FCC RF Test Report

APPLICANT	:	**Nokia Shanghai Bell Co., Ltd.**
EQUIPMENT	:	**NOKIA WiFi Beacon 3.1**
BRAND NAME	:	**NOKIA**
MODEL NAME	:	**Beacon 3.1**
FCC ID	:	**2ADZRBEACON311**
STANDARD	:	**FCC Part 15 Subpart E §15.407**
CLASSIFICATION	:	**(NII) Unlicensed National Information Infrastructure**
TEST DATE(S)	:	**Nov. 23, 2024 ~ Jan. 04, 2025**

We, Sporton International Inc. (Kunshan), would like to declare that the tested sample has been evaluated in accordance with the test procedures and has been in compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of Sporton International Inc. (Kunshan), the test report shall not be reproduced except in full.

Jason Jia

Approved by: Jason Jia

ilac-MRA

ACCREDITED
Cert #5145.02

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REVISION HISTORY

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FR4N0526B	Rev. 01	Initial issue of report	Jan. 16, 2025

SUMMARY OF TEST RESULT

Report Section	FCC Rule	Description	Limit for U-NII-1/2A/2C	Limit for U-NII-3	Result	Remark
3.1	2.1049 & 15.403(i)	6dB, 26dB & 99% Bandwidth	-	6dB Bandwidth > 500kHz	Pass	-
3.2	15.407(a)	Maximum Conducted Output Power	≤ 30 dBm for UNII-1, and 24 dBm for UNII-2A/2C	≤ 30 dBm	Pass	-
3.3	15.407(a)	Power Spectral Density	≤ 17 dBm/MHz for UNII-1, and 11 dBm/MHz for UNII-2A/2C	≤ 30 dBm/500kHz	Pass	-
3.4	15.407(b)	Unwanted Emissions	15.407(b) & 15.209(a)	15.407(b)(4)(i) &15.209(a)	Pass	Under limit 0.11 dB at 5148.76 MHz
3.5	15.207	AC Conducted Emission	15.207(a)	15.207(a)	Pass	Under limit 10.14 dB at 0.408 MHz
3.6	15.203 & 15.407(a)	Antenna Requirement	15.203 & 15.407(a)	15.203 & 15.407(a)	Pass	-

Conformity Assessment Condition:
1. The test results (PASS/FAIL) with all measurement uncertainty excluded are presented against the regulation limits or in accordance with the requirements stipulated by the applicant/manufacturer who shall bear all the risks of non-compliance that may potentially occur if measurement uncertainty is taken into account.
2. The measurement uncertainty please refer to each test result in the section “Measurement Uncertainty”
Disclaimer:
The product specifications of the EUT presented in the test report that may affect the test assessments are declared by the manufacturer who shall take full responsibility for the authenticity.

1 General Description

1.1 Applicant

Nokia Shanghai Bell Co., Ltd.
No.388, Ningqiao Rd, Pilot Free Trade Zone, Shanghai, 201206 P.R. China

1.2 Manufacturer

Nokia of America Corporation
2301 Sugar Bush Rd. Raleigh, NC 27612

1.3 Product Feature of Equipment Under Test

Product Feature	
Equipment	NOKIA WiFi Beacon 3.1
Brand Name	NOKIA
Model Name	Beacon 3.1
FCC ID	2ADZRBEACON311
SN Code	Conducted: ALCLB45B67E2 Conduction: ALCLB45B57D4 Radiation: ALCLB45B67BD
HW Version	PEM1
SW Version	3TN00626
EUT Stage	Production Unit

Remark: The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.

Power Adapter				
AC Adapter 1	**Brand Name**	Ruide	**Model Name**	RD1201500-C55-198MG
AC Adapter 2	**Brand Name**	Fuhua	**Model Name**	UES18LU-120150SPA

1.4 Product Specification of Equipment Under Test

Standards-related Product Specification	
Tx/Rx Frequency Range	5180 MHz ~ 5250 MHz 5260 MHz ~ 5320 MHz 5500 MHz ~ 5720 MHz 5745 MHz ~ 5825 MHz
Maximum Output Power to Antenna	**<MIMO 1S2T>:** **<5180 MHz ~ 5250 MHz>** 802.11a : 28.38 dBm / 0.6887 W 802.11n HT20 : 28.38 dBm / 0.6887 W 802.11n HT40 : 26.31 dBm / 0.4276 W 802.11ac VHT20: 28.42 dBm / 0.6950 W 802.11ac VHT40: 26.36 dBm / 0.4325 W 802.11ac VHT80: 20.52 dBm / 0.1127 W 802.11ac VHT160: 19.09 dBm / 0.0811 W 802.11ax HE20: 28.76 dBm / 0.7516 W 802.11ax HE40: 26.71 dBm / 0.4688 W 802.11ax HE80: 21.17 dBm / 0.1309 W 802.11ax HE160: 19.35 dBm / 0.0861 W **<5260 MHz ~ 5320 MHz>** 802.11a : 22.39 dBm / 0.1734 W 802.11n HT20 : 22.40 dBm / 0.1738 W 802.11n HT40 : 23.52 dBm / 0.2249 W 802.11ac VHT20: 22.44 dBm / 0.1754 W 802.11ac VHT40: 23.57 dBm / 0.2275 W 802.11ac VHT80: 20.57 dBm / 0.1140 W 802.11ac VHT160: 19.09 dBm / 0.0811 W 802.11ax HE20: 22.82 dBm / 0.1914 W 802.11ax HE40: 23.92 dBm / 0.2466 W 802.11ax HE80: 21.13 dBm / 0.1297 W 802.11ax HE160: 19.35 dBm / 0.0861 W **<5500 MHz ~ 5720 MHz >** 802.11a : 22.30 dBm / 0.1698 W 802.11n HT20 : 22.24 dBm / 0.1675 W 802.11n HT40 : 23.47 dBm / 0.2223 W 802.11ac VHT20: 22.29 dBm / 0.1694 W 802.11ac VHT40: 23.51 dBm / 0.2244 W 802.11ac VHT80: 23.12 dBm / 0.2051 W 802.11ac VHT160: 18.62 dBm / 0.0728 W 802.11ax HE20: 22.71 dBm / 0.1866 W 802.11ax HE40: 23.95 dBm / 0.2483 W 802.11ax HE80: 23.61 dBm / 0.2296 W 802.11ax HE160: 18.90 dBm / 0.0776 W **<5745 MHz ~ 5825 MHz>** 802.11a : 28.07 dBm / 0.6412 W 802.11n HT20 : 27.85 dBm / 0.6095 W 802.11n HT40 : 28.45 dBm / 0.6998 W 802.11ac VHT20: 27.89 dBm / 0.6152 W 802.11ac VHT40: 28.49 dBm / 0.7063 W 802.11ac VHT80: 24.18 dBm / 0.2618 W 802.11ax HE20: 28.27 dBm / 0.6714 W 802.11ax HE40: 28.83 dBm / 0.7638 W 802.11ax HE80: 24.72 dBm / 0.2965 W

<table>
<tr><td>99% Occupied Bandwidth</td><td><5180 MHz ~ 5250 MHz>
802.11a : 17.295 MHz
802.11ac VHT20 : 20.000 MHz
802.11ac VHT40 : 36.343 MHz
802.11ac VHT80 : 76.419 MHz
802.11ac VHT160 : 156.19 MHz
802.11ax HE20: 19.371 MHz
802.11ax HE40: 38.133 MHz
802.11ax HE80: 77.562 MHz
802.11ax HE160: 158.171 MHz
<5260 MHz ~ 5320 MHz>
802.11a : 16.629 MHz
802.11ac VHT20 : 17.695 MHz
802.11ac VHT40 : 36.229 MHz
802.11ac VHT80 : 76.495 MHz
802.11ax HE20: 19.029 MHz
802.11ax HE40: 38.019 MHz
802.11ax HE80: 77.562 MHz
<5500 MHz ~ 5720 MHz>
802.11a : 16.648 MHz
802.11ac VHT20 : 17.695 MHz
802.11ac VHT40 : 36.229 MHz
802.11ac VHT80 : 76.419 MHz
802.11ac VHT160 : 156.343 MHz
802.11ax HE20: 19.01 MHz
802.11ax HE40: 38.019 MHz
802.11ax HE80: 77.638 MHz
802.11ax HE160: 158.019 MHz
<5745 MHz ~ 5825 MHz>
802.11a : 21.181 MHz
802.11ac VHT20 : 20.076 MHz
802.11ac VHT40 : 40.076 MHz
802.11ac VHT80 : 76.495 MHz
802.11ax HE20: 19.657 MHz
802.11ax HE40: 41.905 MHz
802.11ax HE80: 77.714 MHz</td></tr>
<tr><td>Antenna Type</td><td>Dipole Antenna</td></tr>
<tr><td>Type of Modulation</td><td>802.11a/n : OFDM (BPSK / QPSK / 16QAM / 64QAM)
802.11ac : OFDM (BPSK / QPSK / 16QAM / 64QAM / 256QAM)
802.11ax : OFDMA (BPSK / QPSK / 16QAM / 64QAM / 256QAM / 1024QAM)</td></tr>
<tr><td>Antenna Function Description</td><td><table>
<tr><td></td><td>Ant. 1</td><td>Ant. 2</td></tr>
<tr><td>802.11 a/n/ac/ax
SISO</td><td>V</td><td>V</td></tr>
<tr><td>802.11 a/n/ac/ax
CDD 1S2T</td><td>V</td><td>V</td></tr>
<tr><td>802.11 ac/ax
Tx Beamforming 1S2T</td><td>V</td><td>V</td></tr>
</table></td></tr>
</table>

Note:

1. For WLAN SISO & MIMO mode, the whole testing has assessed only MIMO mode by referring to the higher normal output power.

2. WLAN MIMO support CDD mode for 802.11a/n/ac/ax and Tx Beamforming mode for 802.11ac/ax.
3. For 802.11ac/ax mode, the power setting of Tx Beamforming mode is lower than CDD mode. Therefore, the all test has assessed CDD mode only.
4. For 802.11n & 802.11ac mode, the whole testing have assessed only 802.11ac VHT20/40 by referring to the higher output power.
5. The device supports multiple spatial streams, the worst cases directional gain will occur when NSS = 1, therefore, the 1S2T(CDD&TXBF) mode is the worst; 1S2T: NSS=1, MIMO 2Tx.
6. The device supports full RU mode only for 802.11ax.
7. Please refer to the antenna report for the maximum Single antenna gain and CDD (Cyclic Delay Diversity) directional gain and TXBF (Tx Beamforming) directional gain.

AOT Antenna:

Frequency Band	Max Single Antenna gain (dBi)		CDD DG (dBi)		TXBF DG (dBi)	
	ANT1	ANT2	For Power	For PSD	For Power	For PSD
5GHz UNII-1	2.96	3.07	3.07	3.75	3.75	3.75
5GHz UNII-2A	2.96	3.07	3.07	3.75	3.75	3.75
5GHz UNII-2C	2.86	2.76	2.86	4.44	4.44	4.44
5GHz UNII-3	2.77	2.79	2.79	4.50	4.50	4.50

1.5 Modification of EUT

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

1.6 Testing Location

Sporton International Inc. (Kunshan) is accredited to ISO/IEC 17025:2017 by American Association for Laboratory Accreditation with Certificate Number 5145.02.

Test Firm	Sporton International Inc. (Kunshan)		
Test Site Location	No. 1098, Pengxi North Road, Kunshan Economic Development Zone Jiangsu Province 215300 People’s Republic of China TEL : +86-512-57900158		
Test Site No.	**Sporton Site No.**	**FCC Designation No.**	**FCC Test Firm Registration No.**
	CO01-KS 03CH08-KS TH01-KS	CN1257	314309

1.7 Test Software

Item	Site	Manufacturer	Name	Version
1.	TH01-KS	Tonscend	JS1120-3 test system China_210602	3.3.10
2.	03CH08-KS	AUDIX	E3	210616
3.	CO01-KS	AUDIX	E3	6.2009-8-24

1.8 Applicable Standards

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

- 47 CFR Part 15 Subpart E
- FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01.
- FCC KDB 662911 D01 Multiple Transmitter Output v02r01.
- ANSI C63.10-2013

Remark:

1. All test items were verified and recorded according to the standards and without any deviation during the test.
2. This EUT has also been tested and complied with the requirements of FCC Part 15, Subpart B, recorded in a separate test report.

2 Test Configuration of Equipment Under Test

a. The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application. Frequency range investigated: conduction emission (150 kHz to 30 MHz), radiation emission (9 kHz to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower). For radiated measurement, pre-scanned in three orthogonal panels, X, Y, Z. The worst cases (Z plane) were recorded in this report.

b. AC power line Conducted Emission was tested under maximum output power.

2.1 Carrier Frequency and Channel

Frequency Band	Channel	Freq.(MHz)	Channel	Freq. (MHz)
5180-5240 MHz U-NII-1	36	5180	44	5220
	38*	5190	46*	5230
	40	5200	48	5240
	42#	5210	50##	5250

Frequency Band	Channel	Freq.(MHz)	Channel	Freq. (MHz)
5260-5320 MHz U-NII-2A	52	5260	60	5300
	54*	5270	62*	5310
	56	5280	64	5320
	58#	5290	-	-

Frequency Band	Channel	Freq.(MHz)	Channel	Freq. (MHz)
5500-5720MHz U-NII-2C	100	5500	112	5560
	102*	5510	116	5580
	104	5520	132	5660
	106#	5530	134*	5670
	108	5540	136	5680
	110*	5550	140	5700

Frequency Band	Channel	Freq.(MHz)	Channel	Freq. (MHz)
5745-5825 MHz U-NII-3	149	5745	157	5785
	151*	5755	159*	5795
	153	5765	161	5805
	155#	5775	165	5825

Frequency Band	Channel	Freq.(MHz)	Channel	Freq. (MHz)
TDWR Channel	118*	5590	124	5620
	120	5600	126*	5630
	122#	5610	128	5640
	-	-	114##	5570

Frequency Band	Channel	Freq. (MHz)	Channel	Freq. (MHz)
Straddle Channel	138#	5690	144	5720
	142*	5710	-	-

Note:

1. The above Frequency and Channel in "*" are 40MHz bandwidth.
2. The above Frequency and Channel in "#" are 80MHz bandwidth.
3. The above Frequency and Channel in "##" are 160MHz bandwidth.

2.2 Test Mode

Final test modes are considering the modulation and worse data rates as below table.

CDD Mode

Modulation	Data Rate
802.11a	6 Mbps
802.11n HT20 (Covered by VHT20)	MCS0
802.11n HT40 (Covered by VHT40)	MCS0
802.11ac VHT20	MCS0
802.11ac VHT40	MCS0
802.11ac VHT80	MCS0
802.11ac VHT160	MCS0
802.11ax HE20	MCS0
802.11ax HE40	MCS0
802.11ax HE80	MCS0
802.11ax HE160	MCS0

Tx Beamforming Mode

Modulation	Data Rate
802.11ac VHT20	MCS0
802.11ac VHT40	MCS0
802.11ac VHT80	MCS0
802.11ac VHT160	MCS0
802.11ax HE20	MCS0
802.11ax HE40	MCS0
802.11ax HE80	MCS0
802.11ax HE160	MCS0

AC Conducted Emission	Mode 1 : WLAN Tx(5G) + Power From Adapter
Remark: For Radiated Test Cases, The tests were performance with Adapter.	

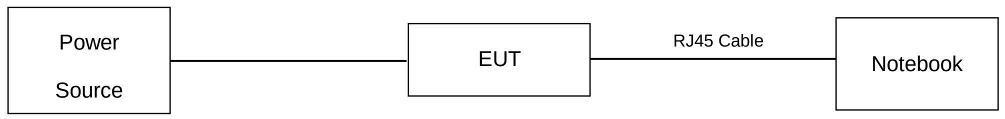
Ch. #		U-NII-1	U-NII-2A	U-NII-2C	U-NII-3
		20M BW	20M BW	20M BW	20M BW
L	Low	36	52	100	149
M	Middle	44	60	116	157
H	High	48	64	140	165
Straddle		-	-	144	-

Ch. #		U-NII-1	U-NII-2A	U-NII-2C	U-NII-3
		40M BW	40M BW	40M BW	40M BW
L	Low	38	54	102	151
M	Middle	-	-	110	-
H	High	46	62	134	159
Straddle		-	-	142	-

Ch. #		U-NII-1	U-NII-2A	U-NII-2C	U-NII-3
		80M BW	80M BW	80M BW	80M BW
L	Low	-	-	106	-
M	Middle	42	58	-	155
H	High	-	-	-	-
Straddle		-	-	138	-

Ch. #		U-NII-1	U-NII-2A	U-NII-2C	U-NII-3
		160M BW		160M BW	160M BW
M	Middle	50		114	-

2.3 Connection Diagram of Test System



This example is connection diagram of EUT test configurations.

For detail, please refer to test mode configuration and setup photographs for each test item.

2.4 Support Unit used in test configuration and system

Item	Equipment	Trade Name	Model Name	FCC ID	Data Cable	Power Cord
1.	Notebook	Lenovo	G480	QDS-BRCM1050I	N/A	shielded cable DC O/P 1.8m , Unshielded AC I/P cable 1.8m
2.	PC	Adwantech	IPC-610MB-L	KA21R655B1	N/A	Unshielded,1.8m
3.	Mouse	Dell	MS111-P	Fcc DoC	Shielded, 1.8m	N/A
4.	Hard disk	KINGSHARE	KSP6120G	N/A	N/A	N/A
5.	Monitor	Dell	N/A	N/A	N/A	Unshielded,1.8m
6.	RJ45 Cable	N/A	N/A	N/A	N/A	N/A

2.5 EUT Operation Test Setup

For WLAN RF test items, enter the command in the “PuTTY” program and enabled to make EUT continuous transmit.

2.6 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 4.38 dB and 20dB attenuator.

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

= 4.38 + 20 = 24.38 (dB)

3 Test Result

3.1 6dB and 26dB and 99% Occupied Bandwidth Measurement

3.1.1 Description of 6dB and 26dB and 99% Occupied Bandwidth

The minimum 6 dB bandwidth shall be at least 500 kHz.

26dB and 99% Occupied bandwidth are reporting only.

3.1.2 Measuring Instruments

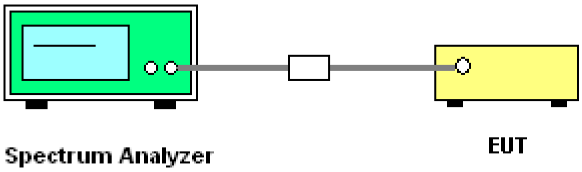
The measuring equipment is listed in the section 4 of this test report.

3.1.3 Test Procedures

1. The testing follows FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01.

☒	Section C) Bandwidth Measurement 1. Emission Bandwidth (EBW) and 99% OBW
	1. Set RBW = approximately 1% of the emission bandwidth. **2.** Set the VBW > RBW. **3.** Detector = Peak. **4.** Trace mode = max hold **5.** Measure the maximum width of the emission that is 26 dB down from the peak of the emission. Compare this with the RBW setting of the analyzer. Readjust RBW and repeat measurement as needed until the RBW/EBW ratio is approximately 1%. **6.** For 99% Bandwidth Measurement, the spectrum analyzer's resolution bandwidth (RBW) is set to 1%~5% of the OBW and set the Video bandwidth (VBW) ≥ 3 * RBW. **7.** Measure and record the results in the test report.
☒	Section C) Bandwidth Measurement 2. Minimum Emission Bandwidth for the band 5.725 - 5.85 GHz
	1. Set RBW = 100kHz. **2.** Set the VBW ≥ 3 x RBW. **3.** Detector = Peak. **4.** Trace mode = max hold **5.** Measure the maximum width of the emission that is 6 dB down from the peak of the emission. **6.** Measure and record the results in the test report.

3.1.4 Test Setup



3.1.5 Test Result of 6dB Bandwidth

Please refer to Appendix A.

3.2 Maximum Conducted Output Power Measurement

3.2.1 Limit of Maximum Conducted Output Power

<FCC 14-30 CFR 15.407>

For an indoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W.

For the 5.25–5.725 GHz bands, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW or 11 dBm +10 $\log_{10}$ B, where B is the 26 dB emission bandwidth in megahertz.

For the band 5.725–5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W.

For the 5.47–5.6 GHz and 5.65–5.725 GHz band, the maximum conducted output power shall not exceed 250 mW or 11 + 10 $\log_{10}$ B, dBm, whichever power is less. The maximum e.i.r.p. shall not exceed 1.0 W or 17 + 10 $\log_{10}$ B, dBm, whichever is less. B is the 99% emission bandwidth in megahertz.

For Straddle Channel, According to KDB 789033 D02 General UNII Test Procedures New Rules v02r01, If the power and PSD of the devices are uniform and comply with the lower limits specified for the U-NII-2 bands, a single measurement over the entire emission bandwidth can be performed to show compliance.

If transmitting antennas of directional gain greater than 6 dBi are used, the peak output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Note that U-NII-2 band, devices with a maximum e.i.r.p. greater than 500 mW shall implement TPC in order to have the capability to operate at least 6 dB below the maximum permitted e.i.r.p. of 1 W.

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3.2.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

3.2.3 Test Procedures

The testing follows Method PM of FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01.

Method PM (Measurement using an RF average power meter):

1. Measurement is performed using a wideband RF power meter.
2. The EUT is configured to transmit continuously with a consistent duty cycle at its maximum power control level.
3. Measure the average power of the transmitter, and the average power is corrected with duty factor, 10 log(1/x), where x is the duty cycle.
4. For MIMO mode, the measure-and-sum technique should be used for measuring the in-band transmit power of a device.

<TXBF Modes>

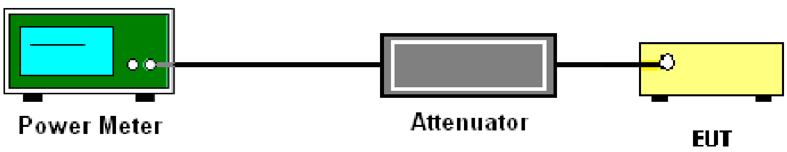
The testing follows Method PM-G of FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01 for TXBF modes.

Method PM-G (Measurement using a gated RF average power meter):

1. Measurement is performed using a wideband RF power meter.
2. The EUT is configured to transmit at its maximum power control level.
3. Measure the average power of the transmitter
4. Since the measurement is made only during the ON time of the transmitter, no duty cycle correction factor is required.

For Straddle Channel, According to KDB 789033 D02 General UNII Test Procedures New Rules v02r01, If the power and PSD of the devices are uniform and comply with the lower limits specified for the U-NII-2 bands, a single measurement over the entire emission bandwidth can be performed to show compliance.

3.2.4 Test Setup



3.2.5 Test Result of Maximum Conducted Output Power

Please refer to Appendix A.

3.3 Power Spectral Density Measurement

3.3.1 Limit of Power Spectral Density

<FCC 14-30 CFR 15.407>

For an indoor access point operating in the band 5.15-5.25 GHz, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band.

For the 5.25–5.725 GHz bands, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band.

For the band 5.725–5.85 GHz, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band.

For Straddle Channel, According to KDB 789033 D02 General UNII Test Procedures New Rules v02r01, If the power and PSD of the devices are uniform and comply with the lower limits specified for the U-NII-2 bands, a single measurement over the entire emission bandwidth can be performed to show compliance.

If transmitting antennas of directional gain greater than 6 dBi are used, the peak output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

3.3.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

3.3.3 Test Procedures

The testing follows FCC KDB 789033 D02 General UNII Test Procedures New Rules v01r04.

Section F) Maximum power spectral density.

<u>For devices operating in the bands UNII-1/2A/2C</u>

 # Method SA-2 #

(trace averaging across on and off times of the EUT transmissions, followed by duty cycle correction).

- Measure the duty cycle.
- Set span to encompass the entire emission bandwidth (EBW) of the signal.
- Set RBW = 1 MHz.
- Set VBW ≥ 3 MHz.
- Number of points in sweep ≥ 2 Span / RBW.
- Sweep time = auto.
- Detector = RMS
- Trace average at least 100 traces in power averaging mode.
- Add 10 log(1/x), where x is the duty cycle, to the measured power in order to compute the average power during the actual transmission times. For example, add 10 log(1/0.25) = 6 dB if the duty cycle is 25 percent.

<u>For devices operating in the band UNII-3</u>

 # Method SA-2 #

(trace averaging across on and off times of the EUT transmissions, followed by duty cycle correction).

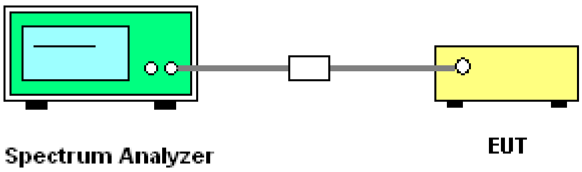
- Measure the duty cycle.
- Set span to encompass the entire emission bandwidth (EBW) of the signal.
- Set RBW = 500KHz (or 300 kHz if the SA can't set RBW=500KHz).
- Set VBW ≥ 1 MHz.
- Number of points in sweep ≥ 2 Span / RBW.
- Sweep time = auto.
- Detector = RMS
- Trace average at least 100 traces in power averaging mode.
- If the SA can't set RBW=500KHz, then add 10 log(500kHz/RBW) to the test result.
- Add 10 log(1/x), where x is the duty cycle, to the measured power in order to compute the average power during the actual transmission times. For example, add 10 log(1/0.25) = 6 dB if the duty cycle is 25 percent.

1. The RF output of EUT was connected to the spectrum analyzer by a low loss cable.
2. Each plot has already offset with cable loss, and attenuator loss. Measure the PPSD and record it.
3. For MIMO mode, calculation method follows FCC KDB 662911 D01 Multiple Transmitter Output v02r01.

   Method (a): Measure and sum the spectra across the outputs.

   The total final Power Spectral Density is the bin-by-bin summation to obtain the combined spectrum. For the device with 2 transmitter outputs. The spectrum measurements of the individual outputs are all performed with the same span and number of points, the spectrum value in the first spectral bin of output 1 is summed with that in the first spectral bin of output 2 to obtain the value for the first frequency bin of the summed spectrum.

3.3.4 Test Setup



3.3.5 Test Result of Power Spectral Density

Please refer to Appendix A.

3.4 Unwanted Emissions Measurement

This section as specified in FCC Part 15.407(b) is to measure unwanted emissions through radiated measurement for band edge spurious emissions and out of band emissions measurement. The unwanted emissions shall comply with 15.407(b)(1) to (6), and restricted bands per FCC Part15.205.

3.4.1 Limit of Unwanted Emissions

(1) For transmitters operating in the 5150-5250 MHz band: all emissions outside of the 5150-5350 MHz band shall not exceed an EIRP of –27dBm/MHz.

For transmitters operating in the 5250-5350 MHz band: all emissions outside of the 5150-5350 MHz band shall not exceed an EIRP of -27 dBm/MHz. Devices operating in the 5250-5350 MHz band that generate emissions in the 5150-5250 MHz band must meet all applicable technical requirements for operation in the 5150-5250 MHz band (including indoor use) or alternatively meet an out-of-band emission EIRP limit of -27 dBm/MHz in the 5150-5250 MHz band.

For transmitters operating in the 5470-5600 MHz and 5650-5725MHz band: all emissions outside of the 5470-5600 MHz and 5650-5725MHz band shall not exceed an EIRP of -27 dBm/MHz.

(2) For transmitters operating in the 5.725-5.85 GHz band:
15.407(b)(4)(i) All emissions shall be limited to a level of -27 dBm/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.

(3) Unwanted spurious emissions fallen in restricted bands shall comply with the general field strength limits as below table,

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

(4) EIRP (dBm)	Field Strength at 3m (dBμV/m)
- 27	68.2

Note: The following formula is used to convert the EIRP to field strength.

$$EIRP = E_{Meas} + 20\log(d_{Meas}) - 104.7$$

where

EIRP is the equivalent isotropically radiated power, in dBm

E_{Meas} is the field strength of the emission at the measurement distance, in dBμV/m

d_{Meas} is the measurement distance, in m

(4) ANSI C63.10-2013 clause 12.7.3 note 97

As specified by regulatory requirements, emissions above 1000 MHz that are outside of the restricted bands are subject to a peak emission limit. However, an out-of-band emission that complies with both the average and peak general regulatory limits is not required to satisfy the peak emission limit.

3.4.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

3.4.3 Test Procedures

1. The testing follows FCC KDB 789033 D02 General UNII Test Procedures New Rules v01r04. Section G) Unwanted emissions measurement.

   (1) Procedure for Unwanted Emissions Measurements Below 1000MHz

   - RBW = 120 kHz
   - VBW = 300 kHz
   - Detector = Peak
   - Trace mode = max hold

   (2) Procedure for Peak Unwanted Emissions Measurements Above 1000 MHz

   - RBW = 1 MHz
   - VBW ≥ 3 MHz
   - Detector = Peak
   - Sweep time = auto
   - Trace mode = max hold

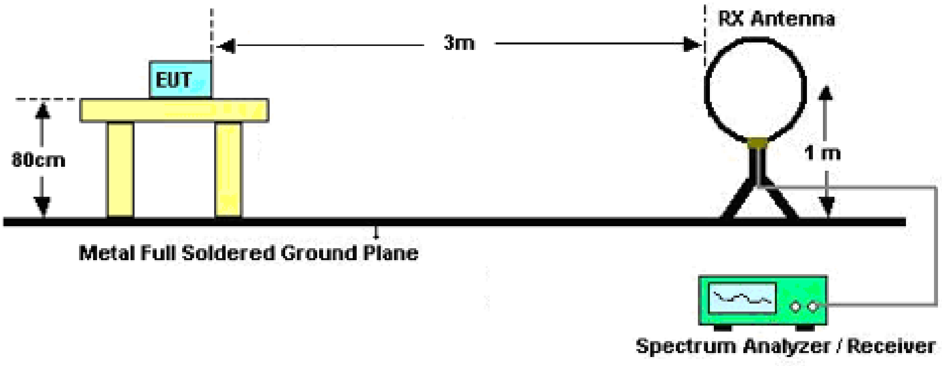
   (3) Procedures for Average Unwanted Emissions Measurements Above 1000MHz

   - RBW = 1 MHz
   - 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.

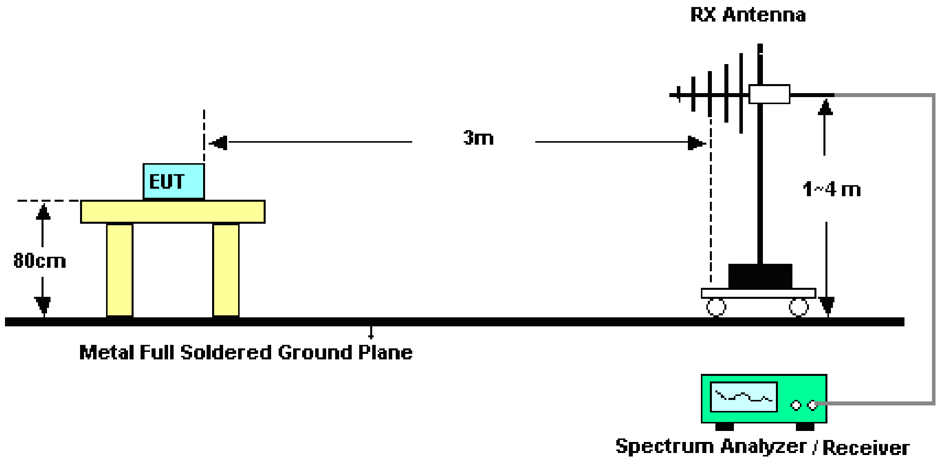
2. The EUT was placed on a turntable with 0.8 meter for frequency below 1GHz and 1.5 meter for frequency above 1GHz respectively above ground.
3. The EUT was set 3 meters from the interference receiving antenna which was mounted on the top of a variable height antenna tower.
4. The antenna is a broadband antenna and its height is adjusted between one meter and four meters above ground to find the maximum value of the field strength for both horizontal polarization and vertical polarization of the antenna.
5. For each suspected emission, the EUT was arranged to its worst case and then adjust the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading.
6. For testing below 1GHz, if the emission level of the EUT in peak mode was 3 dB lower than the limit specified, then peak values of EUT will be reported, otherwise, the emissions will be repeated one by one using the CISPR quasi-peak method and reported.
7. For testing above 1GHz, the emission level of the EUT in peak mode was 20dB lower than average limit (that means the emission level in average mode also complies with the limit in average mode), then peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.

3.4.4 Test Setup

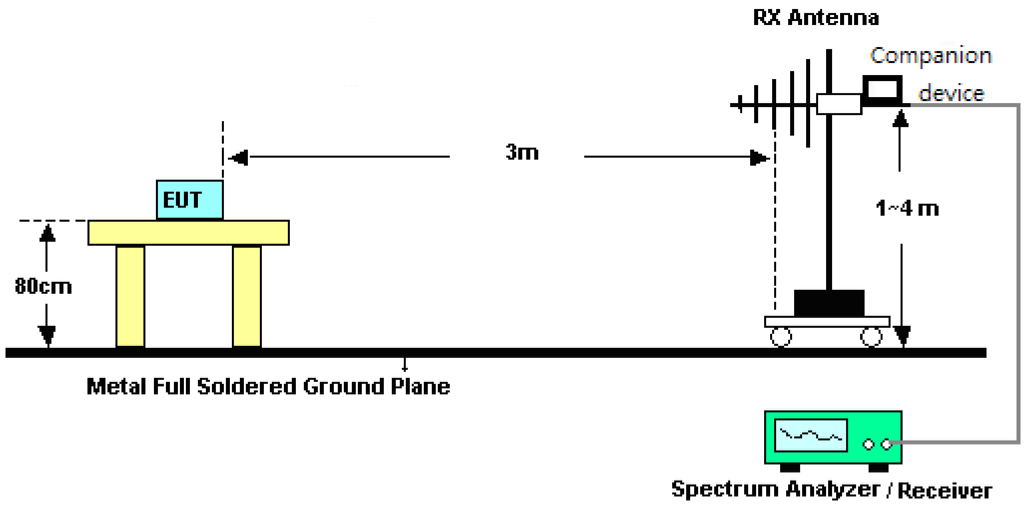
For radiated emissions below 30MHz



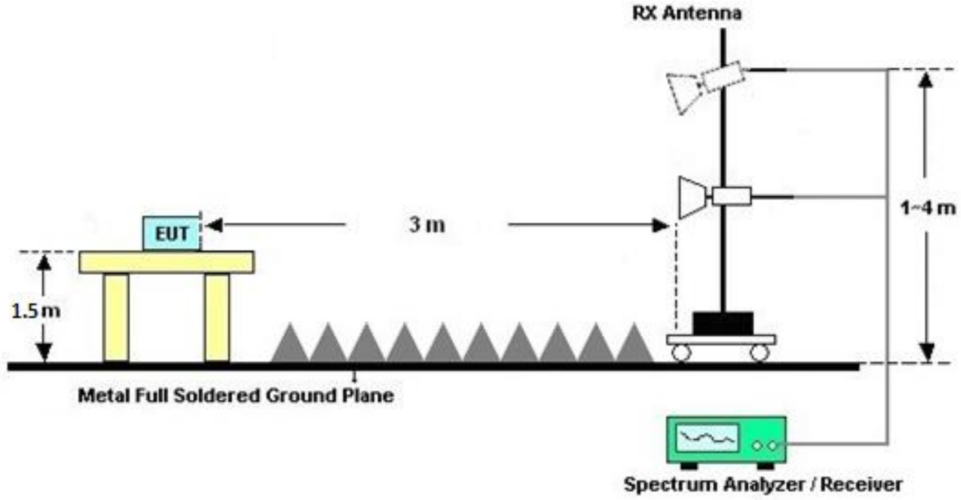
For radiated emissions from 30MHz to 1GHz



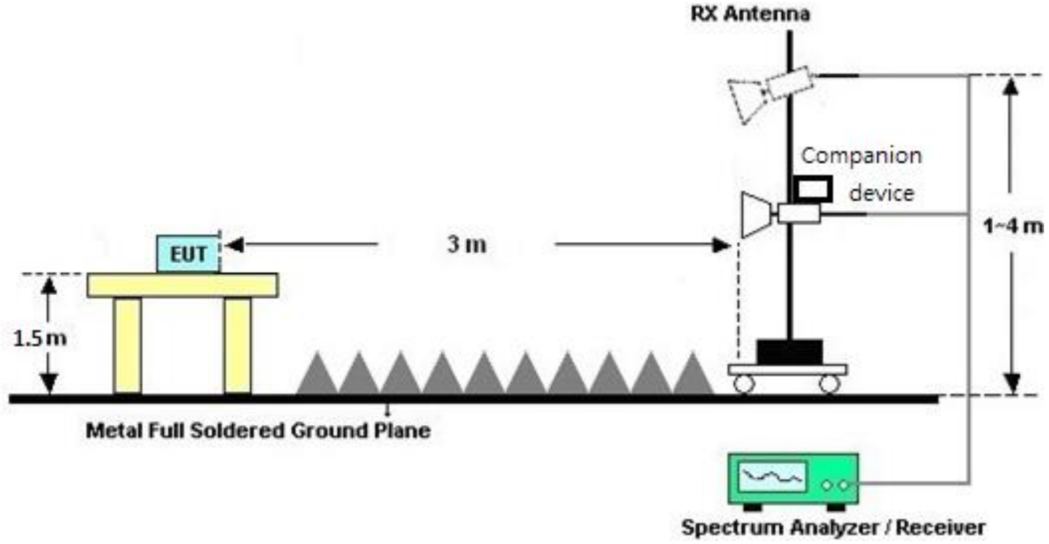
<TXBF Modes>



For radiated emissions above 1GHz



<TXBF Modes>



3.4.5 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 was not reported.

There is a comparison data of both open-field test site and semi-Anechoic chamber, and the result came out very similar.

3.4.6 Test Result of Radiated Spurious at Band Edges

Please refer to Appendix C.

3.4.7 Duty Cycle

Please refer to Appendix D.

3.4.8 Test Result of Radiated Spurious Emissions (30MHz ~ 10th Harmonic)

Please refer to Appendix C.

3.5 AC Conducted Emission Measurement

3.5.1 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.

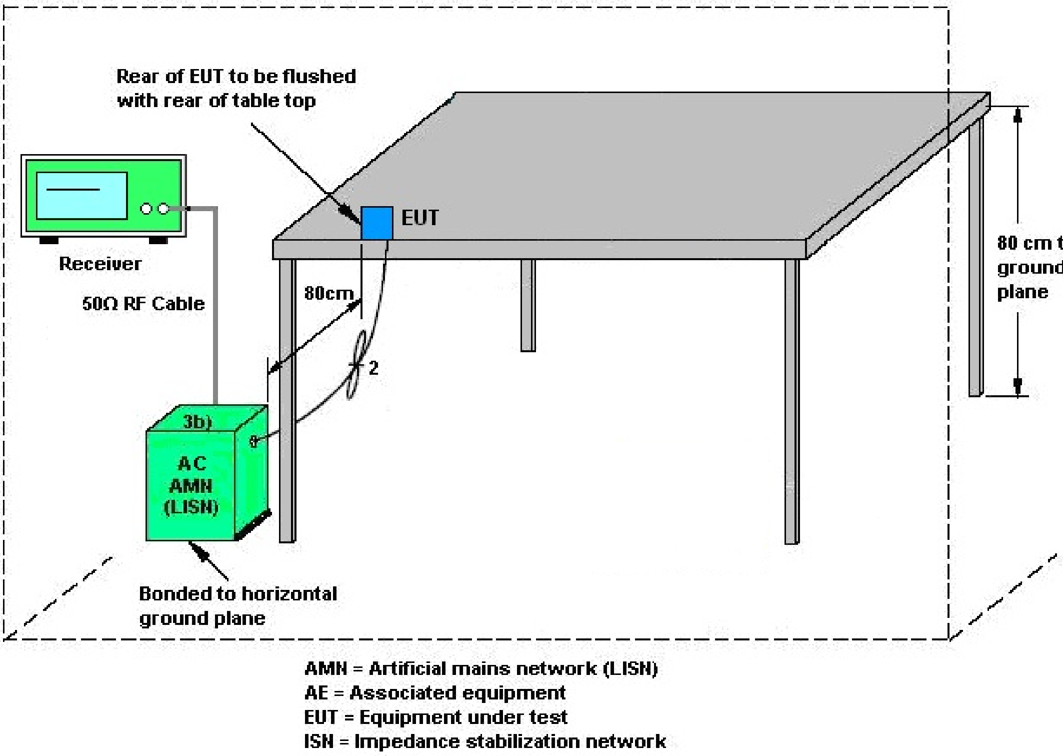
3.5.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

3.5.3 Test Procedures

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

3.5.4 Test Setup



3.5.5 Test Result of AC Conducted Emission

Please refer to Appendix B.

3.6 Antenna Requirements

3.6.1 Standard Applicable

According to FCC 47 CFR Section 15.407(a)(1)(2) ,if transmitting antenna directional gain is greater than 6 dBi, both the peak transmit power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

3.6.2 Antenna Anti-Replacement Construction

An embedded-in antenna design is used.

3.6.3 Antenna Gain

<CDD Modes >

FCC KDB 662911 D01 Multiple Transmitter Output v02r01

For CDD transmissions, directional gain is calculated as

Directional gain = GANT + Array Gain, where Array Gain is as follows.

For power spectral density (PSD) measurements on all devices,

Array Gain = 10 log(NANT/NSS=1) dB.

For power measurements on IEEE 802.11 devices,

Array Gain = 0 dB (i.e., no array gain) for NANT ≤ 4.

Directional gain may be calculated by using the formulas applicable to equal gain antennas with GANT set equal to the gain of the antenna having the highest gain;

The EUT supports CDD mode.

For power, the directional gain GANT is set equal to the antenna having the highest gain, i.e., F)2)f)i).

For PSD, the directional gain calculation is following F)2)f)ii) of KDB 662911 D01 v02r01.

The power and PSD limit should be modified if the directional gain of EUT is over 6 dBi,

The directional gain “DG” is calculated as following table.

<TXBF Mode>

FCC KDB 662911 D01 Multiple Transmitter Output v02r01

For TXBF transmissions, directional gain is calculated as

$$DirectionalGain = 10 \cdot \log \left[\frac{\sum_{j=1}^{N_{SS}} \left\{ \sum_{k=1}^{N_{ANT}} g_{j,k} \right\}^2}{N_{ANT}} \right]$$

where

Each antenna is driven by no more than one spatial stream;

N_{SS} = the number of independent spatial streams of data;

N_{ANT} = the total number of antennas

$g_{j,k} = 10^{G_k/20}$ if the kth antenna is being fed by spatial stream j, or zero if it is not;

G_k is the gain in dBi of the kth antenna.

The EUT supports beamforming for 802.11n/ac/ax modes.

The directional gain calculation is following F)2)e)ii).

The power and PSD limit should be modified if the directional gain of EUT is over 6 dBi,

AOT Antenna:

Frequency Band	Max Single Antenna gain (dBi)		CDD DG (dBi)		TXBF DG (dBi)	
	ANT1	ANT2	For Power	For PSD	For Power	For PSD
5GHz UNII-1	2.96	3.07	3.07	3.75	3.75	3.75
5GHz UNII-2A	2.96	3.07	3.07	3.75	3.75	3.75
5GHz UNII-2C	2.86	2.76	2.86	4.44	4.44	4.44
5GHz UNII-3	2.77	2.79	2.79	4.50	4.50	4.50

Note:

1. Please refer to the antenna report for the maximum Single antenna gain and CDD (Cyclic Delay Diversity) directional gain and TXBF (Tx Beamforming) directional gain.
2. The device supports 1S2T(CDD&TXBF) mode; 1S2T: NSS=1, MIMO 2Tx.

4 List of Measuring Equipment

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Spectrum Analyzer	R&S	FSV40	101040	10Hz~40GHz	Oct. 10, 2024	Nov. 23, 2024~ Dec. 11, 2024	Oct. 09, 2025	Conducted (TH01-KS)
Pulse Power Senor	Anritsu	MA2411B	0917070	300MHz~40GHz	Jan. 02, 2024	Nov. 23, 2024~ Dec. 11, 2024	Jan. 01, 2025	Conducted (TH01-KS)
Power Meter	Anritsu	ML2495A	1005002	50MHz Bandwidth	Jan. 02, 2024	Nov. 23, 2024~ Dec. 11, 2024	Jan. 01, 2025	Conducted (TH01-KS)
EMI Test Receiver	Keysight	N9038A	MY56400023	3Hz~8.5GHz;Max 30dBm	Jan. 01, 2025	Jan. 04, 2025	Dec. 31, 2025	Radiation (03CH08-KS)
EXA Spectrum Analyzer	Keysight	N9010B	MY57441079	10Hz-44GHz	Oct. 09, 2024	Jan. 04, 2025	Oct. 08, 2025	Radiation (03CH08-KS)
Loop Antenna	R&S	HFH2-Z2E	101125	9kHz~30MHz	Sep. 08, 2024	Jan. 04, 2025	Sep. 07, 2025	Radiation (03CH08-KS)
Bilog Antenna	TESEQ	CBL 6111D	59915	30MHz-1GHz	Aug. 18, 2024	Jan. 04, 2025	Aug.17, 2025	Radiation (03CH08-KS)
Double Ridge Horn Antenna	ETS-Lindgren	3117	00240138	1GHz~18GHz	Jul. 06, 2024	Jan. 04, 2025	Jul. 05, 2025	Radiation (03CH08-KS)
high gain Amplifier	EM	EM01G18GA	060845	1Ghz-18Ghz	Jan. 02, 2025	Jan. 04, 2025	Jan. 01, 2026	Radiation (03CH08-KS)
SHF-EHF Horn	Com-power	AH-840	101070	18GHz~40GHz	Jan. 27, 2024	Jan. 04, 2025	Jan. 26, 2025	Radiation (03CH08-KS)
Amplifier	SONOMA	310N	413741	9KHz-1GHz	Jan. 01, 2025	Jan. 04, 2025	Dec. 31, 2025	Radiation (03CH08-KS)
Amplifier	Keysight	83017A	MY53270417	500MHz~26.5GHz	Oct. 09, 2024	Jan. 04, 2025	Oct. 08, 2025	Radiation (03CH08-KS)
Amplifier	EM	EM18G40GGA	060728	18~40GHz	Jan. 01, 2025	Jan. 04, 2025	Dec. 31, 2025	Radiation (03CH08-KS)
AC Power Source	Chroma	61601	616010002473	N/A	NCR	Jan. 04, 2025	NCR	Radiation (03CH08-KS)
Turn Table	EM	EM 1000-T	N/A	0~360 degree	NCR	Jan. 04, 2025	NCR	Radiation (03CH08-KS)
Antenna Mast	EM	EM 1000-A	N/A	1 m~4 m	NCR	Jan. 04, 2025	NCR	Radiation (03CH08-KS)
EMI Receiver	R&S	ESCI7	100768	9kHz~7GHz;	Apr. 18, 2024	Dec. 02, 2024	Apr. 17, 2025	Conduction (CO01-KS)
AC LISN (for auxiliary equipment)	MessTec	AN3016	060103	9kHz~30MHz	Aug. 20, 2024	Dec. 02, 2024	Aug. 19, 2025	Conduction (CO01-KS)
AC LISN	MessTec	AN3016	060105	9kHz~30MHz	Apr. 18, 2024	Dec. 02, 2024	Apr. 17, 2025	Conduction (CO01-KS)
AC Power Source	Chroma	61602	ABP000000811	AC 0V~300V, 45Hz~1000Hz	Oct. 09, 2024	Dec. 02, 2024	Oct. 08, 2025	Conduction (CO01-KS)

NCR: No Calibration Required

5 Measurement Uncertainty

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI 63.10-2013. All the measurement uncertainty value were shown with a coverage K=2 to indicate 95% level of confidence. The measurement data show herein meets or exceeds the CISPR measurement uncertainty values specified in CISPR 16-4-2 and can be compared directly to specified limit to determine compliance.

Uncertainty of Conducted Measurement

Conducted Spurious Emission & Bandedge	**±2.26 dB**
Occupied Channel Bandwidth	**±0.1%**
Conducted Power	**±0.50 dB**
Conducted Power Spectral Density	**±0.90 dB**
Frequency	**±0.4 Hz**

Uncertainty of AC Conducted Emission Measurement (0.15 MHz ~ 30 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**2.84 dB**

Uncertainty of Radiated Emission Measurement (9 KHz ~ 30 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**3.30 dB**

Uncertainty of Radiated Emission Measurement (30 MHz ~ 1000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**6.04 dB**

Uncertainty of Radiated Emission Measurement (1 GHz ~ 18 GHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**5.26 dB**

Uncertainty of Radiated Emission Measurement (18 GHz ~ 40 GHz)

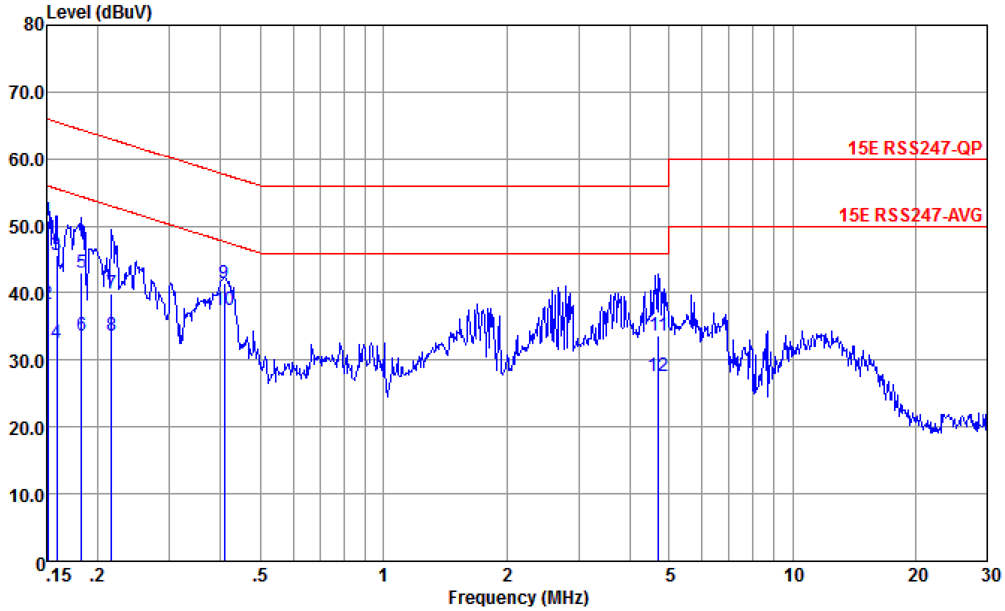
Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**5.40 dB**

----------- THE END -----------

Appendix A. Conducted Test Results

Appendix B. AC Conducted Emission Test Results

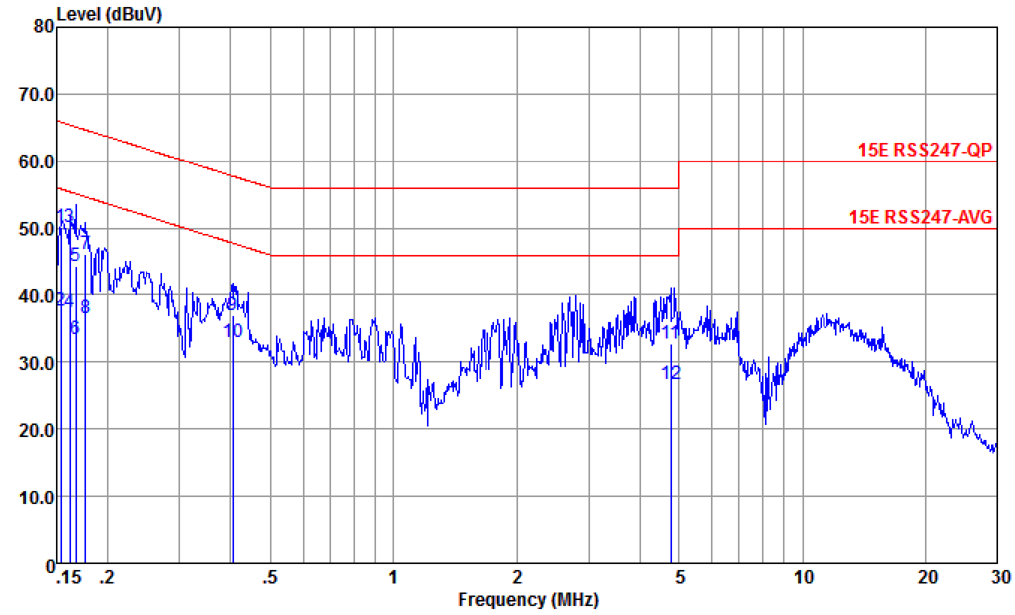
Test Engineer :	Amos Zhang	**Temperature :**	25.3~26.2℃
		Relative Humidity :	38~40%
Test Voltage :	120Vac / 60Hz	**Phase :**	Line
Remark :	All emissions not reported here are more than 10 dB below the prescribed limit.		



Site : CO01-KS
Condition : 15E RSS247-QP LISN-060105-L 2024 LINE

	Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1	0.151	50.74	-15.22	65.96	40.20	0.12	10.42	QP
2	0.151	38.34	-17.62	55.96	27.80	0.12	10.42	Average
3	0.159	45.73	-19.79	65.52	35.20	0.11	10.42	QP
4	0.159	32.43	-23.09	55.52	21.90	0.11	10.42	Average
5	0.182	43.01	-21.36	64.37	32.51	0.09	10.41	QP
6	0.182	33.61	-20.76	54.37	23.11	0.09	10.41	Average
7	0.216	39.98	-22.98	62.96	29.50	0.08	10.40	QP
8	0.216	33.68	-19.28	52.96	23.20	0.08	10.40	Average
9	0.408	41.34	-16.34	57.68	31.10	-0.03	10.27	QP
10 *	0.408	37.54	-10.14	47.68	27.30	-0.03	10.27	Average
11	4.721	33.55	-22.45	56.00	23.70	-0.21	10.06	QP
12	4.721	27.65	-18.35	46.00	17.80	-0.21	10.06	Average

Test Engineer :	Amos Zhang	**Temperature :**	25.3~26.2℃
		Relative Humidity :	38~40%
Test Voltage :	120Vac / 60Hz	**Phase :**	Neutral
Remark :	All emissions not reported here are more than 10 dB below the prescribed limit.		



Site : CO01-KS
Condition : 15E RSS247-QP LISN-060105-N 2024 NEUTRAL

	Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1	0.153	50.04	-15.78	65.82	39.50	0.12	10.42	QP
2	0.153	37.64	-18.18	55.82	27.10	0.12	10.42	Average
3	0.162	50.04	-15.34	65.38	39.50	0.12	10.42	QP
4	0.162	37.44	-17.94	55.38	26.90	0.12	10.42	Average
5	0.167	44.34	-20.78	65.12	33.80	0.12	10.42	QP
6	0.167	33.34	-21.78	55.12	22.80	0.12	10.42	Average
7	0.177	46.14	-18.50	64.64	35.60	0.13	10.41	QP
8	0.177	36.44	-18.20	54.64	25.90	0.13	10.41	Average
9	0.404	37.04	-20.73	57.77	26.90	-0.14	10.28	QP
10 *	0.404	33.04	-14.73	47.77	22.90	-0.14	10.28	Average
11	4.772	32.65	-23.35	56.00	22.80	-0.21	10.06	QP
12	4.772	26.65	-19.35	46.00	16.80	-0.21	10.06	Average

Note:

1. Level(dBμV) = Read Level(dBμV) + LISN Factor(dB) + Cable Loss(dB)
2. Over Limit(dB) = Level(dBμV) – Limit Line(dBμV)