FCC Test Report

Application No.:	DNT2509150451R10332-11663
Applicant:	Sveaverken Software Development (Shanghai) Co., Ltd.
Address of Applicant:	Room 210, 2F, No.6 Pubei Road, Xuhui District, Shanghai
EUT Description:	Mini RTK Receiver V4E
Model No.:	V4E
FCC ID:	2BOPT-V4E
Power Supply:	Input DC 5V; DC 3.6V from rechargeable lithium-ion battery
Trade Mark:	Sveaverken
Standards:	47 CFR Part 2, Subpart J 47 CFR Part 15, Subpart C ANSI C63.10: 2020
Date of Receipt:	2025/8/26
Date of Test:	2025/8/27 to 2025/9/8
Date of Issue:	2025/9/25
Test Result:	**PASS**

Prepared By: Wayne.Lin (Testing Engineer)

Reviewed By: Pencils.Chen (Project Engineer)

Approved By: Jerse Chen (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.

Report Revise Record

Report Version	Revise Time	Issued Date	Valid Version	Notes
V1.0	/	Sept.25, 2025	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: 2020	Clause 3.2	PASS
Conducted Peak Output Power	15.247 (b)(1)	ANSI C63.10: 2020	Clause 3.3	PASS
Carrier Frequencies Separation	15.247 (a)(1)	ANSI C63.10: 2020	Clause 3.4	PASS
Dwell Time	15.247 (a)(1)	ANSI C63.10: 2020	Clause 3.5	PASS
Hopping Channel Number	15.247 (a)(1)	ANSI C63.10: 2020	Clause 3.6	PASS
Band-edge for RF Conducted Emissions	15.247(d)	ANSI C63.10: 2020	Clause 3.7	PASS
RF Conducted Spurious Emissions	15.247(d)	ANSI C63.10: 2020	Clause 3.8	PASS
Radiated Spurious emissions	15.247(d); 15.205/15.209	ANSI C63.10: 2020	Clause 3.9	PASS
Restricted bands around fundamental frequency (Radiated Emission)	15.247(d); 15.205/15.209	ANSI C63.10: 2020	Clause 3.10	PASS
AC Power Line Conducted Emission	15.207	ANSI C63.10: 2020	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 5
2.3 Test Environment 6
2.4 Channel List 6
2.5 Power Setting of Test Software 7
2.6 Assistant equipment used for test 7
2.7 Description of Support Units 7
2.8 Test Facility 7
2.9 Equipment List 8
2.10 Measurement Uncertainty (95% confidence levels, k=2) 10
3 Test results and Measurement Data 11
3.1 Antenna Requirement 11
3.2 20dB Emission Bandwidth 12
3.3 Conducted Output Power 13
3.4 Carrier Frequencies Separationy 14
3.5 Dwell Time 15
3.6 Hopping Channel Number 16
3.7 Band-edge for RF Conducted Emissions 17
3.8 RF Conducted Spurious Emissions 18
3.9 Radiated Spurious Emissions 19
3.10 Restricted bands around fundamental frequency 27
3.11 AC Power Line Conducted Emissions 31
4 Appendix 34
Appendix A: 20dB Emission Bandwidth 34
Appendix B: Maximum conducted output power 38
Appendix C: Carrier frequency separation 42
Appendix D: Dwell Time 44
Appendix E: Number of hopping channels 48
Appendix F: Band edge measurements 50
Appendix G: Conducted Spurious Emission 55

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:	Sveaverken Intelligent Technology (shenzhen) Co., Ltd.
Address of Manufacturer:	Room 401-501, Building 13, Nangang Second Industrial Park, No.1026, Songbai Road, Sunshine Community, Xili Street, Nanshan District, Shenzhen
EUT Description:	Mini RTK Receiver V4E
Model No.:	V4E
Power Supply:	Input DC 5V; DC 3.6V from rechargeable lithium-ion battery
Trade Mark:	Sveaverken
Hardware Version:	V1.0
Software Version:	V1.0.0.12
Serial number:	PR2509150451R10332
Chip Type:	ESP32
Operation Frequency:	2402MHz to 2480MHz
Type of Modulation:	GFSK,π/4-DQPSK,8-DPSK
Modulation Technique:	Frequency Hopping Spread Spectrum(FHSS)
Sample Type:	☒ Portable Device, ☐Module,☐Mobile Device
Antenna Type:	☐ External, ☒ Integrated
Antenna Ports:	☒ Ant 1, ☐ Ant 2, ☐ Ant 3
Antenna Gain*:	☒Provided by applicant
	2.82dBi
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);

Note:

*Since the above data and/or information is provided by the client 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 Test Environment

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.

2.4 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

2.5 Power Setting of Test Software

Software Name	EspRFTestTool_v3.6_Manual		
Frequency(MHz)	2402	2441	2480
GFSK Setting	7	7	7
π/4-DQPSK Setting	7	7	7
8-DPSK Setting	7	7	7

2.6 Assistant equipment used for test

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

2.7 Description of Support Units

The EUT has been tested independent unit.

2.8 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. CAB identifier is CN0149.

IC#: 30755.

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	2024-10-23	2025-10-22
Signal Generator	Keysight	N5182B	MY57300617	2024-10-23	2025-10-22
Power supply	Keysight	E3640A	ZB2022656	2024-10-23	2025-10-22
Radio Communication Tester	R&S	CMW500	105082	2024-10-23	2025-10-22
Spectrum Analyzer	Aglient	N9010A	MY52220200	2024-10-23	2025-10-22
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	2024-10-23	2025-10-22
Pulse Power Sensor	Anritsu	MA2411B	1911397	2024-10-23	2025-10-22
temperature and humidity box	SCOTEK	SCD-C40-80PRO	6866682020008	2024-10-23	2025-10-22
RF Cable	ETS-LINDGREN	RFC-NMS-100-NMS-350-IN	NA	2024-10-23	2025-10-22

Test Equipment for Conducted Emission					
Description	Manufacturer	Model	Serial Number	Cal Date	Due Date
Receiver	R&S	ESCI3	101152	2024-10-23	2025-10-22
LISN	R&S	ENV216	102874	2024-10-23	2025-10-22
ISN	R&S	ENY81-CA6	1309.8590.03	2024-10-23	2025-10-22
RF Cable	ETS-LINDGREN	Cable-CE TS01	/	2024-10-23	2025-10-22

Test Equipment for Radiated Emission(30MHz-1000MHz)					
Description	Manufacturer	Model	Serial Number	Cal Date	Due Date
Receiver	R&S	ESR7	102497	2024-10-23	2025-10-22
Test Software	ETS-LINDGREN	TiLE-FULL	NA	NA	NA
RF Cable	ETS-LINDGREN	RE Cable-TS01	NA	2024-10-23	2025-10-22

Log periodic antenna	ETS-LINDGREN	VULB 9168	01475	2022-11-28	2025-11-27
Pre-amplifier	Schwarzbeck	BBV9743B	00423	2024-10-23	2025-10-22
Attenuator 1	Shanghai Huaxiang	TS2-6-18-A	22061803	2025-5-6	2026-5-5
Attenuator 2	Shanghai Huaxiang	TS2-6-6-A	230927163	2025-5-6	2026-5-5

Test Equipment for Radiated Emission(Above 1000MHz)					
Description	Manufacturer	Model	Serial Number	Cal Date	Due Date
Frequency analyser	Keysight	N9010A	MY52221458	2024-10-23	2025-10-22
RF Cable	ETS-LINDGREN	RE Cable-TS02	NA	2024-10-23	2025-10-22
Horn Antenna	ETS-LINDGREN	3117	00252567	2022-11-28	2025-11-27
Double ridged waveguide antenna	ETS-LINDGREN	3116C	00251780	2022-11-28	2025-11-27
Test Software	ETS-LINDGREN	TiLE-FULL	NA	NA	NA
Pre-amplifier	ETS-LINDGREN	3117-PA	252567	2024-10-23	2025-10-22
Pre-amplifier	ETS-LINDGREN	3116C-PA	251780	2024-10-23	2025-10-22

2.10Measurement 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

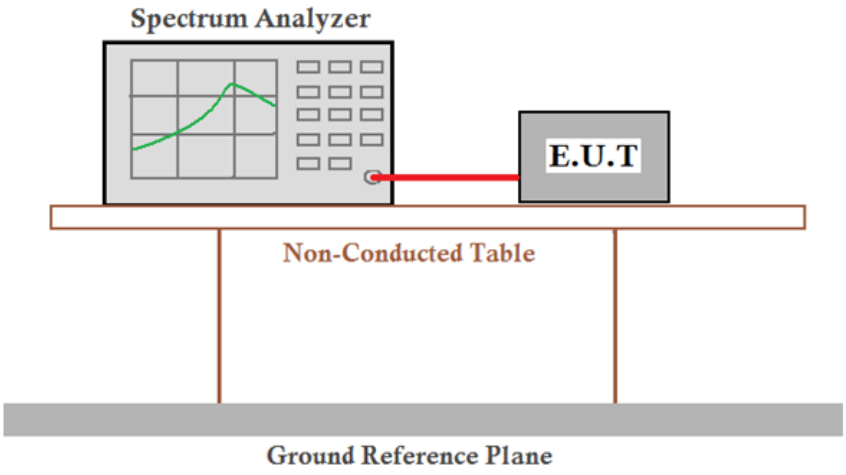
No.	Item	Measurement Uncertainty
1	Conduction Emission	± 3.0dB (150kHz to 30MHz)
2	Radiated Emission	± 4.8dB (Below 1GHz)
		± 4.8dB (1GHz to 6GHz)
		± 4.5dB (6GHz to 18GHz)
		± 5.02dB (Above 18GHz)

3 Test results and Measurement Data

3.1 Antenna Requirement

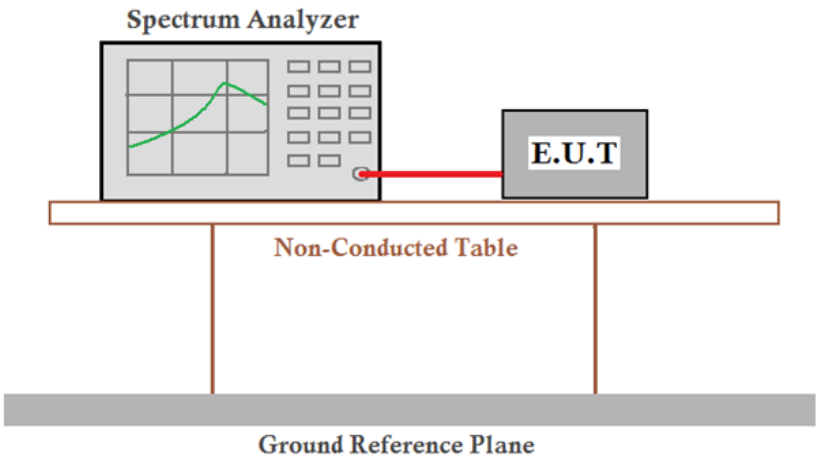
Standard requirement:	47 CFR Part 15C Section 15.203 /247(c)
15.203 requirement: An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a 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 6dBi.	
The FPC antenna is connected to the motherboard, The best case gain of the antenna is 2.82dBi.	

3.2 20dB Emission Bandwidth

Test Requirement:	47 CFR Part 15C Section 15.247 (a)(1)
Test Method:	ANSI C63.10: 2020 Section 6.9.2
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

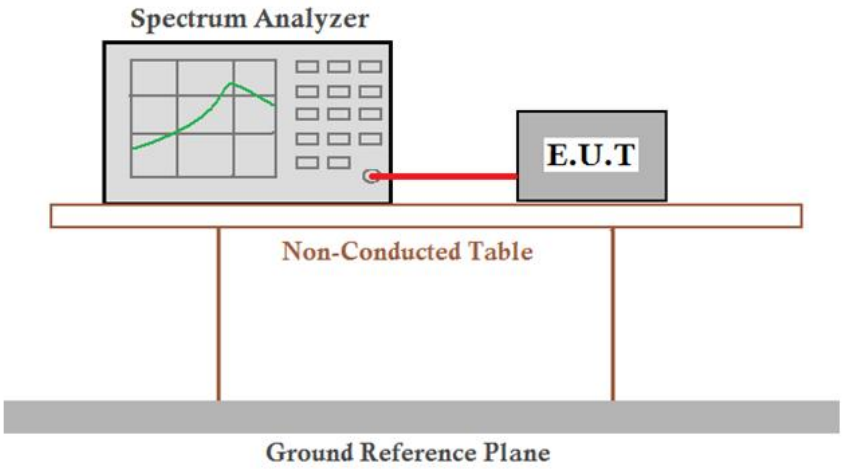
The detailed test data see: **Appendix A**

3.3 Conducted Output Power

Test Requirement:	47 CFR Part 15C Section 15.247 (b)(1)
Test Method:	ANSI C63.10: 2020 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

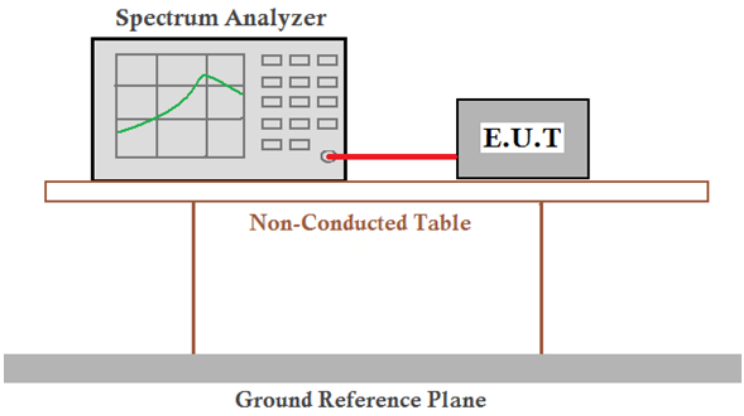
The detailed test data see: **Appendix B**

3.4 Carrier Frequencies Separationy

Test Requirement:	47 CFR Part 15C Section 15.247 (a)(1)
Test Method:	ANSI C63.10: 2020 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

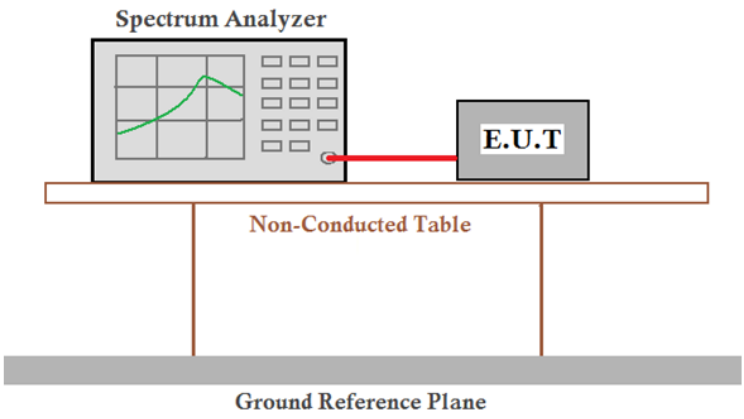
The detailed test data see: **Appendix C**

3.5 Dwell Time

Test Requirement:	47 CFR Part 15C Section 15.247 (a)(1)
Test Method:	ANSI C63.10: 2020 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

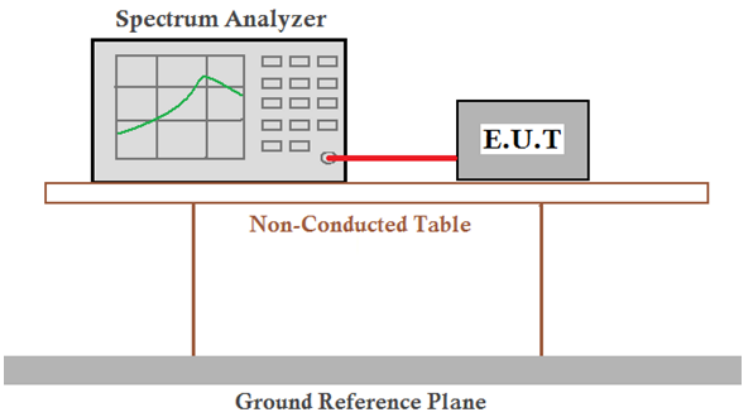
The detailed test data see: **Appendix D**

3.6 Hopping Channel Number

Test Requirement:	47 CFR Part 15C Section 15.247 (a)(1)
Test Method:	ANSI C63.10: 2020 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

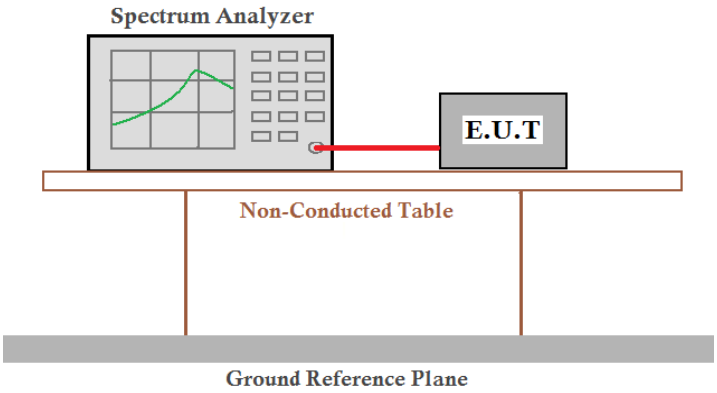
The detailed test data see: **Appendix E**

3.7 Band-edge for RF Conducted Emissions

Test Requirement:	47 CFR Part 15C Section 15.247 (d)
Test Method:	ANSI C63.10: 2020 Section 7.8.7.2
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: 2020 Section 7.8.7.1
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: 2020 Section 7.8.8 / 6.3 / 6.4/ 6.5 / 6.6				
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:	

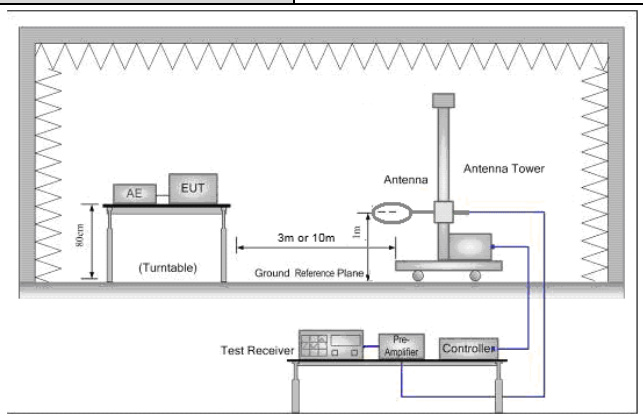


Figure 1. Below 30MHz

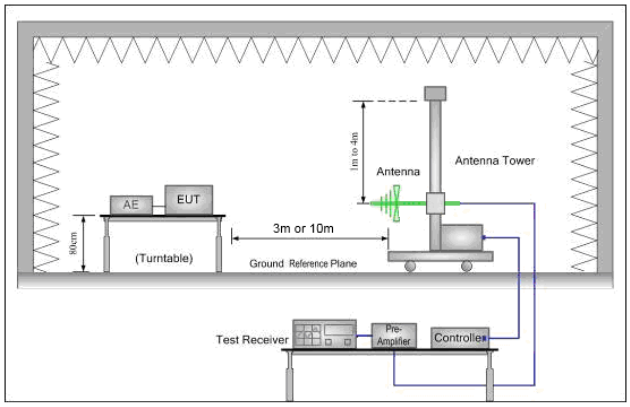


Figure 2. 30MHz to 1GHz

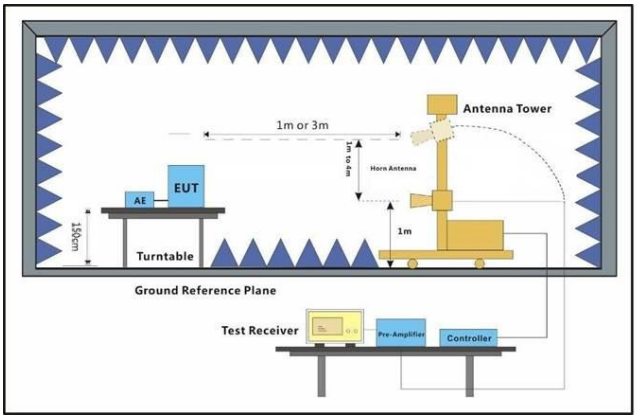


Figure 3. Above 1 GHz

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.

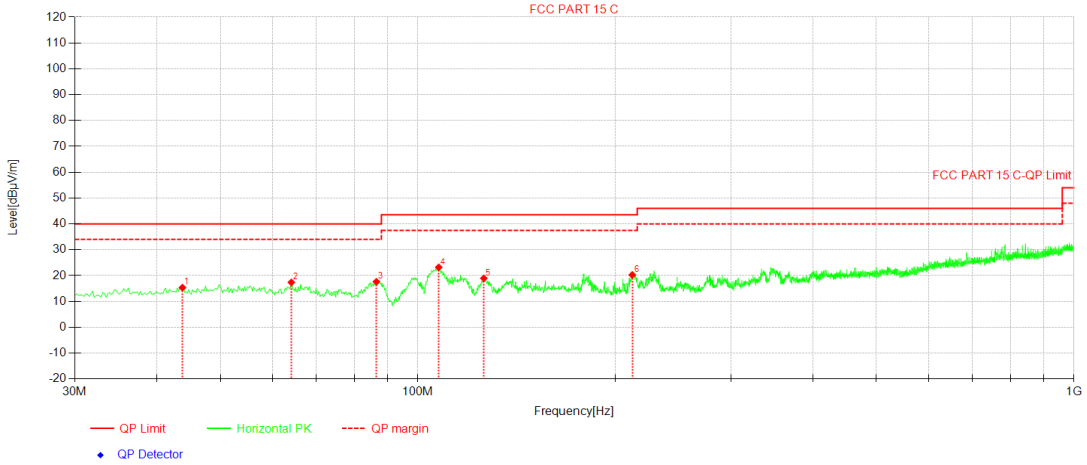
i. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, And found the X axis positioning which it is worse case.

j. Repeat above procedures until all frequencies measured was complete.

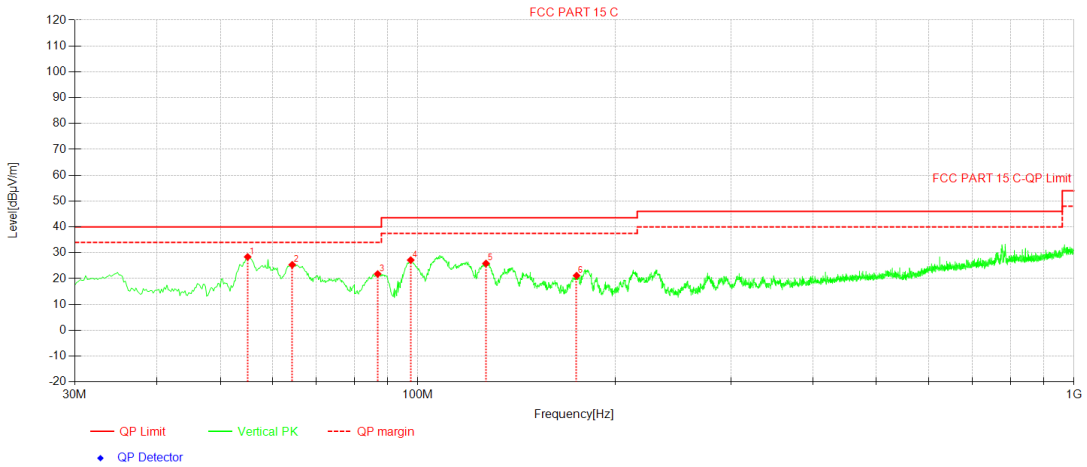
Test Configuration:	Measurements Below 1000MHz • RBW = 120 kHz • VBW = 300 kHz • Detector = Peak • Trace mode = max hold Peak Measurements Above 1000 MHz • RBW = 1 MHz • VBW ⩾ 3 MHz • Detector = Peak • Sweep time = auto • Trace mode = max hold Average Measurements Above 1000MHz • RBW = 1 MHz • VBW = 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



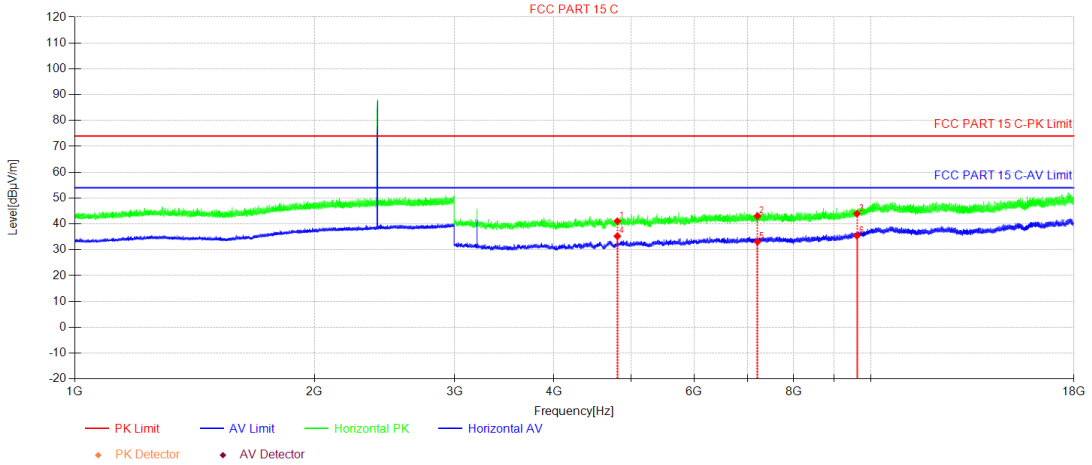
NO.	Freq. [MHz]	Reading Level [dBμV]	Correct Factor [dB/m]	Result Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Remark	Polarity
1	43.78	23.70	-8.35	15.35	40.00	24.65	200	282	PK	H
2	64.15	26.61	-9.23	17.38	40.00	22.62	200	360	PK	H
3	86.47	31.39	-13.77	17.62	40.00	22.38	200	130	PK	H
4	107.62	34.70	-11.50	23.20	43.50	20.30	200	70	PK	H
5	126.05	28.75	-9.79	18.96	43.50	24.54	200	249	PK	H
6	212.20	31.27	-11.01	20.26	43.50	23.24	200	257	PK	H



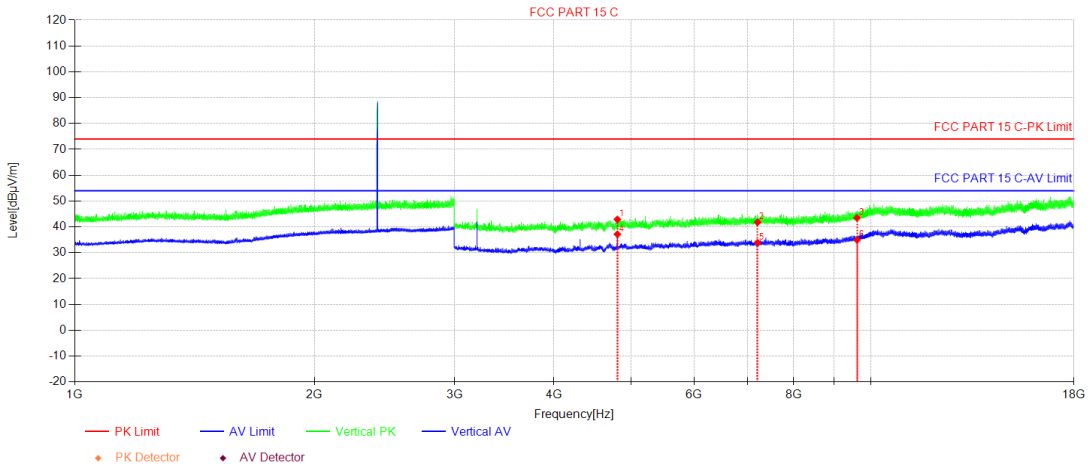
NO.	Freq. [MHz]	Reading Level [dBμV]	Correct Factor [dB/m]	Result Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Remark	Polarity
1	55.03	36.66	-8.27	28.39	40.00	11.61	100	193	PK	V
2	64.34	34.59	-9.25	25.34	40.00	14.66	100	56	PK	V
3	86.85	35.58	-13.80	21.78	40.00	18.22	100	204	PK	V
4	97.53	40.15	-12.99	27.16	43.50	16.34	100	248	PK	V
5	127.02	35.56	-9.70	25.86	43.50	17.64	100	329	PK	V
6	174.56	29.85	-8.71	21.14	43.50	22.36	100	356	PK	V

For above 1GHz

DH5 2402MHz

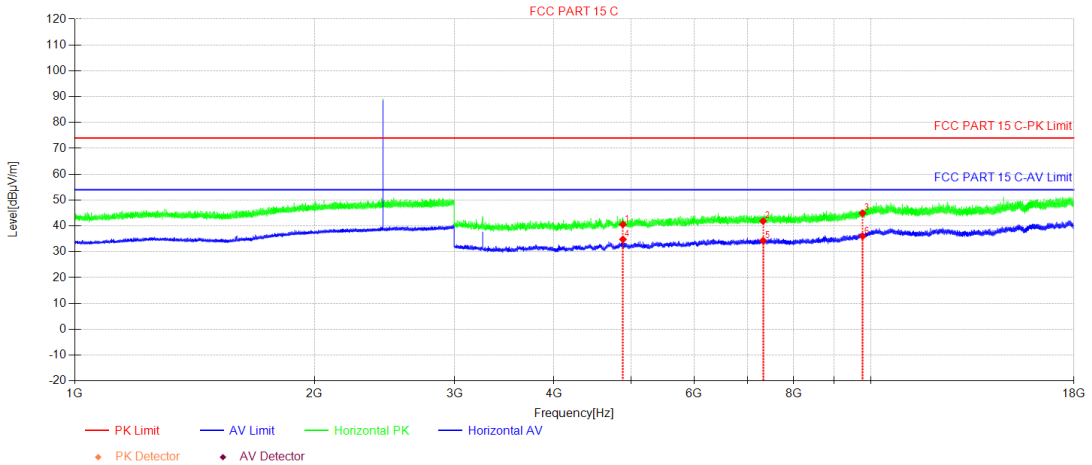


NO.	Freq. [MHz]	Reading Level [dBμV]	Correct Factor [dB/m]	Result Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Remark	Polarity
1	4804.59	45.69	-4.61	41.08	74.00	32.92	150	64	PK	H
2	7206.21	44.83	-1.76	43.07	74.00	30.93	150	165	PK	H
3	9608.58	43.09	0.88	43.97	74.00	30.03	150	209	PK	H
4	4804.59	39.87	-4.61	35.26	54.00	18.74	150	21	AV	H
5	7206.21	34.86	-1.76	33.10	54.00	20.90	150	42	AV	H
6	9608.58	34.57	0.88	35.45	54.00	18.55	150	186	AV	H

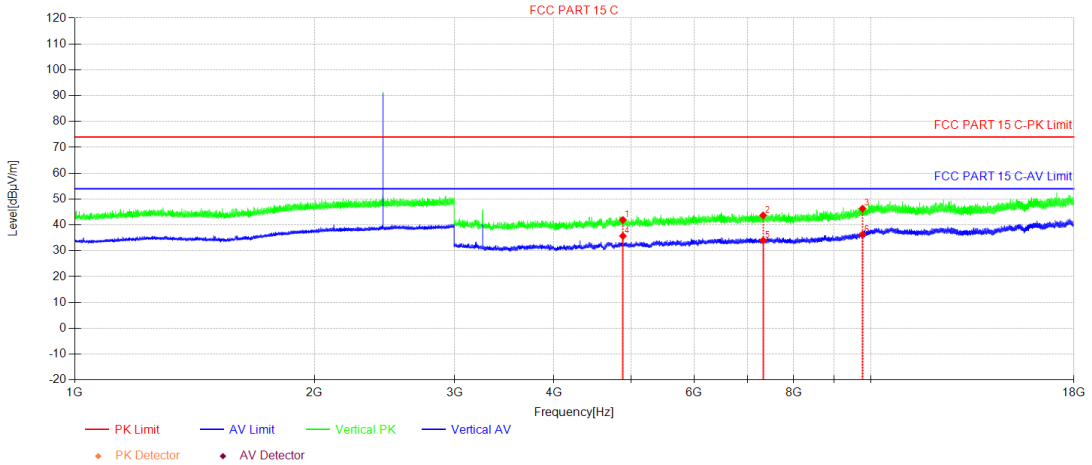


NO.	Freq. [MHz]	Reading Level [dBμV]	Correct Factor [dB/m]	Result Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Remark	Polarity
1	4804.59	47.51	-4.61	42.90	74.00	31.10	150	279	PK	V
2	7206.21	43.58	-1.76	41.82	74.00	32.18	150	198	PK	V
3	9608.58	42.61	0.88	43.49	74.00	30.51	150	50	PK	V
4	4804.59	41.78	-4.61	37.17	54.00	16.83	150	279	AV	V
5	7206.21	35.64	-1.76	33.88	54.00	20.12	150	175	AV	V
6	9608.58	34.07	0.88	34.95	54.00	19.05	150	50	AV	V

DH5 2441MHz

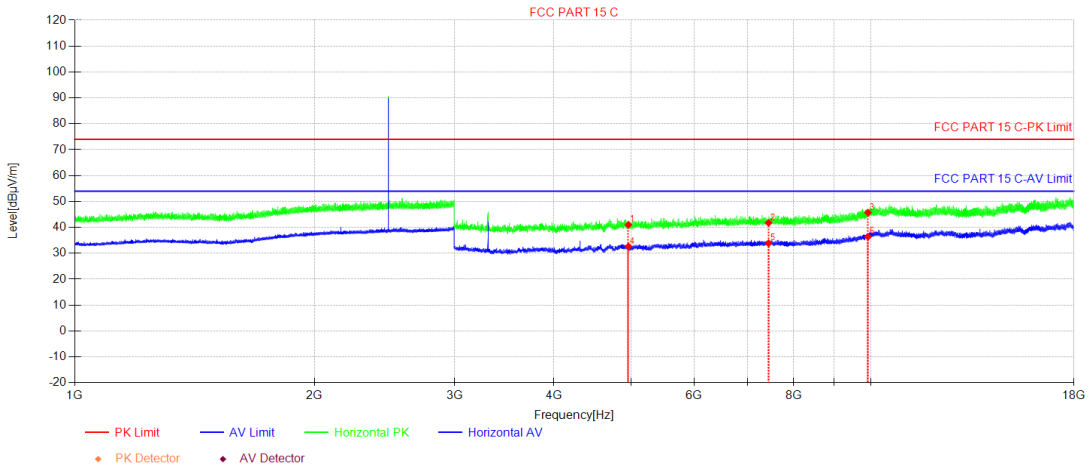


NO.	Freq. [MHz]	Reading Level [dBμV]	Correct Factor [dB/m]	Result Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Remark	Polarity
1	4882.59	45.31	-4.72	40.59	74.00	33.41	150	65	PK	H
2	7323.22	43.37	-1.49	41.88	74.00	32.12	150	299	PK	H
3	9764.59	43.26	1.64	44.90	74.00	29.10	150	86	PK	H
4	4882.59	39.51	-4.72	34.79	54.00	19.21	150	4	AV	H
5	7323.22	35.80	-1.49	34.31	54.00	19.69	150	21	AV	H
6	9764.59	34.37	1.64	36.01	54.00	17.99	150	237	AV	H

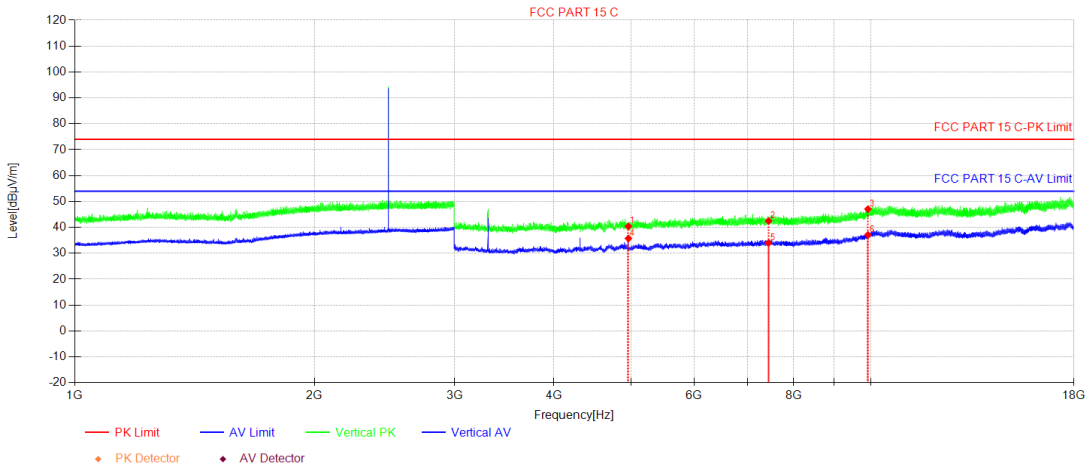


NO.	Freq. [MHz]	Reading Level [dBμV]	Correct Factor [dB/m]	Result Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Remark	Polarity
1	4882.59	46.66	-4.72	41.94	74.00	32.06	150	106	PK	V
2	7323.22	45.18	-1.49	43.69	74.00	30.31	150	66	PK	V
3	9764.59	44.67	1.64	46.31	74.00	27.69	150	106	PK	V
4	4882.59	40.42	-4.72	35.70	54.00	18.30	150	106	AV	V
5	7323.22	35.47	-1.49	33.98	54.00	20.02	150	317	AV	V
6	9764.59	34.64	1.64	36.28	54.00	17.72	150	106	AV	V

DH5 2480MHz



NO.	Freq. [MHz]	Reading Level [dBμV]	Correct Factor [dB/m]	Result Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Remark	Polarity
1	4960.60	45.89	-4.86	41.03	74.00	32.97	150	339	PK	H
2	7440.22	43.09	-1.34	41.75	74.00	32.25	150	3	PK	H
3	9920.60	43.46	2.27	45.73	74.00	28.27	150	297	PK	H
4	4960.60	37.50	-4.86	32.64	54.00	21.36	150	0	AV	H
5	7440.22	35.24	-1.34	33.90	54.00	20.10	150	208	AV	H
6	9920.60	34.11	2.27	36.38	54.00	17.62	150	208	AV	H



NO.	Freq. [MHz]	Reading Level [dBμV]	Correct Factor [dB/m]	Result Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Remark	Polarity
1	4960.60	45.25	-4.86	40.39	74.00	33.61	150	277	PK	V
2	7440.22	43.83	-1.34	42.49	74.00	31.51	150	194	PK	V
3	9920.60	44.81	2.27	47.08	74.00	26.92	150	109	PK	V
4	4960.60	40.59	-4.86	35.73	54.00	18.27	150	91	AV	V
5	7440.22	35.32	-1.34	33.98	54.00	20.02	150	131	AV	V
6	9920.60	34.84	2.27	37.11	54.00	16.89	150	70	AV	V

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 worst 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: 2020 Section 7.8.8 / 6.3 / 6.6		
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:			

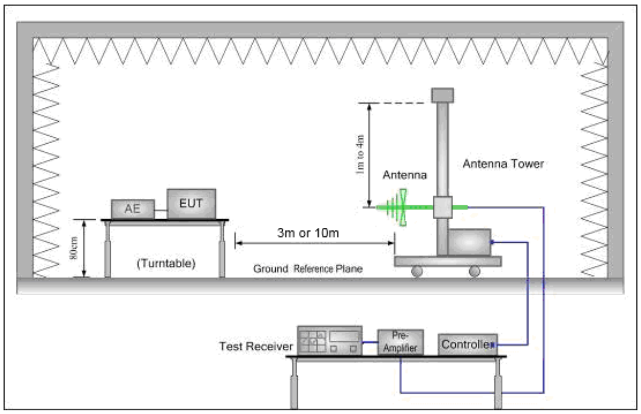


Figure 1. 30MHz to 1GHz

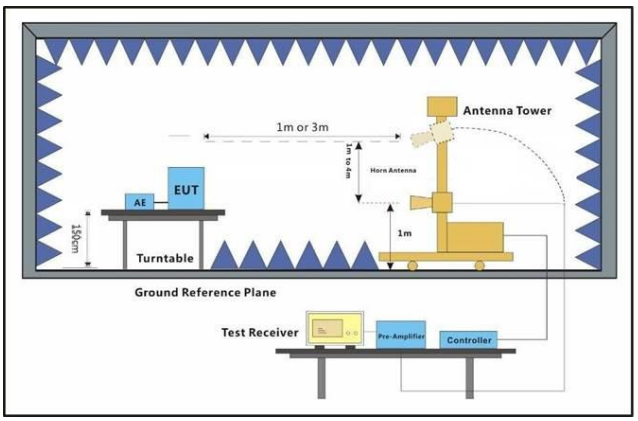


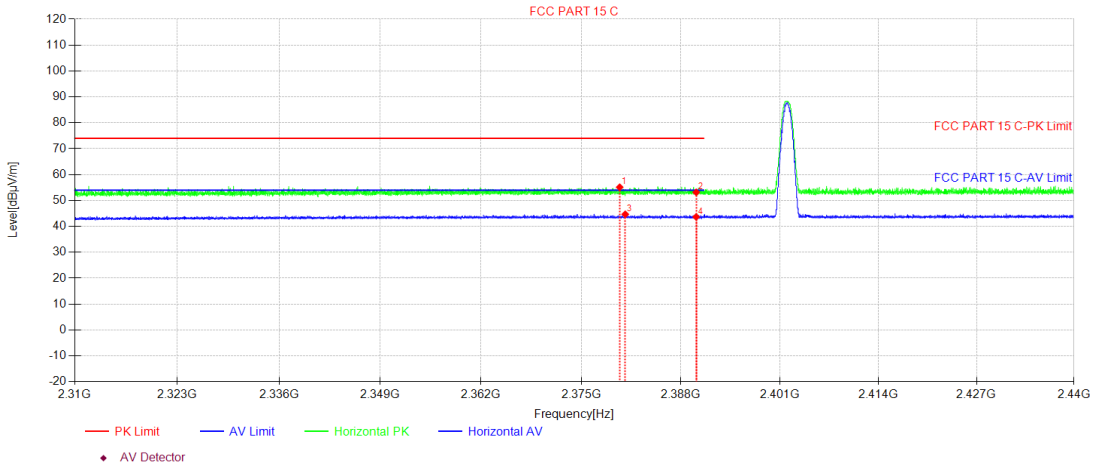
Figure 2. Above 1 GHz

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

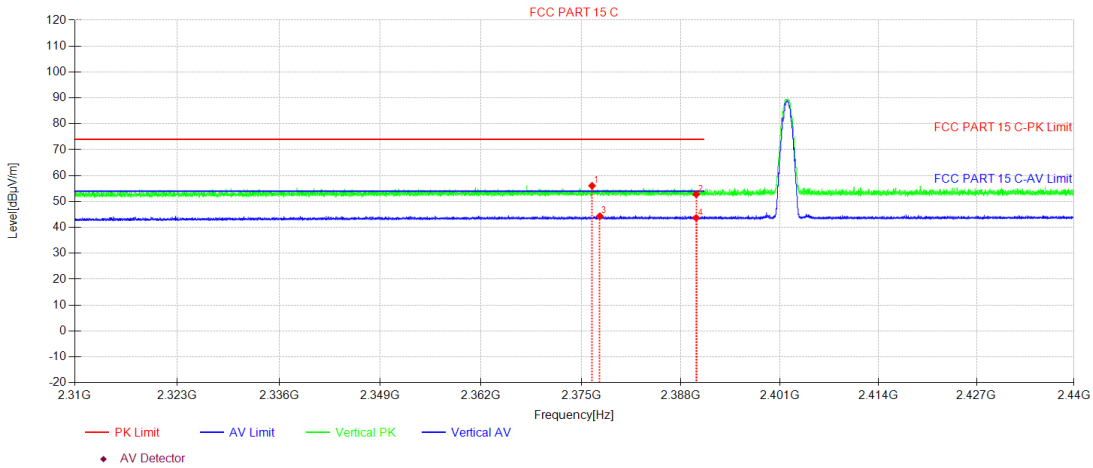
	• RBW = 120 kHz • VBW = 300 kHz • Detector = Peak • Trace mode = max hold Peak Measurements Above 1000 MHz • RBW = 1 MHz • VBW ⩾ 3 MHz • Detector = Peak • Sweep time = auto • Trace mode = max hold Average Measurements Above 1000MHz • RBW = 1 MHz • VBW = 10 Hz, when duty cycle is no less than 98 percent. • 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

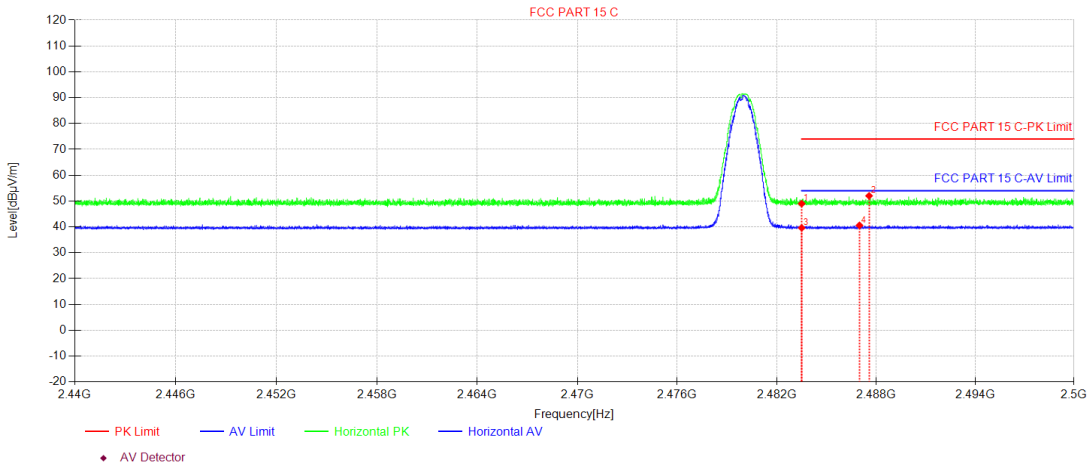


NO.	Freq. [MHz]	Reading Level [dBμV]	Correct Factor [dB/m]	Result Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Remark	Polarity
1	2380.01	55.96	-0.83	55.13	74.00	18.87	150	99	PK	H
2	2390.01	53.96	-0.80	53.16	74.00	20.84	150	360	PK	H
3	2380.74	45.51	-0.83	44.68	54.00	9.32	150	332	AV	H
4	2390.01	44.46	-0.80	43.66	54.00	10.34	150	215	AV	H

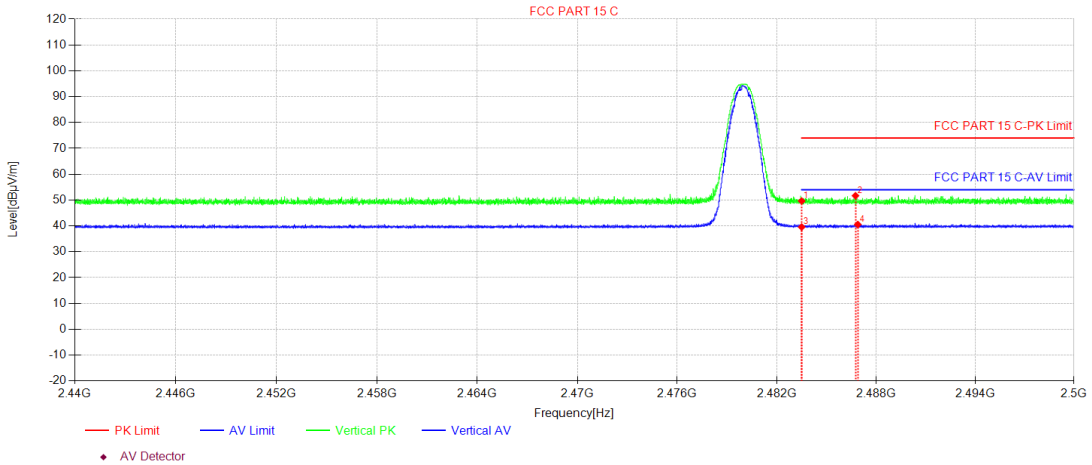


NO.	Freq. [MHz]	Reading Level [dBμV]	Correct Factor [dB/m]	Result Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Remark	Polarity
1	2376.41	56.92	-0.84	56.08	74.00	17.92	150	345	PK	V
2	2390.01	53.56	-0.80	52.76	74.00	21.24	150	345	PK	V
3	2377.42	45.19	-0.84	44.35	54.00	9.65	150	336	AV	V
4	2390.01	44.49	-0.80	43.69	54.00	10.31	150	226	AV	V

DH5 2480MHz



NO.	Freq. [MHz]	Reading Level [dBμV]	Correct Factor [dB/m]	Result Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Remark	Polarity
1	2483.50	49.28	-0.29	48.99	74.00	25.01	150	262	PK	H
2	2487.58	52.28	-0.26	52.02	74.00	21.98	150	195	PK	H
3	2483.50	39.92	-0.29	39.63	54.00	14.37	150	24	AV	H
4	2487.00	40.85	-0.26	40.59	54.00	13.41	150	251	AV	H



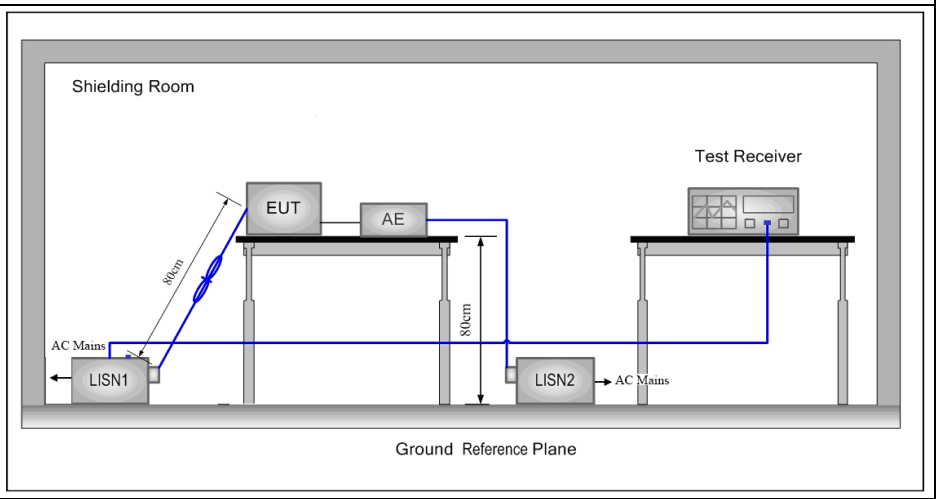
NO.	Freq. [MHz]	Reading Level [dBμV]	Correct Factor [dB/m]	Result Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Remark	Polarity
1	2483.50	49.93	-0.29	49.64	74.00	24.36	150	4	PK	V
2	2486.76	51.94	-0.26	51.68	74.00	22.32	150	67	PK	V
3	2483.50	39.86	-0.29	39.57	54.00	14.43	150	25	AV	V
4	2486.89	40.81	-0.26	40.55	54.00	13.45	150	205	AV	V

Note:

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

3.11 AC Power Line Conducted Emissions

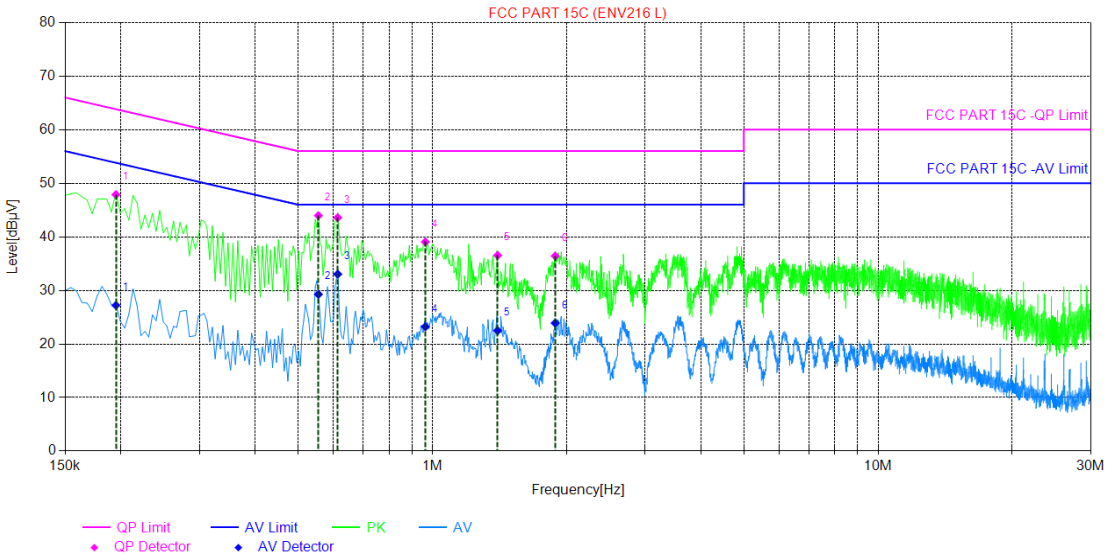
Test Requirement:	47 CFR Part 15C Section 15.207		
Test Method:	ANSI C63.10: 2020 Section 6.2		
Test Frequency Range:	150kHz to 30MHz		
Limit:	Frequency range (MHz)	Limit (dBuV)	
		Quasi-peak	Average
	0.15-0.5	66 to 56*	56 to 46*
	0.5-5	56	46
	5-30	60	50
	* Decreases with the logarithm of the frequency.		
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 2020 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

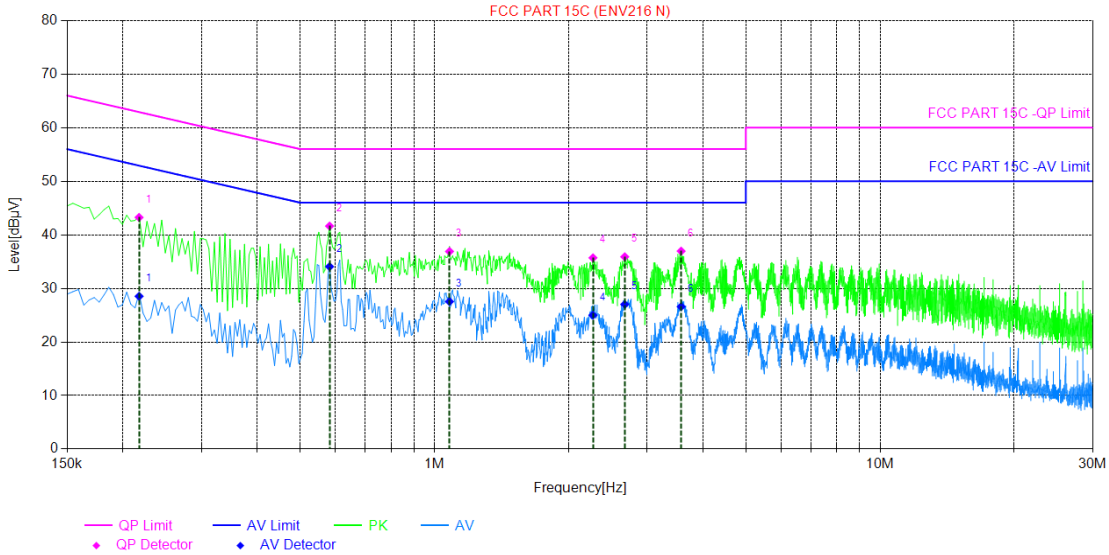
An initial pre-scan was performed on the live and neutral lines with peak detector.
Quasi-Peak and Average measurement were performed at the frequencies with maximized peak emission were detected.

Live Line:



Final Data List									
NO.	Freq. [MHz]	Factor [dB]	QP Value [dBμV]	QP Limit [dBμV]	QP Margin [dB]	AV Value [dBμV]	AV Limit [dBμV]	AV Margin [dB]	Verdict
1	0.195	9.93	47.88	63.82	15.94	27.21	53.82	26.61	PASS
2	0.555	9.84	43.96	56.00	12.04	29.26	46.00	16.74	PASS
3	0.6135	9.81	43.58	56.00	12.42	33.03	46.00	12.97	PASS
4	0.9645	9.73	39.05	56.00	16.95	23.21	46.00	22.79	PASS
5	1.401	9.73	36.54	56.00	19.46	22.49	46.00	23.51	PASS
6	1.887	9.73	36.41	56.00	19.59	23.90	46.00	22.10	PASS

Neutral Line:



Final Data List									
NO.	Freq. [MHz]	Factor [dB]	QP Value [dBµV]	QP Limit [dBµV]	QP Margin [dB]	AV Value [dBµV]	AV Limit [dBµV]	AV Margin [dB]	Verdict
1	0.2175	9.87	43.25	62.91	19.66	28.53	52.91	24.38	PASS
2	0.582	9.77	41.63	56.00	14.37	34.07	46.00	11.93	PASS
3	1.0815	9.69	36.90	56.00	19.10	27.54	46.00	18.46	PASS
4	2.2695	9.80	35.71	56.00	20.29	25.00	46.00	21.00	PASS
5	2.6745	9.84	35.90	56.00	20.10	27.01	46.00	18.99	PASS
6	3.579	9.92	36.96	56.00	19.04	26.60	46.00	19.40	PASS

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

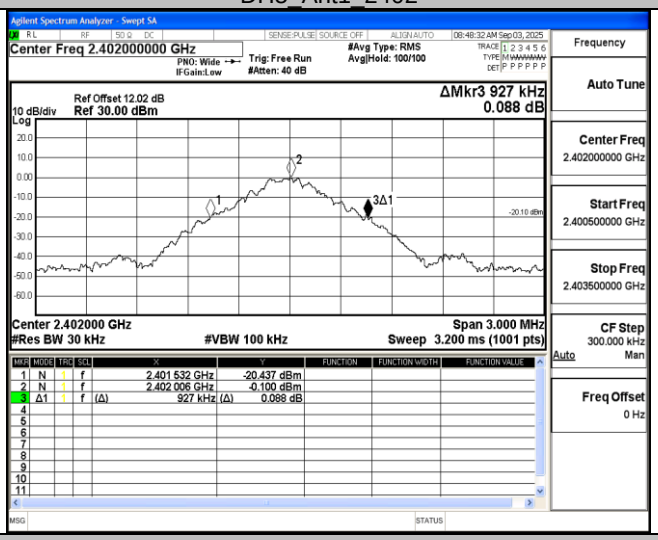
Appendix A: 20dB Emission Bandwidth

Test Result

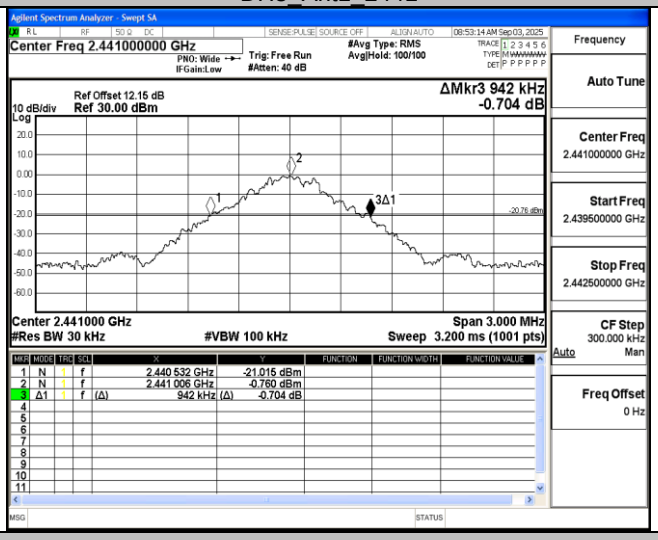
TestMode	Antenna	Freq(MHz)	20dB EBW[MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
DH5	Ant1	2402	0.927	2401.532	2402.459	---	---
		2441	0.942	2440.532	2441.474	---	---
		2480	0.927	2479.541	2480.468	---	---
2DH5	Ant1	2402	1.320	2401.328	2402.648	---	---
		2441	1.314	2440.331	2441.645	---	---
		2480	1.320	2479.328	2480.648	---	---
3DH5	Ant1	2402	1.314	2401.334	2402.648	---	---
		2441	1.311	2440.337	2441.648	---	---
		2480	1.305	2479.334	2480.639	---	---

Test Graphs

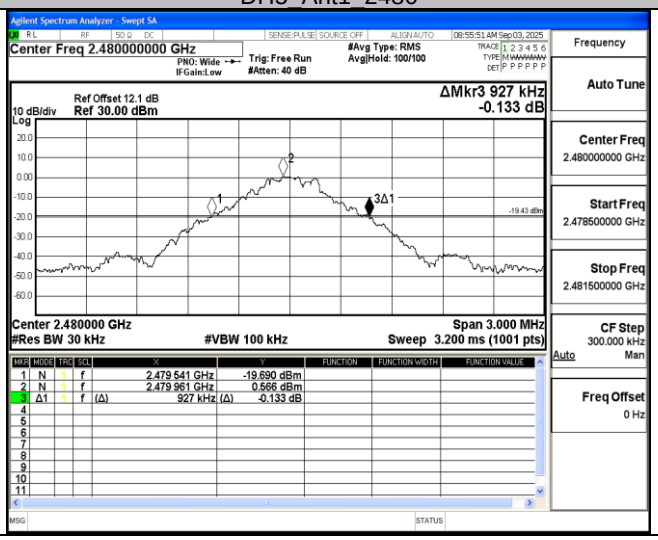
DH5_Ant1_2402



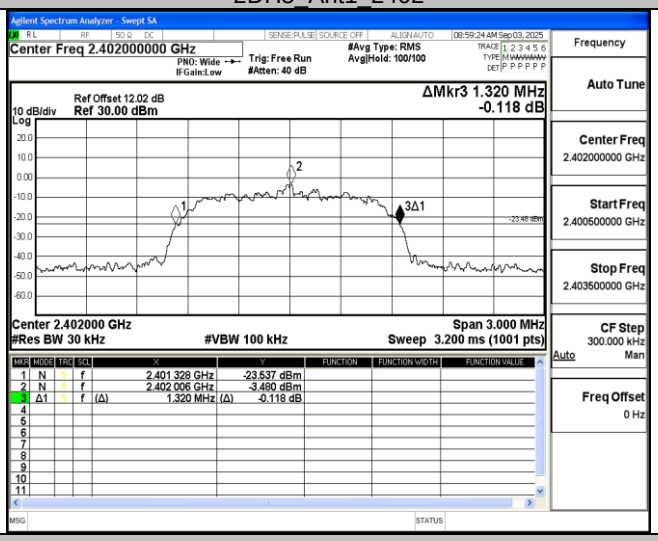
DH5_Ant1_2441



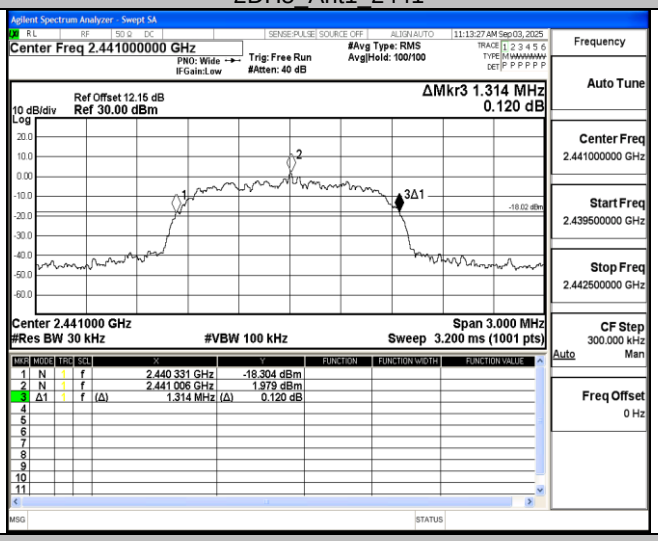
DH5_Ant1_2480



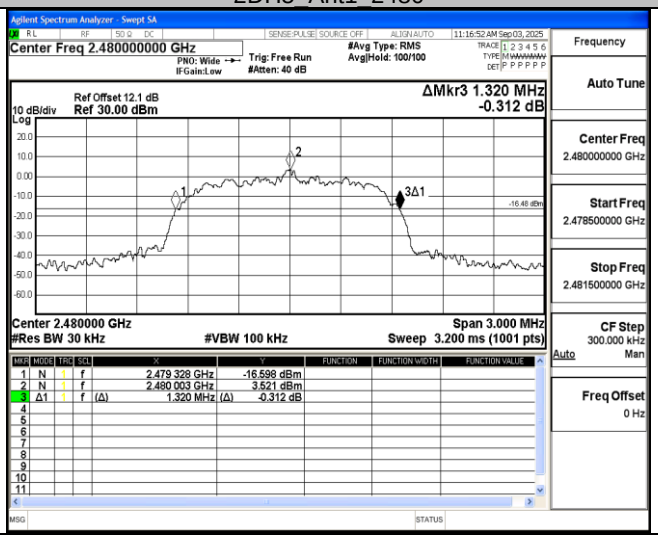
2DH5_Ant1_2402



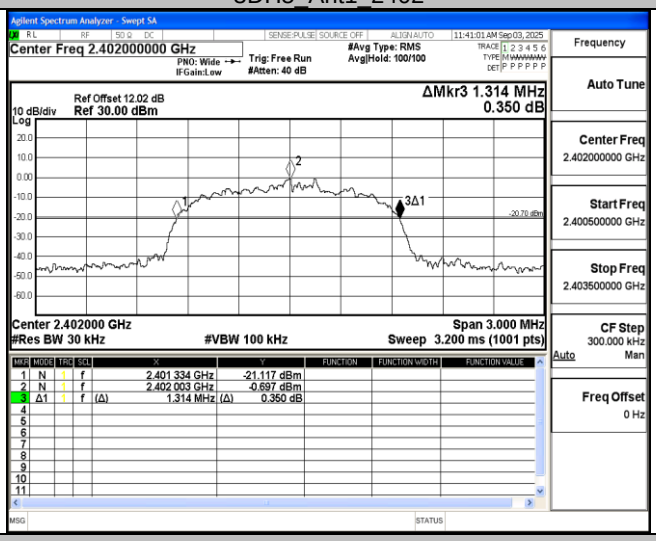
2DH5_Ant1_2441



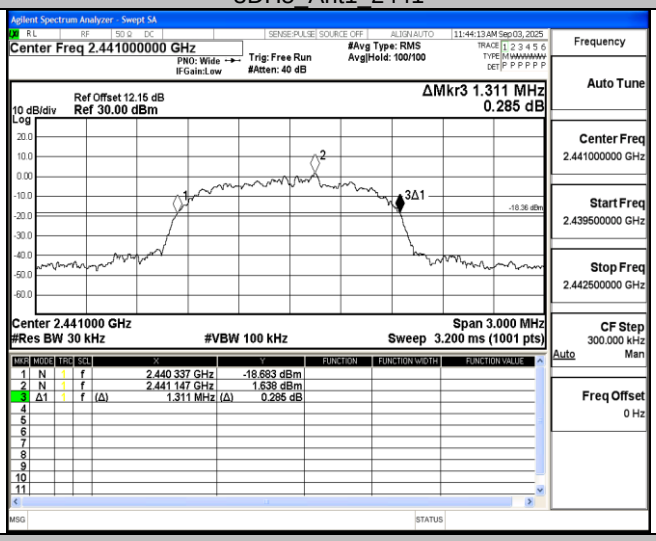
2DH5_Ant1_2480



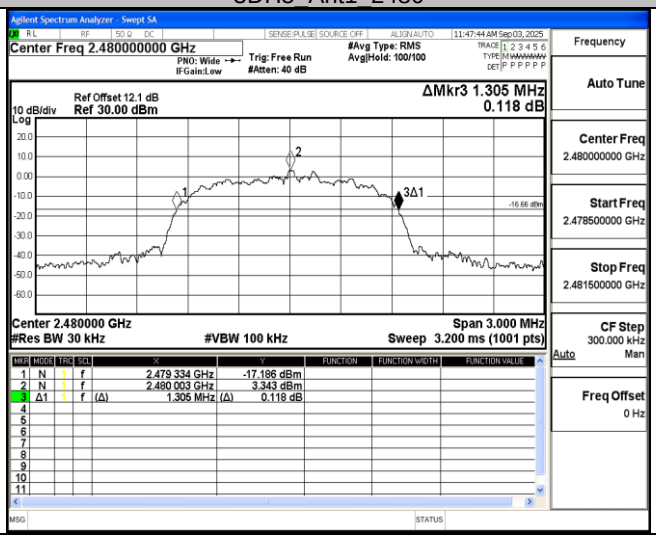
3DH5_Ant1_2402



3DH5_Ant1_2441



3DH5_Ant1_2480



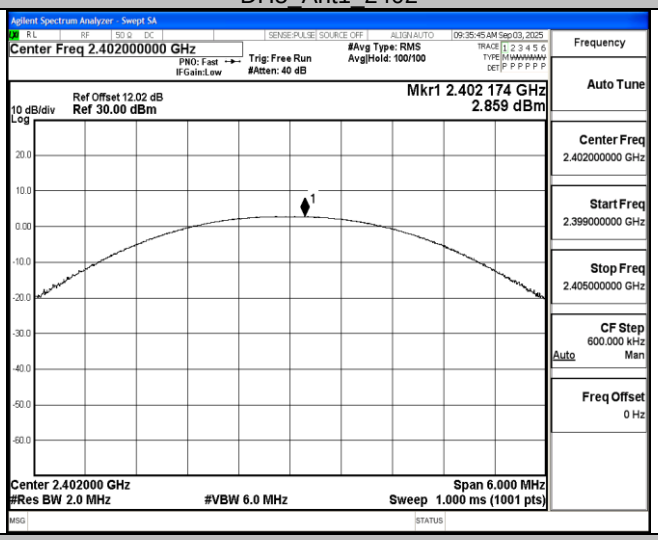
Appendix B: Maximum conducted output power

Test Result

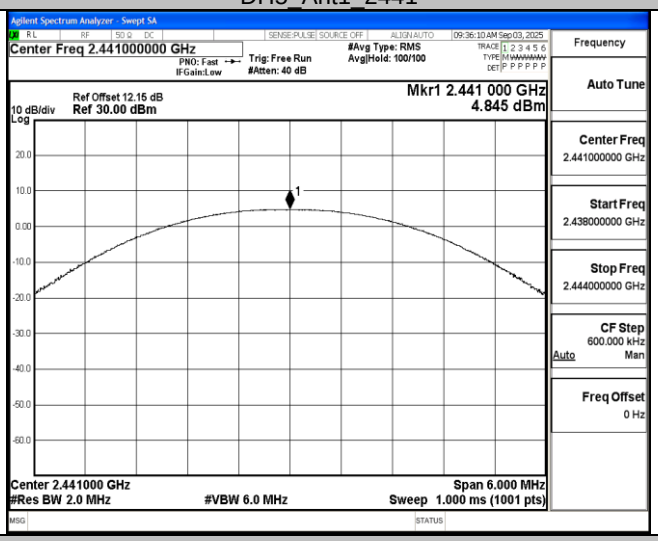
Test Mode	Antenna	Freq(MHz)	Conducted Peak Powert[dBm]	Conducted Limit[dBm]	Verdict
DH5	Ant1	2402	2.86	≤20.97	PASS
		2441	4.85	≤20.97	PASS
		2480	6.21	≤20.97	PASS
2DH5	Ant1	2402	4.74	≤20.97	PASS
		2441	6.95	≤20.97	PASS
		2480	8.71	≤20.97	PASS
3DH5	Ant1	2402	4.96	≤20.97	PASS
		2441	7.43	≤20.97	PASS
		2480	9.12	≤20.97	PASS

Test Graphs

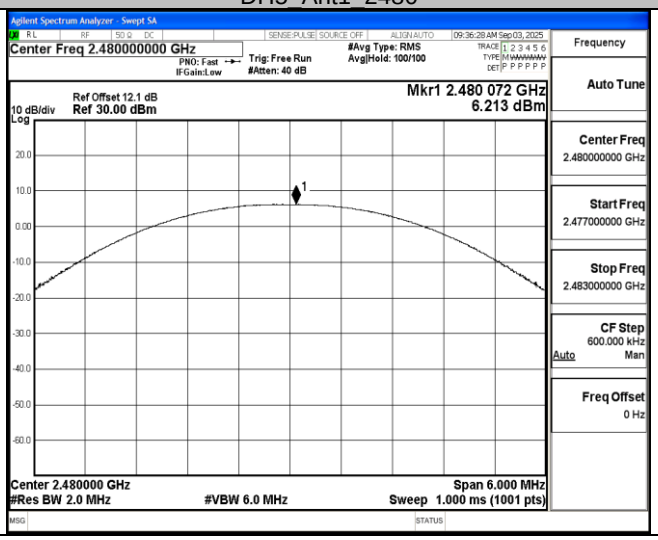
DH5_Ant1_2402



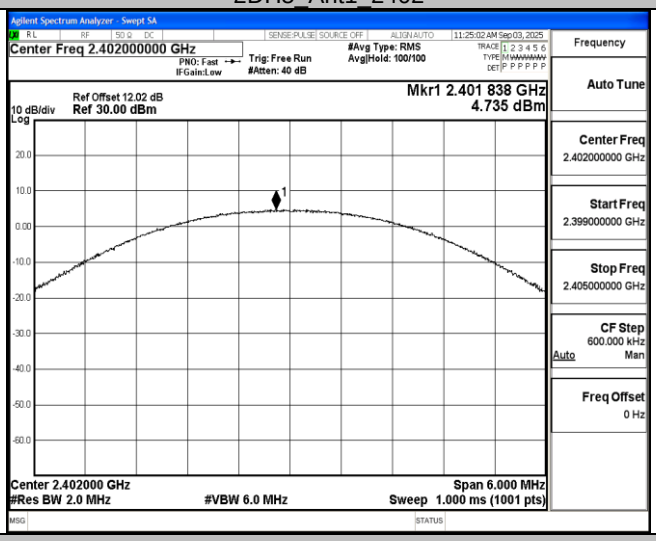
DH5_Ant1_2441



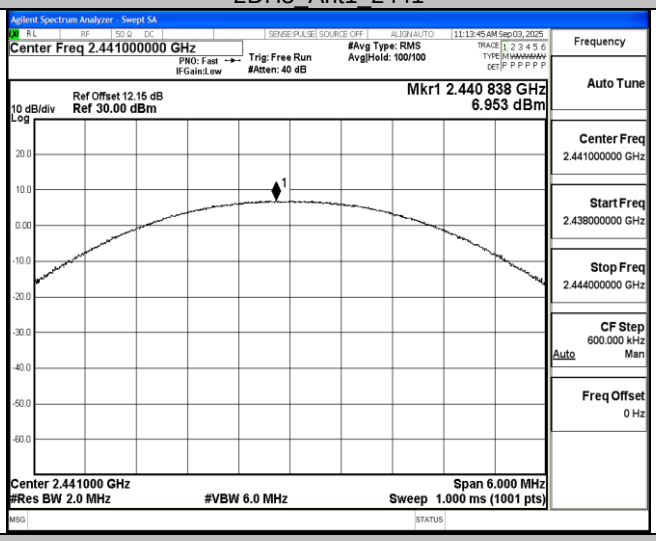
DH5_Ant1_2480



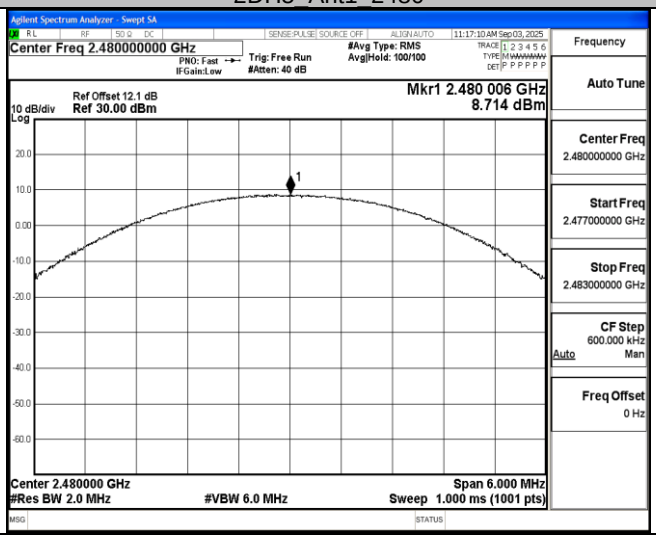
2DH5_Ant1_2402



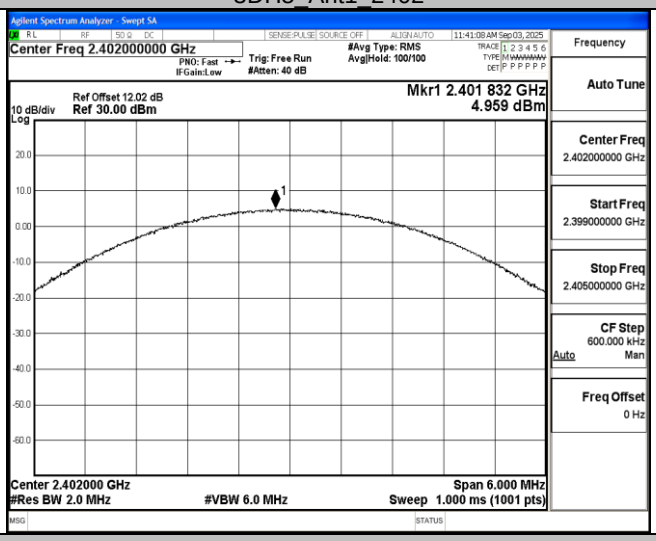
2DH5_Ant1_2441



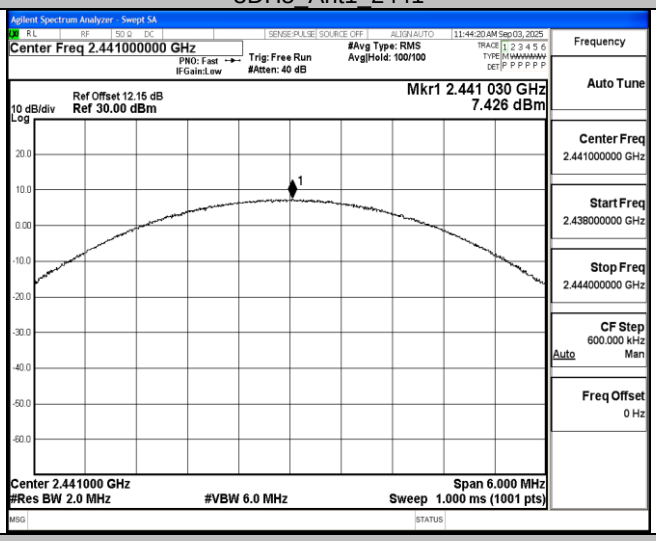
2DH5_Ant1_2480



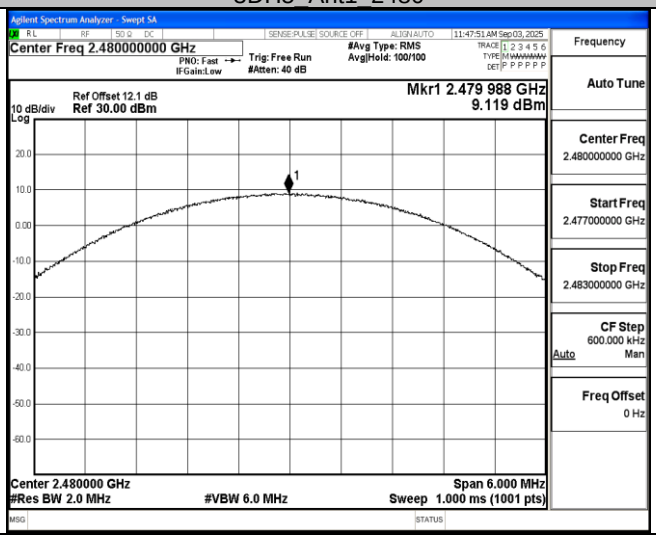
3DH5_Ant1_2402



3DH5_Ant1_2441



3DH5_Ant1_2480



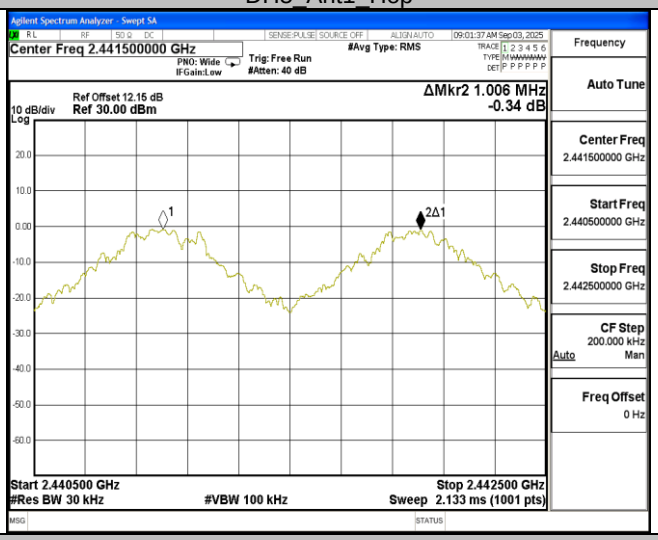
Appendix C: Carrier frequency separation

Test Result

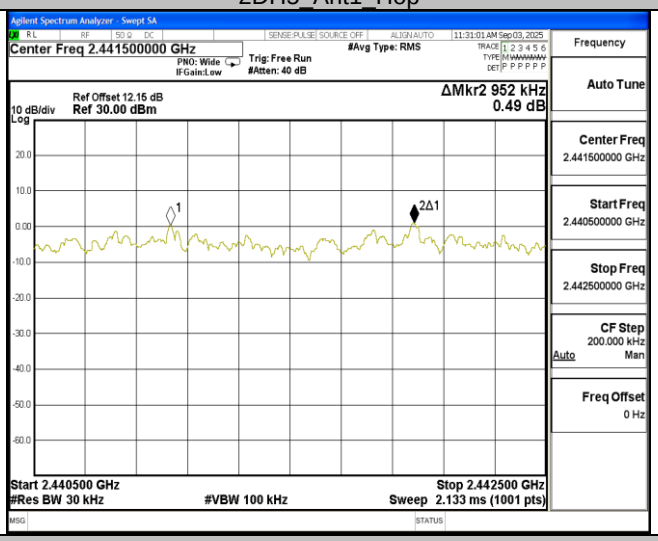
TestMode	Antenna	Freq(MHz)	Result[MHz]	Limit[MHz]	Verdict
DH5	Ant1	Hop	1.006	≥0.942	PASS
2DH5	Ant1	Hop	0.952	≥0.880	PASS
3DH5	Ant1	Hop	1.014	≥0.025	PASS

Test Graphs

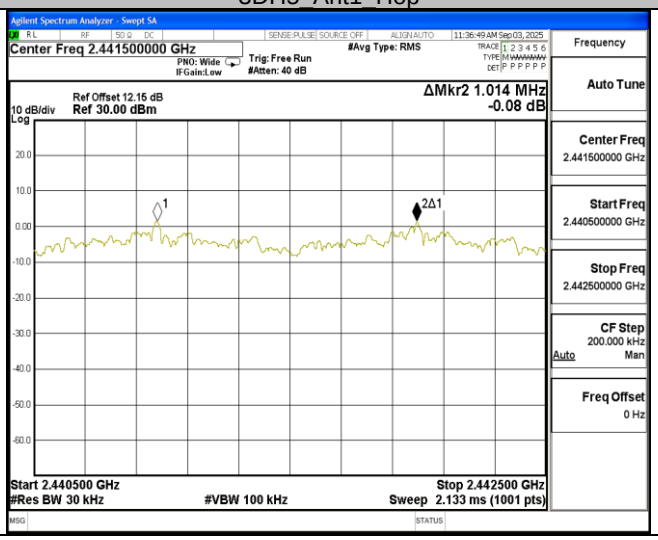
DH5_Ant1_Hop



2DH5_Ant1_Hop



3DH5_Ant1_Hop



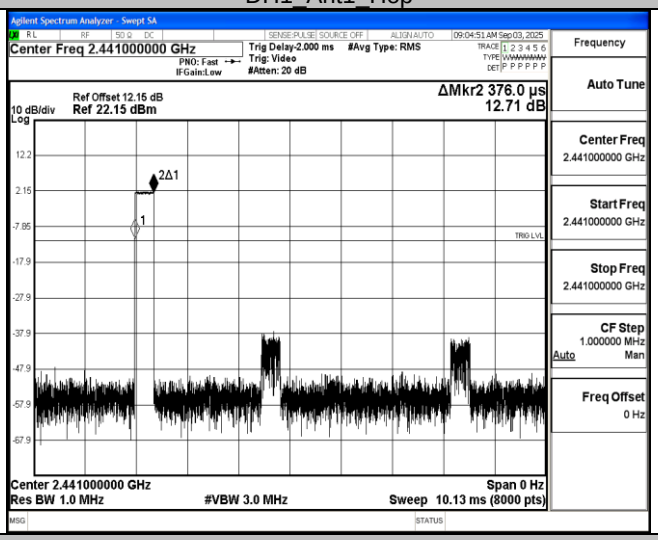
Appendix D: Dwell Time

Test Result

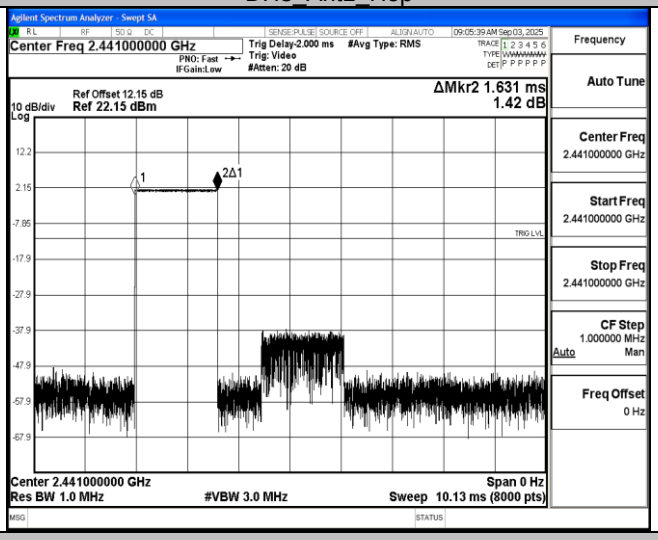
TestMode	Antenna	Freq(MHz)	BurstWidth [ms]	TotalHops [Num]	Result[s]	Limit[s]	Verdict
DH1	Ant1	Hop	0.376	320	0.12	≤0.4	PASS
DH3	Ant1	Hop	1.631	160	0.261	≤0.4	PASS
DH5	Ant1	Hop	2.880	106.67	0.307	≤0.4	PASS
2DH1	Ant1	Hop	0.388	320	0.124	≤0.4	PASS
2DH3	Ant1	Hop	1.640	160	0.262	≤0.4	PASS
2DH5	Ant1	Hop	2.888	106.67	0.308	≤0.4	PASS
3DH1	Ant1	Hop	0.388	320	0.124	≤0.4	PASS
3DH3	Ant1	Hop	1.638	160	0.262	≤0.4	PASS
3DH5	Ant1	Hop	2.889	106.67	0.308	≤0.4	PASS

Test Graphs

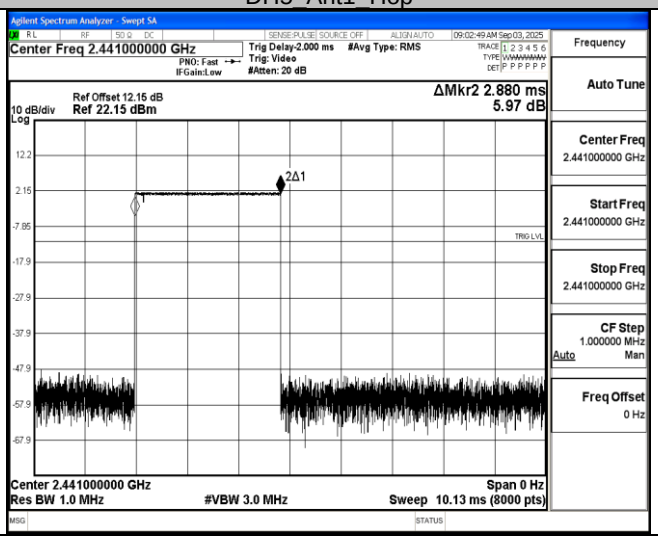
DH1_Ant1_Hop



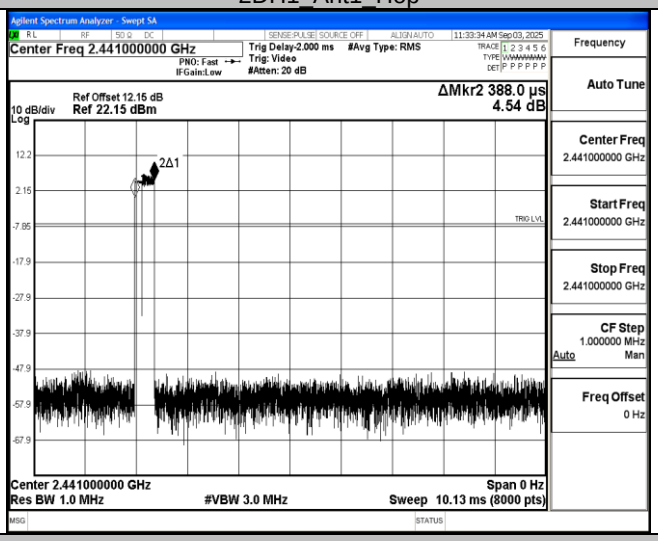
DH3_Ant1_Hop



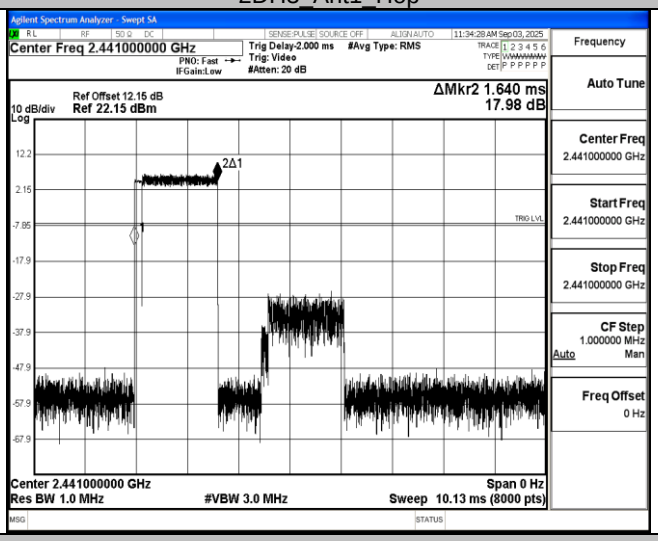
DH5_Ant1_Hop



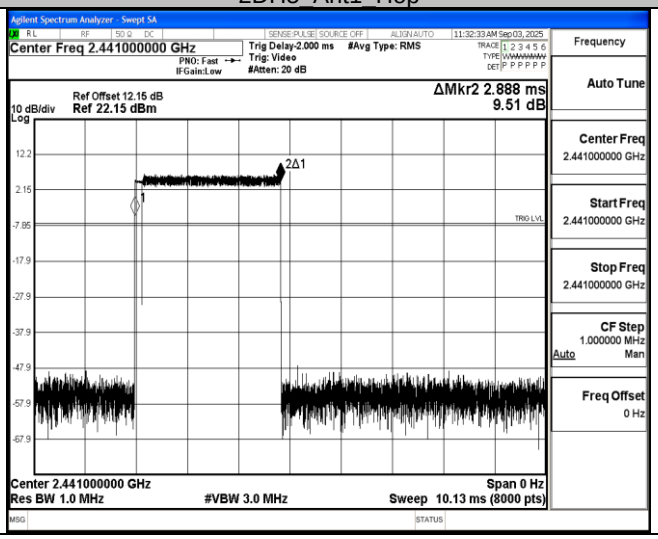
2DH1_Ant1_Hop



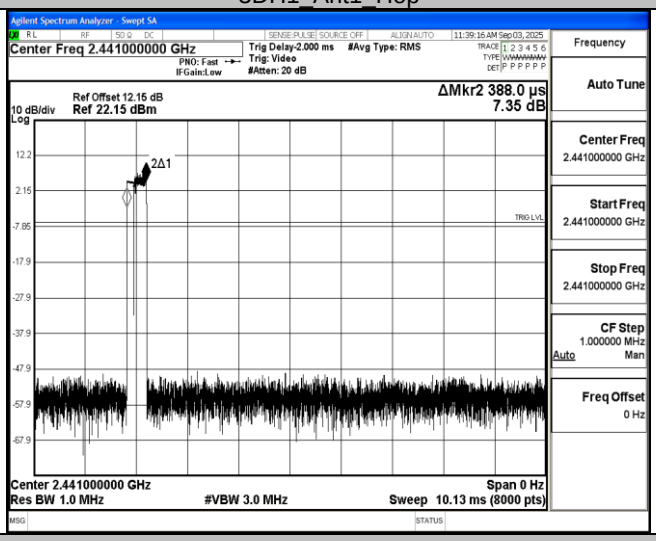
2DH3_Ant1_Hop



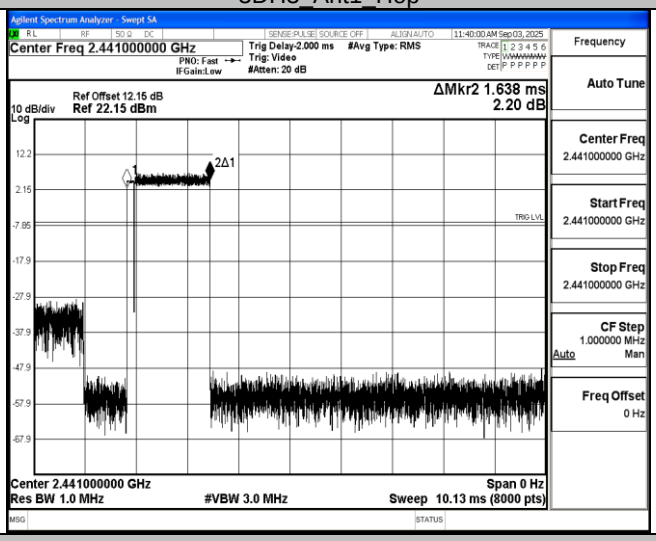
2DH5_Ant1_Hop



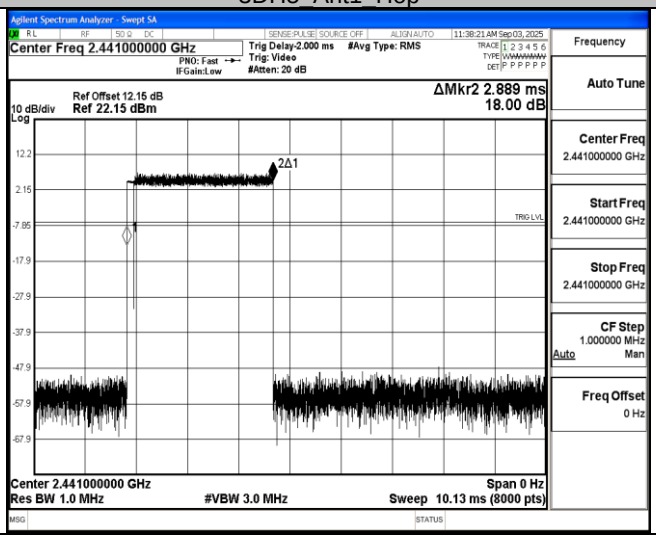
3DH1_Ant1_Hop



3DH3_Ant1_Hop



3DH5_Ant1_Hop



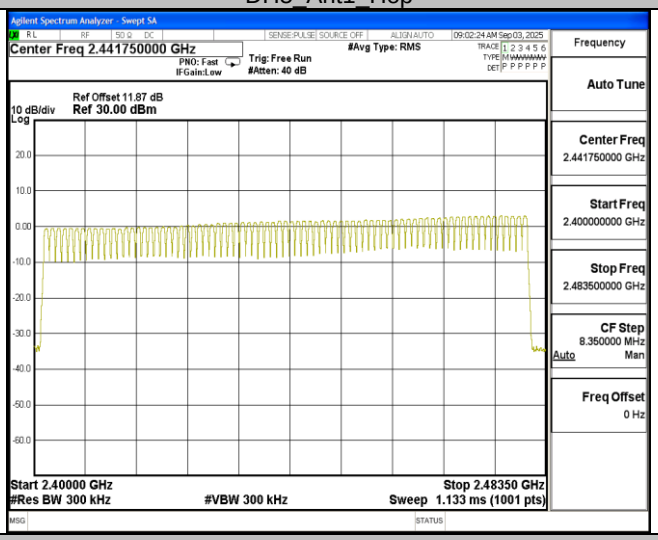
Appendix E: Number of hopping channels

Test Result

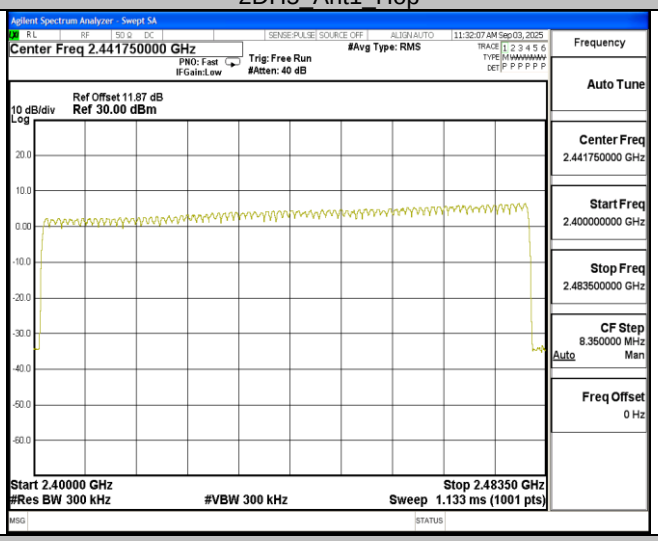
TestMode	Antenna	Freq(MHz)	Result[Num]	Limit[Num]	Verdict
DH5	Ant1	Hop	79	≥15	PASS
2DH5	Ant1	Hop	79	≥15	PASS
3DH5	Ant1	Hop	79	≥15	PASS

Test Graphs

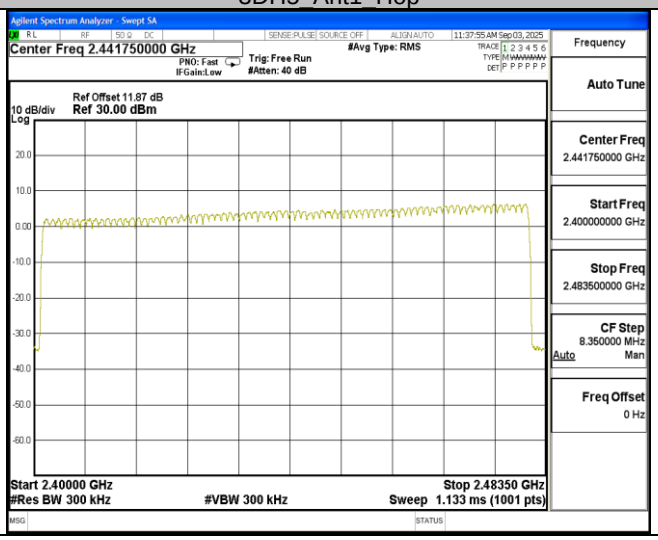
DH5_Ant1_Hop



2DH5_Ant1_Hop



3DH5_Ant1_Hop



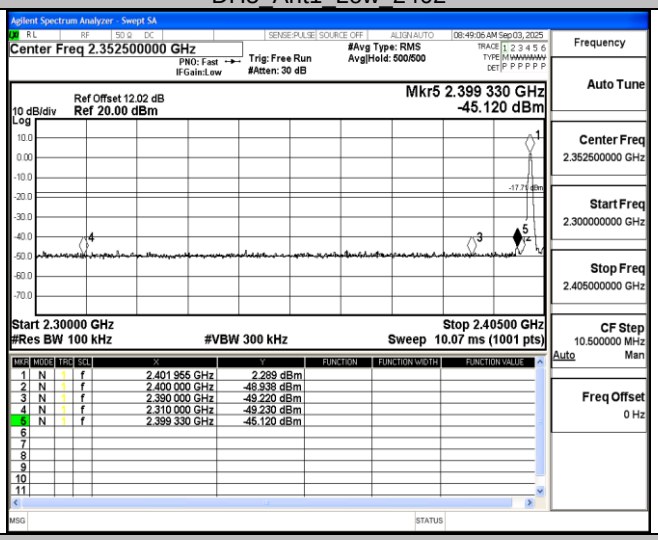
Appendix F: Band edge measurements

Test Result

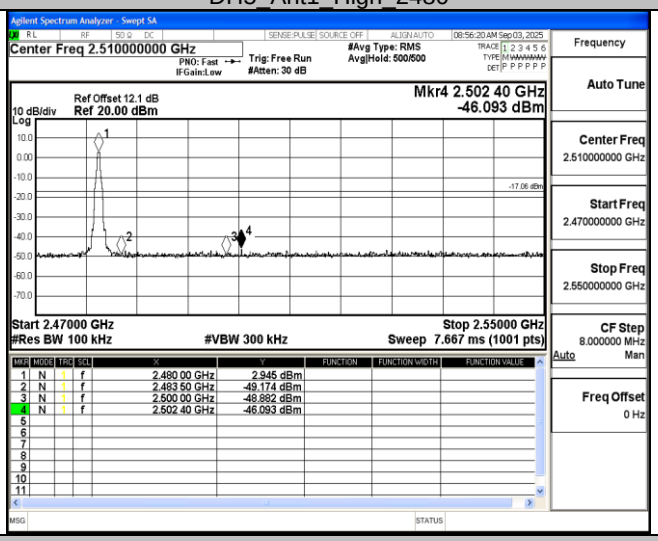
TestMode	Antenna	ChName	Freq(MHz)	RefLevel [dBm]	Result [dBm]	Limit [dBm]	Verdict
DH5	Ant1	Low	2402	2.29	-45.12	≤-17.71	PASS
		High	2480	2.95	-46.09	≤-17.06	PASS
		Low	Hop_2402	-0.89	-47.22	≤-20.89	PASS
		High	Hop_2480	2.67	-46.68	≤-17.33	PASS
2DH5	Ant1	Low	2402	2.13	-45.23	≤-17.87	PASS
		High	2480	6.05	-46.79	≤-13.96	PASS
		Low	Hop_2402	1.64	-46.57	≤-18.36	PASS
		High	Hop_2480	4.35	-46.26	≤-15.65	PASS
3DH5	Ant1	Low	2402	0.82	-44.94	≤-19.18	PASS
		High	2480	6.24	-46.32	≤-13.76	PASS
		Low	Hop_2402	0.51	-46.98	≤-19.49	PASS
		High	Hop_2480	6.00	-46.29	≤-14	PASS

Test Graphs

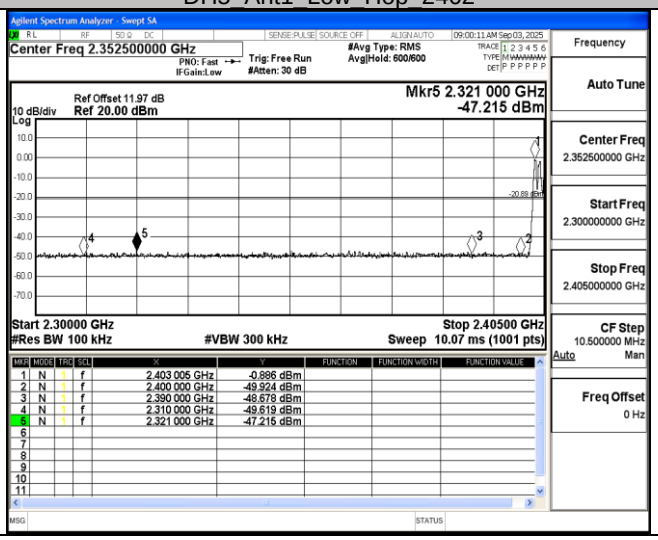
DH5_Ant1_Low_2402



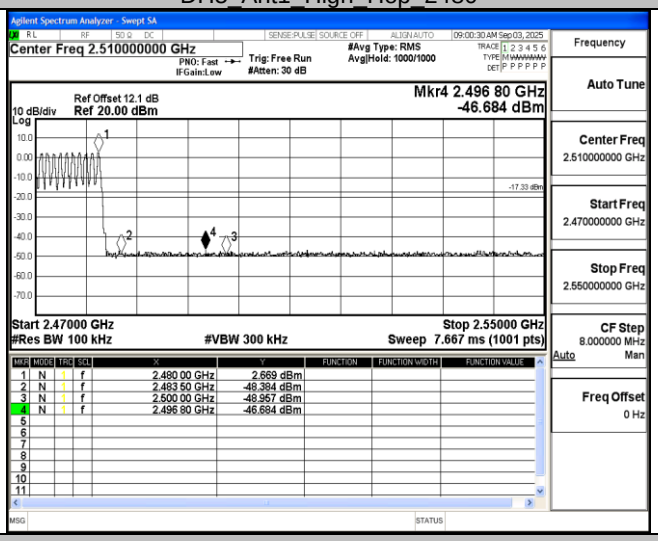
DH5_Ant1_High_2480



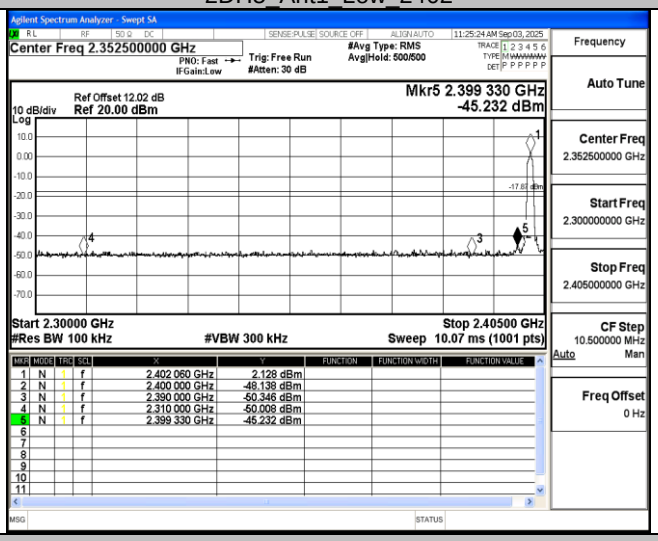
DH5_Ant1_Low_Hop_2402



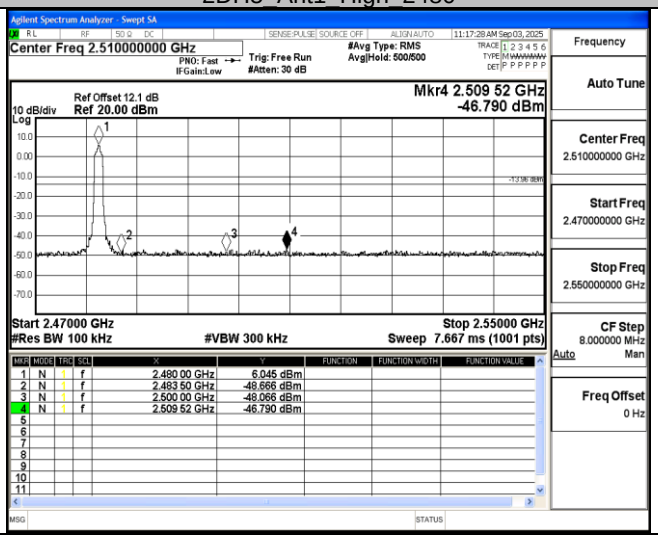
DH5_Ant1_High_Hop_2480



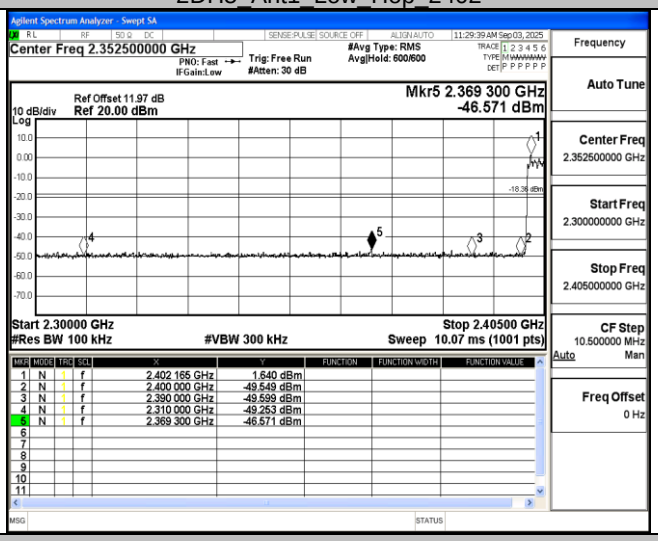
2DH5_Ant1_Low_2402



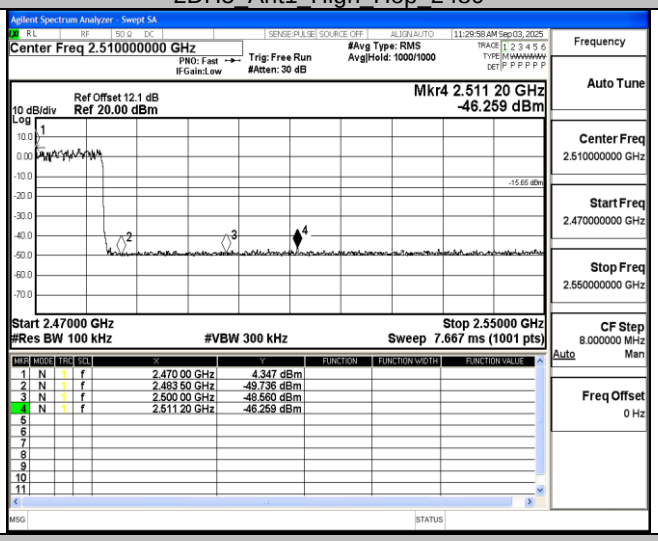
2DH5_Ant1_High_2480



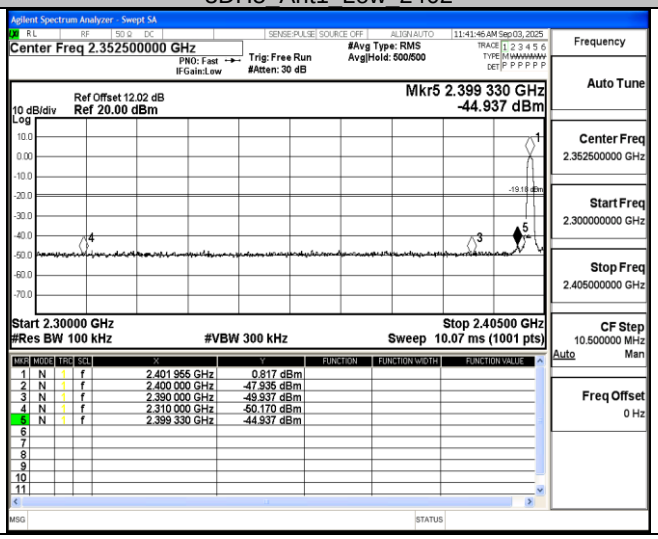
2DH5_Ant1_Low_Hop_2402



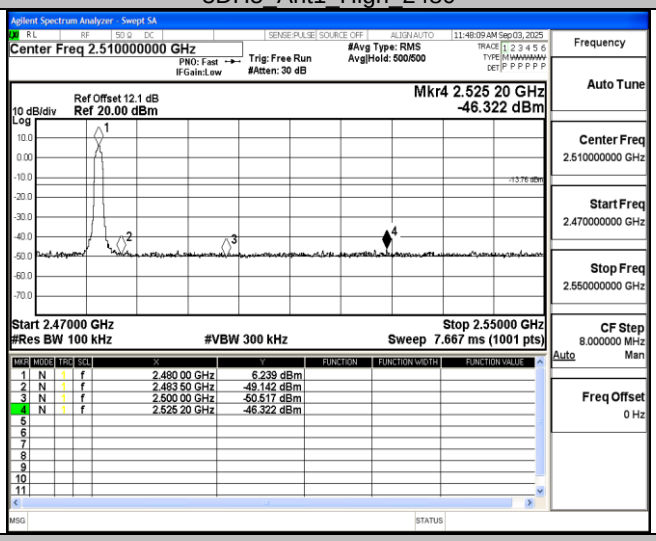
2DH5_Ant1_High_Hop_2480



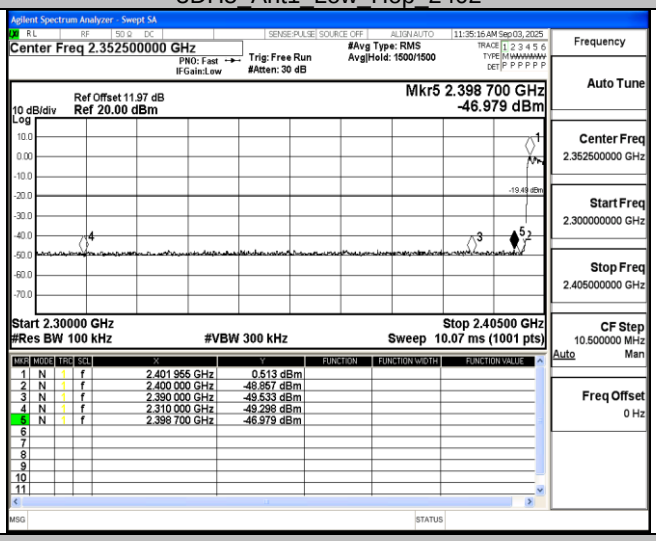
3DH5_Ant1_Low_2402



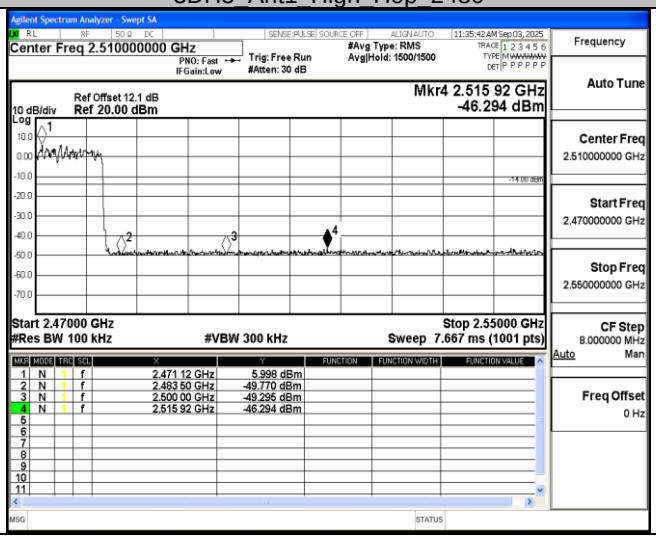
3DH5_Ant1_High_2480



3DH5_Ant1_Low_Hop_2402



3DH5_Ant1_High_Hop_2480



Appendix G: Conducted Spurious Emission

Test Result

TestMode	Antenna	Freq(MHz)	FreqRange [MHz]	RefLevel [dBm]	Result [dBm]	Limit [dBm]	Verdict
DH5	Ant1	2402	Reference	2.12	2.12	---	PASS
			30~1000	2.12	-47.61	≤-17.88	PASS
			1000~26500	2.12	-42.39	≤-17.88	PASS
		2441	Reference	0.94	0.94	---	PASS
			30~1000	0.94	-49.24	≤-19.06	PASS
			1000~26500	0.94	-44.15	≤-19.06	PASS
		2480	Reference	2.78	2.78	---	PASS
			30~1000	2.78	-49.14	≤-17.22	PASS
			1000~26500	2.78	-44.94	≤-17.22	PASS
2DH5	Ant1	2402	Reference	1.02	1.02	---	PASS
			30~1000	1.02	-49.49	≤-18.98	PASS
			1000~26500	1.02	-42.31	≤-18.98	PASS
		2441	Reference	3.49	3.49	---	PASS
			30~1000	3.49	-48.42	≤-16.51	PASS
			1000~26500	3.49	-42.84	≤-16.51	PASS
		2480	Reference	5.29	5.29	---	PASS
			30~1000	5.29	-47.86	≤-14.71	PASS
			1000~26500	5.29	-43.93	≤-14.71	PASS
3DH5	Ant1	2402	Reference	2.32	2.32	---	PASS
			30~1000	2.32	-49.53	≤-17.68	PASS
			1000~26500	2.32	-42.27	≤-17.68	PASS
		2441	Reference	3.56	3.56	---	PASS
			30~1000	3.56	-47.66	≤-16.44	PASS
			1000~26500	3.56	-43.22	≤-16.44	PASS
		2480	Reference	6.00	6.00	---	PASS
			30~1000	6.00	-47.16	≤-14	PASS
			1000~26500	6.00	-43.97	≤-14	PASS