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MEASUREMENT REPORT FCC Part 90

Applicant Name:

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

Date of Testing:

11/09/2018-02/11/2019

Test Site/Location:

PCTEST Lab. Morgan Hill, CA, USA

Test Report Serial No.:

1C1811080029-04.BCG

FCC ID:	BCGA2123
APPLICANT:	Apple Inc.

Application Type:

Certification

Model:

A2123, A2154

EUT Type:

Tablet Device

FCC Classification:

PCS Licensed Transmitter (PCB)

FCC Rule Part:

§2.1049, §90(S), §90(R)

Test Procedure(s):

ANSI C63.26-2015, ANSI/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

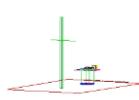
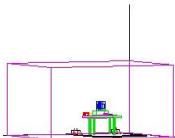


FCC ID: BCGA2123	PCTEST Engineering Laboratory, Inc.		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C1811080029-04.BCG	Test Dates: 11/09/2018-02/11/2019	EUT Type: Tablet Device	Page 1 of 61	

T A B L E O F C O N T E N T S

1.0	INTRODUCTION.....	4
	1.1 Scope.....	4
	1.2 PCTEST Test Location	4
	1.3 Test Facility / Accreditations.....	4
2.0	PRODUCT INFORMATION.....	5
	2.1 Equipment Description.....	5
	2.2 Device Capabilities	5
	2.3 Antenna Description.....	5
	2.4 Test Support Equipment.....	6
	2.5 Test Configuration	6
	2.6 Software and Firmware.....	6
	2.7 EMI Suppression Device(s)/Modifications	6
3.0	DESCRIPTION OF TESTS.....	7
	3.1 Evaluation Procedure.....	7
	3.2 Radiated Power and Radiated Spurious Emissions.....	7
4.0	MEASUREMENT UNCERTAINTY.....	8
5.0	TEST EQUIPMENT CALIBRATION DATA	9
6.0	SAMPLE CALCULATIONS.....	10
7.0	TEST RESULTS	11
	7.1 Summary.....	11
	7.2 Occupied Bandwidth.....	13
	7.3 Spurious and Harmonic Emissions at Antenna Terminal.....	23
	7.4 Band Edge Emissions at Antenna Terminal	30
	7.5 Conducted Power Output Data.....	39
	7.6 Radiated Power (ERP).....	42
	7.7 Radiated Spurious Emissions Measurements	45
	7.7.1 ANT WF3 (Port A) Radiated Spurious Emissions Measurements.....	47
	7.7.2 ANT WF5 (Port B) Radiated Spurious Emissions Measurements.....	52
	7.8 Frequency Stability / Temperature Variation.....	56
8.0	CONCLUSION	61

FCC ID: BCGA2123	 MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager
Test Report S/N: 1C1811080029-04.BCG	Test Dates: 11/09/2018-02/11/2019	EUT Type: Tablet Device	Page 2 of 61



MEASUREMENT REPORT

FCC Part 90

Mode	Tx Frequency (MHz)	Measurement	Max. Power (W)	Max. Power (dBm)	Emission Designator	Modulation
LTE Band 14	790.5 - 795.5	ERP	0.208	23.19	4M54G7W	QPSK
LTE Band 14	790.5 - 795.5	ERP	0.179	22.52	4M56D7W	16-QAM
LTE Band 14	790.5 - 795.5	ERP	0.141	21.50	4M55D7W	64-QAM
LTE Band 14	793	ERP	0.208	23.19	9M05G7W	QPSK
LTE Band 14	793	ERP	0.176	22.46	9M07D7W	16-QAM
LTE Band 14	793	ERP	0.137	21.38	9M06D7W	64-QAM
LTE Band 26	814.7 - 823.3	Conducted	0.355	25.50	1M09G7W	QPSK
LTE Band 26	814.7 - 823.3	Conducted	0.297	24.73	1M09D7W	16-QAM
LTE Band 26	814.7 - 823.3	Conducted	0.234	23.70	1M09D7W	64-QAM
LTE Band 26	815.5 - 822.5	Conducted	0.355	25.50	2M70G7W	QPSK
LTE Band 26	815.5 - 822.5	Conducted	0.303	24.81	2M70D7W	16-QAM
LTE Band 26	815.5 - 822.5	Conducted	0.234	23.70	2M71D7W	64-QAM
LTE Band 26	816.5 - 821.5	Conducted	0.355	25.50	4M51G7W	QPSK
LTE Band 26	816.5 - 821.5	Conducted	0.298	24.74	4M51D7W	16-QAM
LTE Band 26	816.5 - 821.5	Conducted	0.239	23.78	4M51D7W	64-QAM
LTE Band 26	819	Conducted	0.355	25.50	9M00G7W	QPSK
LTE Band 26	819	Conducted	0.310	24.91	9M02D7W	16-QAM
LTE Band 26	819	Conducted	0.245	23.90	9M02D7W	64-QAM

EUT Overview

FCC ID: BCGA2123	 MEASUREMENT REPORT (CERTIFICATION)			Approved by: Quality Manager
Test Report S/N: 1C1811080029-04.BCG	Test Dates: 11/09/2018-02/11/2019	EUT Type: Tablet Device	Page 3 of 61	

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 Engineering Laboratory, Inc. 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.

1.3 Test Facility / Accreditations

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

- PCTEST is an ISO 17025-2005 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.

FCC ID: BCGA2123	 MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager
Test Report S/N: 1C1811080029-04.BCG	Test Dates: 11/09/2018-02/11/2019	EUT Type: Tablet Device	Page 4 of 61

2.0 PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the **Apple Tablet Device FCC ID: BCGA2123**. 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 90(R) and 90(S).

Test Device Serial No.: DLXXT001LT6G, DLXXT00NLT6H

2.2 Device Capabilities

This device contains the following capabilities:

850/1900 GSM/GPRS/EDGE, 850/1700/1900 WCDMA/HSPA, Multi-band LTE, 802.11b/g/n WLAN, 802.11a/n/ac UNII, Bluetooth (1x, EDR, LE, HDR4, HDR8)

2.3 Antenna Description

Following antenna was used for testing.

Antennas	
Port A	Port B
WF3	WF5

Table 2-1. Antenna vs Ports

Frequency [MHz]	Antenna Gain (dBi)	
	Port A	Port B
700-800	-0.16	0.01
820-960	0.49	0.36

Table 2-2. Highest Antenna Gain

FCC ID: BCGA2123	PCTEST Engineering Laboratory, Inc.			MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C1811080029-04.BCG	Test Dates: 11/09/2018-02/11/2019	EUT Type: Tablet Device			

2.4 Test Support Equipment

1	Apple MacBook w/AC/DC Adapter	Model: A1398 Model: A1435	S/N: C2QKP008F6F3 S/N: C04325505K1F288BG
2	Apple Lightning Cable	Model: Kanzi	S/N: 3252E9
3	USB Lightning Cable w/ AC Adapter	Model: N/A Model: A1385	S/N: N/A S/N: D292066H2NLDHLHAE
4	Apple Pencil	Model: A1603	S/N: G64TG0FEGWTJ
5	DC Power Supply	Model: KPS3010D	S/N: N/A

Table 2-3. Test Support Equipment Used

2.5 Test Configuration

The EUT was tested per the guidance of ANSI/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.

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.

The emissions below 1GHz and above 18GHz were tested with the highest transmitting power channel and the worst case configuration.

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 16E31520i 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.

FCC ID: BCGA2123	PCTEST Engineering Laboratory, Inc.		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C1811080029-04.BCG	Test Dates: 11/09/2018-02/11/2019	EUT Type: Tablet Device	Page 6 of 61	

3.0 DESCRIPTION OF TESTS

3.1 Evaluation Procedure

The measurement procedures described in the document titled “Land Mobile FM or PM – Communications Equipment – Measurements and Performance Standards” (ANSI/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 Power and Radiated Spurious Emissions

§2.1053, §90.635, §90.691, §90.543

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 wooden turntable 80cm above the ground plane and 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. Radiated power levels are also investigated with the receive antenna horizontally and vertically polarized. The maximized power level is recorded using the spectrum analyzer “Channel Power” function with the integration band set to the emissions’ occupied bandwidth, a RMS detector, RBW = 100kHz, VBW = 300kHz, and a 1 second sweep time over a minimum of 10 sweeps, per the guidelines of KDB 971168 D01 v03r01.

Per the guidance of ANSI/TIA-603-E-2016, a half-wave dipole is then substituted in place of the EUT. For emissions above 1GHz, a horn antenna is substituted in place of the EUT. The substitute antenna is driven by a signal generator with the level of the signal generator being adjusted to obtain the same receive spectrum analyzer level previously recorded from the spurious emission from the EUT. The power of the emission is calculated using the following formula:

$$P_d \text{ [dBm]} = P_g \text{ [dBm]} - \text{cable loss [dB]} + \text{antenna gain [dBd/dBi]}$$

Where, P_d is the dipole equivalent power, P_g is the generator output into the substitution antenna, and the antenna gain is the gain of the substitute antenna used relative to either a half-wave dipole (dBd) or an isotropic source (dBi). The substitute level is equal to $P_g \text{ [dBm]} - \text{cable loss [dB]}$.

The calculated P_d levels are then compared to the absolute spurious emission limit of -13dBm which is equivalent to the required minimum attenuation of $43 + 10\log_{10}(\text{Power [Watts]})$ specified in 90.691.

For fundamental radiated power measurements, the guidance of KDB 971168 D01 v03r01 is used to record the EUT power level that is subsequently matched via the aforementioned substitution method given in ANSI/TIA-603-E-2016.

FCC ID: BCGA2123	MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager
Test Report S/N: 1C1811080029-04.BCG	Test Dates: 11/09/2018-02/11/2019	EUT Type: Tablet Device	Page 7 of 61

4.0 MEASUREMENT UNCERTAINTY

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.4-2014. 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	1.29
Radiated Disturbance (<1GHz)	4.15
Radiated Disturbance (>1GHz)	4.70
Radiated Disturbance (>18GHz)	5.01
Temperature	0.01

FCC ID: BCGA2123	 MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager
Test Report S/N: 1C1811080029-04.BCG	Test Dates: 11/09/2018-02/11/2019	EUT Type: Tablet Device	Page 8 of 61

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
ATM	180-442A-KF	20dB Nominal Gain Horn Antenna	3/13/2018	Annual	3/13/2019	T058601-02
COM-POWER	LIN-120A	LISN	3/7/2018	Annual	3/7/2019	241296
ESPEC	SU-241	Temperature Chamber	8/10/2018	Annual	8/10/2019	92009574
Keysight Technologies	N9030A	3Hz-44GHz PXA Signal Analyzer	2/27/2018	Annual	2/27/2019	MY49430244
Rohde & Schwarz	FSV40	Signal Analyzer (10Hz-40GHz)	2/6/2018	Annual	2/6/2019	101619
Rohde & Schwarz	ESW26	EMI Test Receiver	7/19/2018	Annual	7/19/2019	101299
Rohde & Schwarz	ESW44	EMI Test Receiver	11/20/2018	Annual	11/20/2019	101570
Rohde & Schwarz	CMW500	Wideband Radio Communication Tester	6/11/2018	Annual	6/11/2019	161675
Rohde & Schwarz	CMW500	Wideband Radio Communication Tester	4/16/2018	Annual	4/16/2019	161617
Rohde & Schwarz	CMW500	Wideband Radio Communication Tester	11/16/2018	Annual	11/16/2019	164175
Rohde & Schwarz	TS-PR1840	Pre-Amplifier (18GHz - 40GHz)	6/11/2018	Annual	6/11/2019	100051
Rohde & Schwarz	TS-PR8	Pre-Amplifier (30MHz - 8GHz)	1/25/2018	Annual	1/25/2019	102333
Rohde & Schwarz	HL562E	Ultra Broadband Antenna (30MHz - 6GHz)	6/8/2018	Annual	6/8/2019	100810
Rohde & Schwarz	TC-TA18	Cross Polarized Vivaldi Antenna (400MHz-18GHz)	11/21/2018	Annual	11/21/2019	101057
Rohde & Schwarz	TC-TA18	Cross Polarized Vivaldi Antenna (400MHz-18GHz)	12/7/2018	Annual	12/7/2019	101063
Rohde & Schwarz	HFH2-Z2	Loop Antenna	3/13/2018	Annual	3/13/2019	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.
2. Equipment with a calibration date of "N/A" shown in this list was not used to make direct calibrated measurements.

FCC ID: BCGA2123	PCTEST Engineering Laboratory, Inc.			MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C1811080029-04.BCG	Test Dates: 11/09/2018-02/11/2019	EUT Type: Tablet Device			

6.0 SAMPLE CALCULATIONS

Emission Designator

QPSK Modulation

Emission Designator = 8M62G7D

LTE BW = 8.62 MHz

G = Phase Modulation

7 = Quantized/Digital Info

D = Data transmission, telemetry, telecommand

16QAM Modulation

Emission Designator = 8M45W7D

LTE BW = 8.45 MHz

W = Amplitude/Angle Modulated

7 = Quantized/Digital Info

D = Data transmission, telemetry, telecommand

Spurious Radiated Emission – LTE Band

Example: Middle Channel LTE Mode 2nd Harmonic (1564 MHz)

The average 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 1564 MHz. So 6.1 dB is added to the signal generator reading of -30.9 dBm yielding -24.80 dBm. The fundamental EIRP was 25.501 dBm so this harmonic was 25.501 dBm - (-24.80).

FCC ID: BCGA2123	 MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager
Test Report S/N: 1C1811080029-04.BCG	Test Dates: 11/09/2018-02/11/2019	EUT Type: Tablet Device	Page 10 of 61

7.0 TEST RESULTS

7.1 Summary

Company Name: Apple Inc.
 FCC ID: BCGA2123
 FCC Classification: PCS Licensed Transmitter Held to Ear (PCE)
 Mode(s): LTE
 Band: Band 26 / Band 14

FCC Part Section(s)	Test Description	Test Limit	Test Condition	Test Result	Reference
2.1049	Occupied Bandwidth	N/A		PASS	Section 7.2
2.1051 90.691(a) 90.543(e)	Conducted Band Edge / Spurious Emissions	On all frequencies between 769-775 MHz and 799-805 MHz, attenuation by a factor not less than $65 + 10\log(P)$ dB in a 6.25 kHz band segment, for mobile and portable stations. On any frequency between 775-788 MHz, above 805 MHz, and below 758 MHz, attenuation by at least $43 + 10\log(P)$ dB. $> 43 + \log_{10}(P[\text{Watts}])$ for all out-of-band emissions except $> 50 + 10\log_{10}(P[\text{Watts}])$ at Band Edge and for all out-of-band emissions within 37.5kHz of Block Edge	CONDUCTED	PASS	Sections 7.3, 7.4
2.1055 90.213	Frequency Stability	< 2.5 ppm		PASS	Section 7.8
2.1046 90.635	Conducted Power	< 100 Watts		PASS	Section 7.5
90.542(a)(7)	Effective Radiated Power (Band 14)	< 3 Watts max. ERP		PASS	Section 7.6
2.1053 90.691(a) 90.543(e)	Radiated Spurious Emissions	$> 43 + \log_{10}(P[\text{Watts}])$ for all out-of-band emissions except $> 50 + 10\log_{10}(P[\text{Watts}])$ at Band Edge and for all out-of-band emissions within 37.5kHz of Block Edge	RADIATED	PASS	Section 7.7

Table 7-1. Summary of Test Results

FCC ID: BCGA2123	 MEASUREMENT REPORT (CERTIFICATION)			Approved by: Quality Manager
Test Report S/N: 1C1811080029-04.BCG	Test Dates: 11/09/2018-02/11/2019	EUT Type: Tablet Device	Page 11 of 61	

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 shown in Section 7.0 were 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) 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 "2G/3G Automation," Version 3.9.
- 5) All ports were investigated and only the worst case data was reported.

FCC ID: BCGA2123	 MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager
Test Report S/N: 1C1811080029-04.BCG	Test Dates: 11/09/2018-02/11/2019	EUT Type: Tablet Device	Page 12 of 61

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.

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.

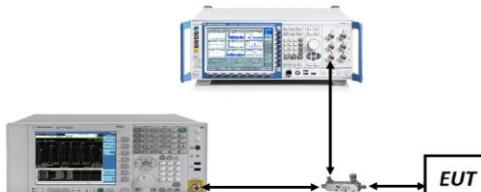


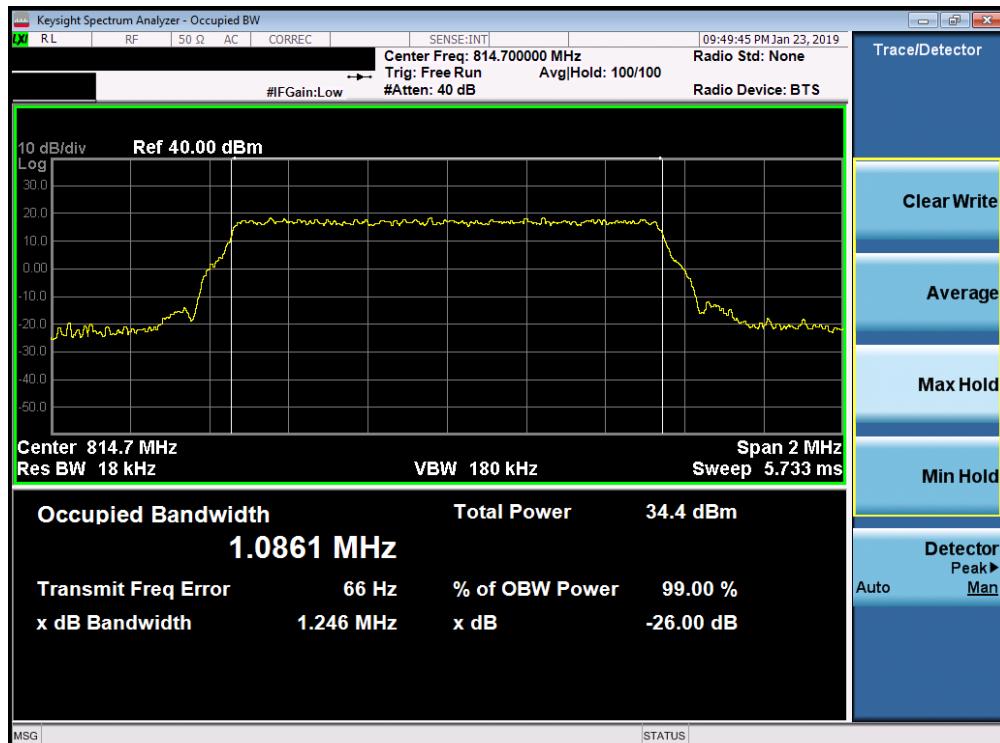
Figure 7-1. Test Instrument & Measurement Setup

Test Notes

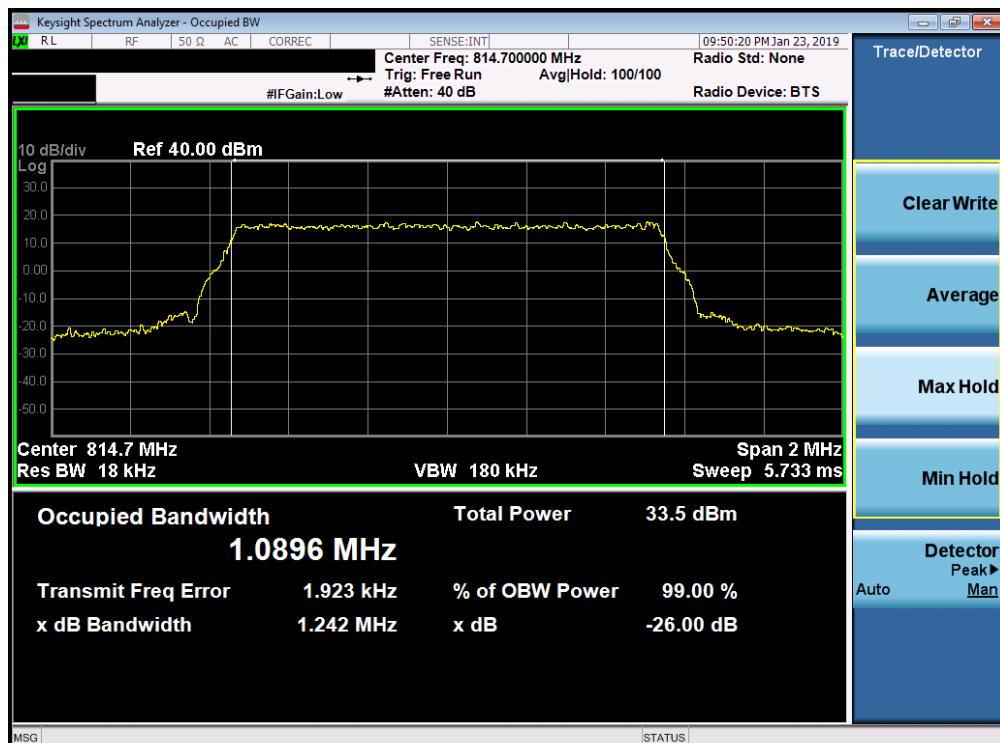
None.

FCC ID: BCGA2123	PCTEST Engineering Laboratory, Inc.		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C1811080029-04.BCG	Test Dates: 11/09/2018-02/11/2019	EUT Type: Tablet Device	Page 13 of 61	

LTE Band 26

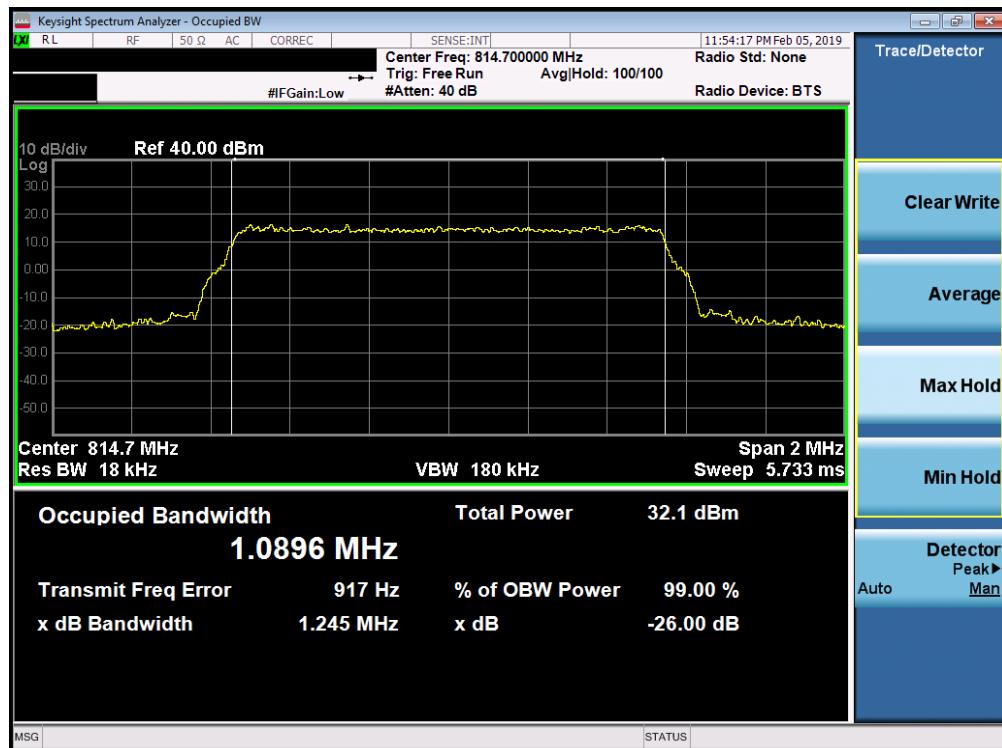


Plot 7-1. Occupied Bandwidth Plot (LTE Band 26, 1.4MHz QPSK – RB Size 6– Low Channel)

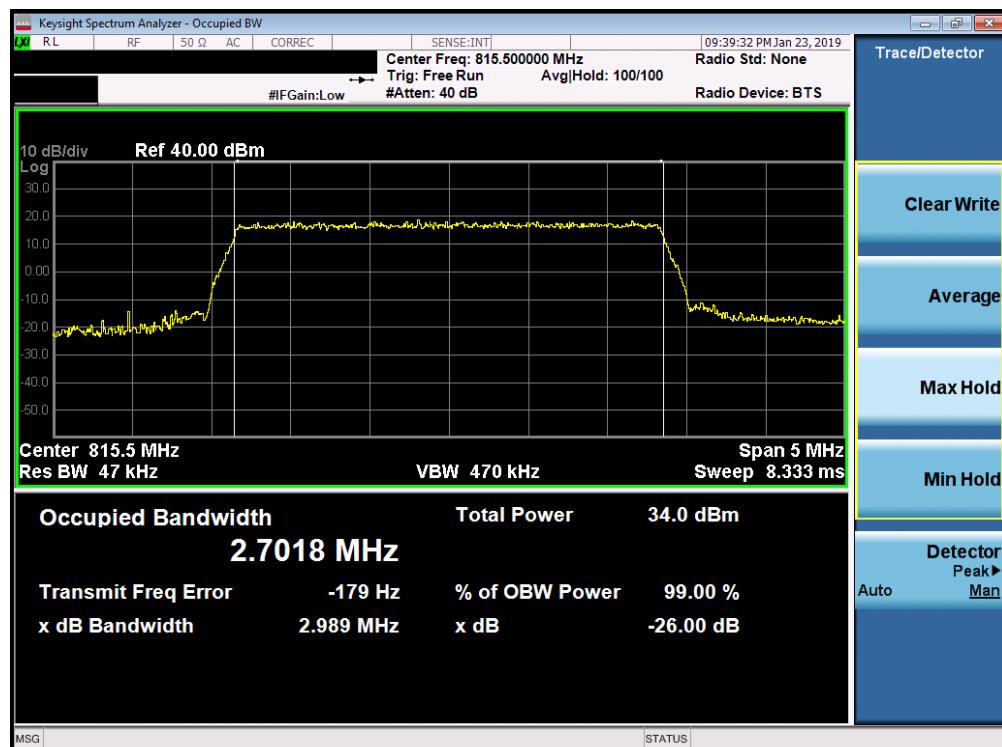


Plot 7-2. Occupied Bandwidth Plot (LTE Band 26, 1.4MHz 16-QAM – RB Size 6– Low Channel)

FCC ID: BCGA2123	PCTEST Engineering Laboratory, Inc.			MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C1811080029-04.BCG	Test Dates: 11/09/2018-02/11/2019	EUT Type: Tablet Device			Page 14 of 61

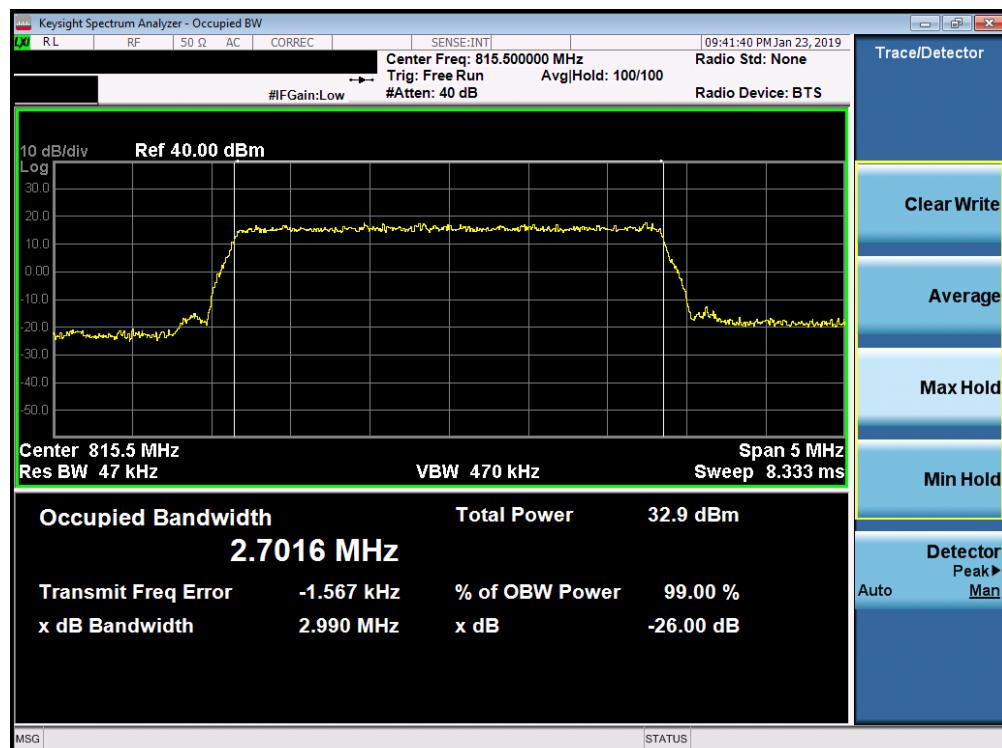


Plot 7-3. Occupied Bandwidth Plot (LTE Band 26, 1.4MHz 64-QAM – RB Size 6– Low Channel)

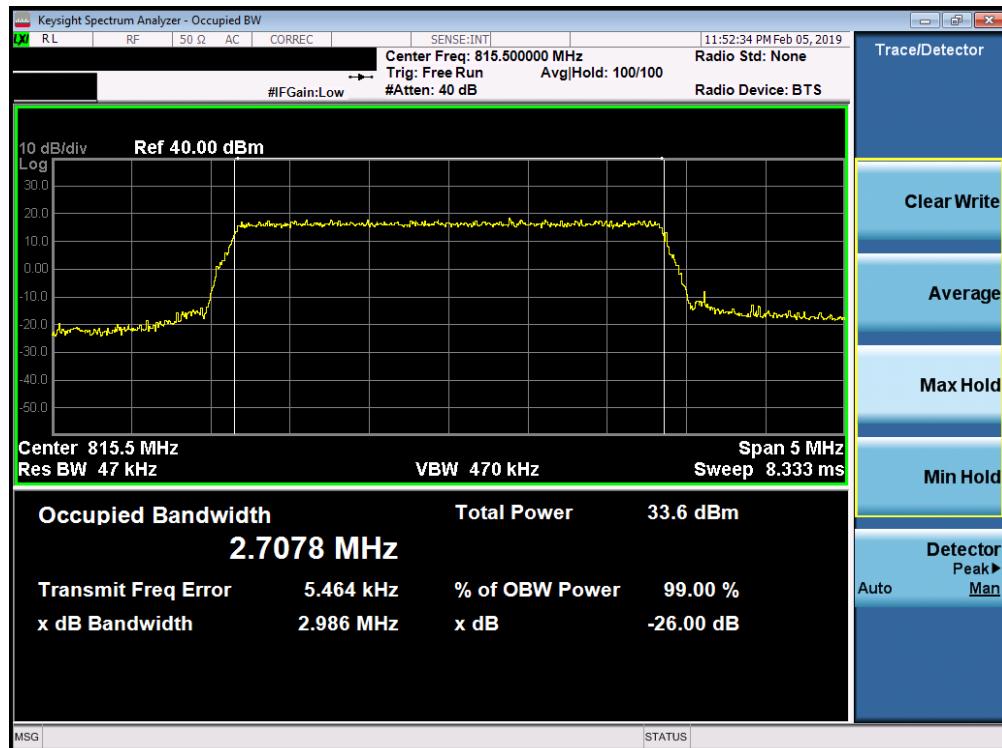


Plot 7-4. Occupied Bandwidth Plot (LTE Band 26, 3MHz QPSK – RB Size 15– Low Channel)

FCC ID: BCGA2123	 MEASUREMENT REPORT (CERTIFICATION)			Approved by: Quality Manager
Test Report S/N: 1C1811080029-04.BCG	Test Dates: 11/09/2018-02/11/2019	EUT Type: Tablet Device	Page 15 of 61	

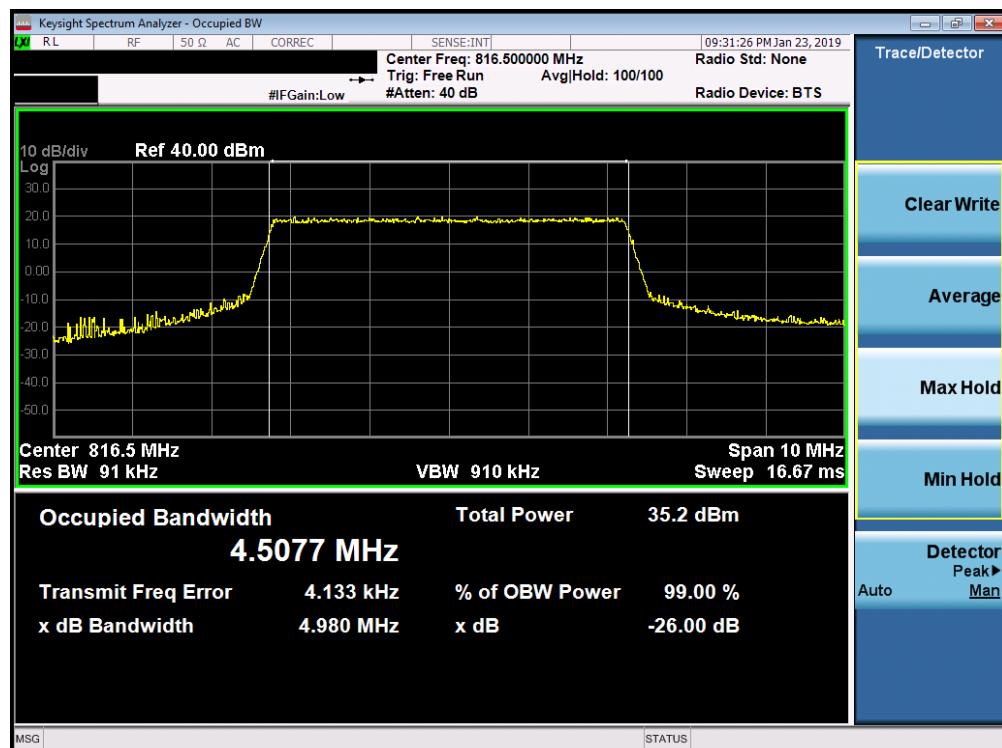


Plot 7-5. Occupied Bandwidth Plot (LTE Band 26, 3MHz 16-QAM – RB Size 15 – Low Channel)

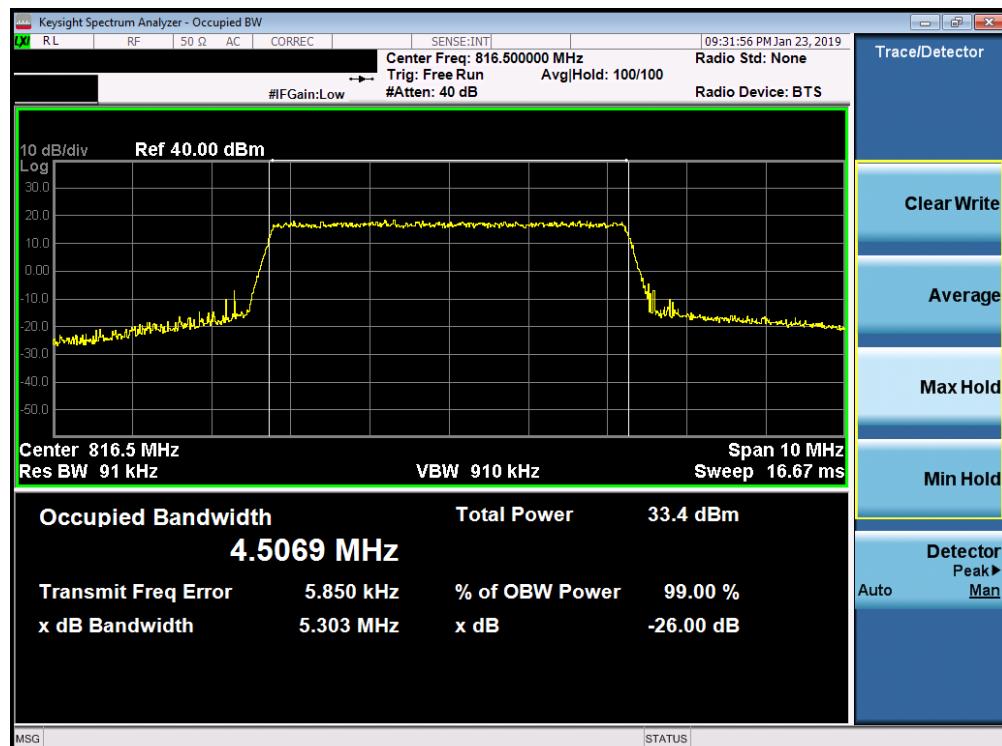


Plot 7-6. Occupied Bandwidth Plot (LTE Band 26, 3MHz 64-QAM – RB Size 15 – Low Channel)

FCC ID: BCGA2123	PCTEST® Engineering Laboratory, Inc.			MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C1811080029-04.BCG	Test Dates: 11/09/2018-02/11/2019	EUT Type: Tablet Device			

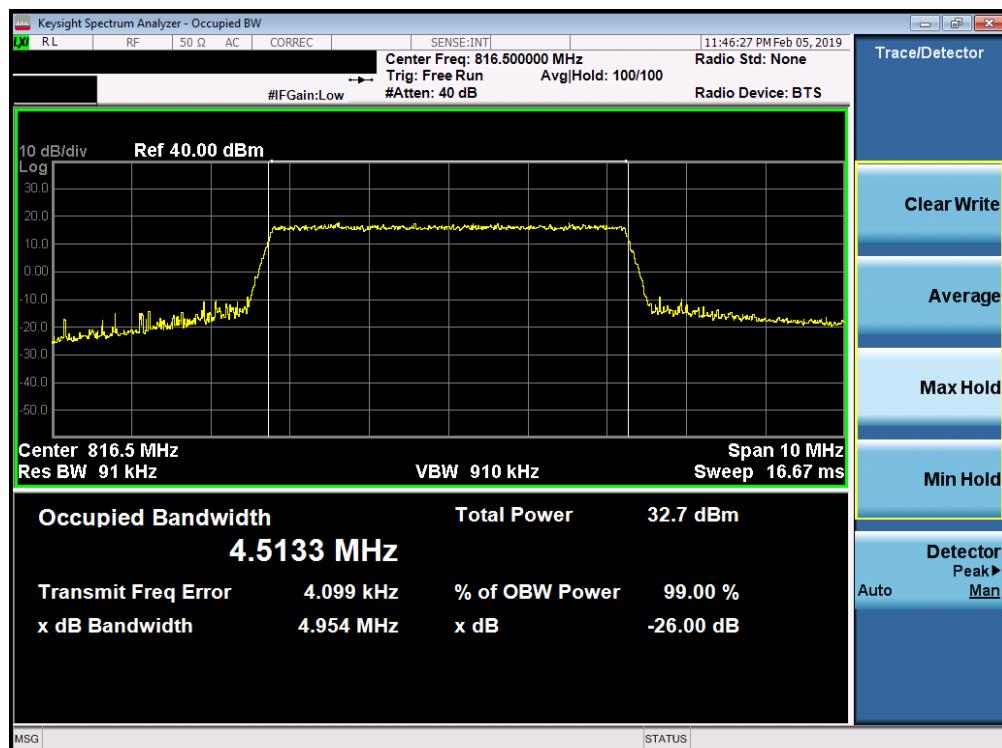


Plot 7-7. Occupied Bandwidth Plot (LTE Band 26, 5MHz QPSK – RB Size 25– Low Channel)

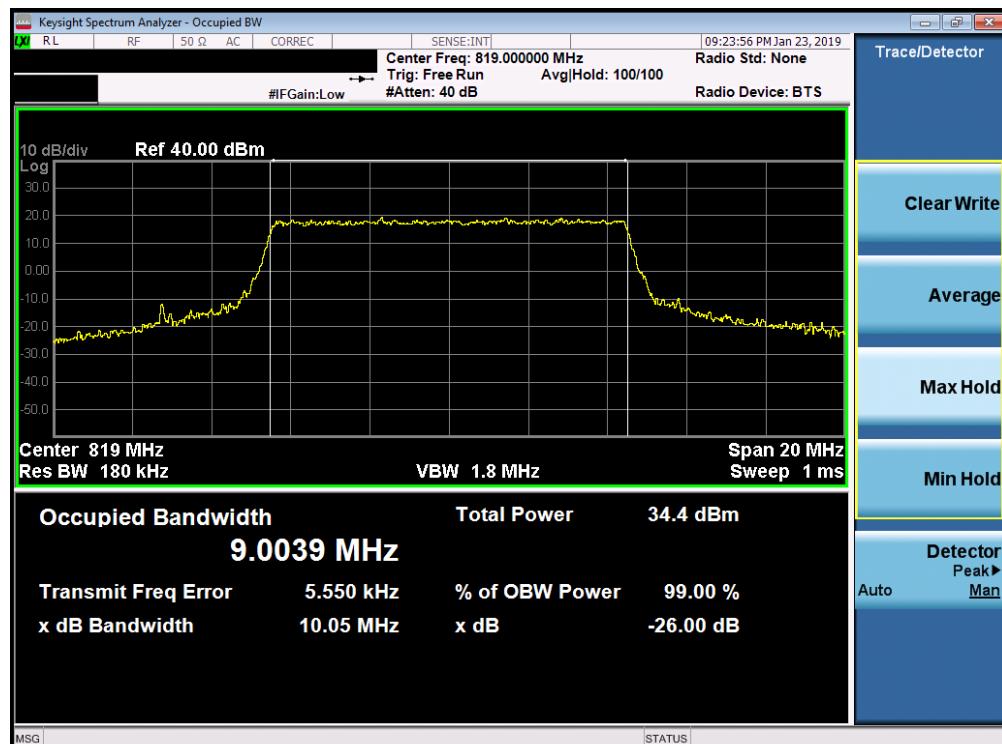


Plot 7-8. Occupied Bandwidth Plot (LTE Band 26, 5MHz 16-QAM – RB Size 25– Low Channel)

FCC ID: BCGA2123	 MEASUREMENT REPORT (CERTIFICATION)			Approved by: Quality Manager
Test Report S/N: 1C1811080029-04.BCG	Test Dates: 11/09/2018-02/11/2019	EUT Type: Tablet Device	Page 17 of 61	

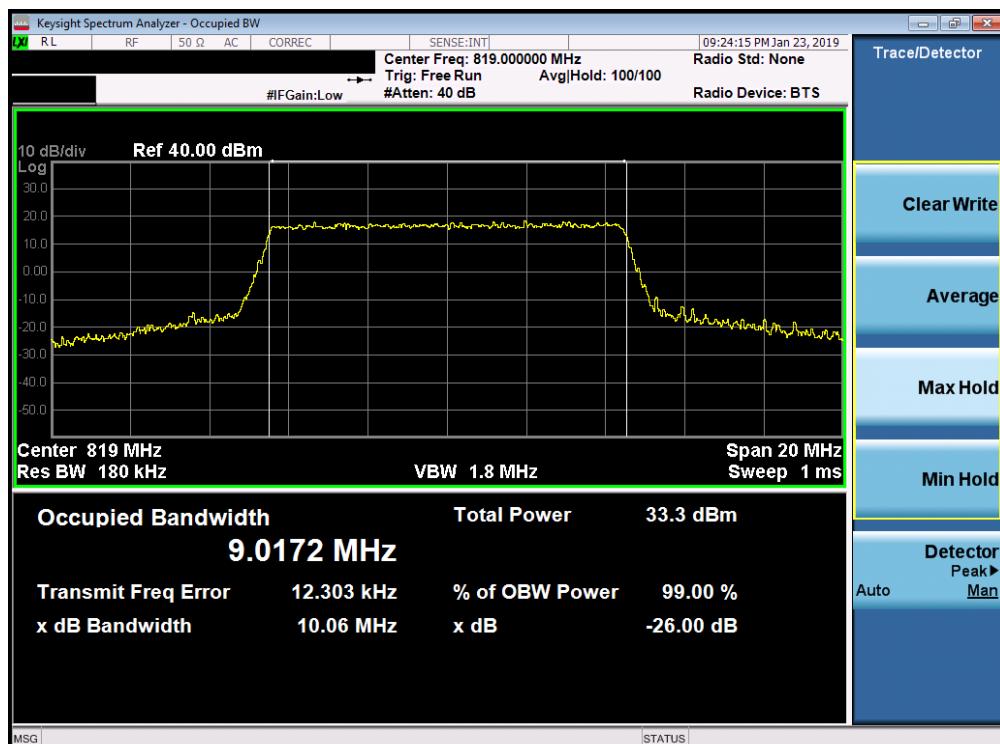


Plot 7-9. Occupied Bandwidth Plot (LTE Band 26, 5MHz 64-QAM – RB Size 25– Low Channel)

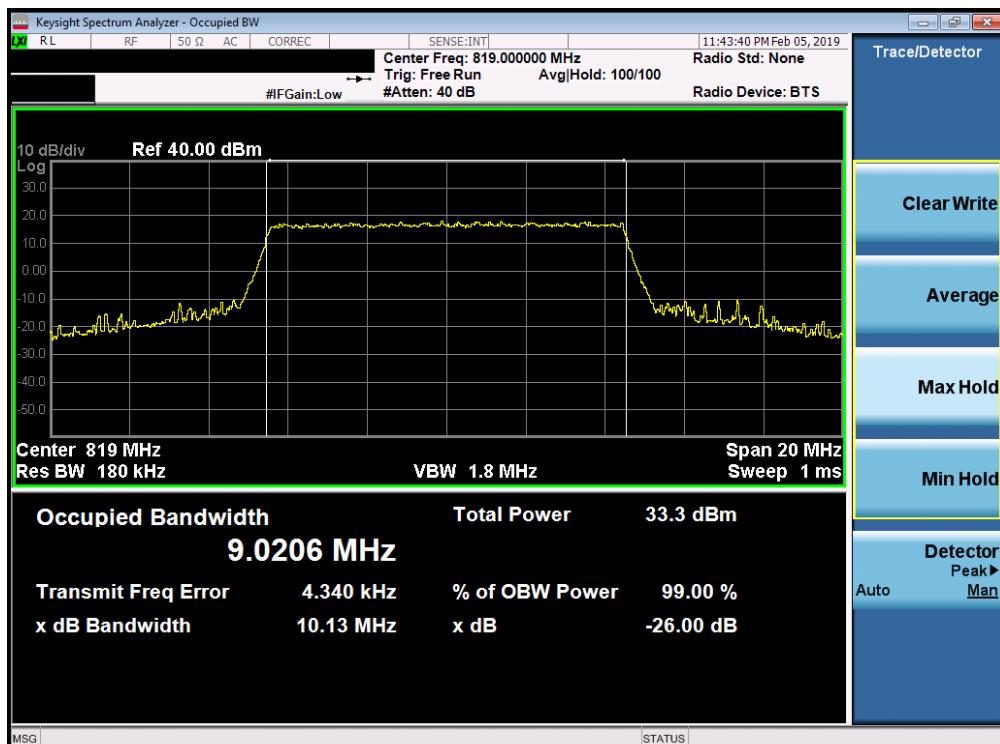


Plot 7-10. Occupied Bandwidth Plot (LTE Band 26, 10MHz QPSK – RB Size 50)

FCC ID: BCGA2123	 MEASUREMENT REPORT (CERTIFICATION)			Approved by: Quality Manager
Test Report S/N: 1C1811080029-04.BCG	Test Dates: 11/09/2018-02/11/2019	EUT Type: Tablet Device	Page 18 of 61	



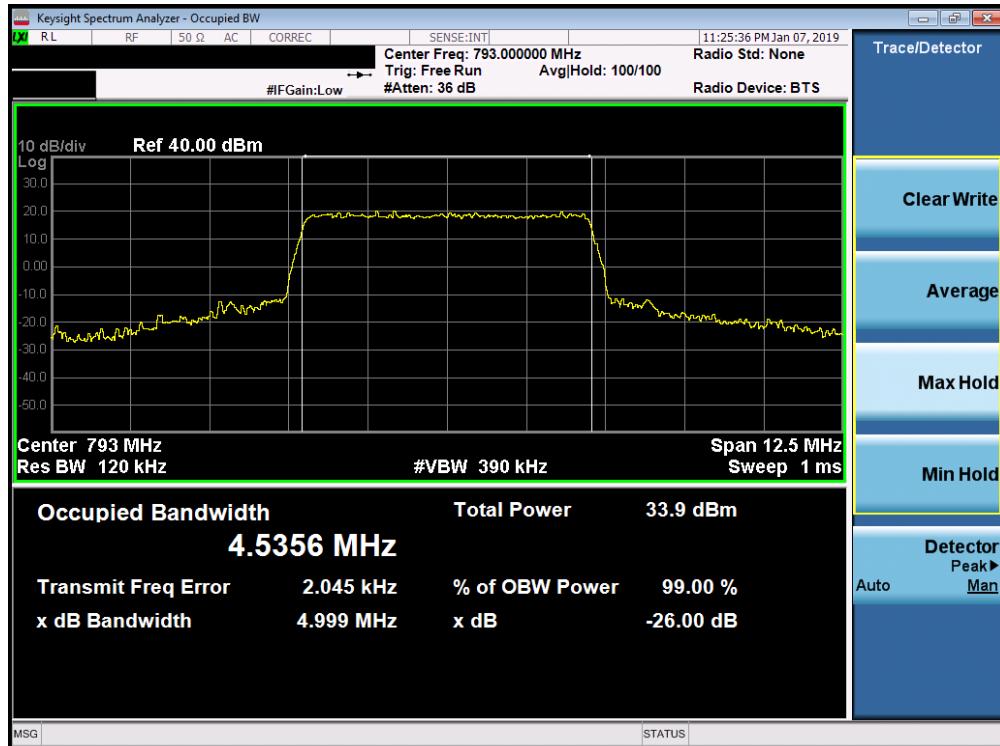
Plot 7-11. Occupied Bandwidth Plot (LTE Band 26, 10MHz 16-QAM – RB Size 50)



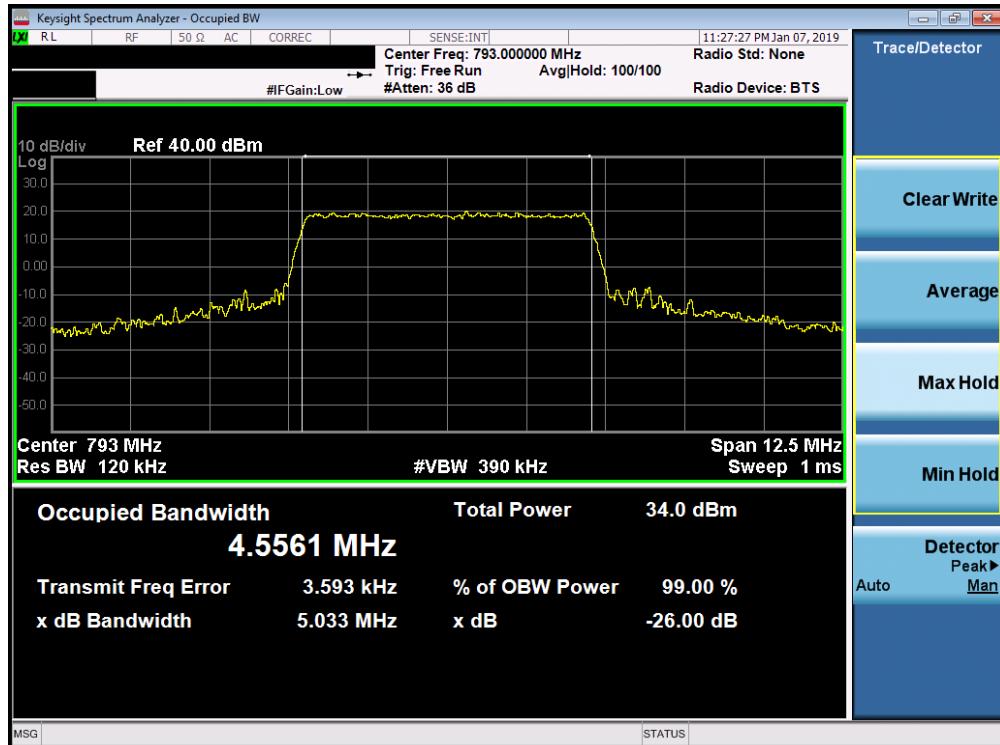
Plot 7-12. Occupied Bandwidth Plot (LTE Band 26, 10MHz 64-QAM – RB Size 50)

FCC ID: BCGA2123	PCTEST ENGINEERING LABORATORY, INC.	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C1811080029-04.BCG	Test Dates: 11/09/2018-02/11/2019	EUT Type: Tablet Device	Page 19 of 61

LTE Band 14

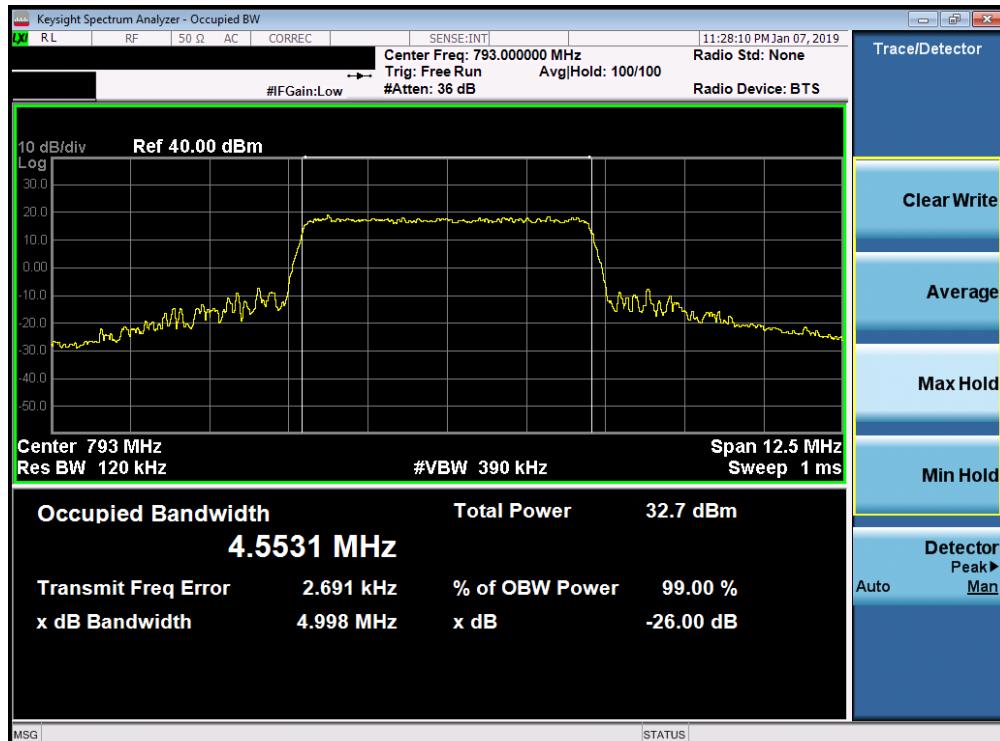


Plot 7-13. Occupied Bandwidth Plot (LTE Band 14, 5MHz QPSK – RB Size 25)

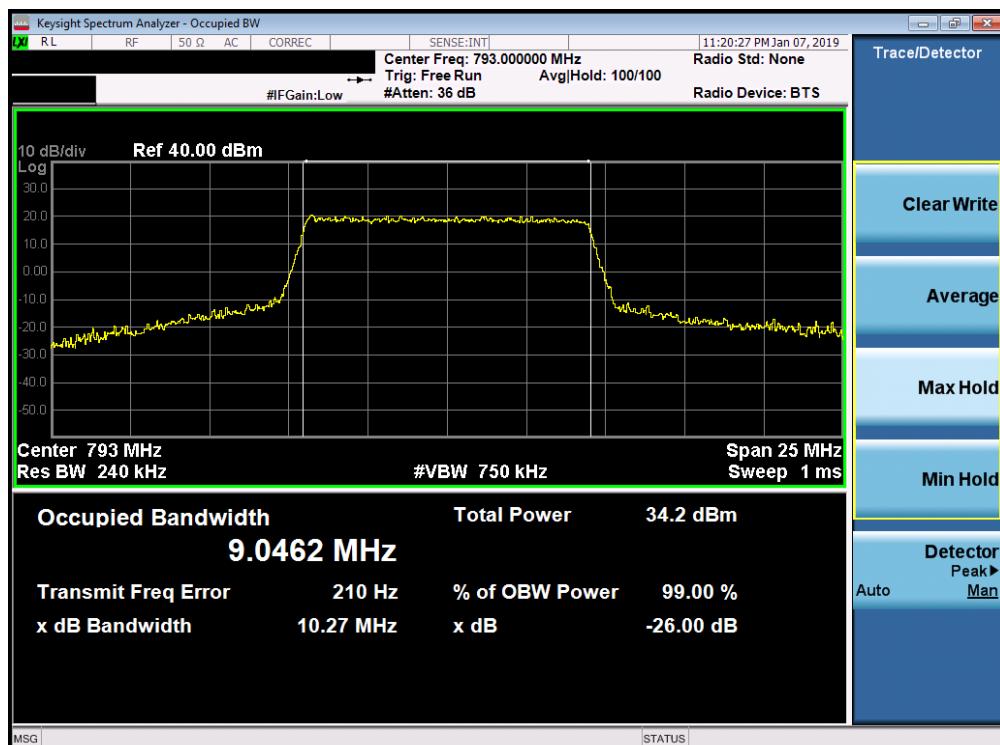


Plot 7-14. Occupied Bandwidth Plot (LTE Band 14, 5MHz 16-QAM – RB Size 25)

FCC ID: BCGA2123	PCTEST Engineering Laboratory, Inc.			MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C1811080029-04.BCG	Test Dates: 11/09/2018-02/11/2019	EUT Type: Tablet Device			

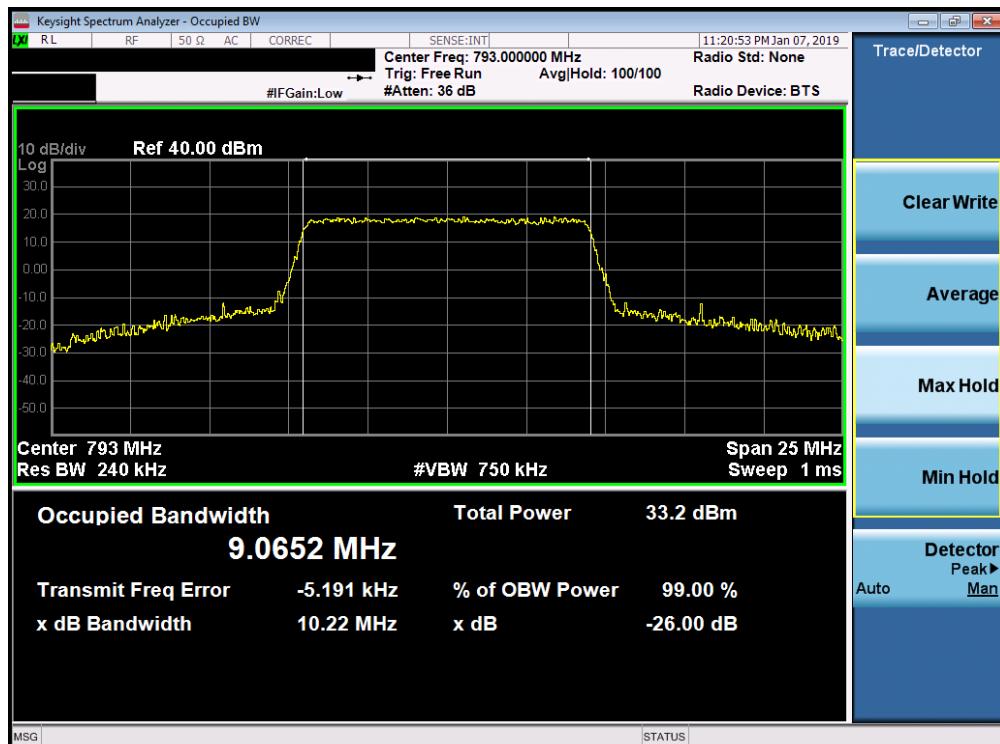


Plot 7-15. Occupied Bandwidth Plot (LTE Band 14, 5MHz 64-QAM – RB Size 25)

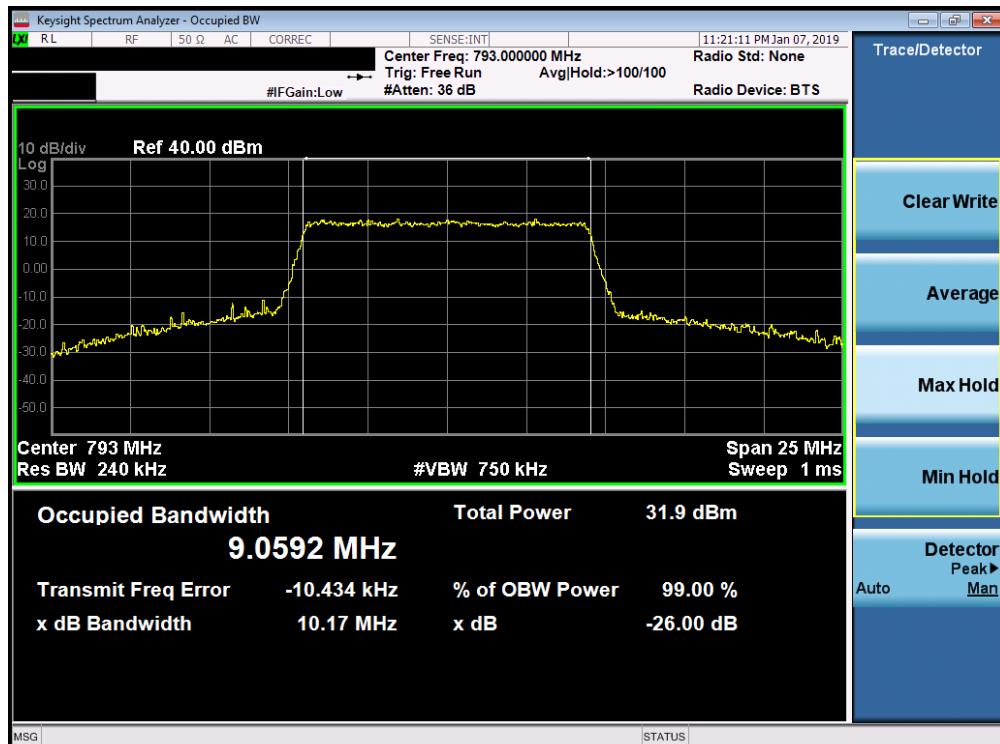


Plot 7-16. Occupied Bandwidth Plot (LTE Band 14, 10MHz QPSK – RB Size 50)

FCC ID: BCGA2123	 MEASUREMENT REPORT (CERTIFICATION)			Approved by: Quality Manager
Test Report S/N: 1C1811080029-04.BCG	Test Dates: 11/09/2018-02/11/2019	EUT Type: Tablet Device	Page 21 of 61	



Plot 7-17. Occupied Bandwidth Plot (LTE Band 14, 10MHz 16-QAM – RB Size 50)



Plot 7-18. Occupied Bandwidth Plot (LTE Band 14, 10MHz 64-QAM – RB Size 50)

FCC ID: BCGA2123	 MEASUREMENT REPORT (CERTIFICATION)			Approved by: Quality Manager
Test Report S/N: 1C1811080029-04.BCG	Test Dates: 11/09/2018-02/11/2019	EUT Type: Tablet Device	Page 22 of 61	

7.3 Spurious and Harmonic Emissions at Antenna Terminal

§2.1051 §90.691 §90.543

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 10th 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.

The minimum permissible attenuation level of any spurious emission is $43 + \log_{10}(P_{\text{Watts}})$, where P is the transmitter power in 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. RBW \geq 1MHz
3. VBW \geq 3 x RBW
4. Detector = RMS
5. Trace mode = max hold
6. Sweep time = auto couple
7. The trace was allowed to stabilize

Test Setup

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

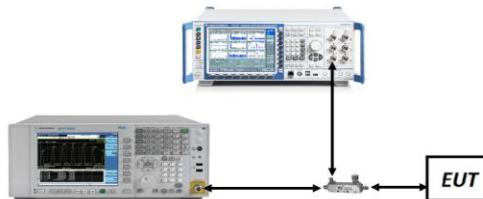
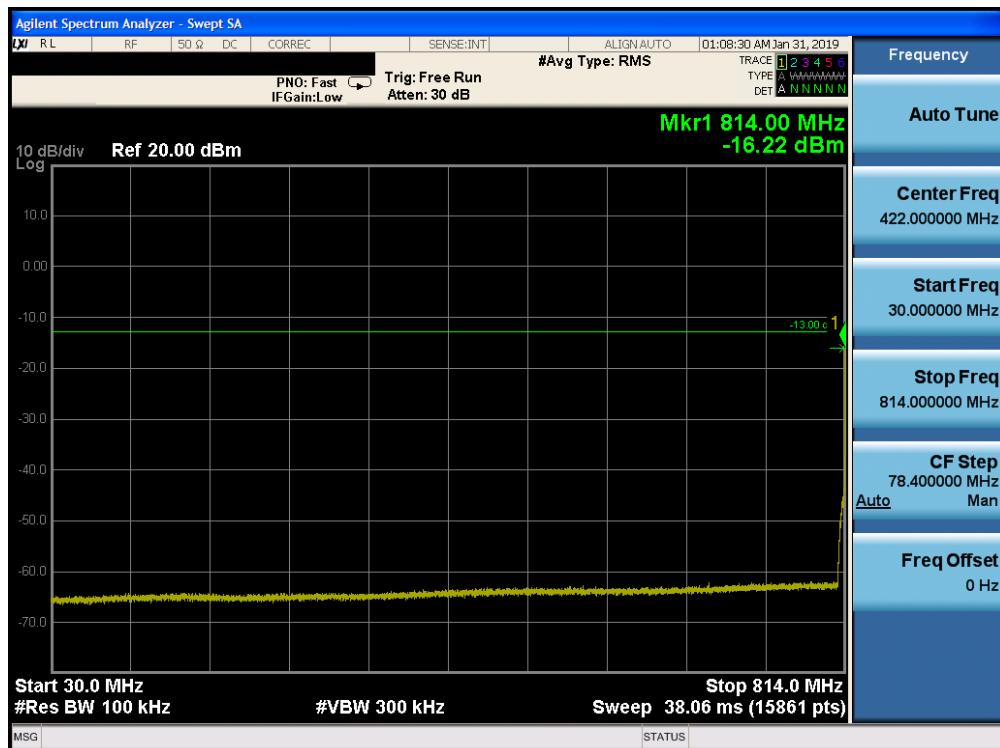


Figure 7-2. Test Instrument & Measurement Setup

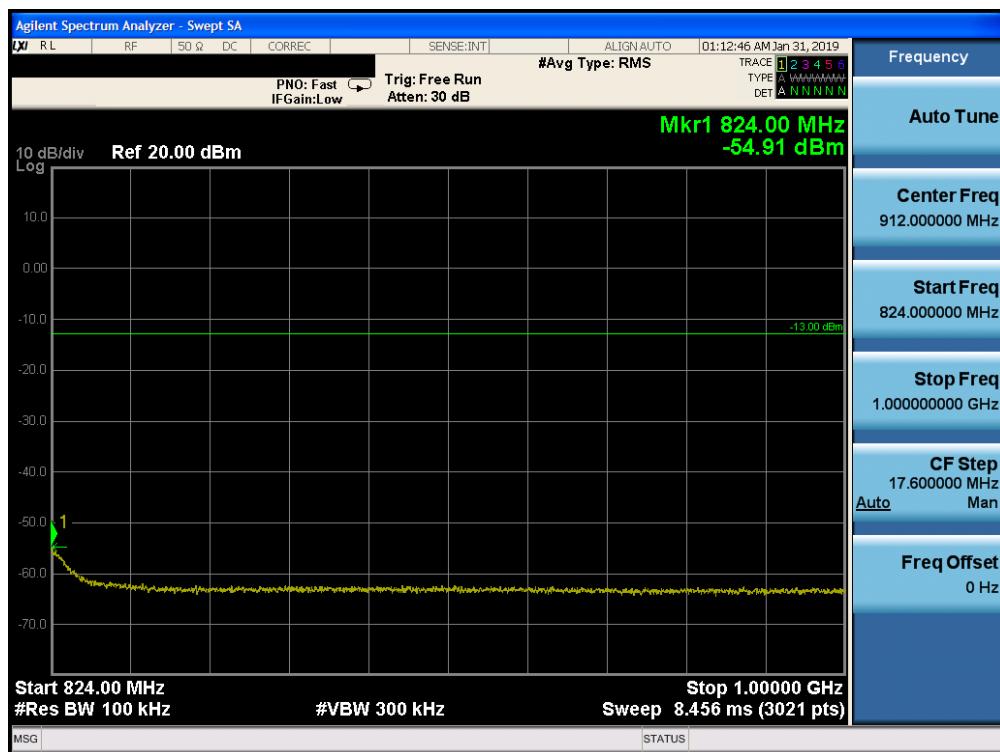
Test Notes

1. Compliance with the applicable limits is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater for Part 90. 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. All ports were tested and only the worst case data were reported.
3. Refer to Table 2-1 Section 2.3 of this test report for correlation between Antennas and Ports

FCC ID: BCGA2123	 MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager
Test Report S/N: 1C1811080029-04.BCG	Test Dates: 11/09/2018-02/11/2019	EUT Type: Tablet Device	Page 23 of 61



Plot 7-19. Conducted Spurious Plot (LTE Band 26, 5MHz QPSK – RB Size 1, RB Offset 0 – Low Channel)

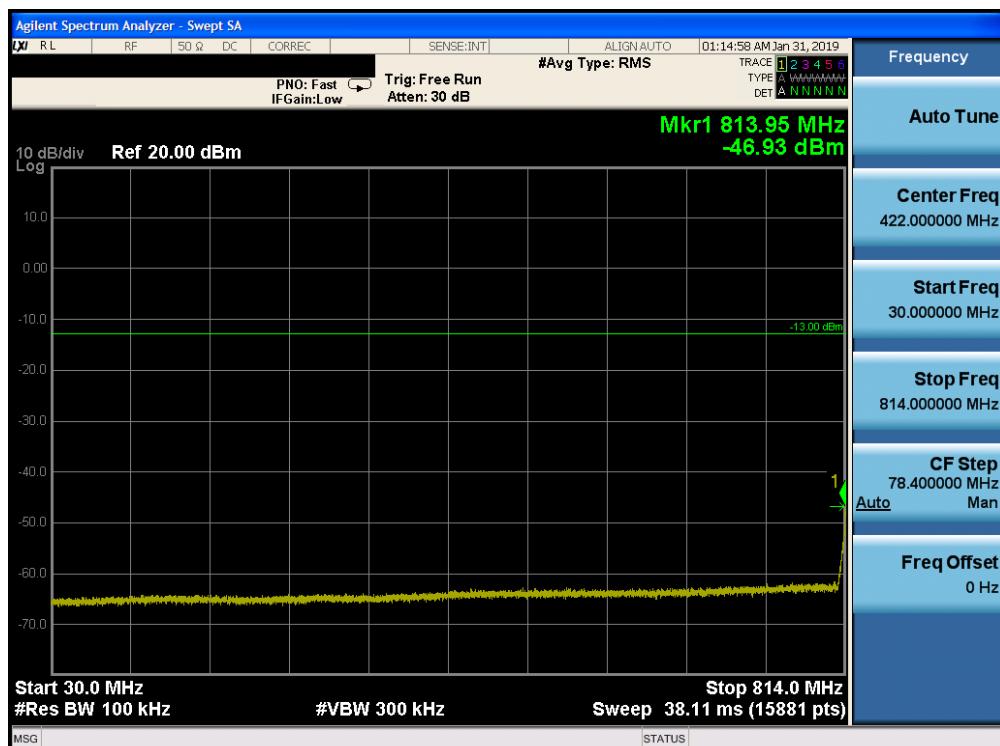


Plot 7-20. Conducted Spurious Plot (LTE Band 26, 5MHz QPSK – RB Size 1, RB Offset 0 – Low Channel)

FCC ID: BCGA2123	 PCTEST ENGINEERING LABORATORY, INC.			MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C1811080029-04.BCG	Test Dates: 11/09/2018-02/11/2019	EUT Type: Tablet Device			

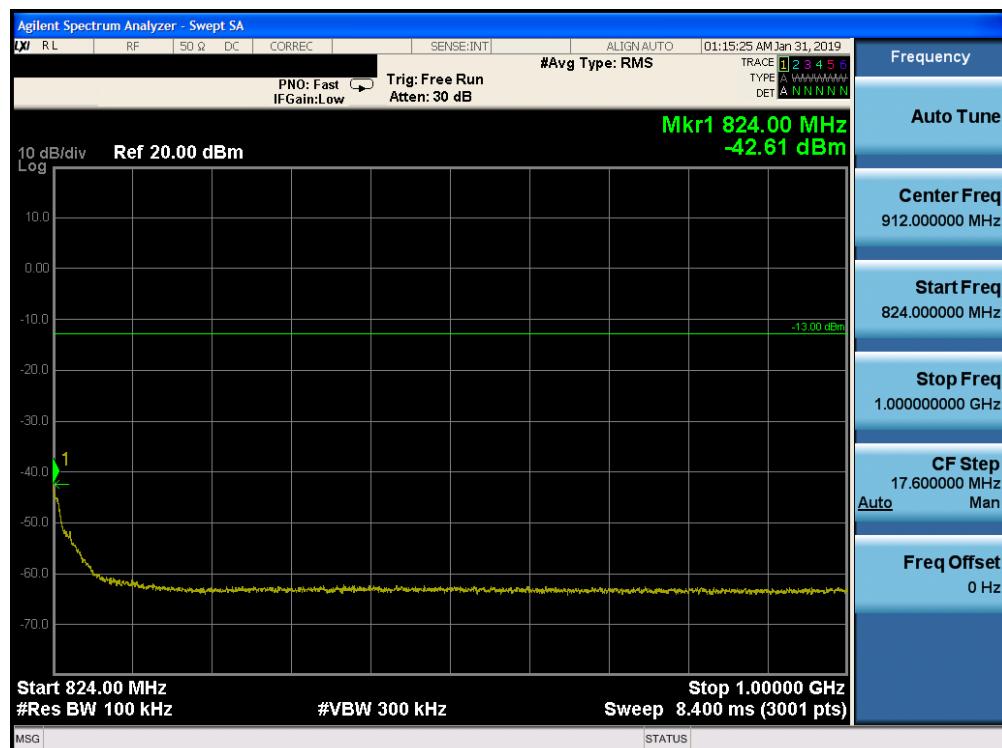


Plot 7-21. Conducted Spurious Plot (LTE Band 26, 5MHz QPSK – RB Size 1, RB Offset 0 – Low Channel)

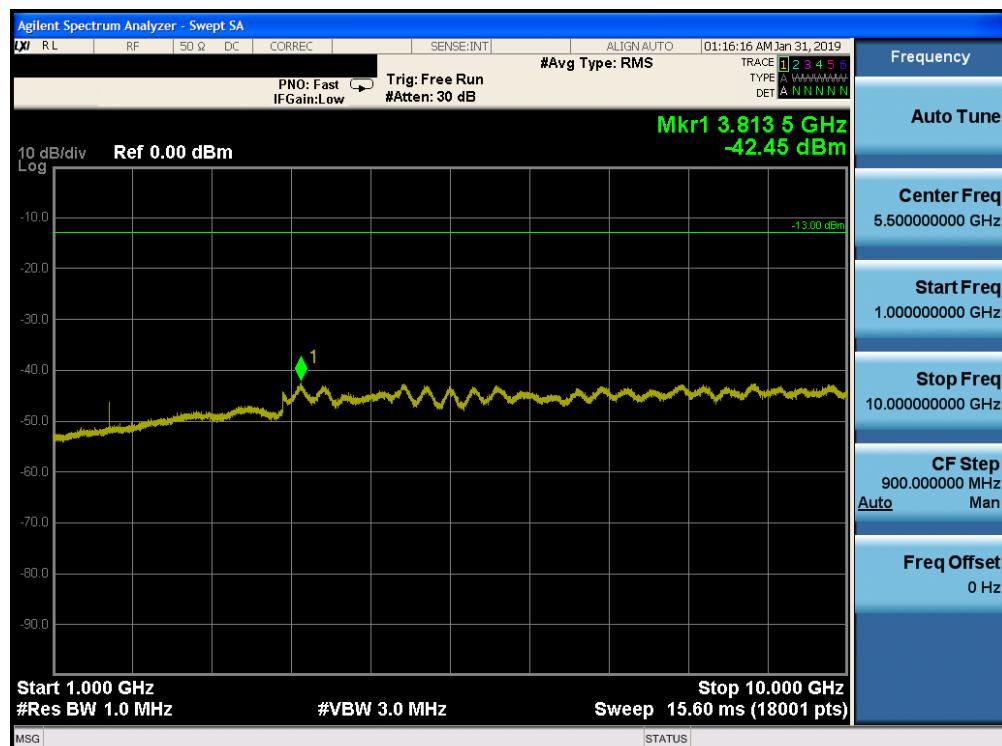


Plot 7-22. Conducted Spurious Plot (LTE Band 26, 5MHz QPSK – RB Size 1, RB Offset 0 – High Channel)

FCC ID: BCGA2123	PCTEST ENGINEERING LABORATORY, INC.			MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C1811080029-04.BCG	Test Dates: 11/09/2018-02/11/2019	EUT Type: Tablet Device			

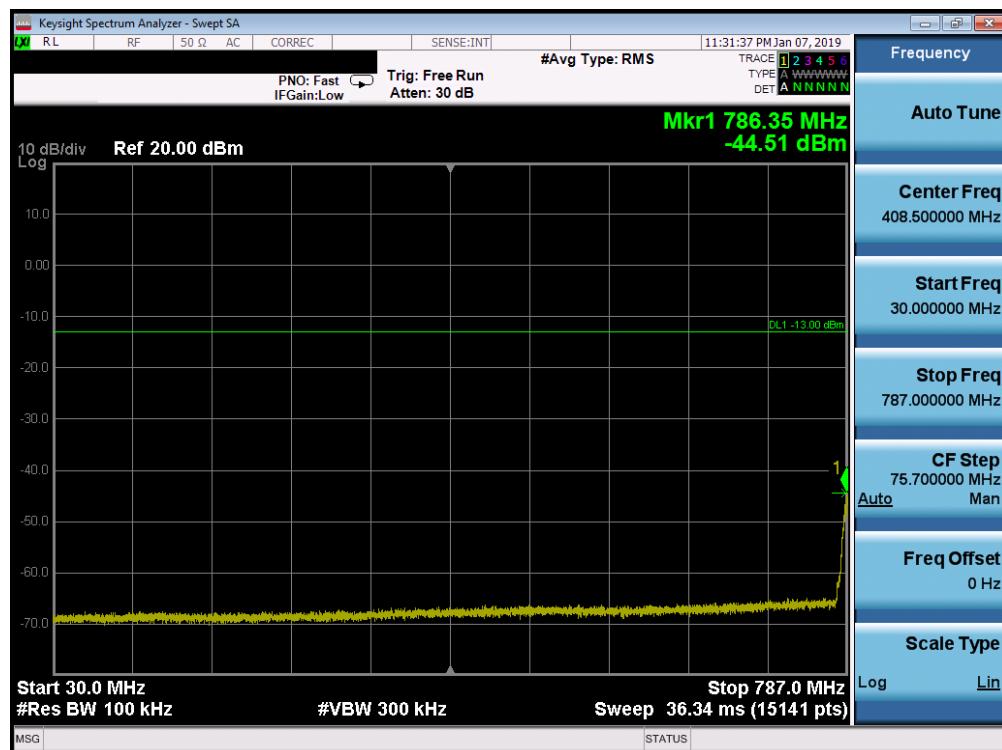


Plot 7-23. Conducted Spurious Plot (LTE Band 26, 5MHz QPSK – RB Size 1, RB Offset 0 – High Channel)

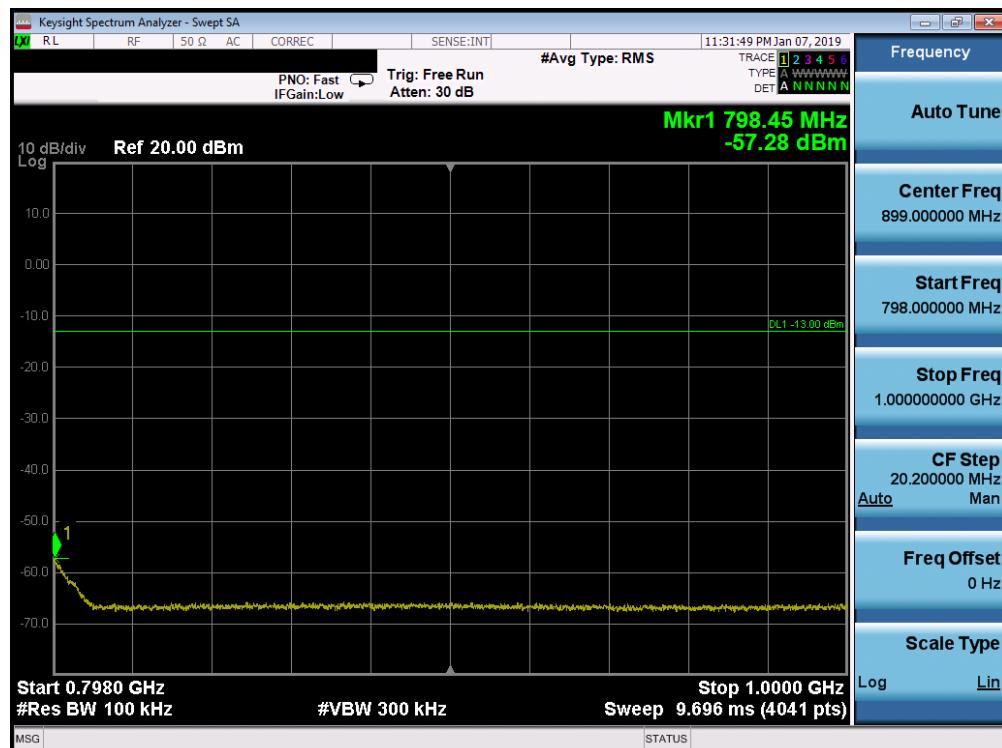


Plot 7-24. Conducted Spurious Plot (LTE Band 26, 5MHz QPSK – RB Size 1, RB Offset 0 – High Channel)

FCC ID: BCGA2123	 MEASUREMENT REPORT (CERTIFICATION)			Approved by: Quality Manager
Test Report S/N: 1C1811080029-04.BCG	Test Dates: 11/09/2018-02/11/2019	EUT Type: Tablet Device	Page 26 of 61	

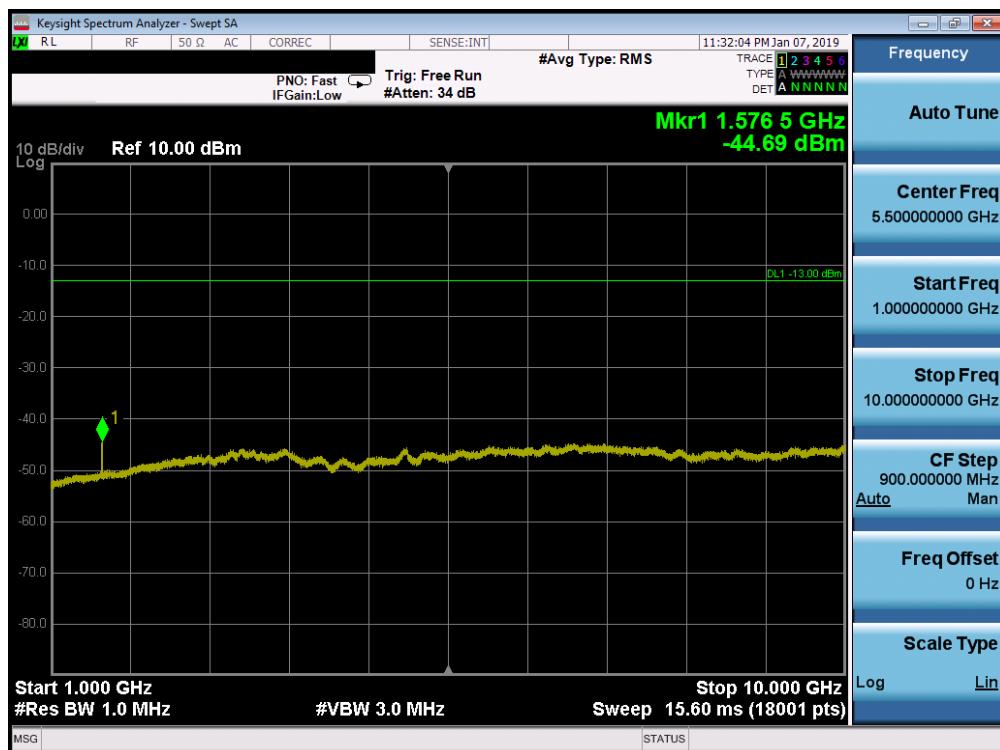


Plot 7-25. Conducted Spurious Plot (LTE Band 14, 5MHz QPSK – RB Size 1, RB Offset 0 – Low Channel)

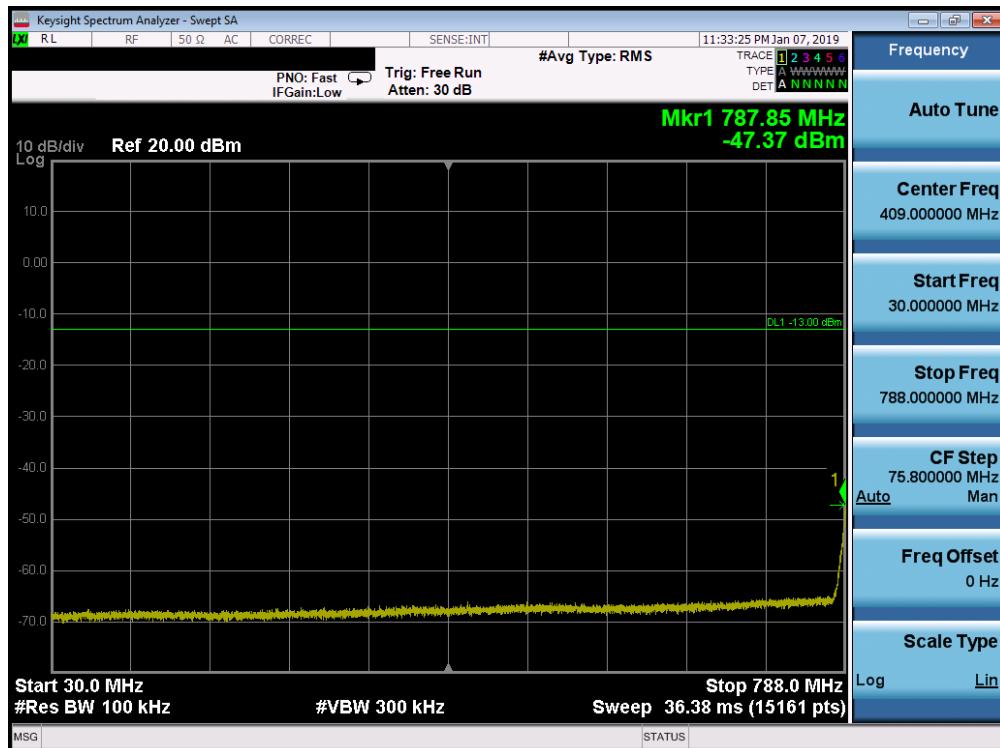


Plot 7-26. Conducted Spurious Plot (LTE Band 14, 5MHz QPSK – RB Size 1, RB Offset 0 – Low Channel)

FCC ID: BCGA2123	PCTEST ENGINEERING LABORATORY, INC.	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C1811080029-04.BCG	Test Dates: 11/09/2018-02/11/2019	EUT Type: Tablet Device	Page 27 of 61

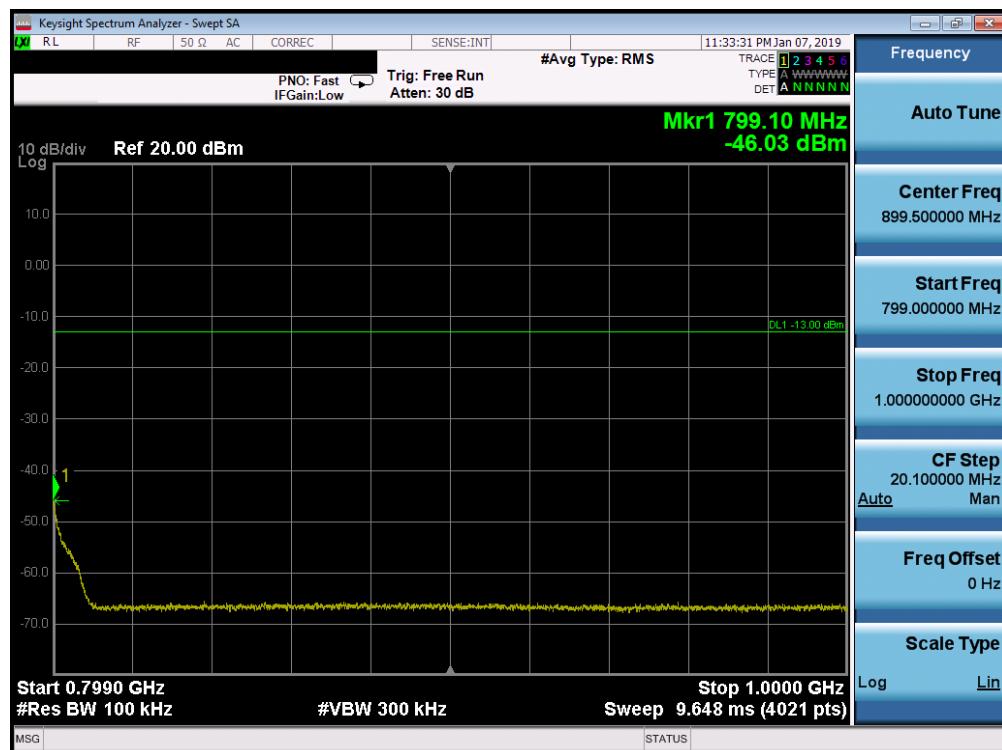


Plot 7-27. Conducted Spurious Plot (LTE Band 14, 5MHz QPSK – RB Size 1, RB Offset 0 – Low Channel)

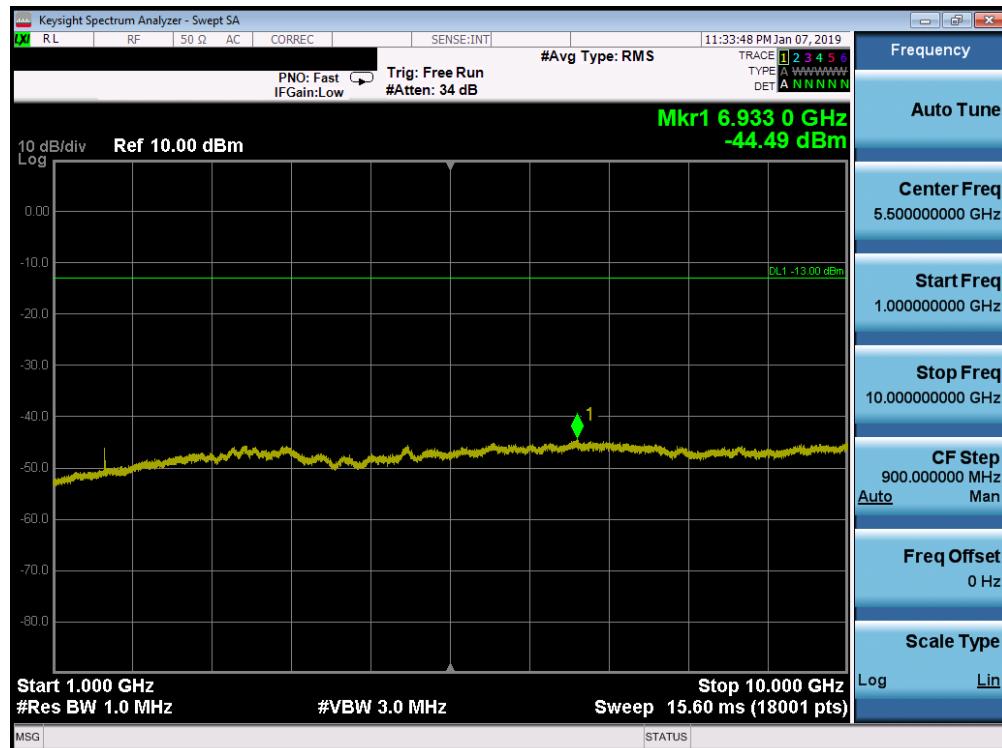


Plot 7-28. Conducted Spurious Plot (LTE Band 14, 5MHz QPSK – RB Size 1, RB Offset 0 – High Channel)

FCC ID: BCGA2123	PCTEST ENGINEERING LABORATORY, INC.	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C1811080029-04.BCG	Test Dates: 11/09/2018-02/11/2019	EUT Type: Tablet Device	Page 28 of 61



Plot 7-29. Conducted Spurious Plot (LTE Band 14, 5MHz QPSK – RB Size 1, RB Offset 0 – High Channel)



Plot 7-30. Conducted Spurious Plot (LTE Band 14, 5MHz QPSK – RB Size 1, RB Offset 0 – High Channel)

FCC ID: BCGA2123	PCTEST ENGINEERING LABORATORY, INC.	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C1811080029-04.BCG	Test Dates: 11/09/2018-02/11/2019	EUT Type: Tablet Device	Page 29 of 61

7.4 Band Edge Emissions at Antenna Terminal

§2.1051 §90.691 §90.543

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.

The minimum permissible attenuation level of any spurious emission removed from the EA licensee's frequency block by greater than 37.5 kHz is $43 + 10\log_{10}(P_{\text{Watts}})$, where P is the transmitter power in Watts.

The minimum permissible attenuation level of any spurious emission removed from the EA licensee's frequency block by up to and including 37.5 kHz is $50 + 10\log_{10}(P_{\text{Watts}})$, where P is the transmitter power in Watts.

Test Procedure Used

KDB 971168 D01 v03r01 – Section 6.0

Test Settings

1. Span was set large enough so as to capture all out of band emissions near the band edge
2. RBW = 100 kHz
3. VBW = 300 kHz
4. Detector = RMS
5. Trace mode = trace average
6. Sweep time = auto couple
7. The trace was allowed to stabilize

Test Setup

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

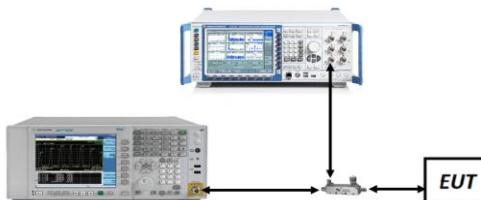
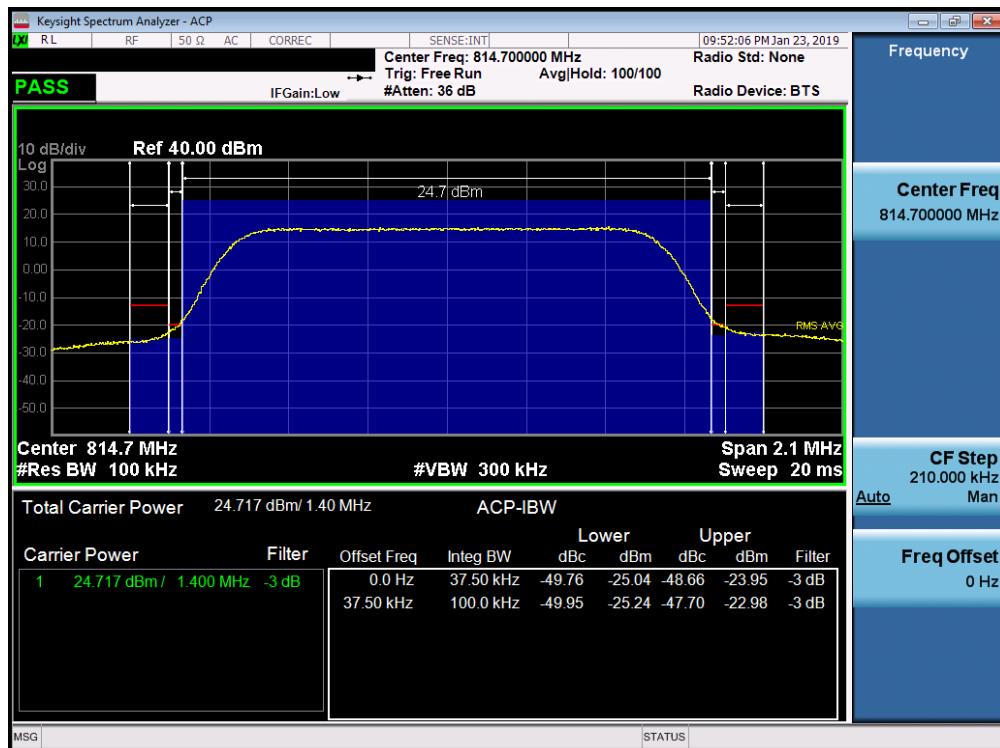


Figure 7-3. Test Instrument & Measurement Setup

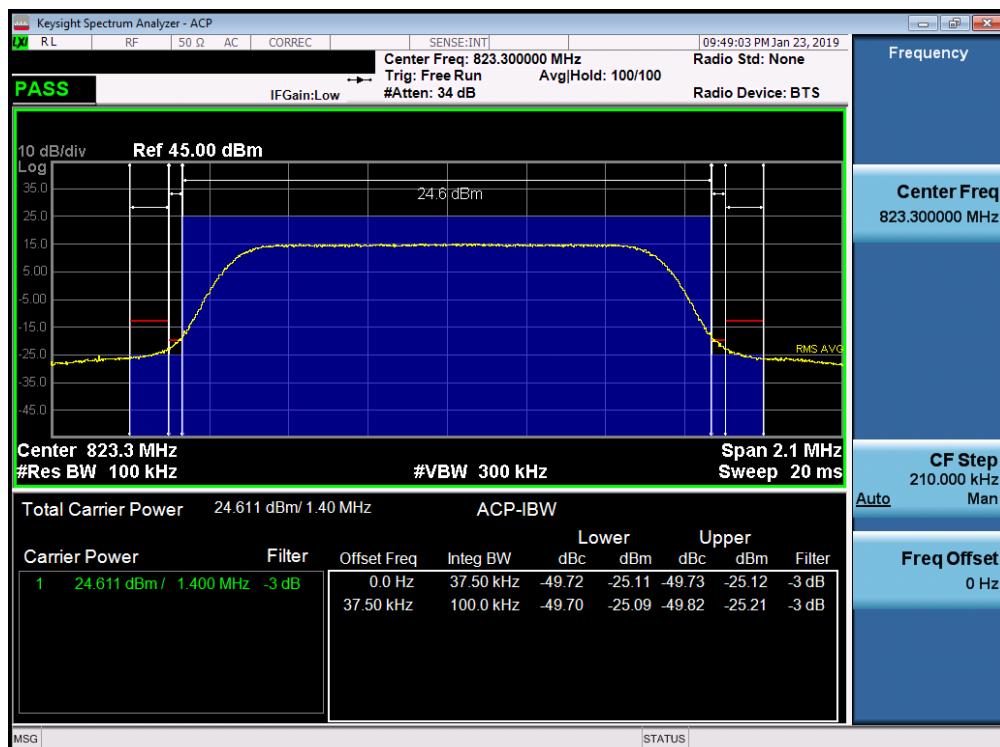
Test Notes

1. For channel edge emission, the signal analyzer's "ACP" measurement capability is used.
2. Per Part 90, in the 100 kHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of 30 kHz 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.
3. All ports were tested and only the worst case data were reported.
4. Refer to Table 2-1 Section 2.3 of this test report for correlation between Antennas and Ports

FCC ID: BCGA2123	PCTEST Engineering Laboratory, Inc.		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C1811080029-04.BCG	Test Dates: 11/09/2018-02/11/2019	EUT Type: Tablet Device		Page 30 of 61

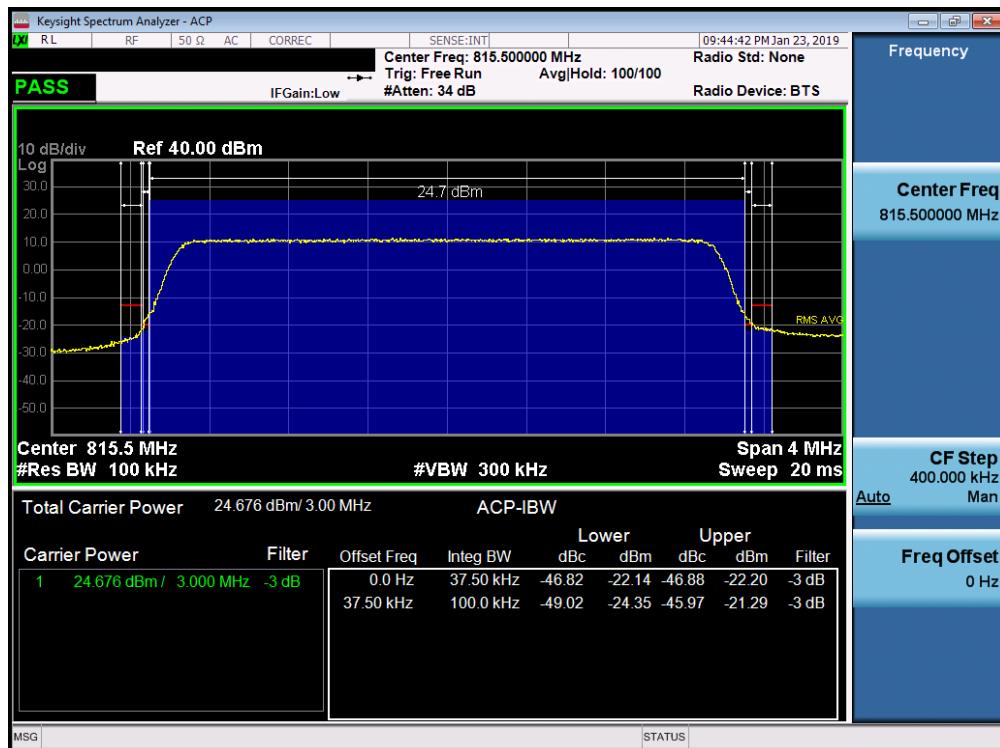


Plot 7-31. Channel Edge Plot (LTE Band 26, 1.4MHz QPSK – RB Size 6 – Low Channel)

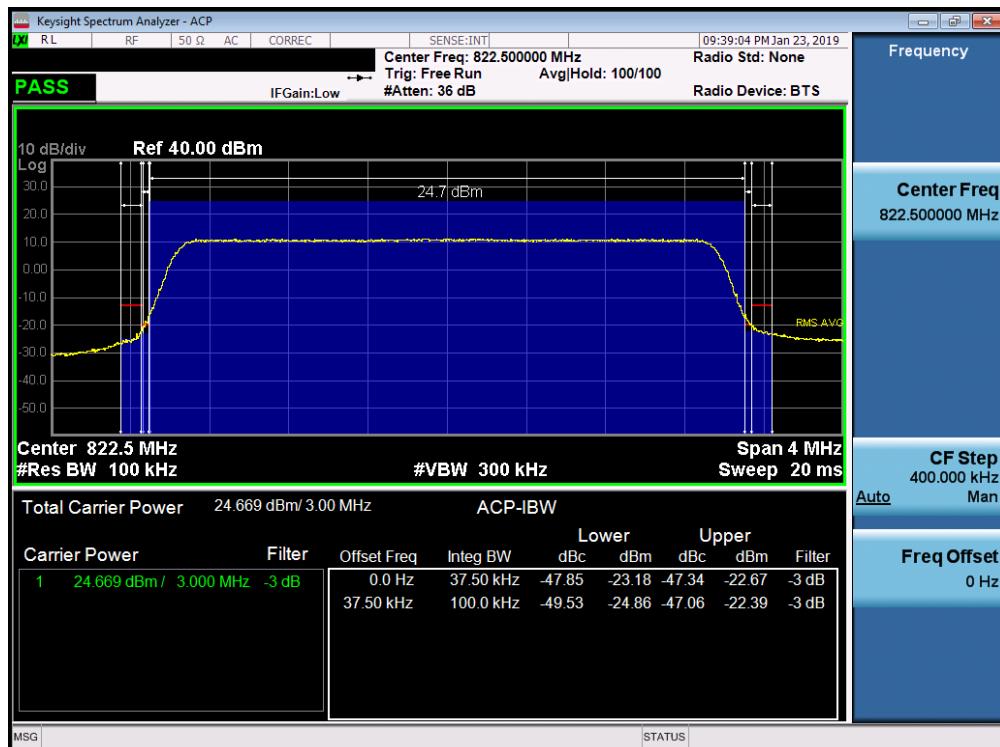


Plot 7-32. Channel Edge Plot (LTE Band 26, 1.4MHz QPSK – RB Size 6 – High Channel)

FCC ID: BCGA2123	 MEASUREMENT REPORT (CERTIFICATION)			Approved by: Quality Manager
Test Report S/N: 1C1811080029-04.BCG	Test Dates: 11/09/2018-02/11/2019	EUT Type: Tablet Device		

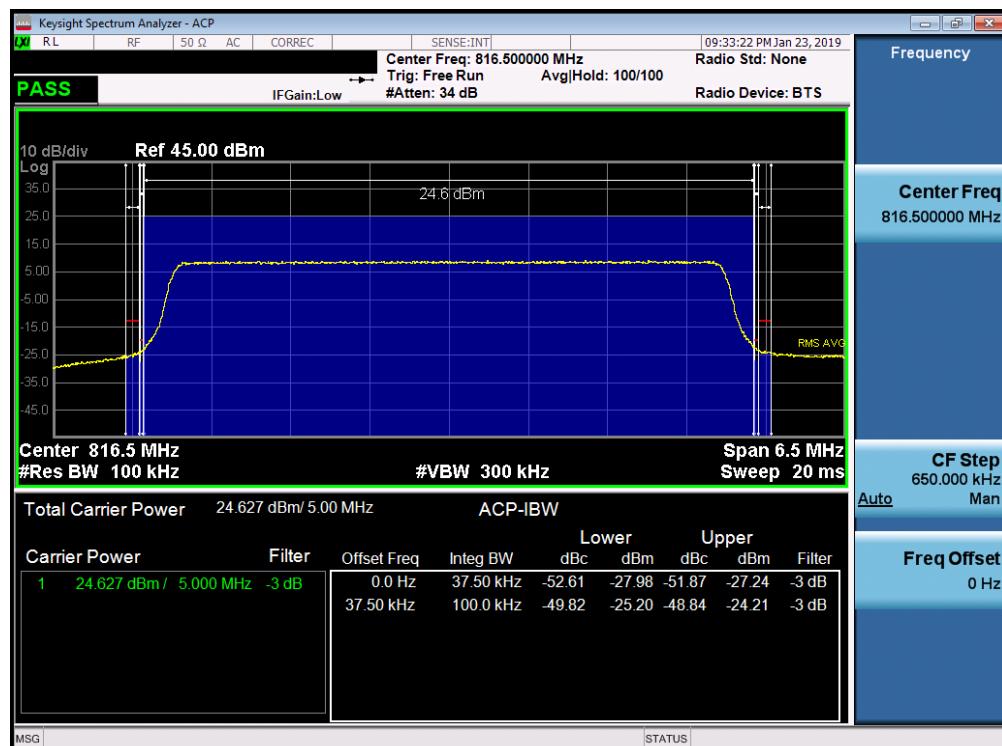


Plot 7-33. Channel Edge Plot (LTE Band 26, 3MHz QPSK – RB Size 15 – Low Channel)

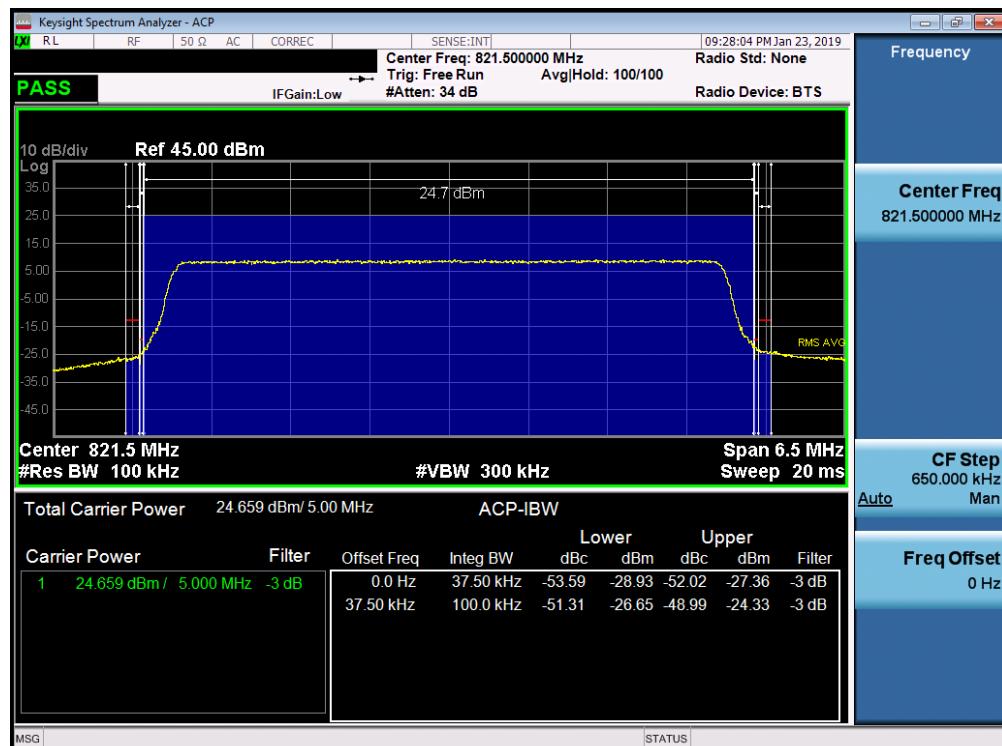


Plot 7-34. Channel Edge Plot (LTE Band 26, 3MHz QPSK – RB Size 15 – High Channel)

FCC ID: BCGA2123	 PCTEST Engineering Laboratory, Inc.	MEASUREMENT REPORT (CERTIFICATION)			Approved by: Quality Manager
Test Report S/N: 1C1811080029-04.BCG	Test Dates: 11/09/2018-02/11/2019	EUT Type: Tablet Device			Page 32 of 61

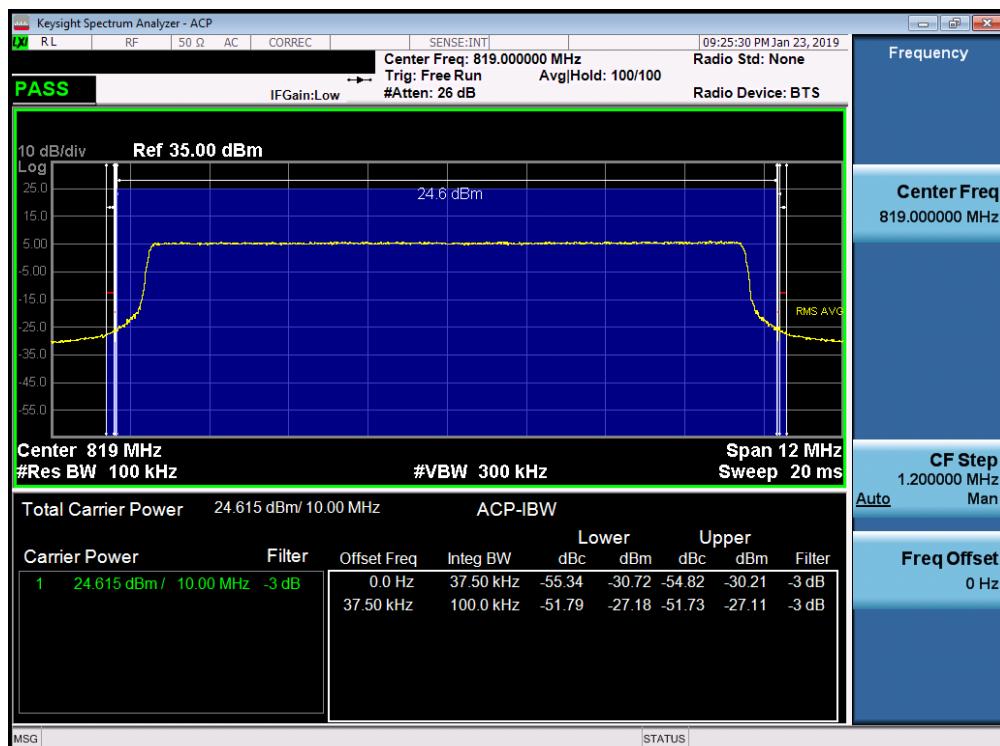


Plot 7-35. Channel Edge Plot (LTE Band 26, 5MHz QPSK – RB Size 25– Low Channel)

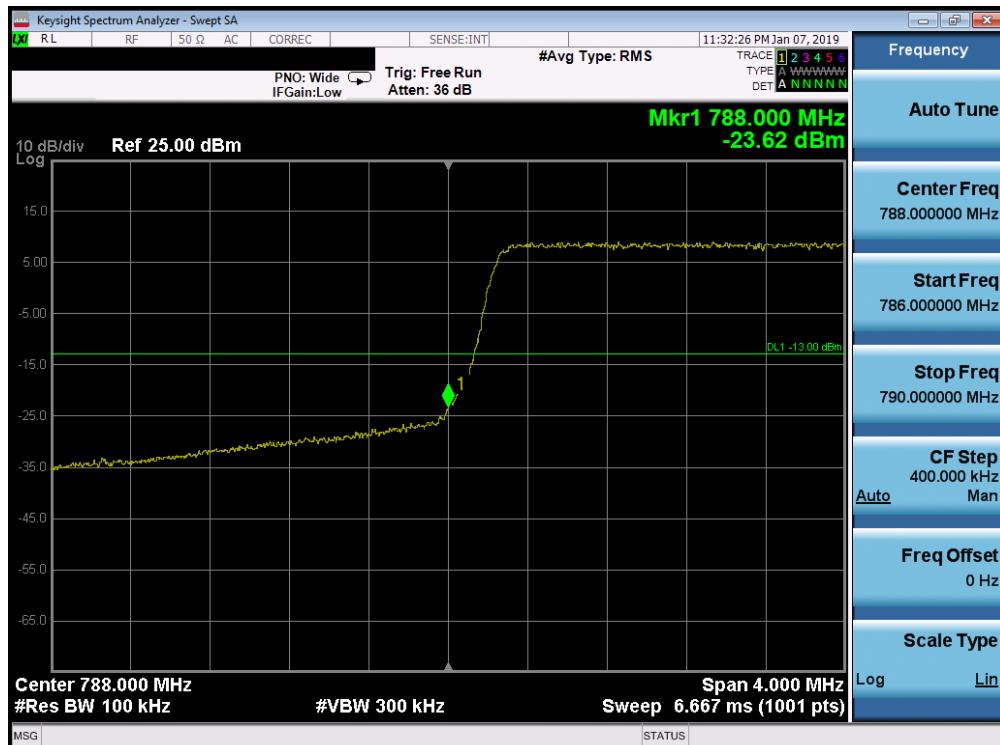


Plot 7-36. Channel Edge Plot (LTE Band 26, 5MHz QPSK – RB Size 25 – High Channel)

FCC ID: BCGA2123	PCTEST ENGINEERING LABORATORY, INC.	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C1811080029-04.BCG	Test Dates: 11/09/2018-02/11/2019	EUT Type: Tablet Device	Page 33 of 61

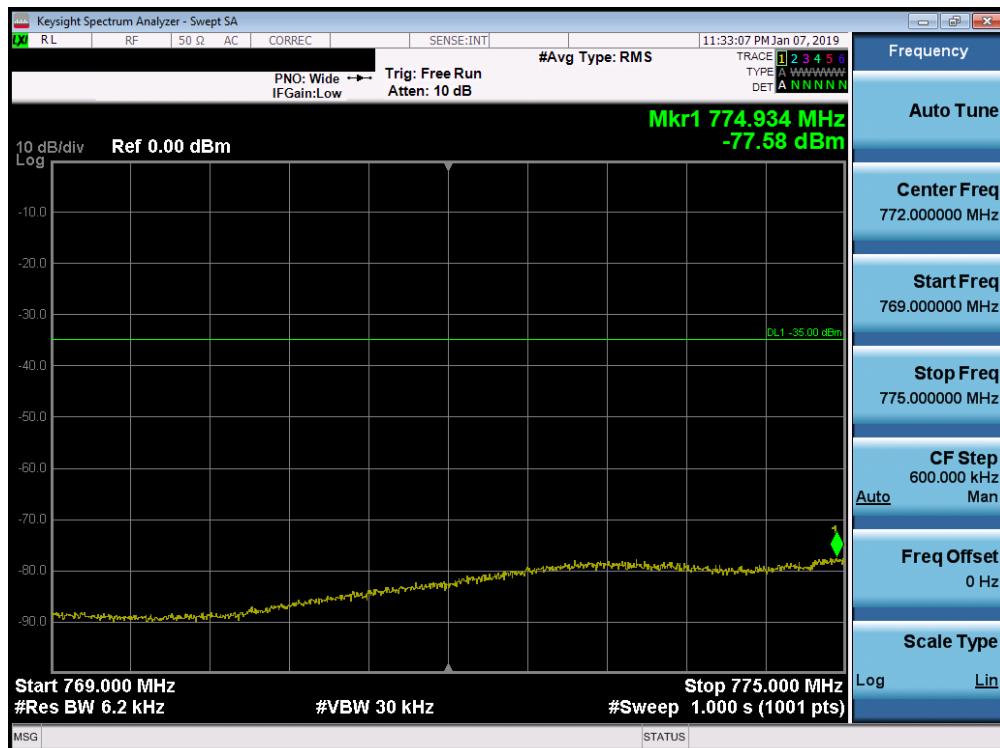


Plot 7-37. Channel Edge Plot (LTE Band 26, 10MHz QPSK – RB Size 50)



Plot 7-38. Lower Band Edge Plot (LTE Band 14, 5MHz QPSK – RB Size 25)

FCC ID: BCGA2123	MEASUREMENT REPORT (CERTIFICATION)			Approved by: Quality Manager
Test Report S/N: 1C1811080029-04.BCG	Test Dates: 11/09/2018-02/11/2019	EUT Type: Tablet Device	Page 34 of 61	



Plot 7-39. Lower Emission Mask Plot (LTE Band 14, 5MHz QPSK – RB Size 25)

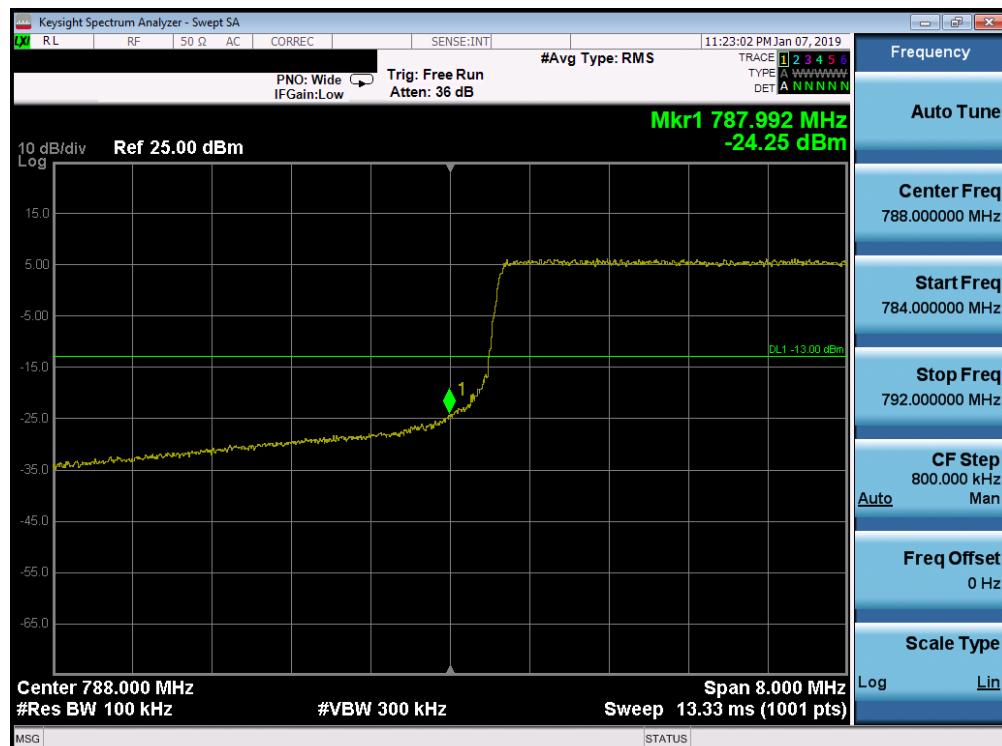


Plot 7-40. Upper Band Edge Plot (LTE Band 14, 5MHz QPSK – RB Size 25)

FCC ID: BCGA2123	 MEASUREMENT REPORT (CERTIFICATION)			Approved by: Quality Manager
Test Report S/N: 1C1811080029-04.BCG	Test Dates: 11/09/2018-02/11/2019	EUT Type: Tablet Device	Page 35 of 61	



Plot 7-41. Upper Emission Mask Plot (LTE Band 14, 5MHz QPSK – RB Size 25)

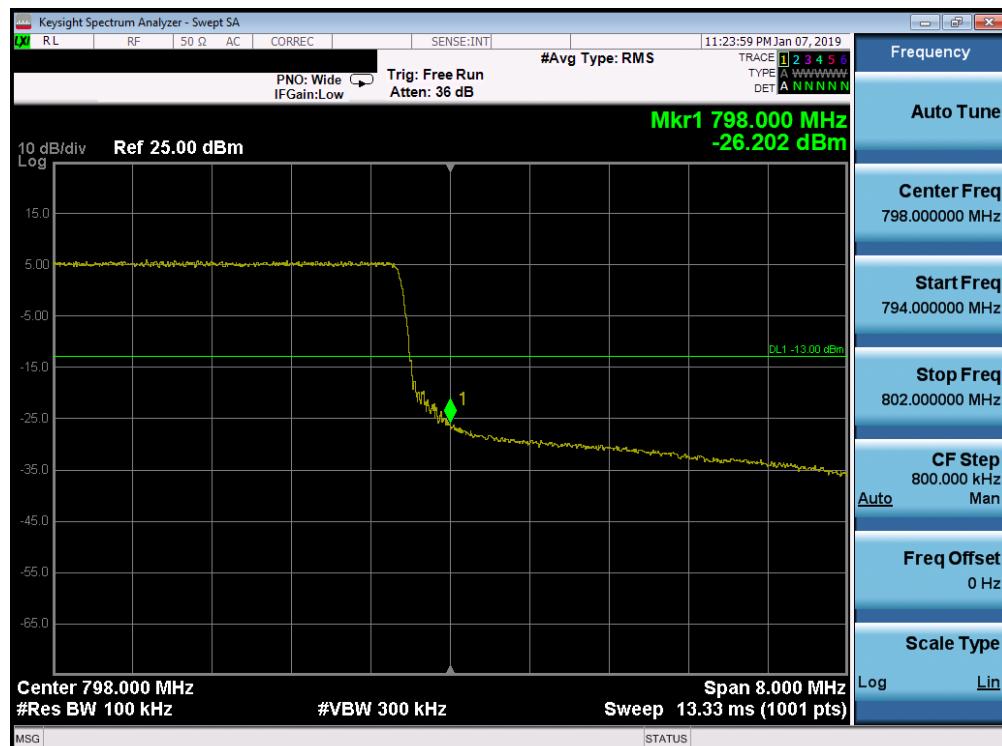


Plot 7-42. Lower Band Edge Plot (LTE Band 14, 10MHz QPSK – RB Size 50)

FCC ID: BCGA2123	PCTEST ENGINEERING LABORATORY, INC.	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C1811080029-04.BCG	Test Dates: 11/09/2018-02/11/2019	EUT Type: Tablet Device	Page 36 of 61

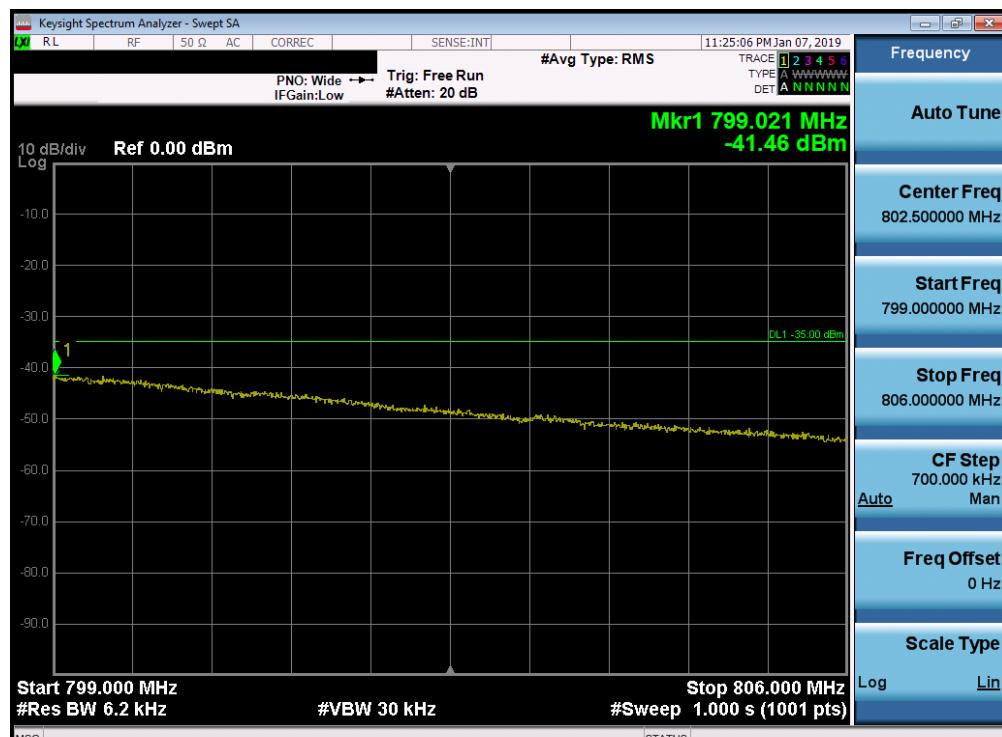


Plot 7-43. Lower Emission Mask Plot (LTE Band 14, 10MHz QPSK – RB Size 50)



Plot 7-44. Upper Band Edge Plot (LTE Band 14, 10MHz QPSK – RB Size 50)

FCC ID: BCGA2123	PCTEST ENGINEERING LABORATORY, INC.	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C1811080029-04.BCG	Test Dates: 11/09/2018-02/11/2019	EUT Type: Tablet Device	Page 37 of 61



Plot 7-45. Upper Emission Mask Plot (LTE Band 14, 10MHz QPSK – RB Size 50)

FCC ID: BCGA2123	 MEASUREMENT REPORT (CERTIFICATION)			Approved by: Quality Manager
Test Report S/N: 1C1811080029-04.BCG	Test Dates: 11/09/2018-02/11/2019	EUT Type: Tablet Device	Page 38 of 61	

7.5 Conducted Power Output Data

§2.1046 §90.635

Test Overview

Conducted power measurements are performed to measure the average output power of the EUT. The averaging is to be performed only over duration of active transmissions at maximum output power level. The average measurements do not include averaging over periods when the transmitter is quiescent or when operating at reduced power level.

Test Procedures Used

KDB 971168 D01 v03

Test Setup

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



Figure 7-4. Conducted Power Measurement Setup

Test Notes

1. The EUT was tested in all possible test configurations. The worst case emissions are reported with the EUT modulations and channel bandwidth configurations shown in the tables below.
2. This unit was tested with its standard battery.
3. Refer to Table 2-1 Section 2.3 of this test report for correlation between Antennas and Ports

FCC ID: BCGA2123	MEASUREMENT REPORT (CERTIFICATION)			Approved by: Quality Manager
Test Report S/N: 1C1811080029-04.BCG	Test Dates: 11/09/2018-02/11/2019	EUT Type: Tablet Device	Page 39 of 61	

Port A

Frequency [MHz]	Channel Bandwidth [MHz]	Mod.	RB Size/Offset	Cond. PWR [dBm]	Cond. PWR [Watts]	Cond. PWR Limit [dBm]	Margin [dB]
814.70	1.4	QPSK	1 / 5	25.50	0.355	50.00	-24.50
823.30	1.4	QPSK	1 / 0	25.50	0.355	50.00	-24.50
814.70	1.4	16-QAM	1 / 5	24.73	0.297	50.00	-25.27
823.30	1.4	16-QAM	1 / 0	24.73	0.297	50.00	-25.27
814.70	1.4	64-QAM	1 / 5	23.70	0.234	50.00	-26.30
823.30	1.4	64-QAM	1 / 0	23.64	0.231	50.00	-26.36
815.50	3	QPSK	1 / 0	25.47	0.352	50.00	-24.53
822.50	3	QPSK	1 / 0	25.50	0.355	50.00	-24.50
815.50	3	16-QAM	1 / 0	24.81	0.303	50.00	-25.19
822.50	3	16-QAM	1 / 0	24.80	0.302	50.00	-25.20
815.50	3	64-QAM	1 / 0	23.63	0.231	50.00	-26.37
822.50	3	64-QAM	1 / 0	23.70	0.234	50.00	-26.30
816.50	5	QPSK	1 / 0	25.50	0.355	50.00	-24.50
821.50	5	QPSK	1 / 0	25.42	0.348	50.00	-24.58
816.50	5	16-QAM	1 / 0	24.74	0.298	50.00	-25.26
821.50	5	16-QAM	1 / 0	24.72	0.296	50.00	-25.28
816.50	5	64-QAM	1 / 0	23.78	0.239	50.00	-26.22
821.50	5	64-QAM	1 / 0	23.65	0.232	50.00	-26.35
819.00	10	QPSK	1 / 0	25.50	0.355	50.00	-24.50
819.00	10	16-QAM	1 / 0	24.91	0.310	50.00	-25.09
819.00	10	64-QAM	1 / 5	23.90	0.245	50.00	-26.10

Table 7-2. LTE Band 26 Conducted Power Output Data

FCC ID: BCGA2123	 MEASUREMENT REPORT (CERTIFICATION)				Approved by: Quality Manager
Test Report S/N: 1C1811080029-04.BCG	Test Dates: 11/09/2018-02/11/2019	EUT Type: Tablet Device			

Port B

Frequency [MHz]	Channel Bandwidth [MHz]	Mod.	RB Size/Offset	Cond. PWR [dBm]	Cond. PWR [Watts]	Cond. PWR Limit [dBm]	Margin [dB]
814.70	1.4	QPSK	1 / 0	24.50	0.282	50.00	-25.50
823.30	1.4	QPSK	1 / 0	24.36	0.273	50.00	-25.64
814.70	1.4	16-QAM	1 / 0	23.77	0.238	50.00	-26.23
823.30	1.4	16-QAM	1 / 5	23.51	0.224	50.00	-26.49
814.70	1.4	64-QAM	1 / 0	22.88	0.194	50.00	-27.12
823.30	1.4	64-QAM	1 / 0	22.57	0.181	50.00	-27.43
815.50	3	QPSK	1 / 0	24.50	0.282	50.00	-25.50
822.50	3	QPSK	1 / 0	24.41	0.276	50.00	-25.59
815.50	3	16-QAM	1 / 0	23.77	0.238	50.00	-26.23
822.50	3	16-QAM	1 / 0	23.50	0.224	50.00	-26.50
815.50	3	64-QAM	1 / 5	22.69	0.186	50.00	-27.31
822.50	3	64-QAM	1 / 0	22.56	0.180	50.00	-27.44
816.50	5	QPSK	1 / 0	24.50	0.282	50.00	-25.50
821.50	5	QPSK	1 / 0	24.35	0.272	50.00	-25.65
816.50	5	16-QAM	1 / 0	23.78	0.239	50.00	-26.22
821.50	5	16-QAM	1 / 5	23.72	0.236	50.00	-26.28
816.50	5	64-QAM	1 / 0	22.92	0.196	50.00	-27.08
821.50	5	64-QAM	1 / 0	22.73	0.187	50.00	-27.27
819.00	10	QPSK	1 / 0	24.50	0.282	50.00	-25.50
819.00	10	16-QAM	1 / 0	23.82	0.241	50.00	-26.18
819.00	10	64-QAM	1 / 0	22.65	0.184	50.00	-27.35

Table 7-3. LTE Band 26 Conducted Power Output Data

FCC ID: BCGA2123	 MEASUREMENT REPORT (CERTIFICATION)				Approved by: Quality Manager
Test Report S/N: 1C1811080029-04.BCG	Test Dates: 11/09/2018-02/11/2019	EUT Type: Tablet Device			Page 41 of 61

7.6 Radiated Power (ERP)

§90.542(a)(7)

Test Overview

Effective Radiated Power (ERP) is specified when the operating frequency is less than or equal to 1 GHz and Equivalent Isotropic Radiated Power (EIRP) is specified when the operating frequency is greater than 1 GHz. Both are determined by adding the transmit antenna gain to the conducted RF output power with the primary difference between the two being that when determining the ERP, the transmit antenna gain is referenced to a dipole antenna (i.e., dBd) whereas when determining the EIRP, the transmit antenna gain is referenced to an isotropic antenna (dBi).

Test Procedures Used

KDB 971168 D01 v03r01 – Section 5.6

Test Settings

The relevant equation for determining the ERP or EIRP from the conducted RF output power measured is:

$$\text{ERP/EIRP} = \text{PMeas} - \text{LC} + \text{GT}$$

where:

ERP/EIRP = effective or equivalent radiated power, respectively (expressed in the same units as PMeas, typically dBW or dBm);

PMeas = measured transmitter output power or PSD, in dBm or dBW;

LC = signal attenuation in the connecting cable between the transmitter and antenna, in dB

GT = gain of the transmitting antenna, in dBd (ERP) or dBi (EIRP)

Test Setup

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



Figure 7-5. ERP Measurement Setu

Test Notes

- 1) The worst case emissions are reported with the modulations, RB sizes and offsets, and channel bandwidth configurations shown in the tables below.
- 2) This unit was tested with its standard battery.

FCC ID: BCGA2123	 PCTEST ENGINEERING LABORATORY, INC.		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C1811080029-04.BCG	Test Dates: 11/09/2018-02/11/2019	EUT Type: Tablet Device	Page 42 of 61	

Port A

Frequency [MHz]	Channel Bandwidth [MHz]	Mod.	RB Size/Offset	Conducted Power [dBm]	Ant. Gain [dBi]	ERP [dBm]	ERP [Watts]	ERP Limit [dBm]	Margin [dB]
790.50	5	QPSK	1 / 0	25.40	-0.16	23.09	0.204	34.77	-11.68
793.00	5	QPSK	1 / 0	25.50	-0.16	23.19	0.208	34.77	-11.58
795.50	5	QPSK	1 / 24	25.43	-0.16	23.12	0.205	34.77	-11.65
790.50	5	16-QAM	1 / 0	24.83	-0.16	22.52	0.179	34.77	-12.25
793.00	5	64-QAM	1 / 0	23.81	-0.16	21.50	0.141	34.77	-13.27
793.00	10	QPSK	1 / 0	25.50	-0.16	23.19	0.208	34.77	-11.58
793.00	10	16-QAM	1 / 0	24.77	-0.16	22.46	0.176	34.77	-12.31
793.00	10	64-QAM	1 / 49	23.69	-0.16	21.38	0.137	34.77	-13.39

Table 7-46. ERP Data (Band 14)

FCC ID: BCGA2123	MEASUREMENT REPORT (CERTIFICATION)				Approved by: Quality Manager
Test Report S/N: 1C1811080029-04.BCG	Test Dates: 11/09/2018-02/11/2019	EUT Type: Tablet Device			

Port B

Frequency [MHz]	Channel Bandwidth [MHz]	Mod.	RB Size/Offset	Conducted Power [dBm]	Ant. Gain [dBi]	ERP [dBm]	ERP [Watts]	ERP Limit [dBm]	Margin [dB]
790.50	5	QPSK	1 / 0	24.49	0.01	22.35	0.172	34.77	-12.42
793.00	5	QPSK	1 / 0	24.50	0.01	22.36	0.172	34.77	-12.41
795.50	5	QPSK	1 / 24	24.44	0.01	22.30	0.170	34.77	-12.47
795.50	5	16-QAM	1 / 24	23.80	0.01	21.66	0.147	34.77	-13.11
790.50	5	64-QAM	1 / 0	22.78	0.01	20.64	0.116	34.77	-14.13
793.00	10	QPSK	1 / 0	24.50	0.01	22.36	0.172	34.77	-12.41
793.00	10	16-QAM	1 / 0	23.80	0.01	21.66	0.147	34.77	-13.11
793.00	10	64-QAM	1 / 0	22.65	0.01	20.51	0.112	34.77	-14.26

Table 7-47. ERP Data (Band 14)

FCC ID: BCGA2123	MEASUREMENT REPORT (CERTIFICATION)				Approved by: Quality Manager
Test Report S/N: 1C1811080029-04.BCG	Test Dates: 11/09/2018-02/11/2019	EUT Type: Tablet Device			

7.7 Radiated Spurious Emissions Measurements

§2.1053 §90.691 §90.543

Test Overview

Radiated spurious emissions measurements are performed using the substitution method described in ANSI/TIA-603-E-2016 with the EUT transmitting into an integral antenna. Measurements on signals operating below 1GHz are performed using horizontally and vertically polarized tuned dipole antennas. Measurements on signals operating above 1GHz are performed using vertically and horizontally polarized broadband horn antennas. All measurements are performed as peak measurements while the EUT is operating at maximum power, and at the appropriate frequencies.

Test Procedures Used

KDB 971168 D01 v03r01 – Section 5.8

ANSI/TIA-603-E-2016 – Section 2.2.12

Test Settings

1. RBW = 100kHz for emissions below 1GHz and 1MHz for emissions above 1GHz
2. VBW $\geq 3 \times$ RBW
3. Span = 1.5 times the OBW
4. No. of sweep points $\geq 2 \times$ span / RBW
5. Detector = RMS
6. Trace mode = Average (Max Hold for pulsed emissions)
7. The trace was allowed to stabilize

FCC ID: BCGA2123	 MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager
Test Report S/N: 1C1811080029-04.BCG	Test Dates: 11/09/2018-02/11/2019	EUT Type: Tablet Device	Page 45 of 61

Test Setup

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

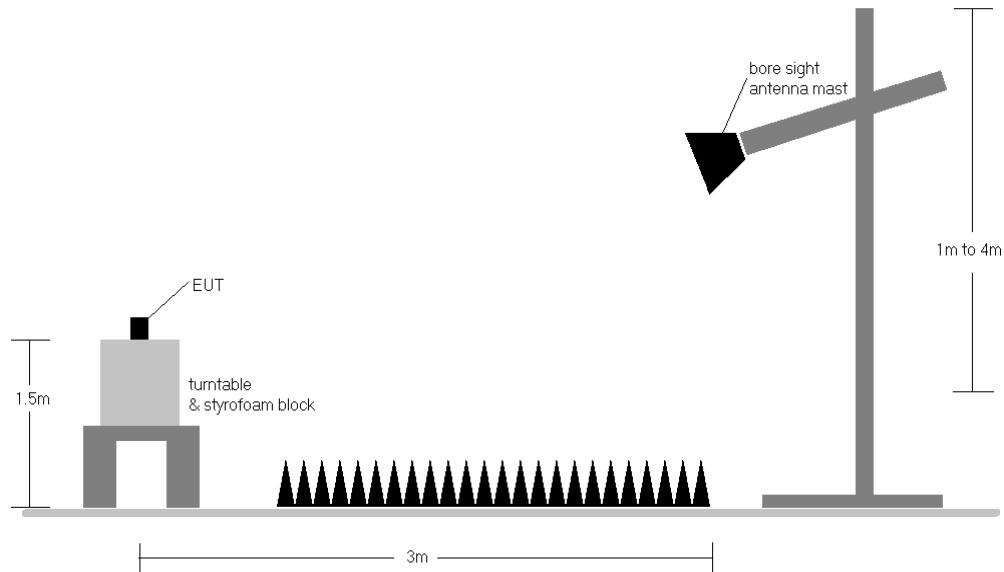


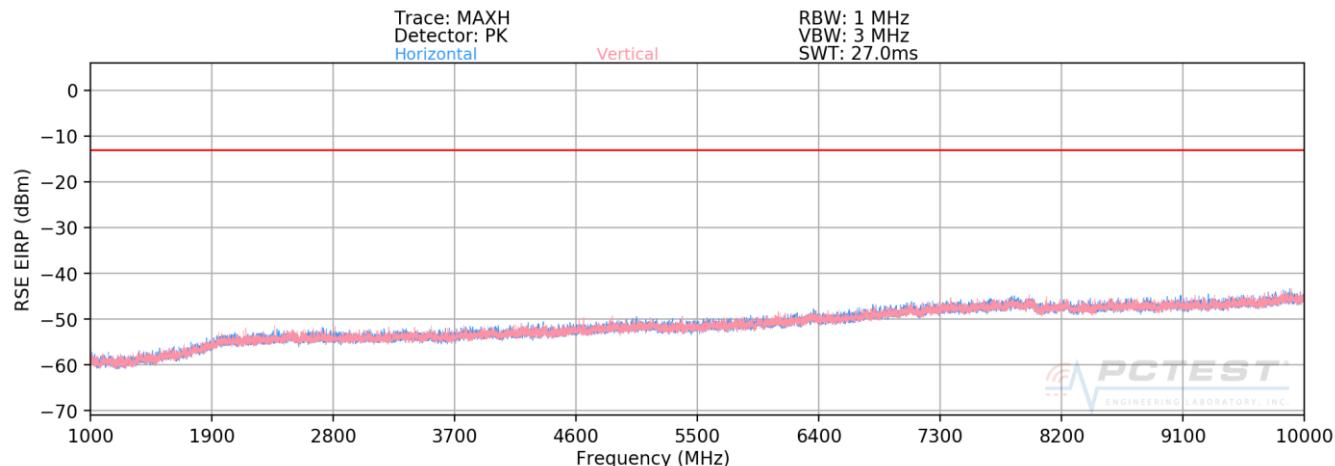
Figure 7-6. Test Instrument & Measurement Setup

Test Notes

1. For LTE mode, the device was tested under all modulations, RB sizes and offsets, and channel bandwidth configurations and the worst case emissions are reported with 1 RB.
2. This unit was tested with its standard battery.
3. The EUT was tested in three orthogonal planes and in all possible test configurations and positioning. The worst case setup is reported in the tables below.
4. The "-" shown in the following RSE tables are used to denote a noise floor measurement.
5. Per 90.543(f), emissions in the 1559 – 1610MHz band are subject to a limit of -40dBm/MHz for wideband signals. These emission measurements are shown in this section below.

FCC ID: BCGA2123	PCTEST ENGINEERING LABORATORY, INC.		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C1811080029-04.BCG	Test Dates: 11/09/2018-02/11/2019	EUT Type: Tablet Device	Page 46 of 61	

7.7.1 ANT WF3 (Port A) Radiated Spurious Emissions Measurements



Plot 7-48. Radiated Spurious Plot above 1GHz (Band 26)

OPERATING FREQUENCY: 816.50 MHz
MODULATION SIGNAL: QPSK
BANDWIDTH: 5.0 MHz
DISTANCE: 3 meters
LIMIT: -13.00 dBm

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Margin [dB]
1633.00	H	-	-	-71.90	4.49	-67.41	-54.4
2449.50	H	-	-	-69.30	5.56	-63.74	-50.7
3266.00	H	-	-	-70.10	7.20	-62.89	-49.9

Table 7-4. Radiated Spurious Data (LTE Band 26 – Low Channel)

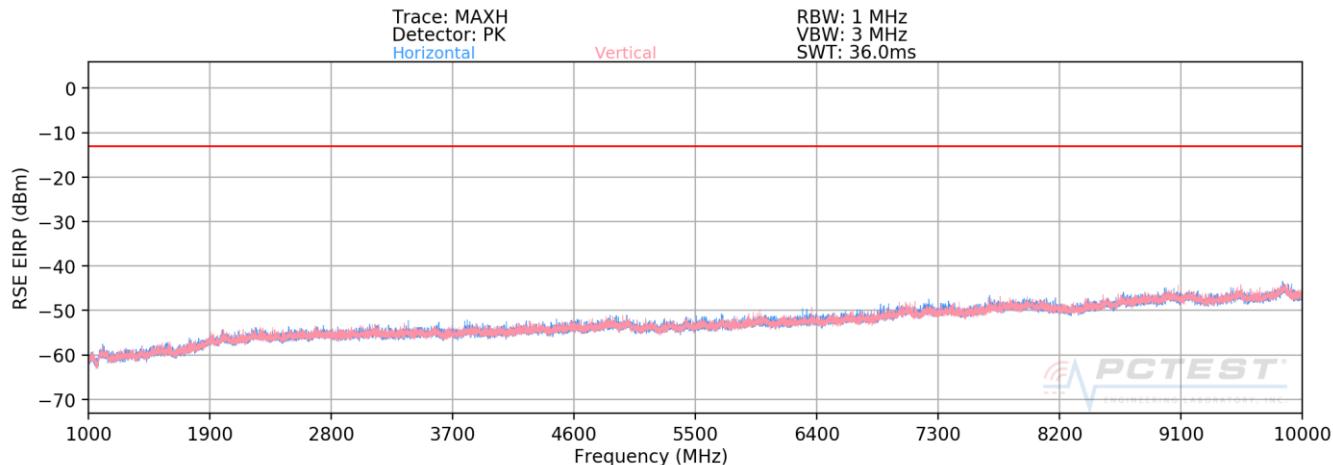
FCC ID: BCGA2123	 MEASUREMENT REPORT (CERTIFICATION)			Approved by: Quality Manager
Test Report S/N: 1C1811080029-04.BCG	Test Dates: 11/09/2018-02/11/2019	EUT Type: Tablet Device		

OPERATING FREQUENCY: 821.50 MHz
 MODULATION SIGNAL: QPSK
 BANDWIDTH: 5.0 MHz
 DISTANCE: 3 meters
 LIMIT: -13.00 dBm

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Margin [dB]
1643.00	H	-	-	-72.21	4.48	-67.73	-54.7
2464.50	H	-	-	-69.02	5.58	-63.44	-50.4
3286.00	H	-	-	-70.31	7.22	-63.10	-50.1

Table 7-5. Radiated Spurious Data (LTE Band 26 – High Channel)

FCC ID: BCGA2123	 MEASUREMENT REPORT (CERTIFICATION)			Approved by: Quality Manager
Test Report S/N: 1C1811080029-04.BCG	Test Dates: 11/09/2018-02/11/2019	EUT Type: Tablet Device	Page 48 of 61	



Plot 7-49. Radiated Spurious Plot above 1GHz (Band 14)

OPERATING FREQUENCY: 790.50 MHz

MODULATION SIGNAL: QPSK

BANDWIDTH: 5.0 MHz

DISTANCE: 3 meters

LIMIT: -13 dBm

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Margin [dB]
2371.50	H	399	166	-68.62	5.50	-63.12	-50.1
3162.00	H	-	-	-70.02	6.82	-63.20	-50.2
3952.50	H	-	-	-70.48	7.77	-62.71	-49.7

Table 7-6. Radiated Spurious Data (LTE Band 14 – Low Channel)

FCC ID: BCGA2123	MEASUREMENT REPORT (CERTIFICATION)			Approved by: Quality Manager
Test Report S/N: 1C1811080029-04.BCG	Test Dates: 11/09/2018-02/11/2019	EUT Type: Tablet Device		

OPERATING FREQUENCY: 793.00 MHz
 MODULATION SIGNAL: QPSK
 BANDWIDTH: 10.0 MHz
 DISTANCE: 3 meters
 LIMIT: -13 dBm

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Margin [dB]
2379.00	H	390	159	-69.25	5.51	-63.75	-50.7
3172.00	H	-	-	-69.75	6.87	-62.88	-49.9
3965.00	H	-	-	-70.32	7.80	-62.51	-49.5

Table 7-7. Radiated Spurious Data (LTE Band 14 – Mid Channel)

OPERATING FREQUENCY: 795.50 MHz
 MODULATION SIGNAL: QPSK
 BANDWIDTH: 5.0 MHz
 DISTANCE: 3 meters
 LIMIT: -13 dBm

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Margin [dB]
2386.50	H	207	111	-69.39	5.51	-63.87	-50.9
3182.00	H	-	-	-69.89	6.91	-62.98	-50.0
3977.50	H	-	-	-70.50	7.84	-62.67	-49.7

Table 7-8. Radiated Spurious Data (LTE Band 14 – High Channel)

FCC ID: BCGA2123	MEASUREMENT REPORT (CERTIFICATION)			Approved by: Quality Manager
Test Report S/N: 1C1811080029-04.BCG	Test Dates: 11/09/2018-02/11/2019	EUT Type: Tablet Device	Page 50 of 61	

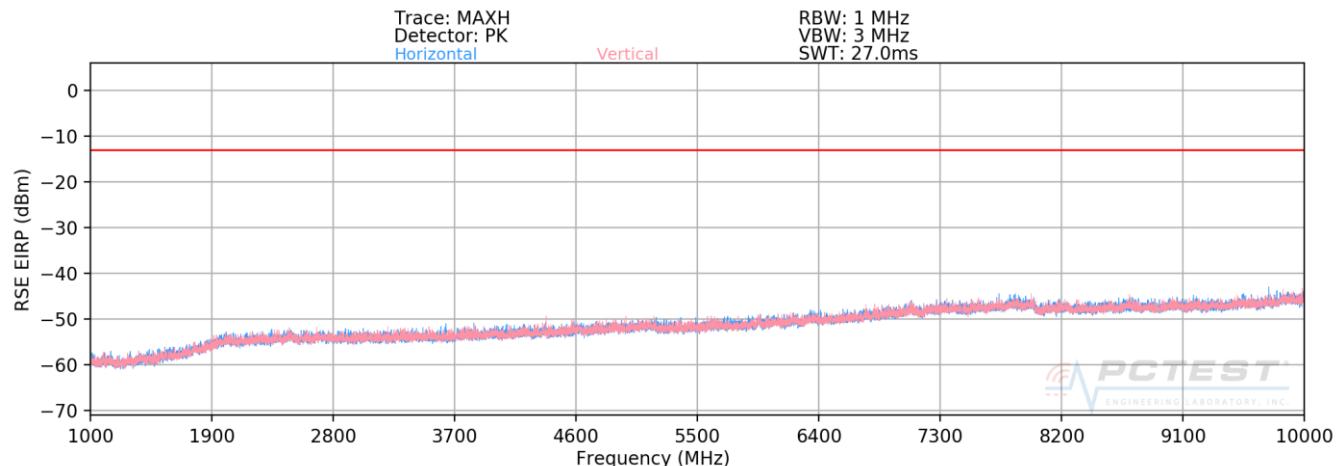
MODULATION SIGNAL: QPSK
 BANDWIDTH: 5.00 MHz
 DISTANCE: 3 meters
 NARROWBAND EMISSION LIMIT: -50 dBm
 WIDEBAND EMISSION LIMIT: -40 dBm/MHz

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Margin [dB]
1581.00	H	-	-	-71.78	4.53	-67.25	-27.2
1586.00	H	-	-	-71.99	4.53	-67.47	-27.5
1591.00	H	-	-	-72.02	4.52	-67.50	-27.5

Table 7-9. Radiated Spurious Data (LTE Band 14 – Wide Band)

FCC ID: BCGA2123	MEASUREMENT REPORT (CERTIFICATION)			Approved by: Quality Manager
Test Report S/N: 1C1811080029-04.BCG	Test Dates: 11/09/2018-02/11/2019	EUT Type: Tablet Device	Page 51 of 61	

7.7.2 ANT WF5 (Port B) Radiated Spurious Emissions Measurements



Plot 7-50. Radiated Spurious Plot above 1GHz (Band 26)

OPERATING FREQUENCY: 814.70 MHz

MODULATION SIGNAL: QPSK

BANDWIDTH: 1.4 MHz

DISTANCE: 3 meters

LIMIT: -13.00 dBm

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Margin [dB]
1633.00	H	195	150	-72.08	4.49	-67.59	-54.6
2449.50	H	-	-	-69.21	5.56	-63.65	-50.7
3266.00	H	-	-	-70.32	7.20	-63.11	-50.1
4082.50	H	-	-	-70.25	7.81	-62.44	-49.4

Table 7-10. Radiated Spurious Data (LTE Band 26 – Low Channel)

FCC ID: BCGA2123	 MEASUREMENT REPORT (CERTIFICATION)			Approved by: Quality Manager
Test Report S/N: 1C1811080029-04.BCG	Test Dates: 11/09/2018-02/11/2019	EUT Type: Tablet Device	Page 52 of 61	

OPERATING FREQUENCY: 823.30 MHz

MODULATION SIGNAL: QPSK

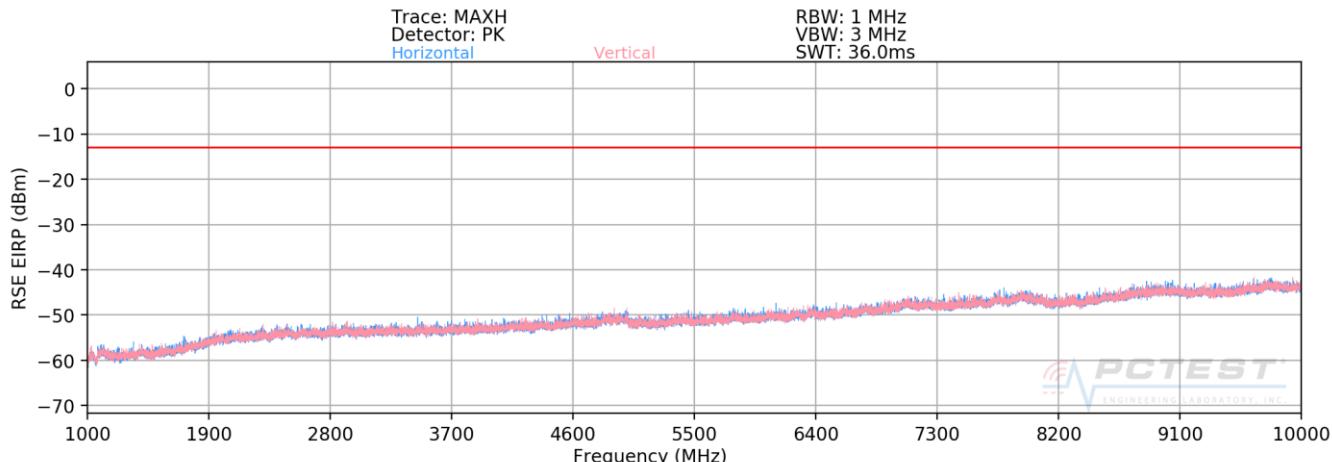
DISTANCE: 3 meters

LIMIT: -13.00 dBm

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Margin [dB]
1643.00	H	-	-	-71.99	4.48	-67.51	-54.5
2464.50	H	-	-	-68.92	5.58	-63.34	-50.3
3286.00	H	-	-	-70.58	7.22	-63.37	-50.4

Table 7-11. Radiated Spurious Data (LTE Band 26 – High Channel)

FCC ID: BCGA2123	 MEASUREMENT REPORT (CERTIFICATION)			Approved by: Quality Manager
Test Report S/N: 1C1811080029-04.BCG	Test Dates: 11/09/2018-02/11/2019	EUT Type: Tablet Device	Page 53 of 61	



Plot 7-51. Radiated Spurious Plot above 1GHz (Band 14)

OPERATING FREQUENCY: 790.50 MHz
 MODULATION SIGNAL: QPSK
 BANDWIDTH: 5.0 MHz
 DISTANCE: 3 meters
 LIMIT: -13 dBm

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Margin [dB]
2371.50	H	-	-	-69.57	5.50	-64.07	-51.1
3162.00	H	-	-	-70.01	6.82	-63.19	-50.2

Table 7-12. Radiated Spurious Data (LTE Band 14 – Low Channel)

OPERATING FREQUENCY: 793.00 MHz
 MODULATION SIGNAL: QPSK
 BANDWIDTH: 10.0 MHz
 DISTANCE: 3 meters
 LIMIT: -13 dBm

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Margin [dB]
2379.00	H	-	-	-69.42	5.51	-63.92	-50.9
3172.00	H	-	-	-69.83	6.87	-62.96	-50.0

Table 7-13. Radiated Spurious Data (LTE Band 14 – Mid Channel)

FCC ID: BCGA2123		MEASUREMENT REPORT (CERTIFICATION)				Approved by: Quality Manager
Test Report S/N: 1C1811080029-04.BCG	Test Dates: 11/09/2018-02/11/2019	EUT Type: Tablet Device				

OPERATING FREQUENCY: 795.50 MHz
 MODULATION SIGNAL: QPSK
 BANDWIDTH: 5.0 MHz
 DISTANCE: 3 meters
 LIMIT: -13 dBm

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Margin [dB]
2386.50	H	-	-	-69.40	5.51	-63.88	-50.9
3182.00	H	-	-	-69.96	6.91	-63.05	-50.1

Table 7-14. Radiated Spurious Data (LTE Band 14 – High Channel)

MODULATION SIGNAL: QPSK
 BANDWIDTH: 5.00 MHz
 DISTANCE: 3 meters
 NARROWBAND EMISSION LIMIT: -50 dBm
 WIDEBAND EMISSION LIMIT: -40 dBm/MHz

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Margin [dB]
1581.00	H	-	-	-71.94	4.53	-67.41	-27.4
1586.00	H	-	-	-72.02	4.53	-67.50	-27.5
1591.00	H	-	-	-72.04	4.52	-67.52	-27.5

Table 7-15. Radiated Spurious Data (LTE Band 14 – Wide Band)

FCC ID: BCGA2123	 MEASUREMENT REPORT (CERTIFICATION)			Approved by: Quality Manager
Test Report S/N: 1C1811080029-04.BCG	Test Dates: 11/09/2018-02/11/2019	EUT Type: Tablet Device	Page 55 of 61	

7.8 Frequency Stability / Temperature Variation

§2.1055 §90.213

Test Overview and Limit

Frequency stability testing is performed in accordance with the guidelines of ANSI/TIA-603-E-2016. The frequency stability of the transmitter is measured by:

- a.) **Temperature:** The temperature is varied from -30°C to +50°C in 10°C increments using an environmental chamber.
- b.) **Primary Supply Voltage:** The primary supply voltage is varied from 85% to 115% of the nominal value for non hand-carried battery and AC powered equipment. For hand-carried, battery-powered equipment, primary supply voltage is reduced to the battery operating end point which shall be specified by the manufacturer.

The frequency stability of the transmitter shall be maintained within ±0.00025% (±2.5 ppm) of the center frequency.

Test Procedure Used

ANSI/TIA-603-E-2016

Test Settings

1. The carrier frequency of the transmitter is measured at room temperature (20°C to provide a reference).
2. The equipment is turned on in a “standby” condition for fifteen minutes before applying power to the transmitter. Measurement of the carrier frequency of the transmitter is made within one minute after applying power to the transmitter.
3. Frequency measurements are made at 10°C intervals ranging from -30°C to +50°C. A period of at least one half-hour is provided to allow stabilization of the equipment at each temperature level.

Test Setup

The EUT was connected via an RF cable to a spectrum analyzer with the EUT placed inside an environmental chamber.

Test Notes

None

FCC ID: BCGA2123	MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager
Test Report S/N: 1C1811080029-04.BCG	Test Dates: 11/09/2018-02/11/2019	EUT Type: Tablet Device	Page 56 of 61

Frequency Stability / Temperature Variation

§2.1055, §90.213

OPERATING FREQUENCY: 819,000,000 Hz
 CHANNEL: 26740
 REFERENCE VOLTAGE: 3.80 VDC
 DEVIATION LIMIT: ± 0.00025 % or 2.5 ppm

VOLTAGE (%)	POWER (VDC)	TEMP (°C)	FREQUENCY (Hz)	Freq. Dev. (Hz)	Deviation (%)
100 %	3.80	- 30	819,000,004	4	0.0000005
100 %		- 20	819,000,004	4	0.0000005
100 %		- 10	819,000,003	3	0.0000004
100 %		0	819,000,003	3	0.0000004
100 %		+ 10	819,000,005	5	0.0000006
100 %		+ 20	819,000,004	4	0.0000004
100 %		+ 30	819,000,004	4	0.0000005
100 %		+ 40	819,000,004	4	0.0000004
100 %		+ 50	819,000,004	4	0.0000004
BATT. ENDPOINT	3.40	+ 20	819,000,004	4	0.0000005

Table 7-16. LTE Band 26 Frequency Stability Data

FCC ID: BCGA2123	MEASUREMENT REPORT (CERTIFICATION)			Approved by: Quality Manager
Test Report S/N: 1C1811080029-04.BCG	Test Dates: 11/09/2018-02/11/2019	EUT Type: Tablet Device	Page 57 of 61	

Frequency Stability / Temperature Variation

§2.1055, §90.213

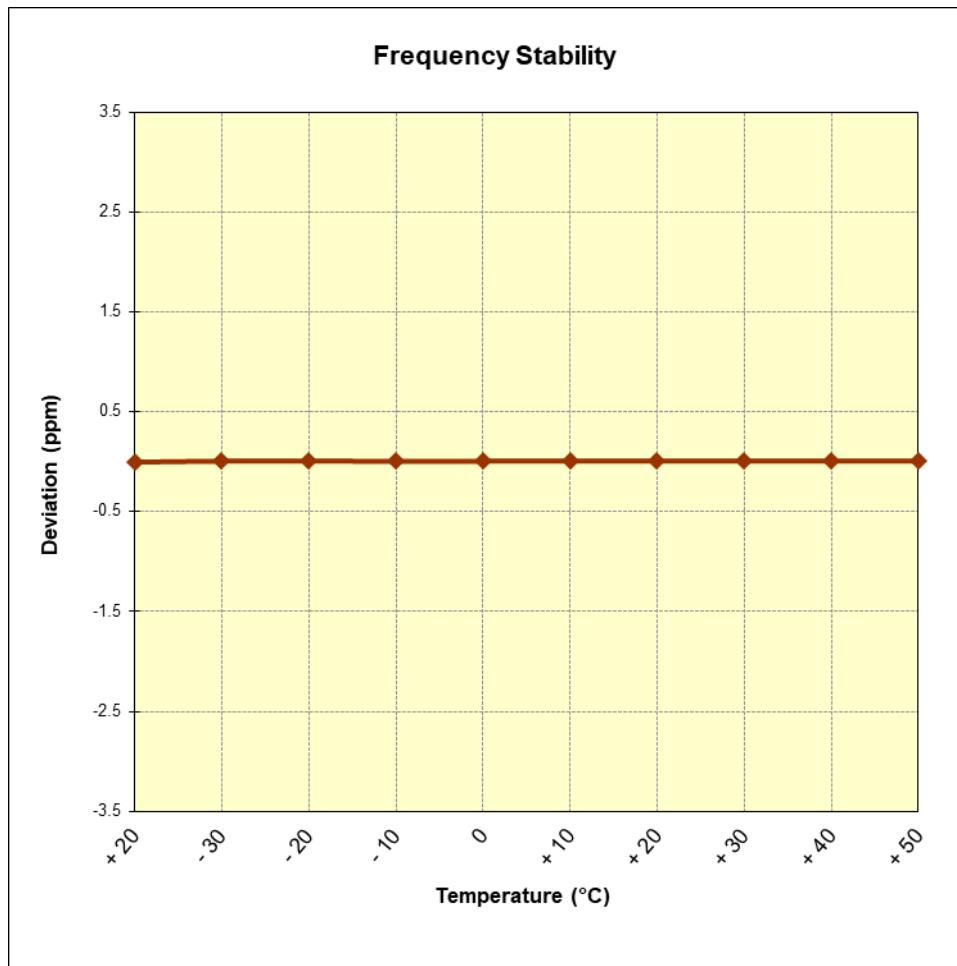


Table 7-17. LTE Band 26 Frequency Stability Data

FCC ID: BCGA2123	 MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager
Test Report S/N: 1C1811080029-04.BCG	Test Dates: 11/09/2018-02/11/2019	EUT Type: Tablet Device	Page 58 of 61

Frequency Stability / Temperature Variation

§2.1055, §90.213

OPERATING FREQUENCY: 793,000,000 Hz
 CHANNEL: 23330
 REFERENCE VOLTAGE: 3.80 VDC

VOLTAGE (%)	POWER (VDC)	TEMP (°C)	FREQUENCY (Hz)	Freq. Dev. (Hz)	Deviation (%)
100 %	3.80	- 30	793,000,004	4	0.0000004
100 %		- 20	793,000,004	4	0.0000005
100 %		- 10	793,000,004	4	0.0000005
100 %		0	793,000,003	3	0.0000004
100 %		+ 10	793,000,004	4	0.0000004
100 %		+ 20	793,000,004	4	0.0000005
100 %		+ 30	793,000,003	3	0.0000004
100 %		+ 40	793,000,004	4	0.0000005
100 %		+ 50	793,000,003	3	0.0000004
BATT. ENDPOINT	3.40	+ 20	793,000,003	3	0.0000004

Table 7-18. LTE Band 14 Frequency Stability Data

FCC ID: BCGA2123	MEASUREMENT REPORT (CERTIFICATION)			Approved by: Quality Manager
Test Report S/N: 1C1811080029-04.BCG	Test Dates: 11/09/2018-02/11/2019	EUT Type: Tablet Device	Page 59 of 61	

Frequency Stability / Temperature Variation

§2.1055, §90.213

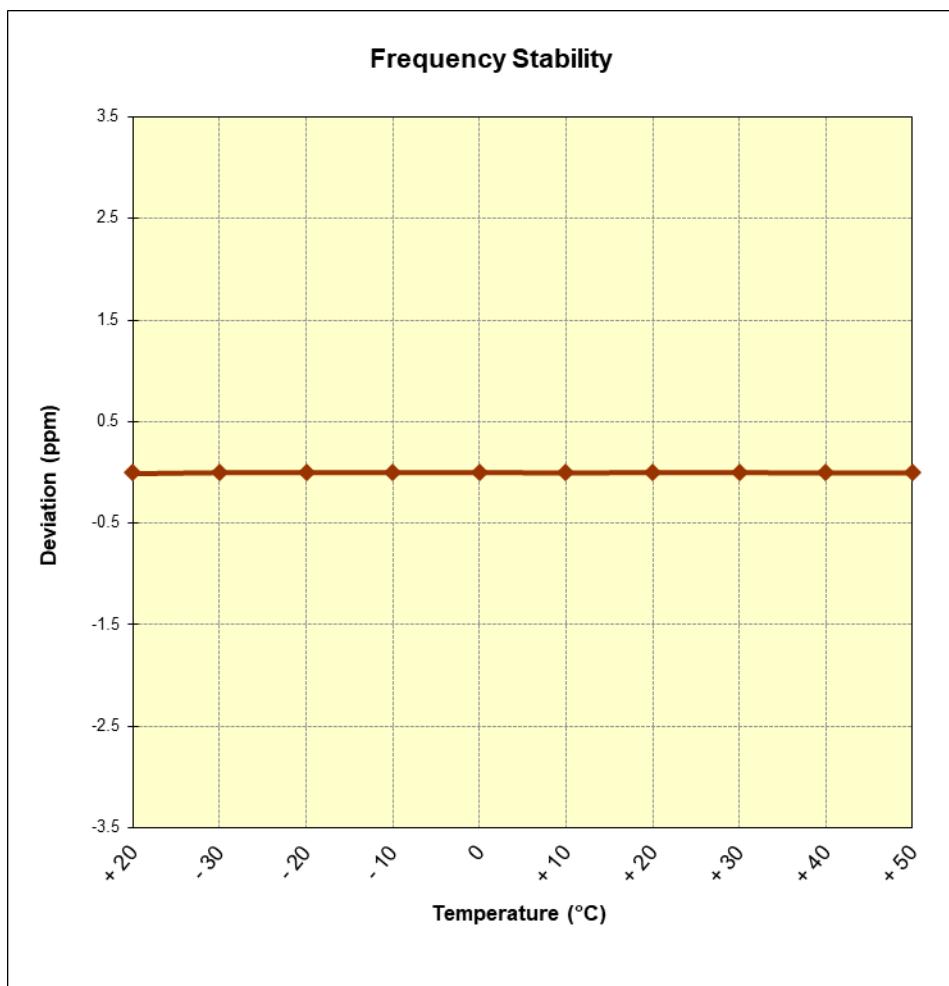


Table 7-19. LTE Band 14 Frequency Stability Data

FCC ID: BCGA2123	 MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager
Test Report S/N: 1C1811080029-04.BCG	Test Dates: 11/09/2018-02/11/2019	EUT Type: Tablet Device	Page 60 of 61

8.0 CONCLUSION

The data collected relate only to the item(s) tested and show that the **Apple Tablet Device**
FCC ID: BCGA2123 complies with all the requirements of Part 90 of the FCC rules.

FCC ID: BCGA2123	 MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager
Test Report S/N: 1C1811080029-04.BCG	Test Dates: 11/09/2018-02/11/2019	EUT Type: Tablet Device	Page 61 of 61