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MEASUREMENT REPORT Part 96 LTE

Applicant Name:

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

Date of Testing:

12/10/2019 - 02/25/2020

Test Site/Location:

PCTEST Morgan Hill, CA, USA

Test Report Serial No.:

1C1912170055-05.BCG

FCC ID:	BCGA2232
APPLICANT:	Apple Inc.

Application Type:	Certification
Model:	A2232, A2233
EUT Type:	Tablet Device
FCC Classification:	Citizens Band End User Devices (CBE)
FCC Rule Part(s):	96
Test Procedure(s):	ANSI C63.26-2015, ANSI/TIA-603-E-2016, KDB 971168 D01 v03r01, KDB 940660 D01 v02, WINNF-TS-0122 V1.0.0

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

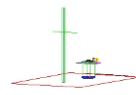
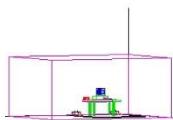


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FCC Part 96

Mode	Bandwidth	Modulation	Tx Frequency Range [MHz]	EIRP		Emission Designator
				Max. Power [W]	Max. Power [dBm]	
LTE Band 48	20 MHz	QPSK	3560.0 - 3690.0	0.129	21.10	18M1G7W
		16QAM	3560.0 - 3690.0	0.109	20.36	18M0D7W
		64QAM	3560.0 - 3690.0	0.092	19.62	18M0D7W
	15 MHz	QPSK	3557.5 - 3692.5	0.124	20.95	13M5G7W
		16QAM	3557.5 - 3692.5	0.108	20.32	13M5D7W
		64QAM	3557.5 - 3692.5	0.087	19.41	13M6D7W
	10 MHz	QPSK	3555.0 - 3695.0	0.126	21.00	9M01G7W
		16QAM	3555.0 - 3695.0	0.109	20.37	9M04D7W
		64QAM	3555.0 - 3695.0	0.089	19.50	9M01D7W
	5 MHz	QPSK	3552.5 - 3697.5	0.121	20.84	4M51G7W
		16QAM	3552.5 - 3697.5	0.105	20.21	4M51D7W
		64QAM	3552.5 - 3697.5	0.090	19.53	4M52D7W

EUT Overview (LTE B48)

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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.

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 a CBRS Alliance (OnGo) Approved Test Lab
- PCTEST is a WInnForum Approved Test Lab
- PCTEST is an ISO 17025-2005 accredited test facility under the American Association for Laboratory Accreditation (A2LA) with Certificate number 2041.02 for CBRS Alliance Certification Test Plan and WInnForum Conformance and Performance Test Technical Standard.
- 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.

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2.0 PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the **Apple Tablet Device FCC ID: BCGA2232**. The test data contained in this report pertains only to the emissions due to the EUT's LTE Band 48 operation in the CBRS band. Per FCC Part 96, this device is evaluated under Citizens Band End User Devices (CBE).

Test Device Serial No.: DLXZN00JP57G, DLXZN002P57G

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/ax WLAN, 802.11a/n/ac/ax UNII, Bluetooth (1x, EDR, LE, HDR4, HDR8)

This device supports BT Beamforming.

2.3 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.

2.4 Antenna Description

Following antennas were used for the testing.

Frequency [MHz]	Antennas			
	Port A	Port B	Port C	Port D
3550-3700	ANT 4b	ANT 2b	ANT 3	ANT 1

Table 2-1. Antennas vs Ports

Frequency [MHz]	Antenna Gain (dBi)			
	Port A	Port B	Port C	Port D
3550-3700	-5.6	-4.0	-3.9	-5.9

Table 2-2. Highest Antenna Gain

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2.5 Test Support Equipment

1	Apple MacBook w/ AC/DC Adapter	Model: A1398 Model: A1435	S/N: C2QKP008F6F3 S/N: C04325505K1F288BG
2	Apple USB-C Cable	Model: Chimp	S/N: 304523
3	USB-C Cable w / AC/DC Adapter	Model: A1997 Model: A1720	S/N: N/A S/N: C3D9274B06YLHDAE
4	Apple Pencil	Model: A2051	S/N: GQXYGSXCJKM9
5	DC Power Supply	Model: KPS3010D	S/N: N/A
6	LTE Access Point	Model: Q710	S/N: 991929000125
7	Dell Laptop (Local SAS - WINNForum Test Harness)	Model: Latitude 5591	S/N: B9WBRV2

Table 2-3. Test Support Equipment Used

2.6 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.

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 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.

2.7 Software and Firmware

The test was conducted with firmware version 17E228 installed on the EUT.

2.8 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/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

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. 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 -40dBm/MHz for End User Devices.

All radiated measurements are performed in a chamber that meets the site requirements per ANSI C63.4-2014. Additionally, radiated emissions below 30MHz are also validated on an Open Area Test Site to assert correlation with the chamber measurements per the requirements of KDB 414788 D01 V01r01.

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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

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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	3/13/2019	Annual	3/13/2020	MY49430244
ATM	180-442A-KF	20dB Nominal Gain Horn Antenna	10/29/2019	Annual	10/29/2020	T058701-02
ESPEC	SU-241	Tabletop Temperature Chamber	9/3/2019	Annual	9/3/2020	92009574
ETS-Lindgren	3142E-PA	Pre-Amplifier (30MHz - 6GHz)	9/19/2019	Annual	9/19/2020	213236
ETS-Lindgren	3142E	BiConiLog Antenna (30MHz - 6GHz)	8/14/2019	Annual	8/14/2020	224569
ETS-Lindgren	3117	Double Ridged Guide Antenna (1-18 GHz)	3/12/2019	Annual	3/12/2020	205956
Rohde & Schwarz	FSV40	Signal Analyzer (10Hz-40GHz)	2/27/2019	Annual	2/27/2020	101619
Rohde & Schwarz	ESW26	EMI Test Receiver	5/21/2019	Annual	5/21/2020	101299
Rohde & Schwarz	ESW44	EMI Test Receiver	7/27/2019	Annual	7/27/2020	101668
Rohde & Schwarz	CMW500	Wideband Radio Communication Tester	4/20/2019	Annual	4/20/2020	161617
Rohde & Schwarz	CMW500	Wideband Radio Communication Tester	8/8/2019	Annual	8/8/2020	151888
Rohde & Schwarz	TS-PR1840	Pre-Amplifier (18GHz - 40GHz)	9/19/2019	Annual	9/19/2020	100051
Rohde & Schwarz	TC-TA18	Cross Polarized Vivaldi Antenna (400MHz-18GHz)	11/14/2019	Annual	11/14/2020	101057
Rohde & Schwarz	HFH2-Z2	Loop Antenna	3/21/2019	Annual	3/21/2020	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

LTE BW = 8.62 MHz

G = Phase Modulation

7 = Quantized/Digital Info

W = Combination of Any

QAM Modulation

Emission Designator = 8M45D7W

LTE BW = 8.45 MHz

D = Amplitude/Angle Modulated

7 = Quantized/Digital Info

W = Combination of Any

Spurious Radiated Emission – LTE Band

Example: Middle Channel LTE Mode 2nd Harmonic (7250 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).

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7.0 TEST RESULTS

7.1 Summary

Company Name: Apple Inc.
 FCC ID: BCGA2232
 FCC Classification: Citizens Band End User Devices (CBE)
 Mode(s): LTE

FCC Part Section(s)	Test Description	Test Limit	Test Condition	Test Result	Reference
2.1049	Occupied Bandwidth	N/A	CONDUCTED	PASS	Section 7.2
2.1046	Transmitter Conducted Output Power	N/A		PASS	Section 7.5
2.1051 96.41(e)(ii)	Out of Band Emissions	<p>-13 dBm/MHz at frequencies within 0-B MHz of channel edge (where B is the bandwidth of the assigned channel)</p> <p>-25 dBm/MHz at frequencies greater than B MHz above and below channel edge</p> <p>-40 dBm/MHz at frequencies below 3530 MHz and above 3720 MHz</p>		PASS	Section 7.3, 7.4
2.1055	Frequency Stability	Fundamental emissions stay within authorized frequency block		PASS	Section 7.7
96.47	End User Device Additional Requirements (CBSD Protocol)	<p>End User Devices may operate only if they can positively receive and decode an authorization signal transmitted by a CBSD, including the frequencies and power limits for their operation.</p> <p>An End User Device must discontinue operations, change frequencies, or change its operational power level within 10 seconds of receiving instructions from its associated CBSD.</p>		PASS	Section 7.8

Table 7-1. Summary of Conducted Test Results

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FCC Part Section(s)	Test Description	Test Limit	Test Condition	Test Result	Reference
96.41(b)	Equivalent Isotropic Radiated Power (EIRP)	23 dBm/10MHz	CONDUCTED	PASS	Section 7.5
2.1053 96.41(e)	Undesirable Emissions	-40 dBm/MHz	RADIATED	PASS	Section 7.6

Table 7-2. Summary of Radiated Test Results

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) 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 "LTE Automation," Version 5.1.

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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.

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.

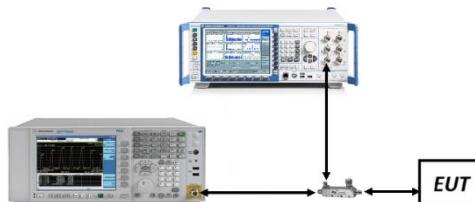


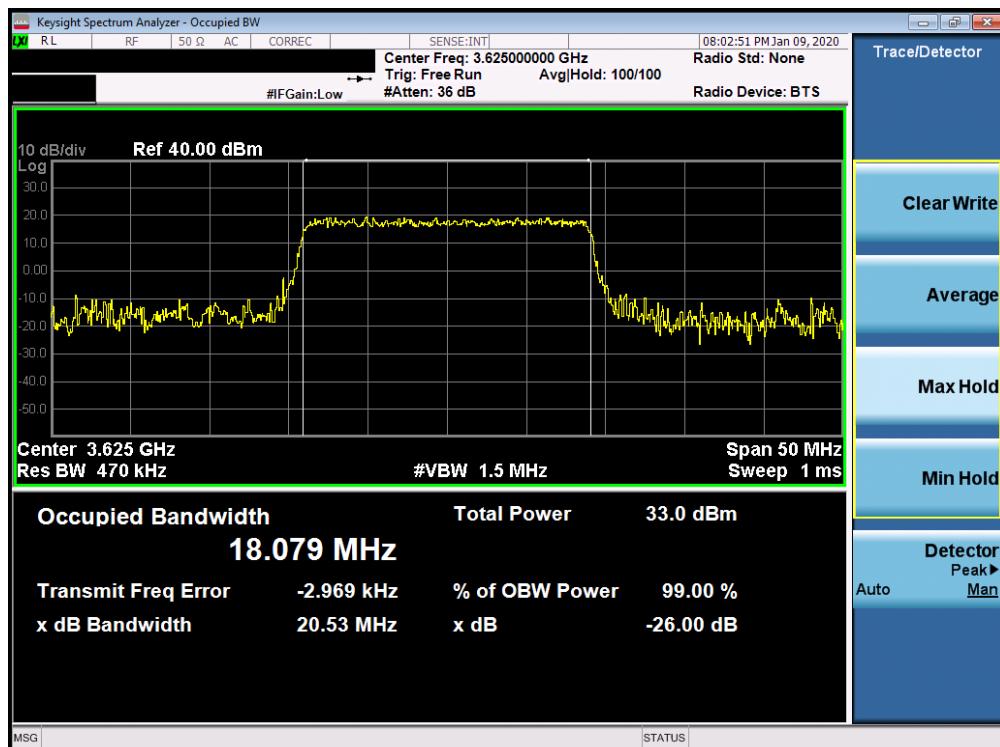
Figure 7-1. Test Instrument & Measurement Setup

Test Notes

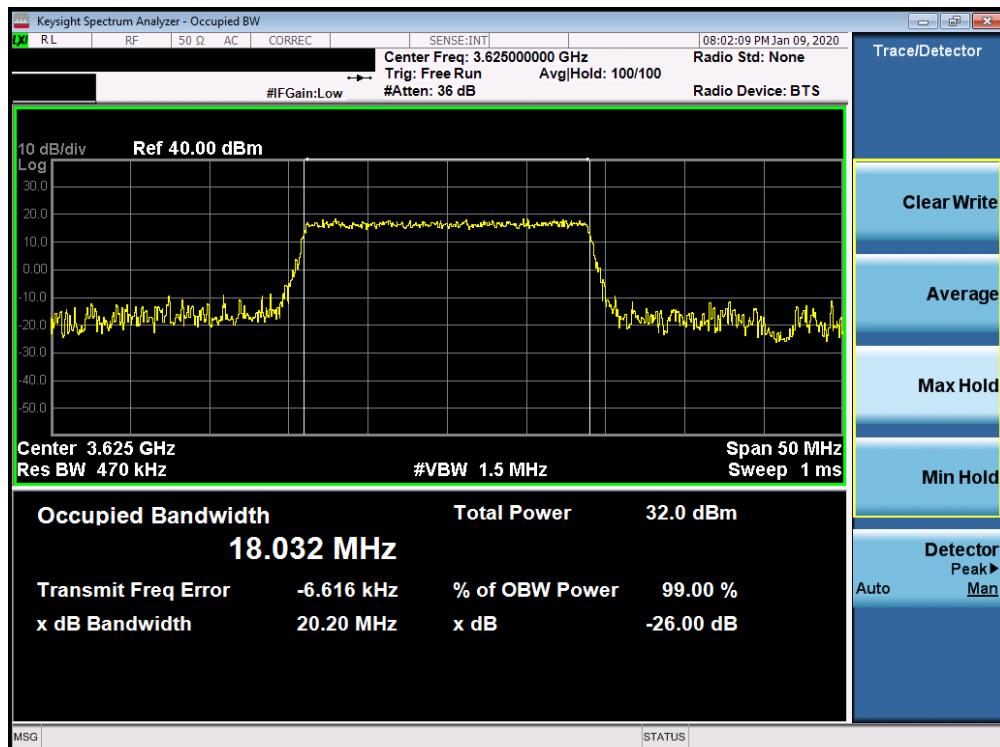
1. All ports were tested and only the worst case data were reported.
2. Refer to Table 2-1 Section 2.3 of this test report for correlation between Antennas and Ports.

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LTE Band 48

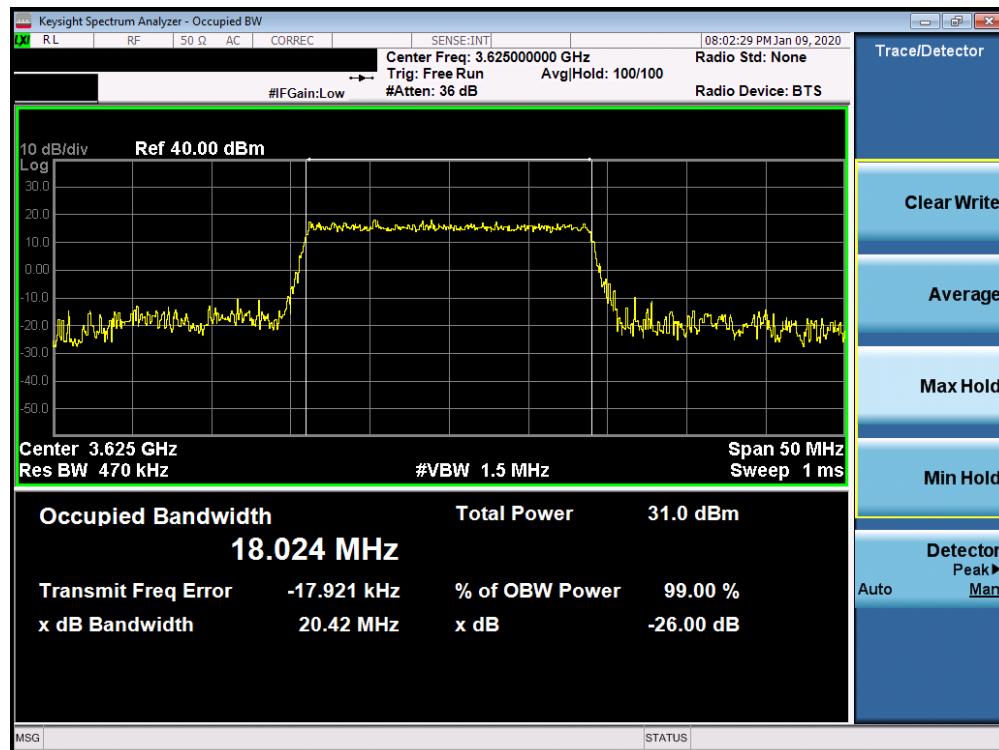


Plot 7-1. Occupied Bandwidth Plot (LTE Band 48 - 20MHz QPSK - Full RB Configuration)



Plot 7-2. Occupied Bandwidth Plot (LTE Band 48 - 20MHz 16-QAM - Full RB Configuration)

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Plot 7-3. Occupied Bandwidth Plot (LTE Band 48 - 20MHz 64-QAM - Full RB Configuration)



Plot 7-4. Occupied Bandwidth Plot (LTE Band 48 - 15MHz QPSK - Full RB Configuration)

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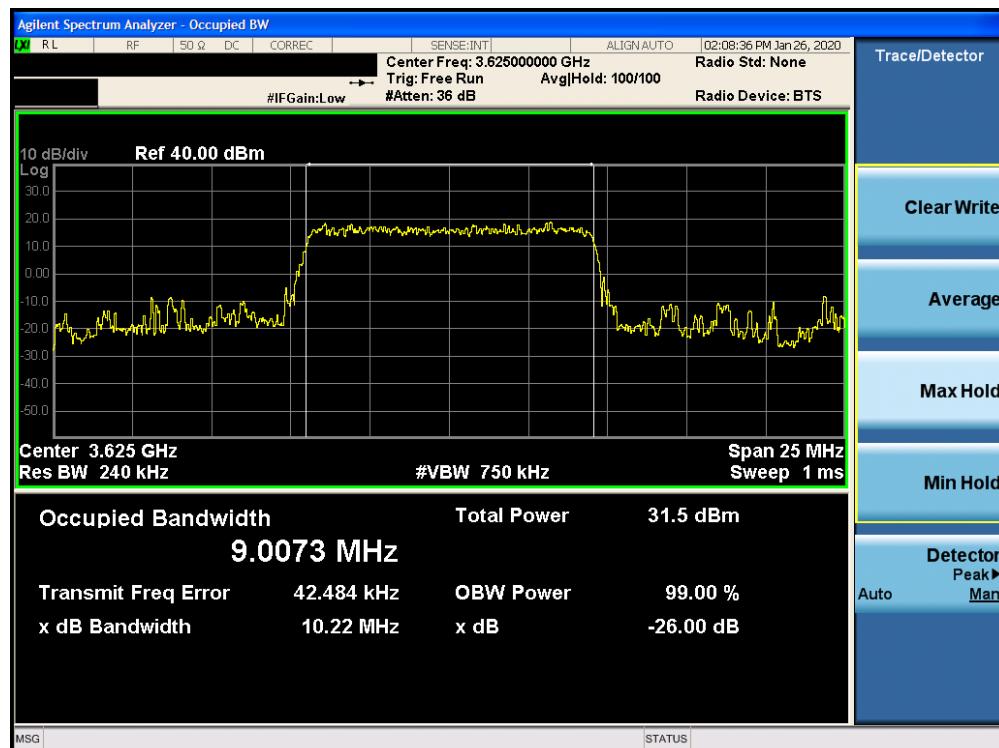


Plot 7-5. Occupied Bandwidth Plot (LTE Band 48 - 15MHz 16-QAM - Full RB Configuration)



Plot 7-6. Occupied Bandwidth Plot (LTE Band 48 - 15MHz 64-QAM - Full RB Configuration)

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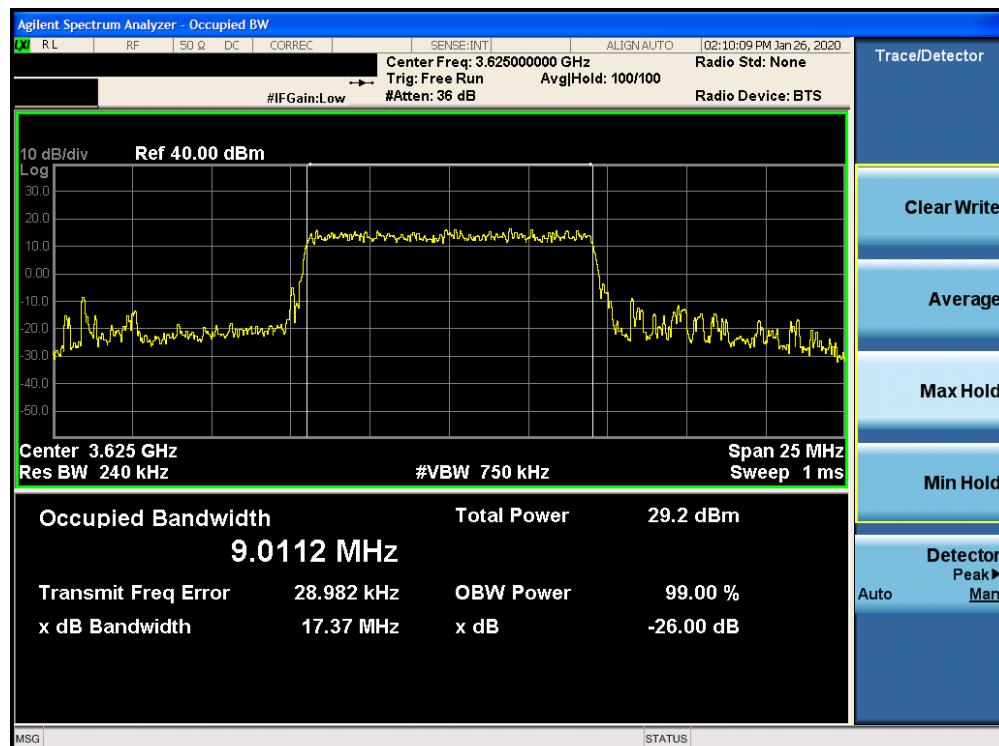


Plot 7-7. Occupied Bandwidth Plot (LTE Band 48 - 10MHz QPSK - Full RB Configuration)



Plot 7-8. Occupied Bandwidth Plot (LTE Band 48 - 10MHz 16-QAM - Full RB Configuration)

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Plot 7-9. Occupied Bandwidth Plot (LTE Band 48 - 10MHz 64-QAM - Full RB Configuration)

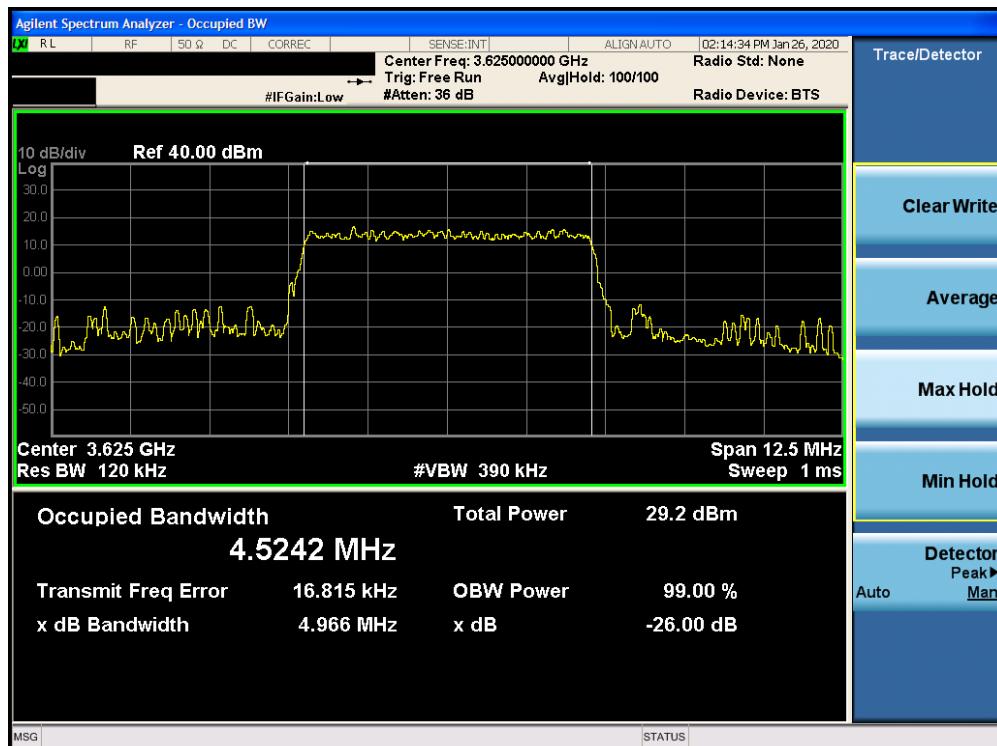


Plot 7-10. Occupied Bandwidth Plot (LTE Band 48 - 5MHz QPSK - Full RB Configuration)

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Plot 7-11. Occupied Bandwidth Plot (LTE Band 48 - 5MHz 16-QAM - Full RB Configuration)



Plot 7-12. Occupied Bandwidth Plot (LTE Band 48 - 5MHz 64-QAM - Full RB Configuration)

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7.3 Spurious and Harmonic Emissions at Antenna Terminal

§2.1051 §96.41(e)

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 its maximum duty cycle, 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 conducted power of any emissions below 3530 MHz or above 3720 MHz shall not exceed -40 dBm/MHz.

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 at least 10 * the fundamental frequency (separated into at least two plots per channel)
2. Detector = RMS
3. Trace mode = Max Hold
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.

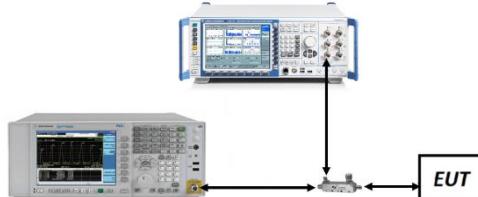


Figure 7-2. Test Instrument & Measurement Setup

Test Notes

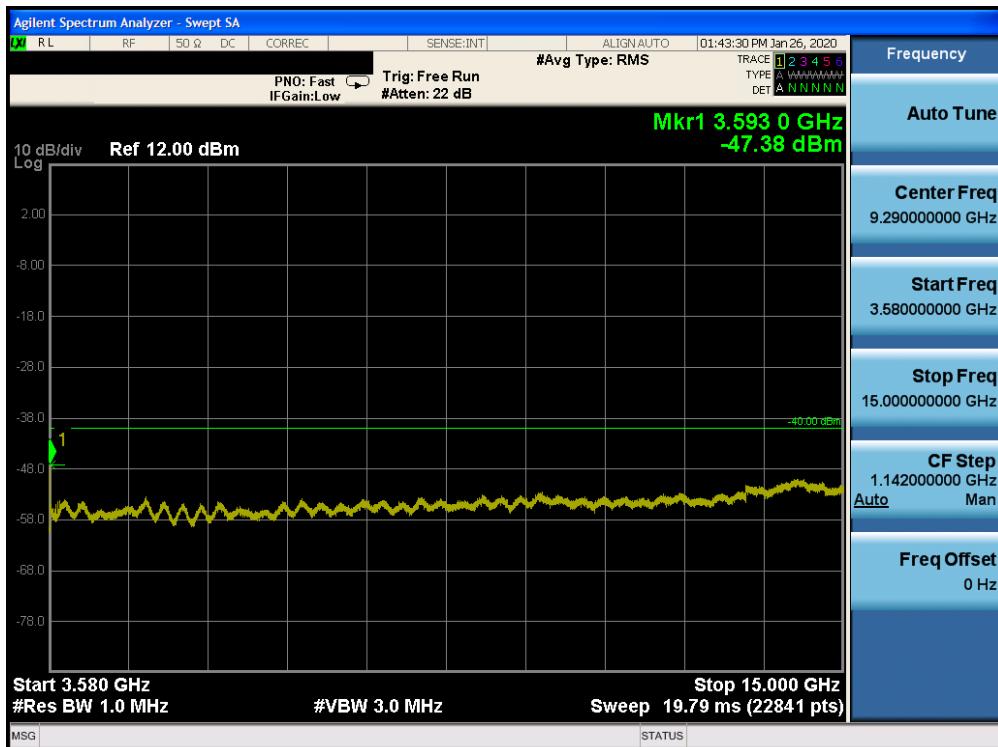
1. Compliance with the applicable limits is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater for frequencies less than 1 GHz and 1 MHz or greater for frequencies greater than 1 GHz. However, in the 1 MHz bands immediately outside and adjacent to the 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.

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LTE Band 48

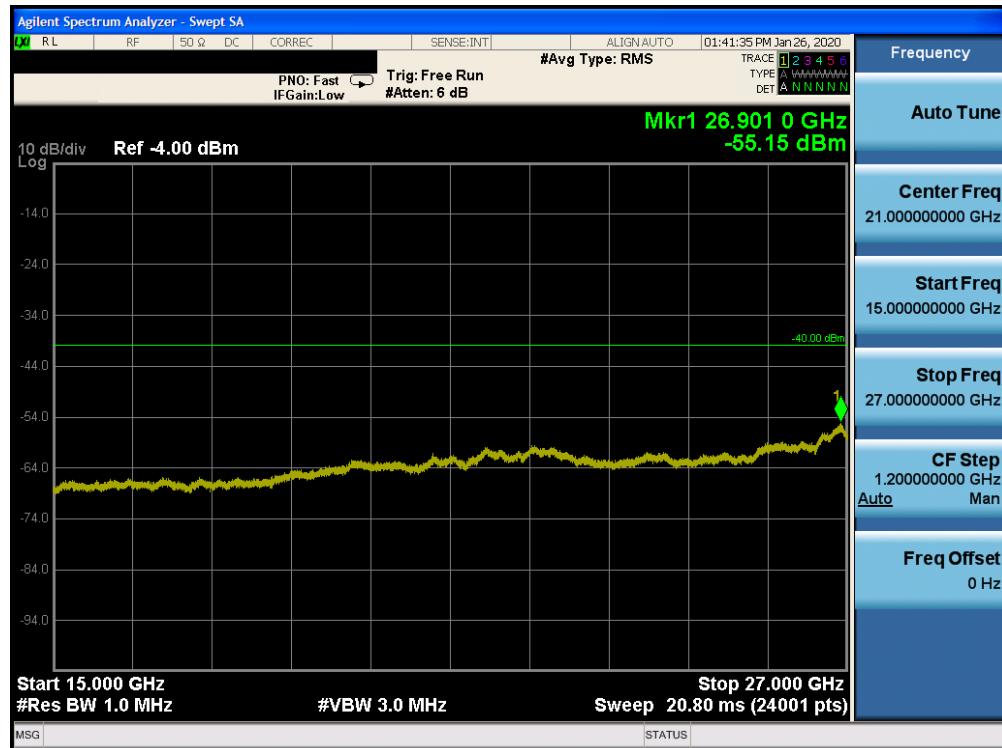


Plot 7-13. Conducted Spurious Plot (LTE Band 48 - 20MHz QPSK - RB Size 1, RB Offset 0 - Low Channel)



Plot 7-14. Conducted Spurious Plot (LTE Band 48 - 20MHz QPSK - RB Size 1, RB Offset 0 - Low Channel)

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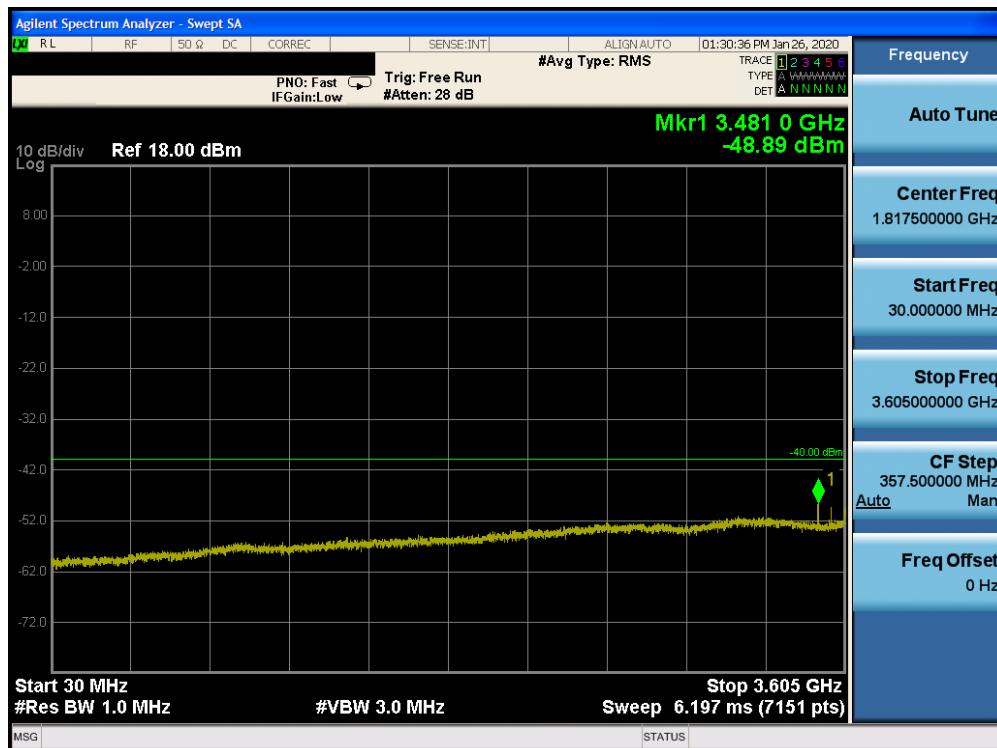


Plot 7-15. Conducted Spurious Plot (LTE Band 48 - 20MHz QPSK - RB Size 1, RB Offset 0 - Low Channel)

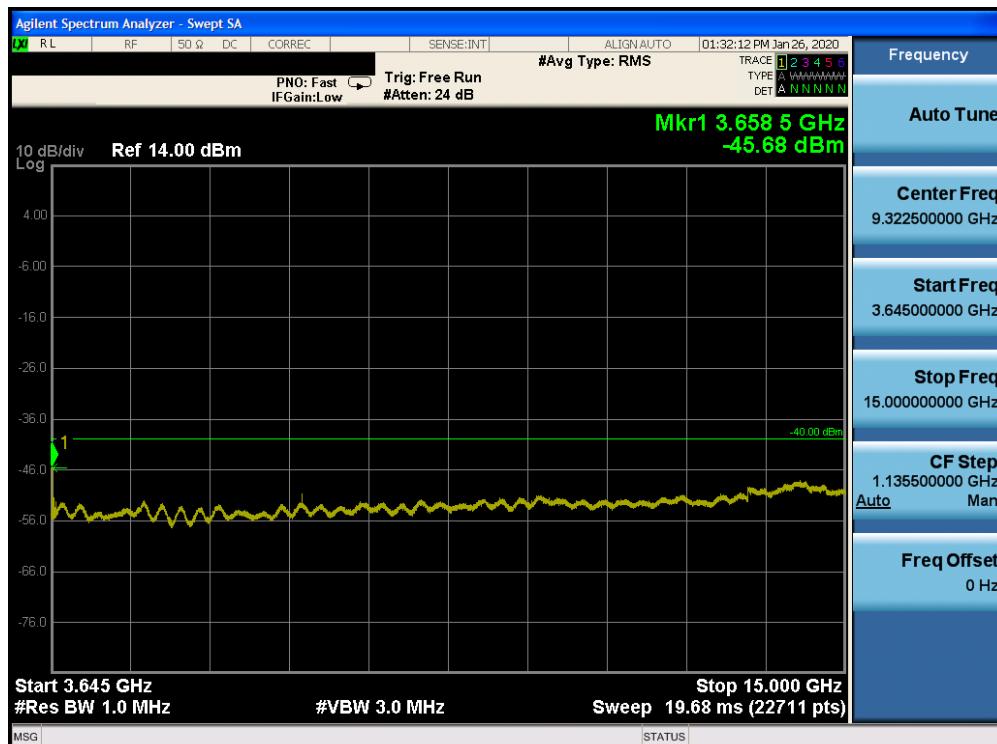


Plot 7-16. Conducted Spurious Plot (LTE Band 48 - 20MHz QPSK - RB Size 1, RB Offset 0 - Low Channel)

FCC ID: BCGA2232		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
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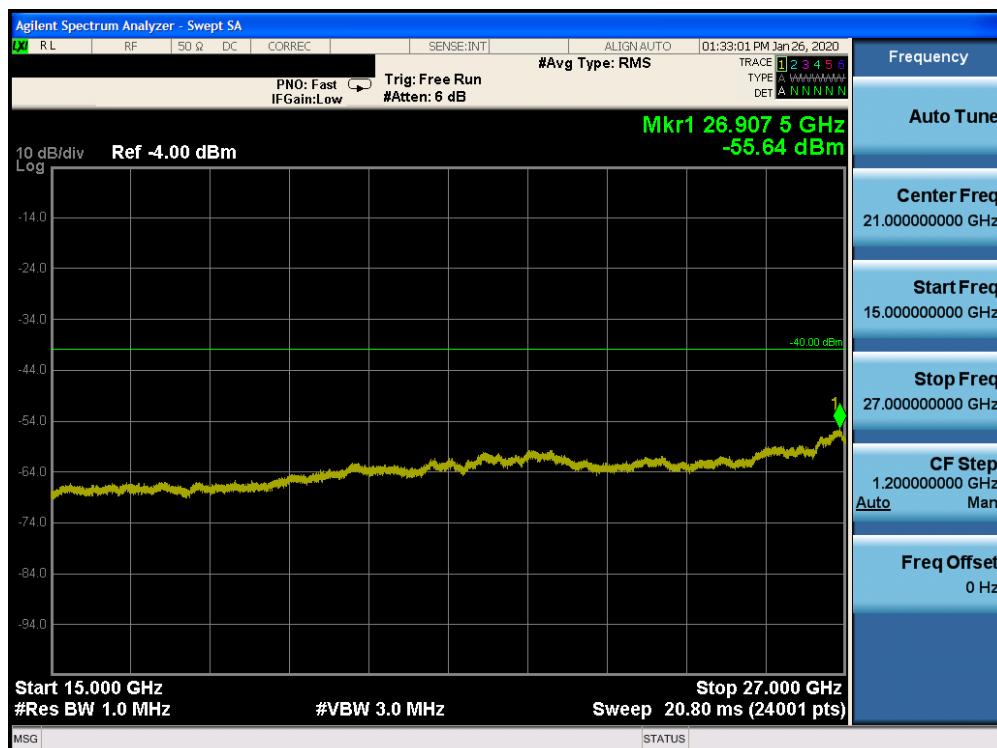


Plot 7-17. Conducted Spurious Plot (LTE Band 48 - 20MHz QPSK - RB Size 1, RB Offset 0 - Mid Channel)



Plot 7-18. Conducted Spurious Plot (LTE Band 48 - 20MHz QPSK - RB Size 1, RB Offset 0 - Mid Channel)

FCC ID: BCGA2232		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
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Plot 7-19. Conducted Spurious Plot (LTE Band 48 - 20MHz QPSK - RB Size 1, RB Offset 0 - Mid Channel)

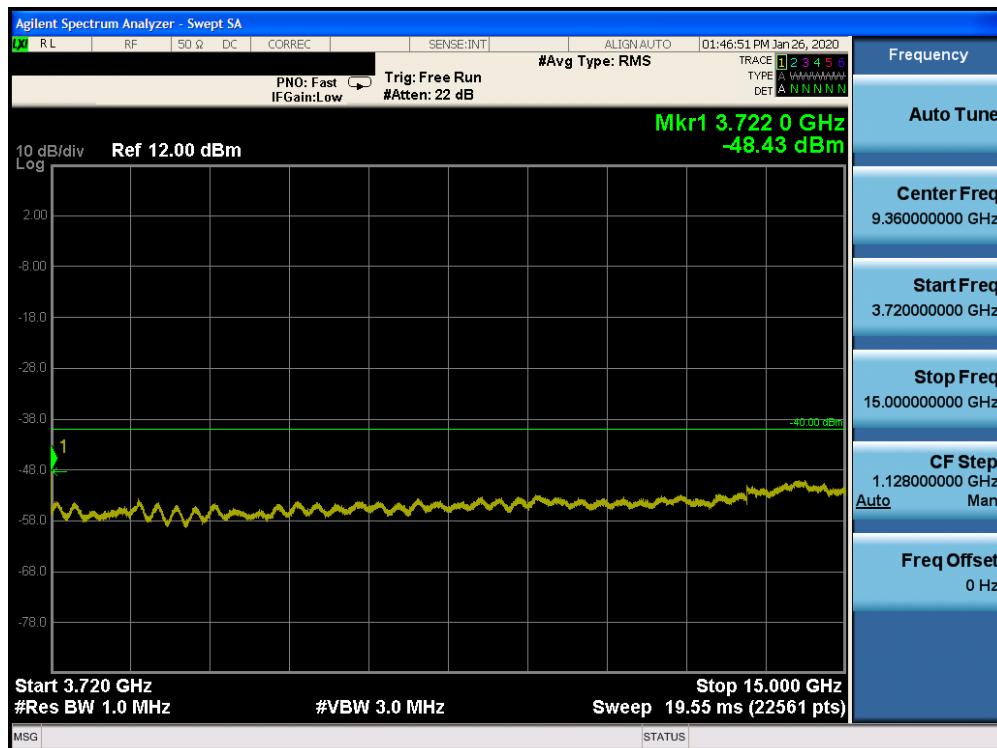


Plot 7-20. Conducted Spurious Plot (LTE Band 48 - 20MHz QPSK - RB Size 1, RB Offset 0 - Mid Channel)

FCC ID: BCGA2232		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
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Plot 7-21. Conducted Spurious Plot (LTE Band 48 - 20MHz QPSK - RB Size 1, RB Offset 0 - High Channel)



Plot 7-22. Conducted Spurious Plot (LTE Band 48 - 20MHz QPSK - RB Size 1, RB Offset 0 - High Channel)

FCC ID: BCGA2232		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
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Plot 7-23. Conducted Spurious Plot (LTE Band 48 - 20MHz QPSK - RB Size 1, RB Offset 0 - High Channel)



Plot 7-24. Conducted Spurious Plot (LTE Band 48 - 20MHz QPSK - RB Size 1, RB Offset 0 - High Channel)

FCC ID: BCGA2232		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
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7.4 Band Edge Emissions at Antenna Terminal

§2.1051 §96.41(e)(ii)

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 its maximum duty cycle, 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 conducted power of any emission outside the fundamental emission (whether in or outside of the authorized band) shall not exceed -13 dBm/MHz within 0 to $B \text{ MHz}$ (where B is the bandwidth in MHz of the assigned channel or multiple contiguous channels of the End User Device) above the upper CBSD-assigned channel edge and within 0 to $B \text{ MHz}$ below the lower CBSD-assigned channel edge. At all frequencies greater than $B \text{ MHz}$ above the upper CBSD assigned channel edge and less than $B \text{ MHz}$ below the lower CBSD-assigned channel edge, the conducted power of any end user device emission shall not exceed -25 dBm/MHz . The conducted power of emissions below 3530 MHz or above 3720 MHz shall not exceed -40 dBm/MHz .

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
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.

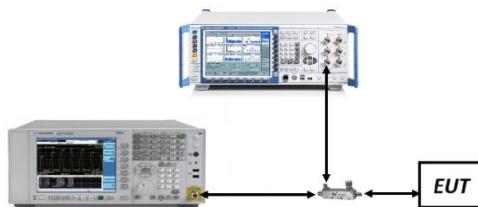


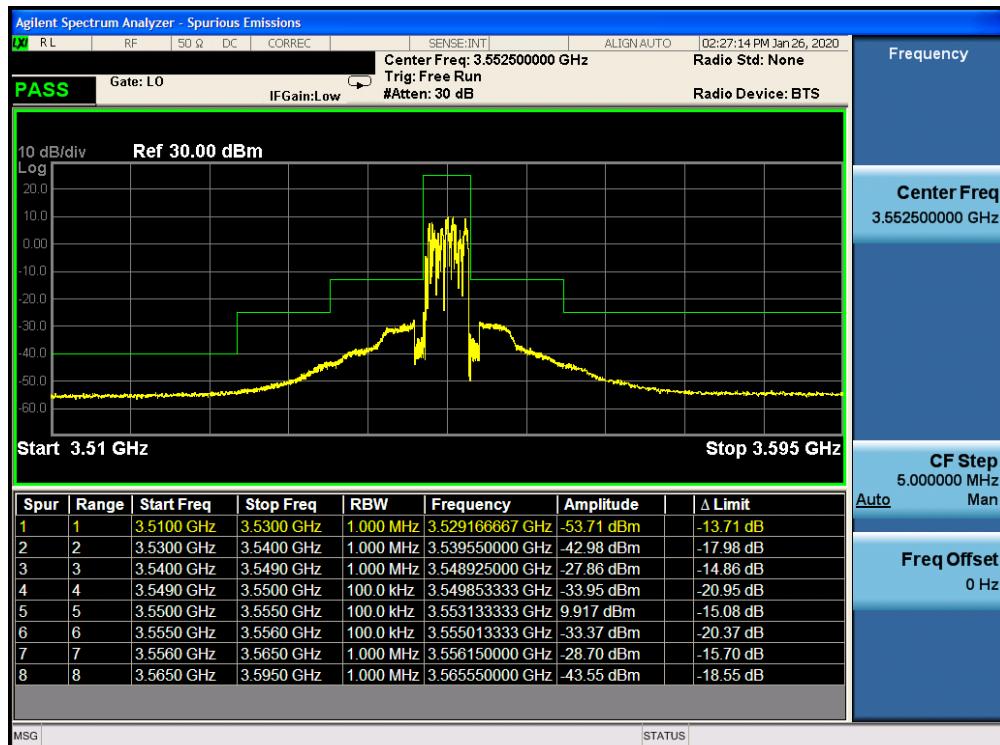
Figure 7-3. Test Instrument & Measurement Setup

Test Notes

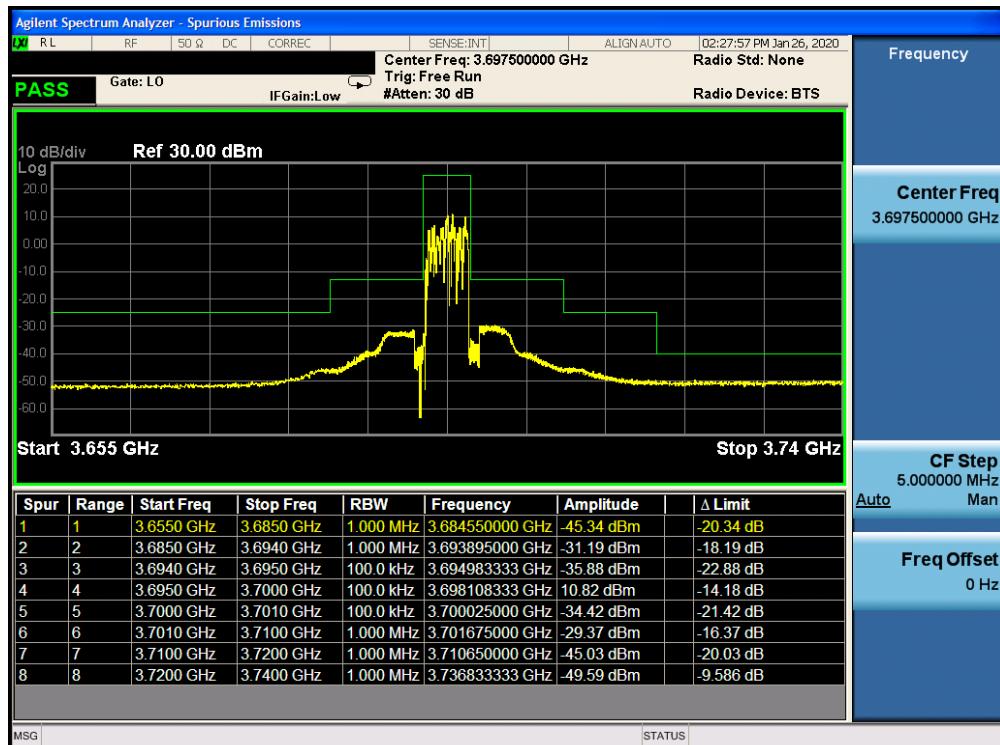
1. All ports were tested and only the worst case data were reported.
2. Refer to Table 2-1 Section 2.3 of this test report for correlation between Antennas and Ports.

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LTE Band 48

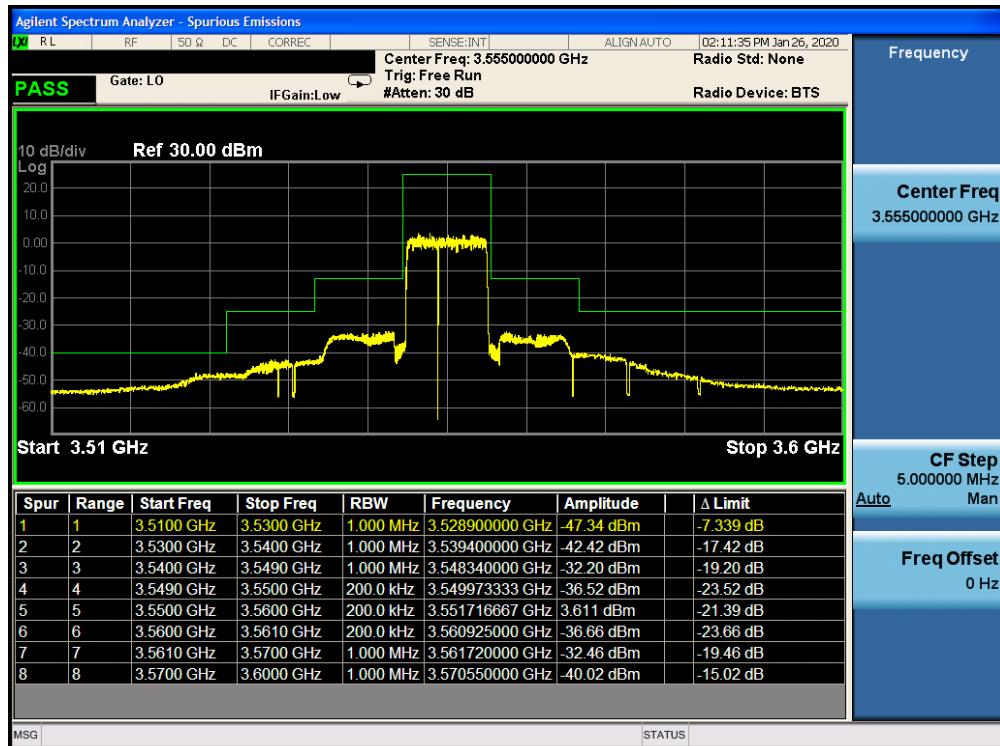


Plot 7-25. Lower ACP Plot (LTE Band 48 - 5MHz QPSK)

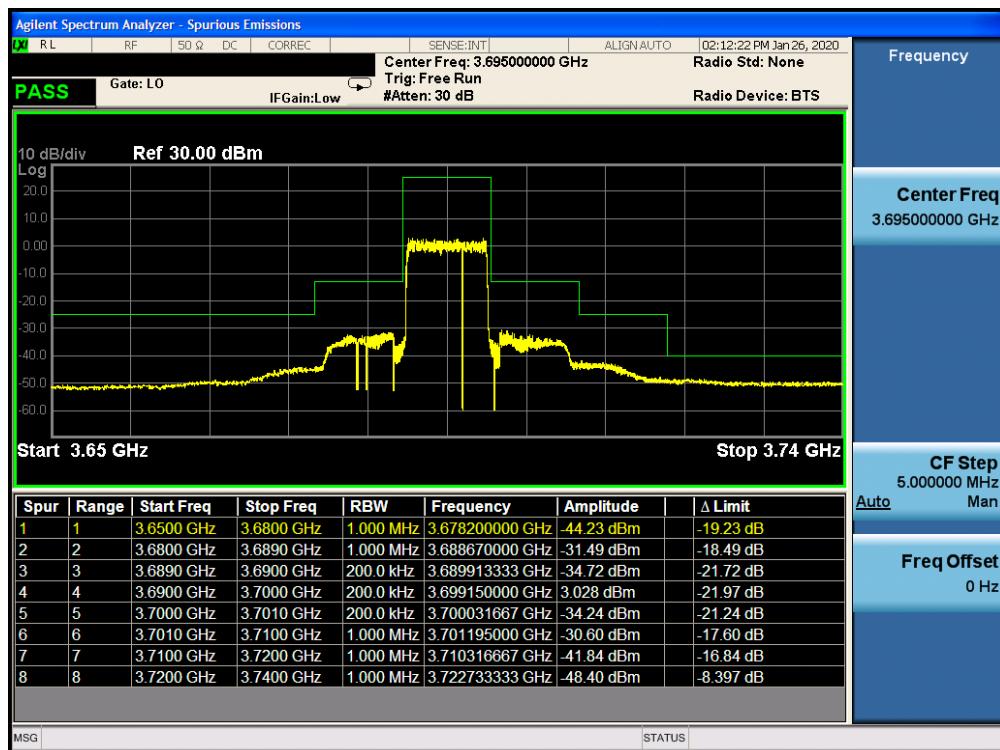


Plot 7-26. Upper ACP Plot (LTE Band 48 - 5MHz QPSK)

FCC ID: BCGA2232	 PCTEST	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
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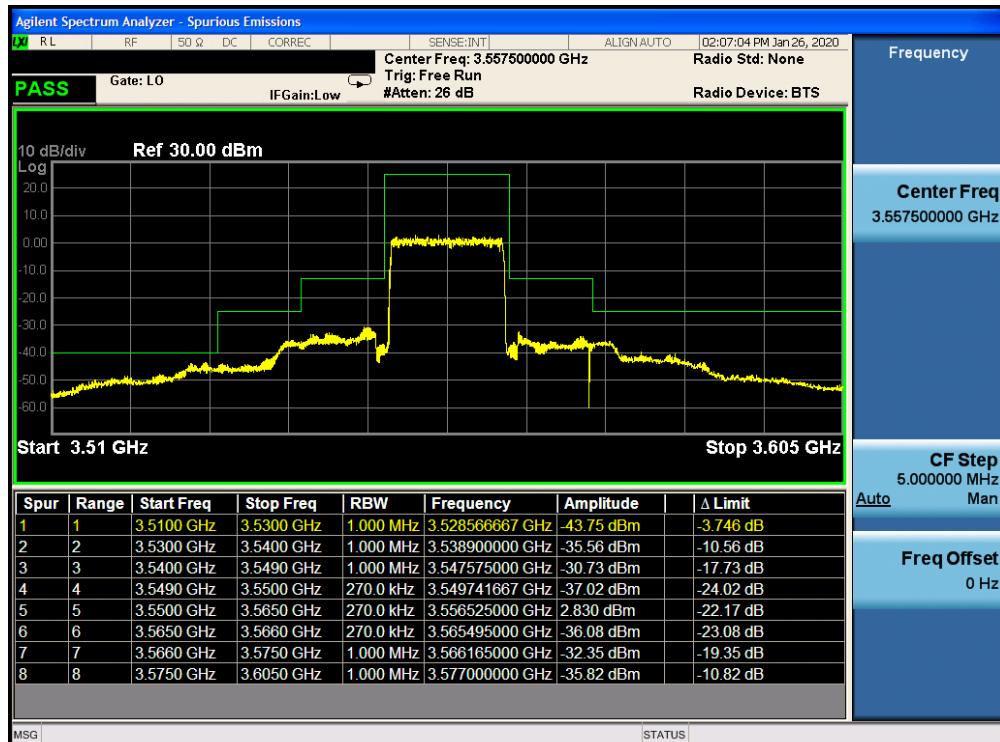


Plot 7-27. Lower ACP Plot (LTE Band 48 - 10MHz QPSK)

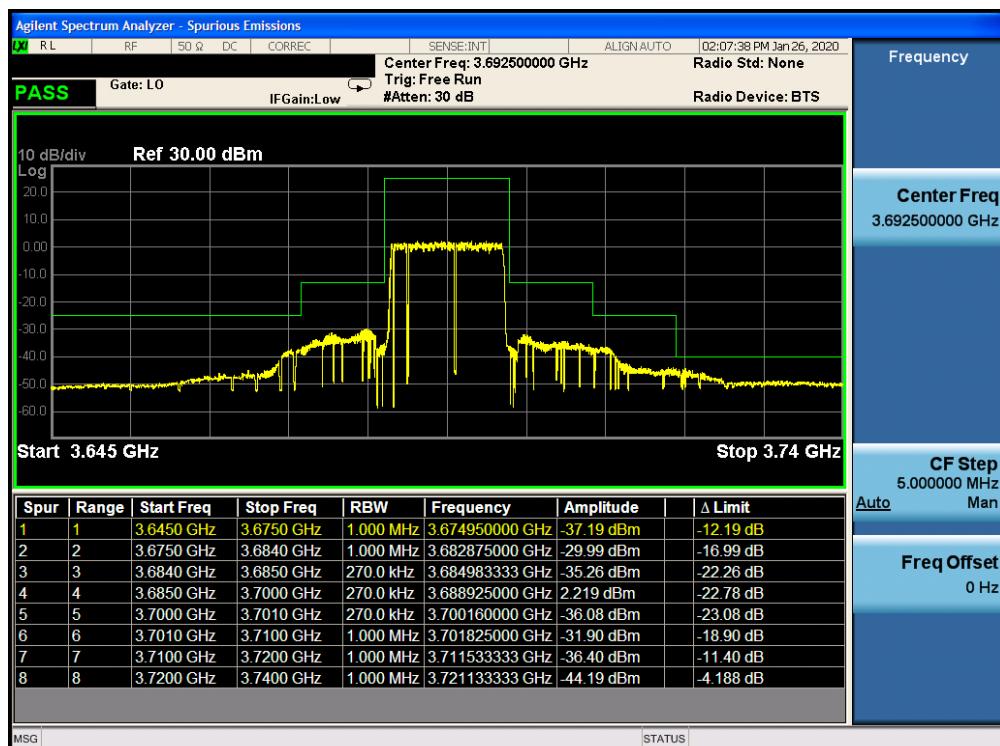


Plot 7-28. Upper ACP Plot (LTE Band 48 - 10MHz QPSK)

FCC ID: BCGA2232	 PCTEST	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
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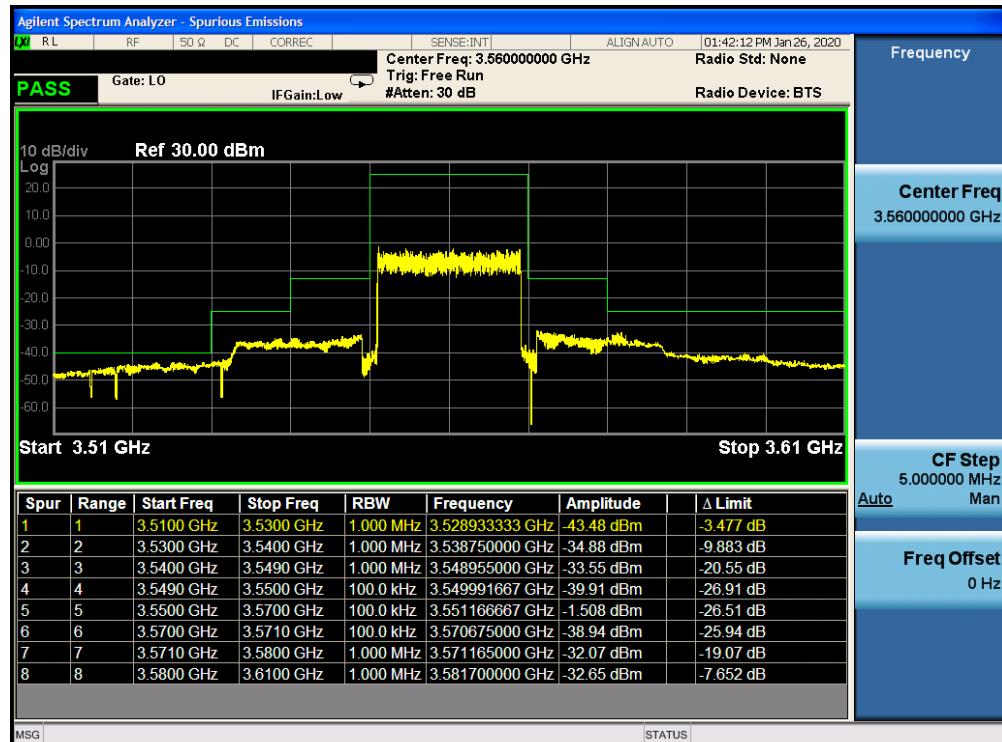


Plot 7-29. Lower ACP Plot (LTE Band 48 - 15MHz QPSK)

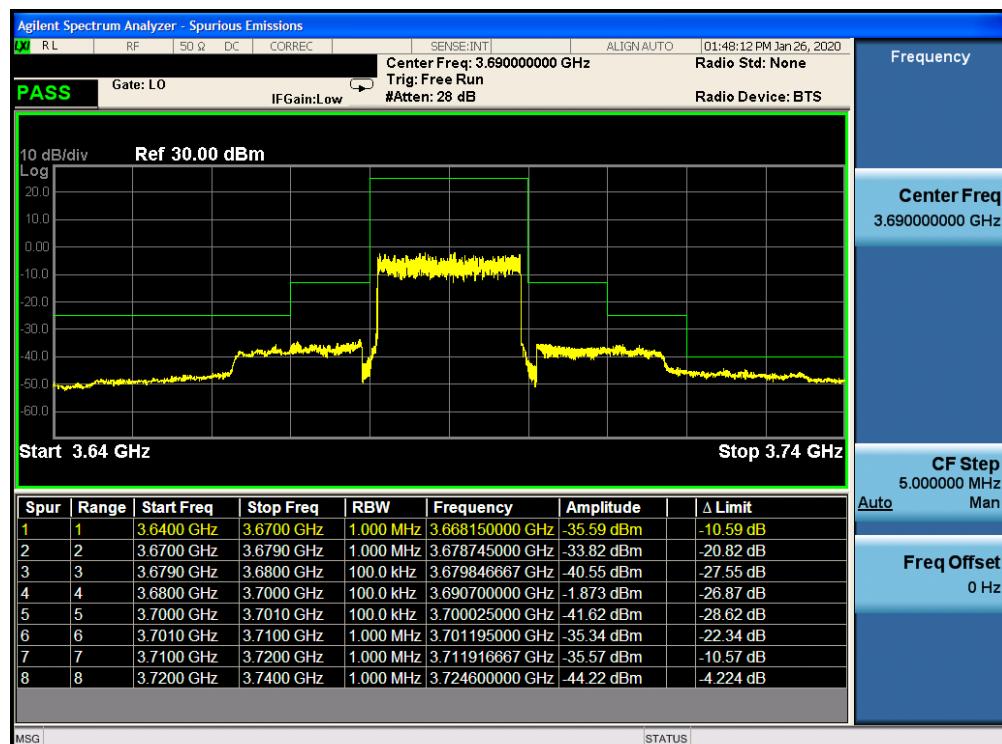


Plot 7-30. Upper ACP Plot (LTE Band 48 - 15MHz QPSK)

FCC ID: BCGA2232	 PCTEST	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
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Plot 7-31. Lower ACP Plot (LTE Band 48 - 20MHz QPSK)



Plot 7-32. Upper ACP Plot (LTE Band 48 - 20MHz QPSK)

FCC ID: BCGA2232	 PCTEST	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
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7.5 Radiated Power (EIRP)

§96.41(b)

Test Overview

Equivalent Isotropic Radiated Power (EIRP) 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 above 1GHz are performed using vertically and horizontally polarized broadband horn antennas. All measurements are performed as RMS average measurements while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies.

Test Procedures Used

KDB 971168 D01 v03r01 – Section 5.2.1

ANSI/TIA-603-E-2016 – Section 2.2.17

Test Settings

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

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

Where:

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

PMes = measured transmitter output power or PSD, in dBW or dBm

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 7-4. ERP/EIRP Measurement Setup

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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.
- 3) The Level (dBm) readings in the table were taken with a correction table loaded into the base station simulator. The correction table was used to account for the signal attenuation in the connecting cable between the transmitter and antenna.
- 4) The Ant. Gains (GT) are listed in dBi.
- 5) The worst case EIRP shown in this section is found with LTE operating only using 1RB. As such, the EIRP/10MHz and full channel EIRP values will be identical since 1RB is fully contained within all available channel bandwidths for LTE Band 48 (i.e. 5, 10, 15, 20MHz).

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Port A

Bandwidth	Modulation	Channel	Frequency [MHz]	Ant. Gain [dBi]	RB Size/Offset	Conducted Power [dBm]	EIRP [dBm/10MHz]	EIRP [Watts/10MHz]	EIRP Limit [dBm/10MHz]	Margin [dB]
20 MHz	QPSK	55340	3560.0	-5.60	1 / 99	21.00	15.40	0.03	23.00	-7.60
		55990	3625.0	-5.60	1 / 99	25.44	19.84	0.10	23.00	-3.16
		56640	3690.0	-5.60	1 / 99	20.76	15.16	0.03	23.00	-7.84
	16-QAM	55990	3625.0	-5.60	1 / 0	24.94	19.34	0.09	23.00	-3.66
		55990	3625.0	-5.60	1 / 0	23.91	18.31	0.07	23.00	-4.69
		55315	3557.5	-5.60	1 / 0	20.97	15.37	0.03	23.00	-7.63
		55990	3625.0	-5.60	1 / 37	25.66	20.06	0.10	23.00	-2.94
	64-QAM	56665	3692.5	-5.60	1 / 74	20.71	15.11	0.03	23.00	-7.89
		55990	3625.0	-5.60	1 / 37	24.78	19.18	0.08	23.00	-3.82
15 MHz	QPSK	55990	3625.0	-5.60	1 / 74	24.03	18.43	0.07	23.00	-4.57
		55290	3555.0	-5.60	1 / 0	21.00	15.40	0.03	23.00	-7.60
		55990	3625.0	-5.60	1 / 25	25.62	20.02	0.10	23.00	-2.98
	16-QAM	56690	3695.0	-5.60	1 / 0	20.65	15.05	0.03	23.00	-7.95
		55990	3625.0	-5.60	1 / 25	24.91	19.31	0.09	23.00	-3.69
		55990	3625.0	-5.60	1 / 0	24.10	18.50	0.07	23.00	-4.50
		55265	3552.5	-5.60	1 / 0	20.92	15.32	0.03	23.00	-7.68
5 MHz	QPSK	55990	3625.0	-5.60	1 / 24	25.70	20.10	0.10	23.00	-2.90
		56715	3697.5	-5.60	1 / 24	20.75	15.15	0.03	23.00	-7.85
		55990	3625.0	-5.60	1 / 0	24.99	19.39	0.09	23.00	-3.61
	16-QAM	55990	3625.0	-5.60	1 / 0	23.90	18.30	0.07	23.00	-4.70
		55990	3625.0	-5.60	1 / 0	23.90	18.30	0.07	23.00	-4.70

Table 7-3. EIRP Data (Band 48)

Port B

Bandwidth	Modulation	Channel	Frequency [MHz]	Ant. Gain [dBi]	RB Size/Offset	Conducted Power [dBm]	EIRP [dBm/10MHz]	EIRP [Watts/10MHz]	EIRP Limit [dBm/10MHz]	Margin [dB]
20 MHz	QPSK	55340	3560.0	-4.00	1 / 0	17.78	13.78	0.02	23.00	-9.22
		55990	3625.0	-4.00	1 / 99	21.80	17.80	0.06	23.00	-5.20
		56640	3690.0	-4.00	1 / 0	17.74	13.74	0.02	23.00	-9.26
	16-QAM	55990	3625.0	-4.00	1 / 99	21.20	17.20	0.05	23.00	-5.80
		55990	3625.0	-4.00	1 / 99	20.40	16.40	0.04	23.00	-6.60
	QPSK	55315	3557.5	-4.00	1 / 0	17.82	13.82	0.02	23.00	-9.18
		55990	3625.0	-4.00	1 / 0	21.88	17.88	0.06	23.00	-5.12
		56665	3692.5	-4.00	1 / 0	17.71	13.71	0.02	23.00	-9.29
		55990	3625.0	-4.00	1 / 37	21.20	17.20	0.05	23.00	-5.80
15 MHz	QPSK	55990	3625.0	-4.00	1 / 37	20.40	16.40	0.04	23.00	-6.60
		55990	3625.0	-4.00	1 / 0	18.00	14.00	0.03	23.00	-9.00
	16-QAM	55990	3625.0	-4.00	1 / 49	21.67	17.67	0.06	23.00	-5.33
		56690	3695.0	-4.00	1 / 0	17.87	13.87	0.02	23.00	-9.13
		55990	3625.0	-4.00	1 / 25	21.06	17.06	0.05	23.00	-5.94
	64-QAM	55990	3625.0	-4.00	1 / 25	20.25	16.25	0.04	23.00	-6.75
		55265	3552.5	-4.00	1 / 24	18.00	14.00	0.03	23.00	-9.00
10 MHz	QPSK	55990	3625.0	-4.00	1 / 12	22.00	18.00	0.06	23.00	-5.00
		56715	3697.5	-4.00	1 / 24	18.00	14.00	0.03	23.00	-9.00
		55990	3625.0	-4.00	1 / 24	21.29	17.29	0.05	23.00	-5.71
	16-QAM	55990	3625.0	-4.00	1 / 12	20.63	16.63	0.05	23.00	-6.37
		55990	3625.0	-4.00	1 / 12	20.63	16.63	0.05	23.00	-6.37
	64-QAM	55265	3552.5	-4.00	1 / 24	18.00	14.00	0.03	23.00	-9.00
		55990	3625.0	-4.00	1 / 12	22.00	18.00	0.06	23.00	-5.00

Table 7-4. EIRP Data (Band 48)

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Port C

Bandwidth	Modulation	Channel	Frequency [MHz]	Ant. Gain [dBi]	RB Size/Offset	Conducted Power [dBm]	EIRP [dBm/10MHz]	EIRP [Watts/10MHz]	EIRP Limit [dBm/10MHz]	Margin [dB]
20 MHz	QPSK	55340	3560.0	-3.90	1 / 50	19.92	16.02	0.04	23.00	-6.98
		55990	3625.0	-3.90	1 / 99	25.00	21.10	0.13	23.00	-1.90
		56640	3690.0	-3.90	1 / 50	20.00	16.10	0.04	23.00	-6.90
	16-QAM	55990	3625.0	-3.90	1 / 99	24.26	20.36	0.11	23.00	-2.64
		55990	3625.0	-3.90	1 / 99	23.52	19.62	0.09	23.00	-3.38
	15 MHz	55315	3557.5	-3.90	1 / 37	19.82	15.92	0.04	23.00	-7.08
		55990	3625.0	-3.90	1 / 74	24.85	20.95	0.12	23.00	-2.05
		56665	3692.5	-3.90	1 / 37	19.79	15.89	0.04	23.00	-7.11
		55990	3625.0	-3.90	1 / 74	24.22	20.32	0.11	23.00	-2.68
10 MHz	QPSK	55290	3555.0	-3.90	1 / 25	20.00	16.10	0.04	23.00	-6.90
		55990	3625.0	-3.90	1 / 25	24.90	21.00	0.13	23.00	-2.00
		56690	3695.0	-3.90	1 / 25	19.98	16.08	0.04	23.00	-6.92
	16-QAM	55990	3625.0	-3.90	1 / 49	24.27	20.37	0.11	23.00	-2.63
		55990	3625.0	-3.90	1 / 49	23.40	19.50	0.09	23.00	-3.50
	5 MHz	55265	3552.5	-3.90	1 / 12	19.72	15.82	0.04	23.00	-7.18
		55990	3625.0	-3.90	1 / 24	24.74	20.84	0.12	23.00	-2.16
		56715	3697.5	-3.90	1 / 12	19.72	15.82	0.04	23.00	-7.18
		55990	3625.0	-3.90	1 / 24	24.11	20.21	0.10	23.00	-2.79
	64-QAM	55990	3625.0	-3.90	1 / 24	23.43	19.53	0.09	23.00	-3.47

Table 7-5. EIRP Data (Band 48)

Port D

Bandwidth	Modulation	Channel	Frequency [MHz]	Ant. Gain [dBi]	RB Size/Offset	Conducted Power [dBm]	EIRP [dBm/10MHz]	EIRP [Watts/10MHz]	EIRP Limit [dBm/10MHz]	Margin [dB]
20 MHz	QPSK	55340	3560.0	-5.90	1 / 0	17.98	12.08	0.02	23.00	-10.92
		55990	3625.0	-5.90	1 / 50	21.86	15.96	0.04	23.00	-7.04
		56640	3690.0	-5.90	100 / 0	17.87	11.97	0.02	23.00	-11.03
	16-QAM	55990	3625.0	-5.90	1 / 50	21.03	15.13	0.03	23.00	-7.87
		55990	3625.0	-5.90	1 / 0	20.22	14.32	0.03	23.00	-8.68
	15 MHz	55315	3557.5	-5.90	75 / 0	17.97	12.07	0.02	23.00	-10.93
		55990	3625.0	-5.90	1 / 0	21.97	16.07	0.04	23.00	-6.93
		56665	3692.5	-5.90	1 / 0	17.88	11.98	0.02	23.00	-11.02
		55990	3625.0	-5.90	1 / 0	21.05	15.15	0.03	23.00	-7.85
10 MHz	QPSK	55290	3555.0	-5.90	1 / 0	17.99	12.09	0.02	23.00	-10.91
		55990	3625.0	-5.90	1 / 25	21.91	16.01	0.04	23.00	-6.99
		56690	3695.0	-5.90	1 / 25	17.79	11.89	0.02	23.00	-11.11
	16-QAM	55990	3625.0	-5.90	1 / 25	21.27	15.37	0.03	23.00	-7.63
		55990	3625.0	-5.90	50 / 0	20.25	14.35	0.03	23.00	-8.65
	5 MHz	55265	3552.5	-5.90	1 / 0	17.98	12.08	0.02	23.00	-10.92
		55990	3625.0	-5.90	1 / 0	21.92	16.02	0.04	23.00	-6.98
		56715	3697.5	-5.90	25 / 0	17.97	12.07	0.02	23.00	-10.93
		55990	3625.0	-5.90	25 / 0	20.94	15.04	0.03	23.00	-7.96
	64-QAM	55990	3625.0	-5.90	25 / 0	20.15	14.25	0.03	23.00	-8.75

Table 7-6. EIRP Data (Band 48)

FCC ID: BCGA2232	 PCTEST	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
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7.6 Radiated Spurious Emissions Measurements

§2.1053 §96.41(e)

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 vertically and horizontally 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 x RBW
3. Span = 1.5 times the OBW
4. No. of sweep points \geq 2 x span / RBW
5. Detector = RMS
6. Trace mode = Max Hold (In cases where the level is within 2dB of the limit, the final measurement is taken using triggering/gating and trace averaging.)
7. The trace was allowed to stabilize

FCC ID: BCGA2232	 PCTEST		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
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Test Setup

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

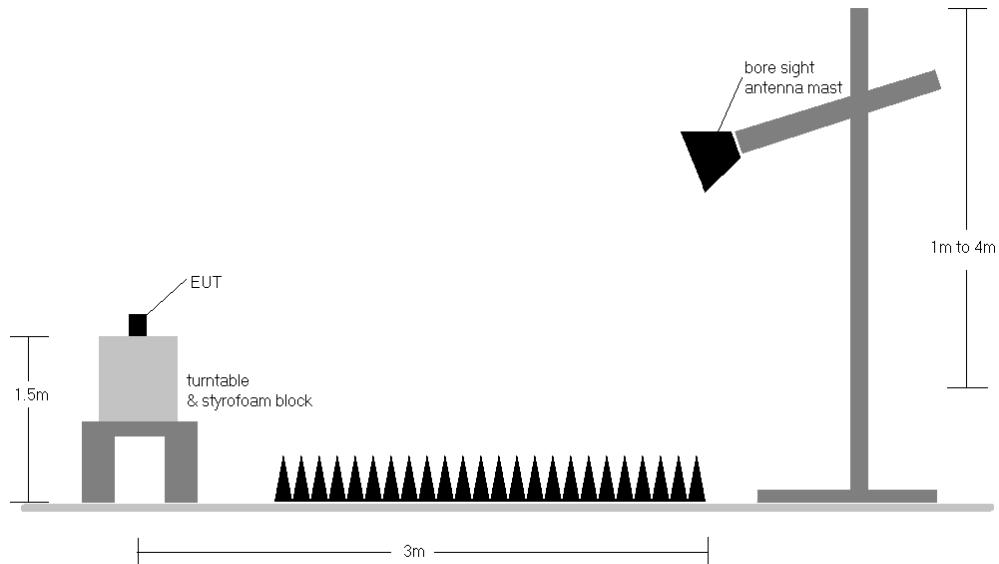


Figure 7-5. Test Instrument & Measurement Setup

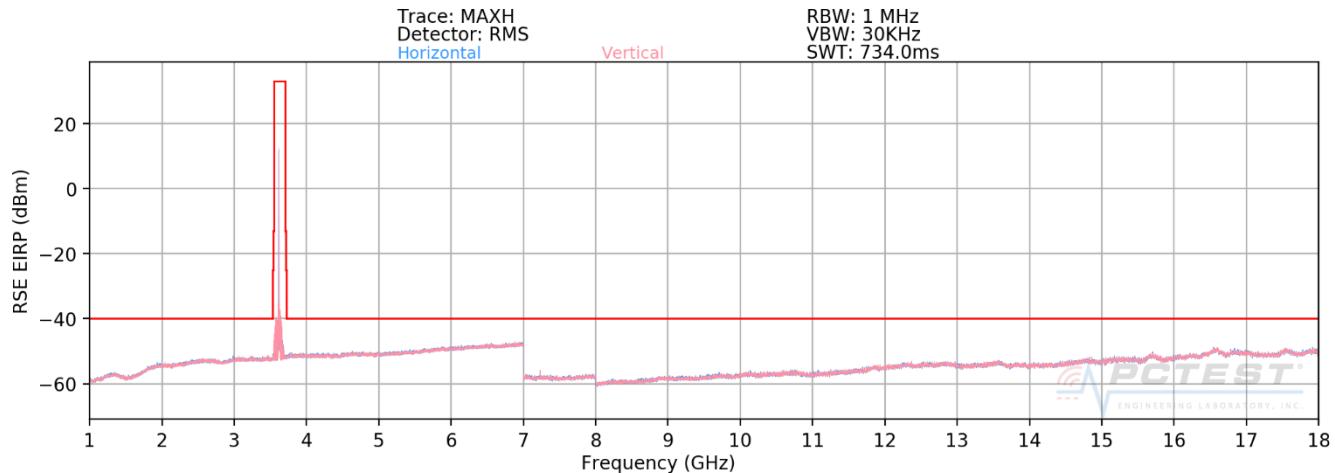
Test Notes

- 1) The EUT was tested in three orthogonal planes and in all possible test configurations and positioning. The worst case emissions are reported with the EUT positioning, modulations, RB sizes and offsets, and channel bandwidth configurations shown in the tables below.
- 2) This unit was tested with its standard battery.
- 3) The spectrum is measured from 9kHz to the 10th harmonic of the fundamental frequency of the transmitter. The worst-case emissions are reported.
- 4) Emissions below 18GHz were measured at a 3 meter test distance while emissions above 18GHz were measured at a 1 meter test distance with the application of a distance correction factor.
- 5) The "-" shown in the following RSE tables are used to denote a noise floor measurement.
- 6) For LTE Band 48 pre-scans 1-18GHz, the RBW is set to 1MHz and VBW to 30kHz. For final measurements above 1GHz, the RBW is set to 1MHz and VBW to 3MHz when measuring with an RMS detector and max hold trace.

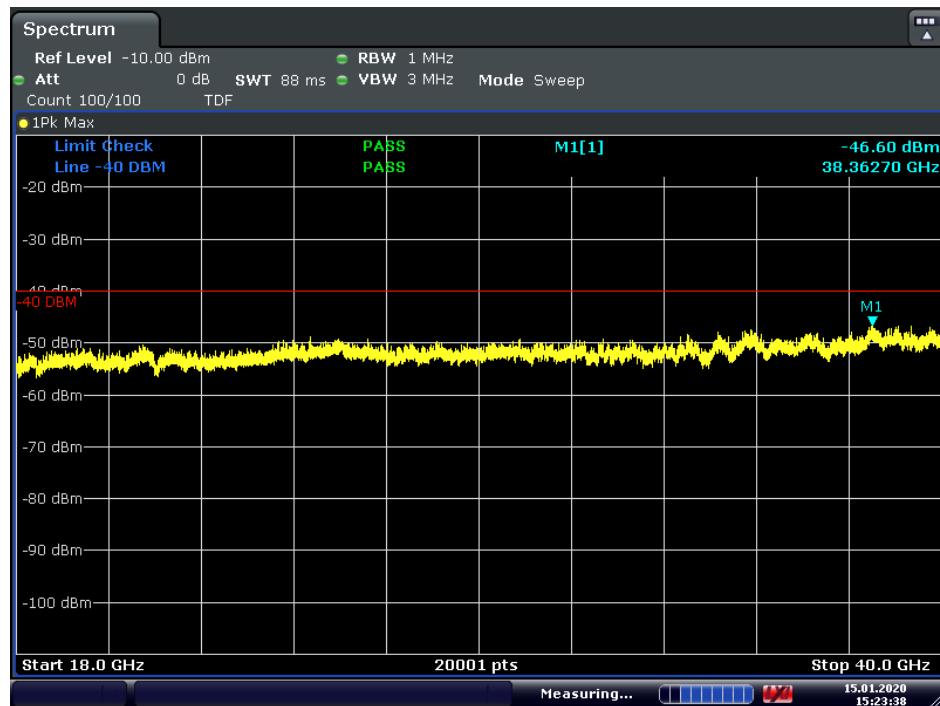
FCC ID: BCGA2232	 PCTEST	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C1912170055-05.BCG	Test Dates: 12/10/2019 - 02/25/2020	EUT Type: Tablet Device	Page 37 of 56

7.6.1 ANT 4b (Port A) Radiated Spurious Emissions Measurements

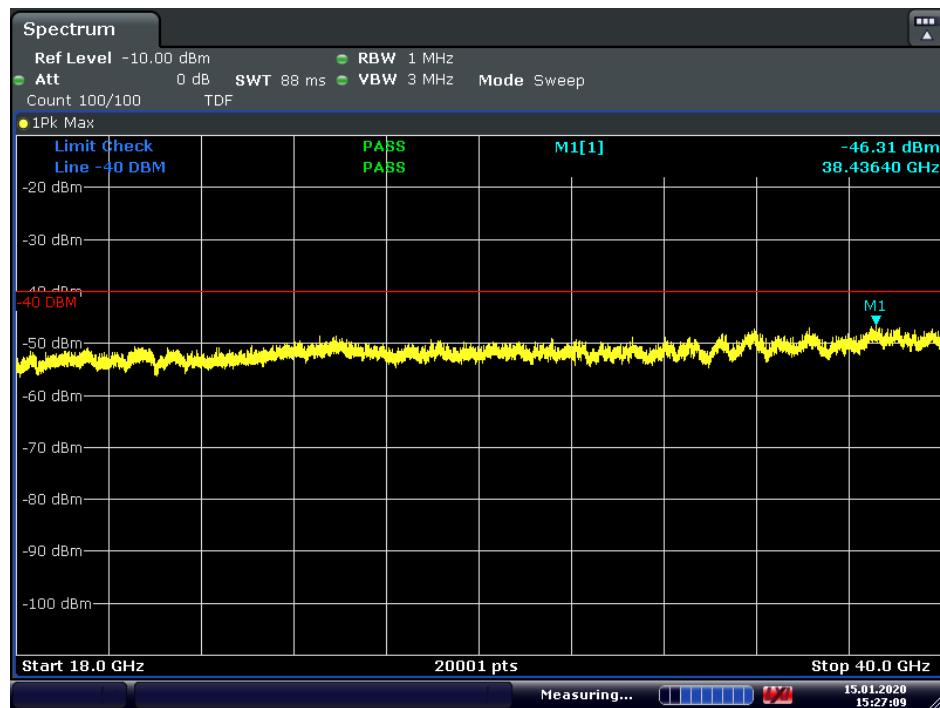
LTE Band 48



FCC ID: BCGA2232	 MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager
Test Report S/N: 1C1912170055-05.BCG	Test Dates: 12/10/2019 - 02/25/2020	EUT Type: Tablet Device	Page 38 of 56



Plot 7-34. Radiated Spurious Plot 18 - 40GHz (Band 48 – Ant. Pol H)



Plot 7-35. Radiated Spurious Plot 18 - 40GHz (Band 48 – Ant. Pol V)

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OPERATING FREQUENCY: 3560.00 MHz
MODULATION SIGNAL: QPSK
BANDWIDTH: 20.0 MHz
DISTANCE: 3 meters
LIMIT: -40 dBm

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	EIRP Level at Sub Ant Port [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Margin [dB]
7120.00	H	-	-	-58.32	9.77	-48.55	-8.5
10680.00	H	-	-	-56.09	9.69	-46.40	-6.4
14240.00	H	-	-	-53.62	8.85	-44.77	-4.8

Table 7-7. Radiated Spurious Data (Band 48 – Low Channel)

OPERATING FREQUENCY: 3625.00 MHz
MODULATION SIGNAL: QPSK
BANDWIDTH: 20.0 MHz
DISTANCE: 3 meters
LIMIT: -40 dBm

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	EIRP Level at Sub Ant Port [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Margin [dB]
7250.00	H	-	-	-58.40	9.60	-48.80	-8.8
10875.00	H	-	-	-56.18	9.65	-46.53	-6.5
14500.00	H	-	-	-54.49	8.83	-45.66	-5.7

Table 7-8. Radiated Spurious Data (Band 48 – Mid Channel)

FCC ID: BCGA2232		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C1912170055-05.BCG	Test Dates: 12/10/2019 - 02/25/2020	EUT Type: Tablet Device	Page 40 of 56



OPERATING FREQUENCY: 3690.00 MHz
MODULATION SIGNAL: QPSK
BANDWIDTH: 20.0 MHz
DISTANCE: 3 meters
LIMIT: -40 dBm

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	EIRP Level at Sub Ant Port [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Margin [dB]
7380.00	H	-	-	-58.16	9.47	-48.69	-8.7
11070.00	H	-	-	-55.78	9.73	-46.04	-6.0
14760.00	H	-	-	-53.71	8.95	-44.77	-4.8

Table 7-9. Radiated Spurious Data (Band 48 – High Channel)

FCC ID: BCGA2232	MEASUREMENT REPORT (CERTIFICATION)			Approved by: Quality Manager
Test Report S/N: 1C1912170055-05.BCG	Test Dates: 12/10/2019 - 02/25/2020	EUT Type: Tablet Device	Page 41 of 56	

7.6.2 ANT 2b (Port B) Radiated Spurious Emissions Measurements

LTE Band 48

OPERATING FREQUENCY: 3560.00 MHz
 MODULATION SIGNAL: QPSK
 BANDWIDTH: 20.0 MHz
 DISTANCE: 3 meters
 LIMIT: -40 dBm

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	EIRP Level at Sub Ant Port [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Margin [dB]
7120.00	H	-	-	-58.39	9.77	-48.62	-8.6
10680.00	H	-	-	-55.72	9.69	-46.03	-6.0
14240.00	H	-	-	-54.70	8.85	-45.85	-5.8

Table 7-10. Radiated Spurious Data (Band 48 – Low Channel)

OPERATING FREQUENCY: 3625.00 MHz
 MODULATION SIGNAL: QPSK
 BANDWIDTH: 20.0 MHz
 DISTANCE: 3 meters
 LIMIT: -40 dBm

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	EIRP Level at Sub Ant Port [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Margin [dB]
7250.00	H	-	-	-58.01	9.60	-48.41	-8.4
10875.00	H	-	-	-55.51	9.65	-45.86	-5.9
14500.00	H	-	-	-54.07	8.83	-45.24	-5.2

Table 7-11. Radiated Spurious Data (Band 48 – Mid Channel)

FCC ID: BCGA2232	 PCTEST	MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager
Test Report S/N: 1C1912170055-05.BCG	Test Dates: 12/10/2019 - 02/25/2020	EUT Type: Tablet Device	Page 42 of 56	



OPERATING FREQUENCY: 3690.00 MHz
MODULATION SIGNAL: QPSK
BANDWIDTH: 20.0 MHz
DISTANCE: 3 meters
LIMIT: -40 dBm

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	EIRP Level at Sub Ant Port [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Margin [dB]
7380.00	H	-	-	-57.95	9.47	-48.48	-8.5
11070.00	H	-	-	-56.03	9.73	-46.29	-6.3
14760.00	H	-	-	-53.32	8.95	-44.38	-4.4

Table 7-12. Radiated Spurious Data (Band 48 – High Channel)

FCC ID: BCGA2232	MEASUREMENT REPORT (CERTIFICATION)			Approved by: Quality Manager
Test Report S/N: 1C1912170055-05.BCG	Test Dates: 12/10/2019 - 02/25/2020	EUT Type: Tablet Device	Page 43 of 56	

7.6.3 ANT 3 (Port C) Radiated Spurious Emissions Measurements

LTE Band 48

OPERATING FREQUENCY: 3560.00 MHz
 MODULATION SIGNAL: QPSK
 BANDWIDTH: 20.0 MHz
 DISTANCE: 3 meters
 LIMIT: -40 dBm

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	EIRP Level at Sub Ant Port [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Margin [dB]
7120.00	H	-	-	-58.03	9.77	-48.26	-8.3
10680.00	H	-	-	-55.81	9.69	-46.12	-6.1
14240.00	H	-	-	-53.84	8.85	-44.99	-5.0

Table 7-13. Radiated Spurious Data (Band 48 – Low Channel)

OPERATING FREQUENCY: 3625.00 MHz
 MODULATION SIGNAL: QPSK
 BANDWIDTH: 20.0 MHz
 DISTANCE: 3 meters
 LIMIT: -40 dBm

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	EIRP Level at Sub Ant Port [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Margin [dB]
7250.00	H	-	-	-58.00	9.60	-48.40	-8.4
10875.00	H	138	331	-55.31	9.65	-45.66	-5.7
14500.00	H	-	-	-52.66	8.83	-43.83	-3.8

Table 7-14. Radiated Spurious Data (Band 48 – Mid Channel)

FCC ID: BCGA2232		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C1912170055-05.BCG	Test Dates: 12/10/2019 - 02/25/2020	EUT Type: Tablet Device	Page 44 of 56



OPERATING FREQUENCY: 3690.00 MHz
MODULATION SIGNAL: QPSK
BANDWIDTH: 20.0 MHz
DISTANCE: 3 meters
LIMIT: -40 dBm

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	EIRP Level at Sub Ant Port [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Margin [dB]
7380.00	H	-	-	-58.02	9.47	-48.55	-8.6
11070.00	H	-	-	-55.52	9.73	-45.78	-5.8
14760.00	H	-	-	-53.30	8.95	-44.36	-4.4

Table 7-15. Radiated Spurious Data (Band 48 – High Channel)

FCC ID: BCGA2232	MEASUREMENT REPORT (CERTIFICATION)			Approved by: Quality Manager
Test Report S/N: 1C1912170055-05.BCG	Test Dates: 12/10/2019 - 02/25/2020	EUT Type: Tablet Device	Page 45 of 56	

7.6.4 ANT 1 (Port D) Radiated Spurious Emissions Measurements

LTE Band 48

OPERATING FREQUENCY: 3560.00 MHz
 MODULATION SIGNAL: QPSK
 BANDWIDTH: 20.0 MHz
 DISTANCE: 3 meters
 LIMIT: -40 dBm

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	EIRP Level at Sub Ant Port [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Margin [dB]
7120.00	H	-	-	-58.44	9.77	-48.67	-8.7
10680.00	H	-	-	-56.31	9.69	-46.62	-6.6
14240.00	H	-	-	-54.80	8.85	-45.95	-5.9

Table 7-16. Radiated Spurious Data (Band 48 – Low Channel)

OPERATING FREQUENCY: 3625.00 MHz
 MODULATION SIGNAL: QPSK
 BANDWIDTH: 20.0 MHz
 DISTANCE: 3 meters
 LIMIT: -40 dBm

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	EIRP Level at Sub Ant Port [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Margin [dB]
7250.00	H	-	-	-58.16	9.60	-48.56	-8.6
10875.00	H	-	-	-56.05	9.65	-46.40	-6.4
14500.00	H	-	-	-54.76	8.83	-45.93	-5.9

Table 7-17. Radiated Spurious Data (Band 48 – Mid Channel)

FCC ID: BCGA2232		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
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OPERATING FREQUENCY: 3690.00 MHz
MODULATION SIGNAL: QPSK
BANDWIDTH: 20.0 MHz
DISTANCE: 3 meters
LIMIT: -40 dBm

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	EIRP Level at Sub Ant Port [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Margin [dB]
7380.00	H	-	-	-58.30	9.47	-48.83	-8.8
11070.00	H	-	-	-56.27	9.73	-46.53	-6.5
14760.00	H	-	-	-54.26	8.95	-45.32	-5.3

Table 7-18. Radiated Spurious Data (Band 48 – High Channel)

FCC ID: BCGA2232	MEASUREMENT REPORT (CERTIFICATION)			Approved by: Quality Manager
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7.7 Frequency Stability / Temperature Variation

§2.1055

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.

For Part 96, the frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block.

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



Figure 7-6. Test Instrument & Measurement Setup

Test Notes

All ports were tested and only the worst case data were reported.

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LTE Band 48 Frequency Stability Measurements

OPERATING FREQUENCY:	3,625,000,000	Hz
CHANNEL:	55990	
REFERENCE VOLTAGE:	3.80	VDC

VOLTAGE (%)	POWER (VDC)	TEMP (°C)	FREQUENCY (Hz)	Freq. Dev. (Hz)	Deviation (%)
100 %	3.80	- 30	3,624,999,986	-14	-0.0000004
100 %		- 20	3,624,999,986	-14	-0.0000004
100 %		- 10	3,624,999,987	-13	-0.0000003
100 %		0	3,625,000,013	13	0.0000004
100 %		+ 10	3,625,000,015	15	0.0000004
100 %		+ 20	3,625,000,015	15	0.0000004
100 %		+ 30	3,625,000,011	11	0.0000003
100 %		+ 40	3,625,000,011	11	0.0000003
100 %		+ 50	3,625,000,011	11	0.0000003
BATT. ENDPOINT	3.20	+ 20	3,625,000,010	10	0.0000003

Table 7-19. Frequency Stability Data (LTE Band 48)

Note:

Based on the results of the frequency stability test at the center channel the frequency deviation results measured are very small. As such it is determined that the channels at the band edge would remain in-band when the maximum measured frequency deviation noted during the frequency stability tests is applied. Therefore the device is determined to remain operating in band over the temperature and voltage range as tested.

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LTE Band 48 Frequency Stability Measurements

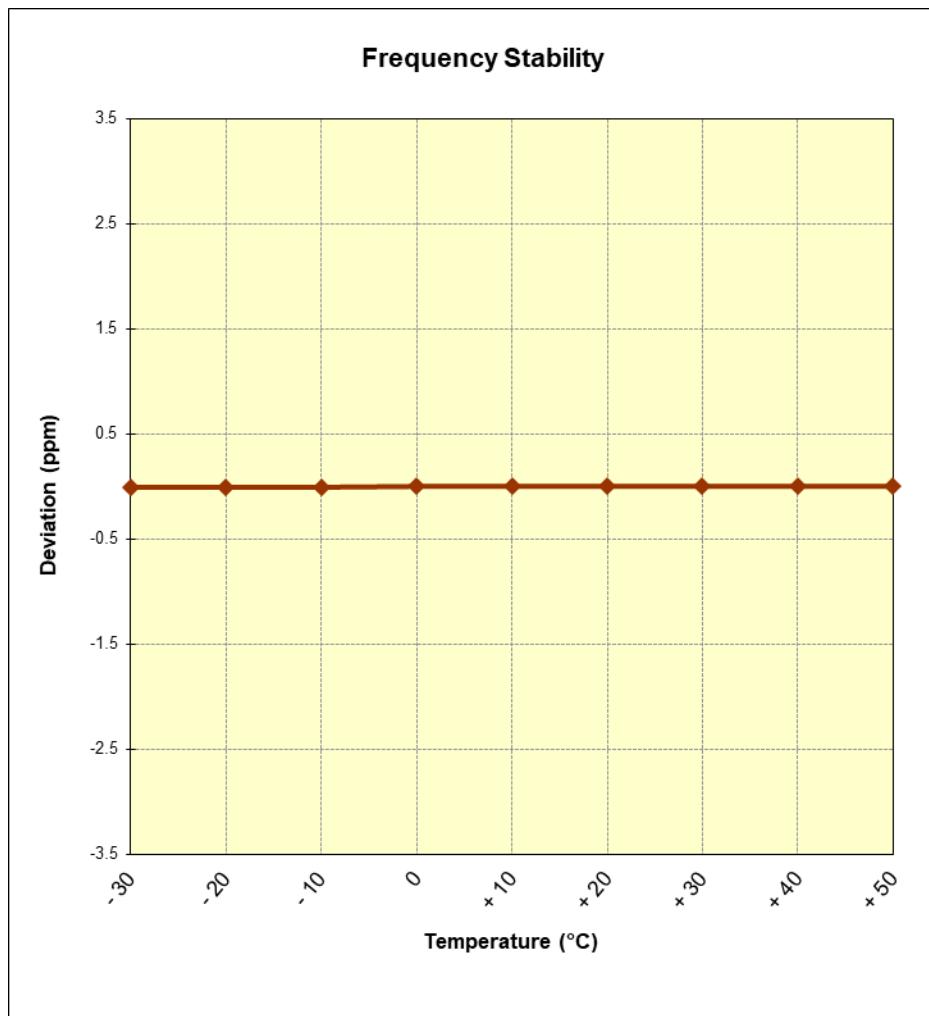


Figure 7-7. Frequency Stability Graph (LTE Band 48)

FCC ID: BCGA2232	MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager
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7.8 End User Device Additional Requirement (CBSD Protocol) §96.47

Test Overview and Limit

End user device additional requirements (CBSD Protocol) are tested per the test procedures listed below. During testing, the EUT is connected to a certified CBSD (Ruckus FCC ID: S9GQ910US00) as a companion device to show compliance with Part 96.47.

End User Devices may operate only if they can positively receive and decode an authorization signal transmitted by a CBSD, including the frequencies and power limits for their operation.

An End User Device must discontinue operations, change frequencies, or change its operational power level within 10 seconds of receiving instructions from its associated CBSD.

Test Procedure Used

KDB 940660 D01 v02, WINNF-TS-0122 V1.0.0.

Test Setup/Method

The EUT was connected via an RF cable to a certified CBSD and spectrum analyzer. The following procedure is performed by applying WINNF-TS-0122 CBRS CBSD Test Specification.

1. Run#1:
 - a. Setup WINNF.PT.C.HBT.1 with 3615MHz – 3635MHz.
 - b. Enable AP service from Ruckus Cloud management.
 - c. Check EUT Tx frequency.
 - d. Disable AP service from Ruckus Cloud management and check EUT stop transmission within 10s.
2. Run#2:
 - a. Setup WINNF.PT.C.HBT.1 with 3660MHz – 3680MHz.
 - b. Enable AP service from Ruckus Cloud management.
 - c. Check EUT Tx frequency.
 - d. Disable AP service from Ruckus Cloud management and check EUT stop transmission within 10s.

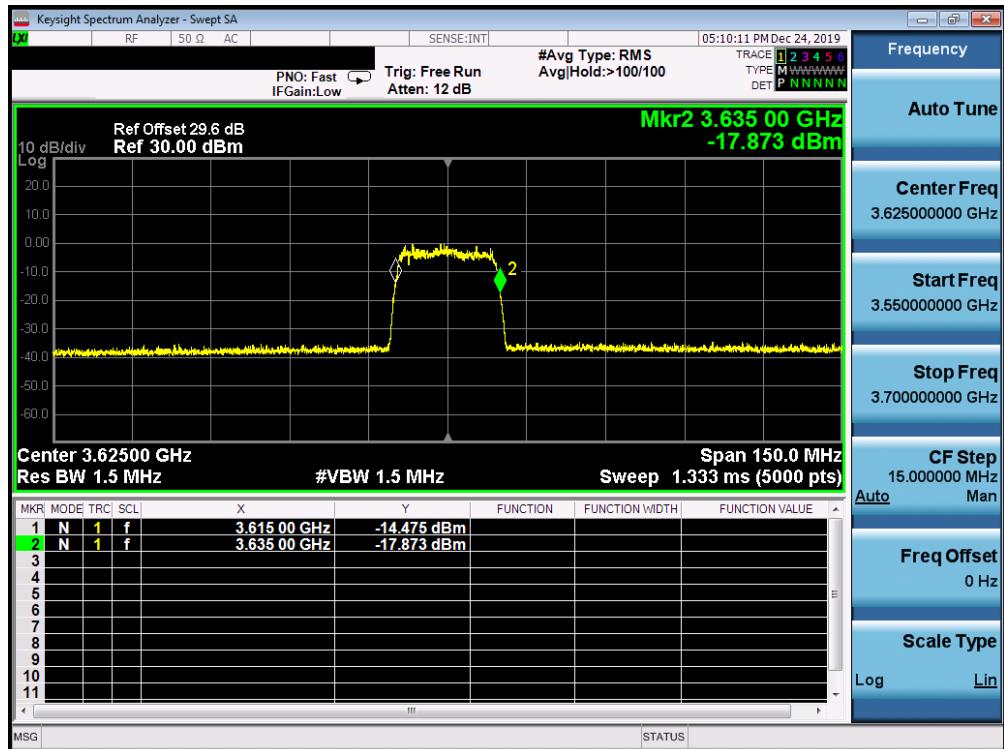
Test Notes

The EUT is an End User Device.

FCC ID: BCGA2232	 MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager
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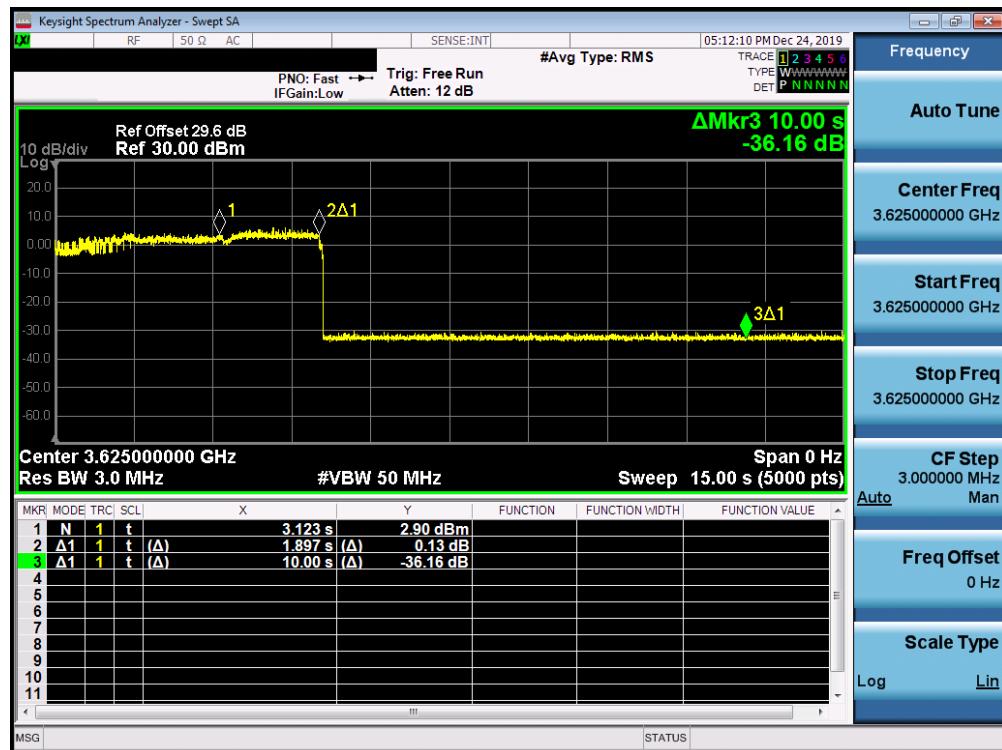
Run#1:

- Tx Frequency Set: 3615 – 3635MHz
- MaxEIRP Set: 13dBm/MHz



Plot 7-36. Run#1 End User Device Frequency of Operations

FCC ID: BCGA2232	 MEASUREMENT REPORT (CERTIFICATION)			Approved by: Quality Manager
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Plot 7-37. Run#1 End User Device Discontinues Operations within 10s

Note:

Marker 1: CBSD sends instructions to discontinue LTE operations.

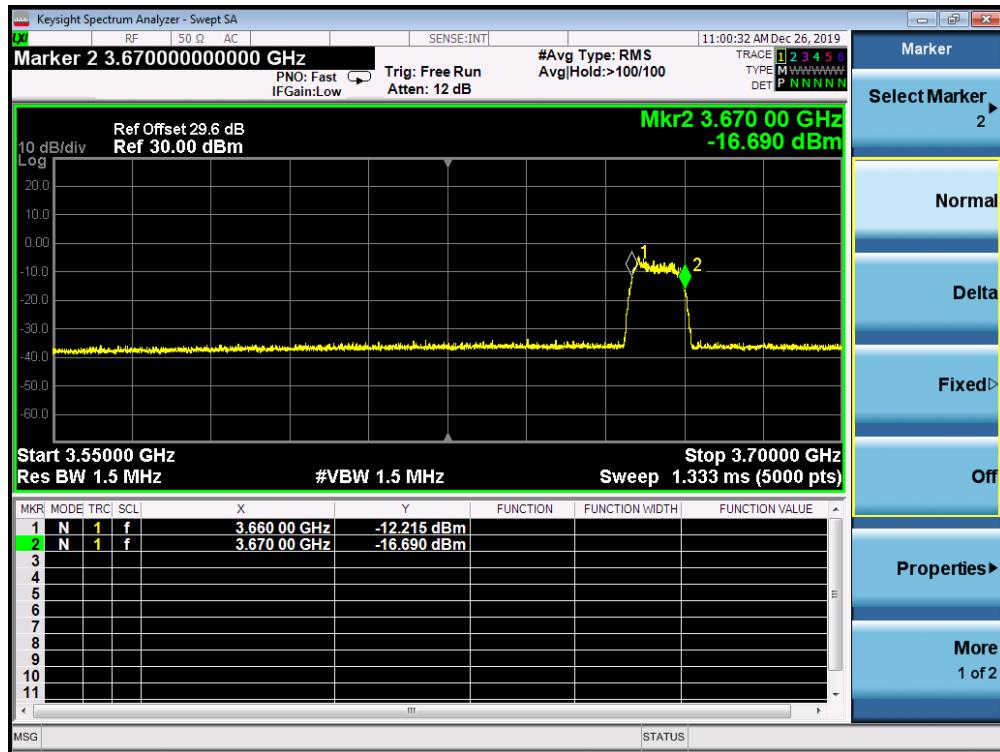
Marker 2: EUT discontinues operation.

Marker 3: 10 seconds elapsed time from CBSD sending instructions to EUT.

FCC ID: BCGA2232	 MEASUREMENT REPORT (CERTIFICATION)			Approved by: Quality Manager
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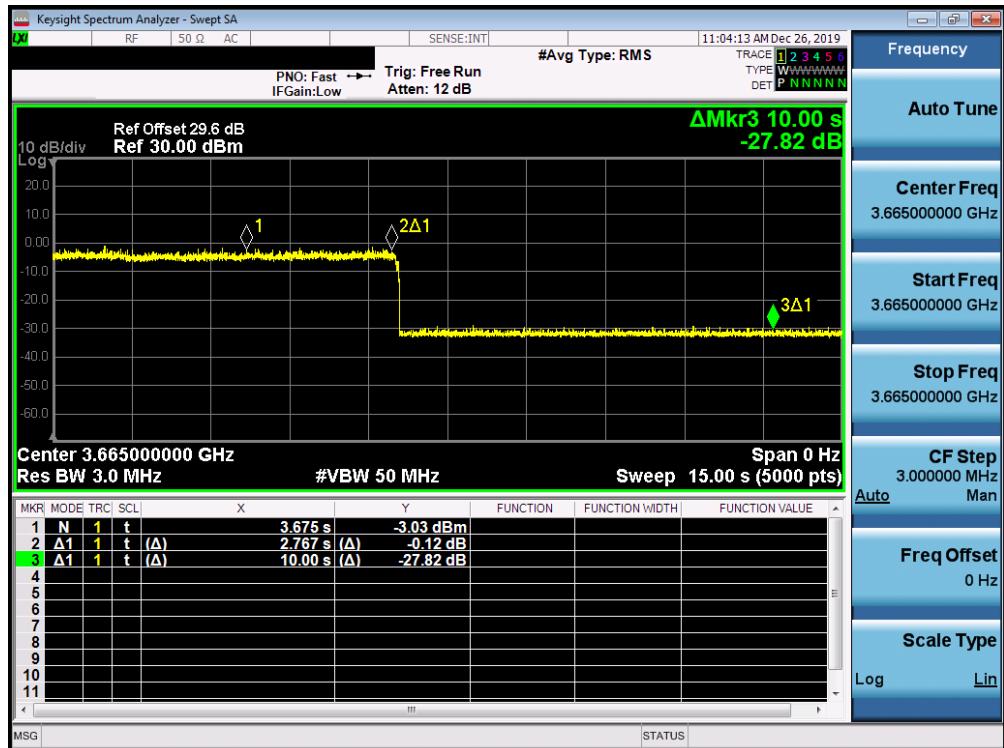
Run#2:

- Tx Frequency Set: 3660 – 3670MHz
- MaxEIRP Set: 8dBm/MHz



Plot 7-38. Run#2 End User Device Frequency of Operations

FCC ID: BCGA2232	 MEASUREMENT REPORT (CERTIFICATION)			Approved by: Quality Manager
Test Report S/N: 1C1912170055-05.BCG	Test Dates: 12/10/2019 - 02/25/2020	EUT Type: Tablet Device	Page 54 of 56	



Plot 7-39. Run#2 End User Device Discontinues Operations within 10s

Note:

Marker 1: CBSD sends instructions to discontinue LTE operations.

Marker 2: EUT discontinues operation.

Marker 3: 10 seconds elapsed time from CBSD sending instructions to EUT.

FCC ID: BCGA2232		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C1912170055-05.BCG	Test Dates: 12/10/2019 - 02/25/2020	EUT Type: Tablet Device	Page 55 of 56

8.0 CONCLUSION

The data collected relate only to the item(s) tested and show that the **Apple Tablet Device** **FCC ID: BCGA2232** complies with all of the End User Device requirements of Part 96 of the FCC Rules for LTE operation only.

FCC ID: BCGA2232	 PCTEST MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager
Test Report S/N: 1C1912170055-05.BCG	Test Dates: 12/10/2019 - 02/25/2020	EUT Type: Tablet Device	Page 56 of 56