



# EMI TEST REPORT

**Test Report No. : 12768726H-B-R3**

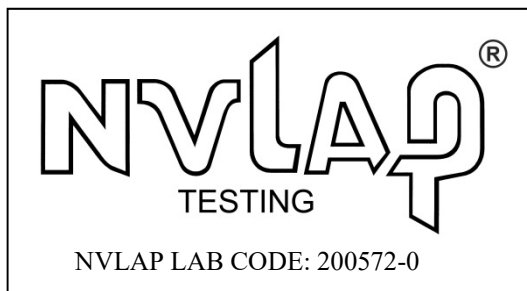
**Applicant** : **Audio-Technica Corporation**  
**Type of Equipment** : **Voting Unit**  
**Model No.** : **ATUC-VU**  
**Test regulation** : **FCC Part 15 Subpart C: 2018**  
**FCC ID** : **JFZATUCVU**  
**Test Result** : **Complied (Refer to SECTION 3.2)**

1. This test report shall not be reproduced in full or partial, without the written approval of UL Japan, Inc.
2. The results in this report apply only to the sample tested.
3. This sample tested is in compliance with above regulation.
4. The test results in this report are traceable to the national or international standards.
5. This test report covers Radio technical requirements. It does not cover administrative issues such as Manual or non-Radio test related Requirements. (if applicable)
6. The all test items in this test report are conducted by UL Japan, Inc. Ise EMC Lab.
7. This test report must not be used by the customer to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.
8. The information provided from the customer for this report is identified in SECTION 1.
9. This report is a revised version of 12768726H-B-R2. 12768726H-B-R2 is replaced with this report.

**Date of test:** April 12 to May 29, 2019

**Representative test engineer:** Ken Fujita  
Ken Fujita  
Engineer  
Consumer Technology Division

**Approved by:** S. Matsuyama  
Satofumi Matsuyama  
Engineer  
Consumer Technology Division



This laboratory is accredited by the NVLAP LAB CODE 200572-0, U.S.A. The tests reported herein have been performed in accordance with its terms of accreditation.  
\*As for the range of Accreditation in NVLAP, you may refer to the WEB address,  
[http://japan.ul.com/resources/emc\\_accredited/](http://japan.ul.com/resources/emc_accredited/)

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

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## **SECTION 1: Customer information**

Company Name : Audio-Technica Corporation \*1)  
Address : 2-46-1 Nishi-Naruse, Machida, Tokyo, Japan  
Telephone Number : +81-42-739-9111  
Facsimile Number : +81-42-739-9110  
Contact Person : Fumio Kamimura

### **\*1) Remarks:**

Audio-Technica Corporation designates Audio-Technica Fukui Inc. as manufacturer of the product (Voting Unit).

The information provided from the customer is as follows;

- Applicant, Type of Equipment, Model No., FCC ID on the cover and other relevant pages
- SECTION 1: Customer information
- SECTION 2: Equipment under test (E.U.T.)
- SECTION 4: Operation of E.U.T. 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 (E.U.T.)**

### **2.1 Identification of E.U.T.**

Type of Equipment : Voting Unit  
Model No. : ATUC-VU  
Serial No. : Refer to Section 4, Clause 4.2  
Rating : DC 5.0 V  
Receipt Date of Sample : March 29, 2019  
(Information from test lab.)  
Country of Mass-production : Japan  
Condition of EUT : Production prototype  
(Not for Sale: This sample is equivalent to mass-produced items.)  
Modification of EUT : No Modification by the test lab

### **2.2 Product Description**

Model: ATUC-VU (referred to as the EUT in this report) is a Voting Unit.

### **Radio Specification**

Radio Type : Transceiver  
Frequency of Operation : 13.56 MHz  
Modulation : ASK  
Antenna type : Loop Coil  
Antenna Gain : -41.65 dBi  
Clock frequency (Maximum) : 27.12 MHz  
Operating Temperature : 0 deg. C to +40 deg. C

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### **SECTION 3: Test specification, procedures & results**

#### **3.1 Test Specification**

Test Specification : FCC Part 15 Subpart C  
FCC Part 15 final revised on March 12, 2018 and effective April 11, 2018

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	ANSI C63.10:2013 6 Standard test methods ----- <IC>RSS-Gen 8.8	Section 15.207 ----- <IC>RSS-Gen 8.8	15.76 dB 13.56000 MHz AV, Phase L/N	Complied a)	-
Electric Field Strength of Fundamental Emission	ANSI C63.10:2013 6 Standard test methods ----- <IC> RSS-Gen 6.4, 6.12	Section 15.225(a) ----- <IC>RSS-210 B.6	61.18 dB, 13.56000 MHz, QP, 180 deg.	Complied b)	Radiated
Spectrum Mask	ANSI C63.10:2013 6 Standard test methods ----- <IC>RSS-Gen 6.4, 6.13	Section 15.225(b)(c) ----- <IC> RSS-210 B.6	40.38 dB, 13.56700 MHz, QP, 180 deg.	Complied b)	Radiated
20dB Bandwidth	ANSI C63.10:2013 6 Standard test methods ----- <IC> -	Section15.215(c) ----- <IC> -	See data	Complied c)	Radiated
Electric Field Strength of Spurious Emission	ANSI C63.10:2013 6 Standard test methods ----- <IC>RSS-Gen 6.4, 6.13	Section 15.209, Section 15.225 (d) ----- <IC>RSS-210 B.6	0.70 dB 94.926 MHz, Vertical, QP	Complied# d)	Radiated
Frequency Tolerance	ANSI C63.10:2013 6 Standard test methods ----- <IC>RSS-Gen 6.11, 8.11	Section 15.225(e) ----- <IC> RSS-210 B.6	See data	Complied# e)	Radiated

Note: UL Japan, Inc.'s EMI Work Procedures No. 13-EM-W0420 and 13-EM-W0422

- 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 20dB Bandwidth and 99% Occupied Bandwidth)
- d) Refer to APPENDIX 1 (data of Spurious emission)
- e) Refer to APPENDIX 1 (data of Frequency Tolerance)

Symbols:

Complied                   The data of this test item has enough margin, more than the measurement uncertainty.  
Complied#                 The data of this test item meets the limits unless the measurement uncertainty is taken into consideration.

**FCC Part 15.31 (e)**

The stable voltage is constantly supplied to the EUT from the ATUC-50DU (Refer to Clause 4.2). 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 % Occupied Band Width	<IC>RSS-Gen 6.7	-	N/A	-	Radiated

Note: UL Japan, Inc.'s EMI Work Procedures No. 13-EM-W0420 and 13-EM-W0422.

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

**3.4 Uncertainty**

There is no applicable rule of uncertainty in this applied standard. Therefore, the following results are derived depending on whether or not laboratory uncertainty is applied.

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

Frequency range	Conducted emission using AMN(LISN) (+/-)
0.009 MHz to 0.15 MHz	3.8 dB
0.15 MHz to 30 MHz	3.4 dB

Test distance	Radiated emission (+/-)
	9 kHz to 30 MHz
3 m*	3.3 dB
10 m*	3.2 dB

\*Measurement distance

Polarity	Radiated emission (Below 1 GHz)			
	(3 m*)(+/-)		(10 m*)(+/-)	
	30 MHz to 200 MHz	200 MHz to 1000 MHz	30 MHz to 200 MHz	200 MHz to 1000 MHz
Horizontal	4.8 dB	5.2 dB	4.8 dB	5.0 dB
Vertical	5.0 dB	6.3 dB	4.9 dB	5.0 dB

\* Measurement distance

Antenna terminal test	Uncertainty (+/-)
Frequency error	
13.56 MHz	0.01541 ppm

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### 3.5 Test Location

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NVLAP Lab. code: 200572-0 / FCC Test Firm Registration Number: 199967

Test site	IC Registration Number	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	2973C-1	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	2973C-2	7.5 x 5.8 x 5.2	4.0 x 4.0	-	3 m
No.3 semi-anechoic chamber	2973C-3	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	2973C-4	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.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.11 measurement room	-	6.2 x 4.7 x 3.0	4.8 x 4.6	-	-

\* Size of vertical conducting plane (for Conducted Emission test) : 2.0 m x 2.0 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 E.U.T. during testing**

### **4.1 Operating Mode(s)**

The mode is used :

<b>Mode</b>	<b>Remarks*</b>
1) Transmitting mode (Tx) 13.56 MHz - Tag: FeliCa / MIFARE	The EUT Transmits and Receives at the same time and there is no receiving mode.
Any condition 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.	

<b>Test Item</b>	<b>Operating mode</b>
Conducted emission	Tx With Tag* Tx Terminated *1)
Electric Field Strength of Fundamental Emission	Tx With Tag*
Spectrum Mask	Tx With Tag*
20dB Bandwidth and 99% Occupied Bandwidth	Tx With Tag, without Tag
Electric Field Strength of Spurious Emission	Tx With Tag*
Frequency Tolerance	Tx Mod off

\*1) 50 ohm termination was installed instead of the antenna.

\* After the comparison of the test data between with Tag and without Tag, the tests were performed with Tag which was the worst case.

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

Frequency Tolerance:

Temperature : -20 deg. C to +50 deg. C Step 10 deg. C  
Voltage : Normal Voltage DC 5.0 V  
Maximum Voltage DC 5.75 V,  
Minimum Voltage DC 4.25 V (DC 5.0 V ±15 %)

\*This EUT provides stable voltage constantly to RF Part regardless of input voltage

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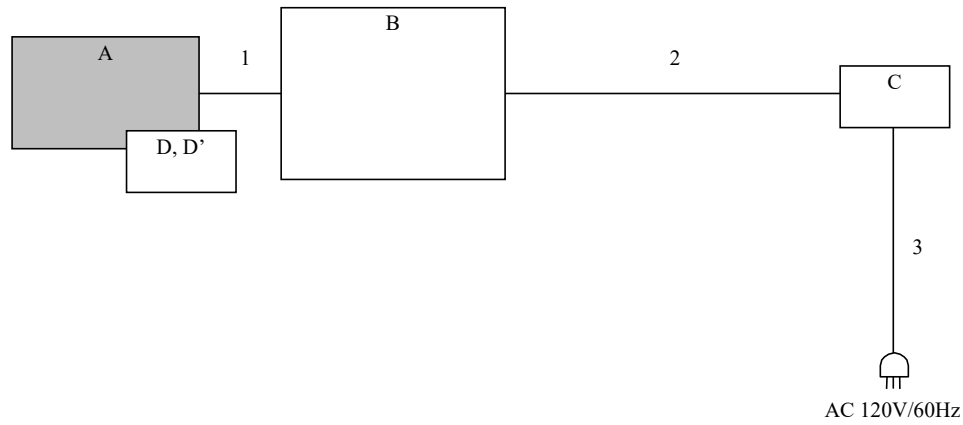
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## 4.2 Configuration and peripherals

[Conducted emission, Radiated Emission tests]



\* Cabling and setup(s) 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	Remarks
A	Voting Unit	ATUC-VU	4	Audio-Technica Fukui Inc.	EUT
B	Discussion Unit	ATUC-50DU	15389137	Audio-Technica Fukui Inc.	-
C	HYBRID CONTROL UNIT	ATUC-IRCU	10701022	Audio-Technica Fukui Inc.	-
D	FeliCa Card	TS-C1-G53582	-	-	-
D'	MIFARE Card	MIFARE Plus S 2K -2/2	-	-	-

### List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	RJ11 Cable	0.5	Unshielded	Unshielded	-
2	LAN Cable	5.0	Shielded	Shielded	for RE
		3.0	Shielded	Shielded	for CE
3	AC Cable	3.8	Unshielded	Unshielded	-

\* RE: Radiated emission test  
CE: Conducted emission test

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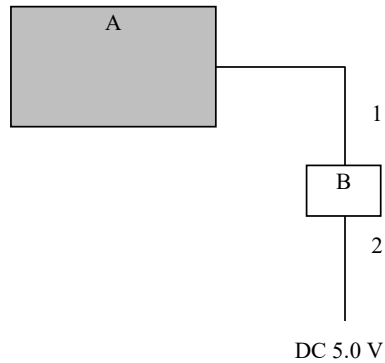
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[Frequency Tolerance]



\* Cabling and setup(s) 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	Remarks
A	Voting Unit	ATUC-VU	4	Audio-Technica Corporation	EUT
B	Jig board	-	-	-	-

**List of cables used**

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	DC and Signal Cable	0.5	Unshielded	Unshielded	-
2	DC Cable	2.1	Unshielded	Unshielded	-

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## **SECTION 5: Conducted Emission**

### **Test Procedure and conditions**

EUT was placed on a wooden 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.

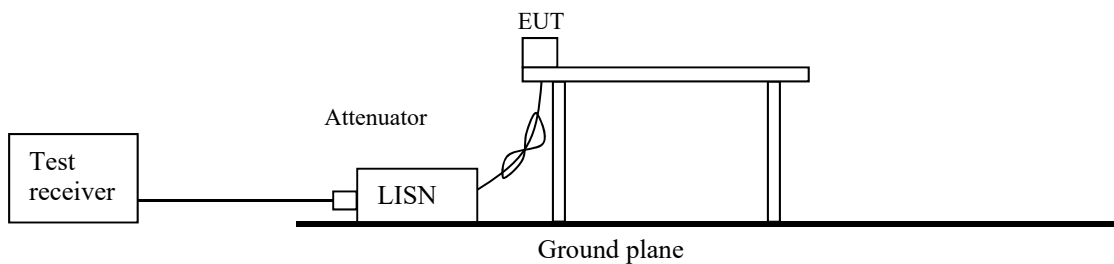
#### For the tests on EUT with other peripherals (as a whole system)

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.

[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 - 30 MHz  
**Test data** : APPENDIX  
**Test result** : Pass

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**SECTION 6: Radiated emission (Fundamental , Spurious Emission and Spectrum Mask)**

Test Procedure

[For below 1GHz]

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.

[For above 1GHz]

EUT was placed on a urethane platform of nominal size, 0.5 m by 0.5 m, raised 1.5 m above the conducting ground plane.

The Radiated Electric Field Strength has been measured in a Semi Anechoic Chamber with absorbent materials lined on a ground plane.

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., and 135 deg.) and horizontal polarization.

\*Refer to Figure 1 about Direction of the Loop Antenna.

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.

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.

**Test Antennas are used as below;**

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

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

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.

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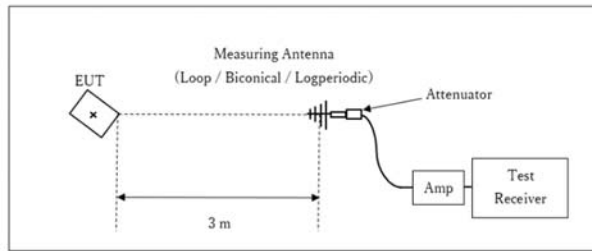
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[Test Setup]  
Below 1 GHz



Test Distance: 3 m

x : Center of turn table

- 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 - 1 GHz  
**Test data** : APPENDIX 1  
**Test result** : Pass

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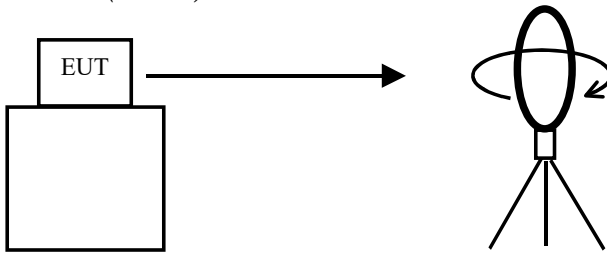
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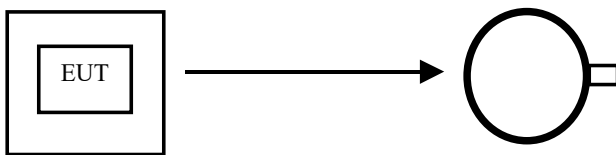
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**Figure 1: Direction of the Loop Antenna**

*Side View (Vertical)*



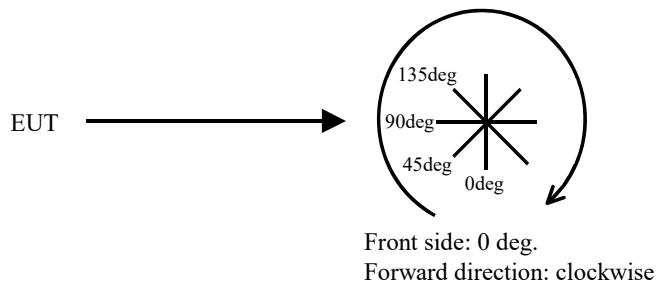
*Top View (Horizontal)*



Antenna was not rotated.

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*Top View (Vertical)*



## **SECTION 7: Other test**

<b>Test</b>	<b>Span</b>	<b>RBW</b>	<b>VBW</b>	<b>Sweep</b>	<b>Detector</b>	<b>Trace</b>	<b>Instrument used</b>
20 dB Bandwidth	Between 2.0 times and 5.0 times of the OBW	1 to 5 % of OBW	Three times of RBW	Auto	Peak	Max Hold	Spectrum Analyzer
99 % Occupied Bandwidth	Between 1.5 times and 5.0 times of the OBW	1 to 5 % of OBW	Three times of RBW	Auto	Peak *1)	Max Hold *1)	Spectrum Analyzer
Frequency Tolerance	-	-	-	-	-	-	Frequency counter

\*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.

**Test data** : APPENDIX  
**Test result** : Pass

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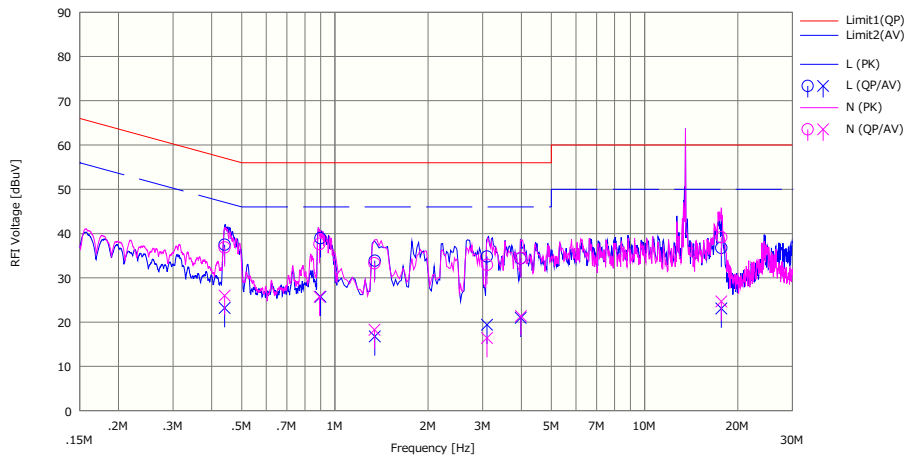
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**APPENDIX 1: Test data**

**Conducted Emission**

Report No. 12768726H  
Test place Ise EMC Lab.  
Semi Anechoic Chamber No.3  
Date May 16, 2019  
Temperature / Humidity 23 deg. C / 53 % RH  
Engineer Takumi Shimada  
Mode Tx 13.56 MHz With tag (MIFARE)

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> [dB]	<AV> [dB]				
1	0.44038	24.30	10.00	0.06	13.13	37.49	23.19	57.10	47.10	19.61	23.91	L	
2	0.89800	25.70	12.50	0.07	13.17	38.94	25.74	56.00	46.00	17.06	20.26	L	
3	1.34498	20.60	3.50	0.08	13.20	33.88	16.78	56.00	46.00	22.12	29.22	L	
4	3.09773	21.40	6.00	0.11	13.30	34.81	19.41	56.00	46.00	21.19	26.59	L	
5	3.98056	20.90	7.50	0.13	13.34	34.37	20.97	56.00	46.00	21.63	25.03	L	
6	17.69640	22.70	9.00	0.34	13.74	36.78	23.08	60.00	50.00	23.22	26.92	L	
7	0.44040	23.70	12.80	0.06	13.13	36.89	25.99	57.10	47.10	20.21	21.11	N	
8	0.89145	24.40	12.50	0.07	13.17	37.64	25.74	56.00	46.00	18.36	20.26	N	
9	1.34133	20.00	5.00	0.08	13.20	33.28	18.28	56.00	46.00	22.72	27.72	N	
10	3.09998	19.50	3.00	0.11	13.30	32.91	16.41	56.00	46.00	23.09	29.59	N	
11	3.98480	21.00	7.90	0.13	13.34	34.47	21.37	56.00	46.00	21.53	24.63	N	
12	17.69375	25.10	10.60	0.34	13.74	39.18	24.68	60.00	50.00	20.82	25.32	N	

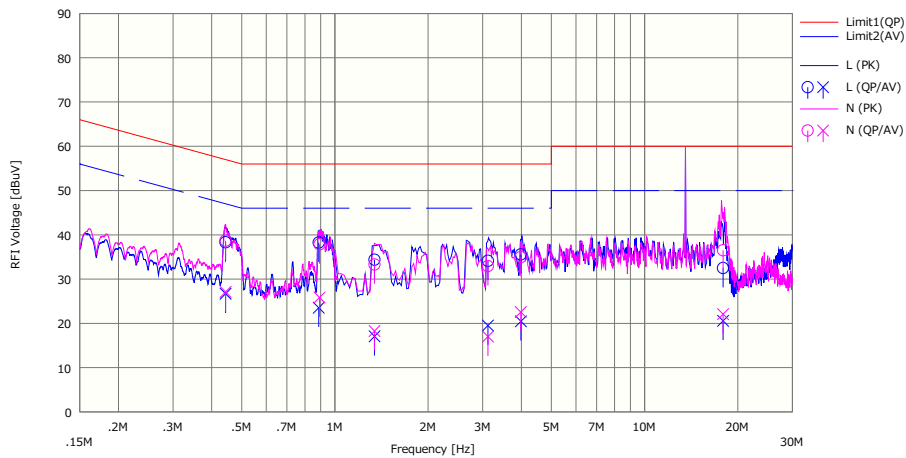
CHART: WITH FACTOR Peak hold data. CALCULATION : RESULT = READING + C.F (LISN + CABLE + ATT)  
Except for the above table: adequate margin data below the limits.



## Conducted Emission

Report No. 12768726H  
Test place Ise EMC Lab.  
Semi Anechoic Chamber No.3  
Date May 16, 2019  
Temperature / Humidity 23 deg. C / 53 % RH  
Engineer Takumi Shimada  
Mode Tx 13.56 MHz With tag (FeliCa)

Limit : FCC\_Part 15 Subpart C(15.207)



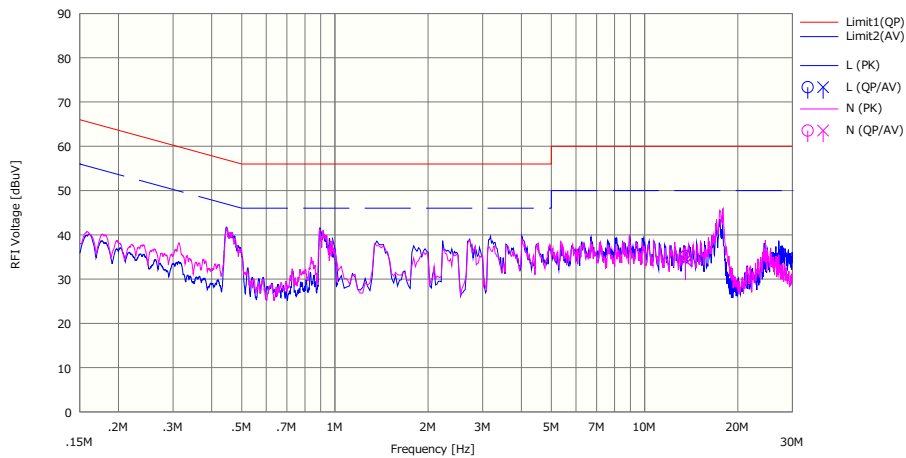
No.	Freq. [MHz]	Reading		LISN [dB]	LOSS [dB]	Results		Limit		Margin		Phase	Comment
		<QP> [dBuV]	<AV> [dBuV]			<QP> [dBuV]	<AV> [dBuV]	<QP> [dB]	<AV> [dB]				
1	0.44350	25.10	13.50	0.06	13.13	38.29	26.69	57.00	47.00	18.71	20.31	L	
2	0.88633	25.00	10.30	0.07	13.17	38.24	23.54	56.00	46.00	17.76	22.46	L	
3	1.34265	21.10	3.80	0.08	13.20	34.38	17.08	56.00	46.00	21.62	28.92	L	
4	3.12147	20.70	6.10	0.11	13.31	34.12	19.52	56.00	46.00	21.88	26.48	L	
5	3.98662	22.10	7.00	0.13	13.34	35.57	20.47	56.00	46.00	20.43	25.53	L	
6	17.92187	18.40	6.50	0.34	13.74	32.48	20.58	60.00	50.00	27.52	29.42	L	
7	0.44360	25.50	13.90	0.06	13.13	38.69	27.09	57.00	47.00	18.31	19.91	N	
8	0.89214	24.60	12.60	0.07	13.17	37.84	25.84	56.00	46.00	18.16	20.16	N	
9	1.34295	20.00	5.00	0.08	13.20	33.28	18.28	56.00	46.00	22.72	27.72	N	
10	3.11808	19.50	3.60	0.11	13.31	32.92	17.02	56.00	46.00	23.08	28.98	N	
11	3.98337	21.50	9.10	0.13	13.34	34.97	22.57	56.00	46.00	21.03	23.43	N	
12	17.92938	22.40	8.00	0.34	13.74	36.48	22.08	60.00	50.00	23.52	27.92	N	

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

## Conducted Emission

Report No. 12768726H  
 Test place Ise EMC Lab.  
 Semi Anechoic Chamber No.3  
 Date May 16, 2019  
 Temperature / Humidity 23 deg. C / 53 % RH  
 Engineer Takumi Shimada  
 Mode Tx 13.56 MHz Terminated

Limit : FCC\_Part 15 Subpart C(15.207)



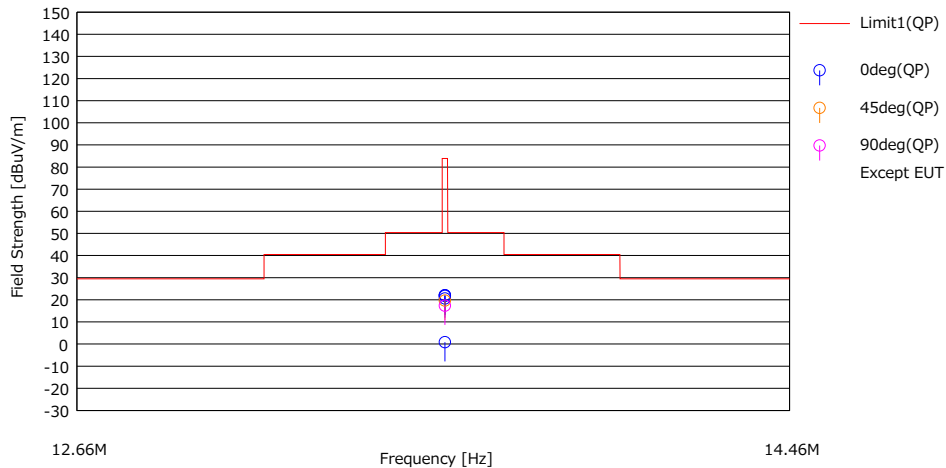
No.	Freq. [MHz]	Reading		USN [dB]	LOSS [dB]	Results		Limit		Margin		Phase	Comment
		<QP> [dBuV]	<AV> [dBuV]			<QP> [dBuV]	<AV> [dBuV]	<QP> [dB]	<AV> [dB]				
1	13.56000	21.20	20.30	0.30	13.64	35.14	34.24	60.00	50.00	24.86	15.76	L	
2	13.56000	21.30	20.30	0.30	13.64	35.24	34.24	60.00	50.00	24.76	15.76	N	

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

## Fundamental emission

Report No. 12768726H  
Test place Ise EMC Lab.  
Semi Anechoic Chamber No.3  
Date May 29, 2019  
Temperature / Humidity 23 deg. C / 35 % RH  
Engineer Junya Okuno  
Mode Tx 13.56 MHz With tag (MIFARE)

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



No.	Freq. [MHz]	Reading	Ant.Fac [dB/m]	Loss [dB]	Gain [dB]	Result	Limit	Margin	Antenna	Table	Comment
		[dBUV]				[QP]	[QP]	[QP]		[deg]	
1	13.56000	68.01	19.24	-33.29	32.23	21.73	83.90	62.17	0deg	185	
2	13.56000	66.90	19.24	-33.29	32.23	20.62	83.90	63.28	0deg	200	Antenna 135deg
3	13.56000	68.30	19.24	-33.29	32.23	22.02	83.90	61.88	0deg	185	Antenna 180deg
4	13.56000	47.10	19.24	-33.29	32.23	0.82	83.90	83.08	0deg	185	Loop Hor
5	13.56000	68.29	19.24	-33.29	32.23	22.01	83.90	61.89	0deg	185	Antenna 180deg / Without Tag
6	13.56000	65.90	19.24	-33.29	32.23	19.62	83.90	64.28	45deg	328	
7	13.56000	63.60	19.24	-33.29	32.23	17.32	83.90	66.58	90deg	89	

### Result of the fundamental emission at 3 m without Distance factor

QP

Ant Deg [deg]	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
180	13.56000	QP	68.30	19.24	6.71	32.23	-	62.02	-	-	Fundamental

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

**UL Japan, Inc.**

**Ise EMC Lab.**

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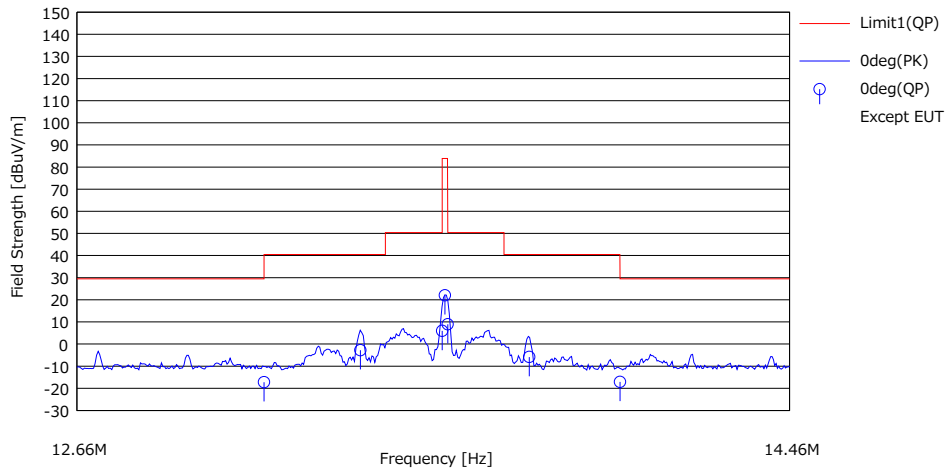
Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

## Fundamental emission and Spectrum Mask

Report No. 12768726H  
Test place Ise EMC Lab.  
Semi Anechoic Chamber No.3  
Date May 29, 2019  
Temperature / Humidity 23 deg. C / 35 % RH  
Engineer Junya Okuno  
Mode Tx 13.56 MHz With tag (MIFARE)

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



No.	Freq. [MHz]	Reading	Ant.Fac [dB/m]	Loss [dB]	Gain [dB]	Result	Limit	Margin	Antenna	Table [deg]	Comment
		[dBUV]				[QP]	[QP]	[QP]			
1	13.11000	29.00	19.29	-33.30	32.23	-17.24	29.50	46.74	0deg	185	Antenna 180deg
2	13.34800	43.50	19.27	-33.29	32.23	-2.75	40.50	43.25	0deg	185	Antenna 180deg
3	13.55300	52.20	19.24	-33.29	32.23	5.92	50.40	44.48	0deg	185	Antenna 180deg
4	13.56000	68.30	19.24	-33.29	32.23	22.02	83.90	61.88	0deg	185	Antenna 180deg
5	13.56700	55.20	19.24	-33.29	32.23	8.92	50.40	41.48	0deg	185	Antenna 180deg
6	13.77500	40.40	19.22	-33.27	32.23	-5.88	40.50	46.38	0deg	185	Antenna 180deg
7	14.01000	29.20	19.20	-33.27	32.23	-17.10	29.50	46.60	0deg	185	Antenna 180deg

### Result of the fundamental emission at 3 m without Distance factor

QP

Ant Deg [deg]	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
180	13.56000	QP	68.30	19.24	6.71	32.23	-	62.02	-	-	Fundamental

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

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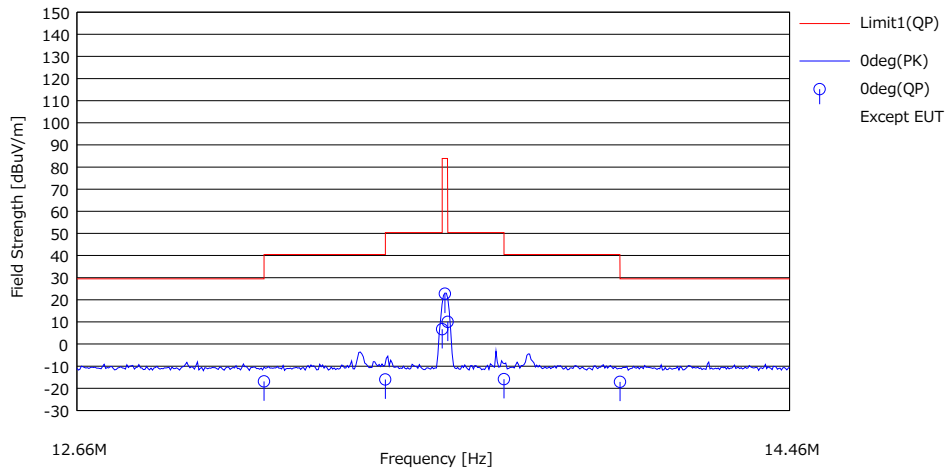
Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

## Fundamental emission and Spectrum Mask

Report No. 12768726H  
Test place Ise EMC Lab.  
Semi Anechoic Chamber No.3  
Date May 29, 2019  
Temperature / Humidity 23 deg. C / 35 % RH  
Engineer Junya Okuno  
Mode Tx 13.56 MHz With tag (FeliCa)

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



No.	Freq. [MHz]	Reading	Ant.Fac [dB/m]	Loss [dB]	Gain [dB]	Result	Limit	Margin	Antenna	Table	Comment
		[dBUV]				[QP]	[QP]	[QP]			
1	13.11000	29.30	19.29	-33.30	32.23	-16.94	29.50	46.44	0deg	185	Antenna 180deg
2	13.41000	30.20	19.26	-33.29	32.23	-16.06	40.50	56.56	0deg	185	Antenna 180deg
3	13.55300	53.00	19.24	-33.29	32.23	6.72	50.40	43.68	0deg	185	Antenna 180deg
4	13.56000	69.00	19.24	-33.29	32.23	22.72	83.90	61.18	0deg	185	Antenna 180deg
5	13.56700	56.30	19.24	-33.29	32.23	10.02	50.40	40.38	0deg	185	Antenna 180deg
6	13.71000	30.40	19.23	-33.28	32.23	-15.88	40.50	56.38	0deg	185	Antenna 180deg
7	14.01000	29.20	19.20	-33.27	32.23	-17.10	29.50	46.60	0deg	185	Antenna 180deg

### Result of the fundamental emission at 3 m without Distance factor

QP

Ant Deg [deg]	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
180	13.56000	QP	69.00	19.24	6.71	32.23	-	62.72	-	-	Fundamental

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

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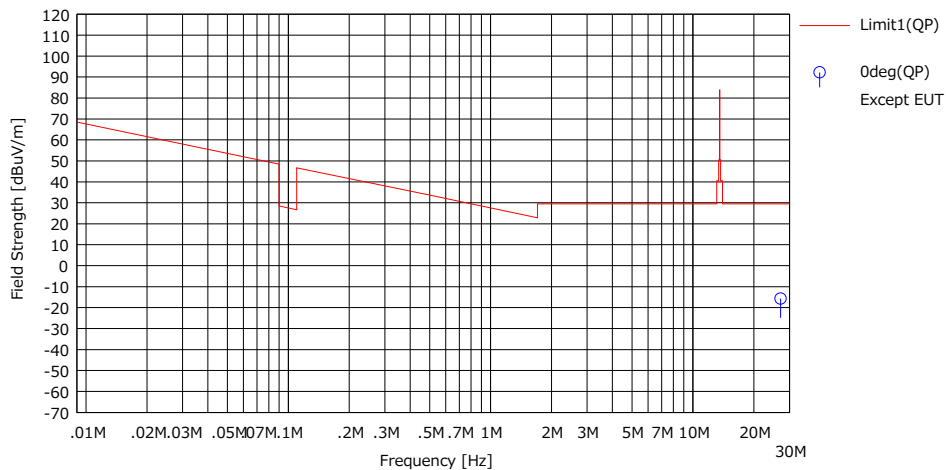
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## Spurious emission

Report No. 12768726H  
 Test place Ise EMC Lab.  
 Semi Anechoic Chamber No.3  
 Date May 29, 2019  
 Temperature / Humidity 23 deg. C / 35 % RH  
 Engineer Junya Okuno  
 Mode Tx 13.56 MHz With tag (MIFARE)

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



No.	Freq. [MHz]	Reading	Ant.Fac [dB/m]	Loss [dB]	Gain [dB]	Result	Limit	Margin	Antenna	Table	Comment
		<QP> [dBuV]				<QP> [dBuV/m]	<QP> [dB]				
1	27.12000	29.40	20.13	-32.98	32.22	-15.67	29.50	45.17	0deg	185	Antenna 180deg

CHART: WITH FACTOR

ANT TYPE: - 30 MHz: LOOP, 30 MHz - 200 MHz: BICONICAL, 200 MHz - 1000 MHz: LOGPERIODIC,  
1000 MHz -: HORN

CALCULATION: RESULT = READING + ANT FACTOR + LOSS & GAIN (CABLE + ATT - GAIN(AMP))

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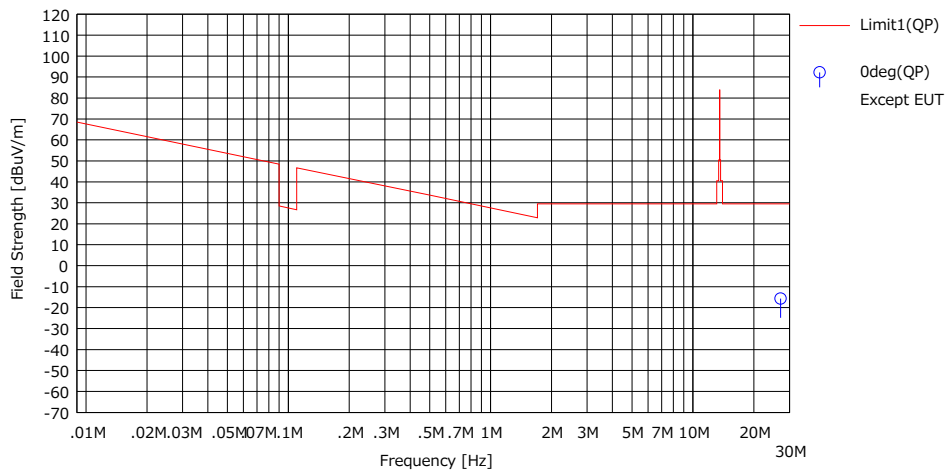
Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

## Spurious emission

Report No. 12768726H  
 Test place Ise EMC Lab.  
 Semi Anechoic Chamber No.3  
 Date May 29, 2019  
 Temperature / Humidity 23 deg. C / 35 % RH  
 Engineer Junya Okuno  
 Mode Tx 13.56 MHz With tag (FeliCa)

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



No.	Freq. [MHz]	Reading	Ant.Fac [dB/m]	Loss [dB]	Gain [dB]	Result	Limit	Margin	Antenna	Table	Comment
		<QP> [dBuV]				<QP> [dBuV/m]	<QP> [dB]				
1	27.12000	29.40	20.13	-32.98	32.22	-15.67	29.50	45.17	0deg	185	Antenna 180deg

CHART: WITH FACTOR

ANT TYPE: - 30 MHz: LOOP, 30 MHz - 200 MHz: BICONICAL, 200 MHz - 1000 MHz: LOGPERIODIC,  
1000 MHz -: HORN

CALCULATION: RESULT = READING + ANT FACTOR + LOSS & GAIN (CABLE + ATT - GAIN(AMP))

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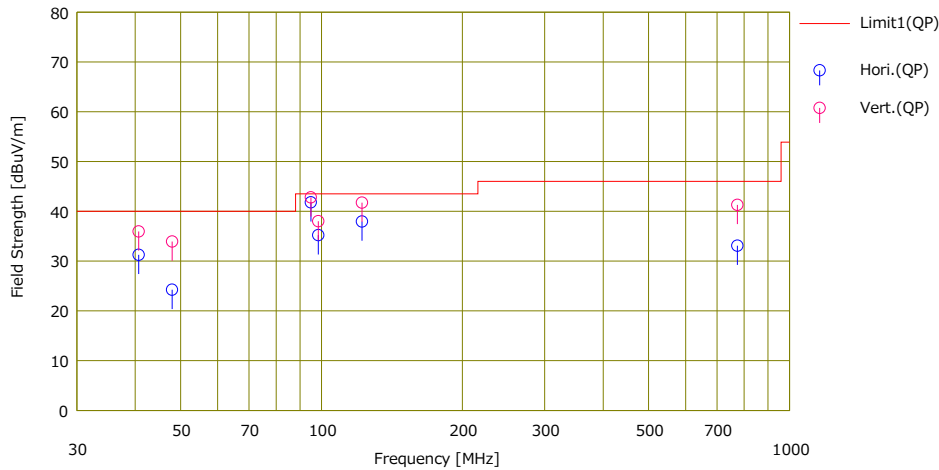
Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

## Spurious emission

Report No. 12768726H  
Test place Ise EMC Lab.  
Semi Anechoic Chamber No.3  
Date May 29, 2019  
Temperature / Humidity 23 deg. C / 35 % RH  
Engineer Junya Okuno  
Mode Tx 13.56 MHz With tag (MIFARE)

Limit : FCC15.209 3 m, below 1 GHz:QP, above 1 GHz:AV/PK



No.	Freq. [MHz]	Reading [QP] [dBuV]	Ant Fac [dB/m]	Loss [dB]	Gain [dB]	Result	Limit	Margn	Polz [H/V]	Height [cm]	Angle [deg]	Ant. Type	Comment
						[QP] [dBuV/m]	[QP] [dBuV/m]	[dB]					
1	40.682	41.50	14.59	7.36	32.20	31.25	40.00	8.75	Hori.	400	158	BA	
2	47.954	36.90	12.03	7.49	32.19	24.23	40.00	15.77	Hori.	400	46	BA	
3	94.919	56.50	9.30	8.15	32.16	41.79	43.50	1.71	Hori.	192	19	BA	
4	98.491	49.20	9.97	8.19	32.15	35.21	43.50	8.29	Hori.	325	194	BA	
5	122.040	48.40	13.21	8.46	32.13	37.94	43.50	5.56	Hori.	298	106	BA	
6	774.142	31.20	20.48	13.02	31.61	33.09	46.00	12.91	Hori.	100	138	LA22	
7	40.681	46.20	14.59	7.36	32.20	35.95	40.00	4.05	Vert.	100	254	BA	
8	47.966	46.60	12.02	7.49	32.19	33.92	40.00	6.08	Vert.	100	307	BA	
9	94.926	57.50	9.31	8.15	32.16	42.80	43.50	0.70	Vert.	100	359	BA	
10	98.490	52.00	9.97	8.19	32.15	38.01	43.50	5.49	Vert.	100	0	BA	
11	122.041	52.20	13.21	8.46	32.13	41.74	43.50	1.76	Vert.	100	16	BA	
12	774.143	39.40	20.48	13.02	31.61	41.29	46.00	4.71	Vert.	100	79	LA22	

CHART: WITH FACTOR

ANT TYPE: - 30 MHz: LOOP, 30 MHz - 200 MHz: BICONICAL, 200 MHz - 1000 MHz: LOGPERIODIC,  
1000 MHz -: HORN

CALCULATION: RESULT = READING + ANT FACTOR + LOSS & GAIN (CABLE + ATT - GAIN(AMP))

**UL Japan, Inc.**

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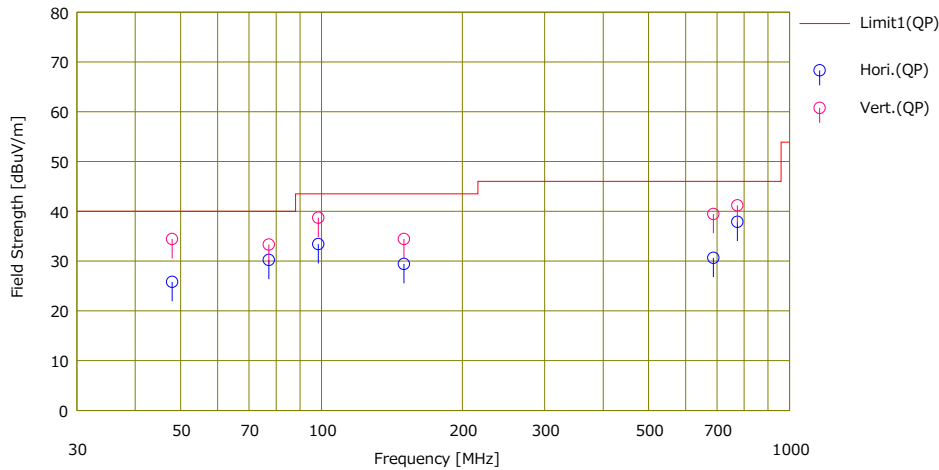
Facsimile : +81 596 24 8124



### Spurious emission

Report No. 12768726H  
Test place Ise EMC Lab.  
Semi Anechoic Chamber No.3  
Date May 29, 2019  
Temperature / Humidity 23 deg. C / 35 % RH  
Engineer Junya Okuno  
Mode Tx 13.56 MHz With tag (Felica)

Limit : FCC15.209 3 m, below 1 GHz:QP, above 1 GHz:AV/PK



No.	Freq. [MHz]	Reading	Ant Fac	Loss	Gain	Result	Limit	Margin	Pola	Height	Angle	Ant. Type	Comment
		<QP>				<QP>							
		[dBuV]	[dB/m]	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dB]	[H/V]	[m]	[deg]		
1	47.967	38.50	12.02	7.49	32.19	25.82	40.00	14.18	Hori.	400	225	BA	
2	77.188	47.80	6.70	7.92	32.19	30.23	40.00	9.77	Hori.	400	10	BA	
3	98.496	47.40	9.97	8.19	32.15	33.41	43.50	10.09	Hori.	283	50	BA	
4	149.999	37.60	15.15	8.77	32.10	29.42	43.50	14.08	Hori.	231	132	BA	
5	688.115	30.30	19.77	12.58	32.00	30.65	46.00	15.35	Hori.	100	21	LA22	
6	774.138	36.00	20.48	13.02	31.61	37.89	46.00	8.11	Hori.	100	133	LA22	
7	47.956	47.10	12.02	7.49	32.19	34.42	40.00	5.58	Vert.	100	303	BA	
8	77.201	50.90	6.70	7.92	32.19	33.33	40.00	6.67	Vert.	100	263	BA	
9	98.463	52.70	9.96	8.19	32.15	38.70	43.50	4.80	Vert.	100	358	BA	
10	149.987	42.60	15.15	8.77	32.10	34.42	43.50	9.08	Vert.	100	10	BA	
11	688.117	39.10	19.77	12.58	32.00	39.45	46.00	6.55	Vert.	100	35	LA22	
12	774.132	39.30	20.48	13.02	31.61	41.19	46.00	4.81	Vert.	100	88	LA22	

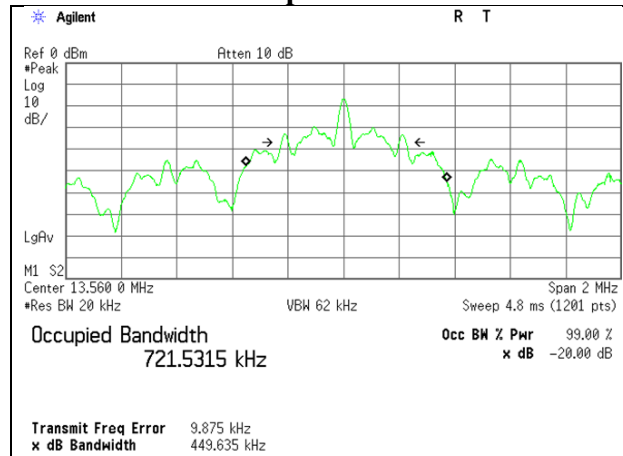
CHART: WITH FACTOR  
ANT TYPE: - 30 MHz: LOOP, 30 MHz - 200 MHz: BICONICAL, 200 MHz - 1000 MHz: LOGPERIODIC,  
1000 MHz -: HORN  
CALCULATION: RESULT = READING + ANT FACTOR + LOSS & GAIN (CABLE + ATT - GAIN(AMP))

## 20dB Bandwidth and 99% Occupied Bandwidth

Report No. 12768726H  
 Test place Ise EMC Lab.  
 Measurement room No.5  
 Date April 12, 2019  
 Temperature / Humidity 24 deg. C / 32 % RH  
 Engineer Takafumi Noguchi  
 Mode Tx 13.56 MHz With Tag (MIFARE)

FREQ [MHz]	20dB Bandwidth [kHz]	99% Occupied Bandwidth [kHz]
13.56	449.635	721.5315

### 20dB Bandwidth 99% Occupied Bandwidth

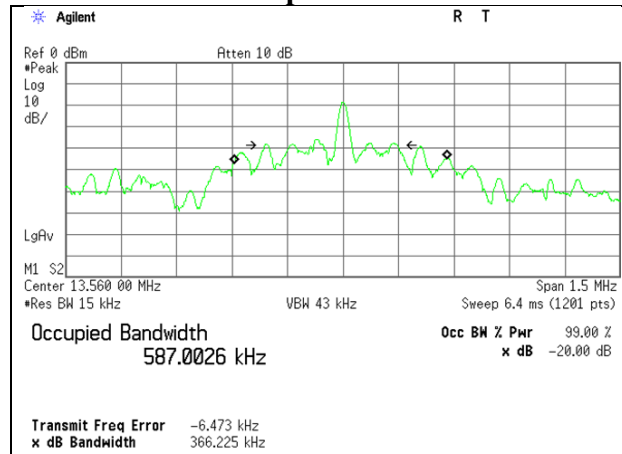


## 20dB Bandwidth and 99% Occupied Bandwidth

Report No. 12768726H  
 Test place Ise EMC Lab.  
 Measurement room No.5  
 Date April 12, 2019  
 Temperature / Humidity 24 deg. C / 32 % RH  
 Engineer Takafumi Noguchi  
 Mode Tx 13.56 MHz With Tag (FeliCa)

FREQ [MHz]	20dB Bandwidth [kHz]	99% Occupied Bandwidth [kHz]
13.56	366.225	587.0096

### 20dB Bandwidth 99% Occupied Bandwidth

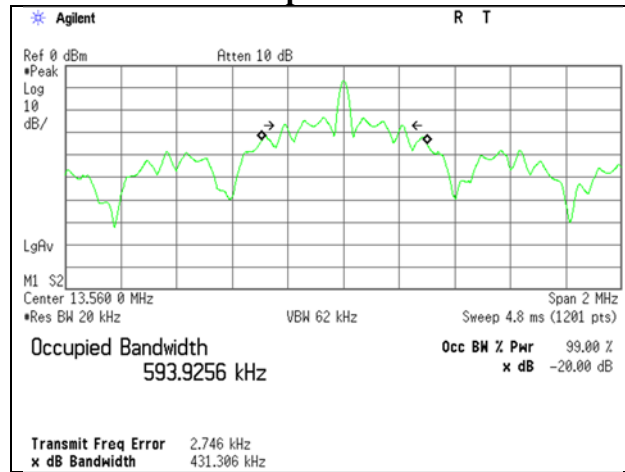


## 20dB Bandwidth and 99% Occupied Bandwidth

Report No. 12768726H  
 Test place Ise EMC Lab.  
 Measurement room No.5  
 Date April 12, 2019  
 Temperature / Humidity 24 deg. C / 32 % RH  
 Engineer Takafumi Noguchi  
 Mode Tx 13.56 MHz Without Tag

FREQ [MHz]	20dB Bandwidth [kHz]	99% Occupied Bandwidth [kHz]
13.56	431.306	593.9256

### 20dB Bandwidth 99% Occupied Bandwidth



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## Frequency Tolerance

Report No. 12768726H  
Test place Ise EMC Lab.  
Measurement room No.5  
Date April 12, 2019  
Temperature / Humidity 24 deg. C / 32 % RH  
Engineer Takafumi Noguchi  
Mode Tx 13.56 MHz Mod off

Test condition		Tested timing	Measured frequency [MHz]	Frequency error [MHz]	Result		Limit [± %]
Temp. [deg. C]	Voltage [V]				[%]	[ppm]	
50	5	Power on	13.560435	0.000435	0.00321	32.1	0.01
		+ 2 min.	13.560438	0.000438	0.00323	32.3	0.01
		+ 5 min.	13.560439	0.000439	0.00324	32.4	0.01
		+ 10 min.	13.560442	0.000442	0.00326	32.6	0.01
40	5	Power on	13.560415	0.000415	0.00306	30.6	0.01
		+ 2 min.	13.560413	0.000413	0.00305	30.5	0.01
		+ 5 min.	13.560416	0.000416	0.00307	30.7	0.01
		+ 10 min.	13.560416	0.000416	0.00307	30.7	0.01
30	5	Power on	13.560433	0.000433	0.00319	31.9	0.01
		+ 2 min.	13.560422	0.000422	0.00311	31.1	0.01
		+ 5 min.	13.560417	0.000417	0.00308	30.8	0.01
		+ 10 min.	13.560417	0.000417	0.00308	30.8	0.01
20	5	Power on	13.560436	0.000436	0.00322	32.2	0.01
		+ 2 min.	13.560431	0.000431	0.00318	31.8	0.01
		+ 5 min.	13.560432	0.000432	0.00319	31.9	0.01
		+ 10 min.	13.560435	0.000435	0.00321	32.1	0.01
20	4.25 (5V -15%)	Power on	13.560443	0.000443	0.00327	32.7	0.01
		+ 2 min.	13.560447	0.000447	0.00330	33.0	0.01
		+ 5 min.	13.560448	0.000448	0.00330	33.0	0.01
		+ 10 min.	13.560449	0.000449	0.00331	33.1	0.01
20	5.75 (5V +15%)	Power on	13.560450	0.000450	0.00332	33.2	0.01
		+ 2 min.	13.560431	0.000431	0.00318	31.8	0.01
		+ 5 min.	13.560427	0.000427	0.00315	31.5	0.01
		+ 10 min.	13.560425	0.000425	0.00313	31.3	0.01
10	5	Power on	13.560480	0.000480	0.00354	35.4	0.01
		+ 2 min.	13.560479	0.000479	0.00353	35.3	0.01
		+ 5 min.	13.560479	0.000479	0.00353	35.3	0.01
		+ 10 min.	13.560479	0.000479	0.00353	35.3	0.01
0	5	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.	13.560499	0.000499	0.00368	36.8	0.01
		+ 10 min.	13.560499	0.000499	0.00368	36.8	0.01
-10	5	Power on	13.560502	0.000502	0.00370	37.0	0.01
		+ 2 min.	13.560504	0.000504	0.00372	37.2	0.01
		+ 5 min.	13.560504	0.000504	0.00372	37.2	0.01
		+ 10 min.	13.560504	0.000504	0.00372	37.2	0.01
-20	5	Power on	13.560441	0.000441	0.00325	32.5	0.01
		+ 2 min.	13.560479	0.000479	0.00353	35.3	0.01
		+ 5 min.	13.560485	0.000485	0.00358	35.8	0.01
		+ 10 min.	13.560488	0.000488	0.00360	36.0	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 Instruments**

Test item	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Calibration Due Date	Cal Int
CE	141246	Attenuator(13dB)	JFW Industries, Inc.	50FP-013H2 N	-	12/18/2018	12/31/2019	12
CE	141216	Coaxial cable	Fujikura/Suhner/TSJ	5D-2W/SFM14/sucoform141-PE/421-010	-/00640	07/03/2018	07/31/2019	12
CE	141532	DIGITAL HiTESTER	HIOKI	3805	51201197	01/29/2019	01/31/2020	12
CE	141554	Thermo-Hygrometer	CUSTOM	CTH-180	1301	01/11/2019	01/31/2020	12
CE	142183	Measure	KOMELON	KMC-36	-	-	-	-
CE	142008	AC3_Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	06/26/2018	06/30/2020	24
CE	141901	Spectrum Analyzer	AGILENT	E4440A	MY48250080	10/04/2018	10/31/2019	12
CE	141357	LISN(AMN)	Schwarzbeck	NSLK8127	8127-729	07/24/2018	07/31/2019	12
CE	141248	Attenuator	JFW Industries, Inc.	50FP-013H2 N	-	12/06/2018	12/31/2019	12
CE/RE	141217	Coaxial cable	Fujikura/Suhner/TSJ	5D-2W/SFM141/421-010/sucoform141-P	-/04178	06/13/2018	06/30/2019	12
CE/RE	142011	AC4_Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	06/28/2018	06/30/2020	24
CE/RE	141562	Thermo-Hygrometer	CUSTOM	CTH-201	0010	01/11/2019	01/31/2020	12
CE/RE	142227	Measure	KOMELON	KMC-36	-	-	-	-
CE/RE	141545	DIGITAL HiTESTER	HIOKI	3805	51201148	01/29/2019	01/31/2020	12
CE/RE	141152	EMI measurement program	TSJ	TEPTO-DV	-	-	-	-
CE/RE	141949	Test Receiver	Rohde & Schwarz	ESCI	100767	08/06/2018	08/31/2019	12
RE	141413	Coaxial Cable	UL Japan	-	-	06/12/2018	06/30/2019	12
RE	141254	Loop Antenna	Rohde & Schwarz	HFH2-Z2	100017	10/11/2018	10/31/2019	12
RE	141425	Biconical Antenna	Schwarzbeck	BBA9106	1302	06/01/2018	06/30/2019	12
RE	141267	Logperiodic Antenna(200-1000MHz)	Schwarzbeck	VUSLP9111B	911B-192	03/21/2019	03/31/2020	12
RE	141397	Coaxial Cable	UL Japan	-	-	06/13/2018	06/30/2019	12
RE	148898	Attenuator	KEYSIGHT	8491A	MY52462282	10/03/2018	10/31/2019	12
RE	141583	Pre Amplifier	SONOMA INSTRUMENT	310	260833	02/08/2019	02/29/2020	12
RE	141884	Spectrum Analyzer	AGILENT	E4448A	MY44020357	03/13/2019	03/31/2020	12
RE/FT	142643	Loop Antenna	UL Japan	-	-	-	-	-
RE/FT	141498	Microwave Counter	ADVANTEST	R5373	120100309	06/28/2018	06/30/2019	12
RE/FT	141563	Thermo-Hygrometer	CUSTOM	CTH-180	1701	01/11/2019	01/31/2020	12
RE/FT	141441	Temperature Chamber	ESPEC CORP.	SU-241	92013843	07/13/2018	07/31/2019	12

\*Hyphens for Last Calibration Date, Calibration Due 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.

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

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

Test item:

CE: Conducted emission  
RE: Radiated Emission  
FT: Frequency Tolerance

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