PCTEST ENGINEERING LABORATORY, INC.
7185 Oakland Mills Road, Columbia, MD 21046 USA
Tel. 410.290.6652 / Fax 410.290.6654
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:
3/16 - 3/24/2016
Test Site/Location:
PCTEST Lab. Columbia, MD, USA
Test Report Serial No.:
0Y1603160556.A3L

FCC ID:	**A3LSMT713**
APPLICANT:	**Samsung Electronics Co., Ltd.**

Application Type:	Certification
Model(s):	SM-T713
EUT Type:	Portable Tablet
Max. RF Output Power:	11.733 mW (10.69 dBm) Peak Conducted
Frequency Range:	2402 – 2480MHz (Bluetooth for US)
Type of Modulation:	GFSK, π/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

© 2016 PCTEST Engineering Laboratory, Inc.

TABLE OF CONTENTS

FCC PART 15.247 MEASUREMENT REPORT 3

1.0 INTRODUCTION 4

1.1 Scope 4

1.2 PCTEST Test Location 4

2.0 PRODUCT INFORMATION 5

2.1 Equipment Description 5

2.2 Device Capabilities 5

2.3 Test Configuration 5

2.4 EMI Suppression Device(s)/Modifications 5

3.0 DESCRIPTION OF TESTS 6

3.1 Evaluation Procedure 6

3.2 AC Line Conducted Emissions 6

3.3 Radiated Emissions 7

3.4 Environmental Conditions 7

4.0 ANTENNA REQUIREMENTS 8

5.0 MEASUREMENT UNCERTAINTY 9

6.0 TEST EQUIPMENT CALIBRATION DATA 10

7.0 TEST RESULTS 11

7.1 Summary 11

7.2 20dB Bandwidth Measurement 12

7.3 Output Power Measurement 18

7.4 Band Edge Compliance 29

7.5 Carrier Frequency Separation 32

7.6 Time of Occupancy 34

7.7 Number of Hopping Channels 36

7.8 Conducted Spurious Emissions 38

7.9 Radiated Spurious Emission Measurements – Above 1GHz 42

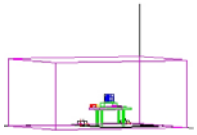
7.10 Radiated Restricted Band Edge Measurements 50

7.11 Radiated Spurious Emissions Measurements – Below 1GHz 52

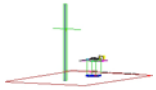
7.12 Line Conducted Measurement Data 56

8.0 CONCLUSION 60

© 2016 PCTEST Engineering Laboratory, Inc.



MEASUREMENT REPORT
FCC Part 15.247



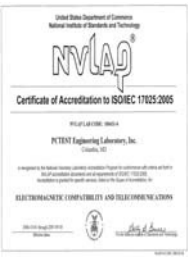
§ 2.1033 General Information

APPLICANT:	Samsung Electronics Co., Ltd.
APPLICANT ADDRESS:	129, Samsung-ro, 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-T713
FCC ID:	A3LSMT713
FCC CLASSIFICATION:	FCC Part 15 Spread Spectrum Transmitter (DSS)
Test Device Serial No.:	0E0FR, 0E0NA, 0D0SJ ☐ Production ☒ Pre-Production ☐ Engineering
Method/System:	Frequency Hopping Spread Spectrum (FHSS)
DATE(S) OF TEST:	3/16 - 3/24/2016
TEST REPORT S/N:	0Y1603160556.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.

© 2016 PCTEST Engineering Laboratory, Inc.

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.

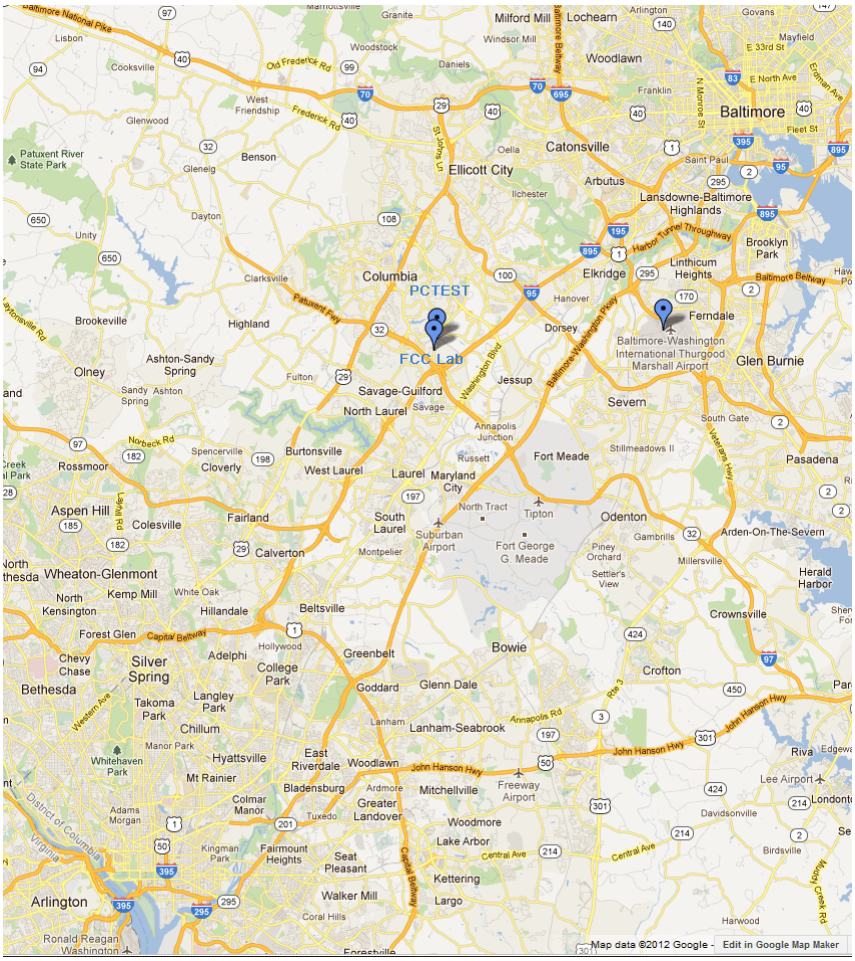


Figure 1-1. Map of the Greater Baltimore and Metropolitan Washington, D.C. area

© 2016 PCTEST Engineering Laboratory, Inc.

2.0 PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the **Samsung Portable Tablet FCC ID: A3LSMT713**. 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/ac WLAN, 802.11a/n/ac UNII, Bluetooth (1x, EDR, LE), ANT+

2.3 Test Configuration

The Samsung Portable Tablet FCC ID: A3LSMT713 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.

© 2016 PCTEST Engineering Laboratory, Inc.

3.0 DESCRIPTION OF TESTS

3.1 Evaluation Procedure

The measurement procedure described in the American National Standard for Testing Unlicensed Wireless Devices (ANSI C63.10-2013) was used in the measurement of the **Samsung Portable Tablet FCC ID: A3LSMT713.**

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. Each emission was also maximized by varying: power lines, the mode of operation or resolution, clock or data exchange speed, scrolling H pattern to the EUT and/or support equipment whichever determined the worst-case 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.

© 2016 PCTEST Engineering Laboratory, Inc.

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. For measurements above 1GHz 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 below 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, clock speed, mode of operation or video resolution, if applicable, 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).

© 2016 PCTEST Engineering Laboratory, Inc.

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 Samsung Portable Tablet are **permanently attached.**
- There are no provisions for connection to an external antenna.

Conclusion:

The **Samsung Portable Tablet FCC ID: A3LSMT713** unit complies with the requirement of §15.203.

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

Table 4-1. Frequency/ Channel Operations

© 2016 PCTEST Engineering Laboratory, Inc.

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

© 2016 PCTEST Engineering Laboratory, Inc.

6.0 TEST EQUIPMENT CALIBRATION DATA

Test Equipment Calibration is traceable to the National Institute of Standards and Technology (NIST).

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
-	BT2	Bluetooth Cable Set	10/13/2015	Annual	10/13/2016	BT2
-	RE3	Radiated Emissions Cable Set	4/29/2015	Annual	4/29/2016	RE3
Agilent	8447D	Broadband Amplifier	6/12/2015	Annual	6/12/2016	2443A01900
Agilent	N4010A	Wireless Connectivity Test Set	N/A			GB46170464
Agilent	N9020A	MXA Signal Analyzer	11/5/2015	Annual	11/5/2016	US46470561
Agilent	N9038A	MXE EMI Receiver	3/24/2015	Annual	3/24/2016	MY51210133
Com-Power	AL-130	9kHz - 30MHz Loop Antenna	7/30/2015	Biennial	7/30/2017	121034
ETS Lindgren	3117	1-18 GHz DRG Horn (Medium)	4/8/2014	Biennial	4/8/2016	125518
ETS Lindgren	3160-09	18-26.5 GHz Standard Gain Horn	6/17/2014	Biennial	6/17/2016	135427
ETS-Lindgren	3816/2NM	Line Impedance Stabilization Network	11/11/2014	Biennial	11/11/2016	114451
K & L	11SH10-3075/U18000	High Pass Filter	7/18/2015	Annual	7/18/2016	11SH10-3075/U18000-2
Pasternack	NMLC-1	Line Conducted Emissions Cable (NM)	4/28/2015	Annual	4/28/2016	NMLC-1
Rhode & Schwarz	TS-PR18	Pre-Amplifier	3/7/2016	Annual	3/7/2017	101622
Rohde & Schwarz	CMU200	Base Station Simulator	N/A			107826
Rohde & Schwarz	ESU40	EMI Test Receiver (40GHz)	7/17/2015	Annual	7/17/2016	100348
Rohde & Schwarz	FSW67	Signal / Spectrum Analyzer	6/2/2015	Annual	6/2/2016	103200
Rohde & Schwarz	TS-PR26	18-26.5 GHz Pre-Amplifier	3/7/2016	Annual	3/7/2017	100040
Seekonk	NC-100	Torque Wrench 5/16", 8" lbs	3/2/2016	Biennial	3/2/2018	N/A
Sunol	JB5	Bi-Log Antenna (30M - 5GHz)	3/28/2014	Biennial	3/28/2016	A051107

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.

© 2016 PCTEST Engineering Laboratory, Inc.

7.0 TEST RESULTS

7.1 Summary

Company Name: Samsung Electronics Co., Ltd.

FCC ID: A3LSMT713

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 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 3.0.
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.

© 2016 PCTEST Engineering Laboratory, Inc.

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.

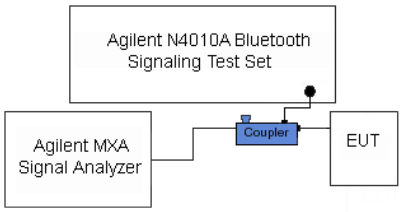


Figure 7-1. Test Instrument & Measurement Setup

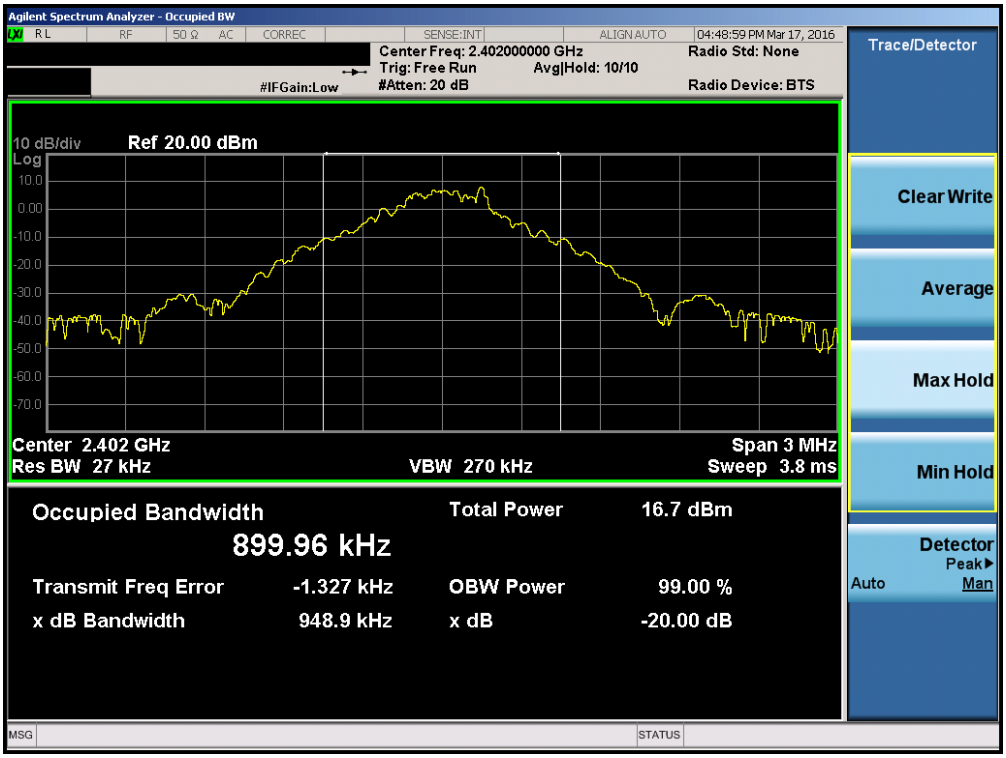
Test Notes

None

© 2016 PCTEST Engineering Laboratory, Inc.

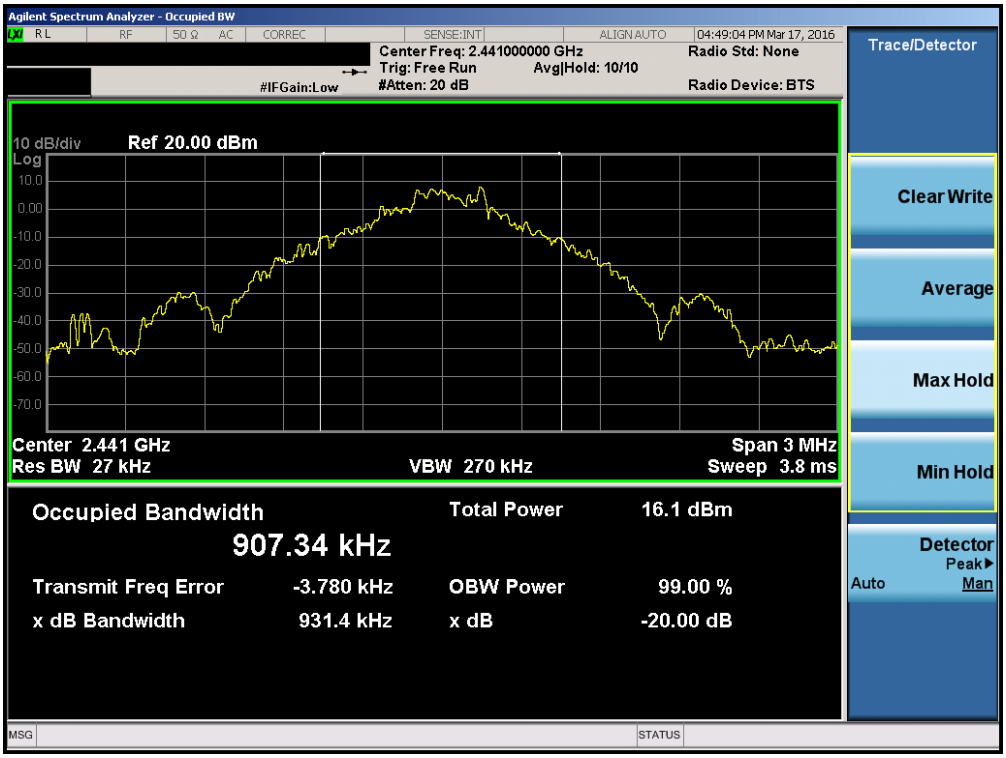
Frequency [MHz]	Data Rate [Mbps]	Channel No.	20dB Bandwidth Test Results	
			Measured Bandwidth [kHz]	Pass/Fail
2402	1.0	0	948.90	Pass
2441	1.0	39	931.40	Pass
2480	1.0	78	937.10	Pass
2402	2.0	0	1334.00	Pass
2441	2.0	39	1312.00	Pass
2480	2.0	78	1296.00	Pass
2402	3.0	0	1272.00	Pass
2441	3.0	39	1257.00	Pass
2480	3.0	78	1322.00	Pass

Table 7-2. Conducted 20dB Bandwidth Measurements

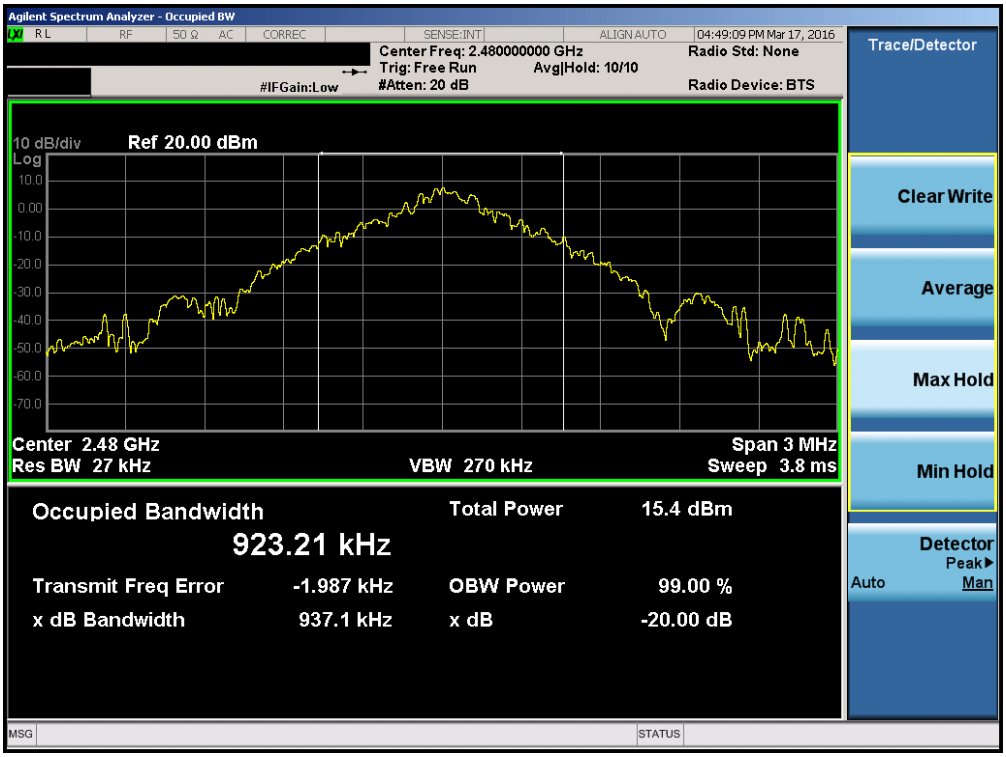


Plot 7-1. 20dB Bandwidth Plot (Bluetooth, 1Mbps – Ch. 0)

© 2016 PCTEST Engineering Laboratory, Inc.

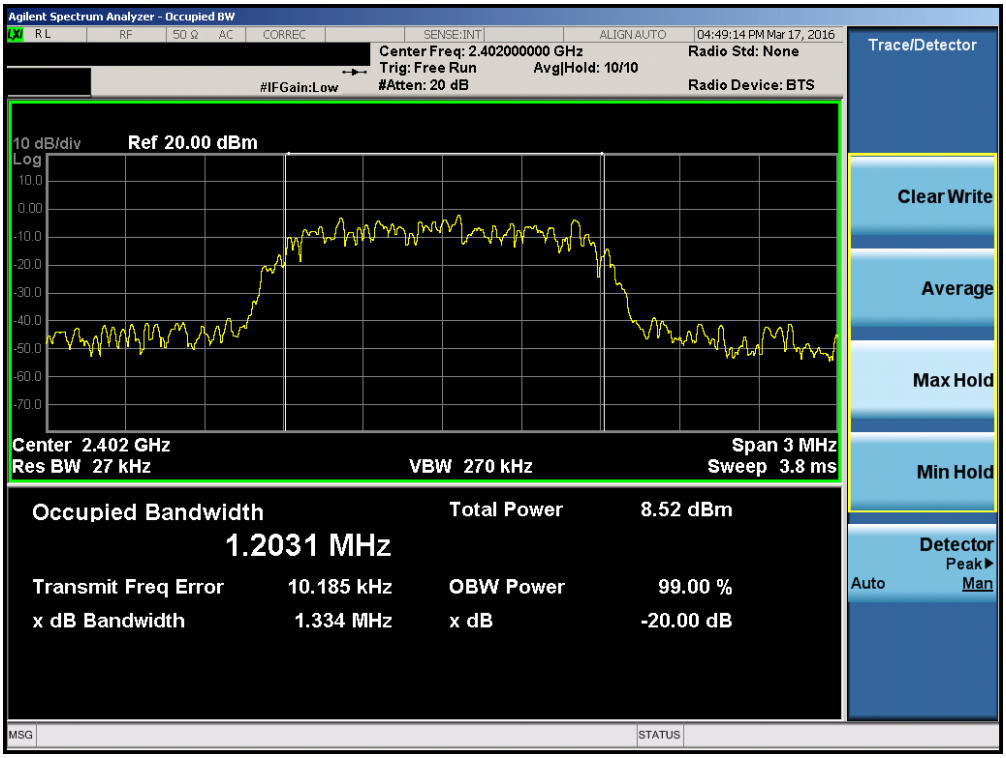


Plot 7-2. 20dB Bandwidth Plot (Bluetooth, 1Mbps – Ch. 39)

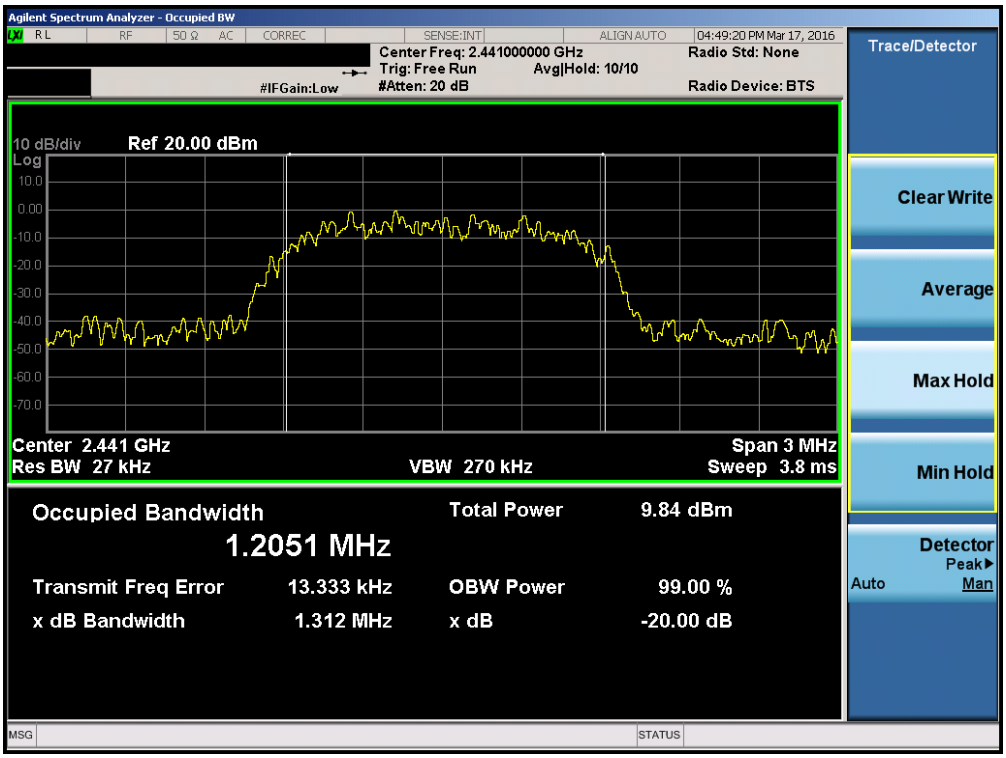


Plot 7-3. 20dB Bandwidth Plot (Bluetooth, 1Mbps – Ch. 78)

© 2016 PCTEST Engineering Laboratory, Inc.

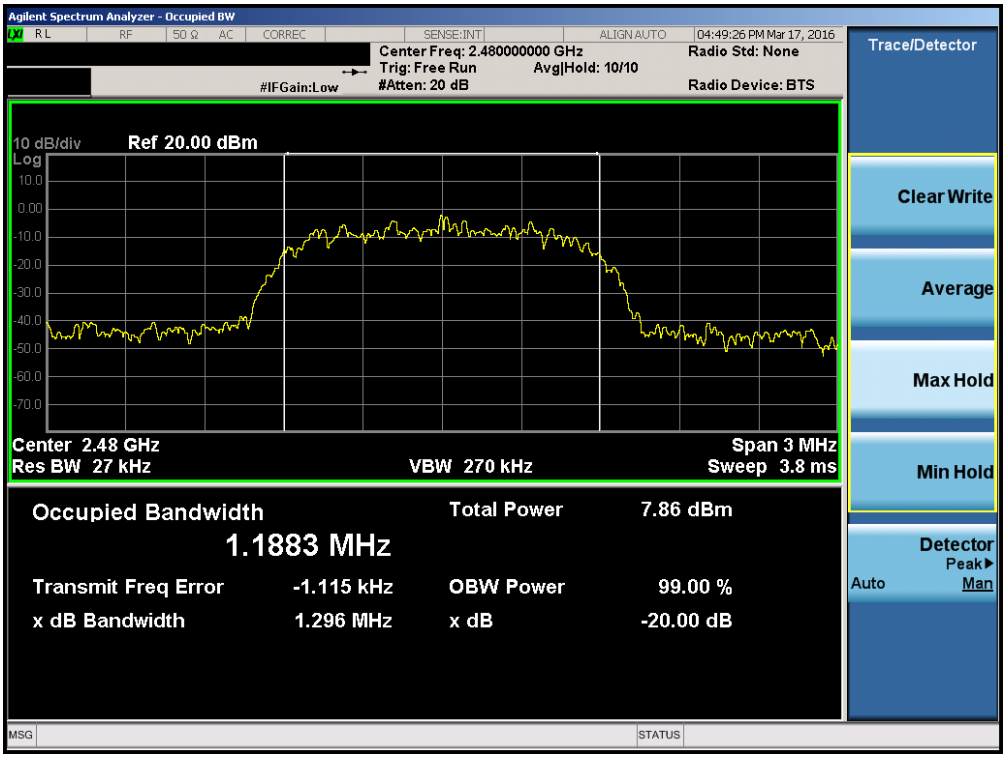


Plot 7-4. 20dB Bandwidth Plot (Bluetooth, 2Mbps – Ch. 0)

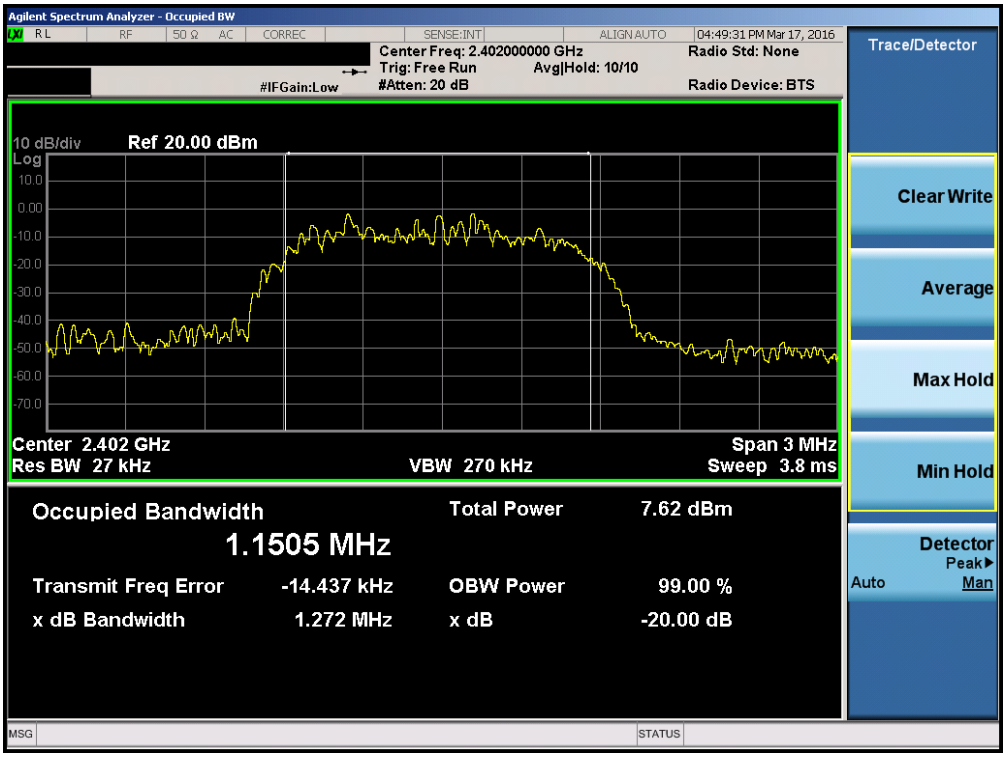


Plot 7-5. 20dB Bandwidth Plot (Bluetooth, 2Mbps – Ch. 39)

© 2016 PCTEST Engineering Laboratory, Inc.

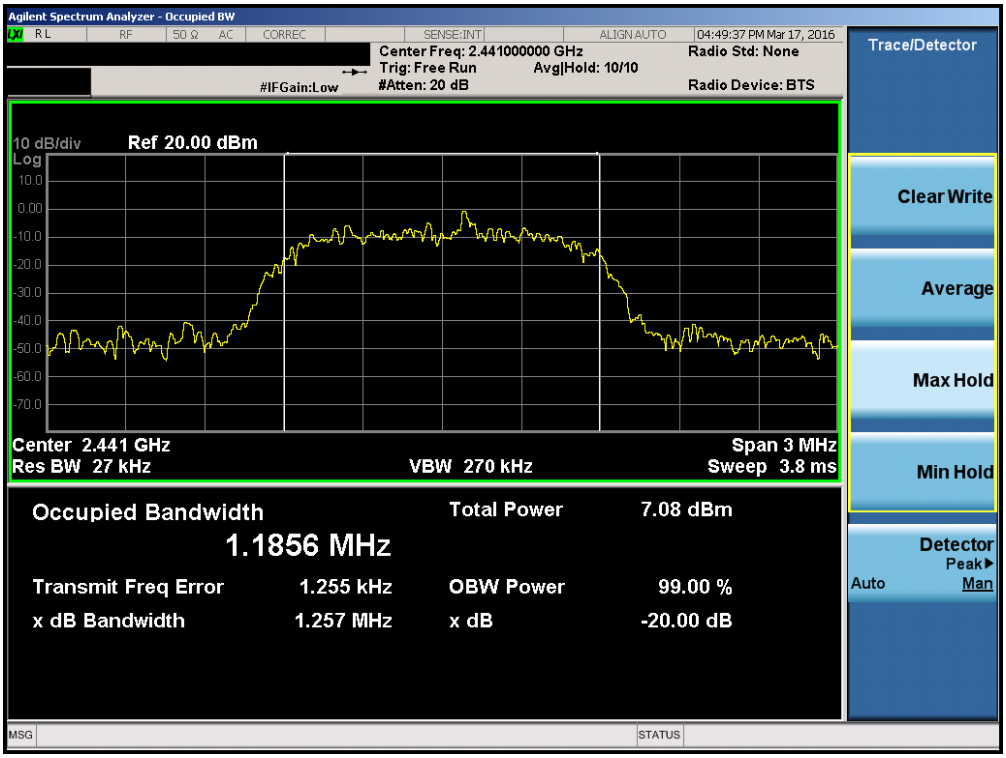


Plot 7-6. 20dB Bandwidth Plot (Bluetooth, 2Mbps – Ch. 78)

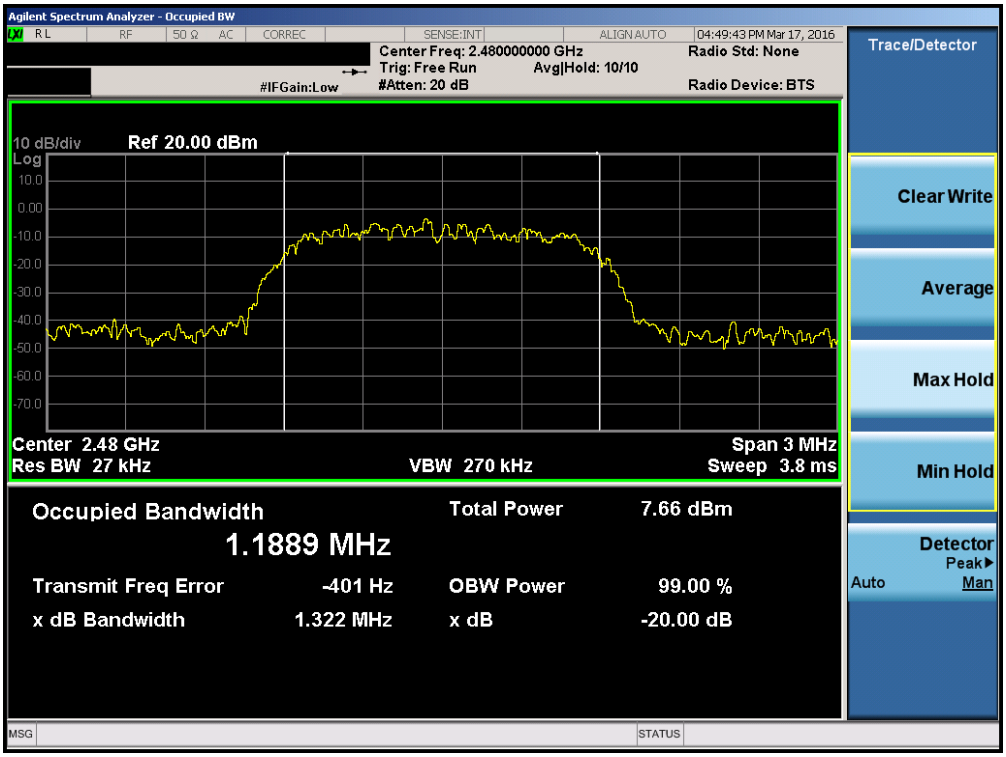


Plot 7-7. 20dB Bandwidth Plot (Bluetooth, 3Mbps – Ch. 0)

© 2016 PCTEST Engineering Laboratory, Inc.



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



Plot 7-9. 20dB Bandwidth Plot (Bluetooth, 3Mbps – Ch. 78)

© 2016 PCTEST Engineering Laboratory, Inc.

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 v05r02. 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.

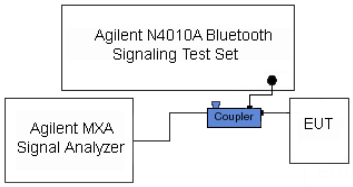


Figure 7-2. Test Instrument & Measurement Setup

Note

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

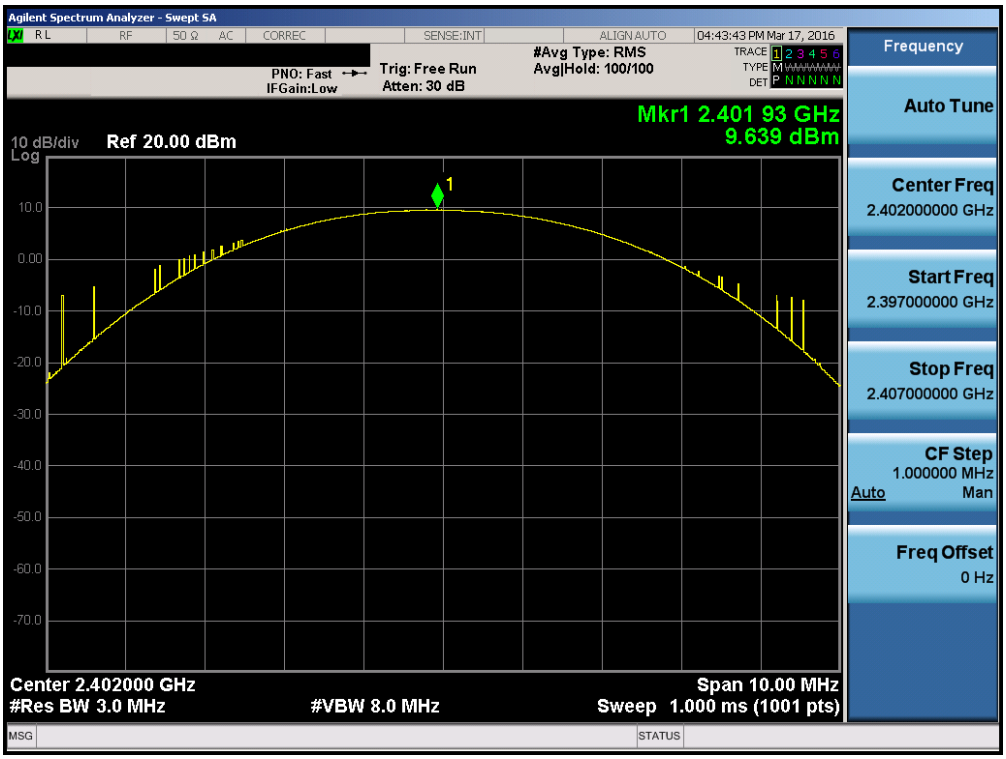
Final results were obtained using calibrated couplers, attenuators and cables. The following formula was used:

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

© 2016 PCTEST Engineering Laboratory, Inc.

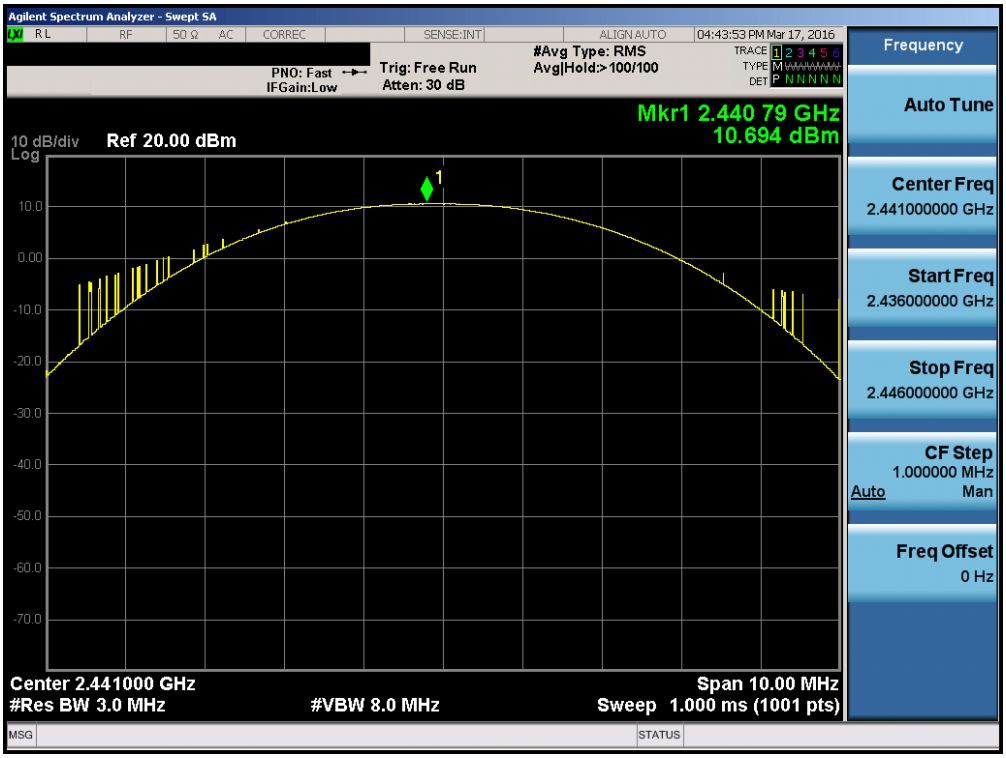
Frequency [MHz]	Data Rate [Mbps]	Channel No.	Peak Conducted Power		Avg Conducted Power	
			[dBm]	[mW]	[dBm]	[mW]
2402	1.0	0	9.64	9.202	9.44	8.791
2441	1.0	39	10.69	11.733	10.48	11.179
2480	1.0	78	10.64	11.580	10.35	10.839
2402	2.0	0	9.48	8.861	5.97	3.957
2441	2.0	39	9.60	9.126	7.10	5.126
2480	2.0	78	9.56	9.045	6.90	4.901
2402	3.0	0	8.92	7.797	5.99	3.972
2441	3.0	39	10.05	10.123	7.17	5.215
2480	3.0	78	9.96	9.913	6.99	5.001

Table 7-3. Conducted Output Power Measurements



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

© 2016 PCTEST Engineering Laboratory, Inc.

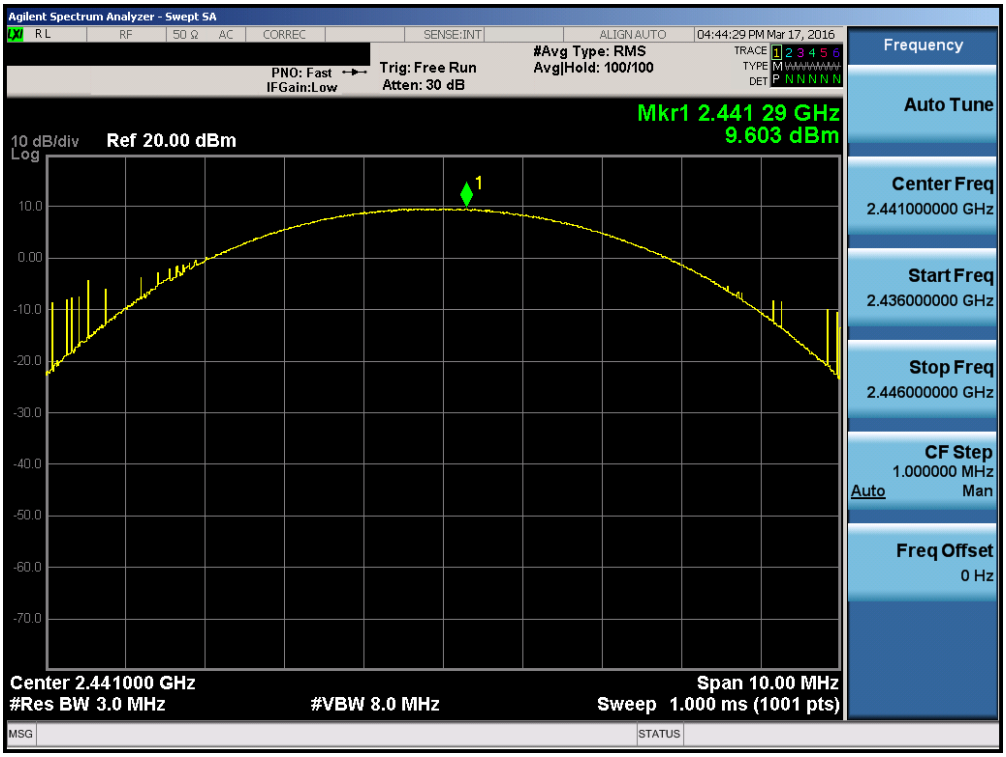


Plot 7-11. Peak Conducted Power (1Mbps – Ch. 39)

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

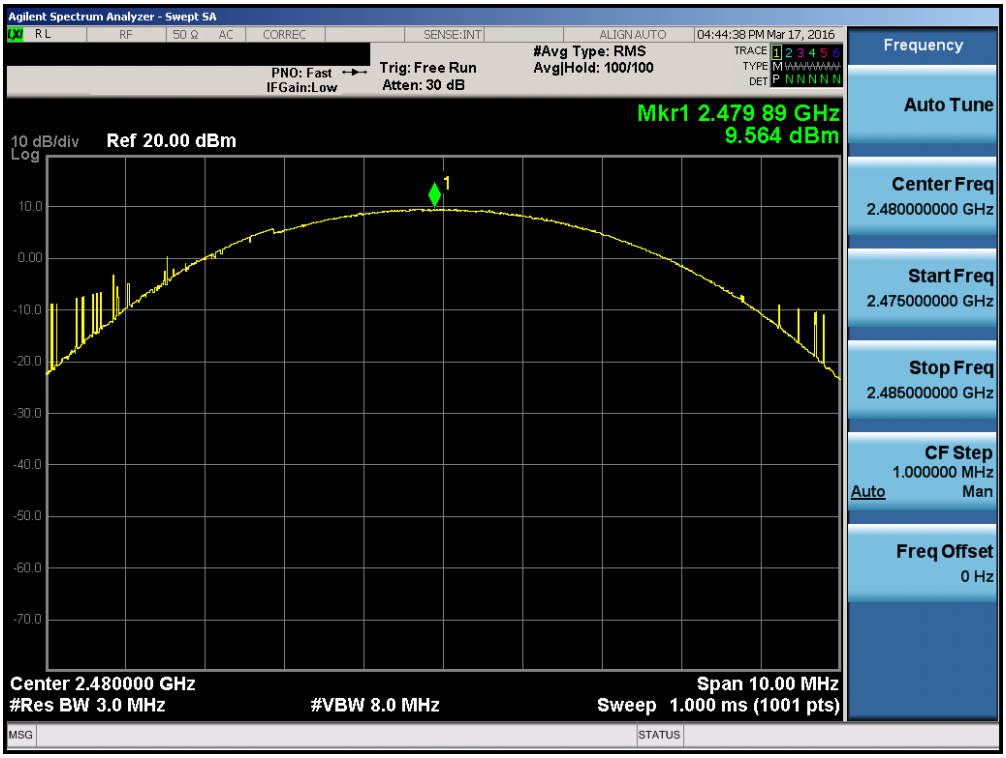
© 2016 PCTEST Engineering Laboratory, Inc.

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

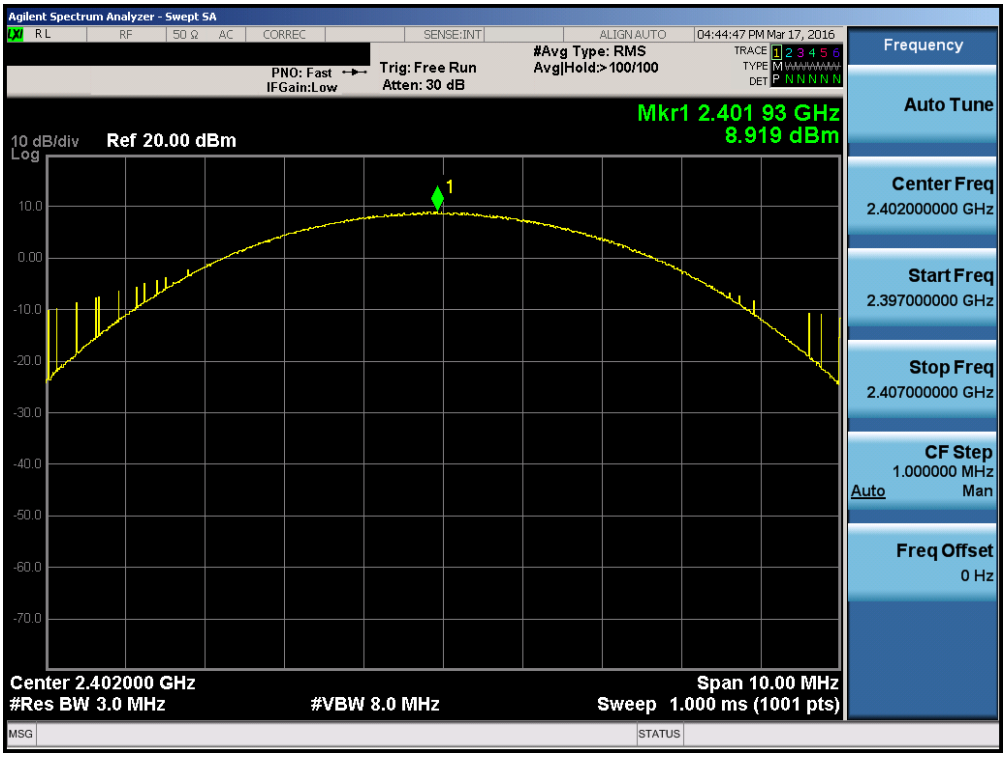


Plot 7-14. Peak Conducted Power (2Mbps – Ch. 39)

© 2016 PCTEST Engineering Laboratory, Inc.

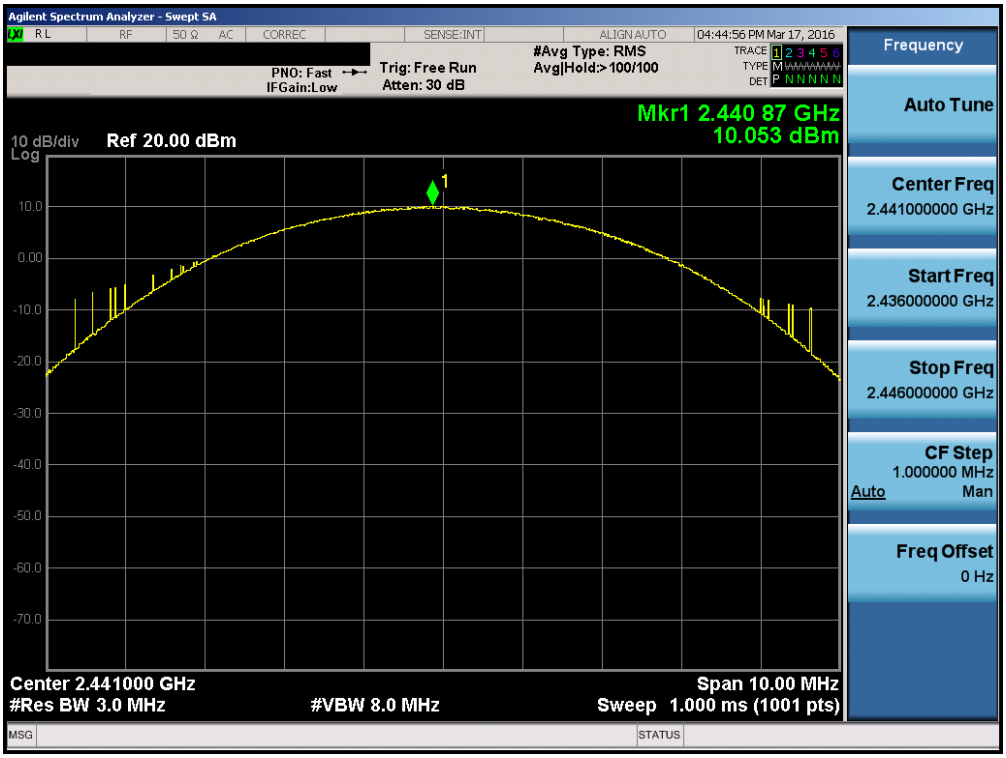


Plot 7-15. Peak Conducted Power (2Mbps – Ch. 78)

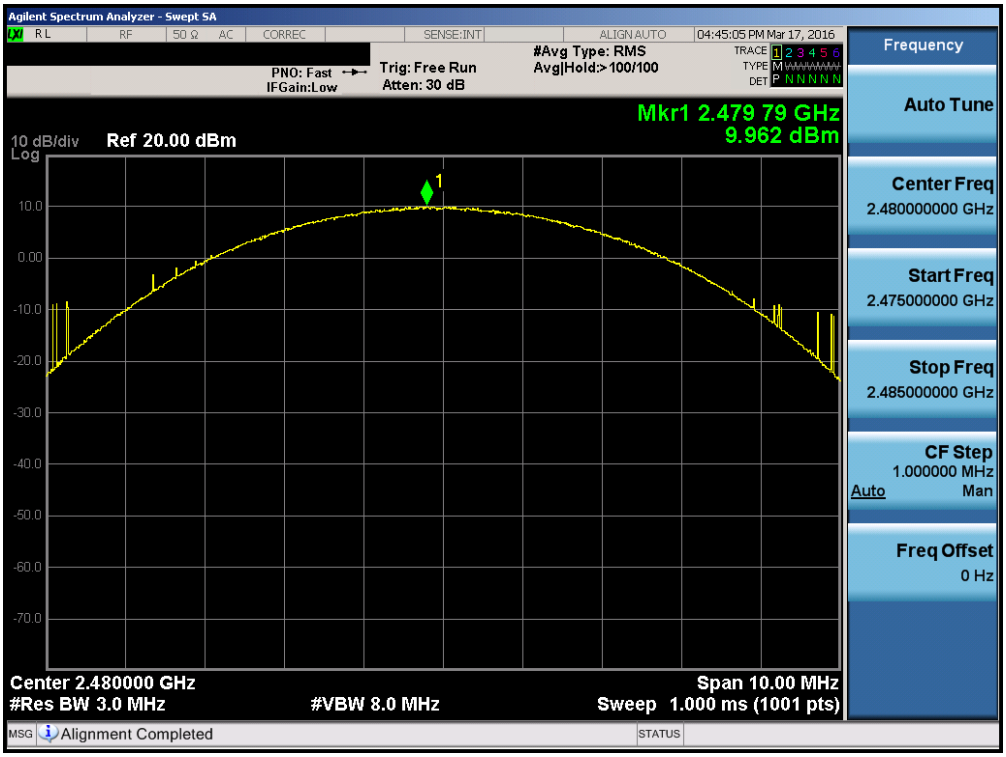


Plot 7-16. Peak Conducted Power (3Mbps – Ch. 0)

© 2016 PCTEST Engineering Laboratory, Inc.

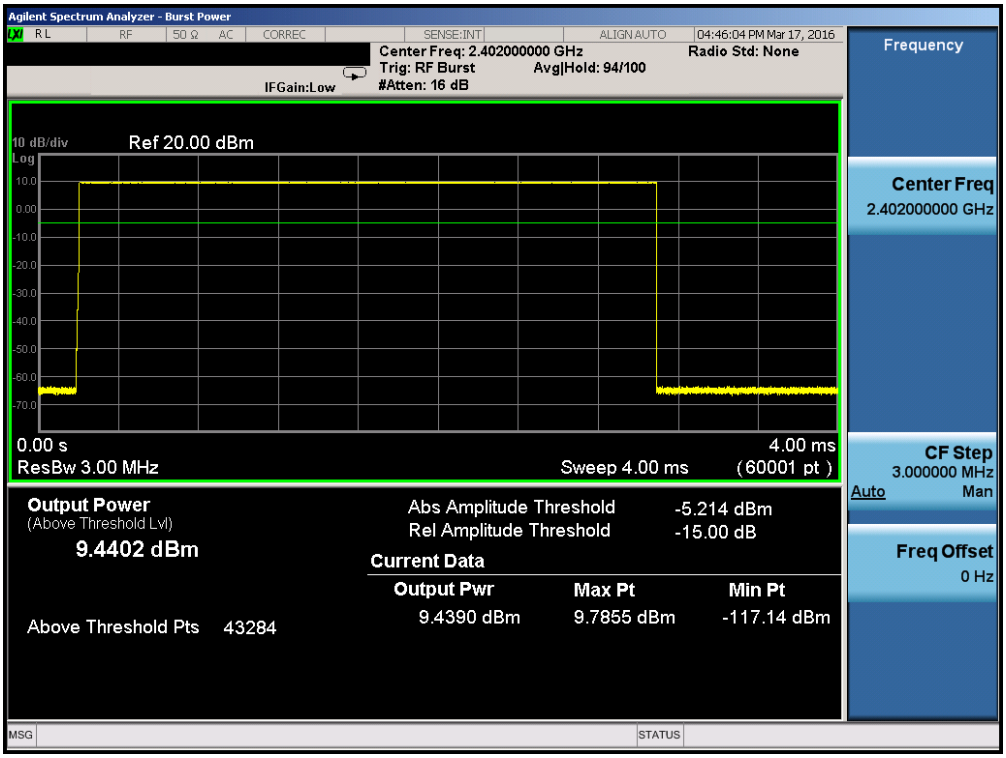


Plot 7-17. Peak Conducted Power (3Mbps – Ch. 39)

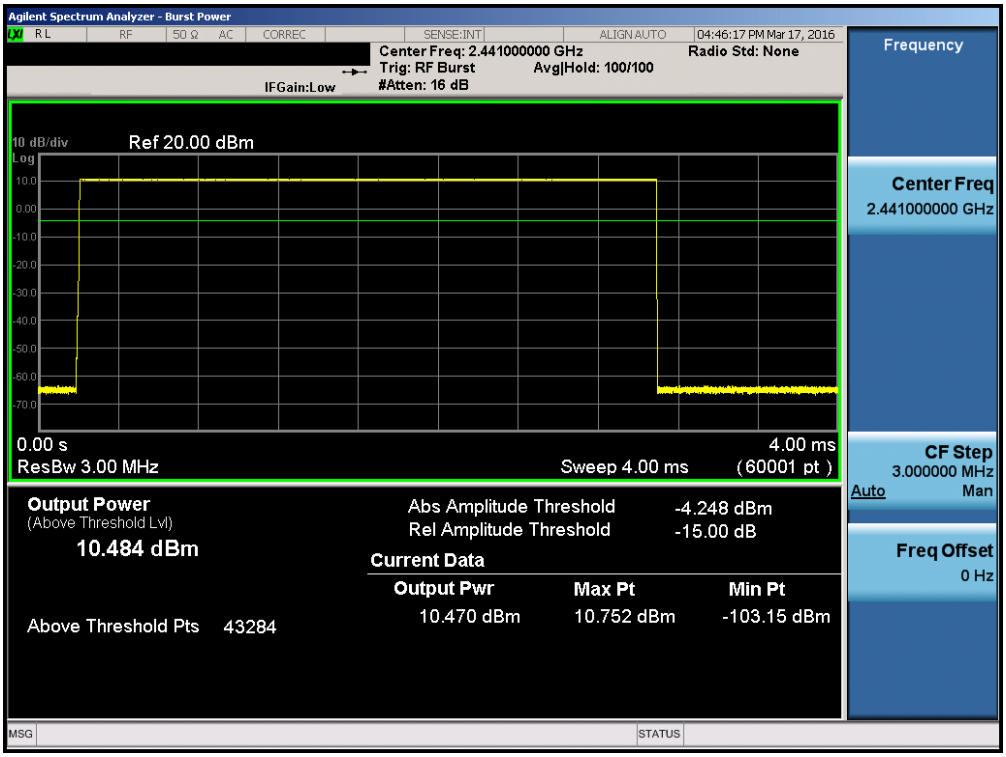


Plot 7-18. Peak Conducted Power (3Mbps – Ch. 78)

© 2016 PCTEST Engineering Laboratory, Inc.

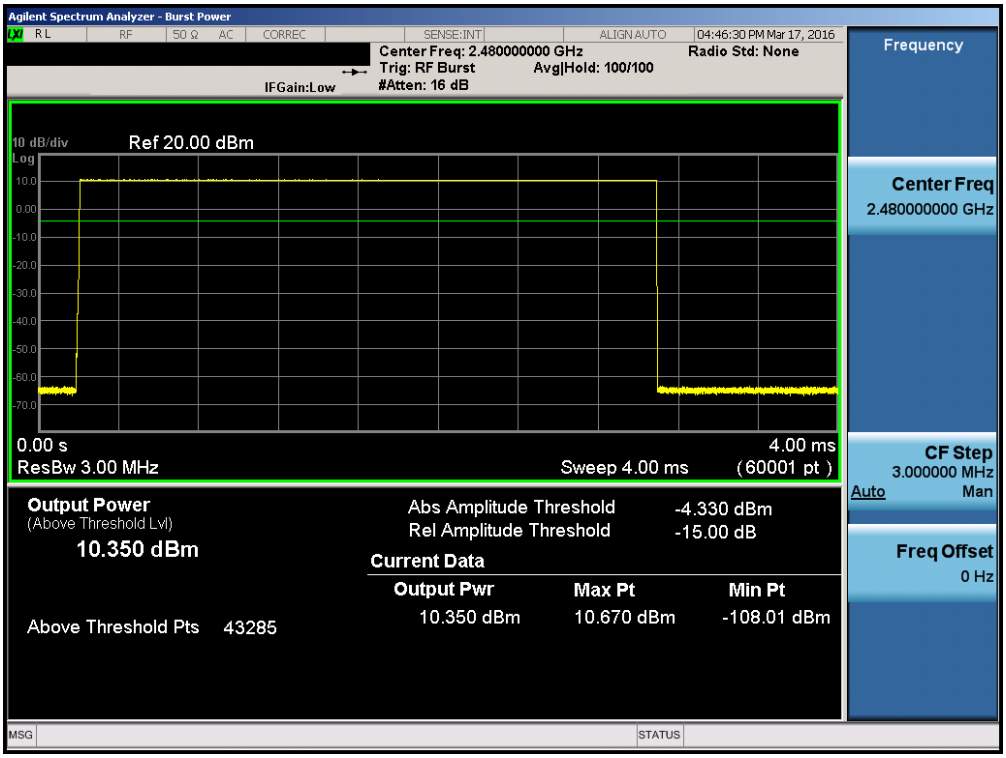


Plot 7-19. Average Conducted Power (1Mbps – Ch. 0)

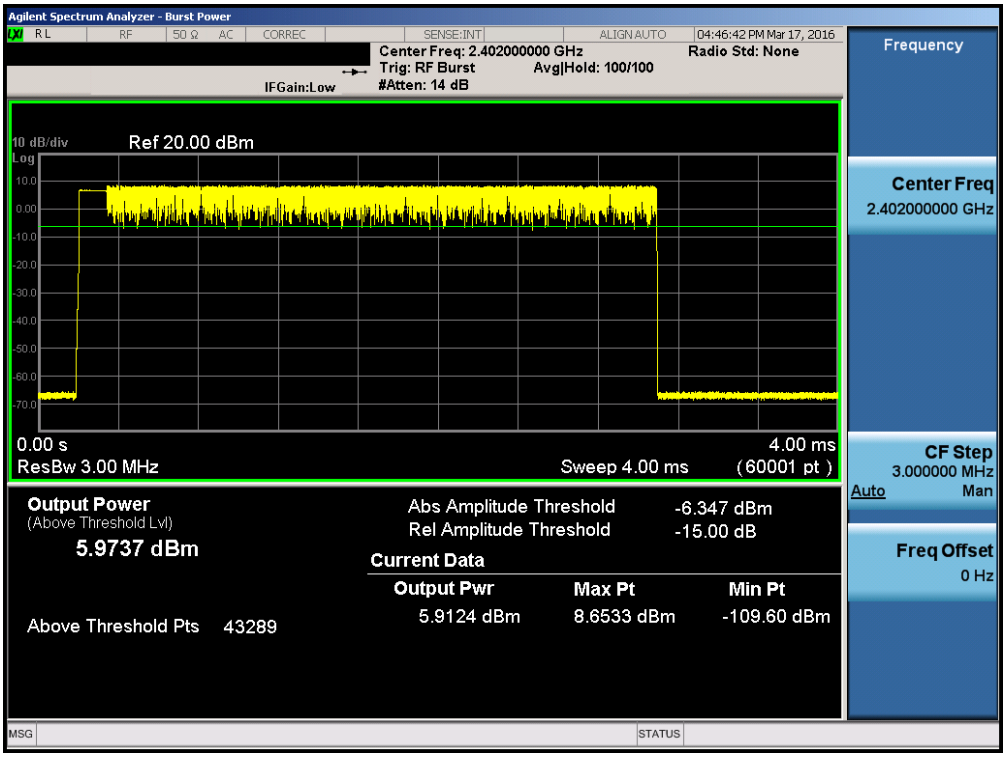


Plot 7-20. Average Conducted Power (1Mbps – Ch. 39)

© 2016 PCTEST Engineering Laboratory, Inc.

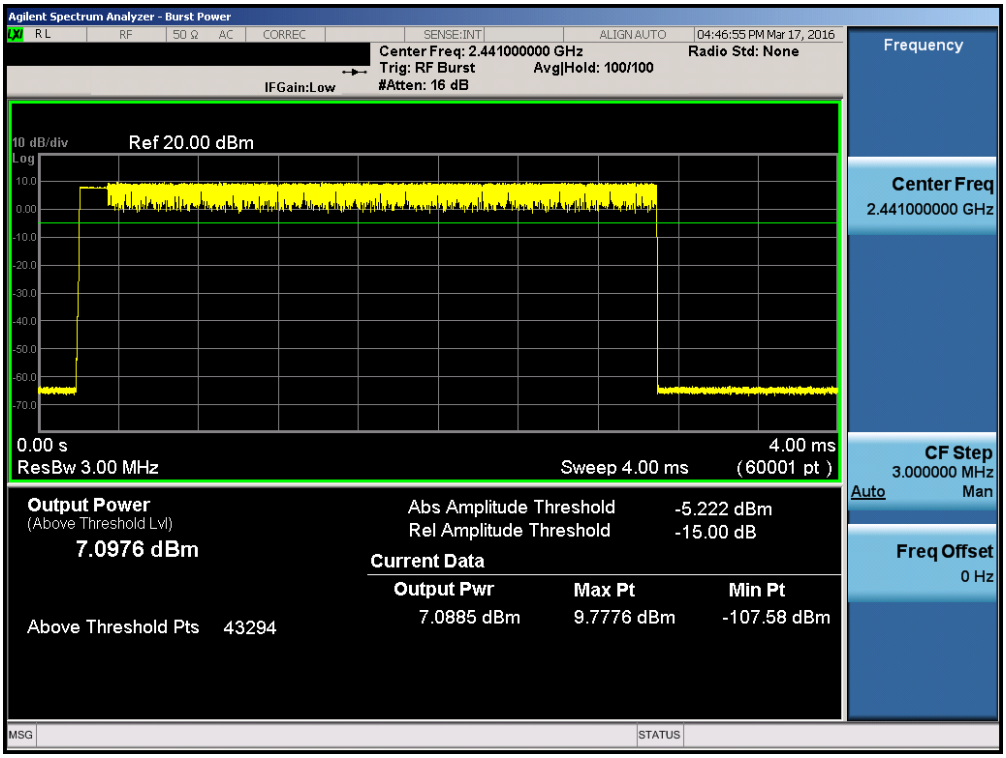


Plot 7-21. Average Conducted Power (1Mbps – Ch. 78)

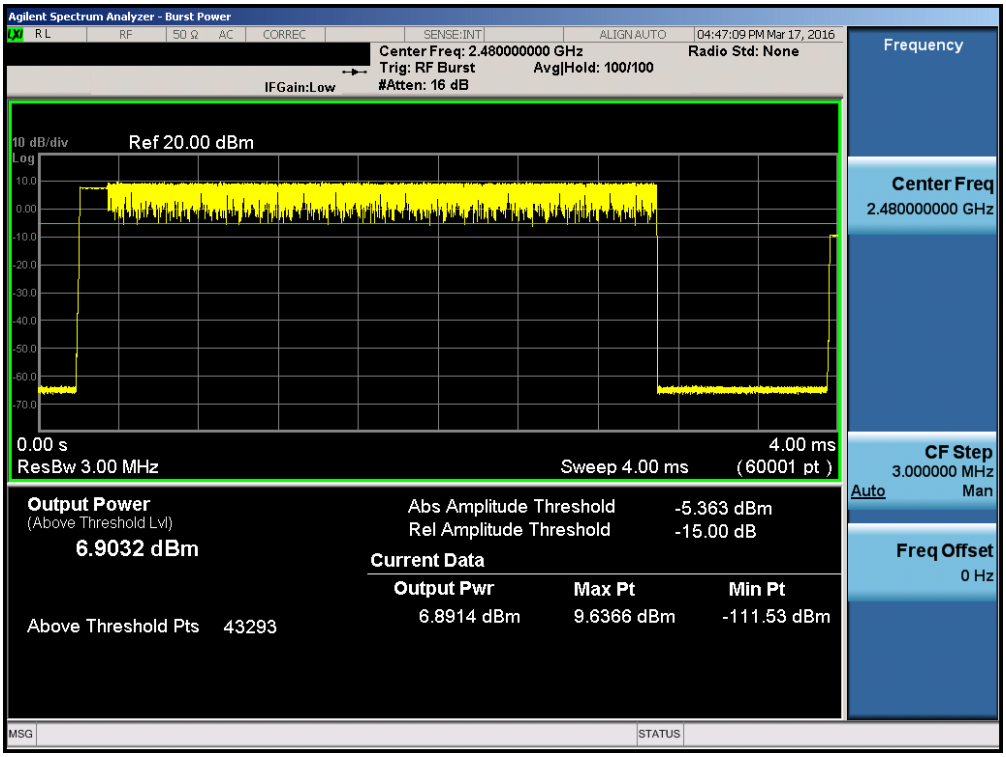


Plot 7-22. Average Conducted Power (2Mbps – Ch. 0)

© 2016 PCTEST Engineering Laboratory, Inc.

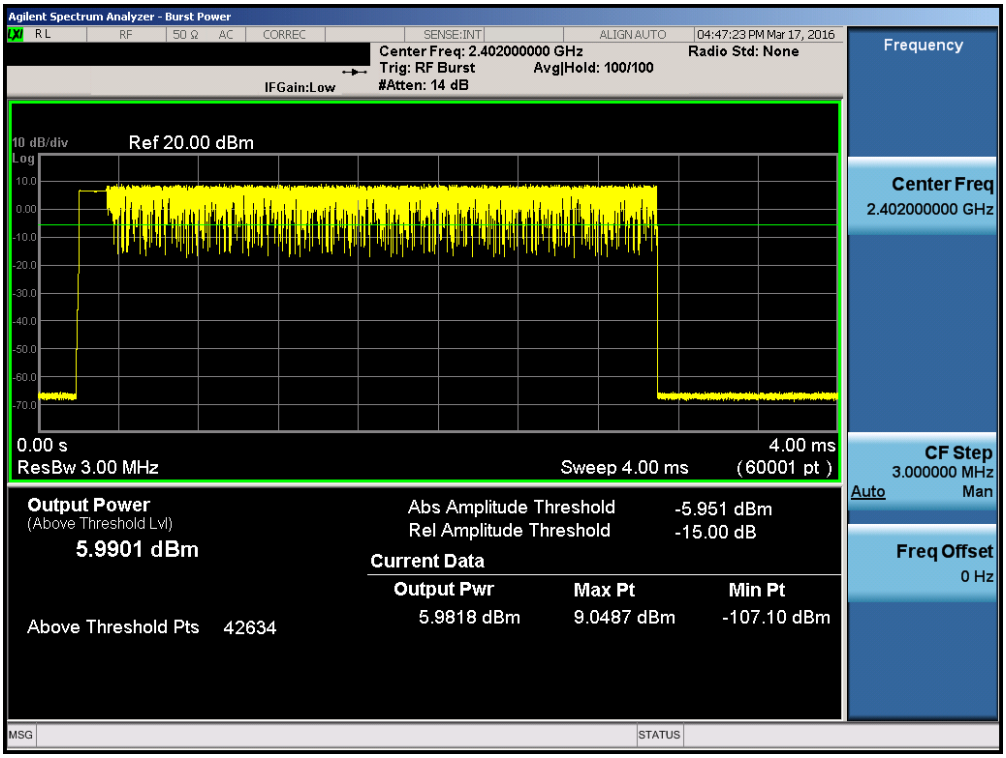


Plot 7-23. Average Conducted Power (2Mbps – Ch. 39)

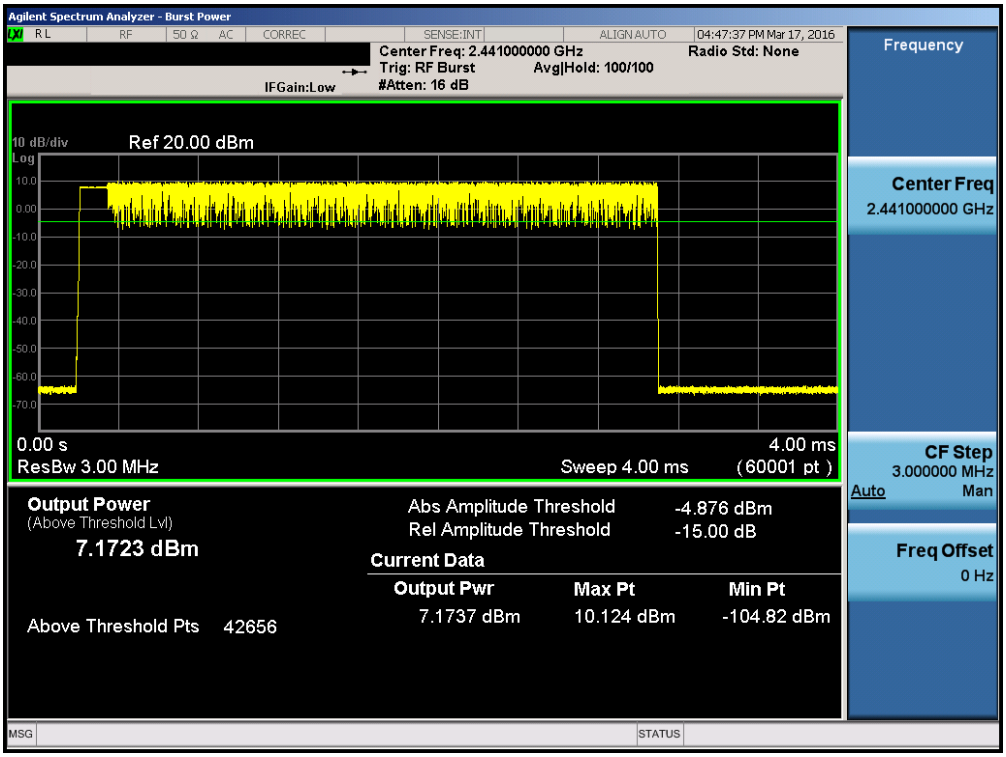


Plot 7-24. Average Conducted Power (2Mbps – Ch. 78)

© 2016 PCTEST Engineering Laboratory, Inc.

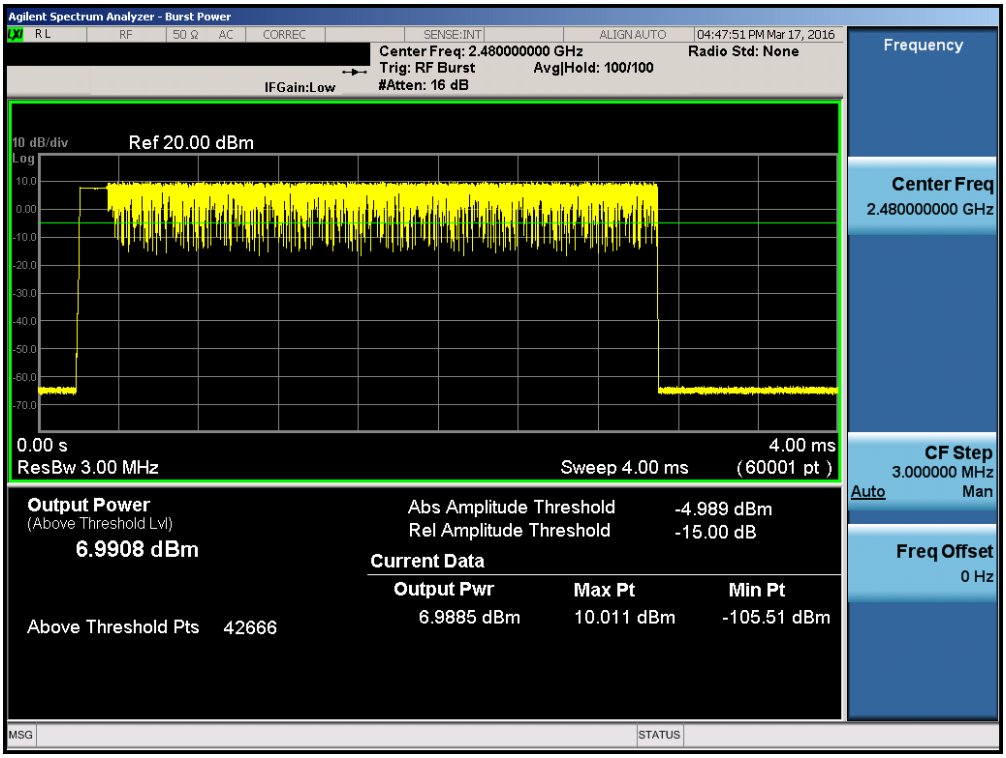


Plot 7-25. Average Conducted Power (3Mbps – Ch. 0)



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

© 2016 PCTEST Engineering Laboratory, Inc.



Plot 7-27. Average Conducted Power (3Mbps – Ch. 78)

© 2016 PCTEST Engineering Laboratory, Inc.

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.

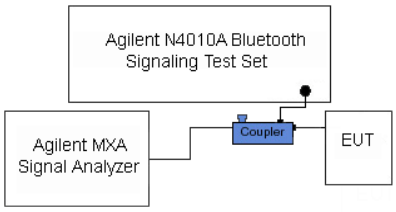
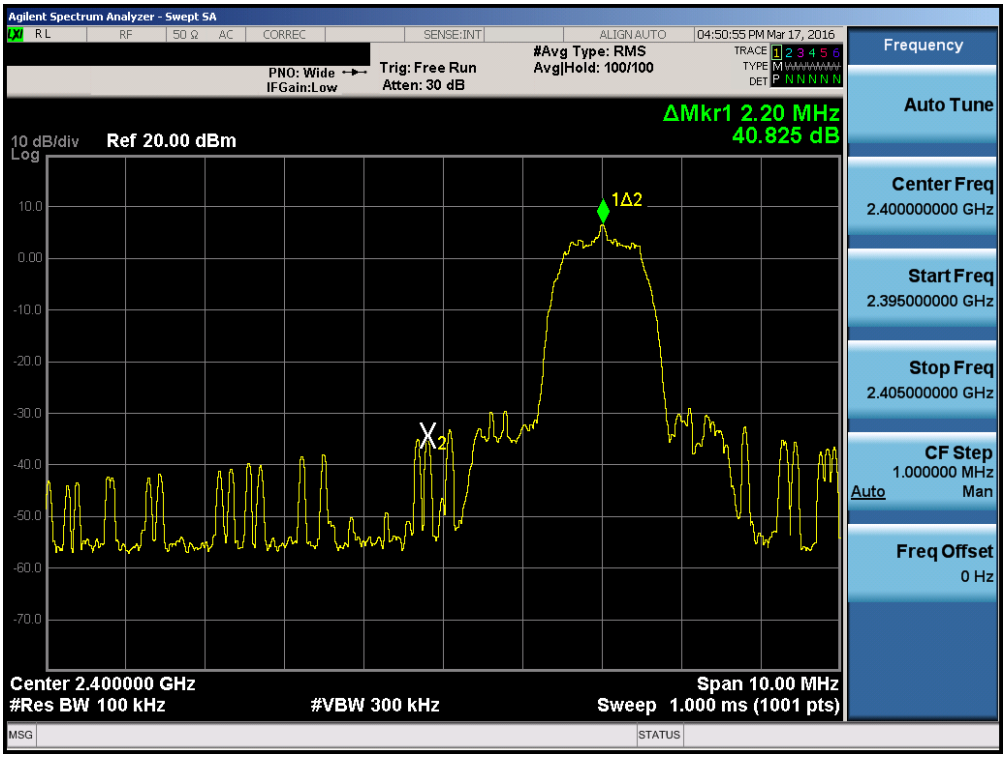


Figure 7-3. Test Instrument & Measurement Setup

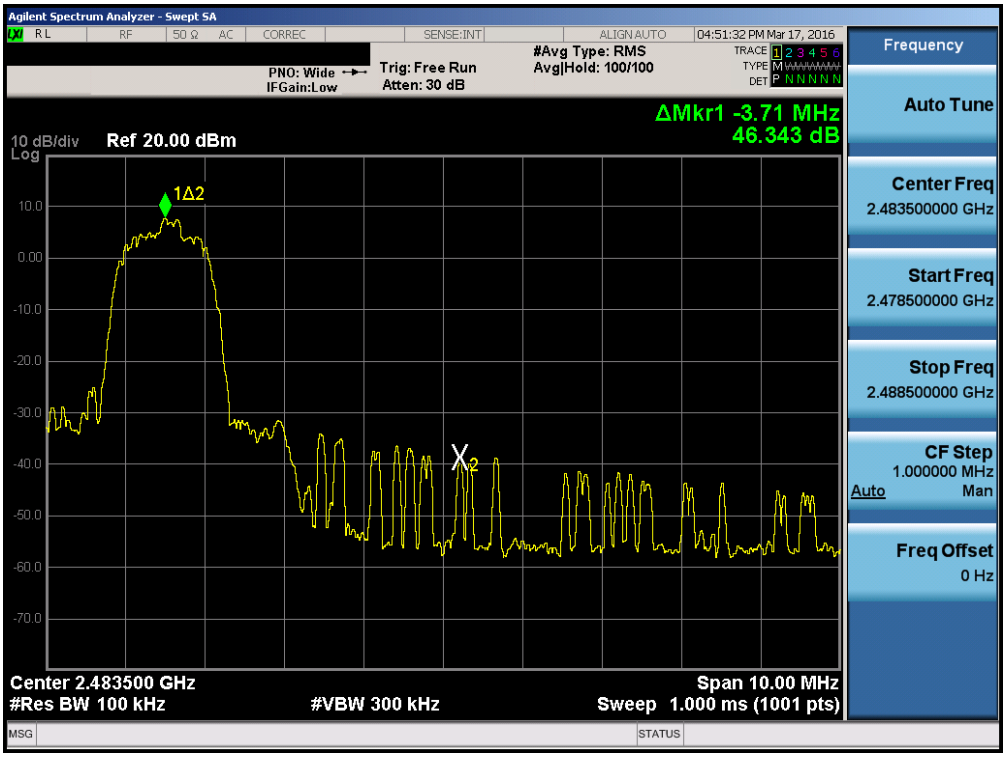
Test Notes

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.

© 2016 PCTEST Engineering Laboratory, Inc.

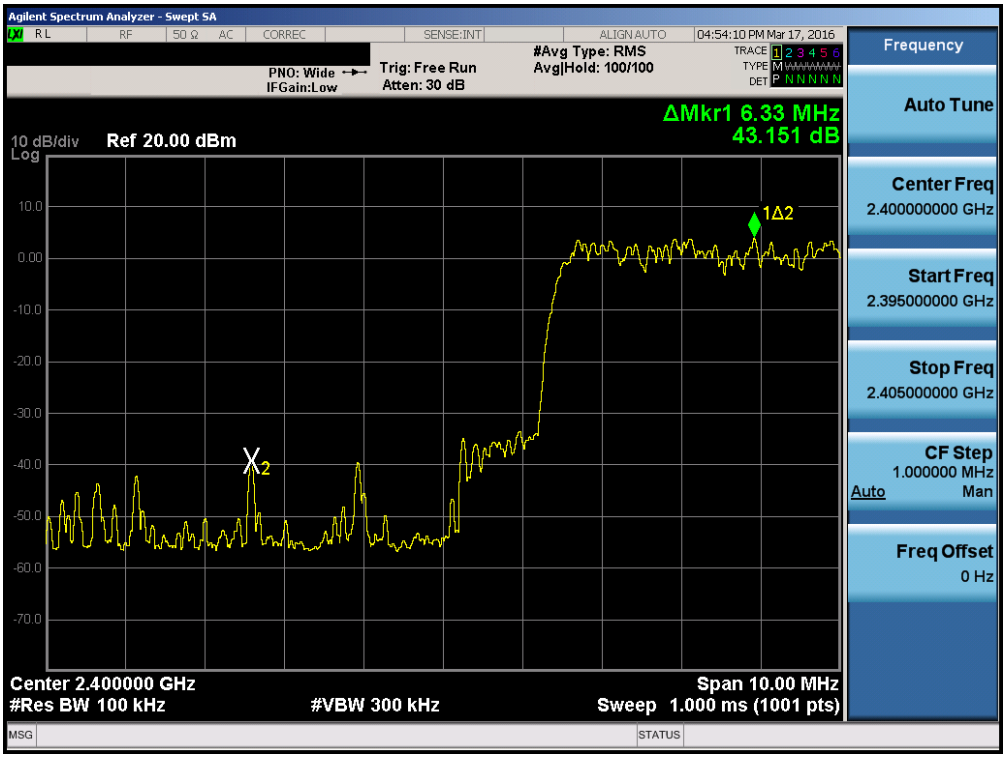


Plot 7-28. Band Edge Plot (Bluetooth with Hopping Disabled, 3 Mbps – Ch. 0)

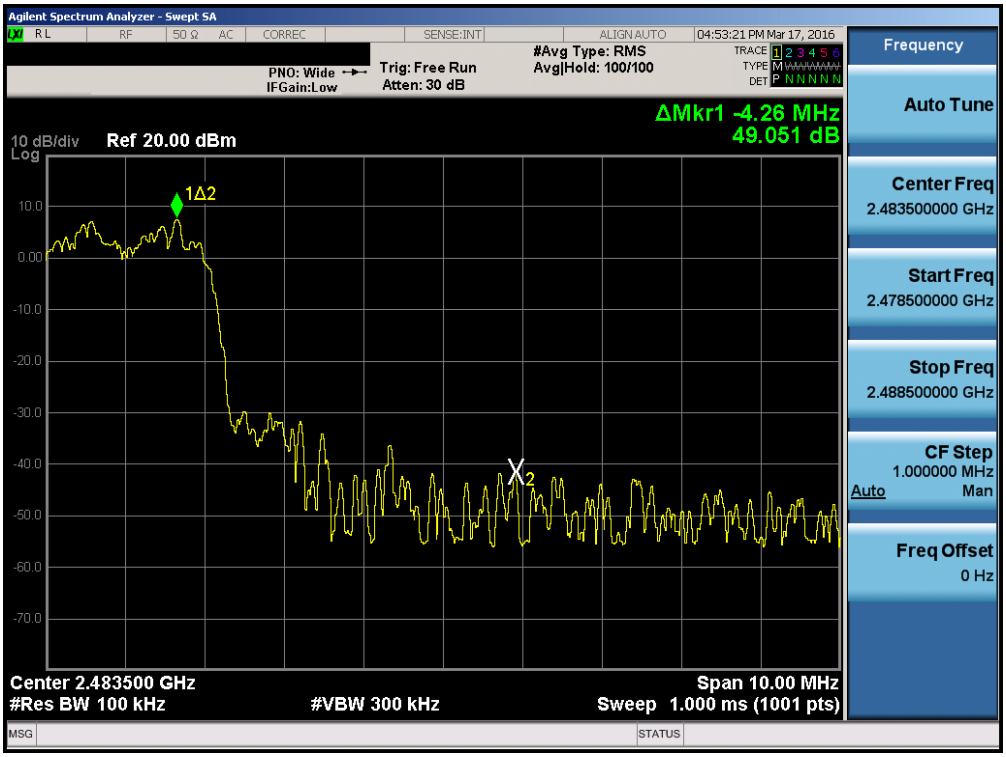


Plot 7-29. Band Edge Plot (Bluetooth with Hopping Disabled, 3 Mbps – Ch. 78)

© 2016 PCTEST Engineering Laboratory, Inc.



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



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

© 2016 PCTEST Engineering Laboratory, Inc.

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.

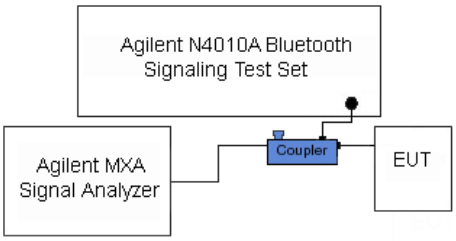


Figure 7-4. Test Instrument & Measurement Setup

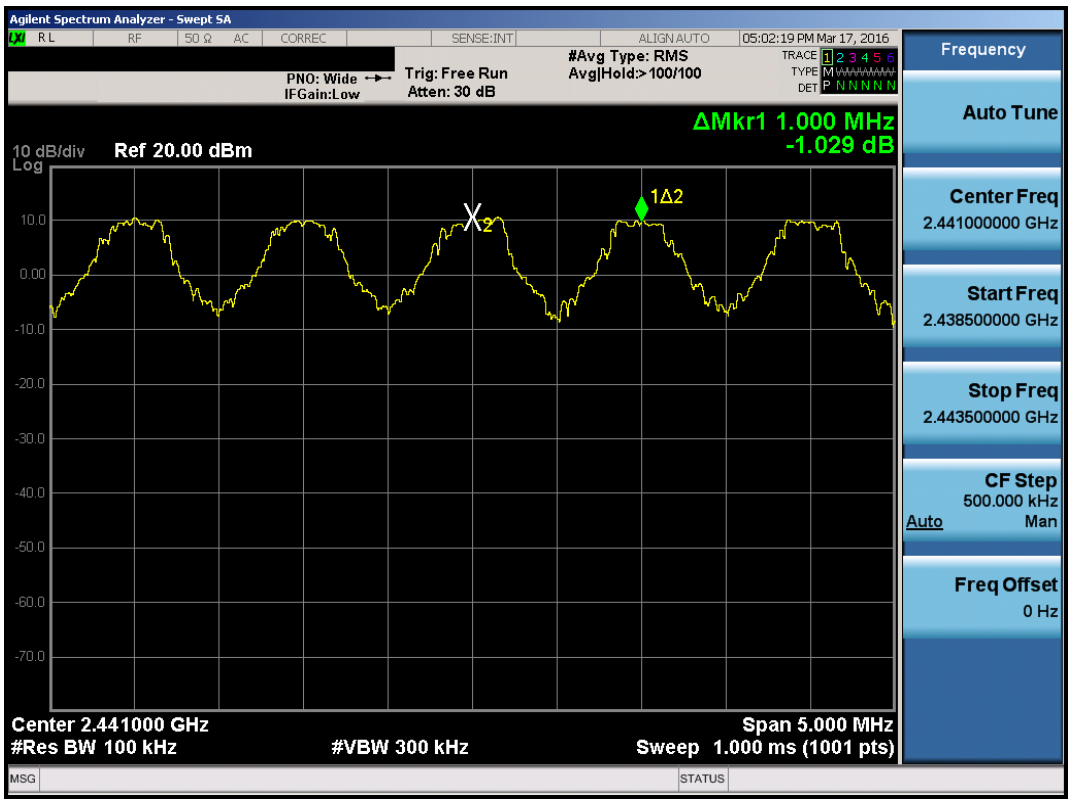
Test Notes

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.

© 2016 PCTEST Engineering Laboratory, Inc.

Frequency [MHz]	Data Rate [Mbps]	Channel No.	Min. Channel Separation [MHz]
2402	1.0	0	0.633
2441	1.0	39	0.623
2480	1.0	78	0.625
2402	2.0	0	0.889
2441	2.0	39	0.875
2480	2.0	78	0.894
2402	3.0	0	0.848
2441	3.0	39	0.857
2480	3.0	78	0.881

Table 7-4. Minimum Channel Separation



Plot 7-32. Channel Spacing Plot (Bluetooth)

© 2016 PCTEST Engineering Laboratory, Inc.

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.

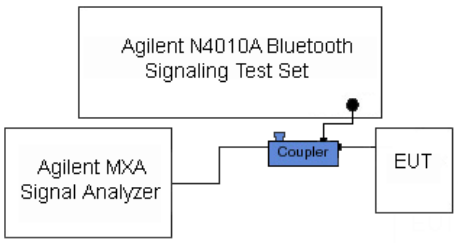
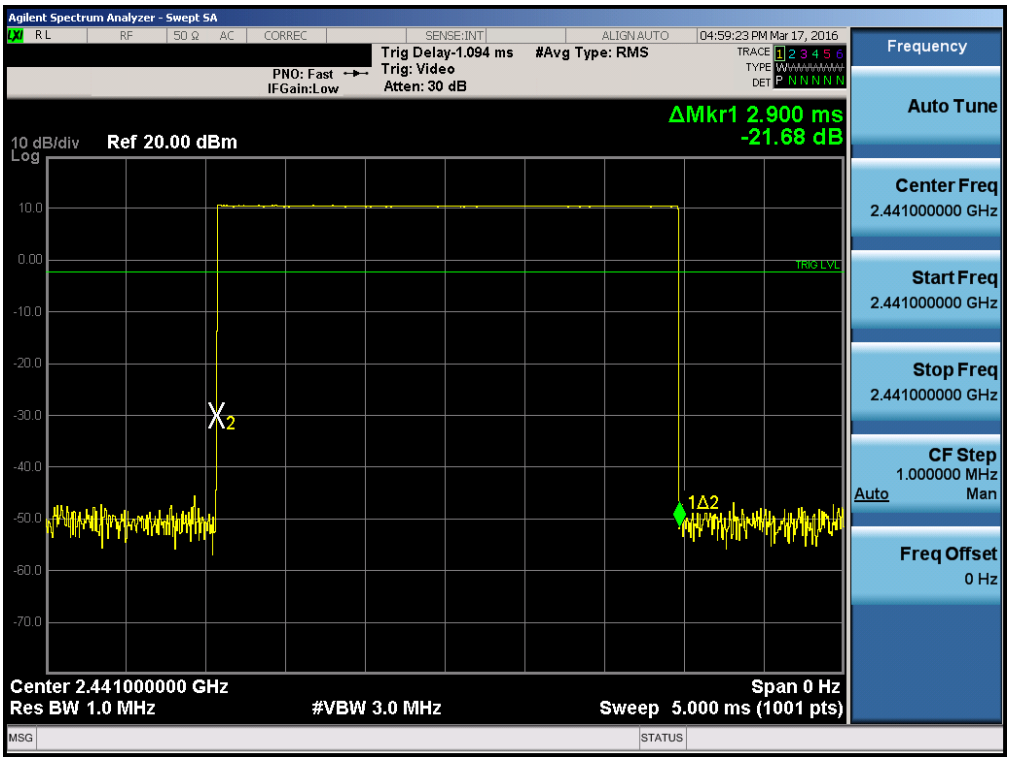


Figure 7-5. Test Instrument & Measurement Setup

Test Notes

None

© 2016 PCTEST Engineering Laboratory, Inc.



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)

© 2016 PCTEST Engineering Laboratory, Inc.

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.

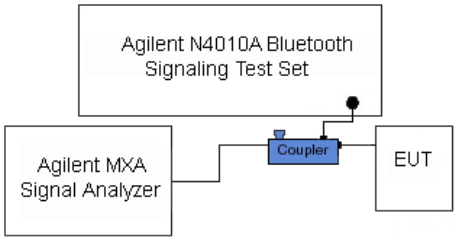
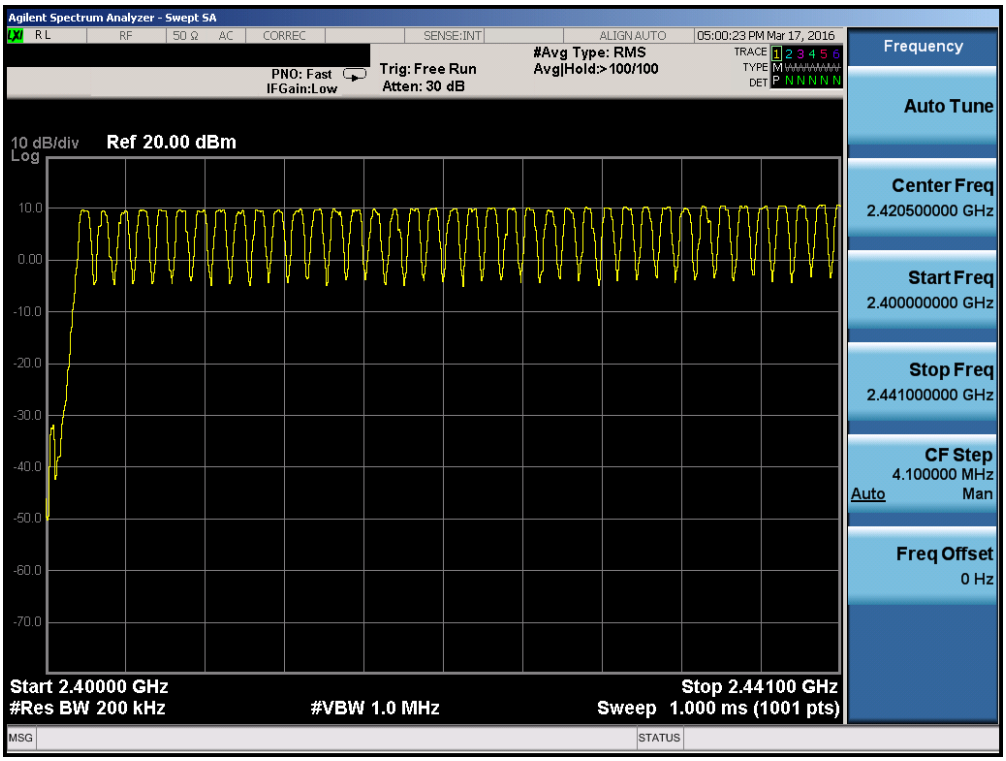


Figure 7-6. Test Instrument & Measurement Setup

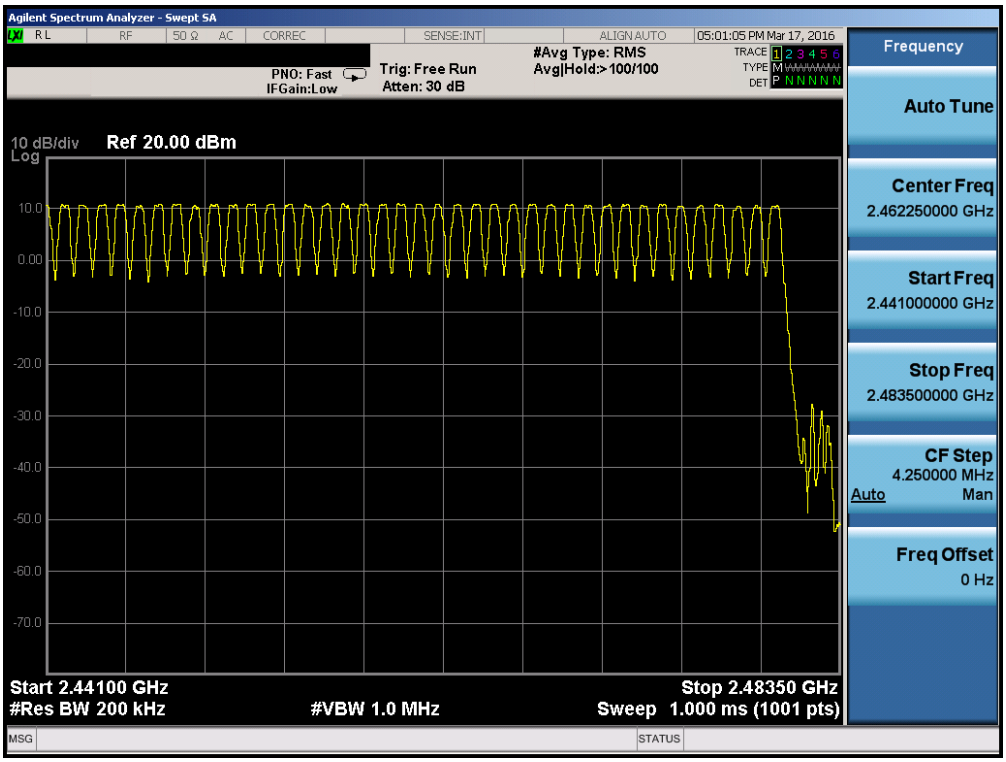
Test Notes

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.

© 2016 PCTEST Engineering Laboratory, Inc.



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



Plot 7-35. High End Spectrum Channel Hopping Plot (Bluetooth)

© 2016 PCTEST Engineering Laboratory, Inc.

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.

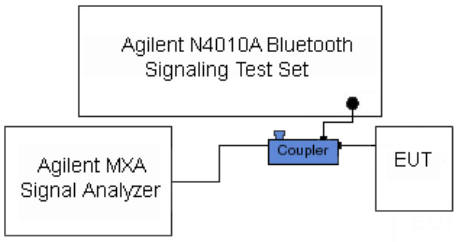
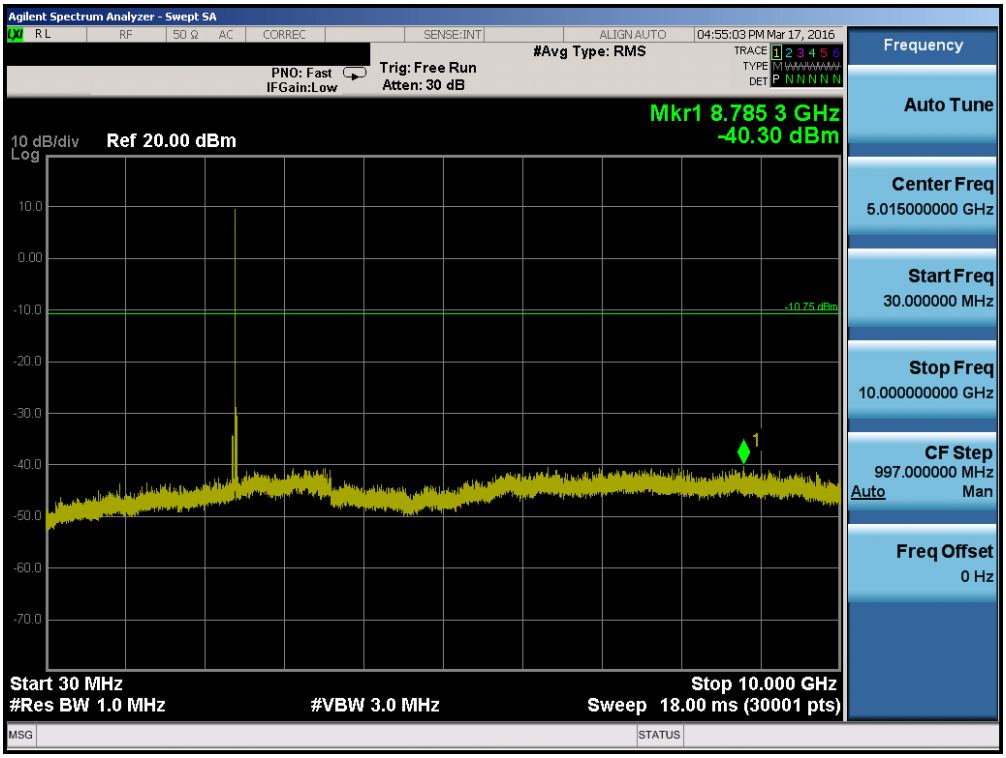


Figure 7-7. Test Instrument & Measurement Setup

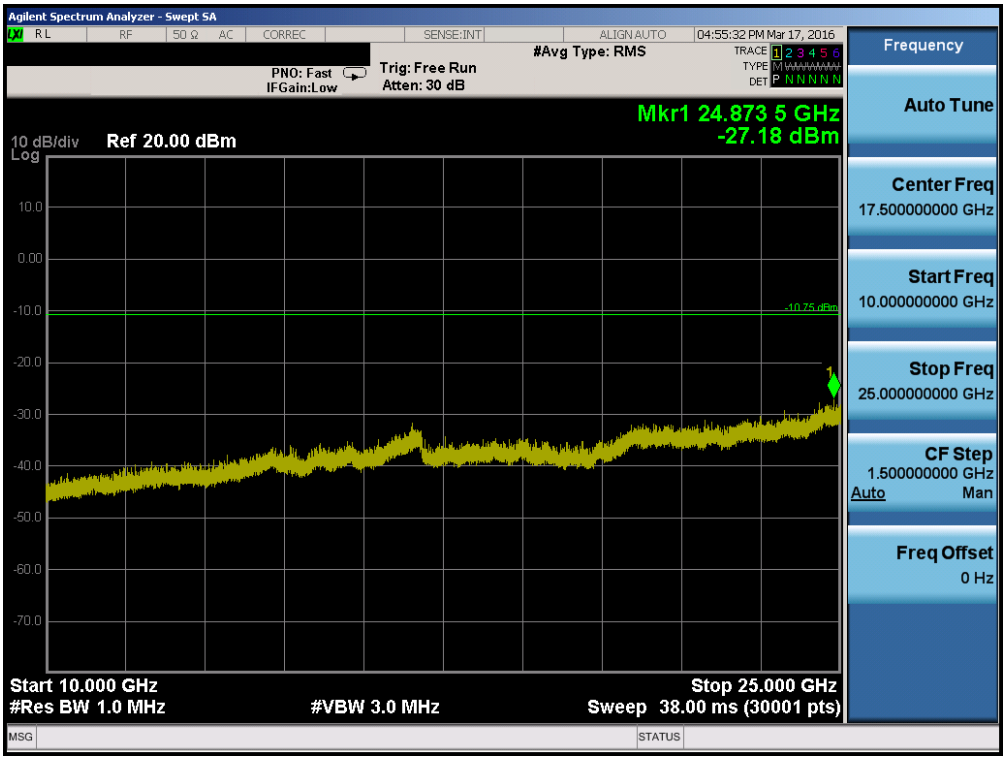
Test Notes

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.

© 2016 PCTEST Engineering Laboratory, Inc.

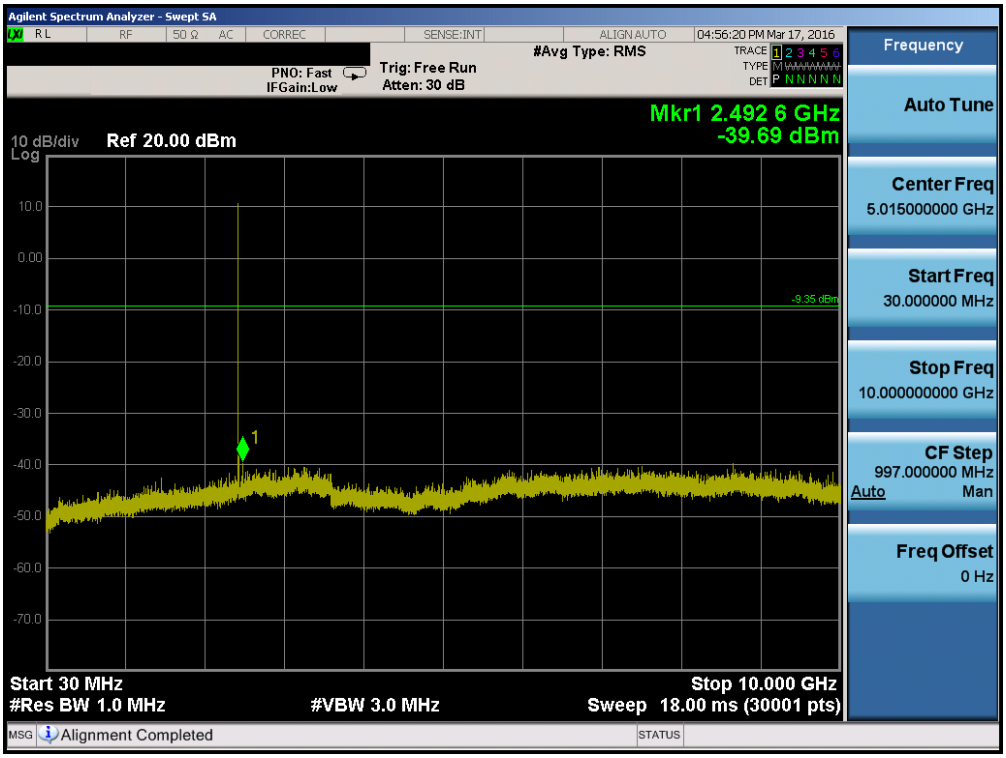


Plot 7-36. Conducted Spurious Plot (Bluetooth, 1Mbps – Ch. 0)

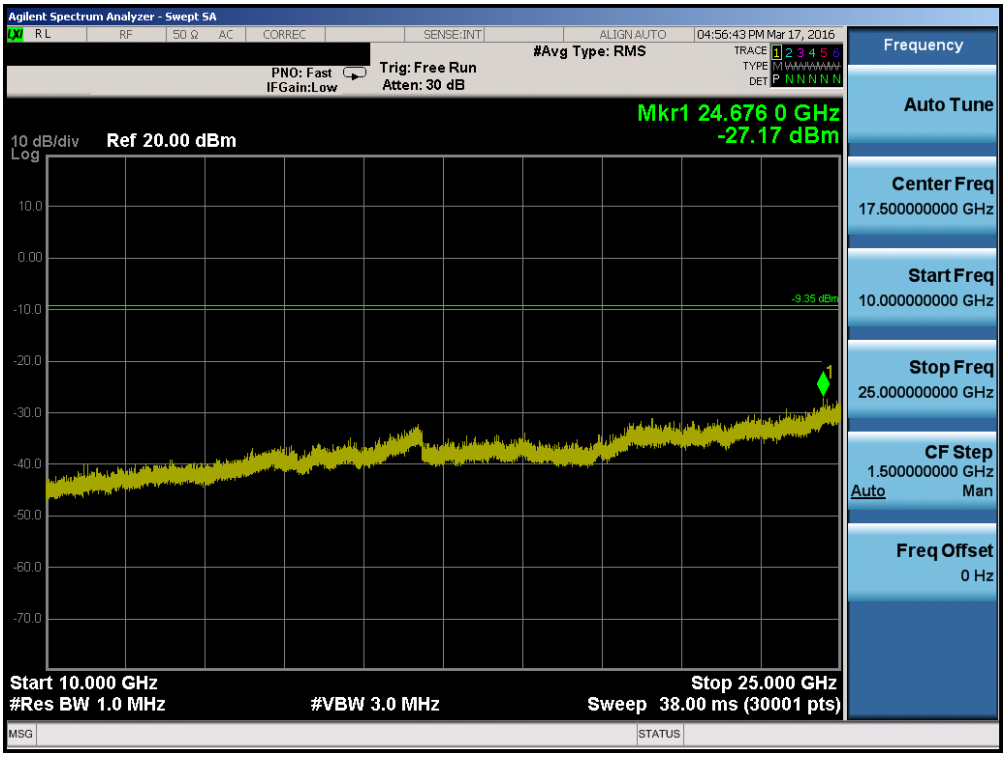


Plot 7-37. Conducted Spurious Plot (Bluetooth, 1Mbps – Ch. 0)

© 2016 PCTEST Engineering Laboratory, Inc.

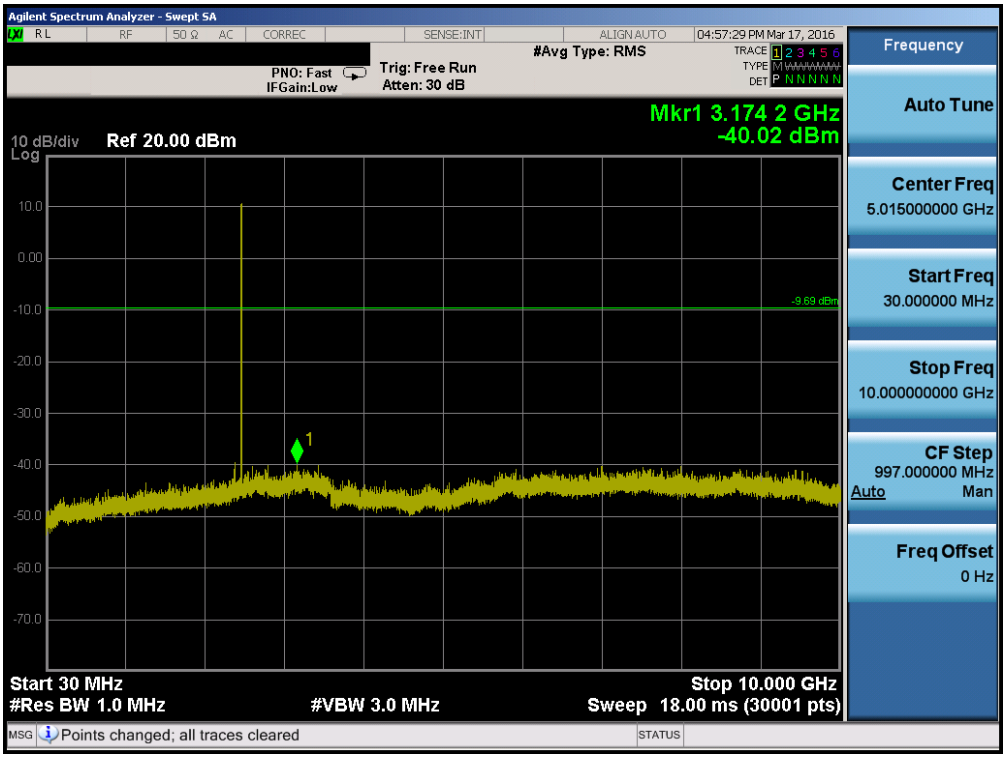


Plot 7-38. Conducted Spurious Plot (Bluetooth, 1Mbps – Ch. 39)

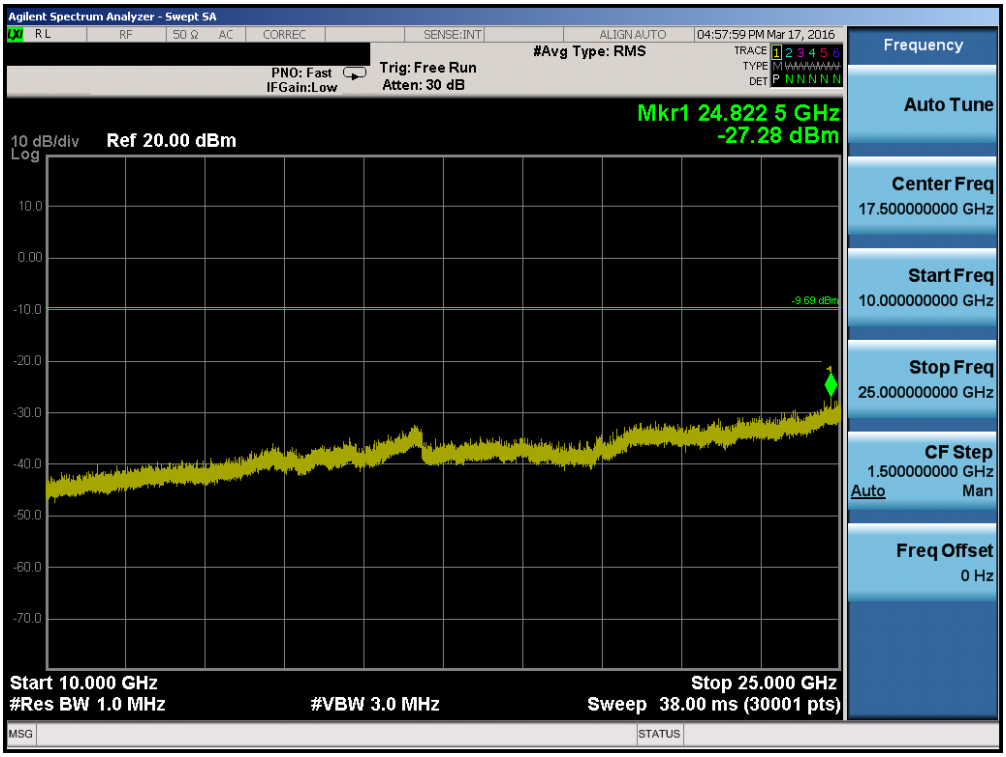


Plot 7-39. Conducted Spurious Plot (Bluetooth, 1Mbps – Ch. 39)

© 2016 PCTEST Engineering Laboratory, Inc.



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



Plot 7-41. Conducted Spurious Plot (Bluetooth, 1Mbps – Ch. 78)

© 2016 PCTEST Engineering Laboratory, Inc.

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 τ = 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

© 2016 PCTEST Engineering Laboratory, Inc.

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.

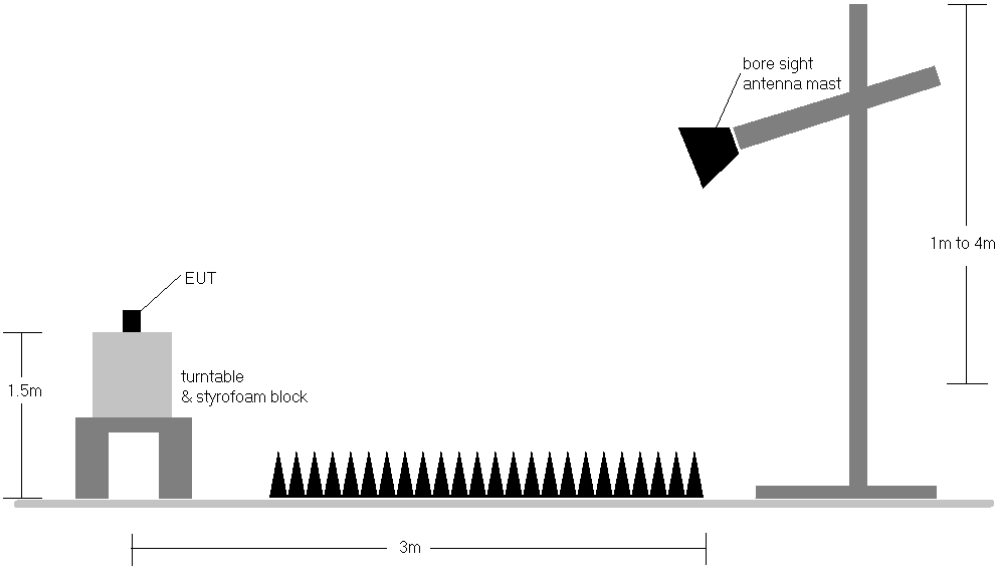


Figure 7-8. Radiated Test Setup >1GHz

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 10th 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 "-" in the RSE tables below denotes a noise floor measurement.

© 2016 PCTEST Engineering Laboratory, Inc.

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]

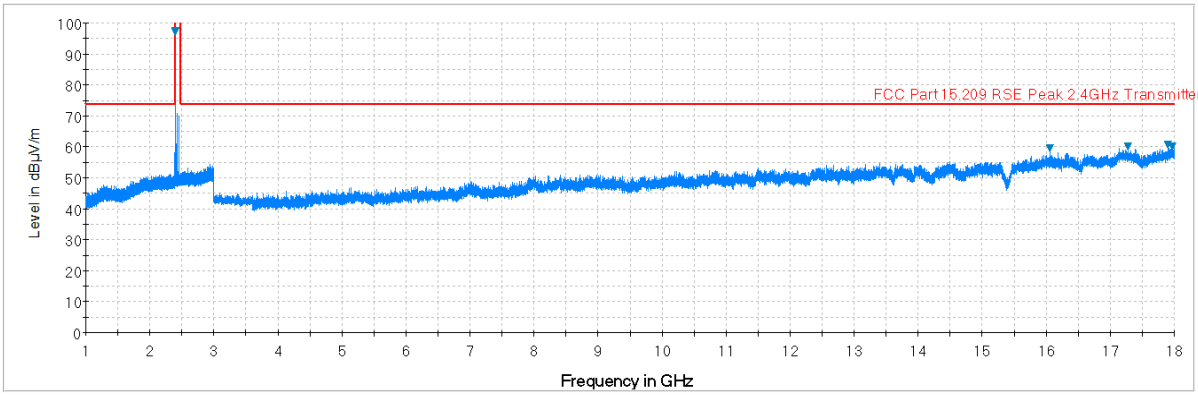
Duty Cycle Correction Factor Calculation

- 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

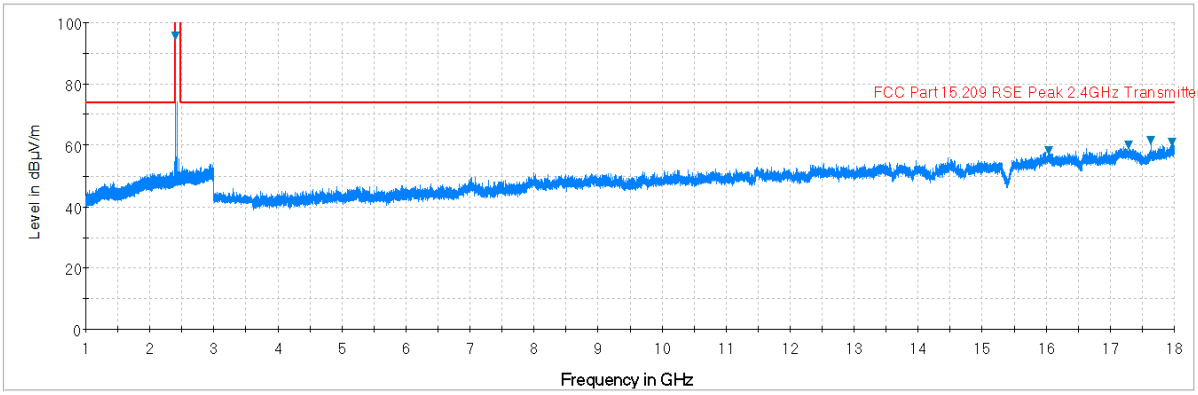
© 2016 PCTEST Engineering Laboratory, Inc.

Radiated Spurious Emission Measurements

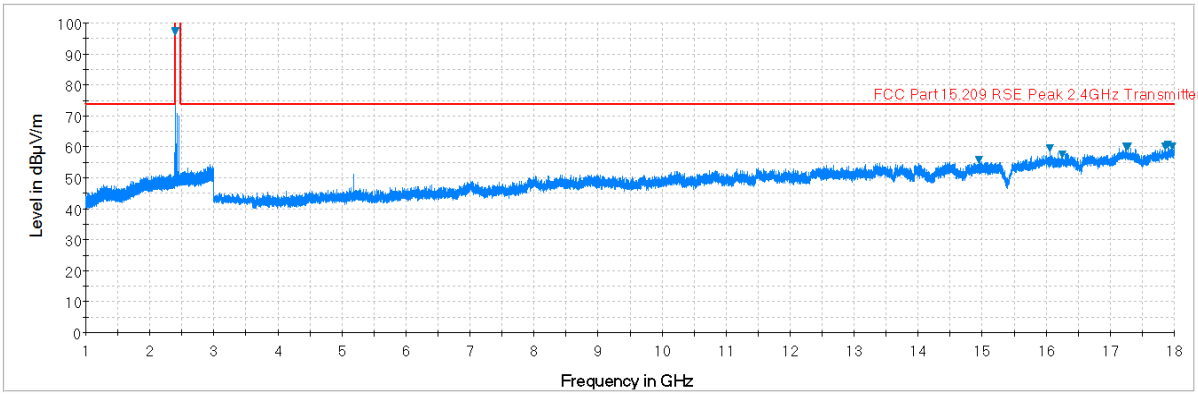
§15.205 §15.209 §15.247 (d)



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

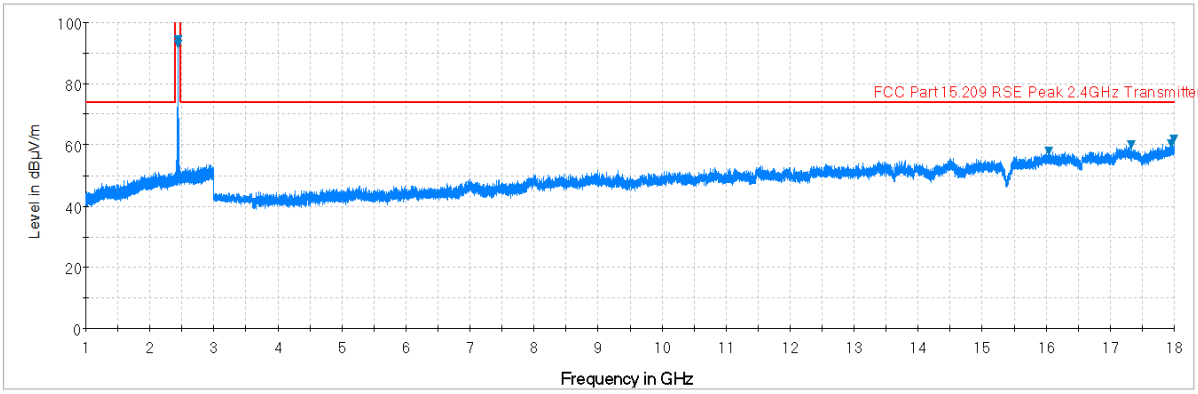


Plot 7-43. Radiated Spurious Plot above 1GHz (BT – Ch. 0, Ant. Pol. V)

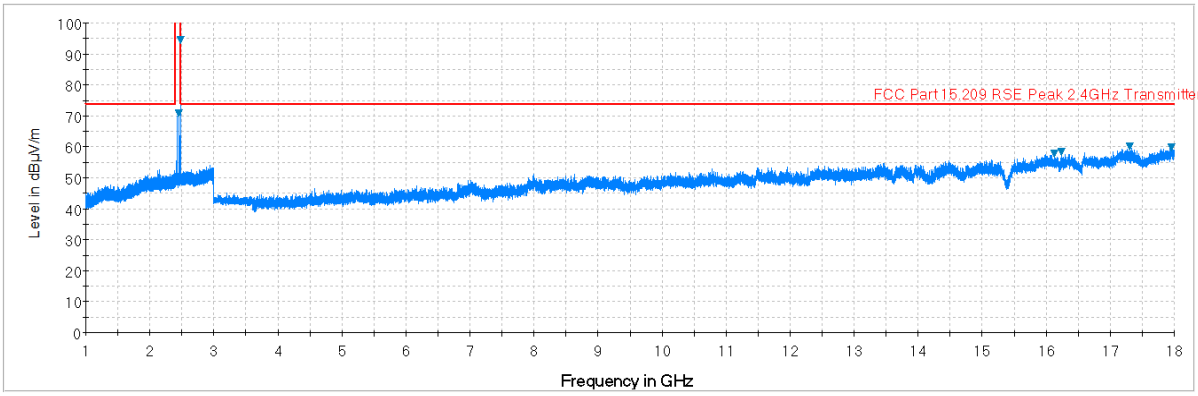


Plot 7-44. Radiated Spurious Plot above 1GHz (BT – Ch. 39, Ant. Pol. H)

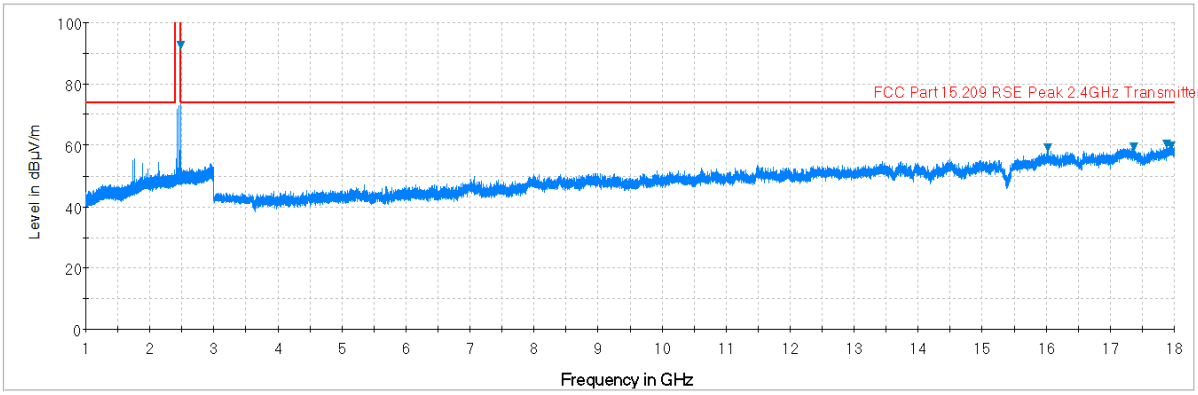
© 2016 PCTEST Engineering Laboratory, Inc.



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)

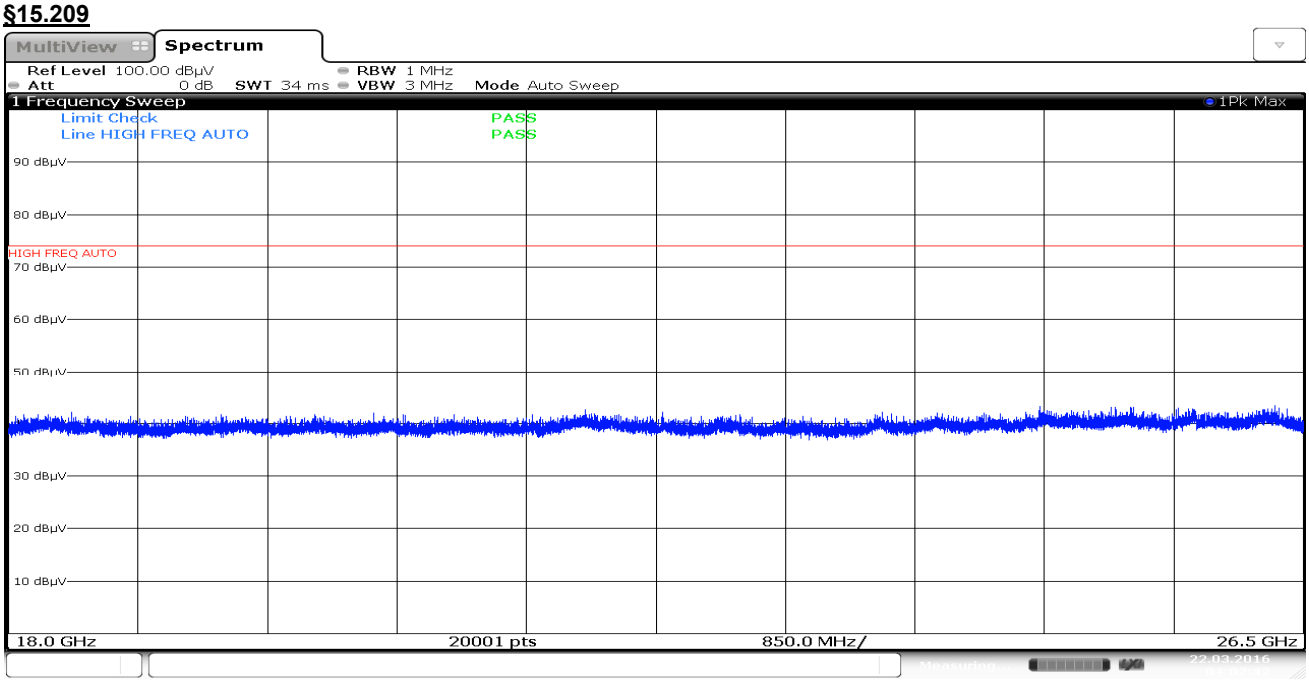


Plot 7-47. Radiated Spurious Plot above 1GHz (BT – Ch. 78, Ant. Pol. V)

© 2016 PCTEST Engineering Laboratory, Inc.

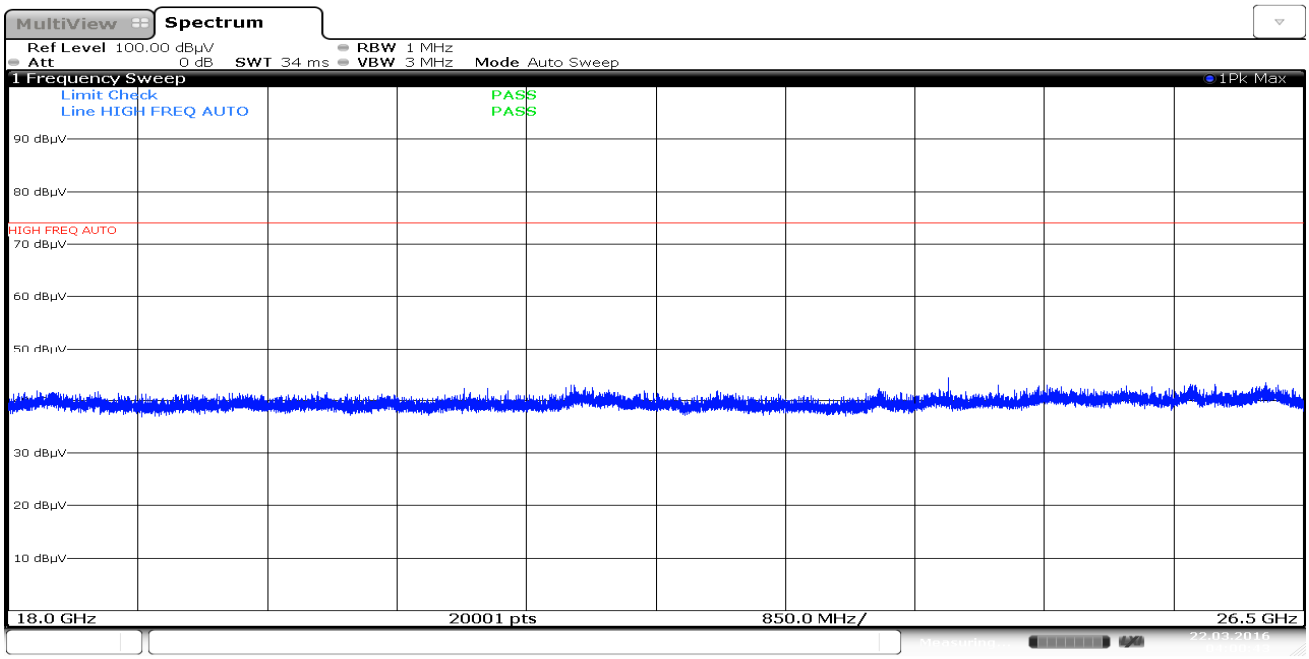
Radiated Spurious Emissions Measurements (Above 18GHz)

§15.209



Date: 22.MAR.2016 04:02:41

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



Date: 22.MAR.2016 04:00:43

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

© 2016 PCTEST Engineering Laboratory, Inc.

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]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
4804.00	Avg	V	-	-	-112.18	41.25	36.07	53.98	-17.91
4804.00	Peak	V	-	-	-98.42	41.25	49.83	73.98	-24.15
12010.00	Avg	V	-	-	-111.77	49.12	44.34	53.98	-9.64
12010.00	Peak	V	-	-	-97.86	49.12	58.25	73.98	-15.73

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]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
4882.00	Avg	V	-	-	-111.99	40.91	35.93	53.98	-18.05
4882.00	Peak	V	-	-	-98.86	40.91	49.06	73.98	-24.92
7323.00	Avg	V	-	-	-111.21	43.38	39.18	53.98	-14.80
7323.00	Peak	V	-	-	-99.00	43.38	51.39	73.98	-22.59
12205.00	Avg	V	-	-	-111.13	49.16	45.03	53.98	-8.95
12205.00	Peak	V	-	-	-98.95	49.16	57.21	73.98	-16.77

Table 7-8. Radiated Measurements

© 2016 PCTEST Engineering Laboratory, Inc.

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]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
4960.00	Avg	V	-	-	-112.78	40.84	35.06	53.98	-18.91
4960.00	Peak	V	-	-	-99.50	40.84	48.34	73.98	-25.63
7440.00	Avg	V	-	-	-112.28	44.11	38.84	53.98	-15.14
7440.00	Peak	V	-	-	-99.25	44.11	51.87	73.98	-22.11
12400.00	Avg	V	-	-	-112.91	49.65	43.74	53.98	-10.24
12400.00	Peak	V	-	-	-98.19	49.65	58.46	73.98	-15.52

Table 7-9. Radiated Measurements

© 2016 PCTEST Engineering Laboratory, Inc.

7.10 Radiated Restricted Band Edge Measurements

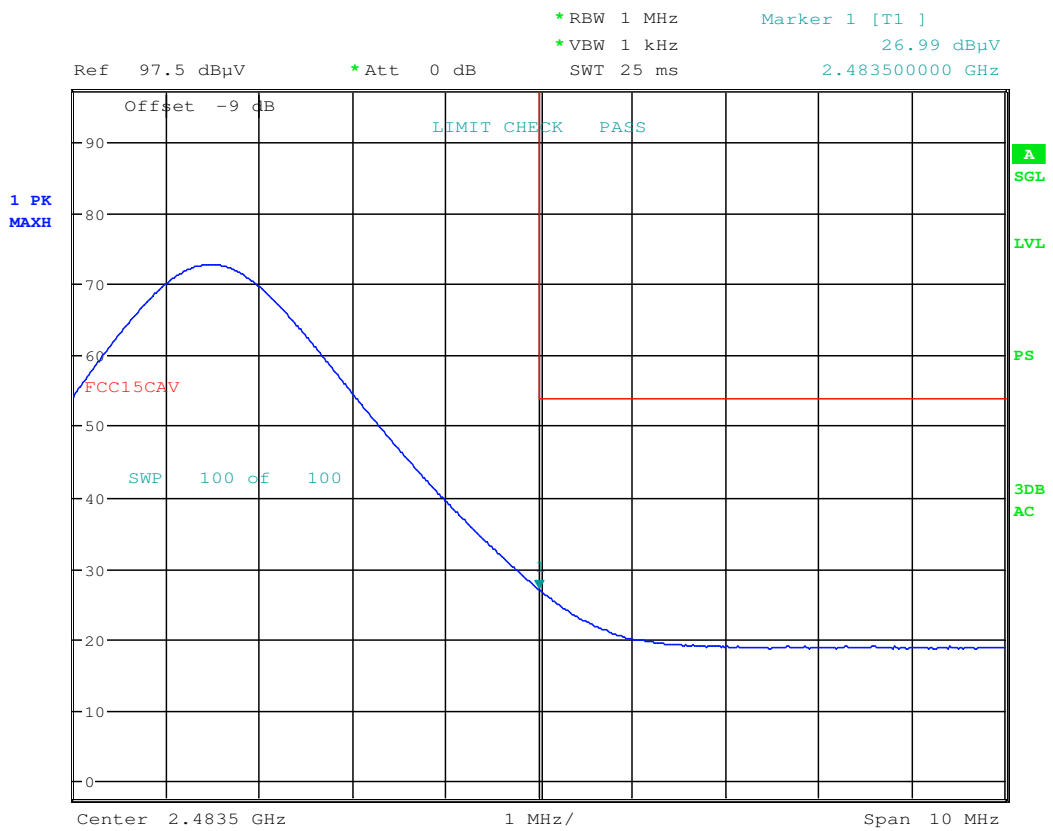
§15.205 §15.209 §15.247 (d)

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: 17.MAR.2016 21:25:32

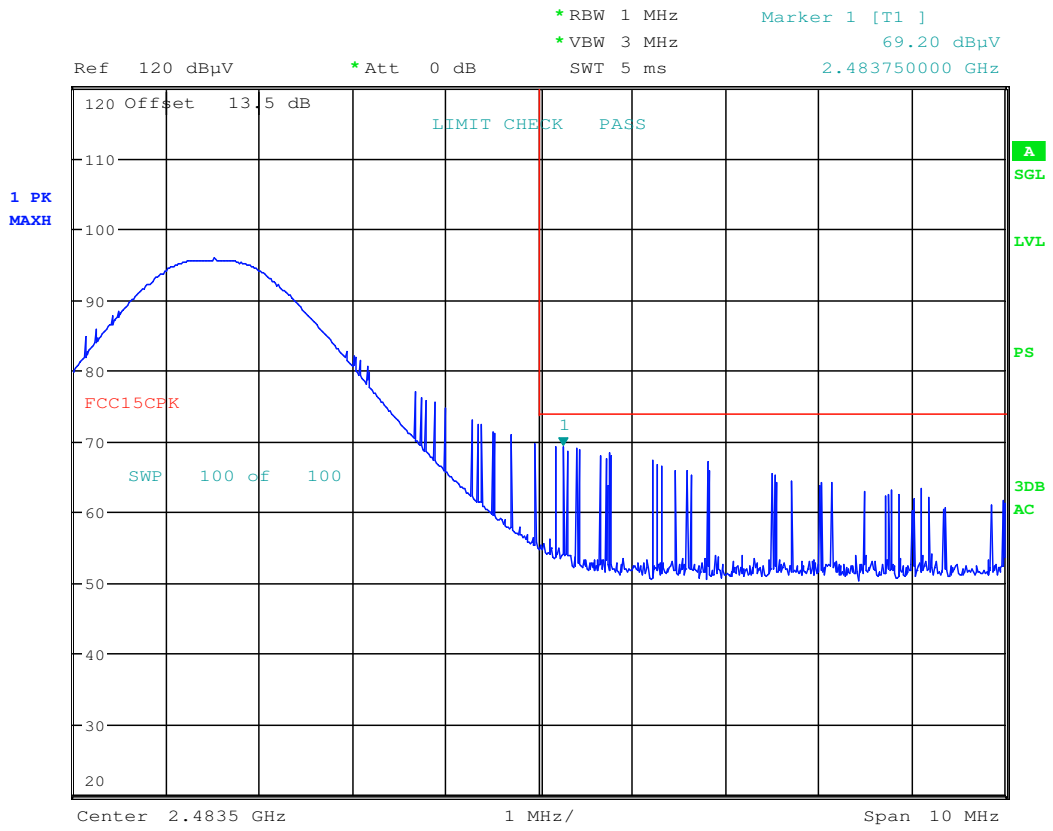
Plot 7-50. Radiated Restricted Upper Band Edge Measurement (Average)

© 2016 PCTEST Engineering Laboratory, Inc.

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: 17.MAR.2016 21:22:23

Plot 7-51. Radiated Restricted Upper Band Edge Measurement (Peak)

© 2016 PCTEST Engineering Laboratory, Inc.

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

© 2016 PCTEST Engineering Laboratory, Inc.

Test Setup

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

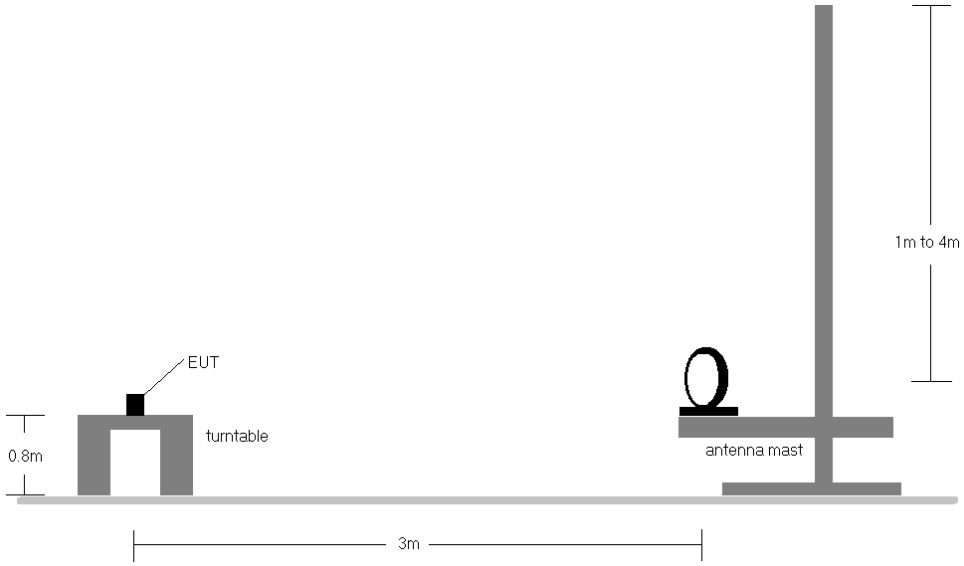


Figure 7-9. Radiated Test Setup < 30Mhz

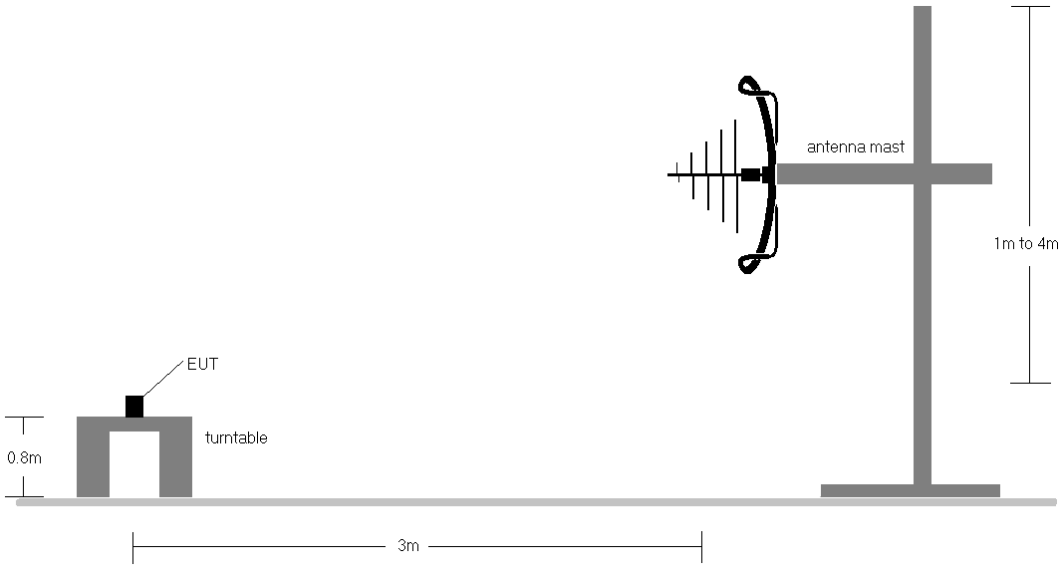


Figure 7-10. Radiated Test Setup < 1GHz

© 2016 PCTEST Engineering Laboratory, Inc.

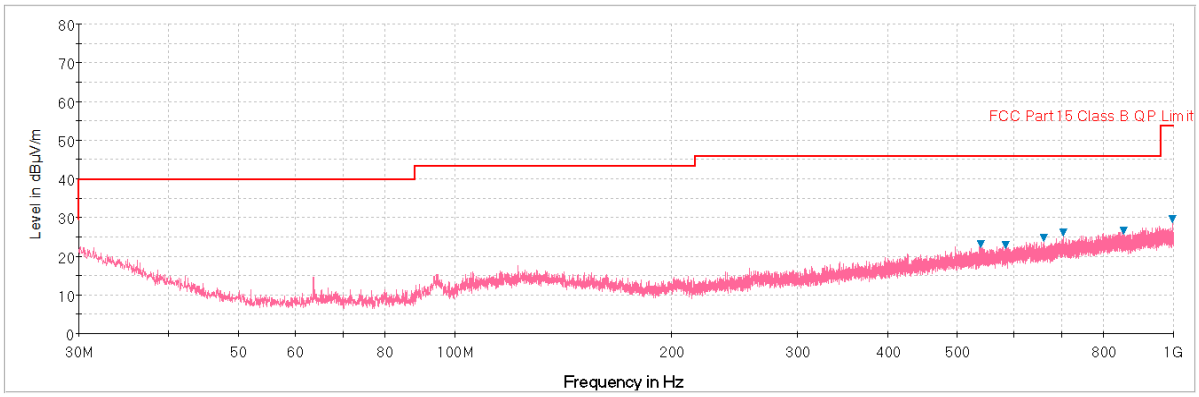
Test Notes

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.
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.

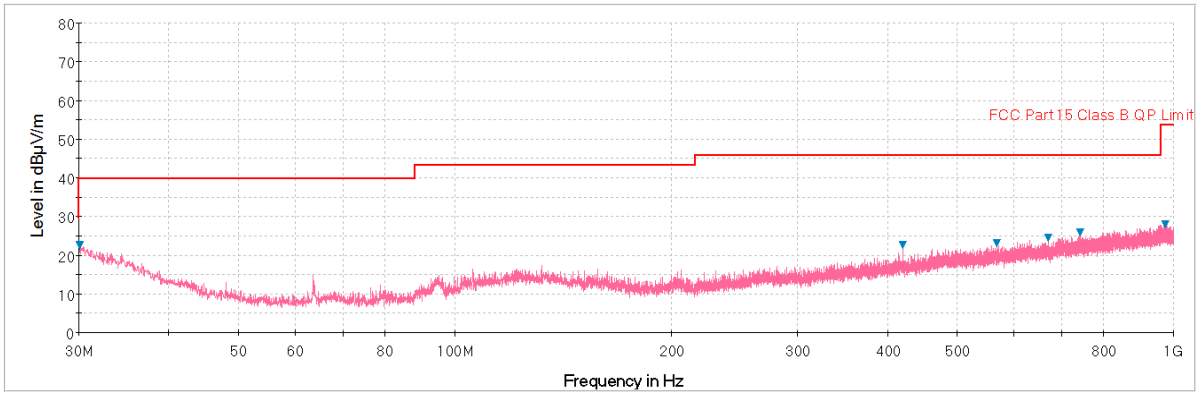
© 2016 PCTEST Engineering Laboratory, Inc.

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)

© 2016 PCTEST Engineering Laboratory, Inc.

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

© 2016 PCTEST Engineering Laboratory, Inc.

Test Setup

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

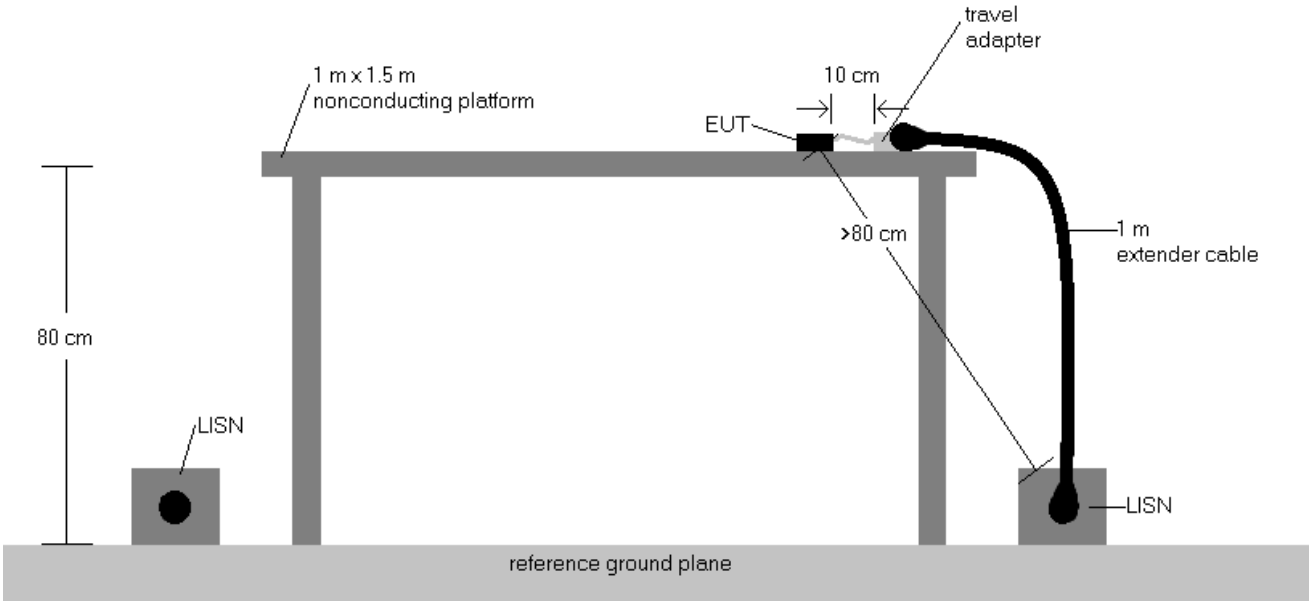


Figure 7-11. Test Instrument & Measurement Setup

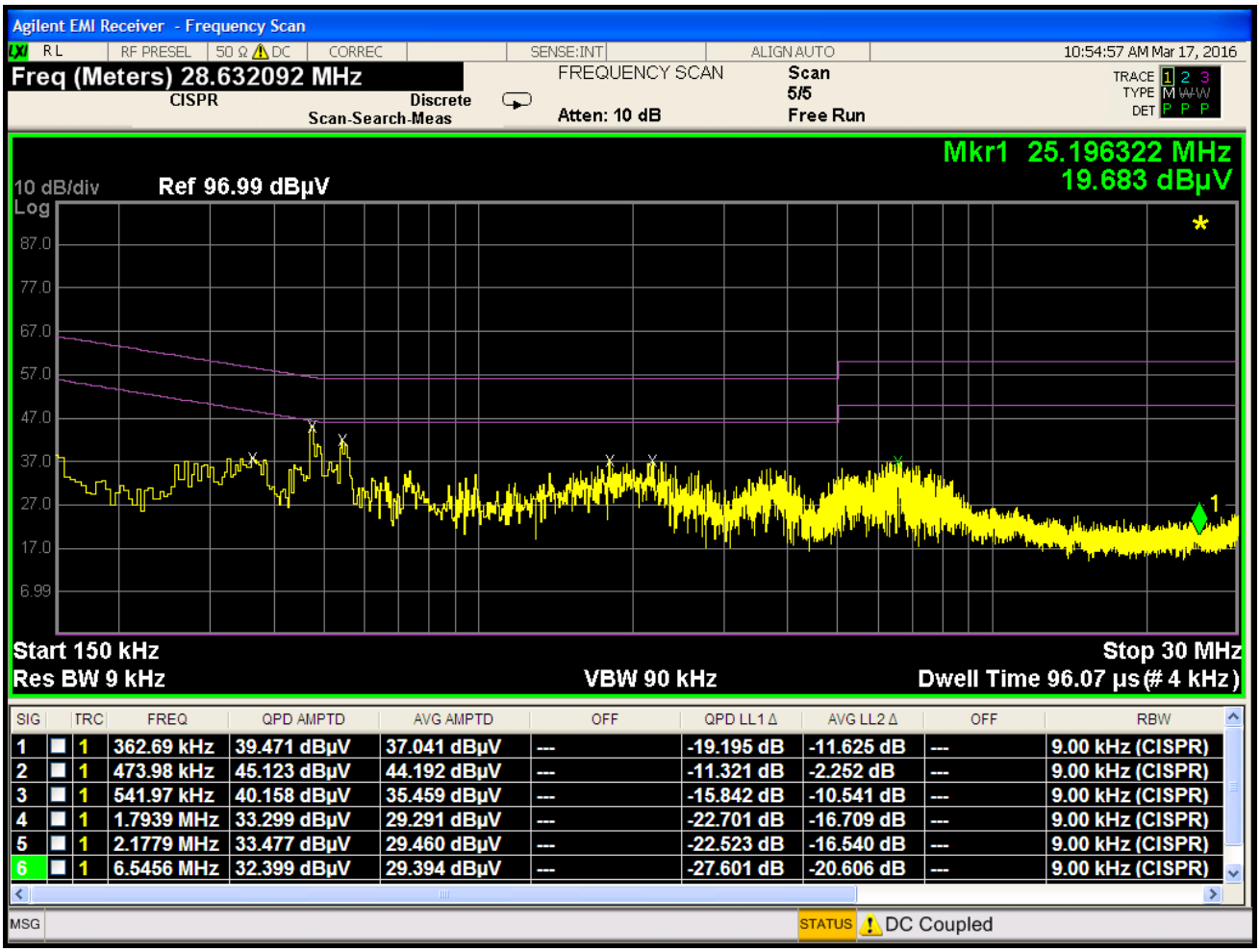
Test Notes

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.

© 2016 PCTEST Engineering Laboratory, Inc.

Line Conducted Measurement Data

§15.207



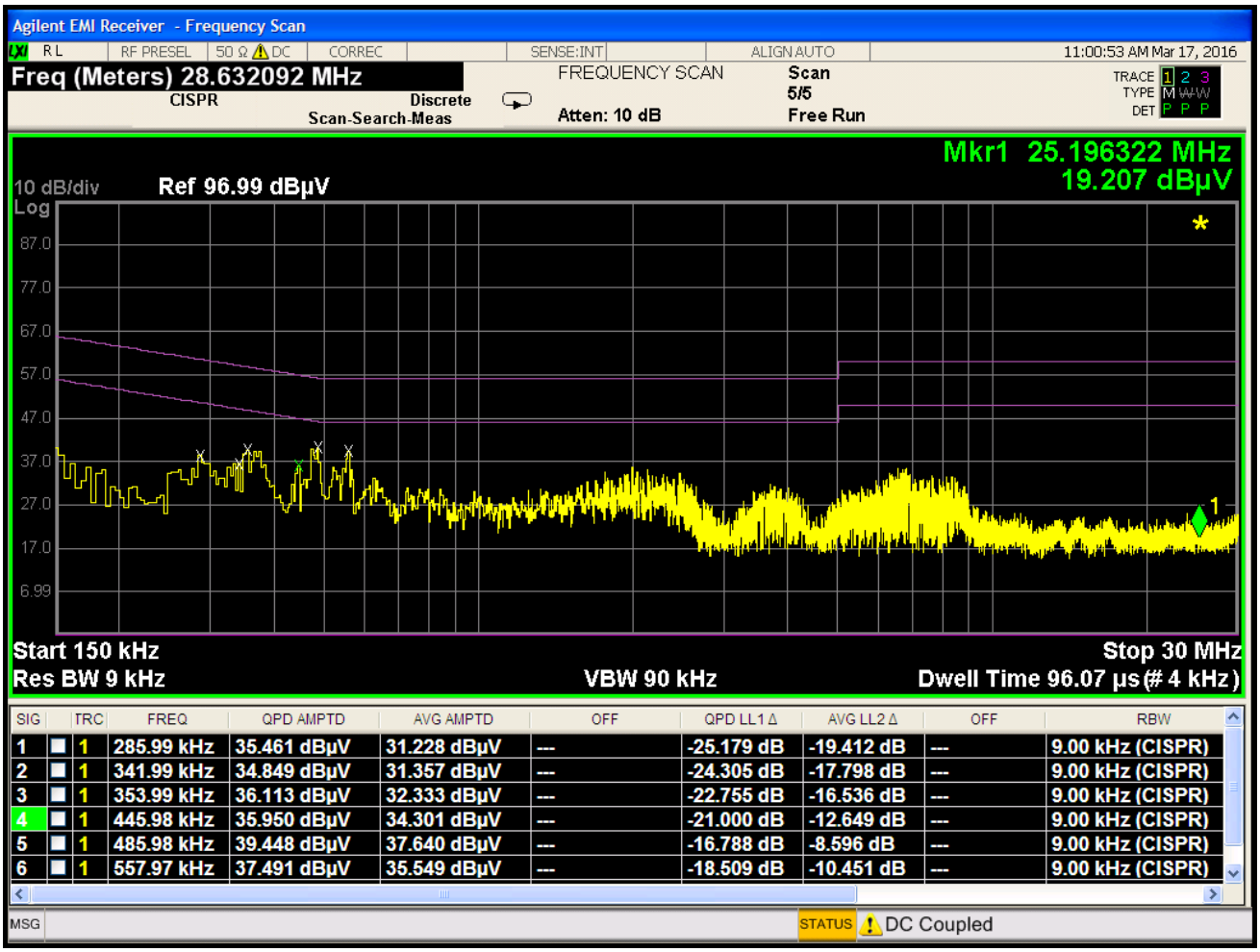
SIG	TRC	FREQ	QPD AMPTD	AVG AMPTD	OFF	QPD LL1 Δ	AVG LL2 Δ	OFF	RBW
1	1	362.69 kHz	39.471 dBµV	37.041 dBµV	---	-19.195 dB	-11.625 dB	---	9.00 kHz (CISPR)
2	1	473.98 kHz	45.123 dBµV	44.192 dBµV	---	-11.321 dB	-2.252 dB	---	9.00 kHz (CISPR)
3	1	541.97 kHz	40.158 dBµV	35.459 dBµV	---	-15.842 dB	-10.541 dB	---	9.00 kHz (CISPR)
4	1	1.7939 MHz	33.299 dBµV	29.291 dBµV	---	-22.701 dB	-16.709 dB	---	9.00 kHz (CISPR)
5	1	2.1779 MHz	33.477 dBµV	29.460 dBµV	---	-22.523 dB	-16.540 dB	---	9.00 kHz (CISPR)
6	1	6.5456 MHz	32.399 dBµV	29.394 dBµV	---	-27.601 dB	-20.606 dB	---	9.00 kHz (CISPR)

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

© 2016 PCTEST Engineering Laboratory, Inc.

Line Conducted Measurement Data

§15.207



SIG	TRC	FREQ	QPD AMPTD	AVG AMPTD	OFF	QPD LL1 Δ	AVG LL2 Δ	OFF	RBW
1	1	285.99 kHz	35.461 dBµV	31.228 dBµV	---	-25.179 dB	-19.412 dB	---	9.00 kHz (CISPR)
2	1	341.99 kHz	34.849 dBµV	31.357 dBµV	---	-24.305 dB	-17.798 dB	---	9.00 kHz (CISPR)
3	1	353.99 kHz	36.113 dBµV	32.333 dBµV	---	-22.755 dB	-16.536 dB	---	9.00 kHz (CISPR)
4	1	445.98 kHz	35.950 dBµV	34.301 dBµV	---	-21.000 dB	-12.649 dB	---	9.00 kHz (CISPR)
5	1	485.98 kHz	39.448 dBµV	37.640 dBµV	---	-16.788 dB	-8.596 dB	---	9.00 kHz (CISPR)
6	1	557.97 kHz	37.491 dBµV	35.549 dBµV	---	-18.509 dB	-10.451 dB	---	9.00 kHz (CISPR)

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

© 2016 PCTEST Engineering Laboratory, Inc.

8.0 CONCLUSION

The data collected relate only to the item(s) tested and show that the **Samsung Portable Tablet FCC ID: A3LSMT713** is in compliance with Part 15 Subpart C (15.247) of the FCC Rules.

© 2016 PCTEST Engineering Laboratory, Inc.