



RADIO TEST REPORT

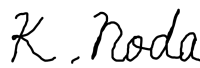
Test Report No. : 13977035S-A

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

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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.

Date of test: October 20 to November 30, 2021

Representative test engineer: 
Kenichi Adachi
Engineer

Approved by: 
Kazuya Noda
Leader



CERTIFICATE 1266.03

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

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REVISION HISTORY

Original Test Report No.: 13977035S-A

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

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Reference: Abbreviations (Including words undescribed in this report)

A2LA	The American Association for Laboratory Accreditation	LIMS	Laboratory Information Management System
AC	Alternating Current	MCS	Modulation and Coding Scheme
AFH	Adaptive Frequency Hopping	MRA	Mutual Recognition Arrangement
AM	Amplitude Modulation	N/A	Not Applicable
Amp, AMP	Amplifier	NIST	National Institute of Standards and Technology
ANSI	American National Standards Institute	NS	No signal detect.
Ant, ANT	Antenna	NSA	Normalized Site Attenuation
AP	Access Point	OBW	Occupied BandWidth
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	Quadrature Phase Shift Keying
CW	Continuous Wave	RBW	Resolution BandWidth
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	RNSS	Radio Navigation Satellite Service
DSSS	Direct Sequence Spread Spectrum	RSS	Radio Standards Specifications
DUT	Device Under Test	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	SVSWR	Site-Voltage Standing Wave Ratio
EMI	ElectroMagnetic Interference	TR, T/R	Test Receiver
EN	European Norm	Tx	Transmitting
ERP, e.r.p.	Effective Radiated Power	VBW	Video BandWidth
ETSI	European Telecommunications Standards Institute	Vert.	Vertical
EU	European Union	WLAN	Wireless LAN
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		

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SECTION 1: Customer information

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

The information provided from the customer is as follows;

- Applicant, Type of EUT, Model Number of EUT, FCC ID on the cover and other relevant pages
 - Operating/Test Mode(s) (Mode(s)) on all the relevant pages
 - SECTION 1: Customer information
 - SECTION 2: Equipment under test (EUT) other than the Receipt Date
 - SECTION 4: Operation of EUT during testing
- * The laboratory is exempted from liability of any test results affected from the above information in SECTION 2 and 4.

SECTION 2: Equipment under test (EUT)

2.1 Identification of EUT

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

2.2 Product Description

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

The EUT has following similar model:

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

General Specification

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

Radio Specification

Bluetooth

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

Bluetooth Low Energy

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

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

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

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

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

SECTION 3: Test specification, procedures & results

3.1 Test Specification

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

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

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

3.2 Procedures and results

Item	Test Procedure	Specification	Worst margin	Results	Remarks
Conducted Emission	FCC: ANSI C63.10-2013 6. Standard test methods ISED: RSS-Gen 8.8	FCC: Section 15.207 ISED: RSS-Gen 8.8	N/A	N/A	*1)
6 dB 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 (below 30 MHz)	FCC: KDB 558074 D01 15.247 Meas Guidance v05r02 ISED: RSS-Gen 6.13	FCC: Section15.247(d) ISED: RSS-247 5.5 RSS-Gen 8.9 RSS-Gen 8.10	See data.	Complied d)	Conducted
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.

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3.3 Addition to standard

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

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

3.4 Uncertainty

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

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

Shonan EMC Lab.

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

3.5 Test Location

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A2LA Certificate Number: 1266.03

(FCC test firm registration number: 626366, ISED lab company number: 2973D / CAB identifier: JP0001)

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

3.6 Test data, Test instruments, and Test set up

Refer to APPENDIX.

SECTION 4: Operation of EUT during testing

4.1 Operating Mode(s)

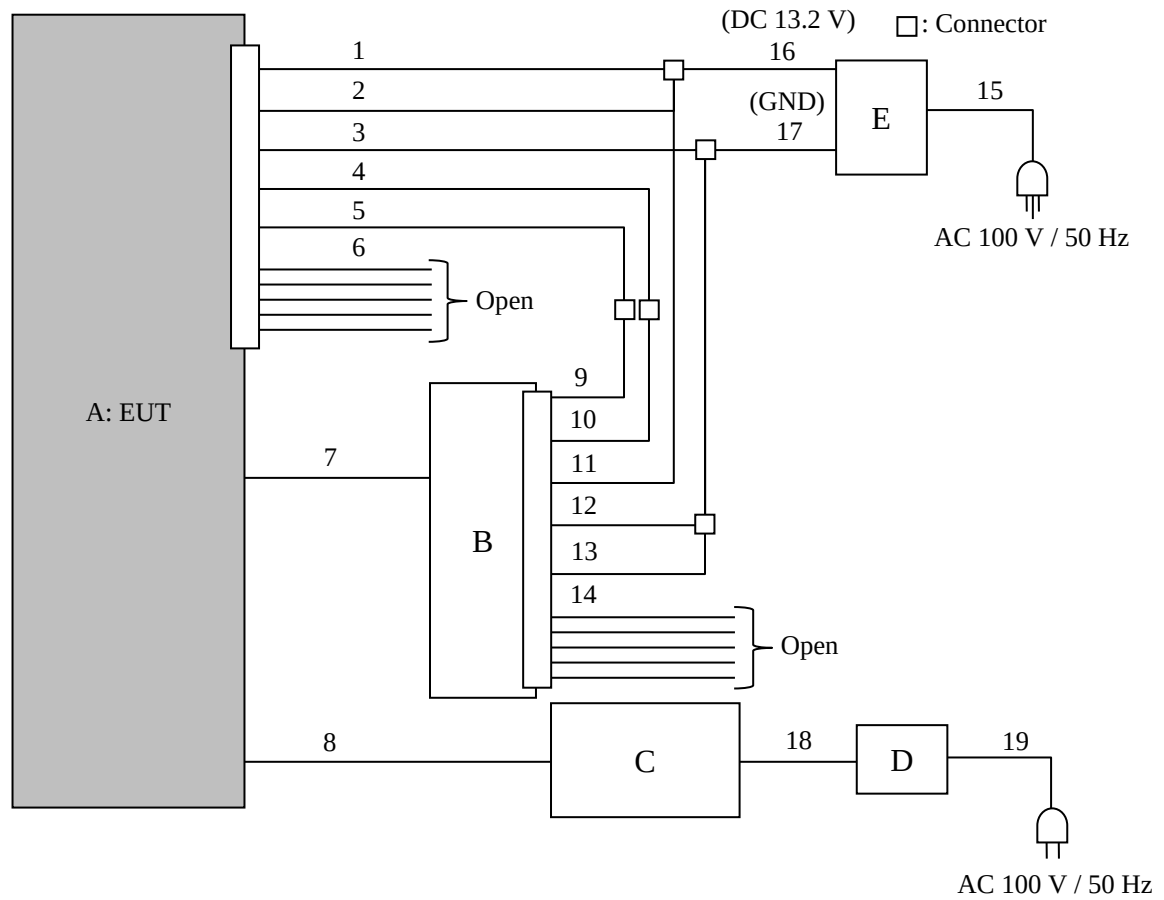
Test operating mode was determined as follows according to “Section 1 of 6 802.11 a/b/g/n testing - Managing Complex Regulatory Approvals - ” of TCB Council Workshop October 2009.

Mode	Remarks*
IEEE 802.11b (11b)	5.5 Mbps (Short), PN9
IEEE 802.11g (11g)	36 Mbps, PN9
IEEE 802.11n 20 MHz BW SISO (11n-20)	MCS 5, PN9
Bluetooth Low Energy (BT LE)	PRBS9
*The worst condition was determined based on the test result of Maximum Peak Output Power. (Mid Channel)	
*Power of the EUT was set by the software as follows; Power settings: 11b: 14 dBm, 11g/n-20: 11 dBm BT LE: 8 (setting value) Software: QRCT (Qualcomm Radio Control Toolkit) v4.0.00195.0 (Date: 2021.10.18, Storage location: Driven by connected PC) *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
Spurious Emission (Conducted)	Tx 11g	2462 MHz
	Tx BT LE	2402 MHz
		2440 MHz
		2480 MHz
Maximum Peak Output Power	Tx 11b	2412 MHz
6 dB Bandwidth	Tx 11g	2437 MHz
Power Density	Tx 11n-20	2462 MHz
99 % Occupied Bandwidth	Tx BT LE	2402 MHz
		2440 MHz
		2480 MHz
		2480 MHz

4.2 Configuration and peripherals



Description of EUT and Support equipment

No.	Item	Model number	Serial number	Manufacturer	Remark
A	Head unit	AH001CB	73	ALPS ALPINE	EUT
B	Display	QH00159A	114	ALPS ALPINE	-
C	Laptop Computer	7666-77J	LV-B8R1X 08/05	Lenovo	-
D	AC Adapter	42T4422	11S92P1154Z1DXF1DBF DN	Lenovo	-
E	Power Supply (DC)	PW16-5ADP	19100034	TEXIO	-

List of cables used

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

SECTION 5: Antenna Terminal Conducted Tests

Test Procedure

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

Test	Span	RBW	VBW	Sweep time	Detector	Trace	Instrument used
6 dB Bandwidth	10 MHz (BT LE) 50 MHz (WLAN)	100 kHz	300 kHz	Auto	Peak	Max Hold	Spectrum Analyzer
99 % Occupied Bandwidth *1)	Enough width to display emission skirts	1 to 5 % of OBW	Three times of RBW	Auto	Peak	Max Hold	Spectrum Analyzer
Maximum Peak Output Power	-	-	-	Auto	Peak/ Average *2)	-	Power Meter (Sensor: 160 MHz BW)
Peak Power Density	1.5 times the 6 dB Bandwidth	3 kHz	9.1 kHz	Auto	Peak	Max Hold	Spectrum Analyzer *3)
Conducted Spurious Emission *4) *5)	9 kHz to 150 kHz 150 kHz to 30 MHz	200 Hz 10 kHz	620 Hz 30 kHz	Auto	Peak	Max Hold	Spectrum Analyzer

*1) Peak hold was applied as Worst-case measurement.
 *2) Reference data
 *3) Section 11.10.2 Method PKPSD (peak PSD) of "ANSI C63.10-2013".
 *4) In the frequency range below 30 MHz, RBW was narrowed to separate the noise contents.
 Then, wide-band noise near the limit was checked separately, however the noise was not detected as shown in the chart.
 (9 kHz - 150 kHz: RBW = 200 Hz, 150 kHz - 30 MHz: RBW = 10 kHz)
 *5) The limits in CFR 47, Part 15, Subpart C, paragraph 15.209(a), are identical to those in RSS-Gen section 8.9, Table 6, since the measurements are performed in terms of magnetic field strength and converted to electric field strength levels (as reported in the table) using the free space impedance of 377 Ohms. For example, the measurement at frequency 9 kHz resulted in a level of 45.5 dBuV/m, which is equivalent to $45.5 - 51.5 = -6.0$ dBuA/m, which has the same margin, 3 dB, to the corresponding RSS-Gen Table 6 limit as it has to 15.209(a) limit.

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

Test data : APPENDIX
 Test result : Pass

APPENDIX 1: Test data

99 % Occupied Bandwidth and 6 dB Bandwidth

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

BT LE 1M-PHY

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

11b

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

11g

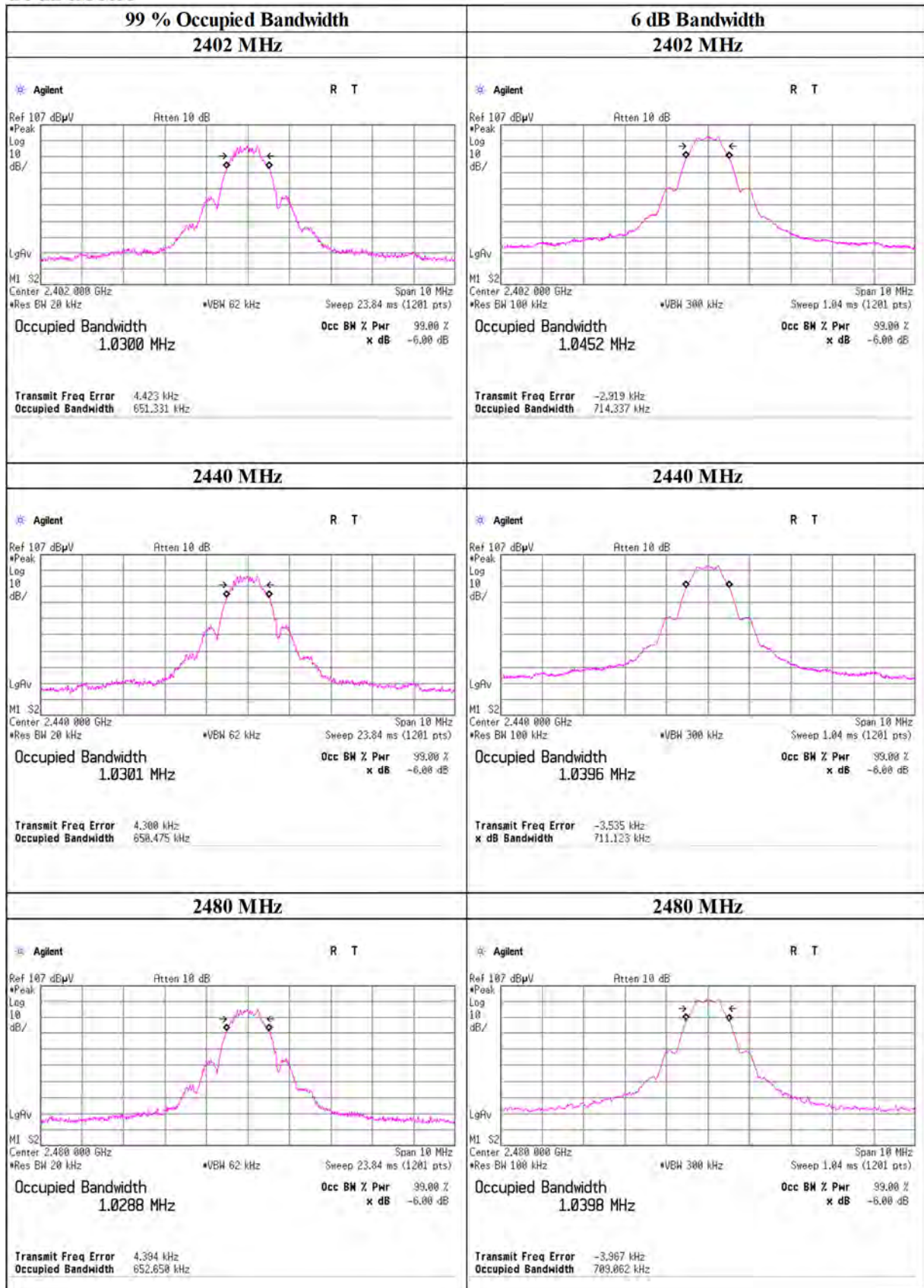
Frequency [MHz]	99 % Occupied Bandwidth [kHz]	6 dB Bandwidth [MHz]	Limit for 6 dB Bandwidth [MHz]
2412	16888.4	16.530	> 0.5000
2437	16885.5	16.524	> 0.5000
2462	16885.1	16.541	> 0.5000

11n-20 (SISO)

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

99 % Occupied Bandwidth and 6 dB Bandwidth

BT LE IM-PHY



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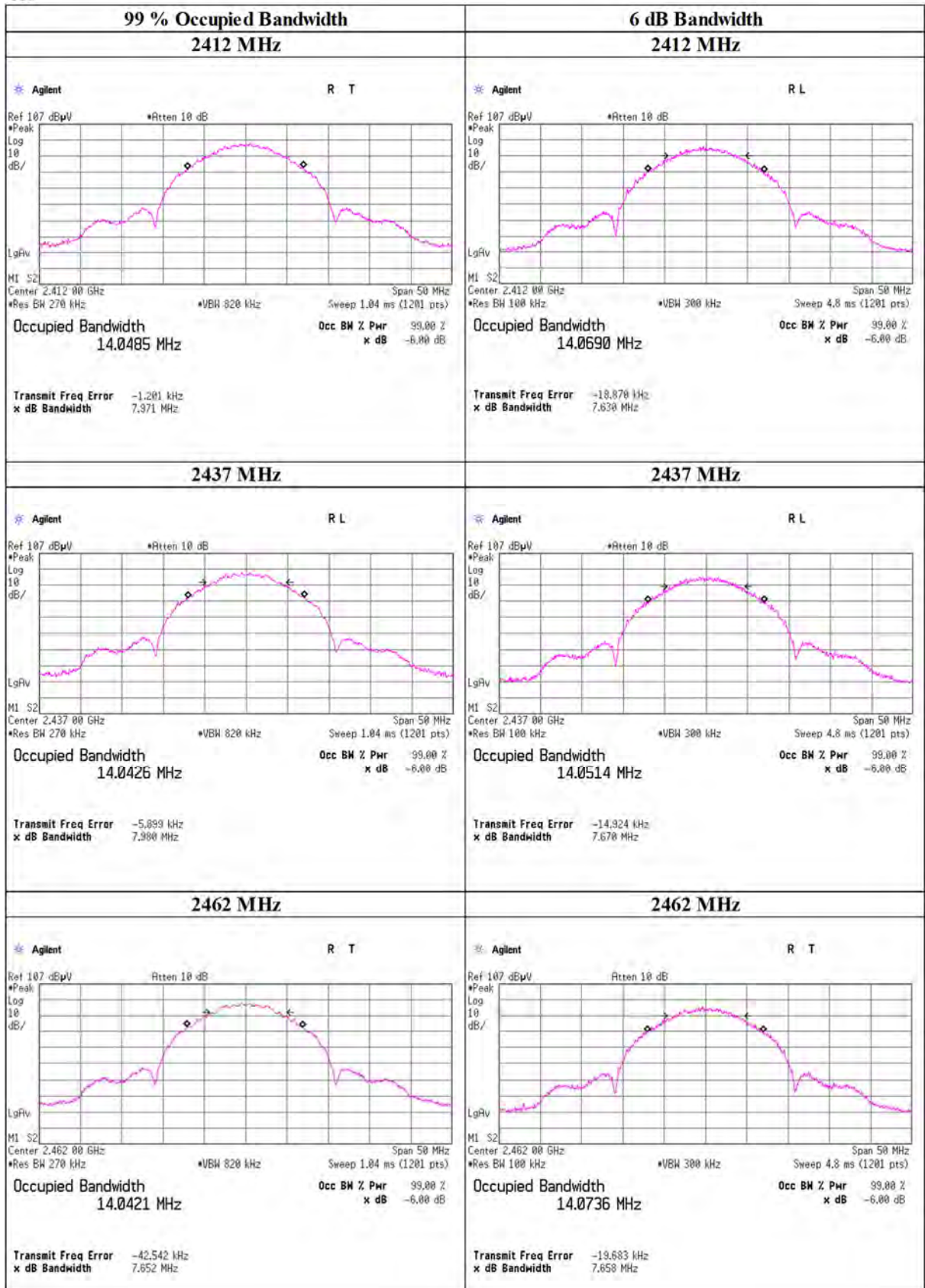
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99 % Occupied Bandwidth and 6 dB Bandwidth

11b



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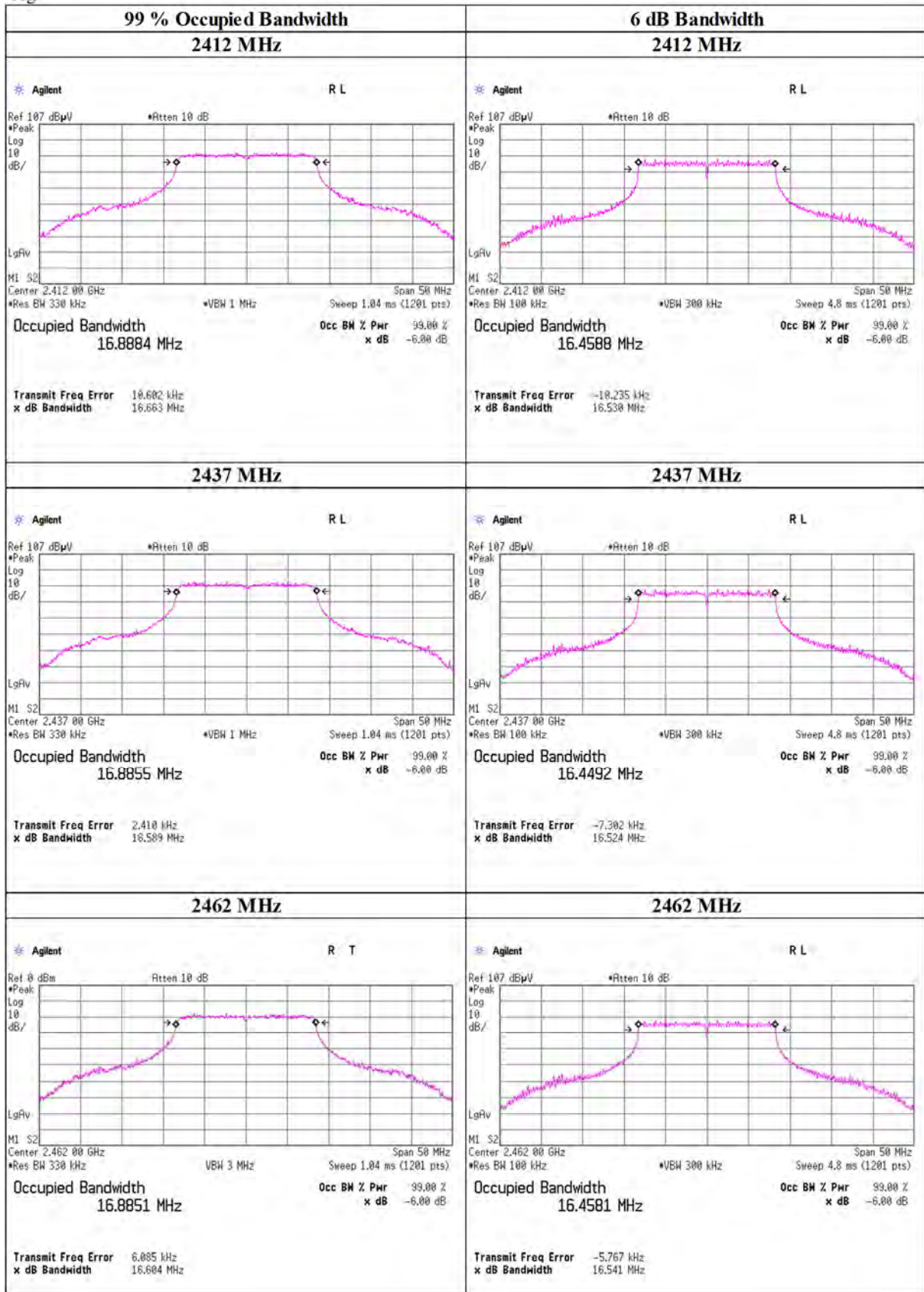
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99 % Occupied Bandwidth and 6 dB Bandwidth

11g



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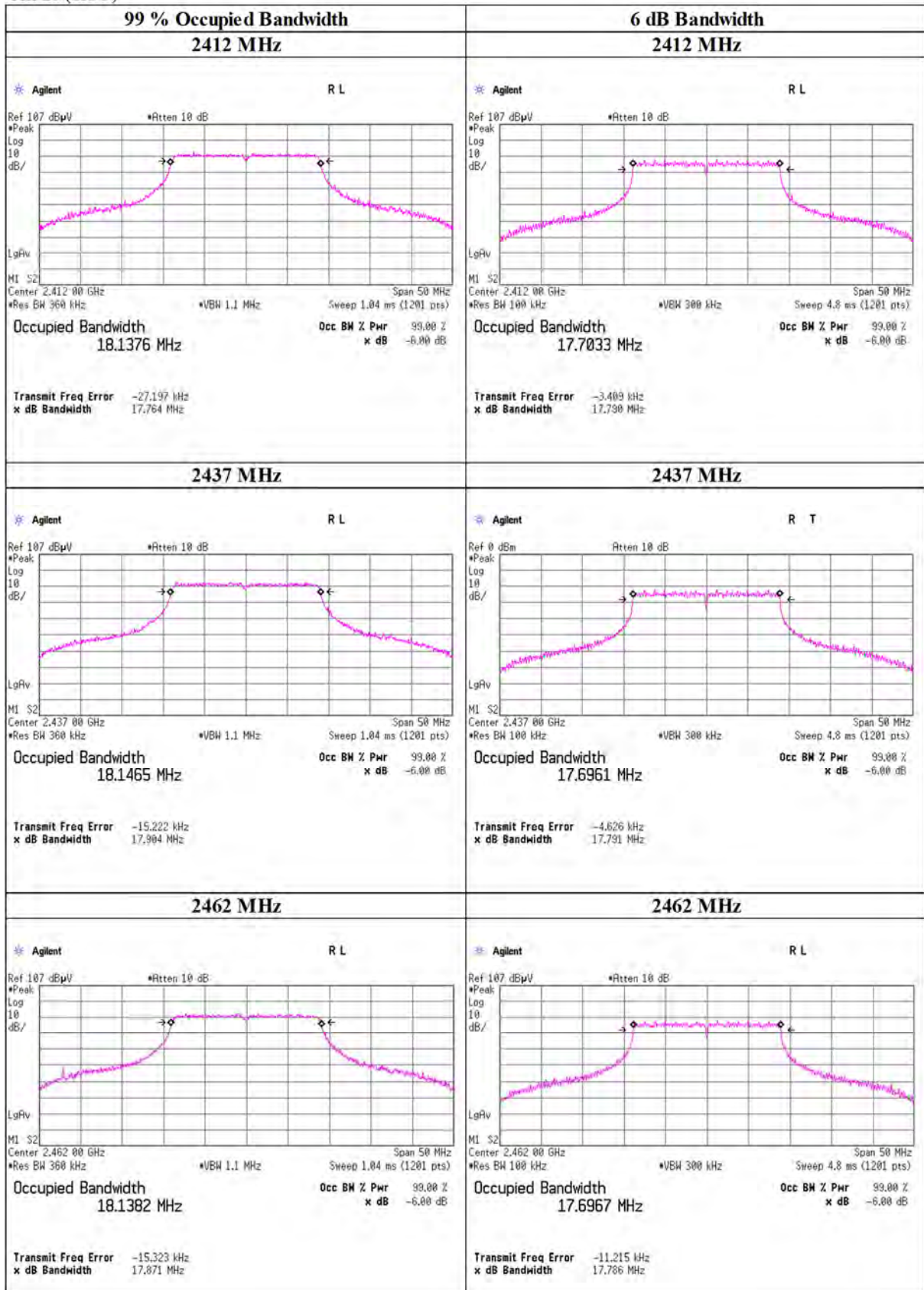
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99 % Occupied Bandwidth and 6 dB Bandwidth

11n-20 (SISO)



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Maximum Peak Output Power and Average power

(Average power: Reference data for RF Exposure)

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

BT LE 1M-PHY

Maximum peak output power

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

Sample Calculation:

Result = Reading + Cable Loss + Attenuator Loss

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

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

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

BT LE 1M-PHY

Average power

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

Sample Calculation:

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

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

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

Maximum Peak Output Power

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

11b 5.5 (short) Mbps

Maximum peak output power

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

11g 36 Mbps

Maximum peak output power

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

11n-20 (SISO) MCS 5

Maximum peak output power

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

Sample Calculation:

Result = Reading + Cable Loss + Attenuator Loss

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

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

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

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Maximum Peak Output Power and Average Output Power

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

(Peak)

11b 2437 MHz

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

**: Worst Rate

(Average)

11b 2437 MHz

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

**: Worst Rate

11g 2437 MHz

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

**: Worst Rate

11g 2437 MHz

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

**: Worst Rate

11n-20 2437 MHz

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

**: Worst Rate

11n-20 2437 MHz

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

**: Worst Rate

Sample Calculation:

Average Result = Reading + Duty Factor

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Average Output Power
(Reference data for RF Exposure)

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

11b

5.5 (short) Mbps

Average power

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

11g

18 Mbps

Average power

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

11n-20 (SISO)

MCS 3

Average power

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

Sample Calculation:

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

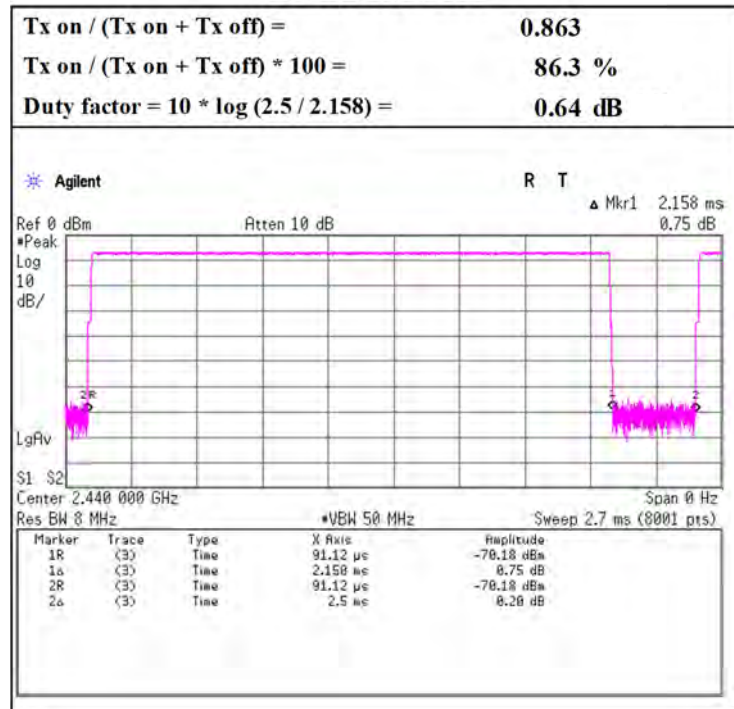
Result (Burst power average) = Result (Time average) + Duty factor

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

Burst rate confirmation

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

BT LE 1M-PHY

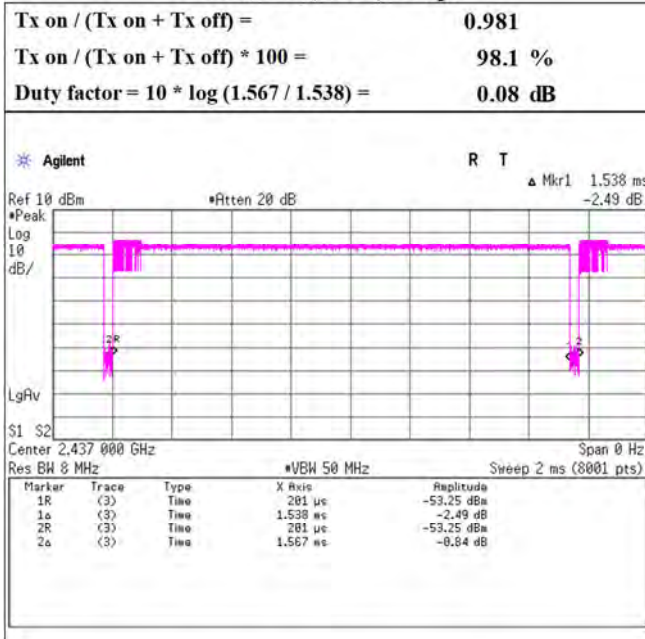


* Since the burst rate is not different between the channels, the data has been obtained on the representative channel.

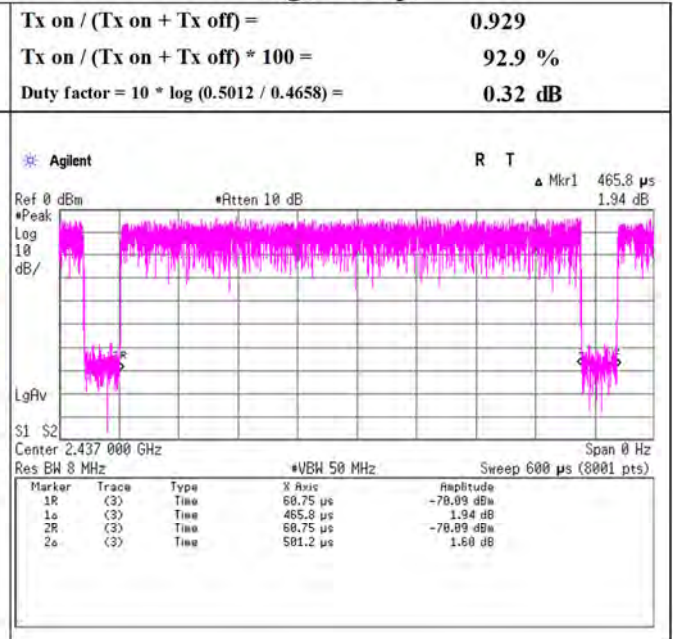
Burst rate confirmation (Average Output Power Worst Rate)

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

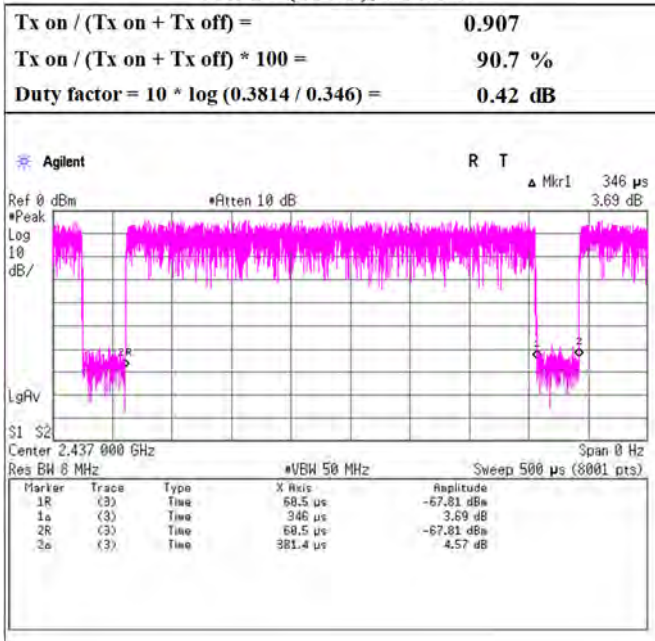
11b, 5.5 (short) Mbps



11g, 18 Mbps



11n-20 (SISO), MCS 3



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

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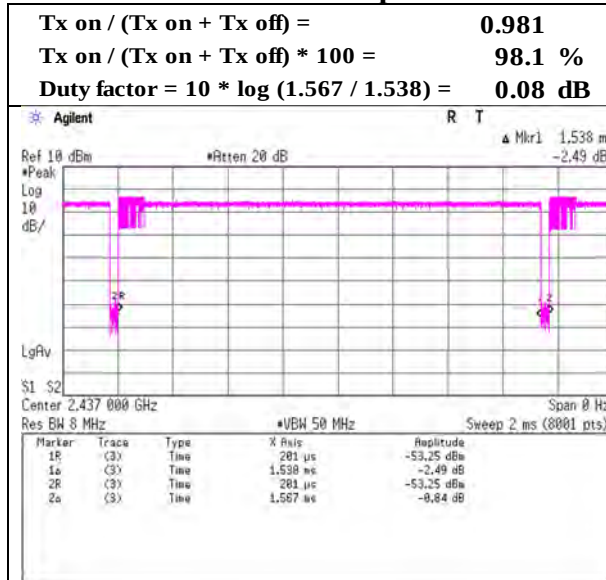
Facsimile : +81 463 50 6401

Burst rate confirmation

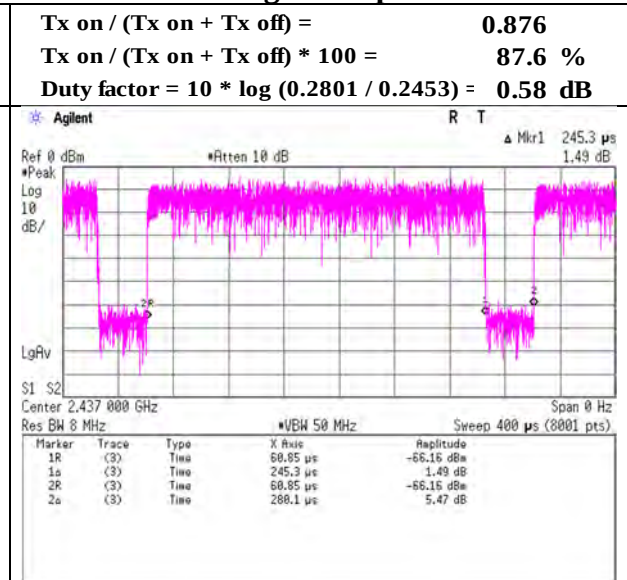
(Maximum Peak Output Power Worst Rate)

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

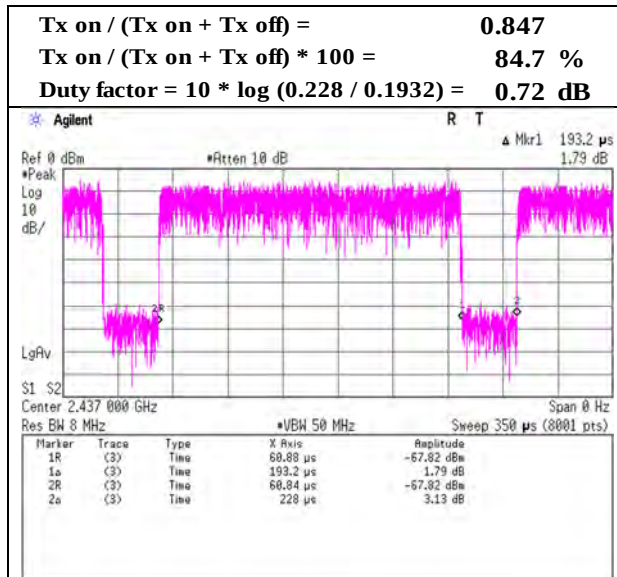
11b 5.5 Mbps



11g 36 Mbps



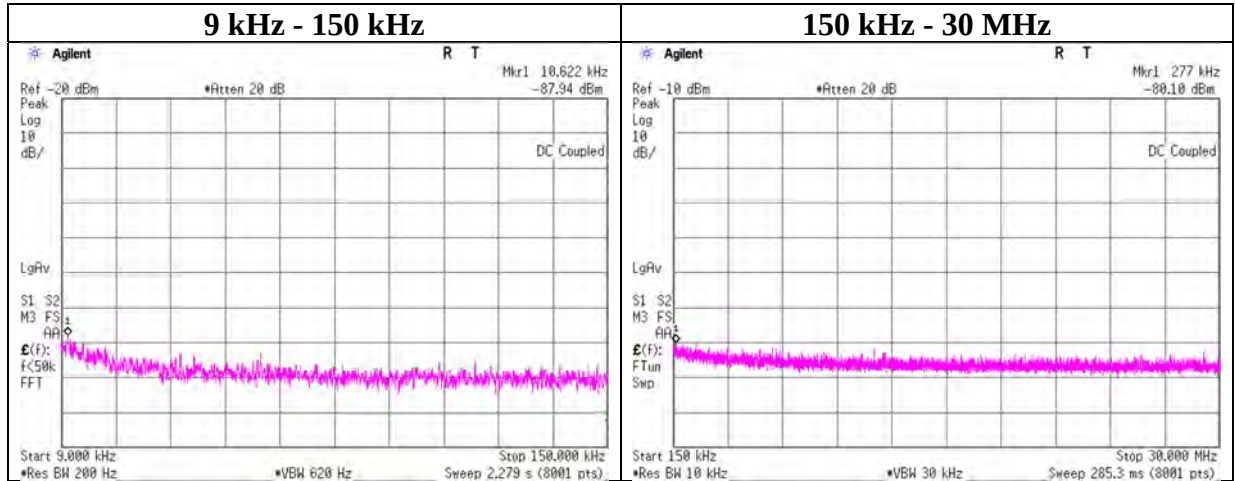
11n-20 MCS 5



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

Conducted Spurious Emission

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



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

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

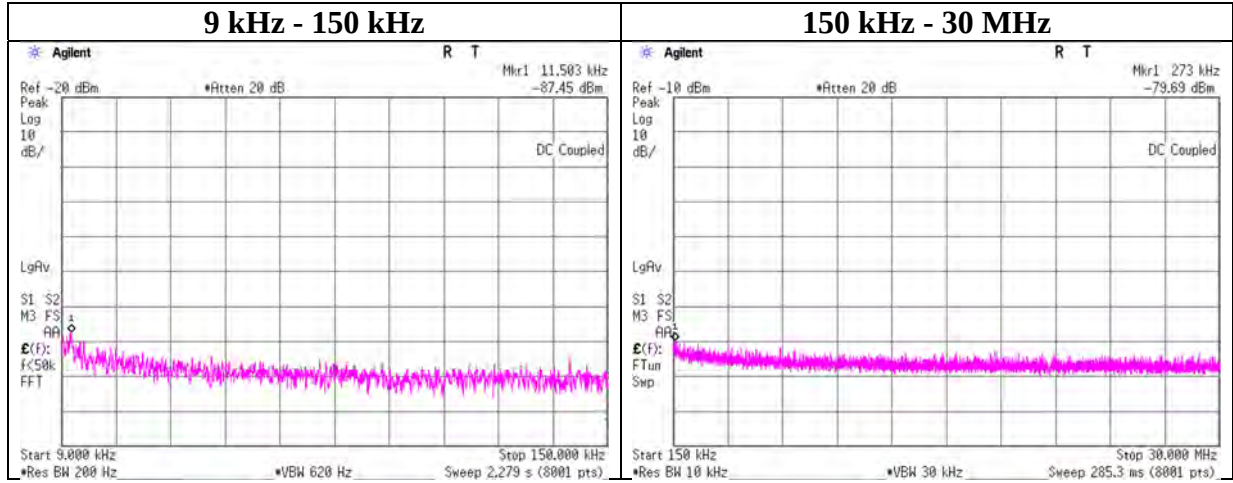
$\text{EIRP [dBm]} = \text{Reading [dBm]} + \text{Cable loss [dB]} + \text{Attenuator Loss [dB]} + \text{Antenna gain [dBi]} + 10 * \log (N)$

N: Number of output

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

Conducted Spurious Emission

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



Frequency [kHz]	Reading [dBm]	Cable Loss [dB]	Attenuator Loss [dB]	Antenna Gain* [dBi]	N (Number of Output)	EIRP [dBm]	Distance [m]	Ground bounce [dB]	E (field strength) [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
11.503	-87.45	0.02	9.54	2.0	1	-75.9	300	6.0	-14.6	46.3	60.9	-
273.000	-79.69	0.02	9.54	2.0	1	-68.1	300	6.0	-6.9	18.8	25.7	-

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

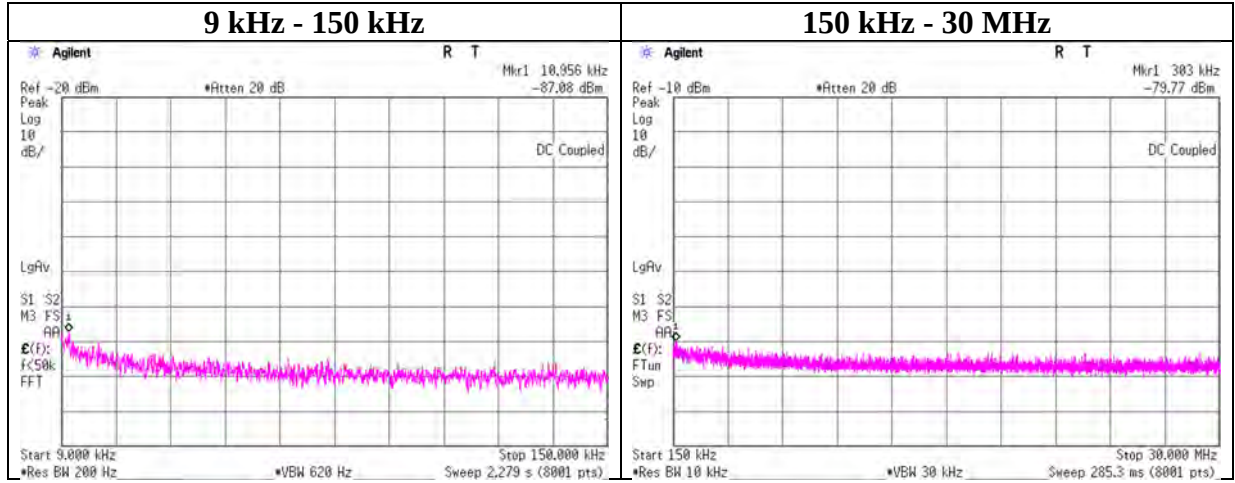
$EIRP [dBm] = Reading [dBm] + Cable\ loss [dB] + Attenuator\ Loss [dB] + Antenna\ gain [dBi] + 10 * \log (N)$

N: Number of output

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

Conducted Spurious Emission

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



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

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

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

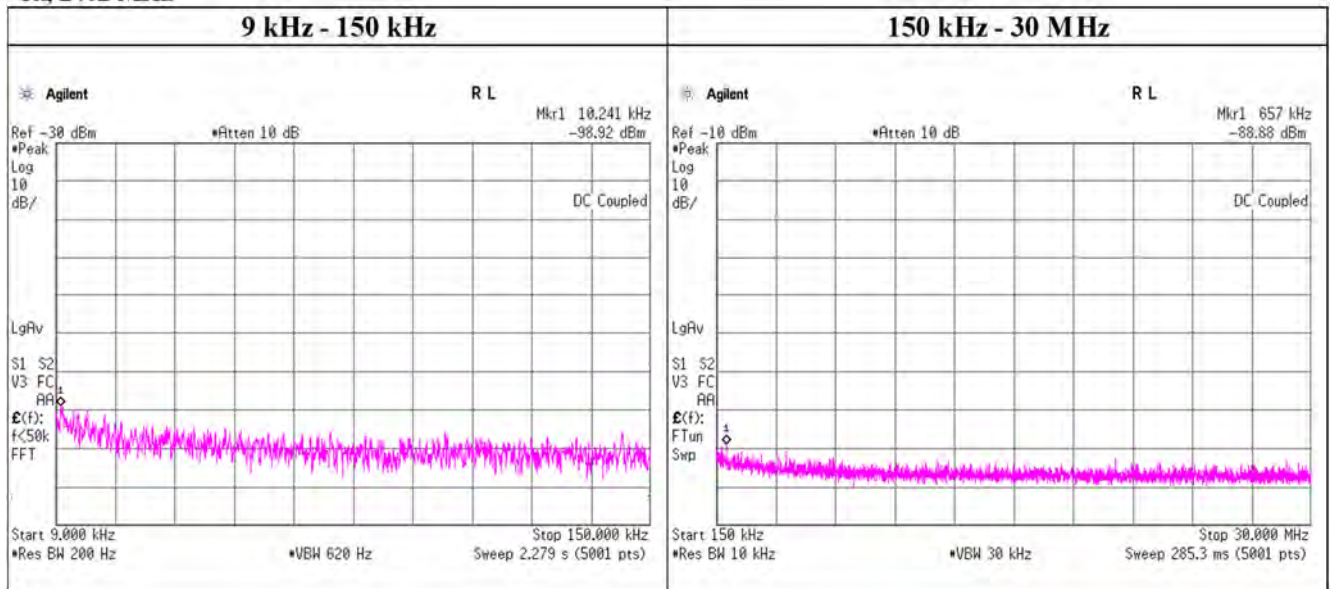
N: Number of output

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

Conducted Spurious Emission

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

Tx, 2462 MHz



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

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

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

N: Number of output

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

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Power Density

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

BT LE 1M-PHY

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

11b

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

11g

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

11n-20 (SISO)

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

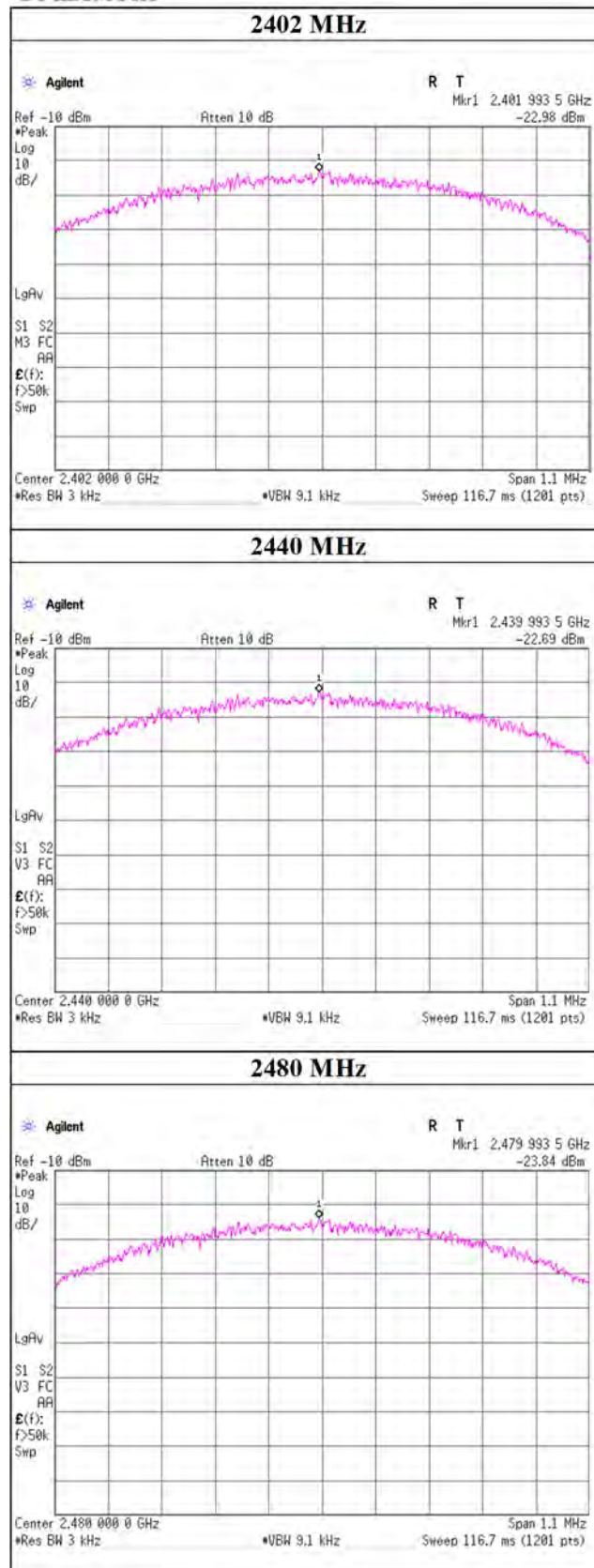
Sample Calculation:

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

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

Power Density

BT LE1M-PHY



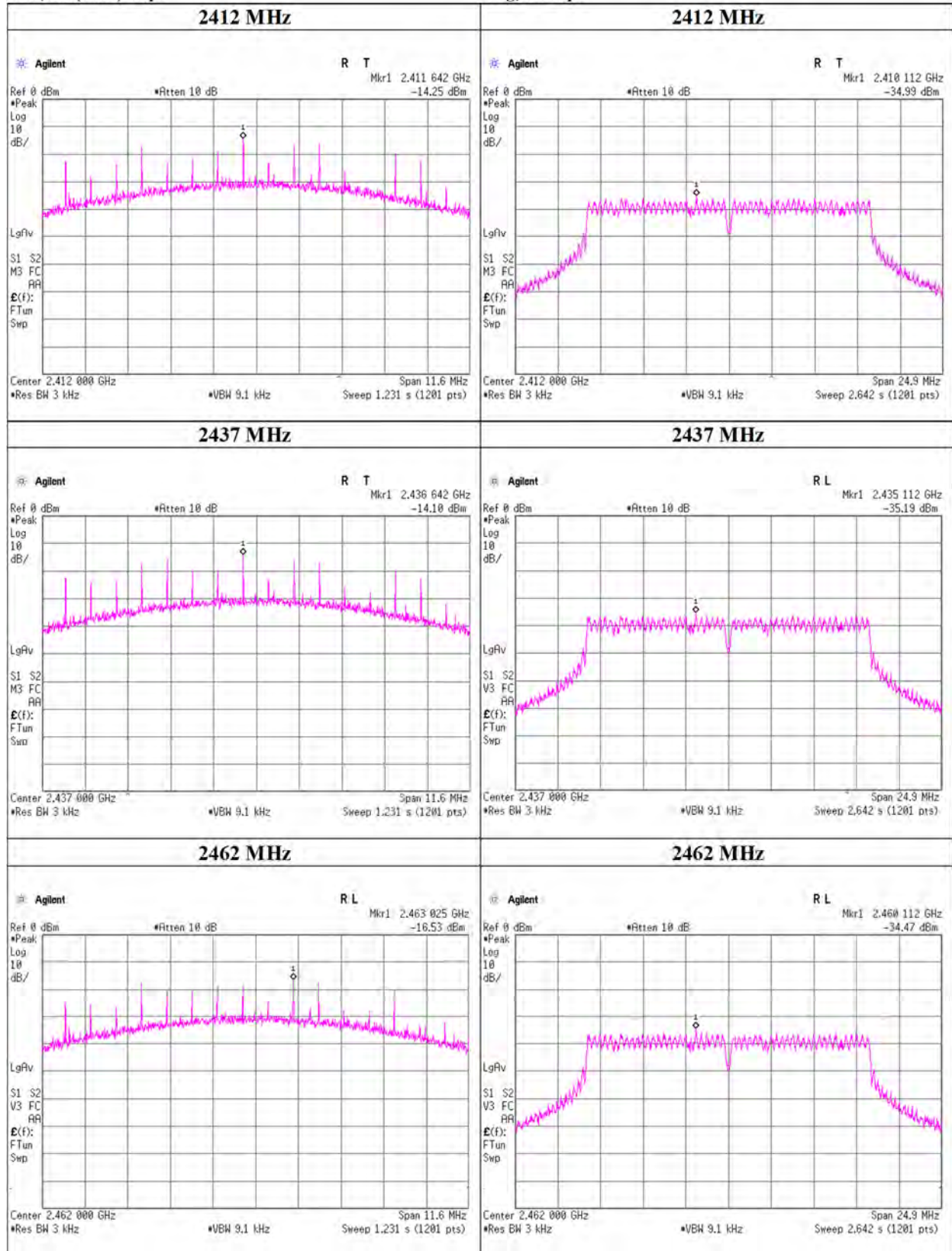
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Power Density

11b, 5.5 (short) Mbps

11g, 36 Mbps



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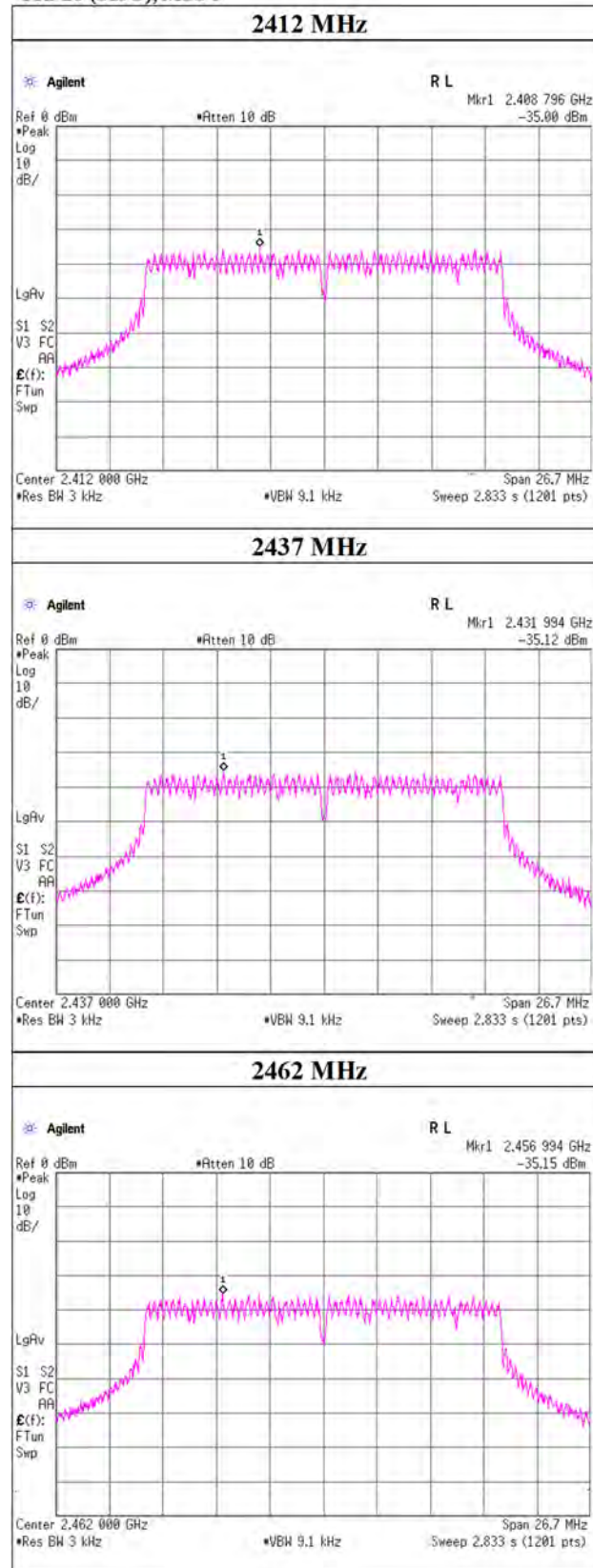
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Power Density

11n-20 (SISO), MCS 5



APPENDIX 2: Test instruments

Test equipment

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

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

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

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

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

Test item: AT: Antenna Terminal Conducted Tests

UL Japan, Inc.

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