# RADIO TEST REPORT

## Test Report No. : 13977035S-A

| | | |
|---|---|---|
| **Applicant** | : | **ALPS ALPINE CO., LTD.** |
| **Type of EUT** | : | **Head unit** |
| **Model Number of EUT** | : | **AH00ICB** |
| **FCC ID** | : | **A269ZUA165** |
| **Test regulation** | : | **FCC Part 15 Subpart C: 2021**<br>**Wireless LAN 2.4 GHz band and Bluetooth low energy part** |
| **Test item** | : | **Antenna Terminal Conducted Tests** |
| **Test Result** | : | **Complied (Refer to SECTION 3)** |

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3. This sample tested is in compliance with the limits of the above regulation.
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6. This test report covers Radio technical requirements.
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7. The all test items in this test report are conducted by UL Japan, Inc. Shonan EMC Lab.
8. The opinions and the interpretations to the result of the description in this report are outside scopes where UL Japan has been accredited.
9. The information provided from the customer for this report is identified in SECTION 1.

**Date of test:** October 20 to November 30, 2021

**Representative test engineer:** K Adachi
Kenichi Adachi
Engineer

**Approved by:** K. Noda
Kazuya Noda
Leader

CERTIFICATE 1266.03

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

# REVISION HISTORY

## Original Test Report No.: 13977035S-A

| Revision | Test report No. | Date | Page revised | Contents |
|---|---|---|---|---|
| -<br>(Original) | 13977035S-A | January 31, 2022 | - | - |

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

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

**CONTENTS** **PAGE**

# SECTION 1: Customer information

| | | |
|---|---|---|
| Company Name | : | ALPS ALPINE CO., LTD. |
| Address | : | 20-1 Yoshima Industrial park, Iwaki, Fukushima, Japan 970-1192 |
| Telephone Number | : | +81-246-36-4111 |
| Contact Person | : | Kenji Nagase |

The information provided from the customer is as follows;
- Applicant, Type of EUT, Model Number of EUT, FCC ID on the cover and other relevant pages
- Operating/Test Mode(s) (Mode(s)) on all the relevant pages
- SECTION 1: Customer information
- SECTION 2: Equipment under test (EUT) other than the Receipt Date
- SECTION 4: Operation of EUT during testing

* The laboratory is exempted from liability of any test results affected from the above information in SECTION 2 and 4.

# SECTION 2: Equipment under test (EUT)

## 2.1 Identification of EUT

| | | |
|---|---|---|
| Type | : | Head unit |
| Model Number | : | AH00ICB |
| Serial Number | : | Refer to SECTION 4.2 |
| Receipt Date | : | October 18, 2021 |
| Condition | : | Engineering prototype<br>(Not for Sale: This sample is equivalent to mass-produced items.) |
| Modification | : | No Modification by the test lab. |

## 2.2 Product Description

Model: AH00ICB (referred to as the EUT in this report) is a Head unit.

The EUT has following similar model:

| Model Name | Details |
|---|---|
| AH00ICB (EUT) | External amplifier model |
| AH00ICB 1 | Internal amplifier model |

**General Specification**

| | | |
|---|---|---|
| Rating | : | DC 13.2 V |
| Operating Temperature | : | -30 deg. C - +70 deg. C |

## Radio Specification

**Bluetooth**

| | | |
|---|---|---|
| Radio Type | : | Transceiver |
| Frequency of Operation | : | 2402 MHz - 2480 MHz |
| Antenna type | : | Planar Inverted-F Antenna |
| Modulation | : | FHSS (GFSK, π/4-DQPSK, 8DPSK) |
| Antenna Gain | : | -0.2 dBi |

**Bluetooth Low Energy**

| | | |
|---|---|---|
| Radio Type | : | Transceiver |
| Frequency of Operation | : | 2402 MHz - 2480 MHz |
| Antenna type | : | Planar Inverted-F Antenna |
| Modulation | : | GFSK |
| Antenna Gain | : | -0.2 dBi |

**WLAN 2.4 GHz (IEEE802.11b/g/n-20)**

| | | |
|---|---|---|
| Radio Type | : | Transceiver |
| Frequency of Operation | : | 2412 MHz - 2462 MHz |
| Antenna type | : | Planar Inverted-F Antenna |
| Modulation | : | DSSS (CCK, DQPSK, DBPSK)<br>OFDM (64QAM, 16QAM, QPSK, BPSK) |
| Antenna Gain | : | -0.2 dBi |

**WLAN 5 GHz (IEEE802.11a/n-20/n-40/ac-20/ac-40/ac-80)**

| | | |
|---|---|---|
| Radio Type | : | Transceiver |
| Frequency of Operation | : | 5180 MHz - 5825 MHz |
| Antenna type | : | Planar Inverted-F Antenna |
| Modulation | : | OFDM (256QAM, 64QAM, 16QAM, QPSK, BPSK) |
| Antenna Gain | : | +2.71 dBi (Chain1)<br>+2.71 dBi (Chain2) |

# SECTION 3: Test specification, procedures & results

## 3.1 Test Specification

Test Specification : FCC Part 15 Subpart C
FCC Part 15 final revised on May 3, 2021 and effective July 2, 2021

Title : FCC 47 CFR Part 15 Radio Frequency Device Subpart C Intentional Radiators
Section 15.207 Conducted limits
Section 15.247 Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz

* Also the EUT complies with FCC Part 15 Subpart B.

## 3.2 Procedures and results

| Item | Test Procedure | Specification | Worst margin | Results | Remarks |
|---|---|---|---|---|---|
| Conducted Emission | **FCC:** ANSI C63.10-2013 6. Standard test methods | **FCC:** Section 15.207 | N/A | N/A | *1) |
| | **ISED:** RSS-Gen 8.8 | **ISED:** RSS-Gen 8.8 | | | |
| 6 dB Bandwidth | **FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02 | **FCC:** Section 15.247(a)(2) | See data. | Complied a) | Conducted |
| | **ISED:** - | **ISED:** RSS-247 5.2(a) | | | |
| Maximum Peak Output Power | **FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02 | **FCC:** Section 15.247(b)(3) | | Complied b) | Conducted |
| | **ISED:** RSS-Gen 6.12 | **ISED:** RSS-247 5.4(d) | | | |
| Power Density | **FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02 | **FCC:** Section 15.247(e) | | Complied c) | Conducted |
| | **ISED:** - | **ISED:** RSS-247 5.2(b) | | | |
| Spurious Emission (below 30 MHz) | **FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02 | **FCC:** Section15.247(d) | See data. | Complied d) | Conducted |
| | **ISED:** RSS-Gen 6.13 | **ISED:** RSS-247 5.5 RSS-Gen 8.9 RSS-Gen 8.10 | | | |

Note: UL Japan, Inc.'s EMI Work Procedures No. 13-EM-W0420 and 13-EM-W0422.
*1) The test is not applicable since the EUT does not have AC Mains.

a) Refer to APPENDIX 1 (data of 6 dB Bandwidth and 99 % Occupied Bandwidth)
b) Refer to APPENDIX 1 (data of Maximum Peak Output Power)
c) Refer to APPENDIX 1 (data of Power Density)
d) Refer to APPENDIX 1 (data of Conducted Spurious Emission)

Symbols:

| | |
|---|---|
| Complied | The data of this test item has enough margin, more than the measurement uncertainty. |
| Complied# | The data of this test item meets the limits unless the measurement uncertainty is taken into consideration. |

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

**FCC Part 15.31 (e)**
The EUT provides stable voltage constantly to the RF Part regardless of input voltage. Instead of a new battery, DC power supply was used for the test. That does not affect the test result, therefore the EUT complies with the requirement.

**FCC Part 15.203 Antenna requirement**
It is impossible for end users to replace the antenna, because the antenna is mounted inside of the EUT. Therefore, the equipment complies with the antenna requirement of Section 15.203.

### 3.3 Addition to standard

| Item | Test Procedure | Specification | Worst margin | Results | Remarks |
|---|---|---|---|---|---|
| 99 % Occupied Bandwidth | **ISED:** RSS-Gen 6.7 | **ISED:** - | N/A | Complied a) | Conducted |
| a) Refer to APPENDIX 1 (data of 6 dB Bandwidth and 99 % Occupied Bandwidth) | | | | | |

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

### 3.4 Uncertainty

There is no applicable rule of uncertainty in this applied standard. Therefore, the results are derived depending on whether or not laboratory uncertainty is applied.

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

Shonan EMC Lab.

| Antenna terminal test | Uncertainty (+/-) |
|---|---|
| Power Measurement above 1 GHz (Average Detector)_SPM-06 | 1.2 dB |
| Power Measurement above 1 GHz (Peak Detector)_SPM-06 | 2.0 dB |
| Power Measurement above 1 GHz (Average Detector)_SPM-07 | 1.2 dB |
| Power Measurement above 1 GHz (Peak Detector)_SPM-07 | 1.3 dB |
| Power Measurement above 1 GHz (Average Detector)_SPM-13 | 1.3 dB |
| Power Measurement above 1 GHz (Peak Detector)_SPM-13 | 1.3 dB |
| Spurious emission (Conducted), Power Density measurement below 1 GHz | 0.93 dB |
| Spurious emission (Conducted), Power Density measurement 1 GHz-3 GHz | 0.92 dB |
| Spurious emission (Conducted), Power Density measurement 3 GHz-18 GHz | 2.3 dB |
| Spurious emission (Conducted), Power Density measurement 18 GHz-26.5 GHz | 2.3 dB |
| Spurious emission (Conducted), Power Density measurement 26.5 GHz-40 GHz | 2.3 dB |
| Bandwidth Measurement | 0.012 % |
| Duty cycle and Time Measurement | 0.27 % |
| Temperature_SCH-01 | 0.93 deg.C. |
| Humidity_SCH-01 | 4.1 % |
| Temperature_SCH-02 | 2.0 deg.C. |
| Humidity_SCH-02 | 6.6 % |
| Voltage | 0.97 % |

### 3.5 Test Location

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1-22-3, Megumigaoka, Hiratsuka-shi, Kanagawa-ken 259-1220 JAPAN
Telephone: +81 463 50 6400, Facsimile: +81 463 50 6401
A2LA Certificate Number: 1266.03
(FCC test firm registration number: 626366, ISED lab company number: 2973D / CAB identifier: JP0001)

| Test site | IC Registration Number | Width x Depth x Height (m) | Size of reference ground plane (m) / horizontal conducting plane | Maximum measurement distance |
|---|---|---|---|---|
| No.1 Semi-anechoic chamber | 2973D-1 | 20.6 x 11.3 x 7.65 | 20.6 x 11.3 | 10 m |
| No.2 Semi-anechoic chamber | 2973D-2 | 20.6 x 11.3 x 7.65 | 20.6 x 11.3 | 10 m |
| No.3 Semi-anechoic chamber | 2973D-3 | 12.7 x 7.7 x 5.35 | 12.7 x 7.7 | 5 m |
| No.4 Semi-anechoic chamber | - | 8.1 x 5.1 x 3.55 | 8.1 x 5.1 | - |
| No.1 Shielded room | - | 6.8 x 4.1 x 2.7 | 6.8 x 4.1 | - |
| No.2 Shielded room | - | 6.8 x 4.1 x 2.7 | 6.8 x 4.1 | - |
| No.3 Shielded room | - | 6.3 x 4.7 x 2.7 | 6.3 x 4.7 | - |
| No.4 Shielded room | - | 4.4 x 4.7 x 2.7 | 4.4 x 4.7 | - |
| No.5 Shielded room | - | 7.8 x 6.4 x 2.7 | 7.8 x 6.4 | - |
| No.6 Shielded room | - | 7.8 x 6.4 x 2.7 | 7.8 x 6.4 | - |
| No.8 Shielded room | - | 3.45 x 5.5 x 2.4 | 3.45 x 5.5 | - |
| No.1 Measurement room | - | 2.55 x 4.1 x 2.5 | - | - |

### 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)

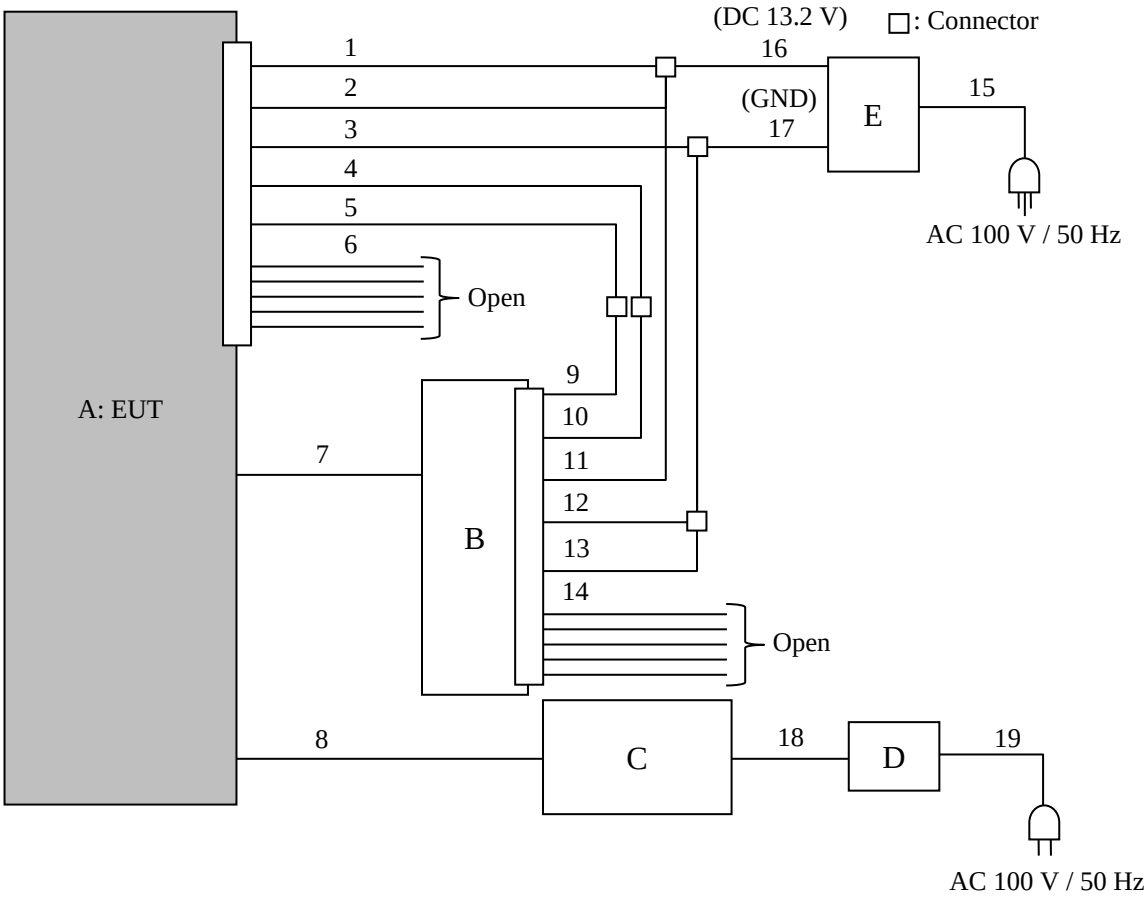
Test operating mode was determined as follows according to "Section 1 of 6 802.11 a/b/g/n testing - Managing Complex Regulatory Approvals - " of TCB Council Workshop October 2009.

| Mode | Remarks* |
|---|---|
| IEEE 802.11b (11b) | 5.5 Mbps (Short), PN9 |
| IEEE 802.11g (11g) | 36 Mbps, PN9 |
| IEEE 802.11n 20 MHz BW SISO (11n-20) | MCS 5, PN9 |
| Bluetooth Low Energy (BT LE) | PRBS9 |
| *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 settings: 11b: 14 dBm, 11g/n-20: 11 dBm<br>BT LE: 8 (setting value)<br>Software: QRCT (Qualcomm Radio Control Toolkit) v4.0.00195.0<br>(Date: 2021.10.18, Storage location: Driven by connected PC)<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. | |

*The details of Operating mode(s)

| Test Item | Operating Mode | Tested frequency |
|---|---|---|
| Spurious Emission (Conducted) | Tx 11g | 2462 MHz |
| | Tx BT LE | 2402 MHz<br>2440 MHz<br>2480 MHz |
| Maximum Peak Output Power<br>6 dB Bandwidth<br>Power Density<br>99 % Occupied Bandwidth | Tx 11b<br>Tx 11g<br>Tx 11n-20 | 2412 MHz<br>2437 MHz<br>2462 MHz |
| | Tx BT LE | 2402 MHz<br>2440 MHz<br>2480 MHz |

## 4.2 Configuration and peripherals



**Description of EUT and Support equipment**

| No. | Item | Model number | Serial number | Manufacturer | Remark |
|---|---|---|---|---|---|
| A | Head unit | AH00ICB | 73 | ALPS ALPINE | EUT |
| B | Display | QH00159A | 114 | ALPS ALPINE | - |
| C | Laptop Computer | 7666-77J | LV-B8R1X 08/05 | Lenovo | - |
| D | AC Adapter | 42T4422 | 11S92P1154Z1DXF1DBFDN | Lenovo | - |
| E | Power Supply (DC) | PW16-5ADP | 19100034 | TEXIO | - |

**List of cables used**

| No. | Name | Length (m) | Shield | | Remark |
|---|---|---|---|---|---|
| | | | Cable | Connector | |
| 1 | +B | 2.2 | Unshielded | Unshielded | - |
| 2 | ACC | 2.2 | Unshielded | Unshielded | - |
| 3 | GND | 2.2 | Unshielded | Unshielded | - |
| 4 | BCAN H | 2.2 | Unshielded | Unshielded | - |
| 5 | BCAN L | 2.2 | Unshielded | Unshielded | - |
| 6 | Signal | 2.2 | Unshielded | Unshielded | - |
| 7 | GVIF | 2.4 | Shielded | Shielded | - |
| 8 | USB | 2.2 + 1.0 | Shielded | Shielded | - |
| 9 | BCAN L | 0.6 | Unshielded | Unshielded | - |
| 10 | BCAN H | 0.6 | Unshielded | Unshielded | - |
| 11 | +B | 0.6 | Unshielded | Unshielded | - |
| 12 | GND | 0.6 | Unshielded | Unshielded | - |
| 13 | DISP CONT | 0.6 | Unshielded | Unshielded | - |
| 14 | Signal | 0.6 | Unshielded | Unshielded | - |
| 15 | AC | 2.0 | Unshielded | Unshielded | - |
| 16 | DC+ | 2.0 | Unshielded | Unshielded | - |
| 17 | DC- | 2.0 | Unshielded | Unshielded | - |
| 18 | DC | 1.8 | Unshielded | Unshielded | - |
| 19 | AC | 0.9 | Unshielded | Unshielded | - |

# SECTION 5: 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 |
|---|---|---|---|---|---|---|---|
| 6 dB Bandwidth | 10 MHz (BT LE)<br>50 MHz (WLAN) | 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/ Average *2) | - | Power Meter (Sensor: 160 MHz BW) |
| Peak Power Density | 1.5 times the 6 dB Bandwidth | 3 kHz | 9.1 kHz | Auto | Peak | Max Hold | Spectrum Analyzer *3) |
| Conducted Spurious Emission *4) *5) | 9 kHz to 150 kHz | 200 Hz | 620 Hz | Auto | Peak | Max Hold | Spectrum Analyzer |
| | 150 kHz to 30 MHz | 10 kHz | 30 kHz | | | | |

*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 30 MHz, 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 Ohmes. 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.

The test results and limit are rounded off to two decimals place, 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

| | | |
|---|---|---|
| Report No. | 13977035S-A | |
| Test place | Shonan EMC Lab. No.5 Shielded Room | |
| Date | November 11, 2021 | November 30, 2021 |
| Temperature / Humidity | 23 deg. C / 40 % RH | 25 deg. C / 30 % RH |
| Engineer | Shiro Kobayashi | Kenichi Adachi |
| Mode | Tx | |

BT LE 1M-PHY

| Frequency [MHz] | 99 % Occupied Bandwidth [kHz] | 6 dB Bandwidth [MHz] | Limit for 6 dB Bandwidth [MHz] |
|---|---|---|---|
| 2402 | 1030.0 | 0.714 | > 0.5000 |
| 2440 | 1030.1 | 0.711 | > 0.5000 |
| 2480 | 1028.8 | 0.709 | > 0.5000 |

11b

| Frequency [MHz] | 99 % Occupied Bandwidth [kHz] | 6 dB Bandwidth [MHz] | Limit for 6 dB Bandwidth [MHz] |
|---|---|---|---|
| 2412 | 14048.5 | 7.630 | > 0.5000 |
| 2437 | 14042.6 | 7.670 | > 0.5000 |
| 2462 | 14042.1 | 7.658 | > 0.5000 |

11g

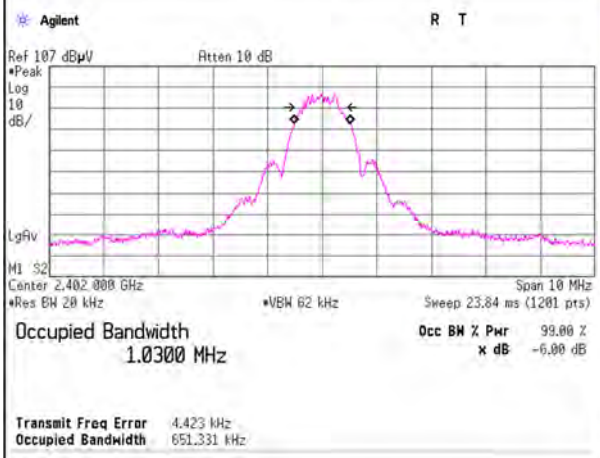
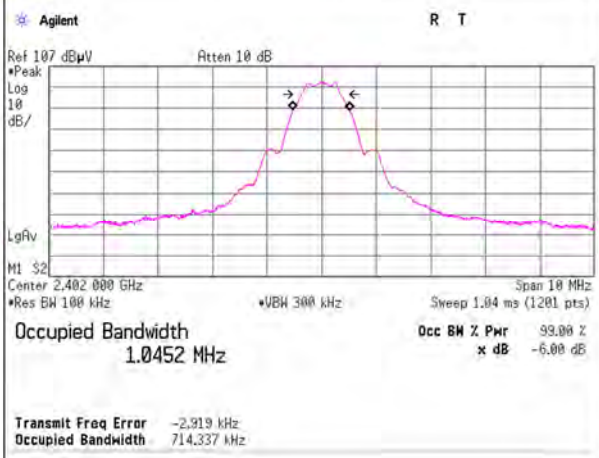
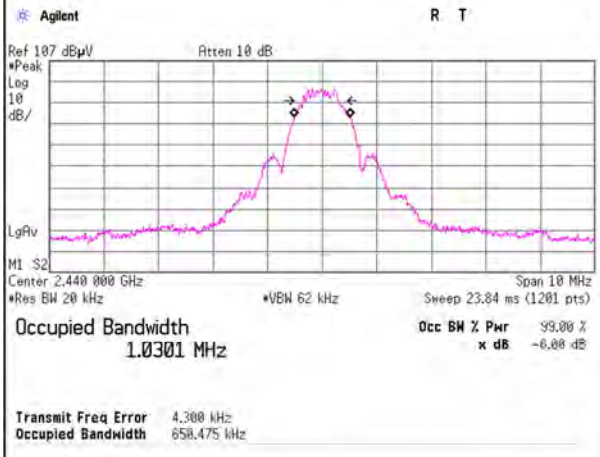
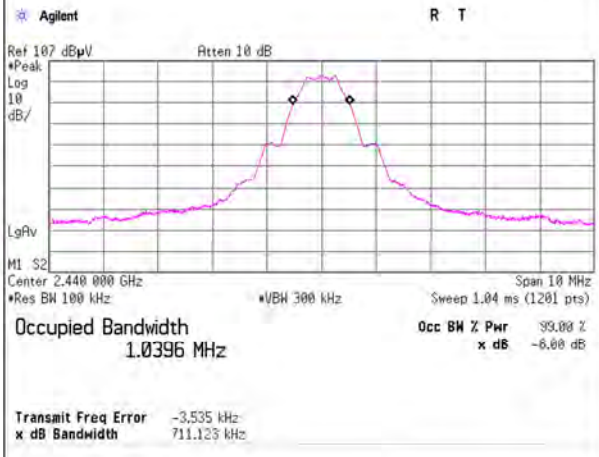
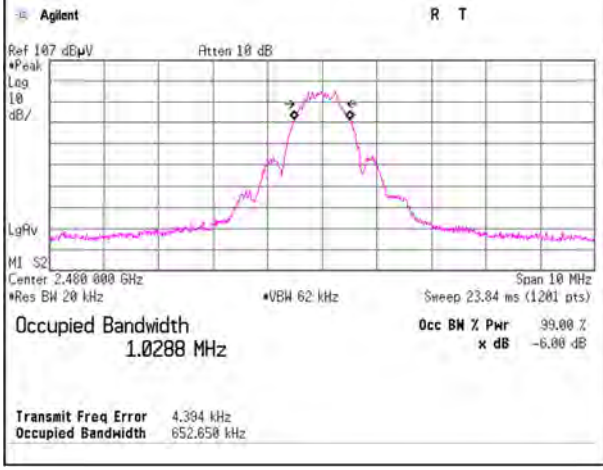
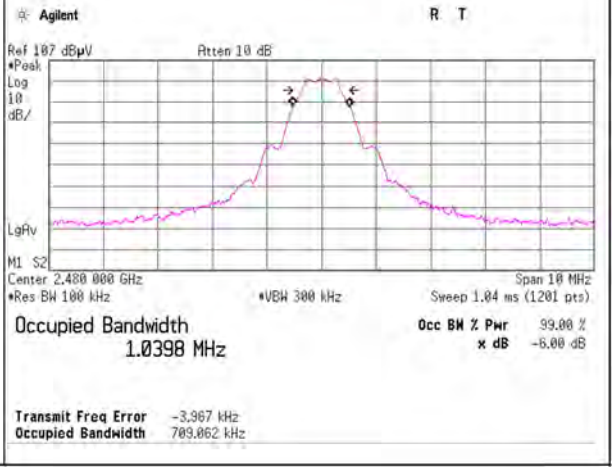
| Frequency [MHz] | 99 % Occupied Bandwidth [kHz] | 6 dB Bandwidth [MHz] | Limit for 6 dB Bandwidth [MHz] |
|---|---|---|---|
| 2412 | 16888.4 | 16.530 | > 0.5000 |
| 2437 | 16885.5 | 16.524 | > 0.5000 |
| 2462 | 16885.1 | 16.541 | > 0.5000 |

11n-20 (SISO)

| Frequency [MHz] | 99 % Occupied Bandwidth [kHz] | 6 dB Bandwidth [MHz] | Limit for 6 dB Bandwidth [MHz] |
|---|---|---|---|
| 2412 | 18137.6 | 17.790 | > 0.5000 |
| 2437 | 18146.5 | 17.791 | > 0.5000 |
| 2462 | 18138.2 | 17.786 | > 0.5000 |

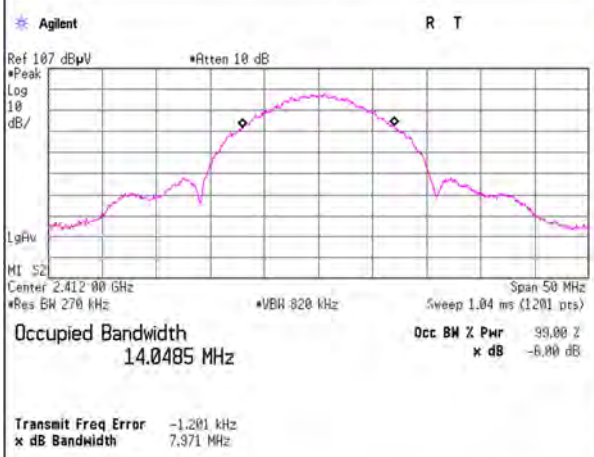
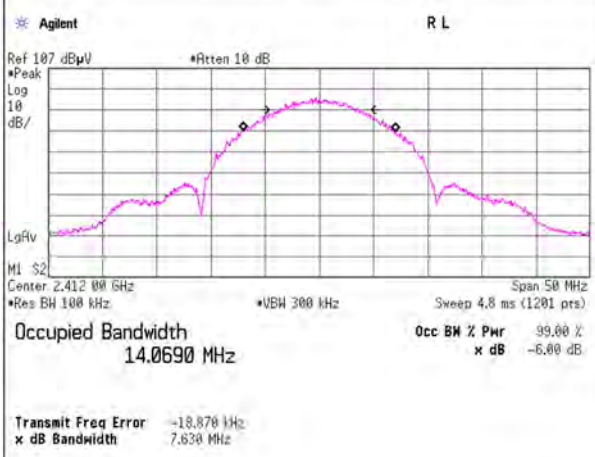
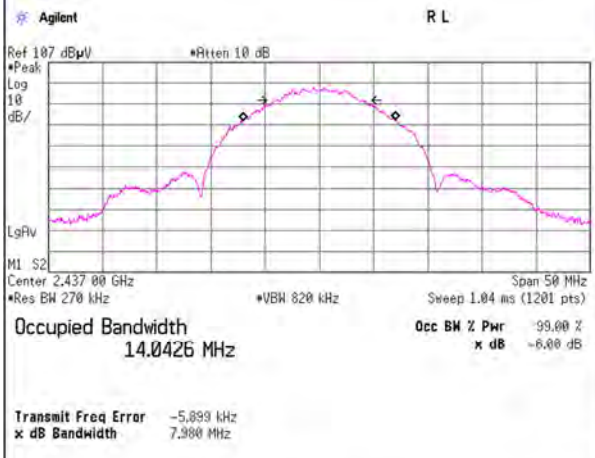
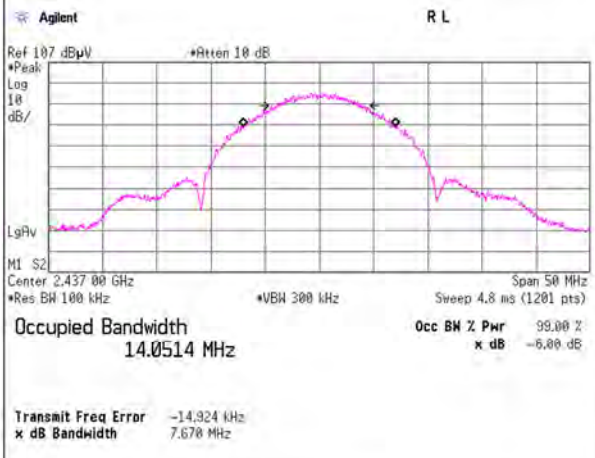
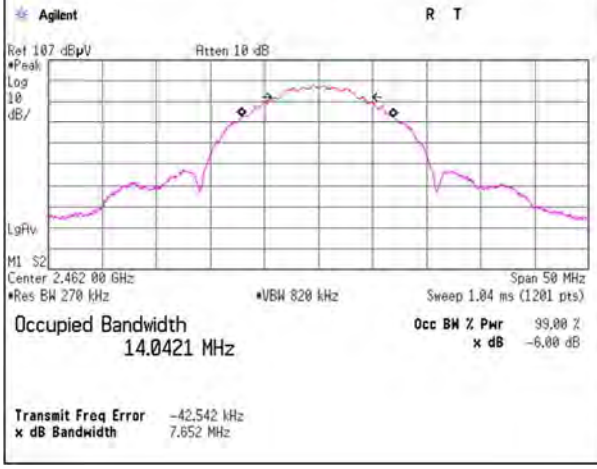
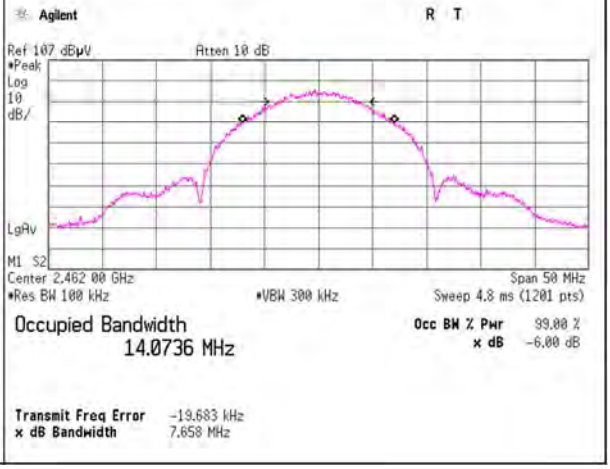
# 99 % Occupied Bandwidth and 6 dB Bandwidth

BT LE 1M-PHY

| 99 % Occupied Bandwidth | 6 dB Bandwidth |
|---|---|
| 2402 MHz | 2402 MHz |
|  |  |
| 2440 MHz | 2440 MHz |
|  |  |
| 2480 MHz | 2480 MHz |
|  |  |

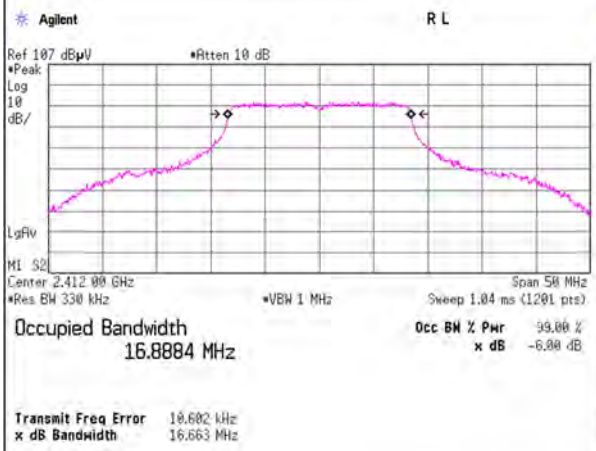
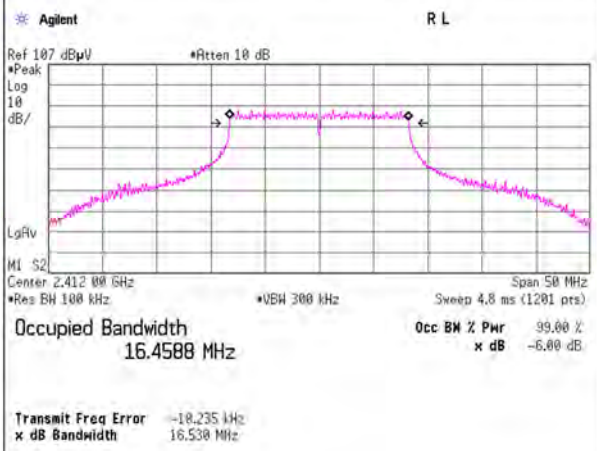
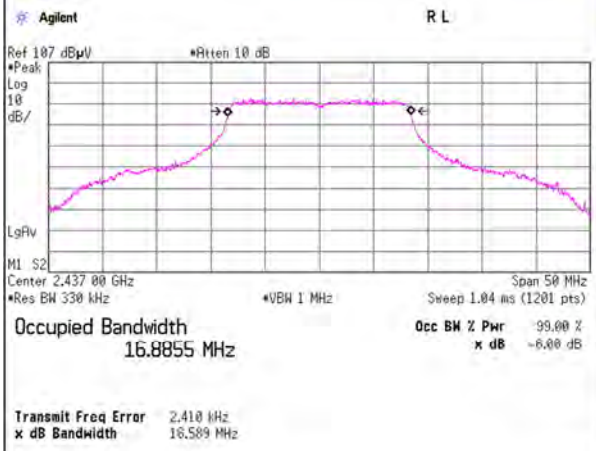
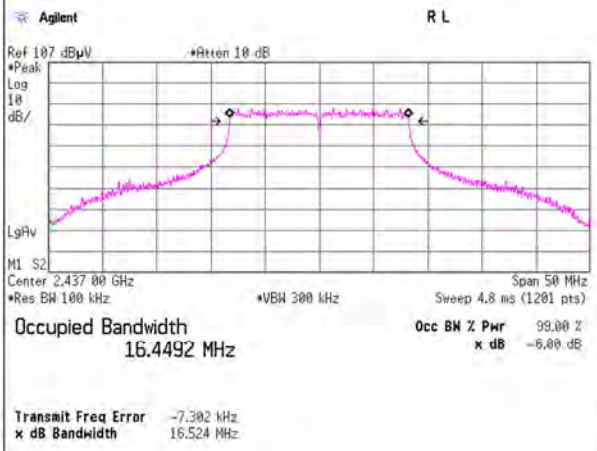
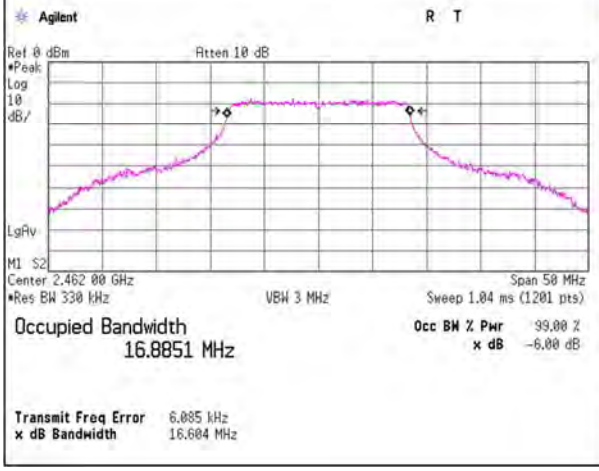
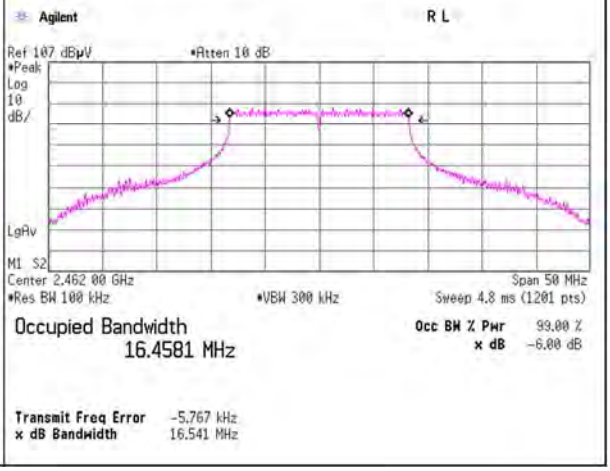
# 99 % Occupied Bandwidth and 6 dB Bandwidth

11b

| 99 % Occupied Bandwidth | 6 dB Bandwidth |
|---|---|
| 2412 MHz | 2412 MHz |
|  |  |
| 2437 MHz | 2437 MHz |
|  |  |
| 2462 MHz | 2462 MHz |
|  |  |

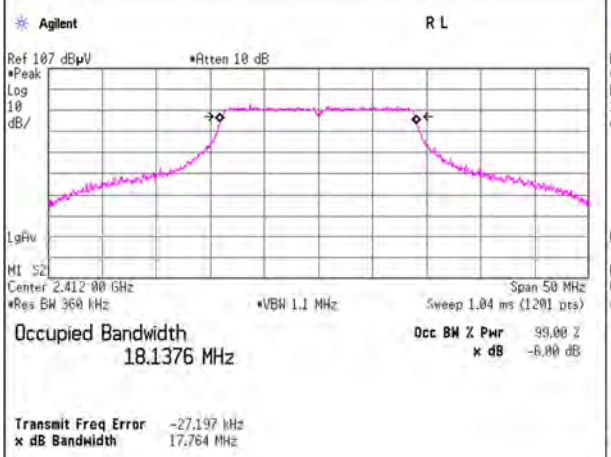
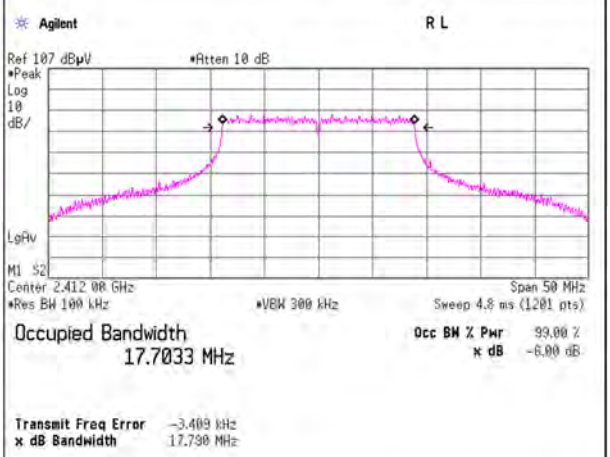
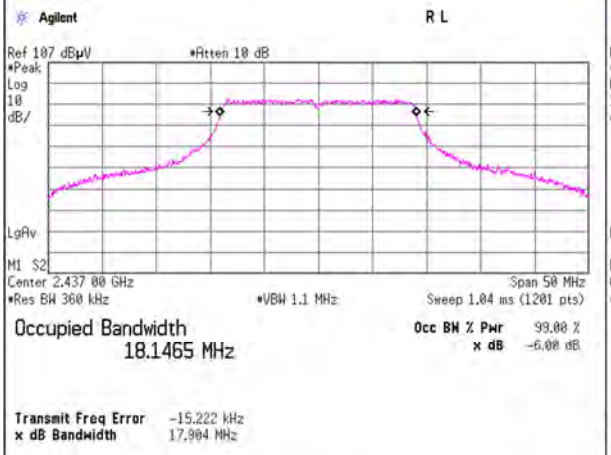
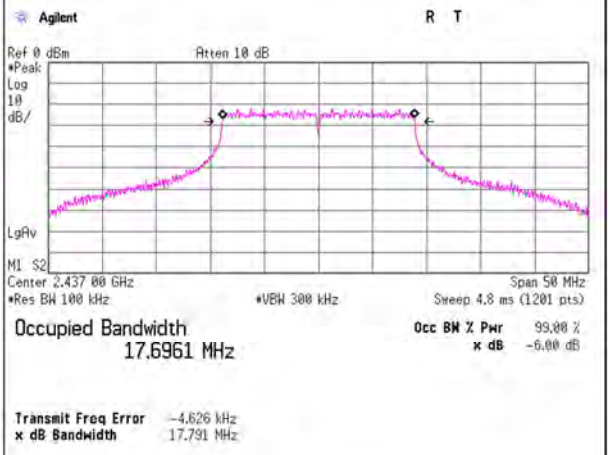
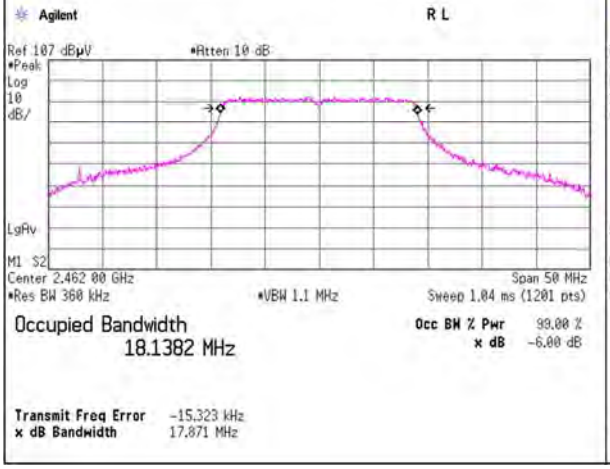
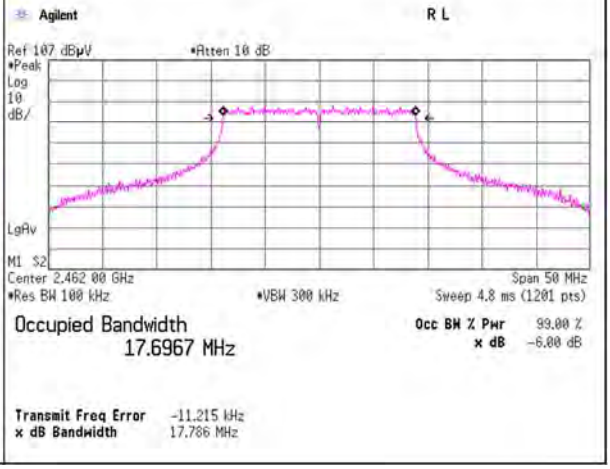
# 99 % Occupied Bandwidth and 6 dB Bandwidth

11g

| 99 % Occupied Bandwidth | 6 dB Bandwidth |
|---|---|
| 2412 MHz | 2412 MHz |
|  |  |
| 2437 MHz | 2437 MHz |
|  |  |
| 2462 MHz | 2462 MHz |
|  |  |

# 99 % Occupied Bandwidth and 6 dB Bandwidth

11n-20 (SISO)

| 99 % Occupied Bandwidth | 6 dB Bandwidth |
|---|---|
| 2412 MHz | 2412 MHz |
|  |  |
| 2437 MHz | 2437 MHz |
|  |  |
| 2462 MHz | 2462 MHz |
|  |  |

# Maximum Peak Output Power and Average power
## (Average power: Reference data for RF Exposure)

| | |
|---|---|
| Report No. | 13977035S-A |
| Test place | Shonan EMC Lab. No.5 Shielded Room |
| Date | November 11, 2021 |
| Temperature / Humidity | 24 deg. C / 30 % RH |
| Engineer | Shiro Kobayashi |
| Mode | Tx BT LE |

BT LE 1M-PHY

**Maximum peak output power**

| | | | | Conducted Power | | | | | e.i.r.p. for RSS-247 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. | Reading | Cable Loss | Atten. Loss | Result | | Limit | | Margin | Antenna Gain | Result | | Limit | | Margin |
| [MHz] | [dBm] | [dB] | [dB] | [dBm] | [mW] | [dBm] | [mW] | [dB] | [dBi] | [dBm] | [mW] | [dBm] | [mW] | [dB] |
| 2402 | -7.23 | 1.69 | 9.64 | 4.10 | 2.57 | 30.00 | 1000 | 25.90 | -0.20 | 3.90 | 2.45 | 36.02 | 4000 | 32.12 |
| 2440 | -7.03 | 1.71 | 9.64 | 4.32 | 2.70 | 30.00 | 1000 | 25.68 | -0.20 | 4.12 | 2.58 | 36.02 | 4000 | 31.90 |
| 2480 | -8.19 | 1.71 | 9.64 | 3.16 | 2.07 | 30.00 | 1000 | 26.84 | -0.20 | 2.96 | 1.98 | 36.02 | 4000 | 33.06 |

Sample Calculation:
Result = Reading + Cable Loss + Attenuator Loss
e.i.r.p. Result = Conducted Power Result + Antenna Gain
*The equipment and cables were not used for factor 0 dB of the data sheets.
All comparison were carried out on same frequency and measurement factors.

BT LE 1M-PHY

**Average power**

| Freq. | Reading | Cable Loss | Atten. Loss | Result (Time average) | | Duty factor | Result (Burst power average) | |
|---|---|---|---|---|---|---|---|---|
| [MHz] | [dBm] | [dB] | [dB] | [dBm] | [mW] | [dB] | [dBm] | [mW] |
| 2402 | -8.42 | 1.69 | 9.64 | 2.91 | 1.95 | 0.64 | 3.55 | 2.26 |
| 2440 | -8.19 | 1.71 | 9.64 | 3.16 | 2.07 | 0.64 | 3.80 | 2.40 |
| 2480 | -9.48 | 1.71 | 9.64 | 1.87 | 1.54 | 0.64 | 2.51 | 1.78 |

Sample Calculation:
Result (Time average) = Reading + Cable Loss + Attenuator Loss
Result (Burst power average) = Result (Time average) + Duty factor
*The equipment and cables were not used for factor 0 dB of the data sheets.

# Maximum Peak Output Power

| | |
|---|---|
| Report No. | 13977035S-A |
| Test place | Shonan EMC Lab. No.1 Measurement Room |
| Date | November 30, 2021 |
| Temperature / Humidity | 25 deg. C / 30 % RH |
| Engineer | Kenichi Adachi |
| Mode | Tx |

11b 5.5 (short) Mbps

**Maximum peak output power**

| | | | | Conducted Power | | | | | e.i.r.p. for RSS-247 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. | Reading | Cable Loss | Atten. Loss | Result | | Limit | | Margin | Antenna Gain | Result | | Limit | | Margin |
| [MHz] | [dBm] | [dB] | [dB] | [dBm] | [mW] | [dBm] | [mW] | [dB] | [dBi] | [dBm] | [mW] | [dBm] | [mW] | [dB] |
| 2412 | -4.89 | 1.00 | 19.94 | 16.05 | 40.27 | 30.00 | 1000 | 13.95 | -0.20 | 15.85 | 38.46 | 36.02 | 4000 | 20.17 |
| 2437 | -4.72 | 1.01 | 19.94 | 16.23 | 41.98 | 30.00 | 1000 | 13.77 | -0.20 | 16.03 | 40.09 | 36.02 | 4000 | 19.99 |
| 2462 | -4.83 | 1.02 | 19.94 | 16.13 | 41.02 | 30.00 | 1000 | 13.87 | -0.20 | 15.93 | 39.17 | 36.02 | 4000 | 20.09 |

11g 36 Mbps

**Maximum peak output power**

| | | | | Conducted Power | | | | | e.i.r.p. for RSS-247 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. | Reading | Cable Loss | Atten. Loss | Result | | Limit | | Margin | Antenna Gain | Result | | Limit | | Margin |
| [MHz] | [dBm] | [dB] | [dB] | [dBm] | [mW] | [dBm] | [mW] | [dB] | [dBi] | [dBm] | [mW] | [dBm] | [mW] | [dB] |
| 2412 | -1.70 | 1.00 | 19.94 | 19.24 | 83.95 | 30.00 | 1000 | 10.76 | -0.20 | 19.04 | 80.17 | 36.02 | 4000 | 16.98 |
| 2437 | -1.46 | 1.01 | 19.94 | 19.49 | 88.92 | 30.00 | 1000 | 10.51 | -0.20 | 19.29 | 84.92 | 36.02 | 4000 | 16.73 |
| 2462 | -1.22 | 1.02 | 19.94 | 19.74 | 94.19 | 30.00 | 1000 | 10.26 | -0.20 | 19.54 | 89.95 | 36.02 | 4000 | 16.48 |

11n-20 (SISO) MCS 5

**Maximum peak output power**

| | | | | Conducted Power | | | | | e.i.r.p. for RSS-247 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. | Reading | Cable Loss | Atten. Loss | Result | | Limit | | Margin | Antenna Gain | Result | | Limit | | Margin |
| [MHz] | [dBm] | [dB] | [dB] | [dBm] | [mW] | [dBm] | [mW] | [dB] | [dBi] | [dBm] | [mW] | [dBm] | [mW] | [dB] |
| 2412 | -1.93 | 1.00 | 19.94 | 19.01 | 79.62 | 30.00 | 1000 | 10.99 | -0.20 | 18.81 | 76.03 | 36.02 | 4000 | 17.21 |
| 2437 | -1.75 | 1.01 | 19.94 | 19.20 | 83.18 | 30.00 | 1000 | 10.80 | -0.20 | 19.00 | 79.43 | 36.02 | 4000 | 17.02 |
| 2462 | -1.61 | 1.02 | 19.94 | 19.35 | 86.10 | 30.00 | 1000 | 10.65 | -0.20 | 19.15 | 82.22 | 36.02 | 4000 | 16.87 |

Sample Calculation:
Result = Reading + Cable Loss + Attenuator Loss
e.i.r.p. Result = Conducted Power Result + Antenna Gain
*The equipment and cables were not used for factor 0 dB of the data sheets.
All comparison were carried out on same frequency and measurement factors.

# Maximum Peak Output Power and Average Output Power

| | |
|---|---|
| Report No. | 13977035S-A |
| Test place | Shonan EMC Lab. No.1 Measurement Room |
| Date | October 20, 2021 |
| Temperature / Humidity | 23 deg. C / 46 % RH |
| Engineer | Kenichi Adachi |
| Mode | Tx |

(Peak)

11b 2437 MHz

| Rate [Mbps] | Reading [dBm] | Remark |
|---|---|---|
| 1 | -4.82 | |
| 2 (Long) | -4.81 | |
| 2 (short) | -4.73 | |
| 5.5 (Long) | -4.80 | |
| 5.5 (short) | -4.72 | ** |
| 11 (Long) | -4.79 | |
| 11 (short) | -4.74 | |

**: Worst Rate

(Average)

11b 2437 MHz

| Rate [Mbps] | Reading [dBm] | Duty Factor [dB] | Average Result [dBm] | Remark |
|---|---|---|---|---|
| 1 | -7.24 | 0.02 | -7.22 | |
| 2 (Long) | -7.25 | 0.03 | -7.22 | |
| 2 (short) | -7.14 | 0.03 | -7.11 | |
| 5.5 (Long) | -7.58 | 0.08 | -7.50 | |
| 5.5 (short) | -7.04 | 0.08 | -6.96 | ** |
| 11 (Long) | -7.29 | 0.14 | -7.15 | |
| 11 (short) | -7.20 | 0.15 | -7.05 | |

**: Worst Rate

11g 2437 MHz

| Rate [Mbps] | Reading [dBm] | Remark |
|---|---|---|
| 6 | -5.87 | |
| 9 | -5.86 | |
| 12 | -5.84 | |
| 18 | -4.12 | |
| 24 | -4.09 | |
| 36 | -1.46 | ** |
| 48 | -1.51 | |
| 54 | -2.09 | |

**: Worst Rate

11g 2437 MHz

| Rate [Mbps] | Reading [dBm] | Duty Factor [dB] | Average Result [dBm] | Remark |
|---|---|---|---|---|
| 6 | -10.36 | 0.11 | -10.25 | |
| 9 | -10.46 | 0.17 | -10.29 | |
| 12 | -10.54 | 0.22 | -10.32 | |
| 18 | -10.06 | 0.32 | -9.74 | ** |
| 24 | -10.27 | 0.41 | -9.86 | |
| 36 | -11.00 | 0.58 | -10.42 | |
| 48 | -11.20 | 0.73 | -10.47 | |
| 54 | -11.33 | 0.81 | -10.52 | |

**: Worst Rate

11n-20 2437 MHz

| MCS | Reading [dBm] | Remark |
|---|---|---|
| 0 | -6.09 | |
| 1 | -6.00 | |
| 2 | -4.24 | |
| 3 | -4.26 | |
| 4 | -1.89 | |
| 5 | -1.75 | ** |
| 6 | -1.86 | |
| 7 | -1.91 | |

**: Worst Rate

11n-20 2437 MHz

| MCS | Reading [dBm] | Duty Factor [dB] | Average Result [dBm] | Remark |
|---|---|---|---|---|
| 0 | -10.41 | 0.12 | -10.29 | |
| 1 | -10.54 | 0.23 | -10.31 | |
| 2 | -10.20 | 0.33 | -9.87 | |
| 3 | -10.23 | 0.42 | -9.81 | ** |
| 4 | -10.90 | 0.58 | -10.32 | |
| 5 | -11.06 | 0.72 | -10.34 | |
| 6 | -11.08 | 0.79 | -10.29 | |
| 7 | -11.24 | 0.84 | -10.40 | |

**: Worst Rate

Sample Calculation:
Average Result = Reading + Duty Factor

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

| | |
|---|---|
| Report No. | 13977035S-A |
| Test place | Shonan EMC Lab. No.1 Measurement Room |
| Date | November 30, 2021 |
| Temperature / Humidity | 25 deg. C / 30 % RH |
| Engineer | Kenichi Adachi |
| Mode | Tx |

11b 5.5 (short) Mbps

**Average power**

| Freq. | Reading | Cable Loss | Atten. Loss | Result (Time average) | | Duty factor | Result (Burst power average) | |
|---|---|---|---|---|---|---|---|---|
| [MHz] | [dBm] | [dB] | [dB] | [dBm] | [mW] | [dB] | [dBm] | [mW] |
| 2412 | -7.22 | 1.00 | 19.94 | 13.72 | 23.55 | 0.08 | 13.80 | 23.99 |
| 2437 | -7.04 | 1.01 | 19.94 | 13.91 | 24.60 | 0.08 | 13.99 | 25.06 |
| 2462 | -7.21 | 1.02 | 19.94 | 13.75 | 23.71 | 0.08 | 13.83 | 24.15 |

11g 18 Mbps

**Average power**

| Freq. | Reading | Cable Loss | Atten. Loss | Result (Time average) | | Duty factor | Result (Burst power average) | |
|---|---|---|---|---|---|---|---|---|
| [MHz] | [dBm] | [dB] | [dB] | [dBm] | [mW] | [dB] | [dBm] | [mW] |
| 2412 | -10.36 | 1.00 | 19.94 | 10.58 | 11.43 | 0.32 | 10.90 | 12.30 |
| 2437 | -10.06 | 1.01 | 19.94 | 10.89 | 12.27 | 0.32 | 11.21 | 13.21 |
| 2462 | -9.99 | 1.02 | 19.94 | 10.97 | 12.50 | 0.32 | 11.29 | 13.46 |

11n-20 (SISO) MCS 3

**Average power**

| Freq. | Reading | Cable Loss | Atten. Loss | Result (Time average) | | Duty factor | Result (Burst power average) | |
|---|---|---|---|---|---|---|---|---|
| [MHz] | [dBm] | [dB] | [dB] | [dBm] | [mW] | [dB] | [dBm] | [mW] |
| 2412 | -10.54 | 1.00 | 19.94 | 10.40 | 10.96 | 0.42 | 10.82 | 12.08 |
| 2437 | -10.23 | 1.01 | 19.94 | 10.72 | 11.80 | 0.42 | 11.14 | 13.00 |
| 2462 | -10.19 | 1.02 | 19.94 | 10.77 | 11.94 | 0.42 | 11.19 | 13.15 |

Sample Calculation:

Result (Time average) = Reading + Cable Loss + Attenuator Loss

Result (Burst power average) = Result (Time average) + Duty factor

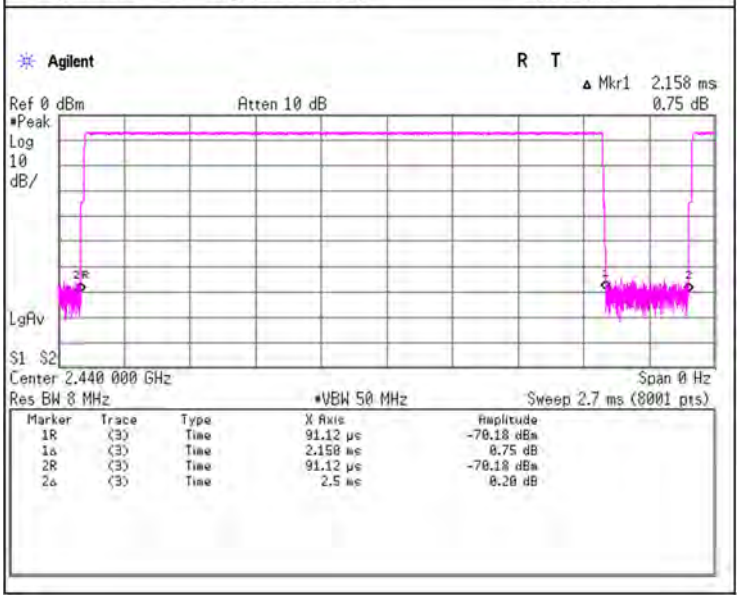
*The equipment and cables were not used for factor 0 dB of the data sheets.

# Burst rate confirmation

| | |
|---|---|
| Report No. | 13977035S-A |
| Test place | Shonan EMC Lab. No.5 Shielded Room |
| Date | November 11, 2021 |
| Temperature / Humidity | 24 deg. C / 30 % RH |
| Engineer | Shiro Kobayashi |
| Mode | Tx |

## BT LE 1M-PHY

| | |
|---|---|
| **Tx on / (Tx on + Tx off) =** | **0.863** |
| **Tx on / (Tx on + Tx off) * 100 =** | **86.3 %** |
| **Duty factor = 10 * log (2.5 / 2.158) =** | **0.64 dB** |




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

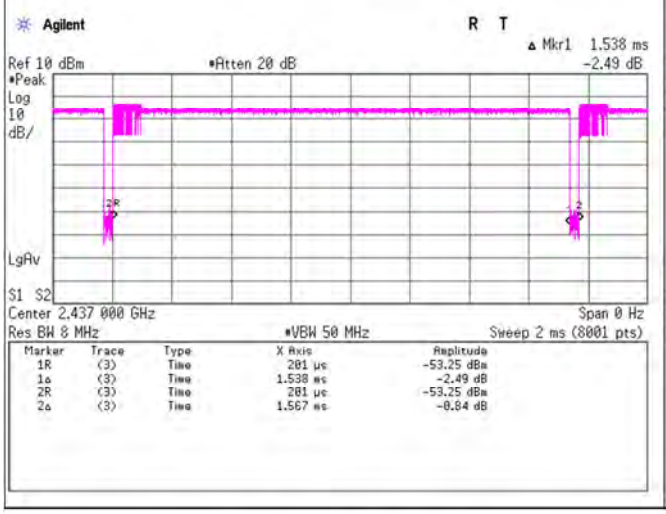
# Burst rate confirmation

(Average Output Power Worst Rate)

| | |
|---|---|
| Report No. | 13977035S-A |
| Test place | Shonan EMC Lab. No.1 Measurement Room |
| Date | October 20, 2021 |
| Temperature / Humidity | 23 deg. C / 46 % RH |
| Engineer | Kenichi Adachi |
| Mode | Tx |

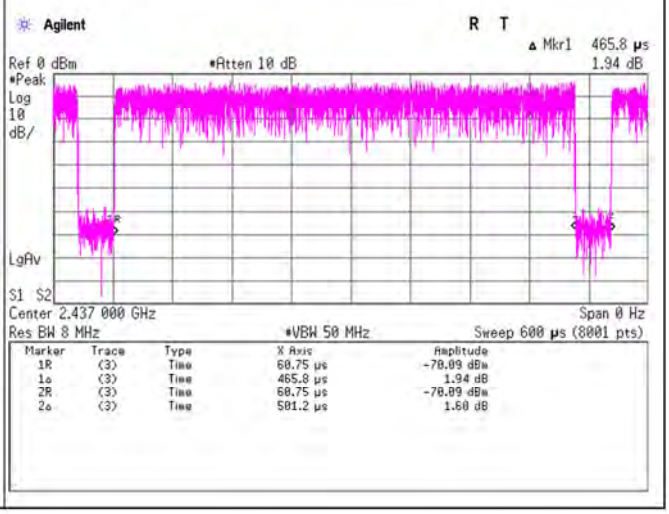
## 11b, 5.5 (short) Mbps

| | |
|---|---|
| **Tx on / (Tx on + Tx off) =** | **0.981** |
| **Tx on / (Tx on + Tx off) * 100 =** | **98.1 %** |
| **Duty factor = 10 * log (1.567 / 1.538) =** | **0.08 dB** |



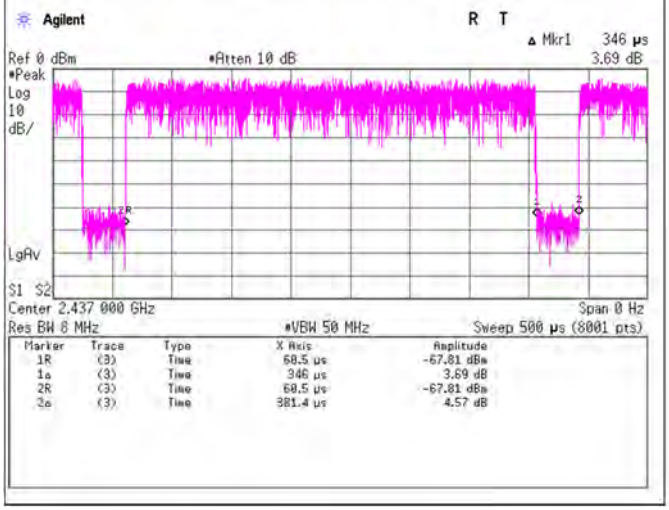

## 11g, 18 Mbps

| | |
|---|---|
| **Tx on / (Tx on + Tx off) =** | **0.929** |
| **Tx on / (Tx on + Tx off) * 100 =** | **92.9 %** |
| **Duty factor = 10 * log (0.5012 / 0.4658) =** | **0.32 dB** |




## 11n-20 (SISO), MCS 3

| | |
|---|---|
| **Tx on / (Tx on + Tx off) =** | **0.907** |
| **Tx on / (Tx on + Tx off) * 100 =** | **90.7 %** |
| **Duty factor = 10 * log (0.3814 / 0.346) =** | **0.42 dB** |




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

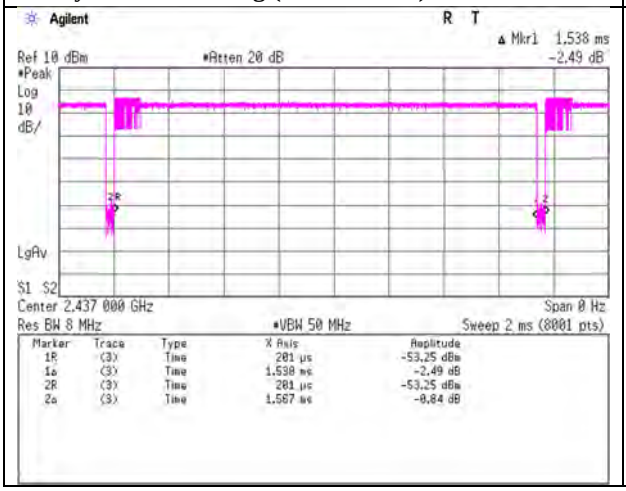
# Burst rate confirmation

(Maximum Peak Output Power Worst Rate)

| | |
|---|---|
| Report No. | 13977035S-A |
| Test place | Shonan EMC Lab. No.1 Measurement Room |
| Date | October 20, 2021 |
| Temperature / Humidity | 23 deg. C / 46 % RH |
| Engineer | Kenichi Adachi |
| Mode | Tx |

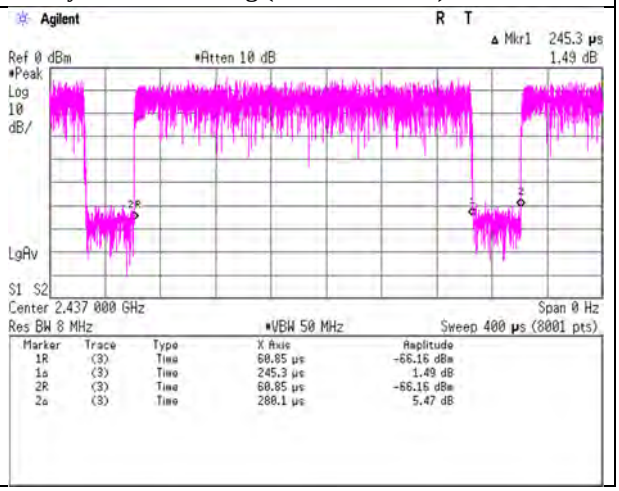
## 11b 5.5 Mbps

| | | |
|---|---|---|
| **Tx on / (Tx on + Tx off) =** | **0.981** | |
| **Tx on / (Tx on + Tx off) * 100 =** | **98.1** | **%** |
| **Duty factor = 10 * log (1.567 / 1.538) =** | **0.08** | **dB** |



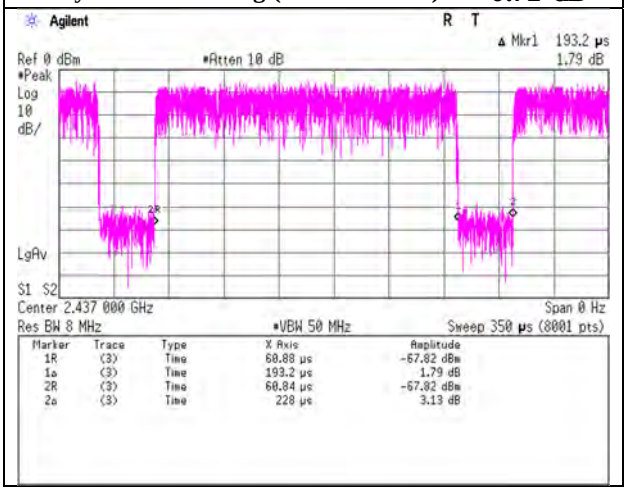

## 11g 36 Mbps

| | | |
|---|---|---|
| **Tx on / (Tx on + Tx off) =** | **0.876** | |
| **Tx on / (Tx on + Tx off) * 100 =** | **87.6** | **%** |
| **Duty factor = 10 * log (0.2801 / 0.2453) =** | **0.58** | **dB** |




## 11n-20 MCS 5

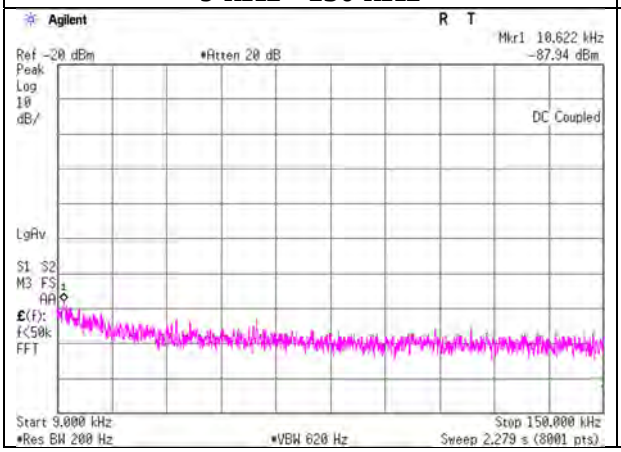
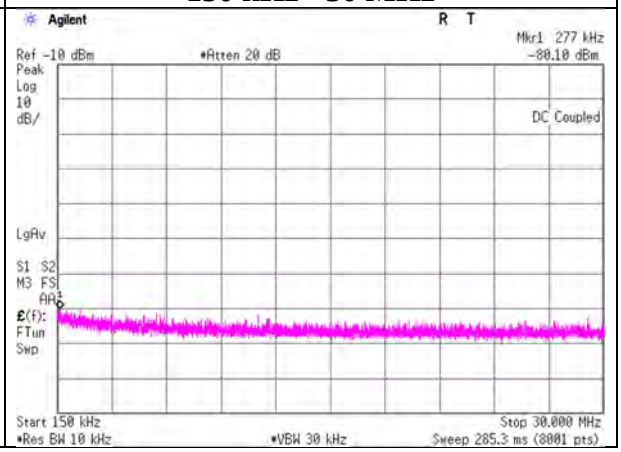
| | | |
|---|---|---|
| **Tx on / (Tx on + Tx off) =** | **0.847** | |
| **Tx on / (Tx on + Tx off) * 100 =** | **84.7** | **%** |
| **Duty factor = 10 * log (0.228 / 0.1932) =** | **0.72** | **dB** |




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

# Conducted Spurious Emission

| | |
|---|---|
| Report No. | 13977035S-A |
| Test place | Shonan EMC Lab. No.5 Shielded Room |
| Date | November 11, 2021 |
| Temperature / Humidity | 24 deg. C / 30 % RH |
| Engineer | Shiro Kobayashi |
| Mode | Tx BT LE 2402 MHz |

| 9 kHz - 150 kHz | 150 kHz - 30 MHz |
|---|---|
|  |  |





| Frequency [kHz] | Reading [dBm] | Cable Loss [dB] | Attenuator Loss [dB] | Antenna Gain* [dBi] | N (Number of Output) | EIRP [dBm] | Distance [m] | Ground bounce [dB] | E (field strength) [dBuV/m] | Limit [dBuV/m] | Margin [dB] | Remark |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10.622 | -87.94 | 0.02 | 9.54 | 2.0 | 1 | -76.4 | 300 | 6.0 | -15.1 | 47.0 | 62.1 | - |
| 277.000 | -80.10 | 0.02 | 9.54 | 2.0 | 1 | -68.5 | 300 | 6.0 | -7.3 | 18.7 | 26.0 | - |

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)

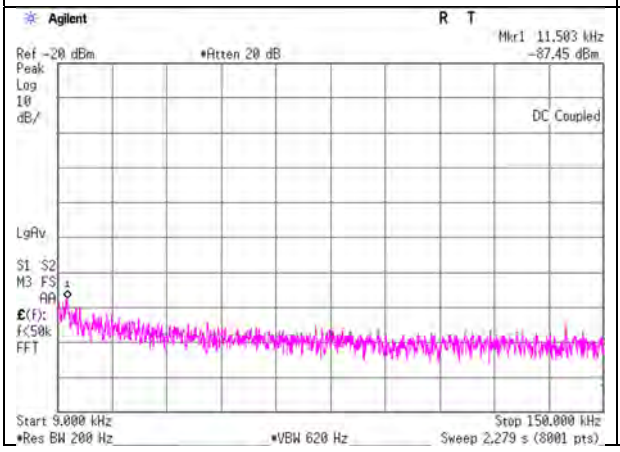
N: Number of output

*2.0 dBi was applied to the test result based on ANSI C63.10 since antenna gain was less than 2.0 dBi.

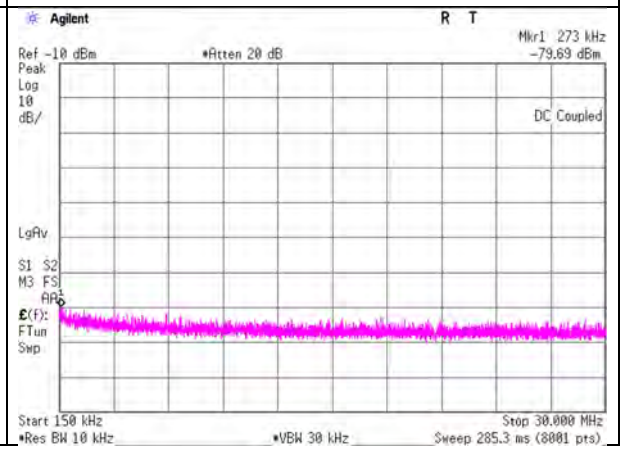
# Conducted Spurious Emission

| | |
|---|---|
| Report No. | 13977035S-A |
| Test place | Shonan EMC Lab. No.5 Shielded Room |
| Date | November 11, 2021 |
| Temperature / Humidity | 24 deg. C / 30 % RH |
| Engineer | Shiro Kobayashi |
| Mode | Tx BT LE 2440 MHz |

## 9 kHz - 150 kHz




## 150 kHz - 30 MHz




| Frequency [kHz] | Reading [dBm] | Cable Loss [dB] | Attenuator Loss [dB] | Antenna Gain* [dBi] | N (Number of Output) | EIRP [dBm] | Distance [m] | Ground bounce [dB] | E (field strength) [dBuV/m] | Limit [dBuV/m] | Margin [dB] | Remark |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 11.503 | -87.45 | 0.02 | 9.54 | 2.0 | 1 | -75.9 | 300 | 6.0 | -14.6 | 46.3 | 60.9 | - |
| 273.000 | -79.69 | 0.02 | 9.54 | 2.0 | 1 | -68.1 | 300 | 6.0 | -6.9 | 18.8 | 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)

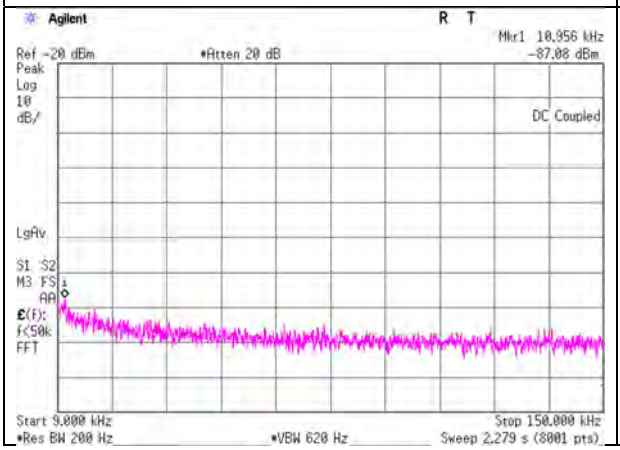
N: Number of output

*2.0 dBi was applied to the test result based on ANSI C63.10 since antenna gain was less than 2.0 dBi.

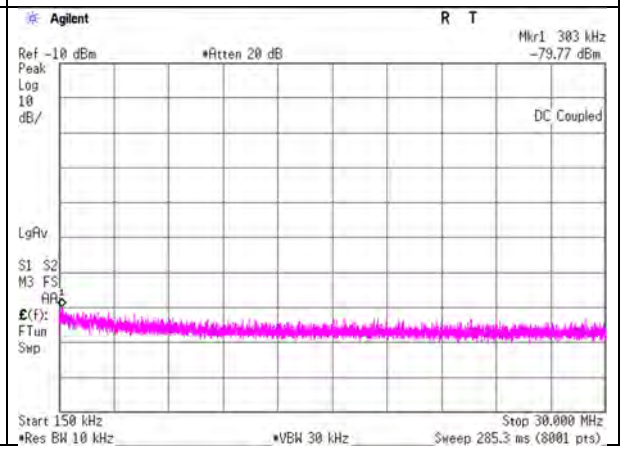
# Conducted Spurious Emission

| | |
|---|---|
| Report No. | 13977035S-A |
| Test place | Shonan EMC Lab. No.5 Shielded Room |
| Date | November 11, 2021 |
| Temperature / Humidity | 24 deg. C / 30 % RH |
| Engineer | Shiro Kobayashi |
| Mode | Tx BT LE 2480 MHz |

## 9 kHz - 150 kHz




## 150 kHz - 30 MHz




| Frequency [kHz] | Reading [dBm] | Cable Loss [dB] | Attenuator Loss [dB] | Antenna Gain* [dBi] | N (Number of Output) | EIRP [dBm] | Distance [m] | Ground bounce [dB] | E (field strength) [dBuV/m] | Limit [dBuV/m] | Margin [dB] | Remark |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10.956 | -87.08 | 0.02 | 9.54 | 2.0 | 1 | -75.5 | 300 | 6.0 | -14.3 | 46.8 | 61.1 | - |
| 303.000 | -79.77 | 0.02 | 9.54 | 2.0 | 1 | -68.2 | 300 | 6.0 | -7.0 | 17.9 | 24.9 | - |

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)

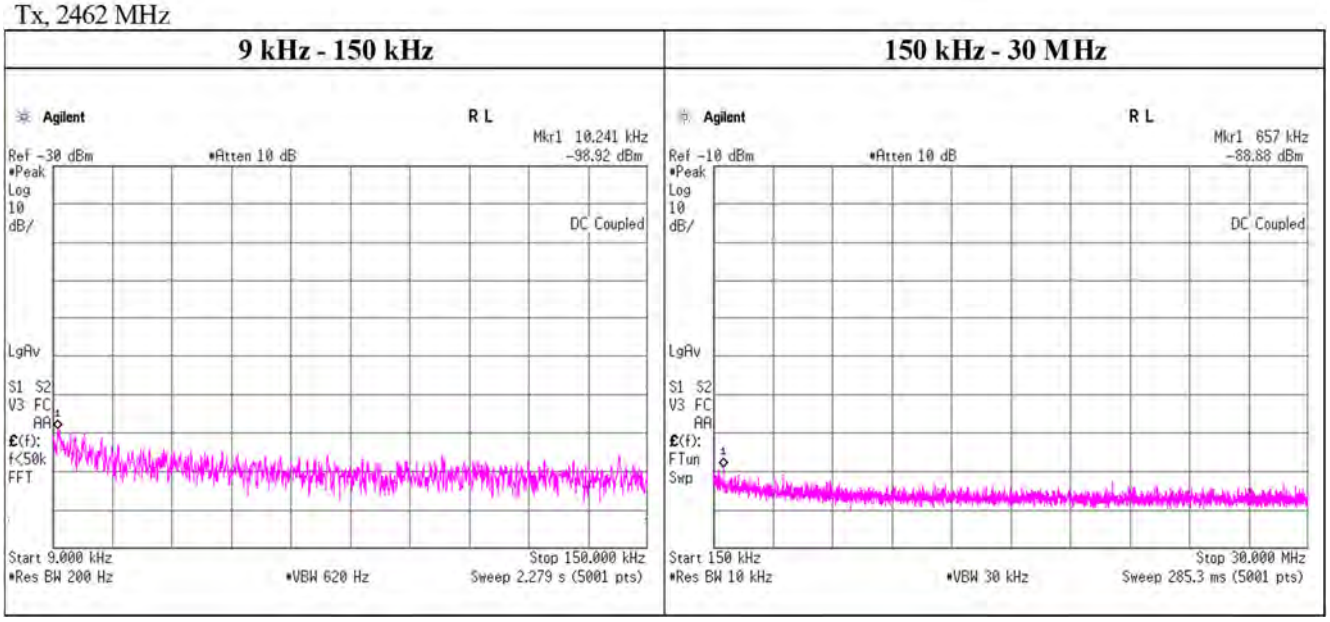
N: Number of output

*2.0 dBi was applied to the test result based on ANSI C63.10 since antenna gain was less than 2.0 dBi.

# Conducted Spurious Emission

| | |
|---|---|
| Report No. | 13977035S-A |
| Test place | Shonan EMC Lab. No.5 Shielded Room |
| Date | November 30, 2021 |
| Temperature / Humidity | 25 deg. C / 30 % RH |
| Engineer | Kenichi Adachi |
| Mode | Tx 11g 2462 MHz |

Tx, 2462 MHz




| Frequency [kHz] | Reading [dBm] | Cable Loss [dB] | Attenuator Loss [dB] | Antenna Gain * [dBi] | N (Number of Output) | EIRP [dBm] | Distance [m] | Ground bounce [dB] | E (field strength) [dBuV/m] | Limit [dBuV/m] | Margin [dB] | Remark |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10.241 | -98.92 | 0.01 | 19.87 | 2.0 | 1.0 | -77.0 | 300 | 6.0 | -15.8 | 47.3 | 63.1 | - |
| 657.00 | -88.88 | 0.01 | 19.87 | 2.0 | 1.0 | -67.0 | 30 | 6.0 | 14.3 | 31.2 | 16.9 | - |

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

*2.0 dBi was applied to the test result based on ANSI C63.10 since antenna gain was less than 2.0 dBi.

# Power Density

| | | |
|---|---|---|
| Report No. | 13977035S-A | |
| Test place | Shonan EMC Lab. No.5 Shielded Room | |
| Date | November 11, 2021 | November 30, 2021 |
| Temperature / Humidity | 24 deg. C / 30 % RH | 25 deg. C / 30 % RH |
| Engineer | Shiro Kobayashi | Kenichi Adachi |
| Mode | Tx | |

BT LE 1M-PHY

| Frequency [MHz] | Measured Frequency [MHz] | Reading [dBm/3 kHz] | Cable Loss [dB] | Atten. Loss [dB] | Result [dBm/3 kHz] | Limit [dBm/3 kHz] | Margin [dB] |
|---|---|---|---|---|---|---|---|
| 2402 | 2401.994 | -22.98 | 1.69 | 9.64 | -11.65 | 8.00 | 19.65 |
| 2440 | 2439.994 | -22.69 | 1.71 | 9.64 | -11.34 | 8.00 | 19.34 |
| 2480 | 2479.994 | -23.84 | 1.71 | 9.64 | -12.49 | 8.00 | 20.49 |

11b

| Frequency [MHz] | Measured Frequency [MHz] | Reading [dBm/3 kHz] | Cable Loss [dB] | Atten. Loss [dB] | Result [dBm/3 kHz] | Limit [dBm/3 kHz] | Margin [dB] |
|---|---|---|---|---|---|---|---|
| 2412 | 2411.642 | -14.25 | 1.00 | 19.94 | 6.69 | 8.00 | 1.31 |
| 2437 | 2436.642 | -14.10 | 1.01 | 19.94 | 6.85 | 8.00 | 1.15 |
| 2462 | 2463.025 | -16.53 | 1.02 | 19.94 | 4.43 | 8.00 | 3.57 |

11g

| Frequency [MHz] | Measured Frequency [MHz] | Reading [dBm/3 kHz] | Cable Loss [dB] | Atten. Loss [dB] | Result [dBm/3 kHz] | Limit [dBm/3 kHz] | Margin [dB] |
|---|---|---|---|---|---|---|---|
| 2412 | 2410.112 | -34.99 | 1.00 | 19.94 | -14.05 | 8.00 | 22.05 |
| 2437 | 2435.112 | -35.19 | 1.01 | 19.94 | -14.24 | 8.00 | 22.24 |
| 2462 | 2460.112 | -34.47 | 1.02 | 19.94 | -13.51 | 8.00 | 21.51 |

11n-20 (SISO)

| Frequency [MHz] | Measured Frequency [MHz] | Reading [dBm/3 kHz] | Cable Loss [dB] | Atten. Loss [dB] | Result [dBm/3 kHz] | Limit [dBm/3 kHz] | Margin [dB] |
|---|---|---|---|---|---|---|---|
| 2412 | 2408.796 | -35.00 | 1.00 | 19.94 | -14.06 | 8.00 | 22.06 |
| 2437 | 2431.994 | -35.12 | 1.01 | 19.94 | -14.17 | 8.00 | 22.17 |
| 2462 | 2456.994 | -35.15 | 1.02 | 19.94 | -14.19 | 8.00 | 22.19 |

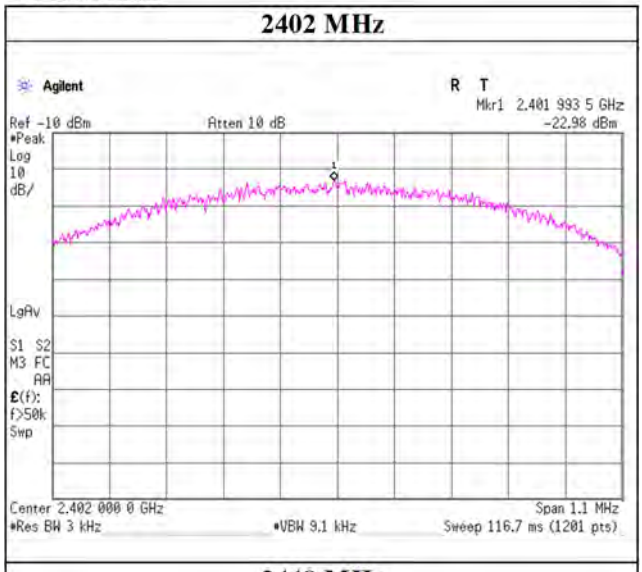
Sample Calculation:
Result = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss

*The equipment and cables were not used for factor 0 dB of the data sheets.

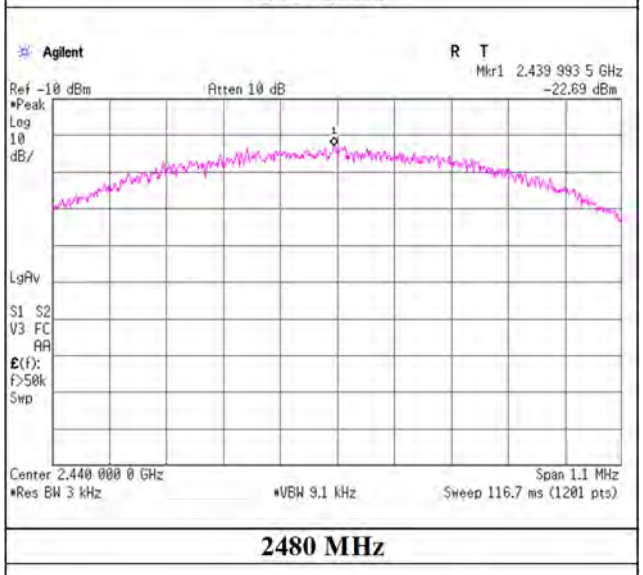
# Power Density

**BT LE 1M-PHY**

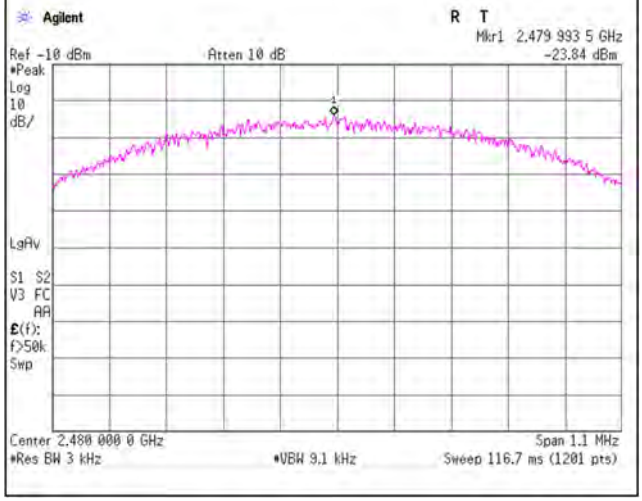
**2402 MHz**




**2440 MHz**



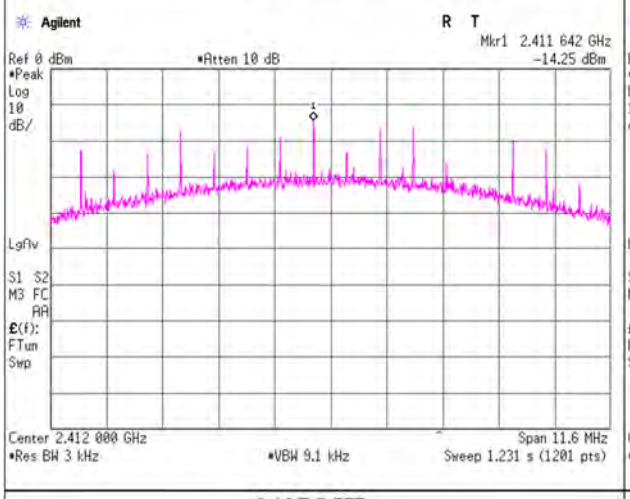

**2480 MHz**



## Power Density

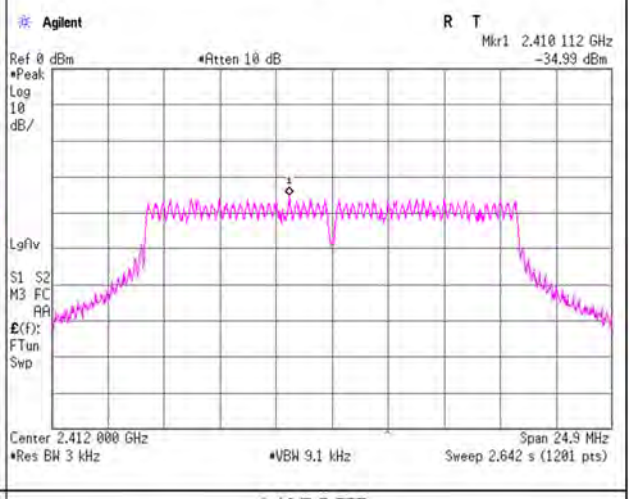
11b, 5.5 (short) Mbps

2412 MHz

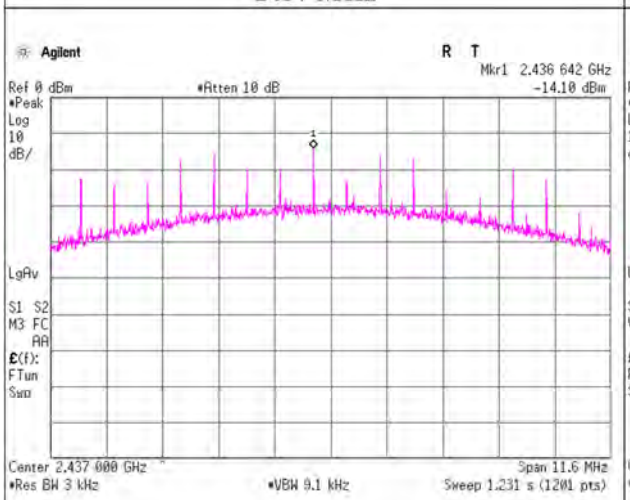



11g, 36 Mbps

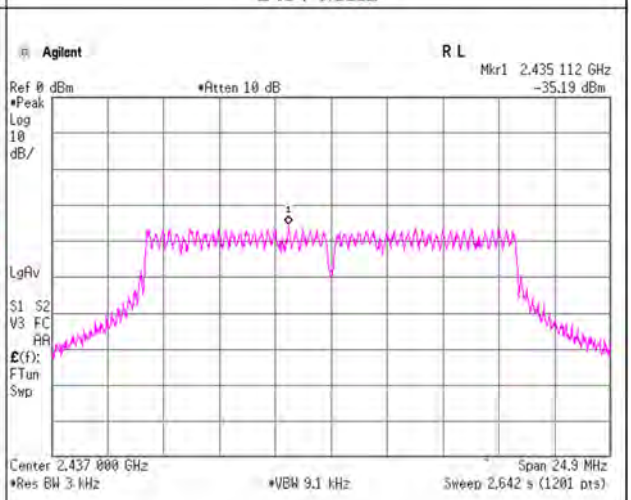
2412 MHz



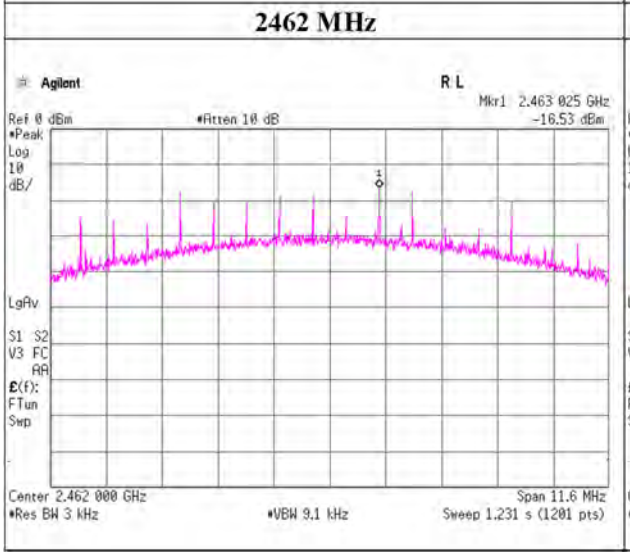

2437 MHz



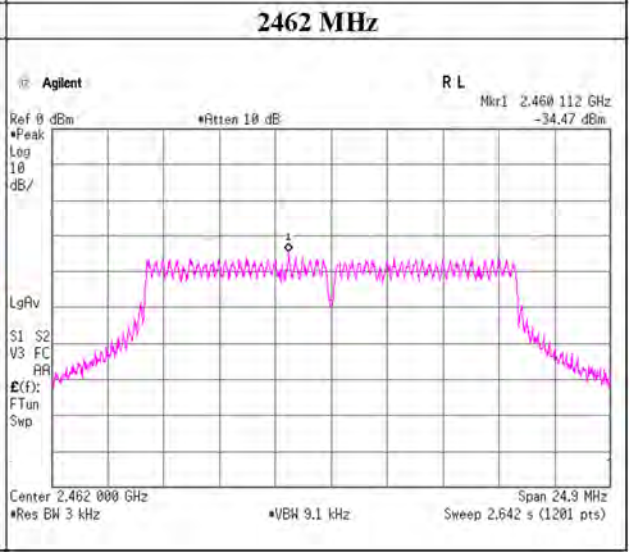

2437 MHz




2462 MHz



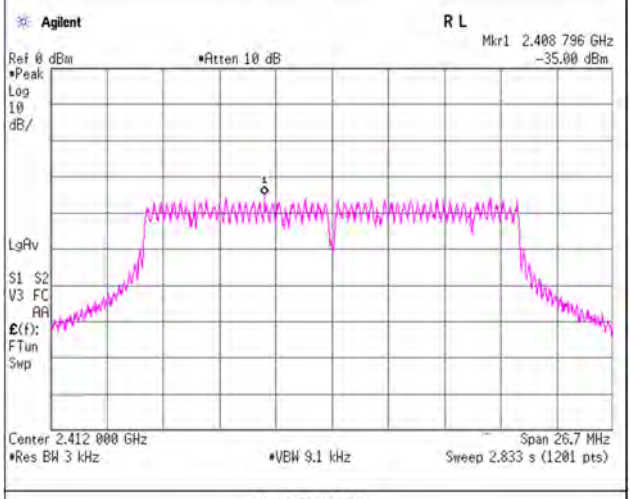

2462 MHz



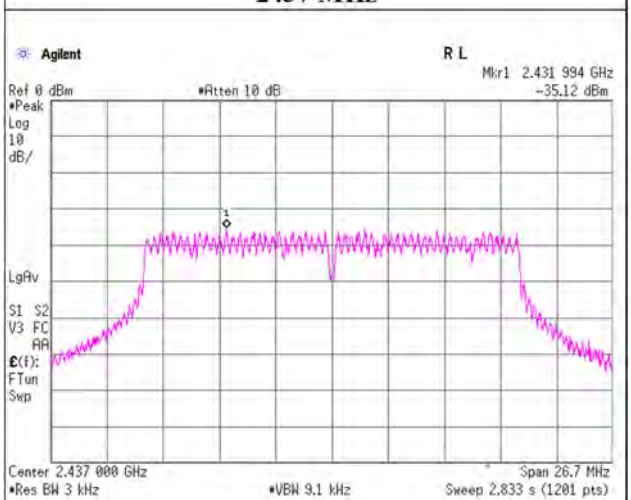
## Power Density

11n-20 (SISO), MCS 5

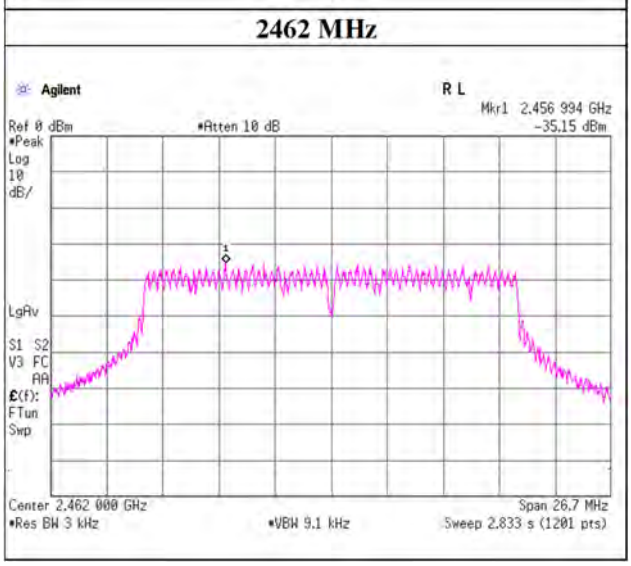
2412 MHz




2437 MHz




2462 MHz



# APPENDIX 2: Test instruments

**Test equipment**

| Test Item | Local ID | LIMS ID | Description | Manufacturer | Model | Serial | Last Calibration Date | Cal Int |
|---|---|---|---|---|---|---|---|---|
| AT | KTS-08 | 145095 | Digital Tester | SANWA | PC500 | 7019224 | 2021/04/26 | 12 |
| AT | SAT10-09 | 145132 | Attenuator | Weinschel Corp. | 54A-10 | W5692 | 2021/10/05 | 12 |
| AT | SAT20-06 | 145146 | Attenuator | Weinschel Corp. | 54A-20 | 31506 | 2021/04/02 | 12 |
| AT | SCC-G14 | 145175 | Coaxial Cable | Suhner | SUCOFLEX 102 | 31600/2 | 2020/12/21 | 12 |
| AT | SCC-G65 | 196942 | Coaxial Cable | Huber+Suhner | SUCOFLEX 102 | 803416/2 | 2021/03/01 | 12 |
| AT | SCC-H22 | 197396 | Microwave cable | RS Pro | R-132G7210 100CO | - | 2021/04/08 | 12 |
| AT | SCC-H23 | 199603 | Microwave cable | RS Pro | R-132G7210 100CO | - | 2021/06/14 | 12 |
| AT | SOS-27 | 191845 | Humidity Indicator | CUSTOM. Inc | CTH-201 | - | 2021/08/02 | 12 |
| AT | SOS-28 | 191846 | Humidity Indicator | CUSTOM. Inc | CTH-201 | - | 2021/08/02 | 12 |
| AT | SPM-13 | 169910 | Power Meter | Keysight Technologies Inc | 8990B | MY51000448 | 2021/01/25 | 12 |
| AT | SPSS-06 | 169911 | Power sensor | Keysight Technologies Inc | N1923A | MY57270004 | 2021/01/25 | 12 |
| AT | SRENT-09 | 150461 | Spectrum Analyzer | Keysight Technologies Inc | E4440A | MY46186392 | 2021/02/22 | 12 |
| AT | SRENT-15 | 160899 | Spectrum Analyzer | Keysight Technologies Inc | E4440A | MY46185516 | 2021/01/26 | 12 |
| AT | STM-G7 | 171614 | Terminator | Weinschel - API Technologies Corp | M1459A | 88995 | 2021/05/17 | 12 |
| AT | STS-05 | 146212 | Digital Hitester | HIOKI E.E. CORPORATION | 3805-50 | 80997828 | 2021/09/14 | 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 Tests**