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:	HW159
Additional Model No.:	N/A
Brand Name:	N/A
FCC ID:	2AKHJHW159
Classification	DXX-Low Power Communication Device Transmitter
Report No.:	EC1809006F01
Tested Date:	2018-09-11 to 2018-09-28
Issued Date:	2018-10-08
Prepared By:	Tiny Yang/ Engineer
Approved By:	Bacon Wu / RF Manager

Hunan Ecloud Testing Technology Co., Ltd.

Building A1, Changsha E Center, No. 18 Xiangtai Avenue, Liuyang Economic and Technological Development Zone, Hunan, P.R.C

Tel.: +86-731-89634887 Fax.: +86-731-89634887

www.hn-ecloud.com

Report Revise Record

Report Version	Revise Time	Issued Date	Valid Version	Notes
V1.0	/	2018.10.08	Valid	Original Report

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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 -1.91 dB at 9620 MHz
15.207	AC Conducted Emission	15.207(a)	Pass	Under limit -12.70 dB at 0.502 MHz
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.

A2LA (Certificate Code : 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.	HW159
Additional No.	N/A
Difference Description	N/A
FCC ID	2AKHJHW159
IC ID	N/A
Power Supply	5Vdc (adapter or host equipment) 3.7Vdc (Li-ion)
Modulation Technology	DXX-Part 15 Low Power Communication Device Transmitter
Modulation Type	GFSK
Operating Frequency	2405MHz~2470MHz
Number Of Channel	8
Antenna Type	PCB Antenna type with -1.2dBi 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			
Channel	Frequency	Channel	Frequency
01	2405MHz	05	2440MHz
02	2413MHz	06	2450MHz
03	2422MHz	07	2460MHz
04	2430MHz	08	2470MHz

Note:

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

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_2405 MHz Mode 2: CH04_2430 MHz Mode 3: CH08_2470 MHz

3.2.2 Radiated Emission Test (Below 1GHz)

Radiated Test Cases	**2.4G Wireless**	
	Transmitting	Mode 1: CH01_2405 MHz Mode 2: CH04_2430 MHz Mode 3: CH08_2470 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)

Radiated Test Cases	**2.4G Wireless**	
	Transmitting	Mode 1: CH01_2405 MHz Mode 2: CH04_2430 MHz Mode 3: CH08_2470 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.

3.2.4 Power Line Conducted Emission Test:

AC Conducted Emission	Mode 1 : Wireless 2.4G Link + USB Cable (Charging from Adapter)

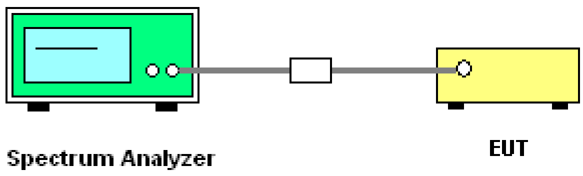
3.3 Support Equipment

Item	Equipment	Trade Name	Model Name	FCC ID	Data Cable	Power Cord
1.	Adapter	HTC	TC E250	N/A	N/A	N/A
2.	Micro-USB Cable	HTC	N/A	N/A	N/A	unshielded 1.2m
3.	Notebook	Lenovo	E540	FCC DoC	N/A	shielded cable DC O/P 1.8 m unshielded AC I/P cable1.2 m

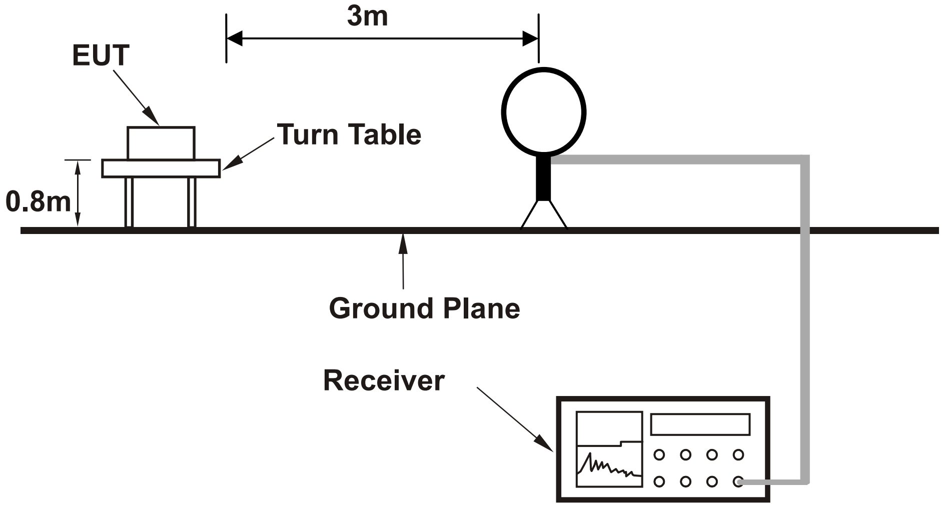
3.4 Test Setup

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

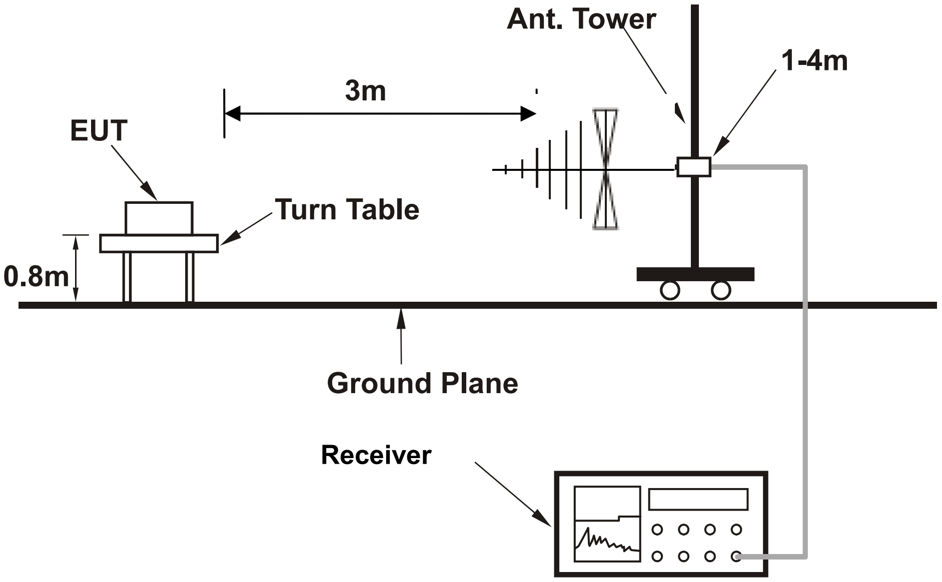
Setup diagram for Conducted Test



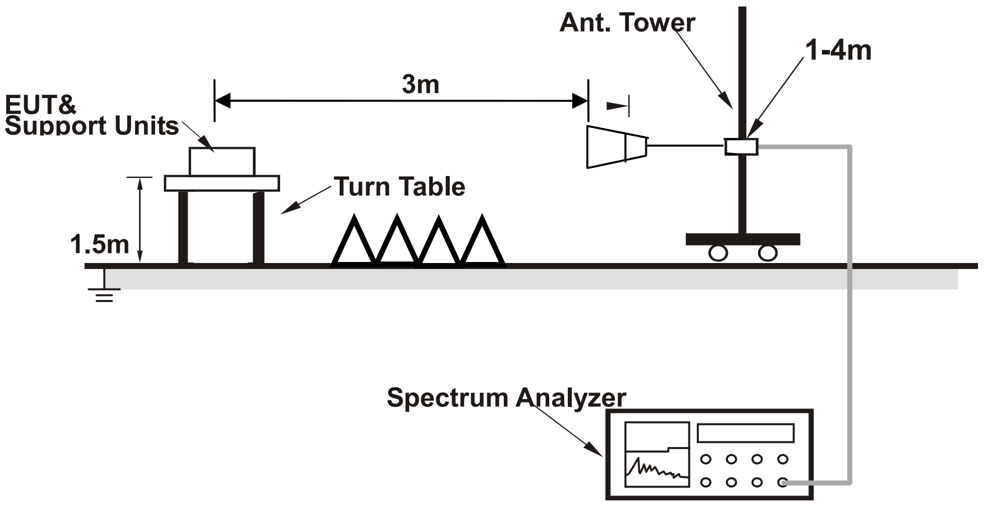
Setup diagram for Raidation(9KHz~30MHz) Test



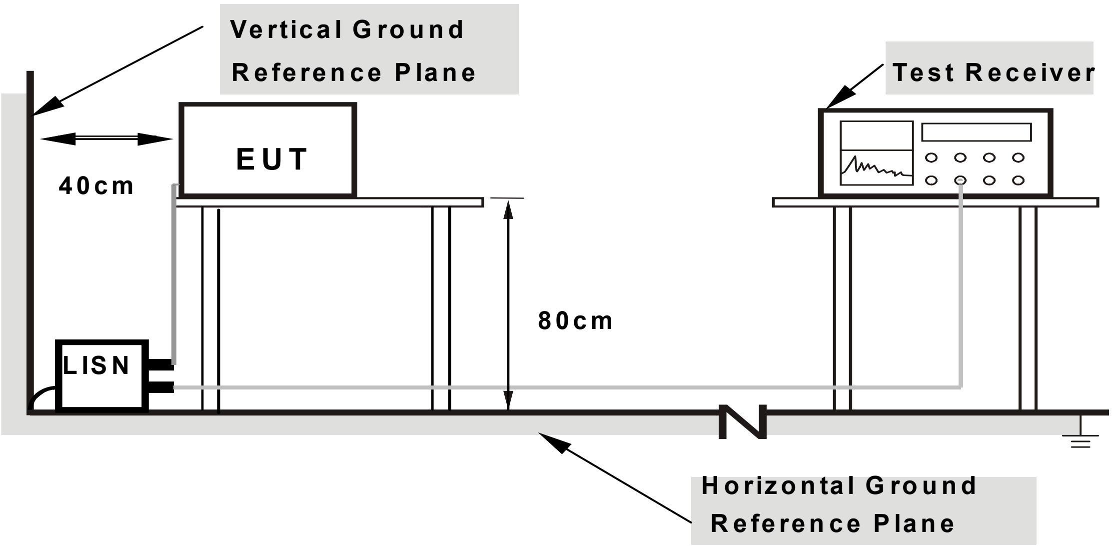
Setup diagram for Raidation(Below 1G) Test



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)

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 :	Damon Zhang	**Relative Humidity :**	41~43%

Channel.	20dB Bandwidth [MHz]	Verdict
LCH	2.597	PASS
MCH	2.555	PASS
HCH	2.586	PASS

20dB Plot

Graphs

GFSK/LCH

GFSK/MCH

GFSK/HCH	Center Freq 2.470000000 GHz Center Freq: 2.470000000 GHz Trig: Free Run Avg|Hold:>10/10 #Atten: 30 dB Radio Std: None Radio Device: BTS Trace/Detector 10 dB/div Ref 20.00 dBm Log Center 2.47 GHz #Res BW 100 kHz #VBW 300 kHz Span 10 MHz Sweep 1 ms Clear Write Average Max Hold Min Hold Detector Peak Auto Man Occupied Bandwidth 2.3459 MHz Total Power 11.3 dBm Transmit Freq Error -33.763 kHz % of OBW Power 99.00 % x dB Bandwidth 2.586 MHz x dB -20.00 dB File <Screen_0015.png> saved STATUS

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

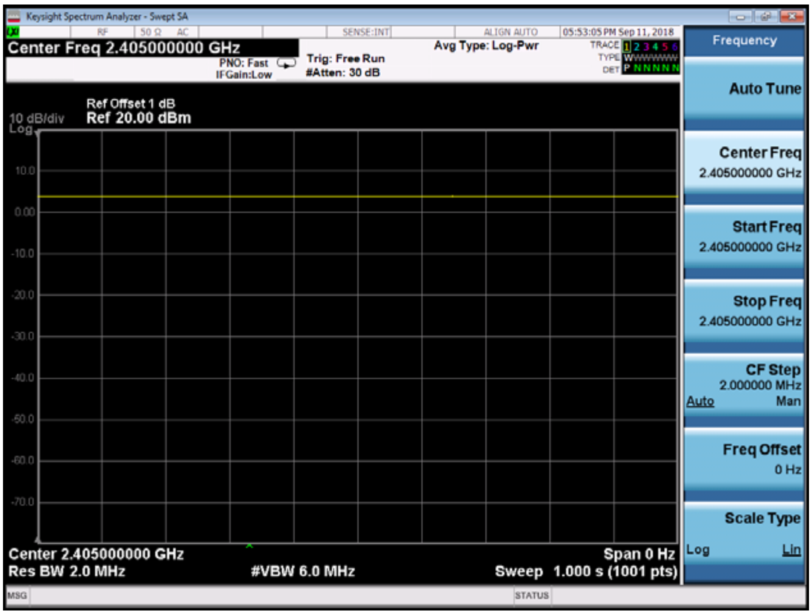
Frequency (MHz)	Field Strength (millivolts/meter)	Measurement Distance (meters)
2400-2483.5	50	3m

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	100	10Hz



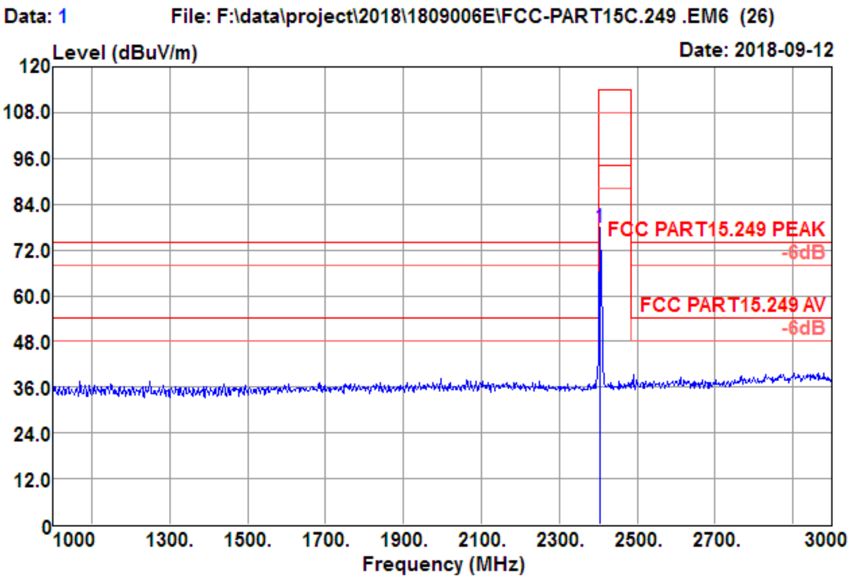
Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level

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.

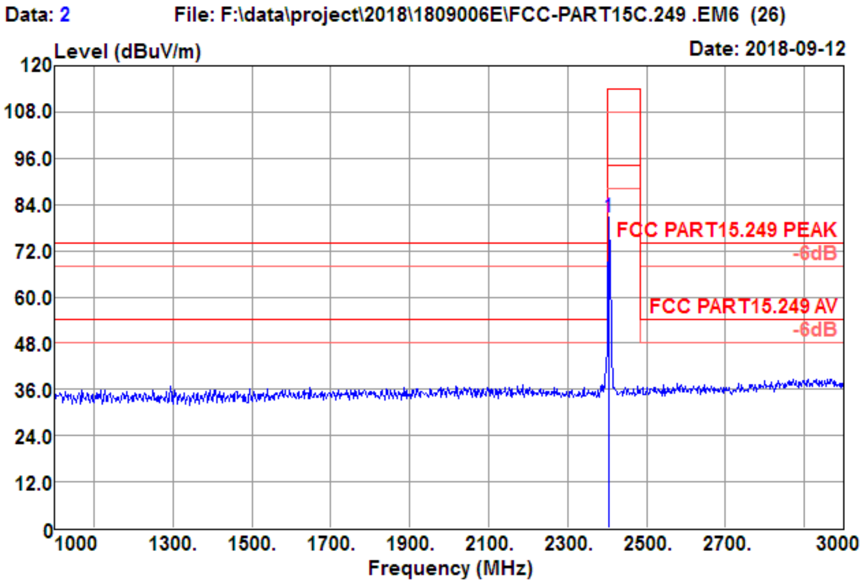
4.2.4 Field Strength of The Fundamental Signal

Low Channel Horizontal:



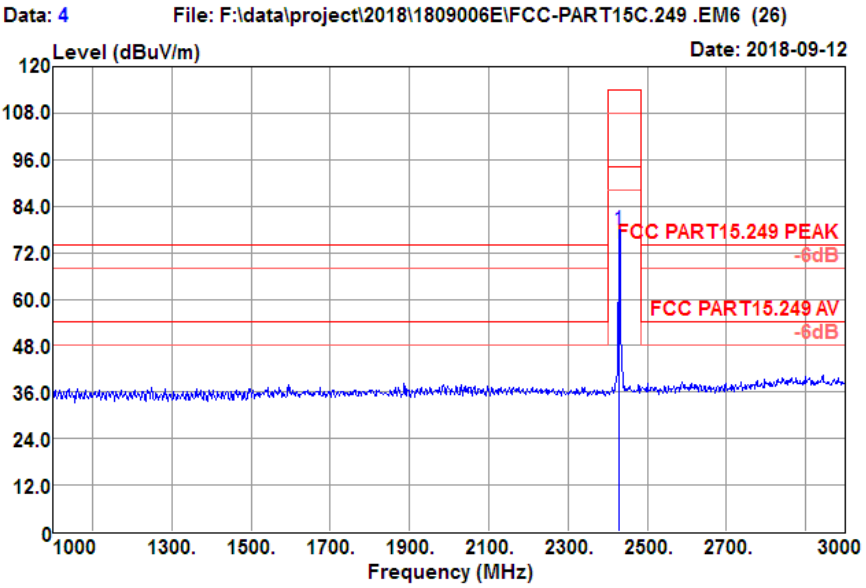
Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV	Limit level dBuV/m	Over limit dB	Remark
2405.000	83.37	27.15	3.65	36.12	78.05	114.00	-35.95	Peak

Low Channel Vertical:



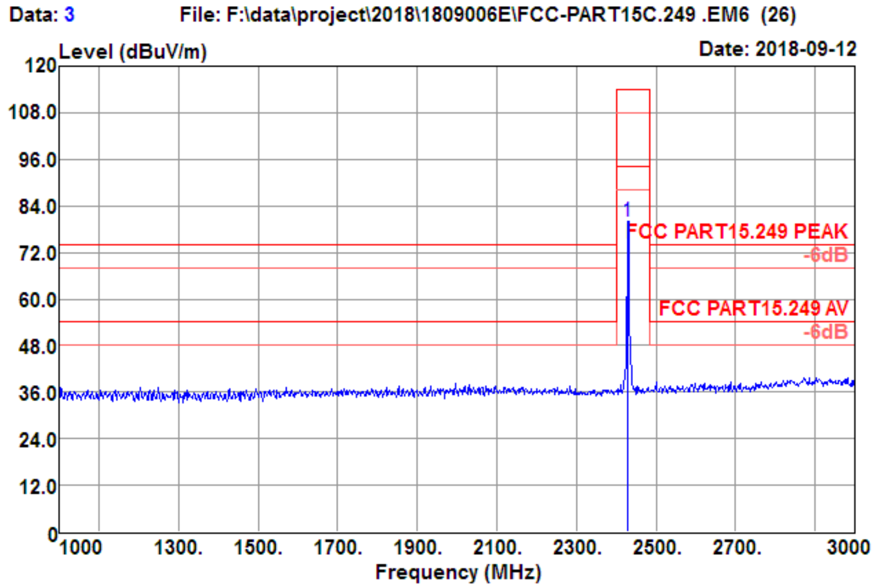
Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV	Limit level dBuV/m	Over limit dB	Remark
2405.000	86.01	27.15	3.65	36.12	80.69	114.00	-33.31	Peak

Middle Channel Horizontal:



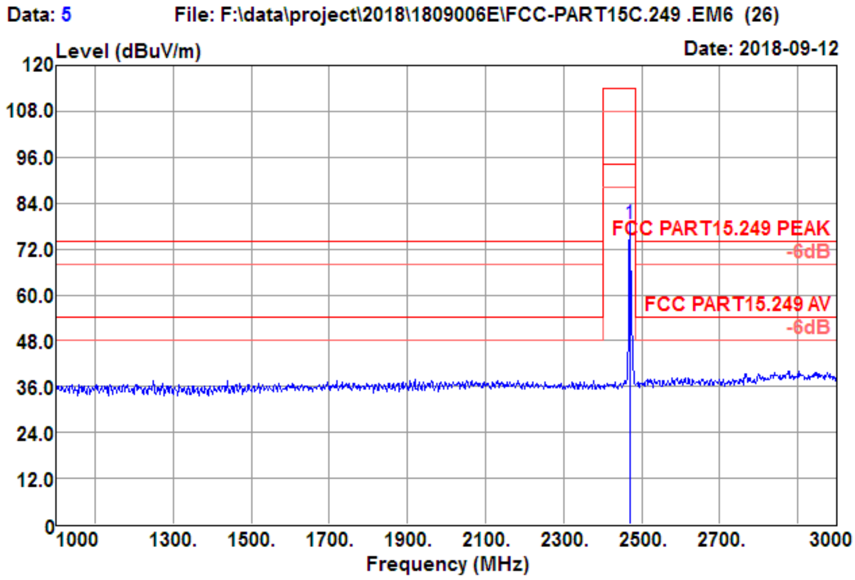
Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV	Limit level dBuV/m	Over limit dB	Remark
2430.000	83.32	27.22	3.66	36.19	78.01	114.00	-35.99	Peak

Middle Channel Vertical:



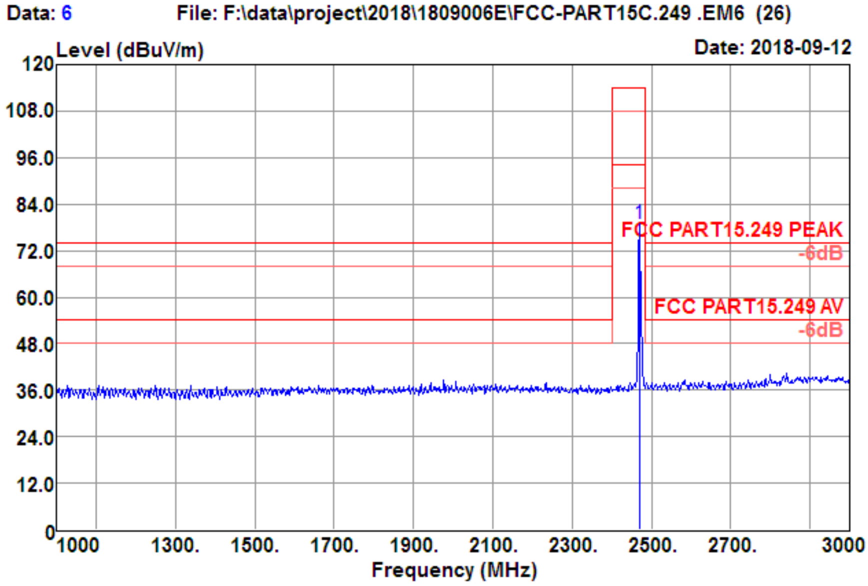
Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV	Limit level dBuV/m	Over limit dB	Remark
2430.000	85.48	27.22	3.66	36.19	80.17	114.00	-33.83	Peak

High Channel Horizontal:



Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV	Limit level dBuV/m	Over limit dB	Remark
2470.000	84.01	27.32	3.67	36.29	78.71	114.00	-35.29	Peak

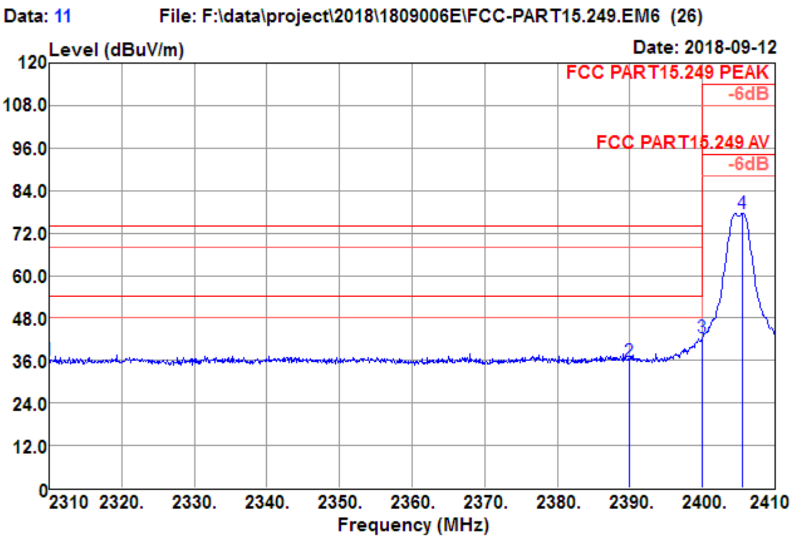
High Channel Vertical:



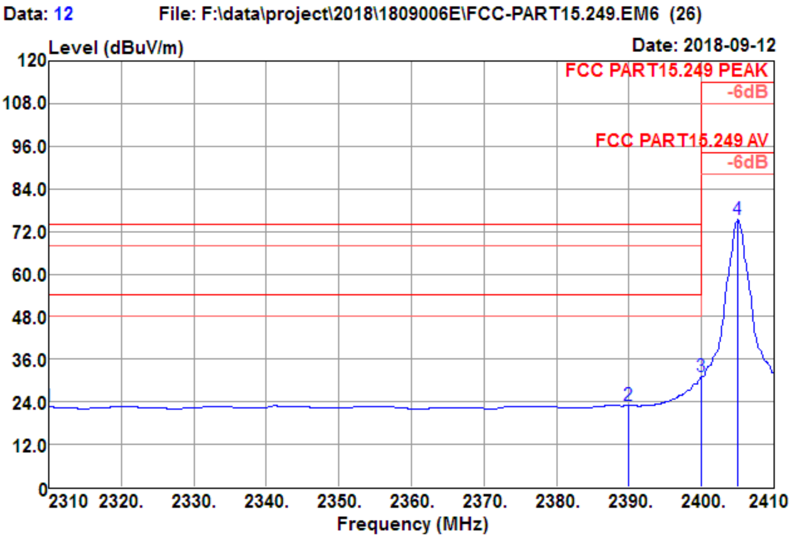
Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV	Limit level dBuV/m	Over limit dB	Remark
2470.000	84.24	27.32	3.67	36.29	78.94	114.00	-35.06	Peak

4.2.5 Test Result of Radiated Spurious at Band Edges

Low Channel Horizontal:

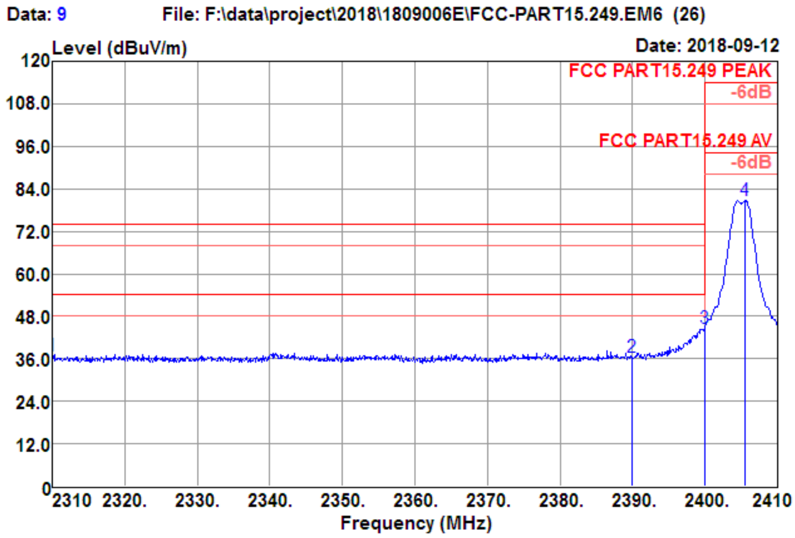


Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV	Limit level dBuV/m	Over limit dB	Remark
2310.000	41.45	26.91	3.56	35.87	36.05	74.00	-37.95	Peak
2390.000	41.14	27.11	3.64	36.08	35.81	74.00	-38.19	Peak
2400.000	47.67	27.14	3.65	36.11	42.35	74.00	-31.65	Peak
2405.500	82.98	27.15	3.65	36.12	77.66	114.00	-36.34	Peak

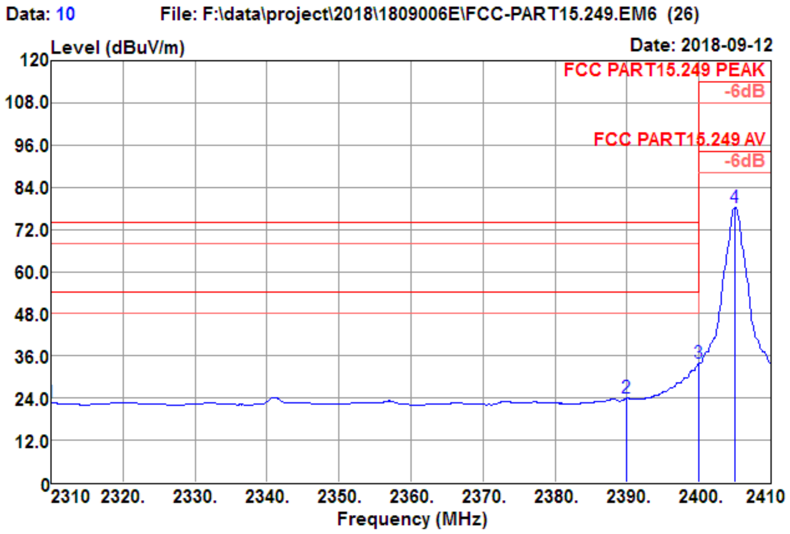


Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV	Limit level dBuV/m	Over limit dB	Remark
2310.000	27.93	26.91	3.56	35.87	22.53	54.00	-31.47	Average
2390.000	28.41	27.11	3.64	36.08	23.08	54.00	-30.92	Average
2400.000	36.47	27.14	3.65	36.11	31.15	54.00	-22.85	Average
2405.000	80.61	27.15	3.65	36.12	75.29	94.00	-18.71	Average

Low Channel Vertical:

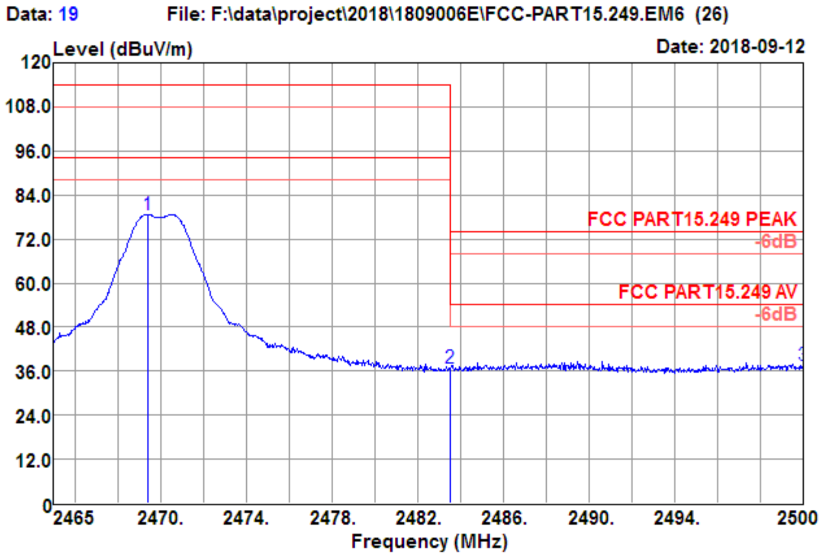


Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV	Limit level dBuV/m	Over limit dB	Remark
2310.000	42.33	26.91	3.56	35.87	36.93	74.00	-37.07	Peak
2390.000	41.98	27.11	3.64	36.08	36.65	74.00	-37.35	Peak
2400.000	50.11	27.14	3.65	36.11	44.79	74.00	-29.21	Peak
2405.500	85.90	27.15	3.65	36.12	80.58	114.00	-33.42	Peak

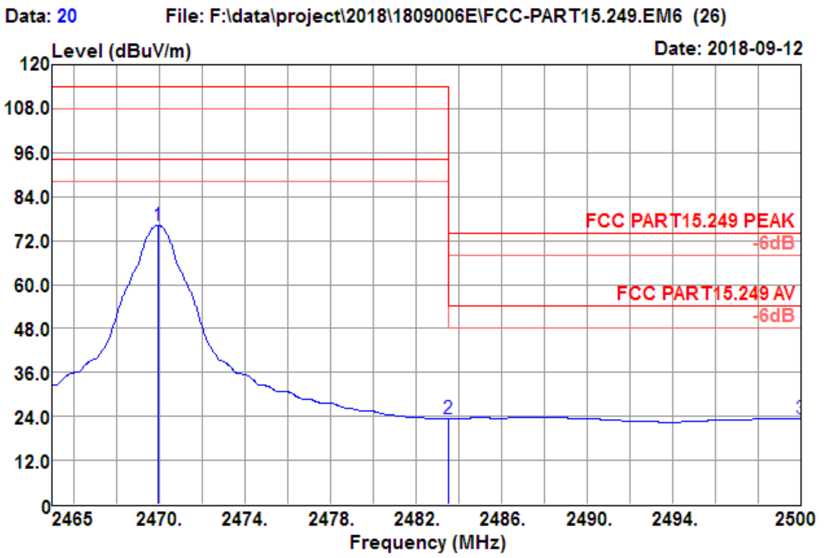


Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV	Limit level dBuV/m	Over limit dB	Remark
2310.000	28.01	26.91	3.56	35.87	22.61	54.00	-31.39	Average
2390.000	29.31	27.11	3.64	36.08	23.98	54.00	-30.02	Average
2400.000	39.33	27.14	3.65	36.11	34.01	54.00	-19.99	Average
2405.000	83.66	27.15	3.65	36.12	78.34	94.00	-15.66	Average

High Channel Horizontal:

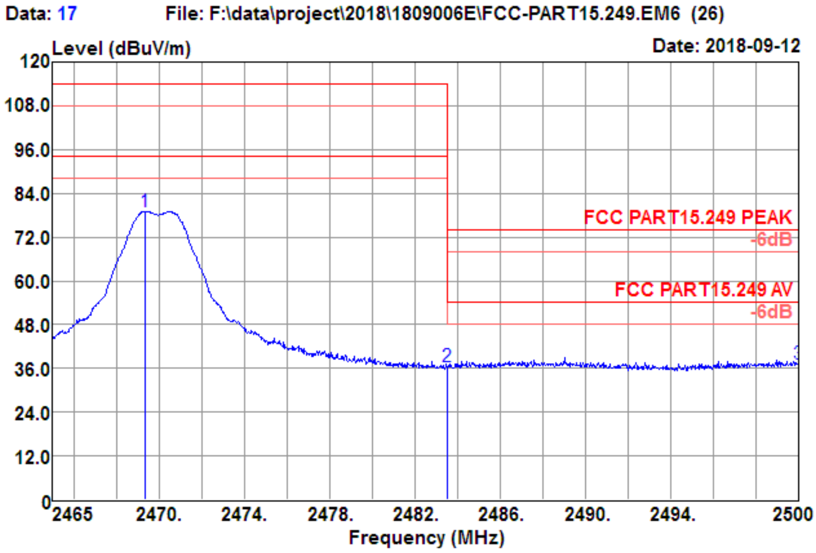


Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV	Limit level dBuV/m	Over limit dB	Remark
2469.410	84.01	27.32	3.67	36.29	78.71	114.00	-35.29	Peak
2483.515	41.96	27.36	3.68	36.33	36.67	74.00	-37.33	Peak
2500.000	42.69	27.40	3.68	36.37	37.40	74.00	-36.60	Peak

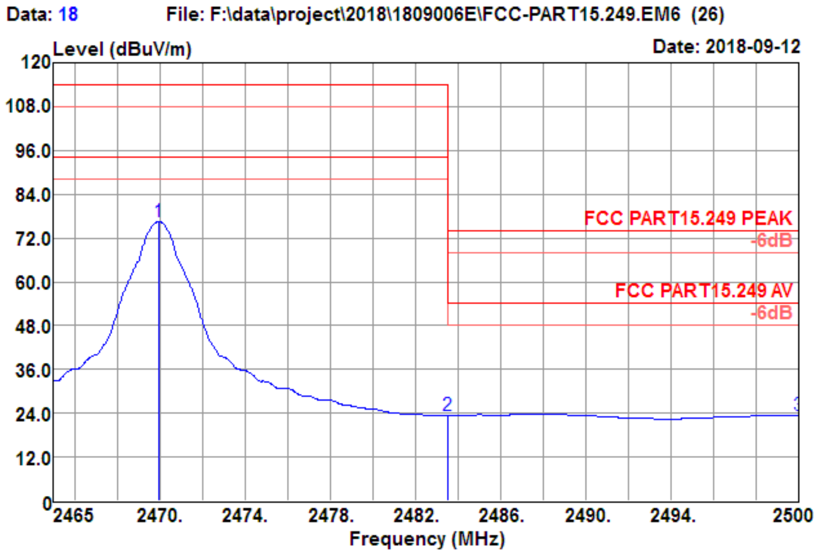


Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV	Limit level dBuV/m	Over limit dB	Remark
2469.935	81.45	27.32	3.67	36.29	76.15	94.00	-17.85	Average
2483.515	28.67	27.36	3.68	36.33	23.38	54.00	-30.62	Average
2500.000	28.66	27.40	3.68	36.37	23.37	54.00	-30.63	Average

High Channel Vertical:



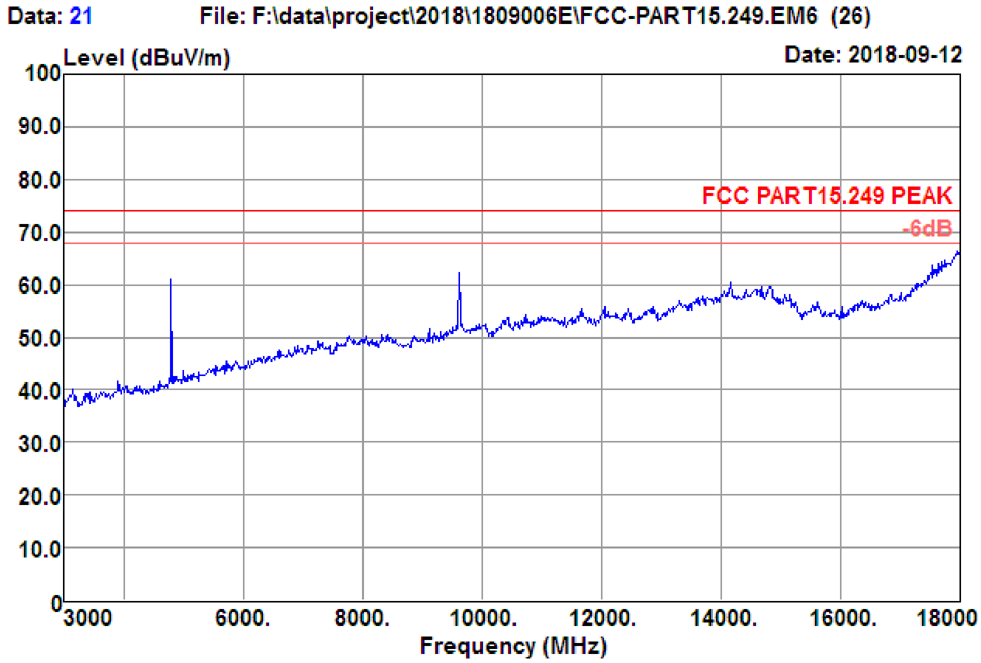
Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV	Limit level dBuV/m	Over limit dB	Remark
2469.375	84.42	27.32	3.67	36.29	79.12	114.00	-34.88	Peak
2483.515	41.68	27.36	3.68	36.33	36.39	74.00	-37.61	Peak
2500.000	42.47	27.40	3.68	36.37	37.18	74.00	-36.82	Peak

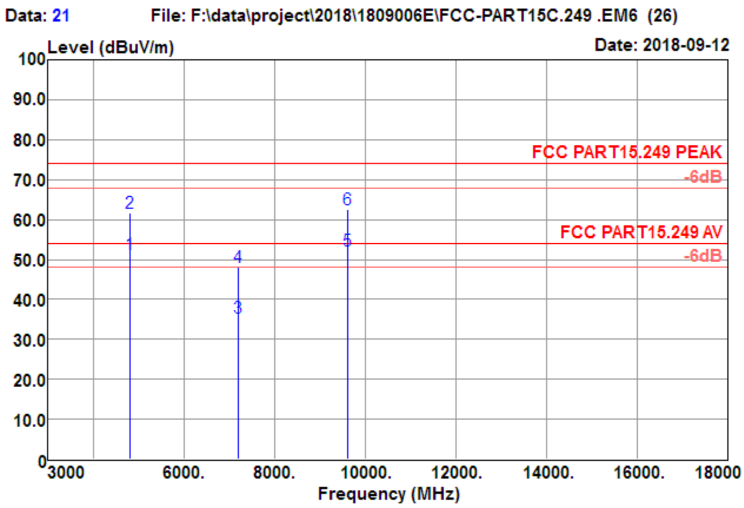


Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV	Limit level dBuV/m	Over limit dB	Remark
2469.970	81.77	27.32	3.67	36.29	76.47	94.00	-17.53	Average
2483.515	28.54	27.36	3.68	36.33	23.25	54.00	-30.75	Average
2500.000	28.66	27.40	3.68	36.37	23.37	54.00	-30.63	Average

4.2.6 Test Result of Radiated Spurious Emission

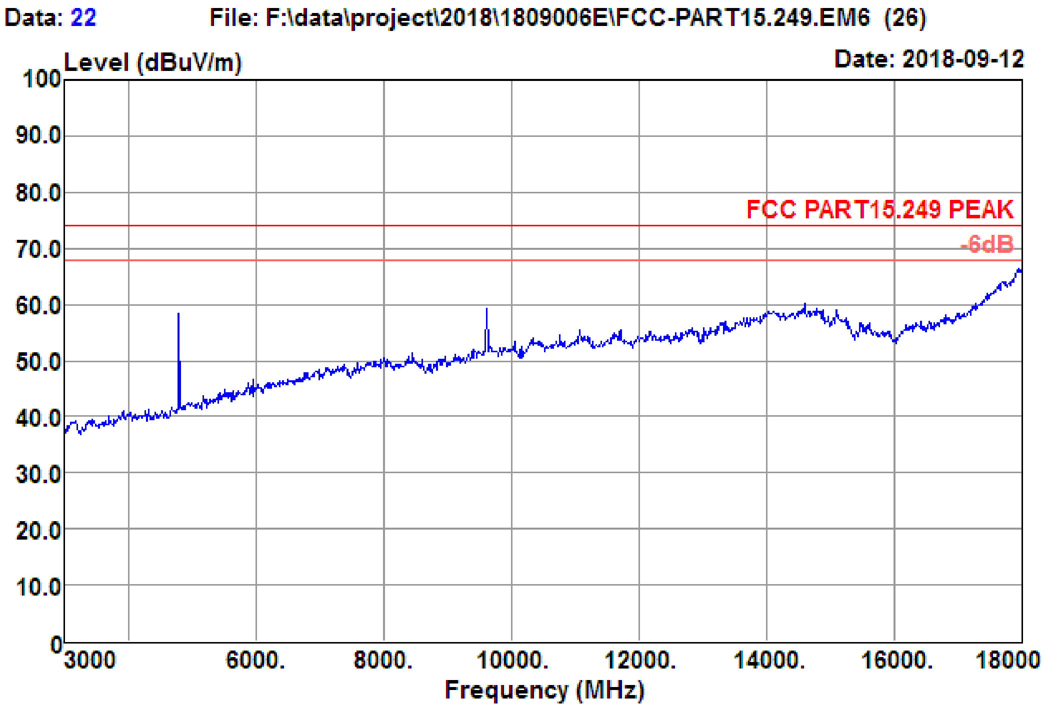
Low Channel Horizontal:

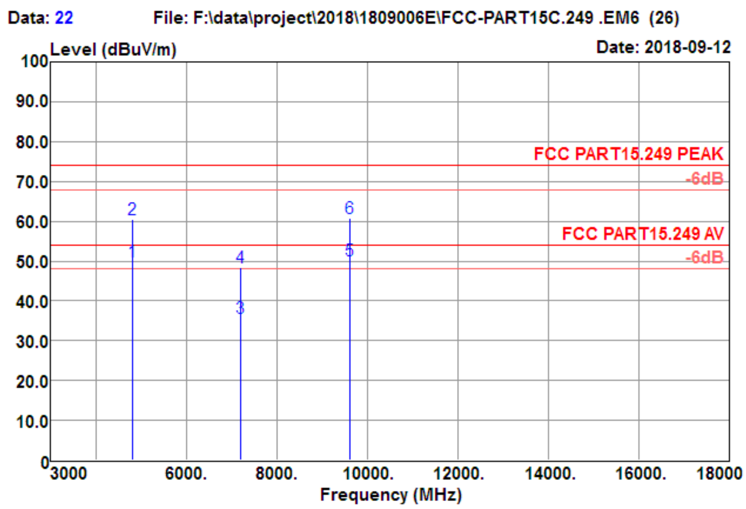




Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV	Limit level dBuV/m	Over limit dB	Remark
4810.000	50.89	31.24	5.44	36.27	51.30	54.00	-2.70	Average
4810.000	61.34	31.24	5.44	36.27	61.75	74.00	-12.25	Peak
7215.000	26.91	35.89	6.96	34.25	35.51	54.00	-18.49	Average
7215.000	39.40	35.89	6.96	34.25	48.00	74.00	-26.00	Peak
9620.000	40.61	37.82	7.79	34.13	52.09	54.00	-1.91	Average
9620.000	51.08	37.82	7.79	34.13	62.56	74.00	-11.44	Peak

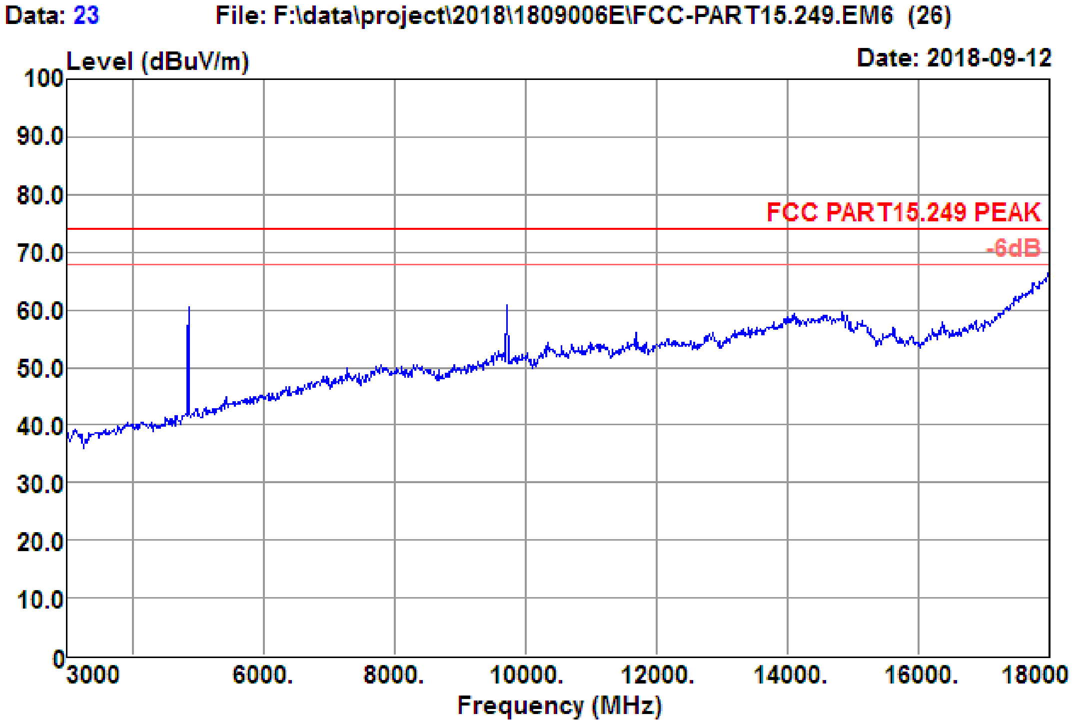
Low Channel Vertical:

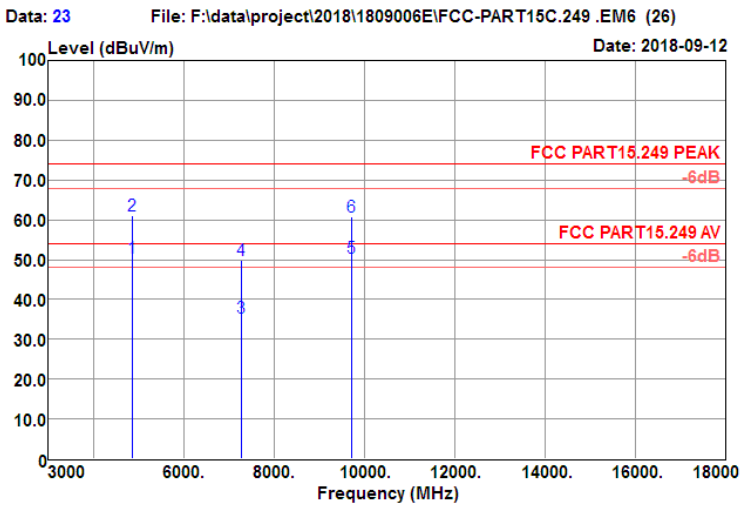




Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV	Limit level dBuV/m	Over limit dB	Remark
4810.000	49.34	31.24	5.44	36.27	49.75	54.00	-4.25	Average
4810.000	60.00	31.24	5.44	36.27	60.41	74.00	-13.59	Peak
7215.000	27.17	35.89	6.96	34.25	35.77	54.00	-18.23	Average
7215.000	39.90	35.89	6.96	34.25	48.50	74.00	-25.50	Peak
9620.000	38.56	37.82	7.79	34.13	50.04	54.00	-3.96	Average
9620.000	49.38	37.82	7.79	34.13	60.86	74.00	-13.14	Peak

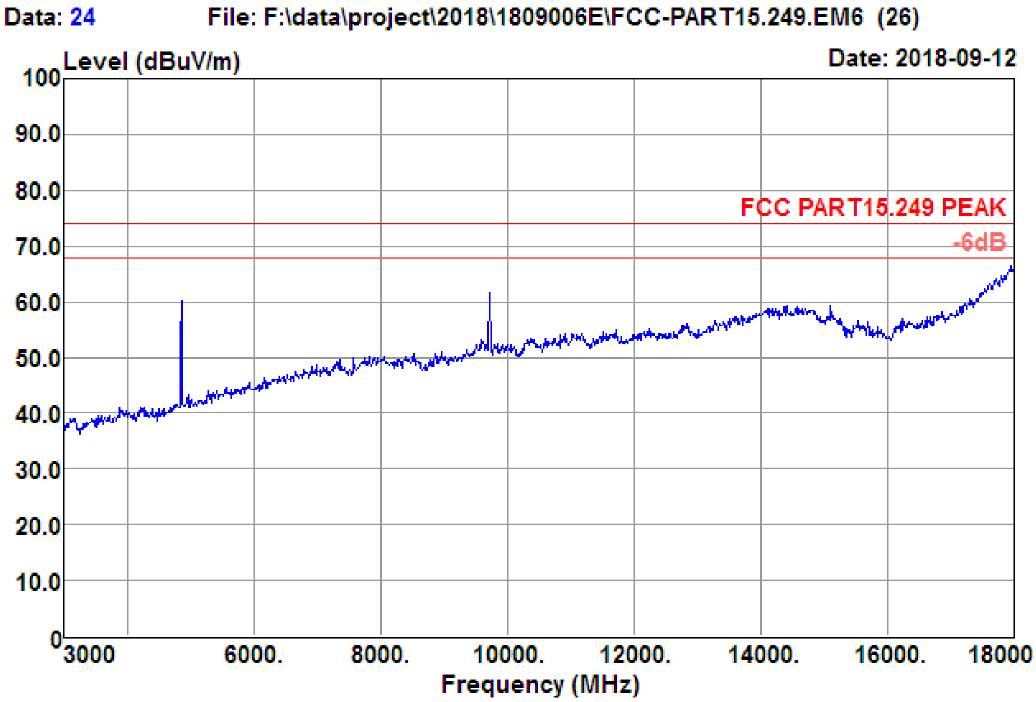
Middle Channel Horizontal:

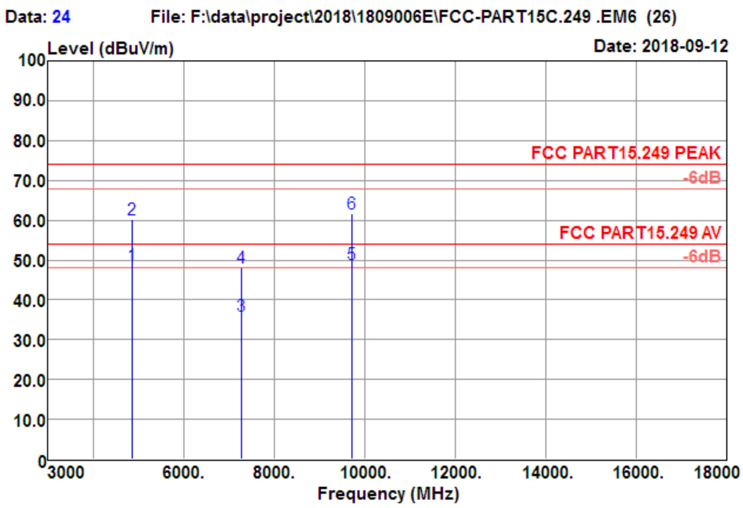




Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV	Limit level dBuV/m	Over limit dB	Remark
4860.000	49.79	31.36	5.42	36.25	50.32	54.00	-3.68	Average
4860.000	60.46	31.36	5.42	36.25	60.99	74.00	-13.01	Peak
7290.000	26.51	36.07	7.18	34.33	35.43	54.00	-18.57	Average
7290.000	40.82	36.07	7.18	34.33	49.74	74.00	-24.26	Peak
9720.000	38.65	38.00	7.92	34.18	50.39	54.00	-3.61	Average
9720.000	49.04	38.00	7.92	34.18	60.78	74.00	-13.22	Peak

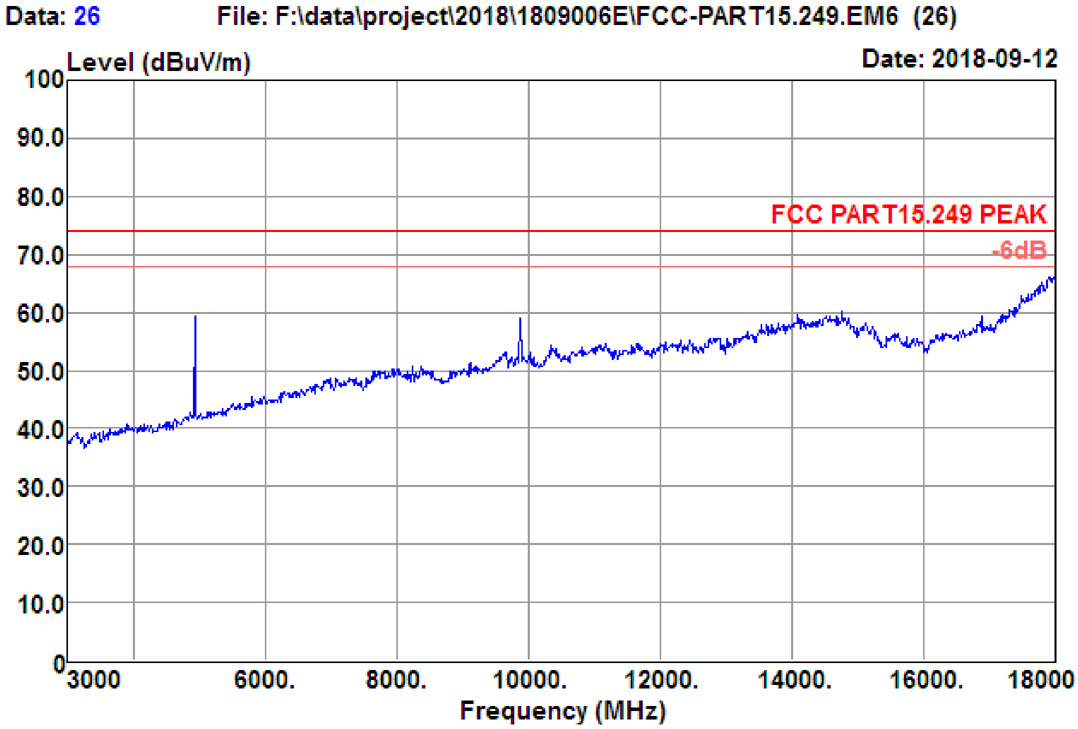
Middle Channel Vertical:

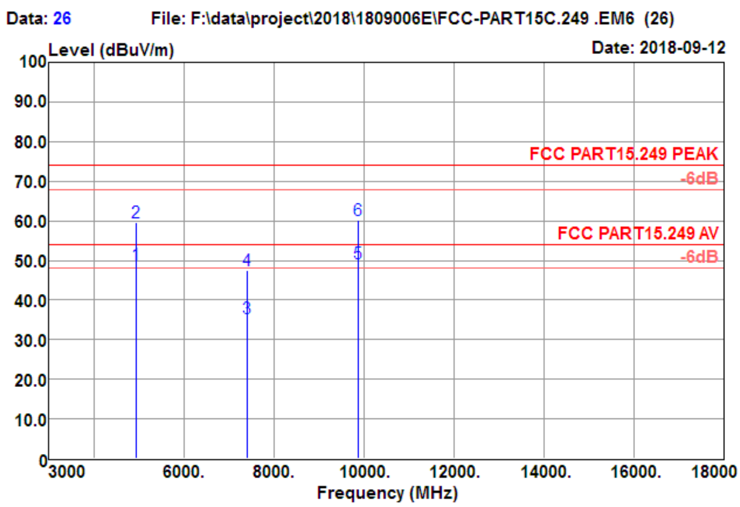




Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV	Limit level dBuV/m	Over limit dB	Remark
4860.000	48.26	31.36	5.42	36.25	48.79	54.00	-5.21	Average
4860.000	59.72	31.36	5.42	36.25	60.25	74.00	-13.75	Peak
7290.000	27.21	36.07	7.18	34.33	36.13	54.00	-17.87	Average
7290.000	39.16	36.07	7.18	34.33	48.08	74.00	-25.92	Peak
9720.000	37.10	38.00	7.92	34.18	48.84	54.00	-5.16	Average
9720.000	49.92	38.00	7.92	34.18	61.66	74.00	-12.34	Peak

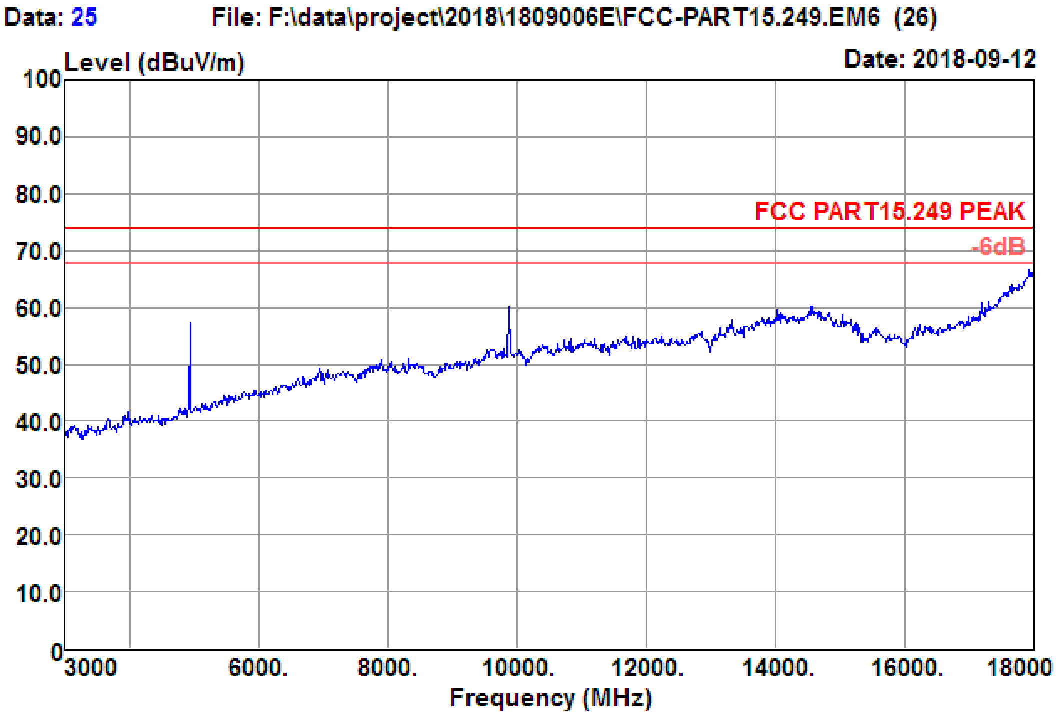
High Channel Horizontal:

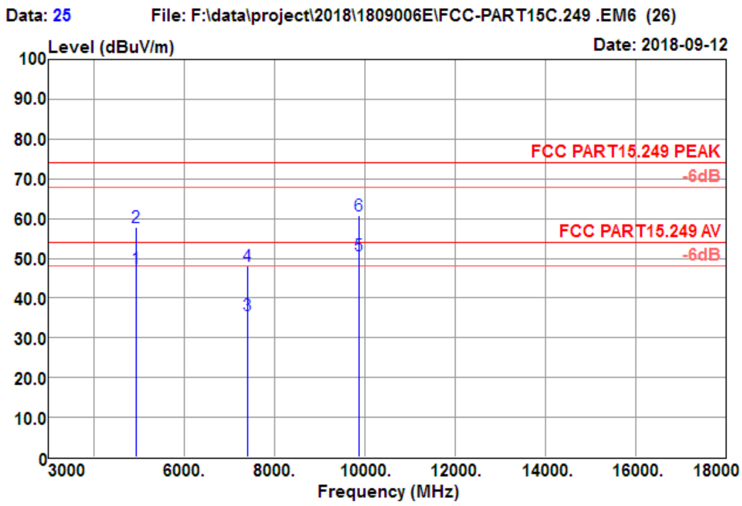




Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV	Limit level dBuV/m	Over limit dB	Remark
4940.000	48.25	31.56	5.37	36.22	48.96	54.00	-5.04	Average
4940.000	58.90	31.56	5.37	36.22	59.61	74.00	-14.39	Peak
7410.000	25.97	36.34	7.49	34.44	35.36	54.00	-18.64	Average
7410.000	38.13	36.34	7.49	34.44	47.52	74.00	-26.48	Peak
9880.000	37.13	38.28	8.04	34.25	49.20	54.00	-4.80	Average
9880.000	48.17	38.28	8.04	34.25	60.24	74.00	-13.76	Peak

High Channel Vertical:

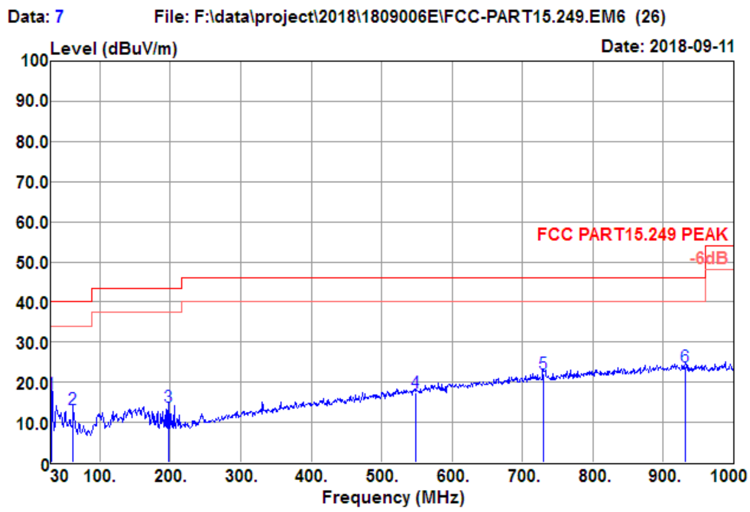




Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV	Limit level dBuV/m	Over limit dB	Remark
4940.000	46.82	31.56	5.37	36.22	47.53	54.00	-6.47	Average
4940.000	57.13	31.56	5.37	36.22	57.84	74.00	-16.16	Peak
7410.000	26.37	36.34	7.49	34.44	35.76	54.00	-18.24	Average
7410.000	38.59	36.34	7.49	34.44	47.98	74.00	-26.02	Peak
9880.000	38.69	38.28	8.04	34.25	50.76	54.00	-3.24	Average
9880.000	48.82	38.28	8.04	34.25	60.89	74.00	-13.11	Peak

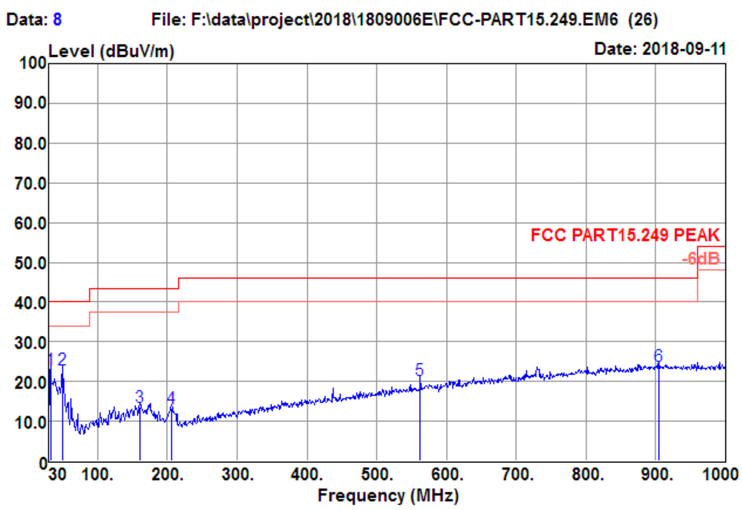
4.2.7 Test Result of Radiated Spurious Emission (30MHz ~ 1GHz)

Horizontal:



Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV	Limit level dBuV/m	Over limit dB	Remark
31.940	35.33	13.28	1.00	32.53	17.08	40.00	-22.92	QP
62.010	31.90	12.32	1.52	32.54	13.20	40.00	-26.80	QP
197.810	33.68	10.03	2.80	32.55	13.96	43.50	-29.54	QP
547.980	27.88	17.41	4.71	32.62	17.38	46.00	-28.62	QP
729.370	29.36	20.02	5.58	32.74	22.22	46.00	-23.78	QP
931.130	27.76	21.89	6.44	32.07	24.02	46.00	-21.98	QP

Vertical:



Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV	Limit level dBuV/m	Over limit dB	Remark
32.910	41.05	13.32	1.04	32.53	22.88	40.00	-17.12	QP
49.400	40.80	13.54	1.38	32.59	23.13	40.00	-16.87	QP
160.950	29.44	14.10	2.49	32.52	13.51	43.50	-29.99	QP
205.570	32.77	10.07	2.86	32.55	13.15	43.50	-30.35	QP
562.530	30.54	17.69	4.84	32.64	20.43	46.00	-25.57	QP
904.940	27.91	21.73	6.46	32.09	24.01	46.00	-21.99	QP

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

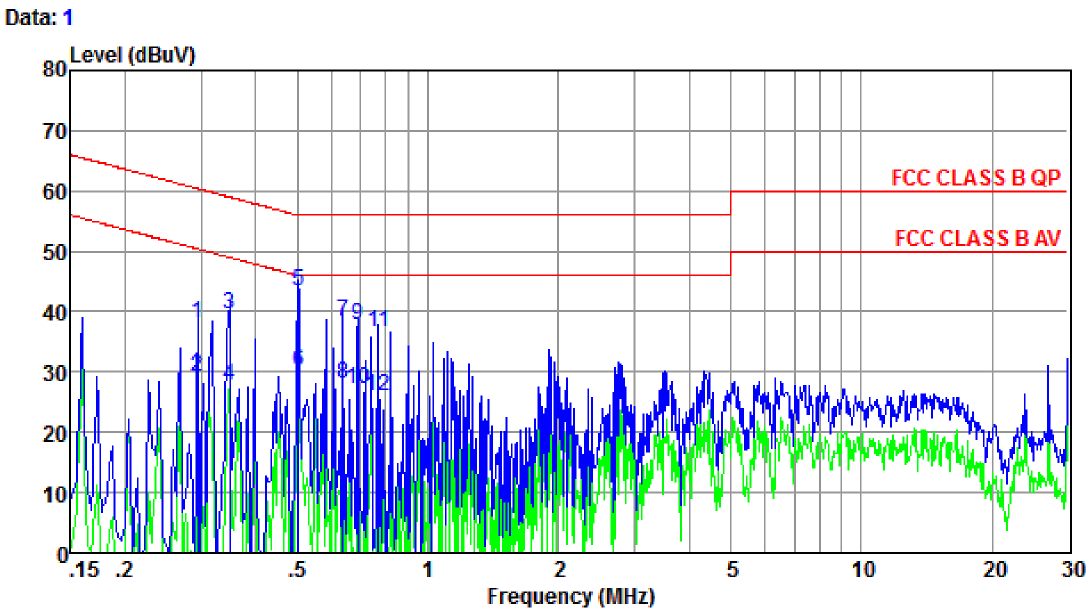
*Decreases with the logarithm of the frequency.

4.3.2 Test Procedures

6. 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.
7. Connect EUT to the power mains through a line impedance stabilization network (LISN).
8. All the support units are connecting to the other LISN.
9. The LISN provides 50 ohm coupling impedance for the measuring instrument.
10. The FCC states that a 50 ohm, 50 microhenry LISN should be used.
11. Both sides of AC line were checked for maximum conducted interference.
12. The frequency range from 150 kHz to 30 MHz was searched.
13. 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

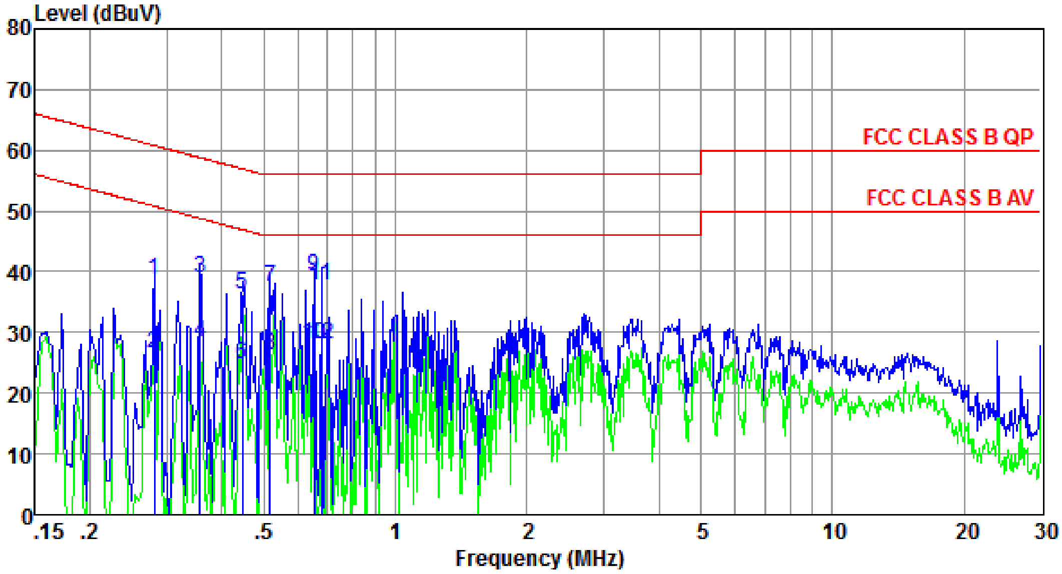
Test Mode :	Mode 1	Temperature :	21~23℃
Test Engineer :	Damon Zhang	Relative Humidity :	41~43%
Test Voltage :	120Vac / 60Hz	Phase :	Line
Function Type :	Wireless 2.4G Link + USB Cable (Charging from Adapter)		



Freq MHz	Reading level dBuV	LISN/ISN factor dB	Cable loss dB	level dBuV	Limit level dBuV	Over limit dB	Remark
0.294	28.41	9.57	0.01	37.99	60.41	-22.42	QP
0.294	19.75	9.57	0.01	29.33	50.41	-21.08	Average
0.348	29.99	9.58	0.02	39.59	59.00	-19.41	QP
0.348	18.07	9.58	0.02	27.67	49.00	-21.33	Average
0.502	33.70	9.58	0.02	43.30	56.00	-12.70	QP
0.502	20.43	9.58	0.02	30.03	46.00	-15.97	Average
0.637	28.69	9.59	0.03	38.31	56.00	-17.69	QP
0.637	18.51	9.59	0.03	28.13	46.00	-17.87	Average
0.690	28.02	9.59	0.03	37.64	56.00	-18.36	QP
0.690	17.52	9.59	0.03	27.14	46.00	-18.86	Average
0.767	27.03	9.59	0.03	36.65	56.00	-19.35	QP
0.767	16.28	9.59	0.03	25.90	46.00	-20.10	Average

Test Mode :	Mode 1	Temperature :	21~23℃
Test Engineer :	Damon Zhang	Relative Humidity :	41~43%
Test Voltage :	120Vac / 60Hz	Phase :	Neutral
Function Type :	Wireless 2.4G Link + USB Cable (Charging from Adapter)		

Data: 3



Freq MHz	Reading level dBuV	LISN/ISN factor dB	Cable loss dB	level dBuV	Limit level dBuV	Over limit dB	Remark
0.280	28.94	9.60	0.01	38.55	60.81	-22.26	QP
0.280	17.07	9.60	0.01	26.68	50.81	-24.13	Average
0.358	29.42	9.62	0.02	39.06	58.78	-19.72	QP
0.358	18.80	9.62	0.02	28.44	48.78	-20.34	Average
0.447	26.71	9.62	0.02	36.35	56.93	-20.58	QP
0.447	15.23	9.62	0.02	24.87	46.93	-22.06	Average
0.516	27.92	9.63	0.02	37.57	56.00	-18.43	QP
0.516	16.62	9.63	0.02	26.27	46.00	-19.73	Average
0.651	29.67	9.64	0.03	39.34	56.00	-16.66	QP
0.651	18.40	9.64	0.03	28.07	46.00	-17.93	Average
0.675	28.14	9.64	0.03	37.81	56.00	-18.19	QP
0.675	18.43	9.64	0.03	28.10	46.00	-17.90	Average

4.4 Antenna Requirements

4.4.1 Standard Applicable

According to antenna requirement of §15.203.

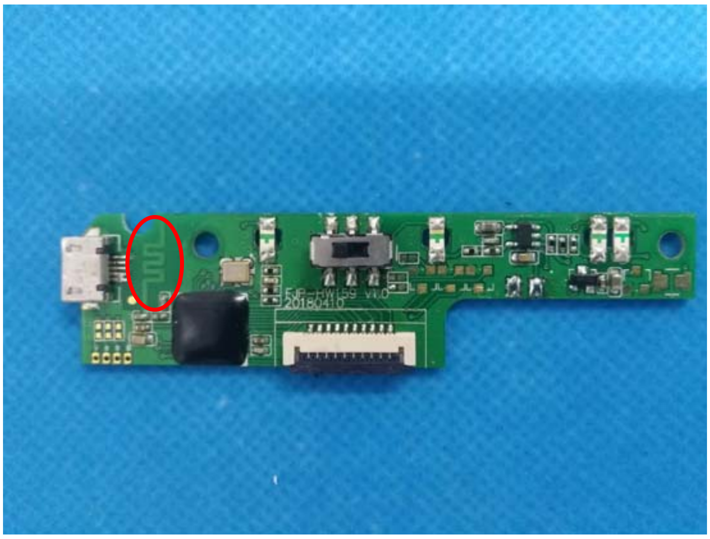
An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply 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 -1.2 dBi.



5 List of Measuring Equipment

Instrument	Manufacturer	Model No.	Serial No.	Calibration Date	Due Date	Remark
Spectrum Analyzer	Keysight	N9010A	MY56070788	2018-03-02	2019-03-01	Conducted
Power Sensor	Keysight	U2021XA	MY56510025	2018-03-02	2019-03-01	Conducted
Power Sensor	Keysight	U2021XA	MY57030005	2018-03-02	2019-03-01	Conducted
Power Sensor	Keysight	U2021XA	MY56510018	2018-03-02	2019-03-01	Conducted
Power Sensor	Keysight	U2021XA	MY56480002	2018-03-02	2019-03-01	Conducted
Thermal Chamber	Sanmtest	SMC-408-CD	2435	2018-07-05	2019-07-04	Conducted
Base Station	R&S	CMW 270	101231	2018-03-17	2019-03-16	Conducted
Signal Generator (Interferer)	Keysight	N5182B	MY56200384	2018-04-10	2019-04-09	Conducted
Signal Generator (Blocker)	Keysight	N5171B	MY56200661	2018-03-15	2019-03-14	Conducted

Instrument	Manufacturer	Model No.	Serial No.	Calibration Date	Due Date	Remark
Spectrum Analyzer	R&S	FSV 40	101433	2018-03-14	2019-03-13	Radiation
Amplifier	Sonoma	310	363917	2018-03-06	2019-03-05	Radiation
Amplifier	Schwarzbeck	BBV 9718	327	2018-03-14	2019-03-13	Radiation
Amplifier	Narda	TTA1840-35-HG	2034380	2018-07-18	2019-07-17	Radiation
Broadband Antenna	Schwarzbeck	VULB 9168	9168-757	2017-03-03	2020-03-02	Radiation
Horn Antenna	Schwarzbeck	BBHA 9120 D	1677	2017-03-03	2020-03-02	Radiation
Horn Antenna	COM-POWER	AH-1840	101117	2018-06-20	2021-06-19	Radiation
Test Software	Auidx	E3	6.111221a	N/A	N/A	Radiation
Filter	Micro-Tronics	BRM 50702	G266	N/A	N/A	Radiation

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	2.64dB
Radiated emission	30MHz ~ 1GMHz	5.05dB
	1GHz ~ 18GHz	5.06 dB
	18GHz ~ 40GHz	3.65dB

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