

RADIO TEST REPORT

Test Report No. 15436699H-A

| | |
|---------------------|-----------------------|
| Customer | Tokai Rika Co., Ltd. |
| Description of EUT | NFC Reader/Writer |
| Model Number of EUT | NC2C2A2 |
| FCC ID | MOZNC2C2A2 |
| Test Regulation | FCC Part 15 Subpart C |
| Test Result | Complied |
| Issue Date | January 22, 2025 |
| Remarks | - |

Representative test engineerShousei Hamaguchi
Engineer**Approved by**Akihiko Maeda
Leader

CERTIFICATE 5107.02

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

Report Cover Page - Form-ULID-003532 (DCS:13-EM-F0429) Issue# 24.0

ANNOUNCEMENT

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

REVISION HISTORY

Original Test Report No. 15436699H-A

| Revision | Test Report No. | Date | Page Revised Contents |
|--------------|-----------------|------------------|-----------------------|
| - (Original) | 15436699H-A | January 22, 2025 | - |

Reference: Abbreviations (Including words undescribed in this report)

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

| CONTENTS | PAGE |
|--|-------------|
| SECTION 1: Customer Information | 5 |
| SECTION 2: Equipment Under Test (EUT)..... | 5 |
| SECTION 3: Test specification, procedures & results | 6 |
| SECTION 4: Operation of EUT during testing | 9 |
| SECTION 5: Radiated Emission (Fundamental, Spurious Emission and Spectrum Mask) | 11 |
| SECTION 6: Other tests..... | 13 |
| APPENDIX 1: Test data | 14 |
| Fundamental Emission and Spectrum Mask | 14 |
| Spurious Emission | 15 |
| 20 dB Bandwidth and 99% Occupied Bandwidth..... | 17 |
| Frequency Tolerance | 18 |
| APPENDIX 2: Test instruments | 19 |
| APPENDIX 3: Photographs of test setup..... | 20 |
| Radiated Emission | 20 |
| Worst Case Position | 21 |
| Frequency Tolerance | 23 |

SECTION 1: Customer Information

| | |
|------------------|---|
| Company Name | Tokai Rika Co., Ltd. |
| Address | 3-260 Toyota, Oguchi-cho, Niwa-gun, Aichi 480-0195, Japan |
| Telephone Number | +81-70-2244-4738 |
| Contact Person | Tetsuhiro Okuoka |

The information provided by the customer is as follows;

- Customer, Description of EUT, Model Number of EUT, FCC ID on the cover and other relevant pages
- Operating/Test Mode(s) (Mode(s)) on all the relevant pages
- SECTION 1: Customer Information
- SECTION 2: Equipment Under Test (EUT) other than the Receipt Date and Test Date
- SECTION 4: Operation of EUT during testing

SECTION 2: Equipment Under Test (EUT)

2.1 Identification of EUT

| | |
|---------------|---|
| Description | NFC Reader/Writer |
| Model Number | NC2C2A2 |
| Serial Number | Refer to SECTION 4.2 |
| Condition | Production prototype (Not for Sale: This sample is equivalent to mass-produced items.) |
| Modification | No Modification by the test lab |
| Receipt Date | September 3 and October 16, 2024 |
| Test Date | October 23 and 29, 2024 |

2.2 Product Description

General Specification

| | |
|-----------------------|-------------------------|
| Rating | DC 12.0 V |
| Operating Temperature | -40 deg. C to 85 deg. C |

Radio Specification

| | |
|------------------------|-------------|
| Equipment Type | Transceiver |
| Frequency of Operation | 13.56 MHz |
| Type of Modulation | ASK |

SECTION 3: Test specification, procedures & results

3.1 Test Specification

| | |
|--------------------|---|
| Test Specification | FCC Part 15 Subpart C The latest version on the first day of the testing period |
| Title | FCC 47CFR Part15 Radio Frequency Device Subpart C Intentional Radiators Section 15.207 Conducted limits Section 15.225 Operation within the band 13.110-14.010 MHz. |

3.2 Procedures and results

| Item | Test Procedure | Specification | Worst margin | Results | Remarks |
|---|---|---|--|----------|----------|
| Conducted Emission | <FCC> ANSI C63.10:2013 6 Standard test methods ----- <ISED> RSS-Gen 8.8 | <FCC> Section 15.207 ----- <ISED> RSS-Gen 8.8 | N/A | N/A | *1) |
| Electric Field Strength of Fundamental Emission | <FCC> ANSI C63.10:2013 6 Standard test methods ----- <ISED> RSS-Gen 6.4, 6.12 | <FCC> Section 15.225(a) ----- <ISED> RSS-210 B.6 | 57.66 dB, 13.56000 MHz, QP, 0 deg. | Complied | Radiated |
| Spectrum Mask | <FCC> ANSI C63.10:2013 6 Standard test methods ----- <ISED> RSS-Gen 6.4, 6.13 | <FCC> Section 15.225(b)(c) ----- <ISED> RSS-210 B.6 | 30.37 dB, 14.08783 MHz, QP, 0 deg. | Complied | Radiated |
| 20 dB Bandwidth | <FCC> ANSI C63.10:2013 6 Standard test methods ----- <ISED> - | <FCC> Section15.215(c) ----- <ISED> - | See data | Complied | Radiated |
| Electric Field Strength of Spurious Emission | <FCC> ANSI C63.10:2013 6 Standard test methods ----- <ISED> RSS-Gen 6.4, 6.13 | <FCC> Section 15.209, Section 15.225 (d) ----- <ISED> RSS-210 B.6 RSS-Gen 8.9 | 6.28 dB 125.387 MHz, Vertical, QP | Complied | Radiated |
| Frequency Tolerance | <FCC> ANSI C63.10:2013 6 Standard test methods ----- <ISED> RSS-Gen 6.11, 8.11 | <FCC> Section 15.225(e) ----- <ISED> RSS-210 B.6 | See data | Complied | Radiated |

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

*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.

FCC Part 15.31 (e)

This EUT provides stable voltage constantly to RF Module regardless of input voltage. Therefore, this EUT complies with the requirement.

However, the supply voltage was varied and tested at 85 % and 115 % of the nominal rated supply voltage during frequency tolerance test according to Section 15.225(e).

FCC Part 15.203 Antenna requirement

It is impossible for end users to replace the antenna, because the antenna is mounted inside of the EUT.

Therefore, the equipment complies with the antenna requirement of Section 15.203.

3.3 Addition to standard

| Item | Test Procedure | Specification | Worst margin | Results | Remarks |
|------------------------|-------------------|---------------|--------------|---------|----------|
| 99% emission bandwidth | <ISED>RSS-Gen 6.7 | - | N/A | - | Radiated |

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

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

3.4 Uncertainty

Measurement uncertainty is not taken into account when stating conformity with a specified requirement.
Note: When margins obtained from test results are less than the measurement uncertainty, the test results may exceed the limit.

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

Radiated emission

| Measurement distance | Frequency range | | Unit | Calculated Uncertainty (+/-) |
|----------------------|---------------------|------------|------|------------------------------|
| 3 m | 9 kHz to 30 MHz | | dB | 3.3 |
| 10 m | | | dB | 3.1 |
| 3 m | 30 MHz to 200 MHz | Horizontal | dB | 5.0 |
| | | Vertical | dB | 5.0 |
| | 200 MHz to 1000 MHz | Horizontal | dB | 5.2 |
| | | Vertical | dB | 6.2 |
| 10 m | 30 MHz to 200 MHz | Horizontal | dB | 5.5 |
| | | Vertical | dB | 5.4 |
| | 200 MHz to 1000 MHz | Horizontal | dB | 5.5 |
| | | Vertical | dB | 5.5 |
| 3 m | 1 GHz to 6 GHz | | dB | 5.1 |
| | 6 GHz to 18 GHz | | dB | 5.4 |
| 1 m | 10 GHz to 18 GHz | | dB | 5.4 |
| | 18 GHz to 26.5 GHz | | dB | 5.3 |
| | 26.5 GHz to 40 GHz | | dB | 4.8 |
| 0.5 m | 26.5 GHz to 40 GHz | | dB | 5.0 |

-20 dB Bandwidth and 99% Occupied Bandwidth, Frequency Tolerance

| Item | Unit | Calculated Uncertainty (+/-) |
|--|------|------------------------------|
| Bandwidth (OBW) | % | 0.96 |
| Frequency Readout (Frequency counter) | ppm | 0.67 |
| Frequency Readout (Spectrum analyzer frequency readout function) | ppm | 2.13 |

3.5 Test Location

UL Japan, Inc. Ise EMC Lab.

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

Telephone: +81-596-24-8999

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

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

| Test site | Width x Depth x Height (m) | Size of reference ground plane (m) / horizontal conducting plane | Other rooms | Maximum measurement distance |
|----------------------------|----------------------------|--|------------------------|------------------------------|
| No.1 semi-anechoic chamber | 19.2 x 11.2 x 7.7 | 7.0 x 6.0 | No.1 Power source room | 10 m |
| No.2 semi-anechoic chamber | 7.5 x 5.8 x 5.2 | 4.0 x 4.0 | - | 3 m |
| No.3 semi-anechoic chamber | 12.0 x 8.5 x 5.9 | 6.8 x 5.75 | No.3 Preparation room | 3 m |
| No.3 shielded room | 4.0 x 6.0 x 2.7 | N/A | - | - |
| No.4 semi-anechoic chamber | 12.0 x 8.5 x 5.9 | 6.8 x 5.75 | No.4 Preparation room | 3 m |
| No.4 shielded room | 4.0 x 6.0 x 2.7 | N/A | - | - |
| No.5 semi-anechoic chamber | 6.0 x 6.0 x 3.9 | 6.0 x 6.0 | - | - |
| No.5 measurement room | 6.4 x 6.4 x 3.0 | 6.4 x 6.4 | - | - |
| No.6 shielded room | 4.0 x 4.5 x 2.7 | 4.0 x 4.5 | - | - |
| No.6 measurement room | 4.75 x 5.4 x 3.0 | 4.75 x 4.15 | - | - |
| No.7 shielded room | 4.7 x 7.5 x 2.7 | 4.7 x 7.5 | - | - |
| No.8 measurement room | 3.1 x 5.0 x 2.7 | 3.1 x 5.0 | - | - |
| No.9 measurement room | 8.8 x 4.6 x 2.8 | 2.4 x 2.4 | - | - |
| No.10 shielded room | 3.8 x 2.8 x 2.8 | 3.8 x 2.8 | - | - |
| No.11 measurement room | 4.0 x 3.4 x 2.5 | N/A | - | - |
| No.12 measurement room | 2.6 x 3.4 x 2.5 | N/A | - | - |
| Large Chamber | 16.9 x 22.1 x 10.17 | 16.9 x 22.1 | - | 10 m |
| Small Chamber | 5.3 x 6.69 x 3.59 | 5.3 x 6.69 | - | - |

3.6 Test data, Test instruments, and Test set up

Refer to APPENDIX.

SECTION 4: Operation of EUT during testing

4.1 Operating Mode(s)

The mode is used:

| Test mode | Remarks |
|--|---|
| 1) Transmitting mode (Tx) Mod on without Tag | The EUT Transmits and Receives at the same time and there is no receiving mode. |
| 2) Transmitting mode (Tx) Mod on with Tag (Type A) | |
| 3) Transmitting mode (Tx) Mod off | |

The EUT was operated in a manner similar to typical use during the tests.

*Power of the EUT was set by the software as follows;

Software: Version: 1.0
(Date: 2024.06.21, Storage location: EUT memory)

*This setting of software is the worst case.

Any conditions under the normal use do not exceed the condition of setting.

In addition, end users cannot change the settings of the output power of the product.

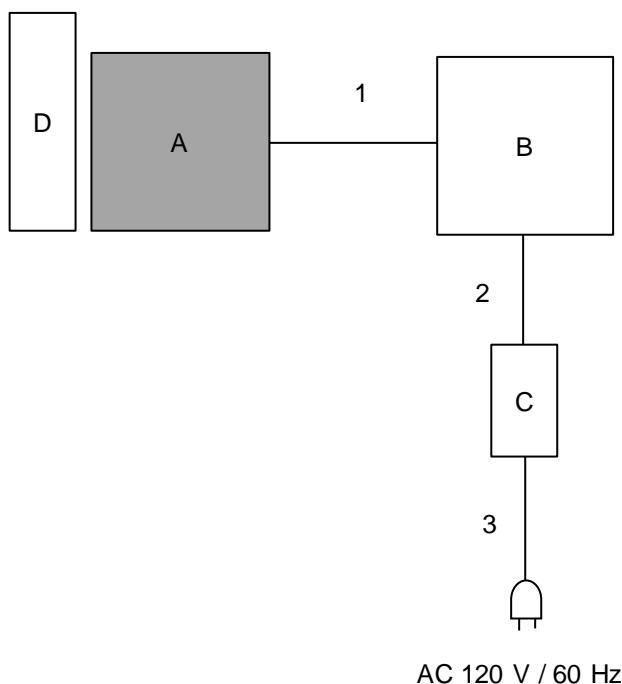
Justification: The system was configured in typical fashion (as a user would normally use it) for testing.

| Test Item | Operating mode |
|---|-----------------------|
| Electric Field Strength of Fundamental Emission | Mode 1 ^{*1)} |
| Spectrum Mask | Mode 1 ^{*1)} |
| 20 dB Bandwidth and 99 % Occupied Bandwidth | Mode1 and 2 |
| Electric Field Strength of Spurious Emission | Mode 1 ^{*1)} |
| Frequency Tolerance | Mode 3 |

*1) After the comparison of the test data between with Tag and without Tag, the tests were performed with the worst case.

| Frequency Tolerance | |
|---|--|
| Temperature | -20 deg. C to +50 deg. C (Step 10 deg. C) |
| Voltage | Normal Voltage DC 12 V Maximum Voltage DC 13.8 V (DC 12 V +15 %) Minimum Voltage DC 10.2 V (DC 12 V -15 %) |
| *This EUT provides stable voltage constantly to RF Part regardless of input voltage | |

4.2 Configuration and peripherals



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

Description of EUT and Support Equipment

| No. | Item | Model number | Serial Number | Manufacturer | Remark |
|-----|-------------------|--------------|---------------|----------------------------------|--------|
| A | NFC Reader/Writer | NC2C2A2 | NC2C2A2_SAR | Tokai Rika Co., Ltd. | EUT |
| B | Checker | - | - | - | - |
| C | AC Adapter | AD-A120P300 | 2231 | Xiamen UME Electronics Co., Ltd. | - |
| D | NFC Key Card | 14-802791 | 231214 TYP-15 | - | - |

List of Cables Used

| No. | Name | Length (m) | Shield | | Remark |
|-----|-------------------|------------|------------|------------|--------|
| | | | Cable | Connector | |
| 1 | DC & Signal Cable | 3.0 | Unshielded | Unshielded | - |
| 2 | DC Cable | 1.4 | Unshielded | Unshielded | - |
| 3 | AC Cable | 1.7 | Unshielded | Unshielded | - |

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

Test Procedure

EUT was placed on a urethane platform of nominal size, 1.0 m by 1.5 m, raised 0.8 m above the conducting ground plane. The Radiated Electric Field Strength has been measured in a Semi Anechoic Chamber with a ground plane.

[Limit conversion]

The limits in CFR 47, Part 15, Subpart C, paragraph 15.209(a), are identical to those in RSS-Gen section 8.9, Table 6, since the measurements are performed in terms of magnetic field strength and converted to electric field strength levels (as reported in the table) using the free space impedance of 377 Ohms. For example, the measurement at frequency 9 kHz resulted in a level of 45.5 dBuV/m, which is equivalent to $45.5 - 51.5 = -6.0$ dBuA/m, which has the same margin, 3 dB, to the corresponding RSS-Gen Table 6 limit as it has to 15.209(a) limit.

[Frequency: From 9 kHz to 30 MHz]

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

The measurements were performed for vertical polarization (antenna angle: 0 deg., 45 deg., 90 deg., 135 deg., and 225 deg.) and horizontal polarization.

*Refer to 02 about Direction of the Loop Antenna.

Although these tests were performed other than open field test site, adequate comparison measurements were confirmed against 30 m open field test site. Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made in an open field based on KDB 414788.

These tests were performed in semi anechoic chamber. Therefore the measured level of emissions may be higher than if measurements were made without a ground plane. However test results were confirmed to pass against standard limit.

[Frequency: From 30 MHz to 1 GHz]

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

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

[Test instruments and test settings]

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

The test was made with the detector (RBW/VBW) in the following table.

When using Spectrum analyzer, the test was made with adjusting span to zero by using peak hold.

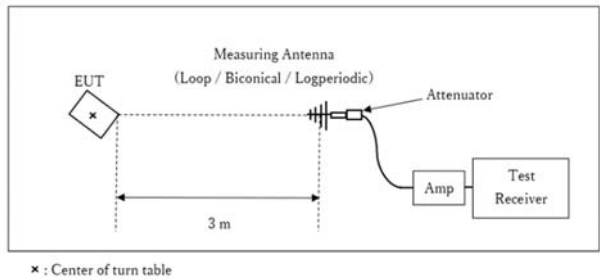
| | | | | | |
|-----------------|--|------------------------|-------------------------|------------------------|----------------------|
| Frequency | From 9 kHz to 90 kHz and From 110 kHz to 150 kHz | From 90 kHz to 110 kHz | From 150 kHz to 490 kHz | From 490 kHz to 30 MHz | From 30 MHz to 1 GHz |
|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

*1) Distance Factor: $40 \times \log (3 \text{ m} / 300 \text{ m}) = -80 \text{ dB}$

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

Figure 1: Test Setup

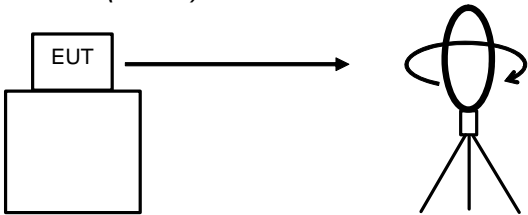
Below 1 GHz



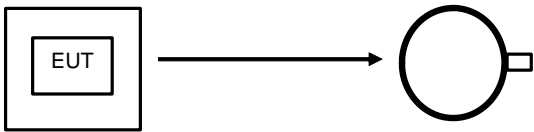
Test Distance: 3 m

Figure 2: Direction of the Loop Antenna

Side View (Vertical)

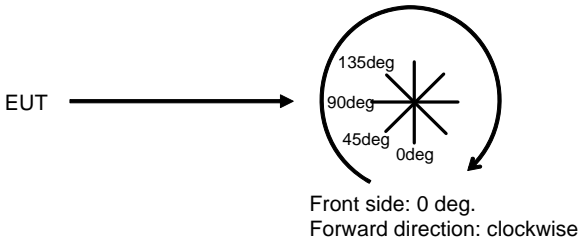


Top View (Horizontal)



Antenna was not rotated.

Top View (Vertical)



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

SECTION 6: Other tests

| Test | Span | RBW | VBW | Sweep | Detector | Trace | Instrument used |
|--|---|-----------------|--------------------|-------|----------|----------|-------------------|
| 20 dB Bandwidth | 2 MHz | 10 kHz | 30 kHz | Auto | Peak | Max Hold | Spectrum Analyzer |
| 99 % Occupied Bandwidth | Enough width to display emission skirts | 1 to 5 % of OBW | Three times of RBW | Auto | Peak | Max Hold | Spectrum Analyzer |
| Frequency Tolerance | - | - | - | - | - | - | Frequency counter |
| Peak hold was applied as Worst-case measurement. | | | | | | | |

Test data : APPENDIX
Test result : Pass

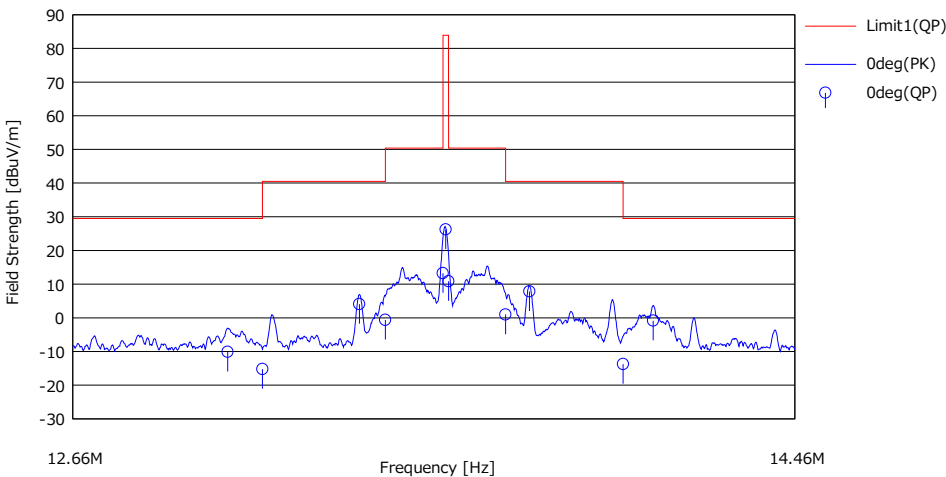
APPENDIX 1: Test data

Fundamental Emission and Spectrum Mask

Test place
Semi Anechoic Chamber
Date
Temperature / Humidity
Engineer
Mode

Ise EMC Lab.
No.4
October 29, 2024
22 deg. C / 57 % RH
Shousei Hamaguchi
Mode 1

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



| No. | Freq. [MHz] | Reading (QP) | Ant.Fac [dB/m] | Loss [dB] | Gain [dB] | Result (QP) | Limit (QP) | Margin (QP) | Antenna [deg] | Table [deg] | Comment |
|-----|----------------|-----------------|-------------------|--------------|--------------|----------------|---------------|----------------|------------------|----------------|---------|
| | | [dBuV] | | | | [dBuV/m] | [dBuV/m] | [dB] | | | |
| 1 | 13.02640 | 35.40 | 19.72 | -33.13 | 32.13 | -10.14 | 29.50 | 39.64 | 0deg | 45 | |
| 2 | 13.11000 | 30.30 | 19.71 | -33.13 | 32.13 | -15.25 | 29.50 | 44.75 | 0deg | 45 | |
| 3 | 13.34611 | 49.60 | 19.70 | -33.12 | 32.13 | 4.05 | 40.50 | 36.45 | 0deg | 45 | |
| 4 | 13.41000 | 44.90 | 19.70 | -33.12 | 32.13 | -0.65 | 40.50 | 41.15 | 0deg | 45 | |
| 5 | 13.55300 | 58.80 | 19.69 | -33.12 | 32.13 | 13.24 | 50.40 | 37.16 | 0deg | 45 | |
| 6 | 13.56000 | 71.80 | 19.69 | -33.12 | 32.13 | 26.24 | 83.90 | 57.66 | 0deg | 45 | |
| 7 | 13.56700 | 56.40 | 19.69 | -33.12 | 32.13 | 10.84 | 50.40 | 39.56 | 0deg | 45 | |
| 8 | 13.71000 | 46.50 | 19.68 | -33.11 | 32.13 | 0.94 | 40.50 | 39.56 | 0deg | 45 | |
| 9 | 13.77044 | 53.40 | 19.67 | -33.10 | 32.13 | 7.84 | 40.50 | 32.66 | 0deg | 45 | |
| 10 | 14.01000 | 31.80 | 19.66 | -33.10 | 32.13 | -13.77 | 29.50 | 43.27 | 0deg | 45 | |
| 11 | 14.08783 | 44.70 | 19.65 | -33.09 | 32.13 | -0.87 | 29.50 | 30.37 | 0deg | 45 | |

RESULT = READING + ANT FACTOR + LOSS (CABLE + Attenuator + Distance Factor*) - GAIN(AMP)
*) Distance Factor: 40 x log (3 m / 30 m) = -40 dB

Result of the fundamental Emission at 3 m without Distance factor

| QP | | | | | | | | | | | | |
|---------------|-----------|----------|---------|------------|------|-------|-------------|----------|----------|--------|-------------|--|
| Ant Deg [deg] | Frequency | Detector | Reading | Ant Factor | Loss | Gain | Duty Factor | Result | Limit | Margin | Remark | |
| | [MHz] | | [dBuV] | [dB/m] | [dB] | [dB] | [dB] | [dBuV/m] | [dBuV/m] | [dB] | | |
| 0 | 13.56000 | QP | 71.80 | 19.69 | 6.88 | 32.13 | - | 66.24 | - | - | Fundamental | |

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

Spurious Emission

| | |
|------------------------|---------------------|
| Test place | Ise EMC Lab. |
| Semi Anechoic Chamber | No.4 |
| Date | October 29, 2024 |
| Temperature / Humidity | 22 deg. C / 57 % RH |
| Engineer | Shousei Hamaguchi |
| Mode | Mode 1 |

PK or QP

| Ant Deg [deg] or Polarity [Hori/Vert] | Frequency [MHz] | Detector | Reading [dBuV] | Ant Factor [dB/m] | Loss [dB] | Gain [dB] | Duty Factor [dB] | Result [dBuV/m] | Limit [dBuV/m] | Margin [dB] |
|--|--------------------|----------|-------------------|----------------------|--------------|--------------|---------------------|--------------------|-------------------|----------------|
| 0deg | 27.120 | QP | 30.20 | 20.29 | -32.79 | 32.12 | - | -14.42 | 29.5 | 43.92 |
| Hori. | 48.694 | QP | 27.80 | 11.65 | 7.28 | 32.09 | - | 14.64 | 40.0 | 25.36 |
| Hori. | 87.225 | QP | 27.70 | 8.09 | 7.73 | 32.08 | - | 11.44 | 40.0 | 28.56 |
| Hori. | 113.982 | QP | 29.70 | 12.22 | 7.98 | 32.05 | - | 17.85 | 43.5 | 25.67 |
| Hori. | 125.387 | QP | 22.00 | 13.41 | 8.08 | 32.05 | - | 11.44 | 43.5 | 32.08 |
| Hori. | 201.652 | QP | 21.30 | 11.61 | 8.75 | 32.01 | - | 9.65 | 43.5 | 33.87 |
| Hori. | 235.235 | QP | 21.40 | 11.62 | 9.06 | 32.01 | - | 10.07 | 46.0 | 35.95 |
| Vert. | 48.694 | QP | 45.70 | 11.65 | 7.28 | 32.09 | - | 32.54 | 40.0 | 7.46 |
| Vert. | 87.225 | QP | 44.80 | 8.09 | 7.73 | 32.08 | - | 28.54 | 40.0 | 11.46 |
| Vert. | 113.982 | QP | 46.80 | 12.22 | 7.98 | 32.05 | - | 34.95 | 43.5 | 8.57 |
| Vert. | 125.387 | QP | 47.80 | 13.41 | 8.08 | 32.05 | - | 37.24 | 43.5 | 6.28 |
| Vert. | 201.652 | QP | 35.10 | 11.61 | 8.75 | 32.01 | - | 23.45 | 43.5 | 20.07 |
| Vert. | 235.235 | QP | 31.00 | 11.62 | 9.06 | 32.01 | - | 19.67 | 46.0 | 26.35 |

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

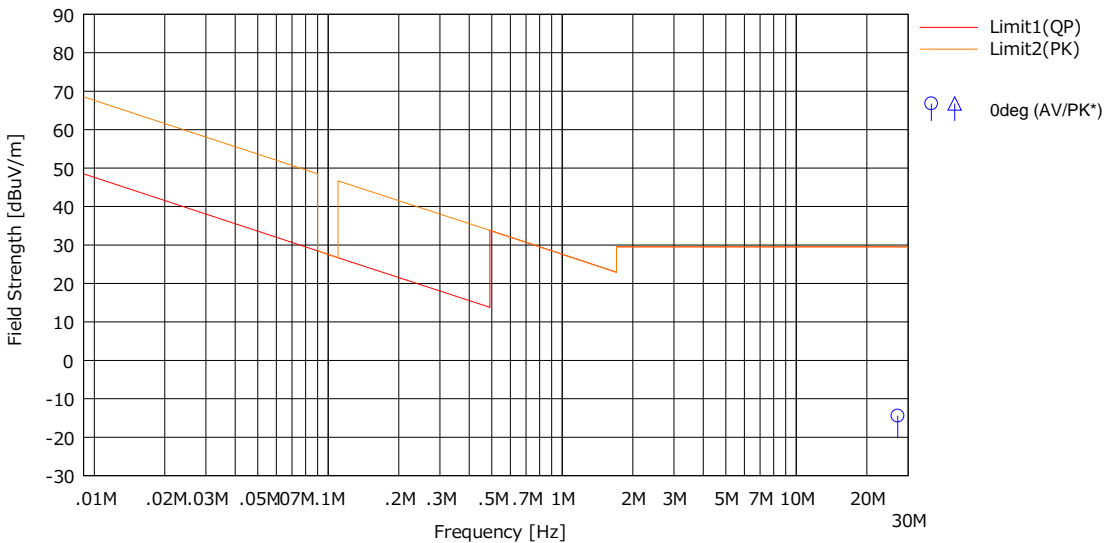
*) Distance Factor: 40 x log (3 m / 30 m) = -40 dB

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

| | |
|------------------------|---------------------|
| Test place | Ise EMC Lab. |
| Semi Anechoic Chamber | No.4 |
| Date | October 29, 2024 |
| Temperature / Humidity | 22 deg. C / 57 % RH |
| Engineer | Shousei Hamaguchi |
| Mode | Mode 1 |

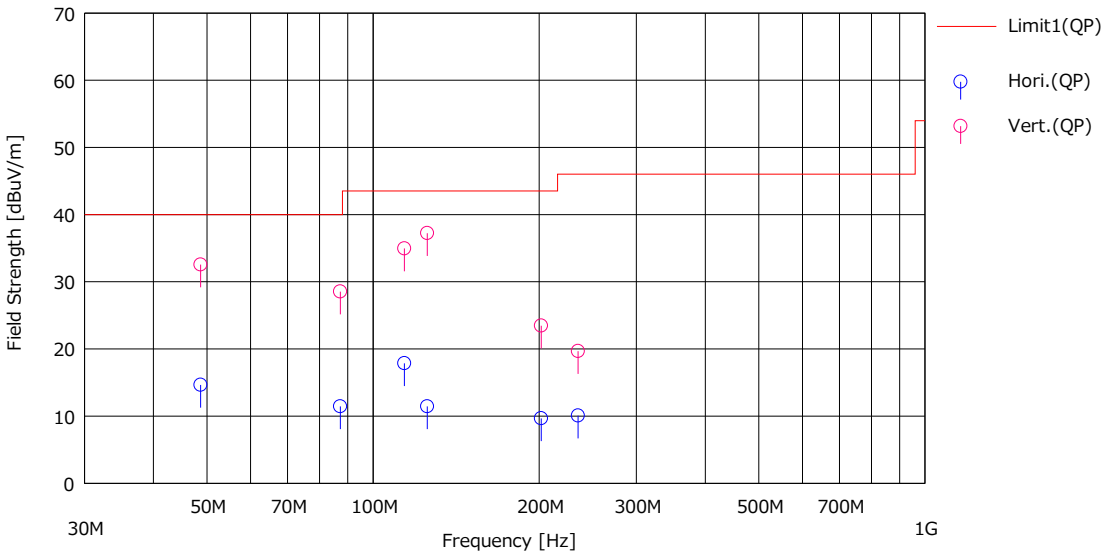
(below 30MHz)

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



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

(above 30MHz)

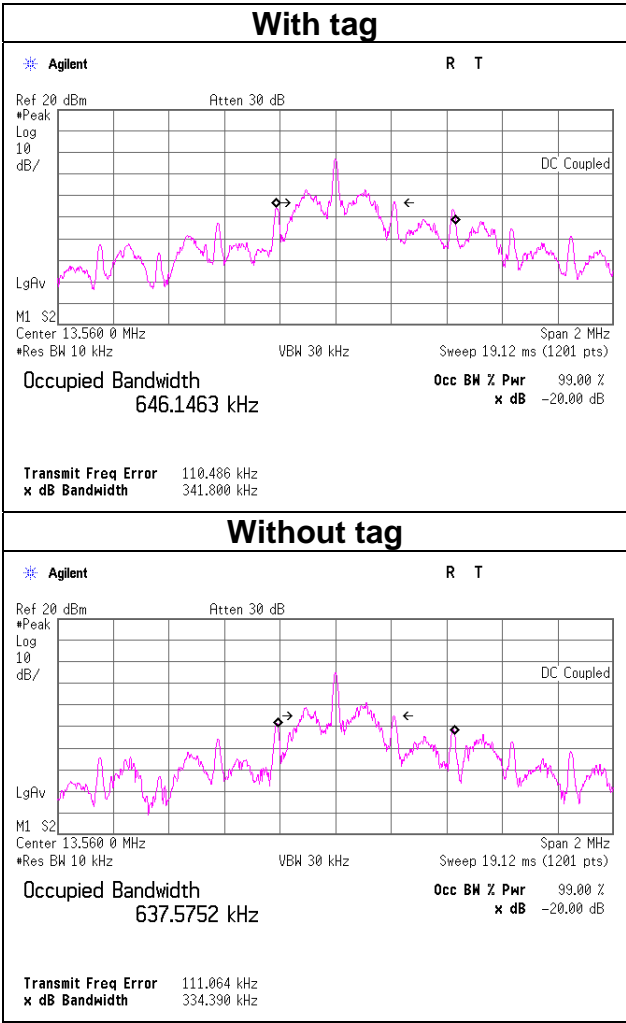


*These plots data contains sufficient number to show the trend of characteristic features for EUT.

20 dB Bandwidth and 99% Occupied Bandwidth

Test place Ise EMC Lab.
 No.8 Measurement Room
Date October 23, 2024
Temperature / Humidity 22 deg. C / 70 % RH
Engineer Tetsuro Yoshida
Mode Mode 1, 2

| FREQ [MHz] | Mode | 20dB Bandwidth [kHz] | 99% Occupied Bandwidth [kHz] |
|---------------|-------------|-------------------------|---------------------------------|
| 13.56 | With Tag | 341.800 | 646.1463 |
| | Without Tag | 334.390 | 637.5752 |



Frequency Tolerance

Test place Ise EMC Lab.
No.8 Measurement Room
Date October 23, 2024
Temperature / Humidity 22 deg. C / 70 % RH
Engineer Tetsuro Yoshida
Mode Mode 3

| Test condition | | Tested timing | Measured frequency [MHz] | Frequency error [MHz] | Result | | Limit [+/- %] |
|-------------------|--------------------|---------------|--------------------------|-----------------------|----------|-------|------------------|
| Temp. [deg. C] | Voltage [V] | | | | [%] | [ppm] | |
| 50 | 12 | Power on | 13.559612 | -0.000388 | -0.00286 | -28.6 | 0.01 |
| | | + 2 min. | 13.559425 | -0.000576 | -0.00424 | -42.4 | 0.01 |
| | | + 5 min. | 13.559477 | -0.000523 | -0.00385 | -38.5 | 0.01 |
| | | + 10 min. | 13.559520 | -0.000480 | -0.00354 | -35.4 | 0.01 |
| 40 | 12 | Power on | 13.559555 | -0.000445 | -0.00328 | -32.8 | 0.01 |
| | | + 2 min. | 13.559636 | -0.000364 | -0.00268 | -26.8 | 0.01 |
| | | + 5 min. | 13.559533 | -0.000467 | -0.00344 | -34.4 | 0.01 |
| | | + 10 min. | 13.559547 | -0.000453 | -0.00334 | -33.4 | 0.01 |
| 30 | 12 | Power on | 13.559802 | -0.000198 | -0.00146 | -14.6 | 0.01 |
| | | + 2 min. | 13.559771 | -0.000229 | -0.00169 | -16.9 | 0.01 |
| | | + 5 min. | 13.559678 | -0.000322 | -0.00237 | -23.7 | 0.01 |
| | | + 10 min. | 13.559669 | -0.000331 | -0.00244 | -24.4 | 0.01 |
| 20 | 12 | Power on | 13.559912 | -0.000088 | -0.00065 | -6.5 | 0.01 |
| | | + 2 min. | 13.559883 | -0.000117 | -0.00086 | -8.6 | 0.01 |
| | | + 5 min. | 13.559831 | -0.000169 | -0.00124 | -12.4 | 0.01 |
| | | + 10 min. | 13.559855 | -0.000145 | -0.00107 | -10.7 | 0.01 |
| 20 | 10.2 (12V -15%) | Power on | 13.560050 | 0.000050 | 0.00037 | 3.7 | 0.01 |
| | | + 2 min. | 13.560272 | 0.000272 | 0.00201 | 20.1 | 0.01 |
| | | + 5 min. | 13.559981 | -0.000020 | -0.00014 | -1.4 | 0.01 |
| | | + 10 min. | 13.560038 | 0.000037 | 0.00028 | 2.8 | 0.01 |
| 20 | 13.8 (12V +15%) | Power on | 13.559561 | -0.000439 | -0.00324 | -32.4 | 0.01 |
| | | + 2 min. | 13.559813 | -0.000187 | -0.00138 | -13.8 | 0.01 |
| | | + 5 min. | 13.559932 | -0.000068 | -0.00050 | -5.0 | 0.01 |
| | | + 10 min. | 13.559945 | -0.000055 | -0.00040 | -4.0 | 0.01 |
| 10 | 12 | Power on | 13.559736 | -0.000265 | -0.00195 | -19.5 | 0.01 |
| | | + 2 min. | 13.559799 | -0.000201 | -0.00148 | -14.8 | 0.01 |
| | | + 5 min. | 13.559806 | -0.000194 | -0.00143 | -14.3 | 0.01 |
| | | + 10 min. | 13.559903 | -0.000097 | -0.00071 | -7.1 | 0.01 |
| 0 | 12 | Power on | 13.559826 | -0.000174 | -0.00128 | -12.8 | 0.01 |
| | | + 2 min. | 13.560049 | 0.000049 | 0.00036 | 3.6 | 0.01 |
| | | + 5 min. | 13.560015 | 0.000015 | 0.00011 | 1.1 | 0.01 |
| | | + 10 min. | 13.560068 | 0.000068 | 0.00050 | 5.0 | 0.01 |
| -10 | 12 | Power on | 13.559888 | -0.000112 | -0.00083 | -8.3 | 0.01 |
| | | + 2 min. | 13.560035 | 0.000035 | 0.00026 | 2.6 | 0.01 |
| | | + 5 min. | 13.559992 | -0.000008 | -0.00006 | -0.6 | 0.01 |
| | | + 10 min. | 13.560027 | 0.000027 | 0.00020 | 2.0 | 0.01 |
| -20 | 12 | Power on | 13.559899 | -0.000101 | -0.00074 | -7.4 | 0.01 |
| | | + 2 min. | 13.559971 | -0.000030 | -0.00022 | -2.2 | 0.01 |
| | | + 5 min. | 13.560161 | 0.000161 | 0.00119 | 11.9 | 0.01 |
| | | + 10 min. | 13.560287 | 0.000287 | 0.00212 | 21.2 | 0.01 |

Calculation formula: Frequency error = Measured frequency - Tested frequency
Result [%] = Frequency error / Tested frequency * 100

Tested frequency: 13.56 MHz
Limit (+/-): 0.01 % (+/- 100ppm)

*The test was begun from 50 deg. C and the temperature was lowered each 10 deg. C.

APPENDIX 2: Test instruments

Test Equipment

| Test Item | LIMS ID | Description | Manufacturer | Model | Serial | Last Calibration Date | Cal Int |
|-----------|---------|-----------------------------------|------------------------------------|--|--------------|-----------------------|---------|
| RE | 141217 | Coaxial cable | Fujikura/Suhner/TSJ | 5D-2W/SFM141/421-010/sucoform141-PE/RFM-E121(SW) | -/04178 | 06/14/2024 | 12 |
| RE | 141267 | Logperiodic Antenna (200-1000MHz) | Schwarzbeck Mess-Elektronik OHG | VUSLP9111B | 9111B-192 | 09/18/2024 | 12 |
| RE | 141331 | Attenuator (6dB) | TME | UFA-01 | - | 02/17/2024 | 12 |
| RE | 141397 | Coaxial Cable | UL Japan | - | - | 11/22/2023 | 12 |
| RE | 141425 | Biconical Antenna | Schwarzbeck Mess-Elektronik OHG | VHA9103+ BBA9106 | VHA 91031302 | 08/23/2024 | 12 |
| RE | 141545 | DIGITAL HiTESTER | HIOKI E.E. CORPORATION | 3805 | 51201148 | 02/01/2024 | 12 |
| RE | 141583 | Pre Amplifier | SONOMA INSTRUMENT | 310 | 260833 | 04/04/2024 | 12 |
| RE | 141951 | EMI Test Receiver | Rohde & Schwarz | ESR26 | 101408 | 05/17/2024 | 12 |
| RE | 142011 | AC4_Semi Anechoic Chamber (NSA) | TDK | Semi Anechoic Chamber 3m | DA-10005 | 12/13/2023 | 24 |
| RE | 142152 | Loop Antenna | Rohde & Schwarz | HFH2-Z2 | 836553/009 | 10/17/2023 | 12 |
| RE | 142230 | Measure, Tape, Steel | KOMELON | KMC-36 | - | - | - |
| RE | 159670 | Coaxial Cable | UL Japan | - | - | 11/21/2023 | 12 |
| RE | 178648 | EMI measurement program | TSJ (Techno Science Japan) | TEPTO-DV | - | - | - |
| RE | 244710 | Thermo-Hygrometer | HIOKI E.E. CORPORATION | LR5001 | 231202104 | 01/25/2024 | 12 |
| FT | 141440 | Temperature and Humidity Chamber | Espec | PL-1KP | 14019569 | 04/09/2024 | 12 |
| FT | 141498 | Microwave Counter | ADVANTEST | R5373 | 120100309 | 07/19/2024 | 12 |
| FT | 141557 | DIGITAL HiTESTER | HIOKI E.E. CORPORATION | 3805 | 070900530 | 01/31/2024 | 12 |
| FT | 141903 | Spectrum Analyzer | Keysight Technologies Inc | E4440A | MY46186390 | 01/26/2024 | 12 |
| FT | 142645 | Loop Antenna | UL Japan | - | - | - | - |
| FT | 244711 | Thermo-Hygrometer | HIOKI E.E. CORPORATION | LR5001 | 231202105 | 01/25/2024 | 12 |

*Hyphens for Last Calibration Date and Cal Int (month) are instruments that Calibration is not required (e.g. software), or instruments checked in advance before use.

The expiration date of the calibration is the end of the expired month.

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

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

Test item:

RE: Radiated Emission

FT: Frequency Tolerance