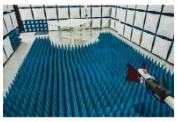
PCTEST
18855 Adams Court, Morgan Hill, CA 95037 USA
Tel. 410.290.6652 / Fax 410.290.6654
http://www.pctest.com



DATA REFERENCE REPORT

FCC PART 15.407 / ISED RSS-247 UNII 802.11ax OFDMA

Applicant Name:
Apple Inc.
One Apple Park Way
Cupertino, CA 95014
United States

Date of Testing:
12/15/2020-3/19/2021
Test Site/Location:
PCTEST Lab. Morgan Hill, CA, USA
Test Report Serial No.:
1C2101020006-17.BCG

FCC ID:	**BCGA2461**
IC:	**579C-A2461**
APPLICANT:	**Apple Inc.**

Reference Model/HVIN:	A2379
Variant Model/HVIN:	A2461, A2462
EUT Type:	Tablet Device
Frequency Range:	5180 – 5825MHz
Modulation Type:	OFDMA
FCC Classification:	Unlicensed National Information Infrastructure (UNII)
FCC Rule Part(s):	Part 15 Subpart E (15.407)
ISED Specification:	RSS-247 Issue 2
Test Procedure(s):	ANSI C63.10-2013, KDB 789033 D02 v02r01, KDB 662911 D01 v02r01

This equipment has been shown to be capable of compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in ANSI C63.10-2013 and KDB 558074 D01 v05r02. Test results reported herein relate only to the item(s) tested.

I attest to the accuracy of data. All measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

Randy Ortanez
President

ACCREDITED
CERT #2041.02

TABLE OF CONTENTS

1.0 INTRODUCTION

1.1 Scope

Per manufacturer declaration, there are two tablet device models, A2379 and A2461(A2462), with high degree of similarity, reference model FCC ID: BCGA2379 / IC: 579C-A2379 and variant model **FCC ID: BCGA2461 / IC: 579C-A2461**. The reference model supports mmWave operations, while the variant model has the mmWave components/antennas removed. Both models share the same material, form factor, circuit design, and components, including antennas and their locations. The reference and variant models use the same power tables and have same tune-up tolerances.

Per FCC/ISED approved Data Referencing Test Plan, testing was done fully on the reference model FCC ID: BCGA2379 / IC: 579C-A2379, while radiated spot-check verification has been performed on variant model **FCC ID: BCGA2461 / IC: 579C-A2461**. Additionally, due to Antenna 4a location being close to the depopulated mmWave components, full radiated testing has been done for all supported technologies on Antenna 4a. Spot-check measurements were conducted, all measurements were investigated and found to be within acceptable tolerance.

Equipment Class	Reference Model FCC ID & IC	Reference Report	Report Title
NII	BCGA2379 579C-A2379	1C2101020005-16-R1.BCG	RF UNII 802.11ax (OFDMA) Test Report

Table 1-1. Reference Model Details

Reference model FCC ID: BCGA2379 / IC: 579C-A2379 test report has been included in Appendix A.

1.2 PCTEST Test Location

These measurement tests were conducted at the PCTEST facility located at 18855 Adams Court, Morgan Hill, CA 95037. The measurement facility is compliant with the test site requirements specified in ANSI C63.4-2014 and KDB 414788 D01 v01r01.

1.3 Test Facility / Accreditations

Measurements were performed at PCTEST located in Morgan Hill, CA 95037, U.S.A.

- PCTEST is an ISO 17025-2017 accredited test facility under the American Association for Laboratory Accreditation (A2LA) with Certificate number 2041.02 for Specific Absorption Rate (SAR), Hearing Aid Compatibility (HAC) testing, where applicable, and Electromagnetic Compatibility (EMC) testing for FCC and Innovation, Science, and Economic Development Canada rules.

- PCTEST TCB is a Telecommunication Certification Body (TCB) accredited to ISO/IEC 17065-2012 by A2LA (Certificate number 2041.03) in all scopes of FCC Rules and ISED Standards (RSS).

- PCTEST facility is a registered (22831) test laboratory with the site description on file with ISED.

2.0 PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the **Apple Tablet Device FCC ID: BCGA2461 / IC: 579C-A2461**. The test data contained in this report pertains only to the emissions due to the EUT's UNII 802.11ax - RU transmitter.

Test Device Serial No.: JP76RWY2XR, XW3JN32D9W

2.2 Device Capabilities

This device contains the following capabilities:

850/1900 GSM/GPRS/EDGE, 850/1700/1900 WCDMA/HSPA, Multi-band LTE, 5G NR (FR1), 802.11b/g/n/ax WLAN, 802.11a/n/ac/ax UNII, Bluetooth (1x, EDR, LE1M, LE2M, HDR4, HDR8), WPT

This device supports BT Beamforming.

Band 1		Band 2A		Band 2C		Band 3	
Ch.	**Frequency (MHz)**	**Ch.**	**Frequency (MHz)**	**Ch.**	**Frequency (MHz)**	**Ch.**	**Frequency (MHz)**
36	5180	52	5260	100	5500	149	5745
:	:	:	:	:	:	:	:
42	5210	56	5280	116	5580	157	5785
:	:	:	:	:	:	:	:
48	5240	64	5320	144	5720	165	5825

Table 2-1. 802.11a / 802.11n / 802.11ac / 802.11ax (20MHz) Frequency / Channel Operations

Band 1		Band 2A		Band 2C		Band 3	
Ch.	**Frequency (MHz)**	**Ch.**	**Frequency (MHz)**	**Ch.**	**Frequency (MHz)**	**Ch.**	**Frequency (MHz)**
38	5190	54	5270	102	5510	151	5755
:	:	:	:	:	:	:	:
46	5230	62	5310	110	5550	159	5795
				:	:		
				142	5710		

Table 2-2. 802.11n / 802.11ac / 802.11ax (40MHz BW) Frequency / Channel Operations

Band 1		Band 2A		Band 2C		Band 3	
Ch.	**Frequency (MHz)**	**Ch.**	**Frequency (MHz)**	**Ch.**	**Frequency (MHz)**	**Ch.**	**Frequency (MHz)**
42	5210	58	5290	106	5530	155	5775
				:	:		
				138	5690		

Table 2-3. 802.11ac / 802.11ax (80MHz BW) Frequency / Channel Operations

Notes:

1. TDWR channels are not supported for ISED.
2. 5GHz NII operation is possible in 20MHz, and 40MHz, and 80MHz channel bandwidths. The maximum achievable duty cycles for all modes were determined based on measurements performed on a spectrum analyzer in zero-span mode with RBW = 8MHz, VBW = 50MHz, and detector = peak per the guidance of Section B)2)b) of KDB 789033 D02 v02r01 and ANSI C63.10-2013. The RBW and VBW were both greater than 50/T, where T is the minimum transmission duration, and the number of sweep points across T was greater than 100. The duty cycles are as follows:

Measured Duty Cycles				
802.11 Mode/Band		Duty Cycle [%]		
		Antenna 5b	Antenna 4b	CDD/SDM
5GHz	ax - RU (HE20)	99.2	98.1	99.0
	ax - RU (HE40)	98.3	98.6	98.5
	ax - RU (HE80)	98.4	98.3	99.1

Table 2-4. Measured Duty Cycles

3. The device employs CDD/SDM technology. Below are the possible configurations.

WiFi Configurations		SISO		CDD		SDM		STBC	
		Antenna 5b	Antenna 4b	Antenna 5b	Antenna 4b	Antenna 5b	Antenna 4b	Antenna 5b	Antenna 4b
5GHz	11ax (20MHz)	✓	✓	✓	✓	✓	✓	✓	✓
	11ax (40MHz)	✓	✓	✓	✓	✓	✓	✓	✓
	11ax (80MHz)	✓	✓	✓	✓	✓	✓	✓	✓

Table 2-5. WIFI Configurations

✓= Support ; × = NOT Support
SISO = Single Input Single Output
CDD = Cyclic Delay Diversity – 2Tx Function
SDM = Spatial Diversity Multiplexing – CDD/SDM function
STBC = Space-Time Block Coding – 2Tx Function

Data Rate(s) Support:

8/8.6, 16/17.2, 24/25.8, 33/34.4, 49/51.6, 65/68.8, 73/77.4, 81/86.0, 98/103.2, 108/114.7, 122/129.0, 135/143.4Mbps (ax – 20MHz)
16/17.2, 33/34.4, 49/51.6, 65/68.8, 98/103.2, 130/137.6, 146/154.9, 163/172.1, 195/206.5, 217/229.4, 244/258.1, 271/286.8Mbps (ax – 40MHz BW)
34/36.0, 68/72.1, 102/108.1, 136/144.1, 204/216.2, 272/288.2, 306/324.4, 340/360.3, 408/432.4, 453/480.4, 510/540.4, 567/600.5Mbps (ax – 80MHz BW)
16/17.2, 33/34.4, 49/51.6, 65/68.8, 98/103.2, 130/137.6, 146/154.9, 163/172.1, 195/206.5, 217/229.4, 244/258.1, 271/286.8Mbps (MIMO ax – 20MHz BW)
34/36.0, 68/72.1, 102/108.1, 136/144.1, 204/216.2, 272/288.2, 306/324.4, 340/360.3, 408/432.4, 453/480.4, 510/540.4, 567/600.5Mbps (MIMO ax – 40MHz BW)
68/72, 136/144.1, 204/216.2, 272/288.2, 408/432.4, 544/576.4, 612/648.8, 680/720.6, 816/864.8, 906/960.8, 1020/1080.8, 1134/1201Mbps (MIMO ax – 80MHz BW)

This device supports simultaneous transmission operations, which allows for multiple transmitters to transmit simultaneously on the same antenna. The table below shows all configurations possible.

Antenna	Simultaneous Tx Config	WLAN	Bluetooth	GSM / WCDMA	LTE / FR1 NR			UNII
		802.11 b/g/n/ax	BDR, EDR, HDR4/8, LE1/2M	Mid Band	Mid Band	High Band	Ultra High Band	802.11 a/n/ac/ax
2a	Config 1	✓	×	×	×	×	✓	×
2a	Config 2	×	✓	×	×	×	✓	×
4a	Config 3	✓	×	×	×	×	✓	×
4a	Config 4	×	✓	×	×	×	✓	×
4b	Config 5	×	×	✓	×	×	×	✓
4b	Config 6	×	×	×	✓	×	×	✓
4b	Config 7	×	×	×	×	✓	×	✓

Table 2-6. Simultaneous Transmission Configurations

✓ = Support; × = Not Support

2.3 Antenna Description

Following antenna gains provided by manufacturer were used for testing.

Frequency [GHz]	Antenna Gain (dBi)	
	Antenna 5b	Antenna 4b
5.150 – 5.250	4.7	0.6
5.250 – 5.350	4.9	-0.6
5.470 – 5.725	5.1	-1.4
5.725 – 5.850	5.1	0.4

Table 2-7. Highest Antenna Gain

2.4 Test Support Equipment

1	Apple MacBook Pro	Model:	A2141	S/N:	C02DV7VKMD6T
	w/AC/DC Adapter	Model:	A2166	S/N:	N/A
2	Apple USB-C Cable	Model:	Chimp	S/N:	420A57
3	USB-C Cable	Model:	A146	S/N:	N/A
	w/ AC Adapter	Model:	A2305	S/N:	N/A
4	Apple Pencil	Model:	N/A	S/N:	GQXYGSXBJKM9
5	DC Power Supply	Model:	KPS3010D	S/N:	N/A

Table 2-8. Test Support Equipment List

2.5 Test Configuration

The EUT was tested per the guidance of ANSI C63.10-2013 and KDB 558074 D01 v05r02. ANSI C63.10-2013 was used to reference the appropriate EUT setup for radiated spurious emissions. See Sections 3.2 for radiated emissions test setups.

There are two vendors of the WiFi/Bluetooth radio modules, variant 1 and variant 2. Both radio modules have the same mechanical outline, same on-board antenna matching circuit, identical antenna structure, and are built and tested to conform to the same specifications and to operate within the same tolerances. The worst case configuration was found between the two variants. The EUT was also investigated with and without charger.

For emissions from 1GHz – 18GHz, low, mid, and high channels were tested with highest power and worst case configuration. The emissions below 1GHz and above 18GHz were tested with the highest transmitting power and the worst case channel.

The EUT was manipulated through three orthogonal planes of X-orientation (flatbed), Y-orientation (landscape), and Z-orientation (portrait) during the testing. Only the worst case emissions were reported in this test report.

Per FCC/ISED Approved Data Referencing Test Plan, spot-check measurements have been conducted and reported. Spot-Check Test Plan can be referred to below Table 2-9.

Technology	Test Case	FCC ID: BCGA2461 IC: 579C-A2461	
		Mode	Channel
UNII (802.11a/n/ac/ax)	Radiated Spurious Emissions	MIMO Max Power 5.8 GHz: 11ax 20 MHz RU26	M
	Radiated Spurious Emissions (Simultaneous Transmission)	MIMO Only 5GHz 11ax RU26	Worst Case

Table 2-9. FCC/ISED Approved Spot-Check Test Plan

Output powers were measured and confirmed to be consistent between Reference and Variant models prior to testing.

2.6 Software and Firmware

The test was conducted with firmware version 18E20700y installed on the EUT.

2.7 EMI Suppression Device(s)/Modifications

No EMI suppression device(s) were added and/or no modifications were made during testing.

3.0 DESCRIPTION OF TESTS

3.1 Evaluation Procedure

The measurement procedures described in the American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices (ANSI C63.10-2013) and the guidance provided in KDB 558074 D01 v05r02 were used in the measurement of the EUT**.**

Deviation from measurement procedure…….....None

3.2 Radiated Emissions

The radiated test facilities consisted of an indoor 3 meter semi-anechoic chamber used for final measurements and exploratory measurements, when necessary. The measurement area is contained within the semi-anechoic chamber which is shielded from any ambient interference. The test site inside the chamber is a 6m x 5.2m elliptical, obstruction-free area in accordance with Figure 5.7 of Clause 5 in ANSI C63.4-2014. Absorbers are arranged on the floor between the turn table and the antenna mast in such a way so as to maximize the reduction of reflections for measurements above 1GHz. An 80cm tall test table made of Styrodur is placed on top of the turn table. For measurements above 1GHz, an additional Styrodur pedestal is placed on top of the test table to bring the total table height to 1.5m.

Per KDB 414788, radiated emission test sites other than open-field test sites (e.g., shielded anechoic chambers), may be employed for emission measurements below 30MHz if characterized so that the measurements correspond to those obtained at an open-field test site. To determine test site equivalency, a reference sample transmitting at 149kHz was measured on an open field test site (asphalt with no ground plane) and then measured in the 3m semi-anechoic chamber. A calibrated 60cm loop antenna was rotated about its vertical axis
while the reference device was rotated through the X, Y and Z axis in order to capture the worst case level. A maximum deviation of 2.77dB at 149kHz was measured when comparing the 3 meter semi-anechoic chamber to the open field site.

For all measurements, the spectrum was scanned through all EUT azimuths and from 1 to 4 meter receive antenna height using a broadband antenna from 30MHz up to the upper frequency shown in 15.33 depending on the highest frequency generated or used in the device or on which the device operates or tunes. For frequencies above 1GHz, linearly polarized double ridge horn antennas were used. For frequencies below 30MHz, a calibrated loop antenna was used. When exploratory measurements were necessary, they were performed at 1 meter test distance inside the semi-anechoic chamber using broadband antennas, broadband amplifiers, and spectrum analyzers to determine the frequencies and modes producing the maximum emissions. Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The test set-up was placed on top of the 1 x 1.5 meter table. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each emission. Appropriate precaution was taken to ensure that all emissions from the EUT were maximized and investigated. The system configuration, mode of operation, turntable azimuth, and receive antenna height was noted for each frequency found.

Final measurements were made in the semi-anechoic chamber using calibrated, linearly polarized broadband and horn antennas. The test setup was configured to the setup that produced the worst case emissions. The spectrum analyzer was set to investigate all frequencies required for testing to compare the highest radiated disturbances with respect to the specified limits. The turntable containing the EUT was rotated through 360 degrees and the height of the receive antenna was varied 1 to 4 meters and stopped at the azimuth and height producing the maximum emission. Each emission was maximized by changing the orientation of the EUT through three orthogonal planes and changing the polarity of the receive antenna, whichever produced the worst-case emissions.

3.3 Environmental Conditions

The temperature is controlled within range of 15ºC to 35ºC. The relative humidity is controlled within range of 10% to 75%. The atmospheric pressure is monitored within the range 86-106kPa (860-1060mbar).

4.0 ANTENNA REQUIREMENTS

Excerpt from §15.203 of the FCC Rules/Regulations:
"An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section."

- The antenna(s) of the EUT are **permanently attached.**
- There are no provisions for connection to an external antenna.

Conclusion:

The EUT complies with the requirement of §15.203.

5.0 MEASUREMENT UNCERTAINTY

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.23-2012. All measurement uncertainty values are shown with a coverage factor of k = 2 to indicate a 95% level of confidence. The measurement uncertainty shown below meets or exceeds the U_{CISPR} measurement uncertainty values specified in CISPR 16-4-2 and, thus, can be compared directly to specified limits to determine compliance.

Contribution	Expanded Uncertainty (±dB)
Radiated Disturbance (<30MHz)	4.06
Radiated Disturbance (30MHz - 1GHz)	4.30
Radiated Disturbance (1 - 18GHz)	4.78
Radiated Disturbance (>18GHz)	4.79

6.0 TEST EQUIPMENT CALIBRATION DATA

Test Equipment Calibration is traceable to the National Institute of Standards and Technology (NIST). Measurement antennas used during testing were calibrated in accordance to the requirements of ANSI C63.5-2017.

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Agilent Technologies	N9030A	PXA Signal Analyzer (3Hz - 26.5 GHz)	7/24/2020	Annual	7/24/2021	MY49430244
Anritsu	ML2496A	Power Meter	4/9/2020	Annual	4/9/2021	2002005
Anritsu	MA2411B	Pulse Power Sensor	11/10/2020	Annual	11/10/2021	1726261
Anritsu	MA2411B	Pulse Power Sensor	12/9/2020	Annual	12/9/2021	1726262
ATM	180-442A-KF	20dB Nominal Gain Horn Antenna	8/11/2020	Annual	8/11/2021	T058701-01
Rohde & Schwarz	TS-PR8	Pre-Amplifier (30MHz - 8GHz)	12/3/2020	Annual	12/3/2021	102328
ETS-Lindgren	3142E	BiConiLog Antenna (30MHz - 6GHz)	9/15/2020	Annual	9/15/2021	208204
ETS-Lindgren	3117	Double Ridged Guide Antenna (1-18 GHz)	4/21/2020	Annual	4/21/2021	205956
Rohde & Schwarz	ESW26	EMI Test Receiver	6/1/2020	Annual	6/1/2021	101299
Rohde & Schwarz	ESW44	EMI Test Receiver	8/7/2020	Annual	8/7/2021	101668
Rohde & Schwarz	TS-PR1840	Pre-Amplifier (18GHz - 40GHz)	4/3/2020	Annual	4/3/2021	100052
Rohde & Schwarz	TC-TA18	Cross Polarized Vivaldi Antenna (400MHz-18GHz)	10/2/2020	Annual	10/2/2021	101063
Rohde & Schwarz	HFH2-Z2	Loop Antenna	3/12/2020	Annual	3/12/2021	100546
Rohde & Schwarz	TS-PR18	Pre-Amplifier (1GHz - 18GHz)	12/3/2020	Annual	12/3/2021	101648
Rohde & Schwarz	ENV216	Two-Line V-Network (LISN)	12/7/2020	Annual	12/7/2021	101364

Table 6-1. Test Equipment List

Note:

For equipment listed above that has a calibration date or calibration due date that falls within the test date range, care was taken to ensure that this equipment was used after the calibration date and before the calibration due date.

7.0 TEST RESULTS (SPOT-CHECK DATA)

7.1 Summary

Company Name: Apple Inc.

FCC ID: BCGA2461

IC: 579C-A2461

FCC Classification: Unlicensed National Information Infrastructure (UNII)

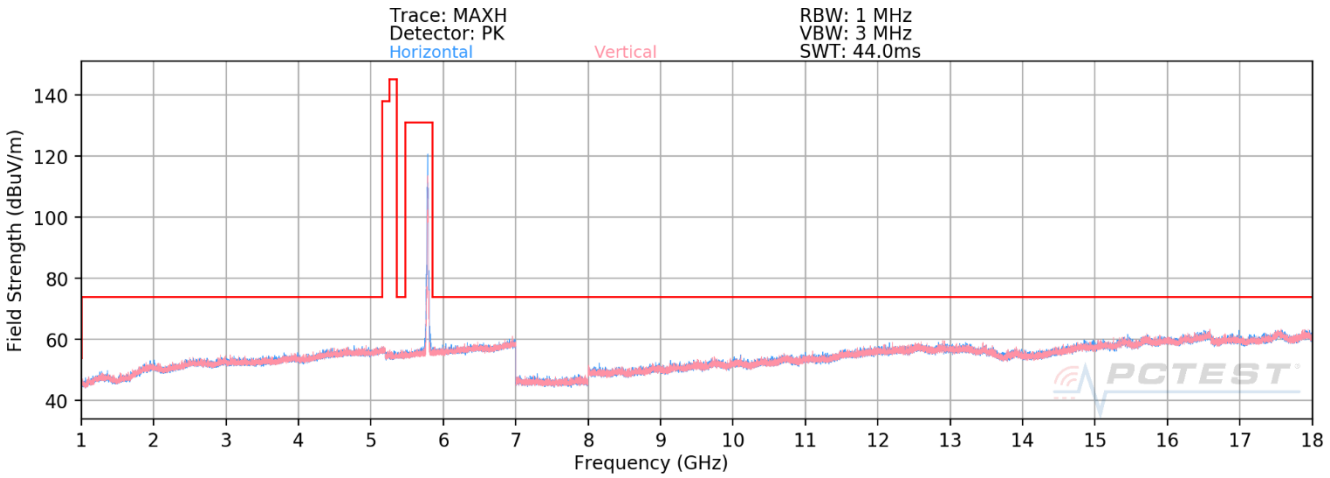
Technology	Test Configurations					Reference Model		Variant Model		Delta	
	Test Description	RU Size	RU Index	Channel	Measurement Frequency [MHz]	FCC ID: BCGA2379 IC: 579C-A2379		FCC ID: BCGA2461 IC: 579C-A2461			
						Peak [dBµV/m]	Average [dBµV/m]	Peak [dBµV/m]	Average [dBµV/m]	Peak [dB]	Average [dB]
UNII 802.11ax-RU	Radiated Spurious Emissions	26	4	157	11570	53.55	43.34	54.34	44.48	0.79	1.14
	Radiated Spurious Emissions (Simultaneous Transmission)	26	4	36	10360	51.05	N/A	51.09	N/A	0.04	N/A

Table 7-1. Worst Case Spot-check Results

Spot-checks were conducted, all measurements were investigated and found to be within acceptable tolerance in accordance with FCC/ISED Approved Data Referencing Test Plan.

7.2 Radiated Spurious Emissions

§15.407(b) §15.205 §15.209; RSS-Gen [8.9]



Plot 7-1. RSE above 1GHz CDD (11ax – Ch.157 – RU26)

Mode:	802.11ax (20MHz BW)
Data Rate:	MCS11
RU Index:	4
Distance of Measurements:	3 Meters
Operating Frequency:	5785MHz
Channel:	157

Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
11570.00	Average	H	-	-	-77.00	14.48	44.48	53.98	-9.50
11570.00	Peak	H	-	-	-67.14	14.48	54.34	73.98	-19.64
17355.00	Peak	H	-	-	-68.71	20.08	58.37	68.20	-9.83

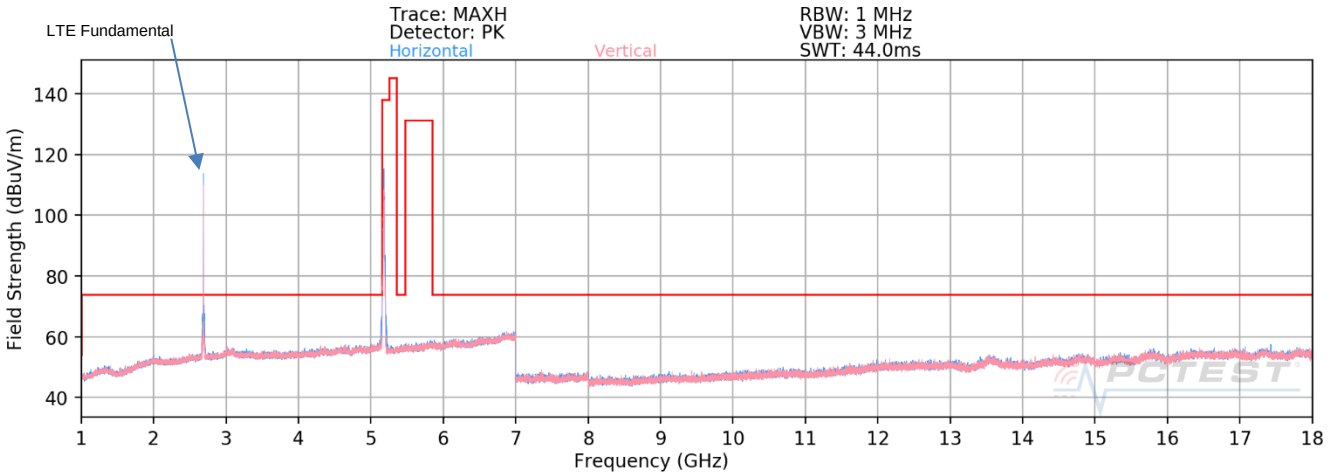
Table 7-2. Radiated Measurements CDD (RU26)

Simultaneous Tx Radiated Spurious Emissions Measurements

§15.407(b) §15.205 & §15.209; RSS-Gen [8.9]

Description	LTE (Band 41)	802.11a/n/ac/ax 5GHz
Antenna	Antenna 4b	Antenna 4b
Channel	41490	36
Operating Frequency (MHz)	2680	5180
Mode/Modulation	QPSK/1RB/20MHz	802.11ax/RU26/MCS11

Table 7-3. Worst Case Simultaneous Transmission Configuration



Plot 7-2. Radiated Spurious Emissions above 1GHz Simultaneous Tx

Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
10360.00	Peak	H	219	224	-69.95	14.04	51.09	68.20	-17.11
15540.00	Avg	H	-	-	-85.30	20.21	41.91	53.98	-12.07
15540.00	Peak	H	-	-	-73.18	20.21	54.03	73.98	-19.95
7680.00	Avg	H	-	-	-80.23	9.77	36.54	53.98	-17.44
7680.00	Peak	H	-	-	-68.67	9.77	48.10	73.98	-25.88

Table 7-4. UNII Harmonics and Intermodulations Emissions Measurements in Simultaneous Transmission Mode

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
5360.00	H	-	-	-60.94	10.44	-50.50	-25.0	-25.5
8040.00	H	-	-	-71.80	12.63	-59.17	-25.0	-34.2
10720.00	H	284	266	-66.62	13.33	-53.29	-25.0	-28.3
13400.00	H	-	-	-69.02	13.85	-55.17	-25.0	-30.2
16080.00	H	-	-	-66.43	13.59	-52.84	-25.0	-27.8
7680.00	H	-	-	-70.25	12.25	-58.00	-25.0	-33.0

Table 7-5. LTE Harmonics and Intermodulations Emissions Measurements in Simultaneous Transmission Mode

8.0 CONCLUSION

The spot-check data measured for variant model **FCC ID: BCGA2461 / IC: 579C-A2461** is in tolerance with reference model FCC ID: BCGA2379 / IC: 579C-A2379 per FCC/ISED Approved Data Referencing Test Plan.

9.0 APPENDIX A: REFERENCE MODEL TEST REPORT

Attached is the test report (1C2101020005-16-R1.BCG) from reference model FCC ID: BCGA2379 / IC: 579C-A2379, which includes referenced data results.

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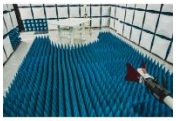
Tel. 410.290.6652 / Fax 410.290.6654
http://www.pctest.com



MEASUREMENT REPORT
FCC PART 15.407 / ISED RSS-247 UNII 802.11ax OFDMA

Applicant Name:
Apple Inc.
One Apple Park Way
Cupertino, CA 95014
United States

Date of Testing:
12/12/2020 - 03/2/2021
Test Site/Location:
PCTEST Morgan Hill, CA, USA
Test Report Serial No.:
1C2101020005-16-R1.BCG

FCC ID:	**BCGA2379**
IC:	**579C-A2379**
APPLICANT:	**Apple Inc.**

Application Type:	Certification
Model/HVIN:	A2379
EUT Type:	Tablet Device
Frequency Range:	5180 – 5825MHz
Modulation Type:	OFDMA
FCC Classification:	Unlicensed National Information Infrastructure (UNII)
FCC Rule Part(s):	Part 15 Subpart E (15.407)
ISED Specification:	RSS-247 Issue 2
Test Procedure(s):	ANSI C63.10-2013, KDB 789033 D02 v02r01, KDB 662911 D01 v02r01

This equipment has been shown to be capable of compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in ANSI C63.10-2013 and KDB 558074 D01 v05r02. Test results reported herein relate only to the item(s) tested.

This revised Test Report (S/N: 1C2101020005-16-R1.BCG) supersedes and replaces the previously issued test report on the same subject device for the same type of testing as indicated. Please discard or destroy the previously issued test report(s) and dispose of it accordingly.

I attest to the accuracy of data. All measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

Randy Ortanez
President

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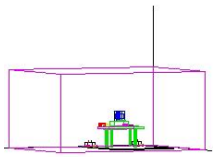
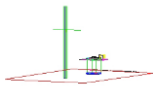


MEASUREMENT REPORT



UNII Band	Channel Bandwidth (MHz)	Tx Frequency (MHz)	SISO				CDD					
			Antenna 5b		Antenna 4b		Antenna 5b		Antenna 4b		Summed	
			Max. Power (mW)	Max. Power (dBm)	Max. Power (mW)	Max. Power (dBm)	Max. Power (mW)	Max. Power (dBm)	Max. Power (mW)	Max. Power (dBm)	Max. Power (mW)	Max. Power (dBm)
1	20	5180 - 5240	88.716	19.48	88.920	19.49	49.431	16.94	49.888	16.98	99.312	19.97
2A		5260 - 5320	87.700	19.43	88.716	19.48	50.119	17.00	49.888	16.98	100.000	20.00
2C		5500 - 5720	89.125	19.50	88.308	19.46	50.003	16.99	50.119	17.00	99.770	19.99
3		5745 - 5825	89.125	19.50	89.125	19.50	89.125	19.50	89.125	19.50	178.238	22.51
1	40	5190 - 5230	87.902	19.44	87.498	19.42	78.886	18.97	78.705	18.96	157.761	21.98
2A		5270 - 5310	89.125	19.50	89.125	19.50	89.125	19.50	87.498	19.42	176.604	22.47
2C		5510 - 5710	89.125	19.50	89.125	19.50	87.297	19.41	88.920	19.49	176.198	22.46
3		5755 - 5795	89.125	19.50	89.125	19.50	89.125	19.50	89.125	19.50	178.238	22.51
1	80	5210	14.093	11.49	14.060	11.48	11.220	10.50	10.914	10.38	22.131	13.45
2A		5290	22.387	13.50	22.233	13.47	17.783	12.50	17.783	12.50	35.563	15.51
2C		5530 - 5690	86.696	19.38	86.696	19.38	86.696	19.38	88.716	19.48	175.388	22.44
3		5775	50.119	17.00	50.119	17.00	39.628	15.98	38.994	15.91	78.705	18.96

FCC EUT Overview

UNII Band	Channel Bandwidth (MHz)	Tx Frequency (MHz)	SISO				CDD/SDM					
			Antenna 5b		Antenna 4b		Antenna 5b		Antenna 4b		Summed	
			Max. Power (mW)	Max. Power (dBm)	Max. Power (mW)	Max. Power (dBm)	Max. Power (mW)	Max. Power (dBm)	Max. Power (mW)	Max. Power (dBm)	Max. Power (mW)	Max. Power (dBm)
1	20	5180 - 5240	26.607	14.25	26.002	14.15	18.239	12.61	18.408	12.65	36.644	15.64
2A		5260 - 5320	87.700	19.43	88.716	19.48	50.119	17.00	49.888	16.98	100.000	20.00
2C		5500 - 5720	89.125	19.50	88.308	19.46	50.003	16.99	50.119	17.00	99.770	19.99
3		5745 - 5825	89.125	19.50	89.125	19.50	89.125	19.50	89.125	19.50	178.238	22.51
1	40	5190 - 5230	49.091	16.91	49.774	16.97	36.141	15.58	34.674	15.40	70.795	18.50
2A		5270 - 5310	89.125	19.50	89.125	19.50	89.125	19.50	87.498	19.42	176.604	22.47
2C		5510 - 5710	89.125	19.50	89.125	19.50	87.297	19.41	88.920	19.49	176.198	22.46
3		5755 - 5795	89.125	19.50	89.125	19.50	89.125	19.50	89.125	19.50	178.238	22.51
1	80	5210	13.996	11.46	14.060	11.48	11.220	10.50	10.914	10.38	22.131	13.45
2A		5290	22.387	13.50	22.233	13.47	17.783	12.50	17.783	12.50	35.563	15.51
2C		5530 - 5690	86.696	19.38	86.696	19.38	86.696	19.38	88.716	19.48	175.388	22.44
3		5775	50.119	17.00	50.119	17.00	39.628	15.98	38.994	15.91	78.705	18.96

ISED EUT Overview

1.0 INTRODUCTION

1.1 Scope

Measurement and determination of electromagnetic emissions (EMC) of radio frequency devices including intentional and/or unintentional radiators for compliance with the technical rules and regulations of the Federal Communications Commission and the Innovation, Science and Economic Development Canada.

1.2 PCTEST Test Location

These measurement tests were conducted at the PCTEST facility located at 18855 Adams Court, Morgan Hill, CA 95037. The measurement facility is compliant with the test site requirements specified in ANSI C63.4-2014 and KDB 414788 D01 v01r01.

1.3 Test Facility / Accreditations

Measurements were performed at PCTEST located in Morgan Hill, CA 95037, U.S.A.

- PCTEST is an ISO 17025-2017 accredited test facility under the American Association for Laboratory Accreditation (A2LA) with Certificate number 2041.02 for Specific Absorption Rate (SAR), Hearing Aid Compatibility (HAC) testing, where applicable, and Electromagnetic Compatibility (EMC) testing for FCC and Innovation, Science, and Economic Development Canada rules.

- PCTEST TCB is a Telecommunication Certification Body (TCB) accredited to ISO/IEC 17065-2012 by A2LA (Certificate number 2041.03) in all scopes of FCC Rules and ISED Standards (RSS).

- PCTEST facility is a registered (22831) test laboratory with the site description on file with ISED.

2.0 PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the **Apple Tablet Device FCC ID: BCGA2379** and **IC: 579C-A2379**. The test data contained in this report pertains only to the emissions due to the EUT's UNII 802.11ax - RU transmitter.

Test Device Serial No.: H4MTX492NT, NN63X069PP, JR9GHQH6LP, KRF23LVQ2T

2.2 Device Capabilities

This device contains the following capabilities:

850/1900 GSM/GPRS/EDGE, 850/1700/1900 WCDMA/HSPA, Multi-band LTE, 5G NR (FR1/FR2), 802.11b/g/n/ax WLAN, 802.11a/n/ac/ax UNII, Bluetooth (1x, EDR, LE1M, LE2M, HDR4, HDR8), WPT.

This device supports BT Beamforming.

Band 1		Band 2A		Band 2C		Band 3	
Ch.	**Frequency (MHz)**	**Ch.**	**Frequency (MHz)**	**Ch.**	**Frequency (MHz)**	**Ch.**	**Frequency (MHz)**
36	5180	52	5260	100	5500	149	5745
:	:	:	:	:	:	:	:
42	5210	56	5280	116	5580	157	5785
:	:	:	:	:	:	:	:
48	5240	64	5320	144	5720	165	5825

Table 2-1. 802.11a / 802.11n / 802.11ac / 802.11ax (20MHz) Frequency / Channel Operations

Band 1		Band 2A		Band 2C		Band 3	
Ch.	**Frequency (MHz)**	**Ch.**	**Frequency (MHz)**	**Ch.**	**Frequency (MHz)**	**Ch.**	**Frequency (MHz)**
38	5190	54	5270	102	5510	151	5755
:	:	:	:	:	:	:	:
46	5230	62	5310	110	5550	159	5795
				:	:		
				142	5710		

Table 2-2. 802.11n / 802.11ac / 802.11ax (40MHz BW) Frequency / Channel Operations

Band 1		Band 2A		Band 2C		Band 3	
Ch.	**Frequency (MHz)**	**Ch.**	**Frequency (MHz)**	**Ch.**	**Frequency (MHz)**	**Ch.**	**Frequency (MHz)**
42	5210	58	5290	106	5530	155	5775
				:	:		
				138	5690		

Table 2-3. 802.11ac / 802.11ax (80MHz BW) Frequency / Channel Operations

Notes:

1. TDWR channels are not supported for ISED.
2. 5GHz NII operation is possible in 20MHz, and 40MHz, and 80MHz channel bandwidths. The maximum achievable duty cycles for all modes were determined based on measurements performed on a spectrum analyzer in zero-span mode with RBW = 8MHz, VBW = 50MHz, and detector = peak per the guidance of Section B)2)b) of KDB 789033 D02 v02r01 and ANSI C63.10-2013. The RBW and VBW were both greater than 50/T, where T is the minimum transmission duration, and the number of sweep points across T was greater than 100. The duty cycles are as follows:

Measured Duty Cycles				
802.11 Mode/Band		Duty Cycle [%]		
		Antenna 5b	Antenna 4b	CDD/SDM
5GHz	ax - RU (HE20)	99.2	98.1	99.0
	ax - RU (HE40)	98.3	98.6	98.5
	ax - RU (HE80)	98.4	98.3	99.1

Table 2-4. Measured Duty Cycles

3. The device employs CDD/SDM technology. Below are the possible configurations.

WiFi Configurations		SISO		CDD		SDM		STBC	
		Antenna 5b	Antenna 4a	Antenna 5b	Antenna 4a	Antenna 5b	Antenna 4a	Antenna 5b	Antenna 4a
5GHz	11ax (20MHz)	✓	✓	✓	✓	✓	✓	✓	✓
	11ax (40MHz)	✓	✓	✓	✓	✓	✓	✓	✓
	11ax (80MHz)	✓	✓	✓	✓	✓	✓	✓	✓

Table 2-5. WIFI Configurations

✓= Support ; ✗ = NOT Support
SISO = Single Input Single Output
CDD = Cyclic Delay Diversity – 2Tx Function
SDM = Spatial Diversity Multiplexing – CDD/SDM function
STBC = Space-Time Block Coding – 2Tx Function

Data Rate(s) Support:

8/8.6, 16/17.2, 24/25.8, 33/34.4, 49/51.6, 65/68.8, 73/77.4, 81/86.0, 98/103.2, 108/114.7, 122/129.0, 135/143.4Mbps (ax – 20MHz)
16/17.2, 33/34.4, 49/51.6, 65/68.8, 98/103.2, 130/137.6, 146/154.9, 163/172.1, 195/206.5, 217/229.4, 244/258.1, 271/286.8Mbps (ax – 40MHz BW)
34/36.0, 68/72.1, 102/108.1, 136/144.1, 204/216.2, 272/288.2, 306/324.4, 340/360.3, 408/432.4, 453/480.4, 510/540.4, 567/600.5Mbps (ax – 80MHz BW)
16/17.2, 33/34.4, 49/51.6, 65/68.8, 98/103.2, 130/137.6, 146/154.9, 163/172.1, 195/206.5, 217/229.4, 244/258.1, 271/286.8Mbps (MIMO ax – 20MHz BW)
34/36.0, 68/72.1, 102/108.1, 136/144.1, 204/216.2, 272/288.2, 306/324.4, 340/360.3, 408/432.4, 453/480.4, 510/540.4, 567/600.5Mbps (MIMO ax – 40MHz BW)
68/72, 136/144.1, 204/216.2, 272/288.2, 408/432.4, 544/576.4, 612/648.8, 680/720.6, 816/864.8, 906/960.8, 1020/1080.8, 1134/1201Mbps (MIMO ax – 80MHz BW)

This device supports simultaneous transmission operations, which allows for multiple transmitters to transmit simultaneously on the same antenna. The table below shows all configurations possible.

Antenna	Simultaneous Tx Config	WLAN	Bluetooth	GSM / WCDMA	LTE / FR1 NR			UNII
		802.11 b/g/n/ax	BDR, EDR, HDR4/8, LE1/2M	Mid Band	Mid Band	High Band	Ultra High Band	802.11 a/n/ac/ax
2a	Config 1	✓	×	×	×	×	✓	×
2a	Config 2	×	✓	×	×	×	✓	×
4a	Config 3	✓	×	×	×	×	✓	×
4a	Config 4	×	✓	×	×	×	✓	×
4b	Config 5	×	×	✓	×	×	×	✓
4b	Config 6	×	×	×	✓	×	×	✓
4b	Config 7	×	×	×	×	✓	×	✓

Table 2-6. Simultaneous Transmission Configurations

✓ = Support; × = Not Support

2.3 Antenna Description

Following antenna gains provided by manufacturer were used for the testing.

Frequency [GHz]	Antenna Gain (dBi)	
	Antenna 5b	Antenna 4b
5.150 – 5.250	4.7	0.6
5.250 – 5.350	4.9	-0.6
5.470 – 5.725	5.1	-1.4
5.725 – 5.850	5.1	0.4

Table 2-7. Highest Antenna Gain

2.4 Test Support Equipment

1	Apple MacBook Pro	Model:	A2141	S/N:	C02DV7VKMD6T
	w/AC/DC Adapter	Model:	A2166	S/N:	N/A
2	Apple USB-C Cable	Model:	Chimp	S/N:	420A57
3	USB-C Cable	Model:	A146	S/N:	N/A
	w/ AC Adapter	Model:	A2305	S/N:	N/A
4	Apple Pencil	Model:	N/A	S/N:	GQXYGSXBJKM9
5	DC Power Supply	Model:	KPS3010D	S/N:	N/A

Table 2-8. Test Support Equipment List

2.5 Test Configuration

The EUT was tested per the guidance of ANSI C63.10-2013 and KDB 789033 D02 v02r01. ANSI C63.10-2013 was used to reference the appropriate EUT setup for radiated spurious emissions testing and AC line conducted testing. See Sections 3.2 for AC line conducted emissions test setups, 3.3 for radiated emissions test setups, and 7.2, 7.3, 7.4, and 7.5 for antenna port conducted emissions test setups.

There are two vendors of the WiFi/Bluetooth radio modules, variant 1 and variant 2. Both radio modules have the same mechanical outline, same on-board antenna matching circuit, identical antenna structure, and are built and tested to conform to the same specifications and to operate within the same tolerances. The worst case configuration was found between the two variants. The EUT was also investigated with and without charger.

For emissions from 1GHz – 18GHz, low, mid, and high channels were tested with highest power and worst case configuration. The emissions below 1GHz and above 18GHz were tested with the highest transmitting power and the worst case channel.

The EUT was manipulated through three orthogonal planes of X-orientation (flatbed), Y-orientation (landscape), and Z-orientation (portrait) during the testing. Only the worst case emissions were reported in this test report.

For AC line conducted and radiated test below 1GHz, following configuration were investigated and EUT powered by AC/DC was the worst case.

- EUT powered by AC/DC adaptor via USB-C cable with wire charger
- EUT powered by host PC via USB-C cable with wire charger

802.11ax-RU HE20/40/80 2TX CDD/SDM mode test data provided in this report covers 802.11ax-RU HE20/40/80 2TX STBC mode.

For 802.11a/n/ac/ax-SU test results, see separate UNII report, 1C2101020005-15.BCG.

All possible simultaneous transmission configurations have been investigated and the worst case config has been reported.

Description	LTE (Band 41)	802.11a/n/ac/ax 5GHz
Antenna	Antenna 4b	Antenna 4b
Channel	41490	36
Operating Frequency (MHz)	2680	5180
Mode/Modulation	QPSK/1RB/20MHz	802.11ax/RU26/MCS11

Table 2-9. Worst Case Simultaneous Transmission Configuration

2.6 Software and Firmware

The test was conducted with firmware version 18E20700y installed on the EUT.

2.7 EMI Suppression Device(s)/Modifications

No EMI suppression device(s) were added and/or no modifications were made during testing.

3.0 DESCRIPTION OF TESTS

3.1 Evaluation Procedure

The measurement procedures described in the American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices (ANSI C63.10-2013) and the guidance provided in KDB 789033 D02 v02r01 were used in the measurement of the EUT**.**

Deviation from measurement procedure……..…….....None

3.2 AC Line Conducted Emissions

The line-conducted facility is located inside a 7m x 3.66m x 2.7m shielded enclosure. The shielded enclosure is manufactured by AP Americas. The shielding effectiveness of the shielded room is in accordance with MIL-Std-285 or NSA 65-6. A 1m x 1.5m wooden table 80cm high is placed 40cm away from the vertical wall and 80cm away from the sidewall of the shielded room. Two 10kHz-30MHz, 50Ω/50μH Line-Impedance Stabilization Networks (LISNs) are bonded to the shielded room floor. Power to the LISNs is filtered by external high-current high-insertion loss power line filters. The external power line filter is EPCOS 2X60A Power Line Filter (100dB Attenuation, 14kHz-18GHz) and the two EPCOs 2X48A filters (100dB Minimum Insertion Loss, 14kHz - 10GHz). These filters attenuate ambient signal noise from entering the measurement lines. These filters are also bonded to the shielded enclosure.

The EUT is powered from one LISN and the support equipment is powered from the second LISN. If the EUT is a DC-powered device, power will be derived from the source power supply it normally will be powered from and this supply line(s) will be connected to the second LISN. All interconnecting cables more than 1 meter were shortened to a 1 meter length by non-inductive bundling (serpentine fashion) and draped over the back edge of the test table. All cables were at least 40cm above the horizontal reference ground plane. Power cables for support equipment were routed down to the second LISN while ensuring that that cables were not draped over the second LISN.

Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The RF output of the LISN was connected to the spectrum analyzer and exploratory measurements were made to determine the frequencies producing the maximum emission from the EUT. The spectrum was scanned from 150kHz to 30MHz with a spectrum analyzer. The detector function was set to peak mode for exploratory measurements while the bandwidth of the analyzer was set to 10kHz. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each emission. Once the worst case emissions have been identified, the one EUT cable configuration/arrangement and mode of operation that produced these emissions is used for final measurements on the same test site. The analyzer is set to CISPR quasi-peak and average detectors with a 9kHz resolution bandwidth for final measurements.

Line conducted emissions test results are shown in Section 7.8. Automated test software was used to perform the AC line conducted emissions testing. Automated measurement software utilized is Rohde & Schwarz EMC32, Version 10.50.40.

3.3 Radiated Emissions

The radiated test facilities consisted of an indoor 3 meter semi-anechoic chamber used for final measurements and exploratory measurements, when necessary. The measurement area is contained within the semi-anechoic chamber which is shielded from any ambient interference. The test site inside the chamber is a 6m x 5.2m elliptical, obstruction-free area in accordance with Figure 5.7 of Clause 5 in ANSI C63.4-2014. Absorbers are arranged on the floor between the turn table and the antenna mast in such a way so as to maximize the reduction of reflections for measurements above 1GHz. An 80cm tall test table made of Styrodur is placed on top of the turn table. For measurements above 1GHz, an additional Styrodur pedestal is placed on top of the test table to bring the total table height to 1.5m.

Per KDB 414788, radiated emission test sites other than open-field test sites (e.g., shielded anechoic chambers), may be employed for emission measurements below 30MHz if characterized so that the measurements correspond to those obtained at an open-field test site. To determine test site equivalency, a reference sample transmitting at 149kHz was measured on an open field test site (asphalt with no ground plane) and then measured in the 3m semi-anechoic chamber. A calibrated 60cm loop antenna was used while the reference device was rotated through the X, Y and Z axis in order to capture the worst case level. A maximum deviation of 2.77dB at 149kHz was measured when comparing the 3 meter semi-anechoic chamber to the open field site.

For all measurements, the spectrum was scanned through all EUT azimuths and from 1 to 4 meter receive antenna height using a broadband antenna from 30MHz up to the upper frequency shown in 15.33 depending on the highest frequency generated or used in the device or on which the device operates or tunes. For frequencies above 1GHz, linearly polarized double ridge horn antennas were used. For frequencies below 30MHz, a calibrated loop antenna was used. When exploratory measurements were necessary, they were performed at 1 meter test distance inside the semi-anechoic chamber using broadband antennas, broadband amplifiers, and spectrum analyzers to determine the frequencies and modes producing the maximum emissions. Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The test set-up was placed on top of the 1 x 1.5 meter table. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each emission. Appropriate precaution was taken to ensure that all emissions from the EUT were maximized and investigated. The system configuration, mode of operation, turntable azimuth, and receive antenna height was noted for each frequency found.

Final measurements were made in the semi-anechoic chamber using calibrated, linearly polarized broadband and horn antennas. The test setup was configured to the setup that produced the worst case emissions. The spectrum analyzer was set to investigate all frequencies required for testing to compare the highest radiated disturbances with respect to the specified limits. The turntable containing the EUT was rotated through 360 degrees and the height of the receive antenna was varied 1 to 4 meters and stopped at the azimuth and height producing the maximum emission. Each emission was maximized by changing the orientation of the EUT through three orthogonal planes and changing the polarity of the receive antenna, whichever produced the worst-case emissions.

3.4 Environmental Conditions

The temperature is controlled within range of 15°C to 35°C. The relative humidity is controlled within range of 10% to 75%. The atmospheric pressure is monitored within the range 86-106kPa (860-1060mbar).

4.0 ANTENNA REQUIREMENTS

Excerpt from §15.203 of the FCC Rules/Regulations:
"An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section."

- The antennas of the EUT are **permanently attached.**
- There are no provisions for connection to an external antenna.

Conclusion:

The EUT complies with the requirement of §15.203.

5.0 MEASUREMENT UNCERTAINTY

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.23-2012. All measurement uncertainty values are shown with a coverage factor of k = 2 to indicate a 95% level of confidence. The measurement uncertainty shown below meets or exceeds the U_{CISPR} measurement uncertainty values specified in CISPR 16-4-2 and, thus, can be compared directly to specified limits to determine compliance.

Contribution	Expanded Uncertainty (±dB)
Conducted Bench Top Measurements	1.65
Line Conducted Disturbance	2.71
Radiated Disturbance (<30MHz)	4.06
Radiated Disturbance (30MHz - 1GHz)	4.30
Radiated Disturbance (1 - 18GHz)	4.78
Radiated Disturbance (>18GHz)	4.79

6.0 TEST EQUIPMENT CALIBRATION DATA

Test Equipment Calibration is traceable to the National Institute of Standards and Technology (NIST). Measurements antennas used during testing were calibrated in accordance to the requirements of ANSI C63.5-2017.

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Agilent Technologies	N9030A	3Hz-44GHz PXA Signal Analyzer	3/4/2020	Annual	3/4/2021	MY49430244
Anritsu	ML2496A	Power Meter	4/9/2020	Annual	4/9/2021	2002005
Anritsu	MA2411B	Pulse Power Sensor	3/10/2020	Annual	3/10/2021	1911105
Anritsu	MA2411B	Pulse Power Sensor	3/10/2020	Annual	3/10/2021	1911106
ATM	180-442A-KF	20dB Nominal Gain Horn Antenna	8/11/2020	Annual	8/11/2021	T058701-01
COM-POWER	LIN-120A	LISN	3/4/2020	Annual	3/4/2021	241297
Rohde & Schwarz	TS-PR8	Pre-Amplifier (30MHz - 8GHz)	3/4/2020	Annual	3/4/2021	102325
ETS-Lindgren	3142E	BiConiLog Antenna (30MHz - 6GHz)	9/15/2020	Annual	9/15/2021	208204
ETS-Lindgren	3117	Double Ridged Guide Antenna (1-18 GHz)	4/21/2020	Annual	4/21/2021	205956
Rohde & Schwarz	ESW26	EMI Test Receiver	6/1/2020	Annual	6/1/2021	101299
Rohde & Schwarz	ESW44	EMI Test Receiver	8/7/2020	Annual	8/7/2021	101668
Rohde & Schwarz	TS-PR1840	Pre-Amplifier (18GHz - 40GHz)	4/3/2020	Annual	4/3/2021	100052
Rohde & Schwarz	TC-TA18	Cross Polarized Vivaldi Antenna (400MHz-18GHz)	10/2/2020	Annual	10/2/2021	101063
Rohde & Schwarz	HFH2-Z2	Loop Antenna	3/12/2020	Annual	3/12/2021	100546
Rohde & Schwarz	TS-PR18	Pre-Amplifier (1GHz - 18GHz)	12/3/2020	Annual	12/3/2021	101648
Rohde & Schwarz	ENV216	Two-Line V-Network (LISN)	12/7/2020	Annual	12/7/2021	101364

Table 6-1. Test Equipment List

Note:

For equipment listed above that has a calibration date or calibration due date that falls within the test date range, care was taken to ensure that this equipment was used after the calibration date and before the calibration due date.

7.0 TEST RESULTS

7.1 Summary

Company Name: Apple Inc.
FCC ID: BCGA2379
IC: 579C-A2379
FCC Classification: Unlicensed National Information Infrastructure (UNII)

FCC Part Section(s)	RSS Section(s)	Test Description	Test Limit	Test Condition	Test Result	Reference
15.407	RSS-Gen [6.7]	26dB Bandwidth	N/A	CONDUCTED	N/A	Section 7.2
15.407(e)	RSS-Gen [6.7]	6dB Bandwidth	>500kHz(5725-5850MHz)		PASS	Section 7.3
2.1049	RSS-Gen [6.7]	Occupied Bandwidth	N/A		N/A	Section 7.2, Section 7.3
15.407 (a.1.iv), (a.2), (a.3)	RSS-247 [6.2]	Maximum Conducted Output Power	Maximum conducted powers must meet the limits detailed in 15.407 (a) (RSS-247 [6.2])		PASS	Section 7.4
15.407 (a.1.iv), (a.2), (a.3)	RSS-247 [6.2]	Maximum Power Spectral Density	Maximum power spectral density must meet the limits detailed in 15.407 (a) (RSS-247 [6.2])		PASS	Section 7.5
15.407(h)	RSS-247 [6.3]	Dynamic Frequency Selection	See DFS Test Report	RADIATED	PASS	See DFS Test Report (1C2101020005-14.BCG)
15.407(b.1), (2), (3), (4)	RSS-247 [6.2]	Undesirable Emissions	Undesirable emissions must meet the limits detailed in 15.407(b) (RSS-247 [6.2])		PASS	Section 7.6
15.205, 15.407(b.1), (4), (5), (6)	RSS-Gen [8.9]	General Field Strength Limits (Restricted Bands and Radiated Emission Limits)	Emissions in restricted bands must meet the radiated limits detailed in 15.209 (RSS-Gen [8.9])		PASS	Section 7.6, 7.7
15.207	RSS-Gen [8.8]	AC Conducted Emissions 150kHz – 30MHz	< FCC 15.207 (RSS-Gen [8.8]) limits	AC LINE CONDUCTED	PASS	Section 7.8

Table 7-1. Summary of Test Results

Notes:

1) All channels, modes, and modulations/data rates were investigated among all UNII bands. The test results shown in the following sections represent the worst case emissions.
2) The analyzer plots shown in this section were all taken with a correction table loaded into the analyzer. The correction table was used to account for the losses of the cables and attenuators used as part of the system to connect the EUT to the analyzer at all frequencies of interest.
3) All antenna port conducted emissions testing was performed on a test bench with the antenna port of the EUT connected to the spectrum analyzer through calibrated cables and attenuators.
4) For conducted spurious emissions, automated test software was used to measure emissions and capture the corresponding plots necessary to show compliance. The measurement software utilized is PCTEST "UNII Automation," Version 5.2.
5) For radiated band edge, automated test software was used to measure emissions and capture the corresponding plots necessary to show compliance. The measurement software utilized is PCTEST "Chamber Automation," Version 1.3.1.
6) Per RSS-247 Section 6.2.3, transmission on channels which overlap the 5600-5650 MHz is prohibited. This device operates under these frequencies only under the control of a certified master device and does not support active scanning on these channels. This device does not transmit any beacons or initiate any transmissions in UNII Bands 2A or 2C.
7) 802.11ax OFDMA testing was performed for all signal tone configurations as specified by the 802.11ax standard. Worst case results are determined and reported per the guidance provided at the October 2018 TCB Workshop.
8) Only one RU index could be selected at a time so no contiguous or non-contiguous RU's were considered for testing.

7.2 26dB & 99% Bandwidth Measurement – 802.11ax OFDMA

§2.1049; §15.407; RSS-Gen [6.7]

Test Overview and Limit

The bandwidth at 26dB down from the highest in-band spectral density is measured with a spectrum analyzer connected to the antenna terminal while the EUT is operating at its maximum duty cycle, at its maximum power control level, as defined in ANSI C63.10-2013 and KDB 789033 D02 v02r01, and at the appropriate frequencies. The spectrum analyzer's bandwidth measurement function is configured to measure the 26dB bandwidth.

The 26dB bandwidth is used to determine the conducted power limits.

Test Procedure Used

ANSI C63.10-2013 – Section 12.4
KDB 789033 D02 v02r01 – Section C

Test Settings

1. The signal analyzers' automatic bandwidth measurement capability was used to perform the 26dB bandwidth measurement. The "X" dB bandwidth parameter was set to X = 26. The automatic bandwidth measurement function also has the capability of simultaneously measuring the 99% occupied bandwidth. The bandwidth measurement was not influenced by any intermediate power nulls in the fundamental emission.
2. RBW = approximately 1% of the emission bandwidth
3. VBW $\geq$ 3 x RBW
4. Detector = Peak
5. Trace mode = max hold

Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.

Figure 7-1. Test Instrument & Measurement Setup

Test Notes

1. All antenna configs were investigated and only the worst case is reported.
2. All RU's were investigated and only worst case partially-loaded and fully-loaded RU's were reported
3. Low, mid, and high channels were tested and tabular data has been reported. Only mid channels bandwidths plots have been reported.

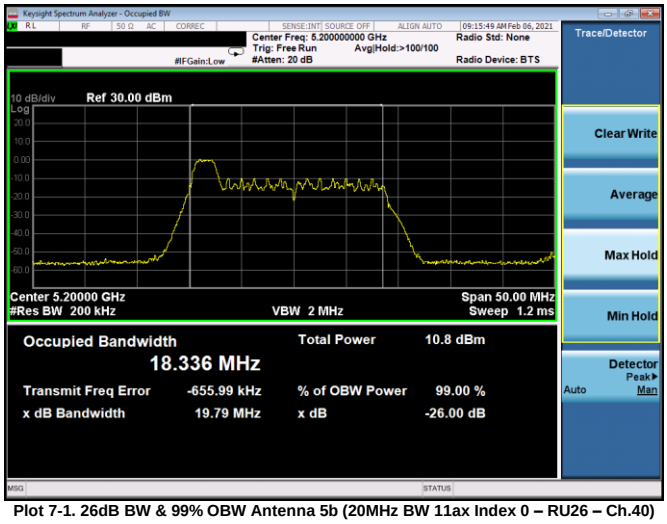
Antenna 5b 26dB & 99% Bandwidth Measurements

	Frequency [MHz]	Channel No.	802.11 Mode	RU Size	RU Index	Data Rate [Mbps]	Measured 99% OBW [MHz]	Measured 26dB Bandwidth [MHz]
Band 1	5180	36	ax (20MHz)	26	0	135/143.4 (MCS11)	18.29	19.74
				26	4	135/143.4 (MCS11)	17.25	18.89
				26	8	135/143.4 (MCS11)	18.49	20.04
	5200	40	ax (20MHz)	26	0	135/143.4 (MCS11)	18.34	19.79
				26	4	135/143.4 (MCS11)	17.30	18.91
				26	8	135/143.4 (MCS11)	18.52	20.43
	5240	48	ax (20MHz)	26	0	135/143.4 (MCS11)	18.35	19.84
				26	4	135/143.4 (MCS11)	17.27	18.97
				26	8	135/143.4 (MCS11)	18.61	20.34
	5190	38	ax (40MHz)	26	0	271/286.8 (MCS11)	18.32	20.26
				26	8	271/286.8 (MCS11)	20.77	24.80
				26	17	271/286.8 (MCS11)	18.33	20.24
	5230	46	ax (40MHz)	26	0	271/286.8 (MCS11)	18.17	19.85
				26	8	271/286.8 (MCS11)	20.35	22.29
				26	17	271/286.8 (MCS11)	18.28	20.30
	5210	42	ax (80MHz)	26	0	567/600.5 (MCS11)	18.05	19.63
				26	18	567/600.5 (MCS11)	36.96	38.75
				26	36	567/600.5 (MCS11)	18.54	20.62
Band 2A	5260	52	ax (20MHz)	26	0	135/143.4 (MCS11)	18.34	19.86
				26	4	135/143.4 (MCS11)	17.26	19.01
				26	8	135/143.4 (MCS11)	18.58	20.39
	5280	56	ax (20MHz)	26	0	135/143.4 (MCS11)	18.36	19.79
				26	4	135/143.4 (MCS11)	17.27	18.87
				26	8	135/143.4 (MCS11)	18.54	20.49
	5320	64	ax (20MHz)	26	0	135/143.4 (MCS11)	18.34	19.68
				26	4	135/143.4 (MCS11)	17.22	18.83
				26	8	135/143.4 (MCS11)	18.50	20.33
	5270	54	ax (40MHz)	26	0	271/286.8 (MCS11)	18.22	20.09
				26	8	271/286.8 (MCS11)	20.84	22.71
				26	17	271/286.8 (MCS11)	18.21	19.60
	5310	62	ax (40MHz)	26	0	271/286.8 (MCS11)	18.25	20.30
				26	8	271/286.8 (MCS11)	20.51	22.43
				26	17	271/286.8 (MCS11)	18.35	20.23
	5290	58	ax (80MHz)	26	0	567/600.5 (MCS11)	18.17	19.45
				26	18	567/600.5 (MCS11)	36.84	39.07
				26	36	567/600.5 (MCS11)	18.19	20.52
Band 2C	5500	100	ax (20MHz)	26	0	135/143.4 (MCS11)	18.25	19.74
				26	4	135/143.4 (MCS11)	17.28	18.78
				26	8	135/143.4 (MCS11)	18.54	20.44
	5580	116	ax (20MHz)	26	0	135/143.4 (MCS11)	18.29	19.80
				26	4	135/143.4 (MCS11)	17.20	18.94
				26	8	135/143.4 (MCS11)	18.48	20.30
	5720	144	ax (20MHz)	26	0	135/143.4 (MCS11)	18.40	19.87
				26	4	135/143.4 (MCS11)	17.17	18.38
				26	8	135/143.4 (MCS11)	18.48	20.16
	5510	102	ax (40MHz)	26	0	271/286.8 (MCS11)	18.29	20.12
				26	8	271/286.8 (MCS11)	20.45	22.12
				26	17	271/286.8 (MCS11)	18.27	20.01
	5550	110	ax (40MHz)	26	0	271/286.8 (MCS11)	18.25	20.31
				26	8	271/286.8 (MCS11)	21.04	23.69
				26	17	271/286.8 (MCS11)	18.26	20.28
	5710	142	ax (40MHz)	26	0	271/286.8 (MCS11)	18.26	20.46
				26	8	271/286.8 (MCS11)	20.96	23.06
				26	17	271/286.8 (MCS11)	18.29	19.85
	5530	106	ax (80MHz)	26	0	567/600.5 (MCS11)	18.14	19.77
				26	18	567/600.5 (MCS11)	37.00	39.00
				26	36	567/600.5 (MCS11)	18.54	20.98
	5690	138	ax (80MHz)	26	0	567/600.5 (MCS11)	18.45	19.73
				26	18	567/600.5 (MCS11)	36.78	38.52
				26	36	567/600.5 (MCS11)	18.58	20.92

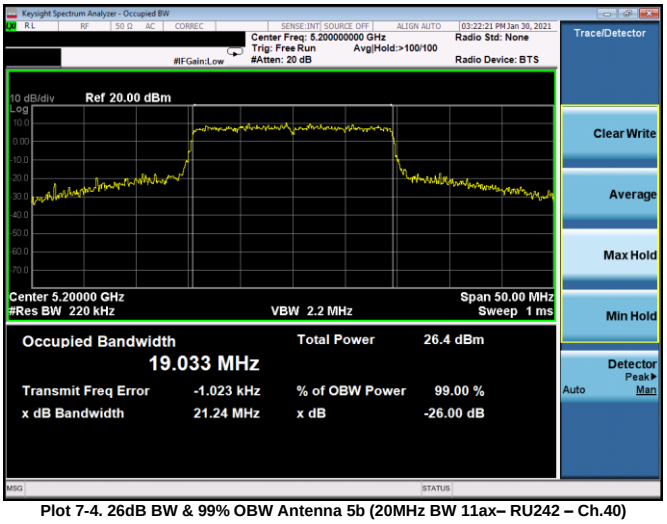
Table 7-2. Conducted BW Measurements Antenna 5b (RU26)

	Frequency [MHz]	Channel No.	802.11 Mode	RU Size	RU Index	Data Rate [Mbps]	Measured 99% OBW [MHz]	Measured 26dB Bandwidth [MHz]
Band 1	5180	36	ax (20MHz)	242	61	135/143.4 (MCS11)	19.05	21.23
	5200	40	ax (20MHz)	242	61	135/143.4 (MCS11)	19.03	21.24
	5240	48	ax (20MHz)	242	61	135/143.4 (MCS11)	19.09	22.05
	5190	38	ax (40MHz)	484	65	271/286.8 (MCS11)	37.98	41.55
	5230	46	ax (40MHz)	484	65	271/286.8 (MCS11)	37.94	41.78
	5210	42	ax (80MHz)	996	67	567/600.5 (MCS11)	77.13	81.80
Band 2A	5260	52	ax (20MHz)	242	61	135/143.4 (MCS11)	19.07	22.24
	5280	56	ax (20MHz)	242	61	135/143.4 (MCS11)	19.07	21.78
	5320	64	ax (20MHz)	242	61	135/143.4 (MCS11)	19.00	21.15
	5270	54	ax (40MHz)	484	65	271/286.8 (MCS11)	37.96	41.96
	5310	62	ax (40MHz)	484	65	271/286.8 (MCS11)	37.96	41.54
	5290	58	ax (80MHz)	996	67	567/600.5 (MCS11)	77.07	81.24
Band 2C	5500	100	ax (20MHz)	242	61	135/143.4 (MCS11)	19.04	21.23
	5580	116	ax (20MHz)	242	61	135/143.4 (MCS11)	19.03	21.37
	5720	144	ax (20MHz)	242	61	135/143.4 (MCS11)	19.07	21.49
	5510	102	ax (40MHz)	484	65	271/286.8 (MCS11)	37.93	41.71
	5550	110	ax (40MHz)	484	65	271/286.8 (MCS11)	37.96	43.05
	5710	142	ax (40MHz)	484	65	271/286.8 (MCS11)	37.99	41.90
	5530	106	ax (80MHz)	996	67	567/600.5 (MCS11)	77.17	81.51
	5690	138	ax (80MHz)	996	67	567/600.5 (MCS11)	77.28	81.57

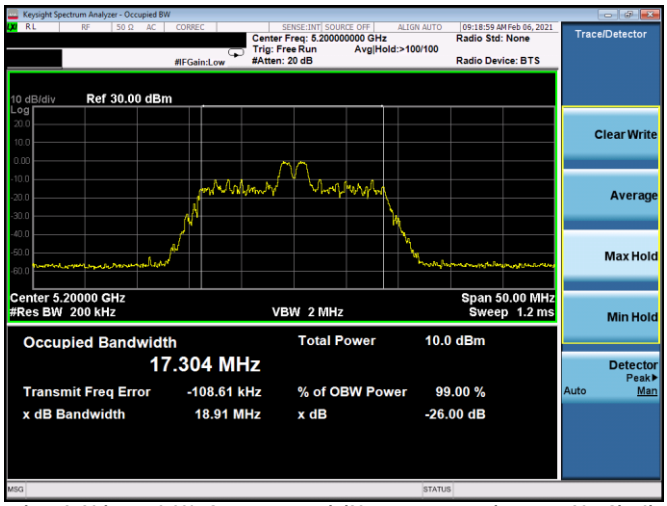
Table 7-3. Conducted BW Measurements Antenna 5b (Fully – loaded RU)



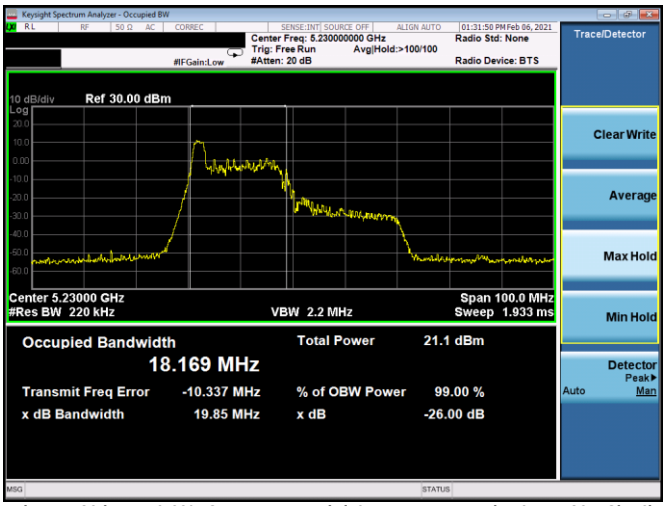
Plot 7-1. 26dB BW & 99% OBW Antenna 5b (20MHz BW 11ax Index 0 – RU26 – Ch.40)



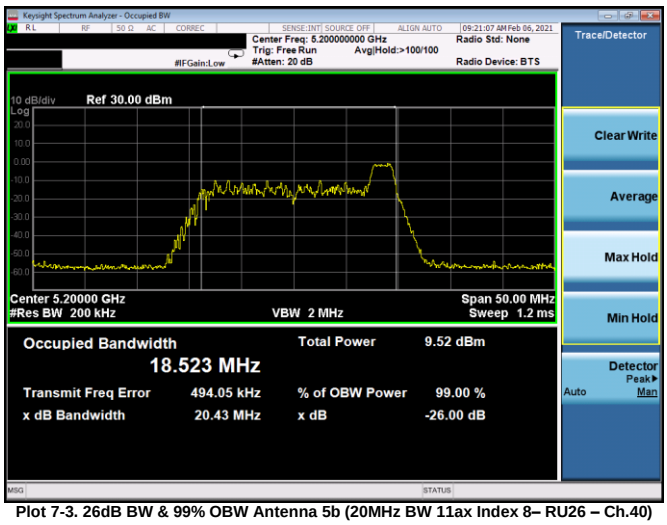
Plot 7-4. 26dB BW & 99% OBW Antenna 5b (20MHz BW 11ax– RU242 – Ch.40)



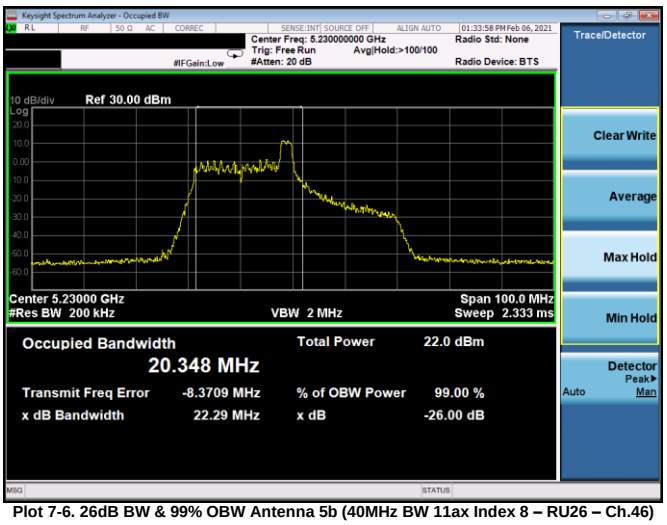
Plot 7-2. 26dB BW & 99% OBW Antenna 5b (20MHz BW 11ax Index 4 – RU26 – Ch.40)



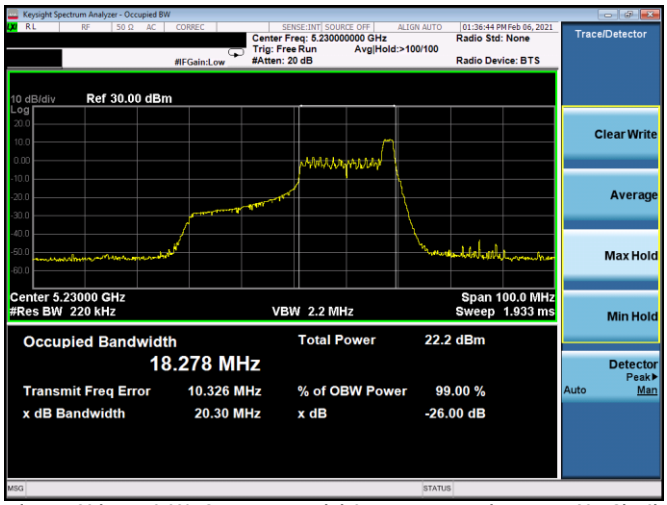
Plot 7-5. 26dB BW & 99% OBW Antenna 5b (40MHz BW 11ax Index 0 – RU26 – Ch.46)



Plot 7-3. 26dB BW & 99% OBW Antenna 5b (20MHz BW 11ax Index 8– RU26 – Ch.40)

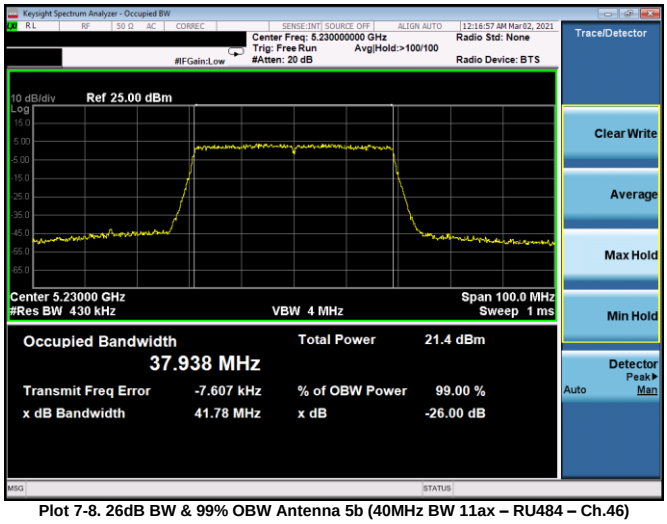


Plot 7-6. 26dB BW & 99% OBW Antenna 5b (40MHz BW 11ax Index 8 – RU26 – Ch.46)

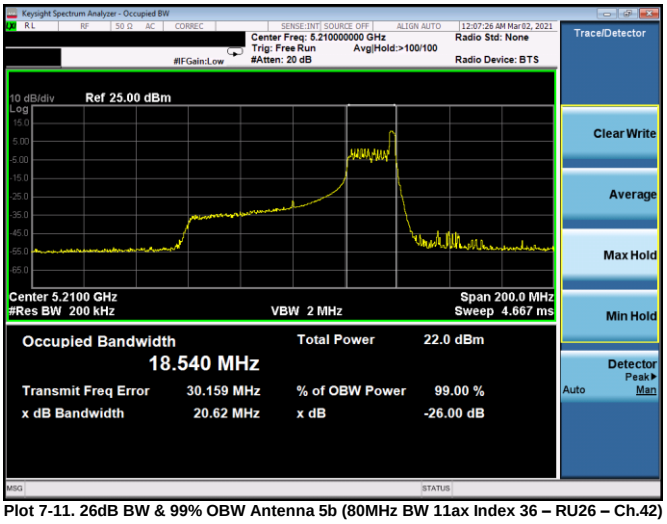


Plot 7-7. 26dB BW & 99% OBW Antenna 5b (40MHz BW 11ax Index 17 – RU26 – Ch.46)

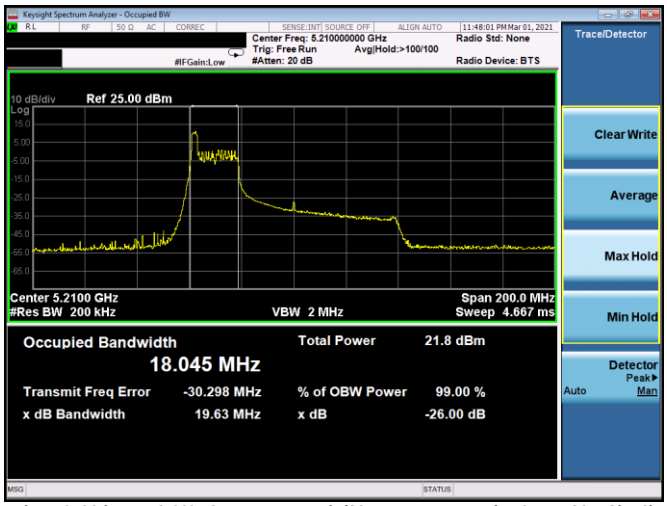
Plot 7-10. 26dB BW & 99% OBW Antenna 5b (80MHz BW 11ax Index 18 – RU26 – Ch.42)



Plot 7-8. 26dB BW & 99% OBW Antenna 5b (40MHz BW 11ax – RU484 – Ch.46)

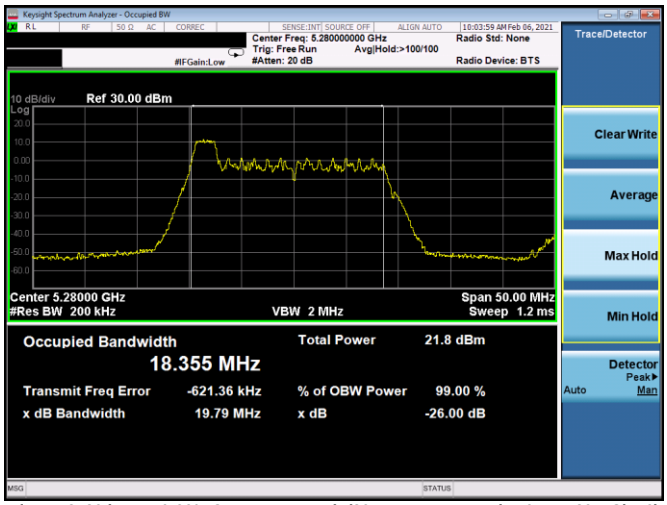


Plot 7-11. 26dB BW & 99% OBW Antenna 5b (80MHz BW 11ax Index 36 – RU26 – Ch.42)

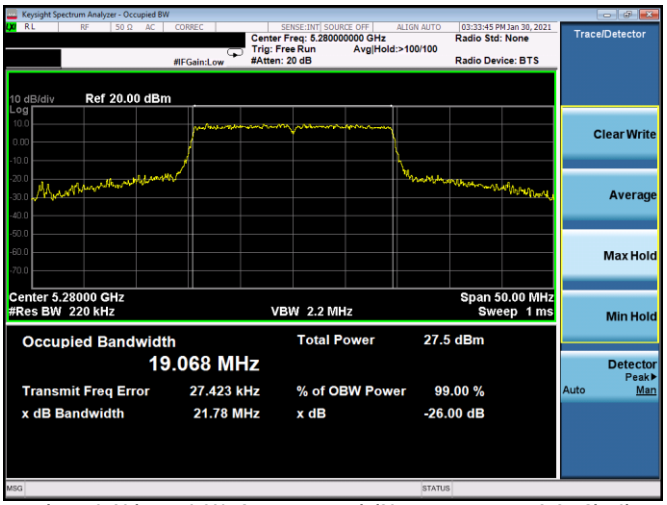


Plot 7-9. 26dB BW & 99% OBW Antenna 5b (80MHz BW 11ax Index 0 – RU26 – Ch.42)

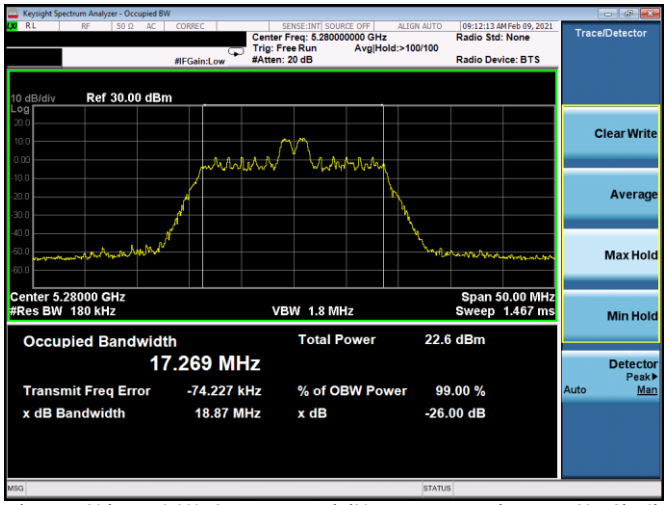
Plot 7-12. 26dB BW & 99% OBW Antenna 5b (80MHz BW 11ax – RU996 – Ch.42)



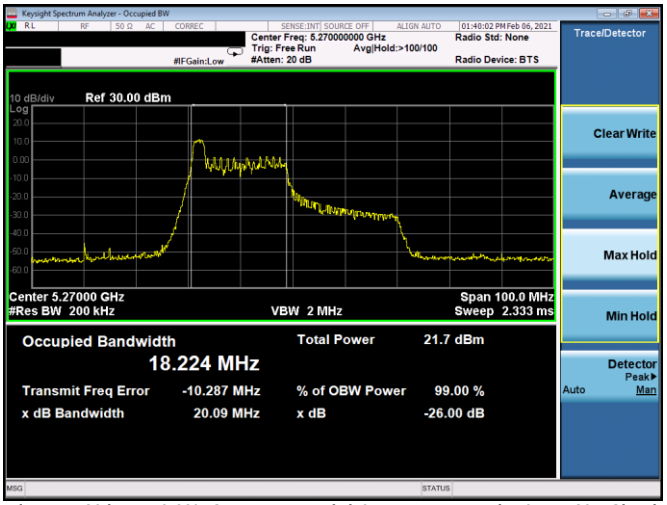
Plot 7-13. 26dB BW & 99% OBW Antenna 5b (20MHz BW 11ax Index 0 – RU26 – Ch.56)



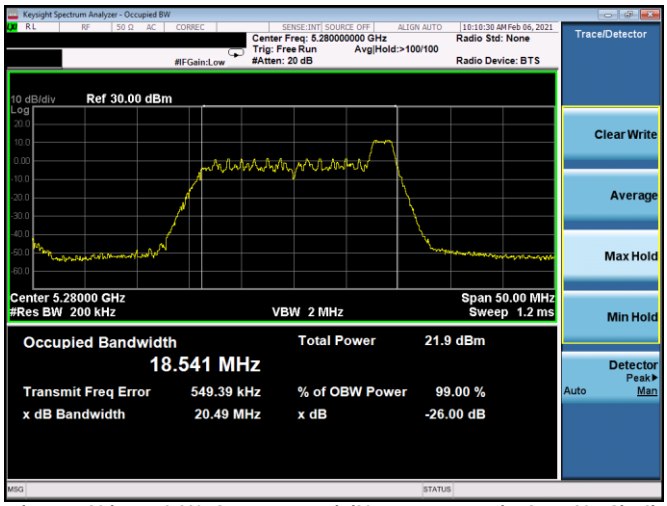
Plot 7-16. 26dB BW & 99% OBW Antenna 5b (20MHz BW 11ax– RU242 – Ch.56)



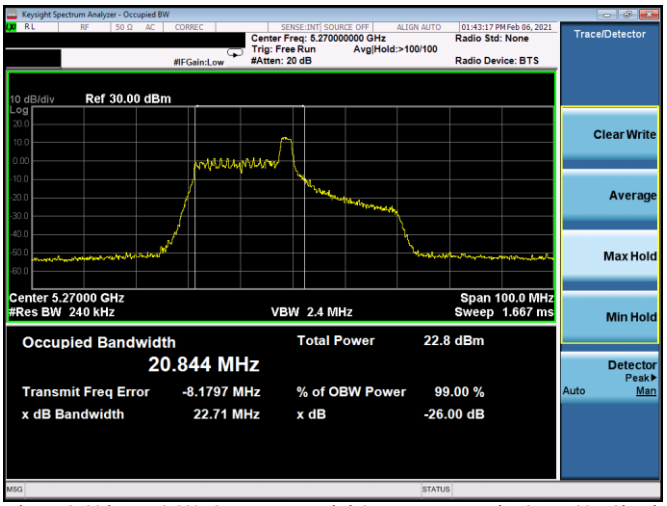
Plot 7-14. 26dB BW & 99% OBW Antenna 5b (20MHz BW 11ax Index 4 – RU26 – Ch.56)



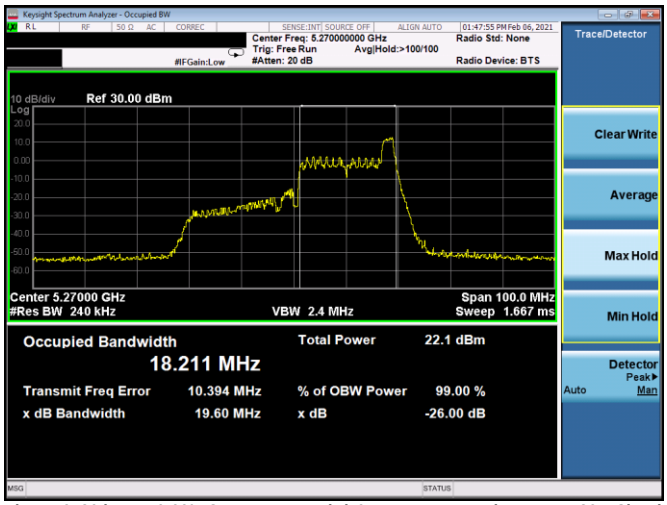
Plot 7-17. 26dB BW & 99% OBW Antenna 5b (40MHz BW 11ax Index 0 – RU26 – Ch.54)



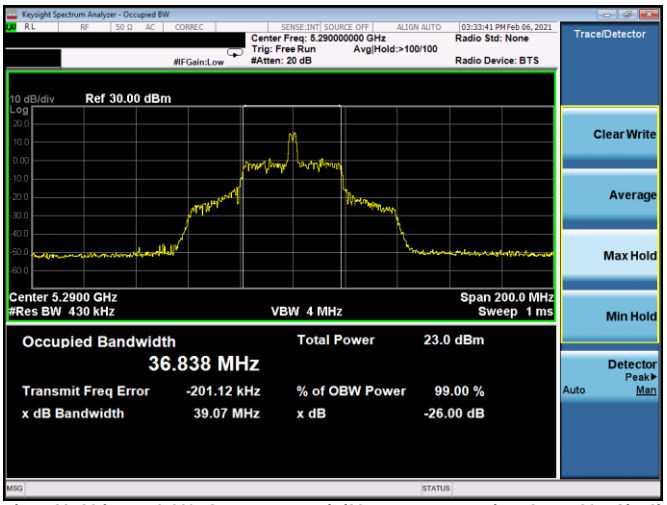
Plot 7-15. 26dB BW & 99% OBW Antenna 5b (20MHz BW 11ax Index 8– RU26 – Ch.56)



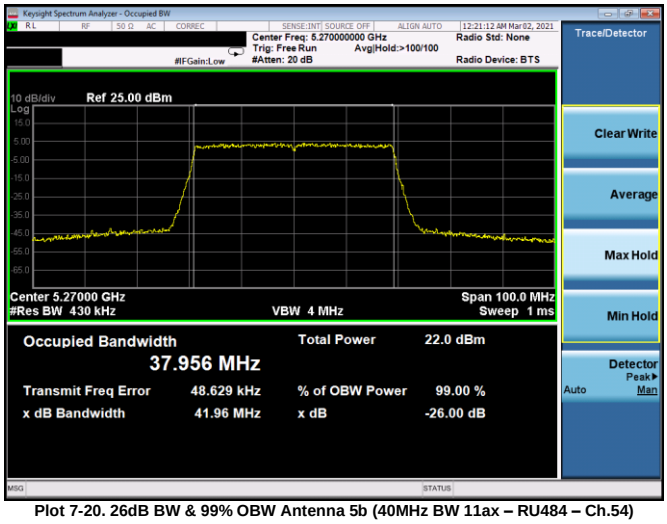
Plot 7-18. 26dB BW & 99% OBW Antenna 5b (40MHz BW 11ax Index 8 – RU26 – Ch.54)



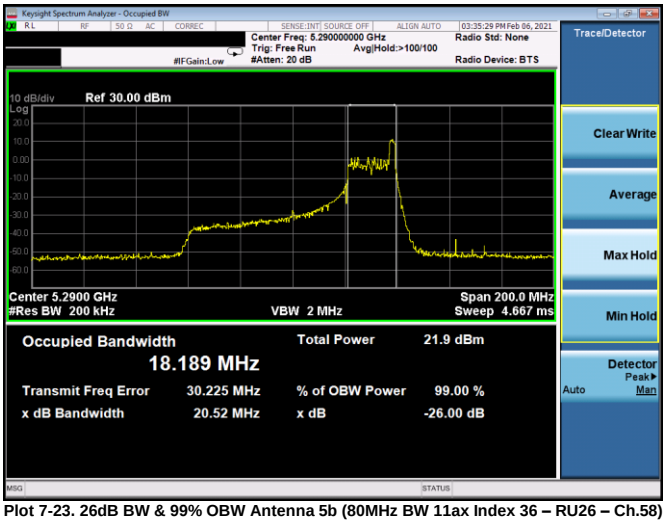
Plot 7-19. 26dB BW & 99% OBW Antenna 5b (40MHz BW 11ax Index 17 – RU26 – Ch.54)



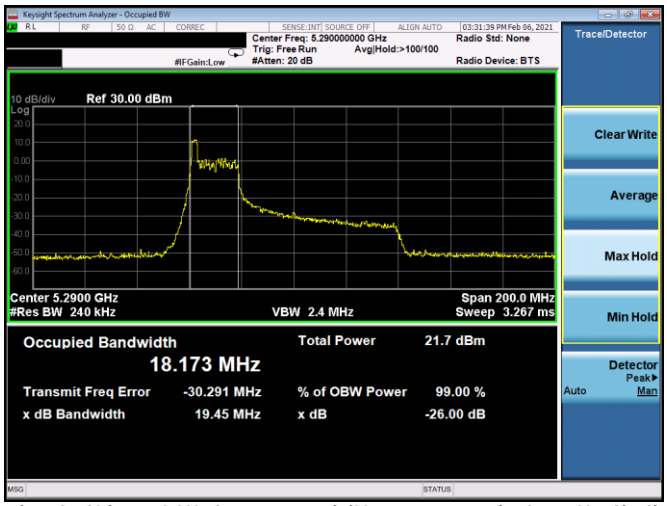
Plot 7-22. 26dB BW & 99% OBW Antenna 5b (80MHz BW 11ax Index 18 – RU26 – Ch.58)



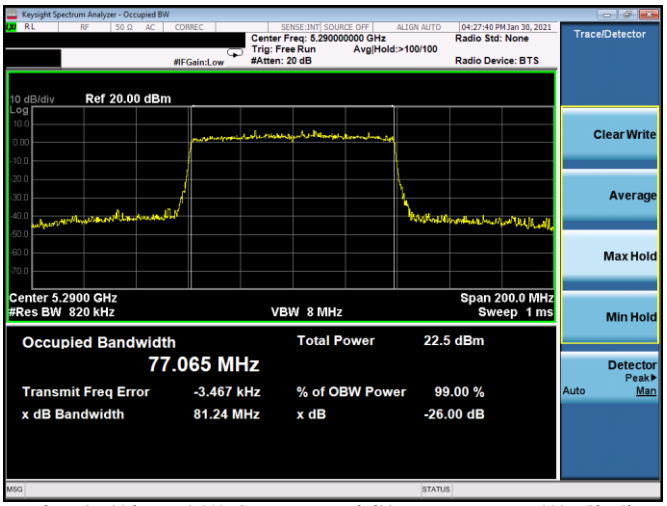
Plot 7-20. 26dB BW & 99% OBW Antenna 5b (40MHz BW 11ax – RU484 – Ch.54)



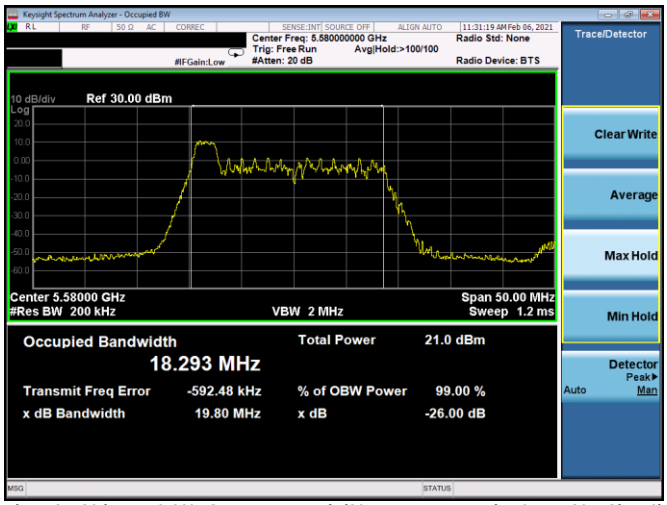
Plot 7-23. 26dB BW & 99% OBW Antenna 5b (80MHz BW 11ax Index 36 – RU26 – Ch.58)



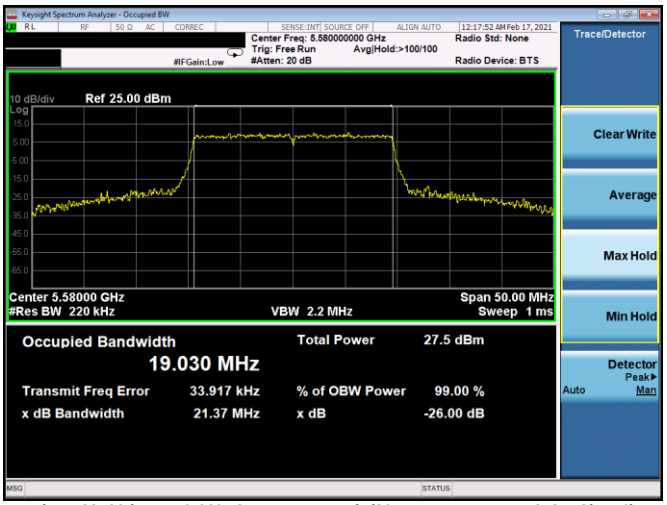
Plot 7-21. 26dB BW & 99% OBW Antenna 5b (80MHz BW 11ax Index 0 – RU26 – Ch.58)



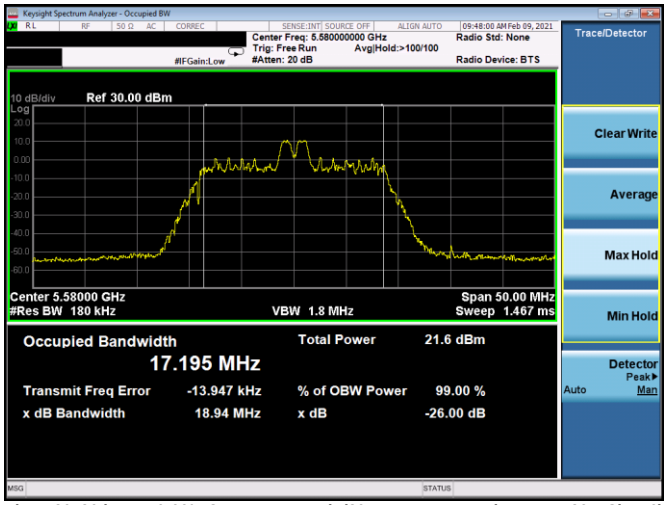
Plot 7-24. 26dB BW & 99% OBW Antenna 5b (80MHz BW 11ax – RU996 – Ch.58)



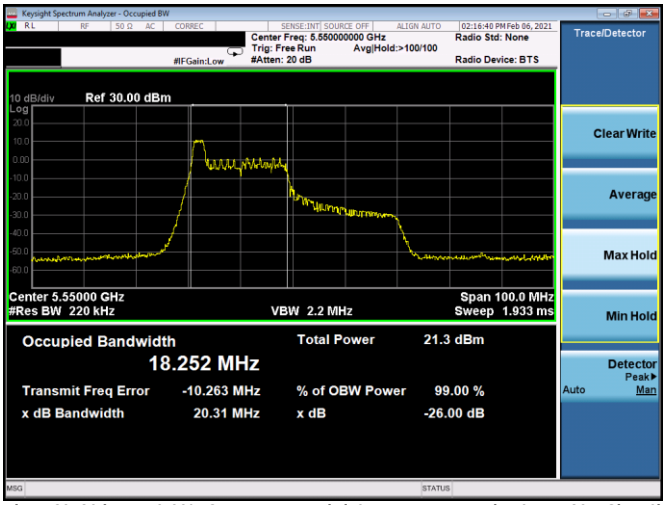
Plot 7-25. 26dB BW & 99% OBW Antenna 5b (20MHz BW 11ax Index 0 – RU26 – Ch.116)



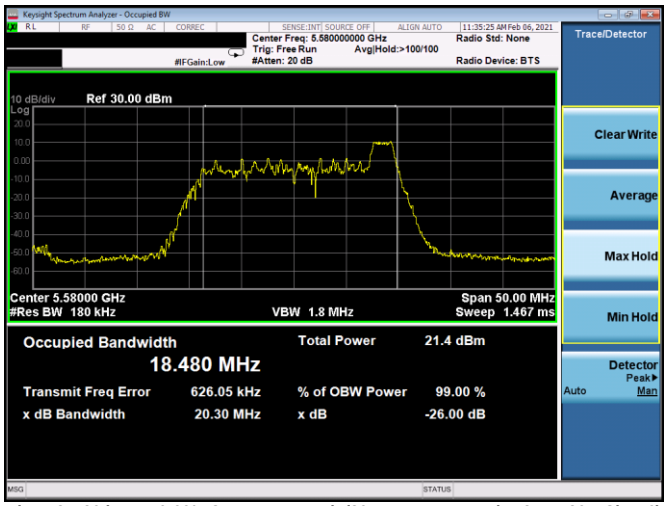
Plot 7-28. 26dB BW & 99% OBW Antenna 5b (20MHz BW 11ax– RU242 – Ch.116)



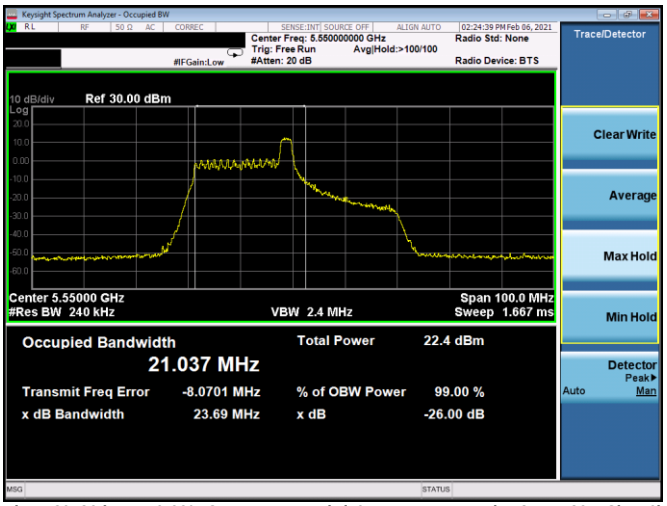
Plot 7-26. 26dB BW & 99% OBW Antenna 5b (20MHz BW 11ax Index 4 – RU26 – Ch.116)



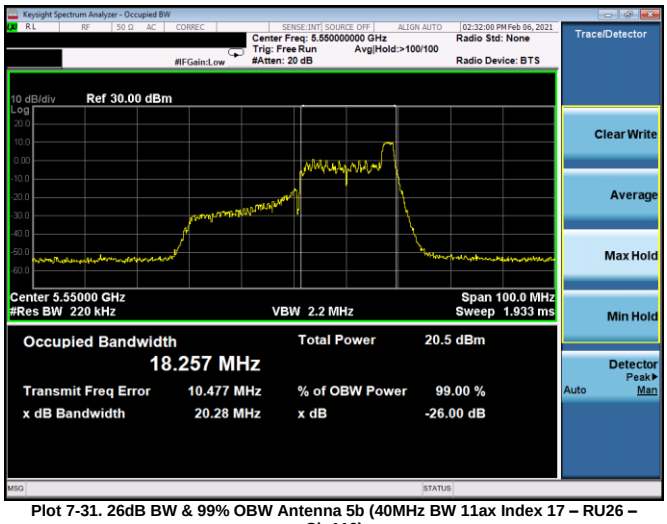
Plot 7-29. 26dB BW & 99% OBW Antenna 5b (40MHz BW 11ax Index 0 – RU26 – Ch.110)



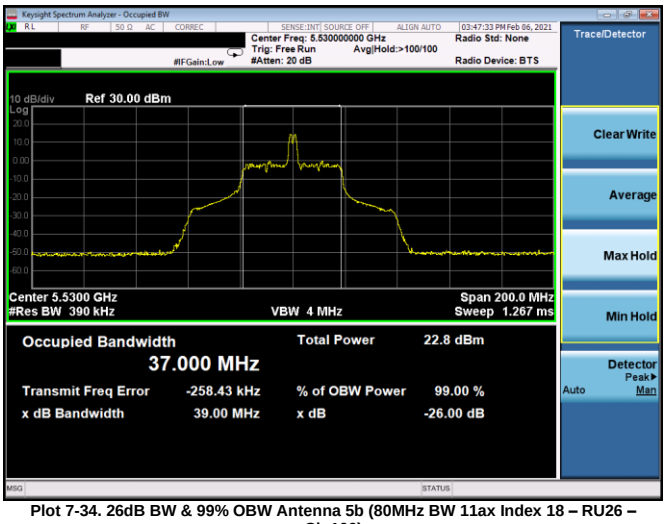
Plot 7-27. 26dB BW & 99% OBW Antenna 5b (20MHz BW 11ax Index 8– RU26 – Ch.116)



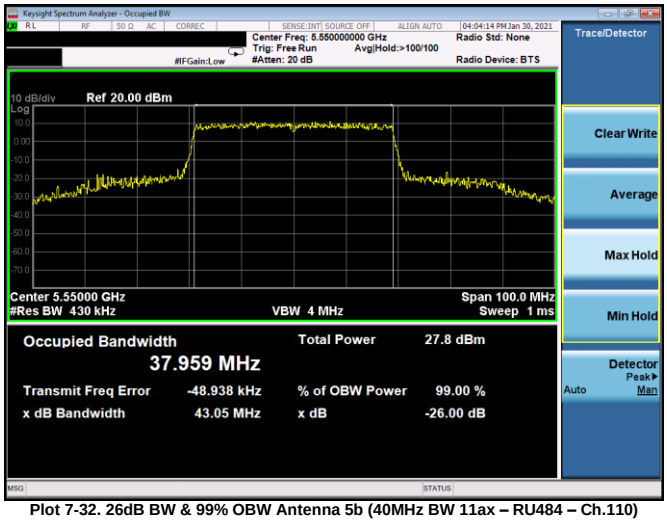
Plot 7-30. 26dB BW & 99% OBW Antenna 5b (40MHz BW 11ax Index 8 – RU26 – Ch.110)



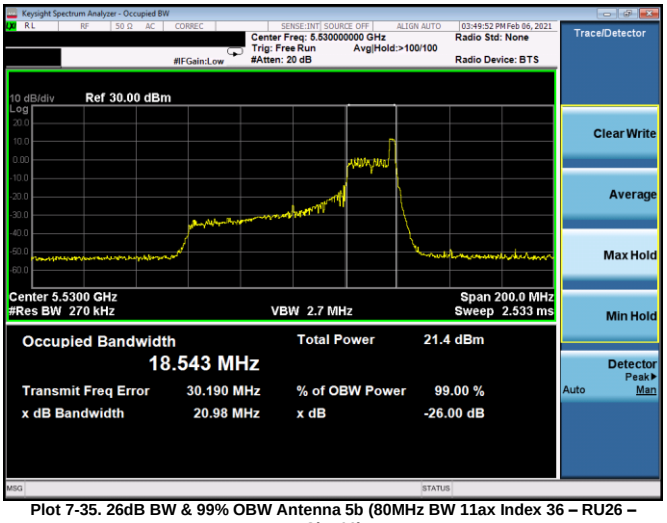
Plot 7-31. 26dB BW & 99% OBW Antenna 5b (40MHz BW 11ax Index 17 – RU26 – Ch.110)



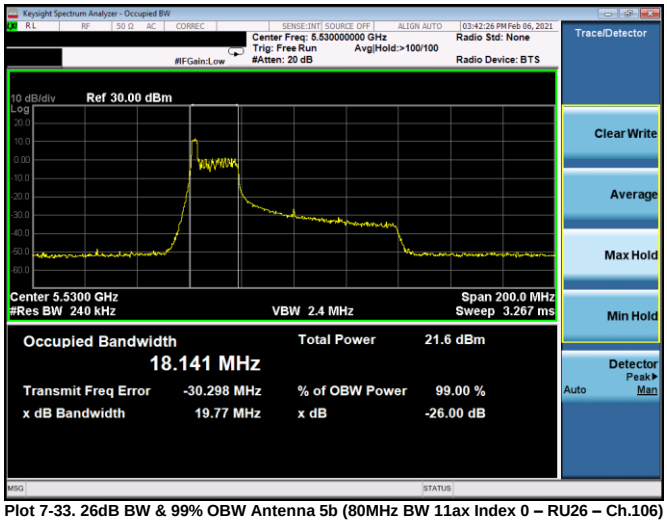
Plot 7-34. 26dB BW & 99% OBW Antenna 5b (80MHz BW 11ax Index 18 – RU26 – Ch.106)



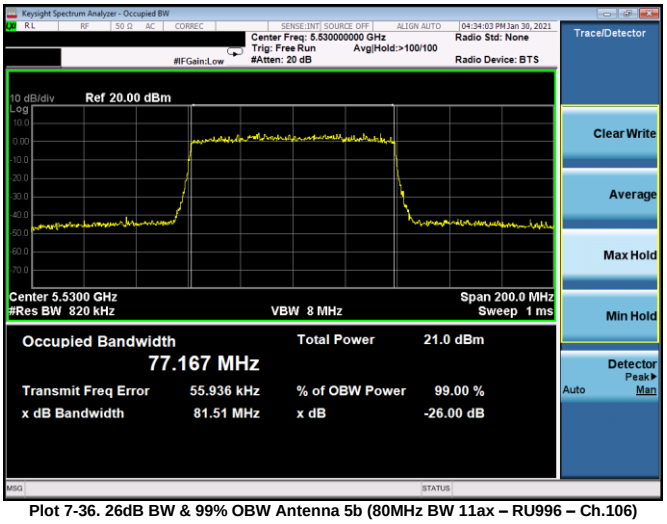
Plot 7-32. 26dB BW & 99% OBW Antenna 5b (40MHz BW 11ax – RU484 – Ch.110)



Plot 7-35. 26dB BW & 99% OBW Antenna 5b (80MHz BW 11ax Index 36 – RU26 – Ch.106)



Plot 7-33. 26dB BW & 99% OBW Antenna 5b (80MHz BW 11ax Index 0 – RU26 – Ch.106)



Plot 7-36. 26dB BW & 99% OBW Antenna 5b (80MHz BW 11ax – RU996 – Ch.106)

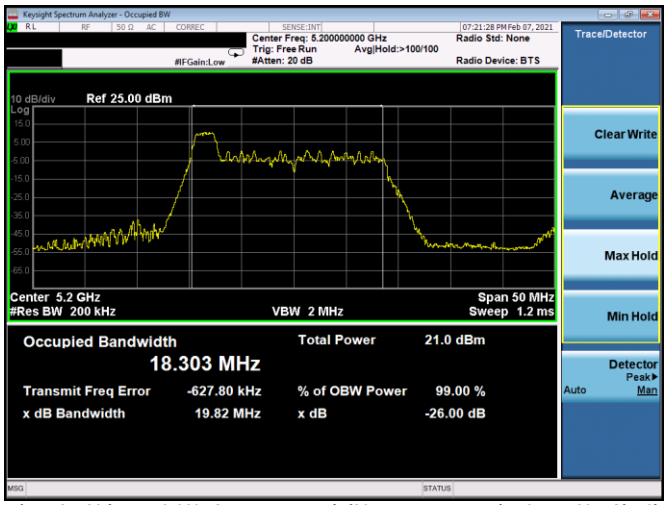
Antenna 4b 26dB & 99% Bandwidth Measurements

	Frequency [MHz]	Channel No.	802.11 Mode	RU Size	RU Index	Data Rate [Mbps]	Measured 99% OBW [MHz]	Measured 26dB Bandwidth [MHz]
Band 1	5180	36	ax (20MHz)	26	0	135/143.4 (MCS11)	18.31	19.72
				26	4	135/143.4 (MCS11)	17.15	19.03
				26	8	135/143.4 (MCS11)	18.53	20.32
	5200	40	ax (20MHz)	26	0	135/143.4 (MCS11)	18.30	19.82
				26	4	135/143.4 (MCS11)	17.20	18.63
				26	8	135/143.4 (MCS11)	18.48	20.33
	5240	48	ax (20MHz)	26	0	135/143.4 (MCS11)	18.32	19.84
				26	4	135/143.4 (MCS11)	17.08	18.71
				26	8	135/143.4 (MCS11)	18.26	20.29
	5190	38	ax (40MHz)	26	0	271/286.8 (MCS11)	18.32	20.22
				26	8	271/286.8 (MCS11)	21.03	24.85
				26	17	271/286.8 (MCS11)	18.42	20.52
	5230	46	ax (40MHz)	26	0	271/286.8 (MCS11)	18.36	20.25
				26	8	271/286.8 (MCS11)	20.48	23.52
				26	17	271/286.8 (MCS11)	18.25	20.35
	5210	42	ax (80MHz)	26	0	567/600.5 (MCS11)	17.99	19.77
				26	18	567/600.5 (MCS11)	37.01	39.16
				26	36	567/600.5 (MCS11)	18.51	20.22
Band 2A	5260	52	ax (20MHz)	26	0	135/143.4 (MCS11)	18.28	19.79
				26	4	135/143.4 (MCS11)	17.18	19.02
				26	8	135/143.4 (MCS11)	18.58	20.30
	5280	56	ax (20MHz)	26	0	135/143.4 (MCS11)	18.31	19.68
				26	4	135/143.4 (MCS11)	17.27	18.66
				26	8	135/143.4 (MCS11)	18.51	20.35
	5320	64	ax (20MHz)	26	0	135/143.4 (MCS11)	18.22	19.80
				26	4	135/143.4 (MCS11)	17.28	18.97
				26	8	135/143.4 (MCS11)	18.39	20.31
	5270	54	ax (40MHz)	26	0	271/286.8 (MCS11)	18.42	20.32
				26	8	271/286.8 (MCS11)	20.69	22.90
				26	17	271/286.8 (MCS11)	18.34	20.23
	5310	62	ax (40MHz)	26	0	271/286.8 (MCS11)	18.44	20.52
				26	8	271/286.8 (MCS11)	20.48	22.23
				26	17	271/286.8 (MCS11)	18.32	19.96
	5290	58	ax (80MHz)	26	0	567/600.5 (MCS11)	18.02	19.39
				26	18	567/600.5 (MCS11)	36.98	38.94
				26	36	567/600.5 (MCS11)	18.45	20.30
Band 2C	5500	100	ax (20MHz)	26	0	135/143.4 (MCS11)	18.21	19.67
				26	4	135/143.4 (MCS11)	17.07	18.85
				26	8	135/143.4 (MCS11)	18.49	20.08
	5580	116	ax (20MHz)	26	0	135/143.4 (MCS11)	18.31	19.74
				26	4	135/143.4 (MCS11)	17.26	18.97
				26	8	135/143.4 (MCS11)	18.50	20.36
	5720	144	ax (20MHz)	26	0	135/143.4 (MCS11)	18.30	19.58
				26	4	135/143.4 (MCS11)	17.27	18.81
				26	8	135/143.4 (MCS11)	18.49	20.33
	5510	102	ax (40MHz)	26	0	271/286.8 (MCS11)	18.20	20.06
				26	8	271/286.8 (MCS11)	20.24	22.48
				26	17	271/286.8 (MCS11)	18.44	20.41
	5550	110	ax (40MHz)	26	0	271/286.8 (MCS11)	18.07	19.98
				26	8	271/286.8 (MCS11)	20.89	23.10
				26	17	271/286.8 (MCS11)	18.26	20.11
	5710	142	ax (40MHz)	26	0	271/286.8 (MCS11)	18.25	20.40
				26	8	271/286.8 (MCS11)	20.88	22.59
				26	17	271/286.8 (MCS11)	18.33	20.25
	5530	106	ax (80MHz)	26	0	567/600.5 (MCS11)	18.15	19.60
				26	18	567/600.5 (MCS11)	37.08	39.00
				26	36	567/600.5 (MCS11)	18.48	20.57
	5690	138	ax (80MHz)	26	0	567/600.5 (MCS11)	18.28	19.78
				26	18	567/600.5 (MCS11)	36.90	39.08
				26	36	567/600.5 (MCS11)	18.77	20.49

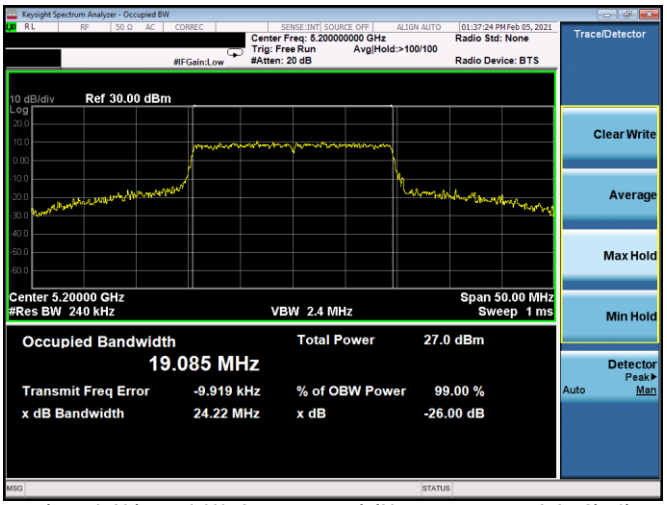
Table 7-4. Conducted Bandwidth Measurements Antenna 4b (RU26)

	Frequency [MHz]	Channel No.	802.11 Mode	RU Size	RU Index	Data Rate [Mbps]	Measured 99% OBW [MHz]	Measured 26dB Bandwidth [MHz]
Band 1	5180	36	ax (20MHz)	242	61	135/143.4 (MCS11)	18.99	20.99
	5200	40	ax (20MHz)	242	61	135/143.4 (MCS11)	19.09	24.22
	5240	48	ax (20MHz)	242	61	135/143.4 (MCS11)	19.11	26.21
	5190	38	ax (40MHz)	484	65	271/286.8 (MCS11)	37.88	41.42
	5230	46	ax (40MHz)	484	65	271/286.8 (MCS11)	38.48	71.91
	5210	42	ax (80MHz)	996	67	567/600.5 (MCS11)	77.23	81.93
Band 2A	5260	52	ax (20MHz)	242	61	135/143.4 (MCS11)	19.08	22.71
	5280	56	ax (20MHz)	242	61	135/143.4 (MCS11)	19.05	24.00
	5320	64	ax (20MHz)	242	61	135/143.4 (MCS11)	18.99	21.30
	5270	54	ax (40MHz)	484	65	271/286.8 (MCS11)	38.93	77.36
	5310	62	ax (40MHz)	484	65	271/286.8 (MCS11)	37.92	41.30
	5290	58	ax (80MHz)	996	67	567/600.5 (MCS11)	77.17	81.80
Band 2C	5500	100	ax (20MHz)	242	61	135/143.4 (MCS11)	18.98	21.17
	5580	116	ax (20MHz)	242	61	135/143.4 (MCS11)	19.05	24.12
	5720	144	ax (20MHz)	242	61	135/143.4 (MCS11)	19.05	22.27
	5510	102	ax (40MHz)	484	65	271/286.8 (MCS11)	37.92	41.98
	5550	110	ax (40MHz)	484	65	271/286.8 (MCS11)	37.91	41.87
	5710	142	ax (40MHz)	484	65	271/286.8 (MCS11)	37.99	41.48
	5530	106	ax (80MHz)	996	67	567/600.5 (MCS11)	77.25	81.94
	5690	138	ax (80MHz)	996	67	567/600.5 (MCS11)	77.26	81.90

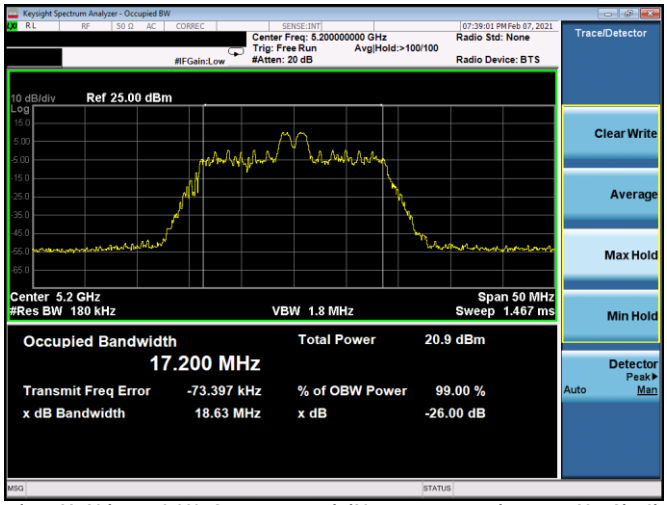
Table 7-5. Conducted Bandwidth Measurements Antenna 4b (Fully- loaded RU)



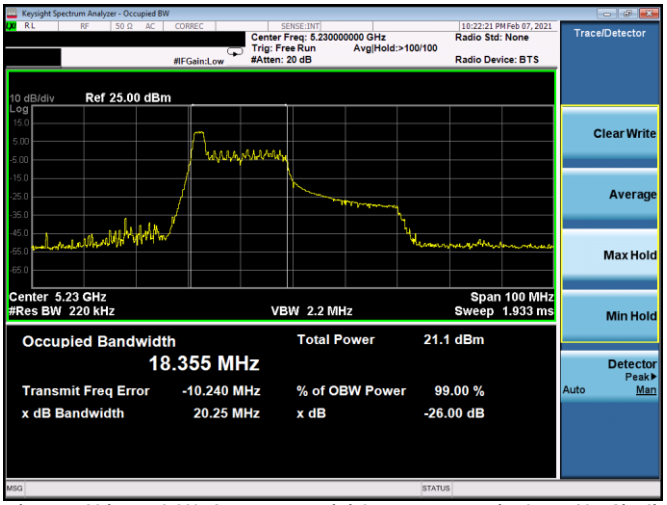
Plot 7-37. 26dB BW & 99% OBW Antenna 4b (20MHz BW 11ax Index 0 – RU26 – Ch.40)



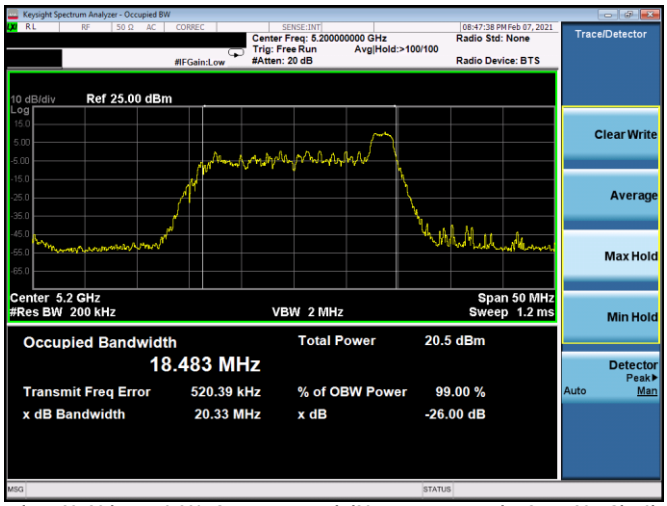
Plot 7-40. 26dB BW & 99% OBW Antenna 4b (20MHz BW 11ax– RU242 – Ch.40)



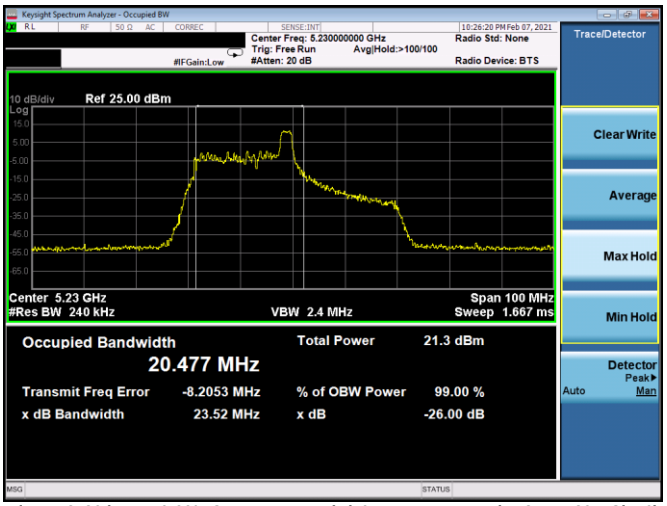
Plot 7-38. 26dB BW & 99% OBW Antenna 4b (20MHz BW 11ax Index 4 – RU26 – Ch.40)



Plot 7-41. 26dB BW & 99% OBW Antenna 4b (40MHz BW 11ax Index 0 – RU26 – Ch.46)



Plot 7-39. 26dB BW & 99% OBW Antenna 4b (20MHz BW 11ax Index 8– RU26 – Ch.40)



Plot 7-42. 26dB BW & 99% OBW Antenna 4b (40MHz BW 11ax Index 8 – RU26 – Ch.46)