TESTING LABORATORY
CERTIFICATE#4323.01

FCC PART 15.255

TEST REPORT

For

Nokia Shanghai Bell Co. Ltd.

No. 388, Ningqiao Rd. Pilot Free Trade Zone, Shanghai, China 201206

FCC ID: 2ADZR7577WPONAPDC

Report Type:	**Product Type:**
Original Report	WPON

Test Engineer:	Kyle Xu
Report Number:	RSHA181022002-00B
Report Date:	2018-12-17
Reviewed By:	Oscar Ye RF Leader
Prepared By:	Bay Area Compliance Laboratories Corp. (Kunshan) No.248 Chenghu Road,Kunshan,Jiangsu province,China Tel: +86-0512-86175000 Fax: +86-0512-88934268 www.baclcorp.com.cn

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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Applicant	Nokia Shanghai Bell Co. Ltd.
Tested Model	WPON AP-DC
Product Type	WPON
Dimension	252mm(L)*166mm(w)*91.5mm(H)
Power Supply	DC 48V

**All measurement and test data in this report was gathered from production sample serial number: 20181022002. (Assigned by the BACL. The EUT supplied by the applicant was received on 2018-10-22)*

Objective

This Type approval report is prepared on behalf of *Nokia Shanghai Bell Co. Ltd.* in accordance with Part 2- Subpart J, and Part 15-Subparts A and C of the Federal Communication Commission's rules.

The objective is to determine the compliance of the EUT with FCC rules, sec 15.203, 15.205, 15.207, 15.209 and 15.255.

This device is modified base on model: WPON AP-AC, FCC ID: 2ADZR7577WPONAPAC, granted on 2018-12-14, the difference between the Model: WPON AP-DC is change the power supply from "AC 100~240V" to "DC 48V".
The change made to the device affected AC Line Conducted Emissions test, Spurious Emissions test, Frequency Stability,the data for the items recorded in this report, the other items please refer to the related report for FCC ID:2ADZR7577WPONAPAC

Related Submittal(s)/Grant(s)

FCC Part 15.247 DSS submission with FCC ID: 2ADZR7577WPONAPDC.
Grant with FCC ID: 2ADZR7577WPONHOU.

Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

All radiated and conducted emissions measurement was performed at Bay Area Compliance Lab Corp. (Kunshan). The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

Measurement Uncertainty

Item		Uncertainty
AC Power Lines Conducted Emissions		3.19dB
RF conducted test with spectrum		0.9dB
RF Output Power with Power meter		0.5dB
Radiated emission	30MHz~1GHz	6.11dB
	1GHz~6GHz	4.45dB
	6GHz~18GHz	5.23dB
	18GHz~40GHz	5.65dB
Occupied Bandwidth		0.5kHz
Temperature		1.0℃
Humidity		6%

Test Facility

The test site used by Bay Area Compliance Laboratories Corp. (Kunshan) to collect test data is located on the No.248 Chenghu Road,Kunshan,Jiangsu province,China.

Bay Area Compliance Laboratories Corp. (Kunshan) Lab is accredited to ISO/IEC 17025 by A2LA (Lab code: 4323.01) and the FCC designation No. CN1185 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

Justification

The system was configured for testing in a typical fashion (as normally used by a typical user).

The device built in 3 identical 60 GHz module, but module 2 only supports SISO mode(ANT 3,4,5), and module 1(ANT 1,2) and 3(ANT 6,7) only supports MIMO mode, which was default by software.

All of the modules only support 3 channels as below:

Channel	Frequency (GHz)
1	58.32
2	60.48
3	62.64

EUT Exercise Software

The software "QRCT3.0" was used for testing, which was provided by manufacturer. The worst condition (maximum power) was configured by system default setting. The worst data rate: 1Gbps.

Equipment Modifications

No modification on the EUT.

Support Equipment List and Details

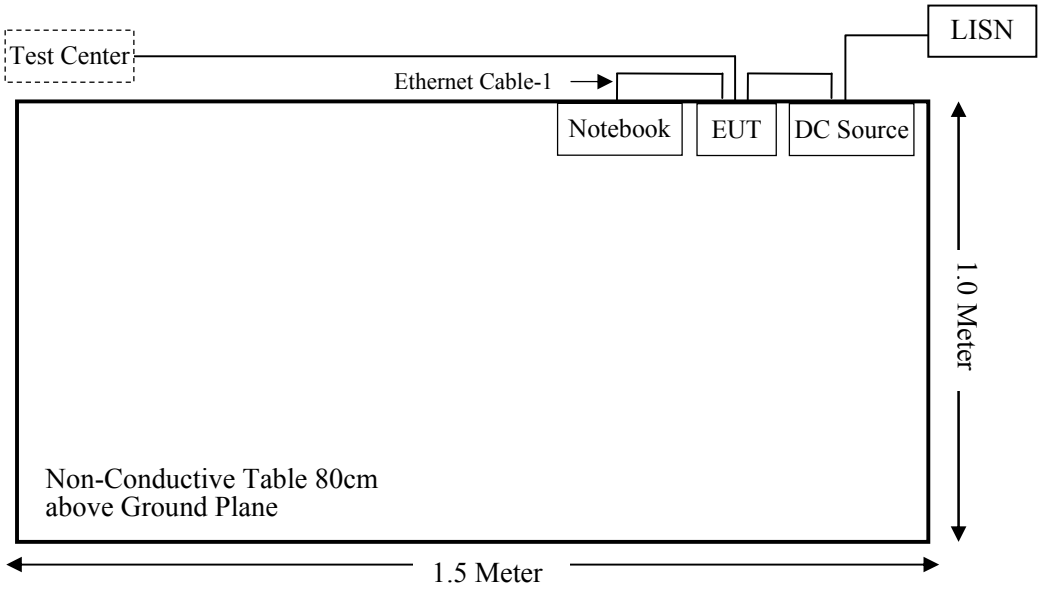
Manufacturer	Description	Model	Serial Number
DELL	Notebook	GX620	D65874152
ZHAOXIN	DC Power Supply	RXN-605D	DC002
Spirent Communications	Test Center	SPT-C1	R18250018

External I/O Cable

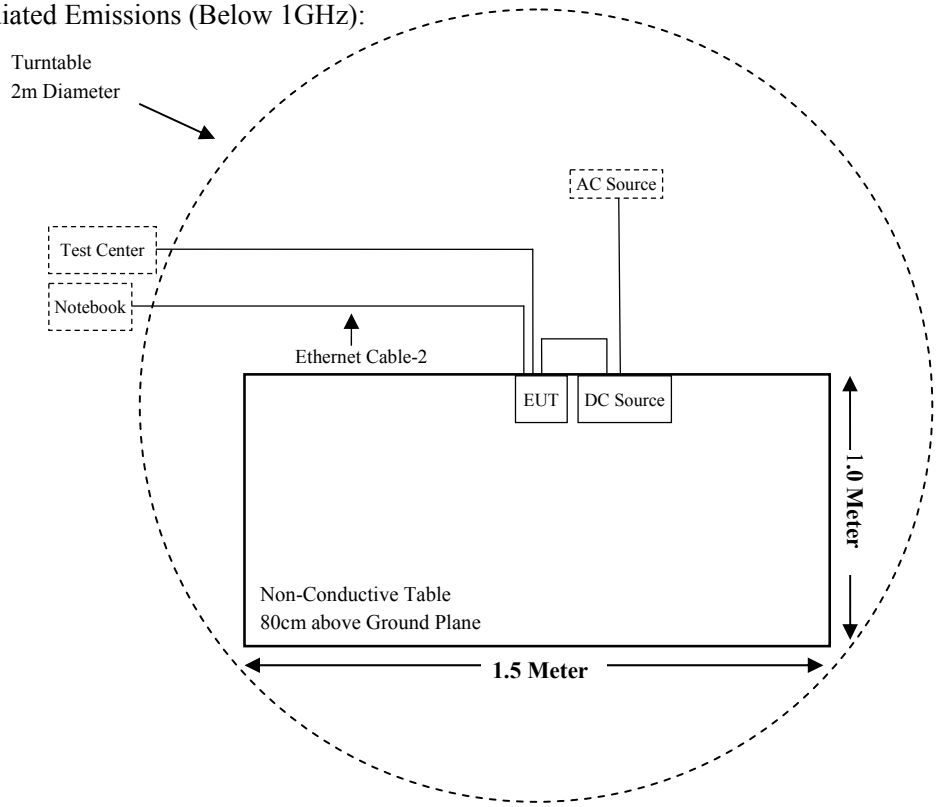
Cable Description	Length (m)	From Port	To
Power Cable-1	1.8	EUT	DC Source
Power Cable-2	1.0	DC Source	LISN/AC Source
Ethernet Cable-1	1.0	EUT	Notebook
Ethernet Cable-2	8.0	EUT	Notebook
Optical Fibre Cable	10	EUT	Test Center

Block Diagram of Test Setup

For Conducted Emissions:



For Radiated Emissions (Below 1GHz):



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§1.1310 & §2.1091	MAXIMUM PERMISSIBLE EXPOSURE (MPE)	Compliant
§15.203	Antenna Requirement	Compliance
§15.207 (a)	AC Line Conducted Emissions	Compliance
§ 15.255 (e) (1)	Occupied Bandwidth	Compliance*
§15.255 (c)	EIRP Power	Compliance*
§15.255 (e)	Peak Conducted Output Power	Compliance*
§15.255 (d)	Spurious Emissions(Below 1GHz)	Compliance
§15.255 (d)	Spurious Emissions(Above 1GHz)	Compliance*
§15.255(f)	Frequency Stability	Compliance
§15.255 (a) (h)	Operation Restriction And Group Installation	Compliance*

Compliant*: For these items, all the test data please refer to the original report RSHA181022001-00B FCC ID: 2ADZR7577WPONAPAC.

TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Radiated Emission Test（Chamber 1#）					
Rohde & Schwarz	EMI Test Receiver	ESCI	100195	2018-11-12	2019-11-11
Sunol Sciences	Broadband Antenna	JB3	A090413-1	2016-12-26	2019-12-25
Sonoma Instrunent	Pre-amplifier	310N	171205	2018-08-15	2019-08-14
Rohde & Schwarz	Auto test Software	EMC32	100361	/	/
MICRO-COAX	Coaxial Cable	Cable-8	008	2018-08-15	2019-08-14
MICRO-COAX	Coaxial Cable	Cable-9	009	2018-08-15	2019-08-14
MICRO-COAX	Coaxial Cable	Cable-10	010	2018-08-15	2019-08-14
Frequency Stability Test					
Agilent	Spectrum Analyzer	8565E	3442A0253	2018-10-25	2019-10-24
Agilent	Harmonic Mixer	11970V	2521A01767	2016-12-07	2019-12-07
Flann Micowave	Horn Antenna	861V/385	736	2016-12-07	2019-12-07
EAST	Regulated DC Power Supply	MCH-303D-II	14070562	2018-10-10	2019-10-09
BACL	Temperature & Humidity Chamber	BTH-150	30023	2018-10-10	2019-10-09
MICRO-COAX	Coaxial Cable	Cable-1	001	2018-08-15	2019-08-14
MICRO-COAX	Coaxial Cable	Cable-2	002	2018-08-15	2019-08-14
Conducted Emission Test					
Rohde & Schwarz	EMI Test Receiver	ESCS30	834115/007	2018-11-12	2019-11-11
Rohde & Schwarz	LISN	ENV216	3560655016	2018-11-12	2019-11-11
BACL	Auto test Software	BACL-EMC	CE001	/	/
Narda	Attenuator/6dB	10690812-2	26850-6	2018-01-10	2019-01-09
MICRO-COAX	Coaxial Cable	Cable-15	015	2018-08-15	2019-08-14

*** Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Kunshan) attests that all calibrations have been performed in accordance to requirements that traceable to National Primary Standards and International System of Units (SI).

FAR FIELD BOUNDARY CALCULATIONS

The far-field boundary is given in ANSI C63.10-2013:

$Rm=2D^2/\lambda$

Where:
D is the largest dimension of the antenna aperture in m and
λ is the free-space wavelength in m at the frequency of measurement.

The minimum test distance for the frequency range 40GHz-200GHz determine as below:

Model	Frequency Range (GHz)	Largest Dimension of the Horn Antenna (mm)	Minimum Test Distance Rm (m)
M19RH	40-60	46.3	0.57
861V/385	50-75	43.7	0.64
M12RH	60-90	30.02	0.36
M08RH	90-140	19.7	0.23
M05RH	140-220	12.5	0.15

Note: the maximum antenna dimension of the EUT was 18 mm. This length is smaller than the largest dimension of the smallest Horn Antenna used to measure up in the frequency range 40 GHz to 140 GHz. and larger than 140GHz to 220GHz. Given that the test distances used were 1.0 m from 40 GHz to 90 GHz, and 0.5 m from 90 GHz to 200 GHz, it can be seen that the EUT was always in the Far-field of the Receive Antenna during all Radiated Emissions Tests.

FCC §1.1310 & §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Applicable Standard

According to subpart 1.1310 & 2.1091 systems operating under the provisions of this section shall be operated in a manner that ensures the public is not exposed to RF energy level in excess of the communication guidelines.

Limits for General Population/Uncontrolled Exposure				
Frequency Range (MHz)	**Electric Field Strength (V/m)**	**Magnetic Field Strength (A/m)**	**Power Density (mW/cm^2)**	**Averaging Time (minutes)**
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*(180/f^2)	30
30-300	27.5	0.073	0.2	30
300-1500	/	/	f/1500	30
1500-100,000	/	/	1.0	30

f = frequency in MHz; * = Plane-wave equivalent power density

Calculated Formulary:

Predication of MPE limit at a given distance

$S = PG/4\pi R^2$ = power density (in appropriate units, e.g. mW/cm^2);
P = power input to the antenna (in appropriate units, e.g., mW);
G = power gain of the antenna in the direction of interest relative to an isotropic radiator, the power gain factor, is normally numeric gain;
R = distance to the center of radiation of the antenna (appropriate units, e.g., cm);

For simultaneously transmit system, the calculated power density should comply with:

$$\sum_i \frac{S_i}{S_{Limit,i}} \leq 1$$

Calculated Data:

Radio	Frequency Range (GHz)	EIRP		Evaluation Distance (cm)	Power Density (mW/cm^2)	MPE Limit (mW/cm^2)
		(dBm)	(mW)			
60G Module 1	58.32-62.64	34.2	2630.27	25	0.3349	1.00
60G Module 2	58.32-62.64	32.0	1584.89	25	0.2018	1.00
60G Module 3	58.32-62.64	35.2	3311.31	25	0.4216	1.00
Bluetooth	2.402-2.48	4.6	2.88	25	0.0004	1.00

Note:

The output power was declared by manufacturer (Bluetooth conducted power is -0.3dBm, antenna gain is 4.9dBi)

The three 60GHz radio and Bluetooth can transmit simultaneously:

$$\sum_i \frac{S_i}{S_{Limit,i}}$$

= 0.3349/1.00 + 0.2018/1.00 + 0.4216/1.00 + 0.0004/1.00
= 0.3349 + 0.2018 + 0.4216 + 0.0004
= 0.9585 < 1.0

Result: The device complied with the applicable MPE Limit at the 25 cm distance.

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 use of a standard antenna jack or electrical connector is prohibited.

Antenna Connected Construction

The EUT has 7 PCB antennas, the antenna gain are 18dBi , which use unique couplings to the intentional radiator, fulfill the requirement of this section. Please refer to the EUT internal photos.

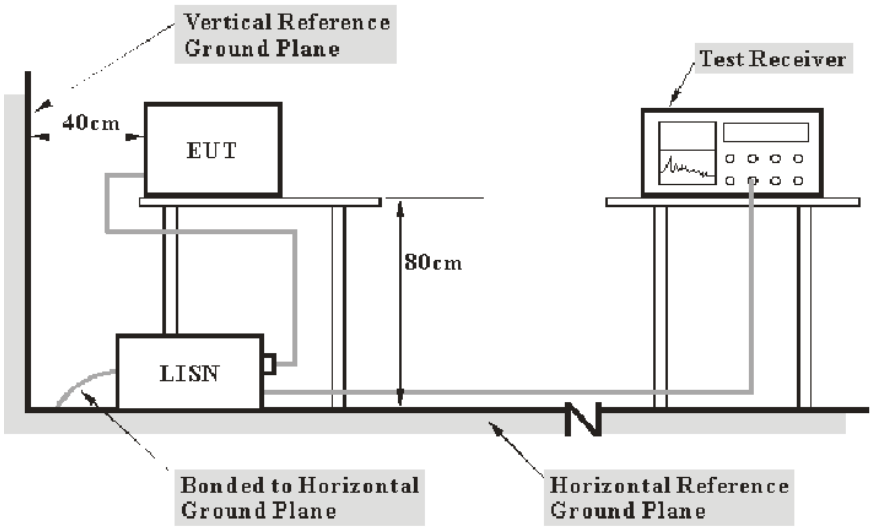
Result: Compliance.

FCC §15.207 (a) – AC LINE CONDUCTED EMISSIONS

Applicable Standard

FCC §15.207(a)

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 measurement procedure of EUT setup is according with ANSI C63.10-2013. The related limit was specified in FCC Part 15.207.

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 LISN.

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

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

Corrected Factor & Margin Calculation

The Corrected factor is calculated by adding LISN VDF (Voltage Division Factor), Cable Loss and Transient Limiter Attenuation. The basic equation is as follows:

Corrected Factor = LISN VDF + Cable Loss + Transient Limiter Attenuation

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

Margin = Limit – Corrected Amplitude

Test Results Summary

According to the recorded data in following table, the EUT complied with the FCC Part 15.207.

Test Data

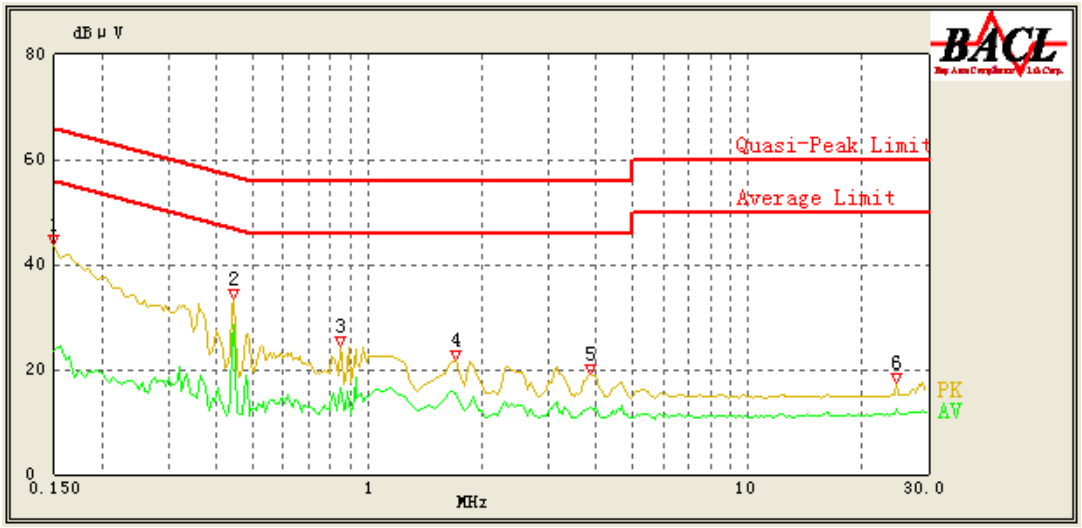
Environmental Conditions

Temperature:	25.4 ℃
Relative Humidity:	51 %
ATM Pressure:	101.0 kPa

The testing was performed by Kyle Xu on 2018-11-27.

EUT operation mode: Transmitting
*(The data for worst case of **module 1 middle channel + module 2 ANT4 low channel + module 3 middle channel** was recorded)*

AC 120V/60 Hz, Line



Frequency (MHz)	Corrected Amplitude (dBµV)	Detector (PK/AV/QP)	Bandwidth (kHz)	Line	Corrected Factor (dB)	Limit (dBµV)	Margin (dB)	Comment
0.150	43.68	QP	9.000	L1	16.06	66.00	22.32	Compliant
0.150	23.45	AV	9.000	L1	16.06	56.00	32.55	Compliant
0.445	33.65	QP	9.000	L1	16.07	56.97	23.32	Compliant
0.445	28.48	AV	9.000	L1	16.07	46.97	18.49	Compliant
0.845	24.43	QP	9.000	L1	15.92	56.00	31.57	Compliant
0.845	16.62	AV	9.000	L1	15.92	46.00	29.38	Compliant
1.700	21.79	QP	9.000	L1	15.86	56.00	34.21	Compliant
1.700	15.56	AV	9.000	L1	15.86	46.00	30.44	Compliant
3.850	19.14	QP	9.000	L1	15.85	56.00	36.86	Compliant
3.850	12.80	AV	9.000	L1	15.85	46.00	33.20	Compliant
24.750	17.37	QP	9.000	L1	16.46	60.00	42.63	Compliant
24.750	12.36	AV	9.000	L1	16.46	50.00	37.64	Compliant

AC 120V/60 Hz, Neutral

Frequency (MHz)	Corrected Amplitude (dBµV)	Detector (PK/AV/QP)	Bandwidth (kHz)	Line	Corrected Factor (dB)	Limit (dBµV)	Margin (dB)	Comment
0.150	42.25	QP	9.000	N	16.06	66.00	23.75	Compliant
0.150	24.99	AV	9.000	N	16.06	56.00	31.01	Compliant
0.445	36.18	QP	9.000	N	16.10	56.97	20.79	Compliant
0.445	32.95	AV	9.000	N	16.10	46.97	14.02	Compliant
0.970	25.94	QP	9.000	N	15.94	56.00	30.06	Compliant
0.970	19.60	AV	9.000	N	15.94	46.00	26.40	Compliant
3.150	22.84	QP	9.000	N	15.89	56.00	33.16	Compliant
3.150	17.37	AV	9.000	N	15.89	46.00	28.63	Compliant
8.400	16.35	QP	9.000	N	15.95	60.00	43.65	Compliant
8.350	11.57	AV	9.000	N	15.95	50.00	38.43	Compliant
24.750	18.06	QP	9.000	N	16.24	60.00	41.94	Compliant
24.750	13.32	AV	9.000	N	16.24	50.00	36.68	Compliant

Note:
1) Corrected Factor = LISN VDF + Cable Loss + Transient Limiter Attenuation
2) Margin = Limit– Corrected Amplitude

FCC§15.205, §15.209&§15.255(d) - TRANSMITTER SPURIOUS EMISSIONS

Applicable Standard

(d) Limits on spurious emissions:

(1) The power density of any emissions outside the 57-64GHz band shall consist solely of spurious emissions.

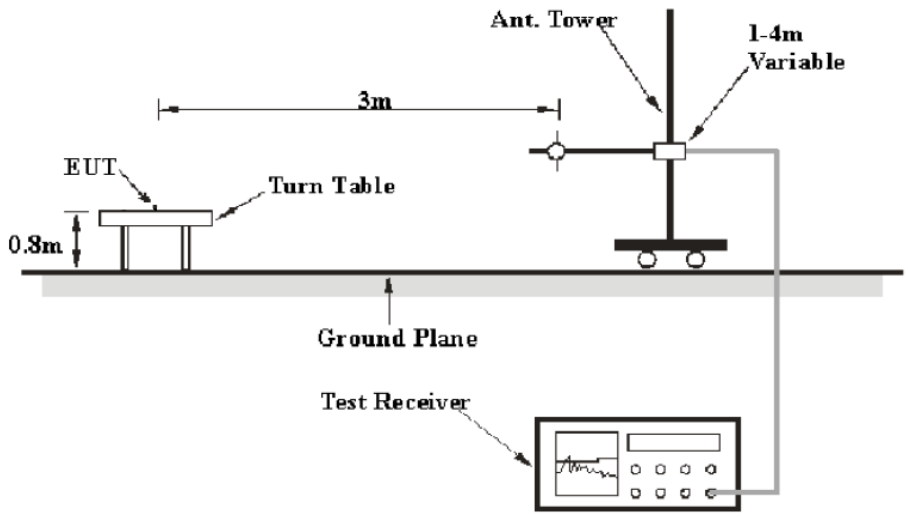
(2) Radiated emissions below 40GHz shall not exceed the general limits in §15.209.

(3) Between 40GHz and200 GHz, the level of these emissions shall not exceed 90pW/cm^2 at a distance of 3 meters.

(4) The levels of the spurious emissions shall not exceed the level of the fundamental emission.

EUT Setup

Below 1 GHz:



The radiated emission tests were performed in the 3-meter chamber a test site, using the setup accordance with the ANSI C63.10. The specification used was the FCC 15.205, 15.209 and FCC 15.255 limits.

The spacing between the peripherals was 10 cm.

Test Equipment Setup

The system was investigated from 30MHz to 1GHz.

During the radiated emission test, the EMI test receiver setup & Spectrum Analyzer Setup were 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

Test Procedure

A Maximizing procedure was performed to ensure that the highest emissions from the EUT were actually measured in all of the Test Arrangements of the EUT and Local Support Equipment.

In accordance with FCC Rules Part 15 Subpart A Section 15.35, from 30 MHz to 1 GHz all radiated emissions measurements were made using a Quasi-peak Detector.

Corrected Amplitude & Margin Calculation

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

Corrected = Antenna Loss + Cable Loss- Amplifier Gain

Or

Corrected Amplitude = Antenna Loss + Cable Loss - Amplifier Gain- Distance extrapolation factor

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

Result = Reading + Corrected

Margin = Limit – Result

Test Results Summary

According to the data in the following table, the EUT complied with the FCC Part 15.205, 15.209 and 15.255.

Test Data

Environmental Conditions

Temperature:	24.1 ℃-24.3℃
Relative Humidity:	50 %-52%
ATM Pressure:	101.2kPa-101.3kPa

The testing was performed by Kyle Xu from 2018-11-15.

EUT operation mode: Transmitting

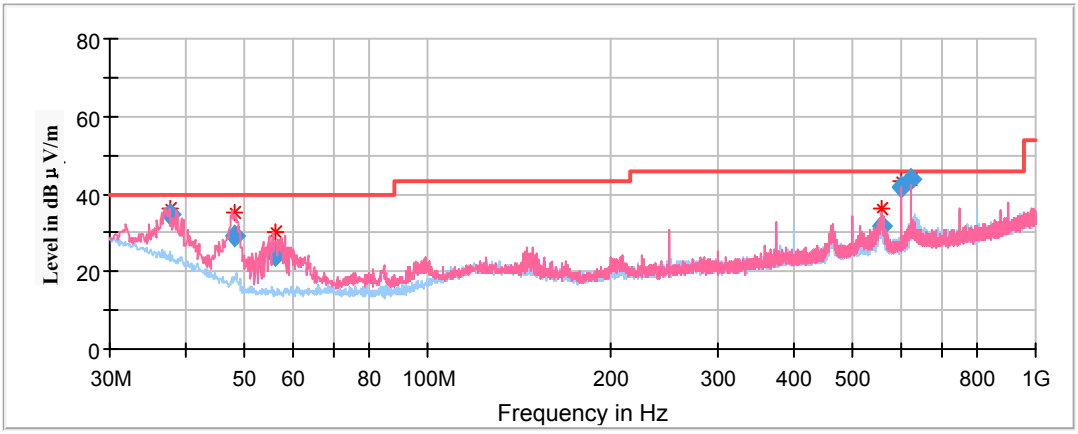
Module 1& Module 2 & Module 3 transmit simultaneously:

*(The data for worst case of **module 1 middle channel + module 2 ANT4 low channel + module 3 middle channel** was recorded)*

30MHz-1GHz:

(*Pre-Scan in the **X, Y and Z axes of orientation**, the worst case **in X-axis of orientation** was recorded)*

Low Channel



Frequency (MHz)	Corrected Amplitude	Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
	Quasi-peak (dBµV/m)	Height (cm)	Polar (H/V)				
37.630050	34.76	101.0	V	216.0	-9.1	40.00	5.24
48.151000	29.23	101.0	V	0.0	-16.3	40.00	10.77
56.215250	24.04	101.0	V	2.0	-17.8	40.00	15.96
558.209950	31.54	101.0	V	180.0	-5.6	46.00	14.46
600.125600	42.00	101.0	V	175.0	-5.2	46.00	4.00
625.085700	43.59	101.0	V	154.0	-4.7	46.00	2.41

FCC§15.255(f) - FREQUENCY STABILITY

Applicable Standard

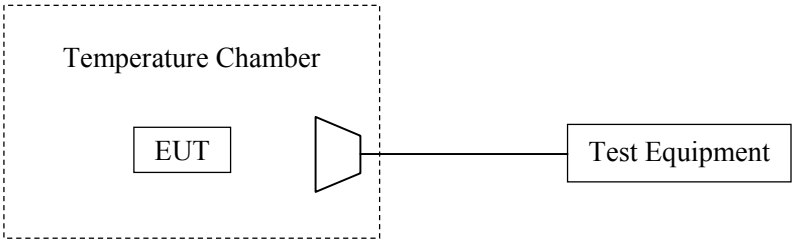
Fundamental emissions must be contained within the frequency bands specified in this section during all conditions of operation. Equipment is presumed to operate over the temperature range −20 to +50 degrees Celsius with an input voltage variation of 85% to 115% of rated input voltage, unless justification is presented to demonstrate otherwise.

Test Procedure

Frequency Stability vs. Temperature: The adapter of the equipment under test was connected to an DC power source. The EUT was placed inside the temperature chamber. Place the Horn antenna outside the temperature chamber. Place the EUT antenna toward the Horn antenna.

After the temperature stabilized for approximately 20 minutes, the frequency output was recorded from the communication test set.

Frequency Stability vs. Voltage: An external variable AC power supply was connected to the equipment under test. The voltage was set from 85% to 115% of the nominal value. The output frequency was recorded for each voltage.



Test Data

Environmental Conditions

Temperature:	23.2 ℃
Relative Humidity:	50 %
ATM Pressure:	101.3 kPa

The testing was performed by Kyle Xu on 2018-11-27.

Test Mode: Transmitting.

Test Result: Pass

Temperature	Voltage	Frequency (MHz)			
℃	V_{DC}	f_L at Low Channel	F_H at High Channel	f_L Limit	F_H Limit
-20	48	57352	63642	57000	71000
-10		57353	63641	57000	71000
0		57356	63639	57000	71000
10		57352	63644	57000	71000
20		57355	63638	57000	71000
30		57351	63645	57000	71000
40		57352	63641	57000	71000
50		57350	63642	57000	71000
25	40.8	57354	63637	57000	71000
25	55.2	57351	63652	57000	71000

******* END OF REPORT *******