FCC Test Report

Report No.:	RFBEDW-WTW-P22070684
FCC ID:	E2K-DWRFID2203
Test Model:	DWRFID2203
Received Date:	Jul. 22, 2022
Test Date:	Nov. 10 ~ Nov. 14, 2022
Issued Date:	Nov. 30, 2022
Applicant:	Dell Inc.
Address:	One Dell Way, Round Rock, Texas 78682, USA
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.19, Hwa Ya 2nd Rd., Wen Hwa Vil., Kwei Shan Dist., Taoyuan City 33383, Taiwan
FCC Registration / Designation Number:	788550 / TW0003

Testing Laboratory
2021

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Release Control Record

Issue No.	Description	Date Issued
RFBEDW-WTW-P22070684	Original Release	Nov. 30, 2022

1 Certificate of Conformity

Product:	RFID 13.56MHz Wireless Module
Brand:	DELL
Test Model:	DWRFID2203
Sample Status:	Production Unit
Applicant:	Dell Inc.
Test Date:	Nov. 10 ~ Nov. 14, 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 : Gina Liu , **Date:** Nov. 30, 2022

Gina Liu / Specialist

Approved by : Jeremy Lin , **Date:** Nov. 30, 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	Pass	Meet the requirement of limit. Minimum passing margin is -8.02 dB at 13.55800 MHz.
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 -74.2 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 -5.2 dB at 43.58 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) (±)
Conducted Emissions at mains ports	150 kHz ~ 30 MHz	2.79 dB
Radiated Emissions up to 1 GHz	9 kHz ~ 30 MHz	3.04 dB
	30 MHz ~ 200 MHz	2.93 dB
	200 MHz ~ 1000 MHz	2.95 dB

2.2 Modification Record

There were no modifications required for compliance.

3 General Information

3.1 General Description of EUT

Product	RFID 13.56MHz Wireless Module
Brand	DELL
Test Model	DWRFID2203
Status of EUT	Production Unit
Power Supply Rating	3.3 Vdc (host equipment)
Modulation Type	ASK
Data Rate	Type A: 106 kbit/s Type B: 106 kbit/s Type F: 212 kbit/s, 424 kbit/s Type V: 26.48 kbit/s
Operating Frequency	13.56 MHz
Field Strength (Maximum)	9.8 dBuV/m (30m)
Antenna Type	Refer to Note as below
Accessory Device	Refer to Note as below
Data Cable Supplied	NA

Note:

1. The EUT is authorized for use in specific End-product. Please refer to below table for further details.

Product Name	Brand	Model
Portable Computer	DELL	P165G

2. The antenna information is listed as below.

Antenna Manufacturer	Antenna Model No.	Antenna Type	Antenna Gain (dBi)
Hong-Bo	350-24030 (DC33002RW3L)	Loop Antenna	N/A
Speedwire	F-0W-FH-6161-001-00 (DC33002RX3L)	Loop Antenna	N/A

*After pre-test, Hong-Bo antenna was the worst for the final tests.

3. The EUT support NFC Type: A, B, F, V. The EUT had been pre-tested on Type A, Type B, Type F, Type V data rate. The Type F is the worst for the final tests.
4. Detail antenna specification please refer to antenna photos/or drawings, including antenna dimensions.
5. The End-product contains following accessory devices.

Product	Brand	Model	Description
Adapter	DELL	HA130PM170	I/P: 100-240 Vac, 50-60 Hz, 1.8 A O/P: 20.0Vdc, 6.5A or 5.0Vdc, 1.0A Power cord: 0.85 meter
Battery	DELL	DR02P	4623mAh, 54Wh, 11.4V

6. 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.

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	
-	√	√	√	√	EUT with Hong-Bo Ant

Where **RE:** Radiated Emission **PLC:** Power Line Conducted Emission
FS: Frequency Stability **EB:** 20 dB Bandwidth measurement

NOTE: The EUT had been pre-test on Type A, Type B, Type F and Type V. Type F was the worst case for final test.

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
-	1	1	ASK

Power Line Conducted 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
-	1	1	ASK

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
-	1	1	ASK

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
-	1	1	ASK

Test Condition:

Applicable To	Environmental Conditions	Input Power	Tested By
RE	24 deg. C, 69 % RH	120 Vac, 60 Hz	Vincent Chen
FS	22 deg. C, 67 % RH	120 Vac, 60 Hz	Vincent Chen
PLC	23.1 deg. C, 71.4 % RH	120 Vac, 60 Hz	Thomas Cheng
EB	22 deg. C, 67 % RH	120 Vac, 60 Hz	Vincent Chen

3.3 Description of Support Units

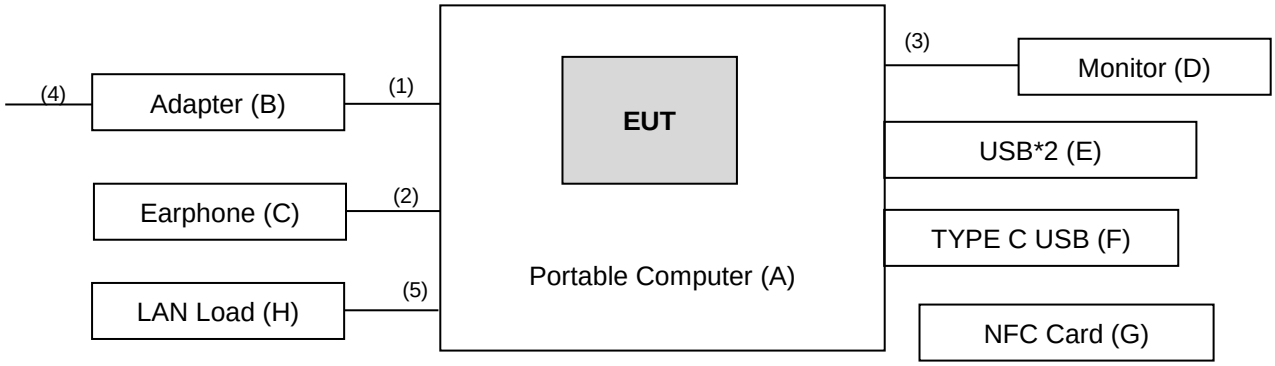
The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

ID	Product	Brand	Model No.	Serial No.	FCC ID	Remarks
A.	Portable Computer	DELL	P165G	NA	NA	Provided by client
B.	Adapter	DELL	HA130PM170	NA	NA	Provided by client
C	Earphone	APPLE	MB77PFEB	NA	NA	Provided by Lab
D	Monitor	DELL	A14S2421HSXmTW	CN-01KWFW-WSL00-24C-711B	NA	Provided by Lab
E	USB*2	TRANSCEND	USB3.0 32GB	NA	NA	Provided by Lab
F	TYPE C USB	SanDisk	SDDDC3-032G	NA	NA	Provided by Lab
G	NFC Card	NA	NA	NA	NA	Provided by Lab
H	LAN Load	NA	NA	NA	NA	Provided by Lab

ID	Descriptions	Qty.	Length (m)	Shielding (Yes/No)	Cores (Qty.)	Remarks
1.	DC Power cable	1	1.8	N	0	Provided by client
2.	Audio cable	1	1.2	N	0	Provided by Lab
3.	HDMI cable	1	1.8	Y	0	Provided by Lab
4.	Power Cord	1	0.85	N	0	Provided by client
5.	LAN cable	1	1.5	N	0	Provided by Lab

Note: 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

a. The field strength of any emissions within the band 13.553-13.567 MHz shall not exceed 15,848 microvolts/meter at 30 meters.
b. 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.
c. 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.
d. 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:

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBuV/m) = 20 log Emission level (uV/m).
3. 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.	Date of Calibration	Due Date of Calibration
Software BV ADT	ADT_Radiated_ V7.6.15.9.5	NA	NA	NA
Antenna Tower &Turn Max-Full	MFA-440H	AT93021705	NA	NA
Turn Table Max-Full	MFT-201SS	NA	NA	NA
Turn Table Controller Max-Full	MG-7802	NA	NA	NA
Test Receiver KEYSIGHT	N9038A	MY55420137	Apr. 27, 2022	Apr. 26, 2023
Signal Analyzer Agilent	N9010A	MY52220207	Jan. 06, 2022	Jan. 05, 2023
Loop Antenna TESEQ	HLA 6121	45745	July 27, 2022	July 26, 2023
Loop Antenna EMCI	EM-6879	269	Sep. 19, 2022	Sep. 18, 2023
Pre-amplifier EMCI	EMC001340	980201	Sep. 23, 2022	Sep. 22, 2023
RF Coaxial Cable EMCI	5D-NM-BM	140903+140902	Jan. 15, 2022	Jan. 14, 2023
Pre-Ammlifier EMCI	EMC 330H	980112	Oct. 01, 2022	Sep. 30, 2023
Bi_Log Antenna Schwarzbeck	VULB9168	9168-472	Oct. 21, 2022	Oct. 20, 2023
RF Coaxial Cable WOKEN	8D-FB	Cable-Ch10-01	Oct. 01, 2022	Sep. 30, 2023

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 HY - 966 chamber 5.

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 (9kHz-90kHz, 110Hz-490kHz) set to average 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:

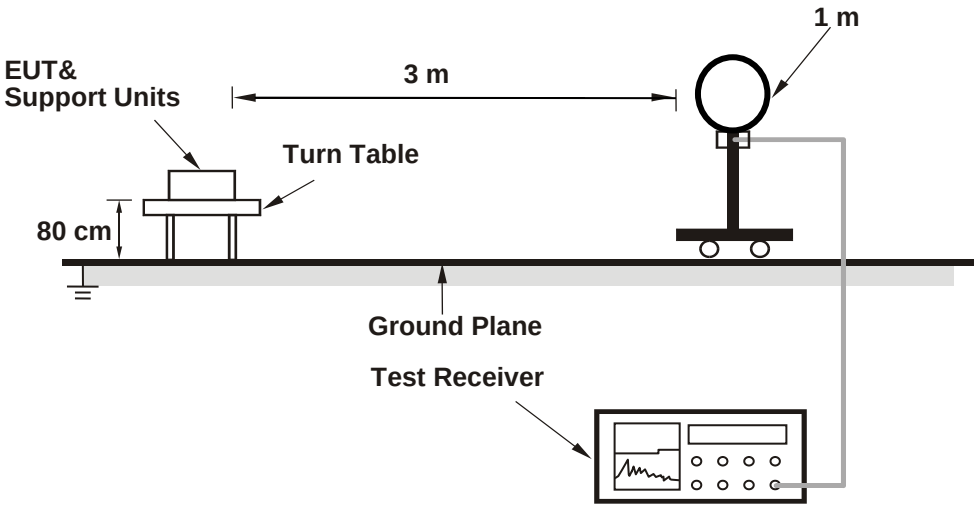
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Quasi-peak detection (QP) at frequency below 1 GHz.
2. All modes of operation were investigated and the worst-case emissions are reported.

4.1.4 Deviation from Test Standard

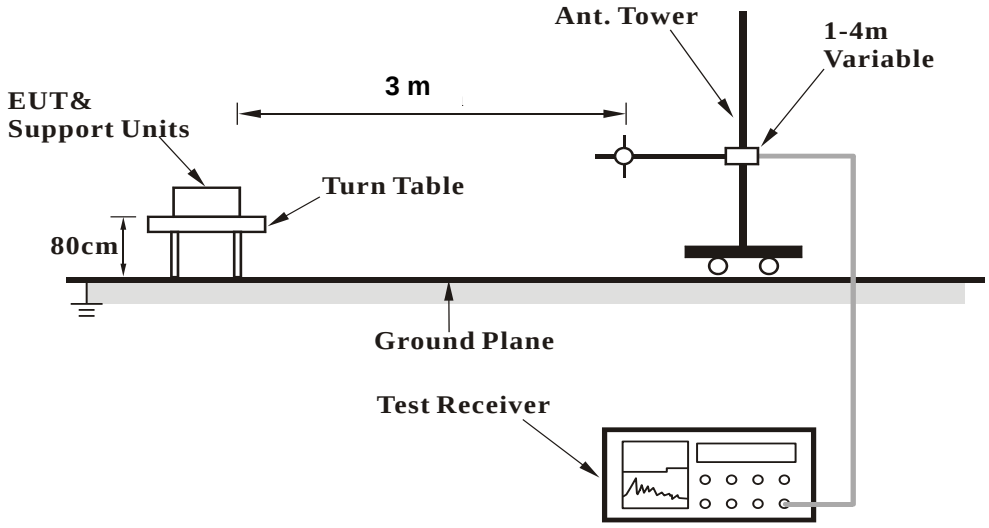
No deviation.

4.1.5 Test Set Up

<Radiated Emission below 30 MHz>



<Radiated Emission 30 MHz to 1 GHz>



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 F

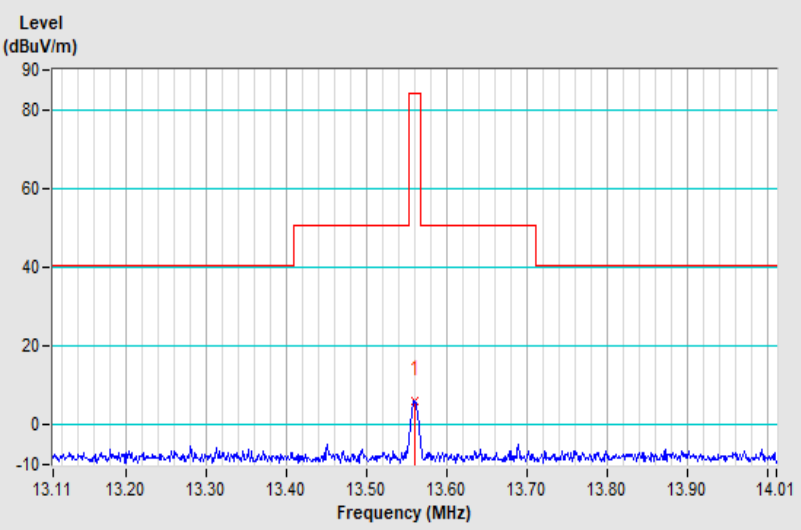
Channel	Channel 1	**Frequency Range**	13.11MHz ~ 14.01MHz
Input Power	120Vac, 60Hz	**Detector Function & Bandwidth**	Quasi-Peak (QP), 9kHz
Environmental Conditions	24°C, 69% RH	**Tested By**	Vincent Chen

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	6.3 QP	84.0	-77.7	1.00	286	24.5	-18.2

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. Above limits have been translated by the formula

The measured field strength was extrapolated to distance 30 meters distance factor@3m = 40* log(3/10) = -40dB, using the formula that the limit of field strength varies as the inverse distance square (40dB per decade of distance)



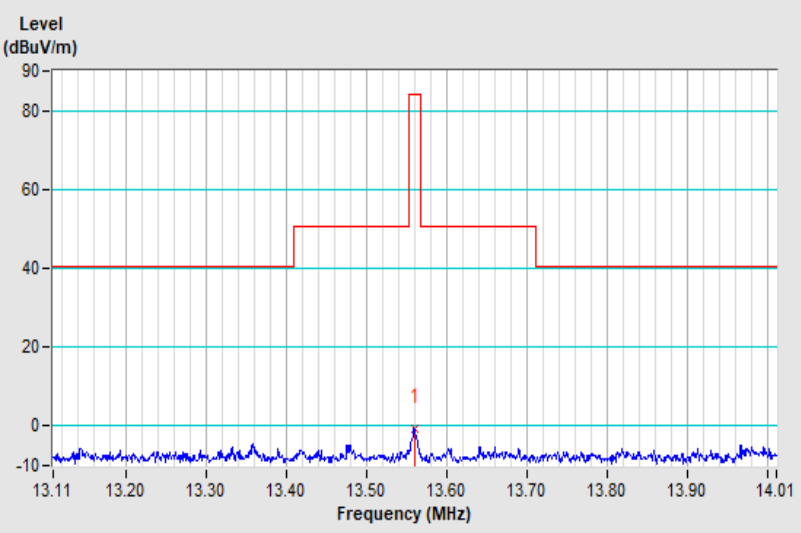
Channel	Channel 1	**Frequency Range**	13.11MHz ~ 14.01MHz
Input Power	120Vac, 60Hz	**Detector Function & Bandwidth**	Quasi-Peak (QP), 9kHz
Environmental Conditions	24°C, 69% RH	**Tested By**	Vincent Chen

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	-0.6 QP	84.0	-84.6	1.00	266	17.6	-18.2

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. Above limits have been translated by the formula

The measured field strength was extrapolated to distance 30 meters distance factor@3m = 40* log(3/10) = -40dB, using the formula that the limit of field strength varies as the inverse distance square (40dB per decade of distance)



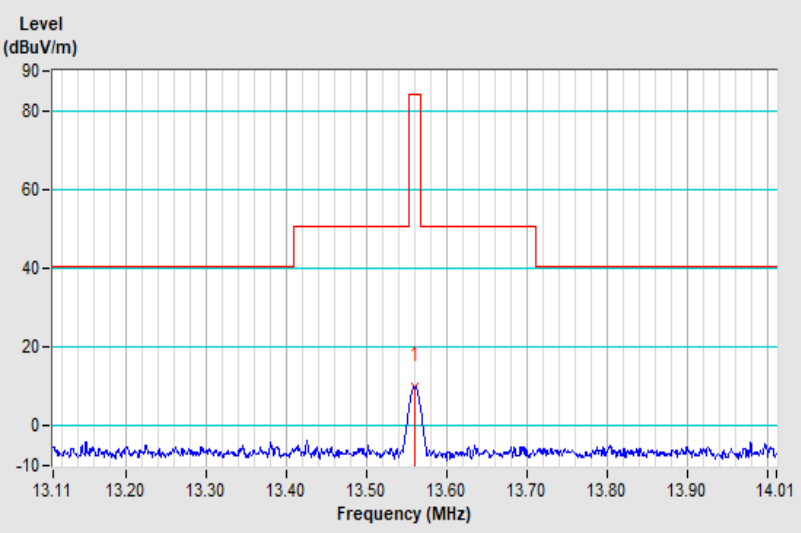
Channel	Channel 1	**Frequency Range**	13.11MHz ~ 14.01MHz
Input Power	120Vac, 60Hz	**Detector Function & Bandwidth**	Quasi-Peak (QP), 9kHz
Environmental Conditions	24°C, 69% RH	**Tested By**	Vincent Chen

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**	**9.8 QP**	**84.0**	**-74.2**	**1.00**	**2**	**28.0**	**-18.2**

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. Above limits have been translated by the formula

The measured field strength was extrapolated to distance 30 meters distance factor@3m = 40* log(3/10) = -40dB, using the formula that the limit of field strength varies as the inverse distance square (40dB per decade of distance)

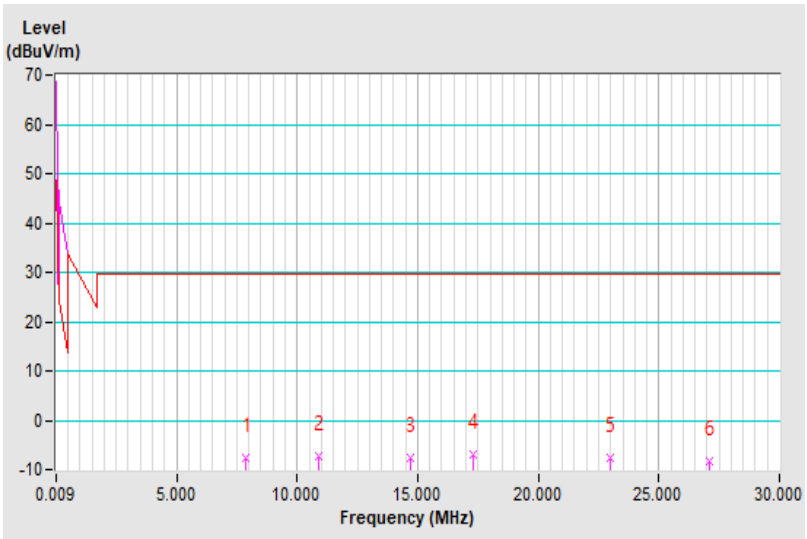


Channel	Channel 1	**Frequency Range**	9kHz ~ 30MHz
Input Power	120Vac, 60Hz	**Detector Function & Bandwidth**	Quasi-Peak (QP), 9kHz
Environmental Conditions	24°C, 69% RH	**Tested By**	Vincent Chen

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	7.90	-7.5 QP	29.5	-37.0	1.00	246	11.5	-19.0
2	10.87	-7.2 QP	29.5	-36.7	1.00	328	11.0	-18.2
3	14.70	-7.5 QP	29.5	-37.0	1.00	18	10.7	-18.2
4	17.31	-6.9 QP	29.5	-36.4	1.00	49	11.2	-18.1
5	23.01	-7.6 QP	29.5	-37.1	1.00	340	10.5	-18.1
6	27.12	-8.2 QP	29.5	-37.7	1.00	317	9.9	-18.1

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) + Distance Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. For 0.49 ~ 30MHz, the measured field strength was extrapolated to distance 30 meters Distance factor@3m = 40*log(3/30) = -40dB

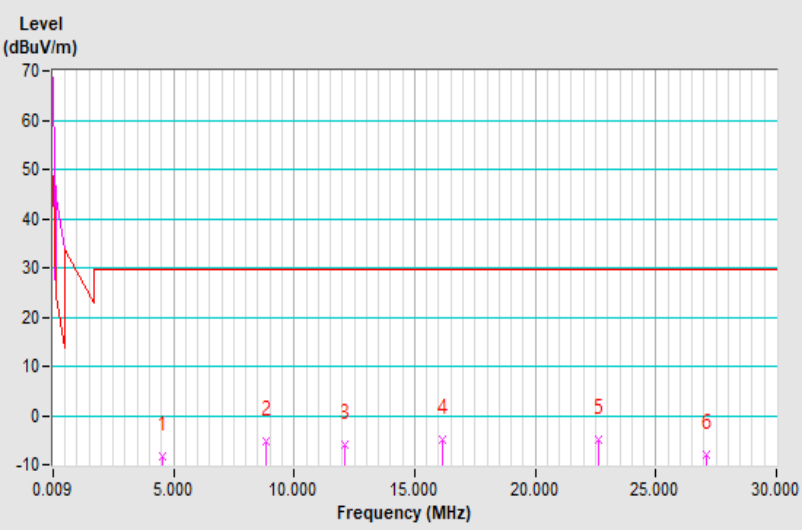


Channel	Channel 1	Frequency Range	9kHz ~ 30MHz
Input Power	120Vac, 60Hz	Detector Function & Bandwidth	Quasi-Peak (QP), 9kHz
Environmental Conditions	24°C, 69% RH	Tested By	Vincent Chen

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	4.57	-8.4 QP	29.5	-37.9	1.00	338	11.6	-20.0
2	8.83	-5.2 QP	29.5	-34.7	1.00	322	13.4	-18.6
3	12.13	-5.9 QP	29.5	-35.4	1.00	323	12.3	-18.2
4	16.17	-4.9 QP	29.5	-34.4	1.00	284	13.2	-18.1
5	22.62	-5.0 QP	29.5	-34.5	1.00	2	13.1	-18.1
6	27.12	-7.9 QP	29.5	-37.4	1.00	81	10.2	-18.1

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) + Distance Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. For 0.49 ~ 30MHz, the measured field strength was extrapolated to distance 30 meters Distance factor@3m = 40*log(3/30) = -40dB

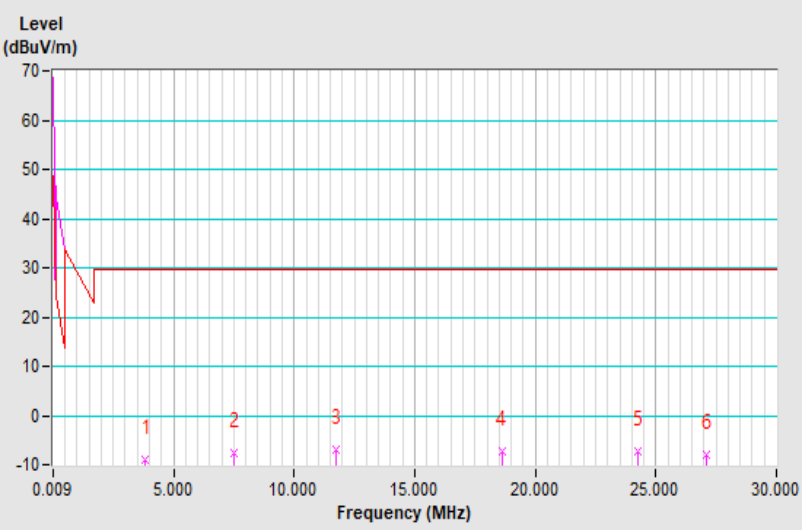


Channel	Channel 1	**Frequency Range**	9kHz ~ 30MHz
Input Power	120Vac, 60Hz	**Detector Function & Bandwidth**	Quasi-Peak (QP), 9kHz
Environmental Conditions	24°C, 69% RH	**Tested By**	Vincent Chen

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	3.85	-9.0 QP	29.5	-38.5	1.00	123	10.9	-19.9
2	7.48	-7.6 QP	29.5	-37.1	1.00	351	11.6	-19.2
3	11.74	-6.9 QP	29.5	-36.4	1.00	306	11.3	-18.2
4	18.60	-7.3 QP	29.5	-36.8	1.00	4	10.8	-18.1
5	24.24	-7.4 QP	29.5	-36.9	1.00	256	10.7	-18.1
6	27.12	-8.1 QP	29.5	-37.6	1.00	316	10.0	-18.1

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) + Distance Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. For 0.49 ~ 30MHz, the measured field strength was extrapolated to distance 30 meters Distance factor@3m = 40*log(3/30) = -40dB

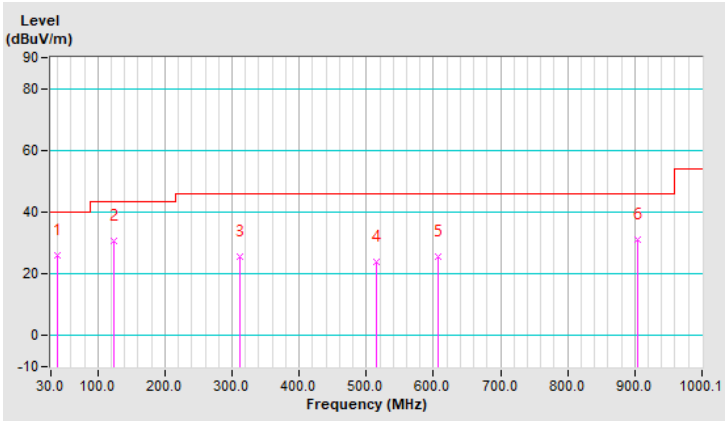


Channel	Channel 1	**Frequency Range**	30MHz ~ 1GHz
Input Power	120Vac, 60Hz	**Detector Function**	Quasi-Peak (QP)
Environmental Conditions	24°C, 69% RH	**Tested By**	Vincent Chen

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	40.67	26.2 QP	40.0	-13.8	2.00 H	278	38.6	-12.4
2	124.10	30.7 QP	43.5	-12.8	2.00 H	322	44.7	-14.0
3	312.30	25.8 QP	46.0	-20.2	1.00 H	4	37.2	-11.4
4	515.05	24.1 QP	46.0	-21.9	1.50 H	275	30.6	-6.5
5	607.21	25.4 QP	46.0	-20.6	1.50 H	20	30.6	-5.2
6	904.06	31.2 QP	46.0	-14.8	1.00 H	280	32.2	-1.0

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.

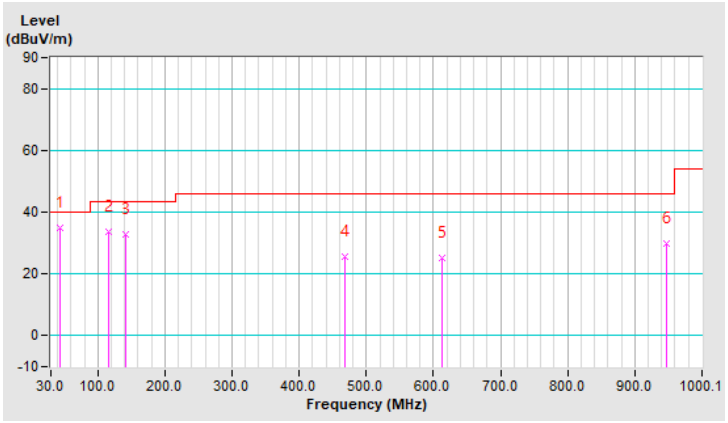


Channel	Channel 1	**Frequency Range**	30MHz ~ 1GHz
Input Power	120Vac, 60Hz	**Detector Function**	Quasi-Peak (QP)
Environmental Conditions	24°C, 69% RH	**Tested By**	Vincent Chen

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	**43.58**	**34.8 QP**	**40.0**	**-5.2**	**1.00 V**	**93**	**47.2**	**-12.4**
2	115.37	33.7 QP	43.5	-9.8	1.00 V	327	48.4	-14.7
3	140.59	32.8 QP	43.5	-10.7	1.00 V	118	45.5	-12.7
4	467.52	25.7 QP	46.0	-20.3	1.00 V	175	33.4	-7.7
5	613.03	25.0 QP	46.0	-21.0	1.50 V	332	30.0	-5.0
6	947.71	29.7 QP	46.0	-16.3	2.00 V	18	30.2	-0.5

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.



4.2 Conducted Emission Measurement

4.2.1 Limits of Conducted Emission Measurement

Frequency (MHz)	Conducted Limit (dBuV)	
	Quasi-Peak	Average
0.15 - 0.5	66 - 56	56 - 46
0.50 - 5.0	56	46
5.0 - 30.0	60	50

Note:

1. The lower limit shall apply at the transition frequencies.
2. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50 MHz.
3. All emanations from a class A/B digital device or system, including any network of conductors and apparatus connected thereto, shall not exceed the level of field strengths specified above.

4.2.2 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Date of Calibration	Due Date of Calibration
Test Receiver ROHDE & SCHWARZ	ESR3	102783	Dec. 20, 2021	Dec. 19, 2022
RF signal cable (with 10dB PAD) Woken	5D-FB	Cable-cond2-01	Sep. 03, 2022	Sep. 02, 2023
LISN/AMN ROHDE & SCHWARZ (EUT)	ESH2-Z5	100100	Feb. 17, 2022	Feb. 16, 2023
LISN/AMN ROHDE & SCHWARZ (Peripheral)	ESH3-Z5	100312	Sep. 22, 2022	Sep. 21, 2023
Software ADT	BV ADT_Cond_ V7.3.7.4	NA	NA	NA

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 HwaYa Shielded Room 2 (Conduction 2).
3. The VCCI Site Registration No. is C-12047.
4. Test Date: 2022/11/14

4.2.3 Test Procedures

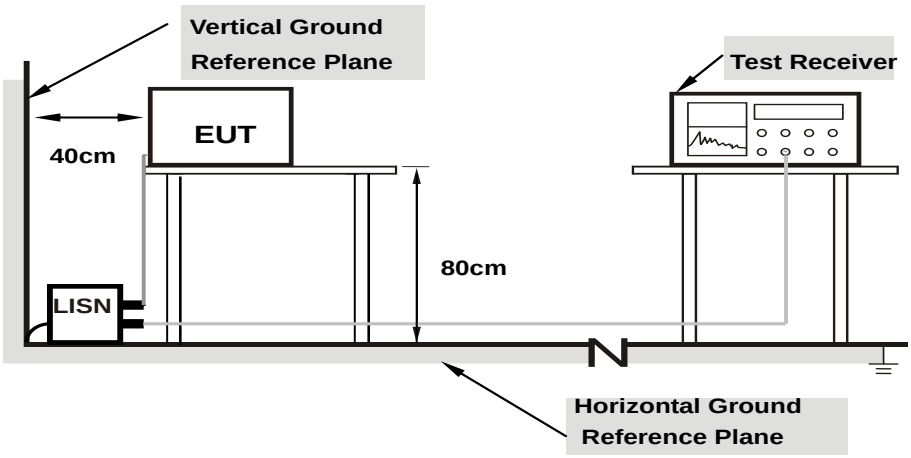
a. The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/50 uH of coupling impedance for the measuring instrument.
b. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.
c. The frequency range from 150 kHz to 30 MHz was searched. Emission levels under (Limit – 20 dB) was not recorded.

Note: The resolution bandwidth and video bandwidth of test receiver is 9 kHz for quasi-peak detection (QP) and average detection (AV) at frequency 0.15 MHz - 30 MHz.

4.2.4 Deviation from Test Standard

No deviation.

4.2.5 Test Setup



Note: 1.Support units were connected to second LISN.
2.Both of LISNs (AMN) are 80 cm from EUT and at least 80 from other units and other metal planes

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

4.2.6 EUT Operating Conditions

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

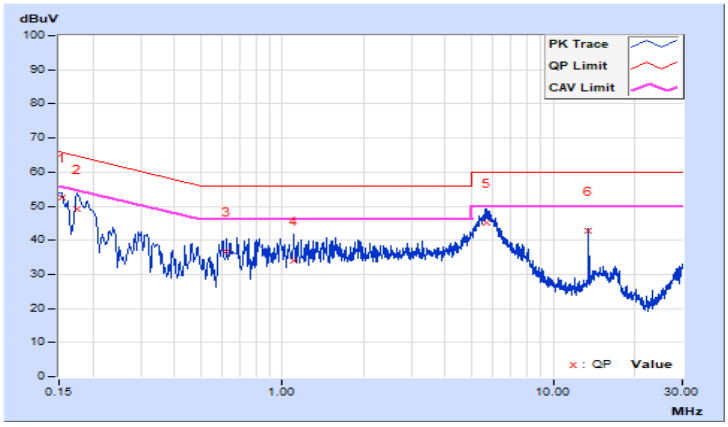
4.2.7 Test Results

RF Mode	TX NFC-13.56MHz	Channel	CH 1：13.56 MHz
Frequency Range	150kHz ~ 30MHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz

Phase Of Power : Line (L)										
No	Frequency (MHz)	Correction Factor (dB)	Reading Value (dBuV)		Emission Level (dBuV)		Limit (dBuV)		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.15400	10.11	42.33	34.20	52.44	44.31	65.78	55.78	-13.34	-11.47
2	0.17400	10.12	38.88	26.48	49.00	36.60	64.77	54.77	-15.77	-18.17
3	0.62200	10.15	26.40	16.29	36.55	26.44	56.00	46.00	-19.45	-19.56
4	1.09800	10.16	23.73	16.46	33.89	26.62	56.00	46.00	-22.11	-19.38
5	5.71000	10.25	34.72	28.50	44.97	38.75	60.00	50.00	-15.03	-11.25
6	13.55800	10.30	32.33	31.52	42.63	41.82	60.00	50.00	-17.37	-8.18

Remarks:

1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level – Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value

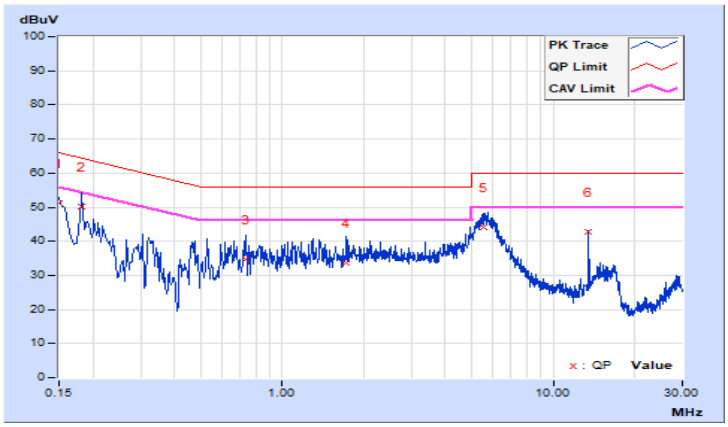


RF Mode	TX NFC-13.56MHz	Channel	CH 1：13.56 MHz
Frequency Range	150kHz ~ 30MHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz

Phase Of Power : Neutral (N)										
No	Frequency (MHz)	Correction Factor (dB)	Reading Value (dBuV)		Emission Level (dBuV)		Limit (dBuV)		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.15000	10.12	41.14	32.06	51.26	42.18	66.00	56.00	-14.74	-13.82
2	0.18200	10.13	40.20	29.47	50.33	39.60	64.39	54.39	-14.06	-14.79
3	0.73800	10.16	24.38	19.09	34.54	29.25	56.00	46.00	-21.46	-16.75
4	1.72600	10.21	23.38	15.62	33.59	25.83	56.00	46.00	-22.41	-20.17
5	5.51400	10.29	33.68	27.50	43.97	37.79	60.00	50.00	-16.03	-12.21
6	**13.55800**	**10.40**	**32.39**	**31.58**	**42.79**	**41.98**	**60.00**	**50.00**	**-17.21**	**-8.02**

Remarks:

1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level – Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value

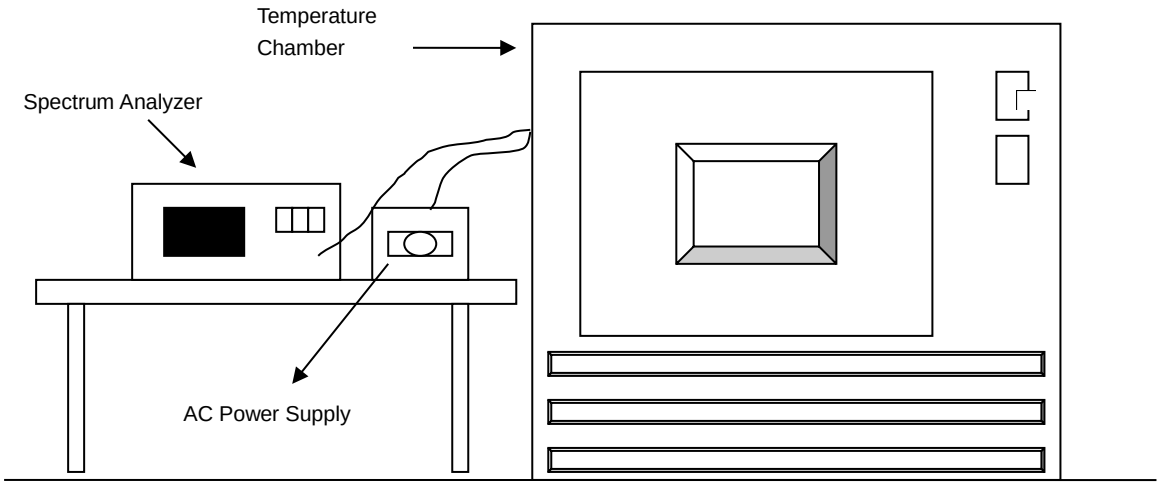


4.3 Frequency Stability

4.3.1 Limits of Frequency Stability Measurement

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

4.3.2 Test Setup



4.3.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.3.4 Test Procedure

a. The EUT was placed inside the environmental test chamber and powered by nominal AC voltage.
b. Turned the EUT on and coupled its output to a spectrum analyzer.
c. Turned the EUT off and set the chamber to the highest temperature specified.
d. 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.
e. Repeated step c and d with the every 10 degrees reduction until the lowest temperature achieved.
f. 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.

4.3.5 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

Frequency Stability Versus Temperature									
Temp. (℃)	Power Supply (Vac)	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	120	13.56005	0.00037	13.56005	0.00037	13.56005	0.00037	13.56005	0.00037
40	120	13.56003	0.00022	13.56003	0.00022	13.56003	0.00022	13.56004	0.00029
30	120	13.55998	-0.00015	13.55998	-0.00015	13.55998	-0.00015	13.55998	-0.00015
20	120	13.55997	-0.00022	13.55997	-0.00022	13.55996	-0.00029	13.55996	-0.00029
10	120	13.56002	0.00015	13.56002	0.00015	13.56003	0.00022	13.56002	0.00015
0	120	13.56004	0.00029	13.56003	0.00022	13.56004	0.00029	13.56004	0.00029
-10	120	13.55999	-0.00007	13.55999	-0.00007	13.55999	-0.00007	13.55999	-0.00007
-20	120	13.55994	-0.00044	13.55994	-0.00044	13.55994	-0.00044	13.55994	-0.00044

Frequency Stability Versus Voltage									
Temp. (℃)	Power Supply (Vac)	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	138	13.55997	-0.00022	13.55997	-0.00022	13.55996	-0.00029	13.55996	-0.00029
	120	13.55997	-0.00022	13.55997	-0.00022	13.55996	-0.00029	13.55996	-0.00029
	102	13.55997	-0.00022	13.55997	-0.00022	13.55996	-0.00029	13.55996	-0.00029

4.4 20 dB Bandwidth

4.4.1 Limits of 20 dB Bandwidth Measurement

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

4.4.2 Test Setup

Refer to section 4.1.5.

4.4.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.4.4 Test Procedures

The bandwidth of the fundamental frequency was measured by spectrum analyzer with 958 Hz 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.

4.4.5 Deviation from Test Standard

No deviation.

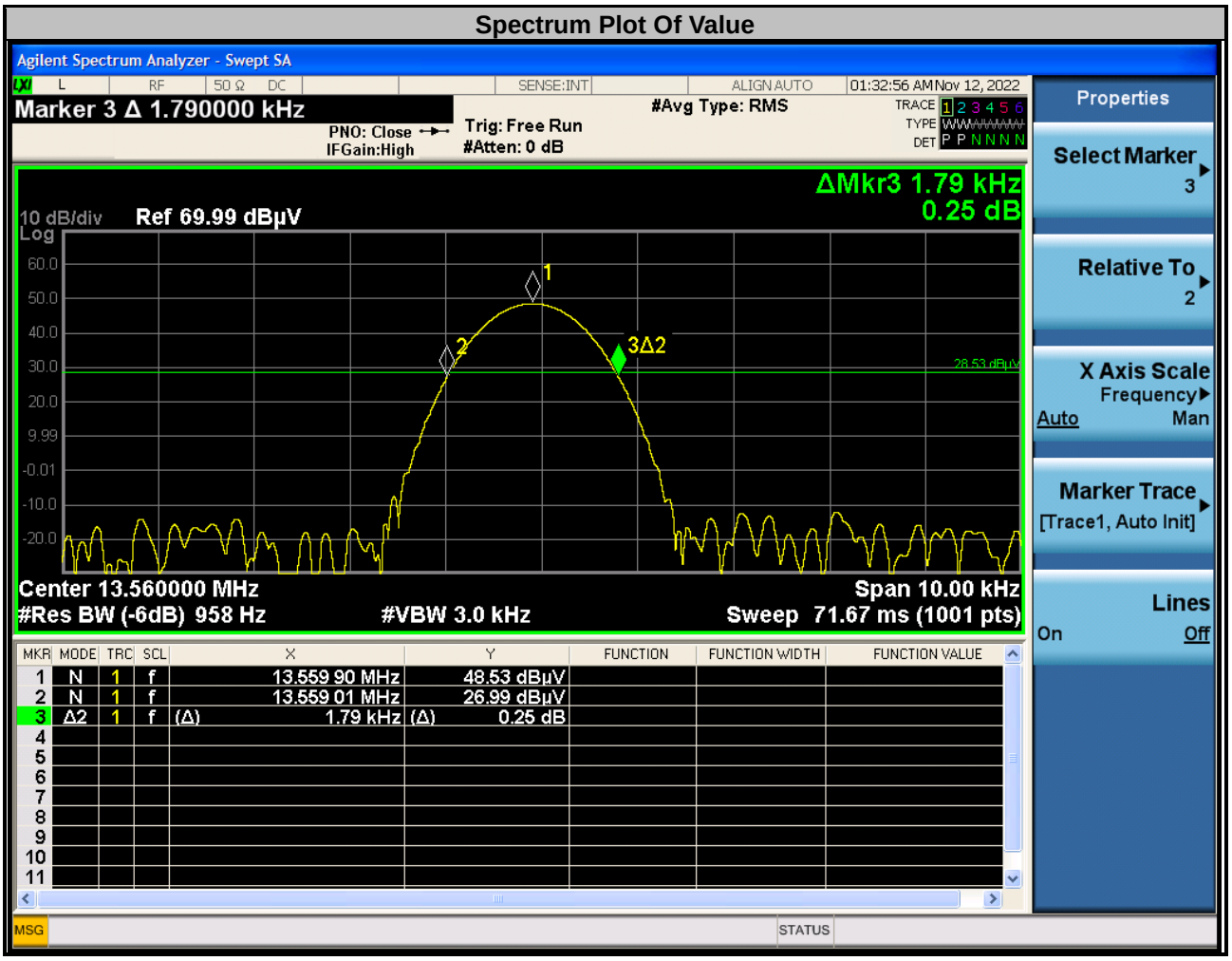
4.4.6 EUT Operating Conditions

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

4.4.7 Test Results

20 dBc Point (Low)	20 dBc Point (High)	Operating Frequency Band (MHz)	Pass / Fail
13.55901 MHz	13.56080 MHz	13.553~13.567	Pass

Spectrum Plot Of Value



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:

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

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