

# RADIO TEST REPORT

## Test Report No. 15600416H-A-R1

|                     |   |
|---------------------|---|
| Customer            | DENSO CORPORATION   |
| Description of EUT  | Cockpit Control Unit  |
| Model Number of EUT | DNNS137   |
| FCC ID              | HYQDNNS137  |
| Test Regulation     | FCC Part 15 Subpart C   |
| Test Result         | Complied  |
| Issue Date          | January 14, 2025  |
| Remarks             | Wireless LAN (2.4 GHz band) part<br>IEEE 802.11n SISO / MIMO 40 MHz BW only<br>*For permissive change |

**Representative Test Engineer**Takumi Nishida  
Engineer**Approved By**Ryota Yamanaka  
Engineer

CERTIFICATE 5107.02

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

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- 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. 15600416H-A**

This report is a revised version of 15600416H-A. 15600416H-A is replaced with this report.

| Revision        | Test Report No. | Date              | Page Revised Contents  |
|-----------------|-----------------|-------------------|--|
| -<br>(Original) | 15600416H-A     | December 19, 2024 | -  |
| 1               | 15600416H-A-R1  | January 14, 2025  | <b><u>APPENDIX 1: Test Data</u></b><br>- <b>Maximum Peak Output Power (Page 20)</b><br>Corrected data of "Antenna 0 / 1 e.i.r.p. Result" in table for Antenna 0 + Antenna 1 of Tx 11n-40 mode.<br>Antenna 0: 30.07 → 32.82<br>Antenna 1: 69.86 → 67.80<br><br>- <b>Radiated Spurious Emission (Page 23)</b> <ul style="list-style-type: none"><li>• Added "Floor noise" to remarks column of Horizontal 4844.0 MHz.</li><li>• Corrected data of Horizontal 2387.8 MHz.</li></ul> |

## Reference: Abbreviations (Including words undescribed in this report)

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

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## SECTION 1: Customer Information

|                  |  |
|------------------|--|
| Company Name     | DENSO CORPORATION                                      |
| Address          | 1-1, Showa-cho, Kariya-shi, Aichi-ken, 448-8661, Japan |
| Telephone Number | +81-566-26-5879  |
| Contact Person   | Akina Takakura   |

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   | Cockpit Control Unit  |
| Model Number  | DNNS137   |
| Serial Number | Refer to SECTION 4.2  |
| Condition     | Production prototype<br>(Not for Sale: This sample is equivalent to mass-produced items.) |
| Modification  | No Modification by the test lab   |
| Receipt Date  | December 1, 2024  |
| Test Date     | December 3 and 5, 2024  |

### 2.2 Product Description

#### General Specification

|                       |   |
|-----------------------|---|
| Rating                | DC 13.2 V<br>VDD DC 1.8 V, 3.3 V, 2.2 V |
| Operating temperature | 5 deg. C to 35 deg. C                   |

#### Radio Specification (1/2)

This report contains data provided by the customer which can impact the validity of results. UL Japan, Inc. is only responsible for the validity of results after the integration of the data provided by the customer. The data provided by the customer is marked "a)" in the table below.

#### WLAN (IEEE802.11b/11g/11n-20/n-40)

|                            |   |                             |
|----------------------------|---|-----------------------------|
| Equipment Type             | Transceiver   |                             |
| Frequency of Operation     | 20 MHz Band: 2412 MHz to 2462 MHz                                   |                             |
|                            | 40 MHz Band: 2422 MHz to 2452 MHz                                   |                             |
| Type of Modulation         | DSSS (CCK, DQPSK, DBPSK)<br>OFDM (64QAM, 16QAM, QPSK, BPSK, 256QAM) |                             |
| Antenna Type               | Inverted F Antenna  |                             |
| Antenna Gain <sup>a)</sup> | Antenna 0:  | 0.71 dBi (Peak) (for Right) |
|                            | Antenna 1:  | 2.19 dBi (Peak) (for Left)  |

## Radio Specification (2/2)

### Bluetooth (BR / EDR)

|                        |                                    |
|------------------------|------------------------------------|
| Equipment Type         | Transceiver                        |
| Frequency of Operation | 2402 MHz to 2480 MHz               |
| Type of Modulation     | FHSS (GFSK, $\pi/4$ DQPSK, 8 DPSK) |
| Antenna Type           | Inverted F Antenna                 |
| Antenna Gain           | 0.71 dBi (Peak) (for Right)        |

### WLAN (IEEE802.11a/11n-20/11ac-20/11n-40/11ac-40/11ac-80)

|                        |   |  |
|------------------------|---|--|
| Equipment Type         | Transceiver                             |  |
| Frequency of Operation | 20 MHz Band                             | 5180 MHz to 5240 MHz<br>5745 MHz to 5825 MHz |
|                        | 40 MHz Band                             | 5190 MHz to 5230 MHz<br>5755 MHz to 5795 MHz |
|                        | 80 MHz Band                             | 5210 MHz<br>5775 MHz                         |
| Type of Modulation     | OFDM (64QAM, 16QAM, QPSK, BPSK, 256QAM) |  |
| Antenna Type           | Inverted F Antenna                      |  |
| Antenna Gain           | Antenna 0:                              | 1.66 dBi (Peak) (for Right)                  |
|                        | Antenna 1:                              | 4.04 dBi (Peak) (for Left)                   |

### GNSS

|                        |   |
|------------------------|---|
| Equipment Type         | Receiver  |
| Frequency of Operation | GPS: 1575.42MHz<br>GLONASS: 1598.0625 MHz to 1605.375 MHz |
| Type of Modulation     | BPSK  |

### Broadcast

|                        |   |
|------------------------|---|
| Equipment Type         | Receiver  |
| Frequency of Operation | AM: 522 kHz to 1710 kHz<br>FM: 87.75 MHz to 107.9 MHz<br>RBDS: 87.75 MHz to 107.9 MHz<br>XM: 2333.465 MHz to 2344.045 MHz |

## SECTION 3: Test Specification, Procedures & Results

### 3.1 Test Specification

|                    |  |
|--------------------|--|
| Test Specification | FCC Part 15 Subpart C<br>The latest version on the first day of the testing period   |
| Title              | FCC 47 CFR Part 15 Radio Frequency Device Subpart C Intentional Radiators<br>Section 15.207 Conducted limits<br>Section 15.247 Operation within the bands 902-928 MHz, 2400-2483.5 MHz,<br>and 5725-5850 MHz |

### 3.2 Procedures and Results

| Item                                    | Test Procedure  | Specification  | Worst Margin                             | Results  | Remarks   |
|---|---|--|--|----------|---|
| Conducted Emission                      | FCC: ANSI C63.10-2013<br>6. Standard test methods<br>ISED: RSS-Gen 8.8      | FCC: Section 15.207<br>ISED: RSS-Gen 8.8                                   | -  | N/A      | *1)   |
| 6dB Bandwidth                           | FCC: KDB 558074 D01<br>15.247<br>Meas Guidance v05r02<br>ISED: -            | FCC: Section 15.247(a)(2)<br>ISED: RSS-247 5.2(a)                          | See data.                                | Complied | Conducted   |
| Maximum Peak Output Power               | FCC: KDB 558074 D01<br>15.247<br>Meas Guidance v05r02<br>ISED: RSS-Gen 6.12 | FCC: Section 15.247(b)(3)<br>ISED: RSS-247 5.4(d)                          |  | Complied | Conducted   |
| Power Density                           | FCC: KDB 558074 D01<br>15.247<br>Meas Guidance v05r02<br>ISED: -            | FCC: Section 15.247(e)<br>ISED: RSS-247 5.2(b)                             |  | Complied | Conducted   |
| Spurious Emission Restricted Band Edges | FCC: KDB 558074 D01<br>15.247<br>Meas Guidance v05r02<br>ISED: RSS-Gen 6.13 | FCC: Section 15.247(d)<br>ISED: RSS-247 5.5<br>RSS-Gen 8.9<br>RSS-Gen 8.10 | 6.5 dB<br>2390.00 MHz,<br>AV, Horizontal | Complied | Conducted (below 30 MHz)/<br>Radiated (above 30 MHz)<br>*2) |

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

\* In case any questions arise about test procedure, ANSI C63.10: 2013 is also referred.

\*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.

\*2) Radiated test was selected over 30 MHz based on section 15.247(d) and KDB 558074 D01 15.247 Meas Guidance v05r02 8.5 and 8.6.

#### **FCC Part 15.31 (e)**

This EUT provides the stable voltage constantly to RF part regardless of input voltage.  
Therefore, this 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.

### 3.3 Addition to Standard

| Item                   | Test Procedure    | Specification | Worst Margin | Results | Remarks   |
|------------------------|-------------------|---------------|--------------|---------|-----------|
| 99% Occupied Bandwidth | ISED: RSS-Gen 6.7 | ISED: -       | N/A          | -       | Conducted |

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 | 5.0                          |
|                      |                     | Vertical   | 5.0                          |
|                      | 200 MHz to 1000 MHz | Horizontal | 5.2                          |
|                      |                     | Vertical   | 6.2                          |
| 10 m                 | 30 MHz to 200 MHz   | Horizontal | 5.5                          |
|                      |                     | Vertical   | 5.4                          |
|                      | 200 MHz to 1000 MHz | Horizontal | 5.5                          |
|                      |                     | Vertical   | 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                          |

#### Antenna Terminal Conducted

| Item  | Unit   | Calculated Uncertainty (+/-) |
|---|--------|------------------------------|
| Antenna terminated conducted emission / Power density / Burst power | dB     | 3.47                         |
| Adjacent channel power (ACP)  | dB     | 2.28                         |
| Bandwidth (OBW)   | %      | 0.96                         |
| Time readout (time span upto 100 msec)                              | %      | 0.11                         |
| Time readout (time span upto 1000 msec)                             | %      | 0.11                         |
| Time readout (time span upto 60 sec)                                | %      | 0.02                         |
| Power measurement (Power meter < 8 GHz)                             | dB     | 1.46                         |
| Power measurement (Call box < 6 GHz)                                | dB     | 1.69                         |
| Frequency readout (Frequency counter)                               | ppm    | 0.67                         |
| Frequency readout (Spectrum analyzer frequency readout function)    | ppm    | 2.13                         |
| Temperature (constant temperature bath)                             | deg. C | 0.69                         |
| Humidity (constant temperature bath)                                | %RH    | 2.98                         |
| Modulation characteristics  | %      | 6.93                         |
| Frequency for mobile  | ppm    | 0.08                         |
| Contention-based protocol   | dB     | 2.26                         |



### 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)

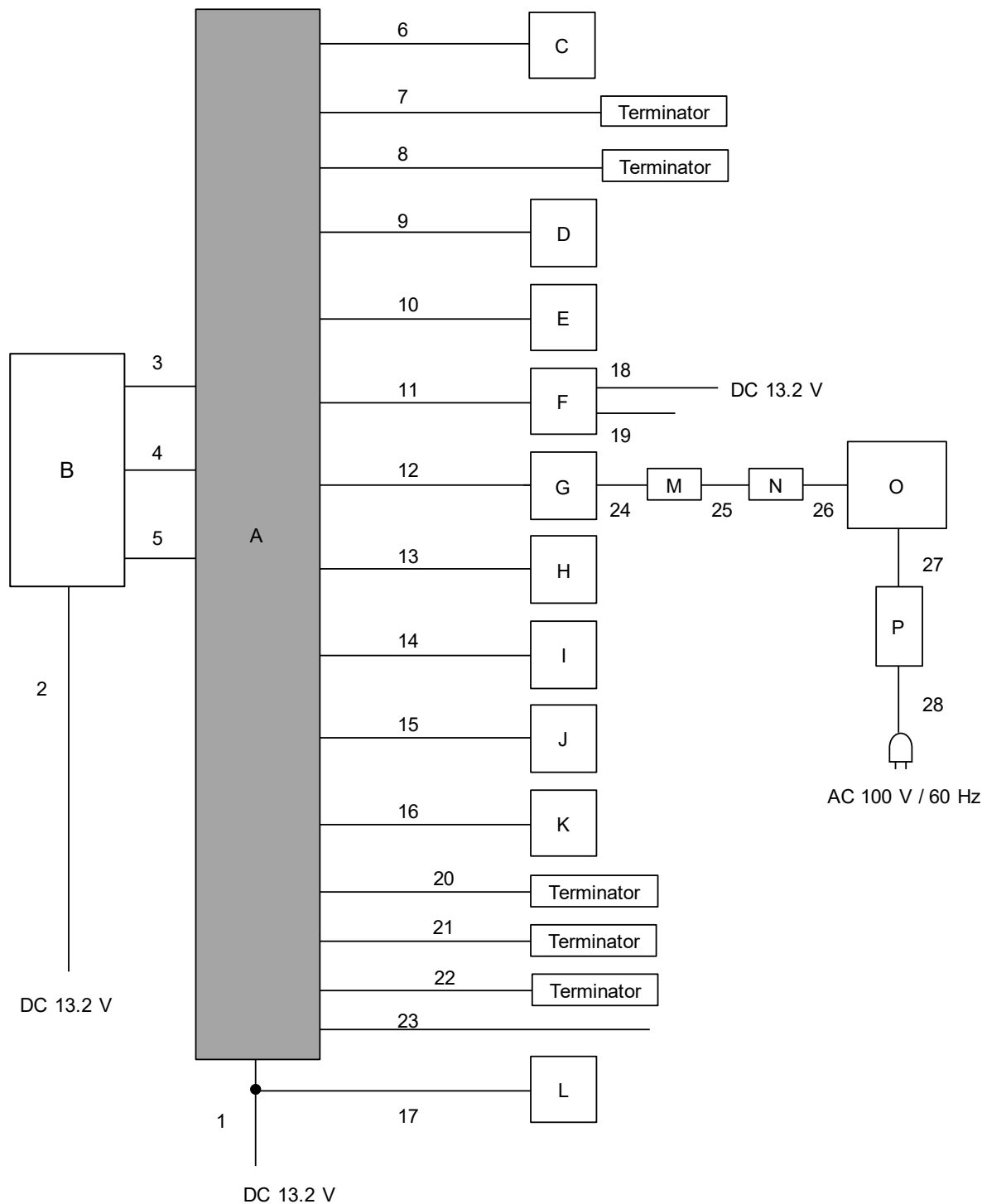
| Mode  | Remarks*              |
|---|-----------------------|
| IEEE 802.11n SISO / MIMO 40 MHz BW (11n-40)   | MCS 15 (Long GI), PN9 |
| *The worst condition was determined based on the test result of Maximum Peak Output Power (Mid Channel)   |                       |
| *Power of the EUT was set by the software as follows;<br>Power Setting: 11n-40 (SISO): 5 dBm<br>11n-40 (MIMO): 8 dBm<br>Software: CCU TEST Program<br>Soc: Version: CP25_20240517<br>(Date: 2024.05.17, Storage location: EUT memory)<br>VCPU: Version: CP25_20240517<br>(Date: 2024.05.17, Storage location: EUT memory)<br>*This setting of software is the worst case.<br>Any conditions under the normal use do not exceed the condition of setting.<br>In addition, end users cannot change the settings of the output power of the product.<br>Test operating mode was determined as follows according to "Section 1 of 6 802.11 a/b/g/n testing - Managing Complex Regulatory Approvals - " of TCB Council Workshop October 2009 |                       |

\*The Details of Operating Mode(s)

| Test Item   | Operating Mode | Tested Antenna             | Tested Frequency |
|---|----------------|----------------------------|------------------|
| Radiated Spurious Emission,<br>Conducted Spurious Emission,<br>6dB Bandwidth,<br>Maximum Peak Output Power,<br>Power Density,<br>99% Occupied Bandwidth | Tx 11n-40      | 0 to 1<br>(Simultaneously) | 2422 MHz         |

4.2 Configuration and Peripherals

Antenna Terminal Conducted Tests



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

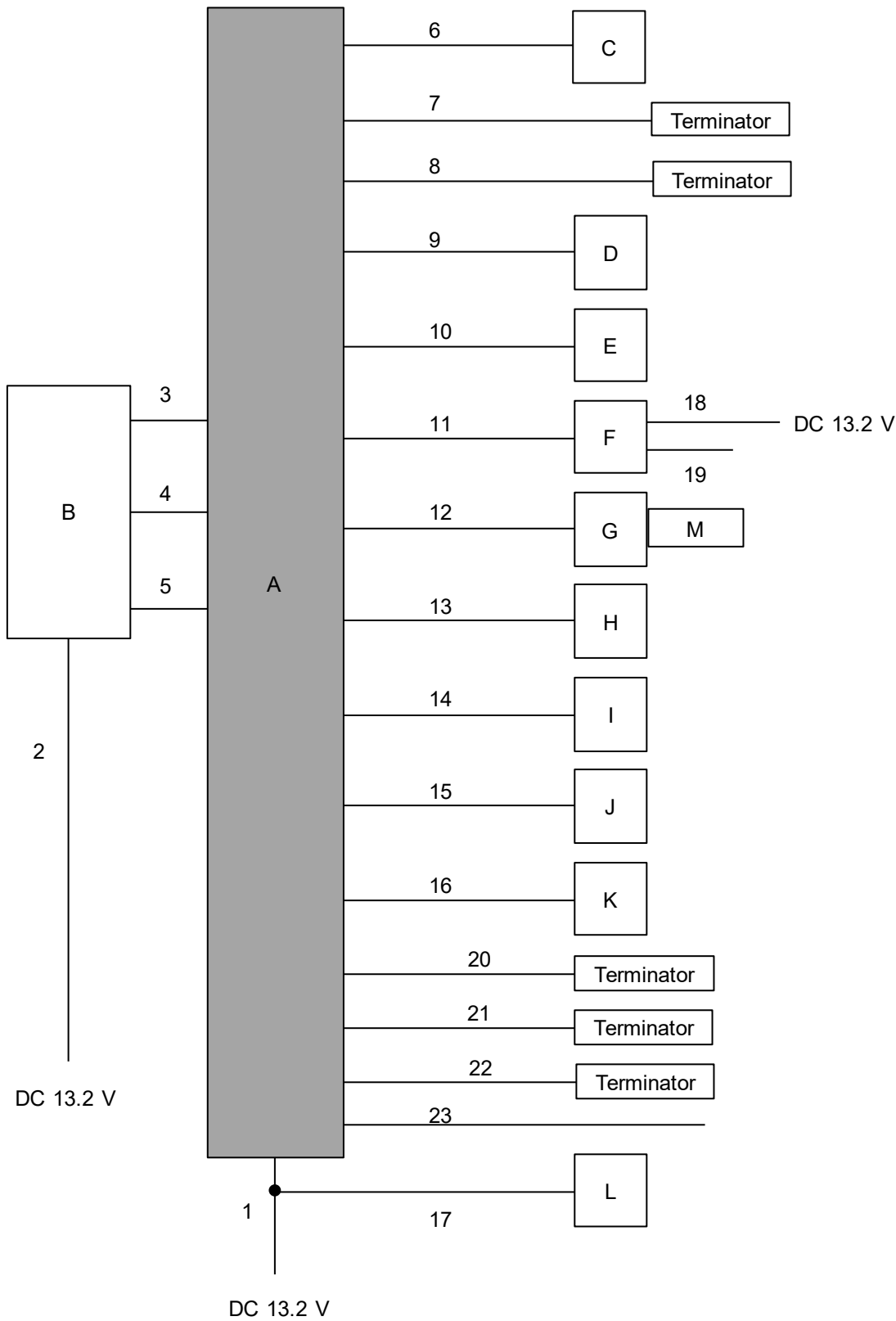
#### Description of EUT and Support Equipment

| No. | Item                    | Model number          | Serial Number               | Manufacturer             | Remarks |
|-----|-------------------------|-----------------------|-----------------------------|--------------------------|---------|
| A   | Cockpit Control Unit    | DNNS137               | 46872600100000000<br>000002 | DENSO<br>CORPORATION     | EUT     |
| B   | Display (CID)           | 137000-15890001       | No.1                        | DENSO TEN<br>CORPORATION | -       |
| C   | GPS Antenna             | 86277AL000            | 29550172                    | SUBARU<br>CORPORATION    | -       |
| D   | Camera Dummy            | MAX96778COAXE<br>VKIT | -                           | Maxim integrated         | -       |
| E   | Ether Dummy             | EtherBoard            | -                           | DENSO<br>CORPORATION     | -       |
| F   | METER                   | 5-157500-186          | No.S44                      | DENSO<br>CORPORATION     | -       |
| G   | USB BOX                 | TAP8006 cable         | No.12                       | HOSHIDEN                 | -       |
| H   | Speaker                 | AK-122                | -                           | archill                  | -       |
| I   | Speaker                 | AK-122                | -                           | archill                  | -       |
| J   | Speaker                 | AK-122                | -                           | archill                  | -       |
| K   | Speaker                 | AK-122                | -                           | archill                  | -       |
| L   | HEATER CONTROL<br>Panel | 137000-15990005       | No.1                        | DENSO TEN<br>CORPORATION | -       |
| M   | USB-LAN Adapter         | LUA3-U2-ATX           | 26495621036190              | BUFFALO INC.             | -       |
| N   | USB-LAN Adapter         | LUA3-U2-ATX           | 26495621036077              | BUFFALO INC.             | -       |
| O   | Laptop PC               | X1 Carbon             | R9-OH8OBW 15/9              | LENOVO                   | -       |
| P   | AC Adapter              | ADXL45NCC2A           | 11S45N0299Z1ZS944<br>B6KBR  | LENOVO                   | -       |

#### List of Cables Used

| No. | Name                       | Length (m) | Shield     |            | Remarks |
|-----|----------------------------|------------|------------|------------|---------|
|     |                            |            | Cable      | Connector  |         |
| 1   | DC Cable                   | 4.20       | Unshielded | Unshielded | -       |
| 2   | DC Cable                   | 4.30       | Unshielded | Unshielded | -       |
| 3   | Antenna Cable              | 0.57       | Shielded   | Shielded   | -       |
| 4   | Antenna Cable              | 0.57       | Shielded   | Shielded   | -       |
| 5   | Display Signal Cable       | 0.57       | Shielded   | Shielded   | -       |
| 6   | GPS Antenna Cable          | 1.00       | Shielded   | Shielded   | -       |
| 7   | Radio Antenna Cable(AM/FM) | 2.00       | Shielded   | Shielded   | -       |
| 8   | Radio Antenna Cable(XM)    | 2.00       | Shielded   | Shielded   | -       |
| 9   | Camera Cable               | 2.00       | Shielded   | Shielded   | -       |
| 10  | Ether Cable                | 2.00       | Shielded   | Shielded   | -       |
| 11  | METER Signal Cable         | 2.00       | Unshielded | Unshielded | -       |
| 12  | USB BOX Cable              | 2.00       | Shielded   | Shielded   | -       |
| 13  | Speaker Cable              | 6.30       | Unshielded | Unshielded | -       |
| 14  | Speaker Cable              | 6.30       | Unshielded | Unshielded | -       |
| 15  | Speaker Cable              | 6.30       | Unshielded | Unshielded | -       |
| 16  | Speaker Cable              | 6.30       | Unshielded | Unshielded | -       |
| 17  | DC Cable                   | 4.60       | Unshielded | Unshielded | -       |
| 18  | DC Cable                   | 4.60       | Unshielded | Unshielded | -       |
| 19  | Signal Cable               | 2.00       | Unshielded | Unshielded | -       |
| 20  | Signal Cable               | 2.00       | Unshielded | Unshielded | -       |
| 21  | Signal Cable               | 2.00       | Unshielded | Unshielded | -       |
| 22  | Signal Cable               | 2.00       | Unshielded | Unshielded | -       |
| 23  | Signal Cable               | 2.00       | Unshielded | Unshielded | -       |
| 24  | USB Cable                  | 0.18       | Shielded   | Shielded   | -       |
| 25  | LAN Cable                  | 2.00       | Shielded   | Shielded   | -       |
| 26  | USB Cable                  | 0.18       | Shielded   | Shielded   | -       |
| 27  | DC Cable                   | 1.70       | Unshielded | Unshielded | -       |
| 28  | AC Cable                   | 1.00       | Unshielded | Unshielded | -       |

**Radiated Spurious Emission**



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

#### Description of EUT and Support Equipment

| No. | Item                    | Model number          | Serial Number               | Manufacturer             | Remarks |
|-----|-------------------------|-----------------------|-----------------------------|--------------------------|---------|
| A   | Cockpit Control Unit    | DNNS137               | 4687260010000000<br>0000002 | DENSO<br>CORPORATION     | EUT     |
| B   | Display (CID)           | 137000-15890001       | No.1                        | DENSO TEN<br>CORPORATION | -       |
| C   | GPS Antenna             | 86277AL000            | 29550172                    | SUBARU<br>CORPORATION    | -       |
| D   | Camera Dummy            | MAX96778COAXE<br>VKIT | -                           | Maxim integrated         | -       |
| E   | Ether Dummy             | EtherBoard            | -                           | DENSO<br>CORPORATION     | -       |
| F   | METER                   | 5-157500-186          | No.S44                      | DENSO<br>CORPORATION     | -       |
| G   | USB BOX                 | TAP8006 cable         | No.12                       | HOSHIDEN                 | -       |
| H   | Speaker                 | AK-122                | -                           | archill                  | -       |
| I   | Speaker                 | AK-122                | -                           | archill                  | -       |
| J   | Speaker                 | AK-122                | -                           | archill                  | -       |
| K   | Speaker                 | AK-122                | -                           | archill                  | -       |
| L   | HEATER CONTROL<br>Panel | 137000-15990005       | No.1                        | DENSO TEN<br>CORPORATION | -       |
| M   | USB Memory              | RUF3-K16GB            | P10416                      | BUFFALO INC.             | -       |

#### List of Cables Used

| No. | Name                       | Length (m) | Shield     |            | Remarks |
|-----|----------------------------|------------|------------|------------|---------|
|     |                            |            | Cable      | Connector  |         |
| 1   | DC Cable                   | 4.20       | Unshielded | Unshielded | -       |
| 2   | DC Cable                   | 4.30       | Unshielded | Unshielded | -       |
| 3   | Antenna Cable              | 0.57       | Shielded   | Shielded   | -       |
| 4   | Antenna Cable              | 0.57       | Shielded   | Shielded   | -       |
| 5   | Display Signal Cable       | 0.57       | Shielded   | Shielded   | -       |
| 6   | GPS Antenna Cable          | 1.00       | Shielded   | Shielded   | -       |
| 7   | Radio Antenna Cable(AM/FM) | 2.00       | Shielded   | Shielded   | -       |
| 8   | Radio Antenna Cable(XM)    | 2.00       | Shielded   | Shielded   | -       |
| 9   | Camera Cable               | 2.00       | Shielded   | Shielded   | -       |
| 10  | Ether Cable                | 2.00       | Shielded   | Shielded   | -       |
| 11  | METER Signal Cable         | 2.00       | Unshielded | Unshielded | -       |
| 12  | USB BOX Cable              | 2.00       | Shielded   | Shielded   | -       |
| 13  | Speaker Cable              | 6.30       | Unshielded | Unshielded | -       |
| 14  | Speaker Cable              | 6.30       | Unshielded | Unshielded | -       |
| 15  | Speaker Cable              | 6.30       | Unshielded | Unshielded | -       |
| 16  | Speaker Cable              | 6.30       | Unshielded | Unshielded | -       |
| 17  | DC Cable                   | 4.60       | Unshielded | Unshielded | -       |
| 18  | DC Cable                   | 4.60       | Unshielded | Unshielded | -       |
| 19  | Signal Cable               | 2.00       | Unshielded | Unshielded | -       |
| 20  | Signal Cable               | 2.00       | Unshielded | Unshielded | -       |
| 21  | Signal Cable               | 2.00       | Unshielded | Unshielded | -       |
| 22  | Signal Cable               | 2.00       | Unshielded | Unshielded | -       |
| 23  | Signal Cable               | 2.00       | Unshielded | Unshielded | -       |

## SECTION 5: Radiated Spurious Emission

### Test Procedure

It was measured based on "8.5 and 8.6 of KDB 558074 D01 15.247 Meas Guidance v05r02".

[For below 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. Test antenna was aimed at the EUT for receiving the maximum signal and always kept within the illumination area of the 3 dB beamwidth of the antenna.

The height of the measuring antenna varied between 1 m 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 with the Test Receiver, or the Spectrum Analyzer.

The measurements were made with the following detector function of the test receiver and the Spectrum analyzer (in linear mode).

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    | 30 MHz to 200 MHz | 200 MHz to 1 GHz | Above 1 GHz |
| Antenna Type | Biconical         | Logperiodic      | Horn        |

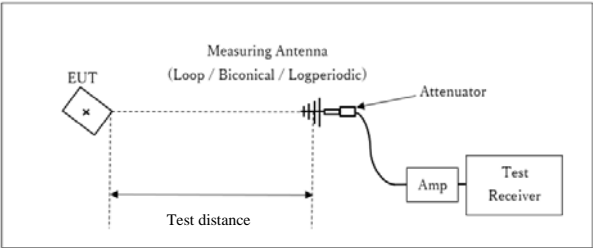
In any 100 kHz bandwidth outside the restricted band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator confirmed 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on a radiated measurement.

### 20 dBc was applied to the frequency over the limit of FCC 15.209 / Table 4 of RSS-Gen 8.9(ISED) and outside the restricted band of FCC15.205 / Table 6 of RSS-Gen 8.10 (ISED).

|                 |               |                          |   |                              |
|-----------------|---------------|--------------------------|---|------------------------------|
| Frequency       | Below 1 GHz   | Above 1 GHz              |   | 20 dBc                       |
| Instrument Used | Test Receiver | Spectrum Analyzer        |   | Spectrum Analyzer            |
| Detector        | QP            | PK                       | AV  | PK                           |
| IF Bandwidth    | BW 120 kHz    | RBW: 1 MHz<br>VBW: 3 MHz | 11.12.2.5.1<br>RBW: 1 MHz<br>VBW: 3 MHz<br>Detector:<br>Power Averaging (RMS)<br>Trace: 100 traces<br>11.12.2.5.2<br>The duty cycle was less than 98% for detected noise, a duty factor was added to the 11.12.2.5.1 results. | RBW: 100 kHz<br>VBW: 300 kHz |

Figure 2: Test Setup

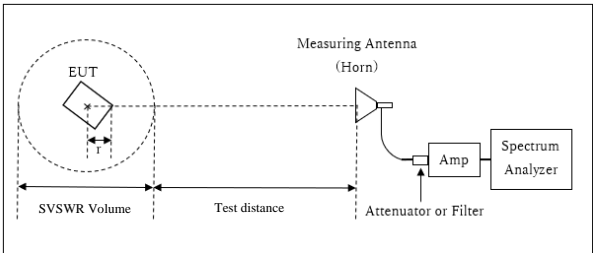
Below 1 GHz



x : Center of turn table

Test Distance: 3 m

1 GHz to 10 GHz



r : Radius of an outer periphery of EUT  
x : Center of turn table

[1 GHz to 6 GHz]

Distance Factor:  $20 \times \log (3.55 \text{ m}^* / 3.0 \text{ m}) = 1.47 \text{ dB}$   
\*(Test Distance + SVSWR Volume / 2) - r = 3.55 m

Test Distance: 3.00 m

SVSWR Volume: 1.5 m

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

r: 0.2 m

[6 GHz to 10 GHz]

Distance Factor:  $20 \times \log (3.55 \text{ m}^* / 3.0 \text{ m}) = 1.47 \text{ dB}$   
\*(Test Distance + SVSWR Volume / 2) - r = 3.55 m

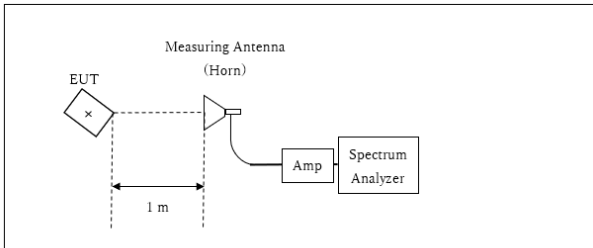
Test Distance: 3.25 m

SVSWR Volume: 1.0 m

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

r: 0.2 m

10 GHz to 26.5 GHz



x : Center of turn table

Distance Factor:  $20 \times \log (1.0 \text{ m} / 3.0 \text{ m}) = -9.5 \text{ dB}$

\*Test Distance: 1 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.

Test results are rounded off and limit are rounded down, so some differences might be observed.

Measurement Range : 30 MHz to 26.5 GHz  
Test Data : APPENDIX  
Test Result : Pass



## SECTION 6: Antenna Terminal Conducted Tests

### Test Procedure

The tests were made with below setting connected to the antenna port.

| Test                                | Span                                    | RBW              | VBW                | Sweep time | Detector             | Trace    | Instrument Used                    |
|-------------------------------------|---|------------------|--------------------|------------|----------------------|----------|------------------------------------|
| 6dB Bandwidth                       | 20 MHz                                  | 100 kHz          | 300 kHz            | Auto       | Peak                 | Max Hold | Spectrum Analyzer                  |
| 99% Occupied Bandwidth *1)          | Enough width to display emission skirts | 1 to 5 % of OBW  | Three times of RBW | Auto       | Peak                 | Max Hold | Spectrum Analyzer                  |
| Maximum Peak Output Power           | -                                       | -                | -                  | Auto       | Peak/<br>Average *2) | -        | Power Meter<br>(Sensor: 50 MHz BW) |
| Peak Power Density                  | 1.5 times the 6dB Bandwidth             | 3 kHz            | 10 kHz             | Auto       | Peak                 | Max Hold | Spectrum Analyzer *3)              |
| Conducted Spurious Emission *4) *5) | 9 kHz to 150 kHz<br>150 kHz to 30 MHz   | 200 Hz<br>10 kHz | 620 Hz<br>30 kHz   | Auto       | Peak                 | Max Hold | Spectrum Analyzer                  |

\*1) Peak hold was applied as Worst-case measurement.

\*2) Reference data

\*3) Section 11.10.2 Method PKPSD (peak PSD) of "ANSI C63.10-2013".

\*4) In the frequency range below 30MHz, RBW was narrowed to separate the noise contents.  
Then, wide-band noise near the limit was checked separately, however the noise was not detected as shown in the chart.  
(9 kHz - 150 kHz: RBW = 200 Hz, 150 kHz - 30 MHz: RBW = 10 kHz)

\*5) 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.

Test results are rounded off and limit are rounded down, so some differences might be observed.  
The equipment and cables were not used for factor 0 dB of the data sheets.

Test Data : APPENDIX  
Test Result : Pass

## APPENDIX 1: Test Data

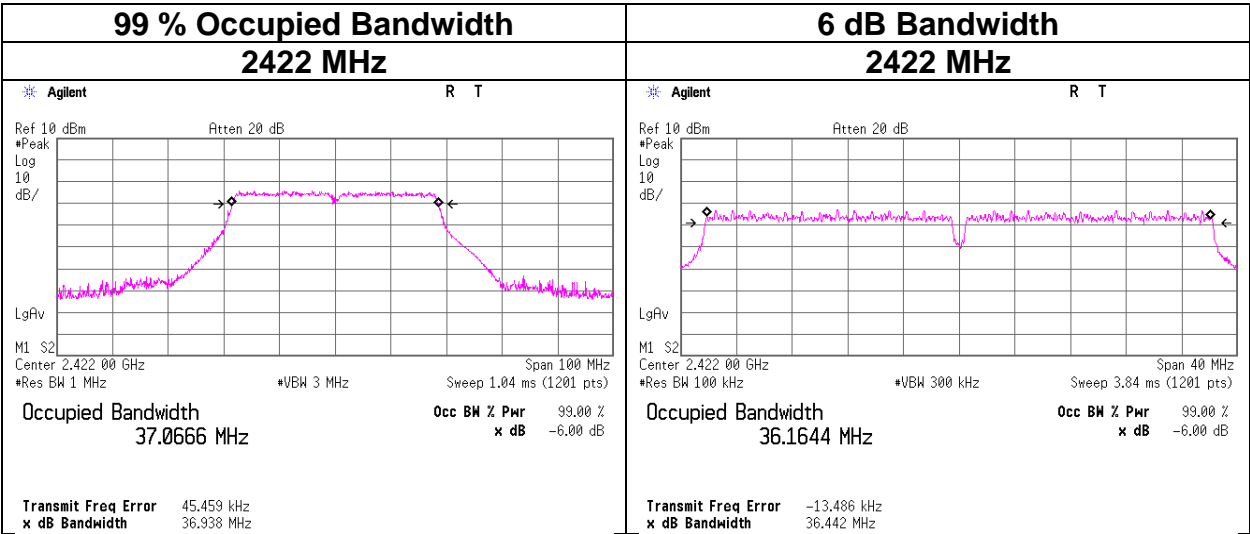
### 99 % Occupied Bandwidth and 6 dB Bandwidth

|                        |                                    |
|------------------------|------------------------------------|
| Test place             | Ise EMC Lab. No.6 Measurement Room |
| Date                   | December 3, 2024                   |
| Temperature / Humidity | 23 deg. C / 55 % RH                |
| Engineer               | Takumi Nishida                     |
| Mode                   | Tx                                 |

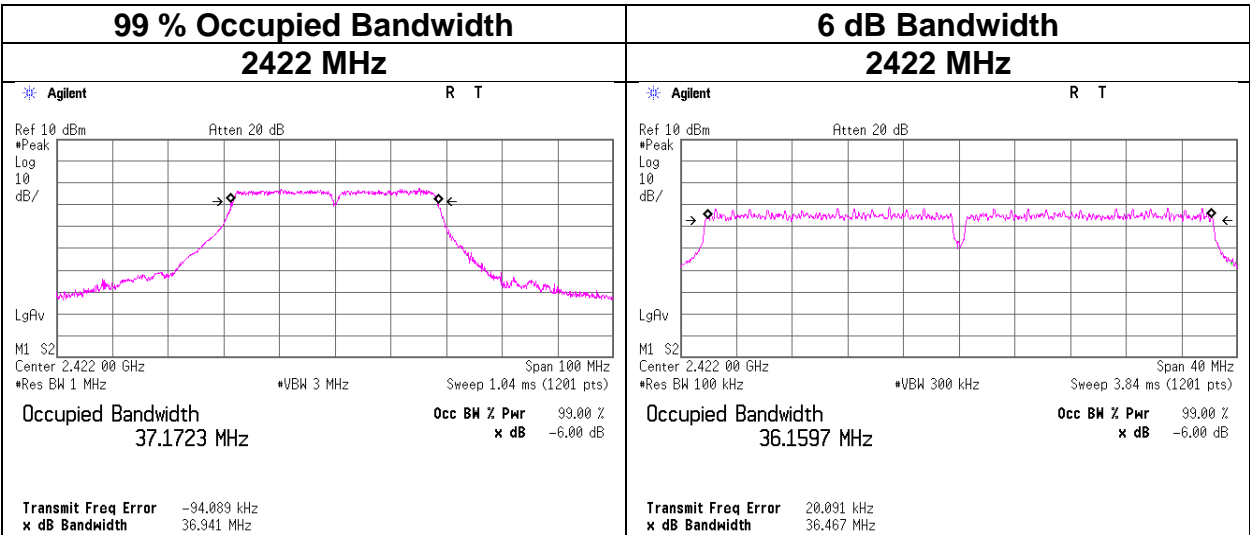
| Mode   | Antenna | Frequency<br>[MHz] | 99 % Occupied<br>Bandwidth<br>[kHz] | 6 dB Bandwidth<br>[MHz] | Limit for<br>6 dB Bandwidth<br>[MHz] |
|--------|---------|--------------------|-------------------------------------|-------------------------|--------------------------------------|
| 11n-40 | 0       | 2422               | 37066.6                             | 36.442                  | > 0.5000                             |
|        | 1       | 2422               | <b>37172.3</b>                      | 36.467                  | > 0.5000                             |

99 % Occupied Bandwidth and 6 dB Bandwidth

11n-40 Antenna 0



11n-40 Antenna 1



## Maximum Peak Output Power

Test place Ise EMC Lab. No.6 Measurement Room  
Date December 3, 2024  
Temperature / Humidity 23 deg. C / 55 % RH  
Engineer Takumi Nishida  
Mode Tx 11n-40

| Antenna 0 + Antenna 1 |  |  | Conducted Power |       |       |      |        | e.i.r.p. for RSS-247            |                                 |        |        |       |         |        |
|-----------------------|--|--|-----------------|-------|-------|------|--------|---------------------------------|---------------------------------|--------|--------|-------|---------|--------|
| Freq.                 | Antenna 0<br>Conducted Power<br>Result | Antenna 1<br>Conducted Power<br>Result | Result          |       | Limit |      | Margin | Antenna 0<br>e.i.r.p.<br>Result | Antenna 1<br>e.i.r.p.<br>Result | Result |        | Limit |         | Margin |
| [MHz]                 | [mW]                                   | [mW]                                   | [dBm]           | [mW]  | [dBm] | [mW] | [dB]   | [mW]                            | [mW]                            | [dBm]  | [mW]   | [dBm] | [mW]    | [dB]   |
| 2422                  | 27.87                                  | 40.94                                  | 18.38           | 68.81 | 30.00 | 1000 | 11.62  | 32.82                           | 67.80                           | 20.03  | 100.61 | 36.02 | 4000.00 | 15.99  |

Sample Calculation:

Conducted Power Result = Antenna 0 Conducted Power Result + Antenna 1 Conducted Power Result

e.i.r.p. Result = Antenna 0 e.i.r.p. Result + Antenna 1 e.i.r.p. Result

Antenna 0

| Freq. | Reading | Cable<br>Loss | Atten.<br>Loss | Conducted Power<br>Result |       | Antenna<br>Gain | e.i.r.p.<br>Result |       |
|-------|---------|---------------|----------------|---------------------------|-------|-----------------|--------------------|-------|
| [MHz] | [dBm]   | [dB]          | [dB]           | [dBm]                     | [mW]  | [dBi]           | [dBm]              | [mW]  |
| 2422  | 2.15    | 2.20          | 10.10          | 14.45                     | 27.87 | 0.71            | 15.16              | 32.82 |

Antenna 1

| Freq. | Reading | Cable<br>Loss | Atten.<br>Loss | Conducted Power<br>Result |       | Antenna<br>Gain | e.i.r.p.<br>Result |       |
|-------|---------|---------------|----------------|---------------------------|-------|-----------------|--------------------|-------|
| [MHz] | [dBm]   | [dB]          | [dB]           | [dBm]                     | [mW]  | [dBi]           | [dBm]              | [mW]  |
| 2422  | 3.85    | 2.17          | 10.10          | 16.12                     | 40.94 | 2.19            | 18.31              | 67.80 |

Sample Calculation:

Conducted Power Result = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss

e.i.r.p. Result = Conducted Power Result + Antenna Gain

2422 MHz

| Tx   | MCS<br>Number | Antenna 0 |      | Antenna 1 |      | Long GI<br>Total<br>Reading Power |      | Antenna 0 |      | Antenna 1 |      | Short GI<br>Total<br>Reading Power |      | Remark    |
|------|---------------|-----------|------|-----------|------|-----------------------------------|------|-----------|------|-----------|------|------------------------------------|------|-----------|
|      |               | [dBm]     | [mW] | [dBm]     | [mW] | [dBm]                             | [mW] | [dBm]     | [mW] | [dBm]     | [mW] | [dBm]                              | [mW] |           |
| SISO | 0             | -0.90     | 0.81 | -         | -    | -0.90                             | 0.81 | -         | -    | -         | -    | -                                  | -    |           |
|      | 1             | -0.77     | 0.84 | -         | -    | -0.77                             | 0.84 | -         | -    | -         | -    | -                                  | -    |           |
|      | 2             | 0.39      | 1.09 | -         | -    | 0.39                              | 1.09 | -         | -    | -         | -    | -                                  | -    |           |
|      | 3             | -0.02     | 1.00 | -         | -    | -0.02                             | 1.00 | -         | -    | -         | -    | -                                  | -    |           |
|      | 4             | 2.71      | 1.87 | -         | -    | 2.71                              | 1.87 | -         | -    | -         | -    | -                                  | -    |           |
|      | 5             | 3.09      | 2.04 | -         | -    | 3.09                              | 2.04 | -         | -    | -         | -    | -                                  | -    |           |
|      | 6             | 2.55      | 1.80 | -         | -    | 2.55                              | 1.80 | -         | -    | -         | -    | -                                  | -    |           |
|      | 7             | 2.41      | 1.74 | -         | -    | 2.41                              | 1.74 | -         | -    | -         | -    | -                                  | -    |           |
|      | 0             | -         | -    | 0.96      | 1.25 | 0.96                              | 1.25 | -         | -    | -         | -    | -                                  | -    |           |
|      | 1             | -         | -    | 1.04      | 1.27 | 1.04                              | 1.27 | -         | -    | -         | -    | -                                  | -    |           |
|      | 2             | -         | -    | 2.04      | 1.60 | 2.04                              | 1.60 | -         | -    | -         | -    | -                                  | -    |           |
|      | 3             | -         | -    | 1.71      | 1.48 | 1.71                              | 1.48 | -         | -    | -         | -    | -                                  | -    |           |
|      | 4             | -         | -    | 4.41      | 2.76 | 4.41                              | 2.76 | -         | -    | -         | -    | -                                  | -    |           |
|      | 5             | -         | -    | 4.75      | 2.99 | 4.75                              | 2.99 | -         | -    | -         | -    | -                                  | -    |           |
|      | 6             | -         | -    | 4.53      | 2.84 | 4.53                              | 2.84 | -         | -    | -         | -    | -                                  | -    |           |
|      | 7             | -         | -    | 3.92      | 2.47 | 3.92                              | 2.47 | -         | -    | -         | -    | -                                  | -    |           |
| MIMO | 0             | -0.66     | 0.86 | 0.94      | 1.24 | 3.23                              | 2.10 | -         | -    | -         | -    | -                                  | -    |           |
|      | 1             | -0.54     | 0.88 | 1.05      | 1.27 | 3.34                              | 2.16 | -         | -    | -         | -    | -                                  | -    |           |
|      | 2             | 0.41      | 1.10 | 2.03      | 1.60 | 4.31                              | 2.70 | -         | -    | -         | -    | -                                  | -    |           |
|      | 3             | 0.07      | 1.02 | 1.73      | 1.49 | 3.99                              | 2.51 | -         | -    | -         | -    | -                                  | -    |           |
|      | 4             | 3.13      | 2.06 | 4.45      | 2.79 | 6.85                              | 4.84 | -         | -    | -         | -    | -                                  | -    |           |
|      | 5             | 3.21      | 2.10 | 4.60      | 2.89 | 6.97                              | 4.98 | -         | -    | -         | -    | -                                  | -    |           |
|      | 6             | 2.86      | 1.93 | 4.42      | 2.77 | 6.72                              | 4.70 | -         | -    | -         | -    | -                                  | -    |           |
|      | 7             | 2.29      | 1.70 | 4.00      | 2.51 | 6.24                              | 4.21 | -         | -    | -         | -    | -                                  | -    |           |
|      | 8             | -0.36     | 0.92 | 1.08      | 1.28 | 3.43                              | 2.20 | -         | -    | -         | -    | -                                  | -    |           |
|      | 9             | -0.78     | 0.84 | 1.04      | 1.27 | 3.24                              | 2.11 | -         | -    | -         | -    | -                                  | -    |           |
|      | 10            | 0.74      | 1.19 | 2.04      | 1.60 | 4.45                              | 2.79 | -         | -    | -         | -    | -                                  | -    |           |
|      | 11            | 0.21      | 1.05 | 1.75      | 1.50 | 4.06                              | 2.55 | -         | -    | -         | -    | -                                  | -    |           |
|      | 12            | 2.87      | 1.94 | 4.60      | 2.89 | 6.83                              | 4.82 | -         | -    | -         | -    | -                                  | -    |           |
|      | 13            | 2.74      | 1.88 | 4.33      | 2.71 | 6.62                              | 4.59 | -         | -    | -         | -    | -                                  | -    |           |
|      | 14            | 2.79      | 1.90 | 4.45      | 2.79 | 6.71                              | 4.69 | -         | -    | -         | -    | -                                  | -    |           |
|      | 15            | 3.10      | 2.04 | 5.30      | 3.39 | 7.35                              | 5.43 | 2.92      | 1.96 | 5.04      | 3.19 | 7.12                               | 5.15 | * Long GI |

\*Worst MCS

All comparison were carried out on same frequency and measurement factors.

## **Average Output Power** **(Reference data for RF Exposure)**

|                        |                                    |
|------------------------|------------------------------------|
| Test place             | Ise EMC Lab. No.6 Measurement Room |
| Date                   | December 3, 2024                   |
| Temperature / Humidity | 23 deg. C / 55 % RH                |
| Engineer               | Takumi Nishida                     |
| Mode                   | Tx 11n-40                          |

Antenna 0 + Antenna 1 MCS0

| Freq.<br>[MHz] | Antenna 1<br>Result<br>[mW] | Antenna 2<br>Result<br>[mW] | Result<br>(Burst average) |      |
|----------------|-----------------------------|-----------------------------|---------------------------|------|
|                |                             |                             | [dBm]                     | [mW] |
| 2422           | 3.10                        | 4.77                        | 8.96                      | 7.86 |

Antenna 0

| Freq.<br>[MHz] | Reading<br>[dBm] | Cable<br>Loss<br>[dB] | Atten.<br>Loss<br>[dB] | Result<br>(Time average) |      | Duty<br>factor<br>[dB] | Result<br>(Burst power average) |      |
|----------------|------------------|-----------------------|------------------------|--------------------------|------|------------------------|---------------------------------|------|
|                |                  |                       |                        | [dBm]                    | [mW] |                        | [dBm]                           | [mW] |
| 2422           | -7.60            | 2.20                  | 10.10                  | 4.70                     | 2.95 | 0.21                   | 4.91                            | 3.10 |

Antenna 1

| Freq.<br>[MHz] | Reading<br>[dBm] | Cable<br>Loss<br>[dB] | Atten.<br>Loss<br>[dB] | Result<br>(Time average) |      | Duty<br>factor<br>[dB] | Result<br>(Burst power average) |      |
|----------------|------------------|-----------------------|------------------------|--------------------------|------|------------------------|---------------------------------|------|
|                |                  |                       |                        | [dBm]                    | [mW] |                        | [dBm]                           | [mW] |
| 2422           | -5.70            | 2.17                  | 10.10                  | 6.57                     | 4.54 | 0.21                   | 6.78                            | 4.77 |

Sample Calculation:

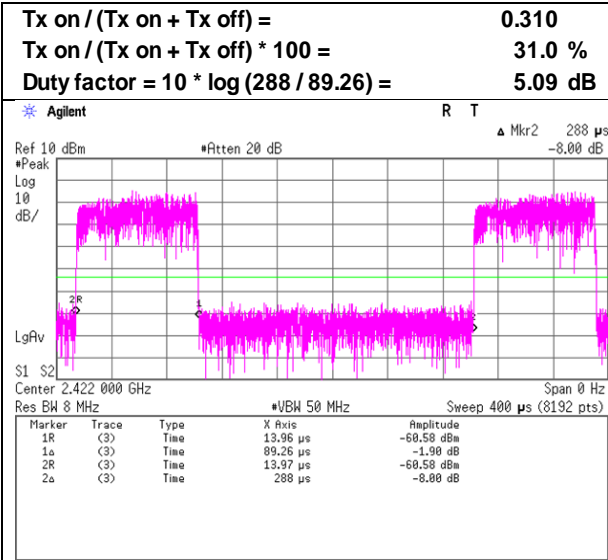
Result (Time average) = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss  
Result (Burst power average) = Time average + Duty factor

**The average output power was measured with the lowest order modulation and lowest data rate configuration in each IEEE 802.11 mode based on KDB 248227 D01.**

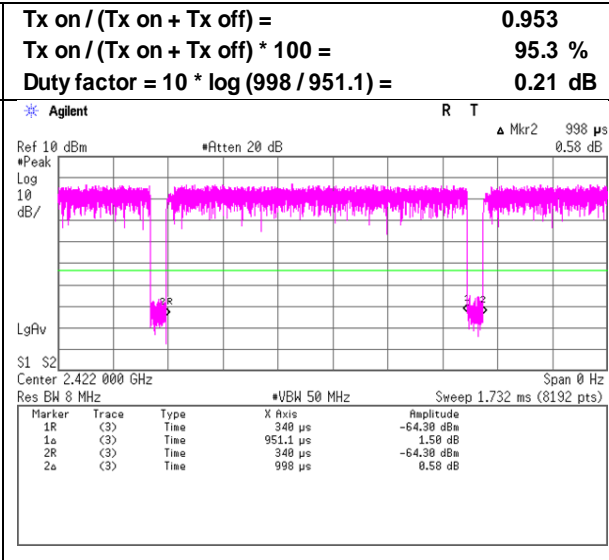
Burst rate confirmation

Test place                   Ise EMC Lab. No.6 Measurement Room  
Date                        December 3, 2024  
Temperature / Humidity   23 deg. C / 55 % RH  
Engineer                 Takumi Nishida  
Mode                      Tx

11n40 MCS 15



11n40 MCS 0



\* Since the burst rate is not different between the channels, the data has been obtained on the representative channel.

## Radiated Spurious Emission

|                        |                     |
|------------------------|---------------------|
| Test place             | Ise EMC Lab.        |
| Semi Anechoic Chamber  | No.2                |
| Date                   | December 5, 2024    |
| Temperature / Humidity | 21 deg. C / 42 % RH |
| Engineer               | Junki Nagatomi      |
| Mode                   | Tx 11n-40 2422 MHz  |

| Polarity    | Frequency | Reading<br>(QP / PK) | Reading<br>(AV) | Ant.<br>Factor | Loss | Gain | Duty<br>Factor | Result<br>(QP / PK) | Result<br>(AV) | Limit<br>(QP / PK) | Limit<br>(AV) | Margin<br>(QP / PK) | Margin<br>(AV) | Remark      |
|-------------|-----------|----------------------|-----------------|----------------|------|------|----------------|---------------------|----------------|--------------------|---------------|---------------------|----------------|-------------|
| [Hori/Vert] | [MHz]     | [dBuV]               | [dBuV]          | [dB/m]         | [dB] | [dB] | [dB]           | [dBuV/m]            | [dBuV/m]       | [dBuV/m]           | [dBuV/m]      | [dB]                | [dB]           |             |
| Hori.       | 69.6      | 27.4                 | -               | 6.3            | 7.3  | 28.5 | -              | 12.5                | -              | 40.0               | -             | 27.5                | -              |             |
| Hori.       | 94.7      | 35.8                 | -               | 9.4            | 7.5  | 28.4 | -              | 24.2                | -              | 43.5               | -             | 19.3                | -              |             |
| Hori.       | 125.7     | 26.4                 | -               | 13.4           | 7.8  | 28.3 | -              | 19.2                | -              | 43.5               | -             | 24.3                | -              |             |
| Hori.       | 220.6     | 25.8                 | -               | 11.3           | 8.4  | 27.9 | -              | 17.7                | -              | 46.0               | -             | 28.4                | -              |             |
| Hori.       | 260.7     | 32.7                 | -               | 12.4           | 8.7  | 27.7 | -              | 26.0                | -              | 46.0               | -             | 20.0                | -              |             |
| Hori.       | 290.0     | 37.5                 | -               | 13.6           | 8.8  | 27.7 | -              | 32.3                | -              | 46.0               | -             | 13.8                | -              |             |
| Hori.       | 2387.8    | 54.7                 | 42.6            | 27.5           | 4.5  | 33.2 | 5.1            | 53.5                | 46.5           | 73.9               | 53.9          | 20.5                | 7.4            | *1)         |
| Hori.       | 2390.0    | 55.9                 | 43.5            | 27.5           | 4.5  | 33.2 | 5.1            | 54.7                | 47.4           | 73.9               | 53.9          | 19.2                | 6.5            | *1)         |
| Hori.       | 4108.3    | 45.6                 | 37.4            | 30.0           | 6.5  | 32.8 | 5.1            | 49.3                | 46.2           | 73.9               | 53.9          | 24.6                | 7.7            |             |
| Hori.       | 4844.0    | 44.7                 | 35.5            | 31.4           | 6.6  | 32.6 | -              | 50.2                | 41.0           | 73.9               | 53.9          | 23.8                | 12.9           | Floor noise |
| Hori.       | 7266.0    | 43.9                 | 35.5            | 35.4           | 7.9  | 32.5 | -              | 54.6                | 46.2           | 73.9               | 53.9          | 19.3                | 7.7            | Floor noise |
| Hori.       | 9688.0    | 44.2                 | 35.8            | 35.9           | 8.4  | 33.2 | -              | 55.2                | 46.9           | 73.9               | 53.9          | 18.7                | 7.0            | Floor noise |
| Vert.       | 44.1      | 26.6                 | -               | 13.5           | 7.0  | 28.5 | -              | 18.6                | -              | 40.0               | -             | 21.4                | -              |             |
| Vert.       | 54.5      | 28.0                 | -               | 9.5            | 7.1  | 28.5 | -              | 16.1                | -              | 40.0               | -             | 23.9                | -              |             |
| Vert.       | 69.3      | 29.6                 | -               | 6.3            | 7.3  | 28.5 | -              | 14.7                | -              | 40.0               | -             | 25.3                | -              |             |
| Vert.       | 96.2      | 32.1                 | -               | 9.6            | 7.5  | 28.4 | -              | 20.8                | -              | 43.5               | -             | 22.7                | -              |             |
| Vert.       | 127.6     | 25.0                 | -               | 13.6           | 7.8  | 28.3 | -              | 18.0                | -              | 43.5               | -             | 25.5                | -              |             |
| Vert.       | 290.3     | 34.7                 | -               | 13.6           | 8.8  | 27.7 | -              | 29.5                | -              | 46.0               | -             | 16.6                | -              |             |
| Vert.       | 2387.8    | 53.4                 | 41.5            | 27.5           | 4.5  | 33.2 | 5.1            | 52.2                | 45.4           | 73.9               | 53.9          | 21.7                | 8.5            | *1)         |
| Vert.       | 2390.0    | 50.8                 | 40.3            | 27.5           | 4.5  | 33.2 | 5.1            | 49.6                | 44.2           | 73.9               | 53.9          | 24.3                | 9.7            | *1)         |
| Vert.       | 4108.3    | 45.9                 | 37.1            | 30.0           | 6.5  | 32.8 | 5.1            | 49.6                | 45.9           | 73.9               | 53.9          | 24.3                | 8.0            |             |
| Vert.       | 4844.0    | 44.2                 | 35.5            | 31.4           | 6.6  | 32.6 | -              | 49.6                | 41.0           | 73.9               | 53.9          | 24.3                | 12.9           | Floor noise |
| Vert.       | 7266.0    | 44.1                 | 35.5            | 35.4           | 7.9  | 32.5 | -              | 54.8                | 46.2           | 73.9               | 53.9          | 19.1                | 7.7            | Floor noise |
| Vert.       | 9688.0    | 44.2                 | 35.8            | 35.9           | 8.4  | 33.2 | -              | 55.2                | 46.9           | 73.9               | 53.9          | 18.7                | 7.0            | Floor noise |

$$\text{Result (QP / PK)} = \text{Reading} + \text{Ant Factor} + \text{Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz))} - \text{Gain(Amplifier)}$$
$$\text{Result (AV)} = \text{Reading} + \text{Ant Factor} + \text{Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz))} - \text{Gain(Amplifier)} + \text{Duty factor}$$

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

\*QP detector was used up to 1GHz.

\*1) Not Out of Band emission(Leakage Power)

## 20dBc Data Sheet

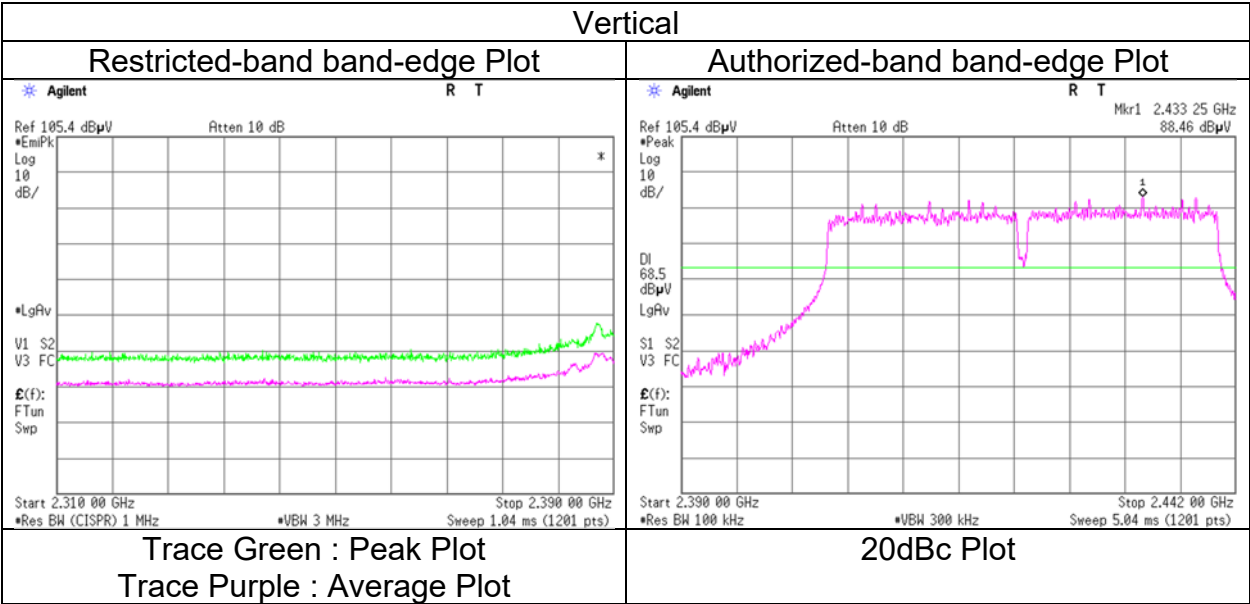
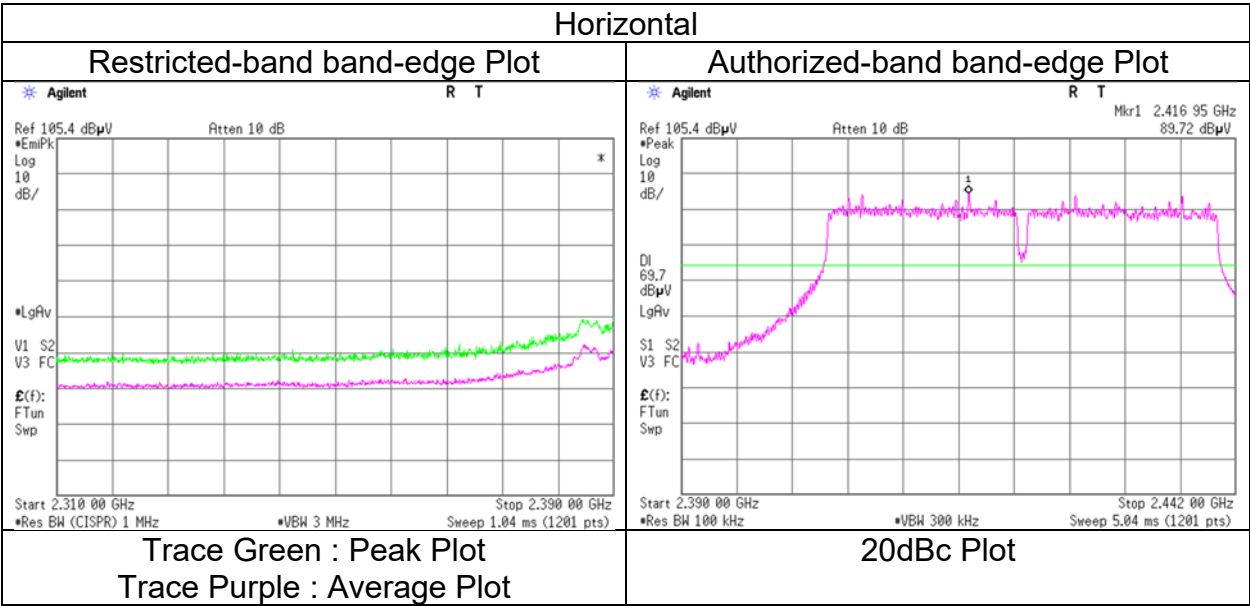
| Polarity    | Frequency | Reading<br>(PK) | Ant<br>Factor | Loss | Gain | Result   | Limit    | Margin | Remark  |
|-------------|-----------|-----------------|---------------|------|------|----------|----------|--------|---------|
| [Hori/Vert] | [MHz]     | [dBuV]          | [dB/m]        | [dB] | [dB] | [dBuV/m] | [dBuV/m] | [dB]   |         |
| Hori.       | 2422.0    | 89.7            | 27.5          | 4.5  | 33.2 | 88.5     | -        | -      | Carrier |
| Hori.       | 2400.0    | 55.4            | 27.5          | 4.5  | 33.2 | 54.2     | 68.5     | 14.3   |         |
| Vert.       | 2422.0    | 88.5            | 27.5          | 4.5  | 33.2 | 87.2     | -        | -      | Carrier |
| Vert.       | 2400.0    | 52.4            | 27.5          | 4.5  | 33.2 | 51.1     | 67.2     | 16.1   |         |

$$\text{Result} = \text{Reading} + \text{Ant Factor} + \text{Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz))} - \text{Gain(Amplifier)}$$

|                  |                   |  |
|------------------|-------------------|--|
| Distance factor: | 1 GHz - 6 GHz     | $20\log(3.55 \text{ m} / 3.0 \text{ m}) = 1.47 \text{ dB}$ |
|                  | 6 GHz - 10 GHz    | $20\log(3.55 \text{ m} / 3.0 \text{ m}) = 1.47 \text{ dB}$ |
|                  | 10 GHz - 26.5 GHz | $20\log(1.0 \text{ m} / 3.0 \text{ m}) = -9.54 \text{ dB}$ |

**Radiated Spurious Emission**  
**(Reference Plot for band-edge)**

|                        |                     |
|------------------------|---------------------|
| Test place             | Ise EMC Lab.        |
| Semi Anechoic Chamber  | No.2                |
| Date                   | December 5, 2024    |
| Temperature / Humidity | 21 deg. C / 42 % RH |
| Engineer               | Junki Nagatomi      |
| Mode                   | Tx 11n-40 2422 MHz  |

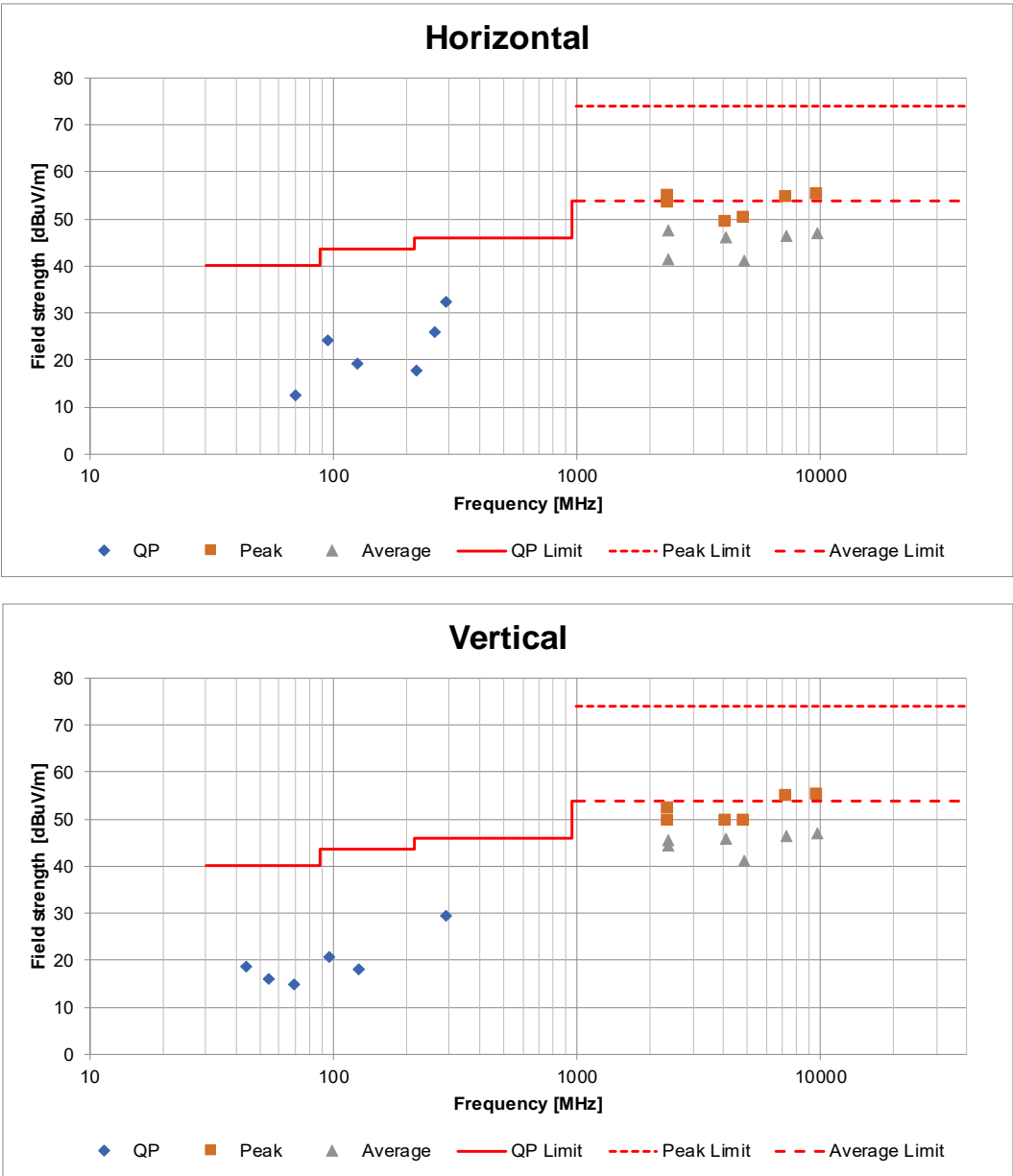


\* The measurement was conducted for a sufficiently long enough time to detect any possible spurious emissions.  
Final result of restricted band edge and authorized band edge were shown in tabular data.



**Radiated Spurious Emission**  
**(Plot data, Worst case mode for Maximum Peak Output Power)**

|                        |                     |
|------------------------|---------------------|
| Test place             | Ise EMC Lab.        |
| Semi Anechoic Chamber  | No.2                |
| Date                   | December 5, 2024    |
| Temperature / Humidity | 21 deg. C / 42 % RH |
| Engineer               | Junki Nagatomi      |
| Mode                   | Tx 11n-40 2422 MHz  |

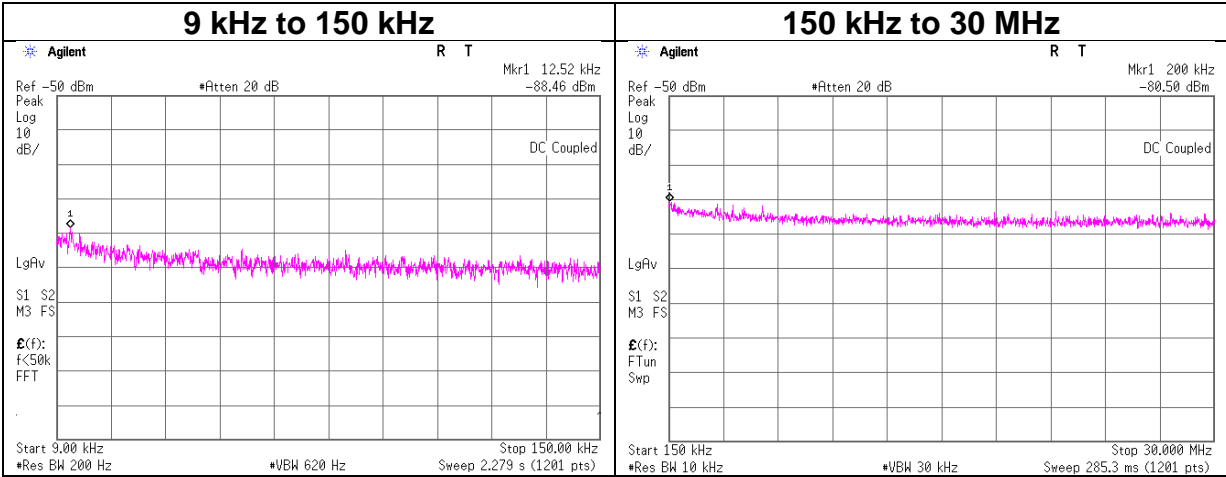


\*These plots data contain sufficient number to show the trend of characteristic features for EUT.

Conducted Spurious Emission

Test place  
Date  
Temperature / Humidity  
Engineer  
Mode

Ise EMC Lab. No.6 Measurement Room  
December 3, 2024  
23 deg. C / 55 % RH  
Takumi Nishida  
Tx 11n-40 2422 MHz



| Frequency | Reading | Cable Loss | Attenuator Loss | Antenna Gain | N                  | EIRP  | Distance | Ground bounce | E                         | Limit    | Margin | Remark |
|-----------|---------|------------|-----------------|--------------|--------------------|-------|----------|---------------|---------------------------|----------|--------|--------|
| [kHz]     | [dBm]   | [dB]       | [dB]            | [dBi]        | (Number of Output) | [dBm] | [m]      | [dB]          | (field strength) [dBuV/m] | [dBuV/m] | [dB]   |        |
| 12.52     | -88.5   | 0.01       | 9.8             | 2.2          | 2                  | -73.4 | 300      | 6.0           | -12.2                     | 45.6     | 57.8   |        |
| 200.00    | -80.5   | 0.01       | 9.8             | 2.2          | 2                  | -65.4 | 300      | 6.0           | -4.2                      | 21.5     | 25.7   |        |

E [dBuV/m] = EIRP [dBm] - 20 log (Distance [m]) + Ground bounce [dB] + 104.8 [dBuV/m]

EIRP[dBm] = Reading [dBm] + Cable loss [dB] + Attenuator Loss [dB] + Antenna gain [dBi] + 10 \* log (N)

N: Number of output

Power Density

Test place Ise EMC Lab. No.6 Measurement Room  
Date December 3, 2024  
Temperature / Humidity 23 deg. C / 55 % RH  
Engineer Takumi Nishida  
Mode Tx 11n-40

Antenna 0 +1

| Freq. | Antenna 1<br>Result | Antenna 2<br>Result | Result        |              | Limit         | Margin |
|-------|---------------------|---------------------|---------------|--------------|---------------|--------|
| [MHz] | [mW / 3 kHz]        | [mW / 3 kHz]        | [dBm / 3 kHz] | [mW / 3 kHz] | [dBm / 3 kHz] | [dB]   |
| 2422  | 0.004               | 0.007               | -19.65        | 0.011        | 8.00          | 27.65  |

Sample Calculation:  
Result = Antenna 0 + 1

Antenna 0

| Freq. | Reading       | Cable<br>Loss | Atten.<br>Loss | Result        |              | Limit         | Margin |
|-------|---------------|---------------|----------------|---------------|--------------|---------------|--------|
| [MHz] | [dBm / 3 kHz] | [dB]          | [dB]           | [dBm / 3 kHz] | [mW / 3 kHz] | [dBm / 3 kHz] | [dB]   |
| 2422  | -36.53        | 2.20          | 10.10          | -24.23        | 0.004        | 8.00          | 32.23  |

Antenna 1

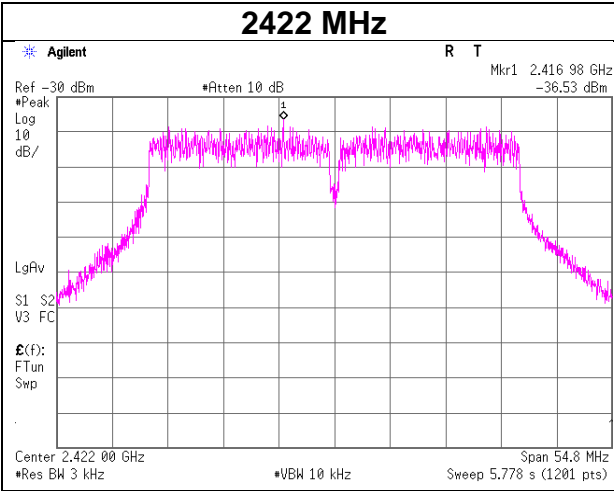
| Freq. | Reading       | Cable<br>Loss | Atten.<br>Loss | Result        |              | Limit         | Margin |
|-------|---------------|---------------|----------------|---------------|--------------|---------------|--------|
| [MHz] | [dBm / 3 kHz] | [dB]          | [dB]           | [dBm / 3 kHz] | [mW / 3 kHz] | [dBm / 3 kHz] | [dB]   |
| 2422  | -33.78        | 2.17          | 10.10          | -21.51        | 0.007        | 8.00          | 29.51  |

Sample Calculation:  
Result = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss

Power Density

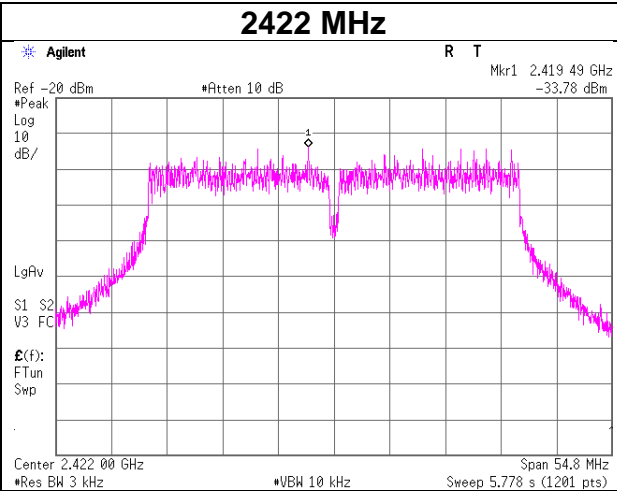
11n-40 Antenna 0

2422 MHz



11n-40 Antenna 1

2422 MHz



## APPENDIX 2: Test Instruments

### Test Equipment

| Test Item | LIMS ID | Description                          | Manufacturer                    | Model                                | Serial                    | Last Calibration Date | Cal Int |
|-----------|---------|--------------------------------------|---------------------------------|--------------------------------------|---------------------------|-----------------------|---------|
| AT        | 141156  | Attenuator (10dB)                    | Weinschel Corp                  | 2                                    | BL1173                    | 11/11/2024            | 12      |
| AT        | 141173  | Attenuator (10dB) (above 1GHz)       | HIROSE ELECTRIC CO.,LTD.        | AT-110                               | -                         | 12/11/2023            | 12      |
| AT        | 141327  | Coaxial Cable                        | UL-ISE                          | -                                    | -                         | 02/09/2024            | 12      |
| AT        | 141329  | Microwave Cable 1G-40GHz             | Suhner                          | SUCOFLEX102                          | 28635/2                   | 04/08/2024            | 12      |
| AT        | 141558  | Digital Tester (TRUE RMS MULTIMETER) | Fluke Corporation               | 115                                  | 17930030                  | 05/17/2024            | 12      |
| AT        | 141809  | Power Meter                          | Anritsu Corporation             | ML2495A                              | 825002                    | 05/22/2024            | 12      |
| AT        | 141830  | Power sensor                         | Anritsu Corporation             | MA2411B                              | 738285                    | 05/22/2024            | 12      |
| AT        | 141900  | Spectrum Analyzer                    | Keysight Technologies Inc       | E4440A                               | MY46185823                | 11/13/2024            | 12      |
| AT        | 244712  | Thermo-Hygrometer                    | HIOKI E.E. CORPORATION          | LR5001                               | 231202106                 | 01/25/2024            | 12      |
| RE        | 141232  | High Pass Filter 3.5-18.0GHz         | UL-ISE                          | HPF SELECTOR                         | 001                       | 09/13/2024            | 12      |
| RE        | 141265  | Logperiodic Antenna (200-1000MHz)    | Schwarzbeck Mess-Elektronik OHG | VUSLP9111B                           | 9111B-190                 | 07/10/2024            | 12      |
| RE        | 141317  | Coaxial Cable                        | UL-ISE                          | -                                    | -                         | 09/11/2024            | 12      |
| RE        | 141331  | Attenuator(6dB)                      | TME                             | UFA-01                               | -                         | 02/17/2024            | 12      |
| RE        | 141427  | Biconical Antenna                    | Schwarzbeck Mess-Elektronik OHG | VHA9103B+ BBA9106                    | 08031                     | 07/30/2024            | 12      |
| RE        | 141503  | Horn Antenna 18-26.5GHz              | EMCO                            | 3160-09                              | 1265                      | 06/25/2024            | 12      |
| RE        | 141512  | Horn Antenna 1-18GHz                 | Schwarzbeck Mess-Elektronik OHG | BBHA9120D                            | 254                       | 10/17/2024            | 12      |
| RE        | 141542  | Digital Tester                       | Fluke Corporation               | FLUKE 26-3                           | 78030611                  | 08/06/2024            | 12      |
| RE        | 141594  | Pre Amplifier                        | Keysight Technologies Inc       | 8447D                                | 2944A10150                | 02/17/2024            | 12      |
| RE        | 141899  | Spectrum Analyzer                    | Keysight Technologies Inc       | E4448A                               | MY46180655                | 05/09/2024            | 12      |
| RE        | 141949  | Test Receiver                        | Rohde & Schwarz                 | ESCI                                 | 100767                    | 06/05/2024            | 12      |
| RE        | 142004  | AC2_Semi Anechoic Chamber (NSA)      | TDK                             | Semi Anechoic Chamber 3m             | DA-06902                  | 12/12/2023            | 24      |
| RE        | 142006  | AC2_Semi Anechoic Chamber (SVSWR)    | TDK                             | Semi Anechoic Chamber 3m             | DA-06902                  | 04/17/2023            | 24      |
| RE        | 142228  | Measure, Tape, Steel                 | KOMELON                         | KMC-36                               | -                         | -                     | -       |
| RE        | 178648  | EMI measurement program              | TSJ (Techno Science Japan)      | TEPTO-DV                             | -                         | -                     | -       |
| RE        | 238713  | Double Ridge Horn Antenna            | Schwarzbeck Mess-Elektronik OHG | BBHA 9120 C                          | 688                       | 09/02/2024            | 12      |
| RE        | 244707  | Thermo-Hygrometer                    | HIOKI E.E. CORPORATION          | LR5001                               | 231202102                 | 01/25/2024            | 12      |
| RE        | 252663  | Microwave Cable                      | Huber+Suhner                    | SF126E/ 11PC35/11PC35/ 1000MM,5000MM | 616276/126E / 616275/126E | 09/10/2024            | 12      |
| RE        | 253739  | Pre Amplifier                        | Keysight Technologies Inc       | 8449B                                | 3008A01919                | 10/23/2024            | 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:

AT: Antenna Terminal Conducted test

RE: Radiated Emission