

RF MEASUREMENT REPORT

FCC ID: 2ALS8-SS0004

Applicant: Ninebot (Changzhou) Tech Co., Ltd.

Product: ninebot smart dashboard

Model No.: WF-100

Brand Name: ninebot

FCC Classification: Part 15 Low Power Communication Device Transmitter (DXX)

FCC Rule Part(s): Part 15 Subpart C (Section 15.225)

Result: Complies

Test Date: 2022-10-27 ~ 2022-11-02

Reviewed By:

Vincent Yu

Approved By:

Robin Wu



The test results relate only to the samples tested.

This equipment has been shown to be capable of compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in ANSI C63.10-2013. Test results reported herein relate only to the item(s) tested.

The test report shall not be reproduced except in full without the written approval of MRT Technology (Suzhou) Co., Ltd.

Revision History

Report No.	Version	Description	Issue Date	Note
2210RSU031-U1	Rev. 01	Initial Report	2022-12-06	Valid

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1.4. Product Information

Product Name	ninebot smart dashboard
Model No.	WF-100
EUT Identification No.	20221021Sample#05
NFC Specification	13.56MHz
WPT Specification	115 ~ 135kHz
Power Supply	18VDC / 1.5A
Output	15W (Max)
Operating Temp.	0 ~ 40°C
Note: The information of EUT was provided by the manufacturer, and the accuracy of the information shall be the responsibility of the manufacturer.	

1.5. Radio Specification under Test

NFC Specification	13.56MHz
Type of modulation	ASK
Antenna Type	Coil Antenna

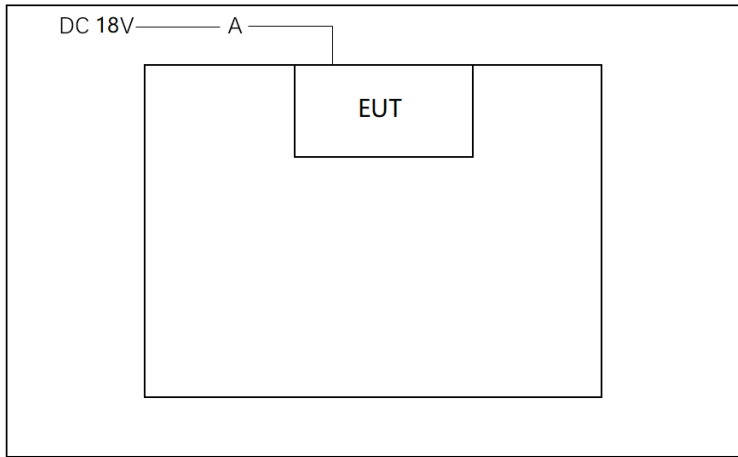
2. Test Configuration

2.1. Test Mode

Test Mode
Mode 1: Transmit by NFC

2.2. Test Configuration and Software

The device was tested per the guidance ANSI C63.10-2013 that was used to reference the appropriate EUT setup for radiated spurious emissions and AC line conducted emission testing.

			
Cable Type	Cable Spec.	Length	
A	Power Cable	Non-Shielded	>10.0m

2.3. Applied Standards

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

- FCC Part 15.225
- ANSI C63.10-2013

2.4. Test Environment Condition

Ambient Temperature	15 ~ 35 °C
Relative Humidity	20 ~ 75 %RH

3. Antenna Requirements

Excerpt from §15.203 of the FCC Rules/Regulations:

“An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can 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 antenna of this device is **permanently attached**.
- There are no provisions for connection to an external antenna.

Conclusion:

The unit complies with the requirement of §15.203.

4. Measuring Instrument

Instrument Name	Manufacturer	Model No.	Asset No.	Cali. Interval	Cal. Due Date	Test Site
EMI Test Receiver	R&S	ESR3	MRTSUE06613	1 year	2023/06/01	SIP-AC3
Signal Analyzer	Keysight	N9010B	MRTSUE06559	1 year	2023/06/01	SIP-AC3
Loop Antenna	Schwarzbeck	FMZB 1519 B	MRTSUE06937	1 year	2023/03/14	SIP-AC3/SIP-TR1
TRILOG Antenna	Schwarzbeck	VULB9168	MRTSUE06646	1 year	2023/08/16	SIP-AC3
Thermal Hygrometer	testo	608-H1	MRTSUE06619	1 year	2023/11/01	SIP-AC3
Thermal Hygrometer	testo	608-H1	MRTSUE06622	1 year	2022/11/28	SIP-AC3
Anechoic Chamber	RIKEN	SIP-AC3	MRTSUE06782	1 year	2022/12/23	SIP-AC3
Signal Analyzer	Keysight	N9010B	MRTSUE06558	1 year	2023-06-01	SIP-TR1
Temperature Chamber	BAOYT	BYG-408CS	MRTSUE06847	1 year	2023-02-22	SIP-TR1
Thermohygrometer	testo	608-H1	MRTSUE11022	1 year	2023-11-01	SIP-TR1

Software	Version	Function
EMI Software	V3.0.0	EMI Test Software
Controller_MF 7802BS	1.02	RE Antenna & Turntable

5. Decision Rules and Measurement Uncertainty

5.1. Decision Rules

The Decision Rule is based on Simple Acceptance in accordance with ISO Guide 98-4: 2012 Clause 8.2. (Measurement uncertainty is not taken into account when stating conformity with a specified requirement.)

5.2. Measurement Uncertainty

Where relevant, the following test uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of $k = 2$.

AC Conducted Emission Measurement
Measurement Uncertainty for a Level of Confidence of 95% ($U=2Uc(y)$): 9kHz~150kHz: 3.58dB 150kHz~30MHz: 3.20dB
Radiated Disturbance
Measurement Uncertainty for a Level of Confidence of 95% ($U=2Uc(y)$): Horizontal: 30MHz~200MHz: 3.85dB 200MHz~1GHz: 4.36dB 1GHz~6GHz: 4.98dB Vertical: 30MHz~200MHz: 4.06dB 200MHz~1GHz: 5.28dB 1GHz~6GHz: 4.91dB

6. Test Result

6.1. Summary

FCC Part Section(s)	Test Description	Test Condition	Verdict
15.225 (a), (b), (c)	In-Band Emission	Radiated	Pass
15.225(d)	Out-Band Emission		Pass
15.215 (c)	20dB Bandwidth		Pass
15.225(e)	Frequency Stability Tolerance		Pass
15.207	AC Conducted Emissions 150kHz - 30MHz	Line Conducted	N/A

Remark:

1. For radiated emission test, every axis (X, Y, Z) was also verified. The test results shown in the following sections represent the worst-case emissions.
2. "N/A" means not applicable.

6.2. In-band Emission Measurement

6.2.1. Test Limit

FCC Part 15 Subpart C Paragraph 15.225		
Frequency (MHz)	Distance (m)	Level ($\mu\text{V/m}$)
13.553 ~13.567	30	15848
13.410 ~13.553, 13.567 ~13.710	30	334
13.110 ~13.410, 13.710 ~14.010	30	106

Note 1: The lower limit shall apply at the transition frequency.

Note 2: Distance refers to the distance in meters between the measuring instrument antenna and the closed point of any part of the device or system.

Note 3: E field strength (dB $\mu\text{V/m}$) = 20 log E field strength ($\mu\text{V/m}$)

6.2.2. Test Procedure

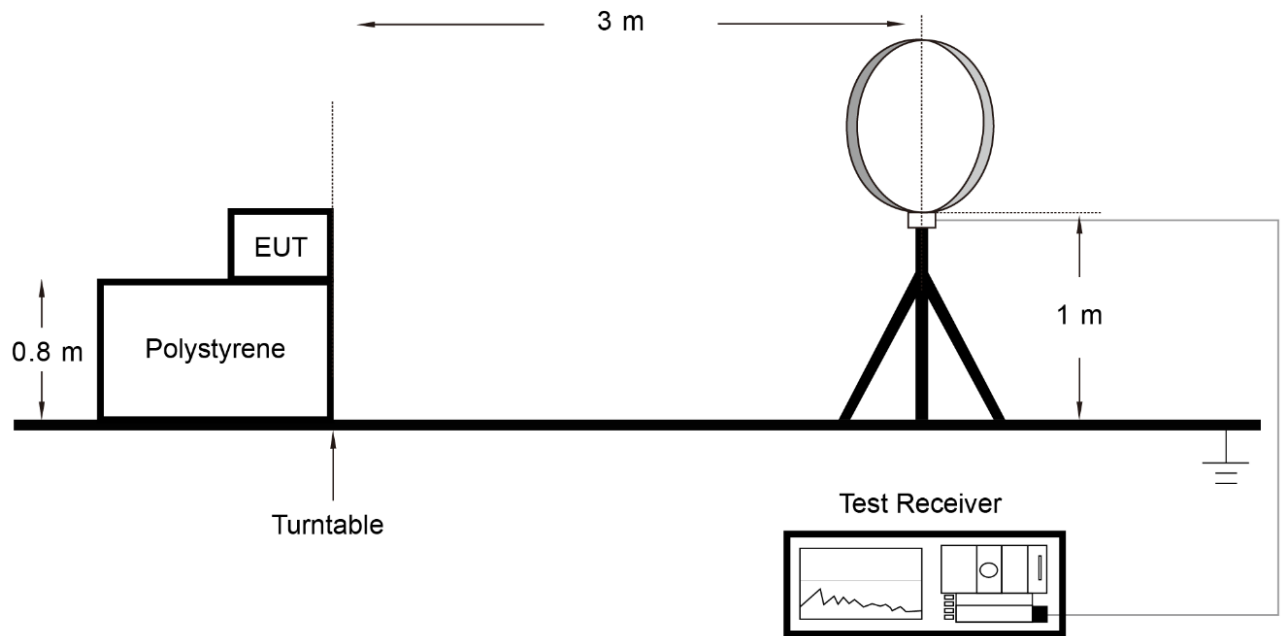
ANSI C63.10-2013 - Section 6.4.7

6.2.3. Test Setting

1. RBW = 9kHz
2. VBW = 3 * RBW
3. Detector = Peak
4. Trace mode = Max hold
5. Sweep = Auto couple
6. Allow the trace to stabilize

6.2.4. Test Setup

9kHz ~ 30MHz Test Setup:



6.2.5. Test Result

Refer to Appendix A.1.

6.3. Out-band Emission Measurement

6.3.1. Test Limit

FCC Part 15 Subpart C Paragraph 15.209		
Frequency (MHz)	Distance (m)	Level ($\mu\text{V}/\text{m}$)
0.009 - 0.490	300	2400/F (kHz)
0.490 - 1.705	30	24000/F (kHz)
1.705 - 30	30	30
30 - 88	3	100
88 - 216	3	150
216 - 960	3	200
Above 960	3	500

Note 1: The lower limit shall apply at the transition frequency.

Note 2: Distance refers to the distance in meters between the measuring instrument antenna and the closed point of any part of the device or system.

Note 3: E field strength (dB $\mu\text{V}/\text{m}$) = 20 log E field strength ($\mu\text{V}/\text{m}$)

6.3.2. Test Procedure

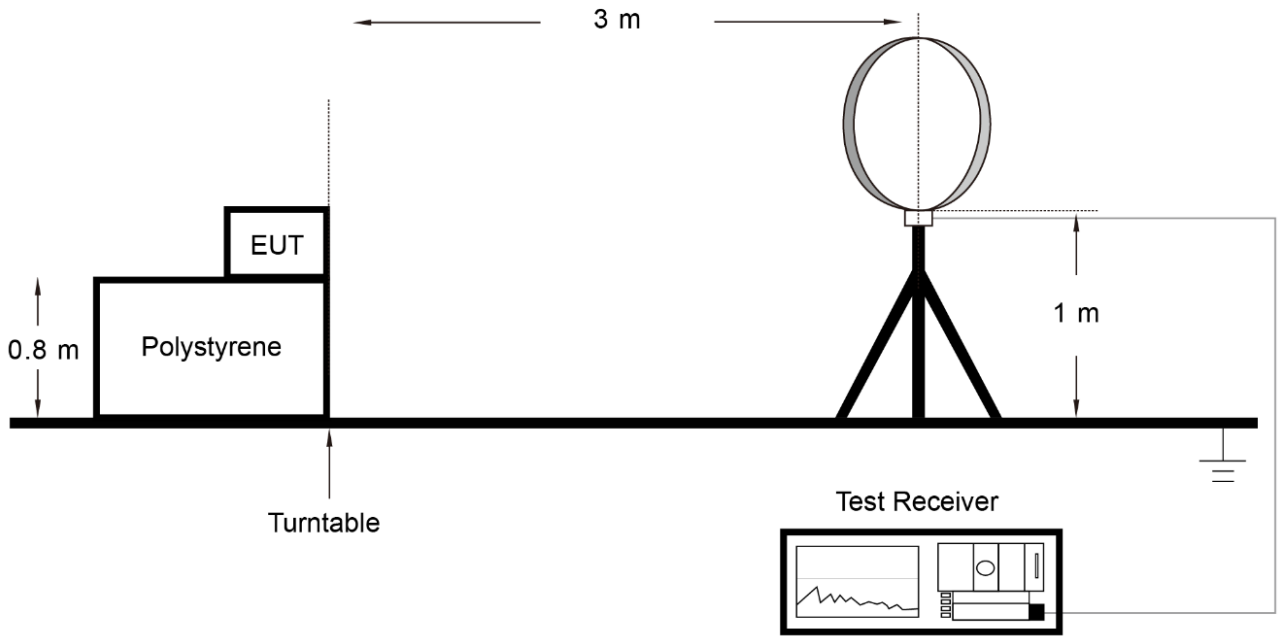
ANSI C63.10-2013 - Section 6.5.4

6.3.3. Test Setting

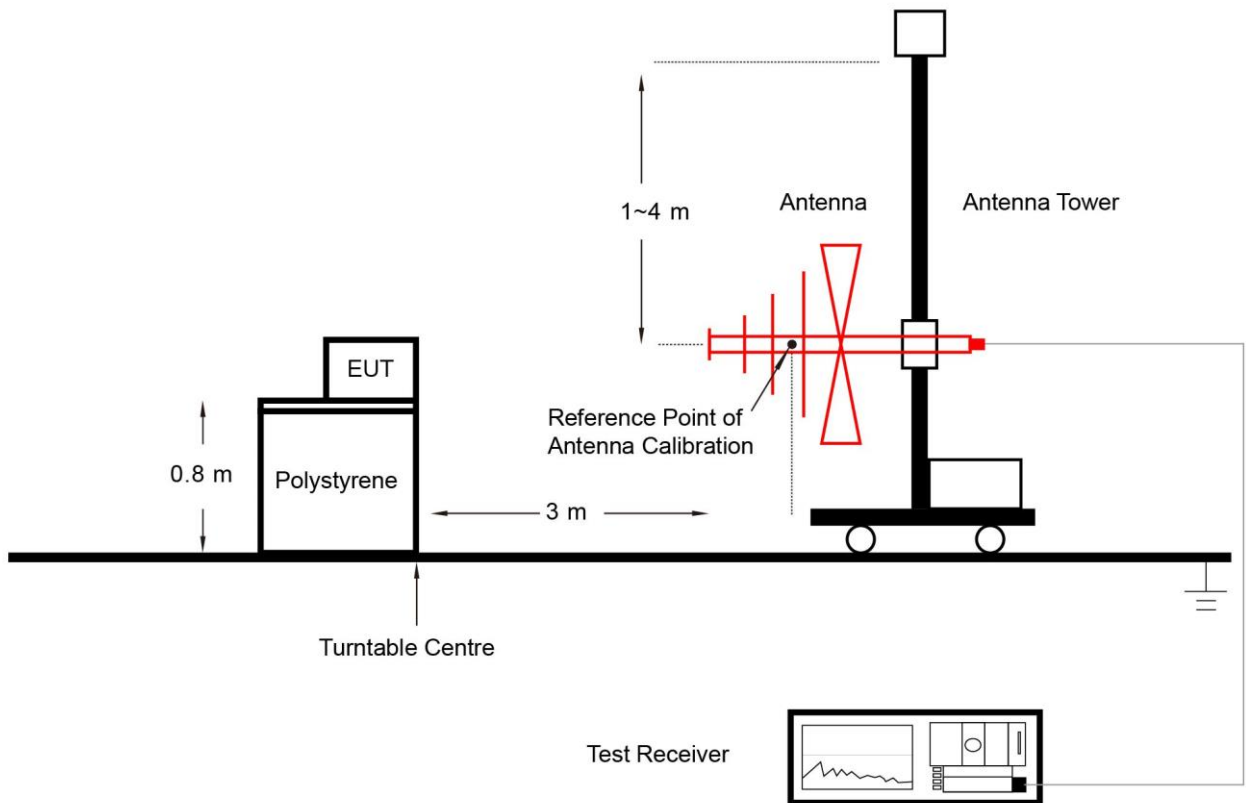
1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 9kHz for emission below 30MHz and 100kHz for emission between 30MHz and 1GHz
3. VBW = 3 * RBW
4. Detector = Peak
5. Trace mode = Max hold
6. Sweep = Auto couple
7. Allow the trace to stabilize

6.3.4. Test Setup

9kHz ~ 30MHz Test Setup:



30MHz ~ 1GHz Test Setup:



6.3.5. Test Result

Refer to Appendix A.2.

6.4. Occupied Bandwidth Measurement

6.4.1. Test Limit

Within the operating frequency band (13.110 ~ 14.010 MHz).

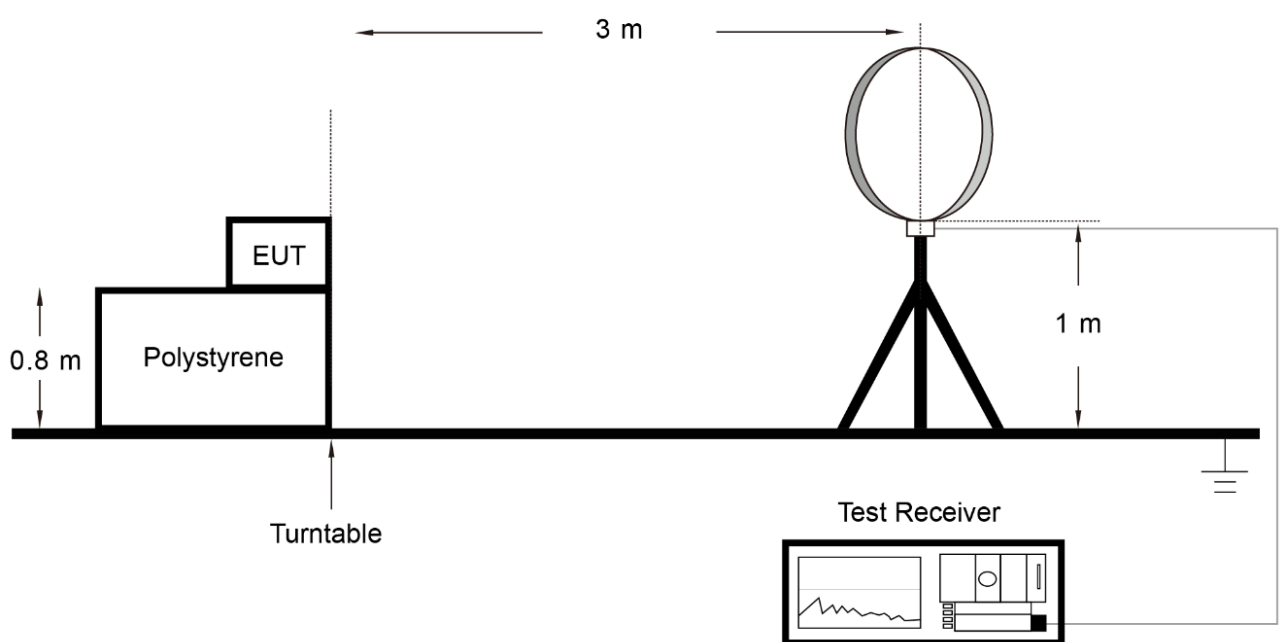
6.4.2. Test Procedure

ANSI C63.10-2013 - Section 6.9.2

6.4.3. Test Setting

1. Set RBW \geq 1% to 5% of the 20dB bandwidth
2. VBW = approximately three times RBW
3. Span = approximately 2 to 5 times the 20dB bandwidth
4. Detector = Peak
5. Trace mode = max hold
6. Sweep = auto couple
7. Allow the trace to stabilize
8. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 20 dB relative to the maximum level measured in the fundamental emission.

6.4.4. Test Setup



6.4.5. Test Result

Refer to Appendix A.3.

6.5. Frequency Tolerance Measurement

6.5.1. Test Limit

The frequency tolerance of the carrier signal shall be maintained within +/- 0.01% of the operating frequency.

6.5.2. Test Procedure

ANSI C63.10-2013 - Section 6.8

6.5.3. Test Setting

Frequency Stability Under Temperature Variations:

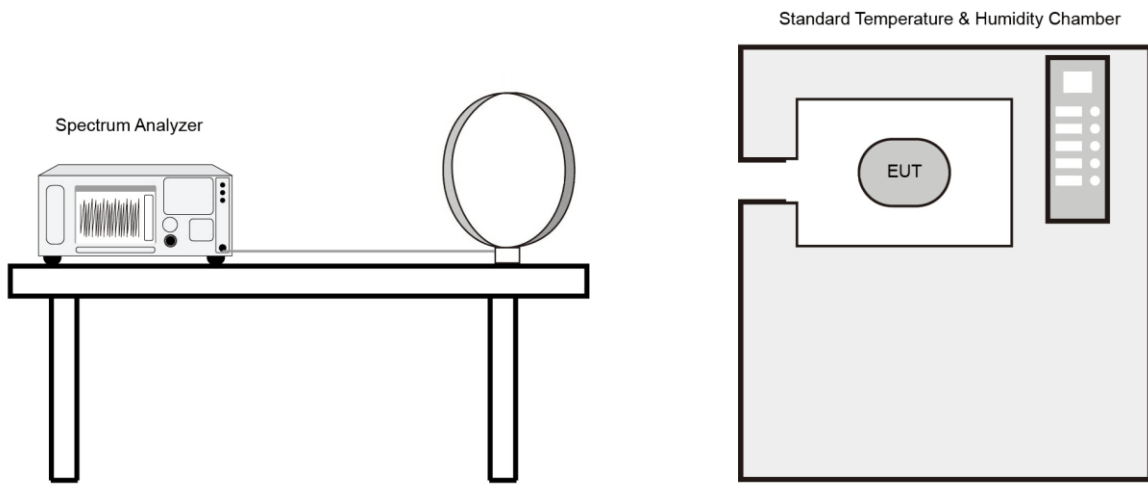
The equipment under test was connected to an external AC or DC power supply and input rated voltage. RF output was connected to a frequency counter or spectrum analyzer via feed through attenuators. The EUT was placed inside the temperature chamber. Set the spectrum analyzer RBW low enough to obtain the desired frequency resolution and measure EUT 20°C operating frequency as reference frequency. Turn EUT off and set the chamber temperature to highest. After the temperature stabilized for approximately 30 minutes recorded the frequency. Repeat step measure with 10°C decreased per stage until the lowest temperature reached.

Frequency Stability Under Voltage Variations:

Set chamber temperature to 20°C. Use a variable AC power supply / DC power source to power the EUT and set the voltage to rated voltage. Set the spectrum analyzer RBW low enough to obtain the desired frequency resolution and recorded the frequency.

Reduce the input voltage to specify extreme voltage variation ($\pm 15\%$) and endpoint, record the maximum frequency change. For hand-carried battery-powered equipment, primary supply voltage is reduced to the battery operating end point which shall be specified by the manufacturer.

6.5.4. Test Setup



6.5.5. Test Result

Refer to Appendix A.4.

6.6. AC Conducted Emissions Measurement

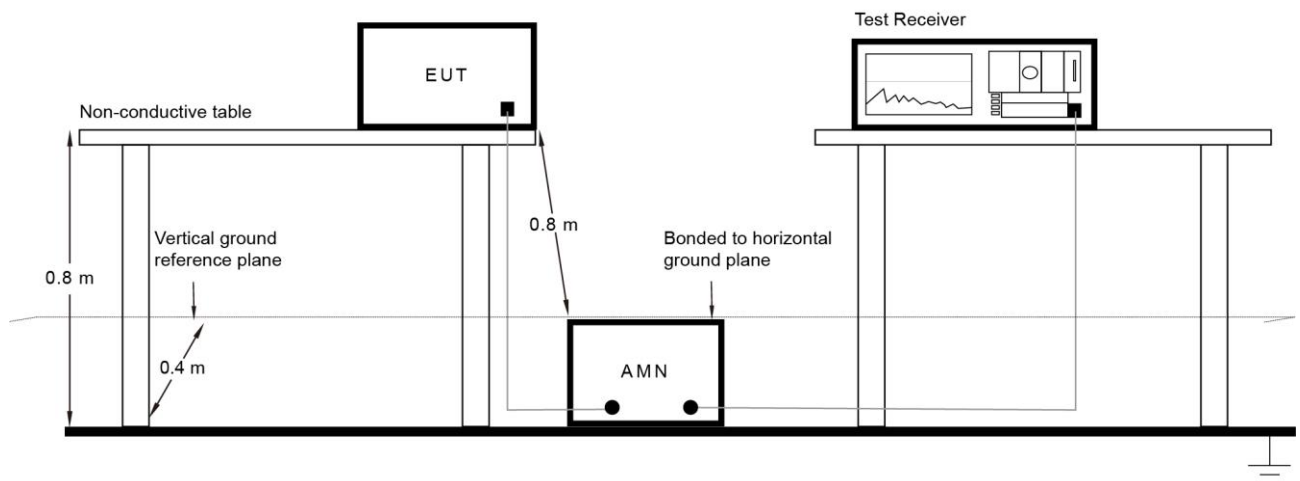
6.6.1. Test Limit

FCC Part 15 Subpart C Paragraph 15.207		
Frequency (MHz)	QP (dB μ V)	AV (dB μ V)
0.15 - 0.50	66 - 56	56 - 46
0.50 - 5.0	56	46
5.0 - 30	60	50

Note 1: The lower limit shall apply at the transition frequencies.

Note 2: The limit decreases linearly with the logarithm of the frequency in the range 0.15MHz to 0.5MHz.

6.6.2. Test Setup



6.6.3. Test Result

Refer to Appendix A.5.

Appendix A - Test Result

A.1 In-band Emission Test Result

Test Engineer	Simon Lu	Test Date	2022-10-27
Test Mode	Mode 1	Test Site	SIP-AC3

Frequency (MHz)	Reading Level (dB μ V)	Factor (dB/m)	Measure Level @3m (dB μ V/m)	Measure Level @30m (dB μ V/m)	Limit @30m (dB μ V/m)	Margin [dB]
Coaxial						
13.110	6.383	18.706	25.089	-14.911	40.506	-55.417
13.410	14.004	18.691	32.695	-7.305	40.506	-47.811
13.553	30.622	18.548	49.170	9.17	50.475	-41.305
13.560	35.955	18.551	54.506	14.506	83.999	-69.493
13.567	30.902	18.558	49.460	9.46	50.475	-41.015
13.710	14.040	18.716	32.757	-7.243	40.506	-47.749
14.010	5.459	18.679	24.138	-15.862	40.506	-56.368
Coplanar						
13.110	6.926	18.706	25.632	-14.368	40.506	-54.874
13.410	9.930	18.691	28.621	-11.379	40.506	-51.885
13.553	27.710	18.548	46.258	6.258	50.475	-44.217
13.560	33.243	18.551	51.794	11.794	83.999	-72.205
13.567	27.905	18.558	46.463	6.463	50.475	-44.012
13.710	6.141	18.716	24.858	-15.142	40.506	-55.648
14.010	5.128	18.679	23.807	-16.193	40.506	-56.699

Note:

- Measure Level @3m (dB μ V/m) = Reading Level (dB μ V) + Factor (dB/m)
Factor (dB/m) = Cable Loss (dB) + Antenna Factor (dB/m)
- Measurements were tested at 3m and the data was extrapolated to the specified measurement distance of 30m using the square of an inverse linear extrapolation factor (40 dB/decade) as specified in &15.31(f)(2).
Extrapolation Factor = $40 \cdot \log(30/3) = 40$ dB.
Measure Level @30m (dB μ V/m) = Measure Level @3m (dB μ V/m) - 40 dB
- All measurements were recorded using an EMI test receiver employing a peak detector.

A.2 Out-Band Emission Test Result

Test Engineer	Simon Lu	Test Date	2022-10-27
Test Mode	Mode 1	Test Site	SIP-AC3
Remark	9kHz ~ 490kHz		

Frequency (kHz)	Reading Level (dB μ V)	Factor (dB/m)	Measure Level @3m (dB μ V/m)	Measure Level @300m (dB μ V/m)	Limit @300m (dB μ V/m)	Margin (dB)
Coaxial						
102	38.828	18.730	57.058	-22.942	27.432	-50.374
128	71.991	18.770	90.761	10.761	25.460	-14.699
147	65.492	18.737	84.229	4.229	24.258	-20.029
Coplanar						
99	34.197	18.725	52.922	-27.078	27.692	-54.770
128	68.005	18.770	86.775	6.775	25.460	-18.685
147	54.877	18.737	73.614	-6.386	24.258	-30.644

Note

- Measure Level @3m (dB μ V/m) = Reading Level (dB μ V) + Factor (dB/m)
 Factor (dB/m) = Cable Loss (dB) + Antenna Factor (dB/m)
- Measurements were tested at 3m and the data was extrapolated to the specified measurement distance of 300m using the square of an inverse linear extrapolation factor (40 dB/decade) as specified in 15.31(f)(2).
 Extrapolation Factor = $40 \cdot \log(300/3) = 80$ dB.
 Measure Level @300m (dB μ V/m) = Measure Level @3m (dB μ V/m) - 80 dB
- All measurements were recorded using an EMI test receiver employing a peak detector.

Test Engineer	Simon Lu	Test Date	2022-10-27
Test Mode	Mode 1	Test Site	SIP-AC3
Remark	490kHz ~ 30MHz		

Frequency (MHz)	Reading Level (dB μ V)	Factor (dB/m)	Measure Level @3m (dB μ V/m)	Measure Level @30m (dB μ V/m)	Limit @30m (dB μ V/m)	Margin (dB)
Coaxial						
0.508	37.925	19.038	56.963	16.963	33.487	-16.524
0.628	40.229	18.757	58.986	18.986	31.645	-12.659
0.881	33.012	18.965	51.977	11.977	28.705	-16.728
Coplanar						
0.628	36.400	18.757	55.157	15.157	31.645	-16.488
0.881	29.588	18.965	48.553	8.553	28.705	-20.152
27.119	22.632	18.986	41.618	1.618	29.542	-27.924

Note

- Measure Level @3m (dB μ V/m) = Reading Level (dB μ V) + Factor (dB/m)
 Factor (dB/m) = Cable Loss (dB) + Antenna Factor (dB/m)
- Measurements were tested at 3m and the data was extrapolated to the specified measurement distance of 30m using the square of an inverse linear extrapolation factor (40 dB/decade) as specified in &15.31(f)(2).
 Extrapolation Factor = $40 * \text{Log}(30/3) = 40 \text{ dB}$.
 Measure Level @30m (dB μ V/m) = Measure Level @3m (dB μ V/m) - 40 dB
- All measurements were recorded using an EMI test receiver employing a peak detector.

Test Engineer	Simon Lu	Test Date	2022-10-27
Test Mode	Mode 1	Test Site	SIP-AC3
Remark	30MHz ~ 1GHz		

Frequency (MHz)	Reading Level (dB μ V)	Factor (dB)	Measure Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Detector	Polarization
40.625	7.458	17.650	25.108	40.000	-14.892	Peak	Horizontal
54.225	7.506	17.657	25.163	40.000	-14.837	Peak	Horizontal
135.570	4.190	17.109	21.299	43.500	-22.201	Peak	Horizontal
175.010	15.123	17.071	32.194	43.500	-11.306	Peak	Horizontal
187.335	15.744	15.688	31.433	43.500	-12.067	Peak	Horizontal
199.660	16.863	14.856	31.719	43.500	-11.781	Peak	Horizontal
35.015	16.186	17.035	33.221	40.000	-6.779	Peak	Vertical
40.678	21.100	17.655	38.755	40.000	-1.245	QP	Vertical
54.225	17.524	17.657	35.181	40.000	-4.819	Peak	Vertical
81.340	11.975	13.089	25.064	40.000	-14.936	Peak	Vertical
162.770	8.076	17.842	25.919	43.500	-17.581	Peak	Vertical
187.505	10.925	15.671	26.596	43.500	-16.904	Peak	Vertical

Note:

Measure Level (dB μ V/m) = Reading Level (dB μ V) + Factor (dB/m)

Factor (dB/m) = Cable Loss (dB) + Antenna Factor (dB/m)

A.3 Occupied Bandwidth Test Result

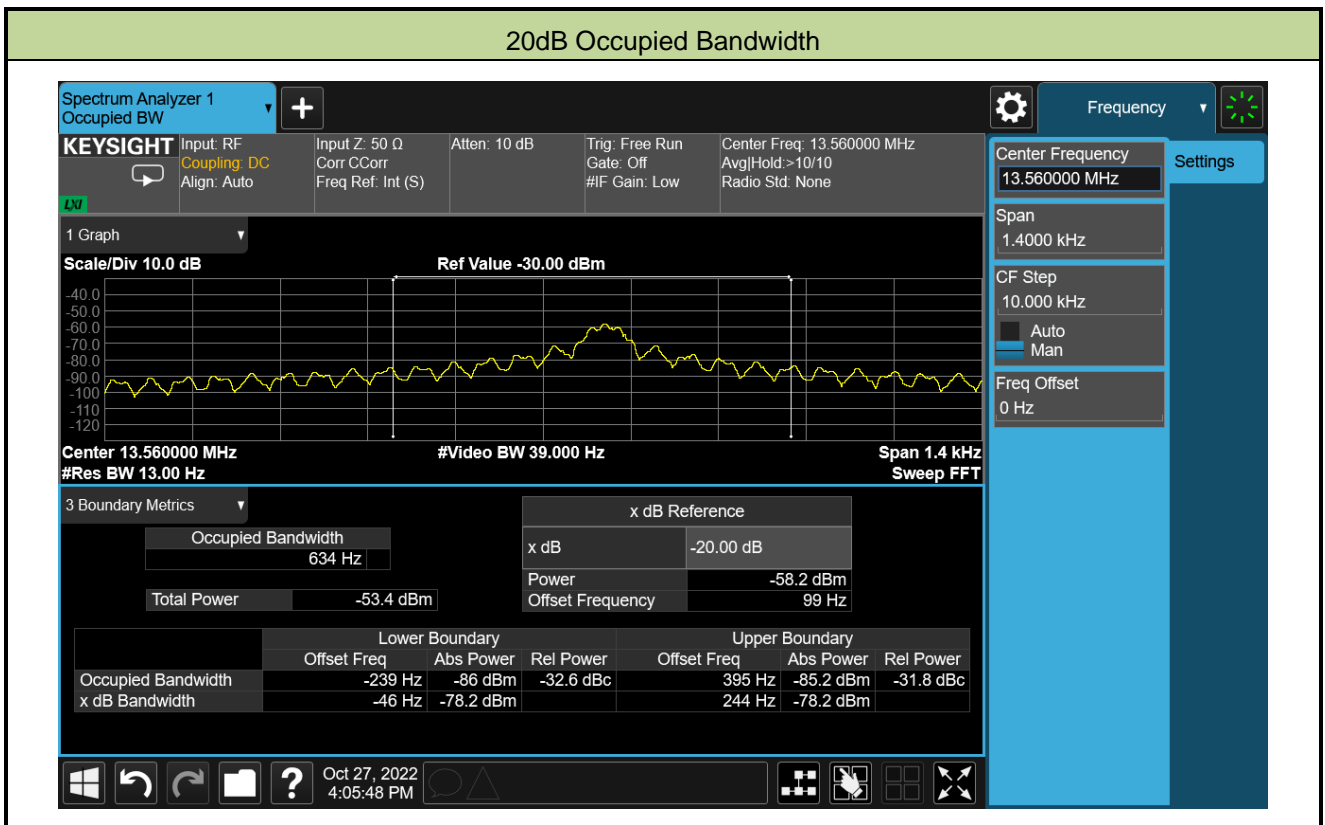
Test Engineer	Simon Lu	Test Date	2022-10-27
Test Mode	Mode 1	Test Site	SIP-AC3

Frequency (F _C) (MHz)	20dB Occupied Bandwidth (Hz)
13.56	290

Note:

$$F_L = F_C - F_{\text{Lower Boundary}} = 13.559954 \text{ MHz} > 13.110\text{MHz}$$

$$F_H = F_C + F_{\text{Upper Boundary}} = 13.560244 \text{ MHz} < 14.010\text{MHz}$$



A.4 Frequency Stability Tolerance Test Result

Test Engineer	Chase Zhu	Test Date	2022-11-02
Test Mode	Mode 1	Test Site	SIP-TR1

Frequency (MHz)	Voltage (%)	Voltage (V _{dc})	Temperature (°C)	Frequency Deviation (Hz)	Tolerance (%)	Limit (%)
13.56	100%	18V	50	-4	-0.000029	-0.01 ~ +0.01
			40	13	0.000096	-0.01 ~ +0.01
			30	19	0.000140	-0.01 ~ +0.01
			20	45	0.000332	-0.01 ~ +0.01
			10	217	0.001600	-0.01 ~ +0.01
			0	135	0.000996	-0.01 ~ +0.01
			-10	137	0.001010	-0.01 ~ +0.01
			-20	163	0.001202	-0.01 ~ +0.01
	85%	15.3V	20	281	0.002072	-0.01 ~ +0.01
	115%	20.7V	20	142	0.001047	-0.01 ~ +0.01

Note: Tolerance = Frequency Deviation (Hz) / Frequency (Hz) * 100%

A.5 AC Conducted Emissions Test Result

This device is powered by external DC source, so the item is not applicable.

Appendix B - Test Setup Photograph

Refer to "2210RSU031-UT" file.

Appendix C - EUT Photograph

Refer to "2210RSU031-UE" file.