

FCC Test Report

Report No.: RFBBQJ-WTW-P23100340

FCC ID: ACJ9TGRI23B

Test Model: RI23B

Received Date: Oct. 16, 2023

Test Date: Oct. 20 ~ Oct. 21, 2023

Issued Date: Nov. 14, 2023

Applicant: Panasonic Corporation of North America

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

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33383, Taiwan

FCC Registration /
Designation Number: 788550 / TW0003



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Release Control Record

Issue No.	Description	Date Issued
RFBBQJ-WTW-P23100340	Original Release	Nov. 14, 2023

1 Certificate of Conformity

Product: RFID Module

Brand: Panasonic

Test Model: RI23B

Sample Status: Engineering Sample

Applicant: Panasonic Corporation of North America

Test Date: Oct. 20 ~ Oct. 21, 2023

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

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

Prepared by :

Lena Wang

Date: Nov. 14, 2023

Lena Wang / Specialist

Approved by :

Jeremy Lin

Date: Nov. 14, 2023

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 -3.52 dB at 13.56000 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 -64.7 dB at 13.56 MHz.
15.225 (b)	The field strength of any emissions within the bands 13.410-13.553 MHz and 13.567-13.710 MHz	Pass	Meet the requirement of limit.
15.225 (c)	The field strength of any emissions within the bands 13.110-13.410 MHz and 13.710-14.010 MHz	Pass	Meet the requirement of limit.
15.225 (d)	The field strength of any emissions appearing outside of the 13.110-14.010 MHz band	Pass	Meet the requirement of limit. Minimum passing margin is -4.4 dB at 35.82 MHz & 197.83 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 Module
Brand	Panasonic
Test Model	RI23B
Status of EUT	Engineering Sample
Power Supply Rating	5.0 Vdc (host equipment)
Modulation Type	ASK
Data Rate	Type A: 106 kbit/s Type B: 106 kbit/s Type F: 212 kbit/s Type V: 26.48 kbit/s
Operating Frequency	13.56 MHz
Field Strength (Maximum)	19.3 dBuV/m (30m)
Antenna Model	FZ-VNF552_RFID
Antenna Type	Loop Antenna
Antenna Connector	Connector for FPC/FFC
Accessory Device	N/A
Data Cable Supplied	N/A

Note:

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

Product	Brand	Model
Contactless Smart Card Reader	Panasonic	FZ-VNF552

2. Due to radiated measurements are made and the antenna gain is already accounted for this device, so provide an antenna datasheet and/or antenna measurement report is not required. The antenna dimensions and pictures (include antenna wire length if have) are stated in EUT photo exhibit.
3. 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.
4. This module is exclusively for use in the host device FZ-VNF552 RFID Reader, which is available both as a pre-installed and user-attachable accessory solely designed to be inserted into an expansion slot of the host system FZ-55 Personal Computer. Evaluation and testing was conducted for this combined system as a whole.

3.2 Description of Test Modes

One channel was provided to this EUT:

Channel	Frequency (MHz)
1	13.56

3.2.1 Test Mode Applicability and Tested Channel Detail

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

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

NOTE: The EUT had been pre-tested on Type A, Type B, Type F and Type V. The worst case was found when data rate was Type B. Type B was chosen for final test..

NOTE: "-" means no effect.

NOTE: The EUT had been pre-tested on the positioned of each 3 axis. The worst case was found when positioned on **X-axis**..

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	21 deg. C, 68 % RH	120 Vac, 60 Hz	Vincent Chen
FS	23 deg. C, 67 % RH	120 Vac, 60 Hz	Vincent Chen
PLC	23 deg. C, 64 % RH	120 Vac, 60 Hz	Vincent Chen
EB	23 deg. C, 67 % RH	120 Vac, 60 Hz	Vincent Chen

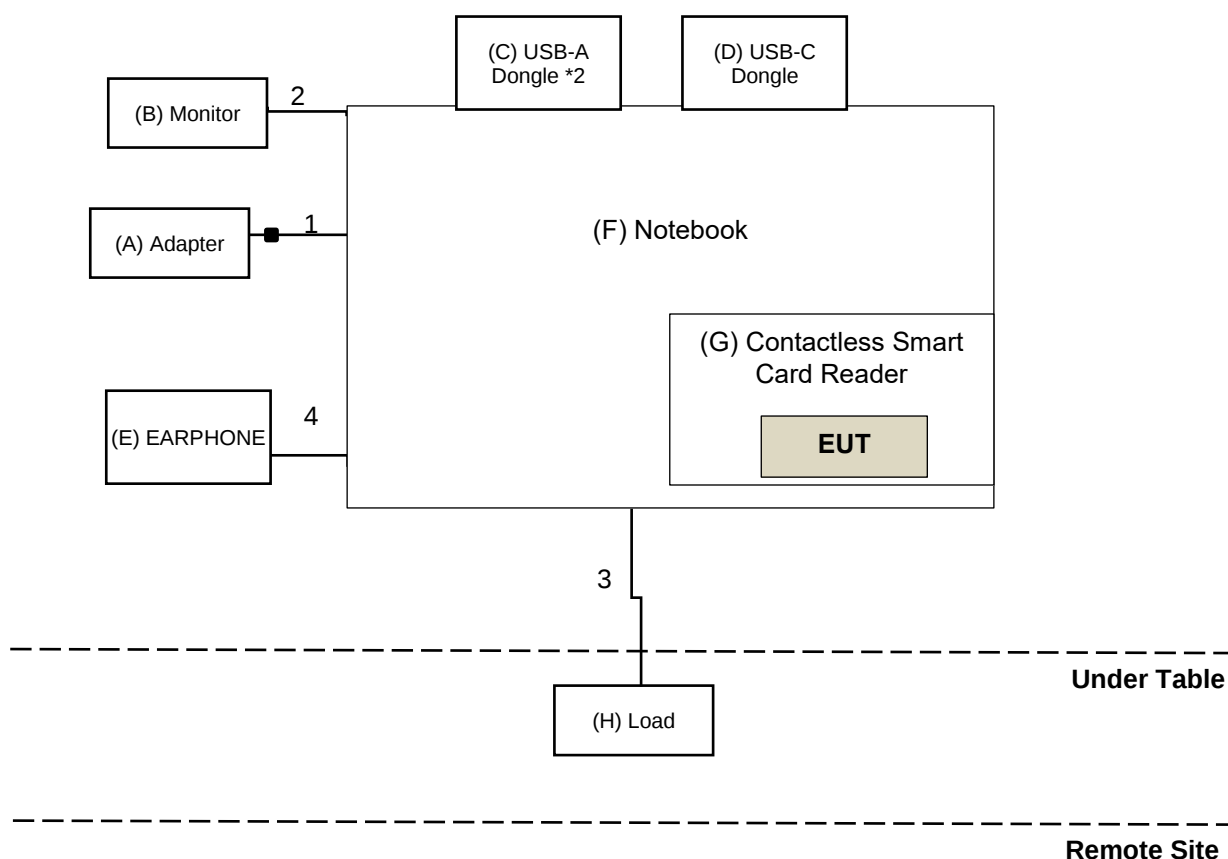
3.3 Description of Support Units

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	Adapter	Panasonic	CF-AA5713A	N/A	N/A	Supplied by applicant
B	Monitor	DELL	A14S2421HSXmTW	CN-01KFWF-WSL00-24C-711B	N/A	V6-010669
C	USB-A Dongle*2	Transcend	JetFlash 700	N/A	N/A	Provided by Lab
D	USB-C Dongle	SanDisk	SDDDC3-032G	N/A	N/A	Provided by Lab
E	EARPHONE	HTC	MAX320	N/A	N/A	Provided by Lab
F	Notebook	Panasonic	FZ-55	N/A	N/A	Supplied by applicant
G	Contactless Smart Card Reader	Panasonic	FZ-VNF552	N/A	N/A	Supplied by applicant
H	Load	N/A	N/A	N/A	N/A	Provided by Lab

ID	Cable Descriptions	Qty.	Length (m)	Shielding (Yes/No)	Cores (Qty.)	Remarks
1	DC Cable	1	1.42	Yes	1	Supplied by applicant
2	HDMI Cable	1	1.8	Yes	0	Provided by Lab
3	LAN Cable	1	1.5	No	0	Provided by Lab
4	Audio Cable	1	1.2	No	0	Provided by Lab

3.3.1 Configuration of System under Test



3.4 General Description of Applied Standards and references

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

FCC Part 15, Subpart C (15.225)

FCC Part 15, Subpart C (15.215)

ANSI C63.10-2013

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

References Test Guidance :

KDB 414788 D01 Radiated Test Site v01r01

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

4 Test Types and Results

4.1 Radiated Emission Measurement

4.1.1 Limits of Radiated Emission Measurement

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

Frequencies (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009 ~ 0.490	2400/F (kHz)	300
0.490 ~ 1.705	24000/F (kHz)	30
1.705 ~ 30.0	30	30
30 ~ 88	100	3
88 ~ 216	150	3
216 ~ 960	200	3
Above 960	500	3

NOTE:

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

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	May 03, 2023	May 02, 2024
Signal Analyzer Agilent	N9010A	MY52220207	Jan. 03, 2023	Jan. 02, 2024
Loop Antenna TESEQ	HLA 6121	45745	Aug. 08, 2023	Aug. 07, 2024
Loop Antenna EMCI	EM-6879	269	Sep. 23, 2023	Sep. 22, 2024
Pre-amplifier EMCI	EMC001340	980201	Sep. 27, 2023	Sep. 26, 2024
RF Coaxial Cable EMCI	5D-NM-BM	140903+140902	Jan. 07, 2023	Jan. 06, 2024
Pre-Amplifier EMCI	EMC 330H	980112	Sep. 27, 2023	Sep. 26, 2024
Bi_Log Antenna Schwarzbeck	VULB9168	9168-472	Oct. 16, 2023	Oct. 15, 2024
RF Coaxial Cable WOKEN	8D-FB	Cable-Ch10-01	Sep. 27, 2023	Sep. 26, 2024

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.

4.1.2 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:

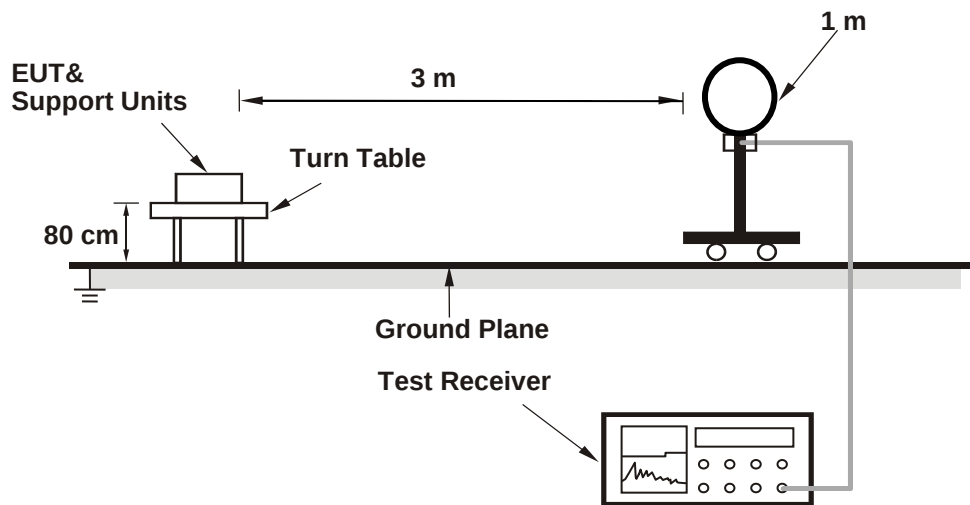
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Quasi-peak detection (QP) frequency below 1 GHz.
2. All modes of operation were investigated and the worst-case emissions are reported.

4.1.3 Deviation from Test Standard

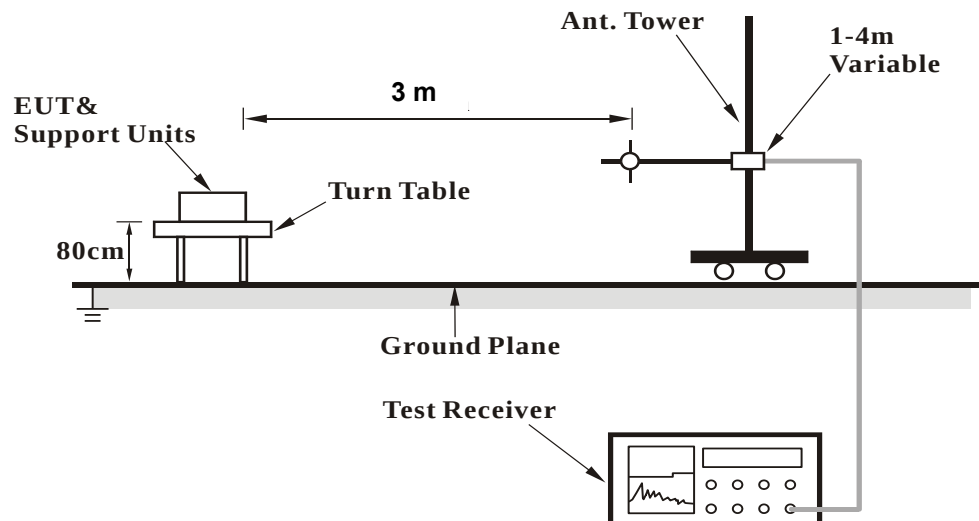
No deviation.

4.1.4 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.

4.1.5 EUT Operating Conditions

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

4.1.6 Test Results

Type B

RF Mode	RFID-13.56MHz	Channel	CH 1 : 13.56 MHz
Frequency Range	13.11 MHz ~ 14.01 MHz	Detector Function & Bandwidth	Quasi-Peak (QP), 9 kHz
Input Power	120 Vac, 60 Hz	Environmental Conditions	21°C, 68% RH
Test Date	Vincent Chen		

Antenna Polarity & Test Distance: Loop Antenna Parallel at 3 m

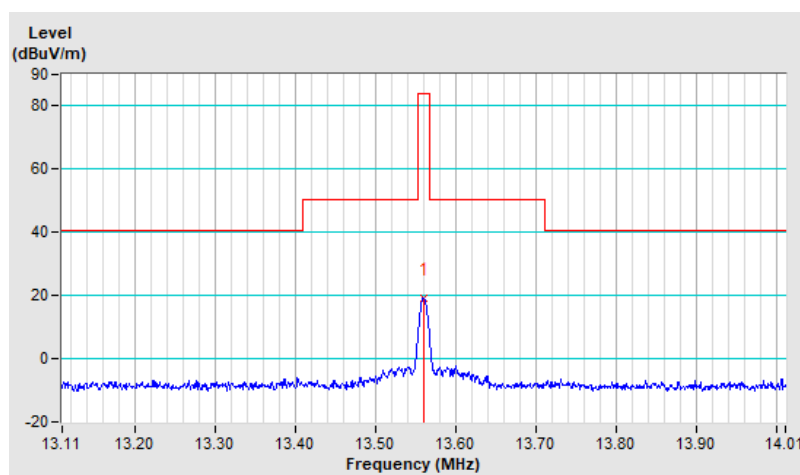
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	*13.56	19.3 QP	84.0	-64.7	1.00	141	37.9	-18.6

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. 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 test distance for 0.49 ~ 30MHz is 3m, extrapolate the measured field strength to a distance of 30 meters.

Distance factor@10m = $40 \cdot \log(3/30) = 40\text{dB}$



RF Mode	RFID-13.56MHz	Channel	CH 1 : 13.56 MHz
Frequency Range	13.11 MHz ~ 14.01 MHz	Detector Function & Bandwidth	Quasi-Peak (QP), 9 kHz
Input Power	120 Vac, 60 Hz	Environmental Conditions	21°C, 68% RH
Test Date	Vincent Chen		

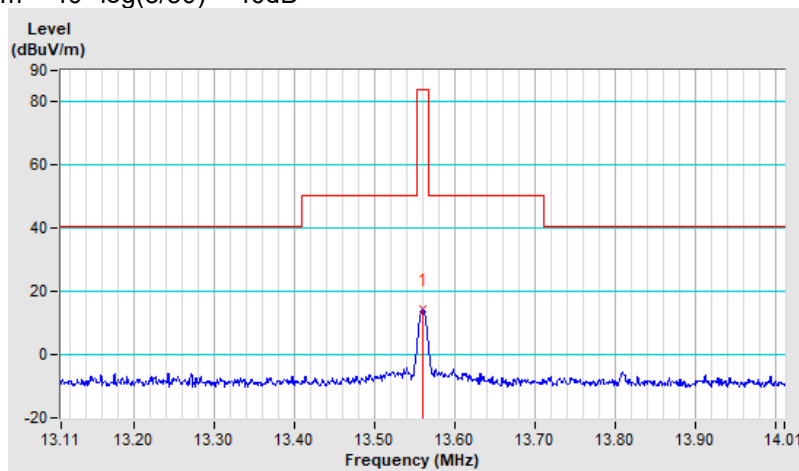
Antenna Polarity & Test Distance: Loop Antenna Perpendicular at 3 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	*13.56	14.5 QP	84.0	-69.5	1.00	38	33.1	-18.6

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. 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 test distance for 0.49 ~ 30MHz is 3m, extrapolate the measured field strength to a distance of 30 meters.

Distance factor@10m = $40 \cdot \log(3/30) = 40\text{dB}$



RF Mode	RFID-13.56MHz	Channel	CH 1 : 13.56 MHz
Frequency Range	13.11 MHz ~ 14.01 MHz	Detector Function & Bandwidth	Quasi-Peak (QP), 9 kHz
Input Power	120 Vac, 60 Hz	Environmental Conditions	21°C, 68% RH
Test Date	Vincent Chen		

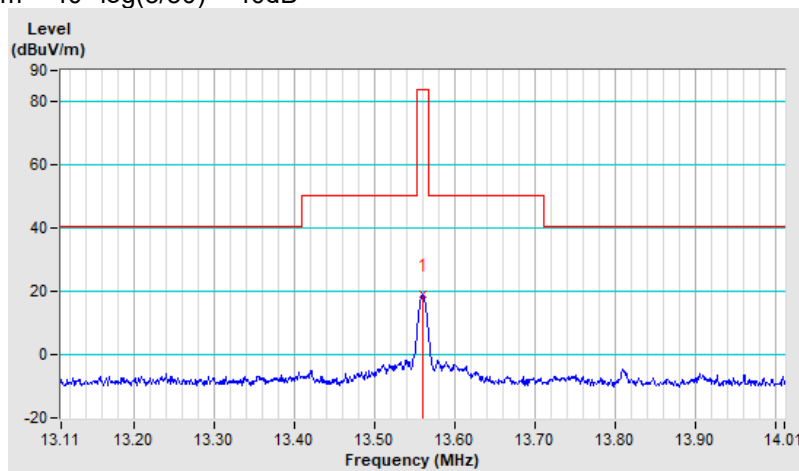
Antenna Polarity & Test Distance: Loop Antenna Ground-Parallel at 3 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	*13.56	19.1 QP	84.0	-64.9	1.00	139	37.7	-18.6

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. 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 test distance for 0.49 ~ 30MHz is 3m, extrapolate the measured field strength to a distance of 30 meters.

Distance factor@10m = $40 \cdot \log(3/30) = 40\text{dB}$



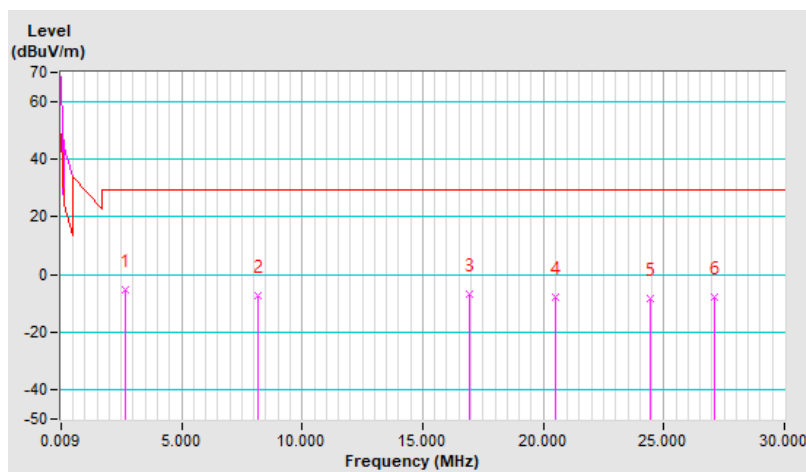
Below 30MHz

RF Mode	RFID-13.56MHz	Channel	CH 1 : 13.56 MHz
Frequency Range	9 kHz ~ 30 MHz	Detector Function & Bandwidth	Quasi-Peak (QP), 9 kHz
Input Power	120 Vac, 60 Hz	Environmental Conditions	21°C, 68% RH
Test Date	Vincent Chen		

Antenna Polarity & Test Distance: Loop Antenna Parallel 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	2.68	-5.0 QP	29.5	-34.5	1.00	336	15.5	-20.5
2	8.17	-7.4 QP	29.5	-36.9	1.00	248	11.5	-18.9
3	16.92	-6.7 QP	29.5	-36.2	1.00	345	11.3	-18.0
4	20.52	-7.6 QP	29.5	-37.1	1.00	240	10.5	-18.1
5	24.42	-8.1 QP	29.5	-37.6	1.00	195	9.9	-18.0
6	27.12	-7.6 QP	29.5	-37.1	1.00	89	10.2	-17.8

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

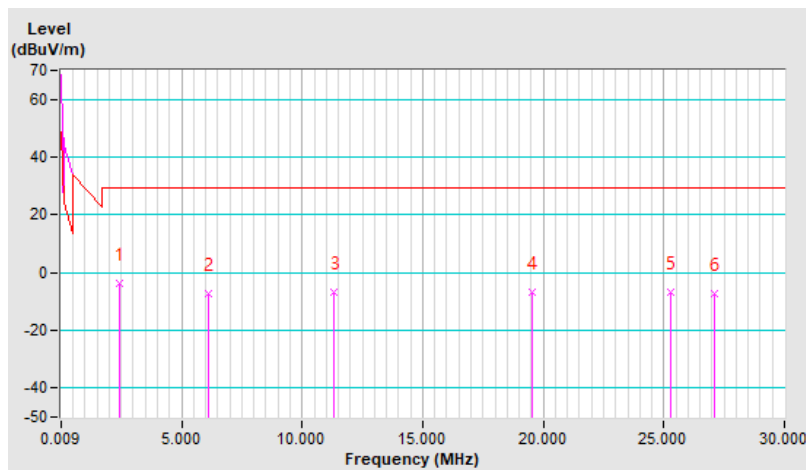


RF Mode	RFID-13.56MHz	Channel	CH 1 : 13.56 MHz
Frequency Range	9 kHz ~ 30 MHz	Detector Function & Bandwidth	Quasi-Peak (QP), 9 kHz
Input Power	120 Vac, 60 Hz	Environmental Conditions	21°C, 68% RH
Test Date	Vincent Chen		

Antenna Polarity & Test Distance: Loop Antenna Perpendicular 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	2.41	-3.6 QP	29.5	-33.1	1.00	169	16.8	-20.4
2	6.10	-7.5 QP	29.5	-37.0	1.00	315	11.3	-18.8
3	11.35	-6.7 QP	29.5	-36.2	1.00	2	11.7	-18.4
4	19.56	-6.9 QP	29.5	-36.4	1.00	12	11.0	-17.9
5	25.26	-7.0 QP	29.5	-36.5	1.00	9	10.6	-17.6
6	27.12	-7.2 QP	29.5	-36.7	1.00	308	10.6	-17.8

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

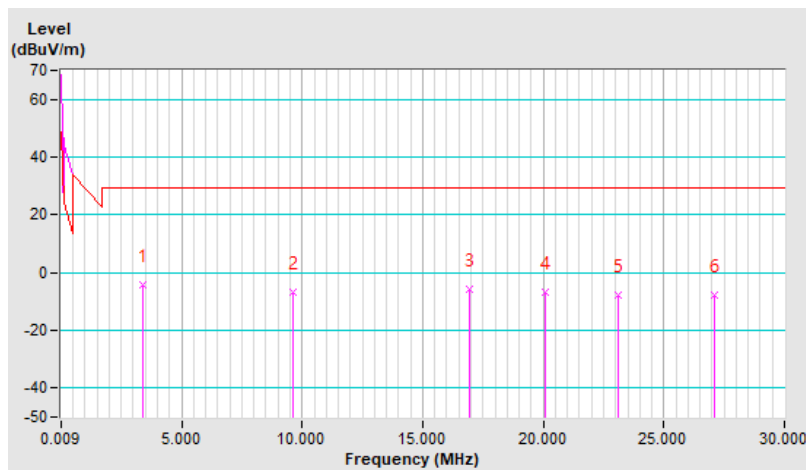


RF Mode	RFID-13.56MHz	Channel	CH 1 : 13.56 MHz
Frequency Range	9 kHz ~ 30 MHz	Detector Function & Bandwidth	Quasi-Peak (QP), 9 kHz
Input Power	120 Vac, 60 Hz	Environmental Conditions	21°C, 68% RH
Test Date	Vincent Chen		

Antenna Polarity & Test Distance: Loop Antenna Ground-Parallel 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	3.37	-4.4 QP	29.5	-33.9	1.00	3	16.0	-20.4
2	9.64	-6.8 QP	29.5	-36.3	1.00	165	11.9	-18.7
3	16.95	-5.9 QP	29.5	-35.4	1.00	13	12.1	-18.0
4	20.07	-6.7 QP	29.5	-36.2	1.00	220	11.2	-17.9
5	23.13	-7.6 QP	29.5	-37.1	1.00	18	11.0	-18.6
6	27.12	-8.0 QP	29.5	-37.5	1.00	110	9.8	-17.8

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



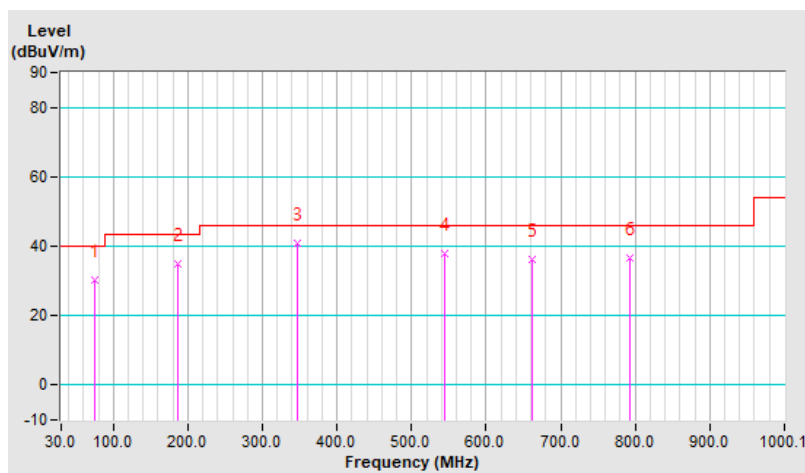
Below 1000MHz

RF Mode	RFID-13.56MHz	Channel	CH 1 : 13.56 MHz
Frequency Range	30 MHz ~ 1 GHz	Detector Function & Bandwidth	Quasi-Peak (QP), RB = 120kHz
Input Power	120 Vac, 60 Hz	Environmental Conditions	21°C, 68% 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	74.62	30.2 QP	40.0	-9.8	2.00 H	2	46.0	-15.8
2	186.19	34.8 QP	43.5	-8.7	2.00 H	4	49.6	-14.8
3	346.25	40.9 QP	46.0	-5.1	1.50 H	248	52.0	-11.1
4	544.15	37.7 QP	46.0	-8.3	1.01 H	259	43.9	-6.2
5	662.51	36.2 QP	46.0	-9.8	1.00 H	200	40.0	-3.8
6	792.50	36.8 QP	46.0	-9.2	1.50 H	188	37.8	-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 30 MHz ~ 1 GHz.

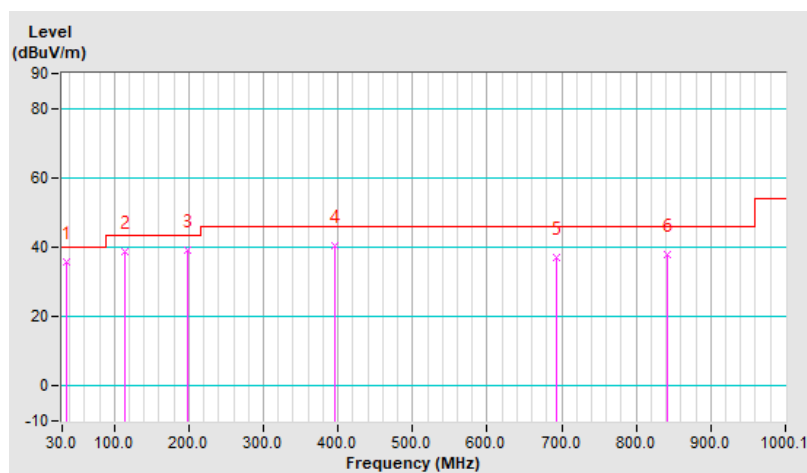


RF Mode	RFID-13.56MHz	Channel	CH 1 : 13.56 MHz
Frequency Range	30 MHz ~ 1 GHz	Detector Function & Bandwidth	Quasi-Peak (QP), RB = 120kHz
Input Power	120 Vac, 60 Hz	Environmental Conditions	21°C, 68% RH
Tested By	Vincent Chen		

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	35.82	35.6 QP	40.0	-4.4	1.00 V	229	48.7	-13.1
2	114.40	38.9 QP	43.5	-4.6	2.00 V	18	54.0	-15.1
3	197.83	39.1 QP	43.5	-4.4	1.00 V	192	55.0	-15.9
4	395.73	40.3 QP	46.0	-5.7	2.00 V	228	50.0	-9.7
5	692.58	37.1 QP	46.0	-8.9	1.50 V	208	40.5	-3.4
6	841.97	37.9 QP	46.0	-8.1	1.50 V	286	38.9	-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 30 MHz ~ 1 GHz.



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.

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. 21, 2022	Dec. 20, 2023
RF signal cable (with 10dB PAD) Woken	5D-FB	Cable-cond2-01	Sep. 02, 2023	Sep. 01, 2024
LISN/AMN ROHDE & SCHWARZ (EUT)	ESH2-Z5	100100	Mar. 07, 2023	Mar. 06, 2024
LISN/AMN ROHDE & SCHWARZ (Peripheral)	ESH3-Z5	100312	Sep. 12, 2023	Sep. 11, 2024
Software ADT	BV ADT_Cond_ V7.3.7.3	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 1.
 3. The VCCI Site Registration No. is C-12040.
 4. Test date: 2023/10/21

4.2.3 Test Procedures

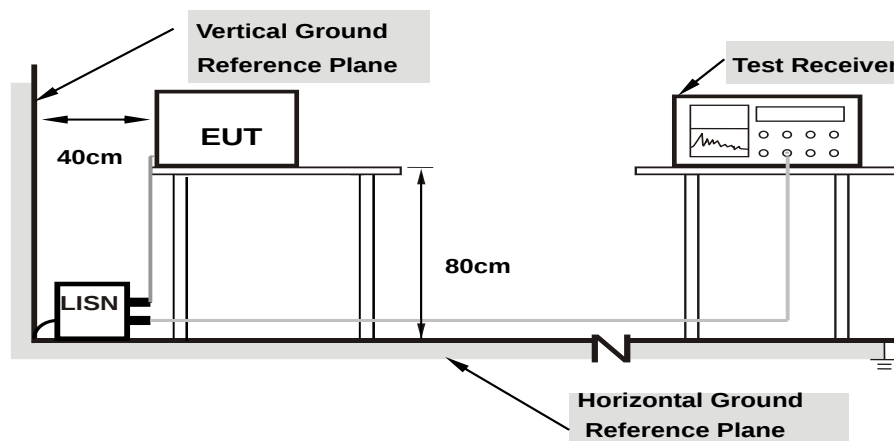
- The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/50 uH of coupling impedance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

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

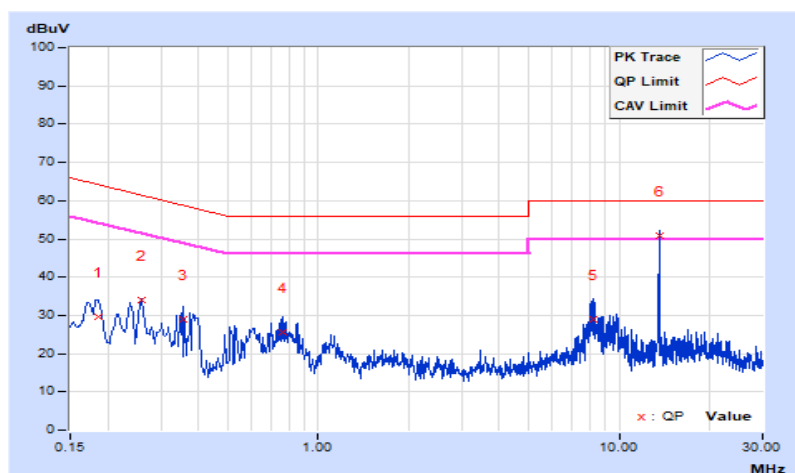
Type B

Frequency Range	150 kHz ~ 30 MHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP) / Average (AV), 9 kHz
Input Power	120 Vac, 60 Hz	Environmental Conditions	23°C, 64% RH
Tested By	Vincent Chen		

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	0.18600	10.33	19.20	10.66	29.53	20.99	64.21	54.21	-34.68	-33.22
2	0.25800	10.36	23.81	20.61	34.17	30.97	61.50	51.50	-27.33	-20.53
3	0.35800	10.40	18.68	3.49	29.08	13.89	58.77	48.77	-29.69	-34.88
4	0.76200	10.43	15.29	8.03	25.72	18.46	56.00	46.00	-30.28	-27.54
5	8.22600	10.56	18.39	4.76	28.95	15.32	60.00	50.00	-31.05	-34.68
6	13.56000	10.63	40.28	35.85	50.91	46.48	60.00	50.00	-9.09	-3.52

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

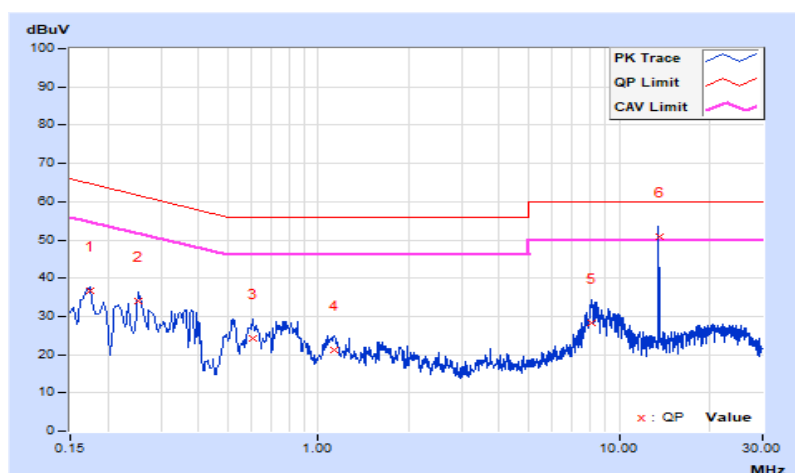


Frequency Range	150 kHz ~ 30 MHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP) / Average (AV), 9 kHz
Input Power	120 Vac, 60 Hz	Environmental Conditions	23°C, 64% RH
Tested By	Vincent Chen		

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	0.17384	10.34	26.45	20.07	36.79	30.41	64.77	54.77	-27.98	-24.36
2	0.25400	10.38	23.57	19.54	33.95	29.92	61.63	51.63	-27.68	-21.71
3	0.60600	10.44	13.74	7.44	24.18	17.88	56.00	46.00	-31.82	-28.12
4	1.13000	10.45	10.86	4.53	21.31	14.98	56.00	46.00	-34.69	-31.02
5	8.09794	10.63	17.59	3.74	28.22	14.37	60.00	50.00	-31.78	-35.63
6	13.56000	10.75	40.26	34.82	51.01	45.57	60.00	50.00	-8.99	-4.43

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

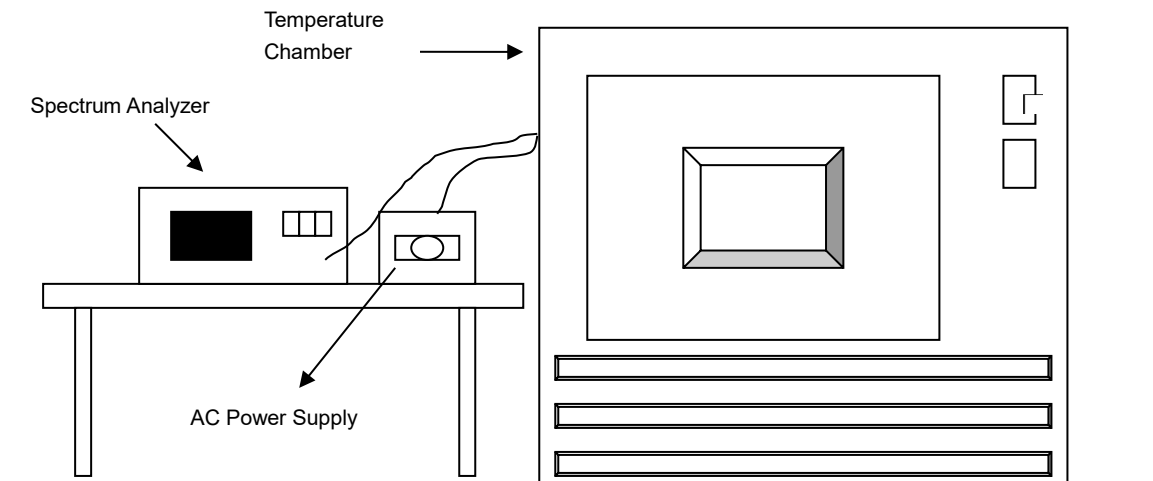


4.3 Frequency Stability

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

Type B

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	13.55998	-0.00015	13.55998	-0.00015	13.55998	-0.00015	13.55998	-0.00015
40	120	13.55999	-0.00007	13.56001	0.00007	13.56	0.00000	13.56	0.00000
30	120	13.55999	-0.00007	13.55999	-0.00007	13.55999	-0.00007	13.55999	-0.00007
20	120	13.56005	0.00037	13.56004	0.00029	13.56004	0.00029	13.56004	0.00029
10	120	13.55995	-0.00037	13.55995	-0.00037	13.55996	-0.00029	13.55995	-0.00037
0	120	13.56002	0.00015	13.56002	0.00015	13.56002	0.00015	13.56002	0.00015
-10	120	13.56005	0.00037	13.56004	0.00029	13.56004	0.00029	13.56004	0.00029
-20	120	13.55997	-0.00022	13.55996	-0.00029	13.55995	-0.00037	13.55997	-0.00022

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	13.56005	0.00037	13.56004	0.00029	13.56004	0.00029	13.56004	0.00029
	120	13.56005	0.00037	13.56004	0.00029	13.56004	0.00029	13.56004	0.00029
	102	13.56005	0.00037	13.56004	0.00029	13.56004	0.00029	13.56004	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 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.

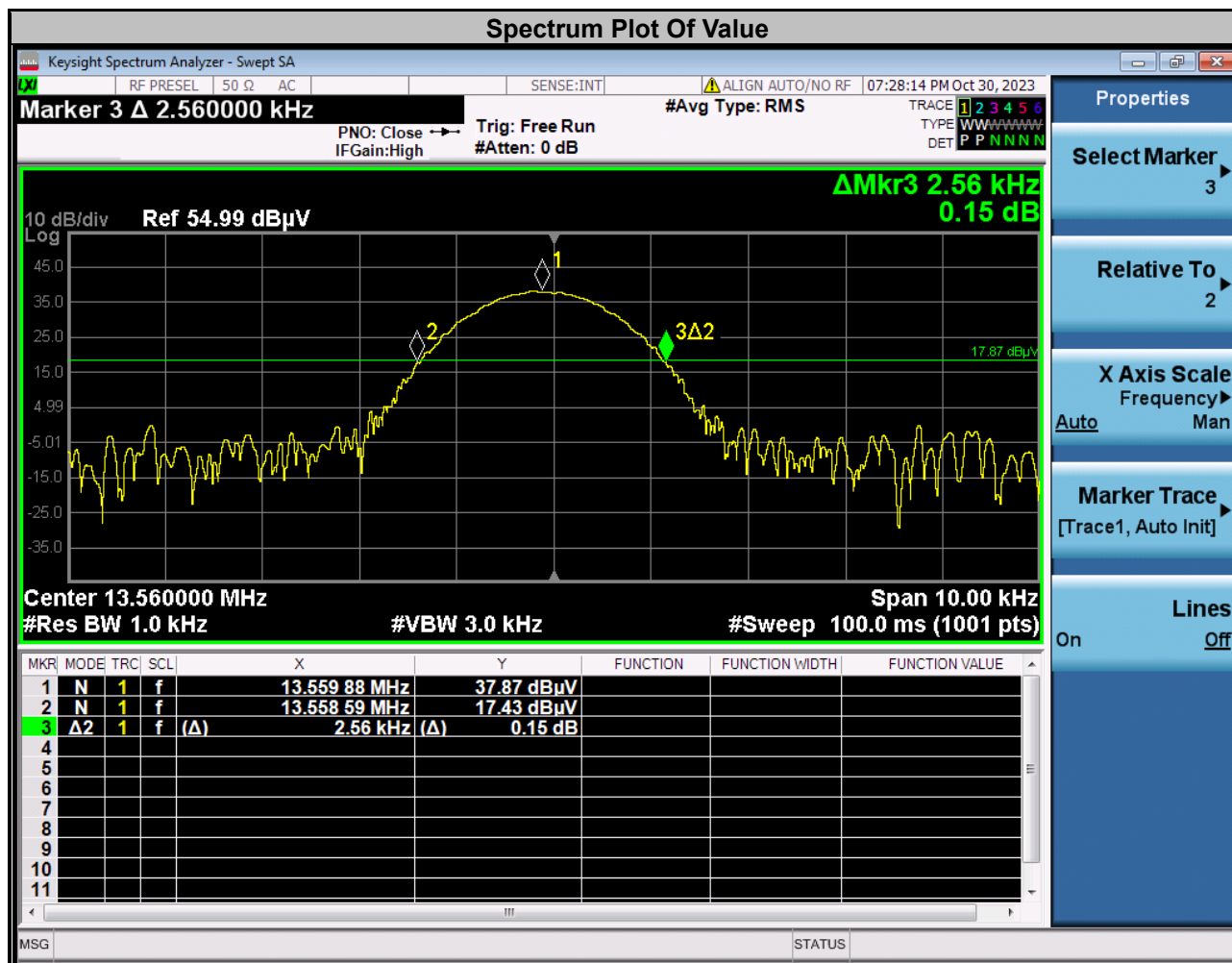
4.4.6 EUT Operating Conditions

- 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

Type B

20 dBc Point (Low)	20 dBc Point (High)	Operating Frequency Band (MHz)	20 dBc Bandwidth (kHz)	Pass / Fail
13.55859 MHz	13.56115 MHz	13.553~13.567	2.56	Pass



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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Web Site: <http://ee.bureauveritas.com.tw>

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

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