RADIO TEST REPORT

Test Report No. : 13408107S-B-R2

Applicant	:	**Panasonic Corporation**
Type of EUT	:	**Car Navigation**
Model Number of EUT	:	**AT2104**
FCC ID	:	**ACJ932AT2104**
Test regulation	:	**FCC Part 15 Subpart C: 2020** ***Wireless LAN & Bluetooth Low Energy part**
Test Item	:	**Antenna Terminal Conducted Tests**
Test Result	:	**Complied (Refer to SECTION 3.2)**

1. This test report shall not be reproduced in full or partial, without the written approval of UL Japan, Inc.
2. The results in this report apply only to the sample tested.
3. This sample tested is in compliance with the limits of the above regulation.
4. The test results in this test report are traceable to the national or international standards.
5. This test report must not be used by the customer to claim product certification, approval, or endorsement by the A2LA accreditation body.
6. This test report covers Radio technical requirements.
   It does not cover administrative issues such as Manual or non-Radio test related Requirements. (if applicable)
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.
10. This report is a revised version of 13408107S-B-R1. 13408107S-B-R1 is replaced with this report.

Date of test: July 3 to August 15, 2020

Representative test engineer:
K. Noda
Kazuya Noda
Engineer
Consumer Technology Division

Approved by:
S. Takano
Shinichi Takano
Engineer
Consumer Technology Division

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".

UL Japan, Inc.
Shonan EMC Lab.
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REVISION HISTORY

Original Test Report No.: 13408107S-B

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<tr><td>-
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2020</td><td>-</td><td>-</td></tr>
<tr><td>1</td><td>13408107S-B-R1</td><td>October 16,
2020</td><td>P.13</td><td>Correction of Table
from
<table>
<tr><th>Test</th><th>Span</th><th>RBW</th><th>VBW</th><th>Sweep time</th><th>Detector</th><th>Trace</th><th>Instrument used</th></tr>
<tr><td>6 dB Bandwidth</td><td>20 MHz</td><td>100 kHz</td><td>300 kHz</td><td>Auto</td><td>Peak</td><td>Max Hold</td><td>Spectrum Analyzer</td></tr>
<tr><td>99 % Occupied Bandwidth *1)</td><td>Enough width to display emission skirts</td><td>1 to 5 % of OBW</td><td>Three times of RBW</td><td>Auto</td><td>Peak</td><td>Max Hold</td><td>Spectrum Analyzer</td></tr>
<tr><td>Maximum Peak Output Power</td><td>-</td><td>-</td><td>-</td><td>Auto</td><td>Peak/ Average *2)</td><td>-</td><td>Power Meter (Sensor: 160 MHz BW)</td></tr>
<tr><td>Peak Power Density</td><td>1.5 times the 6dB Bandwidth</td><td>30 kHz</td><td>100 kHz</td><td>Auto</td><td>Peak</td><td>Max Hold</td><td>Spectrum Analyzer *3) *4)</td></tr>
<tr><td rowspan="2">Conducted Spurious Emission *5) *6)</td><td>9kHz to 150kHz</td><td>200 Hz</td><td>620 Hz</td><td rowspan="2">Auto</td><td rowspan="2">Peak</td><td rowspan="2">Max Hold</td><td rowspan="2">Spectrum Analyzer</td></tr>
<tr><td>150kHz to 30MHz</td><td>10 kHz</td><td>30 kHz</td></tr>
<tr><td colspan="8">*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".
*5) 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)
*6) 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.</td></tr>
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<tr><td>2</td><td>13408107S-B-R2</td><td>November 17, 2020</td><td>P.28</td><td>Adding Measurement data:
“BT LE Coded-PHY(S=8)” and
“BT LE Coded-PHY(S=2)”

Adding 2 comment:
“* Since the burst rate is not different between the channels, the data has been obtained on the representative channel.”,

“* The above chart is obtained with the Maximum Packet Size set that can be by test software, and it is different from the maximum duty cycle of the product.”</td></tr>
</table>

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
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
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
NVLAP	National Voluntary Laboratory Accreditation Program
OBW	Occupied Band Width
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	Quadri-Phase Shift Keying
RBW	Resolution Band Width
RDS	Radio Data System
RE	Radio Equipment
RF	Radio Frequency
RMS	Root Mean Square
RSS	Radio Standards Specifications
Rx	Receiving
SA, S/A	Spectrum Analyzer
SG	Signal Generator
SVSWR	Site-Voltage Standing Wave Ratio
TR	Test Receiver
Tx	Transmitting
VBW	Video BandWidth
Vert.	Vertical
WLAN	Wireless LAN

CONTENTS **PAGE**

SECTION 1: Customer information

Company Name	:	Panasonic Corporation
Address	:	4261 Ikonobe-cho, Tsuzuki-ku, Yokohama-shi, Kanagawa-ken, 224-8520, Japan
Telephone Number	:	+81-50-3689-7112
Contact Person	:	Takahisa Sakai

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	:	Car Navigation
Model Number	:	AT2104
Serial Number	:	Refer to SECTION 4.2
Rating	:	DC 13.2 V
Receipt Date	:	June 29, 2020
Country of Mass-production	:	Japan, Mexico, Czech Republic
Condition	:	Production model (Not for Sale: This sample is equivalent to mass-produced items.)
Modification	:	No Modification by the test lab.

2.2 Product Description

Model: AT2104 (referred to as the EUT in this report) are a Car Navigation.

There are 2 type for AT2104; Hi type(14 inch Display) and Lo type(8 inch Display). The same radio module and antenna are installed in these models, however the substrate pattern and antenna arrangement are different.

Radio Specification

	IEEE802.11b	**IEEE802.11g**	**IEEE802.11n (20 MHz band)**	**IEEE802.11n (40 MHz band)**
Frequency of operation	2412 MHz - 2462 MHz	2412 MHz - 2462 MHz	2412 MHz – 2462 MHz, 5180 MHz – 5240 MHz, 5745 MHz – 5825 MHz	5190 MHz, 5230 MHz, 5755 MHz, 5795 MHz
Channel spacing	5 MHz		2.4 GHz band: 5 MHz 5 GHz band: 20 MHz	40 MHz
Modulation	DSSS (CCK, DQPSK, DBPSK)	OFDM-CCK (64QAM, 16QAM, QPSK, BPSK)	OFDM (64QAM, 16QAM, QPSK, BPSK)	
	IEEE802.11a	**IEEE802.11ac (20 MHz band)**	**IEEE802.11ac (40 MHz band)**	**IEEE802.11ac (80 MHz band)**
Frequency of operation	5180 MHz – 5240 MHz, 5745 MHz – 5825 MHz	5180 MHz – 5240 MHz, 5745 MHz – 5825 MHz	5190 MHz, 5230 MHz, 5755 MHz, 5795 MHz	5210 MHz, 5775 MHz
Channel spacing	20 MHz		40 MHz	80 MHz
Modulation	OFDM (64QAM, 16QAM, QPSK, BPSK)	OFDM (256QAM,16QAM,QPSK,BPSK)		

	Bluetooth (BR/EDR)	**Bluetooth Low Energy**
Frequency of operation	2402 MHz – 2480 MHz	2402 MHz – 2480 MHz
Channel spacing	1 MHz	2 MHz
Modulation	FHSS, GFSK, π/4DQPSK, 8DPSK	FHSS, GFSK

Antenna type	Inverted F type antenna			
Antenna Gain	Hi type (14 inch Display)	RF0	2.4 GHz WLAN	-0.83 dBi
			U-NII-1	2.17 dBi
			U-NII-3	2.37 dBi
		RF1	BT, BT LE	-0.13 dBi
			U-NII-1	2.59 dBi
			U-NII-3	2.64 dBi
	Lo type (8 inch Display)	RF0	2.4 GHz WLAN	2.25 dBi
			U-NII-1	1.41 dBi
			U-NII-3	0.99 dBi
		RF1	BT, BT LE	-0.22 dBi
			U-NII-1	1.08 dBi
			U-NII-3	2.14 dBi
Antenna Connector type	U.FL connector			
Operating Temperature	-30 deg. C to + 65 deg. C			

SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification : FCC Part 15 Subpart C
FCC Part 15 final revised on May 26, 2020 and effective July 27, 2020

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

* The revision does not affect the test result conducted before its effective date.
* 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 *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 Restricted Band Edges	**FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02	**FCC:** Section15.247(d)	See data.	Complied d)	Conducted (below 30 MHz)
	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	- 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	0.98 dB
Power Measurement above 1 GHz (Peak Detector)_SPM-06	1.75 dB
Power Measurement above 1 GHz (Average Detector)_SPM-07	0.89 dB
Power Measurement above 1 GHz (Peak Detector)_SPM-07	1.12 dB
Power Measurement above 1 GHz (Average Detector)_SPM-13	1.06 dB
Power Measurement above 1 GHz (Peak Detector)_SPM-13	1.24 dB
Spurious emission (Conducted) below 1GHz	0.9 dB
Spurious emission (Conducted) 1 GHz-3 GHz	0.9 dB
Spurious emission (Conducted) 3 GHz-18 GHz	2.9 dB
Spurious emission (Conducted) 18 GHz-26.5 GHz	2.6 dB
Spurious emission (Conducted) 26.5 GHz-40 GHz	2.0 dB
Bandwidth Measurement	0.07 %
Duty cycle and Time Measurement	0.262 %
Temperature	0.95 deg.C.
Voltage	0.83 %

3.5 Test Location

UL Japan, Inc. Shonan EMC Lab.
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)

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)

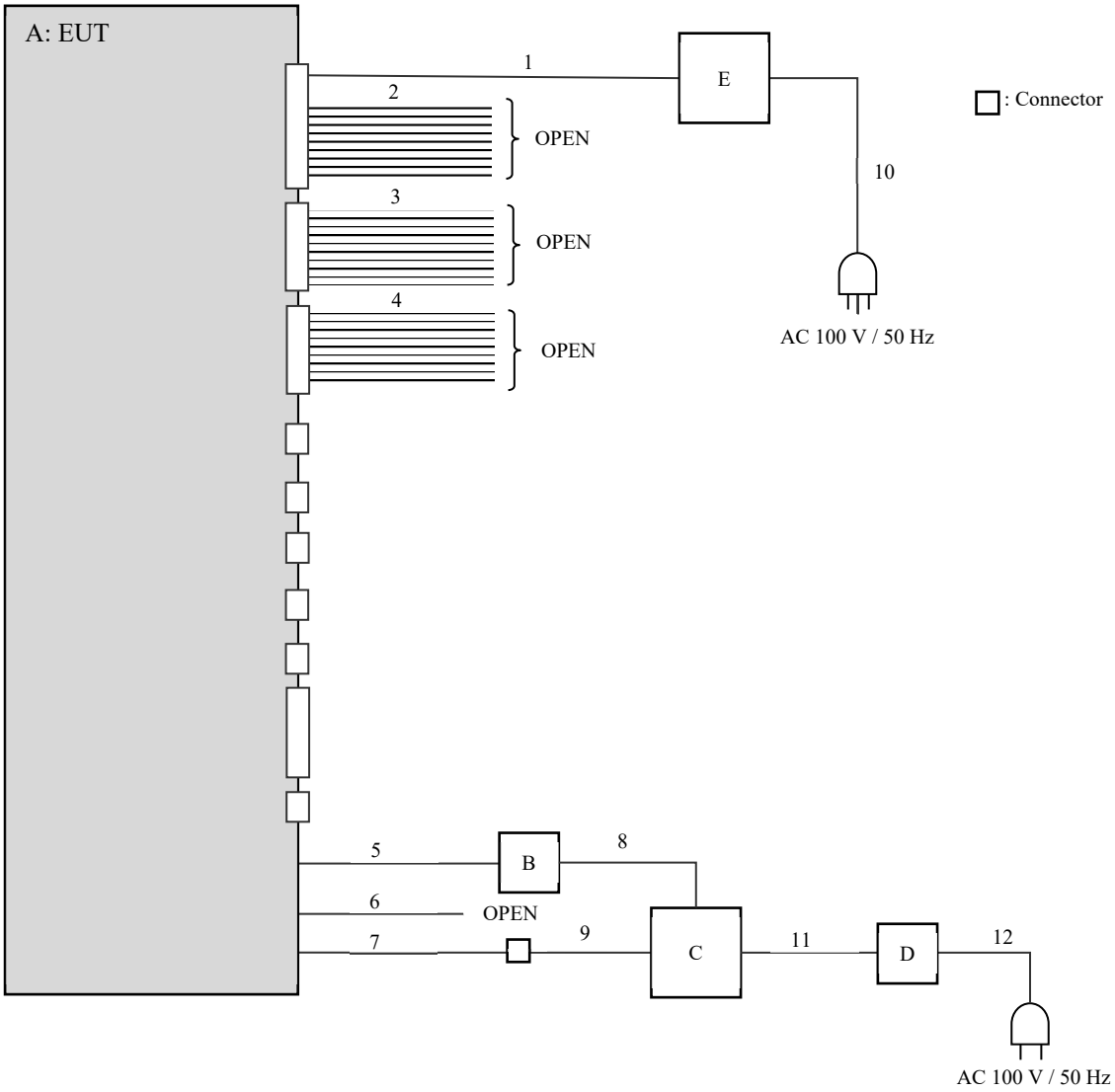
Test operating mode was determined as follows according to "Section 1 of 6 802.11 a/b/g/n testing - Managing Complex Regulatory Approvals - " of TCB Council Workshop October 2009

Mode	Remarks*
IEEE 802.11b (11b)	1 Mbps, PN9
IEEE 802.11g (11g)	24 Mbps, PN9
IEEE 802.11n SISO 20 MHz BW (11n-20)	MCS 2, PN9
Bluetooth (BT) Low Energy (LE)	Uncoded 1 M-PHY, Maximum Packet Size, PRBS9
	Uncoded 2 M-PHY, Maximum Packet Size, 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; Power settings: 11b : 14 dBm, 11g : 12 dBm (2412 MHz, 2462 MHz), 14 dBm (2417 MHz to 2457 MHz) 11n20: 11 dBm (2412 MHz, 2462 MHz), 13 dBm (2417 MHz to 2457 MHz) BT LE 1 M-PHY: Fixed BT LE 2 M-PHY: Fixed Software: Labtool Version: 2.0.0.71 (Date: 2020.05.29, Storage location: EUT memory) *This setting of software is the worst case. Any conditions under the normal use do not exceed the condition of setting. In addition, end users cannot change the settings of the output power of the product.	

*The details of Operating mode(s)

Test Item	Operating Mode	Tested frequency
Conducted Spurious Emission	Tx, 11g	2437 MHz
	Tx BT LE 1 M-PHY, Tx BT LE 2 M-PHY	2402 MHz 2440 MHz 2480 MHz
6 dB Bandwidth Maximum Peak Output Power Power Density 99 % Occupied Bandwidth	Tx, 11b Tx, 11g Tx, 11n-20	2412 MHz 2437 MHz 2462 MHz
	Tx BT LE 1 M-PHY, Tx BT LE 2 M-PHY	2402 MHz 2440 MHz 2480 MHz

4.2 Configuration and peripherals



Description of EUT and support equipment

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	Car Navigation	AT2104 Lo type (8 inch Display)	500107	Panasonic Corporation	EUT
B	Jig board	RCarDBG_JTAG2	WR19-4014	WESTEK	-
C	Laptop Computer	7666-77J	LV-B8R1X 08/05	Lenovo	-
D	AC Adapter	42T4422	11S92P1154Z1DXF 1DBFDN	Lenovo	-
E	Power Supply (DC)	PAN35-10A	ML002085	KIKUSUI	-

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	DC	1.0	Unshielded	Unshielded	-
2	Signal	0.2	Unshielded	Unshielded	-
3	Signal	0.2	Unshielded	Unshielded	-
4	Signal	0.2	Shielded	Shielded	-
5	Signal	0.1	Unshielded	Unshielded	*1)
6	Signal	0.2	Unshielded	Unshielded	*1)
7	UART	0.3	Unshielded	Unshielded	*1)
8	USB	1.5	Shielded	Shielded	-
9	UART-USB	1.8	Shielded	Shielded	-
10	AC	2.0	Unshielded	Unshielded	-
11	DC	1.8	Unshielded	Unshielded	-
12	AC	0.9	Unshielded	Unshielded	-

*1) This cable is for testing and is not included with products.

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	50 MHz, 10 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/ 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 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 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

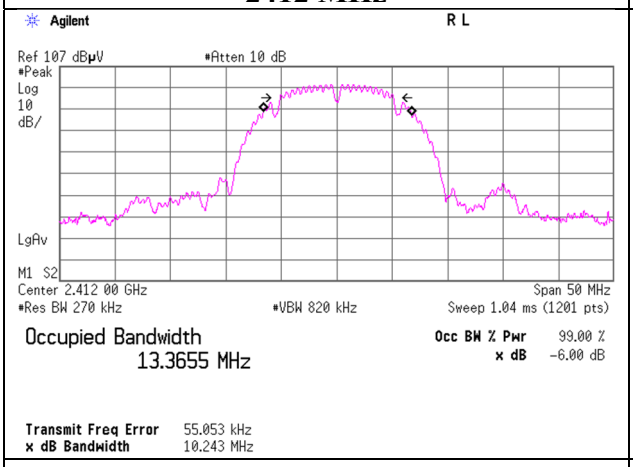
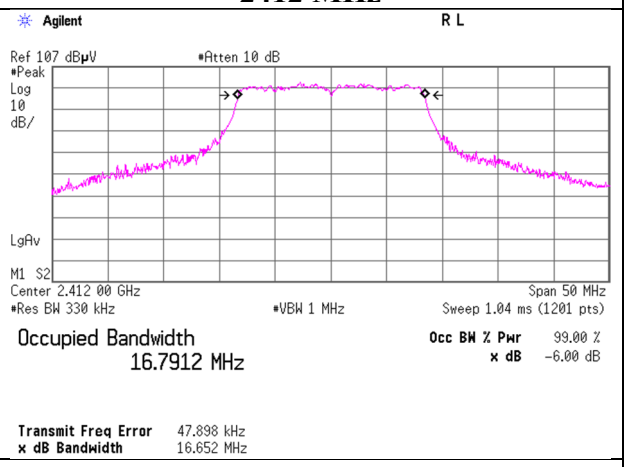
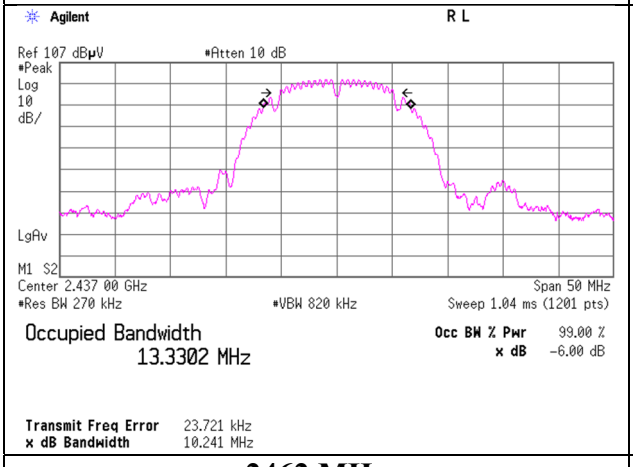
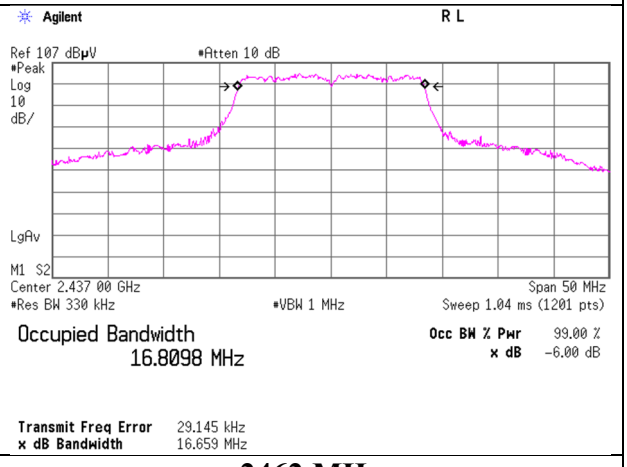
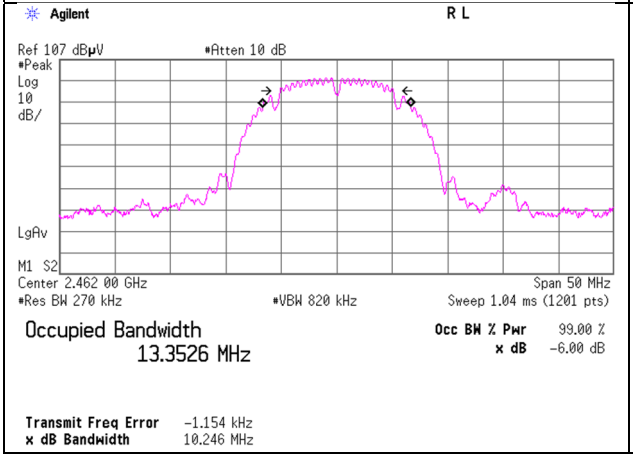
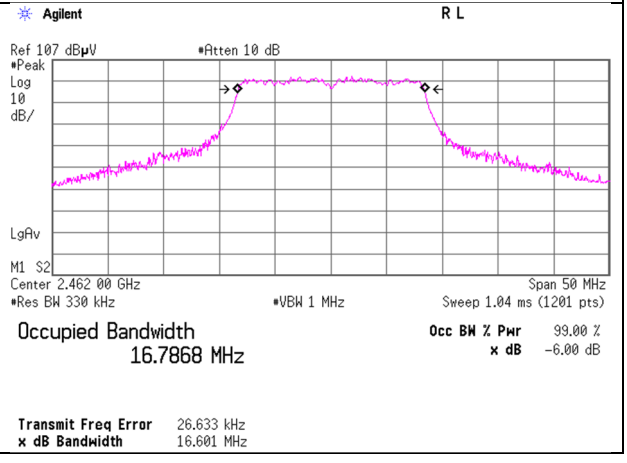
APPENDIX 1: Test data

6 dB Bandwidth and 99 % Occupied Bandwidth

Report No.	13408107S-B-R2	
Test place	Shonan EMC Lab. No.5 Shielded Room	
Date	August 14, 2020	August 15, 2020
Temperature / Humidity	24 deg. C / 61 % RH	23 deg. C / 58 % RH
Engineer	Kazuya Noda	Kazuya Noda
Mode	Tx	

Mode	Frequency [MHz]	99% Occupied Bandwidth [kHz]	6dB Bandwidth [MHz]	Limit for 6dB Bandwidth [MHz]
11b	2412	13365.5	10.103	> 0.5000
	2437	13330.2	10.109	> 0.5000
	2462	13352.6	10.130	> 0.5000
11g	2412	16791.2	16.506	> 0.5000
	2437	16809.8	16.509	> 0.5000
	2462	16786.8	16.508	> 0.5000
11n-20	2412	17767.8	17.632	> 0.5000
	2437	17785.4	17.644	> 0.5000
	2462	17782.6	17.660	> 0.5000
BT LE 1 M-PHY	2402	1040.5	0.716	> 0.5000
	2440	1040.9	0.720	> 0.5000
	2480	1040.6	0.709	> 0.5000
BT LE 2 M-PHY	2402	2072.4	1.259	> 0.5000
	2440	2075.7	1.214	> 0.5000
	2480	2074.3	1.217	> 0.5000

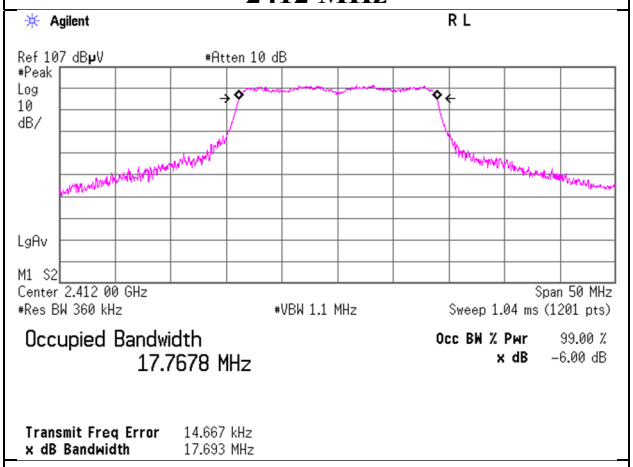
99 % Occupied Bandwidth

11b	11g
2412 MHz	**2412 MHz**
	
2437 MHz	**2437 MHz**
	
2462 MHz	**2462 MHz**
	

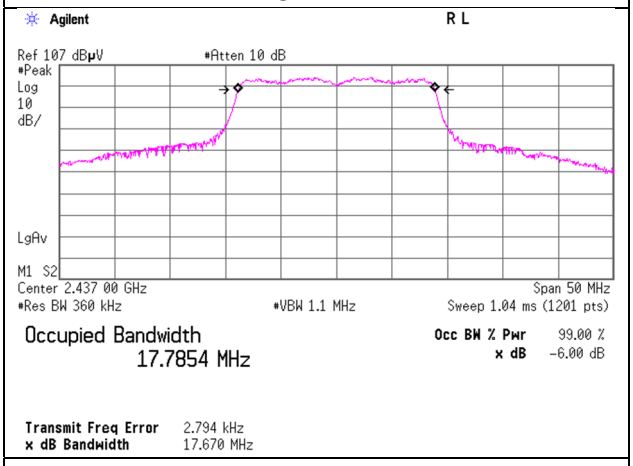
99% Occupied Bandwidth

11n-20

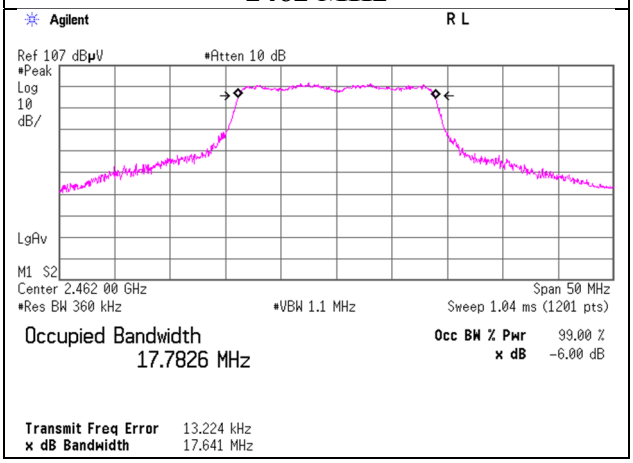
2412 MHz



2437 MHz



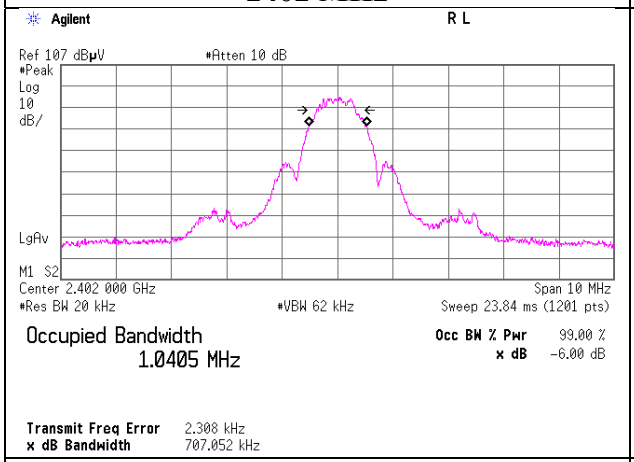
2462 MHz



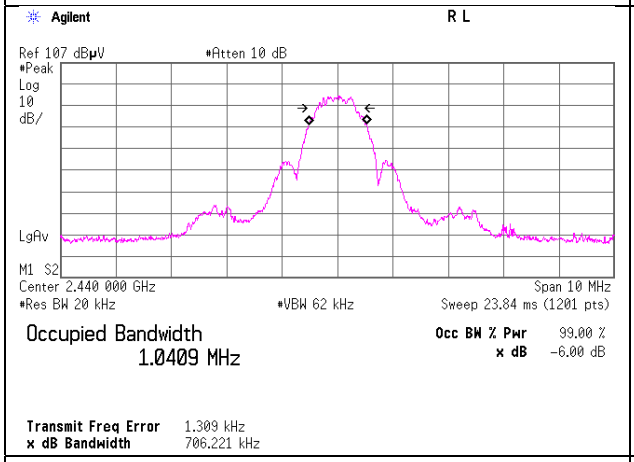
99 % Occupied Bandwidth

BT LE 1 M-PHY

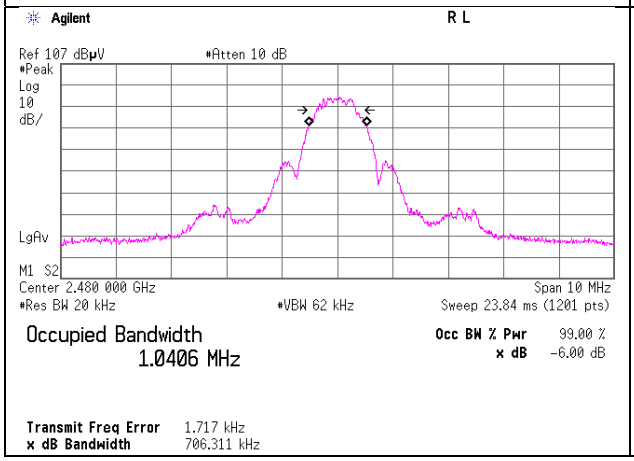
2402 MHz



2440 MHz

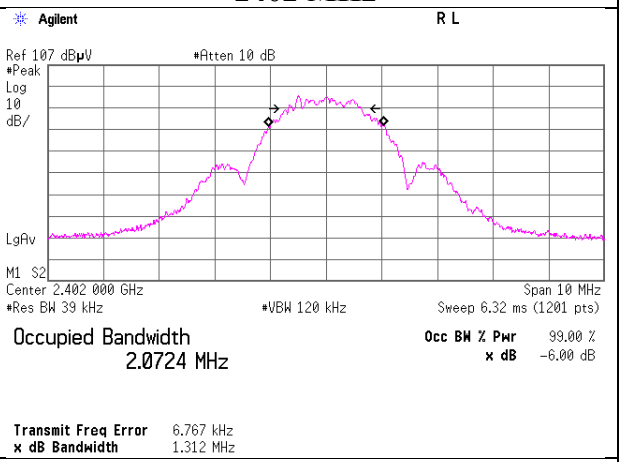


2480 MHz

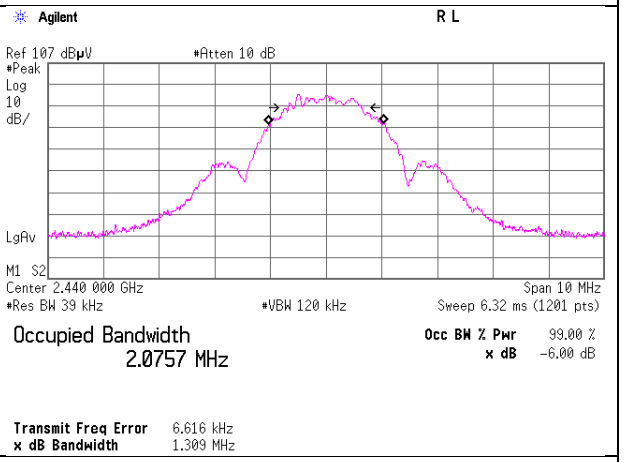


BT LE 2 M-PHY

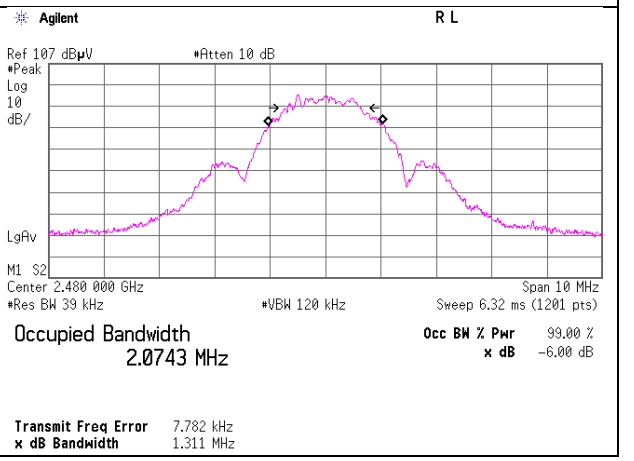
2402 MHz



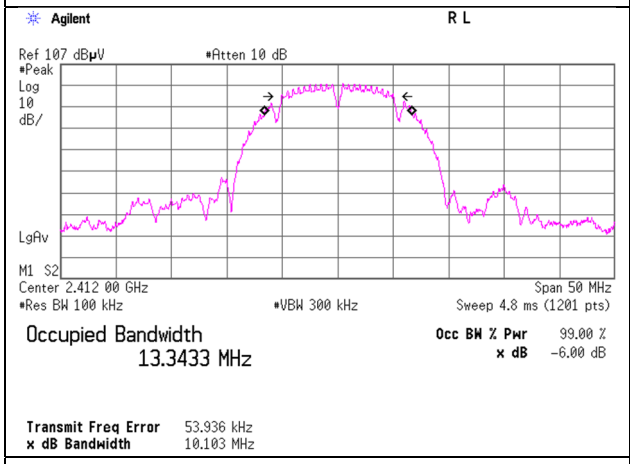
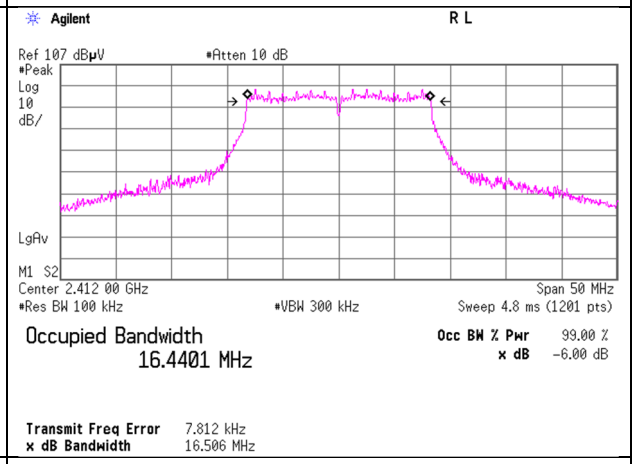
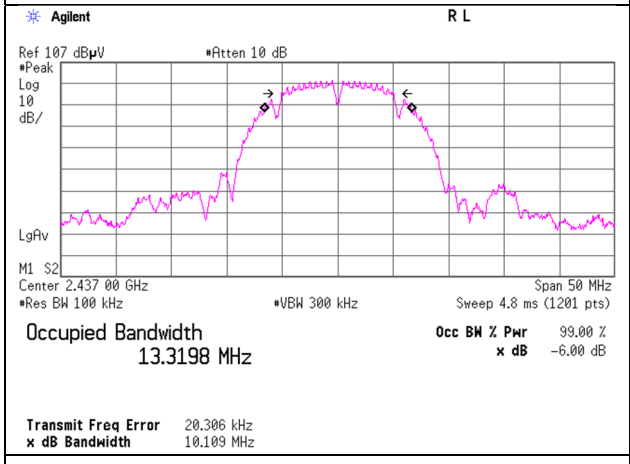
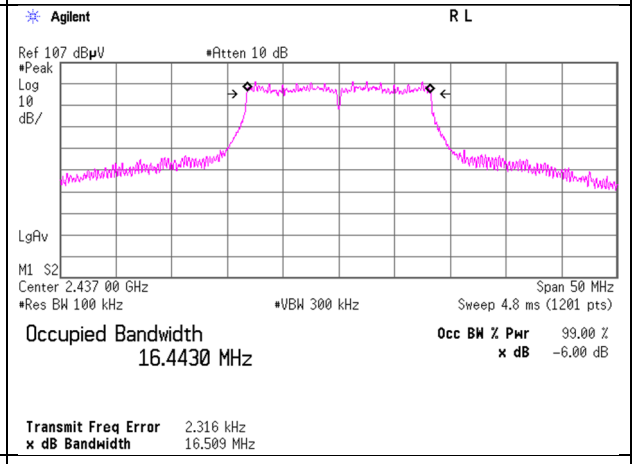
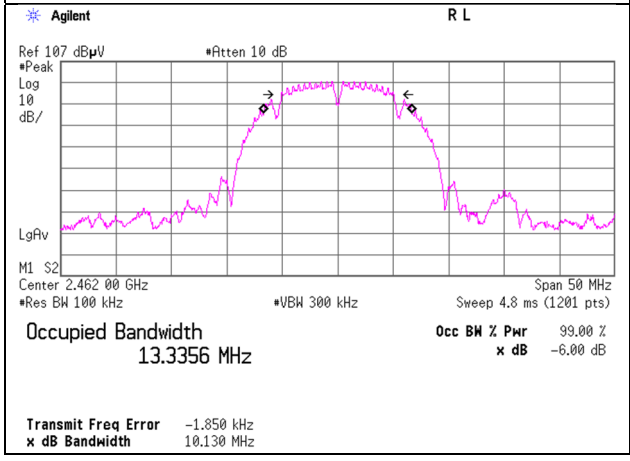
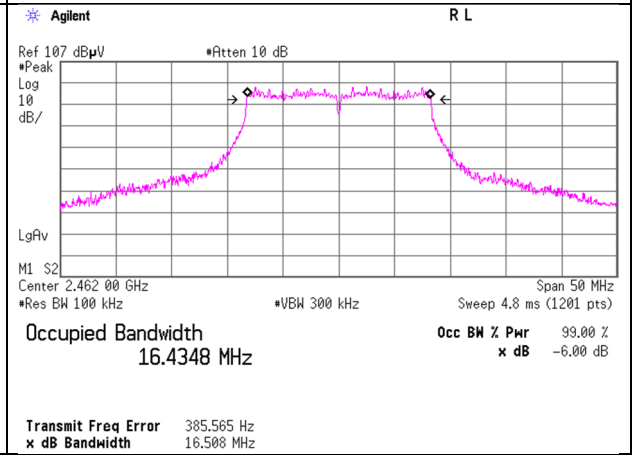
2440 MHz



2480 MHz



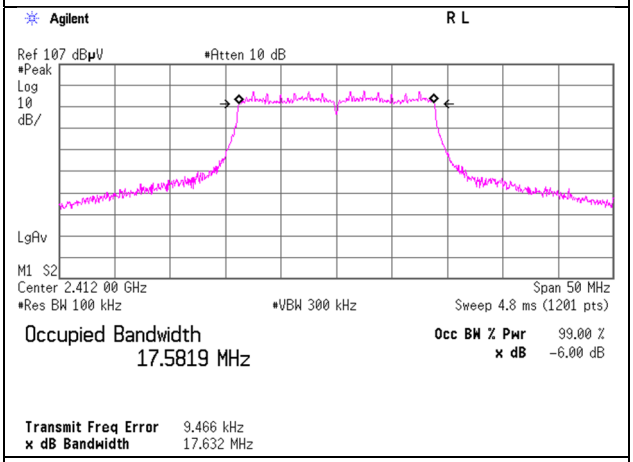
6 dB Bandwidth

11b	11g
2412 MHz	**2412 MHz**
	
2437 MHz	**2437 MHz**
	
2462 MHz	**2462 MHz**
	

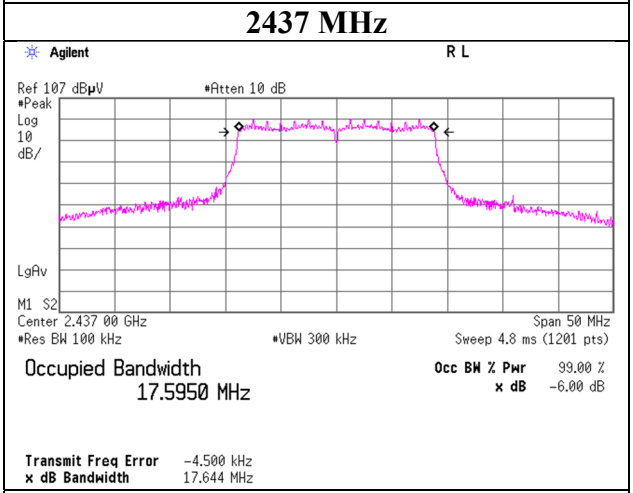
6 dB Bandwidth

11n-20

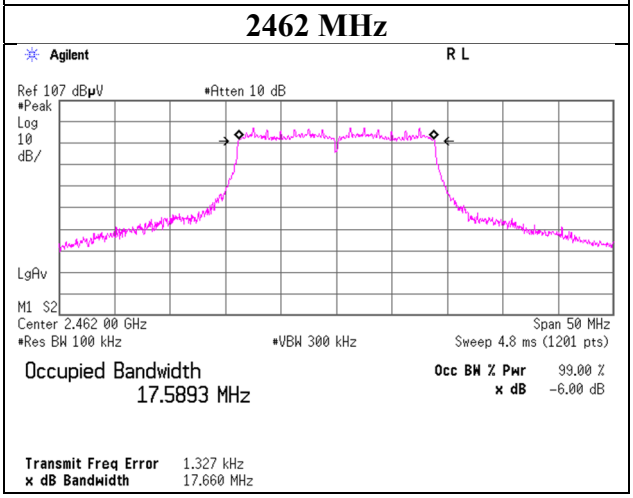
2412 MHz



2437 MHz



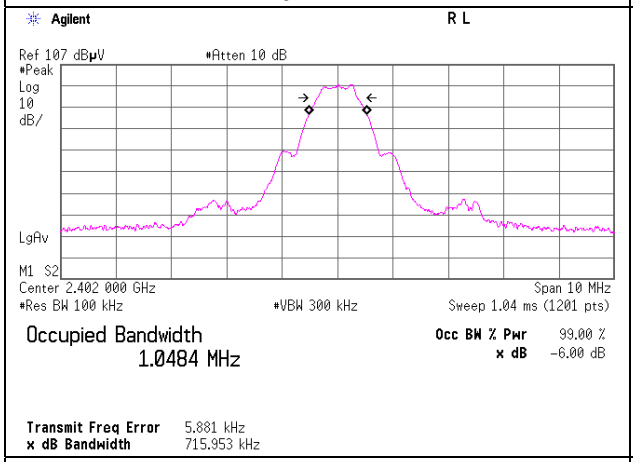
2462 MHz



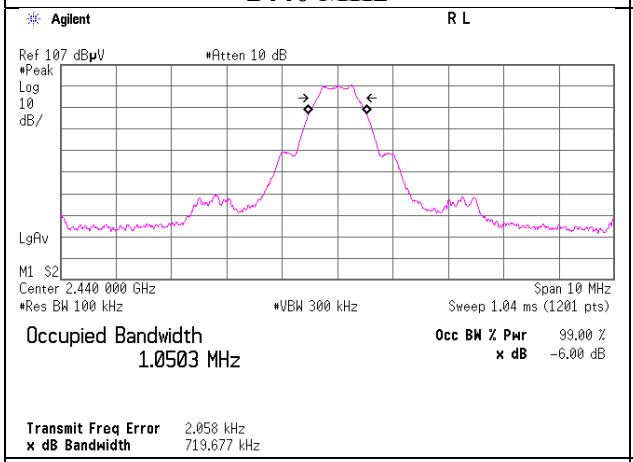
6 dB Bandwidth

BT LE 1 M-PHY

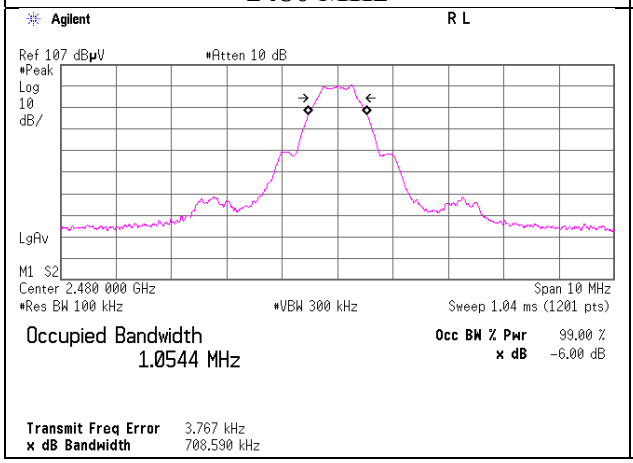
2402 MHz



2440 MHz

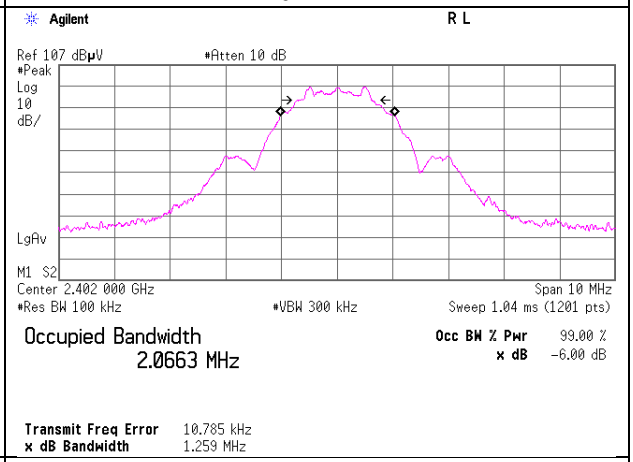


2480 MHz

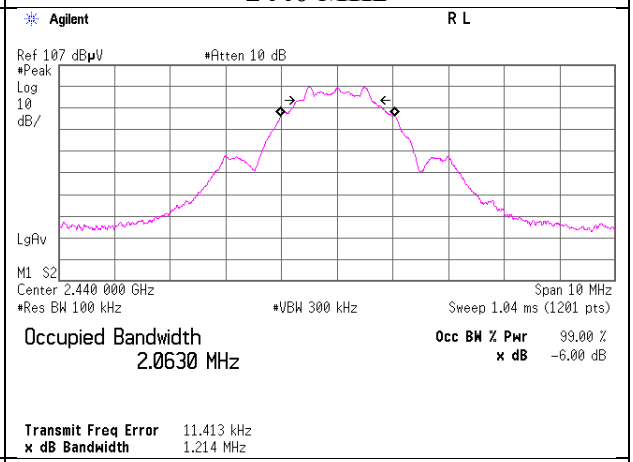


BT LE 2 M-PHY

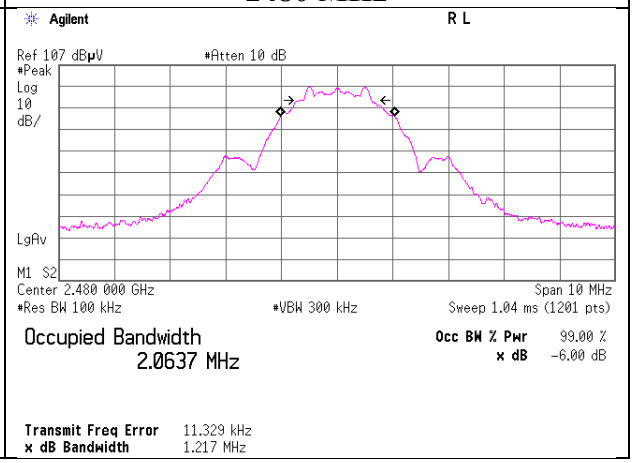
2402 MHz



2440 MHz



2480 MHz



Maximum Peak Output Power

Report No.	13408107S-B-R2
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	July 3, 2020
Temperature / Humidity	23 deg. C / 67 % RH
Engineer	Kazuya Noda
Mode	Tx 11b

				Conducted Power					e.i.r.p. for RSS-247					
Freq.	Reading	Cable Loss	Atten. Loss	Result		Limit		Margin	Antenna Gain *1)	Result		Limit		Margin
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dBm]	[mW]	[dB]	[dBi]	[dBm]	[mW]	[dBm]	[mW]	[dB]
2412	3.42	1.68	9.63	14.73	29.72	30.00	1000	15.27	2.25	16.98	49.89	36.02	4000	19.04
2437	3.82	1.68	9.63	15.13	32.58	30.00	1000	14.87	2.25	17.38	54.70	36.02	4000	18.64
2462	3.06	1.68	9.63	14.37	27.35	30.00	1000	15.63	2.25	16.62	45.92	36.02	4000	19.40

*1) Antenna Gain applied the highest gain of the two models.

Sample Calculation:
Result = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss
e.i.r.p. Result = Conducted Power Result + Antenna Gain

2437MHz

Rate	Reading	Remark
[Mbps]	[dBm]	
1	3.82	*
2	3.77	-
5.5	3.78	-
11	3.79	-

*: Worst Rate
All comparison were carried out on same frequency and measurement factors.

Maximum Peak Output Power

Report No.	13408107S-B-R2
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	July 3, 2020
Temperature / Humidity	23 deg. C / 67 % RH
Engineer	Kazuya Noda
Mode	Tx 11g

				Conducted Power					e.i.r.p. for RSS-247					
Freq.	Reading	Cable Loss	Atten. Loss	Result		Limit		Margin	Antenna Gain *1)	Result		Limit		Margin
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dBm]	[mW]	[dB]	[dBi]	[dBm]	[mW]	[dBm]	[mW]	[dB]
2412	9.71	1.68	9.63	21.02	126.47	30.00	1000	8.98	2.25	23.27	212.32	36.02	4000	12.75
2437	9.98	1.68	9.63	21.29	134.59	30.00	1000	8.71	2.25	23.54	225.94	36.02	4000	12.48
2462	9.55	1.68	9.63	20.86	121.90	30.00	1000	9.14	2.25	23.11	204.64	36.02	4000	12.91

*1) Antenna Gain applied the highest gain of the two models.

Sample Calculation:
Result = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss
e.i.r.p. Result = Conducted Power Result + Antenna Gain

2437 MHz

Rate [Mbps]	Reading [dBm]	Remark
6	9.68	-
9	9.78	-
12	9.89	-
18	9.92	-
24	9.98	*
36	9.87	-
48	9.72	-
54	9.60	-

*: Worst Rate
All comparison were carried out on same frequency and measurement factors.

Maximum Peak Output Power

Report No.	13408107S-B-R2
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	July 3, 2020
Temperature / Humidity	23 deg. C / 67 % RH
Engineer	Kazuya Noda
Mode	Tx 11n-20

				Conducted Power					e.i.r.p. for RSS-247					
Freq.	Reading	Cable Loss	Atten. Loss	Result		Limit		Margin	Antenna Gain *1)	Result		Limit		Margin
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dBm]	[mW]	[dB]	[dBi]	[dBm]	[mW]	[dBm]	[mW]	[dB]
2412	9.78	1.68	9.63	21.09	128.53	30.00	1000	8.91	2.25	23.34	215.77	36.02	4000	12.68
2437	9.97	1.68	9.63	21.28	134.28	30.00	1000	8.72	2.25	23.53	225.42	36.02	4000	12.49
2462	9.64	1.68	9.63	20.95	124.45	30.00	1000	9.05	2.25	23.20	208.93	36.02	4000	12.82

*1) Antenna Gain applied the highest gain of the two models.

Sample Calculation:
Result = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss
e.i.r.p. Result = Conducted Power Result + Antenna Gain

2437 MHz

MCS Number [MCS]	Reading [dBm]	Remark
0	9.41	-
1	9.52	-
2	9.97	*
3	9.83	-
4	9.64	-
5	9.82	-
6	9.72	-
7	9.76	-

*: Worst Rate
All comparison were carried out on same frequency and measurement factors.

Maximum Peak Output Power

Report No.	13408107S-B-R2
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	August 6, 2020
Temperature / Humidity	24 deg. C / 65 % RH
Engineer	Shiro Kobayashi
Mode	Tx BT LE

1 M-PHY

				Conducted Power					e.i.r.p. for RSS-247					
Freq.	Reading	Cable Loss	Atten. Loss	Result		Limit		Margin	Antenna Gain *1)	Result		Limit		Margin
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dBm]	[mW]	[dB]	[dBi]	[dBm]	[mW]	[dBm]	[mW]	[dB]
2402	-8.64	1.68	9.87	2.91	1.95	30.00	1000	27.09	-0.13	2.78	1.90	36.02	4000	33.24
2440	-8.65	1.68	9.87	2.90	1.95	30.00	1000	27.10	-0.13	2.77	1.89	36.02	4000	33.25
2480	-8.89	1.69	9.87	2.67	1.85	30.00	1000	27.33	-0.13	2.54	1.79	36.02	4000	33.48

*1) Antenna Gain applied the highest gain of the two models.

Sample Calculation:
Result = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss
e.i.r.p. Result = Conducted Power Result + Antenna Gain

2440 MHz

Mode	Data rate [bps]	Reading [dBm]	Remark
1 M-PHY	1 M	-8.65	*
Coded-PHY(S=8)	125 k	-8.70	-
Coded-PHY(S=2)	500 k	-8.66	-

*: Worst Rate
All comparison were carried out on same frequency and measurement factors.

2 M-PHY

				Conducted Power					e.i.r.p. for RSS-247					
Freq.	Reading	Cable Loss	Atten. Loss	Result		Limit		Margin	Antenna Gain *1)	Result		Limit		Margin
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dBm]	[mW]	[dB]	[dBi]	[dBm]	[mW]	[dBm]	[mW]	[dB]
2402	-8.65	1.68	9.87	2.90	1.95	30.00	1000	27.10	-0.13	2.77	1.89	36.02	4000	33.25
2440	-8.73	1.68	9.87	2.82	1.91	30.00	1000	27.18	-0.13	2.69	1.86	36.02	4000	33.33
2480	-8.98	1.69	9.87	2.58	1.81	30.00	1000	27.42	-0.13	2.45	1.76	36.02	4000	33.57

*1) Antenna Gain applied the highest gain of the two models.

Sample Calculation:
Result = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss
e.i.r.p. Result = Conducted Power Result + Antenna Gain

Average Output Power
(Reference data for RF Exposure)

Report No.	13408107S-B-R2	
Test place	Shonan EMC Lab. No.5 Shielded Room	
Date	July 3, 2020	August 6, 2020
Temperature / Humidity	23 deg. C / 67 % RH	24 deg. C / 65 % RH
Engineer	Kazuya Noda	Shiro Kobayashi
Mode	Tx	

11b **5.5 Mbps**

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	0.60	1.68	9.63	11.91	15.52	0.27	12.18	16.52
2437	1.12	1.68	9.63	12.43	17.50	0.27	12.70	18.62
2462	0.31	1.68	9.63	11.62	14.52	0.27	11.89	15.45

11g **54 Mbps**

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	-2.75	1.68	9.63	8.56	7.18	1.97	10.53	11.30
2437	-0.01	1.68	9.63	11.30	13.49	1.97	13.27	21.23
2462	-2.92	1.68	9.63	8.39	6.90	1.97	10.36	10.86

11n-20 **MCS 7**

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	-3.74	1.68	9.63	7.57	5.71	2.02	9.59	9.10
2437	-1.02	1.68	9.63	10.29	10.69	2.02	12.31	17.02
2462	-3.71	1.68	9.63	7.60	5.75	2.02	9.62	9.16

BT LE **1 M-PHY**

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	-9.63	1.68	9.87	1.92	1.56	0.68	2.60	1.82
2440	-9.66	1.68	9.87	1.89	1.55	0.68	2.57	1.81
2480	-9.91	1.69	9.87	1.65	1.46	0.68	2.33	1.71

BT LE **2 M-PHY**

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	-12.60	1.68	9.87	-1.05	0.79	3.63	2.58	1.81
2440	-12.64	1.68	9.87	-1.09	0.78	3.63	2.54	1.79
2480	-12.89	1.69	9.87	-1.33	0.74	3.63	2.30	1.70

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

Average Output Power
(Reference data for RF Exposure)

Report No.	13408107S-B-R2	
Test place	Shonan EMC Lab. No.5 Shielded Room	
Date	July 3, 2020	August 6, 2020
Temperature / Humidity	23 deg. C / 67 % RH	24 deg. C / 65 % RH
Engineer	Kazuya Noda	Shiro Kobayashi
Mode	Tx	

2437 MHz

Mode	Rate [Mbps]	Reading [dBm]	Duty factor [dB]	Burst power [dBm]	Remarks
11b	1	1.21	0.05	1.26	-
	2	1.17	0.10	1.27	-
	5.5	1.12	0.27	1.39	*
	11	0.84	0.49	1.33	-
11g	6	1.42	0.30	1.72	-
	9	1.28	0.44	1.72	-
	12	1.15	0.58	1.73	-
	18	0.93	0.82	1.75	-
	24	0.72	1.06	1.78	-
	36	0.40	1.46	1.86	-
	48	0.05	1.84	1.89	-
	54	-0.01	1.97	1.96	*

Mode	MCS Number [MCS]	Reading [dBm]	Duty factor [dB]	Burst power [dBm]	Remarks
11n-20	0	0.47	0.32	0.79	-
	1	0.21	0.59	0.80	-
	2	0.03	0.85	0.88	-
	3	-0.12	1.07	0.95	-
	4	-0.51	1.44	0.93	-
	5	-0.76	1.75	0.99	-
	6	-0.89	1.88	0.99	-
	7	-1.02	2.02	1.00	*

BT LE, 2440 MHz

Mode	Data rate [bps]	Reading [dBm]	Duty factor [dB]	Burst power [dBm]	Remarks
1 M-PHY	1 M	-9.66	0.68	-8.98	*
Coded-PHY(S=8)	125 k	-9.68	0.69	-8.99	-
Coded-PHY(S=2)	500 k	-9.39	0.40	-8.99	-

* Worst rate

Sample Calculation:

Burst power = Reading (timed average) + Duty factor

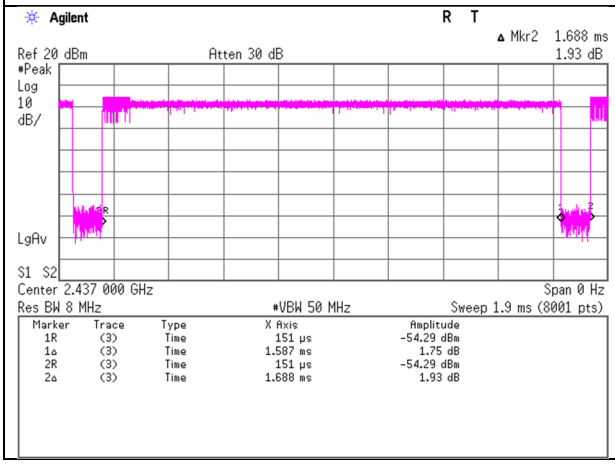
All comparison were carried out on same frequency and measurement factors.

Burst rate confirmation

Report No.	13408107S-B-R2	
Test place	Shonan EMC Lab. No.5 Shielded Room	
Date	July 3, 2020	August 6, 2020
Temperature / Humidity	23 deg. C / 67 % RH	24 deg. C / 65 % RH
Engineer	Kazuya Noda	Shiro Kobayashi
Mode	Tx	

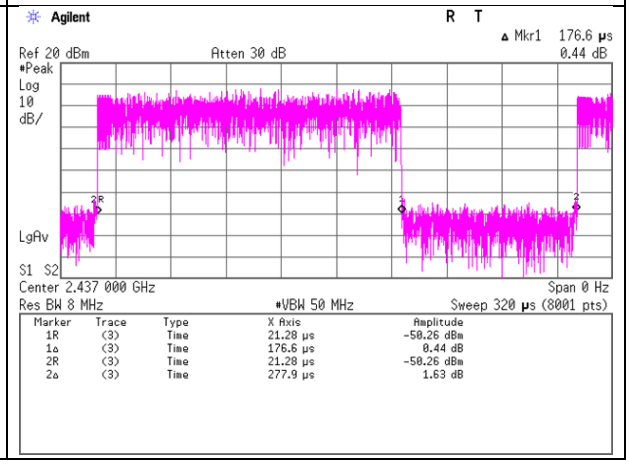
11b 5.5 Mbps

Tx on / (Tx on + Tx off) = 0.940
Tx on / (Tx on + Tx off) * 100 = 94.0 %
Duty factor = 10 * log (1.688 / 1.587) = 0.27 dB



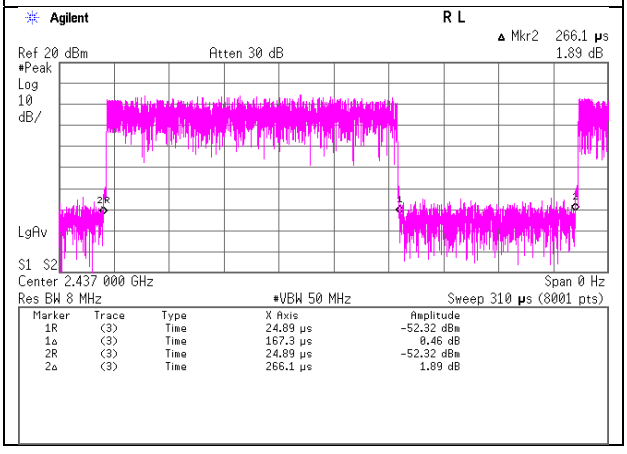
11g 54 Mbps

Tx on / (Tx on + Tx off) = 0.635
Tx on / (Tx on + Tx off) * 100 = 63.5 %
Duty factor = 10 * log (0.2779 / 0.1766) = 1.97 dB



11n-20 MCS 7

Tx on / (Tx on + Tx off) = 0.629
Tx on / (Tx on + Tx off) * 100 = 62.9 %
Duty factor = 10 * log (0.2661 / 0.1673) = 2.02 dB



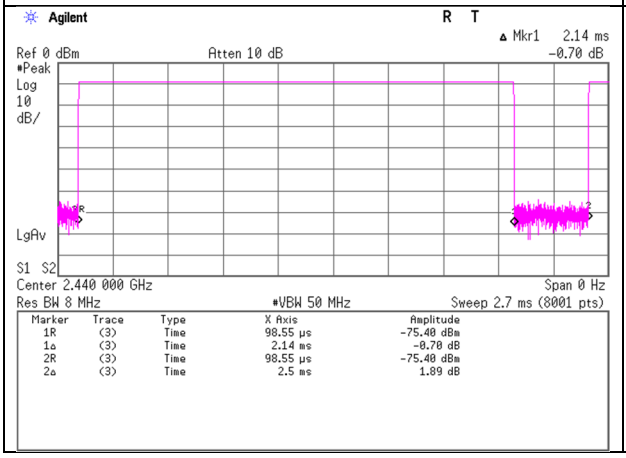
* Since the burst rate is not different between the channels, the data has been obtained on the representative channel.

Burst rate confirmation

Report No.	13408107S-B-R2	
Test place	Shonan EMC Lab. No.5 Shielded Room	
Date	July 3, 2020	August 6, 2020
Temperature / Humidity	23 deg. C / 67 % RH	24 deg. C / 65 % RH
Engineer	Kazuya Noda	Shiro Kobayashi
Mode	Tx	

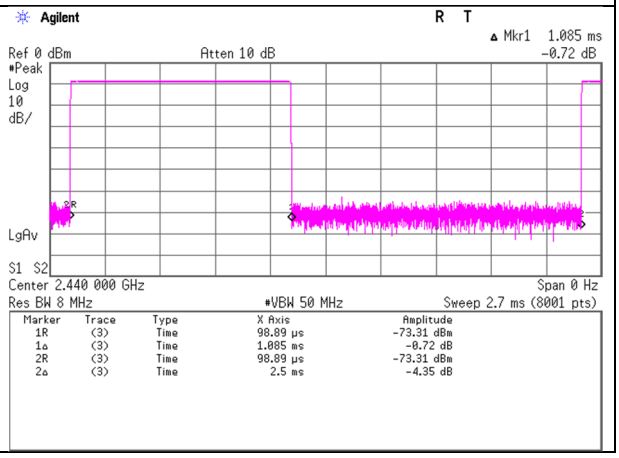
BT LE 1 M-PHY

Tx on / (Tx on + Tx off) =	0.856
Tx on / (Tx on + Tx off) * 100 =	85.6 %
Duty factor = 10 * log (2.5 / 2.14) =	0.68 dB



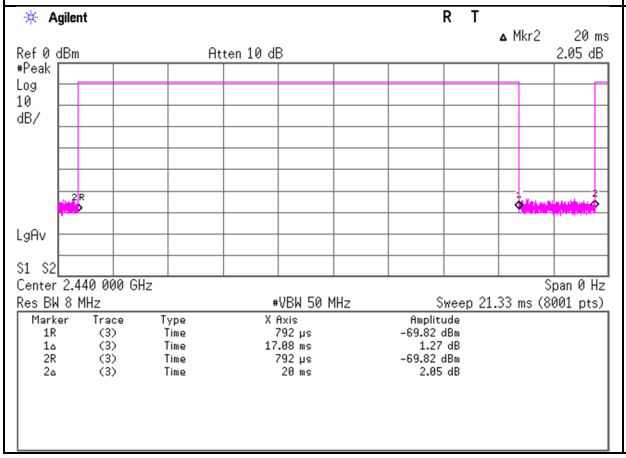
BT LE 2 M-PHY

Tx on / (Tx on + Tx off) =	0.434
Tx on / (Tx on + Tx off) * 100 =	43.4 %
Duty factor = 10 * log (2.5 / 1.085) =	3.63 dB



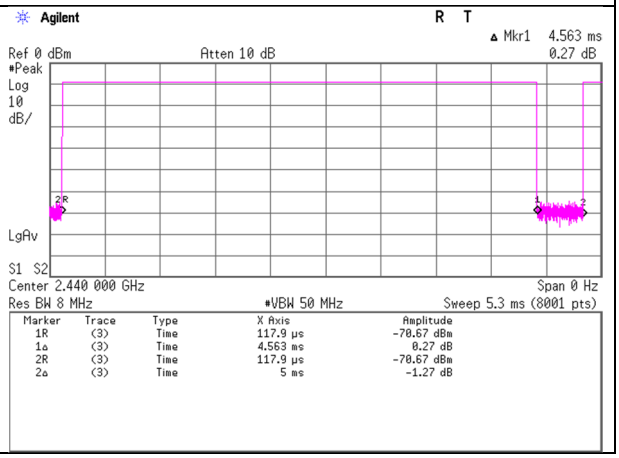
BT LE Coded-PHY(S=8)

Tx on / (Tx on + Tx off) =	0.854
Tx on / (Tx on + Tx off) * 100 =	85.4 %
Duty factor = 10 * log (20 / 17.08) =	0.69 dB



BT LE Coded-PHY(S=2)

Tx on / (Tx on + Tx off) =	0.913
Tx on / (Tx on + Tx off) * 100 =	91.3 %
Duty factor = 10 * log (5 / 4.563) =	0.40 dB

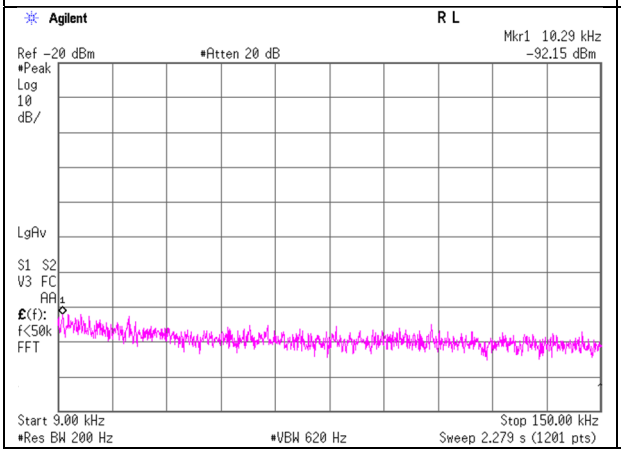


* Since the burst rate is not different between the channels, the data has been obtained on the representative channel.
* The above chart is obtained with the Maximum Packet Size set that can be by test software, and it is different from the maximum duty cycle of the product.

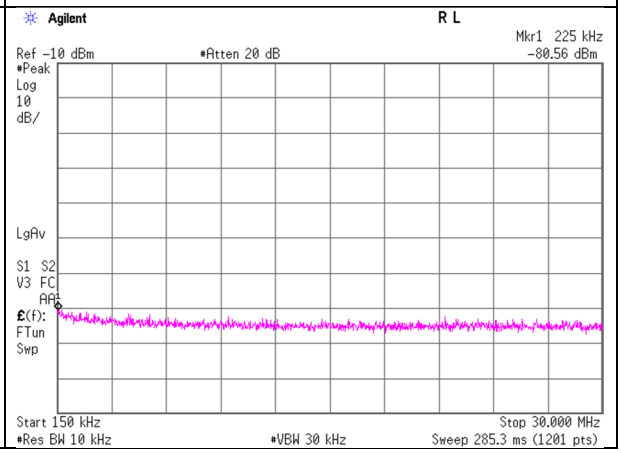
Conducted Spurious Emission

Report No.	13408107S-B-R2
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	August 15, 2020
Temperature / Humidity	23 deg. C / 58 % RH
Engineer	Kazuya Noda
Mode	Tx 11g 2437 MHz

9 kHz - 150 kHz



150 kHz - 30 MHz



Frequency [kHz]	Reading [dBm]	Cable Loss [dB]	Attenuator Loss [dB]	Antenna Gain *1) [dBi]	N (Number of Output)	EIRP [dBm]	Distance [m]	Ground bounce [dB]	E (field strength) [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
10.29	-92.15	0.01	9.54	2.25	1	-80.4	300	6.0	-19.1	47.3	66.4	-
225.00	-80.56	0.01	9.54	2.25	1	-68.8	300	6.0	-7.5	20.5	28.0	-

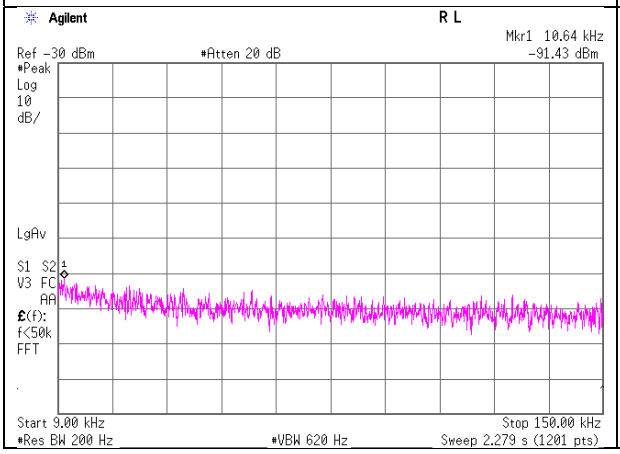
*1) Antenna Gain applied the higher of the two models.

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)

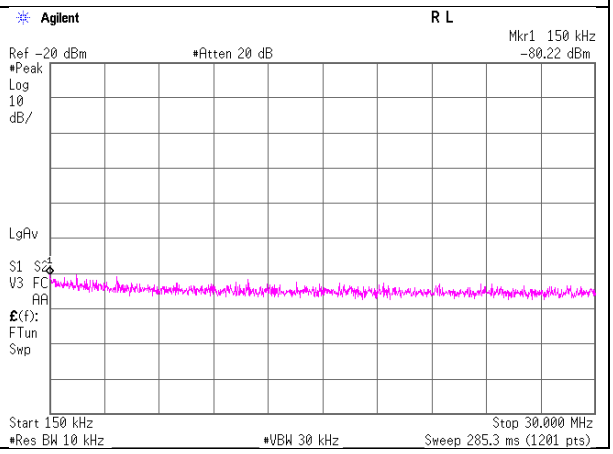
Conducted Spurious Emission

Report No.	13408107S-B-R2
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	August 6, 2020
Temperature / Humidity	23 deg. C / 61 % RH
Engineer	Shiro Kobayashi
Mode	Tx BT LE 1 M-PHY 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
10.64	-91.43	0.01	9.81	2.0	1	-79.6	300	6.0	-18.4	47.0	65.4	-
150.00	-80.22	0.01	9.81	2.0	1	-68.4	300	6.0	-7.1	24.0	31.1	-

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)

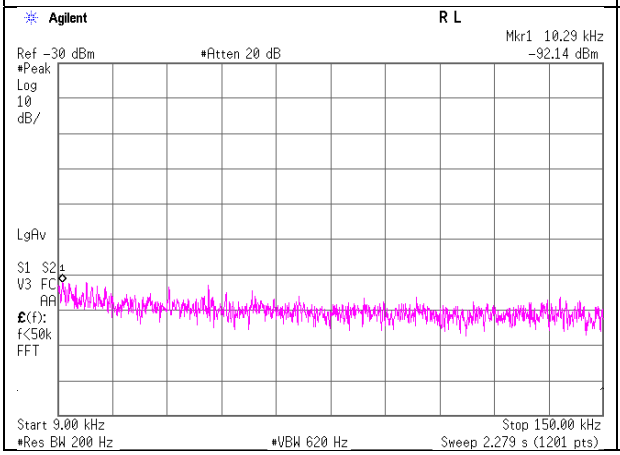
N: Number of output

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

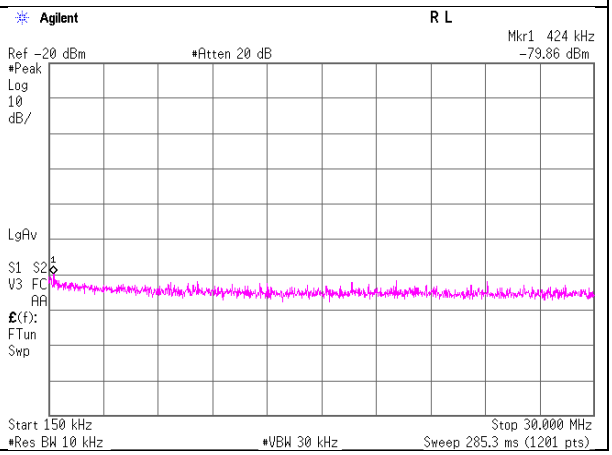
Conducted Spurious Emission

Report No.	13408107S-B-R2
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	August 6, 2020
Temperature / Humidity	23 deg. C / 61 % RH
Engineer	Shiro Kobayashi
Mode	Tx BT LE 1 M-PHY 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
10.29	-92.14	0.01	9.81	2.0	1	-80.3	300	6.0	-19.1	47.3	66.4	-
424.00	-79.86	0.02	9.81	2.0	1	-68.0	300	6.0	-6.8	15.0	21.8	-

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)

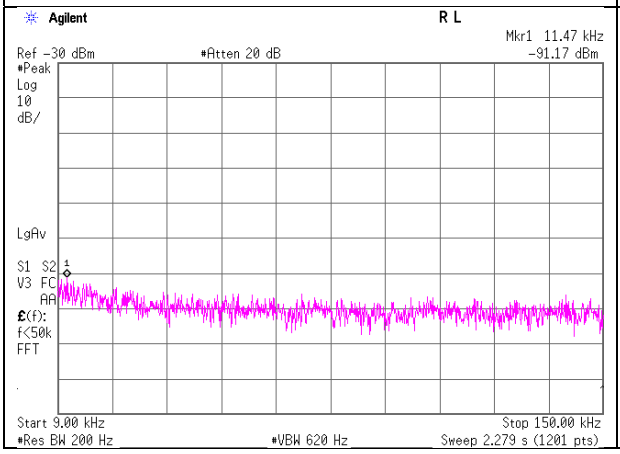
N: Number of output

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

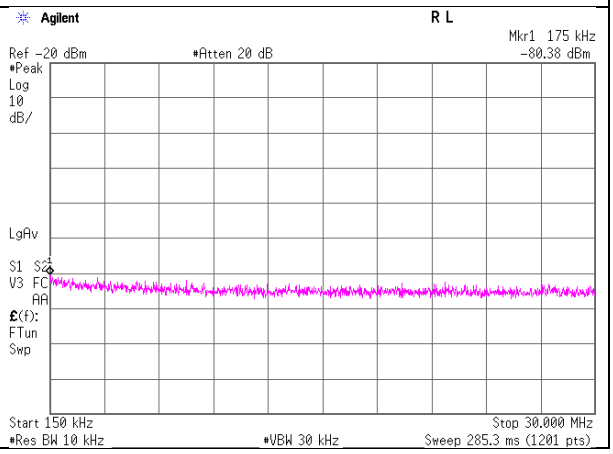
Conducted Spurious Emission

Report No.	13408107S-B-R2
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	August 6, 2020
Temperature / Humidity	23 deg. C / 61 % RH
Engineer	Shiro Kobayashi
Mode	Tx BT LE 1 M-PHY 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
11.47	-91.17	0.01	9.81	2.0	1	-79.4	300	6.0	-18.1	46.4	64.5	-
175.00	-80.38	0.01	9.81	2.0	1	-68.6	300	6.0	-7.3	22.7	30.0	-

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)

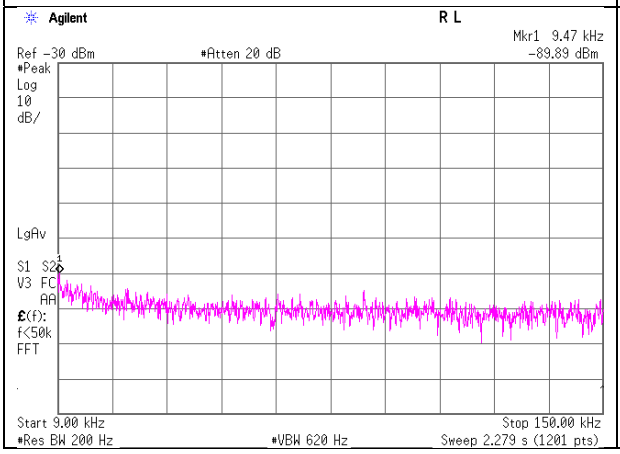
N: Number of output

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

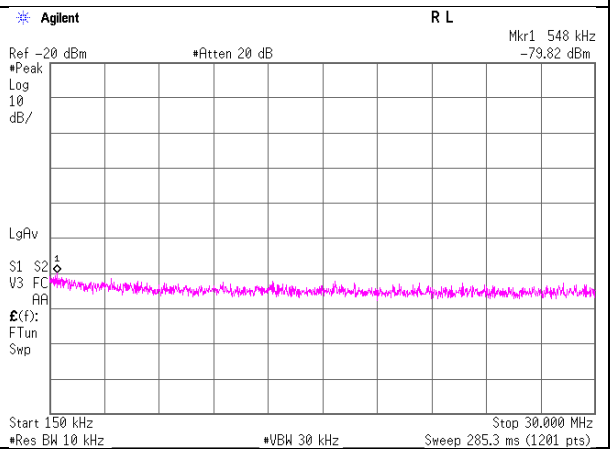
Conducted Spurious Emission

Report No.	13408107S-B-R2
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	August 6, 2020
Temperature / Humidity	23 deg. C / 61 % RH
Engineer	Shiro Kobayashi
Mode	Tx BT LE 2 M-PHY 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
9.47	-89.89	0.01	9.81	2.0	1	-78.1	300	6.0	-16.8	48.0	64.8	-
548.00	-79.82	0.02	9.81	2.0	1	-68.0	30	6.0	13.3	32.8	19.5	-

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)

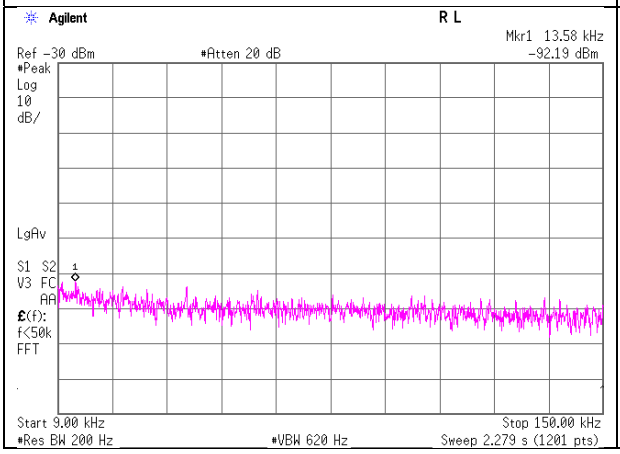
N: Number of output

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

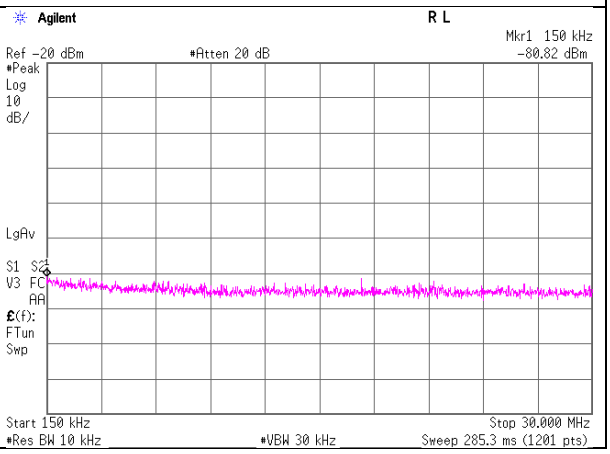
Conducted Spurious Emission

Report No.	13408107S-B-R2
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	August 6, 2020
Temperature / Humidity	23 deg. C / 61 % RH
Engineer	Shiro Kobayashi
Mode	Tx BT LE 2 M-PHY 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
13.58	-92.19	0.01	9.81	2.0	1	-80.4	300	6.0	-19.1	44.9	64.0	-
150.00	-80.82	0.01	9.81	2.0	1	-69.0	300	6.0	-7.7	24.0	31.7	-

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)

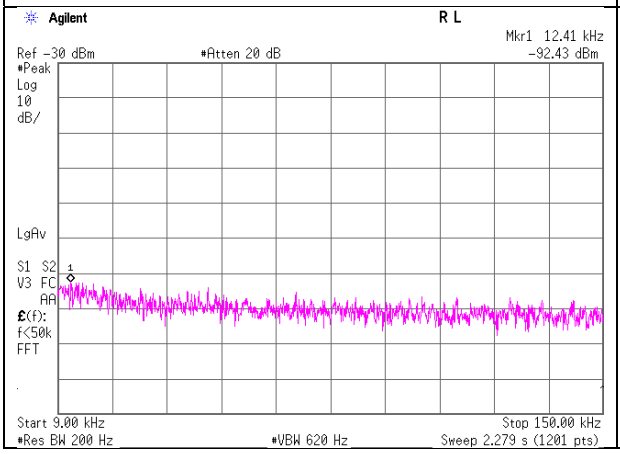
N: Number of output

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

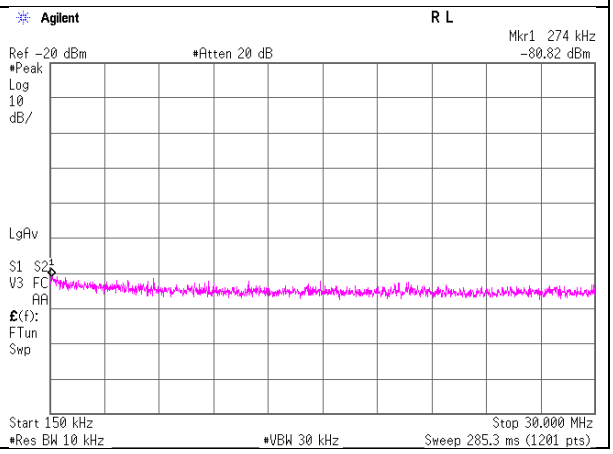
Conducted Spurious Emission

Report No.	13408107S-B-R2
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	August 6, 2020
Temperature / Humidity	23 deg. C / 61 % RH
Engineer	Shiro Kobayashi
Mode	Tx BT LE 2 M-PHY 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
12.41	-92.43	0.01	9.81	2.0	1	-80.6	300	6.0	-19.4	45.7	65.1	-
274.00	-80.82	0.01	9.81	2.0	1	-69.0	300	6.0	-7.7	18.8	26.5	-

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.	13408107S-B-R2
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	August 15, 2020
Temperature / Humidity	23 deg. C / 58 % RH
Engineer	Kazuya Noda
Mode	Tx

11b

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result [dBm]	Limit [dBm]	Margin [dB]
2412	-18.50	1.68	9.63	-7.19	8.00	15.19
2437	-17.89	1.68	9.63	-6.58	8.00	14.58
2462	-19.66	1.68	9.63	-8.35	8.00	16.35

11g

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result [dBm]	Limit [dBm]	Margin [dB]
2412	-25.80	1.68	9.63	-14.49	8.00	22.49
2437	-22.67	1.68	9.63	-11.36	8.00	19.36
2462	-25.02	1.68	9.63	-13.71	8.00	21.71

11n-20

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result [dBm]	Limit [dBm]	Margin [dB]
2412	-26.68	1.68	9.63	-15.37	8.00	23.37
2437	-24.20	1.68	9.63	-12.89	8.00	20.89
2462	-27.13	1.68	9.63	-15.82	8.00	23.82

BT LE 1 M-PHY

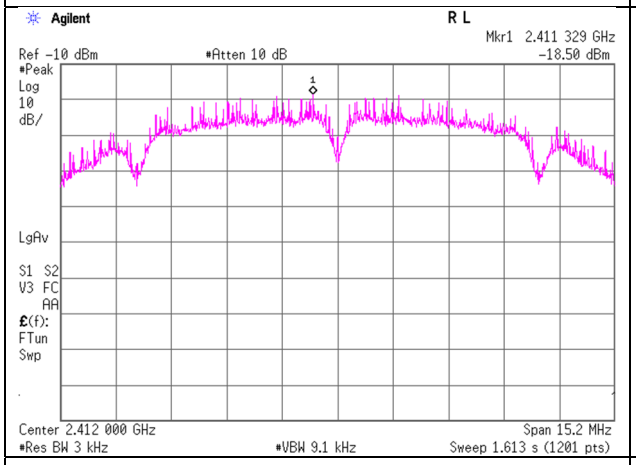
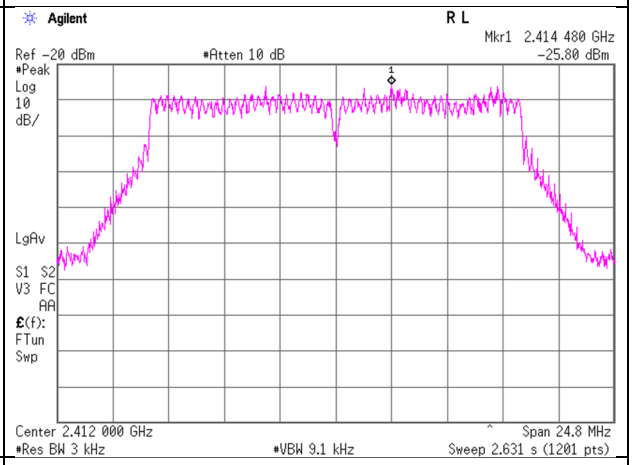
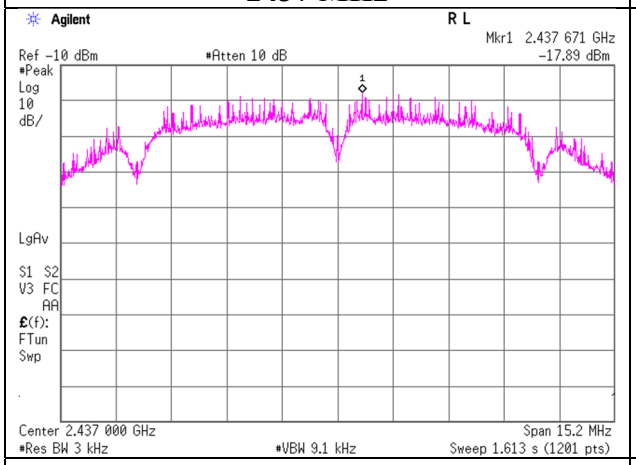
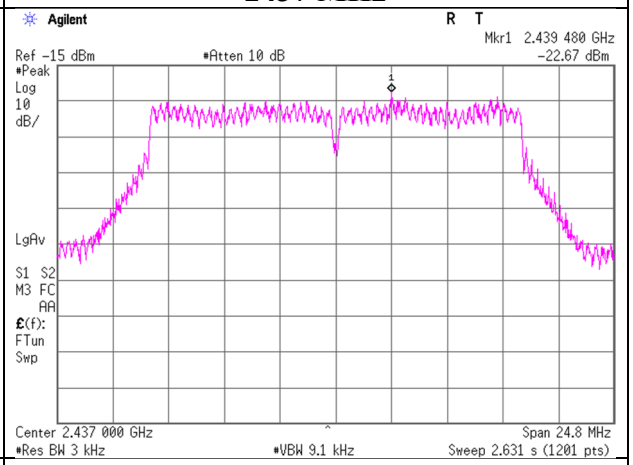
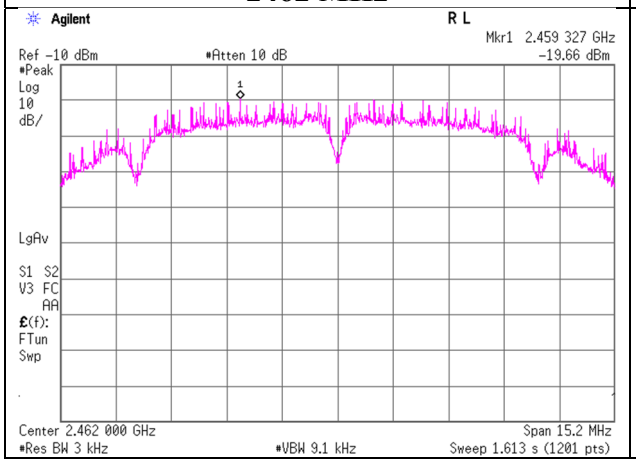
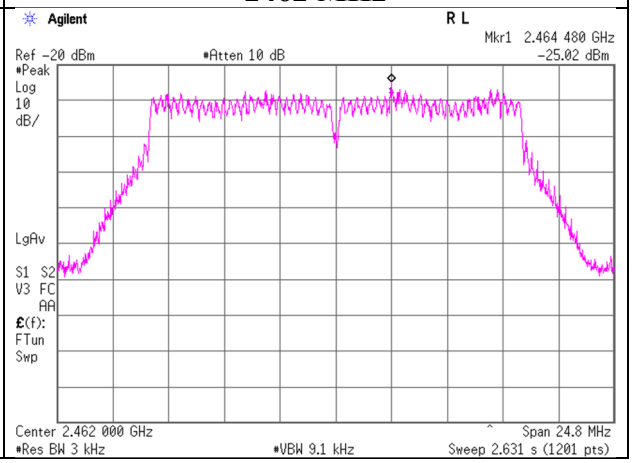
Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result [dBm]	Limit [dBm]	Margin [dB]
2402	-23.61	2.29	9.88	-11.44	8.00	19.44
2440	-23.69	2.30	9.88	-11.51	8.00	19.51
2480	-23.80	2.31	9.88	-11.61	8.00	19.61

BT LE 2 M-PHY

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result [dBm]	Limit [dBm]	Margin [dB]
2402	-25.36	2.29	9.88	-13.19	8.00	21.19
2440	-26.55	2.30	9.88	-14.37	8.00	22.37
2480	-25.56	2.31	9.88	-13.37	8.00	21.37

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

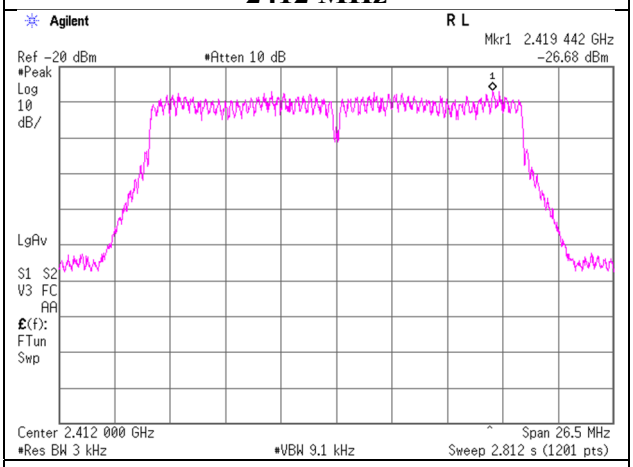
Power Density

11b	11g
2412 MHz	**2412 MHz**
	
2437 MHz	**2437 MHz**
	
2462 MHz	**2462 MHz**
	

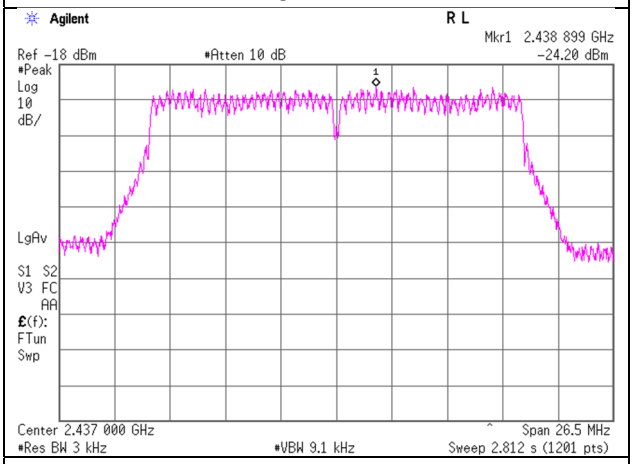
Power Density

11n-20

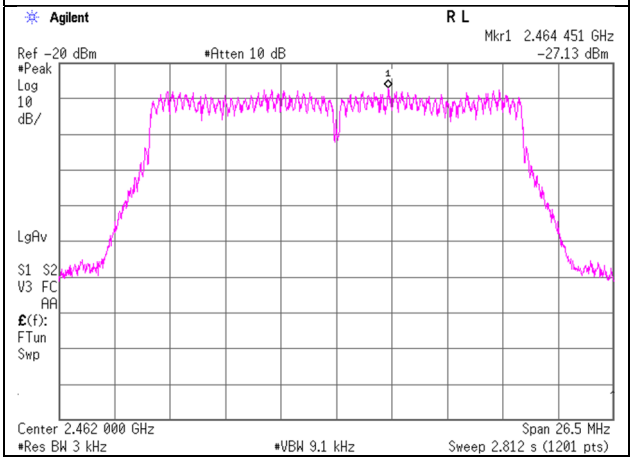
2412 MHz



2437 MHz



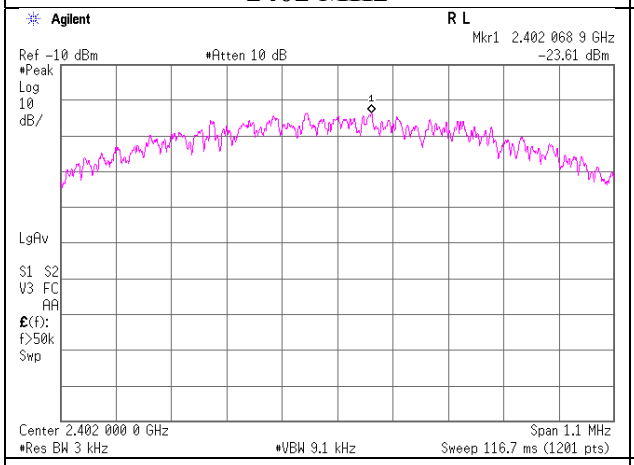
2462 MHz



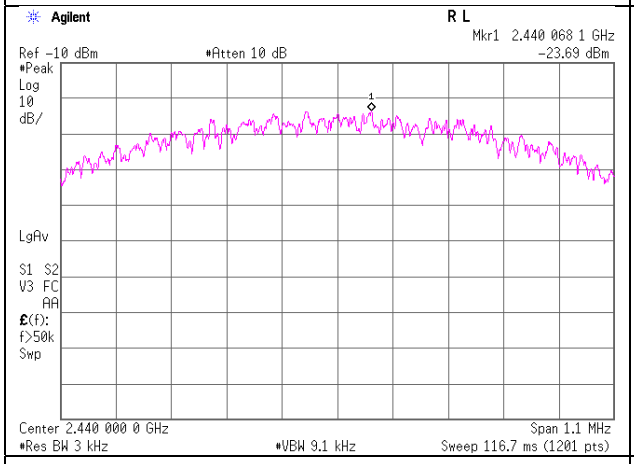
Power Density

BT LE 1 M-PHY

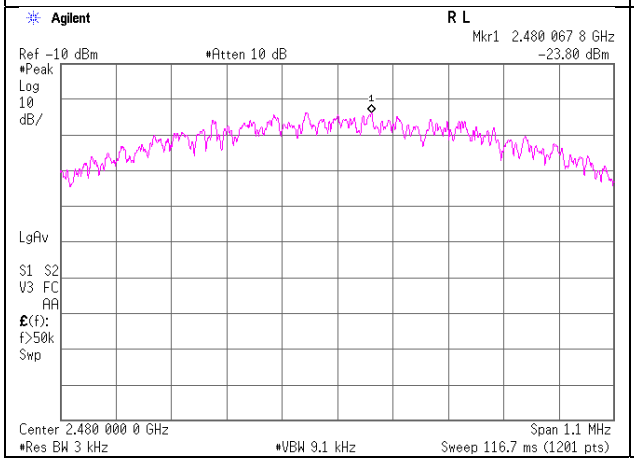
2402 MHz



2440 MHz

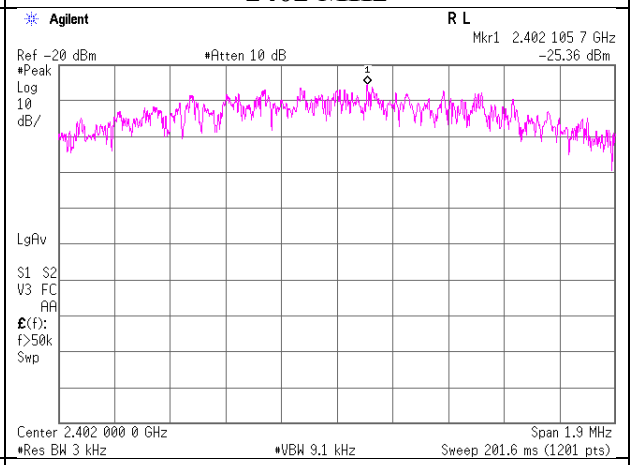


2480 MHz

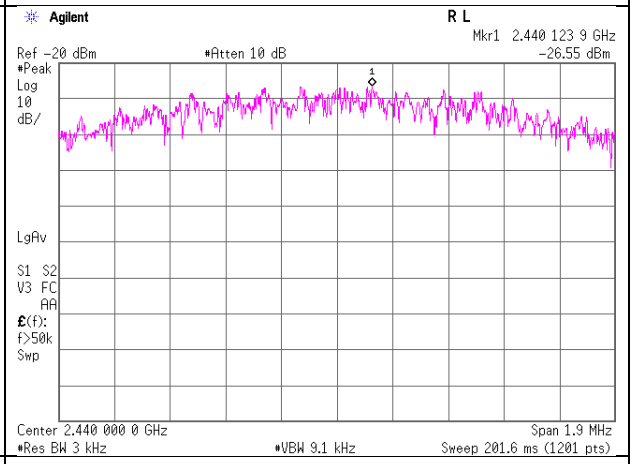


BT LE 2 M-PHY

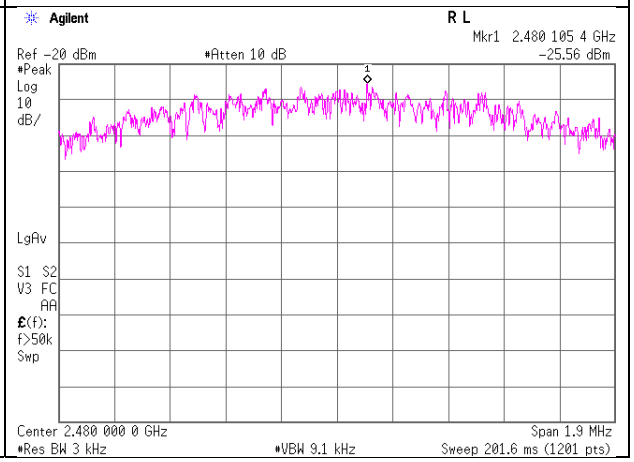
2402 MHz



2440 MHz



2480 MHz



APPENDIX 2: Test instruments

Test equipment

Test Item	Local ID	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Cal Int
AT	KSA-08	145089	Spectrum Analyzer	Keysight Technologies Inc	E4446A	MY46180525	2019/11/05	12
AT	KTS-07	145111	Digital Tester	SANWA	PC500	7019232	2019/10/01	12
AT	SAT10-09	145132	Attenuator	Weinschel Corp.	54A-10	W5692	2019/11/05	12
AT	SAT10-14	154591	Attenuator	Weinschel Corp.	54A-10	81595	2020/04/01	12
AT	SAT10-16	160494	Attenuator	Weinschel Corp.	54A-10	83420	2019/12/12	12
AT	SCC-G63	196946	Coaxial Cable	HUBER+SUNER	SUCOFLEX 102	803411/2	2020/03/10	12
AT	SCC-G66	196947	Coaxial Cable	HUBER+SUNER	SUCOFLEX 102	803478/2	2020/03/10	12
AT	SCC-G67	196949	Coaxial Cable	HUBER+SUNER	SUCOFLEX 102	803480/2	2020/03/10	12
AT	SOS-19	175823	Humidity Indicator	CUSTOM. Inc	CTH-201	-	2019/12/19	12
AT	SPM-07	146247	Power Meter	Keysight Technologies Inc	8990B	MY5100272	2020/05/27	12
AT	SPSS-04	146310	Power sensor	Keysight Technologies Inc	N1923A	MY5326009	2020/05/27	12
AT	SPSS-05	146311	Power sensor	Keysight Technologies Inc	N1923A	MY5349008	2020/05/27	12
AT	STM-G6	146207	Terminator	JFW	50T-128	-	2019/11/05	12
AT	STS-05	146212	Digital Hitester	Hioki	3805-50	80997828	2019/10/01	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