

Prüfbericht-Nr.: Test Report No.:	JP22LCNL 001	Auftrags-Nr.: Order No.:	150256555	Seite 1 von 34 Page 1 of 34
Kunden-Referenz-Nr.: Client Reference No.:	N/A	Auftragsdatum: Order Date:	2022-01-31	
Auftraggeber: Client:	Angel Gaming Co., Ltd. 8-1-5 Seikadai, Seika-cho, Souraku-gun, Kyoto 619-0238 Japan			
Prüfgegenstand: Test Item:	RFID Counter			
Bezeichnung / Typ-Nr.: Identification / Type No.:	ACP2	Serien-Nr.: Serial No.:	Engineering Sample	
Auftrags-Inhalt: Order Content:	Radio Testing			
Prüfgrundlage: Test Specification:	FCC 47 CFR Part 15, Subpart C, Section 15.225 ANSI C63.10-2013			
Wareneingangsdatum: Date of Receipt:	2022-02-09			
Prüfmuster-Nr.: Test Sample No.:	A003210209			
Prüfzeitraum: Testing Period:	2022-02-15 - 2022-04-27			
Ort der Prüfung: Place of Testing:	Yokohama EMC Laboratory			
Prüflaboratorium: Testing Laboratory:	TÜV Rheinland Japan Ltd.			
Prüfergebnis*: Test Result*:	Pass			
Überprüft von: Reviewed by:		Genehmigt von: Authorized by:		
Datum: 2022-06-20 Date:	Daisuke Watanuki	Datum: 2022-06-20 Date:	Pin Zhang	
Stellung / Position:	Inspector	Stellung / Position:	Reviewer	
Sonstiges / Other:				
Zustand des Prüfgegenstandes bei Anlieferung: Condition of the Test Item at Delivery:				
Prüfmuster vollständig und unbeschädigt Test item complete and undamaged				
* Legende: P(ass) = entspricht o.g. Prüfgrundlage(n) F(ail) = entspricht nicht o.g. Prüfgrundlage(n) N/A = nicht anwendbar N/T = nicht getestet * Legend: P(ass) = passed a.m. test specification(s) F(ail) = 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. <i>This test report 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.</i>				

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REVISIONS

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JP22LCNL 001	2022-06-20	Original document

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1. General Remarks

1.1 Test Specifications

Table 1: Test Summary

Test	Specifications	Result
Radio: FCC 47 CFR Part 15, Subpart C, Section 15.225 ANSI C63.10-2013		
Supply Voltage Requirements	FCC 15.31(e)	Pass
Antenna Requirements	FCC 15.203	Pass
Restricted Bands of Operation	FCC 15.205	Pass
20dB Bandwidth	FCC 15.215(c) and 15.225	Pass
99% Bandwidth	Not specified	PERFORMED
Frequency Stability	FCC 15.225(e)	Pass
Field Strength of Fundamental	FCC 15.225(a)(b)(c)	Pass
Radiated Spurious Emissions of Transmitter	FCC 15.209, FCC 15.225	Pass
AC Power Line Conducted Emission of Transmitter	FCC 15.207	Pass

1.2 Test Report Purpose

The purpose of this test report is to show compliance of the EUT (Equipment Under Test) with the requirements of the FCC rules listed in section 1.1 for original grant application.

1.3 Complementary Materials

There is no attachment to this test report.

2. Test Sites

2.1 Test Facilities

TÜV Rheinland Japan Ltd. – Global Technology Assessment Center
4-25-2 Kita-Yamata, Tsuzuki-ku, Yokohama 224-0021, Japan

The used test equipment is in accordance with CISPR 16 for measurement of radio interference.

The test facility is recognized by the Federal Communications Commission (FCC) as Accredited Testing Laboratory under designation number JP0017.

The test facility is accredited by VLAC (member of ILAC) under number VLAC-017 according to ISO/IEC 17025:2017.

2.2 List of Test and Measurement Instruments

Table 2: List of Test and Measurement Equipment

Kind of Equipment	Manufacturer	Model Name	Serial Number	Equip. ID	Cal. Interval	Cal. Date	Next Cal.
For Power Port Conducted Emission							
Conducted Emission Measurement Software	Toyo Corporation	EP9/CE	Ver. 4.2.010	RF-0810	1 year	2022-02-14	2023-02-14
EMI Receiver	Rohde & Schwarz	ESU 8	100025	RF-0020	1 year	2022-03-16	2023-03-16
LISN	Rohde & Schwarz	ENV216	101958	RF-0708	1 year	2021-05-19	2022-05-19
For Radiated Emission, Radiated Spurious Emissions and Others for Fundamental Frequencies							
Radiated Emission Measurement Soft-ware (below 30MHz)	Toyo Corporation	EP5/ME	Ver. 5.2.10	RF-0172	1 year	2022-02-14	2023-02-14
EMI Receiver	Rohde & Schwarz	ESU 8	100025	RF-0020	1 year	2022-03-16	2023-03-16
EMI Receiver	Rohde & Schwarz	ESU 40	100029	RF-0021	1 year	2021-08-25	2022-08-25
EMI Receiver	Rohde & Schwarz	ESW 26	101316	RF-0812	1 year	2021-05-21	2022-05-21
RF Selector (10m Chamber)	Toyo Corporation	NS4900	0703-182	RF-0029	N/A	N/A	N/A
Loop Antenna with Amplifier, 9kHz-30MHz	Rohde & Schwarz	HFH2-Z2	100139	RF-0048	1 year	2021-04-27	2022-04-27
Trilog Antenna No. 2, 30-1000MHz	Schwarzbeck	VULB 9168	9168-475	RF-0462	1 year	2021-05-18	2022-05-18
5dB Attenuator	Pasternack	PE7047-5	-	RF-0731	1 year	2021-05-18	2022-05-18
Low Noise Preamplifier, 9kHz-1GHz	TSJ	MLA-10K01-B01-35	1370750	RF-0253	1 year	2021-12-23	2022-12-23
Low Pass Filter, DC-1GHz	R&K	LP1000CH 3	12104001	RF-0515	1 year	2021-12-23	2022-12-23
Horn Antenna, 1-8GHz	Schwarzbeck	BBHA 9120 D	1059	RF-0553	1 year	2022-03-19	2023-03-19
Microwave Preamplifier, 1-8GHz	Toyo Corporation	TPA0108-40	0634	RF-0052	1 year	2021-12-23	2022-12-23
Constant Voltage Constant Frequency Stabilizers and Power Accessories							
CVCF (Shielded Room)	NF Corporation	ES2000S	9075612	RF-0210	1 year	2022-03-16	2023-03-16
CVCF Booster (Shielded Room)	NF Corporation	ES2000B	9074403	RF-0211	1 year	2022-03-16	2023-03-16
CVCF (10m Chamber)	NF Corporation	ES2000U	9067307	RF-0212	1 year	2022-03-16	2023-03-16
CVCF Booster (10m Chamber)	NF Corporation	ES2000B	9074408	RF-0213	1 year	2022-03-16	2023-03-16
True RMS Multimeter	Fluke	87V	97680445	RF-0281	1 year	2021-12-15	2022-12-15

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Kind of Equipment	Manufacturer	Model Name	Serial Number	Equip. ID	Cal. Interval	Cal. Date	Next Cal.
True RMS Multimeter	Fluke	87V	97680450	RF-0282	1 year	2022-03-24	2023-03-24
True RMS Multimeter	Fluke	87V	16110176	RF-0414	1 year	2021-06-10	2022-06-10
For Frequency Stability							
Temperature Chamber	Voetsch	VT 4018	58566025 090010	BT-8012	1 year	2021-07-02	2022-07-02
EMI Receiver	Rohde & Schwarz	ESW 26	101316	RF-0812	1 year	2021-05-21	2022-05-21
AC/DC Power Source	NF Corporation	EC1000SA	9364678	RF-0940	1 year	2021-09-21	2022-09-21

Conformance of the used measurement and test equipment with the requirements of ISO/IEC 17025 has been confirmed before testing.

2.3 Measurement Uncertainty

Table 3: Emission Measurement Uncertainty

Measurement Type	Frequency	Uncertainty
Radiated Emission	150kHz - 30MHz	±4.7dB
	30MHz - 1GHz	±3.8dB
	> 1GHz	±4.5dB

Note:

The measurement instrumentation uncertainty (MIU) was determined according to CISPR 16-4-2 and ETSI TR 100-028. All MIU values mentioned in the above table are smaller than the uncertainty budgets specified by CISPR 16-4-2 and ETSI TR 100-028, therefore compliance for all emission measurements is deemed to occur if no measured disturbance level exceeds the disturbance limit.

3. General Product Information

3.1 Product Function and Intended Use

The EUT (Equipment Under Test) is an equipment which counts number of chips and calculates the chip denomination and detects incorrect or illegal chips by utilizing RFID technology. The EUT contains 20 antennas which are placed into each chip slot. Therefore, the EUT is able to count up to 20 chips in one operation. The 20 antennas don't work together and the EUT switches an active antenna one by one to sweep all 20 chip slots.

3.2 Ratings and System Details

Radio standard:	ISO18000-3 mode3
Frequency range:	13.56MHz
Antenna gain:	< 2dBi
Antenna type:	Loop Antenna
Antenna mounting type:	Internal
Modulation type:	ASK
Number of channels:	1
Rated temperature:	0 to +35°C
Rated voltage:	AC 100 - 240V, 50/60Hz
Rated input Power:	11W
Protection class:	I

Test voltage, frequency: AC 120V, 60Hz

3.3 Noise Generating and Noise Suppressing Parts

The highest frequency generated or used by the EUT is 528MHz.

3.4 Submitted Documents and Information

Following information provided in this test report has been submitted by the client:

- client name and address;
- EUT identification, ratings, system details, and description of product function and intended use;
- information related to noise generating and noise suppressing parts (if any).

4. Test Setup and Operation Modes

4.1 Test Methodology

The test methodology used is based on the requirements of 47 CFR Part 15, Sections 15.31, 15.33, 15.35, 15.205, 15.207, 15.209, 15.225.

The test methods, which have been used, are based on ANSI C63.10.

For details, see under each test item.

4.2 Operation Modes

Testing was performed at operating frequency 13.56MHz.

The basic operation modes used for testing are:

- A. EUT transmits and receives modulated signals at 13.56MHz
- B. EUT transmits an unmodulated signal at 13.56MHz

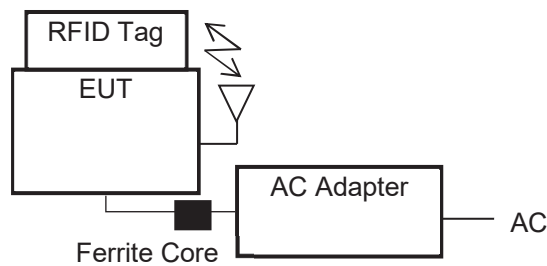
Note:

Mode A also supports antenna switching one by one from 20 antennas. Precheck was performed in 5.2.4 Field Strength of Fundamental to determine the worst antenna. The worst antenna was chosen for the rest of test items.

4.3 Physical Configuration for Testing

The test system was configured in a typical fashion (as a customer would normally use it). The justification and manipulation of cables and equipment in order to simulate a worst-case behavior of the test setup has been carried out as prescribed in ANSI C63.10.

Figure 1: Block Diagram



Note: The EUT is able to transmit without RFID tag. Therefore precheck was performed with, without RFID tag to determine which was worse.
 The ferrite core is a part of the EUT and supplied to end-users together.

Table 4: Interfaces present on the EUT

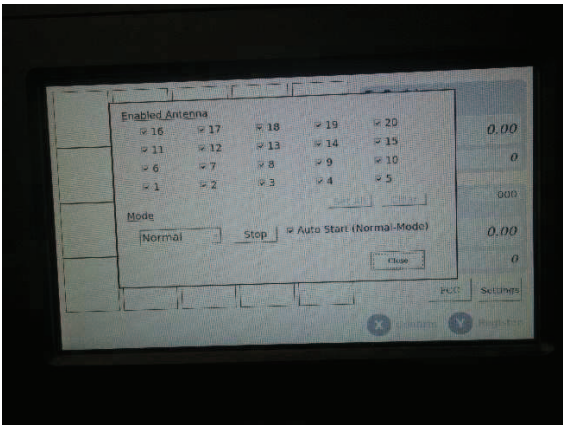
No.	Interface(s):	Max. Cable Length, Shielding	Cable Classification
1.	AC Mains	1.8 m, Un-shielded	AC Power Line

Note: For more details, refer to section: Photographs of the Test Set-Up.

4.4 Test Software

The EUT was provided by the manufacturer with suitable software to allow operation in all the required modes. The software was installed in the EUT’s firmware and operated on its LCD panel.

Photograph 1: Test Software Operated on LCD Panel



4.5 Special Accessories and Auxiliary Equipment

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

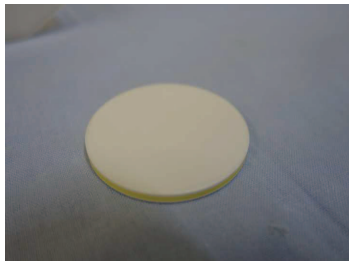
1. Product: AC Adapter (Part of the EUT)
Manufacturer: Adapter Technology Co., Ltd.
Model: ATS065T-P240
Rated Voltage: AC 100-240V
Input Current: 1.4A
Frequency: 50-60Hz
Protection Class: I
2. Product: Ferrite Core (Part of the EUT)
Manufacturer: TDK
Model: ZCAT2032-0930

Photograph 2: Ferrite Core



3. Product: RFID Tag (Part of the EUT)
Manufacturer: Angel Gaming Co., Ltd.

Photograph 3: RFID Tag (Chip)



4.6 Countermeasures to achieve Compliance

No additional measures were employed to achieve compliance.

5. Test Results RADIO

5.1 Technical Requirements

5.2 Supply Voltage Requirements

RESULT:

PASS

Requirements:

FCC 15.31(e)

For intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage. For battery operated equipment, the equipment tests shall be performed using a new battery.

Verdict:

The EUT has an internal voltage regulator to supply the RF circuit. Hence it complies with the supply voltage requirements.

5.2.1 Antenna Requirements

RESULT:

PASS

Requirements:

FCC 15.203

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

Verdict:

The EUT has an internal antenna which is not user accessible. Hence it complies with the antenna requirements.

5.2.2 Restricted Bands of Operation

RESULT:

PASS

Requirements:

FCC 15.205

Only spurious emissions are permitted in any of the restricted frequency bands, unless otherwise specified.

Verdict:

The EUT operation frequency range is 13.110-14.010MHz. Therefore only spurious emissions may be found in the restricted bands of operation and the EUT complies with the restricted frequency band requirement.

5.3 Radiated Measurements

5.3.1 20dB Bandwidth

RESULT:

PASS

Date of testing: 2022-04-15

Ambient temperature: 23°C
Relative humidity: 51%
Atmospheric pressure: 1010hPa
Operation Modes: A

Requirements:

FCC 15.215(c) and 15.225

The 20dB bandwidth of the emission shall be contained within the frequency band designated in the rule section under which the equipment is operated.

Test procedure:

ANSI C63.10 §7.8.7.

The 20dB bandwidth was measured with a loop antenna connected to a spectrum analyzer using a peak detector with the following settings: RBW = 10Hz, VBW = 30Hz. Markers were placed at the lowest and highest intersections of the trace with a 20dBc line to obtain the value of the emission bandwidth.

The measurement was performed for Antenna #1 with RFID tag as the worst condition.

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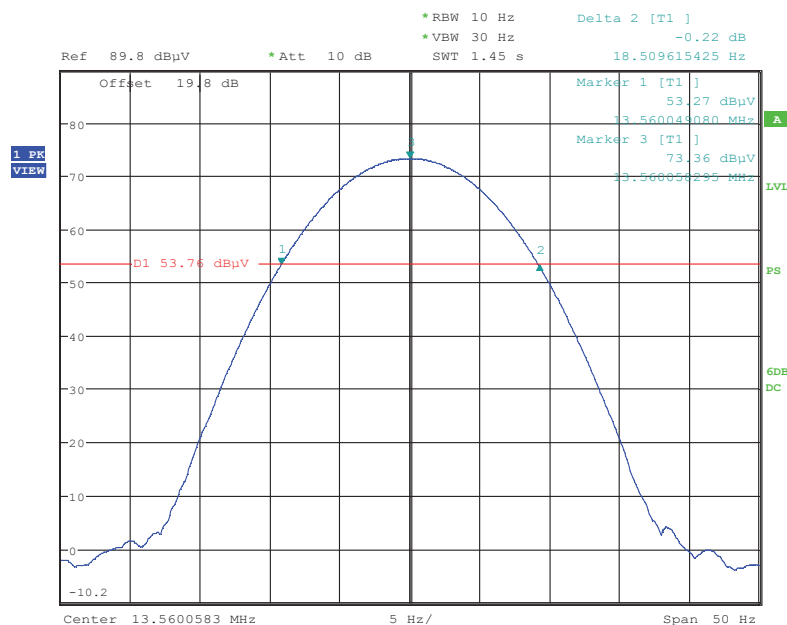
Table 5: 20dB Bandwidth Edge Frequencies, Mode A

20dB Bandwidth Edge Side	Operating Frequency [MHz]	Edge Frequency [MHz]	Limit [MHz]	Margin [MHz]
Lower Frequency	13.560	13.56005	13.11000	0.45005
Higher Frequency		13.56006	14.01000	0.44994

Table 6: 20dB Bandwidth, Mode A

Operating Frequency [MHz]	20dB Bandwidth [kHz]
13.56	0.01

Figure 2: 20dB Bandwidth, Mode A



Date: 15.APR.2022 15:19:07

5.3.2 99% Bandwidth

RESULT:

PERFORMED

Date of testing: 2022-04-15

Ambient temperature: 23°C

Relative humidity: 51%

Atmospheric pressure: 1010hPa

Operation Modes: A

Test procedure:

ANSI C63.10 §6.9.3

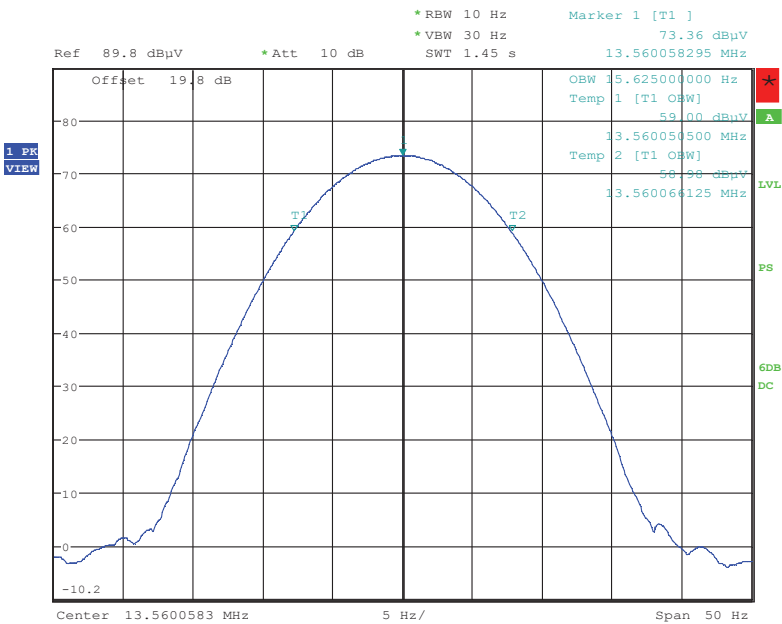
The 99% bandwidth was measured at the antenna port with a spectrum analyzer using a peak detector. The value of the emission bandwidth was obtained by using the OBW function of the analyzer with a 99% coverage setting.

The measurement was performed for Antenna #1 with RFID tag as the worst condition.

Table 7: 99% Bandwidth, Mode A

Operating Frequency [MHz]	99% Bandwidth [Hz]
13.56	15.63

Figure 3: 99% Bandwidth, Mode A



Date: 15.APR.2022 15:22:31

5.3.3 Frequency Stability

RESULT:

PASS

Date of testing: 2022-04-26, 2022-04-27

Ambient temperature: 23, 22°C
Relative humidity: 54, 55%
Atmospheric pressure: 1008, 1002hPa
Temperature range: -20 ~ 50°C
Operation Modes: B
Test Voltage: AC 102, 120 & 138V

Requirements:

FCC 15.225(e)

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. For battery operated equipment, the equipment tests shall be performed using a new battery.

Test procedure:

ANSI C63.10 §6.8

The EUT was placed inside a temperature chamber and was set to produce an unmodulated carrier (Mode B).

The carrier frequency was measured with a loop antenna connected to a spectrum analyzer. Measurements were performed from 50°C down to -20°C for every 10°C. For each temperature step, the measurements started after the temperature was sufficiently stabilized and were performed at start-up of the EUT, and then after 2, 5 and 10 minutes. The EUT was turned off during temperature changes.

The carrier frequency measurement was then performed at a temperature of 20°C for a variation of $\pm 15\%$ of the nominal input voltage.

The measurement was performed for Antenna #1 with RFID tag as the worst condition.

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Table 8: Frequency Stability at 50°C, AC 120V

Elapsed Time [min]	Nominal Frequency [MHz]	Measured Frequency [MHz]	Deviation [%]	Limit [GHz]	Result
Start-up	13.56	13.56003	0.0002	+/-0.01%	Pass
2		13.56005	0.0004		Pass
5		13.55998	-0.0001		Pass
10		13.56007	0.0005		Pass

Table 9: Frequency Stability at 40°C, AC 120V

Elapsed Time [min]	Nominal Frequency [MHz]	Measured Frequency [MHz]	Deviation [%]	Limit [GHz]	Result
Start-up	13.56	13.56007	0.0005	+/-0.01%	Pass
2		13.55998	-0.0001		Pass
5		13.56006	0.0004		Pass
10		13.56004	0.0003		Pass

Table 10: Frequency Stability at 30°C, AC 120V

Elapsed Time [min]	Nominal Frequency [MHz]	Measured Frequency [MHz]	Deviation [%]	Limit [GHz]	Result
Start-up	13.56	13.56008	0.0006	+/-0.01%	Pass
2		13.56005	0.0004		Pass
5		13.55996	-0.0003		Pass
10		13.56013	0.0010		Pass

Table 11: Frequency Stability at 20°C, AC 120V

Elapsed Time [min]	Nominal Frequency [MHz]	Measured Frequency [MHz]	Deviation [%]	Limit [GHz]	Result
Start-up	13.56	13.55993	-0.0005	+/-0.01%	Pass
2		13.56006	0.0004		Pass
5		13.56004	0.0003		Pass
10		13.55988	-0.0009		Pass

Table 12: Frequency Stability at 10°C, AC 120V

Elapsed Time [min]	Nominal Frequency [MHz]	Measured Frequency [MHz]	Deviation [%]	Limit [GHz]	Result
Start-up	13.56	13.56003	0.0002	+/-0.01%	Pass
2		13.55987	-0.0010		Pass
5		13.56000	0.0000		Pass
10		13.55998	-0.0001		Pass

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Table 13: Frequency Stability at 0°C, AC 120V

Elapsed Time [min]	Nominal Frequency [MHz]	Measured Frequency [MHz]	Deviation [%]	Limit [GHz]	Result
Start-up	13.56	13.56008	0.0006	+/-0.01%	Pass
2		13.56008	0.0006		Pass
5		13.56004	0.0003		Pass
10		13.56015	0.0011		Pass

Table 14: Frequency Stability at -10°C, AC 120V

Elapsed Time [min]	Nominal Frequency [MHz]	Measured Frequency [MHz]	Deviation [%]	Limit [GHz]	Result
Start-up	13.56	13.55997	-0.0002	+/-0.01%	Pass
2		13.56002	0.0001		Pass
5		13.55996	-0.0003		Pass
10		13.56002	0.0001		Pass

Table 15: Frequency Stability at -20°C, AC 120V

Elapsed Time [min]	Nominal Frequency [MHz]	Measured Frequency [MHz]	Deviation [%]	Limit [GHz]	Result
Start-up	13.56	13.56018	0.0013	+/-0.01%	Pass
2		13.56005	0.0004		Pass
5		13.56010	0.0007		Pass
10		13.56006	0.0004		Pass

Table 16: Frequency Stability with Supply Voltage Variation at 20°C

Supply Voltage	Nominal Frequency [MHz]	Measured Frequency [MHz]	Deviation [%]	Limit [GHz]	Result
AC 102V	13.56	13.56009	0.0007	+/-0.01%	Pass
AC 120V		13.55988	-0.0009		Pass
AC 138V		13.56003	0.0002		Pass

5.3.4 Field Strength of Fundamental

RESULT:

PASS

Date of testing:	2022-04-15
Ambient temperature:	23°C
Relative humidity:	51%
Atmospheric pressure:	1010hPa
Frequency range:	13.110-14.010MHz
Measurement distance:	3m
Kind of test site:	Semi Anechoic Chamber
Operation Modes:	A

Requirements:

FCC 15.225(a)(b)(c)

The field strength of fundamental shall not exceed the level specified in FCC 15.225(a)(b)(c).

Test procedure:

ANSI C63.10 §6.3 and 6.4

The EUT was placed on a nonconductive turntable whose height was 0.8m. The EUT was rotated 360° in order to determine the emission's maximum level.

Measurements were performed with a test receiver operating in the CISPR quasi-peak detection mode with a 6dB bandwidth set to 9kHz.

Precheck was performed to determine the worst antenna from 20 antennas (Antenna #1 ~ #20). Also another precheck was performed with / without RFID tag to determine which was worse condition. The final measurement was performed for Antenna #1 with RFID tag as the worst condition.

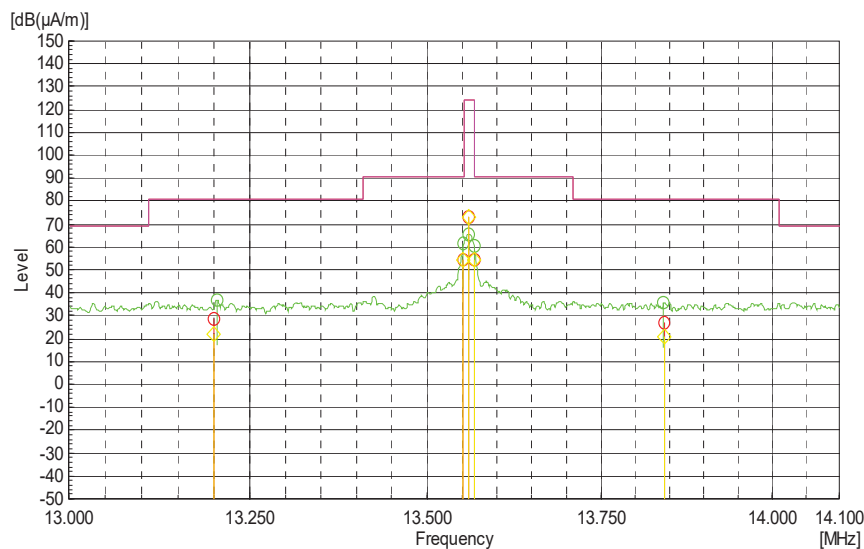
The highest emission amplitudes relative to the appropriate limit were recorded in this report. The field strength values taken at 3m measurement distance were recalculated for a 30m distance using a factor of 40dB/decade according to FCC 15.31(f).

Table 17: Field Strength of Fundamental, Mode A

Frequency [MHz]	Reading QP at 3m [dB(uV)]	Factor [dB(1/m)]	Level QP at 3m [dBuV/m]	Level QP at 30m [dBuV/m]	Limit QP at 30m [dBuV/m]	Margin QP [dB]	Angle [°]
13.12905	6.0	19.8	25.8	-14.2	40.5	54.7	268
13.20059	9.0	19.8	28.8	-11.2	40.5	51.7	243
13.54981	21.6	19.8	41.4	1.4	50.5	49.1	319
13.55200	34.7	19.8	54.5	14.5	50.5	36.0	261
13.56002	47.6	19.8	67.4	27.4	84.0	56.6	313
13.56024	53.5	19.8	73.3	33.3	84.0	50.7	272
13.56800	34.7	19.8	54.5	14.5	50.5	36.0	259
13.56917	23.4	19.8	43.2	3.2	50.5	47.3	312
13.84242	7.3	19.8	27.1	-12.9	40.5	53.4	317
13.91010	6.6	19.8	26.4	-13.6	40.5	54.1	349

Notes: Level QP at 3m = Reading QP at 3m + Factor
Level QP at 30m = Level QP at 3m - distance extrapolation factor for one decade
Distance extrapolation factor = 40dB/decade
Margin QP = Limit QP at 30m – Level QP at 30m

Figure 4: Field Strength of Fundamental, Spectral Diagram, Mode A



Note: This spectral diagram is given for reference purpose only.

5.3.5 Radiated Spurious Emissions of Transmitter

RESULT:

PASS

Date of testing: 2022-04-15, 2022-04-25

Ambient temperature: 23, 23°C

Relative humidity: 51, 58%

Atmospheric pressure: 1010, 1012hPa

Frequency range: 9kHz - 5GHz

Measurement distance: 3m

Kind of test site: Semi Anechoic Chamber

Operation Modes: A

Requirements:

FCC 15.209, FCC 15.225.

Radiated emissions outside the band 13.110-14.010MHz must comply with the radiated emission limits specified in FCC 15.209(a).

Test procedure:

The EUT was placed on a nonconductive turntable. The table height was 0.8m for measurements below 1GHz and 1.5m for measurements above 1GHz. Before final measurements of radiated emissions were performed, the EUT was scanned to determine its emission spectrum profile. The physical arrangement of the test system, the associated cabling were varied in order to ensure that maximum emission amplitudes were attained.

The spectrum was examined from 9kHz to the 10th harmonic of the highest frequency generated by the EUT (5GHz). Final radiated emission measurements were made at 3m distance.

At each frequency where a spurious emission was found, the EUT was rotated 360° in order to determine the emission's maximum level. For frequencies above 30MHz, the antenna was raised and lowered from 1 to 4m and measurements were taken using both horizontal and vertical antenna polarizations.

For emissions below 30MHz, measurements were performed with a test receiver operating in the CISPR quasi-peak detection mode with a 6dB bandwidth set to 9kHz. For emissions between 30MHz and 1GHz, measurements were performed with a test receiver operating in the CISPR quasi-peak detection mode with a 6dB bandwidth set to 120kHz. For emissions above 1GHz, measurements were performed with a spectrum analyzer using Peak and Average detector.

Absorbers have been placed on the floor between the EUT and the measuring antenna for testing above 1GHz.

Precheck was performed to determine the worst antenna from 20 antennas (Antenna #1 ~ #20). Also another precheck was performed with / without RFID tag to determine

which was worse condition. The final measurement was performed for Antenna #1 with RFID tag as the worst condition.

The highest emission amplitudes relative to the appropriate limit were recorded in this report. Emissions other than those mentioned are small or not detectable.

For measurements below 30MHz, the field strength values taken at 3m measurement distance were recalculated for a 30m distance using a factor of 40dB/decade according to FCC 15.31(f).

Table 18: Radiated Emissions, Quasi Peak Data, 9kHz - 30MHz, Mode A

Freq. [MHz]	Reading QP [dBμV]	Factor [dB(1/m)]	Level QP at 3m [dBμV/m]	Level QP at 30m [dBμV/m]	Limit at 30m [dBμV/m]	Margin QP [dB]	Angle [°]
27.120	15.6	20.9	36.5	-3.5	29.5	33.0	145

Note: Level QP at 3m = Reading QP + Factor
 Level QP at 30m = Level QP at 3m – distance extrapolation factor for one decade
 Distance extrapolation factor = 40dB/decade
 Margin QP = Limit QP at 30m – Level QP at 30m

Table 19: Radiated Emissions, Quasi Peak Data, 30MHz - 1GHz, Horizontal and Vertical Antenna Orientations, Mode A

Freq. [MHz]	Antenna Orientation	Reading QP [dBμV]	Factor [dB(1/m)]	Level QP [dBμV/m]	Limit [dBμV/m]	Margin QP [dB]	Height [cm]	Angle [°]
67.500	V	52.5	-22.4	30.1	40.0	9.9	100	252
94.489	V	56.3	-26.1	30.2	43.5	13.3	110	193
94.500	H	50.6	-26.1	24.5	43.5	19.0	400	300
175.50	H	55.4	-21.9	33.5	43.5	10.0	222	74
202.50	H	55.9	-23.3	32.6	43.5	10.9	178	257
243.00	H	64.0	-22.0	42.0	46.0	4.0	133	73
243.00	V	57.7	-22.0	35.7	46.0	10.3	234	113
297.00	V	56.0	-19.4	36.6	46.0	9.4	184	165
346.98	H	37.8	-18.1	19.7	46.0	26.3	100	212
791.99	H	44.7	-9.5	35.2	46.0	10.8	128	142

Note: Level QP = Reading QP + Factor

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Table 20: Radiated Emissions, Peak Data, 1 - 5GHz, Horizontal and Vertical Antenna Orientations, Mode A

Freq. [MHz]	Antenna Orientation	Reading PK [dBμV]	Factor [dB(1/m)]	Level PK [dBμV/m]	Limit [dBμV/m]	Margin PK [dB]	Height [cm]	Angle [°]
1199.94	V	53.8	-18.3	35.5	74.0	38.5	122	222
1499.96	V	57.4	-17.4	40.0	74.0	34.0	194	242
1998.45	V	53.6	-16.7	36.9	74.0	37.1	200	93
2238.33	V	54.1	-14.9	39.2	74.0	34.8	123	239
3811.09	V	53.2	-12.2	41.0	74.0	33.0	185	359
4766.52	H	52.6	-9.8	42.8	74.0	31.2	178	60

Note: Level PK = Reading PK + Factor

Table 21: Radiated Emissions, Average Data, 1 - 5GHz, Horizontal and Vertical Antenna Orientations, Mode A

Freq. [MHz]	Antenna Orientation	Reading AV [dBμV]	Factor [dB(1/m)]	Level AV [dBμV/m]	Limit [dBμV/m]	Margin AV [dB]	Height [cm]	Angle [°]
1199.94	V	40.2	-18.3	21.9	54.0	32.1	122	222
1499.96	V	41.3	-17.4	23.9	54.0	30.1	194	242
1998.45	V	39.4	-16.7	22.7	54.0	31.3	200	93
2238.33	V	39.4	-14.9	24.5	54.0	29.5	123	239
3811.09	V	39.3	-12.2	27.1	54.0	26.9	185	359
4766.52	H	38.8	-9.8	29.0	54.0	25.0	178	60

Note: Level AV = Reading AV + Factor

5.4 AC Power Line Conducted Measurements

5.4.1 AC Power Line Conducted Emission of Transmitter

RESULT:

PASS

Date of testing: 2022-04-25

Ambient temperature: 23°C

Relative humidity: 58%

Atmospheric pressure: 1012hPa

Frequency range: 0.15 - 30MHz

Kind of test site: Shielded Room

Operation Modes: A

Requirements:

FCC 15.207

The AC power line conducted emission on any frequency within the band 150kHz to 30MHz shall not exceed the limits specified in FCC 15.207.

Test procedure:

ANSI C63.10 §6.2

The EUT was placed on a wooden table raised 80cm above the reference ground plane. A vertical conducting plane of the screened room was located 40cm to the rear of the EUT. The EUT was connected to a Line Impedance Stabilization Network (LISN).

The physical arrangement of the test system and associated cabling was varied to determine the effect on the EUT's emissions in amplitude and frequency in order to ensure that maximum emission amplitudes were attained.

The measurements were performed with a test receiver operating in the CISPR quasi-peak and average detection modes. The receiver's 6dB bandwidth was set to 9kHz.

Precheck was performed to determine the worst antenna from 20 antennas (Antenna #1 ~ #20). Also another precheck was performed with / without RFID tag to determine which was worse condition. The final measurement was performed for Antenna #1 with RFID tag as the worst condition.

Disturbances other than those mentioned are small or not detectable.

Figure 5: Conducted Emission on AC Mains Port, Spectral Diagram, 0.15 - 30MHz, Phase N (N), Mode A

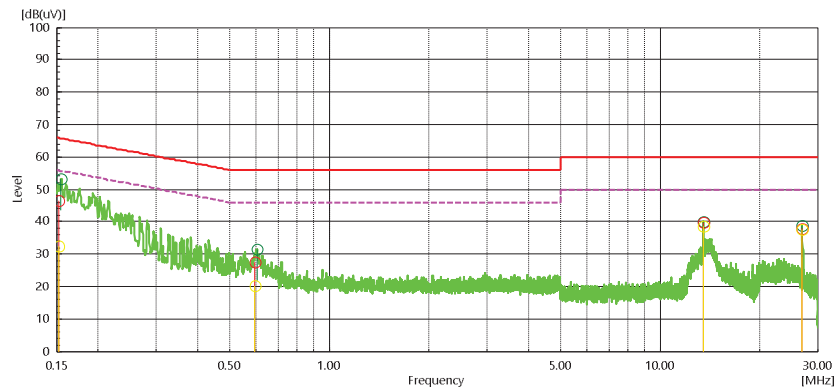


Figure 6: Conducted Emission on AC Mains Port, Spectral Diagram, 0.15 - 30MHz, Phase L1 (L), Mode A

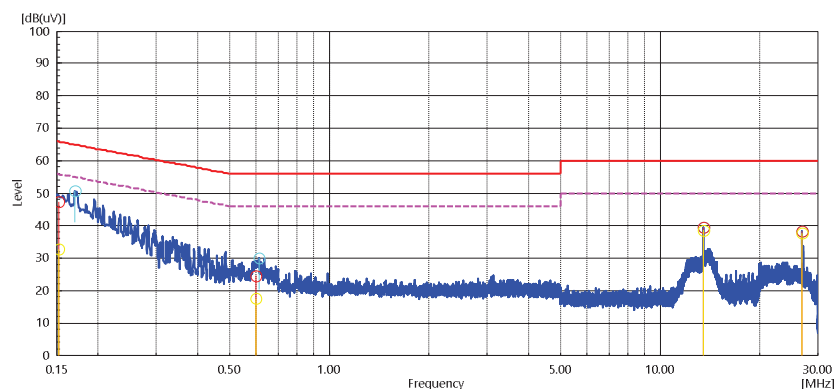


Table 22: AC Power Line Conducted Emission, Quasi Peak and Average Data, 0.15 - 30MHz, Phase N (N) and L1 (L), Mode A

Freq. [MHz]	Phase	Reading QP [dBμV]	Reading AV [dBμV]	Factor [dB]	Level QP [dBμV]	Level AV [dBμV]	Limit QP [dBμV]	Limit AV [dBμV]	Margin QP [dB]	Margin AV [dB]
0.153	L1	37.7	23.2	9.6	47.3	32.8	65.9	55.9	18.6	23.1
0.153	N	37.0	23.0	9.6	46.6	32.6	65.8	55.8	19.2	23.2
0.599	N	18.0	10.5	9.7	27.7	20.2	56.0	46.0	28.3	25.8
0.600	L1	15.0	7.9	9.7	24.7	17.6	56.0	46.0	31.3	28.4
13.560	N	29.5	28.1	10.4	39.9	38.5	60.0	50.0	20.1	11.5
13.560	L1	29.1	28.1	10.4	39.5	38.5	60.0	50.0	20.5	11.5
26.999	L1	27.5	27.0	10.7	38.2	37.7	60.0	50.0	21.8	12.3
27.000	N	27.1	26.8	10.9	38.0	37.7	60.0	50.0	22.0	12.3

Note: Level QP = Reading QP + Factor, Level AV = Reading AV + Factor

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– End of test report –