

RADIO TEST REPORT

Test Report No. 14747914S-B

Customer	Panasonic Automotive Systems Co., Ltd.
Description of EUT	Car Navigation
Model Number of EUT	AT2403
FCC ID	ACJ932AT2403
Test Regulation	FCC Part 15 Subpart C
Test Result	Complied
Issue Date	October 25, 2024
Remarks	Wireless LAN (2.4 GHz band) and Bluetooth Low Energy part(s) Antenna Terminal Conducted Tests

Representative Test EngineerShiro Kobayashi
Engineer**Approved By**Shinichi Takano
Engineer

CERTIFICATE 1266.03

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

Report Cover Page - Form-ULID-003532 (DCS:13-EM-F0429) Issue# 23.0

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- The information provided by the customer for this report is identified in SECTION 1.
- The laboratory is not responsible for information provided by the customer which can impact the validity of the results.
- For test report(s) referred in this report, the latest version (including any revisions) is always referred.

REVISION HISTORY

Original Test Report No.: 14747914S-B

Revision	Test Report No.	Date	Page Revised Contents
- (Original)	14747914S-B	October 25, 2024	-

Reference: Abbreviations (Including words undescribed in this report)

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

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SECTION 1: Customer Information

Company Name	Panasonic Automotive Systems Co., Ltd. *1)
Address	4261, Ikonobe-cho, Tsuzuki-ku, Yokohama-shi, Kanagawa-ken 224-8520, Japan
Telephone Number	+81-50-1802-5117
Contact Person	Daisuke Takahata

*1) The Grantee name in the FCC application is "Panasonic Corporation of North America".

The information provided by the customer is as follows;

- Customer, Description of EUT, Model Number of EUT, FCC ID on the cover and other relevant pages
- Operating/Test Mode(s) (Mode(s)) on all the relevant pages
- SECTION 1: Customer Information
- SECTION 2: Equipment Under Test (EUT) other than the Receipt Date and Test Date
- SECTION 4: Operation of EUT during testing

SECTION 2: Equipment Under Test (EUT)

2.1 Identification of EUT

Description	Car Navigation
Model Number	AT2403
Serial Number	Refer to SECTION 4.2
Condition	Production prototype (Not for Sale: This sample is equivalent to mass-produced items.)
Modification	No Modification by the test lab
Receipt Date	April 3, 2023
Test Date	April 4 to May 26, 2023

2.2 Product Description

General Specification

Rating	DC 13.2 V
Operating temperature	-30 deg. C to +65 deg. C

Radio Specification

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

Bluetooth (BR / EDR / BT LE)

Equipment Type	Transceiver
Frequency of Operation	2402 MHz to 2480 MHz
Type of Modulation	FHSS, GFSK / $\pi/4$ -DQPSK, 8DPSK / GFSK
Antenna Gain ^{a)}	4.00 dBi

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

Equipment Type	Transceiver
Frequency of Operation	2412 MHz to 2462 MHz
Type of Modulation	DSSS, OFDM
	OFDMA: (20 MHz band): 26/52/106/242-tone RU
Antenna Gain ^{a)}	4.00 dBi

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

Equipment Type	Transceiver	
Frequency of Operation	20 MHz Band	5180 MHz to 5240 MHz 5745 MHz to 5825 MHz
	40 MHz Band	5190 MHz to 5230 MHz 5755 MHz to 5795 MHz
	80 MHz Band	5210 MHz, 5775 MHz
Type of Modulation	OFDM	
	OFDMA (IEEE802.11ax only)	(20 MHz band): 26/52/106/242-tone RU
		(40 MHz band): 26/52/106/242/484-tone RU
		(80 MHz band): 26/52/106/242/484/996-tone RU
Antenna Gain ^{a)}	RF0: 5.00 dBi, RF1: 5.00 dBi	

SECTION 3: Test Specification, Procedures & Results

3.1 Test Specification

Test Specification	FCC Part 15 Subpart C The latest version on the first day of the testing period
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	*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	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	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	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	Conducted (below 30 MHz)
Note: UL Japan, Inc.'s EMI Work Procedures: Work Instructions-ULID-003591 and Work Instructions-ULID-003593. * In case any questions arise about test procedure, ANSI C63.10: 2013 is also referred. *1) The test is not applicable since the EUT does not have AC Mains.					

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	-	Conducted

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

3.4 Uncertainty

Measurement uncertainty is not taken into account when stating conformity with a specified requirement.
Note: When margins obtained from test results are less than the measurement uncertainty, the test results may exceed the limit.

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

Antenna terminal test	Uncertainty (+/-)
Power Measurement above 1 GHz (Average Detector)	1.3 dB
Power Measurement above 1 GHz (Peak Detector)	1.8 dB
Spurious Emission (Conducted) below 1 GHz	0.91 dB
Conducted Emissions Power Density Measurement 1 GHz to 3 GHz	1.3 dB
Conducted Emissions Power Density Measurement 3 GHz to 18 GHz	2.5 dB
Spurious Emission (Conducted) 18 GHz to 26.5 GHz	2.8 dB
Spurious Emission (Conducted) 26.5 GHz to 40 GHz	2.6 dB
Bandwidth Measurement	0.012 %
Duty Cycle and Time Measurement	0.27 %
Temperature	2.2 deg.C.
Humidity	4.0 %
Voltage	0.74 %

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

A2LA Certificate Number: 1266.03

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

Test room	Width x Depth x Height (m)	Size of reference ground plane (m) / horizontal conducting plane	Maximum measurement distance
No.1 Semi-anechoic chamber (SAC1)	20.6 x 11.3 x 7.65	20.6 x 11.3	10 m
No.2 Semi-anechoic chamber (SAC2)	20.6 x 11.3 x 7.65	20.6 x 11.3	10 m
No.3 Semi-anechoic chamber (SAC3)	12.7 x 7.7 x 5.35	12.7 x 7.7	5 m
No.4 Semi-anechoic chamber (SAC4)	8.1 x 5.1 x 3.55	8.1 x 5.1	-
Wireless anechoic chamber 1 (WAC1)	9.5 x 6.0 x 5.4	9.5 x 6.0	3 m
Wireless anechoic chamber 2 (WAC2)	9.5 x 6.0 x 5.4	9.5 x 6.0	3 m
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	-	-
No.2 Measurement room	4.5 x 3.5 x 2.5	-	-
Wireless shielded room 1	3.0 x 4.5 x 2.7	3.0 x 4.5	-
Wireless shielded room 2	3.0 x 4.5 x 2.7	3.0 x 4.5	-

3.6 Test Data, Test Instruments, and Test Set Up

Refer to APPENDIX.

SECTION 4: Operation of EUT during testing

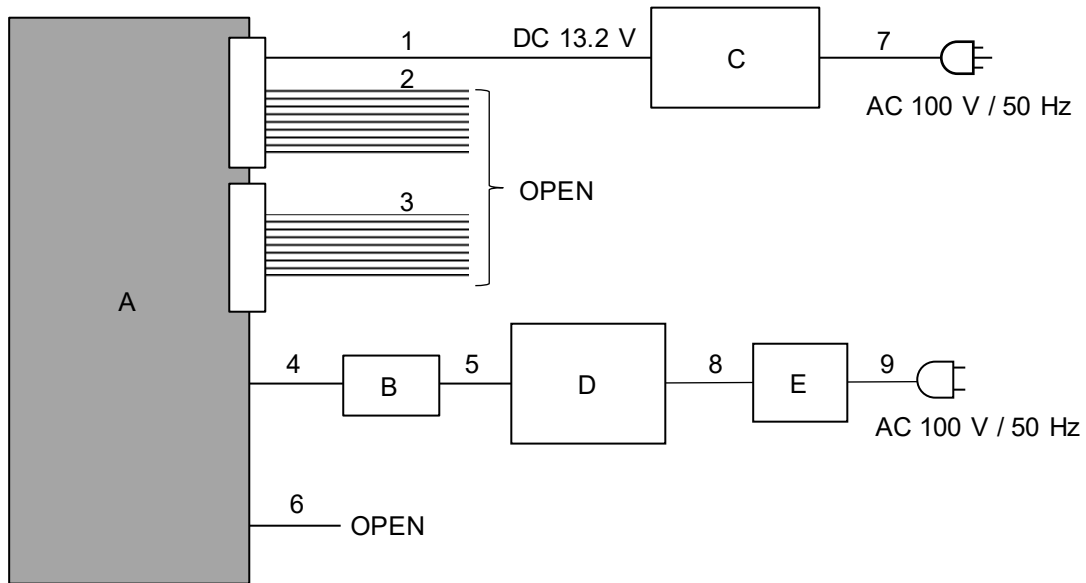
4.1 Operating Mode(s)

Mode	Remarks*
IEEE 802.11b (11b)	1 Mbps, PN9
IEEE 802.11g (11g)	24 Mbps, PN9
IEEE 802.11n 20 MHz BW (11n-20)	MCS 3 G.I. 400 ns, PN9
IEEE 802.11ax 20 MHz BW (11ax-20)	MCS 10 G.I. 1600 ns, PN9
Bluetooth Low Energy (BT LE)	1M-PHY Uncoded PHY (1M-PHY), Maximum Packet Size, PRBS9
Bluetooth Low Energy (BT LE)	2M-PHY Uncoded PHY (2M-PHY), Maximum Packet Size, PRBS9
*The worst condition was determined based on the test result of Maximum Peak Output Power (Low Channel)	
*Power of the EUT was set by the software as follows; Power Setting: 11b: 12 dBm 11g, 11n-20, 11ax-20: 13 dBm 11ax-20 OFDMA: 7 dBm (26-tone), 10 dBm (52-tone), 13 dBm (106/242-tone) BT LE: Fixed Software: wifi_2g_serial Version: 1 (Date: 2023.04.03, Storage location: Driven by connected PC) OFDMA_TX_2G_serial Version: 2 (Date: 2023.04.12, Storage location: Driven by connected PC) bluetooth_serial Version: 1 (Date: 2023.04.03, 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. 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 and also was judged the necessity of 802.11ac/ax mode by the pre-test.	

*The Details of Operating Mode(s)

Test Item	Operating Mode	Tested Frequency
Conducted Spurious Emission	Tx 11ax-20 (OFDM) *1)	2462 MHz
	Tx BT LE, 2M-PHY *1)	2402 MHz
6 dB Bandwidth, Maximum Peak Output Power, Power Density, 99 % Occupied Bandwidth	Tx 11b	2412 MHz
	Tx 11g	2437 MHz
	Tx 11n-20	2462 MHz
	Tx 11ax-20 (OFDM)	
	Tx 11ax-20 (OFDMA)	
	Tx BT LE, 1M-PHY	2402 MHz
	Tx BT LE, 2M-PHY	2440 MHz 2480 MHz
*1) The mode was tested as a representative, because it had the highest power at antenna terminal test.		

4.2 Configuration and Peripherals



Description of EUT and Support Equipment

No.	Item	Model number	Serial Number	Manufacturer	Remarks
A	Car Navigation	AT2403	008	Panasonic	EUT
B	Jig Board	-	-	-	-
C	Power Supply(DC)	PAN35-10A	DE001677	KIKUSUI	-
D	Laptop Computer	ThinkPad E14 Gen2	PF397TQG	LENOVO	-
E	AC Adapter	ADLX65YCC2D	8SSA10R16922C2TJ19M1368	LENOVO	-

List of Cables Used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	DC	1.0 + 1.9	Unshielded	Unshielded	-
2	Signal	1.0	Unshielded	Unshielded	-
3	Signal	1.0	Unshielded	Unshielded	-
4	Signal	0.1	Unshielded	Unshielded	-
5	USB	0.8	Shielded	Shielded	-
6	Signal	0.1	Unshielded	Unshielded	-
7	AC	2.0	Unshielded	Unshielded	-
8	DC	1.8	Unshielded	Unshielded	-
9	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	50 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 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 30MHz, RBW was narrowed to separate the noise contents.

Then, wide-band noise near the limit was checked separately, however the noise was not detected as shown in the chart.

(9 kHz - 150 kHz: RBW = 200 Hz, 150 kHz - 30 MHz: RBW = 10 kHz)

*5) The limits in CFR 47, Part 15, Subpart C, paragraph 15.209(a), are identical to those in RSS-Gen section 8.9, Table 6, since the measurements are performed in terms of magnetic field strength and converted to electric field strength levels (as reported in the table) using the free space impedance of 377 Ohms. For example, the measurement at frequency 9 kHz resulted in a level of 45.5 dBuV/m, which is equivalent to $45.5 - 51.5 = -6.0$ dBuA/m, which has the same margin, 3 dB, to the corresponding RSS-Gen Table 6 limit as it has to 15.209(a) limit.

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

Test Data : APPENDIX
Test Result : Pass

APPENDIX 1: Test Data

99 % Occupied Bandwidth and 6 dB Bandwidth

Test place	Shonan EMC Lab. No.5 Shielded Room		
Date	April 20, 2023	May 26, 2023	
Temperature / Humidity	27 deg. C / 46 % RH	25 deg. C / 39 % RH	
Engineer	Kouki Yamada	Shiro Kobayashi	
Mode	Tx		

11b

Frequency [MHz]	99 % Occupied Bandwidth [kHz]	6 dB Bandwidth [MHz]	Limit for 6 dB Bandwidth [MHz]
2412	13110.1	8.059	> 0.5000
2437	13116.6	8.114	> 0.5000
2462	13117.8	8.097	> 0.5000

11g

Frequency [MHz]	99 % Occupied Bandwidth [kHz]	6 dB Bandwidth [MHz]	Limit for 6 dB Bandwidth [MHz]
2412	17152.4	16.533	> 0.5000
2437	17126.2	16.536	> 0.5000
2462	17151.1	16.529	> 0.5000

11n-20

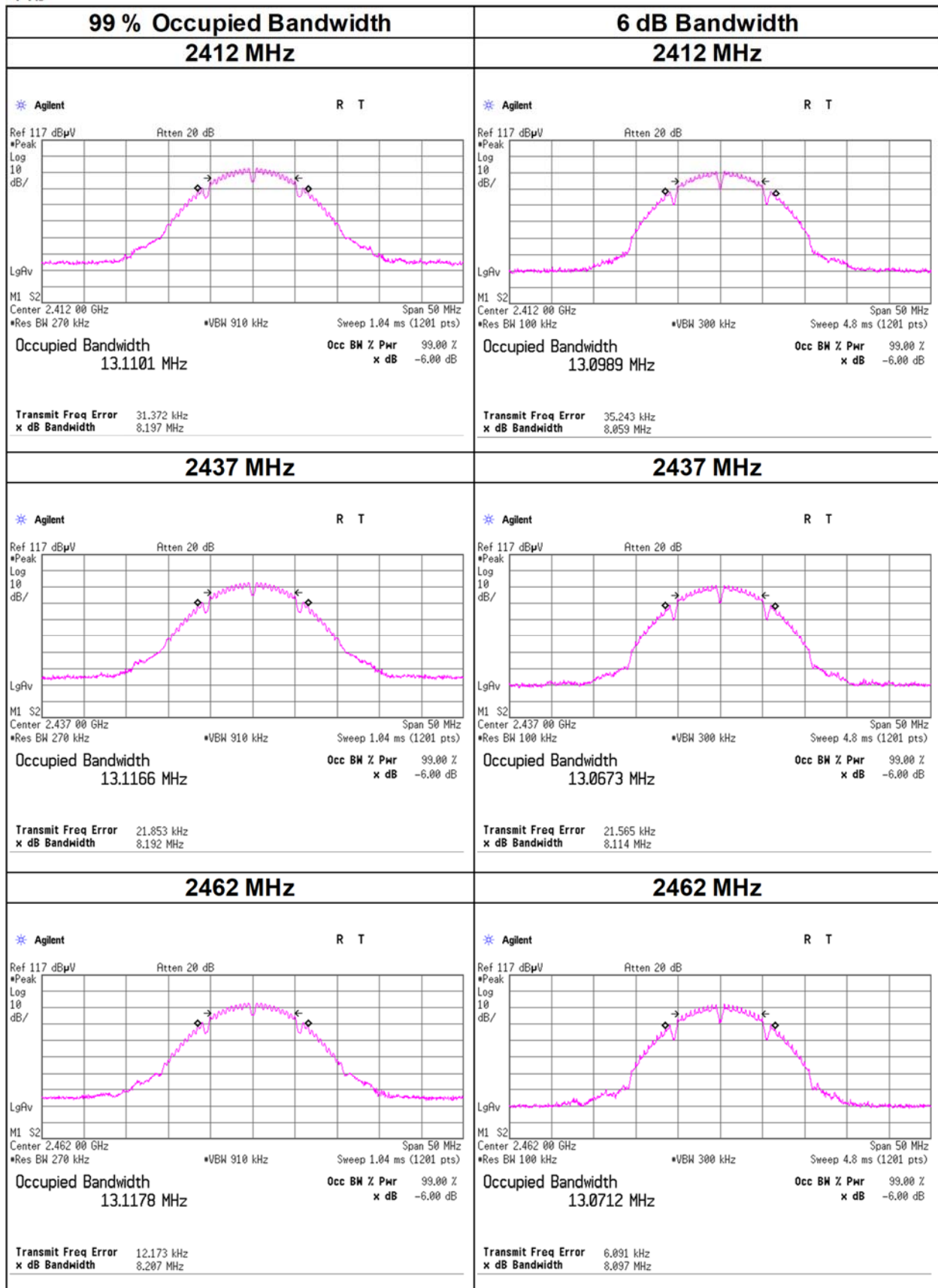
Frequency [MHz]	99 % Occupied Bandwidth [kHz]	6 dB Bandwidth [MHz]	Limit for 6 dB Bandwidth [MHz]
2412	17124.3	16.544	> 0.5000
2437	17132.9	16.542	> 0.5000
2462	17108.5	16.540	> 0.5000

11ax-20 (OFDM)

Frequency [MHz]	99 % Occupied Bandwidth [kHz]	6 dB Bandwidth [MHz]	Limit for 6 dB Bandwidth [MHz]
2412	19391.9	19.162	> 0.5000
2437	19402.1	19.124	> 0.5000
2462	19354.4	19.135	> 0.5000

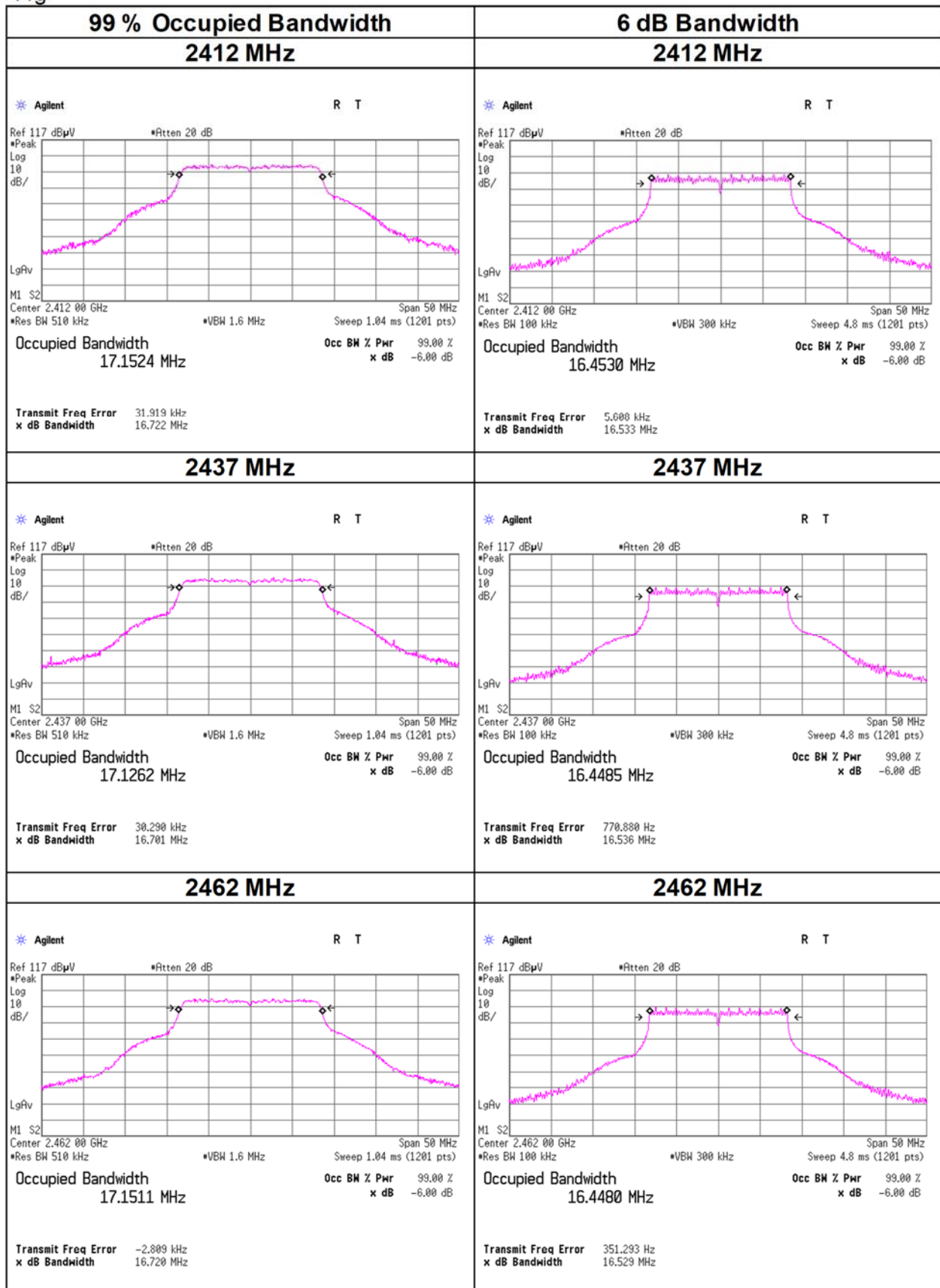
99 % Occupied Bandwidth and 6 dB Bandwidth

11b



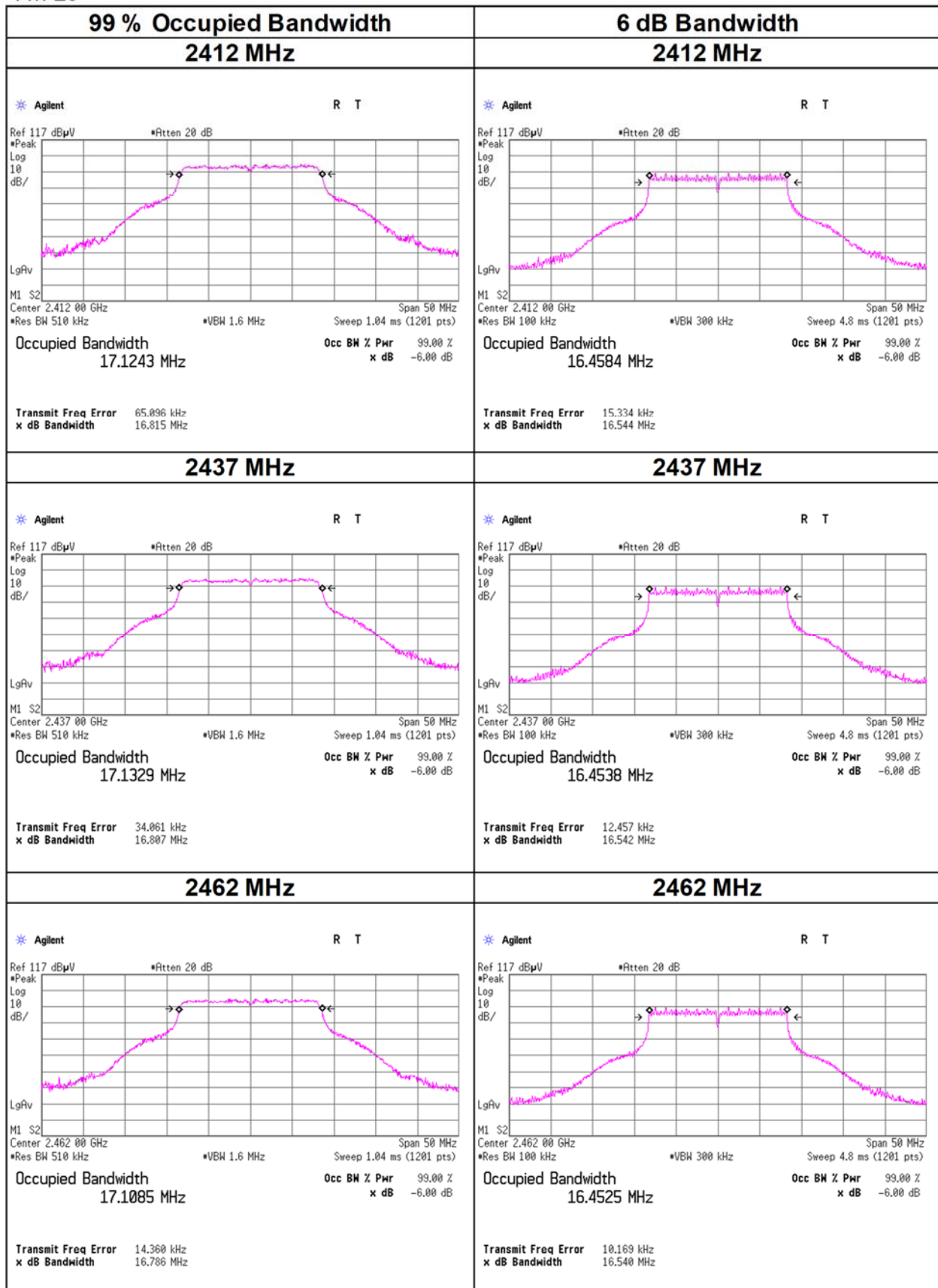
99 % Occupied Bandwidth and 6 dB Bandwidth

11g



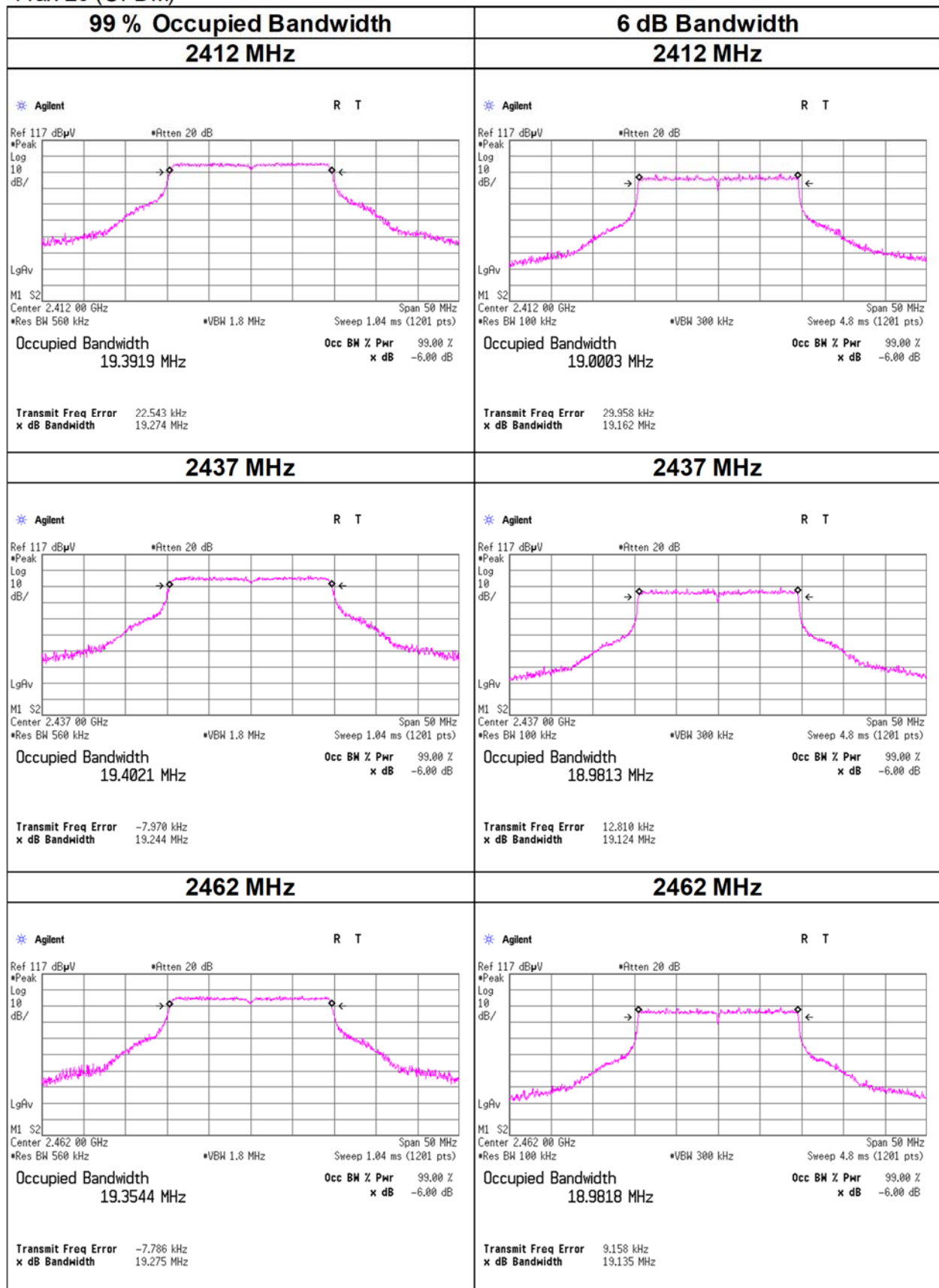
99 % Occupied Bandwidth and 6 dB Bandwidth

11n-20



99 % Occupied Bandwidth and 6 dB Bandwidth

11ax-20 (OFDM)



99 % Occupied Bandwidth and 6 dB Bandwidth

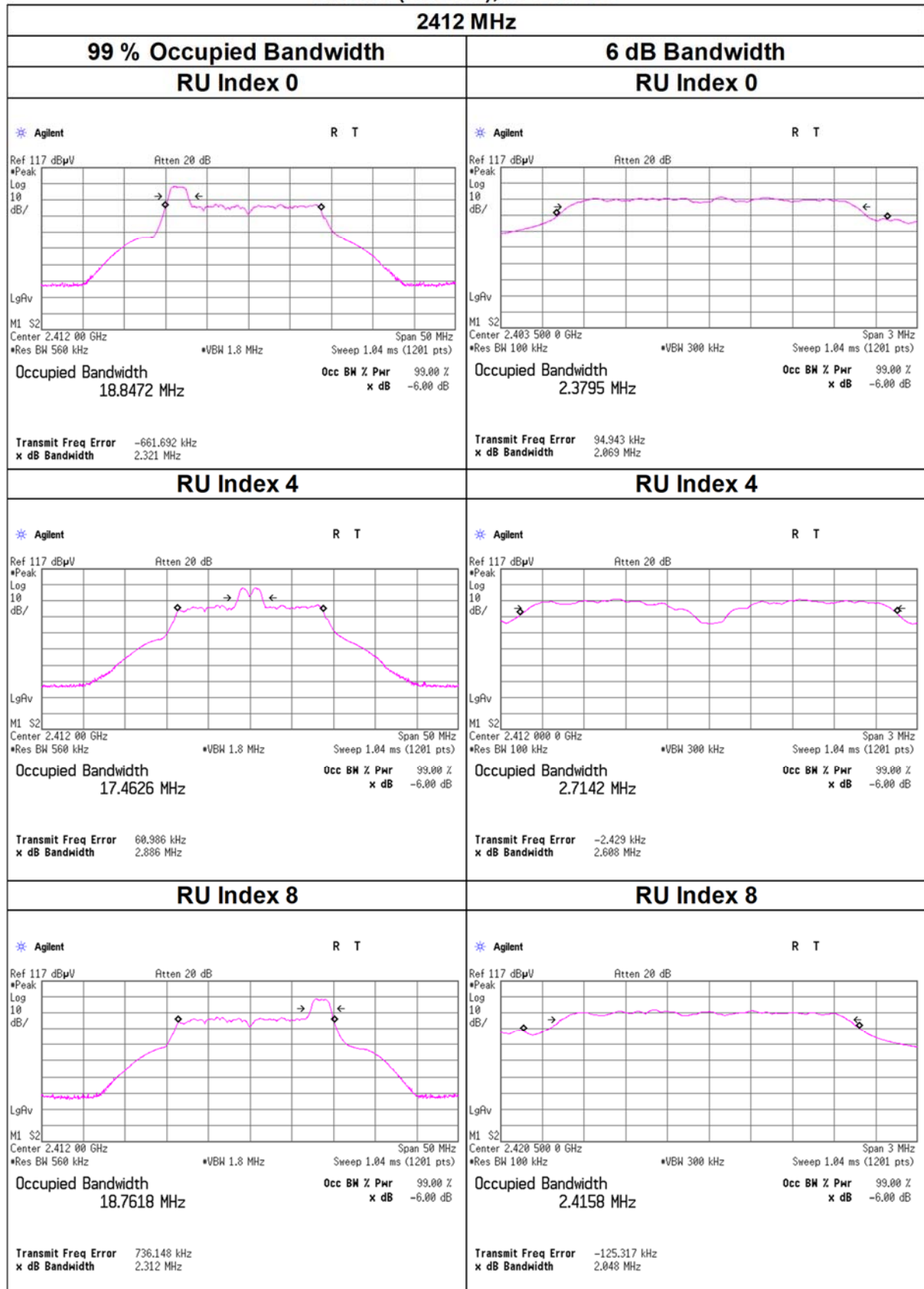
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	May 25, 2023
Temperature / Humidity	25 deg. C / 33 % RH
Engineer	Shiro Kobayashi
Mode	Tx

11ax-20 (OFDMA)

RU Type	Frequency [MHz]	RU Index	99 % Occupied Bandwidth [kHz]	6 dB Bandwidth [MHz]	Limit for 6 dB Bandwidth [MHz]
26-tone RU	2412	0	18847.2	2.069	> 0.5000
		4	17462.6	2.608	> 0.5000
		8	18761.8	2.048	> 0.5000
	2437	0	18840.7	2.073	> 0.5000
		4	17450.5	2.607	> 0.5000
		8	18772.5	2.033	> 0.5000
	2462	0	18822.9	2.071	> 0.5000
		4	17438.0	2.618	> 0.5000
		8	18771.4	2.034	> 0.5000
52-tone RU	2412	37	18691.0	4.116	> 0.5000
		38	17520.2	4.119	> 0.5000
		40	18632.9	4.090	> 0.5000
	2437	37	18666.5	4.118	> 0.5000
		38	17516.3	4.119	> 0.5000
		40	18650.6	4.082	> 0.5000
	2462	37	18667.3	4.117	> 0.5000
		38	17512.6	4.113	> 0.5000
		40	18666.0	4.085	> 0.5000
106-tone RU	2412	53	18735.9	8.396	> 0.5000
		54	18550.1	8.388	> 0.5000
	2437	53	18720.1	8.399	> 0.5000
		54	18551.1	8.398	> 0.5000
	2462	53	18713.7	8.405	> 0.5000
242-tone RU	2412	61	19318.8	19.113	> 0.5000
		61	19313.6	19.117	> 0.5000
		61	19323.3	19.102	> 0.5000

99 % Occupied Bandwidth and 6 dB Bandwidth

11ax-20 (OFDMA), 26-tone RU



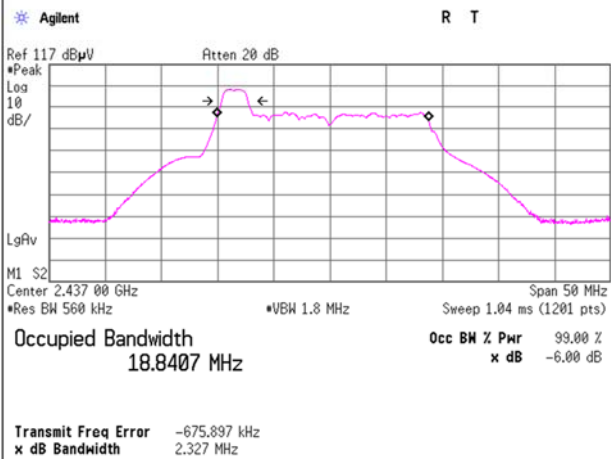
99 % Occupied Bandwidth and 6 dB Bandwidth

11ax-20 (OFDMA), 26-tone RU

2437 MHz

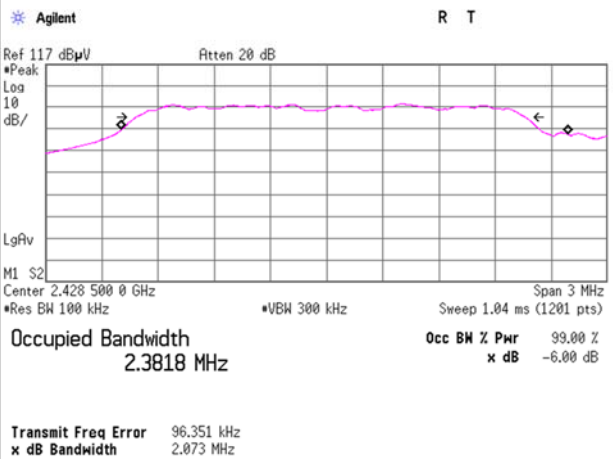
99 % Occupied Bandwidth

RU Index 0

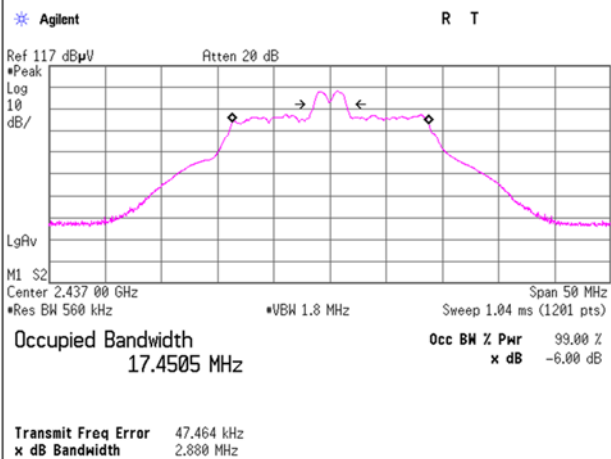


6 dB Bandwidth

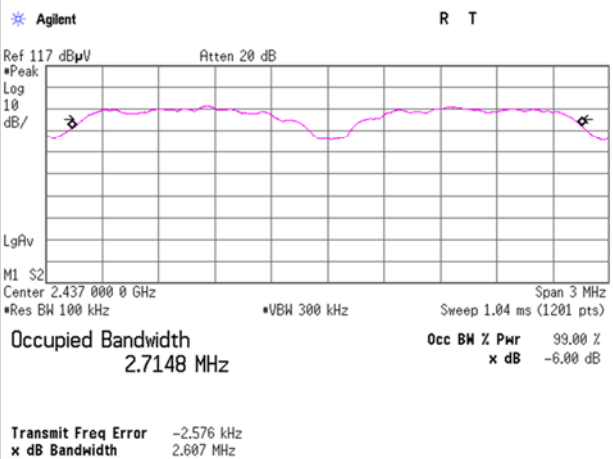
RU Index 0



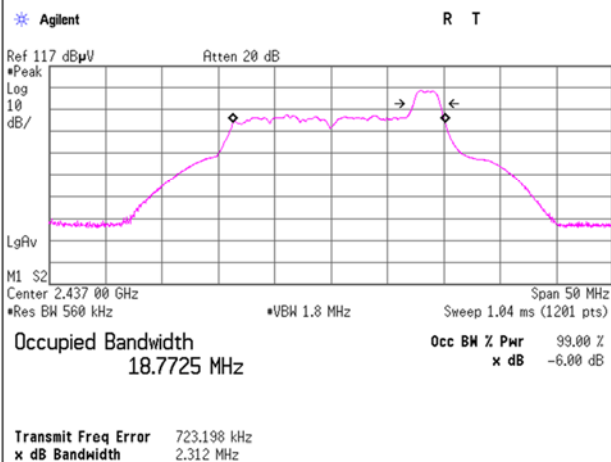
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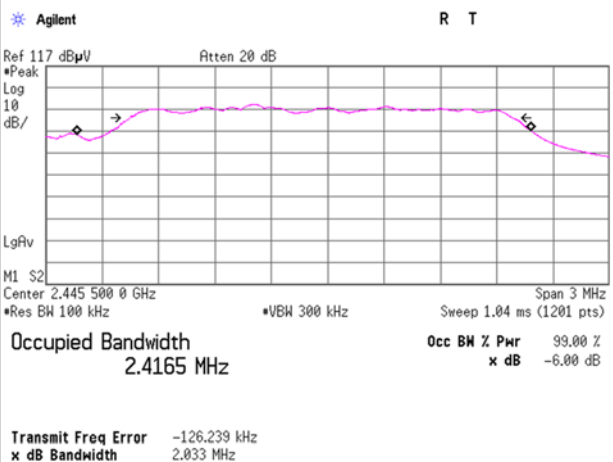
RU Index 4



RU Index 8



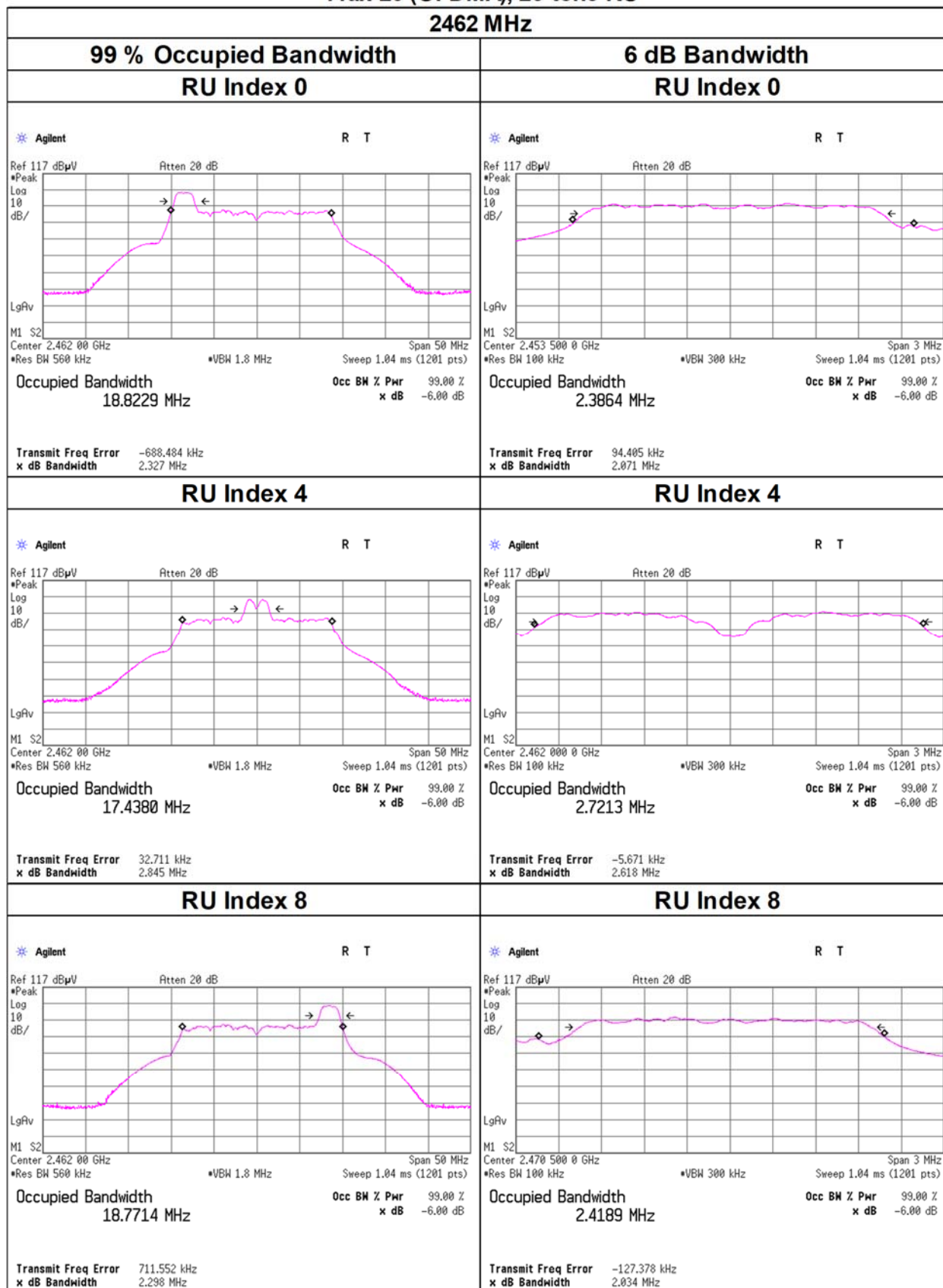
RU Index 8



99 % Occupied Bandwidth and 6 dB Bandwidth

11ax-20 (OFDMA), 26-tone RU

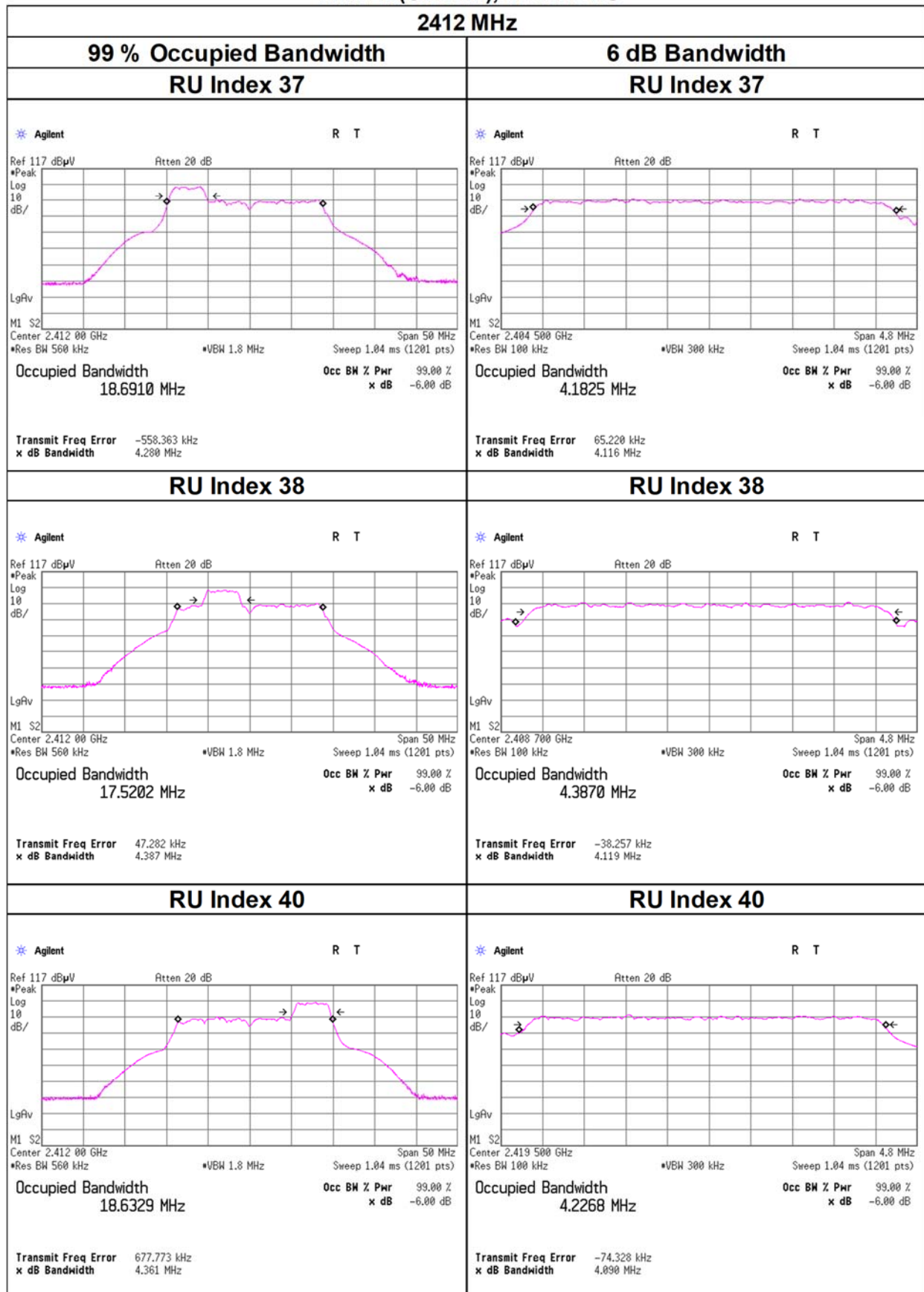
2462 MHz



99 % Occupied Bandwidth and 6 dB Bandwidth

11ax-20 (OFDMA), 52-tone RU

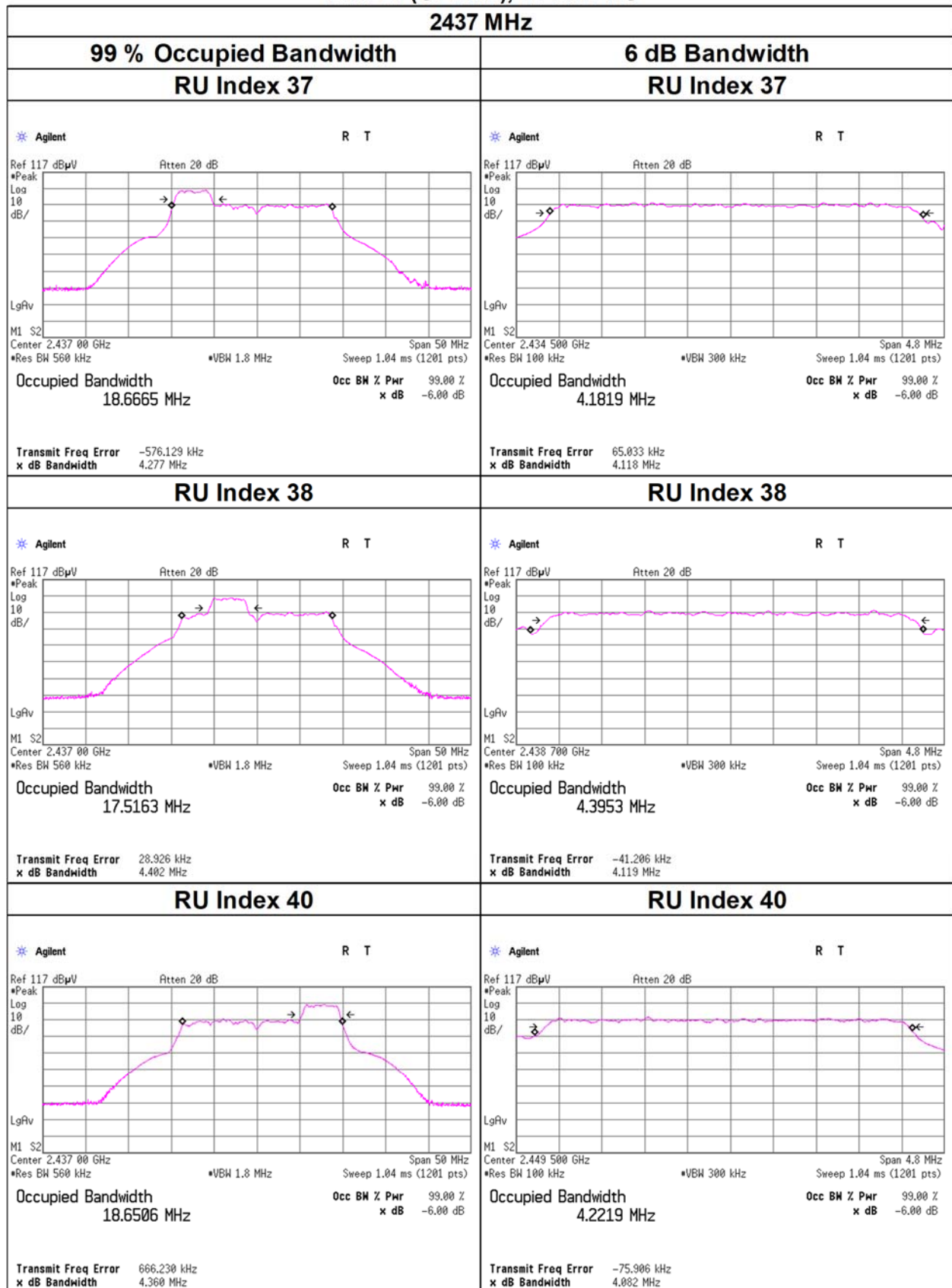
2412 MHz



99 % Occupied Bandwidth and 6 dB Bandwidth

11ax-20 (OFDMA), 52-tone RU

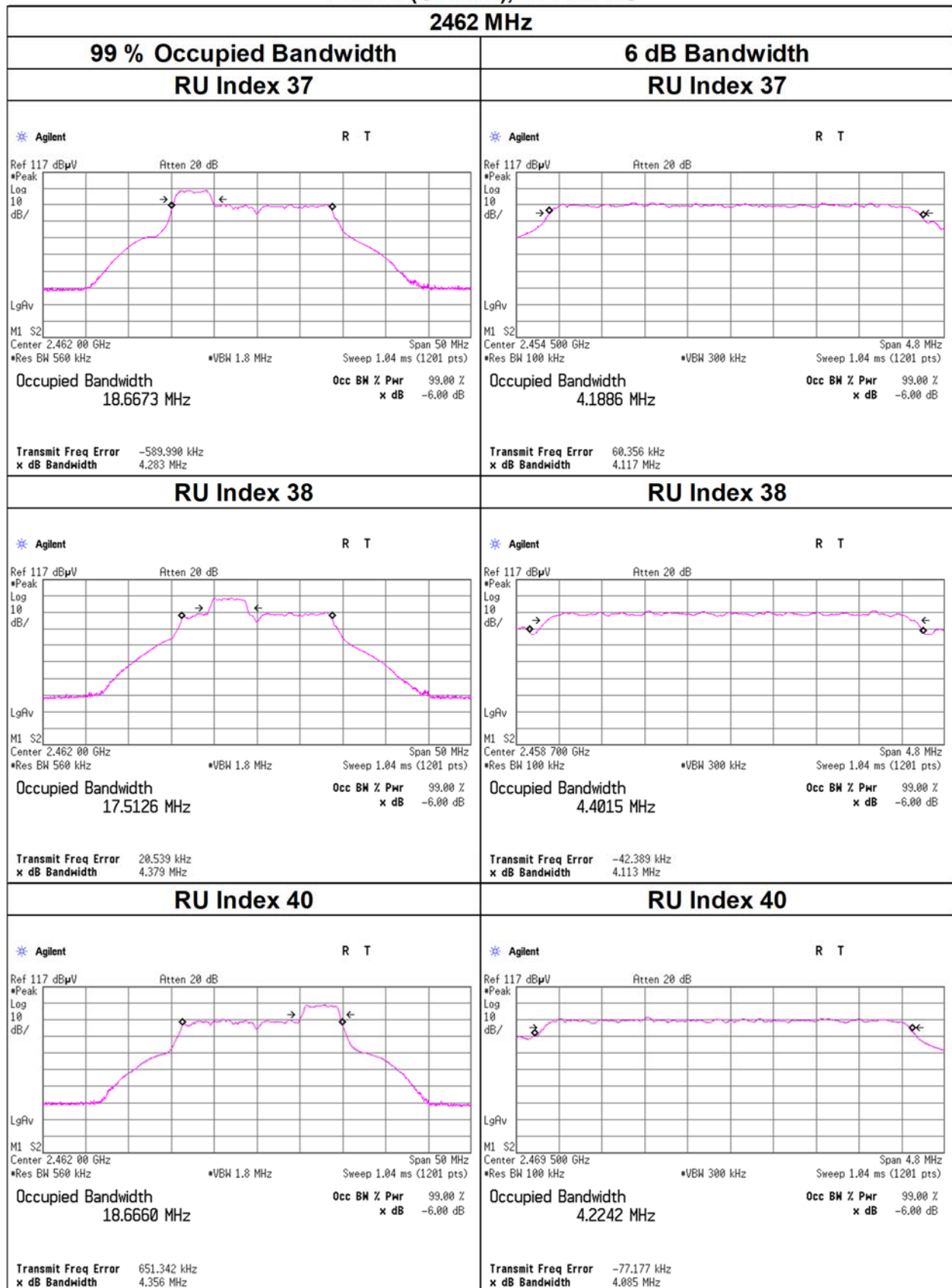
2437 MHz



99 % Occupied Bandwidth and 6 dB Bandwidth

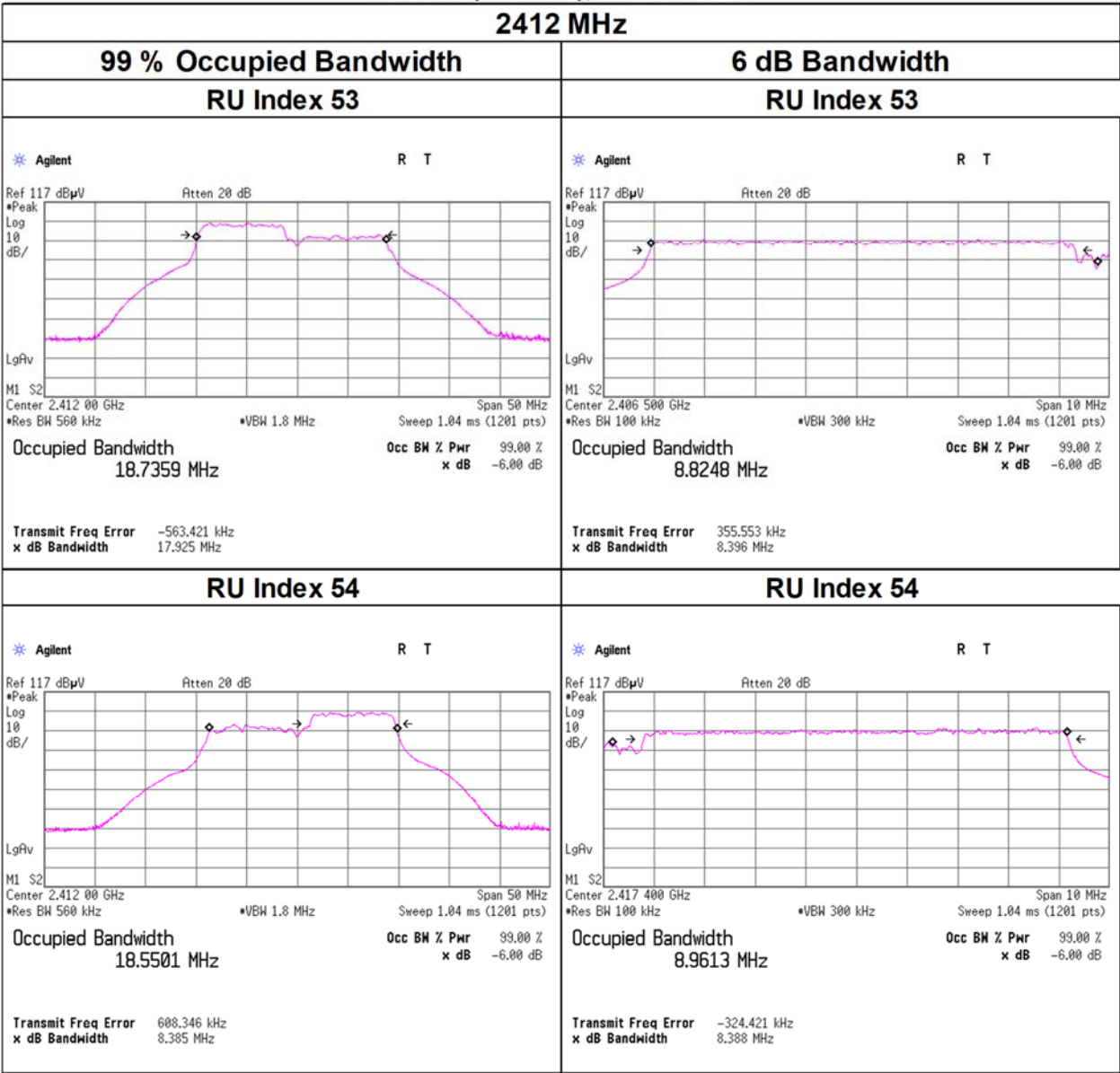
11ax-20 (OFDMA), 52-tone RU

2462 MHz



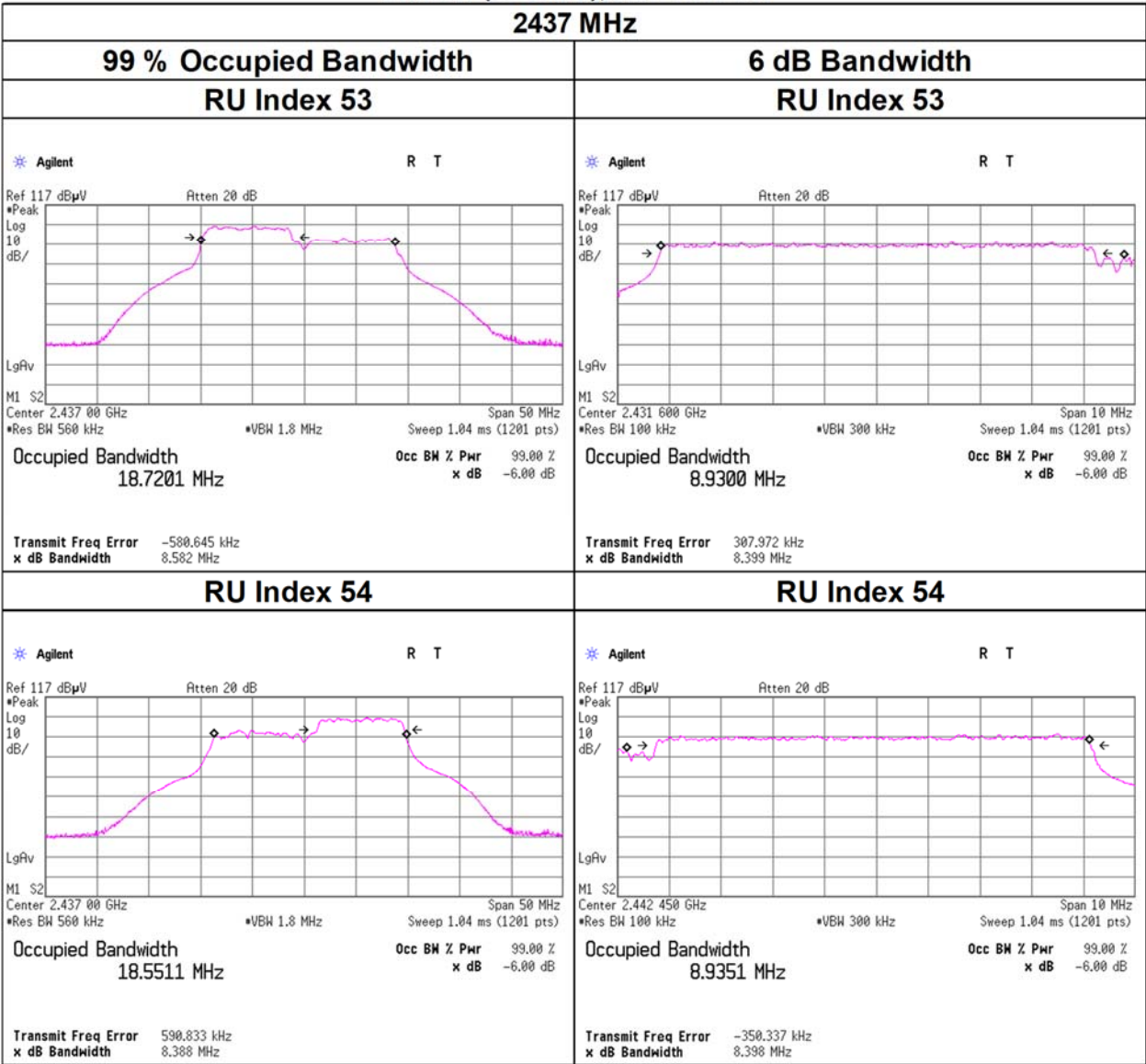
99 % Occupied Bandwidth and 6 dB Bandwidth

11ax-20 (OFDMA), 106-tone RU



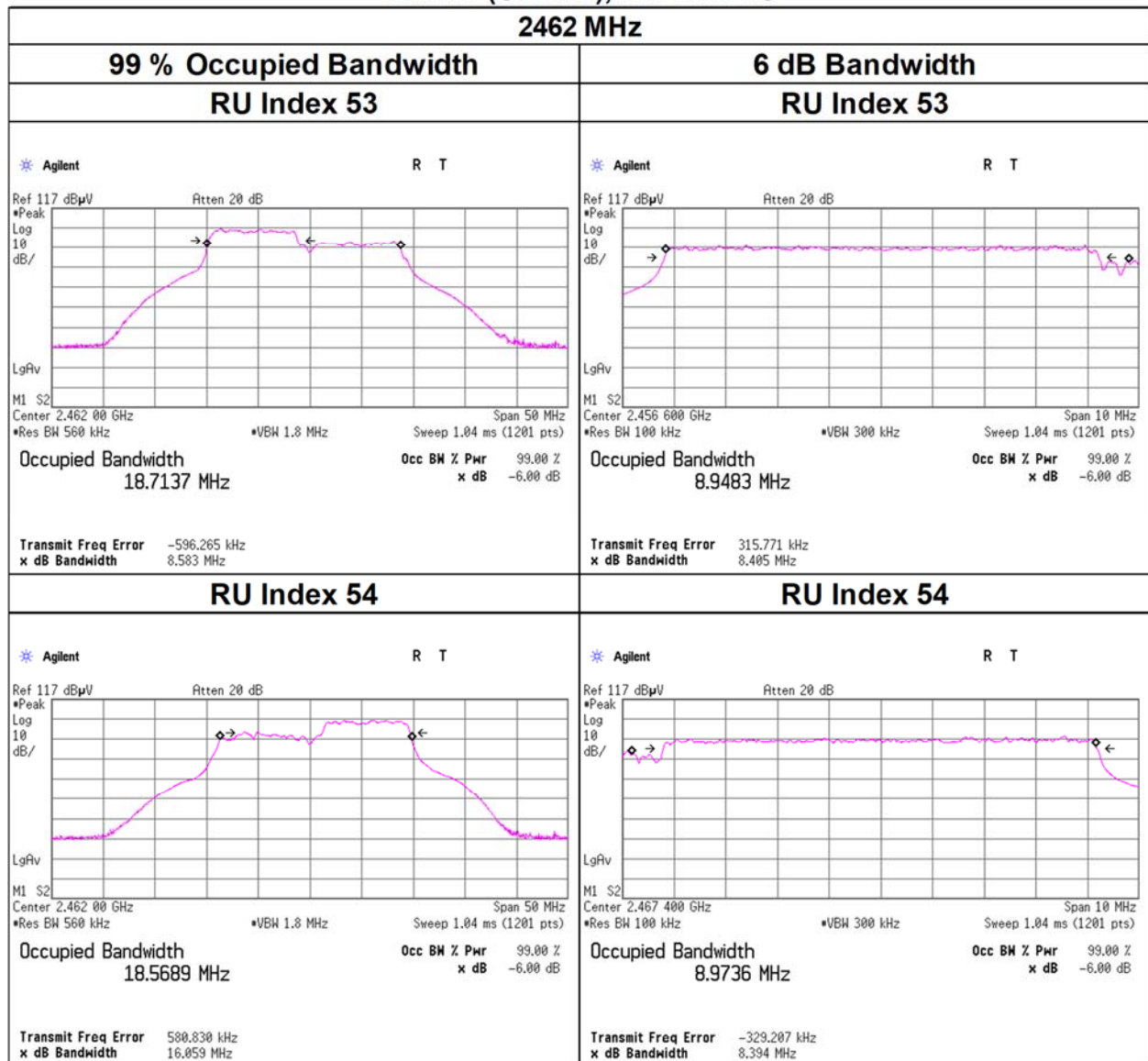
99 % Occupied Bandwidth and 6 dB Bandwidth

11ax-20 (OFDMA), 106-tone RU



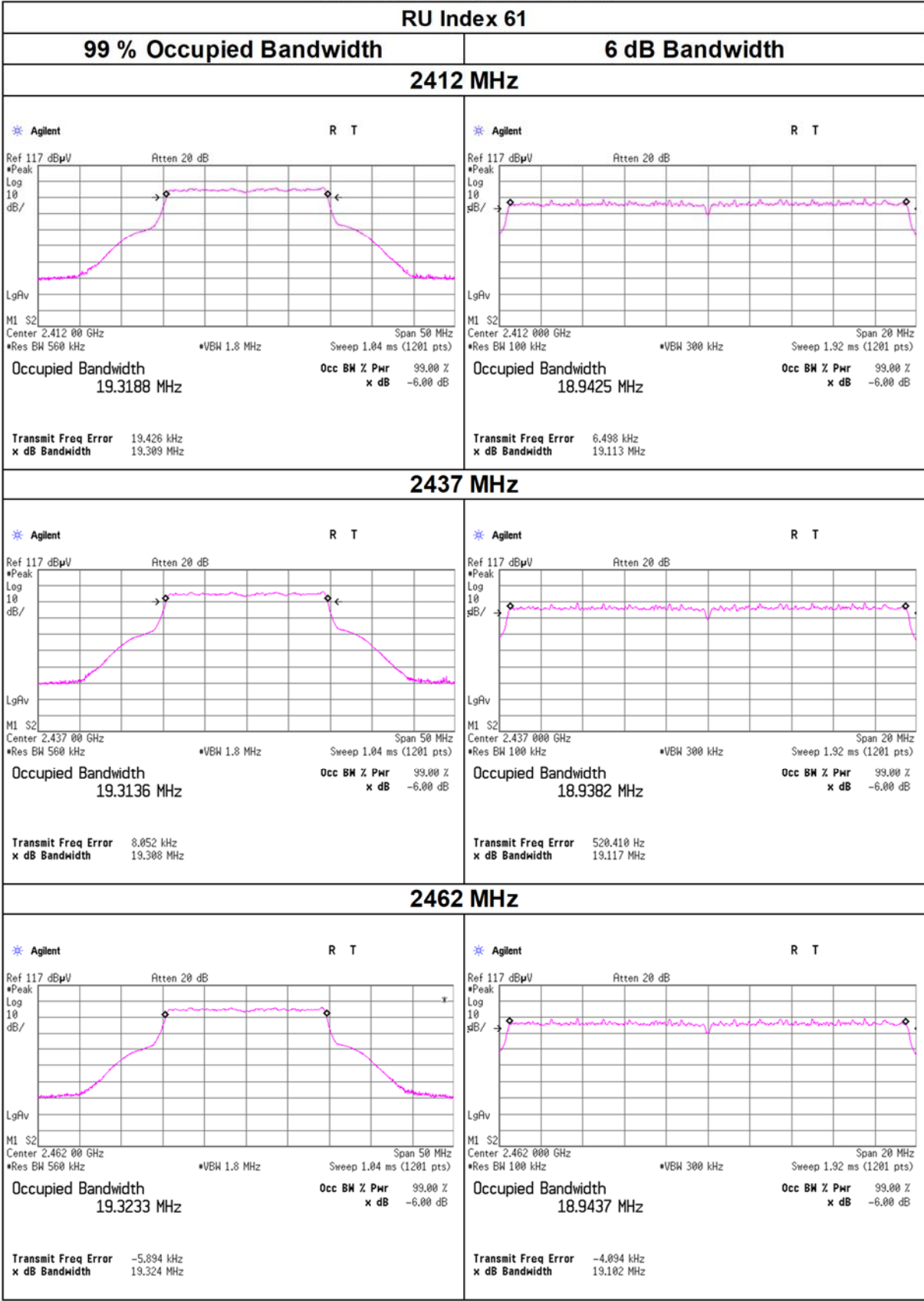
99 % Occupied Bandwidth and 6 dB Bandwidth

11ax-20 (OFDMA), 106-tone RU



99 % Occupied Bandwidth and 6 dB Bandwidth

11ax-20 (OFDMA), 242-tone RU



99 % Occupied Bandwidth and 6 dB Bandwidth

Test place Shonan EMC Lab. No.5 Shielded Room
Date April 7, 2023
Temperature / Humidity 24 deg. C / 49 % RH
Engineer Hiromasa Sato
Mode Tx

BT LE 1 M-PHY

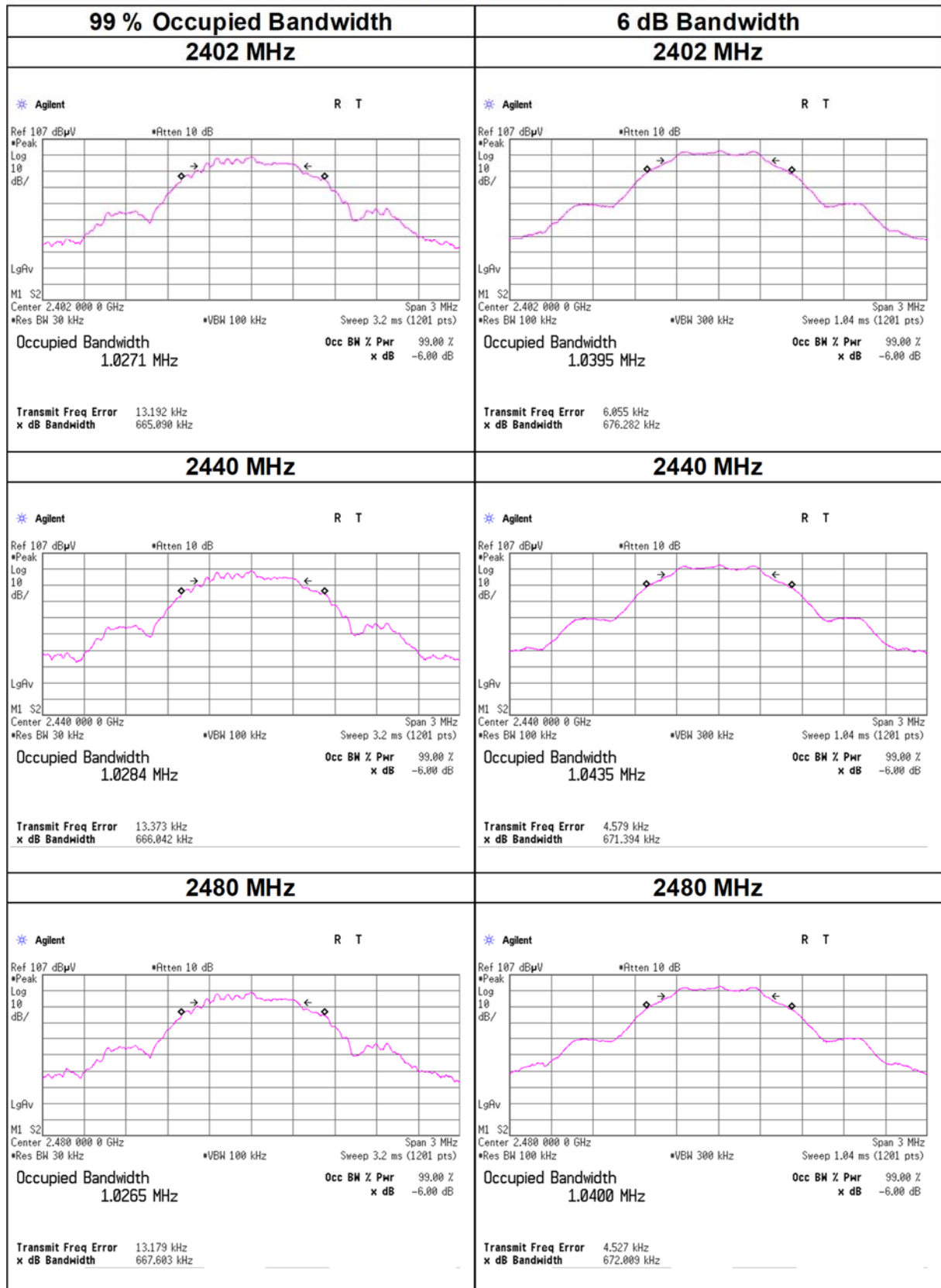
Frequency [MHz]	99 % Occupied Bandwidth [kHz]	6 dB Bandwidth [MHz]	Limit for 6 dB Bandwidth [MHz]
2402	1027.1	0.676	> 0.5000
2440	1028.4	0.671	> 0.5000
2480	1026.5	0.672	> 0.5000

BT LE 2 M-PHY

Frequency [MHz]	99 % Occupied Bandwidth [kHz]	6 dB Bandwidth [MHz]	Limit for 6 dB Bandwidth [MHz]
2402	2006.9	1.157	> 0.5000
2440	2002.0	1.150	> 0.5000
2480	2004.7	1.154	> 0.5000

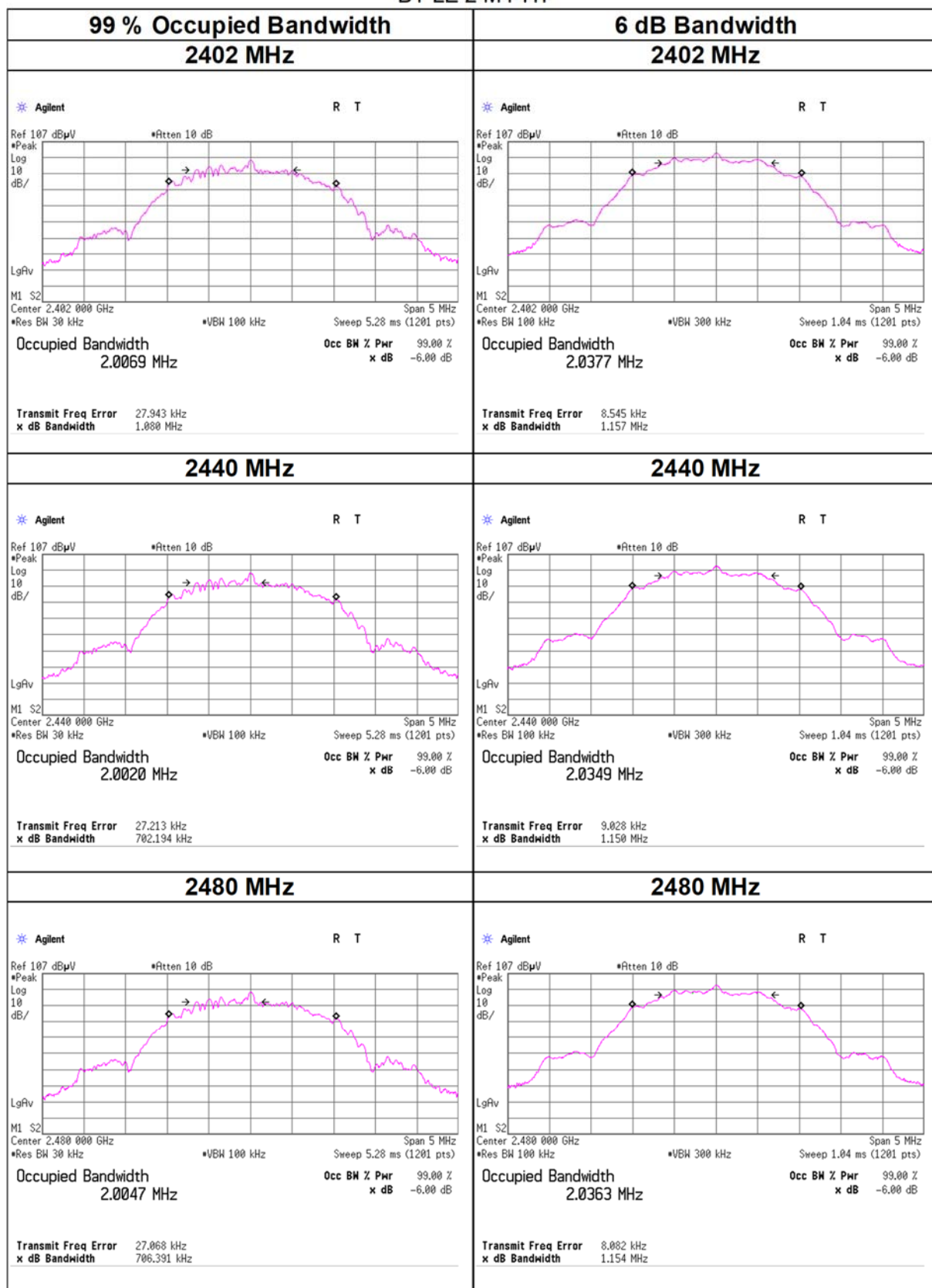
99 % Occupied Bandwidth and 6 dB Bandwidth

BT LE 1 M-PHY



99 % Occupied Bandwidth and 6 dB Bandwidth

BT LE 2 M-PHY



Maximum Peak Output Power

Test place Shonan EMC Lab. No.5 Shielded Room
Date April 4, 2023 April 20, 2023 May 26, 2023
Temperature / Humidity 21 deg. C / 30 % RH 27 deg. C / 46 % RH 25 deg. C / 39 % RH
Engineer Shiro Kobayashi Kouki Yamada Shiro Kobayashi
Mode Tx

11b

Maximum peak output power 1 Mbps (worst)

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Conducted Power				Antenna Gain [dBi]	e.i.r.p. for RSS-247				
				Result		Limit	Margin		Result		Limit		Margin
				[dBm]	[mW]	[mW]	[dB]		[dBm]	[mW]	[dBm]	[mW]	[dB]
2412	2.84	2.29	9.90	15.03	31.84	1000	14.97	4.00	19.03	79.98	36.02	4000	16.99
2437	2.91	2.30	9.91	15.12	32.51	1000	14.88	4.00	19.12	81.66	36.02	4000	16.90
2462	2.96	2.32	9.91	15.19	33.04	1000	14.81	4.00	19.19	82.99	36.02	4000	16.83

11g

Maximum peak output power 24 Mbps (worst)

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Conducted Power				Antenna Gain [dBi]	e.i.r.p. for RSS-247				
				Result		Limit	Margin		Result		Limit		Margin
				[dBm]	[mW]	[mW]	[dB]		[dBm]	[mW]	[dBm]	[mW]	[dB]
2412	10.83	2.29	9.90	23.02	200.45	1000	6.98	4.00	27.02	503.50	36.02	4000	9.00
2437	10.93	2.30	9.91	23.14	206.06	1000	6.86	4.00	27.14	517.61	36.02	4000	8.88
2462	10.95	2.32	9.91	23.18	207.97	1000	6.82	4.00	27.18	522.40	36.02	4000	8.84

11n-20

Maximum peak output power MCS 3 G.I. 400 ns (worst)

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Conducted Power				Antenna Gain [dBi]	e.i.r.p. for RSS-247				
				Result		Limit	Margin		Result		Limit		Margin
				[dBm]	[mW]	[mW]	[dB]		[dBm]	[mW]	[dBm]	[mW]	[dB]
2412	10.54	2.29	9.90	22.73	187.50	1000	7.27	4.00	26.73	470.98	36.02	4000	9.29
2437	10.56	2.30	9.91	22.77	189.23	1000	7.23	4.00	26.77	475.34	36.02	4000	9.25
2462	10.63	2.32	9.91	22.86	193.20	1000	7.14	4.00	26.86	485.29	36.02	4000	9.16

11ax-20(OFDM)

Maximum peak output power MCS 10 G.I. 1600 ns (worst)

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Conducted Power				Antenna Gain [dBi]	e.i.r.p. for RSS-247				
				Result		Limit	Margin		Result		Limit		Margin
				[dBm]	[mW]	[mW]	[dB]		[dBm]	[mW]	[dBm]	[mW]	[dB]
2412	13.12	2.29	9.90	25.31	339.63	1000	4.69	4.00	29.31	853.10	36.02	4000	6.71
2437	12.54	2.30	9.91	24.75	298.54	1000	5.25	4.00	28.75	749.89	36.02	4000	7.27
2462	12.64	2.32	9.91	24.87	306.90	1000	5.13	4.00	28.87	770.90	36.02	4000	7.15

Sample Calculation:

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

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

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

Maximum Peak Output Power

Test place Shonan EMC Lab. No.5 Shielded Room
Date April 27, 2023
Temperature / Humidity 23 deg. C / 40 % RH
Engineer Shiro Kobayashi
Mode Tx

11ax-20, RU Type: 26-tone RU

Maximum peak output power

					Conducted Power					e.i.r.p. for RSS-247					
Freq.	RU Index	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	0	6.12	2.29	9.90	18.31	67.76	30.00	1000	11.69	4.00	22.31	170.22	36.02	4000	13.71
	4	6.07	2.29	9.90	18.26	66.99	30.00	1000	11.74	4.00	22.26	168.27	36.02	4001	13.76
	8	6.09	2.29	9.90	18.28	67.30	30.00	1000	11.72	4.00	22.28	169.04	36.02	4002	13.74
2437	0	6.00	2.31	9.91	18.22	66.37	30.00	1000	11.78	4.00	22.22	166.72	36.02	4003	13.80
	4	6.04	2.31	9.91	18.26	66.99	30.00	1000	11.74	4.00	22.26	168.27	36.02	4004	13.76
	8	6.09	2.31	9.91	18.31	67.76	30.00	1000	11.69	4.00	22.31	170.22	36.03	4005	13.72
2462	0	6.04	2.32	9.91	18.27	67.14	30.00	1000	11.73	4.00	22.27	168.66	36.03	4006	13.76
	4	6.01	2.32	9.91	18.24	66.68	30.00	1000	11.76	4.00	22.24	167.49	36.03	4007	13.79
	8	5.98	2.32	9.91	18.21	66.22	30.00	1000	11.79	4.00	22.21	166.34	36.03	4008	13.82

11ax-20, RU Type: 52-tone RU

Maximum peak output power

					Conducted Power					e.i.r.p. for RSS-247					
Freq.	RU Index	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	37	8.61	2.29	9.90	20.80	120.23	30.00	1000	9.20	4.00	24.80	302.00	36.02	4000	11.22
	38	8.58	2.29	9.90	20.77	119.40	30.00	1000	9.23	4.00	24.77	299.92	36.02	4001	11.25
	40	8.64	2.29	9.90	20.83	121.06	30.00	1000	9.17	4.00	24.83	304.09	36.02	4002	11.19
2437	37	8.88	2.31	9.91	21.10	128.82	30.00	1000	8.90	4.00	25.10	323.59	36.02	4003	10.92
	38	8.74	2.31	9.91	20.96	124.74	30.00	1000	9.04	4.00	24.96	313.33	36.02	4004	11.06
	40	8.84	2.31	9.91	21.06	127.64	30.00	1000	8.94	4.00	25.06	320.63	36.03	4005	10.97
2462	37	8.80	2.32	9.91	21.03	126.77	30.00	1000	8.97	4.00	25.03	318.42	36.03	4006	11.00
	38	8.75	2.32	9.91	20.98	125.31	30.00	1000	9.02	4.00	24.98	314.77	36.03	4007	11.05
	40	8.77	2.32	9.91	21.00	125.89	30.00	1000	9.00	4.00	25.00	316.23	36.03	4008	11.03

11ax-20, RU Type: 106-tone RU

Maximum peak output power

					Conducted Power					e.i.r.p. for RSS-247						
Freq.	RU Index	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	53	11.91	2.29	9.90	24.10	257.04	30.00	1000	5.90	4.00	28.10	645.65	36.02	4000	7.92	
	54	11.92	2.29	9.90	24.11	257.63	30.00	1000	5.89	4.00	28.11	647.14	36.02	4001	7.91	
2437	53	11.87	2.31	9.91	24.09	256.45	30.00	1000	5.91	4.00	28.09	644.17	36.02	4002	7.93	
	54	11.86	2.31	9.91	24.08	255.86	30.00	1000	5.92	4.00	28.08	642.69	36.02	4003	7.94	
2462	53	11.82	2.32	9.91	24.05	254.10	30.00	1000	5.95	4.00	28.05	638.26	36.02	4004	7.97	
	54	11.86	2.32	9.91	24.09	256.45	30.00	1000	5.91	4.00	28.09	644.17	36.03	4005	7.94	

11ax-20, RU Type: 242-tone RU

Maximum peak output power

					Conducted Power					e.i.r.p. for RSS-247						
Freq. [MHz]	RU Index	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result		Limit		Margin [dB]	Antenna Gain [dBi]	Result		Limit		Margin [dB]	
					[dBm]	[mW]	[dBm]	[mW]			[dBm]	[mW]	[dBm]	[mW]		
2412	61	11.96	2.29	9.90	24.15	260.02	30.00	1000	5.85	4.00	28.15	653.13	36.02	4000	7.87	
2437	61	11.81	2.31	9.91	24.03	252.93	30.00	1000	5.97	4.00	28.03	635.33	36.02	4000	7.99	
2462	61	11.91	2.32	9.91	24.14	259.42	30.00	1000	5.86	4.00	28.14	651.63	36.02	4000	7.88	

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.

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

Maximum Peak Output Power

Test place Shonan EMC Lab. No.5 Shielded Room
Date April 7, 2023
Temperature / Humidity 24 deg. C / 49 % RH
Engineer Hiromasa Sato
Mode Tx

BT LE 1 M-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	-6.66	2.30	9.64	5.28	3.37	30.00	1000	24.72	4.00	9.28	8.47	36.02	4000	26.74
2440	-6.94	2.31	9.64	5.01	3.17	30.00	1000	24.99	4.00	9.01	7.96	36.02	4000	27.01
2480	-6.85	2.33	9.64	5.12	3.25	30.00	1000	24.88	4.00	9.12	8.17	36.02	4000	26.90

BT LE 2 M-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	-6.45	2.30	9.64	5.49	3.54	30.00	1000	24.51	4.00	9.49	8.89	36.02	4000	26.53
2440	-6.70	2.31	9.64	5.25	3.35	30.00	1000	24.75	4.00	9.25	8.41	36.02	4000	26.77
2480	-6.63	2.33	9.64	5.34	3.42	30.00	1000	24.66	4.00	9.34	8.59	36.02	4000	26.68

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.

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

Maximum Peak Output Power

Test place	Shonan EMC Lab. No.5 Shielded Room
Date	April 4, 2023
Temperature / Humidity	21 deg. C / 30 % RH
Engineer	Shiro Kobayashi
Mode	Tx

11b 2412 MHz

Rate	Reading	Remark
[Mbps]	[dBm]	
1	2.84	*
2	2.78	
5.5	2.81	
11	2.83	

*: Worst Rate

11g 2412 MHz

Rate	Reading	Remark
[Mbps]	[dBm]	
6	8.02	*
9	8.32	
12	8.34	
18	8.35	
24	10.83	
36	10.54	
48	10.57	
54	10.48	

*: Worst Rate

Sample Calculation:

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

Maximum Peak Output Power

Test place Shonan EMC Lab. No.5 Shielded Room
Date April 4, 2023
Temperature / Humidity 21 deg. C / 30 % RH
Engineer Shiro Kobayashi
Mode Tx

11n-20 2412 MHz

G.I.	MCS	Reading	Remark
		[dBm]	
800 ns	0	10.48	*
	1	10.46	
	2	10.44	
	3	10.48	
	4	10.46	
	5	10.54	
	6	10.50	
	7	10.44	
400 ns	0	10.48	
	1	10.45	
	2	10.52	
	3	10.55	
	4	10.40	
	5	10.52	
	6	10.48	
	7	10.54	

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

Maximum Peak Output Power

Test place Shonan EMC Lab. No.5 Shielded Room
Date April 4, 2023
Temperature / Humidity 21 deg. C / 30 % RH
Engineer Shiro Kobayashi
Mode Tx

11ax-20(OFDM)		2412 MHz	
G.I.	MCS	Reading [dBm]	Remark
3200 ns	0	9.33	
	1	9.13	
	2	9.06	
	3	9.13	
	4	11.05	
	5	11.06	
	6	11.12	
	7	10.86	
	8	11.60	
	9	11.96	
	10	12.21	
	11	12.33	
1600 ns	0	9.46	
	1	9.24	
	2	9.29	
	3	9.04	
	4	10.91	
	5	10.99	
	6	11.19	
	7	11.00	
	8	11.91	
	9	12.10	
	10	13.12	
	11	12.09	*

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