

## FCC Test Report

**Report No.:** RFBEDW-WTW-P21090372

**FCC ID:** E2K-DWRFID2003

**Test Model:** DWRFID2003

**Received Date:** Sep. 14, 2021

**Test Date:** Sep. 15 ~ Sep. 16, 2021

**Issued Date:** Oct. 26, 2021

**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



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### Release Control Record

Issue No.	Description	Date Issued
RFBEDW-WTW-P21090372	Original Release	Oct. 26, 2021

## 1 Certificate of Conformity

**Product:** RFID 13.56MHz Wireless Module

**Brand:** DELL

**Test Model:** DWRFID2003

**Sample Status:** Production Unit

**Applicant:** Dell Inc.

**Test Date:** Sep. 15 ~ Sep. 16, 2021

**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 :** Pettie Chen, **Date:** Oct. 26, 2021  
Pettie Chen / Senior Specialist

**Approved by :** Bruce Chen, **Date:** Oct. 26, 2021  
Bruce Chen / Senior 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 -8.70 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 -76.88 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 -8.85 dB at 37.76 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

<b>Product</b>	RFID 13.56MHz Wireless Module
<b>Brand</b>	DELL
<b>Test Model</b>	DWRFID2003
<b>Status of EUT</b>	Production Unit
<b>Power Supply Rating</b>	3.3 Vdc (host equipment)
<b>Modulation Type</b>	ASK
<b>Data Rate</b>	Type A: 106 kbit/s Type B: 106 kbit/s Type F: 212 kbit/s, 424 kbit/s Type V: 26.48 kbit/s
<b>Operating Frequency</b>	13.56 MHz
<b>Field Strength (Maximum)</b>	7.12 dBμV/m (30m)
<b>Antenna Type</b>	Refer to Note as below
<b>Accessory Device</b>	Refer to Note as below
<b>Data Cable Supplied</b>	NA

Note:

1. The CPU type of EUT is changed from TGL-U to ADL.
2. The EUT is authorized for use in specific End-product. Please refer to below table for further details.

<b>Product Name</b>	<b>Brand</b>	<b>Model</b>
Portable Computer	DELL	P135G

3. The antenna information is listed as below.

<b>Antenna Manufacturer</b>	<b>Antenna Model No.</b>	<b>Antenna Type</b>	<b>Antenna Gain (dBi)</b>
Hong-Bo	260-24331 (DC33002H32L)	Loop Antenna	N/A
Speedwire	F-0W-FH-6122-001-00 (DC33002H85L)	Loop Antenna	N/A

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

4. The above Antenna information is declared by manufacturer and for more detailed features description, please refer to the manufacturer's specifications, the laboratory shall not be held responsible.
5. The End-product contains following accessory devices.

<b>Product</b>	<b>Brand</b>	<b>Model</b>	<b>Description</b>
Adapter	DELL	DA65NM190	I/P: 100-240 Vac, 50/60 Hz, 1.7 A O/P: 5.0V=3.0A/15.0W, 15.0V=3.0A/45.0W 9.0V=3.0A/27.0W, 20.0V=3.25A/65.0W 1.8m non-shielded cable
Battery	DELL	FKOVR	58Wh (15.2Vdc, 3625mAh)

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 B 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	23 deg. C, 66 % RH	120 Vac, 60 Hz	Cookie Ku, Tim Chen
FS	23 deg. C, 69 % RH	120 Vac, 60 Hz	Willy Cheng
PLC	23 deg. C, 66 % RH	120 Vac, 60 Hz	Cookie Ku
EB	23 deg. C, 69 % RH	120 Vac, 60 Hz	Willy Cheng



### 3.3 Description of Support Units

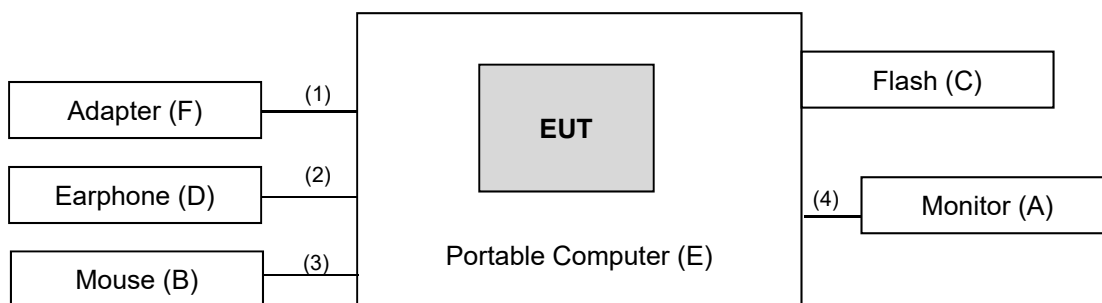
The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

ID	Product	Brand	Model No.	Serial No.	FCC ID	Remarks
A.	Monitor	DELL	SE2416Hc	CN-OWJKMC-64180-66D-013B-A00	N/A	-
B.	Mouse	DELL	MS111-P	CN-011D3V-71581-1CJ-019A	FCC DoC Approved	-
C.	Flash	HP	v250W	05	NA	-
D.	Earphone	HTC	NA	NA	NA	-
E.	Portable Computer	DELL	P135G	NA	NA	Provided by client
F.	Adapter	DELL	DA65NM190	NA	NA	Provided by client

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

ID	Descriptions	Qty.	Length (m)	Shielding (Yes/No)	Cores (Qty.)	Remarks
1.	Power cable	1	1.8	N	0	Provided by client
2.	Earphone cable	1	1.2	N	0	-
3.	USB cable	1	1.2	Y	0	-
4.	HDMI cable	1	1.2	Y	0	-

#### 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
Test Receiver Agilent	N9038A	MY55420137	Apr. 09, 2021	Apr. 08, 2022
Spectrum Analyzer Agilent	N9010A	MY52220207	Jan. 05, 2021	Jan. 04, 2022
Spectrum Analyzer ROHDE & SCHWARZ	FSU43	101261	Apr. 12, 2021	Apr. 11, 2022
HORN Antenna SCHWARZBECK	BBHA 9120D	9120D-969	Nov. 22, 2020	Nov. 21, 2021
BILOG Antenna SCHWARZBECK	VULB 9168	9168-472	Nov. 06, 2020	Nov. 05, 2021
Fixed Attenuator WOKEN	MDCS18N-10	MDCS18N-10-01	Apr. 13, 2021	Apr. 12, 2022
Loop Antenna	EM-6879	269	Sep. 17, 2020	Sep. 16, 2021
Loop Antenna TESEQ	HLA 6121	45745	Jul. 21, 2021	Jul. 20, 2022
Preamplifier EMCI	EMC001340	980201	Oct. 21, 2020	Oct. 20, 2021
Preamplifier EMCI	EMC 330H	980112	Oct. 07, 2020	Oct. 06, 2021
RF Coaxial Cable EMCI	EMC104-SM-SM-8000	171005	Oct. 07, 2020	Oct. 06, 2021
RF Coaxial Cable HUBER+SUHNNER	SUCOFLEX 104	EMC104-SM-SM-1000(140807)	Oct. 07, 2020	Oct. 06, 2021
RF Coaxial Cable WOKEN	8D-FB	Cable-Ch10-01	Oct. 07, 2020	Oct. 06, 2021
Boresight Antenna Fixture	FBA-01	FBA-SIP01	NA	NA
Software BV ADT	E3 6.120103	NA	NA	NA
Antenna Tower MF	MFA-440H	NA	NA	NA
Turn Table MF	MFT-201SS	NA	NA	NA
Antenna Tower & Turn Table Controller MF	MF-7802	NA	NA	NA
Temperature & Humidity Chamber TERCHY	HRM-120RF	931022	Dec. 24, 2020	Dec. 23, 2021
AC Power Source Extech	6905S	1991553	NA	NA
Digital Multimeter Fluke	87-III	70360742	Jun. 24, 2021	Jun. 23, 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 HwaYa Chamber 10.

#### 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:**

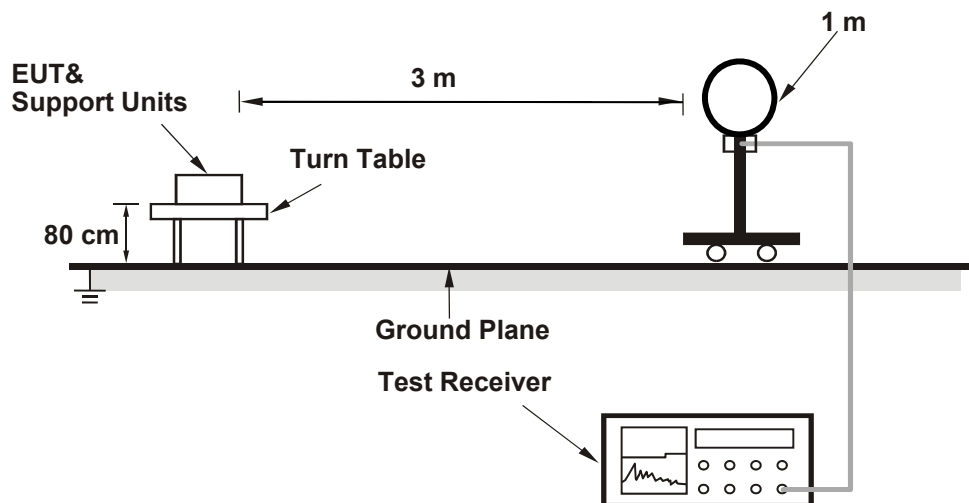
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Quasi-peak detection (QP) at frequency below 1 GHz.
2. All modes of operation were investigated and the worst-case emissions are reported.

#### 4.1.4 Deviation from Test Standard

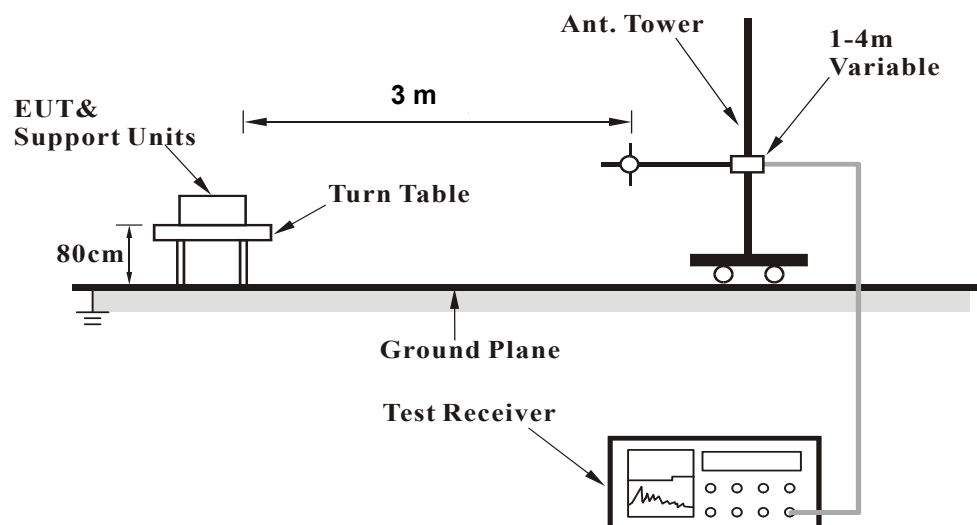
No deviation.

#### 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 B

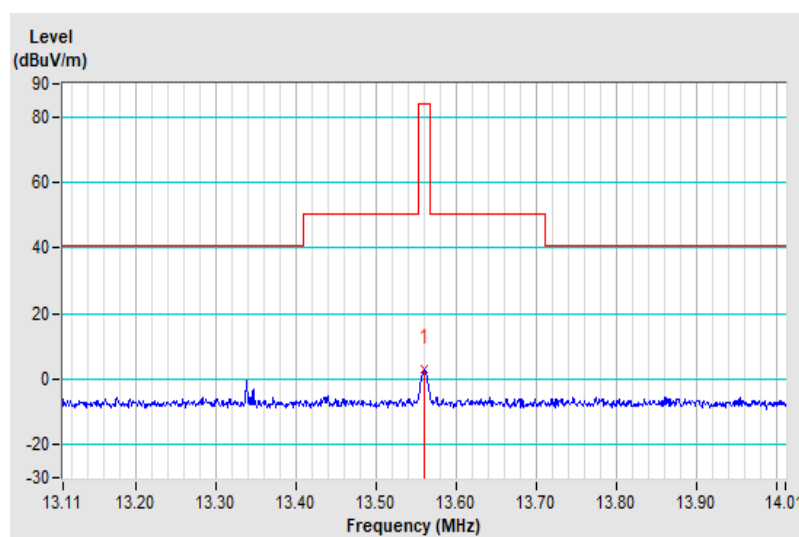
EUT Test Condition		Measurement Detail	
Channel	Channel 1	Frequency Range	13.553 ~ 13.567MHz
Input Power	120Vac, 60Hz	Detector Function	Quasi-Peak
Environmental Conditions	23 deg. C, 66% RH	Tested By	Cookie Ku

Antenna Polarity & Test Distance: Loop Antenna Parallel At 3m								
No.	Freq. (MHz)	Emission Level (dBuV/m) (30m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV) (3m)	Correction Factor (dB/m)
1	*13.56	2.92 QP	84.00	-81.08	1.00	187	20.91	-17.99

##### 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
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value
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 =  $40 \times \log(3/30) = -40\text{dB}$ , using the formula that the limit of field strength varies as the inverse distance square (40dB per decade of distance)



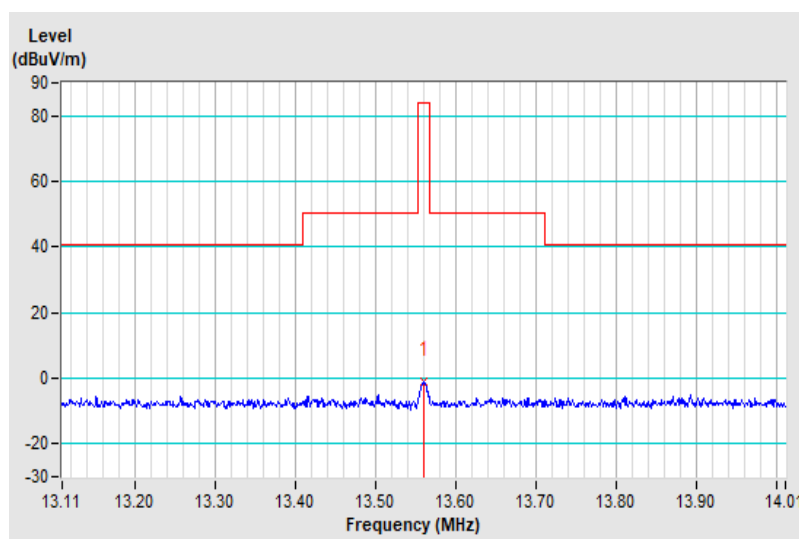
EUT Test Condition		Measurement Detail	
Channel	Channel 1	Frequency Range	13.553 ~ 13.567MHz
Input Power	120Vac, 60Hz	Detector Function	Quasi-Peak
Environmental Conditions	23 deg. C, 66% RH	Tested By	Cookie Ku

Antenna Polarity & Test Distance: Loop Antenna Perpendicular At 3m								
No.	Freq. (MHz)	Emission Level (dBuV/m) (30m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV) (3m)	Correction Factor (dB/m)
1	*13.56	-1.02 QP	84.00	-85.02	1.00	215	16.97	-17.99

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
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value
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 =  $40 \times \log(3/30) = -40\text{dB}$ , using the formula that the limit of field strength varies as the inverse distance square (40dB per decade of distance)



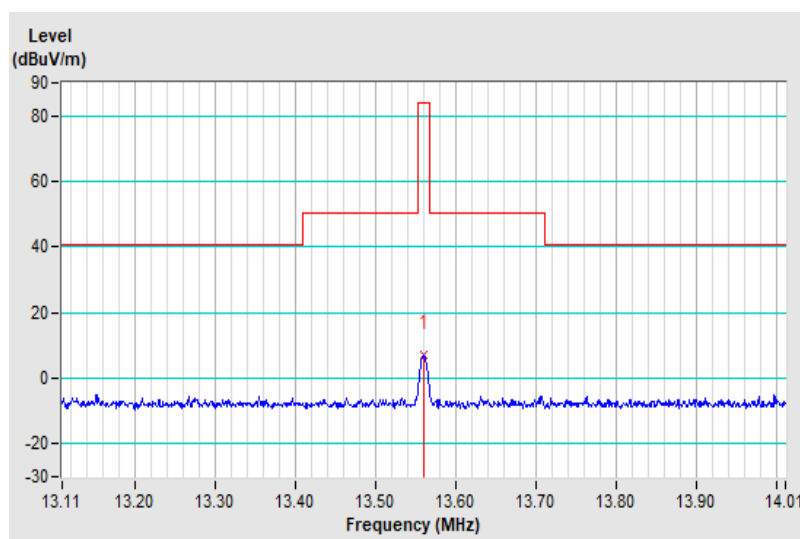
EUT Test Condition		Measurement Detail	
Channel	Channel 1	Frequency Range	13.553 ~ 13.567MHz
Input Power	120Vac, 60Hz	Detector Function	Quasi-Peak
Environmental Conditions	23 deg. C, 66% RH	Tested By	Cookie Ku

Antenna Polarity & Test Distance: Loop Antenna Ground-Parallel At 3m								
No.	Freq. (MHz)	Emission Level (dBuV/m) (30m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV) (3m)	Correction Factor (dB/m)
1	*13.56	7.12 QP	84.00	-76.88	1.00	283	25.11	-17.99

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
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value
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 =  $40 \times \log(3/30) = -40\text{dB}$ , using the formula that the limit of field strength varies as the inverse distance square (40dB per decade of distance)



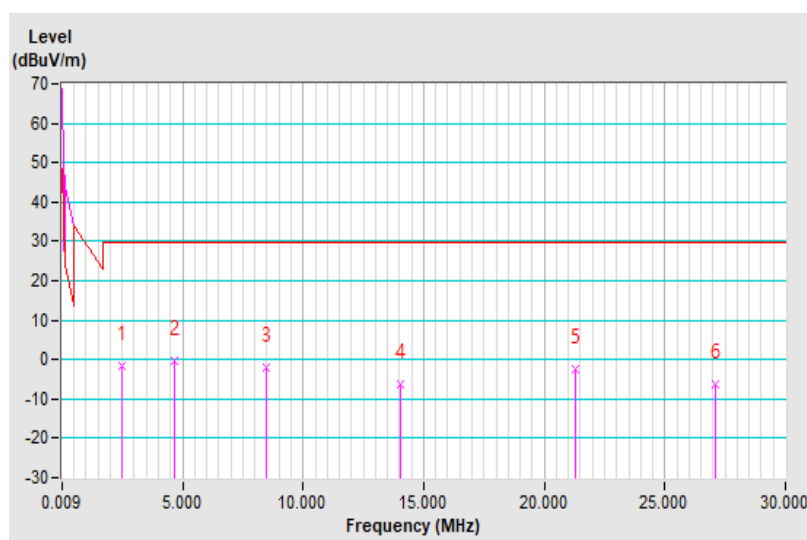


EUT Test Condition		Measurement Detail	
Channel	Channel 1	Frequency Range	Below 30MHz
Input Power	120Vac, 60Hz	Detector Function	Quasi-Peak
Environmental Conditions	23 deg. C, 66% RH	Tested By	Cookie Ku

Antenna Polarity & Test Distance: Loop Antenna Parallel At 3m								
No.	Freq. (MHz)	Emission Level (dBuV/m) (30m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV) (3m)	Correction Factor (dB/m)
1	2.50	-1.42 QP	29.54	-30.96	1.00	269	18.51	-19.93
2	4.66	-0.33 QP	29.54	-29.87	1.00	156	19.50	-19.83
3	8.47	-1.99 QP	29.54	-31.53	1.00	117	16.63	-18.62
4	14.01	-6.16 QP	29.54	-35.70	1.00	301	11.82	-17.98
5	21.27	-2.53 QP	29.54	-32.07	1.00	273	15.30	-17.83
6	27.12	-6.16 QP	29.54	-35.70	1.00	94	11.78	-17.94

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

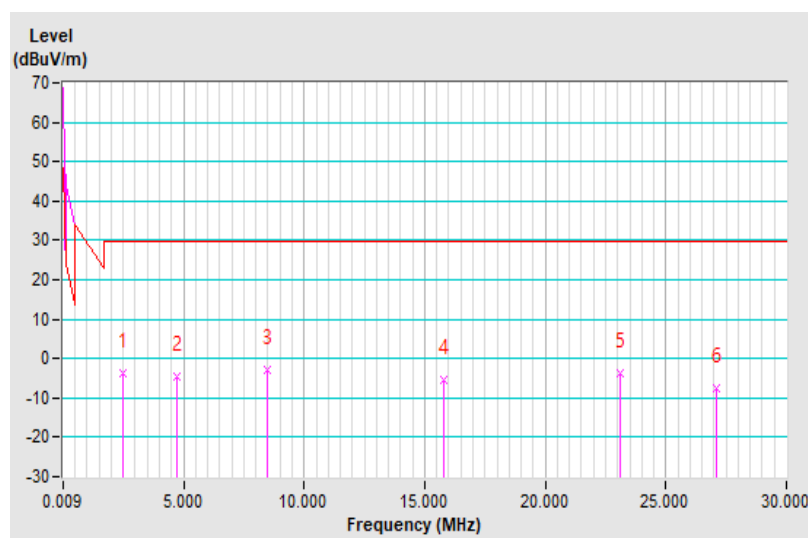


EUT Test Condition		Measurement Detail	
Channel	Channel 1	Frequency Range	Below 30MHz
Input Power	120Vac, 60Hz	Detector Function	Quasi-Peak
Environmental Conditions	23 deg. C, 66% RH	Tested By	Cookie Ku

Antenna Polarity & Test Distance: Loop Antenna Perpendicular At 3m								
No.	Freq. (MHz)	Emission Level (dBuV/m) (30m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV) (3m)	Correction Factor (dB/m)
1	2.50	-3.56 QP	29.54	-33.10	1.00	145	16.37	-19.93
2	4.72	-4.65 QP	29.54	-34.19	1.00	138	15.18	-19.83
3	8.47	-2.74 QP	29.54	-32.28	1.00	259	15.88	-18.62
4	15.81	-5.25 QP	29.54	-34.79	1.00	258	12.68	-17.93
5	23.13	-3.94 QP	29.54	-33.48	1.00	94	13.92	-17.86
6	27.12	-7.57 QP	29.54	-37.11	1.00	329	10.37	-17.94

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

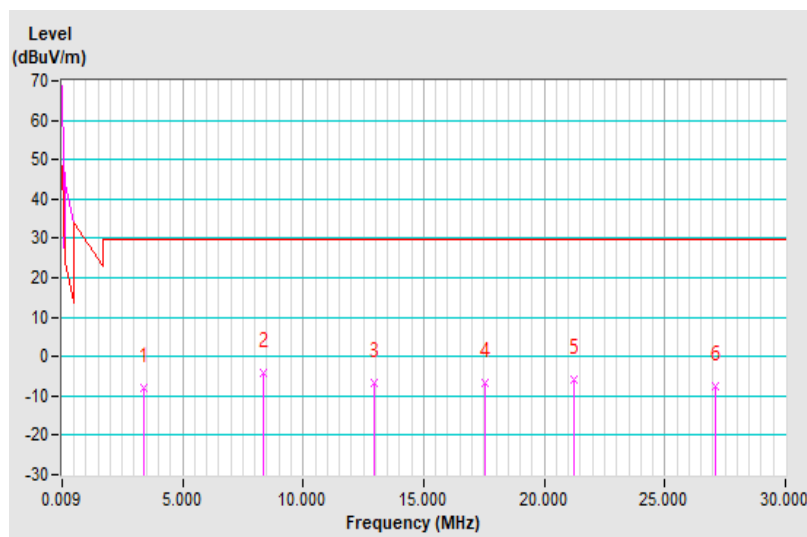


EUT Test Condition		Measurement Detail	
Channel	Channel 1	Frequency Range	Below 30MHz
Input Power	120Vac, 60Hz	Detector Function	Quasi-Peak
Environmental Conditions	23 deg. C, 66% RH	Tested By	Cookie Ku

Antenna Polarity & Test Distance: Loop Antenna Ground-Parallel At 3m								
No.	Freq. (MHz)	Emission Level (dBuV/m) (30m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV) (3m)	Correction Factor (dB/m)
1	3.40	-7.78 QP	29.54	-37.32	1.00	179	12.18	-19.96
2	8.38	-4.31 QP	29.54	-33.85	1.00	65	14.34	-18.65
3	12.94	-6.75 QP	29.54	-36.29	1.00	183	11.26	-18.01
4	17.52	-6.71 QP	29.54	-36.25	1.00	359	11.16	-17.87
5	21.21	-5.93 QP	29.54	-35.47	1.00	164	11.89	-17.82
6	27.12	-7.69 QP	29.54	-37.23	1.00	157	10.25	-17.94

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

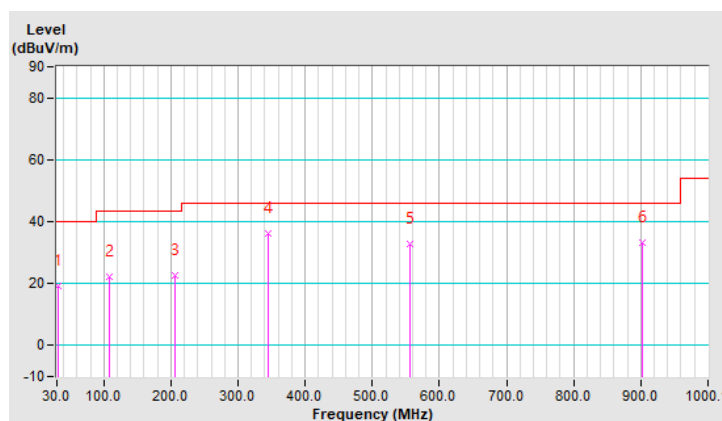


EUT Test Condition		Measurement Detail	
Channel	Channel 1	Frequency Range	Below 1000MHz
Input Power	120Vac, 60Hz	Detector Function	Quasi-Peak
Environmental Conditions	23 deg. C, 66% RH	Tested By	Tim Chen

Antenna Polarity & Test Distance: Horizontal At 3m								
No.	Freq. (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	32.91	19.12 QP	40.00	-20.88	1.00 H	208	32.60	-13.48
2	108.58	22.22 QP	43.50	-21.28	1.49 H	120	37.31	-15.09
3	206.56	22.52 QP	43.50	-20.98	1.00 H	143	38.56	-16.04
4	345.28	36.28 QP	46.00	-9.72	1.15 H	86	46.71	-10.43
5	555.79	32.77 QP	46.00	-13.23	1.36 H	50	37.24	-4.47
6	903.09	33.26 QP	46.00	-12.74	2.49 H	154	31.45	1.81

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. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value

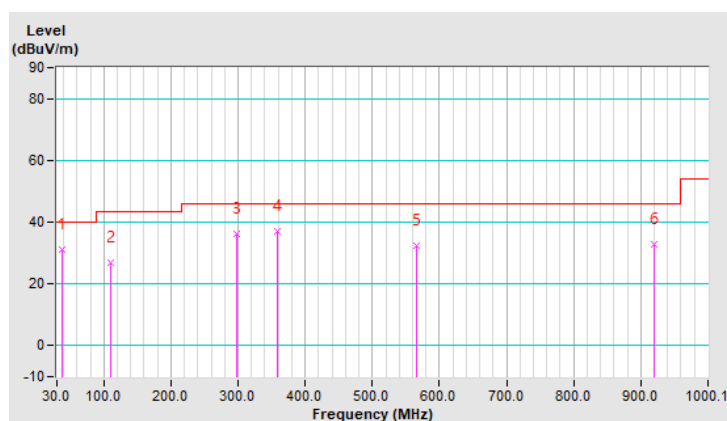


EUT Test Condition		Measurement Detail	
Channel	Channel 1	Frequency Range	Below 1000MHz
Input Power	120Vac, 60Hz	Detector Function	Quasi-Peak
Environmental Conditions	23 deg. C, 66% RH	Tested By	Tim Chen

Antenna Polarity & Test Distance: Vertical At 3m								
No.	Freq. (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	37.76	31.15 QP	40.00	-8.85	1.51 V	327	44.21	-13.06
2	110.52	26.90 QP	43.50	-16.60	1.01 V	222	41.86	-14.96
3	298.72	36.20 QP	46.00	-9.80	2.50 V	349	47.88	-11.68
4	357.89	37.07 QP	46.00	-8.93	1.51 V	18	47.09	-10.02
5	566.47	32.44 QP	46.00	-13.56	1.44 V	107	36.56	-4.12
6	920.55	32.92 QP	46.00	-13.08	1.23 V	105	30.58	2.34

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. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value



## 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	102412	Jan. 29, 2021	Jan. 28, 2022
RF signal cable (with 10dB PAD) Woken	5D-FB	Cable-cond2-01	Sep. 04, 2021	Sep. 03, 2022
LISN/AMN ROHDE & SCHWARZ (EUT)	ESH2-Z5	100100	Jan. 28, 2021	Jan. 27, 2022
LISN/AMN ROHDE & SCHWARZ (Peripheral)	ESH3-Z5	100311	Sep. 07, 2021	Sep. 06, 2022
Software ADT	BV ADT_Conc_ 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.
  3. The VCCI Site Registration No. is C-12047.

#### 4.2.3 Test Procedures

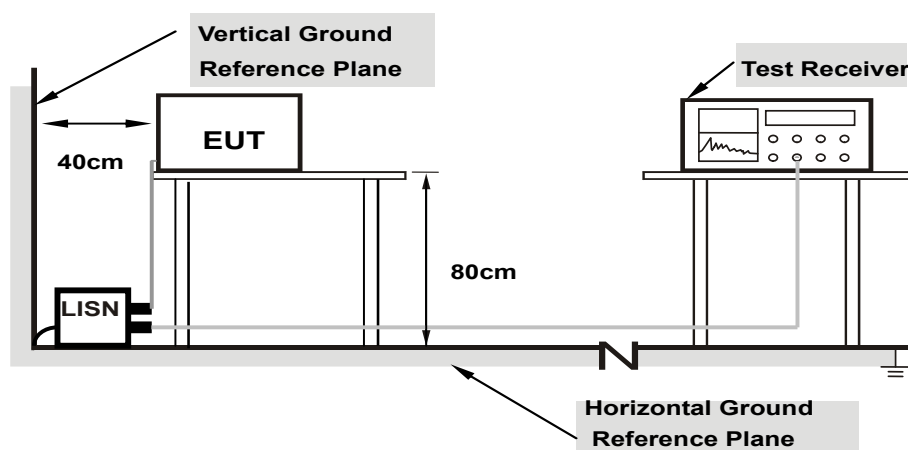
- The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/50 uH of coupling impedance for the measuring instrument.
- Both lines of the power mains connected to the EUT were checked for maximum conducted interference.
- 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

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

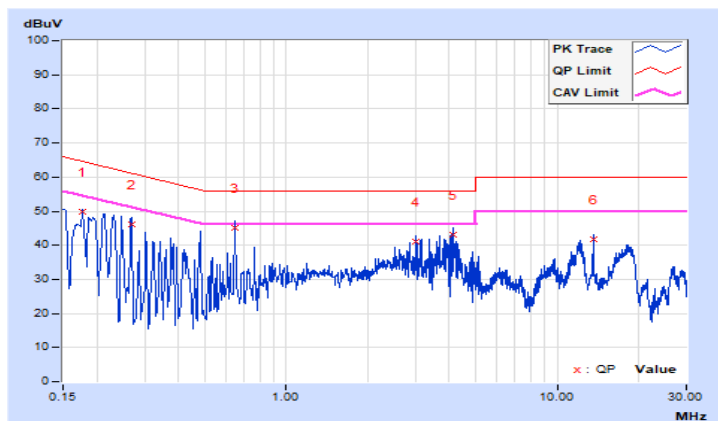
#### 4.2.7 Test Results

Frequency Range	150kHz ~ 30MHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz
Input Power	120Vac, 60Hz	Environmental Conditions	23°C, 66%RH
Tested by	Cookie Ku	Test Date	2020/9/16

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	0.17800	10.12	39.66	24.46	49.78	34.58	64.58	54.58	-14.80	-20.00
2	0.26921	10.13	35.89	17.62	46.02	27.75	61.14	51.14	-15.12	-23.39
3	0.64600	10.15	35.02	7.56	45.17	17.71	56.00	46.00	-10.83	-28.29
4	3.00200	10.23	30.92	14.28	41.15	24.51	56.00	46.00	-14.85	-21.49
5	4.13400	10.24	32.69	15.66	42.93	25.90	56.00	46.00	-13.07	-20.10
6	13.56200	10.37	31.54	30.55	41.91	40.92	60.00	50.00	-18.09	-9.08

#### 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



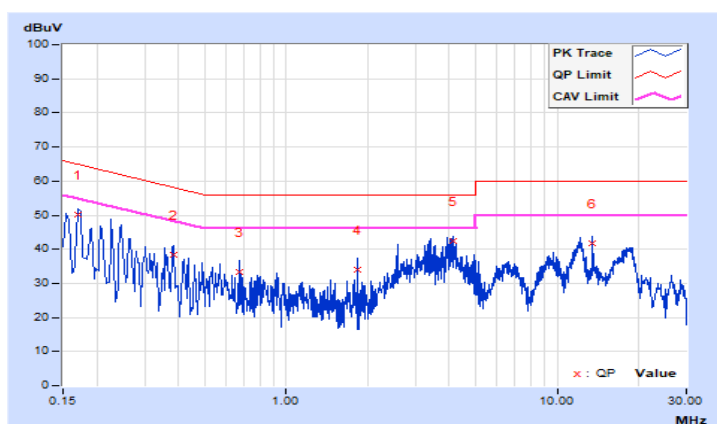


Frequency Range	150kHz ~ 30MHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz
Input Power	120Vac, 60Hz	Environmental Conditions	23°C, 66%RH
Tested by	Cookie Ku	Test Date	2020/9/16

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	0.17000	10.12	40.08	25.75	50.20	35.87	64.96	54.96	-14.76	-19.09
2	0.38218	10.15	28.21	14.27	38.36	24.42	58.23	48.23	-19.87	-23.81
3	0.67000	10.16	23.33	6.47	33.49	16.63	56.00	46.00	-22.51	-29.37
4	1.83800	10.21	23.64	3.89	33.85	14.10	56.00	46.00	-22.15	-31.90
5	4.15800	10.28	32.18	18.03	42.46	28.31	56.00	46.00	-13.54	-17.69
6	13.55800	10.50	31.11	30.80	41.61	41.30	60.00	50.00	-18.39	-8.70

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

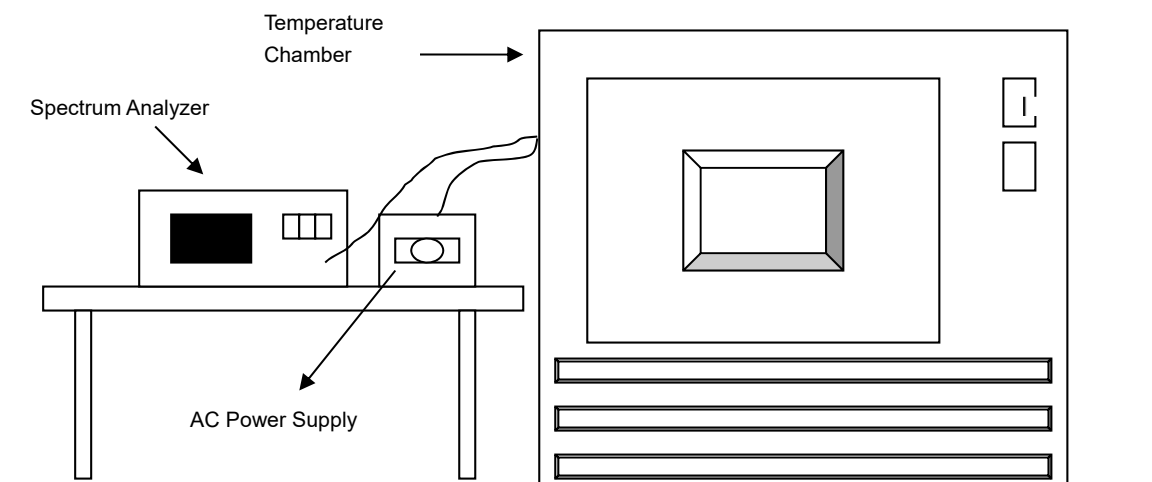


### 4.3 Frequency Stability

#### 4.3.1 Limits of Frequency Stability Measurement

The frequency tolerance of the carrier signal shall be maintained within  $\pm 0.01\%$  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.

#### 4.3.2 Test Setup



#### 4.3.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

#### 4.3.4 Test Procedure

- The EUT was placed inside the environmental test chamber and powered by nominal AC 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.

#### 4.3.5 Deviation from Test Standard

No deviation.

#### 4.3.6 EUT Operating Conditions

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

#### 4.3.7 Test Results

Frequency Stability Versus Temperature									
Temp. (°C)	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	13.55995	-0.00037	13.55996	-0.00029	13.55996	-0.00029	13.55996	-0.00029
40	120	13.55996	-0.00029	13.55996	-0.00029	13.55996	-0.00029	13.55996	-0.00029
30	120	13.55995	-0.00037	13.55996	-0.00029	13.55995	-0.00037	13.55995	-0.00037
20	120	13.56000	0.00000	13.56002	0.00015	13.56001	0.00007	13.56001	0.00007
10	120	13.56004	0.00029	13.56004	0.00029	13.56004	0.00029	13.56004	0.00029
0	120	13.56001	0.00007	13.56000	0.00000	13.56002	0.00015	13.56001	0.00007
-10	120	13.55996	-0.00029	13.55997	-0.00022	13.55996	-0.00029	13.55996	-0.00029
-20	120	13.56003	0.00022	13.56004	0.00029	13.56005	0.00037	13.56004	0.00029

Frequency Stability Versus Voltage									
Temp. (°C)	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	13.56000	0.00000	13.56002	0.00015	13.56001	0.00007	13.56001	0.00007
	120	13.56000	0.00000	13.56002	0.00015	13.56001	0.00007	13.56001	0.00007
	102	13.56000	0.00000	13.56002	0.00015	13.56001	0.00007	13.56001	0.00007

#### **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 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.

##### **4.4.5 Deviation from Test Standard**

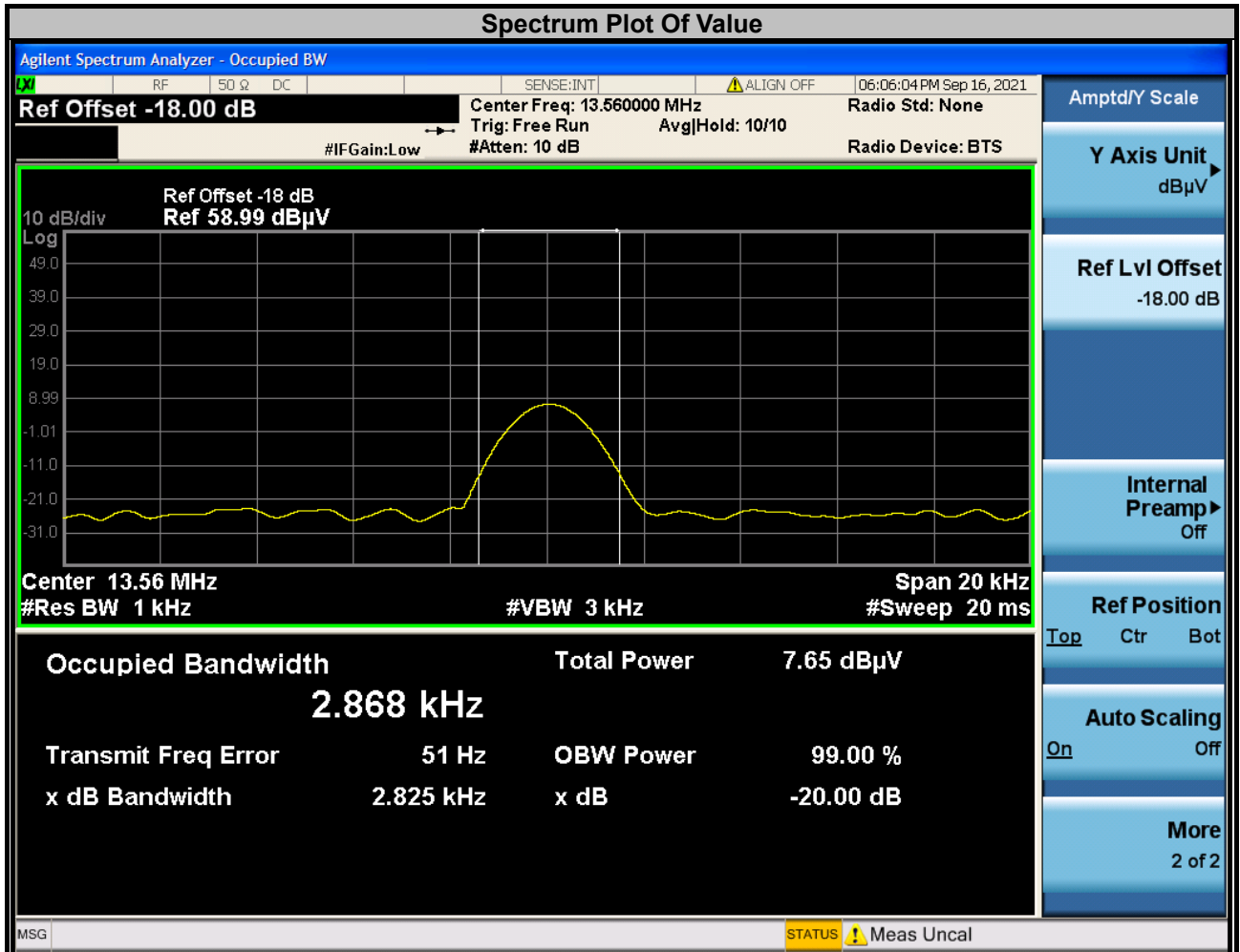
No deviation.

##### **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

Operating Frequency Band (MHz)	20dBc Bandwidth (kHz)
13.553~13.567	2.825



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.

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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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