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NingBo Panel Electric Appliance Co., Ltd

RF TEST REPORT

Report Type:
FCC Part 15.249 RF report

Model:
BJ-LR68

REPORT NUMBER:
231200828HAN-001

ISSUE DATE:
April 20, 2024

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Report no.: 231200828HAN-001

Applicant:	**NingBo Panel Electric Appliance Co., Ltd.** **No.255, Lvyuan 1st Road, Chongshou Town, Cixi City, Ningbo, China**
Manufacturer:	**Same as Applicant**
Manufacturing site:	**Same as Applicant**
FCC ID:	**2BEK4-PANEL01**

SUMMARY:

The equipment complies with the requirements according to the following standard(s) or Specification:
47CFR Part 15 (2021): Radio Frequency Devices (Subpart C) **ANSI C63.10 (2020):** American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

PREPARED BY:	**REVIEWED BY:**
Alex Wu	Wakeyou Wang
Project Engineer	Reviewer

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TEST REPORT

Content

REVISION HISTORY 4

MEASUREMENT RESULT SUMMARY 5

1 GENERAL INFORMATION 6

1.1 DESCRIPTION OF EQUIPMENT UNDER TEST (EUT) 6
1.2 TECHNICAL SPECIFICATION 6
1.3 DESCRIPTION OF TEST FACILITY 7

2 TEST SPECIFICATIONS 8

2.1 STANDARDS OR SPECIFICATION 8
2.2 MODE OF OPERATION DURING THE TEST 8
2.3 TEST SOFTWARE LIST 8
2.4 TEST PERIPHERALS LIST 8
2.5 TEST ENVIRONMENT CONDITION: 8
2.6 INSTRUMENT LIST 9
2.7 MEASUREMENT UNCERTAINTY 10

3 FUNDAMENTAL FIELD STRENGTH AND RADIATED SPURIOUS EMISSION. 11

3.1 LIMIT 11
3.2 MEASUREMENT PROCEDURE 11
3.3 TEST CONFIGURATION 13
3.4 TEST RESULTS 15
3.5 DUTY CYCLE: 19

4 POWER LINE CONDUCTED EMISSION 20

4.1 LIMIT 20
4.2 TEST CONFIGURATION 21
4.3 MEASUREMENT PROCEDURE 22
4.4 TEST RESULTS OF POWER LINE CONDUCTED EMISSION 23

5 20DB BANDWIDTH & 99% OCCUPIED BANDWIDTH 25

5.1 LIMIT 25
5.2 MEASUREMENT PROCEDURE 25
5.3 TEST CONFIGURATION 26
5.4 THE RESULTS 27

6 ANTENNA REQUIREMENT 28

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TEST REPORT

Revision History

Report No.	Version	Description	Issued Date
231200828HAN-001	Rev. 01	Initial issue of report	April 20, 2024

TEST REPORT

Measurement result summary

TEST ITEM	FCC REFERENCE	RESULT
Fundamental field strength and radiated spurious emission	15.249	Pass
Power line conducted emission	15.207	Pass
20dB bandwidth & 99% occupied bandwidth	15.215(c) & 15.249(e)	Pass
Antenna requirement	15.203	Pass

Notes:

1: NA =Not Applicable

2: Determination of the test conclusion is based on ICE Guide 115 in consideration of measurement uncertainty.

3: Additions, Deviations and Exclusions from Standards: None.

TEST REPORT

1 GENERAL INFORMATION

1.1 Description of Equipment Under Test (EUT)

Product name:	Cat Litter Box
Type/Model:	BJ-LR68
Description of EUT:	The EUT is Cat Litter Box which is powered by an adaptor. The adaptor model No is M120200-S99US. It has only one model It incorporates the Wi-Fi and Bluetooth module which FCC-ID is: 2ANDL-WBR3. Another new RF module is working at 24GHz for sensor. Therefore, the EUT is applied for the new FCC ID: **2BEK4-PANEL01.** Therefore, we test it under all different working modes, the worst testing data is listed in the report as representative.
Rating:	DC12V, 24w powered by adaptor, Adaptor input: 120V, 60Hz Output:12VDC, 24W
Category of EUT:	Class B
EUT type:	☐ Tabletop ☒ Floor standing
Software Version:	--
Hardware Version:	--
Sample received date:	December 27, 2023
Date of test:	January 20-February 15, 2024

1.2 Technical Specification

Frequency Range:	24000MHz ~ 24250MHz
Type of Modulation:	FSK
Antenna Information:	Integrated PCB antenna
Channel Number:	1
Center frequency:	24065.8MHz

1.3 Description of Test Facility

Name:	Intertek Testing Services Shanghai
Address:	Building 86, No. 1198 Qinzhou Road (North), Shanghai 200233, P.R. China
Telephone:	86 21 61278200
Telefax:	86 21 54262353

The test facility is recognized, certified, or accredited by these organizations:	CNAS Accreditation Lab Registration No. CNAS L0139
	FCC Accredited Lab Designation Number: CN0175
	IC Registration Lab CAB identifier.: CN0014
	VCCI Registration Lab Member No: 3598 (Registration No.: R-14243, G-10845, C-14723, T-12252)
	A2LA Accreditation Lab Certificate Number: 3309.02

2 TEST SPECIFICATIONS

2.1 Standards or specification

47CFR Part 15 (2021)
ANSI C63.10 (2020)

2.2 Mode of operation during the test

The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case.

Within this test report, EUT was tested under its rating voltage and frequency. The EUT is set as the default mode, and the highest reading among the whole test procedure was recorded.

2.3 Test software list

Test Items	Software	Manufacturer	Version
Conducted emission	ESxS-K1	R&S	V2.1.0
Radiated emission	ES-K1	R&S	V1.71

2.4 Test peripherals list

Item No.	Name	Band and Model	Description
-	-	-	-

2.5 Test environment condition:

Test items	Temperature	Humidity
Fundamental field strength and radiated spurious emission	21°C	53% RH
Power line conducted emission	22°C	54% RH
20dB bandwidth & 99% occupied bandwidth	22°C	55% RH

2.6 Instrument list

Conducted Emission					
Used	Equipment	Manufacturer	Type	Internal no.	Due date
☒	Test Receiver	R&S	ESR7	EC 6194	2025-02-07
☒	A.M.N.	R&S	ESH2-Z5	EC 3119	2024-11-19
☒	Attenuator	Hua Xiang	Ts5-10db-6g	EC 6194-1	2024-12-07
☒	Shielded room	Zhongyu	-	EC 2838	2025-01-10
Radiated Emission					
Used	Equipment	Manufacturer	Type	Internal no.	Due date
☒	Test Receiver	R&S	ESIB 26	EC 3045	2024-08-22
☒	PXA Signal Analyzer	Keysight	N9030A	EC 5338	2024-03-05
☒	Bilog Antenna	TESEQ	CBL 6112B	EC 6411	2024-09-12
☒	Pre-amplifier	R&S	AFS42-00101800-25-S-42	EC 5262	2024-06-15
☒	Pre-amplifier	Tonscend	tap01018050	EC 6432-1	2024-12-07
☒	Horn antenna	Tonscend	bha9120d	EC 6432-2	2025-02-14
☒	Horn antenna	ETS	3116c	EC 5955	2024-06-16
☒	WW wave antenna (40-60G)	HengDa	HD-500SGAH25	EC 6529	2025-03-27
☒	Mixer (40-60G)	Keysight	M19RH	EC 6529-1	2025-03-08
☒	WW wave antenna (60-90G)	HengDa	HD-620SGAH25	EC 6382	2025-03-27
☒	Mixer (60-90G)	Keysight	M12RH	EC 6382-1	2025-03-13
☒	WW wave antenna (90-140G)	HengDa	HD-900SGAH25	EC 6383	2025-03-27
☒	Mixer (90-140G)	Keysight	M8RH	EC 6383-1	2025-03-27
☒	Semi-anechoic chamber	Albatross project	-	EC 3048	2024-07-08
Additional instrument					
Used	Equipment	Manufacturer	Type	Internal no.	Due date
☒	Thermo-Hygrograph	Testo	175h1	EC 6643	2024-08-28
☒	Pressure meter	YM3	Shanghai Mengde	EC 3320	2024-08-16
☒	Thermo-Hygrograph	Testo	175h1	EC6642	2024-08-28

2.7 Measurement uncertainty

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

Test item	Measurement uncertainty
Maximum peak output power	± 0.74dB
Radiated Emissions in restricted frequency bands below 1GHz	± 4.90dB
Radiated Emissions in restricted frequency bands above 1GHz	± 5.02dB
Emission outside the frequency band	± 2.89dB
Power line conducted emission	± 3.19dB

3 Fundamental field strength and radiated spurious emission.

Test result: **Pass**

3.1 Limit

The field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Fundamental Frequency (MHz)	Average Fundamental limit (dBuV/m) at 3m	Average Harmonic limit (dBuV/m) at 3m
☐ 902 - 928	94	54
☐ 2400 - 2483.5	94	54
☐ 5725 - 5875	94	54
☒ 24000 - 24250	108	68

The radiated emissions which fall in the restricted bands, must also comply with the radiated emission limits:

Frequencies (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

3.2 Measurement Procedure

For Radiated emission below 30MHz:

a) The EUT was placed on the top of a rotating table 0.1 meters above the ground at a 3 meters chamber room. The table was rotated 360 degrees to determine the position of the highest radiation.
b) The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
c) Both X and Y axes of the antenna are set to make the measurement.
d) For each suspected emission, the EUT was arranged to its worst case and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
e) The test-receiver system was set to Quasi-Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

NOTE:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 9kHz at frequency below 30MHz.

TEST REPORT

For Radiated emission above 30MHz:

a) For 30MHz-1GHz, the EUT was placed on the top of a rotating table 0.1 meters above the ground at 3 meters chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.

b) For 1-40GHz, the EUT was placed on the top of a rotating table 1.5 meters above the ground at 3 meters chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.

c) For above 40GHz, the EUT was placed on the top of a rotating table 1.5 meters above the ground at 1 meter's chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.

d) The EUT was set 3 or 1 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

e) The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.

f) For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.

g) The test-receiver system was set to quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1 GHz.

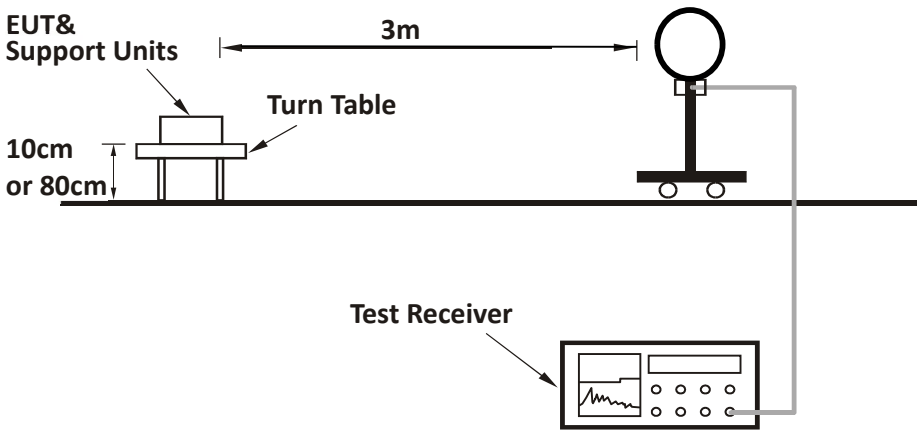
h) The test-receiver system was set to peak, and average detect function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz. If the peak reading value also meets average limit, measurement with the average detector is unnecessary.

Note:

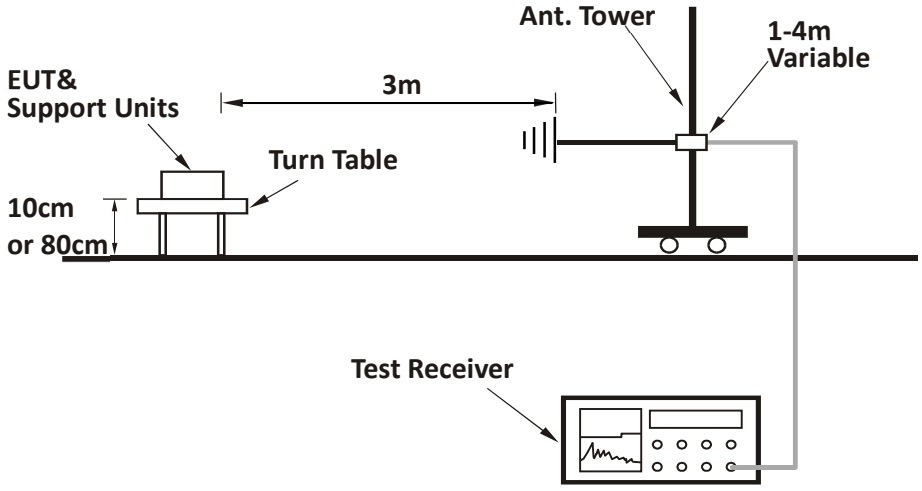
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz, and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz, and the video bandwidth is ≥ 1/T (Duty cycle < 98%) or 3 x RBW (Duty cycle ≥ 98%) for Average detection (AV) at frequency above 1GHz.
4. All modes of operation were investigated, and the worst-case emissions are reported.

3.3 Test Configuration

For Radiated emission below 30MHz:

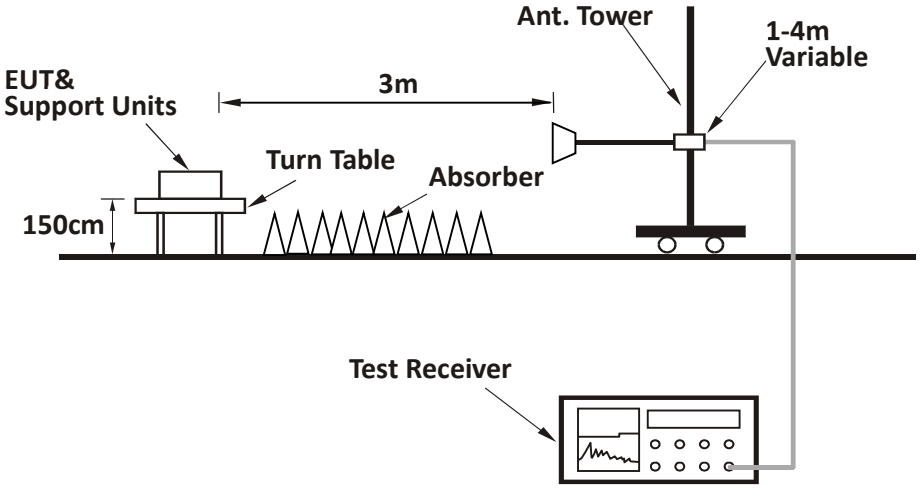


For Radiated emission 30MHz to 1GHz:

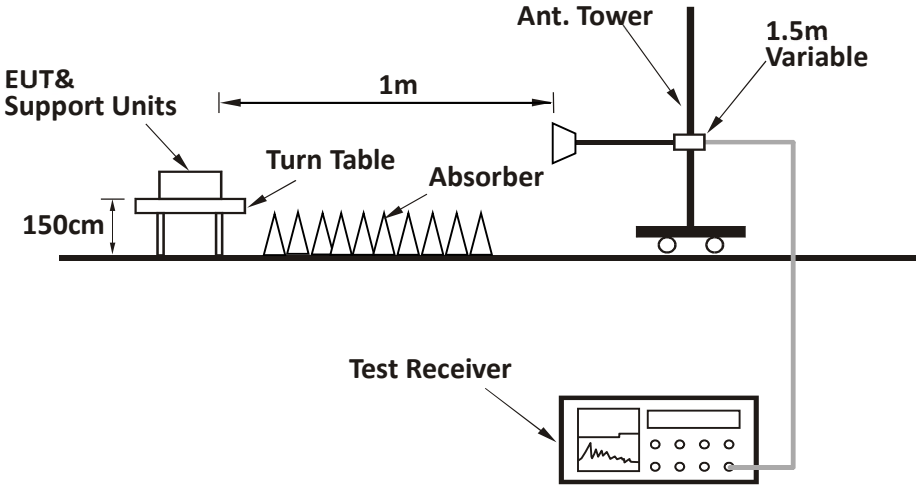


TEST REPORT

For Radiated emission 1GHz to 40GHz:



For Radiated emission above 40GHz:



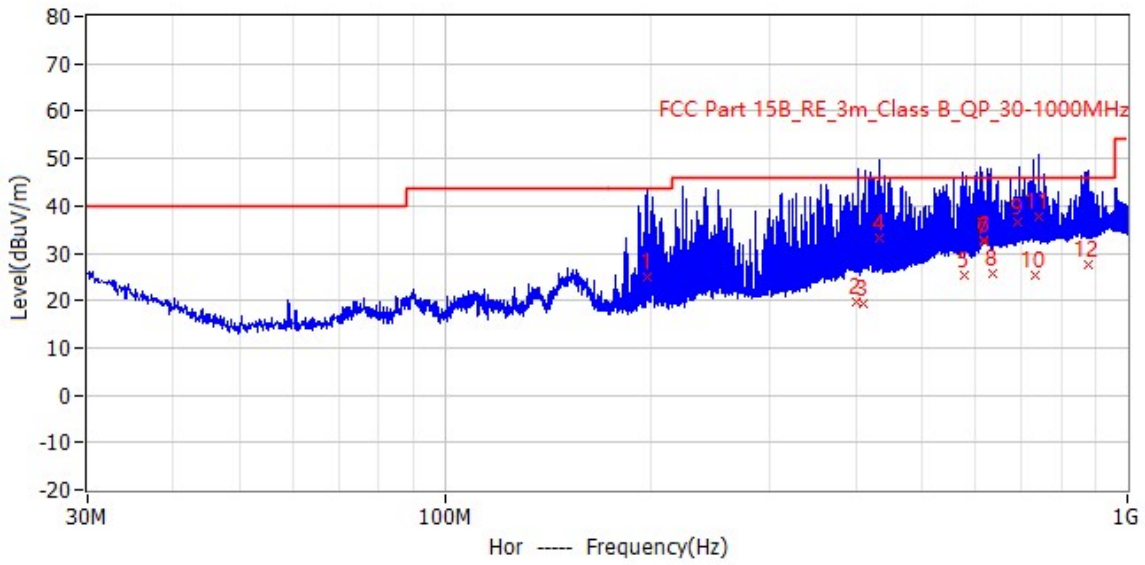
3.4 Test Results

Radiated emission below 1 GHz:

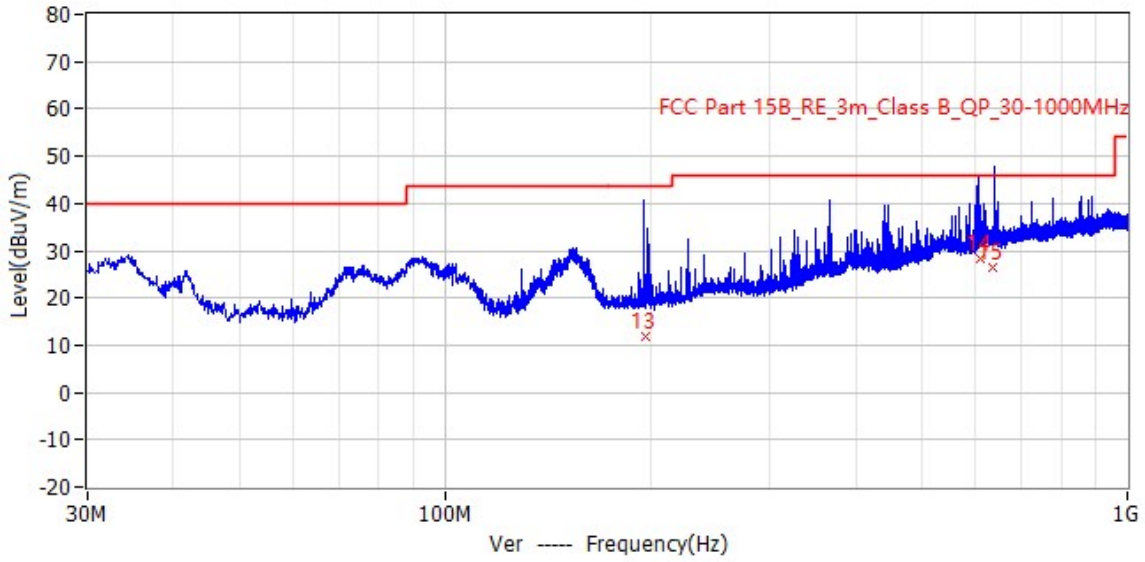
The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line per 15.31(o) was not reported.

The worst waveform from 30MHz to 1000MHz is listed as below:

Horizontal



Vertical



TEST REPORT

Frequency	Limit dBμV/m	Level dBμV/m	Delta dB	Limit dBμV/m	Factor dB	Detector	Polar
197.618MHz	43.5	25.0	-18.5	14.1	10.9	QP	Hor
401.729MHz	46.0	19.7	-26.3	1.0	18.7	QP	Hor
410.096MHz	46.0	19.4	-26.6	0.6	18.8	QP	Hor
433.634MHz	46.0	33.3	-12.7	14.8	18.5	QP	Hor
578.114MHz	46.0	25.5	-20.5	4.0	21.5	QP	Hor
615.327MHz	46.0	32.8	-13.2	9.1	23.7	QP	Hor
616.822MHz	46.0	32.3	-13.7	8.5	23.8	QP	Hor
635.663MHz	46.0	25.6	-20.4	1.9	23.7	QP	Hor
689.365MHz	46.0	36.4	-9.6	12.2	24.2	QP	Hor
734.200MHz	46.0	25.4	-20.6	0.9	24.5	QP	Hor
742.372MHz	46.0	37.5	-8.5	13.0	24.5	QP	Hor
876.587MHz	46.0	27.6	-18.4	2.7	24.9	QP	Hor
196.962MHz	43.5	11.8	-31.7	1.0	10.8	QP	Ver
607.300MHz	46.0	28.5	-17.5	5.5	23.0	QP	Ver
633.568MHz	46.0	26.4	-19.6	2.6	23.8	QP	Ver

Test result above 1GHz:

Antenna	Frequency Band (MHz)	Corrected Reading (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
Hor	24000.00 ~ 24250.00	67.36	128.00	60.64	PK
Hor		65.75	108.00	42.25	AV
Ver		**67.51**	128.00	60.49	PK
Ver		65.62	108.00	42.38	AV

Antenna	Frequency (MHz)	Corrected Reading (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
Hor	24000.00	45.56	74.00	28.44	PK
Hor	24250.00	40.43	74.00	33.57	PK
Ver	24000.00	41.54	74.00	32.46	PK
Ver	24250.00	39.05	74.00	34.95	PK

TEST REPORT

The emission was conducted from 1GHz to 40GHz:

Antenna	Frequency (MHz)	Corrected Reading (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
Hor	2396.79	36.72	74.00	37.28	QP
Hor	2704.68	43.50	74.00	30.50	QP
Hor	7159.73	45.60	74.00	28.40	QP
Hor	9346.69	48.20	74.00	25.80	QP
Hor	13617.21	47.60	74.00	26.40	QP
Ver	2633.06	35.70	74.00	38.30	QP
Ver	3105.71	39.70	74.00	34.30	QP
Ver	5667.33	43.40	74.00	30.60	QP
Ver	8516.03	48.60	74.00	25.40	QP
Ver	12740.72	48.30	74.00	25.70	QP

Remark: 1. Correct Factor = Antenna Factor + Cable Loss (- Amplifier, for higher than 1GHz), the value was added to Original Receiver Reading by the software automatically.
2. Corrected Reading = Original Receiver Reading + Correct Factor
3. Margin = Limit - Corrected Reading
4. If the PK Corrected Reading is lower than AV limit, the AV test can be elided.

Example: Assuming Antenna Factor = 30.20dB/m, Cable Loss = 2.00dB,
Gain of Preamplifier = 32.00dB, Original Receiver Reading = 10.00dBuV,
Limit = 40.00dBuV/m.
Then Correct Factor = 30.20 + 2.00 – 32.00 = 0.20dB/m;
Corrected Reading = 10dBuV + 0.20dB/m = 10.20dBuV/m;
Margin = 40.00dBuV/m - 10.20dBuV/m = 29.80dB.

TEST REPORT

The emission was conducted from 40GHz to 100GHz:

Antenna	Frequency (MHz)	Measured Level (dBm)	Antenna Gain (dBi)	Level @1m (dBuV/m)	Level @3m (dBuV/m)	Limit @3m (dBuV/m)	Margin (dB)	Detector
Hor	48240.00	-62.51	23.25	85.17	75.62	88.00	12.38	PK
Hor	48240.00	-70.90	23.25	76.78	67.23	68.00	0.77	AV
Hor	72360.00	-65.21	23.60	85.64	76.10	88.00	11.90	PK
Hor	72360.00	-76.62	23.60	74.23	64.69	68.00	3.31	AV
Hor	96480.00	-65.46	22.70	88.79	79.24	88.00	8.76	PK
Hor	96480.00	-78.92	22.70	75.33	65.78	68.00	2.22	AV
Ver	48240.00	-58.46	23.25	89.22	79.67	88.00	8.33	PK
Ver	48240.00	-70.80	23.25	76.88	67.33	68.00	0.67	AV
Ver	72360.00	-60.51	23.60	90.34	80.80	88.00	7.20	PK
Ver	72360.00	-76.69	23.60	74.16	64.62	68.00	3.38	AV
Ver	96480.00	-65.57	22.70	88.68	79.13	88.00	8.87	PK
Ver	96480.00	-77.35	22.70	76.90	67.35	68.00	0.65	AV

Remark:

E (at 1m) = 126.8 – 20log(λ) + P – G

E (at 3m) = E (at 1m) + 20log(1/3)

where (According to ANSI 63.10 section 9.4):

E is the field strength of the emission at the measurement distance, in dBμV/m

P is the power measured at the output of the test antenna, in dBm

λ is the wavelength of the emission under investigation [300/fMHz], in m

G is the gain of the test antenna, in dBi

Margin = Limit – Level

If the PK Corrected Reading is lower than AV limit, the AV test can be elided.

For example:

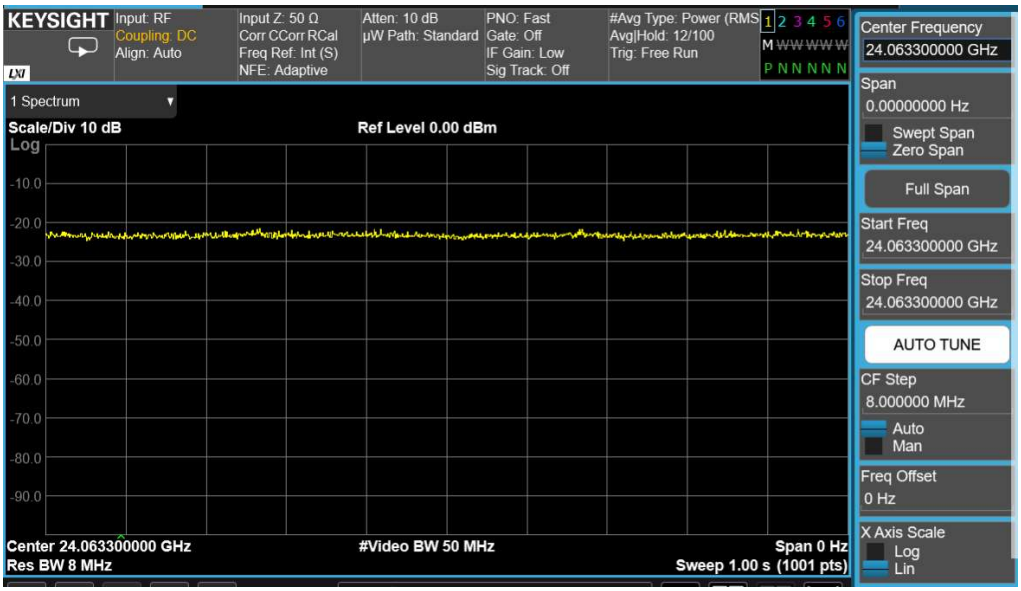
fMHz = 48000MHz, then G = 23.9 dBi, P = -65.20 dBm

then E (at 1m) = 126.8 -20log(300/48000) – 65.20 – 23.9 = 81.78 dBuV/m

E (at 3m) = 81.78 + 20log(1/3) = 72.24 dBuV/m

3.5 Duty Cycle:

The test data with maximum duty cycle was listed below.
The worst Duty cycle= 100%



4 Power line conducted emission

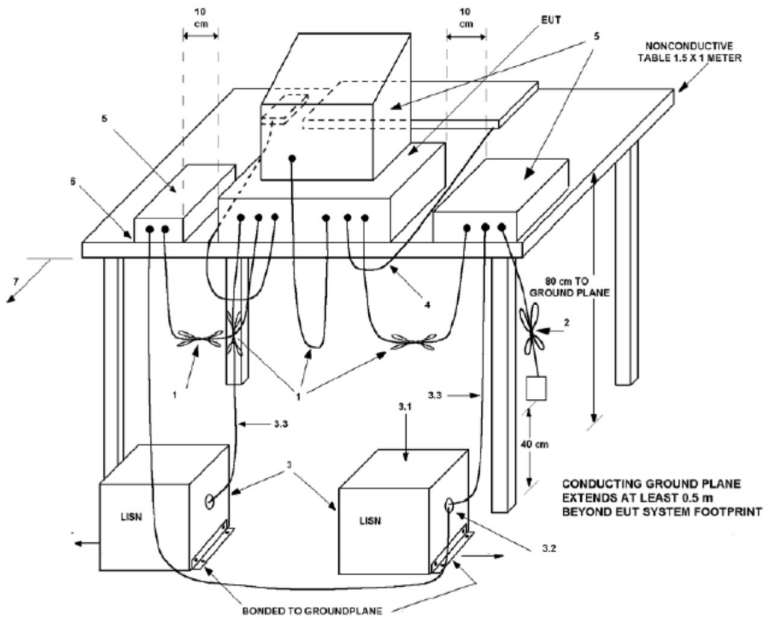
Test result: **Pass**

4.1 Limit

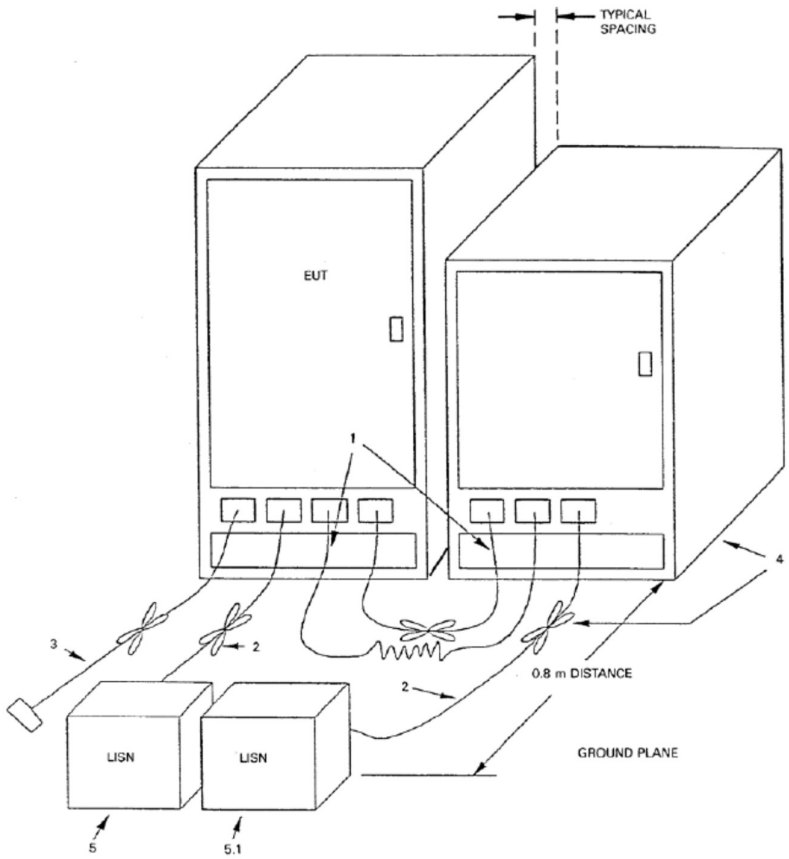
Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	QP	AV
0.15-0.5	66 to 56*	56 to 46 *
0.5-5	56	46
5-30	60	50
* Decreases with the logarithm of the frequency.		

4.2 Test Configuration

☐ For table top equipment



☒ For floor standing equipment



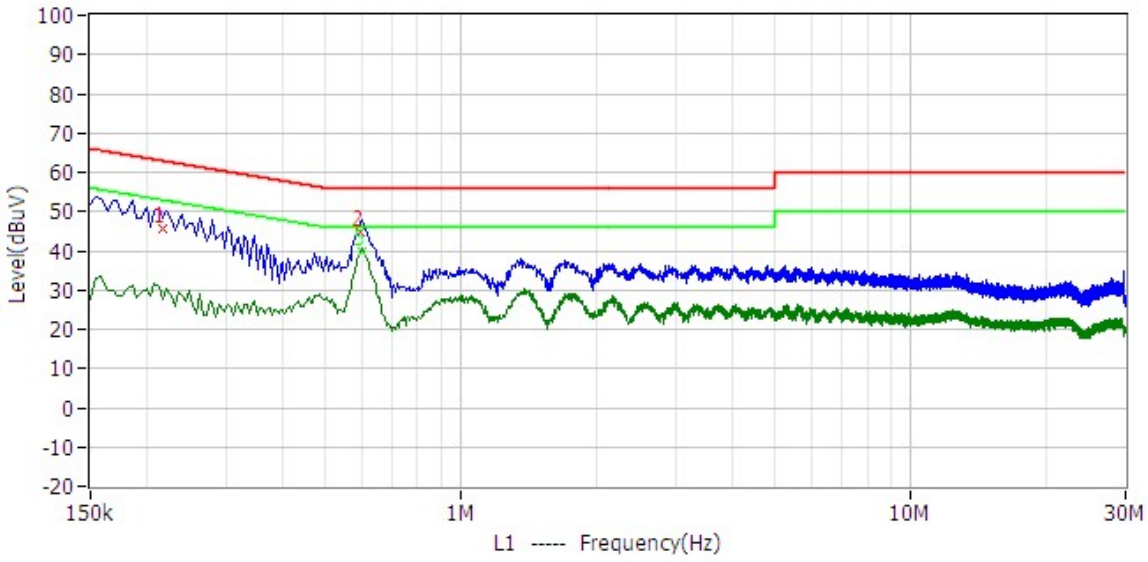
4.3 Measurement Procedure

Measurement was performed in shielded room, and instruments used were following clause 4 and clause 5 of ANSI 63.4.
Detailed test procedure was following clause 7.3 of ANSI 63.4.
EUT arrangement and operation conditions were according to clause 6 and clause 7 of ANSI 63.4.
Frequency range 150kHz – 30MHz was checked and EMI receiver measurement bandwidth was set to 9 kHz.

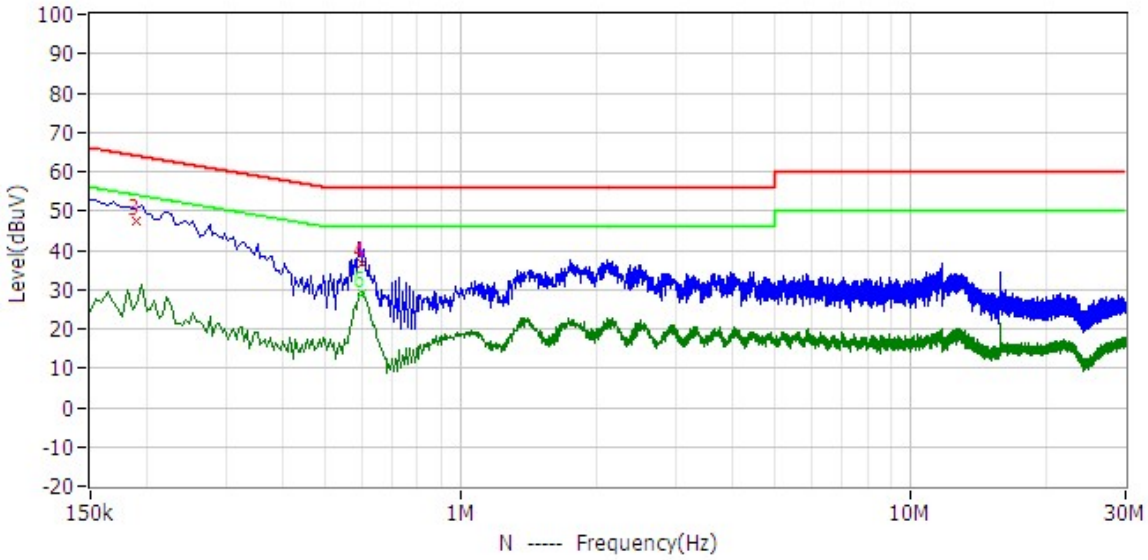
4.4 Test Results of Power line conducted emission

Test Curve:

L line:



N line:



Frequency	Limit dBµV	Level dBµV	Delta dB	Reading dBµV	Factor dB	Detector	Phase
217.500kHz	62.9	45.5	-17.4	35.3	10.2	QP	L1
595.500kHz	56.0	44.5	-11.5	34.3	10.2	QP	L1
190.500kHz	64.0	47.3	-16.7	37.1	10.2	QP	N
600.000kHz	56.0	36.8	-19.2	26.6	10.2	QP	N

TEST REPORT

Frequency	Limit dBµV	Level dBµV	Delta dB	Reading dBµV	Factor dB	Detector	Phase
600.000kHz	46.0	39.7	-6.3	29.5	10.2	CAV	L1
600.000kHz	46.0	28.9	-17.1	18.7	10.2	CAV	N

Remark: 1. Correct Factor = LISN Factor + Cable Loss, the value was added to Original Receiver Reading by the software automatically.
2. Level = Original Receiver Reading + Correct Factor
3. Margin = Limit - Level
4. If the PK Corrected Reading is lower than AV limit, the AV test can be elided.

5 20dB bandwidth & 99% occupied bandwidth

Test result: **Pass**

5.1 Limit

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

The 99% OBW is for reporting purpose only. The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission.

5.2 Measurement Procedure

According to subclause 6.9.2 of ANSI C63.10-2020:

a) The spectrum analyzer center frequency is set to the nominal EUT channel center frequency. The span range for the EMI receiver or spectrum analyzer shall be between two times and five times the OBW.

b) The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW and video bandwidth (VBW) shall be approximately three times RBW, unless otherwise specified by the applicable requirement.

c) Set the reference level of the instrument as required, keeping the signal from exceeding the maximum input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than [10 log (OBW/RBW)] below the reference level. Specific guidance is given in 4.1.5.2.

d) Steps a) through c) might require iteration to adjust within the specified tolerances.

e) The dynamic range of the instrument at the selected RBW shall be more than 10 dB below the target “-xx dB down” requirement; that is, if the requirement calls for measuring the -20 dB OBW, the instrument noise floor at the selected RBW shall be at least 30 dB below the reference value.

f) Set detection mode to peak and trace mode to max hold.

g) Determine the reference value: Set the EUT to transmit an unmodulated carrier or modulated signal, as applicable. Allow the trace to stabilize. Set the spectrum analyzer marker to the highest level of the displayed trace (this is the reference value).

h) Determine the "−xx dB down amplitude" using [(reference value) - xx]. Alternatively, this calculation may be made by using the marker-delta function of the instrument.

i) If the reference value is determined by an unmodulated carrier, then turn the EUT modulation ON, and either clear the existing trace or start a new trace on the spectrum analyzer and allow the new trace to stabilize. Otherwise, the trace from step g) shall be used for step j).

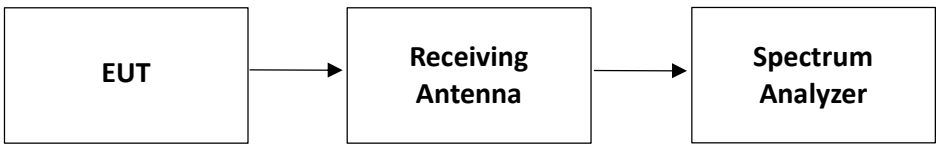
j) Place two markers, one at the lowest frequency and the other at the highest frequency of the envelope of the spectral display, such that each marker is at or slightly below the "-xx dB down amplitude" determined in step h). If a marker is below this "-xx dB down amplitude" value, then it shall be as close as possible to this value. The occupied bandwidth is the frequency difference between the two markers. Alternatively, set a marker at the lowest frequency of the envelope of the spectral display, such that the marker is at or slightly below the "-xx dB down amplitude" determined in step h). Reset the marker-delta function and move the marker to the other side of the emission until the delta marker amplitude is at the same level as the reference marker amplitude. The marker-delta frequency reading at this point is the specified emission bandwidth.

k) The occupied bandwidth shall be reported by providing plot(s) of the measuring instrument display; the plot axes and the scale units per division shall be clearly labelled. Tabular data may be reported in addition to the plot(s).

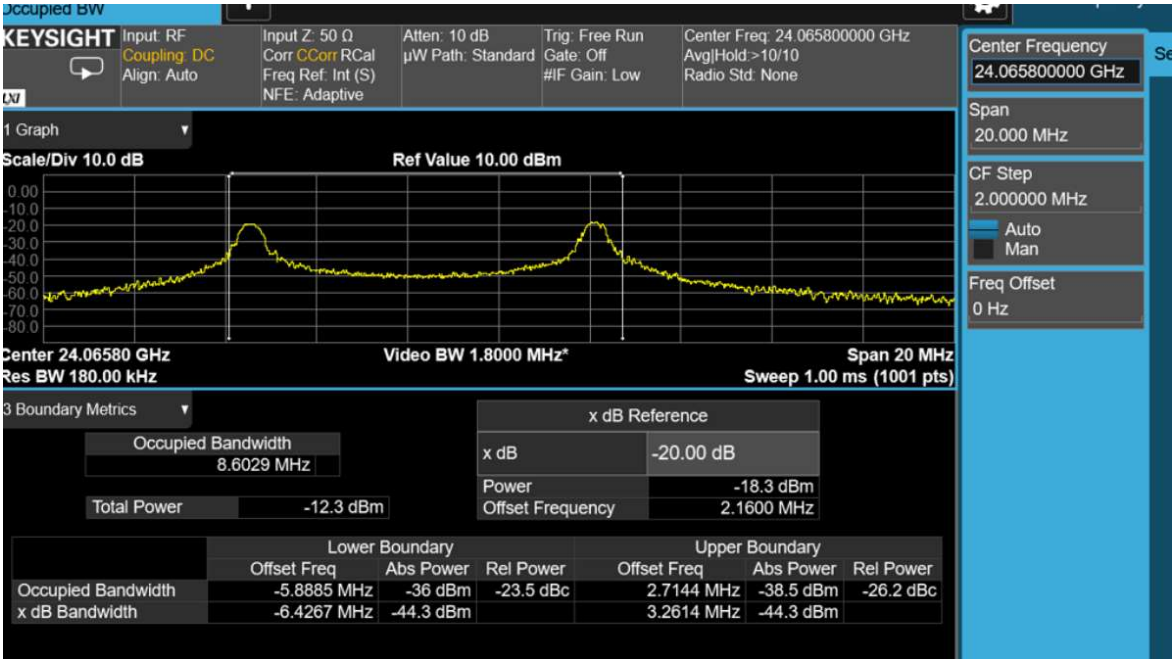
According to subclause 6.9.3 of ANSI C63.10-2020:

1. Set RBW = 1% to 5% of the actual occupied BW.
2. Set the video bandwidth (VBW) ≥ 3 x RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Span = large enough to capture all products of the modulation process
7. Allow the trace to stabilize.
8. Use automatic bandwidth measurement capability on instrument to obtain BW result.

5.3 Test Configuration



5.4 The results



20dB Bandwidth:

Frequency (MHz)	Measured Bandwidth (MHz)	Frequency Lower (MHz)	Frequency Upper (MHz)	Result
24000.00 ~ 24250.00	9.69	24059.37	24069.06	Pass

99% Bandwidth:

Frequency (MHz)	Measured Bandwidth (MHz)	Frequency Lower (MHz)	Frequency Upper (MHz)	Result
24000.00 ~ 24250.00	8.60	24059.91	24068.51	Pass

6 Antenna requirement

Test result: **Pass**

Requirement:

Per § 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.

Result:

Analysis:
- EUT uses Integral PCB patch antenna. No standard RF connector is used.

Conclusion:
- EUT complies with antenna requirement in § 15.203.

********** END **********