Test Report

FCC ID:	APIMLNO5909
Applicant:	Harman International Industries, Inc
Address:	8500 Balboa Boulevard, Northridge, CA 91329, United States of America
Manufacturer:	Harman International Industries, Inc
Address:	8500 Balboa Boulevard, Northridge, CA 91329, United States of America
Product:	Bluetooth and ANC Headphone
Brand:	Mark Levinson
Test Model(s):	No5909
Series Model(s):	N/A
Test Date:	Apr.19, 2021 ~ Jul. 02, 2021
Issued By:	Hwa-Hsing (Dongguan) Testing Co., Ltd.
Address:	No.101, Bld N1, Yuyuan 2Rd, Yuyuan Industrial Park, HuangJiang Town, Dongguan, China
FCC Designation No.:	CN1255
Standards:	47 CFR FCC Part 15, Subpart C (Section 15.247) ANSI C63.10:2013

The above equipment has been tested by **Hwa-Hsing (Dongguan) Testing Co., Ltd.**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's EMC characteristics under the conditions specified in this report.

Prepared by : Scott He Date: Sep. 25, 2021

Scott He/ Project Engineer

Approved by : Harry Li Date: Sep. 27, 2021

Harry Li/ Technical Director

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Release Control Record

Issue No.	Description	Date Issued
210128EL19-RF-US-02	Original Release	Sep. 27, 2021

1 Summary of Test Results

47 CFR FCC Part 15, Subpart C (Section 15.247) KDB 558074 D01 15.247 Meas Guidance v05r02 ANSI C63.10:2013;			
FCCClause	Test Item	Result	Remarks
15.207	AC Power Conducted Emission	Pass	Meet the requirement of limit.
15.247(a)(1) (iii)	Number of Hopping Frequency Used	Pass	Meet the requirement of limit.
15.247(a)(1) (iii)	Dwell Time on Each Channel	Pass	Meet the requirement of limit.
15.247(a)(1)	1. Hopping Channel Separation 2. Spectrum Bandwidth of a Frequency Hopping Sequence Spread Spectrum System	Pass	Meet the requirement of limit.
15.247(b)	Maximum Peak Output Power	Pass	Meet the requirement of limit.
---	Occupied Bandwidth Measurement	Pass	Reference only
15.205 & 209	Radiated Emissions	Pass	Meet the requirement of limit.
15.247(d)	Band Edge Measurement	Pass	Meet the requirement of limit.
15.247(d)	Antenna Port Emission	Pass	Meet the requirement of limit.
15.203	Antenna Requirement	Pass	No antenna connector is used.

Note1: If the Frequency Hopping System operating in 2400-2483.5MHz band and the output power less than 125mW. The hopping channel carrier frequencies separated by a minimum of 25kHz or two-thirds of the 20dB bandwidth of hopping channel whichever is greater.

Note2: The EUT has been verified to comply with the requirements of FCC Part 15, Subpart B, Class B (sDoC). The test report has been issued separately.

1.1 Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUTas specified in CISPR 16-4-2:

The listed uncertainties are the worst-case uncertainty for the entire range of measurement. Please note that the uncertainty values are provided for informational purposes only and are not used in determining the PASS/FAIL results.

Measurement	Frequency	Expended Uncertainty (k=2) (±)
Conducted Emissions at mains ports	150kHz ~ 30MHz	2.66 dB
Radiated Emissions up to 1 GHz	9KHz ~ 30MHz	2.90dB
	30MHz ~ 1000MHz	3.47 dB
Radiated Emissions above 1 GHz	1GHz ~ 18GHz	4.84 dB
	18GHz ~ 40GHz	4.62 dB

Note: This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k = 2.

1.2 Modification Record

There were no modifications required for compliance.

2 General Information

2.1 General Description of EUT

Product	Bluetooth and ANC Headphone
Brand	Mark Levinson
Test Model(s)	No5909
Series Model(s)	N/A
FCC ID:	APIMLNO5909
Status of EUT	Engineeringprototype
Power Supply Rating	DC5V from USB or DC 3.7V from battery
Modulation Type	GFSK, π/4DQPSK,8DPSK
Transfer Rate	1/2/3Mbps
Operating Frequency	2402 ~ 2480MHz
Number of Channel	79
Output Power	14.256mW
Antenna Type	PFCB Antenna
Antenna Gain	1.47dBi Maximum peak Gain
Antenna Connector	I-PEX
Radio HW	V2.3
Radio FW	V1208
Accessory Device	Aux in Line: 125 cm; DC Line: 132cm Please see Note 1
Cable Supplied	N/A

Note:

1. Please refer to the EUT photo document (Reference No.:210128EL19) for detailed product photo.
2. The above EUT information is declared by manufacturer and for more detailed features description, please refer to the manufacturer's specifications or User's Manual.

2.2 Description of Test Modes

79 channels are provided to this EUT:

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

2.2.1 Test Mode Applicability and Tested Channel Detail

EUT Configure Mode	Applicable test items	X-Axis	Y-Axis	Z-Axis	Voltage Supply
Radiated	AC Power Conducted Emission	N/A	N/A	N/A	DC3.7V from battery
Radiated	Radiated Emissions	√	√	√*	
Antenna Port Conducted Measurement	Number of Hopping Frequency Used	N/A	N/A	N/A	
	Dwell Time on Each Channel	N/A	N/A	N/A	
	1. Hopping Channel Separation 2. Spectrum Bandwidth of a Frequency Hopping Sequence Spread Spectrum System	N/A	N/A	N/A	
	Maximum Peak Output Power	N/A	N/A	N/A	
	Occupied Bandwidth Measurement	N/A	N/A	N/A	
	Band Edge Measurement	N/A	N/A	N/A	

1. *: The EUT had been pre-tested on the positioned of each 3 Axis. The worst case was found when positioned on **Z-plane**.
2. "N/A" means no effect.

Test Condition:

Applicable test items	Environmental Conditions	Power supply	Tested by
AC Power Conducted Emission	25deg. C, 65%RH	DC5V from USB	Banson
Radiated Emissions	25deg. C, 65%RH	DC3.7V from battery	Jim Xu
Antenna Port Conducted Measurement	25deg. C, 65%RH	DC3.7V from battery	Dragonlong

Radiated Emission Test (Above 1 GHz):

☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).

☒ Following channel(s) was (were) selected for the final test as listed below.

EUT Configure Mode	Available Channel	Tested Channel	Modulation Technology	Modulation Type	Packet Type
-	0 to 78	0, 39, 78	FHSS	GFSK	DH5
-	0 to 78	0, 39, 78	FHSS	8DPSK	3DH5

Radiated Emission Test (Below 1 GHz):

☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
☒ Following channel(s) was (were) selected for the final test as listed below.

EUT Configure Mode	Available Channel	Tested Channel	Modulation Technology	Modulation Type	Packet Type
-	0 to 78	78	FHSS	GFSK	DH5

Power Line Conducted Emission Test:

☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
☒ Following channel(s) was (were) selected for the final test as listed below.

EUT Configure Mode	Available Channel	Tested Channel	Modulation Technology	Modulation Type	Packet Type
-	0 to 78	78	FHSS	GFSK	DH5

Antenna Port Conducted Measurement:

☒ This item includes all test value of each mode, but only includes spectrum plot of worst value of each mode.
☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
☒ Following channel(s) was (were) selected for the final test as listed below.

EUT Configure Mode	Available Channel	Tested Channel	Modulation Technology	Modulation Type	Packet Type
-	0 to 78	0, 39, 78	FHSS	GFSK	DH5
-	0 to 78	0, 39, 78	FHSS	8DPSK	3DH5

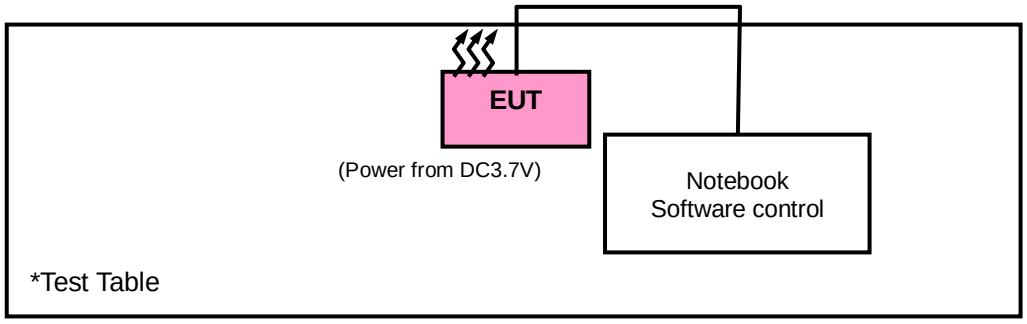
2.3 Description of Support Units

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

No.	Product	Brand	Model No.	Serial No.	FCC ID
1.	Notebook	Lenovo	E430	MP-0DN27	N/A

No.	Signal Cable Description Of The Above Support Units
1.	AC Line: Un-shieldin 2.0m
2.	/
3.	/

2.3.1 Configuration of System under Test



3 Test Typesand Results

3.1 Radiated Emission andBandedge Measurement

3.1.1 Limits of Radiated Emission andBandedge Measurement

Radiated emissions which fall in the restricted bands must comply with the radiated emission limits specified as below table. Other emissions shall be at least 20 dB below the highest level of the desired power:

Frequencies (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

Note:

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBuV/m) = 20 log Emission level (uV/m).
3. For frequencies above 1000 MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20 dB under any condition of modulation.

3.1.2 Test Instruments

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
EMI Test Receiver	Rohde&Schwarz	ESCI 7	100962	2021/01/06	2022/01/05
Broadband antenna	Schwarzbeck	VULB 9168	00937	2021/04/16	2022/04/15
3m Semi-anechoic Chamber	MAORUI	9m*6m*6m	NSEMC003	2021/04/15	2022/04/14
Signal Amplifier	Com-power	PAM-103	18020051	2021/03/15	2022/03/14
Attenuator	Rohde&Schwarz	TS2GA-6dB	18101101	N/A	N/A
Test software	FARAD	FARAD	EZ_EMCV1.1.4.2	N/A	N/A
Fixed Attenuator	Mini-Circuits	MDCS18N-10	MDCS18N-10-01	2020/10/18	2021/10/17
Loop Antenna	EMCI	HLA 6121	45745	2020/04/14	2022/04/13
Preamplifier	EMCI	EMC001340	980201	2020/10/18	2021/10/17
Digital Multimete	FLUKE	15B+	43512617WS	2020/09/17	2021/09/16
Horn Antenna	Schwarzbeck	BBHA 9170	01959	2020/04/16	2022/04/15
Spectrum Analyzer	Rohde&Schwarz	FSV-40N	101783	2021/03/15	2022/03/14
Broadband Coaxial Preamplifier	Schwarzbeck	BBV 9718	00025	2021/03/15	2022/03/14
Horn Antenna	Schwarzbeck	BBHA 9170	BBHA9170242	2020/04/16	2022/04/15
Pre-Amplifier	EMCI	EMC 184045	980102	2021/03/15	2022/03/14
Antenna Tower	MF	MFA-440H	NA	NA	NA
Turn Table	MF	MFT-201SS	NA	NA	NA
Antenna Tower&Turn Table Controller	MF	MF-7802	NA	NA	NA
Spectrum	Keysight	N9020A	MY51240612	2020/09/17	2021/09/16
Power Meter 10Hz~18GHz	Tonscend	JS0806-2	188060126	2020/09/17	2021/09/16
Spectrum Analyzer	Rohde&Schwarz	FSV-40N	101783	2020/09/17	2021/09/16
Signal generator	Keysight	N5182A	GB40051020	2020/09/17	2021/09/16
Signal generator	Keysight	N5182A	MY47420944	2020/09/17	2021/09/16
Universal Switch Control Unit	Rohde&Schwarz	CMW500	12010002K50	2020/09/17	2021/09/16
Test Software	Tonscend	JS0806-2	NA	NA	NA

Note: 1. The calibration interval of the above test instruments is 12/24months and the calibrations are traceable to CEPREI/CHINA.
2. The test was performed in 966.

3.1.3 Test Procedures

a. The EUT was placed on the top of a rotating table 0.8 meters (for below 1GHz) / 1.5 meters (for above 1GHz) above the ground at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
c. The height of antenna 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.
d. 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.
e. The test-receiver system was set to quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1 GHz.
f. The test-receiver system was set to peak and average detected function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz. If the peak reading value also meets average limit, measurement with the average detector is unnecessary.

Note:

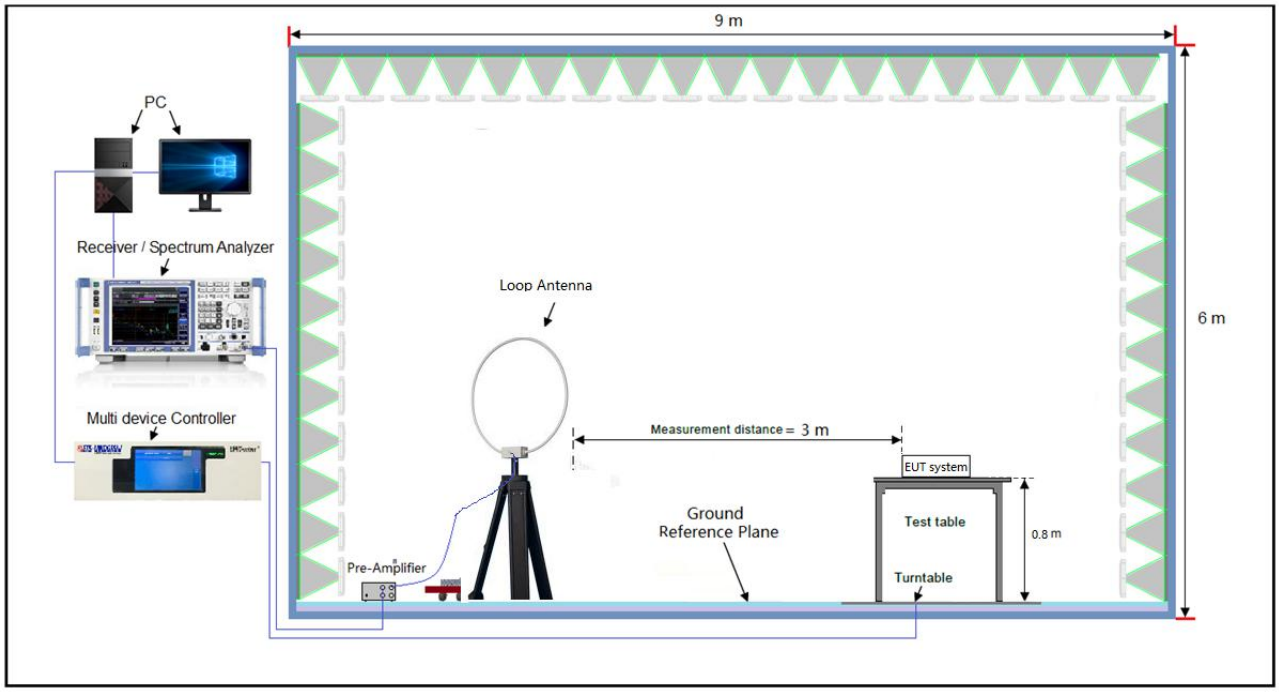
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz & 360 kHz for Quasi-peak detection (QP) at frequency below 1 GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1 GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 1/T for Average (Duty cycle < 98 %) detection at frequency above 1 GHz.
4. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 10 Hz (Duty cycle ≥ 98 %) for Average detection (AV) at frequency above 1 GHz.
5. Test procedures for measuring FHSS device: The use of a duty cycle correction factor (DCCF) is permitted for calculating average radiated field strength emission levels for an FHSS device in 15.247. This DCCF can be applied when the unwanted emission limit is subject to an average field strength limit (e.g., within a Government Restricted band) and the conditions specified in Section 15.35(c) can be satisfied. The average radiated field strength is calculated by subtracting the DCCF from the maximum radiated field strength level as determined through measurement. The maximum radiated field strength level represents the worst-case (maximum amplitude) RMS measurement of the emission(s) during continuous transmission (i.e., not including any time intervals during which the transmitter is off or is transmitting at a reduced power level). It is also acceptable to apply the DCCF to a measurement performed with a peak detector instead of the specified RMS power averaging detector. Note that Section 15.35(c) specifies that the DCCF shall represent the worst-case (greatest duty cycle) over any 100 msec transmission period. Subclause 7.5 of ANSI C63.10 provides additional measurement guidance applicable to determination of the DCCF.
6. All modes of operation were investigated and the worst-case emissions are reported.

3.1.4 Deviation from Test Standard

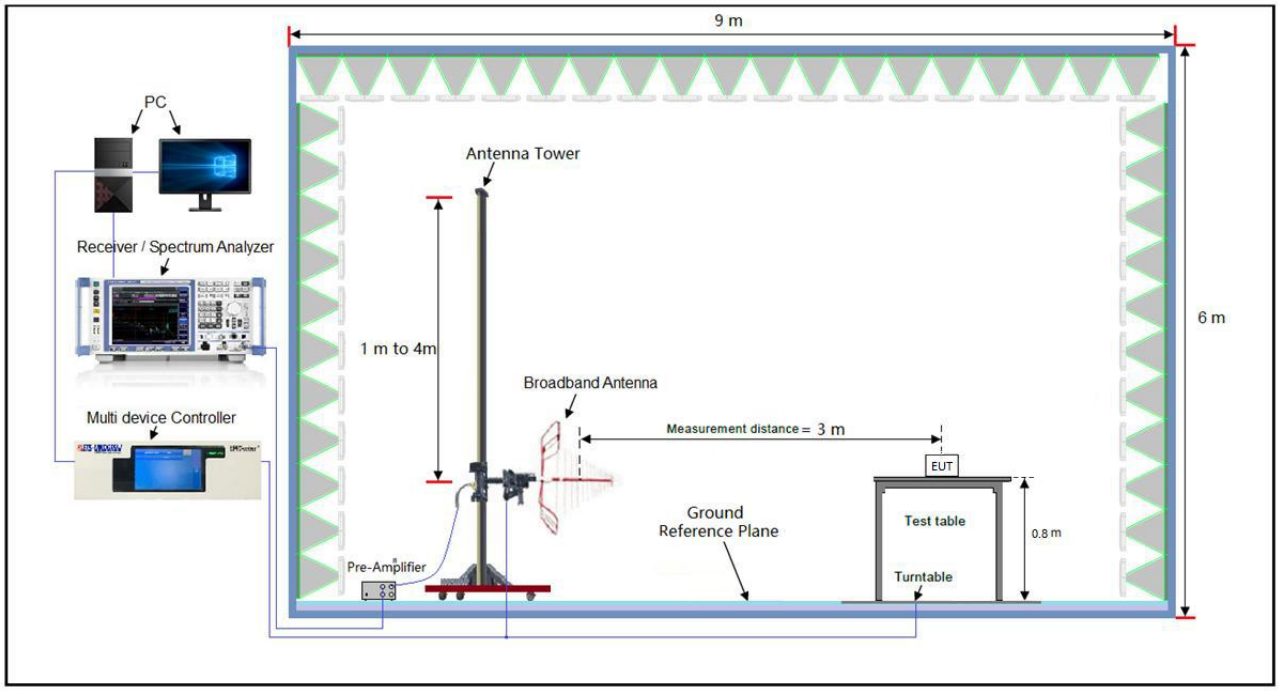
No deviation.

3.1.5 Test Setup

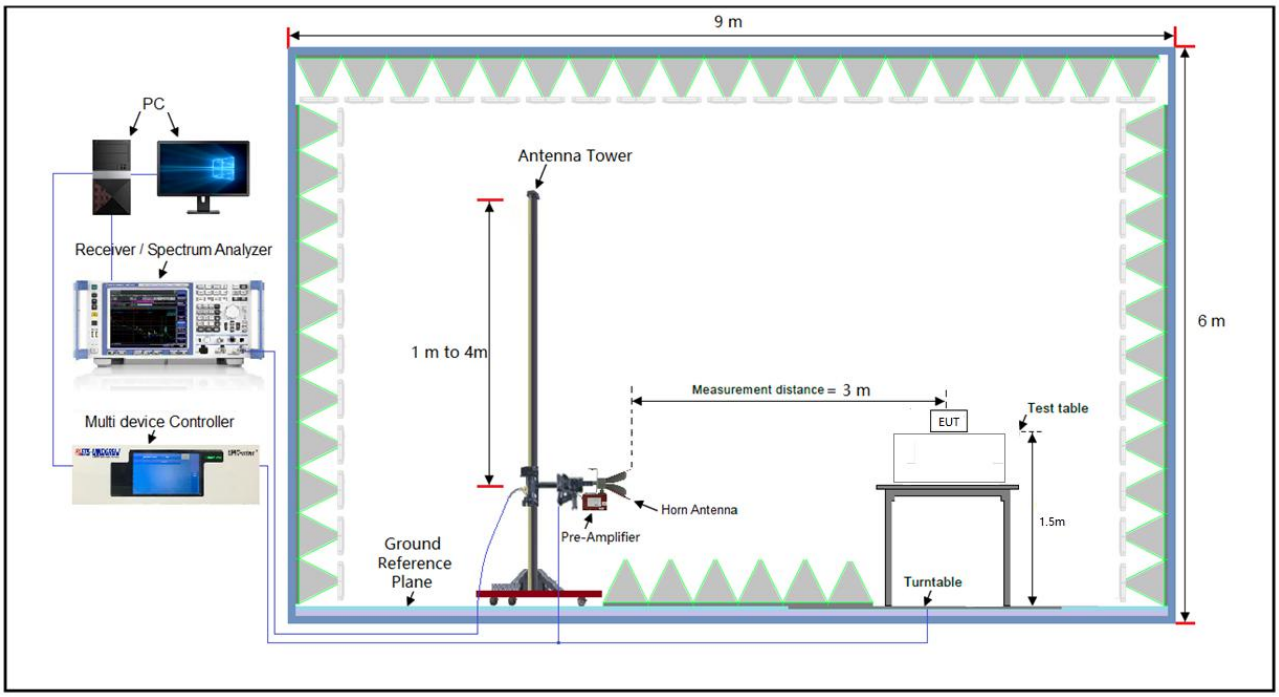
Radiated emission below 30MHz:



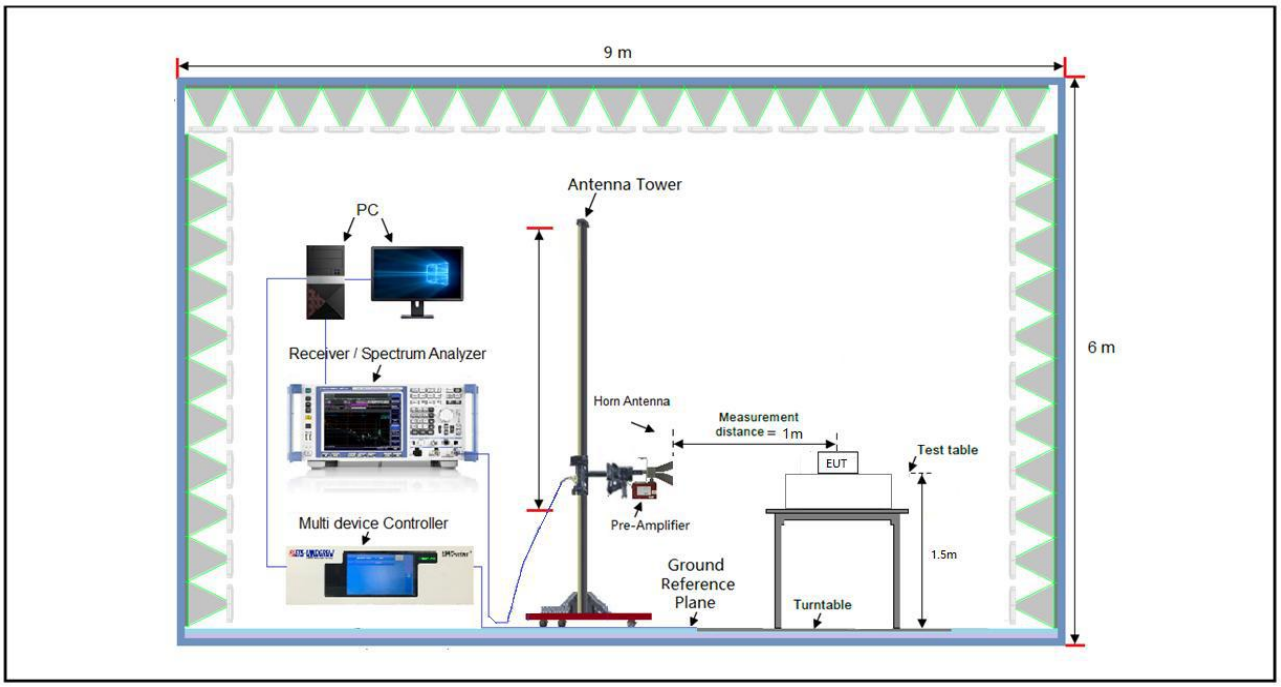
Frequency Range below 1GHz:



Frequency Range above 1GHz:



Frequency Range 18-40GHz:



Directional antenna.

For the actual test configuration, please refer to the attached file (Test Setup Photo).

3.1.6 EUT Operating Conditions

Set the EUT under transmission condition continuously at specific channel frequency.

3.1.7 Test Results

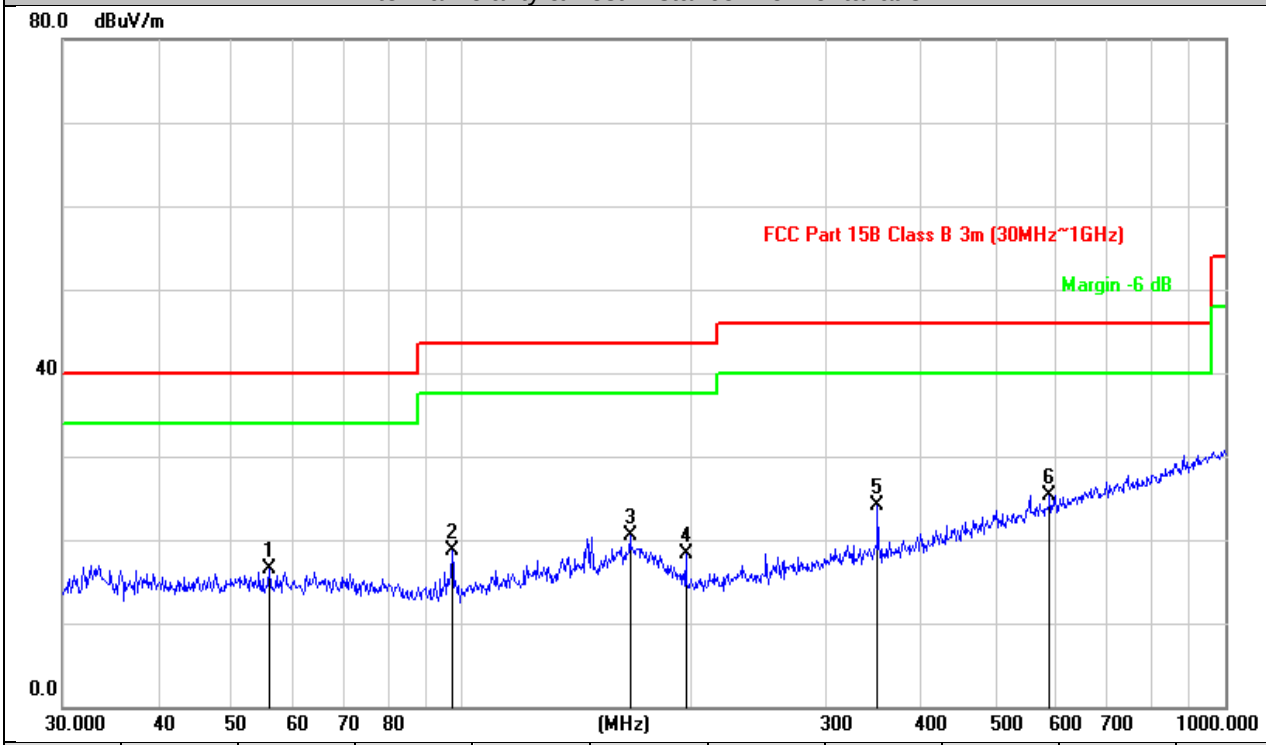
9 kHz ~ 30 MHz Data:

The amplitude of spurious emissions attenuated more than 20 dB below the permissible value is not required to be report.

30 MHz ~ 1GHz Worst-Case Data:

Test Channel	Channel 78	Frequency Range	30MHz ~ 1GHz
Detector Function	Peak (PK) Quasi-peak (QP)	Tested By	Jim Xu

Antenna Polarity & Test Distance: Horizontal at 3 m



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detecter	Antenna Height (cm)	Table Angle (Degree)	Remark
1	56.0007	33.18	-16.70	16.48	40.00	-23.52	QP	200	298	
2	97.1148	36.40	-17.66	18.74	43.50	-24.76	QP	200	277	
3	166.0680	33.24	-12.74	20.50	43.50	-23.00	QP	200	253	
4	196.5098	34.64	-16.31	18.33	43.50	-25.17	QP	200	176	
5	350.4768	36.66	-12.64	24.02	46.00	-21.98	QP	300	287	
6	588.9051	32.42	-7.04	25.38	46.00	-20.62	QP	200	142	

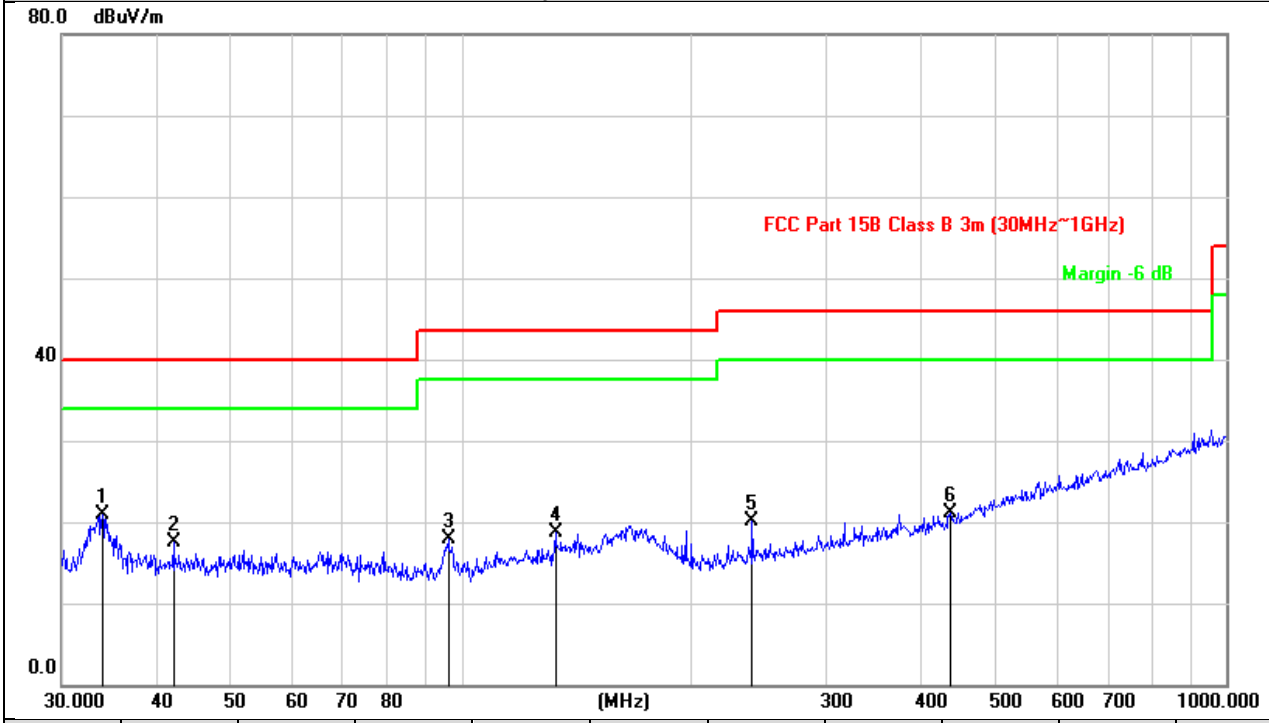
Remarks:

1.Emission Level = Read Level + Factor (Antenna Factor + Cable Loss - Preamp Factor)

2.Margin value = Emission level – Limit value

Test Channel	Channel 78	Frequency Range	30MHz ~ 1GHz
Detector Function	Peak (PK) Quasi-peak (QP)	Tested By	Jim Xu

Antenna Polarity & Test Distance: Vertical at 3 m



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detecter	Antenna Height (cm)	Table Angle (Degree)	Remark
1	33.9174	37.57	-16.60	20.97	40.00	-19.03	peak	200	178	
2	42.0066	34.09	-16.58	17.51	40.00	-22.49	peak	100	156	
3	96.0986	35.73	-17.77	17.96	43.50	-25.54	peak	100	187	
4	132.6850	34.14	-15.44	18.70	43.50	-24.80	peak	200	325	
5	239.9874	35.48	-15.47	20.01	46.00	-25.99	peak	300	160	
6	435.5898	31.75	-10.71	21.04	46.00	-24.96	peak	200	158	

Remarks:

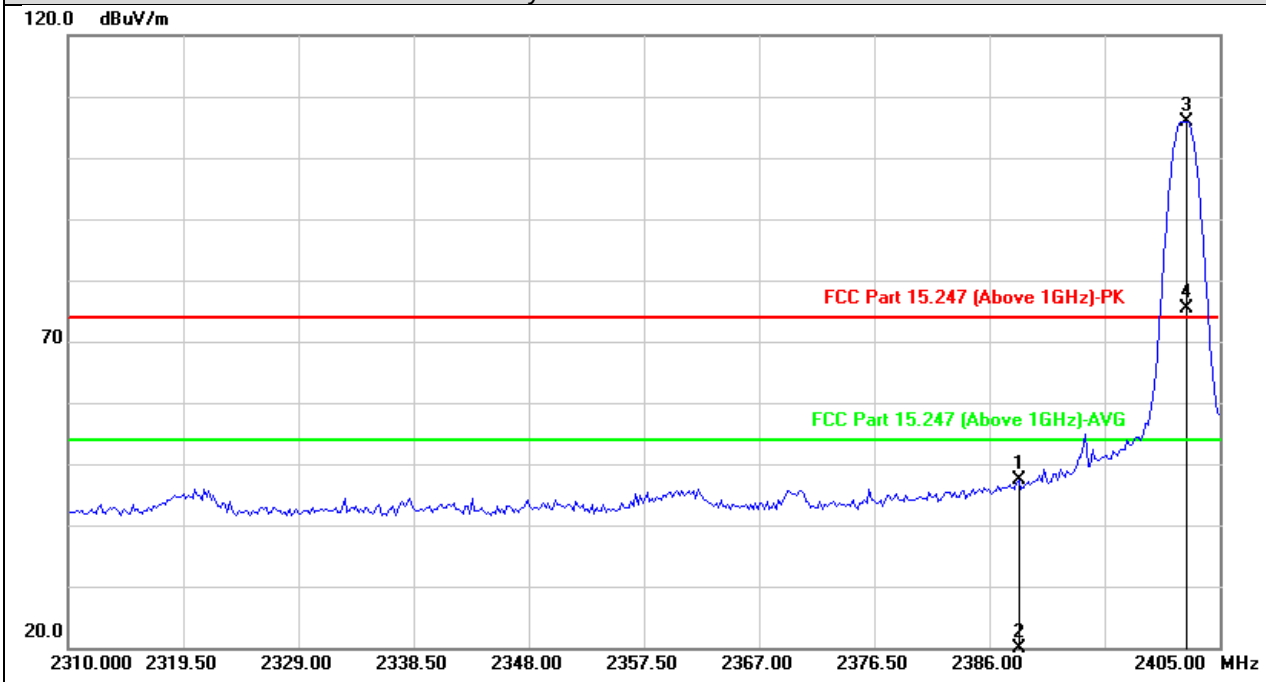
1.Emission Level = Read Level + Factor (Antenna Factor + Cable Loss - Preamp Factor)

2. Margin value = Emission level – Limit value

Above 1GHz Data:

Test Channel	Channel 0	Frequency Range	1GHz ~ 25GHz
Detector Function	Peak (PK) Average (AVG)	Tested By	Jim Xu

Antenna Polarity & Test Distance: Horizontal at 3 m



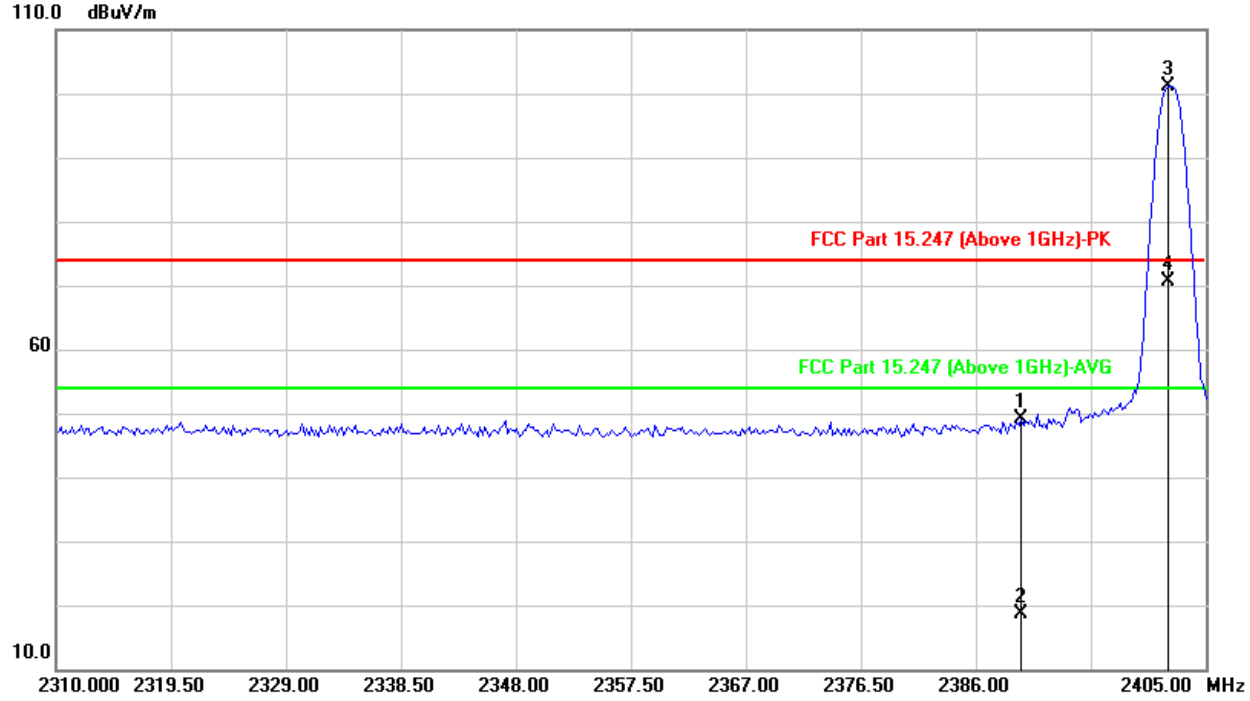
No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detecter	Antenna Height (cm)	Table Angle (Degree)	Remark
1	2388.437	49.04	-1.67	47.37	74.00	-26.63	peak	100	236	
2	2388.437	18.54	-1.67	16.87	54.00	-37.13	AVG	100	236	
3	2402.335	107.52	-1.65	105.87			peak	100	236	
4	2402.335	77.02	-1.65	75.37			AVG	100	236	
5	4804.000	52.46	4.49	56.95	74.00	-17.05	peak	133	288	
6	4804.000	21.96	4.49	26.45	54.00	-27.55	AVG	133	288	
7	7206.000	59.94	8.44	68.38	74.00	-5.62	peak	100	126	
8	7206.000	29.44	8.44	37.88	54.00	-16.12	AVG	100	126	

Remarks:

1. Emission Level = Read Level + Factor (Antenna Factor + Cable Loss - Preamp Factor)
   Margin value = Emission level – Limit value
2. #2402MHz: Fundamental frequency.
3. The amplitude of spurious emissions attenuated more than 20 dB below the permissible value is not required to be report.

Test Channel	Channel 0	Frequency Range	1GHz ~ 25GHz
Detector Function	Peak (PK) Average (AVG)	Tested By	Jim Xu

Antenna Polarity & Test Distance: Vertical at 3 m



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detecter	Antenna Height (cm)	Table Angle (Degree)	Remark
1	2389.769	50.89	-1.65	49.24	74.00	-24.76	peak	365	226	
2	2389.769	20.39	-1.65	18.74	54.00	-35.26	AVG	365	226	
3	2401.954	102.71	-1.66	101.05			peak	365	226	
4	2401.954	72.21	-1.66	70.55			AVG	365	226	
5	4804.000	58.00	4.49	62.49	74.00	-11.51	peak	220	276	
6	4804.000	27.50	4.49	31.99	54.00	-22.01	AVG	220	276	
7	7206.000	61.74	8.44	70.18	74.00	-3.82	peak	100	254	
8	7206.000	31.24	8.44	39.68	54.00	-14.32	AVG	100	254	

Remarks:

1. Emission Level = Read Level + Factor (Antenna Factor + Cable Loss - Preamp Factor)
   Margin value = Emission level – Limit value
2. #2402MHz: Fundamental frequency.
3. The amplitude of spurious emissions attenuated more than 20 dB below the permissible value is not required to be report.

Test Channel	Channel 39	Frequency Range	1GHz ~ 25GHz
Detector Function	Peak (PK) Average (AVG)	Tested By	Jim Xu

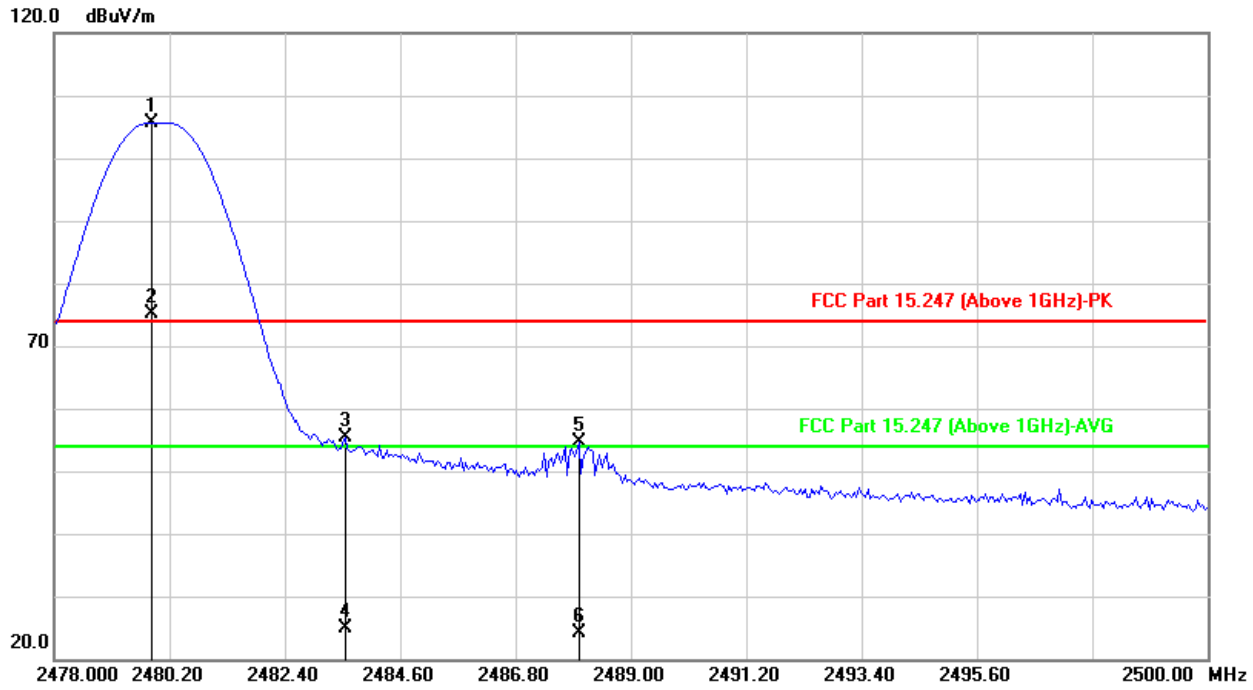
Antenna Polarity & Test Distance: Horizontal at 3 m										
No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detecter	Antenna Height (cm)	Table Angle (Degree)	Remark
1	2441.000	107.81	-1.61	106.20			peak	233	155	
2	2441.000	77.31	-1.61	75.70			AVG	233	155	
3	4882.000	52.36	4.66	57.02	74.00	-16.98	peak	133	201	
4	4882.000	21.86	4.66	26.52	54.00	-27.48	AVG	133	201	
5	7323.000	59.13	8.73	67.86	74.00	-6.14	peak	100	145	
6	7323.000	31.83	8.73	40.56	54.00	-13.44	AVG	100	145	
Antenna Polarity & Test Distance: Vertical at 3 m										
No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detecter	Antenna Height (cm)	Table Angle (Degree)	Remark
1	2441.000	103.81	-1.61	102.20			peak	155	135	
2	2441.000	73.31	-1.61	71.70			AVG	155	135	
3	4882.000	57.17	4.66	61.83	74.00	-12.17	peak	120	236	
4	4882.000	26.67	4.66	31.33	54.00	-22.67	AVG	120	236	
5	7323.000	62.33	8.73	71.06	74.00	-2.94	peak	238	73	
6	7323.000	31.83	8.73	40.56	54.00	-13.44	AVG	238	73	

Remarks:

1. Emission Level = Read Level + Factor (Antenna Factor + Cable Loss - Preamp Factor)
   Margin value = Emission level – Limit value
2. #2441MHz: Fundamental frequency.
3. The amplitude of spurious emissions attenuated more than 20 dB below the permissible value is not required to be report.

Test Channel	Channel 78	Frequency Range	1GHz ~ 25GHz
Detector Function	Peak (PK) Average (AVG)	Tested By	Jim Xu

Antenna Polarity & Test Distance: Horizontal at 3 m



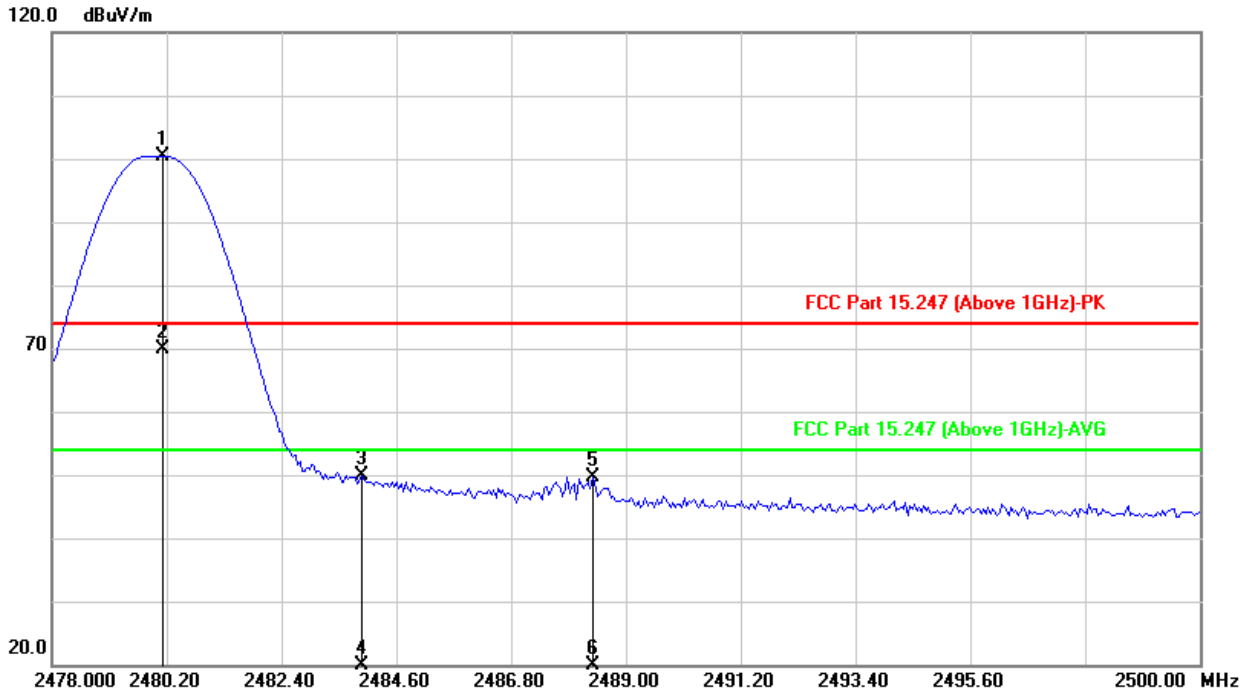
No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detecter	Antenna Height (cm)	Table Angle (Degree)	Remark
1	2479.852	107.18	-1.55	105.63			peak	149	273	
2	2479.852	76.68	-1.55	75.13			AVG	149	273	
3	2483.555	56.86	-1.56	55.30	74.00	-18.70	peak	149	273	
4	2483.555	26.36	-1.56	24.80	54.00	-29.20	AVG	149	273	
5	2488.008	56.18	-1.56	54.62	74.00	-19.38	peak	149	273	
6	2488.008	25.68	-1.56	24.12	54.00	-29.88	AVG	149	273	
7	4960.000	54.44	4.83	59.27	74.00	-14.73	peak	100	66	
8	4960.000	23.94	4.83	28.77	54.00	-25.23	AVG	100	66	
9	7440.000	59.77	9.02	68.79	74.00	-5.21	peak	100	126	
10	7440.000	29.27	9.02	38.29	54.00	-15.71	AVG	100	126	

Remarks:

1. Emission Level = Read Level + Factor (Antenna Factor + Cable Loss - Preamp Factor)
   Margin value = Emission level – Limit value
2. #2480MHz: Fundamental frequency.
3. The amplitude of spurious emissions attenuated more than 20 dB below the permissible value is not required to be report.

Test Channel	Channel 78	Frequency Range	1GHz ~ 25GHz
Detector Function	Peak (PK) Average (AVG)	Tested By	Jim Xu

Antenna Polarity & Test Distance: Vertical at 3 m



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detecter	Antenna Height (cm)	Table Angle (Degree)	Remark
1	2480.116	101.93	-1.55	100.38			peak	341	277	
2	2480.116	71.43	-1.55	69.88			AVG	341	227	
3	2483.952	51.54	-1.56	49.98	74.00	-24.02	peak	341	227	
4	2483.952	21.04	-1.56	19.48	54.00	-34.52	AVG	341	227	
5	2488.361	51.28	-1.56	49.72	74.00	-24.28	peak	341	227	
6	2488.361	20.78	-1.56	19.22	54.00	-34.78	AVG	341	227	
7	4960.000	58.37	4.83	63.20	74.00	-10.80	peak	188	156	
8	4960.000	27.87	4.83	32.70	54.00	-21.30	AVG	188	156	
9	7440.000	61.90	9.02	70.92	74.00	-3.08	peak	100	78	
10	7440.000	31.40	9.02	40.42	54.00	-13.58	AVG	100	78	

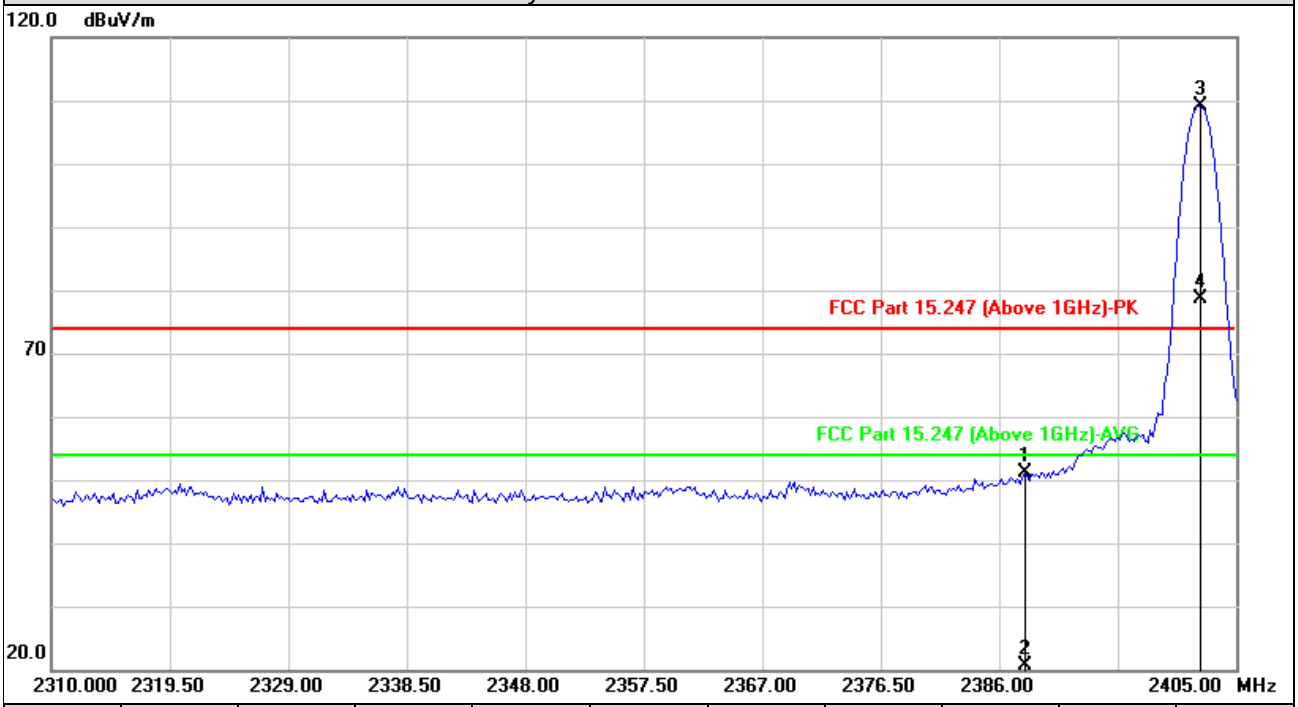
Remarks:

1. Emission Level = Read Level + Factor (Antenna Factor + Cable Loss - Preamp Factor)
   Margin value = Emission level – Limit value
2. #2480MHz: Fundamental frequency.
3. The amplitude of spurious emissions attenuated more than 20 dB below the permissible value is not required to be report.

8DPSK

Test Channel	Channel 0	Frequency Range	1GHz ~ 25GHz
Detector Function	Peak (PK) Average (AVG)	Tested By	Jim Xu

Antenna Polarity & Test Distance: Horizontal at 3 m



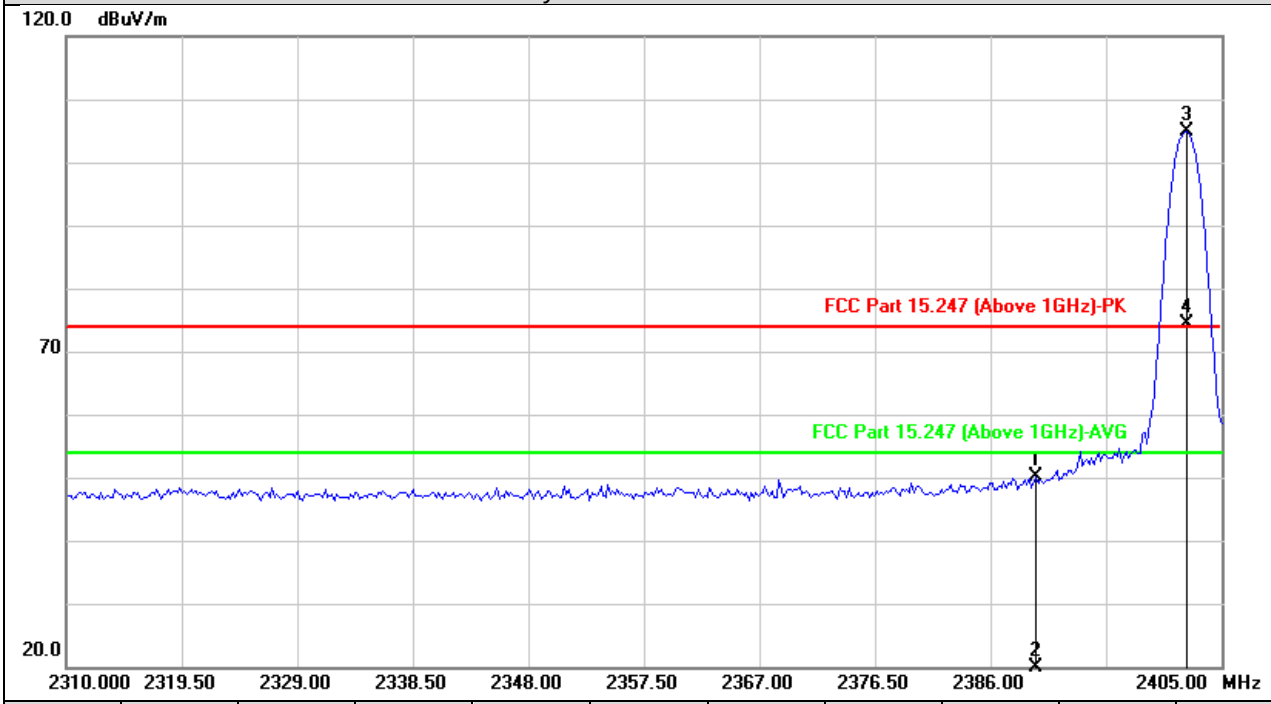
No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detecter	Antenna Height (cm)	Table Angle (Degree)	Remark
1	2388.056	52.76	-1.67	51.09	74.00	-22.91	peak	100	239	
2	2388.056	22.26	-1.67	20.59	54.00	-33.41	AVG	100	239	
3	2402.144	110.71	-1.66	109.05			peak	100	239	
4	2402.144	80.21	-1.66	78.55			AVG	100	239	
5	4804.000	52.58	4.49	57.07	74.00	-16.93	peak	152	138	
6	4804.000	22.08	4.49	26.57	54.00	-27.43	AVG	152	138	
7	7206.000	59.70	8.44	68.14	74.00	-5.86	peak	165	35	
8	7206.000	29.20	8.44	37.64	54.00	-16.36	AVG	165	35	

Remarks:

1. Emission Level = Read Level + Factor (Antenna Factor + Cable Loss - Preamp Factor)
   Margin value = Emission level – Limit value
2. #2402MHz: Fundamental frequency.
3. The amplitude of spurious emissions attenuated more than 20 dB below the permissible value is not required to be report.

Test Channel	Channel 0	Frequency Range	1GHz ~ 25GHz
Detector Function	Peak (PK) Average (AVG)	Tested By	Jim Xu

Antenna Polarity & Test Distance: Vertical at 3 m



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detecter	Antenna Height (cm)	Table Angle (Degree)	Remark
1	2389.769	51.90	-1.65	50.25	74.00	-23.75	peak	332	225	
2	2389.769	21.40	-1.65	19.75	54.00	-34.25	AVG	332	225	
3	2402.144	106.44	-1.66	104.78			peak	332	225	
4	2402.144	75.94	-1.66	74.28			AVG	332	225	
5	4804.000	57.86	4.49	62.35	74.00	-11.65	peak	250	276	
6	4804.000	27.36	4.49	31.85	54.00	-22.15	AVG	250	276	
7	7206.000	62.01	8.44	70.45	74.00	-3.55	peak	100	254	
8	7206.000	31.51	8.44	39.95	54.00	-14.05	AVG	100	254	

Remarks:

1. Emission Level = Read Level + Factor (Antenna Factor + Cable Loss - Preamp Factor)
   Margin value = Emission level – Limit value
2. #2402MHz: Fundamental frequency.
3. The amplitude of spurious emissions attenuated more than 20 dB below the permissible value is not required to be report.

Test Channel	Channel 39	Frequency Range	1GHz ~ 25GHz
Detector Function	Peak (PK) Average (AVG)	Tested By	Jim Xu

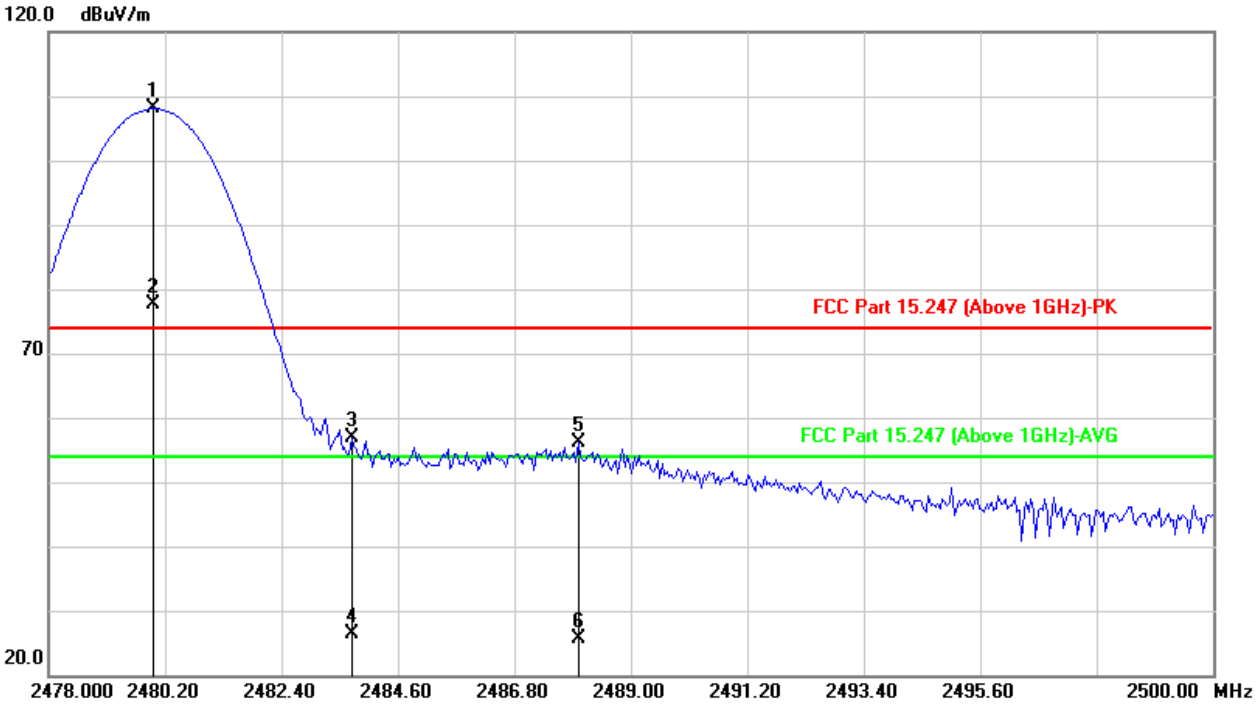
Antenna Polarity & Test Distance: Horizontal at 3 m										
No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detecter	Antenna Height (cm)	Table Angle (Degree)	Remark
1	2441.000	111.11	-1.61	109.50			peak	120	322	
2	2441.000	80.61	-1.61	79.00			AVG	120	322	
3	4882.000	51.88	4.66	56.54	74.00	-17.46	peak	210	165	
4	4882.000	21.38	4.66	26.04	54.00	-27.96	AVG	210	165	
5	7323.000	59.74	8.73	68.47	74.00	-5.53	peak	101	34	
6	7323.000	29.24	8.73	37.97	54.00	-16.03	AVG	101	34	
Antenna Polarity & Test Distance: Vertical at 3 m										
No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detecter	Antenna Height (cm)	Table Angle (Degree)	Remark
1	2441.000	110.51	-1.61	108.90			peak	135	266	
2	2441.000	80.01	-1.61	78.40			AVG	135	266	
3	4882.000	57.55	4.66	62.21	74.00	-11.79	peak	142	272	
4	4882.000	27.05	4.66	31.71	54.00	-22.29	AVG	142	272	
5	7323.000	60.34	8.73	69.07	74.00	-4.93	peak	130	163	
6	7323.000	29.84	8.73	38.57	54.00	-15.43	AVG	130	163	

Remarks:

1. Emission Level = Read Level + Factor (Antenna Factor + Cable Loss - Preamp Factor)
   Margin value = Emission level – Limit value
2. #2441MHz: Fundamental frequency.
3. The amplitude of spurious emissions attenuated more than 20 dB below the permissible value is not required to be report.

Test Channel	Channel 78	Frequency Range	1GHz ~ 25GHz
Detector Function	Peak (PK) Average (AVG)	Tested By	Jim Xu

Antenna Polarity & Test Distance: Horizontal at 3 m



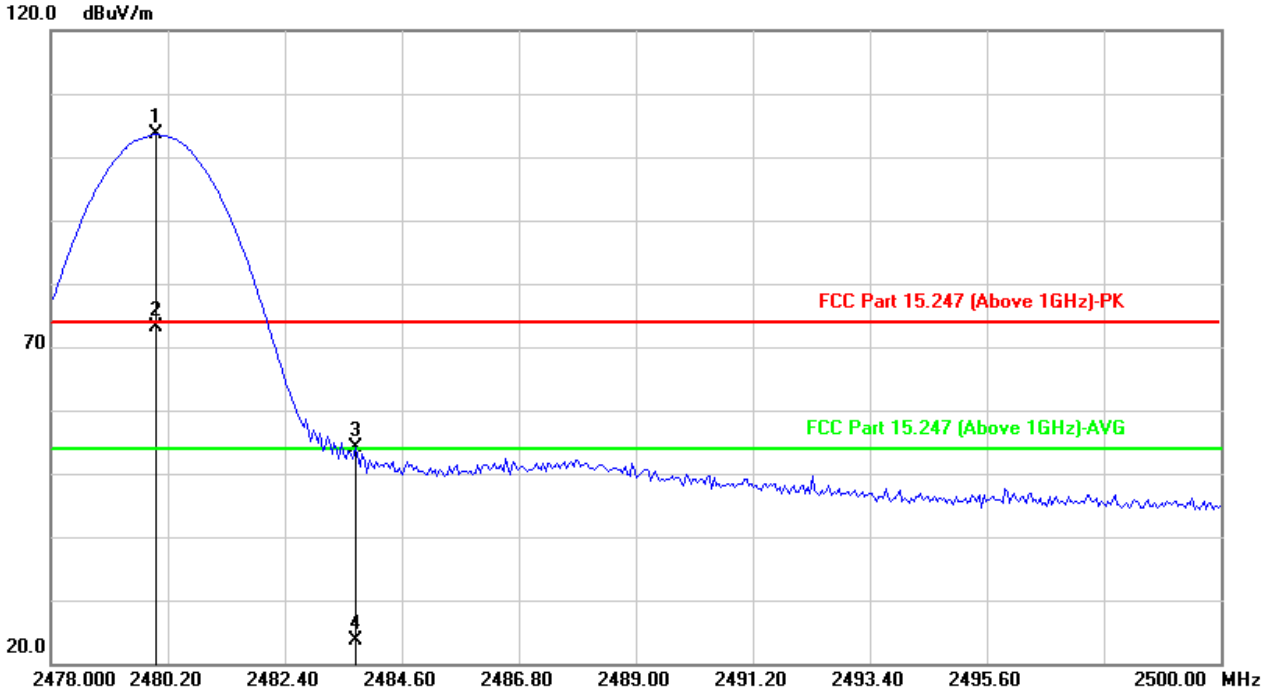
No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detecter	Antenna Height (cm)	Table Angle (Degree)	Remark
1	2479.984	109.63	-1.55	108.08			peak	133	268	
2	2479.984	79.13	-1.55	77.58			AVG	133	268	
3	2483.731	58.56	-1.56	57.00	74.00	-17.00	peak	133	268	
4	2483.731	28.06	-1.56	26.50	54.00	-27.50	AVG	133	268	
5	2488.008	57.59	-1.56	56.03	74.00	-17.97	peak	133	268	
6	2488.008	27.09	-1.56	25.53	54.00	-28.47	AVG	133	268	
7	4960.000	54.88	4.83	59.71	74.00	-14.29	peak	198	236	
8	4960.000	24.38	4.83	29.21	54.00	-24.79	AVG	198	236	
9	7440.000	59.90	9.02	68.92	74.00	-5.08	peak	233	278	
10	7440.000	29.40	9.02	38.42	54.00	-15.58	AVG	233	278	

Remarks:

1. Emission Level = Read Level + Factor (Antenna Factor + Cable Loss - Preamp Factor)
   Margin value = Emission level – Limit value
2. #2480MHz: Fundamental frequency.
3. The amplitude of spurious emissions attenuated more than 20 dB below the permissible value is not required to be report.

Test Channel	Channel 78	Frequency Range	1GHz ~ 25GHz
Detector Function	Peak (PK) Average (AVG)	Tested By	Jim Xu

Antenna Polarity & Test Distance: Vertical at 3 m



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detecter	Antenna Height (cm)	Table Angle (Degree)	Remark
1	2479.984	105.07	-1.55	103.52			peak	339	299	
2	2479.984	74.57	-1.55	73.02			AVG	339	299	
3	2483.731	55.73	-1.56	54.17	74.00	-19.83	peak	339	299	
4	2483.731	25.23	-1.56	23.67	54.00	-30.33	AVG	339	299	
5	4960.000	58.50	4.83	63.33	74.00	-10.67	peak	155	36	
6	4960.000	28.00	4.83	32.83	54.00	-21.17	AVG	155	36	
7	7440.000	62.24	9.02	71.26	74.00	-2.74	peak	100	165	
8	7440.000	31.74	9.02	40.76	54.00	-13.24	AVG	100	165	

Remarks:

1. Emission Level = Read Level + Factor (Antenna Factor + Cable Loss - Preamp Factor)
   Margin value = Emission level – Limit value
2. #2480MHz: Fundamental frequency.
3. The amplitude of spurious emissions attenuated more than 20 dB below the permissible value is not required to be report.

3.2 Conducted Emission Measurement

3.2.1 Limits of Conducted Emission Measurement

Frequency (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average
0.15 - 0.5	66 - 56	56 - 46
0.50 - 5.0	56	46
5.0 - 30.0	60	50

Note: 1. The lower limit shall apply at the transition frequencies.
2. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50MHz.

3.2.2 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Due Date of Calibration
EMI Test Receiver Rohde&Schwarz	ESCI3	101418	2021/09/05
Artificial Mains Network Rohde&Schwarz	ENV216	3560.6550.15	2021/09/16
Test software FARAD	EZ_EMC V1.1.4.2	N/A	N/A
Hygrothermograph Yuhuaze	HTC-1	NA	2021/09/16
Digital Multimeter FLUKE	15B+	43512617WS	2021/09/16

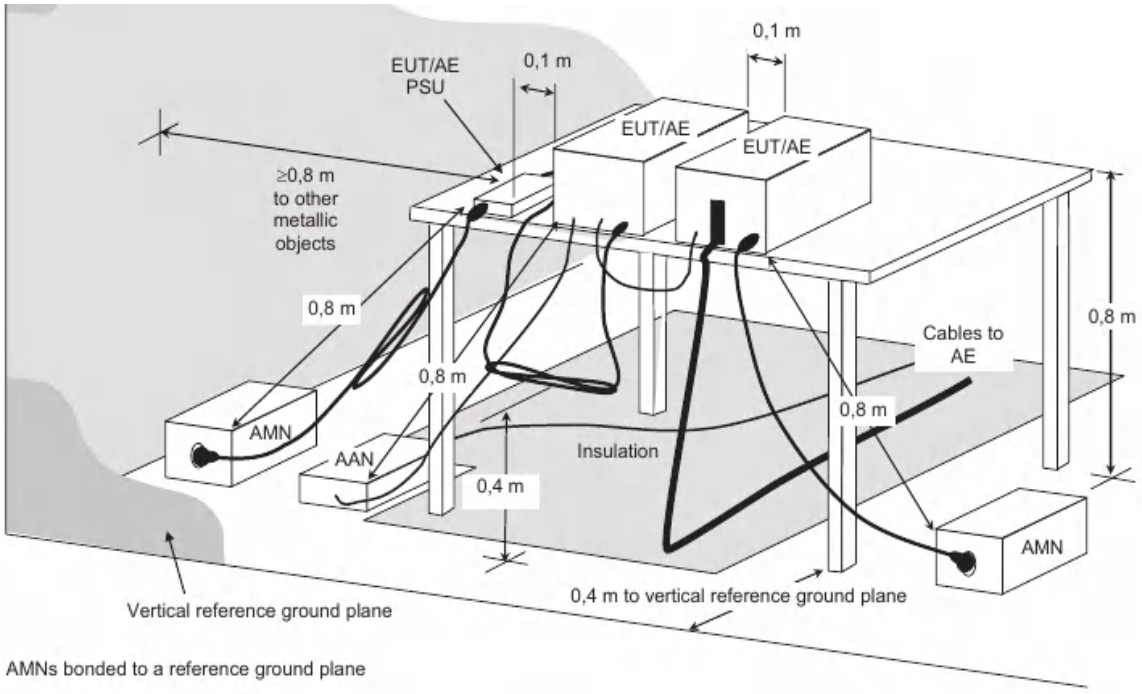
Note: 1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to CEPREI/CHINA.
2. The test was performed in Shielded Room 1.

3.2.3 Test Procedures

a. The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/ 50uH of coupling impedance for the measuring instrument.
b. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.
c. The frequency range from 150kHz to 30MHz was searched. Emission levels under (Limit – 20dB)was not recorded.

Note: All modes of operation were investigated and the worst-case emissions are reported.

3.2.4 Test Setup



For the actual test configuration, please refer to the attached file (Test Setup Photo).

3.2.5 EUT Operating Condition

Set the EUT under transmission condition continuously at specific channel frequency.

3.2.6 Deviation from Test Standard

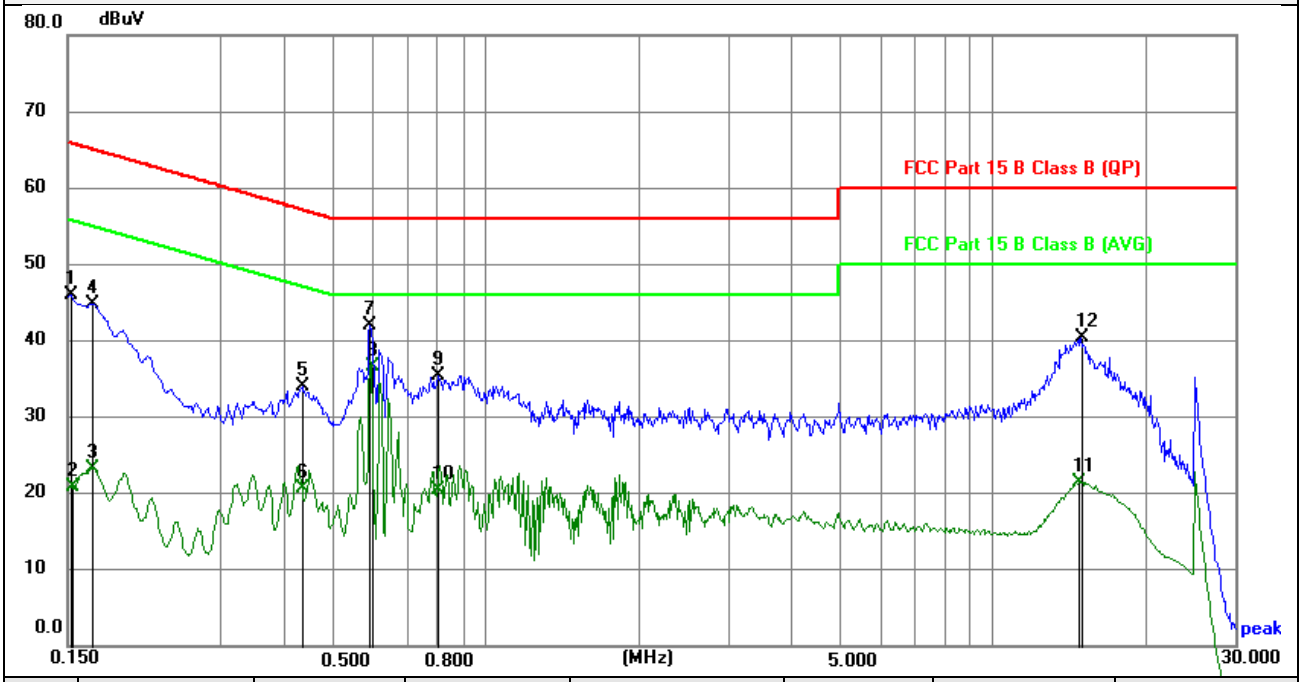
No deviation.

3.2.7 Test Results

Conducted Worst-Case Data:

Frequency Range	150kHz ~ 30MHz	Detector Function & Resolution andwidth	Quasi-Peak (QP) / Average (AV), 9kHz
Power supply	DC5V from USB Adapter input AC120V/60Hz	Tested by	Jim Xu

Phase Of Power: Line (L)



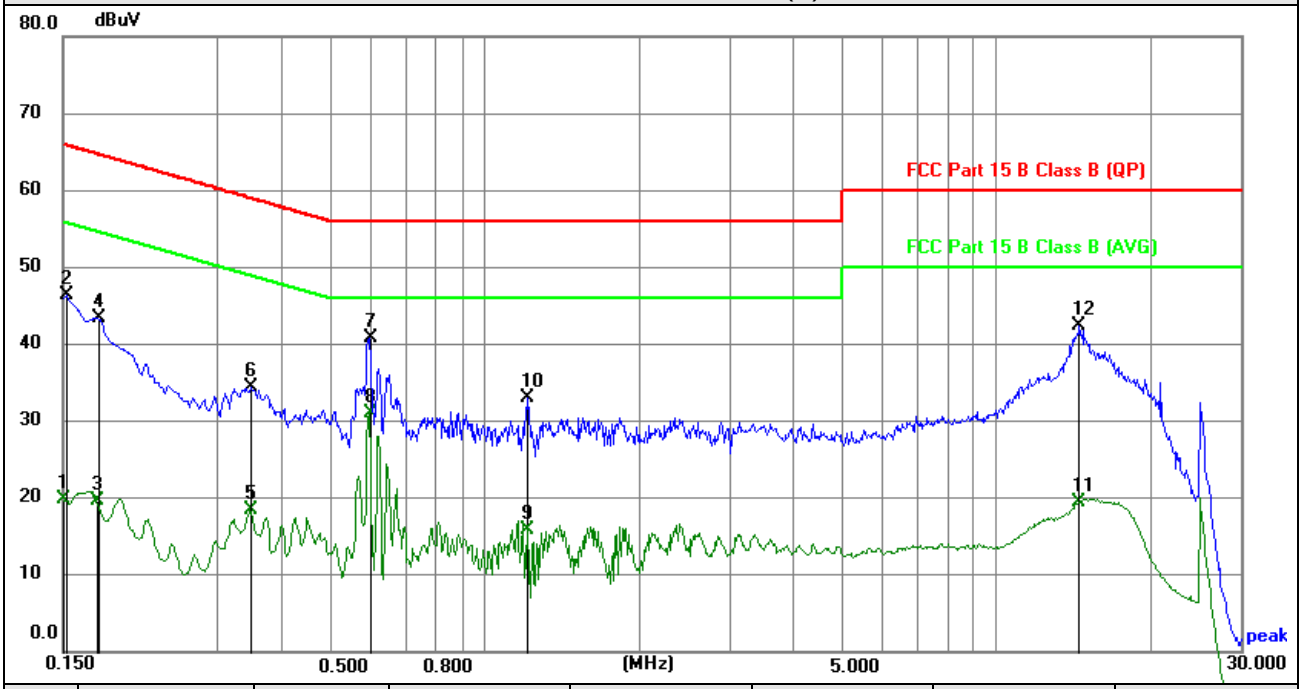
No.	Frequency	Reading	Correcttion Factor	Emission Level	Limit	Margin	Remark
	(MHz)	(dBuV)	dB	(dBuV)	(dBuV)	(dB)	Detecter
1	0.1522	36.22	9.82	46.04	65.88	-19.84	peak
2	0.1532	10.95	9.82	20.77	55.82	-35.05	AVG
3	0.1677	13.51	9.81	23.32	55.07	-31.75	AVG
4	0.1680	35.01	9.81	44.82	65.06	-20.24	peak
5	0.4357	24.13	9.82	33.95	57.14	-23.19	peak
6	0.4357	10.91	9.82	20.73	47.14	-26.41	AVG
7	0.5932	32.20	9.86	42.06	56.00	-13.94	peak
8	0.5955	26.79	9.86	36.65	46.00	-9.35	AVG
9	0.8070	25.59	9.88	35.47	56.00	-20.53	peak
10	0.8070	10.64	9.88	20.52	46.00	-25.48	AVG
11	14.7705	11.21	10.29	21.50	50.00	-28.50	AVG
12	14.9258	30.13	10.29	40.42	60.00	-19.58	peak

Remarks:

1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level - Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value.

Frequency Range	150kHz ~ 30MHz	Detector Function & Resolution andwidth	Quasi-Peak (QP) / Average (AV), 9kHz
Power supply	DC5V from USB Adapter input AC120V/60Hz	Tested by	Jim Xu

Phase Of Power: Neutral (N)



No.	Frequency	Reading	Correct Factor	Emission Level	Limit	Margin	Remark
	(MHz)	(dBuV)	dB	(dBuV)	(dBuV)	(dB)	Detecter
1	0.1500	9.99	9.78	19.77	56.00	-36.23	AVG
2	0.1522	36.55	9.78	46.33	65.88	-19.55	peak
3	0.1740	9.81	9.77	19.58	54.77	-35.19	AVG
4	0.1748	33.66	9.77	43.43	64.73	-21.30	peak
5	0.3480	8.65	9.74	18.39	49.01	-30.62	AVG
6	0.3502	24.64	9.74	34.38	58.96	-24.58	peak
7	0.5955	31.08	9.78	40.86	56.00	-15.14	peak
8	0.5955	21.28	9.78	31.06	46.00	-14.94	AVG
9	1.2142	6.21	9.73	15.94	46.00	-30.06	AVG
10	1.2164	23.29	9.73	33.02	56.00	-22.98	peak
11	14.5140	9.33	10.15	19.48	50.00	-30.52	AVG
12	14.5185	32.15	10.15	42.30	60.00	-17.70	peak

Remarks:

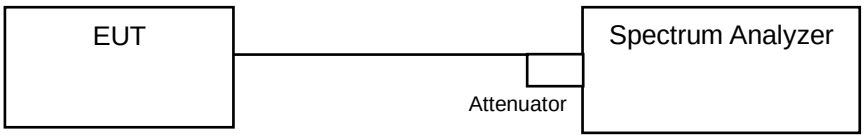
1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level - Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value.

3.3 Numberof Hopping Frequency Used

3.3.1 Limits of Hopping Frequency Used Measurement

At least 15 channels frequencies, and should be equally spaced.

3.3.2 Test Setup



3.3.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

3.3.4 Test Procedure

a. Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.
b. Turn on the EUT and connect its antenna terminal to measurement via a low loss cable. Then set it to any one measured frequency within its operating range and make sure the instrument is operated in its linear range.
c. Set the SA on MaxHold Mode, and then keep the EUT in hopping mode. Record all the signals from each channel until each one has been recorded.
d. Set the SA on View mode and then plot the result on SA screen.
e. Repeat above procedures until all frequencies measured were complete.

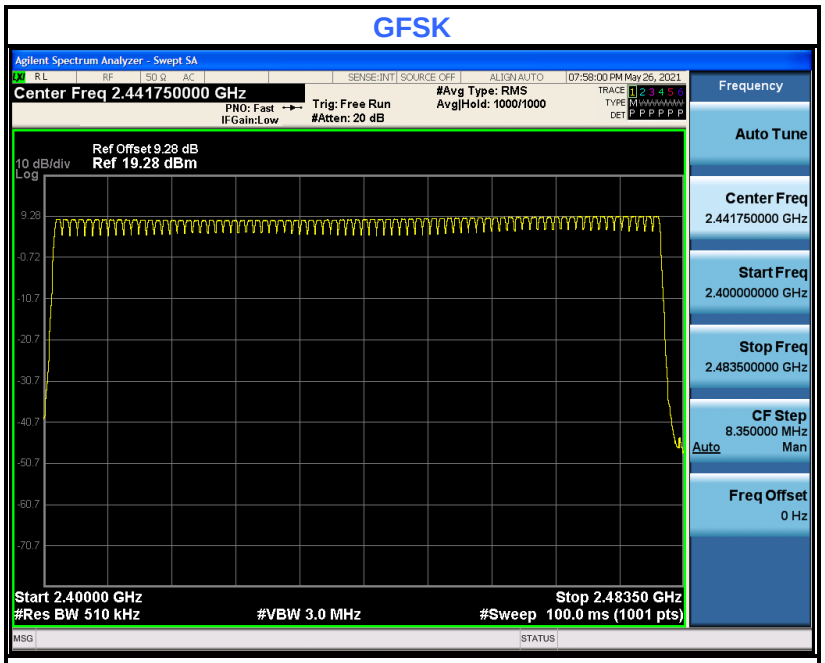
3.3.5 Deviation fromTest Standard

No deviation.

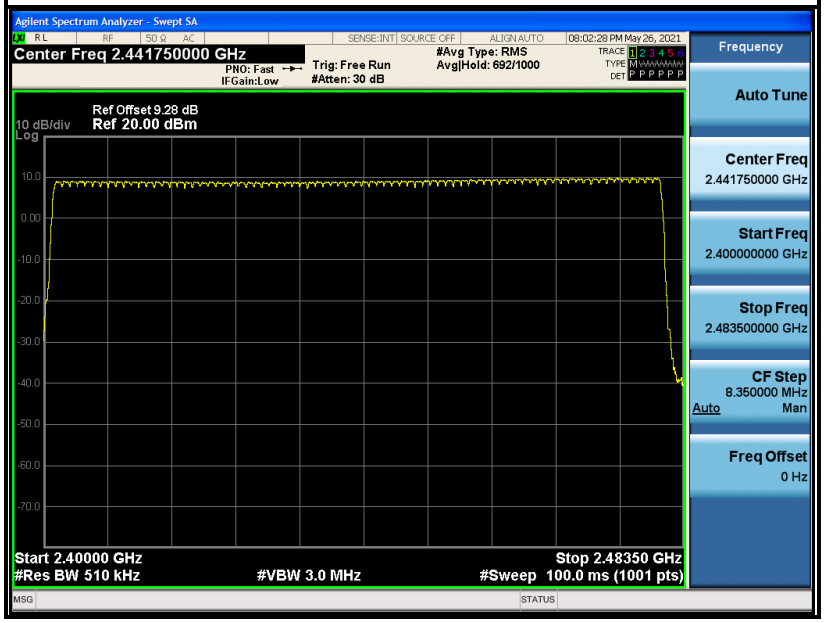
3.3.6 Test Results

There are 79 hopping frequencies in the hopping mode. Please refer to next page for the test result. On the plots, it shows that the hopping frequencies are equally spaced.

GFSK



8DPSK

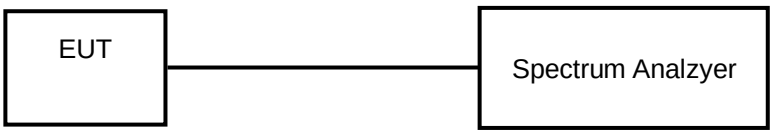


3.4 Dwell Time on Each Channel

3.4.1 Limits of Dwell Time on Each Channel Measurement

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

3.4.2 Test Setup



3.4.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

3.4.4 Test Procedures

a. Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.
b. Turn on the EUT and connect its antenna terminal to measurement via a low loss cable. Then set it to any one measured frequency within its operating range and make sure the instrument is operated in its linear range.
c. Adjust the center frequency of SA on any frequency be measured and set SA to zero span mode. And then, set RBW and VBW of spectrum analyzer to proper value.
d. Measure the time duration of one transmission on the measured frequency. And then plot the result with time difference of this time duration.
e. Repeat above procedures until all different time-slot modes have been completed.

3.4.5 Deviation from Test Standard

No deviation.

3.4.6 Test Results

GFSK

Mode	Number of Hopping Channel	Number of transmision in a period (channel number*0.4 sec)				Length of transmission time (msec)	Result (msec)	Limit (msec)	Pass / Fail
		Period (sec)	Sweep time (sec)	times in a sweep	times in a period				
DH1	79	31.6	3.16	32	320	0.3851	123.23	400	PASS
DH3	79	31.6	3.16	16	160	1.64	262.4	400	PASS
DH5	79	31.6	3.16	11	110	2.889	317.79	400	PASS

Note: Test plots of the transmitting time slot are shown as below.

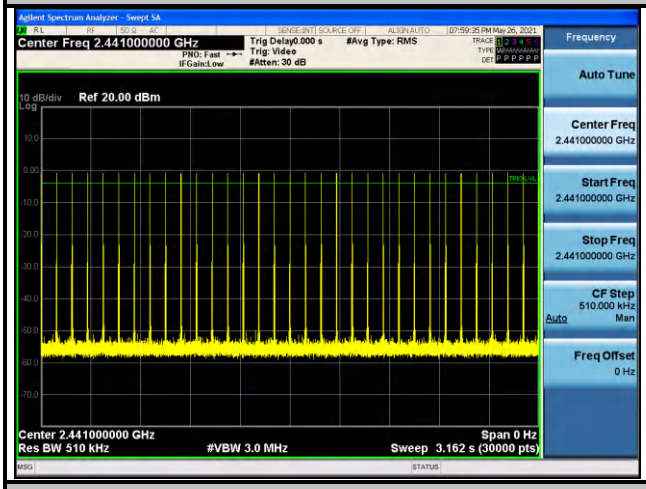
8DPSK

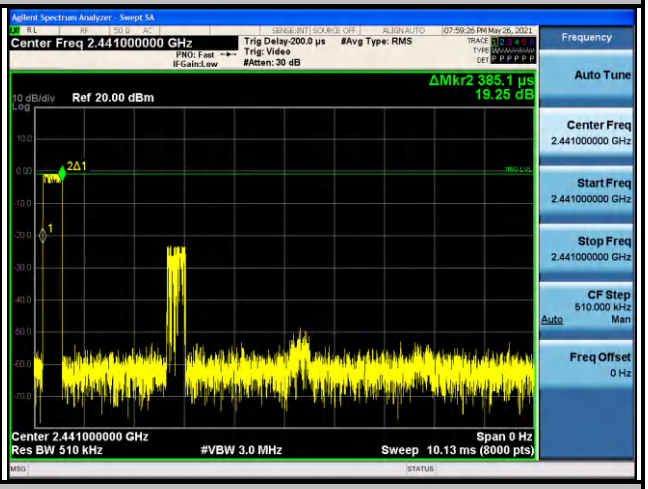
Mode	Number of Hopping Channel	Number of transmision in a period (channel number*0.4 sec)				Length of transmission time (msec)	Result (msec)	Limit (msec)	Pass / Fail
		Period (sec)	Sweep time (sec)	times in a sweep	times in a period				
3DH1	79	31.6	3.16	32	320	0.3813	122.02	400	PASS
3DH3	79	31.6	3.16	16	160	1.638	262.08	400	PASS
3DH5	79	31.6	3.16	11	110	2.888	317.68	400	PASS

Note: Test plots of the transmitting time slot are shown as below.

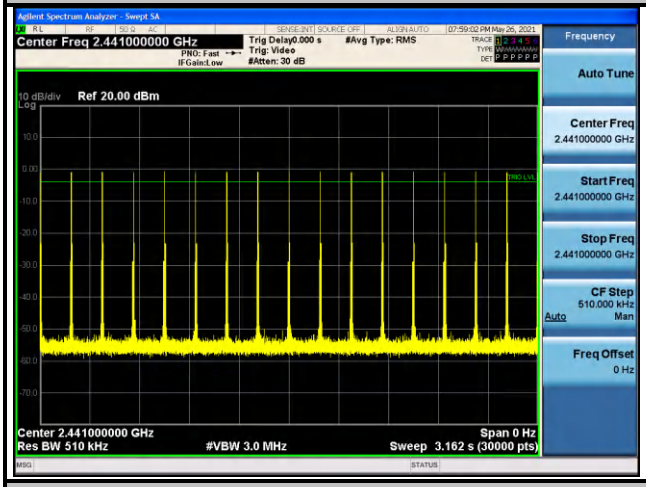
GFSK

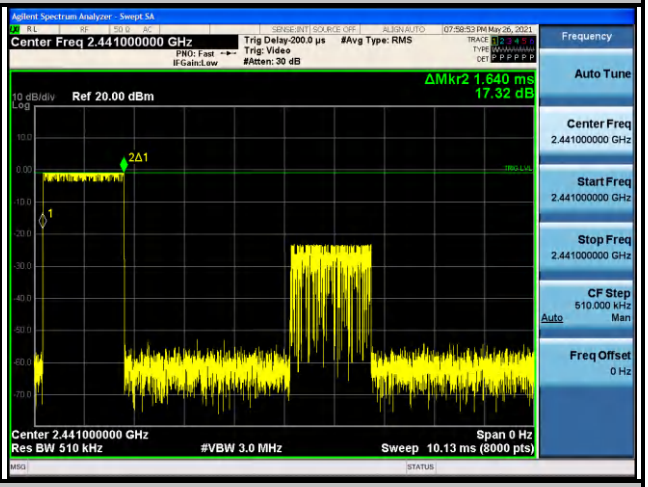
DH1



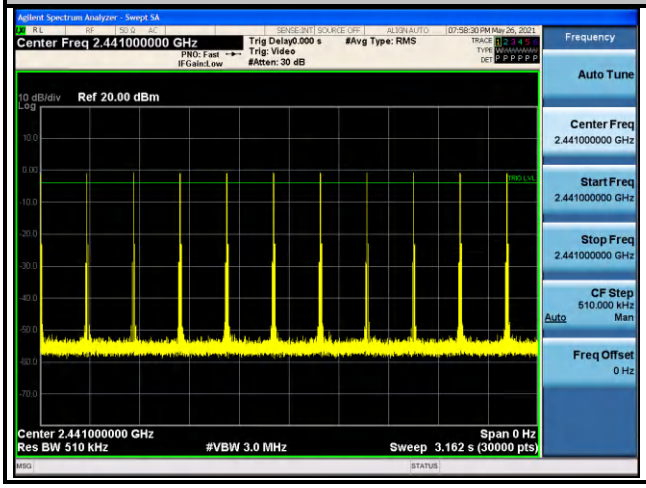


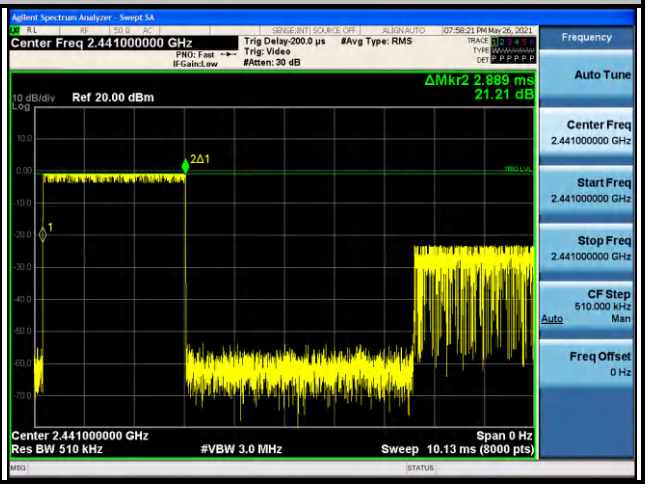
DH3





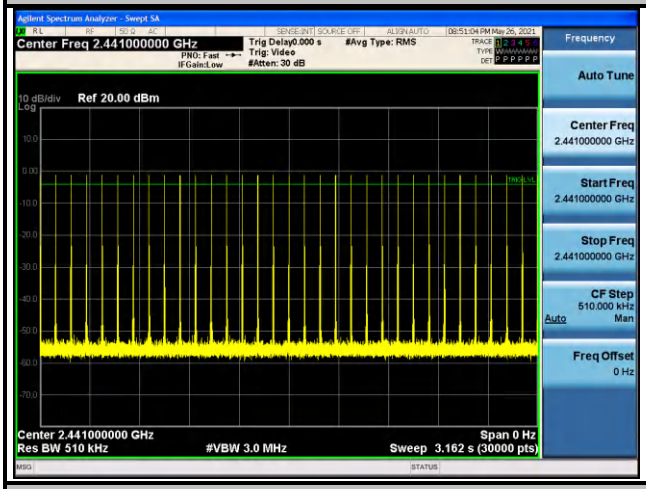
DH5

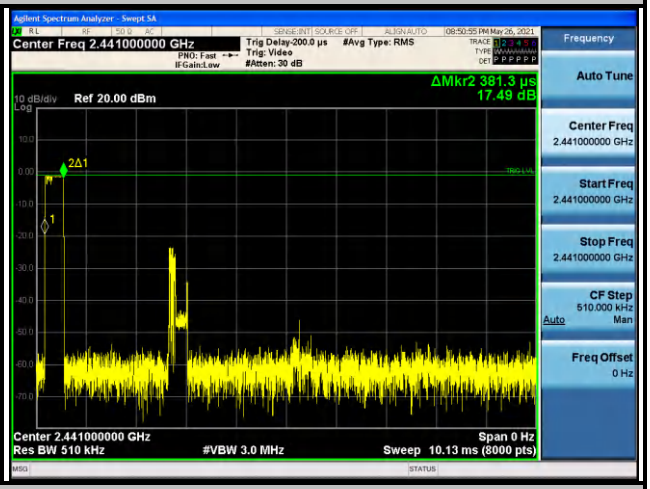




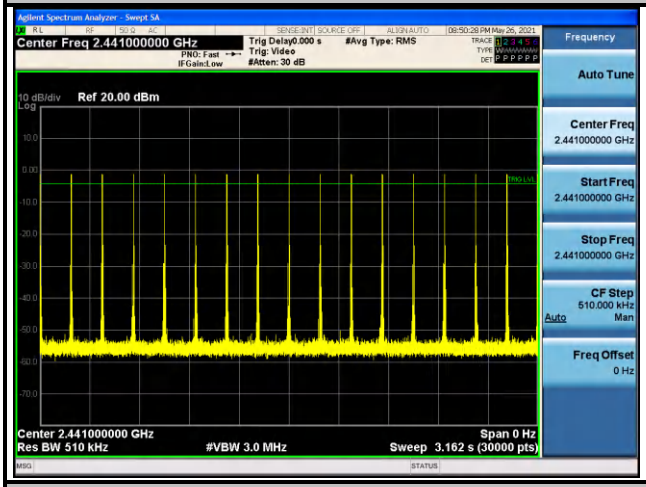
8DPSK

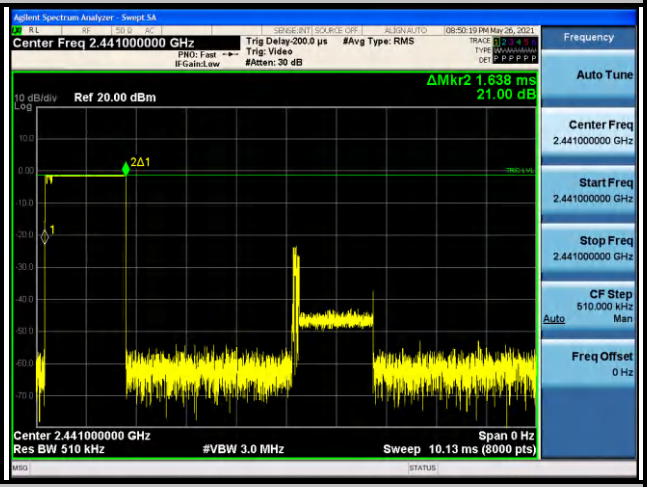
3DH1



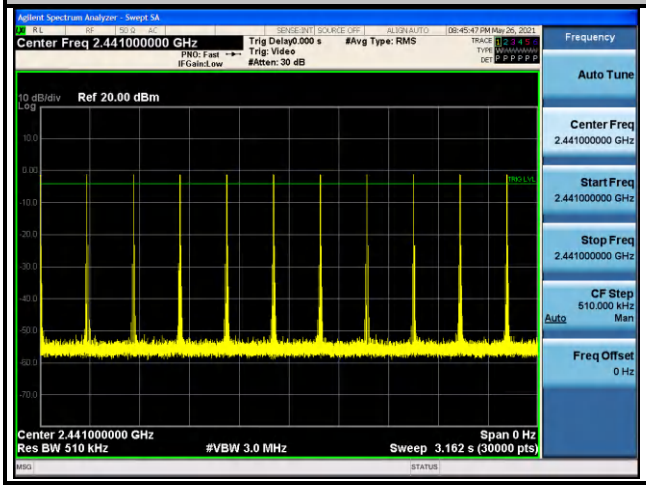


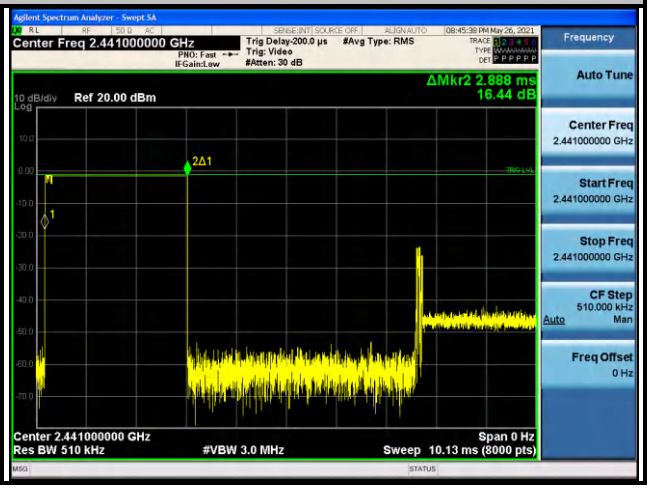
3DH3





3DH5





3.5 Channel Bandwidth

3.5.1 Limits of Channel Bandwidth Measurement

For frequency hopping system operating in the 2400-2483.5 MHz, if the 20 dB bandwidth of hopping channel is greater than 25 kHz, two-thirds 20 dB bandwidth of hopping channel shell be a minimum limit for the hopping channel separation.

3.5.2 Test Setup

3.5.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

3.5.4 Test Procedure

a. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
b. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
c. Measure the frequency difference of two frequencies that were attenuated 20 dB from the reference level. Record the frequency difference as the emission bandwidth.
d. Repeat above procedures until all frequencies measured were complete.

3.5.5 Deviation from Test Standard

No deviation.

3.5.6 EUT Operating Condition

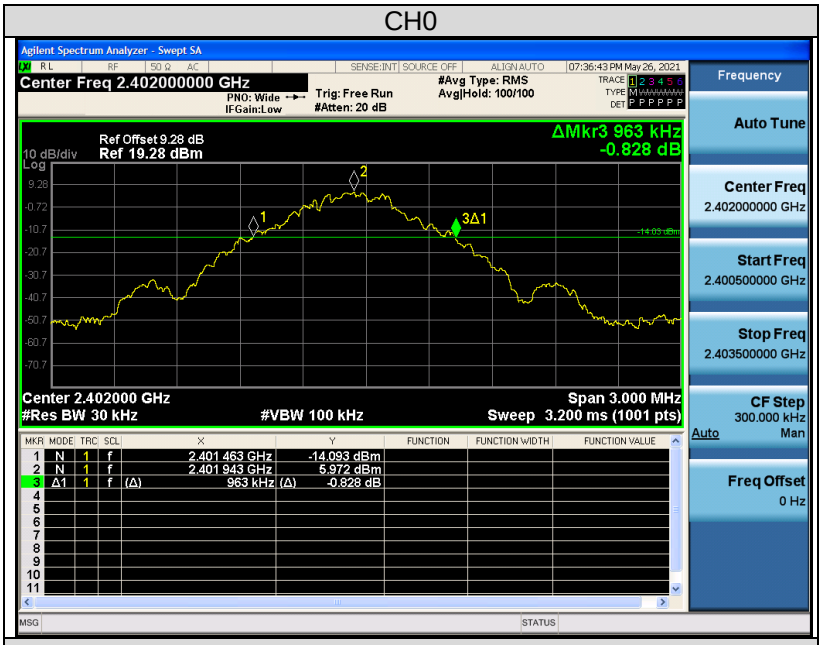
The software provided by client enabled the EUT to transmit and receive data at lowest, middle and highest channel frequencies individually.

3.5.7 Test Results

Channel	Frequency (MHz)	20dB Bandwidth (MHz)	
		GFSK	8DPSK
0	2402	0.963	1.314
39	2441	0.966	1.311
78	2480	0.963	1.308

GFSK

CH0

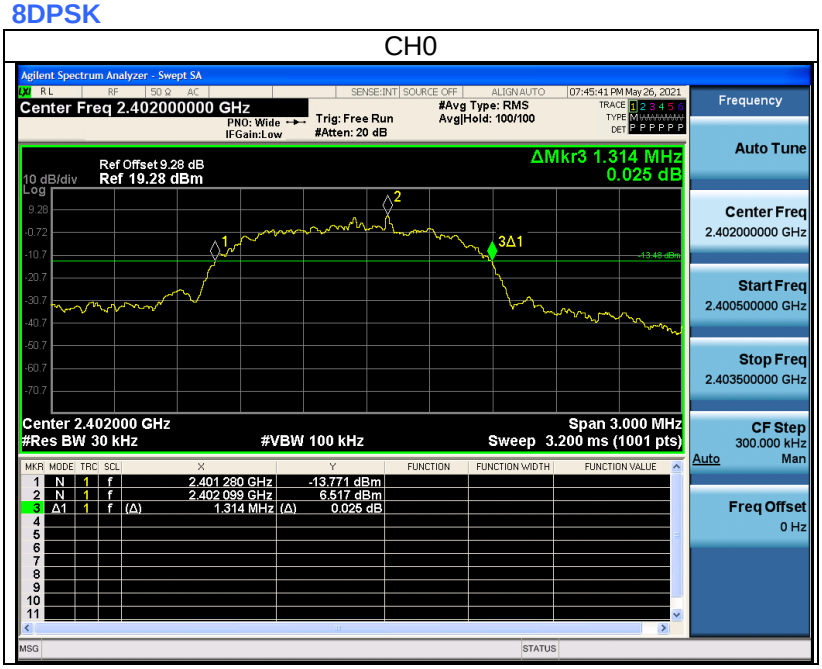


CH39

CH78

8DPSK

CH0



CH39

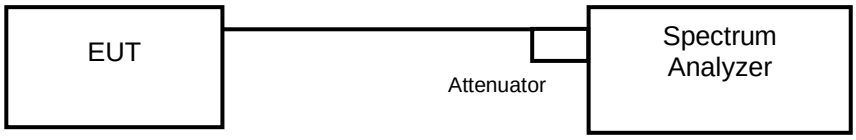
Agilent Spectrum Analyzer - Swept SA
Center Freq 2.441000000 GHz
PNO: Wide
IFGain:Low
Trig: Free Run
#Atten: 20 dB
#Avg Type: RMS
Avg|Hold: 100/100
07:52:06 PM May 26, 2021
Frequency
Auto Tune
Ref Offset 9.19 dB
10 dB/div
Ref 19.19 dBm
ΔMkr3 1.311 MHz
0.956 dB
Center Freq
2.441000000 GHz
Start Freq
2.439500000 GHz
Stop Freq
2.442500000 GHz
CF Step
300.000 kHz
Auto
Man
Freq Offset
0 Hz
Center 2.441000 GHz
#Res BW 30 kHz
#VBW 100 kHz
Span 3.000 MHz
Sweep 3.200 ms (1001 pts)
1 N 1 f 2.440 283 GHz -15.423 dBm
2 N 1 f 2.441 102 GHz 5.889 dBm
3 Δ1 1 f (Δ) 1.311 MHz (Δ) 0.956 dB
MSG
STATUS

CH78

Agilent Spectrum Analyzer - Swept SA
Center Freq 2.480000000 GHz
PNO: Wide
IFGain:Low
Trig: Free Run
#Atten: 20 dB
#Avg Type: RMS
Avg|Hold: 100/100
07:53:51 PM May 26, 2021
Frequency
Auto Tune
Ref Offset 9.19 dB
10 dB/div
Ref 19.19 dBm
ΔMkr3 1.308 MHz
0.496 dB
Center Freq
2.480000000 GHz
Start Freq
2.478500000 GHz
Stop Freq
2.481500000 GHz
CF Step
300.000 kHz
Auto
Man
Freq Offset
0 Hz
Center 2.480000 GHz
#Res BW 30 kHz
#VBW 100 kHz
Span 3.000 MHz
Sweep 3.200 ms (1001 pts)
1 N 1 f 2.479 277 GHz -13.178 dBm
2 N 1 f 2.480 093 GHz 7.340 dBm
3 Δ1 1 f (Δ) 1.308 MHz (Δ) 0.496 dB
MSG
STATUS

3.6 Occupied Bandwidth Measurement

3.6.1 Test Setup



3.6.2 Test Instruments

Refer to section 4.1.2 to get information of above instrument

3.6.3 Test Procedure

The transmitter output was connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured by spectrum analyzer with resolution bandwidth in the range of 1% to 5% of the anticipated emission bandwidth, and a video bandwidth at least 3x the resolution bandwidth and set the detector to PEAK. The width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to a specified percentage 0.5%of the total mean power of a given emission.

3.6.4 Deviation from Test Standard

No deviation.

3.6.5 EUT Operating Conditions

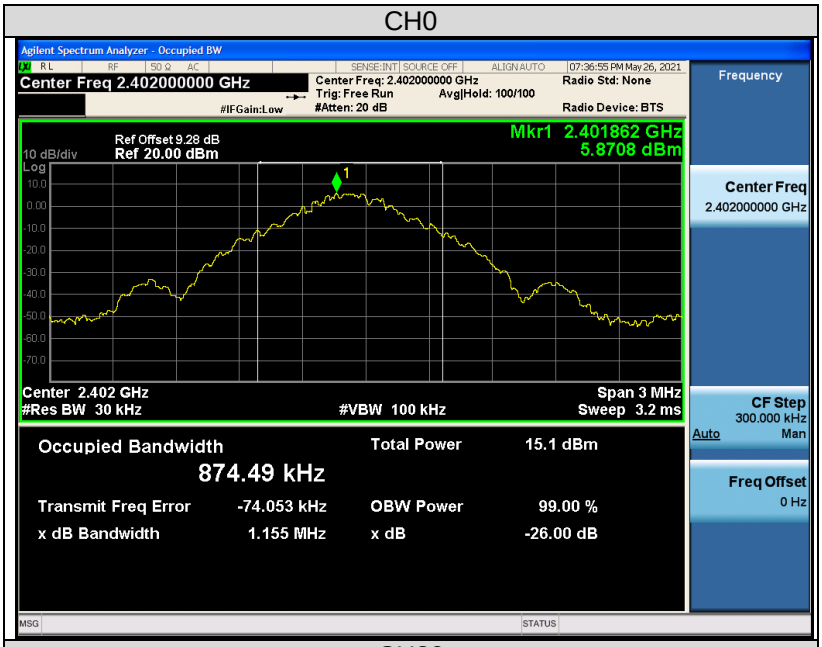
The software provided by client to enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies individually.

3.6.6 Test Results

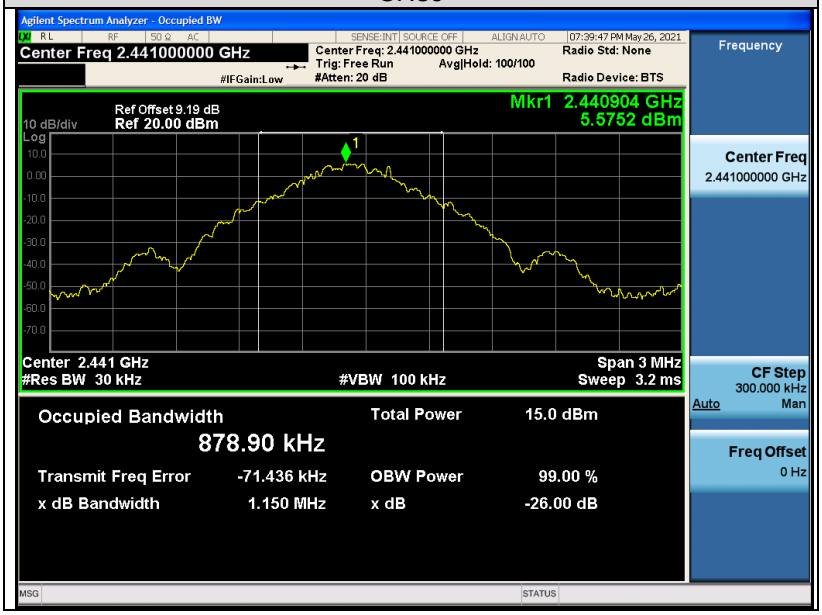
Channel	Frequency (MHz)	OccupiedBandwidth (MHz)	
		GFSK	8DPSK
0	2402	0.8745	1.1859
39	2441	0.8789	1.1995
78	2480	0.8664	1.1985

GFSK

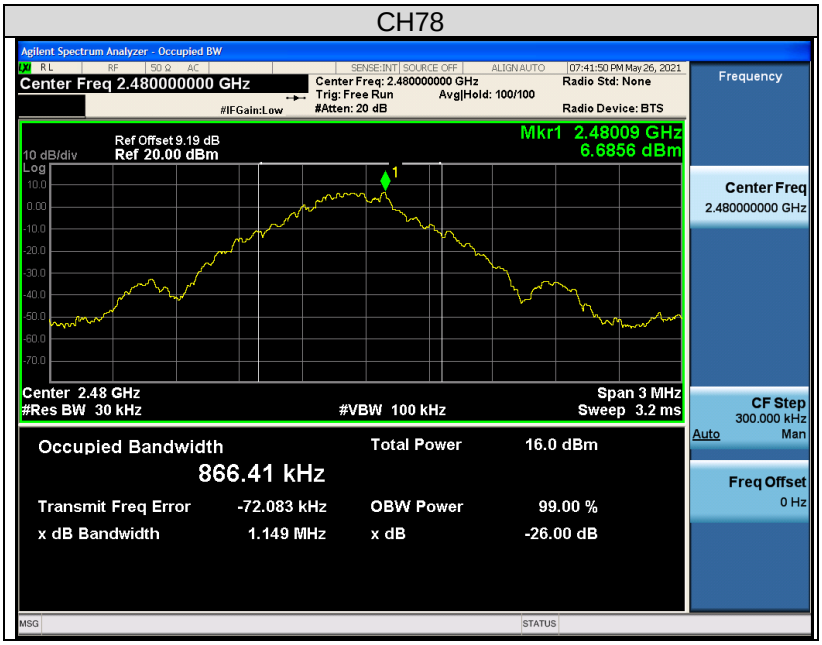
CH0



CH39

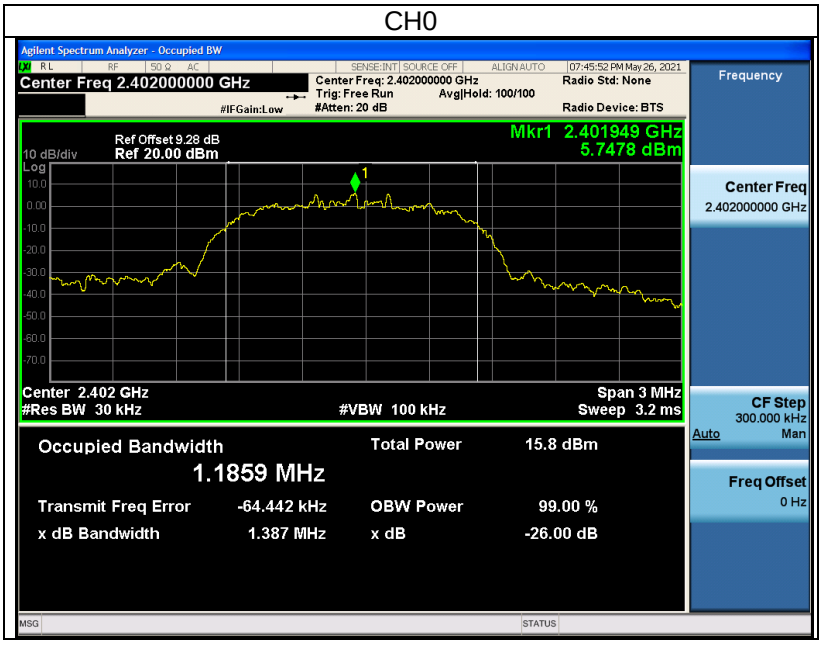


CH78

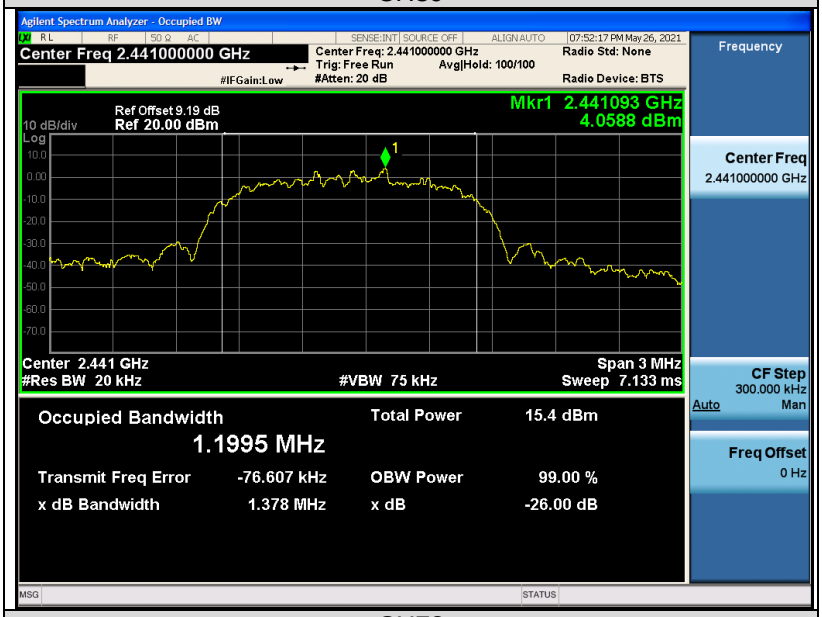


8DPSK

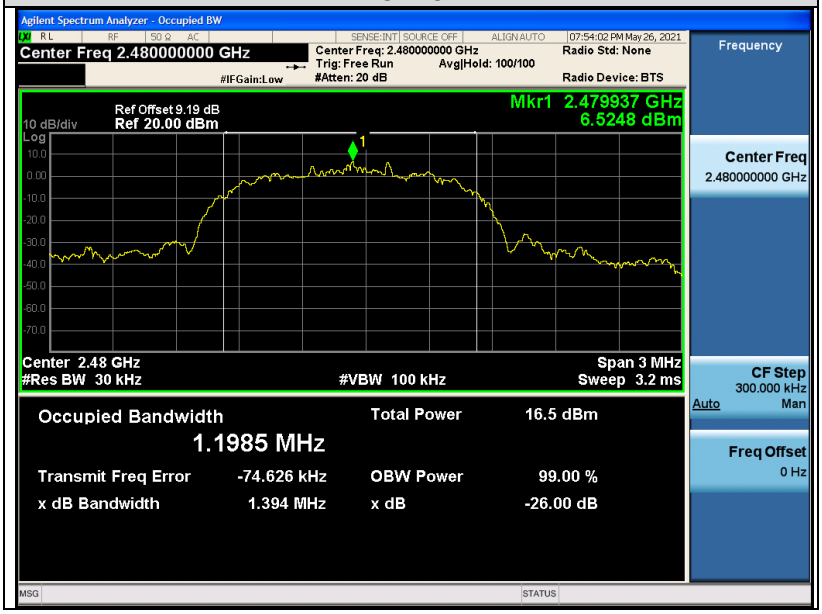
CH0



CH39


Agilent Spectrum Analyzer - Occupied BW
Center Freq 2.441000000 GHz
Center Freq: 2.441000000 GHz
Trig: Free Run
Avg|Hold: 100/100
#Atten: 20 dB
Radio Std: None
Radio Device: BTS
#IFGain:Low
07:52:17 PM May 26, 2021
Frequency
Mkr1 2.441093 GHz
4.0588 dBm
Ref Offset 9.19 dB
10 dB/div
Ref 20.00 dBm
Log
Center 2.441 GHz
#Res BW 20 kHz
#VBW 75 kHz
Span 3 MHz
Sweep 7.133 ms
Occupied Bandwidth
1.1995 MHz
Total Power 15.4 dBm
Transmit Freq Error -76.607 kHz
OBW Power 99.00 %
x dB Bandwidth 1.378 MHz
x dB -26.00 dB
Center Freq
2.441000000 GHz
CF Step
300.000 kHz
Auto
Man
Freq Offset
0 Hz
MSG
STATUS

CH78

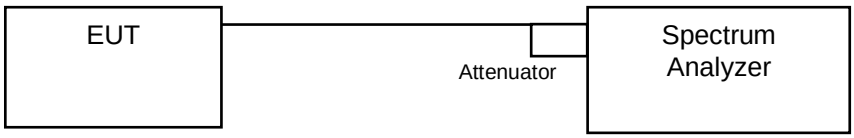

Agilent Spectrum Analyzer - Occupied BW
Center Freq 2.480000000 GHz
Center Freq: 2.480000000 GHz
Trig: Free Run
Avg|Hold: 100/100
#Atten: 20 dB
Radio Std: None
Radio Device: BTS
#IFGain:Low
07:54:02 PM May 26, 2021
Frequency
Mkr1 2.479937 GHz
6.5248 dBm
Ref Offset 9.19 dB
10 dB/div
Ref 20.00 dBm
Log
Center 2.48 GHz
#Res BW 30 kHz
#VBW 100 kHz
Span 3 MHz
Sweep 3.2 ms
Occupied Bandwidth
1.1985 MHz
Total Power 16.5 dBm
Transmit Freq Error -74.626 kHz
OBW Power 99.00 %
x dB Bandwidth 1.394 MHz
x dB -26.00 dB
Center Freq
2.480000000 GHz
CF Step
300.000 kHz
Auto
Man
Freq Offset
0 Hz
MSG
STATUS

3.7 Hopping Channel Separation

3.7.1 Limits of Hopping Channel Separation Measurement

At least 25 kHz or two-third of 20 dB hopping channel bandwidth (whichever is greater).

3.7.2 Test Setup



3.7.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

3.7.4 Test Procedure

Measurement Procedure REF

a. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
b. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range.
c. By using the MaxHold function record the separation of two adjacent channels.
d. Measure the frequency difference of these two adjacent channels by SA MARK function. And then plot the result on SA screen.
e. Repeat above procedures until all frequencies measured were complete.

3.7.5 Deviation from Test Standard

No deviation.

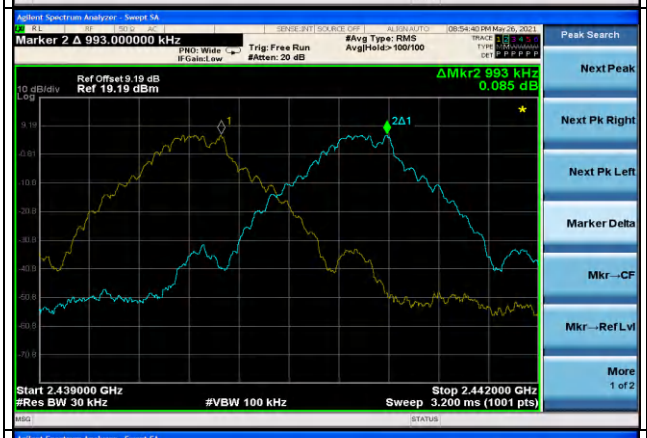
3.7.6 Test Results

Channel No.	Frequency (MHz)	Adjacent Channel Separation (MHz)		Minimum Limit (MHz)		Pass / Fail
		GFSK	8DPSK	GFSK	8DPSK	
0	2402	0.996	1.002	0.64	0.88	Pass
39	2441	0.993	0.999	0.65	0.88	Pass
78	2480	1.005	1.002	0.64	0.88	Pass

Note:

1. The minimum limit is two-third 20 dB bandwidth.

Spectrum Plot of Worst Value

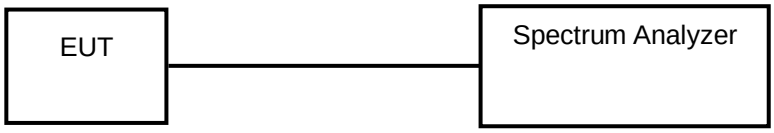
GFSK	8DPSK
	

3.8 Maximum Output Power

3.8.1 Limits of Maximum Output Power Measurement

The Maximum Output Power Measurement is 125mW.

3.8.2 Test Setup



3.8.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

3.8.4 Test Procedure

a. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
b. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
c. The center frequency of the spectrum analyzer is set to the fundamental frequency and using 1MHz RBW and 3 MHz VBW.
d. Measure the captured power within the band and recording the plot.
e. Repeat above procedures until all frequencies required were complete.

3.8.5 Deviation fromTest Standard

No deviation.

3.8.6 EUT Operating Condition

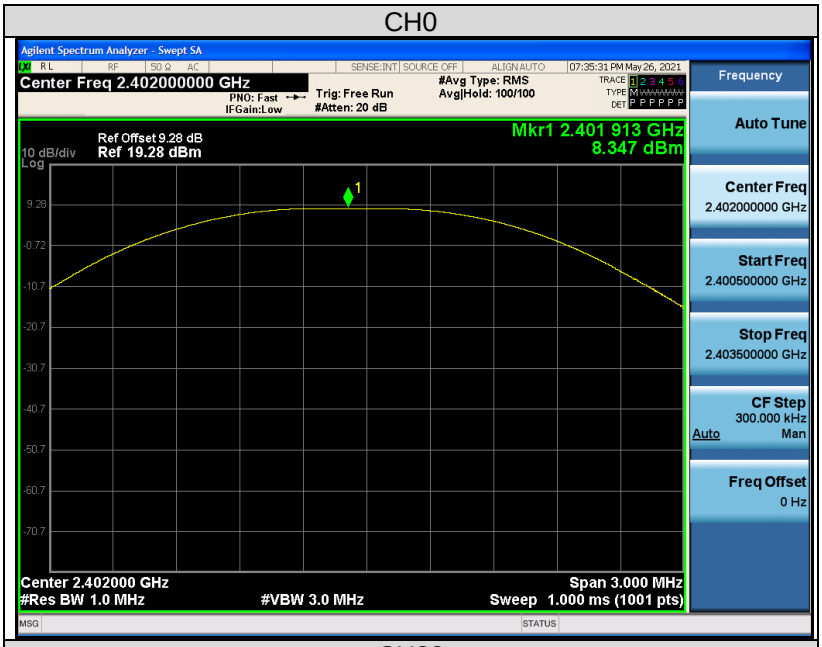
The software provided by client enabled the EUT to transmit and receive data at lowest, middle and highest channel frequencies individually.

3.8.7 Test Results

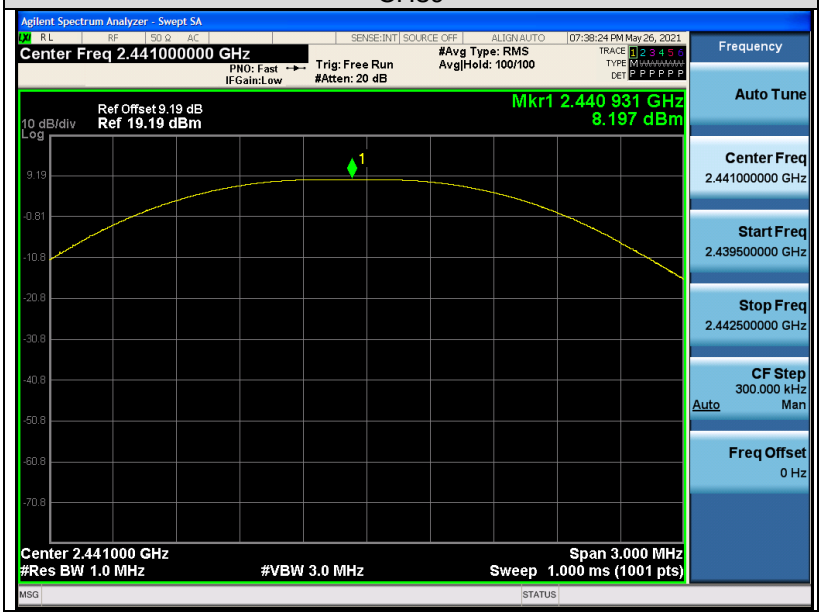
Channel No.	Freq. (MHz)	Output Power (mW)		Output Power (dBm)		Power Limit (mW)	Pass / Fail
		GFSK	8DPSK	GFSK	8DPSK		
0	2402	6.839	12.618	8.35	11.01	125	Pass
39	2441	6.607	12.023	8.20	10.80	125	Pass
78	2480	7.816	14.256	8.93	11.54	125	Pass

GFSK

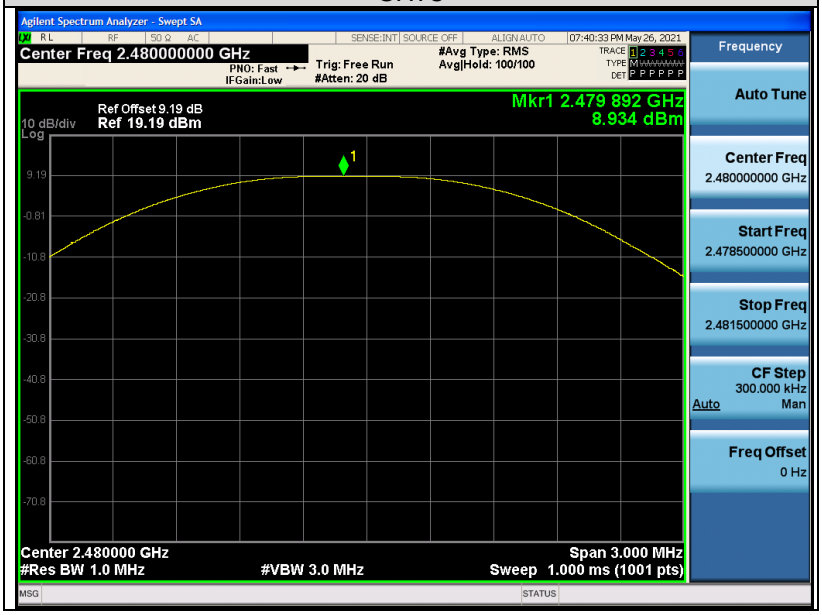
CH0



CH39

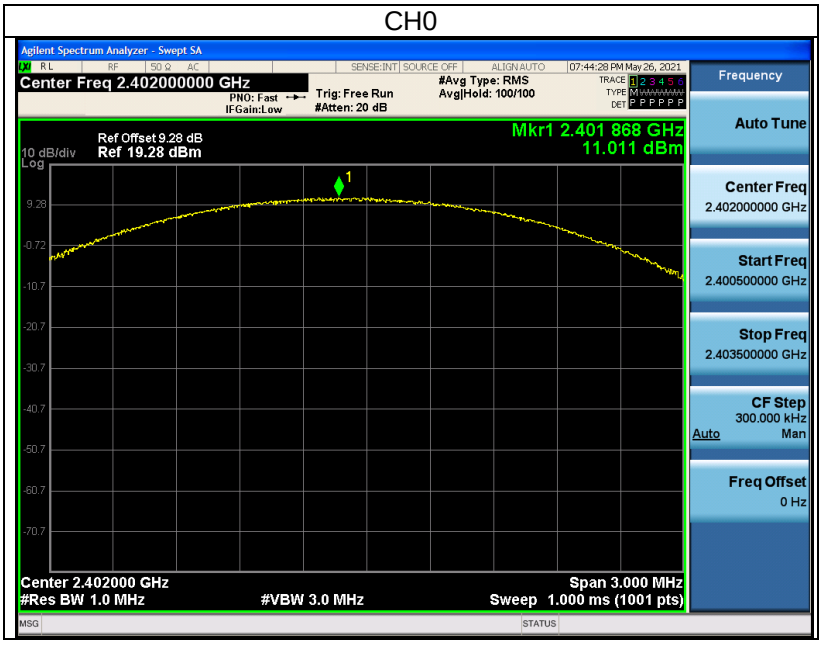


CH78

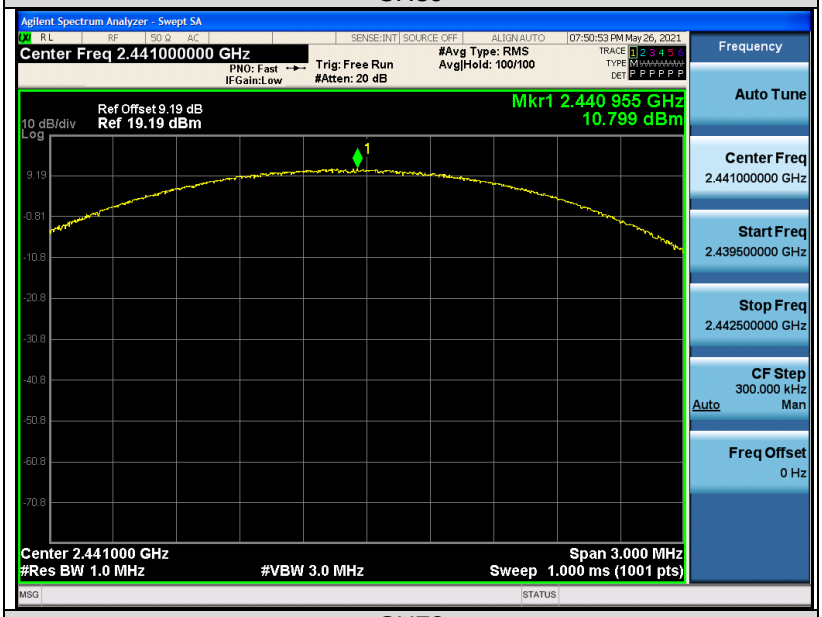


8DPSK

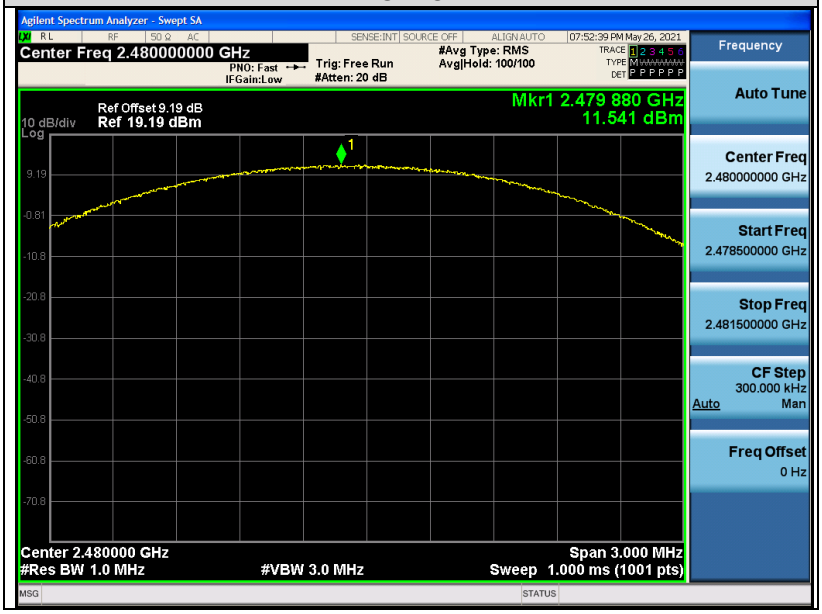
CH0



CH39


Agilent Spectrum Analyzer - Swept SA
Center Freq 2.441000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
#Avg Type: RMS
Avg|Hold: 100/100
07:50:53 PM May 26, 2021
Frequency
Auto Tune
Ref Offset 9.19 dB
10 dB/div
Ref 19.19 dBm
Mkr1 2.440 955 GHz
10.799 dBm
Center Freq
2.441000000 GHz
Start Freq
2.439500000 GHz
Stop Freq
2.442500000 GHz
CF Step
300.000 kHz
Auto
Man
Freq Offset
0 Hz
Center 2.441000 GHz
#Res BW 1.0 MHz
#VBW 3.0 MHz
Span 3.000 MHz
Sweep 1.000 ms (1001 pts)
MSG
STATUS

CH78


Agilent Spectrum Analyzer - Swept SA
Center Freq 2.480000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
#Avg Type: RMS
Avg|Hold: 100/100
07:52:39 PM May 26, 2021
Frequency
Auto Tune
Ref Offset 9.19 dB
10 dB/div
Ref 19.19 dBm
Mkr1 2.479 880 GHz
11.541 dBm
Center Freq
2.480000000 GHz
Start Freq
2.478500000 GHz
Stop Freq
2.481500000 GHz
CF Step
300.000 kHz
Auto
Man
Freq Offset
0 Hz
Center 2.480000 GHz
#Res BW 1.0 MHz
#VBW 3.0 MHz
Span 3.000 MHz
Sweep 1.000 ms (1001 pts)
MSG
STATUS

3.9 Conducted Out of Band Emission Measurement

3.9.1 Limits of Conducted Out of Band Emission Measurement

For average power:

Below –30 dB of the highest emission level of operating band (in 100 kHz Resolution Bandwidth).

For peak power:

Below –20 dB of the highest emission level of operating band (in 100 kHz Resolution Bandwidth)

3.9.2 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

3.9.3 Test Procedure

The transmitter output was connected to the spectrum analyzer via a low lose cable. Set both RBW and VBW of spectrum analyzer to 100 kHz and 300 kHz with suitable frequency span including 100 MHz bandwidth from band edge. The band edges was measured and recorded.

3.9.4 Deviation from Test Standard

No deviation.

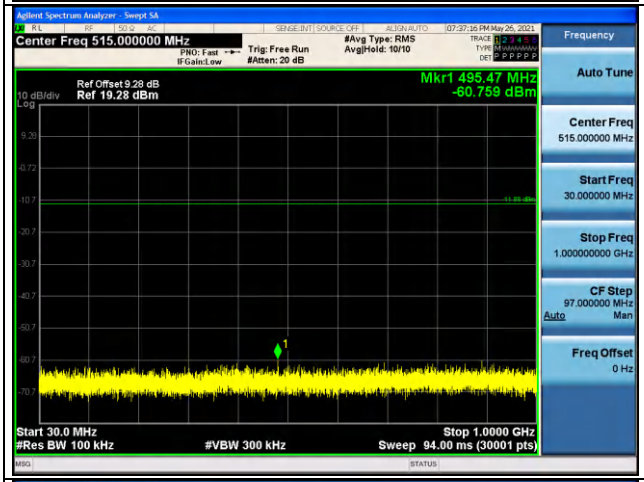
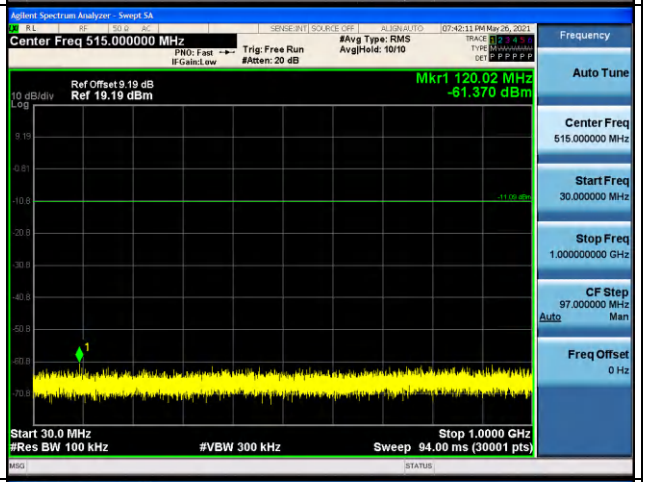
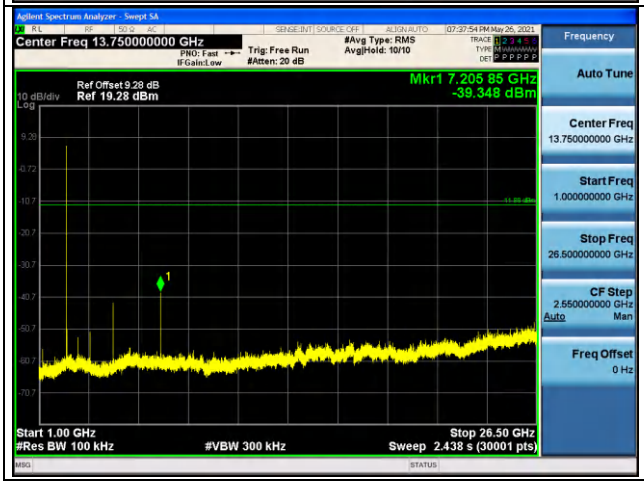
3.9.5 EUT Operating Condition

The software provided by client enabled the EUT to transmit and receive data at lowest, middle and highest channel frequencies individually.

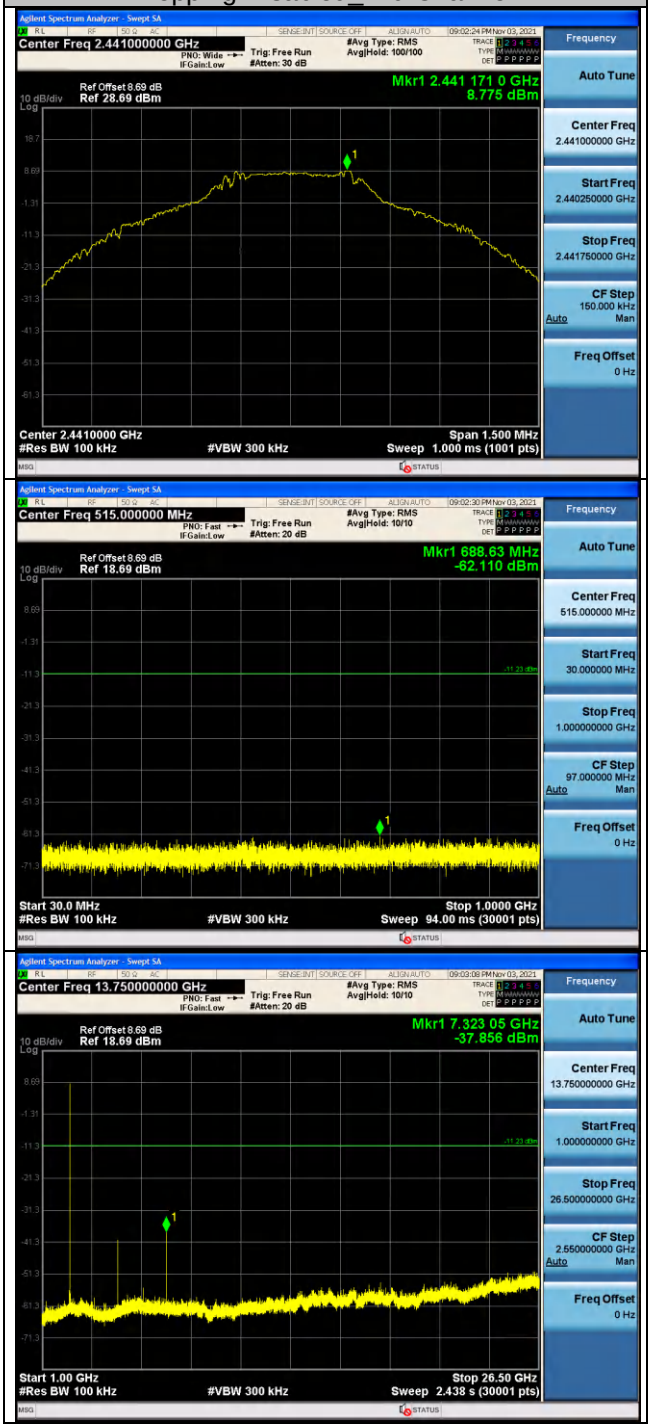
3.9.6 Test Results

The spectrum plots are attached on the following images. D1 line indicates the highest level, D2 line indicates the 20dB offset below D1. It shows compliance with the requirement.

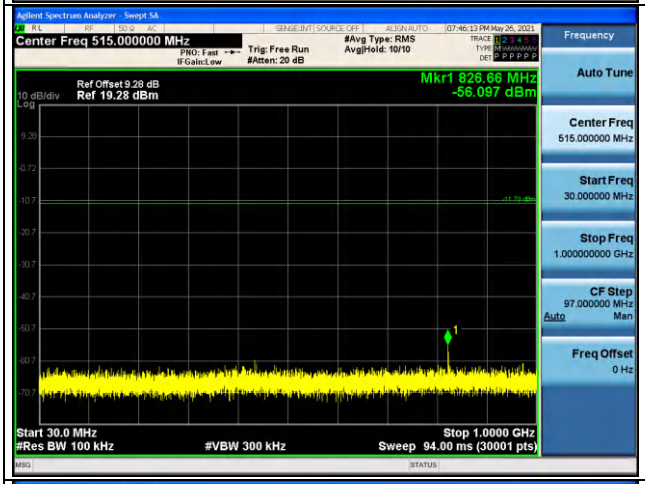
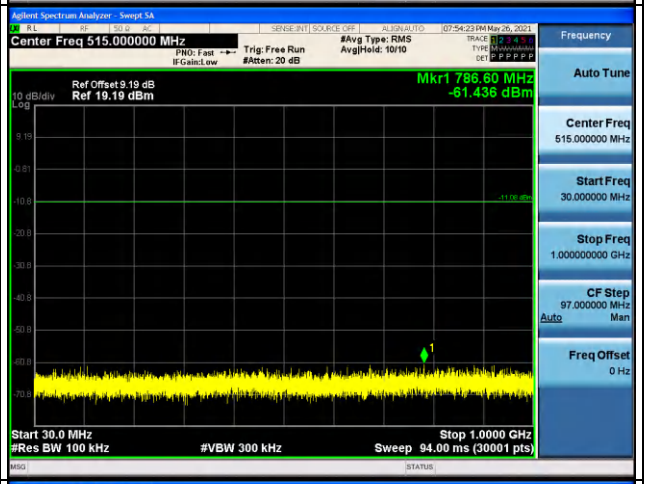
GFSK

Hopping Disabled_Low Channel	Hopping Disabled_High Channel
	
	

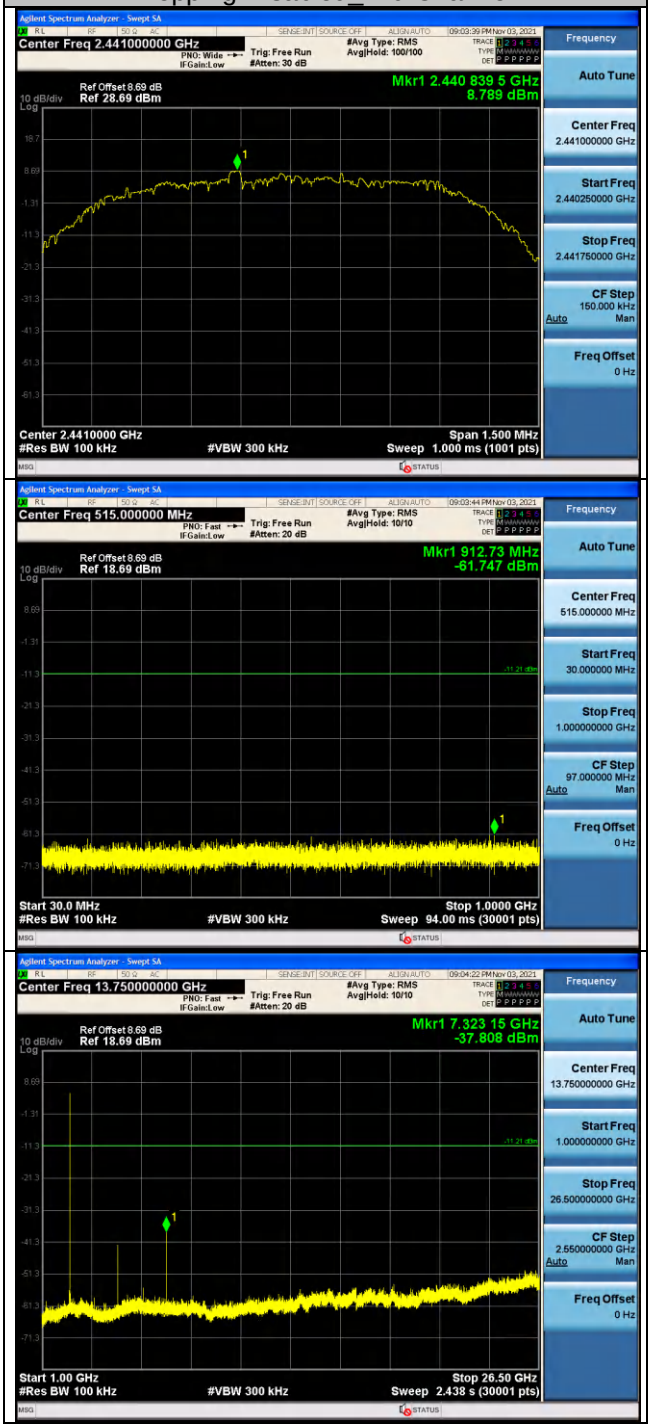
Hopping Disabled_Mid Channel



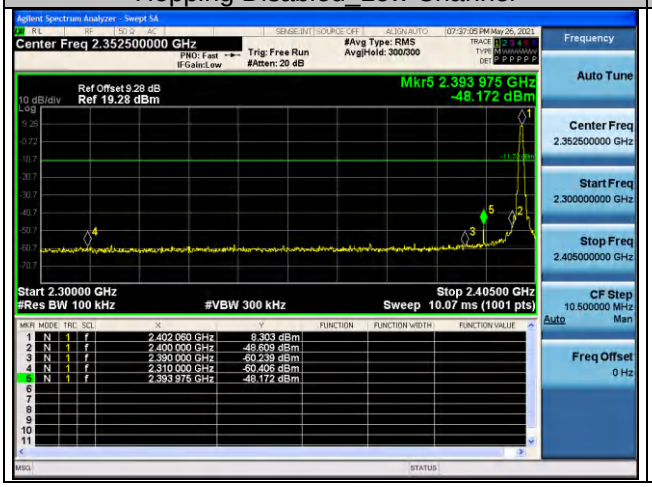
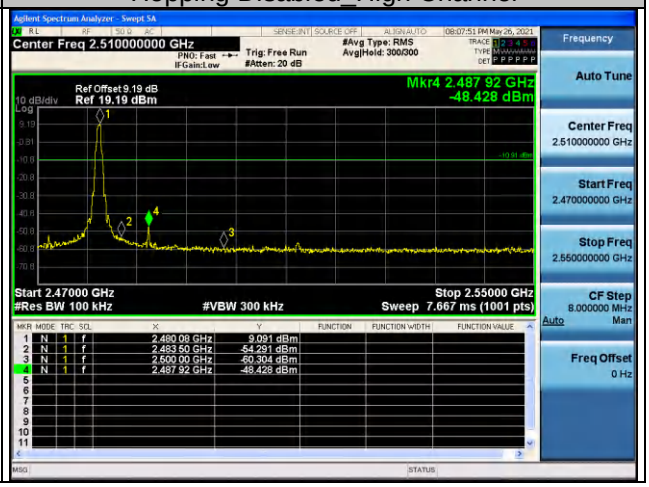
8DPSK

Hopping Disabled_Low Channel	Hopping Disabled_High Channel
	

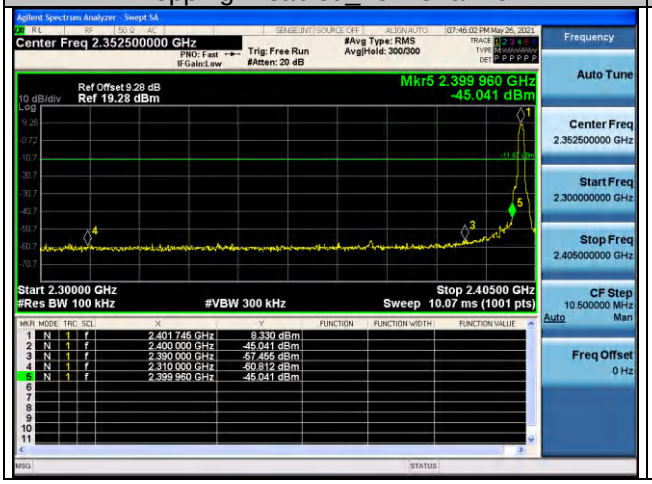
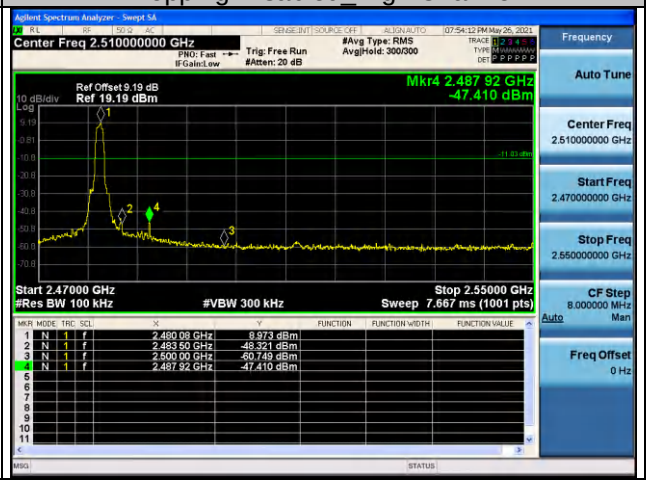
Hopping Disabled_Mid Channel



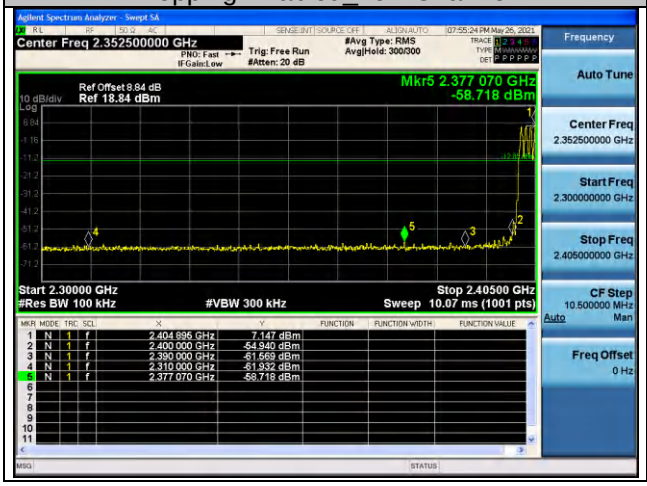
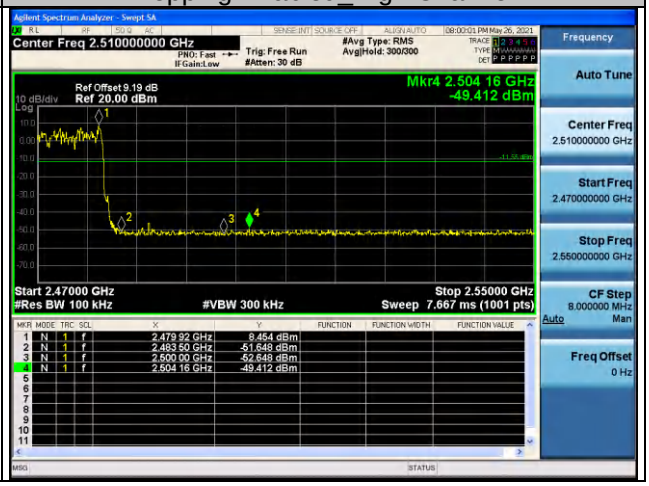
Bandedge: GFSK

Hopping Disabled_Low Channel	Hopping Disabled_High Channel
	

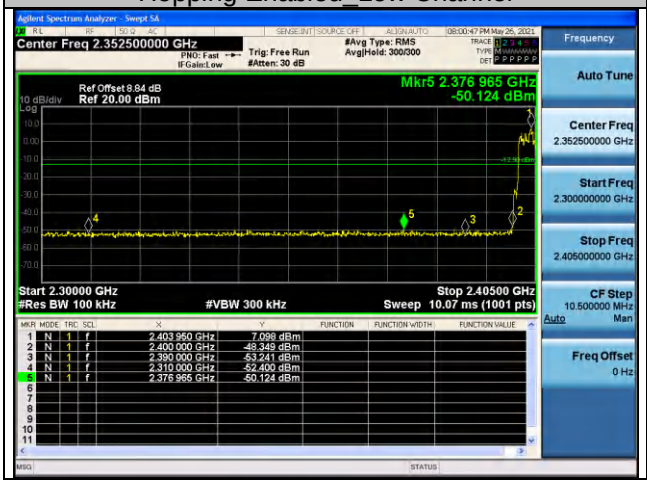
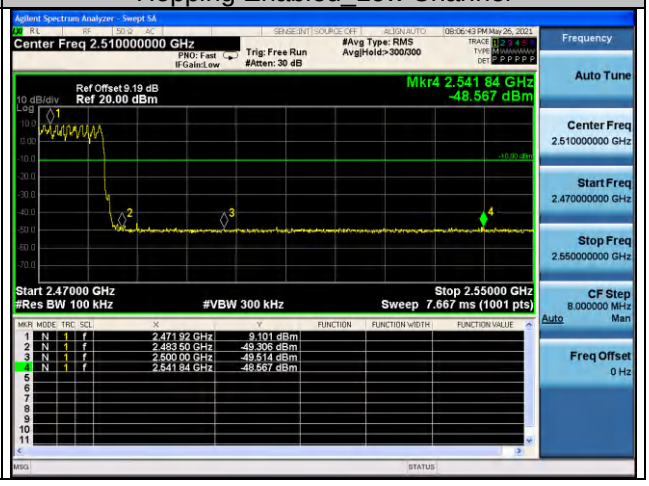
Bandedge: 8DPSK

Hopping Disabled_Low Channel	Hopping Disabled_High Channel
	

GFSK

Hopping Enabled_Low Channel	Hopping Enabled_High Channel
	

8DPSK

Hopping Enabled_Low Channel	Hopping Enabled_Low Channel
	

4 Pictures of Test Arrangements

Please refer to the attached file (Test Setup Photo).

4.1.2Test Instruments

Description & Manufacturer	Model No.	Serial No.	Due Date of Calibration
Spectrum Keysight	N9020A	MY51240612	2021/09/16
Spectrum Analyzer Rohde&Schwarz	FSV-40N	101783	2021/09/16
Power Meter 10Hz~18GHz Tonscend	JS0806-2	188060126	2021/09/16
Signal generator Keysight	E4421B	GB40051020	2021/09/16
Signal generator Keysight	N5182A	MY47420944	2021/09/16
Test Software Tonscend	JS0806-2	NA	NA
Hygrothermograph Yuhuaze	HTC-1	NA	2021/09/16

Note:

1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to CEPREI/CHINA.
2. The test was performed in Chamber 1.

Appendix – Information on the Testing Laboratories

We, Hwa-Hsing (Dongguan) Co., Ltd.,A global provider of TESTING and CERTIFICATION services for consumer products, electronic products and wireless information technology products. Adhering to the core values “HONEST and TRUSTWORTHY, OBJECTIVE and IMPARTIALITY, RIGOROUS and AFFICIENT”, commitment to provide professional, perfect and efficient comprehensive ONE-STOP solution of TESTING and CERTIFICATION services for Manufacturers, Buyers, Traders, Brands, Retailers. Assist client to better manage risk, protect their brands, reduce costs and cut time to over 150 markets in global. Our laboratories are FCC recognized accredited test firms and accredited and approved according to ISO/IEC 17025.

If you have any comments, please feel free to contact us at the following:

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Contact Tel: 0769-83078199
Email: customerservice.dg@hwa-hsing.com
Web Site: www.hwa-hsing.com

The address and road map of all our labs can be found in our web site also.

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