FCC RF Test Report

For

Shenzhen Hangshi Technology Co.,Ltd

Test Standards:	Part 15C Subpart C §15.249
Product Description:	2.4G Keyboard
Tested Model:	HW098SG
Additional Model:	HW098SG-2/HW098SG-3
FCC ID:	2AKHJ-HW098SG
Classification	DXX-Low Power Communication Device Transmitter
Report No.:	EC1912002RF01
Tested Date:	2020-04-01 to 2020-04-29
Issued Date:	2020-04-29
Prepared By:	Jerry Wang / Engineer
Approved By:	Bacon Wu / RF Manager

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Report Revise Record

Report Version	Revise Time	Issued Date	Valid Version	Notes
V1.0	/	2020.04.29	Valid	Original Report

TABLE OF CONTENTS

Summary of Test Result

FCC Rule	Description	Limit	Result	Remark
15.215(c)	20dB Bandwidth	NA	Pass	-
15.249(a)	Field strength of the fundamental signal	15.249(a)	Pass	-
15.249(a)(d)/15.209	Radiated Band Edges and Radiated Spurious Emission	15.249(a)(d)/15.209	Pass	Under limit 7.85 dB at 9767.4 MHz
15.207	AC Conducted Emission	15.207(a)	Not Required	
15.203	Antenna Requirement	N/A	Pass	-

1 Test Laboratory

1.1 Test facility

CNAS (accreditation number:L11138)

Hunan Ecloud Testing Technology Co., Ltd. has obtained the accreditation of China National Accreditation Service for Conformity Assessment (CNAS).

FCC (Designation number:CN1244 , Test Firm Registration Number:793308)

Hunan Ecloud Testing Technology Co., Ltd. has been listed on the US Federal Communications Commission list of test facilities recognized to perform electromagnetic emissions measurements.

ISED(CAB identifier: CN0012, ISED# :24347)

Hunan Ecloud Testing Technology Co., Ltd. has been listed on the Wireless Device Testing Laboratories list of innovation, Science and Economic Development Canada to test to Canadian radio equipment requirements.

A2LA (Certificate Number:4895.01)

Hunan Ecloud Testing Technology Co., Ltd. has been listed by American Association for Laboratory Accreditation to perform electromagnetic emission measurement.

2 General Description

2.1 Applicant

Shenzhen Hangshi Technology Co.,Ltd
Hangshi Technology Park,Democracy West Industry Area,Shajing Town,Bao'an District,Shenzhen,China.

2.2 Manufacturer

Shenzhen Hangshi Technology Co.,Ltd
Hangshi Technology Park,Democracy West Industry Area,Shajing Town,Bao'an District,Shenzhen,China.

2.3 General Description Of EUT

Product	2.4G Keyboard
Model No.	HW098SG
Additional No.	HW098SG-2/HW098SG-3
Difference Description	HW098SG-2 / HW098SG-3 has numeric keyboard area and HW098SG does not have numeric keyboard area, which does not affect RF parameters
FCC ID	2AKHJ-HW098SG
Power Supply	3Vdc (2xAAA dry battery)
Modulation Type	GFSK
Operating Frequency	2403.85MHz~2479.85MHz
Number Of Channel	16
Antenna Type	PCB Antenna type with 1.87dBi gain
I/O Ports	Refer to user's manual
Cable Supplied	N/A

NOTE:

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

2. For the test results, the EUT had been tested with all conditions. But only the worst case was shown in test report.

2.4 Modification of EUT

No modifications are made to the EUT during all test items.

2.5 Applicable Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- FCC Part 15 Subpart C §15.249
- ANSI C63.10-2013

3 Test Configuration of Equipment Under Test

3.1 Descriptions of Test Mode

The Operation Frequency each of channel as follows:

Operation Frequency each of channel			
No.:	Frequency(MHz)	No.:	Frequency(MHz)
01	**2403.85**	09	2414.85
02	2426.85	10	2436.85
03	2466.85	11	2459.85
04	2463.85	12	2473.85
05	2407.85	13	2419.85
06	2422.85	14	2439.85
07	2445.85	15	2453.85
08	**2441.85**	**16**	**2479.85**

Note:

according to ANSI C63.10 2013, for unlicensed wireless device frequency range more than 10MHz, measurement shall be performed and reported at low, middle and high frequency

a. Radiated emission and power line conducted emission were performed with the EUT set to transmit at the channel with highest output power as worst-case scenario.

b. The fundamental of the EUT was investigated in three orthogonal orientations X, Y and Z it was determined that Y orientation was worst-case orientation; therefore, all final radiated testing was performed with the EUT in Y orientation.

3.2 Test Mode

3.2.1 Antenna Port Conducted Measurement

Summary table of Test Cases	
Test Item	**2.4G Wireless**
Conducted Test Cases	Mode 1: CH01_2403.85 MHz Mode 2: CH04_2441.85 MHz Mode 3: CH08_2479.85 MHz

3.2.2 Radiated Emission Test (Below 1GHz)

	2.4G Wireless	
Radiated Test Cases	Transmitting	Mode 1: CH01_2403.85 MHz Mode 2: CH04_2441.85 MHz Mode 3: CH08_2479.85 MHz
	Transmitting+Charging	

Note : 1. Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, XYZ axis, antenna ports (if EUT with antenna diversity architecture) and packet type.

2. All above modes were tested, but only the worst case test mode 1 while transmitting was reported.

3.2.3 Radiated Emission Test (Above 1GHz)

	2.4G Wireless	
Radiated Test Cases	Transmitting	Mode 1: CH01_2403.85 MHz Mode 2: CH04_2441.85 MHz Mode 3: CH08_2479.85 MHz
	Transmitting+Charging	

Note : 1. Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, XYZ axis, antenna ports (if EUT with antenna diversity architecture) and packet type.

2. All above modes were tested, but only the worst case transmitting was reported.

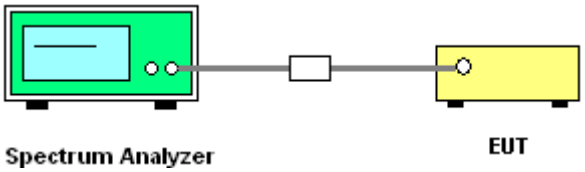
3.3 Support Equipment

Item	Equipment	Trade Name	Model Name	FCC ID	Data Cable	Power Cord
1.	Notebook	Lenovo	E470C	N/A	N/A	shielded cable DC O/P 1.8 m unshielded AC I/P cable1.2 m
2.	2.4G Dongle	Shenzhen Hastech industries Co., Ltd	HW086-1	2AC9LHW086-1	N/A	N/A

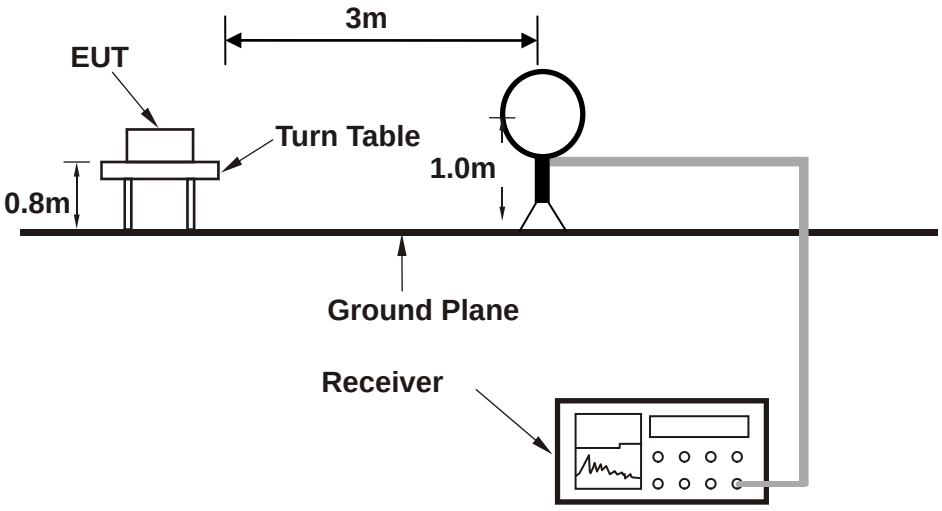
3.4 Test Setup

The software provided by client to enable the EUT under transmission condition continuously at specific channel frequencies individually.

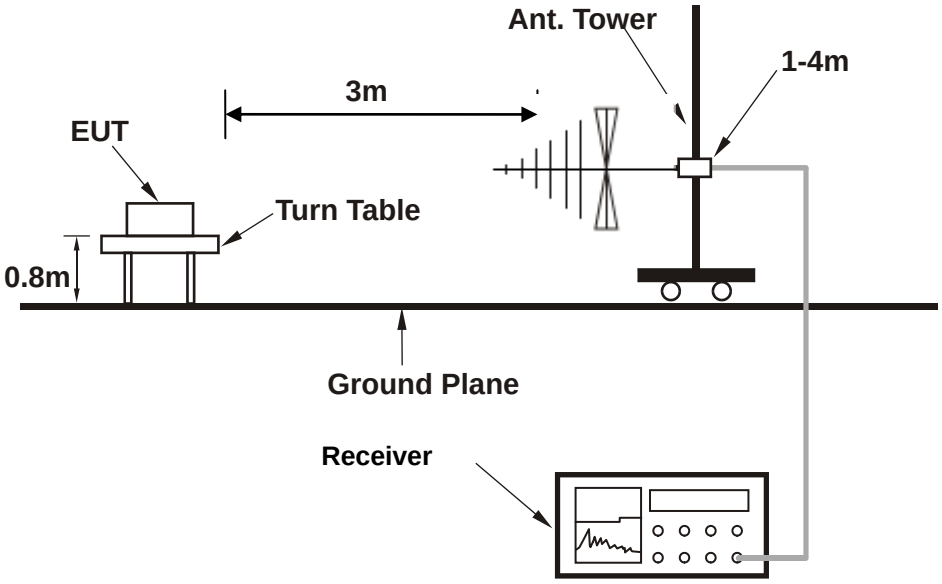
Setup diagram for Conducted Test



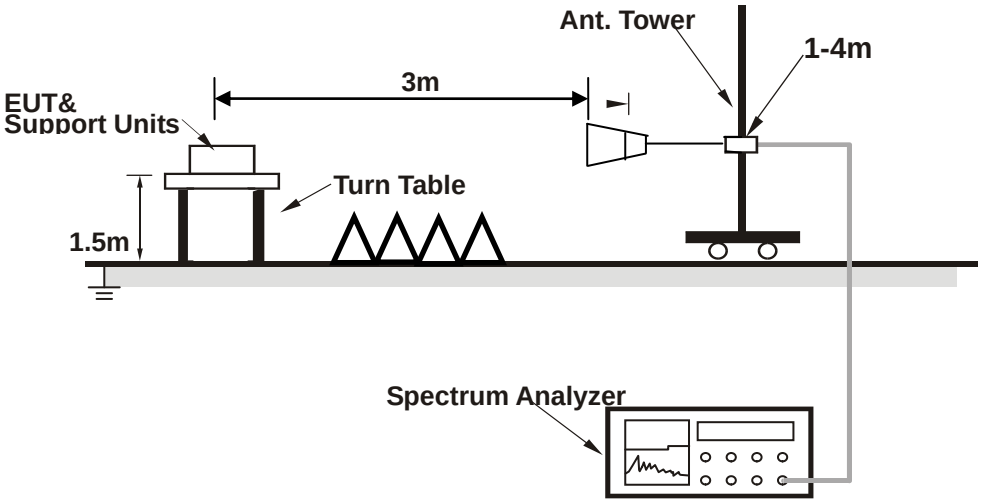
Setup diagram for Raidation(9KHz~30MHz) Test



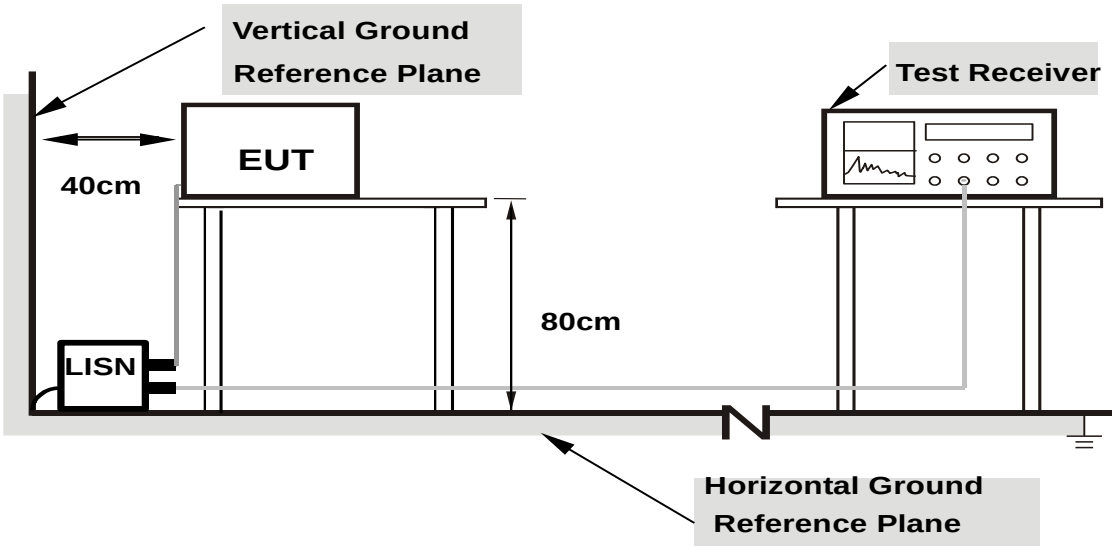
Setup diagram for Raidation(Below 1G) Test



Setup diagram for Raidation(Above1G) Test



Setup diagram for AC Conducted Emission Test



Note: 1.Support units were connected to second LISN.
2.Both of LISNs (AMN) are 80 cm from EUT and at least 80 from other units and other metal planes

3.5 Measurement Results Explanation Example

For all conducted test items:

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuator factor between EUT conducted output port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly the EUT RF output level.

Example:
The spectrum analyzer offset is derived from RF cable loss and attenuator factor.
Offset = RF cable loss + attenuator factor.
Following shows an offset computation example with cable loss 5 dB and 10dB attenuator.

Offset(dB) = RF cable loss(dB) + attenuator factor(dB).
= 5 + 10 = 15 (dB)

For all radiated test items:

Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level
Over Limit (dB μ V/m) = Level(dB μ V/m) - Limit Level (dB μ V/m)

4 Test Result

4.1 20dB Occupy Bandwidth Measurement

4.1.1 Limit of 20dB Occupy Bandwidth

None; for reporting purposes only.

4.1.2 Test Procedures

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Turn on the EUT and connect it to measurement instrument.
3. Use the following spectrum analyzer settings for 20dB Bandwidth measurement.

   Span = approximately 2 to 5 times the 20 dB bandwidth, centered on a hopping channel;

   RBW = 1% to 5% of the 20 dB bandwidth; VBW = approximately 3 times RBW; Sweep = auto;

   Detector function = peak; Trace = max hold.

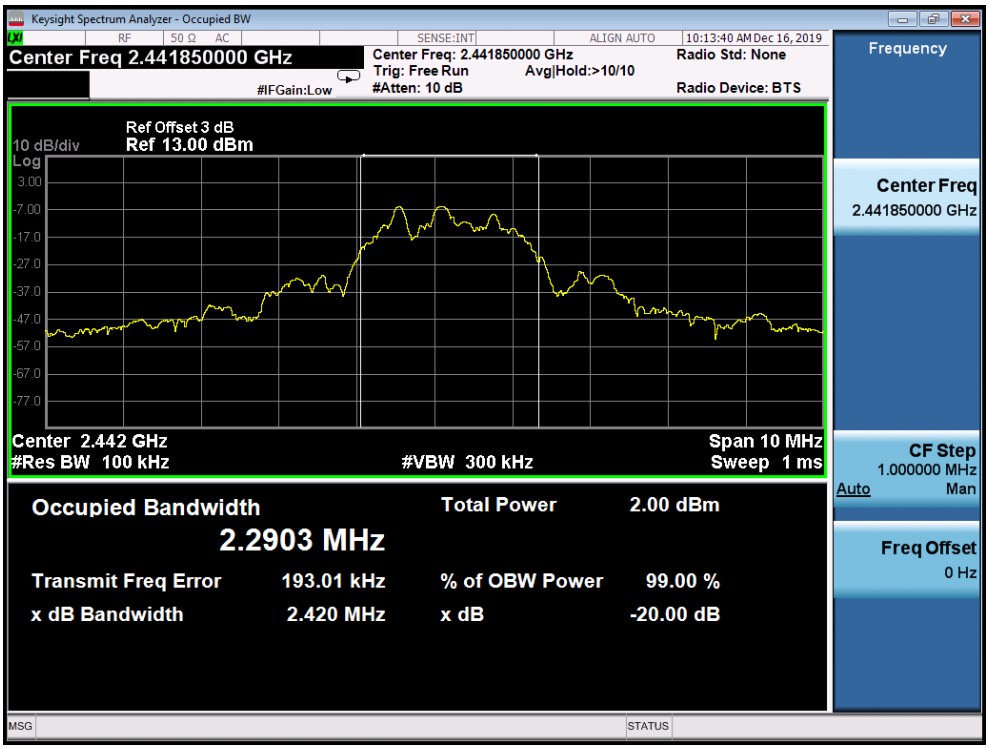
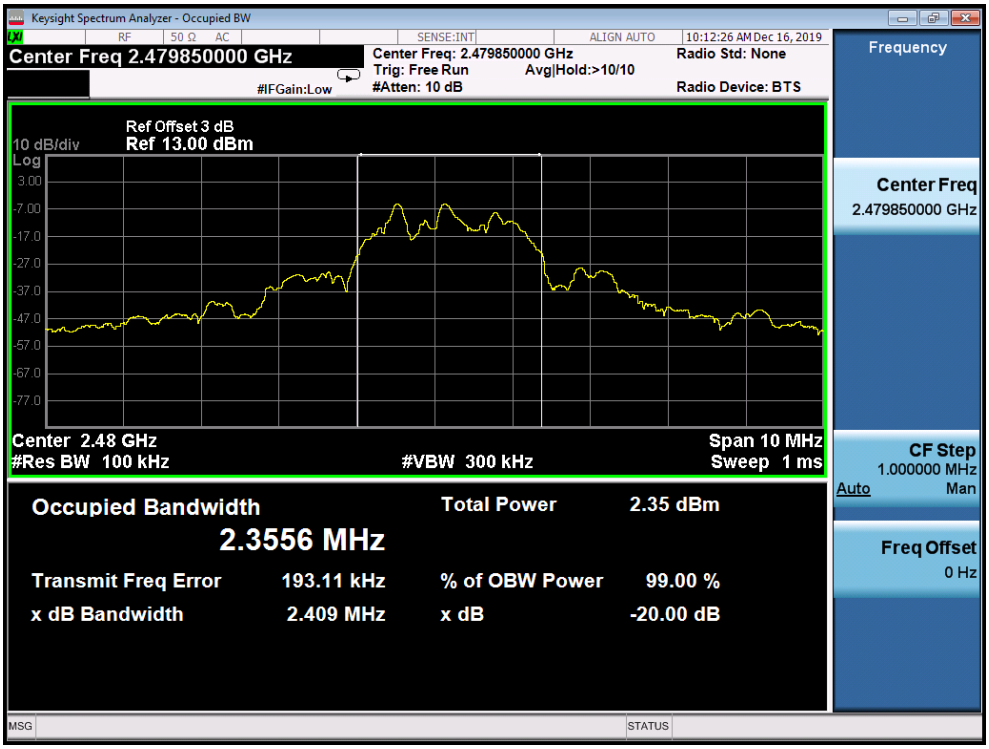
4.1.3 Test Result of 20dB Bandwidth

Test Mode :	2.4G Wireless Transmitting	Temperature :	21~23℃
Test Engineer :	Jack Liu	Relative Humidity :	41~43%

Channel.	20dB Bandwidth [MHz]	Verdict
LCH	2.452	PASS
MCH	2.420	PASS
HCH	2.409	PASS

20dB Plot

Graphs	
GFSK/LCH	

GFSK/MCH	
GFSK/HCH	

4.2 Field Strength of The Fundamental Signal, Radiated Band Edges and Spurious Emission Measurement

4.2.1 Limit of Fundamental Signal, Radiated Band Edges and Spurious Emission

In any 100 kHz bandwidth outside the intentional radiator frequency band, all harmonics/spurious must be at least 20 dB below the highest emission level within the authorized band. In addition, radiated emissions which fall in the restricted bands must also comply with the FCC section 15.209&15.249 limits as below.

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

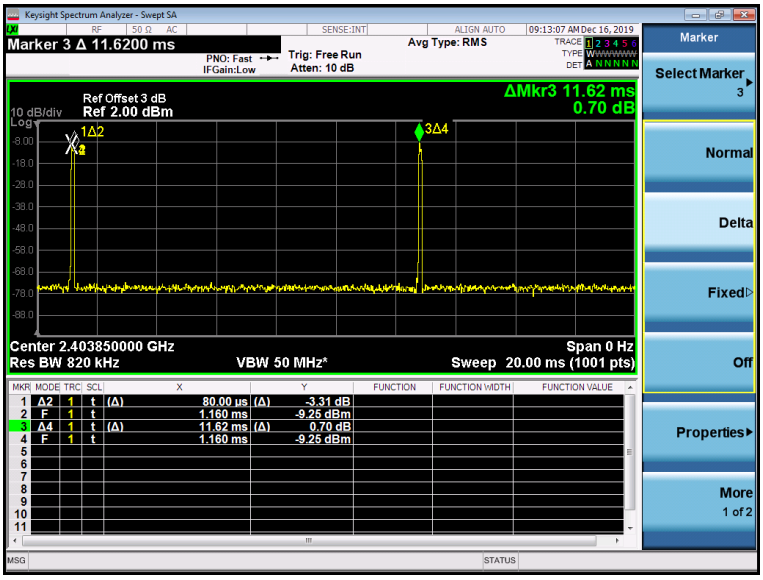
Frequency (MHz)	Field Strength (millivolts/meter)	Measurement Distance (meters)
2400-2483.5	50	3m

Note: The frequency range from 9KHz to 10th harmonic (25GHz) are checked, and no any emissions were found from 18GHz to 25GHz, So the radiated emissions from 18GHz to 25GHz were not record.

4.2.2 Test Procedures

1. The EUT was placed on a turntable with 0.8 meter for frequency below 1GHz and 1.5 meter for frequency above 1GHz respectively above ground.
2. The measurement distance is 3 meter.
3. For each suspected emission, the EUT was arranged to its worst case and then tune the Antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level to comply with the guidelines.
4. Set to the maximum power setting and enable the EUT transmit continuously.
5. Use the following spectrum analyzer settings:
   (1) Span shall wide enough to fully capture the emission being measured;
   (2) Set RBW=100 kHz for f < 1 GHz, RBW=1MHz for f>1GHz ; VBW ≥RBW; Sweep = auto; Detector function = peak; Trace = max hold for peak
   (3) For average measurement:
   VBW = 10 Hz, when duty cycle is no less than 98 percent.
   VBW ≥ 1/T, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.

Band	Duty Cycle(%)	VBW Setting
2.4G Wireless	0.7	20kHz



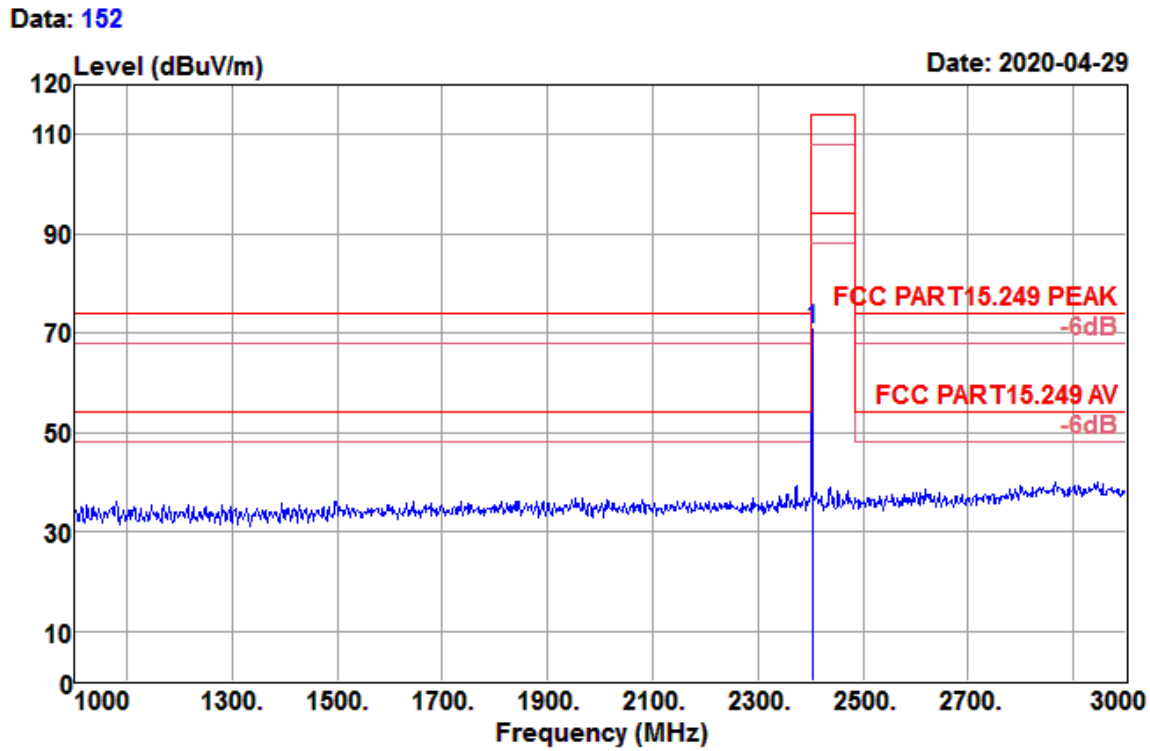
Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level

4.2.3 Test Results of Radiated Spurious Emissions (9 kHz ~ 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 per 15.31(o) was not reported.

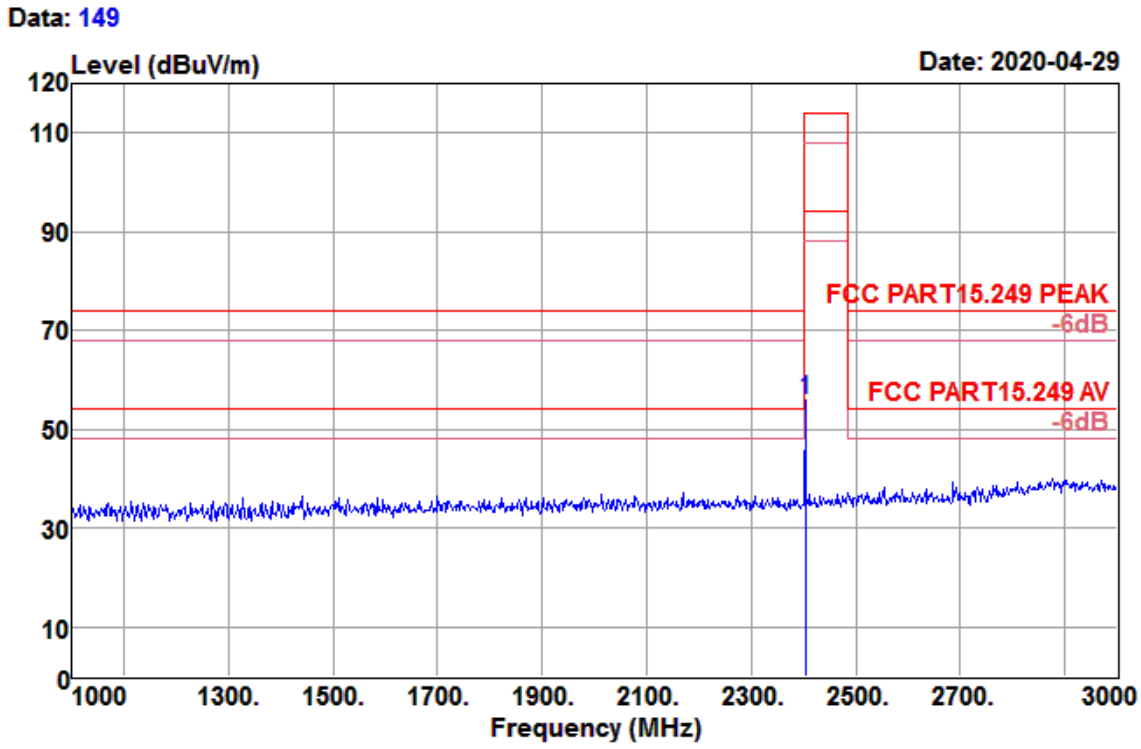
4.2.4 Field Strength of The Fundamental Signal

Test Mode :	Mode 1: CH01_2403.85 MHz	**Temperature :**	21~23℃
Test Engineer :	Jack Liu	**Relative Humidity :**	63~65%
Frequencey Range	1GHz~3GHz	**Polarization :**	Horizontal



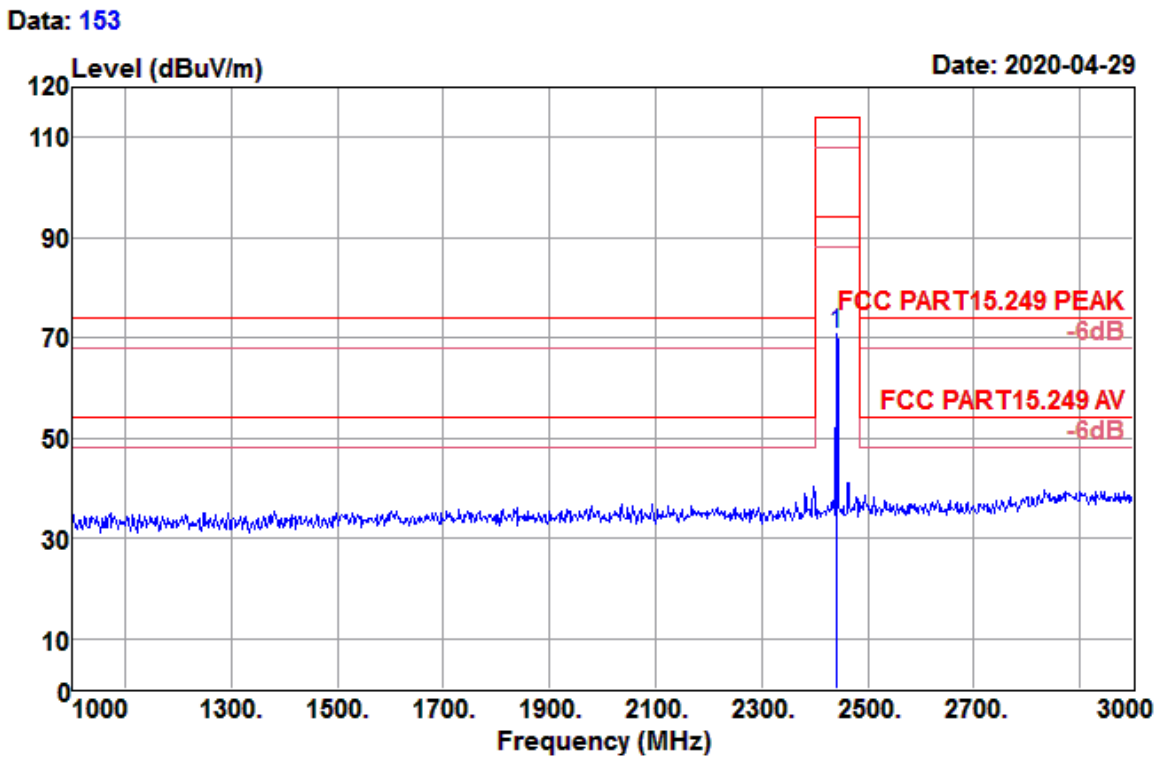
Freq	Reading level	Antenna factor	Cable loss	Preamp factor	level	Limit level	Over limit	Remark
MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
2403.850	75.71	27.15	3.54	35.57	70.83	114.00	-43.17	Peak

Test Mode :	Mode 1: CH01_2403.85 MHz	**Temperature :**	21~23℃
Test Engineer :	Jack Liu	**Relative Humidity :**	63~65%
Frequencey Range	1GHz~3GHz	**Polarization :**	Vertical



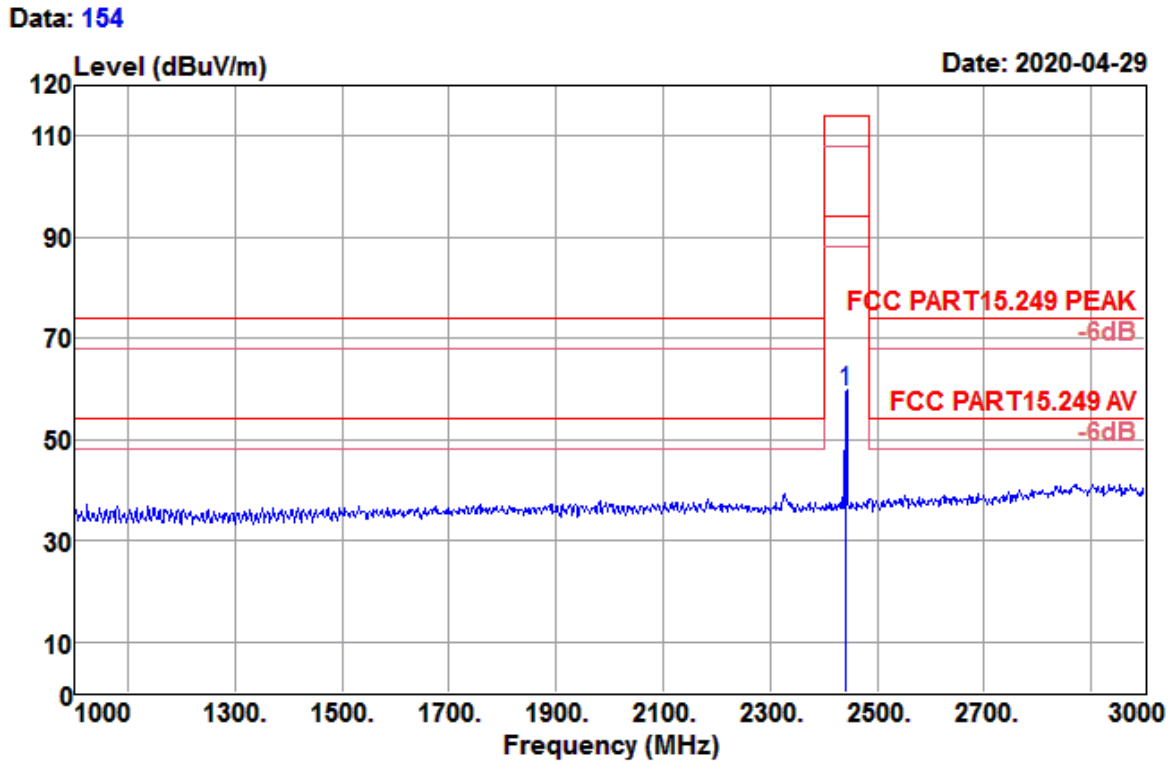
Freq	Reading level	Antenna factor	Cable loss	Preamp factor	level	Limit level	Over limit	Remark
MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
2403.850	60.87	27.15	3.54	35.57	55.99	114.00	-58.01	Peak

Test Mode :	Mode 2: CH04_2441.85 MHz	**Temperature :**	21~23℃
Test Engineer :	Jack Liu	**Relative Humidity :**	63~65%
Frequencey Range	1GHz~3GHz	**Polarization :**	Horizontal



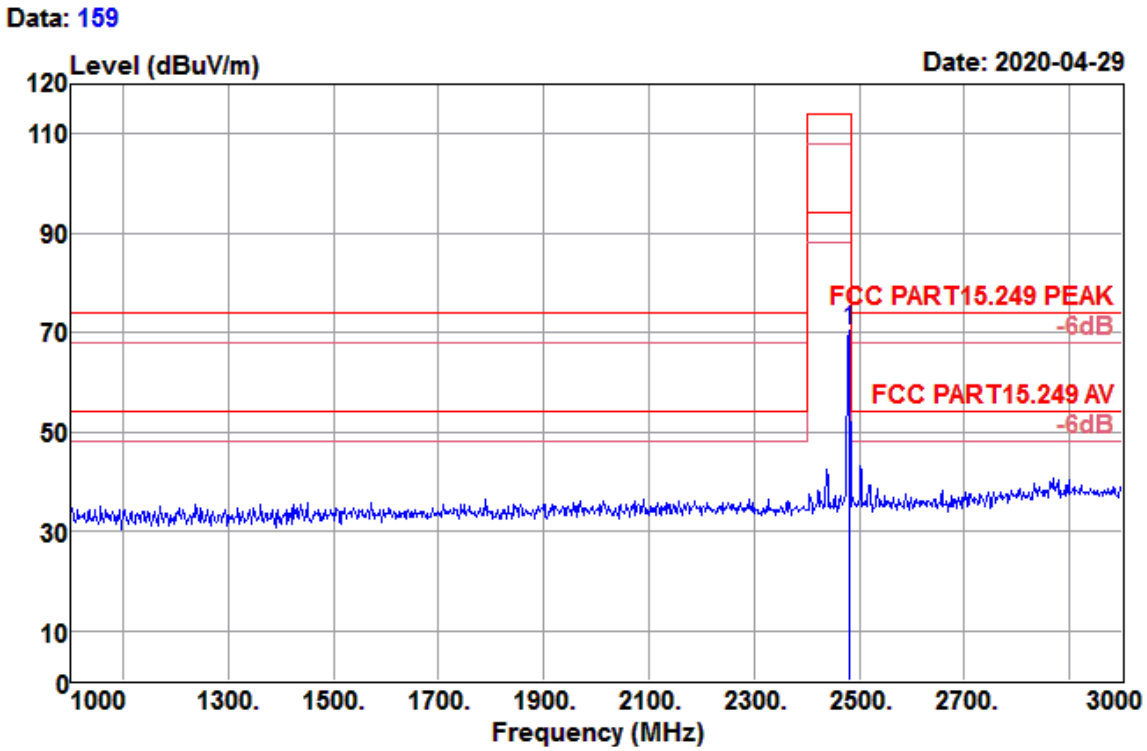
Freq	Reading level	Antenna factor	Cable loss	Preamp factor	level	Limit level	Over limit	Remark
MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
2441.850	75.57	27.25	3.57	35.62	70.77	114.00	-43.23	Peak

Test Mode :	Mode 2: CH04_2441.85 MHz	Temperature :	21~23℃
Test Engineer :	Jack Liu	Relative Humidity :	63~65%
Frequencey Range	1GHz~3GHz	Polarization :	Vertical



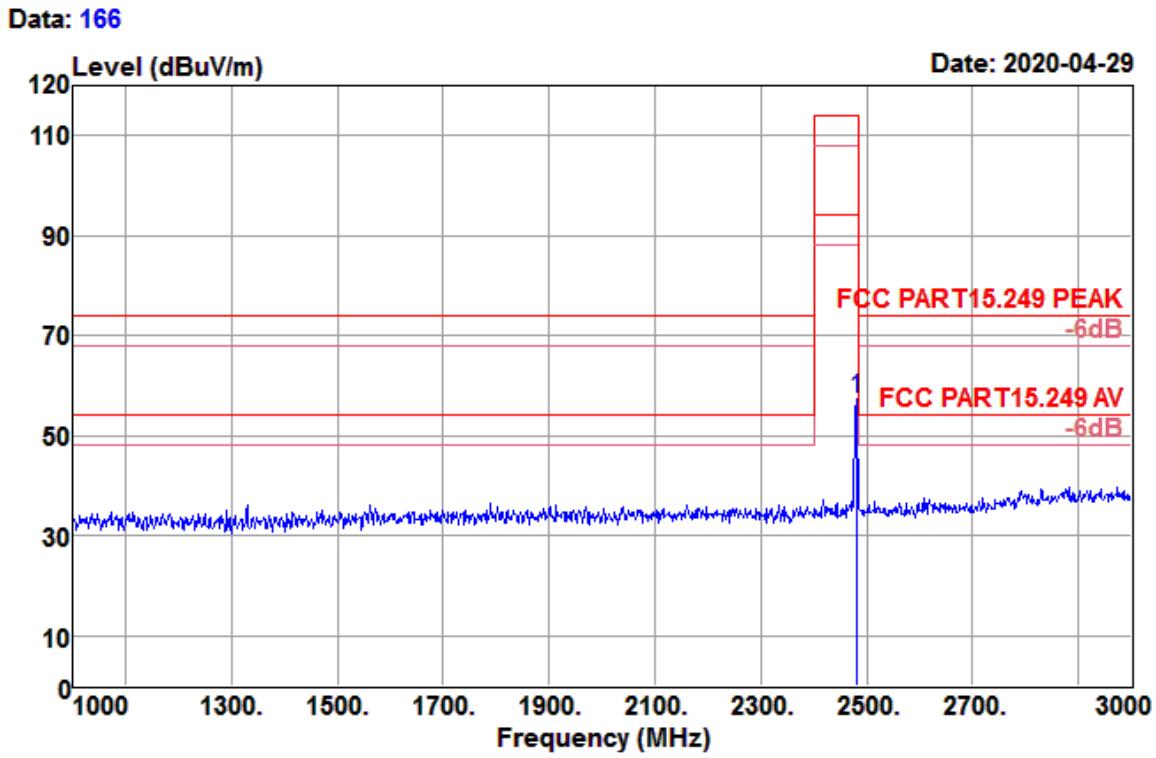
Freq	Reading level	Antenna factor	Cable loss	Preamp factor	level	Limit level	Over limit	Remark
MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
2441.850	64.42	27.25	3.57	35.62	59.62	114.00	-54.38	Peak

Test Mode :	Mode 3: CH08_2479.85 MHz	Temperature :	21~23℃
Test Engineer :	Jack Liu	Relative Humidity :	63~65%
Frequencey Range	1GHz~3GHz	Polarization :	Horizontal



Freq	Reading level	Antenna factor	Cable loss	Preamp factor	level	Limit level	Over limit	Remark
MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
2479.850	75.33	27.35	3.59	35.67	70.60	114.00	-43.40	Peak

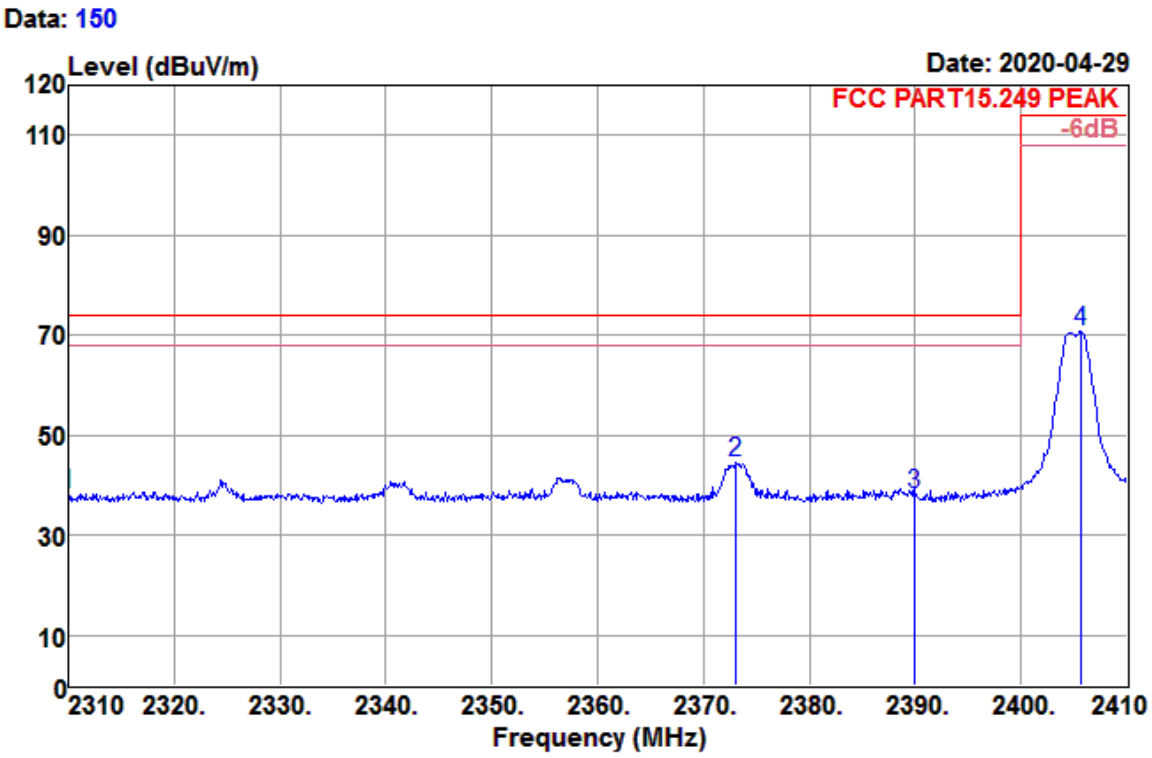
Test Mode :	Mode 3: CH08_2479.85 MHz	Temperature :	21~23℃
Test Engineer :	Jack Liu	Relative Humidity :	63~65%
Frequencey Range	1GHz~3GHz	Polarization :	Vertical



Freq	Reading level	Antenna factor	Cable loss	Preamp factor	level	Limit level	Over limit	Remark
MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
2479.850	62.14	27.35	3.59	35.67	57.41	114.00	-56.59	Peak

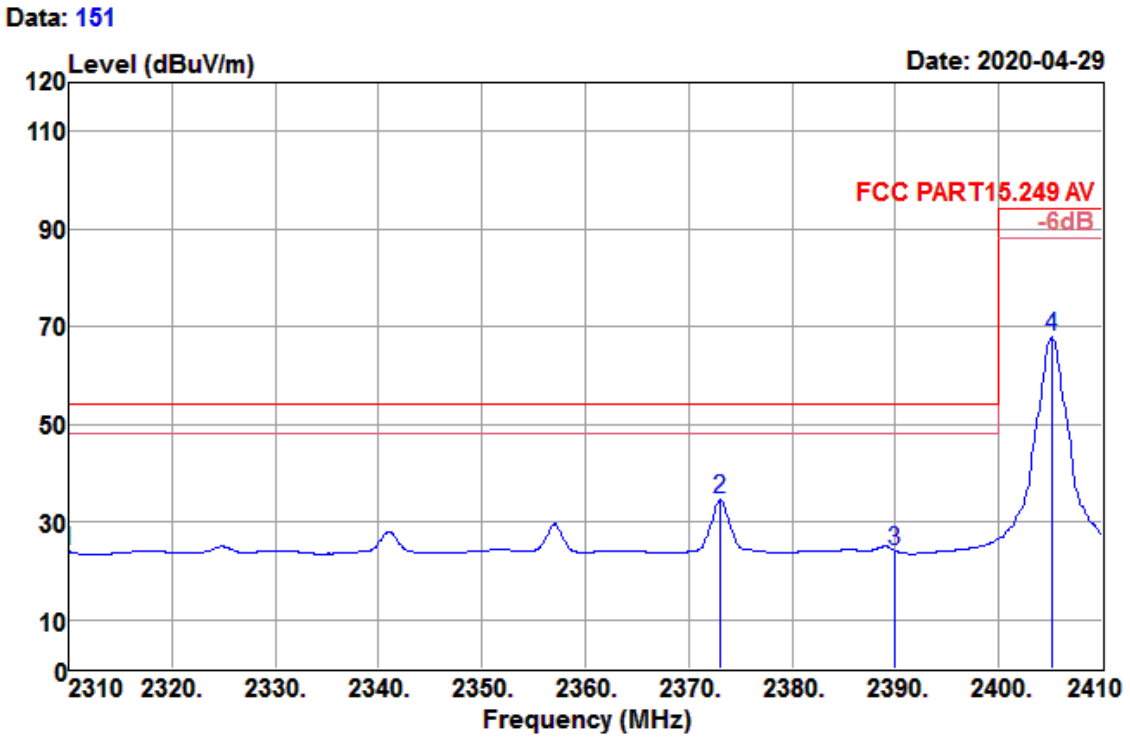
4.2.5 Test Result of Radiated Spurious at Band Edges

Test Mode :	Mode 1: CH01_2403.85 MHz	**Temperature :**	21~23℃
Test Engineer :	Jack Liu	**Relative Humidity :**	63~65%
Frequencey Range	2.31GHz~2.41GHz	**Polarization :**	Horizontal



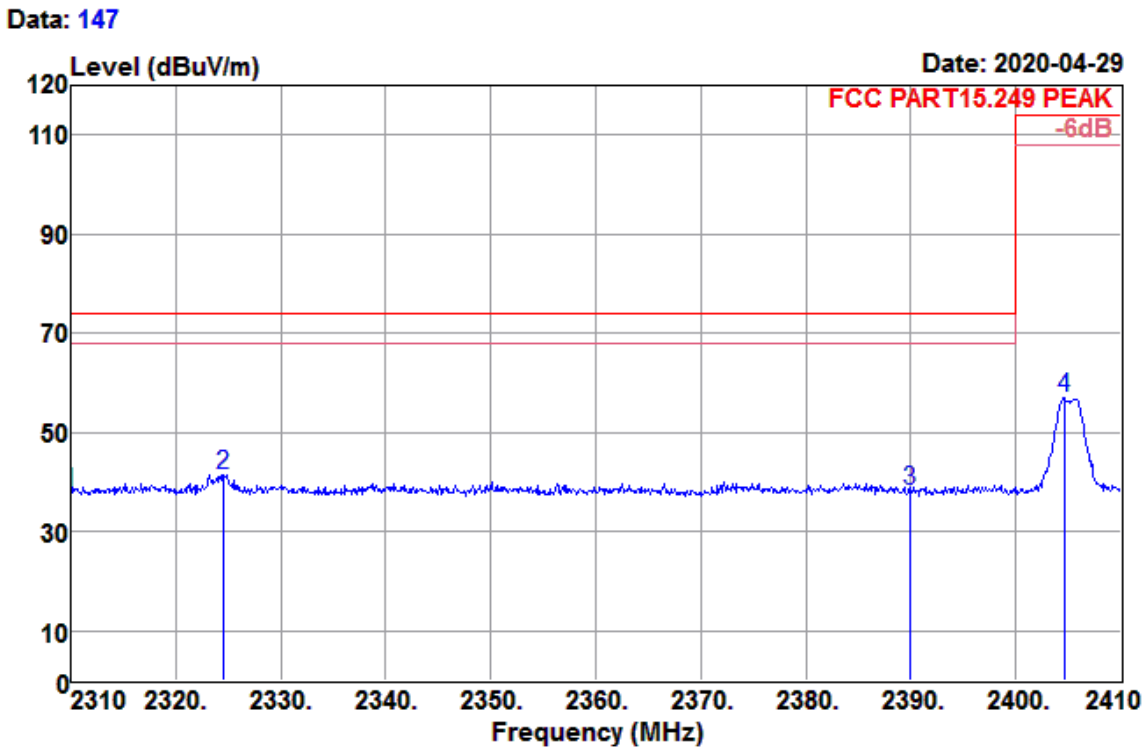
Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
2310.000	43.24	26.91	3.48	35.43	38.20	74.00	-35.80	Peak
2373.100	49.45	27.07	3.52	35.52	44.52	74.00	-29.48	Peak
2390.000	43.20	27.11	3.53	35.55	38.29	74.00	-35.71	Peak
2405.700	75.63	27.15	3.54	35.57	70.75	114.00	-43.25	Peak

Test Mode :	Mode 1: CH01_2403.85 MHz	Temperature :	21~23℃
Test Engineer :	Jack Liu	Relative Humidity :	63~65%
Frequencey Range	2.31GHz~2.41GHz	Polarization :	Horizontal



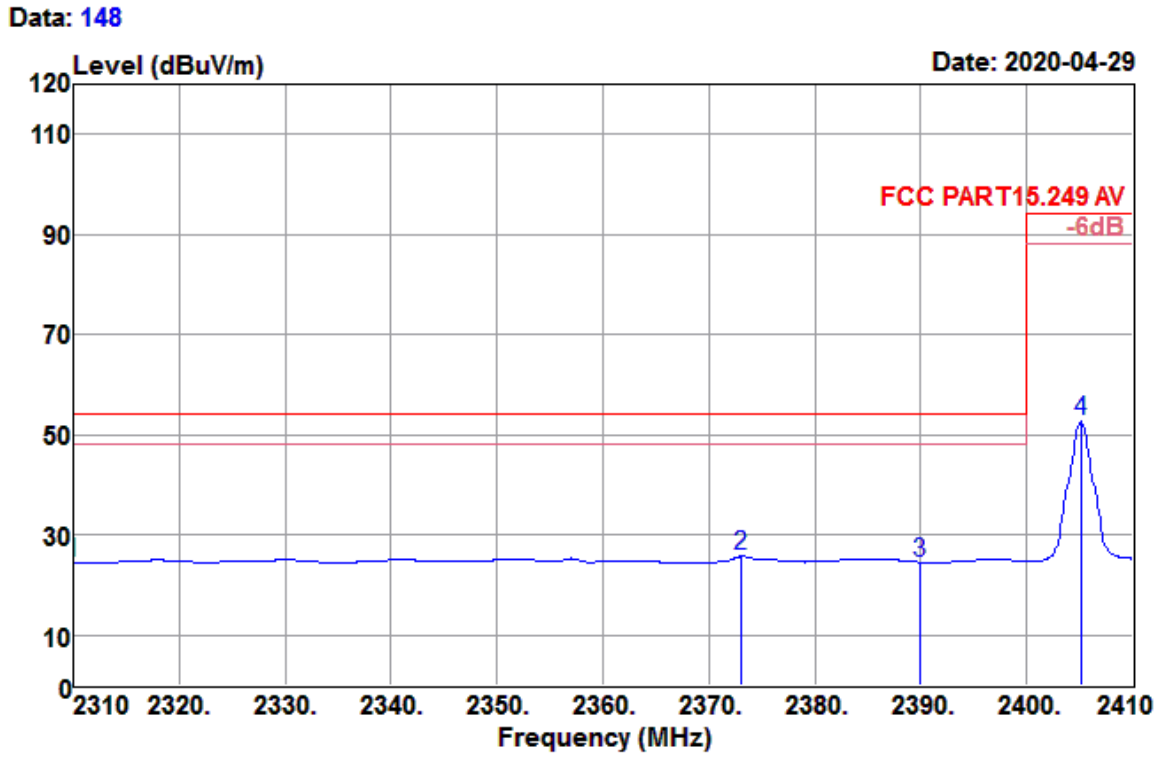
Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
2310.000	29.07	26.91	3.48	35.43	24.03	54.00	-29.97	Average
2373.100	39.64	27.07	3.52	35.52	34.71	54.00	-19.29	Average
2390.000	29.03	27.11	3.53	35.55	24.12	54.00	-29.88	Average
2405.100	72.76	27.15	3.54	35.57	67.88	94.00	-26.12	Average

Test Mode :	Mode 1: CH01_2403.85 MHz	Temperature :	21~23℃
Test Engineer :	Jack Liu	Relative Humidity :	63~65%
Frequencey Range	2.31GHz~2.41GHz	Polarization :	Vertical



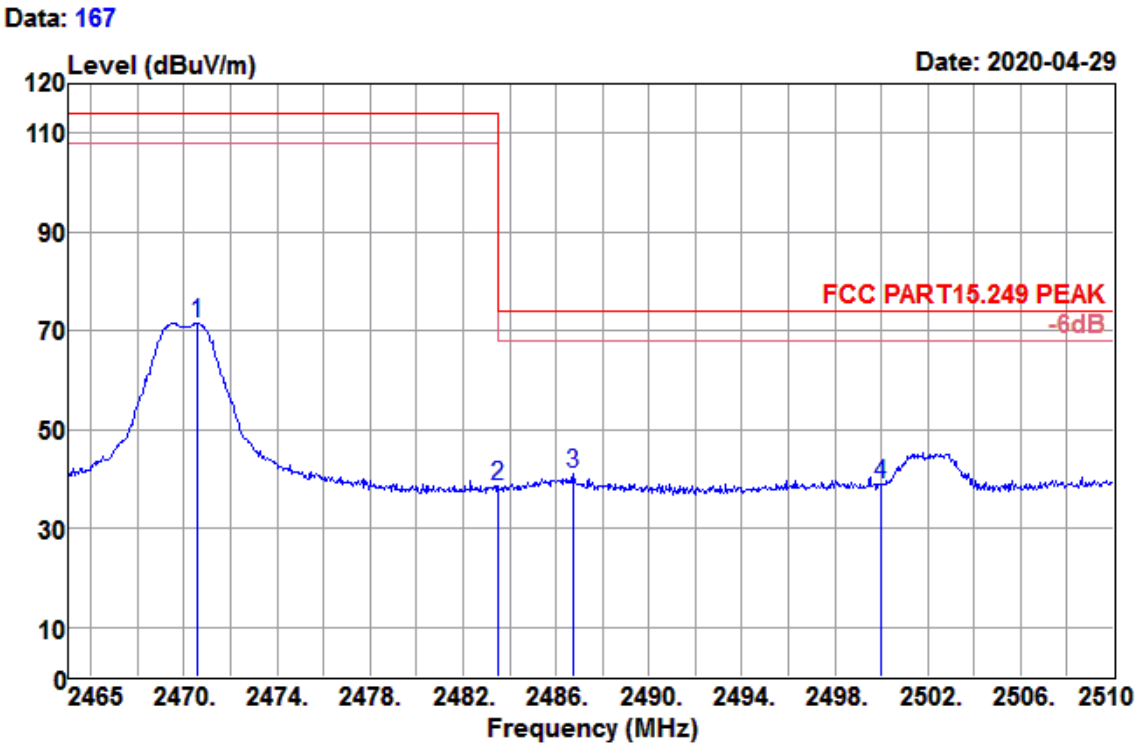
Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
2310.000	43.05	26.91	3.48	35.43	38.01	74.00	-35.99	Peak
2324.500	46.55	26.94	3.49	35.45	41.53	74.00	-32.47	Peak
2390.000	43.11	27.11	3.53	35.55	38.20	74.00	-35.80	Peak
2404.600	61.79	27.15	3.54	35.57	56.91	114.00	-57.09	Peak

Test Mode :	Mode 1: CH01_2403.85 MHz	Temperature :	21~23℃
Test Engineer :	Jack Liu	Relative Humidity :	63~65%
Frequencey Range	2.31GHz~2.41GHz	Polarization :	Vertical



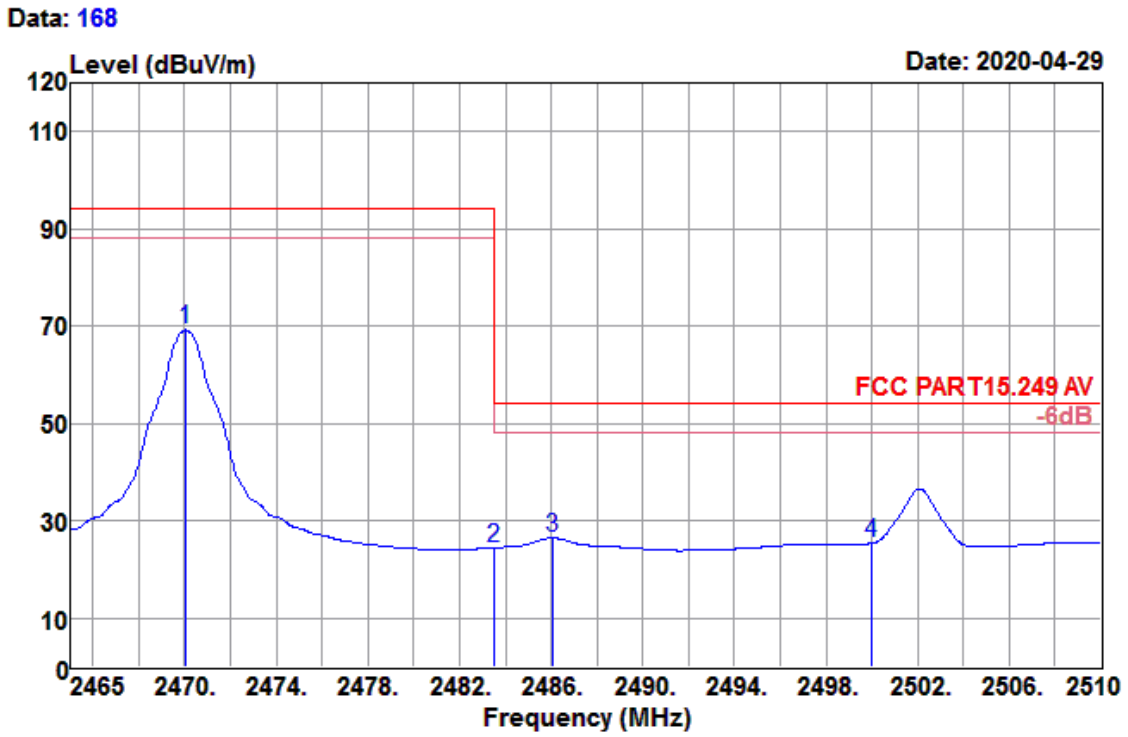
Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
2310.000	29.59	26.91	3.48	35.43	24.55	54.00	-29.45	Average
2373.100	30.68	27.07	3.52	35.52	25.75	54.00	-28.25	Average
2390.000	29.50	27.11	3.53	35.55	24.59	54.00	-29.41	Average
2405.100	57.49	27.15	3.54	35.57	52.61	94.00	-41.39	Average

Test Mode :	Mode 3: CH08_2479.85 MHz	Temperature :	21~23℃
Test Engineer :	Jack Liu	Relative Humidity :	63~65%
Frequencey Range	2.465GHz~2.51GHz	Polarization :	Horizontal



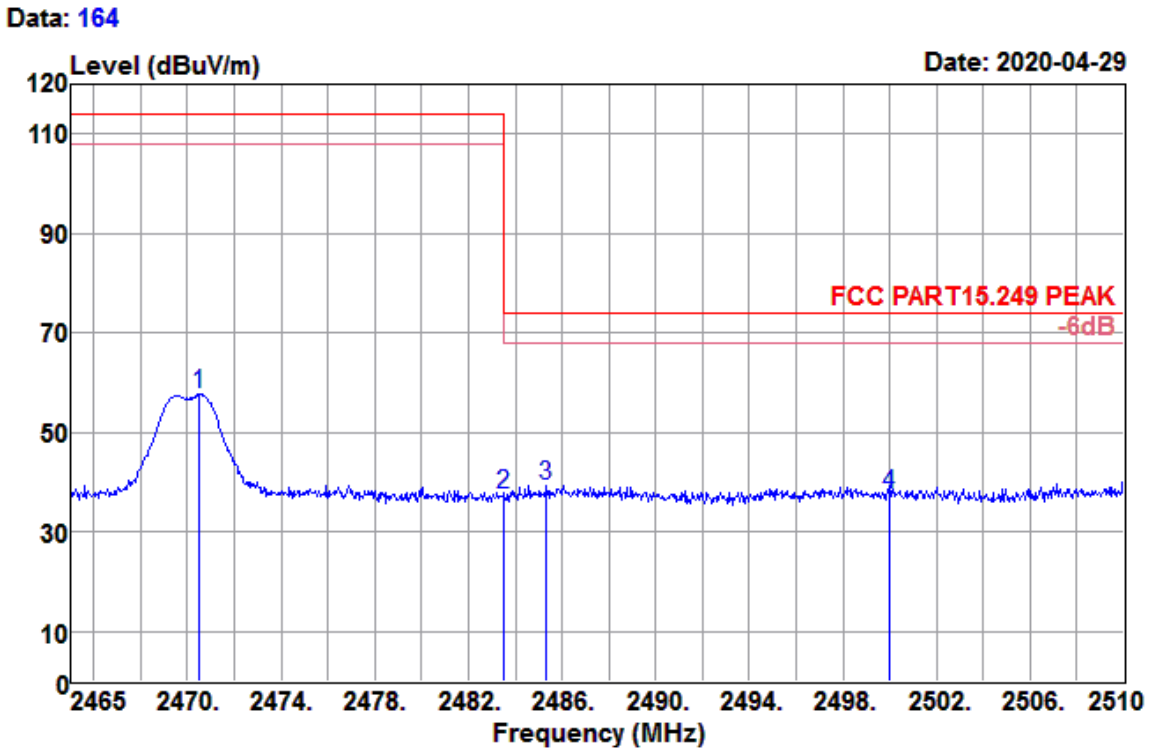
Freq	Reading level	Antenna factor	Cable loss	Preamp factor	level	Limit level	Over limit	Remark
MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
2470.580	76.22	27.32	3.58	35.66	71.46	114.00	-42.54	Peak
2483.500	43.30	27.36	3.59	35.68	38.57	74.00	-35.43	Peak
2486.780	45.86	27.37	3.59	35.68	41.14	74.00	-32.86	Peak
2500.000	43.63	27.40	3.60	35.70	38.93	74.00	-35.07	Peak

Test Mode :	Mode 3: CH08_2479.85 MHz	Temperature :	21~23℃
Test Engineer :	Jack Liu	Relative Humidity :	63~65%
Frequencey Range	2.465GHz~2.51GHz	Polarization :	Horizontal



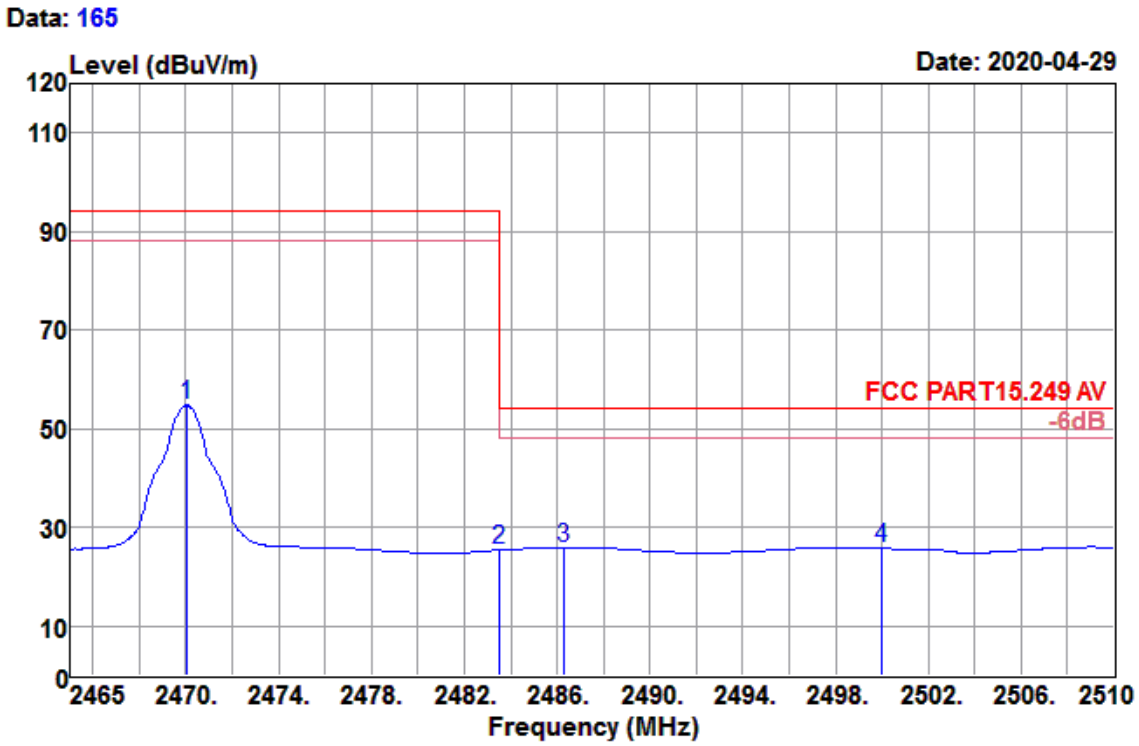
Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
2470.040	73.99	27.32	3.58	35.66	69.23	94.00	-24.77	Average
2483.500	29.27	27.36	3.59	35.68	24.54	54.00	-29.46	Average
2486.060	31.24	27.36	3.59	35.68	26.51	54.00	-27.49	Average
2500.000	30.13	27.40	3.60	35.70	25.43	54.00	-28.57	Average

Test Mode :	Mode 3: CH08_2479.85 MHz	Temperature :	21~23℃
Test Engineer :	Jack Liu	Relative Humidity :	63~65%
Frequencey Range	2.465GHz~2.51GHz	Polarization :	Vertical



Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
2470.490	62.53	27.32	3.58	35.66	57.77	114.00	-56.23	Peak
2483.500	42.23	27.36	3.59	35.68	37.50	74.00	-36.50	Peak
2485.340	44.11	27.36	3.59	35.68	39.38	74.00	-34.62	Peak
2500.000	42.09	27.40	3.60	35.70	37.39	74.00	-36.61	Peak

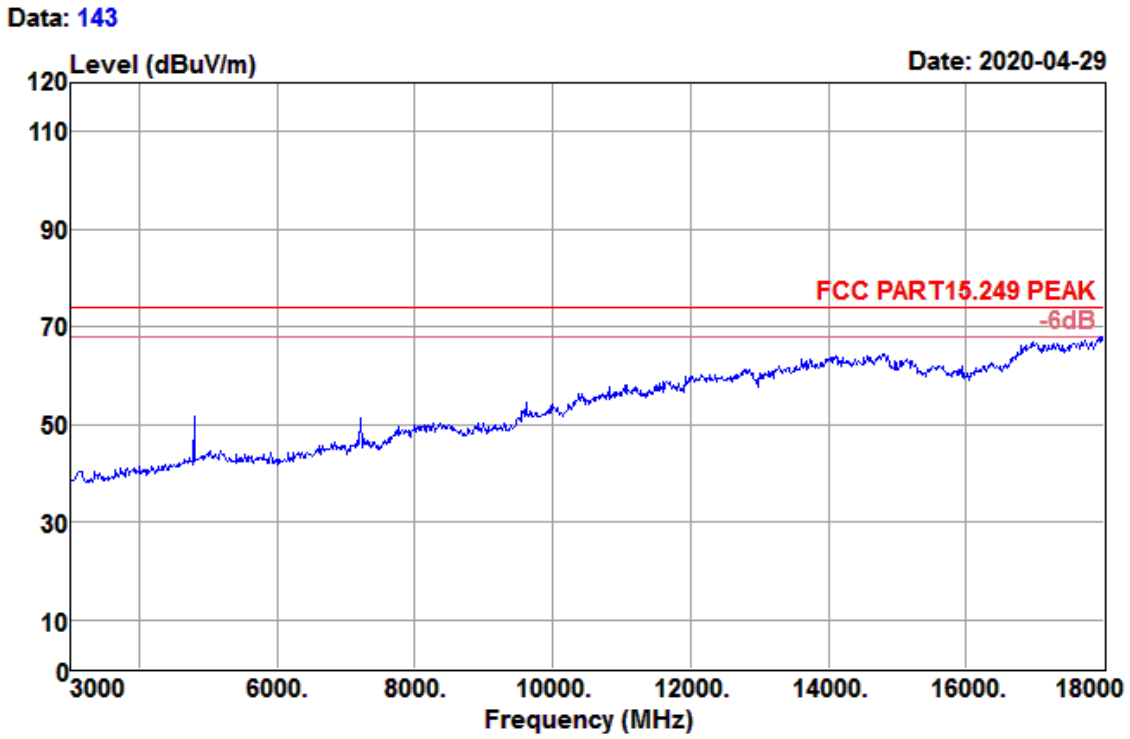
Test Mode :	Mode 3: CH08_2479.85 MHz	Temperature :	21~23℃
Test Engineer :	Jack Liu	Relative Humidity :	63~65%
Frequencey Range	2.465GHz~2.51GHz	Polarization :	Vertical



Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
2470.040	59.51	27.32	3.58	35.66	54.75	94.00	-39.25	Average
2483.500	30.18	27.36	3.59	35.68	25.45	54.00	-28.55	Average
2486.330	30.73	27.36	3.59	35.68	26.00	54.00	-28.00	Average
2500.000	30.42	27.40	3.60	35.70	25.72	54.00	-28.28	Average

4.2.6 Test Result of Radiated Spurious Emission

Test Mode :	Mode 1: CH01_2403.85 MHz	**Temperature :**	21~23℃
Test Engineer :	Jack Liu	**Relative Humidity :**	63~65%
Frequencey Range	3GHz~18GHz	**Polarization :**	Horizontal



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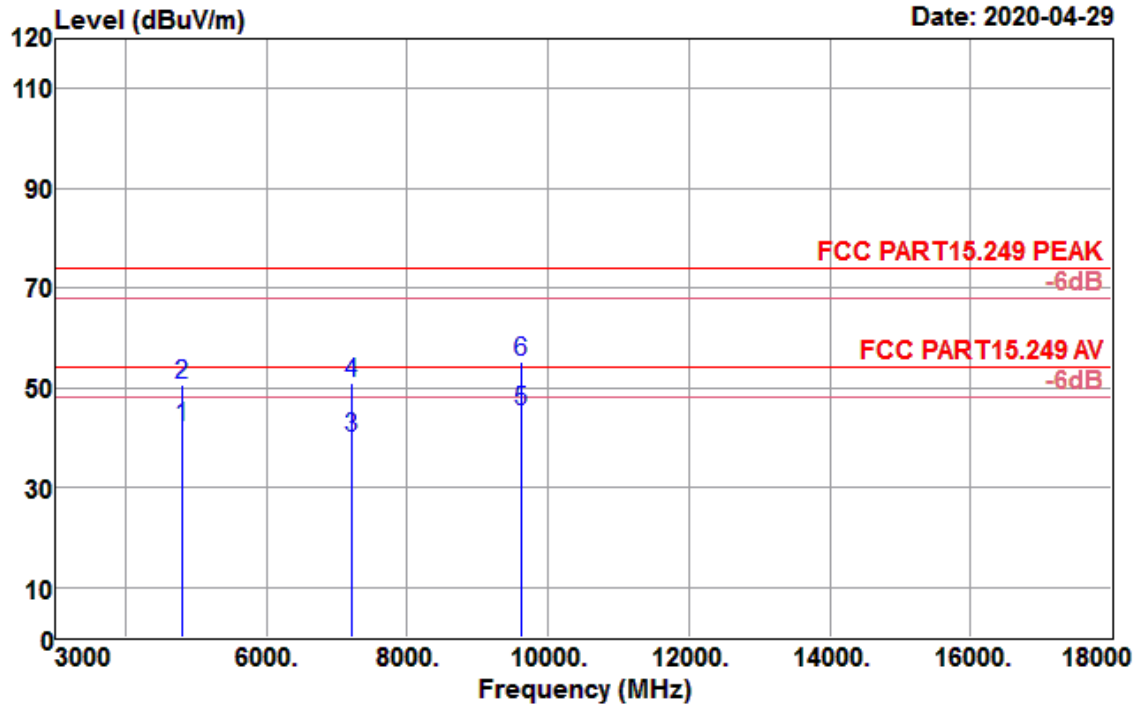
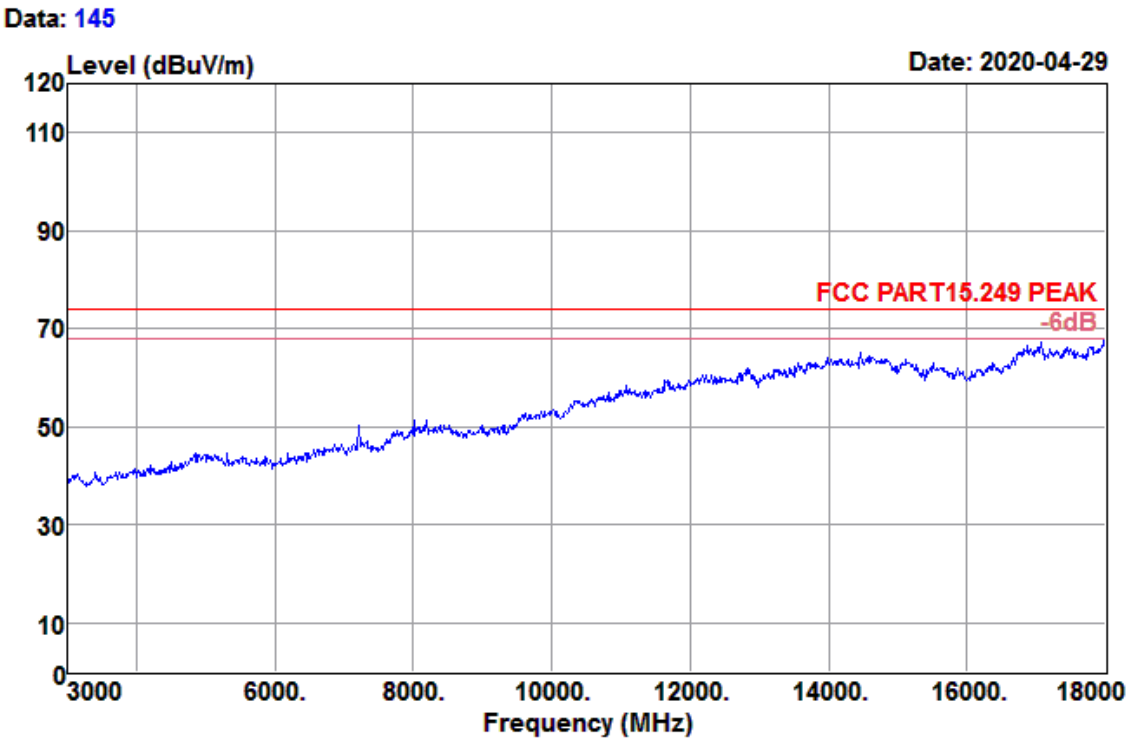
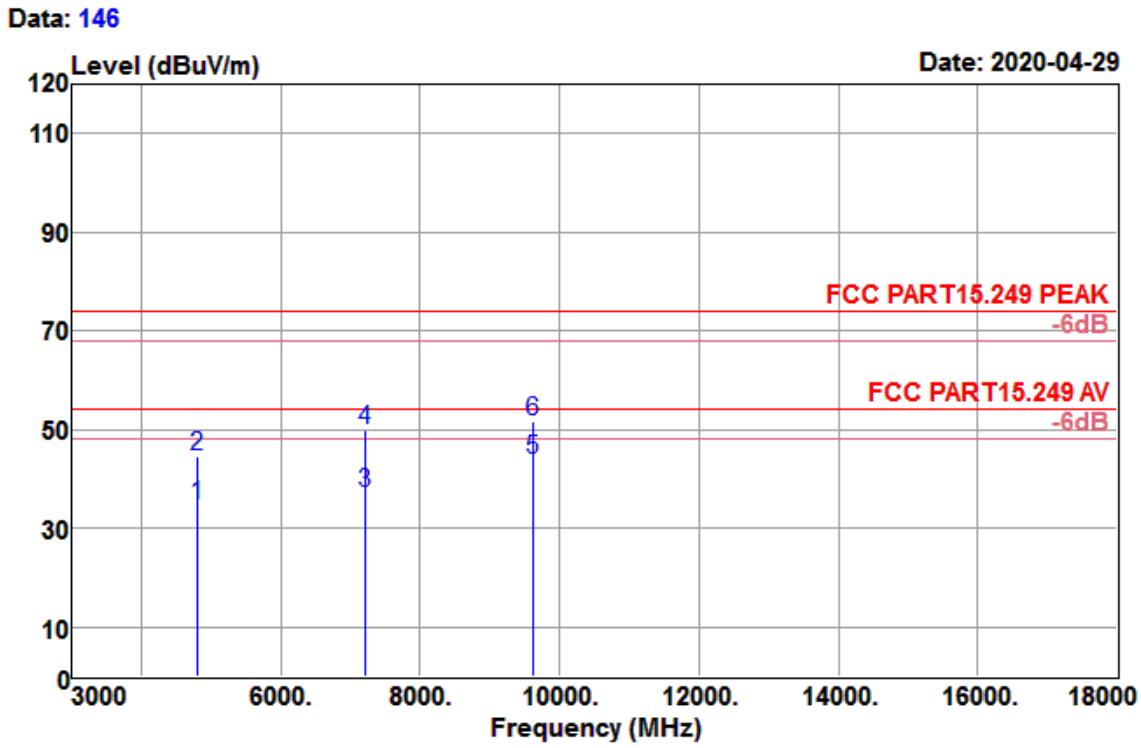


Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
4807.700	40.25	31.24	5.57	34.85	42.21	54.00	-11.79	Average
4807.700	48.53	31.24	5.57	34.85	50.49	74.00	-23.51	Peak
7211.550	32.92	35.89	7.63	36.40	40.04	54.00	-13.96	Average
7211.550	43.96	35.89	7.63	36.40	51.08	74.00	-22.92	Peak
9615.400	33.61	37.81	10.31	36.40	45.33	54.00	-8.67	Average
9615.400	43.62	37.81	10.31	36.40	55.34	74.00	-18.66	Peak

Test Mode :	Mode 1: CH01_2403.85 MHz	Temperature :	21~23℃
Test Engineer :	Jack Liu	Relative Humidity :	63~65%
Frequencey Range	3GHz~18GHz	Polarization :	Vertical

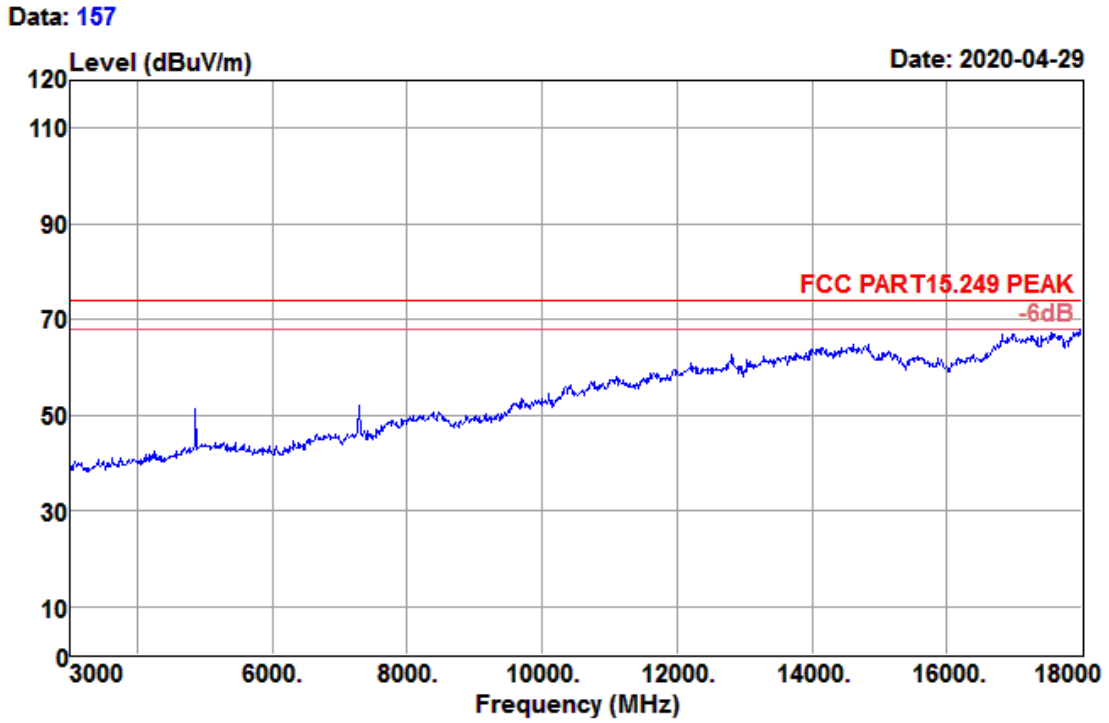




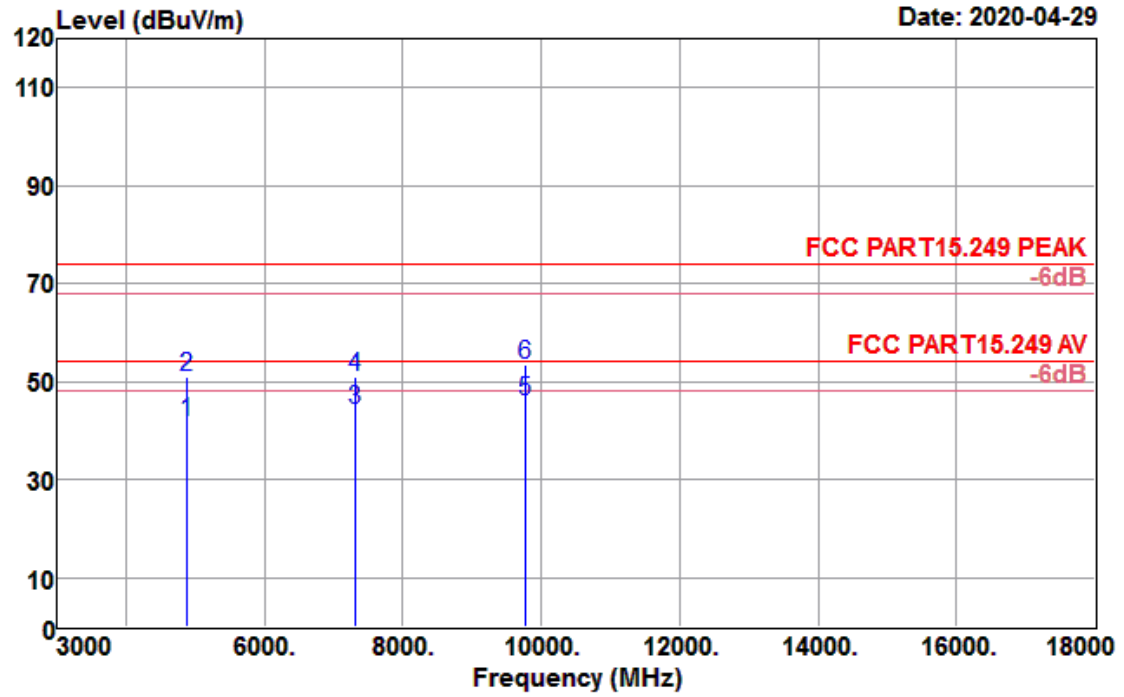
Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
4807.700	32.85	31.24	5.57	34.85	34.81	54.00	-19.19	Average
4807.700	42.59	31.24	5.57	34.85	44.55	74.00	-29.45	Peak
7211.550	30.19	35.89	7.63	36.40	37.31	54.00	-16.69	Average
7211.550	42.85	35.89	7.63	36.40	49.97	74.00	-24.03	Peak
9615.400	32.18	37.81	10.31	36.40	43.90	54.00	-10.10	Average
9615.400	39.82	37.81	10.31	36.40	51.54	74.00	-22.46	Peak

Note: Emission was scanned up to 26GHz; No emissions were detected above the noise floor which was at least 20dB below the specification limit.

Test Mode :	Mode 2: CH04_2441.85 MHz	Temperature :	21~23℃
Test Engineer :	Jack Liu	Relative Humidity :	63~65%
Frequencey Range	3GHz~18GHz	Polarization :	Horizontal

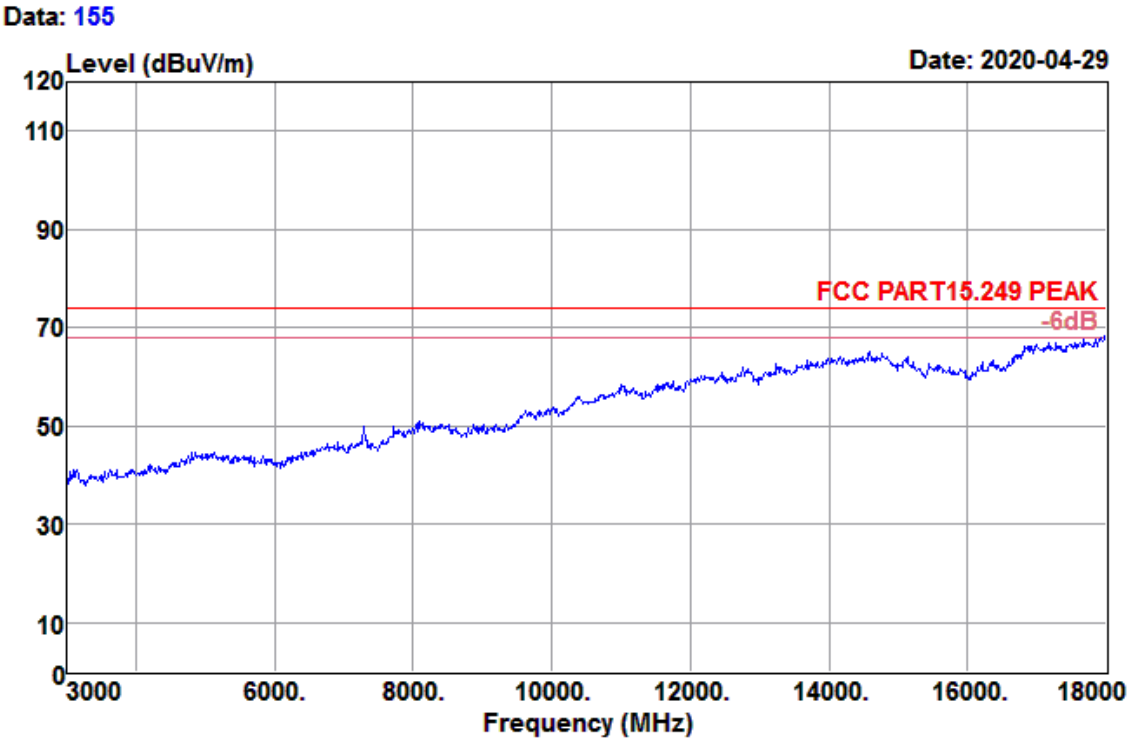


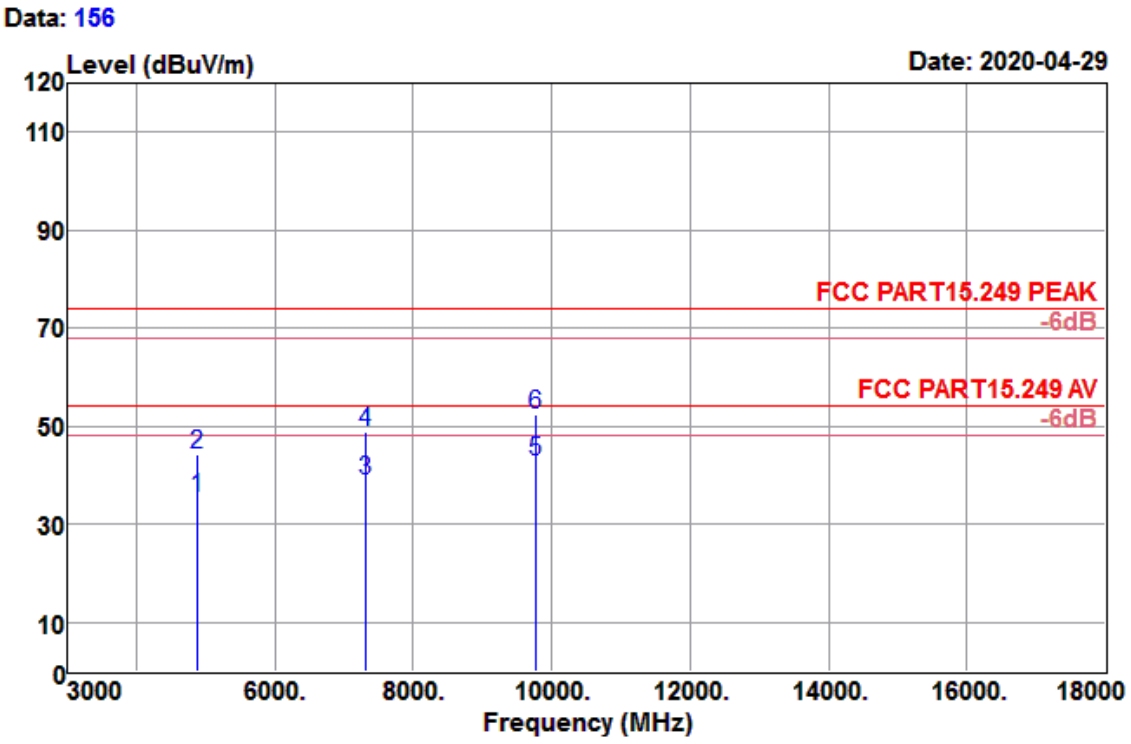
Data: 158



Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
4883.700	39.58	31.42	5.54	34.79	41.75	54.00	-12.25	Average
4883.700	48.75	31.42	5.54	34.79	50.92	74.00	-23.08	Peak
7325.550	36.91	36.15	7.52	36.40	44.18	54.00	-9.82	Average
7325.550	43.81	36.15	7.52	36.40	51.08	74.00	-22.92	Peak
9767.400	33.71	38.08	10.76	36.40	46.15	54.00	-7.85	Average
9767.400	40.91	38.08	10.76	36.40	53.35	74.00	-20.65	Peak

Test Mode :	Mode 2: CH04_2441.85 MHz	Temperature :	21~23℃
Test Engineer :	Jack Liu	Relative Humidity :	63~65%
Frequencey Range	3GHz~18GHz	Polarization :	Vertical

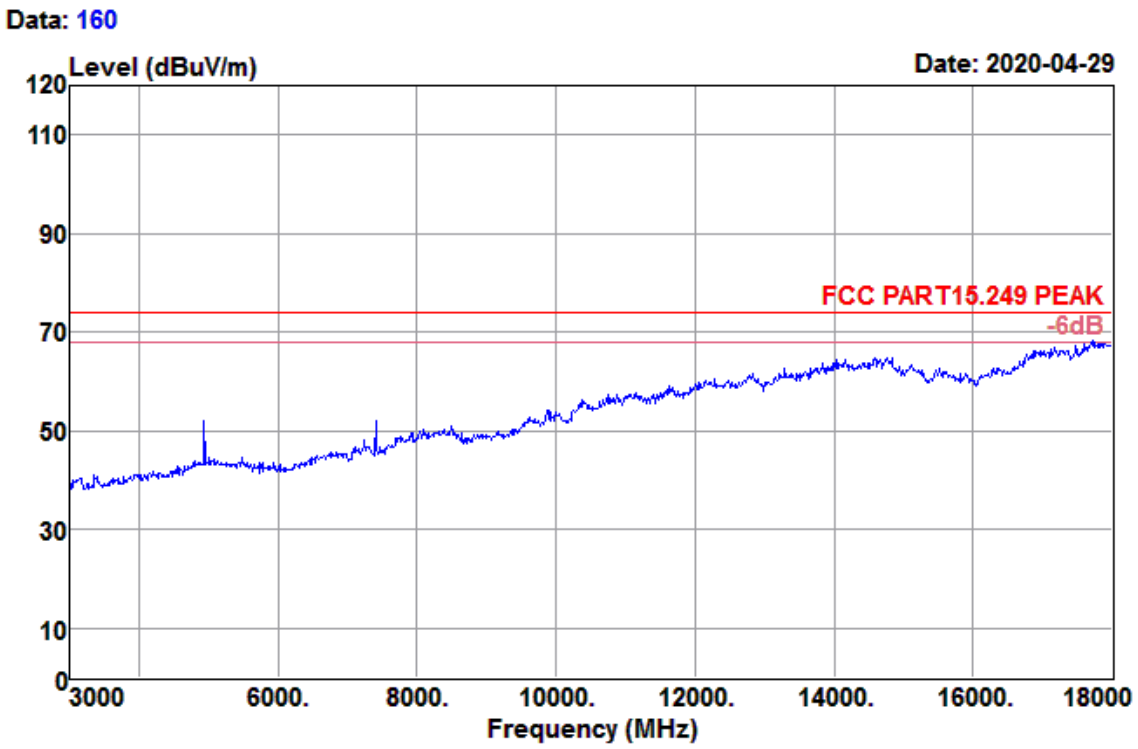




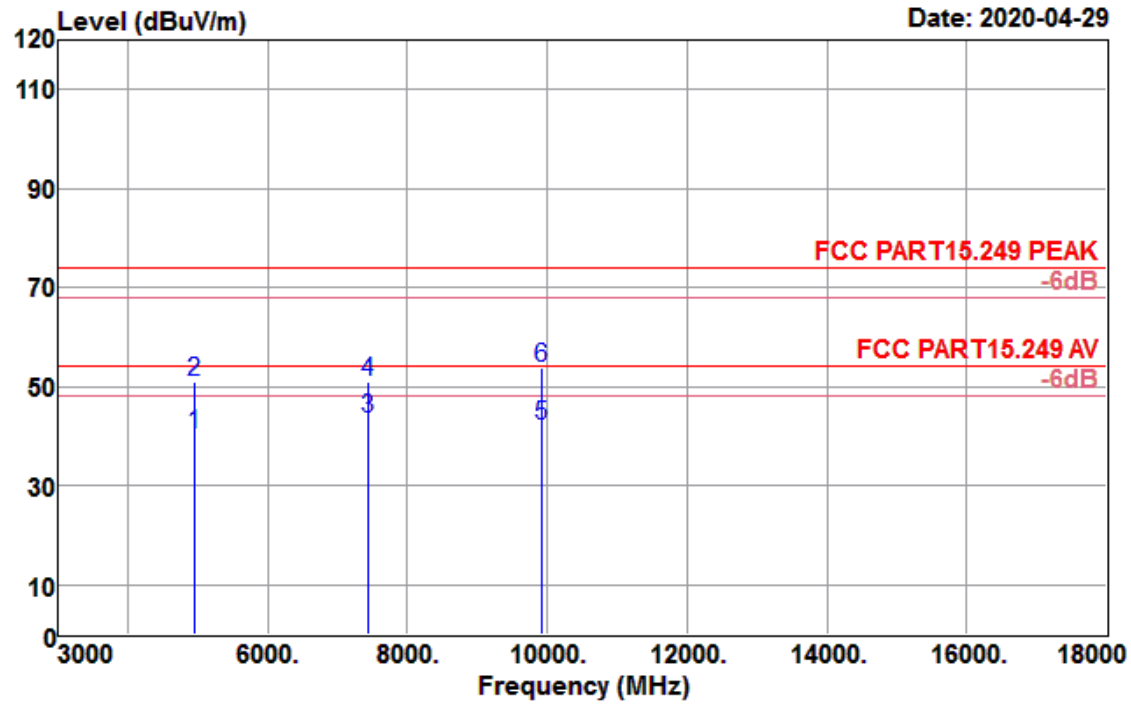
Freq	Reading level	Antenna factor	Cable loss	Preamp factor	level	Limit level	Over limit	Remark
MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
4883.700	33.18	31.42	5.54	34.79	35.35	54.00	-18.65	Average
4883.700	41.92	31.42	5.54	34.79	44.09	74.00	-29.91	Peak
7325.550	31.52	36.15	7.52	36.40	38.79	54.00	-15.21	Average
7325.550	41.68	36.15	7.52	36.40	48.95	74.00	-25.05	Peak
9767.400	30.52	38.08	10.76	36.40	42.96	54.00	-11.04	Average
9767.400	39.93	38.08	10.76	36.40	52.37	74.00	-21.63	Peak

Note: Emission was scanned up to 26GHz; No emissions were detected above the noise floor which was at least 20dB below the specification limit.

Test Mode :	Mode 3: CH08_2479.85 MHz	Temperature :	21~23℃
Test Engineer :	Jack Liu	Relative Humidity :	63~65%
Frequencey Range	3GHz~18GHz	Polarization :	Horizontal

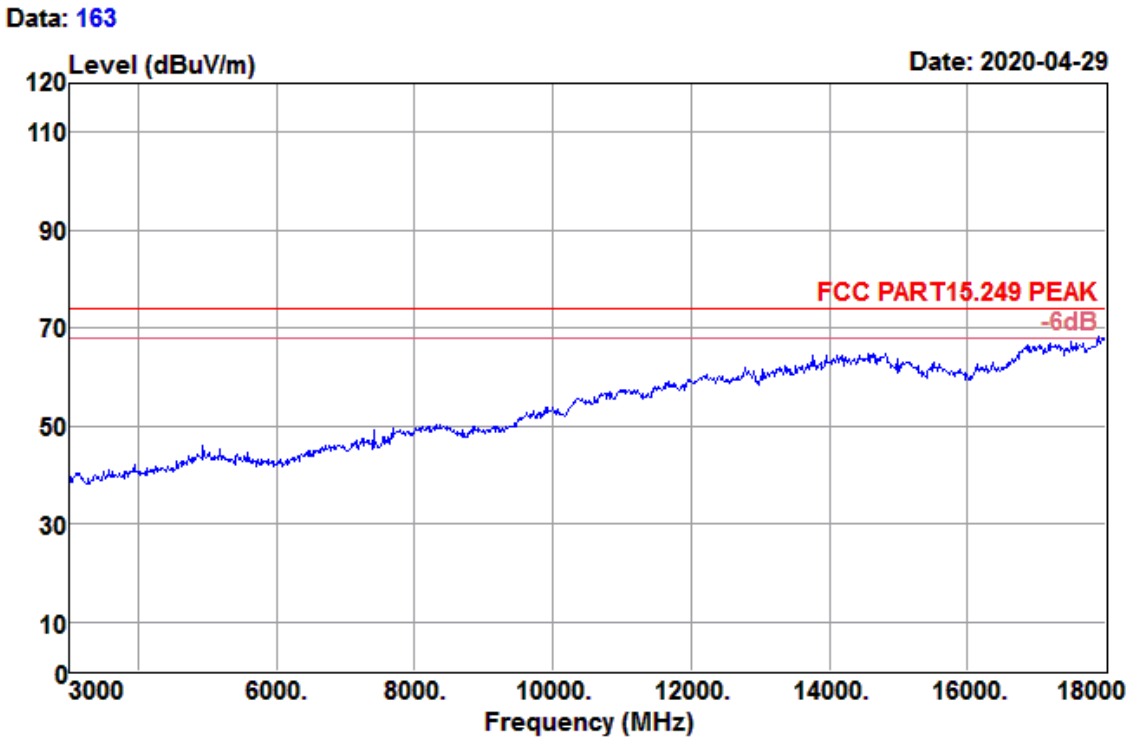


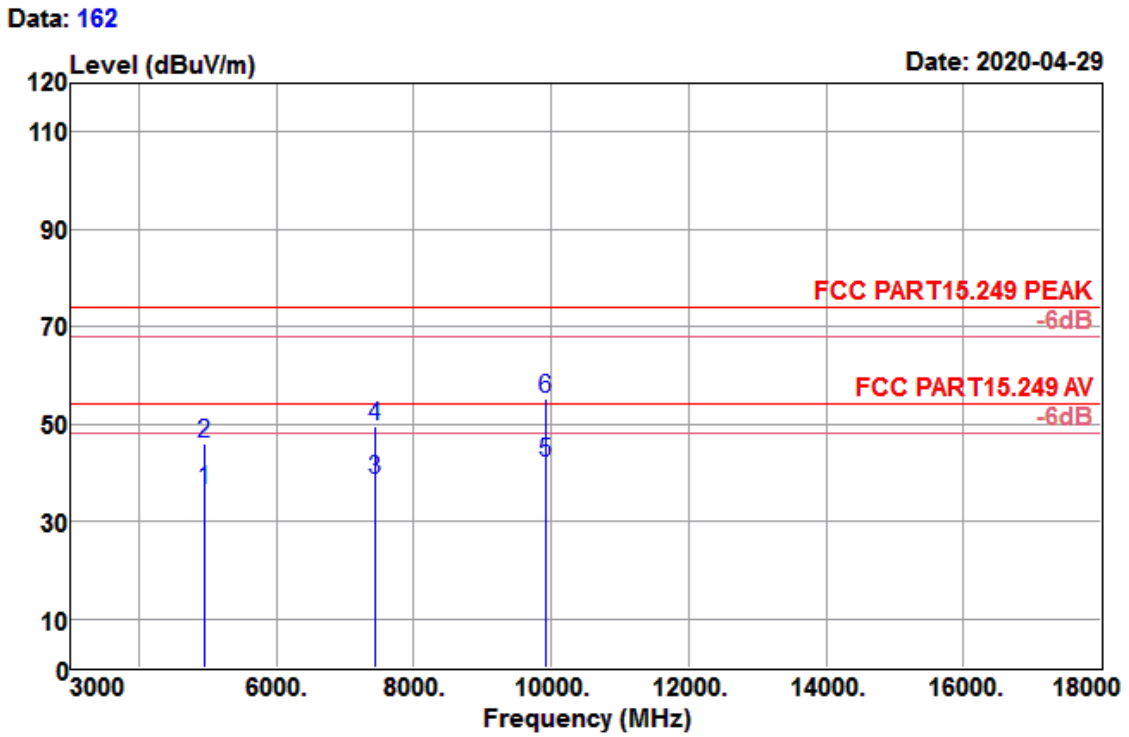
Data: 161



Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
4959.700	37.82	31.60	5.52	34.73	40.21	54.00	-13.79	Average
4959.700	48.69	31.60	5.52	34.73	51.08	74.00	-22.92	Peak
7439.550	35.93	36.41	7.56	36.40	43.50	54.00	-10.50	Average
7439.550	43.59	36.41	7.56	36.40	51.16	74.00	-22.84	Peak
9919.400	28.91	38.35	11.17	36.40	42.03	54.00	-11.97	Average
9919.400	40.84	38.35	11.17	36.40	53.96	74.00	-20.04	Peak

Test Mode :	Mode 3: CH08_2479.85 MHz	Temperature :	21~23℃
Test Engineer :	Jack Liu	Relative Humidity :	63~65%
Frequencey Range	3GHz~18GHz	Polarization :	Vertical



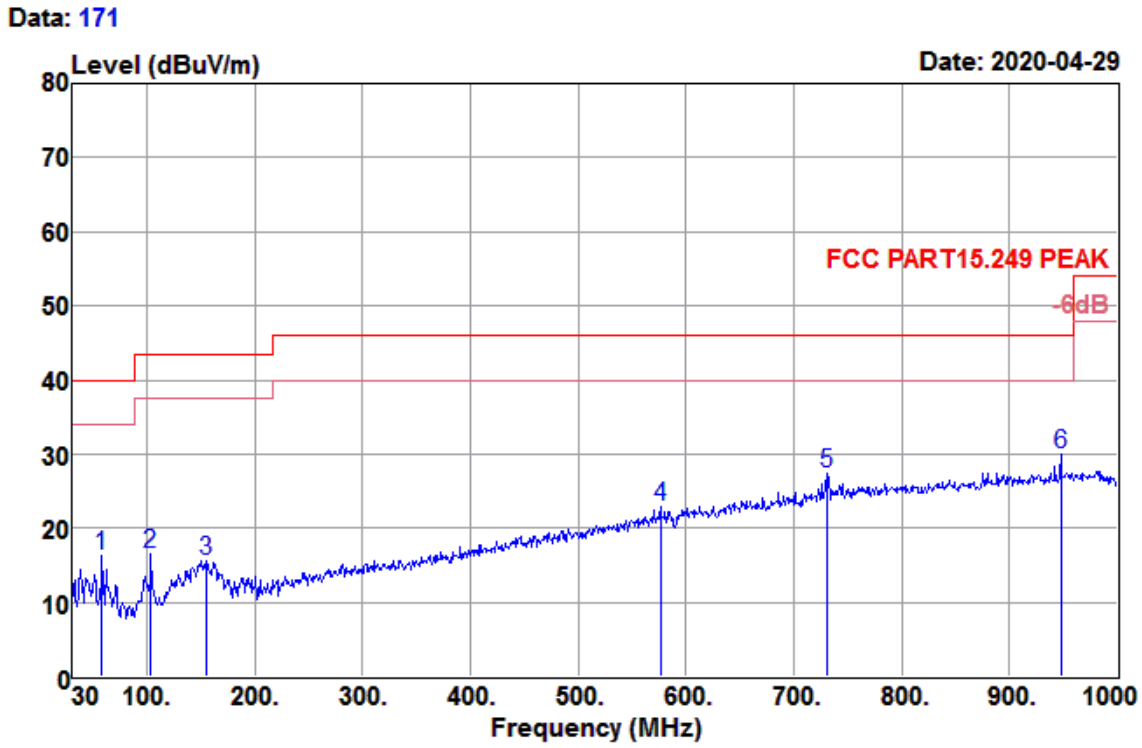


Freq	Reading level	Antenna factor	Cable loss	Preamp factor	level	Limit level	Over limit	Remark
MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
4959.700	33.95	31.60	5.52	34.73	36.34	54.00	-17.66	Average
4959.700	43.70	31.60	5.52	34.73	46.09	74.00	-27.91	Peak
7439.550	30.93	36.41	7.56	36.40	38.50	54.00	-15.50	Average
7439.550	41.84	36.41	7.56	36.40	49.41	74.00	-24.59	Peak
9919.400	29.12	38.35	11.17	36.40	42.24	54.00	-11.76	Average
9919.400	42.13	38.35	11.17	36.40	55.25	74.00	-18.75	Peak

Note: Emission was scanned up to 26GHz; No emissions were detected above the noise floor which was at least 20dB below the specification limit.

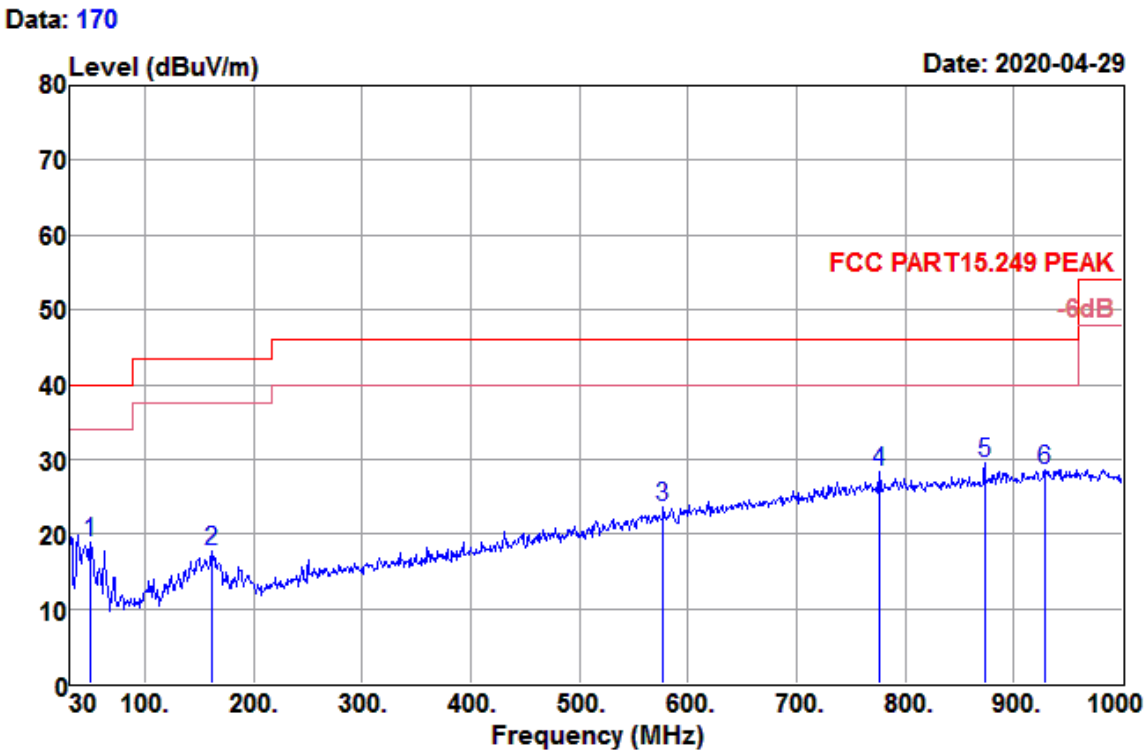
4.2.7 Test Result of Radiated Spurious Emission (30MHz ~ 1GHz)

Test Mode :	Mode 1: CH01_2403.85 MHz	**Temperature :**	21~23℃
Test Engineer :	Jack Liu	**Relative Humidity :**	63~65%
Frequencey Range	30MHz~1GHz	**Polarization :**	Horizontal



Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
58.130	35.41	11.64	1.64	32.50	16.19	40.00	-23.81	Peak
103.720	37.96	9.33	1.95	32.60	16.64	43.50	-26.86	Peak
154.160	31.79	14.21	2.14	32.63	15.51	43.50	-27.99	Peak
576.110	32.23	19.57	3.85	32.67	22.98	46.00	-23.02	Peak
731.310	33.26	21.83	4.42	32.21	27.30	46.00	-18.70	Peak
947.620	32.29	24.36	5.14	31.78	30.01	46.00	-15.99	Peak

Test Mode :	Mode 1: CH01_2403.85 MHz	Temperature :	21~23℃
Test Engineer :	Jack Liu	Relative Humidity :	63~65%
Frequencey Range	30MHz~1GHz	Polarization :	Vertical



Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
49.400	37.00	12.70	1.65	32.50	18.85	40.00	-21.15	Peak
161.920	34.54	13.70	2.19	32.63	17.80	43.50	-25.70	Peak
577.080	32.77	19.59	3.86	32.67	23.55	46.00	-22.45	Peak
775.930	33.56	22.30	4.59	32.07	28.38	46.00	-17.62	Peak
872.930	33.32	23.12	4.87	31.89	29.42	46.00	-16.58	Peak
928.220	31.29	24.01	5.08	31.81	28.57	46.00	-17.43	Peak

4.3 AC Conducted Emission Measurement

4.3.1 Limit of AC Conducted Emission

For equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table.

Frequency of emission (MHz)	Conducted limit (dBμV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

*Decreases with the logarithm of the frequency.

4.3.2 Test Procedures

1. The EUT was placed 0.4 meter from the conducting wall of the shielding room was kept at least 80 centimeters from any other grounded conducting surface.
2. Connect EUT to the power mains through a line impedance stabilization network (LISN).
3. All the support units are connecting to the other LISN.
4. The LISN provides 50 ohm coupling impedance for the measuring instrument.
5. The FCC states that a 50 ohm, 50 microhenry LISN should be used.
6. Both sides of AC line were checked for maximum conducted interference.
7. The frequency range from 150 kHz to 30 MHz was searched.
8. Set the test-receiver system to Peak Detect Function and specified bandwidth (IF Bandwidth = 9kHz) with Maximum Hold Mode. Then measurement is also conducted by Average Detector and Quasi-Peak Detector Function respectively.

4.3.3 Test Result of AC Conducted Emission

Not Required

4.4 Antenna Requirements

4.4.1 Standard Applicable

According to antenna requirement of §15.203.

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be re-placed by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of Sections 15.211, 15.213, 15.217, 15.219, or 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with Section 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this Part are not exceeded..

4.4.2 Antenna Connected Construction

An embedded-in antenna design is used.

4.4.3 Antenna Gain

The antenna peak gain of EUT is 1.87 dBi.

5 List of Measuring Equipment

Instrument	Manufacturer	Model No.	Serial No.	Calibration Date (YY-MM-DD)	Due Date (YY-MM-DD)	Remark
Spectrum Analyzer	Keysight	N9010A	MY56070788	2020-01-15	2021-01-14	Conducted
Power Sensor	Keysight	U2021XA	MY56510025	2020-01-16	2021-01-15	Conducted
Power Sensor	Keysight	U2021XA	MY57030005	2020-01-16	2021-01-15	Conducted
Power Sensor	Keysight	U2021XA	MY56510018	2020-01-16	2021-01-15	Conducted
Power Sensor	Keysight	U2021XA	MY56480002	2020-01-16	2021-01-15	Conducted
Thermal Chamber	Sanmtest	SMC-408-CD	2435	2019-05-09	2020-05-08	Conducted
Base Station	R&S	CMW 270	101231	2020-01-16	2021-01-15	Conducted
Signal Generator (Interferer)	Keysight	N5182B	MY56200384	2020-02-21	2021-02-20	Conducted
Signal Generator (Blocker)	Keysight	N5171B	MY56200661	2020-01-15	2021-01-14	Conducted

Instrument	Manufacturer	Model No.	Serial No.	Calibration Date (YY-MM-DD)	Due Date (YY-MM-DD)	Remark
Spectrum Analyzer	R&S	FSV 40	101433	2020-01-16	2021-01-15	Radiation
Amplifier	Sonoma	310	363917	2020-01-15	2021-01-14	Radiation
Amplifier	Schwarzbeck	BBV 9718	327	2020-01-15	2021-01-14	Radiation
Amplifier	Narda	TTA1840-35-HG	2034380	2019-05-15	2020-05-14	Radiation
Loop Antenna	Schwarzbeck	FMZB 1519B	1519B-051	2020-02-14	2023-02-13	Radiation
Broadband Antenna	Schwarzbeck	VULB 9168	9168-757	2018-08-31	2021-08-30	Radiation
Horn Antenna	Schwarzbeck	BBHA 9120 D	1677	2020-02-14	2023-02-13	Radiation
Horn Antenna	COM-POWER	AH-1840	101117	2018-06-20	2021-06-19	Radiation
Test Software	Audix	E3	6.111221a	N/A	N/A	Radiation
Filter	Micro-Tronics	BRM 50702	G266	N/A	N/A	Radiation

Instrument	Manufacturer	Model No.	Serial No.	Calibration Date	Due Date	Remark
LISN	R&S	ENV216	102125	2020-01-08	2021-01-07	Conducted
LISN	R&S	ENV432	101327	2020-01-08	2021-01-07	Conducted
EMI Test Receiver	R&S	ESR3	102143	2020-01-16	2021-01-15	Conducted
EMI Test Software	Audix	E3	N/A	N/A	N/A	Conducted

N/A: No Calibration Required

6 Uncertainty of Evaluation

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

MEASUREMENT	FREQUENCY	UNCERTAINTY
Conducted emissions	9kHz~30MHz	2.60dB
Radiated emission	30MHz ~ 1GMHz	5.05dB
	1GHz ~ 18GHz	5.06 dB
	18GHz ~ 40GHz	3.65dB

MEASUREMENT	UNCERTAINTY
Occupied Channel Bandwidth	±0.1%
RF output power, conducted	±1.2dB
Power density, conducted	±1.2dB

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