



RADIO TEST REPORT

Test Report No. : 13063553S-A-R2

Applicant : PIONEER CORPORATION
Type of Equipment : RDS AV RECEIVER
Model No. : DMH-W4660NEX
FCC ID : AJDK111
Test regulation : FCC Part 15 Subpart C: 2019
*Wireless LAN & Bluetooth Low Energy part
Test items : Antenna Terminal Conducted Tests
Test Result : Complied (Refer to SECTION 3.2)

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2. The results in this report apply only to the sample tested.
3. This sample tested is in compliance with the limits of the above regulation.
4. The test results in this test report are traceable to the national or international standards.
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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 13063553S-A-R1. 13063553S-A-R1 is replaced with this report.

Date of test: September 27 to October 16, 2019

Representative test engineer:

T. Kawakami

Takahiro Kawakami
Engineer
Consumer Technology Division

Approved by:

K. Takeyama

Kazutaka Takeyama
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".

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REVISION HISTORY

Original Test Report No.: 13063553S-A

Revision	Test report No.	Date	Page revised	Contents
- (Original)	13063553S-A	November 28, 2019	-	-
1	13063553S-A-R1	January 7, 2020	P.6	Modification of the clock frequency for Bluetooth Wi-Fi module from 32.768 MHz to 32.768 kHz
			P.6	Modification of the clock frequency for CHIPS from 32.768 MHz to 32.768 kHz
			P.6	GNSS Frequency of Operation from: See table below. to: GPS: 1575.42 MHz GLONASS: 1598.025 MHz -1605.375 MHz Galileo: 1575.42 MHz
			P.7	Modification of the reference test report number from: No.13063554M-B to: No.13063554M-B-R1
			P.23	Update Duty factor from: "10*log (8.7/8.62)" to: "10*log (8.702/8.616)" in 11b 1 Mbps, from: "10*log (1.31/1.21)" to: "10*log (1.31/1.211)" in 11n-20 MCS 0 (Short GI:ON)
2	13063553S-A-R2	January 27, 2020	P.1	Addition of Test items: Antenna Terminal Conducted Tests
			P.6	Modification of product description from: is a RDS AV RECEIVER to: is an RDS AV RECEIVER
			P.6	Removed from Clock frequency (ies) in the system: "Bluetooth Wi-Fi module: 32.768 kHz"
			P.7	Modification of the reference test report number from: No.13063554M-B-R1 to: No.13063554M-B-R2

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Reference: Abbreviations (Including words undescribed in this report)

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

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SECTION 1: Customer information

Company Name	:	PIONEER CORPORATION
Address	:	25-1, Yamada, Kawagoe-shi, Saitama, 350-8555, JAPAN
Telephone Number	:	+81-49-228-7681
Facsimile Number	:	+81-49-228-6172
Contact Person	:	Shigeru Yoshida

The information provided from the customer is as follows;

- Applicant, Type of Equipment, Model No., FCC ID on the cover and other relevant pages
- Operating/Test Mode(s) (Mode(s)) on all the relevant pages
- SECTION 1: Customer information
- SECTION 2: Equipment under test (E.U.T.)
- SECTION 4: Operation of E.U.T. during testing

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

SECTION 2: Equipment under test (E.U.T.)

2.1 Identification of E.U.T.

Type of Equipment	:	RDS AV RECEIVER
Model No.	:	DMH-W4660NEX
Serial No.	:	Refer to SECTION 4.2
Rating	:	DC 14.4 V (DC 10.8 V to 15.1 V)
Receipt Date of Sample (Information from test lab.)	:	September 11, 2019
Country of Mass-production	:	Thailand
Condition of EUT	:	Production prototype (Not for Sale: This sample is equivalent to mass-produced items.)
Modification of EUT	:	No Modification by the test lab.

2.2 Product Description

Model: DMH-W4660NEX (referred to as the EUT in this report) is an RDS AV RECEIVER.

General Specification

The clock frequencies used in the EUT:

Clock frequency(ies) in the system : DC-DC CONVERTER: 1008 kHz/ 700.5 kHz, 365.8 kHz/ 413.9 kHz
FM/AM TUNER: 55.467 MHz (VCO: 5.9904 GHz/ 6.2208 GHz)
MAIN PROCESSER: 24 MHz
SYSTEM MICRO COMPUTER: 12.5 MHz
LCD BACK LIGHT: 515.7 kHz/ 476.6 kHz
LINE AMPLIFIER: 515.7 kHz/ 476.6 kHz
CHIPS: 26 MHz, 32.768 kHz, 10 MHz
HDMI RECEIVER: 27 MHz
VIDEO DECODER: 32 MHz
WWR UNIT: 55.467 MHz

Radio Specification

Radio Type	:	Transceiver
Frequency of Operation	:	2.4 GHz: 2402 MHz - 2480 MHz (Bluetooth BDR/EDR, Bluetooth Low Energy) 2412 MHz - 2462 MHz (IEEE 802.11b/g/n) 5 GHz 5745 MHz (IEEE 802.11a/n-20) 5755 MHz (IEEE 802.11n-40/ac-40) 5775 MHz (IEEE 802.11ac-80)
Modulation	:	DSSS (IEEE 802.11b), OFDM (IEEE 802.11g/n/a/ac) FHSS (Bluetooth BDR/EDR) GFSK (Bluetooth Low Energy)
Power Supply (inner)	:	DC 3.3 V/1.8 V
Antenna type	:	Monopole Antenna
Antenna Gain	:	2.4 GHz: -9.4 dBi (Bluetooth BDR/EDR, Bluetooth Low Energy) -11.9 dBi (IEEE 802.11b/g/n) 5 GHz: -11.1 dBi
Operating Temperature	:	-10 deg. C to +60 deg. C

GNSS

Radio Type	:	Receiver
Frequency of Operation	:	GPS: 1575.42 MHz GLONASS: 1598.025 MHz -1605.375 MHz Galileo: 1575.42 MHz
Antenna type	:	External Antenna
Antenna Gain	:	2.0 dBi (Elevation Angle:90 deg.) -6.0 dBi (Elevation Angle:10 deg.)

SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification : FCC Part 15 Subpart C
FCC Part 15 final revised on July 19, 2019 and effective August 19, 2019 except 15.258

Title : FCC 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 customer has declared that the EUT has complies with FCC Part 15 Subpart B as SDoC.

3.2 Procedures and results

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

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 power ports.

*2) For the Radiated spurious emission test, refer to test report No.13063554M-B-R2.

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)

This EUT provides stable voltage constantly to the wireless transmitter regardless of input voltage. Instead of a new battery, DC power supply was used for the test. That does not affect the test result, therefore this EUT complies with the requirement.

FCC Part 15.203 Antenna requirement

It is impossible for end users to replace the antenna, because the antenna is mounted inside of the 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	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 $k=2$.

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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 %

3.5 Test Location

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A2LA Certificate Number: 1266.03 (FCC Test Firm Registration Number: 626366, ISED Lab Company Number: 2973D)

Test site	Width x Depth x Height (m)	Size of reference ground plane (m) / horizontal conducting plane	Maximum measurement distance
No.1 Semi-anechoic chamber	20.6 x 11.3 x 7.65	20.6 x 11.3	10 m
No.2 Semi-anechoic chamber	20.6 x 11.3 x 7.65	20.6 x 11.3	10 m
No.3 Semi-anechoic chamber	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.

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

4.1 Operating Mode(s)

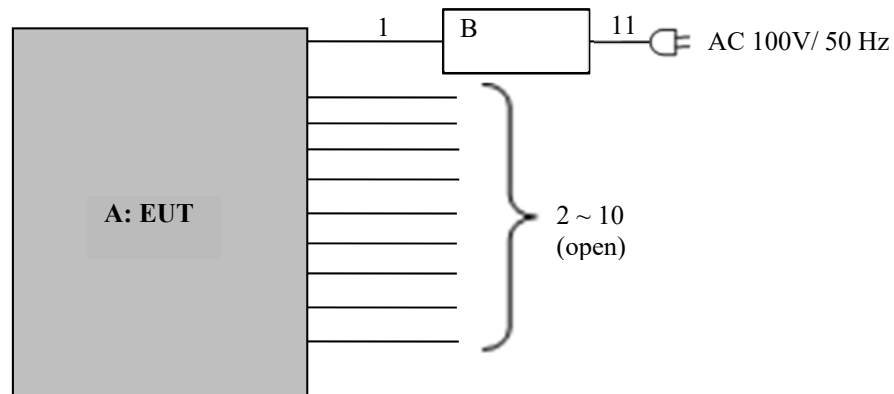
Test operating mode was determined as follows according to “Section 1 of 6 802.11 a/b/g/n testing - Managing Complex Regulatory Approvals - ” of TCB Council Workshop October 2009 .

Mode	Remarks*
IEEE 802.11b (11b)	1 Mbps, PN9
IEEE 802.11g (11g)	48 Mbps, PN9
IEEE 802.11n 20 MHz BW (11n-20)	MCS 5 (SGI on), PN9
Tx (Transmitting), Bluetooth Low Energy (BT LE)	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 11n-20: 11 dBm BT LE: Fixed Software: SoC: 0.0601107 SYS: 7.13 *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
6dB Bandwidth	Tx 11b	2412 MHz
Maximum Peak Output Power	Tx 11g	2437 MHz
Power Density	Tx 11n-20	2462 MHz
99% Occupied Bandwidth	Tx BT LE	2402 MHz
		2440 MHz
		2480 MHz
Conducted Spurious Emission	Tx 11n-20	2412 MHz
	Tx BT LE	2402 MHz
		2440 MHz
		2480 MHz

4.2 Configuration and peripherals



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

Description of EUT and support equipment

No.	Item	Model number	Serial number	Manufacturer	Remark
A	RDS AV RECEIVER	DMH-W4660NEX	SGTM000072UC	Pioneer Corporation	EUT
B	DC Power Supply	PAN 35-10A	DE001677	Kikusui	-

List of cables used

No.	Name	Length (m)	Cable		Remark
			Cable	Connector	
1	DC (+B, ACC, GND)	0.15 + 2.4	Unshielded	Unshielded	-
2	Speaker Front L	0.15	Unshielded	Unshielded	-
3	Speaker Front R	0.15	Unshielded	Unshielded	-
4	Speaker Rear L	0.15	Unshielded	Unshielded	-
5	Speaker Rear R	0.15	Unshielded	Unshielded	-
6	System Remote Control	0.15	Unshielded	Unshielded	-
7	ILL +	0.15	Unshielded	Unshielded	-
8	Reverse Gear Signal In	0.15	Unshielded	Unshielded	-
9	Parking Brake	2.0	Unshielded	Unshielded	-
10	Car Speed Signal In	0.15	Unshielded	Unshielded	-
11	AC	2.0	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
6dB Bandwidth	Enough width to display emission skirts	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 6dB Bandwidth	3 kHz	9.1 kHz	Auto	Peak	Max Hold	Spectrum Analyzer *3)
Conducted Spurious Emission *4)	9kHz to 150kHz	200 Hz	620 Hz	Auto	Peak	Max Hold	Spectrum Analyzer
	150kHz to 30MHz	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)							

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

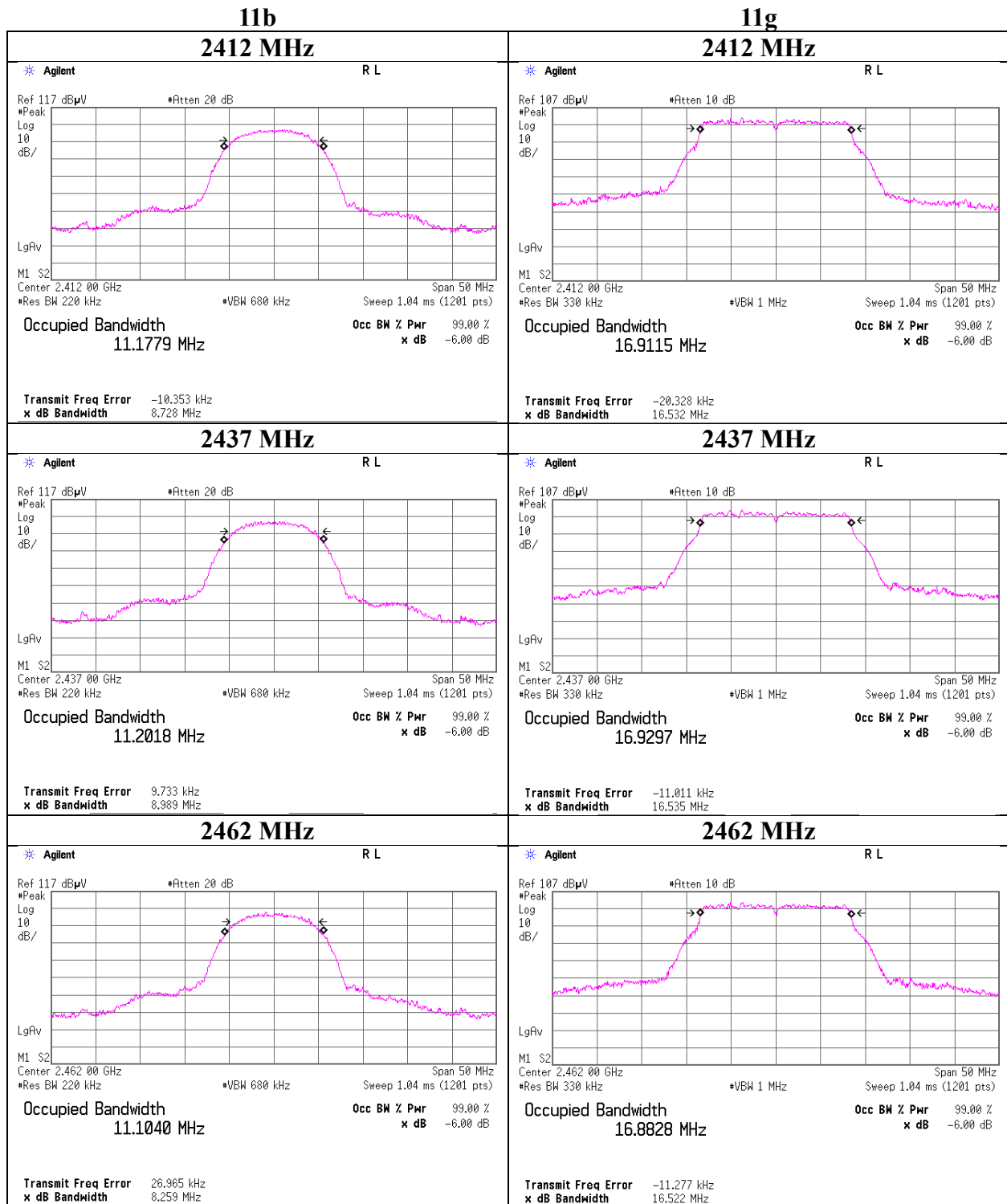
APPENDIX 1: Test data

6 dB Bandwidth and 99 % Occupied Bandwidth

Report No.	13063553S-A-R2	
Test place	Shonan EMC Lab.	
	No.5 Shielded Room	No.1 Measurement Room
Date	October 3, 2019	October 16, 2019
Temperature / Humidity	25 deg. C / 41 % RH	25 deg. C / 47 % RH
Engineer	Takahiro Kawakami	Hiromasa Sato
Mode	Tx	

Mode	Frequency [MHz]	99% Occupied Bandwidth [kHz]	6dB Bandwidth [MHz]	Limit for 6dB Bandwidth [MHz]
11b	2412	11177.9	8.506	> 0.5000
	2437	11201.8	8.707	> 0.5000
	2462	11104.0	8.220	> 0.5000
11g	2412	16911.5	16.485	> 0.5000
	2437	16929.7	16.474	> 0.5000
	2462	16882.8	16.479	> 0.5000
11n-20	2412	17998.9	17.725	> 0.5000
	2437	18061.6	17.749	> 0.5000
	2462	18068.2	17.757	> 0.5000
BT LE	2402	1065.7	0.736	> 0.5000
	2440	1066.9	0.737	> 0.5000
	2480	1065.3	0.734	> 0.5000

99%Occupied Bandwidth



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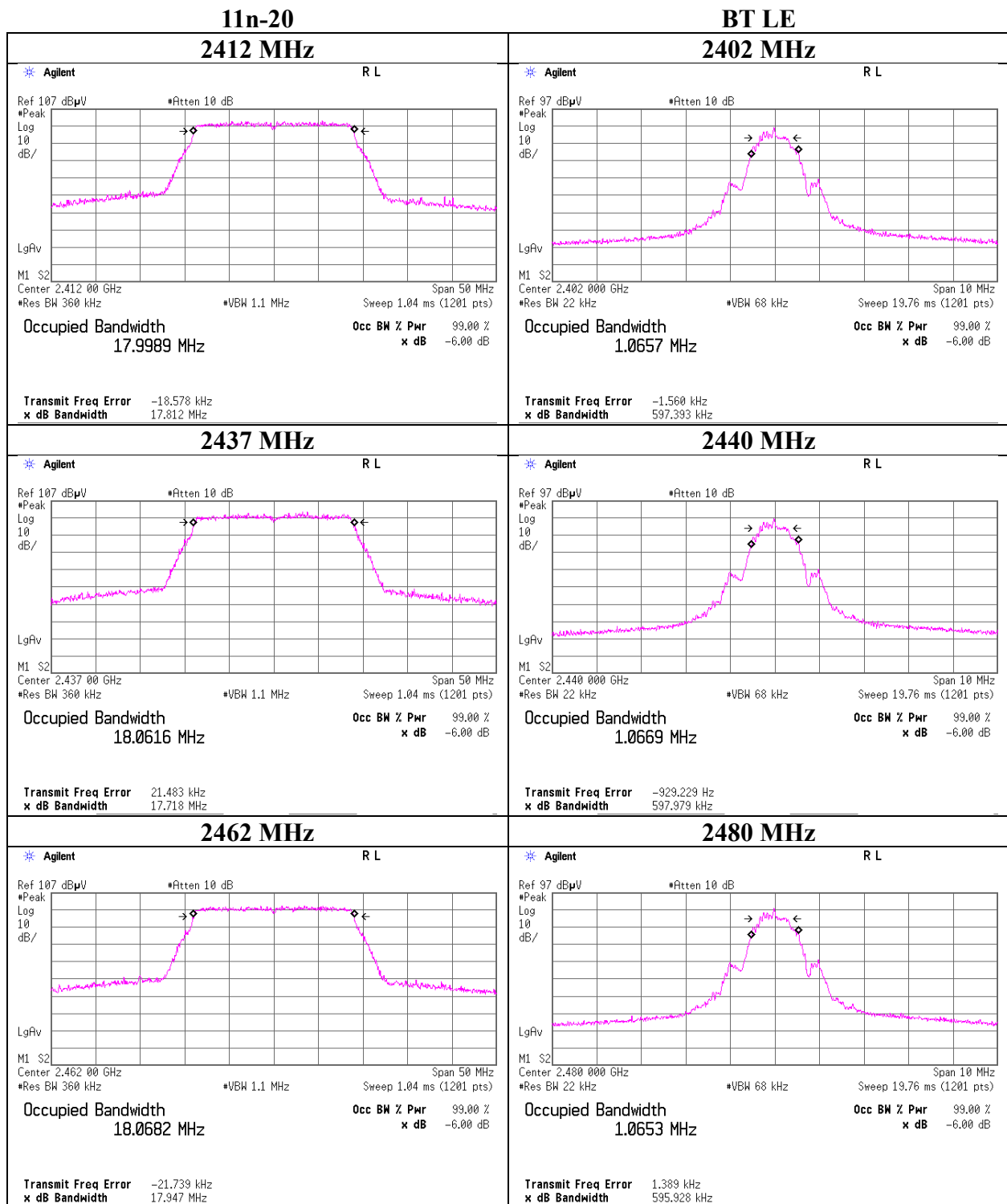
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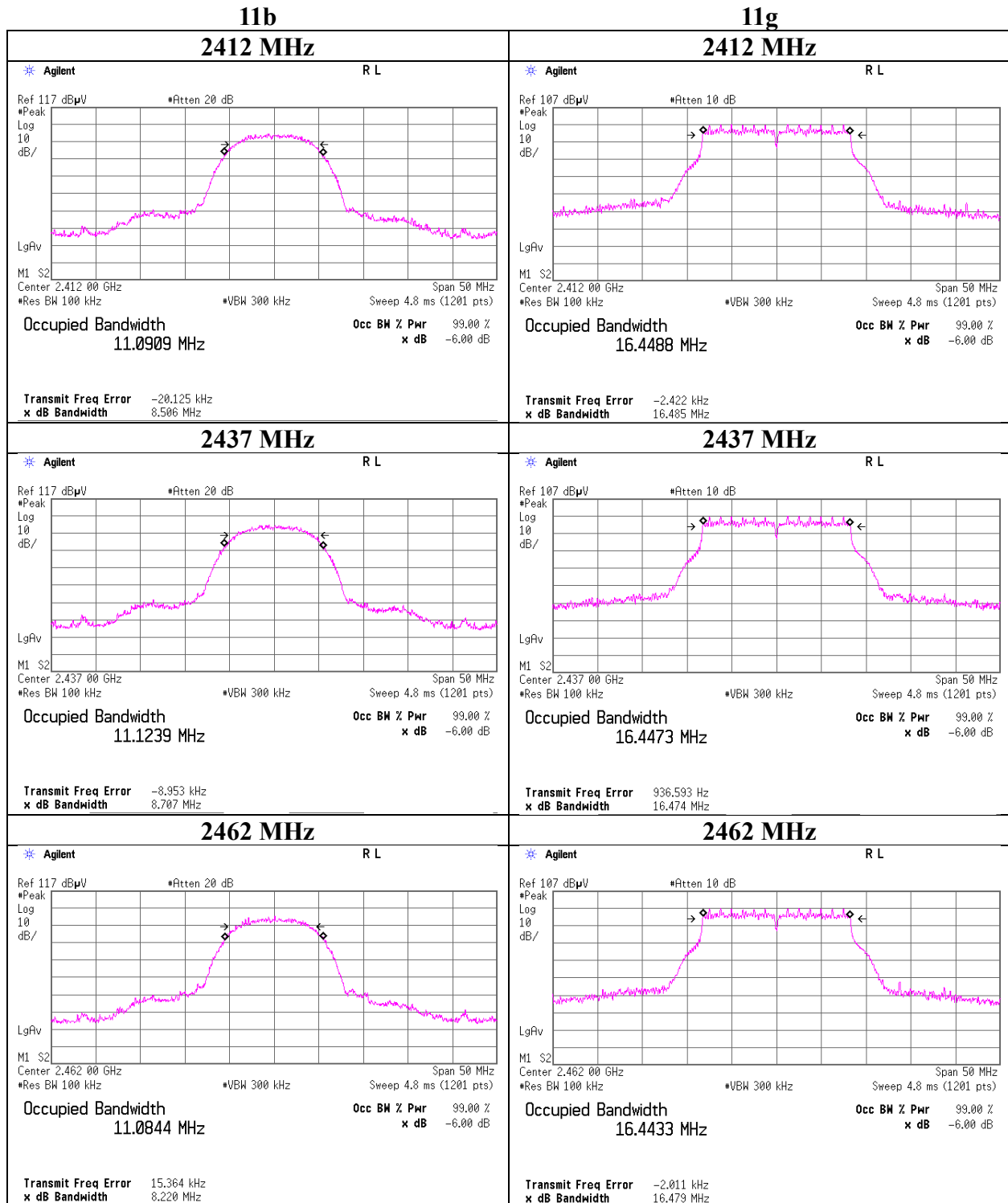
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99% Occupied Bandwidth



6dB Bandwidth



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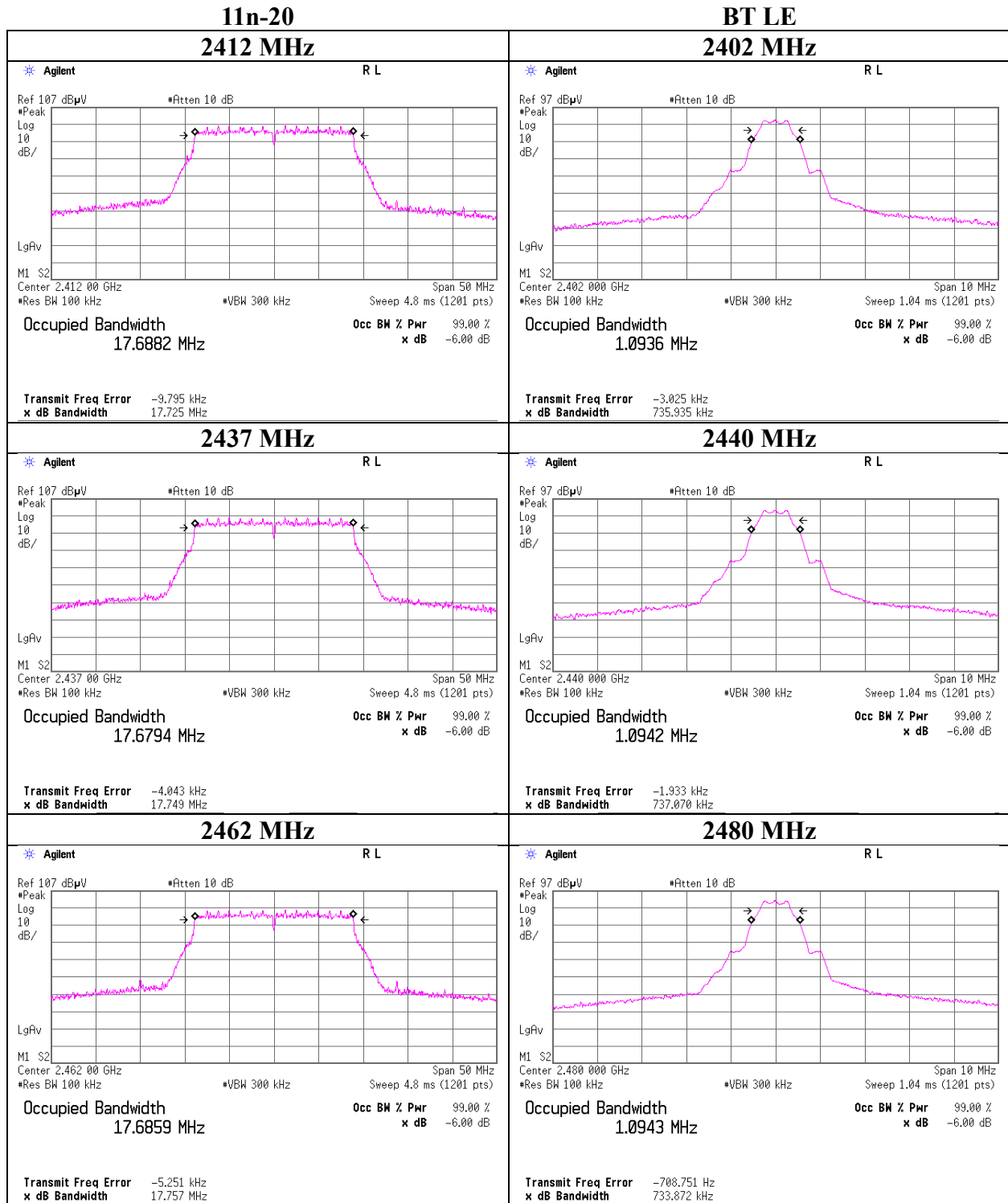
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6dB Bandwidth



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Maximum Peak Output Power

Report No. 13063553S-A-R2
Test place Shonan EMC Lab. No.5 Shielded Room
Date September 27, 2019
Temperature / Humidity 26 deg. C / 45 % RH
Engineer Makoto Hosaka
Mode Tx 11b

				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	6.91	2.15	9.92	18.98	79.07	30.00	1000	11.02	-11.90	7.08	5.11	36.02	4000	28.94	
2437	7.01	2.15	9.92	19.08	80.91	30.00	1000	10.92	-11.90	7.18	5.22	36.02	4000	28.84	
2462	6.80	2.16	9.92	18.88	77.27	30.00	1000	11.12	-11.90	6.98	4.99	36.02	4000	29.04	

Sample Calculation:

Result = Reading + Cable Loss (including the cable(s) customer supplied) + 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.

Rate	Reading	Remark
[Mbps]	[dBm]	
1	7.01	*
2	6.65	
5.5	6.64	
11	6.92	

*: Worst Rate

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

Maximum Peak Output Power

Report No. 13063553S-A-R2
Test place Shonan EMC Lab. No.5 Shielded Room
Date September 27, 2019
Temperature / Humidity 26 deg. C / 45 % RH
Engineer Makoto Hosaka
Mode Tx 11g

				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	12.42	2.15	9.92	24.49	281.19	30.00	1000	5.51	-11.90	12.59	18.16	36.02	4000	23.43
2437	11.78	2.15	9.92	23.85	242.66	30.00	1000	6.15	-11.90	11.95	15.67	36.02	4000	24.07
2462	11.93	2.16	9.92	24.01	251.77	30.00	1000	5.99	-11.90	12.11	16.26	36.02	4000	23.91

Sample Calculation:

Result = Reading + Cable Loss (including the cable(s) customer supplied) + 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.

Rate [Mbps]	Reading [dBm]	Remark
6	11.04	
9	10.78	
12	10.80	
18	10.75	
24	11.30	
36	10.85	
48	11.78	*
54	9.96	

*: Worst Rate

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

Maximum Peak Output Power

Report No.	13063553S-A-R2
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	September 27, 2019
Temperature / Humidity	26 deg. C / 45 % RH
Engineer	Makoto Hosaka
Mode	Tx 11n-20

				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	12.57	2.15	9.92	24.64	291.07	30.00	1000	5.36	-11.90	12.74	18.79	36.02	4000	23.28
2437	12.11	2.15	9.92	24.18	261.82	30.00	1000	5.82	-11.90	12.28	16.90	36.02	4000	23.74
2462	11.75	2.16	9.92	23.83	241.55	30.00	1000	6.17	-11.90	11.93	15.60	36.02	4000	24.09

Sample Calculation:

Result = Reading + Cable Loss (including the cable(s) customer supplied) + 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.

Short GI: ON

MCS Number	Reading [dBm]	Remark
0	10.85	
1	10.83	
2	10.52	
3	11.04	
4	11.26	
5	12.11	*
6	11.06	
7	11.02	

Short GI: OFF

MCS Number	Reading [dBm]	Remark
0	10.86	
1	11.01	
2	10.77	
3	11.15	
4	10.93	
5	11.96	
6	11.16	
7	10.96	

* Worst Condition

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

Maximum Peak Output Power

Report No. 13063553S-A-R2
Test place Shonan EMC Lab. No.3 Shielded Room
Date October 11, 2019
Temperature / Humidity 25 deg. C / 50 % RH
Engineer Toshinori Yamada
Mode Tx BT LE

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Conducted Power					e.i.r.p. for RSS-247					
				Result		Limit		Margin [dB]	Antenna Gain [dBi]	Result		Limit		Margin [dB]
				[dBm]	[mW]	[dBm]	[mW]			[dBm]	[mW]	[dBm]	[mW]	
2402	-15.08	1.24	9.82	-4.02	0.40	30.00	1000	34.02	-9.40	-13.42	0.05	36.02	4000	49.44
2440	-14.67	1.24	9.82	-3.61	0.44	30.00	1000	33.61	-9.40	-13.01	0.05	36.02	4000	49.03
2480	-14.25	1.25	9.82	-3.18	0.48	30.00	1000	33.18	-9.40	-12.58	0.06	36.02	4000	48.60

Sample Calculation:

Result = Reading + Cable Loss (including the cable(s) customer supplied) + 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.

Average Output Power (Reference data for RF Exposure)

Report No. 13063553S-A-R2
Test place Shonan EMC Lab.
No.5 Shielded Room No.5 Shielded Room No.1 Measurement Room
Date September 27, 2019 September 30, 2019 October 16, 2019
Temperature / Humidity 26 deg. C / 45 % RH 23 deg. C / 54 % RH 25 deg. C / 47 % RH
Engineer Makoto Hosaka Makoto Hosaka Hiromasa Sato
Mode Tx

11b 1 Mbps

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result (Time average)		Duty factor [dB]	Result (Burst power average)	
				[dBm]	[mW]		[dBm]	[mW]
2412	3.07	2.93	9.92	15.92	39.08	0.04	15.96	39.45
2437	3.08	2.94	9.92	15.94	39.26	0.04	15.98	39.63
2462	2.89	2.95	9.92	15.76	37.67	0.04	15.80	38.02

11g 6 Mbps

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result (Time average)		Duty factor [dB]	Result (Burst power average)	
				[dBm]	[mW]		[dBm]	[mW]
2412	0.80	2.93	9.92	13.65	23.17	0.29	13.94	24.77
2437	0.76	2.94	9.92	13.62	23.01	0.29	13.91	24.60
2462	0.66	2.95	9.92	13.53	22.54	0.29	13.82	24.10

11n-20 MCS 0 Short GI:ON

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result (Time average)		Duty factor [dB]	Result (Burst power average)	
				[dBm]	[mW]		[dBm]	[mW]
2412	-0.21	2.93	9.92	12.64	18.37	0.34	12.98	19.86
2437	-0.29	2.94	9.92	12.57	18.07	0.34	12.91	19.54
2462	-0.42	2.95	9.92	12.45	17.58	0.34	12.79	19.01

BT LE

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result (Time average)		Duty factor [dB]	Result (Burst power average)	
				[dBm]	[mW]		[dBm]	[mW]
2412	-18.54	1.24	9.89	-7.41	0.18	1.80	-5.61	0.27
2437	-18.11	1.24	9.89	-6.98	0.20	1.80	-5.18	0.30
2462	-17.55	1.25	9.89	-6.41	0.23	1.80	-4.61	0.35

Sample Calculation:

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

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

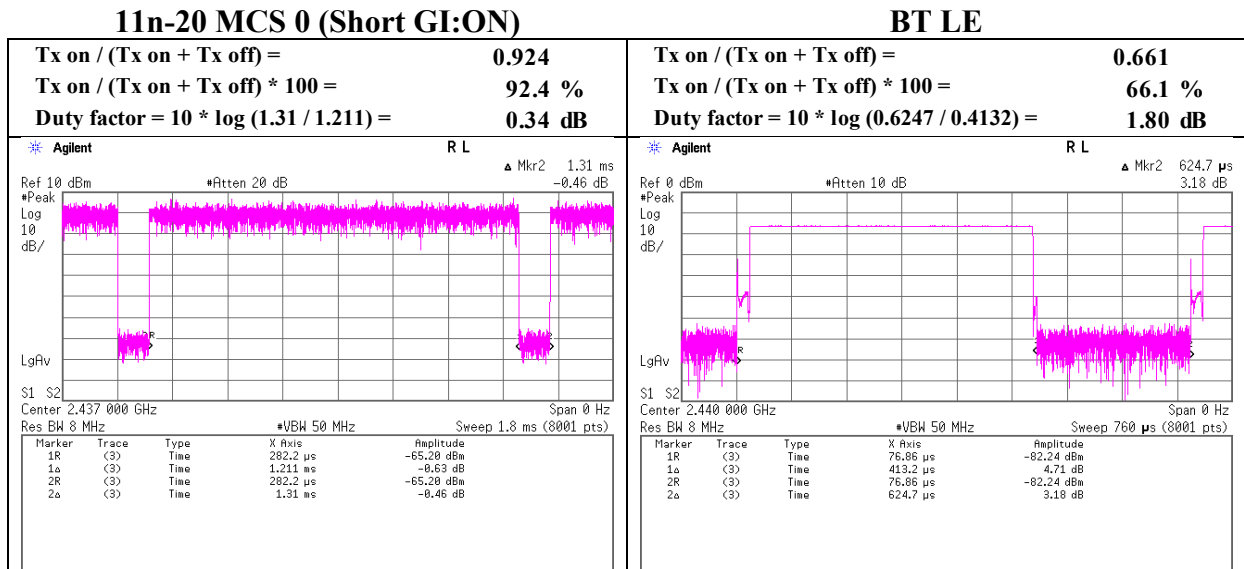
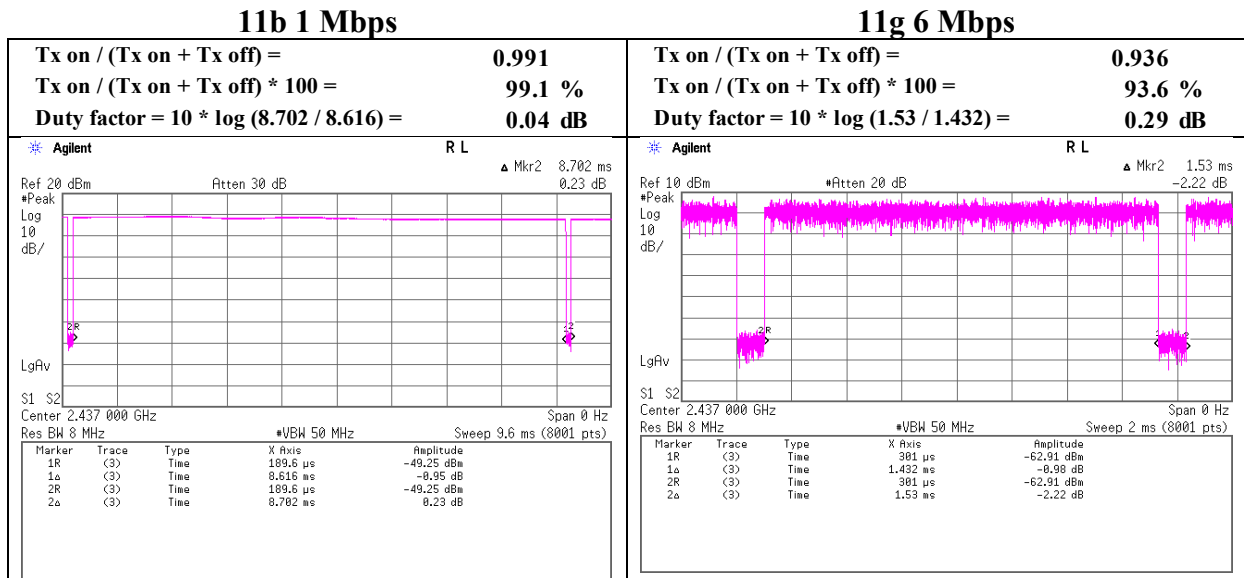
*The equipment and cables were not used for factor 0 dB of the data sheets.

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

Burst rate confirmation (for average output power)

Report No.	13063553S-A-R2	
Test place	Shonan EMC Lab.	
	No.5 Shielded Room	No.1 Measurement Room
Date	September 27, 2019	October 16, 2019
Temperature / Humidity	26 deg. C / 45 % RH	25 deg. C / 47 % RH
Engineer	Makoto Hosaka	Hiromasa Sato
Mode	Tx	

Lowest Rate

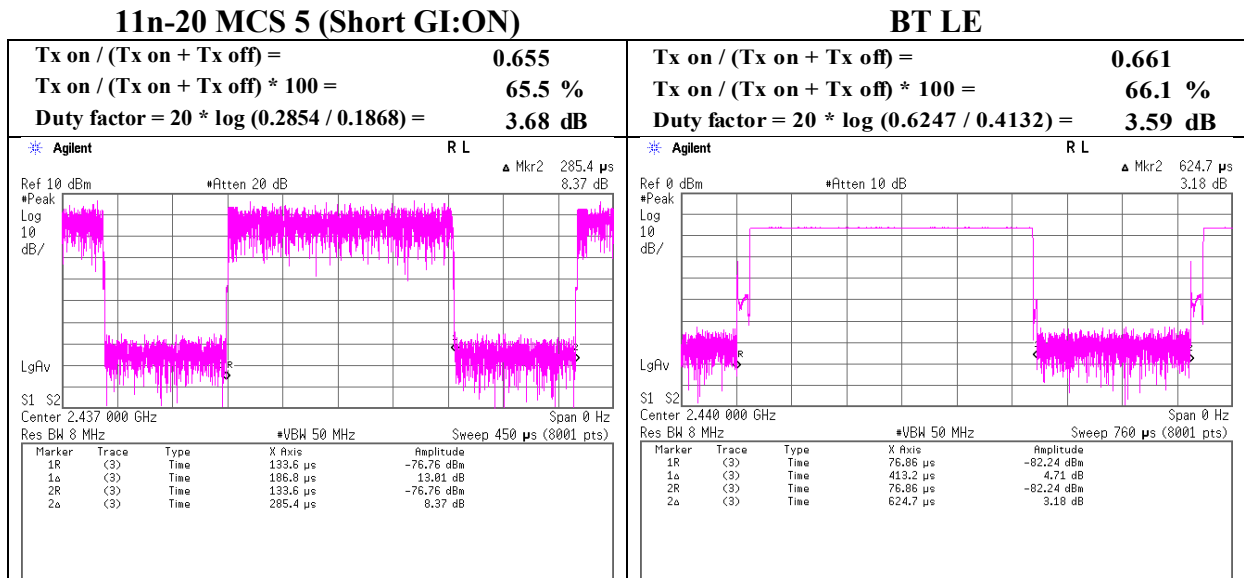
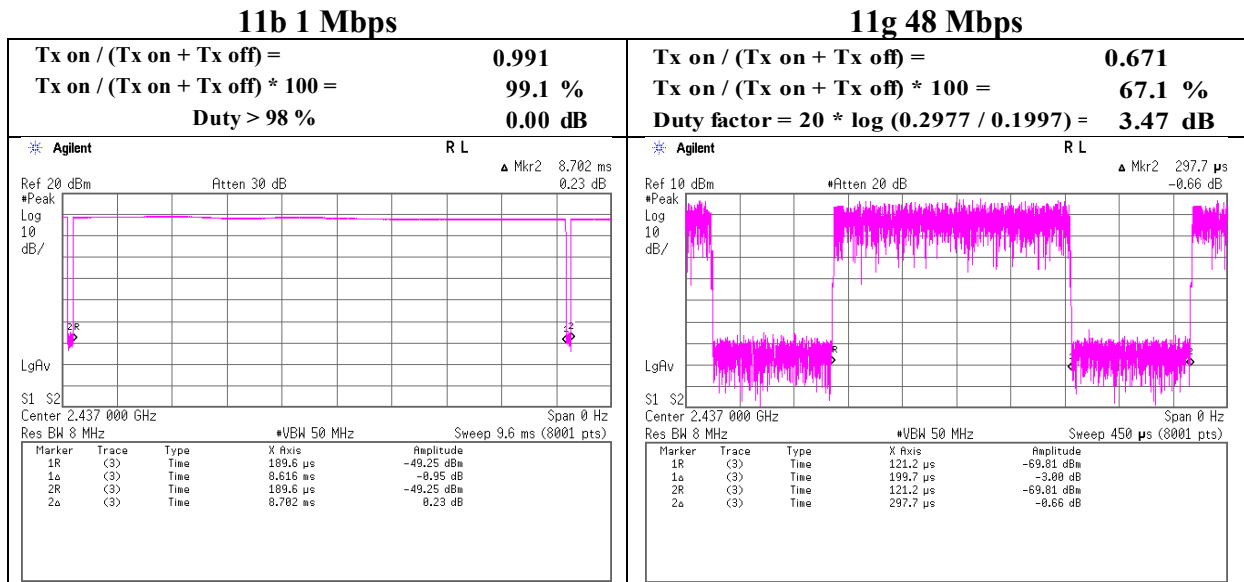


* Since the burst rate is not different between the channels, the data has been obtained on the representative channel.

Burst rate confirmation (for radiated spurious emission)

Report No.	13063553S-A-R2	
Test place	Shonan EMC Lab.	
	No.5 Shielded Room	No.1 Measurement Room
Date	September 27, 2019	October 16, 2019
Temperature / Humidity	26 deg. C / 45 % RH	25 deg. C / 47 % RH
Engineer	Makoto Hosaka	Hiromasa Sato
Mode	Tx	

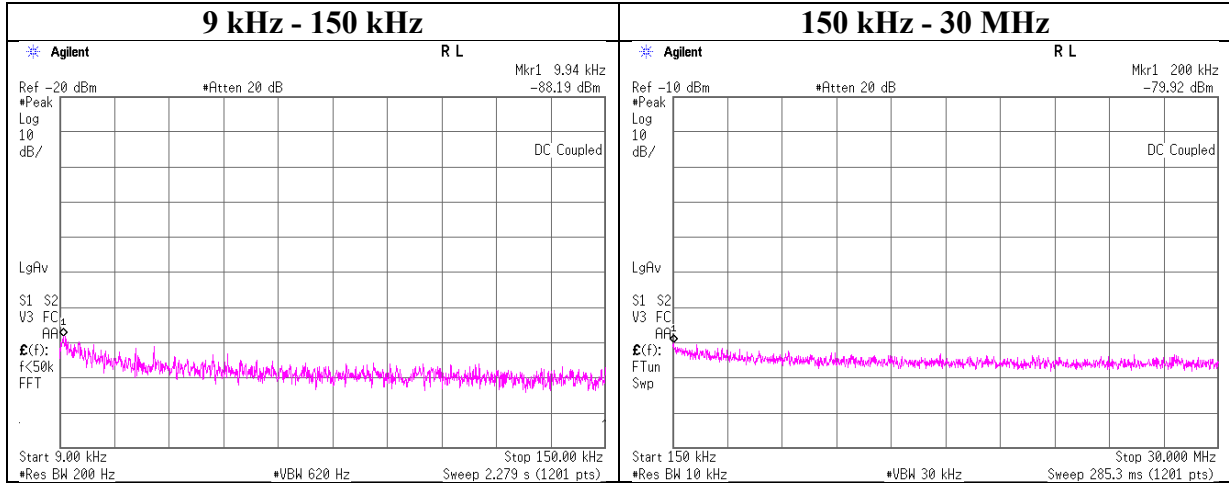
Worst Rate



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

Conducted Spurious Emission

Report No.	13063553S-A-R2
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	October 3, 2019
Temperature / Humidity	25 deg. C / 41 % RH
Engineer	Takahiro Kawakami
Mode	Tx 11n-20 2412 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
9.94	-88.2	0.00	9.7	2.0	1	-76.4	300	6.0	-15.2	47.6	62.8	
200.00	-79.9	0.01	9.7	2.0	1	-68.2	300	6.0	-6.9	21.5	28.4	

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

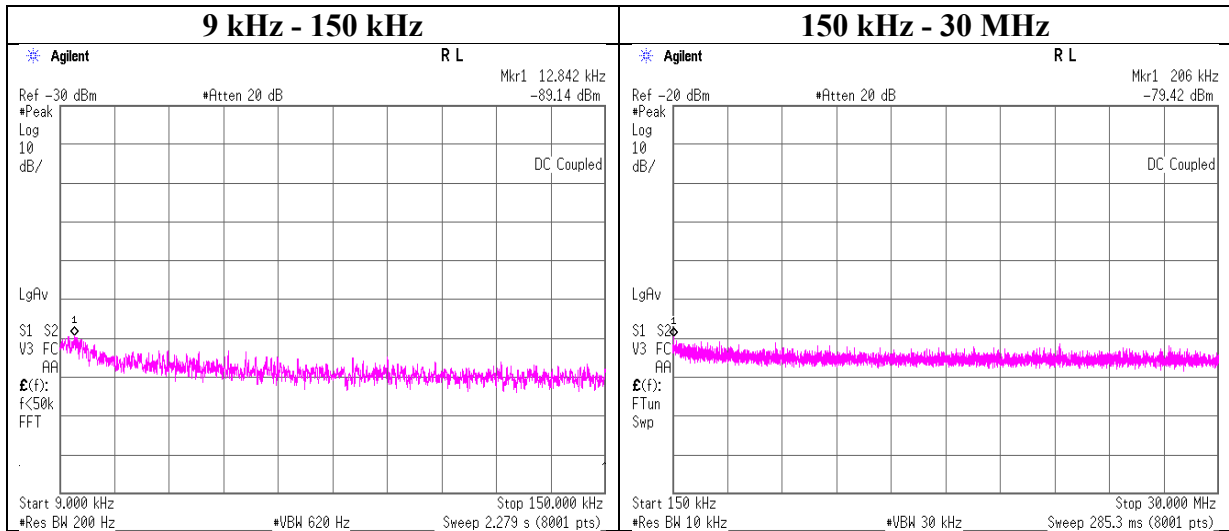
$EIRP [dBm] = Reading [dBm] + Cable\ loss [dB] + Attenuator\ Loss [dB] + Antenna\ gain [dBi] + 10 * \log (N)$

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. 13063553S-A-R2
Test place Shonan EMC Lab. No.1 Measurement Room
Date October 16, 2019
Temperature / Humidity 25 deg. C / 47 % RH
Engineer Hiromasa Sato
Mode Tx BT LE 2402 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
12.84	-89.1	0.02	9.8	2.0	1	-77.3	300	6.0	-16.1	45.4	61.5	
206.00	-79.4	0.02	9.8	2.0	1	-67.6	300	6.0	-6.3	21.3	27.6	

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

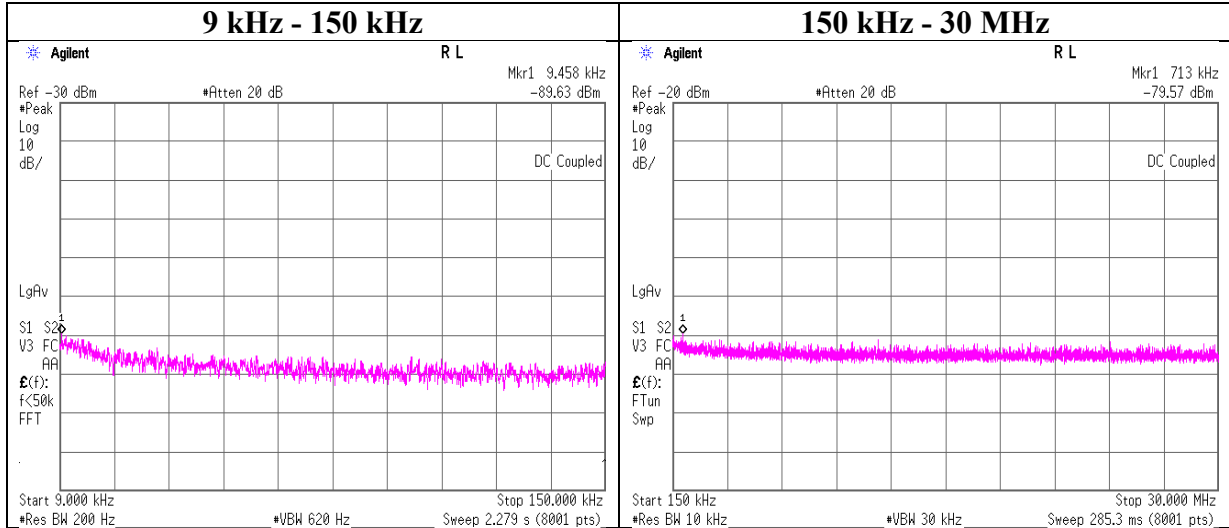
$EIRP [dBm] = Reading [dBm] + Cable\ loss [dB] + Attenuator\ Loss [dB] + Antenna\ gain [dBi] + 10 * \log (N)$

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. 13063553S-A-R2
Test place Shonan EMC Lab. No.1 Measurement Room
Date October 16, 2019
Temperature / Humidity 25 deg. C / 47 % RH
Engineer Hiromasa Sato
Mode Tx BT LE 2440 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
9.46	-89.6	0.02	9.8	2.0	1	-77.8	300	6.0	-16.6	48.0	64.6	
713.00	-79.6	0.02	9.8	2.0	1	-67.7	30	6.0	13.5	30.5	17.0	

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

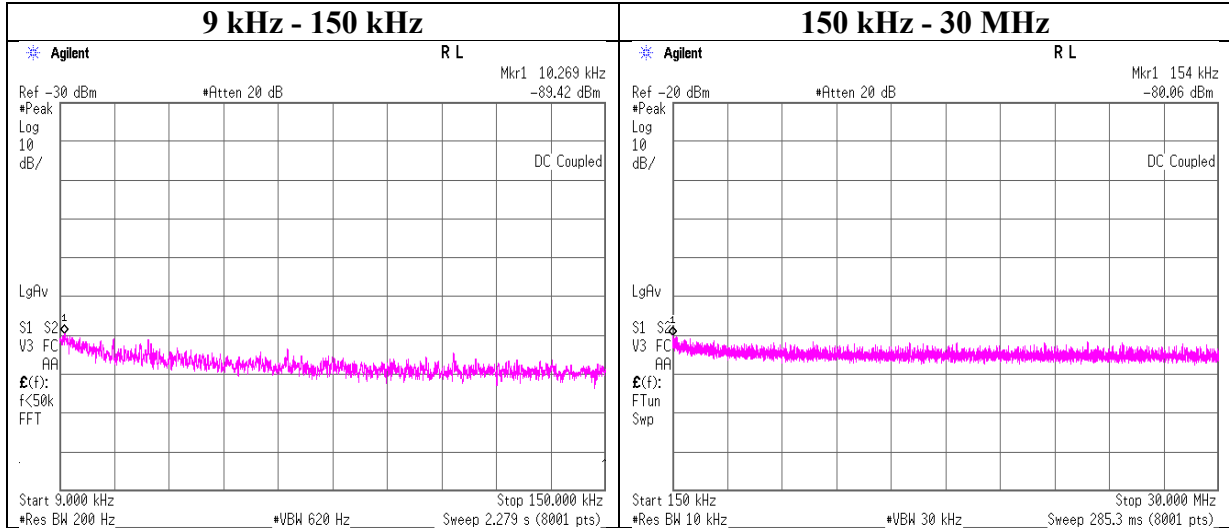
$EIRP [dBm] = Reading [dBm] + Cable\ loss [dB] + Attenuator\ Loss [dB] + Antenna\ gain [dBi] + 10 * \log (N)$

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. 13063553S-A-R2
Test place Shonan EMC Lab. No.1 Measurement Room
Date October 16, 2019
Temperature / Humidity 25 deg. C / 47 % RH
Engineer Hiromasa Sato
Mode Tx BT LE 2480 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
10.27	-89.4	0.02	9.8	2.0	1	-77.6	300	6.0	-16.3	47.3	63.6	
154.00	-80.1	0.02	9.8	2.0	1	-68.2	300	6.0	-7.0	23.8	30.8	

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

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

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.

Power Density

Report No. 13063553S-A-R2
Test place Shonan EMC Lab. No.5 Shielded Room
Date October 3, 2019
Temperature / Humidity 25 deg. C / 41 % RH
Engineer Takahiro Kawakami
Mode Tx

11b

Freq.	Reading	Cable Loss	Atten. Loss	Result	Limit	Margin
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[dBm]	[dB]
2412	-19.51	2.14	9.82	-7.55	8.00	15.55
2437	-19.73	2.14	9.82	-7.77	8.00	15.77
2462	-19.41	2.15	9.82	-7.44	8.00	15.44

11g

Freq.	Reading	Cable Loss	Atten. Loss	Result	Limit	Margin
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[dBm]	[dB]
2412	-25.26	2.14	9.82	-13.30	8.00	21.30
2437	-25.55	2.14	9.82	-13.59	8.00	21.59
2462	-25.52	2.15	9.82	-13.55	8.00	21.55

11n-20

Freq.	Reading	Cable Loss	Atten. Loss	Result	Limit	Margin
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[dBm]	[dB]
2412	-25.50	2.14	9.82	-13.54	8.00	21.54
2437	-25.49	2.14	9.82	-13.53	8.00	21.53
2462	-26.37	2.15	9.82	-14.40	8.00	22.40

BT LE

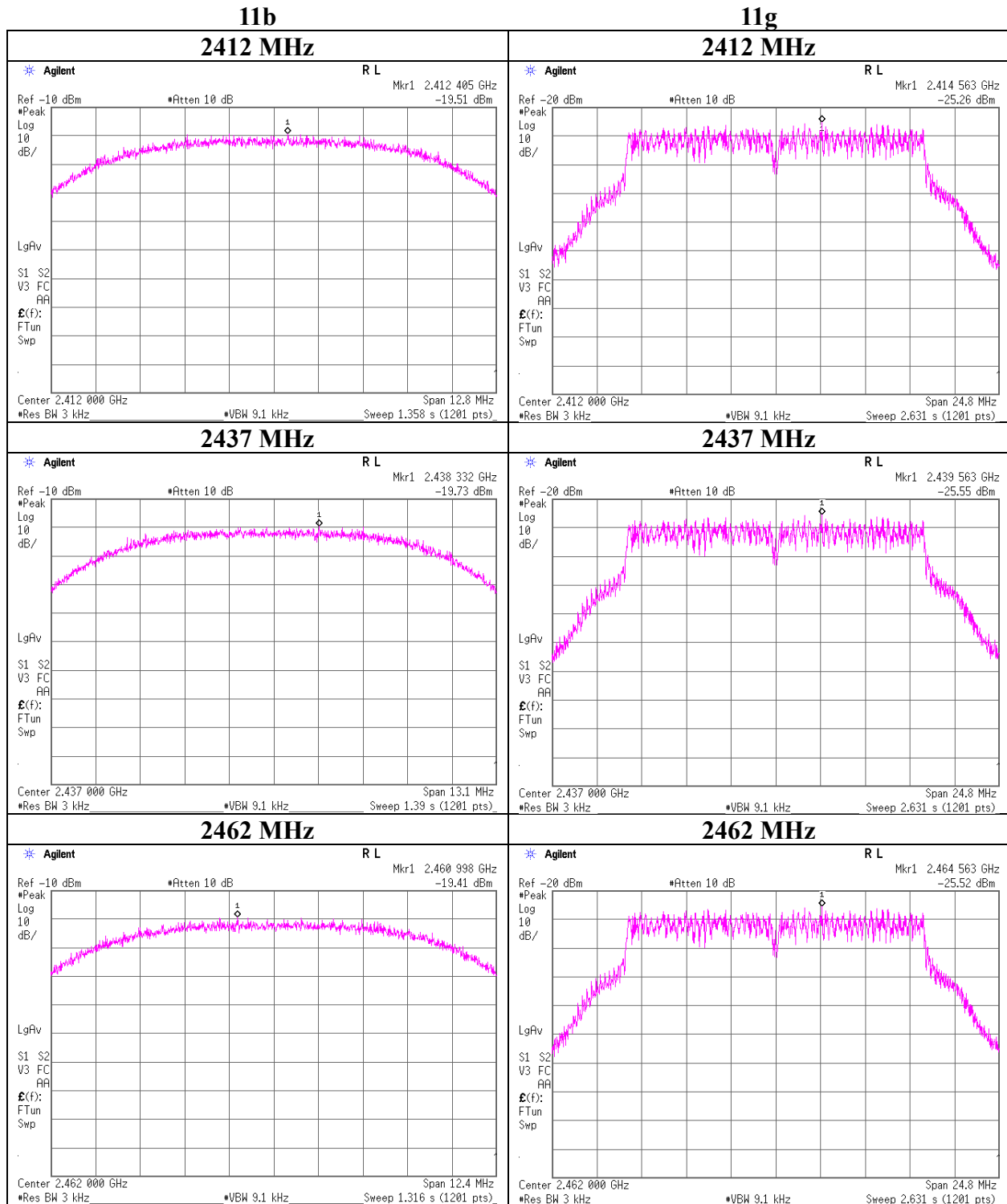
Freq.	Reading	Cable Loss	Atten. Loss	Result	Limit	Margin
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[dBm]	[dB]
2402	-27.86	2.23	9.89	-15.74	8.00	23.74
2440	-29.91	2.24	9.89	-17.78	8.00	25.78
2480	-29.35	2.25	9.89	-17.21	8.00	25.21

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



UL Japan, Inc.

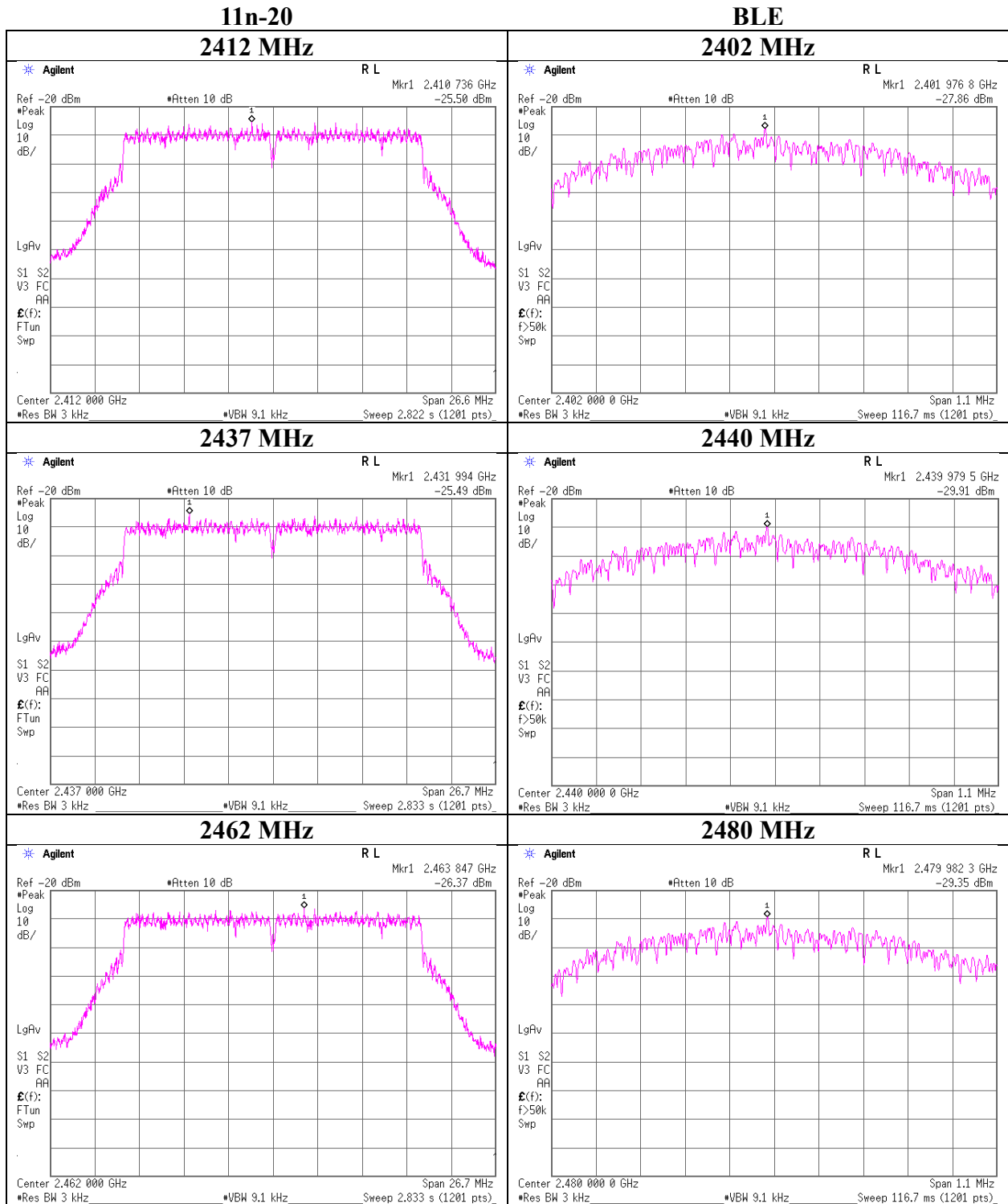
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APPENDIX 2: Test instruments

Test Instruments

Local ID	Test Name	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Calibration Due Date	Calibration Interval (Month)
KTS-06	AT	145110	Digital Tester	SANWA	PC500	7019240	2019/4/2	2020/4/30	12
KTS-07	AT	145111	Digital Tester	SANWA	PC500	7019232	2019/10/1	2020/10/31	12
SAT10-13	AT	151610	Attenuator	Weinschel Corp.	54A-10	81626	2019/3/27	2020/3/31	12
SAT10-14	AT	154591	Attenuator	Weinschel Corp.	54A-10	81595	2019/4/16	2020/4/30	12
SCC-G37	AT	151614	Coaxial Cable	Junkosha	MWX241-01000KMSK MS/B	1612Q035	2018/12/25	2019/12/31	12
SCC-G39	AT	151616	Coaxial Cable	Junkosha	MWX241-01000KMSK MS/B	1612Q037	2018/12/25	2019/12/31	12
SOS-06	AT	146294	Humidity Indicator	A&D	AD-5681	4062118	2018/12/5	2019/12/31	12
SOS-09	AT	146318	Humidity Indicator	A&D	AD-5681	4061484	2018/12/5	2019/12/31	12
SPM-13	AT	169910	Power Meter	EMC Instruments Corporation	8990B	MY51000448	2019/3/6	2020/3/31	12
SPSS-06	AT	169911	Power sensor	EMC Instruments Corporation	N1923A	MY57270004	2019/3/6	2020/3/31	12
SRENT-15	AT	160899	Spectrum Analyzer	AGILENT (KEYSIGHT)	E4440A	MY46185516	2019/1/21	2020/1/31	12
SSA-03	AT	145801	Spectrum Analyzer	AGILENT	E4448A	MY48250152	2019/8/8	2020/8/31	12
STM-G8	AT	171615	Terminator	Weinschel - API Technologies Corp	M1459A	88997	2019/7/4	2020/7/31	12
STM-G9	AT	171616	Terminator	Weinschel - API Technologies Corp	M1459A	89025	2019/7/4	2020/7/31	12
STS-03	AT	146210	Digital Hitester	HIOKI	3805-50	80997823	2019/10/1	2020/10/31	12

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

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

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

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

Test item: AT: Antenna Terminal Conducted test

UL Japan, Inc.

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