RF Test Report

FCC ID: 2A7OH-EA-XRN-7B004

Test Report No……..:	RF240314002-03-004
Product(s) Name……...:	Industrial touch all-in-one PC
Model(s)……..:	EA-XRN-7B004
Trade Mark……....:	N/A
Applicant……..:	Shenzhen Tengtek Technology Co., Ltd
Address……..…...:	Room 1202, Building 160, East Lisongkuang Community, Gongming Street, Guangming District, Shenzhen, China 518106
Receipt Date……..:	2024.03.24
Test Date……....:	2024.03.26~2024.04.15
Issued Date……..:	2024.04.15
Standards……..:	47 CFR FCC Part 15, Subpart C(Section 15.247) ANSI C63.10:2013
Testing Laboratory……:	Shenzhen Haiyun Standard Technical Co., Ltd.

Prepared By:	Checked By:	Approved By:	
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HISTORY OF THIS TEST REPORT

Original Report Issue Date: 2024.04.15

● No additional attachment

○ Additional attachments were issued following record

Attachment No.	Issue Date	Description

1.. SUMMARY OF TEST RESULTS

Test procedures according to the technical standard(s):

FCC CFR Title 47, Part 15, Subpart C				
Standard(s) Section	**Test Item**	**Test Result**	**Judgment**	**Remark**
15.207	AC Power Line Conducted Emissions	APPENDIX A	PASS	------
15.247(d) 15.205(a) 15.209(a)	Radiated Emission	APPENDIX B APPENDIX C APPENDIX D	PASS	------
15.247 (a)(1)(iii)	Number of Hopping Frequency	APPENDIX E	PASS	------
15.247 (a)(1)(iii)	Average Time of Occupancy	APPENDIX F	PASS	------
15.247(a)(1)	Hopping Channel Separation	APPENDIX G	PASS	------
15.247(a)(1)	Bandwidth	APPENDIX H	PASS	------
15.247(a)(1)	Maximum Output Power	APPENDIX I	PASS	------
15.247(d)	Conducted Spurious Emission	APPENDIX J	PASS	------
15.203	Antenna Requirement	------	PASS	Note(2)

Note:

(1) “N/A” denotes test is not applicable in this test report

(2) The device what use a RP-SMA antenna interface design was considered sufficient to comply with the provisions of 15.203.

1.1. TEST FACILITY

Company:	Shenzhen Haiyun Standard Technical CO., Ltd.
Address:	No. 110-113, 115, 116, Block B, Jinyuan Business Building, Bao'an District, Shenzhen, China
CNAS Registration Number:	CNAS L18252
CAB identifier:	CN0145
A2LA Certificate Number:	6823.01
Telephone:	0755-26024411

1.2. MEASUREMENT UNCERTAINTY

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level (based on a coverage factor (k=2))

Uncertainty	
Parameter	Uncertainty
Occupied Channel Bandwidth	±143.88kHz
Power Spectral Density	±0.743dB
Conducted Spurious Emission	±1.328dB
RF power conducted	±0.384dB
Conducted emission(9kHz~30MHz) AC main	±2.72dB
Radiated emission(9kHz~30MHz)	±2.66dB
Radiated emission (30MHz~1GHz)	±4.62dB
Radiated emission (1GHz~18GHz)	±4.86dB
Radiated emission (18GHz~40GHz)	±3.80dB

Note: Unless specifically mentioned, the uncertainty of measurement has not been taken into account to declare the compliance or non-compliance to the specification.

1.3. TEST ENVIRONMENT CONDITIONS

Test Item	Temperature	Humidity	Test Voltage	Tested By
AC Power Line Conducted Emissions	24.8°C	48%	AC 120V/60Hz	Freedom Zhuo
Radiated Emissions-9 kHz to 30 MHz	23.6°C	56%	AC 120V/60Hz	Freedom Zhuo
Radiated Emissions-30 MHz to 1000 MHz	23.6°C	56%	AC 120V/60Hz	Freedom Zhuo
Radiated Emissions-Above 1000 MHz	23.6°C	56%	AC 120V/60Hz	Freedom Zhuo
Bandwidth	24.5°C	52%	DC 12V	Albert Fan
Maximum Output Power	24.5°C	52%	DC 12V	Albert Fan
Conducted Spurious Emission	24.5°C	52%	DC 12V	Albert Fan
Number of Hopping Frequency	24.5°C	52%	DC 12V	Albert Fan
Average Time of Occupancy	24.5°C	52%	DC 12V	Albert Fan
Hopping Channel Separation	24.5°C	52%	DC 12V	Albert Fan

Note: Adapter supply voltage AC 120V/60Hz.

2.. GENERAL INFORMATION

2.1. GENERAL DESCRIPTION OF EUT

Product No.	POC240314002-S003
Product Name	Industrial touch all-in-one PC
Model Name	EA-XRN-7B004
Trade Mark	N/A
Power Supply	DC 12V from adapter
Adapter Information	Model: HKA09012070-7U Input: 100-240V~, 50/60Hz 1.5A Output: 12V⎓7.0A, 84.0W
Operation Frequency	2402 MHz ~ 2480 MHz
Modulation Type	GFSK, π/4-DQPSK
Bit Rate of Transmitter	1Mbps, 2Mbps
Max. Output Power	1Mbps: 0.80dBm (0.001W)
Antenna gain	1.09dBi
Antenna type	External Antenna

Note:

1. For a more detailed features description, please refer to the manufacturer's specifications or the user's manual.
2. Channel List:

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
00	2402	27	2429	54	2456
01	2403	28	2430	55	2457
02	2404	29	2431	56	2458
03	2405	30	2432	57	2459
04	2406	31	2433	58	2460
05	2407	32	2434	59	2461
06	2408	33	2435	60	2462
07	2409	34	2436	61	2463
08	2410	35	2437	62	2464
09	2411	36	2438	63	2465
10	2412	37	2439	64	2466
11	2413	38	2440	65	2467
12	2414	39	2441	66	2468
13	2415	40	2442	67	2469
14	2416	41	2443	68	2470
15	2417	42	2444	69	2471
16	2418	43	2445	70	2472
17	2419	44	2446	71	2473
18	2420	45	2447	72	2474
19	2421	46	2448	73	2475
20	2422	47	2449	74	2476
21	2423	48	2450	75	2477
22	2424	49	2451	76	2478
23	2425	50	2452	77	2479
24	2426	51	2453	78	2480
25	2427	52	2454		
26	2428	53	2455		

2.2. DESCRIPTION OF TEST MODES

The test system was pre-tested based on the consideration of all possible combinations of EUT operation mode.

Pretest Mode	Description
Mode 1	TX Mode_1Mbps Channel 00/39/78
Mode 2	TX Mode_2Mbps Channel 00/39/78
Mode 3	TX Mode_1Mbps Channel 00

Following mode(s) was (were) found to be the worst case(s) and selected for the final test.

AC power line conducted emissions test	
Final Test Mode	Description
Mode 3	TX Mode_1Mbps Channel 00

Radiated emissions test - Below 1GHz	
Final Test Mode	Description
Mode 3	TX Mode_1Mbps Channel 00

Radiated emissions test - Above 1GHz	
Final Test Mode	Description
Mode 1	TX Mode_1Mbps Channel 00/39/78

Maximum Output Power	
Final Test Mode	Description
Mode 1	TX Mode_1Mbps Channel 00/39/78
Mode 2	TX Mode_2Mbps Channel 00/39/78

Other Conducted test	
Final Test Mode	Description
Mode 1	TX Mode_1Mbps Channel 00/39/78
Mode 2	TX Mode_2Mbps Channel 00/39/78

Note:

(1) The measurements for Output Power were tested with DH1/3/5 during 1Mbps and 2Mbps, the worst case were 1Mbps (DH5) and 2Mbps (DH5), only worst case were documented for other test items except Average Time of Occupancy.

(2) For radiated emission above 1 GHz test, the spurious points of 1GHz~26.5GHz have been pre-tested and in this report only recorded the worst case. The remaining spurious points are all below the limit value of 20dB.

(3) This product has the mode of BT AFH, which was considered during testing.
800/20/X(X = 2 of DH1, X = 4 of DH3 or X = 6 of DH5) with 20, 10 or 6.67 hops per second in a channel, and then multiply 0.4*20 (20 # of hopping). But this mode is not the worst case mode as

duration of the packet is same, and this report only shows the worst case mode.

(4) For AC power line conducted emissions and radiated spurious emissions below 1 GHz test, the 1Mbps Channel 00 are found to be the worst case and recorded.

2.3. PARAMETERS OF TEST SOFTWARE

During testing, channel & power controlling software provided by the customer was used to control the operating channel as well as the output power level.

Test Software Version	cmd.exe		
Frequency (MHz)	2402	2441	2480
1Mbps	default	default	default
2Mbps	default	default	default

2.4. SUPPORT UNITS

No.	Equipment	Model	Manufacturer	Series No
1	Displayer	T24S-28	LENOVO	M032004854IT
2	Mouse	DOK-680U	LENOVO	701E8328
3	Earphone	E1	LENOVO	/
4	USB Disk	32GB	Kingston	/
5	Keyboard	SK-8827	LENOVO	21R1ADL

3.. AC POWER LINE CONDUCTED EMISSIONS

3.1. LIMIT

Frequency of Emission (MHz)	Limit (dBμV)	
	Quasi-peak	Average
0.15 - 0.5	66 to 56*	56 to 46*
0.5 - 5.0	56	46
5.0 - 30.0	60	50

Note:

(1) The tighter limit applies at the band edges.
(2) The limit of " * " marked band means the limitation decreases linearly with the logarithm of the frequency in the range.

3.2. TEST PROCEDURE

a. The EUT was placed 0.8 meters from the horizontal ground plane with EUT being connected to the power mains through a line impedance stabilization network (LISN). All other support equipment powered from additional LISN(s). The LISN provide 50 Ohm/ 50uH of coupling impedance for the measuring instrument.
b. Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 to 40 cm long.
c. I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m.
d. LISN at least 80 cm from nearest part of EUT chassis.
e. For the actual test configuration, please refer to the related Item –EUT Test Photos.

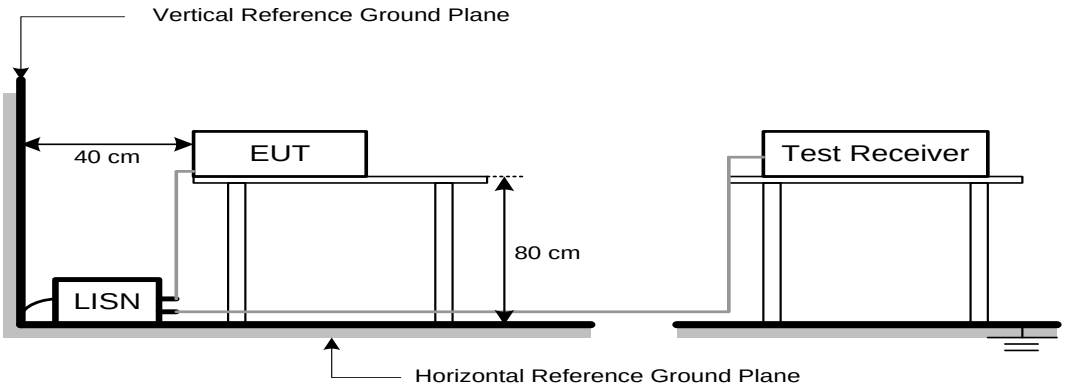
The following table is the setting of the receiver:

Receiver Parameters	Setting
Start Frequency	0.15 MHz
Stop Frequency	30 MHz
IF Bandwidth	9 kHz

3.3. DEVIATION FROM TEST STANDARD

No deviation.

3.4. TEST SETUP



3.5. EUT OPERATING CONDITIONS

The EUT was configured for testing in a typical function (as a customer would normally use it), EUT was programmed to be in continuously transmitting data or hopping on mode.

3.6. TEST RESULTS

Please refer to the APPENDIX A.

Remark:

(1) All readings are QP Mode value unless otherwise stated AVG in column of『Note』. If the QP Mode Measured value compliance with the QP Limits and lower than AVG Limits, the EUT shall be deemed to meet both QP & AVG Limits and then only QP Mode was measured, but AVG Mode didn‘t perform in this case, a “*” marked in AVG Mode column of Interference Voltage Measured.

(2) Measuring frequency range from 150 kHz to 30 MHz.

4.. RADIATED EMISSIONS

4.1. LIMIT

In case the emission fall within the restricted band specified on 15.205(a), then the 15.209(a) limit in the table below has to be followed.

LIMITS OF RADIATED EMISSION MEASUREMENT (9 kHz-1000 MHz)

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

LIMITS OF RADIATED EMISSION MEASUREMENT (Above 1000 MHz)

Frequency (MHz)	(dBuV/m at 3 m)	
	Peak	Average
Above 1000	74	54

Note:

(1) The limit for radiated test was performed according to FCC CFR Title 47, Part 15, Subpart C.

(2) The tighter limit applies at the band edges.

(3) Emission level (dBuV/m)=20log Emission level (uV/m).

4.2. TEST PROCEDURE

a. The measuring distance of 3 m shall be used for measurements. The EUT was placed on the top of a rotating table 0.8 meter above the ground at a 3 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.(below 1 GHz)
b. The measuring distance of 3 m shall be used for measurements. The EUT was placed on the top of a rotating table 1.5 meter above the ground at a 3 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.(above 1 GHz)
c. The height of the equipment or of the substitution antenna shall be 0.8m or 1.5m; the height of the test antenna shall vary between 1 m to 4 m. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights find the maximum reading (used Bore sight function).
e. The receiver system was set to peak and average detect function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz.
f. The initial step in collecting radiated emission data is a receiver peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked and then Quasi Peak detector mode re-measured.
g. All readings are Peak unless otherwise stated QP in column of Note. Peak denotes that the Peak reading compliance with the QP Limits and then QP Mode measurement didn't perform. (below 1 GHz)
h. All readings are Peak Mode value unless otherwise stated AVG in column of Note. If the Peak Mode Measured value compliance with the Peak Limits and lower than AVG Limits, the EUT shall be deemed to meet both Peak & AVG Limits and then only Peak Mode was measured, but AVG Mode didn't perform. (above 1 GHz)
i. For the actual test configuration, please refer to the related Item –EUT Test Photos.

The following table is the setting of the receiver:

Spectrum Parameters	Setting
Start ~ Stop Frequency	9 kHz~150 kHz for RBW 200 Hz
Start ~ Stop Frequency	0.15 MHz~30 MHz for RBW 9 kHz
Start ~ Stop Frequency	30 MHz~1000 MHz for RBW 100 kHz

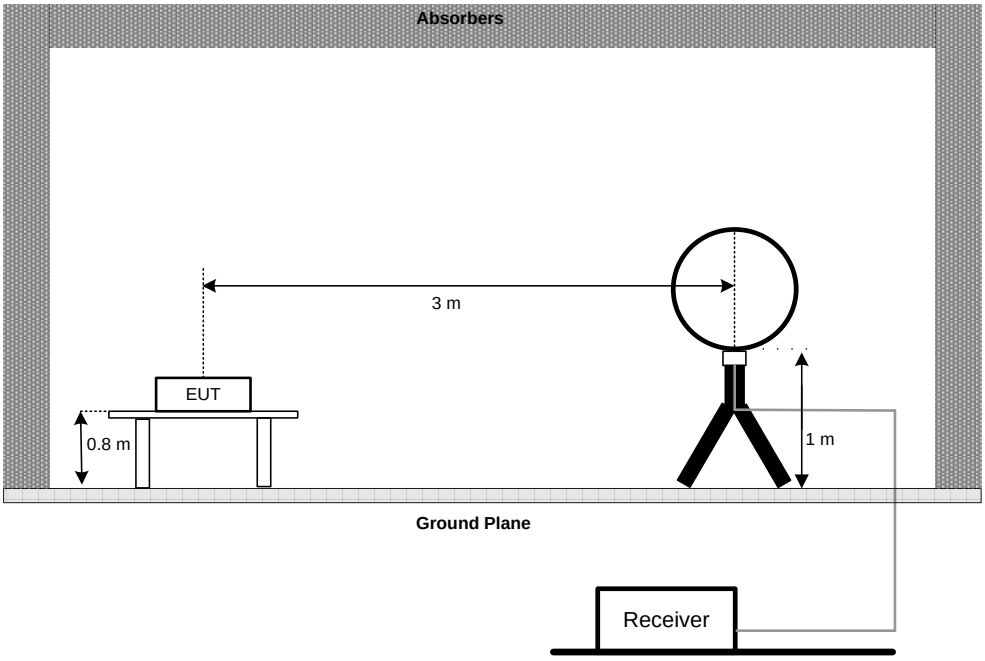
Spectrum Parameters	Setting
Start Frequency	1000 MHz
Stop Frequency	10th carrier harmonic
RBW / VBW (Emission in restricted band)	1 MHz / 3 MHz for PK value 1 MHz / 1/T Hz for AVG value

Spectrum Parameters	Setting
Start ~ Stop Frequency	9 kHz~90 kHz for PK/AVG detector
Start ~ Stop Frequency	90 kHz~110 kHz for QP detector
Start ~ Stop Frequency	110 kHz~490 kHz for PK/AVG detector
Start ~ Stop Frequency	490 kHz~30 MHz for QP detector
Start ~ Stop Frequency	30 MHz~1000 MHz for QP detector
Start ~ Stop Frequency	1 GHz~26.5 GHz for PK/AVG detector

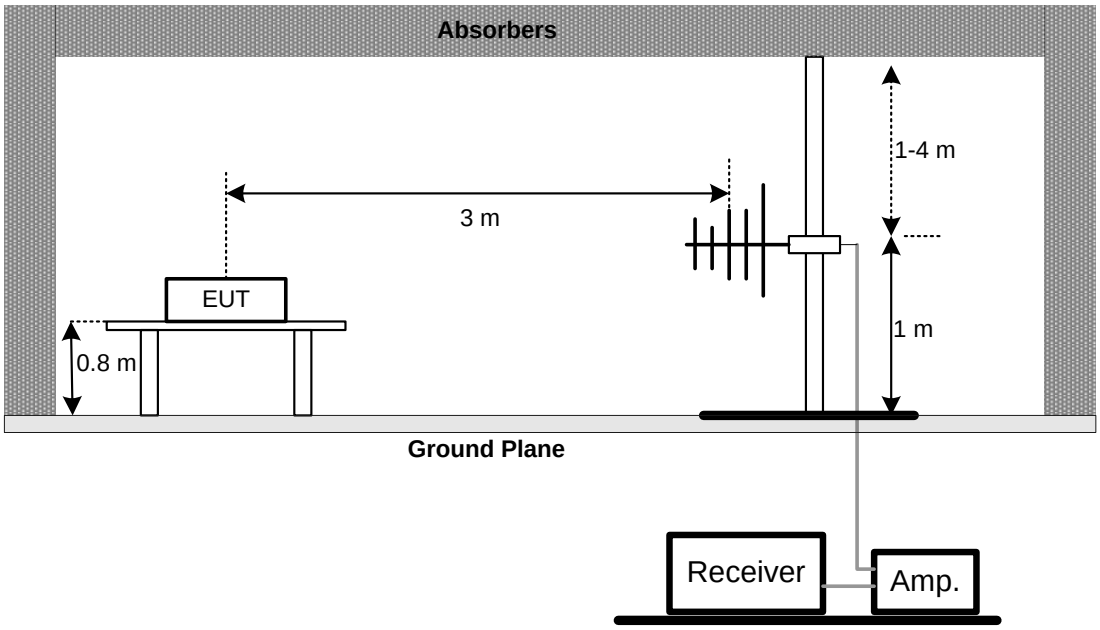
4.3. DEVIATION FROM TEST STANDARD
No deviation.

4.4. TEST SETUP

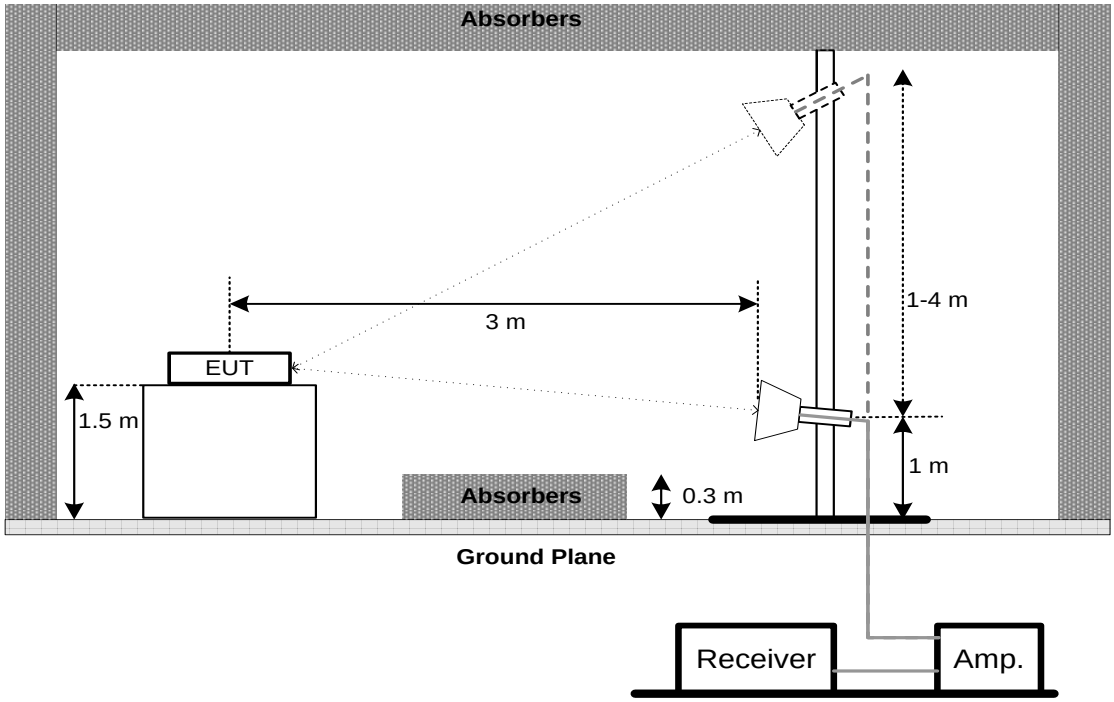
9 kHz to 30 MHz



30 MHz to 1 GHz



Above 1 GHz



4.5. EUT OPERATING CONDITIONS

The EUT was programmed to be in continuously transmitting mode.

4.6. TEST RESULTS - 9 kHz TO 30 MHz

Please refer to the APPENDIX B.

Remark:

(1) Distance extrapolation factor = 40 log (specific distance / test distance) (dB).
(2) Limit line = specific limits (dBuV) + distance extrapolation factor.

4.7. TEST RESULTS - 30 MHz TO 1000 MHz

Please refer to the APPENDIX C.

4.8. TEST RESULTS - ABOVE 1000 MHz

Please refer to the APPENDIX D.

Remark:

(1) No limit: This is fundamental signal, the judgment is not applicable.
For fundamental signal judgment was referred to Peak output test.

5.. NUMBER OF HOPPING FREQUENCY

5.1. LIMIT

Section	Test Item	Limit
FCC 15.247(a)(1)(iii)	Number of Hopping Frequency	15

5.2. TEST PROCEDURE

a. The EUT was directly connected to the tonscend test system and antenna output port as show in the block diagram below.

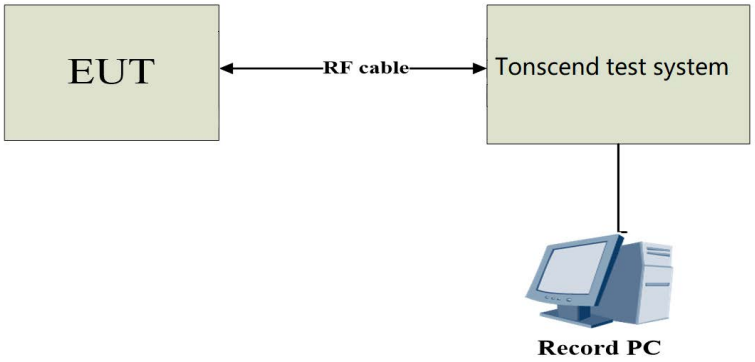
b. The following table is the setting of the spectrum analyzer:

Spectrum Parameters	Setting
Span Frequency	> Operating Frequency Range
RBW	300 kHz
VBW	300 kHz
Detector	Peak
Trace	Max Hold
Sweep Time	Auto

5.3. DEVIATION FROM STANDARD

No deviation.

5.4. TEST SETUP



5.5. EUT OPERATION CONDITIONS

The EUT was programmed to be in continuously transmitting mode.

5.6. TEST RESULTS

Please refer to the APPENDIX E.

6.. AVERAGE TIME OF OCCUPANCY

6.1. LIMIT

Section	Test Item	Limit
FCC 15.247(a)(1)(iii)	Average Time of Occupancy	0.4sec

6.2. TEST PROCEDURE

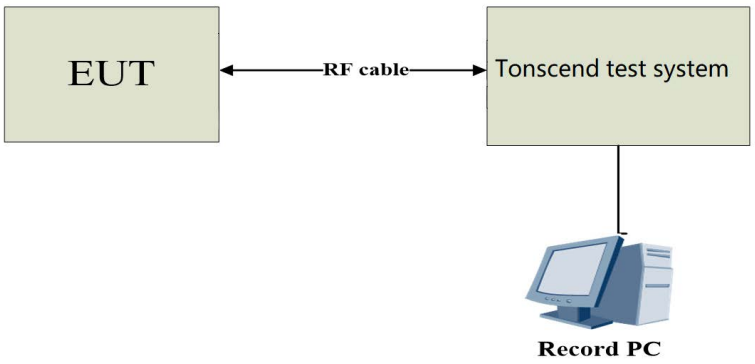
a. Set the EUT for DH1, DH3 and DH5 packet transmitting.
b. Measure the maximum time duration of one single pulse.
c. DH1 Packet permit maximum 1600 / 79 /2 = 10.12 hops per second in each channel (1 time slot TX, 1 time slot RX). So, the dwell time is the time duration of the pulse times 10.12 x 31.6 = 320 within 31.6 seconds.
d. DH3 Packet permit maximum 1600 / 79 / 4 = 5.06 hops per second in each channel (3 time slots TX, 1 time slot RX). So, the dwell time is the time duration of the pulse times 5.06 x 31.6 = 160 within 31.6 seconds.
e. DH5 Packet permit maximum 1600/ 79 / 6 = 3.37 hops per second in each channel (5 time slots TX, 1 time slot RX). So, the dwell time is the time duration of the pulse times 3.37 x 31.6 = 106.6 within 31.6 seconds.
f. The EUT was directly connected to the tonscend test system and antenna output port as show in the block diagram below.
g. The following table is the setting of the spectrum analyzer:

Spectrum Parameters	Setting
Span Frequency	0 MHz
RBW	1 MHz
VBW	1 MHz
Detector	Peak
Trace	Max Hold
Sweep Time	As necessary to capture the entire dwell time per hopping channel

6.3. DEVIATION FROM STANDARD

No deviation.

6.4. TEST SETUP



6.5. EUT OPERATION CONDITIONS

The EUT was programmed to be in continuously transmitting mode.

6.6. TEST RESULTS

Please refer to the APPENDIX F.

7.. HOPPING CHANNEL SEPARATION

7.1. LIMIT

Frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

7.2. TEST PROCEDURE

a. The EUT was directly connected to the tonscend test system and antenna output port as show in the block diagram below.

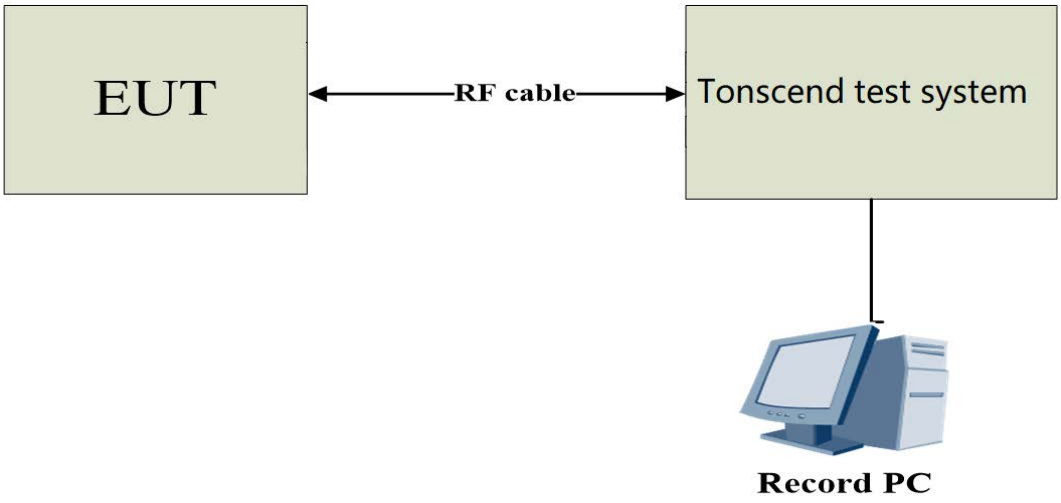
b. The following table is the setting of the spectrum analyzer:

Spectrum Parameters	Setting
Span Frequency	Wide enough to capture the peaks of two adjacent channels
RBW	30 kHz
VBW	100 kHz
Detector	Peak
Trace	Max Hold
Sweep Time	Auto

7.3. DEVIATION FROM STANDARD

No deviation.

7.4. TEST SETUP



7.5. EUT OPERATION CONDITIONS

The EUT was programmed to be in continuously transmitting mode.

7.6. TEST RESULTS

Please refer to the APPENDIX G.

8.. BANDWIDTH

8.1. LIMIT

Section	Test Item
FCC 15.247(a)(1)	Bandwidth

8.2. TEST PROCEDURE

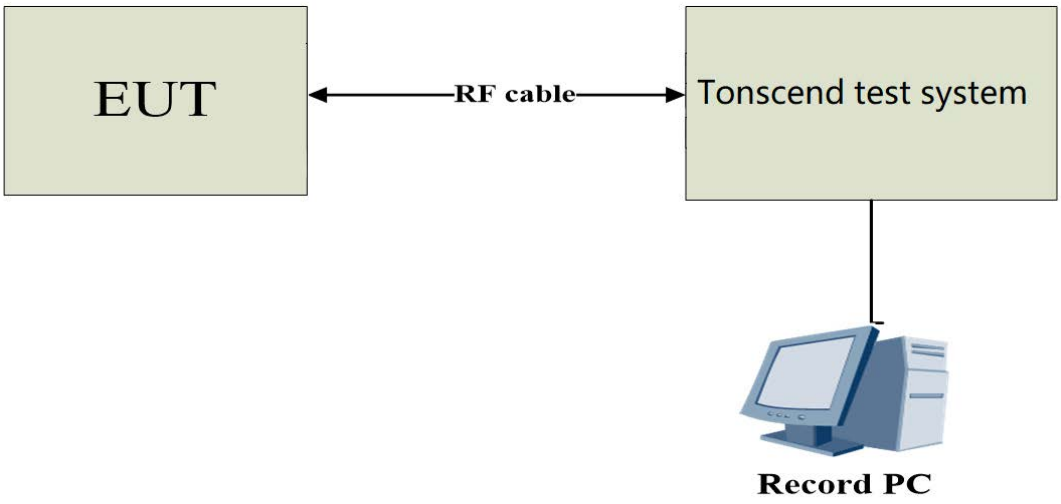
a. The EUT was directly connected to the tonscend test system and antenna output port as show in the block diagram below.
b. The following table is the setting of the spectrum analyzer:

Spectrum Parameters	Setting
Span Frequency	> Measurement Bandwidth
RBW	30 kHz
VBW	100 kHz
Detector	Peak
Trace	Max Hold
Sweep Time	Auto

8.3. DEVIATION FROM STANDARD

No deviation.

8.4. TEST SETUP



8.5. EUT OPERATION CONDITIONS

The EUT was programmed to be in continuously transmitting mode.

8.6. TEST RESULTS

Please refer to the APPENDIX H.

9.. MAXIMUM OUTPUT POWER

9.1. LIMIT

Section	Test Item	Limit
FCC 15.247(a)(1)	Maximum Output Power	0.1250 Watt or 20.97 dBm

Note: Frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

9.2. TEST PROCEDURE

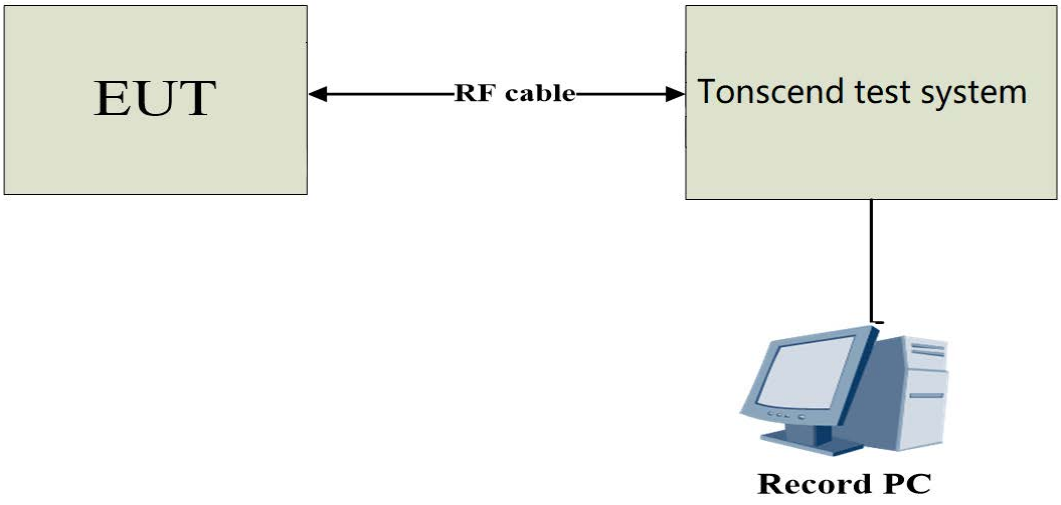
a. The EUT was directly connected to the tonscend test system and antenna output port as show in the block diagram below.
b. The following table is the setting of the spectrum analyzer:

Spectrum Parameters	Setting
Span Frequency	Approximately five times the 20 dB bandwidth, centered on a hopping channel.
RBW	3 MHz
VBW	8 MHz
Detector	Peak
Trace	Max Hold
Sweep Time	Auto

9.3. DEVIATION FROM STANDARD

No deviation.

9.4. TEST SETUP



9.5. EUT OPERATION CONDITIONS

The EUT was programmed to be in continuously transmitting mode.

9.6. TEST RESULTS

Please refer to the APPENDIX I.

10.. CONDUCTED SPURIOUS EMISSION

10.1. LIMIT

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak Output Power limits. If the transmitter complies with the Output Power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Section 15.209(a) is not required.

10.2. TEST PROCEDURE

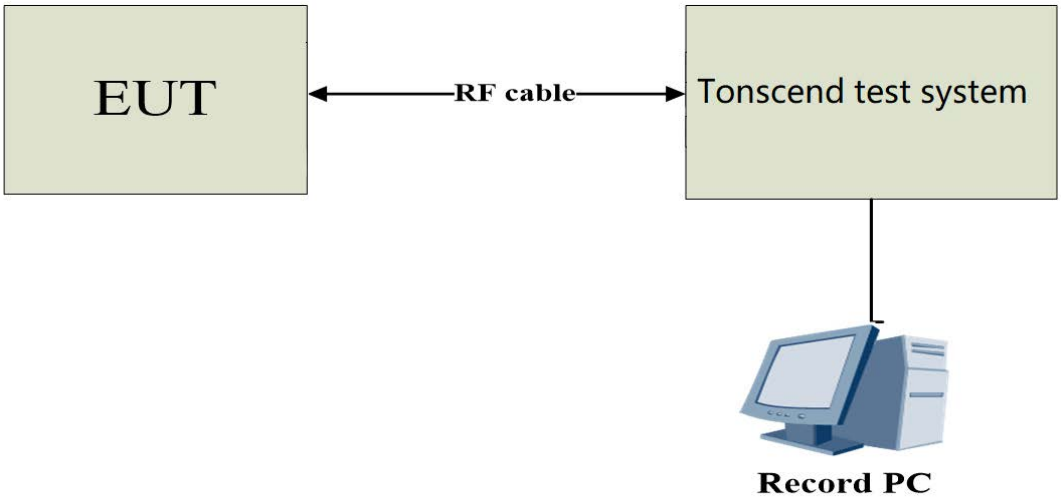
a. The EUT was directly connected to the tonscend test system and antenna output port as show in the block diagram below.
b. The following table is the setting of the spectrum analyzer:

Spectrum Parameters	Setting
Start Frequency	30 MHz
Stop Frequency	26.5 GHz
RBW	100 kHz
VBW	300 kHz
Detector	Peak
Trace	Max Hold
Sweep Time	Auto

10.3. DEVIATION FROM STANDARD

No deviation.

10.4. TEST SETUP



10.5. EUT OPERATION CONDITIONS

The EUT was programmed to be in continuously transmitting mode.

10.6. TEST RESULTS

Please refer to the APPENDIX J.

11.. MEASUREMENT INSTRUMENTS LIST

Radiated Emissions						
No.	Equipment	Manufacturer	Type No.	Serial No.	Cal. date (yyyy/mm/dd)	Cal. Due date (yyyy/mm/dd)
1	Test receiver	Rohde&Schwarz	ESU	100184	2023/5/3	2024/5/2
2	MXA Signal Analyzer	Keysight	N9010A	MY51440158	2023/4/22	2024/4/21
3	Log periodic antenna	Schwarzbeck	VULB 9168	1151	2023/5/4	2024/5/3
4	Low frequency amplifier	/	LNA 0920N	2014	2023/5/3	2024/5/2
5	High frequency amplifier	Schwarzbeck	BBV 9718	284	2023/5/3	2024/5/2
6	Horn Antenna	SCHWARZBECK	BBHA 9120 D	9120D-1273	2023/5/4	2024/5/3
7	Temp&Humidity Recorder	Meideshi	JR900	/	2023/5/3	2024/5/2
8	Horn Antenna	SCHWARZBECK	BBHA 9170	9170#685	2023/7/16	2024/7/15
9	Loop Antenna	SCHWARZBECK	FMZB1519 B	00029	2023/7/16	2024/7/15
10	Broadband preamplifier	Schwarzbeck	BBV9721	9721-019	2023/5/3	2024/5/2
13	Test software	Farad Technology Co., Ltd	EZ-EMC Ver.TW-03A2			
Conducted Emission						
1	LISN	Rohde&Schwarz	ENV216	100075	2023/5/3	2024/5/2
2	ISN	Schwarzbeck	CATE 5 8158	#171	2023/5/3	2024/5/2
3	Test receiver	Rohde&Schwarz	ESCI	100718	2023/5/3	2024/5/2
4	Pulse limiter	Rohde&Schwarz	ESH3-Z2	102299	2023/5/3	2024/5/2
5	Temp&Humidity Recorder	Meideshi	JR900	/	2023/5/3	2024/5/2
6	Test software	Farad Technology Co., Ltd	EZ-EMC Ver.TW-03A2			
RF conducted Emissions						
1	MXA Signal Analyzer	Keysight	N9021B	MY60080169	2023/4/23	2024/4/22
2	RF Control Unit	dsusoft	JS0806-2	21G8060449	2023/4/23	2024/4/22
3	power supply unit	dsusoft	JS0806-4ADC	N/A	2023/4/23	2024/4/22
4	VXG Signal Generator	Keysight	M9384B	MY61270787	2023/4/23	2024/4/22
5	EXG Analog Signal Generator	Keysight	N5173B	MY59101282	2023/4/23	2024/4/22
6	Wideband Radio Communication Tester	Rohde&Schwarz	CMW500	1201.0002K50-116064-Dt	2023/4/23	2024/4/22
6	Test software	dsusoft	JS1120-3 Ver.3.2.22.0			

12.. ANTENNA REQUIREMENT

Test standard: FCC part 15.203

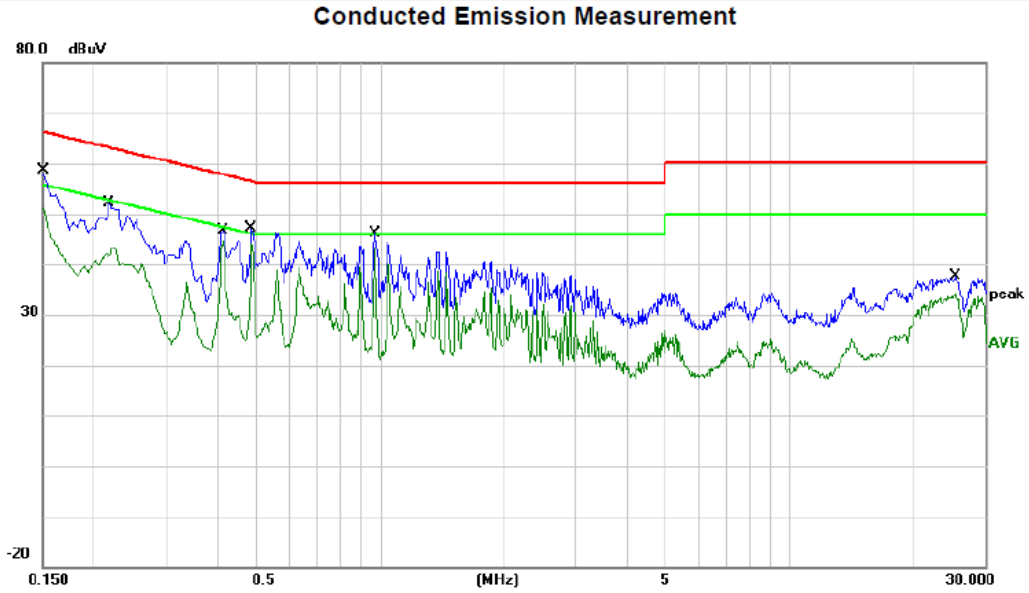
According to the manufacturer declared, the EUT has an external antenna, the antenna gain is 1.09dBi and the antenna connector is designed RP-SMA antenna interface

Therefore the EUT is considered sufficient to comply with the provision.

Refer to EUT Photo for further details.

APPENDIX A - AC POWER LINE CONDUCTED EMISSIONS

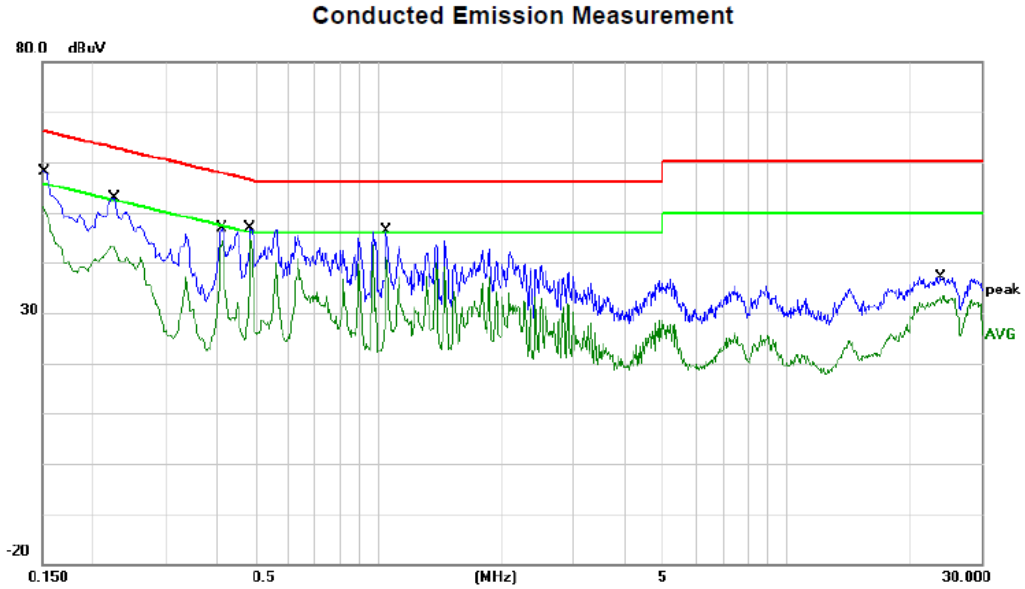
Test Mode	TX Mode_1Mbps Channel 00	Phase	Line



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1		0.1500	36.14	20.05	56.19	66.00	-9.81	QP	
2		0.1500	31.54	20.05	51.59	56.00	-4.41	AVG	
3		0.2180	26.65	19.99	46.64	62.89	-16.25	QP	
4		0.2180	21.42	19.99	41.41	52.89	-11.48	AVG	
5		0.4140	24.61	20.34	44.95	57.57	-12.62	QP	
6		0.4140	23.42	20.34	43.76	47.57	-3.81	AVG	
7		0.4860	24.62	20.23	44.85	56.24	-11.39	QP	
8	*	0.4860	23.84	20.23	44.07	46.24	-2.17	AVG	
9		0.9700	24.02	20.04	44.06	56.00	-11.94	QP	
10		0.9700	21.27	20.04	41.31	46.00	-4.69	AVG	
11		25.3660	15.31	20.05	35.36	60.00	-24.64	QP	
12		25.3660	13.35	20.05	33.40	50.00	-16.60	AVG	

REMARKS:
(1) Measurement Value = Reading Level + Correct Factor.
(2) Margin Level = Measurement Value - Limit Value.

Test Mode	TX Mode_1Mbps Channel 00	Phase	Neutral



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1		0.1540	33.66	20.29	53.95	65.78	-11.83	QP	
2		0.1540	27.36	20.29	47.65	55.78	-8.13	AVG	
3		0.2260	29.26	20.19	49.45	62.60	-13.15	QP	
4		0.2260	22.75	20.19	42.94	52.60	-9.66	AVG	
5		0.4140	24.54	20.21	44.75	57.57	-12.82	QP	
6		0.4140	23.32	20.21	43.53	47.57	-4.04	AVG	
7		0.4860	25.09	20.06	45.15	56.24	-11.09	QP	
8	*	0.4860	24.35	20.06	44.41	46.24	-1.83	AVG	
9		1.0460	23.14	20.05	43.19	56.00	-12.81	QP	
10		1.0460	20.99	20.05	41.04	46.00	-4.96	AVG	
11		23.8540	14.69	20.03	34.72	60.00	-25.28	QP	
12		23.8540	12.89	20.03	32.92	50.00	-17.08	AVG	

REMARKS:
(1) Measurement Value = Reading Level + Correct Factor.
(2) Margin Level = Measurement Value - Limit Value.

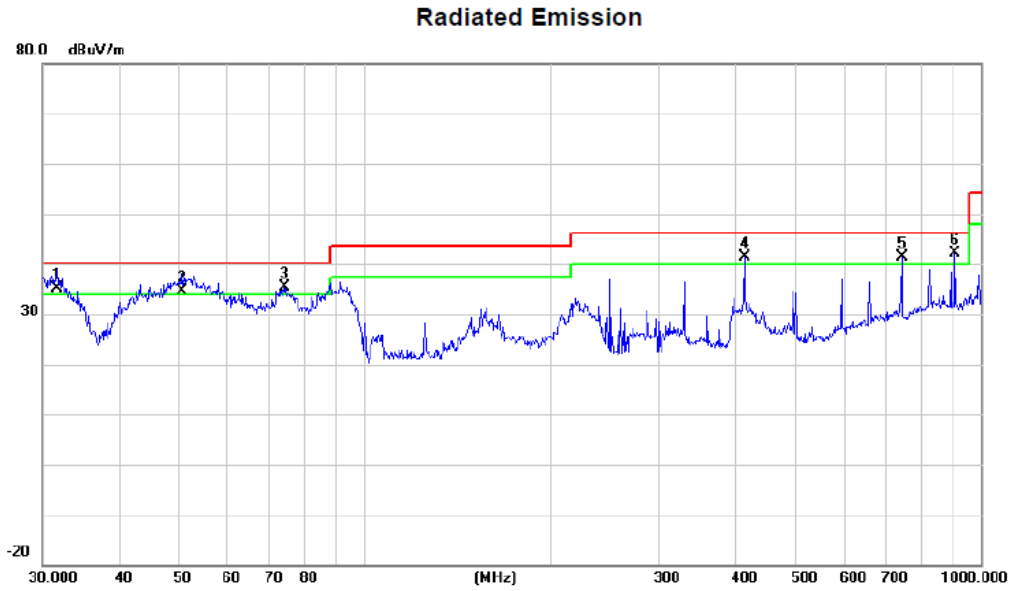
APPENDIX B - RADIATED EMISSION - 9 KHZ TO 30 MHZ

The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line was not reported.

There is a comparison data of both open-field test site and semi-Anechoic chamber, and the result came out very similar.

APPENDIX C - RADIATED EMISSION - 30 MHZ TO 1000 MHZ

Test Mode	TX Mode_1Mbps Channel 00	Polarization	Vertical

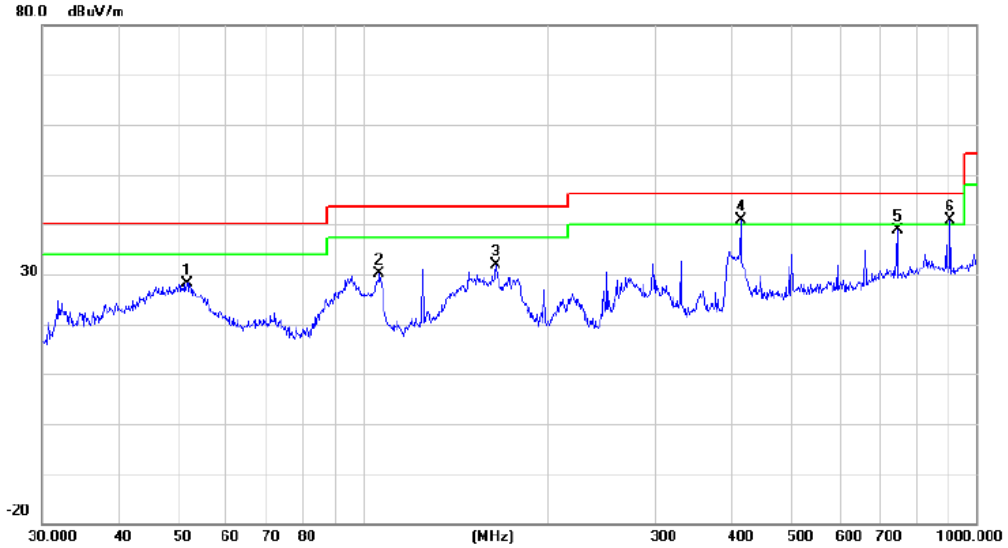


No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		Antenna Height	Table Degree	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector	cm	degree	Comment
1	!	31.6201	46.04	-10.90	35.14	40.00	-4.86	QP			
2	!	50.4090	44.03	-9.37	34.66	40.00	-5.34	QP			
3	!	74.1350	47.87	-12.47	35.40	40.00	-4.60	peak			
4	!	413.2706	46.89	-5.54	41.35	46.00	-4.65	peak			
5	!	744.8660	40.28	1.12	41.40	46.00	-4.60	peak			
6	*	909.6666	38.89	3.27	42.16	46.00	-3.84	peak			

REMARKS:
(1) Measurement Value = Reading Level + Correct Factor.
(2) Margin Level = Measurement Value - Limit Value.

Test Mode	TX Mode_1Mbps Channel 00	Polarization	Horizontal

Radiated Emission

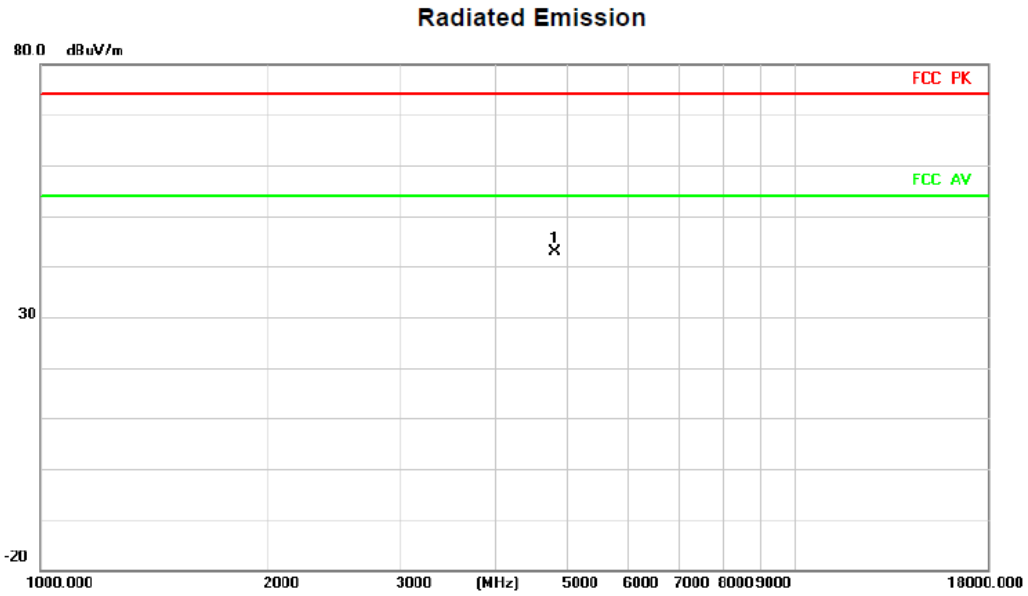


No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		Antenna Height	Table Degree	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector	cm	degree	Comment
1		51.6613	37.38	-9.23	28.15	40.00	-11.85	peak			
2		106.3850	42.30	-12.18	30.12	43.50	-13.38	peak			
3		164.9072	40.39	-8.47	31.92	43.50	-11.58	peak			
4	*	413.2706	46.50	-5.54	40.96	46.00	-5.04	peak			
5		744.8660	37.69	1.12	38.81	46.00	-7.19	peak			
6	!	909.6666	37.67	3.27	40.94	46.00	-5.06	peak			

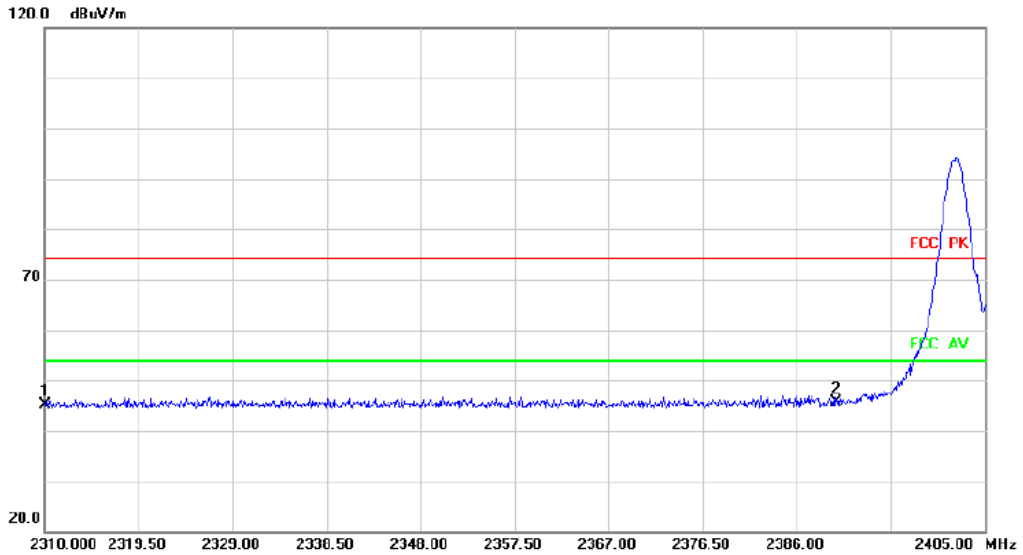
REMARKS:
(1) Measurement Value = Reading Level + Correct Factor.
(2) Margin Level = Measurement Value - Limit Value.

APPENDIX D - RADIATED EMISSION - ABOVE 1000 MHZ

Test Mode	TX Mode_1Mbps Channel 00	Polarization	Vertical

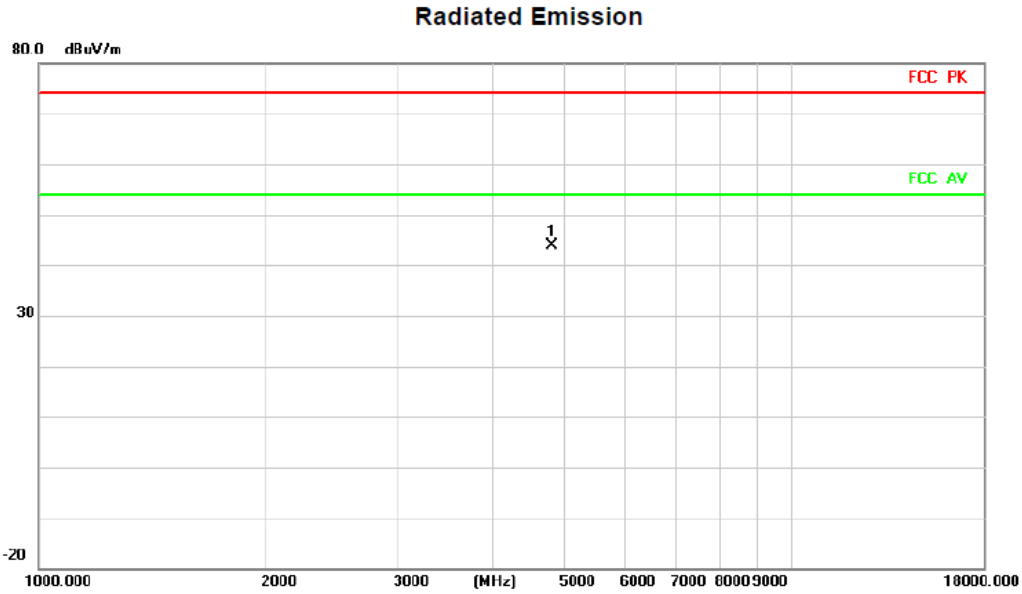


No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1	*	4804.000	32.90	10.00	42.90	74.00	-31.10	peak

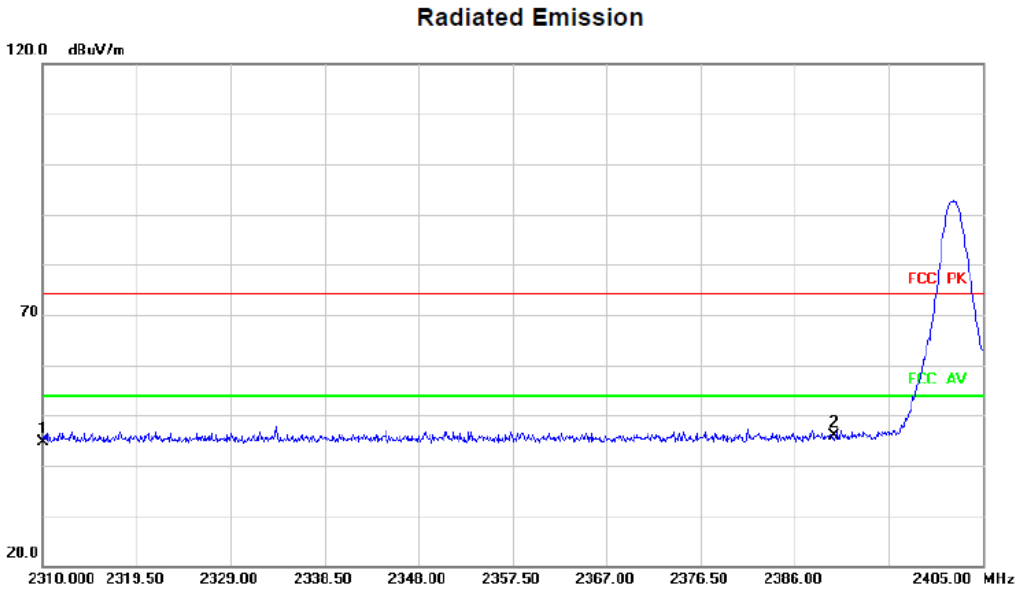


No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1		2310.000	44.85	0.19	45.04	74.00	-28.96	peak
2	*	2390.000	45.22	0.41	45.63	74.00	-28.37	peak

Test Mode	TX Mode_1Mbps Channel 00	Polarization	Horizontal

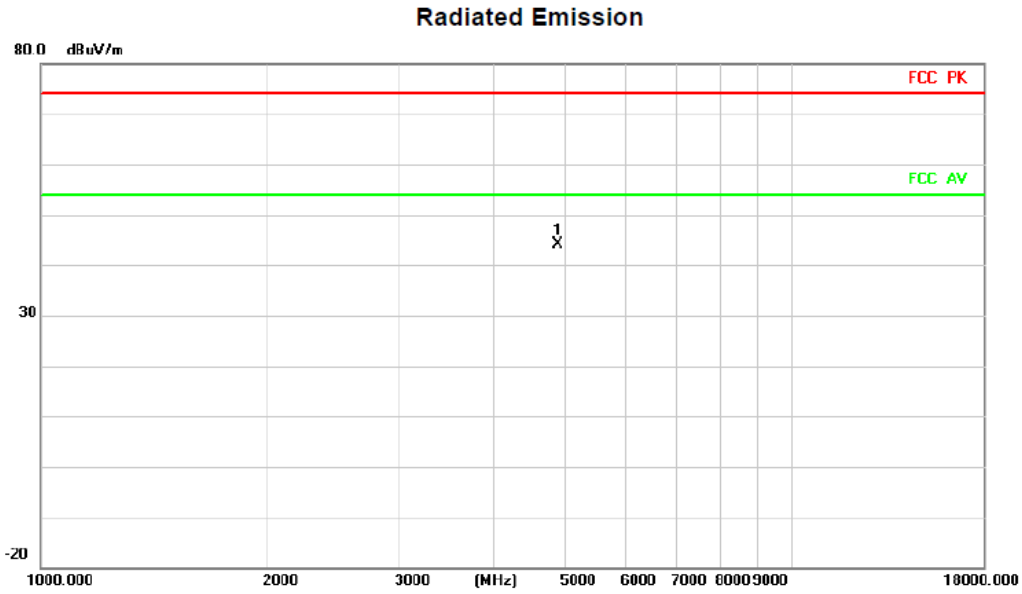


No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1	*	4804.000	33.81	10.00	43.81	74.00	-30.19	peak



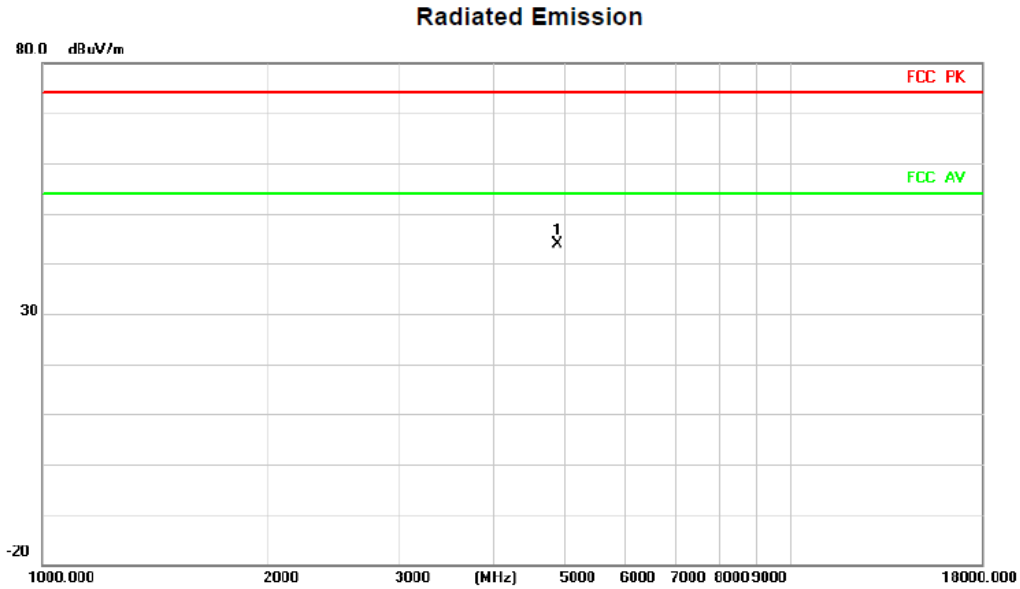
No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1		2310.000	44.49	0.19	44.68	74.00	-29.32	peak
2	*	2390.000	45.46	0.41	45.87	74.00	-28.13	peak

Test Mode	TX Mode_1Mbps Channel 39	Polarization	Vertical



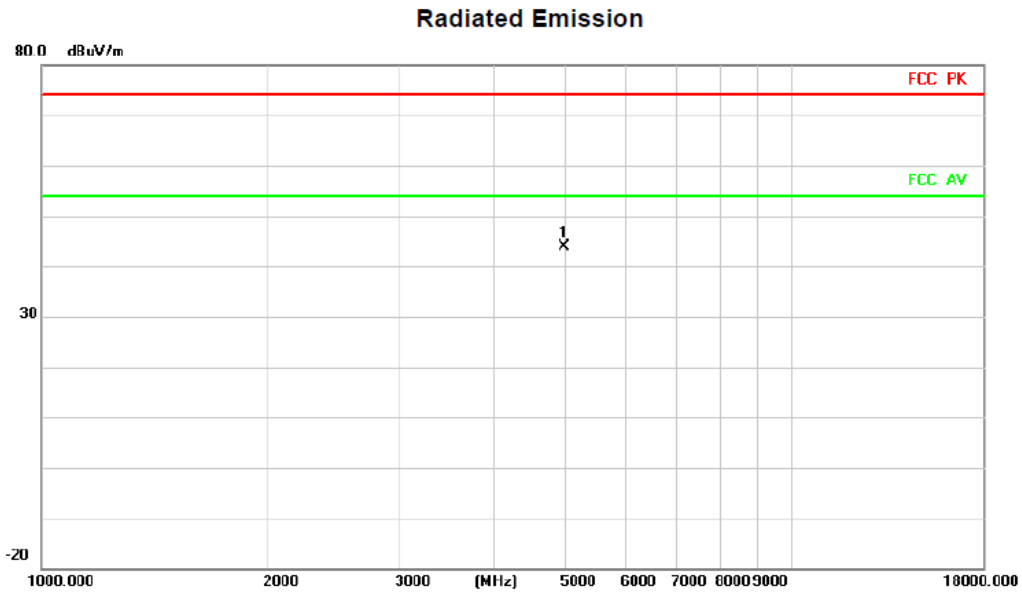
No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1	*	4882.000	34.14	10.00	44.14	74.00	-29.86	peak

Test Mode	TX Mode_1Mbps Channel 39	Polarization	Horizontal

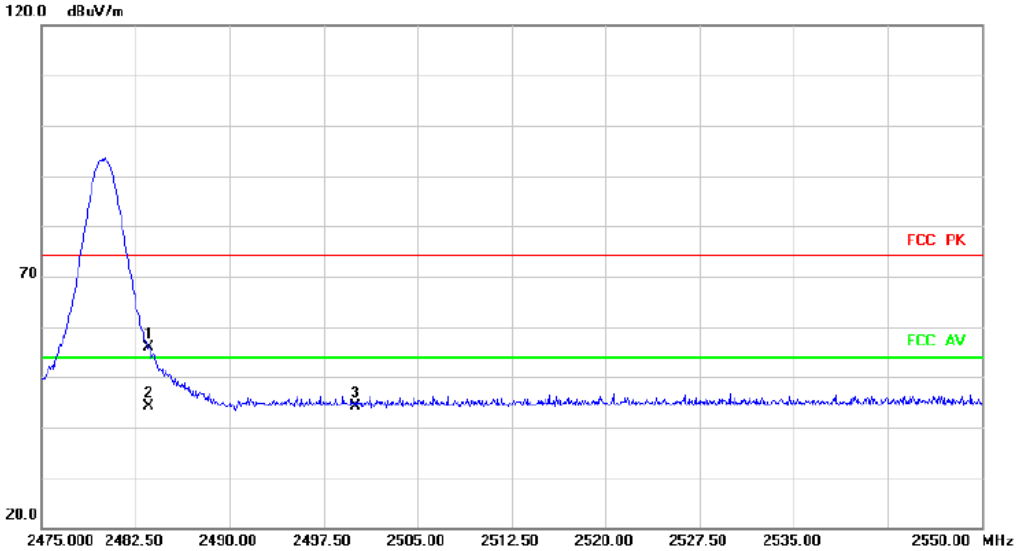


No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1	*	4882.000	33.98	10.00	43.98	74.00	-30.02	peak

Test Mode	TX Mode_1Mbps Channel78	Polarization	Vertical

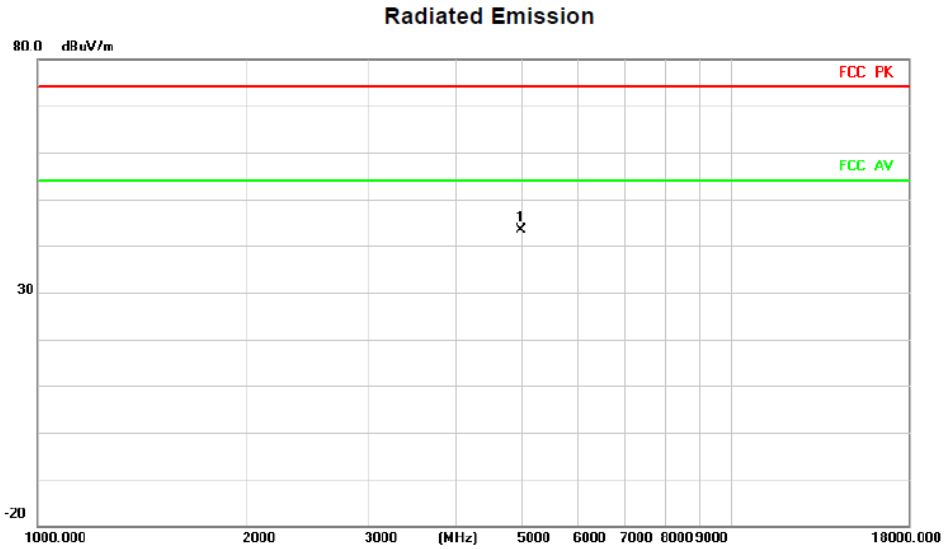


No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1	*	4960.000	33.96	10.00	43.96	74.00	-30.04	peak

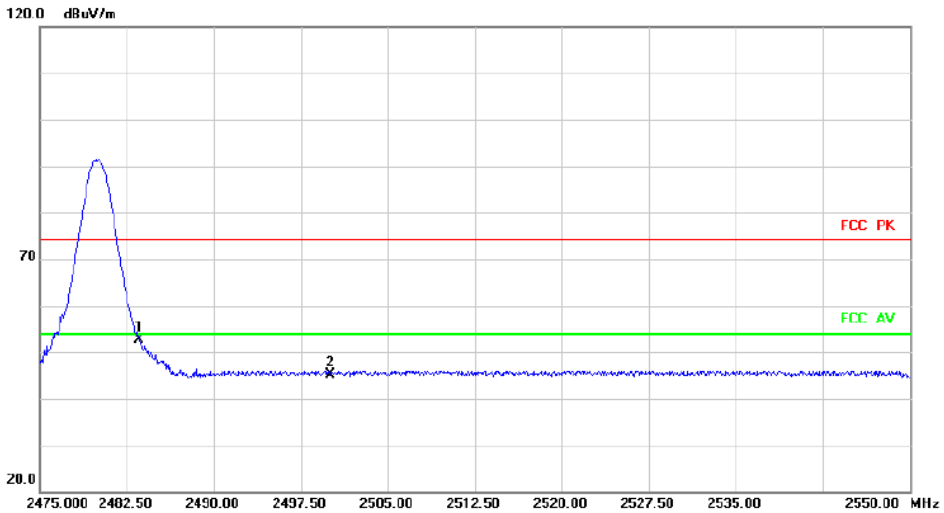


No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1		2483.500	54.87	1.09	55.96	74.00	-18.04	peak
2	*	2483.500	43.14	1.09	44.23	54.00	-9.77	AVG
3		2500.000	43.01	1.22	44.23	74.00	-29.77	peak

Test Mode	TX Mode_1Mbps Channel 78	Polarization	Horizontal



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1	*	4960.000	33.39	10.00	43.39	74.00	-30.61	peak



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1	*	2483.500	51.54	1.09	52.63	74.00	-21.37	peak
2		2500.000	43.85	1.22	45.07	74.00	-28.93	peak

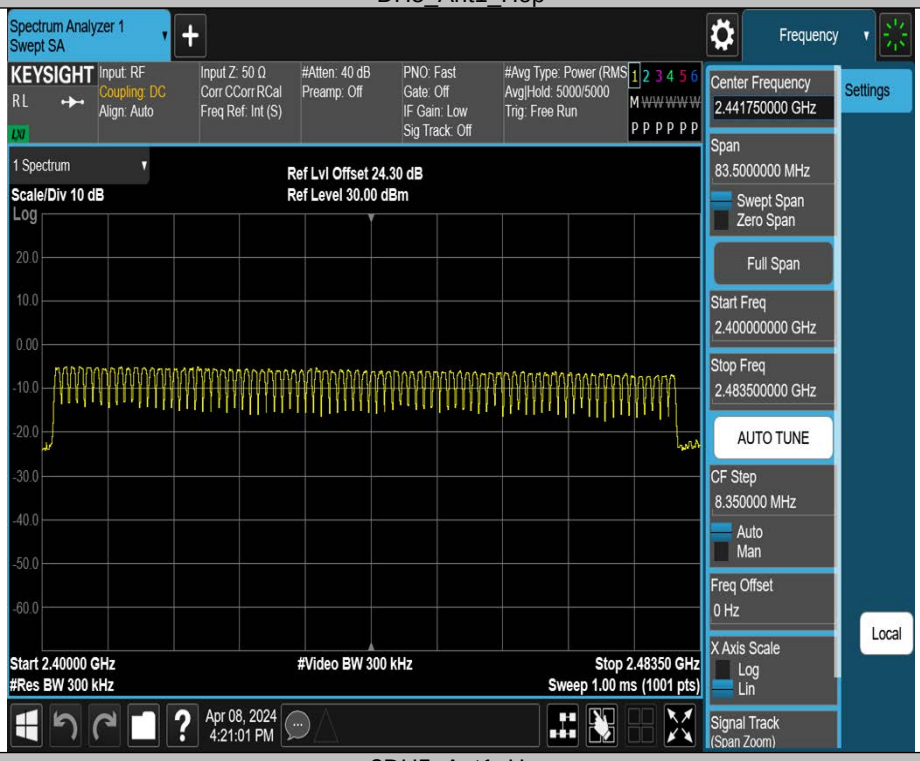
REMARKS:
(1) Measurement Value = Reading Level + Correct Factor.
(2) Margin Level = Measurement Value - Limit Value.

APPENDIX E - NUMBER OF HOPPING FREQUENCY

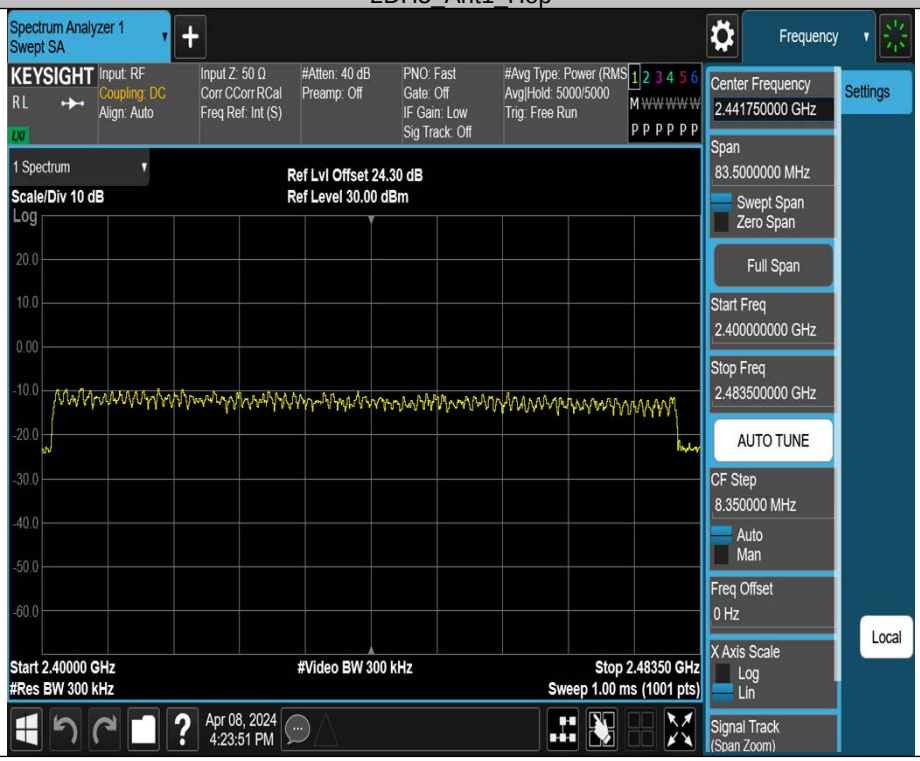
Test Mode	Antenna	Freq(MHz)	Result[Num]	Limit[Num]	Verdict
DH5	Ant1	Hop	79	≥15	PASS
2DH5	Ant1	Hop	79	≥15	PASS

Test Graphs

DH5_Ant1_Hop



2DH5_Ant1_Hop

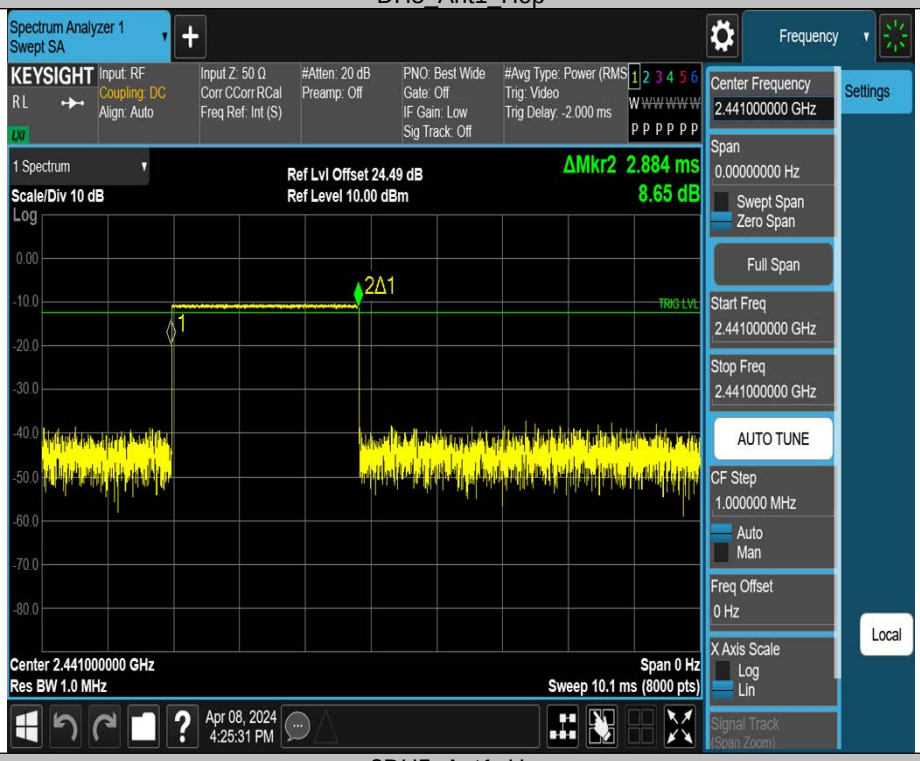


APPENDIX F - AVERAGE TIME OF OCCUPANCY

Test Mode	Antenna	Freq(MHz)	BurstWidth [ms]	TotalHops [Num]	Result[s]	Limit[s]	Verdict
DH5	Ant1	Hop	2.884	106.67	0.308	≤0.4	PASS
2DH5	Ant1	Hop	2.891	106.67	0.308	≤0.4	PASS

Test Graphs

DH5_Ant1_Hop



2DH5_Ant1_Hop

APPENDIX G - HOPPING CHANNEL SEPARATION

Test Mode	Antenna	Freq(MHz)	Result[MHz]	Limit[MHz]	Verdict
DH5	Ant1	Hop	0.91	≥0.674	PASS
2DH5	Ant1	Hop	1	≥0.880	PASS

Test Graphs

DH5_Ant1_Hop

2DH5_Ant1_Hop

APPENDIX H - BANDWIDTH

20dB Emission Bandwidth

Test Mode	Antenna	Freq(MHz)	20dB EBW[MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
DH5	Ant1	2402	1.002	2401.487	2402.489	---	---
		2441	0.996	2440.478	2441.474	---	---
		2480	1.011	2479.472	2480.483	---	---
2DH5	Ant1	2402	1.290	2401.349	2402.639	---	---
		2441	1.293	2440.343	2441.636	---	---
		2480	1.320	2479.316	2480.636	---	---

Test Graphs

DH5_Ant1_2402

DH5_Ant1_2441

DH5_Ant1_2480

2DH5_Ant1_2402

2DH5_Ant1_2441

2DH5_Ant1_2480

Occupied Channel Bandwidth

Test Mode	Antenna	Freq(MHz)	OCB [MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
DH5	Ant1	2402	0.89370	2401.5327	2402.4264	---	---
		2441	0.89041	2440.5327	2441.4231	---	---
		2480	0.88577	2479.5323	2480.4181	---	---
2DH5	Ant1	2402	1.1837	2401.3844	2402.5681	---	---
		2441	1.1938	2440.3812	2441.5750	---	---
		2480	1.1879	2479.3835	2480.5714	---	---

Test Graphs

DH5_Ant1_2402

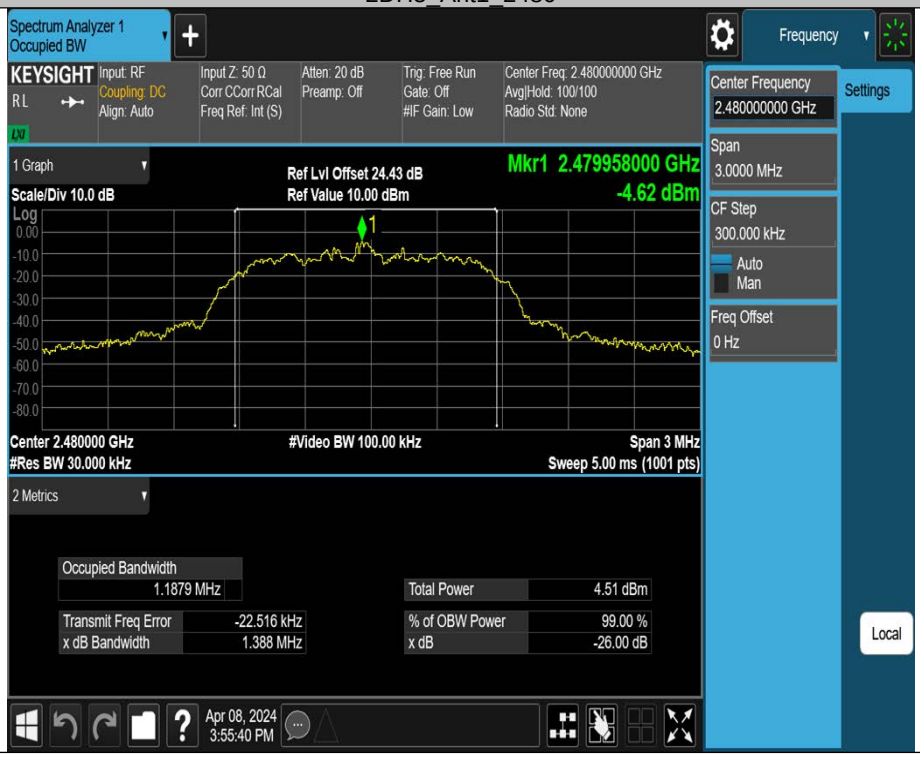
DH5_Ant1_2441

DH5_Ant1_2480

2DH5_Ant1_2402

2DH5_Ant1_2441

2DH5_Ant1_2480

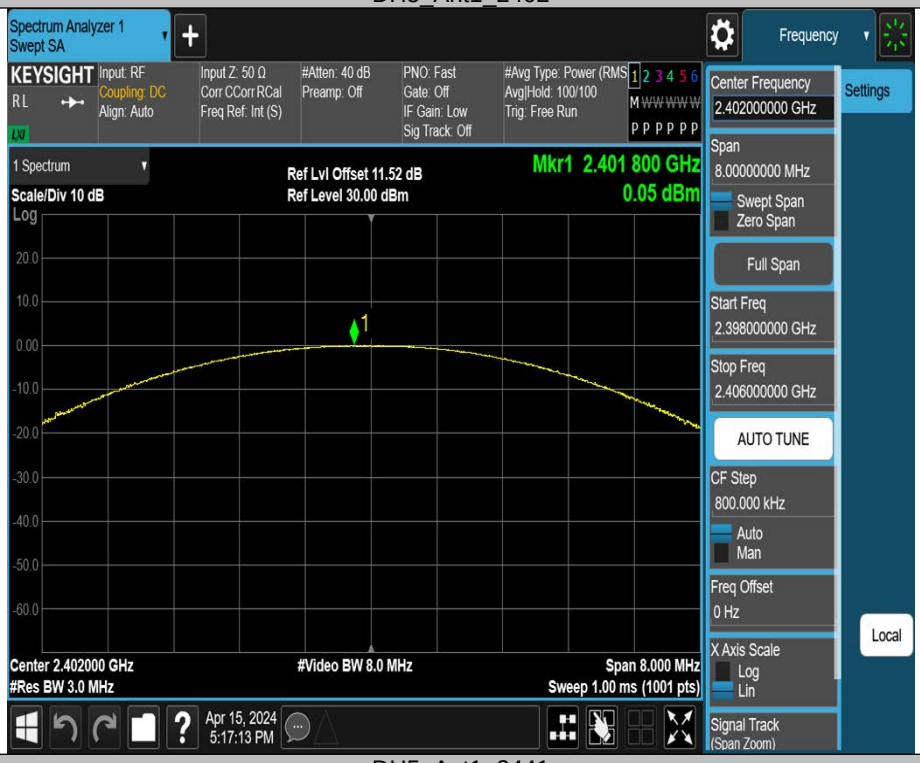


APPENDIX I - MAXIMUM OUTPUT POWER

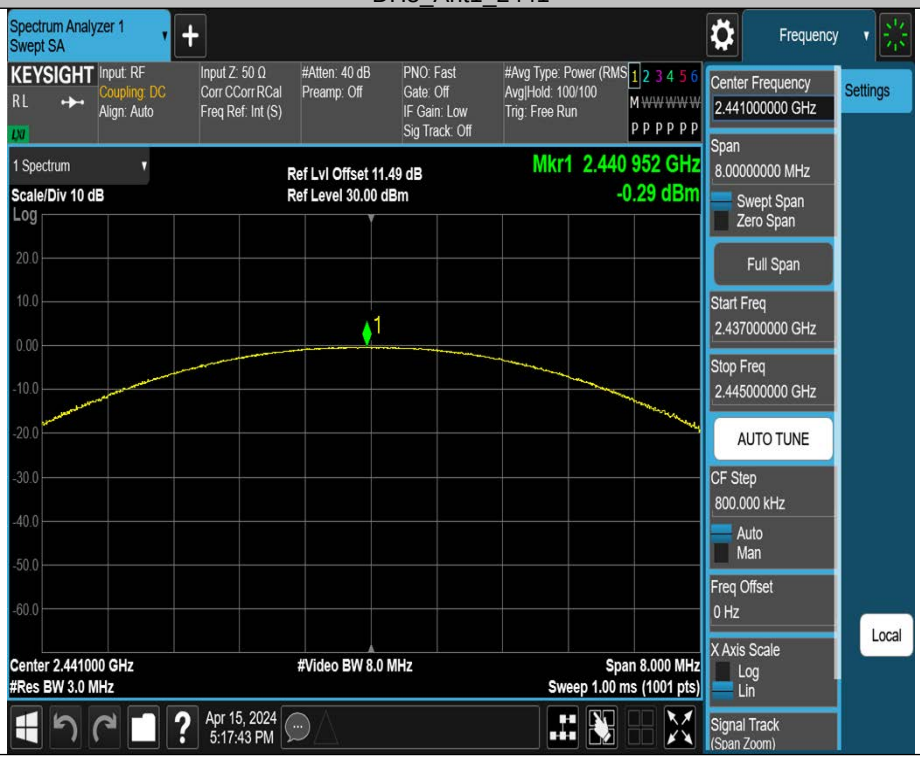
Test Mode	Antenna	Freq(MHz)	Conducted Peak Powert[dBm]	Conducted Limit[dBm]	Verdict
DH5	Ant1	2402	0.05	≤20.97	PASS
		2441	-0.29	≤20.97	PASS
		2480	-1.06	≤20.97	PASS
2DH5	Ant1	2402	0.80	≤20.97	PASS
		2441	0.47	≤20.97	PASS
		2480	-0.41	≤20.97	PASS

Test Graphs

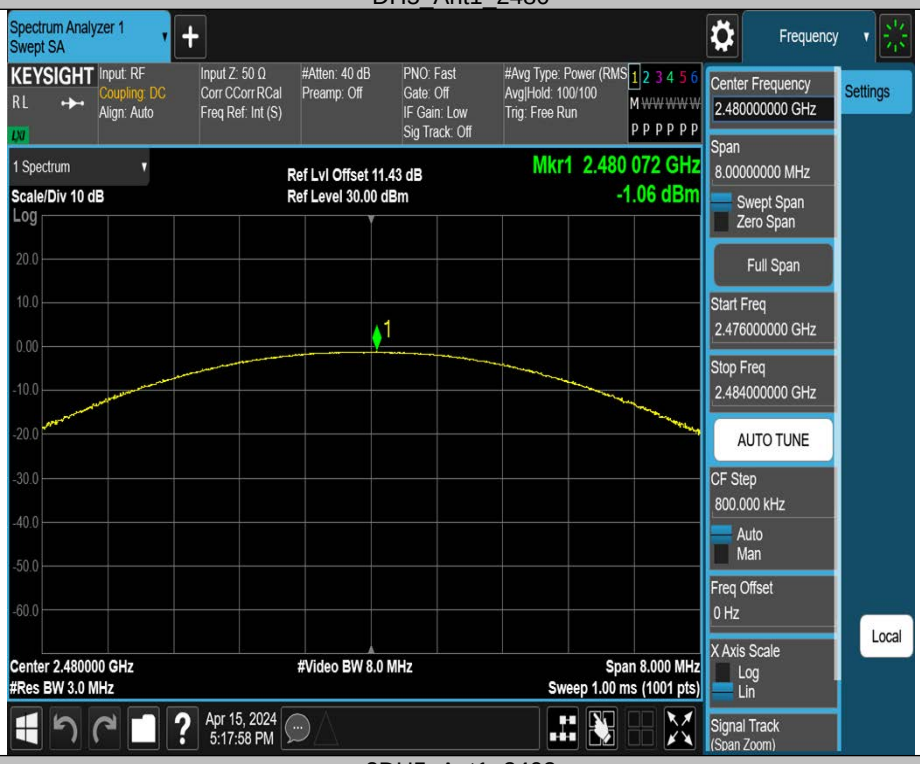
DH5_Ant1_2402



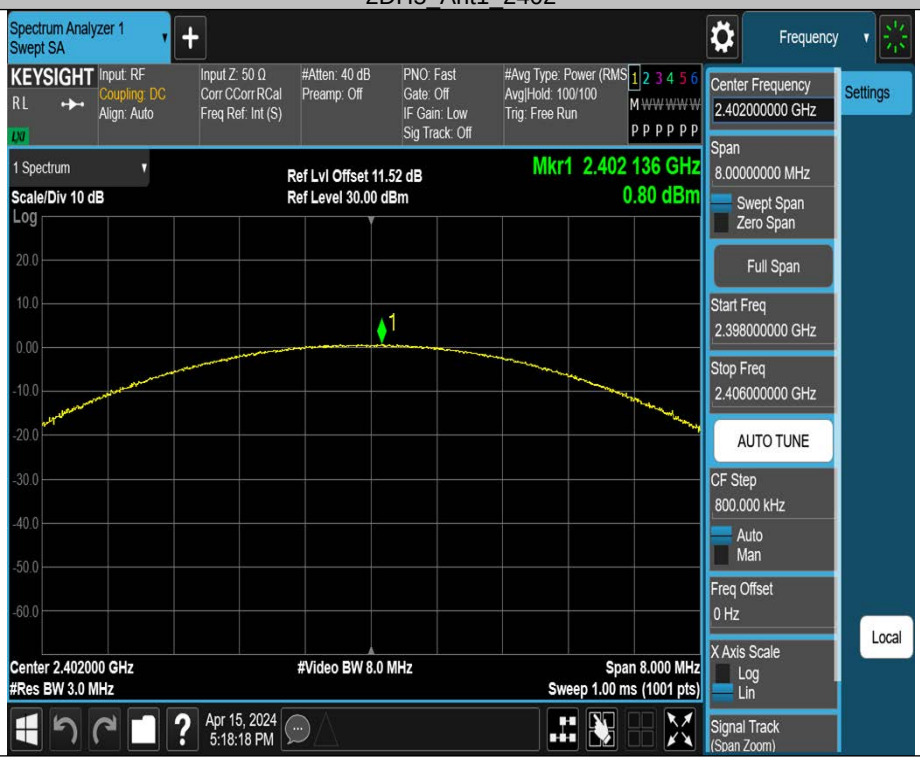
DH5_Ant1_2441



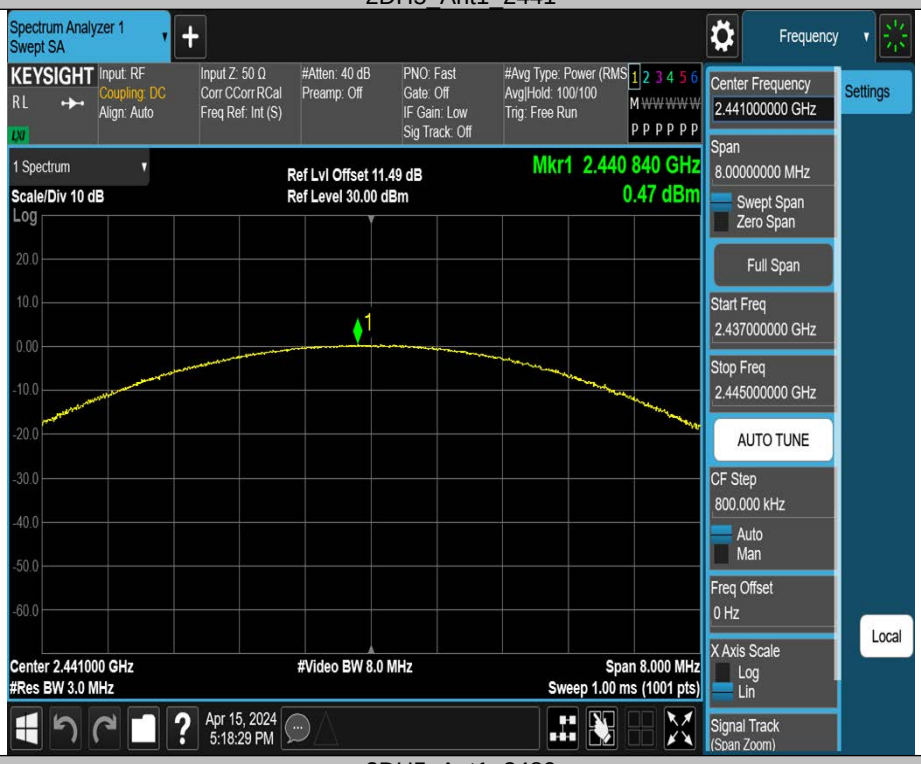
DH5_Ant1_2480



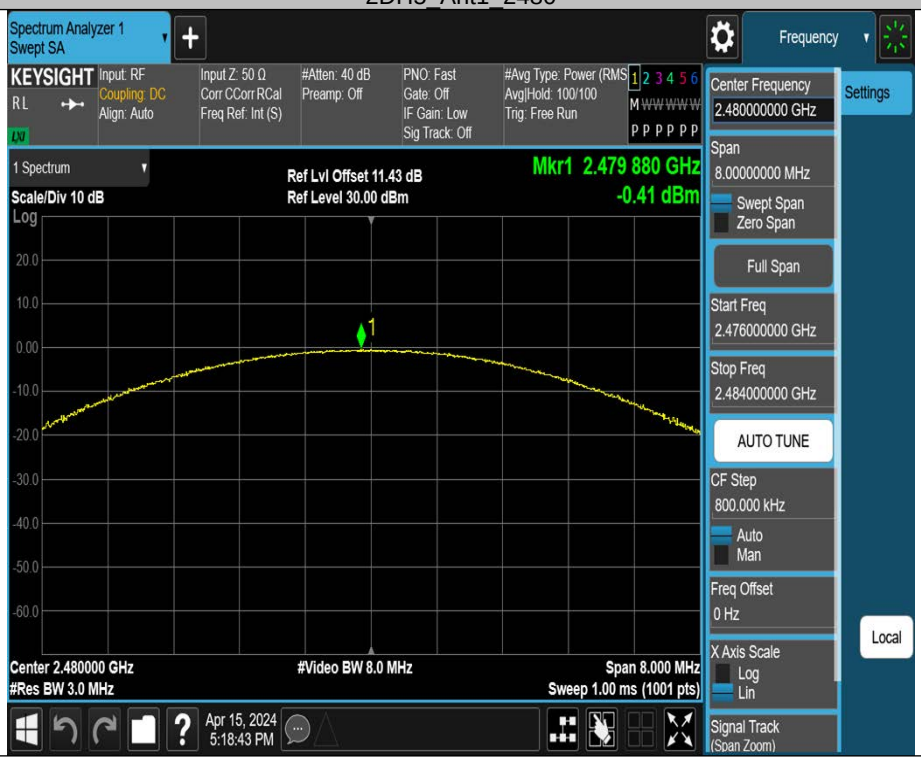
2DH5_Ant1_2402



2DH5_Ant1_2441



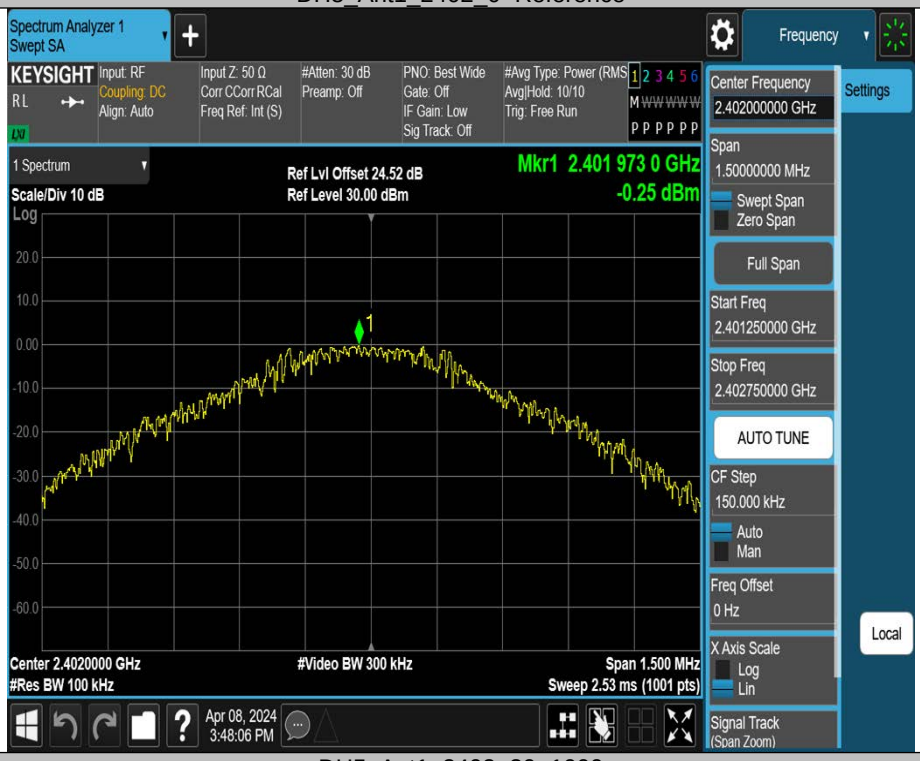
2DH5_Ant1_2480



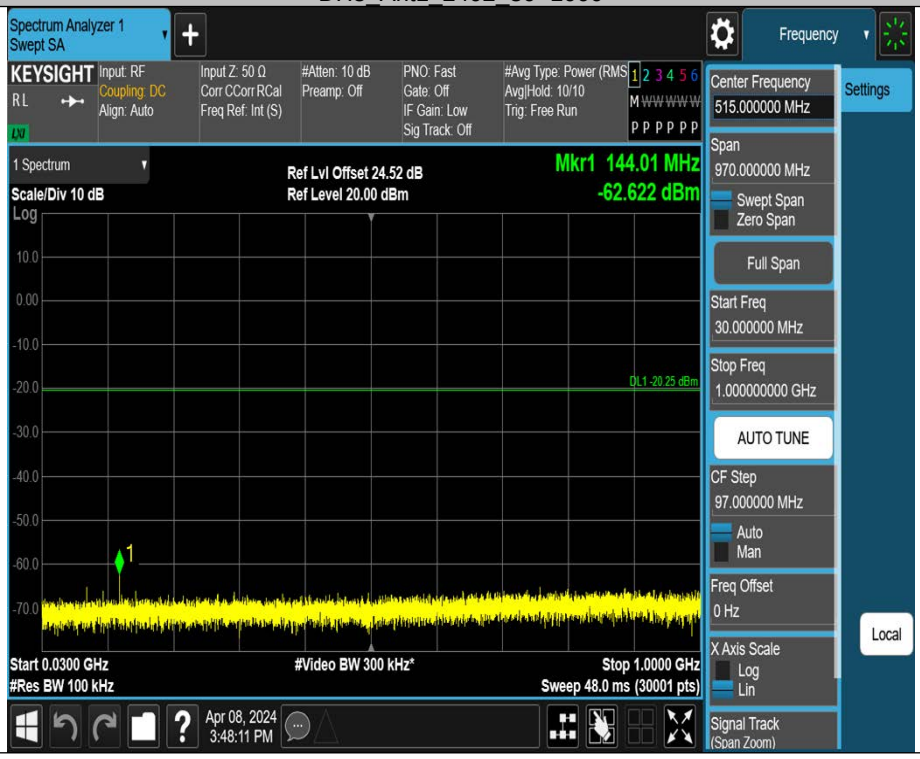
APPENDIX J - CONDUCTED SPURIOUS EMISSION

Test Graphs

DH5_Ant1_2402_0~Reference

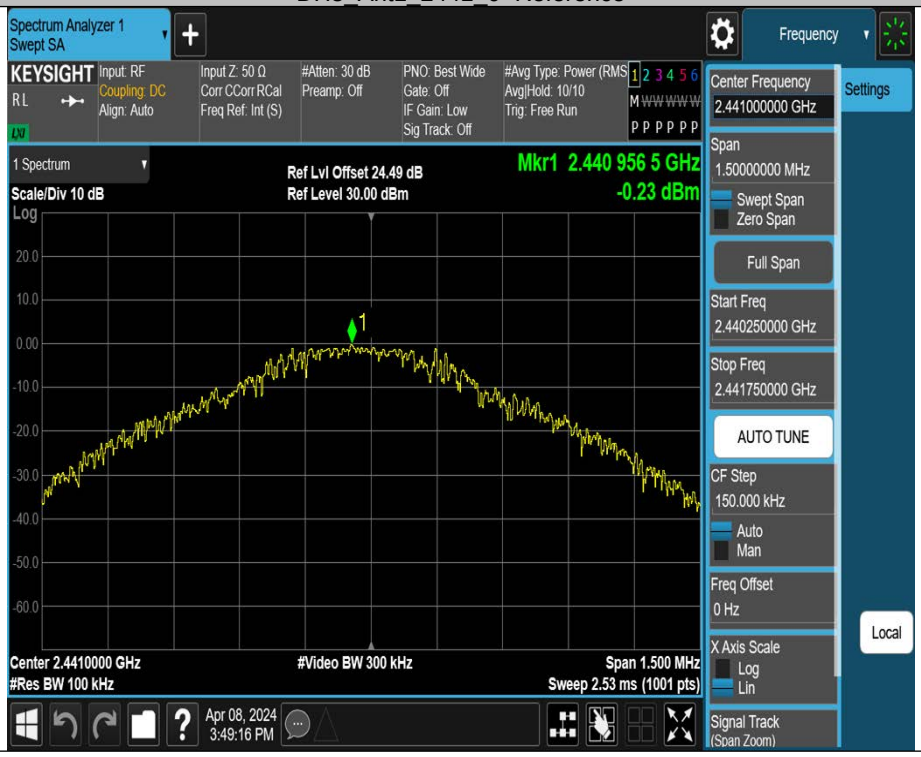


DH5_Ant1_2402_30~1000

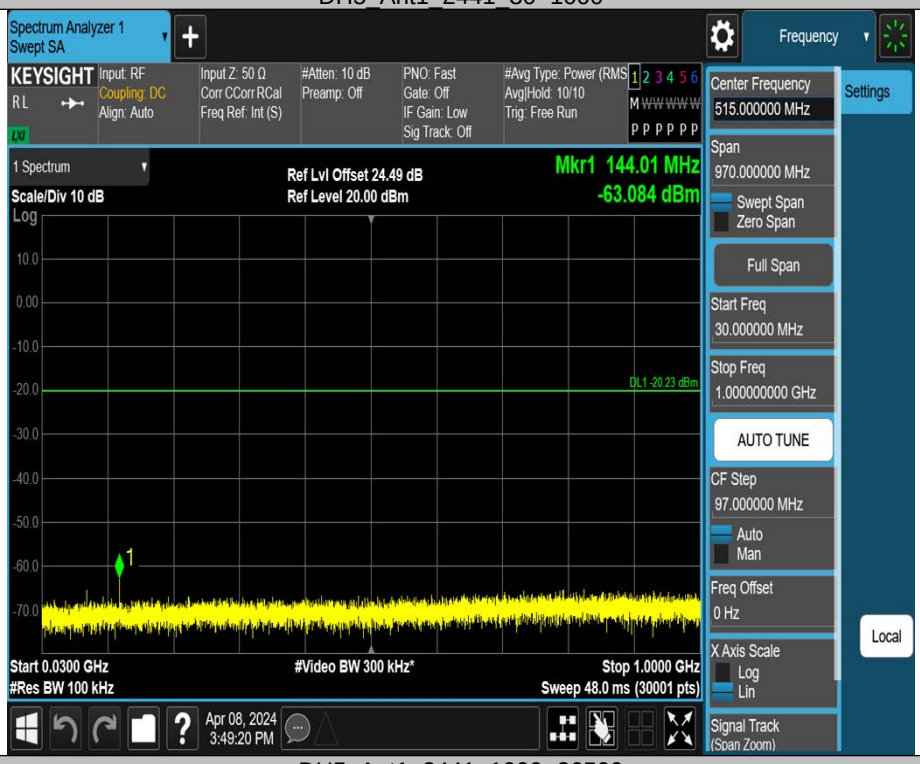


DH5_Ant1_2402_1000~26500

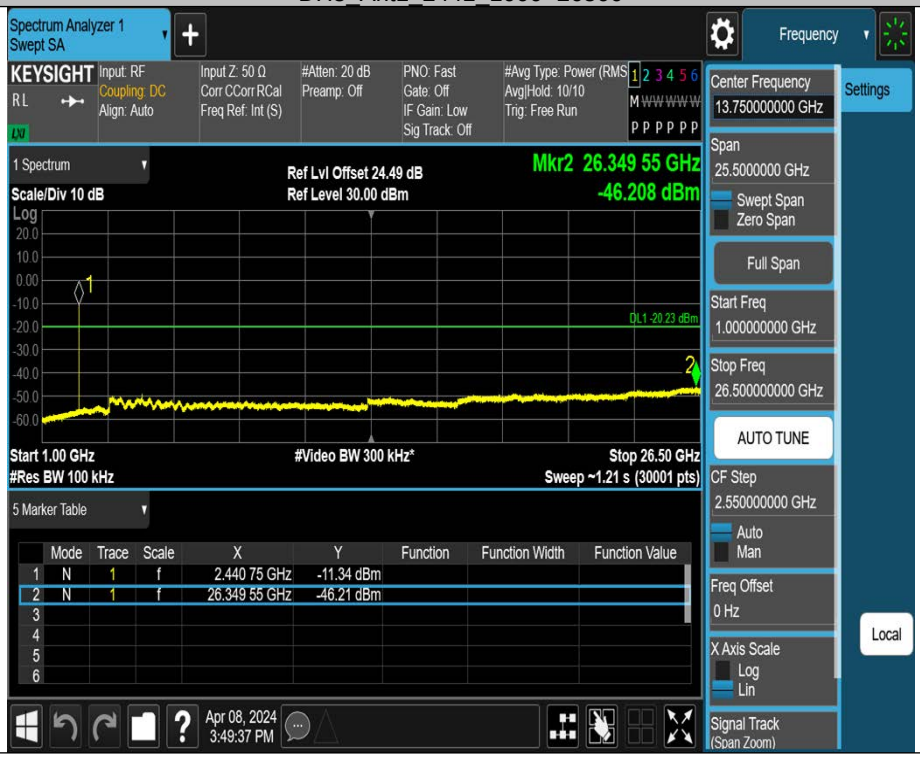
DH5_Ant1_2441_0~Reference



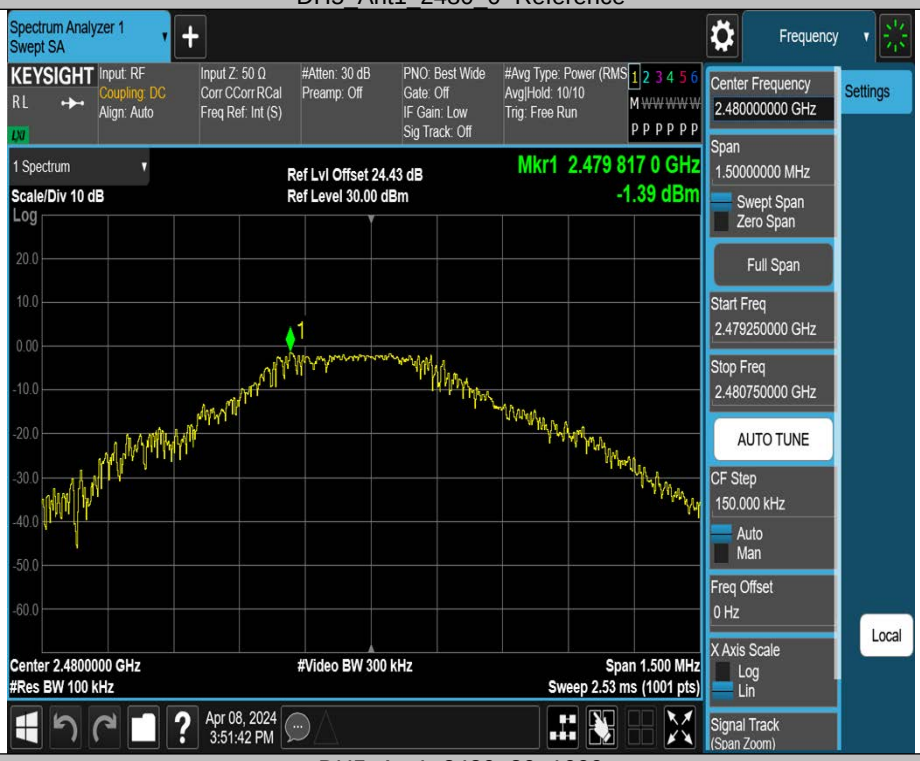
DH5_Ant1_2441_30~1000



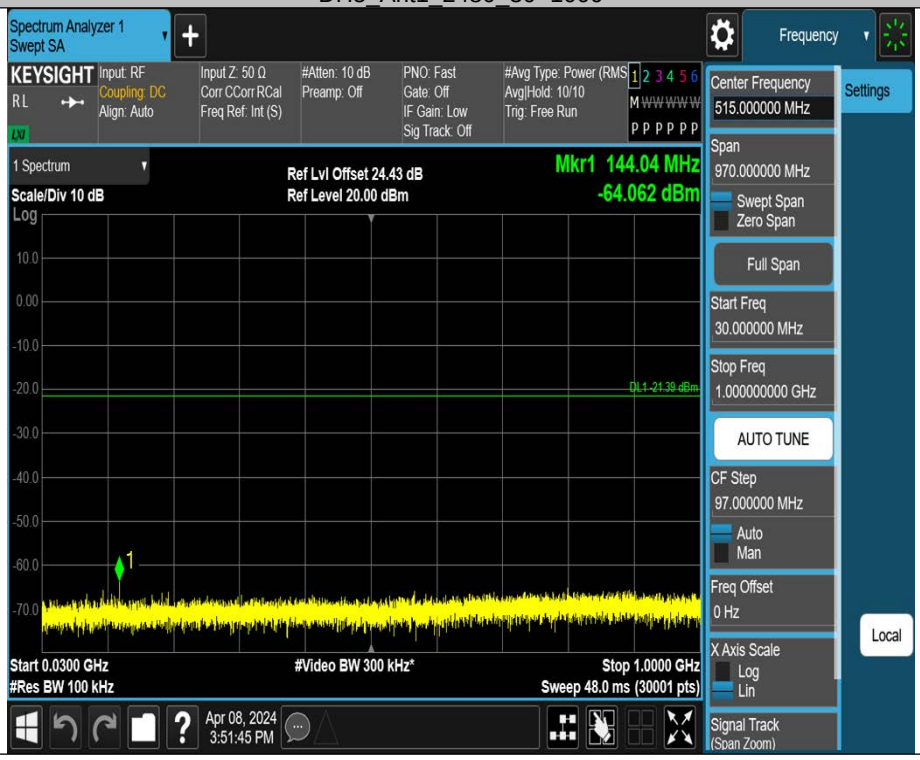
DH5_Ant1_2441_1000~26500



DH5_Ant1_2480_0~Reference

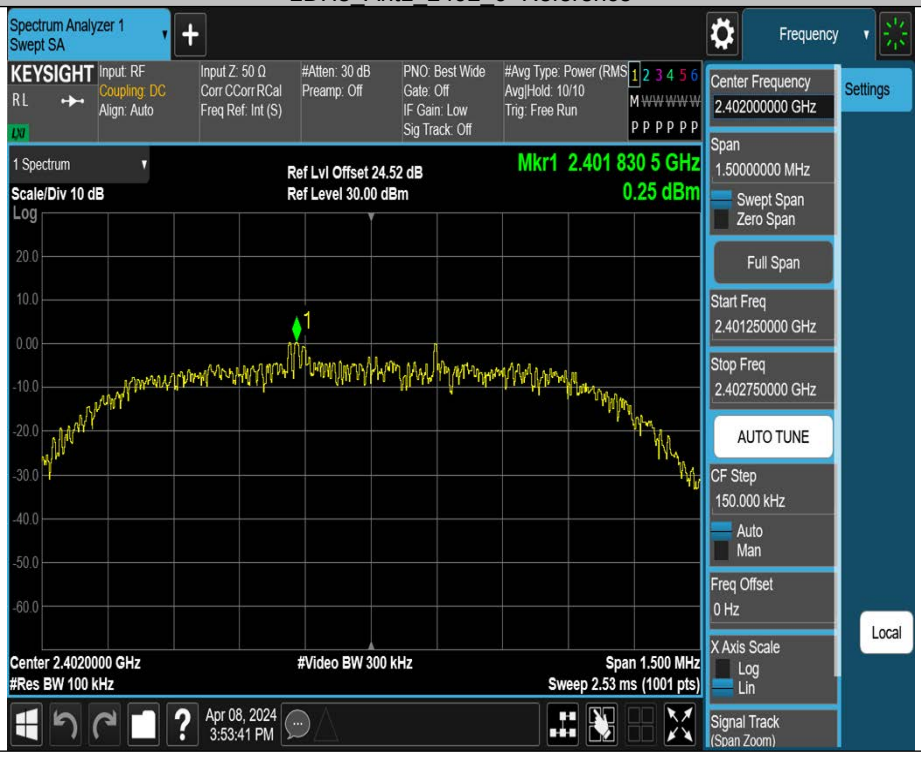


DH5_Ant1_2480_30~1000

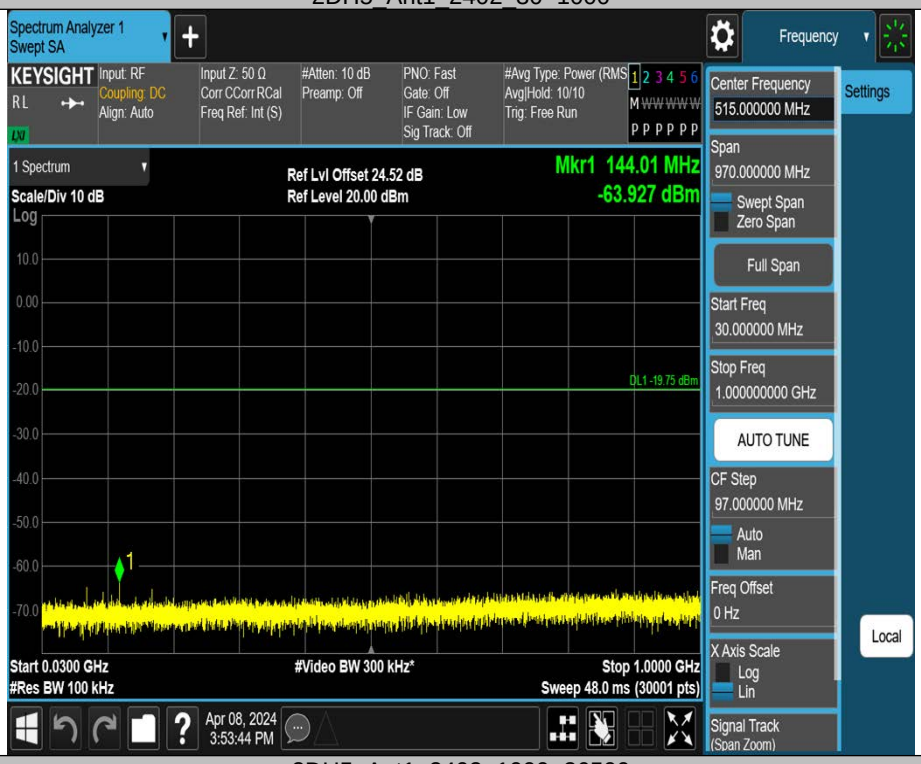


DH5_Ant1_2480_1000~26500

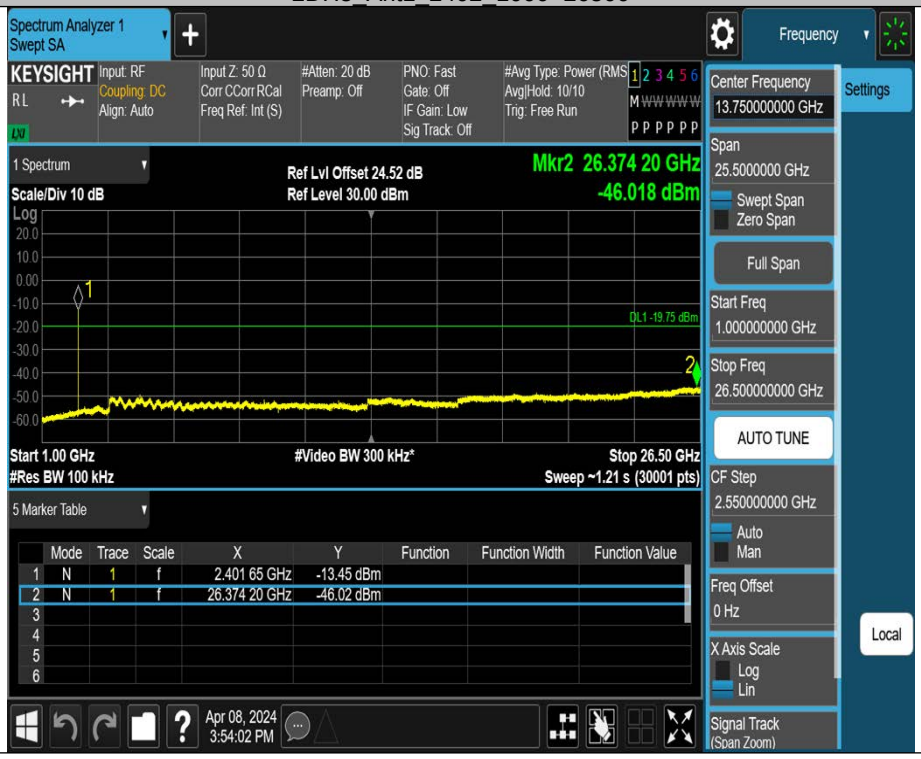
2DH5_Ant1_2402_0~Reference



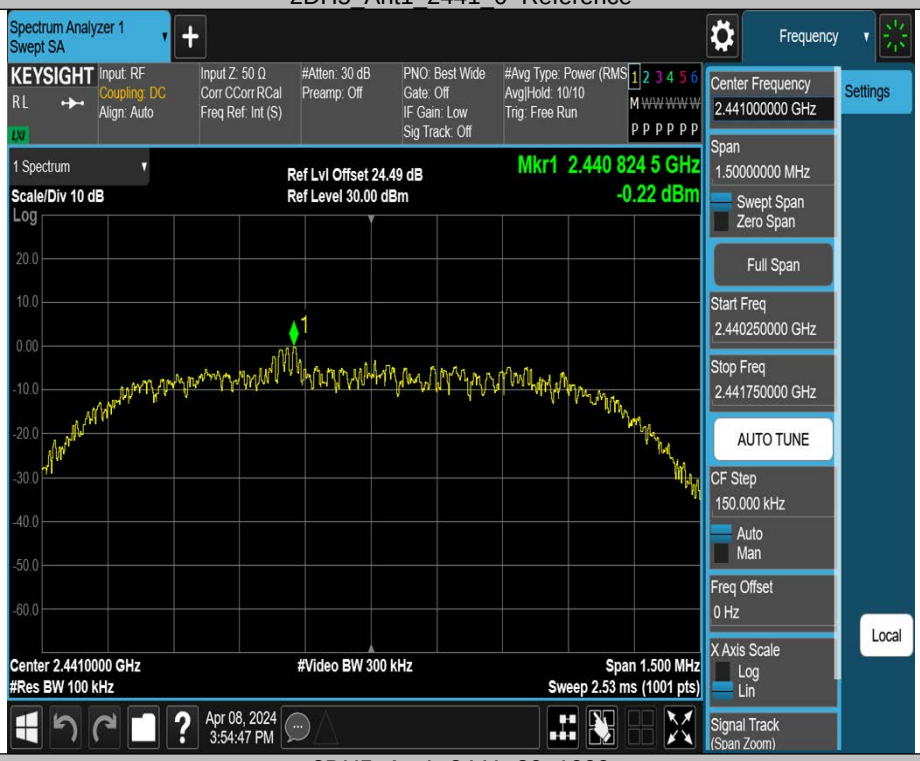
2DH5_Ant1_2402_30~1000



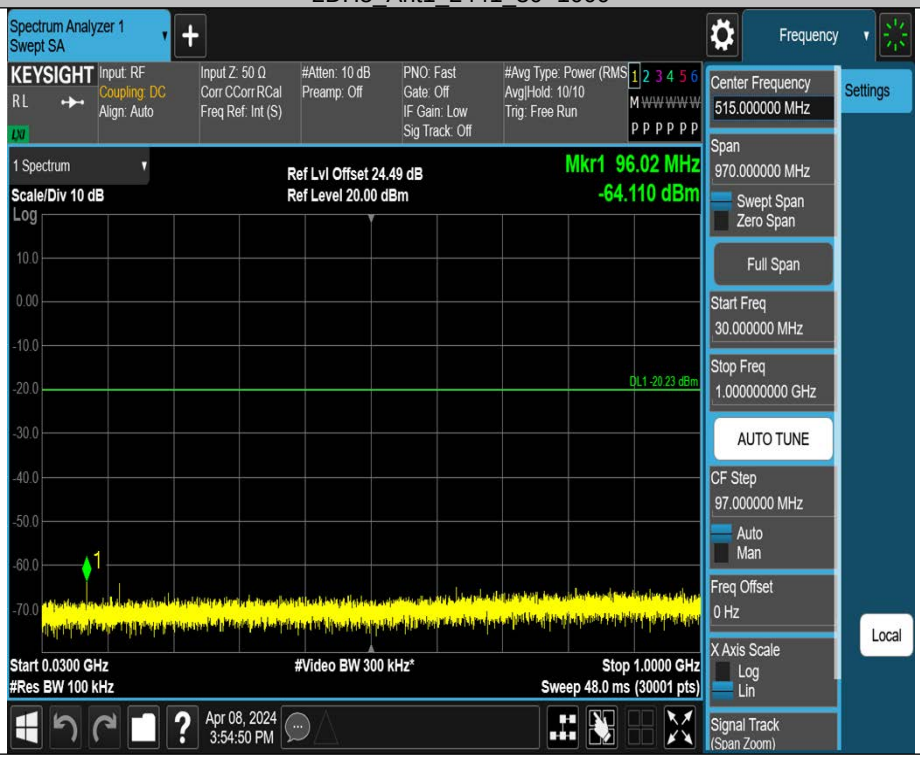
2DH5_Ant1_2402_1000~26500



2DH5_Ant1_2441_0~Reference

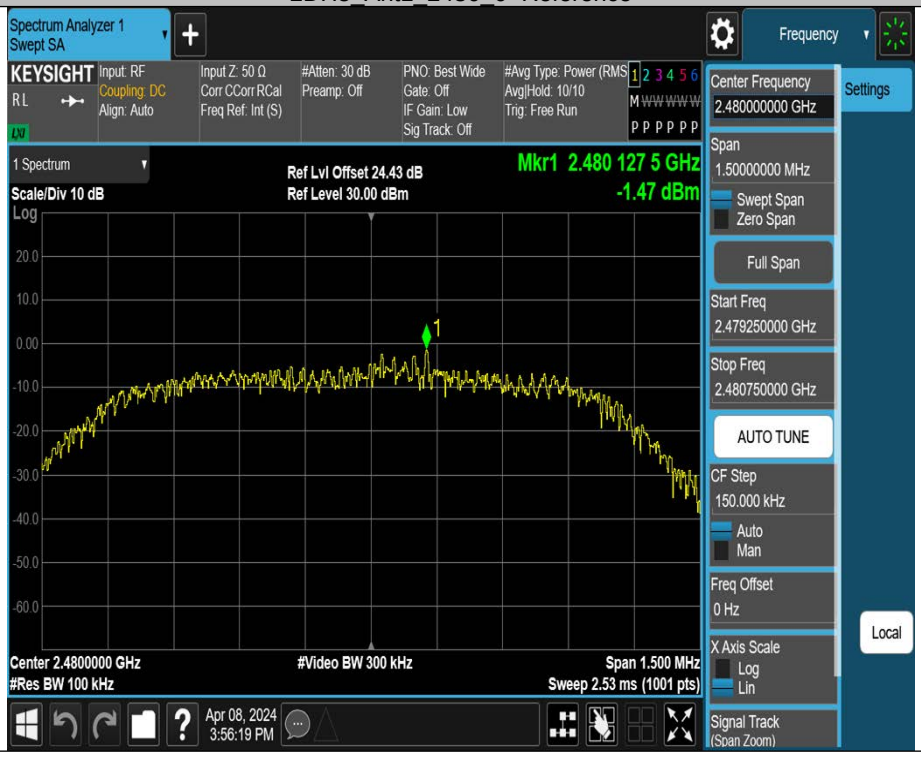


2DH5_Ant1_2441_30~1000

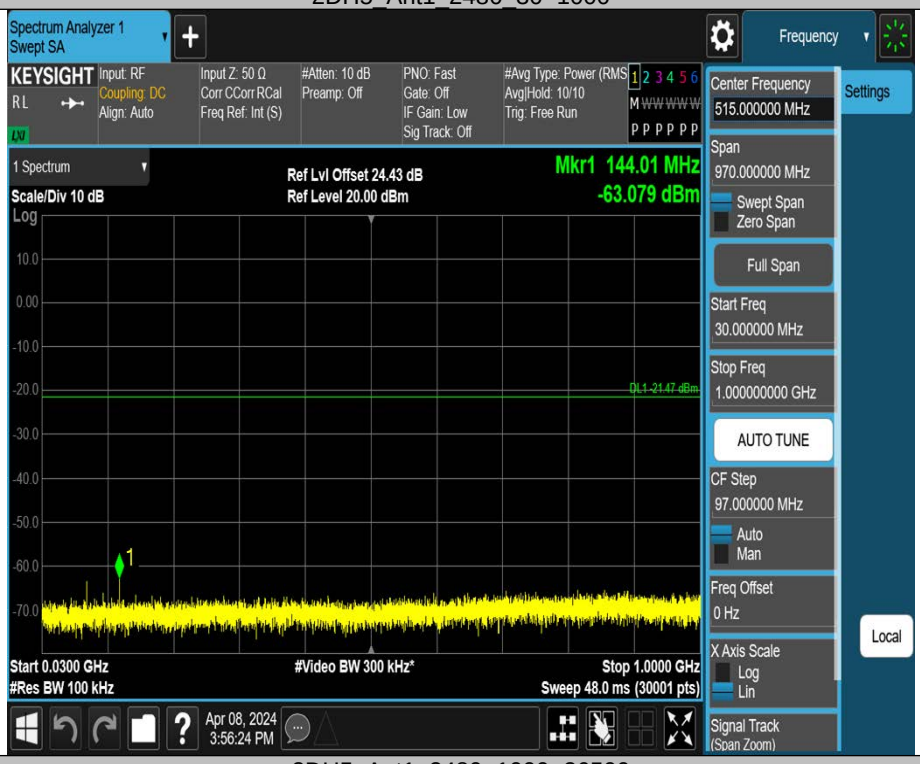


2DH5_Ant1_2441_1000~26500

2DH5_Ant1_2480_0~Reference



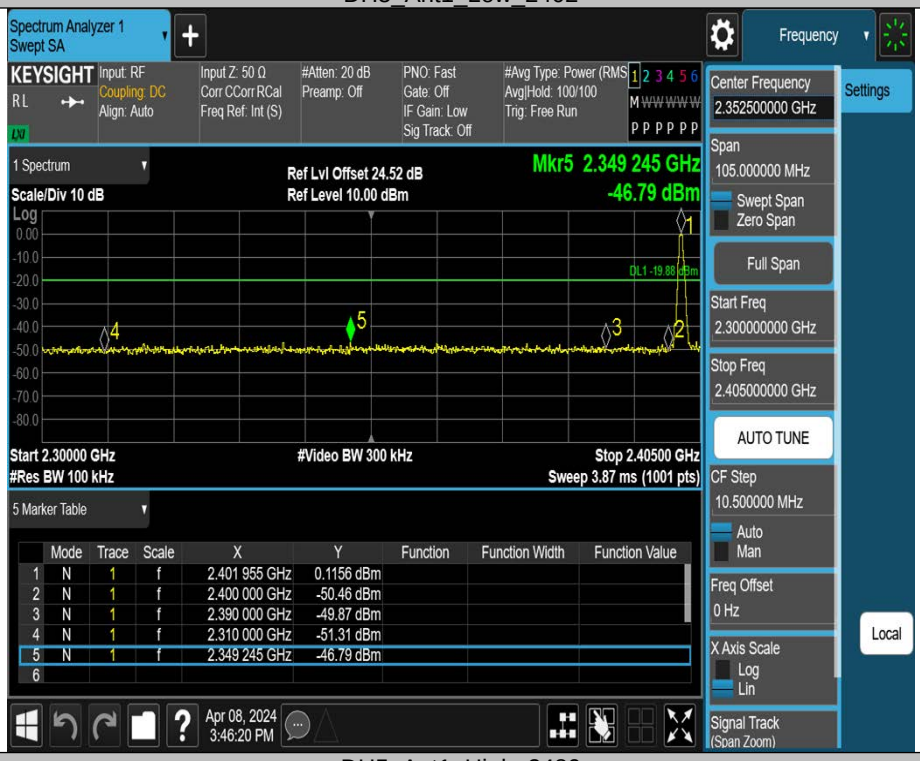
2DH5_Ant1_2480_30~1000



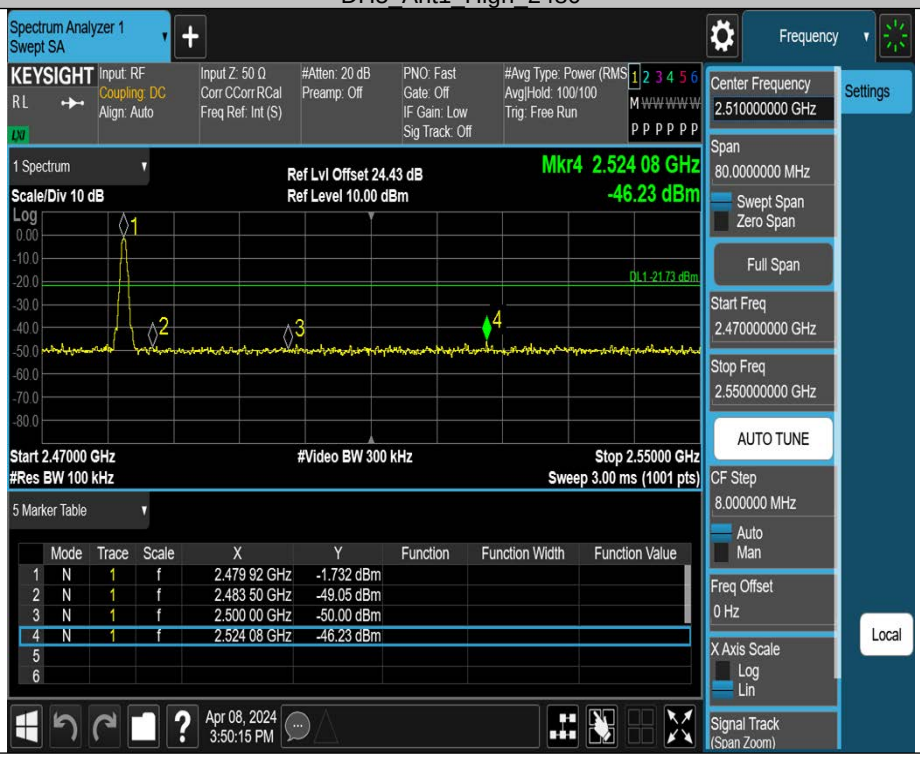
2DH5_Ant1_2480_1000~26500

Band edge

DH5_Ant1_Low_2402

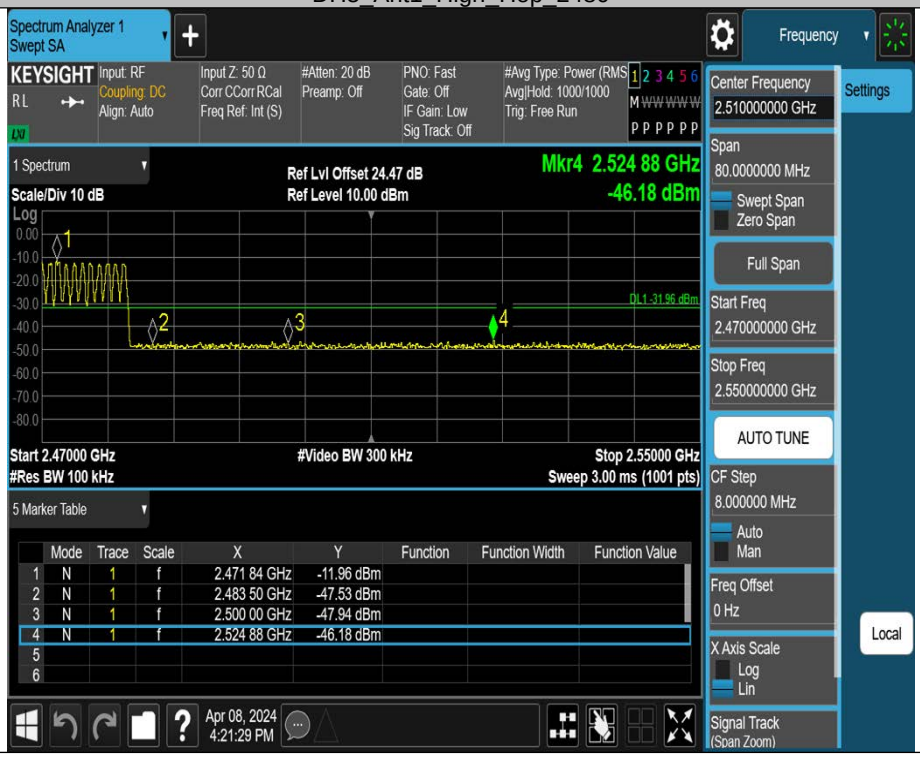


DH5_Ant1_High_2480

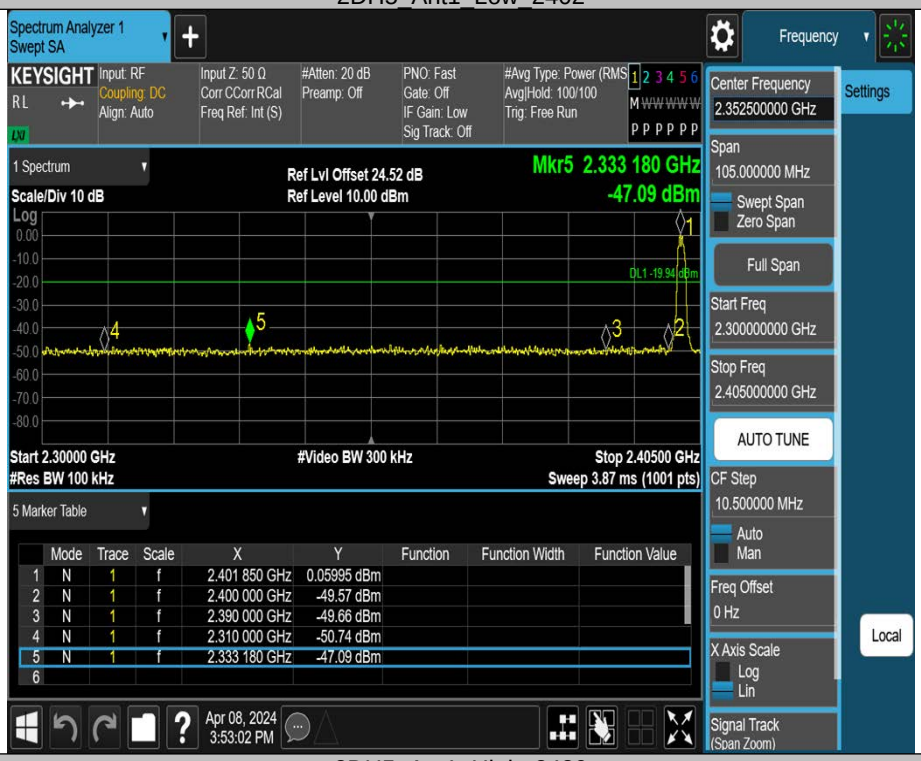


DH5_Ant1_Low_Hop_2402

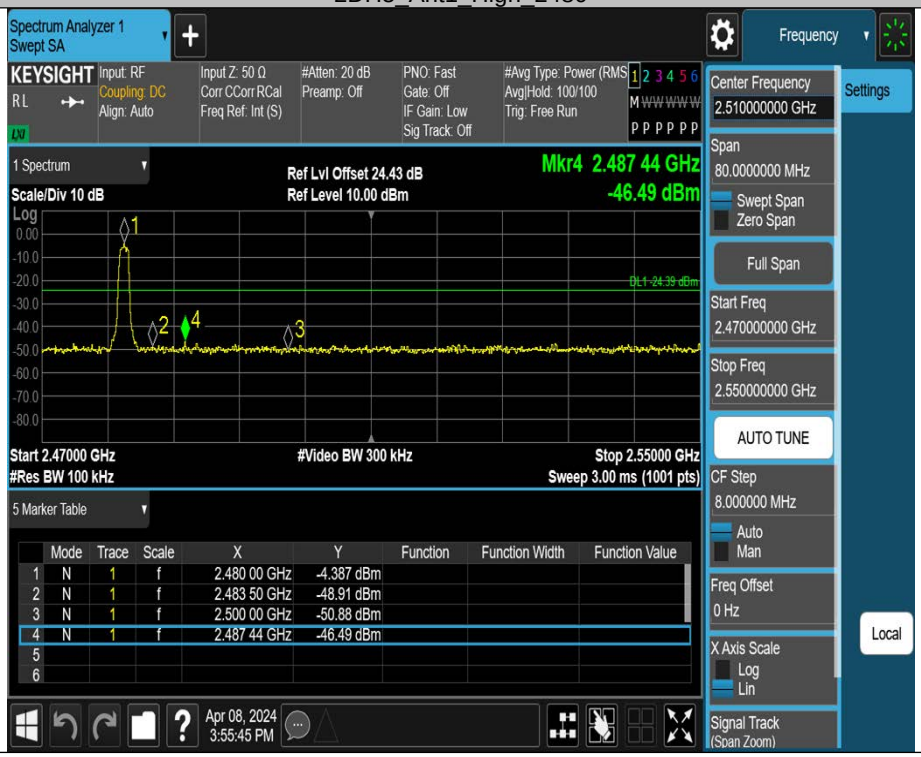
DH5_Ant1_High_Hop_2480



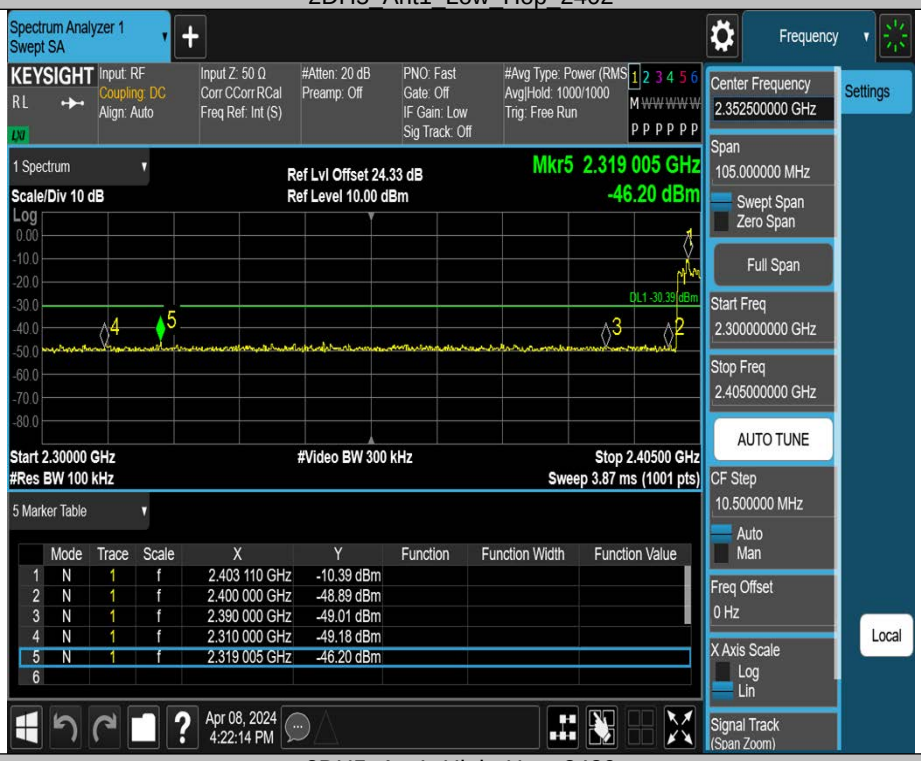
2DH5_Ant1_Low_2402



2DH5_Ant1_High_2480



2DH5_Ant1_Low_Hop_2402



2DH5_Ant1_High_Hop_2480

APPENDIX K - DECLARATION FOR BLUETOOTH DEVICE

1. Output power and channel separation of a Bluetooth device in the different operating modes:

The different operating modes (data-mode, acquisition-mode) of a Bluetooth device has no influence on the output power and the channel spacing. There is only one transmitter which is driven by identical input parameters concerning these two parameters.
Only a different hopping sequence will be used. For this reason the check of these RF parameters in one op-mode is sufficient.

2. Frequency range of a Bluetooth device:

Hereby we declare that the maximum frequency of this device is: 2402 - 2480MHz. This is according to the Bluetooth Core Specification (+ critical errata) for devices which will be operated in the USA.
This was checked during the Bluetooth Qualification tests (Test Case: TRM/CA/04-E). Other frequency ranges (e.g. for Spain, France, Japan) which are allowed according the Core Specification are not supported by this device.

3. Co-ordination of the hopping sequence in data mode to avoid simultaneous occupancy by multiple transmitters:

Bluetooth units which want to communicate with other units must be organised in a structure called piconet. This piconet consist of max. 8 Bluetooth units. One unit is the master the other seven are the slaves. The master co-ordinates frequency occupation in this piconet for all units. As the master hop sequence is derived from its BD address which is unique for each Bluetooth device, additional masters intending to establish new piconets will always use different hop sequences.

4. Example of a hopping sequence in data mode:

Example of a 79 hopping sequence in data mode:
40, 21, 44, 23, 42, 53, 46, 55, 48, 33, 52, 35, 50, 65, 54, 67, 56, 37, 60, 39, 58, 69, 62, 71, 64, 25, 68, 27, 66, 57, 70, 59, 72, 29, 76, 31, 74, 61, 78, 63, 01, 41, 05, 43, 03, 73, 07, 75, 09, 45, 13, 47, 11, 77, 15, 00, 64, 49, 66, 53, 68, 02, 70, 06, 01, 51, 03, 55, 05, 04

5. Equally average use of frequencies in data mode and behaviour for short transmissions:

The generation of the hopping sequence in connection mode depends essentially on two input values:
a) LAP/UAP of the master of the connection.
b) Internal master clock.

The LAP (lower address part) are the 24 LSB's of the 48 BD_ADDRESS. The BD_ADDRESS is an unambiguous number of every Bluetooth unit. The UAP (upper address part) are the 24 MSB's of the 48 BD_ADDRESS.

The internal clock of a Bluetooth unit is derived from a free running clock which is never adjusted and is never turned off. For synchronisation with other units only offset are used. It has no relation to the time of the day. Its resolution is at least half the RX/TX slot length of 312.5 µs. The clock has a cycle of about one day (23h30). In most case it is implemented as 28 bit counter. For the deriving of the hopping sequence the entire.
LAP (24 bits), 4 LSB's (4 bits) (Input 1) and the 27 MSB's of the clock (Input 2) are used. With this input values different mathematical procedures (permutations, additions, XOR- operations) are performed to generate the sequence. This will be done at the beginning of every new transmission.

Regarding short transmissions the Bluetooth system has the following behaviour:
The first connection between the two devices is established, a hopping sequence was generated. For transmitting the wanted data the complete hopping sequence was not used. The connection ended.
The second connection will be established. A new hopping sequence is generated. Due to the fact that the Bluetooth clock has a different value, because the period between the two transmission is longer (and it cannot be shorter) than the minimum resolution of the clock (312.5 µs). The hopping sequence will always

differ from the first one.

6. Receiver input bandwidth and behaviour for repeated single or multiple packets:

The input bandwidth of the receiver is 1 MHz. In every connection one Bluetooth device is the master and the other one is the slave. The master determines the hopping sequence (see chapter 5). The slave follows this sequence. Both devices shift between RX and TX time slot according to the clock of the master.
Additionally the type of connection (e.g. single or multislot packet) is set up at the beginning of the connection. The master adapts its hopping frequency and its TX/RX timing according to the packet type of the connection. Also the slave of the connection will use these settings.
Repeating of a packet has no influence on the hopping sequence. The hopping sequence generated by the master of the connection will be followed in any case. That means, a repeated packet will not be send on the same frequency, it is send on the next frequency of the hopping sequence.

Statement

1. The report is invalid without the official seal or special seal of Shenzhen Haiyun Standard Technology Co., Ltd. (hereinafter referred to as the unit).

2. The report is invalid without the signature of the approver.

3. The report is invalid if altered arbitrarily.

4. The report shall not be partially copied without the written approval of the unit.

5. The reported test results are only valid for the tested samples.

6. If there is any objection to the test report, it shall be submitted to the test unit within 15 days from the date of receiving the report, and the overdue shall not be accepted.

Shenzhen Haiyun Standard Technology Co., Ltd.

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Email: service@hy-lab.cn

End of Test Report