

Dreame Trading (Tianjin) Co., Ltd.

RF TEST REPORT

Report Type:

FCC Part 15.249 & ISED RSS-210 RF report

Model:

RLS5C

REPORT NUMBER:

210702541SHA-001

ISSUE DATE:

Aug 27, 2021

DOCUMENT CONTROL NUMBER:

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Applicant: Dreame Trading (Tianjin) Co., Ltd.
Room 2112-1-1, South District, Finance and trade Center, 6975
Yazhou Road, Dongjiang Bonded Port Area, Tianjin Pilot Free Trade
Zone, 300463 Tianjin, China

Manufacturer: Dreame Trading (Tianjin) Co., Ltd.
Room 2112-1-1, South District, Finance and trade Center, 6975
Yazhou Road, Dongjiang Bonded Port Area, Tianjin Pilot Free Trade
Zone, 300463 Tianjin, China

FCC ID: 2AXGD-RLS5C

IC: 26444-RLS5C

SUMMARY:

The equipment complies with the requirements according to the following standard(s) or Specification:
47CFR Part 15 (2019): Radio Frequency Devices (Subpart C)
ANSI C63.10 (2013): American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
RSS-210 Issue 10 (December 2019): Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment
RSS-Gen Issue 5 (April 2018)+A1(March 2019): General Requirements for Compliance of Radio Apparatus

PREPARED BY:

REVIEWED BY:



Project Engineer

Teddy Yin

Reviewer

Daniel Zhao

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TEST REPORT

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Revision History

Report No.	Version	Description	Issued Date
210702541SHA-001	Rev. 01	Initial issue of report	Aug 27, 2021

Measurement result summary

TEST ITEM	FCC REFERANCE	IC REFERANCE	RESULT
Radiated emission	15.249 & 15.209	RSS-210 Issue 10 Clause B.10	Pass
Power line conducted emission	15.207	RSS-Gen Issue 5 Clause 8.8	Pass
Assigned bandwidth (20dB bandwidth)	15.215(c)	RSS-Gen Issue 5 Clause 6.7	Pass
Antenna requirement	15.203	-	Pass

Notes: 1: NA =Not Applicable

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

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

1 GENERAL INFORMATION

1.1 Description of Equipment Under Test (EUT)

Product name:	Robotic Vacuum Cleaner
Type/Model/PMN/HVIN:	RLS5C
Description of EUT:	The EUT is a Robotic Vacuum Cleaner that contains a transceiver of 915MHz.
Rating:	DC 14.4V
Category of EUT:	Class B
EUT type:	<input type="checkbox"/> Table top <input checked="" type="checkbox"/> Floor standing
Software Version:	V1.0
Hardware Version:	V1.0
Sample Identification No.:	0210801-12-004
Sample received date:	Aug 1, 2021
Date of test:	Aug 1~20, 2021

1.2 Technical Specification

Frequency Range:	915MHz
Support Standards:	/
Type of Modulation:	FSK
Channel Number:	1
Data Rate:	/
Channel Separation:	/
Antenna Information:	Internal antenna, 0dBi(Declared by manufacturer)

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.: CN0051
	VCCI Registration Lab 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 (2019)
 ANSI C63.10 (2013)
 RSS-210 Issue 10 (December 2019)
 RSS-Gen Issue 5 (April 2018)+A1(March 2019)

2.2 Mode of operation during the test

The lowest, middle and highest channel were tested as representatives.

Frequency Band (MHz)				915			
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	915	/	/	/	/	/	/

While testing transmitting mode of EUT, the internal modulation and continuously transmission was applied.

- 1) Radiated test mode: EUT transmitted signal with internal antenna;

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
1	Self-Wash Base	RCS3	Input:100-240V~, 50-60Hz, 1.5A Output: DC 20V, 1A
/	/	/	/
/	/	/	/

2.5 Test environment condition:

Test items	Temperature	Humidity
Radiated emission	25°C	55% RH
Assigned bandwidth (20dB bandwidth)	25°C	55% RH
Power line conducted emission	25°C	55% RH

2.6 Instrument list

Conducted Emission					
Used	Equipment	Manufacturer	Type	Internal no.	Due date
<input checked="" type="checkbox"/>	Test Receiver	R&S	ESCS 30	EC 2107	2022-07-15
<input checked="" type="checkbox"/>	A.M.N.	R&S	ESH2-Z5	EC 3119	2021-11-30
<input checked="" type="checkbox"/>	Shielded room	Zhongyu	-	EC 2838	2022-01-07
Radiated Emission					
Used	Equipment	Manufacturer	Type	Internal no.	Due date
<input checked="" type="checkbox"/>	Test Receiver	R&S	ESIB 26	EC 3045	2021-09-16
<input checked="" type="checkbox"/>	Bilog Antenna	TESEQ	CBL 6112D	EC 4206	2021-09-24
<input checked="" type="checkbox"/>	Pre-amplifier	R&S	AFS42-00101800-25-S-42	EC5262	2022-06-11
<input checked="" type="checkbox"/>	Horn antenna	ETS	3117	EC 4792-1	2022-01-17
<input checked="" type="checkbox"/>	Semi-anechoic chamber	Albatross	-	EC 3048	2022-07-31
RF test					
Used	Equipment	Manufacturer	Type	Internal no.	Due date
<input checked="" type="checkbox"/>	PXA Signal Analyzer	Keysight	N9030A	EC 5338	2022-03-16
<input checked="" type="checkbox"/>	Coaxial cable	ETS	/	/	2022-03-16
Additional instrument					
Used	Equipment	Manufacturer	Type	Internal no.	Due date
<input checked="" type="checkbox"/>	Therom-Hygrograph	ZJ1-2A	S.M.I.F.	EC 5198	2022-01-05
<input checked="" type="checkbox"/>	Therom-Hygrograph	ZJ1-2A	S.M.I.F.	EC 3481	2022-01-05
<input checked="" type="checkbox"/>	Therom-Hygrograph	ZJ1-2A	S.M.I.F.	EC 3442	2022-01-05

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
Occupied Channel Bandwidth	± 0.88 %
Power line conducted emission	± 3.19dB

3 Radiated emission

Test result: Pass

3.1 Limit

Fundamental Frequency (MHz)	Fundamental limit (dBuV/m)	Harmonic limit (dBuV/m)
<input checked="" type="checkbox"/> 902 - 928	94	54
<input type="checkbox"/> 2400 - 2483.5	94	54
<input type="checkbox"/> 5725 - 5875	94	54
<input type="checkbox"/> 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:

- The EUT was placed on the top of a rotating table 0.8 meters(0.1 meters for floor-standing device) above the ground at a 3 meter chamber room. The table was rotated 360 degrees to determine the position of the highest radiation.
- The EUT was set 3 meters away from the interference-receiving antenna, the lowest height of the magnetic antenna was 1 m above the ground.
- Both X and Y axes of the antenna are set to make the measurement.
- 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.
- The test-receiver system was set to Quasi-Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

NOTE:

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

TEST REPORT**For Radiated emission above 30MHz:**

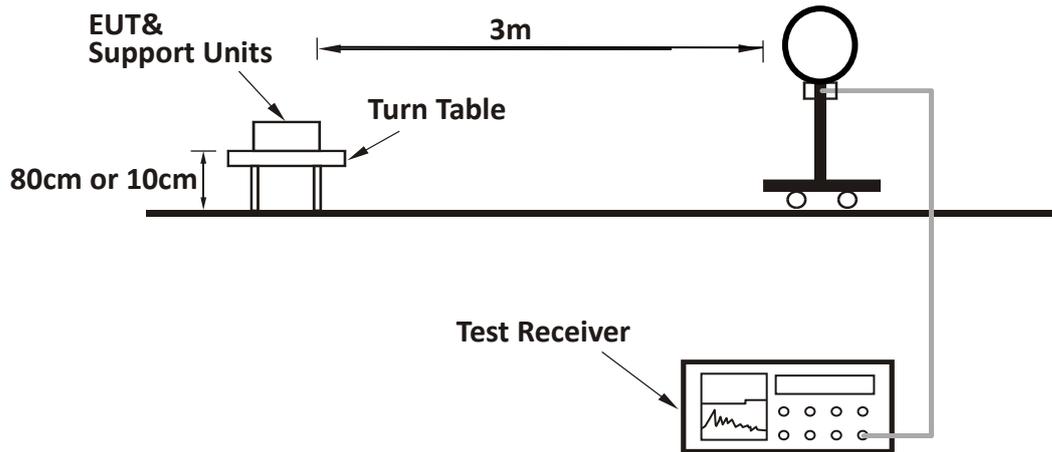
- a) The EUT was placed on the top of a rotating table 0.8 meters (for 30MHz ~ 1GHz) / 1.5 meters (for above 1GHz) or 0.1 meters (for floor-standing device) above the ground at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
- b) The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c) 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.
- d) 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.
- e) 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.
- f) 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:

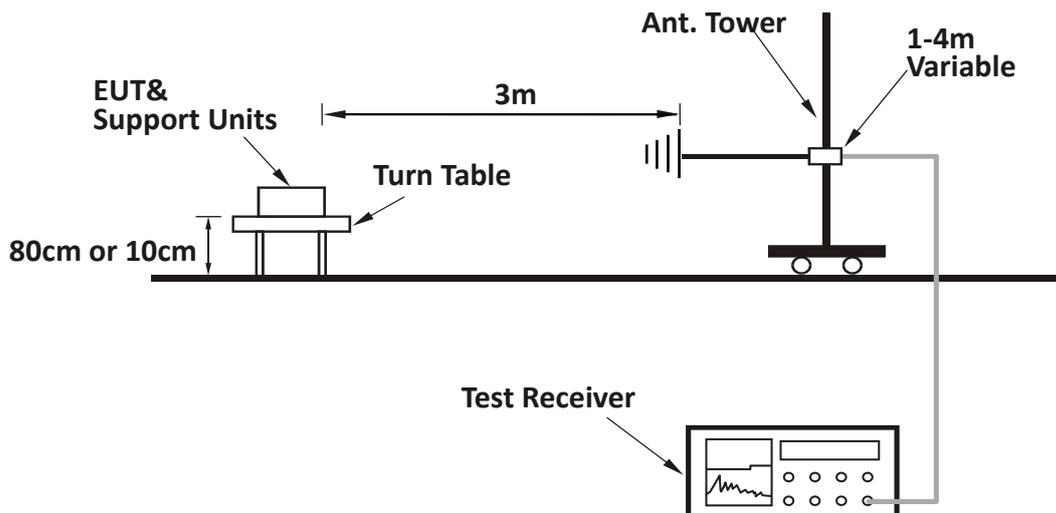
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is $\geq 1/T$ (Duty cycle < 98%) or 3 x RBW (Duty cycle \geq 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

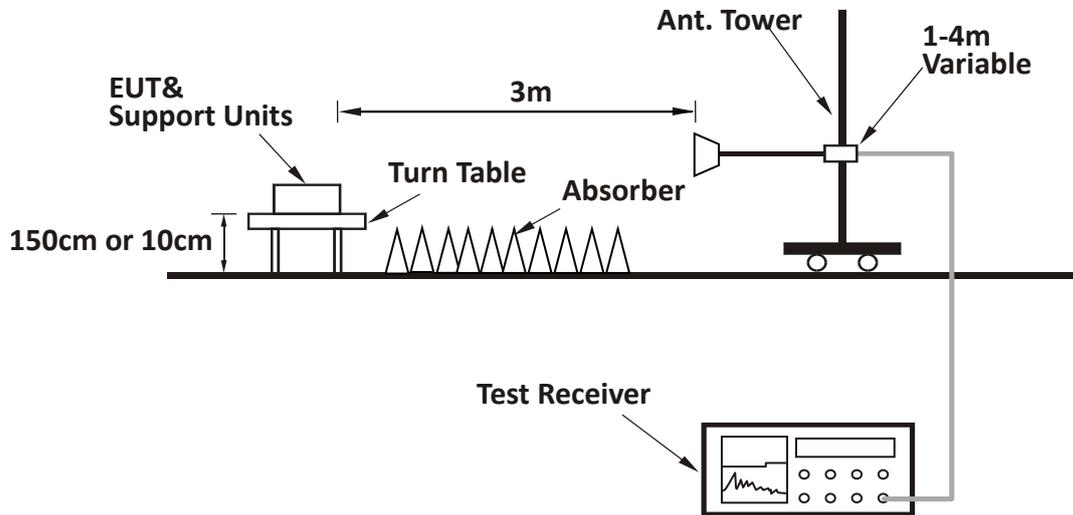
For Radiated emission below 30MHz:



For Radiated emission 30MHz to 1GHz:



For Radiated emission above 1GHz:

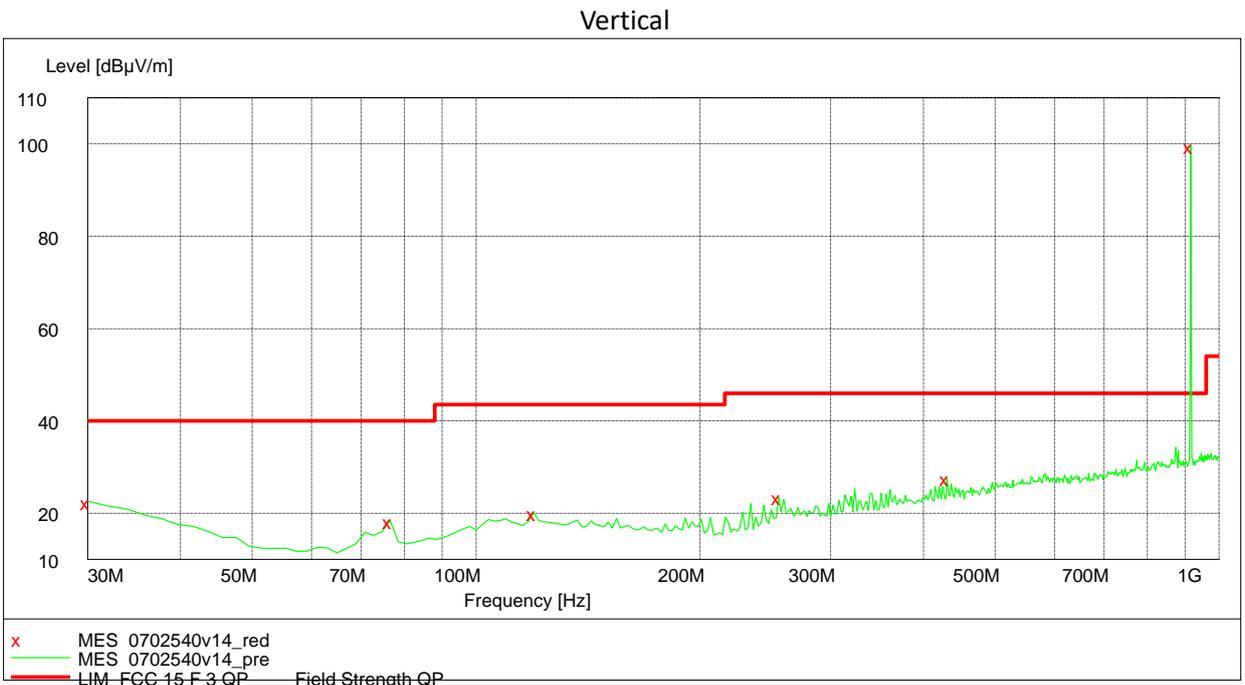
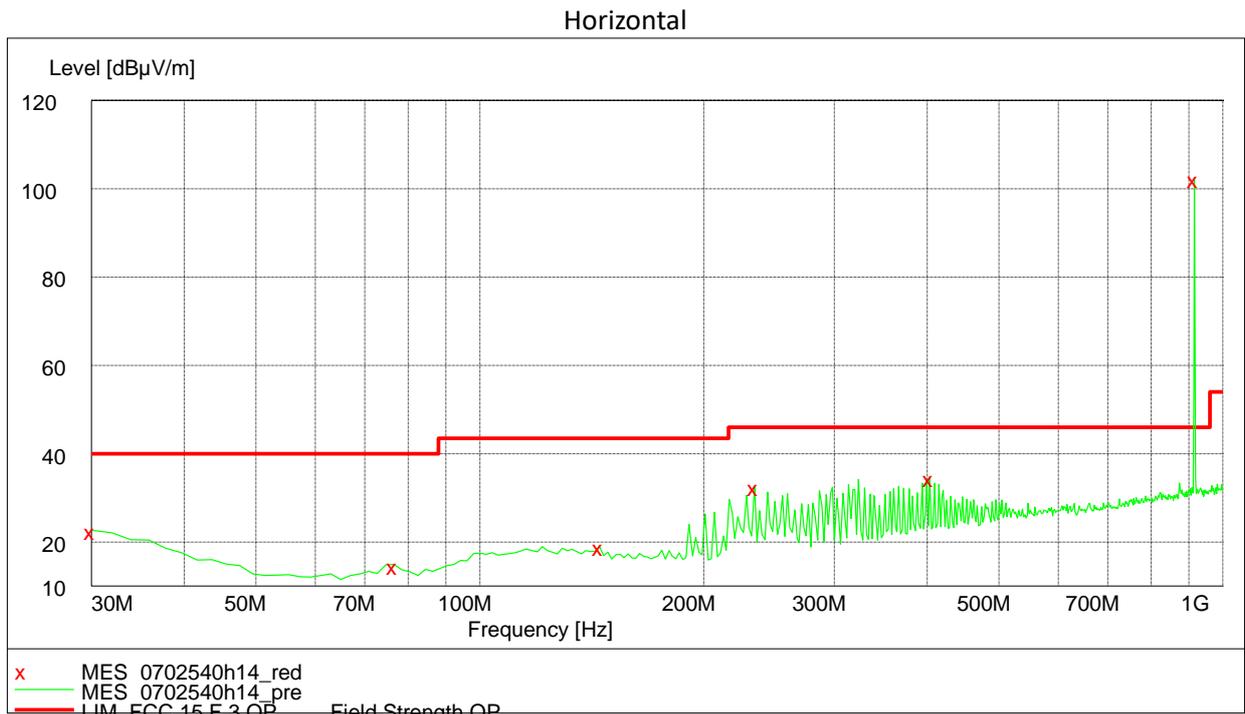


TEST REPORT

3.4 Test Results of Radiated Emissions

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:



TEST REPORT

Test data

Antenna	Frequency (MHz)	Corrected Reading (dBuV/m)	Correct Factor (dB/m)	Limit (dBuV/m)	Margin (dB)	Detector
H	30.00	22.60	18.80	40.00	17.40	PK
H	76.65	14.80	7.70	40.00	25.20	PK
H	144.69	19.00	12.20	43.50	24.50	PK
H	234.11	32.70	12.40	46.00	13.30	PK
H	403.23	34.70	17.80	46.00	11.30	PK
H	915.00	102.40	23.90	114.00	11.60	PK
H	1817.64	44.10	-8.50	74.00	29.90	PK
H	3657.31	56.40	-0.60	74.00	17.60	PK
H	4577.15	49.90	1.30	74.00	24.10	PK
V	30.00	22.50	18.80	40.00	17.50	PK
V	76.65	18.50	7.70	40.00	21.50	PK
V	119.42	20.10	13.30	43.50	23.40	PK
V	255.49	23.40	14.90	46.00	22.60	PK
V	430.44	27.60	18.40	46.00	18.40	PK
V	915.00	99.60	23.90	114.00	14.40	PK
V	1817.64	52.60	-8.50	74.00	21.40	PK
V	3657.31	52.40	-0.60	74.00	21.60	PK
V	4577.15	54.60	1.30	74.00	19.40	PK

- 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.

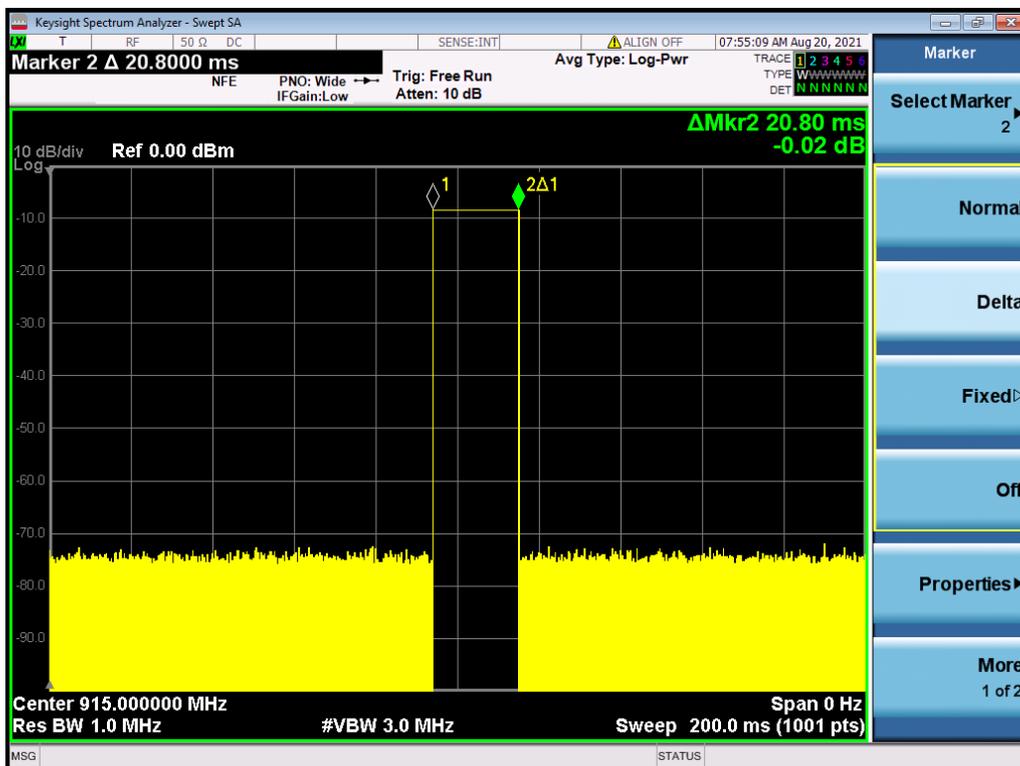
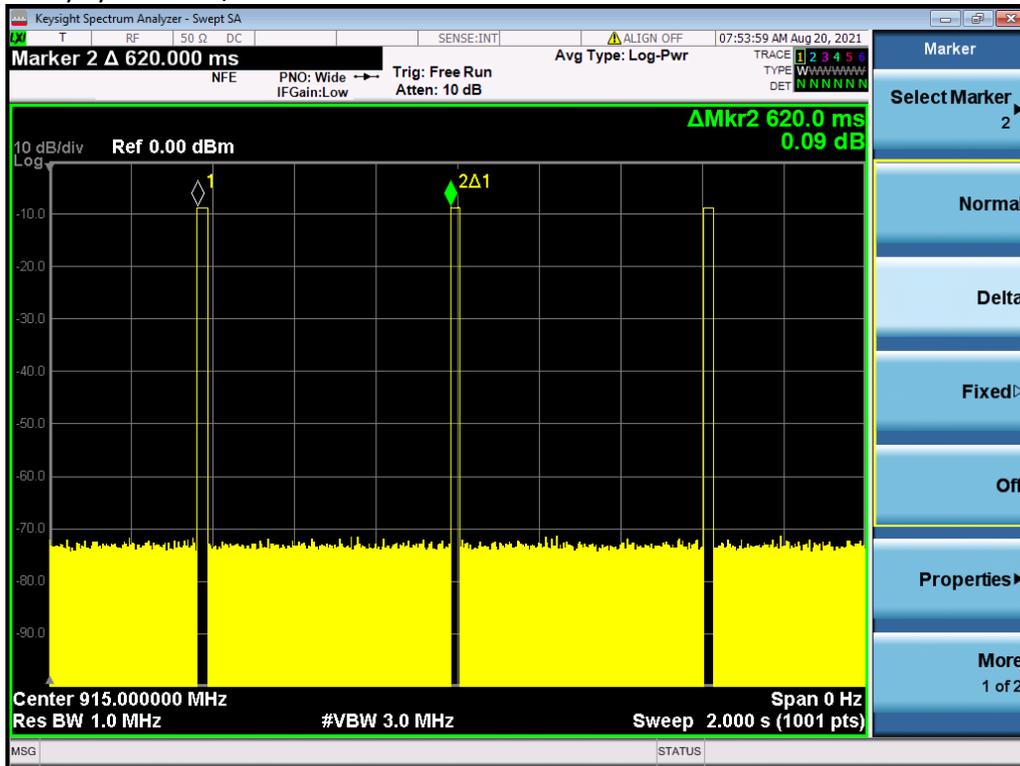
Example: Assuming Antenna Factor = 30.20dB/m, Cable Loss = 2.00dB,
 Gain of Pre-amplifier = 32.00dB, Original Receiver Reading = 10.00dBuV,
 Limit = 40.00dBuV/m.
 Then Correct Factor = 30.20 + 2.00 – 32.00 = 0.20dB/m;
 Corrected Reading = 10dBuV + 0.20dB/m = 10.20dBuV/m;
 Margin = 40.00dBuV/m - 10.20dBuV/m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

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Duty Cycle:

The test data with maximum duty cycle was listed below.

The worst Duty cycle = $20.8 / 620 = 0.034$



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Calculating the AV value according to the duty cycle

Antenna	Frequency (MHz)	PK Reading (dBuV/m)	Correct Factor (dB)	AV Reading (dBuV/m)	Limit (dBuV/m)	Margin (dB)
H	915.00	102.40	-29.37	73.03	94.00	20.97
H	1817.64	44.10		14.73	54.00	39.27
H	3657.31	56.40		27.03	54.00	26.97
H	4577.15	49.90		20.53	54.00	33.47
V	915.00	99.60		70.23	94.00	23.77
V	1817.64	52.60		23.23	54.00	30.77
V	3657.31	52.40		23.03	54.00	30.97
V	4577.15	54.60		25.23	54.00	28.77

Remark:

1. Correct Factor = $20\lg(\text{duty cycle}) = 20\lg(0.034) = -29.37$;
2. AV Reading = PK Reading + Correct Factor;
3. Margin = limit - AV Reading.

4 Power line conducted emission

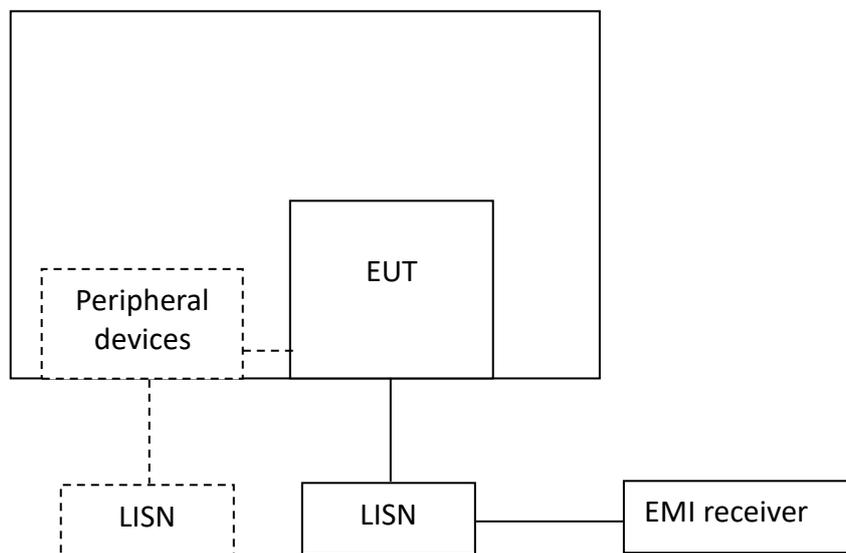
Test result: Pass

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



TEST REPORT**4.3 Measurement Procedure**

Measured levels of ac power-line conducted emission shall be the emission voltages from the voltage probe, where permitted, or across the 50 Ω LISN port (to which the EUT is connected), where permitted, terminated into a 50 Ω measuring instrument. All emission voltage and current measurements shall be made on each current-carrying conductor at the plug end of the EUT power cord by the use of mating plugs and receptacles on the LISN, if used. Equipment shall be tested with power cords that are normally supplied or recommended by the manufacturer and that have electrical and shielding characteristics that are the same as those cords normally supplied or recommended by the manufacturer. For those measurements using a LISN, the 50 Ω measuring port is terminated by a measuring instrument having 50 Ω input impedance. All other ports are terminated in 50 Ω loads.

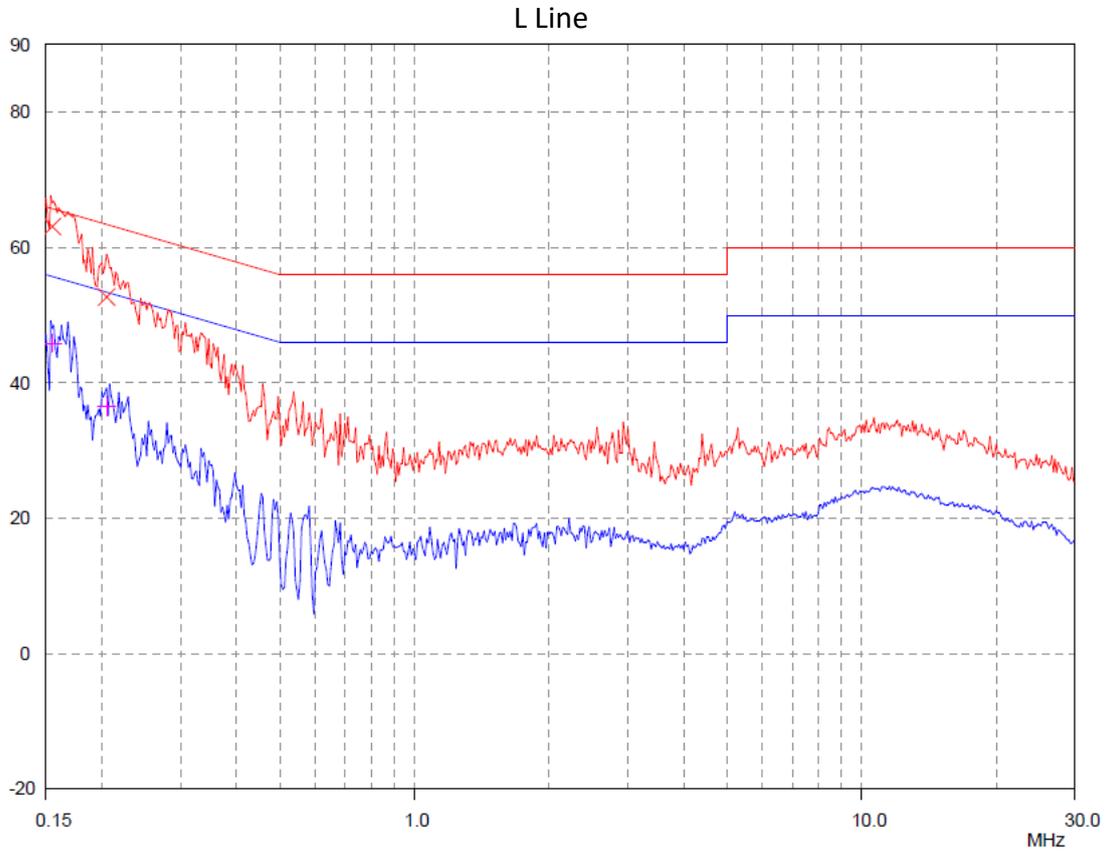
Tabletop devices shall be placed on a platform of nominal size 1 m by 1.5 m, raised 80 cm above the reference ground plane. The vertical conducting plane or wall of an RF-shielded (screened) room shall be located 40 cm to the rear of the EUT. Floor-standing devices shall be placed either directly on the reference ground-plane or on insulating material as described in ANSI C63.4. All other surfaces of tabletop or floor-standing EUTs shall be at least 80 cm from any other grounded conducting surface, including the case or cases of one or more LISNs.

The bandwidth of the test receiver is set at 9 kHz.

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4.4 Test Results of Power line conducted emission

Test Curve:



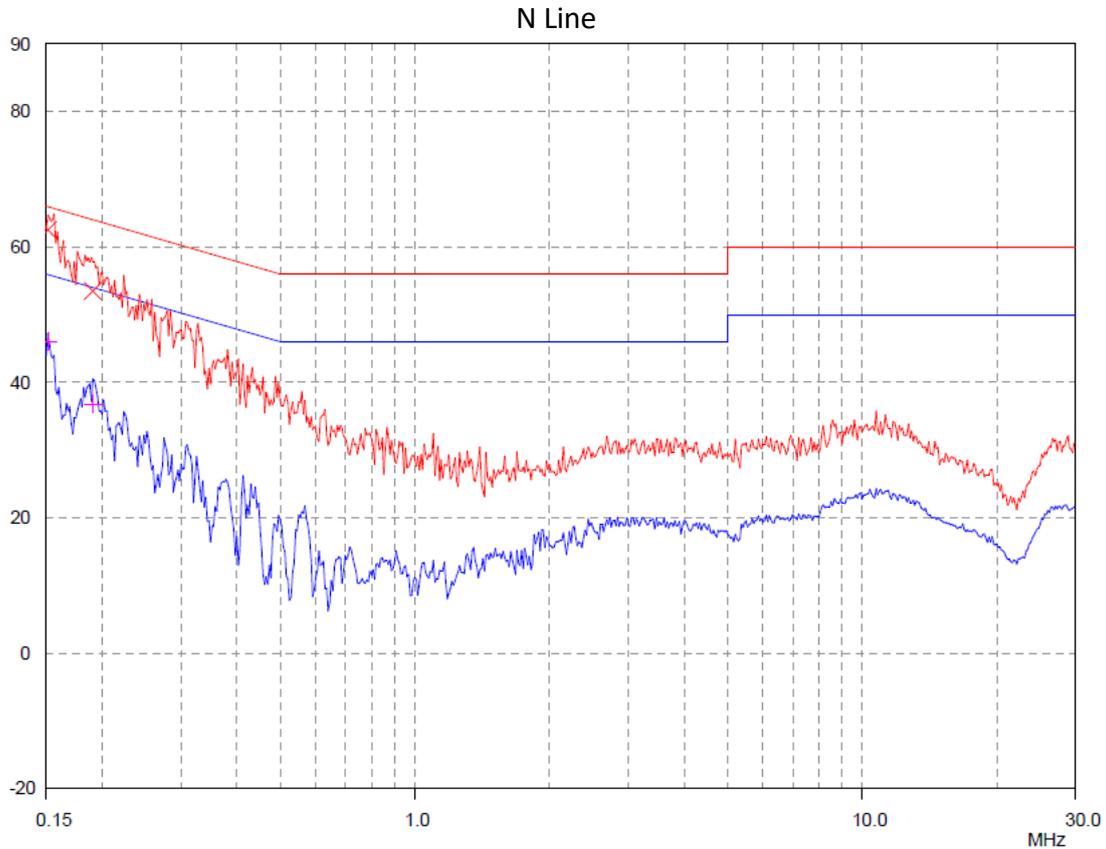
Test Data:

Frequency (MHz)	Quasi-peak			Average		
	level dB(μV)	Limit dB(μV)	Margin (dB)	level dB(μV)	limit dB(μV)	Margin (dB)
0.15	63.10	65.74	2.64	45.87	55.74	9.87
0.20	*	63.42	*	*	53.42	*
0.51	*	56.00	*	*	46.00	*
4.29	*	56.00	*	*	46.00	*
10.45	*	60.00	*	*	50.00	*
19.40	*	60.00	*	*	50.00	*

Note: *means margin is more than 10dB.

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Test Curve:



Test Data:

Frequency (MHz)	Quasi-peak			Average		
	level dB(μV)	Limit dB(μV)	Margin (dB)	level dB(μV)	limit dB(μV)	Margin (dB)
0.15	62.50	65.93	3.43	46.06	55.93	9.87
0.19	*	64.01	*	*	54.01	*
0.51	*	56.00	*	*	46.00	*
4.29	*	56.00	*	*	46.00	*
10.45	*	60.00	*	*	50.00	*
19.40	*	60.00	*	*	50.00	*

Note: *means margin is more than 10dB.

Remark: 1. Correct Factor = LISN Factor + Cable Loss, 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.

5 Assigned bandwidth (20dB bandwidth)

Test result: Pass

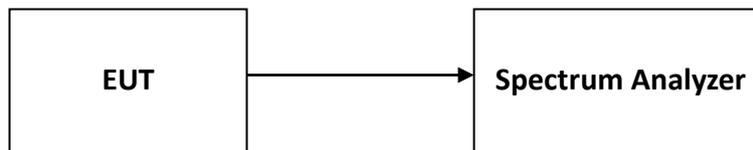
5.1 Limit

Intentional radiators must be designed to ensure that the 20 dB bandwidth of the emission is contained within the allocated frequency band.

5.2 Measurement Procedure

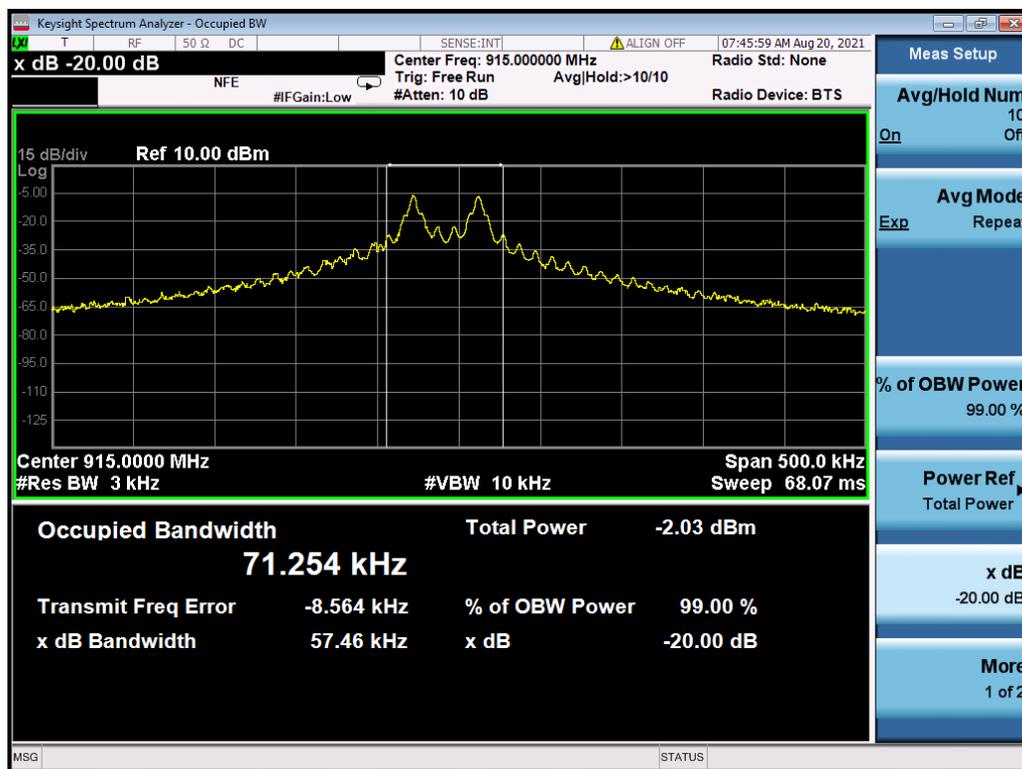
The 20dB Bandwidth is measured using the Spectrum Analyzer.
Set Span = 2 to 3 times the 20 dB bandwidth, RBW = approximately 1% of the 20 dB bandwidth, VBW>RBW, Sweep = auto, Detector = peak, Trace = max hold.
The test was performed at 2 channels (lowest and highest channel).

5.3 Test Configuration



5.4 The results

Test Mode	Frequency (MHz)	20dB Bandwidth (kHz)	99% Bandwidth (kHz)	F _L at 20dB BW (MHz)	F _H at 20dB BW (MHz)
transmit	915.0	57.46	71.25	>902	<928
Limit		N/A	N/A	F _L >902	F _H <928
Result		Complied			



6 Antenna requirement

Requirement:

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.

Result:

EUT uses permanently attached antenna to the intentional radiator, so it can comply with the provisions of this section.

***** END *****