

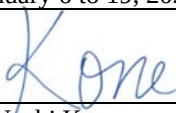


EMI TEST REPORT

Test Report No. : 14135793H-A-R1

Applicant : MIWA LOCK CO., LTD.
Type of EUT : Hotel Card Lock System
Model Number of EUT : V3HTMA
Test regulation : FCC Part 15 Subpart C
FCC ID : VBU-ALV3M
Test Result : **Complied (Refer to SECTION 3)**

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 the limits of the above regulation.
4. The test results in this test report are traceable to the national or international standards.
5. This test report must not be used by the customer to claim product certification, approval, or endorsement by the A2LA accreditation body.
6. This test report covers Radio technical requirements. It does not cover administrative issues such as Manual or non-Radio test related Requirements. (if applicable)
7. The all test items in this test report are conducted by UL Japan, Inc. Ise EMC Lab.
8. The opinions and the interpretations to the result of the description in this report are outside scopes where UL Japan, Inc. has been accredited.
9. The information provided from the customer for this report is identified in Section 1.
10. This report is a revised version of 14135793H-A. 14135793H-A is replaced with this report.

Date of test: January 6 to 19, 2022
Representative test engineer: 
Nachi Konegawa
Engineer
Approved by: 
Takumi Shimada
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".

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REVISION HISTORY

Original Test Report No.: 14135793H-A

Revision	Test report No.	Date	Page revised	Contents
- (Original)	14135793H-A	January 26, 2022	-	-
1	14135793H-A-R1	December 20, 2022	P.1	Deletion of "2021" from Test regulation in Cover page
1	14135793H-A-R1	December 20, 2022	P.6, 10	Correction of BLE Model number; From "EYSHCNZXXZ" to "EYSHCN"
1	14135793H-A-R1	December 20, 2022	P.6	Deletion of the Antenna Gain from RFID and Detector in Radio Specification of Clause 2.2
1	14135793H-A-R1	December 20, 2022	P.7	Update for FCC version
1	14135793H-A-R1	December 20, 2022	P.10	Deletion of "(-30 deg. C: Reference)" from Frequency Tolerance description in Clause 4.1
1	14135793H-A-R1	December 20, 2022	P.26, 27	Deletion of -30 deg. C data from Frequency Tolerance test data.

Reference: Abbreviations (Including words undescribed in this report)

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

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SECTION 1: Customer information

Company Name	:	MIWA LOCK CO., LTD.
Address	:	3-1-12, Shiba, Minato-ku, Tokyo, 105-8510, Japan,
Telephone Number	:	+81-3-4330-3069
Contact Person	:	Tatsuya Nakamura

The information provided from the customer is as follows;

- Applicant, Type 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
 - 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

Type	:	Hotel Card Lock System
Model Number	:	V3HTMA
Serial Number	:	Refer to SECTION 4.2
Receipt Date	:	December 27, 2021
Condition	:	Production prototype (Not for Sale: This sample is equivalent to mass-produced items.)
Modification	:	No Modification by the test lab

2.2 Product Description

Model: V3HTMA (referred to as the EUT in this report) is a Hotel Card Lock System.

General Specification

Rating	:	DC 3.0 V
Clock frequency (ies) in the system	:	20 MHz (CPU)

Radio Specification

[V3HTMA]

<Bluetooth Low Energy> *1)

[Module: V2HT]

Radio Type	:	Transceiver
Frequency of Operation	:	2412 MHz - 2462 MHz
Type of Modulation	:	GFSK
Antenna type	:	PCBAntenna
Antenna Gain	:	2.25 dBi
Clock frequency (Maximum)	:	64 MHz

[Module: EYSHCN]

Equipment Type	:	Transceiver
Frequency of Operation	:	2402 MHz - 2480MHz
Type of Modulation	:	GFSK
Antenna Type	:	Monopole Antenna
Antenna Gain	:	0.9 dBi
Clock frequency (Maximum)	:	32 MHz

<RFID>

Radio Type	:	Transceiver
Frequency of Operation	:	13.56 MHz
Type of Modulation	:	ASK
Antenna type	:	PCB Antenna
Clock frequency (Maximum)	:	27.12 MHz

<Detector>

Radio Type	:	Transmitter
Frequency of Operation	:	13.56 MHz
Type of Modulation	:	Non modulation
Antenna type	:	PCB Antenna*
Clock frequency (Maximum)	:	13.56 MHz

* Uses a common antenna with the RFID side (switching by an analog switch)

*1) This is a FCC certificated module.

Model number: V2HT (FCC ID: VBU-V2HT), EYSHCN (FCC ID: RYYEYSHCN)

Variant model

This tested model (V3HTMA) has variant models: ALV3MA, V3HTM, ALV3M.

The differences of these models are follows, they are completely identical in electrical characteristics.

	V3HTMA (Tested model)	ALV3MA	V3HTM	ALV3M
BLE module "V2HT"	✓	-	✓	-
electric lock model number	AL5HA	AL5HA	AL6H	AL6H

The test was performed with V3HTMA as representative.

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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 April 1, 2022 and effective May 2, 2022

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	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	68.61 dB, 13.56000 MHz, QP, 0 deg. <Mode 1 with Tag>	Complied a)	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	39.43 dB, 13.34581 MHz, QP, 0 deg. <Mode 1 with Tag>	Complied a)	Radiated
20 dB Bandwidth	<FCC> ANSI C63.10:2013 6 Standard test methods <ISED> -	<FCC> Section 15.215(c) ----- <ISED> -	See data	Complied b)	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	4.34 dB 922.386 MHz, Vertical, QP <Mode 2 with Tag>	Complied# c)	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 d)	Radiated
Note: UL Japan, Inc.'s EMI Work Procedures No. 13-EM-W0420 and 13-EM-W0422 *1) The test was not performed since the EUT was DC device. 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)					
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.					

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FCC Part 15.31 (e)

The test was performed with the New Battery and the stable voltage was supplied to the EUT during the tests. Therefore, the 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 Bandwidth	<ISED>RSS-Gen 6.7	-	N/A	-	Radiated

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 $k = 2$.

Test Item	Frequency range	Uncertainty (+/-)
Radiated emission	3 m	9 kHz to 30 MHz
	10 m	3.3 dB
	3 m	3.2 dB
		30 MHz to 200 MHz (Horizontal)
		(Vertical)
		4.8 dB
	10 m	5.0 dB
		200 MHz to 1000 MHz (Horizontal)
		(Vertical)
		5.2 dB
		6.3 dB
		4.8 dB
		4.8 dB
		5.0 dB
		5.0 dB
Frequency Tolerance	-	0.0154 ppm
20 dB Bandwidth / 99 % Occupied Bandwidth	-	0.96 %

3.5 Test Location

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

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

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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	-	-

3.6 Test data, Test instruments, and Test set up

Refer to APPENDIX.

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SECTION 4: Operation of EUT during testing

4.1 Operating Mode(s)

The mode is used :

Mode	Remarks*
1) Transmitting mode (Tx) - RFID (Without Tag / With Tag)	The EUT Transmits and Receives at the same time and there is no receiving mode.
2) Transmitting mode (Tx) - Detector (Without Tag / With Tag)	-
The EUT was operated in a manner similar to typical use during the tests. * EUT was set by the software as follows; Software: (for Host device) RF test software(host) Version ZE18-02 (Date: 2021.12.22, Storage location: EUT memory) (for BLE Module) BLE(EYSHCN) RF test software: Version DTM-XXAA (Date: 2021.12.20, 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.	

Test Item	Operating mode	
	Mode 1	Mode 2
Electric Field Strength of Fundamental Emission Spectrum Mask 20 dB Bandwidth and 99 % Occupied Bandwidth Electric Field Strength of Spurious Emission Frequency Tolerance	Tx Modulated on	Tx Modulated off

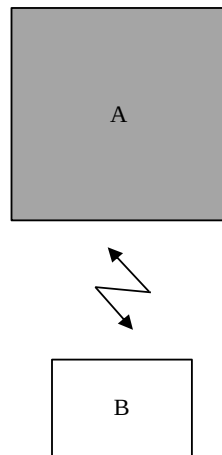
Justification: The system was configured in typical fashion (as a user would normally use it) for testing.

Frequency Tolerance:

Temperature : -20 deg. C to +50 deg. C Step 10 deg. C
 Voltage : Normal Voltage DC 3.0 V
 Maximum Voltage DC 3.45 V,
 Minimum Voltage DC 2.55 V (DC 3.0 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	Remarks
A	Hotel Card Lock System	V3HTMA	V00048A	MIWA LOCK CO., LTD.	EUT
B	Tag	-	MIVSTD001	MIWA LOCK CO., LTD.	-

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

Test Procedure

[For below 1GHz]

EUT was placed on a urethane platform of nominal size, 0.5 m by 1.0 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.

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 $45.5 - 51.5 = -6.0 \text{ dBuA/m}$, which has the same margin, 3 dB, to the corresponding RSS-Gen Table 6 limit as it has to 15.209(a) limit.

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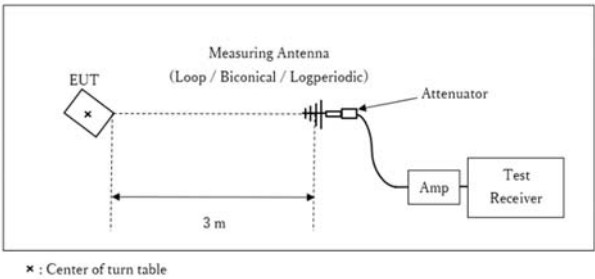
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[Test Setup]
Below 1 GHz



Test Distance: 3 m

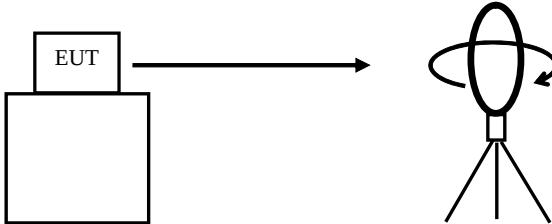
The test was made on EUT at the normal use position.

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

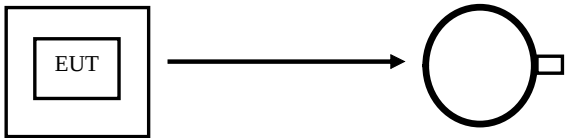
Measurement range : 9 kHz - 1 GHz
Test data : APPENDIX 1
Test result : Pass

Figure 1: Direction of the Loop Antenna

Side View (Vertical)

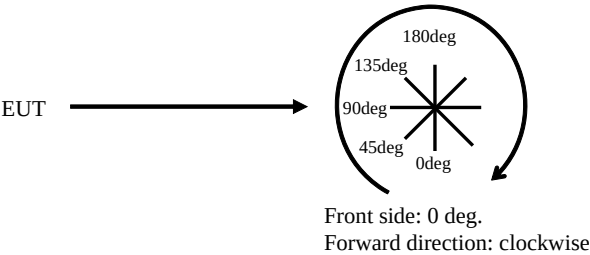


Top View (Horizontal)



Antenna was not rotated.

Top View (Vertical)



SECTION 6: Other test

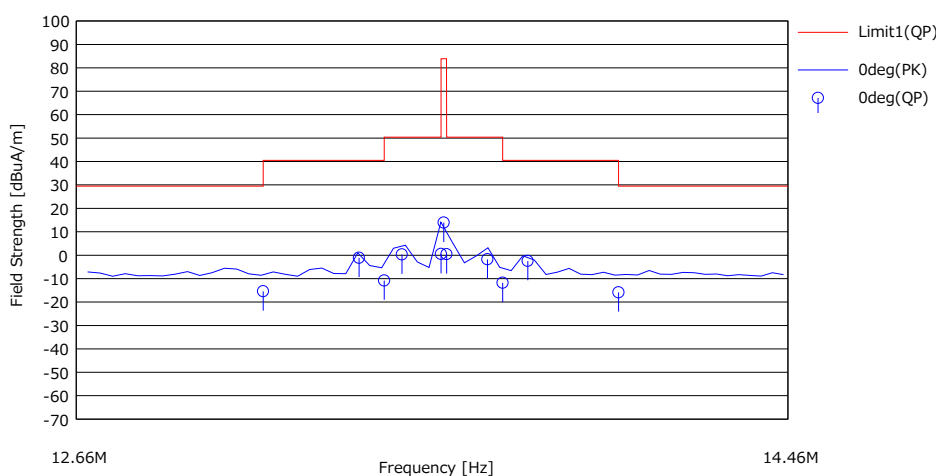
Test	Span	RBW	VBW	Sweep	Detector	Trace	Instrument used
20 dB Bandwidth	5 MHz (Mode 1)	30 kHz (Mode 1)	91 kHz (Mode 1)	Auto	Peak	Max Hold	Spectrum Analyzer
	200 kHz (Mode 2)	3 kHz (Mode 2)	10 kHz (Mode 2)				
99 % Occupied Bandwidth	Enough width to display emission skirts	1 to 5 % of OBW	Three times of RBW	Auto	Sample	Clear Write (Single)	Spectrum Analyzer *1)
Frequency Tolerance	-	-	-	-	-	-	Spectrum Analyzer *2)
*1) The measurement was performed with Sample detector, Clear Write (Single) since the duty cycle was 100 %. Peak hold was applied as Worst-case measurement. *2) The measurement was performed with Marker Frequency Counter Function.							

Test data : APPENDIX
Test result : Pass

APPENDIX 1: Test data**Fundamental emission and Spectrum Mask**

Report No. 14135793H
 Test place Ise EMC Lab.
 Semi Anechoic Chamber No.1
 Date January 9, 2022
 Temperature / Humidity 20 deg. C / 38 % RH
 Engineer Nachi Konegawa
 Mode Mode 1 without Tag

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	Comment
		[dBuV]				[dBuA/m]	[dBuA/m]	[dB]			
1	13.11000	30.10	19.45	-32.94	32.05	-15.44	29.50	44.94	Odeg	163	
2	13.34690	44.40	19.45	-32.93	32.05	-1.13	40.50	41.63	Odeg	163	
3	13.41000	34.70	19.46	-32.92	32.05	-10.81	40.50	51.31	Odeg	163	
4	13.45451	45.80	19.46	-32.92	32.05	0.29	50.40	50.11	Odeg	163	
5	13.55300	46.00	19.46	-32.92	32.05	0.49	50.40	49.91	Odeg	163	
6	13.56000	59.40	19.46	-32.92	32.05	13.89	83.90	70.01	Odeg	163	
7	13.56700	45.90	19.46	-32.92	32.05	0.39	50.40	50.01	Odeg	163	
8	13.67110	43.70	19.47	-32.91	32.05	-1.79	50.40	52.19	Odeg	163	
9	13.71000	33.70	19.47	-32.91	32.05	-11.79	40.50	52.29	Odeg	163	
10	13.77428	43.00	19.47	-32.91	32.05	-2.49	40.50	42.99	Odeg	163	
11	14.01000	29.60	19.48	-32.90	32.05	-15.87	29.50	45.37	Odeg	163	

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

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

Result of the fundamental emission at 3 m without Distance factor

Result of the fundamental emission at 3 m without Distance factor

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
0deg	13.56000	QP	59.40	19.46	7.08	32.05	-	53.89	-	-	Fundamental

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

UL Japan, Inc.

Ise EMC Lab.

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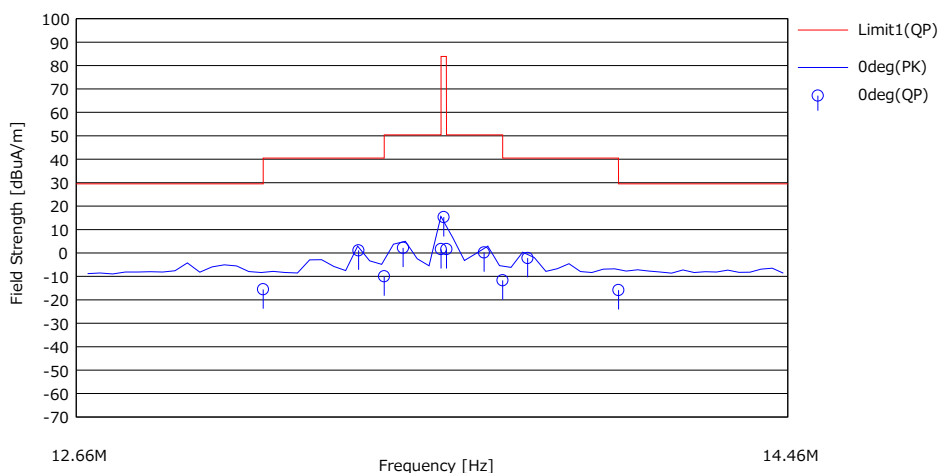
Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Fundamental emission and Spectrum Mask

Report No. 14135793H
 Test place Ise EMC Lab.
 Semi Anechoic Chamber No.1
 Date January 9, 2022
 Temperature / Humidity 20 deg. C / 38 % RH
 Engineer Nachi Konegawa
 Mode Mode 1 with Tag

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



No.	Freq. [MHz]	Reading <QP> [dBuV]	Ant.Fac [dB/m]	Loss [dB]	Gain [dB]	Result <QP> [dBuA/m]	Limit <QP> [dBuA/m]	Margin <QP> [dB]	Antenna	Table [deg]	Comment
1	13.11000	30.00	19.45	-32.94	32.05	-15.54	29.50	45.04	Odeg	164	
2	13.34581	46.60	19.45	-32.93	32.05	1.07	40.50	39.43	Odeg	164	
3	13.41000	35.50	19.46	-32.92	32.05	-10.01	40.50	50.51	Odeg	164	
4	13.45756	47.70	19.46	-32.92	32.05	2.19	50.40	48.21	Odeg	164	
5	13.55300	47.10	19.46	-32.92	32.05	1.59	50.40	48.81	Odeg	164	
6	13.56000	60.80	19.46	-32.92	32.05	15.29	83.90	68.61	Odeg	164	
7	13.56700	47.10	19.46	-32.92	32.05	1.59	50.40	48.81	Odeg	164	
8	13.66245	45.70	19.47	-32.91	32.05	0.21	50.40	50.19	Odeg	164	
9	13.71000	33.80	19.47	-32.91	32.05	-11.69	40.50	52.19	Odeg	164	
10	13.77415	43.30	19.47	-32.91	32.05	-2.19	40.50	42.69	Odeg	164	
11	14.01000	29.60	19.48	-32.90	32.05	-15.87	29.50	45.37	Odeg	164	

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

Result of the fundamental emission at 3 m without Distance factor

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
0deg	13.56000	QP	60.80	19.46	7.08	32.05	-	55.29	-	-	Fundamental

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

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Ise EMC Lab.

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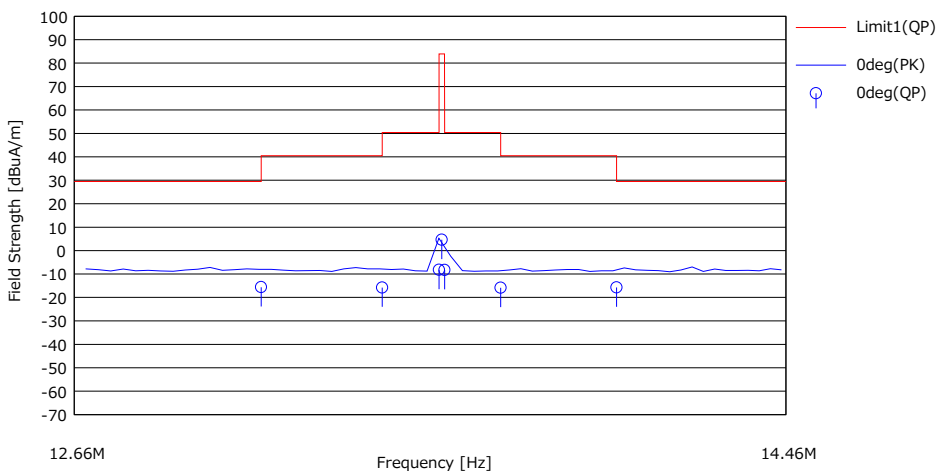
Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Fundamental emission and Spectrum Mask

Report No.	14135793H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.1
Date	January 9, 2022
Temperature / Humidity	20 deg. C / 38 % RH
Engineer	Nachi Konegawa
Mode	Mode 2 without Tag

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	Table	Comment
		[dBuV]				[dBuA/m]	[dBuA/m]	[dB]		[deg]	
1	13.11000	29.90	19.45	-32.94	32.05	-15.64	29.50	45.14	0deg	176	
2	13.41000	29.70	19.46	-32.92	32.05	-15.81	40.50	56.31	0deg	176	
3	13.55300	37.30	19.46	-32.92	32.05	-8.21	50.40	58.61	0deg	176	
4	13.56000	50.10	19.46	-32.92	32.05	4.59	83.90	79.31	0deg	176	
5	13.56700	37.20	19.46	-32.92	32.05	-8.31	50.40	58.71	0deg	176	
6	13.71000	29.60	19.47	-32.91	32.05	-15.89	40.50	56.39	0deg	176	
7	14.01000	29.70	19.48	-32.90	32.05	-15.77	29.50	45.27	0deg	176	

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

Result of the fundamental emission at 3 m without Distance factor

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]	
0deg	13.56000	QP	50.10	19.46	7.08	32.05	-	44.59	-	-	Fundamental

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

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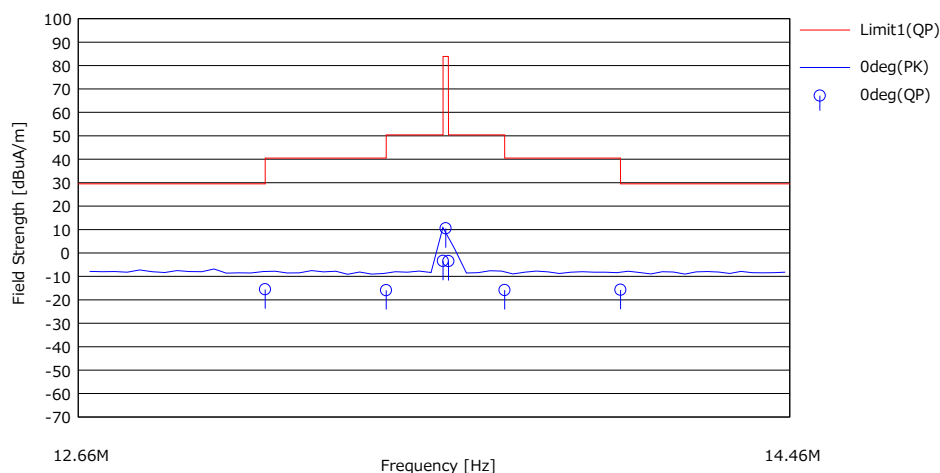
Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Fundamental emission and Spectrum Mask

Report No.	14135793H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.1
Date	January 9, 2022
Temperature / Humidity	20 deg. C / 38 % RH
Engineer	Nachi Konegawa
Mode	Mode 2 with Tag

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



No.	Freq. [MHz]	Reading <QP> [dBuV]	Ant.Fac [dB/m]	Loss [dB]	Gain [dB]	Result <QP> [dBuA/m]	Limit <QP> [dBuA/m]	Margin <QP> [dB]	Antenna	Table	Comment
1	13.11000	30.00	19.45	-32.94	32.05	-15.54	29.50	45.04	Odeg	168	
2	13.41000	29.60	19.46	-32.92	32.05	-15.91	40.50	56.41	Odeg	168	
3	13.55300	42.10	19.46	-32.92	32.05	-3.41	50.40	53.81	Odeg	168	
4	13.56000	56.00	19.46	-32.92	32.05	10.49	83.90	73.41	Odeg	168	
5	13.56700	42.00	19.46	-32.92	32.05	-3.51	50.40	53.91	Odeg	168	
6	13.71000	29.60	19.47	-32.91	32.05	-15.89	40.50	56.39	Odeg	168	
7	14.01000	29.70	19.48	-32.90	32.05	-15.77	29.50	45.27	Odeg	168	

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

Result of the fundamental emission at 3 m without Distance factor

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
0deg	13.56000	QP	56.00	19.46	7.08	32.05	-	50.49	-	-	Fundamental

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

UL Japan, Inc.

Ise EMC Lab.

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Spurious emission

Report No.	14135793H	
Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.1	No.2
Date	January 9, 2022	January 6, 2022
Temperature / Humidity	20 deg. C / 38 % RH	21 deg. C / 45 % RH
Engineer	Nachi Konegawa (Below 30 MHz)	Nachi Konegawa (Above 30 MHz)
Mode	Mode 1 without Tag	

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
0deg	6.989	QP	30.50	19.15	-33.26	32.08	-	-15.69	29.50	45.19	
0deg	9.665	QP	30.00	19.31	-33.11	32.05	-	-15.85	29.50	45.35	
0deg	21.291	QP	38.40	19.64	-32.57	32.04	-	-6.57	29.50	36.07	
0deg	27.120	QP	31.10	19.37	-32.35	32.04	-	-13.92	29.50	43.42	
Hori.	40.680	QP	27.00	14.72	6.86	28.45	-	20.13	40.00	19.87	*
Hori.	54.240	QP	26.30	9.80	7.01	28.42	-	14.69	40.00	25.31	*
Hori.	67.800	QP	31.10	6.55	7.17	28.39	-	16.43	40.00	23.57	*
Hori.	108.480	QP	30.10	11.51	7.51	28.29	-	20.83	43.52	22.69	*
Hori.	122.040	QP	23.70	13.06	7.61	28.25	-	16.12	43.52	27.40	*
Hori.	135.600	QP	25.40	14.19	7.72	28.21	-	19.10	43.52	24.42	*
Vert.	40.680	QP	35.50	14.72	6.86	28.45	-	28.63	40.00	11.37	*
Vert.	54.240	QP	37.30	9.80	7.01	28.42	-	25.69	40.00	14.31	*
Vert.	67.800	QP	42.30	6.55	7.17	28.39	-	27.63	40.00	12.37	*
Vert.	108.480	QP	44.90	11.51	7.51	28.29	-	35.63	43.52	7.89	*
Vert.	122.040	QP	32.40	13.06	7.61	28.25	-	24.82	43.52	18.70	*
Vert.	135.600	QP	37.10	14.19	7.72	28.21	-	30.80	43.52	12.72	*

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

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

UL Japan, Inc.

Ise EMC Lab.

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

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Spurious emission

Report No.	14135793H	
Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.1	No.2
Date	January 9, 2022	January 6, 2022
Temperature / Humidity	20 deg. C / 38 % RH	21 deg. C / 45 % RH
Engineer	Nachi Konegawa (Below 30 MHz)	Nachi Konegawa (Above 30 MHz)
Mode	Mode 1 with Tag	

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
0deg	6.986	QP	30.40	19.15	-33.26	32.08	-	-15.79	29.50	45.29	
0deg	9.998	QP	30.10	19.33	-33.09	32.05	-	-15.71	29.50	45.21	
0deg	21.340	QP	35.60	19.64	-32.57	32.04	-	-9.37	29.50	38.87	
0deg	27.120	QP	30.90	19.37	-32.35	32.04	-	-14.12	29.50	43.62	
Hori.	40.680	QP	35.10	14.72	6.86	28.45	-	28.23	40.00	11.77	*
Hori.	54.240	QP	23.70	9.80	7.01	28.42	-	12.09	40.00	27.91	*
Hori.	67.800	QP	27.10	6.55	7.17	28.39	-	12.43	40.00	27.57	*
Hori.	108.480	QP	32.00	11.51	7.51	28.29	-	22.73	43.52	20.79	*
Hori.	122.040	QP	25.00	13.06	7.61	28.25	-	17.42	43.52	26.10	*
Hori.	135.600	QP	25.40	14.19	7.72	28.21	-	19.10	43.52	24.42	*
Vert.	40.680	QP	42.10	14.72	6.86	28.45	-	35.23	40.00	4.77	*
Vert.	54.240	QP	31.50	9.80	7.01	28.42	-	19.89	40.00	20.11	*
Vert.	67.800	QP	38.10	6.55	7.17	28.39	-	23.43	40.00	16.57	*
Vert.	108.480	QP	45.60	11.51	7.51	28.29	-	36.33	43.52	7.19	*
Vert.	122.040	QP	34.70	13.06	7.61	28.25	-	27.12	43.52	16.40	*
Vert.	135.600	QP	36.00	14.19	7.72	28.21	-	29.70	43.52	13.82	*

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

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

UL Japan, Inc.

Ise EMC Lab.

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

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Spurious emission

Report No.	14135793H	
Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.1	No.2
Date	January 9, 2022	January 6, 2022
Temperature / Humidity	20 deg. C / 38 % RH	21 deg. C / 45 % RH
Engineer	Nachi Konegawa (Below 30 MHz)	Nachi Konegawa (Above 30 MHz)
Mode	Mode 2 without Tag	

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
0deg	6.987	QP	30.50	19.15	-33.26	32.08	-	-15.69	29.50	45.19	
0deg	10.000	QP	29.90	19.33	-33.09	32.05	-	-15.91	29.50	45.41	
0deg	21.340	QP	35.60	19.64	-32.57	32.04	-	-9.37	29.50	38.87	
0deg	27.120	QP	29.00	19.37	-32.35	32.04	-	-16.02	29.50	45.52	
Hori.	40.680	QP	21.88	14.72	6.86	28.45	-	15.01	40.00	24.99	*
Hori.	67.800	QP	24.20	6.55	7.17	28.39	-	9.53	40.00	30.47	*
Hori.	94.920	QP	27.90	9.42	7.40	28.33	-	16.39	43.52	27.13	*
Hori.	122.040	QP	25.80	13.06	7.61	28.25	-	18.22	43.52	25.30	*
Hori.	135.600	QP	21.20	14.19	7.72	28.21	-	14.90	43.52	28.62	*
Hori.	759.362	QP	28.20	20.40	10.69	29.11	-	30.18	46.02	15.84	*
Vert.	40.680	QP	25.00	14.72	6.86	28.45	-	18.13	40.00	21.87	*
Vert.	67.800	QP	31.30	6.55	7.17	28.39	-	16.63	40.00	23.37	*
Vert.	94.920	QP	36.20	9.42	7.40	28.33	-	24.69	43.52	18.83	*
Vert.	122.040	QP	35.80	13.06	7.61	28.25	-	28.22	43.52	15.30	*
Vert.	135.600	QP	24.80	14.19	7.72	28.21	-	18.50	43.52	25.02	*
Vert.	759.362	QP	35.47	20.40	10.69	29.11	-	37.45	46.02	8.57	*

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

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

UL Japan, Inc.

Ise EMC Lab.

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Telephone : +81 596 24 8999

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Spurious emission

Report No.	14135793H	
Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.1	No.2
Date	January 9, 2022	January 6, 2022
Temperature / Humidity	20 deg. C / 38 % RH	21 deg. C / 45 % RH
Engineer	Nachi Konegawa (Below 30 MHz)	Nachi Konegawa (Above 30 MHz)
Mode	Mode 2 with Tag	

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
0deg	6.989	QP	30.50	19.15	-33.26	32.08	-	-15.69	29.50	45.19	
0deg	9.999	QP	30.00	19.33	-33.09	32.05	-	-15.81	29.50	45.31	
0deg	21.341	QP	35.50	19.64	-32.57	32.04	-	-9.47	29.50	38.97	
0deg	27.120	QP	29.70	19.37	-32.35	32.04	-	-15.32	29.50	44.82	
Hori.	40.680	QP	24.50	14.72	6.86	28.45	-	17.63	40.00	22.37	*
Hori.	67.800	QP	25.20	6.55	7.17	28.39	-	10.53	40.00	29.47	*
Hori.	94.920	QP	27.60	9.42	7.40	28.33	-	16.09	43.52	27.43	*
Hori.	122.040	QP	25.30	13.06	7.61	28.25	-	17.72	43.52	25.80	*
Hori.	135.600	QP	21.10	14.19	7.72	28.21	-	14.80	43.52	28.72	*
Hori.	922.386	QP	29.50	22.22	11.28	28.72	-	34.28	46.02	11.74	*
Vert.	40.680	QP	27.70	14.72	6.86	28.45	-	20.83	40.00	19.17	*
Vert.	67.800	QP	33.00	6.55	7.17	28.39	-	18.33	40.00	21.67	*
Vert.	94.920	QP	36.30	9.42	7.40	28.33	-	24.79	43.52	18.73	*
Vert.	122.040	QP	35.80	13.06	7.61	28.25	-	28.22	43.52	15.30	*
Vert.	135.600	QP	24.20	14.19	7.72	28.21	-	17.90	43.52	25.62	*
Vert.	922.386	QP	36.90	22.22	11.28	28.72	-	41.68	46.02	4.34	*

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

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

UL Japan, Inc.

Ise EMC Lab.

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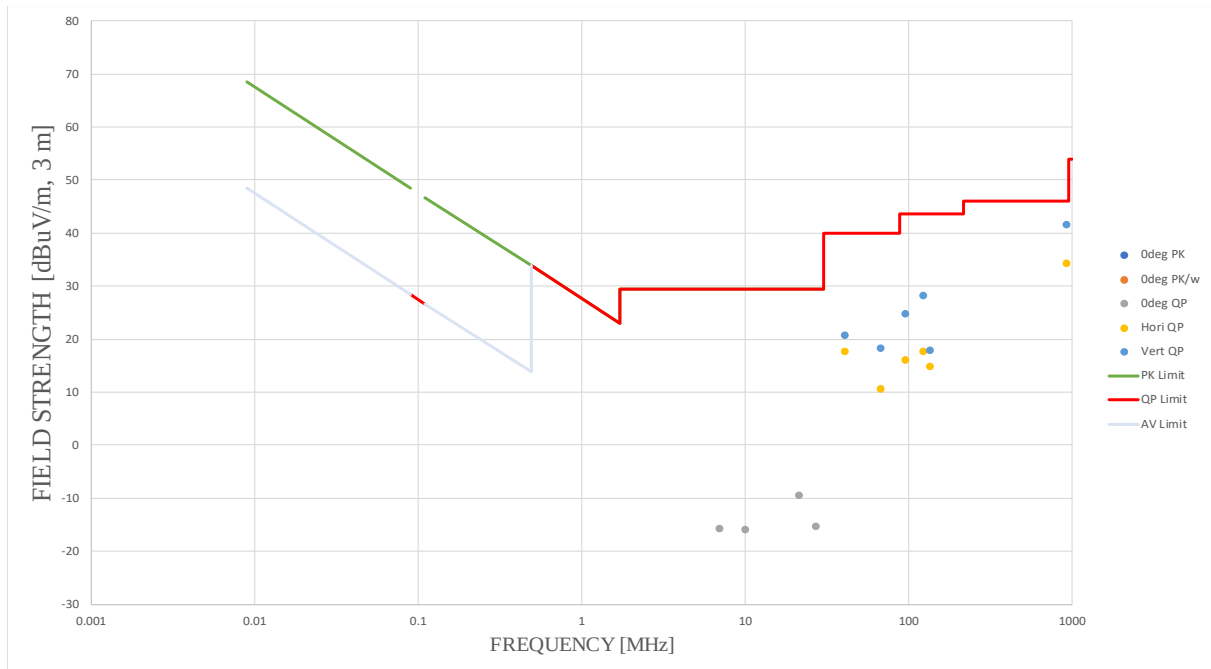
Telephone : +81 596 24 8999

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Radiated Emission

(Plot data, Worst case for Spurious Emission)

Report No.	14135793H	No.2
Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.1	
Date	January 9, 2022	January 6, 2022
Temperature / Humidity	20 deg. C / 38 % RH	21 deg. C / 45 % RH
Engineer	Nachi Konegawa (Below 30 MHz)	Nachi Konegawa (Above 30 MHz)
Mode	Mode 2 with Tag	

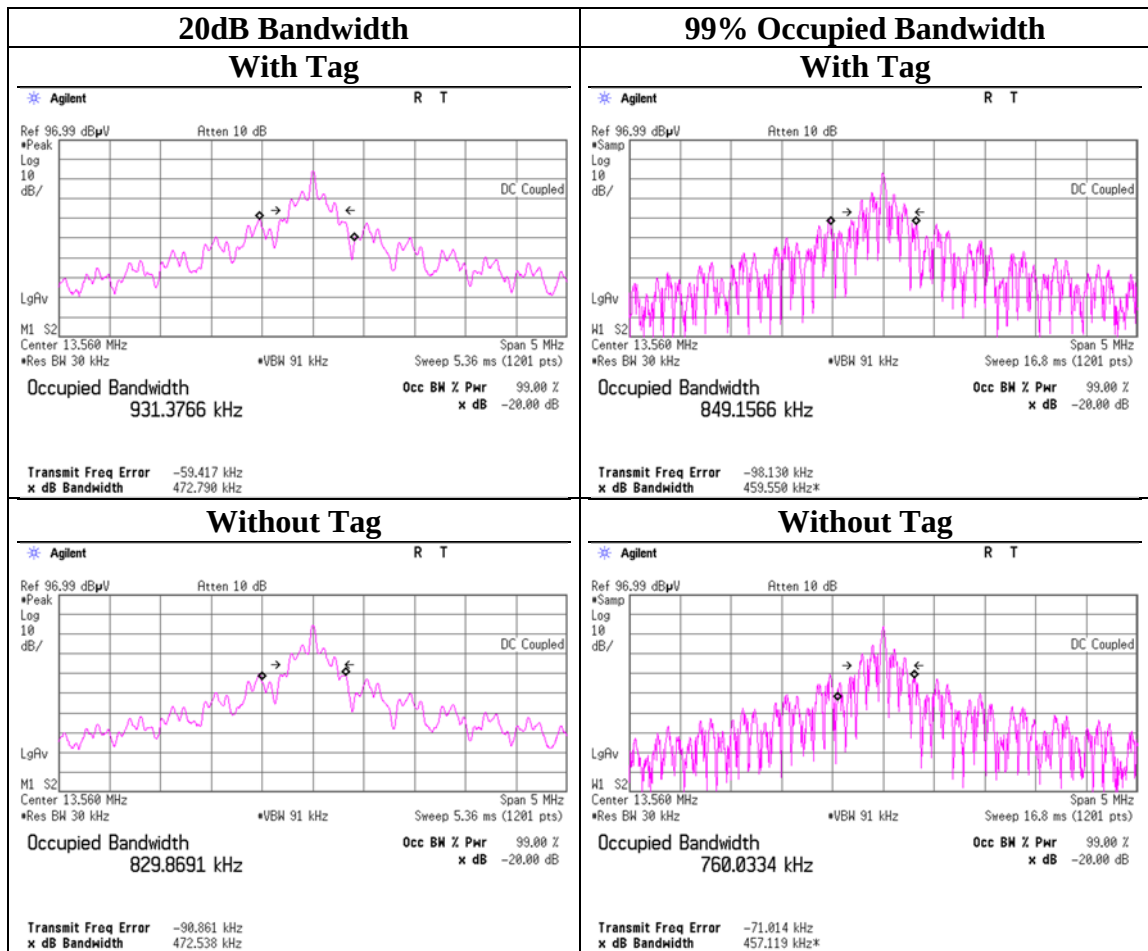


*These plots data contains sufficient number to show the trend of characteristic features for EUT.

20 dB Bandwidth and 99% Occupied Bandwidth

Report No.	14135793H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.1
Date	January 9, 2022
Temperature / Humidity	20 deg. C / 38 % RH
Engineer	Nachi Konegawa
Mode	Mode 1

FREQ [MHz]	Mode	20dB Bandwidth [kHz]	99% Occupied Bandwidth [kHz]
13.56	With Tag	472.79	849.16
	Without Tag	472.54	760.03



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.

UL Japan, Inc.

Ise EMC Lab.

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20 dB Bandwidth and 99% Occupied Bandwidth

Report No.

Test place

Semi Anechoic Chamber

Date

Temperature / Humidity

Engineer

Mode

14135793H

Ise EMC Lab.

No.1

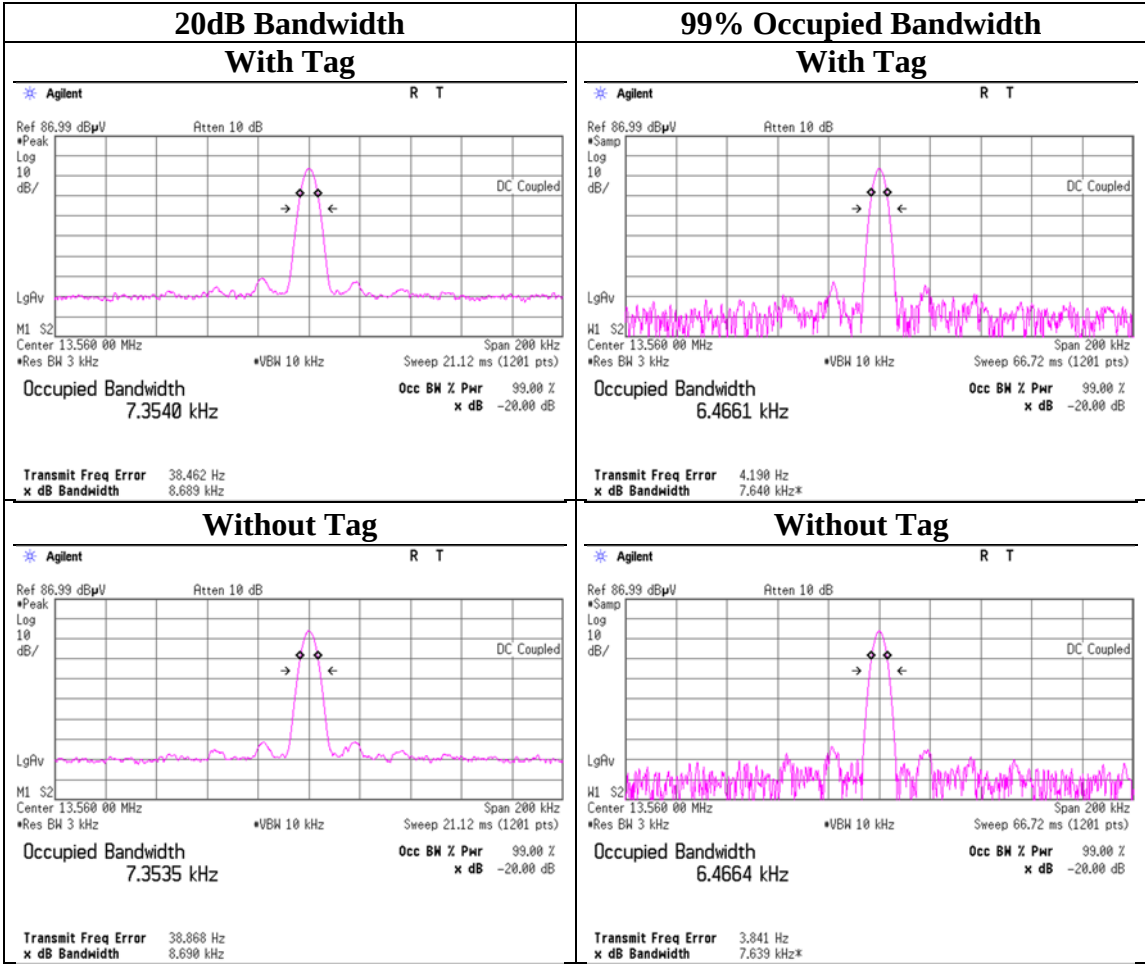
January 9, 2022

20 deg. C / 38 % RH

Nachi Konegawa

Mode 2

FREQ [MHz]	Mode	20dB Bandwidth [kHz]	99% Occupied Bandwidth [kHz]
13.56	With Tag	8.69	6.47
	Without Tag	8.69	6.47



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

Report No. 14135793H
Test place Ise EMC Lab. No.6 Measurement Room
Date January 14, 2022 January 19, 2022
Temperature / Humidity 19 deg. C / 39 % RH 21 deg. C / 38 % RH
Engineer Kiyoshiro Okazaki Nachi Konegawa
Mode Mode 1

Test condition		Tested timing	Measured frequency [MHz]	Frequency error [MHz]	Result		Limit [+/- %]
Temp. [deg. C]	Voltage [V]				[%]	[ppm]	
50	3	Power on	13.560009	0.000009	0.00007	0.7	0.01
		+ 2 min.	13.560010	0.000010	0.00007	0.7	0.01
		+ 5 min.	13.560011	0.000011	0.00008	0.8	0.01
		+ 10 min.	13.560014	0.000014	0.00010	1.0	0.01
40	3	Power on	13.560002	0.000002	0.00002	0.2	0.01
		+ 2 min.	13.560003	0.000003	0.00002	0.2	0.01
		+ 5 min.	13.560004	0.000004	0.00003	0.3	0.01
		+ 10 min.	13.560004	0.000004	0.00003	0.3	0.01
30	3	Power on	13.560000	0.000000	0.00000	0.0	0.01
		+ 2 min.	13.560000	0.000000	0.00000	0.0	0.01
		+ 5 min.	13.560000	0.000000	0.00000	0.0	0.01
		+ 10 min.	13.560000	0.000000	0.00000	0.0	0.01
20	3	Power on	13.560002	0.000002	0.00002	0.2	0.01
		+ 2 min.	13.560002	0.000002	0.00002	0.2	0.01
		+ 5 min.	13.560002	0.000002	0.00001	0.1	0.01
		+ 10 min.	13.560002	0.000002	0.00001	0.1	0.01
20	2.55 (3V -15%)	Power on	13.560002	0.000002	0.00002	0.2	0.01
		+ 2 min.	13.560002	0.000002	0.00001	0.1	0.01
		+ 5 min.	13.560002	0.000002	0.00001	0.1	0.01
		+ 10 min.	13.560002	0.000002	0.00001	0.1	0.01
20	3.45 (3V +15%)	Power on	13.560003	0.000003	0.00002	0.2	0.01
		+ 2 min.	13.560002	0.000002	0.00002	0.2	0.01
		+ 5 min.	13.560002	0.000002	0.00002	0.2	0.01
		+ 10 min.	13.560002	0.000002	0.00002	0.2	0.01
10	3	Power on	13.560000	0.000000	0.00000	0.0	0.01
		+ 2 min.	13.560001	0.000001	0.00001	0.1	0.01
		+ 5 min.	13.560002	0.000002	0.00001	0.1	0.01
		+ 10 min.	13.560002	0.000002	0.00002	0.2	0.01
0	3	Power on	13.559986	-0.000014	-0.00010	-1.0	0.01
		+ 2 min.	13.559990	-0.000010	-0.00008	-0.8	0.01
		+ 5 min.	13.559991	-0.000009	-0.00007	-0.7	0.01
		+ 10 min.	13.559992	-0.000008	-0.00006	-0.6	0.01
-10	3	Power on	13.559953	-0.000047	-0.00035	-3.5	0.01
		+ 2 min.	13.559959	-0.000041	-0.00030	-3.0	0.01
		+ 5 min.	13.559963	-0.000037	-0.00027	-2.7	0.01
		+ 10 min.	13.559964	-0.000036	-0.00026	-2.6	0.01
-20	3	Power on	13.559892	-0.000108	-0.00079	-7.9	0.01
		+ 2 min.	13.559899	-0.000101	-0.00074	-7.4	0.01
		+ 5 min.	13.559906	-0.000094	-0.00069	-6.9	0.01
		+ 10 min.	13.559910	-0.000090	-0.00066	-6.6	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.

UL Japan, Inc.

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Frequency Tolerance

Report No. 14135793H
Test place Ise EMC Lab. No.6 Measurement Room
Date January 14, 2022 January 19, 2022
Temperature / Humidity 20 deg. C / 41 % RH 21 deg. C / 38 % RH
Engineer Junki Nagatomi Nachi Konegawa
Mode Mode 2

Test condition		Tested timing	Measured frequency [MHz]	Frequency error [MHz]	Result		Limit [+/- %]
Temp. [deg. C]	Voltage [V]				[%]	[ppm]	
50	3	Power on	13.559933	-0.000067	-0.00049	-4.9	0.01
		+ 2 min.	13.559932	-0.000068	-0.00050	-5.0	0.01
		+ 5 min.	13.559930	-0.000070	-0.00051	-5.1	0.01
		+ 10 min.	13.559929	-0.000071	-0.00052	-5.2	0.01
40	3	Power on	13.559937	-0.000063	-0.00047	-4.7	0.01
		+ 2 min.	13.559937	-0.000063	-0.00047	-4.7	0.01
		+ 5 min.	13.559937	-0.000063	-0.00047	-4.7	0.01
		+ 10 min.	13.559937	-0.000063	-0.00046	-4.6	0.01
30	3	Power on	13.559956	-0.000044	-0.00032	-3.2	0.01
		+ 2 min.	13.559956	-0.000044	-0.00032	-3.2	0.01
		+ 5 min.	13.559957	-0.000043	-0.00032	-3.2	0.01
		+ 10 min.	13.559957	-0.000043	-0.00031	-3.1	0.01
20	3	Power on	13.559982	-0.000018	-0.00014	-1.4	0.01
		+ 2 min.	13.559981	-0.000019	-0.00014	-1.4	0.01
		+ 5 min.	13.559981	-0.000019	-0.00014	-1.4	0.01
		+ 10 min.	13.559981	-0.000019	-0.00014	-1.4	0.01
20	2.55 (3V -15%)	Power on	13.559978	-0.000022	-0.00016	-1.6	0.01
		+ 2 min.	13.559978	-0.000022	-0.00016	-1.6	0.01
		+ 5 min.	13.559978	-0.000022	-0.00016	-1.6	0.01
		+ 10 min.	13.559978	-0.000022	-0.00016	-1.6	0.01
20	3.45 (3V +15%)	Power on	13.559978	-0.000022	-0.00016	-1.6	0.01
		+ 2 min.	13.559978	-0.000022	-0.00016	-1.6	0.01
		+ 5 min.	13.559978	-0.000022	-0.00016	-1.6	0.01
		+ 10 min.	13.559978	-0.000022	-0.00016	-1.6	0.01
10	3	Power on	13.560002	0.000002	0.00001	0.1	0.01
		+ 2 min.	13.560002	0.000002	0.00001	0.1	0.01
		+ 5 min.	13.560002	0.000002	0.00002	0.2	0.01
		+ 10 min.	13.560003	0.000003	0.00002	0.2	0.01
0	3	Power on	13.560011	0.000011	0.00008	0.8	0.01
		+ 2 min.	13.560011	0.000011	0.00008	0.8	0.01
		+ 5 min.	13.560011	0.000011	0.00008	0.8	0.01
		+ 10 min.	13.560011	0.000011	0.00008	0.8	0.01
-10	3	Power on	13.559988	-0.000012	-0.00009	-0.9	0.01
		+ 2 min.	13.559990	-0.000010	-0.00007	-0.7	0.01
		+ 5 min.	13.559990	-0.000010	-0.00007	-0.7	0.01
		+ 10 min.	13.559990	-0.000010	-0.00007	-0.7	0.01
-20	3	Power on	13.559935	-0.000065	-0.00048	-4.8	0.01
		+ 2 min.	13.559938	-0.000062	-0.00046	-4.6	0.01
		+ 5 min.	13.559940	-0.000060	-0.00044	-4.4	0.01
		+ 10 min.	13.559940	-0.000060	-0.00044	-4.4	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.

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APPENDIX 2: Test instruments

Test equipment

Test Item	Local ID	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Cal Int
RE	MAEC-02	142004	AC2_Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-06902	05/26/2020	24
RE	MOS-41	192300	Thermo-Hygrometer	CUSTOM. Inc	CTH-201	0013	12/19/2021	12
RE	MMM-01	141542	Digital Tester	Fluke Corporation	FLUKE 26-3	78030611	08/10/2021	12
RE	MJM-27	142228	Measure	KOMELON	KMC-36	-	-	-
RE	COTS-MEMI-02	178648	EMI measurement program	TSJ (Techno Science Japan)	TEPTO-DV	-	-	-
RE	MAT-07	141203	Attenuator(6dB)	Weinschel Corp	2	BK7970	11/09/2021	12
RE	MBA-08	141427	Biconical Antenna	Schwarzbeck Mess-Elektronik OHG	VHA9103B+BBA9106	08031	07/10/2021	12
RE	MCC-12	141317	Coaxial Cable	UL Japan Inc.	-	-	09/06/2021	12
RE	MLA-21	141265	Logperiodic Antenna (200-1000MHz)	Schwarzbeck Mess-Elektronik OHG	VUSLP9111B	9111B-190	07/10/2021	12
RE	MPA-24	141594	Pre Amplifier	Keysight Technologies Inc	8447D	2944A10150	02/18/2021	12
RE	MTR-08	141949	Test Receiver	Rohde & Schwarz	ESCI	100767	08/05/2021	12
RE	MAEC-01	141998	AC1_Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 10m	DA-06881	06/08/2020	24
RE	MOS-27	141566	Thermo-Hygrometer	CUSTOM. Inc	CTH-201	A08Q26	01/10/2022	12
RE	MMM-03	141530	Digital Tester	Fluke Corporation	FLUKE 26-3	78030621	08/10/2021	12
RE	MJM-25	142226	Measure	KOMELON	KMC-36	-	-	-
RE	MTR-10	141951	EMI Test Receiver	Rohde & Schwarz	ESR26	101408	03/09/2021	12
RE	MPA-14	141583	Pre Amplifier	SONOMA INSTRUMENT	310	260833	02/18/2021	12
RE	MCC-03	141215	Coaxial Cable	Fujikura/Suhner/TSJ	5D-2W/3D-2W/RG400u/RFM-E421(SW)	-/01068 (Switcher)	06/02/2021	12
RE	MCC-64	141327	Coaxial Cable	UL Japan	-	-	02/03/2021	12
RE	MAT-08	141213	Attenuator(6dB)	Weinschel Corp	2	BK7971	11/09/2021	12
RE	LP-01	146966	Loop Antenna	Rohde & Schwarz	HFH2-Z2	829425/014	01/19/2021	12
FT	MOS-14	141561	Thermo-Hygrometer	CUSTOM. Inc	CTH-201	1401	01/10/2022	12
FT	MMM-18	141558	Digital Tester(TRUE RMS MULTIMETER)	Fluke Corporation	115	17930030	05/24/2021	12
FT	MCH-04	141429	Temperature and Humidity Chamber	Espec	PL-2KP	14015723	08/05/2021	12
FT	MLPA-07	142645	Loop Antenna	UL Japan	-	-	-	-
FT	MSA-16	141903	Spectrum Analyzer	Keysight Technologies Inc	E4440A	MY46186390	01/07/2022	12
FT	MRENT-130	141855	Spectrum Analyzer	Keysight Technologies Inc	E4440A	MY46187750	11/28/2021	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

UL Japan, Inc.

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