

FCC Test Report

Report No.: RF190329C01B

FCC ID: HFS-A5QB

Test Model: A5QB

Received Date: Nov. 15, 2019

Test Date: Dec. 04 ~Dec. 16, 2019

Issued Date: Dec. 17, 2019

Applicant: QUANTA COMPUTER INC.

Address: 188, WEN HUA 2ND RD., GUISHAN DIST., TAO YUAN CITY 33377,
TAIWAN

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

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33383, TAIWAN

FCC Registration / 788550 / TW0003
Designation Number:



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Release Control Record

Issue No.	Description	Date Issued
RF190329C01B	Original release.	Dec. 17, 2019

1 Certificate of Conformity

Product: server

Brand: Quanta computer Inc

Test Model: A5QB

Sample Status: Engineering sample

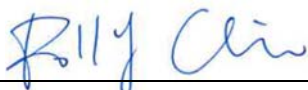
Applicant: QUANTA COMPUTER INC.

Test Date: Dec. 04 ~Dec. 16, 2019

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 :



Polly Chien / Specialist

Date:

Dec. 17, 2019

Approved by :



Bruce Chen / Senior Project Engineer

Date:

Dec. 17, 2019

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 -2.61dB at 13.55800MHz
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 -65.10dB at 13.56MHz.
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 -0.28dB at 152.22MHz.
15.225 (e)	The frequency tolerance	Pass	Meet the requirement of limit.
15.215 (c)	20dB 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) ($\pm$)
Conducted Emissions at mains ports	150kHz ~ 30MHz	2.79 dB
Radiated Emissions up to 1 GHz	9kHz ~ 30MHz	3.04 dB
	30MHz ~ 200MHz	2.93 dB
	200MHz ~1000MHz	2.95 dB

2.2 Modification Record

There were no modifications required for compliance.

3 General Information

3.1 General Description of EUT

Product	server
Brand	Quanta computer Inc
Test Model	A5QB
Sample Status	Engineering sample
Nominal Voltage	12Vdc, 170A (from PSU)
Modulation Type	ASK
Operating Frequency	13.56MHz
Data Rate	424 kbit/s
Field Strength	58.90dBuV/m (3m)
Antenna Type	Loop Antenna
Antenna Connector	NA
Accessory Device	Refer to note
Cable Supplied	NA

Note:

1. The EUT uses the following components.

Type	Vendor	Specification / Model
MB	-	MP-10031601-XXX (X can be any alphanumeric character or blank)
	-	MP-10033750-XXX (X can be any alphanumeric character or blank)
CPU	Intel	Xeon series up to 2.5GHz
DIMM	Samsung	Memory, DDR4, 21300(2666MHz), 32GB
2.5" HDD/SSD	Samsung	SSD, SATA, 2.5", 240GB
	Intel	SSD, PCI-e/NVMe, 2.5", 1TB
Add on card	Annapurna	K2X-N
		K2T-QB
		K2C-AB
	NVIDIA	GPU Tesla/T4
NFC Module	Smart Approach	SM-MFAD4-C02

2. The EUT uses the following PSU. (Support unit)

Product	Brand	Model	Description
PSU	AcBel	FSE023	Input: 200V~240V 50/60Hz ,10A Output:1600W

3.2 Description of Test Modes

1 channel is provided to this EUT

Channel	Freq. (MHz)
1	13.56

3.2.1 Test Mode Applicability and Tested Channel Data

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

Where RE: Radiated Emission
FS: Frequency Stability

PLC: Power Line Conducted Emission
EB: 20dB Bandwidth measurement

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:

- ☒ 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

20dB Bandwidth:

- ☒ 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 (System)	Tested by
RE	21 deg. C, 67% RH	220 Vac, 60 Hz	Tim Chen
PLC	25 deg. C, 65% RH	220 Vac, 60 Hz	Jisyong Wang
FS	21 deg. C, 68% RH	12Vdc	Tim Chen
EB	23 deg. C, 66% RH	220 Vac, 60 Hz	Tim 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.

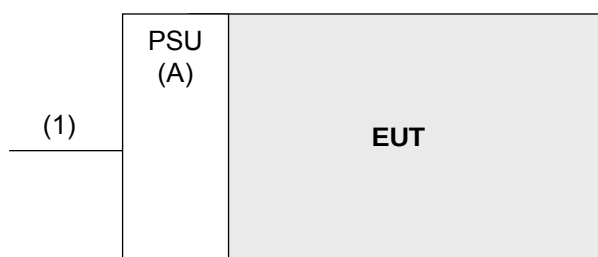
ID	Product	Brand	Model No.	Serial No.	FCC ID	Remarks
A.	PSU	AcBel	FSE023	NA	NA	Provided by client

Note:

1. 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.	DC power Cable	1	1	N	0	Provided by client

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.

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 1000MHz, 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 20dB under any condition of modulation.

4.1.2 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due
Test Receiver Agilent	N9038A	MY51210203	Mar. 18, 2019	Mar. 17, 2020
Spectrum Analyzer Agilent	N9010A	MY52220207	Dec. 26, 2018	Dec. 25, 2019
BILOG Antenna SCHWARZBECK	VULB 9168	9168-472	Nov. 08, 2019	Nov. 07, 2020
Loop Antenna TESEQ	HLA 6121	45745	Jul. 01, 2019	Jun. 30, 2020
Preamplifier EMCI	EMC 330H	980112	Oct. 08, 2019	Oct. 07, 2020
RF Coaxial Cable WOKEN	8D-FB	Cable-Ch10-01	Oct. 08, 2019	Oct. 07, 2020
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

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 30MHz

- a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter chamber room. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. 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 or except (9-90 kHz, 110-490 kHz) for Average Detect Function and Specified Bandwidth with Maximum Hold Mode.

Note:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 9kHz at frequency below 30MHz.
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 30MHz

- a. The EUT was placed on the top of a rotating table 0.8 meters (for 30MHz ~ 1GHz) / 1.5 meters (for above 1GHz) above the ground at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e. The test-receiver system was set to quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1 GHz.
- f. The test-receiver system was set to peak and average detect function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz. If the peak reading value also meets average limit, measurement with the average detector is unnecessary.

Note:

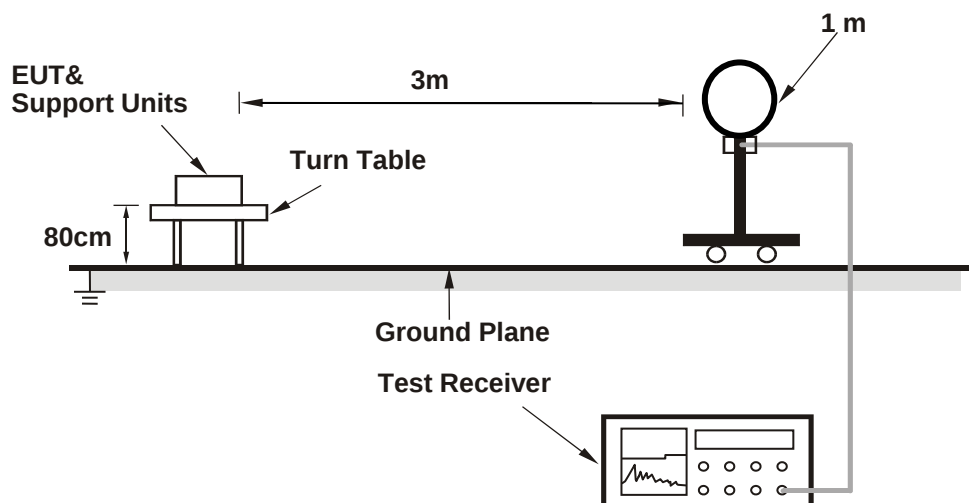
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is $\geq 1/T$ (Duty cycle < 98%) or 10Hz (Duty cycle $\geq 98\%$) for Average detection (AV) at frequency above 1GHz.
4. All modes of operation were investigated and the worst-case emissions are reported.

4.1.4 Deviation from Test Standard

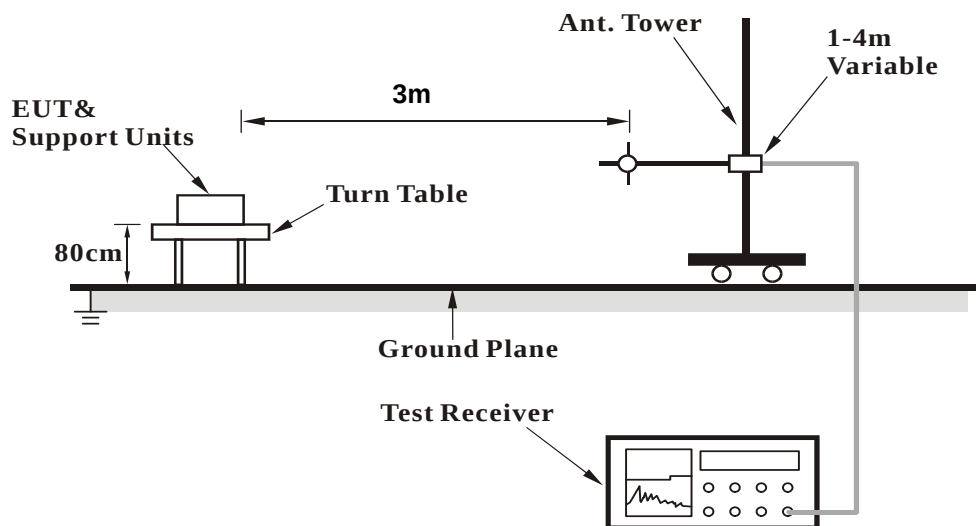
No deviation.

4.1.5 Test Set Up

For Radiated emission below 30MHz



For Radiated emission 30MHz to 1GHz



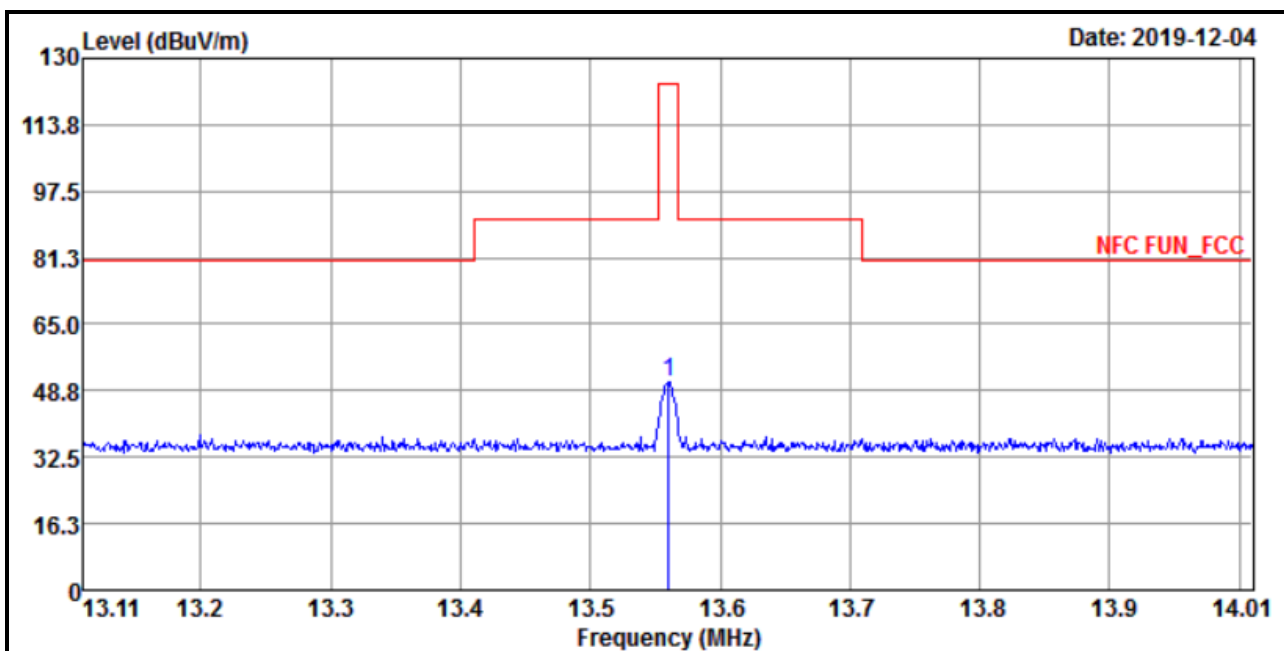
For the actual test configuration, please refer to the attached file (Test Setup Photo).

4.1.6 EUT Operating Conditions

Set the EUT under transmission condition continuously at specific channel frequency.

4.1.7 Test Results

EUT Test Condition		Measurement Detail	
Channel	Channel 1	Frequency Range	13.553 ~ 13.567 MHz
Input Power	220 Vac, 60 Hz	Detector Function	Quasi-Peak
Environmental Conditions	21 deg. C, 67 % RH	Tested By	Tim Chen



Antenna Polarity & Test Distance: Loop Antenna Parallel at 3 m								
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Factor (dB/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
13.56	50.73	28.88	21.85	124	-73.27	100	0	QP

Remarks:

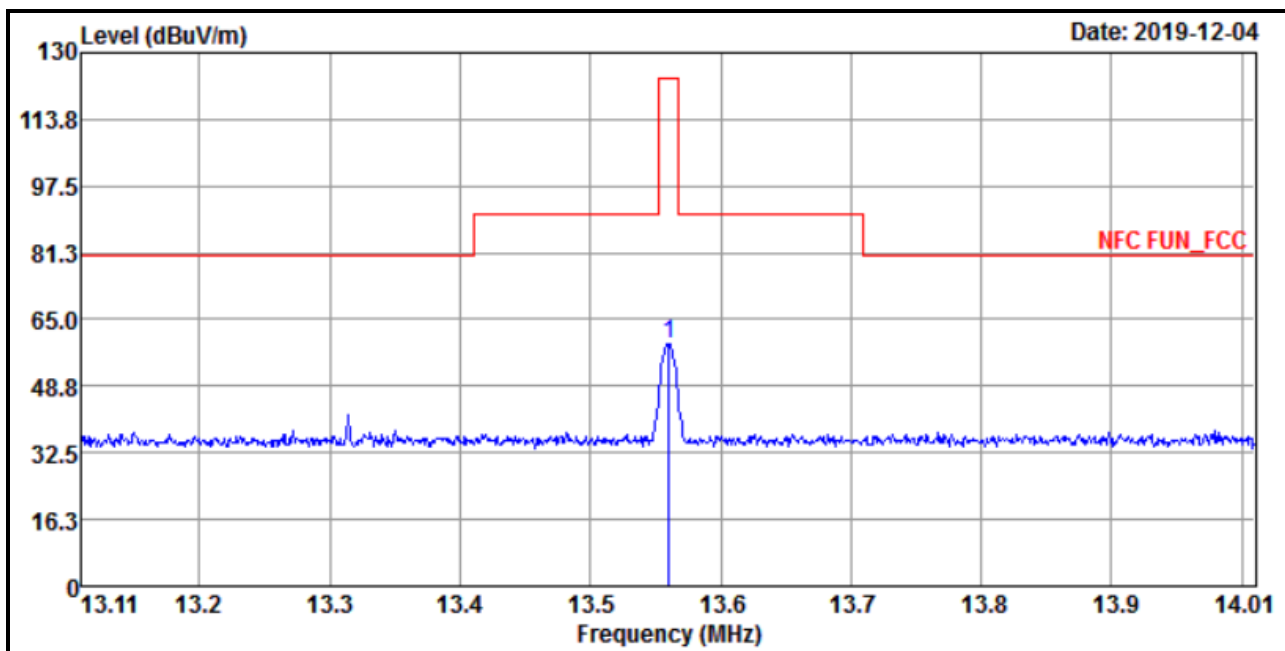
1. Emission level (dBuV/m) = Raw Value (dBuV) + Factor (dB/m)
2. The other emission levels were very low against the limit.
3. Margin value = Emission level – Limit value.
4. Above limits have been translated by the formula

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)

Example:

$$\begin{aligned}
 13.56 \text{ MHz} &= 15848 \text{ uV/m} && 30\text{m} \\
 &= 84 \text{ dBuV/m} && 30\text{m} \\
 &= 84 + 20\log(30/3)^2 && 3\text{m} \\
 &= 124 \text{ dBuV/m}
 \end{aligned}$$

EUT Test Condition		Measurement Detail	
Channel	Channel 1	Frequency Range	13.553 ~ 13.567 MHz
Input Power	220 Vac, 60 Hz	Detector Function	Quasi-Peak
Environmental Conditions	21 deg. C, 67 % RH	Tested By	Tim Chen



Antenna Polarity & Test Distance: Loop Antenna Perpendicular at 3 m								
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Factor (dB/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
13.56	58.90	37.05	21.85	124	-65.10	100	360	QP

Remarks:

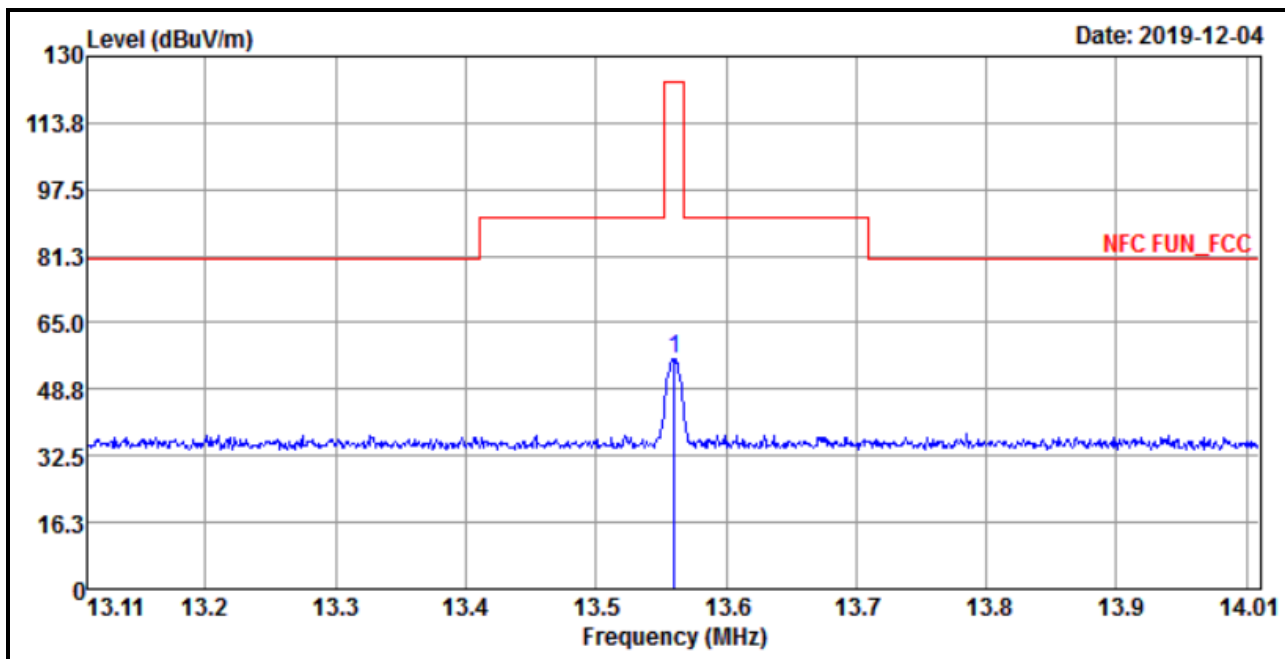
1. Emission level (dBuV/m) = Raw Value (dBuV) + Factor (dB/m)
2. The other emission levels were very low against the limit.
3. Margin value = Emission level – Limit value.
4. Above limits have been translated by the formula

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)

Example:

$$\begin{aligned}
 13.56 \text{ MHz} &= 15848 \text{ uV/m} & 30\text{m} \\
 &= 84 \text{ dBuV/m} & 30\text{m} \\
 &= 84 + 20\log(30/3)^2 & 3\text{m} \\
 &= 124 \text{ dBuV/m}
 \end{aligned}$$

EUT Test Condition		Measurement Detail	
Channel	Channel 1	Frequency Range	13.553 ~ 13.567 MHz
Input Power	220 Vac, 60 Hz	Detector Function	Quasi-Peak
Environmental Conditions	21 deg. C, 67 % RH	Tested By	Tim Chen



Antenna Polarity & Test Distance: Loop Antenna Ground-parallel at 3 m								
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Factor (dB/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
13.56	56.05	34.2	21.85	124	-67.95	100	0	QP

Remarks:

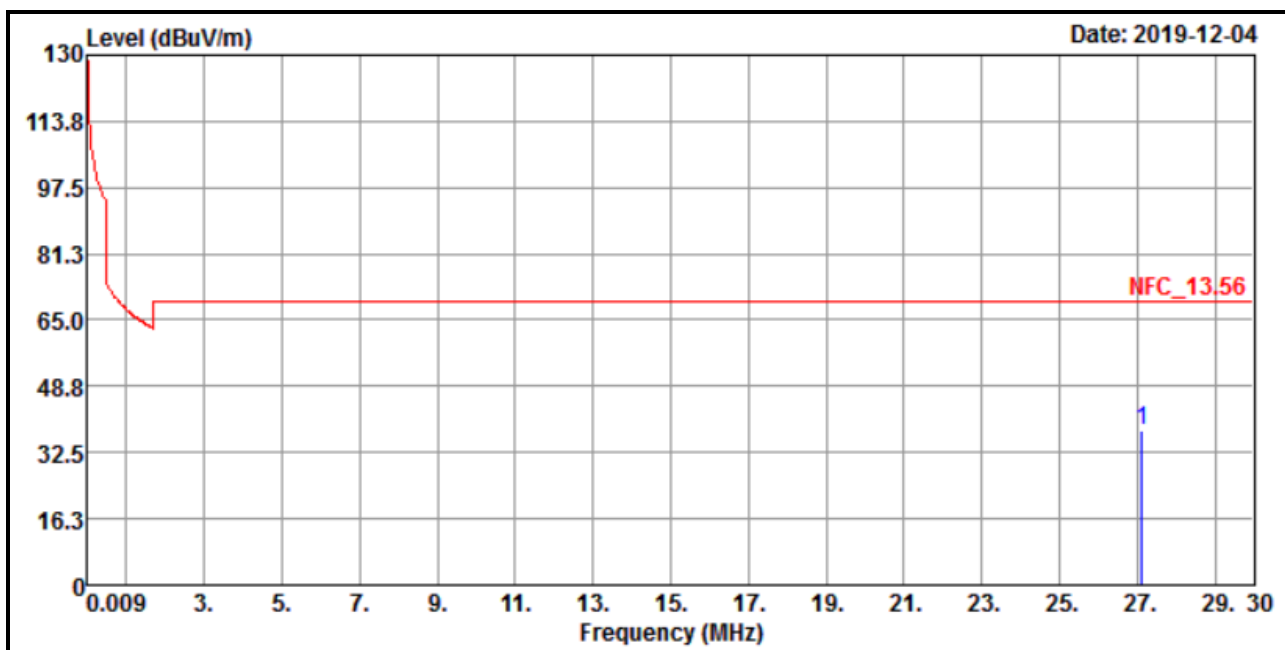
1. Emission level (dBuV/m) = Raw Value (dBuV) + Factor (dB/m)
2. The other emission levels were very low against the limit.
3. Margin value = Emission level – Limit value.
4. Above limits have been translated by the formula

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)

Example:

$$\begin{aligned}
 13.56 \text{ MHz} &= 15848 \text{ uV/m} && 30\text{m} \\
 &= 84 \text{ dBuV/m} && 30\text{m} \\
 &= 84 + 20\log(30/3)^2 && 3\text{m} \\
 &= 124 \text{ dBuV/m}
 \end{aligned}$$

EUT Test Condition		Measurement Detail	
Channel	Channel 1	Frequency Range	Below 30 MHz
Input Power	220 Vac, 60 Hz	Detector Function	Quasi-Peak
Environmental Conditions	21 deg. C, 67 % RH	Tested By	Tim Chen



Antenna Polarity & Test Distance: Loop Antenna Parallel at 3 m								
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Factor (dB/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
27.12	37.88	15.72	22.16	69.54	-31.66	100	360	QP

Remarks:

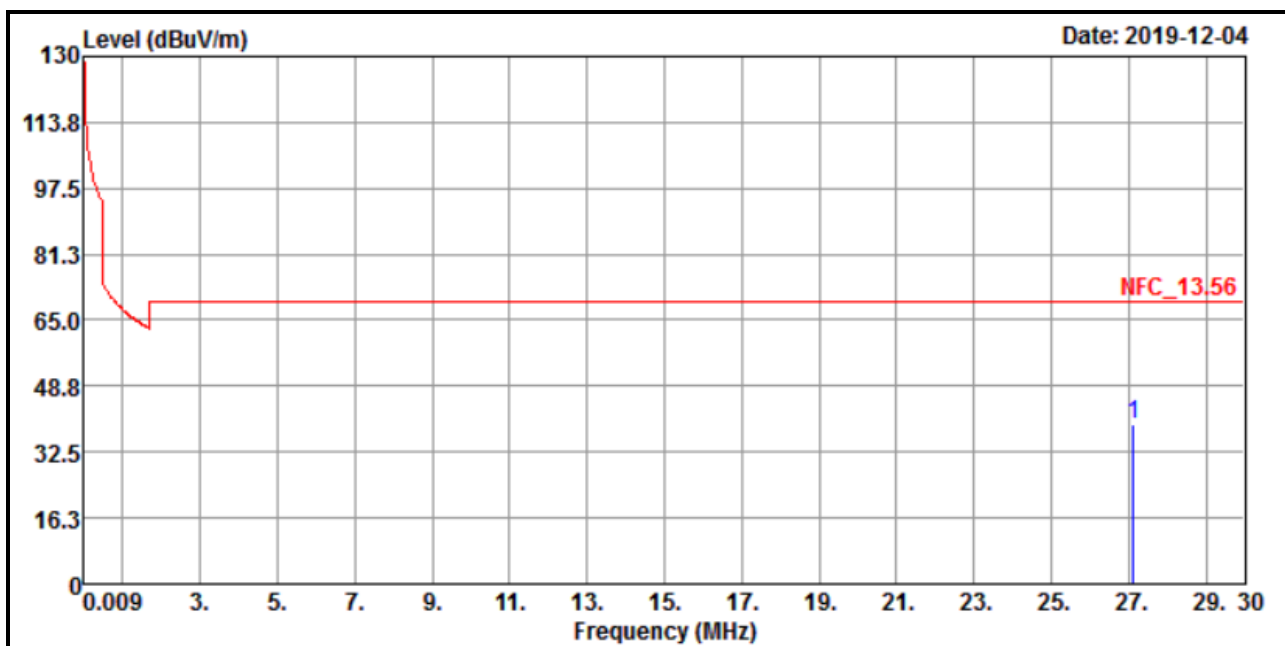
1. Emission level (dBuV/m) = Raw Value (dBuV) + Factor (dB/m)
2. The other emission levels were very low against the limit.
3. Margin value = Emission level – Limit value.

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)

Example:

$$\begin{aligned}
 1.705 \text{ MHz} \sim 30 \text{ MHz} &= 30 \text{ uV/m} && 30\text{m} \quad (\text{except } 13.110\text{MHz} \sim 14.010\text{MHz}) \\
 &= 29.54 \text{ dBuV/m} && 30\text{m} \\
 &= 29.54 + 20 \log(30/3)^2 && 3\text{m} \\
 &= 69.54 \text{ dBuV/m} && 3\text{m}
 \end{aligned}$$

EUT Test Condition		Measurement Detail	
Channel	Channel 1	Frequency Range	Below 30 MHz
Input Power	220 Vac, 60 Hz	Detector Function	Quasi-Peak
Environmental Conditions	21 deg. C, 67 % RH	Tested By	Tim Chen



Antenna Polarity & Test Distance: Loop Antenna Perpendicular at 3 m								
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Factor (dB/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
27.12	39.42	17.26	22.16	69.54	-30.12	100	0	QP

Remarks:

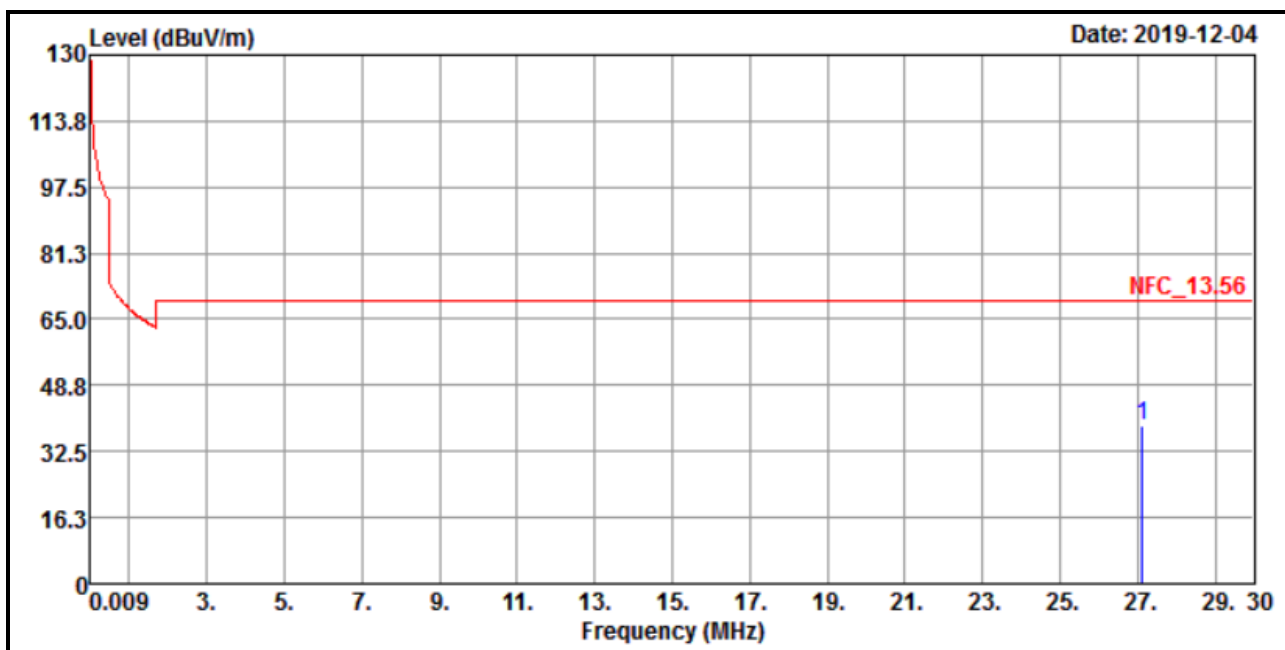
1. Emission level (dBuV/m) = Raw Value (dBuV) + Factor (dB/m)
- 2 The other emission levels were very low against the limit.
3. Margin value = Emission level – Limit value.

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)

Example:

$$\begin{aligned}
 1.705 \text{ MHz} \sim 30 \text{ MHz} &= 30 \text{ uV/m} && 30\text{m} \quad (\text{except } 13.110\text{MHz} \sim 14.010\text{MHz}) \\
 &= 29.54 \text{ dBuV/m} && 30\text{m} \\
 &= 29.54 + 20 \log(30/3)^2 && 3\text{m} \\
 &= 69.54 \text{ dBuV/m} && 3\text{m}
 \end{aligned}$$

EUT Test Condition		Measurement Detail	
Channel	Channel 1	Frequency Range	Below 30 MHz
Input Power	220 Vac, 60 Hz	Detector Function	Quasi-Peak
Environmental Conditions	21 deg. C, 67 % RH	Tested By	Tim Chen



Antenna Polarity & Test Distance: Loop Antenna Ground-parallel at 3 m								
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Factor (dB/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
27.12	39.05	16.89	22.16	69.54	-30.49	100	0	QP

Remarks:

1. Emission level (dBuV/m) = Raw Value (dBuV) + Factor (dB/m)
2. The other emission levels were very low against the limit.
3. Margin value = Emission level – Limit value.

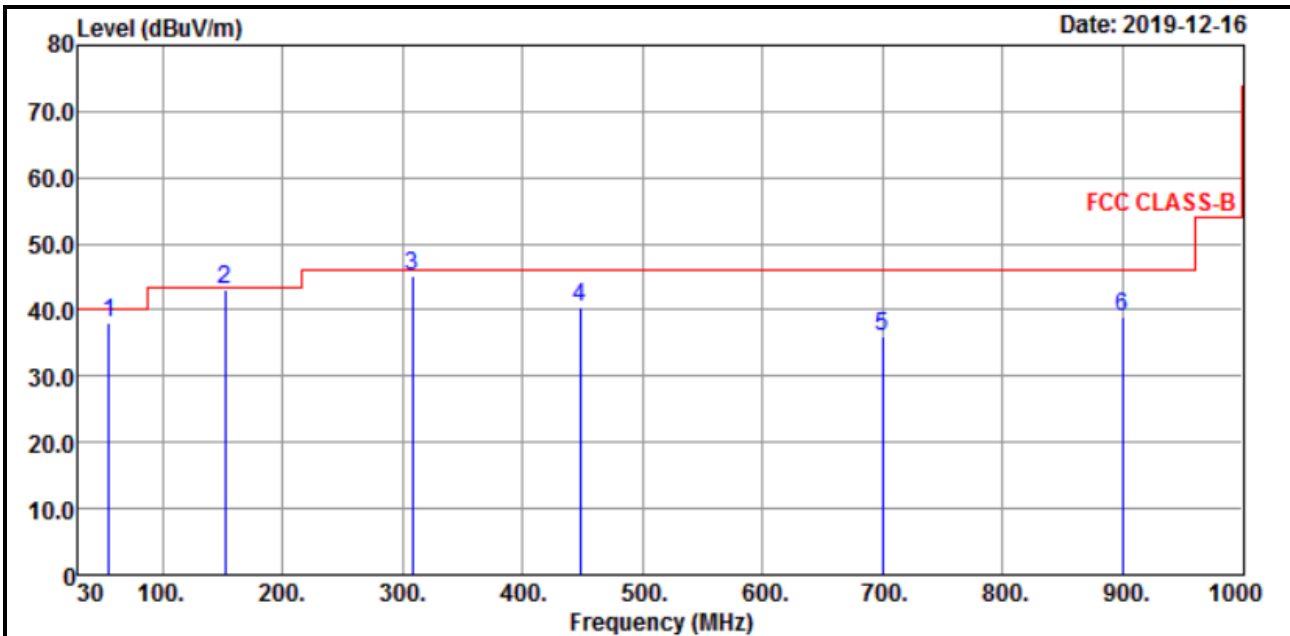
The measured field strength was extrapolated to distance 30 meters, using the formula that the limit of field strength varies as the inverse distance square (40dB per decade of distance)

Example:

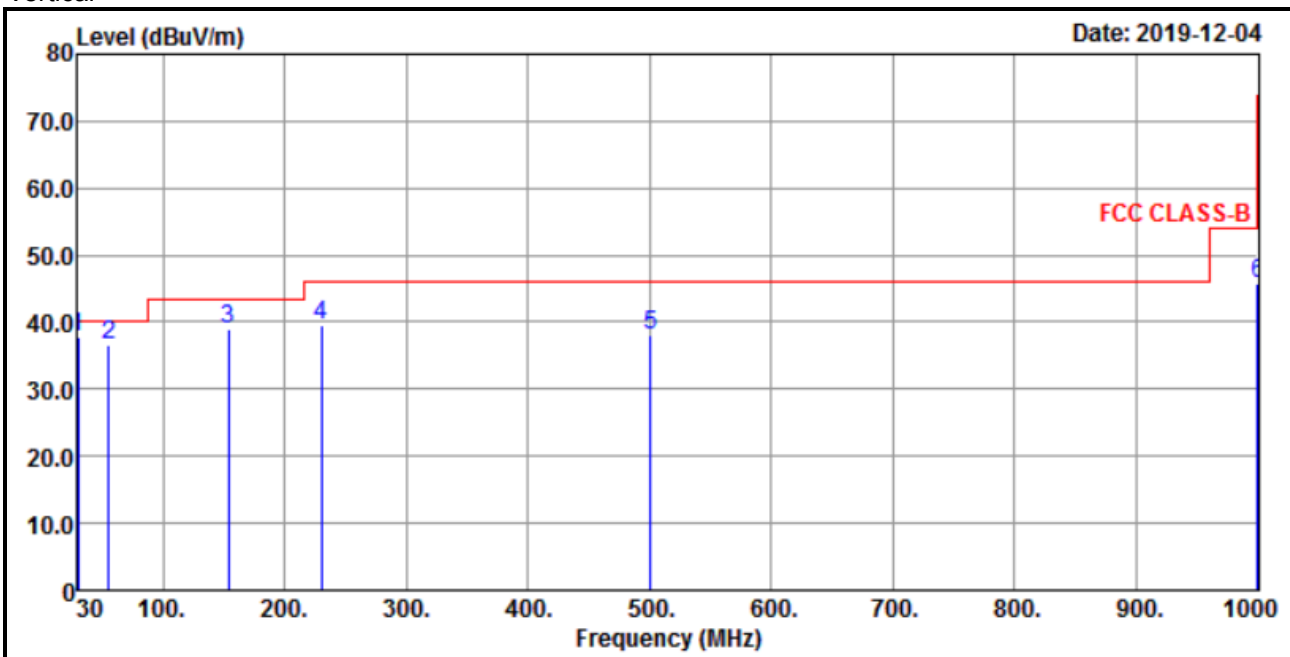
$$\begin{aligned}
 1.705 \text{ MHz} \sim 30 \text{ MHz} &= 30 \text{ uV/m} && 30\text{m} \quad (\text{except } 13.110\text{MHz} \sim 14.010\text{MHz}) \\
 &= 29.54 \text{ dBuV/m} && 30\text{m} \\
 &= 29.54 + 20 \log(30/3)^2 && 3\text{m} \\
 &= 69.54 \text{ dBuV/m} && 3\text{m}
 \end{aligned}$$

EUT Test Condition		Measurement Detail	
Channel	Channel 1	Frequency Range	Below 1000 MHz
Input Power	220 Vac, 60 Hz	Detector Function	Quasi-Peak
Environmental Conditions	21 deg. C, 67 % RH	Tested By	Tim Chen

Horizontal



Vertical



Antenna Polarity & Test Distance: Horizontal at 3 m

Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Factor (dB/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
55.22	38.02	49.95	-11.93	40	-1.98	168	203	Peak
152.22	43.22	54.93	-11.71	43.5	-0.28	180	122	QP
308.39	45.16	56.01	-10.85	46	-0.84	100	226	QP
448.07	40.42	46.90	-6.48	46	-5.58	177	103	Peak
700.27	35.92	36.57	-0.65	46	-10.08	103	164	Peak
900.09	39.00	36.02	2.98	46	-7.00	118	222	Peak

Antenna Polarity & Test Distance: Vertical at 3 m

Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Factor (dB/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
30.03	37.74	50.63	-12.89	40	-2.26	121	48	Peak
55.22	36.65	48.58	-11.93	40	-3.35	100	126	QP
154.16	38.93	50.49	-11.56	43.5	-4.57	106	241	Peak
229.82	39.69	54.27	-14.58	46	-6.31	116	138	Peak
500.45	38.11	43.55	-5.44	46	-7.89	129	304	Peak
1000.00	45.90	41.92	3.98	54	-8.10	133	155	Peak

Remarks:

1. Emission Level = Read Level + Factor
2. Margin value = Emission level – Limit value.
3. The other emission levels were very low against the limit.
4. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB)
– Pre-Amplifier Factor (dB)

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 0.50MHz.

4.2.2 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due
Test Receiver ROHDE & SCHWARZ	ESR3	102412	Feb. 14, 2019	Feb. 13, 2020
RF signal cable (with 10dB PAD) Woken	5D-FB	Cable-cond2-01	Sep. 05, 2019	Sep. 04, 2020
LISN ROHDE & SCHWARZ (EUT)	ESH2-Z5	100100	Jan. 30, 2019	Jan. 29, 2020
LISN ROHDE & SCHWARZ (Peripheral)	ESH3-Z5	100312	Aug. 13, 2019	Aug. 12, 2020
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.
3. The VCCI Site Registration No. is C-12047.

4.2.3 Test Procedures

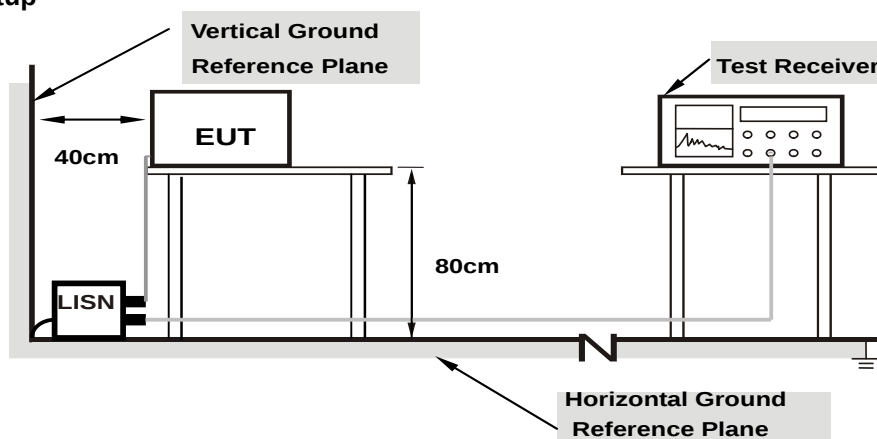
- The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/ 50uH of coupling impedance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

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

4.2.4 Deviation from Test Standard

No deviation.

4.2.5 Test Setup



Note: 1.Support units were connected to second LISN.

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

4.2.6 EUT Operating Conditions

Same as 4.1.6.

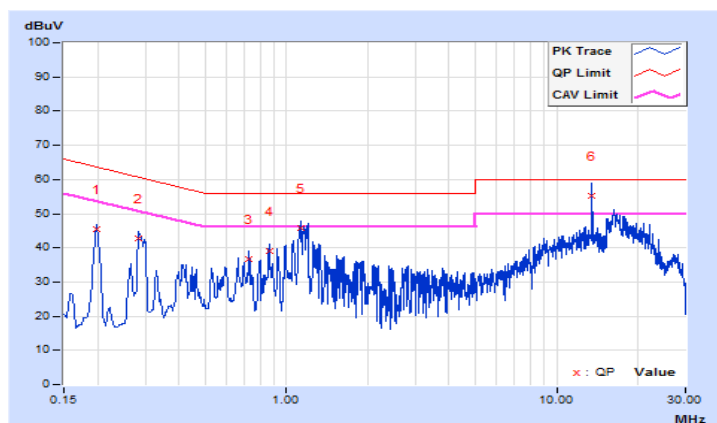
4.2.7 Test Results

Phase	Line (L)	Detector Function	Quasi-Peak (QP) / Average (AV)
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No	Freq. [MHz]	Corr. Factor (dB)	Reading Value [dB (uV)]		Emission Level [dB (uV)]		Limit [dB (uV)]		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.19800	10.12	35.50	30.81	45.62	40.93	63.69	53.69	-18.07	-12.76
2	0.28200	10.14	32.74	26.33	42.88	36.47	60.76	50.76	-17.88	-14.29
3	0.72600	10.19	26.63	21.28	36.82	31.47	56.00	46.00	-19.18	-14.53
4	0.86200	10.21	28.98	22.73	39.19	32.94	56.00	46.00	-16.81	-13.06
5	1.13000	10.23	35.54	27.19	45.77	37.42	56.00	46.00	-10.23	-8.58
6	13.55800	10.49	44.57	36.37	55.06	46.86	60.00	50.00	-4.94	-3.14

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.

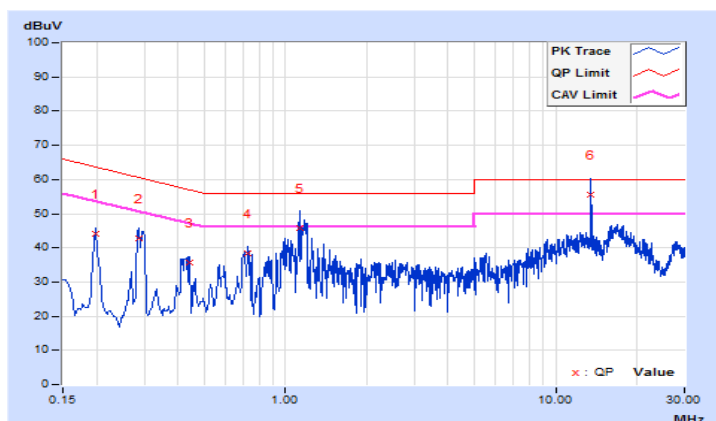


Phase	Neutral (N)	Detector Function	Quasi-Peak (QP) / Average (AV)
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No	Freq. [MHz]	Corr. Factor (dB)	Reading Value [dB (uV)]		Emission Level [dB (uV)]		Limit [dB (uV)]		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.19800	10.18	33.99	30.62	44.17	40.80	63.69	53.69	-19.52	-12.89
2	0.28600	10.20	32.68	26.31	42.88	36.51	60.64	50.64	-17.76	-14.13
3	0.43945	10.22	25.49	18.46	35.71	28.68	57.07	47.07	-21.36	-18.39
4	0.72600	10.25	28.13	21.20	38.38	31.45	56.00	46.00	-17.62	-14.55
5	1.13000	10.29	35.45	29.15	45.74	39.44	56.00	46.00	-10.26	-6.56
6	13.55800	10.62	44.86	36.77	55.48	47.39	60.00	50.00	-4.52	-2.61

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.

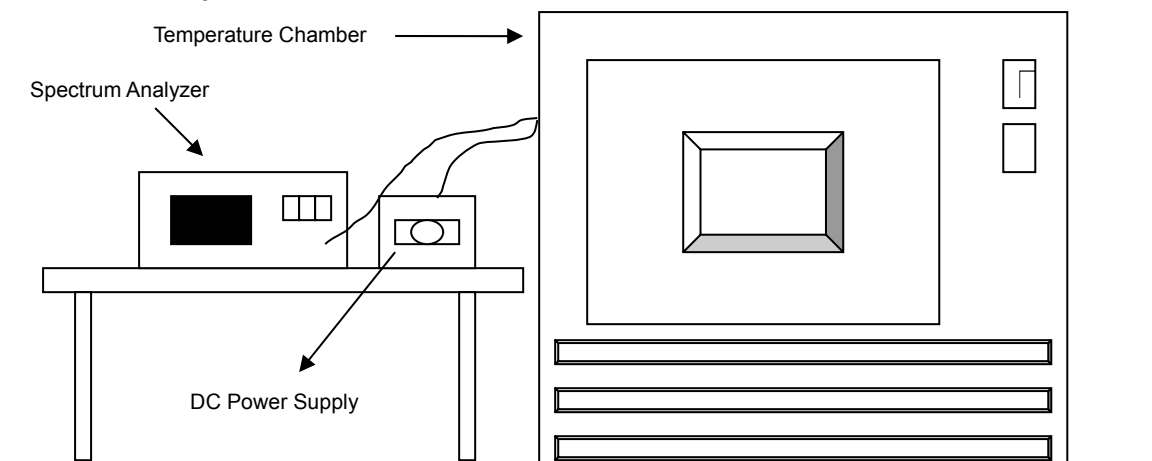


4.3 Frequency Stability

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

Description & Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due
Spectrum Analyzer ROHDE & SCHWARZ	FSP40	100039	Jun. 12, 2019	Jun. 11, 2020
Standard Temperature And Humidity Chamber TERCHY	MHU-225AU	920842	May 31, 2019	May 30, 2020
Digital Multimeter Fluke	87-III	70360742	Jun. 27, 2019	Jun. 26, 2020
DC Power Supply Topward	6306A	727263	NA	NA
True RMS Clamp Meter Fluke	325	31130711WS	May 21, 2019	May 20, 2020

Note: 1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.

4.3.4 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.
- Repeat step (d) with the temperature chamber set to the next desired temperature until measurements down to the lowest specified temperature have been completed.
- 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

Same as Item 4.1.6.

4.3.7 Test Result

Frequency Stability Versus Temp.									
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	13.56004	0.00029	13.56003	0.00022	13.56003	0.00022	13.56003	0.00022
40	12	13.56004	0.00029	13.56004	0.00029	13.56004	0.00029	13.56004	0.00029
30	12	13.56001	0.00007	13.56001	0.00007	13.56001	0.00007	13.56001	0.00007
20	12	13.56	0.00000	13.56001	0.00007	13.55999	-0.00007	13.56001	0.00007
10	12	13.56001	0.00007	13.56002	0.00015	13.56002	0.00015	13.56001	0.00007
0	12	13.55996	-0.00029	13.55996	-0.00029	13.55996	-0.00029	13.55996	-0.00029
-10	12	13.55994	-0.00044	13.55993	-0.00052	13.55994	-0.00044	13.55994	-0.00044
-20	12	13.56002	0.00015	13.56002	0.00015	13.56002	0.00015	13.56003	0.00022

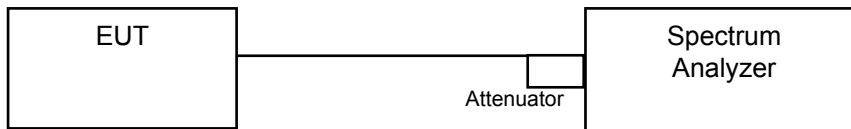
Frequency Stability Versus Voltage									
TEMP. (°C)	Power Supply (Vdc)	0 Minute		2 Minute		5 Minute		10 Minute	
		Measured Frequency	Frequency Drift	Measured Frequency	Frequency Drift	Measured Frequency	Frequency Drift	Measured Frequency	Frequency Drift
		(MHz)	%	(MHz)	%	(MHz)	%	(MHz)	%
20	13.8	13.56	0.00000	13.56001	0.00007	13.55999	-0.00007	13.56001	0.00007
	12	13.56	0.00000	13.56001	0.00007	13.55999	-0.00007	13.56001	0.00007
	10.2	13.56	0.00000	13.56001	0.00007	13.55999	-0.00007	13.56001	0.00007

4.4 20dB Bandwidth

4.4.1 Limits of 20dB Bandwidth Measurement

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

4.4.2 Test Setup



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 1kHz RBW and 3kHz VBW. The 20dB bandwidth is defined as the total spectrum the power of which is higher than peak power minus 20dB.

4.4.5 Deviation from Test Standard

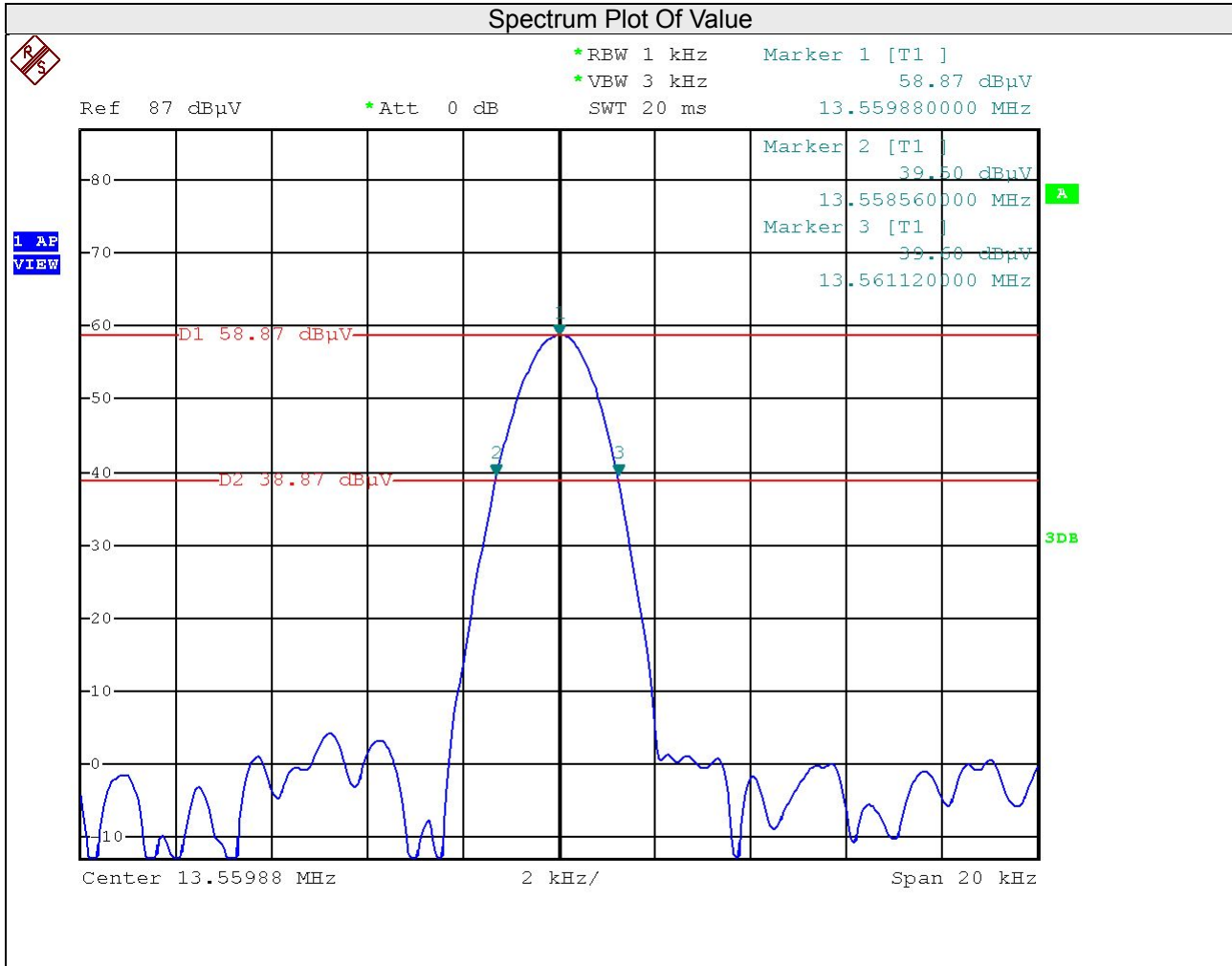
No deviation.

4.4.6 EUT Operating Conditions

Same as Item 4.1.6.

4.4.7 Test Results

20dBc point (Low)	20dBc point (High)	Operating frequency band (MHz)	20dBc Bandwidth (kHz)	Pass / Fail
13.5586 MHz	13.56112 MHz	13.553~13.567	2.56	Pass



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 and approved according to ISO/IEC 17025.

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

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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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