

RADIO TEST REPORT

Test Report No. 15436699H-A

Customer	Tokai Rika Co., Ltd.
Description of EUT	NFC Reader/Writer
Model Number of EUT	NC2C2A2
FCC ID	MOZNC2C2A2
Test Regulation	FCC Part 15 Subpart C
Test Result	Complied
Issue Date	January 22, 2025
Remarks	-

Representative test engineerShousei Hamaguchi
Engineer**Approved by**Akihiko Maeda
Leader

CERTIFICATE 5107.02

- ☐ The testing in which "Non-accreditation" is displayed is outside the accreditation scopes in UL Japan, Inc.
☒ There is no testing item of "Non-accreditation".

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- For test report(s) referred in this report, the latest version (including any revisions) is always referred.

REVISION HISTORY

Original Test Report No. 15436699H-A

Revision	Test Report No.	Date	Page Revised Contents
- (Original)	15436699H-A	January 22, 2025	-

Reference: Abbreviations (Including words undescribed in this report)

A2LA	The American Association for Laboratory Accreditation	ICES	Interference-Causing Equipment Standard
AC	Alternating Current	IEC	International Electrotechnical Commission
AFH	Adaptive Frequency Hopping	IEEE	Institute of Electrical and Electronics Engineers
AM	Amplitude Modulation	IF	Intermediate Frequency
Amp, AMP	Amplifier	ILAC	International Laboratory Accreditation Conference
ANSI	American National Standards Institute	ISED	Innovation, Science and Economic Development Canada
Ant, ANT	Antenna	ISO	International Organization for Standardization
AP	Access Point	JAB	Japan Accreditation Board
ASK	Amplitude Shift Keying	LAN	Local Area Network
Atten., ATT	Attenuator	LIMS	Laboratory Information Management System
AV	Average	MCS	Modulation and Coding Scheme
BPSK	Binary Phase-Shift Keying	MRA	Mutual Recognition Arrangement
BR	Bluetooth Basic Rate	N/A	Not Applicable
BT	Bluetooth	NIST	National Institute of Standards and Technology
BT LE	Bluetooth Low Energy	NS	No signal detect.
BW	BandWidth	NSA	Normalized Site Attenuation
Cal Int	Calibration Interval	NVLAP	National Voluntary Laboratory Accreditation Program
CCK	Complementary Code Keying	OBW	Occupied Band Width
Ch., CH	Channel	OFDM	Orthogonal Frequency Division Multiplexing
CISPR	Comite International Special des Perturbations Radioelectriques	P/M	Power meter
CW	Continuous Wave	PCB	Printed Circuit Board
DBPSK	Differential BPSK	PER	Packet Error Rate
DC	Direct Current	PHY	Physical Layer
D-factor	Distance factor	PK	Peak
DFS	Dynamic Frequency Selection	PN	Pseudo random Noise
DQPSK	Differential QPSK	PRBS	Pseudo-Random Bit Sequence
DSSS	Direct Sequence Spread Spectrum	PSD	Power Spectral Density
EDR	Enhanced Data Rate	QAM	Quadrature Amplitude Modulation
EIRP, e.i.r.p.	Equivalent Isotropically Radiated Power	QP	Quasi-Peak
EMC	ElectroMagnetic Compatibility	QPSK	Quadri-Phase Shift Keying
EMI	ElectroMagnetic Interference	RBW	Resolution Band Width
EN	European Norm	RDS	Radio Data System
ERP, e.r.p.	Effective Radiated Power	RE	Radio Equipment
EU	European Union	RF	Radio Frequency
EUT	Equipment Under Test	RMS	Root Mean Square
Fac.	Factor	RSS	Radio Standards Specifications
FCC	Federal Communications Commission	Rx	Receiving
FHSS	Frequency Hopping Spread Spectrum	SA, S/A	Spectrum Analyzer
FM	Frequency Modulation	SG	Signal Generator
Freq.	Frequency	SVSWR	Site-Voltage Standing Wave Ratio
FSK	Frequency Shift Keying	TR	Test Receiver
GFSK	Gaussian Frequency-Shift Keying	Tx	Transmitting
GNSS	Global Navigation Satellite System	VBW	Video BandWidth
GPS	Global Positioning System	Vert.	Vertical
Hori.	Horizontal	WLAN	Wireless LAN

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SECTION 1: Customer Information

Company Name	Tokai Rika Co., Ltd.
Address	3-260 Toyota, Oguchi-cho, Niwa-gun, Aichi 480-0195, Japan
Telephone Number	+81-70-2244-4738
Contact Person	Tetsuhiro Okuoka

The information provided by the customer is as follows;

- Customer, Description of EUT, Model Number of EUT, FCC ID on the cover and other relevant pages
- Operating/Test Mode(s) (Mode(s)) on all the relevant pages
- SECTION 1: Customer Information
- SECTION 2: Equipment Under Test (EUT) other than the Receipt Date and Test Date
- SECTION 4: Operation of EUT during testing

SECTION 2: Equipment Under Test (EUT)

2.1 Identification of EUT

Description	NFC Reader/Writer
Model Number	NC2C2A2
Serial Number	Refer to SECTION 4.2
Condition	Production prototype (Not for Sale: This sample is equivalent to mass-produced items.)
Modification	No Modification by the test lab
Receipt Date	September 3 and October 16, 2024
Test Date	October 23 and 29, 2024

2.2 Product Description

General Specification

Rating	DC 12.0 V
Operating Temperature	-40 deg. C to 85 deg. C

Radio Specification

Equipment Type	Transceiver
Frequency of Operation	13.56 MHz
Type of Modulation	ASK

SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification	FCC Part 15 Subpart C The latest version on the first day of the testing period
Title	FCC 47CFR Part15 Radio Frequency Device Subpart C Intentional Radiators Section 15.207 Conducted limits Section 15.225 Operation within the band 13.110-14.010 MHz.

3.2 Procedures and results

Item	Test Procedure	Specification	Worst margin	Results	Remarks
Conducted Emission	<FCC> ANSI C63.10:2013 6 Standard test methods ----- <ISED> RSS-Gen 8.8	<FCC> Section 15.207 ----- <ISED> RSS-Gen 8.8	N/A	N/A	*1)
Electric Field Strength of Fundamental Emission	<FCC> ANSI C63.10:2013 6 Standard test methods ----- <ISED> RSS-Gen 6.4, 6.12	<FCC> Section 15.225(a) ----- <ISED> RSS-210 B.6	57.66 dB, 13.56000 MHz, QP, 0 deg.	Complied	Radiated
Spectrum Mask	<FCC> ANSI C63.10:2013 6 Standard test methods ----- <ISED> RSS-Gen 6.4, 6.13	<FCC> Section 15.225(b)(c) ----- <ISED> RSS-210 B.6	30.37 dB, 14.08783 MHz, QP, 0 deg.	Complied	Radiated
20 dB Bandwidth	<FCC> ANSI C63.10:2013 6 Standard test methods ----- <ISED> -	<FCC> Section15.215(c) ----- <ISED> -	See data	Complied	Radiated
Electric Field Strength of Spurious Emission	<FCC> ANSI C63.10:2013 6 Standard test methods ----- <ISED> RSS-Gen 6.4, 6.13	<FCC> Section 15.209, Section 15.225 (d) ----- <ISED> RSS-210 B.6 RSS-Gen 8.9	6.28 dB 125.387 MHz, Vertical, QP	Complied	Radiated
Frequency Tolerance	<FCC> ANSI C63.10:2013 6 Standard test methods ----- <ISED> RSS-Gen 6.11, 8.11	<FCC> Section 15.225(e) ----- <ISED> RSS-210 B.6	See data	Complied	Radiated

Note: UL Japan, Inc.'s EMI Work Procedures: Work Instructions-ULID-003591 and Work Instructions-ULID-003593.

*1) The test is not applicable since the EUT is not the device that is designed to be connected to the public utility (AC) power line.

FCC Part 15.31 (e)

This EUT provides stable voltage constantly to RF Module regardless of input voltage. Therefore, this EUT complies with the requirement.

However, the supply voltage was varied and tested at 85 % and 115 % of the nominal rated supply voltage during frequency tolerance test according to Section 15.225(e).

FCC Part 15.203 Antenna requirement

It is impossible for end users to replace the antenna, because the antenna is mounted inside of the EUT.

Therefore, the equipment complies with the antenna requirement of Section 15.203.

3.3 Addition to standard

Item	Test Procedure	Specification	Worst margin	Results	Remarks
99% emission bandwidth	<ISED>RSS-Gen 6.7	-	N/A	-	Radiated

Note: UL Japan, Inc.'s EMI Work Procedures: Work Instructions-ULID-003591 and Work Instructions-ULID-003593.

Other than above, no addition, exclusion nor deviation has been made from the standard.

3.4 Uncertainty

Measurement uncertainty is not taken into account when stating conformity with a specified requirement.
Note: When margins obtained from test results are less than the measurement uncertainty, the test results may exceed the limit.

The following uncertainties have been calculated to provide a confidence level of 95 % using a coverage factor $k = 2$.

Radiated emission

Measurement distance	Frequency range		Unit	Calculated Uncertainty (+/-)
3 m	9 kHz to 30 MHz		dB	3.3
10 m			dB	3.1
3 m	30 MHz to 200 MHz	Horizontal	dB	5.0
		Vertical	dB	5.0
	200 MHz to 1000 MHz	Horizontal	dB	5.2
		Vertical	dB	6.2
10 m	30 MHz to 200 MHz	Horizontal	dB	5.5
		Vertical	dB	5.4
	200 MHz to 1000 MHz	Horizontal	dB	5.5
		Vertical	dB	5.5
3 m	1 GHz to 6 GHz		dB	5.1
	6 GHz to 18 GHz		dB	5.4
1 m	10 GHz to 18 GHz		dB	5.4
	18 GHz to 26.5 GHz		dB	5.3
	26.5 GHz to 40 GHz		dB	4.8
0.5 m	26.5 GHz to 40 GHz		dB	5.0

-20 dB Bandwidth and 99% Occupied Bandwidth, Frequency Tolerance

Item	Unit	Calculated Uncertainty (+/-)
Bandwidth (OBW)	%	0.96
Frequency Readout (Frequency counter)	ppm	0.67
Frequency Readout (Spectrum analyzer frequency readout function)	ppm	2.13

3.5 Test Location

UL Japan, Inc. Ise EMC Lab.

4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 Japan

Telephone: +81-596-24-8999

*A2LA Certificate Number: 5107.02 / FCC Test Firm Registration Number: 884919

ISED Lab Company Number: 2973C / CAB identifier: JP0002

Test site	Width x Depth x Height (m)	Size of reference ground plane (m) / horizontal conducting plane	Other rooms	Maximum measurement distance
No.1 semi-anechoic chamber	19.2 x 11.2 x 7.7	7.0 x 6.0	No.1 Power source room	10 m
No.2 semi-anechoic chamber	7.5 x 5.8 x 5.2	4.0 x 4.0	-	3 m
No.3 semi-anechoic chamber	12.0 x 8.5 x 5.9	6.8 x 5.75	No.3 Preparation room	3 m
No.3 shielded room	4.0 x 6.0 x 2.7	N/A	-	-
No.4 semi-anechoic chamber	12.0 x 8.5 x 5.9	6.8 x 5.75	No.4 Preparation room	3 m
No.4 shielded room	4.0 x 6.0 x 2.7	N/A	-	-
No.5 semi-anechoic chamber	6.0 x 6.0 x 3.9	6.0 x 6.0	-	-
No.5 measurement room	6.4 x 6.4 x 3.0	6.4 x 6.4	-	-
No.6 shielded room	4.0 x 4.5 x 2.7	4.0 x 4.5	-	-
No.6 measurement room	4.75 x 5.4 x 3.0	4.75 x 4.15	-	-
No.7 shielded room	4.7 x 7.5 x 2.7	4.7 x 7.5	-	-
No.8 measurement room	3.1 x 5.0 x 2.7	3.1 x 5.0	-	-
No.9 measurement room	8.8 x 4.6 x 2.8	2.4 x 2.4	-	-
No.10 shielded room	3.8 x 2.8 x 2.8	3.8 x 2.8	-	-
No.11 measurement room	4.0 x 3.4 x 2.5	N/A	-	-
No.12 measurement room	2.6 x 3.4 x 2.5	N/A	-	-
Large Chamber	16.9 x 22.1 x 10.17	16.9 x 22.1	-	10 m
Small Chamber	5.3 x 6.69 x 3.59	5.3 x 6.69	-	-

3.6 Test data, Test instruments, and Test set up

Refer to APPENDIX.

SECTION 4: Operation of EUT during testing

4.1 Operating Mode(s)

The mode is used:

Test mode	Remarks
1) Transmitting mode (Tx) Mod on without Tag	The EUT Transmits and Receives at the same time and there is no receiving mode.
2) Transmitting mode (Tx) Mod on with Tag (Type A)	
3) Transmitting mode (Tx) Mod off	

The EUT was operated in a manner similar to typical use during the tests.

*Power of the EUT was set by the software as follows;

Software: Version: 1.0

(Date: 2024.06.21, Storage location: EUT memory)

*This setting of software is the worst case.

Any conditions under the normal use do not exceed the condition of setting.

In addition, end users cannot change the settings of the output power of the product.

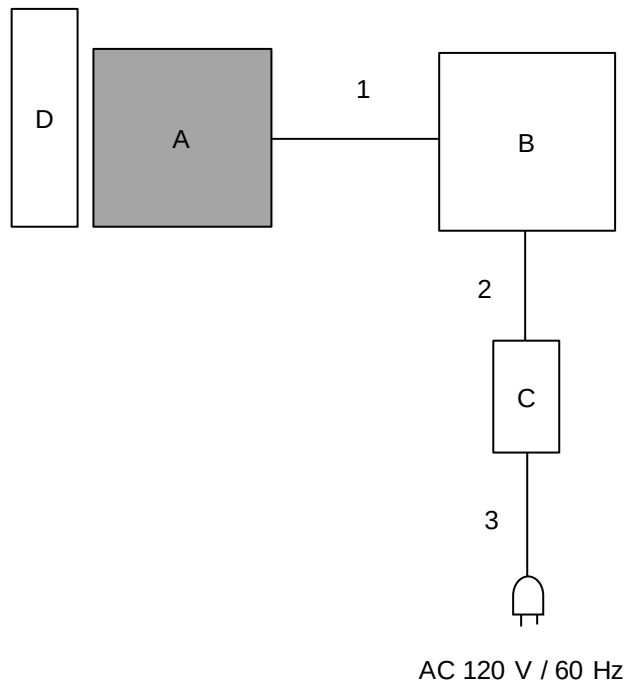
Justification: The system was configured in typical fashion (as a user would normally use it) for testing.

Test Item	Operating mode
Electric Field Strength of Fundamental Emission	Mode 1 ^{*1)}
Spectrum Mask	Mode 1 ^{*1)}
20 dB Bandwidth and 99 % Occupied Bandwidth	Mode1 and 2
Electric Field Strength of Spurious Emission	Mode 1 ^{*1)}
Frequency Tolerance	Mode 3

*1) After the comparison of the test data between with Tag and without Tag, the tests were performed with the worst case.

Frequency Tolerance	
Temperature	-20 deg. C to +50 deg. C (Step 10 deg. C)
Voltage	Normal Voltage DC 12 V Maximum Voltage DC 13.8 V (DC 12 V +15 %) Minimum Voltage DC 10.2 V (DC 12 V -15 %)
*This EUT provides stable voltage constantly to RF Part regardless of input voltage	

4.2 Configuration and peripherals



* Cabling and setup were taken into consideration and test data was taken under worse case conditions.

Description of EUT and Support Equipment

No.	Item	Model number	Serial Number	Manufacturer	Remark
A	NFC Reader/Writer	NC2C2A2	NC2C2A2 SAR	Tokai Rika Co., Ltd.	EUT
B	Checker	-	-	-	-
C	AC Adapter	AD-A120P300	2231	Xiamen UME Electronics Co., Ltd.	-
D	NFC Key Card	14-802791	231214 TYP-15	-	-

List of Cables Used

No.	Name	Length (m)	Shield		Remark
			Cable	Connector	
1	DC & Signal Cable	3.0	Unshielded	Unshielded	-
2	DC Cable	1.4	Unshielded	Unshielded	-
3	AC Cable	1.7	Unshielded	Unshielded	-

SECTION 5: Radiated Emission (Fundamental, Spurious Emission and Spectrum Mask)

Test Procedure

EUT was placed on a urethane platform of nominal size, 1.0 m by 1.5 m, raised 0.8 m above the conducting ground plane. The Radiated Electric Field Strength has been measured in a Semi Anechoic Chamber with a ground plane.

[Limit conversion]

The limits in CFR 47, Part 15, Subpart C, paragraph 15.209(a), are identical to those in RSS-Gen section 8.9, Table 6, since the measurements are performed in terms of magnetic field strength and converted to electric field strength levels (as reported in the table) using the free space impedance of 377 Ohms. For example, the measurement at frequency 9 kHz resulted in a level of 45.5 dBuV/m, which is equivalent to $45.5 - 51.5 = -6.0$ dBuA/m, which has the same margin, 3 dB, to the corresponding RSS-Gen Table 6 limit as it has to 15.209(a) limit.

[Frequency: From 9 kHz to 30 MHz]

The EUT was rotated a full revolution in order to obtain the maximum value of the electric field intensity.

The measurements were performed for vertical polarization (antenna angle: 0 deg., 45 deg., 90 deg., 135 deg., and 225 deg.) and horizontal polarization.

*Refer to 02 about Direction of the Loop Antenna.

Although these tests were performed other than open field test site, adequate comparison measurements were confirmed against 30 m open field test site. Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made in an open field based on KDB 414788.

These tests were performed in semi anechoic chamber. Therefore the measured level of emissions may be higher than if measurements were made without a ground plane. However test results were confirmed to pass against standard limit.

[Frequency: From 30 MHz to 1 GHz]

The measuring antenna height varied between 1 and 4 m and EUT was rotated a full revolution in order to obtain the maximum value of the electric field intensity.

The measurements were performed for both vertical and horizontal antenna polarization.

[Test instruments and test settings]

Frequency	Below 30 MHz	30 MHz to 200 MHz	200 MHz to 1 GHz
Antenna Type	Loop	Biconical	Logperiodic

The test was made with the detector (RBW/VBW) in the following table.

When using Spectrum analyzer, the test was made with adjusting span to zero by using peak hold.

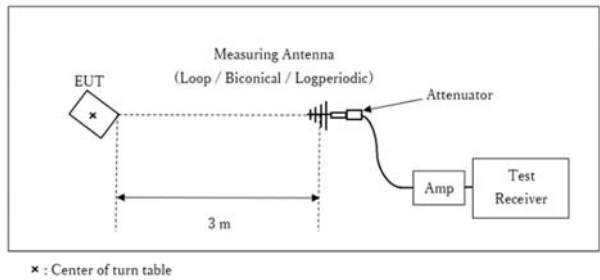
Frequency	From 9 kHz to 90 kHz and From 110 kHz to 150 kHz	From 90 kHz to 110 kHz	From 150 kHz to 490 kHz	From 490 kHz to 30 MHz	From 30 MHz to 1 GHz
Instrument used	Test Receiver				
Detector	PK / AV	QP	PK / AV	QP	QP
IF Bandwidth	200 Hz	200 Hz	9 kHz	9 kHz	120 kHz
Test Distance	3 m *1)	3 m *1)	3 m *1)	3 m *2)	3 m

*1) Distance Factor: $40 \times \log (3 \text{ m} / 300 \text{ m}) = -80 \text{ dB}$

*2) Distance Factor: $40 \times \log (3 \text{ m} / 30 \text{ m}) = -40 \text{ dB}$

Figure 1: Test Setup

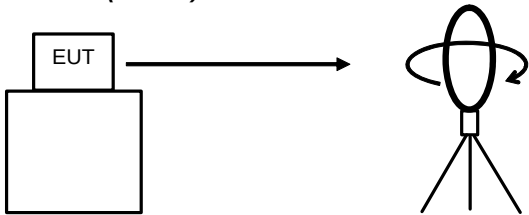
Below 1 GHz



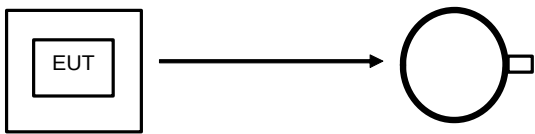
Test Distance: 3 m

Figure 2: Direction of the Loop Antenna

Side View (Vertical)

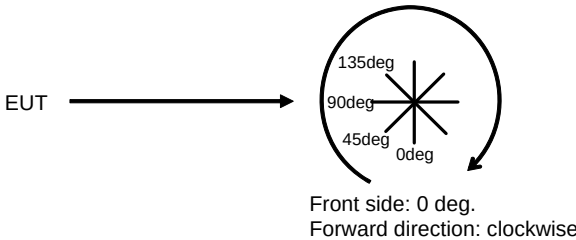


Top View (Horizontal)



Antenna was not rotated.

Top View (Vertical)



- The carrier level and noise levels were confirmed at each position of X, Y and Z axes of EUT to see the position of maximum noise, and the test was made at the position that has the maximum noise.

The test results and limit are rounded off to one decimal place, so some differences might be observed.

Measurement range : 9 kHz to 1 GHz
Test data : APPENDIX
Test result : Pass

SECTION 6: Other tests

Test	Span	RBW	VBW	Sweep	Detector	Trace	Instrument used
20 dB Bandwidth	2 MHz	10 kHz	30 kHz	Auto	Peak	Max Hold	Spectrum Analyzer
99 % Occupied Bandwidth	Enough width to display emission skirts	1 to 5 % of OBW	Three times of RBW	Auto	Peak	Max Hold	Spectrum Analyzer
Frequency Tolerance	-	-	-	-	-	-	Frequency counter
Peak hold was applied as Worst-case measurement.							

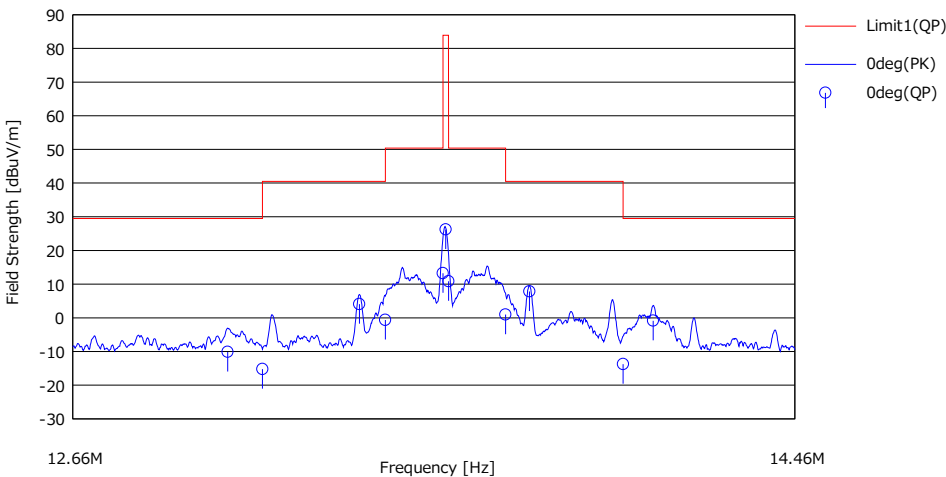
Test data : APPENDIX
Test result : Pass

APPENDIX 1: Test data

Fundamental Emission and Spectrum Mask

Test place Ise EMC Lab.
Semi Anechoic Chamber No.4
Date October 29, 2024
Temperature / Humidity 22 deg. C / 57 % RH
Engineer Shousei Hamaguchi
Mode Mode 1

Limit : FCC15.225(a), 9-90kHz:PK, 110-490kHz:PK, other:QP



No.	Freq. [MHz]	Reading (QP)	Ant.Fac [dB/m]	Loss [dB]	Gain [dB]	Result (QP)	Limit (QP)	Margin (QP)	Antenna [deg]	Table [deg]	Comment
		[dBuV]				[dBuV/m]	[dBuV/m]	[dB]			
1	13.02640	35.40	19.72	-33.13	32.13	-10.14	29.50	39.64	0deg	45	
2	13.11000	30.30	19.71	-33.13	32.13	-15.25	29.50	44.75	0deg	45	
3	13.34611	49.60	19.70	-33.12	32.13	4.05	40.50	36.45	0deg	45	
4	13.41000	44.90	19.70	-33.12	32.13	-0.65	40.50	41.15	0deg	45	
5	13.55300	58.80	19.69	-33.12	32.13	13.24	50.40	37.16	0deg	45	
6	13.56000	71.80	19.69	-33.12	32.13	26.24	83.90	57.66	0deg	45	
7	13.56700	56.40	19.69	-33.12	32.13	10.84	50.40	39.56	0deg	45	
8	13.71000	46.50	19.68	-33.11	32.13	0.94	40.50	39.56	0deg	45	
9	13.77044	53.40	19.67	-33.10	32.13	7.84	40.50	32.66	0deg	45	
10	14.01000	31.80	19.66	-33.10	32.13	-13.77	29.50	43.27	0deg	45	
11	14.08783	44.70	19.65	-33.09	32.13	-0.87	29.50	30.37	0deg	45	

RESULT = READING + ANT FACTOR + LOSS (CABLE + Attenuator + Distance Factor*) - GAIN(AMP)
*) Distance Factor: 40 x log (3 m / 30 m) = -40 dB

Result of the fundamental Emission at 3 m without Distance factor

QP												
Ant Deg [deg]	Frequency	Detector	Reading	Ant Factor	Loss	Gain	Duty Factor	Result	Limit	Margin	Remark	
	[MHz]		[dBuV]	[dB/m]	[dB]	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dB]		
0	13.56000	QP	71.80	19.69	6.88	32.13	-	66.24	-	-	Fundamental	

RESULT = READING + ANT FACTOR + LOSS (CABLE + Attenuator) - GAIN(AMP)

Spurious Emission

Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.4
Date	October 29, 2024
Temperature / Humidity	22 deg. C / 57 % RH
Engineer	Shousei Hamaguchi
Mode	Mode 1

PK or QP

Ant Deg [deg] or Polarity [Hori/Vert]	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]
0deg	27.120	QP	30.20	20.29	-32.79	32.12	-	-14.42	29.5	43.92
Hori.	48.694	QP	27.80	11.65	7.28	32.09	-	14.64	40.0	25.36
Hori.	87.225	QP	27.70	8.09	7.73	32.08	-	11.44	40.0	28.56
Hori.	113.982	QP	29.70	12.22	7.98	32.05	-	17.85	43.5	25.67
Hori.	125.387	QP	22.00	13.41	8.08	32.05	-	11.44	43.5	32.08
Hori.	201.652	QP	21.30	11.61	8.75	32.01	-	9.65	43.5	33.87
Hori.	235.235	QP	21.40	11.62	9.06	32.01	-	10.07	46.0	35.95
Vert.	48.694	QP	45.70	11.65	7.28	32.09	-	32.54	40.0	7.46
Vert.	87.225	QP	44.80	8.09	7.73	32.08	-	28.54	40.0	11.46
Vert.	113.982	QP	46.80	12.22	7.98	32.05	-	34.95	43.5	8.57
Vert.	125.387	QP	47.80	13.41	8.08	32.05	-	37.24	43.5	6.28
Vert.	201.652	QP	35.10	11.61	8.75	32.01	-	23.45	43.5	20.07
Vert.	235.235	QP	31.00	11.62	9.06	32.01	-	19.67	46.0	26.35

RESULT = READING + ANT FACTOR + LOSS (CABLE + Attenuator + Distance Factor*) - GAIN(AMP)

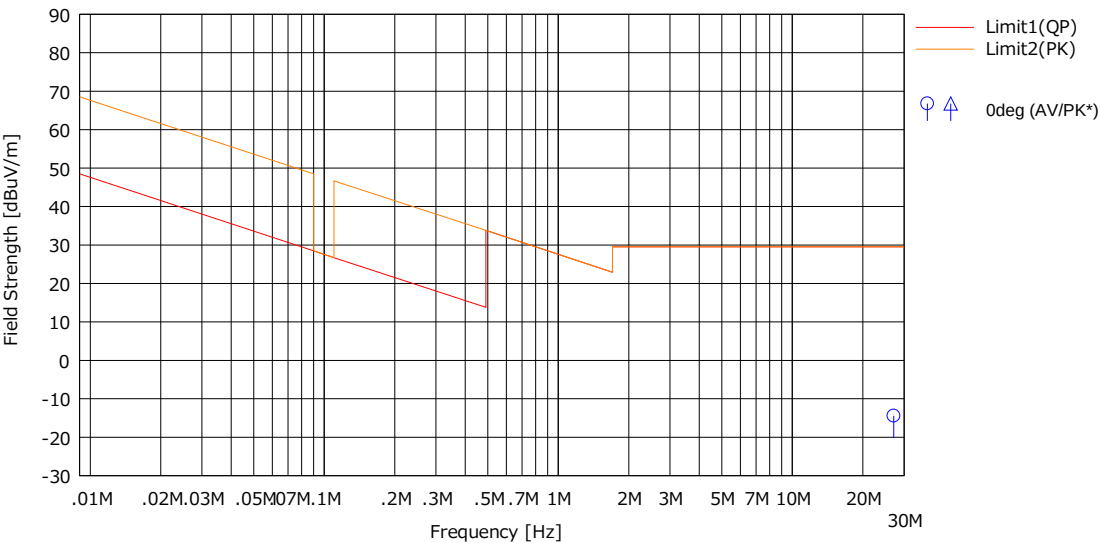
*) Distance Factor: 40 x log (3 m / 30 m) = -40 dB

Radiated Spurious Emission
(Plot data, Worst case for Spurious Emission)

Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.4
Date	October 29, 2024
Temperature / Humidity	22 deg. C / 57 % RH
Engineer	Shousei Hamaguchi
Mode	Mode 1

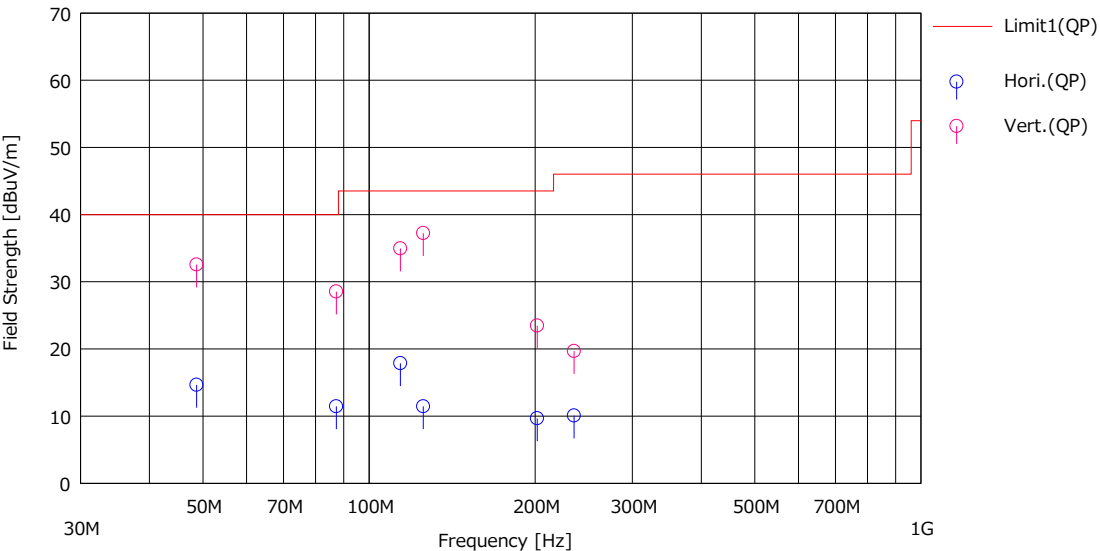
(below 30MHz)

Limit : FCC15.209(a), 9-90kHz:PK, 110-490kHz:PK, other:QP



* Data above 490 kHz were measured using a QP detector.

(above 30MHz)

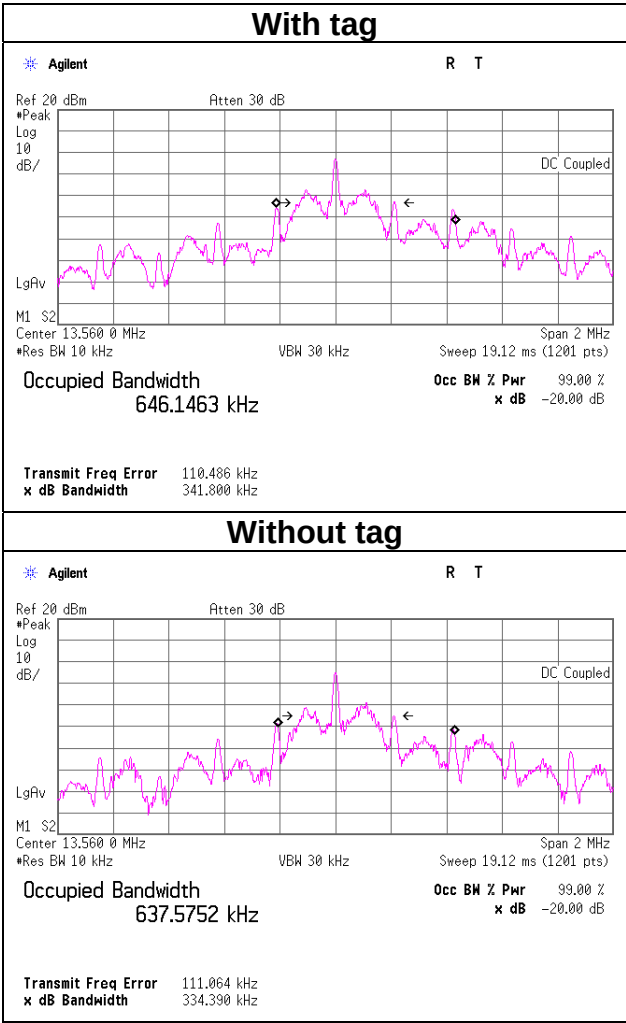


*These plots data contains sufficient number to show the trend of characteristic features for EUT.

20 dB Bandwidth and 99% Occupied Bandwidth

Test place Ise EMC Lab.
 No.8 Measurement Room
Date October 23, 2024
Temperature / Humidity 22 deg. C / 70 % RH
Engineer Tetsuro Yoshida
Mode Mode 1, 2

FREQ [MHz]	Mode	20dB Bandwidth [kHz]	99% Occupied Bandwidth [kHz]
13.56	With Tag	341.800	646.1463
	Without Tag	334.390	637.5752



Frequency Tolerance

Test place Ise EMC Lab.
No.8 Measurement Room
Date October 23, 2024
Temperature / Humidity 22 deg. C / 70 % RH
Engineer Tetsuro Yoshida
Mode Mode 3

Test condition		Tested timing	Measured frequency [MHz]	Frequency error [MHz]	Result		Limit [+/- %]
Temp. [deg. C]	Voltage [V]				[%]	[ppm]	
50	12	Power on	13.559612	-0.000388	-0.00286	-28.6	0.01
		+ 2 min.	13.559425	-0.000576	-0.00424	-42.4	0.01
		+ 5 min.	13.559477	-0.000523	-0.00385	-38.5	0.01
		+ 10 min.	13.559520	-0.000480	-0.00354	-35.4	0.01
40	12	Power on	13.559555	-0.000445	-0.00328	-32.8	0.01
		+ 2 min.	13.559636	-0.000364	-0.00268	-26.8	0.01
		+ 5 min.	13.559533	-0.000467	-0.00344	-34.4	0.01
		+ 10 min.	13.559547	-0.000453	-0.00334	-33.4	0.01
30	12	Power on	13.559802	-0.000198	-0.00146	-14.6	0.01
		+ 2 min.	13.559771	-0.000229	-0.00169	-16.9	0.01
		+ 5 min.	13.559678	-0.000322	-0.00237	-23.7	0.01
		+ 10 min.	13.559669	-0.000331	-0.00244	-24.4	0.01
20	12	Power on	13.559912	-0.000088	-0.00065	-6.5	0.01
		+ 2 min.	13.559883	-0.000117	-0.00086	-8.6	0.01
		+ 5 min.	13.559831	-0.000169	-0.00124	-12.4	0.01
		+ 10 min.	13.559855	-0.000145	-0.00107	-10.7	0.01
20	10.2 (12V -15%)	Power on	13.560050	0.000050	0.00037	3.7	0.01
		+ 2 min.	13.560272	0.000272	0.00201	20.1	0.01
		+ 5 min.	13.559981	-0.000020	-0.00014	-1.4	0.01
		+ 10 min.	13.560038	0.000037	0.00028	2.8	0.01
20	13.8 (12V +15%)	Power on	13.559561	-0.000439	-0.00324	-32.4	0.01
		+ 2 min.	13.559813	-0.000187	-0.00138	-13.8	0.01
		+ 5 min.	13.559932	-0.000068	-0.00050	-5.0	0.01
		+ 10 min.	13.559945	-0.000055	-0.00040	-4.0	0.01
10	12	Power on	13.559736	-0.000265	-0.00195	-19.5	0.01
		+ 2 min.	13.559799	-0.000201	-0.00148	-14.8	0.01
		+ 5 min.	13.559806	-0.000194	-0.00143	-14.3	0.01
		+ 10 min.	13.559903	-0.000097	-0.00071	-7.1	0.01
0	12	Power on	13.559826	-0.000174	-0.00128	-12.8	0.01
		+ 2 min.	13.560049	0.000049	0.00036	3.6	0.01
		+ 5 min.	13.560015	0.000015	0.00011	1.1	0.01
		+ 10 min.	13.560068	0.000068	0.00050	5.0	0.01
-10	12	Power on	13.559888	-0.000112	-0.00083	-8.3	0.01
		+ 2 min.	13.560035	0.000035	0.00026	2.6	0.01
		+ 5 min.	13.559992	-0.000008	-0.00006	-0.6	0.01
		+ 10 min.	13.560027	0.000027	0.00020	2.0	0.01
-20	12	Power on	13.559899	-0.000101	-0.00074	-7.4	0.01
		+ 2 min.	13.559971	-0.000030	-0.00022	-2.2	0.01
		+ 5 min.	13.560161	0.000161	0.00119	11.9	0.01
		+ 10 min.	13.560287	0.000287	0.00212	21.2	0.01

Calculation formula: Frequency error = Measured frequency - Tested frequency
Result [%] = Frequency error / Tested frequency * 100

Tested frequency: 13.56 MHz
Limit (+/-): 0.01 % (+/- 100ppm)

*The test was begun from 50 deg. C and the temperature was lowered each 10 deg. C.

APPENDIX 2: Test instruments

Test Equipment

Test Item	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Cal Int
RE	141217	Coaxial cable	Fujikura/Suhner/TSJ	5D-2W/SFM141/421-010/sucoform141-PE/RFM-E121(SW)	-/04178	06/14/2024	12
RE	141267	Logperiodic Antenna (200-1000MHz)	Schwarzbeck Mess-Elektronik OHG	VUSLP9111B	9111B-192	09/18/2024	12
RE	141331	Attenuator (6dB)	TME	UFA-01	-	02/17/2024	12
RE	141397	Coaxial Cable	UL Japan	-	-	11/22/2023	12
RE	141425	Biconical Antenna	Schwarzbeck Mess-Elektronik OHG	VHA9103+ BBA9106	VHA 91031302	08/23/2024	12
RE	141545	DIGITAL HiTESTER	HIOKI E.E. CORPORATION	3805	51201148	02/01/2024	12
RE	141583	Pre Amplifier	SONOMA INSTRUMENT	310	260833	04/04/2024	12
RE	141951	EMI Test Receiver	Rohde & Schwarz	ESR26	101408	05/17/2024	12
RE	142011	AC4_Semi Anechoic Chamber (NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	12/13/2023	24
RE	142152	Loop Antenna	Rohde & Schwarz	HFH2-Z2	836553/009	10/17/2023	12
RE	142230	Measure, Tape, Steel	KOMELON	KMC-36	-	-	-
RE	159670	Coaxial Cable	UL Japan	-	-	11/21/2023	12
RE	178648	EMI measurement program	TSJ (Techno Science Japan)	TEPTO-DV	-	-	-
RE	244710	Thermo-Hygrometer	HIOKI E.E. CORPORATION	LR5001	231202104	01/25/2024	12
FT	141440	Temperature and Humidity Chamber	Espec	PL-1KP	14019569	04/09/2024	12
FT	141498	Microwave Counter	ADVANTEST	R5373	120100309	07/19/2024	12
FT	141557	DIGITAL HiTESTER	HIOKI E.E. CORPORATION	3805	070900530	01/31/2024	12
FT	141903	Spectrum Analyzer	Keysight Technologies Inc	E4440A	MY46186390	01/26/2024	12
FT	142645	Loop Antenna	UL Japan	-	-	-	-
FT	244711	Thermo-Hygrometer	HIOKI E.E. CORPORATION	LR5001	231202105	01/25/2024	12

*Hyphens for Last Calibration Date and Cal Int (month) are instruments that Calibration is not required (e.g. software), or instruments checked in advance before use.

The expiration date of the calibration is the end of the expired month.

As for some calibrations performed after the tested dates, those test equipment have been controlled by means of an unbroken chains of calibrations.

All equipment is calibrated with valid calibrations. Each measurement data is traceable to the national or international standards.

Test item:

RE: Radiated Emission

FT: Frequency Tolerance