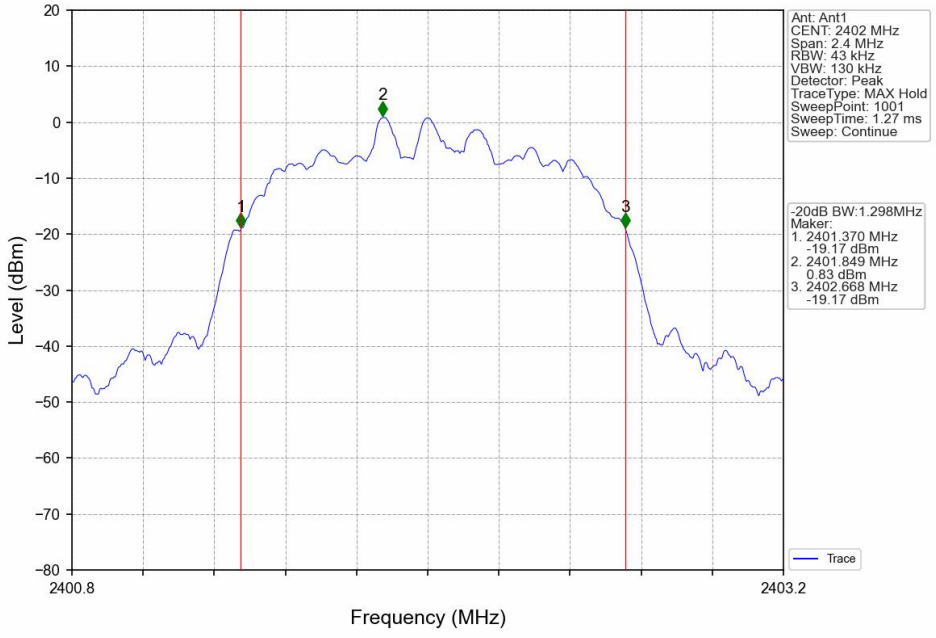
GFSK_DH5_MCH_2441MHz_Ant1_NTNV



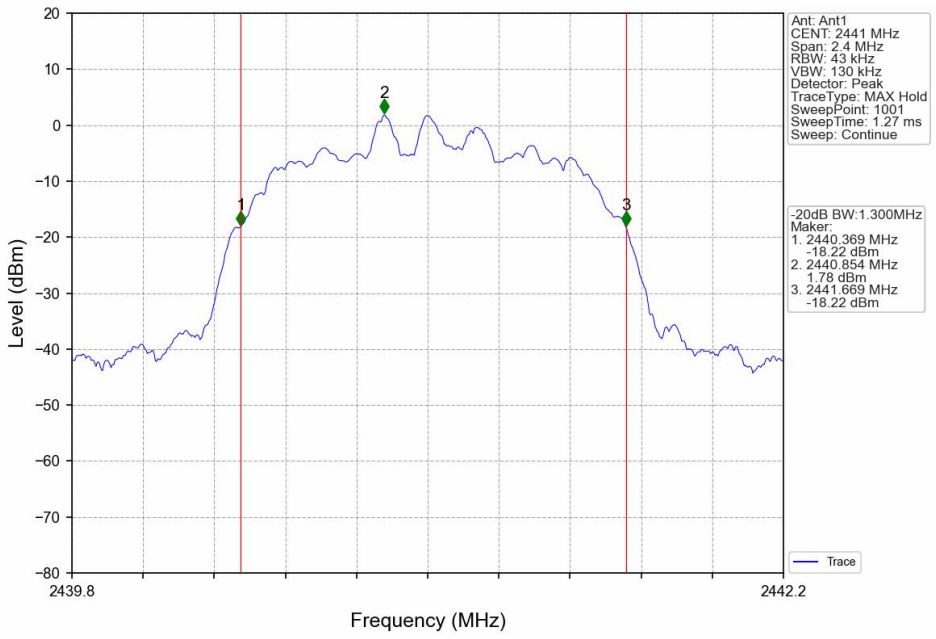
GFSK_DH5_HCH_2480MHz_Ant1_NTNV



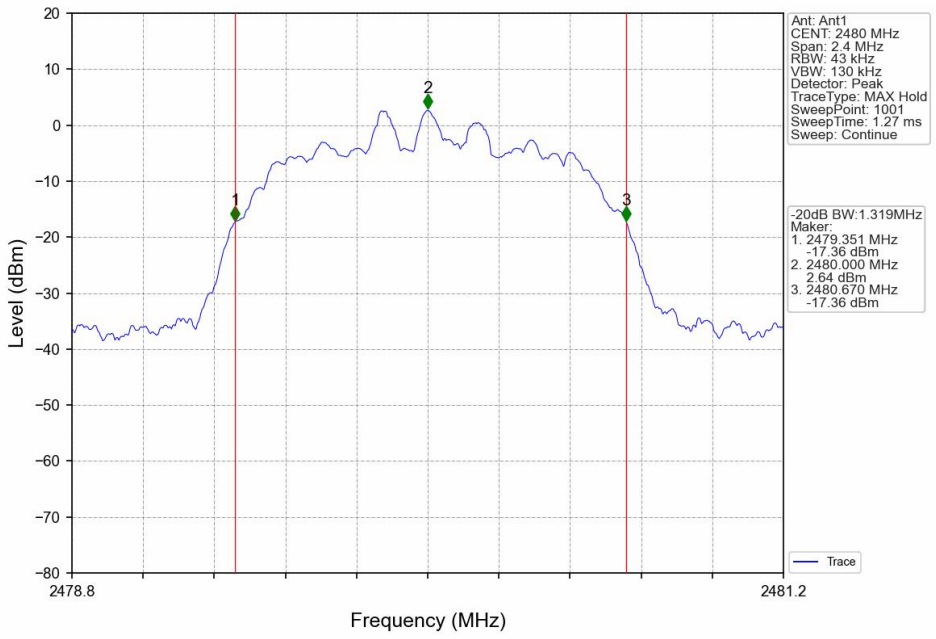
Pi/4DQPSK_2DH5_LCH_2402MHz_Ant1_NTNV



Pi/4DQPSK_2DH5_MCH_2441MHz_Ant1_NTNV



Pi/4DQPSK_2DH5_HCH_2480MHz_Ant1_NTNV



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