



RADIO TEST REPORT

Test Report No. : 12936408H-A-R1

Applicant : **DENSO CORPORATION**
Type of Equipment : **Electronic Key**
Model No. : **1AS**
FCC ID : **HYQ1AS**
Test regulation : **FCC Part 15 Subpart C: 2019**
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 12936408H-A. 12936408H-A is replaced with this report.

Date of test: July 8 and 10, 2019

Representative test engineer:

K. Yamamoto

Koji Yamamoto
Engineer

Consumer Technology Division

Approved by:

M. Imura

Motoya Imura

Leader

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/

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

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

REVISION HISTORY

Original Test Report No.: 12936408H-A

[illegible]

| CONTENTS | PAGE |
|---|-------------|
| SECTION 1: Customer information | 4 |
| SECTION 2: Equipment under test (E.U.T.) | 4 |
| SECTION 3: Test specification, procedures & results | 5 |
| SECTION 4: Operation of E.U.T. during testing | 8 |
| SECTION 5: Radiated emission (Electric Field Strength of Fundamental and Spurious Emission) .. | 9 |
| SECTION 6: Automatically deactivate..... | 11 |
| SECTION 7: -20 dB and 99 % Occupied Bandwidth..... | 11 |
| APPENDIX 1: Test data..... | 12 |
| Automatically deactivate | 12 |
| Radiated Emission (Electric Field Strength of Fundamental and Spurious Emission) | 14 |
| -20dB and 99% Occupied Bandwidth | 18 |
| Duty Cycle..... | 20 |
| APPENDIX 2: Test instruments..... | 25 |
| APPENDIX 3: Photographs of test setup | 26 |
| Radiated emission..... | 26 |
| Worst case position..... | 27 |

SECTION 1: Customer information

| | |
|------------------|--|
| Company Name | : DENSO CORPORATION |
| Address | : 1-1, Showa-cho, Kariya-shi, Aichi-ken, 448-8661, Japan |
| Telephone Number | : +81-566-20-3955 |
| Facsimile Number | : +81-566-25-4837 |
| Contact Person | : TAKAYUKI HATTORI |

The information provided from the customer is as follows;

- Applicant, Type of Equipment, Model No. 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 (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 | : Electronic Key |
| Model No. | : 1AS |
| Serial No. | : Refer to Section 4, Clause 4.2 |
| Rating | : DC 3.0 V |
| Receipt Date of Sample (Information from test lab.) | : July 3, 2019 |
| Country of Mass-production | : United States of America, China |
| 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: 1AS (referred to as the EUT in this report) is a Electronic Key.
The EUT (1AS) transmits radio wave signals of ASK and FSK.
The radio wave signals of ASK and FSK are not transmitted simultaneously.
Either one of ASK and FSK is transmitted by operator's action.
End users cannot control which of ASK and FSK to be transmitted.

EUT has variations of 6-Button type, 5-Button type, 4-Button type, and 3-Button type.

The difference of these variations is only the Number of buttons.

After test results of the four types were compared, the test was performed only with 6-Button type as its result was the worst one.

Radio Specification

| | |
|---------------------------|-------------------------|
| Radio Type | : Transceiver |
| Frequency of Operation | : 314.9 MHz |
| Modulation | : ASK (A1D) / FSK (F1D) |
| Type of Battery | : One lithium battery |
| Antenna type | : Built-in type (Fixed) |
| Clock frequency (Maximum) | : 27.6 MHz Crystal |
| Radio Type | : Receiver |
| Frequency of Operation | : 125 kHz *1) |

*1) The test of receiver part was performed separately from this test report, and the conformability is confirmed.

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

SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification : FCC Part 15 Subpart C
FCC Part 15 final revised on July 19, 2019 and effective August 19, 2019 except 15.258

Title : FCC 47CFR Part15 Radio Frequency Device Subpart C Intentional Radiators
Section 15.231 Periodic operation in the band 40.66-40.70 MHz and above 70 MHz.

* The revisions made after testing date do not affect the test specification applied to the EUT.

3.2 Procedures and results

| Item | Test Procedure | Specification | Worst margin | Results | Remarks |
|--|--|--|---|-----------------|----------|
| Conducted emission | FCC: ANSI C63.10:2013 6 Standard test methods | FCC: Section 15.207 | N/A | N/A *1) | - |
| | IC: RSS-Gen 8.8 | IC: RSS-Gen 8.8 | | | |
| Automatically Deactivate | FCC: ANSI C63.10:2013 6 Standard test methods | FCC: Section 15.231(a)(1) | N/A | Complied a) | Radiated |
| | IC: - | IC: RSS-210 A1.1 | | | |
| Electric Field Strength of Fundamental Emission | FCC: ANSI C63.10:2013 6 Standard test methods | FCC: Section 15.231(b) | 4.7 dB 314.9 MHz PK with Duty factor Horizontal <ASK> | Complied# b) | Radiated |
| | IC: RSS-Gen 6.12 | IC: RSS-210 A1.2 | | | |
| Electric Field Strength of Spurious Emission | FCC: ANSI C63.10:2013 6 Standard test methods | FCC: Section 15.205 Section 15.209 Section 15.231(b) | 12.2 dB 2204.300 MHz PK with Duty factor Vertical <FSK> | Complied b) | Radiated |
| | IC: RSS-Gen 6.13 | IC: RSS-210 A1.2, 4.4 RSS-Gen 8.9 | | | |
| -20dB Bandwidth | FCC: ANSI C63.10:2013 6 Standard test methods | FCC: Section 15.231(c) | N/A | Complied c) | Radiated |
| | IC: - | IC: Reference data | | | |

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

*1) The test is not applicable since the EUT does not have AC Mains.

a) Refer to APPENDIX 1 (data of Automatically deactivate)

b) Refer to APPENDIX 1 (data of Radiated Emission (Electric Field Strength of Fundamental and Spurious Emission))

c) Refer to APPENDIX 1 (data of -20dB and 99% Occupied Bandwidth)

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)

This test was performed with the New Battery (DC 3.0 V) and the constant voltage was supplied to the EUT during the tests. Therefore, the EUT complies with the requirement.

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.

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

3.3 Addition to standard

| Item | Test Procedure | Specification | Worst margin | Results | Remarks |
|-------------------------|-----------------|------------------|--------------|---------|----------|
| 99 % Occupied Bandwidth | IC: RSS-Gen 6.7 | IC: RSS-210 A1.3 | 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 $k = 2$.

| 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 |

| Radiated emission (Above 1 GHz) | | | | |
|---------------------------------|-----------------|--------------------|--------------------|-----------------|
| (3 m*)(+/-) | | (1 m*)(+/-) | | (10 m*)(+/-) |
| 1 GHz to 6 GHz | 6 GHz to 18 GHz | 10 GHz to 26.5 GHz | 26.5 GHz to 40 GHz | 1 GHz to 18 GHz |
| 5.0 dB | 5.3 dB | 5.8 dB | 5.8 dB | 5.2 dB |

* Measurement distance

| Automatically Deactivate |
|--------------------------|
| 0.10 % |

| Bandwidth |
|-----------|
| 0.96 % |

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

3.5 Test Location

UL Japan, Inc. Ise EMC Lab.

*NVLAP Lab. code: 200572-0 / FCC Test Firm Registration Number: 199967 / ISED Lab Company Number: 2973C

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

Telephone: +81 596 24 8999, Facsimile: +81 596 24 8124

| 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.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 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.

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

SECTION 4: Operation of E.U.T. during testing

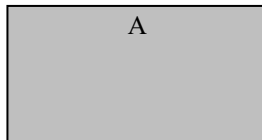
4.1 Operating Mode(s)

| Test Item* | Mode |
|--|---|
| Automatically Deactivate Duty Cycle | Normal use mode ASK/FSK (314.9 MHz) |
| Electric Field Strength of Fundamental Emission Electric Field Strength of Spurious Emission -20 dB & 99 % Occupied Bandwidth | Transmitting mode ASK/FSK (314.9 MHz) *1) |
| * The system was configured in typical fashion (as a user would normally use it) for testing. *1) The software of this mode is the same as one of normal product, except that EUT continues to transmit when transmitter button is being pressed (For Normal use mode, EUT stops to transmit in a given time, even if transceiver button is being pressed.) End users cannot change the settings of the output power of the product. | |

*The EUT has two mode; "Manual transmission (Normal Keyless function)" and "Transmission when receiving LF signal (Smart Keyless function)".

The test except for Transmit timing test was performed with the operation mode of Manual transmission since the transmission output and modulation except for the transmission timing (Transmit timing) are identical in the two modes.

4.2 Configuration and peripherals



* Setup was taken into consideration and test data was taken under worse case conditions.

Description of EUT

| No. | Item | Model number | Serial number | Manufacturer | Remarks |
|-----|----------------|--------------|----------------------|-------------------|---------|
| A | Electronic Key | 1AS | No.2 *1) No.1 *2) | DENSO CORPORATION | EUT |

*1) Used for Normal use mode

*2) Used for Transmitting mode

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

SECTION 5: Radiated emission (Electric Field Strength of Fundamental and Spurious Emission)

Test Procedure and conditions

[For below 30 MHz]

The noise level was checked by moving a search-coil (Loop Antenna) close to the EUT.

[For 30 MHz to 1 GHz]

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 1 GHz]

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.

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

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

The radiated emission measurements were made with the following detector function of the test receiver / spectrum analyzer.

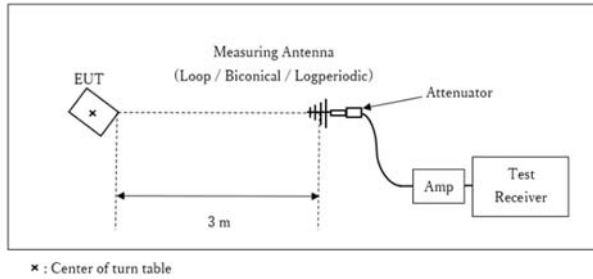
Test Antennas are used as below;

| Frequency | Below 30 MHz | 30 MHz to 200 MHz | 200 MHz to 1 GHz | Above 1 GHz |
|--------------|--------------|-------------------|------------------|-------------|
| Antenna Type | Loop | Biconical | Logperiodic | Horn |

| | 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 | Above 1 GHz |
|---------------|--|------------------------|-------------------------|------------------------|--------------------------------|--------------------------------|
| Detector Type | Peak | Peak | Peak | Peak | Peak and Peak with Duty factor | Peak and Peak with Duty factor |
| IF Bandwidth | 200 Hz | 200 Hz | 9.0 kHz | 9.0 kHz | 120 kHz | PK: S/A: RBW 1 MHz, VBW: 3 MHz |

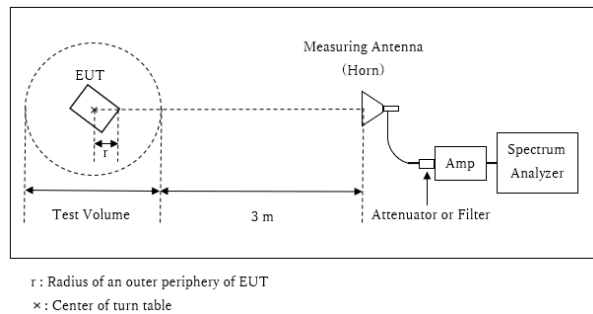
[Test Setup]

Below 1 GHz



Test Distance: 3 m

1 GHz – 3.2 GHz



Distance Factor: $20 \times \log (4.0 \text{ m} / 3.0 \text{ m}) = 2.50 \text{ dB}$

* Test Distance: $(3 + \text{Test Volume} / 2) - r = 4.0 \text{ m}$

Test Volume : 2.0 m

(Test Volume has been calibrated based on CISPR 16-1-4.)

$r = 0.0 \text{ m}$

* The test was performed with $r = 0.0 \text{ m}$ since EUT is small and it was the rather conservative condition.

- The carrier level (or, noise levels) was (or were) measured at each position of all three axes X, Y and Z, and the position that has the maximum noise was determined.

Noise levels of all the frequencies were measured at the position.

This EUT has two modes which mechanical key is inserted or not. The worst case was confirmed with and without mechanical key, as a result, the test without mechanical key was the worst case. Therefore the test without mechanical key was performed only.

*The result is rounded off to the second decimal place, so some differences might be observed.

| | |
|-------------------|-------------------|
| Measurement range | : 9 kHz - 3.2 GHz |
| Test data | : APPENDIX |
| Test result | : Pass |

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

SECTION 6: Automatically deactivate

Test Procedure

The measurement was performed with Electric field strength using a spectrum analyzer.

Test data : APPENDIX

Test result : Pass

SECTION 7: -20 dB and 99 % Occupied Bandwidth

Test Procedure

The test was measured with a spectrum analyzer using a test fixture.

| Test | Span | RBW | VBW | Sweep | Detector | Trace | Instrument used |
|--|--|-----------------|--------------------|-------|----------|----------|-------------------|
| 20 dB Bandwidth | 400 kHz | 1.5 kHz | 5.1 kHz | 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 | Max Hold | Spectrum Analyzer |
| Peak hold was applied as Worst-case measurement. | | | | | | | |

Test data : APPENDIX

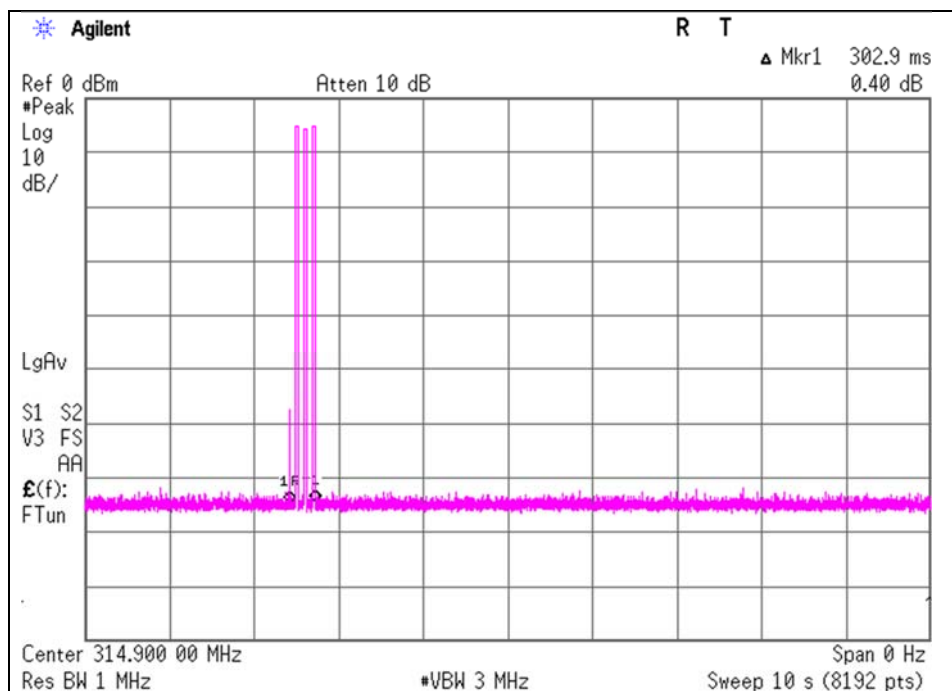
Test result : Pass

APPENDIX 1: Test data

Automatically deactivate

| | |
|------------------------|---|
| Report No. | 12936408H |
| Test place | Ise EMC Lab. No.3 Semi Anechoic Chamber |
| Date | July 8, 2019 |
| Temperature / Humidity | 22 deg. C / 53 % RH |
| Engineer | Akihiko Maeda |
| Mode | Normal use mode ASK (314.9 MHz) |

| Time of Transmitting [sec] | Limit [sec] | Result |
|-------------------------------|----------------|--------|
| 0.3029 | 5.00 | Pass |

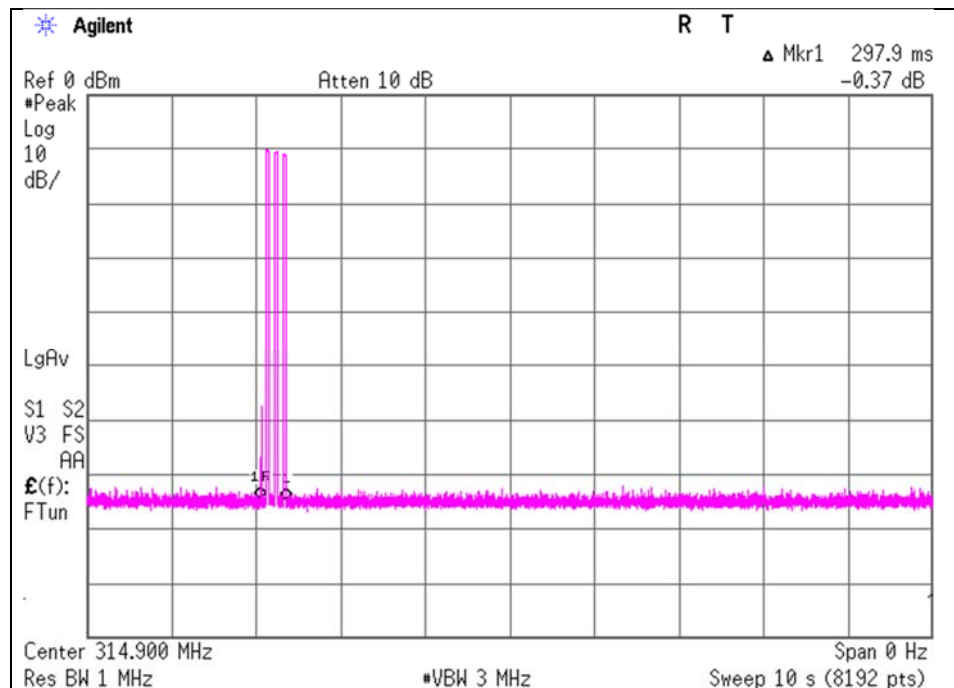


* The EUT transmits UHF when LF signal is received from a car or a button on the EUT is pressed. In both cases, the UHF transmission is stopped within 5 seconds. So the test was performed by a button-pressed operation as the worst case. Please refer to the “Theory of Operation” for details.

Automatically deactivate

| | |
|------------------------|---|
| Report No. | 12936408H |
| Test place | Ise EMC Lab. No.3 Semi Anechoic Chamber |
| Date | July 8, 2019 |
| Temperature / Humidity | 22 deg. C / 53 % RH |
| Engineer | Akihiko Maeda |
| Mode | Normal use mode FSK (314.9 MHz) |

| Time of Transmitting [sec] | Limit [sec] | Result |
|-------------------------------|----------------|--------|
| 0.2979 | 5.00 | Pass |



* The EUT transmits UHF when LF signal is received from a car or a button on the EUT is pressed. In both cases, the UHF transmission is stopped within 5 seconds. So the test was performed by a button-pressed operation as the worst case. Please refer to the “Theory of Operation” for details.

Radiated Emission (Electric Field Strength of Fundamental and Spurious Emission)

| | | |
|------------------------|-----------------------------------|---------------------|
| Report No. | 12936408H | |
| Test place | Ise EMC Lab. | |
| Semi Anechoic Chamber | No.3 | No.3 |
| Date | July 8, 2019 | July 10, 2019 |
| Temperature / Humidity | 22 deg. C / 53 % RH | 22 deg. C / 55 % RH |
| Engineer | Akihiko Maeda | Koji Yamamoto |
| | (Below 1 GHz) | (Above 1 GHz) |
| Mode | Transmitting mode ASK (314.9 MHz) | |

QP or PK

| 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 Inside or Outside of Restricted Bands |
|--------------------|----------|-------------------|------|-------------------------|--------------|--------------|------------------------|--------------------|------|-------------------|----------------|------|--|
| | | Hor | Ver | | | | | Hor | Ver | | Hor | Ver | |
| 314.900 | PK | 93.7 | 89.9 | 14.0 | 10.2 | 31.9 | - | 86.0 | 82.2 | 95.6 | 9.6 | 13.4 | Carrier |
| 629.800 | PK | 38.5 | 33.4 | 19.4 | 12.2 | 32.0 | - | 38.1 | 33.0 | 75.6 | 37.5 | 42.6 | Outside |
| 944.700 | PK | 30.5 | 30.1 | 22.0 | 13.9 | 30.7 | - | 35.7 | 35.3 | 75.6 | 39.9 | 40.3 | Outside |
| 1259.600 | PK | 44.3 | 44.6 | 25.5 | 6.1 | 34.7 | - | 41.2 | 41.5 | 75.6 | 34.4 | 34.1 | Outside |
| 1574.500 | PK | 42.2 | 42.7 | 25.5 | 5.5 | 34.0 | - | 39.2 | 39.8 | 73.9 | 34.7 | 34.1 | Inside |
| 1889.400 | PK | 45.1 | 44.6 | 26.2 | 5.5 | 33.2 | - | 43.7 | 43.1 | 75.6 | 32.0 | 32.5 | Outside |
| 2204.300 | PK | 44.5 | 45.8 | 28.3 | 5.6 | 32.8 | - | 45.5 | 46.9 | 73.9 | 28.4 | 27.0 | Inside |
| 2519.200 | PK | 49.1 | 48.5 | 27.7 | 5.7 | 32.7 | - | 49.8 | 49.2 | 75.6 | 25.8 | 26.4 | Outside |
| 2834.100 | PK | 46.0 | 45.6 | 28.8 | 5.8 | 32.5 | - | 48.1 | 47.7 | 73.9 | 25.8 | 26.3 | Inside |
| 3149.000 | PK | 45.1 | 44.1 | 29.1 | 5.9 | 32.4 | - | 47.7 | 46.7 | 75.6 | 27.9 | 28.9 | Outside |

PK with Duty factor

| 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 |
|--------------------|----------|-------------------|------|-------------------------|--------------|--------------|------------------------|--------------------|------|-------------------|----------------|------|---------|
| | | Hor | Ver | | | | | Hor | Ver | | Hor | Ver | |
| 314.900 | PK | 93.7 | 89.9 | 14.0 | 10.2 | 31.9 | -15.1 | 70.9 | 67.1 | 75.6 | 4.7 | 8.5 | Carrier |
| 629.800 | PK | 38.5 | 33.4 | 19.4 | 12.2 | 32.0 | -15.1 | 23.0 | 17.9 | 55.6 | 32.6 | 37.7 | Outside |
| 944.700 | PK | 30.5 | 30.1 | 22.0 | 13.9 | 30.7 | -15.1 | 20.6 | 20.2 | 55.6 | 35.0 | 35.4 | Outside |
| 1259.600 | PK | 44.3 | 44.6 | 25.5 | 6.1 | 34.7 | -15.1 | 26.1 | 26.4 | 55.6 | 29.5 | 29.2 | Outside |
| 1574.500 | PK | 42.2 | 42.7 | 25.5 | 5.5 | 34.0 | -15.1 | 24.1 | 24.7 | 53.9 | 29.8 | 29.2 | Inside |
| 1889.400 | PK | 45.1 | 44.6 | 26.2 | 5.5 | 33.2 | -15.1 | 28.6 | 28.0 | 55.6 | 27.1 | 27.6 | Outside |
| 2204.300 | PK | 44.5 | 45.8 | 28.3 | 5.6 | 32.8 | -15.1 | 30.4 | 31.8 | 53.9 | 23.5 | 22.1 | Inside |
| 2519.200 | PK | 49.1 | 48.5 | 27.7 | 5.7 | 32.7 | -15.1 | 34.7 | 34.1 | 55.6 | 20.9 | 21.5 | Outside |
| 2834.100 | PK | 46.0 | 45.6 | 28.8 | 5.8 | 32.5 | -15.1 | 33.0 | 32.6 | 53.9 | 20.9 | 21.4 | Inside |
| 3149.000 | PK | 45.1 | 44.1 | 29.1 | 5.9 | 32.4 | -15.1 | 32.6 | 31.6 | 55.6 | 23.0 | 24.0 | Outside |

*Other frequency noises omitted in this report were not seen or had enough margin (more than 20dB).

Sample calculation:

Result of PK = Reading + Ant Factor + Loss {Cable + Attenuator + Distance factor (above 1 GHz)} - Gain (Amplifier)

Result of PK with Duty factor = Reading + Ant Factor + Loss {Cable + Attenuator + Distance factor (above 1 GHz)} - Gain (Amplifier) + Duty factor

For above 1GHz : Distance Factor: $20 \times \log(4.0 \text{ m}/3.0 \text{ m}) = 2.50 \text{ dB}$

*Other frequency noises omitted in this report were not seen or had enough margin (more than 20dB).

UL Japan, Inc.

Ise EMC Lab.

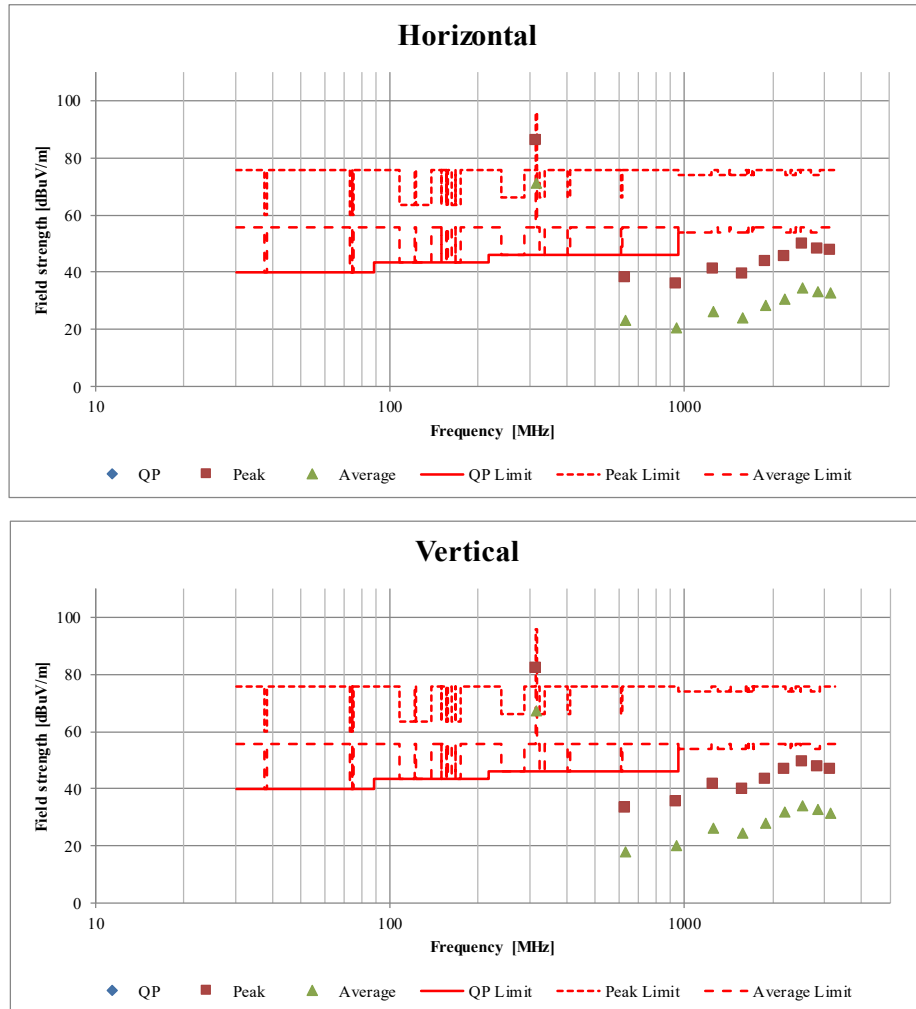
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

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

| | | |
|------------------------|-----------------------------------|---------------------|
| Report No. | 12936408H | |
| Test place | Ise EMC Lab. | |
| Semi Anechoic Chamber | No.3 | No.3 |
| Date | July 8, 2019 | July 10, 2019 |
| Temperature / Humidity | 22 deg. C / 53 % RH | 22 deg. C / 55 % RH |
| Engineer | Akihiko Maeda | Koji Yamamoto |
| | (Below 1 GHz) | (Above 1 GHz) |
| Mode | Transmitting mode ASK (314.9 MHz) | |



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

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

Radiated Emission (Electric Field Strength of Fundamental and Spurious Emission)

Report No. 12936408H
Test place Ise EMC Lab.
Semi Anechoic Chamber No.3 No.3
Date July 8, 2019 July 10, 2019
Temperature / Humidity 22 deg. C / 53 % RH 22 deg. C / 55 % RH
Engineer Akihiko Maeda Koji Yamamoto
(Below 1 GHz) (Above 1 GHz)
Mode Transmitting mode FSK (314.9 MHz)

QP or PK

| 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 Inside or Outside of Restricted Bands |
|--------------------|----------|-------------------|------|-------------------------|--------------|--------------|------------------------|--------------------|------|-----------------|----------------|------|--|
| | | Hor | Ver | | | | | Hor | Ver | | Hor | Ver | |
| 314.900 | PK | 87.0 | 83.3 | 14.0 | 10.2 | 31.9 | - | 79.3 | 75.6 | 95.6 | 16.3 | 20.0 | Carrier |
| 629.800 | PK | 31.4 | 29.1 | 19.4 | 12.2 | 32.0 | - | 31.0 | 28.7 | 75.6 | 44.6 | 46.9 | Outside |
| 944.700 | PK | 27.3 | 26.5 | 22.0 | 13.9 | 30.7 | - | 32.5 | 31.7 | 75.6 | 43.1 | 43.9 | Outside |
| 1259.600 | PK | 43.9 | 43.6 | 25.5 | 6.1 | 34.7 | - | 40.8 | 40.6 | 75.6 | 34.8 | 35.1 | Outside |
| 1574.500 | PK | 42.6 | 42.7 | 25.5 | 5.5 | 34.0 | - | 39.7 | 39.8 | 73.9 | 34.2 | 34.1 | Inside |
| 1889.400 | PK | 44.3 | 44.2 | 26.2 | 5.5 | 33.2 | - | 42.9 | 42.7 | 75.6 | 32.7 | 32.9 | Outside |
| 2204.300 | PK | 47.2 | 49.7 | 28.3 | 5.6 | 32.8 | - | 48.3 | 50.8 | 73.9 | 25.6 | 23.1 | Inside |
| 2519.200 | PK | 48.7 | 48.7 | 27.7 | 5.7 | 32.7 | - | 49.4 | 49.4 | 75.6 | 26.2 | 26.2 | Outside |
| 2834.100 | PK | 47.0 | 46.8 | 28.8 | 5.8 | 32.5 | - | 49.0 | 48.9 | 73.9 | 24.9 | 25.0 | Inside |
| 3149.000 | PK | 45.8 | 46.2 | 29.1 | 5.9 | 32.4 | - | 48.4 | 48.8 | 75.6 | 27.2 | 26.8 | Outside |

PK with Duty factor

| 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 |
|--------------------|----------|-------------------|------|-------------------------|--------------|--------------|------------------------|--------------------|------|-----------------|----------------|------|---------|
| | | Hor | Ver | | | | | Hor | Ver | | Hor | Ver | |
| 314.900 | PK | 87.0 | 83.3 | 14.0 | 10.2 | 31.9 | -9.1 | 70.3 | 66.6 | 75.6 | 5.4 | 9.1 | Carrier |
| 629.800 | PK | 31.4 | 29.1 | 19.4 | 12.2 | 32.0 | -9.1 | 22.0 | 19.7 | 55.6 | 33.7 | 36.0 | Outside |
| 944.700 | PK | 27.3 | 26.5 | 22.0 | 13.9 | 30.7 | -9.1 | 23.4 | 22.6 | 55.6 | 32.2 | 33.0 | Outside |
| 1259.600 | PK | 43.9 | 43.6 | 25.5 | 6.1 | 34.7 | -9.1 | 31.7 | 31.5 | 55.6 | 23.9 | 24.1 | Outside |
| 1574.500 | PK | 42.6 | 42.7 | 25.5 | 5.5 | 34.0 | -9.1 | 30.6 | 30.7 | 53.9 | 23.3 | 23.2 | Inside |
| 1889.400 | PK | 44.3 | 44.2 | 26.2 | 5.5 | 33.2 | -9.1 | 33.8 | 33.7 | 55.6 | 21.8 | 22.0 | Outside |
| 2204.300 | PK | 47.2 | 49.7 | 28.3 | 5.6 | 32.8 | -9.1 | 39.2 | 41.7 | 53.9 | 14.7 | 12.2 | Inside |
| 2519.200 | PK | 48.7 | 48.7 | 27.7 | 5.7 | 32.7 | -9.1 | 40.3 | 40.3 | 55.6 | 15.3 | 15.3 | Outside |
| 2834.100 | PK | 47.0 | 46.8 | 28.8 | 5.8 | 32.5 | -9.1 | 40.0 | 39.8 | 53.9 | 14.0 | 14.1 | Inside |
| 3149.000 | PK | 45.8 | 46.2 | 29.1 | 5.9 | 32.4 | -9.1 | 39.3 | 39.7 | 55.6 | 16.3 | 15.9 | Outside |

*Other frequency noises omitted in this report were not seen or had enough margin (more than 20dB).

Sample calculation:

Result of PK = Reading + Ant Factor + Loss {Cable + Attenuator + Distance factor (above 1 GHz)} - Gain (Amplifier)

Result of PK with Duty factor = Reading + Ant Factor + Loss {Cable + Attenuator + Distance factor (above 1 GHz)} - Gain (Amplifier) + Duty factor

For above 1GHz : Distance Factor: $20 \times \log(4.0 \text{ m}/3.0 \text{ m}) = 2.50 \text{ dB}$

*Other frequency noises omitted in this report were not seen or had enough margin (more than 20dB).

UL Japan, Inc.

Ise EMC Lab.

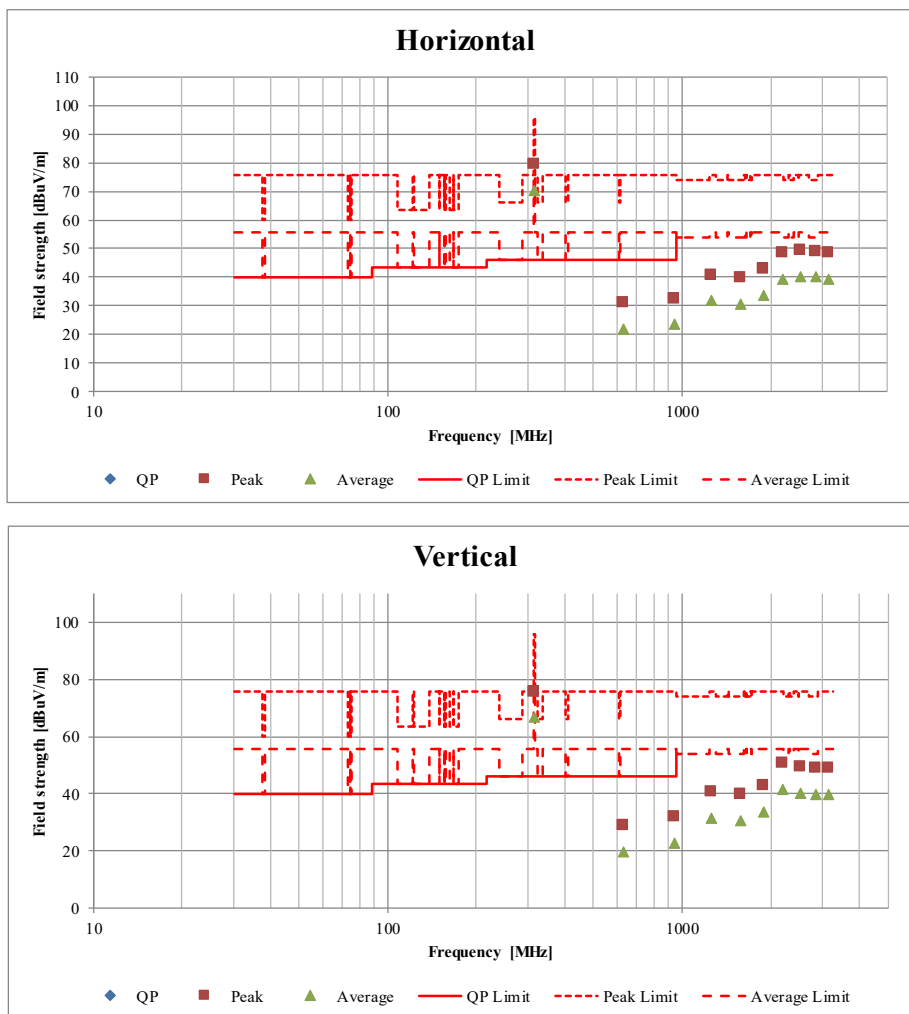
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

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

| | | |
|------------------------|-----------------------------------|---------------------|
| Report No. | 12936408H | |
| Test place | Ise EMC Lab. | |
| Semi Anechoic Chamber | No.3 | No.3 |
| Date | July 8, 2019 | July 10, 2019 |
| Temperature / Humidity | 22 deg. C / 53 % RH | 22 deg. C / 55 % RH |
| Engineer | Akihiko Maeda | Koji Yamamoto |
| | (Below 1 GHz) | (Above 1 GHz) |
| Mode | Transmitting mode FSK (314.9 MHz) | |



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

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

-20dB and 99% Occupied Bandwidth

Report No. 12936408H
Test place Ise EMC Lab. No.3 Semi Anechoic Chamber
Date July 8, 2019
Temperature / Humidity 22 deg. C / 53 % RH
Engineer Akihiko Maeda
Mode Transmitting Mode ASK/FSK (314.9 MHz)

ASK

Bandwidth Limit : Fundamental Frequency **314.90** MHz x 0.25% = 787.25 kHz

* The above limit was calculated from more stringent nominal frequency.

| -20dB Bandwidth [kHz] | Bandwidth Limit [kHz] | Result |
|--------------------------|--------------------------|--------|
| 42.818 | 787.25 | Pass |

| 99% Occupied Bandwidth [kHz] | Bandwidth Limit [kHz] | Result |
|---------------------------------|--------------------------|--------|
| 109.6345 | 787.25 | Pass |

FSK

Bandwidth Limit : Fundamental Frequency **314.90** MHz x 0.25% = 787.25 kHz

* The above limit was calculated from more stringent nominal frequency.

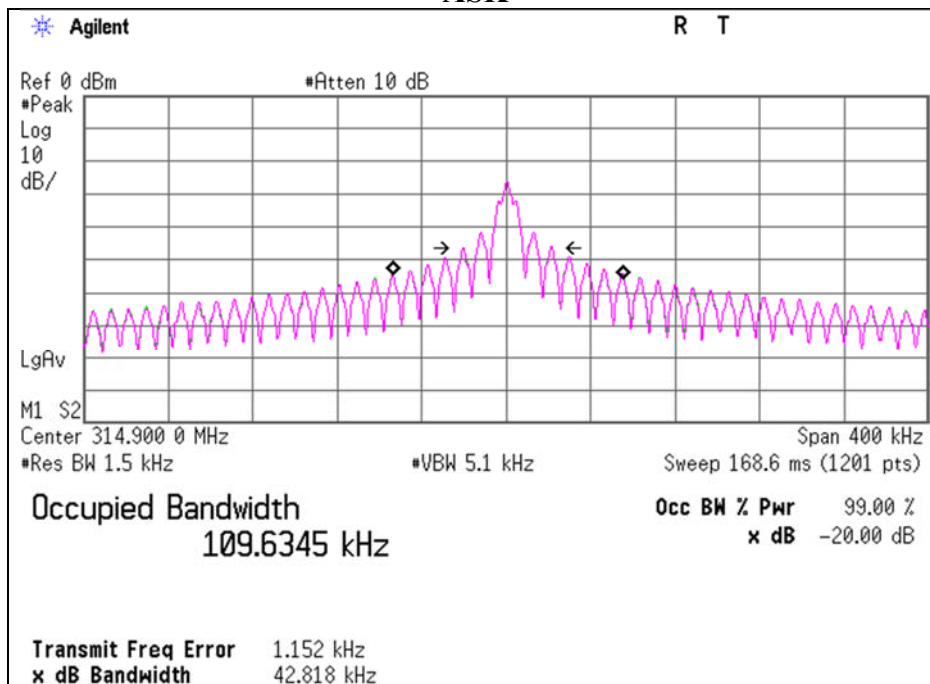
| -20dB Bandwidth [kHz] | Bandwidth Limit [kHz] | Result |
|--------------------------|--------------------------|--------|
| 86.688 | 787.25 | Pass |

| 99% Occupied Bandwidth [kHz] | Bandwidth Limit [kHz] | Result |
|---------------------------------|--------------------------|--------|
| 94.1251 | 787.25 | Pass |

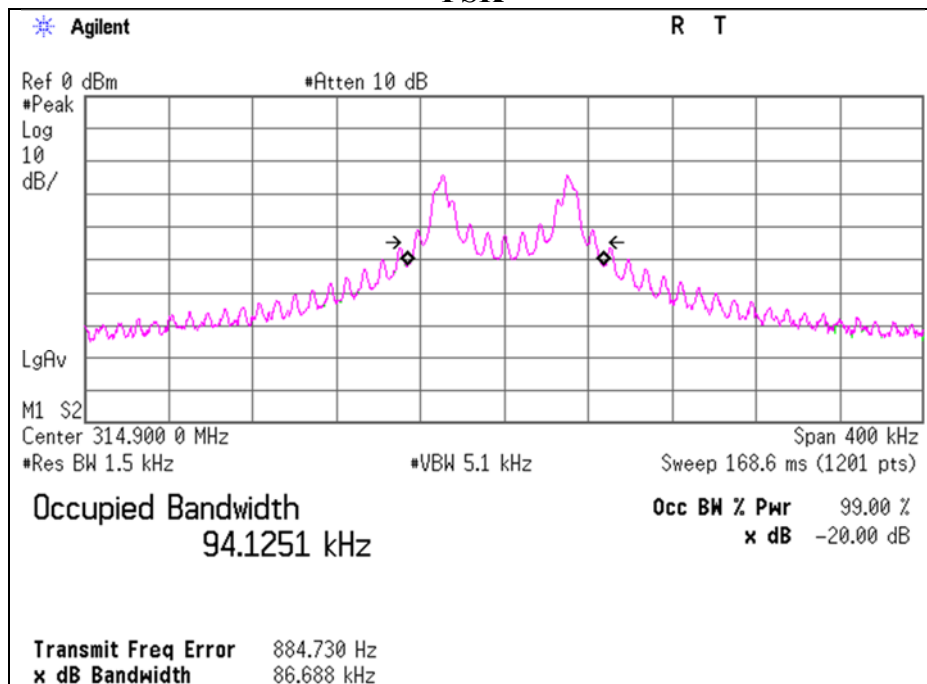
-20dB and 99% Occupied Bandwidth

| | |
|------------------------|---|
| Report No. | 12936408H |
| Test place | Ise EMC Lab. No.3 Semi Anechoic Chamber |
| Date | July 8, 2019 |
| Temperature / Humidity | 22 deg. C / 53 % RH |
| Engineer | Akihiko Maeda |
| Mode | Transmitting Mode ASK/FSK (314.9 MHz) |

ASK



FSK



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

Duty Cycle

Report No. 12936408H
Test place Ise EMC Lab. No.3 Semi Anechoic Chamber
Date July 8, 2019
Temperature / Humidity 22 deg. C / 53 % RH
Engineer Akihiko Maeda
Mode Transmitting Mode ASK (314.9 MHz)

| Type | Times | ON time(One pulse) [ms] | ON time(in 100ms) [ms] |
|------|-------|----------------------------|---------------------------|
| A | 50 | 0.123 | 6.15 |
| B | 47 | 0.244 | 11.4539 |

*1)ON time(in 100ms) = Times * ON time(One pulse)

*2)The train of pulses was exceeding 100msec, and that sampled 100msec was the worst case against the pulse train.

(Total)

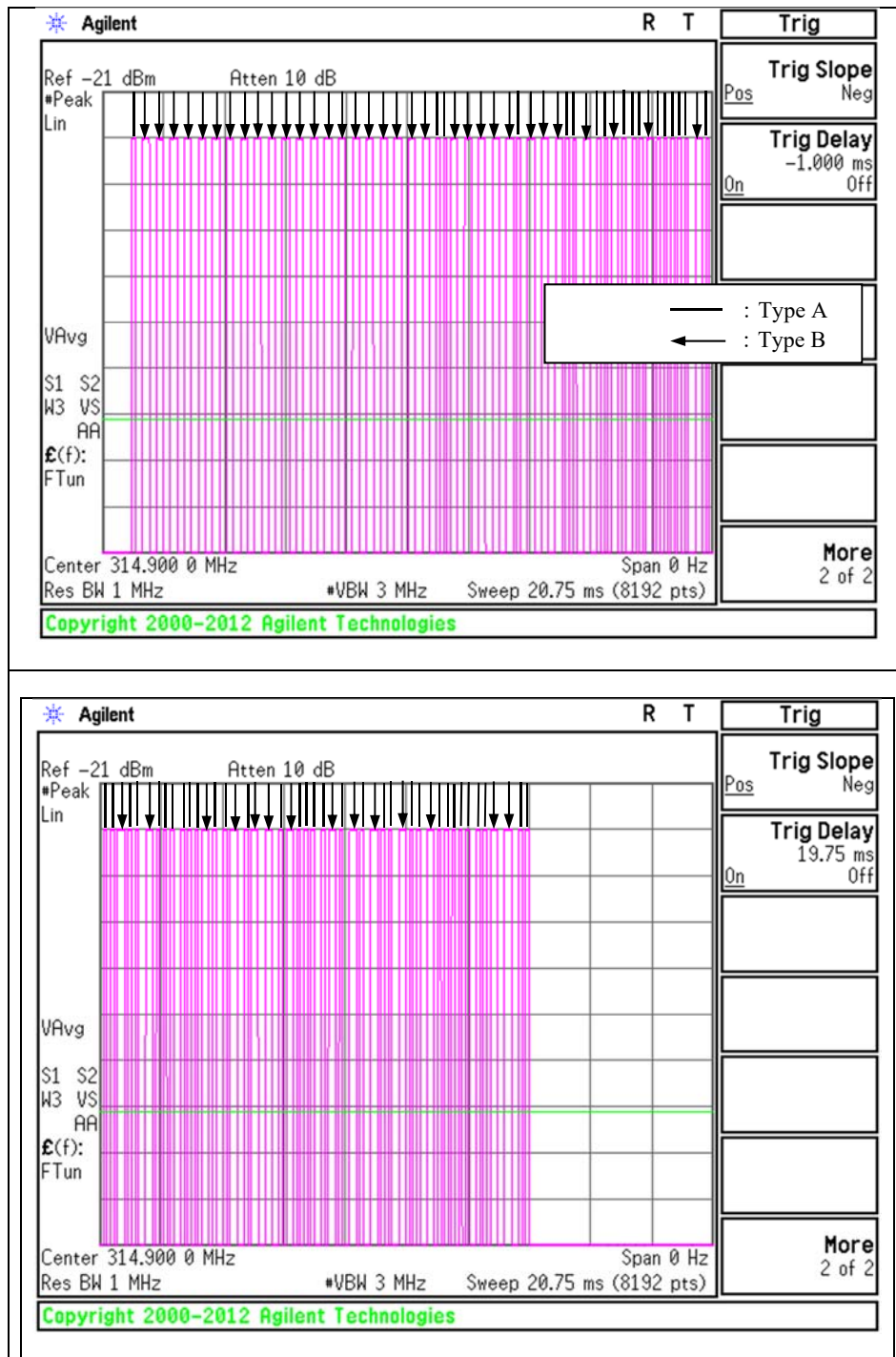
| ON time [ms] | Cycle [ms] | Duty (On time/Cycle) | Duty [dB] |
|-----------------|---------------|-------------------------|--------------|
| 17.60 | 100.00 | 0.18 | -15.1 |

*3)ON time = Type A's ON time (in 100ms) + Type B's ON time (in 100ms)

*4)Duty = $20\log_{10}(\text{ON time/Cycle})$

*The test was performed by a button-pressed operation as the worst case.
Please refer to the "Theory of Operation" for details.

Duty Cycle



UL Japan, Inc.

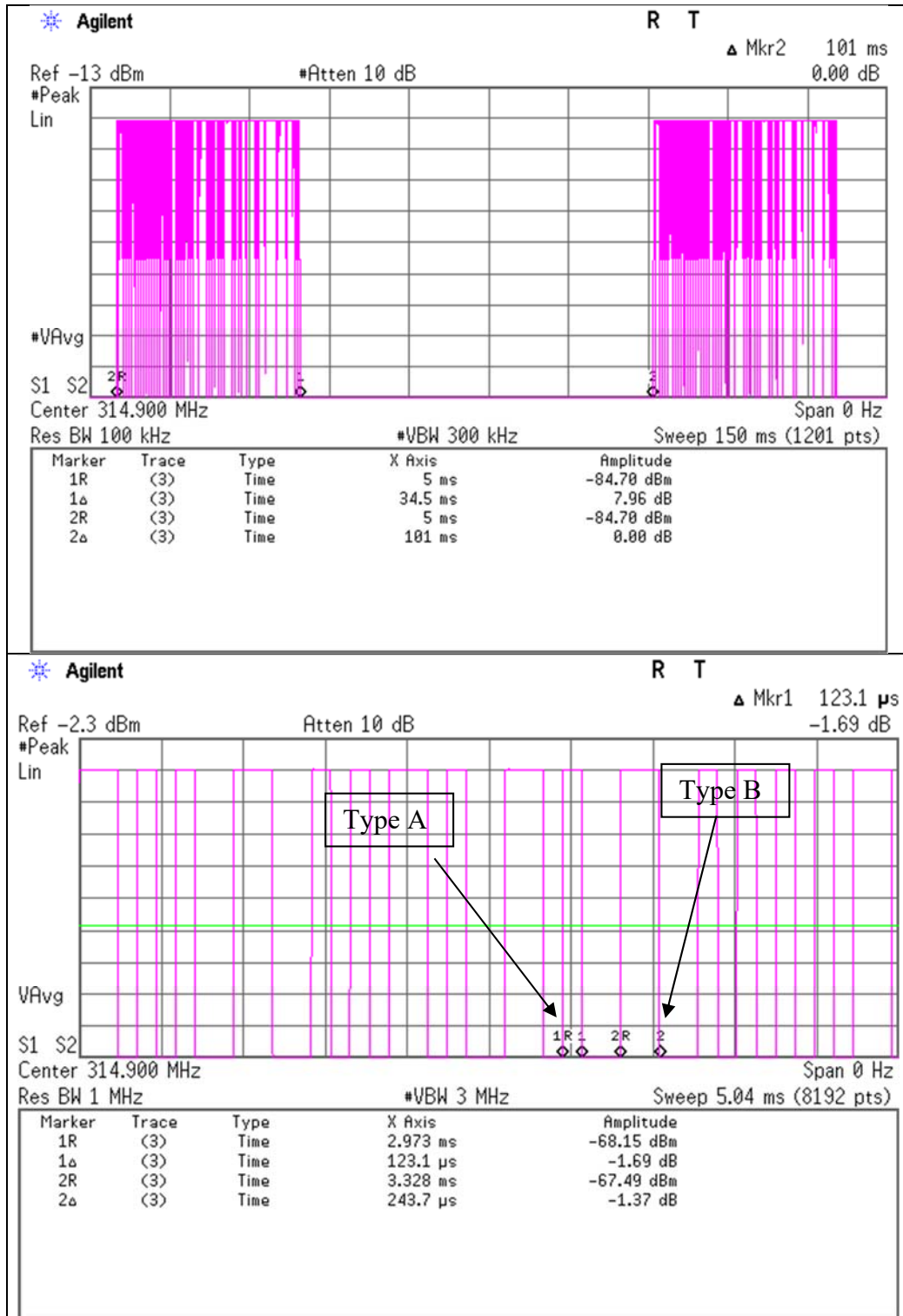
Ise EMC Lab.

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

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Duty Cycle



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

Duty Cycle

Report No. 12936408H
Test place Ise EMC Lab. No.3 Semi Anechoic Chamber
Date July 8, 2019
Temperature / Humidity 22 deg. C / 53 % RH
Engineer Akihiko Maeda
Mode Transmitting Mode FSK (314.9 MHz)

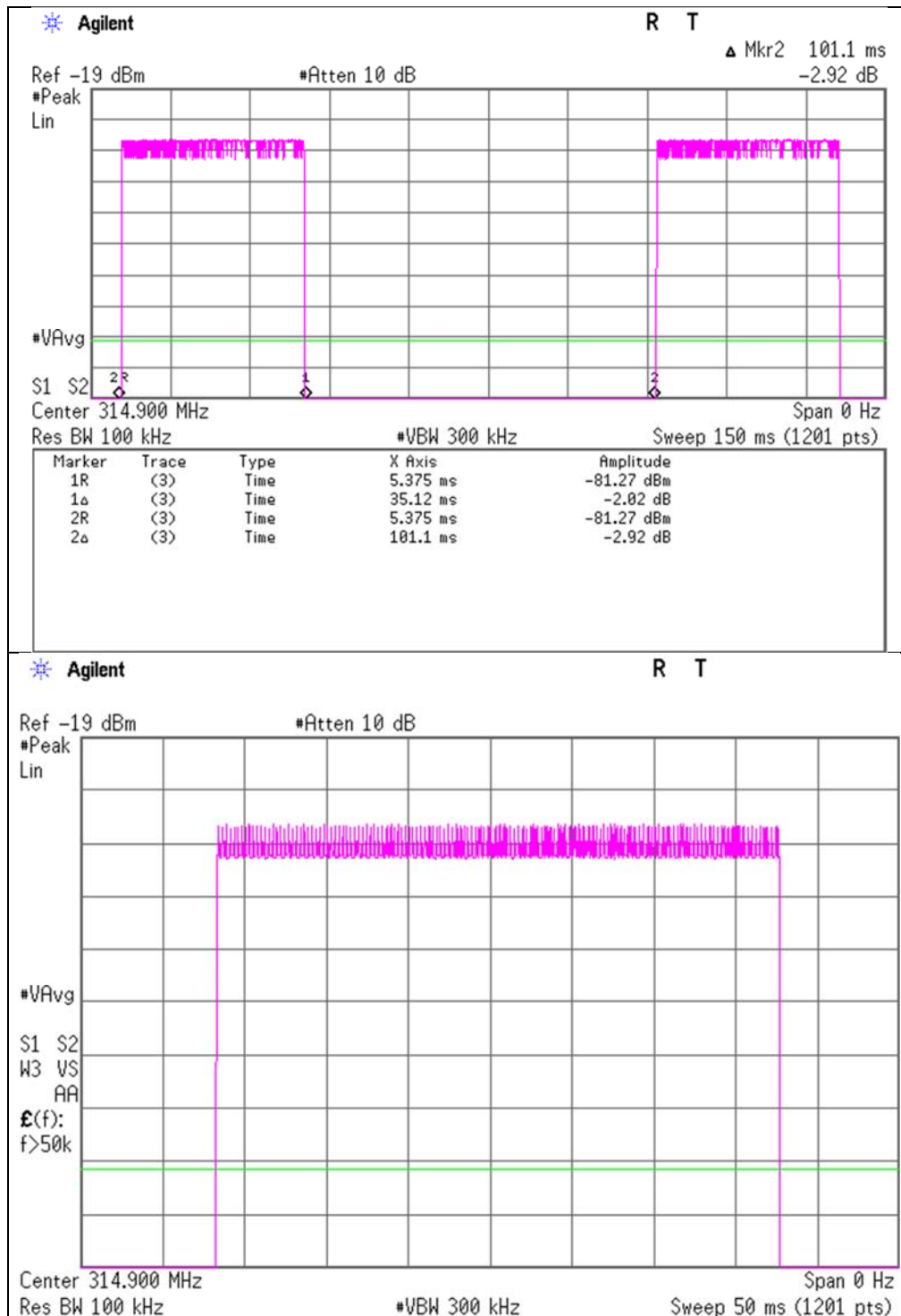
(Total)

| ON time [ms] | Cycle [ms] | Duty (On time/Cycle) | Duty [dB] |
|-----------------|---------------|-------------------------|--------------|
| 35.120 | 100.00 | 0.3512 | -9.09 |

*1)Duty = $20\log_{10}(\text{ON time/Cycle})$

*The test was performed by a button-pressed operation as the worst case.
Please refer to the “Theory of Operation” for details.

Duty Cycle



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

APPENDIX 2: Test instruments

Test Instruments

| Test item | LIMS ID | Description | Manufacturer | Model | Serial | Last Calibration Date | Calibration Due Date | Cal Int |
|-----------|---------|----------------------------------|----------------------|--------------------------|-------------------------------|-----------------------|----------------------|---------|
| RE | 141424 | Biconical Antenna | Schwarzbeck | BBA9106 | 1915 | 5/24/2019 | 5/31/2020 | 12 |
| RE | 177964 | Microwave Cable | Junkosha INC. | MMX221 | 1901S329(1m)/ 1902S579(5m) | 3/5/2019 | 3/31/2020 | 12 |
| RE | 141323 | Coaxial cable | UL Japan | - | - | 7/2/2019 | 7/31/2020 | 12 |
| RE | 141582 | Pre Amplifier | SONOMA INSTRUMENT | 310 | 260834 | 2/8/2019 | 2/29/2020 | 12 |
| RE | 141949 | Test Receiver | Rohde & Schwarz | ESCI | 100767 | 8/6/2018 | 8/31/2019 | 12 |
| RE | 141901 | Spectrum Analyzer | AGILENT | E4440A | MY48250080 | 10/4/2018 | 10/31/2019 | 12 |
| RE | 141554 | Thermo-Hygrometer | CUSTOM | CTH-180 | 1301 | 1/11/2019 | 1/31/2020 | 12 |
| RE | 141532 | DIGITAL HiTESTER | HIOKI | 3805 | 51201197 | 1/29/2019 | 1/31/2020 | 12 |
| RE | 142181 | Measure | KOMELON | KMC-36 | - | - | - | - |
| RE | 141331 | Attenuator(6dB) | TME | UFA-01 | - | 2/5/2019 | 2/29/2020 | 12 |
| RE | 142013 | AC3_Semi Anechoic Chamber(SVSWR) | TDK | Semi Anechoic Chamber 3m | DA-10005 | 4/8/2019 | 4/30/2021 | 24 |
| RE | 141297 | High Pass Filter(1.1-10GHz) | TOKYO KEIKI | TF219CD1 | 1001 | 1/10/2019 | 1/31/2020 | 12 |
| RE | 141507 | Horn Antenna 1-18GHz | Schwarzbeck | BBHA9120D | 258 | 5/10/2019 | 5/31/2020 | 12 |
| RE | 141580 | MicroWave System Amplifier | AGILENT | 83017A | MY39500779 | 3/5/2019 | 3/31/2020 | 12 |
| RE | 141266 | Logperiodic Antenna(200-1000MHz) | Schwarzbeck | VUSLP9111B | 911B-191 | 3/25/2019 | 3/31/2020 | 12 |
| RE | 142645 | Loop Antenna | UL Japan | - | - | - | - | - |

*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:

RE: Radiated emission, 99 % Occupied Bandwidth, -20 dB bandwidth, Automatically deactivate and Duty cycle tests

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