

FCC PART 15.249 TEST REPORT

For

Qolsys, Inc.

1900 The Alameda 4th Floor, San Jose, California 95126, United States

Tested Model: IQ Hub
FCC ID: 2AAJXQS-IQHUB

Report Type: Original Report	Equipment Name: IQ Hub
Report Number: RSC191224001-0D	
Date of Report Issue: 2019-12-31	
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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Applicant	Qolsys, Inc.
Product	IQ Hub
Tested Model	IQ Hub
FCC ID	2AAJXQS-IQHUB
Frequency Range	908.4 MHz-916 MHz
Modulation Type	GFSK
Voltage Range	DC 3.7V rechargeable Li-ion battery or DC 12V from adapter
Measure approximately	196.4 mm (L) x 155 mm (W) x 25.6 mm (H)
Sample serial number	191224001/01 (assigned by the BACL, Chengdu)
Sample/EUT Status	The test sample was in good condition and received:2019-12-24
Adapter	Manufacturer: SURE-POWER Model : SW-120100 Voltage Input: AC 100-240V 50/60Hz, 0.68A Max Voltage Output: DC 12V 1000mA

Note: Unless otherwise stated the results shown in this test report refer only to the sample(s) tested.

Objective

This report is prepared on behalf of **Qolsys, Inc.** in accordance with Part 2, Subpart J, Part 15, Subparts A and C of the Federal Communications Commission's rules.

The tests were performed in order to determine compliance with FCC Part 15, Subpart C, and section 15.203, 15.205, 15.207, 15.209 and 15.249 rules.

Related Submittal(s)/Grant(s)

FCC Part 15C DTS submissions with FCC ID: 2AAJXQS-IQHUB
FCC Part 15E NII submissions with FCC ID: 2AAJXQS-IQHUB

Measurement Uncertainty

Item			Uncertainty
AC power line conducted emission			2.24 dB
Radiated Emission(Field Strength)	30MHz-200MHz	H	4.47 dB
		V	4.73 dB
	200MHz-1GHz	H	4.87 dB
		V	5.93 dB
	1GHz-6GHz		4.51 dB
	6GHz-18GHz		4.49 dB
	18GHz-40GHz		5.48 dB

Note: The extended uncertainty given in this report is obtained by combining the standard uncertainty times the corresponding inclusion factor K when the inclusion probability is about 95%.

Test Methodology

All measurements contained in this report are conducted with ANSI C63.10-2014, American National Standard for Compliance testing of Unlicensed Wireless devices.

All radiated and conducted emissions measurement is performed at BACL. The radiated testing is performed at an antenna-to-EUT distance of 3 Meters.

Test Facility

The test site used by Bay Area Compliance Laboratories Corp. (Chengdu) to collect test data is located No.5040, Huilongwan Plaza, No. 1, Shawan Road, Jinniu District, Chengdu, Sichuan, China.

Bay Area Compliance Laboratories Corp. (Chengdu) lab is accredited to ISO/IEC 17025 by A2LA (Lab code: 4324.01) and the FCC designation No. CN1186 under the FCC KDB 974614 D01. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-2014.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

The system was configured in testing mode, the maximum output power configured by default Setting:

Channel List:

Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	908.4	2	916

Equipment Modifications

No modification was made to the EUT tested.

EUT Exercise Software

RF test tool installed in the device

Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
-	-	-	-

External I/O Cable

Cable Description	Length (m)	From	To
DC Power Cable	1.50	Adapter	EUT

Block Diagram of Test Setup



TEST EQUIPMENTS LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Conducted Emission					
Rohde & Schwarz	EMI Test Receiver	ESCI	100028	2019-04-15	2020-04-14
ROHDE&SCHWARZ	L.I.S.N.	ENV216	3560.6550.16	2019-02-25	2020-02-24
HP	RF Limiter	11947A	3107A01270	2019-10-18	2020-10-17
Micro-coax	Conducted Cable	L-E003	000003	2019-08-05	2020-08-04
Rohde & Schwarz	EMC32	EMC32	V 8.52.0	NCR	NCR
Radiated Emission					
EMCT	Semi-Anechoic Chamber	966	001	2017-05-18	2020-05-17
SONOMA INSTRUMENT	Amplifier	310 N	186684	2019-09-06	2020-09-05
SUNOL SCIENCES	Broadband Antenna	JB3	A121808	2017-05-19	2020-05-18
INMET	Attenuator	18N-6dB	N/A	2019-10-17	2020-10-16
Rohde & Schwarz	EMI Test Receiver	ESR3	102456	2019-04-15	2020-04-14
Rohde & Schwarz	Spectrum Analyzer	FSU26	200835	2019-04-15	2020-04-14
EMCO	Horn Antenna	3115	2192	2019-09-25	2021-09-24
A.H. Systems, Inc	Amplifier	PAM-0118P	467	2019-08-30	2020-08-29
Unknown	RF Cable (Below 1GHz)	L-E005	000005	2019-09-06	2020-09-05
Unknown	RF Cable (Below 1GHz)	T-E128	000128	2019-10-17	2020-10-16
Micro-coax	Flexible microwave cable	T-E237	233522-001	2019-07-19	2020-07-18
Unknown	RF Cable (Above 1GHz)	T-E069	000069	2019-07-24	2020-07-23
Micro-coax	RF Cable (Above 1GHz)	T-E209	MFR 64639 2310	2019-07-19	2020-07-18
Rohde & Schwarz	EMC32	EMC32	V9.10.00	NCR	NCR

SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§15.203	Antenna Requirement	Compliant
§15.207(a)	AC Line Conducted Emissions	Compliant
§15.205, §15.209 §15.249	Spurious Emissions	Compliant
§15.215(c)	20 dB Emission Bandwidth	Compliant

Note: Otherwise required by the applicant or Product Regulations, Decision Rule in this report did not consider the uncertainty.

FCC §15.203 - ANTENNA REQUIREMENT

Applicable Standard

According to FCC §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 replaced by the user, but the user of a standard antenna jack or electrical connector is prohibited. The structure and application of the EUT were analyzed to determine compliance with section §15.203 of the rules. §15.203 state that the subject device must meet the following criteria:

- a. Antenna must be permanently attached to the unit.
 - b. Antenna must use a unique type of connector to attach to the EUT.
- Unit must be professionally installed, and installer shall be responsible for verifying that the correct antenna is employed with the unit.

Antenna Connector Construction

The EUT has one WiFi/Bluetooth LE antenna, one LTE antenna, one Z-wave antenna and one Power-G antenna, fulfill the requirement of this section. Please refer to the table below and EUT photo.

Antenna	Manufacturer	Model Number	Antenna Gain (Max)	Antenna Connector	Impedance	Antenna Type
WLAN/ Bluetooth LE	Taoglas	FXP838	2.67dBi(2400-2500MHz) 1.02dBi(5150-5850MHz)	IPEX	50 Ohm	PCB
LTE	Taoglas	FXUB79	1.6dBi (698-960MHz) 2.4dBi (1710-2700MHz)	IPEX	50 Ohm	PCB
Power-G	Taoglas	PC95	0.43dBi (902-928MHz)	IPEX	50 Ohm	PCB
Z-wave	Taoglas	FXP291	0.5dBi (902-928MHz)	IPEX	50 Ohm	PCB

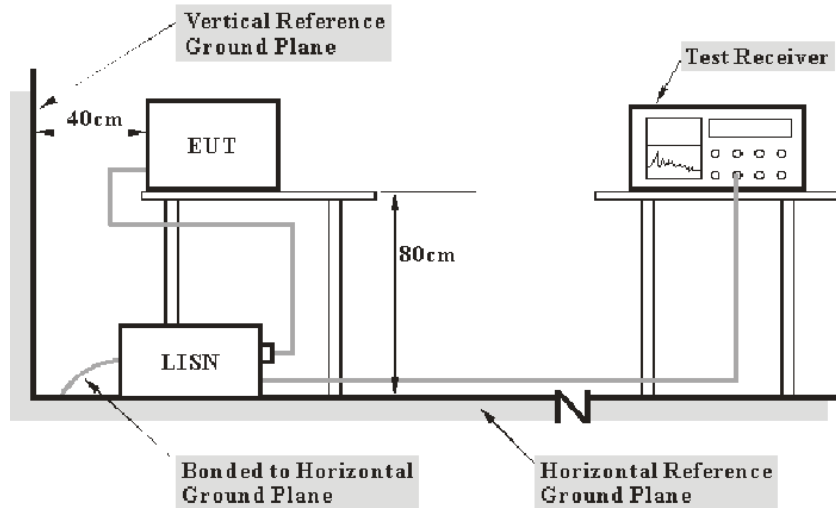
Result: Compliance.

FCC §15.207 (a) – AC LINE CONDUCTED EMISSIONS

Applicable Standard

FCC§15.207

EUT Setup



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

The setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.207 limits.

EMI Test Receiver Setup

The EMI test receiver was set to investigate the spectrum from 150 kHz to 30 MHz.

During the conducted emission test, the EMI test receiver was set with the following configurations:

Frequency Range	IF B/W
150 kHz – 30 MHz	9 kHz

Test Procedure

During the conducted emission test, the adapter was connected to the outlet of the first LISN.

Maximizing procedure was performed on the six (6) highest emissions of the EUT.

All data was recorded in the Quasi-peak and average detection mode.

Corrected Amplitude & Margin Calculation

The basic equation is as follows:

$$V_C = V_R + A_C + VDF$$

Herein,

V_C : corrected voltage amplitude

V_R : reading voltage amplitude

A_C : attenuation caused by cable loss

VDF: voltage division factor of AMN or ISN

The “**Margin**” column of the following data tables indicates the degree of compliance within the applicable limit. For example, a margin of 7dB means the emission is 7dB below the limit. The equation for margin calculation is as follows:

$$\text{Margin} = \text{Limit} - \text{Corrected Amplitude}$$

Test Data

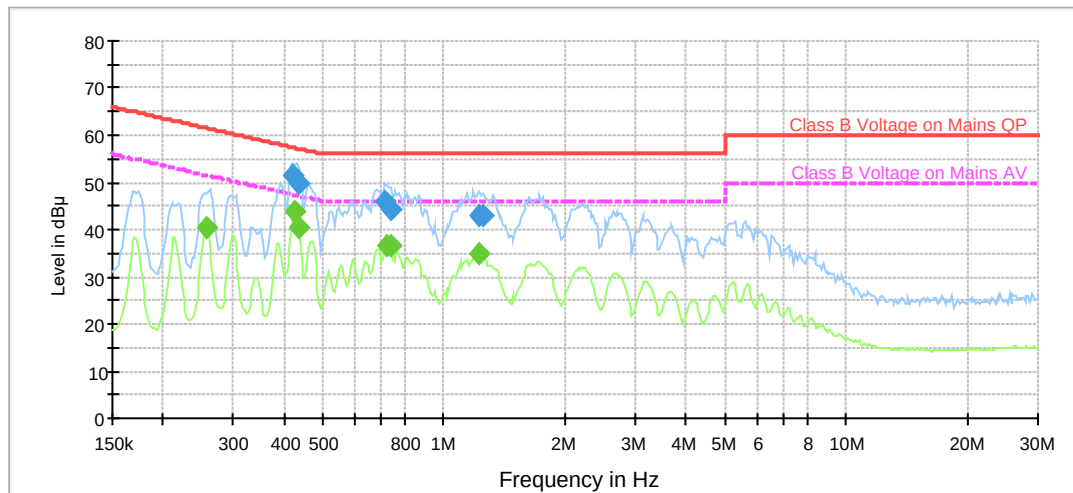
Environmental Conditions

Temperature:	17 °C
Relative Humidity:	52 %
ATM Pressure:	96.2 kPa

The testing was performed by Eric Xiao on 2019-12-25.

Test Mode: Transmitting

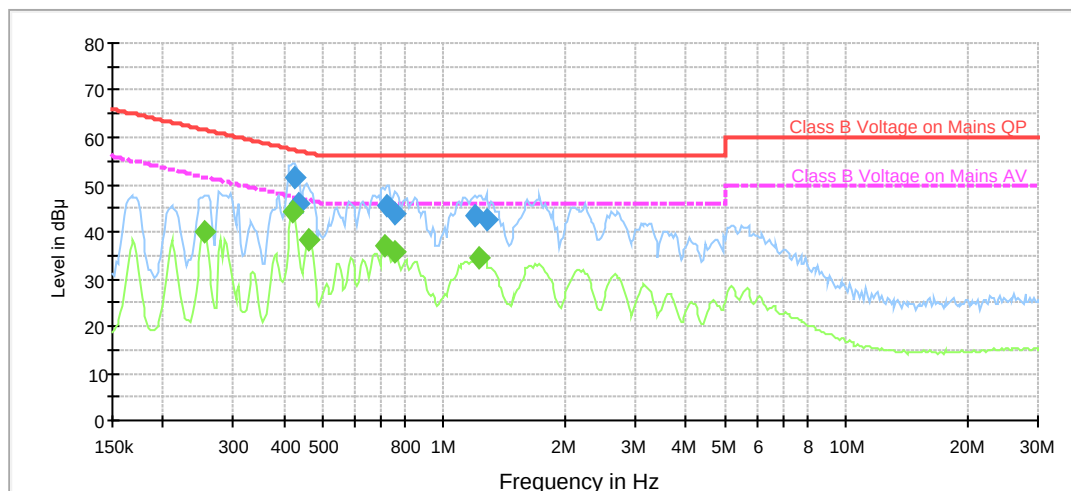
AC120 V, 60 Hz, Line:



Frequency (MHz)	QuasiPeak (dB μ V)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB μ V)
0.422196	51.6	200.0	9.000	L1	19.6	5.8	57.4
0.434989	49.9	200.0	9.000	L1	19.6	7.3	57.2
0.715397	46.0	200.0	9.000	L1	19.6	10.0	56.0
0.737074	44.5	200.0	9.000	L1	19.6	11.5	56.0
1.224338	42.8	200.0	9.000	L1	19.6	13.2	56.0
1.248947	43.1	200.0	9.000	L1	19.6	12.9	56.0

Frequency (MHz)	Average (dB μ V)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB μ V)
0.256712	40.5	200.0	9.000	L1	19.6	11.0	51.5
0.426418	43.7	200.0	9.000	L1	19.6	3.6	47.3
0.434989	40.5	200.0	9.000	L1	19.6	6.7	47.2
0.722551	36.7	200.0	9.000	L1	19.6	9.3	46.0
0.737074	36.5	200.0	9.000	L1	19.6	9.5	46.0
1.224338	35.1	200.0	9.000	L1	19.6	10.9	46.0

AC120 V, 60 Hz, Neutral:



Frequency (MHz)	QuasiPeak (dB μ V)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB μ V)
0.426418	51.5	200.0	9.000	N	19.6	5.8	57.3
0.434989	46.0	200.0	9.000	N	19.6	11.2	57.2
0.722551	45.4	200.0	9.000	N	19.7	10.6	56.0
0.759409	43.8	200.0	9.000	N	19.7	12.2	56.0
1.200214	43.2	200.0	9.000	N	19.7	12.8	56.0
1.274051	42.4	200.0	9.000	N	19.7	13.6	56.0

Frequency (MHz)	Average (dB μ V)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB μ V)
0.254170	40.1	200.0	9.000	N	19.6	11.5	51.6
0.422196	44.1	200.0	9.000	N	19.6	3.3	47.4
0.461750	38.2	200.0	9.000	N	19.6	8.5	46.7
0.715397	37.2	200.0	9.000	N	19.7	8.8	46.0
0.759409	35.6	200.0	9.000	N	19.7	10.4	46.0
1.224338	34.6	200.0	9.000	N	19.7	11.4	46.0

Note:

- 1) Corrected Amplitude = Reading + Correction Factor
- 2) Correction Factor = LISN VDF (Voltage Division Factor) + Cable Loss + Transient Limiter Attenuation
- 3) Margin = Limit – Corrected Amplitude

FCC §15.205, §15.209 & §15.249 - SPURIOUS EMISSIONS

Applicable Standard

As per FCC§15.249 (a), except as provided in paragraph (b) of this section, the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

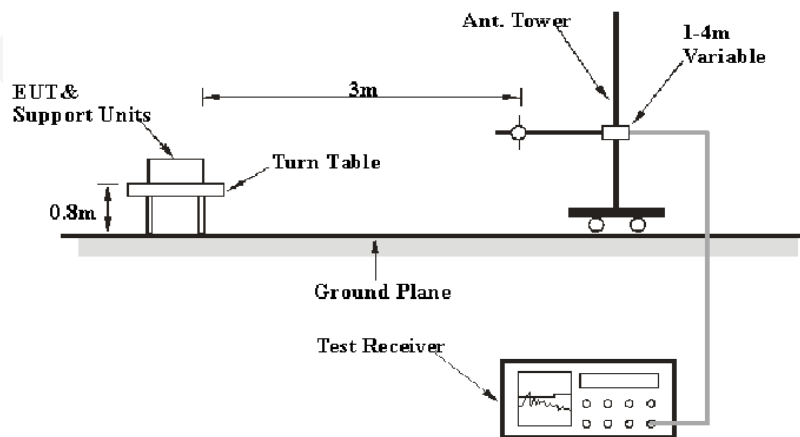
Fundamental frequency	Field strength of fundamental (millivolts/meter)	Field strength of harmonics (microvolts/meter)
902–928 MHz	50	500
2400–2483.5 MHz	50	500
5725–5875 MHz	50	500
24.0–24.25 GHz	250	2500

As per FCC§15.249 (c), Field strength limits are specified at a distance of 3 meters.

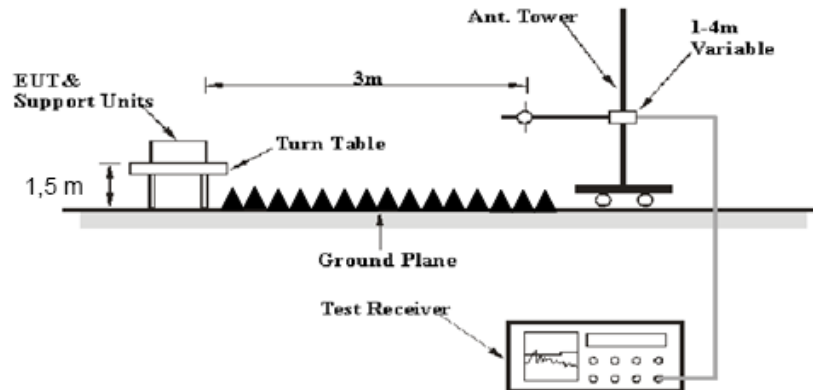
(d) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

EUT Setup

Below 1GHz:



Above 1GHz:



The radiated emission tests were performed in the 3 meters chamber test site, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC 15.209, and FCC 15.249 limits.

EMI Test Receiver Setup

The system was investigated from 30 MHz to 10 GHz.

During the radiated emission test, the EMI test receiver was set with the following configurations:

Frequency Range	RBW	Video B/W	IF B/W	Detector
30 MHz – 1000 MHz	120 kHz	300 kHz	120 kHz	QP
Above 1 GHz	1MHz	3 MHz	/	PK
	1MHz	3 MHz	/	AV

Test Procedure

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

Data was recorded in Quasi-peak detection mode for frequency range of 30 MHz-1 GHz, peak and Average detection modes for frequencies above 1 GHz.

Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Loss and Cable Loss, and subtracting the Amplifier Gain from the Meter Reading. The basic equation is as follows:

$$\text{Corrected Amplitude} = \text{Receiver Reading} + \text{Antenna Factor} + \text{Cable Loss} - \text{Amplifier Gain}$$

The “**Margin**” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of 7dB means the emission is 7dB below the limit. The equation for margin calculation is as follows:

$$\text{Margin} = \text{Limit} - \text{Corrected Amplitude}$$

Test Data

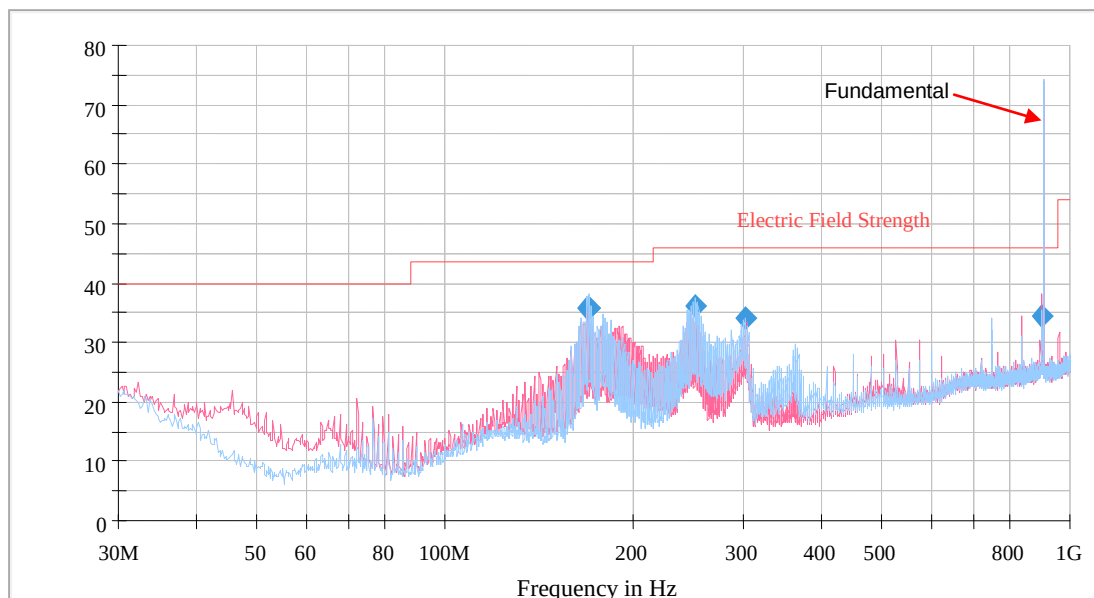
Environmental Conditions

Temperature:	21 °C
Relative Humidity:	44 %
ATM Pressure:	95.5 kPa

The testing was performed by Eric Xiao on 2019-12-28

Test Mode: Transmitting

1) 30 MHz to 1 GHz_Low channel-worst case



Frequency (MHz)	QuasiPeak (dB μV/m)	Limit (dB μV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
168.449200	35.90	43.50	7.60	200.0	120.000	174.0	H	248.0	-13.0
169.964300	35.84	43.50	7.66	200.0	120.000	143.0	H	236.0	-13.0
170.015400	35.74	43.50	7.76	200.0	120.000	157.0	H	245.0	-13.0
251.237600	36.21	46.00	9.79	200.0	120.000	129.0	H	225.0	-12.8
300.448200	32.19	46.00	13.81	200.0	120.000	146.0	H	19.0	-11.3
900.126000	34.46	46.00	11.54	200.0	120.000	116.0	V	251.0	-0.7

2) Above 1 GHz

Frequency	Receiver		Rx Antenna		Cable loss	Amplifier Gain	Corrected Amplitude	Limit	Margin
	Reading	Measurement	Polar	Factor					
MHz	dBμV	PK/QP/AV	H/V	dB(1/m)	dB	dB	dBμV/m	dBμV/m	dB
Frequency: 908.4 MHz									
908.4	75.63	QP	H	28.07	2.54	31.34	74.90	94.00	19.10
908.4	73.85	QP	V	28.07	2.54	31.34	73.12	94.00	20.88
902.0	33.58	QP	H	28.02	2.56	31.33	32.83	46.00	13.17
1816.8	48.24	PK	H	28.12	3.10	41.79	37.67	74.00	36.33
1816.8	36.15	AV	H	28.12	3.10	41.79	25.58	54.00	28.42
2725.2	50.51	PK	H	29.54	3.78	42.15	41.68	74.00	32.32
2725.2	39.32	AV	H	29.54	3.78	42.15	30.49	54.00	23.51
1649.8	64.08	PK	H	26.68	2.96	41.69	52.03	74.00	21.97
1649.8	45.70	AV	H	26.68	2.96	41.69	33.65	54.00	20.35
2699.2	64.31	PK	H	29.48	3.76	42.14	55.41	74.00	18.59
2699.2	48.78	AV	H	29.48	3.76	42.14	39.88	54.00	14.12
2747.8	67.19	PK	V	29.60	3.80	42.15	58.44	74.00	15.56
2747.8	61.48	AV	V	29.60	3.80	42.15	52.73	54.00	1.27
4580.2	55.16	PK	V	32.41	4.92	42.75	49.74	74.00	24.26
4580.2	48.90	AV	V	32.41	4.92	42.75	43.48	54.00	10.52
6412.6	57.11	PK	V	34.35	5.64	43.28	53.82	74.00	20.18
6412.6	50.76	AV	V	34.35	5.64	43.28	47.47	54.00	6.53
Frequency: 916 MHz									
916.0	71.34	QP	H	28.13	2.52	31.34	70.65	94.00	23.35
916.0	69.71	QP	V	28.13	2.52	31.34	69.02	94.00	24.98
928	20.89	QP	H	28.22	2.48	31.34	20.25	46.00	25.75
1832	48.33	PK	H	28.26	3.11	41.80	37.90	74.00	36.10
1832	37.15	AV	H	28.26	3.11	41.80	26.72	54.00	27.28
2748	50.51	PK	H	29.60	3.80	42.15	41.76	74.00	32.24
2748	39.32	AV	H	29.60	3.80	42.15	30.57	54.00	23.43
1649.8	64.68	PK	H	26.68	2.96	41.69	52.63	74.00	21.37
1649.8	46.36	AV	H	26.68	2.96	41.69	34.31	54.00	19.69
2699.2	65.04	PK	H	29.48	3.76	42.14	56.14	74.00	17.86
2699.2	49.15	AV	H	29.48	3.76	42.14	40.25	54.00	13.75
2747.8	67.41	PK	V	29.60	3.80	42.15	58.66	74.00	15.34
2747.8	61.43	AV	V	29.60	3.80	42.15	52.68	54.00	1.32
4580.2	54.94	PK	V	32.41	4.92	42.75	49.52	74.00	24.48
4580.2	49.07	AV	V	32.41	4.92	42.75	43.65	54.00	10.35
6412.6	57.56	PK	V	34.35	5.64	43.28	54.27	74.00	19.73
6412.6	51.05	AV	V	34.35	5.64	43.28	47.76	54.00	6.24

Note:

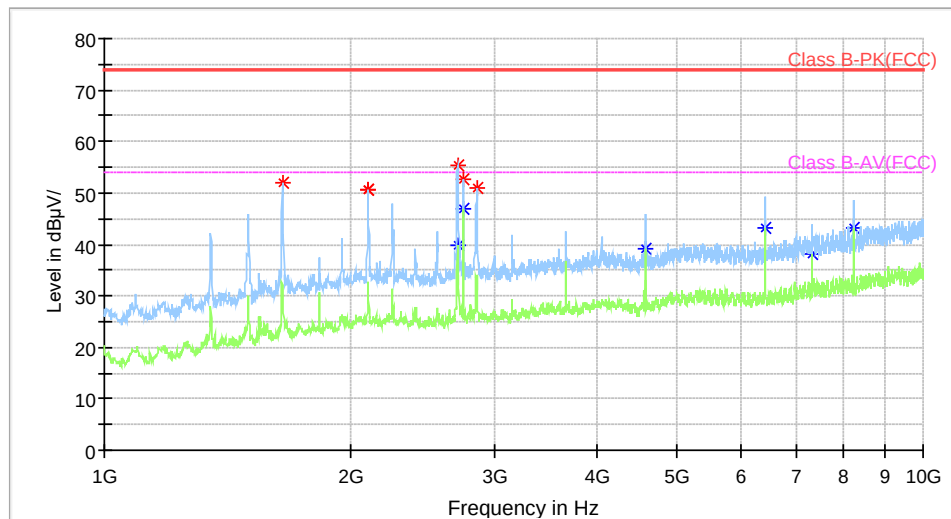
Corrected Amplitude = Corrected Factor + Reading

Corrected Factor=Antenna factor (RX) + Cable Loss – Amplifier Factor

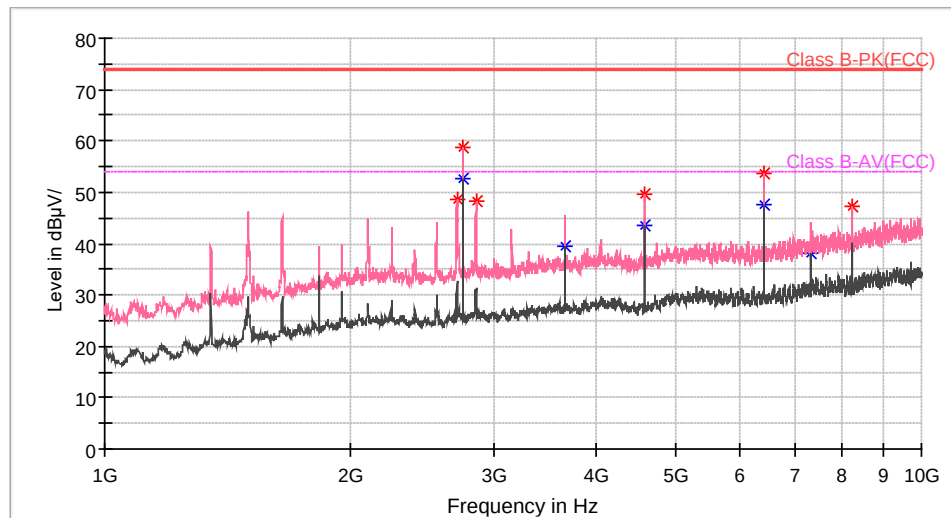
Margin = Limit- Corr. Amplitude

Please refer to the below pre-scan plot of worst case:

Low Channel_Horizontal_1GHz-10GHz



Low Channel_Horizontal_1GHz-10GHz



FCC §15.215(c) – 20 dB BANDWIDTH TESTING

Applicable Standard

Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§ 15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.

Test Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT on the test table without connection to measurement instrument. Turn on the EUT. 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.
3. Measure the frequency difference of two frequencies that were attenuated 20 dB from the reference level. Record the frequency difference as the emission bandwidth.
4. Repeat above procedures until all frequencies measured were complete.

Test Data

Environmental Conditions

Temperature:	21 °C
Relative Humidity:	44 %
ATM Pressure:	95.5 kPa

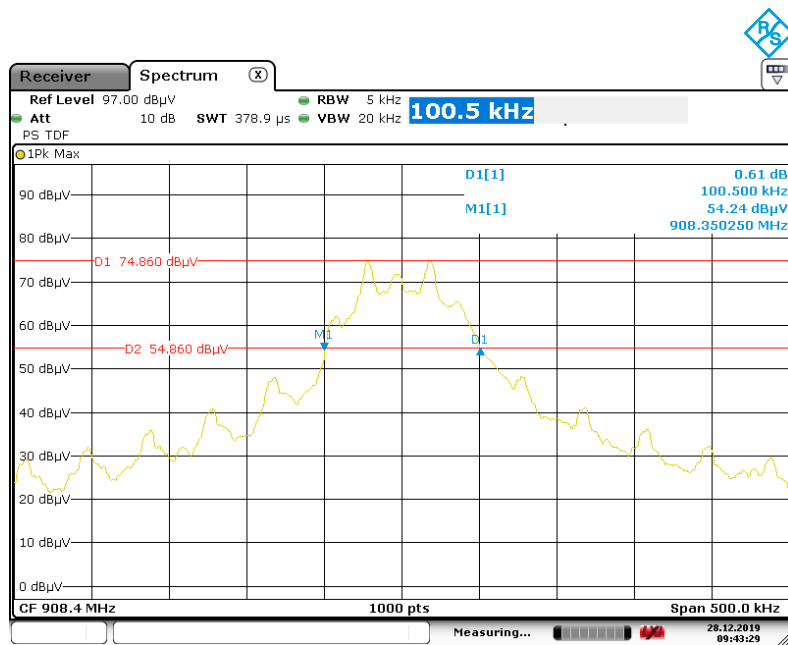
The testing was performed by Eric Xiao on 2019-12-28.

Test Mode: Transmitting

Test Result: Compliance. Please refer to the following table and plots.

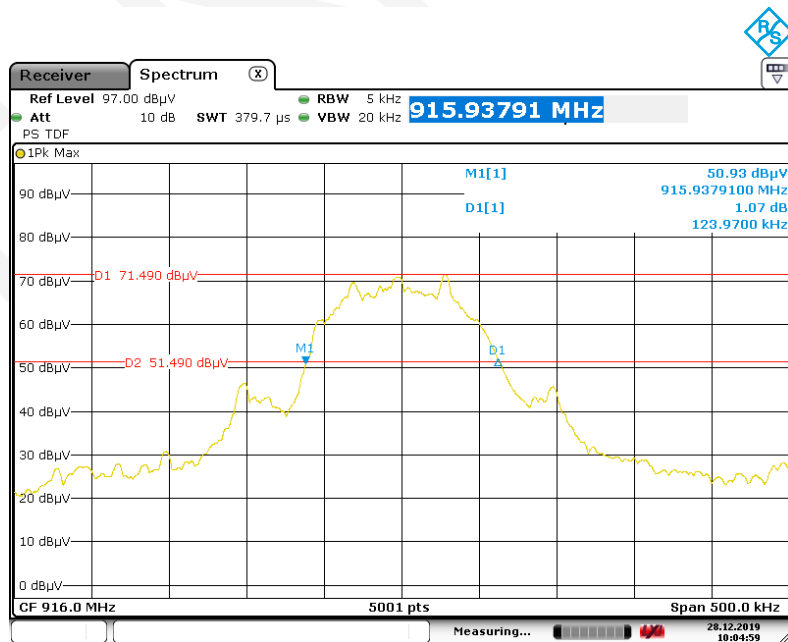
Channel	Frequency (MHz)	20dB Bandwidth (MHz)
Low	908.40	0.10
High	916.00	0.12

Low Channel



Date: 28.DEC.2019 09:43:29

High Channel



Date: 28.DEC.2019 10:04:59

END OF REPORT