PCTEST ENGINEERING LABORATORY, INC.
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http://www.pctestlab.com

# MEASUREMENT REPORT
## FCC PART 15.247 Bluetooth

**Applicant Name:**
Samsung Electronics Co., Ltd.
129, Samsung-ro,
Yeongtong-gu, Suwon-si
Gyeonggi-do, 16677, Korea

**Date of Testing:**
11/3 - 11/19/2016
**Test Site/Location:**
PCTEST Lab. Columbia, MD, USA
**Test Report Serial No.:**
0Y1612051880.A3L

| | |
|---|---|
| **FCC ID:** | **A3LSMA720X** |
| **APPLICANT:** | **Samsung Electronics Co., Ltd.** |

| | |
|---|---|
| **Application Type:** | Certification |
| **Model(s):** | SM-A720X |
| **EUT Type:** | Portable Handset |
| **Max. RF Output Power:** | 10.33 mW (10.14 dBm) Peak Conducted |
| **Frequency Range:** | 2402 – 2480MHz (Bluetooth for US) |
| **Type of Modulation:** | GFSK, $\pi$/4-DQPSK, 8DPSK |
| **FCC Classification:** | FCC Part 15 Spread Spectrum Transmitter (DSS) |
| **FCC Rule Part(s):** | Part 15 Subpart C (15.247) |
| **Test Procedure(s):** | ANSI C63.10-2013 |

This equipment has been shown to be capable of compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in ANSI C63.10-2013. 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#2041.01


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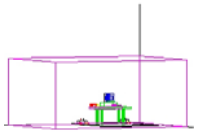
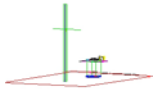


# MEASUREMENT REPORT
## FCC Part 15.247



## § 2.1033 General Information

| | |
|---|---|
| **APPLICANT:** | Samsung Electronics Co., Ltd. |
| **APPLICANT ADDRESS:** | 129, Samsung-ro,<br>Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Korea |
| **TEST SITE:** | PCTEST ENGINEERING LABORATORY, INC. |
| **TEST SITE ADDRESS:** | 7185 Oakland Mills Road, Columbia, MD 21046 USA |
| **FCC RULE PART(S):** | Part 15 Subpart C (15.247) |
| **BASE MODEL:** | SM-A720X |
| **FCC ID:** | A3LSMA720X |
| **FCC CLASSIFICATION:** | FCC Part 15 Spread Spectrum Transmitter (DSS) |
| **Test Device Serial No.:** | 54702, 9S4EF, 54744, JD1VJ, JD1XH ☐ Production ☒ Pre-Production ☐ Engineering |
| **Method/System:** | Frequency Hopping Spread Spectrum (FHSS) |
| **DATE(S) OF TEST:** | 11/3 - 11/19/2016 |
| **TEST REPORT S/N:** | 0Y1612051880.A3L |

## Test Facility / Accreditations

**Measurements were performed at PCTEST Engineering Lab located in Columbia, MD 21046, U.S.A.**

- PCTEST facility is an FCC registered (PCTEST Reg. No. 159966) test facility with the site description report on file and has met all the requirements specified in Section 2.948 of the FCC Rules and Industry Canada (2451B-1).
- PCTEST Lab is accredited to ISO 17025 by U.S. National Institute of Standards and Technology (NIST) under the National Voluntary Laboratory Accreditation Program (NVLAP Lab code: 100431-0) in EMC, FCC and Telecommunications.
- PCTEST Lab is accredited to ISO 17025-2005 by the American Association for Laboratory Accreditation (A2LA) in Specific Absorption Rate (SAR) testing, Hearing Aid Compatibility (HAC) testing, CTIA Test Plans, and wireless testing for FCC and Industry Canada Rules.
- PCTEST Lab is a recognized U.S. Conformity Assessment Body (CAB) in EMC and R&TTE (n.b. 0982) under the U.S.-EU Mutual Recognition Agreement (MRA).
- PCTEST TCB is a Telecommunication Certification Body (TCB) accredited to ISO/IEC Guide 65 by the American National Standards Institute (ANSI) in all scopes of FCC Rules and Industry Canada Standards (RSS).
- PCTEST facility is an IC registered (2451B-1) test laboratory with the site description on file at Industry Canada.
- PCTEST is a CTIA Authorized Test Laboratory (CATL) for AMPS, CDMA, and EvDO wireless devices and for Over-the-Air (OTA) Antenna Performance testing for AMPS, CDMA, GSM, GPRS, EGPRS, UMTS (W-CDMA), CDMA 1xEVDO, and CDMA 1xRTT.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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 Industry Canada Certification and Engineering Bureau.

## 1.2 PCTEST Test Location

The map below shows the location of the PCTEST LABORATORY, its proximity to the FCC Laboratory, the Columbia vicinity, the Baltimore-Washington Internt'l (BWI) airport, the city of Baltimore and the Washington, DC area. (*See Figure 1-1*).

These measurement tests were conducted at the PCTEST Engineering Laboratory, Inc. facility located at 7185 Oakland Mills Road, Columbia, MD 21046. The site coordinates are 39º 10'23" N latitude and 76º 49'50" W longitude. The facility is 0.4 miles North of the FCC laboratory, and the ambient signal and ambient signal strength are approximately equal to those of the FCC laboratory. The detailed description of the measurement facility was found to be in compliance with the requirements of § 2.948 according to ANSI C63.4-2014 on January 22, 2015.

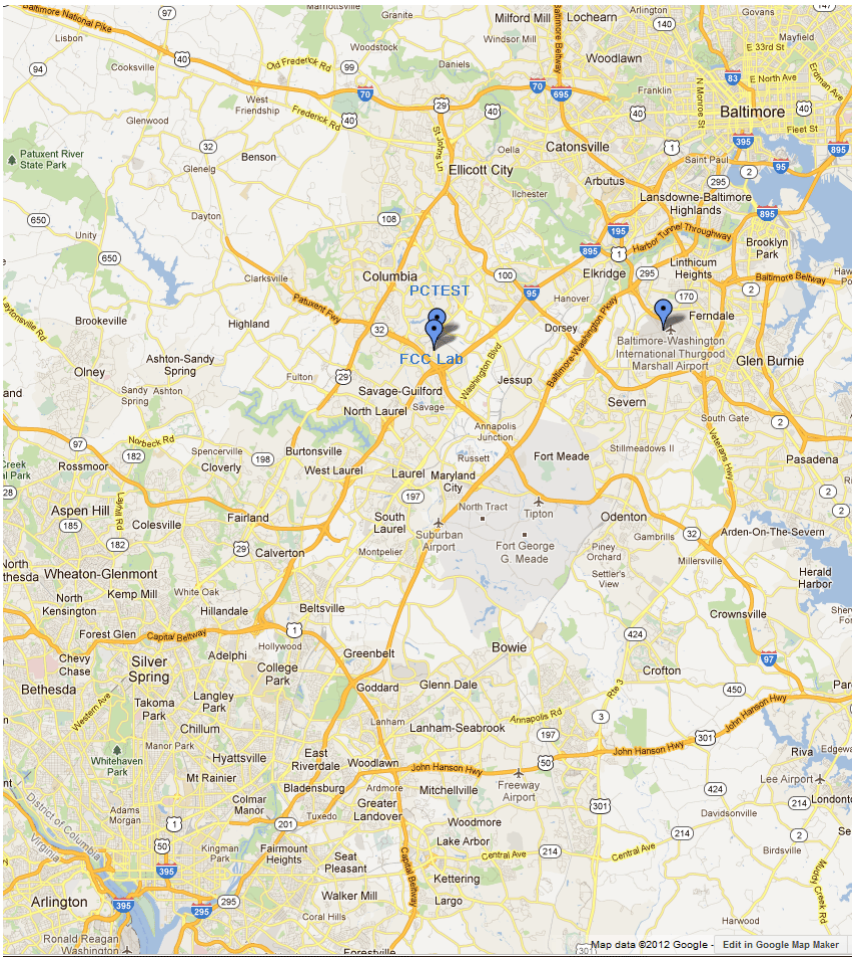


**Figure 1-1. Map of the Greater Baltimore and Metropolitan Washington, D.C. area**


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# 2.0 PRODUCT INFORMATION

## 2.1 Equipment Description

The Equipment Under Test (EUT) is the **Samsung Portable Handset FCC ID: A3LSMA720X**. The test data contained in this report pertains only to the emissions due to the EUT's Bluetooth transmitter.

- This Bluetooth module has been tested by a Bluetooth Qualification Lab, and we confirm the following:
  - A) The hopping sequence is pseudorandom
  - B) All channels are used equally on average
  - C) The receiver input bandwidth equals the transmit bandwidth
  - D) The receiver hops in sequence with the transmit signal
- 15.247(g): In accordance with the Bluetooth Industry Standard, the system is designed to comply with all of the regulations in Section 15.247 when the transmitter is presented with a continuous data (or information) system.
- 15.247(h): In accordance with the Bluetooth Industry Standard, the system does not coordinate its channels selection/ hopping sequence with other frequency hopping systems for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters.
- 15.247(h): The EUT employs Adaptive Frequency Hopping (AFH) which identifies sources of interference namely devices operating in 802.11 WLAN and excludes them from the list of available channels. The process of re-mapping reduces the number of test channels from 79 channels to a minimum number of 20 channels.

## 2.2 Device Capabilities

This device contains the following capabilities:

802.11b/g/n WLAN, 802.11a/n/ac UNII, Bluetooth (1x, EDR, LE), NFC, ANT+

## 2.3 Test Configuration

The EUT was tested per the guidance of ANSI C63.10-2013. ANSI C63.10-2013 was also used to reference the appropriate EUT setup for radiated spurious emissions testing and AC line conducted testing. See Sections 3.2 for AC line conducted emissions test setups, 3.3 for radiated emissions test setups, and 7.2, 7.3, 7.4, 7.5, 7.6, 7.7, and 7.8 for antenna port conducted emissions test setups.

## 2.4 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 procedure described in the American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices (ANSI C63.10-2013) was used in the measurement of the EUT.

**Deviation from measurement procedure…….....None**

## 3.2 AC Line Conducted Emissions

The line-conducted facility is located inside a 10'x16'x9' shielded enclosure. The shielded enclosure is manufactured by ETS Lindgren RF Enclosures. The shielding effectiveness of the shielded room is in accordance with MIL-Std-285 or NSA 65-5. A 1m x 1.5m wooden table 80cm high is placed 40cm away from the vertical wall and 80cm away from the sidewall of the shielded room. Two 10kHz-30MHz, 50Ω/50μH Line-Impedance Stabilization Networks (LISNs) are bonded to the shielded room floor. Power to the LISNs is filtered by external high-current high-insertion loss power line filters. The external power line filter is an ETS Lindgren Model LPRX-4X30 (100dB Attenuation, 14kHz-18GHz) and the two EMI/RFI filters are ETS Lindgren Model LRW-2030-S1 (100dB Minimum Insertion Loss, 14kHz – 10GHz). These filters attenuate ambient signal noise from entering the measurement lines. These filters are also bonded to the shielded enclosure.

The EUT is powered from one LISN and the support equipment is powered from the second LISN. If the EUT is a DC-powered device, power will be derived from the source power supply it normally will be powered from and this supply line(s) will be connected to the second LISN. All interconnecting cables more than 1 meter were shortened to a 1 meter length by non-inductive bundling (serpentine fashion) and draped over the back edge of the test table. All cables were at least 40cm above the horizontal reference groundplane. Power cables for support equipment were routed down to the second LISN while ensuring that that cables were not draped over the second LISN.

Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The RF output of the LISN was connected to the spectrum analyzer and exploratory measurements were made to determine the frequencies producing the maximum emission from the EUT. The spectrum was scanned from 150kHz to 30MHz with a spectrum analyzer. The detector function was set to peak mode for exploratory measurements while the bandwidth of the analyzer was set to 10kHz. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each emission. Once the worst case emissions have been identified, the one EUT cable configuration/arrangement and mode of operation that produced these emissions is used for final measurements on the same test site. The analyzer is set to CISPR quasi-peak and average detectors with a 9kHz resolution bandwidth for final measurements.

Line conducted emissions test results are shown in Section 7.12. The EMI Receiver mode of the Agilent MXE was used to perform AC line conducted emissions testing.


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## 3.3 Radiated Emissions

The radiated test facilities consisted of an indoor 3 meter semi-anechoic chamber used for final measurements and exploratory measurements, when necessary. The measurement area is contained within the semi-anechoic chamber which is shielded from any ambient interference. The test site inside the chamber is a 6m x 5.2m elliptical, obstruction-free area in accordance with Figure 5.7 of Clause 5 in ANSI C63.4-2014. Absorbers are arranged on the floor between the turn table and the antenna mast in such a way so as to maximize the reduction of reflections for measurements above 1GHz. A 72.4cm high PVC support structure is placed on top of the turntable. A 3" (~7.6cm) sheet of high density polystyrene is used as the table top and is placed on top of the PVC supports to bring the total height of the table to 80cm. For measurements above 1GHz, a high density expanded polystyrene block is placed on top of the test table to bring the total table height to 1.5m.

For all measurements, the spectrum was scanned through all EUT azimuths and from 1 to 4 meter receive antenna height using a broadband antenna from 30MHz up to the upper frequency shown in 15.33(b)(1) depending on the highest frequency generated or used in the device or on which the device operates or tunes. For frequencies above 1GHz, linearly polarized double ridge horn antennas were used. For frequencies below 30MHz, a calibrated loop antenna was used. When exploratory measurements were necessary, they were performed at 1 meter test distance inside the semi-anechoic chamber using broadband antennas, broadband amplifiers, and spectrum analyzers to determine the frequencies and modes producing the maximum emissions. Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The test set-up was placed on top of the 1 x 1.5 meter table. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each emission. Appropriate precaution was taken to ensure that all emissions from the EUT were maximized and investigated. The system configuration, mode of operation, turntable azimuth, and receive antenna height was noted for each frequency found.

Final measurements were made in the semi-anechoic chamber using calibrated, linearly polarized broadband and horn antennas. The test setup was configured to the setup that produced the worst case emissions. The spectrum analyzer was set to investigate all frequencies required for testing to compare the highest radiated disturbances with respect to the specified limits. The turntable containing the EUT was rotated through 360 degrees and the height of the receive antenna was varied 1 to 4 meters and stopped at the azimuth and height producing the maximum emission. Each emission was maximized by changing the orientation of the EUT through three orthogonal planes and changing the polarity of the receive antenna, whichever produced the worst-case emissions.

## 3.4 Environmental Conditions

The temperature is controlled within range of 15°C to 35°C. The relative humidity is controlled within range of 10% to 75%. The atmospheric pressure is monitored within the range 86-106kPa (860-1060mbar).


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# 4.0 ANTENNA REQUIREMENTS

**Excerpt from §15.203 of the FCC Rules/Regulations:**
"An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section."

- The antennas of the EUT are **permanently attached.**
- There are no provisions for connection to an external antenna.

**Conclusion:**

The EUT complies with the requirement of §15.203.

| Ch. | Frequency (MHz) |
|---|---|
| 00 | 2402 |
| : | : |
| 39 | 2441 |
| : | : |
| 78 | 2480 |

**Table 4-1. Frequency/ Channel Operations**


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# 5.0 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 data shown herein 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 | 1.13 |
| Conducted Disturbance | 3.09 |
| Radiated Disturbance (<1GHz) | 4.98 |
| Radiated Disturbance (>1GHz) | 5.07 |
| Radiated Disturbance (>18GHz) | 5.09 |


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# 6.0 TEST EQUIPMENT CALIBRATION DATA

Test Equipment Calibration is traceable to the National Institute of Standards and Technology (NIST). Measurements antennas used during testing were calibrated in accordance to the requirements of ANSI C63.5-2006.

| Manufacturer | Model | Description | Cal Date | Cal Interval | Cal Due | Serial Number |
|---|---|---|---|---|---|---|
| - | RE1 | Radiated Emissions Cable Set (UHF/EHF) | 3/4/2016 | Annual | 3/4/2017 | RE1 |
| - | BT2 | Bluetooth Cable Set | 4/11/2016 | Annual | 4/11/2017 | BT2 |
| Agilent | N9020A | MXA Signal Analyzer | 11/5/2015 | Annual | 11/5/2016 | US46470561 |
| Agilent | N9038A | MXE EMI Receiver | 4/21/2016 | Annual | 4/21/2017 | MY51210133 |
| Agilent | N4010A | Wireless Connectivity Test Set | N/A | | | GB46170464 |
| Com-Power | AL-130 | 9kHz - 30MHz Loop Antenna | 7/30/2015 | Biennial | 7/30/2017 | 121034 |
| Com-Power | PAM-103 | Pre-Amplifier (1-1000MHz) | 2/26/2016 | Annual | 2/26/2017 | 441128 |
| Emco | 3115 | Horn Antenna (1-18GHz) | 3/10/2016 | Biennial | 3/10/2018 | 9704-5182 |
| ETS Lindgren | 3160-09 | 18-26.5 GHz Standard Gain Horn | 8/23/2016 | Biennial | 8/23/2018 | 135427 |
| ETS-Lindgren | 3816/2NM | Line Impedance Stabilization Network | 11/11/2014 | Biennial | 11/11/2016 | 114451 |
| PCTEST | - | EMC Switch System | 7/11/2016 | Annual | 7/11/2017 | NM1 |
| PCTEST | - | EMC Switch System | 7/6/2016 | Annual | 7/6/2017 | NM2 |
| Rhode & Schwarz | TS-PR18 | Pre-Amplifier | 3/7/2016 | Annual | 3/7/2017 | 101622 |
| Rohde & Schwarz | FSW67 | Signal / Spectrum Analyzer | 7/27/2016 | Annual | 7/27/2017 | 103200 |
| Rohde & Schwarz | TS-PR18 | 1-18 GHz Pre-Amplifier | 3/7/2016 | Annual | 3/7/2017 | 100071 |
| Rohde & Schwarz | CMU200 | Base Station Simulator | N/A | | | 836536/0005 |
| Rohde & Schwarz | TS-PR26 | 18-26.5 GHz Pre-Amplifier | 3/7/2016 | Annual | 3/7/2017 | 100040 |
| Rohde & Schwarz | ESU40 | EMI Test Receiver (40GHz) | 7/15/2016 | Annual | 7/15/2017 | 100348 |
| Sunol | JB5 | Bi-Log Antenna (30M - 5GHz) | 3/14/2016 | Biennial | 3/14/2018 | A051107 |
| Sunol | DRH-118 | Horn Antenna (1 - 18GHz) | 7/30/2015 | Biennial | 7/30/2017 | A050307 |

**Table 6-1. Annual Test Equipment Calibration Schedule**

**Notes:**

1. For equipment listed above that has a calibration date or calibration due date that falls within the test date range, care was taken to ensure that this equipment was used after the calibration date and before the calibration due date.

2. Equipment with a calibration date of "N/A" shown in this list was not used to make direct calibrated measurements.


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# 7.0 TEST RESULTS

## 7.1 Summary

Company Name: Samsung Electronics Co., Ltd.

FCC ID: A3LSMA720X

Method/System: Frequency Hopping Spread Spectrum (FHSS)

Number of Channels: 79

| FCC Part Section(s) | Test Description | Test Limit | Test Condition | Test Result | Reference |
|---|---|---|---|---|---|
| **TRANSMITTER MODE (Tx)** | | | | | |
| 15.247(a)(1)(iii) | 20dB Bandwidth | N/A | CONDUCTED | PASS | Section 7.2 |
| 15.247(b)(1) | Peak Transmitter Output Power | < 1 Watt if ≥ 75 non-overlapping channels used | | PASS | Section 7.3 |
| 15.247(a)(1) | Channel Separation | > 2/3 of 20 dB BW for systems with Output Power < 125mW | | PASS | Section 7.5 |
| 15.247(a)(1)(iii) | Number of Channels | > 15 Channels | | PASS | Section 7.7 |
| 15.247(a)(1)(iii) | Time of Occupancy | < 0.4 sec in 31.6 sec period | | PASS | Section 7.6 |
| 15.247(d) | Band Edge / Out-of-Band Emissions | Conducted > 20dBc | | PASS | Section 7.4, Section 7.8 |
| 15.205<br>15.209 | General Field Strength Limits (Restricted Bands and Radiated Emission Limits) | Emissions in restricted bands must meet the radiated limits detailed in 15.209 | RADIATED | PASS | Section 7.9, Section 7.10, Section 7.11 |
| 15.207 | AC Conducted Emissions 150kHz – 30MHz | < FCC 15.207 limits | LINE CONDUCTED | PASS | Section 7.12 |

**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 this section were all taken with a correction table loaded into the analyzer. The correction table was used to account for the losses of the cables, 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 "BT Auto," Version 3.1.
5) For radiated band edge, automated test software was used to measure emissions and capture the corresponding plots necessary to show compliance. The measurement software utilized is PCTEST "Chamber Automation," Version 1.1.2.


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## 7.2 20dB Bandwidth Measurement

**§15.247 (a.1.iii)**

**Test Overview and Limit**

The bandwidth at 20dB down from the highest in-band spectral density is measured with a spectrum analyzer connected to the receive antenna while the EUT is operating in transmission mode at the appropriate frequencies.

**Test Procedure Used**

ANSI C63.10-2013 – Section 6.9.2

**Test Settings**

1. The signal analyzers' automatic bandwidth measurement capability of the spectrum analyzer was used to perform the 20dB bandwidth measurement. The "X" dB bandwidth parameter was set to X = 20. The bandwidth measurement was not influenced by any intermediate power nulls in the fundamental emission.
2. RBW = 1 – 5% OBW
3. VBW ≥ 3 x RBW
4. Reference level set to keep signal from exceeding maximum input mixer level for linear operation.
5. Detector = Peak
6. Trace mode = max hold
7. Sweep = auto couple
8. The trace was allowed to stabilize

**Test Setup**

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

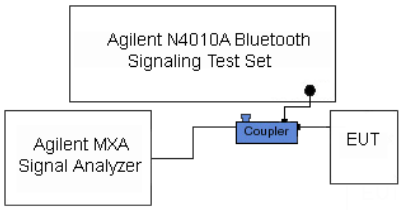


**Figure 7-1. Test Instrument & Measurement Setup**

**Test Notes**

None


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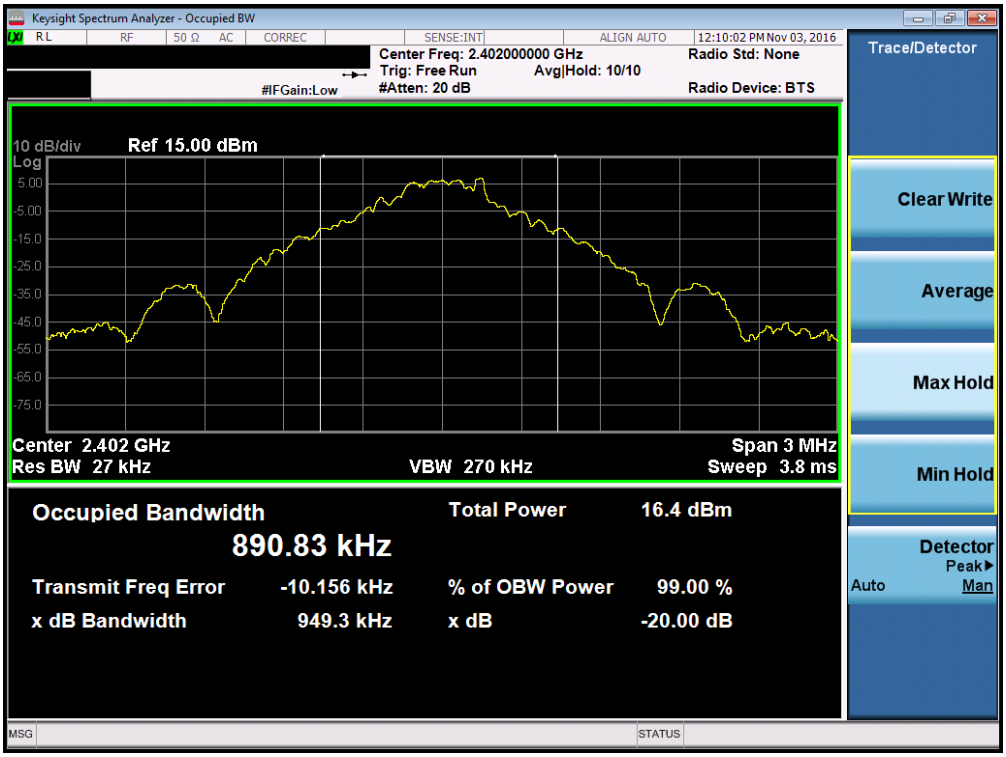
| Frequency [MHz] | Data Rate [Mbps] | Channel No. | 20dB Bandwidth Test Results | |
|---|---|---|---|---|
| | | | Measured Bandwidth [kHz] | Pass/Fail |
| 2402 | 1.0 | 0 | 949.30 | Pass |
| 2441 | 1.0 | 39 | 925.00 | Pass |
| 2480 | 1.0 | 78 | 926.60 | Pass |
| 2402 | 2.0 | 0 | 1340.00 | Pass |
| 2441 | 2.0 | 39 | 1345.00 | Pass |
| 2480 | 2.0 | 78 | 1258.00 | Pass |
| 2402 | 3.0 | 0 | 1284.00 | Pass |
| 2441 | 3.0 | 39 | 1282.00 | Pass |
| 2480 | 3.0 | 78 | 1269.00 | Pass |

**Table 7-2. Conducted 20dB Bandwidth Measurements**




**Plot 7-1. 20dB Bandwidth Plot (Bluetooth, 1Mbps – Ch. 0)**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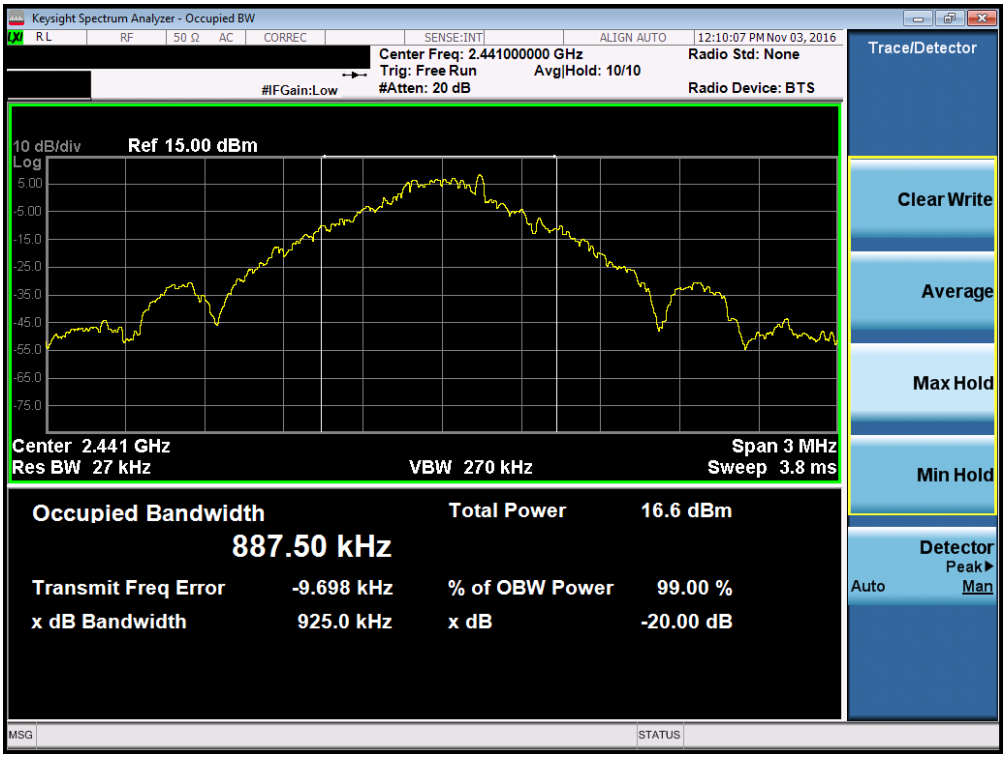
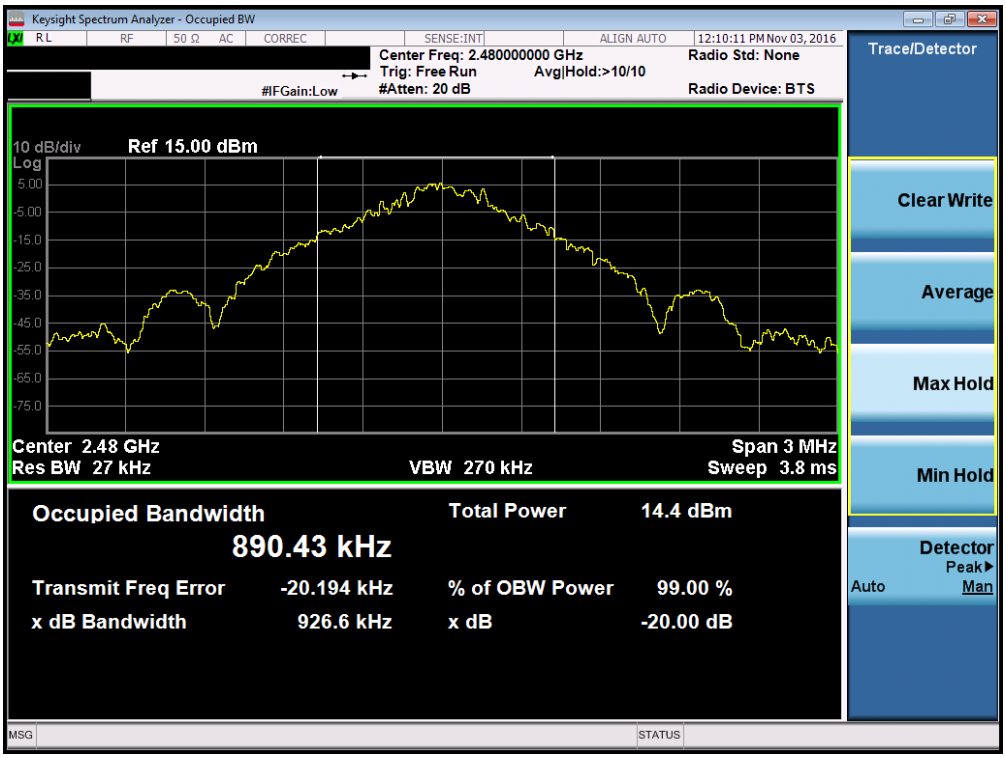



**Plot 7-2. 20dB Bandwidth Plot (Bluetooth, 1Mbps – Ch. 39)**




**Plot 7-3. 20dB Bandwidth Plot (Bluetooth, 1Mbps – Ch. 78)**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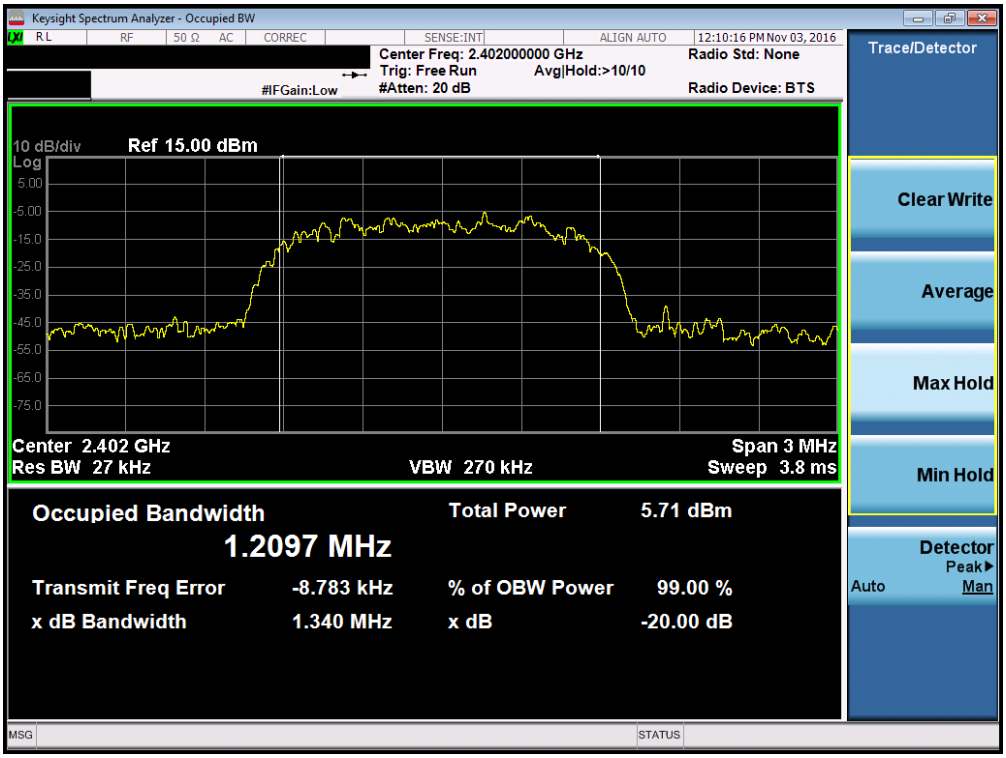
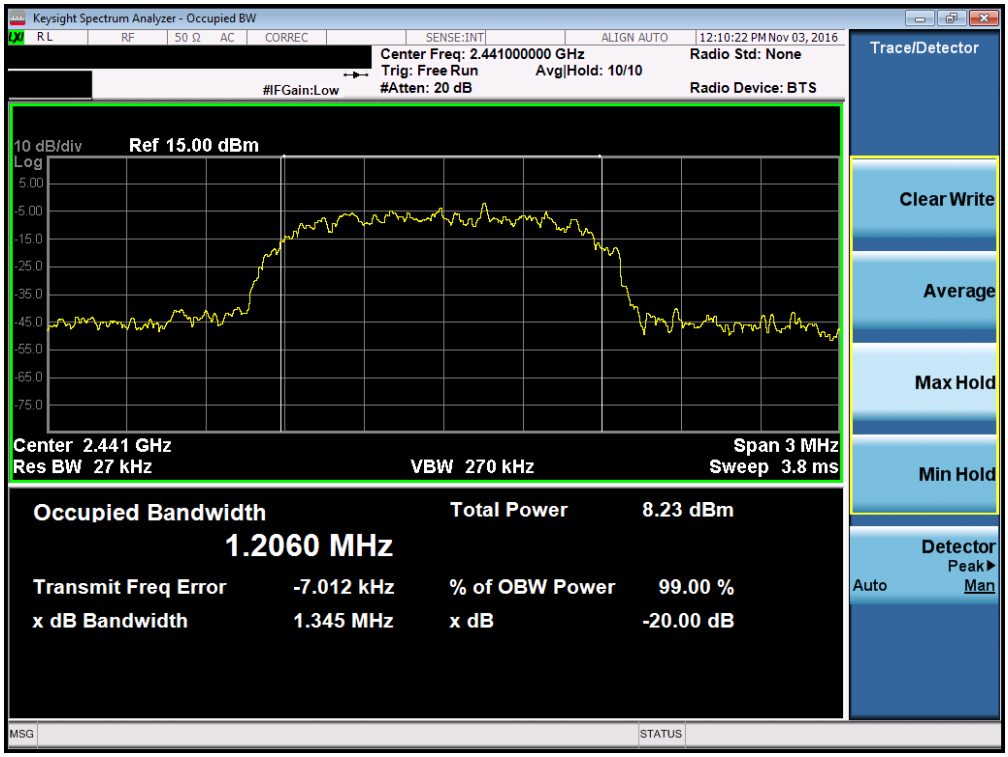



**Plot 7-4. 20dB Bandwidth Plot (Bluetooth, 2Mbps – Ch. 0)**




**Plot 7-5. 20dB Bandwidth Plot (Bluetooth, 2Mbps – Ch. 39)**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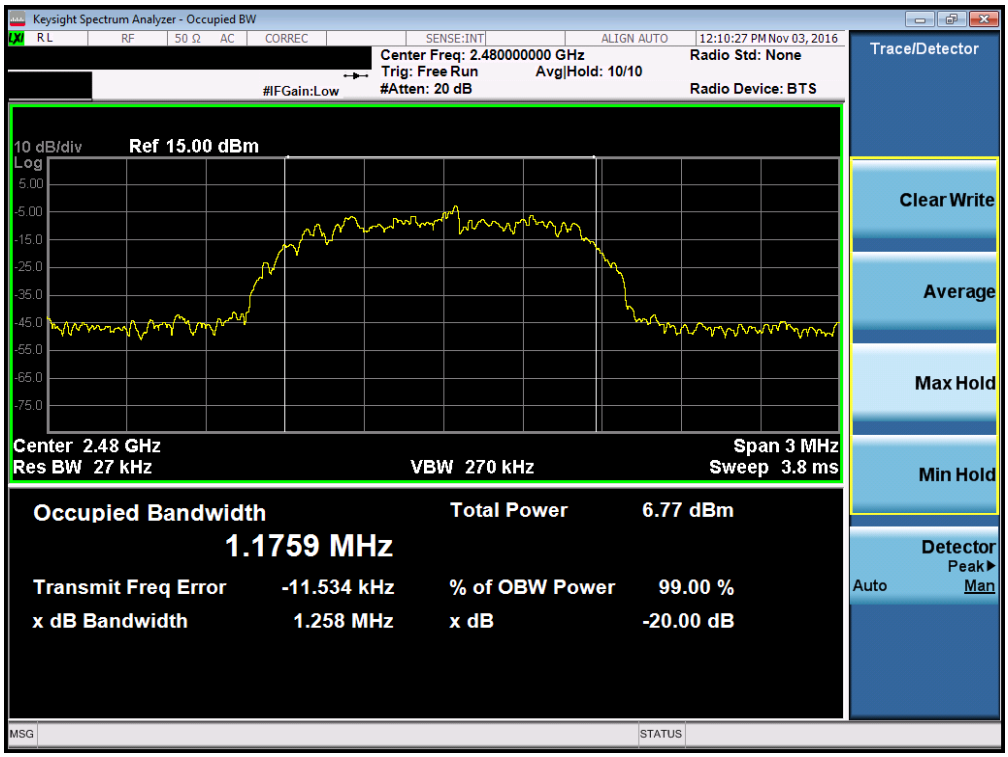
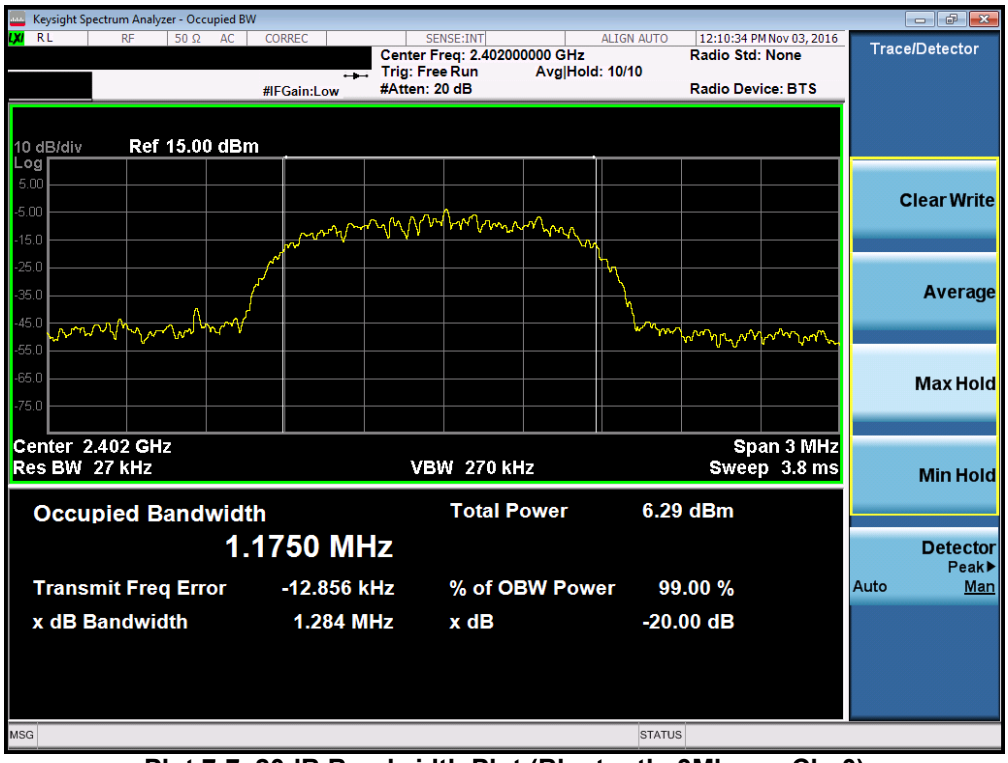



**Plot 7-6. 20dB Bandwidth Plot (Bluetooth, 2Mbps – Ch. 78)**




**Plot 7-7. 20dB Bandwidth Plot (Bluetooth, 3Mbps – Ch. 0)**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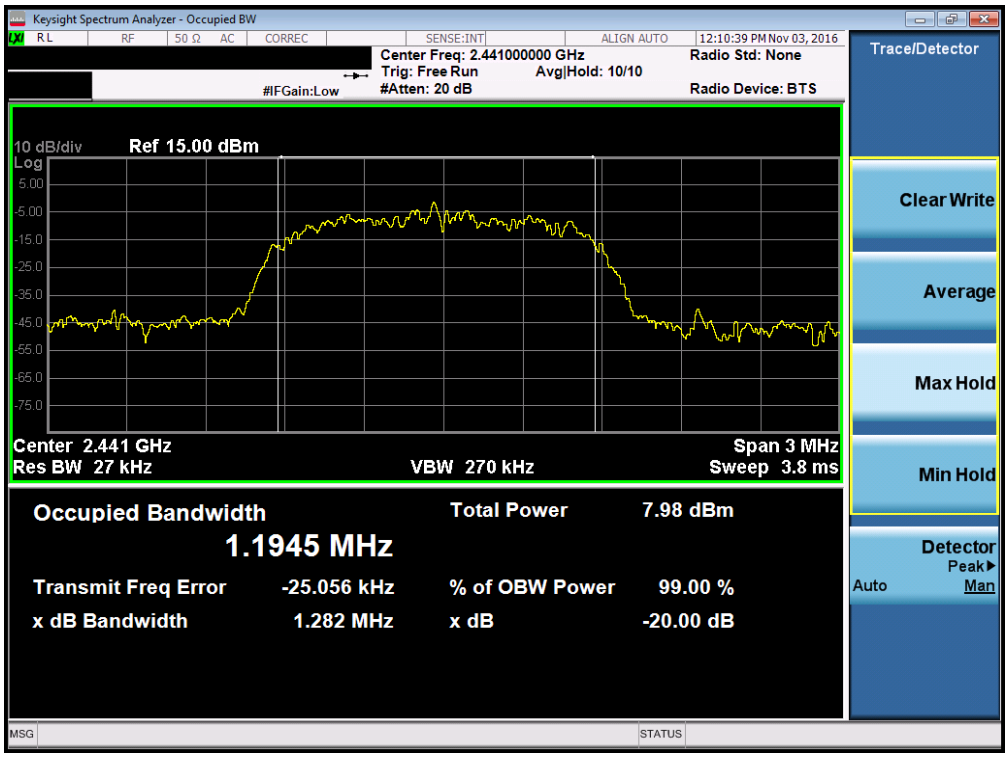
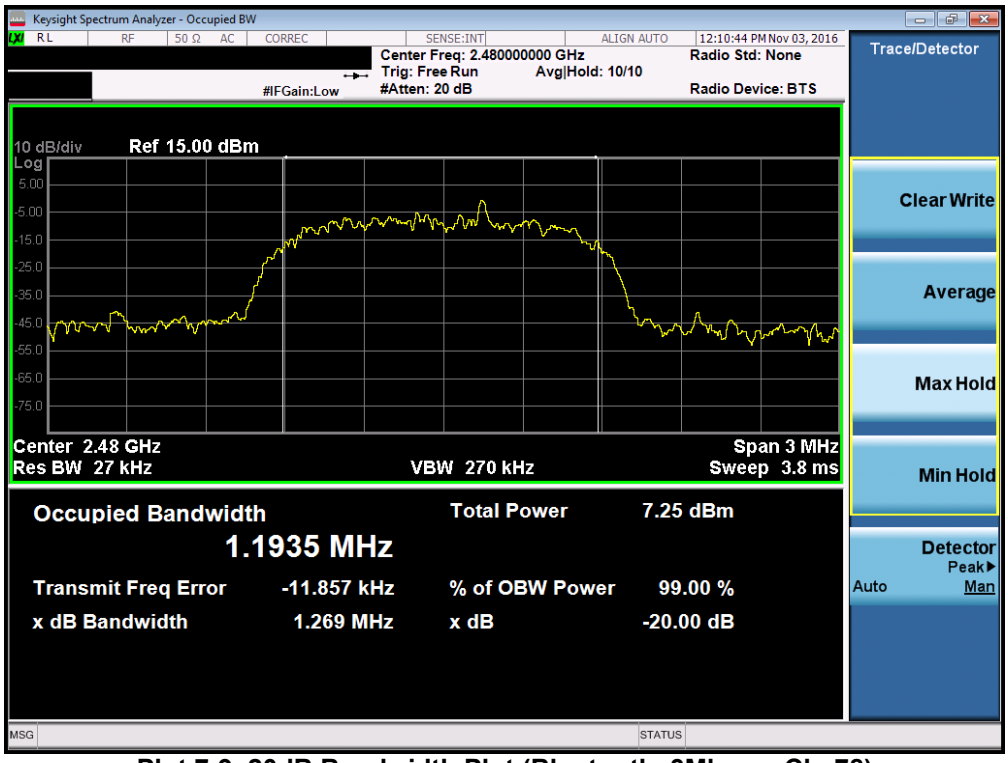



**Plot 7-8. 20dB Bandwidth Plot (Bluetooth, 3Mbps – Ch. 39)**




**Plot 7-9. 20dB Bandwidth Plot (Bluetooth, 3Mbps – Ch. 78)**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## 7.3 Output Power Measurement

**§15.247 (b.1)**

**Test Overview and Limits**

Measurement is made while the EUT is operating in non-hopping transmission mode. The powers shown below were measured using a spectrum analyzer with a Bluetooth signaling test set (Agilent Model: N4010A) used only to maintain a Bluetooth link with the EUT. Average power data is provided to determine the need for Bluetooth SAR testing according to KDB 447498 D01 v06. Average power measurements are performed using the analyzer's "burst power" function with RBW = 3MHz. The burst power function triggers on a single set burst set to maximum power and measures the maximum average power on the on-time.

***The maximum permissible output power is 1 Watt.***

**Test Procedure Used**

ANSI C63.10-2013 – Section 7.8.5

**Test Settings**

Peak Power Measurement

1. Span = approximately 5x 20dB bandwidth, centered on hopping channel
2. RBW > 20dB bandwidth of emission being measured
3. VBW ≥ RBW
4. Sweep = auto
5. Detector = peak
6. Trace mode = max hold
7. The trace was allowed to stabilize

**Test Setup**

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

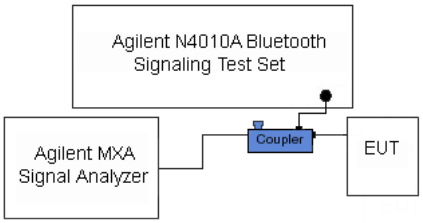


**Figure 7-2. Test Instrument & Measurement Setup**

**Note**

This unit was tested with all possible data rates and the highest peak power is reported with the unit transmitting at 1Mbps.


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Final results were obtained using calibrated couplers, attenuators and cables. The following formula was used:

Output Power (dBm) = Raw Analyzer Level (dBm) + Cable Loss (dB) + Loss in Directional Coupler/Insertion Loss (dB)

| Frequency [MHz] | Data Rate [Mbps] | Channel No. | Peak Conducted Power | | Avg Conducted Power | |
|---|---|---|---|---|---|---|
| | | | [dBm] | [mW] | [dBm] | [mW] |
| 2402 | 1.0 | 0 | 9.09 | 8.102 | 8.87 | 7.701 |
| 2441 | 1.0 | 39 | 10.14 | 10.330 | 9.90 | 9.762 |
| 2480 | 1.0 | 78 | 8.51 | 7.101 | 8.20 | 6.601 |
| 2402 | 2.0 | 0 | 8.13 | 6.495 | 5.56 | 3.600 |
| 2441 | 2.0 | 39 | 9.18 | 8.279 | 6.64 | 4.615 |
| 2480 | 2.0 | 78 | 7.52 | 5.644 | 4.85 | 3.057 |
| 2402 | 3.0 | 0 | 8.45 | 7.000 | 5.62 | 3.651 |
| 2441 | 3.0 | 39 | 9.57 | 9.055 | 6.70 | 4.672 |
| 2480 | 3.0 | 78 | 7.86 | 6.104 | 4.92 | 3.103 |

**Table 7-3. Conducted Output Power Measurements**


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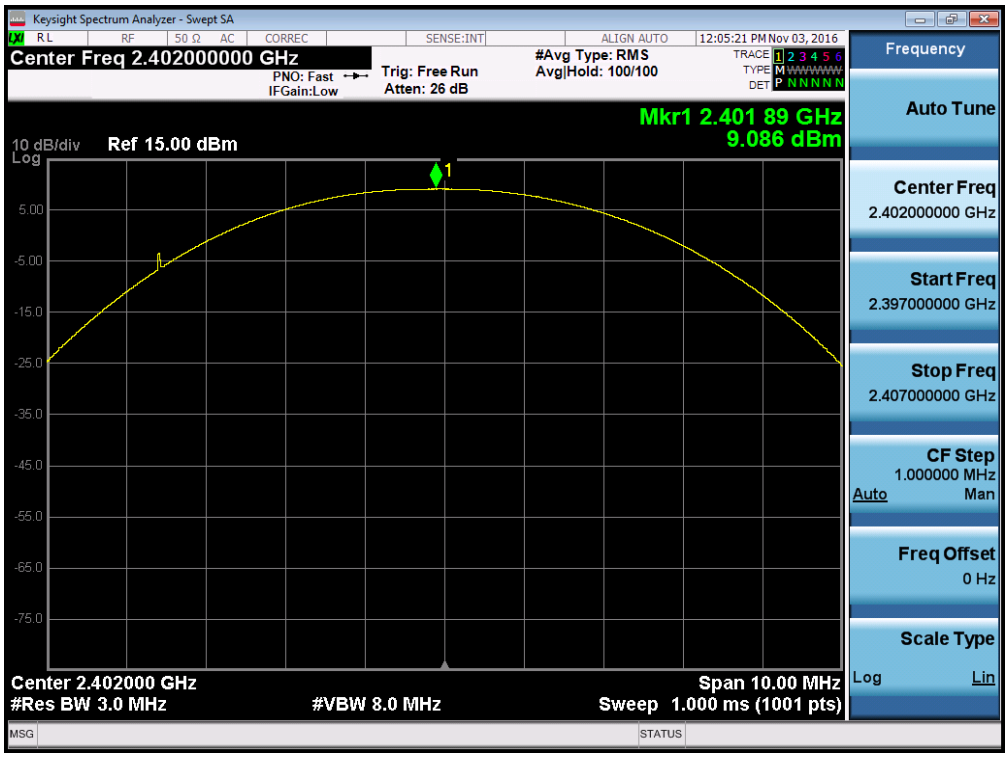
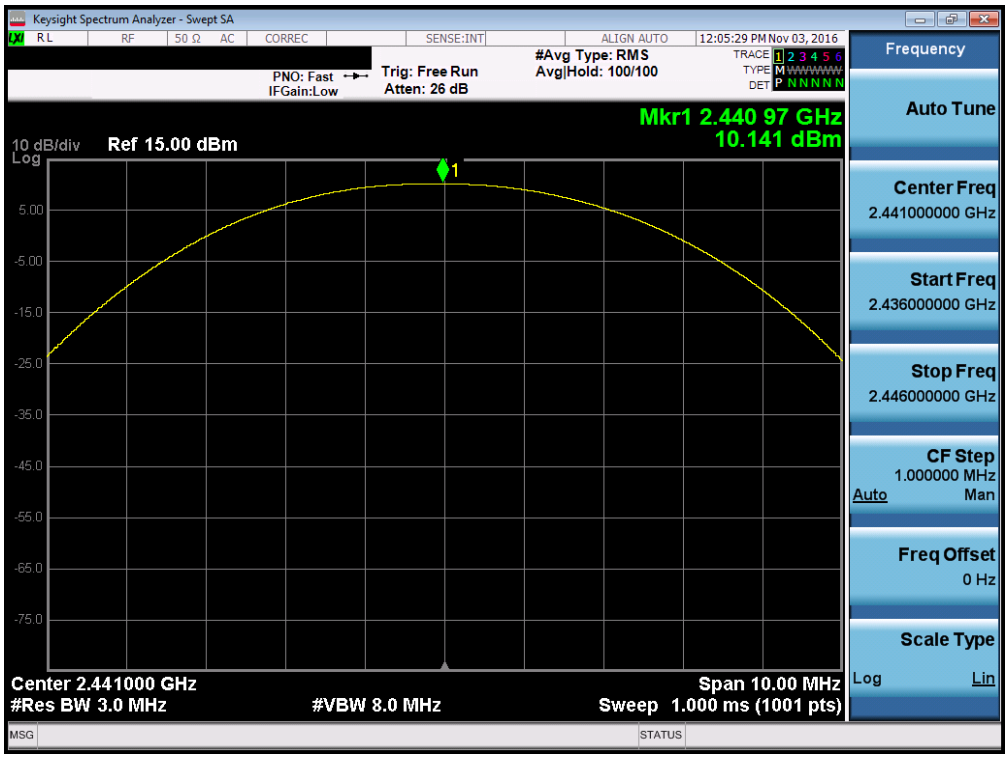



**Plot 7-10. Peak Conducted Power (1Mbps – Ch. 0)**




**Plot 7-11. Peak Conducted Power (1Mbps – Ch. 39)**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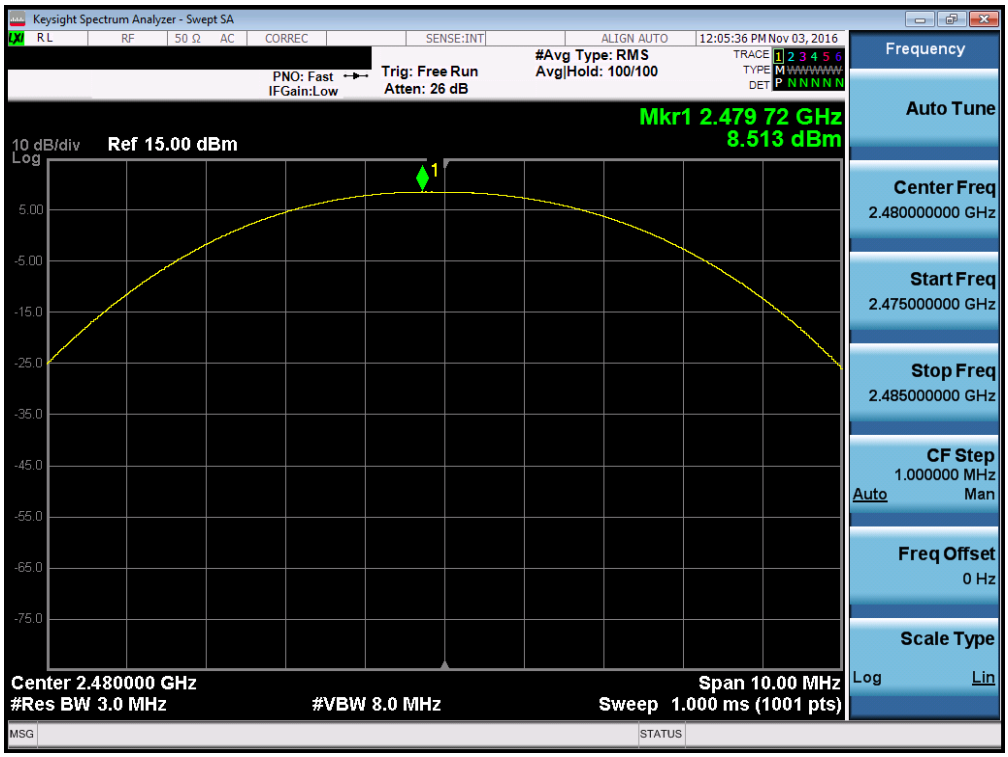
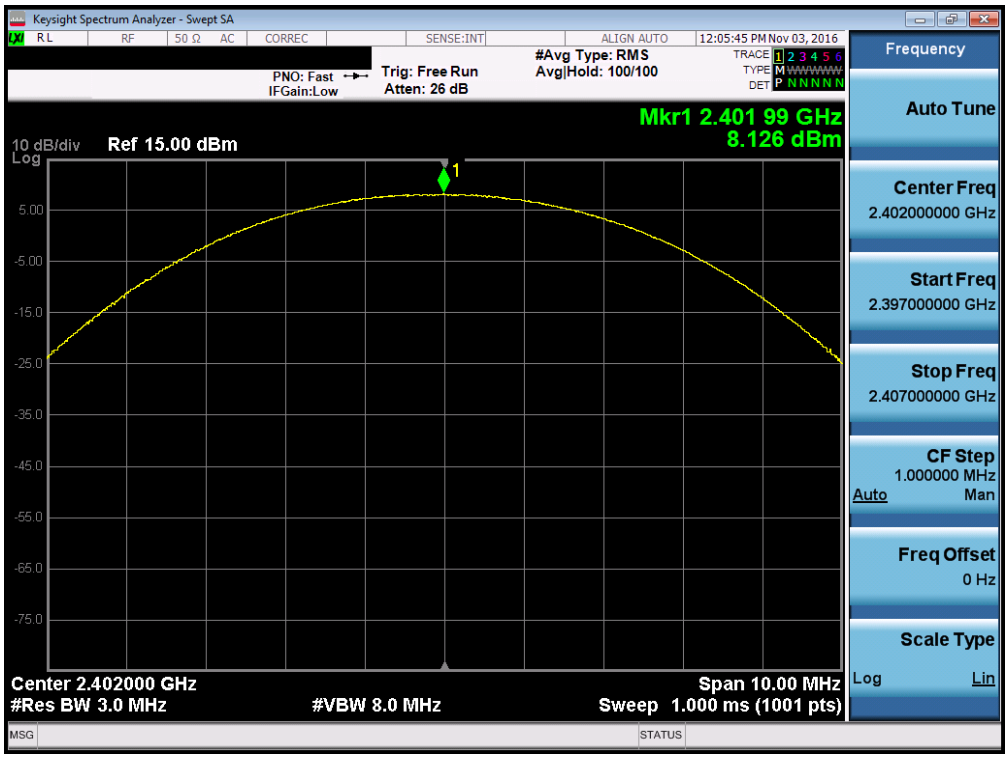



**Plot 7-12. Peak Conducted Power (1Mbps – Ch. 78)**




**Plot 7-13. Peak Conducted Power (2Mbps – Ch. 0)**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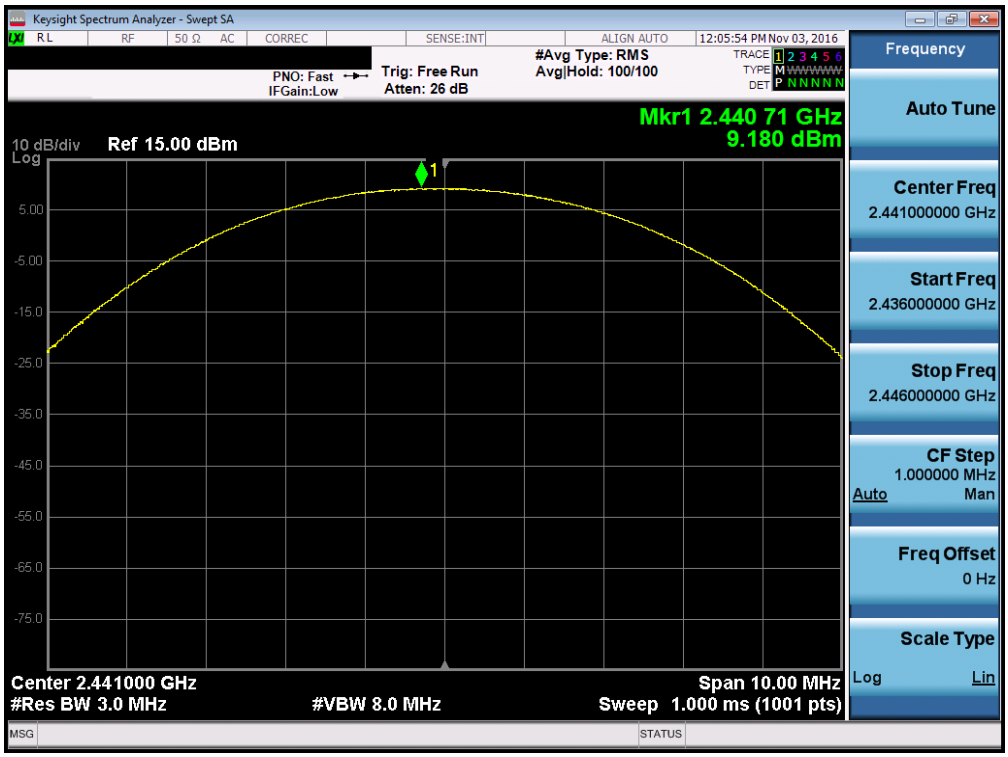
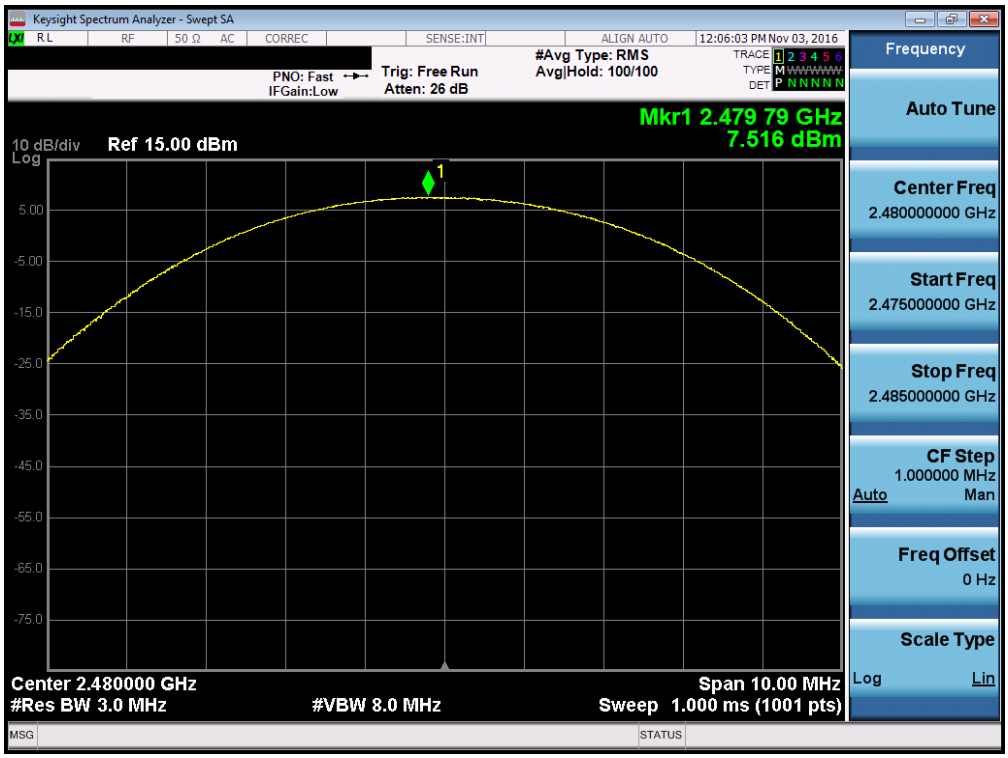



**Plot 7-14. Peak Conducted Power (2Mbps – Ch. 39)**




**Plot 7-15. Peak Conducted Power (2Mbps – Ch. 78)**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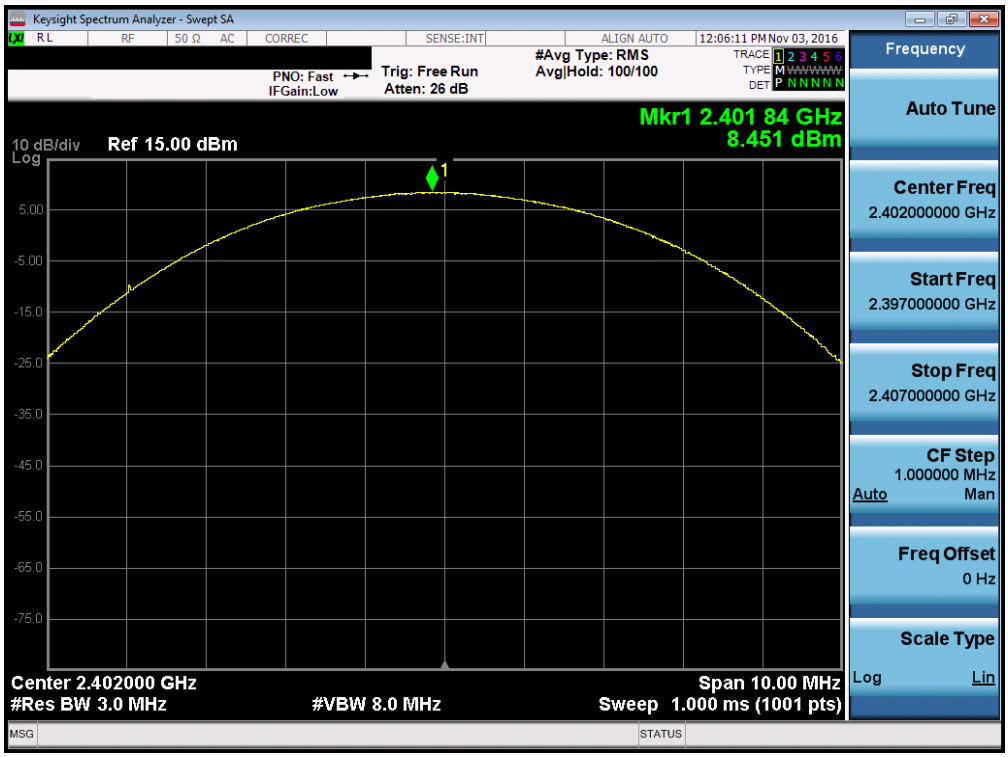
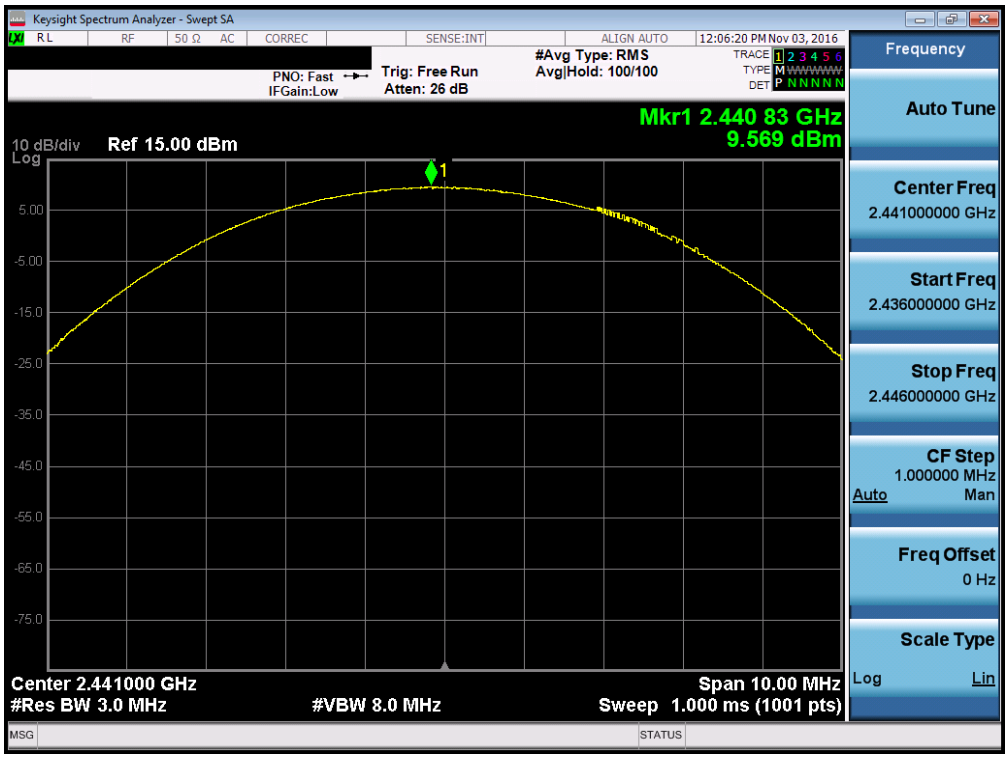



**Plot 7-16. Peak Conducted Power (3Mbps – Ch. 0)**




**Plot 7-17. Peak Conducted Power (3Mbps – Ch. 39)**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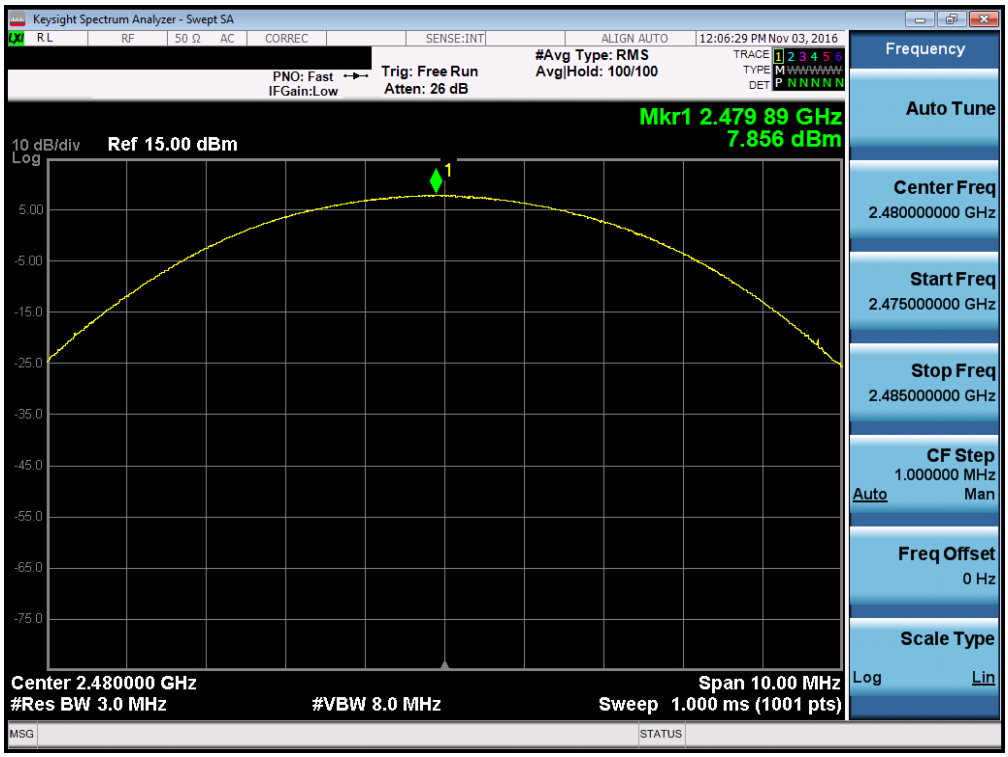


**Plot 7-18. Peak Conducted Power (3Mbps – Ch. 78)**

**Plot 7-19. Average Conducted Power (1Mbps – Ch. 0)**


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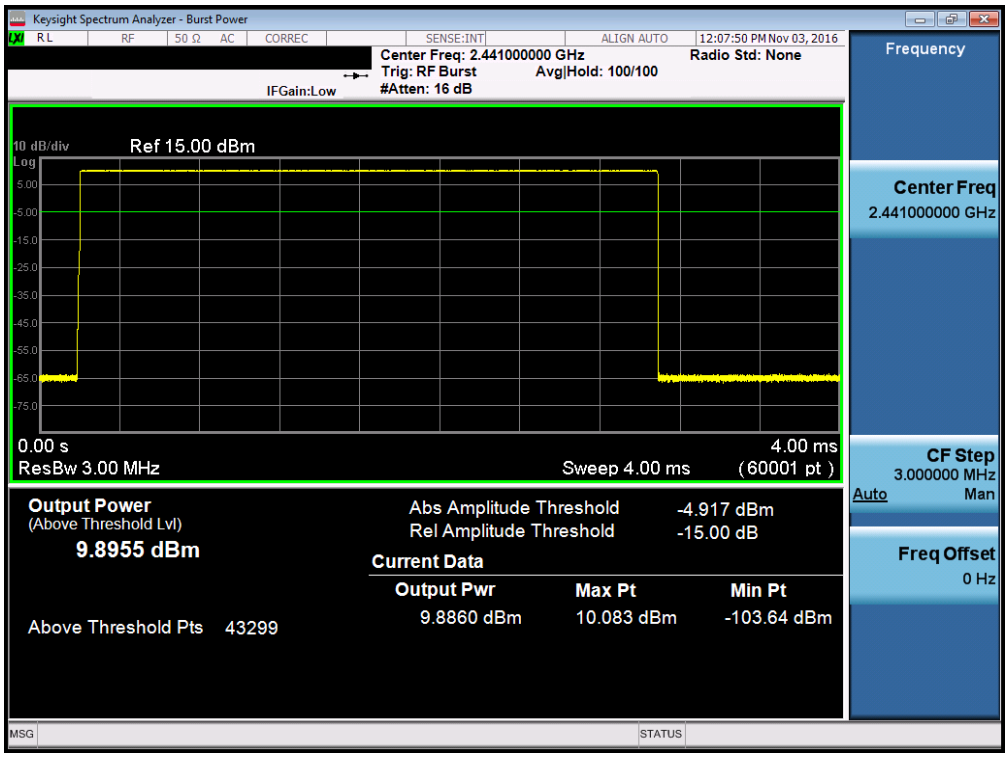
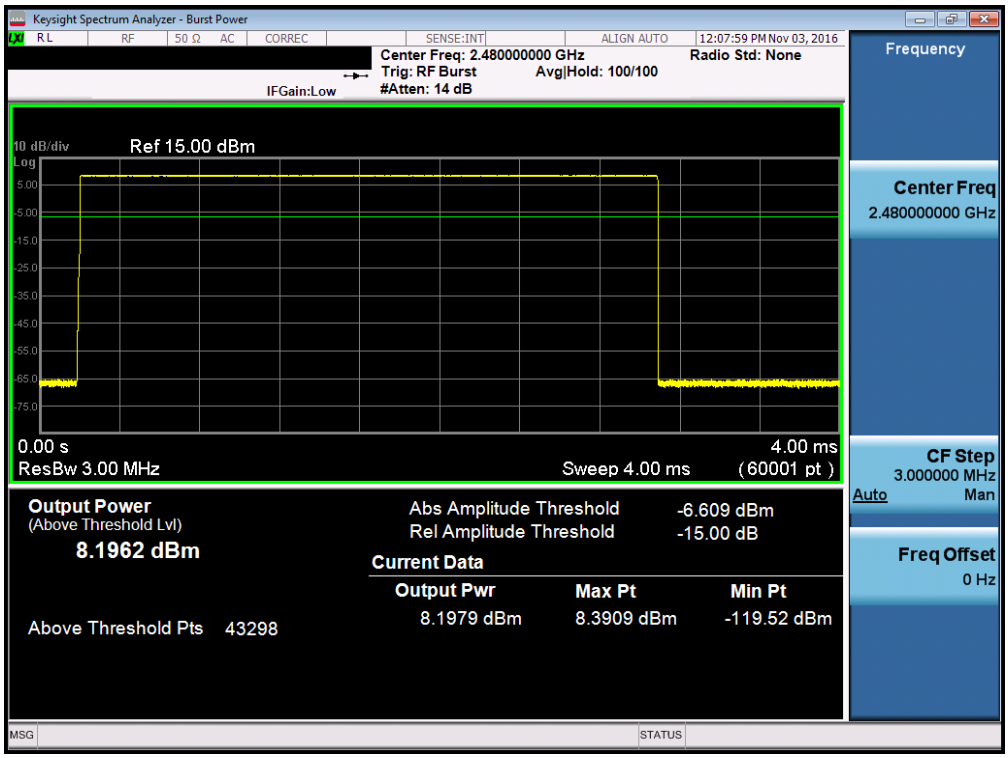



**Plot 7-20. Average Conducted Power (1Mbps – Ch. 39)**




**Plot 7-21. Average Conducted Power (1Mbps – Ch. 78)**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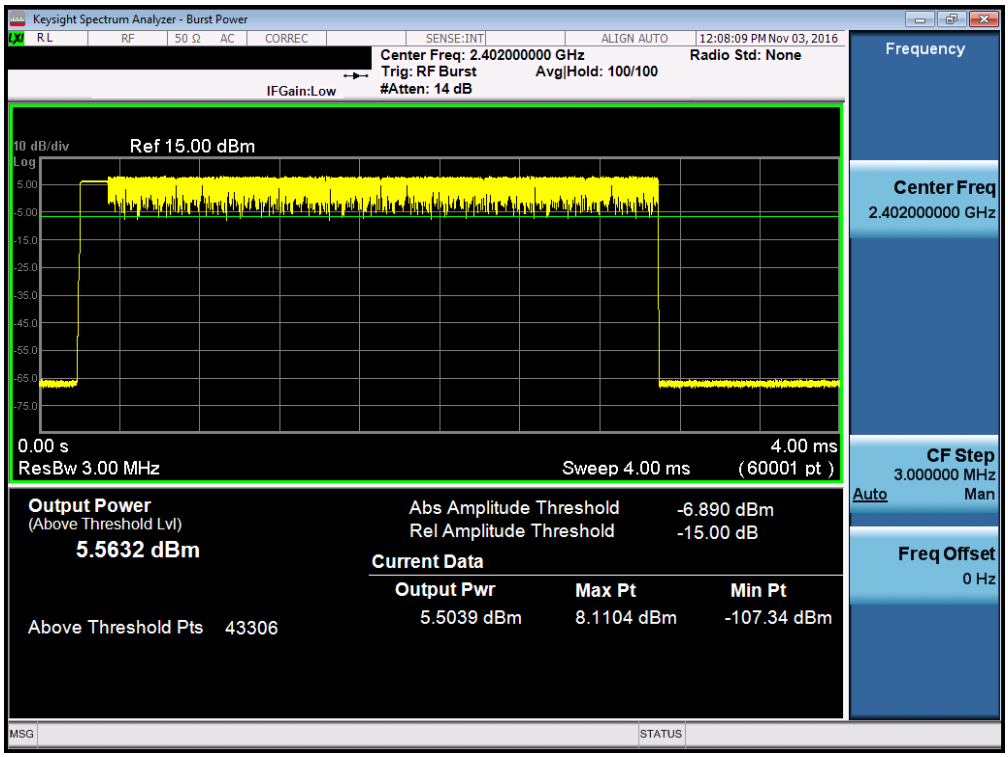
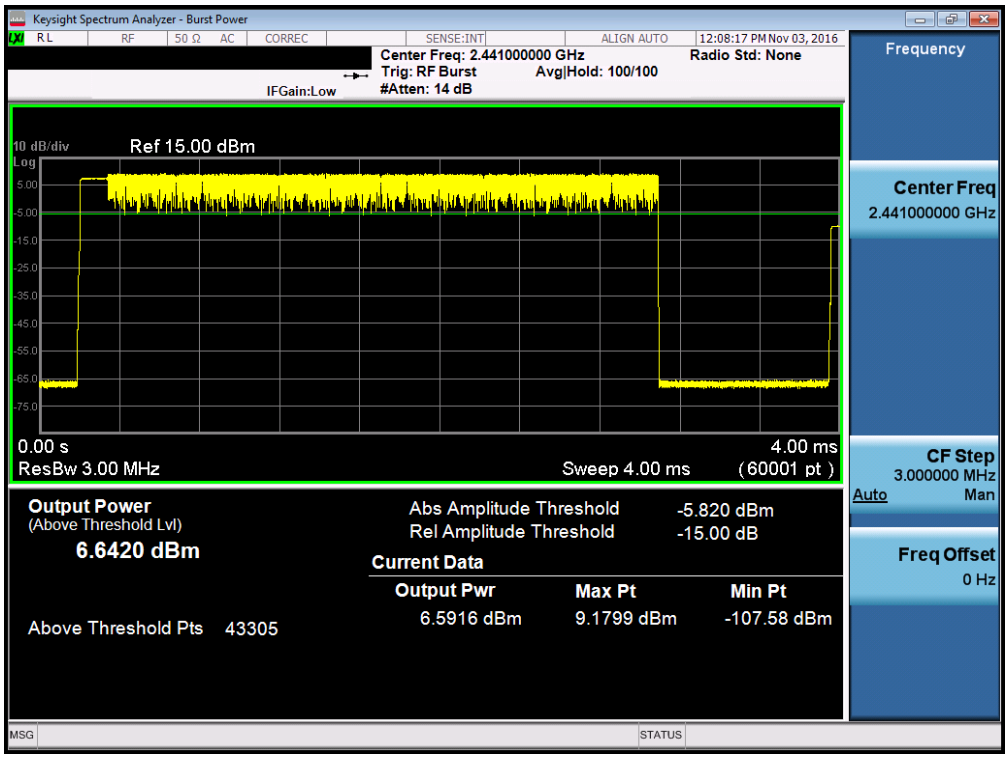



**Plot 7-22. Average Conducted Power (2Mbps – Ch. 0)**




**Plot 7-23. Average Conducted Power (2Mbps – Ch. 39)**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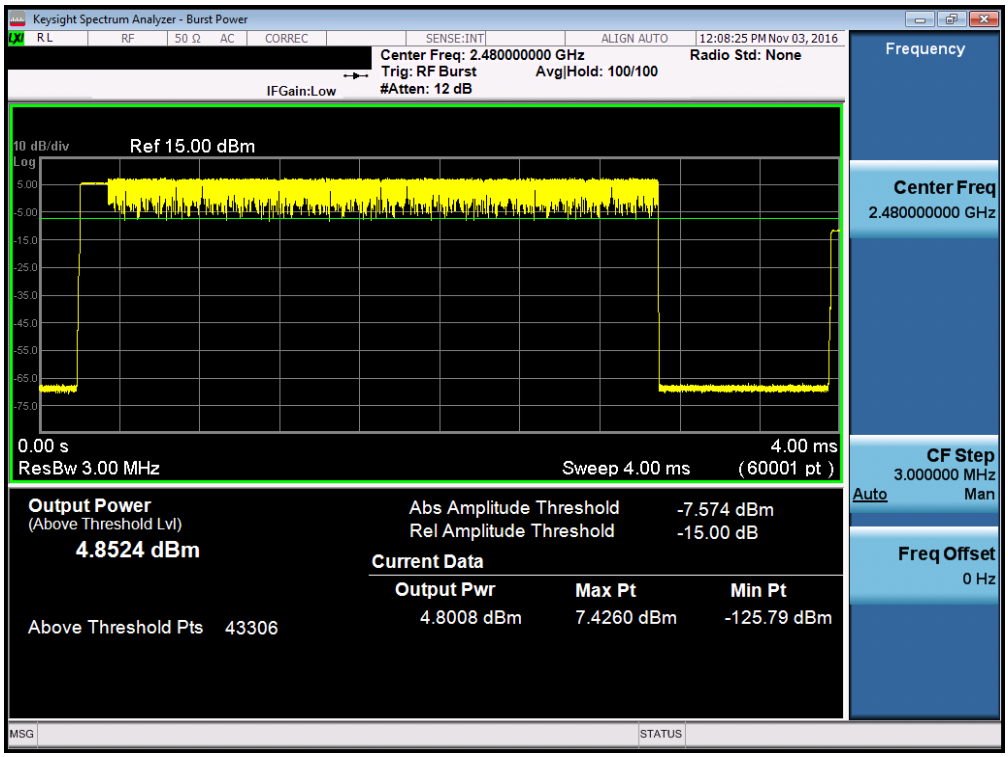
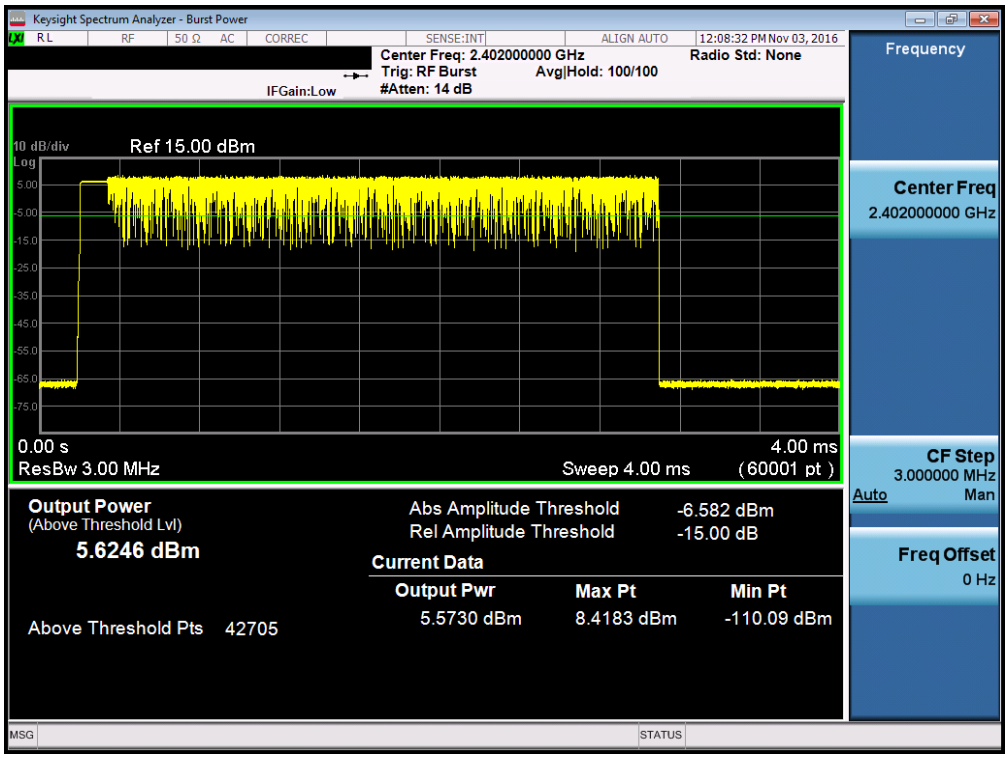



**Plot 7-24. Average Conducted Power (2Mbps – Ch. 78)**




**Plot 7-25. Average Conducted Power (3Mbps – Ch. 0)**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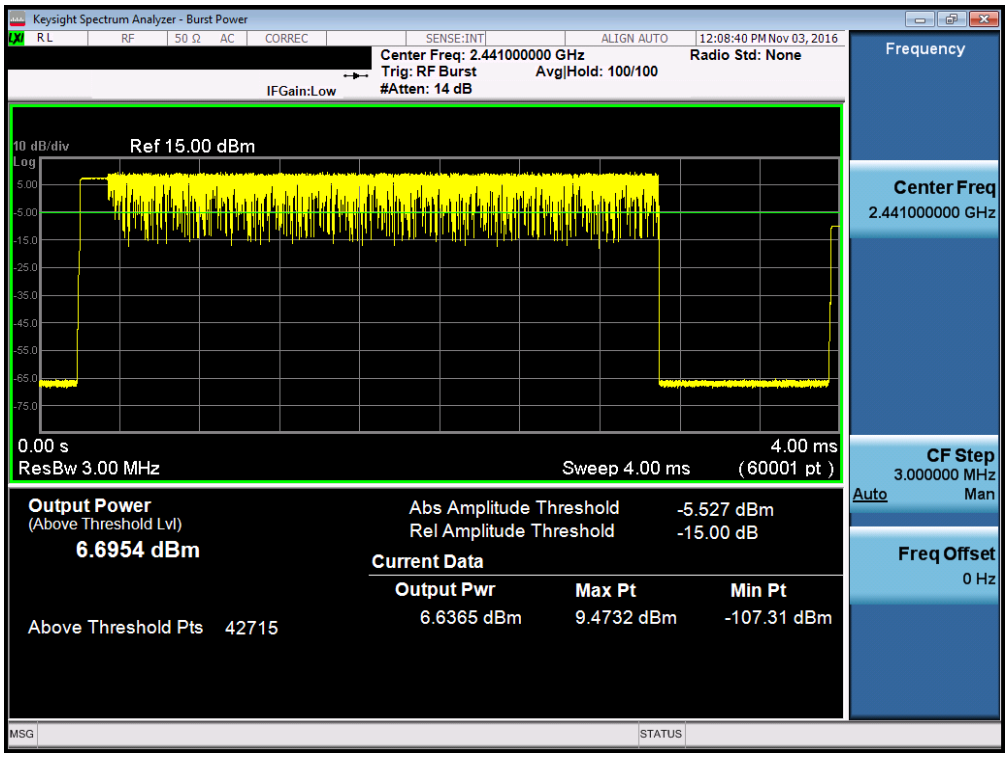
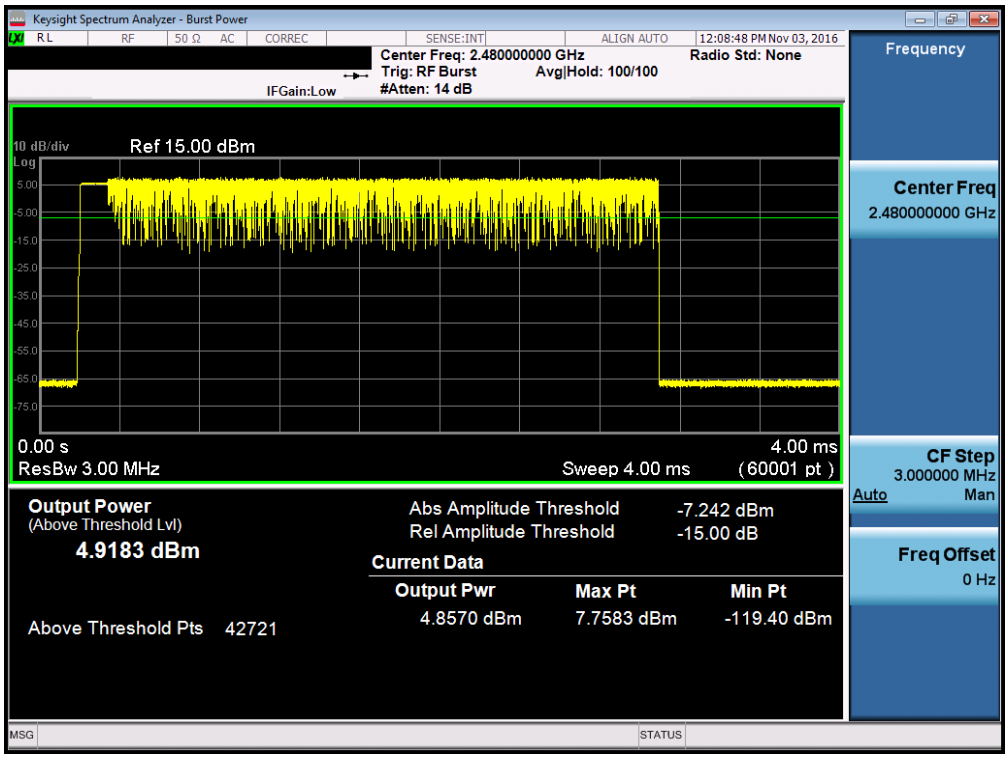



**Plot 7-26. Average Conducted Power (3Mbps – Ch. 39)**




**Plot 7-27. Average Conducted Power (3Mbps – Ch. 78)**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## 7.4 Band Edge Compliance

**§15.247 (d)**

**Test Overview and Limits**

EUT operates in hopping and non-hopping transmission mode. Measurement is taken at the highest point located outside of the emission bandwidth. ***The maximum permissible out-of-band emission level is 20 dBc.***

**Test Procedure Used**

ANSI C63.10-2013 – Section 6.10.4

**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 = 100kHz
4. VBW = 300kHz
5. Detector = Peak
6. Number of sweep points ≥ 2 x Span/RBW
7. Trace mode = max hold
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.

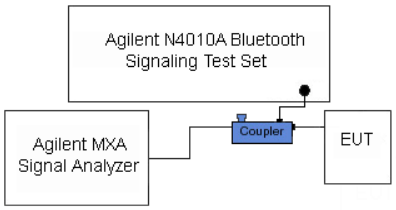


**Figure 7-3. Test Instrument & Measurement Setup**

**Test Notes**

Out of band conducted spurious emissions at the band edge were investigated for all data rates in hopping and non-hopping modes. The worst case emissions were found with the EUT transmitting at 3 Mbps. Band edge emissions were also investigated with the EUT transmitting in all data rates. Plots of the worst case emissions are shown below.


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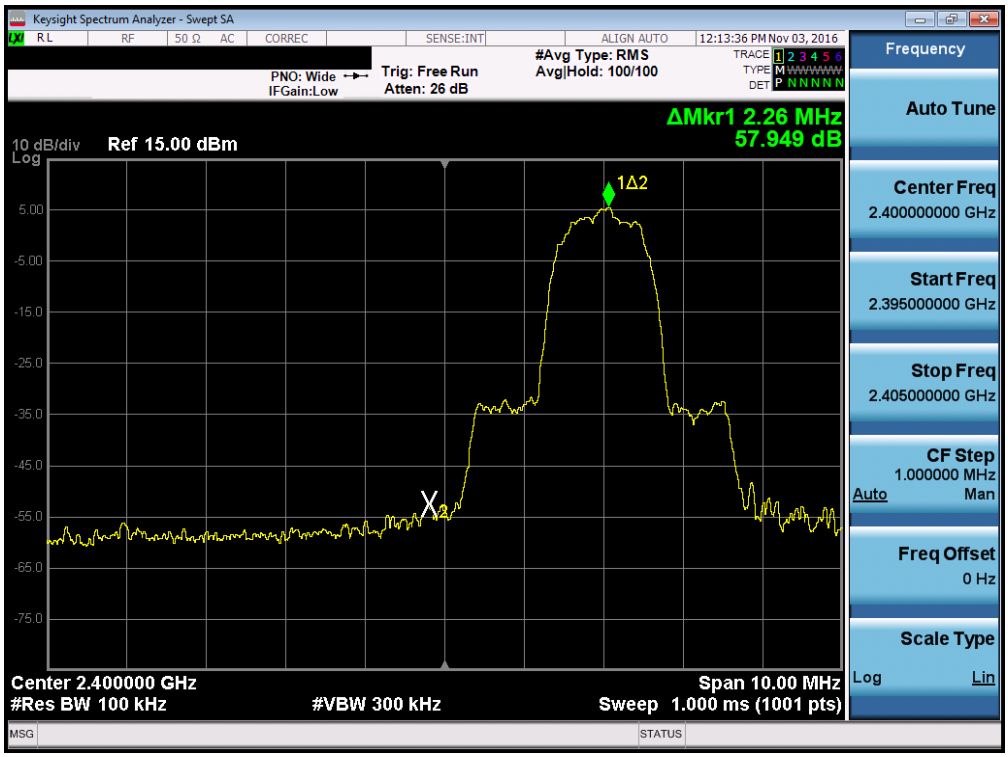


**Plot 7-28. Band Edge Plot (Bluetooth with Hopping Disabled, 3 Mbps – Ch. 0)**

**Plot 7-29. Band Edge Plot (Bluetooth with Hopping Disabled, 3 Mbps – Ch. 78)**


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**Plot 7-30. Band Edge Plot (Bluetooth with Hopping Enabled, 3 Mbps)**

**Plot 7-31. Band Edge Plot (Bluetooth with Hopping Enabled, 3 Mbps)**


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## 7.5 Carrier Frequency Separation

**§15.247 (a.1)**

**Test Overview and Limit**

Measurement is made with EUT operating in hopping mode. ***The minimum permissible channel separation for this system is 2/3 the value of the 20dB BW.***

**Test Procedure Used**

ANSI C63.10-2013 – Section 7.8.2

**Test Settings**

1. Span = Wide enough to capture peaks of two adjacent channels
2. RBW = 30% of channel spacing. Adjust as necessary to best identify center of each individual channel
3. VBW ≥ RBW
4. Sweep = Auto
5. Detector = Peak
6. Trace mode = max hold
7. The trace was allowed to stabilize.
8. Marker-delta function used to determine separation between peaks of the adjacent channels

**Test Setup**

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

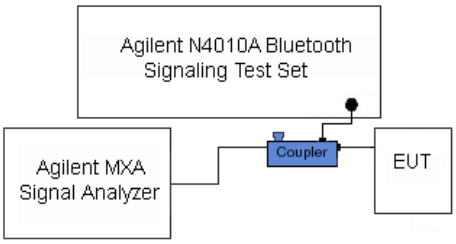


**Figure 7-4. Test Instrument & Measurement Setup**

**Test Notes**

The EUT complies with the minimum channel separation requirement when it is operating in 1x/EDR mode using 79 channels and when operating in AFH mode using 20 channels.


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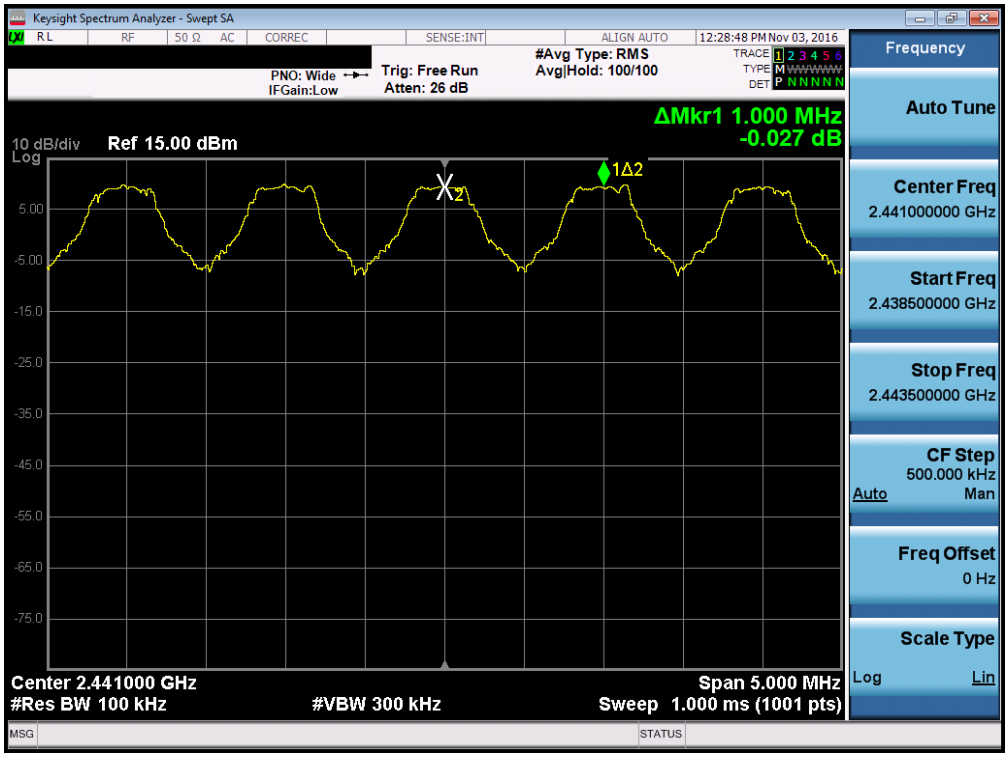
| Frequency [MHz] | Data Rate [Mbps] | Channel No. | Min. Channel Separation [MHz] |
|---|---|---|---|
| 2402 | 1.0 | 0 | 0.633 |
| 2441 | 1.0 | 39 | 0.617 |
| 2480 | 1.0 | 78 | 0.618 |
| 2402 | 2.0 | 0 | 0.893 |
| 2441 | 2.0 | 39 | 0.897 |
| 2480 | 2.0 | 78 | 0.841 |
| 2402 | 3.0 | 0 | 0.865 |
| 2441 | 3.0 | 39 | 0.873 |
| 2480 | 3.0 | 78 | 0.865 |

**Table 7-4. Minimum Channel Separation**




**Plot 7-32. Channel Spacing Plot (Bluetooth)**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## 7.6 Time of Occupancy

**§15.247 (a.1.iii)**

**Test Overview and Limit**

Measurement is made while EUT is operating in hopping mode with the spectrum analyzer set to zero span. ***The maximum permissible time of occupancy is 400 ms within a period of 400ms multiplied by the number of hopping channels employed.***

**Test Procedure Used**

ANSI C63.10-2013 – Section 7.8.4

**Test Settings**

1. Span = zero span, centered on a hopping channel
2. RBW ≤ channel spacing and >> 1/T, where T is expected dwell time per channel
3. Sweep = as necessary to capture entire dwell time. Second plot may be required to demonstrate two successive hops on a channel
4. Trigger is set with appropriate trigger delay to place pulse near the center of the plot
5. Detector = peak
6. Trace mode = max hold
7. Marker-delta function used to determine transmit time per hop

**Test Setup**

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

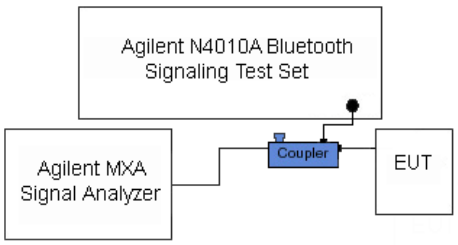


**Figure 7-5. Test Instrument & Measurement Setup**

**Test Notes**

None


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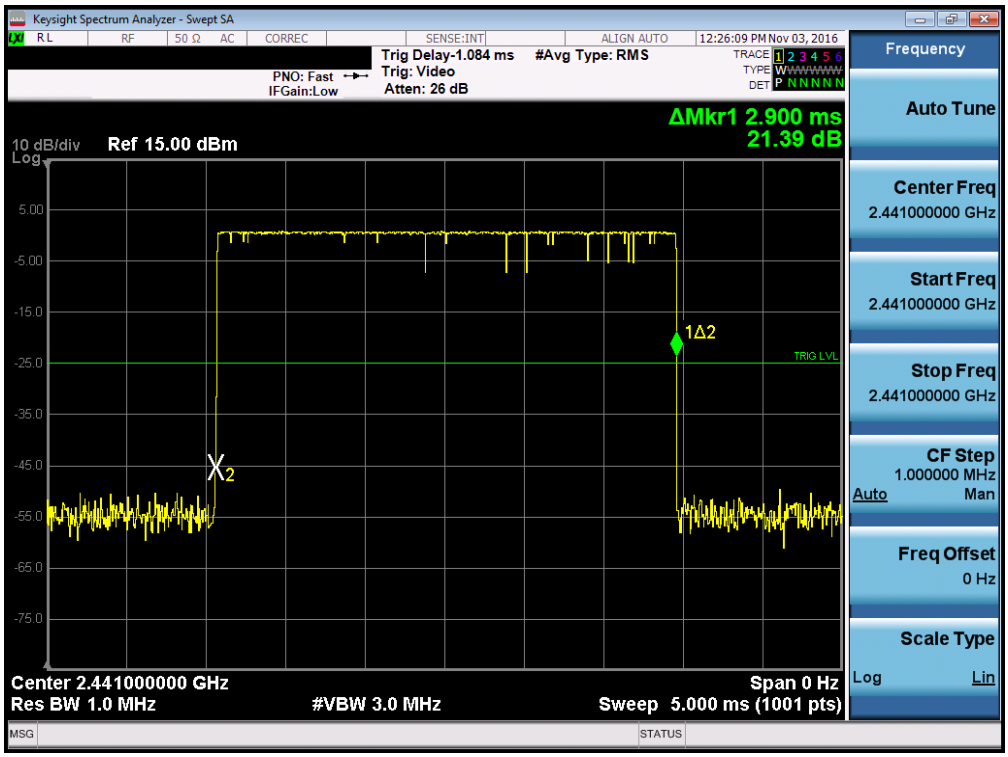


**Plot 7-33. Time of Occupancy Plot (Bluetooth)**

**Bluetooth Time of Occupancy Calculation**

Typically, Bluetooth 1x/EDR mode has a channel hopping rate of 1600 hops/s. Since 1x/EDR modes use 5 transmit and 1 receive slot, for a total of 6 slots, the Bluetooth transmitter is actually hopping at a rate of 1600 / 6 = 266.67 hops/s/slot

- 400ms x 79 hopping channels = 31.6 sec (Time of Occupancy Limit)
- Worst case BT has 266.67 hops/second (for 1x/EDR modes with DH5 operation)
- 266.67 hops/second / 79 channels = 3.38 hops/second (# of hops/second on one channel)
- 3.38 hops/second/channel x 31.6 seconds = 106.67 hops (# hops over a 31.6 second period)
- 106.67 hops x 2.900 ms/channel = 309.34 ms (worst case dwell time for one channel in 1x/EDR modes)

With AFH, the number of channels is reduced to a minimum of 20 channels and the channel hopping rate is reduced by 50% to 800 hops/s. AFH mode also uses 6 total slots so the Bluetooth transmitter hops at a rate of 800 / 6 = 133.3 hops/s/slot

- 400ms x 20 hopping channels = 8 sec (Time of Occupancy Limit)
- Worst case BT has 133.3 hops/second/slot (for AFH mode with DH5 operation)
- 133.3 hops/s / 20 channels = 6.67 hops/second (# of hops/second on one channel)
- 6.67 hops/s / channel x 8 seconds = 53.34 hops (# hops over a 8 second period)
- 53.34 hops x 2.900 ms/channel = 154.68 ms (worst case dwell time for one channel in AFH mode)


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## 7.7 Number of Hopping Channels

**§15.247 (a.1.iii)**

**Test Overview and Limit**

Measurement is made while EUT is operating in hopping mode. ***This frequency hopping system must employ a minimum of 15 hopping channels.***

**Test Procedure Used**

ANSI C63.10-2013 – Section 7.8.3

**Test Settings**

1. Span = frequency of band of operation (divided into two plots)
2. RBW < 30% of channel spacing or 20dB bandwidth, whichever is smaller.
3. VBW ≥ RBW
4. Sweep = auto
5. Detector = peak
6. Trace mode = max hold
7. Trace was allowed to stabilize

**Test Setup**

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

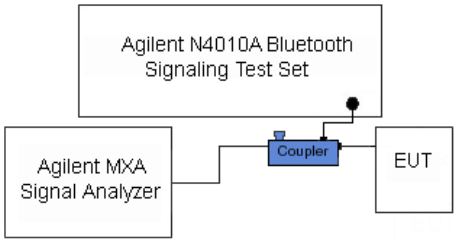


**Figure 7-6. Test Instrument & Measurement Setup**

**Test Notes**

The frequency spectrum was broken up into two sub-ranges to clearly show all of the hopping frequencies. In AFH mode, this device operates using 20 channels so the requirement for minimum number of hopping channels is satisfied.


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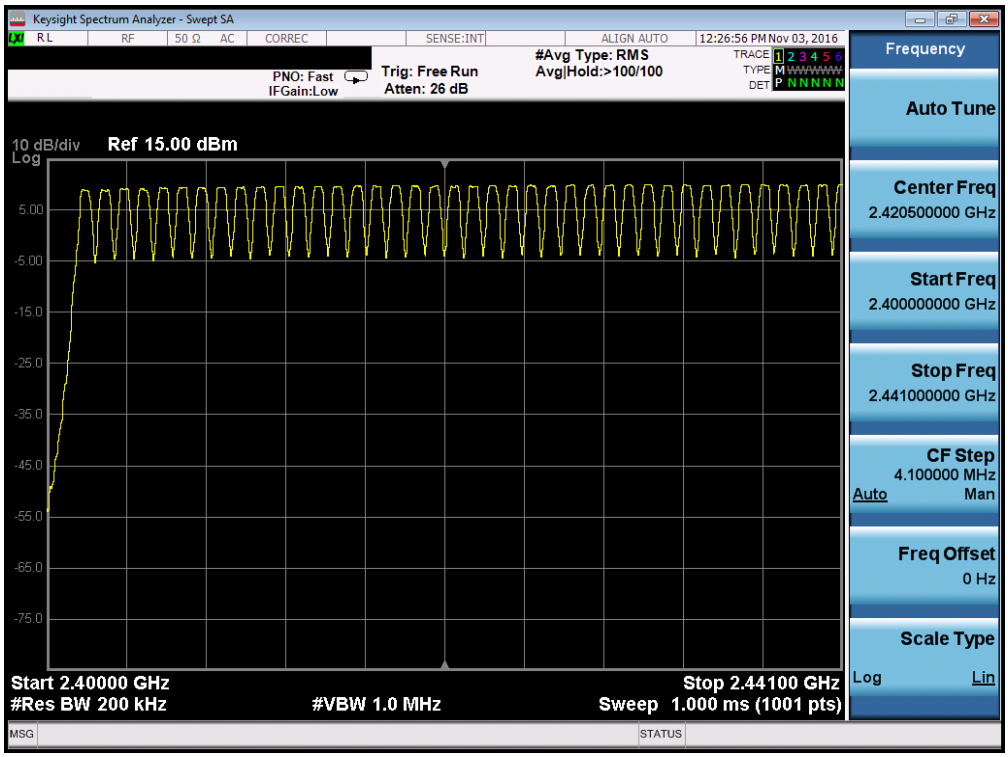
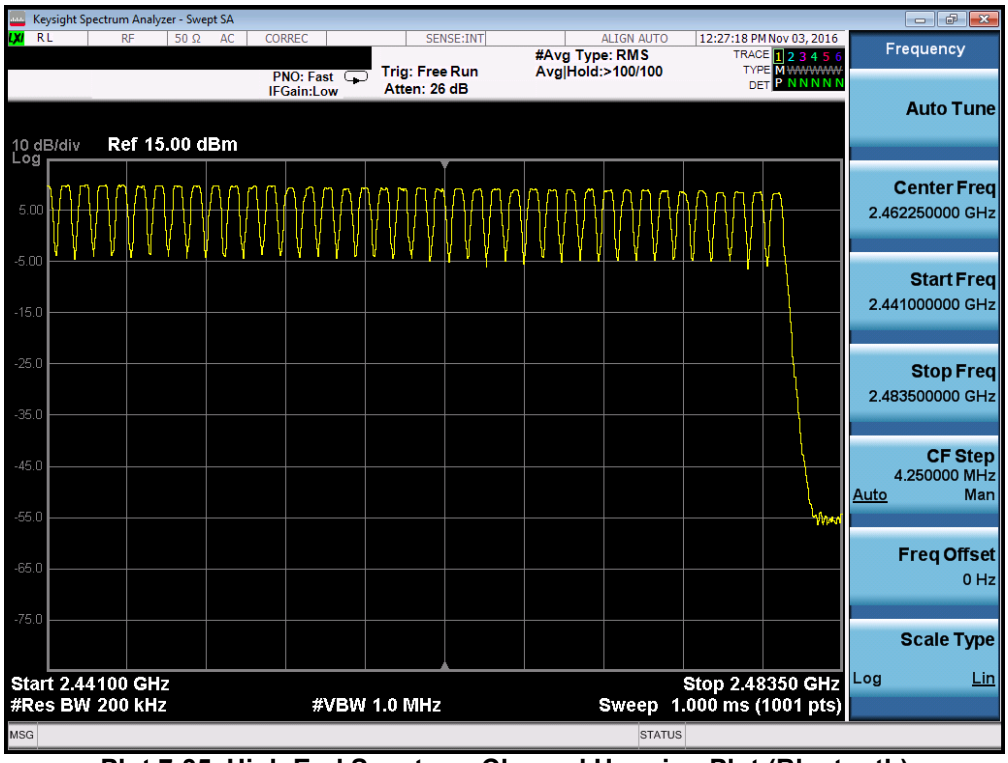



**Plot 7-34. Low End Spectrum Channel Hopping Plot (Bluetooth)**




**Plot 7-35. High End Spectrum Channel Hopping Plot (Bluetooth)**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## 7.8 Conducted Spurious Emissions

**§15.247 (d)**

**Test Overview and Limit**

Conducted out-of-band spurious emissions were investigated from 30MHz up to 25GHz to include the 10th harmonic of the fundamental transmit frequency. ***The maximum permissible out-of-band emission level is 20 dBc.***

**Test Procedure Used**

ANSI C63.10-2013 – Section 7.8.8

**Test Settings**

1. Start frequency was set to 30MHz and stop frequency was set to 25GHz (separated into two plots per channel)
2. RBW = 1MHz* (See note below)
3. VBW = 3MHz
4. Detector = Peak
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.

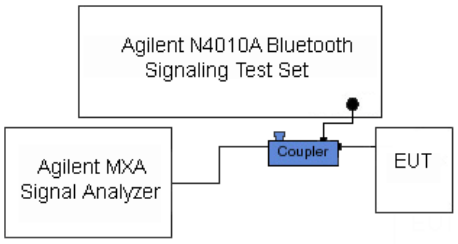


**Figure 7-7. Test Instrument & Measurement Setup**

**Test Notes**

Out-of-band conducted spurious emissions were investigated for all data rates and the worst case emissions were found with the EUT transmitting at 1Mbps. The display line shown in the following plots is the limit at 20dB below the fundamental emission level measured in a 100kHz bandwidth. However, the traces in the following plots are measured with a 1MHz RBW to reduce test time, so the display line may not necessarily appear to be 20dB below the level of the fundamental in a 1MHz bandwidth.


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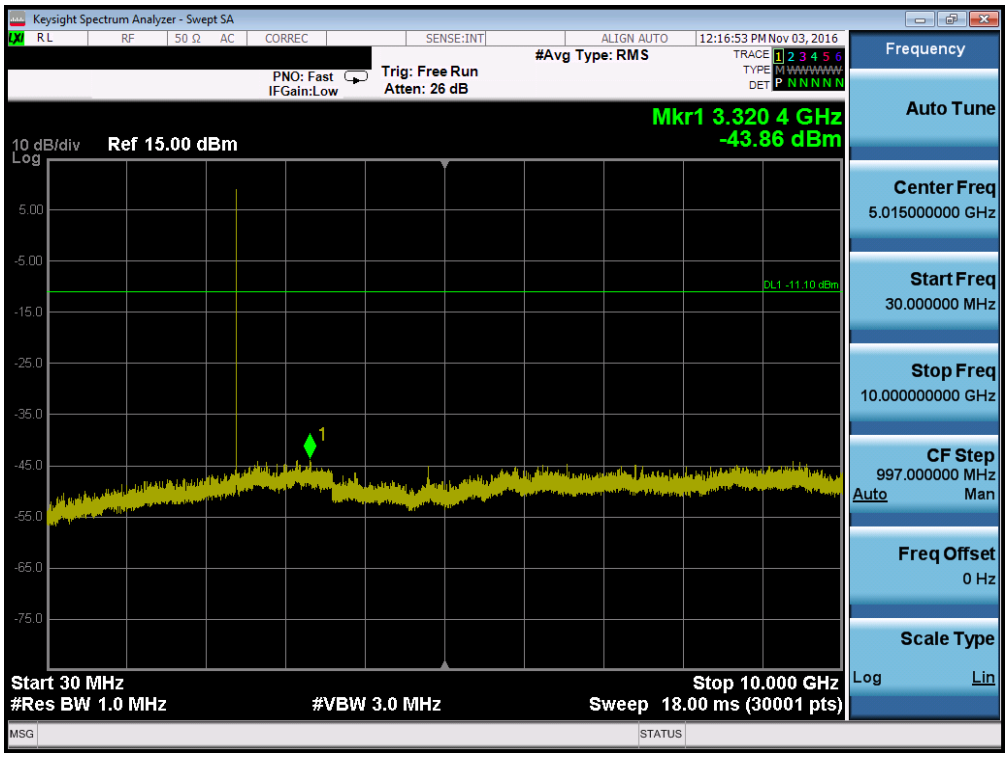
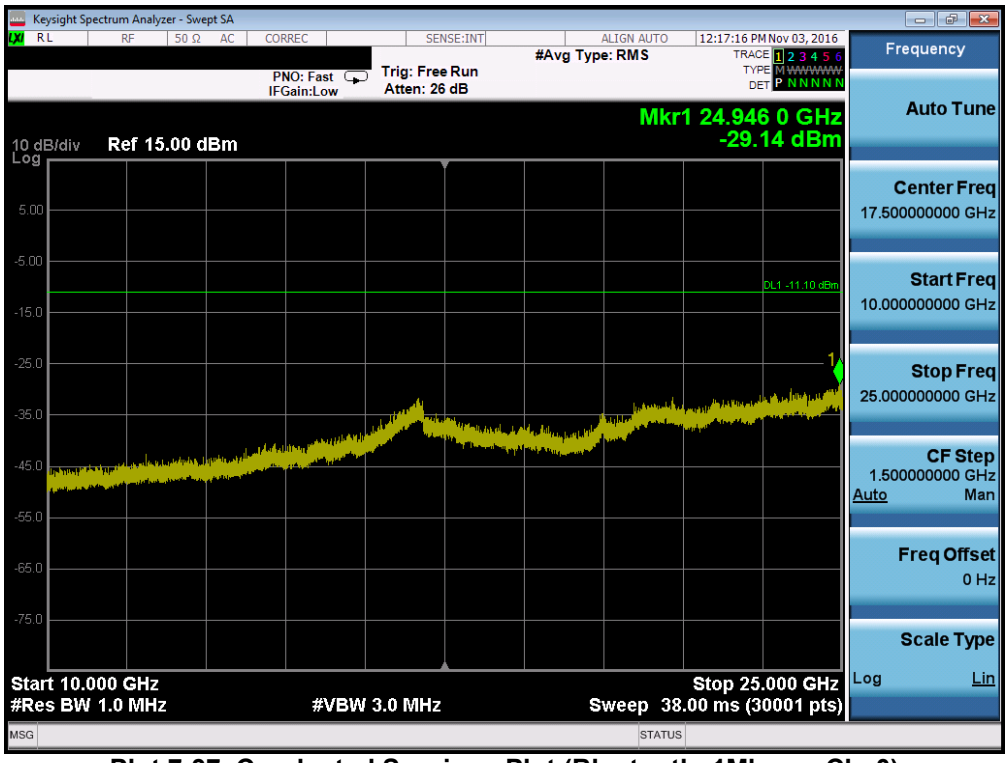



**Plot 7-36. Conducted Spurious Plot (Bluetooth, 1Mbps – Ch. 0)**




**Plot 7-37. Conducted Spurious Plot (Bluetooth, 1Mbps – Ch. 0)**



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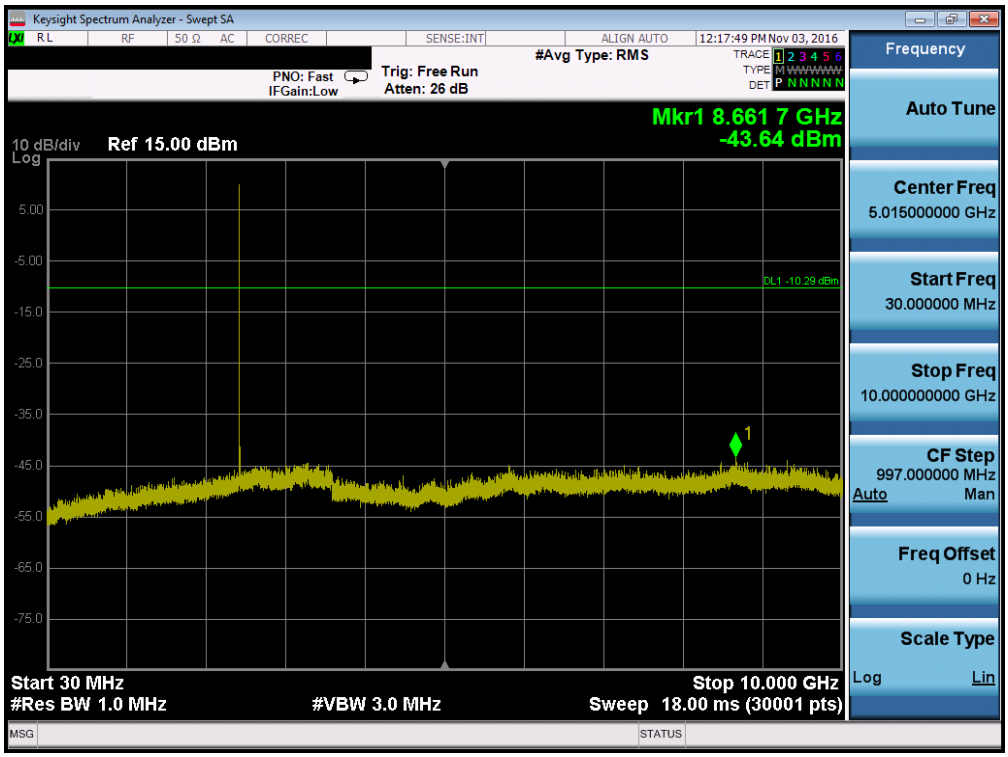


**Plot 7-38. Conducted Spurious Plot (Bluetooth, 1Mbps – Ch. 39)**

**Plot 7-39. Conducted Spurious Plot (Bluetooth, 1Mbps – Ch. 39)**



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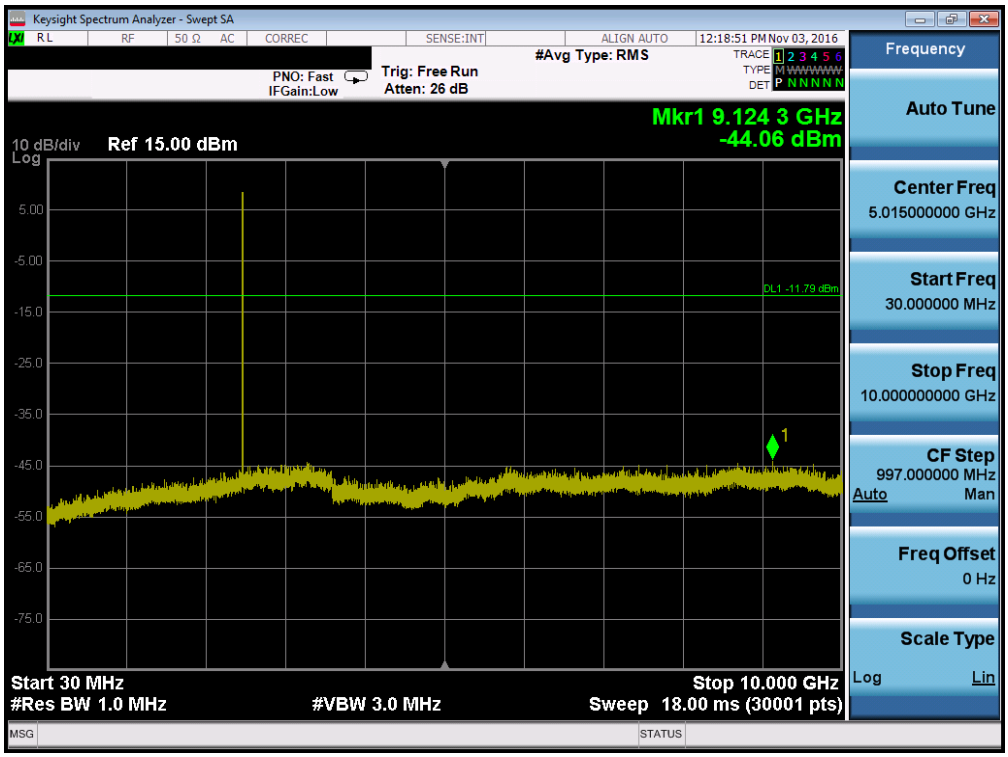
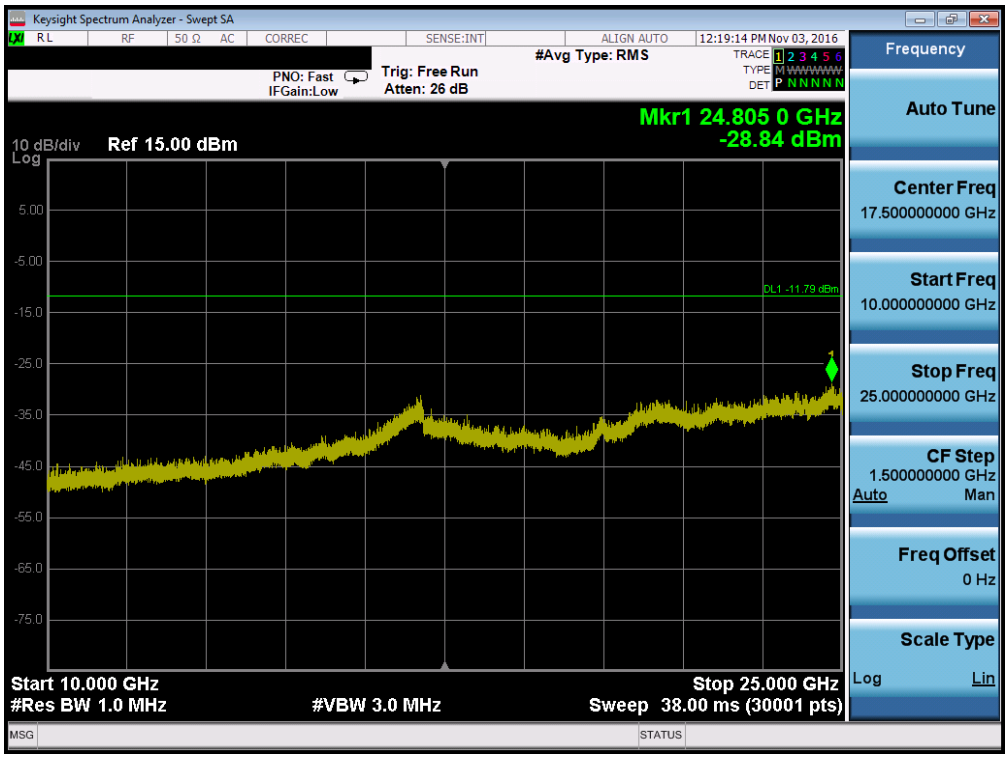



**Plot 7-40. Conducted Spurious Plot (Bluetooth, 1Mbps – Ch. 78)**




**Plot 7-41. Conducted Spurious Plot (Bluetooth, 1Mbps – Ch. 78)**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## 7.9 Radiated Spurious Emission Measurements – Above 1GHz

**§15.205 §15.209 §15.247 (d)**

**Test Overview and Limit**

All out of band radiated spurious emissions are measured with a spectrum analyzer connected to a receive antenna while the EUT is operating at maximum power and at the appropriate frequencies. Only the radiated emissions of the configuration that produced the worst case emissions are reported in this section.

***All out of band emissions appearing in a restricted band as specified in Section 15.205 of the Title 47 CFR must not exceed the limits shown in Table 7-5 per Section 15.209.***

| Frequency | Field Strength [μV/m] | Measured Distance [Meters] |
|---|---|---|
| Above 960.0 MHz | 500 | 3 |

**Table 7-5. Radiated Limits**

**Test Procedure Used**

ANSI C63.10-2013 – Section 6.6.4.3

**Test Settings**

**Average Field Strength Measurements per Section 4.1.4.2.3 of ANSI C63.10-2013**

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 1MHz
3. VBW = 1kHz $\geq 1/\tau$ Hz, where $\tau$ = pulse width in seconds
4. Averaging type was set to RMS to ensure that video filtering was applied in the power domain
5. Detector = peak
6. Sweep time = auto
7. Trace mode = max hold
8. Trace was allowed to stabilize

**Peak Field Strength Measurements per Section 4.1.4.2.2 of ANSI C63.10-2013**

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW is set depending on measurement frequency, as specified in Table 7-6 below
3. VBW = 3MHz
4. Detector = peak
5. Sweep time = auto couple
6. Trace mode = max hold
7. Trace was allowed to stabilize


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| Frequency | RBW |
|---|---|
| 9 – 150kHz | 200 – 300Hz |
| 0.15 – 30MHz | 9 – 10kHz |
| 30 – 1000MHz | 100 – 120kHz |
| > 1000MHz | 1MHz |

**Table 7-6. RBW as a Function of Frequency**

## Test Setup

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

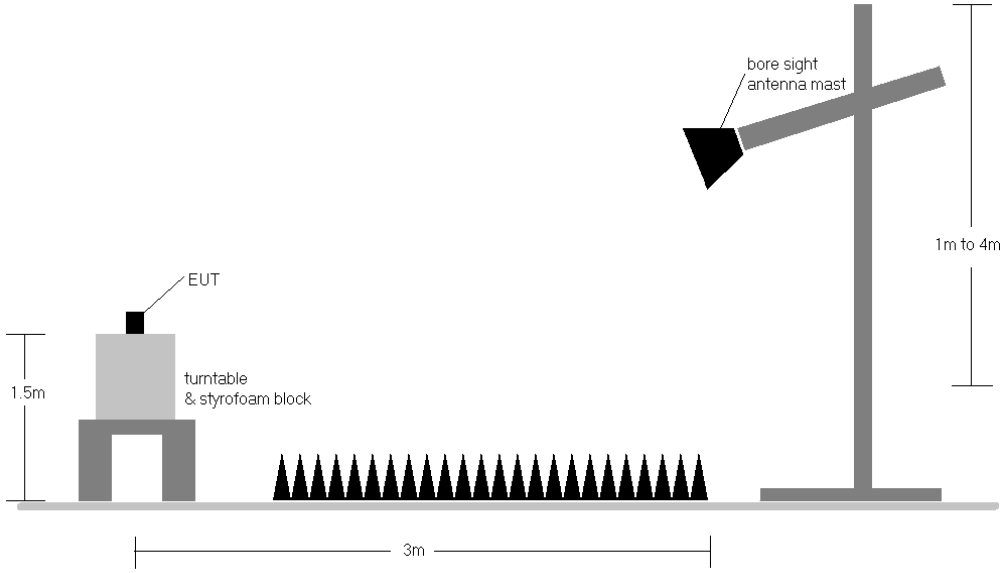


**Figure 7-8. Radiated Test Setup >1GHz**

## Test Notes

1. All emissions lying in restricted bands specified in §15.205 are below the limit shown in Table 7-5.
2. No significant radiated emissions were found in the 2310 - 2390MHz restricted band.
3. The antenna is manipulated through typical positions, polarity and length during the tests. The EUT is manipulated through three orthogonal planes.
4. This unit was tested with its standard battery.
5. The spectrum is measured from 9kHz to the 10$^{th}$ harmonic and the worst-case emissions are reported.
6. The duty cycle correction factor was not applied to noise floor measurements.
7. The wide spectrum spurious emissions plots shown on the following pages are used only for the purpose of emission identification. Any emissions found to be within 20dB of the limit are fully investigated and the results are shown in this section.
8. The "-" shown in the following RSE tables are used to denote a noise floor measurement.


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## Sample Calculation

- Field Strength Level [dBμV/m] = Analyzer Level [dBm] + 107 + AFCL [dB/m] + Duty Cycle Correction [dB]
- AFCL [dB/m] = Antenna Factor [dB/m] + Cable Loss [dB]
- Margin [dB] = Field Strength Level [dBμV/m] – Limit [dBμV/m]

## Duty Cycle Correction Factor Calculation

- Channel hop rate = 800 hops/second (AFH Mode)
- Adjusted channel hop rate for DH5 mode **=** 133.33 hops/second
- Time per channel hop **=** 1 / 133.33 hops/second = 7.50 ms
- Time to cycle through all channels = 7.50 x 20 channels = 150 ms
- Number of times transmitter hits on one channel = 100 ms / 150 ms = 1 time(s)
- Worst case dwell time = 7.5 ms
- Duty cycle correction factor = $20\log_{10}(7.5ms/100ms)$ = -22.5 dB


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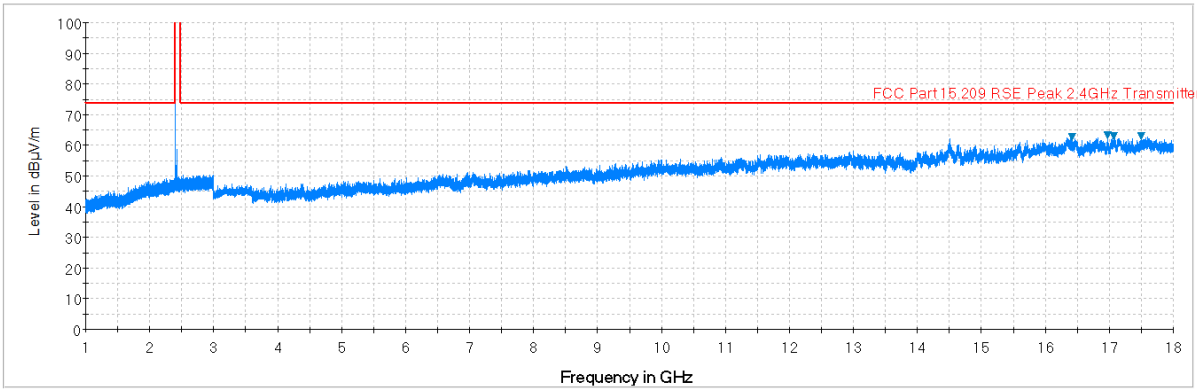
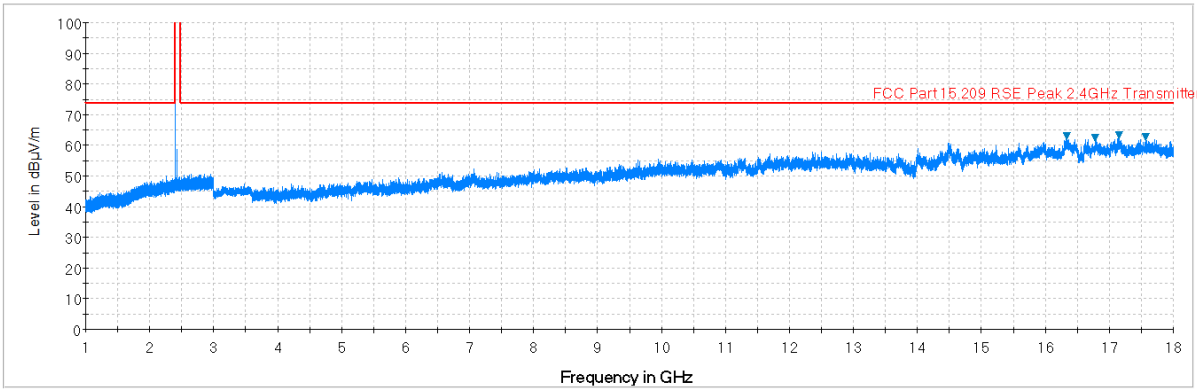
# Radiated Spurious Emission Measurements

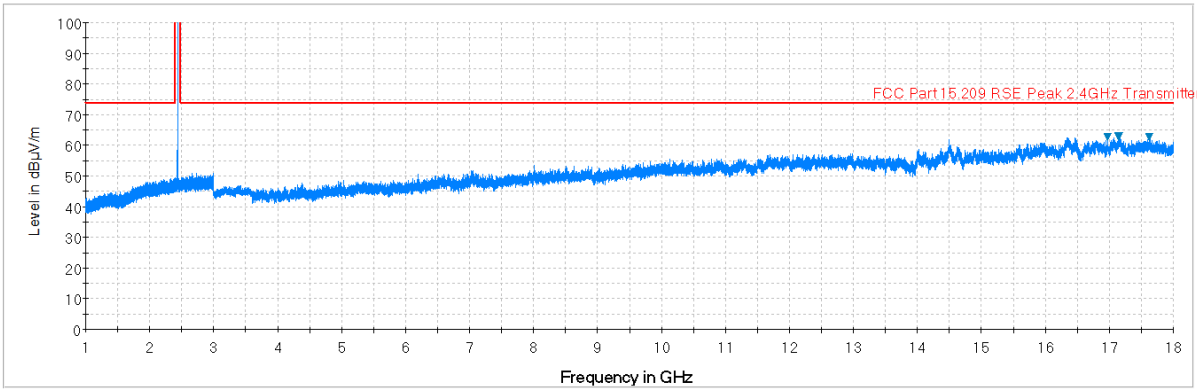
**§15.205 §15.209 §15.247 (d)**




**Plot 7-42. Radiated Spurious Plot above 1GHz (BT – Ch. 0, Ant. Pol. H)**




**Plot 7-43. Radiated Spurious Plot above 1GHz (BT – Ch. 0, Ant. Pol. V)**




**Plot 7-44. Radiated Spurious Plot above 1GHz (BT – Ch. 39, Ant. Pol. H)**



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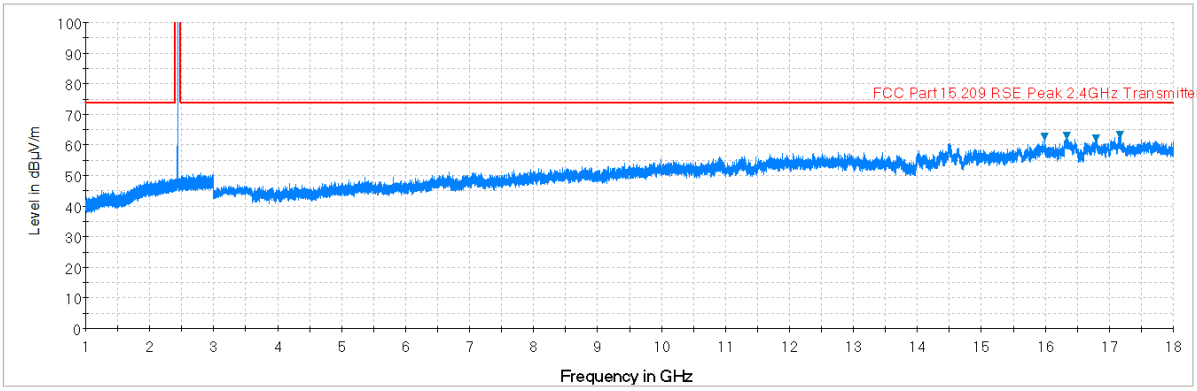
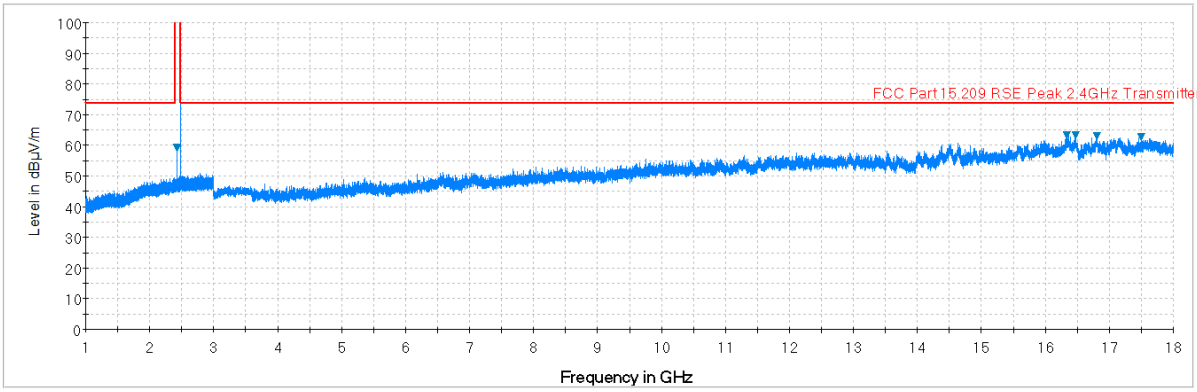
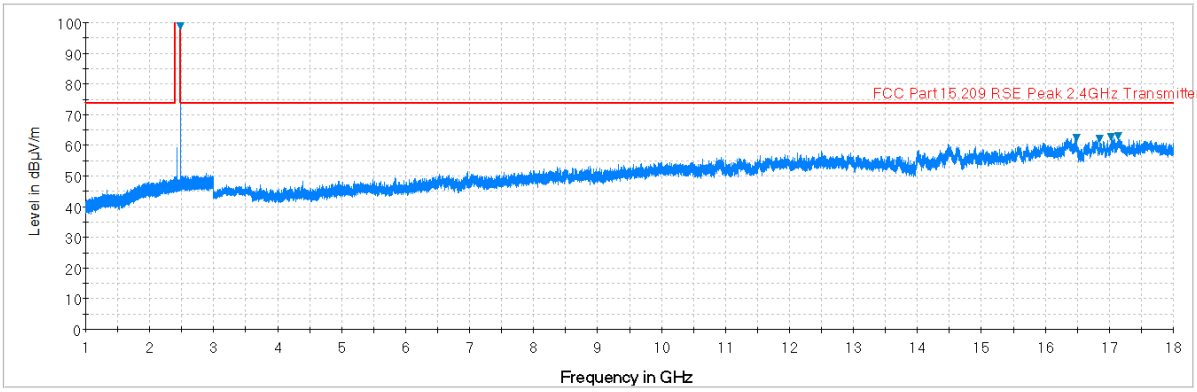



**Plot 7-45. Radiated Spurious Plot above 1GHz (BT – Ch. 39, Ant. Pol. V)**




**Plot 7-46. Radiated Spurious Plot above 1GHz (BT – Ch. 78, Ant. Pol. H)**




**Plot 7-47. Radiated Spurious Plot above 1GHz (BT – Ch. 78, Ant. Pol. V)**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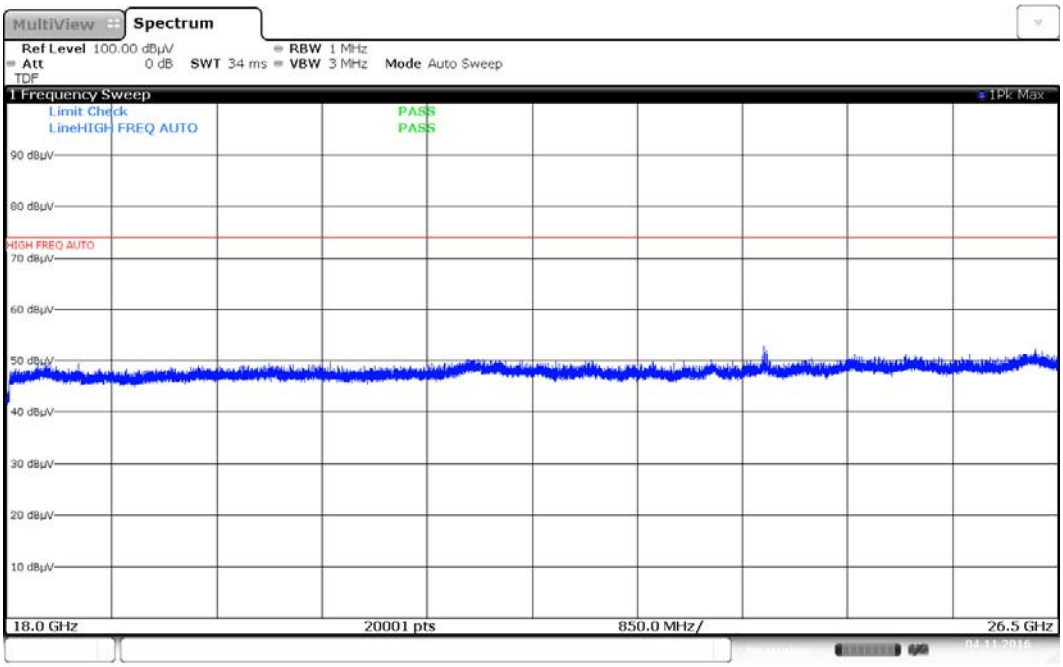
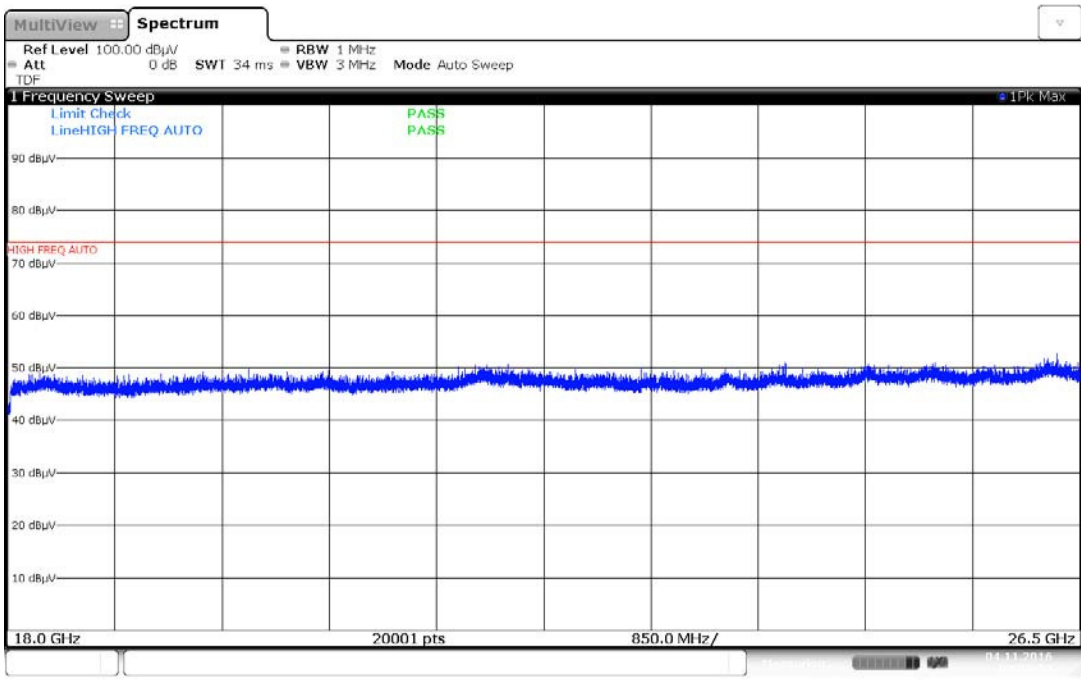
# Radiated Spurious Emissions Measurements (Above 18GHz)

**§15.209**




02:01:09 04.11.2016

**Plot 7-48. Radiated Spurious Plot above 18GHz (Pol. H)**




02:04:34 04.11.2016

**Plot 7-49. Radiated Spurious Plot above 18GHz (Pol. V)**



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## Radiated Spurious Emission Measurements
**§15.205 §15.209 §15.247 (d)**

Worst Case Mode: Bluetooth
Worst Case Data Rate: 1 Mbps
Measurement Distance: 3 Meters
Operating Frequency: 2402MHz
Channel: 0

| Frequency [MHz] | Detector | Ant. Pol. [H/V] | Antenna Height [cm] | Turntable Azimuth [degree] | Analyzer Level [dBm] | AFCL [dB/m] | Duty Cycle Correction [dB] | Field Strength [dBµV/m] | Limit [dBµV/m] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|---|---|
| 4804.00 | Avg | H | 110 | 46 | -60.85 | 0.45 | -22.50 | 24.10 | 53.98 | -29.88 |
| 4804.00 | Peak | H | 110 | 46 | -53.65 | 0.45 | 0.00 | 53.80 | 73.98 | -20.18 |
| 12010.00 | Avg | H | - | - | -72.15 | 15.73 | 0.00 | 50.58 | 53.98 | -3.40 |
| 12010.00 | Peak | H | - | - | -59.18 | 15.73 | 0.00 | 63.55 | 73.98 | -10.43 |

**Table 7-7. Radiated Measurements**

Worst Case Mode: Bluetooth
Worst Case Data Rate: 1 Mbps
Measurement Distance: 3 Meters
Operating Frequency: 2441MHz
Channel: 39

| Frequency [MHz] | Detector | Ant. Pol. [H/V] | Antenna Height [cm] | Turntable Azimuth [degree] | Analyzer Level [dBm] | AFCL [dB/m] | Duty Cycle Correction [dB] | Field Strength [dBµV/m] | Limit [dBµV/m] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|---|---|
| 4882.00 | Avg | H | 115 | 50 | -60.68 | 0.91 | -22.50 | 24.73 | 53.98 | -29.25 |
| 4882.00 | Peak | H | 115 | 50 | -54.51 | 0.91 | 0.00 | 53.40 | 73.98 | -20.58 |
| 7323.00 | Avg | H | - | - | -71.96 | 9.69 | 0.00 | 44.73 | 53.98 | -9.25 |
| 7323.00 | Peak | H | - | - | -58.49 | 9.69 | 0.00 | 58.20 | 73.98 | -15.78 |
| 12205.00 | Avg | H | - | - | -72.57 | 15.26 | 0.00 | 49.69 | 53.98 | -4.28 |
| 12205.00 | Peak | H | - | - | -59.68 | 15.26 | 0.00 | 62.58 | 73.98 | -11.39 |

**Table 7-8. Radiated Measurements**


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## Radiated Spurious Emission Measurements
**§15.205 §15.209 §15.247 (d)**

| | |
|---|---|
| Worst Case Mode: | Bluetooth |
| Worst Case Data Rate: | 1 Mbps |
| Measurement Distance: | 3 Meters |
| Operating Frequency: | 2480MHz |
| Channel: | 78 |

| Frequency [MHz] | Detector | Ant. Pol. [H/V] | Antenna Height [cm] | Turntable Azimuth [degree] | Analyzer Level [dBm] | AFCL [dB/m] | Duty Cycle Correction [dB] | Field Strength [dBµV/m] | Limit [dBµV/m] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|---|---|
| 4960.00 | Avg | H | - | - | -63.95 | 0.73 | 0.00 | 43.78 | 53.98 | -10.20 |
| 4960.00 | Peak | H | - | - | -55.07 | 0.73 | 0.00 | 52.66 | 73.98 | -21.32 |
| 7440.00 | Avg | H | - | - | -72.42 | 10.32 | 0.00 | 44.90 | 53.98 | -9.08 |
| 7440.00 | Peak | H | - | - | -59.38 | 10.32 | 0.00 | 57.94 | 73.98 | -16.04 |
| 12400.00 | Avg | H | - | - | -72.49 | 15.02 | 0.00 | 49.53 | 53.98 | -4.45 |
| 12400.00 | Peak | H | - | - | -59.47 | 15.02 | 0.00 | 62.55 | 73.98 | -11.43 |

**Table 7-9. Radiated Measurements**


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## 7.10 Radiated Restricted Band Edge Measurements

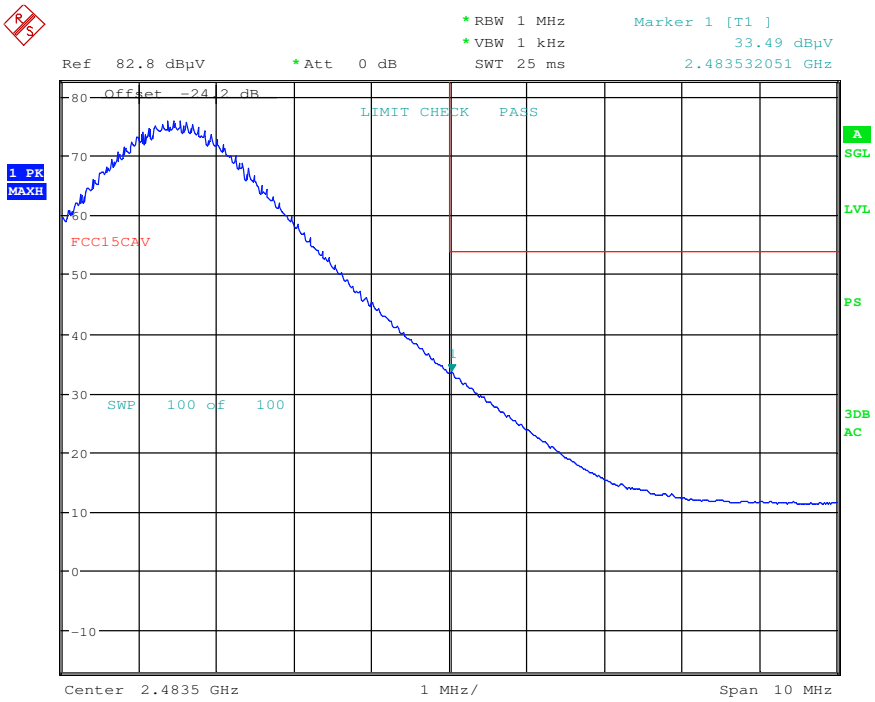
**§15.205 §15.209 §15.247 (d)**

The radiated restricted band edge measurements are measured with an EMI test receiver connected to the receive antenna while the EUT is transmitting. Two different amplitude offsets were used depending on whether peak or average measurements were measured. The average measurements use a duty cycle correction factor (DCCF).

The amplitude offset shown in the following plots for average measurements was calculated using the formula:

Offset (dB) = (Antenna Factor + Cable Loss + 10 dB Attenuator) – Preamplifier Gain + DCCF

| | |
|---|---|
| Worst Case Mode: | Bluetooth |
| Worst Case Data Rate: | 1 Mbps |
| Measurement Distance: | 3 Meters |
| Operating Frequency: | 2480MHz |
| Channel: | 78 |




Date: 7.NOV.2016 21:30:47

**Plot 7-50. Radiated Restricted Upper Band Edge Measurement (Average)**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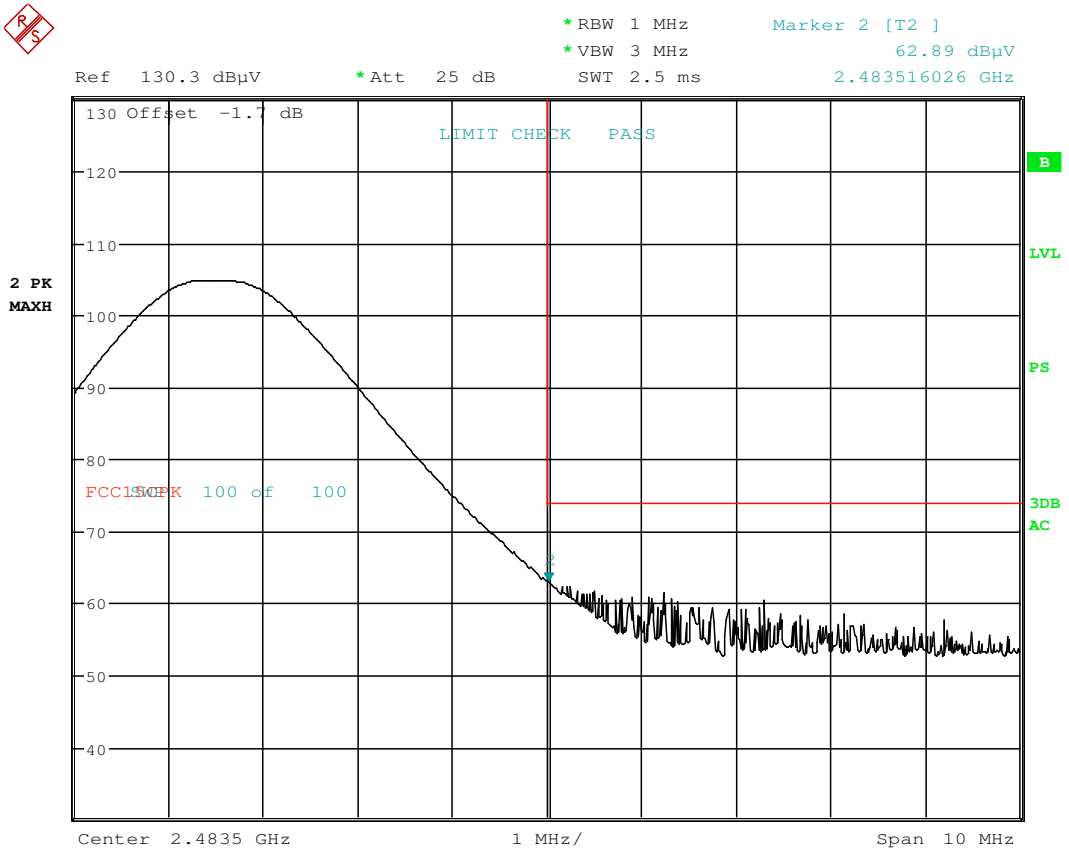
## Radiated Restricted Band Edge Measurements
**§15.205 §15.209 §15.247 (d)**

The amplitude offset shown in the following plots for peak measurements was calculated using the formula:

Offset (dB) = (Antenna Factor + Cable Loss + 10 dB Attenuator) – Preamplifier Gain




Date: 7.NOV.2016 21:31:27

**Plot 7-51. Radiated Restricted Upper Band Edge Measurement (Peak)**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## 7.11 Radiated Spurious Emissions Measurements – Below 1GHz

**§15.209**

**Test Overview and Limit**

All out of band radiated spurious emissions are measured with a spectrum analyzer connected to a receive antenna while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies. All data rates and modes were investigated for radiated spurious emissions. Only the radiated emissions of the configuration that produced the worst case emissions are reported in this section.

***All out of band emissions appearing in a restricted band as specified in Section 15.205 of the Title 47 CFR must not exceed the limits shown in Table 7-10 per Section 15.209.***

| Frequency | Field Strength [µV/m] | Measured Distance [Meters] |
|---|---|---|
| 0.009 – 0.490 MHz | 2400/F (kHz) | 300 |
| 0.490 – 1.705 MHz | 24000/F (kHz) | 30 |
| 1.705 – 30.00 MHz | 30 | 30 |
| 30.00 – 88.00 MHz | 100 | 3 |
| 88.00 – 216.0 MHz | 150 | 3 |
| 216.0 – 960.0 MHz | 200 | 3 |
| Above 960.0 MHz | 500 | 3 |

**Table 7-10. Radiated Limits**

**Test Procedures Used**

ANSI C63.10-2013

**Test Settings**

**Quasi-Peak Field Strength Measurements**

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 120kHz (for emissions from 30MHz – 1GHz)
3. Detector = quasi-peak
4. Sweep time = auto couple
5. Trace mode = max hold
6. Trace was allowed to stabilize


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## Test Setup

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

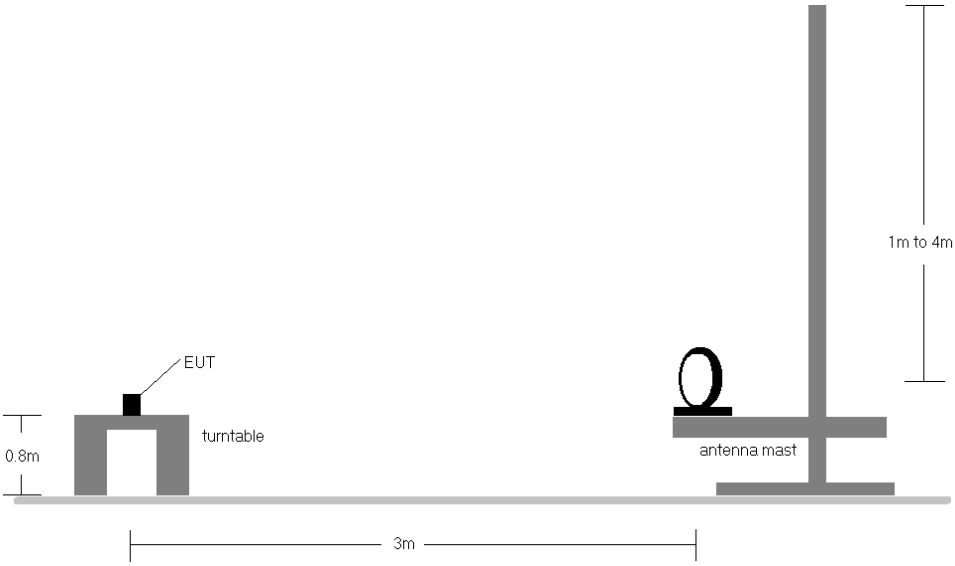


**Figure 7-9. Radiated Test Setup < 30Mhz**

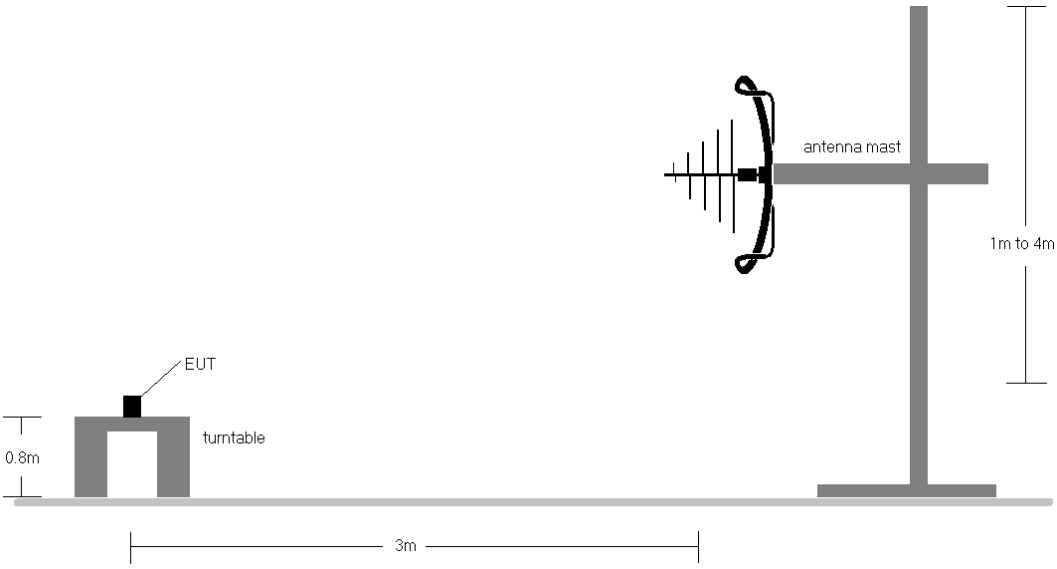


**Figure 7-10. Radiated Test Setup < 1GHz**

## Test Notes

1. All emissions lying in restricted bands specified in §15.205 are below the limit shown in Table 7-10.
2. The broadband receive antenna is manipulated through vertical and horizontal polarizations during the tests. The EUT is manipulated through three orthogonal planes.
3. This unit was tested with its standard battery.


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4. The spectrum is investigated using a peak detector and final measurements are recorded using CISPR quasi peak detector. The worst-case emissions are reported however emissions whose levels were not within 20dB of the respective limits were not reported.
5. Emissions were measured at a 3 meter test distance.
6. Emissions are investigated while operating on the center channel of the mode, band, and modulation that produced the worst case results during the transmitter spurious emissions testing.
7. No spurious emissions were detected within 20dB of the limit below 30MHz.
8. The results recorded using the broadband antenna is known to correlate with the results obtained by using a tuned dipole with an acceptable degree of accuracy. The VSWR for the measurement antenna was found to be less than 2:1.
9. The wide spectrum spurious emissions plots shown on the following pages are used only for the purpose of emission identification. There were no emissions detected in the 30MHz – 1GHz frequency range, as shown in the subsequent plots.


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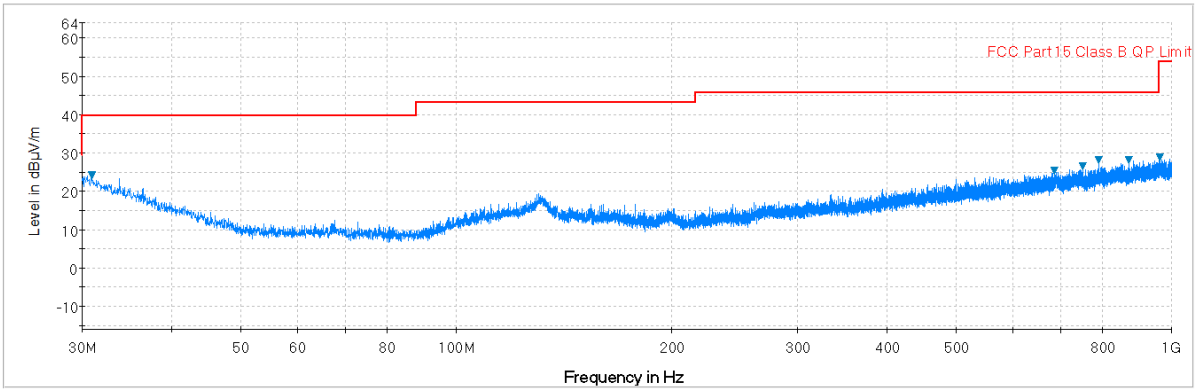
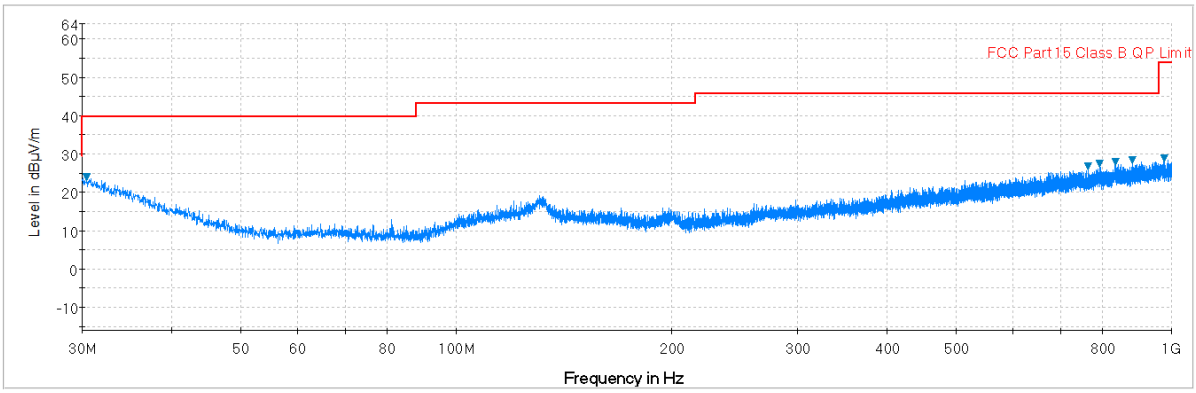
# Radiated Spurious Emissions Measurements (Below 1GHz)

**§15.209**




**Plot 7-52. Radiated Spurious Plot below 1GHz (Pol. H)**




**Plot 7-53. Radiated Spurious Plot below 1GHz (Pol. V)**



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## 7.12 Line Conducted Measurement Data

**§15.207**

**Test Overview and Limit**

All AC line conducted spurious emissions are measured with a receiver connected to a grounded LISN while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies. All data rates and modes were investigated for conducted spurious emissions. Only the conducted emissions of the configuration that produced the worst case emissions are reported in this section.

***All conducted emissions must not exceed the limits shown in the table below, per Section 15.207.***

| Frequency of emission (MHz) | Conducted Limit (dBμV) | |
|---|---|---|
| | Quasi-peak | Average |
| 0.15 – 0.5 | 66 to 56* | 56 to 46* |
| 0.5 – 5 | 56 | 46 |
| 5 – 30 | 60 | 50 |

**Table 7-11. Conducted Limits**

*Decreases with the logarithm of the frequency.

**Test Procedures Used**

ANSI C63.10-2013, Section 6.2

**Test Settings**

**Quasi-Peak Field Strength Measurements**

1. Analyzer center frequency was set to the frequency of the spurious emission of interest
2. RBW = 9kHz (for emissions from 150kHz – 30MHz)
3. Detector = quasi-peak
4. Sweep time = auto couple
5. Trace mode = max hold
6. Trace was allowed to stabilize

**Average Field Strength Measurements**

1. Analyzer center frequency was set to the frequency of the spurious emission of interest
2. RBW = 9kHz (for emissions from 150kHz – 30MHz)
3. Detector = RMS
4. Sweep time = auto couple
5. Trace mode = max hold
6. 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.

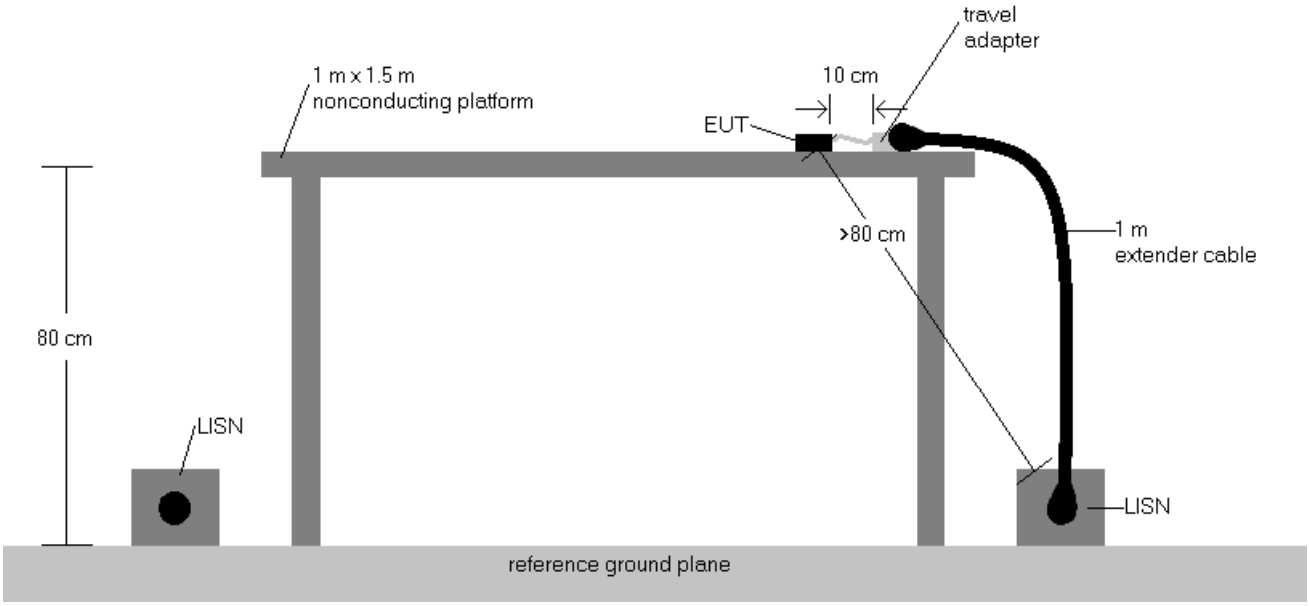


**Figure 7-11. Test Instrument & Measurement Setup**

## Test Notes

1. All modes of operation were investigated and the worst-case emissions are reported using mid channel. The emissions found were not affected by the choice of channel used during testing.
2. The limit for an intentional radiator from 150kHz to 30MHz are specified in 15.207.
3. Corr. (dB) = Cable loss (dB) + LISN insertion factor (dB)
4. QP/AV Level (dBμV) = QP/AV Analyzer/Receiver Level (dBμV) + Corr. (dB)
5. Margin (dB) = QP/AV Limit (dBμV) - QP/AV Level (dBμV)
6. Traces shown in plot are made using a peak detector.
7. Deviations to the Specifications: None.


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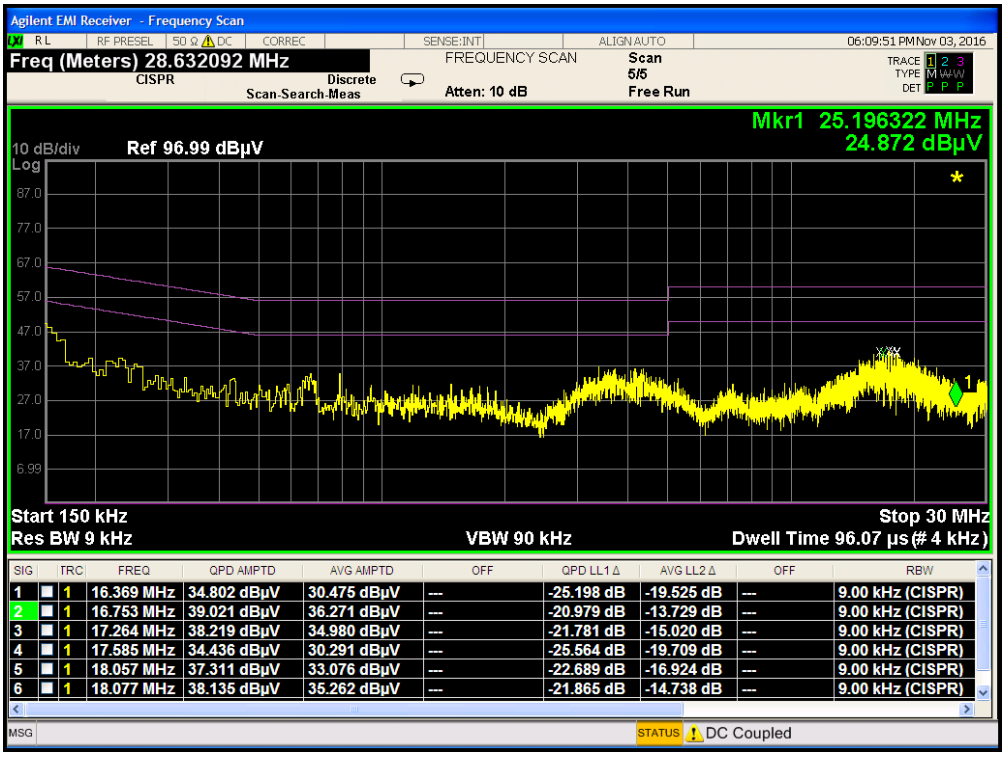
# Line Conducted Measurement Data

**§15.207**




| SIG | TRC | FREQ | QPD AMPTD | AVG AMPTD | OFF | QPD LL1 Δ | AVG LL2 Δ | OFF | RBW |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 16.369 MHz | 34.802 dBµV | 30.475 dBµV | --- | -25.198 dB | -19.525 dB | --- | 9.00 kHz (CISPR) |
| 2 | 1 | 16.753 MHz | 39.021 dBµV | 36.271 dBµV | --- | -20.979 dB | -13.729 dB | --- | 9.00 kHz (CISPR) |
| 3 | 1 | 17.264 MHz | 38.219 dBµV | 34.980 dBµV | --- | -21.781 dB | -15.020 dB | --- | 9.00 kHz (CISPR) |
| 4 | 1 | 17.585 MHz | 34.436 dBµV | 30.291 dBµV | --- | -25.564 dB | -19.709 dB | --- | 9.00 kHz (CISPR) |
| 5 | 1 | 18.057 MHz | 37.311 dBµV | 33.076 dBµV | --- | -22.689 dB | -16.924 dB | --- | 9.00 kHz (CISPR) |
| 6 | 1 | 18.077 MHz | 38.135 dBµV | 35.262 dBµV | --- | -21.865 dB | -14.738 dB | --- | 9.00 kHz (CISPR) |

**Plot 7-54. Line-Conducted Test Plot (L1)**



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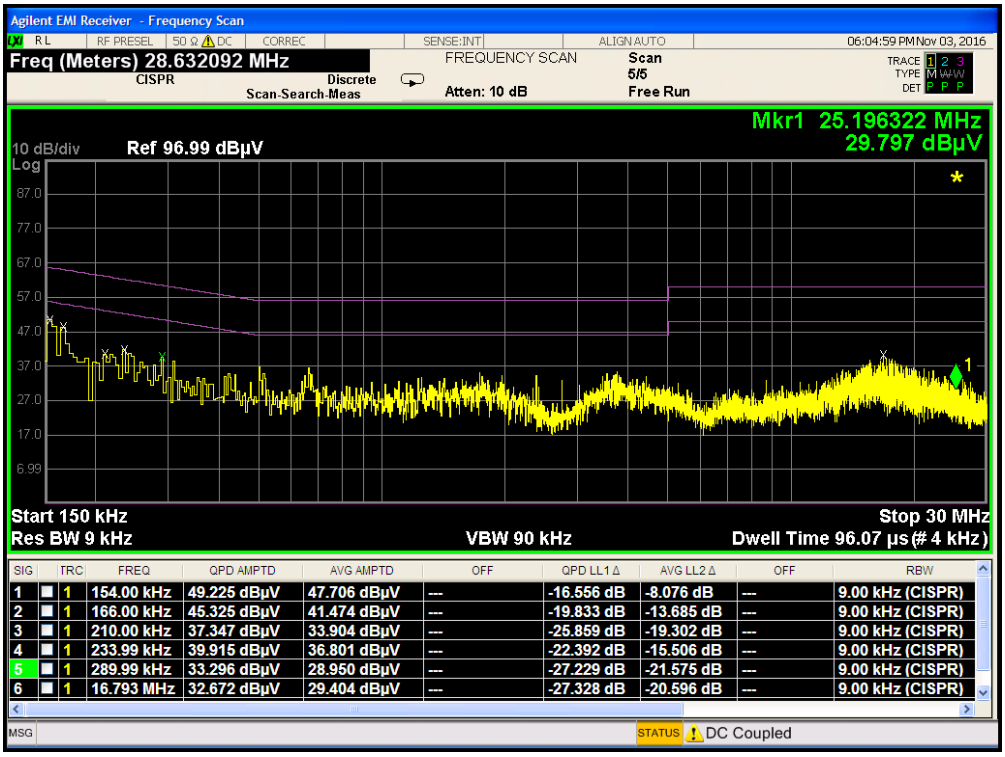
# Line Conducted Measurement Data

**§15.207**




**Plot 7-55. Line-Conducted Test Plot (N)**



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# 8.0 CONCLUSION

The data collected relate only to the item(s) tested and show that the **Samsung Portable Handset FCC ID: A3LSMA720X** is in compliance with Part 15 Subpart C (15.247) of the FCC Rules.


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