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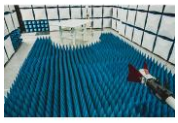

MEASUREMENT REPORT
FCC Part 90

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

Date of Testing:
12/10/2019 - 02/25/2020
Test Site/Location:
PCTEST Morgan Hill, CA, USA
Test Report Serial No.:
1C1912170055-04.BCG

FCC ID:	**BCGA2232**
APPLICANT:	**Apple Inc.**

Application Type:	Certification
Model:	A2232, A2233
EUT Type:	Tablet Device
FCC Classification:	PCS Licensed Transmitter (PCB)
FCC Rule Part:	§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

ACCREDITED
TESTING CERT#2041.02

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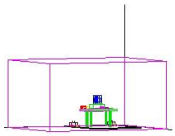
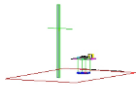


MEASUREMENT REPORT
FCC Part 90



Mode	Bandwidth	Modulation	Tx Frequency Range [MHz]	Measurement	Max. Power [W]	Max. Power [dBm]	Emission Designator
LTE Band 26	10 MHz	QPSK	819.0	Conducted	0.366	25.64	8M99G7W
		16QAM	819.0	Conducted	0.319	25.04	8M99D7W
		64QAM	819.0	Conducted	0.249	23.97	9M00D7W
	5 MHz	QPSK	816.5 - 821.5	Conducted	0.372	25.70	4M51G7W
		16QAM	816.5 - 821.5	Conducted	0.324	25.03	4M50D7W
		64QAM	816.5 - 821.5	Conducted	0.248	23.94	4M51D7W
	3 MHz	QPSK	815.5 - 822.5	Conducted	0.371	25.69	2M70G7W
		16QAM	815.5 - 822.5	Conducted	0.322	25.08	2M71D7W
		64QAM	815.5 - 822.5	Conducted	0.248	23.95	2M70D7W
	1.4 MHz	QPSK	814.7 - 823.3	Conducted	0.366	25.63	1M09G7W
		16QAM	814.7 - 823.3	Conducted	0.322	25.08	1M09D7W
		64QAM	814.7 - 823.3	Conducted	0.253	24.03	1M09D7W

EUT Overview

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1.0 INTRODUCTION

1.1 Scope

Measurement and determination of electromagnetic emissions (EMC) of radio frequency devices including intentional and/or unintentional radiators for compliance with the technical rules and regulations of the Federal Communications Commission and the Innovation, Science and Economic Development Canada.

1.2 PCTEST Test Location

These measurement tests were conducted at the PCTEST facility located at 18855 Adams Court, Morgan Hill, CA 95037. The measurement facility is compliant with the test site requirements specified in ANSI C63.4-2014 and KDB 414788 D01 v01r01.

1.3 Test Facility / Accreditations

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

- PCTEST is an ISO 17025-2005 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 licensed transmitters that operate under the provisions of Part 90(R) and 90(S).

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 Antenna Description

Following antenna was used for the testing.

Frequency [MHz]	Antennas	
	Port A	Port B
650-800	ANT 3	ANT 1
820-960		

Table 2-1. Antennas vs Ports

Frequency [MHz]	Antenna Gain (dBi)	
	Port A	Port B
650-800	-2.3	-2.0
820-960	-1.9	-1.5

Table 2-2. Highest Antenna Gain

2.4 Test Support Equipment

1	Apple MacBook	Model:	A1398	S/N:	C2QKP008F6F3
	w/ AC/DC Adapter	Model:	A1435	S/N:	C04325505K1F288BG
2	Apple USB-C Cable	Model:	Chimp	S/N:	304523
3	USB-C Cable	Model:	A1997	S/N:	N/A
	w / AC/DC Adapter	Model:	A1720	S/N:	C3D9274B06YLHDAE
4	Apple Pencil	Model:	A2051	S/N:	GQXYGSXCJKM9
5	DC Power Supply	Model:	KPS3010D	S/N	N/A

Table 2-3. Test Support Equipment Used

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2.5 Test Configuration

The EUT was tested per the guidance of ANSI C63.26/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 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 17E228 installed on the EUT.

2.7 EMI Suppression Device(s)/Modifications

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

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3.0 DESCRIPTION OF TESTS

3.1 Evaluation Procedure

The measurement procedures described in the document titled "Land Mobile FM or PM – Communications Equipment – Measurements and Performance Standards" (ANSI C63.26/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(S), §90(R)

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 C63.26/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:

$$P_{d\ [dBm]} = P_{g\ [dBm]} - \text{cable loss}_{\ [dB]} + \text{antenna gain}_{\ [dBd/dBi]}$$

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 $P_{g\ [dBm]}$ – 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 $\log_{10}$(Power $_{[Watts]}$) specified in 90(S).

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 C63.26/TIA-603-E-2016.

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.

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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 (±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
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	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

16QAM 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 (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).

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7.0 TEST RESULTS

7.1 Summary

Company Name: Apple Inc.

FCC ID: BCGA2232

FCC Classification: PCS Licensed Transmitter (PCB)

Mode(s): LTE

Band: Band 26

FCC Part Section(s)	Test Description	Test Limit	Test Condition	Test Result	Reference
2.1049	Occupied Bandwidth	N/A	CONDUCTED	PASS	Section 7.2
2.1051 90(S).691(a) 90(R).543(a)	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. > 43 + 10 $\log_{10}$ (P[Watts]) for all out-of-band emissions except > 50 + 10 $\log_{10}$ (P[Watts]) at Band Edge and for all out-of-band emissions within 37.5kHz of Block Edge (Band 26)		PASS	Sections 7.3, 7.4
2.1055 90.213	Frequency Stability	< 2.5 ppm		PASS	Section 7.7
2.1046 90.635	Conducted Power	< 100 Watts		PASS	Section 7.5
2.1053 90(S).691(a) 90(R).543(e)	Radiated Spurious Emissions	> 43 + 10 $\log_{10}$ (P[Watts]) for all out-of-band emissions except > 50 + 10 $\log_{10}$ (P[Watts]) at Band Edge and for all out-of-band emissions within 37.5kHz of Block Edge	RADIATED	PASS	Section 7.6

Table 7-1. Summary of 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 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 4.2.
5) All ports were investigated and only the worst case data was reported.

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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 ≥ 3 x 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.

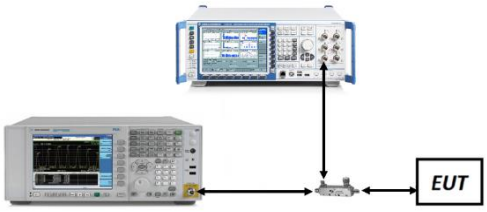

Figure 7-1. Test Instrument & Measurement Setup

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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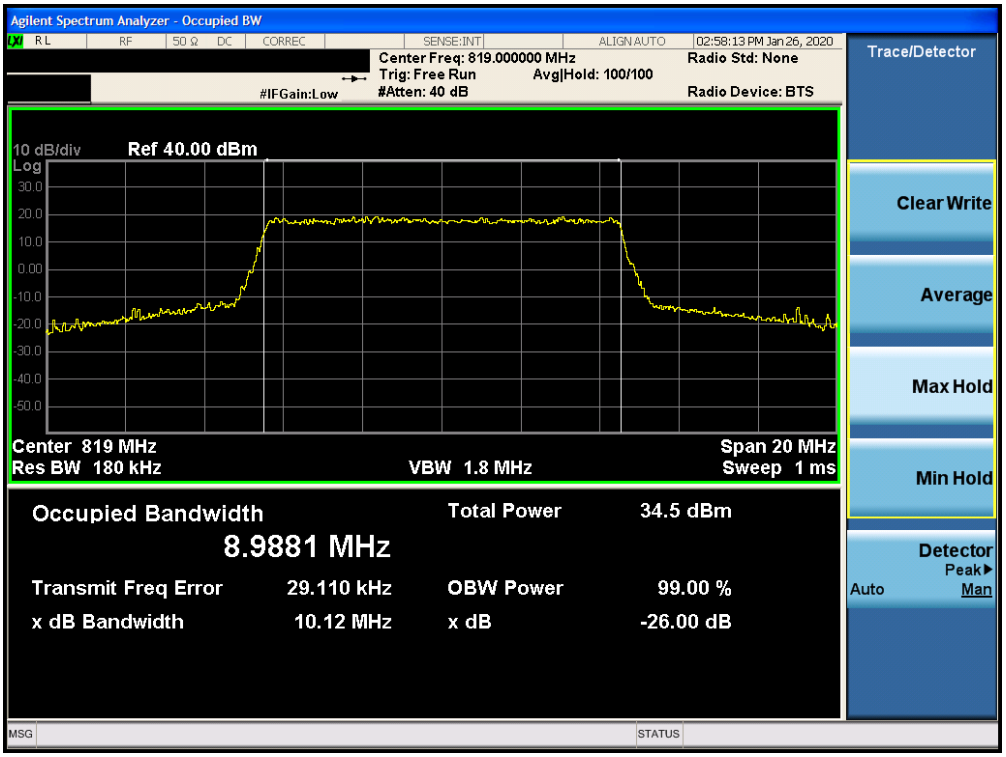
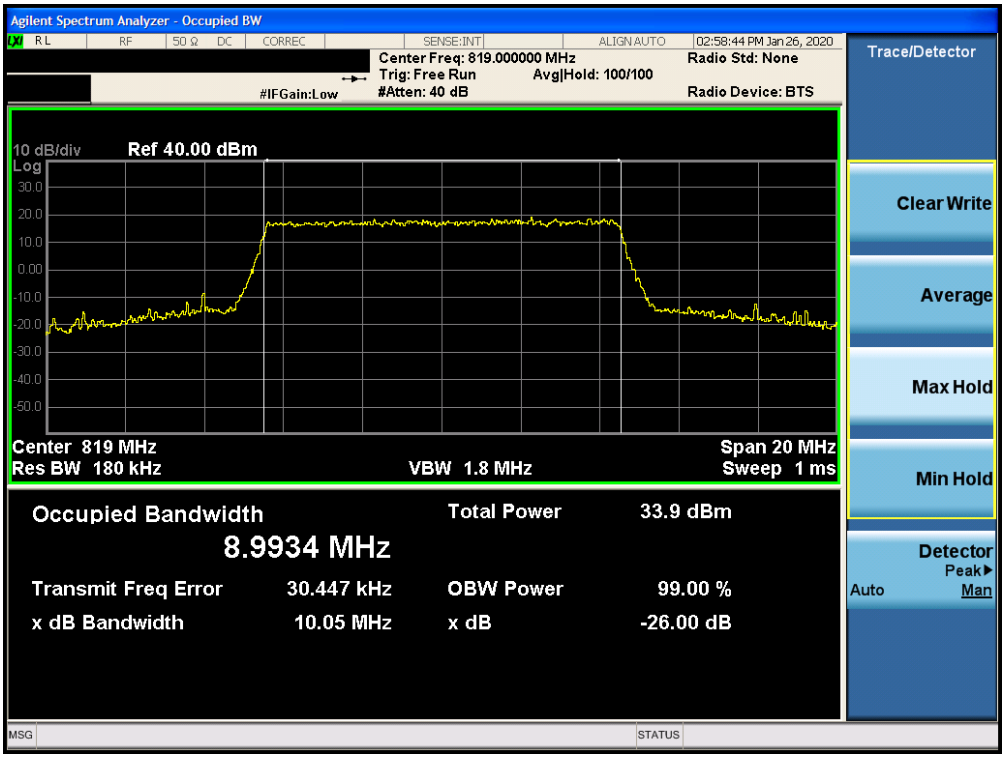


Plot 7-1. Occupied Bandwidth Plot (LTE Band 26 - 10MHz QPSK - Full RB Configuration)



Plot 7-2. Occupied Bandwidth Plot (LTE Band 26 - 10MHz 16-QAM - Full RB Configuration)

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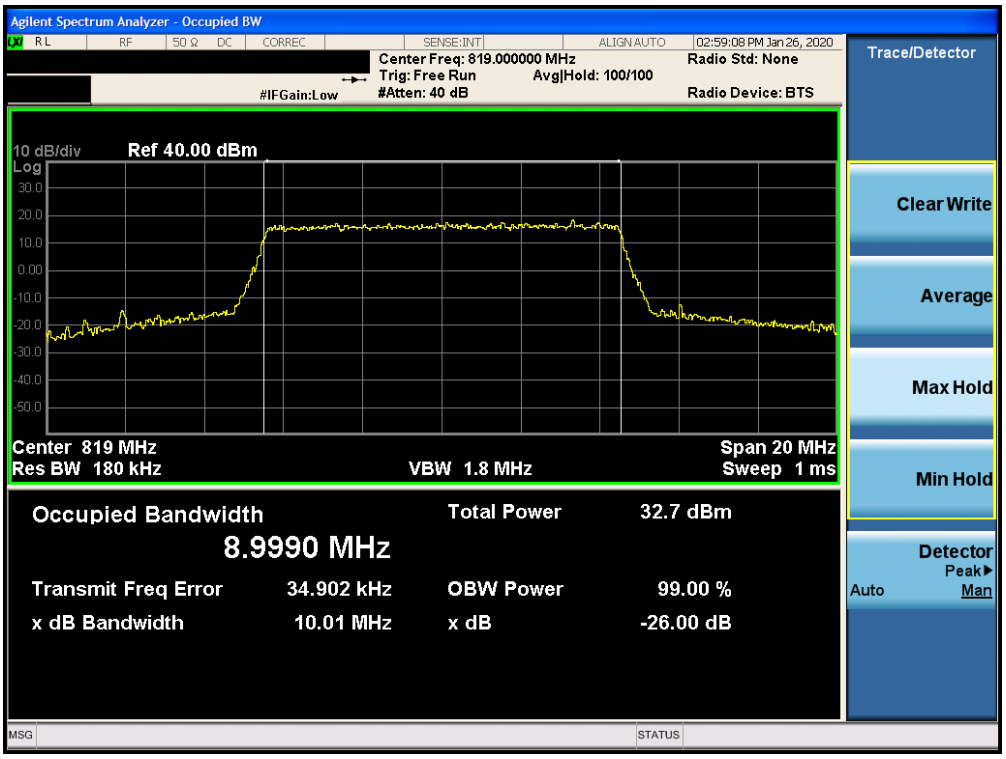
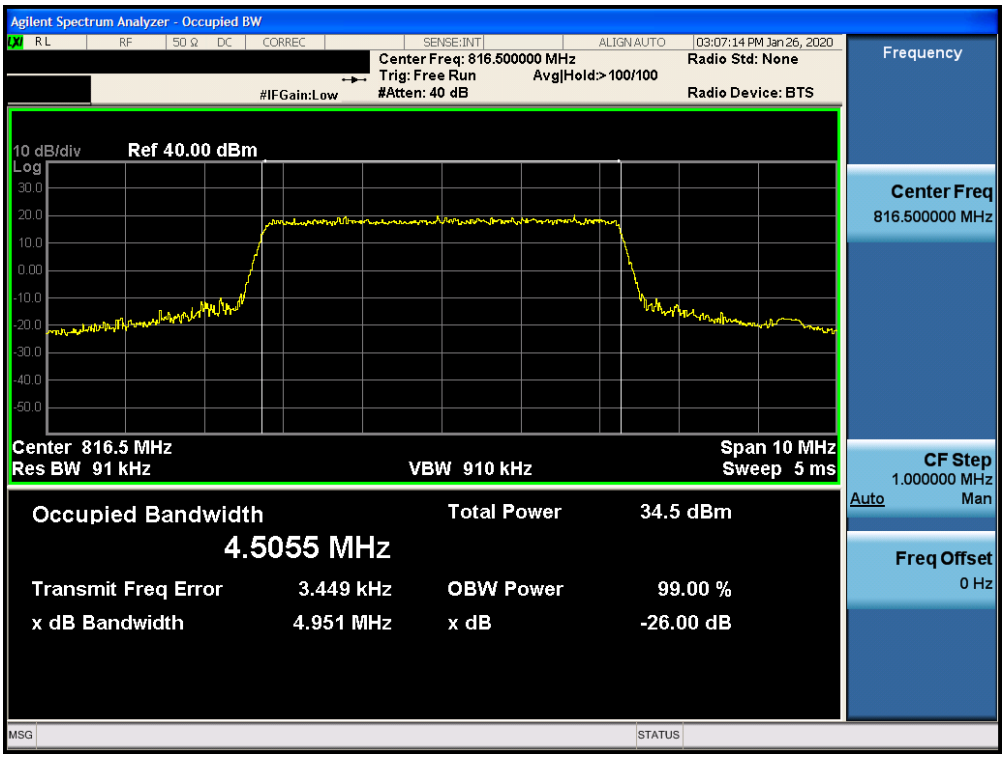


Plot 7-3. Occupied Bandwidth Plot (LTE Band 26 - 10MHz 64-QAM - Full RB Configuration)



Plot 7-4. Occupied Bandwidth Plot (LTE Band 26 - 5MHz QPSK - Full RB Configuration)

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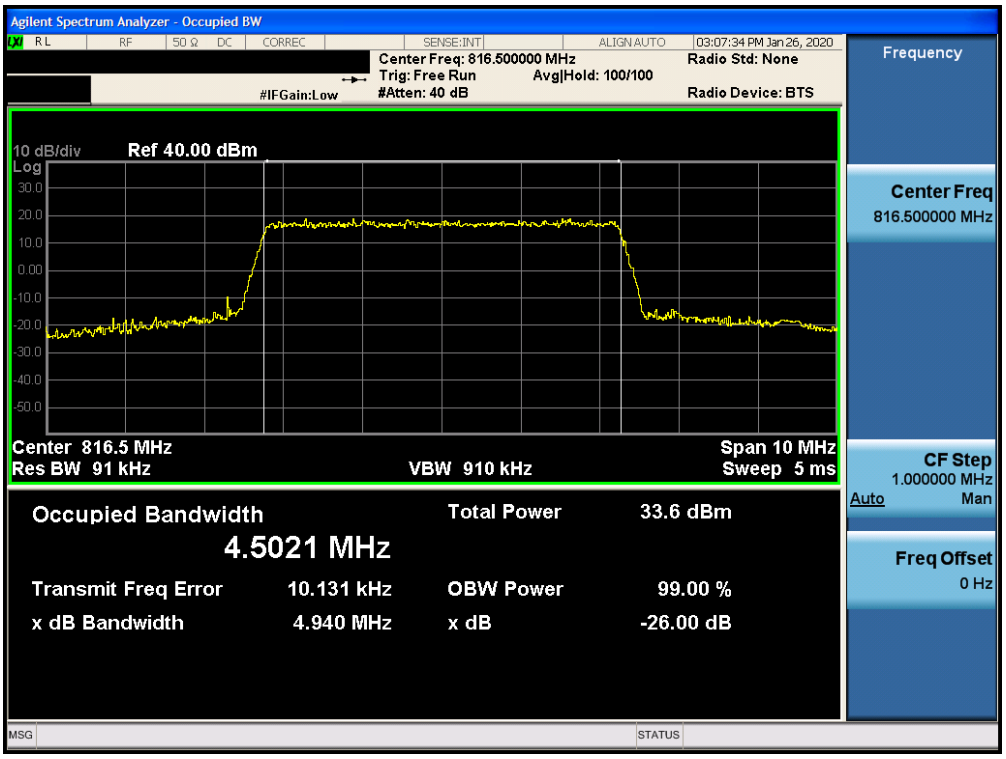
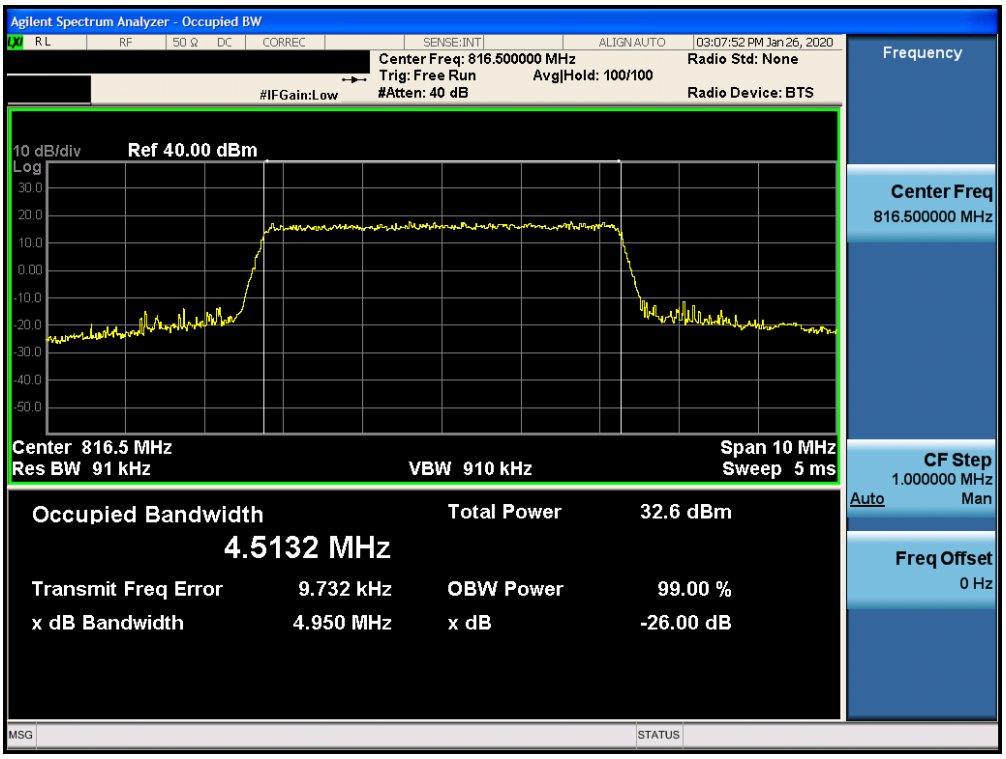


Plot 7-5. Occupied Bandwidth Plot (LTE Band 26 - 5MHz 16-QAM - Full RB Configuration)



Plot 7-6. Occupied Bandwidth Plot (LTE Band 26 - 5MHz 64-QAM - Full RB Configuration)

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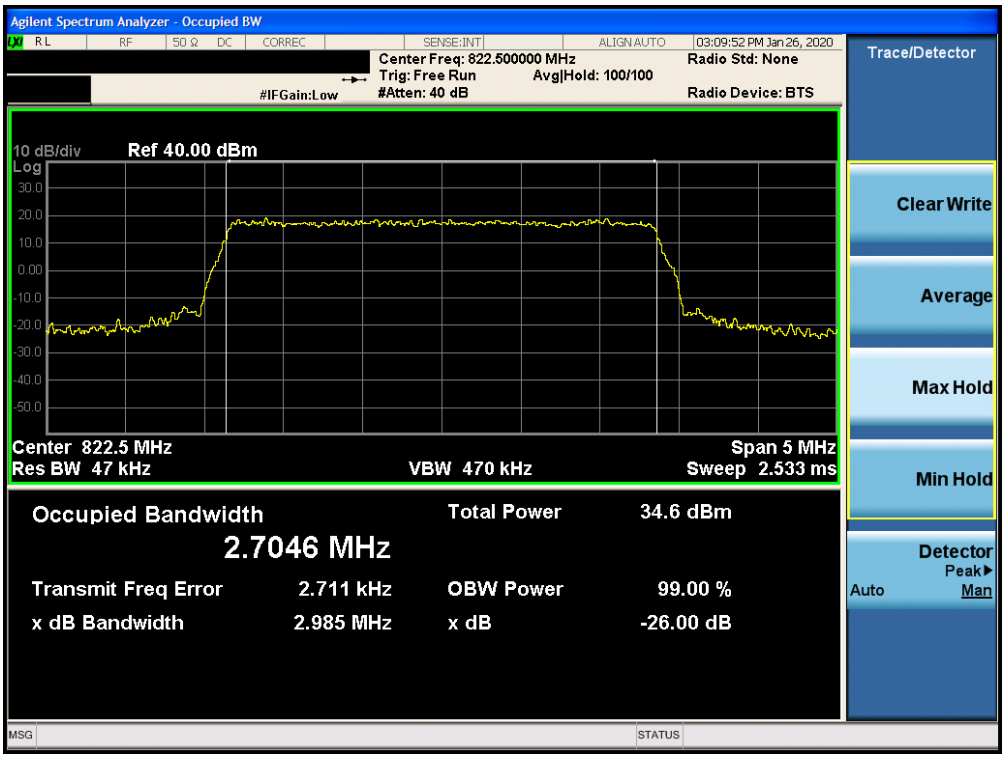
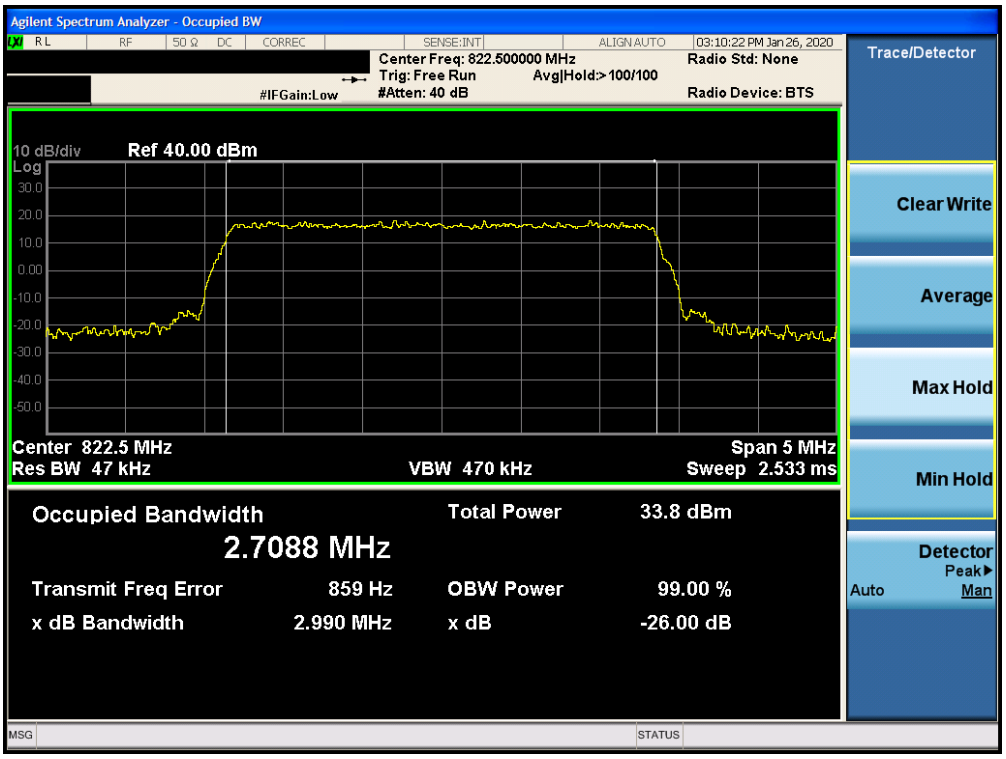


Plot 7-7. Occupied Bandwidth Plot (LTE Band 26 - 3MHz QPSK - Full RB Configuration)



Plot 7-8. Occupied Bandwidth Plot (LTE Band 26 - 3MHz 16-QAM - Full RB Configuration)

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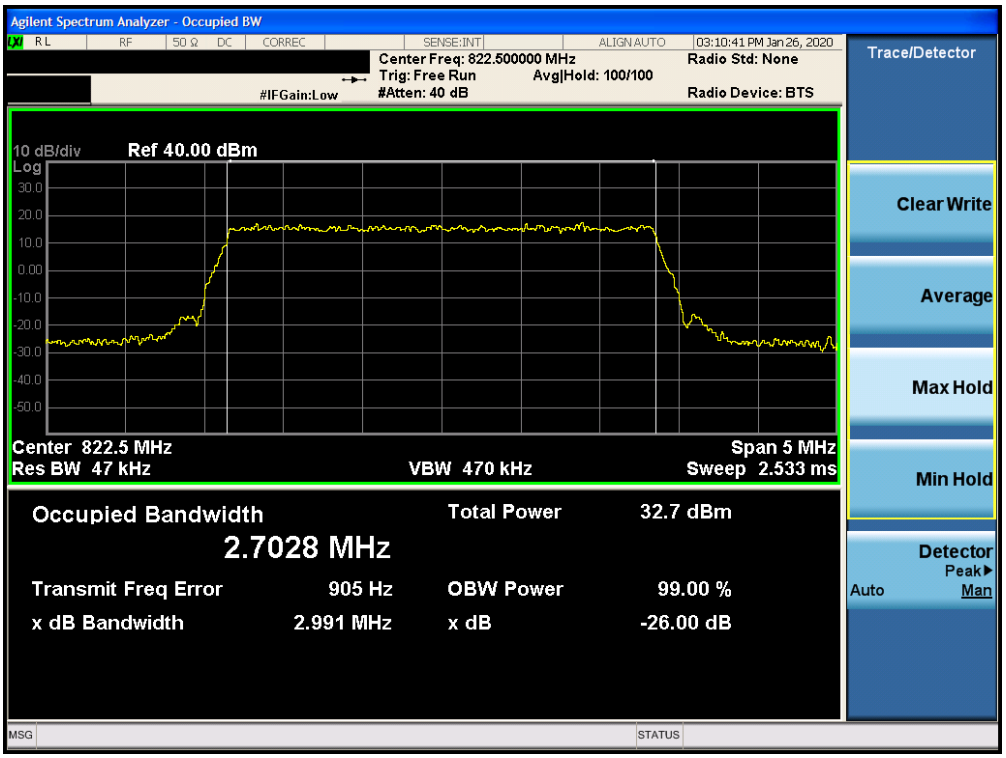
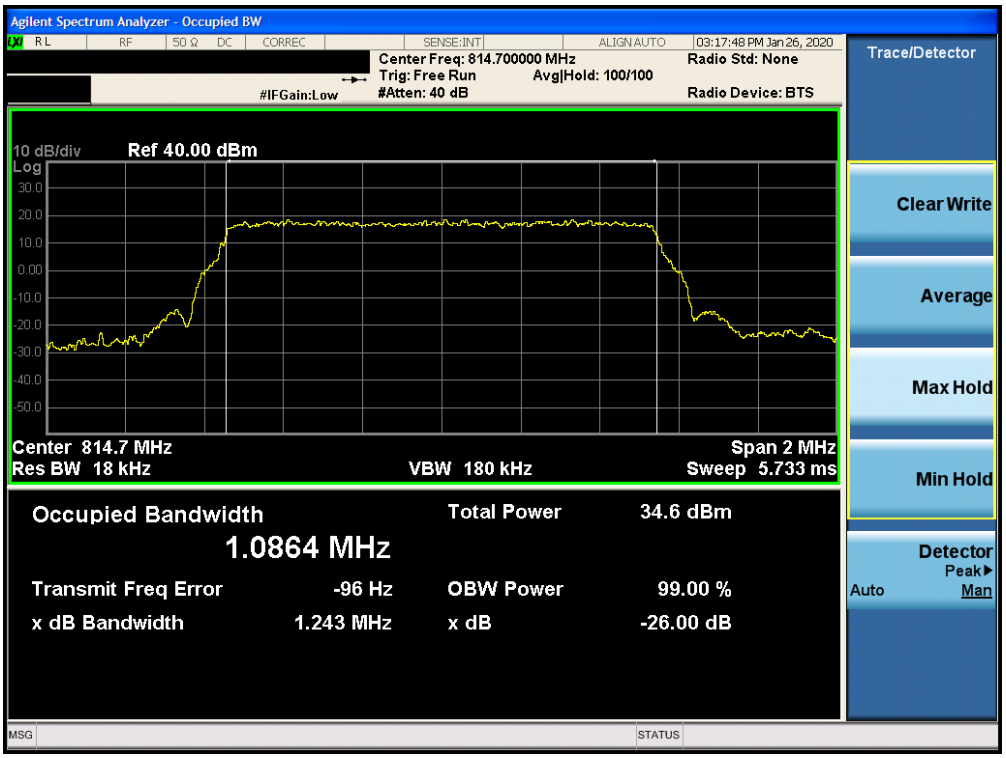


Plot 7-9. Occupied Bandwidth Plot (LTE Band 26 - 3MHz 64-QAM - Full RB Configuration)



Plot 7-10. Occupied Bandwidth Plot (LTE Band 26 - 1.4MHz QPSK - Full RB Configuration)

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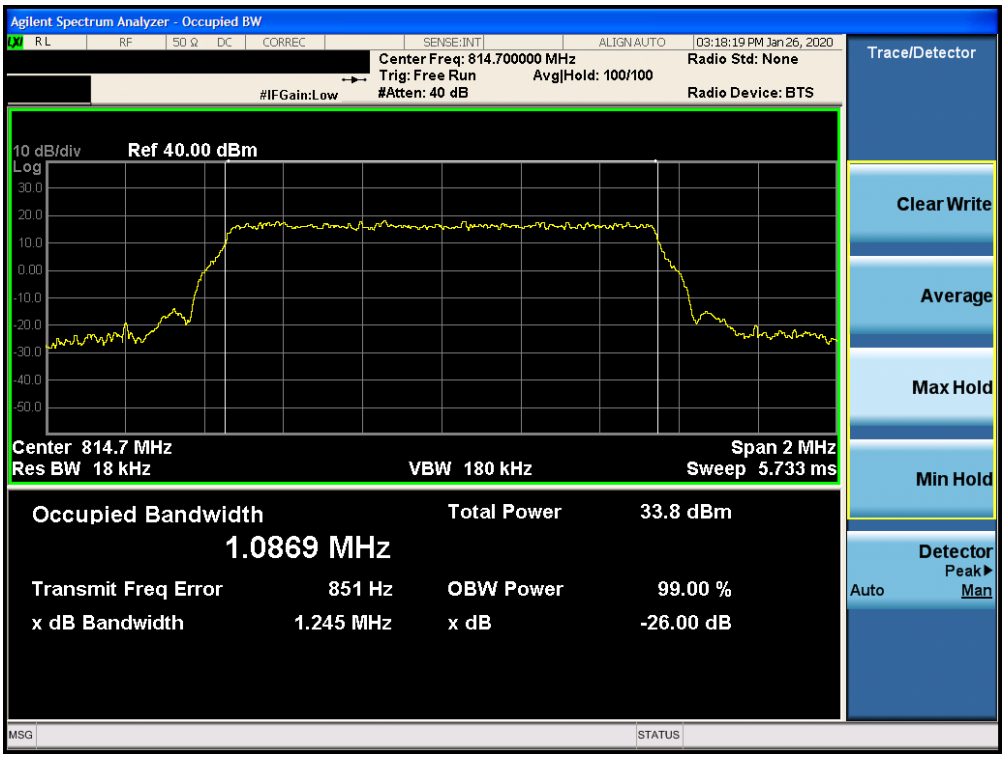
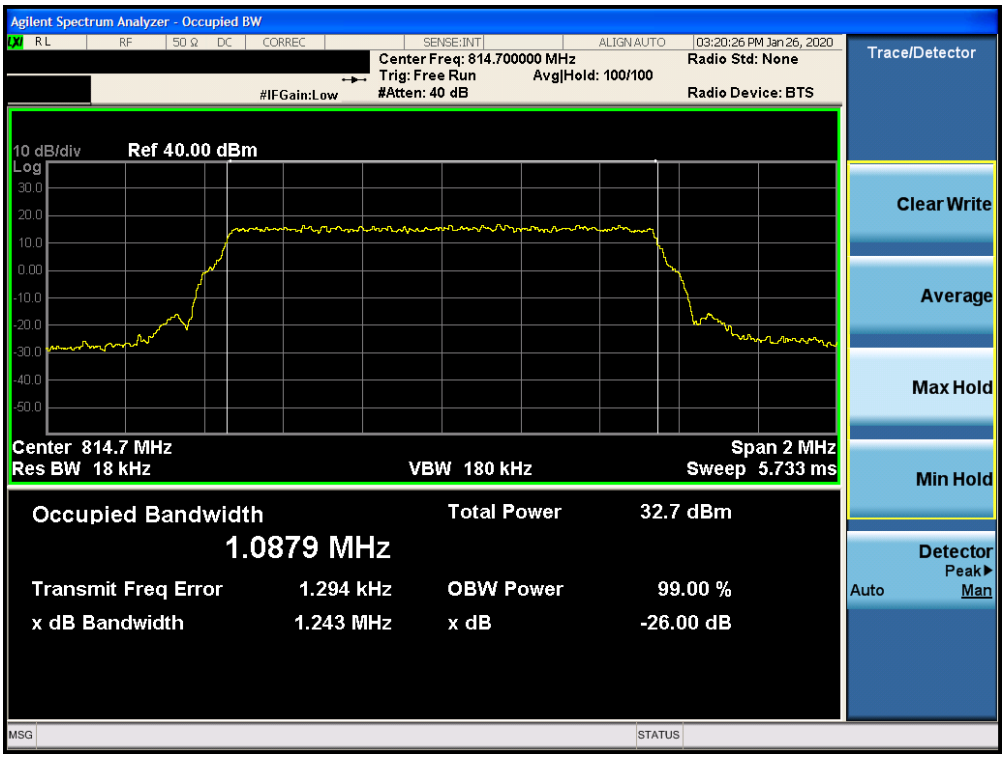


Plot 7-11. Occupied Bandwidth Plot (LTE Band 26 - 1.4MHz 16-QAM - Full RB Configuration)



Plot 7-12. Occupied Bandwidth Plot (LTE Band 26 - 1.4MHz 64-QAM - Full RB Configuration)

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7.3 Spurious and Harmonic Emissions at Antenna Terminal

§2.1051 §90(S).691(a) §90(R).543(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 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 + 10 $log_{10}(P_{[Watts]})$, 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 ≥ 100kHz
3. VBW ≥ 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.

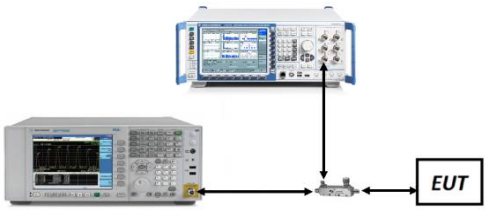

Figure 7-2. Test Instrument & Measurement Setup

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 22. 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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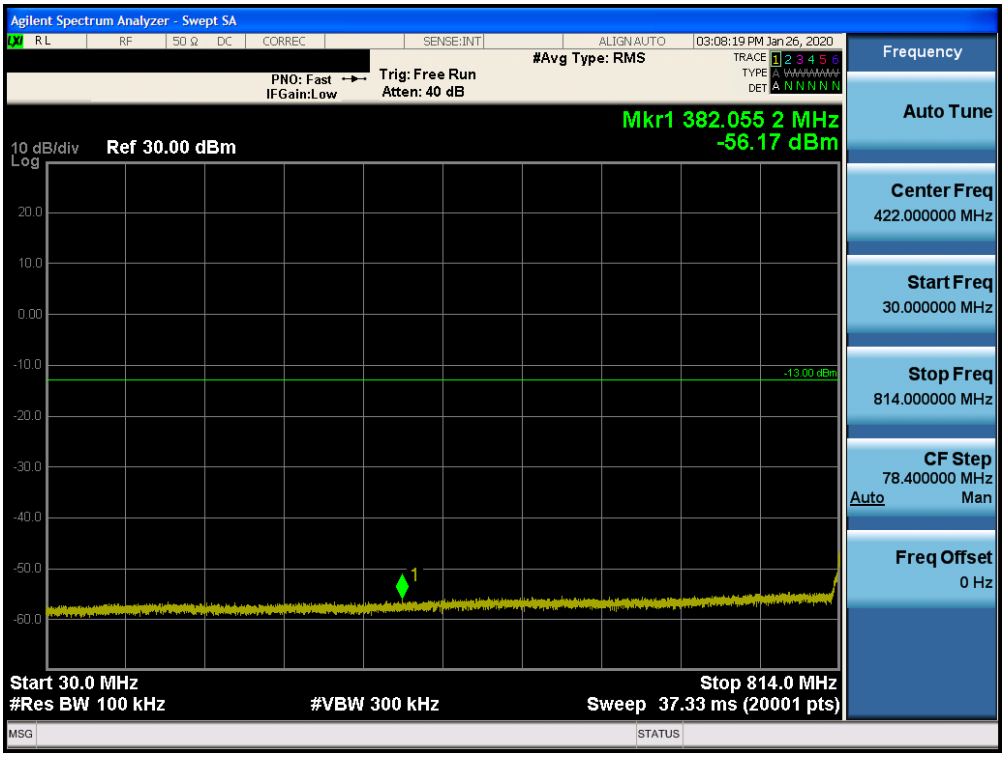
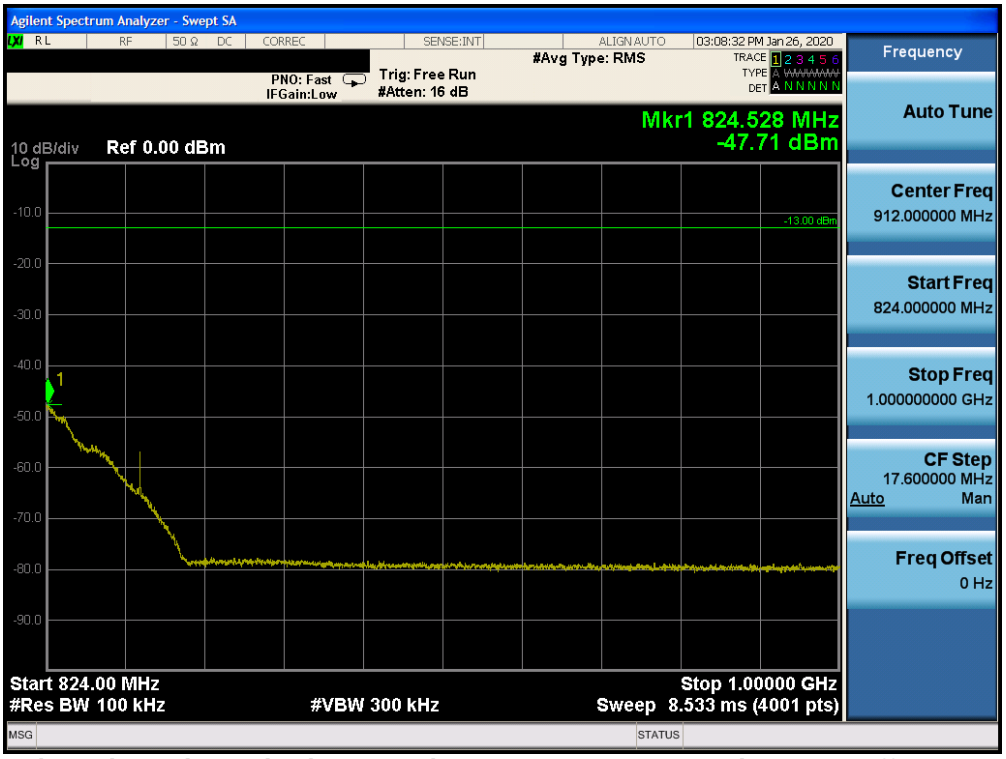


Plot 7-13. Conducted Spurious Plot (LTE Band 26 - 5MHz QPSK - RB Size 1, RB Offset 0 - Low Channel)



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

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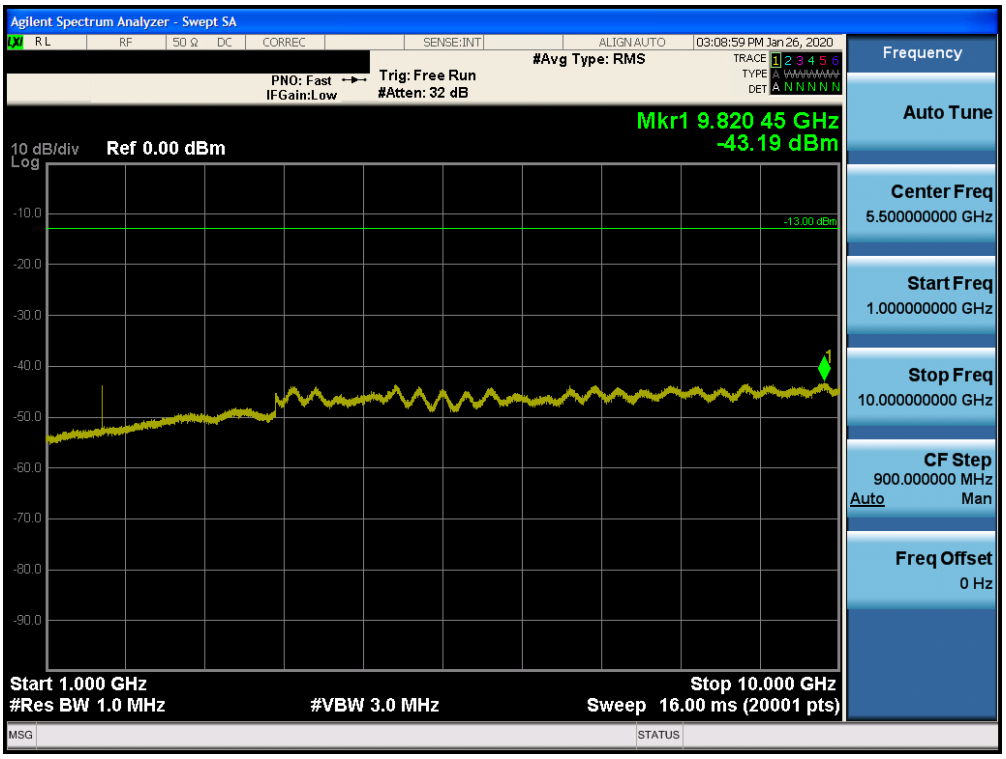
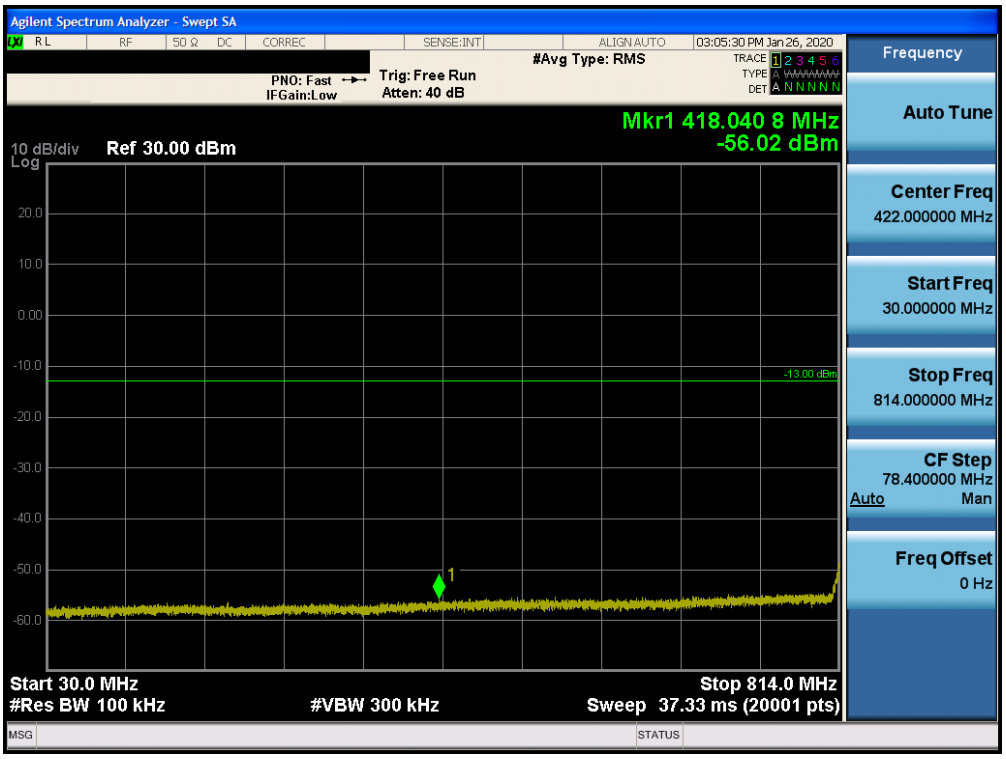


Plot 7-15. Conducted Spurious Plot (LTE Band 26 - 5MHz QPSK - RB Size 1, RB Offset 0 - Low Channel)



Plot 7-16. Conducted Spurious Plot (LTE Band 26 - 5MHz QPSK - RB Size 1, RB Offset 0 - High Channel)

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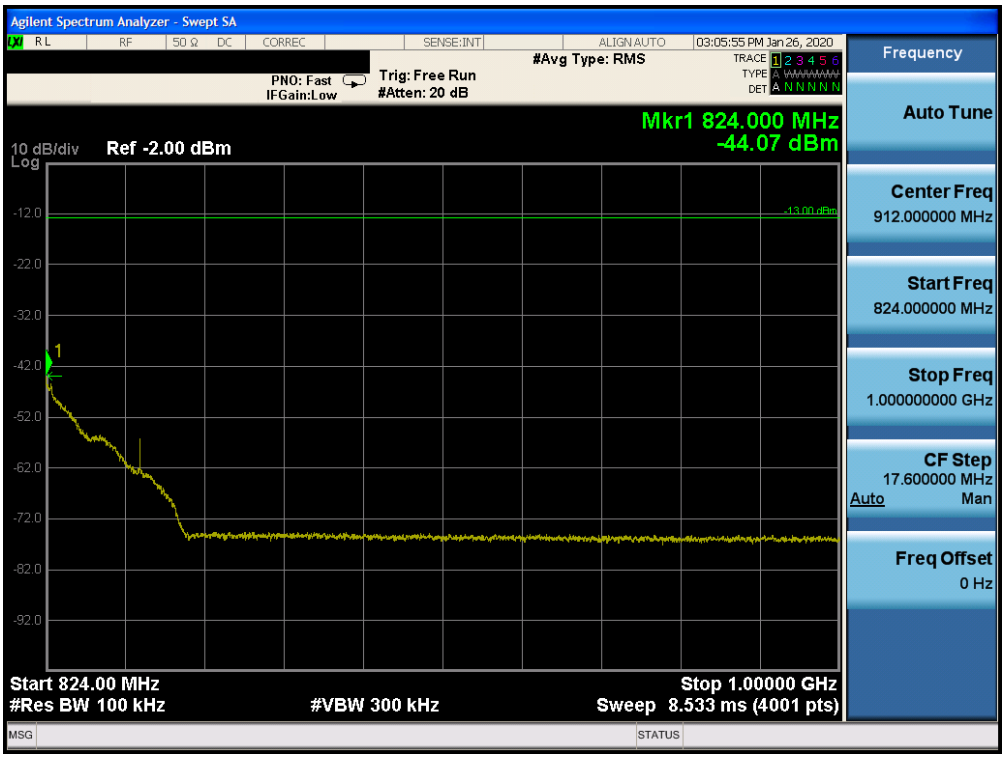
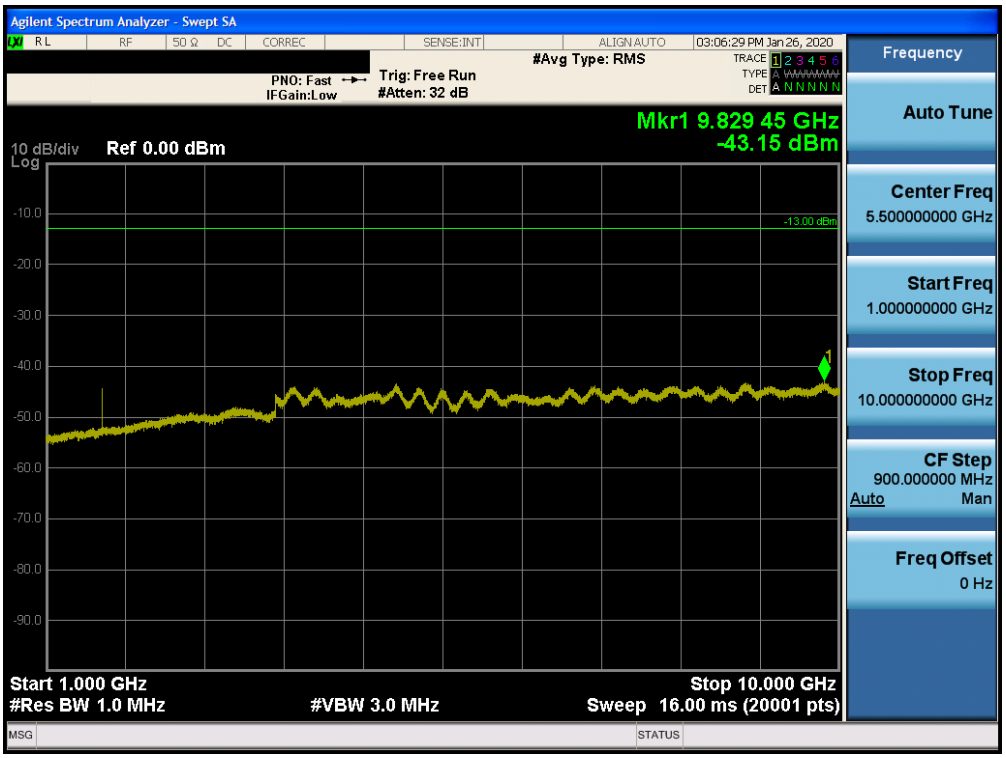


Plot 7-17. Conducted Spurious Plot (LTE Band 26 - 5MHz QPSK - RB Size 1, RB Offset 0 - High Channel)



Plot 7-18. Conducted Spurious Plot (LTE Band 26 - 5MHz QPSK - RB Size 1, RB Offset 0 - High Channel)

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7.4 Band Edge Emissions at Antenna Terminal

§2.1051 §90(S).691(a) §90(R).543(e)

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.

For LTE B26 operation under Part 90.691, 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 + 10log$_{10}$(P$_{[Watts]}$), 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 + 10log$_{10}$(P$_{[Watts]}$), 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.

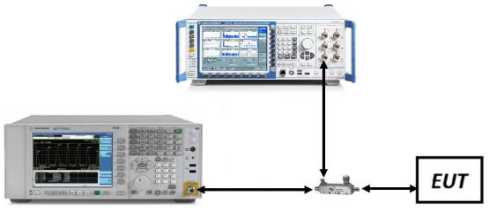

Figure 7-3. Test Instrument & Measurement Setup

Test Notes

For channel edge emission, the signal analyzer's "ACP" measurement capability is used.

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.

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

Refer to Table 2-1 Section 2.3 of this test report for correlation between Antennas and Ports

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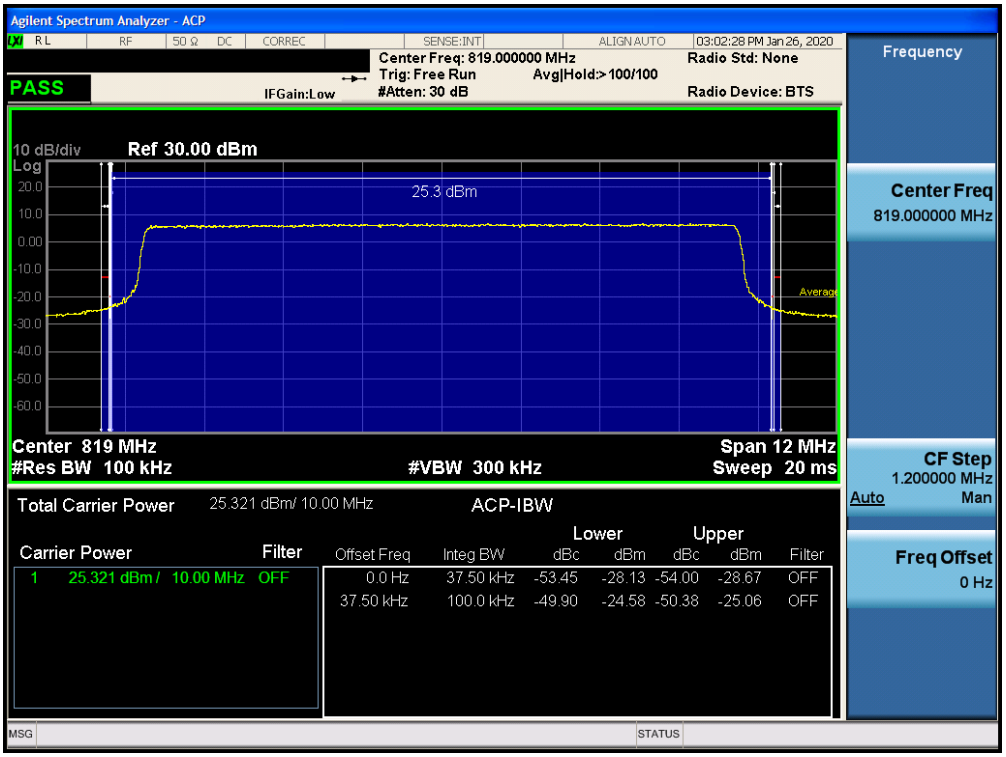
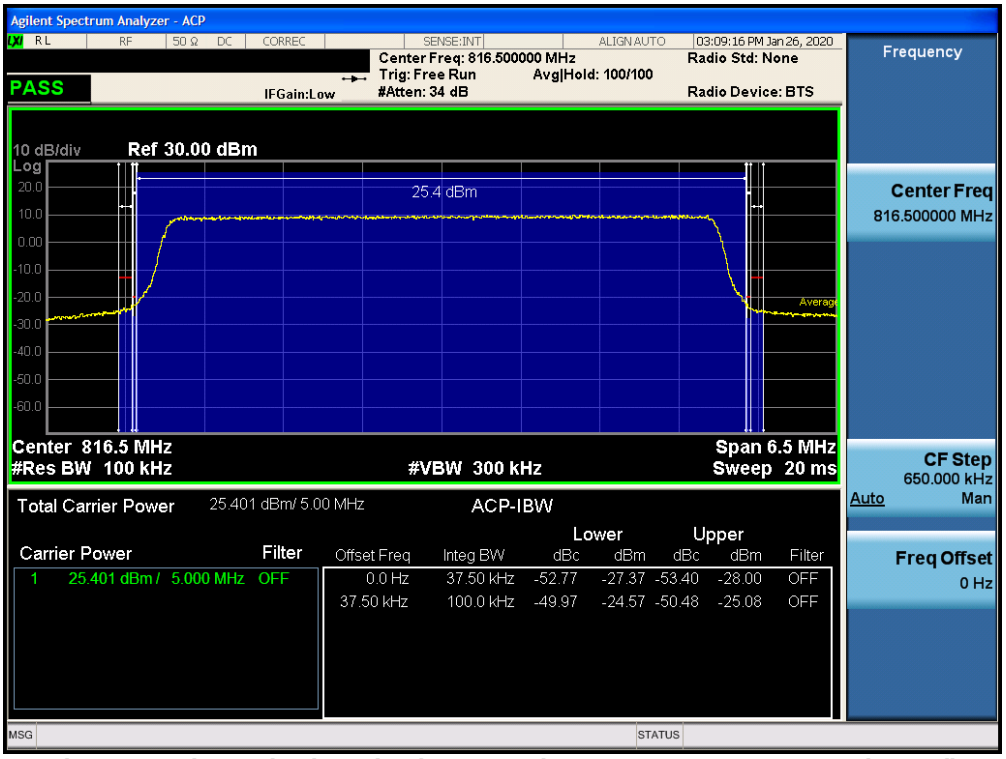


Plot 7-19. Channel Edge Plot (LTE Band 26 - 10MHz QPSK - Mid Channel)



Plot 7-20. Channel Edge Plot (LTE Band 26 - 5MHz QPSK - Low Channel)

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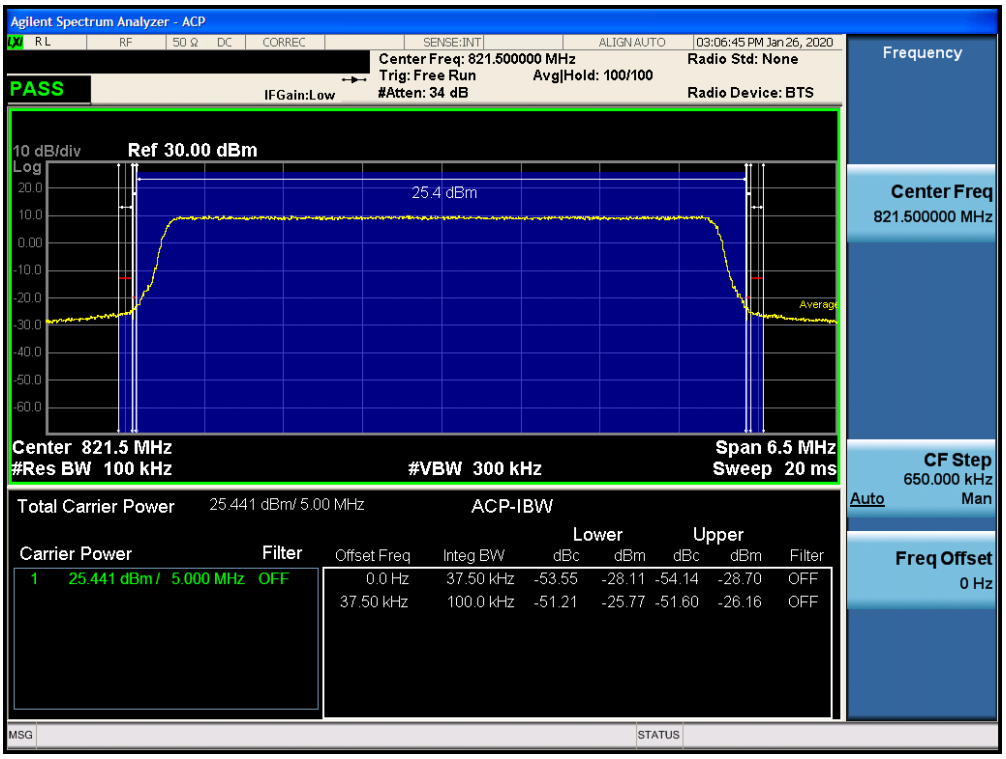
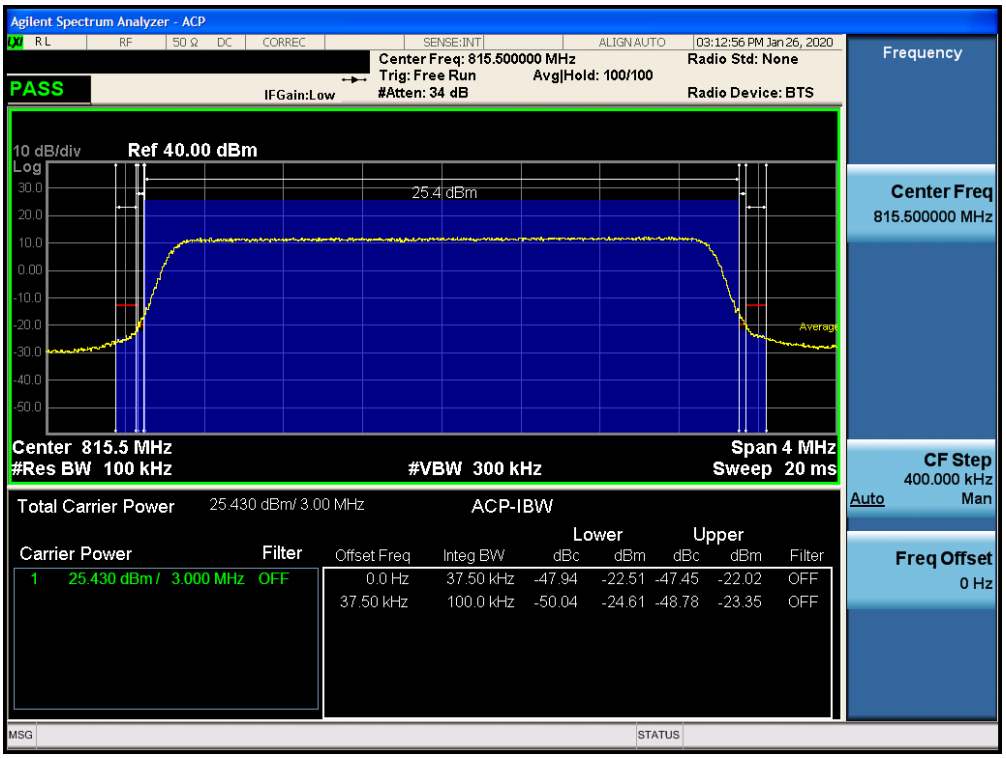


Plot 7-21. Channel Edge Plot (LTE Band 26 - 5MHz QPSK - High Channel)



Plot 7-22. Channel Edge Plot (LTE Band 26 - 3MHz QPSK - Low Channel)

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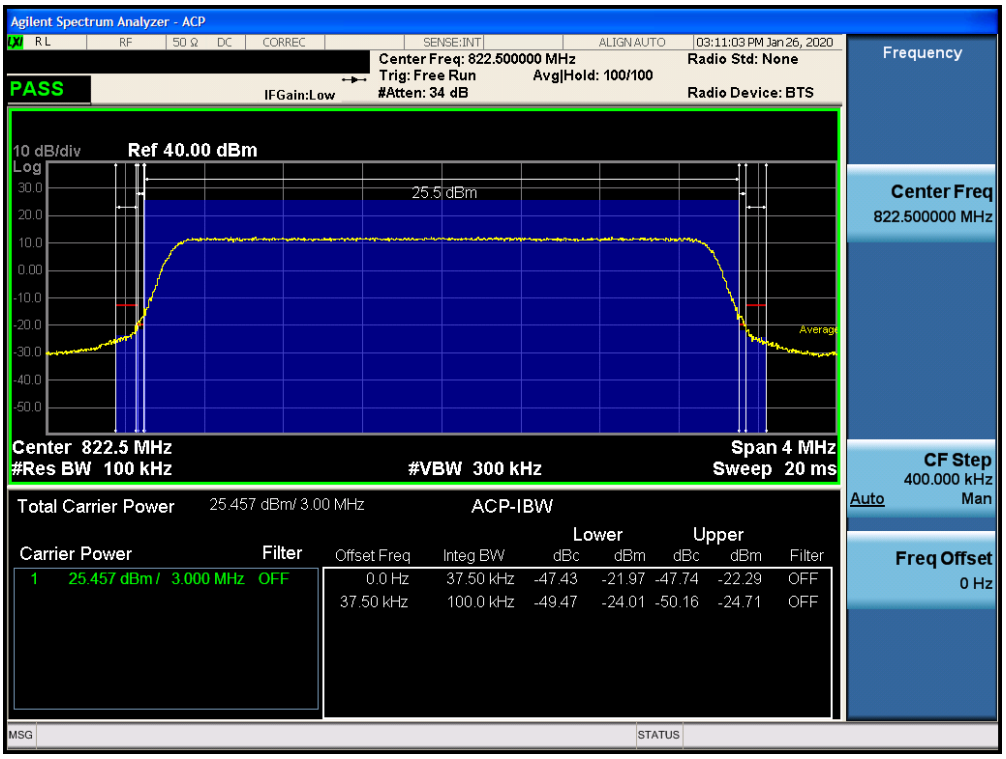
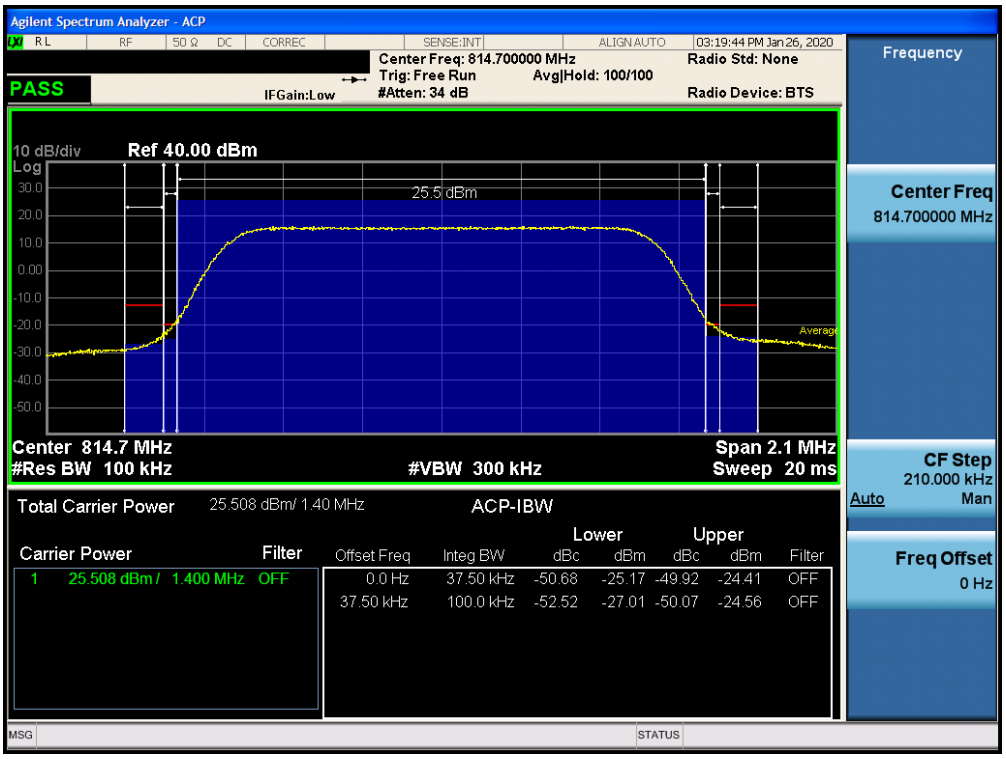


Plot 7-23. Channel Edge Plot (LTE Band 26 - 3MHz QPSK - High Channel)



Plot 7-24. Channel Edge Plot (LTE Band 26 - 1.4MHz QPSK - Low Channel)

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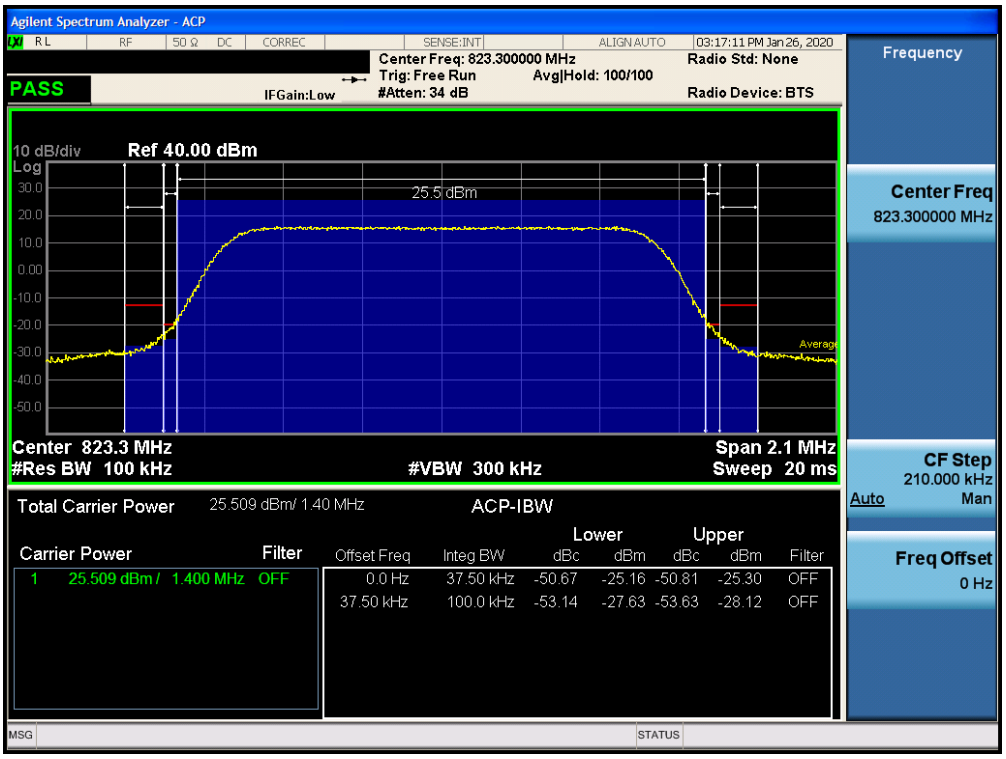

Plot 7-25. Channel Edge Plot (LTE Band 26 - 1.4MHz QPSK - High Channel)

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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 v03r01

Test Setup

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

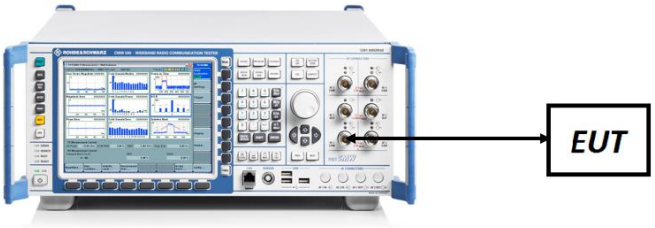

Figure 7-4. Conducted Power Measurement Setup

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

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Port A

Bandwidth	Modulation	Channel	Frequency [MHz]	RB Size/Offset	Conducted Power [dBm]	Conducted Power [Watts]	Conducted Power Limit [dBm]	Margin [dB]
10 MHz	QPSK	26740	819.0	1 / 0	25.64	0.366	50.00	-24.36
	16-QAM	26740	819.0	1 / 0	25.04	0.319	50.00	-24.96
	64-QAM	26740	819.0	1 / 0	23.97	0.249	50.00	-26.03
5 MHz	QPSK	26715	816.5	1 / 0	25.70	0.372	50.00	-24.30
		26765	821.5	1 / 24	25.55	0.359	50.00	-24.45
	16-QAM	26715	816.5	1 / 0	25.03	0.318	50.00	-24.97
	64-QAM	26715	816.5	1 / 0	23.94	0.248	50.00	-26.06
3 MHz	QPSK	26705	815.5	1 / 0	25.69	0.371	50.00	-24.31
		26775	822.5	1 / 14	25.48	0.353	50.00	-24.52
	16-QAM	26705	815.5	1 / 0	25.08	0.322	50.00	-24.92
	64-QAM	26705	815.5	1 / 0	23.95	0.248	50.00	-26.05
1.4 MHz	QPSK	26697	814.7	3 / 2	25.63	0.366	50.00	-24.37
		26783	823.3	1 / 0	25.57	0.361	50.00	-24.43
	16-QAM	26697	814.7	1 / 0	25.08	0.322	50.00	-24.92
	64-QAM	26697	814.7	1 / 0	24.03	0.253	50.00	-25.97

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

Port B

Bandwidth	Modulation	Channel	Frequency [MHz]	RB Size/Offset	Conducted Power [dBm]	Conducted Power [Watts]	Conducted Power Limit [dBm]	Margin [dB]
10 MHz	QPSK	26740	819.0	1 / 0	24.42	0.277	50.00	-25.58
	16-QAM	26740	819.0	1 / 0	23.73	0.236	50.00	-26.27
	64-QAM	26740	819.0	1 / 0	22.79	0.190	50.00	-27.21
5 MHz	QPSK	26715	816.5	1 / 0	24.50	0.282	50.00	-25.50
		26765	821.5	1 / 0	24.19	0.262	50.00	-25.81
	16-QAM	26715	816.5	1 / 0	23.97	0.249	50.00	-26.03
	64-QAM	26715	816.5	1 / 0	22.67	0.185	50.00	-27.33
3 MHz	QPSK	26705	815.5	1 / 0	24.50	0.282	50.00	-25.50
		26775	822.5	1 / 0	24.11	0.258	50.00	-25.89
	16-QAM	26705	815.5	1 / 14	23.74	0.237	50.00	-26.26
	64-QAM	26705	815.5	1 / 0	22.72	0.187	50.00	-27.28
1.4 MHz	QPSK	26697	814.7	1 / 0	24.47	0.280	50.00	-25.53
		26783	823.3	1 / 5	24.12	0.258	50.00	-25.88
	16-QAM	26697	814.7	1 / 5	23.61	0.230	50.00	-26.39
	64-QAM	26697	814.7	1 / 0	22.83	0.192	50.00	-27.17

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

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7.6 Radiated Spurious Emissions Measurements

§2.1053 §90(S).691(a) §90(R).543(e)

Test Overview

Radiated spurious emissions measurements are performed using the substitution method described in ANSI C63.26/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 C63.26/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 ≥ 3 x RBW
3. Span = 1.5 times the OBW
4. No. of sweep points ≥ 2 x span / RBW
5. Detector = RMS
6. Trace mode = Average (Max Hold for pulsed emissions)
7. The trace was allowed to stabilize

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Test Setup

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

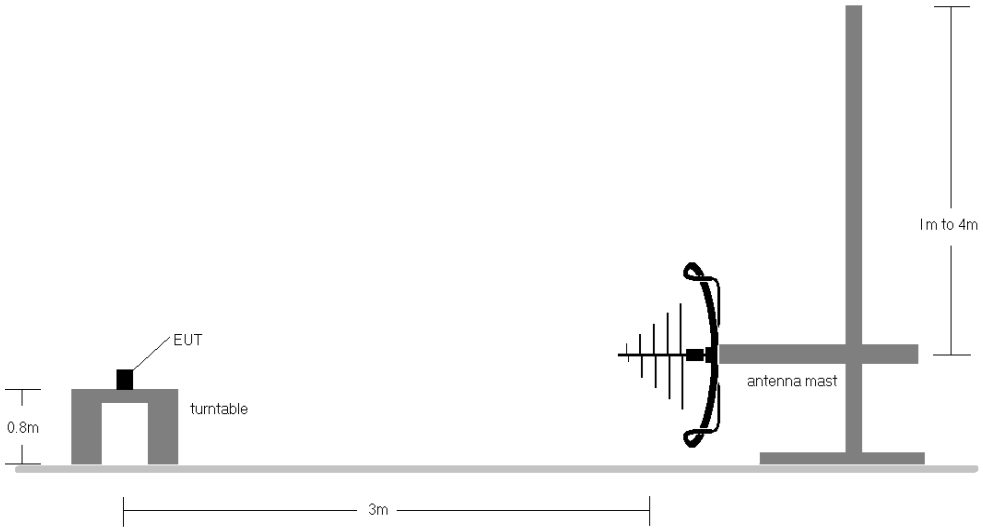

Figure 7-5. Test Instrument & Measurement Setup < 1GHz

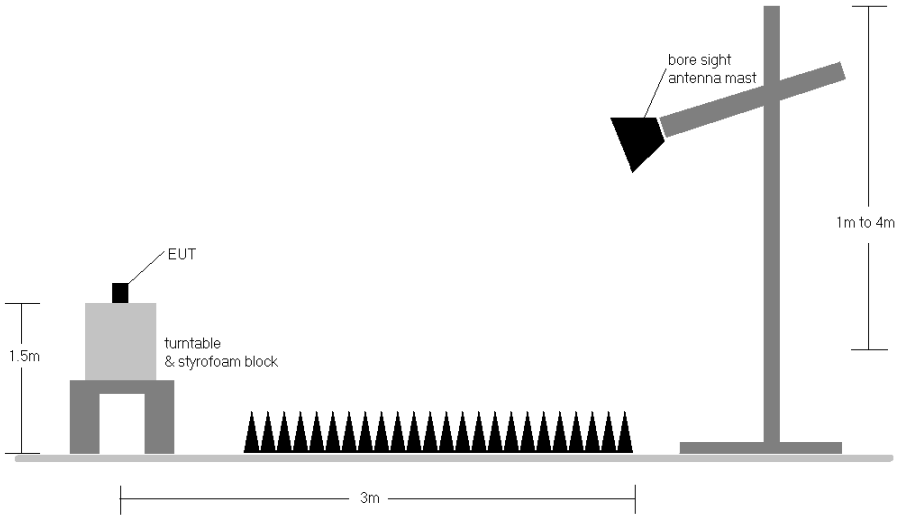

Figure 7-6. Test Instrument & Measurement Setup > 1GHz

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.

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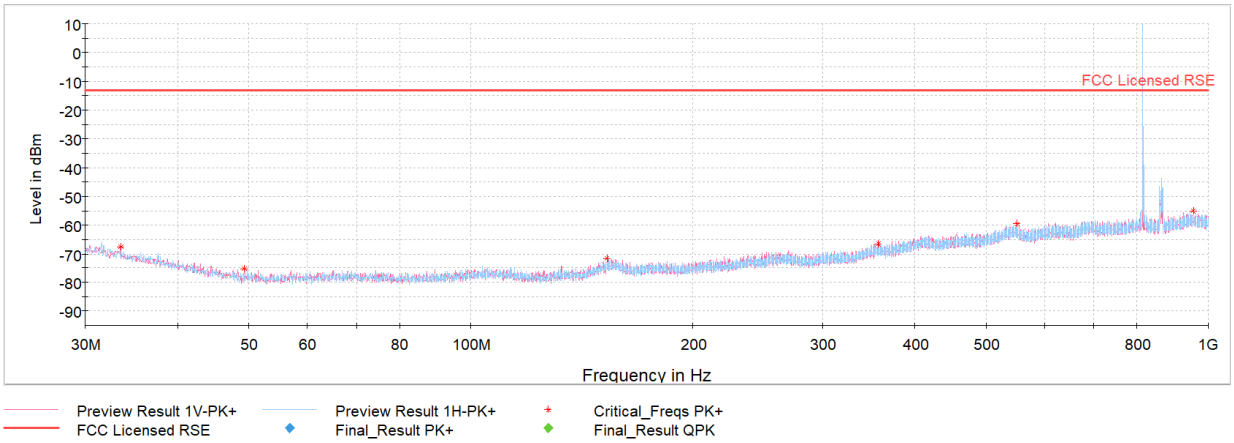
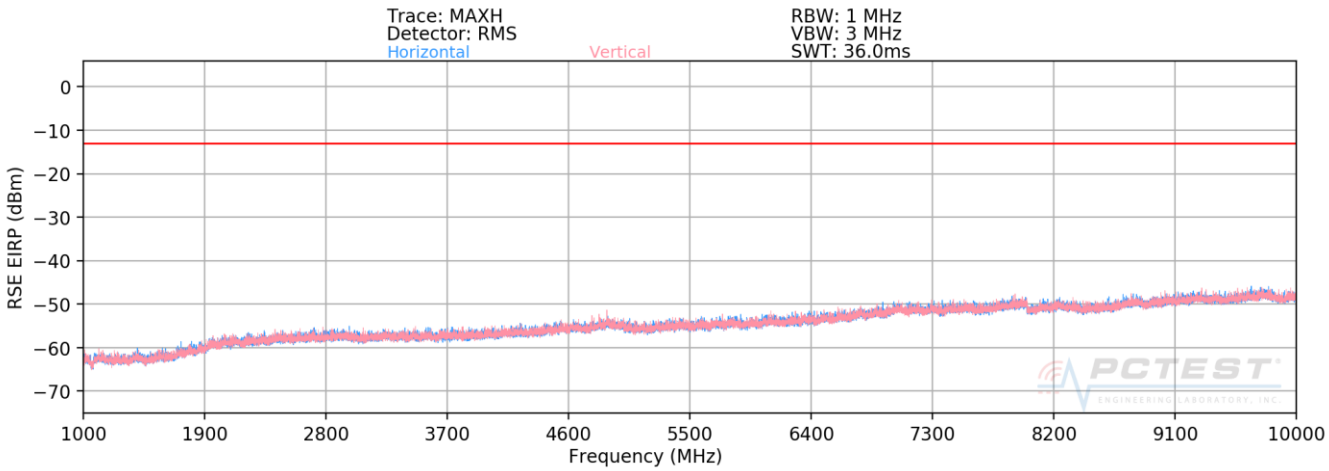
7.6.1 ANT 3 (Port A) Radiated Spurious Emissions Measurements

LTE Band 26



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



Plot 7-27. Radiated Spurious Plot Above 1GHz (Band 26)

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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]	EIRP Level at Sub Ant Port [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Margin [dB]
1633.00	H	-	-	-72.94	5.37	-67.56	-54.6
2449.50	H	-	-	-69.44	6.06	-63.37	-50.4
3266.00	H	-	-	-70.79	7.71	-63.08	-50.1

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

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]	EIRP Level at Sub Ant Port [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Margin [dB]
1643.00	H	-	-	-72.88	5.35	-67.52	-54.5
2464.50	H	-	-	-69.15	5.95	-63.20	-50.2
3286.00	H	-	-	-70.90	7.78	-63.12	-50.1

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

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7.6.2 ANT 1 (Port B) Radiated Spurious Emissions Measurements

LTE 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]	EIRP Level at Sub Ant Port [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Margin [dB]
1633.00	H	-	-	-73.01	5.37	-67.63	-54.6
2449.50	H	-	-	-69.65	6.06	-63.58	-50.6
3266.00	H	-	-	-70.97	7.71	-63.26	-50.3

Table 7-6. Radiated Spurious Data (LTE Band 26 – Low Channel)

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]	EIRP Level at Sub Ant Port [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Margin [dB]
1643.00	H	-	-	-73.21	5.35	-67.85	-54.9
2464.50	H	-	-	-69.22	5.95	-63.27	-50.3
3286.00	H	-	-	-70.85	7.78	-63.07	-50.1

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

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7.7 Frequency Stability / Temperature Variation

§2.1055 §90.213

Test Overview and Limit

Frequency stability testing is performed in accordance with the guidelines of ANSI C63.26/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 C63.26/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 7-7. Test Instrument & Measurement Setup

Test Notes

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

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Frequency Stability / Temperature Variation

§2.1055, §90.213

Operating Frequency (Hz):	819,000,000
Ref. Voltage (VDC):	3.80
Deviation Limit:	± 0.00025% or 2.5 ppm

Voltage (%)	Power (VDC)	Temp (°C)	Frequency (Hz)	Freq. Dev. (Hz)	Deviation (%)
100 %	3.80	- 30	819,000,005	5	0.0000006
		- 20	819,000,004	4	0.0000005
		- 10	819,000,004	4	0.0000005
		0	819,000,004	4	0.0000005
		+ 10	819,000,005	5	0.0000006
		+ 30	819,000,006	6	0.0000007
		+ 40	819,000,004	4	0.0000005
		+ 50	819,000,004	4	0.0000005
Battery Endpoint	3.20	+ 20	819,000,006	6	0.0000007

Table 7-8. LTE Band 26 Frequency Stability Data

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Frequency Stability / Temperature Variation

§2.1055, §90.213

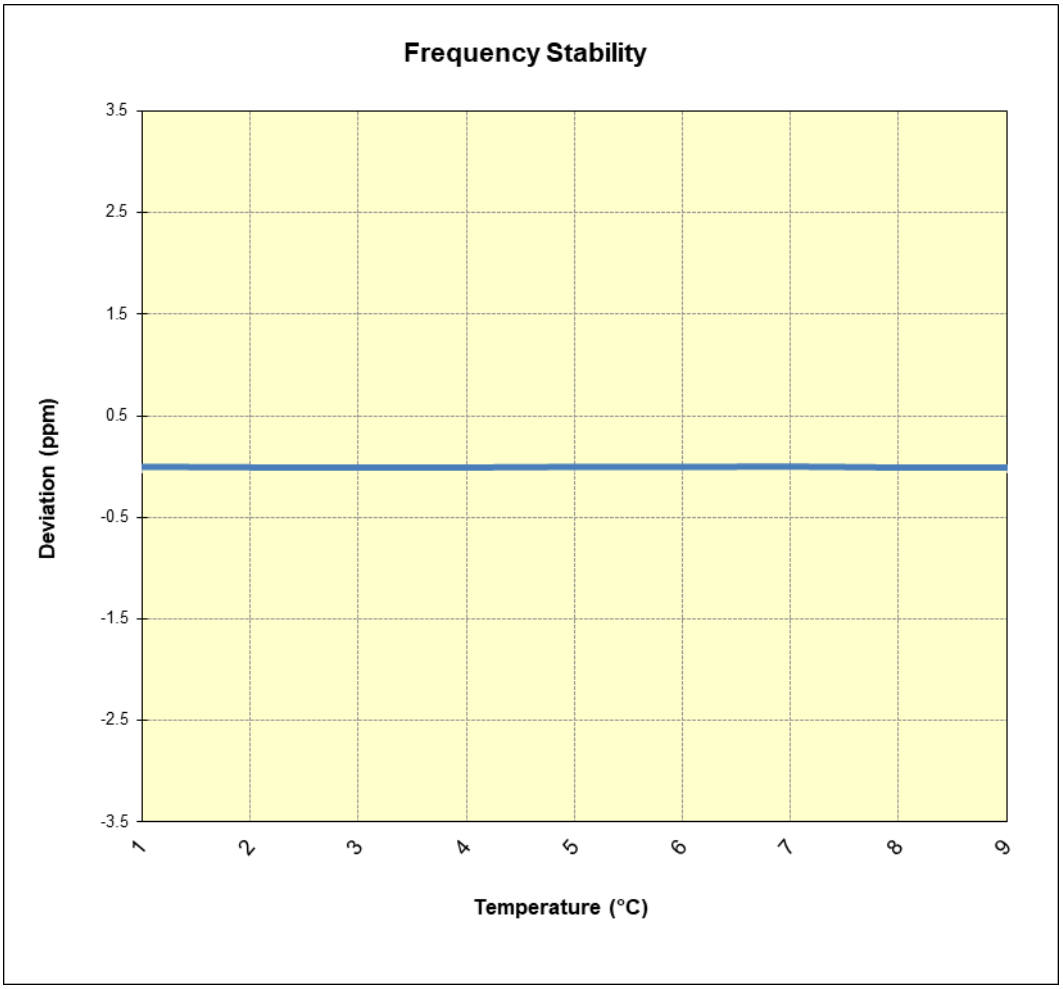

Figure 7-8. LTE Band 26 Frequency Stability Chart

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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 the requirements of Part 90 of the FCC rules.

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