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: 2ADZR7577WPONAPED

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

Test Engineer:	Kyle Xu
Report Number:	RSHA181022003-00B
Report Date:	2018-11-28
Reviewed By:	Oscar Ye RF Leader
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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Applicant	Nokia Shanghai Bell Co. Ltd.
Tested Model	WPON AP-Ext-DC
Product Type	WPON
Dimension	251.6mm (L)*166.1mm (W)*80mm(H)
Power Supply	DC 48V

**All measurement and test data in this report was gathered from production sample serial number: 20181022003. (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.

Related Submittal(s)/Grant(s)

FCC Part 15.247 DSS submission with FCC ID: 2ADZR7577WPONAPED.
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 a 60 GHz module, which supports SISO mode at ANT 0, 1, 2. The module

only supports 3 channels as below for each antenna port:

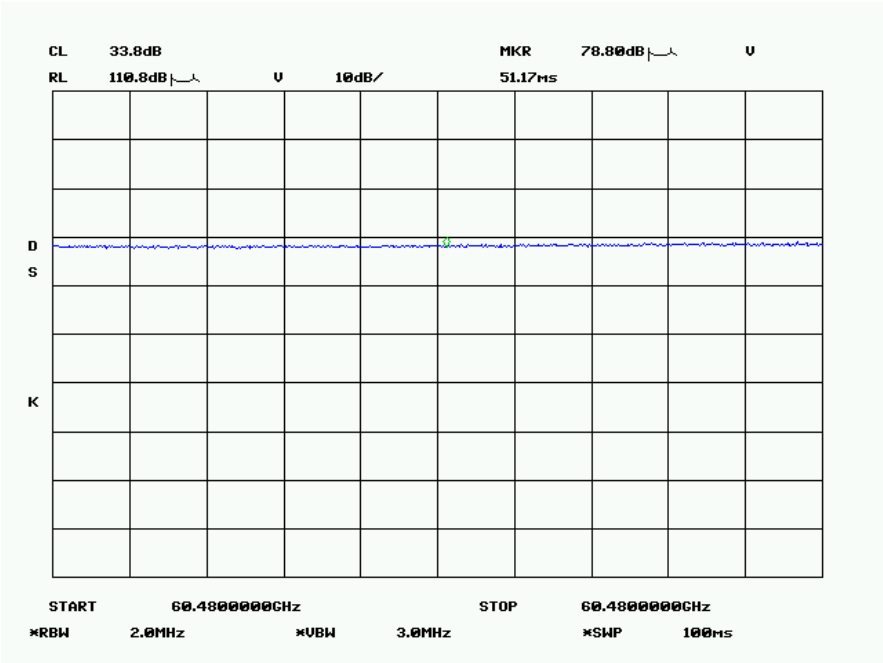
Channel	Frequency (GHz)
1	58.32
2	60.48
3	62.64

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.

Duty Cycle:

Middle Channel



Duty Cycle (%)	T(ms)	1/T(kHz)	10log(1/x)
100	/	/	0

Note: "x" means the Duty Cycle.

Equipment Modifications

No modification on the EUT.

Support Equipment List and Details

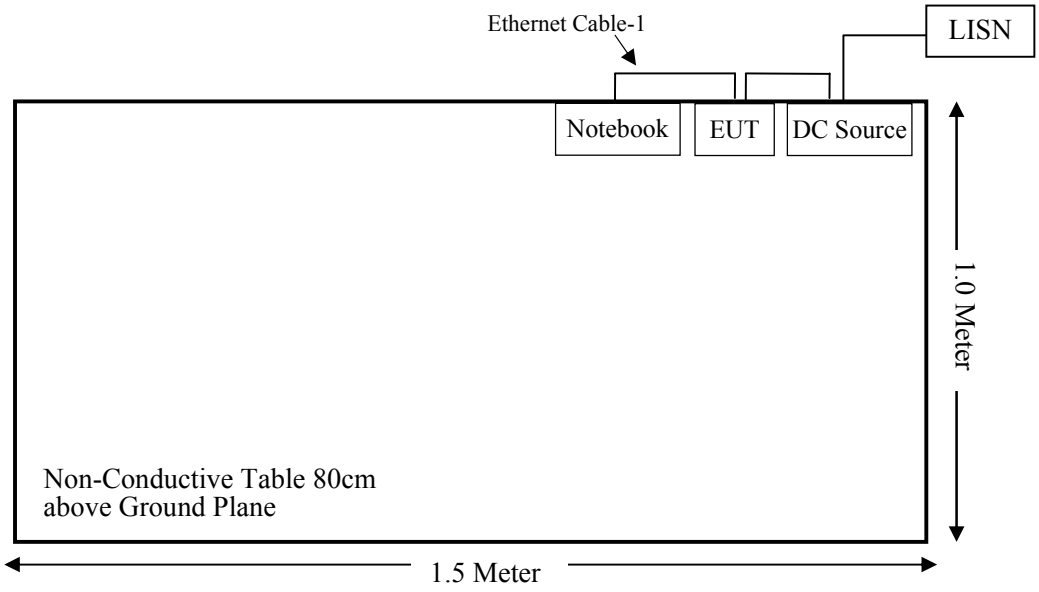
Manufacturer	Description	Model	Serial Number
DELL	Notebook	GX620	D65874152
ZHAOXIN	DC Power Supply	RXN-605D	DC002

External I/O Cable

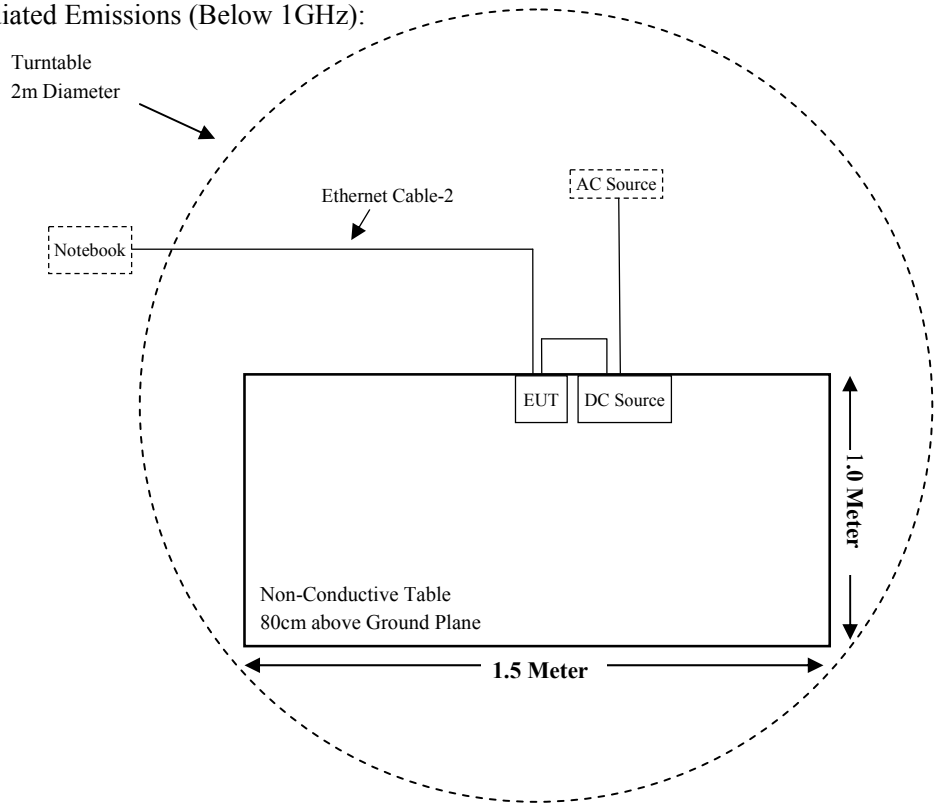
Cable Description	Length (m)	From Port	To
Power Cable-1	1.8	EUT	DC Source
Power Cable-2	1.0	DC Source	LISN/AC Source
Ethernet Cable-1	1.0	EUT	Notebook
Ethernet Cable-2	8.0	EUT	Notebook

Block Diagram of Test Setup

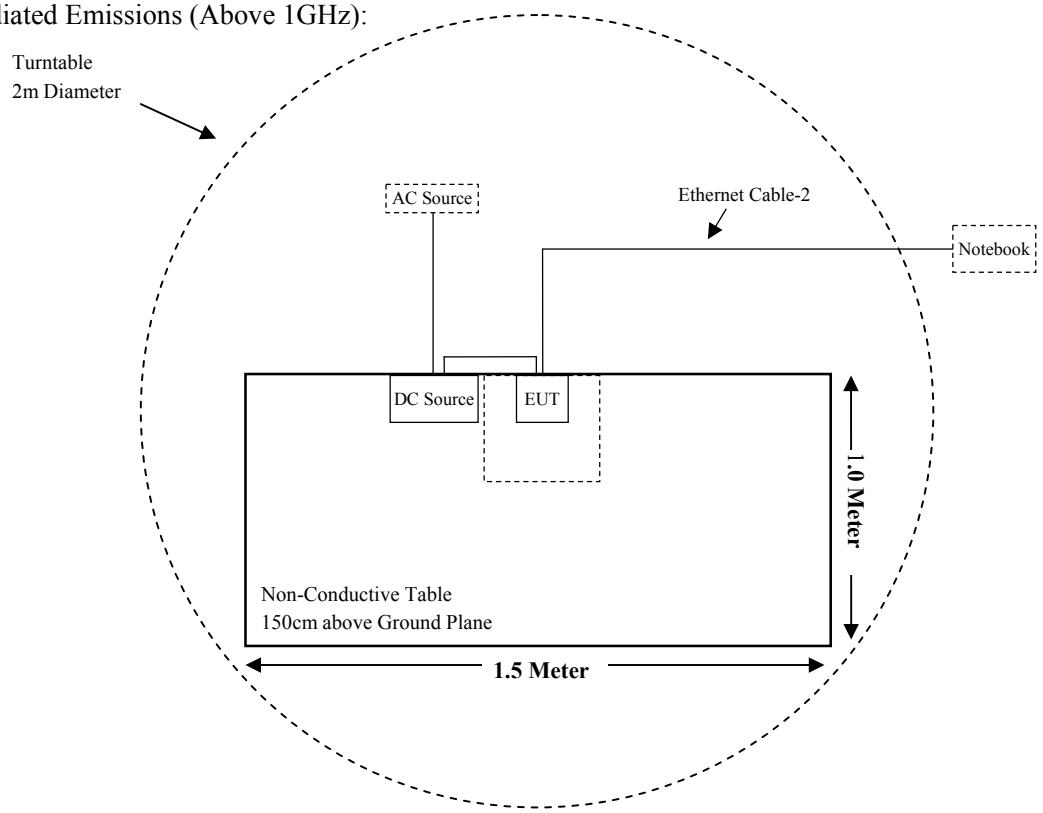
For Conducted Emissions:



For Radiated Emissions (Below 1GHz):



For Radiated Emissions (Above 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	Compliance
§15.255(f)	Frequency Stability	Compliance
§15.255 (a) (h)	Operation Restriction And Group Installation	Compliance

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
ZHAOXIN	DC Power Supply	RXN-605D	DC002	2018-10-10	2019-10-09
Radiated Emission Test（Chamber 2#）					
Rohde & Schwarz	EMI Test Receiver	ESU40	100207	2018-08-27	2019-08-26
Agilent	Spectrum Analyzer	8565E	3442A0253	2018-10-25	2019-10-24
ETS-LINDGREN	Horn Antenna	3115	6229	2016-01-11	2019-01-10
ETS-LINDGREN	Horn Antenna	3116	00084159	2016-10-18	2019-10-17
A.H.Systems, inc	Amplifier	2641-1	466	2018-09-11	2019-09-10
EM Electronics Corporation	Amplifier	EM18G40G	060726	2018-03-22	2019-03-21
OML	Harmonic Mixer	WR19/M19HWD	U60313-1	2016-10-14	2019-10-14
OML	Horn Antenna	M19RH	11648-01	2016-10-14	2019-10-14
Agilent	Harmonic Mixer	11970V	2521A01767	2016-12-07	2019-12-07
Flann Micowave	Horn Antenna	861V/385	736	2016-12-07	2019-12-07
OML	Harmonic Mixer	WR12/M12HWD	E60120-1	2016-10-19	2019-10-19
OML	Horn Antenna	M12RH	E60120-2	2016-10-19	2019-10-19
OML	Harmonic Mixer	WR08/M08HWD	F60313-1	2016-10-24	2019-10-24
OML	Horn Antenna	M08RH	F60313-2	2016-10-24	2019-10-24
OML	Harmonic Mixer	WR05/M05HWD	G60106-1	2016-10-27	2019-10-27
OML	Horn Antenna	M05RH	G60106-2	2016-10-27	2019-10-27
millitech	RF Detector	DET-15-RPFW0	A18521	2017-12-15	2019-12-15
Tektronix	Digital Phosphor Oscilloscope	TDS 3054	B015264	2018-06-15	2019-06-14
Agilent	Signal Generator	E8247C	MY43321350	2017-12-11	2018-12-11
Agilent	mm-Wave Source Modules	83557A	2735A00145	2017-08-16	2019-08-15
UNI-T	Multimeter	UT39A	M130199938	2018-05-09	2019-05-09
BACL	Temperature & Humidity Chamber	BTH-150	30023	2018-10-10	2019-10-09
OML	Diplexer	DPL.26	EM-128	2016-10-11	2019-10-10
Narda	Attenuator	10dB	010	2018-08-15	2019-08-14
Rohde & Schwarz	Auto test Software	EMC32	100361	/	/
MICRO-COAX	Coaxial Cable	Cable-6	006	2018-08-15	2019-08-14
MICRO-COAX	Coaxial Cable	Cable-11	011	2018-08-15	2019-08-14
MICRO-COAX	Coaxial Cable	Cable-12	012	2018-08-15	2019-08-14
MICRO-COAX	Coaxial Cable	Cable-13	013	2018-08-15	2019-08-14
ZHAOXIN	DC Power Supply	RXN-605D	DC002	2018-10-10	2019-10-09

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Conducted Emission Test					
Rohde & Schwarz	EMI Test Receiver	ESCS30	834115/007	2017-11-12	2018-11-11
Rohde & Schwarz	LISN	ENV216	3560655016	2017-11-12	2018-11-11
BACL	Auto test Software	BACL-EMC	CE001	/	/
Narda	Attenuator/6dB	10690812-2	26850-6	2018-01-10	2019-01-09
ZHAOXIN	DC Power Supply	RXN-605D	DC002	2018-10-10	2019-10-09
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)	Tune-up power		Evaluation Distance (cm)	Power Density (mW/cm^2)	MPE Limit (mW/cm^2)
		(dBm)	(mW)			
60G	58.32-62.64	32.0	1584.89	20	0.3153	1.00
Bluetooth	2.402-2.48	3.9	2.45	20	0.0005	1.00

Note:

The output power was declared by manufacturer. (Bluetooth conducted power is -1.0dBm, antenna gain is 4.9dBi)

The 60GHz radio and Bluetooth can transmit simultaneously:

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

= 0.3153/1.00 + 0.0005/1.00
= 0.3153 + 0.0005
= 0.3158 < 1.0

Result: The device complied with the applicable MPE Limit at the 20cm 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 3 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.

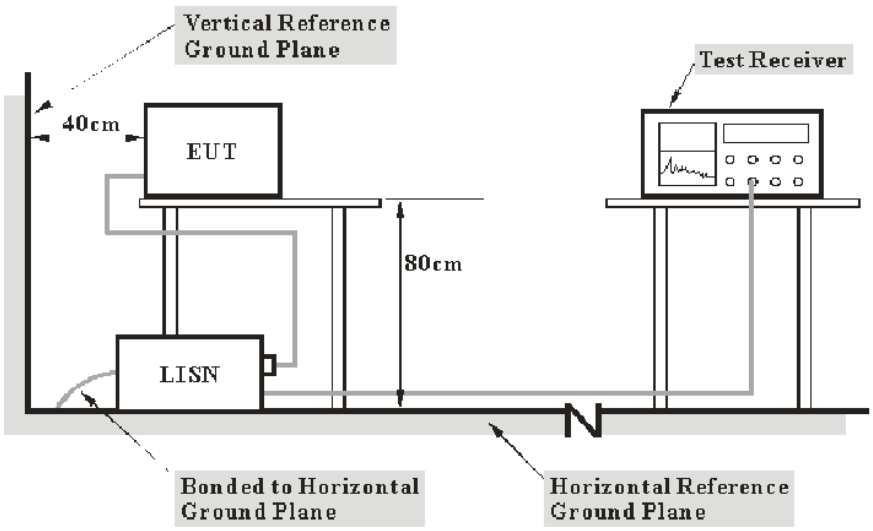
Result: Compliance.

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

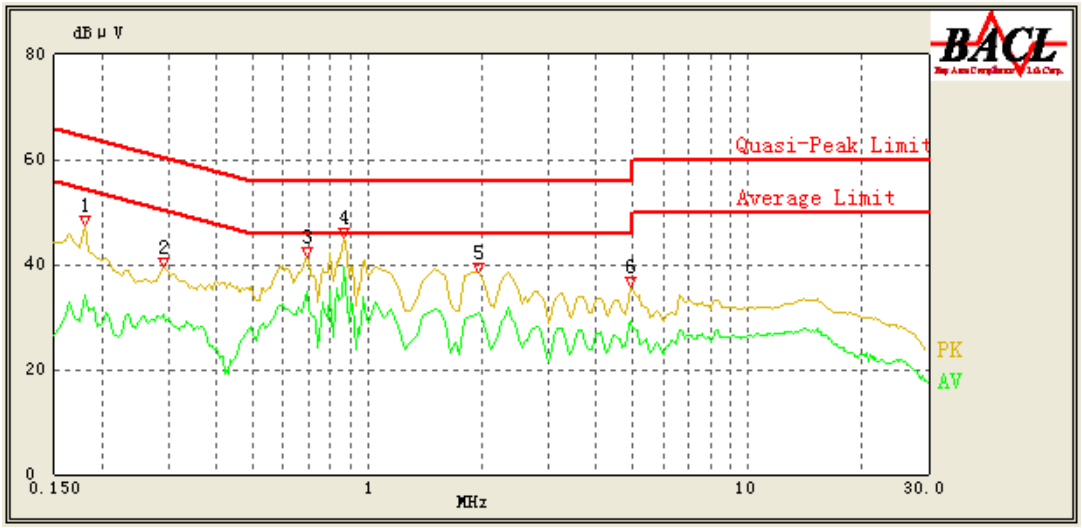
Environmental Conditions

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

The testing was performed by Kyle Xu on 2018-10-22.

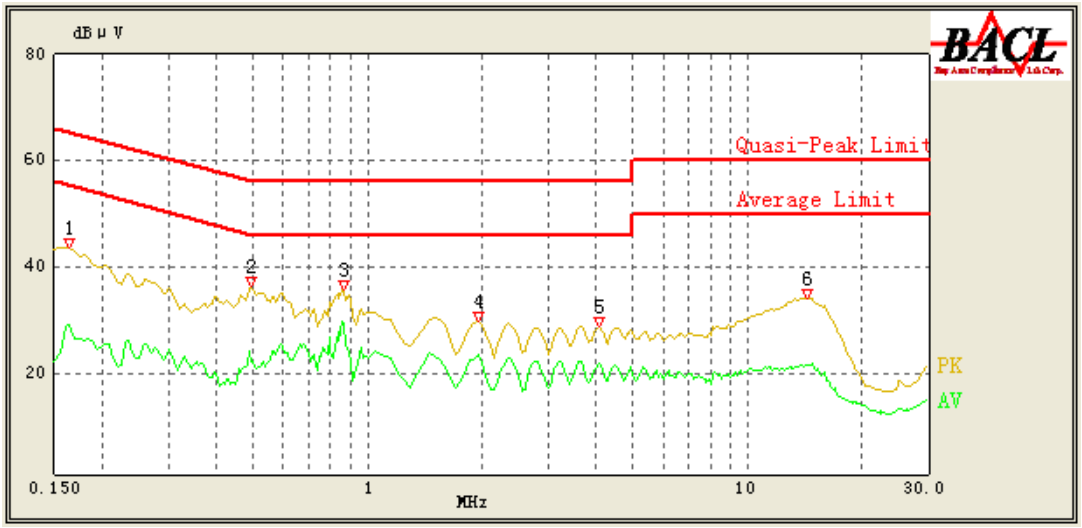
EUT operation mode: Transmitting
*(The data for the worst case of **ANT2 middle channel** was recorded)*

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
0.180	47.42	QP	9.000	L1	16.03	64.49	17.07	Compliant
0.180	34.18	AV	9.000	L1	16.03	54.49	20.31	Compliant
0.290	39.37	QP	9.000	L1	16.03	60.52	21.15	Compliant
0.290	30.66	AV	9.000	L1	16.03	50.52	19.86	Compliant
0.695	41.37	QP	9.000	L1	15.95	56.00	14.63	Compliant
0.695	34.80	AV	9.000	L1	15.96	46.00	11.20	Compliant
0.865	45.22	QP	9.000	L1	15.91	56.00	10.78	Compliant
0.865	39.41	AV	9.000	L1	15.91	46.00	6.59	Compliant
1.950	38.65	QP	9.000	L1	15.85	56.00	17.35	Compliant
1.950	30.95	AV	9.000	L1	15.85	46.00	15.05	Compliant
4.900	35.72	QP	9.000	L1	15.85	56.00	20.28	Compliant
4.900	29.22	AV	9.000	L1	15.85	46.00	16.78	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
0.165	43.77	QP	9.000	N	16.06	65.21	21.44	Compliant
0.165	29.23	AV	9.000	N	16.06	55.21	25.98	Compliant
0.495	36.47	QP	9.000	N	16.11	56.08	19.61	Compliant
0.495	22.33	AV	9.000	N	16.11	46.08	23.75	Compliant
0.865	35.67	QP	9.000	N	15.96	56.00	20.33	Compliant
0.865	29.63	AV	9.000	N	15.96	46.00	16.37	Compliant
1.950	29.79	QP	9.000	N	15.91	56.00	26.21	Compliant
1.950	23.57	AV	9.000	N	15.91	46.00	22.43	Compliant
4.050	28.81	QP	9.000	N	15.88	56.00	27.19	Compliant
4.050	21.87	AV	9.000	N	15.88	46.00	24.13	Compliant
14.350	34.18	QP	9.000	N	16.01	60.00	25.82	Compliant
14.350	21.45	AV	9.000	N	16.01	50.00	28.55	Compliant

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

FCC§15.255(c) – EQUIVALENT ISOTROPICALLY RADIATED POWER (EIRP)

Applicable Standard

(c) Within the 57-71 GHz band, emission levels shall not exceed the following equivalent isotropically radiated power (EIRP):

(1) Products other than fixed field disturbance sensors and short-range devices for interactive motion sensing shall comply with one of the following emission limits, as measured during the transmit interval:

(i) The average power of any emission shall not exceed 40 dBm and the peak power of any emission shall not exceed 43 dBm; or

(ii) For fixed point-to-point transmitters located outdoors, the average power of any emission shall not exceed 82 dBm, and shall be reduced by 2 dB for every dB that the antenna gain is less than 51 dBi. The peak power of any emission shall not exceed 85 dBm, and shall be reduced by 2 dB for every dB that the antenna gain is less than 51 dBi.

(A) The provisions in this paragraph for reducing transmit power based on antenna gain shall not require that the power levels be reduced below the limits specified in paragraph (b)(1)(i) of this section.

(B) The provisions of §15.204(c)(2) and (4) that permit the use of different antennas of the same type and of equal or less directional gain do not apply to intentional radiator systems operating under this provision. In lieu thereof, intentional radiator systems shall be certified using the specific antenna(s) with which the system will be marketed and operated. Compliance testing shall be performed using the highest gain and the lowest gain antennas for which certification is sought and with the intentional radiator operated at its maximum available output power level. The responsible party, as defined in §2.909 of this chapter, shall supply a list of acceptable antennas with the application for certification.

(2) For fixed field disturbance sensors that occupy 500 MHz or less of bandwidth and that are contained wholly within the frequency band 61.0-61.5 GHz, the average power of any emission, measured during the transmit interval, shall not exceed 40 dBm, and the peak power of any emission shall not exceed 43 dBm. In addition, the average power of any emission outside of the 61.0-61.5 GHz band, measured during the transmit interval, but still within the 57-71 GHz band, shall not exceed 10 dBm, and the peak power of any emission shall not exceed 13 dBm.

(3) For fixed field disturbance sensors other than those operating under the provisions of paragraph (b)(2) of this section, and short-range devices for interactive motion sensing, the peak transmitter conducted output power shall not exceed −10 dBm and the peak EIRP level shall not exceed 10 dBm.

(4) The peak power shall be measured with an RF detector that has a detection bandwidth that encompasses the 57-71 GHz band and has a video bandwidth of at least 10 MHz. The average emission levels shall be measured over the actual time period during which transmission occurs.

Test Procedure

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

At frequencies greater than or equal to 1 GHz, measurements were recorded using the Peak Detector and the CISPR Average Detector.

Test Data

Environmental Conditions

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

The testing was performed by Kyle Xu on 2018-11-17.

EUT operation mode: Transmitting

Please refer to the following table:

ANT0:

Frequency (GHz)	Detector (PK/AV)	Polar (H/V)	Submitted Level (dBm)	Antenna Gain (dBi)	EIPR Power (dBm)	Duty cycle correction factor (dB)	Limit (dBm)	Margin (dB)
58.32	PK	V	-12.67	24	31.20	/	43	11.80
58.32	AV	V	-18.92	24	24.95	0	40	15.05
60.48	PK	V	-13.31	24	30.88	/	43	12.12
60.48	AV	V	-19.48	24	24.71	0	40	15.29
62.64	PK	V	-14.58	24	29.91	/	43	13.09
62.64	AV	V	-21.59	24	22.90	0	40	17.10

ANT1:

Frequency (GHz)	Detector (PK/AV)	Polar (H/V)	Submitted Level (dBm)	Antenna Gain (dBi)	EIPR Power (dBm)	Duty cycle correction factor (dB)	Limit (dBm)	Margin (dB)
58.32	PK	V	-12.17	24	31.70	/	43	11.30
58.32	AV	V	-18.78	24	25.09	0	40	14.91
60.48	PK	V	-12.27	24	31.92	/	43	11.08
60.48	AV	V	-19.51	24	24.68	0	40	15.32
62.64	PK	V	-13.38	24	31.11	/	43	11.89
62.64	AV	V	-21.29	24	23.20	0	40	16.80

ANT2:

Frequency (GHz)	Detector (PK/AV)	Polar (H/V)	Submitted Level (dBm)	Antenna Gain (dBi)	EIPR Power (dBm)	Duty cycle correction factor (dB)	Limit (dBm)	Margin (dB)
58.32	PK	V	-12.01	24	31.86	/	43	11.14
58.32	AV	V	-18.69	24	25.18	0	40	14.82
60.48	PK	V	-12.22	24	31.97	/	43	11.03
60.48	AV	V	-18.84	24	25.35	0	40	14.65
62.64	PK	V	-12.85	24	31.64	/	43	11.36
62.64	AV	V	-20.75	24	23.74	0	40	16.26

Note 1: The measurement distance is 1.0 m.

Note 2: RF Detector and a DSO with a bandwidth greater than 10 MHz were used to make the measurements

Note 3: The measurement performed with radiation method, according to ANSI C63.10-2013 Clause 9.11:

$E = 126.8\text{-}20\log(\lambda) + P - G$
$EIRP = E_{Meas} + 20\log(d_{Meas}) - 104.7$
$\geq EIRP = 126.8 - 20\log(\lambda) + P - G + 20\log(1) - 104.7$
$= 22.1 - 20\log(\lambda) + P - G$

λ is the free-space wavelength in m at the frequency of measurement.
$= 3 \times 10^8/f$

f is frequency in Hz.

Note 4: The Mixers and their RF cables compose a system for calibration.

Note 5: The test data recorded was the maximum polarization.

Note 6: Submitted Level is the power recoded in Step e) 9) of §9.11 of ANSI C63.10-2013

Note 7: Horn antenna gain is 24dBi.

Note 8: . EIPR Power(AV)= Submitted Level+ Submitted Antenna Gain+ Duty cycle correction factor

FCC§15.255(e) (1) - OCCUPIED BANDWIDTH

Applicable Standard

Transmitters with an emission bandwidth of less than 100 MHz must limit their peak transmitter conducted output power to the product of 500 mW times their emission bandwidth divided by 100 MHz. For the purposes of this paragraph, emission bandwidth is defined as the instantaneous frequency range occupied by a steady state radiated signal with modulation, outside which the radiated power spectral density never exceeds 6 dB below the maximum radiated power spectral density in the band, as measured with a 100kHz resolution bandwidth spectrum analyzer. The center frequency must be stationary during the measurement interval, even if not stationary during normal operation (e.g., for frequency hopping devices).

Test Procedure

The Marker is to be placed on the highest amplitude peak of the "hash", and then the Display Line should be moved to the -6dB than the highest amplitude peak, the Marker should be moved leftward off of the peak amplitude point to identify the -6 dB point, the Delta should be moved rightward off of the peak amplitude point to identify the -6 dB point. The Delta is the 6 dB Bandwidth.

Test Data

Environmental Conditions

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

The testing was performed by Kyle Xu on 2018-11-17.

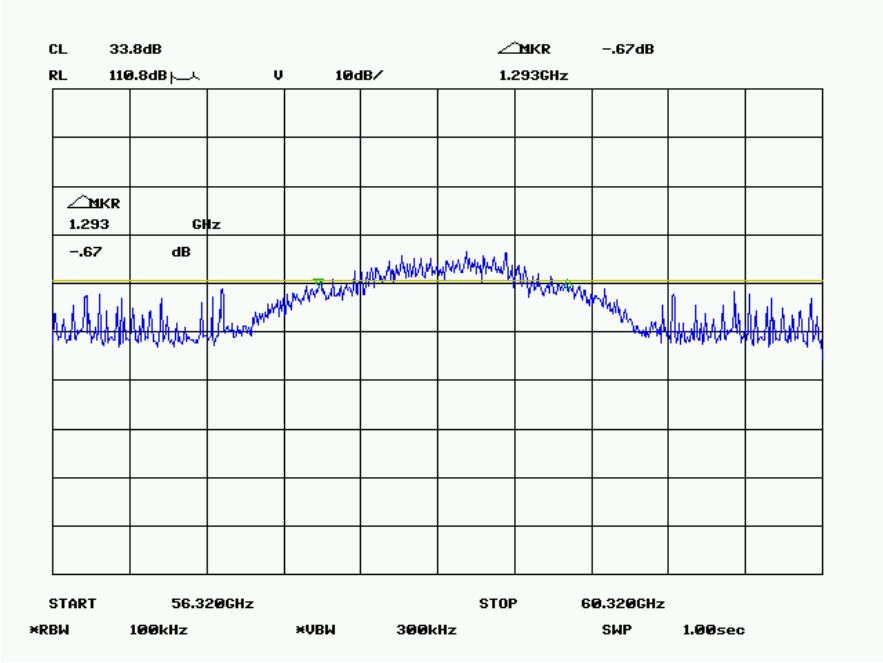
EUT operation mode: Transmitting (Test performed at ANT2)

Please refer to the following table and plots:

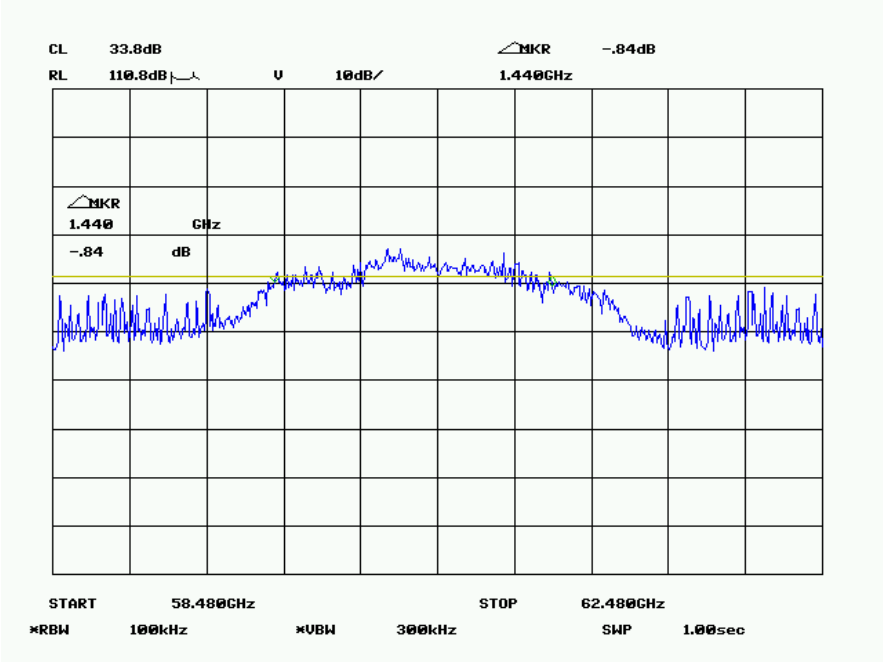
Channel	Frequency (GHz)	6 dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	58.32	1293	1800
Middle	60.48	1440	1840
High	62.64	1487	1813

6 dB Bandwidth

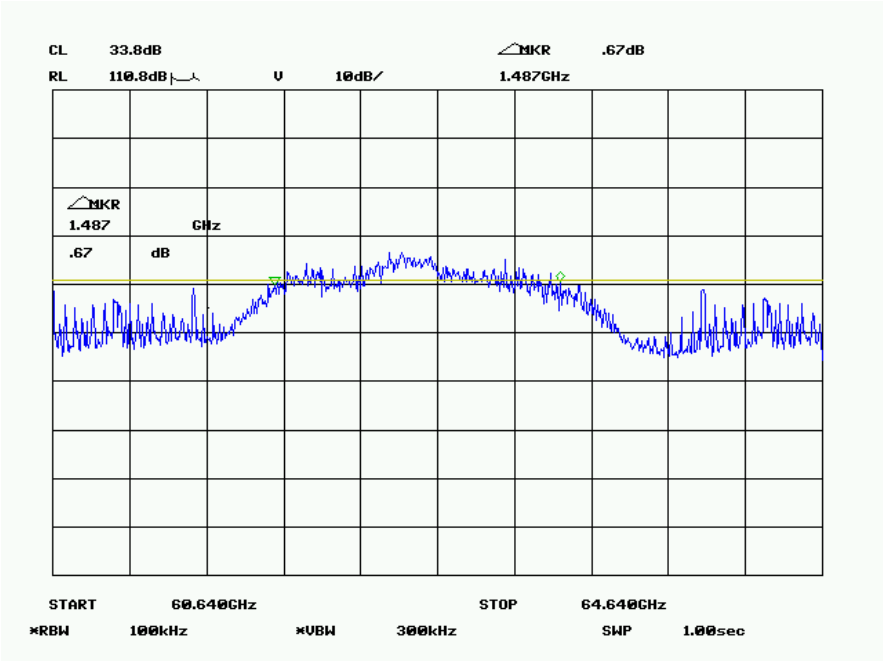
Low Channel



Middle Channel

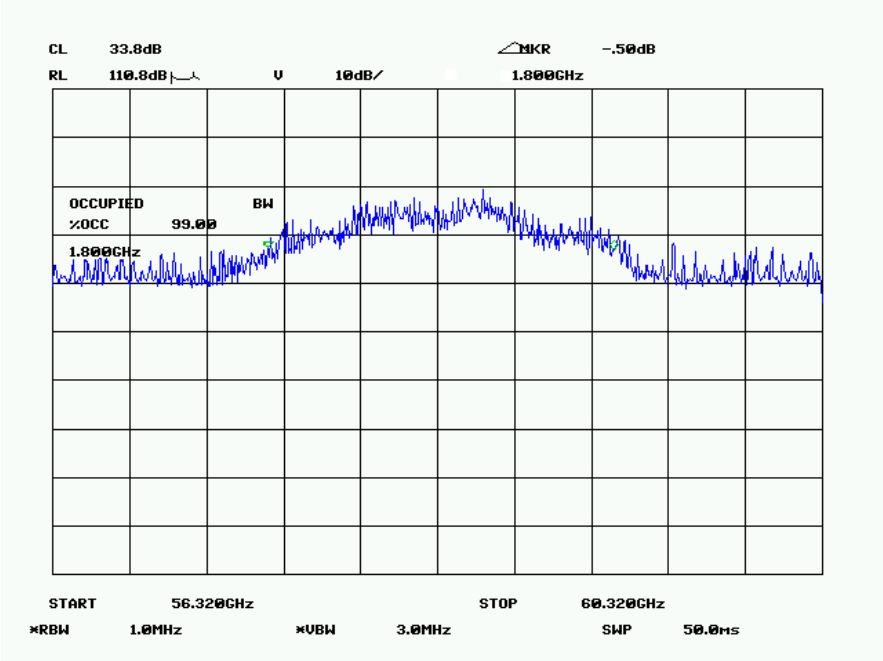


High Channel

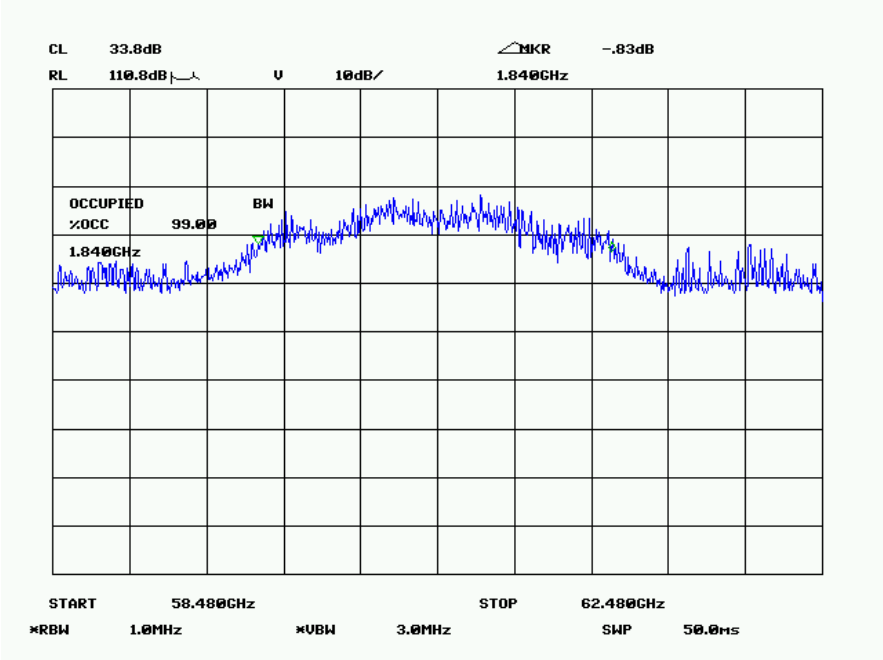


99% Bandwidth

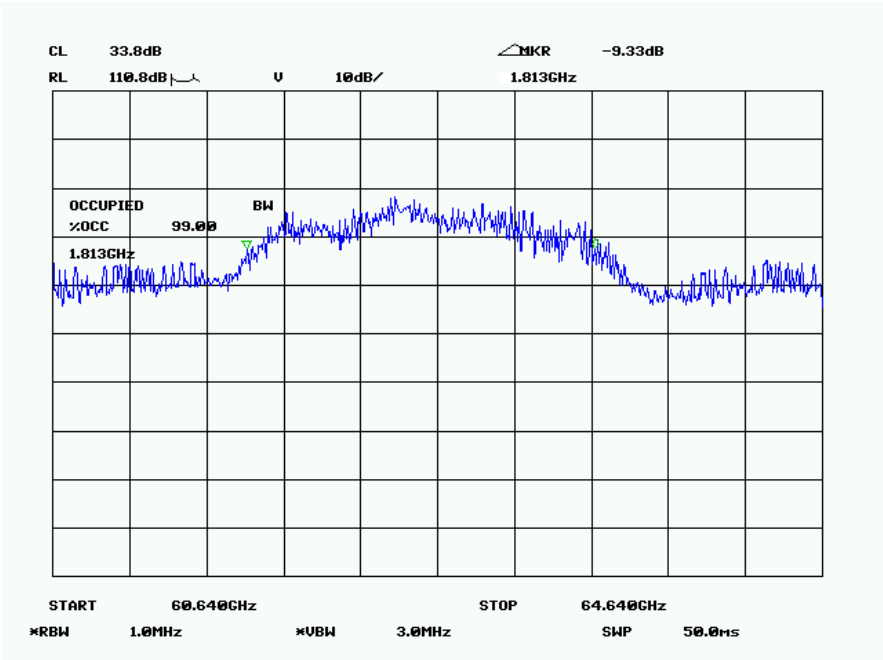
Low Channel



Middle Channel



High Channel



FCC§15.255(e) –PEAK CONDUCTED OUTPUT POWER

Applicable Standard

(e) Except as specified paragraph (e)(1) of this section, the peak transmitter conducted output power shall not exceed 500 mW. Depending on the gain of the antenna, it may be necessary to operate the intentional radiator using a lower peak transmitter output power in order to comply with the EIRP limits specified in paragraph (b) of this section.

(1) Transmitters with an emission bandwidth of less than 100 MHz must limit their peak transmitter conducted output power to the product of 500 mW times their emission bandwidth divided by 100 MHz. For the purposes of this paragraph, emission bandwidth is defined as the instantaneous frequency range occupied by a steady state radiated signal with modulation, outside which the radiated power spectral density never exceeds 6 dB below the maximum radiated power spectral density in the band, as measured with a 100 kHz resolution bandwidth spectrum analyzer. The center frequency must be stationary during the measurement interval, even if not stationary during normal operation (e.g., for frequency hopping devices).

(2) Peak transmitter conducted output power shall be measured with an RF detector that has a detection bandwidth that encompasses the 57-71 GHz band and that has a video bandwidth of at least 10 MHz.

(3) For purposes of demonstrating compliance with this paragraph, corrections to the transmitter conducted output power may be made due to the antenna and circuit loss.

Test Procedure

Refer to ANSI C63.10-2013 Clause 9.7 : equation to calculate power output.

Test Data

Environmental Conditions

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

The testing was performed by Kyle Xu on 2018-11-17.

EUT operation mode: Transmitting

Please refer to the following table:

Frequency (GHz)	Peak EIPR Power (dBm)	Antenna Gain (dBi)	Peak Conducted Power (dBm)	Limit (dBm)	Margin (dB)
ANT0					
58.32	31.20	18	13.20	27	13.80
60.48	30.88	18	12.88	27	14.12
62.64	29.91	18	11.91	27	15.09
ANT1					
58.32	31.70	18	13.70	27	13.30
60.48	31.92	18	13.92	27	13.08
62.64	31.11	18	13.11	27	13.89
ANT2					
58.32	31.86	18	13.86	27	13.14
60.48	31.97	18	13.97	27	13.03
62.64	31.64	18	13.64	27	13.36

Note 1: EIRP Power refers to §15.255 (c)
Note 2: For radiated emissions measurements, calculated transmitter conducted output power P (con)
P (con) =EIRP-Antenna gain (dBi)

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.

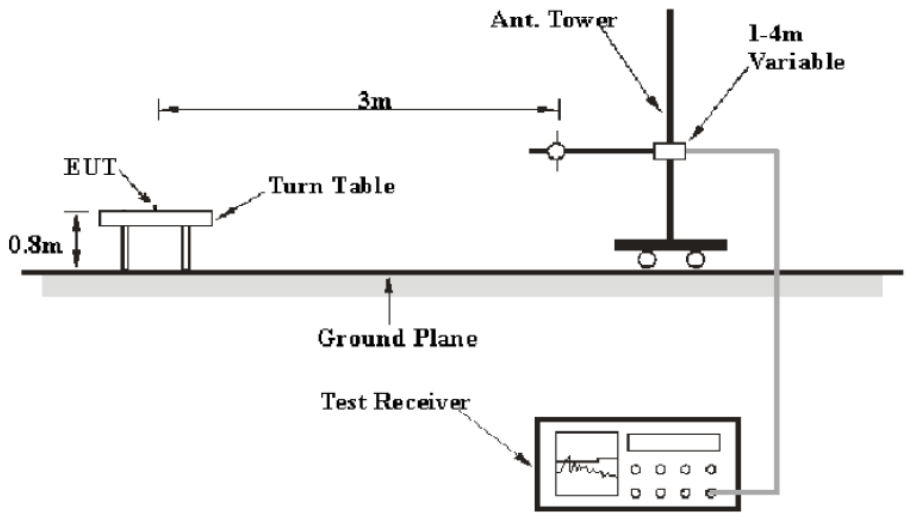
(2) Radiated emissions below 40GHz shall not exceed the general limits in §15.209.

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

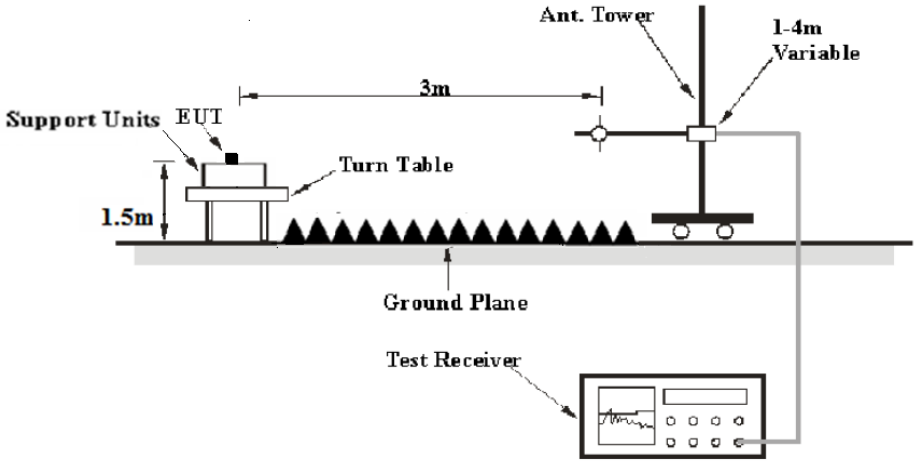
(4) The levels of the spurious emissions shall not exceed the level of the fundamental emission.

EUT Setup

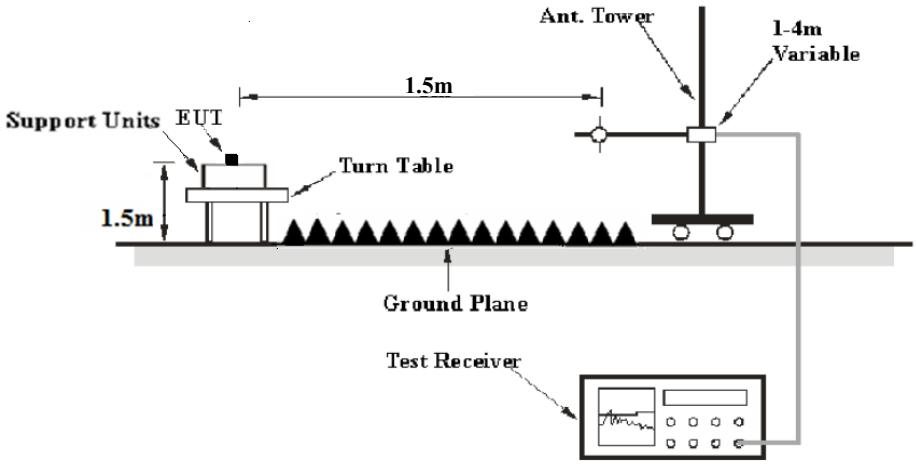
Below 1 GHz:



1 GHz-18GHz:



18 GHz-40GHz:



Above 40GHz:

The antenna is scanned around the entire perimeter surface of the EUT, in both horizontal and vertical polarizations, at the distance of 1.0 m from 40 GHz to 90GHz, and 0.5 m from 90GHz to 200GHz.

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 200GHz.

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
1 GHz - 40 GHz	1MHz	3 MHz	/	PK
	1MHz	3M Hz	/	Ave.
40 GHz -200 GHz	1MHz	3 MHz	/	PK

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, and from 1 GHz to 40 GHz, all radiated emissions measurements were made using a Peak Detector and CISPR Average Detector. In accordance with FCC Rules Part 15 Subpart C Section 15.255, from 40 GHz to 200 GHz, all radiated emissions measurements were made using a Peak Detector.

According to C63.10, the 26.5-40GHz test result shall be extrapolated to the specified distance using an extrapolation factor of 20dB/decade from 3m to 1m

Distance extrapolation factor =20 log (specific distance [3m]/test distance [1m]) dB= 9.54 dB

All emissions under the average limit and under the noise floor have not recorded in the report.

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

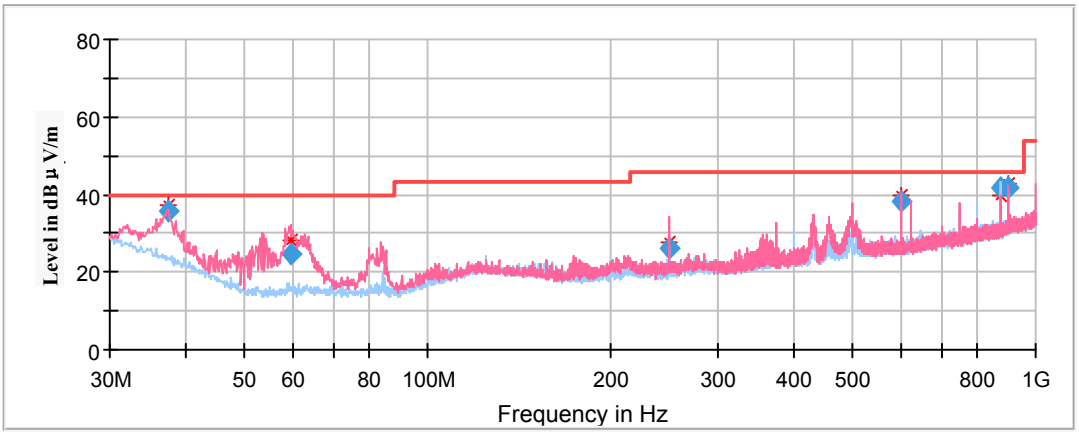
The testing was performed by Kyle Xu from 2018-11-17 to 2018-11-26.

EUT operation mode: Transmitting
*(The data for the worst case of **ANT2** was recorded)*

30MHz-1GHz:

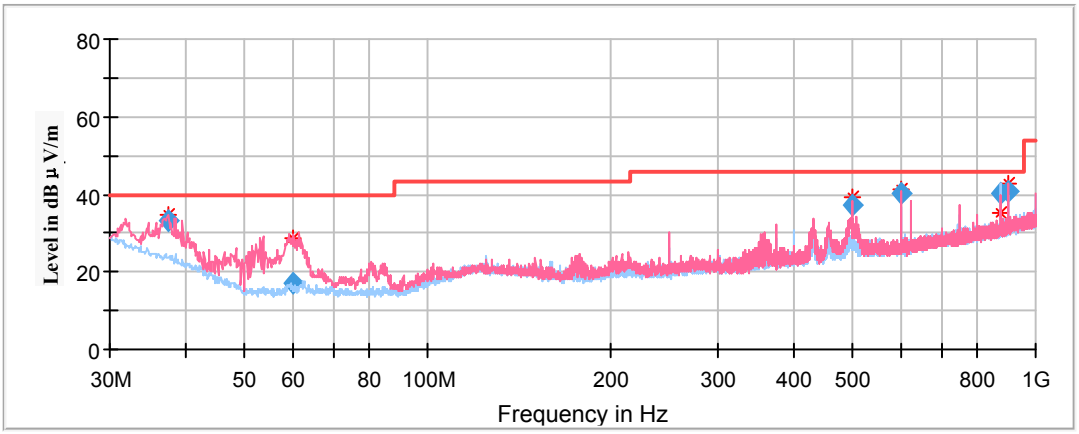
(*Pre-Scan in the **X, Y and Z axes of orientation**, the worst case **in X-axis of orientation** was recorded)*

Low Channel



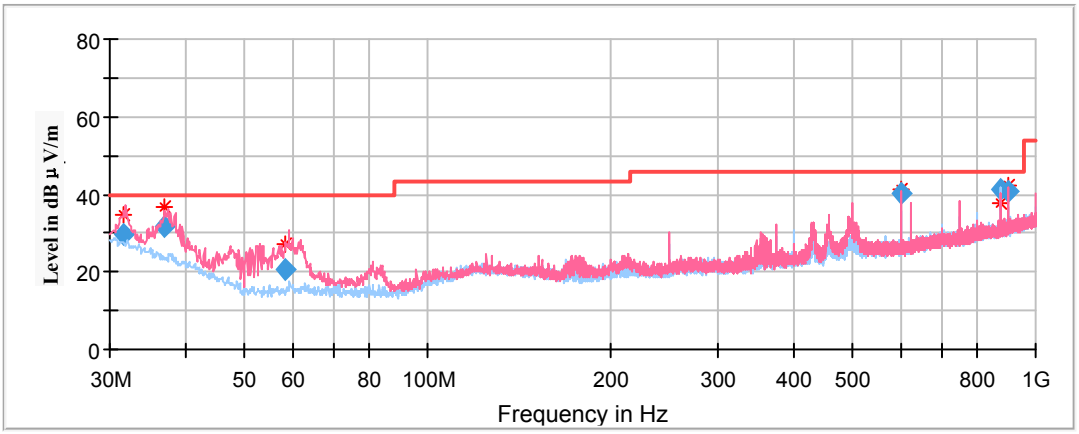
Frequency (MHz)	Corrected Amplitude	Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
	Quasi-peak (dBµV/m)	Height (cm)	Polar (H/V)				
37.496450	35.65	101.0	V	13.0	-9.0	40.00	4.35
59.519850	24.41	101.0	V	225.0	-17.9	40.00	15.59
250.009950	26.02	199.0	V	40.0	-12.1	46.00	19.98
600.015500	38.35	101.0	V	0.0	-5.2	46.00	7.65
875.122400	41.61	101.0	H	19.0	-0.5	46.00	4.39
900.108900	41.69	101.0	V	13.0	0.0	46.00	4.31

Middle 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)				
37.451450	33.05	101.0	V	0.0	-9.0	40.00	6.95
59.903250	17.01	199.0	V	107.0	-17.9	40.00	22.99
500.046650	37.48	101.0	V	358.0	-6.1	46.00	8.52
600.087200	40.31	101.0	V	19.0	-5.2	46.00	5.69
875.104100	40.37	101.0	H	359.0	-0.5	46.00	5.63
900.180950	40.58	101.0	V	14.0	0.0	46.00	5.42

High Channel

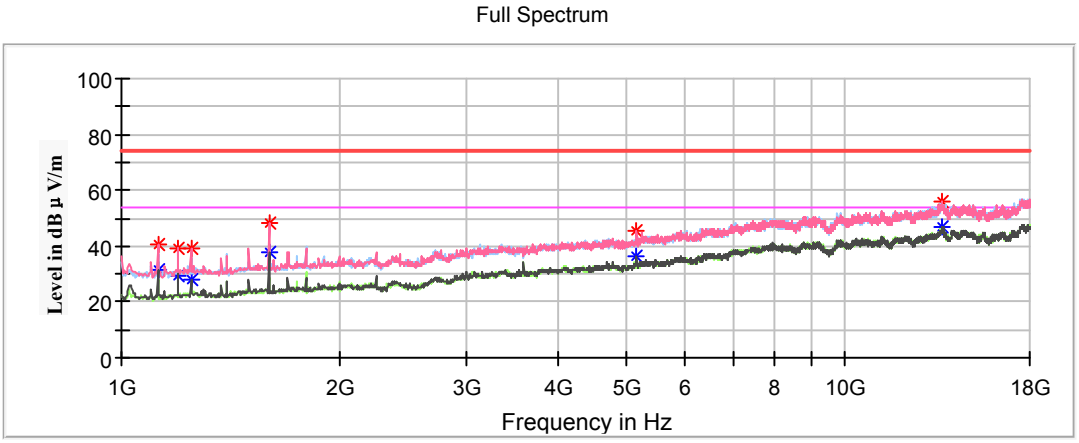


Frequency (MHz)	Corrected Amplitude	Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
	Quasi-peak (dBµV/m)	Height (cm)	Polar (H/V)				
31.604300	29.77	101.0	V	90.0	-5.0	40.00	10.23
36.796250	31.68	101.0	V	0.0	-8.5	40.00	8.32
58.285200	20.62	101.0	V	336.0	-17.9	40.00	19.38
600.072500	40.26	101.0	V	21.0	-5.2	46.00	5.74
875.119450	41.05	101.0	H	2.0	-0.5	46.00	4.95
900.087300	40.90	101.0	V	11.0	0.0	46.00	5.10

1GHz-18GHz:

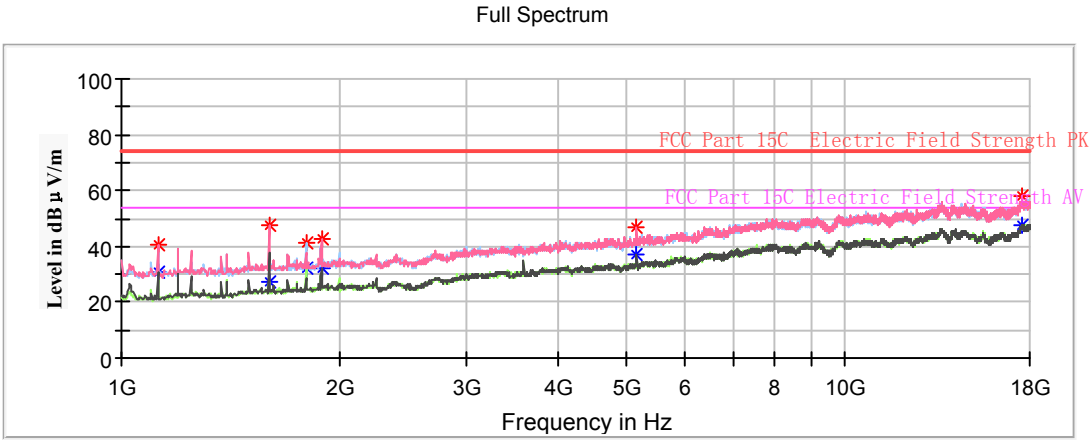
(*Pre-Scan in the **X, Y and Z axes of orientation**, the worst case **in X-axis of orientation** was recorded)*

Low Channel



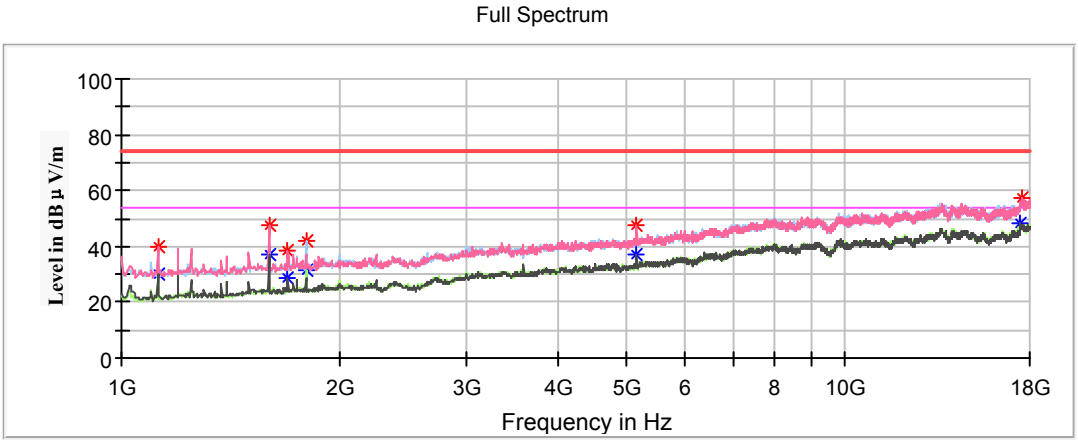
Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
	MaxPeak (dBµV /m)	Average (dBµV /m)	Height (cm)	Polar (H/V)				
1122.400000	---	31.54	100.0	V	32.0	-9.8	54.00	22.46
1122.400000	40.63	---	100.0	V	32.0	-9.8	74.00	33.37
1197.200000	---	29.62	100.0	H	197.0	-9.3	54.00	24.38
1197.200000	39.47	---	100.0	H	197.0	-9.3	74.00	34.53
1248.200000	---	28.28	250.0	V	13.0	-9.0	54.00	25.72
1248.200000	38.93	---	250.0	V	13.0	-9.0	74.00	35.07
1598.400000	---	37.84	100.0	V	58.0	-7.2	54.00	16.16
1598.400000	48.16	---	100.0	V	58.0	-7.2	74.00	25.84
5154.800000	---	36.39	200.0	V	319.0	2.7	54.00	17.61
5154.800000	45.57	---	200.0	V	319.0	2.7	74.00	28.43
13583.400000	56.17	---	100.0	V	326.0	14.7	74.00	17.83
13583.400000	---	46.92	100.0	V	326.0	14.7	54.00	7.08

Middle Channel



Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
	MaxPeak (dBµV /m)	Average (dBµV /m)	Height (cm)	Polar (H/V)				
1122.400000	---	30.49	200.0	V	14.0	-9.8	54.00	23.51
1122.400000	40.84	---	200.0	V	14.0	-9.8	74.00	33.16
1598.400000	---	27.36	100.0	H	136.0	-7.2	54.00	26.64
1598.400000	47.76	---	100.0	H	136.0	-7.2	74.00	26.24
1799.000000	40.91	---	100.0	H	58.0	-6.5	74.00	33.09
1799.000000	---	32.35	100.0	H	58.0	-6.5	54.00	21.65
1890.800000	42.96	---	200.0	V	126.0	-6.2	74.00	31.04
1890.800000	---	31.86	200.0	V	126.0	-6.2	54.00	22.14
5154.800000	---	36.96	100.0	V	269.0	2.7	54.00	17.04
5154.800000	47.04	---	100.0	V	269.0	2.7	74.00	26.96
17524.000000	57.72	---	250.0	V	51.0	17.2	74.00	16.28
17564.800000	---	47.88	250.0	V	51.0	17.3	54.00	6.12

High Channel



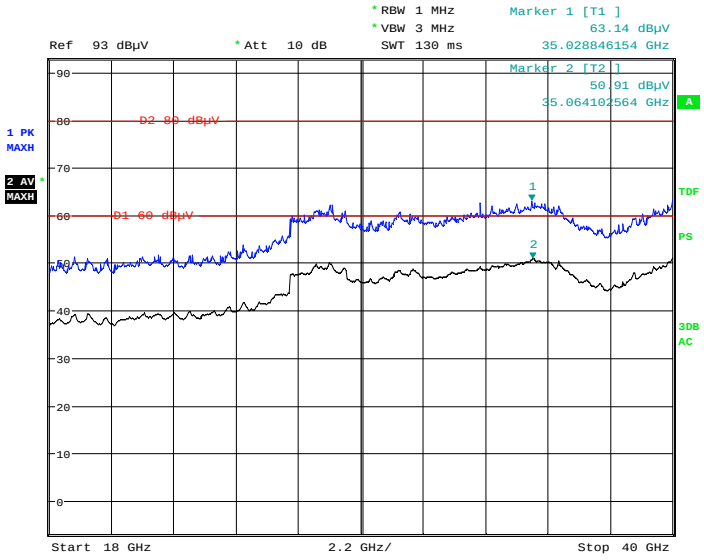
Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
	MaxPeak (dBµV /m)	Average (dBµV /m)	Height (cm)	Polar (H/V)				
1122.400000	---	30.34	200.0	V	182.0	-9.8	54.00	23.66
1122.400000	39.71	---	200.0	V	182.0	-9.8	74.00	34.29
1598.400000	47.33	---	100.0	V	297.0	-7.2	74.00	26.67
1598.400000	---	37.41	100.0	V	297.0	-7.2	54.00	16.59
1697.000000	38.80	---	250.0	V	39.0	-6.9	74.00	35.20
1697.000000	---	28.43	250.0	V	39.0	-6.9	54.00	25.57
1799.000000	41.76	---	200.0	H	192.0	-6.5	74.00	32.24
1799.000000	---	31.32	200.0	H	192.0	-6.5	54.00	22.68
5154.800000	47.85	---	100.0	V	339.0	2.7	74.00	26.15
5154.800000	---	37.21	100.0	V	339.0	2.7	54.00	16.79
17483.200000	---	48.04	200.0	V	175.0	17.1	54.00	5.96
17483.200000	57.25	---	200.0	V	175.0	17.3	74.00	16.75

Note:
Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor
Corrected Amplitude = Corrected Factor + Reading
Margin = Limit– Corrected Amplitude

18GHz-40GHz:

(*Pre-scan with low, middle and high channels of operation in the X,Y and Z axes of orientation, the worst case* ***middle channel of operation in X-axis of orientation*** *was recorded)*

Horizontal



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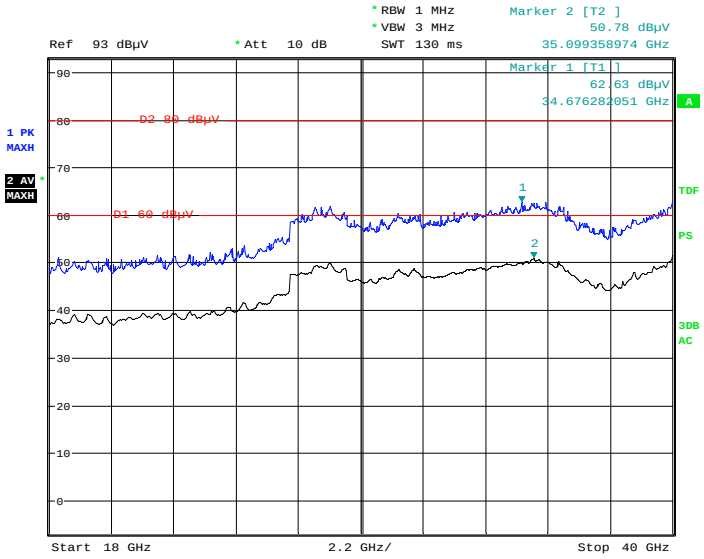
Vertical



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Note: The test distance is 1.5m.

40GHz-200GHz:
(*Pre-Scan in the **X, Y and Z axes of orientation**, the worst case **in X-axis of orientation** was recorded)*

Frequency	Receiver		Rx Antenna		Corrected Amplitude	EIRP	Power Density	Limit
	Reading	Detector	Polar	Factor				
(GHz)	dBµV	PK/AV/QP	H/V	dB(1/m)	dBµV/m	dBm	pW/cm^2	pW/cm^2
Low Channel								
55.32	37.32	PK	H	41.72	79.04	-25.66	2.40	90
55.32	38.03	PK	V	41.72	79.75	-24.95	2.83	90
72.41	43.13	PK	H	44.91	88.04	-16.66	19.08	90
72.41	44.32	PK	V	44.91	89.23	-15.47	25.09	90
116.64	46.52	PK	H	53.18	99.70	-11.02	69.91	90
116.64	46.77	PK	V	53.18	99.95	-10.77	74.06	90
Middle Channel								
53.32	37.12	PK	H	41.35	78.47	-26.23	2.11	90
53.32	38.63	PK	V	41.35	79.98	-24.72	2.98	90
65.77	43.88	PK	H	43.67	87.55	-17.15	17.04	90
65.77	44.86	PK	V	43.67	88.53	-16.17	21.36	90
120.96	45.76	PK	H	53.98	99.74	-10.98	70.56	90
120.96	46.32	PK	V	53.98	100.30	-10.42	80.27	90
High Channel								
52.36	36.87	PK	H	41.17	78.04	-26.66	1.91	90
52.36	37.13	PK	V	41.17	78.30	-26.40	2.03	90
80.32	43.02	PK	H	46.39	89.41	-15.29	26.16	90
80.32	44.35	PK	V	46.39	90.74	-13.96	35.53	90
125.28	44.63	PK	H	54.79	99.42	-11.30	65.55	90
125.28	45.03	PK	V	54.79	99.82	-10.90	71.87	90

Note 1:
EIRP = E-meas + 20log (d-meas) – 104.7
where:
EIRP: is the equivalent isotopically radiated power, in dBm
E-meas: is the field strength of the emission at the measurement distance, in dBuV/m
d-meas: is the measurement distance, in m

Note 2: The test distance is 1m for 40-90GHz, and 0.5m for 90-200GHz.

Note 3: Corrected Amplitude = Meter Reading + Antenna Factor

Note 4: The Mixers and their RF cables are compose a system for calibration, the conversion factor was added into the test Spectrum Analyzer in testing.

Note 5: $PD = \frac{EIRP_{Linear}}{4\pi d^2}$
where
PD: is the power density at the distance specified by the limit, in W/m^2
$EIRP_{Linear}$: is the equivalent isotropically radiated power, in watts
d: is the distance at the which the power density limit is specified, in m
The specified distance is 3m.

FCC§15.255(f) - FREQUENCY STABILITY

Applicable Standard

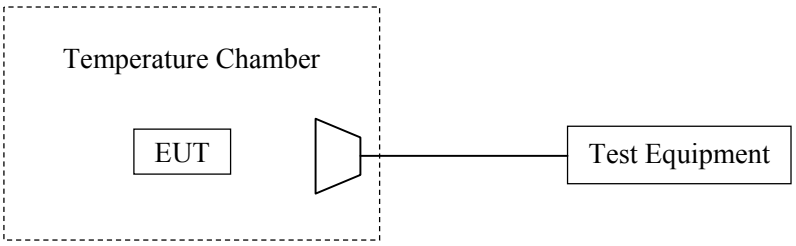
Fundamental emissions must be contained within the frequency bands specified in this section during all conditions of operation. Equipment is presumed to operate over the temperature range −20 to +50 degrees Celsius with an input voltage variation of 85% to 115% of rated input voltage, unless justification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

Test Procedure

Frequency Stability vs. Temperature: The adapter of the equipment under test was connected to an AC 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 2018-11-17.

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	57351	63639	57000	71000
-10		57354	63637	57000	71000
0		57353	63636	57000	71000
10		57352	63643	57000	71000
20		57351	63640	57000	71000
30		57354	63642	57000	71000
40		57357	63635	57000	71000
50		57356	63641	57000	71000
25	40.8	57355	63643	57000	71000
25	55.2	57353	63644	57000	71000

FCC§15.255(a) (h) – OPERATION RESTRICTION AND GROUP INSTALLTION

Applicable Standard

§15.255 (a) Operation under the provisions of this section is not permitted for the following products:
(1) Equipment used on aircraft or satellites.
(2) Field disturbance sensors, including vehicle radar systems, unless the field disturbance sensors are employed for fixed operation. For the purposes of this section, the reference to fixed operation includes field disturbance sensors installed in fixed equipment, even if the sensor itself moves within the equipment.

§15.255 (h) Any transmitter that has received the necessary FCC equipment authorization under the rules of this chapter may be mounted in a group installation for simultaneous operation with one or more other transmitter(s) that have received the necessary FCC equipment authorization, without any additional equipment authorization. However, no transmitter operating under the provisions of this section may be equipped with external phase-locking inputs that permit beam-forming arrays to be realized.

Result of Operation Restriction

The Manufacturer declared that the EUT will not be advertised or sold for use on aircraft or satellites. The user manual includes a statement that cautions users that it is not permitted to use the product on aircraft or satellites.

Result of Group Installations

The frequency, amplitude and phase of the transmit sign al are set within the EUT. There are no external phase-locking inputs or any other means of combining two or more units together to realize a beamforming array

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