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NINGBO SHARKWARD ELECTRONICS CO.,LTD.

RF TEST REPORT

Report Type:
FCC Part 15.249 RF report

Model:
ANT-5-Z10-BLE-SR, ANT-5-4R-BLE-SR,
ANT-5-4T-BLE-SR, ANT-5-ZT-BLE-SR ANT-5-4H-BLE-SR
(all may be followed by -; may be followed WH or BK or BN)

REPORT NUMBER:
230401253SHA-002

ISSUE DATE:
July 11, 2023

DOCUMENT CONTROL NUMBER:
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TEST REPORT

Report no.: 230401253SHA-002

Applicant:	NINGBO SHARKWARD ELECTRONICS CO.,LTD. #88 GONGMAO ROAD NO.3,JISHIGANG INDUSTRIAL ZONE,HAISHU DISTRICT,NINGBO 315171,CHINA
Manufacturer:	NINGBO SHARKWARD ELECTRONICS CO.,LTD. #88 GONGMAO ROAD NO.3,JISHIGANG INDUSTRIAL ZONE,HAISHU DISTRICT,NINGBO 315171,CHINA
Manufacturing site:	NINGBO SHARKWARD ELECTRONICS CO.,LTD. #88 GONGMAO ROAD NO.3,JISHIGANG INDUSTRIAL ZONE,HAISHU DISTRICT,NINGBO 315171,CHINA
FCC ID:	2AVMOANT-5-X-BLE

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:**
Project Engineer Erick Liu	Reviewer Wakeyou Wang

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TEST REPORT

Content

TEST REPORT

Revision History

Report No.	Version	Description	Issued Date
230401253SHA-002	Rev. 01	Initial issue of report	July 11, 2023

Measurement result summary

TEST ITEM	FCC REFERANCE	RESULT
Radiated emission	15.249 & 15.209	Pass
Power line conducted emission	15.207	Pass
Assigned bandwidth (20dB bandwidth)	15.215(c)	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.

TEST REPORT

1 GENERAL INFORMATION

1.1 Description of Equipment Under Test (EUT)

Product name:	Microwave sensor
Type/Model:	ANT-5-Z10-BLE-SR, ANT-5-4R-BLE-SR, ANT-5-4T-BLE-SR, ANT-5-ZT-BLE-SR, ANT-5-4H-BLE-SR(all may be followed by -; may be followed WH or BK or BN)
Description of EUT:	EUT is a microwave sensor that dims lighting from high to low based on movement. It's a transceiver with BLE and HF system 5.8GHz. All the models have same ratings and PCB design, just difference is the sensing method and connectors. all model names may be followed by -; may be followed WH or BK or BN. ANT-5-4R-BLE-SR: means the product with three pins can be used with connector ANT-5-4S, ANT-5-4H-BLE-SR: means the product with three pins can be used with connector ANT-5-4S and the three pins is 4mm Longer than ANT-5-4R-BLE-SR, ANT-5-4T-BLE-SR: means the product with single pin can be used with connector ANT-5-14B, ANT-5-Z10-BLE-SR: means the product with four pins can be used with connector 2343403-1, ANT-5-ZT-BLE-SR: means the product can be used with connectors 2343403-1 & JL-700. After evaluation, we choose ANT-5-Z10-BLE-SR for all tests.
Rating:	Input: 12-24V DC Output: 0-10V DC
Category of EUT:	Class B
EUT type:	☒ Table top ☐ Floor standing
Software Version:	/
Hardware Version:	/
Sample received date:	2023.06.15
Date of test:	2023.06.16 ~ 2023.7.13

1.2 Technical Specification

Frequency Range:	5725MHz – 5875MHz
Channel Frequency:	5776.9MHz
Modulation:	FSK
Channel Number:	1
Support Standards:	SRD

1.3 Antenna information

Antenna No.	Model	Antenna type	Antenna Gain	Note
1	-	microstrip antenna	3.4 dBi	-

1.4 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 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

Within this test report, EUT was tested under all available operation modes and tested under its rating voltage and frequency. Other voltage and frequency is specified if used.

2.3 Test software list

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

2.4 Test peripherals list

Item No.	Name	Band and Model	Description
1	DC Regulated Power Supply	QJE/QJ3003H	0~30V/0~3A

2.5 Test environment condition:

Test items	Temperature	Humidity
Radiated emission	21°C	53%
Assigned bandwidth (20dB bandwidth)	21°C	53%
Power line conducted emission	22°C	55%

2.6 Instrument list

Conducted Emission/Disturbance Power/Tri-loop Test/CDN method					
Used	Equipment	Manufacturer	Type	Internal no.	Due date
☒	Test Receiver	R&S	ESCS 30	EC 2107	2024-07-13
☒	A.M.N.	R&S	ESH2-Z5	EC 3119	2023-12-07
☐	A.M.N.	R&S	ENV 216	EC 3393	2024-07-03
☐	A.M.N.	R&S	ENV4200	EC 3558	2024-06-09
☐	Absorbing clamp	R&S	MDS 21	EC 2108	2024-06-18
☐	CDN	Frankonia	CDN M2M316	EC 5969	2024-03-15
☐	CDN	Schaffner	CDN M316	EC 2113-1	2024-07-15
☒	Attenuator	Weinschel	68-6-44	EC 3043-9	2024-02-05
☐	Tri-loop	Schwarzbeck	HXYZ 9170	EC 3384	2023-10-10
☐	Voltage Probe	Schwarzbeck	TK9420	EC 4888	2023-09-10
☐	Current probe	R&S	EZ-17	EC 3221	2024-03-15
☐	I.S.N.	FCC	FCC-TLISN -T2-02	EC 3754	2024-02-05
☐	I.S.N.	FCC	FCC-TLISN -T4-02	EC 3755	2024-02-05
☐	I.S.N.	FCC	FCC-TLISN -T8-02	EC 3756	2024-02-05
Radiated Emission					
Used	Equipment	Manufacturer	Type	Internal no.	Due date
☒	Test Receiver	R&S	ESIB 26	EC 3045	2023-09-11
☒	Bilog Antenna	TESEQ	CBL 6112D	EC 4206	2024-06-09
☒	Pre-amplifier	R&S	AFS42-00101800-25-S-42	EC5262	2024-06-09
☐	Horn antenna	R&S	HF 906	EC 3049	2023-11-16
☒	Horn antenna	ETS	3117	EC 4792-1	2024-01-09
☐	Horn antenna	TOYO	HAP18-26W	EC 4792-3	2024-07-08
☒	Active loop antenna	Schwarzbeck	FMZB1519	EC 5345	2024-03-07
☒	Horn antenna	ETS	3116c	EC 5955	2024-06-11
RF test					
Used	Equipment	Manufacturer	Type	Internal no.	Due date
☒	PXA Signal Analyzer	Keysight	N9030A	EC 5338	2024-03-05

☐	Power sensor	Agilent	U2021XA	EC 5338-1	2024-03-05
☐	MXG Analog Signal Generator	Agilent	N5181A	EC 5338-2	2024-03-05
☐	Vector Signal Generator	Agilent	N5182B	EC 5175	2024-03-05
☐	Power meter	Keysight	N1911A	EC 4318	2024-05-11
☐	Wideband Radio Communication Tester	R&S	CMW500	EC 5944	2023-12-07
☐	Mobile Test System	LitePoint	IQxel	EC 5176	2024-01-09
☐	Test Receiver	R&S	ESCI 7	EC 4501	2023-09-11
☐	Spectrum analyzer	Agilent	E7402A	EC 2254	2023-09-11
Tet Site					
Used	Equipment	Manufacturer	Type	Internal no.	Due date
☒	Shielded room	Zhongyu	-	EC 2838	2024-01-07
☐	Shielded room	Zhongyu	-	EC 2839	2024-01-14
☒	Semi-anechoic chamber	Albatross project	-	EC 3048	2023-07-30
☐	Fully-anechoic chamber	Albatross project	-	EC 3047	2023-07-30
Additional instrument					
Used	Equipment	Manufacturer	Type	Internal no.	Due date
☐	Spectrum analyzer	Agilent	E7402A	EC 2254	2024-07-14
☒	Therom-Hygrograph	ZJ1-2A	S.M.I.F.	EC 3783	2024-02-28
☐	Therom-Hygrograph	ZJ1-2A	S.M.I.F.	EC 2122	2024-03-11
☒	Therom-Hygrograph	ZJ1-2A	S.M.I.F.	EC 5198	2024-01-18
☐	Therom-Hygrograph	ZJ1-2A	S.M.I.F.	EC 3326	2024-03-28
☐	Pressure meter	YM3	Shanghai Mengde	EC 3320	2024-07-01

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 Radiated emission

Test result: **Pass**

3.1 Limit

Fundamental Frequency (MHz)	Fundamental limit (dBuV/m)	Harmonic limit (dBuV/m)
☐ 902 - 928	94	54
☐ 2400 - 2483.5	114	74
☒ 5725 - 5875	114	74
☐ 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 0.8 meters above the ground at a 3 meter 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.

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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) 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.

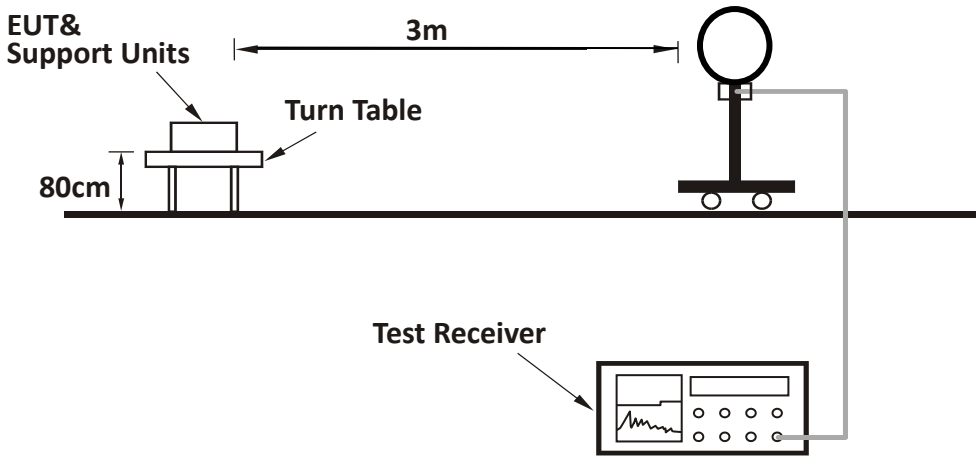
f) The test-receiver system was set to peak and average detect function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz. If the peak reading value also meets average limit, measurement with the average detector is unnecessary.

Note:

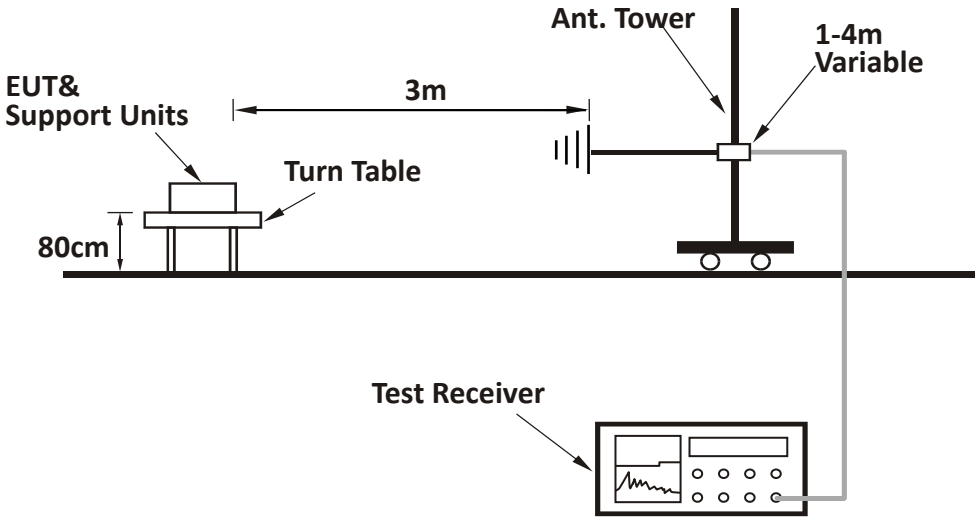
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is ≥ 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:

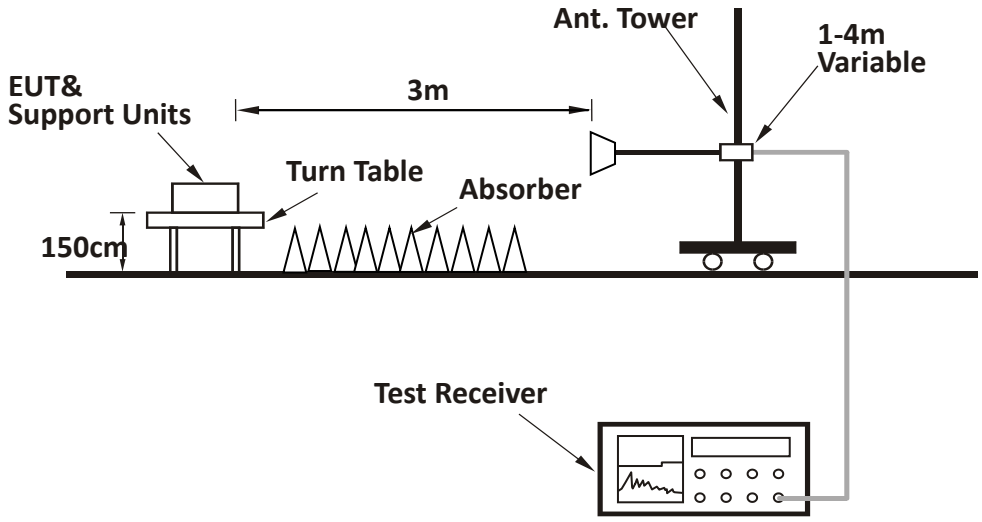


For Radiated emission 30MHz to 1GHz:



TEST REPORT

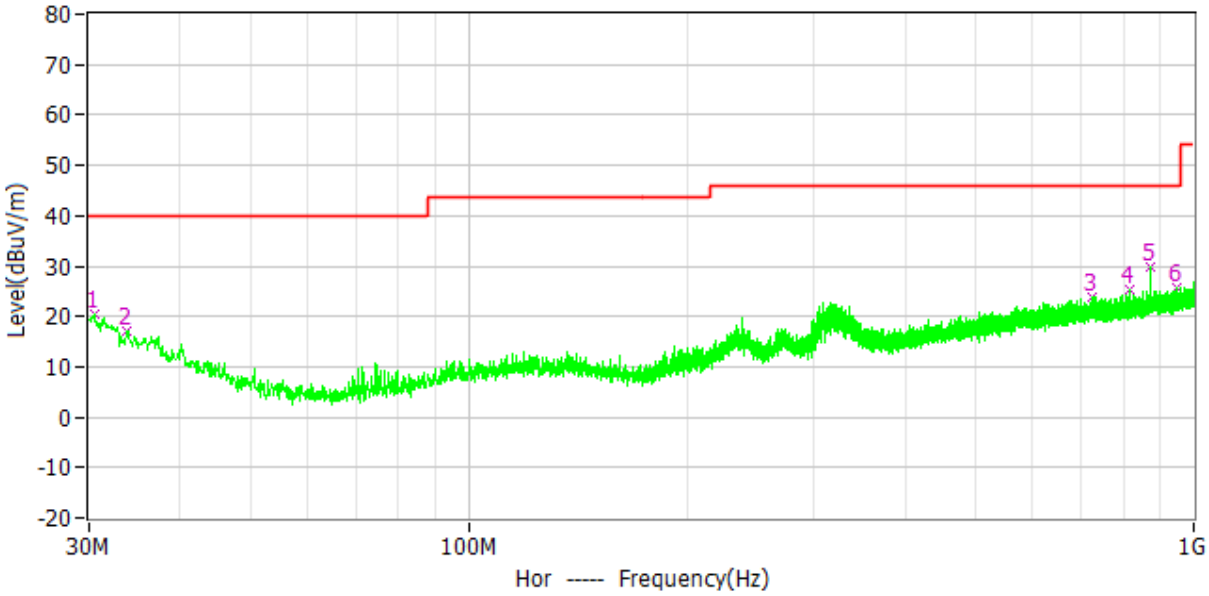
For Radiated emission above 1GHz:

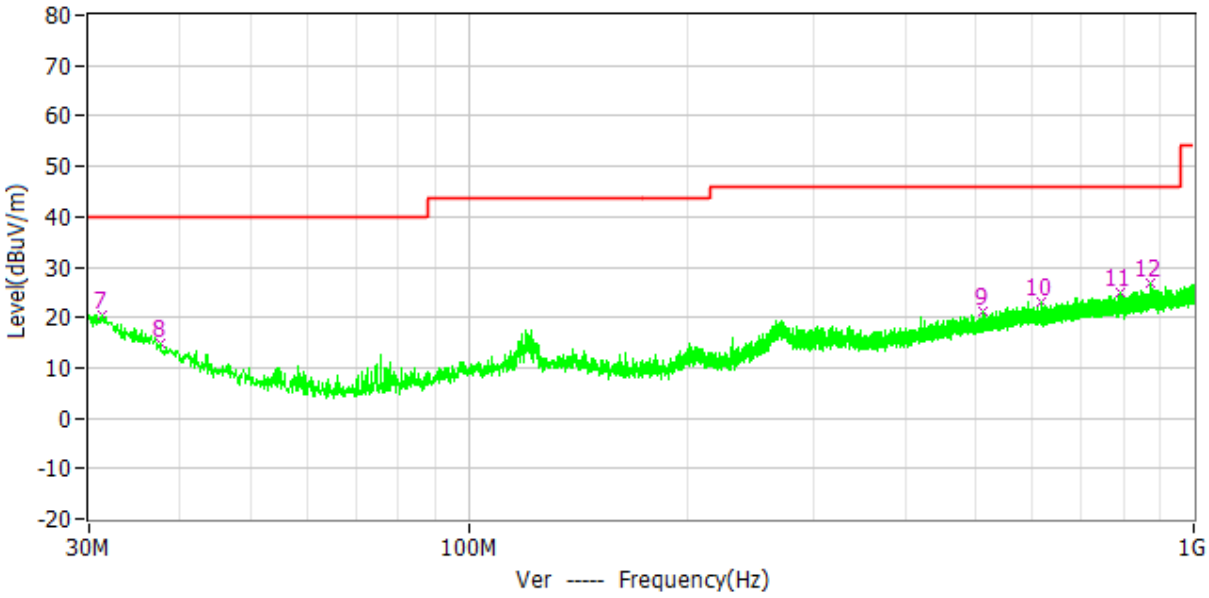


3.4 Test Results of Radiated Emissions

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 below 1GHz

No.	Frequency	Limit dBuV/m	Level dBuV/m	Delta dB	Reading dBuV	Factor dB/m	Detector	Polar
1*	30.485MHz	40.0	20.3	-19.7	-0.8	21.1	QP	Hor
2*	33.783MHz	40.0	17.0	-23.0	-2.0	19.0	QP	Hor
3*	725.975MHz	46.0	23.9	-22.1	1.0	22.9	QP	Hor
4*	817.349MHz	46.0	25.3	-20.7	1.5	23.8	QP	Hor
5*	871.087MHz	46.0	29.7	-16.3	5.6	24.1	QP	Hor
6*	948.493MHz	46.0	25.7	-20.3	0.9	24.8	QP	Hor
7*	31.261MHz	40.0	20.6	-19.4	0.0	20.6	QP	Ver
8*	37.566MHz	40.0	14.7	-25.3	-1.9	16.6	QP	Ver
9*	511.120MHz	46.0	21.2	-24.8	0.7	20.5	QP	Ver
10*	617.141MHz	46.0	23.2	-22.8	1.0	22.2	QP	Ver
11*	792.905MHz	46.0	24.8	-21.2	1.2	23.6	QP	Ver
12*	871.378MHz	46.0	26.7	-19.3	2.6	24.1	QP	Ver

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

Example: Assuming LISN Factor = 10.00dB, Cable Loss = 2.00dB,
Original Receiver Reading = 10.00dBuV, Limit = 66.00dBuV.
Then Factor = 10.00 + 2.00 = 12.00dB;
Level = 10dBuV + 12.00dB = 22.00dBuV;
Delta = 22.00dBuV - 66.00dBuV = –44.00dB.

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Test result above 1GHz:

Antenna	Frequency (MHz)	Corrected Reading (dBuV/m)	Correct Factor (dB/m)	Limit (dBuV/m)	Margin (dB)	Detector
H	**5776.00**	**73.50**	**42.40**	**114.00**	**40.50**	PK
V	**5776.00**	**74.20**	**42.40**	**114.00**	**39.80**	PK
H	11552.00	58.10	12.50	74.00	**15.90**	PK
H	11552.00	51.50	12.50	54.00	**2.50**	AV
V	11552.00	58.50	12.50	74.00	**15.50**	PK
V	11552.00	52.90	12.50	54.00	**1.10**	AV
H	17328.00	53.50	19.80	74.00	**20.50**	PK
V	17328.00	58.40	19.80	74.00	**15.60**	PK
V	17328.00	51.50	19.80	54.00	**2.50**	AV

Note: The field strength of each frequency in spurious domain is lower than the harmonic limit.

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.

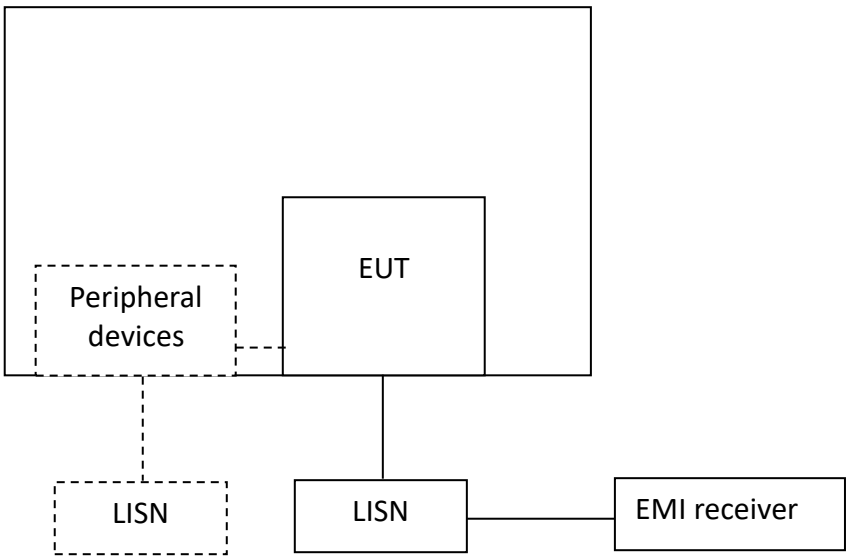
4 Power line conducted emission

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



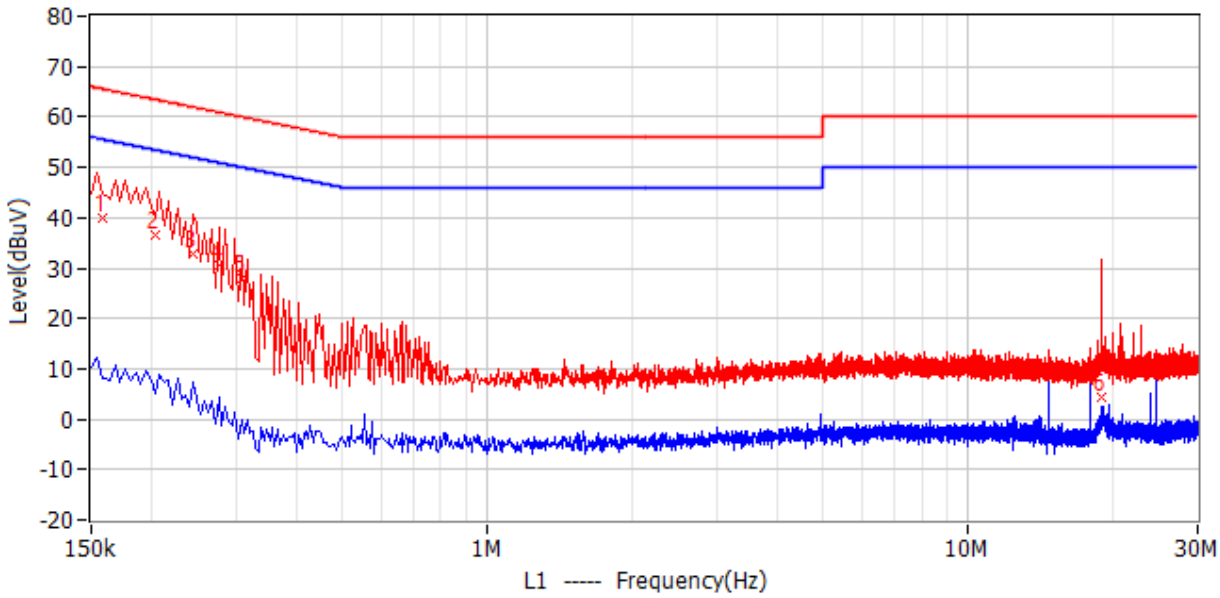
4.3 Measurement Procedure

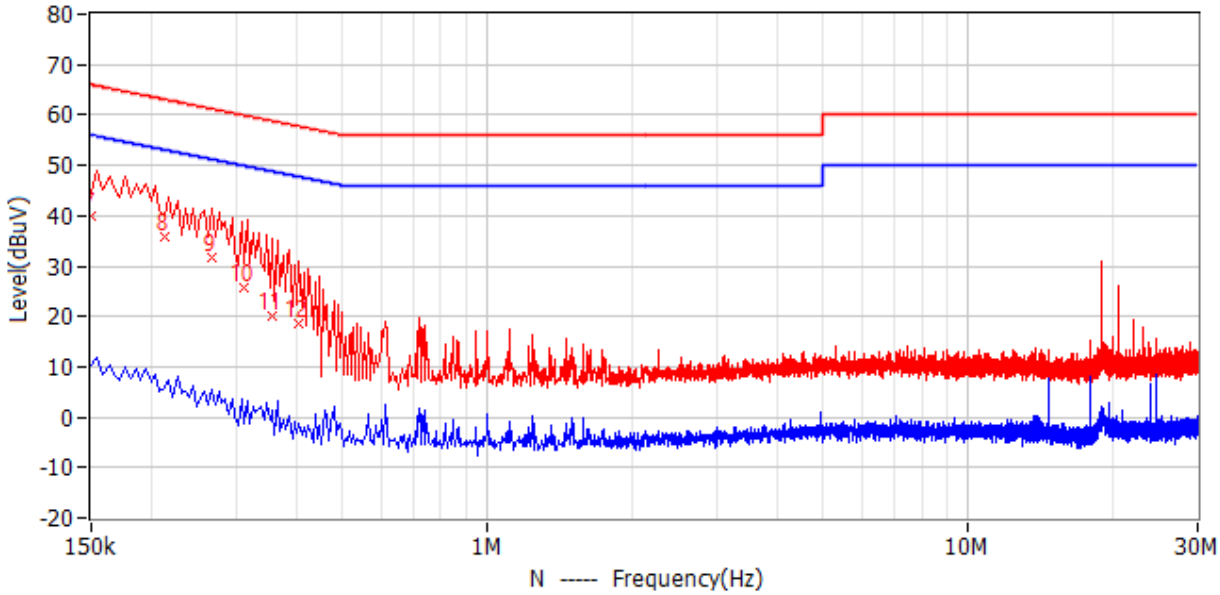
Measured levels of ac power-line conducted emission shall be the emission voltages from the voltage probe, where permitted, or across the 50 Ω LISN port (to which the EUT is connected), where permitted, terminated into a 50 Ω measuring instrument. All emission voltage and current measurements shall be 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.

4.4 Test Results of Power line conducted emission





No.	Frequency	Limit dBuV	Level dBuV	Delta dB	Reading dBuV	Factor dB	Detector	Phase
1	159.000kHz	65.5	40.0	-25.5	33.8	6.2	QP	L1
2	204.000kHz	63.4	36.5	-26.9	30.2	6.3	QP	L1
3	244.500kHz	61.9	32.7	-29.2	26.4	6.3	QP	L1
4	276.000kHz	60.9	30.6	-30.4	24.4	6.2	QP	L1
5	307.500kHz	60.0	27.8	-32.2	21.6	6.2	QP	L1
6	18.951MHz	60.0	4.5	-55.5	-2.0	6.5	QP	L1
7	150.000kHz	66.0	40.0	-26.0	33.8	6.2	QP	N
8	213.000kHz	63.1	35.9	-27.2	29.6	6.3	QP	N
9	267.000kHz	61.2	31.6	-29.6	25.4	6.2	QP	N

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No.	Frequency	Limit dBuV	Level dBuV	Delta dB	Reading dBuV	Factor dB	Detector	Phase
10	312.000kHz	59.9	25.7	-34.2	19.5	6.2	QP	N
11	357.000kHz	58.8	20.1	-38.6	13.9	6.2	QP	N
12	406.500kHz	57.7	18.4	-39.3	12.2	6.2	QP	N

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

Example: Assuming LISN Factor = 10.00dB, Cable Loss = 2.00dB,
Original Receiver Reading = 10.00dBuV, Limit = 66.00dBuV.
Then Factor = 10.00 + 2.00 = 12.00dB;
Level = 10dBuV + 12.00dB = 22.00dBuV;
Delta = 22.00dBuV - 66.00dBuV = –44.00dB.

5 Assigned bandwidth (20dB bandwidth)

Test result: **Pass**

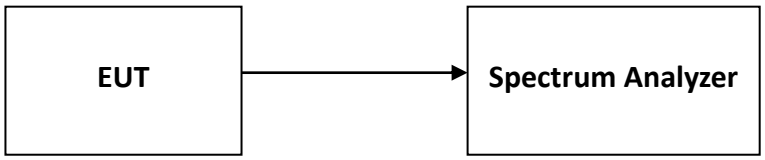
5.1 Limit

Intentional radiators must be designed to ensure that the 20dB bandwidth of the emission is contained within the allocated frequency band.
If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

5.2 Measurement Procedure

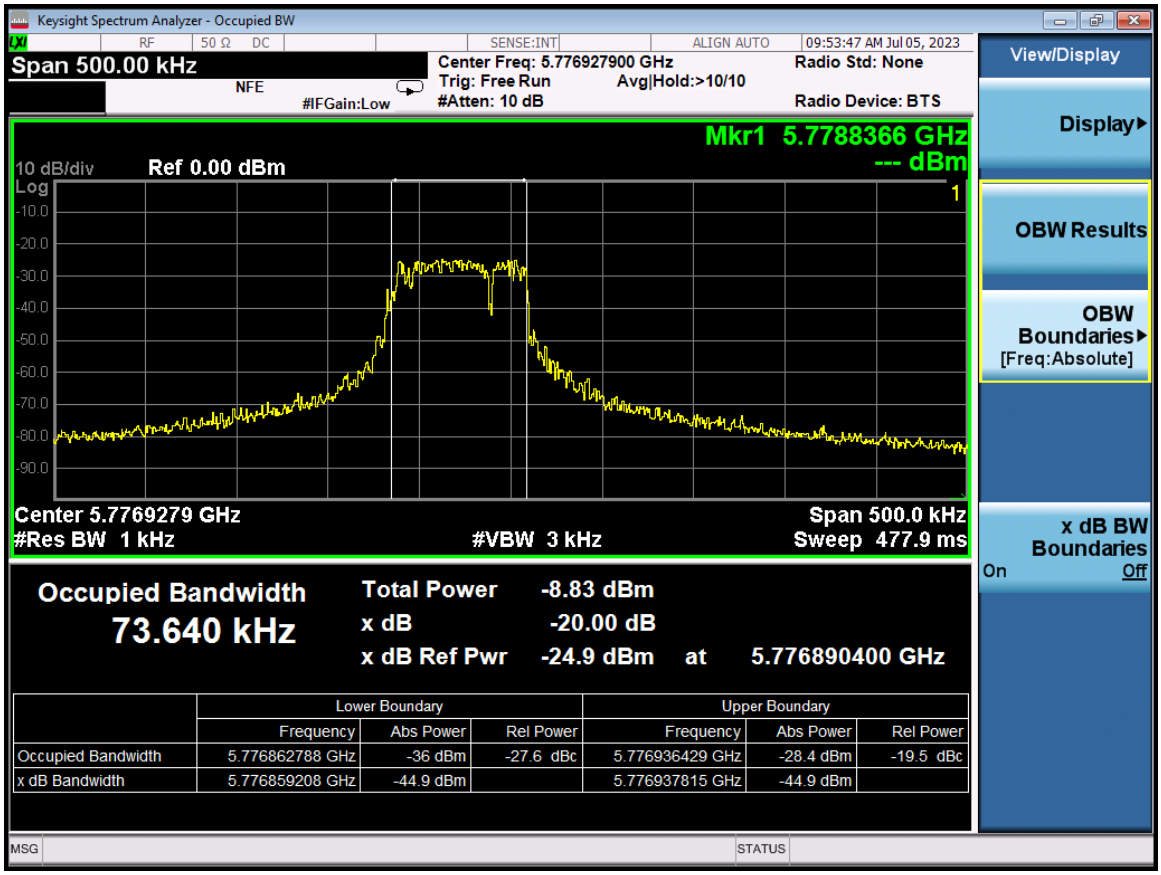
The 20dB Bandwidth is measured using the Spectrum Analyzer.
Set Span = 2 to 3 times the 20dB bandwidth, RBW = approximately 1% of the 20dB bandwidth, VBW>RBW, Sweep = auto, Detector = peak, Trace = max hold.
The test was performed at 2 channels (lowest and highest channel).

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)
5.8G	5776.93	73.64	78.60	5776.86	5776.94
Limit		N/A	N/A	>5740	<5860
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 **********