

Prüfbericht-Nr.: <i>Test report no.:</i>	CN23U1MU 001	Auftrags-Nr.: <i>Order no.:</i>	48224436	Seite 1 von 25 Page 1 of 25
Kunden-Referenz-Nr.: <i>Client reference no.:</i>	N/A	Auftragsdatum: <i>Order date:</i>	2023-09-18	
Auftraggeber: <i>Client:</i>	3S System Technology Inc. 6F., No.5, Lane 16, Sec. 2, Sichuan Rd. Banqiao Dist., New Taipei City 22061, Taiwan (R.O.C.)			
Prüfgegenstand: <i>Test item:</i>	Card Reader			
Bezeichnung / Typ-Nr.: <i>Identification / Type no.:</i>	CA017			
Auftrags-Inhalt: <i>Order content:</i>	FCC Part 15C Test report (RFID)			
Prüfgrundlage: <i>Test specification:</i>	FCC 47CFR Part 15: Subpart C Section 15.225			
Wareneingangsdatum: <i>Date of sample receipt:</i>	2023-10-06			
Prüfmuster-Nr.: <i>Test sample no.:</i>	A003575241-001			
Prüfzeitraum: <i>Testing period:</i>	2023-10-06 - 2023-10-26			
Ort der Prüfung: <i>Place of testing:</i>	EMC/RF Taipei Testing Site			
Prüflaboratorium: <i>Testing laboratory:</i>	Taipei Testing Laboratories			
Prüfergebnis*: <i>Test result*:</i>	Pass			
zusammengestellt von: <i>compiled by:</i>	Ryan Chen Senior Project Manager	genehmigt von: <i>authorized by:</i>	Brenda Chen Senior Project Manager	
Datum: <i>Date:</i>	2023-11-08	Ausstellungsdatum: <i>Issue date:</i>	2023-11-08	
Stellung / Position:		Stellung / Position:		
Sonstiges / Other:				
Zustand des Prüfgegenstandes bei Anlieferung: <i>Condition of the test item at delivery:</i>		Prüfmuster vollständig und unbeschädigt <i>Test item complete and undamaged</i>		
* Legende: 1 = sehr gut 2 = gut 3 = befriedigend 4 = ausreichend 5 = mangelhaft P(pass) = entspricht o.g. Prüfgrundlage(n) F(fail) = entspricht nicht o.g. Prüfgrundlage(n) N/A = nicht anwendbar N/T = nicht getestet * Legend: 1 = very good 2 = good 3 = satisfactory 4 = sufficient 5 = poor P(pass) = passed a.m. test specification(s) F(fail) = failed a.m. test specification(s) N/A = not applicable N/T = not tested				
Dieser Prüfbericht bezieht sich nur auf das o.g. Prüfmuster und darf ohne Genehmigung der Prüfstelle nicht auszugsweise vervielfältigt werden. Dieser Bericht berechtigt nicht zur Verwendung eines Prüfzeichens. This test report only relates to the a. m. test sample. Without permission of the test center this test report is not permitted to be duplicated in extracts. This test report does not entitle to carry any test mark.				

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TEST SUMMARY

Report Section	FCC Clause	Test Item	Result
5.1.1	15.203	Antenna Requirement	Pass
5.1.2	15.225 (a)(b)(c)	Field Strength of Fundamental Emissions	Pass
5.1.3	15.225 (d)	Radiated Spurious Emissions	Pass
5.1.4	15.225 (e)	Frequency Stability	Pass
5.1.5	15.215 (c)	20 dB Bandwidth	Pass
5.1.5	2.1049	99% Occupied Bandwidth	Pass
5.2.1	15.207	Mains Conducted Emission	Pass

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

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APPENDIX A - TEST RESULT OF RADIATED EMISSIONS & MAINS CONDUCTED EMISSION

APPENDIX SP - PHOTOGRAPHS OF TEST SETUP

APPENDIX EP - PHOTOGRAPHS OF EUT

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HISTORY OF THIS TEST REPORT

Revision	Description	Date Issued
R01	Original Release	2023-11-08

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1. General Remarks

1.1 Complementary Materials

All attachments are integral parts of this test report. This applies especially to the following appendix:

Appendix A - Test Result of Radiated Emissions & Mains Conducted Emission

Appendix SP - Photographs of Test Setup

Appendix EP - Photographs of EUT

Applied Standard and Test Levels

Radio
FCC 47CFR Part 15: Subpart C Section 15.225
FCC 47CFR Part 2: Subpart J Section 2.1049
ANSI C63.10:2013

1.2 Decision Rule of Conformity

The decision rule of conformity of this test report is following the requirements of the requested standard in the quotation, and agreed among testing laboratory and manufacturer (applicant) to exclude the consideration of Measurement Uncertainty, unless it is required by the specific standard.

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2. Test Sites

2.1 Test Laboratory

Taipei Testing Laboratories

11F. No.758, Sec. 4, Bade Rd., Songshan Dist.
Taipei City 105
Taiwan (R.O.C.)

2.2 Test Facility

Taipei Testing Laboratories

No.458-18, Sec. 2, Fenliao Rd., Linkou Dist.,
New Taipei City 244
Taiwan (R.O.C.)
FCC Registration No.: 180491
ISED Registration No.: 25563

2.3 Traceability

All measurement equipment calibrations are traceable to NML(Taiwan)/NIST(USA) or where calibration is performed outside Taiwan, to equivalent nationally recognized standards organizations.

2.4 Calibration

Equipment requiring calibration is calibrated periodically in a suitably accredited Calibration Lab. Additionally all equipment is verified for proper performance on a regular basis using in house standards or comparisons.

2.5 Measurement Uncertainty

All measurement uncertainty values are shown with a coverage factor of k=2 to indicate a 95% level of confidence.

Emission Measurement Uncertainty

Parameter	Uncertainty
Radiated Emission (9 kHz ~ 30 MHz)	± 1.15 dB
Radiated Emission (30 MHz ~ 200 MHz)	± 1.32 dB
Radiated Emission (200 MHz ~ 1 GHz)	± 1.31 dB
Mains Conducted Emission	± 1.65 dB

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3. General Product Information

3.1 Product Function and Intended Use

The EUT is a Card Reader working at 13.56 MHz with RFID function.
For details refer to the User Guide, Data Sheet and Circuit Diagram.

3.2 System Details and Ratings

Basic Information of EUT

Item	EUT information
Kind of Equipment/Test Item	Card Reader
Type Identification	CA017
FCC ID	2BC3U-CA017001

Technical Specification of EUT

Item	EUT information
Operating Frequency	13.56 MHz
Operation Voltage	12Vdc
Modulation	OOK
Antenna Information	Refer to 5.1.1
Accessory Device	Refer to 4.3

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3.3 Noise Generating and Noise Suppressing Parts

Refer to the Circuit Diagram.

3.4 Submitted Documents

- Circuit Diagram
- Instruction Manual
- Rating Label
- Technical Description

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4. Test Set-up and Operation Modes

4.1 Principle of Configuration Selection

The equipment under test (EUT) was configured to measure its maximum emission level. The test modes were adapted accordingly in reference to the instructions for use.

4.2 Test Operation and Test Software

Setup for testing: The EUT has a modified firmware which makes it possible to continuous transmit when power on. The RFID reader is permanently on.

Test Software	None.
---------------	-------

The samples were used as follows:

A003575241-001

Full test was applied on all test modes, but only worst case was shown.

EUT Configure Mode	Applicable To				Description
	Radiated Spurious Emissions	Frequency Stability	20 dB Bandwidth	Mains Conducted Emission	
-	√	√	√	√	-

Note:

1. The EUT had been pre-tested on the positioned of each 3 axis. The worst case was found when position on Z-plane.
2. "-" means no effect.

Radiated Spurious Emissions

- Pre-Scan full test was applied on all test modes, but only worst case was shown.
- Following channel(s) was (were) selected for the final test as listed below.

EUT Configure Mode	Available Frequency (MHz)	Tested Frequency (MHz)
-	13.56	13.56

Frequency Stability

- Pre-Scan full test was applied on all test modes, but only worst case was shown.
- Following channel(s) was (were) selected for the final test as listed below.

EUT Configure Mode	Available Frequency (MHz)	Tested Frequency (MHz)
-	13.56	13.56

20 dB Bandwidth

- Pre-Scan full test was applied on all test modes, but only worst case was shown.
- Following channel(s) was (were) selected for the final test as listed below.

EUT Configure Mode	Available Frequency (MHz)	Tested Frequency (MHz)
-	13.56	13.56

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Mains Conducted Emission

- Pre-Scan full test was applied on all test modes, but only worst case was shown.
- Following channel(s) was (were) selected for the final test as listed below.

EUT Configure Mode	Available Frequency (MHz)	Tested Frequency (MHz)
-	13.56	13.56

Test Condition

Test Item	Ambient Temperature	Relative Humidity	Tested by
Radiated Spurious Emissions	22.7-24.5 °C	52-55 %	Ray Huang
Frequency Stability	21.3-22.4 °C	57.4-61.3 %	Andy Chen
20 dB Bandwidth	21.3-22.4 °C	57.4-61.3 %	Andy Chen
Mains Conducted Emission	19.1-25.9 °C	50.2-58.9 %	Roger Liao

4.3 Special Accessories and Auxiliary Equipment

The product has been tested together with the following additional accessories:

Accessory of EUT

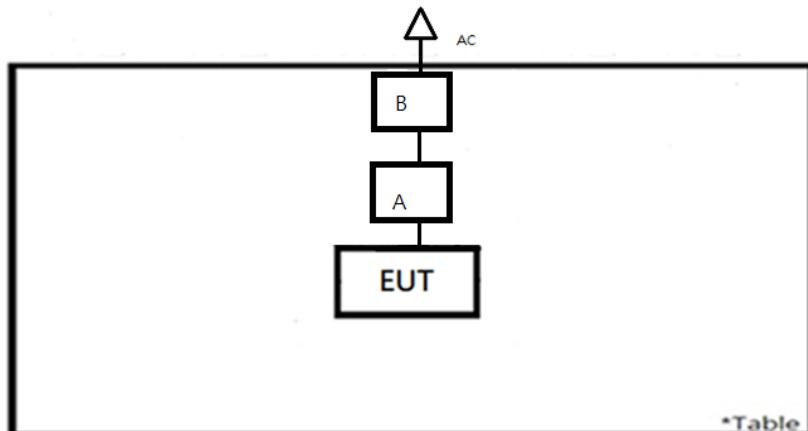
None.

Support Unit

No.	Description	Brand	Model	S/N	Remark
Radiated Test					
A	Fixture	3S	3S System-01	--	10 cm non-shielded cable with core
B	Adapter	3S	KEL-122000A	--	100 cm non-shielded cable with core
Mains Conducted Test					
A	Fixture	3S	3S System-01	--	10 cm non-shielded cable w/o core
B	Adapter	TUV	STD-2020U	--	155 cm non-shielded cable with core

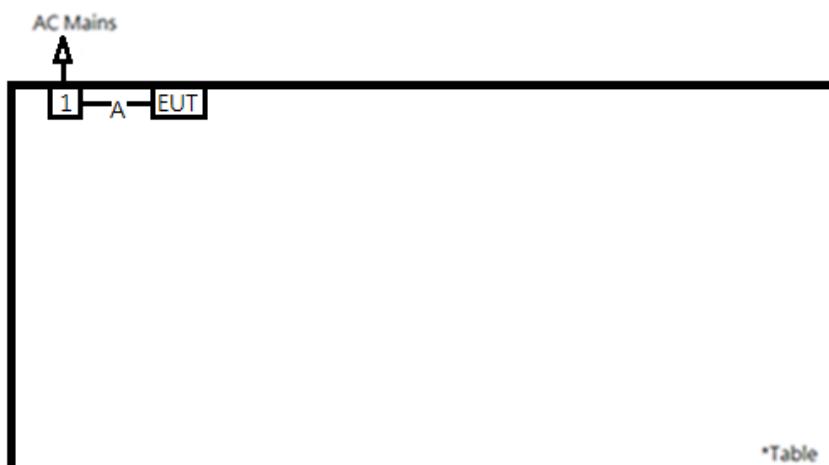
4.4 Test Setup Diagram

<Radiated Spurious Emissions Mode>



*Table

<Mains Conducted Emission Mode>



*Table

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5. Test Results

5.1 Transmitter Requirement & Test Suites

5.1.1 Antenna Requirement

Requirement Use of approved antennas only

The antenna is a loop antenna with no possibility of replacement with a non-approved antenna by the end-user. Therefore, the EUT is considered to comply with this provision.

Refer to EUT photo for details.

5.1.2 Field Strength of Fundamental Emissions

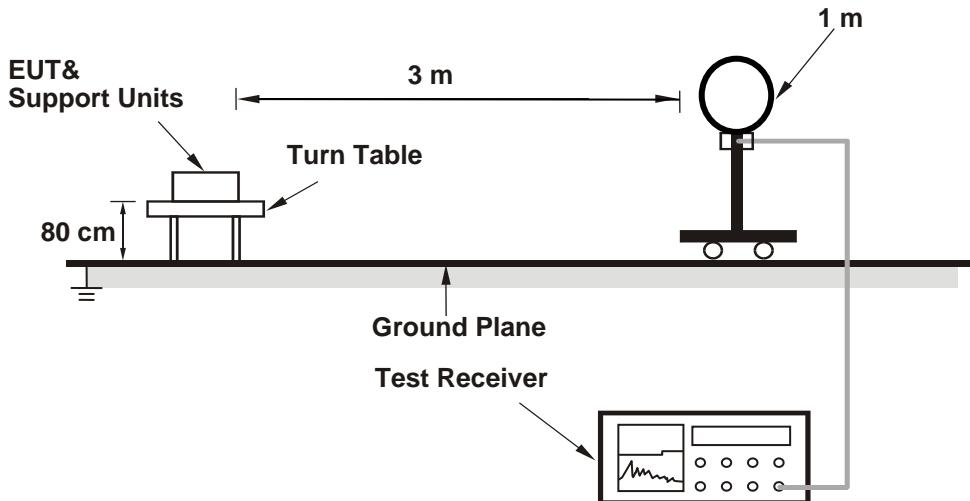
Limit

- 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.

Kind of Test Site

3m Semi-Anechoic Chamber

Test Setup



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

Test Instruments

Test Date: 2023/10/20

Kind of Equipment	Manufacturer	Type	S/N	Calibration Date	Calibration Due Date
Receiver	R&S	ESR7	102109	2023/2/24	2024/2/23
Bilog Antenna	SCHWARZBECK	VULB-9168	00951	2023/3/31	2024/3/29
LF-AMP	Agilent	8447D	2944A107722	2023/3/22	2024/3/20
Receiver	R&S	ESR7	102109	2023/2/24	2024/2/23
Loop Antenna	SCHWARZBECK	FMZB 1519B	00215	2023/1/4	2024/1/3

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Test Procedures

- 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 (OPEN), perpendicular (CLOSE), and ground-parallel (GROUND) 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.

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

Test Results

Factor (dB/m) = Antenna Factor (dB/m) + Cable Loss (dB)

Level (dBuV/m) = Reading (dBuV) + Factor (dB/m)

Limit at 30m = 15848 (uV/m)

$$\begin{aligned}\text{**Limit at 3m} &= 20 \cdot \log(15848) + 40 \log(30m/3m) \text{ (dBuV/m)} \\ &= 84 + 40 \text{ (dBuV/m)} \\ &= 124 \text{ (dBuV/m)}\end{aligned}$$

Please refer to Appendix A.

5.1.3 Radiated Spurious Emissions

Limit

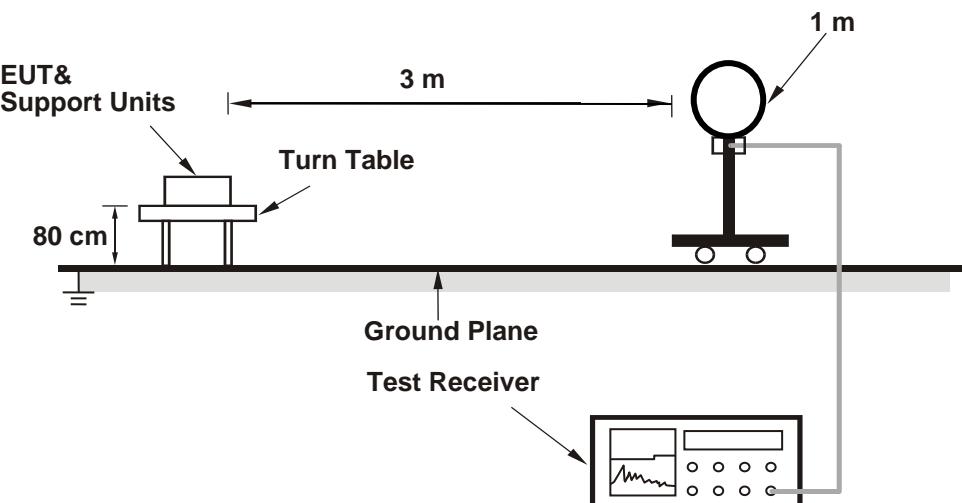
The field strength of any emissions appearing outside of the 13.110-14.010 MHz band shall not exceed the general radiated emission limits in §15.209 as below table:

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

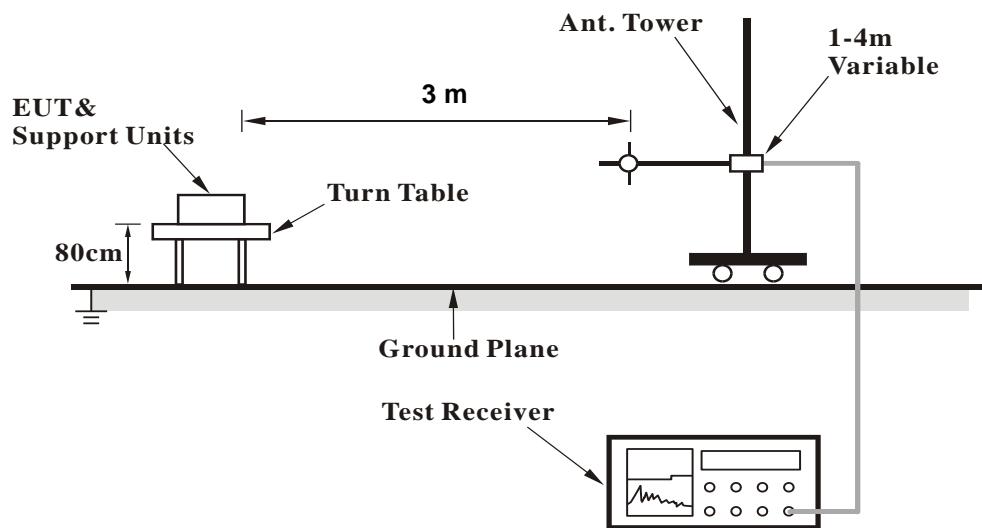
Kind of Test Site 3m Semi-Anechoic Chamber

Test Setup

<Radiated Emissions below 30 MHz>



<Radiated Emissions 30 MHz to 1 GHz>



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

Test Instruments

Please refer to 5.1.2 Instruments

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Test Procedures

For Radiated Emissions 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 (OPEN), perpendicular (CLOSE), and ground-parallel (GROUND) 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.

Note:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 9 kHz at frequency below 30 MHz.
2. All modes of operation were investigated and the worst-case emissions are reported.

For Radiated Emissions above 30 MHz

- a. The EUT was placed on the top of a rotating table 0.8 meters (for 30 MHz ~ 1 GHz) / 1.5 meters (for above 1 GHz) 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 detected 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 120 kHz for Quasi-peak detection (QP) or Peak detection (PK) at frequency below 1 GHz.
2. All modes of operation were investigated and the worst-case emissions are reported.
3. The Radiated Emissions testing was performed in the X(E1), Y(H) and Z(E2) axis orientation. The worst-case Axis orientation is recorded in this test report.
4. The emission levels of other frequencies (including the 10th harmonic of the highest fundamental frequency) are very lower than the limit and are not shown in the test report.

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Test Results

Factor (dB/m) = Antenna Factor (dB/m) + Cable Loss (dB)

Level (dBuV/m) = Reading (dBuV) + Factor (dB/m)

Please refer to Appendix A.

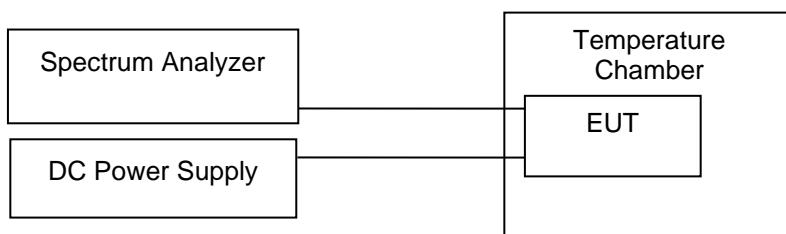
5.1.4 Frequency Stability

Limit

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

Kind of Test Site Shielded room

Test Setup



Test Instruments

Kind of Equipment	Manufacturer	Type	S/N	Calibration Date	Calibration Due Date	Test Date	
						From	Until
Spectrum Analyzer	R&S	FSV	101512	2023/2/23	2024/2/22	2023/10/6	2023/10/11
Thermal Chamber	GIANT FORCE	GCT-099-40-S	MAF0103-007	2023/2/20	2024/2/19	2023/10/6	2023/10/11

Test Procedures

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

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Test Report - Products

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Test Result

Frequency (MHz):		13.56		Voltage (Vdc):		V _{norm} : 12 V _{max} : 13.2 V _{min} : 10.8			
Condition		Test Time				Frequency Error (ppm)			
Extreme	Modulation Mode	0 min	2 min	5 min	10 min	0 min	2 min	5 min	10 min
T _{20°C} V _{max}	CW	13.559855	13.559855	13.559855	13.559855	-10.69	-10.69	-10.69	-10.69
T _{20°C} V _{min}	CW	13.559855	13.559855	13.559855	13.559855	-10.69	-10.69	-10.69	-10.69
T _{50°C} V _{nom}	CW	13.559855	13.559855	13.559855	13.559855	-10.69	-10.69	-10.69	-10.69
T _{40°C} V _{nom}	CW	13.559855	13.559855	13.559855	13.559855	-10.69	-10.69	-10.69	-10.69
T _{30°C} V _{nom}	CW	13.559855	13.559855	13.559855	13.559855	-10.69	-10.69	-10.69	-10.69
T _{20°C} V _{nom}	CW	13.559855	13.559855	13.559855	13.559855	-10.69	-10.69	-10.69	-10.69
T _{10°C} V _{nom}	CW	13.559855	13.559855	13.559855	13.559855	-10.69	-10.69	-10.69	-10.69
T _{0°C} V _{nom}	CW	13.559855	13.559855	13.559855	13.559855	-10.69	-10.69	-10.69	-10.69
T _{-10°C} V _{nom}	CW	13.559855	13.559855	13.559855	13.559855	-10.69	-10.69	-10.69	-10.69
T _{-20°C} V _{nom}	CW	13.559855	13.559855	13.559855	13.559855	-10.69	-10.69	-10.69	-10.69
Limit (ppm)		-				100			
Result		Pass							

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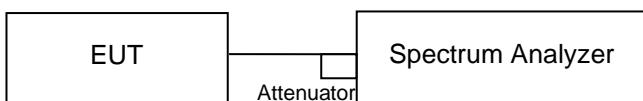
5.1.5 20 dB Bandwidth and 99% Occupied Bandwidth

Limit

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

Kind of Test Site Shielded room

Test Setup



Test Instruments

Kind of Equipment	Manufacturer	Type	S/N	Calibration Date	Calibration Due Date	Test Date	
						From	Until
Spectrum Analyzer	R&S	FSV	101512	2023/2/23	2024/2/22	2023/10/6	2023/10/11
Thermal Chamber	GIANT FORCE	GCT-099-40-S	MAF0103-007	2023/2/20	2024/2/19	2023/10/6	2023/10/11

Test Procedure

<20 dB Bandwidth>

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.

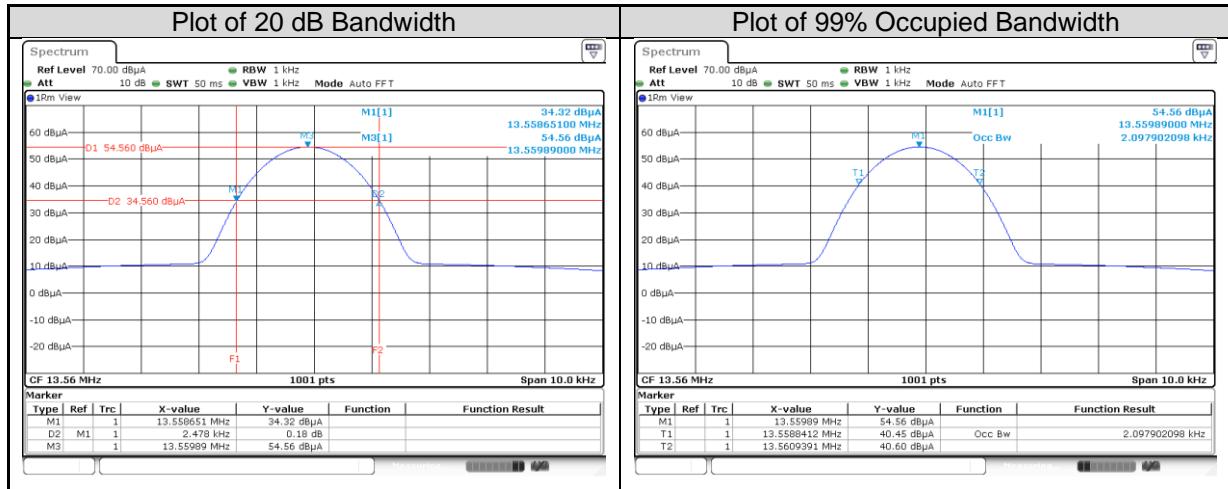
<99% Occupied Bandwidth>

The transmitter output was connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured by spectrum analyzer with resolution bandwidth in the range of 1 % to 5 % of the anticipated emission bandwidth, and a video bandwidth at least 3x the resolution bandwidth and set the detector to Sampling. The width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to a specified percentage 0.5 % of the total mean power of a given emission.

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5.2 Mains Emission

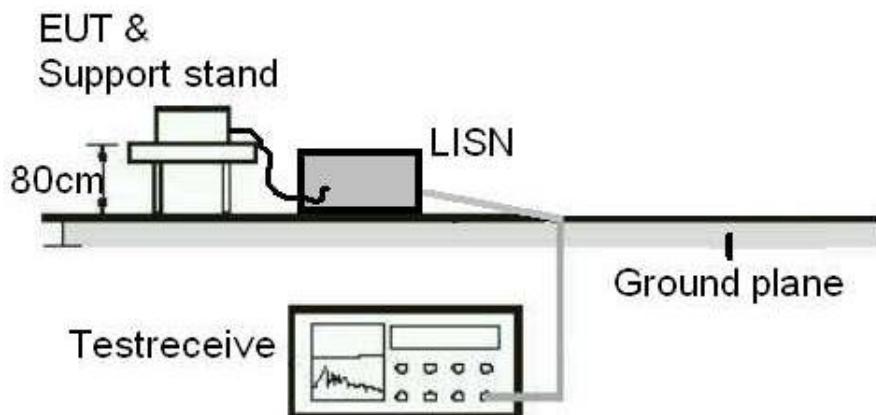
5.2.1 Mains Conducted Emission

Limit

Mains Conducted emissions as defined in §15.207 must comply with the mains conducted emission limits.

Kind of Test Site Shielded room

Test Setup



Test Instruments

Test Date: 2023/10/26

Kind of Equipment	Manufacturer	Type	S/N	Calibration Date	Calibration Due Date
Two-Line V-Network	Rohde & Schwarz	ENV216	101262	2022/12/26	2023/12/25
EMI Test Receiver	R&S	ESCI	101094	2022/11/24	2023/11/23

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Test Procedures

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

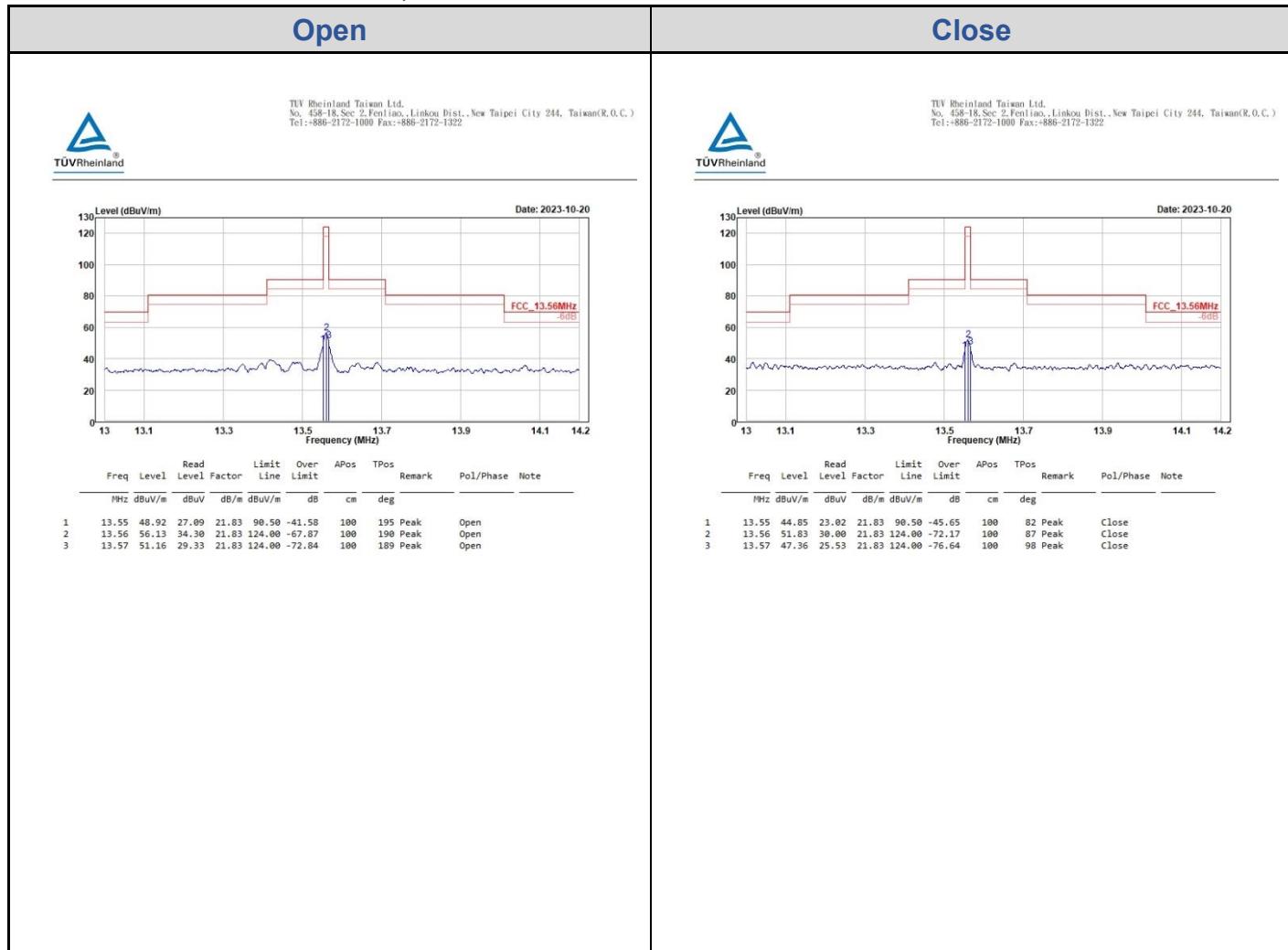
Note: The resolution bandwidth and video bandwidth of test receiver is 9 kHz for quasi-peak detection (QP) and average detection (AV) at frequency 0.15 MHz – 30 MHz.

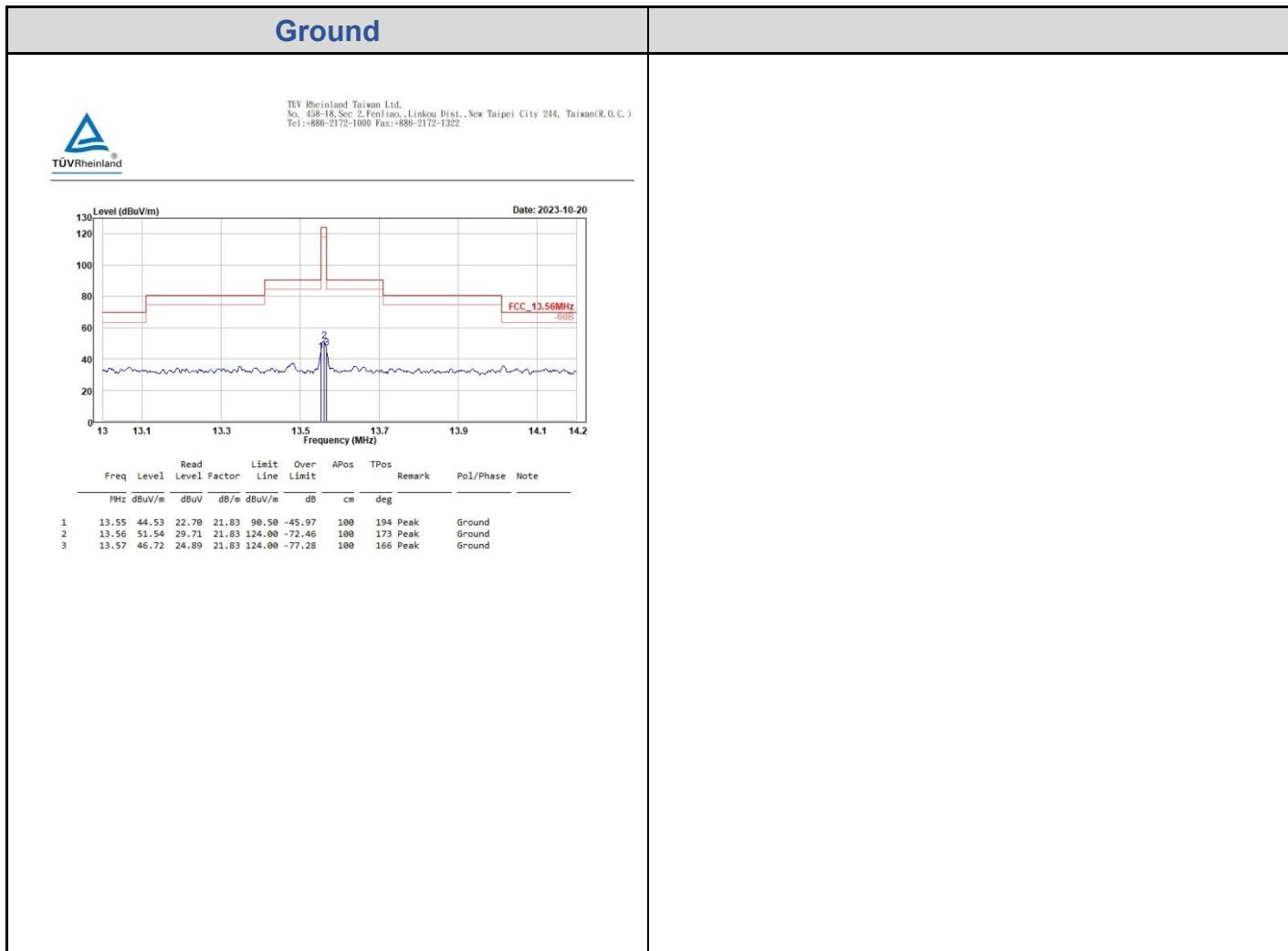
Test Results

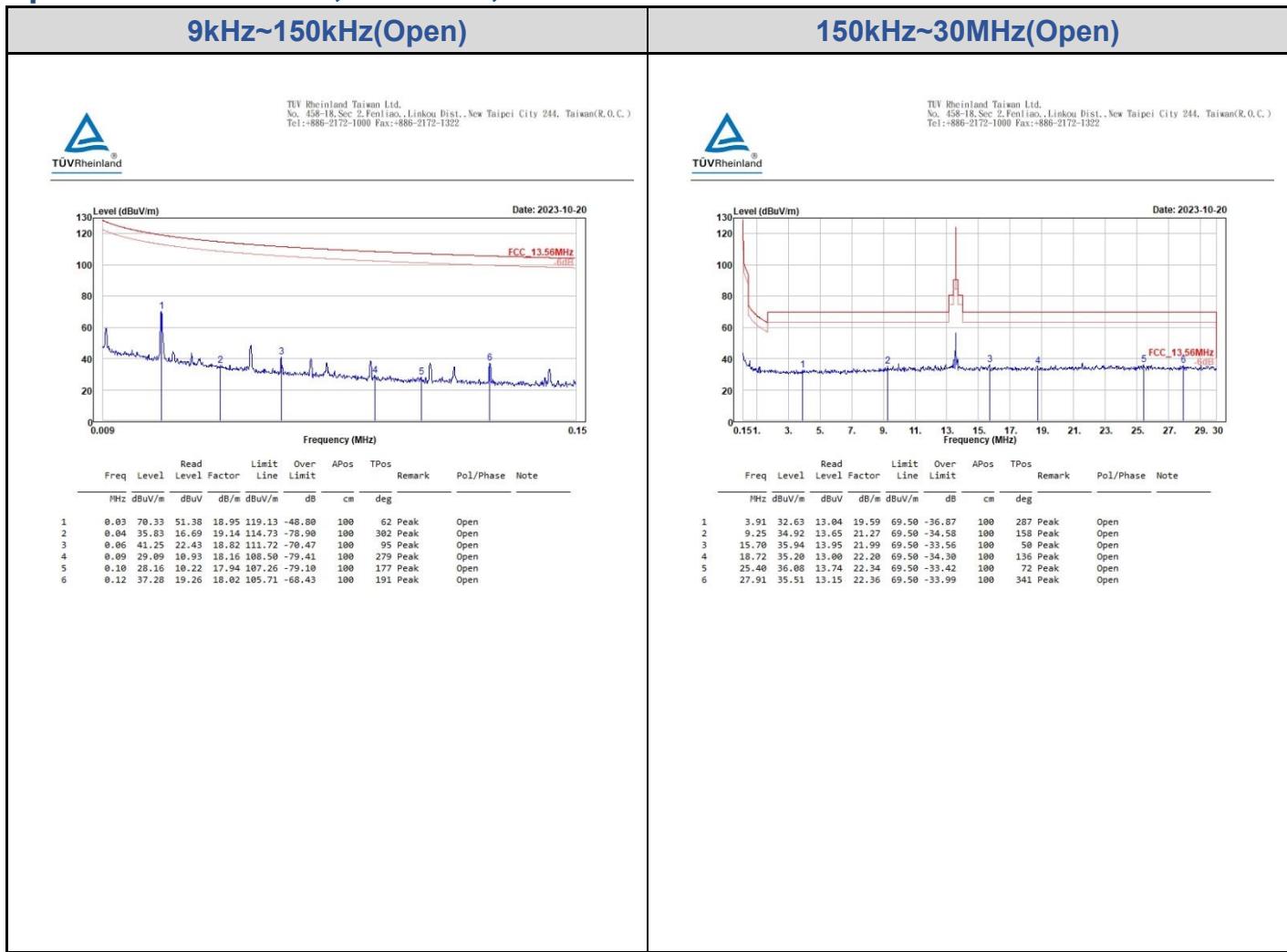
Please refer to Appendix A.

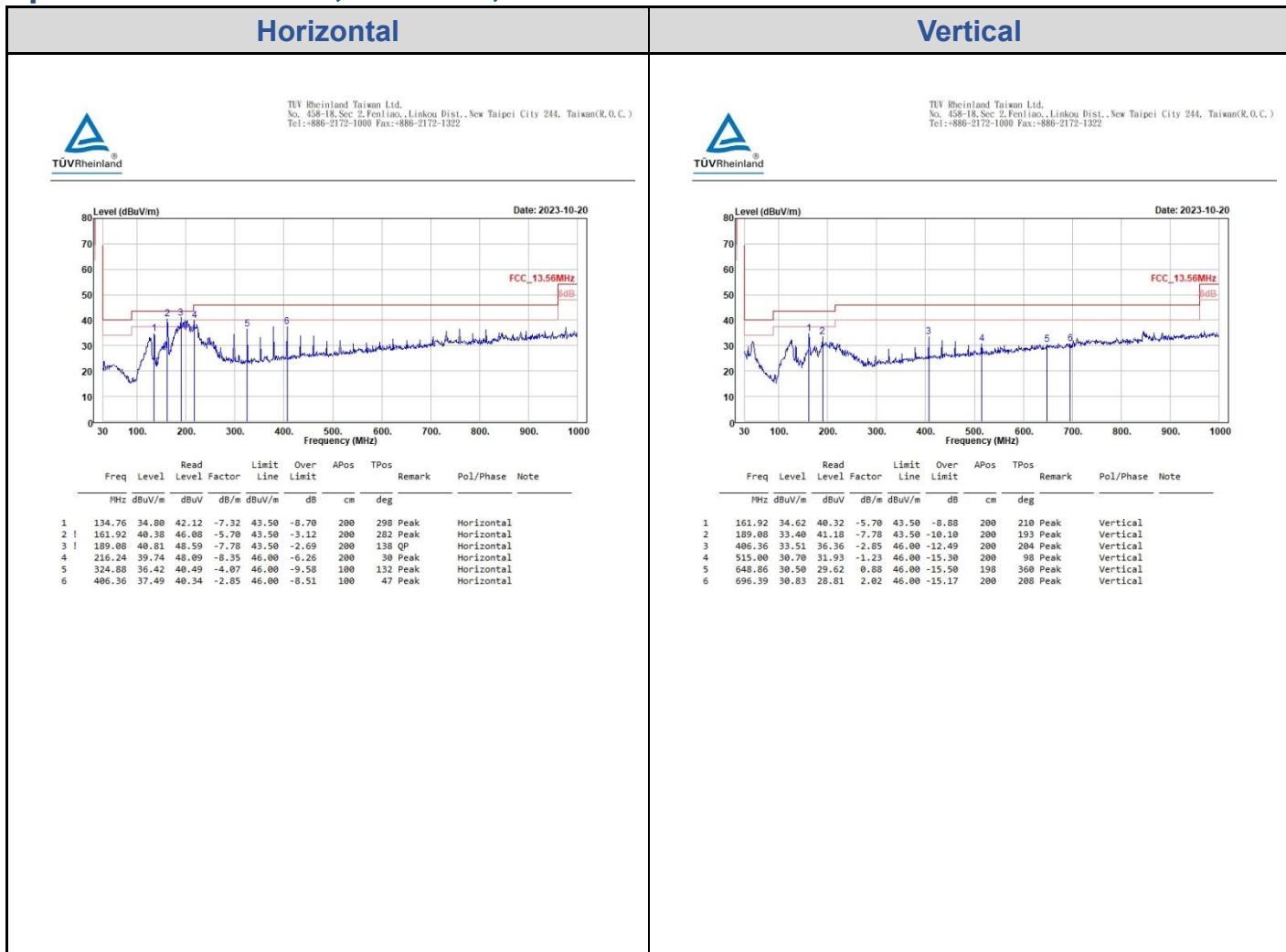
Appendix A: Test Results of Radiated Spurious Emissions

Fundamental Emissions, 13MHz ~ 14.2MHz





Spurious Emissions, Tx Mode, 9kHz ~ 30MHz


Spurious Emissions, Tx Mode, 30MHz ~ 1GHz


Mains Conducted Emission, Tx Mode, 150kHz ~ 30MHz
