

FCC Test Report

Report No.: RFBHCP-WTW-P22040326-3

FCC ID: ACJ932AT2202

Test Model: AT2202

Received Date: Apr. 13, 2022

Test Date: May 20 ~ Jul. 11, 2022

Issued Date: Sep. 14, 2022

Applicant: Panasonic Corporation of North America

Address: Two Riverfront Plaza, 9th Floor, Newark New Jersey, United States, 07102-5490

Issued By: Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch
Lin Kou Laboratories

Lab Address: No. 47-2, 14th Ling, Chia Pau Vil., Lin Kou Dist., New Taipei City, Taiwan

Test Location: No. 70, Wenming Rd., Guishan Dist., Taoyuan City 333, Taiwan

FCC Registration /
Designation Number: 281270 / TW0032



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Release Control Record

Issue No.	Description	Date Issued
RFBHCP-WTW-P22040326-3	Original Release	Sep. 14, 2022

1 Certificate of Conformity

Product: Display Audio

Brand: Panasonic or Panasonic Automotive Systems Asia Pacific.,Ltd.

Test Model: AT2202

Sample Status: Engineering Sample

Applicant: Panasonic Corporation of North America

Test Date: May 20 ~ Jul. 11, 2022

Standards: 47 CFR FCC Part 15, Subpart C (Section 15.225)
47 CFR FCC Part 15, Subpart C (Section 15.215)
ANSI C63.10:2013

The above equipment has been tested by **Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's RF characteristics under the conditions specified in this report.

Prepared by : Lena Wang, **Date:** Sep. 14, 2022
Lena Wang / Specialist

Approved by : Jeremy Lin, **Date:** Sep. 14, 2022
Jeremy Lin / Project Engineer

2 Summary of Test Results

47 CFR FCC Part 15, Subpart C (Section 15.225, 15.215)			
FCC Clause	Test Item	Result	Remarks
15.207	Conducted emission test	N/A	Without AC power port of the EUT
15.225 (a)	The field strength of any emissions within the band 13.553-13.567 MHz	Pass	Meet the requirement of limit. Minimum passing margin is -72.5 dB at 13.56 MHz.
15.225 (b)	The field strength of any emissions within the bands 13.410-13.553 MHz and 13.567-13.710 MHz	Pass	Meet the requirement of limit.
15.225 (c)	The field strength of any emissions within the bands 13.110-13.410 MHz and 13.710-14.010 MHz	Pass	Meet the requirement of limit.
15.225 (d)	The field strength of any emissions appearing outside of the 13.110-14.010 MHz band	Pass	Meet the requirement of limit. Minimum passing margin is -4.4 dB at 38.73 MHz.
15.225 (e)	The frequency tolerance	Pass	Meet the requirement of limit.
15.215 (c)	20 dB Bandwidth	Pass	Meet the requirement of limit.
15.203	Antenna Requirement	Pass	No antenna connector is used.

Note: Determining compliance based on the results of the compliance measurement, not taking into account measurement instrumentation uncertainty.

2.1 Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2:

Measurement	Frequency	Expanded Uncertainty (k=2) (±)
Radiated Emissions up to 1 GHz	9kHz ~ 30MHz	3.00 dB
	30MHz ~ 200MHz	2.91 dB
	200MHz ~ 1000MHz	2.93 dB
Radiated Emissions above 1 GHz	1GHz ~ 18GHz	1.76 dB
	18GHz ~ 40GHz	1.77 dB

2.2 Modification Record

There were no modifications required for compliance.

3 General Information

3.1 General Description of EUT

Product	Display Audio
Brand	Panasonic or Panasonic Automotive Systems Asia Pacific.,Ltd.
Test Model	AT2202
Status of EUT	Engineering Sample
Power Supply Rating	12.0 Vdc
Modulation Type	ASK
Data Rate	Type A: 106 kbit/s Type B: 106 kbit/s
Operating Frequency	13.56 MHz
Field Strength (Maximum)	11.5 dBuV/m (30m)
Antenna Type	Flexible Antenna
Accessory Device	N/A
Data Cable Supplied	N/A

Note:

1. The above EUT information is declared by manufacturer and for more detailed features description, please refers to the manufacturer's specifications or user's manual.
2. The EUT supports NFC Type: Type A, B. The Type A is the worst for the final tests.

3.2 Description of Test Modes

One channel was provided to this EUT:

Channel	Frequency (MHz)
1	13.56

3.2.1 Test Mode Applicability and Tested Channel Detail

EUT Configure Mode	Applicable To				Description
	RE	PLC	FS	EB	
-	√	-	√	√	-

Where **RE:** Radiated Emission

PLC: Power Line Conducted Emission

FS: Frequency Stability

EB: 20 dB Bandwidth measurement

NOTE: The EUT is designed to be positioned on the z-plane only.

NOTE: "-" means no effect.

Radiated Emission Test:

- ☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
- ☒ Following channel(s) was (were) selected for the final test as listed below.

EUT Configure Mode	Available Channel	Tested Channel	Modulation Type	Axis
-	1	1	ASK	Z

Frequency Stability:

- ☒ This item includes all test value of each mode, but only includes spectrum plot of worst value of each mode.
- ☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
- ☒ Following channel(s) was (were) selected for the final test as listed below.

EUT Configure Mode	Available Channel	Tested Channel	Modulation Type	Axis
-	1	1	ASK	Z

20 dB Bandwidth:

- ☒ This item includes all test value of each mode, but only includes spectrum plot of worst value of each mode.
- ☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
- ☒ Following channel(s) was (were) selected for the final test as listed below.

EUT Configure Mode	Available Channel	Tested Channel	Modulation Type	Axis
-	1	1	ASK	Z

Test Condition:

Applicable To	Environmental Conditions	Input Power	Tested By
RE	21 deg. C, 68 % RH	12 Vdc	Edison Lee
FS	24 deg. C, 68 % RH	12 Vdc	Wade Huang
EB	24 deg. C, 68 % RH	12 Vdc	Wade Huang

3.3 Description of Support Units

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

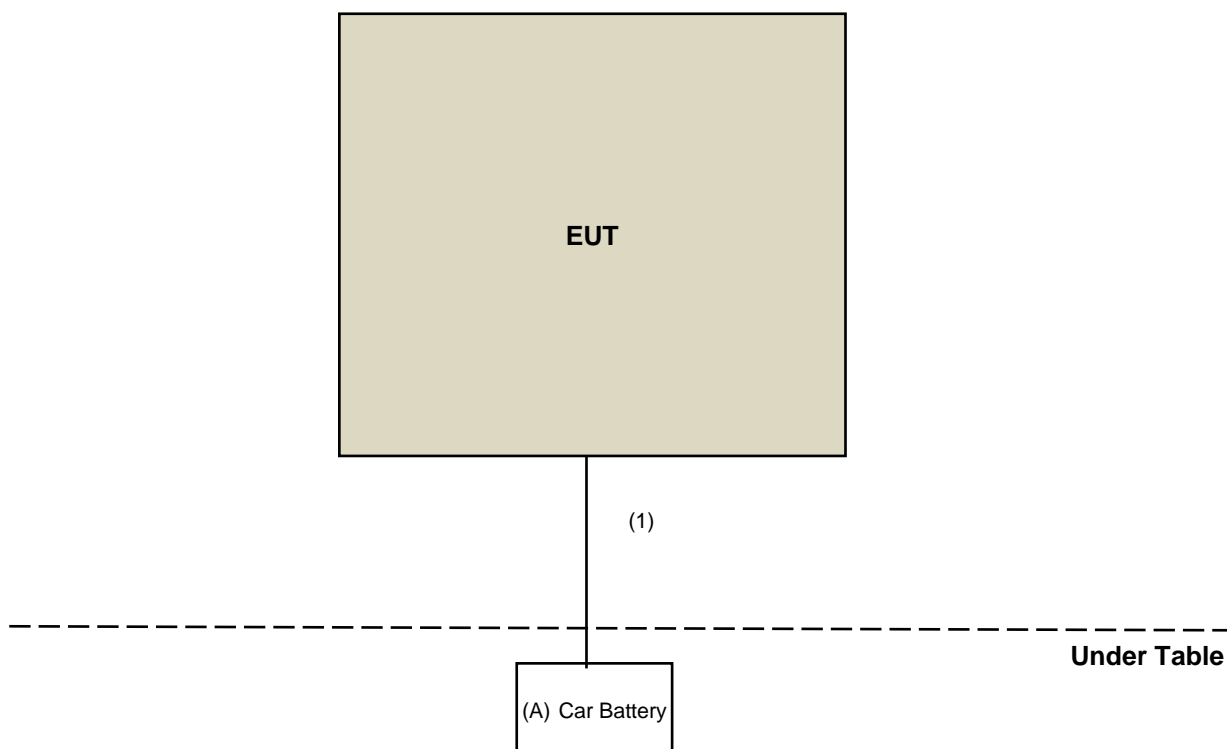
No.	Product	Brand	Model No.	Serial No.	FCC ID
A	Car Battery	Global	NX120-7L	N/A	N/A

ID	Cable Descriptions	Qty.	Length (m)	Shielding (Yes/No)	Cores (Qty.)	Remarks
1	DC Cable	1	2	N	0	Supplied by applicant

Note:

1. All power cords of the above support units are non-shielded (1.8m).

3.3.1 Configuration of System under Test



3.4 General Description of Applied Standards and references

The EUT is a RF Product. According to the specifications of the manufacturer, it must comply with the requirements of the following standards and references:

FCC Part 15, Subpart C (15.225)

FCC Part 15, Subpart C (15.215)

ANSI C63.10-2013

All test items have been performed and recorded as per the above standards.

References Test Guidance :

KDB 414788 D01 Radiated Test Site v01r01

All test items have been performed as a reference to the above KDB test guidance.

4 Test Types and Results

4.1 Radiated Emission Measurement

4.1.1 Limits of Radiated Emission Measurement

- The field strength of any emissions within the band 13.553-13.567 MHz shall not exceed 15,848 microvolts/meter at 30 meters.
- Within the bands 13.410-13.553 MHz and 13.567-13.710 MHz, the field strength of any emissions shall not exceed 334 microvolts/meter at 30 meters.
- Within the bands 13.110-13.410 MHz and 13.710-14.010 MHz the field strength of any emissions shall not exceed 106 microvolts/meter at 30 meters.
- The field strength of any emissions appearing outside of the 13.110-14.010 MHz band shall not exceed the general radiated emission limits in §15.209 as below table:

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

NOTE:

- The lower limit shall apply at the transition frequencies.
- Emission level (dBuV/m) = 20 log Emission level (uV/m).
- For frequencies above 1000 MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20 dB under any condition of modulation.

4.1.2 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due
Test Receiver Rohde & Schwarz	N9038A	MY55420137	Apr. 27, 2022	Apr. 26, 2023
Spectrum Analyzer KEYSIGHT	N9020B	MY60110440	Dec. 09, 2021	Dec. 08, 2022
BILOG Antenna SCHWARZBECK	VULB9168	1213	Oct. 27, 2021	Oct. 26, 2022
HORN Antenna RF SPIN	DRH18-E	210103A18E	Nov. 14, 2021	Nov. 13, 2022
HORN Antenna SCHWARZBECK	BBHA 9170	9170	Nov. 14, 2021	Nov. 13, 2022
Loop Antenna EMCI	EM-6879	269	Sep. 16, 2021	Sep. 15, 2022
Loop Antenna TESEQ	HLA 6121	45745	Jul. 21, 2021	Jul. 20, 2022
Preamplifier EMCI	EMC330N	980782	Jan. 17, 2022	Jan. 16, 2023
Preamplifier EMCI	EMC118A45SE	980808	Dec. 30, 2021	Dec. 29, 2022
Preamplifier EMCI	EMC184045SE	980788	Jan. 17, 2022	Jan. 16, 2023
RF signal cable EMCI	EMC104-SM-SM- (9000+2000+1000)	201243+ 201231+ 210102	Jan. 17, 2022	Jan. 16, 2023
RF signal cable EMCI	EMCCFD400-NM- NM- (9000+300+500)	201236+ 201235+ 201233	Jan. 17, 2022	Jan. 16, 2023
RF signal cable EMCI	EMC101G-KM-KM- (5000+3000+2000)	201260+201257+20125 4	Jan. 17, 2022	Jan. 16, 2023
Software BV ADT	ADT_Radiated_V7. 6.15.9.5	NA	NA	NA
Antenna Tower Max-Full	MFT-151SS-0.5T	NA	NA	NA
Turn Table Max-Full	MF-7802BS	NA	NA	NA
Turn Table Controller Max-Full	MF-7802BS	MF780208674	NA	NA
USB Wideband Power Sensor KEYSIGHT	U2021XA	MY55050005/MY55190004 /MY55190007/MY5521000 5	Jul. 12, 2021	Jul. 11, 2022

Note: 1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.
 2. The test was performed in WM Chamber 8.

4.1.3 Test Procedures

For Radiated Emission below 30 MHz

- 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. Parallel, perpendicular, and ground-parallel orientations 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, except for the frequency band (9 kHz~90 kHz, 110 kHz~490 kHz) set to average detect function and peak detect function

Note:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 9 kHz at frequency below 30 MHz.
2. There is a comparison data of both open-field test site and semi-Anechoic chamber, and the result came out very similar.

For Radiated Emission above 30 MHz

- a. The EUT was placed on the top of a rotating table 0.8 meters 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.

Note:

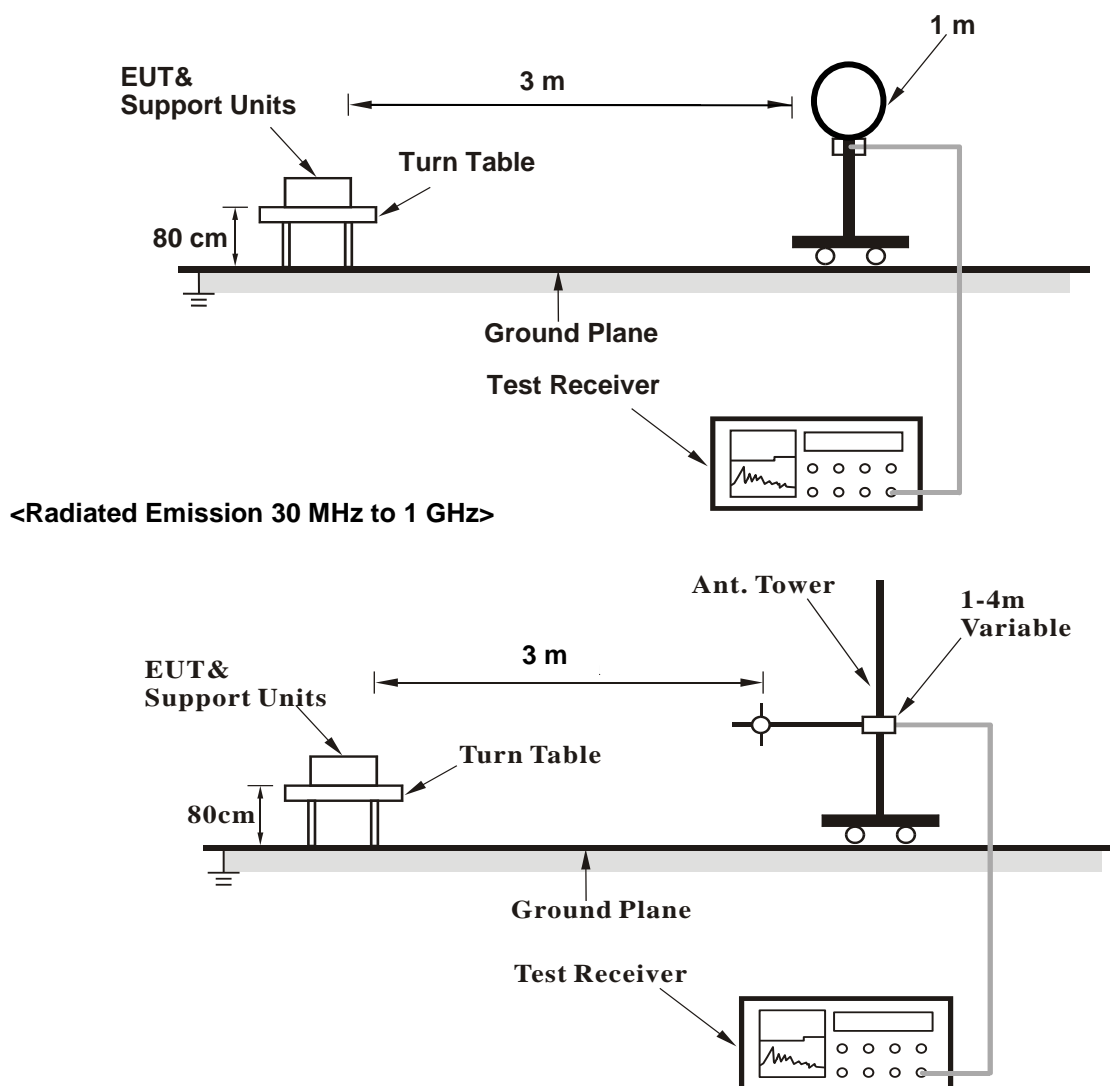
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Quasi-peak detection (QP) at frequency below 1 GHz.
2. All modes of operation were investigated and the worst-case emissions are reported.

4.1.4 Deviation from Test Standard

No deviation.

4.1.5 Test Set Up

<Radiated Emission below 30 MHz>



For the actual test configuration, please refer to the attached file (Test Setup Photo).

KDB 414788 OFS and Chamber Correlation Justification

- Base on FCC 15.31 (f) (2): measurements may be performed at a distance closer than that specified in the regulations; however, an attempt should be made to avoid making measurements in the near field.
- Open-field site and chamber correlation testing had been performed and chamber measured test result is the worst case test result.

4.1.6 EUT Operating Conditions

- a. Placed the EUT on the testing table.
- b. Set the EUT under transmission condition continuously at specific channel frequency.

4.1.7 Test Results

Type A

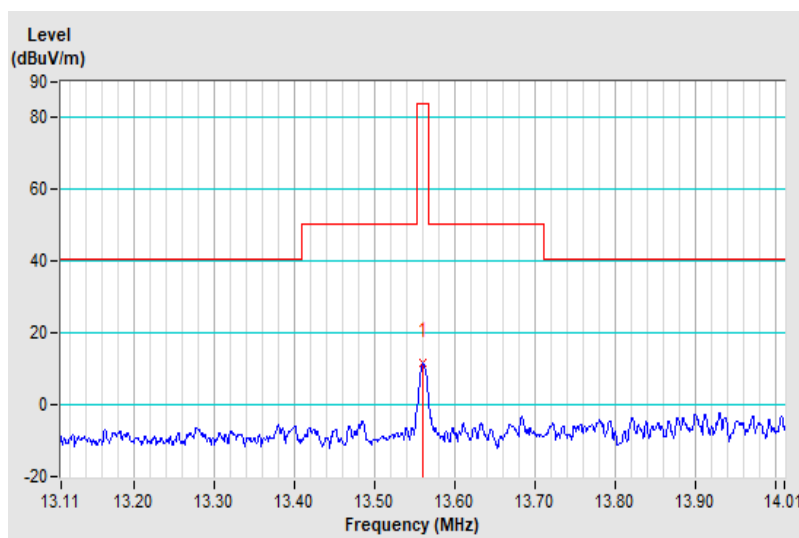
Test Mode	Tx		
RF Mode	NFC-13.56MHz	Channel	CH 1 : 13.56 MHz
Frequency Range	13.11MHz ~ 14.01MHz	Detector Function & Bandwidth	Quasi-Peak (QP), 9kHz
Input Power	12Vdc	Environmental Conditions	21 °C, 68% RH
Test Date	2022/5/20	Tested By	Edison Lee

Antenna Polarity: Parallel								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	*13.56	11.5 QP	84.0	-72.5	1.0	166	29.5	-18.0

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB) + Distance Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " * ": Fundamental frequency.
6. The test distance for 0.49 ~ 30MHz is 3m, extrapolate the measured field strength to a distance of 30 meters.
Distance factor@10m = $40 \cdot \log(3/30) = -40\text{dB}$

The measured field strength was extrapolated to distance 30 meters, using the formula that the limit of field strength varies as the inverse distance square (40dB per decade of distance)



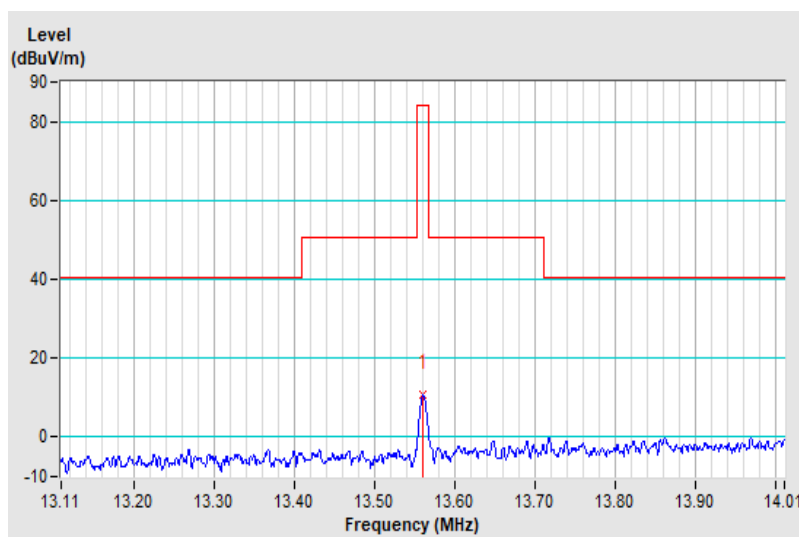
Test Mode	Tx		
RF Mode	NFC-13.56MHz	Channel	CH 1 : 13.56 MHz
Frequency Range	13.11MHz ~ 14.01MHz	Detector Function & Bandwidth	Quasi-Peak (QP), 9kHz
Input Power	12Vdc	Environmental Conditions	21 °C, 68% RH
Test Date	2022/5/20	Tested By	Edison Lee

Antenna Polarity: Perpendicular								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	*13.56	10.7 QP	84.0	-73.3	1.00	101	28.7	-18.0

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB) + Distance Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " * ": Fundamental frequency.
6. The test distance for 0.49 ~ 30MHz is 3m, extrapolate the measured field strength to a distance of 30 meters.
Distance factor@ 10m = $40 \times \log(3/30) = -40\text{dB}$

The measured field strength was extrapolated to distance 30 meters, using the formula that the limit of field strength varies as the inverse distance square (40dB per decade of distance)



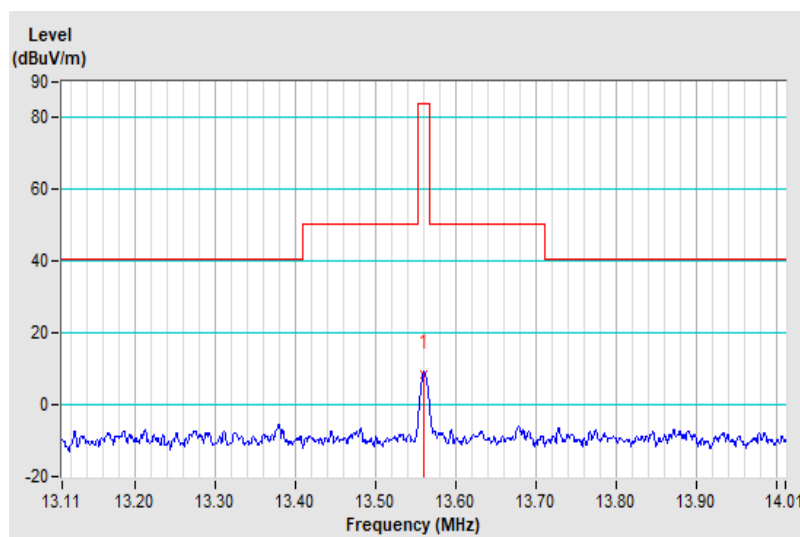
Test Mode	Tx		
RF Mode	NFC-13.56MHz	Channel	CH 1 : 13.56 MHz
Frequency Range	13.11MHz ~ 14.01MHz	Detector Function & Bandwidth	Quasi-Peak (QP), 9kHz
Input Power	12Vdc	Environmental Conditions	21 °C, 68% RH
Test Date	2022/5/20	Tested By	Edison Lee

Antenna Polarity: Ground-parallel								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	*13.56	8.5 QP	84.0	-75.5	1.0	180	26.5	-18.0

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB) + Distance Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " * ": Fundamental frequency.
6. The test distance for 0.49 ~ 30MHz is 3m, extrapolate the measured field strength to a distance of 30 meters.
Distance factor@ 10m = $40 \cdot \log(3/30) = -40\text{dB}$

The measured field strength was extrapolated to distance 30 meters, using the formula that the limit of field strength varies as the inverse distance square (40dB per decade of distance)

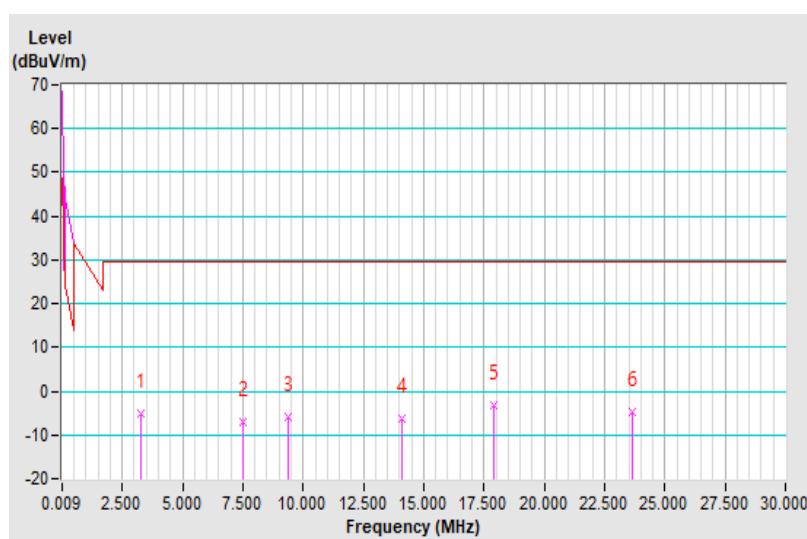


Test Mode	Tx		
RF Mode	NFC-13.56MHz	Channel	CH 1 : 13.56 MHz
Frequency Range	9kHz ~ 30MHz	Detector Function & Bandwidth	Quasi-Peak (QP), 9kHz
Input Power	12Vdc	Environmental Conditions	22 °C, 71% RH
Test Date	2022/6/1	Tested By	Greg Lin

Antenna Polarity: Parallel								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	3.250	-5.20 QP	29.50	-34.70	1.00	230	14.80	-20.00
2	7.510	-6.90 QP	29.50	-36.40	1.00	236	12.00	-18.90
3	9.370	-5.80 QP	29.50	-35.30	1.00	178	12.50	-18.30
4	14.070	-6.30 QP	29.50	-35.80	1.00	203	11.70	-18.00
5	17.880	-3.30 QP	29.50	-32.80	1.00	268	14.60	-17.90
6	23.670	-4.60 QP	29.50	-34.10	1.00	216	13.30	-17.90

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB) + Distance Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. The test distance for 0.49 ~ 30MHz is 3m, extrapolate the measured field strength to a distance of 30 meters.
Distance factor@ 10m = $40 \cdot \log(3/30) = -40\text{dB}$

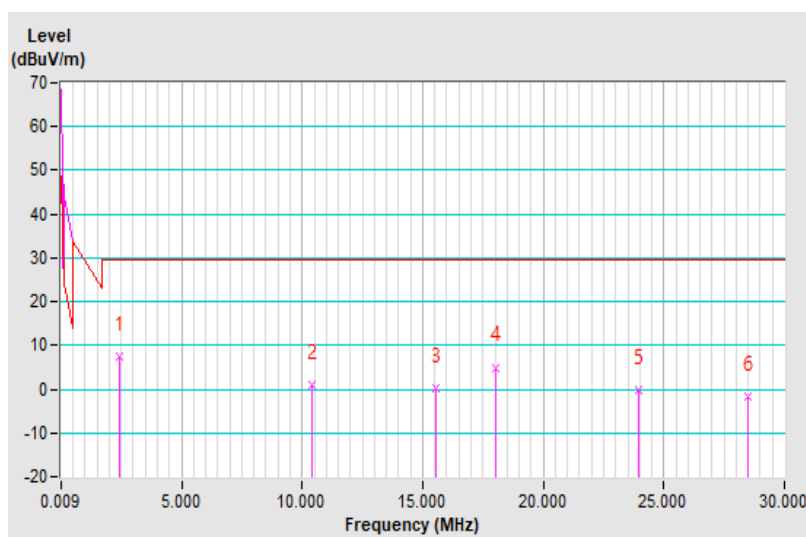


Test Mode	Tx		
RF Mode	NFC-13.56MHz	Channel	CH 1 : 13.56 MHz
Frequency Range	9kHz ~ 30MHz	Detector Function & Bandwidth	Quasi-Peak (QP), 9kHz
Input Power	12Vdc	Environmental Conditions	22 °C, 71% RH
Test Date	2022/6/1	Tested By	Greg Lin

Antenna Polarity: Perpendicular								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	2.440	7.30 QP	29.50	-22.20	1.00	2	27.20	-19.90
2	10.390	1.00 QP	29.50	-28.50	1.00	92	19.10	-18.10
3	15.570	0.10 QP	29.50	-29.40	1.00	167	18.00	-17.90
4	18.000	5.00 QP	29.50	-24.50	1.00	161	22.90	-17.90
5	23.970	-0.10 QP	29.50	-29.60	1.00	8	17.80	-17.90
6	28.470	-1.80 QP	29.50	-31.30	1.00	178	16.20	-18.00

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB) + Distance Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. The test distance for 0.49 ~ 30MHz is 3m, extrapolate the measured field strength to a distance of 30 meters.
Distance factor@ 10m = $40 \cdot \log(3/30) = -40\text{dB}$

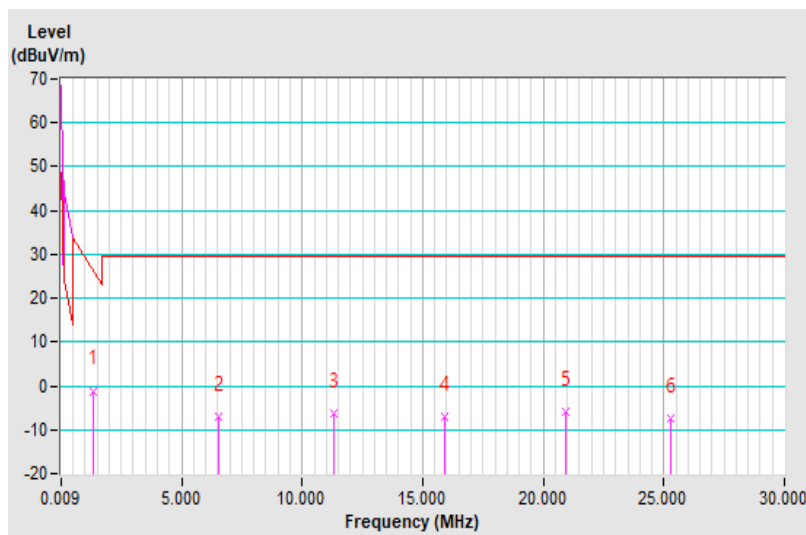


Test Mode	Tx		
RF Mode	NFC-13.56MHz	Channel	CH 1 : 13.56 MHz
Frequency Range	9kHz ~ 30MHz	Detector Function & Bandwidth	Quasi-Peak (QP), 9kHz
Input Power	12Vdc	Environmental Conditions	22 °C, 71% RH
Test Date	2022/6/1	Tested By	Greg Lin

Antenna Polarity: Ground-parallel								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	1.360	-1.10 QP	24.90	-26.00	1.00	43	18.70	-19.80
2	6.520	-7.20 QP	29.50	-36.70	1.00	110	12.10	-19.30
3	11.320	-6.40 QP	29.50	-35.90	1.00	51	11.70	-18.10
4	15.930	-6.90 QP	29.50	-36.40	1.00	224	11.00	-17.90
5	20.910	-5.90 QP	29.50	-35.40	1.00	17	11.90	-17.80
6	25.290	-7.40 QP	29.50	-36.90	1.00	195	10.50	-17.90

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB) + Distance Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. The test distance for 0.49 ~ 30MHz is 3m, extrapolate the measured field strength to a distance of 30 meters.
Distance factor@ 10m = $40 \cdot \log(3/30) = -40\text{dB}$

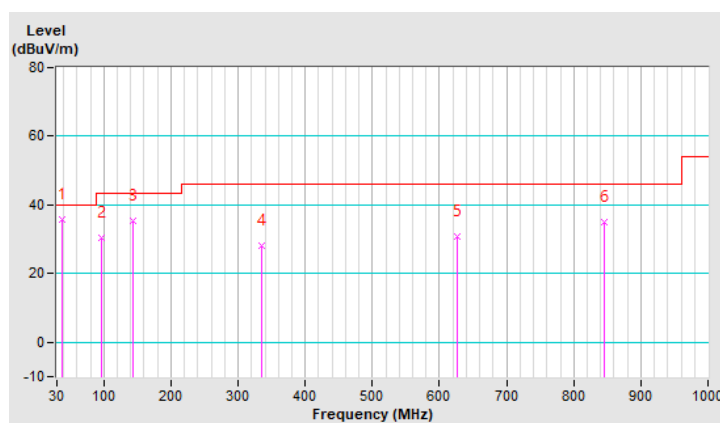


RF Mode	TX NFC-13.56MHz	Channel	CH 1 : 13.56 MHz
Frequency Range	30 MHz ~ 1 GHz	Detector Function & Bandwidth	(QP) RB = 120kHz
Input Power	12Vdc	Environmental Conditions	22 °C, 71% RH
Test Date	2022/6/1	Tested By	Greg Lin

Antenna Polarity & Test Distance : Horizontal at 3 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	38.73	35.6 QP	40.0	-4.4	1.25 H	268	49.4	-13.8
2	95.96	30.6 QP	43.5	-12.9	1.25 H	255	49.3	-18.7
3	143.49	35.3 QP	43.5	-8.2	1.00 H	79	48.8	-13.5
4	334.58	28.2 QP	46.0	-17.8	1.50 H	43	40.1	-11.9
5	626.55	30.8 QP	46.0	-15.2	1.00 H	73	36.2	-5.4
6	844.80	35.1 QP	46.0	-10.9	1.25 H	207	37.2	-2.1

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit of frequency range 30MHz~1000MHz.
5. The emission levels were very low against the limit of frequency range 9kHz~30MHz: the amplitude of spurious emissions attenuated more than 20 dB below the permissible value to be report.

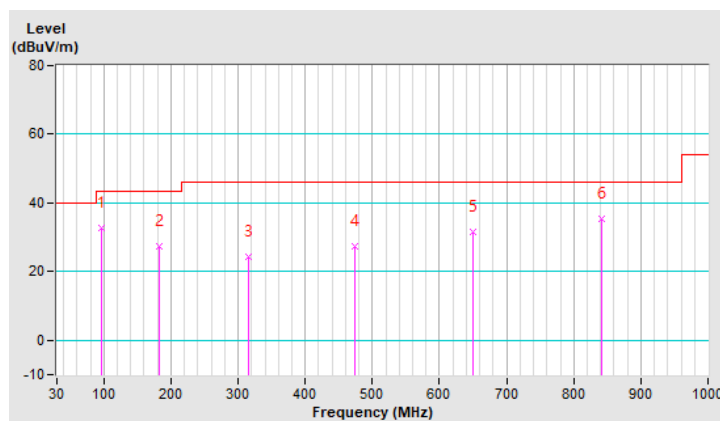


RF Mode	TX NFC-13.56MHz	Channel	CH 1 : 13.56 MHz
Frequency Range	30 MHz ~ 1 GHz	Detector Function & Bandwidth	(QP) RB = 120kHz
Input Power	12Vdc	Environmental Conditions	22 °C, 71% RH
Test Date	2022/6/1	Tested By	Greg Lin

Antenna Polarity & Test Distance : Vertical at 3 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	96.93	32.9 QP	43.5	-10.6	1.00 V	229	51.4	-18.5
2	182.29	27.3 QP	43.5	-16.2	1.25 V	194	42.4	-15.1
3	316.15	24.2 QP	46.0	-21.8	1.00 V	123	36.6	-12.4
4	474.26	27.5 QP	46.0	-18.5	1.50 V	210	36.2	-8.7
5	649.83	31.7 QP	46.0	-14.3	1.25 V	3	36.9	-5.2
6	840.92	35.4 QP	46.0	-10.6	1.50 V	151	37.4	-2.0

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit of frequency range 30MHz~1000MHz.
5. The emission levels were very low against the limit of frequency range 9kHz~30MHz: the amplitude of spurious emissions attenuated more than 20 dB below the permissible value to be report.



Type B

Test Mode	Tx		
RF Mode	NFC-13.56MHz	Channel	CH 1 : 13.56 MHz
Frequency Range	13.11MHz ~ 14.01MHz	Detector Function & Bandwidth	Quasi-Peak (QP), 9kHz
Input Power	12Vdc	Environmental Conditions	21 °C, 68% RH
Test Date	2022/5/31	Tested By	Edison Lee

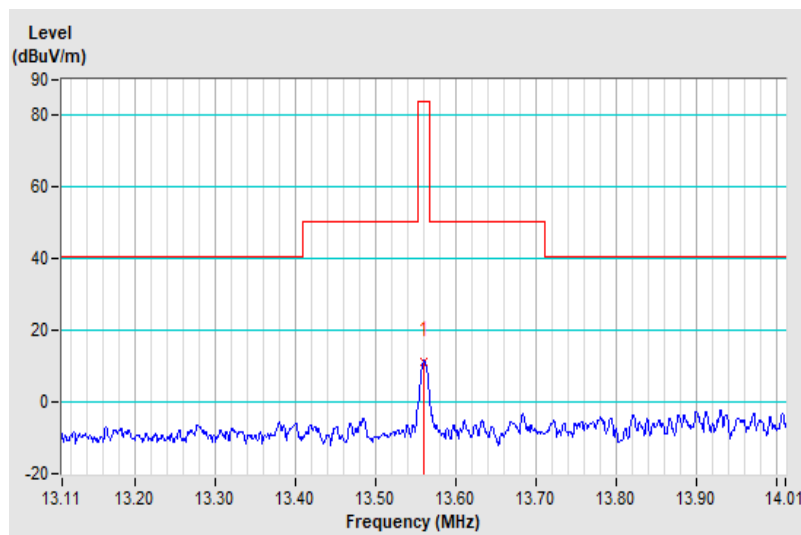
Antenna Polarity & Test Distance: Loop Antenna Parallel at 30 m

No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	*13.56	11.4 QP	84.0	-72.6	1.0	170	29.4	-18.0

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB) + Distance Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " * ": Fundamental frequency.
6. The test distance for 0.49 ~ 30MHz is 3m, extrapolate the measured field strength to a distance of 30 meters.
Distance factor@10m = $40 \times \log(3/30) = -40\text{dB}$

The measured field strength was extrapolated to distance 30 meters, using the formula that the limit of field strength varies as the inverse distance square (40dB per decade of distance)



Test Mode	Tx		
RF Mode	NFC-13.56MHz	Channel	CH 1 : 13.56 MHz
Frequency Range	13.11MHz ~ 14.01MHz	Detector Function & Bandwidth	Quasi-Peak (QP), 9kHz
Input Power	12Vdc	Environmental Conditions	21 °C, 68% RH
Test Date	2022/5/31	Tested By	Edison Lee

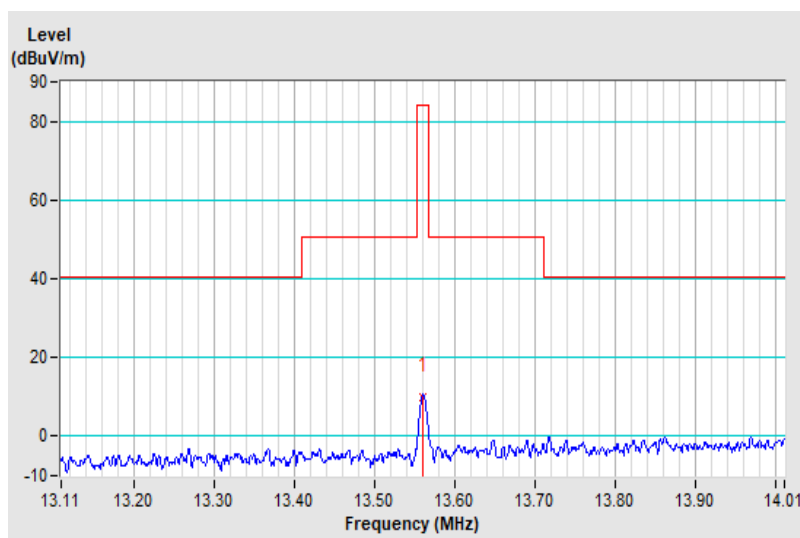
Antenna Polarity & Test Distance: Loop Antenna Perpendicular at 30 m

No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	*13.56	9.8 QP	84.0	-74.2	1.00	92	27.8	-18.0

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB) + Distance Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " * ": Fundamental frequency.
6. The test distance for 0.49 ~ 30MHz is 3m, extrapolate the measured field strength to a distance of 30 meters.
Distance factor@10m = $40 \times \log(3/30) = -40\text{dB}$

The measured field strength was extrapolated to distance 30 meters, using the formula that the limit of field strength varies as the inverse distance square (40dB per decade of distance)



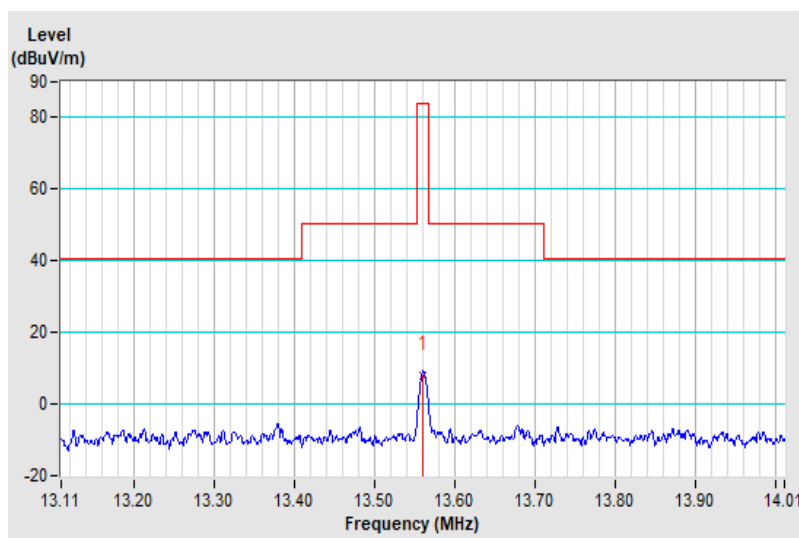
Test Mode	Tx		
RF Mode	NFC-13.56MHz	Channel	CH 1 : 13.56 MHz
Frequency Range	13.11MHz ~ 14.01MHz	Detector Function & Bandwidth	Quasi-Peak (QP), 9kHz
Input Power	12Vdc	Environmental Conditions	21 °C, 68% RH
Test Date	2022/5/20	Tested By	Edison Lee

Antenna Polarity & Test Distance: Loop Antenna Ground-parallel at 30 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	*13.56	8.1 QP	84.0	-75.9	1.0	185	26.1	-18.0

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB) + Distance Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " * ": Fundamental frequency.
6. The test distance for 0.49 ~ 30MHz is 3m, extrapolate the measured field strength to a distance of 30 meters.
Distance factor@10m = $40 \cdot \log(3/30) = -40\text{dB}$

The measured field strength was extrapolated to distance 30 meters, using the formula that the limit of field strength varies as the inverse distance square (40dB per decade of distance)

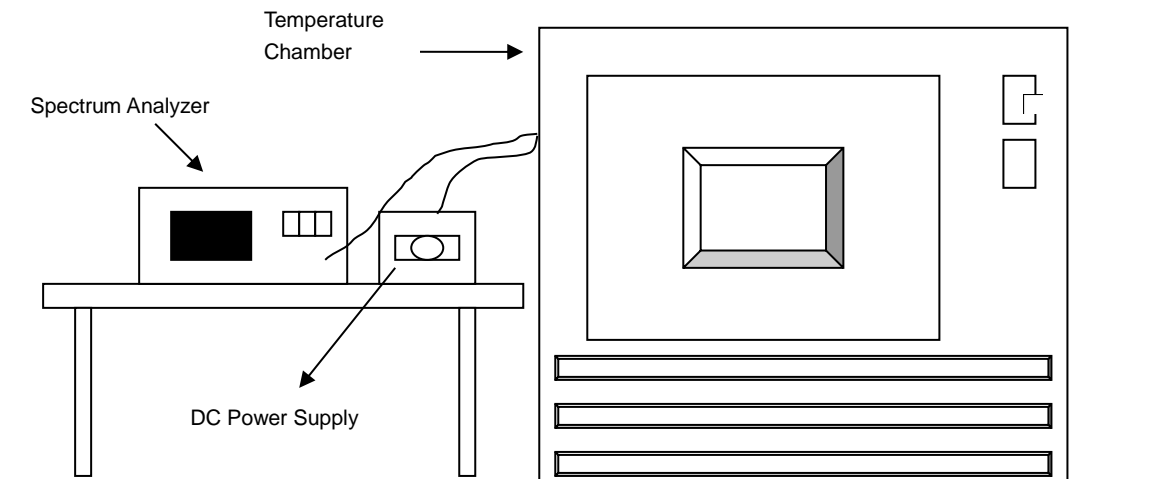


4.2 Frequency Stability

4.2.1 Limits of Frequency Stability Measurement

The frequency tolerance of the carrier signal shall be maintained within $\pm 0.01\%$ of the operating frequency over a temperature variation of -20 degrees to 50 degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C.

4.2.2 Test Setup



4.2.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.2.4 Test Procedure

- The EUT was placed inside the environmental test chamber and powered by nominal DC voltage.
- Turned the EUT on and coupled its output to a spectrum analyzer.
- Turned the EUT off and set the chamber to the highest temperature specified.
- Allowed sufficient time (approximately 30 min) for the temperature of the chamber to stabilize then turned the EUT on and measured the operating frequency after 2, 5, and 10 minutes.
- Repeated step c and d with the every 10 degrees reduction until the lowest temperature achieved.
- The test chamber was allowed to stabilize at $+20$ degree C for a minimum of 30 minutes. The supply voltage was then adjusted on the EUT from 85% to 115% and the frequency record.

4.2.5 Deviation from Test Standard

No deviation.

4.2.6 EUT Operating Conditions

- Placed the EUT on the testing table.
- Set the EUT under transmission condition continuously at specific channel frequency.

4.2.7 Test Results

Type A

Frequency Stability Versus Temperature									
Temp. (°C)	Power Supply (Vdc)	0 Minute		2 Minute		5 Minute		10 Minute	
		Measured Frequency	Frequency Drift	Measured Frequency	Frequency Drift	Measured Frequency	Frequency Drift	Measured Frequency	Frequency Drift
		(MHz)	%	(MHz)	%	(MHz)	%	(MHz)	%
50	12	13.55998	-0.00015	13.55998	-0.00015	13.55998	-0.00015	13.55998	-0.00015
40	12	13.55999	-0.00007	13.55998	-0.00015	13.55999	-0.00007	13.55999	-0.00007
30	12	13.55998	-0.00015	13.55997	-0.00022	13.55997	-0.00022	13.55997	-0.00022
20	12	13.56006	0.00044	13.56006	0.00044	13.56007	0.00052	13.56007	0.00052
10	12	13.55995	-0.00037	13.55995	-0.00037	13.55994	-0.00044	13.55995	-0.00037
0	12	13.55994	-0.00044	13.55994	-0.00044	13.55995	-0.00037	13.55994	-0.00044
-10	12	13.56006	0.00044	13.56006	0.00044	13.56005	0.00037	13.56006	0.00044
-20	12	13.56004	0.00029	13.56004	0.00029	13.56004	0.00029	13.56005	0.00037

Frequency Stability Versus Voltage									
Temp. (°C)	Power Supply (Vdc)	0 Minute		2 Minute		5 Minute		10 Minute	
		Measured Frequency	Frequency Drift	Measured Frequency	Frequency Drift	Measured Frequency	Frequency Drift	Measured Frequency	Frequency Drift
		(MHz)	%	(MHz)	%	(MHz)	%	(MHz)	%
20	13.8	13.56006	0.00044	13.56006	0.00044	13.56007	0.00052	13.56007	0.00052
	12	13.56006	0.00044	13.56006	0.00044	13.56007	0.00052	13.56007	0.00052
	10.2	13.56006	0.00044	13.56006	0.00044	13.56007	0.00052	13.56007	0.00052

4.3 20 dB Bandwidth

4.3.1 Limits of 20 dB Bandwidth Measurement

The 20 dB bandwidth shall be specified in operating frequency band.

4.3.2 Test Setup

Refer to section 4.1.5.

4.3.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.3.4 Test Procedures

The bandwidth of the fundamental frequency was measured by spectrum analyzer with 1 kHz RBW and 3 kHz VBW. The 20 dB bandwidth is defined as the total spectrum the power of which is higher than peak power minus 20 dB.

4.3.5 Deviation from Test Standard

No deviation.

4.3.6 EUT Operating Conditions

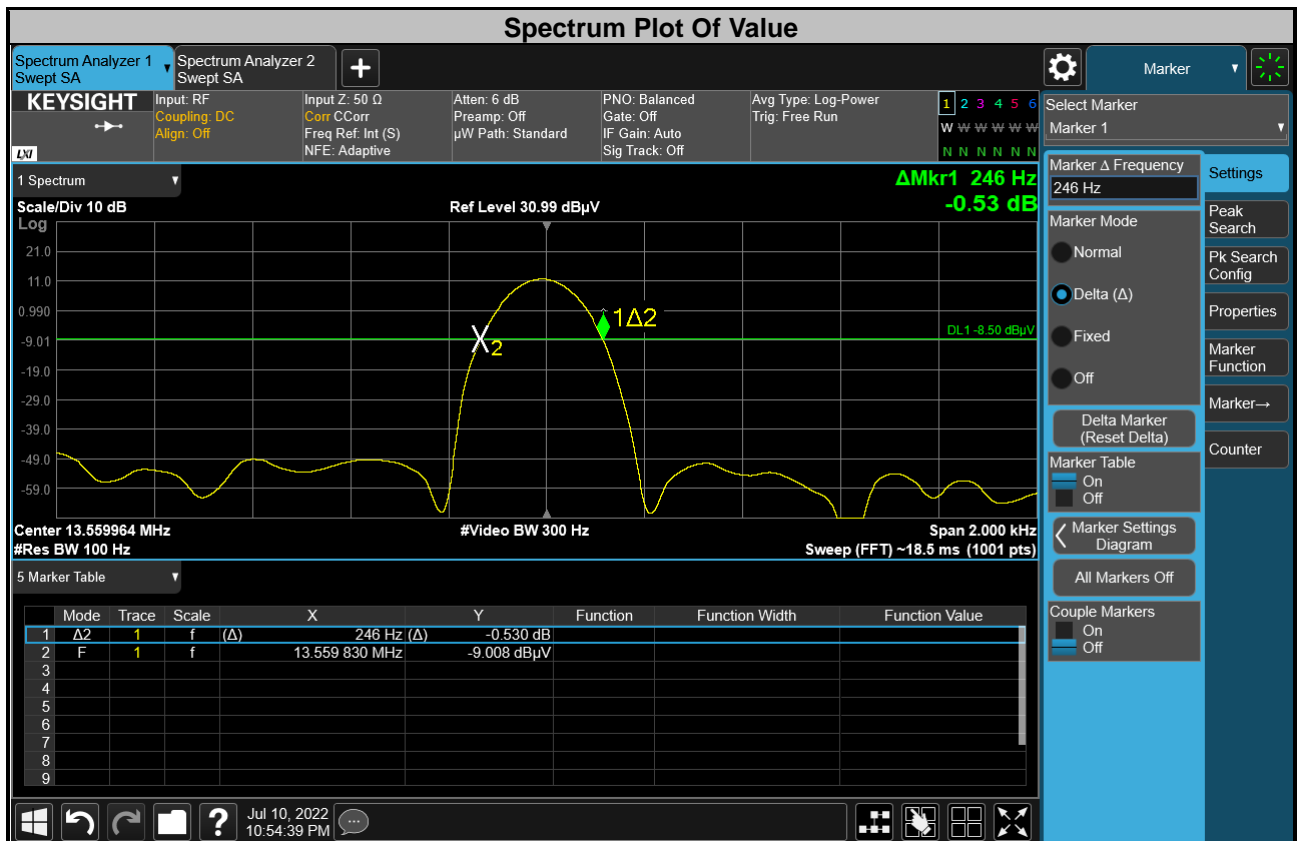
- a. Placed the EUT on the testing table.
- b. Set the EUT under transmission condition continuously at specific channel frequency.

4.3.7 Test Results

Type A

20 dBc Point (Low)	20 dBc Point (High)	Operating Frequency Band (MHz)	Pass / Fail
13.559830 MHz	13.560076 MHz	13.553~13.567	Pass

*20 dBc Point (High)= Marker 1 + Delta 1



Note: The signal look like CW signal, so RBW can't be match 1~5 % OBW.

5 Pictures of Test Arrangements

Please refer to the attached file (Test Setup Photo).

Appendix – Information of the Testing Laboratories

We, Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch, were founded in 1988 to provide our best service in EMC, Radio, Telecom and Safety consultation. Our laboratories are FCC recognized accredited test firms and accredited according to ISO/IEC 17025.

If you have any comments, please feel free to contact us at the following:

Lin Kou EMC/RF Lab

Tel: 886-2-26052180

Fax: 886-2-26051924

Hsin Chu EMC/RF/Telecom Lab

Tel: 886-3-6668565

Fax: 886-3-6668323

Hwa Ya EMC/RF/Safety Lab

Tel: 886-3-3183232

Fax: 886-3-3270892

Email: service.adt@tw.bureauveritas.com

Web Site: www.bureauveritas-adt.com

The address and road map of all our labs can be found in our web site also.

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