



**DATA REFERENCE REPORT**  
**PART 27**

**Applicant Name:**

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

**Date of Testing:**

6/7/2021 - 7/30/2021

**Test Site/Location:**

PCTEST Lab. Morgan Hill, CA, USA

**Test Report Serial No.:**

1C2106080052-04.BCG

<b>FCC ID:</b>	<b>BCGA2604</b>
<b>Applicant Name:</b>	<b>Apple Inc.</b>

**Reference Model:** A2603

**Variant Model:** A2604(A2605)

**EUT Type:** Tablet Device

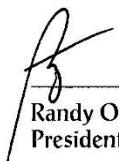
**FCC Classification:** PCS Licensed Transmitter (PCB)

**FCC Rule Part:** 27

**Test Procedure(s):** ANSI C63.26-2015, TIA-603-E-2016, KDB 971168 D01 v03r01

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 §2.947. 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: BCGA2604	<b>PCTEST</b> <small>Proud to be part of element</small>		<b>PART 27 DATA REFERENCE REPORT</b>	Approved by: Quality Manager
<b>Test Report S/N:</b> 1C2106080052-04.BCG	<b>Test Dates:</b> 6/7/2021 - 7/30/2021	<b>EUT Type:</b> Tablet Device		Page 1 of 13

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## 1.0 INTRODUCTION

### 1.1 Scope

Per manufacturer declaration, there are two tablet device models, A2603 and A2604(A2605), with high degree of similarity, reference model FCC ID: BCGA2603 and variant model **FCC ID: BCGA2604**. The reference model supports LTE Band 71, while the variant model replaces LTE Band 71 with LTE Band 28 components. 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 approved Data Referencing Test Plan, testing was done fully on the reference model FCC ID: BCGA2603, while radiated spot-check verification has been performed on variant model **FCC ID: BCGA2604**. Spot-check measurements were conducted, all measurements were investigated and found to be within acceptable tolerance.

Equipment Class	Reference Model FCC ID	Reference Report	Report Title
PCB	BCGA2603	1C2106080051-04.BCG	RF Part 27b Test Report

**Table 1-1. Reference Model Details**

Reference model FCC ID: BCGA2603 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

- 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:BCGA2604**. The test data contained in this report pertains only to the emissions due to the EUT's licensed transmitters that operate under the provisions of Part 27.

**Test Device Serial No.:** W2162DHGJW, PRFPL4023V

### 2.2 Device Capabilities

This device contains the following capabilities:

WCDMA/HSPA, Multi-Band LTE, 802.11b/g/n WLAN, 802.11a/n/ac UNII, BT (1x, EDR, LE)

### 2.3 Antenna Description

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

Frequency [MHz]	Antennas	
	Antenna C	Antenna D
2300-2320	1.4	1.7
2400-2700	1.7	2.0

**Table 2-1. Highest Antenna Gain**

### 2.4 Test Support Equipment

1	Apple MacBook w/AC/DC Adapter	Model: A2141	S/N: C02DV7VKMD6T	
2	Apple Cable	Model: Kanzi	S/N: 32530F	
3	Apple USB-C to Lightning Cable w/ AC/DC Adapter	Model: N/A	S/N: N/A	
4	DC Power Supply	Model: KPS3010D	S/N: N/A	

**Table 2-2. Test Support Equipment**

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## 2.5 Test Configuration

The EUT was tested per the guidance of ANSI C63.26 2015, TIA-603-E-2016 and KDB 971168 D01 v03r01. See Section 7.0 of this test report for a description of the radiated emissions tests.

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 Approved Data Referencing Test Plan, Antenna C spot-check measurements have been conducted and reported. Spot-check Test Plan can be referred to below Table 2-3.

Technology	Test Case	FCC ID: BCGA2604	
		Mode	Channel
WCDMA, LTE	Radiated Spurious Emissions	Antenna C LTE Band 5, 2, 7 Max BW, 1RB, QPSK	M

**Table 2-3. FCC 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 19A32670z installed on the EUT.

## 2.7 EMI Suppression Device(s)/Modifications

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

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## 3.0 DESCRIPTION OF TESTS

### 3.1 Measurement Procedure

The measurement procedures described in the document titled “Land Mobile FM or PM – Communications Equipment – Measurements and Performance Standards” (ANSI C63.26-2015/TIA-603-E-2016) and “Procedures for Compliance Measurement of the Fundamental Emission Power of Licensed Wideband (> 1 MHz) Digital Transmission Systems” (KDB 971168 D01 v03r01) were used in the measurement of the EUT.

### 3.2 Radiated Spurious 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. For measurements below 1GHz, the absorbers are removed. A raised turntable is used for radiated measurement. The turn table is a continuously rotatable, remote-controlled, metallic turntable and 2 meters (6.56 ft.) in diameter. The turn table is flush with the raised floor of the chamber in order to maintain its function as a ground plane. An 80cm tall test table made of Styrodur is placed on top of the turn table. A Styrodur pedestal is placed on top of the test table to bring the total table height to 1.5m.

The equipment under test was transmitting while connected to its integral antenna and is placed on a turntable 3 meters from the receive antenna. The receive antenna height is adjusted between 1 and 4 meter height, the turntable is rotated through 360 degrees, and the EUT is manipulated through all orthogonal planes representative of its typical use to achieve the highest reading on the receive spectrum analyzer.

For radiated spurious emissions measurements and calculations, conversion method is used per the formulas in KDB 971168 Section 5.8.4. Field Strength (EIRP) is calculated using the following formulas:

$$E_{[\text{dB}\mu\text{V}/\text{m}]} = \text{Measured amplitude level}_{[\text{dBm}]} + 107 + \text{Cable Loss}_{[\text{dB}]} + \text{Antenna Factor}_{[\text{dB}/\text{m}]}$$

And

$$\text{EIRP}_{[\text{dBm}]} = E_{[\text{dB}\mu\text{V}/\text{m}]} + 20\log D - 104.8;$$

Where D is the measurement distance in meters.

All radiated measurements are performed in a chamber that meets the site requirements per ANSI C63.4-2014.

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.

Radiated spurious emission levels are investigated with the receive antenna horizontally and vertically polarized per ANSI C63.26 and TIA-603-E-2016.

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## 4.0 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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## 5.0 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
ATM	180-442A-KF	20dB Nominal Gain Horn Antenna	12/1/2020	Annual	12/1/2021	T058701-02
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)	11/4/2020	Annual	11/4/2021	227597
ESPEC	SU-241	Tabletop Temperature Chamber	9/28/2020	Annual	9/28/2021	92009574
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)	11/4/2020	Annual	11/4/2021	227597
Keysight Technology	N9040B	UXA Signal Analyzer	12/19/2020	Annual	12/19/2021	MY57212015
Rohde & Schwarz	TS-PR8	Pre-Amplifier (30MHz - 8GHz)	12/3/2020	Annual	12/3/2021	102327
Rohde & Schwarz	TS-PR18	Pre-Amplifier (1GHz - 18GHz)	12/3/2020	Annual	12/3/2021	101648
Rohde & Schwarz	FSV40	Signal Analyzer (10Hz-40GHz)	3/16/2021	Annual	3/16/2022	101619
Rohde & Schwarz	ESW26	EMI Test Receiver	6/11/2021	Annual	6/11/2022	101299
Rohde & Schwarz	ESW44	EMI Test Receiver	12/14/2020	Annual	12/14/2021	101867
Rohde & Schwarz	CMW500	Wideband Radio Communication Tester	10/13/2020	Annual	10/13/2021	161616
Rohde & Schwarz	CMW500	Wideband Radio Communication Tester	9/24/2020	Annual	9/24/2021	151888
Rohde & Schwarz	TS-PR1840	Pre-Amplifier (18GHz - 40GHz)	4/29/2021	Annual	4/29/2022	100051
Rohde & Schwarz	TC-TA18	Cross Polarized Vivaldi Antenna (400MHz-18GHz)	10/2/2020	Annual	10/2/2021	101063
Rohde & Schwarz	HFH2-Z2	Loop Antenna	4/5/2021	Annual	4/5/2022	100519

**Table 5-1. Test Equipment**

**Notes:**

1. 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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## 6.0 SAMPLE CALCULATIONS

### Spurious Radiated Emission

#### **Example: Spurious emission at 3700.40 MHz**

The receive spectrum analyzer reading at 3 meters with the EUT on the turntable was  $-81.0$  dBm. The gain of the substituted antenna is  $8.1$  dBi. The signal generator connected to the substituted antenna terminals is adjusted to produce a reading of  $-81.0$  dBm on the spectrum analyzer. The loss of the cable between the signal generator and the terminals of the substituted antenna is  $2.0$  dB at  $3700.40$  MHz. So  $6.1$  dB is added to the signal generator reading of  $-30.9$  dBm yielding  $-24.80$  dBm. The fundamental EIRP was  $25.50$  dBm so this harmonic was  $25.50$  dBm  $- (-24.80) = 50.3$  dBc.

FCC ID: BCGA2604	 <b>PCTEST</b> Proud to be part of 			PART 27 DATA REFERENCE REPORT	Approved by: Quality Manager
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## 7.0 TEST RESULTS (SPOT-CHECK DATA)

### 7.1 Summary

Company Name: Apple Inc.  
 FCC ID: BCGA2604  
 FCC Classification: PCS Licensed Transmitter (PCB)  
 Mode(s): LTE

Technology	Test Configurations					Reference Model	Variant model	Delta
	Test Description	Modulation	BW / RB Config	Channel	Measurement Frequency [MHz]	FCC ID: BCGA2603	FCC ID: BCGA2604	
						Average [dBm]	Average [dBm]	
LTE Band 7	Radiated Spurious Emissions	QPSK	20MHz / 1/50 RB	M	10140.00	-58.25	-57.04	1.21

Table 7-1. Worst Case Spot-Check Results

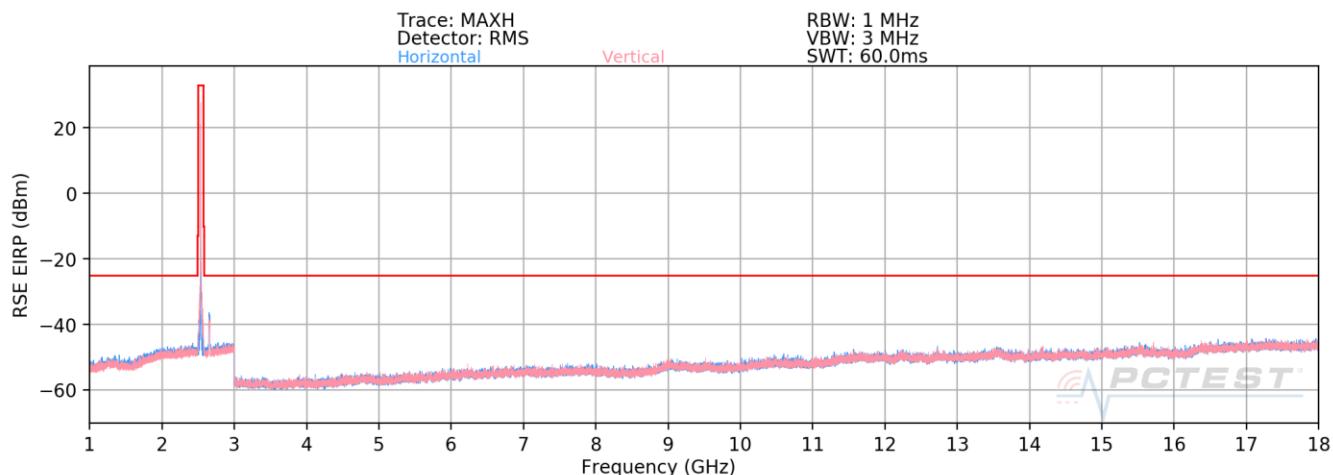
Spot-checks were conducted, all measurements were investigated and found to be within acceptable tolerance in accordance with FCC Approved Data Referencing Test Plan.

FCC ID: BCGA2604	PART 27 DATA REFERENCE REPORT			Approved by: Quality Manager
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## 7.2 Radiated Spurious Emissions

§2.1053, 27.53(a), §2.1053, 27.53(m)

### LTE Band 7



**Plot 7-1. Radiated Spurious Emission above 1GHz (LTE Band 7)**

Bandwidth (MHz):	20
Frequency (MHz):	2535.0
RB / Offset:	1 / 50

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dB $\mu$ V/m]	EIRP Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
5070.0	V	-	-	-79.66	5.49	32.83	-62.42	-25.00	-37.42
7605.0	V	-	-	-79.89	8.97	36.08	-59.18	-25.00	-34.18
10140.0	V	-	-	-80.94	12.15	38.21	-57.04	-25.00	-32.04

**Table 7-2. Radiated Spurious Data (LTE Band 7 – Mid Channel)**

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## 8.0 CONCLUSION

The spot-check data measured for variant model **FCC ID: BCGA2604** is in tolerance with reference model FCC ID: BCGA2603 per FCC Approved Data Referencing Test Plan.

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## 9.0 APPENDIX A: REFERENCE MODEL TEST REPORT

Attached is the test report (1C2106080051-04.BCG) from reference model FCC ID: BCGA2603, which includes referenced data results.

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## PART 27 MEASUREMENT REPORT

**Applicant Name:**

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

**Date of Testing:**

6/7/2021 - 7/30/2021

**Test Site/Location:**

PCTEST Morgan Hill, CA, USA

**Test Report Serial No.:**

1C2106080051-04.BCG

**FCC ID:**
**BCGA2603**
**Applicant Name:**
**Apple Inc.**
**Application Type:**

Certification

**Model:**

A2603

**EUT Type:**

Tablet Device

**FCC Classification:**

PCS Licensed Transmitter (PCB)

**FCC Rule Part:**

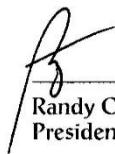
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**Test Procedure(s):**

 ANSI C63.26-2015, TIA-603-E-2016, KDB 971168 D01  
 v03r01

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 §2.947. 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

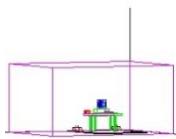


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Mode	Bandwidth	Modulation	Tx Frequency Range [MHz]	OBW [MHz]	EIRP		Emission Designator
					Max. Power [W]	Max. Power [dBm]	
LTE Band 30	5 MHz	QPSK	2307.5 - 2312.5	4.5559	0.209	23.20	4M56G7W
		16QAM	2307.5 - 2312.5	4.5497	0.185	22.67	4M55D7W
		64QAM	2307.5 - 2312.5	4.5586	0.151	21.80	4M56D7W
	10MHz	QPSK	2310.0	9.0239	0.209	23.20	9M02G7W
		16QAM	2310.0	9.0338	0.192	22.83	9M03D7W
		64QAM	2310.0	9.0016	0.148	21.69	9M00D7W
LTE Band 7	5 MHz	QPSK	2502.5 - 2567.5	4.5541	0.519	27.15	4M55G7W
		16QAM	2502.5 - 2567.5	4.5330	0.446	26.49	4M53D7W
		64QAM	2502.5 - 2567.5	4.5525	0.360	25.56	4M55D7W
	10 MHz	QPSK	2505.0 - 2565.0	9.0575	0.504	27.02	9M06G7W
		16QAM	2505.0 - 2565.0	9.0203	0.446	26.49	9M02D7W
		64QAM	2505.0 - 2565.0	9.0525	0.341	25.33	9M05D7W
	15 MHz	QPSK	2507.5 - 2562.5	13.6280	0.525	27.20	13M6G7W
		16QAM	2507.5 - 2562.5	13.6500	0.443	26.46	13M7D7W
		64QAM	2507.5 - 2562.5	13.5723	0.351	25.45	13M6D7W
	20 MHz	QPSK	2510.0 - 2560.0	18.0867	0.502	27.01	18M1G7W
		16QAM	2510.0 - 2560.0	18.0714	0.433	26.36	18M1D7W
		64QAM	2510.0 - 2560.0	18.0422	0.353	25.48	18M0D7W
LTE Band 41 (PC2)	5 MHz	QPSK	2498.5 - 2687.5	4.5589	0.708	28.50	4M56G7W
		16QAM	2498.5 - 2687.5	4.5933	0.658	28.18	4M59D7W
		64QAM	2498.5 - 2687.5	4.6223	0.530	27.24	4M62D7W
	10 MHz	QPSK	2501.0 - 2685.0	9.1830	0.738	28.68	9M18G7W
		16QAM	2501.0 - 2685.0	9.1836	0.661	28.20	9M18D7W
		64QAM	2501.0 - 2685.0	9.1481	0.543	27.35	9M15D7W
	15 MHz	QPSK	2503.5 - 2682.5	13.9410	0.740	28.69	13M9G7W
		16QAM	2503.5 - 2682.5	13.8282	0.640	28.06	13M8D7W
		64QAM	2503.5 - 2682.5	13.8332	0.526	27.21	13M8D7W
	20 MHz	QPSK	2506.0 - 2680.0	18.3084	0.733	28.65	18M3G7W
		16QAM	2506.0 - 2680.0	18.2122	0.632	28.01	18M2D7W
		64QAM	2506.0 - 2680.0	18.2739	0.543	27.35	18M3D7W
LTE Band 41(PC3)	5 MHz	QPSK	2498.5 - 2687.5	4.5589	0.493	26.93	4M56G7W
		16QAM	2498.5 - 2687.5	4.5933	0.414	26.17	4M59D7W
		64QAM	2498.5 - 2687.5	4.6223	0.356	25.51	4M62D7W
	10 MHz	QPSK	2501.0 - 2685.0	9.1830	0.521	27.17	9M18G7W
		16QAM	2501.0 - 2685.0	9.1836	0.414	26.17	9M18D7W
		64QAM	2501.0 - 2685.0	9.1481	0.331	25.20	9M15D7W
	15 MHz	QPSK	2503.5 - 2682.5	13.9410	0.525	27.20	13M9G7W
		16QAM	2503.5 - 2682.5	13.8282	0.403	26.05	13M8D7W
		64QAM	2503.5 - 2682.5	13.8332	0.333	25.23	13M8D7W
	20 MHz	QPSK	2506.0 - 2680.0	18.3084	0.525	27.20	18M3G7W
		16QAM	2506.0 - 2680.0	18.2122	0.423	26.26	18M2D7W
		64QAM	2506.0 - 2680.0	18.2739	0.337	25.28	18M3D7W
ULCA LTE Band 7	20 + 20 MHz	QPSK	2510.0 - 2560.0	37.8190	0.468	26.70	37M8G7W
		16QAM	2510.0 - 2560.0	37.6360	0.234	23.70	37M6D7W
		64QAM	2510.0 - 2560.0	37.7380	0.229	23.60	37M7D7W
ULCA LTE Band 41	20 + 20 MHz	QPSK	2506.0 - 2680.0	38.1010	0.468	26.70	38M1G7W
		16QAM	2506.0 - 2680.0	37.9450	0.306	24.86	37M9D7W
		64QAM	2506.0 - 2680.0	37.9070	0.301	24.79	37M9D7W

**Overview Table**

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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 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:BCGA2603**. The test data contained in this report pertains only to the emissions due to the EUT's licensed transmitters that operate under the provisions of Part 27.

**Test Device Serial No.:** QCQ16N0YCW, VCXH667WN9, F9F11660HE012891K

### 2.2 Device Capabilities

This device contains the following capabilities:

WCDMA/HSPA, Multi-Band LTE, 802.11b/g/n WLAN, 802.11a/n/ac UNII, BT (1x, EDR, LE)

### 2.3 Antenna Description

Following antenna gains provided by manufacturer were used for testing.

Frequency [MHz]	Antennas	
	Antenna C	Antenna D
2300-2320	1.4	1.7
2400-2700	1.7	2.0

**Table 2-1. Highest Antenna Gain**

### 2.4 Test Support Equipment

1	Apple MacBook w/AC/DC Adapter	Model: A2141	S/N: C02DV7VKMD6T	
2	Apple Cable	Model: Kanzi	S/N: 32530F	
3	Apple USB-C to Lightning Cable w/ AC/DC Adapter	Model: N/A	S/N: N/A	
4	DC Power Supply	Model: KPS3010D	S/N: N/A	

**Table 2-2. Test Support Equipment**

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## 2.5 Test Configuration

The EUT was tested per the guidance of ANSI C63.26 2015, TIA-603-E-2016 and KDB 971168 D01 v03r01. See Section 7.0 of this test report for a description of the radiated and antenna port conducted emissions tests.

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.

## 2.6 Software and Firmware

The test was conducted with firmware version 19A32670z installed on the EUT.

## 2.7 EMI Suppression Device(s)/Modifications

No EMI suppression device(s) were added and 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 “Land Mobile FM or PM – Communications Equipment – Measurements and Performance Standards” (ANSI C63.26 2015, TIA-603-E-2016) and “Measurement Guidance for Certification of Licensed Digital Transmitters” (KDB 971168 D01 v03r01) were used in the measurement of the EUT.

**Deviation from Measurement Procedure.....**None

### 3.2 Radiated Spurious 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. For measurements below 1GHz, the absorbers are removed. A raised turntable is used for radiated measurement. The turn table is a continuously rotatable, remote-controlled, metallic turntable and 2 meters (6.56 ft.) in diameter. The turn table is flush with the raised floor of the chamber in order to maintain its function as a ground plane. An 80cm tall test table made of Styrodur is placed on top of the turn table. A Styrodur pedestal is placed on top of the test table to bring the total table height to 1.5m.

The equipment under test was transmitting while connected to its integral antenna and is placed on a turntable 3 meters from the receive antenna. The receive antenna height is adjusted between 1 and 4 meter height, the turntable is rotated through 360 degrees, and the EUT is manipulated through all orthogonal planes representative of its typical use to achieve the highest reading on the receive spectrum analyzer.

For radiated spurious emissions measurements and calculations, conversion method is used per the formulas in KDB 971168 Section 5.8.4. Field Strength (EIRP) is calculated using the following formulas:

$$E_{[\text{dB}\mu\text{V}/\text{m}]} = \text{Measured amplitude level}_{[\text{dBm}]} + 107 + \text{Cable Loss}_{[\text{dB}]} + \text{Antenna Factor}_{[\text{dB}/\text{m}]} \\ \text{And}$$

$$\text{EIRP}_{[\text{dBm}]} = E_{[\text{dB}\mu\text{V}/\text{m}]} + 20\log D - 104.8; \text{ where } D \text{ is the measurement distance in meters.}$$

All radiated measurements are performed in a chamber that meets the site requirements per ANSI C63.4-2014.

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.

Radiated spurious emission levels are investigated with the receive antenna horizontally and vertically polarized per ANSI C63.26-2015 and TIA-603-E-2016.

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## 4.0 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
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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## 5.0 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
ATM	180-442A-KF	20dB Nominal Gain Horn Antenna	12/1/2020	Annual	12/1/2021	T058701-02
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)	11/4/2020	Annual	11/4/2021	227597
ESPEC	SU-241	Tabletop Temperature Chamber	9/28/2020	Annual	9/28/2021	92009574
Keysight Technology	N9040B	UXA Signal Analyzer	12/19/2020	Annual	12/19/2021	MY57212015
Rohde & Schwarz	TS-PR8	Pre-Amplifier (30MHz - 8GHz)	12/3/2020	Annual	12/3/2021	102327
Rohde & Schwarz	TS-PR18	Pre-Amplifier (1GHz - 18GHz)	12/3/2020	Annual	12/3/2021	101648
Rohde & Schwarz	FSV40	Signal Analyzer (10Hz-40GHz)	3/16/2021	Annual	3/16/2022	101619
Rohde & Schwarz	ESW26	EMI Test Receiver	6/11/2021	Annual	6/11/2022	101299
Rohde & Schwarz	ESW44	EMI Test Receiver	12/14/2020	Annual	12/14/2021	101867
Rohde & Schwarz	CMW500	Wideband Radio Communication Tester	10/13/2020	Annual	10/13/2021	161616
Rohde & Schwarz	CMW500	Wideband Radio Communication Tester	9/24/2020	Annual	9/24/2021	151888
Rohde & Schwarz	TS-PR1840	Pre-Amplifier (18GHz - 40GHz)	4/29/2021	Annual	4/29/2022	100051
Rohde & Schwarz	TC-TA18	ross Polarized Vivaldi Antenna (400MHz-18GHz)	10/2/2020	Annual	10/2/2021	101063
Rohde & Schwarz	HFH2-Z2	Loop Antenna	4/5/2021	Annual	4/5/2022	100519

**Table 5-1. Test Equipment**

**Notes:**

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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## 6.0 SAMPLE CALCULATIONS

### Emission Designator

#### QPSK Modulation

**Emission Designator = 8M62G7W**

BW = 8.62 MHz

G = Phase Modulation

7 = Quantized/Digital Info

W = Combination of Any

#### QAM Modulation

**Emission Designator = 8M45D7W**

BW = 8.45 MHz

W = Amplitude/Angle Modulated

7 = Quantized/Digital Info

W = Combination of Any

### Spurious Radiated Emission

#### **Example: Spurious emission at 3700.40 MHz**

The receive spectrum analyzer reading at 3 meters with the EUT on the turntable was  $-81.0$  dBm. The gain of the substituted antenna is  $8.1$  dBi. The signal generator connected to the substituted antenna terminals is adjusted to produce a reading of  $-81.0$  dBm on the spectrum analyzer. The loss of the cable between the signal generator and the terminals of the substituted antenna is  $2.0$  dB at  $3700.40$  MHz. So  $6.1$  dB is added to the signal generator reading of  $-30.9$  dBm yielding  $-24.80$  dBm. The fundamental EIRP was  $25.50$  dBm so this harmonic was  $25.50$  dBm  $- (-24.80) = 50.3$  dBc.

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## 7.0 TEST RESULTS

### 7.1 Summary

Company Name: Apple Inc.  
 FCC ID: BCGA2603  
 FCC Classification: PCS Licensed Transmitter (PCB)  
 Mode(s): LTE/ULCA

Test Condition	Test Description	FCC Part Section(s)	Test Limit	Test Result	Reference
CONDUCTED	Occupied Bandwidth	2.1049	N/A	<span style="background-color: #e0f2f1; border: 1px solid #4a7ebb; padding: 2px 5px; border-radius: 5px;">N/A</span>	Section 7.2
	Conducted Band Edge / Spurious Emissions (LTE Band 30)	2.1051, 27.53(a)	Undesirable emissions must meet the limits detailed in 27.53(a)	<span style="background-color: #e0f2f1; border: 1px solid #4a7ebb; padding: 2px 5px; border-radius: 5px;">PASS</span>	Sections 7.3, 7.4
	Conducted Band Edge / Spurious Emissions (LTE Band 7)	2.1051, 27.53(m)	Undesirable emissions must meet the limits detailed in 27.53(m)	<span style="background-color: #e0f2f1; border: 1px solid #4a7ebb; padding: 2px 5px; border-radius: 5px;">PASS</span>	Sections 7.3, 7.4
	Conducted Band Edge / Spurious Emissions (LTE Band 41)			<span style="background-color: #e0f2f1; border: 1px solid #4a7ebb; padding: 2px 5px; border-radius: 5px;">PASS</span>	Sections 7.3, 7.4
	Transmitter Conducted Output Power	2.1046	N/A	<span style="background-color: #e0f2f1; border: 1px solid #4a7ebb; padding: 2px 5px; border-radius: 5px;">N/A</span>	See RF Exposure Report
	Additional Maximum Power Reduction (A-MPR)	2.1046	N/A	<span style="background-color: #e0f2f1; border: 1px solid #4a7ebb; padding: 2px 5px; border-radius: 5px;">N/A</span>	Section 7.5
	Effective Radiated Power / Equivalent Isotropic Radiated Power (LTE Band 30)	27.50(a)(3)	< 0.25 Watts max. EIRP	<span style="background-color: #e0f2f1; border: 1px solid #4a7ebb; padding: 2px 5px; border-radius: 5px;">PASS</span>	Section 7.6
	Effective Radiated Power / Equivalent Isotropic Radiated Power (LTE Band 7)	27.50(h)(2)	< 2 Watts max. EIRP	<span style="background-color: #e0f2f1; border: 1px solid #4a7ebb; padding: 2px 5px; border-radius: 5px;">PASS</span>	Section 7.6
	Effective Radiated Power / Equivalent Isotropic Radiated Power (LTE Band 41)			<span style="background-color: #e0f2f1; border: 1px solid #4a7ebb; padding: 2px 5px; border-radius: 5px;">PASS</span>	Section 7.6
	Frequency Stability	2.1055, 27.54	Fundamental emissions stay within authorized frequency block over the temperature and voltage range as tested	<span style="background-color: #e0f2f1; border: 1px solid #4a7ebb; padding: 2px 5px; border-radius: 5px;">PASS</span>	Section 7.8
RADIATED	Radiated Spurious Emissions (LTE Band 30)	2.1053, 27.53(a)	Undesirable emissions must meet the limits detailed in 27.53(a)	<span style="background-color: #e0f2f1; border: 1px solid #4a7ebb; padding: 2px 5px; border-radius: 5px;">PASS</span>	Section 7.7
	Radiated Spurious Emissions (LTE Band 7)	2.1053, 27.53(m)	Undesirable emissions must meet the limits detailed in 27.53(m)	<span style="background-color: #e0f2f1; border: 1px solid #4a7ebb; padding: 2px 5px; border-radius: 5px;">PASS</span>	Section 7.7
	Radiated Spurious Emissions (LTE Band 41)			<span style="background-color: #e0f2f1; border: 1px solid #4a7ebb; padding: 2px 5px; border-radius: 5px;">PASS</span>	Section 7.7

Table 7-1. Summary of Test Results

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**Notes:**

1. All modes of operation and data rates were investigated. The test results shown in the following sections represent the worst case emissions.
2. The analyzer plots were all taken with a correction table loaded into the analyzer. The correction table was used to account for the losses of the cables, directional couplers, and attenuators used as part of the system to maintain a link between the call box and the EUT at all frequencies of interest.
3. All antenna port conducted emissions testing was performed on a test bench with the antenna port of the EUT connected to the spectrum analyzer through calibrated cables, attenuators, and couplers.
4. All conducted emissions measurements are performed with automated test software to capture the corresponding plots necessary to show compliance. The measurement software utilized was PCTEST EMC Software Tool 1.0.

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## 7.2 Occupied Bandwidth

§2.1049

### Test Overview

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured. All modes of operation were investigated and the worst case configuration results are reported in this section. All ports were tested and only the worst case data were reported.

### Test Procedure Used

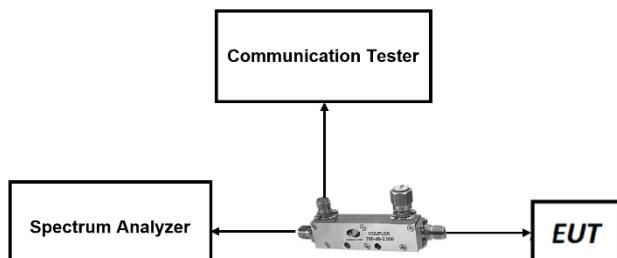
KDB 971168 D01 v03r01 – Section 4.2

### Test Settings

1. The signal analyzer's automatic bandwidth measurement capability was used to perform the 99% occupied bandwidth and the 26dB bandwidth. The bandwidth measurement was not influenced by any intermediate power nulls in the fundamental emission.
2. RBW = 1 – 5% of the expected OBW
3. VBW  $\geq 3 \times$  RBW
4. Detector = Peak
5. Trace mode = max hold
6. Sweep = auto couple
7. The trace was allowed to stabilize
8. If necessary, steps 2 – 7 were repeated after changing the RBW such that it would be within 1 – 5% of the 99% occupied bandwidth observed in Step 7

### Test Setup

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



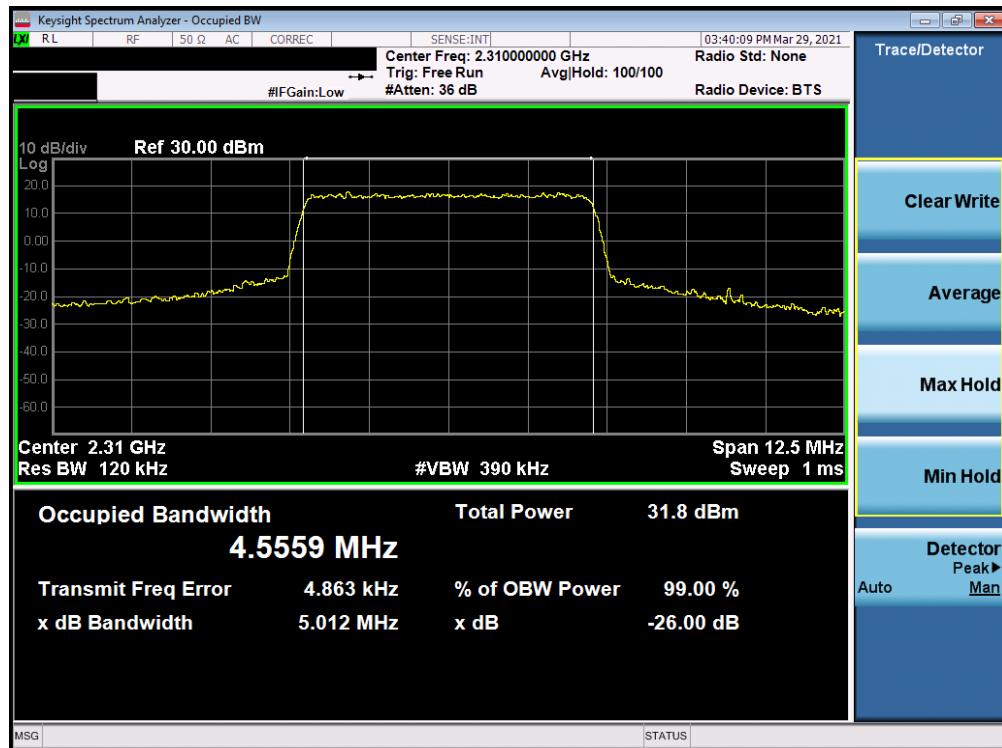
**Figure 7-1. Test Instrument & Measurement Setup**

### Test Notes

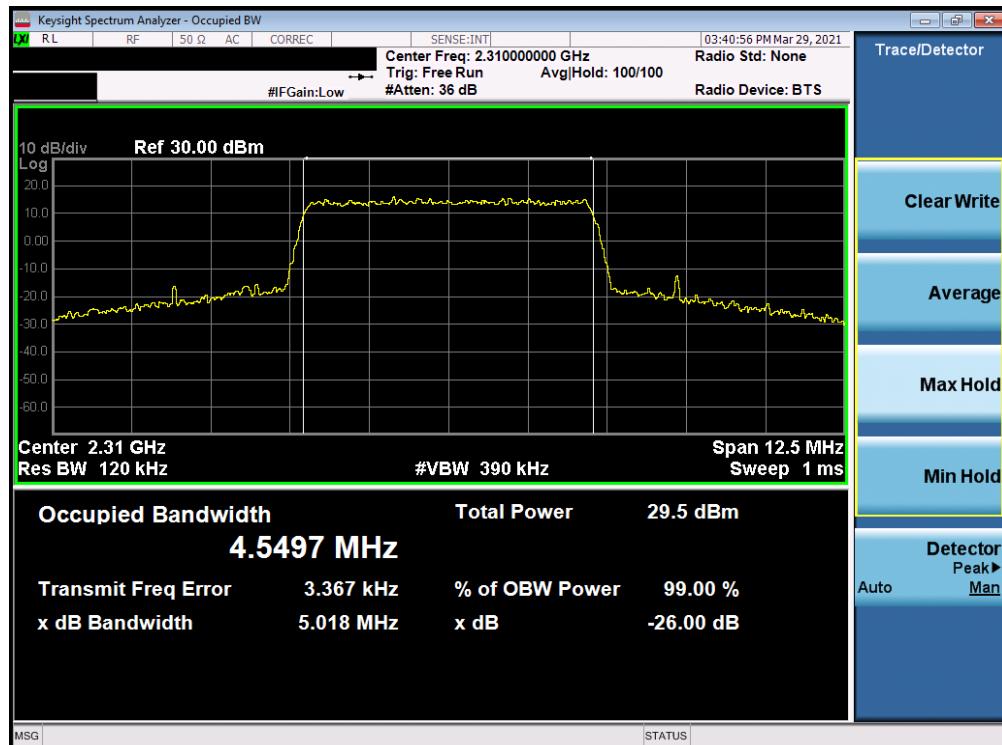
None.

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## LTE Band 30

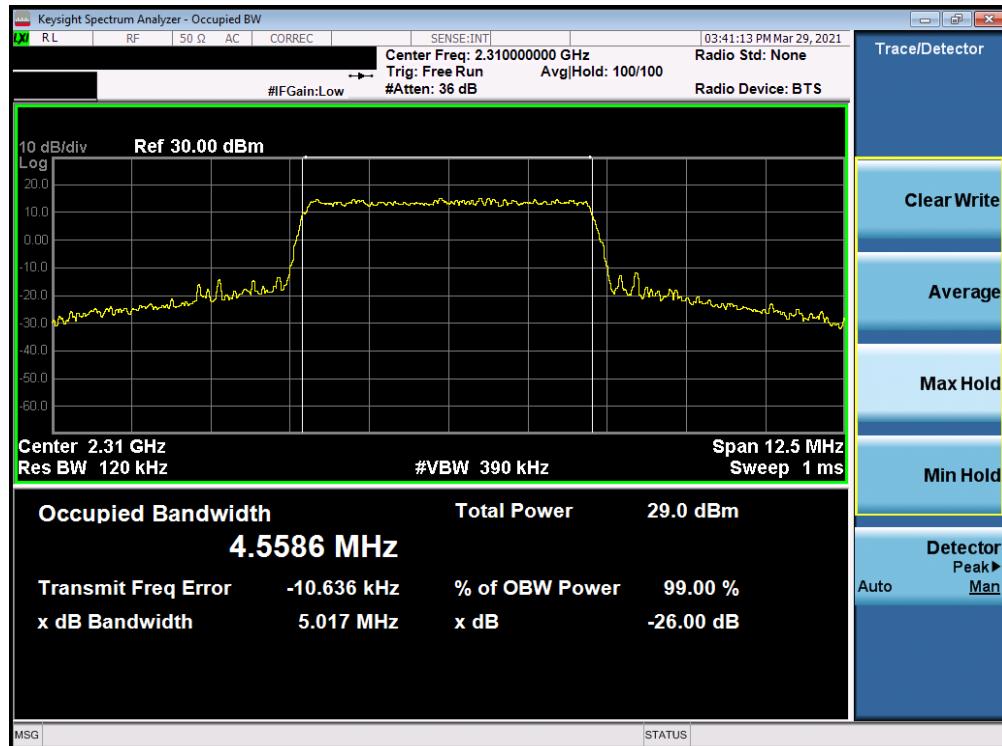


Plot 7-1. Occupied Bandwidth Plot (Band 30 - 5.0MHz QPSK - Full RB Configuration)

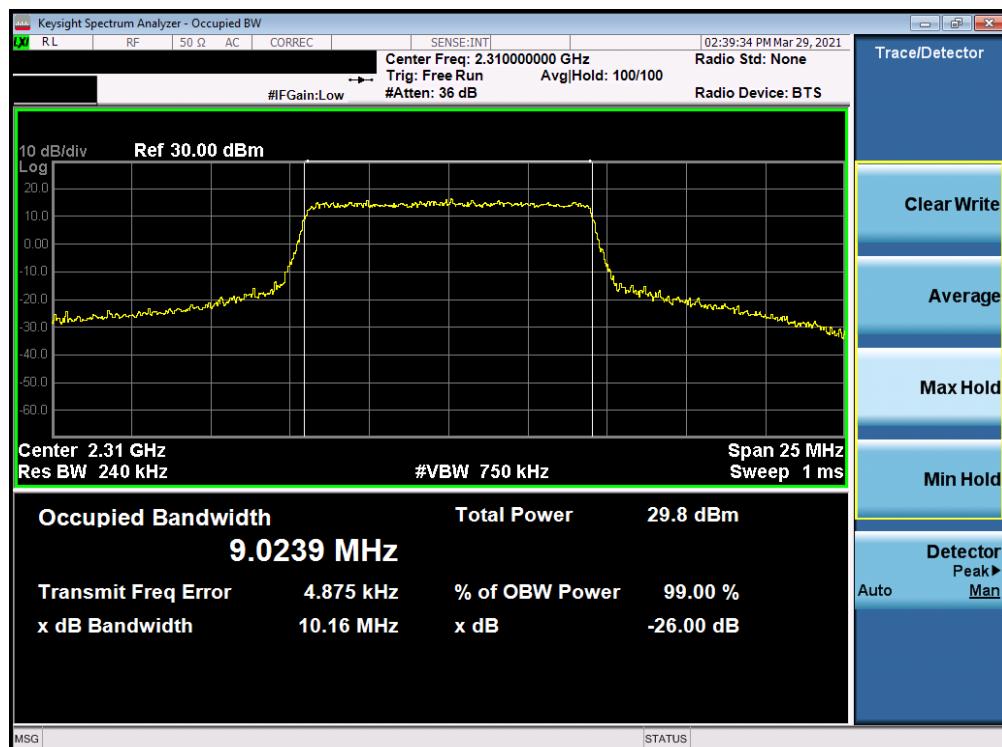


Plot 7-2. Occupied Bandwidth Plot (Band 30 - 5.0MHz 16-QAM - Full RB Configuration)

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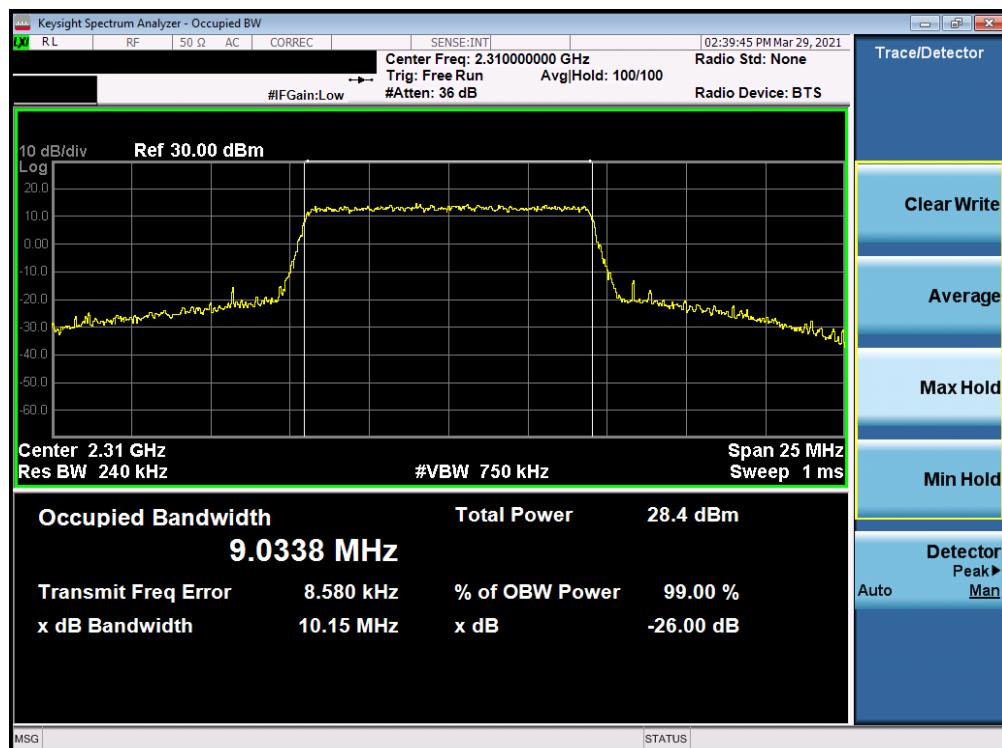


Plot 7-3. Occupied Bandwidth Plot (Band 30 - 5.0MHz 64-QAM - Full RB Configuration)



Plot 7-4. Occupied Bandwidth Plot (Band 30 - 10.0MHz QPSK - Full RB Configuration)

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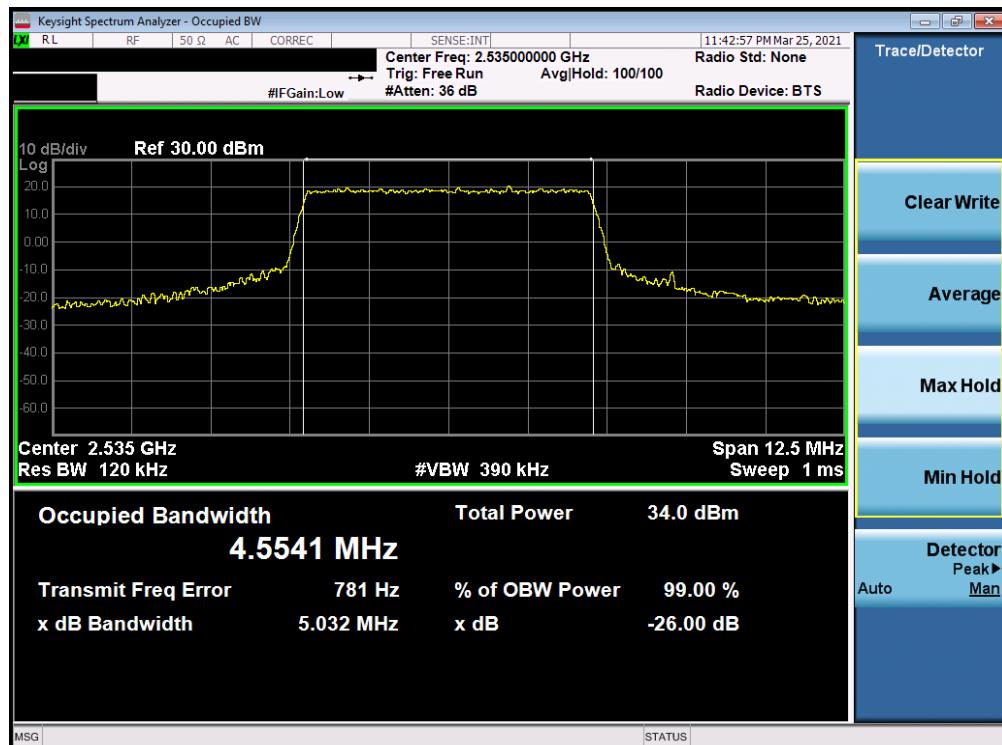
Plot 7-5. Occupied Bandwidth Plot (Band 30 - 10.0MHz 16-QAM - Full RB Configuration)



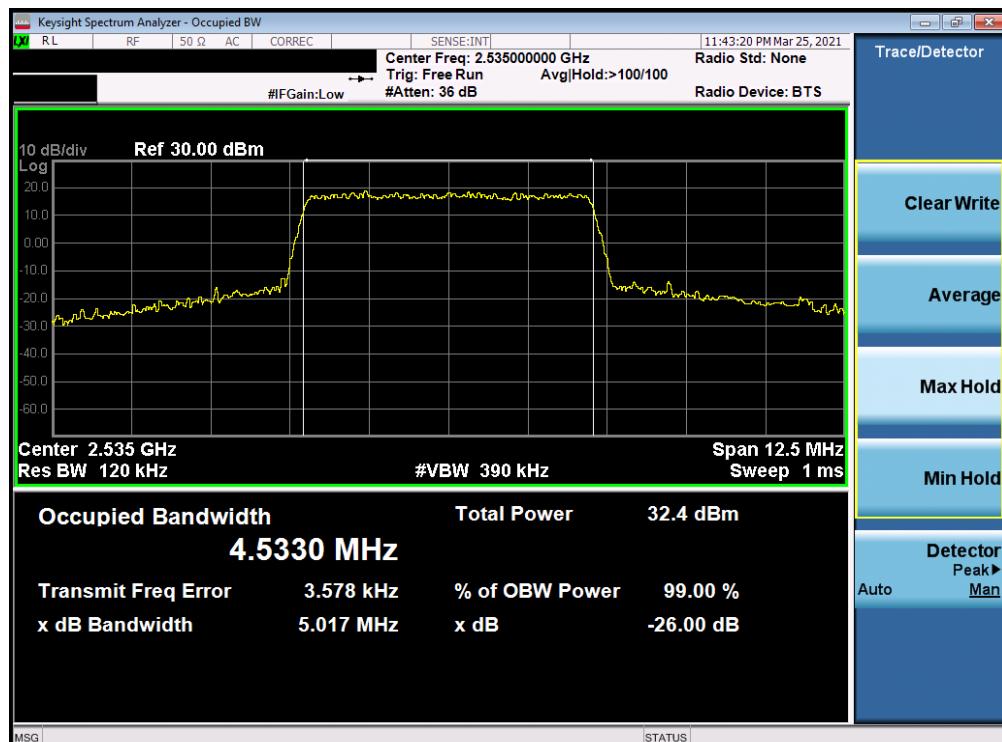
Plot 7-6. Occupied Bandwidth Plot (Band 30 - 10.0MHz 64-QAM - Full RB Configuration)

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## LTE Band 7

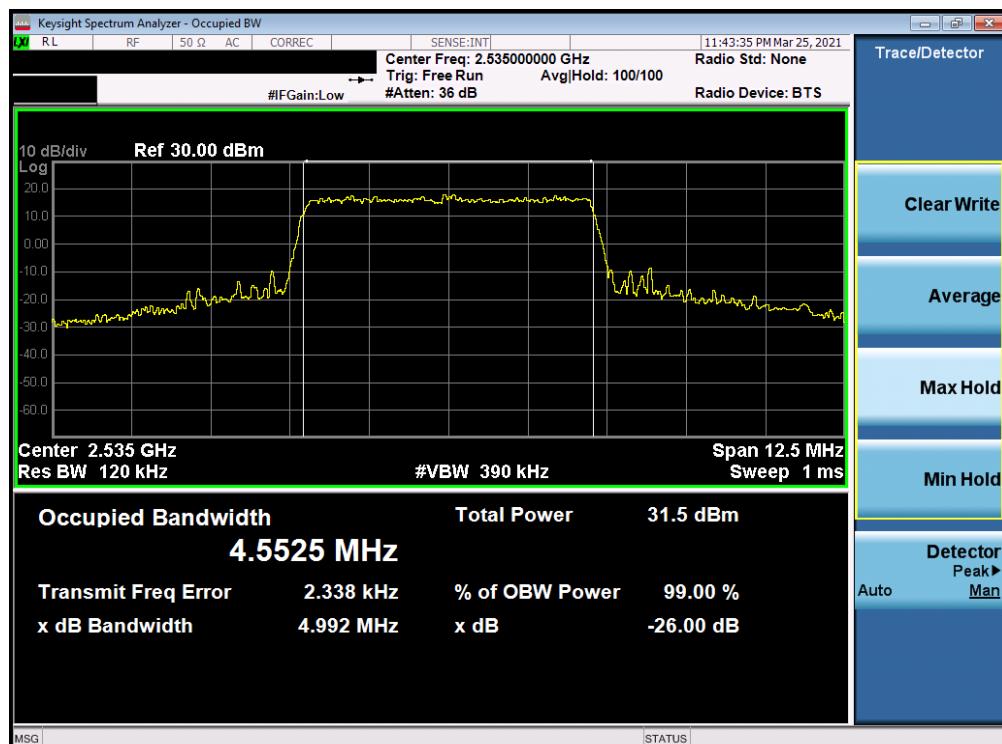


Plot 7-7. Occupied Bandwidth Plot (LTE Band 7 - 5MHz QPSK - Full RB Configuration)



Plot 7-8. Occupied Bandwidth Plot (LTE Band 7 - 5MHz 16-QAM - Full RB Configuration)

FCC ID: BCGA2603	PART 27 MEASUREMENT REPORT			Approved by: Quality Manager
Test Report S/N: 1C2106080051-04.BCG	Test Dates: 6/7/2021 - 7/30/2021	EUT Type: Tablet Device		Page 17 of 102



Plot 7-9. Occupied Bandwidth Plot (LTE Band 7 - 5MHz 64-QAM - Full RB Configuration)



Plot 7-10. Occupied Bandwidth Plot (LTE Band 7 - 10MHz QPSK - Full RB Configuration)

FCC ID: BCGA2603	PART 27 MEASUREMENT REPORT			Approved by: Quality Manager
Test Report S/N: 1C2106080051-04.BCG	Test Dates: 6/7/2021 - 7/30/2021	EUT Type: Tablet Device		Page 18 of 102

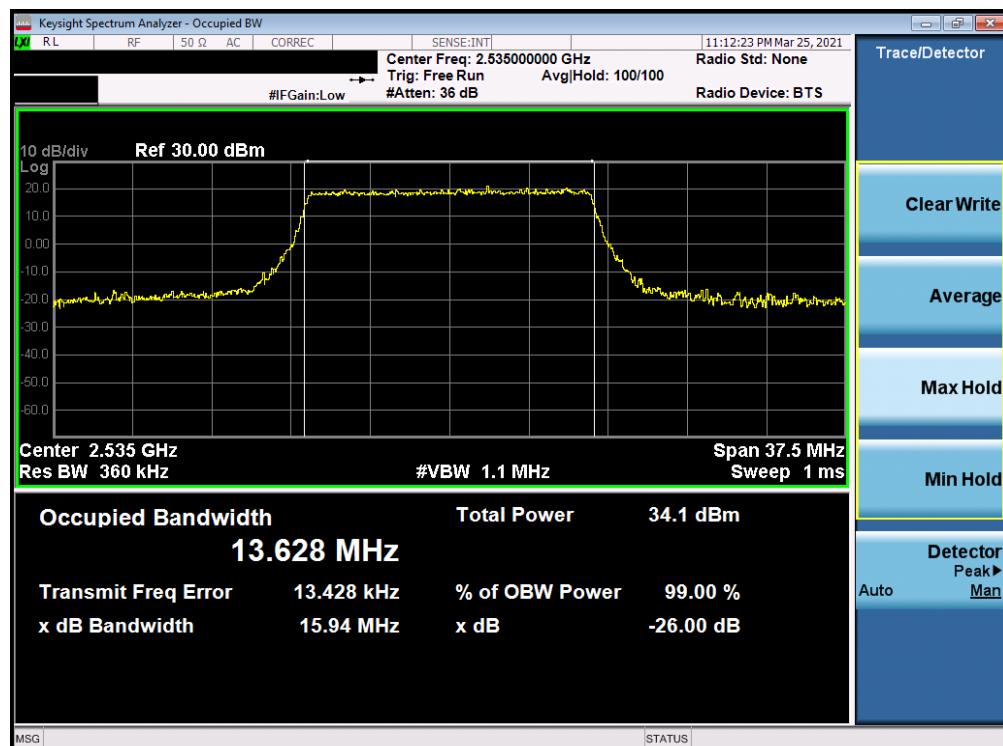


Plot 7-11. Occupied Bandwidth Plot (LTE Band 7 - 10MHz 16-QAM - Full RB Configuration)

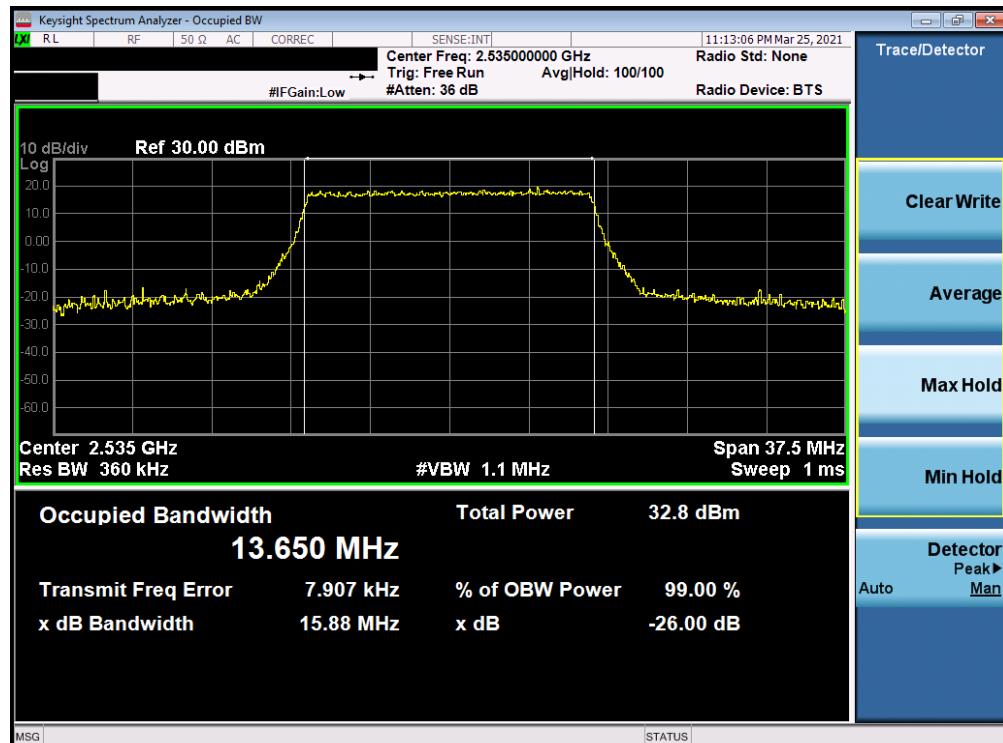


Plot 7-12. Occupied Bandwidth Plot (LTE Band 7 - 10MHz 64-QAM - Full RB Configuration)

FCC ID: BCGA2603	PART 27 MEASUREMENT REPORT			Approved by: Quality Manager
Test Report S/N: 1C2106080051-04.BCG	Test Dates: 6/7/2021 - 7/30/2021	EUT Type: Tablet Device		Page 19 of 102

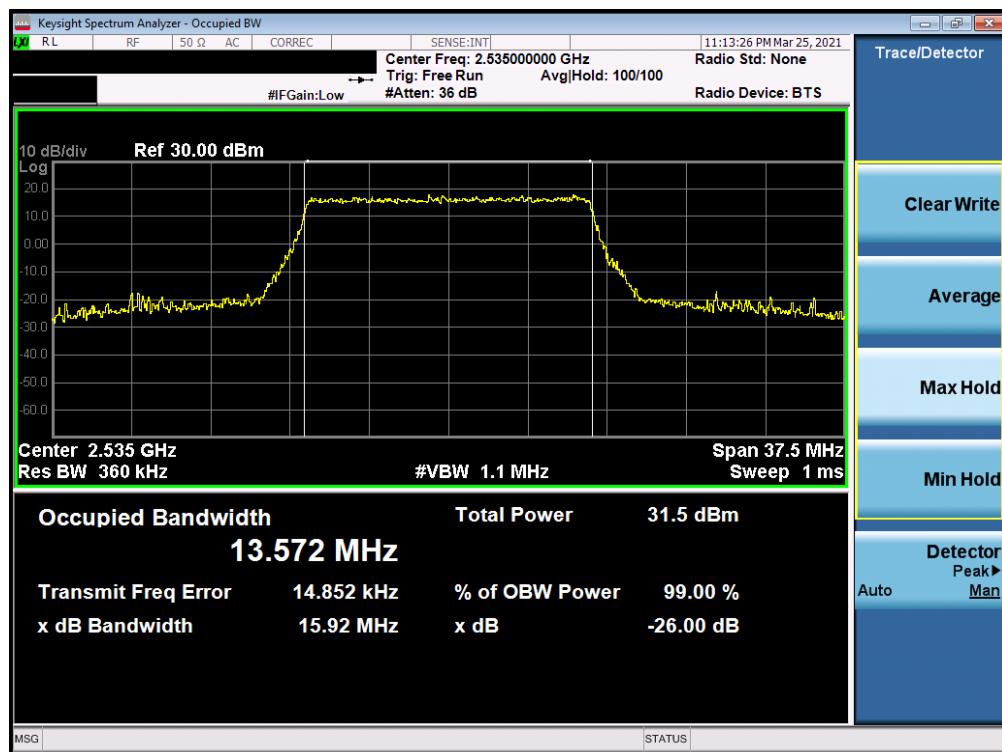


Plot 7-13. Occupied Bandwidth Plot (LTE Band 7 - 15MHz QPSK - Full RB Configuration)



Plot 7-14. Occupied Bandwidth Plot (LTE Band 7 - 15MHz 16-QAM - Full RB Configuration)

FCC ID: BCGA2603	PART 27 MEASUREMENT REPORT			Approved by: Quality Manager
Test Report S/N: 1C2106080051-04.BCG	Test Dates: 6/7/2021 - 7/30/2021	EUT Type: Tablet Device		Page 20 of 102

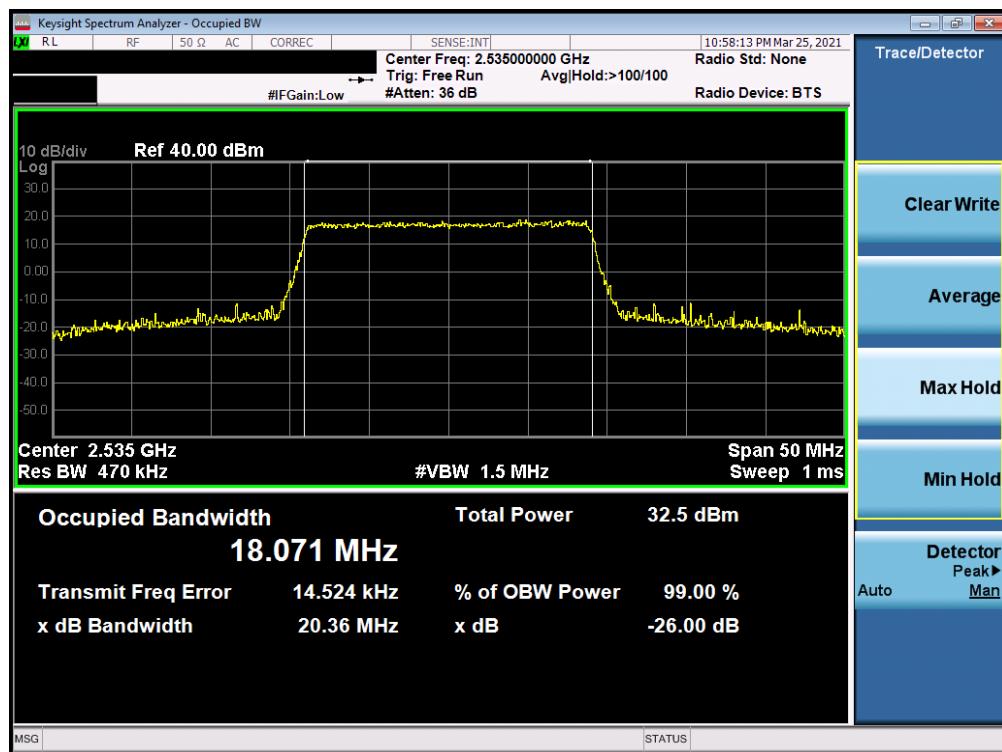


Plot 7-15. Occupied Bandwidth Plot (LTE Band 7 - 15MHz 64-QAM - Full RB Configuration)



Plot 7-16. Occupied Bandwidth Plot (LTE Band 7 - 20MHz QPSK - Full RB Configuration)

FCC ID: BCGA2603	PART 27 MEASUREMENT REPORT			Approved by: Quality Manager
Test Report S/N: 1C2106080051-04.BCG	Test Dates: 6/7/2021 - 7/30/2021	EUT Type: Tablet Device		Page 21 of 102



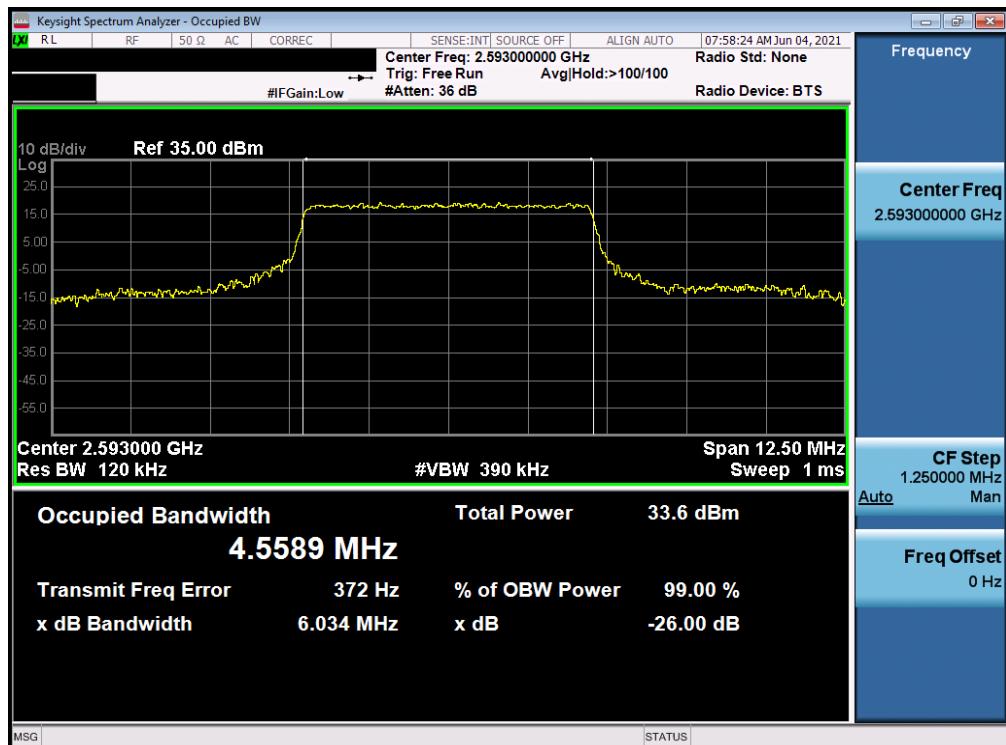
Plot 7-17. Occupied Bandwidth Plot (LTE Band 7 - 20MHz 16-QAM - Full RB Configuration)



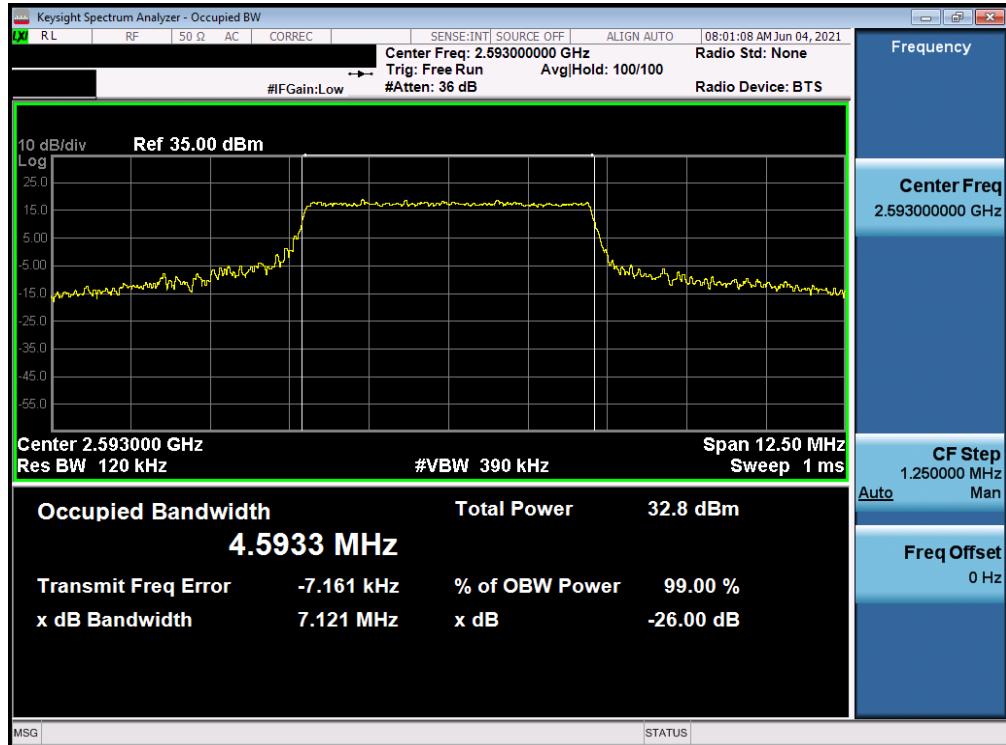
Plot 7-18. Occupied Bandwidth Plot (LTE Band 7 - 20MHz 64-QAM - Full RB Configuration)

FCC ID: BCGA2603	PART 27 MEASUREMENT REPORT			Approved by: Quality Manager
Test Report S/N: 1C2106080051-04.BCG	Test Dates: 6/7/2021 - 7/30/2021	EUT Type: Tablet Device		Page 22 of 102

## LTE Band 41

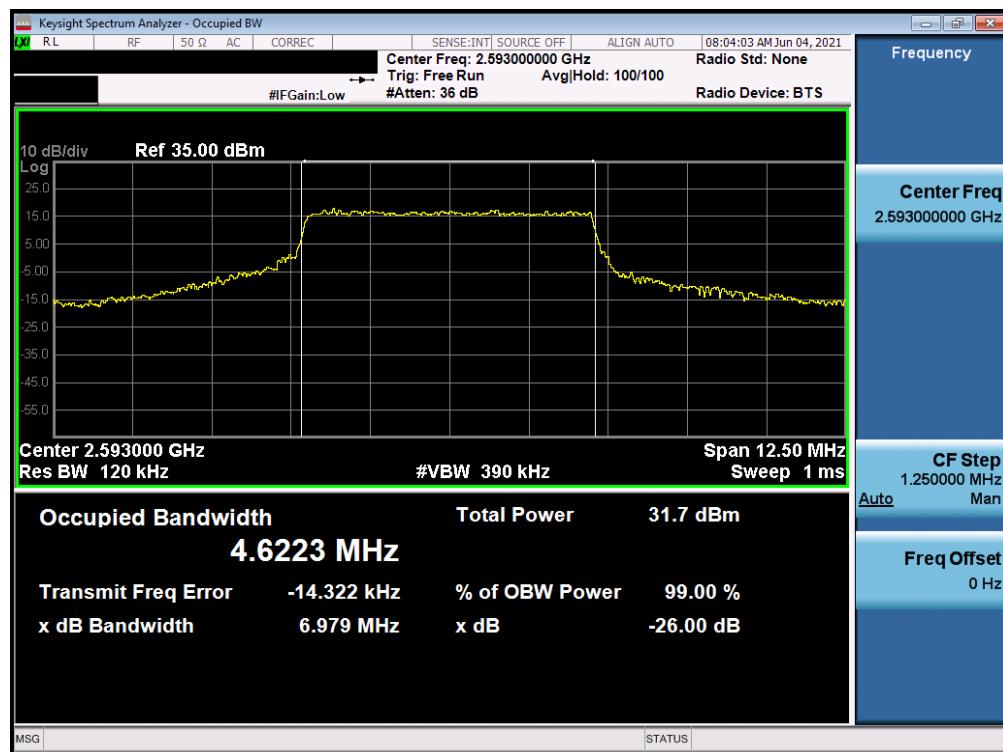


Plot 7-19. Occupied Bandwidth Plot (LTE Band 41 - 5MHz QPSK - Full RB Configuration)



Plot 7-20. Occupied Bandwidth Plot (LTE Band 41 - 5MHz 16-QAM - Full RB Configuration)

FCC ID: BCGA2603	PART 27 MEASUREMENT REPORT			Approved by: Quality Manager
Test Report S/N: 1C2106080051-04.BCG	Test Dates: 6/7/2021 - 7/30/2021	EUT Type: Tablet Device		Page 23 of 102

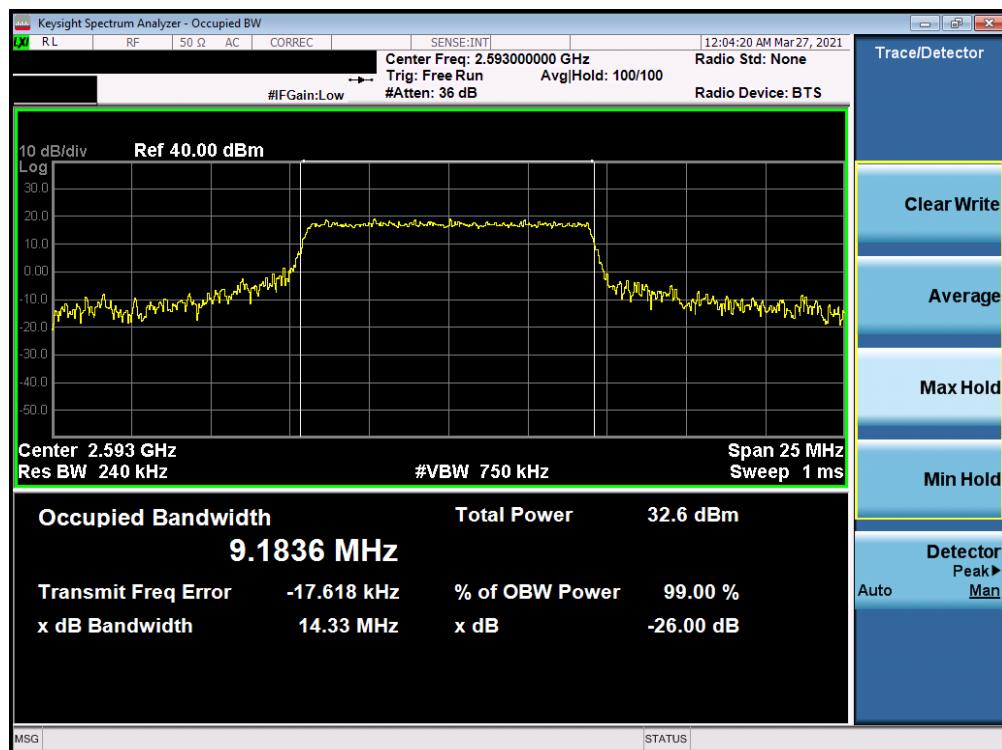


Plot 7-21. Occupied Bandwidth Plot (LTE Band 41 - 5MHz 64-QAM - Full RB Configuration)

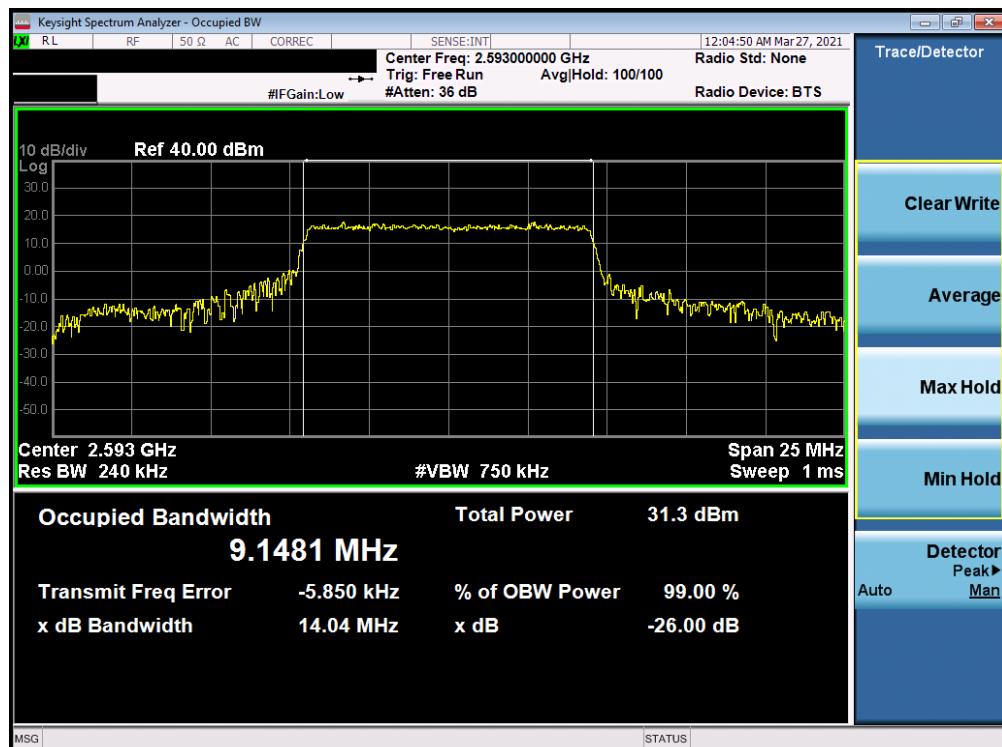


Plot 7-22. Occupied Bandwidth Plot (LTE Band 41 - 10MHz QPSK - Full RB Configuration)

FCC ID: BCGA2603	PART 27 MEASUREMENT REPORT			Approved by: Quality Manager
Test Report S/N: 1C2106080051-04.BCG	Test Dates: 6/7/2021 - 7/30/2021	EUT Type: Tablet Device		Page 24 of 102

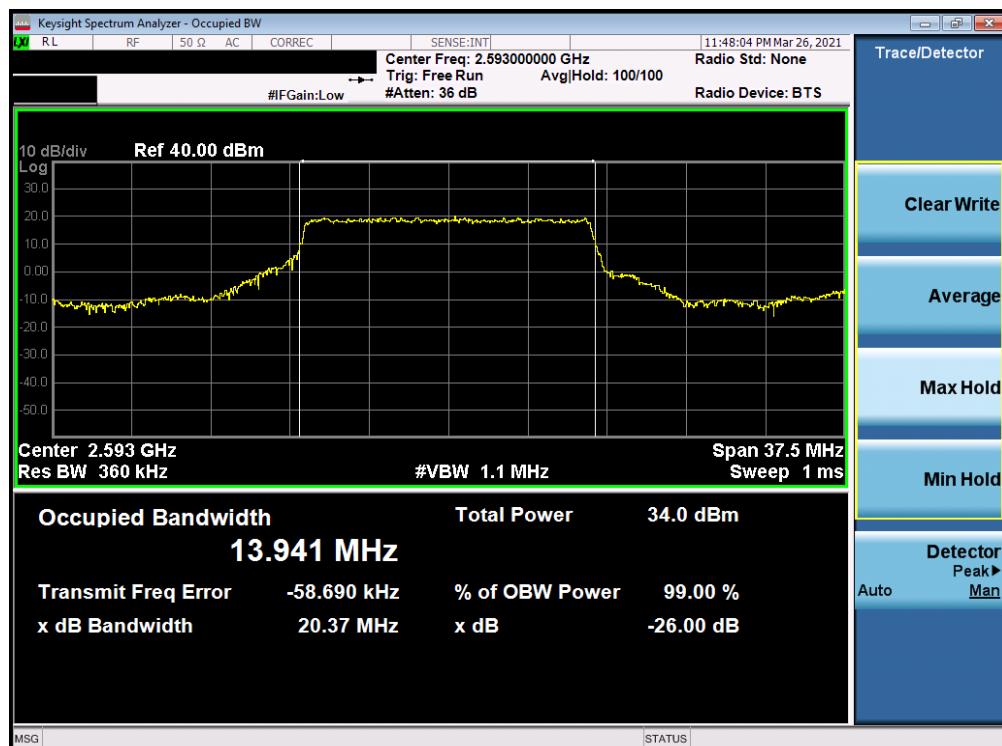


Plot 7-23. Occupied Bandwidth Plot (LTE Band 41 - 10MHz 16-QAM - Full RB Configuration)



Plot 7-24. Occupied Bandwidth Plot (LTE Band 41 - 10MHz 64-QAM - Full RB Configuration)

FCC ID: BCGA2603	PART 27 MEASUREMENT REPORT			Approved by: Quality Manager
Test Report S/N: 1C2106080051-04.BCG	Test Dates: 6/7/2021 - 7/30/2021	EUT Type: Tablet Device		Page 25 of 102

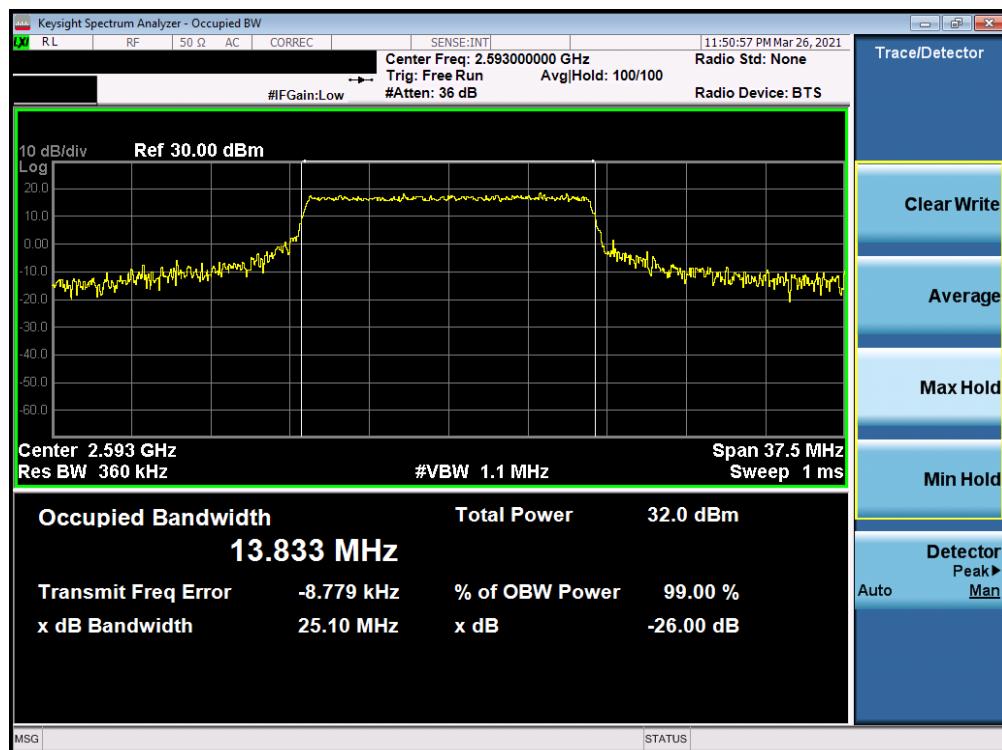


Plot 7-25. Occupied Bandwidth Plot (LTE Band 41 - 15MHz QPSK - Full RB Configuration)



Plot 7-26. Occupied Bandwidth Plot (LTE Band 41 - 15MHz 16-QAM - Full RB Configuration)

FCC ID: BCGA2603	PART 27 MEASUREMENT REPORT			Approved by: Quality Manager
Test Report S/N: 1C2106080051-04.BCG	Test Dates: 6/7/2021 - 7/30/2021	EUT Type: Tablet Device		Page 26 of 102



Plot 7-27. Occupied Bandwidth Plot (LTE Band 41 - 15MHz 64-QAM - Full RB Configuration)

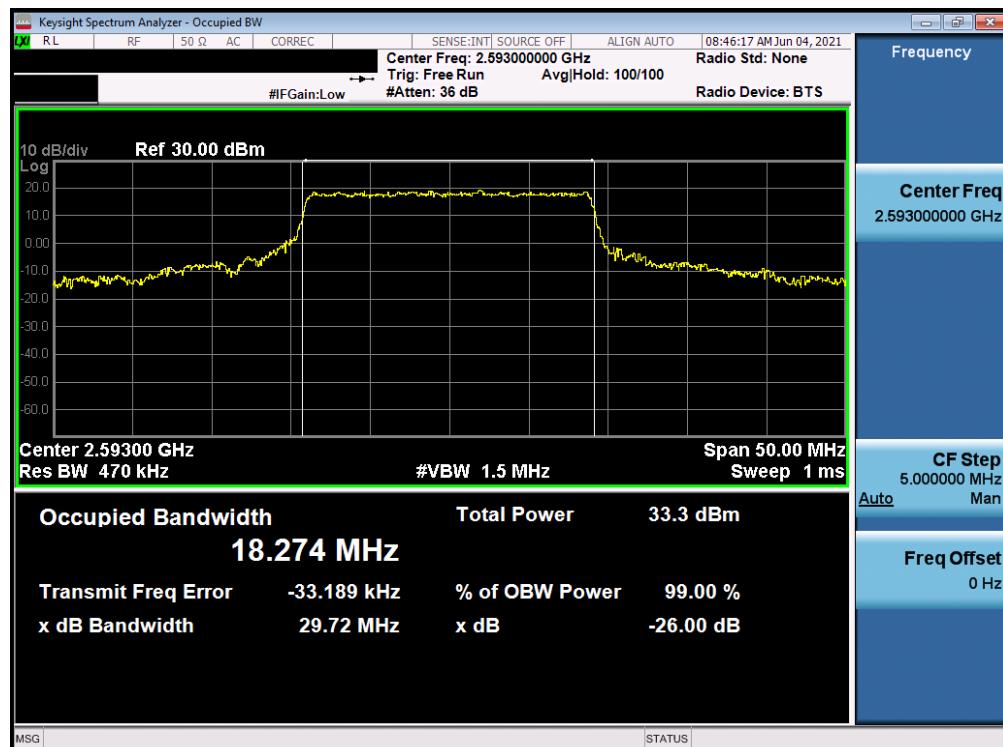


Plot 7-28. Occupied Bandwidth Plot (LTE Band 41 - 20MHz QPSK - Full RB Configuration)

FCC ID: BCGA2603	PART 27 MEASUREMENT REPORT			Approved by: Quality Manager
Test Report S/N: 1C2106080051-04.BCG	Test Dates: 6/7/2021 - 7/30/2021	EUT Type: Tablet Device		Page 27 of 102



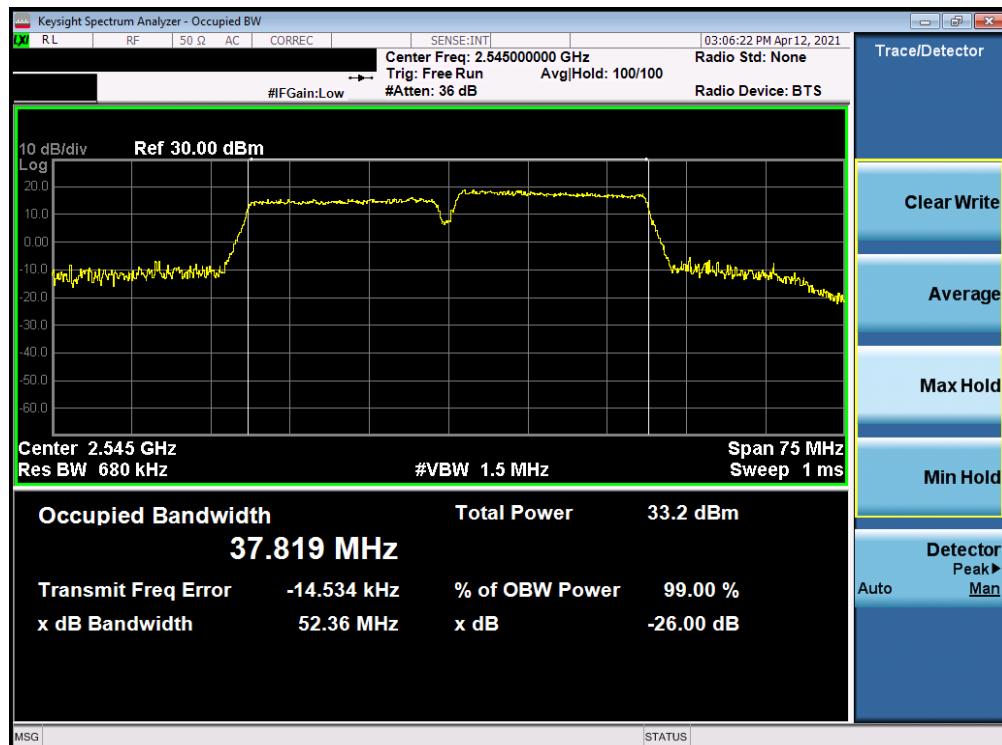
Plot 7-29. Occupied Bandwidth Plot (LTE Band 41 - 20MHz 16-QAM - Full RB Configuration)



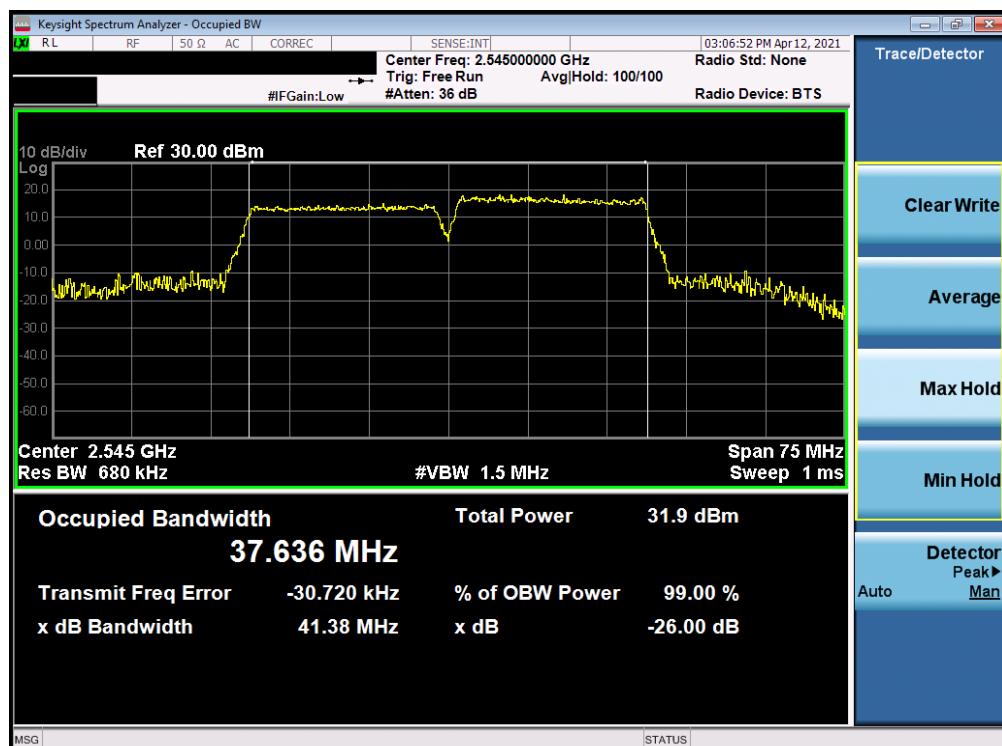
Plot 7-30. Occupied Bandwidth Plot (LTE Band 41 - 20MHz 64-QAM - Full RB Configuration)

FCC ID: BCGA2603	PART 27 MEASUREMENT REPORT			Approved by: Quality Manager
Test Report S/N: 1C2106080051-04.BCG	Test Dates: 6/7/2021 - 7/30/2021	EUT Type: Tablet Device		Page 28 of 102

## ULCA - LTE Band 7

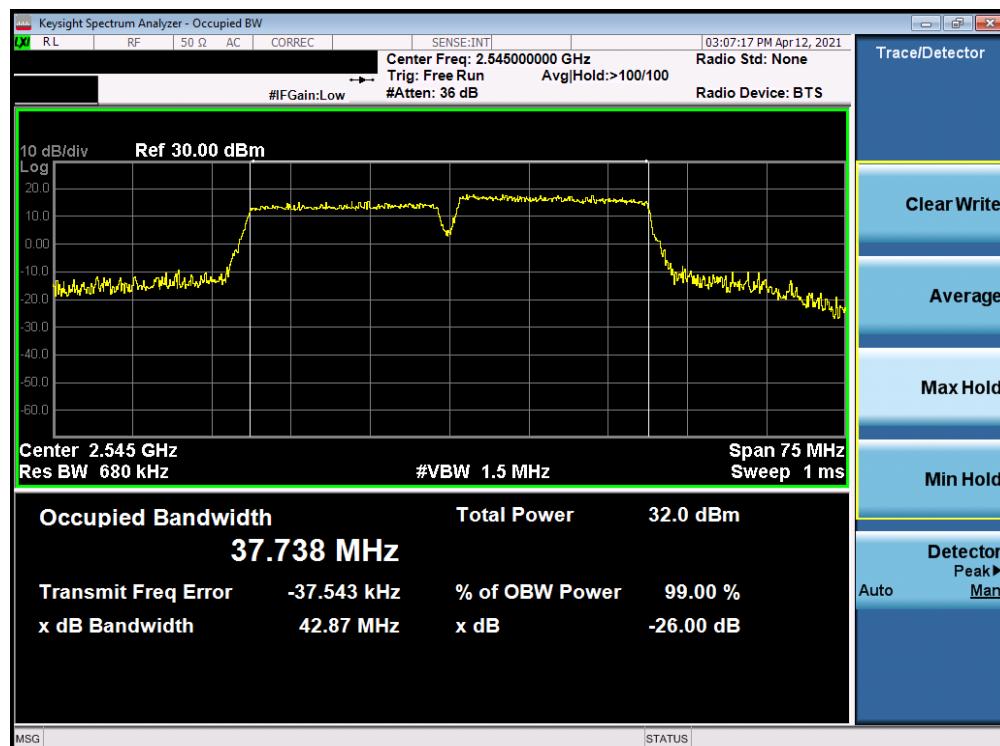


Plot 7-31. Occupied Bandwidth Plot (ULCA - LTE Band 7 - (20 + 20)MHz QPSK - Full RB Configuration)



Plot 7-32. Occupied Bandwidth Plot (ULCA - LTE Band 7 - (20 + 20)MHz 16-QAM - Full RB Configuration)

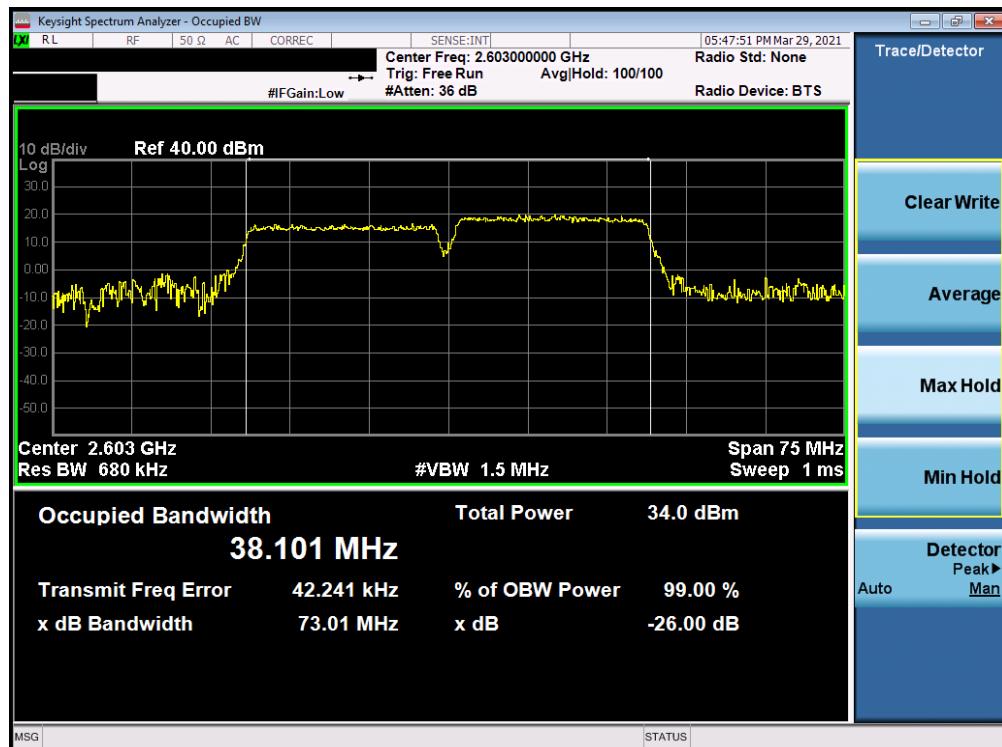
FCC ID: BCGA2603	 <b>PART 27 MEASUREMENT REPORT</b>			Approved by: Quality Manager
Test Report S/N: 1C2106080051-04.BCG	Test Dates: 6/7/2021 - 7/30/2021	EUT Type: Tablet Device		Page 29 of 102



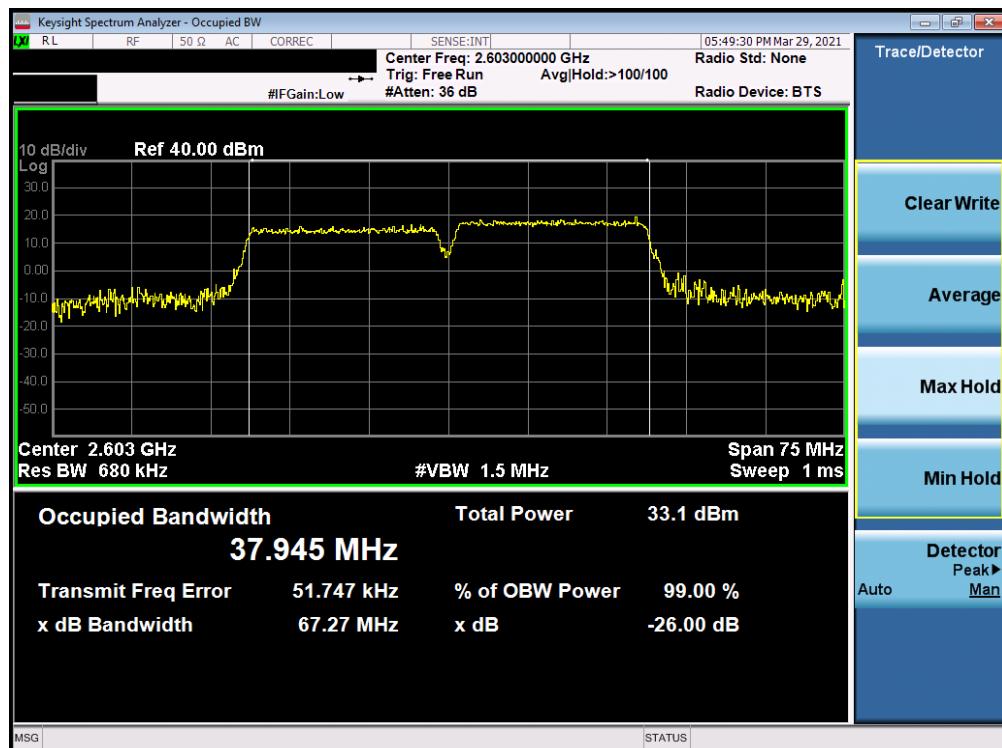
Plot 7-33. Occupied Bandwidth Plot (ULCA - LTE Band 7 - (20 + 20)MHz 64-QAM - Full RB Configuration)

FCC ID: BCGA2603	PART 27 MEASUREMENT REPORT			Approved by: Quality Manager
Test Report S/N: 1C2106080051-04.BCG	Test Dates: 6/7/2021 - 7/30/2021	EUT Type: Tablet Device		Page 30 of 102

## ULCA - LTE Band 41

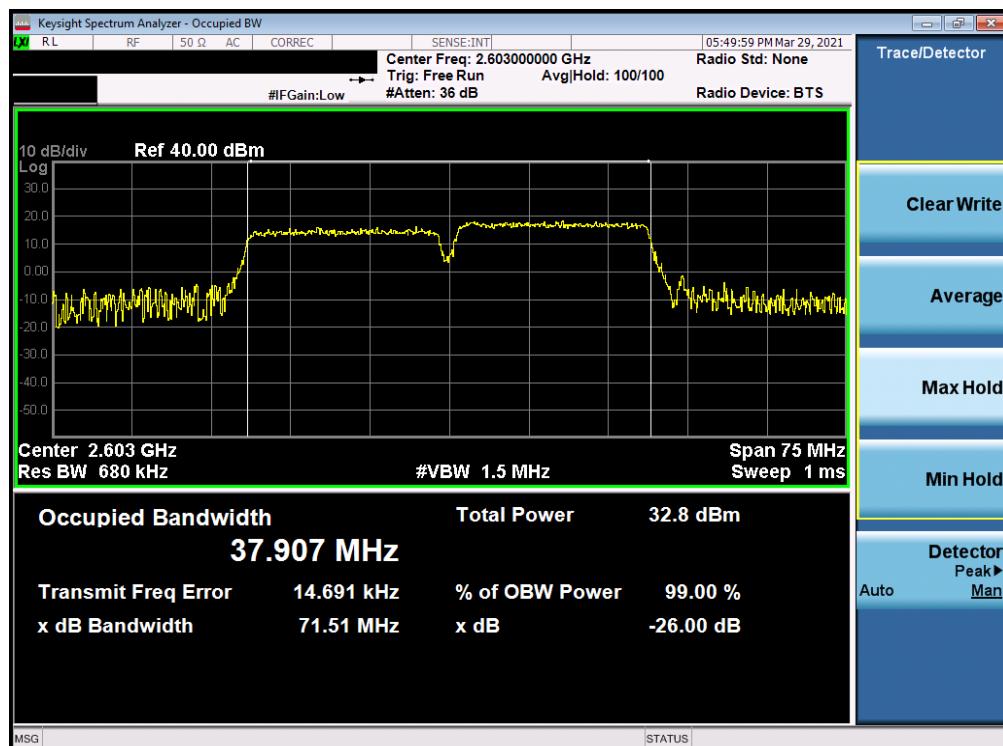


Plot 7-34. Occupied Bandwidth Plot (LTE Band 41 – (20 + 20)MHz QPSK - Full RB Configuration)



Plot 7-35. Occupied Bandwidth Plot (LTE Band 41 - (20 + 20)MHz 16-QAM - Full RB Configuration)

FCC ID: BCGA2603	PART 27 MEASUREMENT REPORT			Approved by: Quality Manager
Test Report S/N: 1C2106080051-04.BCG	Test Dates: 6/7/2021 - 7/30/2021	EUT Type: Tablet Device		Page 31 of 102



Plot 7-36. Occupied Bandwidth Plot (LTE Band 41 - (20 + 20)MHz 64-QAM - Full RB Configuration)

FCC ID: BCGA2603	PART 27 MEASUREMENT REPORT			Approved by: Quality Manager
Test Report S/N: 1C2106080051-04.BCG	Test Dates: 6/7/2021 - 7/30/2021	EUT Type: Tablet Device		Page 32 of 102

## 7.3 Spurious and Harmonic Emissions at Antenna Terminal

§2.1051, §27.53(a), §27.53(m)

### Test Overview

The level of the carrier and the various conducted spurious and harmonic frequencies is measured by means of a calibrated spectrum analyzer. The spectrum is scanned from the lowest frequency generated in the equipment up to a frequency including its 10<sup>th</sup> harmonic. All out of band emissions are measured with a spectrum analyzer connected to the antenna terminal of the EUT while the EUT is operating at maximum power, and at the appropriate frequencies. All data rates were investigated to determine the worst case configuration. All modes of operation were investigated and the worst case configuration results are reported in this section. All ports were tested and only the worst case data were reported.

**For Band 30, the minimum permissible attenuation level of any spurious emission <2288MHz and >2365MHz is  $70 + 10 \log_{10}(P_{[Watts]})$ .**

**For LTE Bands 7 and 41, the minimum permissible attenuation level of any spurious emission is  $55 + 10 \log_{10}(P_{[Watts]})$ .**

### Test Procedure Used

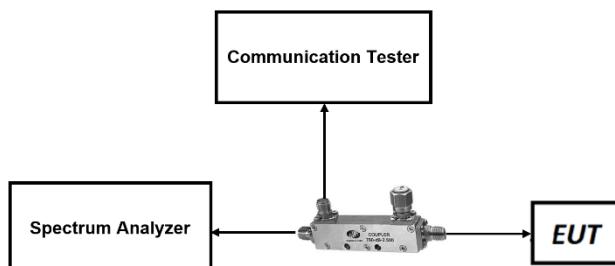
KDB 971168 D01 v03r01 – Section 6.0

### Test Settings

1. Start frequency was set to 30MHz and stop frequency was set to 10GHz (separated into at least two plots per channel)
2. Detector = RMS
3. Trace mode = trace average for continuous emissions, max hold for pulse emissions
4. Sweep time = auto couple
5. The trace was allowed to stabilize
6. Please see test notes below for RBW and VBW settings

### Test Setup

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



**Figure 7-2. Test Instrument & Measurement Setup**

FCC ID: BCGA2603	<b>PCTEST</b> Proud to be part of element		PART 27 MEASUREMENT REPORT	Approved by: Quality Manager
Test Report S/N: 1C2106080051-04.BCG	Test Dates: 6/7/2021 - 7/30/2021	EUT Type: Tablet Device		Page 33 of 102

## Test Notes

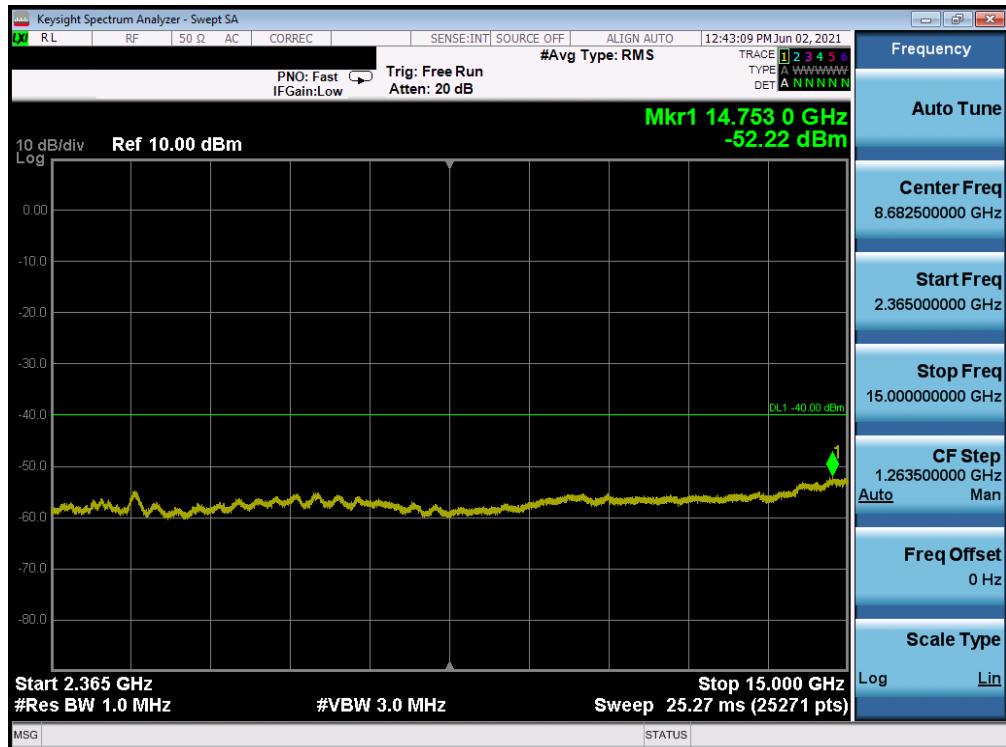
1. Compliance with the applicable limits is based on the use of measurement instrumentation employing a resolution bandwidth 100 kHz or greater for measurements below 1GHz. However, in the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emission are attenuated at least 26 dB below the transmitter power.
2. Uplink carrier aggregation for LTE Band 7 is only supported in this EUT while operating in Power Class 3.
3. Uplink carrier aggregation for LTE Band 41 is supported in this EUT while operating in Power Class 2 and Power Class 3.
4. Uplink carrier aggregation intra-band conducted spurious emissions were evaluated for the two contiguous channels using various combinations of RB size, RB offset, modulation, and channel bandwidth. Channel bandwidth data is shown in the tables below based only on the channel bandwidths that were supported in this device. The worst case (highest) powers were found while operating with QPSK modulation, as shown in the tables below, with both carriers set to transmit using 1RB.

FCC ID: BCGA2603	 <b>PCTEST</b> Proud to be part of 		<b>PART 27 MEASUREMENT REPORT</b>	Approved by: Quality Manager
Test Report S/N: 1C2106080051-04.BCG	Test Dates: 6/7/2021 - 7/30/2021	EUT Type: Tablet Device		Page 34 of 102

## LTE Band 30

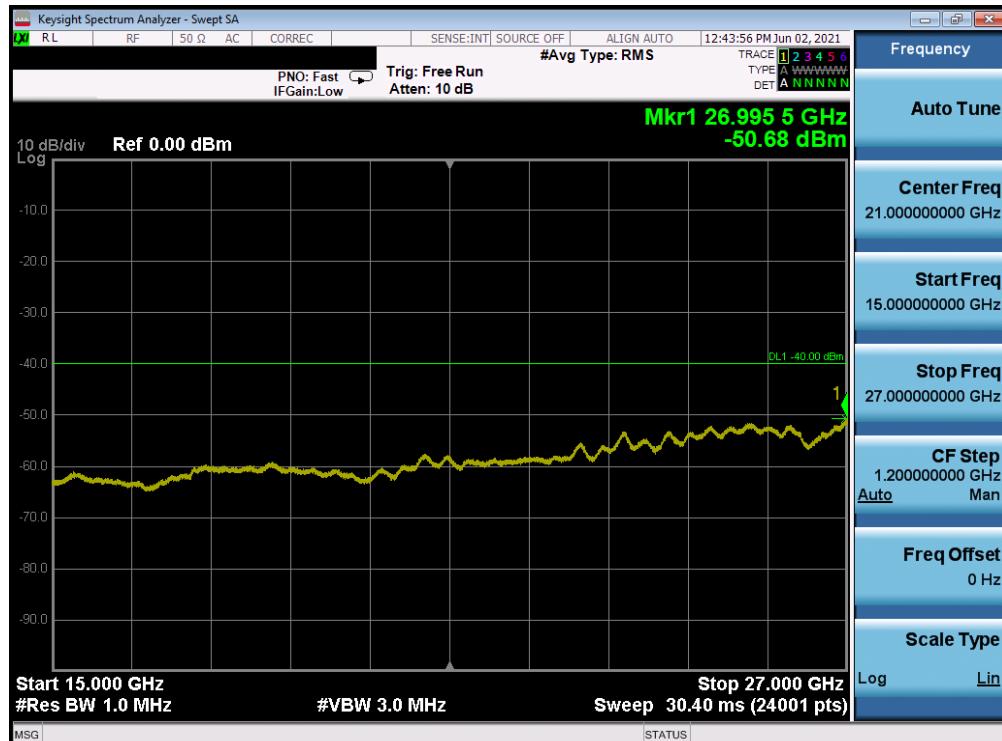


Plot 7-37. CSE (Band 30 - 5.0MHz QPSK - RB Size 1, RB Offset 0 - Low Channel)



Plot 7-38. CSE (Band 30 - 5.0MHz QPSK - RB Size 1, RB Offset 0 – Low Channel)

FCC ID: BCGA2603	PART 27 MEASUREMENT REPORT		Approved by: Quality Manager
Test Report S/N: 1C2106080051-04.BCG	Test Dates: 6/7/2021 - 7/30/2021	EUT Type: Tablet Device	Page 35 of 102

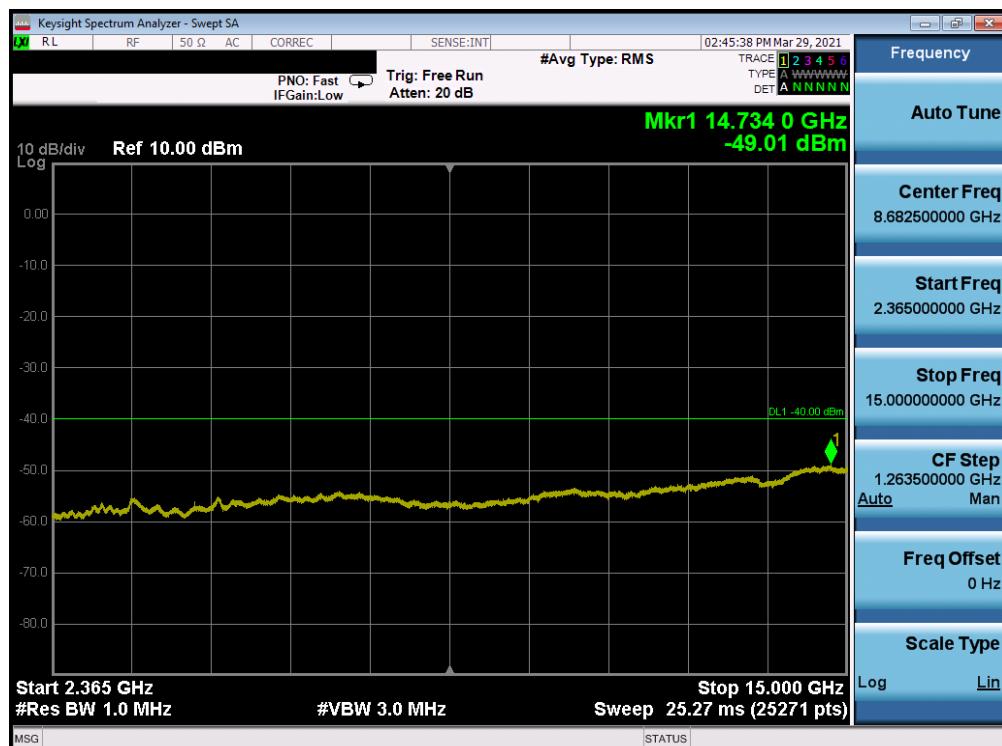


Plot 7-39. CSE (Band 30 - 5.0MHz QPSK - RB Size 1, RB Offset 0 - Low Channel)



Plot 7-40. CSE (Band 30 - 10.0MHz QPSK - RB Size 1, RB Offset 0 - Mid Channel)

FCC ID: BCGA2603	PART 27 MEASUREMENT REPORT			Approved by: Quality Manager
Test Report S/N: 1C2106080051-04.BCG	Test Dates: 6/7/2021 - 7/30/2021	EUT Type: Tablet Device		Page 36 of 102

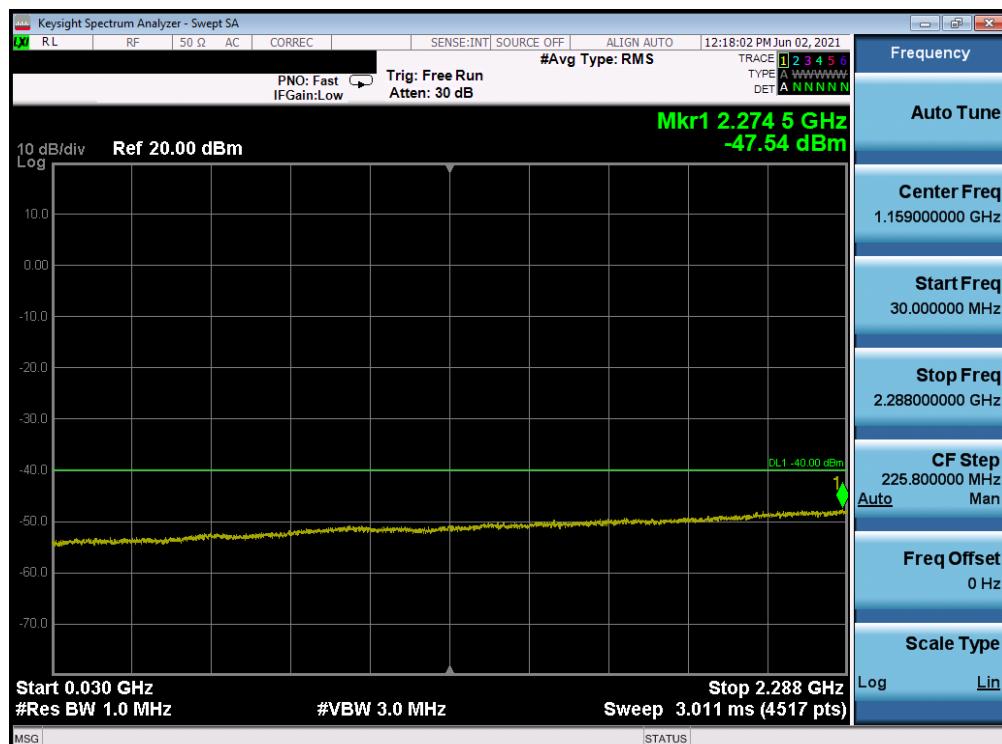


Plot 7-41. CSE (Band 30 - 10.0MHz QPSK - RB Size 1, RB Offset 0 - Mid Channel)

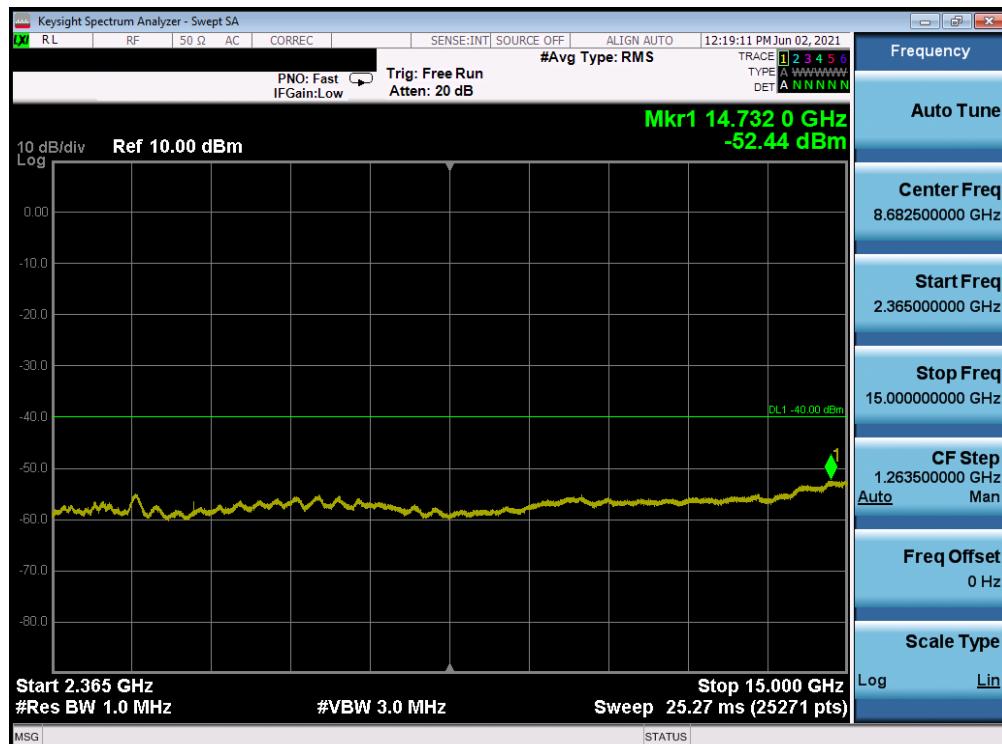


Plot 7-42. CSE (Band 30 - 10.0MHz QPSK - RB Size 1, RB Offset 0 - Mid Channel)

FCC ID: BCGA2603	PART 27 MEASUREMENT REPORT			Approved by: Quality Manager
Test Report S/N: 1C2106080051-04.BCG	Test Dates: 6/7/2021 - 7/30/2021	EUT Type: Tablet Device		Page 37 of 102

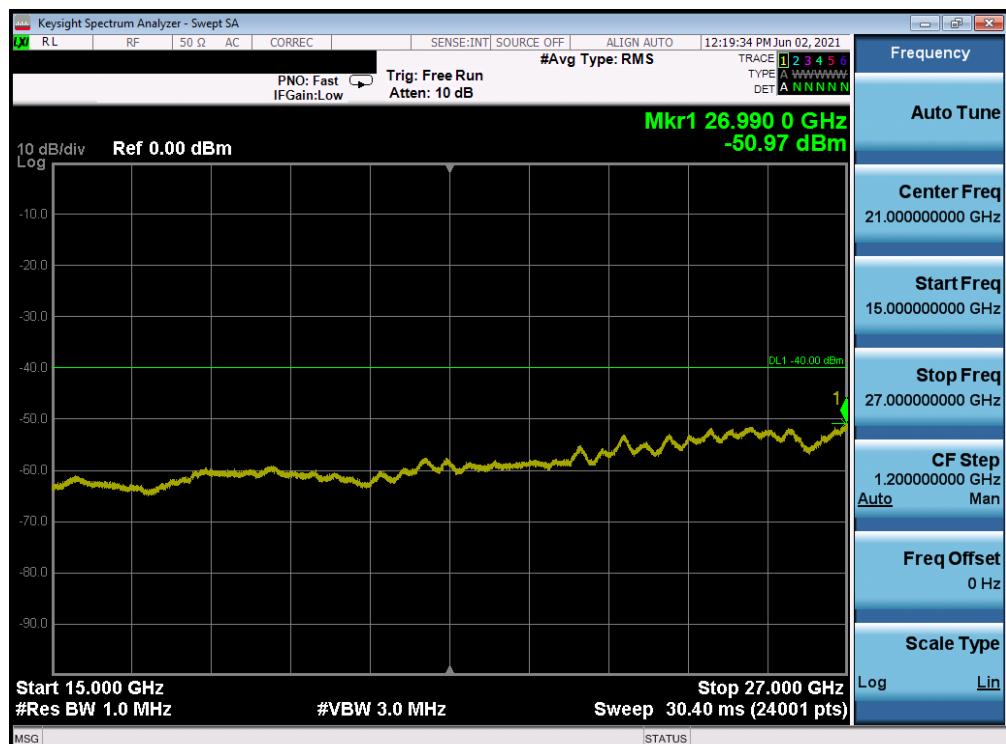


Plot 7-43. CSE (Band 30 - 5.0MHz QPSK - RB Size 1, RB Offset 0 - High Channel)



Plot 7-44. CSE (Band 30 - 5.0MHz QPSK - RB Size 1, RB Offset 0 - High Channel)

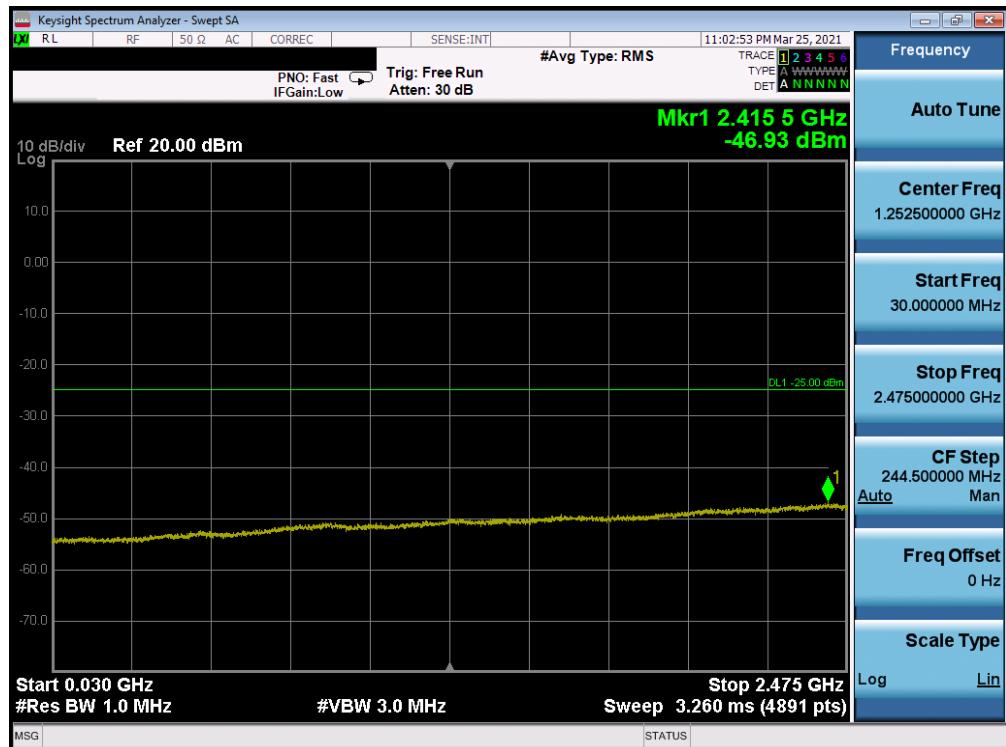
FCC ID: BCGA2603	 <b>PART 27 MEASUREMENT REPORT</b>			Approved by: Quality Manager
Test Report S/N: 1C2106080051-04.BCG	Test Dates: 6/7/2021 - 7/30/2021	EUT Type: Tablet Device		Page 38 of 102



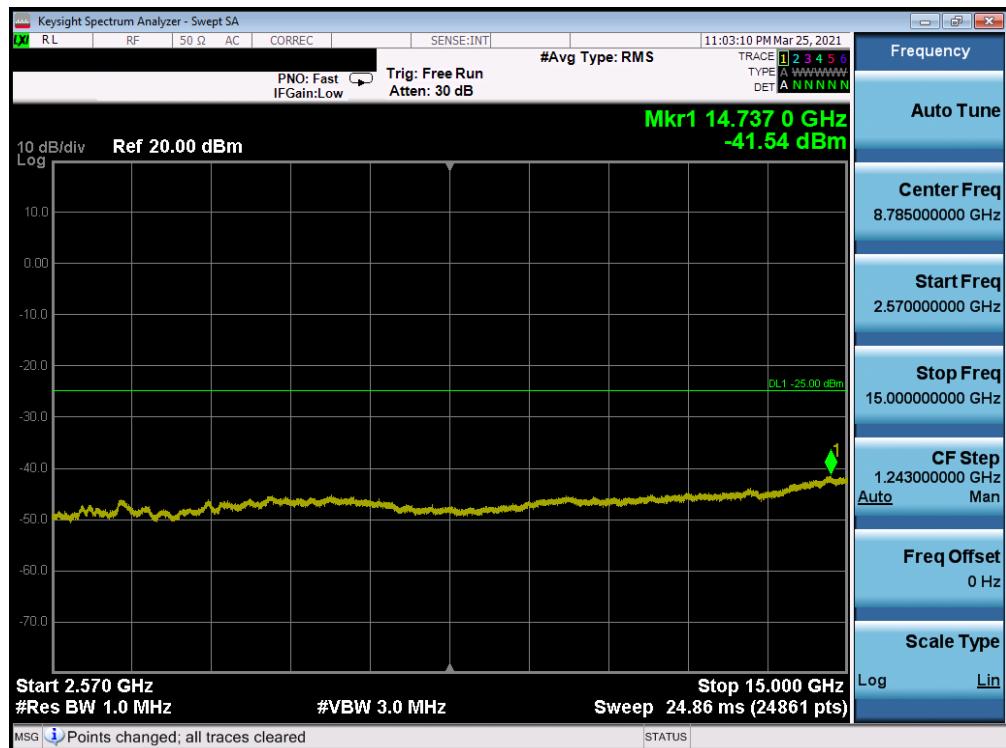
Plot 7-45. CSE (Band 30 - 5.0MHz QPSK - RB Size 1, RB Offset 0 - High Channel)

FCC ID: BCGA2603	PART 27 MEASUREMENT REPORT			Approved by: Quality Manager
Test Report S/N: 1C2106080051-04.BCG	Test Dates: 6/7/2021 - 7/30/2021	EUT Type: Tablet Device		Page 39 of 102

## LTE Band 7



Plot 7-46. CSE (LTE Band 7 - 20MHz QPSK - RB Size 1, RB Offset 0 - Low Channel)

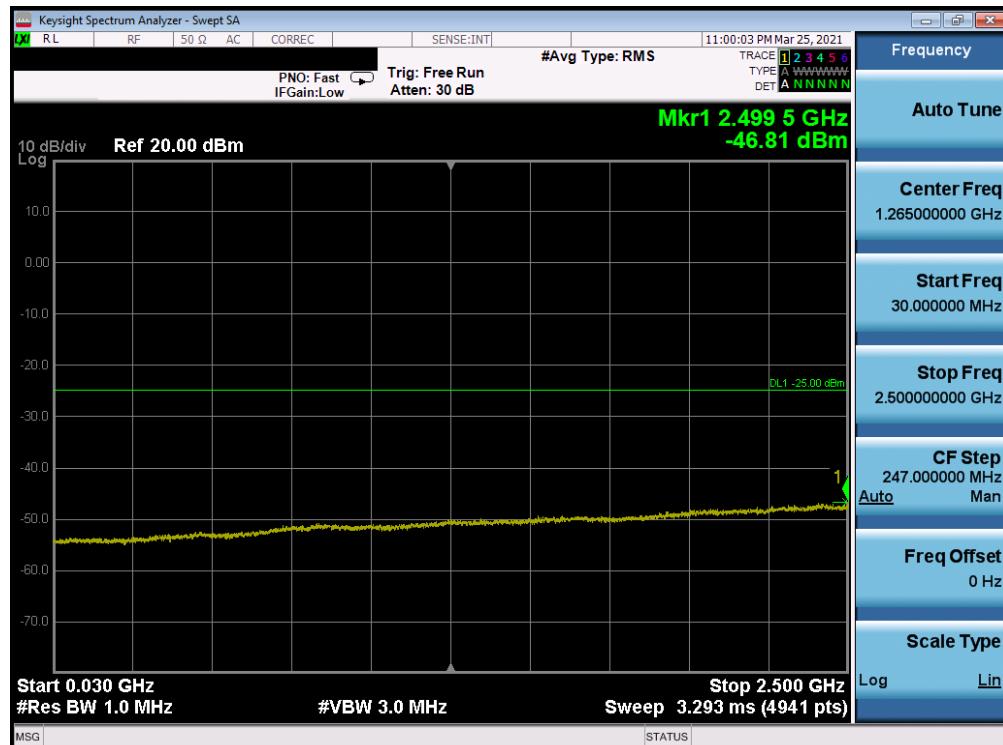


Plot 7-47. CSE (LTE Band 7 - 20MHz QPSK - RB Size 1, RB Offset 0 - Low Channel)

FCC ID: BCGA2603	 <b>PART 27 MEASUREMENT REPORT</b>			Approved by: Quality Manager
Test Report S/N: 1C2106080051-04.BCG	Test Dates: 6/7/2021 - 7/30/2021	EUT Type: Tablet Device		Page 40 of 102



Plot 7-48. CSE (LTE Band 7 - 20MHz QPSK - RB Size 1, RB Offset 0 - Low Channel)



Plot 7-49. CSE (LTE Band 7 - 20MHz QPSK - RB Size 1, RB Offset 0 - Mid Channel)

FCC ID: BCGA2603	PART 27 MEASUREMENT REPORT			Approved by: Quality Manager
Test Report S/N: 1C2106080051-04.BCG	Test Dates: 6/7/2021 - 7/30/2021	EUT Type: Tablet Device		Page 41 of 102

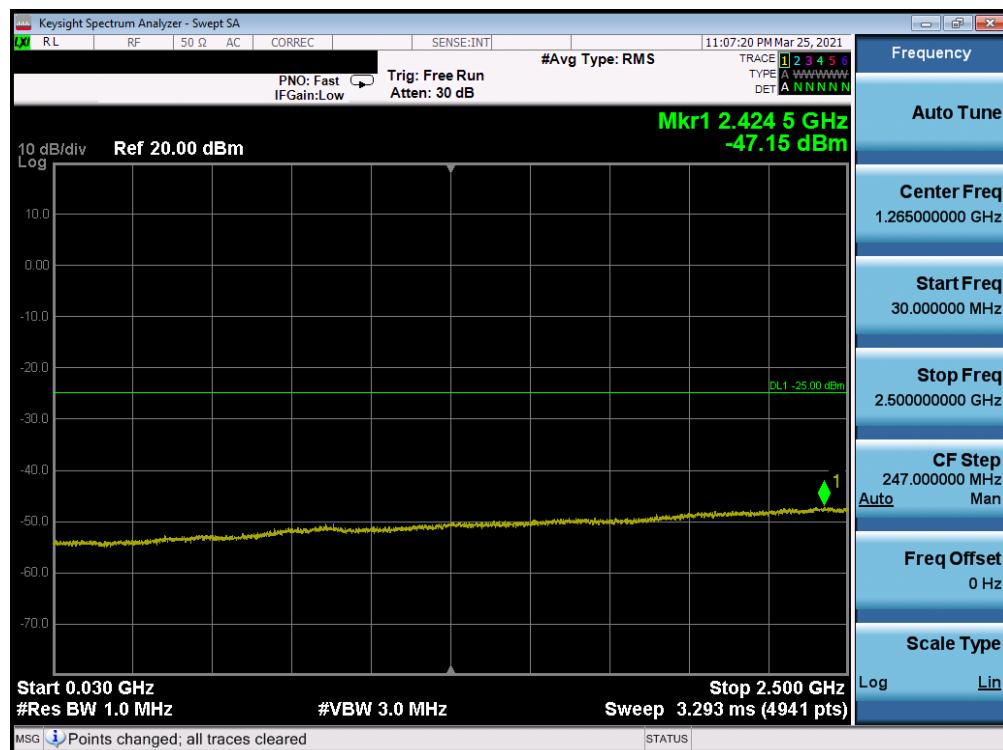


Plot 7-50. CSE (LTE Band 7 - 20MHz QPSK - RB Size 1, RB Offset 0 - Mid Channel)

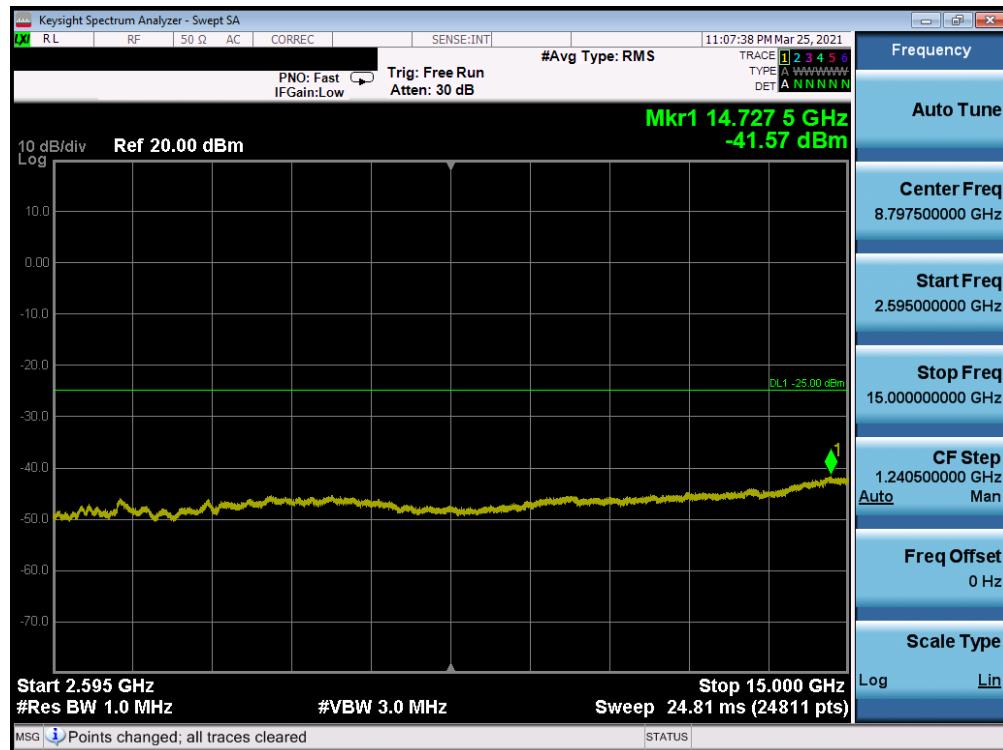


Plot 7-51. CSE (LTE Band 7 - 20MHz QPSK - RB Size 1, RB Offset 0 - Mid Channel)

FCC ID: BCGA2603	PART 27 MEASUREMENT REPORT			Approved by: Quality Manager
Test Report S/N: 1C2106080051-04.BCG	Test Dates: 6/7/2021 - 7/30/2021	EUT Type: Tablet Device		Page 42 of 102

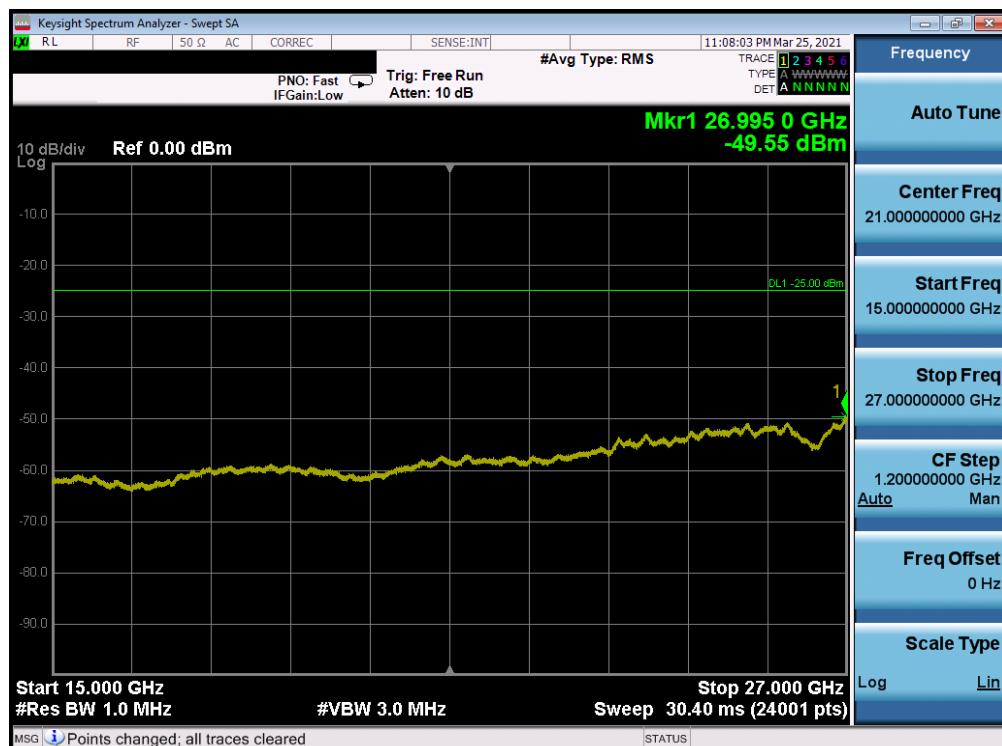


Plot 7-52. CSE (LTE Band 7 - 20MHz QPSK - RB Size 1, RB Offset 0 - High Channel)



Plot 7-53. CSE (LTE Band 7 - 20MHz QPSK - RB Size 1, RB Offset 0 - High Channel)

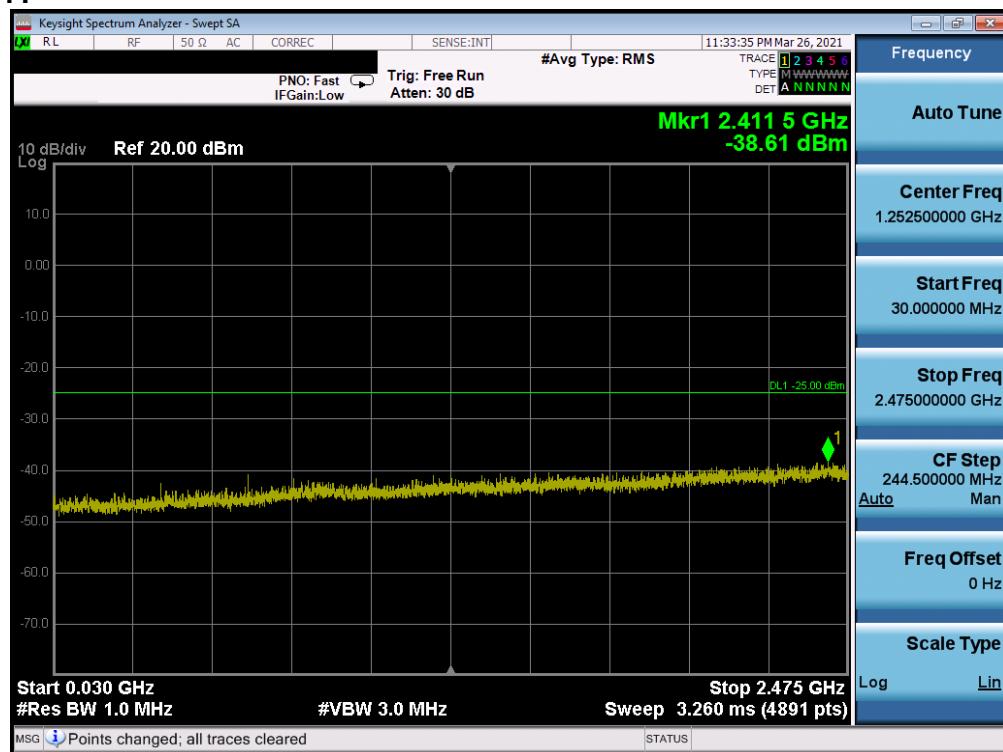
FCC ID: BCGA2603	PART 27 MEASUREMENT REPORT			Approved by: Quality Manager
Test Report S/N: 1C2106080051-04.BCG	Test Dates: 6/7/2021 - 7/30/2021	EUT Type: Tablet Device		Page 43 of 102



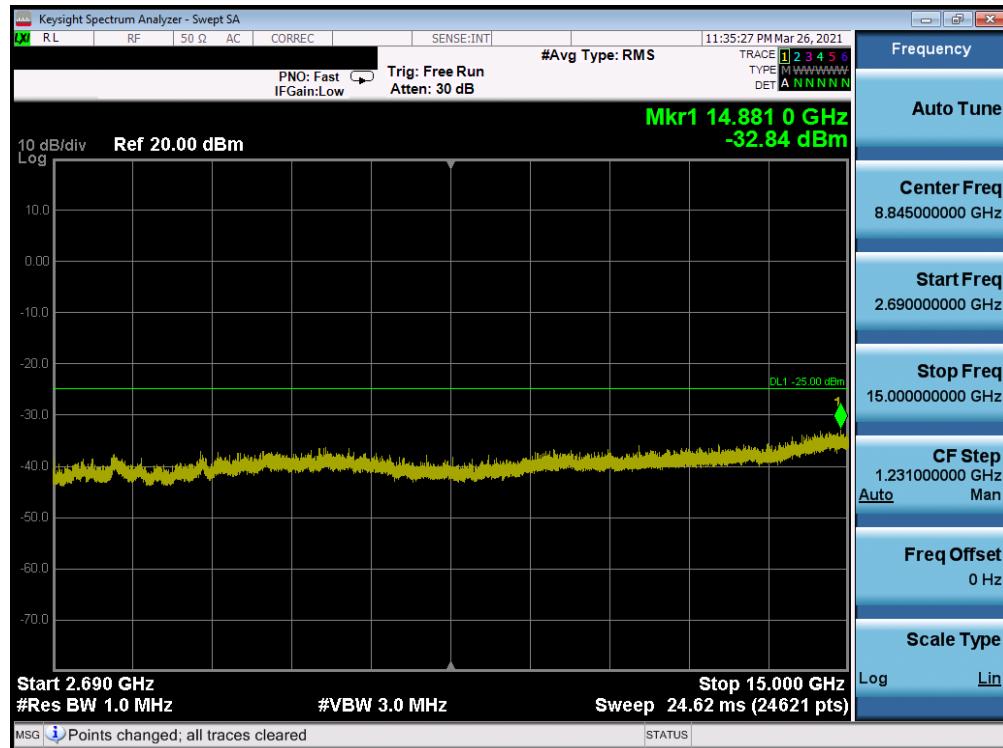
Plot 7-54. CSE (LTE Band 7 - 20MHz QPSK - RB Size 1, RB Offset 0 - High Channel)

FCC ID: BCGA2603	PART 27 MEASUREMENT REPORT			Approved by: Quality Manager
Test Report S/N: 1C2106080051-04.BCG	Test Dates: 6/7/2021 - 7/30/2021	EUT Type: Tablet Device		Page 44 of 102

## LTE Band 41

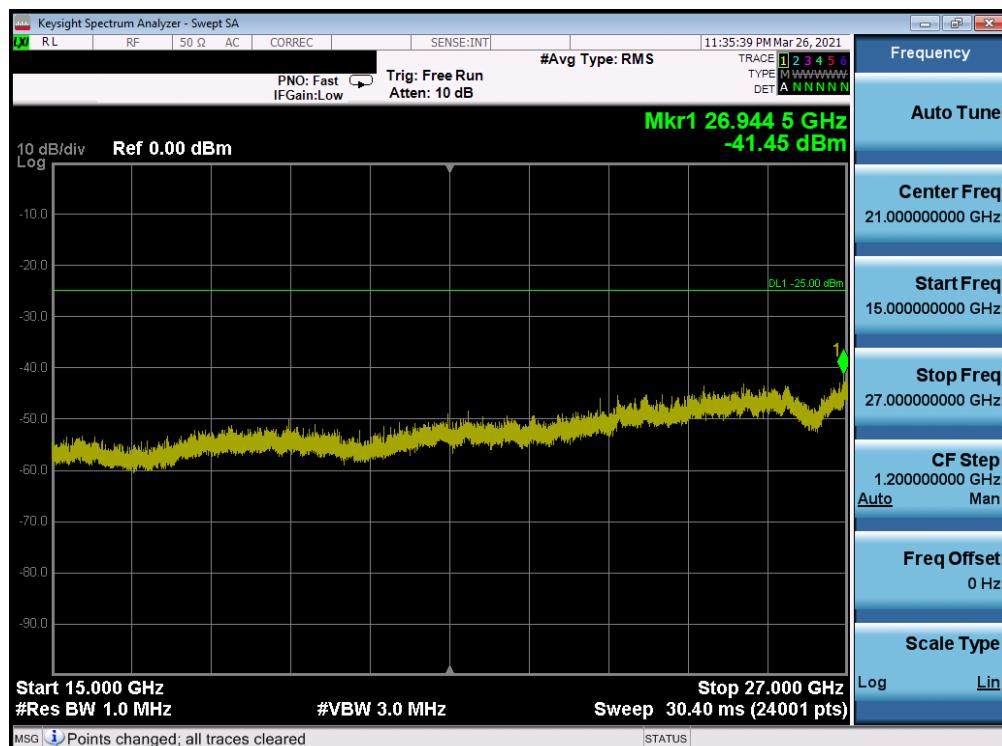


Plot 7-55. CSE (LTE Band 41 - 20MHz QPSK - RB Size 1, RB Offset 0 - Low Channel)

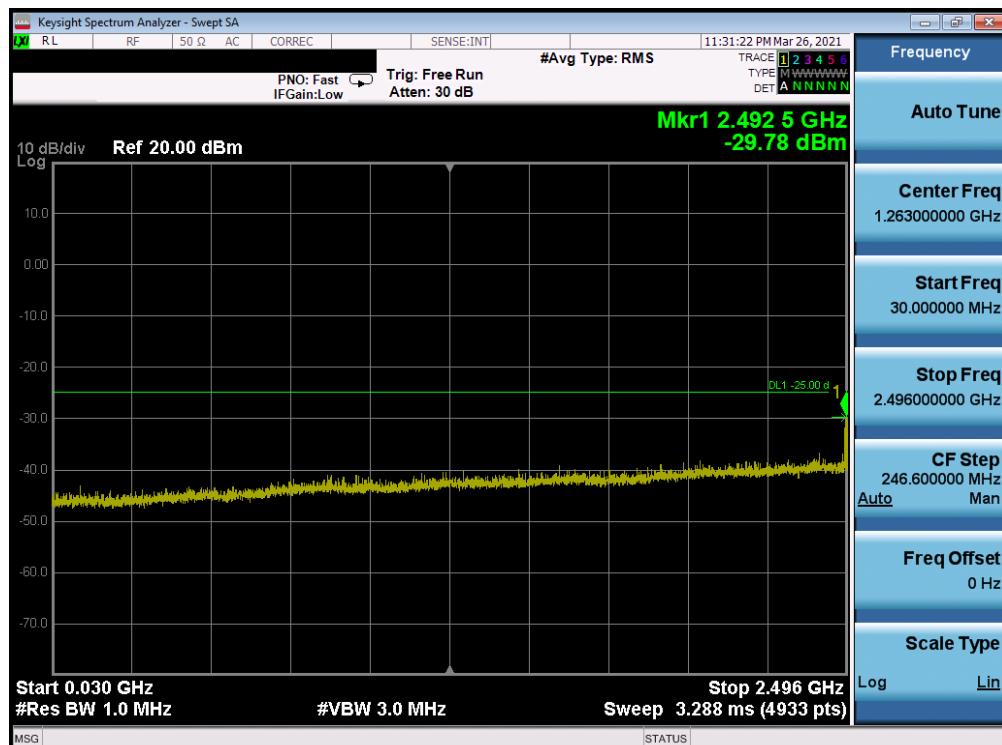


Plot 7-56. CSE (LTE Band 41 - 20MHz QPSK - RB Size 1, RB Offset 0 - Low Channel)

FCC ID: BCGA2603	 <b>PART 27 MEASUREMENT REPORT</b>			Approved by: Quality Manager
Test Report S/N: 1C2106080051-04.BCG	Test Dates: 6/7/2021 - 7/30/2021	EUT Type: Tablet Device		Page 45 of 102

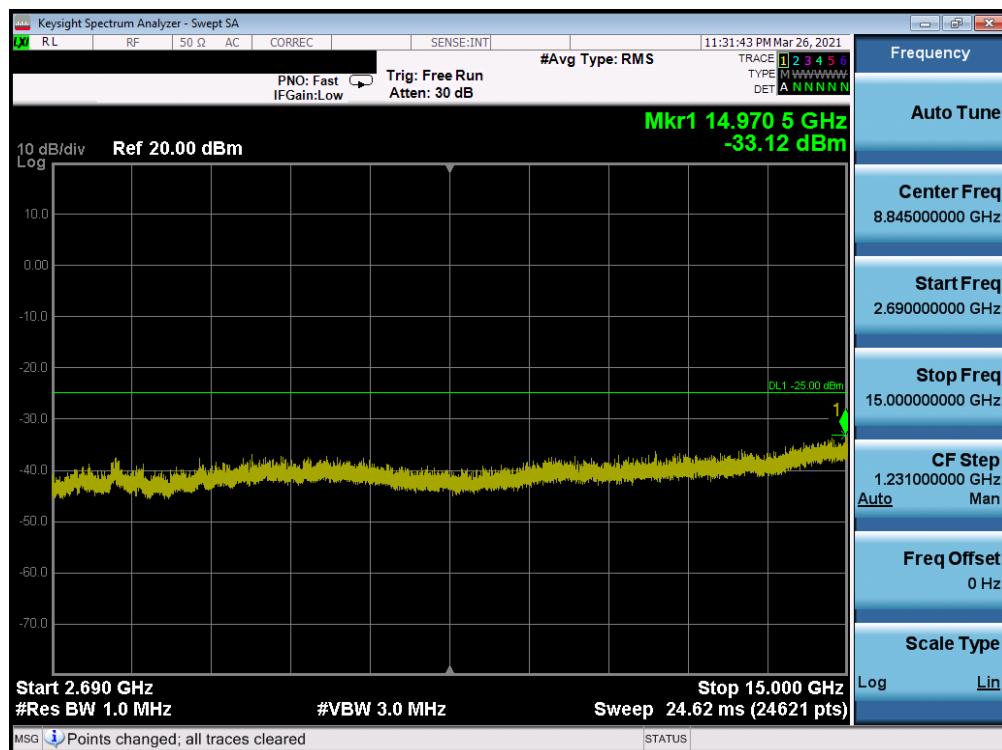


Plot 7-57. CSE (LTE Band 41 - 20MHz QPSK - RB Size 1, RB Offset 0 - Low Channel)

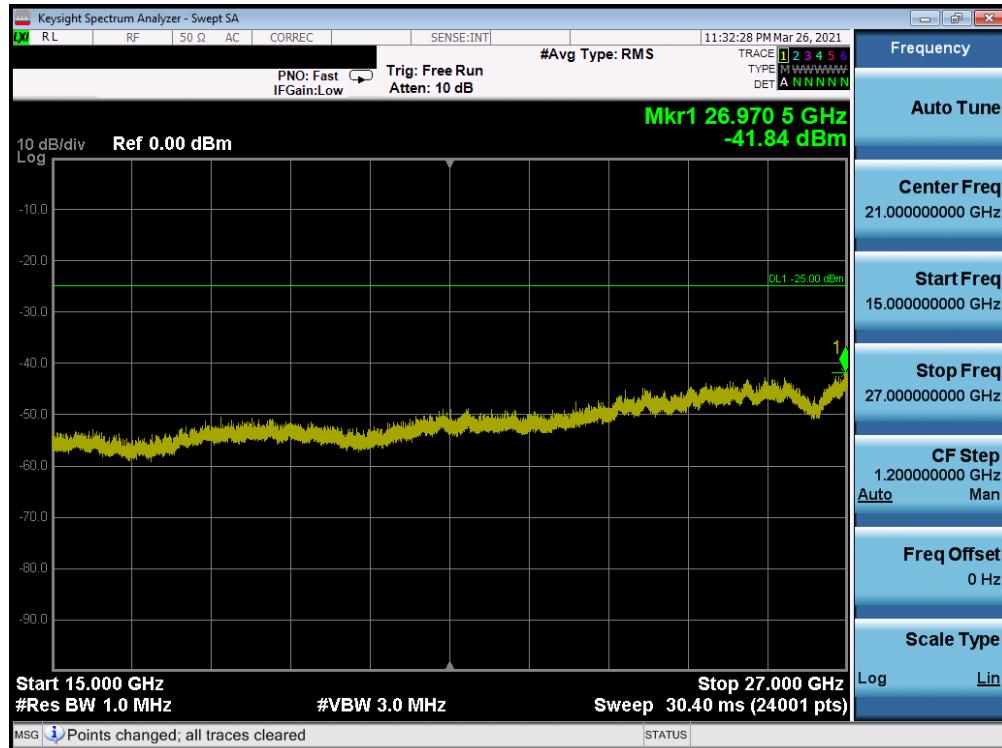


Plot 7-58. CSE (LTE Band 41 - 20MHz QPSK - RB Size 1, RB Offset 0 - Mid Channel)

FCC ID: BCGA2603	PART 27 MEASUREMENT REPORT			Approved by: Quality Manager
Test Report S/N: 1C2106080051-04.BCG	Test Dates: 6/7/2021 - 7/30/2021	EUT Type: Tablet Device		Page 46 of 102

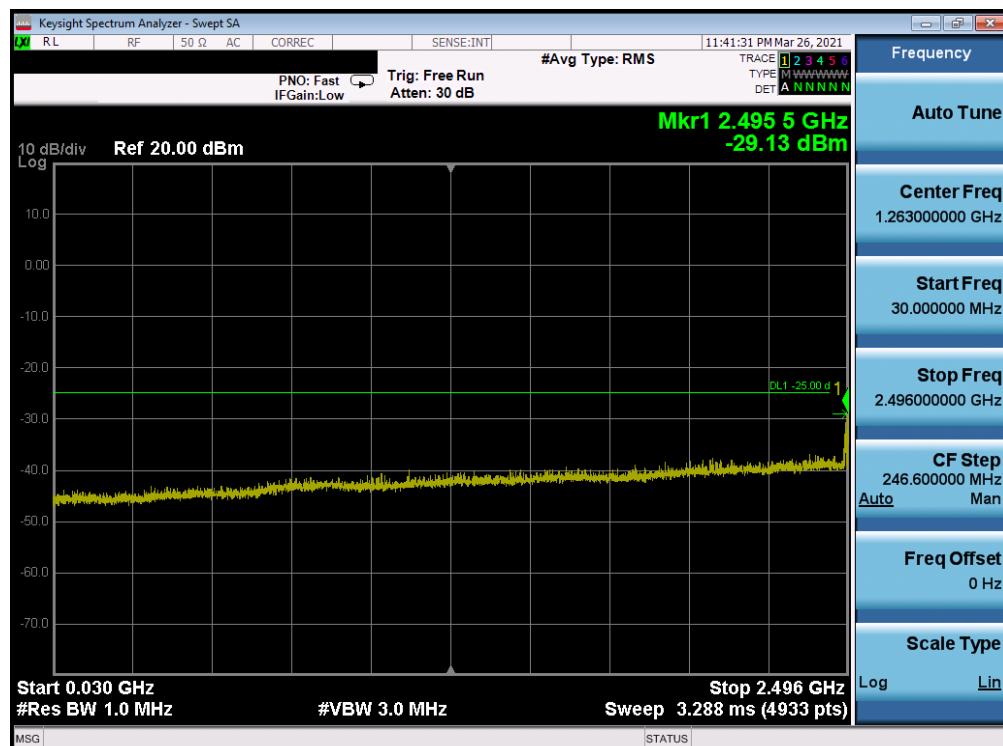


Plot 7-59. CSE (LTE Band 41 - 20MHz QPSK - RB Size 1, RB Offset 0 - Mid Channel)

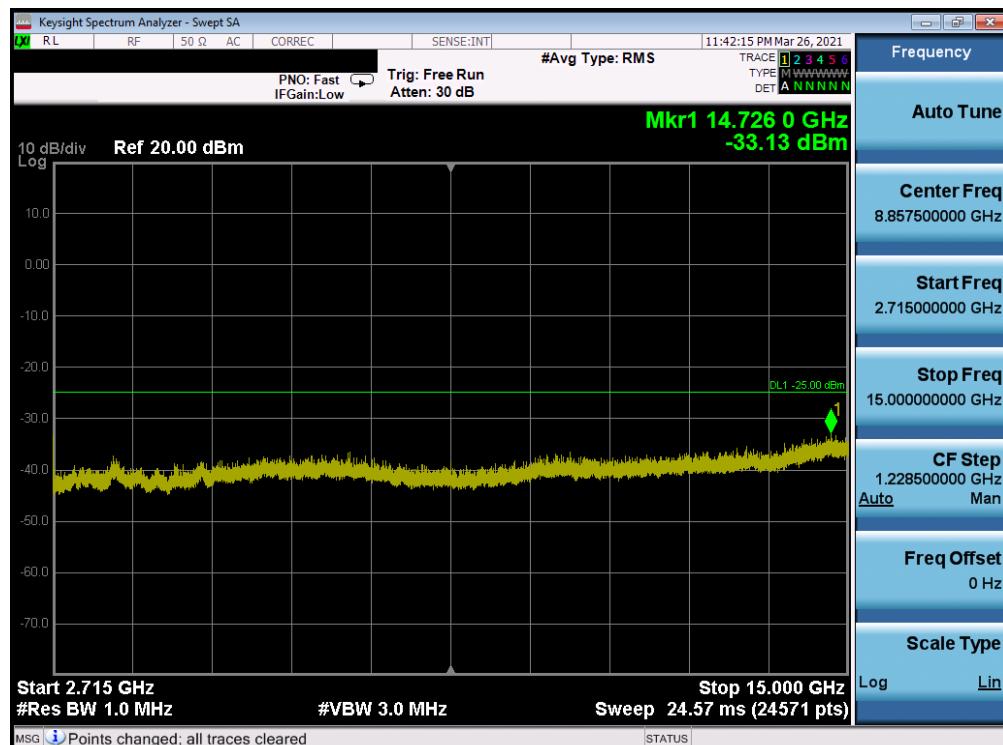


Plot 7-60. CSE (LTE Band 41 - 20MHz QPSK - RB Size 1, RB Offset 0 - Mid Channel)

FCC ID: BCGA2603	PART 27 MEASUREMENT REPORT			Approved by: Quality Manager
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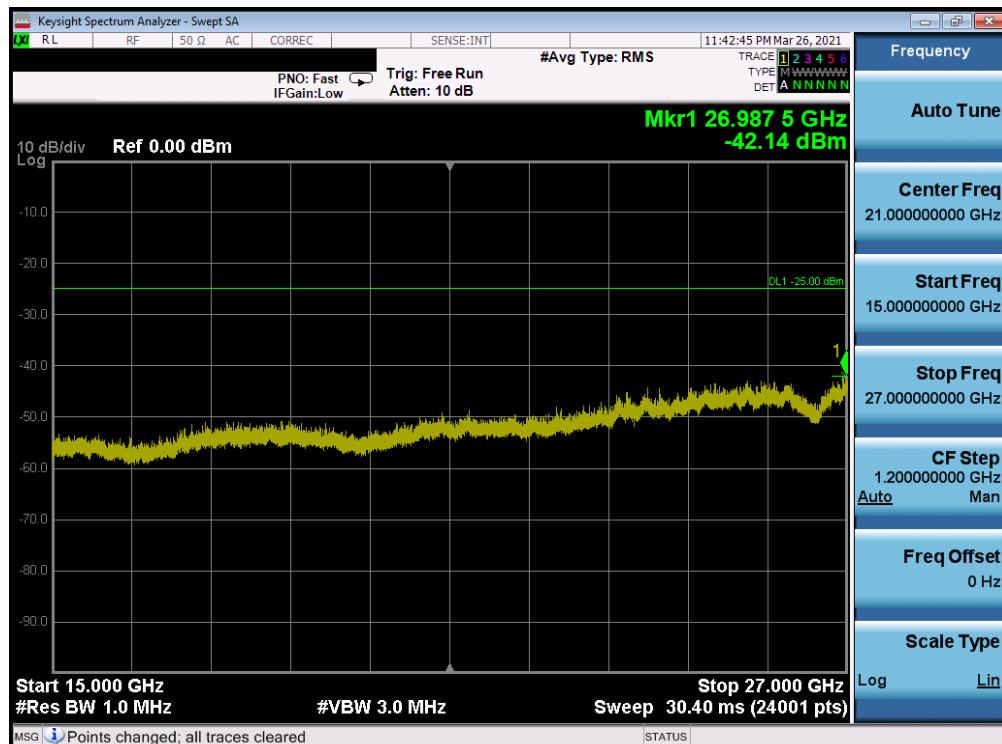


Plot 7-61. CSE (LTE Band 41 - 20MHz QPSK - RB Size 1, RB Offset 0 - High Channel)



Plot 7-62. CSE (LTE Band 41 - 20MHz QPSK - RB Size 1, RB Offset 0 - High Channel)

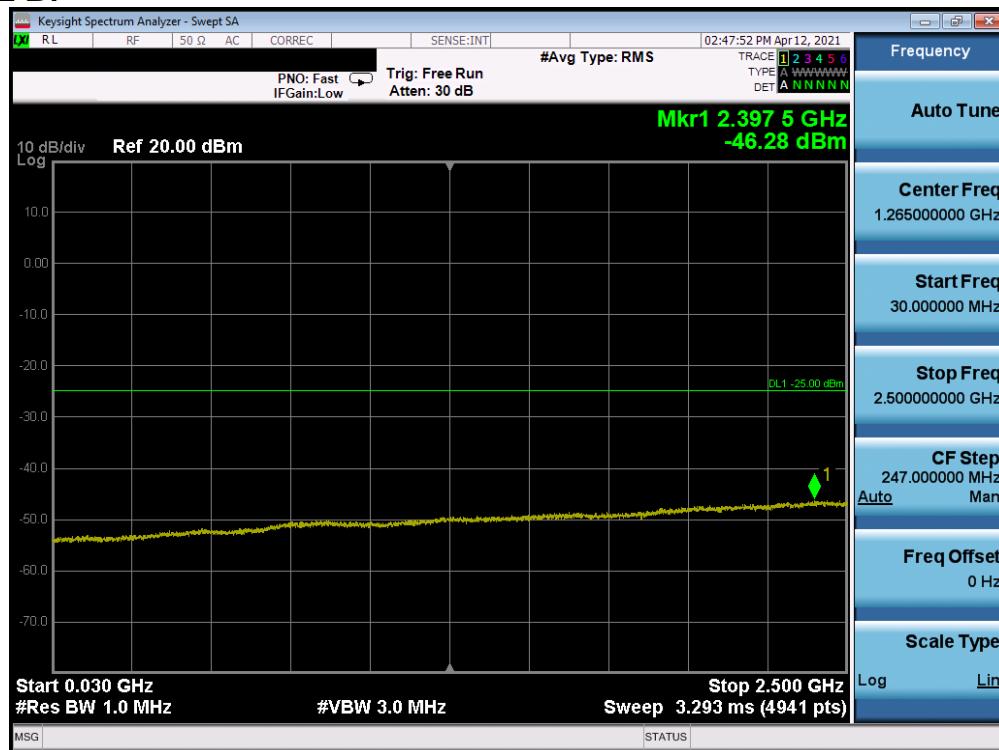
FCC ID: BCGA2603	PART 27 MEASUREMENT REPORT			Approved by: Quality Manager
Test Report S/N: 1C2106080051-04.BCG	Test Dates: 6/7/2021 - 7/30/2021	EUT Type: Tablet Device		Page 48 of 102



Plot 7-63. CSE (LTE Band 41 - 20MHz QPSK - RB Size 1, RB Offset 0 - High Channel)

FCC ID: BCGA2603	PART 27 MEASUREMENT REPORT			Approved by: Quality Manager
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## ULCA - LTE B7



Plot 7-64. CSE (ULCA LTE Band 7 - (20 + 20)MHz QPSK - PCC 1/99 SCC 1/0, - Mid Channel)



Plot 7-65. CSE (ULCA LTE Band 7 - (20 + 20)MHz QPSK - PCC 1/99 SCC 1/0, - Mid Channel)

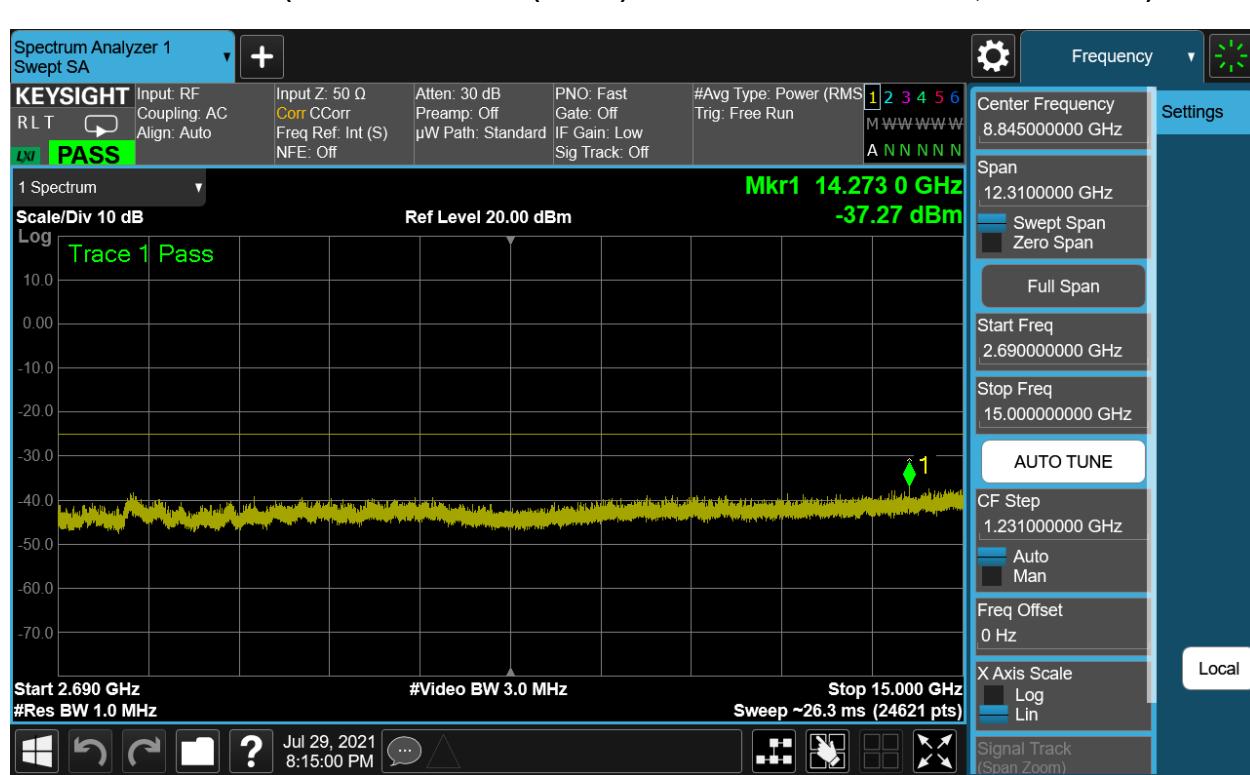
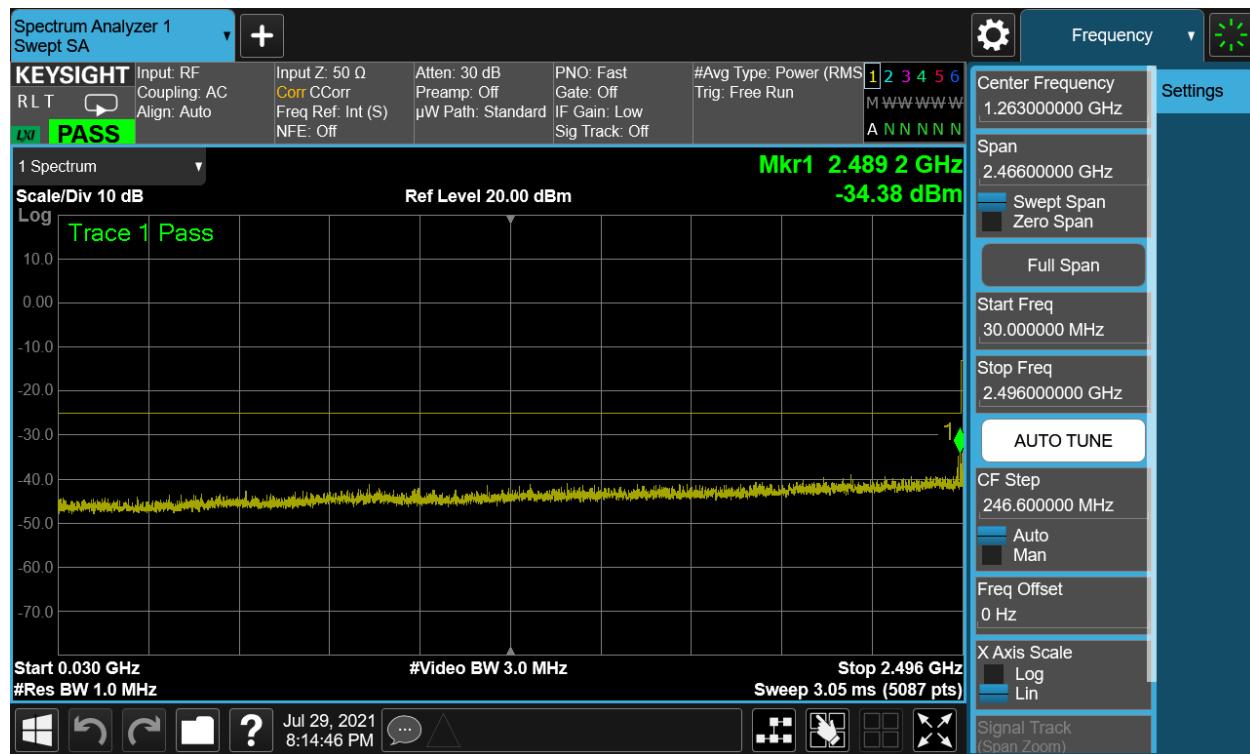
FCC ID: BCGA2603	 <b>PART 27 MEASUREMENT REPORT</b>			Approved by: Quality Manager
Test Report S/N: 1C2106080051-04.BCG	Test Dates: 6/7/2021 - 7/30/2021	EUT Type: Tablet Device		Page 50 of 102



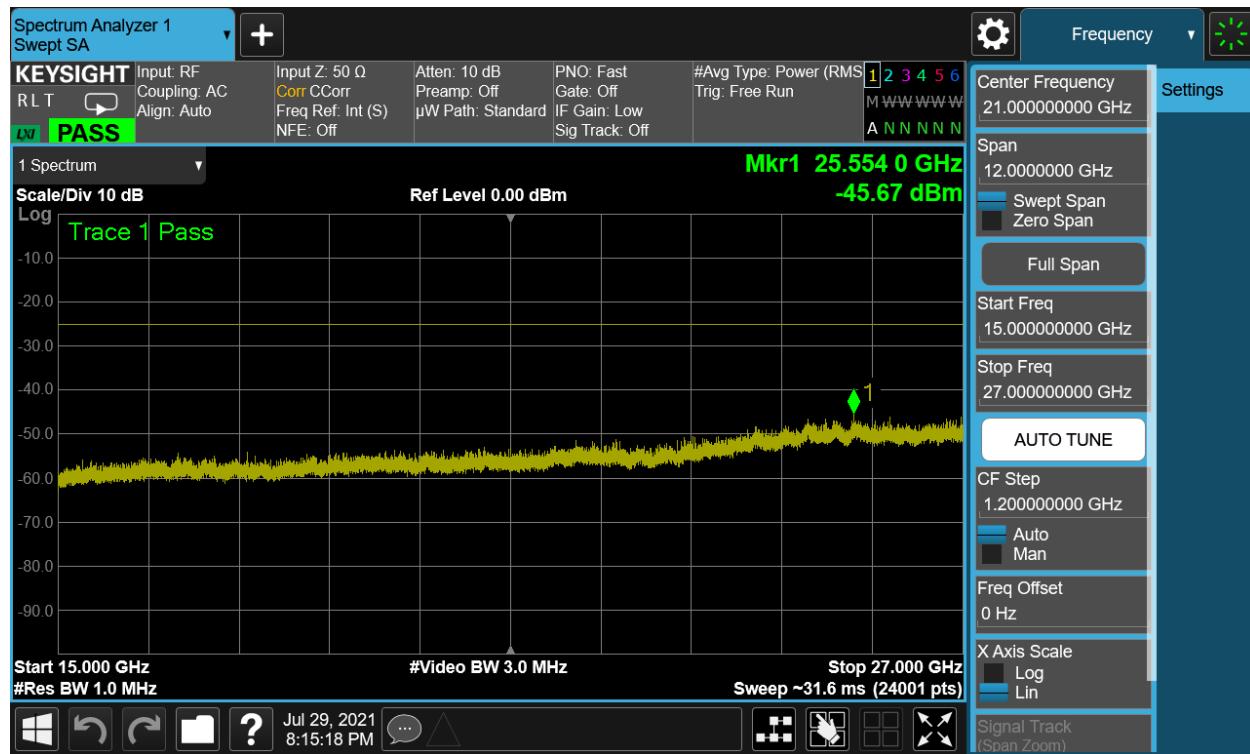
Plot 7-66. CSE (ULCA LTE Band 7 - (20 + 20)MHz QPSK - PCC 1/99 SCC 1/0, - Mid Channel)

FCC ID: BCGA2603	PART 27 MEASUREMENT REPORT			Approved by: Quality Manager
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## ULCA - LTE B41



FCC ID: BCGA2603	 <b>PART 27 MEASUREMENT REPORT</b>		Approved by: Quality Manager
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Plot 7-69. CSE (ULCA LTE Band 41 - (20 + 20)MHz QPSK - PCC 1/99 SCC 1/0, - Mid Channel)

FCC ID: BCGA2603	PART 27 MEASUREMENT REPORT			Approved by: Quality Manager
Test Report S/N: 1C2106080051-04.BCG	Test Dates: 6/7/2021 - 7/30/2021	EUT Type: Tablet Device		Page 53 of 102

## 7.4 Band Edge Emissions at Antenna Terminal

§2.1051, §27.53(a), §27.53(m)

### Test Overview

All out of band emissions are measured with a spectrum analyzer connected to the antenna terminal of the EUT while the EUT is operating at maximum power, and at the appropriate frequencies. All data rates were investigated to determine the worst case configuration. All modes of operation were investigated and the worst case configuration results are reported in this section. All ports were tested and only the worst case data was reported.

***The minimum permissible attenuation level for Band 30 is  $> 43 + 10 \log_{10} (P[\text{Watts}])$  at 2300-2305MHz & 2345-2360MHz,  $> 55 + 10 \log_{10} (P[\text{Watts}])$  at 2320-2324MHz & 2341-2345MHz,  $> 61 + 10 \log_{10} (P[\text{Watts}])$  at 2324-2328MHz & 2337-2341MHz,  $> 67 + 10 \log_{10} (P[\text{Watts}])$  at 2288-2292MHz & 2328-2337MHz, and  $> 70 + 10 \log_{10} (P[\text{Watts}])$  at frequencies  $< 2288\text{MHz}$  &  $> 2365\text{MHz}$ .***

***For LTE Bands 7 and 41 the minimum permissible attenuation level is noted in the Test Notes on the following page.***

### Test Procedure Used

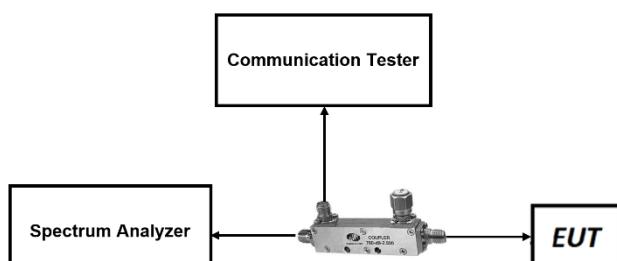
KDB 971168 D01 v03r01 – Section 6.0

### Test Settings

1. Start and stop frequency were set such that the band edge would be placed in the center of the plot
2. Span was set large enough so as to capture all out of band emissions near the band edge
3. RBW  $\geq 1\%$  of the emission bandwidth
4. VBW  $\geq 3 \times \text{RBW}$
5. Detector = RMS
6. Number of sweep points  $\geq 2 \times \text{Span/RBW}$
7. Trace mode = trace average for continuous emissions, max hold for pulse emissions
8. Sweep time = auto couple
9. The trace was allowed to stabilize

### Test Setup

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



**Figure 7-3. Test Instrument & Measurement Setup**

FCC ID: BCGA2603	 <b>PCTEST</b> Proud to be part of element		<b>PART 27 MEASUREMENT REPORT</b>	Approved by: Quality Manager
Test Report S/N: 1C2106080051-04.BCG	Test Dates: 6/7/2021 - 7/30/2021	EUT Type: Tablet Device		Page 54 of 102

## Test Notes

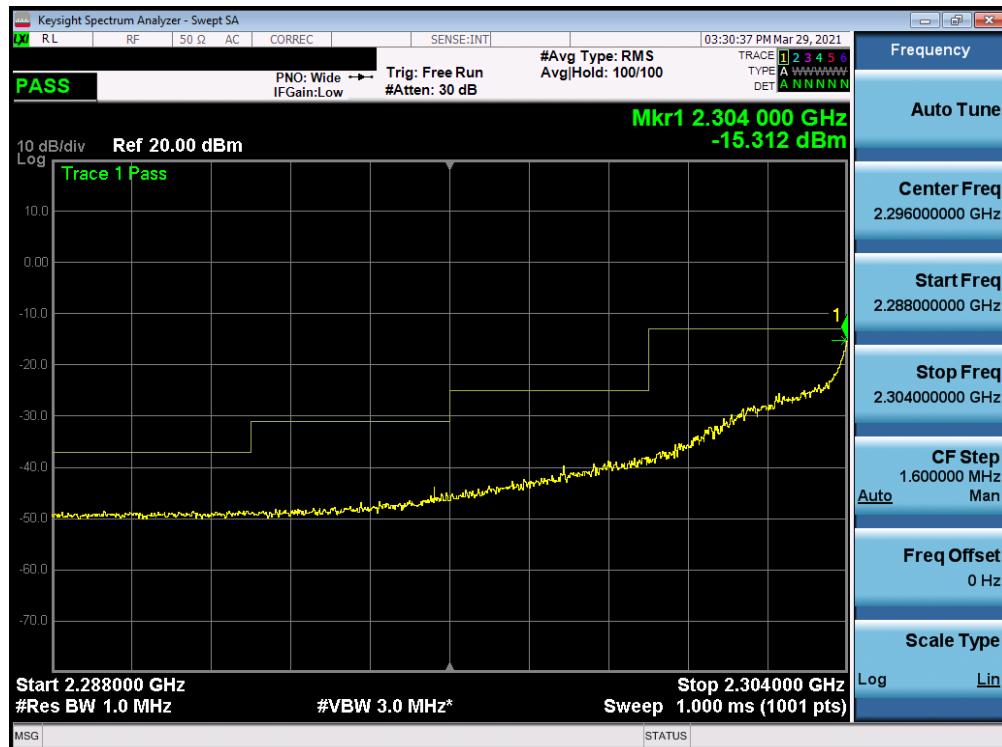
1. Per 27.53(h), in the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed to demonstrate compliance with the out-of-band emissions limit. The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emission are attenuated at least 26 dB below the transmitter power.
2. Per 27.53(a)(5) in the 1 MHz bands immediately outside and adjacent to the channel blocks at 2305, 2310, 2315, 2320, 2345, 2350, 2355, and 2360 MHz, a resolution bandwidth of at least 1 percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy provided the measured power is integrated over the full required measurement bandwidth (i.e., 1 MHz). The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.
3. Per 27.53(m) for operations in the BRS/EBS bands, the attenuation factor shall be not less than  $40 + 10 \log (P)$  dB on all frequencies between the channel edge and 5 megahertz from the channel edge,  $43 + 10 \log (P)$  dB on all frequencies between 5 megahertz and X megahertz from the channel edge, and  $55 + 10 \log (P)$  dB on all frequencies more than X megahertz from the channel edge, where X is the greater of 6 megahertz or the actual emission bandwidth. In addition, the attenuation factor shall not be less than  $43 + 10 \log (P)$  dB on all frequencies between 2490.5 MHz and 2496 MHz and  $55 + 10 \log (P)$  dB at or below 2490.5 MHz.

FCC ID: BCGA2603	 <b>PART 27 MEASUREMENT REPORT</b>			Approved by: Quality Manager
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## LTE Band 30



Plot 7-70. Lower Band Edge Plot (Band 30 - 5.0MHz QPSK - Full RB Configuration)

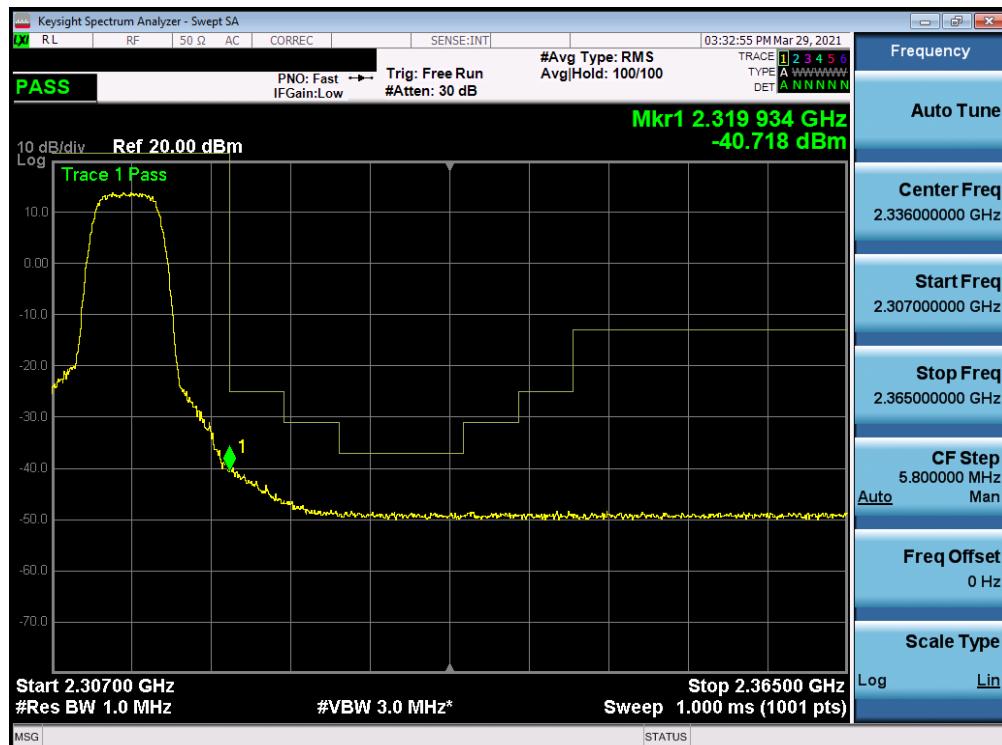


Plot 7-71. Lower Extended Band Edge Plot (Band 30 - 5.0MHz QPSK - Full RB Configuration)

FCC ID: BCGA2603	 <b>PCTEST</b> Proud to be part of Element		PART 27 MEASUREMENT REPORT	Approved by: Quality Manager
Test Report S/N: 1C2106080051-04.BCG	Test Dates: 6/7/2021 - 7/30/2021	EUT Type: Tablet Device		Page 56 of 102

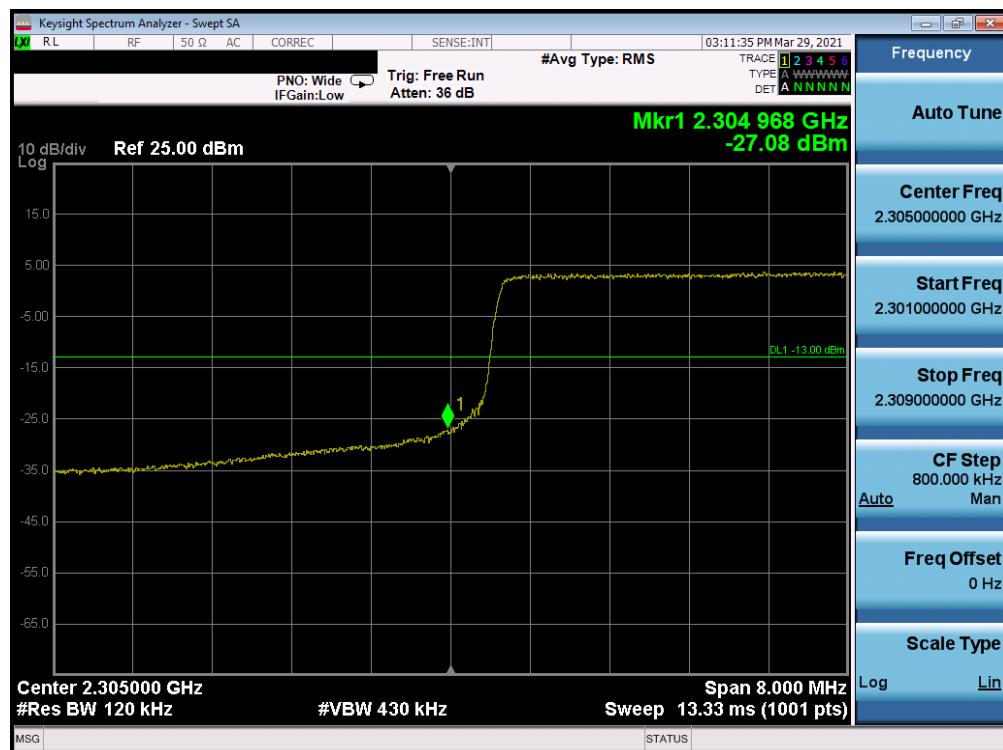


Plot 7-72. Upper Band Edge Plot (Band 30 - 5.0MHz QPSK - Full RB Configuration)



Plot 7-73. Upper Extended Band Edge Plot (Band 30 - 5.0MHz QPSK - Full RB Configuration)

FCC ID: BCGA2603	PART 27 MEASUREMENT REPORT			Approved by: Quality Manager
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Plot 7-74. Lower Band Edge Plot (Band 30 - 10.0MHz QPSK - Full RB Configuration)

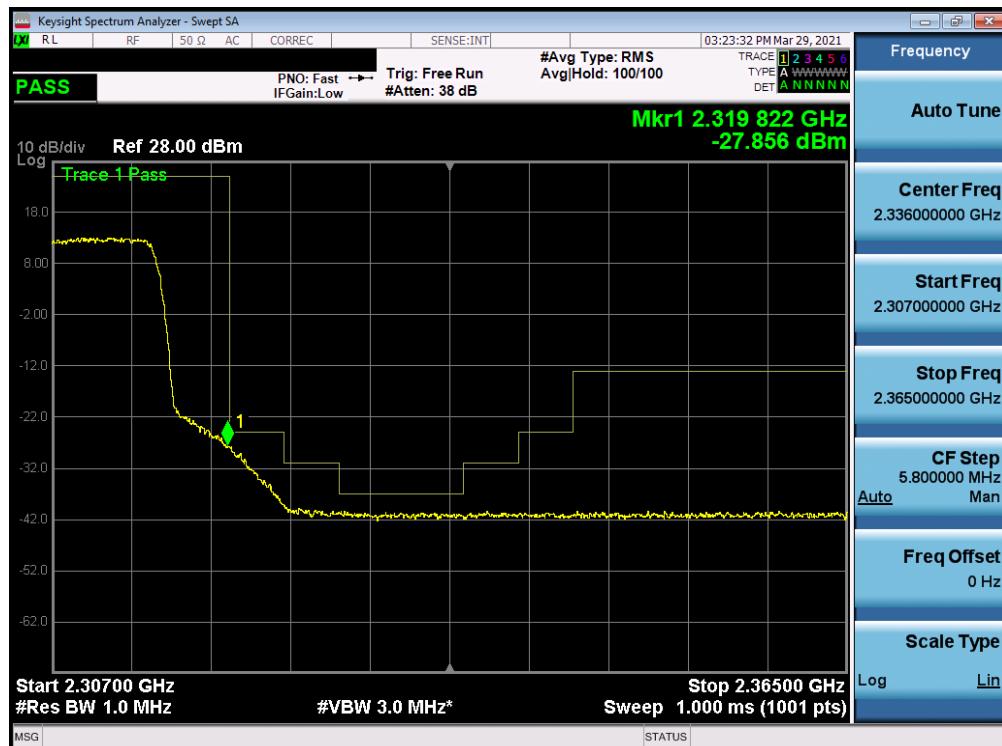


Plot 7-75. Lower Extended Band Edge Plot (Band 30 - 10.0MHz QPSK - Full RB Configuration)

FCC ID: BCGA2603	PART 27 MEASUREMENT REPORT			Approved by: Quality Manager
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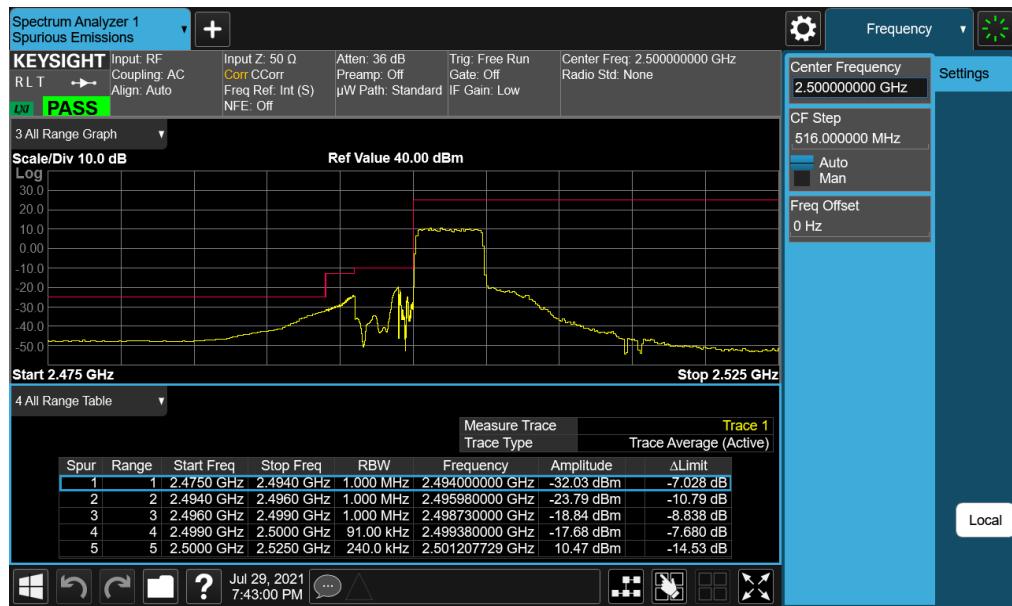
Plot 7-76. Upper Band Edge Plot (Band 30 - 10.0MHz QPSK - Full RB Configuration)



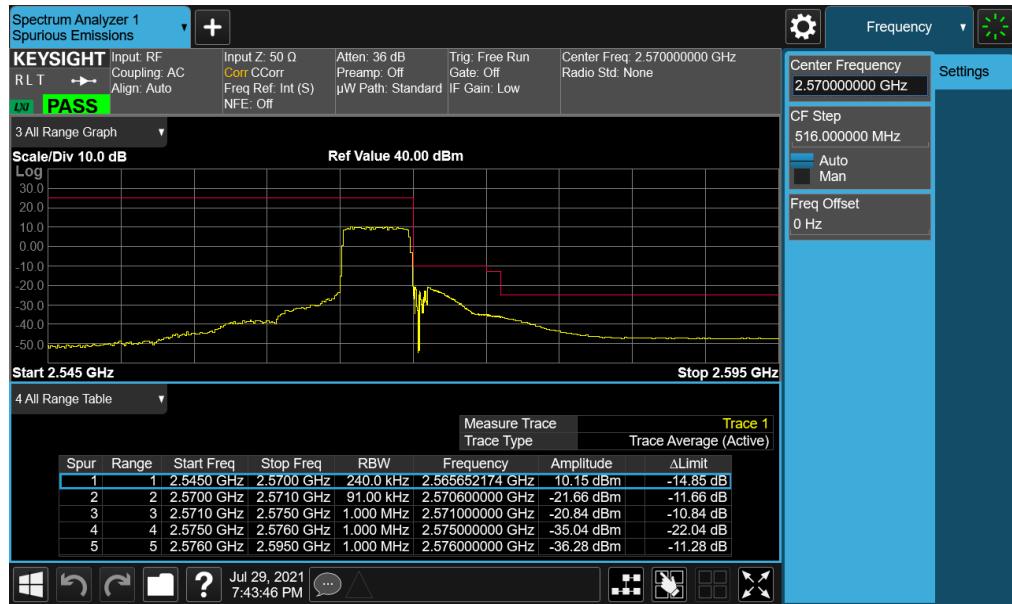
Plot 7-77. Upper Extended Band Edge Plot (Band 30 - 10.0MHz QPSK - Full RB Configuration)

FCC ID: BCGA2603	PART 27 MEASUREMENT REPORT			Approved by: Quality Manager
Test Report S/N: 1C2106080051-04.BCG	Test Dates: 6/7/2021 - 7/30/2021	EUT Type: Tablet Device		Page 59 of 102

## LTE Band 7



Plot 7-78. Lower ACP Plot (LTE Band 7 - 5MHz QPSK – Full RB Configuration)



Plot 7-79. Upper ACP Plot (LTE Band 7 - 5MHz QPSK – Full RB Configuration)

FCC ID: BCGA2603	PART 27 MEASUREMENT REPORT			Approved by: Quality Manager
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