FCC Test Report

Application No.:	DNT240707R1215-2127
Applicant:	Zhongshan Haoshi Electronics Co., LTD
Address of Applicant:	No.5-8 card,2nd floor,Building 9, No. 33-35, East Jucheng Avenue, Xiaolan Town, Zhongshan City
EUT Description:	Musical instrument speaker
Model No.:	X20
FCC ID:	2BF5H-X20
Power Supply:	DC 7.4V From Battery; DC 5V From Adapter Input AC 100-240V,50/60Hz
Charging Voltage:	DC 5V/0.5A
Trade Mark:	/
Standards:	47 CFR FCC Part 2, Subpart J 47 CFR Part 15, Subpart C ANSI C63.10: 2013
Date of Receipt:	2024/4/19
Date of Test:	2024/4/20 to 2024/4/25
Date of Issue:	2024/4/26
Test Result:	**PASS ***

Prepared By: Wayne.Lin (Testing Engineer)

Reviewed By: Pencils.Chen (Project Engineer)

Approved By: Wick.Peng (Manager)

Note: If there is any objection to the results in this report, please submit a written inquiry to the company within 15 days from the date of receiving the report. The test report is effective only with both signature and specialized stamp, and is issued by the company in accordance with the requirements of the "Conditions of Issuance of Test Reports" printed in the attached page. Unless otherwise stated, the results presented in this report only apply to the samples tested this time. Partial reproduction of this report is not allowed unless approved by the company in writing.

Dongguan DN Testing Co., Ltd.

Add: No. 1, West Fourth Street, Xingfa South Road, Wusha Community, Chang 'an Town, Dongguan City, Guangdong P.R.China

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Report Revise Record

Report Version	Revise Time	Issued Date	Valid Version	Notes
V1.0	/	Apr.26, 2024	Valid	Original Report

1 Test Summary

Test Item	Test Requirement	Test Method	Test Result	Result
Antenna Requirement	15.203/247(b)	--	Clause 3.1	PASS
20dB Emission Bandwidth	15.247 (a)(1)	ANSI C63.10 (2013)	Clause 3.2	PASS
Conducted Peak Output Power	15.247 (b)(1)	ANSI C63.10 (2013)	Clause 3.3	PASS
Carrier Frequencies Separation	15.247 (a)(1)	ANSI C63.10 (2013)	Clause 3.4	PASS
Dwell Time	15.247 (a)(1)	ANSI C63.10 (2013)	Clause 3.5	PASS
Hopping Channel Number	15.247 (a)(1)	ANSI C63.10 (2013)	Clause 3.6	PASS
Band-edge for RF Conducted Emissions	15.247(d)	ANSI C63.10 (2013)	Clause 3.7	PASS
RF Conducted Spurious Emissions	15.247(d)	ANSI C63.10 (2013)	Clause 3.8	PASS
Radiated Spurious emissions	15.247(d); 15.205/15.209	ANSI C63.10 (2013)	Clause 3.9	PASS
Restricted bands around fundamental frequency (Radiated Emission)	15.247(d); 15.205/15.209	ANSI C63.10 (2013)	Clause 3.10	PASS
AC Power Line Conducted Emission	15.207	ANSI C63.10 (2013)	Clause 3.11	PASS

Note:
1. “N/A” denotes test is not applicable in this test report.

Contents

1 Test Summary 3
2 General Information 5
2.1 Test Location 5
2.2 General Description of EUT 6
2.3 Channel List 7
2.4 Test Environment and Mode 8
2.5 Power Setting of Test Software 9
2.6 Description of Support Units 9
2.7 Test Facility 9
2.8 Measurement Uncertainty (95% confidence levels, k=2) 10
2.9 Equipment List 11
2.10 Assistant equipment used for test 12
3 Test results and Measurement Data 13
3.1 Antenna Requirement 13
3.2 20dB Emission Bandwidth 14
3.3 Conducted Output Power 15
3.4 Carrier Frequencies Separationy 16
3.5 Dwell Time 17
3.6 Hopping Channel Number 18
3.7 Band-edge for RF Conducted Emissions 19
3.8 RF Conducted Spurious Emissions 20
3.9 Radiated Spurious Emissions 21
3.10 Restricted bands around fundamental frequency 29
3.11 AC Power Line Conducted Emissions 33
4 Appendix 36
Appendix A: 20dB Emission Bandwidth 36
Appendix B: Maximum conducted output power 40
Appendix C: Carrier frequency separation 44
Appendix D: Dwell Time 46
Appendix F: Number of hopping channels 50
Appendix F: Band edge measurements 52
Appendix F: Conducted Spurious Emission 56

2 General Information

2.1 Test Location

Company:	Dongguan DN Testing Co., Ltd
Address:	No. 1, West Fourth Street, South Xinfa Road, Wusha Liwu, Chang ' an Town, Dongguan City, Guangdong P.R.China
Test engineer:	Wayne Lin

2.2 General Description of EUT

Manufacturer:	Zhongshan Haoshi Electronics Co., LTD
Address of Manufacturer:	No.5-8 card,2nd floor,Building 9, No. 33-35, East Jucheng Avenue, Xiaolan Town, Zhongshan City
Test EUT Description:	Musical instrument speaker
Model No.:	X20
Additional Model(s):	/
Chip Type:	AB5301A
Serial number:	PR240707R1215
Power Supply:	DC 7.4V From Battery; DC 5V From Adapter Input AC 100-240V,50/60Hz
Charging Voltage:	DC 5V/0.5A
Trade Mark:	/
Hardware Version:	V1.0
Software Version:	V1.0
Operation Frequency:	2402 MHz to 2480 MHz
Modulation Technique:	Frequency Hopping Spread Spectrum(FHSS)
Type of Modulation:	GFSK,π/4-DQPSK,8DPSK
Sample Type:	☒ Portable Device, ☐ Module,☐ Mobile Device
Antenna Type:	☐ External, ☒ Integrated
Antenna Ports:	☒ Ant 1, ☐ Ant 2, ☐ Ant 3
Antenna Gain*:	☒ Provided by applicant
	-0.58dBi
RF Cable*:	☒ Provided by applicant
	0.5dB(0.6~1GHz); 0.8dB(1.4~2GHz); 1.0dB(2.1~2.7GHz); 1.5dB(3~4GHz); 1.8dB(4.4~6GHz);

Remark:

*Since the above data and/or information is provided by the applicant relevant results or conclusions of this report are only made for these data and/or information, DNT is not responsible for the authenticity, integrity and results of the data and information and/or the validity of the conclusion.

2.3 Channel List

Operation Frequency of each channel							
Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
0	2402MHz	20	2422MHz	40	2442MHz	60	2462MHz
1	2403MHz	21	2423MHz	41	2443MHz	61	2463MHz
2	2404MHz	22	2424MHz	42	2444MHz	62	2464MHz
3	2405MHz	23	2425MHz	43	2445MHz	63	2465MHz
4	2406MHz	24	2426MHz	44	2446MHz	64	2466MHz
5	2407MHz	25	2427MHz	45	2447MHz	65	2467MHz
6	2408MHz	26	2428MHz	46	2448MHz	66	2468MHz
7	2409MHz	27	2429MHz	47	2449MHz	67	2469MHz
8	2410MHz	28	2430MHz	48	2450MHz	68	2470MHz
9	2411MHz	29	2431MHz	49	2451MHz	69	2471MHz
10	2412MHz	30	2432MHz	50	2452MHz	70	2472MHz
11	2413MHz	31	2433MHz	51	2453MHz	71	2473MHz
12	2414MHz	32	2434MHz	52	2454MHz	72	2474MHz
13	2415MHz	33	2435MHz	53	2455MHz	73	2475MHz
14	2416MHz	34	2436MHz	54	2456MHz	74	2476MHz
15	2417MHz	35	2437MHz	55	2457MHz	75	2477MHz
16	2418MHz	36	2438MHz	56	2458MHz	76	2478MHz
17	2419MHz	37	2439MHz	57	2459MHz	77	2479MHz
18	2420MHz	38	2440MHz	58	2460MHz	78	2480MHz
19	2421MHz	39	2441MHz	59	2461MHz		

Remark:
In section 15.31(m), regards to the operating frequency range over 10 MHz, the Lowest frequency, the middle frequency, and the highest frequency of channel were selected to perform the test, and the selected channel see below:

Channel	Frequency
The Lowest channel	2402MHz
The Middle channel	2441MHz
The Highest channel	2480MHz

2.4 5Test Environment and Mode

Operating Environment:	
Temperature:	20~25.0 ˚C
Humidity:	45~56 % RH
Atmospheric Pressure:	101.0~101.30 KPa
Test mode:	
Transmitting mode:	Keep the EUT in transmitting mode with all kind of modulation and all kind of data rate.

2.5 Power Setting of Test Software

Software Name	BT_Tool V1.0.9		
Frequency(MHz)	2402	2441	2480
GFSK Setting	7	7	7
π/4-DQPSK Setting	7	7	7
8DPSK	7	7	7

2.6 Description of Support Units

The EUT has been tested independent unit.

2.7 Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

Lab A:

• FCC, USA

Designation Number: CN1348

• A2LA (Certificate No. 7050.01)

DONGGUAN DN TESTING CO., LTD. is accredited by the American Association for Laboratory Accreditation(A2LA). Certificate No. 7050.01.

• Innovation, Science and Economic Development Canada

DONGGUAN DN TESTING CO., LTD. EMC Laboratory has been recognized by ISED as an accredited testing laboratory.

IC#: 31026.

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

No.	Item	Measurement Uncertainty
1	20dB Emission Bandwidth	±0.0196%
2	Carrier Frequency Separation	±1.9%
3	Number of Hopping Channel	±1.9%
4	Time of Occupancy	±0.028%
5	Max Peak Conducted Output Power	±0.743 dB
6	Band-edge Spurious Emission	±1.328 dB
7	Conducted RF Spurious Emission	9KHz-1GHz:±0.746dB 1GHz-26GHz:±1.328dB

No.	Item	Measurement Uncertainty
1	Conduction Emission	± 3.0dB (150kHz to 30MHz)
2	Radiated Emission	± 4.8dB (Below 1GHz)
		± 4.8dB (1GHz to 6GHz)
		± 4.5dB (6GHz to 18GHz)
		± 5.02dB (Above 18GHz)

2.9 Equipment List

For Connect EUT Antenna Terminal Test					
Description	Manufacturer	Model	Serial Number	Cal date	Due date
Signal Generator	Keysight	N5181A-6G	MY48180415	2023-10-25	2024-10-24
Signal Generator	Keysight	N5182B	MY57300617	2023-10-25	2024-10-24
Power supply	Keysight	E3640A	ZB2022656	2023-10-25	2024-10-24
Radio Communication Tester	R&S	CMW500	105082	2023-10-25	2024-10-24
Spectrum Analyzer	Aglient	N9010A	MY52221458	2023-10-25	2024-10-24
BT/WIFI Test Software	Tonscend	JS1120 V3.1.83	NA	NA	NA
RF Control Unit	Tonscend	JS0806-2	22F8060581	NA	NA
Power Sensor	Anritsu	ML2495A	2129005	2023-10-25	2024-10-24
Pulse Power Sensor	Anritsu	MA2411B	1911397	2023-10-25	2024-10-24
temperature and humidity box	SCOTEK	SCD-C40-80PRO	6866682020008	2023-10-25	2024-10-24

Test Equipment for Conducted Emission					
Description	Manufacturer	Model	Serial Number	Cal Date	Due Date
Receiver	R&S	ESCI3	101152	2023-10-24	2024-10-23
LISN	R&S	ENV216	102874	2023-10-24	2024-10-23
ISN	R&S	ENY81-CA6	1309.8590.03	2023-10-24	2024-10-23

Test Equipment for Radiated Emission(30MHz-1000MHz)					
Description	Manufacturer	Model	Serial Number	Cal Date	Due Date
Receiver	R&S	ESR7	102497	2023-10-24	2024-10-23
Test Software	ETS-LINDGREN	TiLE-FULL	NA	NA	NA
RF Cable	ETS-LINDGREN	RFC-NMS-100-NMS-350-IN	NA	2023-10-24	2024-10-23
Log periodic antenna	ETS-LINDGREN	VULB 9168	01475	2023-10-24	2024-10-23
Pre-amplifier	Schwarzbeck	BBV9743B	00423	2023-10-24	2024-10-23

Test Equipment for Radiated Emission(Above 1000MHz)					
Description	Manufacturer	Model	Serial Number	Cal Date	Due Date
Frequency analyser	Keysight	N9010A	MY52221458	2023-10-24	2024-10-23
RF Cable	ETS-LINDGREN	RFC-NMS-100-NMS-350-IN	NA	2023-10-24	2024-10-23
Horn Antenna	ETS-LINDGREN	3117	00252567	2023-10-24	2024-10-23
Double ridged waveguide antenna	ETS-LINDGREN	3116C	00251780	2023-10-24	2024-10-23
Test Software	ETS-LINDGREN	TiLE-FULL	NA	NA	NA
Pre-amplifier	ETS-LINDGREN	3117-PA	252567	2023-10-24	2024-10-23
Pre-amplifier	ETS-LINDGREN	3116C-PA	251780	2023-10-24	2024-10-23

2.10 Assistant equipment used for test

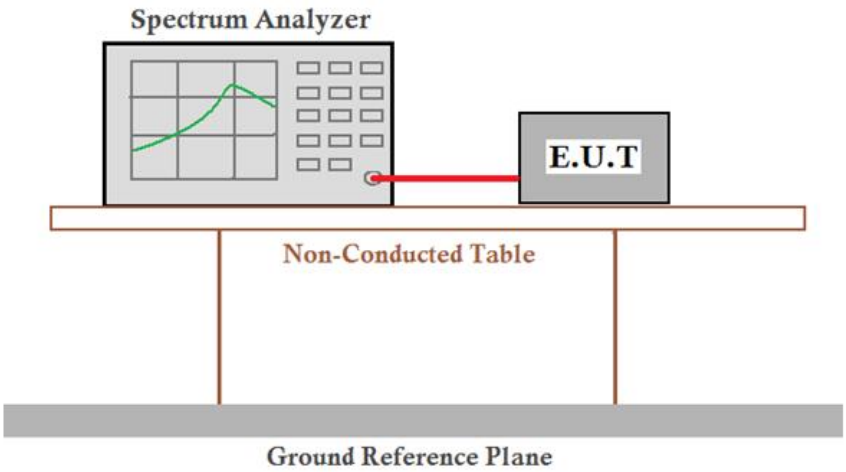
Code	Equipment	Manufacturer	Model No.	Equipment No.
1	Computer	acer	N22C8	EMC notebook01
2	Adapter	HUAWEI	HW-100225C00	NA

3 Test results and Measurement Data

3.1 Antenna Requirement

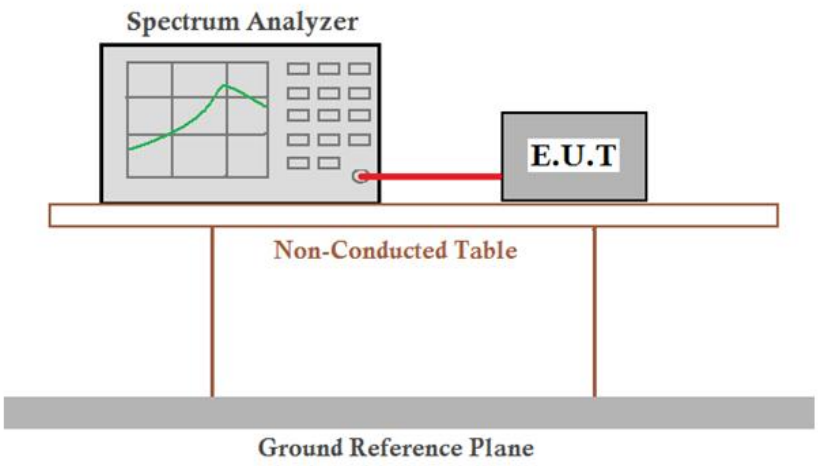
Standard requirement:	47 CFR Part 15C Section 15.203 /247(c)
15.203 requirement: An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. 15.247(b) (4) requirement: The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.	
The antenna is integrated on the main PCB and no consideration of replacement. The best case gain of the antenna is -0.58dBi.	

3.2 20dB Emission Bandwidth

Test Requirement:	47 CFR Part 15C Section 15.247 (a)(1)
Test Method:	ANSI C63.10:2013 Section 7.8.7
Test Setup:	
Instruments Used:	Refer to section 2.9 for details
Exploratory Test Mode:	Non-hopping transmitting with all kind of modulation and all kind of data type.
Final Test Mode:	Through Pre-scan, find the worst case of all modulation type.
Limit:	NA
Test Results:	Pass

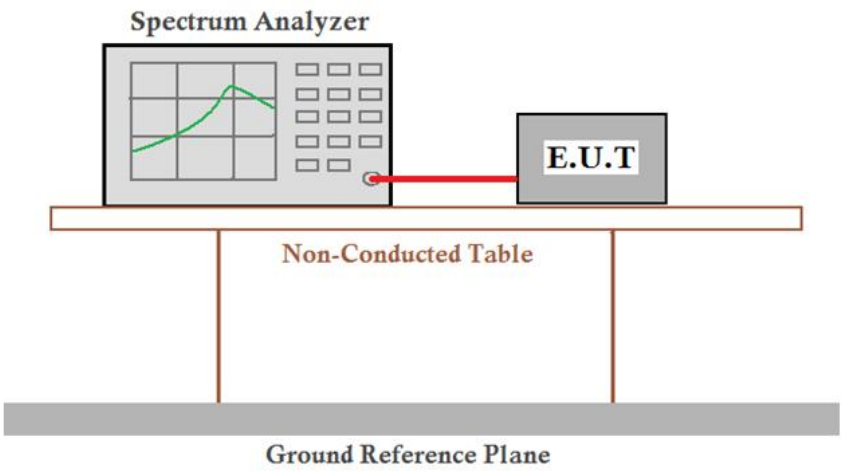
The detailed test data see: **Appendix A**

3.3 Conducted Output Power

Test Requirement:	47 CFR Part 15C Section 15.247 (b)(1)
Test Method:	ANSI C63.10:2013 Section 7.8.5
Test Setup:	
Test Instruments:	Refer to section 2.9 for details
Exploratory Test Mode:	Non-hopping transmitting with all kind of modulation and all kind of data type.
Final Test Mode:	Through Pre-scan, find the worst case of all modulation type.
Limit:	(20.97dBm) 125mW
Test Results:	Pass

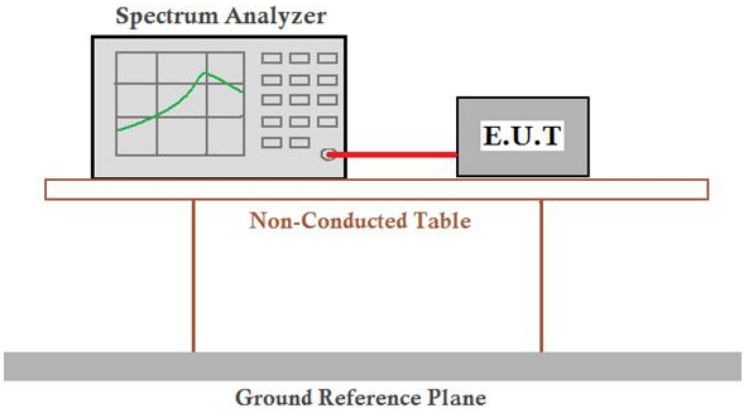
The detailed test data see: **Appendix B**

3.4 Carrier Frequencies Separationy

Test Requirement:	47 CFR Part 15C Section 15.247 (a)(1)
Test Method:	ANSI C63.10:2013 Section 7.8.2
Test Setup:	
Test Instruments:	Refer to section 2.9 for details
Exploratory Test Mode:	Hopping transmitting with all kind of modulation and all kind of data type.
Final Test Mode:	Through Pre-scan, find the worst case of all modulation type.
Limit:	2/3 of the 20dB bandwidth
	Remark: the transmission power is less than 0.125W.
Test Results:	Pass

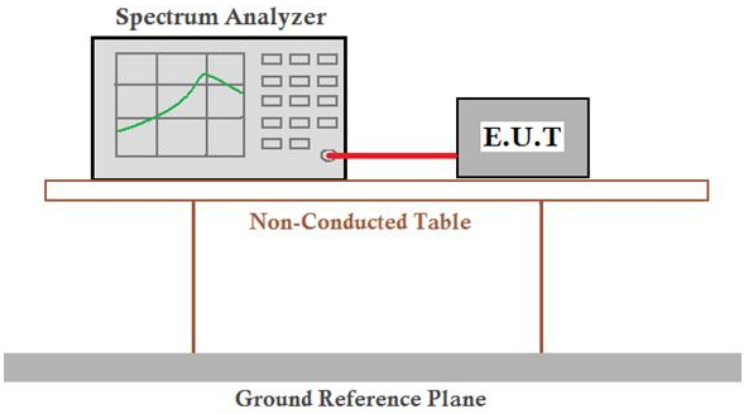
The detailed test data see: **Appendix C**

3.5 Dwell Time

Test Requirement:	47 CFR Part 15C Section 15.247 (a)(1)
Test Method:	ANSI C63.10:2013 Section 7.8.4
Test Setup:	
Instruments Used:	Refer to section 2.9 for details
Test Mode:	Hopping transmitting with all kind of modulation and all kind of data type.
Limit:	0.4 Second
Test Results:	Pass

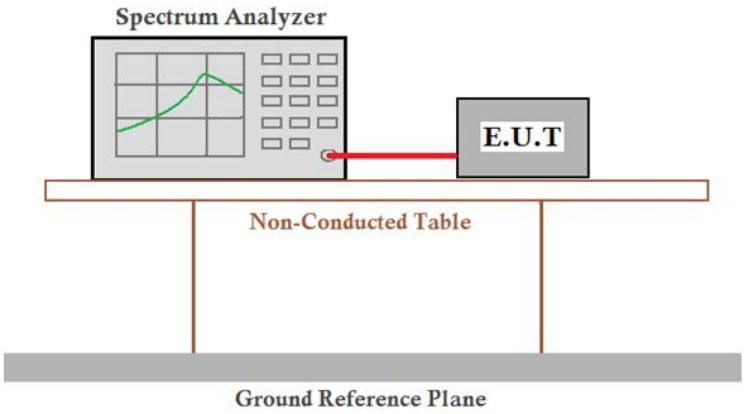
The detailed test data see: **Appendix D**

3.6 Hopping Channel Number

Test Requirement:	47 CFR Part 15C Section 15.247 (a)(1)
Test Method:	ANSI C63.10:2013 Section 7.8.3
Test Setup:	
Instruments Used:	Refer to section 2.9 for details
Test Mode:	Hopping transmitting with all kind of modulation
Limit:	At least 15 channels
Test Results:	Pass

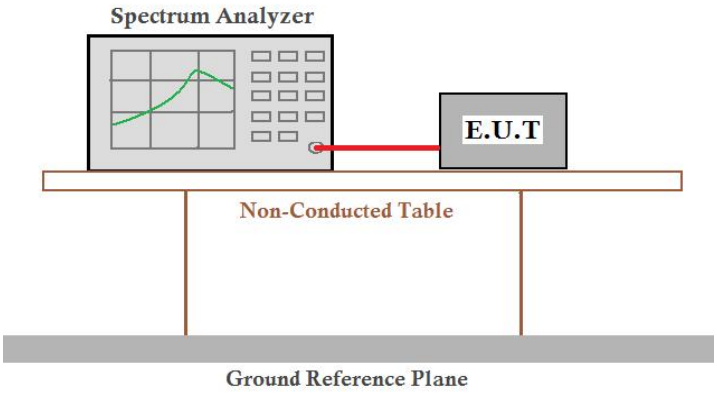
The detailed test data see: **Appendix E**

3.7 Band-edge for RF Conducted Emissions

Test Requirement:	47 CFR Part 15C Section 15.247 (d)
Test Method:	ANSI C63.10:2013 Section 7.8.6
Test Setup:	
Instruments Used:	Refer to section 2.9 for details
Exploratory Test Mode:	Hopping and Non-hopping transmitting with all kind of modulation and all kind of data type.
Final Test Mode:	Through Pre-scan, find the worst case of all modulation type.
Limit:	In any 100 kHz bandwidth outside the frequency band in which the spread spectrum 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.
Test Results:	Pass

The detailed test data see: **Appendix F**

3.8 RF Conducted Spurious Emissions

Test Requirement:	47 CFR Part 15C Section 15.247 (d)
Test Method:	ANSI C63.10: 2013 Section 11.11
Test Setup:	
Instruments Used:	Refer to section 2.9 for details
Exploratory Test Mode:	Transmitting with all kind of modulations, data rates
Final Test Mode:	Through Pre-scan, find the worst case of all modulation type.
Limit:	In any 100 kHz bandwidth outside the frequency band in which the spread spectrum 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.
Test Results:	Pass

The detailed test data see: **Appendix G**

3.9 Radiated Spurious Emissions

Test Requirement:	47 CFR Part 15C Section 15.209 and 15.205				
Test Method:	ANSI C63.10: 2013 Section 11.12				
Test Site:	Measurement Distance: 3m or 10m (Semi-Anechoic Chamber)				
Receiver Setup:	Frequency	Detector	RBW	VBW	Remark
	0.009MHz-0.090MHz	Peak	10kHz	30kHz	Peak
	0.009MHz-0.090MHz	Average	10kHz	30kHz	Average
	0.090MHz-0.110MHz	Quasi-peak	10kHz	30kHz	Quasi-peak
	0.110MHz-0.490MHz	Peak	10kHz	30kHz	Peak
	0.110MHz-0.490MHz	Average	10kHz	30kHz	Average
	0.490MHz -30MHz	Quasi-peak	10kHz	30kHz	Quasi-peak
	30MHz-1GHz	Quasi-peak	120kHz	300kHz	Quasi-peak
	Above 1GHz	Peak	1MHz	3MHz	Peak
		Peak	1MHz	10Hz (DC⩾0.98) ⩾1/T (DC<0.98)	Average
Limit:	Frequency	Field strength (microvolt/meter)	Limit (dBuV/m)	Remark	Measurement distance (m)
	0.009MHz-0.490MHz	2400/F(kHz)	-	-	300
	0.490MHz-1.705MHz	24000/F(kHz)	-	-	30
	1.705MHz-30MHz	30	-	-	30
	30MHz-88MHz	100	40.0	Quasi-peak	3
	88MHz-216MHz	150	43.5	Quasi-peak	3
	216MHz-960MHz	200	46.0	Quasi-peak	3
	960MHz-1GHz	500	54.0	Quasi-peak	3
	Above 1GHz	500	54.0	Average	3
	Remark: 15.35(b),Unless otherwise specified, the limit on peak radio frequency emissions is 20dB above the maximum permitted average emission limit applicable to the equipment under test. This peak limit applies to the total peak emission level radiated by the device.				

Test Setup:

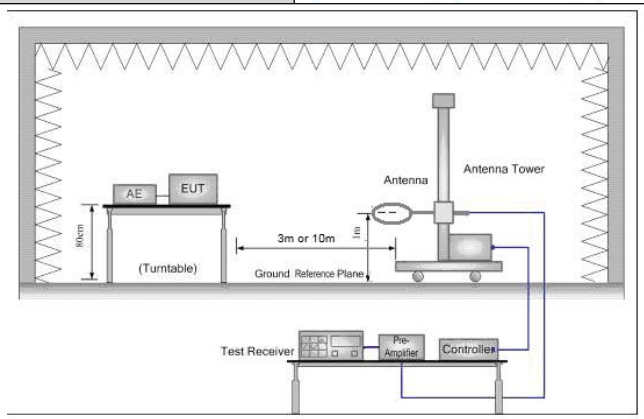


Figure 1. Below 30MHz

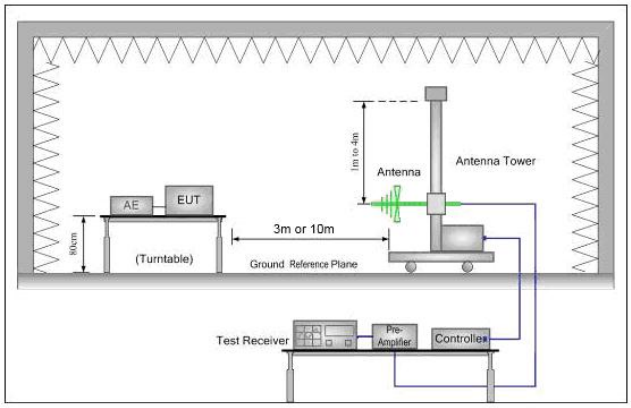


Figure 2. 30MHz to 1GHz

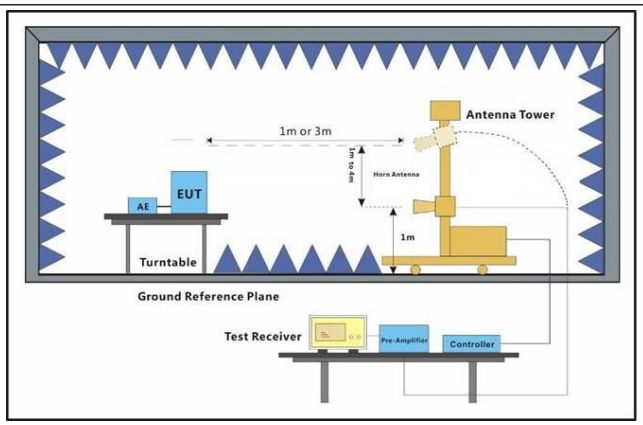


Figure 3. Above 1 GHz

Test Procedure:

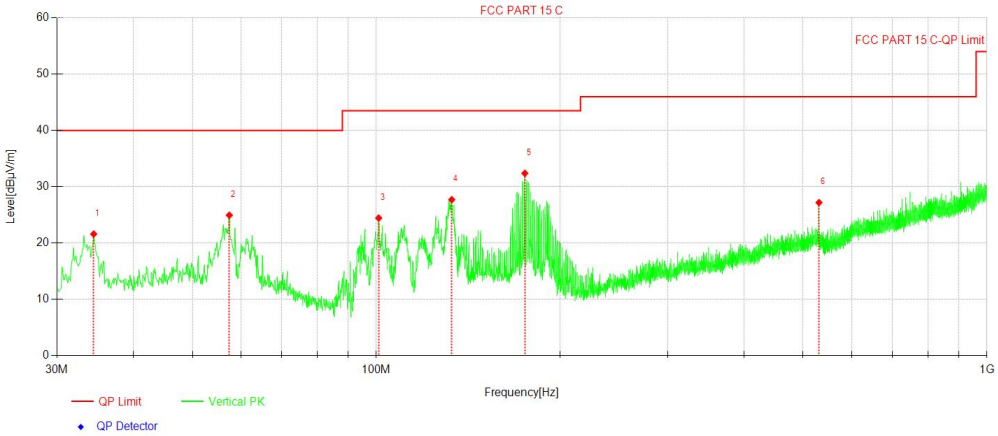
a. For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 or 10 meter semi-anechoic camber. The table was rotated 360 degrees to determine the position of the highest radiation.
b. For above 1GHz, the EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter semi-anechoic camber. The table was rotated 360 degrees to determine the position of the highest radiation
c. The EUT was set 3 or 10 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
d. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
e. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters(for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
f. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
g. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.
h. Test the EUT in the lowest channel, the middle channel ,the Highest channel.
i. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, And found the X axis positioning which it is worse case.
j. Repeat above procedures until all frequencies measured was complete.

Test Configuration:	Measurements Below 1000MHz • RBW = 120 kHz • VBW = 300 kHz • Detector = Peak • Trace mode = max hold Peak Measurements Above 1000 MHz • RBW = 1 MHz • VBW ⩾ 3 MHz • Detector = Peak • Sweep time = auto • Trace mode = max hold Average Measurements Above 1000MHz • RBW = 1 MHz • VBW = 10 Hz, when duty cycle is no less than 98 percent. • VBW ⩾ 1/T, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.
Exploratory Test Mode:	Transmitting with all kind of modulations, data rates. Charge+Transmitting mode.
Final Test Mode:	Pretest the EUT at Transmitting mode. Through Pre-scan, find the DH5 of data type is the worst case of All modulation type.
Instruments Used:	Refer to section 2.9 for details
Test Results:	Pass

Test data

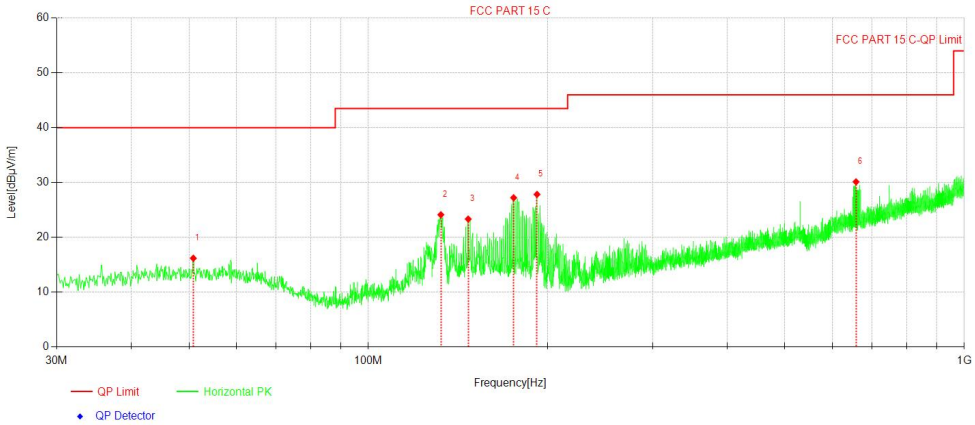
For 30-1000MHz

Vertical:



NO.	Freq. [MHz]	Reading Level [dBµV]	Correct Factor [dB/m]	Result Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Remark
1	34.46	30.97	-9.38	21.59	40.00	18.41	100	98	QP
2	57.45	33.44	-8.51	24.93	40.00	15.07	100	314	QP
3	100.91	36.93	-12.50	24.43	43.50	19.07	100	359	QP
4	132.92	36.86	-9.16	27.70	43.50	15.80	100	360	QP
5	175.12	41.15	-8.77	32.38	43.50	11.12	100	270	QP
6	530.76	28.35	-1.17	27.18	46.00	18.82	100	170	QP

Horizontal :

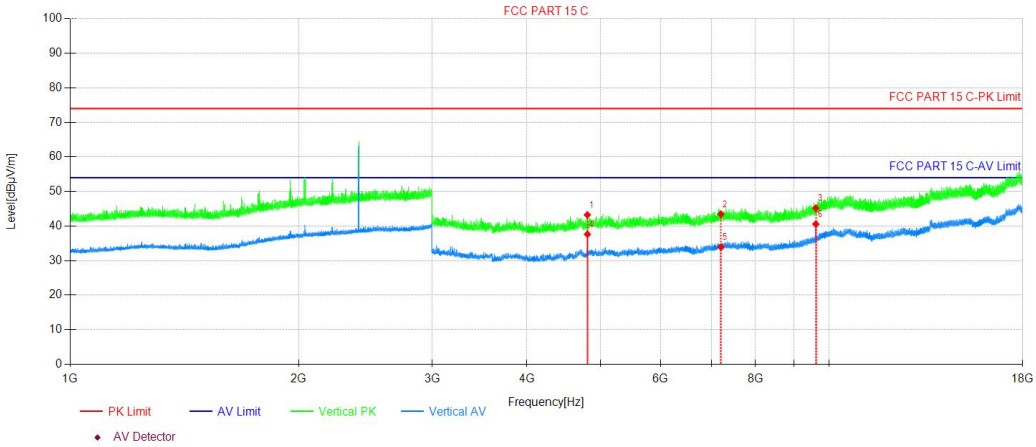


NO.	Freq. [MHz]	Reading Level [dBµV]	Correct Factor [dB/m]	Result Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Remark
1	50.85	24.25	-8.08	16.17	40.00	23.83	100	126	QP
2	132.34	33.32	-9.21	24.11	43.50	19.39	100	0	QP
3	147.09	31.36	-8.04	23.32	43.50	20.18	100	0	QP
4	175.32	36.00	-8.79	27.21	43.50	16.29	100	218	QP
5	191.90	38.52	-10.69	27.83	43.50	15.67	100	22	QP
6	658.23	28.59	1.54	30.13	46.00	15.87	100	305	QP

For above 1GHz

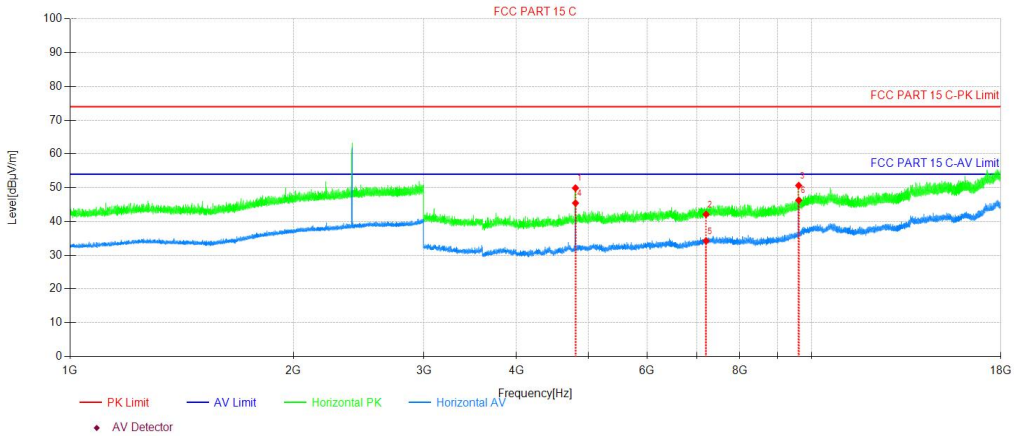
DH5 2402MHz

Vertical:



NO.	Freq. [MHz]	Reading Level [dBμV]	Correct Factor [dB/m]	Result Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Remark
1	4803.84	47.84	-4.61	43.23	74.00	30.77	150	164	Peak
2	7206.21	45.21	-1.76	43.45	74.00	30.55	150	51	Peak
3	9608.58	44.31	0.88	45.19	74.00	28.81	150	107	Peak
4	4804.59	42.24	-4.61	37.63	54.00	16.37	150	149	AV
5	7206.21	35.66	-1.76	33.90	54.00	20.10	150	222	AV
6	9608.58	39.69	0.88	40.57	54.00	13.43	150	51	AV

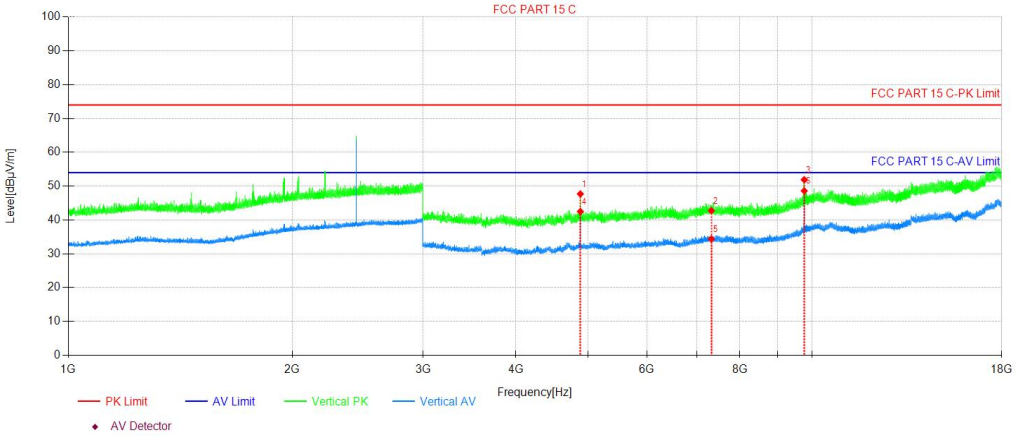
Horizontal:



NO.	Freq. [MHz]	Reading Level [dBμV]	Correct Factor [dB/m]	Result Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Remark
1	4803.84	54.51	-4.61	49.90	74.00	24.10	150	124	Peak
2	7206.21	43.86	-1.76	42.10	74.00	31.90	150	13	Peak
3	9607.83	49.78	0.87	50.65	74.00	23.35	150	124	Peak
4	4804.59	50.05	-4.61	45.44	54.00	8.56	150	124	AV
5	7206.21	35.99	-1.76	34.23	54.00	19.77	150	150	AV
6	9608.58	45.39	0.88	46.27	54.00	7.73	150	111	AV

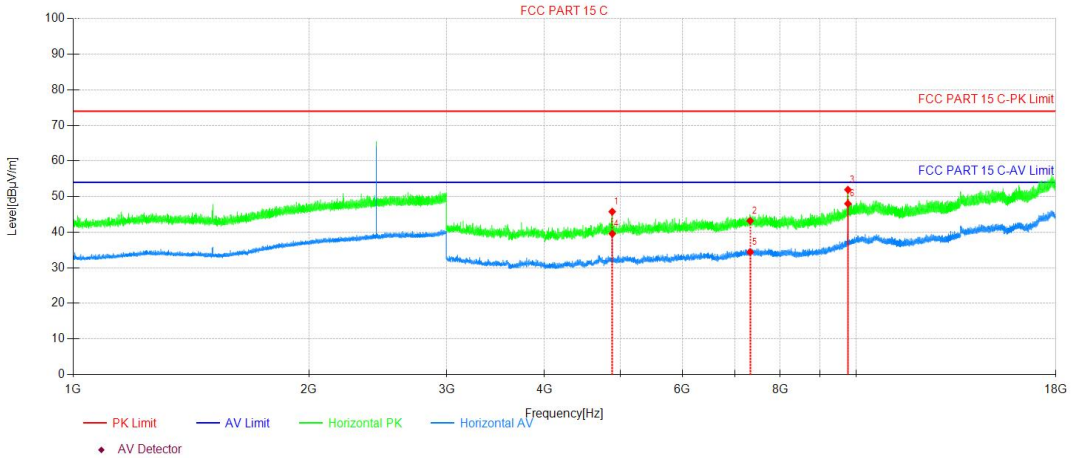
DH5 2441MHz

Vertical:



NO.	Freq. [MHz]	Reading Level [dBμV]	Correct Factor [dB/m]	Result Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Remark
1	4881.84	52.41	-4.72	47.69	74.00	26.31	150	292	Peak
2	7323.21	44.24	-1.49	42.75	74.00	31.25	150	8	Peak
3	9763.83	50.26	1.64	51.90	74.00	22.10	150	122	Peak
4	4882.59	47.21	-4.72	42.49	54.00	11.51	150	292	AV
5	7323.21	35.88	-1.49	34.39	54.00	19.61	150	357	AV
6	9764.58	46.96	1.64	48.60	54.00	5.40	150	135	AV

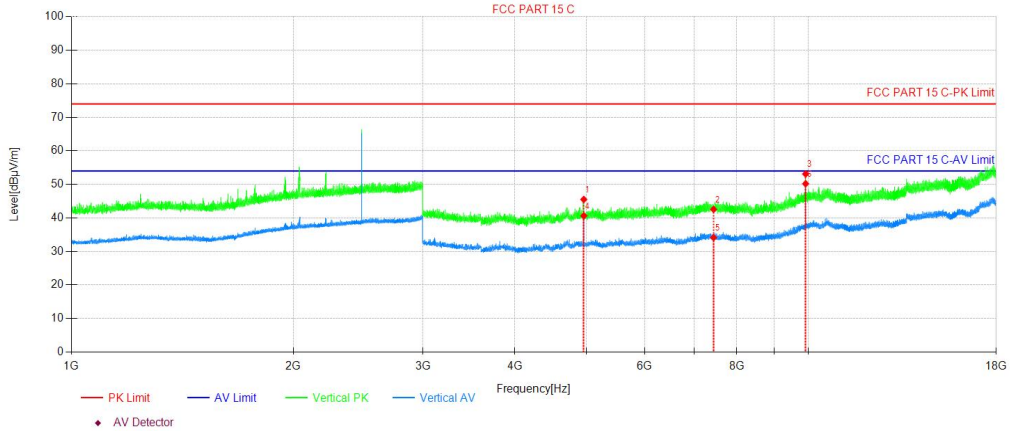
Horizontal:



NO.	Freq. [MHz]	Reading Level [dBμV]	Correct Factor [dB/m]	Result Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Remark
1	4881.84	50.48	-4.72	45.76	74.00	28.24	150	93	Peak
2	7323.21	44.68	-1.49	43.19	74.00	30.81	150	205	Peak
3	9763.83	50.29	1.64	51.93	74.00	22.07	150	148	Peak
4	4882.59	44.27	-4.72	39.55	54.00	14.45	150	176	AV
5	7323.21	35.88	-1.49	34.39	54.00	19.61	150	93	AV
6	9764.58	46.36	1.64	48.00	54.00	6.00	150	148	AV

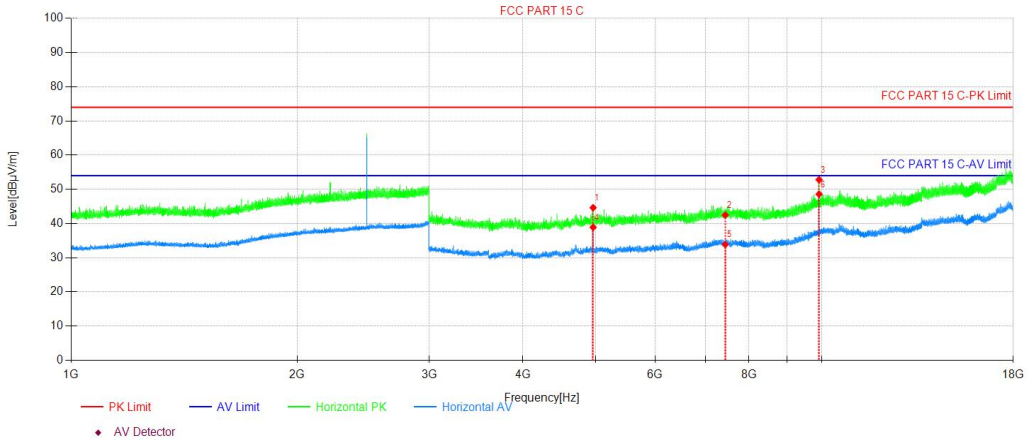
DH5 2480MHz

Vertical:



NO.	Freq. [MHz]	Reading Level [dBμV]	Correct Factor [dB/m]	Result Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Remark
1	4959.09	50.38	-4.86	45.52	74.00	28.48	150	289	Peak
2	7440.22	43.91	-1.34	42.57	74.00	31.43	150	167	Peak
3	9919.84	50.85	2.26	53.11	74.00	20.89	150	124	Peak
4	4960.59	45.49	-4.86	40.63	54.00	13.37	150	302	AV
5	7440.22	35.48	-1.34	34.14	54.00	19.86	150	345	AV
6	9920.59	47.92	2.27	50.19	54.00	3.81	150	138	AV

Horizontal:



NO.	Freq. [MHz]	Reading Level [dBμV]	Correct Factor [dB/m]	Result Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Remark
1	4959.84	49.49	-4.86	44.63	74.00	29.37	150	76	Peak
2	7440.22	43.80	-1.34	42.46	74.00	31.54	150	145	Peak
3	9919.84	50.56	2.26	52.82	74.00	21.18	150	159	Peak
4	4960.59	43.75	-4.86	38.89	54.00	15.11	150	238	AV
5	7440.22	35.20	-1.34	33.86	54.00	20.14	150	225	AV
6	9920.59	46.32	2.27	48.59	54.00	5.41	150	171	AV

Note:

1. The Measurement (Result Level) is calculated by Reading Level adding the Correct Factor(maybe including Ant.Factor and the Cable Factor etc.), The basic equation is as follows:

   Result Level= Reading Level + Correct Factor(including Ant.Factor, Cable Factor etc.)

2. The amplitude of 9KHz to 30MHz spurious emission that is attenuated by more than 20dB below the permissible limit has no need to be reported.

3. The amplitude of 18GHz to 25GHz spurious emission that is attenuated by more than 20dB below the permissible limit has no need to be report.

4. All channels had been pre-test, DH5 is the worse case. only the worst case was reported.

3.10 Restricted bands around fundamental frequency

Test Requirement:	47 CFR Part 15C Section 15.209 and 15.205		
Test Method:	ANSI C63.10: 2013 Section 11.12		
Test Site:	Measurement Distance: 3m or 10m (Semi-Anechoic Chamber)		
Limit:	Frequency	Limit (dBuV/m)	Remark
	30MHz-88MHz	40.0	Quasi-peak
	88MHz-216MHz	43.5	Quasi-peak
	216MHz-960MHz	46.0	Quasi-peak
	960MHz-1GHz	54.0	Quasi-peak
	Above 1GHz	54.0	Average Value
		74.0	Peak Value
Test Setup:			

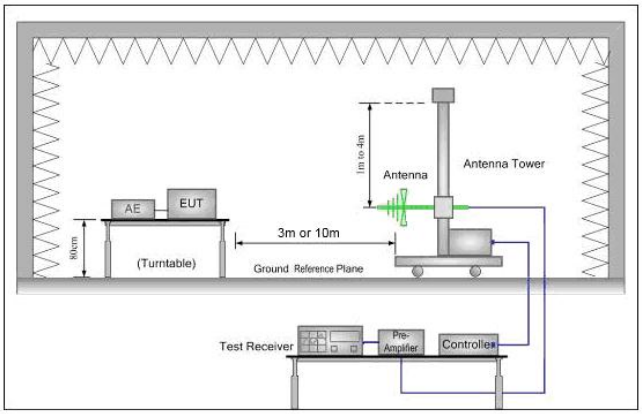


Figure 1. 30MHz to 1GHz

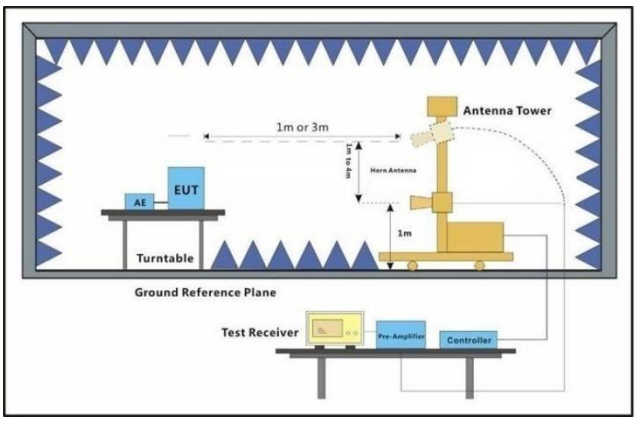


Figure 2. Above 1 GHz

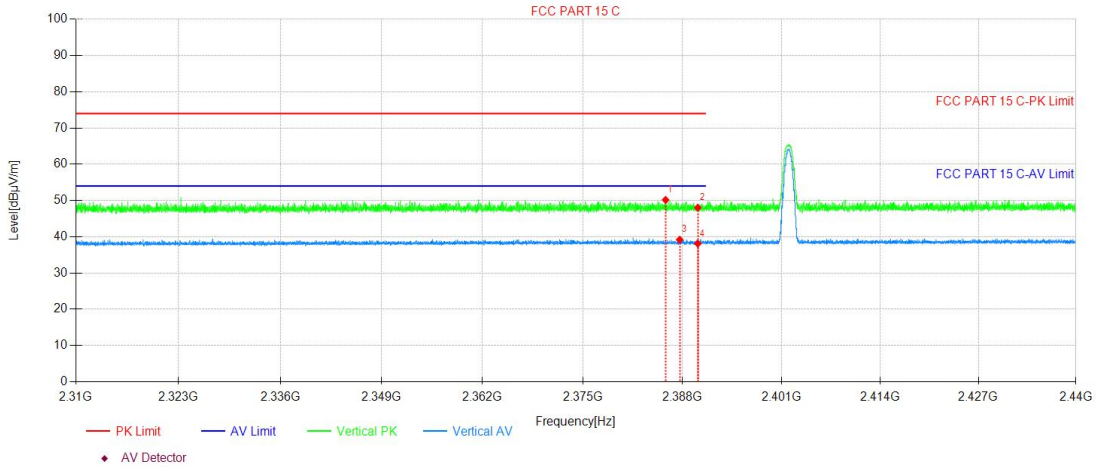
Test Procedure:	a. For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 or 10 meter semi-anechoic camber. The table was rotated 360 degrees to determine the position of the highest radiation. b. For above 1GHz, the EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter semi-anechoic camber. The table was rotated 360 degrees to determine the position of the highest radiation. c. The EUT was set 3 or 10 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower. d. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement. e. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading. f. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode. g. Place a marker at the end of the restricted band closest to the transmit frequency to show compliance. Also measure any emissions in the restricted bands. Save the spectrum analyzer plot. Repeat for each power and modulation for lowest and highest channel h. Test the EUT in the lowest channel , the Highest channel i. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode,And found the X axis positioning which it is worse case. j. Repeat above procedures until all frequencies measured was complete.
Test Configuration:	Measurements Below 1000MHz

	• RBW = 120 kHz • VBW = 300 kHz • Detector = Peak • Trace mode = max hold Peak Measurements Above 1000 MHz • RBW = 1 MHz • VBW ⩾ 3 MHz • Detector = Peak • Sweep time = auto • Trace mode = max hold Average Measurements Above 1000MHz • RBW = 1 MHz • VBW = 10 Hz, when duty cycle is no less than 98 percent. • VBW ⩾ 1/T, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.
Exploratory Test Mode:	Transmitting with all kind of modulations, data rates. Transmitting mode.
Final Test Mode:	Pretest the EUT Transmitting mode. Through Pre-scan, find the DH5 of data type is the worst case of all modulation type. Only the worst case is recorded in the report.
Instruments Used:	Refer to section 2.9 for details
Test Results:	Pass

Test Date

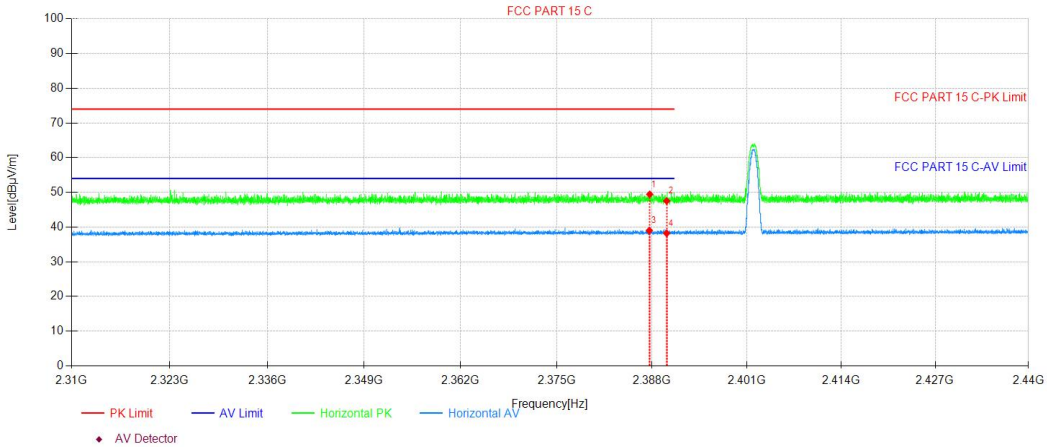
DH5 2402MHz

Vertical:



NO.	Freq. [MHz]	Reading Level [dBμV]	Correct Factor [dB/m]	Result Level [dBμV/m]	AV Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Remark
1	2385.79	50.97	-0.81	50.16	74.00	23.84	150	130	Peak
2	2390.01	48.82	-0.80	48.02	74.00	25.98	150	357	Peak
3	2387.64	39.99	-0.80	39.19	54.00	14.81	150	357	AV
4	2390.01	38.90	-0.80	38.10	54.00	15.90	150	339	AV

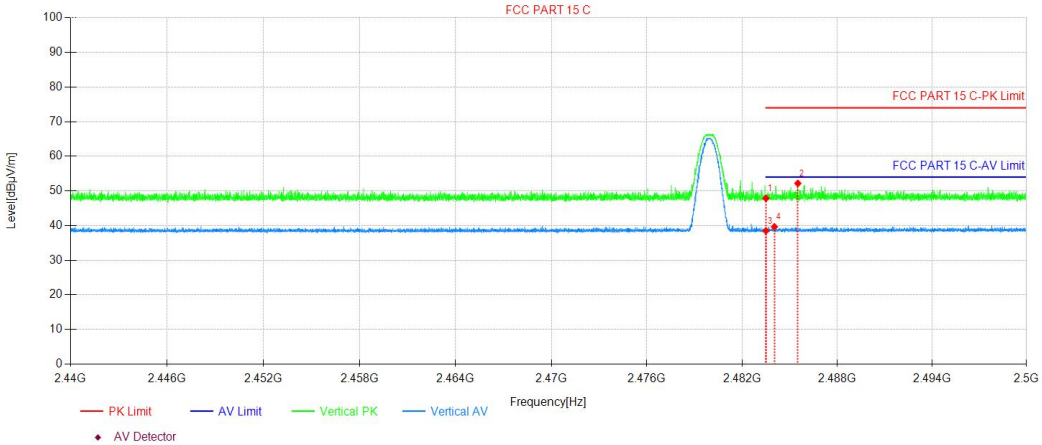
Horizontal:



NO.	Freq. [MHz]	Reading Level [dBμV]	Correct Factor [dB/m]	Result Level [dBμV/m]	AV Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Remark
1	2387.69	50.24	-0.80	49.44	74.00	24.56	150	310	Peak
2	2390.01	48.33	-0.80	47.53	74.00	26.47	150	180	Peak
3	2387.64	39.80	-0.80	39.00	54.00	15.00	150	4	AV
4	2390.01	39.01	-0.80	38.21	54.00	15.79	150	107	AV

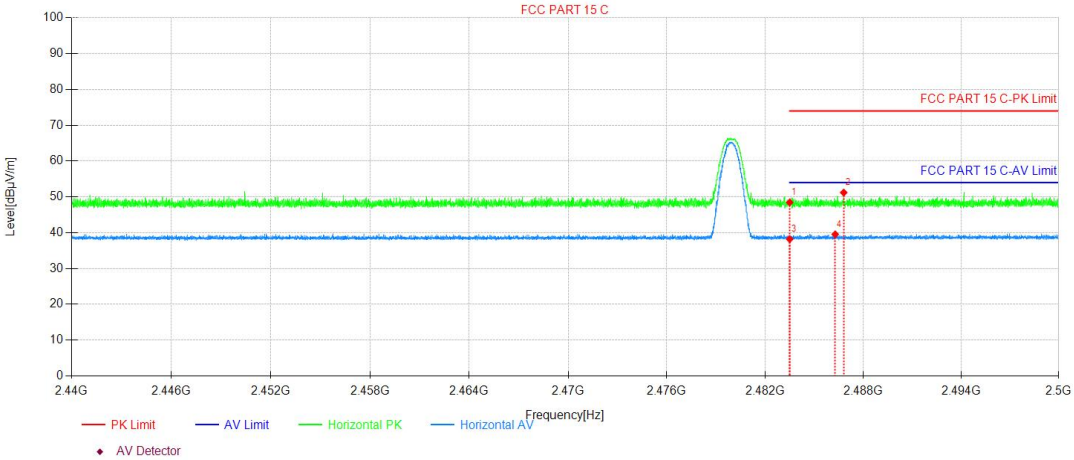
DH5 2480MHz

Vertical:



NO.	Freq. [MHz]	Reading Level [dBµV]	Correct Factor [dB/m]	Result Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Remark
1	2483.50	48.16	-0.29	47.87	74.00	26.13	150	117	Peak
2	2485.520	52.45	-0.27	52.18	74.00	21.82	150	189	Peak
3	2483.50	38.77	-0.29	38.48	54.00	15.52	150	44	AV
4	2484.03	39.91	-0.28	39.63	54.00	14.37	150	200	AV

Horizontal:



NO.	Freq. [MHz]	Reading Level [dBµV]	Correct Factor [dB/m]	Result Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Remark
1	2483.50	48.74	-0.29	48.45	74.00	25.55	150	356	Peak
2	2486.81	51.46	-0.26	51.20	74.00	22.80	150	3	Peak
3	2483.50	38.50	-0.29	38.21	54.00	15.79	150	202	AV
4	2486.28	39.80	-0.26	39.54	54.00	14.46	150	326	AV

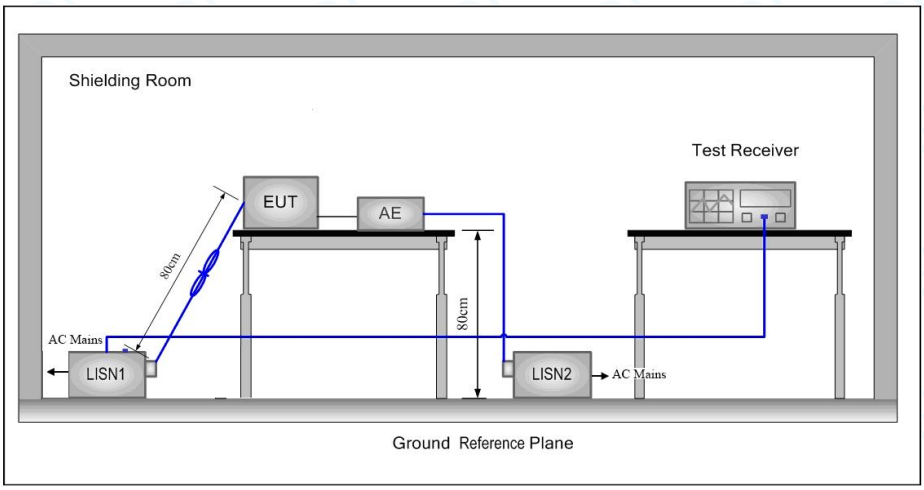
Note:

1. The Measurement (Result Level) is calculated by Reading Level adding the Correct Factor(maybe including Ant.Factor and the Cable Factor etc.), The basic equation is as follows:

Result Level= Reading Level + Correct Factor(including Ant.Factor ,Cable Factor etc.

2.All channels had been pre-test, DH5 is the worse case. only the worst case was reported.

3.11 AC Power Line Conducted Emissions

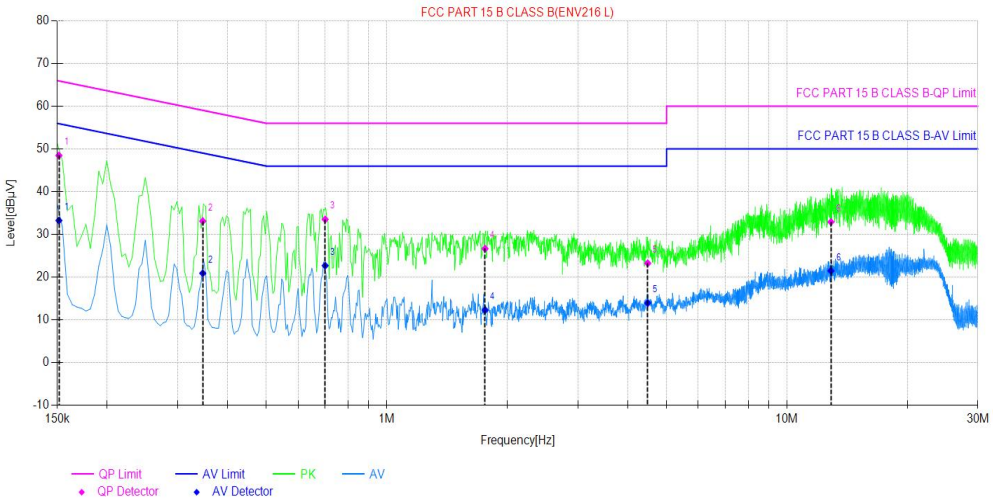
Test Requirement:	47 CFR Part 15C Section 15.207		
Test Method:	ANSI C63.10: 2013		
Test Frequency Range:	150kHz to 30MHz		
Limit:	Frequency range (MHz)	Limit (dBuV)	
		Quasi-peak	Average
	0.15-0.5	66 to 56*	56 to 46*
	0.5-5	56	46
	5-30	60	50
	* Decreases with the logarithm of the frequency.		
Test Procedure:	1) The mains terminal disturbance voltage test was conducted in a shielded room. 2) The EUT was connected to AC power source through a LISN 1 (Line Impedance Stabilization Network) which provides a 50Ω/50μH + 5Ω linear impedance. The power cables of all other units of the EUT were connected to a second LISN 2, which was bonded to the ground reference plane in the same way as the LISN 1 for the unit being measured. A multiple socket outlet strip was used to connect multiple power cables to a single LISN provided the rating of the LISN was not exceeded. 3) The tabletop EUT was placed upon a non-metallic table 0.8m above the ground reference plane. And for floor-standing arrangement, the EUT was placed on the horizontal ground reference plane, 4) The test was performed with a vertical ground reference plane. The rear of the EUT shall be 0.4 m from the vertical ground reference plane. The vertical ground reference plane was bonded to the horizontal ground reference plane. The LISN 1 was placed 0.8 m from the boundary of the unit under test and bonded to a ground reference plane for LISNs mounted on top of the ground reference plane. This distance was between the closest points of the LISN 1 and the EUT. All other units of the EUT and associated equipment was at least 0.8 m from the LISN 2. In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.10 2013 on conducted measurement.		
Test Setup:			
Exploratory Test Mode:	Transmitting with all kind of modulations, data rates at lowest, middle and highest channel. Charge + Transmitting mode.		

Final Test Mode:	Through Pre-scan, find the the worst case.
Instruments Used:	Refer to section 2.9 for details
Test Results:	PASS

Measurement Data

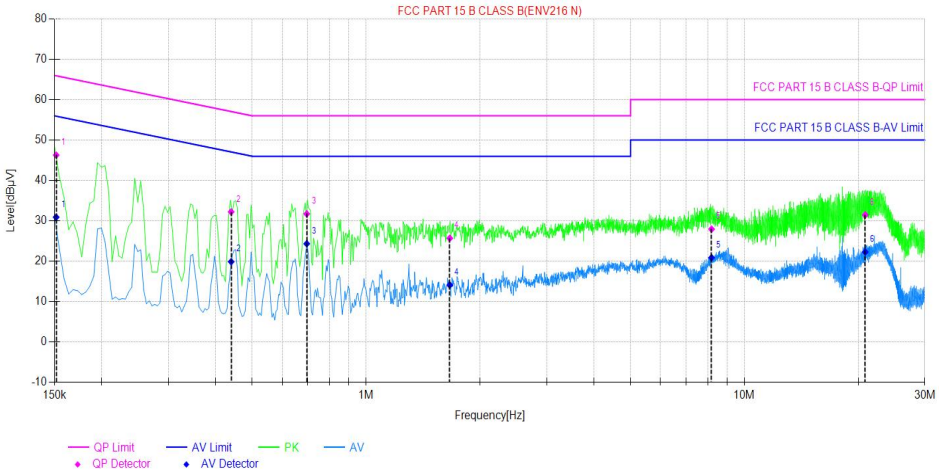
An initial pre-scan was performed on the live and neutral lines with peak detector.
Quasi-Peak and Average measurement were performed at the frequencies with maximized peak emission were detected.

Live Line:



NO.	Freq. [MHz]	Correct Factor [dB]	QP Reading Level [dBµV]	QP Result Level [dBµV]	QP Limit [dBµV]	QP Margin [dB]	AV Reading Level [dBµV]	AV Result Level [dBµV]	AV Limit [dBµV]	AV Margin [dB]
1	0.1515	9.89	38.58	48.47	65.92	17.45	23.38	33.27	55.92	22.65
2	0.3466	9.83	23.3	33.13	59.04	25.91	11.1	20.93	49.04	28.11
3	0.7012	9.76	23.76	33.52	56.00	22.48	12.96	22.72	46.00	23.28
4	1.7598	9.73	16.95	26.68	56.00	29.32	2.59	12.32	46.00	33.68
5	4.4866	9.77	13.51	23.28	56.00	32.72	4.21	13.98	46.00	32.02
6	12.879	9.94	22.99	32.93	60.00	27.07	11.56	21.50	50.00	28.50

Neutral Line:



NO.	Freq. [MHz]	Correct Factor [dB]	QP Reading Level [dBµV]	QP Result Level [dBµV]	QP Limit [dBµV]	QP Margin [dB]	AV Reading Level [dBµV]	AV Result Level [dBµV]	AV Limit [dBµV]	AV Margin [dB]
1	0.1515	9.79	36.49	46.28	65.92	19.64	21.13	30.92	55.92	25.00
2	0.4396	9.81	22.43	32.24	57.07	24.83	10.09	19.90	47.07	27.17
3	0.6966	9.86	21.89	31.75	56.00	24.25	14.49	24.35	46.00	21.65
4	1.6638	9.74	15.97	25.71	56.00	30.29	4.38	14.12	46.00	31.88
5	8.1906	9.92	18.04	27.96	60.00	32.04	10.99	20.91	50.00	29.09
6	20.8806	10.08	21.4	31.48	60.00	28.52	12.23	22.31	50.00	27.69

Remark:

1. The following Quasi-Peak and Average measurements were performed on the EUT:

2. The Measurement (Result Level) is calculated by Reading Level adding the Correct Factor(maybe including LISN Factor and the Cable Factor etc.), The basic equation is as follows:

Result Level= Reading Level + Correct Factor(including LISN Factor, Cable Factor etc

4 Appendix

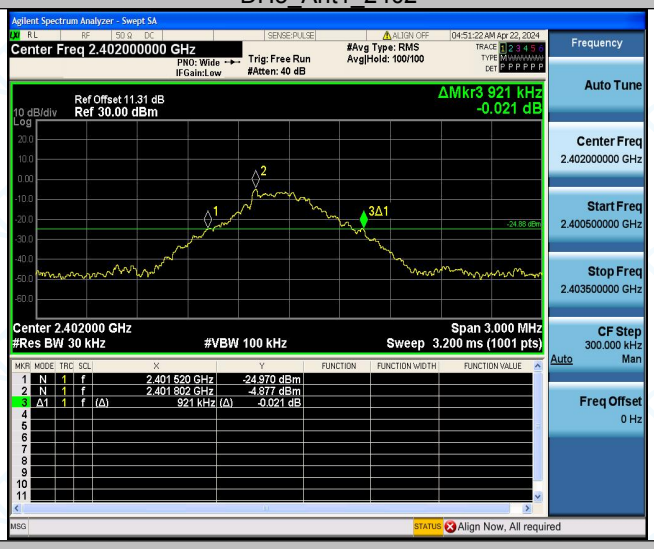
Appendix A: 20dB Emission Bandwidth

Test Result

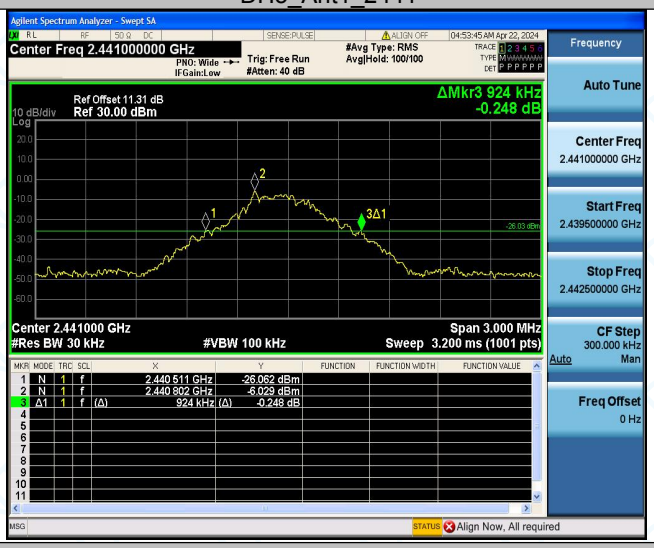
Test Mode	Antenna	Freq(MHz)	20dB EBW[MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
DH5	Ant1	2402	0.921	2401.520	2402.441	---	---
		2441	0.924	2440.511	2441.435	---	---
		2480	0.870	2479.505	2480.375	---	---
2DH5	Ant1	2402	1.320	2401.295	2402.615	---	---
		2441	1.335	2440.289	2441.624	---	---
		2480	1.329	2479.292	2480.621	---	---
3DH5	Ant1	2402	1.290	2401.322	2402.612	---	---
		2441	1.290	2440.319	2441.609	---	---
		2480	1.275	2479.322	2480.597	---	---

Test Graphs

DH5_Ant1_2402



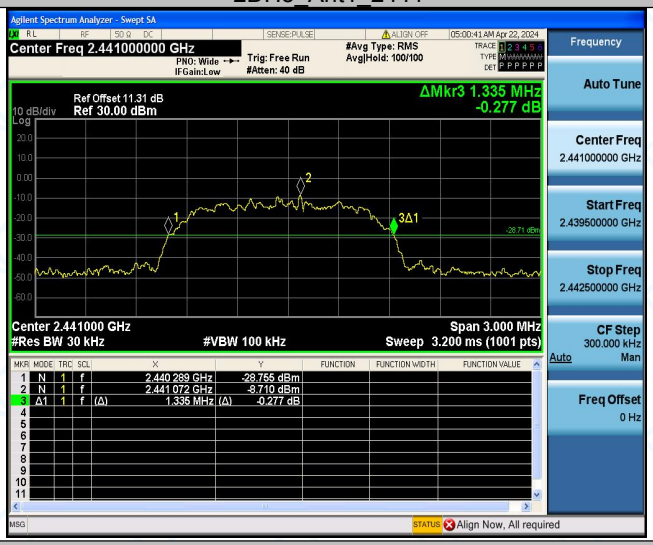
DH5_Ant1_2441



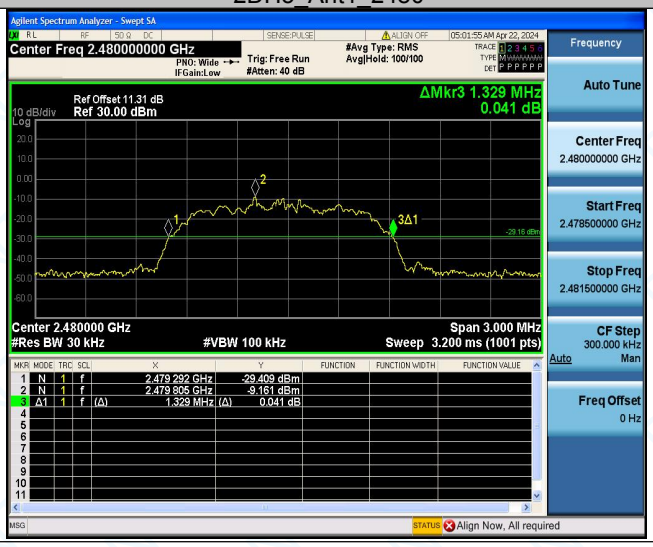
DH5_Ant1_2480

2DH5_Ant1_2402

2DH5_Ant1_2441



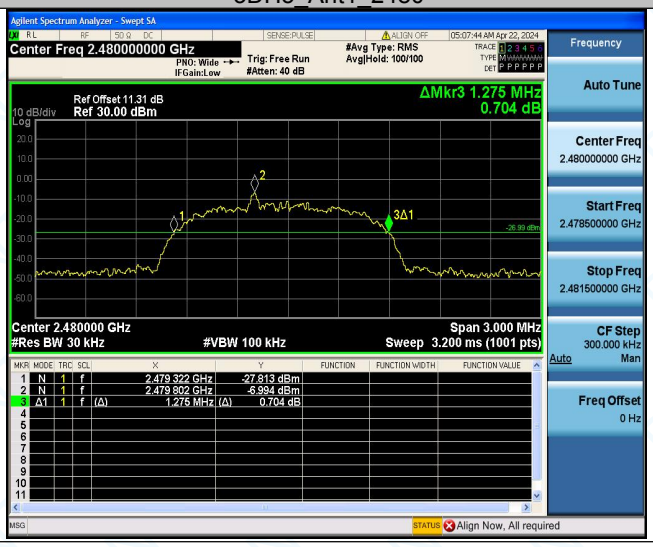
2DH5_Ant1_2480



3DH5_Ant1_2402

3DH5_Ant1_2441

3DH5_Ant1_2480



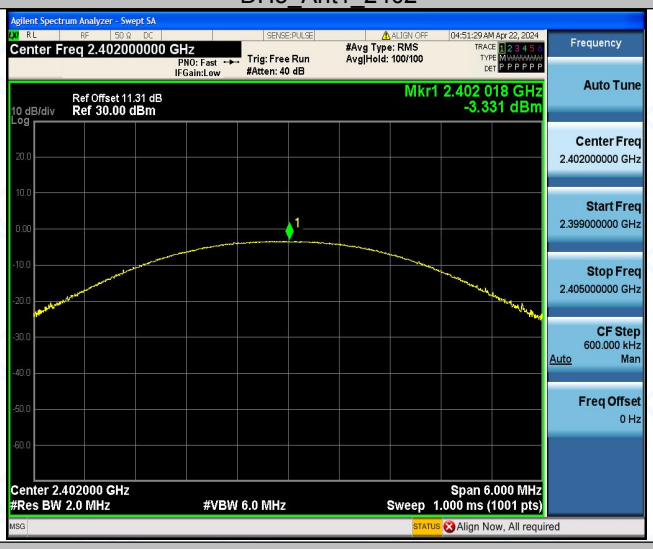
Appendix B: Maximum conducted output power

Test Result

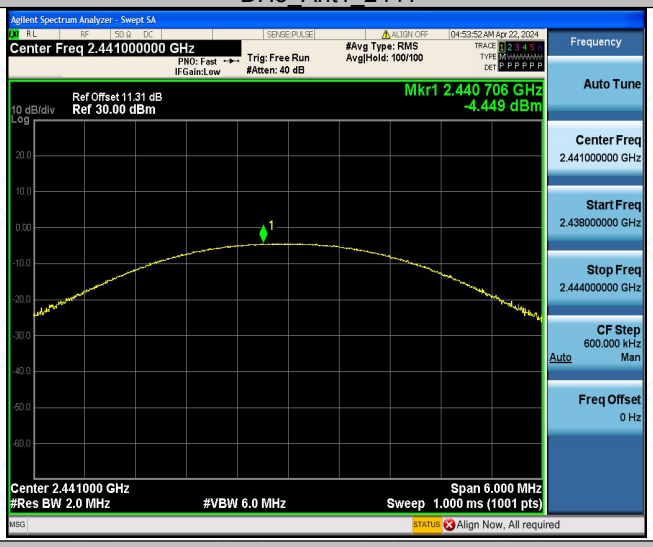
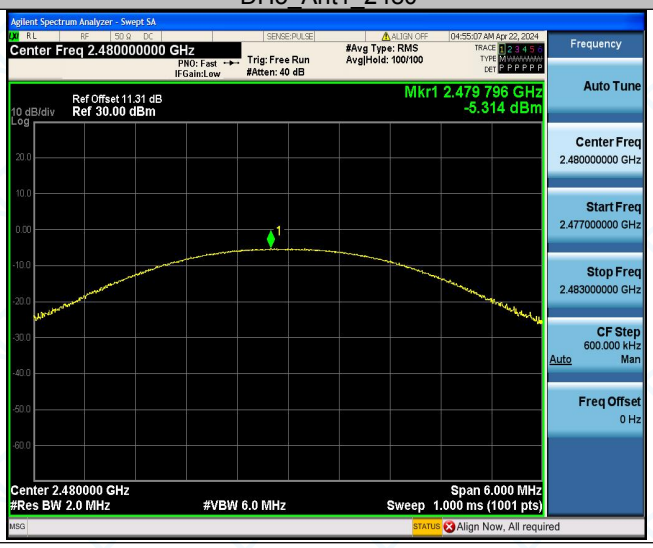
Test Mode	Antenna	Freq(MHz)	Conducted Peak Powert[dBm]	Conducted Limit[dBm]	Verdict
DH5	Ant1	2402	-3.33	≤20.97	PASS
		2441	-4.45	≤20.97	PASS
		2480	-5.31	≤20.97	PASS
2DH5	Ant1	2402	-1.23	≤20.97	PASS
		2441	-2.41	≤20.97	PASS
		2480	-3.3	≤20.97	PASS
3DH5	Ant1	2402	-0.73	≤20.97	PASS
		2441	-1.95	≤20.97	PASS
		2480	-2.78	≤20.97	PASS

Test Graphs

DH5_Ant1_2402



DH5_Ant1_2441



DH5_Ant1_2480