



RADIO TEST REPORT

Test Report No. : 12873561H-B

Applicant : TOYOTA MOTOR CORPORATION
Type of Equipment : Smart LF Oscillator
Model No. : TMLF19D-1
FCC ID : NI4TMLF19D-1
Test regulation : FCC Part 15 Subpart C: 2019
Test Result : Complied (Refer to SECTION 3.2)

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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.

Date of test: July 2 to 3, 2019

Representative test engineer: 
 Akihiko Maeda
 Engineer
 Consumer Technology Division

Approved by: 
 Motoya Imura
 Leader
 Consumer Technology Division



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

REVISION HISTORY

Original Test Report No.: 12873561H-B

| Revision | Test report No. | Date | Page revised | Contents |
|-----------------|-----------------|---------------------|--------------|----------|
| - (Original) | 12873561H-B | November 13 2019 | - | - |

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Reference: Abbreviations (Including words undescribed in this report)

| | | | |
|----------------|---|---------|---|
| A2LA | The American Association for Laboratory Accreditation | MCS | Modulation and Coding Scheme |
| AC | Alternating Current | MRA | Mutual Recognition Arrangement |
| AFH | Adaptive Frequency Hopping | N/A | Not Applicable |
| AM | Amplitude Modulation | NIST | National Institute of Standards and Technology |
| Amp, AMP | Amplifier | NS | No signal detect. |
| ANSI | American National Standards Institute | NSA | Normalized Site Attenuation |
| Ant, ANT | Antenna | NVLAP | National Voluntary Laboratory Accreditation Program |
| AP | Access Point | OBW | Occupied Band Width |
| 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 | Quadri-Phase Shift Keying |
| CW | Continuous Wave | RBW | Resolution Band Width |
| 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 | RSS | Radio Standards Specifications |
| DSSS | Direct Sequence Spread Spectrum | 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 | Test Receiver |
| EN | European Norm | Tx | Transmitting |
| ERP, e.r.p. | Effective Radiated Power | VBW | Video BandWidth |
| EU | European Union | Vert. | Vertical |
| EUT | Equipment Under Test | WLAN | Wireless LAN |
| 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 | | |
| LIMS | Laboratory Information Management System | | |

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| CONTENTS | PAGE |
|---|-------------|
| SECTION 1: Customer information | 5 |
| SECTION 2: Equipment under test (E.U.T.)..... | 5 |
| SECTION 3: Test specification, procedures & results | 6 |
| SECTION 4: Operation of E.U.T. during testing..... | 9 |
| SECTION 5: Radiated emission (Fundamental and Spurious Emission)..... | 11 |
| SECTION 6: -26dB Bandwidth..... | 14 |
| SECTION 7: 99% Occupied Bandwidth..... | 14 |
| APPENDIX 1: Test data | 15 |
| Radiated Emission below 30 MHz (Fundamental and Spurious Emission) | 15 |
| Radiated Emission above 30 MHz (Spurious Emission)..... | 20 |
| -26 dB Bandwidth and 99 % Occupied Bandwidth | 26 |
| APPENDIX 2: Test instruments | 31 |
| APPENDIX 3: Photographs of test setup | 32 |
| Radiated Emission..... | 32 |
| Worst Case Position | 33 |

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SECTION 1: Customer information

Company Name : TOYOTA MOTOR CORPORATION
Address : 1, Toyota-Cho, Toyota, Aichi, 471-8572 Japan
Telephone Number : +81-565-94-1250
Facsimile Number : +81-565-94-0414
Contact Person : Hidemasa Yoshida

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 : Smart LF Oscillator
Model No. : TMLF19D-1
Serial No. : Refer to Section 4, Clause 4.2
Rating : DC 12.0 V (Max 0.5 A)
Receipt Date of Sample : June 28, 2019
(Information from test lab.)
Country of Mass-production : Japan
Condition of EUT : Engineering 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

Smart LF Oscillator, model: TMLF19D-1 is a transmitter that is installed in a motor vehicle and is used as part of Smart System.

Radio Specification

Radio Type : Transmitter
Frequency of Operation : 134.2 kHz
Modulation : ASK
Method of Frequency Generation : Crystal (for Outside Antenna, Inside Antenna, Rear Antenna)
Ceramic (for Immobilizer Antenna)
Antenna type : Ferrite Antenna Coil (for Outside Antenna, Inside Antenna, Rear Antenna)
Loop Antenna Coil (for Immobilizer Antenna)

Smart LF Oscillator (model: TMLF19D-1) consists of the following parts:

- Smart ECU
- Immobilizer Antenna
- Inside Antenna
- Outside Antenna
- Rear Antenna

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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 July 19, 2019 and effective August 19, 2019 except 15.258

Title : FCC 47CFR Part15 Radio Frequency Device Subpart C Intentional Radiators
Section 15.207 Conducted limits
Section 15.209 Radiated emission limits; general requirements.

* 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 | Remarks | Deviation | Worst margin | Results |
|---|--|---|----------|-----------|--|----------------|
| Conducted Emission | <FCC> ANSI C63.10:2013 6 Standard test methods <IC> RSS-Gen 8.8 | <FCC> Section 15.207 <IC> RSS-Gen 8.8 | - | N/A | N/A *1) | N/A |
| Electric Field Strength of Fundamental Emission | <FCC> ANSI C63.10:2013 6 Standard test methods <IC> RSS-Gen 6.5, 6.12 | <FCC> Section 15.209 <IC> RSS-210 4.4 RSS-Gen 8.9 | Radiated | N/A | 5.8 dB 0.13420 MHz 0 deg. PK with Duty factor | Complied a) |
| Electric Field Strength of Spurious Emission | <FCC> ANSI C63.10:2013 6 Standard test methods <IC> RSS-Gen 6.5, 6.6, 6.13 | <FCC> Section 15.209 <IC> RSS-210 4.4 RSS-Gen 8.9 | Radiated | N/A | 15.4 dB 0.67100 MHz, 0 deg., QP | Complied a) |
| -26dB Bandwidth | <FCC> ANSI C63.10:2013 6 Standard test methods <IC> - | <FCC> Reference data <IC> - | Radiated | N/A | N/A | Complied b) |

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 is not the device that is designed to be connected to the public utility (AC) power line.

a) Refer to APPENDIX 1 (data of Radiated emission)

b) Refer to APPENDIX 1 (data of -26 dB Bandwidth 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 15.31 (e)

The EUT provides stable voltage constantly to the wireless transmitter regardless of input voltage.

Instead of a new battery, DC power supply was used for the test.

That does not affect the test result, 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 vehicle. Therefore, the equipment complies with the antenna requirement of Section 15.203.

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3.3 Addition to standard

| Item | Test Procedure | Specification | Remarks | Deviation | Worst margin | Results |
|--------------------------|----------------|---------------|----------|-----------|--------------|---------|
| 99 % Occupied Band Width | RSS-Gen 6.7 | - | Radiated | N/A | N/A | - |

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 |

* Measurement distance

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

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3.5 Test Location

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

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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.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.

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

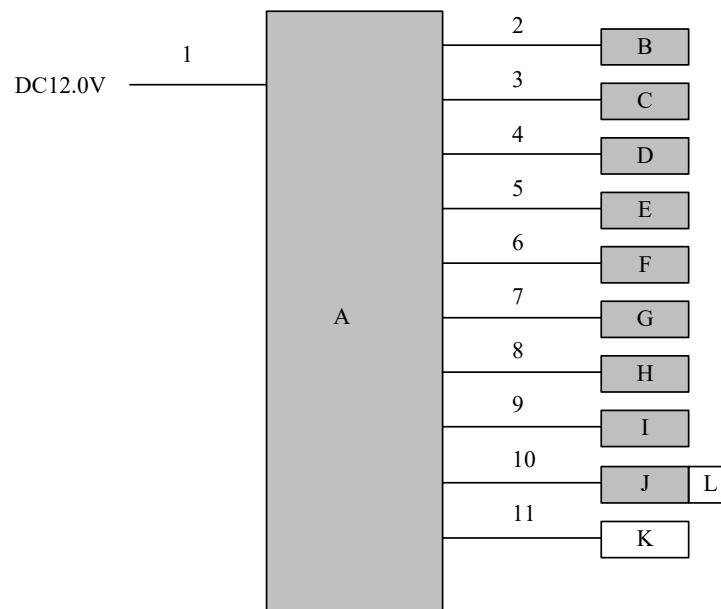
4.1 Operating Modes

| Test mode | Remarks *1) |
|--|-------------------------------------|
| 1) Tx 134.2 kHz Outside Antenna | Section 2 of Timing of transmission |
| 2) Tx 134.2 kHz Inside Antenna | Section 2 of Timing of transmission |
| 3) Tx 134.2 kHz Rear Antenna | Section 2 of Timing of transmission |
| 4) Tx 134.2 kHz Immobilizer Antenna | Section 3 of Timing of transmission |
| 5) Tx 134.2 kHz, Outside Antenna 1+2+3+4 | Section 1 of Timing of transmission |

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

*1) Refer to Timing of transmission in "Theory of Operation" for details.

4.2 Configuration and peripherals



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

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Description of EUT and Support equipment

| No. | Item | Model number | Serial number | Manufacturer | Remarks |
|-----|---------------------|--------------|--------------------------------------|--------------|---------|
| A | Smart ECU | TMLF19D-1 | E19A2:No.036 *1) E19A2:No.033 *2) | - | EUT |
| B | Outside Antenna | D19A2 | No.043 | - | EUT |
| C | Outside Antenna | D19A2 | No.041 | - | EUT |
| D | Outside Antenna | D19A1 | No.037 | - | EUT |
| E | Outside Antenna | D19A1 | No.039 | - | EUT |
| F | Inside Antenna | 18WA0 | No.025 | - | EUT |
| G | Inside Antenna | 18WA0 | No.027 | - | EUT |
| H | Inside Antenna | 18WA0 | No.026 | - | EUT |
| I | Rear Antenna | 12TA0 | No.019 | - | EUT |
| J | Immobilizer Antenna | 18PA1 | No.021 | - | EUT |
| K | Switch BOX | 19CY-MAX | No.016 | - | - |
| L | Smart Key | - | No.024 | - | - |

*1) Used for Mode 1, 2, 3, 4

*2) Used for Mode 5

List of cables used

| No. | Name | Length (m) | Shield | | Remarks |
|-----|---------------|------------|------------|------------|---------|
| | | | Cable | Connector | |
| 1 | DC Cable | 2.0 | Unshielded | Unshielded | - |
| 2 | Antenna Cable | 3.0 | Unshielded | Unshielded | - |
| 3 | Antenna Cable | 3.0 | Unshielded | Unshielded | - |
| 4 | Antenna Cable | 3.0 | Unshielded | Unshielded | - |
| 5 | Antenna Cable | 3.0 | Unshielded | Unshielded | - |
| 6 | Antenna Cable | 3.0 | Unshielded | Unshielded | - |
| 7 | Antenna Cable | 3.0 | Unshielded | Unshielded | - |
| 8 | Antenna Cable | 3.0 | Unshielded | Unshielded | - |
| 9 | Antenna Cable | 3.0 | Unshielded | Unshielded | - |
| 10 | Antenna Cable | 3.0 | Unshielded | Unshielded | - |
| 11 | Signal Cable | 3.0 | Unshielded | Unshielded | - |

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SECTION 5: Radiated emission (Fundamental and Spurious Emission)

Test Procedure

EUT was placed on a urethane platform of nominal size, 1.0 m by 1.5 m, raised 0.8 m above the conducting ground plane.

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

Frequency : From 9 kHz to 30 MHz

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

The measurements were performed for vertical polarization (antenna angle: 0 deg., 45 deg., 90 deg., 135 deg. and 180 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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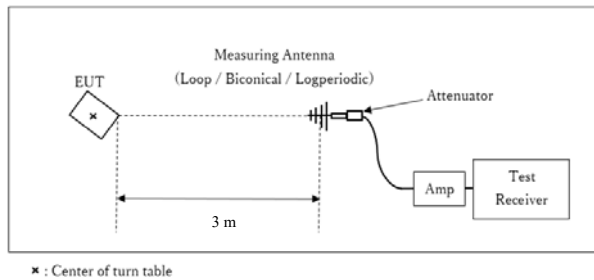
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[Test Setup]
Below 1 GHz



Test Distance: 3 m

- 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.

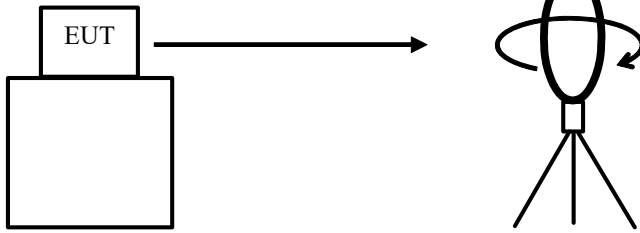
Measurement range : 9 kHz - 1 GHz
Test data : APPENDIX 1
Test result : Pass

Date: July 2, 2019
July 3, 2019 (day)
July 3, 2019 (night)

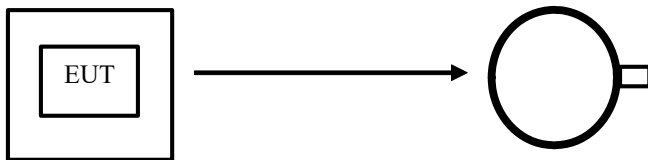
Test engineer: Akihiko Maeda
Junya Okuno
Akihiko Maeda

Figure 1: Direction of the Loop Antenna

Side View (Vertical)

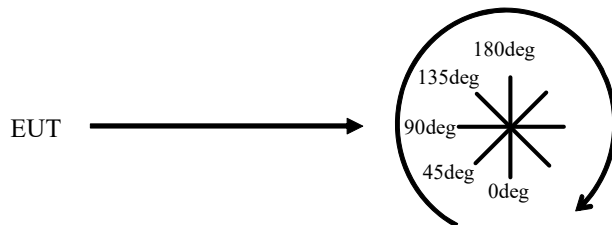


.....
Top View (Horizontal)



Antenna was not rotated.

.....
Top View (Vertical)



Front side: 0 deg.
Forward direction: clockwise

SECTION 6: -26dB Bandwidth

Test Procedure

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

| Test | Span | RBW | VBW | Sweep | Detector | Trace | Instrument used |
|------------------|--------|--------|---------|-------|----------|----------|-------------------|
| -26 dB Bandwidth | 50 kHz | 510 Hz | 1.6 kHz | Auto | Peak | Max Hold | Spectrum Analyzer |

Test data : APPENDIX 1
Test result : Pass

SECTION 7: 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 |
|-------------------------|---|-----------------|--------------------|-------|----------|--------------|-------------------|
| 99 % Occupied Bandwidth | Enough width to display emission skirts | 1 to 5 % of OBW | Three times of RBW | Auto | Peak *1) | Max Hold *1) | Spectrum Analyzer |

*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 1
Test result : Pass

APPENDIX 1: Test data

Radiated Emission below 30 MHz (Fundamental and Spurious Emission)

Report No. 12873561H
Test place Ise EMC Lab. No.1 Semi Anechoic Chamber
Date 07/02/2019
Temperature/ Humidity 24 deg. C / 73 % RH
Engineer Akihiko Maeda
Mode Tx 134.2 kHz, Outside Antenna

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 |
|---|--------------------|----------|-------------------|-------------------------|--------------|--------------|------------------------|--------------------|-------------------|----------------|-------------|
| 0 | 0.13420 | PK | 102.9 | 19.7 | -74.0 | 32.2 | - | 16.4 | 45.0 | 28.6 | Fundamental |
| 0 | 0.26840 | PK | 59.3 | 19.7 | -74.0 | 32.2 | - | -27.2 | 39.0 | 66.2 | |
| 0 | 0.40260 | PK | 66.7 | 19.6 | -73.9 | 32.2 | - | -19.8 | 35.5 | 55.3 | |
| 0 | 0.53680 | QP | 36.3 | 19.6 | -33.9 | 32.1 | - | -10.1 | 33.0 | 43.1 | |
| 0 | 0.67100 | QP | 56.1 | 19.6 | -33.9 | 32.2 | - | 9.7 | 31.1 | 21.4 | |
| 0 | 0.80520 | QP | 32.7 | 19.6 | -33.9 | 32.2 | - | -13.7 | 29.5 | 43.2 | |
| 0 | 0.93940 | QP | 46.6 | 19.6 | -33.8 | 32.2 | - | 0.2 | 28.1 | 27.9 | |
| 0 | 1.07360 | QP | 31.5 | 19.6 | -33.8 | 32.2 | - | -14.9 | 26.9 | 41.8 | |
| 0 | 1.20780 | QP | 38.5 | 19.6 | -33.8 | 32.2 | - | -7.9 | 25.9 | 33.8 | |
| 0 | 1.34200 | QP | 31.2 | 19.6 | -33.8 | 32.2 | - | -15.2 | 25.0 | 40.2 | |

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

PK with Duty 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 |
|---------------|--------------------|----------|-------------------|-------------------------|--------------|--------------|------------------------|--------------------|-------------------|----------------|--------|
| 0 | 0.13420 | AV | 102.9 | 19.7 | -74.0 | 32.2 | 0.0 | 16.4 | 25.0 | 8.6 | |
| 0 | 0.26840 | AV | 59.3 | 19.7 | -74.0 | 32.2 | 0.0 | -27.2 | 19.0 | 46.2 | |
| 0 | 0.40260 | AV | 66.7 | 19.6 | -73.9 | 32.2 | 0.0 | -19.8 | 15.5 | 35.3 | |

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

* Since the peak emission result satisfied the average limit, duty factor was omitted.

Result of the fundamental emission at 3m without Distance factor

PK or 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 |
|---------------|--------------------|----------|-------------------|-------------------------|--------------|--------------|------------------------|--------------------|-------------------|----------------|-------------|
| 0 | 0.13420 | PK | 102.9 | 19.7 | 6.0 | 32.2 | - | 96.4 | - | - | Fundamental |

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

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

*The test result is rounded off to one or two decimal places, so some differences might be observed.

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Facsimile : +81 596 24 8124

Radiated Emission below 30 MHz (Fundamental and Spurious Emission)

Report No. 12873561H
Test place Ise EMC Lab. No.1 Semi Anechoic Chamber
Date 07/02/2019
Temperature/ Humidity 24 deg. C / 73 % RH
Engineer Akihiko Maeda
Mode Tx 134.2 kHz, Inside Antenna

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 |
|---|--------------------|----------|-------------------|-------------------------|--------------|--------------|------------------------|--------------------|-------------------|----------------|-------------|
| 0 | 0.13420 | PK | 102.1 | 19.7 | -74.0 | 32.2 | - | 15.6 | 45.0 | 29.4 | Fundamental |
| 0 | 0.26840 | PK | 58.5 | 19.7 | -74.0 | 32.2 | - | -28.0 | 39.0 | 67.0 | |
| 0 | 0.40260 | PK | 68.1 | 19.6 | -73.9 | 32.2 | - | -18.4 | 35.5 | 53.9 | |
| 0 | 0.53680 | QP | 45.0 | 19.6 | -33.9 | 32.1 | - | -1.4 | 33.0 | 34.4 | |
| 0 | 0.67100 | QP | 59.1 | 19.6 | -33.9 | 32.2 | - | 12.7 | 31.1 | 18.4 | |
| 0 | 0.80520 | QP | 32.1 | 19.6 | -33.9 | 32.2 | - | -14.3 | 29.5 | 43.8 | |
| 0 | 0.93940 | QP | 50.6 | 19.6 | -33.8 | 32.2 | - | 4.2 | 28.1 | 23.9 | |
| 0 | 1.07360 | QP | 31.0 | 19.6 | -33.8 | 32.2 | - | -15.4 | 26.9 | 42.3 | |
| 0 | 1.20780 | QP | 41.9 | 19.6 | -33.8 | 32.2 | - | -4.5 | 25.9 | 30.4 | |
| 0 | 1.34200 | QP | 30.9 | 19.6 | -33.8 | 32.2 | - | -15.5 | 25.0 | 40.5 | |

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

PK with Duty 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 |
|---------------|--------------------|----------|-------------------|-------------------------|--------------|--------------|------------------------|--------------------|-------------------|----------------|--------|
| 0 | 0.13420 | AV | 102.1 | 19.7 | -74.0 | 32.2 | 0.0 | 15.6 | 25.0 | 9.4 | |
| 0 | 0.26840 | AV | 58.5 | 19.7 | -74.0 | 32.2 | 0.0 | -28.0 | 19.0 | 47.0 | |
| 0 | 0.40260 | AV | 68.1 | 19.6 | -73.9 | 32.2 | 0.0 | -18.4 | 15.5 | 33.9 | |

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

* Since the peak emission result satisfied the average limit, duty factor was omitted.

Result of the fundamental emission at 3m without Distance factor

PK or 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 |
|---------------|--------------------|----------|-------------------|-------------------------|--------------|--------------|------------------------|--------------------|-------------------|----------------|-------------|
| 0 | 0.13420 | PK | 102.1 | 19.7 | 6.0 | 32.2 | - | 95.6 | - | - | Fundamental |

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

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

*The test result is rounded off to one or two decimal places, so some differences might be observed.

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Radiated Emission below 30 MHz (Fundamental and Spurious Emission)

Report No. 12873561H
Test place Ise EMC Lab. No.1 Semi Anechoic Chamber
Date 07/02/2019
Temperature/ Humidity 24 deg. C / 73 % RH
Engineer Akihiko Maeda
Mode Tx 134.2 kHz, Rear Antenna

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 |
|---|--------------------|----------|-------------------|-------------------------|--------------|--------------|------------------------|--------------------|-------------------|----------------|-------------|
| 0 | 0.13420 | PK | 101.8 | 19.7 | -74.0 | 32.2 | - | 15.3 | 45.0 | 29.7 | Fundamental |
| 0 | 0.26840 | PK | 58.3 | 19.7 | -74.0 | 32.2 | - | -28.2 | 39.0 | 67.2 | |
| 0 | 0.40260 | PK | 61.2 | 19.6 | -73.9 | 32.2 | - | -25.3 | 35.5 | 60.8 | |
| 0 | 0.53680 | QP | 55.1 | 19.6 | -33.9 | 32.1 | - | 8.7 | 33.0 | 24.3 | |
| 0 | 0.67100 | QP | 50.8 | 19.6 | -33.9 | 32.2 | - | 4.4 | 31.1 | 26.7 | |
| 0 | 0.80520 | QP | 31.8 | 19.6 | -33.9 | 32.2 | - | -14.6 | 29.5 | 44.1 | |
| 0 | 0.93940 | QP | 48.2 | 19.6 | -33.8 | 32.2 | - | 1.8 | 28.1 | 26.3 | |
| 0 | 1.07360 | QP | 31.0 | 19.6 | -33.8 | 32.2 | - | -15.4 | 26.9 | 42.3 | |
| 0 | 1.20780 | QP | 44.0 | 19.6 | -33.8 | 32.2 | - | -2.4 | 25.9 | 28.3 | |
| 0 | 1.34200 | QP | 30.9 | 19.6 | -33.8 | 32.2 | - | -15.5 | 25.0 | 40.5 | |

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

PK with Duty 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 |
|---------------|--------------------|----------|-------------------|-------------------------|--------------|--------------|------------------------|--------------------|-------------------|----------------|--------|
| 0 | 0.13420 | AV | 101.8 | 19.7 | -74.0 | 32.2 | 0.0 | 15.3 | 25.0 | 9.7 | |
| 0 | 0.26840 | AV | 58.3 | 19.7 | -74.0 | 32.2 | 0.0 | -28.2 | 19.0 | 47.2 | |
| 0 | 0.40260 | AV | 61.2 | 19.6 | -73.9 | 32.2 | 0.0 | -25.3 | 15.5 | 40.8 | |

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

* Since the peak emission result satisfied the average limit, duty factor was omitted.

Result of the fundamental emission at 3m without Distance factor

PK or 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 |
|---------------|--------------------|----------|-------------------|-------------------------|--------------|--------------|------------------------|--------------------|-------------------|----------------|-------------|
| 0 | 0.13420 | PK | 101.8 | 19.7 | 6.0 | 32.2 | - | 95.3 | - | - | Fundamental |

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

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

*The test result is rounded off to one or two decimal places, so some differences might be observed.

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Radiated Emission below 30 MHz (Fundamental and Spurious Emission)

Report No. 12873561H
Test place Ise EMC Lab. No.1 Semi Anechoic Chamber
Date 07/02/2019
Temperature/ Humidity 24 deg. C / 73 % RH
Engineer Akihiko Maeda
Mode Tx 134.2 kHz, Immobilizer Antenna

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 |
|---|--------------------|----------|-------------------|-------------------------|--------------|--------------|------------------------|--------------------|-------------------|----------------|-------------|
| 0 | 0.13420 | PK | 95.5 | 19.7 | -74.0 | 32.2 | - | 9.0 | 45.0 | 36.0 | Fundamental |
| 0 | 0.26840 | PK | 47.9 | 19.7 | -74.0 | 32.2 | - | -38.6 | 39.0 | 77.6 | |
| 0 | 0.40260 | PK | 59.5 | 19.6 | -73.9 | 32.2 | - | -27.0 | 35.5 | 62.5 | |
| 0 | 0.53680 | QP | 32.8 | 19.6 | -33.9 | 32.1 | - | -13.6 | 33.0 | 46.6 | |
| 0 | 0.67100 | QP | 49.0 | 19.6 | -33.9 | 32.2 | - | 2.6 | 31.1 | 28.5 | |
| 0 | 0.80520 | QP | 31.6 | 19.6 | -33.9 | 32.2 | - | -14.8 | 29.5 | 44.3 | |
| 0 | 0.93940 | QP | 41.9 | 19.6 | -33.8 | 32.2 | - | -4.5 | 28.1 | 32.6 | |
| 0 | 1.07360 | QP | 37.2 | 19.6 | -33.8 | 32.2 | - | -9.2 | 26.9 | 36.1 | |
| 0 | 1.20780 | QP | 36.9 | 19.6 | -33.8 | 32.2 | - | -9.5 | 25.9 | 35.4 | |
| 0 | 1.34200 | QP | 31.3 | 19.6 | -33.8 | 32.2 | - | -15.1 | 25.0 | 40.1 | |

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

PK with Duty 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 |
|---------------|--------------------|----------|-------------------|-------------------------|--------------|--------------|------------------------|--------------------|-------------------|----------------|--------|
| 0 | 0.13420 | AV | 95.5 | 19.7 | -74.0 | 32.2 | 0.0 | 9.0 | 25.0 | 16.0 | |
| 0 | 0.26840 | AV | 47.9 | 19.7 | -74.0 | 32.2 | 0.0 | -38.6 | 19.0 | 57.6 | |
| 0 | 0.40260 | AV | 59.5 | 19.6 | -73.9 | 32.2 | 0.0 | -27.0 | 15.5 | 42.5 | |

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

* Since the peak emission result satisfied the average limit, duty factor was omitted.

Result of the fundamental emission at 3m without Distance factor

PK or 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 |
|---------------|--------------------|----------|-------------------|-------------------------|--------------|--------------|------------------------|--------------------|-------------------|----------------|-------------|
| 0 | 0.13420 | PK | 95.5 | 19.7 | 6.0 | 32.2 | - | 89.0 | - | - | Fundamental |

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

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

*The test result is rounded off to one or two decimal places, so some differences might be observed.

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Radiated Emission below 30 MHz (Fundamental and Spurious Emission)

Report No. 12873561H
Test place Ise EMC Lab. No.1 Semi Anechoic Chamber
Date 07/02/2019
Temperature/ Humidity 24 deg. C / 73 % RH
Engineer Akihiko Maeda
Mode Tx 134.2 kHz, Outside Antenna 1+2+3+4

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 |
|---|--------------------|----------|-------------------|-------------------------|--------------|--------------|------------------------|--------------------|-------------------|----------------|-------------|
| 0 | 0.13420 | PK | 105.7 | 19.7 | -74.0 | 32.2 | - | 19.2 | 45.0 | 25.8 | Fundamental |
| 0 | 0.26840 | PK | 53.9 | 19.7 | -64.3 | 32.2 | - | -22.9 | 39.0 | 61.9 | |
| 0 | 0.40260 | PK | 67.8 | 19.6 | -64.3 | 32.2 | - | -9.0 | 35.5 | 44.5 | |
| 0 | 0.53680 | QP | 32.4 | 19.6 | -24.3 | 32.1 | - | -4.4 | 33.0 | 37.4 | |
| 0 | 0.67100 | QP | 52.5 | 19.6 | -24.3 | 32.2 | - | 15.7 | 31.1 | 15.4 | |
| 0 | 0.80520 | QP | 28.8 | 19.6 | -24.2 | 32.2 | - | -8.0 | 29.5 | 37.5 | |
| 0 | 0.93940 | QP | 42.6 | 19.6 | -24.2 | 32.2 | - | 5.8 | 28.1 | 22.3 | |
| 0 | 1.07360 | QP | 25.5 | 19.6 | -24.2 | 32.2 | - | -11.3 | 26.9 | 38.2 | |
| 0 | 1.20780 | QP | 33.6 | 19.6 | -24.2 | 32.2 | - | -3.2 | 25.9 | 29.1 | |
| 0 | 1.34200 | QP | 23.5 | 19.6 | -24.2 | 32.2 | - | -13.2 | 25.0 | 38.2 | |

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

PK with Duty 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 |
|---------------|--------------------|----------|-------------------|-------------------------|--------------|--------------|------------------------|--------------------|-------------------|----------------|--------|
| 0 | 0.13420 | AV | 105.7 | 19.7 | -74.0 | 32.2 | 0.0 | 19.2 | 25.0 | 5.8 | |
| 0 | 0.26840 | AV | 53.9 | 19.7 | -64.3 | 32.2 | 0.0 | -22.9 | 19.0 | 41.9 | |
| 0 | 0.40260 | AV | 67.8 | 19.6 | -64.3 | 32.2 | 0.0 | -9.0 | 15.5 | 24.5 | |

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

* Since the peak emission result satisfied the average limit, duty factor was omitted.

Result of the fundamental emission at 3m without Distance factor

PK or 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 |
|---------------|--------------------|----------|-------------------|-------------------------|--------------|--------------|------------------------|--------------------|-------------------|----------------|-------------|
| 0 | 0.13420 | PK | 105.7 | 19.7 | 6.0 | 32.2 | - | 99.2 | - | - | Fundamental |

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

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

*The test result is rounded off to one or two decimal places, so some differences might be observed.

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Radiated Emission above 30 MHz (Spurious Emission)

Report No. 12873561H
Test place Ise EMC Lab.
Semi Anechoic Chamber No.1
Date 07/03/2019
Temperature / Humidity 22 deg. C / 68% RH
Engineer Junya Okuno
(Above 30MHz)
Mode Tx 134.2 kHz, Outside Antenna

| Pola. [H/V] | Frequency [MHz] | Detector | Reading [dBuV] | Ant.Fac. [dB/m] | Loss [dB] | Gain [dB] | Result [dBuV/m] | Limit [dBuV/m] | Margin [dB] | Remark |
|----------------|--------------------|----------|-------------------|--------------------|--------------|--------------|--------------------|-------------------|----------------|--------|
| H | 35.076 | QP | 36.1 | 15.8 | 7.5 | 38.9 | 20.5 | 40.0 | 19.5 | |
| H | 77.299 | QP | 32.3 | 6.3 | 8.3 | 39.0 | 7.8 | 40.0 | 32.2 | |
| H | 88.776 | QP | 28.4 | 7.9 | 8.4 | 39.1 | 5.7 | 43.5 | 37.8 | |
| H | 352.530 | QP | 27.6 | 15.1 | 11.2 | 38.8 | 15.1 | 46.0 | 30.9 | |
| H | 601.509 | QP | 26.6 | 19.5 | 12.9 | 38.4 | 20.6 | 46.0 | 25.4 | |
| H | 939.581 | QP | 26.4 | 22.1 | 14.9 | 38.1 | 25.2 | 46.0 | 20.8 | |
| V | 34.355 | QP | 37.9 | 16.1 | 7.5 | 38.9 | 22.5 | 40.0 | 17.5 | |
| V | 77.295 | QP | 34.6 | 6.3 | 8.3 | 39.0 | 10.1 | 40.0 | 29.9 | |
| V | 88.789 | QP | 29.0 | 7.9 | 8.4 | 39.1 | 6.3 | 43.5 | 37.2 | |
| V | 352.530 | QP | 27.6 | 15.1 | 11.2 | 38.8 | 15.1 | 46.0 | 30.9 | |
| V | 601.509 | QP | 26.6 | 19.5 | 12.9 | 38.4 | 20.6 | 46.0 | 25.4 | |
| V | 939.581 | QP | 26.4 | 22.1 | 14.9 | 38.1 | 25.2 | 46.0 | 20.8 | |

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(CABLE + ATT) - GAIN(AMP)

*The test result is rounded off to one or two decimal places, so some differences might be observed.

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Radiated Emission above 30 MHz (Spurious Emission)

Report No. 12873561H
Test place Ise EMC Lab.
Semi Anechoic Chamber No.1
Date 07/03/2019
Temperature / Humidity 22 deg. C / 68% RH
Engineer Junya Okuno
(Above 30MHz)
Mode Tx 134.2 kHz, Inside Antenna

| Pola. [H/V] | Frequency [MHz] | Detector | Reading [dBuV] | Ant.Fac. [dB/m] | Loss [dB] | Gain [dB] | Result [dBuV/m] | Limit [dBuV/m] | Margin [dB] | Remark |
|----------------|--------------------|----------|-------------------|--------------------|--------------|--------------|--------------------|-------------------|----------------|--------|
| H | 62.202 | QP | 29.2 | 6.8 | 8.0 | 39.0 | 5.0 | 40.0 | 35.0 | |
| H | 77.299 | QP | 36.7 | 6.3 | 8.3 | 39.0 | 12.2 | 40.0 | 27.8 | |
| H | 91.249 | QP | 34.0 | 8.3 | 8.5 | 39.1 | 11.7 | 43.5 | 31.8 | |
| H | 352.530 | QP | 27.7 | 15.1 | 11.2 | 38.8 | 15.2 | 46.0 | 30.8 | |
| H | 601.509 | QP | 27.2 | 19.5 | 12.9 | 38.4 | 21.2 | 46.0 | 24.8 | |
| H | 939.581 | QP | 26.4 | 22.1 | 14.9 | 38.1 | 25.2 | 46.0 | 20.8 | |
| V | 62.201 | QP | 34.9 | 6.8 | 8.0 | 39.0 | 10.7 | 40.0 | 29.3 | |
| V | 77.276 | QP | 37.7 | 6.3 | 8.3 | 39.0 | 13.2 | 40.0 | 26.8 | |
| V | 91.205 | QP | 33.6 | 8.3 | 8.5 | 39.1 | 11.3 | 43.5 | 32.2 | |
| V | 352.530 | QP | 27.6 | 15.1 | 11.2 | 38.8 | 15.1 | 46.0 | 30.9 | |
| V | 601.509 | QP | 26.6 | 19.5 | 12.9 | 38.4 | 20.6 | 46.0 | 25.4 | |
| V | 939.581 | QP | 26.4 | 22.1 | 14.9 | 38.1 | 25.2 | 46.0 | 20.8 | |

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(CABLE + ATT) - GAIN(AMP)

*The test result is rounded off to one or two decimal places, so some differences might be observed.

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Radiated Emission above 30 MHz (Spurious Emission)

Report No. 12873561H
Test place Ise EMC Lab.
Semi Anechoic Chamber No.1
Date 07/03/2019
Temperature / Humidity 22 deg. C / 68% RH
Engineer Junya Okuno
(Above 30MHz)
Mode Tx 134.2 kHz, Rear Antenna

| Pola. [H/V] | Frequency [MHz] | Detector | Reading [dBuV] | Ant.Fac. [dB/m] | Loss [dB] | Gain [dB] | Result [dBuV/m] | Limit [dBuV/m] | Margin [dB] | Remark |
|----------------|--------------------|----------|-------------------|--------------------|--------------|--------------|--------------------|-------------------|----------------|--------|
| H | 60.792 | QP | 28.6 | 7.2 | 8.0 | 39.0 | 4.8 | 40.0 | 35.2 | |
| H | 73.005 | QP | 32.9 | 6.1 | 8.2 | 39.0 | 8.2 | 40.0 | 31.8 | |
| H | 90.182 | QP | 34.4 | 8.2 | 8.5 | 39.1 | 12.0 | 43.5 | 31.5 | |
| H | 352.530 | QP | 27.7 | 15.1 | 11.2 | 38.8 | 15.2 | 46.0 | 30.8 | |
| H | 601.509 | QP | 27.2 | 19.5 | 12.9 | 38.4 | 21.2 | 46.0 | 24.8 | |
| H | 939.581 | QP | 26.4 | 22.1 | 14.9 | 38.1 | 25.2 | 46.0 | 20.8 | |
| V | 60.836 | QP | 36.7 | 7.2 | 8.0 | 39.0 | 12.9 | 40.0 | 27.1 | |
| V | 73.005 | QP | 34.9 | 6.1 | 8.2 | 39.0 | 10.2 | 40.0 | 29.8 | |
| V | 90.182 | QP | 34.0 | 8.2 | 8.5 | 39.1 | 11.6 | 43.5 | 31.9 | |
| V | 352.530 | QP | 27.6 | 15.1 | 11.2 | 38.8 | 15.1 | 46.0 | 30.9 | |
| V | 601.509 | QP | 26.6 | 19.5 | 12.9 | 38.4 | 20.6 | 46.0 | 25.4 | |
| V | 939.581 | QP | 26.4 | 22.1 | 14.9 | 38.1 | 25.2 | 46.0 | 20.8 | |

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(CABLE + ATT) - GAIN(AMP)

*The test result is rounded off to one or two decimal places, so some differences might be observed.

UL Japan, Inc.

Ise EMC Lab.

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Facsimile : +81 596 24 8124

Radiated Emission above 30 MHz (Spurious Emission)

Report No. 12873561H
Test place Ise EMC Lab.
Semi Anechoic Chamber No.1
Date 07/03/2019
Temperature / Humidity 22 deg. C / 68% RH
Engineer Junya Okuno
(Above 30MHz)
Mode Tx 134.2 kHz, Immobilizer Antenna

| Pola. [H/V] | Frequency [MHz] | Detector | Reading [dBuV] | Ant.Fac. [dB/m] | Loss [dB] | Gain [dB] | Result [dBuV/m] | Limit [dBuV/m] | Margin [dB] | Remark |
|----------------|--------------------|----------|-------------------|--------------------|--------------|--------------|--------------------|-------------------|----------------|--------|
| H | 62.198 | QP | 29.1 | 6.8 | 8.0 | 39.0 | 4.9 | 40.0 | 35.1 | |
| H | 89.401 | QP | 32.7 | 8.1 | 8.4 | 39.1 | 10.2 | 43.5 | 33.3 | |
| H | 184.162 | QP | 28.1 | 15.8 | 9.6 | 39.1 | 14.5 | 43.5 | 29.1 | |
| H | 352.530 | QP | 27.7 | 15.1 | 11.2 | 38.8 | 15.2 | 46.0 | 30.8 | |
| H | 601.509 | QP | 27.2 | 19.5 | 12.9 | 38.4 | 21.2 | 46.0 | 24.8 | |
| H | 939.581 | QP | 26.4 | 22.1 | 14.9 | 38.1 | 25.2 | 46.0 | 20.8 | |
| V | 62.220 | QP | 34.7 | 6.8 | 8.0 | 39.0 | 10.5 | 40.0 | 29.5 | |
| V | 83.197 | QP | 28.8 | 6.9 | 8.4 | 39.0 | 5.1 | 40.0 | 35.0 | |
| V | 184.158 | QP | 28.0 | 15.8 | 9.6 | 39.1 | 14.4 | 43.5 | 29.2 | |
| V | 352.530 | QP | 27.6 | 15.1 | 11.2 | 38.8 | 15.1 | 46.0 | 30.9 | |
| V | 601.509 | QP | 26.6 | 19.5 | 12.9 | 38.4 | 20.6 | 46.0 | 25.4 | |
| V | 939.581 | QP | 26.4 | 22.1 | 14.9 | 38.1 | 25.2 | 46.0 | 20.8 | |

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(CABLE + ATT) - GAIN(AMP)

*The test result is rounded off to one or two decimal places, so some differences might be observed.

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Ise EMC Lab.

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Radiated Emission above 30 MHz (Spurious Emission)

Report No. 12873561H
Test place Ise EMC Lab.
Semi Anechoic Chamber No.1
Date 07/03/2019
Temperature / Humidity 24 deg. C / 68% RH
Engineer Akihiko Maeda
(Above 30MHz)
Mode Tx 134.2 kHz, Outside Antenna 1+2+3+4

| Pola. [H/V] | Frequency [MHz] | Detector | Reading [dBuV] | Ant.Fac. [dB/m] | Loss [dB] | Gain [dB] | Result [dBuV/m] | Limit [dBuV/m] | Margin [dB] | Remark |
|----------------|--------------------|----------|-------------------|--------------------|--------------|--------------|--------------------|-------------------|----------------|--------|
| H | 33.956 | QP | 32.5 | 16.2 | 7.5 | 38.9 | 17.2 | 40.0 | 22.8 | |
| H | 49.162 | QP | 35.1 | 10.9 | 7.8 | 38.9 | 14.8 | 40.0 | 25.2 | |
| H | 66.113 | QP | 28.8 | 6.2 | 8.1 | 39.0 | 4.1 | 40.0 | 35.9 | |
| H | 77.302 | QP | 32.2 | 6.3 | 8.3 | 39.0 | 7.7 | 40.0 | 32.3 | |
| H | 85.890 | QP | 34.0 | 7.4 | 8.4 | 39.0 | 10.8 | 40.0 | 29.2 | |
| H | 90.767 | QP | 31.7 | 8.2 | 8.5 | 39.1 | 9.3 | 43.5 | 34.2 | |
| V | 33.956 | QP | 33.0 | 16.2 | 7.5 | 38.9 | 17.7 | 40.0 | 22.3 | |
| V | 49.162 | QP | 38.5 | 10.9 | 7.8 | 38.9 | 18.2 | 40.0 | 21.8 | |
| V | 66.113 | QP | 34.4 | 6.2 | 8.1 | 39.0 | 9.7 | 40.0 | 30.3 | |
| V | 77.302 | QP | 34.7 | 6.3 | 8.3 | 39.0 | 10.2 | 40.0 | 29.8 | |
| V | 85.890 | QP | 33.5 | 7.4 | 8.4 | 39.0 | 10.3 | 40.0 | 29.7 | |
| V | 90.767 | QP | 34.5 | 8.2 | 8.5 | 39.1 | 12.1 | 43.5 | 31.4 | |

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(CABLE + ATT) - GAIN(AMP)

*The test result is rounded off to one or two decimal places, so some differences might be observed.

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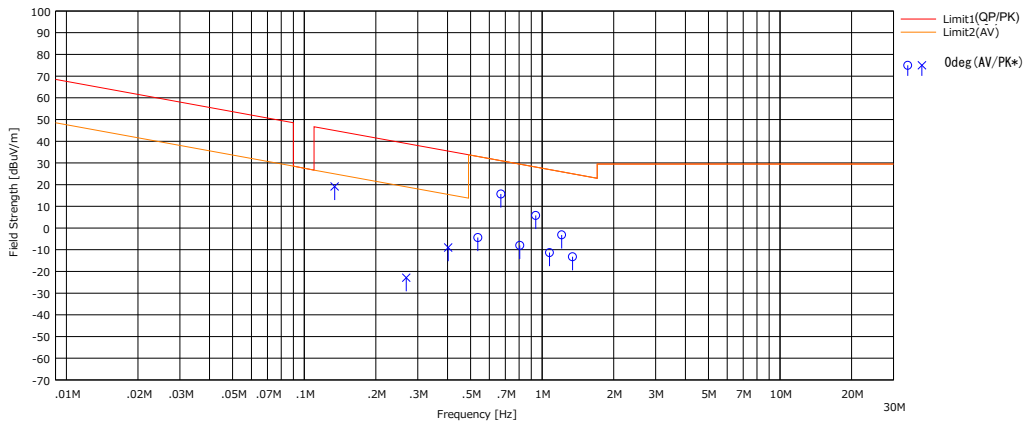
Facsimile : +81 596 24 8124

Radiated Emission Plot data, Worst case

| | | |
|------------------------|---------------------------------------|--------------------|
| Report No. | 12873561H | |
| Test place | Ise EMC Lab. | |
| Semi Anechoic Chamber | No.1 | No.1 |
| Date | 07/02/2019 | 07/03/2019 |
| Temperature / Humidity | 24 deg. C / 73% RH | 24 deg. C / 68% RH |
| Engineer | Akihiko Maeda | Akihiko Maeda |
| | (Below 30MHz) | (Above 30MHz) |
| Mode | Tx 134.2 kHz, Outside Antenna 1+2+3+4 | |

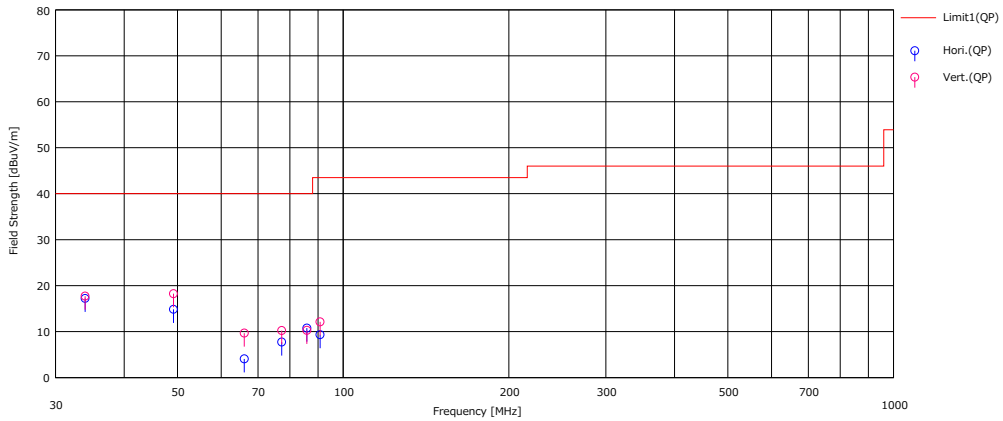
(below 30MHz)

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



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

(above 30MHz)

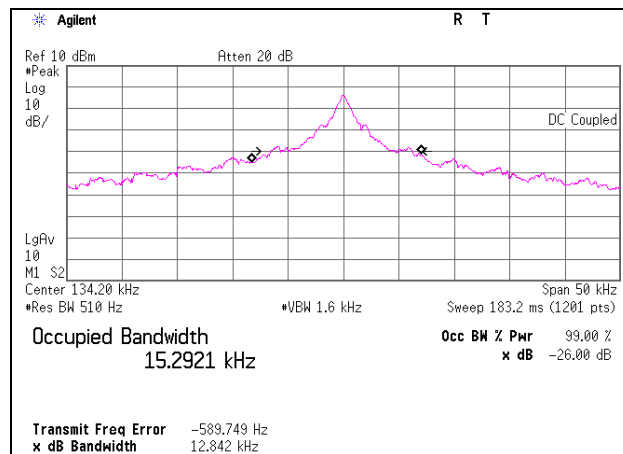


*These plots data contains sufficient number to show the trend of characteristic features for EUT.

-26 dB Bandwidth and 99 % Occupied Bandwidth

Report No. 12873561H
 Test place Ise EMC Lab. No.1 Semi Anechoic Chamber
 Date 07/02/2019
 Temperature/ Humidity 24 deg. C / 73 % RH
 Engineer Akihiko Maeda
 Mode Tx 134.2 kHz, Outside Antenna

| -26 dB Bandwidth [kHz] | 99 % Occupied Bandwidth [kHz] |
|---------------------------|----------------------------------|
| 12.842 | 15.2921 |



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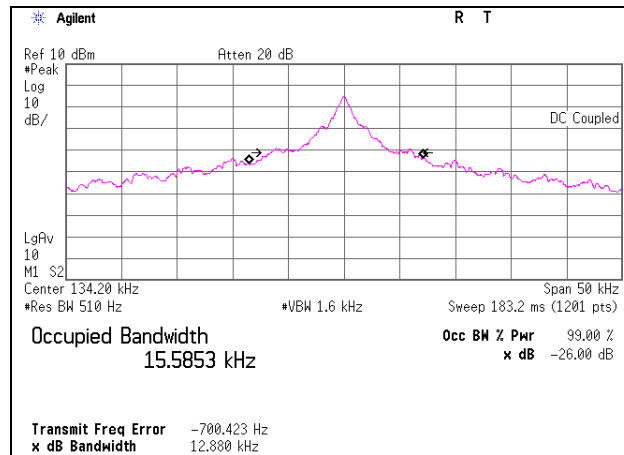
Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

-26 dB Bandwidth and 99 % Occupied Bandwidth

| | |
|-----------------------|---|
| Report No. | 12873561H |
| Test place | Ise EMC Lab. No.1 Semi Anechoic Chamber |
| Date | 07/02/2019 |
| Temperature/ Humidity | 24 deg. C / 73 % RH |
| Engineer | Akihiko Maeda |
| Mode | Tx 134.2 kHz, Inside Antenna |

| -26 dB Bandwidth [kHz] | 99 % Occupied Bandwidth [kHz] |
|---------------------------|----------------------------------|
| 12.880 | 15.5853 |



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Ise EMC Lab.

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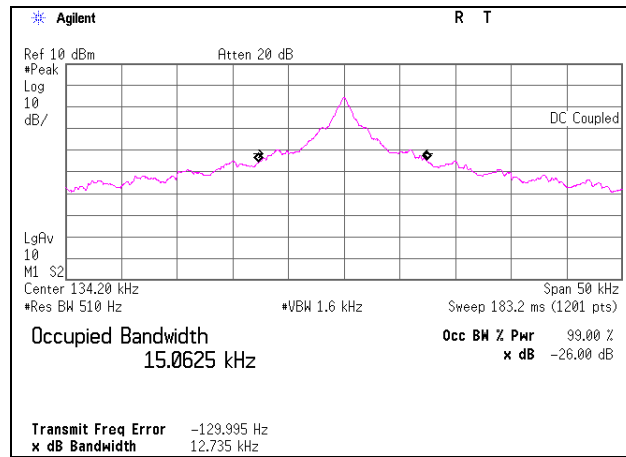
Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

-26 dB Bandwidth and 99 % Occupied Bandwidth

| | |
|-----------------------|---|
| Report No. | 12873561H |
| Test place | Ise EMC Lab. No.1 Semi Anechoic Chamber |
| Date | 07/02/2019 |
| Temperature/ Humidity | 24 deg. C / 73 % RH |
| Engineer | Akihiko Maeda |
| Mode | Tx 134.2 kHz, Rear Antenna |

| -26 dB Bandwidth [kHz] | 99 % Occupied Bandwidth [kHz] |
|---------------------------|----------------------------------|
| 12.735 | 15.0625 |



-26 dB Bandwidth and 99 % Occupied Bandwidth

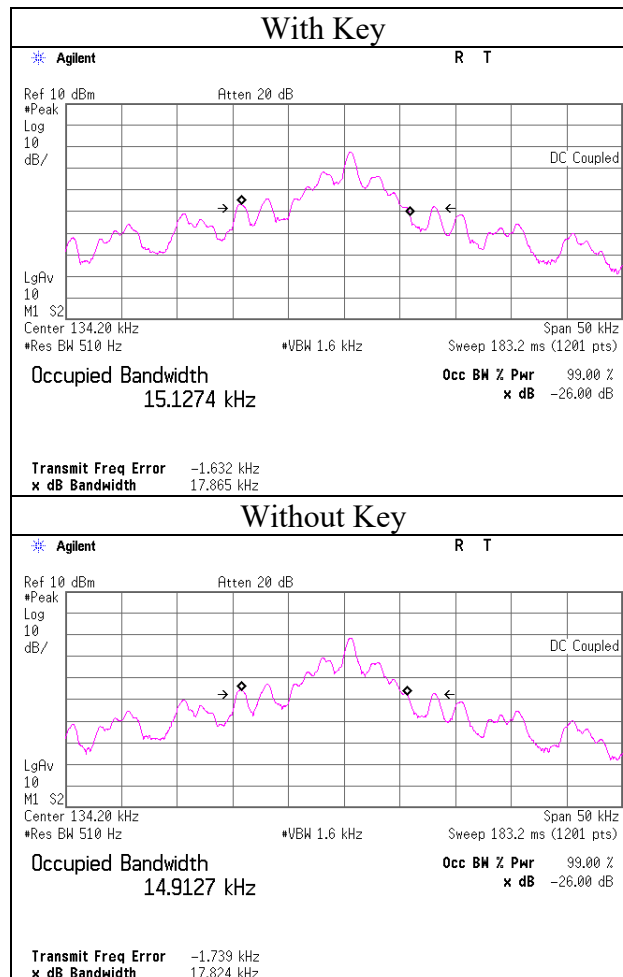
Report No. 12873561H
Test place Ise EMC Lab. No.1 Semi Anechoic Chamber
Date 07/02/2019
Temperature/ Humidity 24 deg. C / 73 % RH
Engineer Akihiko Maeda
Mode Tx 134.2 kHz, Immobilizer Antenna

With Key

| -26 dB Bandwidth [kHz] | 99 % Occupied Bandwidth [kHz] |
|---------------------------|----------------------------------|
| 17.865 | 15.1274 |

Without Key

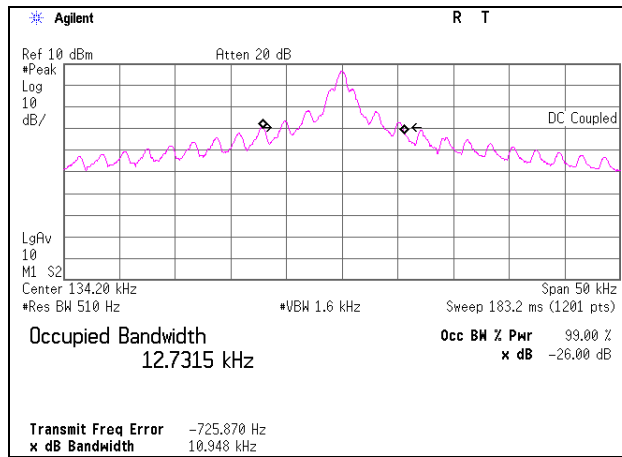
| -26 dB Bandwidth [kHz] | 99 % Occupied Bandwidth [kHz] |
|---------------------------|----------------------------------|
| 17.824 | 14.9127 |



-26 dB Bandwidth and 99 % Occupied Bandwidth

Report No. 12873561H
 Test place Ise EMC Lab. No.1 Semi Anechoic Chamber
 Date 07/02/2019
 Temperature/ Humidity 24 deg. C / 73 % RH
 Engineer Akihiko Maeda
 Mode Tx 134.2 kHz, Outside Antenna 1+2+3+4

| -26 dB Bandwidth [kHz] | 99 % Occupied Bandwidth [kHz] |
|---------------------------|----------------------------------|
| 10.948 | 12.7315 |



APPENDIX 2: Test instruments

Test Instruments

| Test item | LIMS ID | Description | Manufacturer | Model | Serial | Last Calibration Date | Calibration Due Date | Cal Int |
|-----------|---------|----------------------------------|--------------------------|---------------------------------|--------------------|-----------------------|----------------------|---------|
| RE | 141566 | Thermo-Hygrometer | CUSTOM | CTH-201 | A08Q26 | 01/11/2019 | 01/31/2020 | 12 |
| RE | 141350 | Coaxial Cable | Suhner/storm/Agilent/TSJ | - | - | 06/27/2019 | 06/30/2020 | 12 |
| RE | 141264 | Logperiodic Antenna(200-1000MHz) | Schwarzbeck | VUSLP9111B | 911B-189 | 03/21/2019 | 03/31/2020 | 12 |
| RE | 141198 | Biconical Antenna | Schwarzbeck | BBA9106 | 2513 | 04/12/2019 | 04/30/2020 | 12 |
| RE | 141583 | Pre Amplifier | SONOMA INSTRUMENT | 310 | 260833 | 02/08/2019 | 02/29/2020 | 12 |
| RE | 141295 | High Pass Filter 0.15-30MHz | Rohde & Schwarz | EZ-25/3 | 100041 | 02/07/2019 | 02/29/2020 | 12 |
| RE | 141213 | Attenuator(6dB) | Weinschel Corp | 2 | BK7971 | 11/05/2018 | 11/30/2019 | 12 |
| RE | 141998 | AC1_Semi Anechoic Chamber(NSA) | TDK | Semi Anechoic Chamber 10m | DA-06881 | 06/18/2018 | 06/30/2020 | 24 |
| RE | 178648 | EMI measurement program | TSJ | TEPTO-DV | - | - | - | - |
| RE | 142226 | Measure | KOMELON | KMC-36 | - | - | - | - |
| RE | 141585 | Pre Amplifier | MITEQ | MLA-10K01-B01-35 | 1237616 | 02/08/2019 | 02/29/2020 | 12 |
| RE | 141950 | EMI Test Receiver | Rohde & Schwarz | ESU26 | 100412 | 06/27/2019 | 06/30/2020 | 12 |
| RE | 141215 | Coaxial Cable | Fujikura/Suhner/TSJ | 5D-2W/3D-2W/RG400u/RFM-E421(SW) | -/01068 (Switcher) | 06/27/2019 | 06/30/2020 | 12 |
| RE | 141254 | Loop Antenna | Rohde & Schwarz | HFH2-Z2 | 100017 | 10/11/2018 | 10/31/2019 | 12 |
| RE | 141413 | Coaxial Cable | UL Japan | - | - | 06/07/2019 | 06/30/2020 | 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:

RE: Spurious emission

UL Japan, Inc.

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