

MEASUREMENT REPORT

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

Applicant Name:

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

Date of Testing:

12/02/2021 - 02/16/2022

Test Site/Location:

PCTEST Morgan Hill, CA, USA

Test Report Serial No.:

1C2111150079-15.BCG

FCC ID:	BCGA2589
IC:	579C-A2589
APPLICANT:	Apple Inc.

Application Type:

Certification

Model/HVIN:

A2589(A2591)

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.



RJ Ortanez

Executive Vice President





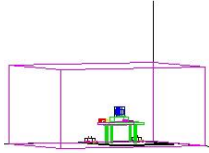
FCC ID: BCGA2589 IC: 579C-A2589		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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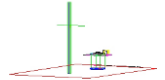
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UNII Band	Channel Bandwidth (MHz)	Tx Frequency (MHz)	SISO						CDD/SDM Primary						CDD/SDM Diversity					
			Antenna 2b		Antenna 1b		Antenna 3a		Antenna 2b		Antenna 1b		Summed		Antenna 2b		Antenna 3a		Summed	
			Max. Power (mW)	Max. Power (dBm)	Max. Power (mW)	Max. Power (dBm)	Max. Power (mW)	Max. Power (dBm)	Max. Power (mW)	Max. Power (dBm)	Max. Power (mW)	Max. Power (dBm)	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	79.433	19.00	79.433	19.00	79.433	19.00	39.811	16.00	39.811	16.00	79.616	19.01	39.811	16.00	39.811	16.00	79.621	19.01
2A		5260 - 5320	79.433	19.00	78.705	18.96	79.433	19.00	39.811	16.00	39.811	16.00	79.616	19.01	39.811	16.00	39.811	16.00	79.621	19.01
2C		5500 - 5720	78.886	18.97	79.433	19.00	79.433	19.00	39.811	16.00	39.811	16.00	79.616	19.01	39.811	16.00	39.811	16.00	79.530	19.01
3	40	5745 - 5825	99.083	19.96	100.000	20.00	99.770	19.99	99.770	19.99	99.770	19.99	96.828	19.86	196.789	22.94	100.000	20.00	200.000	23.01
1		5190 - 5230	88.105	19.45	87.902	19.44	87.700	19.43	87.096	19.40	85.507	19.32	174.181	22.41	88.512	19.47	89.125	19.50	177.637	22.50
2A		5270 - 5310	87.297	19.41	88.105	19.45	89.125	19.50	85.704	19.33	87.297	19.41	172.982	22.38	85.114	19.30	84.333	19.26	169.447	22.29
2C	80	5510 - 5710	100.000	20.00	100.000	20.00	100.000	20.00	89.125	19.50	87.700	19.43	177.011	22.48	89.125	19.50	88.920	19.49	176.221	22.46
3		5755 - 5795	100.000	20.00	100.000	20.00	100.000	20.00	97.724	19.90	100.000	20.00	196.789	22.94	100.000	20.00	100.000	20.00	200.000	23.01
1		5210	25.119	14.00	25.119	14.00	25.119	14.00	22.387	13.50	22.387	13.50	44.771	16.51	22.387	13.50	22.387	13.50	44.164	16.45
2A	80	5290	19.953	13.00	19.953	13.00	19.815	12.97	17.378	12.40	17.783	12.50	35.075	15.45	17.783	12.50	17.783	12.50	35.566	15.51
2C		5530 - 5690	100.000	20.00	100.000	20.00	98.855	19.95	99.083	19.96	100.000	20.00	199.067	22.99	99.312	19.97	95.940	19.82	195.252	22.91
3		5775	56.105	17.49	55.081	17.41	56.234	17.50	50.003	16.99	50.119	17.00	98.855	19.95	50.003	16.99	49.431	16.94	99.435	19.98

FCC EUT Overview

UNII Band	Channel Bandwidth (MHz)	Tx Frequency (MHz)	SISO						CDD/SDM Primary						CDD/SDM Diversity					
			Antenna 2b		Antenna 1b		Antenna 3a		Antenna 2b		Antenna 1b		Summed		Antenna 2b		Antenna 3a		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)	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	37.497	15.74	37.584	15.75	37.497	15.74	23.659	13.74	23.714	13.75	47.098	16.73	23.714	13.75	23.714	13.75	47.424	16.76
2A		5260 - 5320	79.433	19.00	78.705	18.96	79.433	19.00	39.811	16.00	39.811	16.00	79.616	19.01	39.811	16.00	39.811	16.00	79.621	19.01
2C		5500 - 5720	78.886	18.97	79.433	19.00	79.433	19.00	39.811	16.00	39.811	16.00	79.616	19.01	39.811	16.00	39.811	16.00	79.530	19.01
3	40	5745 - 5825	99.083	19.96	100.000	20.00	99.770	19.99	99.770	19.99	99.770	19.99	96.828	19.86	196.789	22.94	100.000	20.00	200.000	23.01
1		5190 - 5230	89.125	19.50	88.308	19.46	88.512	19.47	65.766	18.18	64.565	18.10	130.317	21.15	66.834	18.25	65.313	18.15	132.130	21.21
2A		5270 - 5310	87.297	19.41	88.105	19.45	89.125	19.50	85.704	19.33	87.297	19.41	172.982	22.38	85.114	19.30	84.333	19.26	169.447	22.29
2C	80	5510 - 5710	100.000	20.00	100.000	20.00	100.000	20.00	89.125	19.50	87.700	19.43	177.011	22.48	89.125	19.50	88.920	19.49	176.221	22.46
3		5755 - 5795	100.000	20.00	100.000	20.00	100.000	20.00	97.724	19.90	100.000	20.00	196.789	22.94	100.000	20.00	100.000	20.00	200.000	23.01
1		5210	25.119	14.00	25.119	14.00	25.119	14.00	22.387	13.50	22.387	13.50	44.771	16.51	22.387	13.50	22.387	13.50	44.164	16.45
2A	80	5290	19.953	13.00	19.953	13.00	19.815	12.97	17.378	12.40	17.783	12.50	35.075	15.45	17.783	12.50	17.783	12.50	35.566	15.51
2C		5530 - 5690	100.000	20.00	100.000	20.00	98.855	19.95	99.083	19.96	100.000	20.00	199.067	22.99	99.312	19.97	95.940	19.82	195.252	22.91
3		5775	56.105	17.49	55.081	17.41	56.234	17.50	50.003	16.99	50.119	17.00	98.855	19.95	50.003	16.99	49.431	16.94	99.435	19.98

ISED EUT Overview

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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: BCGA2589** and **IC: 579C-A2589**. 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.: Y257GJ4FH2, MK616422XY, MVX6WLP646, HCVMXQ057K, GQX4NQYP7W
H2QQT9962G, HQ52VJLF0X, LM9C04R9XT

2.2 Device Capabilities

This device contains the following capabilities:

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 ISSED.
- 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 2b	Antenna 1b	Antenna 3a	CDD/SDM (Primary)	CDD/SDM (Diversity)
5GHz	ax(RU) (HE20)	98.7	98.6	98.6	98.6	98.5
	ax(RU) (HE40)	98.8	98.7	98.7	98.7	98.6
	ax(RU) (HE80)	98.6	98.6	98.5	98.5	98.2

Table 2-4. Measured Duty Cycles

CDD/SDM Primary = Antenna 2b + Antenna 1b
CDD/SDM Diversity = Antenna 2b + Antenna 3a


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

WiFi Configurations		SISO			Primary						Diversity					
		Antenna 2b	Antenna 1b	Antenna 3a	CDD		SDM		STBC		CDD		SDM		STBC	
					Antenna 2b	Antenna 1b	Antenna 2b	Antenna 1b	Antenna 2b	Antenna 1b	Antenna 2b	Antenna 3a	Antenna 2b	Antenna 3a	Antenna 2b	Antenna 3a
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)

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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	WCDMA / LTE / FR1 NR	LTE / FR1 NR		UNII
		802.11 b/g/n/ax	BDR, EDR, HDR4/8, LE1/2M	Mid Band	High Band	Ultra High Band	802.11 a/n/ac/ax
3A	Config 1	✗	✓	✗	✗	✗	✓
3A	Config 2	✓	✗	✗	✓	✗	✗
3A	Config 3	✗	✓	✗	✓	✗	✗
3A	Config 4	✗	✓	✗	✓	✗	✓
3A	Config 5	✗	✗	✗	✓	✗	✓
3A	Config 6	✓	✗	✓	✗	✗	✗
3A	Config 7	✗	✓	✓	✗	✗	✗
3A	Config 8	✗	✓	✓	✗	✗	✓
3A	Config 9	✗	✗	✓	✗	✗	✓
1A	Config 10	✓	✗	✗	✓	✗	✗
1A	Config 11	✗	✓	✗	✓	✗	✗
1A	Config 12	✓	✗	✓	✗	✗	✗
1A	Config 13	✗	✓	✓	✗	✗	✗
1B	Config 14	✗	✗	✗	✗	✓	✓
2B	Config 15	✗	✗	✗	✗	✓	✓

Table 2-6. Simultaneous Transmission Configurations

✓ = Support; ✗ = Not Support

Note:

All of the above simultaneous transmission configurations have been tested and the worst case configuration was found to be Config 4 and reported in the Bluetooth, UNII OFDM, and Part 27b RF test reports.


Wi-Fi 2.4GHz and Bluetooth 2.4 GHz can transmit simultaneously on separate antennas. 2.4 GHz WLAN Antenna 3a can only transmit simultaneously with 2.4GHz Bluetooth Antenna 1a. In this scenario Wi-Fi max power will not exceed minimum of (13.5dBm, SAR max cap, Regulatory max cap) power.

2.3 Antenna Description

Following antenna gains provided by manufacturer were used for testing.

Frequency [GHz]	Antenna Gain (dBi)		
	Antenna 2b	Antenna 1b	Antenna 3a
5.150 – 5.250	-1.1	-0.1	1.2
5.250 – 5.350	0.9	-0.7	0.7
5.470 – 5.725	0.3	1.1	1.2
5.725 – 5.850	-1.2	1.1	1.0


Table 2-7. Highest Antenna Gain

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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	Apple USB-C Cable	Model: Spartan	S/N: 000MKTR02U
4	USB-C Cable	Model: A146	S/N: N/A
	w/ AC Adapter	Model: A2305	S/N: N/A
5	Apple Pencil	Model: N/A	S/N: GQXGSXBJKM9
6	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 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, 1C2111150079-14.BCG.

2.6 Software and Firmware

The test was conducted with firmware version 19E11500Q 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 D01 v01r01, 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	2.75
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	3/31/2021	Annual	3/31/2022	MY49430244
Anritsu	ML2496A	Power Meter	11/29/2021	Annual	11/29/2022	184005
Anritsu	MA2411B	Pulse Power Sensor	11/30/2021	Annual	11/30/2022	1726261
Anritsu	MA2411B	Pulse Power Sensor	11/30/2021	Annual	11/30/2022	1726262
ATM	180-442A-KF	20dB Nominal Gain Horn Antenna	8/13/2021	Annual	8/13/2022	T058701-01
Com-Power Corporation	LIN-120A	Line Impedance Stabilization Network (LISN)	3/29/2021	Annual	3/29/2022	241297
ETS-Lindgren	3142E	Biconilog Antenna (26-6000MHz)	10/21/2021	Annual	10/21/2022	208204
ETS-Lindgren	3117	Double Ridged Guide Horn Antenna (1-18GHz)	10/25/2021	Annual	10/25/2022	227597
Keysight Technology	N9040B	UXA Signal Analyzer	2/8/2022	Annual	2/8/2023	MY57212015
Rohde & Schwarz	TS-PR8	Pre-Amplifier (30MHz-6GHz)	1/6/2022	Annual	1/6/2023	102328
Rohde & Schwarz	TS-PR18	Pre-Amplifier (1GHz-18GHz)	1/6/2022	Annual	1/6/2023	101639
Rohde & Schwarz	TS-PR1840	Pre-Amplifier (18GHz-40GHz)	4/29/2021	Annual	4/29/2022	100051
Rohde & Schwarz	ESW26	EMI Test Receiver	6/11/2021	Annual	6/11/2022	101299
Rohde & Schwarz	ESW44	EMI Test Receiver	12/2/2021	Annual	12/2/2022	101570
Rohde & Schwarz	HFH2-Z2	Loop Antenna	4/5/2021	Annual	4/5/2022	100519
Rohde & Schwarz	FSV40	Signal Analyzer (10Hz-40GHz)	3/16/2021	Annual	3/16/2022	101619
Rohde & Schwarz	FSVA3044	Signal Analyzer (up to 44 GHz)	4/26/2021	Annual	4/26/2022	101098

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: BCGA2589
 IC: 579C-A2589
 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, 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 (1C211115007 9-13.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:

- 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 7.0.
- 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 1.3.2.
- 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.
- 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.
- Only one RU index could be selected at a time so no contiguous or non-contiguous RU's were considered for testing.

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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 – Subclause 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 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 channel bandwidth plots have been reported.

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Antenna 2b 26dB & 99% Bandwidth Measurements


	Frequency [MHz]	Channel No.	802.11 Mode	RU Size	RU Index	Data Rate [Mbps]	Measured 99% Occupied Bandwidth [MHz]	Measured 26dB Bandwidth [MHz]
Band 1	5180	36	ax (20MHz)	26	0	135/143.4 (MCS11)	18.11	19.48
				26	4	135/143.4 (MCS11)	17.01	18.82
				26	8	135/143.4 (MCS11)	18.51	20.14
	5200	40	ax (20MHz)	26	0	135/143.4 (MCS11)	18.39	19.86
				26	4	135/143.4 (MCS11)	17.26	18.91
				26	8	135/143.4 (MCS11)	18.62	20.40
	5240	48	ax (20MHz)	26	0	135/143.4 (MCS11)	17.72	18.83
				26	4	135/143.4 (MCS11)	17.04	18.28
				26	8	135/143.4 (MCS11)	18.54	20.15
	5190	38	ax (40MHz)	26	0	271/286.8 (MCS11)	18.26	20.40
				26	8	271/286.8 (MCS11)	20.10	21.06
				26	17	271/286.8 (MCS11)	17.97	20.11
	5230	46	ax (40MHz)	26	0	271/286.8 (MCS11)	18.40	19.97
				26	8	271/286.8 (MCS11)	21.19	23.18
				26	17	271/286.8 (MCS11)	17.91	19.87
	5210	42	ax (80MHz)	26	0	567/600.5 (MCS11)	18.16	19.38
				26	18	567/600.5 (MCS11)	36.90	38.95
				26	36	567/600.5 (MCS11)	18.53	20.45
Band 2A	5260	52	ax (20MHz)	26	0	135/143.4 (MCS11)	18.29	19.61
				26	4	135/143.4 (MCS11)	15.98	18.71
				26	8	135/143.4 (MCS11)	18.35	19.52
	5280	56	ax (20MHz)	26	0	135/143.4 (MCS11)	18.35	19.86
				26	4	135/143.4 (MCS11)	17.23	19.01
				26	8	135/143.4 (MCS11)	18.60	20.46
	5320	64	ax (20MHz)	26	0	135/143.4 (MCS11)	17.65	18.55
				26	4	135/143.4 (MCS11)	14.19	15.22
				26	8	135/143.4 (MCS11)	18.05	19.36
	5270	54	ax (40MHz)	26	0	271/286.8 (MCS11)	18.42	20.24
				26	8	271/286.8 (MCS11)	21.06	22.84
				26	17	271/286.8 (MCS11)	18.22	20.39
	5310	62	ax (40MHz)	26	0	271/286.8 (MCS11)	18.04	19.96
				26	8	271/286.8 (MCS11)	19.98	21.89
				26	17	271/286.8 (MCS11)	18.27	20.65
	5290	58	ax (80MHz)	26	0	567/600.5 (MCS11)	18.10	19.60
				26	18	567/600.5 (MCS11)	36.95	39.09
				26	36	567/600.5 (MCS11)	18.28	20.04
Band 2C	5500	100	ax (20MHz)	26	0	135/143.4 (MCS11)	18.25	19.32
				26	4	135/143.4 (MCS11)	16.33	16.95
				26	8	135/143.4 (MCS11)	18.40	20.46
	5580	116	ax (20MHz)	26	0	135/143.4 (MCS11)	18.34	19.81
				26	4	135/143.4 (MCS11)	17.27	18.88
				26	8	135/143.4 (MCS11)	18.62	20.51
	5720	144	ax (20MHz)	26	0	135/143.4 (MCS11)	18.22	19.33
				26	4	135/143.4 (MCS11)	17.30	18.75
				26	8	135/143.4 (MCS11)	17.74	19.91
	5510	102	ax (40MHz)	26	0	271/286.8 (MCS11)	17.75	19.16
				26	8	271/286.8 (MCS11)	20.38	22.47
				26	17	271/286.8 (MCS11)	17.46	19.91
	5550	110	ax (40MHz)	26	0	271/286.8 (MCS11)	18.48	20.41
				26	8	271/286.8 (MCS11)	21.28	23.04
				26	17	271/286.8 (MCS11)	18.34	20.20
	5710	142	ax (40MHz)	26	0	271/286.8 (MCS11)	18.07	19.47
				26	8	271/286.8 (MCS11)	19.29	21.59
				26	17	271/286.8 (MCS11)	18.20	19.94
	5530	106	ax (80MHz)	26	0	567/600.5 (MCS11)	18.07	19.83
				26	18	567/600.5 (MCS11)	36.69	38.97
				26	36	567/600.5 (MCS11)	18.56	20.48
	5690	138	ax (80MHz)	26	0	567/600.5 (MCS11)	18.10	19.55
				26	18	567/600.5 (MCS11)	34.79	36.73
				26	36	567/600.5 (MCS11)	18.18	19.74

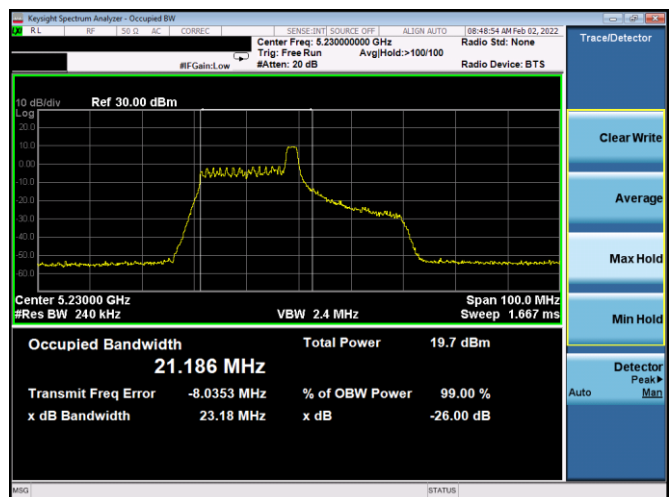
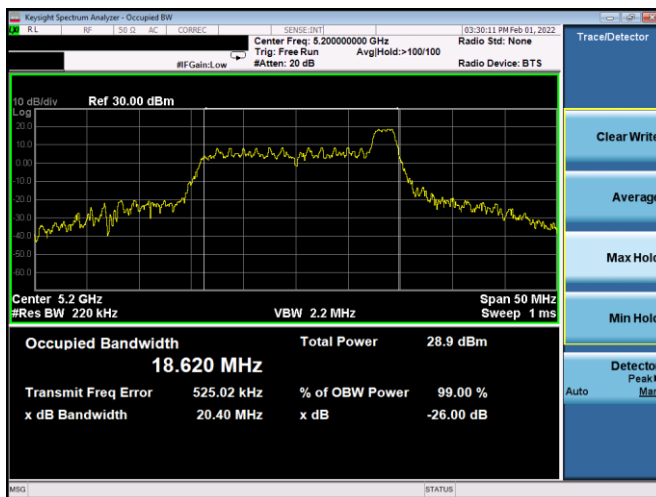
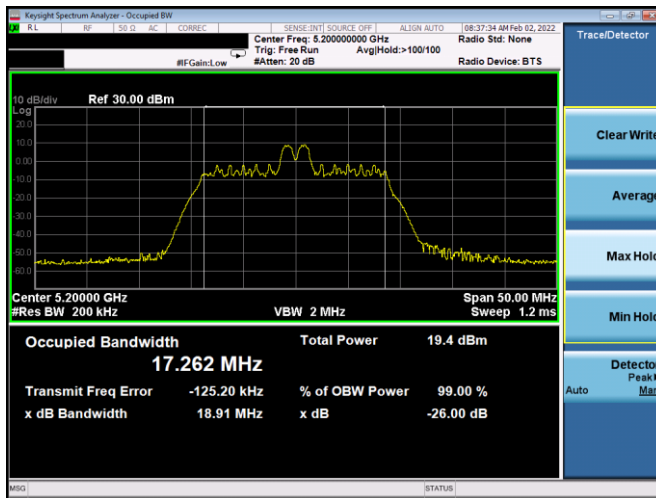
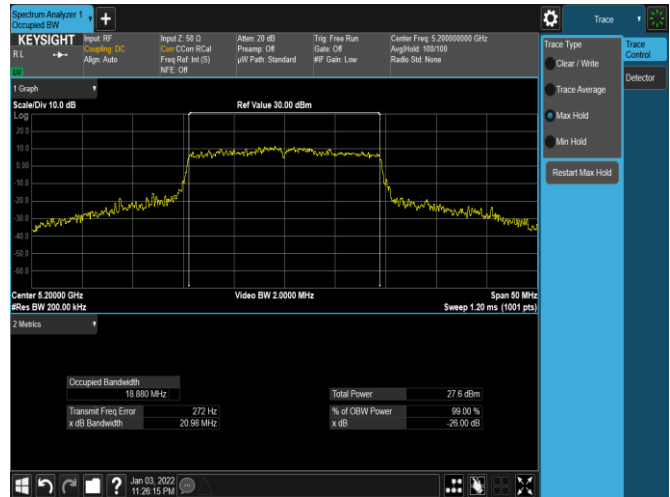
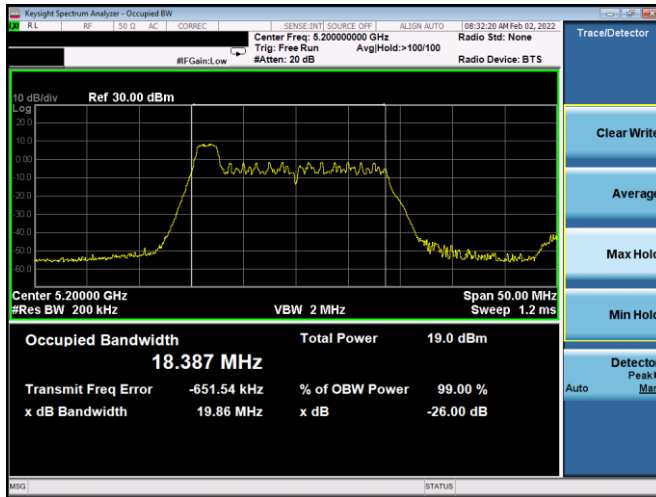
Table 7-2. Conducted BW Measurements Antenna 2b (RU26)

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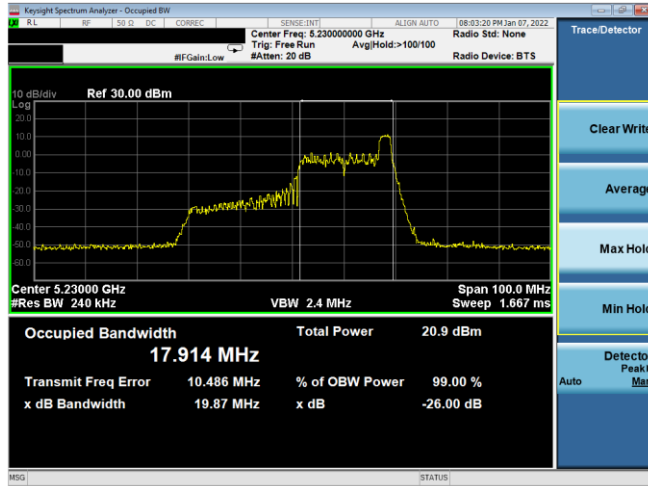
	Frequency [MHz]	Channel No.	802.11 Mode	RU Size	RU Index	Data Rate [Mbps]	Measured 99% Occupied Bandwidth [MHz]	Measured 26dB Bandwidth [MHz]
Band 1	5180	36	ax (20MHz)	242	61	135/143.4 (MCS11)	18.95	20.78
	5200	40	ax (20MHz)	242	61	135/143.4 (MCS11)	18.88	20.98
	5240	48	ax (20MHz)	242	61	135/143.4 (MCS11)	18.94	22.84
	5190	38	ax (40MHz)	484	65	271/286.8 (MCS11)	37.99	41.20
	5230	46	ax (40MHz)	484	65	271/286.8 (MCS11)	38.55	73.39
	5210	42	ax (80MHz)	996	67	567/600.5 (MCS11)	77.16	81.29
Band 2A	5260	52	ax (20MHz)	242	61	135/143.4 (MCS11)	18.93	20.84
	5280	56	ax (20MHz)	242	61	135/143.4 (MCS11)	18.90	21.19
	5320	64	ax (20MHz)	242	61	135/143.4 (MCS11)	18.90	20.84
	5270	54	ax (40MHz)	484	65	271/286.8 (MCS11)	37.95	43.38
	5310	62	ax (40MHz)	484	65	271/286.8 (MCS11)	37.91	41.23
	5290	58	ax (80MHz)	996	67	567/600.5 (MCS11)	77.16	82.05
Band 2C	5500	100	ax (20MHz)	242	61	135/143.4 (MCS11)	18.93	20.87
	5580	116	ax (20MHz)	242	61	135/143.4 (MCS11)	18.88	20.48
	5720	144	ax (20MHz)	242	61	135/143.4 (MCS11)	18.88	20.74
	5510	102	ax (40MHz)	484	65	271/286.8 (MCS11)	37.92	40.89
	5550	110	ax (40MHz)	484	65	271/286.8 (MCS11)	37.90	41.45
	5710	142	ax (40MHz)	484	65	271/286.8 (MCS11)	37.99	41.50
	5530	106	ax (80MHz)	996	67	567/600.5 (MCS11)	77.06	81.97
	5690	138	ax (80MHz)	996	67	567/600.5 (MCS11)	77.25	97.93

Table 7-3. Conducted BW Measurements Antenna 2b (Fully – loaded RU)

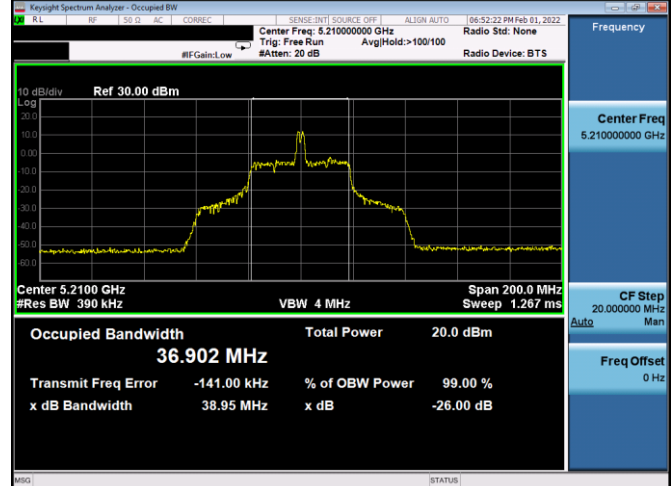
FCC ID: BCGA2589 IC: 579C-A2589		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2111150079-15.BCG	Test Dates: 12/02/2021 - 02/16/2022	EUT Type: Tablet Device	Page 18 of 397



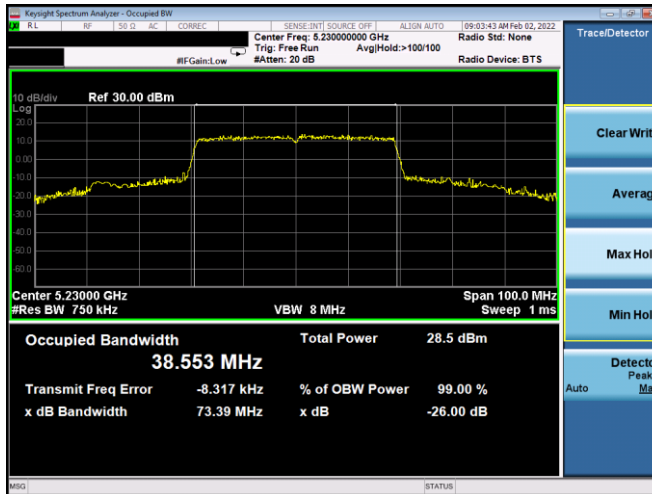
FCC ID: BCGA2589 IC: 579C-A2589		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2111150079-15.BCG	Test Dates: 12/02/2021 - 02/16/2022		Page 19 of 397



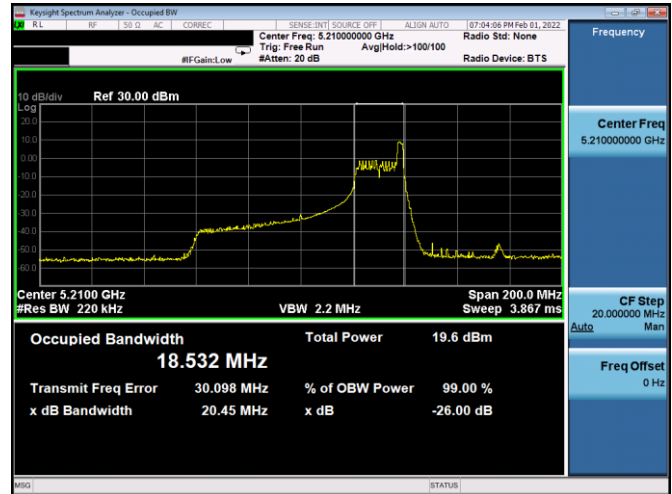
Plot 7-7. 26dB BW & 99% OBW Antenna 2b (40MHz BW 11ax Index 17 – RU26 – Ch.46)



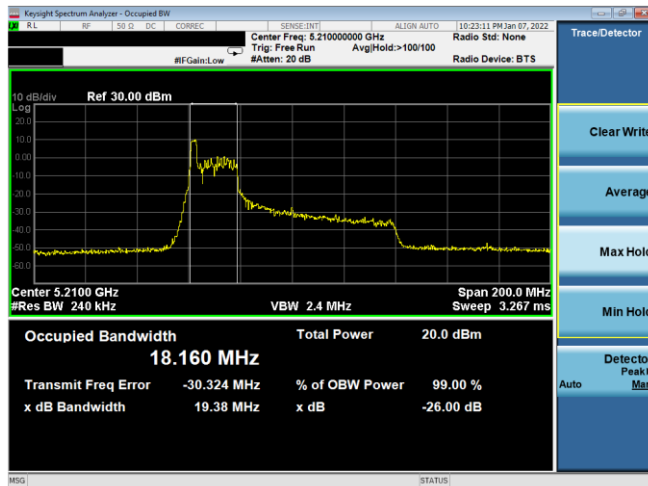
Plot 7-10. 26dB BW & 99% OBW Antenna 2b (80MHz BW 11ax Index 18 – RU26 – Ch.42)



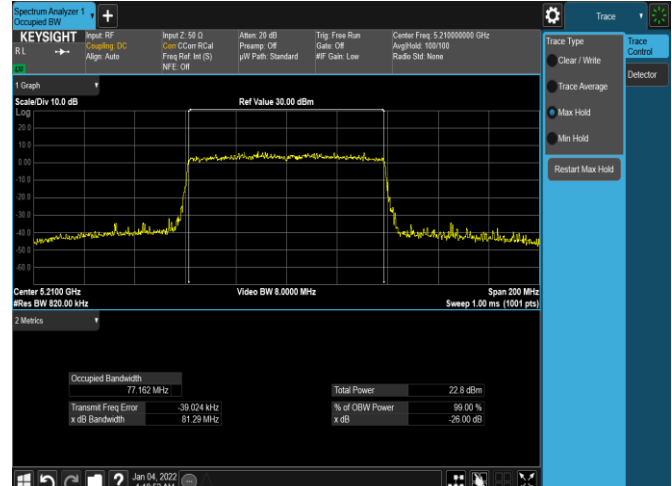
Plot 7-8. 26dB BW & 99% OBW Antenna 2b (40MHz BW 11ax – RU484 – Ch.46)



Plot 7-11. 26dB BW & 99% OBW Antenna 2b (80MHz BW 11ax Index 36 – RU26 – Ch.42)

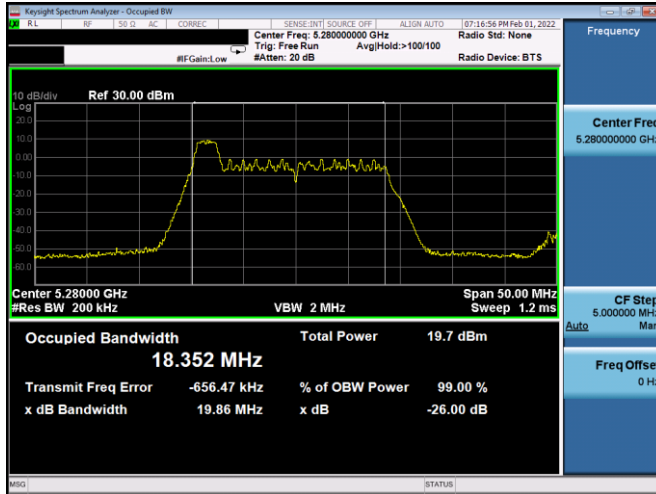


Plot 7-9. 26dB BW & 99% OBW Antenna 2b (80MHz BW 11ax Index 0 – RU26 – Ch.42)

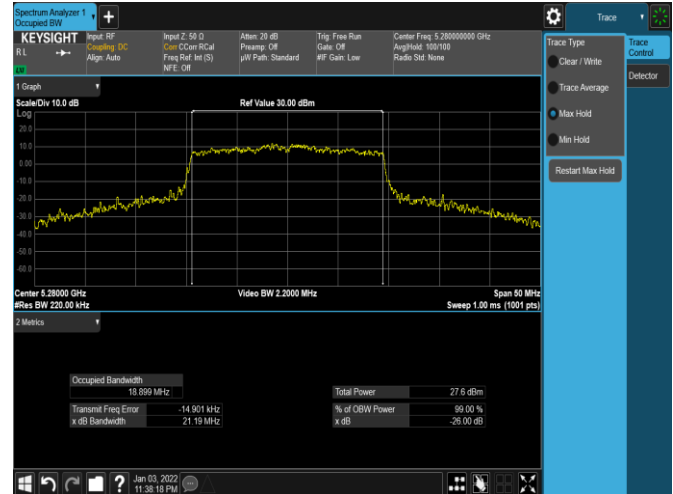


Plot 7-12. 26dB BW & 99% OBW Antenna 2b (80MHz BW 11ax – RU996 – Ch.42)

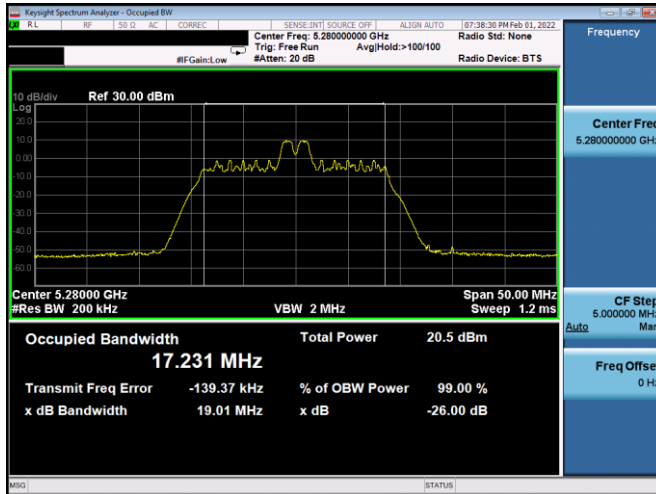
FCC ID: BCGA2589 IC: 579C-A2589		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2111150079-15.BCG	Test Dates: 12/02/2021 - 02/16/2022	EUT Type: Tablet Device	Page 20 of 397



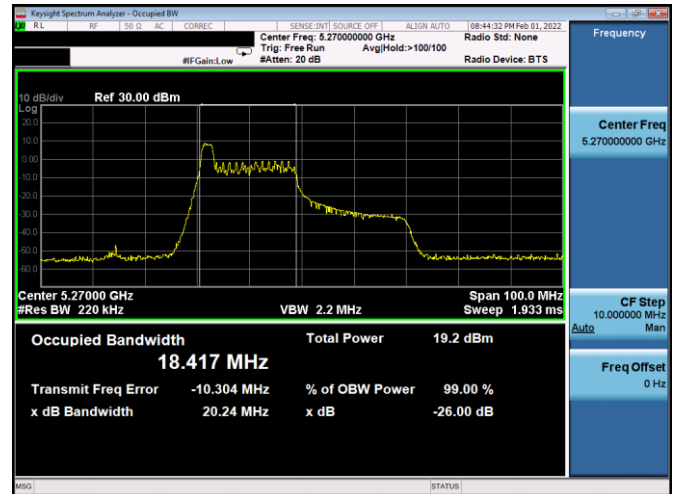
Plot 7-13. 26dB BW & 99% OBW Antenna 2b (20MHz BW 11ax Index 0 – RU26 – Ch.56)



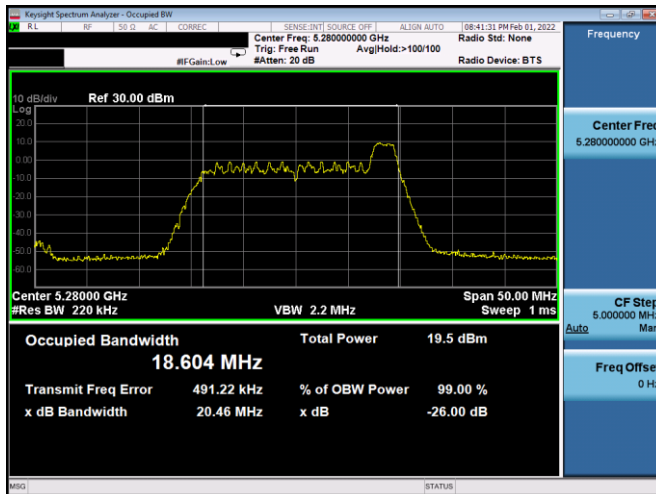
Plot 7-16. 26dB BW & 99% OBW Antenna 2b (20MHz BW 11ax– RU242 – Ch.56)



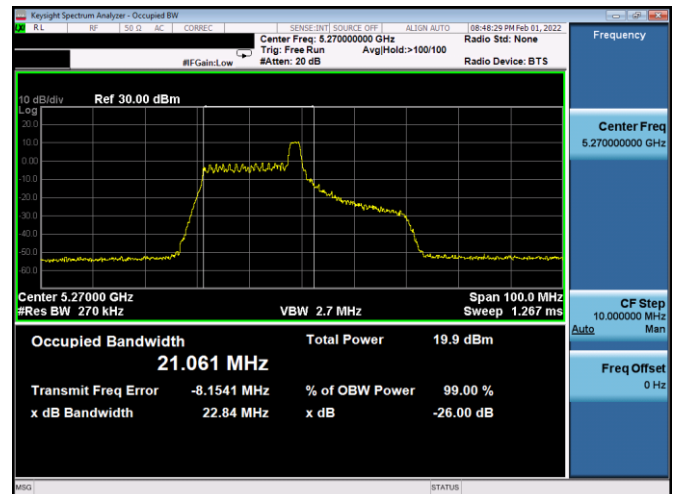
Plot 7-14. 26dB BW & 99% OBW Antenna 2b (20MHz BW 11ax Index 4 – RU26 – Ch.56)



Plot 7-17. 26dB BW & 99% OBW Antenna 2b (40MHz BW 11ax Index 0 – RU26 – Ch.54)

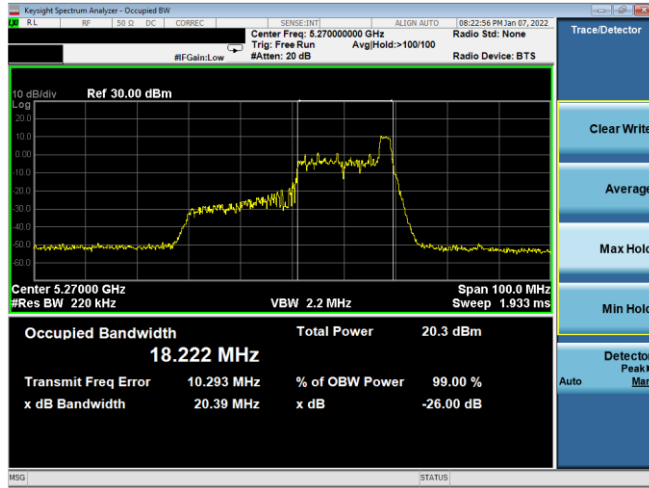


Plot 7-15. 26dB BW & 99% OBW Antenna 2b (20MHz BW 11ax Index 8– RU26 – Ch.56)

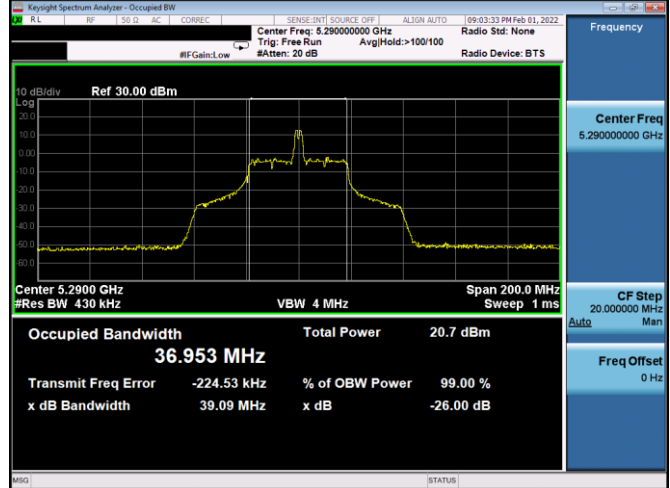


Plot 7-18. 26dB BW & 99% OBW Antenna 2b (40MHz BW 11ax Index 8 – RU26 – Ch.54)

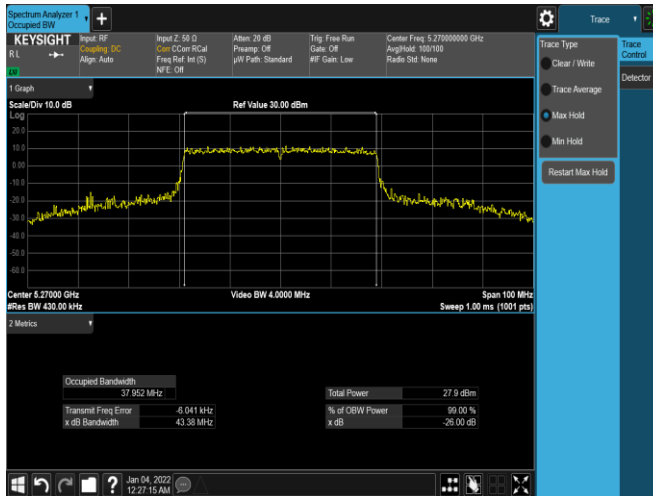
FCC ID: BCGA2589 IC: 579C-A2589		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2111150079-15.BCG	Test Dates: 12/02/2021 - 02/16/2022	EUT Type: Tablet Device	Page 21 of 397



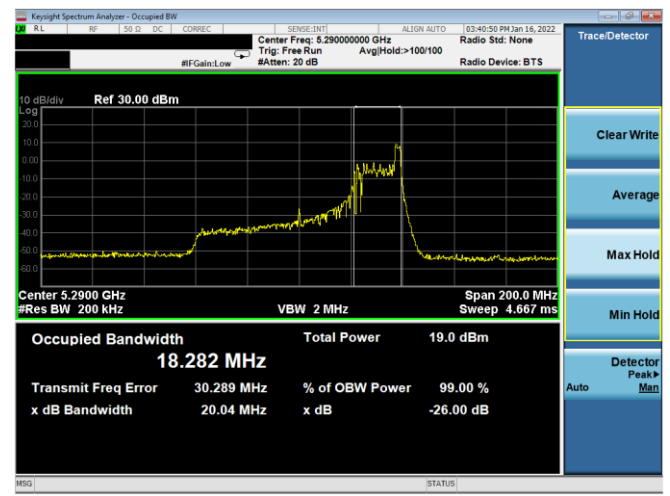
Plot 7-19. 26dB BW & 99% OBW Antenna 2b (40MHz BW 11ax Index 17 – RU26 – Ch.54)



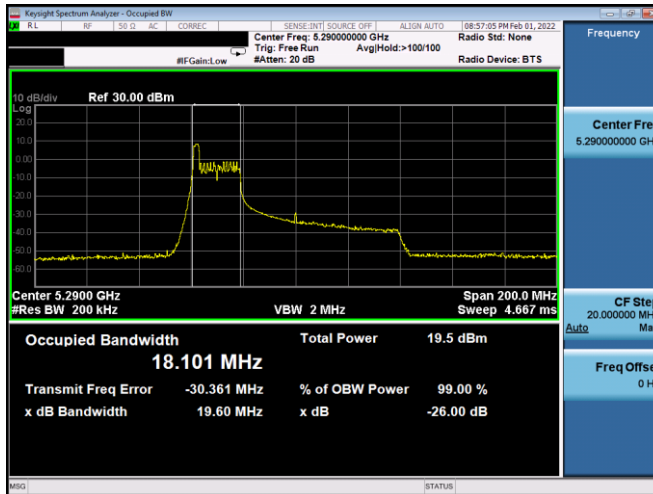
Plot 7-22. 26dB BW & 99% OBW Antenna 2b (80MHz BW 11ax Index 18 – RU26 – Ch.58)



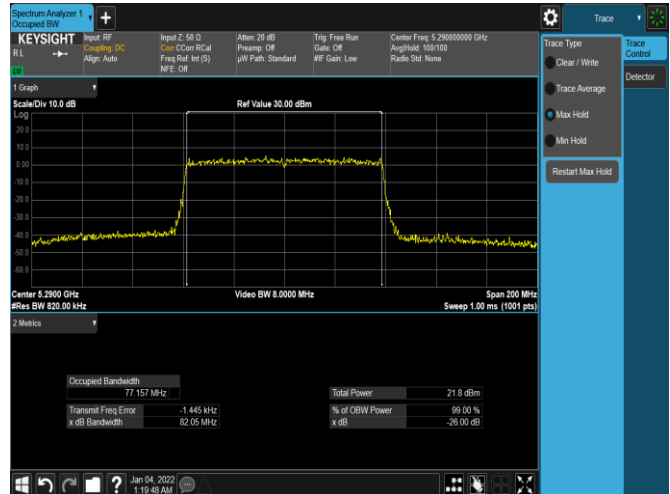
Plot 7-20. 26dB BW & 99% OBW Antenna 2b (40MHz BW 11ax – RU484 – Ch.54)



Plot 7-23. 26dB BW & 99% OBW Antenna 2b (80MHz BW 11ax Index 36 – RU26 – Ch.58)

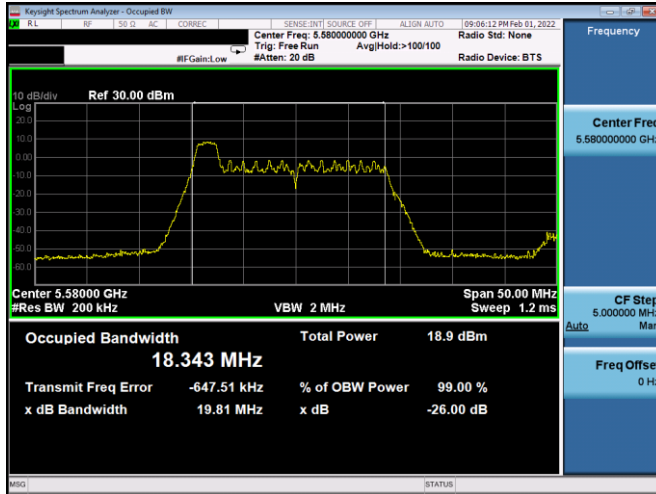


Plot 7-21. 26dB BW & 99% OBW Antenna 2b (80MHz BW 11ax Index 0 – RU26 – Ch.58)



Plot 7-24. 26dB BW & 99% OBW Antenna 2b (80MHz BW 11ax – RU996 – Ch.58)

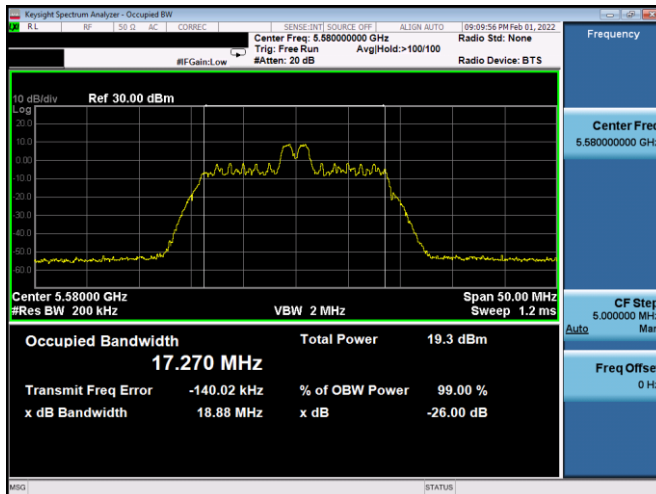
FCC ID: BCGA2589 IC: 579C-A2589		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2111150079-15.BCG	Test Dates: 12/02/2021 - 02/16/2022		Page 22 of 397



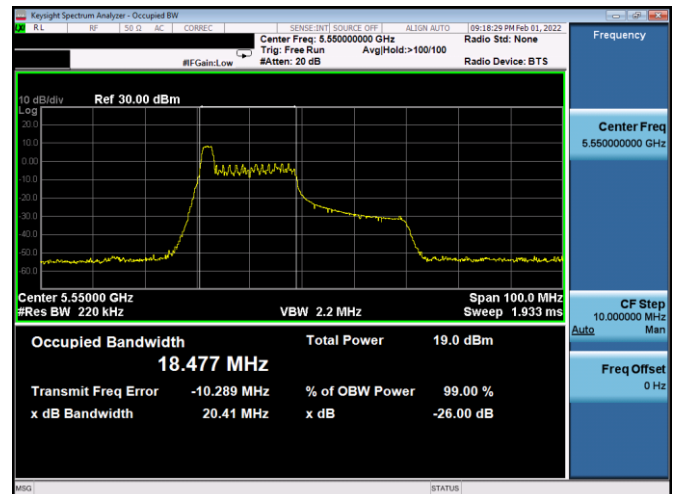
Plot 7-25. 26dB BW & 99% OBW Antenna 2b (20MHz BW 11ax Index 0 – RU26 – Ch.116)



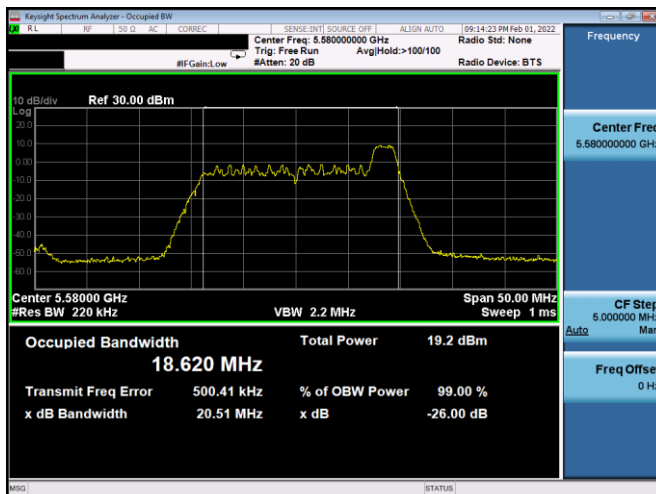
Plot 7-28. 26dB BW & 99% OBW Antenna 2b (20MHz BW 11ax – RU242 – Ch.116)



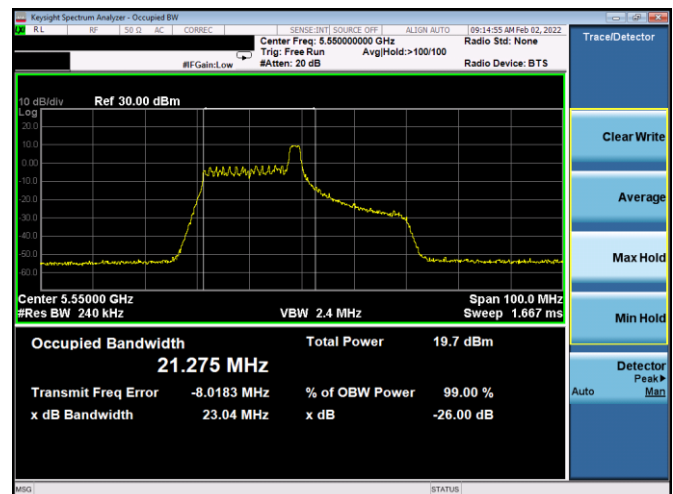
Plot 7-26. 26dB BW & 99% OBW Antenna 2b (20MHz BW 11ax Index 4 – RU26 – Ch.116)



Plot 7-29. 26dB BW & 99% OBW Antenna 2b (40MHz BW 11ax Index 0 – RU26 – Ch.110)

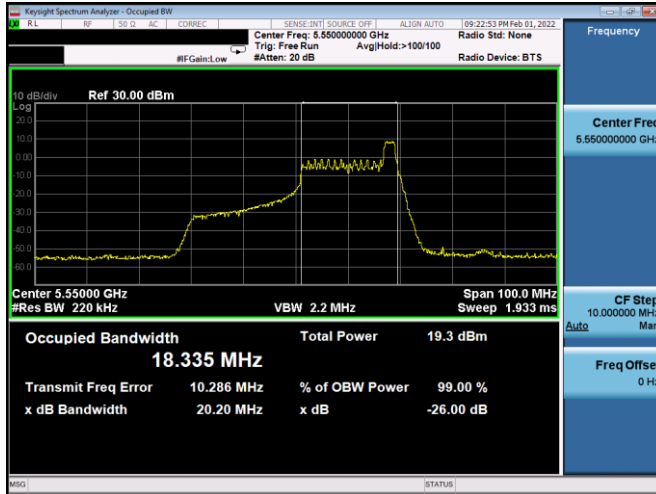


Plot 7-27. 26dB BW & 99% OBW Antenna 2b (20MHz BW 11ax Index 8 – RU26 – Ch.116)

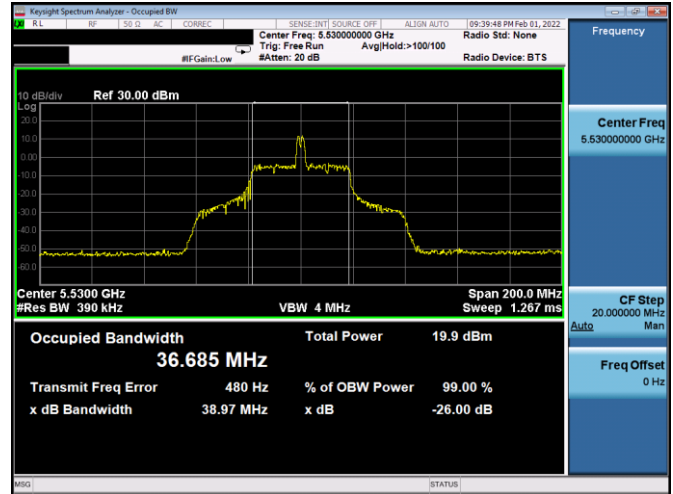


Plot 7-30. 26dB BW & 99% OBW Antenna 2b (40MHz BW 11ax Index 8 – RU26 – Ch.110)

<p>FCC ID: BCGA2589 IC: 579C-A2589</p>	<p>PCTEST Proud to be part of element</p>	<p>MEASUREMENT REPORT (CERTIFICATION)</p>	<p>Approved by: Technical Manager</p>
<p>Test Report S/N: 1C2111150079-15.BCG</p>	<p>Test Dates: 12/02/2021 - 02/16/2022</p>	<p>EUT Type: Tablet Device</p>	<p>Page 23 of 397</p>



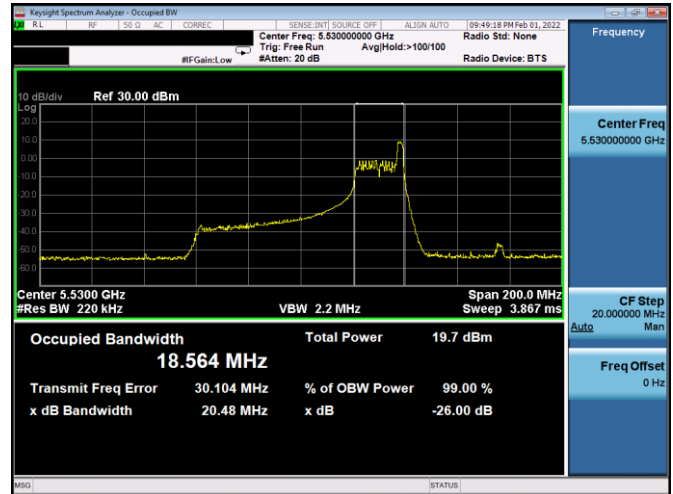
Plot 7-31. 26dB BW & 99% OBW Antenna 2b (40MHz BW 11ax Index 17 – RU26 – Ch.110)



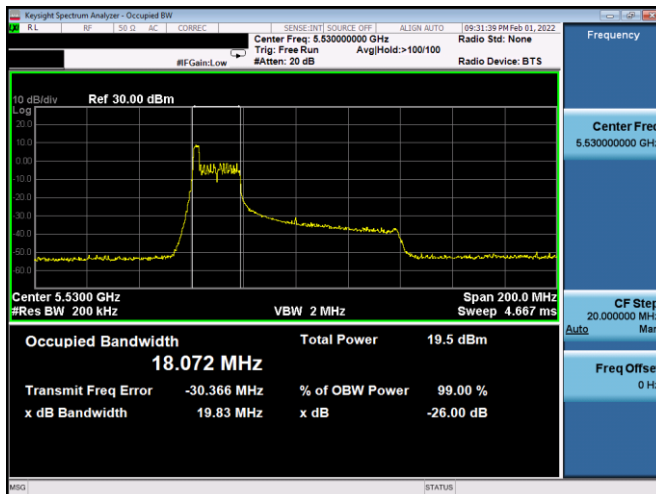
Plot 7-34. 26dB BW & 99% OBW Antenna 2b (80MHz BW 11ax Index 18 – RU26 – Ch.106)



Plot 7-32. 26dB BW & 99% OBW Antenna 2b (40MHz BW 11ax – RU484 – Ch.110)



Plot 7-35. 26dB BW & 99% OBW Antenna 2b (80MHz BW 11ax Index 36 – RU26 – Ch.106)



Plot 7-33. 26dB BW & 99% OBW Antenna 2b (80MHz BW 11ax Index 0 – RU26 – Ch.106)




Plot 7-36. 26dB BW & 99% OBW Antenna 2b (80MHz BW 11ax – RU996 – Ch.106)

<p>FCC ID: BCGA2589 IC: 579C-A2589</p>	<p>PCTEST Proud to be part of element</p>	<p>MEASUREMENT REPORT (CERTIFICATION)</p>	<p>Approved by: Technical Manager</p>
<p>Test Report S/N: 1C2111150079-15.BCG</p>	<p>Test Dates: 12/02/2021 - 02/16/2022</p>	<p>EUT Type: Tablet Device</p>	<p>Page 24 of 397</p>

Antenna 1b 26dB & 99% Bandwidth Measurements


	Frequency [MHz]	Channel No.	802.11 Mode	RU Size	RU Index	Data Rate [Mbps]	Measured 99% Occupied Bandwidth [MHz]	Measured 26dB Bandwidth [MHz]
Band 1	5180	36	ax (20MHz)	26	0	135/143.4 (MCS11)	18.32	19.79
				26	4	135/143.4 (MCS11)	17.22	18.78
				26	8	135/143.4 (MCS11)	18.54	20.47
	5200	40	ax (20MHz)	26	0	135/143.4 (MCS11)	18.35	19.80
				26	4	135/143.4 (MCS11)	17.25	19.18
				26	8	135/143.4 (MCS11)	18.56	20.40
	5240	48	ax (20MHz)	26	0	135/143.4 (MCS11)	18.34	19.75
				26	4	135/143.4 (MCS11)	17.26	18.99
				26	8	135/143.4 (MCS11)	18.61	20.26
	5190	38	ax (40MHz)	26	0	271/286.8 (MCS11)	18.38	20.32
				26	8	271/286.8 (MCS11)	20.42	21.95
				26	17	271/286.8 (MCS11)	18.31	20.00
	5230	46	ax (40MHz)	26	0	271/286.8 (MCS11)	18.28	20.14
				26	8	271/286.8 (MCS11)	21.29	23.29
				26	17	271/286.8 (MCS11)	18.36	19.98
	5210	42	ax (80MHz)	26	0	567/600.5 (MCS11)	18.17	19.60
				26	18	567/600.5 (MCS11)	37.05	38.95
				26	36	567/600.5 (MCS11)	18.42	20.32
Band 2A	5260	52	ax (20MHz)	26	0	135/143.4 (MCS11)	18.32	19.84
				26	4	135/143.4 (MCS11)	17.27	19.08
				26	8	135/143.4 (MCS11)	18.60	20.48
	5280	56	ax (20MHz)	26	0	135/143.4 (MCS11)	18.37	19.87
				26	4	135/143.4 (MCS11)	17.26	18.94
				26	8	135/143.4 (MCS11)	18.60	20.41
	5320	64	ax (20MHz)	26	0	135/143.4 (MCS11)	18.28	19.54
				26	4	135/143.4 (MCS11)	17.26	19.01
				26	8	135/143.4 (MCS11)	18.61	20.41
	5270	54	ax (40MHz)	26	0	271/286.8 (MCS11)	18.27	20.03
				26	8	271/286.8 (MCS11)	20.56	22.40
				26	17	271/286.8 (MCS11)	18.36	20.02
	5310	62	ax (40MHz)	26	0	271/286.8 (MCS11)	18.30	20.13
				26	8	271/286.8 (MCS11)	20.36	22.55
				26	17	271/286.8 (MCS11)	18.33	19.98
	5290	58	ax (80MHz)	26	0	567/600.5 (MCS11)	18.13	19.80
				26	18	567/600.5 (MCS11)	37.09	39.18
				26	36	567/600.5 (MCS11)	18.46	20.51
Band 2C	5500	100	ax (20MHz)	26	0	135/143.4 (MCS11)	18.35	19.82
				26	4	135/143.4 (MCS11)	17.15	18.88
				26	8	135/143.4 (MCS11)	18.46	20.32
	5580	116	ax (20MHz)	26	0	135/143.4 (MCS11)	18.32	19.79
				26	4	135/143.4 (MCS11)	17.22	19.01
				26	8	135/143.4 (MCS11)	18.52	20.30
	5720	144	ax (20MHz)	26	0	135/143.4 (MCS11)	18.37	19.63
				26	4	135/143.4 (MCS11)	17.25	18.94
				26	8	135/143.4 (MCS11)	18.49	19.87
	5510	102	ax (40MHz)	26	0	271/286.8 (MCS11)	18.32	20.15
				26	8	271/286.8 (MCS11)	20.30	22.10
				26	17	271/286.8 (MCS11)	18.36	20.28
	5550	110	ax (40MHz)	26	0	271/286.8 (MCS11)	18.31	20.03
				26	8	271/286.8 (MCS11)	20.51	22.69
				26	17	271/286.8 (MCS11)	18.36	20.16
	5710	142	ax (40MHz)	26	0	271/286.8 (MCS11)	18.32	20.15
				26	8	271/286.8 (MCS11)	20.83	22.82
				26	17	271/286.8 (MCS11)	18.23	19.90
	5530	106	ax (80MHz)	26	0	567/600.5 (MCS11)	18.04	19.39
				26	18	567/600.5 (MCS11)	36.95	38.86
				26	36	567/600.5 (MCS11)	18.50	20.24
	5690	138	ax (80MHz)	26	0	567/600.5 (MCS11)	18.11	19.62
				26	18	567/600.5 (MCS11)	37.12	39.17
				26	36	567/600.5 (MCS11)	18.62	20.24

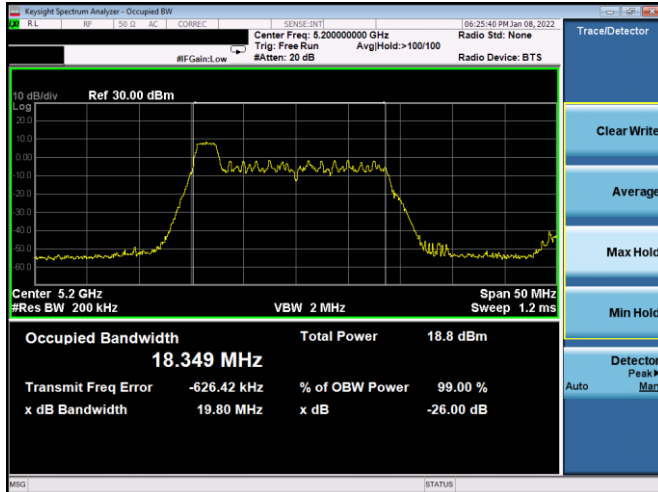
Table 7-4. Conducted Bandwidth Measurements Antenna 1b (RU26)

FCC ID: BCGA2589 IC: 579C-A2589		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2111150079-15.BCG	Test Dates: 12/02/2021 - 02/16/2022	EUT Type: Tablet Device	Page 25 of 397

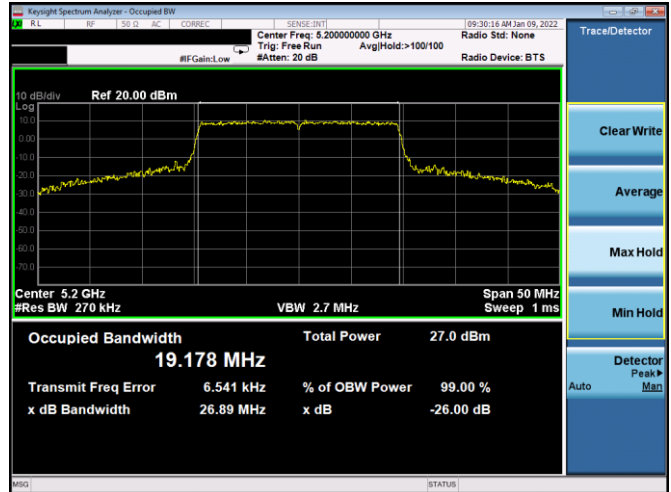
	Frequency [MHz]	Channel No.	802.11 Mode	RU Size	RU Index	Data Rate [Mbps]	Measured 99% Occupied Bandwidth [MHz]	Measured 26dB Bandwidth [MHz]
Band 1	5180	36	ax (20MHz)	242	61	135/143.4 (MCS11)	19.07	21.32
	5200	40	ax (20MHz)	242	61	135/143.4 (MCS11)	19.18	26.89
	5240	48	ax (20MHz)	242	61	135/143.4 (MCS11)	19.12	27.91
	5190	38	ax (40MHz)	484	65	271/286.8 (MCS11)	37.90	41.85
	5230	46	ax (40MHz)	484	65	271/286.8 (MCS11)	38.30	60.74
	5210	42	ax (80MHz)	996	67	567/600.5 (MCS11)	77.17	81.86
Band 2A	5260	52	ax (20MHz)	242	61	135/143.4 (MCS11)	19.15	26.41
	5280	56	ax (20MHz)	242	61	135/143.4 (MCS11)	19.13	27.29
	5320	64	ax (20MHz)	242	61	135/143.4 (MCS11)	19.03	21.22
	5270	54	ax (40MHz)	484	65	271/286.8 (MCS11)	38.07	43.08
	5310	62	ax (40MHz)	484	65	271/286.8 (MCS11)	38.01	42.00
	5290	58	ax (80MHz)	996	67	567/600.5 (MCS11)	77.14	81.87
Band 2C	5500	100	ax (20MHz)	242	61	135/143.4 (MCS11)	19.02	21.24
	5580	116	ax (20MHz)	242	61	135/143.4 (MCS11)	19.11	22.57
	5720	144	ax (20MHz)	242	61	135/143.4 (MCS11)	19.04	22.56
	5510	102	ax (40MHz)	484	65	271/286.8 (MCS11)	37.91	41.70
	5550	110	ax (40MHz)	484	65	271/286.8 (MCS11)	37.96	41.41
	5710	142	ax (40MHz)	484	65	271/286.8 (MCS11)	38.03	43.24
	5530	106	ax (80MHz)	996	67	567/600.5 (MCS11)	77.30	81.80
	5690	138	ax (80MHz)	996	67	567/600.5 (MCS11)	77.30	82.13

Table 7-5. Conducted Bandwidth Measurements Antenna 1b (Fully- loaded RU)

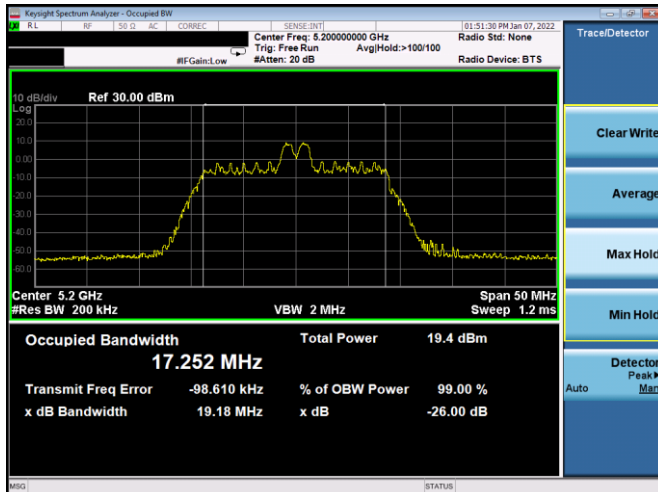
FCC ID: BCGA2589 IC: 579C-A2589		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2111150079-15.BCG	Test Dates: 12/02/2021 - 02/16/2022	EUT Type: Tablet Device	Page 26 of 397



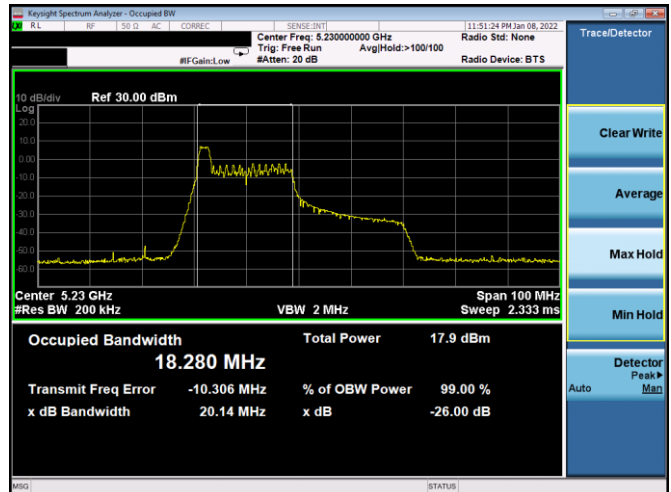
Plot 7-37. 26dB BW & 99% OBW Antenna 1b (20MHz BW 11ax Index 0 – RU26 – Ch.40)



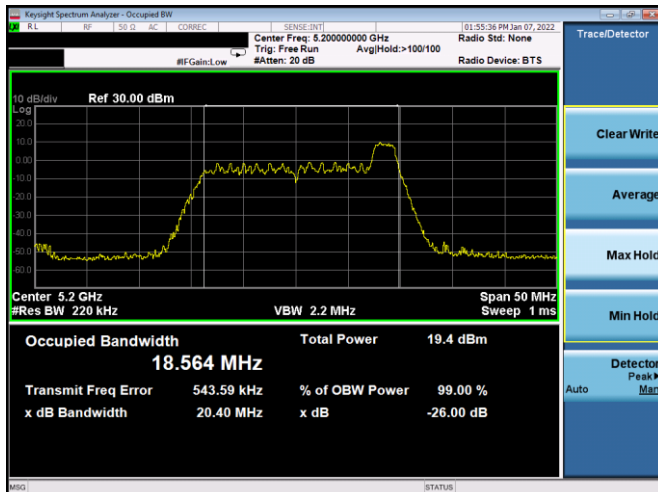
Plot 7-40. 26dB BW & 99% OBW Antenna 1b (20MHz BW 11ax– RU242 – Ch.40)



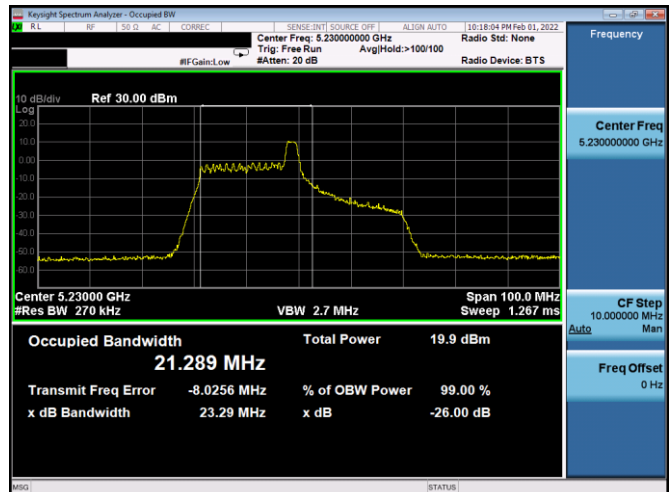
Plot 7-38. 26dB BW & 99% OBW Antenna 1b (20MHz BW 11ax Index 4 – RU26 – Ch.40)



Plot 7-41. 26dB BW & 99% OBW Antenna 1b (40MHz BW 11ax Index 0 – RU26 – Ch.46)

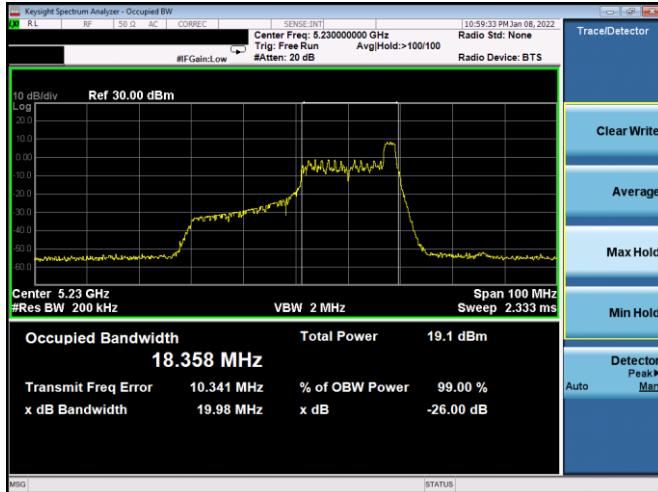


Plot 7-39. 26dB BW & 99% OBW Antenna 1b (20MHz BW 11ax Index 8– RU26 – Ch.40)

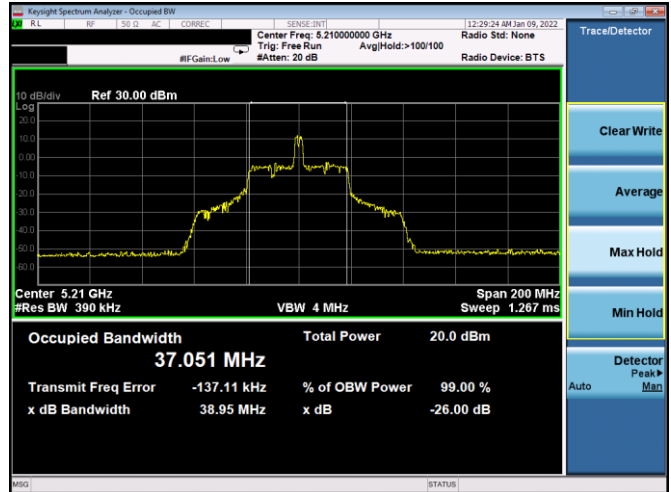


Plot 7-42. 26dB BW & 99% OBW Antenna 1b (40MHz BW 11ax Index 8 – RU26 – Ch.46)

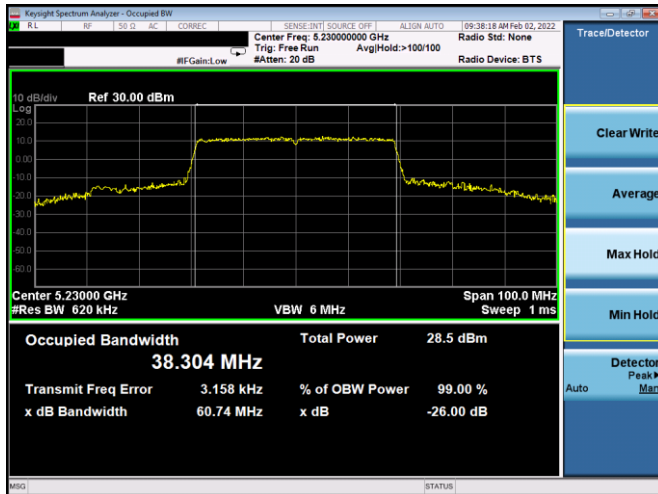
FCC ID: BCGA2589 IC: 579C-A2589		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2111150079-15.BCG	Test Dates: 12/02/2021 - 02/16/2022	EUT Type: Tablet Device	Page 27 of 397



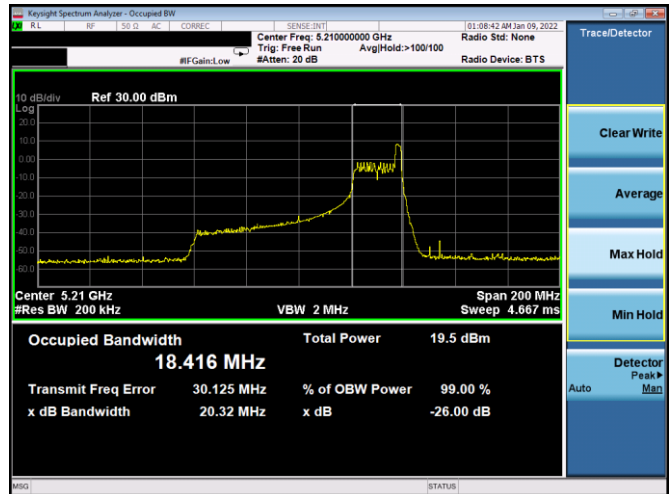
Plot 7-43. 26dB BW & 99% OBW Antenna 1b (40MHz BW 11ax Index 17 – RU26 – Ch.46)



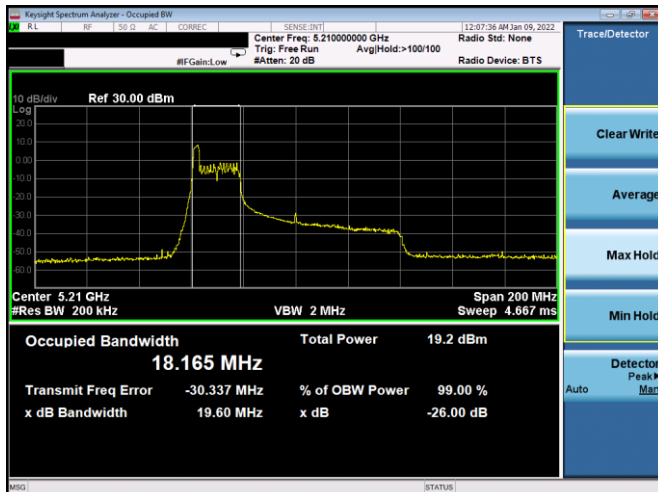
Plot 7-46. 26dB BW & 99% OBW Antenna 1b (80MHz BW 11ax Index 18 – RU26 – Ch.42)



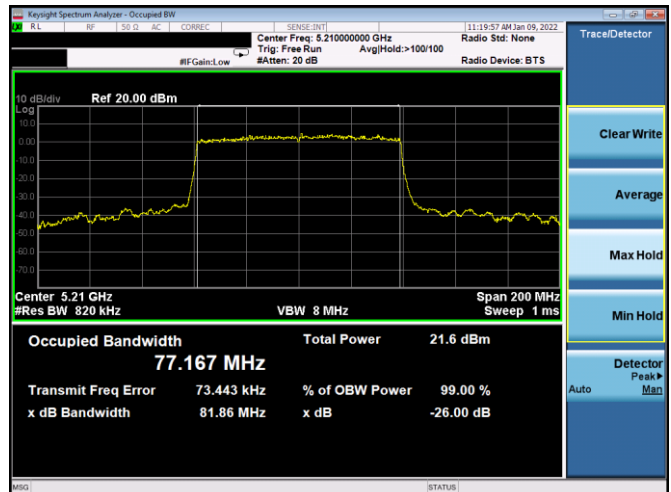
Plot 7-44. 26dB BW & 99% OBW Antenna 1b (40MHz BW 11ax – RU484 – Ch.46)



Plot 7-47. 26dB BW & 99% OBW Antenna 1b (80MHz BW 11ax Index 36 – RU26 – Ch.42)

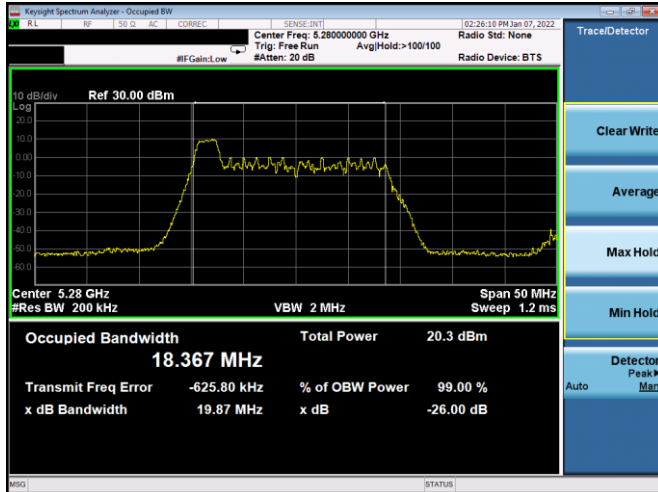


Plot 7-45. 26dB BW & 99% OBW Antenna 1b (80MHz BW 11ax Index 0 – RU26 – Ch.42)

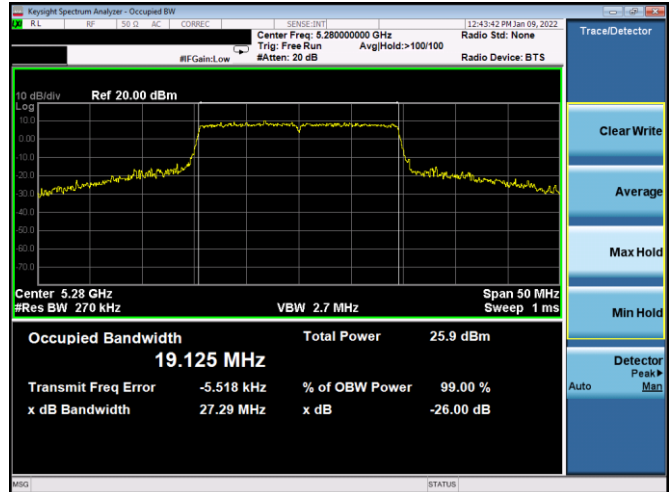


Plot 7-48. 26dB BW & 99% OBW Antenna 1b (80MHz BW 11ax – RU996 – Ch.42)

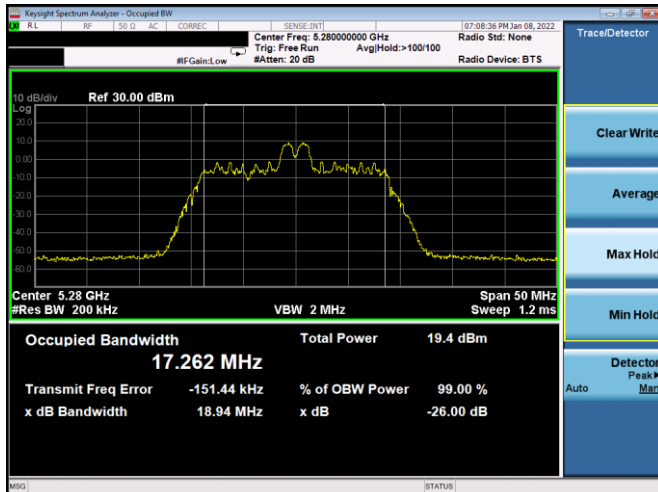
FCC ID: BCGA2589 IC: 579C-A2589	PCTEST Proud to be part of element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2111150079-15.BCG	Test Dates: 12/02/2021 - 02/16/2022	EUT Type: Tablet Device	Page 28 of 397



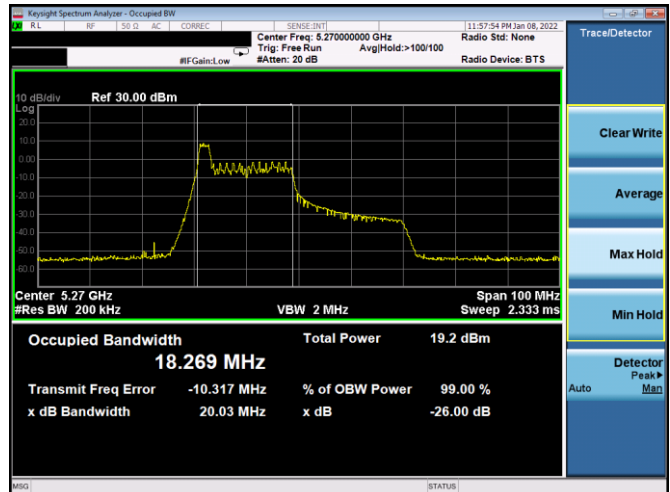
Plot 7-49. 26dB BW & 99% OBW Antenna 1b (20MHz BW 11ax Index 0 – RU26 – Ch.56)



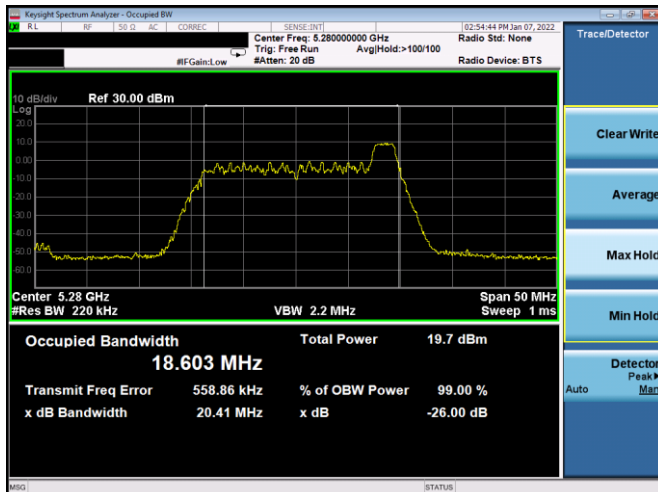
Plot 7-52. 26dB BW & 99% OBW Antenna 1b (20MHz BW 11ax– RU242 – Ch.56)



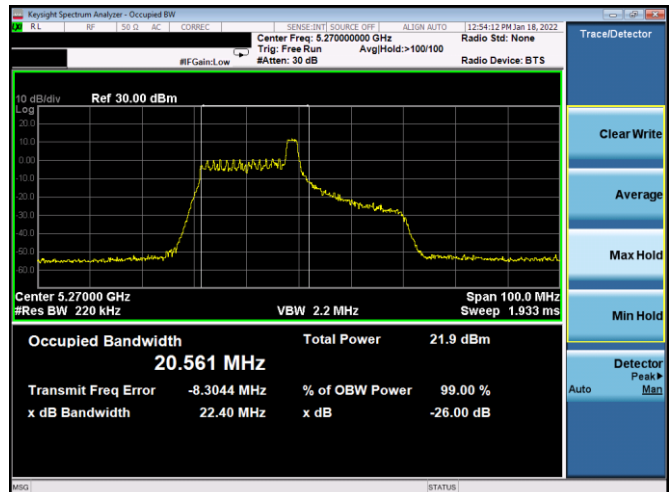
Plot 7-50. 26dB BW & 99% OBW Antenna 1b (20MHz BW 11ax Index 4 – RU26 – Ch.56)



Plot 7-53. 26dB BW & 99% OBW Antenna 1b (40MHz BW 11ax Index 0 – RU26 – Ch.54)



Plot 7-51. 26dB BW & 99% OBW Antenna 1b (20MHz BW 11ax Index 8– RU26 – Ch.56)



Plot 7-54. 26dB BW & 99% OBW Antenna 1b (40MHz BW 11ax Index 8 – RU26 – Ch.54)

FCC ID: BCGA2589 IC: 579C-A2589	PCTEST Proud to be part of element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2111150079-15.BCG	Test Dates: 12/02/2021 - 02/16/2022	EUT Type: Tablet Device	Page 29 of 397