



DATA REFERENCE REPORT

FCC PART 15.407 / ISSED RSS-247 UNII 802.11a/n/ac/ax(SU)

Applicant Name:

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

Date of Testing:

12/12/2020 - 3/19/2021

Test Site/Location:

PCTEST Lab. Morgan Hill, CA, USA

Test Report Serial No.:

1C2101020003-16.BCG

FCC ID:	BCGA2459
IC:	579C-A2459
APPLICANT:	Apple Inc.

Reference Model/HVIN:	A2301
Variant Model/HVIN:	A2459, A2460
EUT Type:	Tablet Device
Frequency Range:	5180 – 5825MHz
Modulation Type:	OFDM
FCC Classification:	Unlicensed National Information Infrastructure (UNII)
FCC Rule Part(s):	Part 15 Subpart E (15.407)
ISSED 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



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1.0 INTRODUCTION

1.1 Scope

Per manufacturer declaration, there are two tablet device models, A2301 and A2459(A2460), with high degree of similarity, reference model FCC ID: BCGA2301 / IC: 579C-A2301 and variant model **FCC ID: BCGA2459 / IC: 579C-A2459**. 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: BCGA2301 / IC: 579C-A2301, while radiated spot-check verification has been performed on variant model **FCC ID: BCGA2459 / IC: 579C-A2459**. 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	BCGA2301 579C-A2301	1C2101020002-15.BCG	RF UNII Test Report

Table 1-1. Reference Model Details

Reference model FCC ID: BCGA2301 / IC: 579C-A2301 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.

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2.0 PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the **Apple Tablet Device FCC ID: BCGA2459** and **IC: 579C-A2459**. The test data contained in this report pertains only to the emissions due to the EUT's UNII 802.11a/n/ac/ax(SU) transmitter.

Test Device Serial No.: QJ59J42G1X, TM6JQGGX3H

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

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Notes:

- TDWR channels are not supported for ISED.
- 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	a (Low Rate)	99.2	99.0	98.7
	a (Mid Rate)	96.5	96.7	94.0
	a (High Rate)	94.2	94.3	91.0
	n (HT20) (Low Rate)	98.9	99.0	98.0
	n (HT20) (Mid Rate)	96.0	96.1	93.0
	n (HT20) (High Rate)	93.6	93.2	89.0
	ax(SU) (HE20 Low Rate)	98.5	98.7	98.0
	ax(SU) (HE20 Mid Rate)	95.0	94.8	94.6
	ax(SU) (HE20 High Rate)	88.0	88.0	87.5
	n (HT40 Low Rate)	98.0	97.9	95.9
	n (HT40 Mid Rate)	92.8	93.0	88.3
	n (HT40 High Rate)	88.6	88.5	83.6
	ax(SU) (HE40 Low Rate)	98.2	98.5	98.6
	ax(SU) (HE40 Mid Rate)	94.0	94.8	94.4
	ax(SU) (HE40 High Rate)	88.6	88.0	87.4
	ac (HT80 Low Rate)	95.4	95.3	91.9
	ac (HT80 Mid Rate)	87.2	87.1	82.0
	ac (HT80 High Rate)	82.9	82.1	77.9
	ax(SU) (HE80 Low Rate)	94.5	94.6	94.8
	ax(SU) (HE80 Mid Rate)	86.8	86.7	85.4
	ax(SU) (HE80 High Rate)	79.9	80.1	79.7

Table 2-4. Measured Duty Cycles

- 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	11a	✓	✓	✓	✓	✗	✗	✗	✗
	11n (20MHz)	✓	✓	✓	✓	✓	✓	✓	✓
	11ax(SU) (20MHz)	✓	✓	✓	✓	✓	✓	✓	✓
	11n (40MHz)	✓	✓	✓	✓	✓	✓	✓	✓
	11ax(SU) (40MHz)	✓	✓	✓	✓	✓	✓	✓	✓
	11ac (80MHz)	✓	✓	✓	✓	✓	✓	✓	✓
	11ax(SU) (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

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Data Rate(s) Tested: 6, 9, 12, 18, 24, 36, 48, 54Mbps (802.11a)

6.5/7.2, 13/14.4, 19.5/21.7, 26/28.9, 39/43.3, 52/57.8, 58.5/65, 65/72.2Mbps (n – 20MHz)

13.5/15, 27/30, 40.5/45, 54/60, 81/90, 108/120, 121.5/135, 135/150Mbps (n – 40MHz BW)

29.3/32.5, 58.5/65, 87.8/97.5, 117/130, 175.5/195, 234/260, 263.3/292.5, 292.5/325, 351/390, 390/433.3Mbps (ac – 80MHz BW)

13/14.4, 26.28.9, 39/43.3, 52/57.8, 78/86.7, 104/115.6, 117/130, 130/144.4Mbps (MIMO n/ac – 20MHz)

156/173Mbps (MIMO ac – 20MHz)

27/30, 54/60, 81/90, 108/120, 162/180, 216/240, 243/270, 270/300Mbps (MIMO n/ac – 40MHz) 324/360, 360/400Mbps (MIMO ac – 40MHz)

58.5/65, 117/130, 175.5/195, 234/260, 351/390, 468/520, 526.5/585, 585/650, 702/780, 780/866.7Mbps (MIMO ac – 80MHz)

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)

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 / Sub 6 LTE NR			UNII
		802.11 b/g/n/ax	BDR, EDR, HDR4/8, LE1M/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

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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	5.5	1.0
5.250 – 5.350	5.2	0.0
5.470 – 5.725	4.2	1.6
5725 – 5.850	5.5	2.7

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

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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: BCGA2459 IC: 579C-A2459	
		Mode	Channel
UNII (802.11a/n/ ac/ax)	Radiated Spurious Emissions	MIMO Max Power 5.2/5.3/5.6 GHz: 11ax 20 MHz SU	M

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.

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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.

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3.3 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).

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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.

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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 ($\pm$ dB)
Radiated Disturbance (<30MHz)	4.06
Radiated Disturbance (30MHz - 1GHz)	4.30
Radiated Disturbance (1 - 18GHz)	4.78
Radiated Disturbance (>18GHz)	4.79

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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.

FCC ID: BCGA2459 IC: 579C-A2459		DATA REFERENCE REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C2101020003-16.BCG	Test Dates: 12/12/2020 - 3/19/2021	EUT Type: Tablet Device	Page 13 of 19

7.0 TEST RESULTS (SPOT-CHECK DATA)

7.1 Summary

Company Name: Apple Inc.
 FCC ID: BCGA2459
 IC: 579C-A2459
 FCC Classification: Unlicensed National Information Infrastructure (UNII)

Technology	Test Configurations			Reference Model		Variant Model		Delta	
	Test Description	Channel	Measurement Frequency [MHz]	FCC ID: BCGA2301 IC: 579C-A2301		FCC ID: BCGA2459 IC: 579C-A2459			
				Peak [dBµV/m]	Average [dBµV/m]	Peak [dBµV/m]	Average [dBµV/m]	Peak [dB]	Average [dB]
UNII 802.11ax-SU	Radiated Spurious Emissions	40	10400	54.57	N/A	52.59	N/A	1.98	N/A
		56	15840	57.79	46.40	55.86	44.71	1.93	1.69
		116	16740	55.54	N/A	54.98	N/A	0.56	N/A

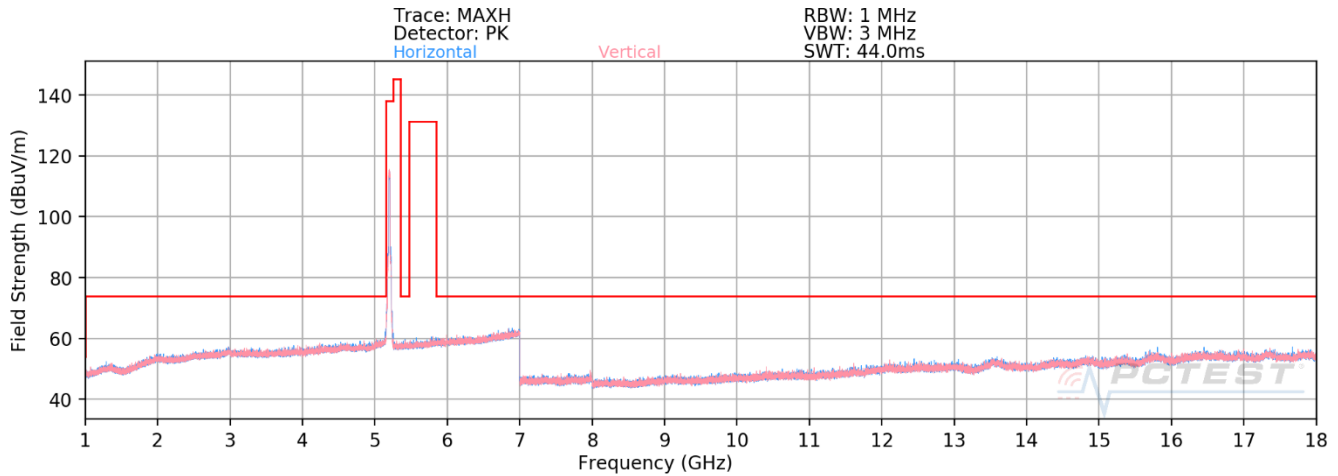
Table 7-1. Worst Case Spot-check Results

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.

FCC ID: BCGA2459 IC: 579C-A2459	 DATA REFERENCE REPORT (CERTIFICATION)		Approved by: Quality Manager
Test Report S/N: 1C2101020003-16.BCG	Test Dates: 12/12/2020 - 3/19/2021	EUT Type: Tablet Device	Page 14 of 19

7.2 Radiated Spurious Emissions

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



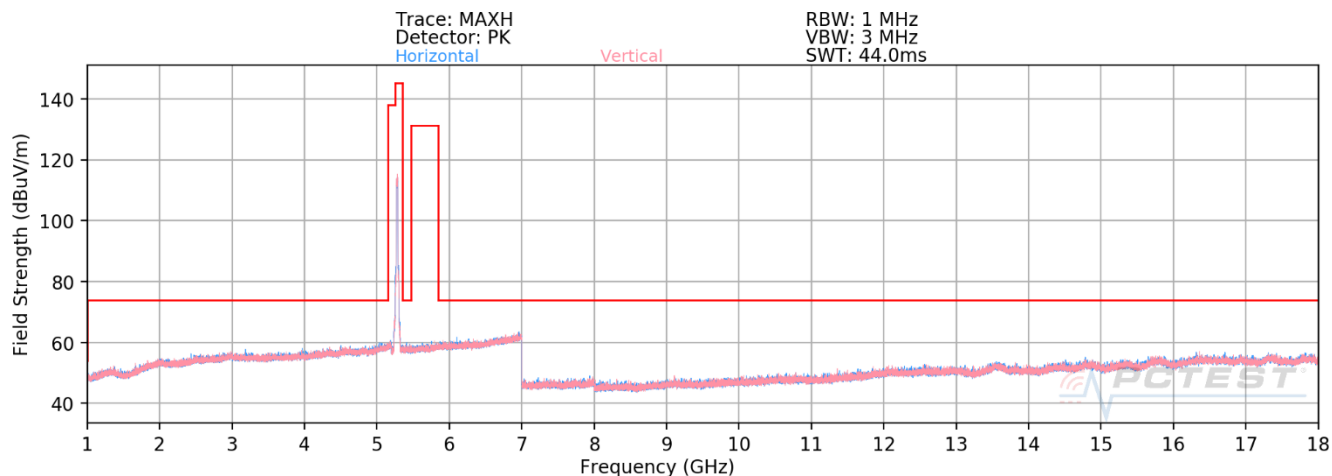
Plot 7-1. RSE above 1GHz SDM (11ax(SU) – Ch.40)

Mode:	802.11ax(SU) (20MHz BW)
Data Rate:	MCS0
Distance of Measurements:	3 Meters
Operating Frequency:	5200MHz
Channel:	40

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]
10400.00	Peak	V	-	-	-68.71	14.30	52.59	68.20	-15.61
* 15600.00	Average	V	-	-	-82.64	20.72	45.08	53.98	-8.90
* 15600.00	Peak	V	-	-	-73.38	20.72	54.34	73.98	-19.64

Table 7-2. Radiated Measurements SDM

FCC ID: BCGA2459 IC: 579C-A2459	PCTEST Proud to be part of element	DATA REFERENCE REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C2101020003-16.BCG	Test Dates: 12/12/2020 - 3/19/2021	EUT Type: Tablet Device	Page 15 of 19



Plot 7-2. RSE above 1GHz SDM (11ax(SU) – Ch.56)

Mode: 802.11ax(SU) (20MHz BW)

Data Rate: MCS0

Distance of Measurements: 3 Meters

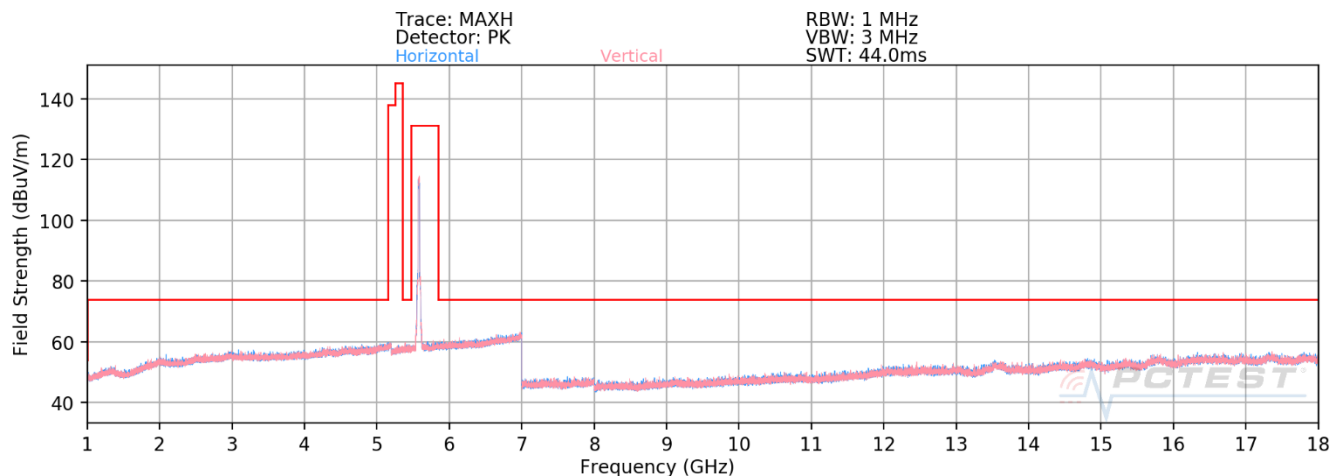
Operating Frequency: 5280MHz

Channel: 56

Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBuV/m]	Limit [dBuV/m]	Margin [dB]
10560.00	Peak	V	-	-	-71.27	14.03	49.76	68.20	-18.44
* 15840.00	Average	V	-	-	-84.20	21.91	44.71	53.98	-9.27
* 15840.00	Peak	V	-	-	-73.05	21.91	55.86	73.98	-18.12

Table 7-3. Radiated Measurements SDM

FCC ID: BCGA2459 IC: 579C-A2459	PCTEST Proud to be part of element	DATA REFERENCE REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C2101020003-16.BCG	Test Dates: 12/12/2020 - 3/19/2021	EUT Type: Tablet Device	Page 16 of 19



Plot 7-3. RSE above 1GHz SDM (11ax(SU) – Ch.116)

Mode: 802.11ax(SU) (20MHz BW)
Data Rate: MCS0
Distance of Measurements: 3 Meters
Operating Frequency: 5580MHz
Channel: 116

	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]
*	11160.00	Average	V	-	-	-83.92	15.10	38.18	53.98	-15.80
*	11160.00	Peak	V	-	-	-72.40	15.10	49.70	73.98	-24.28
	16740.00	Peak	V	-	-	-74.36	22.34	54.98	68.20	-13.22

Table 7-4. Radiated Measurements SDM

FCC ID: BCGA2459 IC: 579C-A2459	PCTEST Proud to be part of element	DATA REFERENCE REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C2101020003-16.BCG	Test Dates: 12/12/2020 - 3/19/2021	EUT Type: Tablet Device	Page 17 of 19

8.0 CONCLUSION

The spot-check data measured for variant model **FCC ID: BCGA2459 / IC: 579C-A2459** is in tolerance with reference model FCC ID: BCGA2301 / IC: 579C-A2301 per FCC/ISED Approved Data Referencing Test Plan.

FCC ID: BCGA2459 IC: 579C-A2459	 DATA REFERENCE REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C2101020003-16.BCG	Test Dates: 12/12/2020 - 3/19/2021	EUT Type: Tablet Device

9.0 APPENDIX A: REFERENCE MODEL TEST REPORT

Attached is the test report (1C2101020002-15.BCG) from reference model FCC ID: BCGA2301 / IC: 579C-A2301, which includes referenced data results.

FCC ID: BCGA2459 IC: 579C-A2459	 DATA REFERENCE REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C2101020003-16.BCG	Test Dates: 12/12/2020 - 3/19/2021	EUT Type: Tablet Device Page 19 of 19



MEASUREMENT REPORT

FCC PART 15.407 / ISSED RSS-247 UNII 802.11a/n/ac/ax(SU)

Applicant Name:

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

Date of Testing:

12/12/2020 - 3/10/2021

Test Site/Location:

PCTEST Lab. Morgan Hill, CA, USA

Test Report Serial No.:

1C2101020002-15.BCG

FCC ID:

BCGA2301

IC:

579C-A2301

APPLICANT:

Apple Inc.

Application Type:

Certification

Model/HVIN:

A2301

EUT Type:

Tablet Device

Frequency Range:

5180 – 5825MHz

Modulation Type:

OFDM

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 789033 D02 v02r01. 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

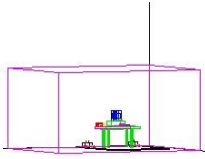


FCC ID: BCGA2301 IC: 579C-A2301	 MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager
Test Report S/N: 1C2101020002-15.BCG	Test Dates: 12/12/2020 - 3/10/2021	EUT Type: Tablet Device	Page 1 of 354

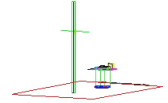
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FCC ID: BCGA2301 IC: 579C-A2301	 MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager
Test Report S/N: 1C2101020002-15.BCG	Test Dates: 12/12/2020 - 3/10/2021	EUT Type: Tablet Device	Page 2 of 354



MEASUREMENT REPORT



UNII Band	Channel Bandwidth (MHz)	Mode	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	802.11a/n	5180 - 5240	88.920	19.49	88.716	19.48	49.774	16.97	50.003	16.99	98.628	19.94
2A		802.11a/n	5260 - 5320	88.920	19.49	88.920	19.49	50.119	17.00	49.659	16.96	99.770	19.99
2C		802.11a/n	5500 - 5720	88.512	19.47	89.125	19.50	50.119	17.00	50.119	17.00	100.231	20.01
3	40	802.11a/n	5745 - 5825	88.920	19.49	89.125	19.50	89.125	19.50	89.125	19.50	178.238	22.51
1		802.11n	5190 - 5230	88.920	19.49	86.896	19.39	85.901	19.34	86.896	19.39	172.982	22.38
2A		802.11n	5270 - 5310	86.298	19.36	84.918	19.29	86.497	19.37	87.700	19.43	174.181	22.41
2C	80	802.11n	5510 - 5710	89.125	19.50	88.512	19.47	88.308	19.46	89.125	19.50	177.011	22.48
3		802.11n	5755 - 5795	87.700	19.43	87.297	19.41	87.700	19.43	87.902	19.44	175.792	22.45
1		802.11ac	5210	24.831	13.95	24.044	13.81	19.231	12.84	19.364	12.87	38.637	15.87
2A	80	802.11ac	5290	37.584	15.75	38.637	15.87	27.102	14.33	27.990	14.47	55.081	17.41
2C		802.11ac	5530 - 5690	89.125	19.50	87.902	19.44	88.308	19.46	85.901	19.34	174.181	22.41
3		802.11ac	5775	79.433	19.00	76.736	18.85	66.834	18.25	68.391	18.35	135.207	21.31
1	20	802.11ax (SU)	5180 - 5240	87.498	19.42	87.498	19.42	48.195	16.83	48.865	16.89	96.828	19.86
2A		802.11ax (SU)	5260 - 5320	86.696	19.38	87.902	19.44	50.003	16.99	49.431	16.94	98.628	19.94
2C		802.11ax (SU)	5500 - 5720	88.920	19.49	87.700	19.43	49.545	16.95	49.888	16.98	99.541	19.98
3	40	802.11ax (SU)	5745 - 5825	88.920	19.49	88.716	19.48	88.716	19.48	87.498	19.42	176.198	22.46
1		802.11ax (SU)	5190 - 5230	68.234	18.34	68.707	18.37	65.766	18.18	66.069	18.20	131.826	21.20
2A		802.11ax (SU)	5270 - 5310	88.308	19.46	85.901	19.34	84.723	19.28	86.099	19.35	171.002	22.33
2C	80	802.11ax (SU)	5510 - 5710	89.125	19.50	87.700	19.43	89.125	19.50	88.105	19.45	177.419	22.49
3		802.11ax (SU)	5755 - 5795	87.902	19.44	88.716	19.48	86.696	19.38	88.308	19.46	174.985	22.43
1		802.11ax (SU)	5210	19.907	12.99	19.320	12.86	17.061	12.32	16.672	12.22	33.729	15.28
2A	80	802.11ax (SU)	5290	29.923	14.76	29.923	14.76	26.792	14.28	26.303	14.20	53.088	17.25
2C		802.11ax (SU)	5530 - 5690	86.298	19.36	88.920	19.49	86.298	19.36	86.497	19.37	172.982	22.38
3		802.11ax (SU)	5775	56.234	17.50	56.234	17.50	48.195	16.83	49.659	16.96	97.949	19.91

FCC EUT Overview (Low Data Rate)

UNII Band	Channel Bandwidth (MHz)	Mode	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	802.11a/n	5180 - 5240	17.742	12.49	17.783	12.50	12.503	10.97	12.331	10.91	24.774	13.94
2A		802.11a/n	5260 - 5320	88.920	19.49	88.920	19.49	50.119	17.00	49.659	16.96	99.770	19.99
2C		802.11a/n	5500 - 5720	88.512	19.47	89.125	19.50	50.119	17.00	50.119	17.00	100.231	20.01
3		802.11a/n	5745 - 5825	88.920	19.49	89.125	19.50	89.125	19.50	89.125	19.50	178.238	22.51
1	40	802.11n	5190 - 5230	30.974	14.91	30.130	14.79	24.155	13.83	24.831	13.95	48.641	16.87
2A		802.11n	5270 - 5310	86.298	19.36	84.918	19.29	86.497	19.37	87.700	19.43	174.181	22.41
2C		802.11n	5510 - 5710	88.920	19.49	87.700	19.43	88.308	19.46	89.125	19.50	177.011	22.48
3		802.11n	5755 - 5795	87.700	19.43	87.297	19.41	87.700	19.43	87.902	19.44	175.792	22.45
1	80	802.11ac	5210	24.831	13.95	24.044	13.81	19.231	12.84	19.364	12.87	38.637	15.87
2A		802.11ac	5290	37.584	15.75	38.637	15.87	27.102	14.33	27.990	14.47	55.081	17.41
2C		802.11ac	5530 - 5690	89.125	19.50	87.902	19.44	88.308	19.46	85.901	19.34	174.181	22.41
3		802.11ac	5775	79.433	19.00	76.736	18.85	66.834	18.25	68.391	18.35	135.207	21.31
1	20	802.11ax (SU)	5180 - 5240	17.539	12.44	17.620	12.46	12.331	10.91	12.246	10.88	24.604	13.91
2A		802.11ax (SU)	5260 - 5320	86.696	19.38	87.902	19.44	50.003	16.99	49.431	16.94	98.628	19.94
2C		802.11ax (SU)	5500 - 5720	88.920	19.49	87.700	19.43	49.545	16.95	49.888	16.98	99.541	19.98
3		802.11ax (SU)	5745 - 5825	88.920	19.49	88.716	19.48	88.716	19.48	87.498	19.42	176.198	22.46
1	40	802.11ax (SU)	5190 - 5230	31.405	14.97	30.479	14.84	24.155	13.83	23.988	13.80	48.195	16.83
2A		802.11ax (SU)	5270 - 5310	88.308	19.46	85.901	19.34	84.723	19.28	86.099	19.35	171.002	22.33
2C		802.11ax (SU)	5510 - 5710	86.298	19.36	84.918	19.29	89.125	19.50	88.105	19.45	177.419	22.49
3		802.11ax (SU)	5755 - 5795	87.902	19.44	88.716	19.48	86.696	19.38	88.308	19.46	174.985	22.43
1	80	802.11ax (SU)	5210	19.907	12.99	19.320	12.86	17.061	12.32	16.672	12.22	33.729	15.28
2A		802.11ax (SU)	5290	29.923	14.76	29.923	14.76	26.792	14.28	26.303	14.20	53.088	17.25
2C		802.11ax (SU)	5530 - 5690	86.298	19.36	88.920	19.49	86.298	19.36	86.497	19.37	172.982	22.38
3		802.11ax (SU)	5775	56.234	17.50	56.234	17.50	48.195	16.83	49.659	16.96	97.949	19.91

ISED EUT Overview (Low Data Rate)

FCC ID: BCGA2301 IC: 579C-A2301		 MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager
Test Report S/N: 1C2101020002-15.BCG		Test Dates: 12/12/2020 - 3/10/2021	EUT Type: Tablet Device	Page 3 of 354

UNII Band	Channel Bandwidth (MHz)	Mode	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	802.11a/n	5180 - 5240	88.512	19.47	86.497	19.37	48.753	16.88	47.534	16.77	96.383	19.84
2A		802.11a/n	5260 - 5320	88.920	19.49	85.507	19.32	48.529	16.86	47.973	16.81	96.605	19.85
2C		802.11a/n	5500 - 5720	88.716	19.48	88.308	19.46	49.317	16.93	50.119	17.00	99.541	19.98
3		802.11a/n	5745 - 5825	89.125	19.50	88.512	19.47	88.308	19.46	85.901	19.34	173.780	22.40
1	40	802.11n	5190 - 5230	87.700	19.43	87.700	19.43	78.886	18.97	77.804	18.91	156.675	21.95
2A		802.11n	5270 - 5310	85.310	19.31	85.507	19.32	88.512	19.47	85.901	19.34	174.582	22.42
2C		802.11n	5510 - 5710	88.716	19.48	87.498	19.42	85.114	19.30	86.099	19.35	170.216	22.31
3		802.11n	5755 - 5795	87.902	19.44	88.716	19.48	89.125	19.50	87.902	19.44	176.604	22.47
1	80	802.11ac	5210	19.634	12.93	19.861	12.98	14.791	11.70	15.849	12.00	30.620	14.86
2A		802.11ac	5290	30.200	14.80	30.269	14.81	22.182	13.46	21.827	13.39	44.055	16.44
2C		802.11ac	5530 - 5690	84.333	19.26	84.333	19.26	87.902	19.44	83.368	19.21	171.396	22.34
3		802.11ac	5775	69.024	18.39	69.823	18.44	59.979	17.78	60.674	17.83	120.781	20.82
1	20	802.11ax (SU)	5180 - 5240	86.099	19.35	88.716	19.48	48.753	16.88	48.978	16.90	97.724	19.90
2A		802.11ax (SU)	5260 - 5320	86.298	19.36	85.901	19.34	50.119	17.00	48.978	16.90	99.083	19.96
2C		802.11ax (SU)	5500 - 5720	88.920	19.49	88.716	19.48	49.888	16.98	50.119	17.00	98.175	19.92
3		802.11ax (SU)	5745 - 5825	88.512	19.47	87.297	19.41	88.105	19.45	89.125	19.50	177.011	22.48
1	40	802.11ax (SU)	5190 - 5230	69.984	18.45	68.865	18.38	61.944	17.92	62.517	17.96	124.451	20.95
2A		802.11ax (SU)	5270 - 5310	75.858	18.80	77.983	18.92	70.795	18.50	66.681	18.24	137.404	21.38
2C		802.11ax (SU)	5510 - 5710	88.512	19.47	86.497	19.37	87.902	19.44	85.704	19.33	173.780	22.40
3		802.11ax (SU)	5755 - 5795	88.920	19.49	87.498	19.42	86.497	19.37	86.298	19.36	172.584	22.37
1	80	802.11ax (SU)	5210	16.827	12.26	17.498	12.43	13.583	11.33	13.335	11.25	26.915	14.30
2A		802.11ax (SU)	5290	24.210	13.84	24.155	13.83	21.528	13.33	21.528	13.33	43.053	16.34
2C		802.11ax (SU)	5530 - 5690	84.918	19.29	88.716	19.48	85.704	19.33	84.333	19.26	170.216	22.31
3		802.11ax (SU)	5775	49.204	16.92	49.091	16.91	38.548	15.86	39.084	15.92	77.625	18.90

FCC EUT Overview (Mid Data Rate)

UNII Band	Channel Bandwidth (MHz)	Mode	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	802.11a/n	5180 - 5240	17.783	12.50	17.783	12.50	12.589	11.00	12.589	11.00	25.119	14.00
2A		802.11a/n	5260 - 5320	88.920	19.49	85.507	19.32	48.529	16.86	47.973	16.81	96.605	19.85
2C		802.11a/n	5500 - 5720	88.716	19.48	88.308	19.46	49.317	16.93	50.119	17.00	99.541	19.98
3		802.11a/n	5745 - 5825	89.125	19.50	88.512	19.47	88.308	19.46	85.901	19.34	173.780	22.40
1	40	802.11n	5190 - 5230	30.339	14.82	31.623	15.00	24.044	13.81	24.210	13.84	48.306	16.84
2A		802.11n	5270 - 5310	85.310	19.31	85.507	19.32	88.512	19.47	85.901	19.34	174.582	22.42
2C		802.11n	5510 - 5710	87.096	19.40	86.497	19.37	83.176	19.20	86.099	19.35	169.434	22.29
3		802.11n	5755 - 5795	87.902	19.44	88.716	19.48	89.125	19.50	87.902	19.44	176.604	22.47
1	80	802.11ac	5210	19.634	12.93	19.861	12.98	14.791	11.70	15.849	12.00	30.620	14.86
2A		802.11ac	5290	30.200	14.80	30.269	14.81	22.182	13.46	21.827	13.39	44.055	16.44
2C		802.11ac	5530 - 5690	84.333	19.26	84.333	19.26	87.902	19.44	83.368	19.21	171.396	22.34
3		802.11ac	5775	69.024	18.39	69.823	18.44	59.979	17.78	60.674	17.83	120.781	20.82
1	20	802.11ax (SU)	5180 - 5240	17.783	12.50	17.783	12.50	12.589	11.00	12.303	10.90	24.831	13.95
2A		802.11ax (SU)	5260 - 5320	86.298	19.36	85.901	19.34	50.119	17.00	48.978	16.90	99.083	19.96
2C		802.11ax (SU)	5500 - 5720	88.920	19.49	88.716	19.48	49.888	16.98	50.119	17.00	98.175	19.92
3		802.11ax (SU)	5745 - 5825	88.512	19.47	87.297	19.41	88.105	19.45	89.125	19.50	177.011	22.48
1	40	802.11ax (SU)	5190 - 5230	31.189	14.94	31.046	14.92	24.604	13.91	24.378	13.87	48.978	16.90
2A		802.11ax (SU)	5270 - 5310	75.858	18.80	77.983	18.92	70.795	18.50	66.681	18.24	137.404	21.38
2C		802.11ax (SU)	5510 - 5710	88.512	19.47	86.497	19.37	87.902	19.44	85.704	19.33	173.780	22.40
3		802.11ax (SU)	5755 - 5795	88.920	19.49	87.498	19.42	86.497	19.37	86.298	19.36	172.584	22.37
1	80	802.11ax (SU)	5210	16.827	12.26	17.498	12.43	13.583	11.33	13.335	11.25	26.915	14.30
2A		802.11ax (SU)	5290	24.210	13.84	24.155	13.83	21.528	13.33	21.528	13.33	43.053	16.34
2C		802.11ax (SU)	5530 - 5690	84.918	19.29	88.716	19.48	85.704	19.33	84.333	19.26	170.216	22.31
3		802.11ax (SU)	5775	49.204	16.92	49.091	16.91	38.548	15.86	39.084	15.92	77.625	18.90

ISED EUT Overview (Mid Data Rate)

FCC ID: BCGA2301 IC: 579C-A2301		 MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager
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UNII Band	Channel Bandwidth (MHz)	Mode	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	802.11a/n	5180 - 5240	88.105	19.45	88.105	19.45	48.306	16.84	48.641	16.87	97.051	19.87
2A		802.11a/n	5260 - 5320	88.920	19.49	87.902	19.44	50.003	16.99	49.545	16.95	99.541	19.98
2C		802.11a/n	5500 - 5720	88.105	19.45	88.716	19.48	49.659	16.96	49.431	16.94	99.083	19.96
3		802.11a/n	5745 - 5825	88.920	19.49	88.920	19.49	88.308	19.46	87.700	19.43	175.388	22.44
1	40	802.11n	5190 - 5230	86.099	19.35	85.507	19.32	61.094	17.86	61.660	17.90	122.744	20.89
2A		802.11n	5270 - 5310	87.700	19.43	84.140	19.25	86.099	19.35	87.096	19.40	173.380	22.39
2C		802.11n	5510 - 5710	87.297	19.41	87.902	19.44	87.297	19.41	88.105	19.45	175.388	22.44
3		802.11n	5755 - 5795	87.902	19.44	88.716	19.48	85.704	19.33	85.507	19.32	171.396	22.34
1	80	802.11ac	5210	17.140	12.34	16.711	12.23	12.050	10.81	12.078	10.82	24.155	13.83
2A		802.11ac	5290	22.233	13.47	22.233	13.47	16.749	12.24	16.788	12.25	33.574	15.26
2C		802.11ac	5530 - 5690	88.308	19.46	85.704	19.33	88.105	19.45	84.528	19.27	172.584	22.37
3		802.11ac	5775	52.845	17.23	55.208	17.42	49.774	16.97	48.417	16.85	98.175	19.92
1	20	802.11ax (SU)	5180 - 5240	88.512	19.47	85.704	19.33	50.003	16.99	47.424	16.76	97.499	19.89
2A		802.11ax (SU)	5260 - 5320	86.497	19.37	86.497	19.37	49.774	16.97	48.753	16.88	98.628	19.94
2C		802.11ax (SU)	5500 - 5720	88.920	19.49	88.308	19.46	48.865	16.89	50.119	17.00	98.175	19.92
3		802.11ax (SU)	5745 - 5825	88.105	19.45	87.096	19.40	85.114	19.30	88.512	19.47	173.780	22.40
1	40	802.11ax (SU)	5190 - 5230	62.517	17.96	62.806	17.98	54.450	17.36	55.208	17.42	109.648	20.40
2A		802.11ax (SU)	5270 - 5310	67.608	18.30	69.343	18.41	59.841	17.77	61.944	17.92	121.899	20.86
2C		802.11ax (SU)	5510 - 5710	86.298	19.36	86.298	19.36	86.298	19.36	86.099	19.35	172.584	22.37
3		802.11ax (SU)	5755 - 5795	86.497	19.37	87.498	19.42	85.114	19.30	88.105	19.45	173.380	22.39
1	80	802.11ax (SU)	5210	13.366	11.26	13.677	11.36	12.134	10.84	12.589	11.00	24.717	13.93
2A		802.11ax (SU)	5290	19.724	12.95	19.409	12.88	15.171	11.81	15.382	11.87	30.549	14.85
2C		802.11ax (SU)	5530 - 5690	86.696	19.38	86.497	19.37	85.704	19.33	85.901	19.34	171.791	22.35
3		802.11ax (SU)	5775	39.355	15.95	38.726	15.88	29.854	14.75	31.477	14.98	61.376	17.88

FCC EUT Overview (High Data Rate)

UNII Band	Channel Bandwidth (MHz)	Mode	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	802.11a/n	5180 - 5240	17.498	12.43	17.783	12.50	12.560	10.99	12.589	11.00	25.061	13.99
2A		802.11a/n	5260 - 5320	88.920	19.49	87.902	19.44	50.003	16.99	49.545	16.95	99.541	19.98
2C		802.11a/n	5500 - 5720	88.105	19.45	88.716	19.48	49.659	16.96	49.431	16.94	99.083	19.96
3		802.11a/n	5745 - 5825	88.920	19.49	88.920	19.49	88.308	19.46	87.700	19.43	175.388	22.44
1	40	802.11n	5190 - 5230	31.623	15.00	31.550	14.99	24.322	13.86	24.660	13.92	48.978	16.90
2A		802.11n	5270 - 5310	87.700	19.43	84.140	19.25	86.099	19.35	87.096	19.40	173.380	22.39
2C		802.11n	5510 - 5710	84.333	19.26	84.918	19.29	83.946	19.24	86.497	19.37	170.608	22.32
3		802.11n	5755 - 5795	87.902	19.44	88.716	19.48	85.704	19.33	85.507	19.32	171.396	22.34
1	80	802.11ac	5210	17.140	12.34	16.711	12.23	12.050	10.81	12.078	10.82	24.155	13.83
2A		802.11ac	5290	22.233	13.47	22.233	13.47	16.749	12.24	16.788	12.25	33.574	15.26
2C		802.11ac	5530 - 5690	88.308	19.46	85.704	19.33	88.105	19.45	84.528	19.27	172.584	22.37
3		802.11ac	5775	52.845	17.23	55.208	17.42	49.774	16.97	48.417	16.85	98.175	19.92
1	20	802.11ax (SU)	5180 - 5240	17.539	12.44	17.458	12.42	12.331	10.91	12.589	11.00	24.946	13.97
2A		802.11ax (SU)	5260 - 5320	86.497	19.37	86.497	19.37	49.774	16.97	48.753	16.88	98.628	19.94
2C		802.11ax (SU)	5500 - 5720	88.920	19.49	88.308	19.46	48.865	16.89	50.119	17.00	98.175	19.92
3		802.11ax (SU)	5745 - 5825	88.105	19.45	87.096	19.40	85.114	19.30	88.512	19.47	173.780	22.40
1	40	802.11ax (SU)	5190 - 5230	29.580	14.71	31.623	15.00	24.547	13.90	24.774	13.94	49.317	16.93
2A		802.11ax (SU)	5270 - 5310	67.608	18.30	69.343	18.41	59.841	17.77	61.944	17.92	121.899	20.86
2C		802.11ax (SU)	5510 - 5710	86.298	19.36	86.298	19.36	86.298	19.36	86.099	19.35	172.584	22.37
3		802.11ax (SU)	5755 - 5795	86.497	19.37	87.498	19.42	85.114	19.30	88.105	19.45	173.380	22.39
1	80	802.11ax (SU)	5210	13.366	11.26	13.677	11.36	12.134	10.84	12.589	11.00	24.717	13.93
2A		802.11ax (SU)	5290	19.724	12.95	19.409	12.88	15.171	11.81	15.382	11.87	30.549	14.85
2C		802.11ax (SU)	5530 - 5690	86.696	19.38	86.497	19.37	85.704	19.33	85.901	19.34	171.791	22.35
3		802.11ax (SU)	5775	39.355	15.95	38.726	15.88	29.854	14.75	31.477	14.98	61.376	17.88

ISED EUT Overview (High Data Rate)

FCC ID: BCGA2301 IC: 579C-A2301		 MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager
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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 ISSED Standards (RSS).
- PCTEST facility is a registered (22831) test laboratory with the site description on file with ISSED.

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2.0 PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the **Apple Tablet Device FCC ID: BCGA2301** and **IC: 579C-A2301**. The test data contained in this report pertains only to the emissions due to the EUT's UNII 802.11a/n/ac/ax(SU) transmitter.

Test Device Serial No.: NQ73CFK6VJ, VTXRQ6J9MW, YRXLKXLMHJ, N9TXL9P7K6

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

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Notes:

- 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) 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	a (Low Rate)	99.2	99.0	98.7
	a (Mid Rate)	96.5	96.7	94.0
	a (High Rate)	94.2	94.3	91.0
	n (HT20) (Low Rate)	98.9	99.0	98.0
	n (HT20) (Mid Rate)	96.0	96.1	93.0
	n (HT20) (High Rate)	93.6	93.2	89.0
	ax(SU) (HE20 Low Rate)	98.5	98.7	98.0
	ax(SU) (HE20 Mid Rate)	95.0	94.8	94.6
	ax(SU) (HE20 High Rate)	88.0	88.0	87.5
	n (HT40 Low Rate)	98.0	97.9	95.9
	n (HT40 Mid Rate)	92.8	93.0	88.3
	n (HT40 High Rate)	88.6	88.5	83.6
	ax(SU) (HE40 Low Rate)	98.2	98.5	98.6
	ax(SU) (HE40 Mid Rate)	94.0	94.8	94.4
	ax(SU) (HE40 High Rate)	88.6	88.0	87.4
	ac (HT80 Low Rate)	95.4	95.3	91.9
	ac (HT80 Mid Rate)	87.2	87.1	82.0
	ac (HT80 High Rate)	82.9	82.1	77.9
	ax(SU) (HE80 Low Rate)	94.5	94.6	94.8
	ax(SU) (HE80 Mid Rate)	86.8	86.7	85.4
	ax(SU) (HE80 High Rate)	79.9	80.1	79.7

Table 2-4. Measured Duty Cycles

- The device employs MIMO 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	11a	✓	✓	✓	✓	✗	✗	✗	✗
	11n (20MHz)	✓	✓	✓	✓	✓	✓	✓	✓
	11ax(SU) (20MHz)	✓	✓	✓	✓	✓	✓	✓	✓
	11n (40MHz)	✓	✓	✓	✓	✓	✓	✓	✓
	11ax(SU) (40MHz)	✓	✓	✓	✓	✓	✓	✓	✓
	11ac (80MHz)	✓	✓	✓	✓	✓	✓	✓	✓
	11ax(SU) (80MHz)	✓	✓	✓	✓	✓	✓	✓	✓

Table 2-5. WIFI Configurations

FCC ID: BCGA2301 IC: 579C-A2301		 MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager
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✓ = Support ; ✗ = NOT Support

SISO = Single Input Single Output

SDM = Spatial Diversity Multiplexing – MIMO function

CDD = Cyclic Delay Diversity - 2Tx Function

STBC = Space-Time Block Coding – 2Tx Function

Data Rate(s) Tested: 6, 9, 12, 18, 24, 36, 48, 54Mbps (802.11a)
6.5/7.2, 13/14.4, 19.5/21.7, 26/28.9, 39/43.3, 52/57.8, 58.5/65, 65/72.2Mbps (n – 20MHz)
13.5/15, 27/30, 40.5/45, 54/60, 81/90, 108/120, 121.5/135, 135/150Mbps (n – 40MHz BW)
29.3/32.5, 58.5/65, 87.8/97.5, 117/130, 175.5/195, 234/260, 263.3/292.5, 292.5/325, 351/390,
390/433.3Mbps (ac – 80MHz BW)
13/14.4, 26.28.9, 39/43.3, 52/57.8, 78/86.7, 104/115.6, 117/130, 130/144.4Mbps (MIMO n/ac – 20MHz)
156/173Mbps (MIMO ac – 20MHz)
27/30, 54/60, 81/90, 108/120, 162/180, 216/240, 243/270, 270/300Mbps (MIMO n/ac – 40MHz) 324/360,
360/400Mbps (MIMO ac – 40MHz)
58.5/65, 117/130, 175.5/195, 234/260, 351/390, 468/520, 526.5/585, 585/650, 702/780, 780/866.7Mbps
(MIMO ac – 80MHz)
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 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 (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)
32/34.4, 66/68.8, 98/103.2, 130/137.6, 196/206.5, 260/275.3, 292/309.7, 326/344.1, 390/412.9, 434/458.8,
488/516.2, 542/573.5Mbps (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)

3. 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 / Sub 6 LTE 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

Note:

All the above simultaneous transmission configurations have been tested and the worst case configuration was found to be Config 6 and reported in UNII 802.11ax (OFDMA) and FCC part 27b test reports.

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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	5.5	1.0
5.250 – 5.350	5.2	0.0
5.470 – 5.725	4.2	1.6
5725 – 5.850	5.5	2.7

Table 2-7. Highest Antenna Gain

2.4 Test Support Equipment

1	Apple MacBook Pro w/AC/DC Adapter	Model: A2141 Model: A2166	S/N: C02DV7VKMD6T S/N: N/A
2	Apple USB-C Cable	Model: Chimp	S/N: 420A57
3	USB-C Cable w/ AC Adapter	Model: A146 Model: A2305	S/N: N/A 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.

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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

802.11n HT20/40, 11ax(SU) HE20/40/80 and acVHT80 2TX CDD/SDM mode test data provided in this report covers 802.11n HT20/40, 11ax(SU) HE20/40/80 and 802.11acVHT80 2TX STBC mode

802.11ac VHT20 and VHT40 mode are different from 802.11n HT20 and HT40 only in control messages and have the same power settings.

The data rates have been classified into three different groups; low data rate, middle data rate, and high data rate. All three groups of data rate have been investigated and only the worst case data rate per group is reported. The worst case data rate for each group per mode are as follows:

- 802.11a:
 - Low Data Rate: 6Mbps
 - Mid Data Rate: 18Mbps
 - High Data Rate: 36Mbps
- 802.11n HT20/40:
 - Low Data Rate: MCS0/MCS8 (SISO/CDD)
 - Mid Data Rate: MCS3/MCS11 (SISO/CDD)
 - High Data Rate: MCS5/MCS13 (SISO/CDD)
- 802.11ac VHT80:
 - Low Data Rate: MCS0
 - Mid Data Rate: MCS3
 - High Data Rate: MCS5
- 802.11ax(SU) HE20/HE40/HE80:
 - Low Data Rate: MCS0
 - Mid Data Rate: MCS3
 - High Data Rate: MCS11

For 802.11ax-RU test results see separate UNII 802.11ax (OFDMA) report, 1C2101020002-16-R1.BCG

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.

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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.

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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).

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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.

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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 ($\pm$ 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

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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
ETS-Lindgren	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.

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7.0 TEST RESULTS

7.1 Summary

Company Name: Apple Inc.
FCC ID: BCGA2301
IC: 579C-A2301
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 (1C21010200 02-14.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	LINE CONDUCTED	PASS	Section 7.8

Table 7-1. Summary of Test Results

Notes:

- 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.
- 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.
- 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.
- 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.
- 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.
- 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.

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7.2 26dB & 99% Bandwidth Measurement – 802.11a/n/ac/ax-SU §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 $\geq 3 \times$ 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 configurations and data rates were investigated and only the worst case are reported.
2. The data rates have been classified into three different groups; low data rate, middle data rate, and high data rate. All three data rate groups of data rate have been investigated and only the worst case data rate per group is reported.
3. Low, mid and high channels were tested and tabular data has been reported. Only mid channel bandwidth plots are reported.

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Antenna 5b 26dB & 99% Bandwidth Measurements

	Frequency [MHz]	Channel No.	802.11 Mode	Data Rate [Mbps]	99% Occupied Bandwidth [MHz]	Measured 26dB Bandwidth [MHz]
Band 1	5180	36	n (20MHz)	6.5/7.2 (MCS0)	17.97	21.66
	5200	40	n (20MHz)	6.5/7.2 (MCS0)	17.82	21.21
	5240	48	n (20MHz)	6.5/7.2 (MCS0)	17.86	21.05
	5180	36	ax-SU (20MHz)	8/8.6 (MCS0)	19.10	22.06
	5200	40	ax-SU (20MHz)	8/8.6 (MCS0)	19.07	21.25
	5240	48	ax-SU (20MHz)	8/8.6 (MCS0)	19.07	21.30
	5190	38	n (40MHz)	13.5/15 (MCS0)	36.57	43.53
	5230	46	n (40MHz)	13.5/15 (MCS0)	36.43	41.31
	5190	38	ax-SU (40MHz)	16/17.2 (MCS0)	38.34	45.29
	5230	46	ax-SU (40MHz)	16/17.2 (MCS0)	37.99	41.82
	5210	42	ac (80MHz)	29.3/32.5 (MCS0)	75.43	82.84
	5210	42	ax-SU (80MHz)	34/36.0 (MCS0)	77.39	82.99
Band 2A	5260	52	n (20MHz)	6.5/7.2 (MCS0)	17.77	21.12
	5280	56	n (20MHz)	6.5/7.2 (MCS0)	17.75	21.03
	5320	64	n (20MHz)	6.5/7.2 (MCS0)	17.93	22.20
	5260	52	ax-SU (20MHz)	8/8.6 (MCS0)	19.05	21.38
	5280	56	ax-SU (20MHz)	8/8.6 (MCS0)	19.04	21.30
	5320	64	ax-SU (20MHz)	8/8.6 (MCS0)	19.16	26.30
	5270	54	n (40MHz)	13.5/15 (MCS0)	36.36	41.36
	5310	62	n (40MHz)	13.5/15 (MCS0)	36.51	42.16
	5270	54	ax-SU (40MHz)	16/17.2 (MCS0)	38.04	41.34
	5310	62	ax-SU (40MHz)	16/17.2 (MCS0)	38.09	42.27
	5290	58	ac (80MHz)	29.3/32.5 (MCS0)	75.52	83.39
	5290	58	ax-SU (80MHz)	34/36.0 (MCS0)	77.14	85.50
Band 2C	5500	100	n (20MHz)	6.5/7.2 (MCS0)	17.93	22.11
	5580	116	n (20MHz)	6.5/7.2 (MCS0)	17.77	21.02
	5720	144	n (20MHz)	6.5/7.2 (MCS0)	17.69	20.99
	5500	100	ax-SU (20MHz)	8/8.6 (MCS0)	19.15	23.02
	5580	116	ax-SU (20MHz)	8/8.6 (MCS0)	19.05	21.33
	5720	144	ax-SU (20MHz)	8/8.6 (MCS0)	19.06	21.42
	5510	102	n (40MHz)	13.5/15 (MCS0)	36.51	45.69
	5550	110	n (40MHz)	13.5/15 (MCS0)	36.31	41.42
	5710	142	n (40MHz)	13.5/15 (MCS0)	36.36	41.31
	5510	102	ax-SU (40MHz)	16/17.2 (MCS0)	38.06	42.49
	5550	110	ax-SU (40MHz)	16/17.2 (MCS0)	38.01	41.62
	5710	142	ax-SU (40MHz)	16/17.2 (MCS0)	37.95	41.38
	5530	106	ac (80MHz)	29.3/32.5 (MCS0)	75.68	83.99
	5690	138	ac (80MHz)	29.3/32.5 (MCS0)	75.52	81.52
	5530	106	ax-SU (80MHz)	34/36.0 (MCS0)	77.35	82.58
	5690	138	ax-SU (80MHz)	34/36.0 (MCS0)	77.23	81.95

Table 7-2. Conducted Bandwidth Measurements Antenna 5b (Low Data Rate)

FCC ID: BCGA2301 IC: 579C-A2301		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C2101020002-15.BCG	Test Dates: 12/12/2020 - 3/10/2021	EUT Type: Tablet Device	Page 19 of 354

	Frequency [MHz]	Channel No.	802.11 Mode	Data Rate [Mbps]	99% Occupied Bandwidth [MHz]	Measured 26dB Bandwidth [MHz]
Band 1	5180	36	n (20MHz)	26/28.9 (MCS3)	17.79	20.85
	5200	40	n (20MHz)	26/28.9 (MCS3)	17.74	20.95
	5240	48	n (20MHz)	26/28.9 (MCS3)	17.72	21.28
	5180	36	ax-SU (20MHz)	33/34.4 (MCS3)	19.06	21.34
	5200	40	ax-SU (20MHz)	33/34.4 (MCS3)	19.05	21.29
	5240	48	ax-SU (20MHz)	33/34.4 (MCS3)	19.07	21.28
	5190	38	n (40MHz)	54/60 (MCS3)	36.38	41.24
	5230	46	n (40MHz)	54/60 (MCS3)	36.35	41.30
	5190	38	ax-SU (40MHz)	65/68.8 (MCS3)	37.95	51.86
	5230	46	ax-SU (40MHz)	65/68.8 (MCS3)	37.91	41.39
	5210	42	ac (80MHz)	117/130 (MCS3)	75.41	80.76
	5210	42	ax-SU (80MHz)	567/600.5 (MCS3)	77.16	81.90
Band 2A	5260	52	n (20MHz)	26/28.9 (MCS3)	17.73	20.85
	5280	56	n (20MHz)	26/28.9 (MCS3)	17.72	20.84
	5320	64	n (20MHz)	26/28.9 (MCS3)	17.73	20.96
	5260	52	ax-SU (20MHz)	33/34.4 (MCS3)	19.04	21.19
	5280	56	ax-SU (20MHz)	33/34.4 (MCS3)	19.01	21.20
	5320	64	ax-SU (20MHz)	33/34.4 (MCS3)	19.11	22.13
	5270	54	n (40MHz)	54/60 (MCS3)	36.31	41.07
	5310	62	n (40MHz)	54/60 (MCS3)	36.35	41.05
	5270	54	ax-SU (40MHz)	65/68.8 (MCS3)	37.92	41.26
	5310	62	ax-SU (40MHz)	65/68.8 (MCS3)	38.01	52.98
	5290	58	ac (80MHz)	117/130 (MCS3)	75.33	81.06
	5290	58	ax-SU (80MHz)	567/600.5 (MCS3)	77.11	82.12
Band 2C	5500	100	n (20MHz)	26/28.9 (MCS3)	17.75	20.90
	5580	116	n (20MHz)	26/28.9 (MCS3)	17.72	20.71
	5720	144	n (20MHz)	26/28.9 (MCS3)	17.71	20.86
	5500	100	ax-SU (20MHz)	33/34.4 (MCS3)	19.11	23.61
	5580	116	ax-SU (20MHz)	33/34.4 (MCS3)	19.03	21.16
	5720	144	ax-SU (20MHz)	33/34.4 (MCS3)	19.04	21.16
	5510	102	n (40MHz)	54/60 (MCS3)	36.38	41.37
	5550	110	n (40MHz)	54/60 (MCS3)	36.32	40.84
	5710	142	n (40MHz)	54/60 (MCS3)	36.38	40.91
	5510	102	ax-SU (40MHz)	65/68.8 (MCS3)	38.00	52.97
	5550	110	ax-SU (40MHz)	65/68.8 (MCS3)	37.92	41.41
	5710	142	ax-SU (40MHz)	65/68.8 (MCS3)	37.95	41.36
	5530	106	ac (80MHz)	117/130 (MCS3)	75.61	81.28
	5690	138	ac (80MHz)	117/130 (MCS3)	75.48	80.89
	5530	106	ax-SU (80MHz)	567/600.5 (MCS3)	77.29	81.77
	5690	138	ax-SU (80MHz)	567/600.5 (MCS3)	77.21	81.81

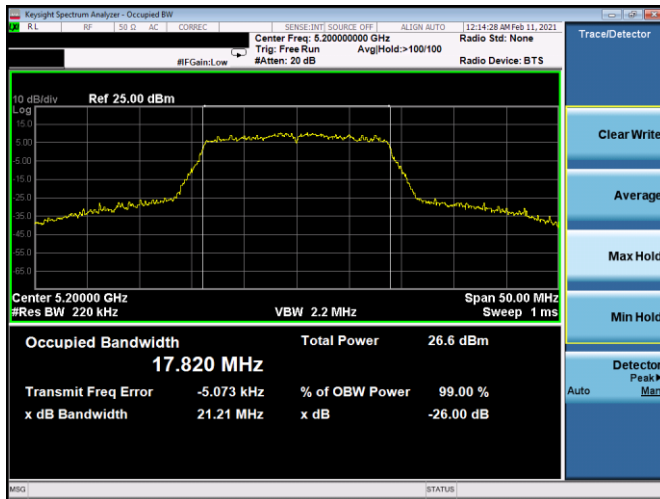
Table 7-3. Conducted Bandwidth Measurements Antenna 5b (Mid Data Rate)

FCC ID: BCGA2301 IC: 579C-A2301	 PCTEST Proud to be part of element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C2101020002-15.BCG	Test Dates: 12/12/2020 - 3/10/2021	EUT Type: Tablet Device	Page 20 of 354

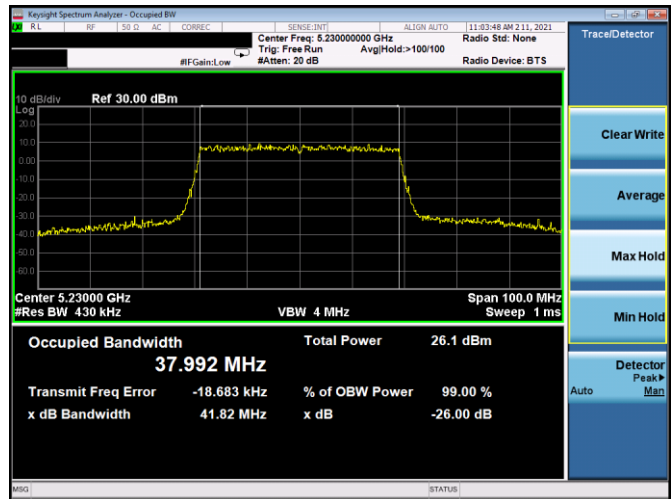
	Frequency [MHz]	Channel No.	802.11 Mode	Data Rate [Mbps]	99% Occupied Bandwidth [MHz]	Measured 26dB Bandwidth [MHz]
Band 1	5180	36	n (20MHz)	52/57.8 (MCS5)	17.77	20.72
	5200	40	n (20MHz)	52/57.8 (MCS5)	17.88	21.27
	5240	48	n (20MHz)	52/57.8 (MCS5)	17.96	23.27
	5180	36	ax-SU (20MHz)	135/143.4 (MCS11)	19.04	21.02
	5200	40	ax-SU (20MHz)	135/143.4 (MCS11)	19.05	24.72
	5240	48	ax-SU (20MHz)	135/143.4 (MCS11)	19.10	27.72
	5190	38	n (40MHz)	108/120 (MCS5)	36.53	41.02
	5230	46	n (40MHz)	108/120 (MCS5)	36.90	47.93
	5190	38	ax-SU (40MHz)	271/286.8 (MCS11)	37.84	41.30
	5230	46	ax-SU (40MHz)	271/286.8 (MCS11)	38.00	44.43
	5210	42	ac (80MHz)	292.5/325 (MCS5)	75.81	81.00
	5210	42	ax-SU (80MHz)	567/600.5 (MCS11)	77.15	81.72
Band 2A	5260	52	n (20MHz)	52/57.8 (MCS5)	17.90	23.84
	5280	56	n (20MHz)	52/57.8 (MCS5)	17.83	21.41
	5320	64	n (20MHz)	52/57.8 (MCS5)	17.82	21.01
	5260	52	ax-SU (20MHz)	135/143.4 (MCS11)	19.11	23.02
	5280	56	ax-SU (20MHz)	135/143.4 (MCS11)	19.06	21.42
	5320	64	ax-SU (20MHz)	135/143.4 (MCS11)	19.02	21.24
	5270	54	n (40MHz)	108/120 (MCS5)	36.55	43.49
	5310	62	n (40MHz)	108/120 (MCS5)	36.43	41.27
	5270	54	ax-SU (40MHz)	271/286.8 (MCS11)	38.03	57.11
	5310	62	ax-SU (40MHz)	271/286.8 (MCS11)	37.85	41.09
	5290	58	ac (80MHz)	292.5/325 (MCS5)	75.81	81.82
	5290	58	ax-SU (80MHz)	567/600.5 (MCS11)	77.06	81.59
Band 2C	5500	100	n (20MHz)	52/57.8 (MCS5)	17.79	21.05
	5580	116	n (20MHz)	52/57.8 (MCS5)	17.87	21.24
	5720	144	n (20MHz)	52/57.8 (MCS5)	17.84	21.06
	5500	100	ax-SU (20MHz)	135/143.4 (MCS11)	19.00	21.09
	5580	116	ax-SU (20MHz)	135/143.4 (MCS11)	19.06	20.96
	5720	144	ax-SU (20MHz)	135/143.4 (MCS11)	19.11	22.49
	5510	102	n (40MHz)	108/120 (MCS5)	36.51	41.35
	5550	110	n (40MHz)	108/120 (MCS5)	36.60	42.16
	5710	142	n (40MHz)	108/120 (MCS5)	36.62	41.72
	5510	102	ax-SU (40MHz)	271/286.8 (MCS11)	37.83	41.22
	5550	110	ax-SU (40MHz)	271/286.8 (MCS11)	37.91	41.36
	5710	142	ax-SU (40MHz)	271/286.8 (MCS11)	38.07	51.72
	5530	106	ac (80MHz)	292.5/325 (MCS5)	75.93	81.58
	5690	138	ac (80MHz)	292.5/325 (MCS5)	75.95	81.44
	5530	106	ax-SU (80MHz)	567/600.5 (MCS11)	77.07	81.32
	5690	138	ax-SU (80MHz)	567/600.5 (MCS11)	77.19	81.46

Table 7-4. Conducted Bandwidth Measurements Antenna 5b (High Data Rate)

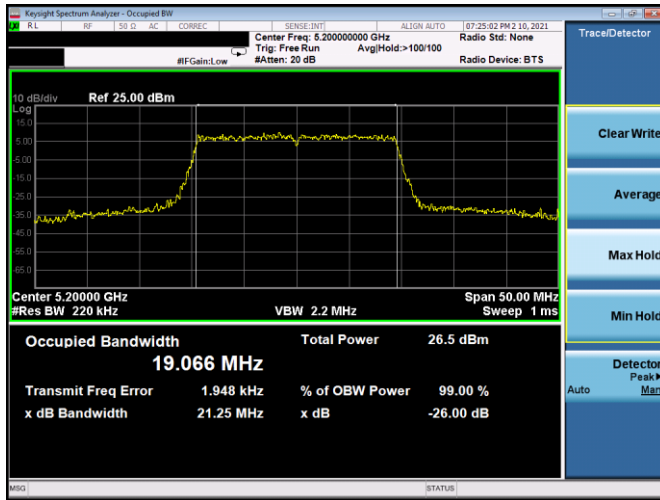
FCC ID: BCGA2301 IC: 579C-A2301	 PCTEST Proud to be part of 	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C2101020002-15.BCG	Test Dates: 12/12/2020 - 3/10/2021	EUT Type: Tablet Device	Page 21 of 354



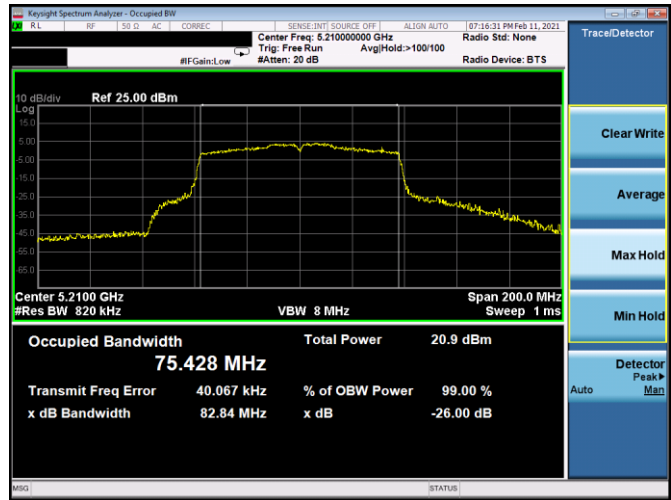
Plot 7-1. 26dB BW & 99% OBW Antenna 5b (20MHz BW 802.11n – Ch. 40, MCS0)



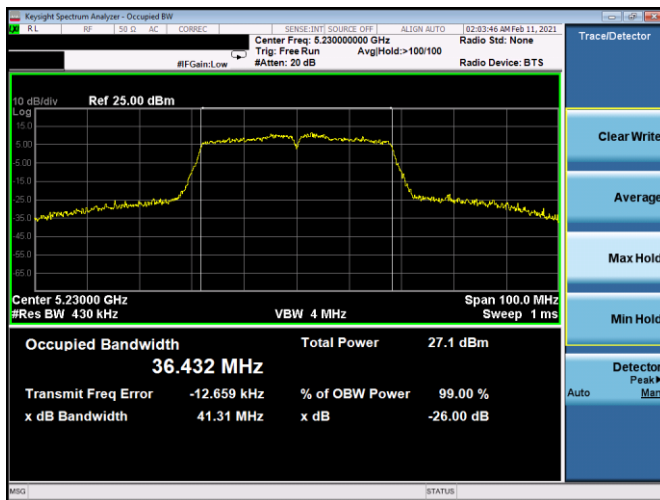
Plot 7-4. 26dB BW & 99% OBW Antenna 5b (40MHz BW 802.11ax(SU) – Ch. 46, MCS0)



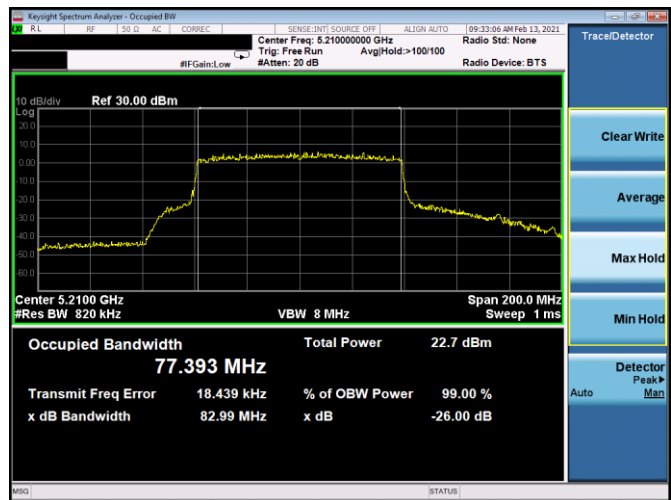
Plot 7-2. 26dB BW & 99% OBW Antenna 5b (20MHz BW 802.11ax(SU) – Ch. 40, MCS0)



Plot 7-5. 26dB BW & 99% OBW Antenna 5b (80MHz BW 802.11ac – Ch. 42, MCS0)

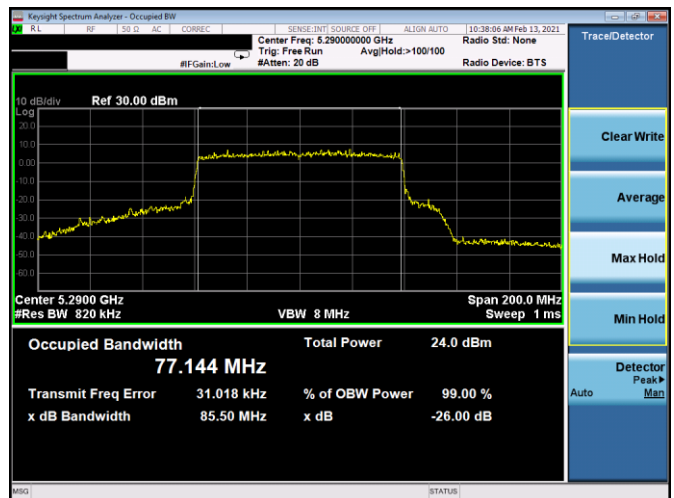
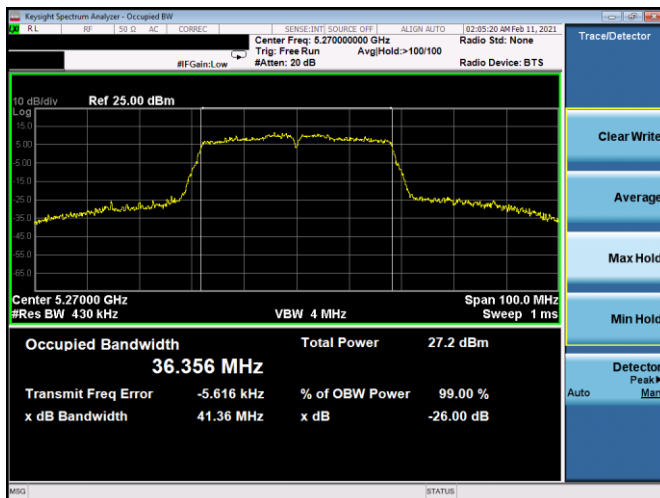
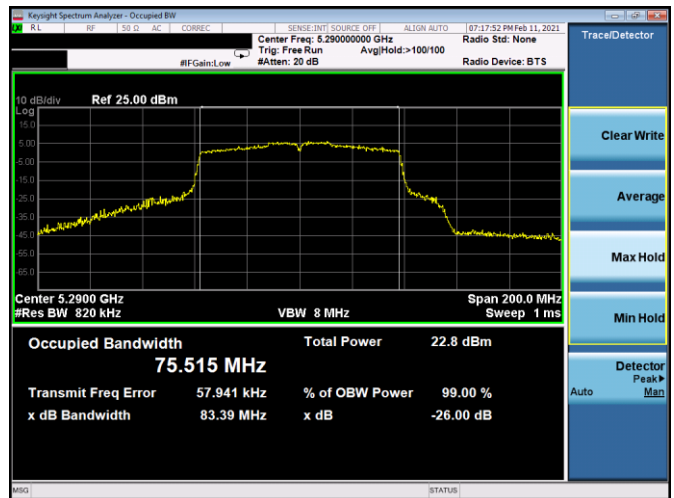
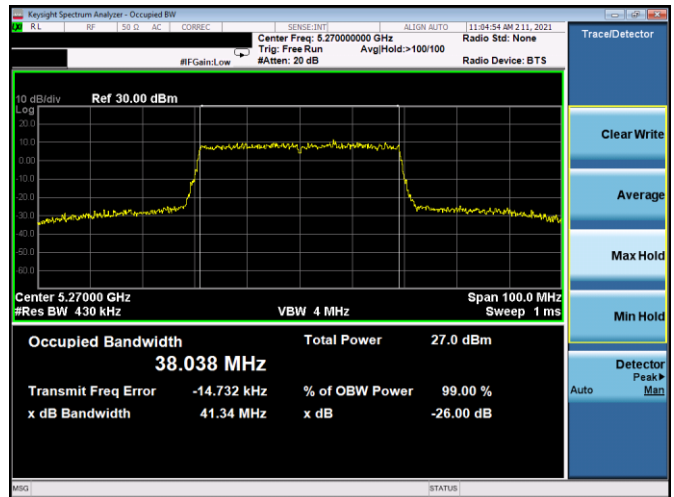
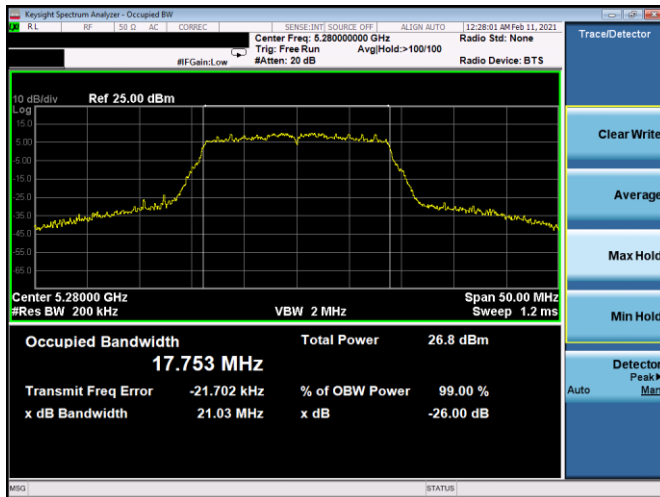


Plot 7-3. 26dB BW & 99% OBW Antenna 5b (40MHz BW 802.11n – Ch. 46, MCS0)

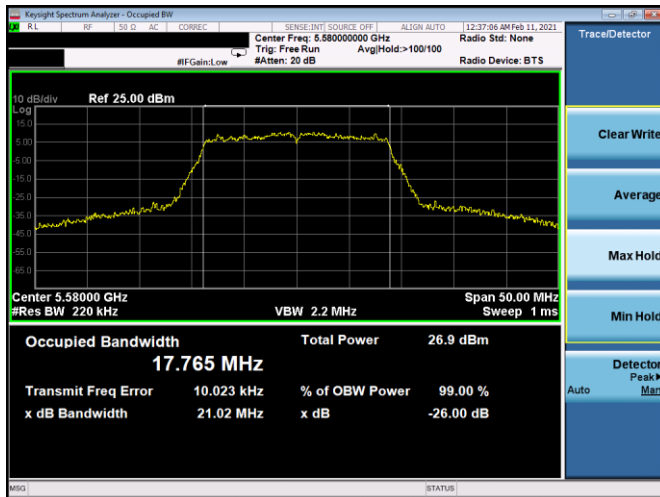


Plot 7-6. 26dB BW & 99% OBW Antenna 5b (80MHz BW 802.11ax(SU) – Ch. 42, MCS0)

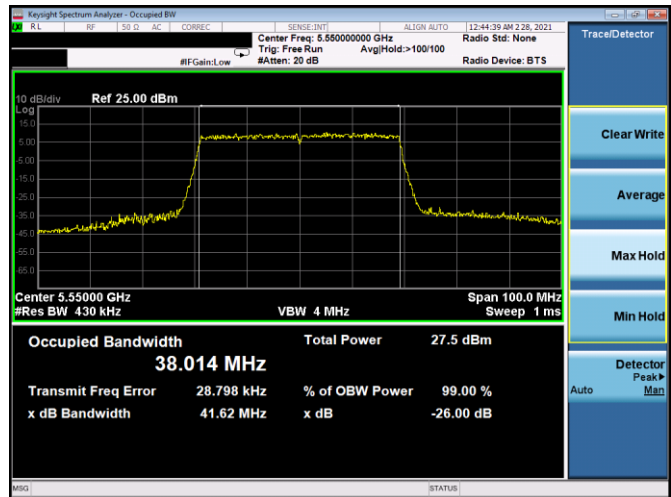
FCC ID: BCGA2301 IC: 579C-A2301	PCTEST Proud to be part of element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C2101020002-15.BCG	Test Dates: 12/12/2020 - 3/10/2021	EUT Type: Tablet Device	Page 22 of 354



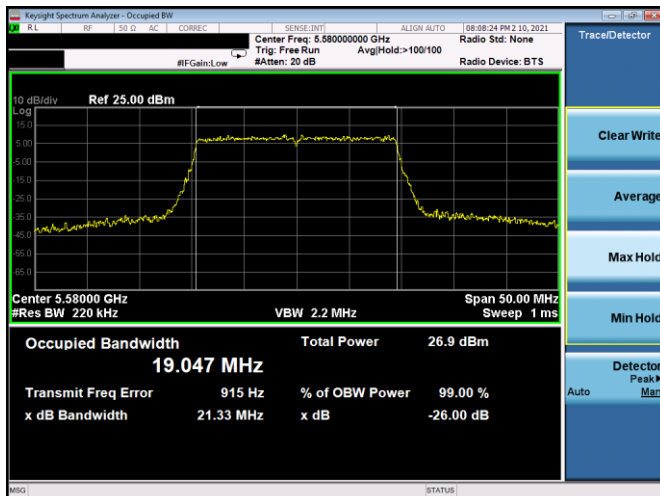
FCC ID: BCGA2301 IC: 579C-A2301		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C2101020002-15.BCG	Test Dates: 12/12/2020 - 3/10/2021	EUT Type: Tablet Device	Page 23 of 354



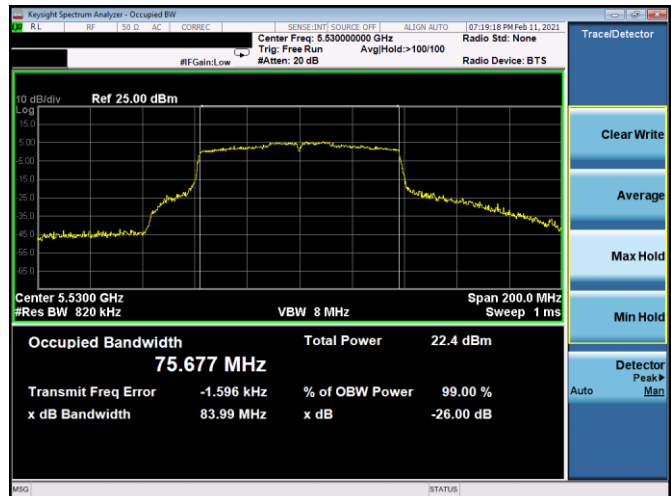
Plot 7-13. 26dB BW & 99% OBW Antenna 5b (20MHz BW 802.11n – Ch. 116, MCS0)



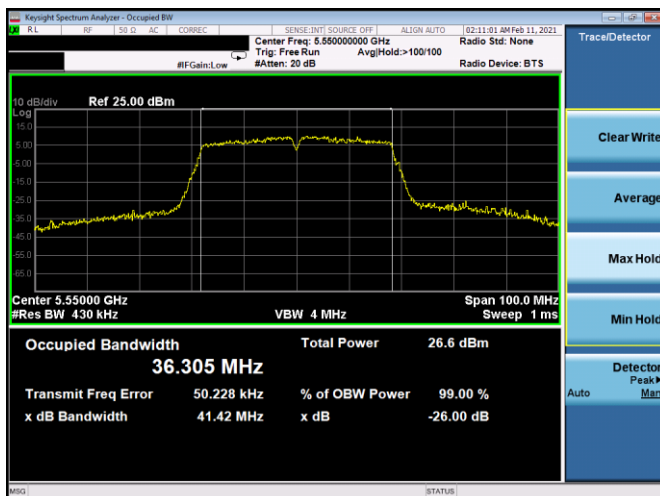
Plot 7-16. 26dB BW & 99% OBW Antenna 5b (40MHz BW 802.11ax(SU) – Ch. 110, MCS0)



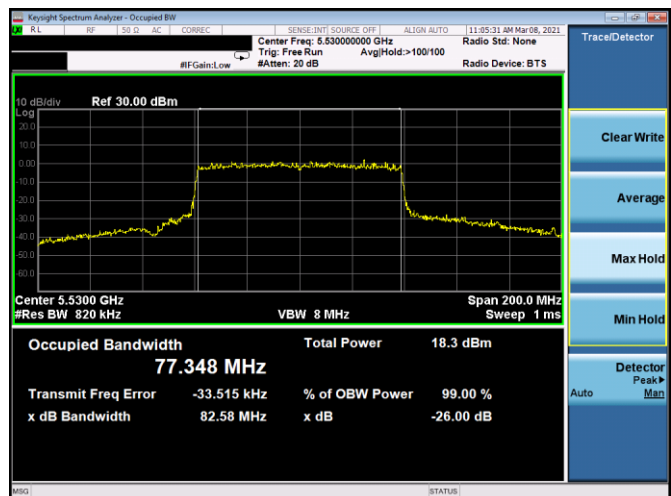
Plot 7-14. 26dB BW & 99% OBW Antenna 5b (20MHz BW 802.11ax(SU) – Ch. 116, MCS0)



Plot 7-17. 26dB BW & 99% OBW Antenna 5b (80MHz BW 802.11ac – Ch. 106, MCS0)

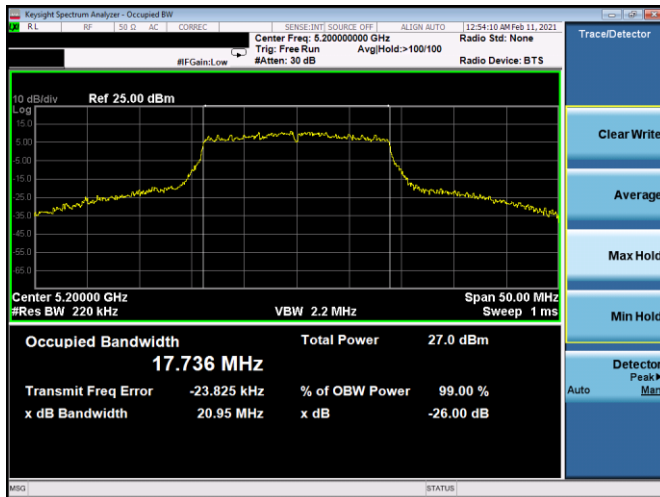


Plot 7-15. 26dB BW & 99% OBW Antenna 5b (40MHz BW 802.11n – Ch. 110, MCS0)



Plot 7-18. 26dB BW & 99% OBW Antenna 5b (80MHz BW 802.11ax(SU) – Ch. 106, MCS0)

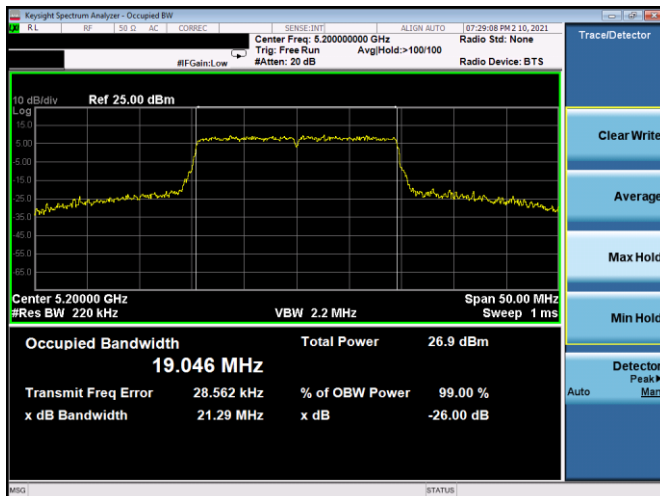
FCC ID: BCGA2301 IC: 579C-A2301			MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C2101020002-15.BCG	Test Dates: 12/12/2020 - 3/10/2021	EUT Type: Tablet Device		Page 24 of 354



Plot 7-19. 26dB BW & 99% OBW Antenna 5b (20MHz BW 802.11n – Ch. 40, MCS3)



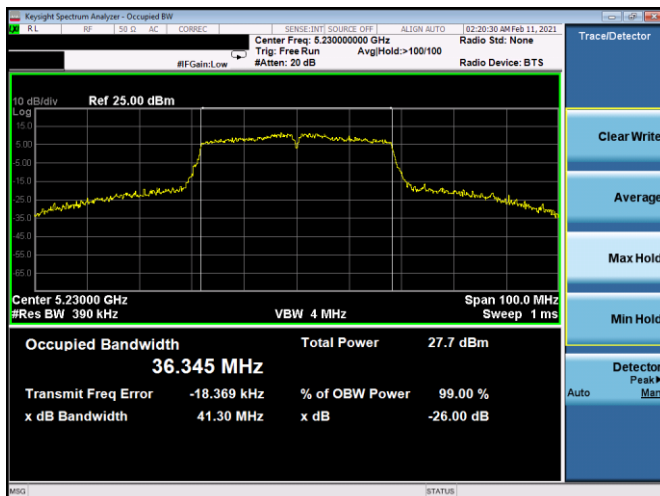
Plot 7-22. 26dB BW & 99% OBW Antenna 5b (40MHz BW 802.11ax(SU) – Ch. 46, MCS3)



Plot 7-20. 26dB BW & 99% OBW Antenna 5b (20MHz BW 802.11ax(SU) – Ch. 40, MCS3)



Plot 7-23. 26dB BW & 99% OBW Antenna 5b (80MHz BW 802.11ac – Ch. 42, MCS3)

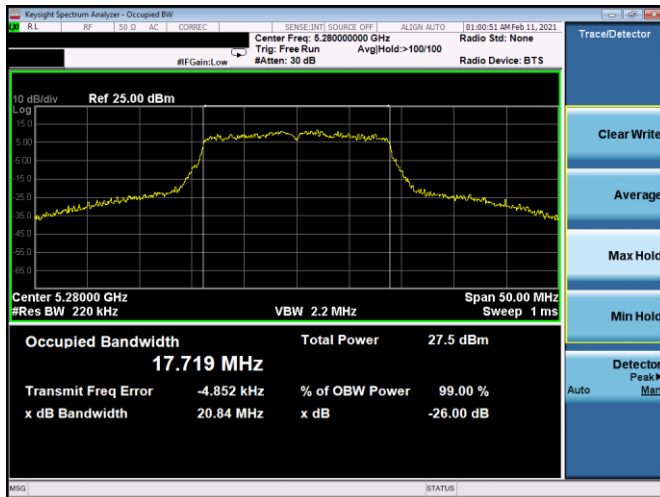


Plot 7-21. 26dB BW & 99% OBW Antenna 5b (40MHz BW 802.11n – Ch. 46, MCS3)

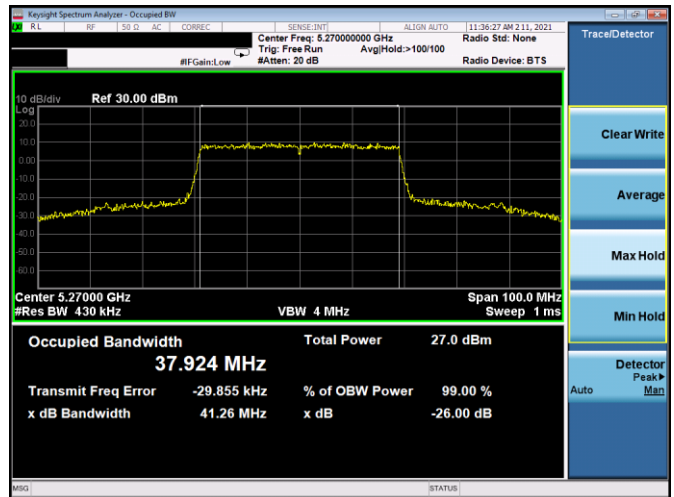


Plot 7-24. 26dB BW & 99% OBW Antenna 5b (80MHz BW 802.11ax(SU) – Ch. 42, MCS3)

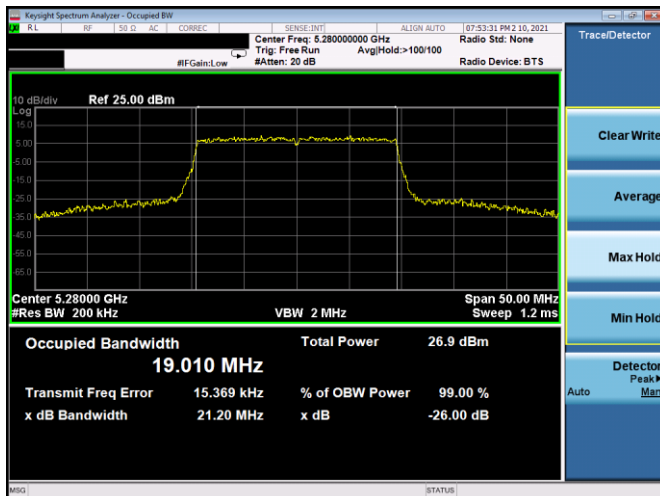
FCC ID: BCGA2301 IC: 579C-A2301			MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C2101020002-15.BCG	Test Dates: 12/12/2020 - 3/10/2021	EUT Type: Tablet Device		Page 25 of 354



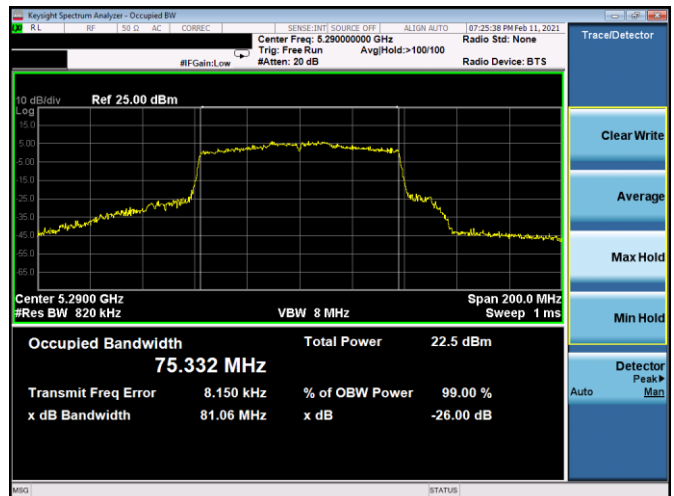
Plot 7-25. 26dB BW & 99% OBW Antenna 5b (20MHz BW 802.11n – Ch. 56, MCS3)



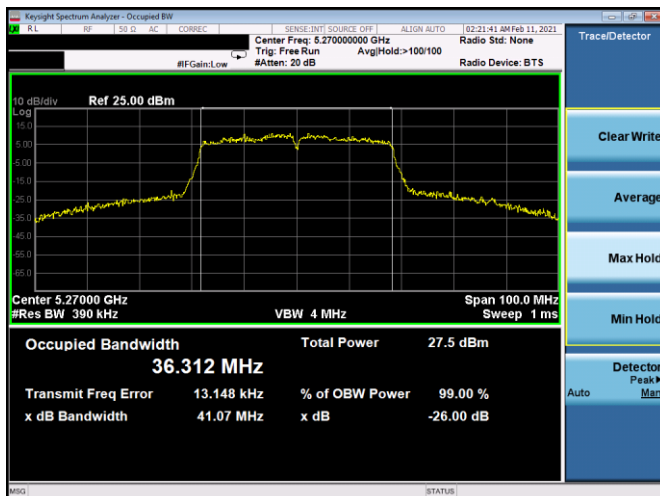
Plot 7-28. 26dB BW & 99% OBW Antenna 5b (40MHz BW 802.11ax(SU) – Ch. 54, MCS3)



Plot 7-26. 26dB BW & 99% OBW Antenna 5b (20MHz BW 802.11ax(SU) – Ch. 56, MCS3)



Plot 7-29. 26dB BW & 99% OBW Antenna 5b (80MHz BW 802.11ac – Ch. 58, MCS3)

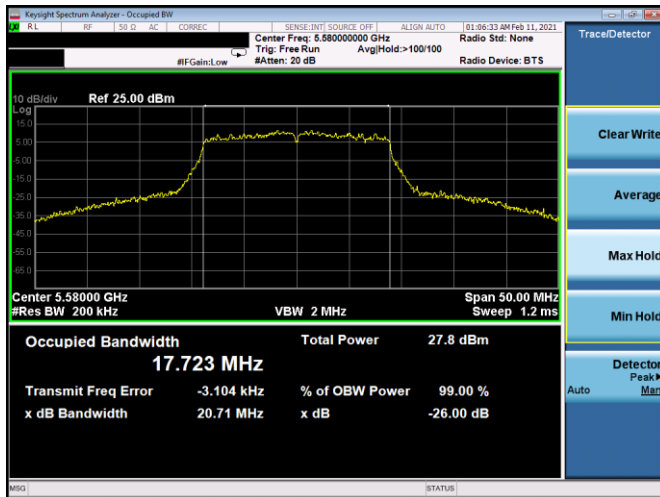


Plot 7-27. 26dB BW & 99% OBW Antenna 5b (40MHz BW 802.11n – Ch. 54, MCS3)

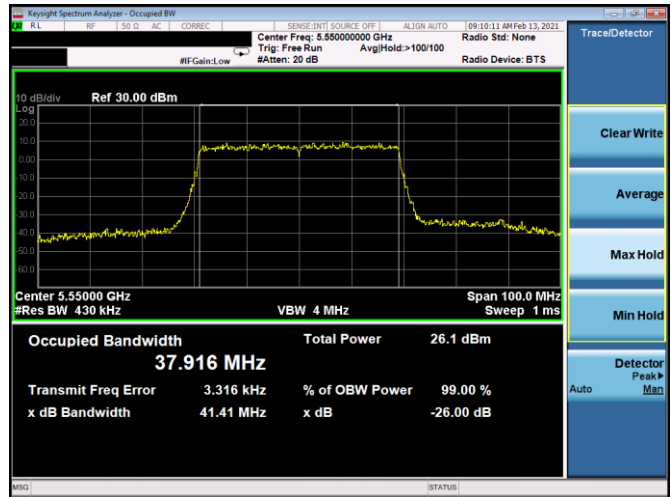


Plot 7-30. 26dB BW & 99% OBW Antenna 5b (80MHz BW 802.11ax(SU) – Ch. 58, MCS3)

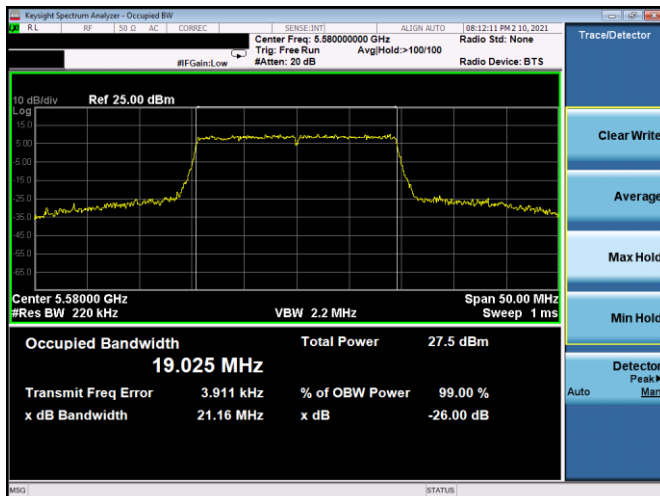
FCC ID: BCGA2301 IC: 579C-A2301	PCTEST Proud to be part of element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C2101020002-15.BCG	Test Dates: 12/12/2020 - 3/10/2021	EUT Type: Tablet Device	Page 26 of 354



Plot 7-31. 26dB BW & 99% OBW Antenna 5b (20MHz BW 802.11n – Ch. 116, MCS3)



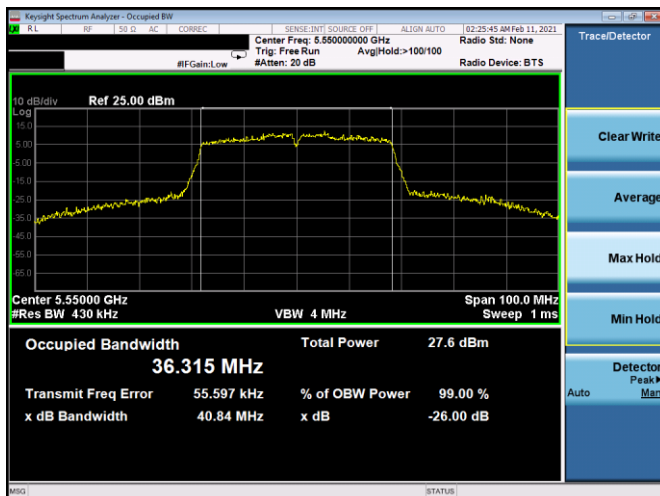
Plot 7-34. 26dB BW & 99% OBW Antenna 5b (40MHz BW 802.11ax(SU) – Ch. 110, MCS3)



Plot 7-32. 26dB BW & 99% OBW Antenna 5b (20MHz BW 802.11ax(SU) – Ch. 116, MCS3)



Plot 7-35. 26dB BW & 99% OBW Antenna 5b (80MHz BW 802.11ac – Ch. 106, MCS3)

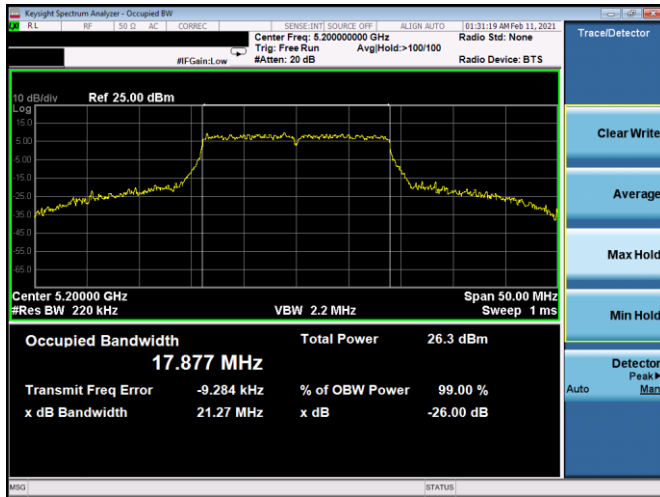


Plot 7-33. 26dB BW & 99% OBW Antenna 5b (40MHz BW 802.11n – Ch. 110, MCS3)

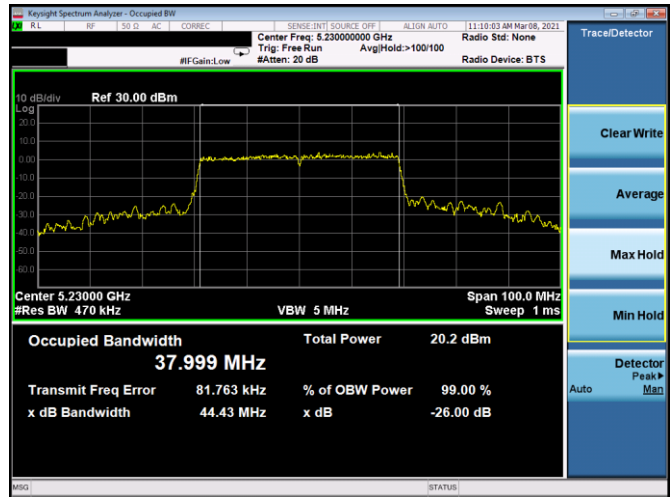


Plot 7-36. 26dB BW & 99% OBW Antenna 5b (80MHz BW 802.11ax(SU) – Ch. 106, MCS3)

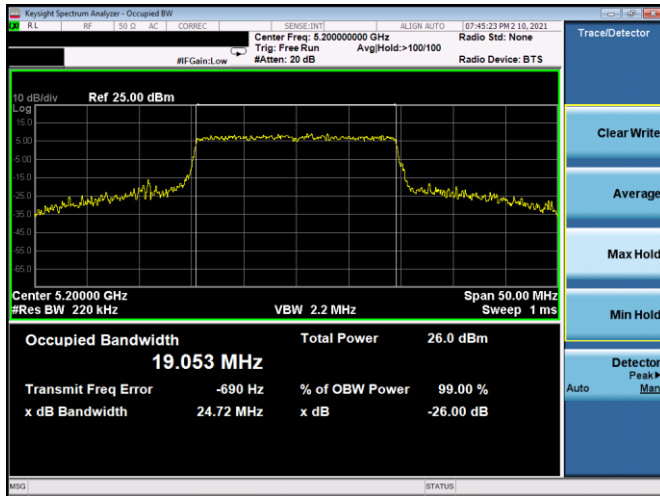
FCC ID: BCGA2301 IC: 579C-A2301	PCTEST Proud to be part of element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C2101020002-15.BCG	Test Dates: 12/12/2020 - 3/10/2021	EUT Type: Tablet Device	Page 27 of 354



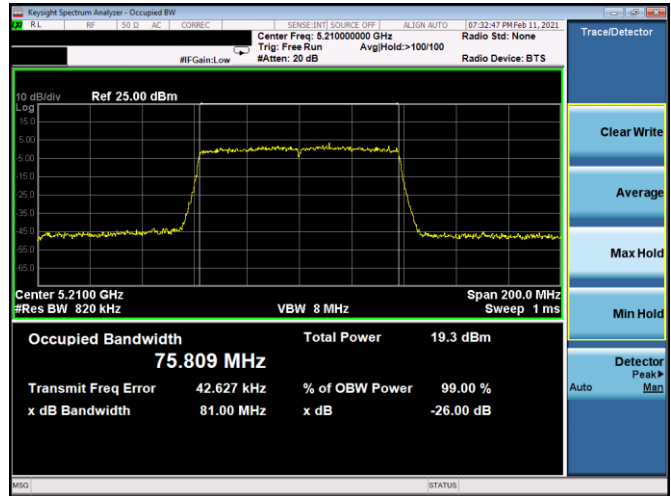
Plot 7-37. 26dB BW & 99% OBW Antenna 5b (20MHz BW 802.11n – Ch. 40, MCS5)



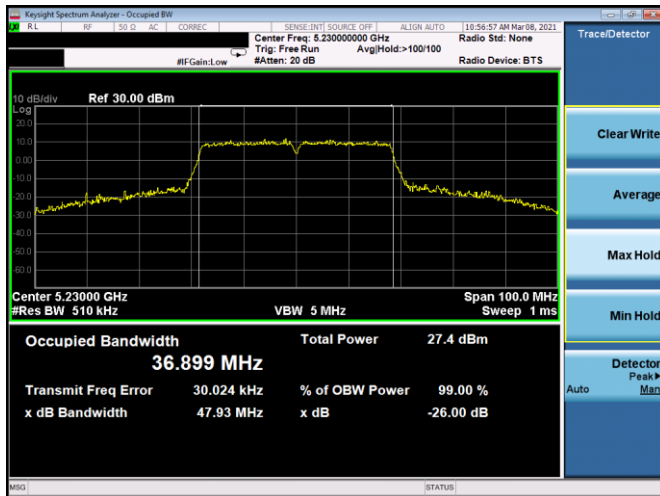
Plot 7-40. 26dB BW & 99% OBW Antenna 5b (40MHz BW 802.11ax(SU) – Ch. 46, MCS11)



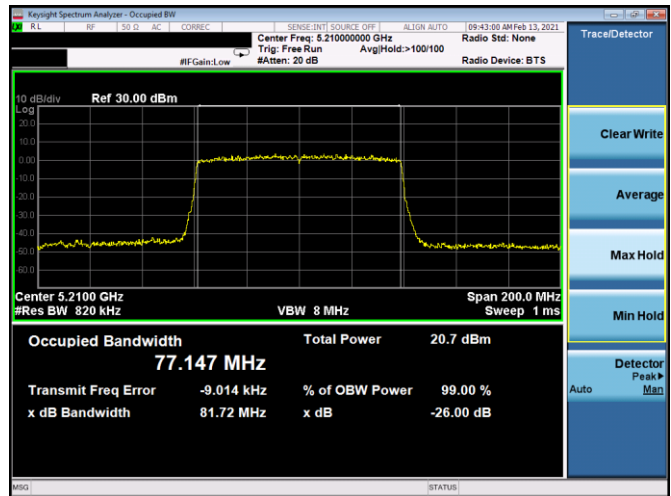
Plot 7-38. 26dB BW & 99% OBW Antenna 5b (20MHz BW 802.11ax(SU) – Ch. 40, MCS1)



Plot 7-41. 26dB BW & 99% OBW Antenna 5b (80MHz BW 802.11ac – Ch. 42, MCS5)

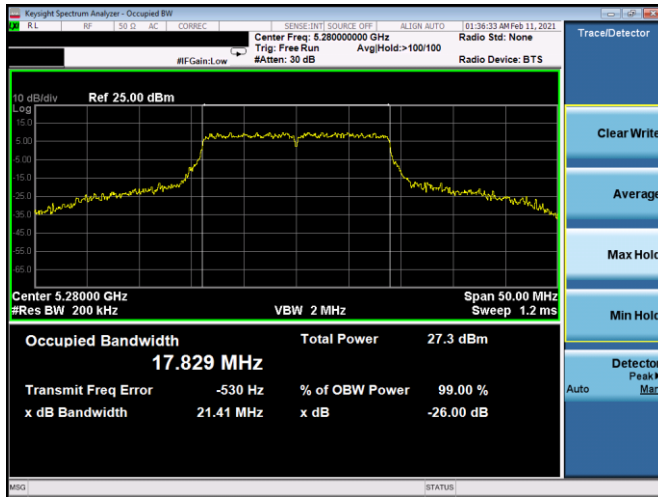


Plot 7-39. 26dB BW & 99% OBW Antenna 5b (40MHz BW 802.11n – Ch. 46, MCS5)

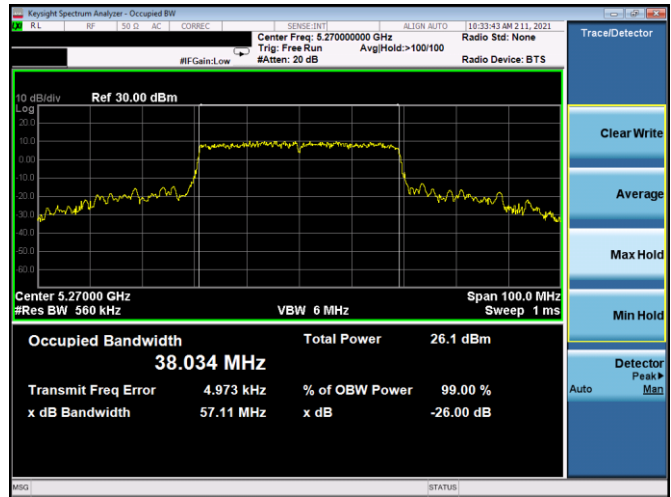


Plot 7-42. 26dB BW & 99% OBW Antenna 5b (80MHz BW 802.11ax(SU) – Ch. 42, MCS11)

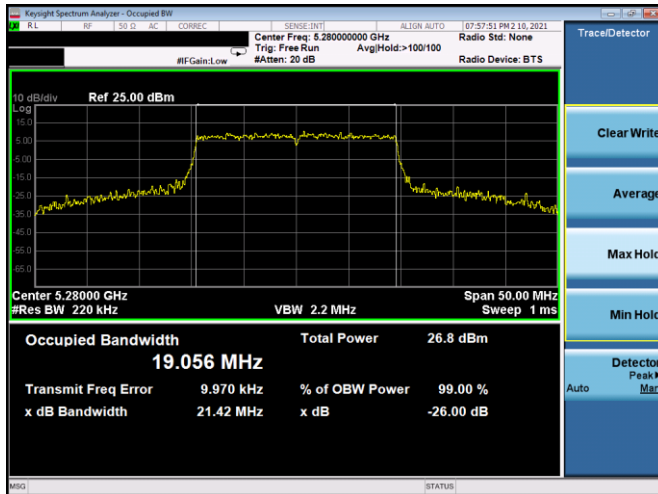
FCC ID: BCGA2301 IC: 579C-A2301	PCTEST Proud to be part of element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C2101020002-15.BCG	Test Dates: 12/12/2020 - 3/10/2021	EUT Type: Tablet Device	Page 28 of 354



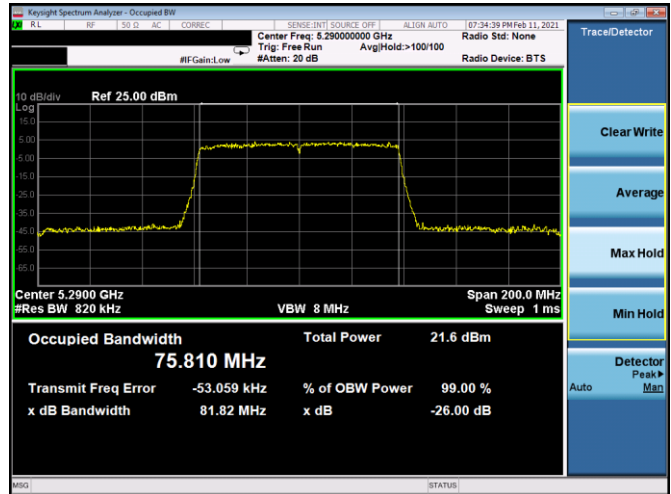
Plot 7-43. 26dB BW & 99% OBW Antenna 5b (20MHz BW 802.11n – Ch. 56, MCS5)



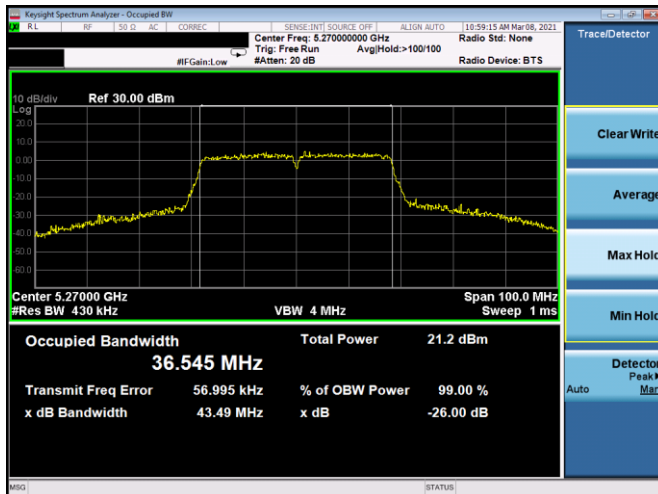
Plot 7-46. 26dB BW & 99% OBW Antenna 5b (40MHz BW 802.11ax(SU) – Ch. 54, MCS11)



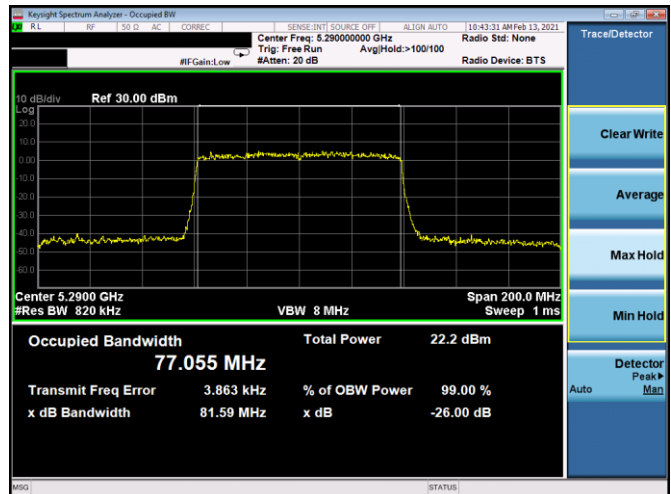
Plot 7-44. 26dB BW & 99% OBW Antenna 5b (20MHz BW 802.11ax(SU) – Ch. 56, MCS11)



Plot 7-47. 26dB BW & 99% OBW Antenna 5b (80MHz BW 802.11ac – Ch. 58, MCS5)



Plot 7-45. 26dB BW & 99% OBW Antenna 5b (40MHz BW 802.11n – Ch. 54, MCS5)



Plot 7-48. 26dB BW & 99% OBW Antenna 5b (80MHz BW 802.11ax(SU) – Ch. 58, MCS11)

FCC ID: BCGA2301 IC: 579C-A2301	PCTEST Proud to be part of element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C2101020002-15.BCG	Test Dates: 12/12/2020 - 3/10/2021	EUT Type: Tablet Device	Page 29 of 354