



RADIO TEST REPORT

Test Report No.: 14511411H-A-R1

Customer	Japan Cash Machine Co Ltd
Description of EUT	iVIZION2 Series Banknote Validator
Model Number of EUT	iVIZION-310-SS
FCC ID	EED-IVZ02
Test Regulation	FCC Part 15 Subpart C
Test Result	Complied (Refer to SECTION 3)
Issue Date	December 5, 2022
Remarks	-

Representative test engineer

Yuta Moriya
Engineer

Approved by

Shinichi Miyazono
Engineer



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".

Report Cover Page - Form-ULID-003532 (DCS:13-EM-F0429) Issue# 21.0

ANNOUNCEMENT

- This test report shall not be reproduced in full or partial, without the written approval of UL Japan, Inc.
- The results in this report apply only to the sample tested. (Laboratory was not involved in sampling.)
- This sample tested is in compliance with the limits of the above regulation.
- The test results in this test report are traceable to the national or international standards.
- This test report must not be used by the customer to claim product certification, approval, or endorsement by the A2LA accreditation body.
- This test report covers Radio technical requirements.
It does not cover administrative issues such as Manual or non-Radio test related Requirements. (if applicable)
- The all test items in this test report are conducted by UL Japan, Inc. Ise EMC Lab.
- The opinions and the interpretations to the result of the description in this report are outside scopes where UL Japan, Inc. has been accredited.
- The information provided from the customer for this report is identified in Section 1.
- For test report(s) referred in this report, the latest version (including any revisions) is always referred.

REVISION HISTORY

Original Test Report No.: 14511411H-A

This report is a revised version of 14511411H-A. 14511411H-A is replaced with this report.

Revision	Test Report No.	Date	Page Revised Contents
- (Original)	14511411H-A	November 28, 2022	-
1	14511411H-A-R1	December 5, 2022	Correction of FCC Part 15.31 (e) in Clause 3.2

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

CONTENTS	PAGE
SECTION 1: Customer Information	5
SECTION 2: Equipment Under Test (EUT).....	5
SECTION 3: Test specification, procedures & results	7
SECTION 4: Operation of EUT during testing.....	10
SECTION 5: Conducted Emission	13
SECTION 6: Radiated Emission (Fundamental, Spurious Emission and Spectrum Mask).....	14
SECTION 7: Other test	16
APPENDIX 1: Test data	17
Conducted Emission	17
Fundamental emission and Spectrum Mask	19
Spurious emission	20
Radiated Spurious Emission	21
20 dB Bandwidth and 99% Occupied Bandwidth	22
Frequency Tolerance.....	23
APPENDIX 2: Test instruments	24
APPENDIX 3: Photographs of test setup	26
Conducted Emission	26
Radiated Emission	27
Frequency Tolerance.....	28

SECTION 1: Customer Information

Company Name	Japan Cash Machine Co Ltd
Address	2-3-15 Nishiwaki, Hirano-ku, Osaka-shi, Osaka 547-0035 Japan
Telephone Number	+81-6-6703-8402
Contact Person	Yutaka Ikeda

The information provided from 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
- * The laboratory is exempted from liability of any test results affected from the above information in SECTION 2 and 4.

SECTION 2: Equipment Under Test (EUT)**2.1 Identification of EUT**

Description	iVIZION2 Series Banknote Validator
Model Number	iVIZION-310-SS
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	October 25, 2022 for RE November 4, 2022 for CE (Other than Antenna Terminated), FT November 15, 2022 for CE (Antenna Terminated)
Test Date	October 26 to November 18, 2022

*CE: Conducted Emission, RE: Radiated Emission, FT: Frequency Tolerance

2.2 Product Description**General Specification**

Rating	DC 12 V (-5 %) to 24 V (+10 %)
Operating temperature	5 deg. C to 50 deg. C

Radio Specification

Equipment Type	Transceiver
Frequency of Operation	13.56 MHz (ISO15693)
Type of Modulation	ASK

2.3 Variant model(s)

< Model: iVIZION-xyz >

Suffix: "x", "y", and "z" are as follows;

iVIZION-xyz	:	"x"	= 2: CIS and UV Point Sensor
		"x"	= 3: CIS (featured UV Sensor)
		"y"	= 0: [DDR3] 4GBit/[FLASH] 128Mbit (Standard)
		"y"	= 1: [DDR3] 4GBit/[FLASH] 256Mbit
		"z"	= 0: SS

"x": Validation Sensor,

"y": CPU Board,

"z": Validator

Model No. iVIZION-310-SS is selected as a representative model based on the above descriptions since this system has the maximum load composition.

These differences cause no influence to radio specification because there is no difference in RF module and the orientation of antenna.

There was no degradation of Radio characteristic. Therefore they are considered electorically identical.

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.

* Also the EUT complies with FCC Part 15 Subpart B.

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	7.26 dB 8.79486 MHz AV, Phase L	Complied a)	-
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	69.78 dB, 13.56000 MHz, QP, 135 deg.	Complied b)	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	45.92 dB, 14.01000 MHz, QP, 135 deg.	Complied b)	Radiated
20 dB Bandwidth	<FCC> ANSI C63.10:2013 6 Standard test methods ----- <ISED> -	<FCC> Section15.215(c) ----- <ISED> -	See data	Complied c)	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	4.89 dB 168.936 MHz, Vertical, QP	Complied d)	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 e)	Radiated

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

- a) Refer to APPENDIX 1 (data of Conducted Emission)
- b) Refer to APPENDIX 1 (data of Fundamental emission and Spectrum Mask)
- c) Refer to APPENDIX 1 (data of 20 dB Bandwidth and 99% Occupied Bandwidth)
- d) Refer to APPENDIX 1 (data of Spurious emission)
- e) Refer to APPENDIX 1 (data of Frequency Tolerance)

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 $k = 2$.

Test Item		Frequency range		Uncertainty (+/-)
Conducted emission AMN (LISN)		0.009 MHz to 0.15 MHz		3.7 dB
		0.15 MHz to 30 MHz		3.3 dB
Radiated emission	3 m	9 kHz to 30 MHz		3.2 dB
	10 m			3.0 dB
	3 m	30 MHz to 200 MHz	Horizontal	4.8 dB
			Vertical	5.0 dB
		200 MHz to 1000 MHz	Horizontal	5.1 dB
			Vertical	6.2 dB
	10 m	30 MHz to 200 MHz	Horizontal	4.8 dB
			Vertical	4.8 dB
		200 MHz to 1000 MHz	Horizontal	5.0 dB
			Vertical	5.0 dB
Frequency Tolerance		-		0.01541 ppm
20 dB Bandwidth / 99 % Occupied Bandwidth		-		0.96 %

3.5 Test Location

UL Japan, Inc. Ise EMC Lab.

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

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

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

Telephone: +81-596-24-8999

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	-	-

* Size of vertical conducting plane (for Conducted Emission test): 2.0 x 3.0 m for No.1, No.2, No.3, and No.4 semi-anechoic chambers and No.3 and No.4 shielded rooms.

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 :

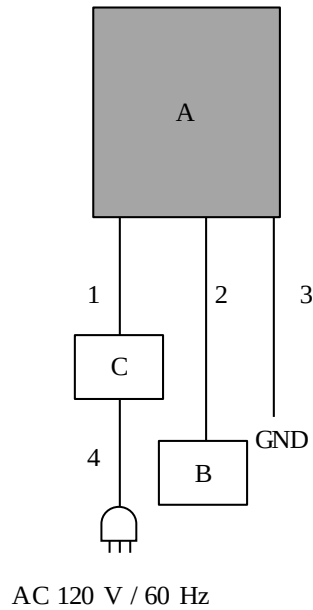
Test mode	Remarks
1) Transmitting mode (Tx)	The EUT Transmits and Receives at the same time and there is no receiving mode.
The EUT was operated in a manner similar to typical use during the tests.	
*Power of the EUT was set by the software as follows; Software: iVIZION-200-SS USA ID-003 Version: V002-01 28SEP22(LOOPBACK TEST) (Date: 2022.10 24, Storage location: Driven by connected PC)	
*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
Conducted Emission	Tx Mod on Antenna Terminated
Electric Field Strength of Fundamental Emission	Tx Mod on
Spectrum Mask	Tx Mod on
20 dB Bandwidth and 99 % Occupied Bandwidth	Tx Mod on
Electric Field Strength of Spurious Emission	Tx Mod on
Frequency Tolerance	Tx Mod on

Frequency Tolerance:	
Temperature	-20 deg. C to +50 deg. C (Step 10 deg. C)
Voltage	Normal Voltage: DC 24 V Maximum Voltage: DC 27.6 V (DC 24 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

[Conducted Emission test]



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

*As a result of comparing DC 12 V and DC 24 V at pre-check, the test was performed with DC 24 V of the worst voltage as representative.

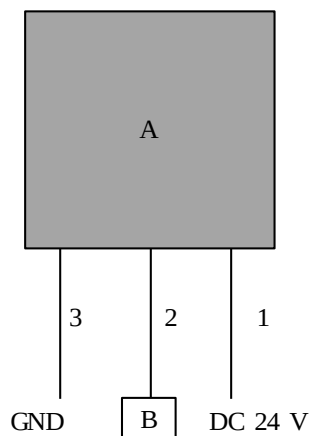
Description of EUT and Support equipment

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	iVIZION2 Series Banknote Validator	iVIZION-310-SS	22090000019	Japan Cash Machine Co Ltd	EUT
B	Terminal	-	-	-	-
C	DC regulated power supply	RPE-4323	824B168G2	RS COMPONENTS LTD	-

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	DC Cable	2.0	Unshielded	Unshielded	-
2	Signal Cable	1.6	Unshielded	Unshielded	-
3	GND Cable	1.6	Unshielded	Unshielded	-
4	AC Cable	1.5	Unshielded	Unshielded	-

[Radiated Emission and Frequency Tolerance tests]



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

*As a result of comparing DC 12 V and DC 24 V at pre-check, the tests were performed with DC 24 V of the worst voltage as representative.

Description of EUT and Support equipment

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	iVIZION2 Series Banknote Validator	iVIZION-310-SS	22090000019	Japan Cash Machine Co Ltd	EUT
B	Terminal	-	-	-	-

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	DC Cable	2.0	Unshielded	Unshielded	-
2	Signal Cable	1.6	Unshielded	Unshielded	-
3	GND Cable	1.6	Unshielded	Unshielded	-

SECTION 5: Conducted Emission

Test Procedure and conditions

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 rear of tabletop was located 40 cm to the vertical conducting plane. The rear of EUT, including peripherals aligned and flushed with rear of tabletop. All other surfaces of tabletop were at least 80 cm from any other grounded conducting surface. EUT was located 80 cm from a Line Impedance Stabilization Network (LISN)/ Artificial mains Network (AMN) and excess AC cable was bundled in center.

For the tests on EUT with other peripherals (as a whole system)

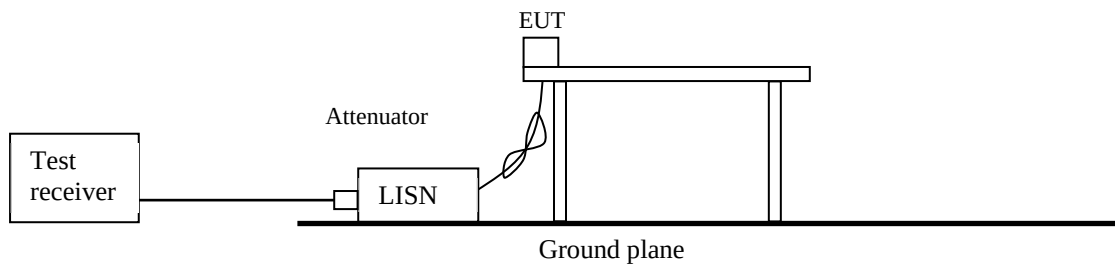
I/O cables that were connected to the peripherals were bundled in center. They were folded back and forth forming a bundle 30 cm to 40 cm long and were hanged at a 40 cm height to the ground plane. All unused 50 ohm connectors of the LISN (AMN) were resistivity terminated in 50 ohm when not connected to the measuring equipment.

The AC Mains Terminal Continuous disturbance Voltage has been measured with the EUT in a Semi Anechoic Chamber.

The EUT was connected to a LISN (AMN).

An overview sweep with peak detection has been performed.

Figure 1: Test Setup



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

Detector	: QP and CISPR AV
Measurement range	: 0.15 MHz to 30 MHz
Test data	: APPENDIX
Test result	: Pass

SECTION 6: 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 315 deg.) and horizontal polarization.
*Refer to Figure 3 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.

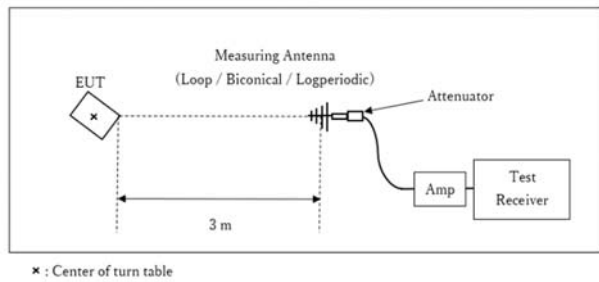
Frequency	From 9 kHz to 90 kHz and From 110 kHz to 150 kHz	From 90 kHz to 110 kHz	From 150 kHz to 490 kHz	From 490 kHz to 30 MHz	From 30 MHz to 1 GHz
Instrument used	Test Receiver				
Detector	PK / AV	QP	PK / AV	QP	QP
IF Bandwidth	200 Hz	200 Hz	9 kHz	9 kHz	120 kHz
Test Distance	3 m *1)	3 m *1)	3 m *1)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

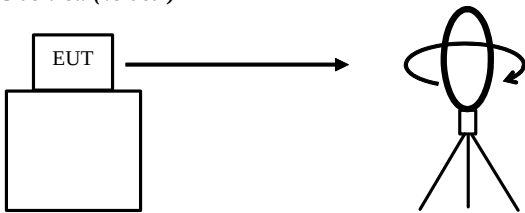
Below 1 GHz



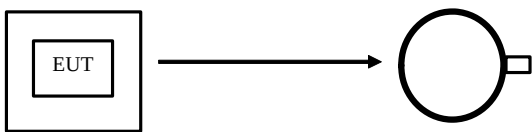
Test Distance: 3 m

Figure 3: Direction of the Loop Antenna

Side View (Vertical)

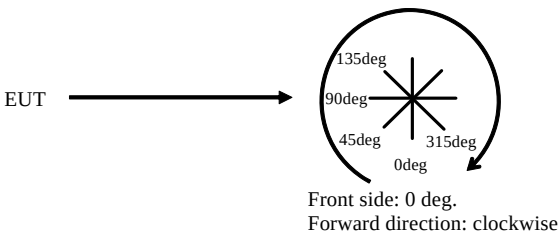


Top View (Horizontal)



Antenna was not rotated.

Top View (Vertical)



The test was made on EUT at the normal use position.

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 7: Other test

Test	Span	RBW	VBW	Sweep	Detector	Trace	Instrument used
20 dB Bandwidth	500 kHz	3 kHz	9.1 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 *1)	Max Hold *1)	Spectrum Analyzer
Frequency Tolerance	20 kHz	3 kHz	9.1 kHz	Auto	Peak	Max Hold	Spectrum Analyzer *2)
*1) The measurement was performed with Peak detector, Max Hold since the duty cycle was not 100 %. Peak hold was applied as Worst-case measurement.							
*2) The measurement was performed Transmit.							

Test data : APPENDIX
Test result : Pass

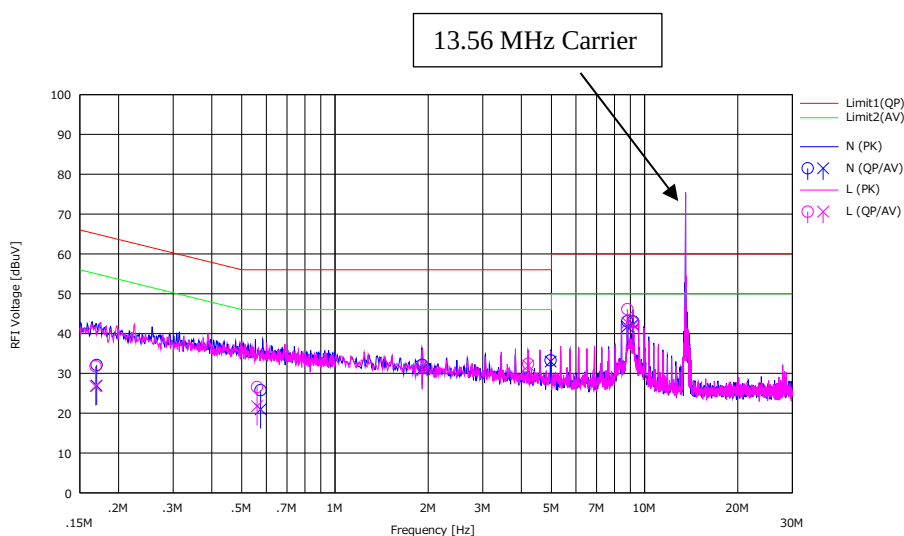
APPENDIX 1: Test data

Conducted Emission

Test place
Semi Anechoic Chamber
Date
Temperature / Humidity
Engineer
Mode

Ise EMC Lab.
No.2
November 6, 2022
22 deg. C / 40 % RH
Takeshi Hiyaji
Mode 1

Limit : FCC_Part 15 Subpart C(15.207)



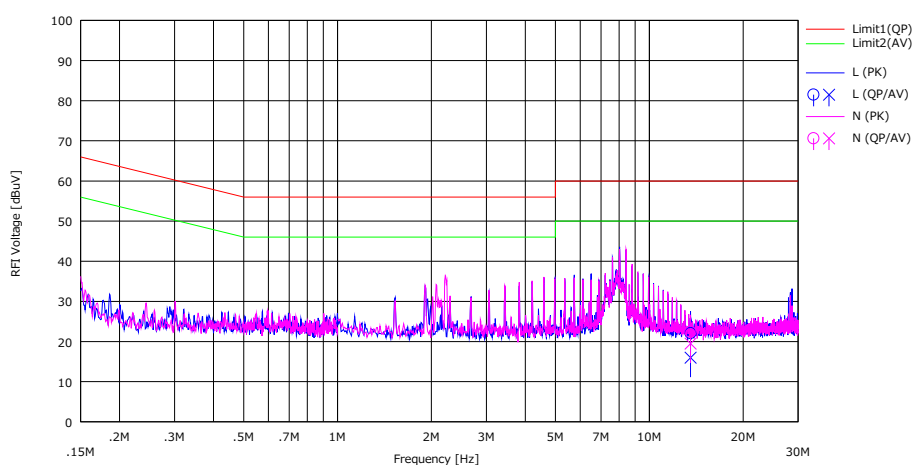
No.	Freq. [MHz]	Reading		USN	LOSS	Results		Limit		Margin		Phase	Comment
		<QP> [dBuV]	<AV> [dBuV]			<QP> [dBuV]	<AV> [dBuV]	<QP> [dBuV]	<AV> [dBuV]	<QP> [dB]	<AV> [dB]		
1	0.16995	18.90	13.70	0.05	13.15	32.10	26.90	64.96	54.96	32.86	28.06	N	
2	0.57523	12.50	7.70	0.04	13.23	25.77	20.97	56.00	46.00	30.23	25.03	N	
3	1.91322	18.70	17.60	0.06	13.39	32.15	31.05	56.00	46.00	23.85	14.95	N	
4	4.97290	19.50	19.20	0.12	13.65	33.27	32.97	56.00	46.00	22.73	13.03	N	
5	8.79785	29.00	27.70	0.20	13.86	43.06	41.76	60.00	50.00	16.94	8.24	N	
6	9.17914	29.00	28.20	0.20	13.88	43.08	42.28	60.00	50.00	16.92	7.72	N	
7	0.16855	18.60	13.60	0.04	13.14	31.78	26.78	65.03	55.03	33.25	28.25	L	
8	0.56050	13.30	8.50	0.04	13.22	26.56	21.76	56.00	46.00	29.44	24.24	L	
9	1.91252	18.40	17.30	0.07	13.39	31.86	30.76	56.00	46.00	24.14	15.24	L	
10	4.20695	18.70	18.30	0.10	13.59	32.39	31.99	56.00	46.00	23.61	14.01	L	
11	8.79486	32.10	28.70	0.18	13.86	46.14	42.74	60.00	50.00	13.86	7.26	L	
12	9.17763	28.70	28.00	0.19	13.88	42.77	42.07	60.00	50.00	17.23	7.93	L	

CHART: WITH FACTOR Peak hold data. CALCULATION : RESULT = READING + LISN + LOSS (CABLE + ATT)
Except for the above table: adequate margin data below the limits.

Conducted Emission

Test place Ise EMC Lab.
Semi Anechoic Chamber No.4
Date November 18, 2022
Temperature / Humidity 23 deg. C / 39 % RH
Engineer Ken Fujita
Mode Mode 1 (Antenna Terminated)

Limit : FCC_Part 15 Subpart C(15.207)



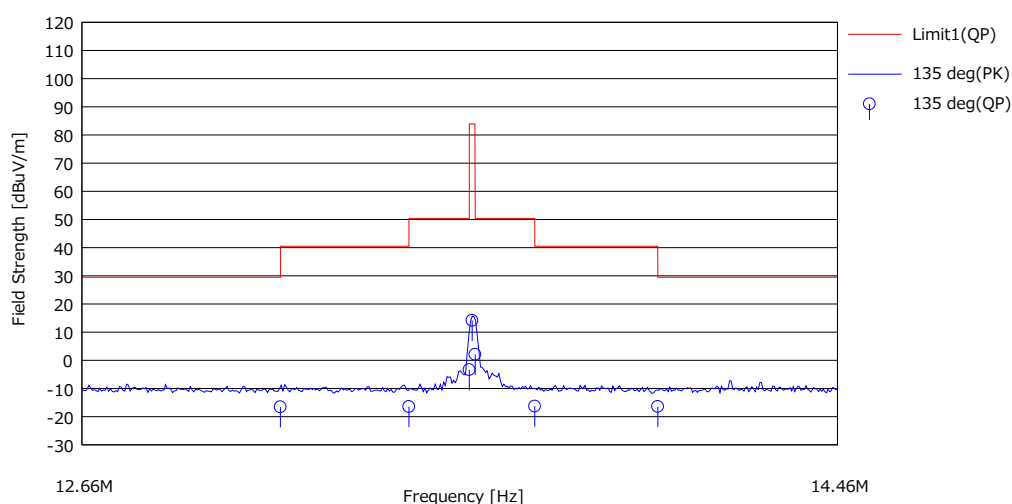
No.	Freq. [MHz]	Reading		LISN [dB]	LOSS [dB]	Results		Limit		Margin		Phase	Comment
		<QP> [dBuV]	<AV> [dBuV]			<QP> [dBuV]	<AV> [dBuV]	<QP> [dBuV]	<AV> [dBuV]	<QP> [dB]	<AV> [dB]		
1	13.56000	8.10	2.00	0.31	13.66	22.07	15.97	60.00	50.00	37.93	34.03	L	
2	13.56000	8.40	5.50	0.32	13.66	22.38	19.48	60.00	50.00	37.62	30.52	N	

CHART: WITH FACTOR Peak hold data. CALCULATION : RESULT = READING + LISN + LOSS (CABLE + ATT)
Except for the above table: adequate margin data below the limits.

Fundamental emission and Spectrum Mask

Test place Ise EMC Lab.
Semi Anechoic Chamber No.3
Date October 26, 2022
Temperature / Humidity 20 deg. C / 31 % RH
Engineer Yuta Moriya
Mode Mode 1

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



No.	Freq.	Reading (QP)	Ant.Fac	Loss	Gain	Result (QP)	Limit (QP)	Margin (QP)	Antenna	Table	Comment
	[MHz]	[dBuV]	[dB/m]	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dB]		[deg]	
1	13.11000	29.80	19.27	-33.42	32.22	-1 6.57	29.50	46.07	135 deg	0	
2	13.41000	29.90	19.29	-33.41	32.22	-1 6.44	40.50	56.94	135 deg	23	
3	13.55300	43.00	19.29	-33.41	32.22	-3 3.4	50.40	53.74	135 deg	23	
4	13.56000	60.46	19.29	-33.41	32.22	14.12	83.90	69.78	135 deg	23	
5	13.56700	48.44	19.29	-33.41	32.22	2.10	50.40	48.30	135 deg	23	
6	13.71000	30.01	19.30	-33.40	32.22	-1 6.31	40.50	56.81	135 deg	23	
7	14.01000	29.88	19.31	-33.39	32.22	-1 6.42	29.50	45.92	135 deg	0	

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]	
135	13.56000	QP	60.46	19.29	6.59	32.22	-	54.12	-	-	Fundamental

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter) - Gain(Amplifier)

Spurious emission

Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.3
Date	October 26, 2022
Temperature / Humidity	20 deg. C / 31 % RH
Engineer	Yuta Moriya
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]	Remark
135	27.120	QP	29.30	20.33	-33.05	32.22	-	-15.64	29.5	45.14	
Hori.	68.950	QP	34.70	6.40	7.67	32.18	-	16.59	40.0	23.41	*
Hori.	131.058	QP	42.40	13.80	8.44	32.11	-	32.53	43.5	10.99	*
Hori.	144.069	QP	42.40	14.71	8.58	32.09	-	33.60	43.5	9.92	*
Hori.	169.051	QP	44.90	15.75	8.85	32.07	-	37.43	43.5	6.09	*
Hori.	181.076	QP	41.20	16.19	8.96	32.07	-	34.28	43.5	9.24	*
Hori.	240.001	QP	42.90	12.01	9.49	32.03	-	32.37	46.0	13.65	*
Hori.	406.406	QP	41.10	16.07	10.78	32.00	-	35.95	46.0	10.07	*
Hori.	431.198	QP	40.10	16.35	10.94	32.00	-	35.39	46.0	10.63	*
Hori.	600.003	QP	37.10	19.32	12.02	32.00	-	36.44	46.0	9.58	*
Vert.	68.950	QP	50.00	6.40	7.67	32.18	-	31.89	40.0	8.11	*
Vert.	131.058	QP	48.00	13.80	8.44	32.11	-	38.13	43.5	5.39	*
Vert.	144.069	QP	44.10	14.71	8.58	32.09	-	35.30	43.5	8.22	*
Vert.	168.936	QP	46.10	15.75	8.85	32.07	-	38.63	43.5	4.89	*
Vert.	181.076	QP	43.30	16.19	8.96	32.07	-	36.38	43.5	7.14	*
Vert.	240.001	QP	48.00	12.01	9.49	32.03	-	37.47	46.0	8.55	*
Vert.	406.406	QP	36.70	16.07	10.78	32.00	-	31.55	46.0	14.47	*
Vert.	431.198	QP	34.30	16.35	10.94	32.00	-	29.59	46.0	16.43	*
Vert.	600.003	QP	37.10	19.32	12.02	32.00	-	36.44	46.0	9.58	*

Result = Reading + Ant Factor + Loss (Cable + Attenuator + D.Factor) - Gain(Amplifier)

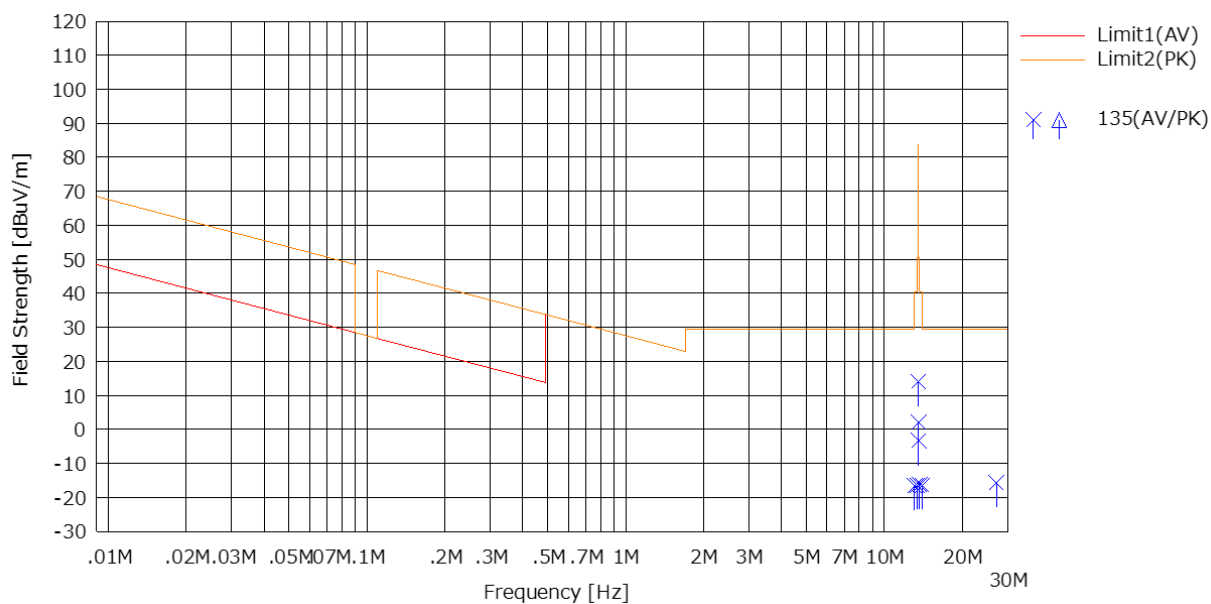
*Result = Reading + Ant Factor + Loss (Cable + Attenuator) - Gain(Amplifier)

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

Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.3
Date	October 26, 2022
Temperature / Humidity	20 deg. C / 31 % RH
Engineer	Yuta Moriya
Mode	Mode 1

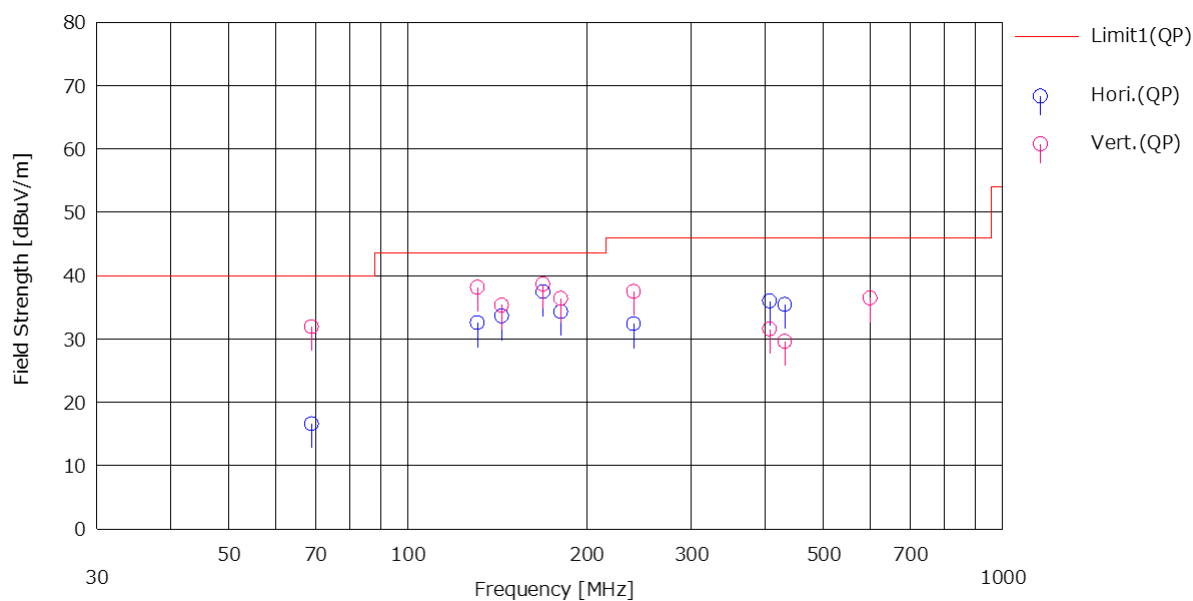
(below 30MHz)

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 placeIse EMC Lab.

Semi Anechoic ChamberNo.3

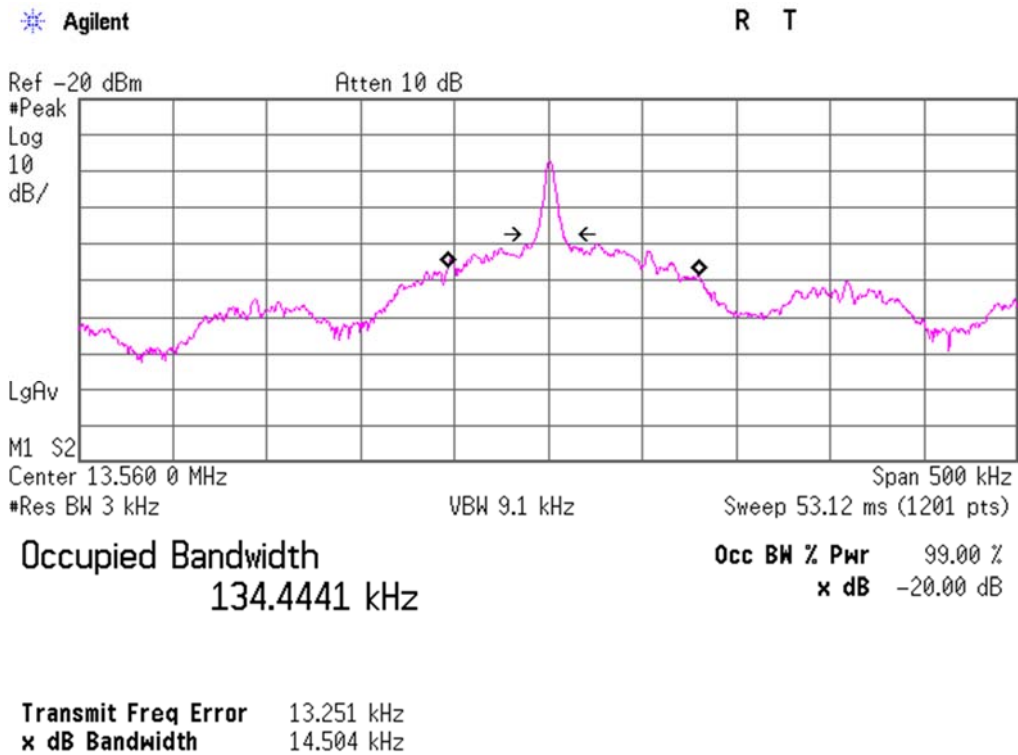
DateOctober 26, 2022

Temperature / Humidity20 deg. C / 31 % RH

EngineerYuta Moriya

ModeMode 1

FREQ [MHz]	20dB Bandwidth [kHz]	99% Occupied Bandwidth [kHz]
13.56	14.504	134.4441



Since the transmitter signal is CW-like it is impractical to use a RBW setting of 1 % - 5 % of the emission bandwidth since the emission bandwidth will be proportional to the RBW.

Frequency Tolerance

Test place Ise EMC Lab.
 Measurement room No.8
 Date November 4, 2022
 Temperature / Humidity 25 deg. C / 37 % RH
 Engineer Hiroyuki Furutaka
 Mode Mode 1

Test condition		Tested timing	Measured frequency [MHz]	Frequency error [MHz]	Result		Limit
Temp. [deg. C]	Voltage [V]				[%]	[ppm]	
50	24	Power on	13.560469	0.000469	0.00346	34.6	0.01
		+ 2 min.	13.560473	0.000473	0.00349	34.9	0.01
		+ 5 min.	13.560466	0.000466	0.00344	34.4	0.01
		+ 10 min.	13.560469	0.000469	0.00346	34.6	0.01
40	24	Power on	13.560450	0.000450	0.00332	33.2	0.01
		+ 2 min.	13.560459	0.000459	0.00338	33.8	0.01
		+ 5 min.	13.560459	0.000459	0.00339	33.9	0.01
		+ 10 min.	13.560465	0.000465	0.00343	34.3	0.01
30	24	Power on	13.560470	0.000470	0.00347	34.7	0.01
		+ 2 min.	13.560443	0.000443	0.00327	32.7	0.01
		+ 5 min.	13.560452	0.000452	0.00334	33.4	0.01
		+ 10 min.	13.560463	0.000463	0.00341	34.1	0.01
20	24	Power on	13.560491	0.000491	0.00362	36.2	0.01
		+ 2 min.	13.560481	0.000481	0.00355	35.5	0.01
		+ 5 min.	13.560487	0.000487	0.00359	35.9	0.01
		+ 10 min.	13.560463	0.000463	0.00341	34.1	0.01
20	10.2 (12V -15%)	Power on	13.560481	0.000481	0.00355	35.5	0.01
		+ 2 min.	13.560484	0.000484	0.00357	35.7	0.01
		+ 5 min.	13.560485	0.000485	0.00358	35.8	0.01
		+ 10 min.	13.560480	0.000480	0.00354	35.4	0.01
20	27.6 (24V +15%)	Power on	13.560492	0.000492	0.00363	36.3	0.01
		+ 2 min.	13.560478	0.000478	0.00352	35.2	0.01
		+ 5 min.	13.560487	0.000487	0.00359	35.9	0.01
		+ 10 min.	13.560481	0.000481	0.00355	35.5	0.01
10	24	Power on	13.560476	0.000476	0.00351	35.1	0.01
		+ 2 min.	13.560481	0.000481	0.00355	35.5	0.01
		+ 5 min.	13.560476	0.000476	0.00351	35.1	0.01
		+ 10 min.	13.560478	0.000478	0.00353	35.3	0.01
0	24	Power on	13.560476	0.000476	0.00351	35.1	0.01
		+ 2 min.	13.560486	0.000486	0.00358	35.8	0.01
		+ 5 min.	13.560486	0.000486	0.00358	35.8	0.01
		+ 10 min.	13.560479	0.000479	0.00354	35.4	0.01
-10	24	Power on	13.560500	0.000500	0.00369	36.9	0.01
		+ 2 min.	13.560499	0.000499	0.00368	36.8	0.01
		+ 5 min.	13.560495	0.000495	0.00365	36.5	0.01
		+ 10 min.	13.560486	0.000486	0.00358	35.8	0.01
-20	24	Power on	13.560494	0.000494	0.00365	36.5	0.01
		+ 2 min.	13.560487	0.000487	0.00359	35.9	0.01
		+ 5 min.	13.560493	0.000493	0.00364	36.4	0.01
		+ 10 min.	13.560491	0.000491	0.00362	36.2	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	Local ID	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Cal Int
CE	COTS-MEMI-02	178648	EMI measurement program	TSJ (Techno Science Japan)	TEPTO-DV	-	-	-
CE	MAEC-02	142004	AC2_Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-06902	05/30/2022	24
CE	MAEC-04	142011	AC4_Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	05/22/2022	24
CE	MAT-67	141248	Attenuator	JFW Industries, Inc.	50FP-013H2 N	-	12/17/2021	12
CE	MCC-113	141217	Coaxial cable	Fujikura/Suhner/TSJ	5D-2W/SFM141/421-010/sucoform141-PE/RFM-E121(SW)	-/04178	06/11/2022	12
CE	MCC-13	141222	Coaxial Cable	Fujikura,HP,Mini-Circuits,Fujikura	3D-2W(12m)/5D-2W(5m)/5D-2W(0.8m)/5D-2W(1m)	-	02/20/2022	12
CE	MJM-27	142228	Measure	KOMELON	KMC-36	-	-	-
CE	MJM-29	142230	Measure	KOMELON	KMC-36	-	-	-
CE	MLS-23	141357	LISN(AMN)	Schwarzbeck Mess-Elektronik OHG	NSLK8127	8127-729	07/28/2022	12
CE	MLS-24	141358	LISN(AMN)	Schwarzbeck Mess-Elektronik OHG	NSLK8127	8127-730	07/28/2022	12
CE	MMM-01	141542	Digital Tester	Fluke Corporation	FLUKE 26-3	78030611	08/12/2022	12
CE	MMM-10	141545	DIGITAL HiTESTER	HIOKI E.E. CORPORATION	3805	51201148	01/16/2022	12
CE	MOS-15	141562	Thermo-Hygrometer	CUSTOM. Inc	CTH-201	0010	01/10/2022	12
CE	MOS-41	192300	Thermo-Hygrometer	CUSTOM. Inc	CTH-201	0013	12/19/2021	12
CE	MTA-56	141938	Terminator	TME	CT-01BP	-	12/16/2021	12
CE	MTR-03	141942	Test Receiver	Rohde & Schwarz	ESCI	100300	07/29/2022	12
CE	MTR-10	141951	EMI Test Receiver	Rohde & Schwarz	ESR26	101408	07/25/2022	12
RE	COTS-MEMI-02	178648	EMI measurement program	TSJ (Techno Science Japan)	TEPTO-DV	-	-	-
RE	MAEC-03	142008	AC3_Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	05/23/2022	24
RE	MAT-95	142314	Attenuator	Pasternack Enterprises	PE7390-6	D/C 1504	06/13/2022	12
RE	MBA-05	141425	Biconical Antenna	Schwarzbeck Mess-Elektronik OHG	VHA9103+BBA9106	VHA 91031302	08/26/2022	12
RE	MCC-112	141216	Coaxial cable	Fujikura/Suhner/TSJ	5D-2W/SFM14/sucoform141-PE/421-010/RFM-E321(SW)	-/00640	07/09/2022	12
RE	MCC-255	207745	Coaxial Cable	UL Japan	-	-	05/17/2022	12
RE	MCC-51	141323	Coaxial cable	UL Japan	-	-	09/27/2022	12
RE	MJM-16	142183	Measure	KOMELON	KMC-36	-	10/03/2022	12
RE	MLA-22	141266	Logperiodic Antenna(200-1000MHz)	Schwarzbeck Mess-Elektronik OHG	VUSLP9111B	9111B-191	08/26/2022	12
RE	MLPA-01	141254	Loop Antenna	Rohde & Schwarz	HFH2-Z2	100017	05/31/2022	12
RE	MMM-08	141532	DIGITAL HiTESTER	HIOKI E.E. CORPORATION	3805	51201197	01/16/2022	12
RE	MOS-13	141554	Thermo-Hygrometer	CUSTOM. Inc	CTH-201	1301	01/10/2022	12
RE	MPA-13	141582	Pre Amplifier	SONOMA INSTRUMENT	310	260834	02/25/2022	12
RE	MSA-10	141899	Spectrum Analyzer	Keysight Technologies Inc	E4448A	MY46180655	02/18/2022	12
RE	MTR-08	141949	Test Receiver	Rohde & Schwarz	ESCI	100767	07/29/2022	12
FT	MCH-05	141440	Temperature and Humidity Chamber	Espec	PL-1KP	14019569	04/24/2022	12
FT	MLPA-08	202511	Loop Antenna	UL Japan	-	-	-	-
FT	MMM-17	141557	DIGITAL HiTESTER	HIOKI E.E. CORPORATION	3805	70900530	01/16/2022	12
FT	MOS-28	141567	Thermo-Hygrometer	CUSTOM. Inc	CTH-201	0008	01/10/2022	12
FT	MSA-16	141903	Spectrum Analyzer	Keysight Technologies Inc	E4440A	MY46186390	01/07/2022	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:

**CE: Conducted Emission,
RE: Radiated Emission,
FT: Frequency Tolerance**