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Report On

Application for Grant of Equipment Authorization of the NantWorks
HBox Access Point for Medical Devices

FCC Part 15 Subpart C §15.247
IC RSS-210 Issue 8 December 2010

Report No. SC1311091B January 2014

REPORT ON	Radio Testing of the NantWorks Access Point for Medical Devices
TEST REPORT NUMBER	SC1311091B
PREPARED FOR	NantWorks 9920 Jefferson Blvd. Culver City, CA 90232
CONTACT PERSON	David Lu Principal Engineer (858) 735-6852 dlu@nantworks.com
PREPARED BY	Ferdinand S. Custodio **Name** Authorized Signatory Title: EMC/Wireless Test Engineer
APPROVED BY	Chip R. Fleury **Name** Authorized Signatory
DATED	January 09, 2014

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

Revision History

SC1311091B NantWorks HBox Access Point for Medical Devices					
DATE	OLD REVISION	NEW REVISION	REASON	PAGES AFFECTED	APPROVED BY
01/09/2014	Initial Release				Chip R. Fleury

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SECTION 1

REPORT SUMMARY

Radio Testing of the
NantWorks
Access Point for Medical Devices

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

1.1 INTRODUCTION

The information contained in this report is intended to show verification of the NantWorks HBox Access Point for Medical Devices to the requirements of FCC Part 15 Subpart C §15.247 and IC RSS-210 Issue 8 December 2010.

Objective	To perform Radio Testing to determine the Equipment Under Test's (EUT's) compliance with the Test Specification, for the series of tests carried out.
Manufacturer	NantWorks
Model Number(s)	200-HBX-PDL
FCC ID Number	IFU1001008
IC Number	N/A (Manufacturer not seeking IC Certification at the time of verification)
Serial Number(s)	N/A (Sample #1) Conducted antenna service port testing sample, serial number not available due to temporary addition of an antenna port for testing / 34008112 (Radiated testing - Sample #2) 34008096 (Radiated testing - Sample #3)
Number of Samples Tested	3
Test Specification/Issue/Date	• FCC Part 15 Subpart C §15.247 (October 1, 2013). • RSS-210 - Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment (Issue 8, December 2010). • RSS-Gen - General Requirements and Information for the Certification of Radio Apparatus (Issue 3, December 2010). • Public Notice (DA 00-705 Released March 30, 2000) Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems
Start of Test	November 26, 2013
Finish of Test	December 24, 2013
Name of Engineer(s)	Ferdinand Custodio
Related Document(s)	None. Supporting documents for EUT certification are separate exhibits.

1.2 BRIEF SUMMARY OF RESULTS

A brief summary of the tests carried out in accordance with FCC Part 15 Subpart C §15.247 with cross-reference to the corresponding IC RSS standard is shown below.

Section	§15.247 Spec Clause	RSS	Test Description	Result	Comments/ Base Standard
2.1	§15.207 (a)	RSS-Gen 7.2.4	Conducted Emissions	Compliant	
2.2	§15.247(a)(1)	RSS-210 A8.1(b)	Carrier Frequency Separation	Compliant	
2.3	§15.247(a)(1)(iii)	RSS-210 A8.1(d)	Number of Hopping Frequencies	Compliant	
2.4	§15.247(a)(1)(iii)	RSS-210 A8.1(d)	Time of Occupancy (Dwell Time)	Compliant	
2.5	§15.215(c)	RSS-210 A8.1(a)	20 dB Bandwidth	Compliant	
2.6		RSS-Gen 4.6.1	99% Emission Bandwidth	Compliant	
2.7	§15.247(b)(1)	RSS-210 A8.4(2)	Peak Output Power	Compliant	
2.8	§15.247(d)	RSS-210 A8.5	Band-edge Compliance of RF Conducted Emissions	Compliant	
2.9	§15.247(d)	RSS-210 A8.5	Spurious RF Conducted Emissions	Compliant	
2.10	§15.247(d)	RSS-210 2.2	Spurious Radiated Emissions	Compliant	
2.11	§15.247(d)	RSS-210 2.2	Radiated Immediate Restricted Bands	Compliant	
2.12		RSS-Gen 6.0	Receiver Spurious Emissions	Compliant	

1.3 PRODUCT INFORMATION

1.3.1 Technical Description

The Equipment Under Test (EUT) was a NantWorks HBox Access Point for Medical Devices. The EUT can connect to a network through Ethernet port or Wi-Fi. In normal operation, the EUT collects user data via USB, Bluetooth or Wi-Fi and upload the information back to a data server. The NFC function is for quick Bluetooth pairing by obtaining the device info when within NFC range of the EUT. Only the Bluetooth V2.0 + EDR function verified in this test report.

1.3.2 EUT General Description

EUT Description	Access Point for Medical Devices
Model Name	HBox
Model Number(s)	200-HBX-PDL
Rated Voltage	Internal 3.7VDC Li-Ion Battery (Gold Peak Industries 130801-00), AC adapter/charger is Hon-Kwang Switching Power Supply Model: HK-AD-050A500-US, output is 5.0VDC 5.0A
Mode Verified	Bluetooth 2.0 + EDR
Capability	802.11 a/b/g/n WLAN (DTS/U-NII), Bluetooth 2.0 + EDR, Bluetooth 4.0 and NFC
Primary Unit (EUT)	☒ Production ☐ Pre-Production ☐ Engineering
Antenna Type	Integral PIFA type (Ant #1 and 2)
Antenna Gain Ant #1 (Main, WiFi +BT)	2400MHz = 2.9dBi 5000MHz = 2.3dBi (Not used for Bluetooth 2.0 + EDR)
Antenna Gain Ant #2 (MIMO 802.11 n ht20 2.4 GHz only)	2400MHz = 5.5dBi (Not used for Bluetooth 2.0 + EDR)

1.3.3 Maximum Conducted Output Power

Modulation	Frequency Range (MHz)	AverageOutput Power (dBm))	Peak Output Power (dBm)	Peak Output Power (mW)
GFSK	2402-2480	11.97	12.18	16.52
π/4-DQPSK	2402-2480	5.50	8.77	7.534
8DPSK	2402-2480	5.61	9.37	8.650

1.4 EUT TEST CONFIGURATION

1.4.1 Test Configuration Description

Test Configuration	Description
A	Antenna conducted port test configuration. All measurements were performed on the main antenna (Ant.#1). MIMO function is limited to 802.11 n ht20 2.4GHz only. Antenna #1 is for both Wi-Fi and Bluetooth functions while Antenna #2 is for MIMO function only. The EUT is programmed using a generic JTAG debug board connected via USB. Radio commands are programmed using Tera Term SSH2 (Secure Shell) client software.
B	Radiated emissions test configuration. The EUT is programmed using PuTTY SSH2 (Secure Shell) client software. The EUT is connected to a support broadband router where the support laptop used to program the EUT is also connected. Client provided radio commands to modify modes, channel number and data rates. TX power is set to max power as a default setting.

1.4.2 EUT Exercise Software

HBOX Function Tester. This is built-in within the firmware. Radio commands are executed via Ethernet or USB via a JTAG debug board using Tera Term or Putty from a support PC.

1.4.3 Support Equipment and I/O cables

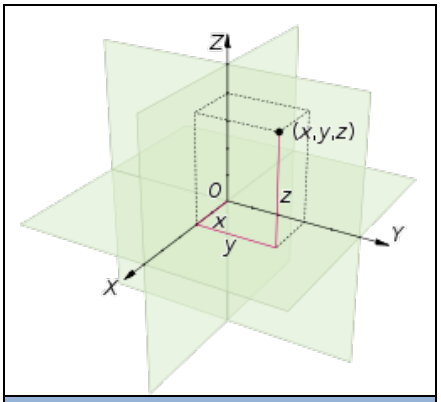
Manufacturer	Equipment/Cable	Description
Sony	Personal Computer (Y Series Laptop)	Model PCG-31311L
Sony	AC Adapter	Model PCGA-AC19V9 S/N:147839091 0023259
Hon-Kwang	I.T.E. Power Supply for EUT	Model HK-AD-050A500-US 5VDC @5A
Trendnet	Broadband Router	Model TW100S4W1CA S/N: RA1332S400789
DVE	Switching Adapter for Broadband Router	Model DSA-6PFE-05 FUS 050100 5VDC @ 1ª
Lorom	CAT5E Patch Cable (2X)	Unshielded, 1.5 meters Ethernet cables
-	Debug board	Generic JTAG (Joint Test Action Group)/IEEE 1149.1 Standard Test Access Port and
	USB cable	Shielded, 1.7m generic USB cable

1.4.4 Worst Case Configuration

Worst-case configuration used in this test report as per maximum conducted output power measurements:

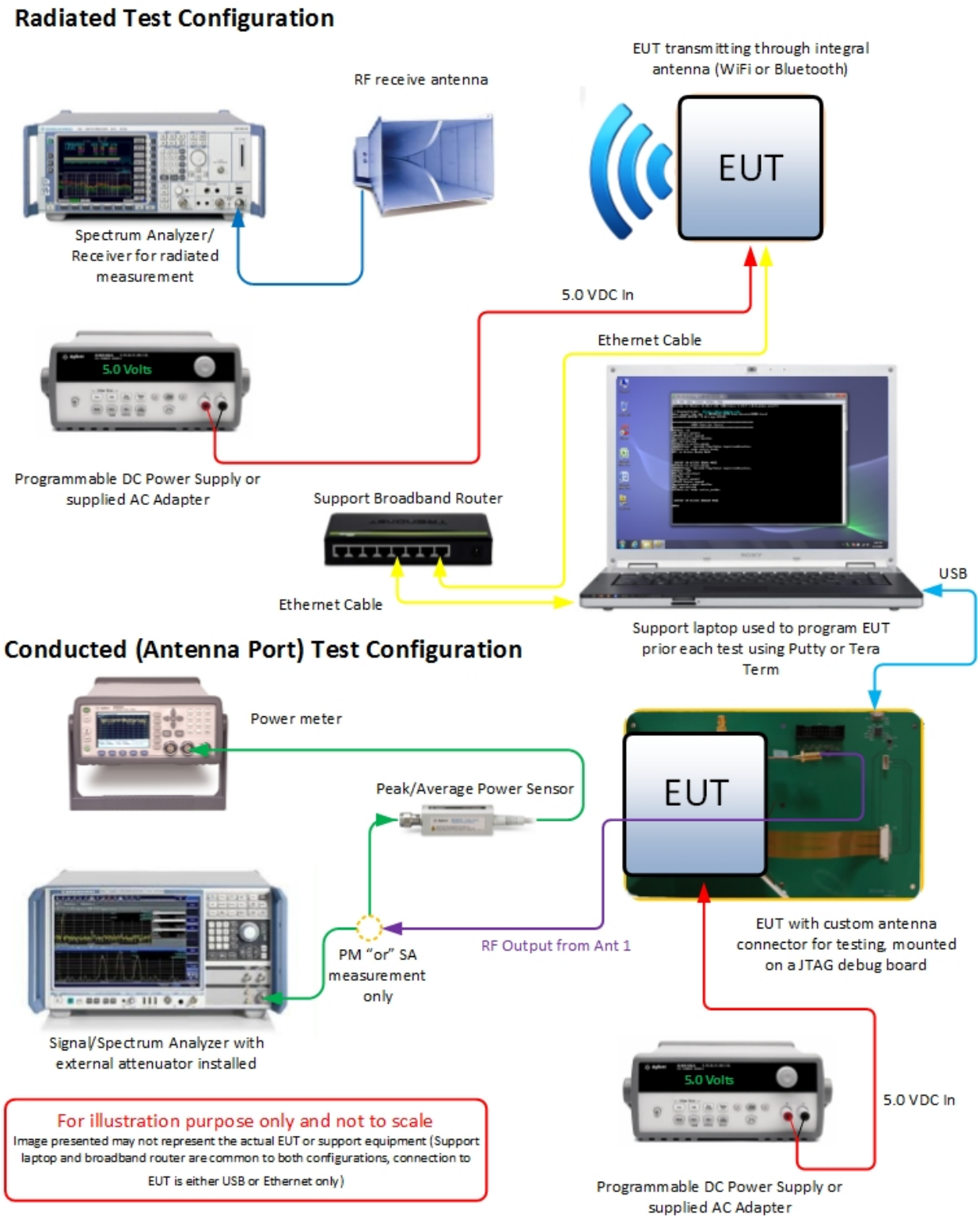
Modulation	Channel/Packet Type	Mode
GFSK	38 (Mid Channel)	Non-hopping
GFSK	-	Hopping

EUT is a mobile device. For radiated measurements X,Y and Z orientations were verified. Worst case position is "X" (wall mounting side of the EUT flat on the test table).



"X, Y and Z" Configuration

1.4.5 Simplified Test Configuration Diagram



1.5 DEVIATIONS FROM THE STANDARD

No deviations from the applicable test standards or test plan were made during testing.

1.6 MODIFICATION RECORD

Description of Modification	Modification Fitted By	Date Modification Fitted
Serial Number N/A (Sample #1) Antenna port conducted sample/34008112 (Sample #2)/34008096 (Sample #3)		
N/A		

The table above details modifications made to the EUT during the test programme. The modifications incorporated during each test (if relevant) are recorded on the appropriate test pages.

1.7 TEST METHODOLOGY

All measurements contained in this report were conducted with ANSI C63.4-2009, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz.
For conducted and radiated emissions the equipment under test (EUT) was configured to measure its highest possible emission level. This level was based on the maximized cable configuration from exploratory testing per ANSI C63.4-2009. The test modes were adapted according to the Operating Instructions provided by the manufacturer/client.

1.8 TEST FACILITY

1.8.1 FCC – Registration No.: US5296

TUV SUD America Inc. (San Diego), is an accredited test facility with the site description report on file and has met all the requirements specified in §2.498 of the FCC rules. The acceptance letter from the FCC is maintained in our files and the Registration is US5296.

1.8.2 Industry Canada (IC) Registration No.: 3067A

The 10m Semi-anechoic chamber of TUV SUD America Inc. (San Diego) has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No. 3067A.

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SECTION 2

TEST DETAILS

Radio Testing of the
NantWorks
Access Point for Medical Devices

2.1 CONDUCTED EMISSIONS

2.1.1 Specification Reference

Part 15 Subpart C §15.207(a)

2.1.2 Standard Applicable

An intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 µH/50 ohms line impedance stabilization network (LISN).

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

**Decreases with the logarithm of the frequency.*

2.1.3 Equipment Under Test and Modification State

Serial No: 34008112 / Test Configuration B

2.1.4 Date of Test/Initial of test personnel who performed the test

December 13, 2013/FSC

2.1.5 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.1.6 Environmental Conditions

Ambient Temperature	17.9°C
Relative Humidity	30.0.%
ATM Pressure	99.8 kPa

2.1.7 Additional Observations

- The EUT was verified using AC adapter supplied by the manufacturer..
- EUT verified using input voltage of 120VAC 60Hz.
- There are no significant variations in test results between each operating modes. Only the worst case observed configuration is presented (See Section 1.4.4 of this test report for details).
- Receive mode is also presented for comparison.

- Measurement was done using EMC32 automated software. Reported level is the actual level with all the correction factors factored in. Correction Factor column is for informational purposes only. See Section 2.1.8 for sample computation.

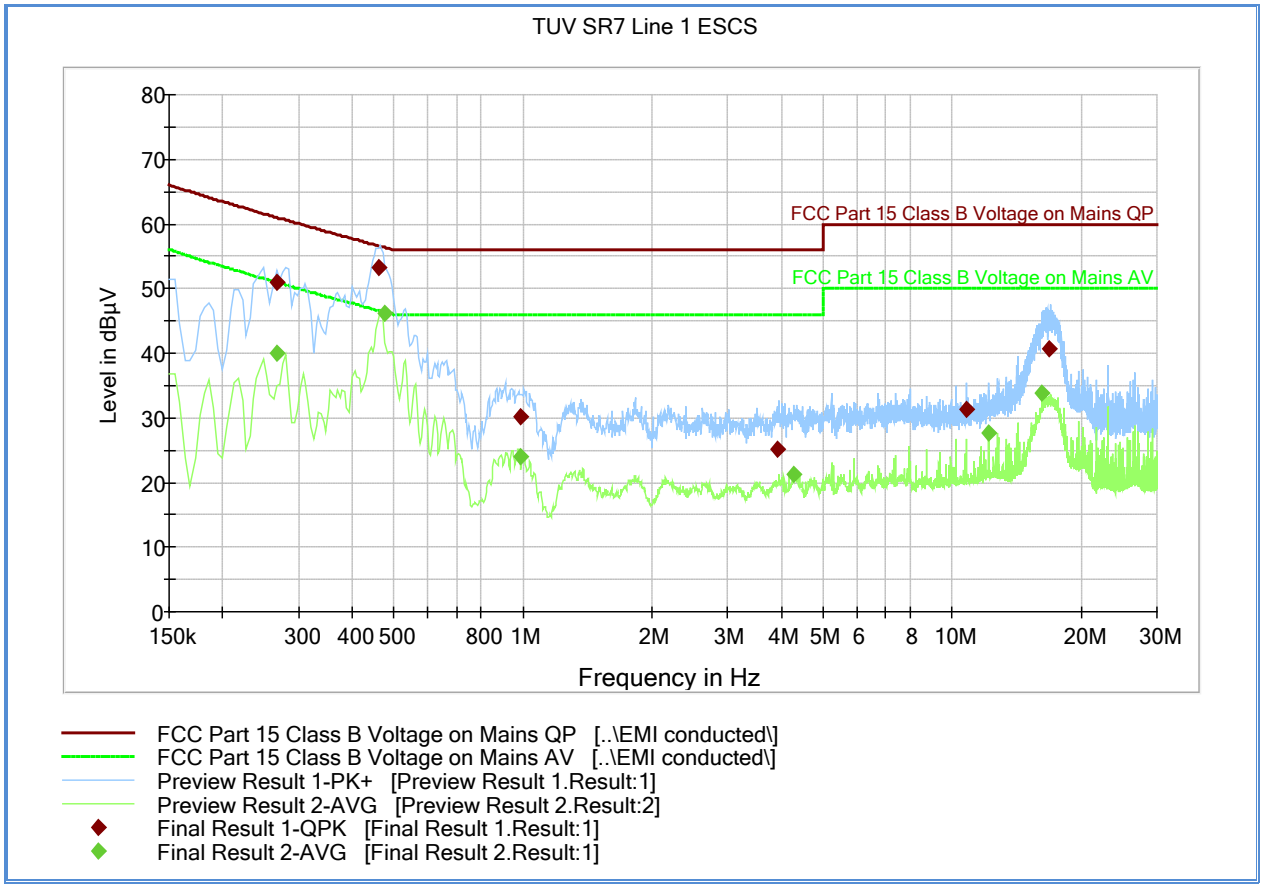
2.1.8 Sample Computation (Conducted Emission – Quasi Peak)

Measuring equipment raw measurement (dbµV) @ 150kHz			5.5
Correction Factor (dB)	Asset# 8607 (20 dB attenuator)	19.9	20.7
	Asset# 1177 (cable)	0.15	
	Asset# 1176 (cable)	0.35	
	Asset# 7567 (LISN)	0.30	
Reported QuasiPeak Final Measurement (dbµV) @ 150kHz			**26.2**

2.1.9 Test Results

Compliant. See attached plots and tables.

2.1.10 FCC Conducted Emissions Line 1 – Hot (Worst Case Transmit Mode)



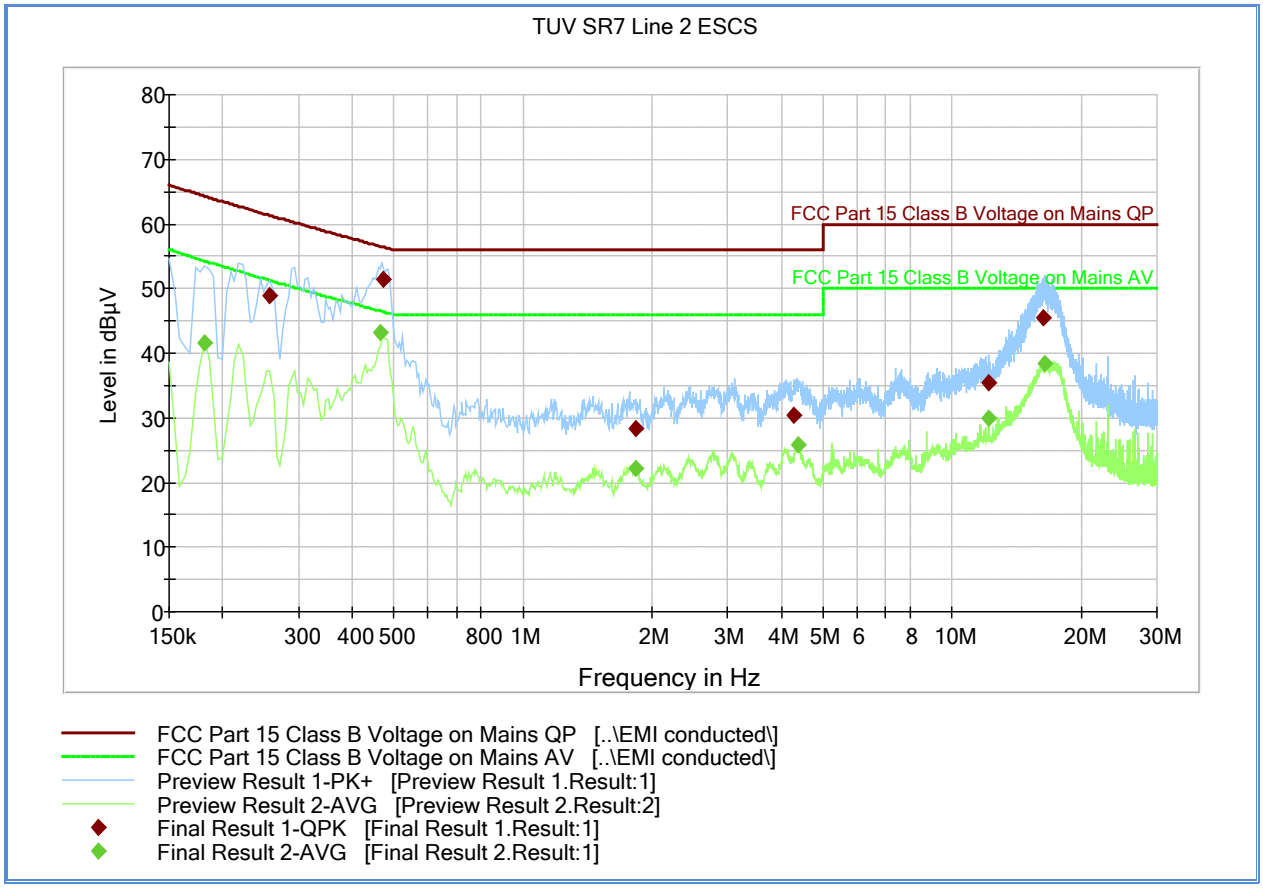
Quasi Peak

Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)
0.267000	50.9	1000.0	9.000	Off	L1	20.3	10.1	61.0
0.460500	53.2	1000.0	9.000	Off	L1	20.2	3.4	56.6
0.987000	30.2	1000.0	9.000	Off	L1	20.2	25.8	56.0
3.916500	25.2	1000.0	9.000	Off	L1	20.3	30.8	56.0
10.792500	31.2	1000.0	9.000	Off	L1	20.5	28.8	60.0
16.863000	40.7	1000.0	9.000	Off	L1	20.8	19.3	60.0

Average

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - Ave (dB)	Limit - Ave (dBµV)
0.267000	39.9	1000.0	9.000	Off	L1	20.3	11.0	51.0
0.478500	46.3	1000.0	9.000	Off	L1	20.2	0.1	46.3
0.991500	23.9	1000.0	9.000	Off	L1	20.2	22.1	46.0
4.263000	21.3	1000.0	9.000	Off	L1	20.4	24.7	46.0
12.196500	27.8	1000.0	9.000	Off	L1	20.5	22.2	50.0
16.228500	33.8	1000.0	9.000	Off	L1	20.8	16.2	50.0

2.1.1 FCC Conducted Emissions Line 2 – Neutral (Worst Case Transmit Mode)



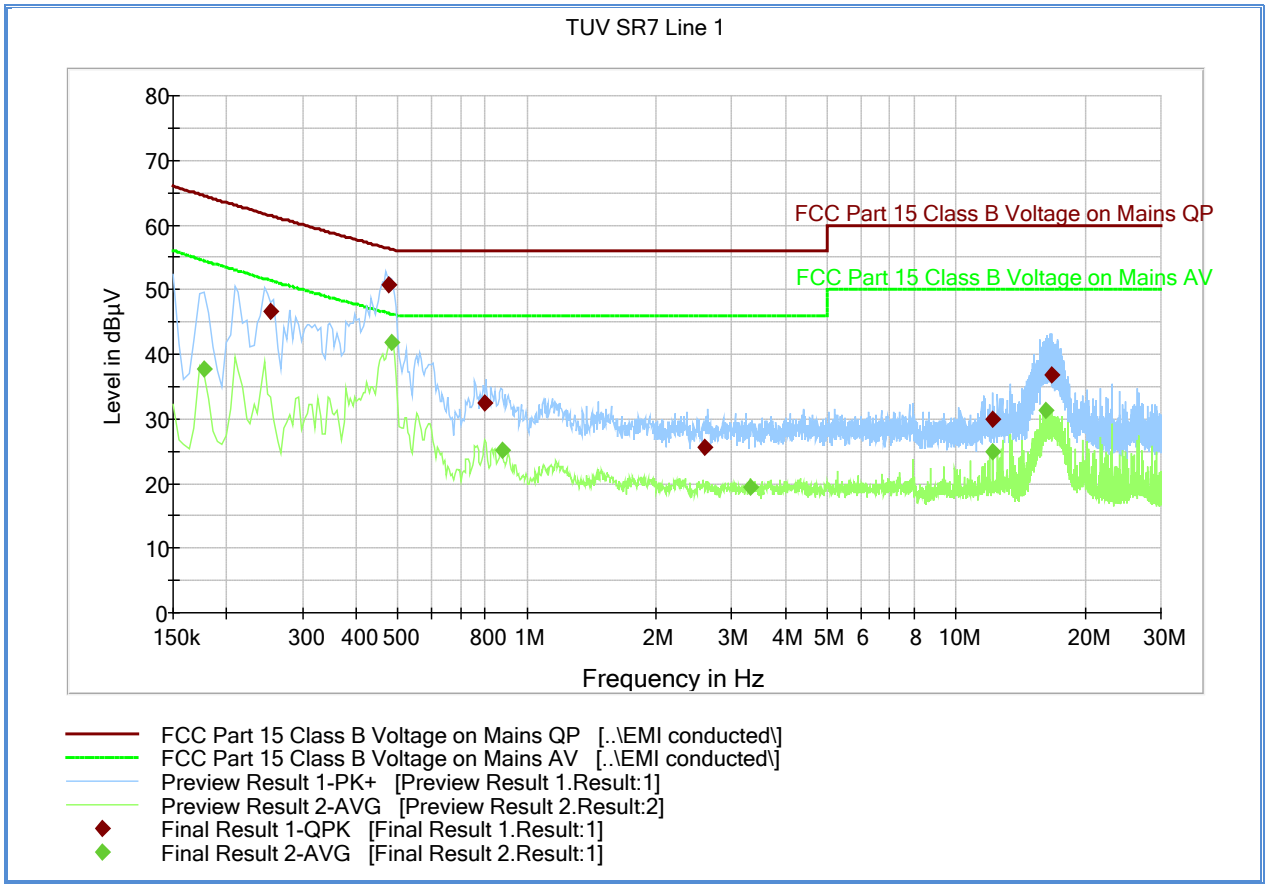
Quasi Peak

Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)
0.258000	49.0	1000.0	9.000	Off	N	21.1	12.3	61.3
0.474000	51.5	1000.0	9.000	Off	N	21.1	4.9	56.4
1.837500	28.3	1000.0	9.000	Off	N	21.1	27.7	56.0
4.267500	30.4	1000.0	9.000	Off	N	21.2	25.6	56.0
12.196500	35.4	1000.0	9.000	Off	N	21.3	24.6	60.0
16.327500	45.4	1000.0	9.000	Off	N	21.6	14.6	60.0

Average

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - Ave (dB)	Limit - Ave (dBµV)
0.181500	41.6	1000.0	9.000	Off	N	21.2	12.7	54.3
0.465000	43.1	1000.0	9.000	Off	N	21.1	3.4	46.5
1.828500	22.1	1000.0	9.000	Off	N	21.1	23.9	46.0
4.380000	25.8	1000.0	9.000	Off	N	21.2	20.2	46.0
12.196500	29.9	1000.0	9.000	Off	N	21.3	20.1	50.0
16.431000	38.3	1000.0	9.000	Off	N	21.6	11.7	50.0

2.1.2 FCC Conducted Emissions Line 1 – Hot (Receive Mode)



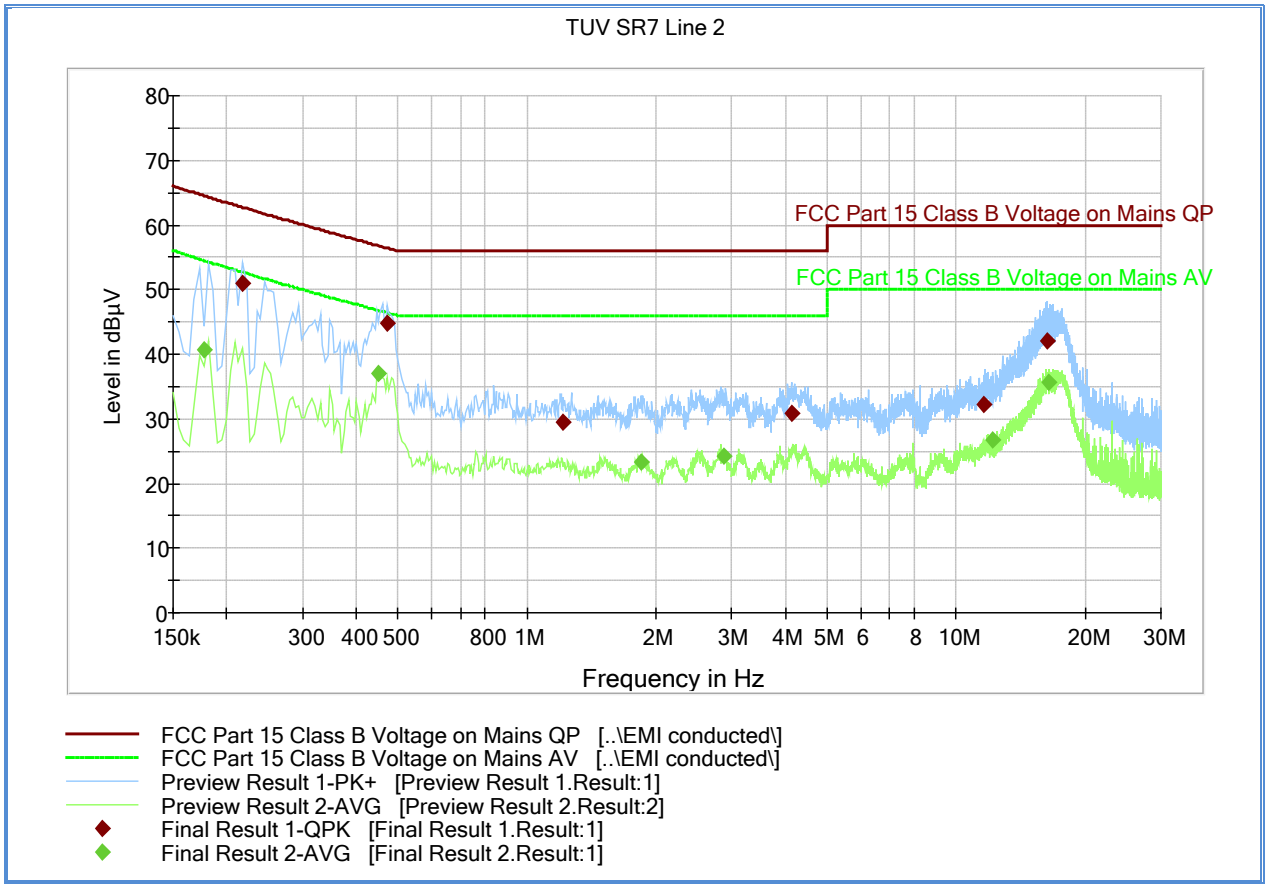
Quasi Peak

Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)
0.253500	46.7	1000.0	9.000	Off	L1	20.3	14.7	61.4
0.478500	50.7	1000.0	9.000	Off	L1	20.2	5.6	56.3
0.798000	32.5	1000.0	9.000	Off	L1	20.2	23.5	56.0
2.598000	25.7	1000.0	9.000	Off	L1	20.3	30.3	56.0
12.138000	30.0	1000.0	9.000	Off	L1	20.5	30.0	60.0
16.746000	36.9	1000.0	9.000	Off	L1	20.8	23.1	60.0

Average

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - Ave (dB)	Limit - Ave (dBµV)
0.177000	37.6	1000.0	9.000	Off	L1	20.4	16.9	54.5
0.483000	41.9	1000.0	9.000	Off	L1	20.2	4.4	46.3
0.874500	25.2	1000.0	9.000	Off	L1	20.2	20.8	46.0
3.318000	19.5	1000.0	9.000	Off	L1	20.3	26.5	46.0
12.196500	25.0	1000.0	9.000	Off	L1	20.5	25.0	50.0
16.228500	31.4	1000.0	9.000	Off	L1	20.8	18.6	50.0

2.1.3 FCC Conducted Emissions Line 2 – Neutral (Receive Mode)



Quasi Peak

Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)
0.217500	50.9	1000.0	9.000	Off	N	21.1	11.9	62.7
0.474000	44.8	1000.0	9.000	Off	N	21.1	11.6	56.4
1.216500	29.5	1000.0	9.000	Off	N	21.1	26.5	56.0
4.137000	30.8	1000.0	9.000	Off	N	21.2	25.2	56.0
11.589000	32.3	1000.0	9.000	Off	N	21.3	27.7	60.0
16.309500	42.0	1000.0	9.000	Off	N	21.6	18.0	60.0

Average

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - Ave (dB)	Limit - Ave (dBµV)
0.177000	40.8	1000.0	9.000	Off	N	21.2	13.8	54.5
0.451500	37.1	1000.0	9.000	Off	N	21.1	9.7	46.8
1.851000	23.3	1000.0	9.000	Off	N	21.1	22.7	46.0
2.868000	24.3	1000.0	9.000	Off	N	21.1	21.7	46.0
12.196500	26.7	1000.0	9.000	Off	N	21.3	23.3	50.0
16.467000	35.6	1000.0	9.000	Off	N	21.6	14.4	50.0

2.2 CARRIER FREQUENCY SEPARATION

2.2.1 Specification Reference

Part 15 Subpart C §15.247(a)(1)

2.2.2 Standard Applicable

(1) Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

2.2.3 Equipment Under Test and Modification State

Serial No: 34008112 / Test Configuration A

2.2.4 Date of Test/Initial of test personnel who performed the test

January 02, 2014/FSC

2.2.5 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.2.6 Environmental Conditions

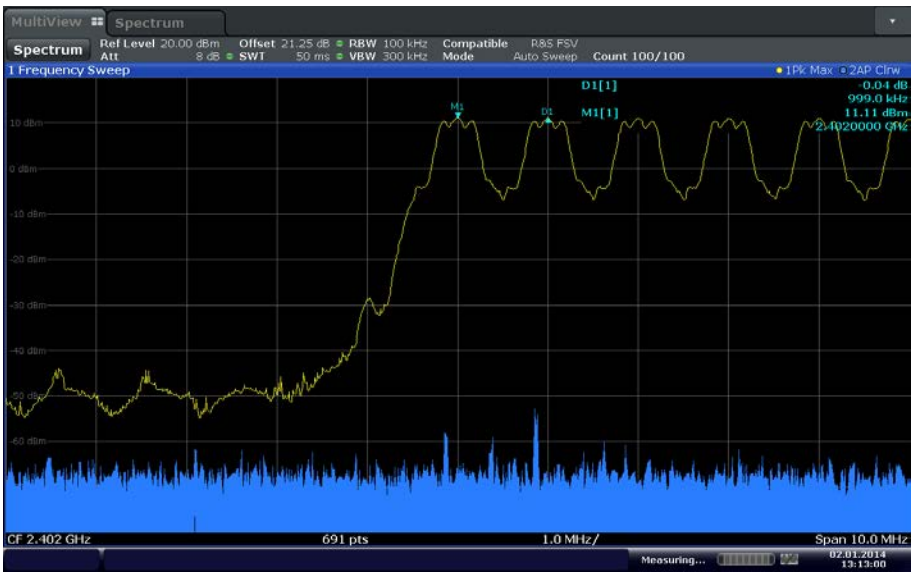
Ambient Temperature	23.8°C
Relative Humidity	26.6%
ATM Pressure	99.4 kPa

2.2.7 Additional Observations

- Hopping function enabled.
- Span is wide enough to capture the peaks of two adjacent channels.
- RBW is 1% of the span.
- VBW is 3x RBW
- Sweep is auto

- Detector is peak.
- Trace is max hold.
- An offset of 21.25dB was added to compensate for the external attenuator and cable used.
- Marker-delta function is used between the peaks of the adjacent channels.
- Limit used is >953.33 kHz (2/3 of worst case 20dB BW).

2.2.8 Test Results



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Observed carrier frequency separation between Channel 0 and Channel 1 = 1.0 MHz (**Complies**. Greater than 953.33 kHz, this is 2/3 of 1.43MHz 20 dB BW)

2.3 NUMBER OF HOPPING FREQUENCIES

2.3.1 Specification Reference

Part 15 Subpart C §15.247(a)(1)(iii)

2.3.2 Standard Applicable

(iii) Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

2.3.3 Equipment Under Test and Modification State

Serial No: 34008112 / Test Configuration A

2.3.4 Date of Test/Initial of test personnel who performed the test

January 02, 2014/FSC

2.3.5 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.3.6 Environmental Conditions

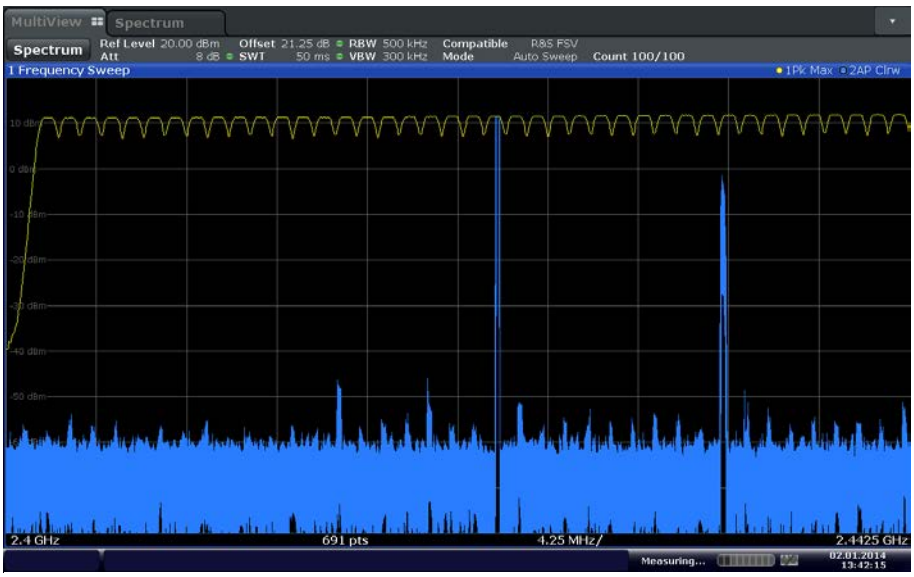
Ambient Temperature	23.8°C
Relative Humidity	26.6%
ATM Pressure	99.4 kPa

2.3.7 Additional Observations

- Hopping function enabled.
- Span is wide enough to capture the channels of interests.
- The span was broken up to two sections in order to clearly show all of the hopping frequencies.
- RBW is 1% of the span, VBW is 3x RBW
- Sweep is auto
- Detector is peak, trace is max hold.
- An offset of 21.25dB was added to compensate for the external attenuator and cable used.

2.3.8 Test Results

Observed Number of Hopping Frequencies is = **79 (Complies)**
= Plot #1 + Plot #2
= 41 + 38



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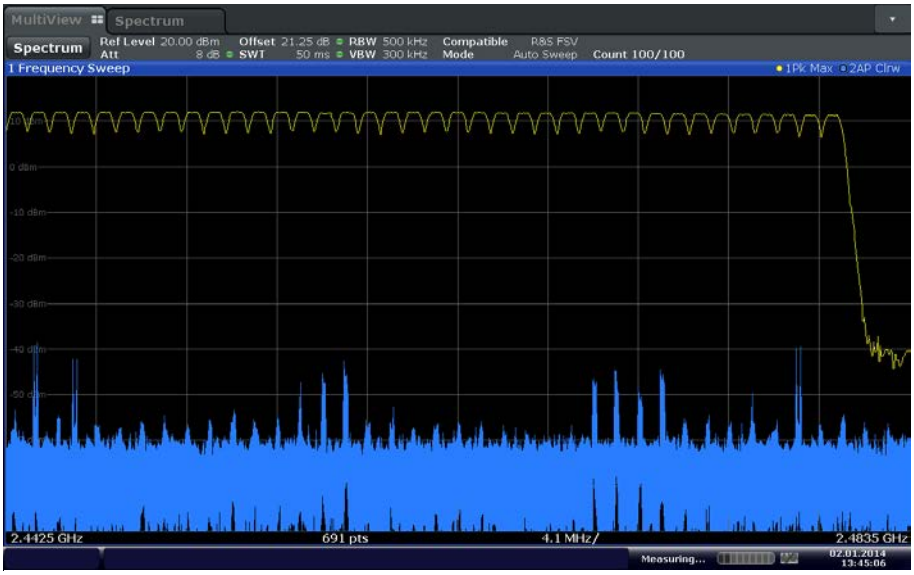
Plot #1



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Plot #2

2.4 TIME OF OCCUPANCY (DWELL TIME)

2.4.1 Specification Reference

Part 15 Subpart C §15.247(a)(1)(iii)

2.4.2 Standard Applicable

(iii) Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

2.4.3 Equipment Under Test and Modification State

Serial No: 34008112 / Test Configuration A

2.4.4 Date of Test/Initial of test personnel who performed the test

January 02, 2014/FSC

2.4.5 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.4.6 Environmental Conditions

Ambient Temperature	23.8°C
Relative Humidity	26.6%
ATM Pressure	99.4 kPa

2.4.7 Additional Observations

- Hopping function enabled.
- Span = zero span, centered on a hopping channel.
- RBW is 1MHz.
- VBW is 3x RBW
- Detector is peak.
- A single pulse is first measured. This measurement is then used to compute the average time of occupancy in the required period (no. of channels x 0.4 second).
- The EUT was configured with the default packet type for each modulation and not configurable at the time of verification. The manufacturer declares that the default packet type verified is the worst case scenario for their application.

2.4.8 Test Results

Modulation	Measured time of occupancy	Requirement
GFSK	8.5120 ms	<400 ms
π/4-DQPSK	130.20 ms	<400 ms
8DPSK	134.08 ms	<400 ms

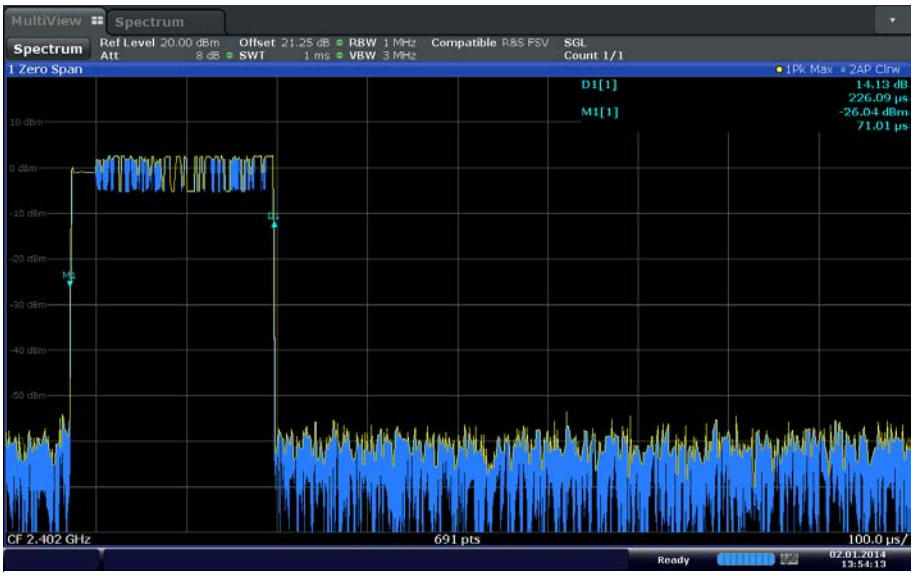
2.4.9 Sample Computation (8DPSK)

Width of single pulse = 0.000419 second
Observed occurrence = 32 pulses/3.16 seconds
Required period = 79 channels x 0.4 second
= 31.6 seconds

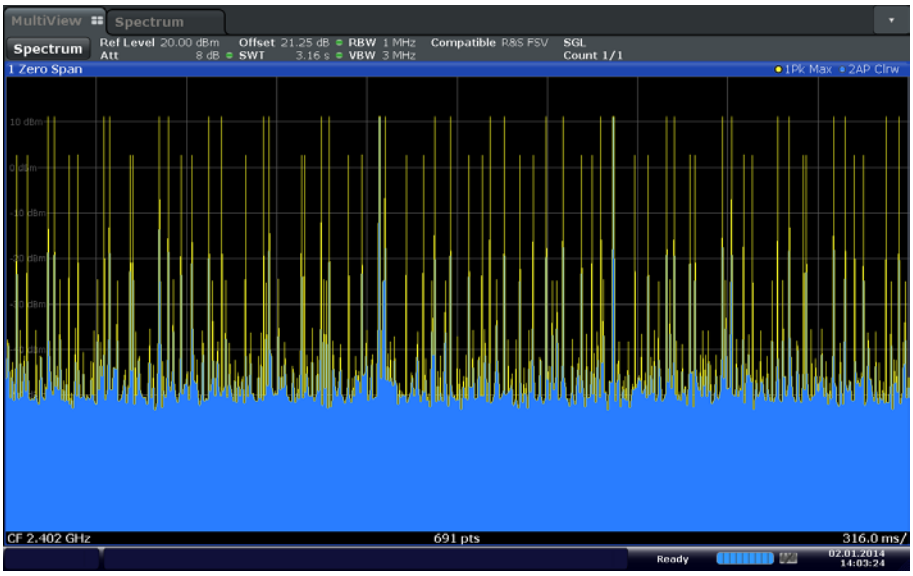
Average time of occupancy = Pulse width x #pulses in 3.16 seconds x 10
= 0.000419 second x 32x 10
= 0.13408 second

Compliance = **Complies.** 0.13408 second < 0.4 second

2.4.10 Test Results Plots

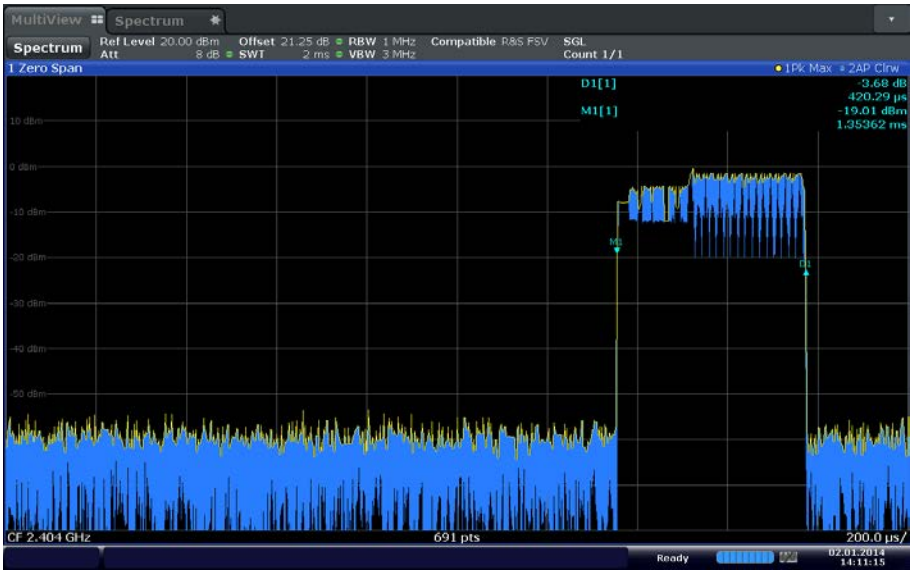


GFSK width of single pulse (0.226ms)



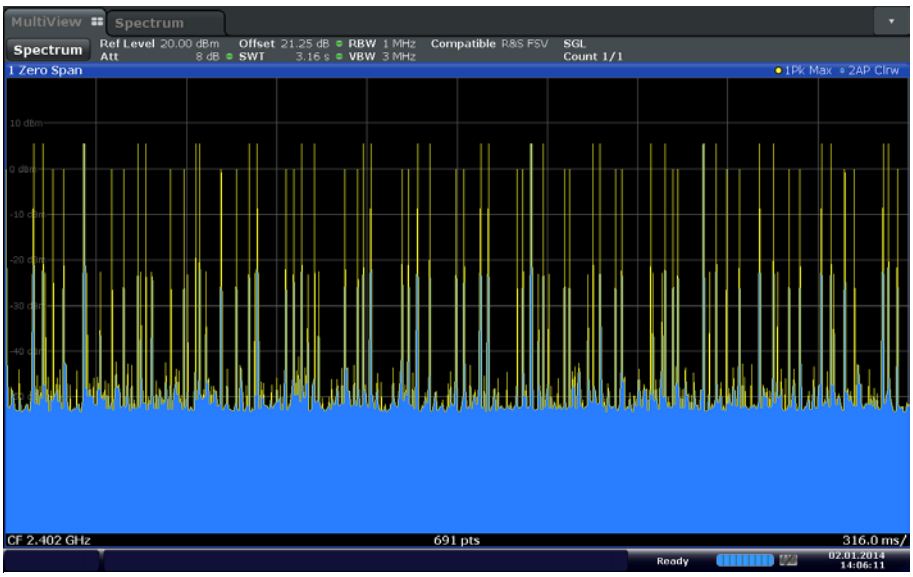
Date: 2.JAN.2014 14:03:24

32 pulses/3.16 seconds (DH1)



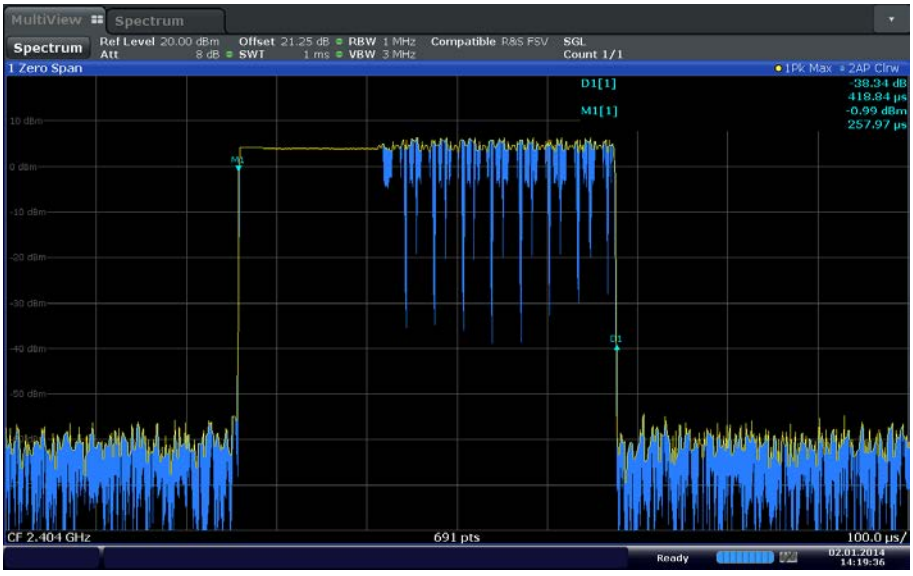
Date: 2.JAN.2014 14:11:15

π/4-DQPSK width of single pulse (0.420ms)



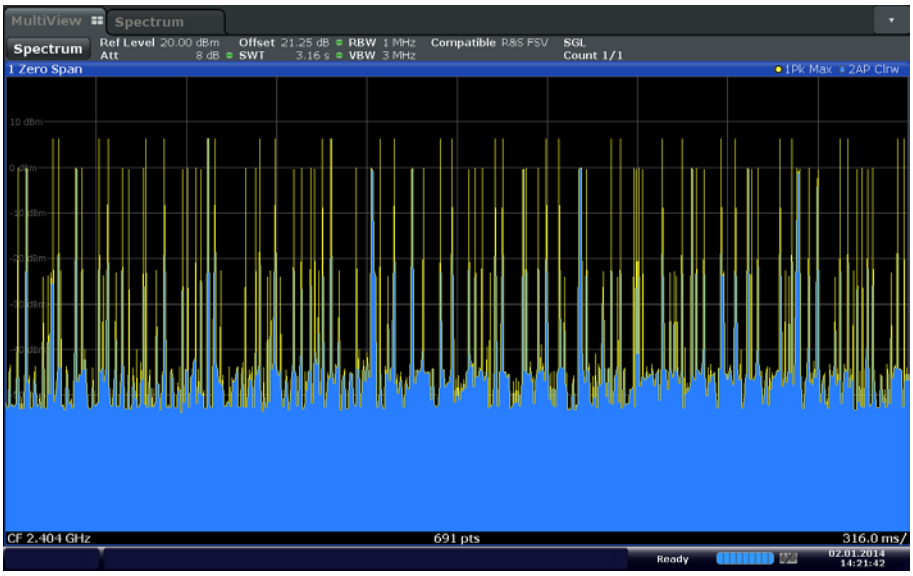
Date: 2.JAN.2014 14:06:11

31 pulses/3.16 seconds (π/4-DQPSK)



Date: 2.JAN.2014 14:19:36

8DPSK width of single pulse (0.419ms)



32 pulses/3.16 seconds (8DPSK)

2.5 20 dB BANDWIDTH

2.5.1 Specification Reference

Part 15 Subpart C §15.215(c)

2.5.2 Standard Applicable

(c) Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

2.5.3 Equipment Under Test and Modification State

Serial No: 34008112 / Test Configuration A

2.5.4 Date of Test/Initial of test personnel who performed the test

January 02, 2014/FSC

2.5.5 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.5.6 Environmental Conditions

Ambient Temperature	23.8°C
Relative Humidity	26.6%
ATM Pressure	99.4 kPa

2.5.7 Additional Observations

- This is a conducted test.
- An offset of 21.25dB was added to compensate for the external attenuator and cable used.
- Span is approximately 2 to 3 times the expected 20dB bandwidth.
- RBW is ≥ 1% of the expected 20dB bandwidth while VBW is ≥ RBW.
- Sweep is auto.
- Detector is peak.
- Max hold function activated.

- "n dB down" marker function (20dB) of the spectrum analyzer was used for this test.

2.5.8 Test Results

Modulation	Channel	Frequency (MHz)	Measured 20dB Bandwidth (MHz)
GFSK	0	2402	1.11
	38	2440	1.11
	78	2480	1.11
π/4-DQPSK	0	2402	1.43
	38	2440	1.43
	78	2480	1.43
8DPSK	0	2402	1.43
	38	2440	1.43
	78	2480	1.42

Worst case configuration (Low Channel π/4-DQPSK)
2402 MHz – (20dB BW/2) = 2401.285 MHz (within the frequency band - **Compliant**)

Worst case configuration (High Channel π/4-DQPSK)
2480 MHz + (20dB BW/2) = 2480.715 MHz (within the frequency band - **Compliant**)

2.5.9 Test Results Plots

GFSK Low Channel

Date: 2.JAN.2014 11:19:53

GFSK Mid Channel

Date: 2.JAN.2014 11:20:36

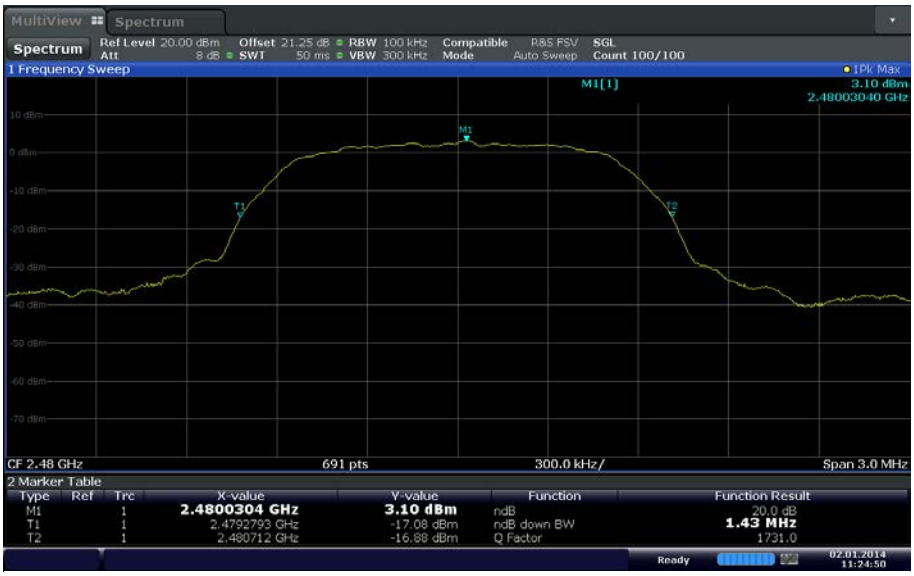
GFSK High Channel

Date: 2.JAN.2014 11:22:07

π/4-DQPSK Low Channel

Date: 2.JAN.2014 11:23:39

π/4-DQPSK Mid Channel

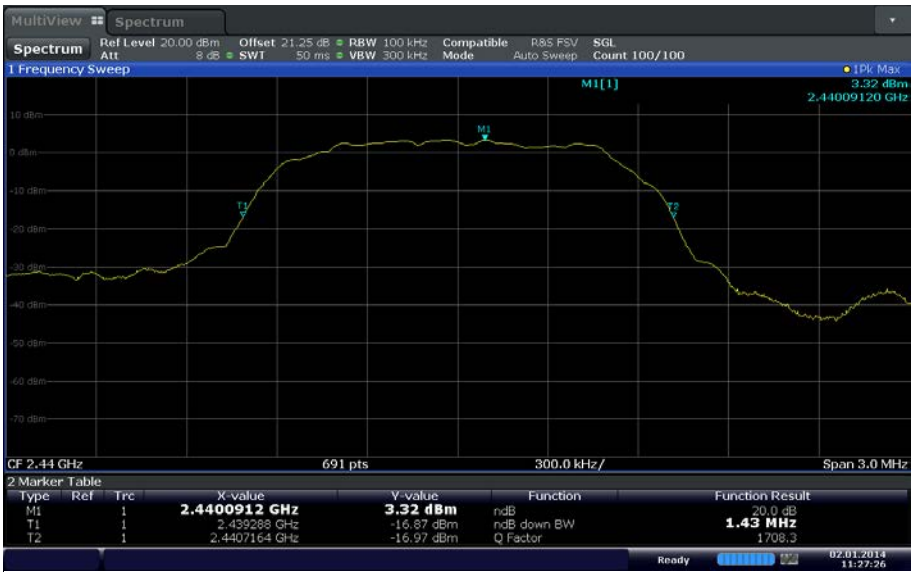


Date: 2.JAN.2014 11:24:50

π/4-DQPSK High Channel

Date: 2.JAN.2014 11:26:28

8DPSK Low Channel



Date: 2.JAN.2014 11:27:26

8DPSK Mid Channel

Date: 2.JAN.2014 11:28:30

8DPSK High Channel

2.6 99% EMISSION BANDWIDTH

2.6.1 Specification Reference

RSS-Gen Clause 4.6.1

2.6.2 Standard Applicable

When an occupied bandwidth value is not specified in the applicable RSS, the transmitted signal bandwidth to be reported is to be its 99% emission bandwidth, as calculated or measured.
The transmitter shall be operated at its maximum carrier power measured under normal test conditions. The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts. The resolution bandwidth shall be set to as close to 1% of the selected span as is possible without being below 1%. The video bandwidth shall be set to 3 times the resolution bandwidth. Video averaging is not permitted. Where practical, a sampling detector shall be used given that a peak or peak hold may produce a wider bandwidth than actual.
The trace data points are recovered and directly summed in linear terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached and that frequency recorded. The process is repeated for the highest frequency data points. This frequency is recorded. The span between the two recorded frequencies is the occupied bandwidth.

2.6.3 Equipment Under Test and Modification State

Serial No: 34008112 / Test Configuration A

2.6.4 Date of Test/Initial of test personnel who performed the test

January 02, 2014/FSC

2.6.5 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.6.6 Environmental Conditions

Ambient Temperature	23.8°C
Relative Humidity	26.6%
ATM Pressure	99.4 kPa

2.6.7 Additional Observations

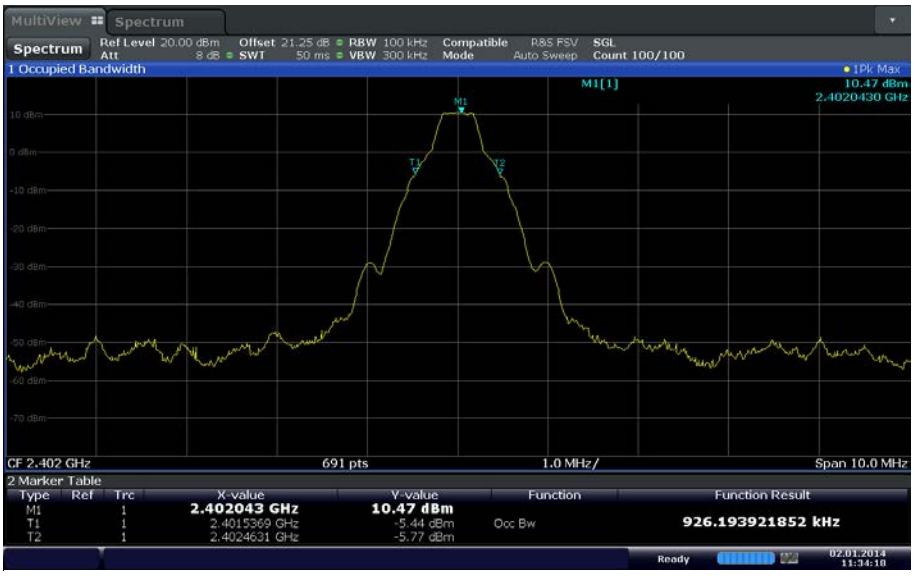
- This is a conducted test.
- An offset of 21.25dB was added to compensate for the external attenuator and cable used.
- Span is wide enough to capture the channel transmission.
- RBW is 1% of the span.
- VBW is 3X RBW.
- Sweep is auto.

- Detector is peak.
- The % Power Bandwidth setting in the spectrum analyzer was set to 99% (default).
- The OBW power measurement function of the spectrum analyzer was used for this test.

2.6.8 Test Results (For reporting purposes only)

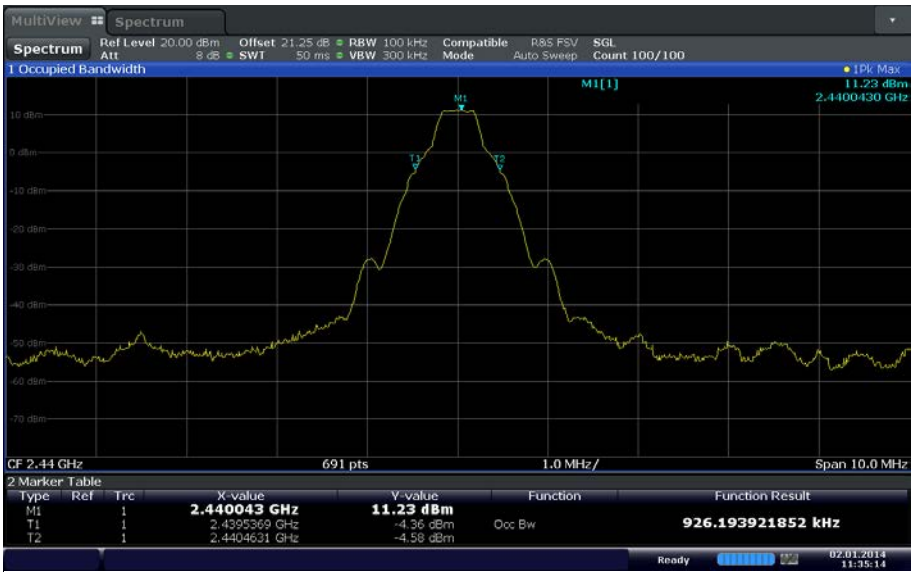
Modulation	Channel	Frequency (MHz)	Measured 20dB Bandwidth (MHz)
GFSK	0	2402	0.926
	38	2440	0.926
	78	2480	0.926
π/4-DQPSK	0	2402	1.245
	38	2440	1.245
	78	2480	1.245
8DPSK	0	2402	1.259
	38	2440	1.259
	78	2480	1.259

2.6.9 Test Results Plots



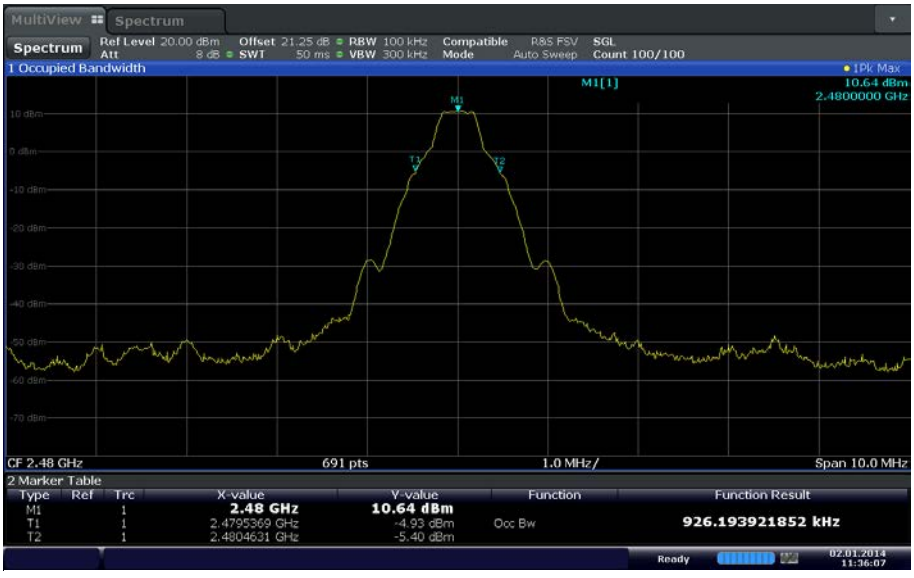
Date: 2.JAN.2014 11:34:18

GFSK Low Channel



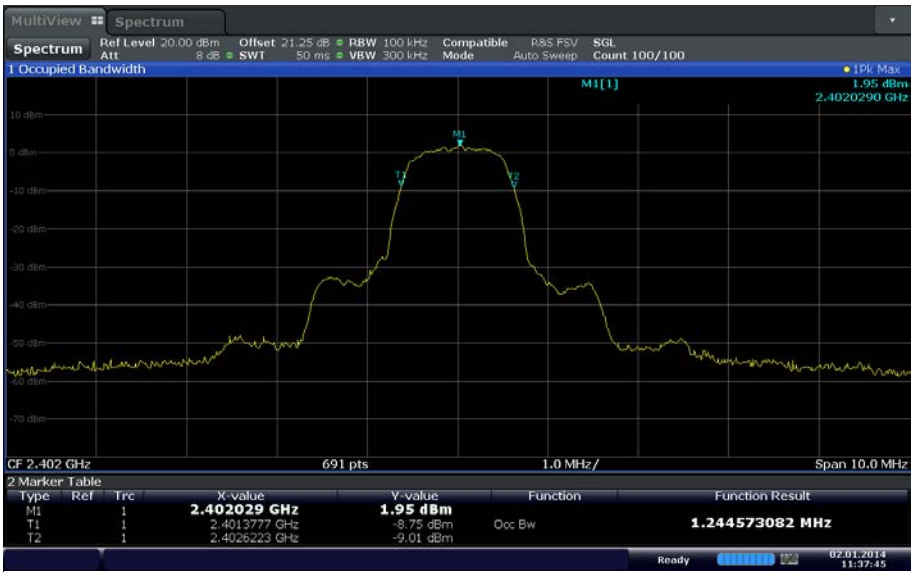
Date: 2.JAN.2014 11:35:13

GFSK Mid Channel



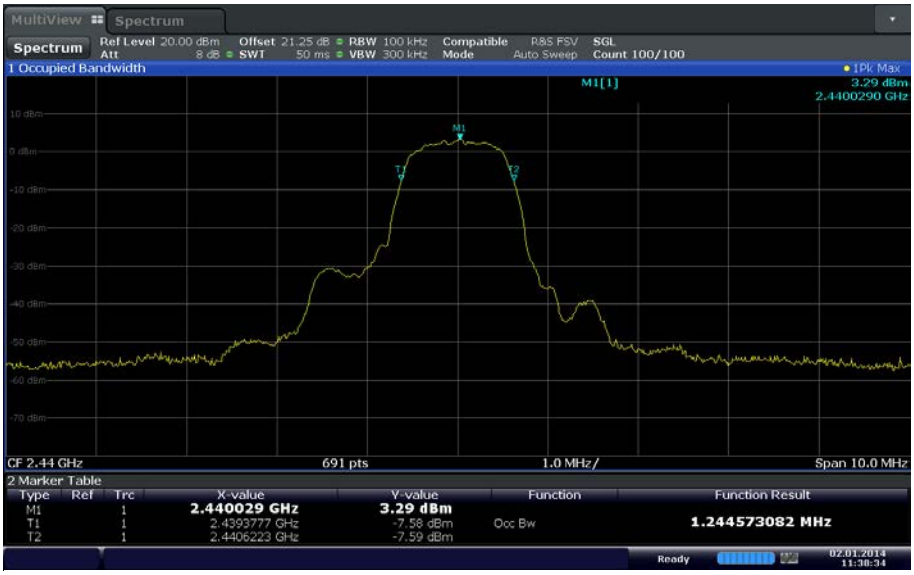
Date: 2.JAN.2014 11:36:06

GFSK High Channel



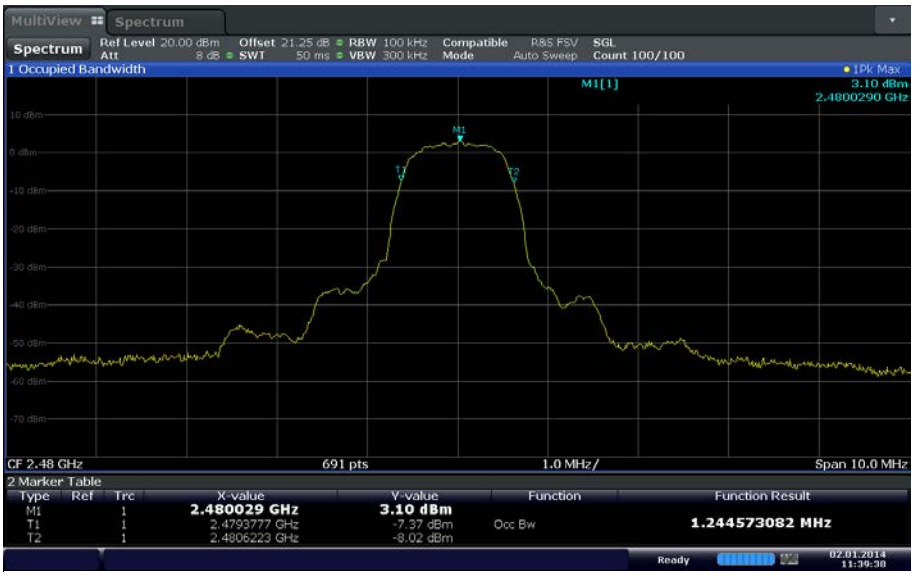
Date: 2.JAN.2014 11:37:45

π/4-DQPSK Low Channel



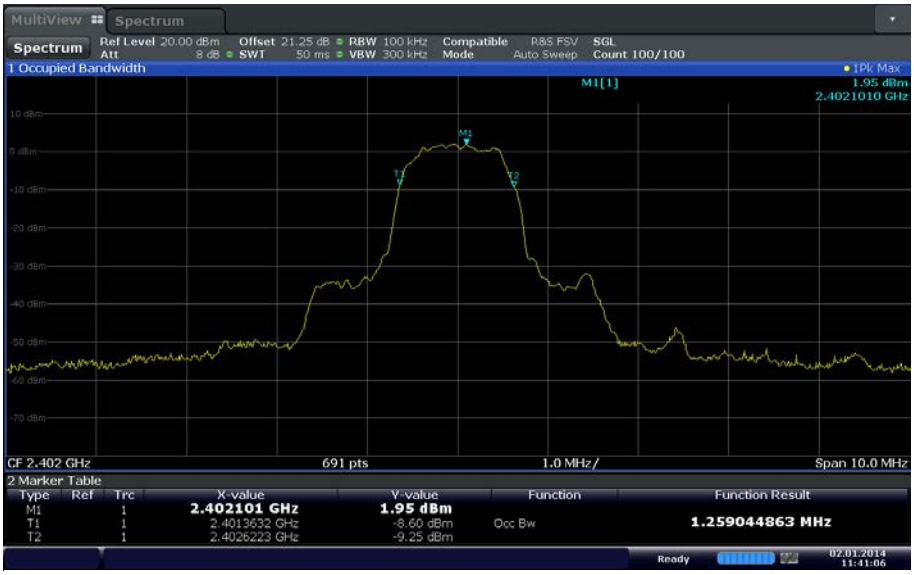
Date: 2.JAN.2014 11:38:33

π/4-DQPSK Mid Channel



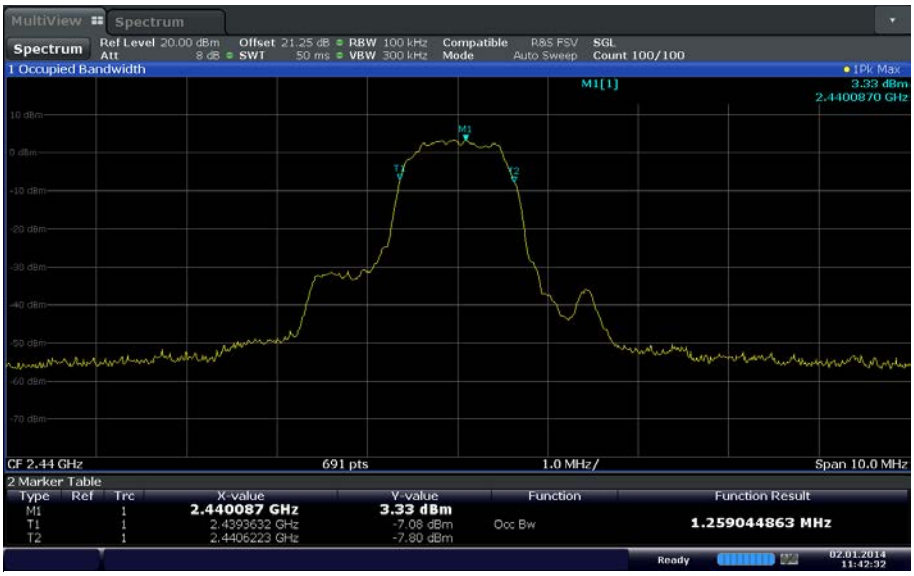
Date: 2.JAN.2014 11:39:38

π/4-DQPSK High Channel



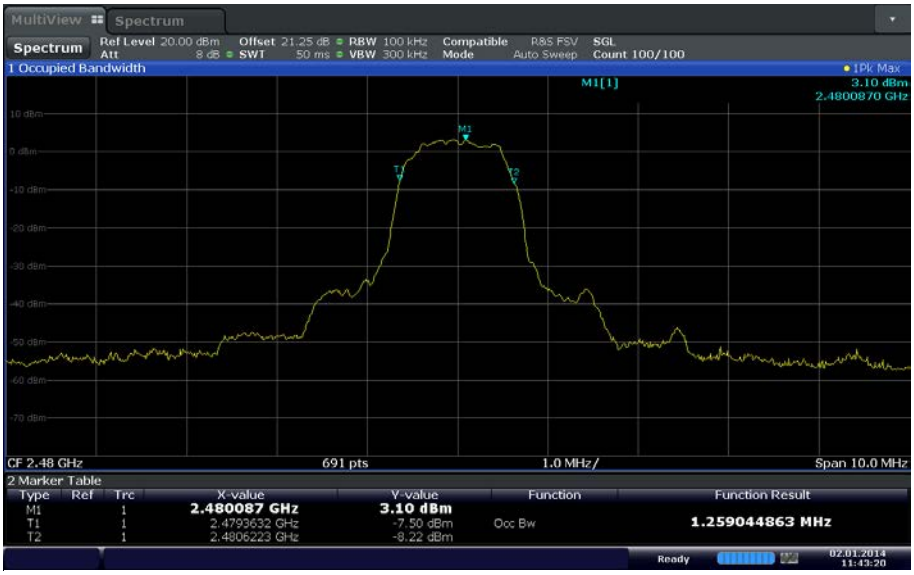
Date: 2.JAN.2014 11:41:06

8DPSK Low Channel



Date: 2.JAN.2014 11:42:31

8DPSK Mid Channel



Date: 2.JAN.2014 11:43:20

8DPSK High Channel

2.7 PEAK OUTPUT POWER

2.7.1 Specification Reference

Part 15 Subpart C §15.247(b)(1)

2.7.2 Standard Applicable

(1) For frequency hopping systems operating in the 2400–2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725–5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400–2483.5 MHz band: 0.125 watts.

2.7.3 Equipment Under Test and Modification State

Serial No: 34008112 / Test Configuration A

2.7.4 Date of Test/Initial of test personnel who performed the test

November 27, 2013/FSC

2.7.5 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.7.6 Environmental Conditions

Ambient Temperature	24.0°C
Relative Humidity	30.5%
ATM Pressure	99.1 kPa

2.7.7 Additional Observations

This is a conducted test using a Peak Power Meter.

2.7.8 Test Results (Conducted)

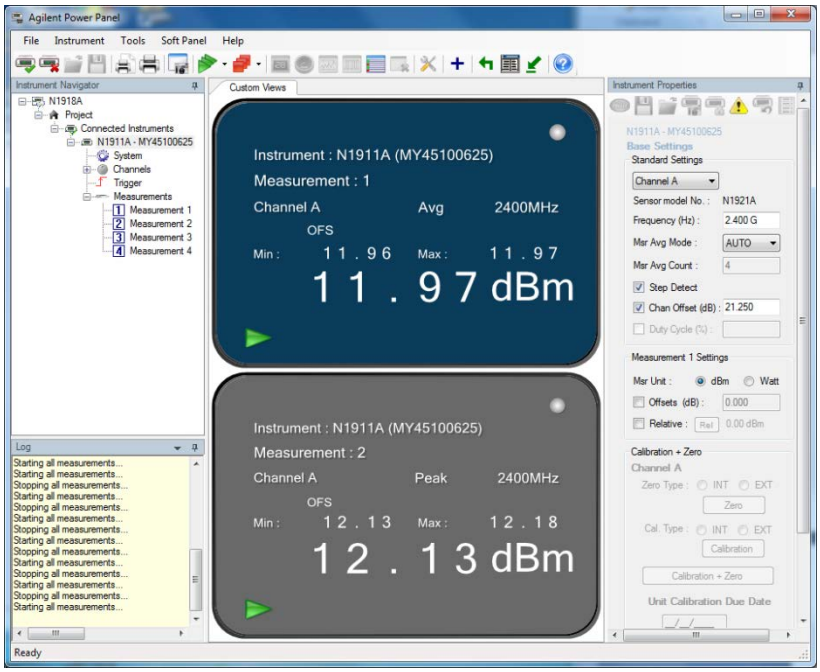
Modulation	Channel	Frequency (MHz)	Measured Average Output Power (dBm)	Measured Peak Output Power (dBm)	Measured Peak Output Power (mW)	Limit (mW)
GFSK	0	2402	11.45	11.69	14.76	1000.0
	38	2440	11.97	12.18	16.52	1000.0
	78	2480	11.93	11.86	15.35	1000.0
π/4-DQPSK	0	2402	4.50	7.90	6.166	1000.0
	38	2440	5.50	8.77	7.534	1000.0
	78	2480	5.24	8.39	6.902	1000.0
8DPSK	0	2402	5.21	8.40	6.918	1000.0

	38	2440	5.61	9.37	8.650	1000.0
	78	2480	5.23	9.00	7.943	1000.0

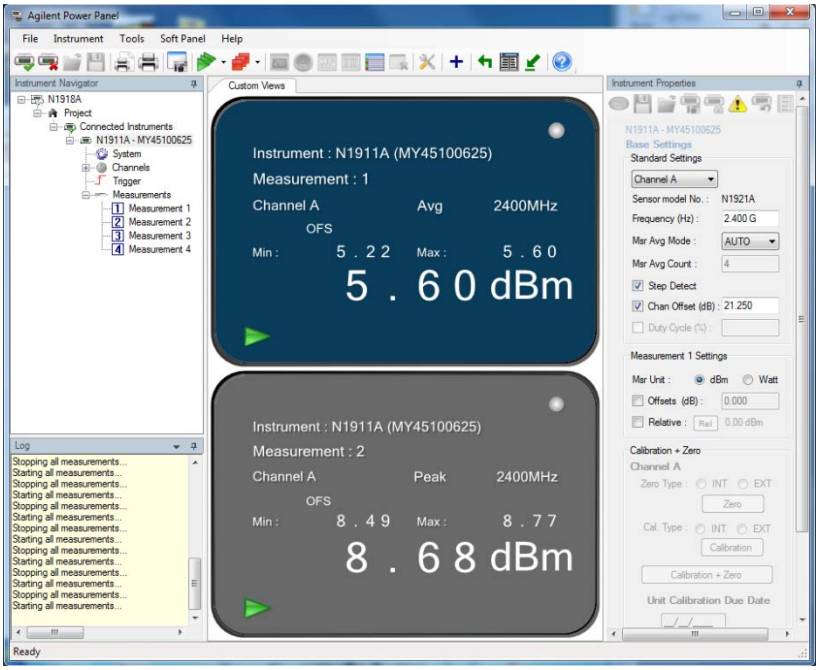
2.7.9 Test Results (*De Facto* EIRP Limit)

Modulation	Channel	Frequency (MHz)	Measured Peak Output Power (dBm))	Antenna Gain (dBi)	Calculated Peak Output Power EIRP (dBm))	Limit (dBm))
GFSK	38	2440	12.18	2.9	15.08	30
π/4-DQPSK	38	2440	8.77	2.9	11.67	30
8DPSK	38	2440	9.37	2.9	12.27	30

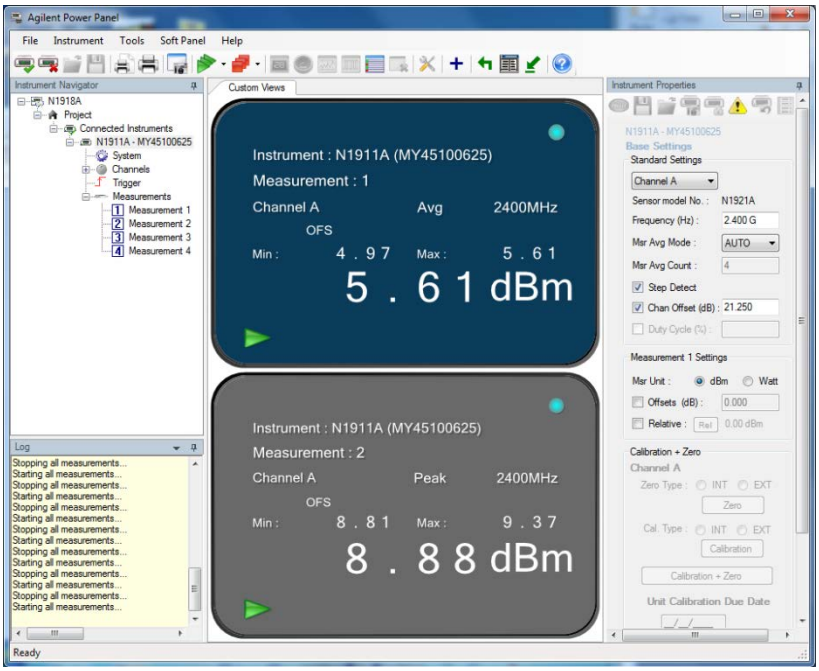
2.7.10 Sample Test Display



GFSK mid channel (Channel 38 2440 MHz)



π/4-DQPSK mid channel (Channel 38 2440 MHz)



8DPSK mid channel (Channel 38 2440 MHz)

2.8 BAND-EDGE COMPLIANCE OF RF CONDUCTED EMISSIONS

2.8.1 Specification Reference

Part 15 Subpart C §15.247(d)

2.8.2 Standard Applicable

(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

2.8.3 Equipment Under Test and Modification State

Serial No: 34008112 / Test Configuration A

2.8.4 Date of Test/Initial of test personnel who performed the test

January 02, 2014/FSC

2.8.5 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.8.6 Environmental Conditions

Ambient Temperature	23.8°C
Relative Humidity	26.6%
ATM Pressure	99.4 kPa

2.8.7 Additional Observations

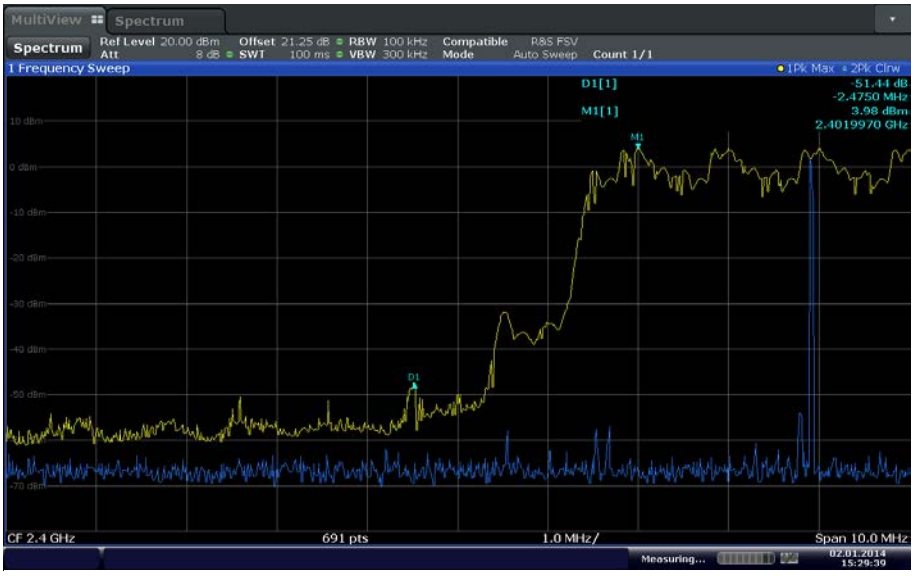
- This is a conducted test.
- An offset of 21.25dB was added to compensate for the external attenuator and cable used.
- Span is wide enough to capture the peak level of the emission operating on the channel closest to the band edge.
- RBW is ≥ 1% of the span, VBW is ≥ RBW.
- Sweep is auto, detector is peak, trace is max hold.
- Trace allowed to stabilize. Marker-delta function used to verify compliance.

- Limit is 20dBc.
- Both Hopping and Non-Hopping mode verified.

2.8.8 Test Results

Date: 2.JAN.2014 15:26:06

Hopping lower bandedge (GFSK)

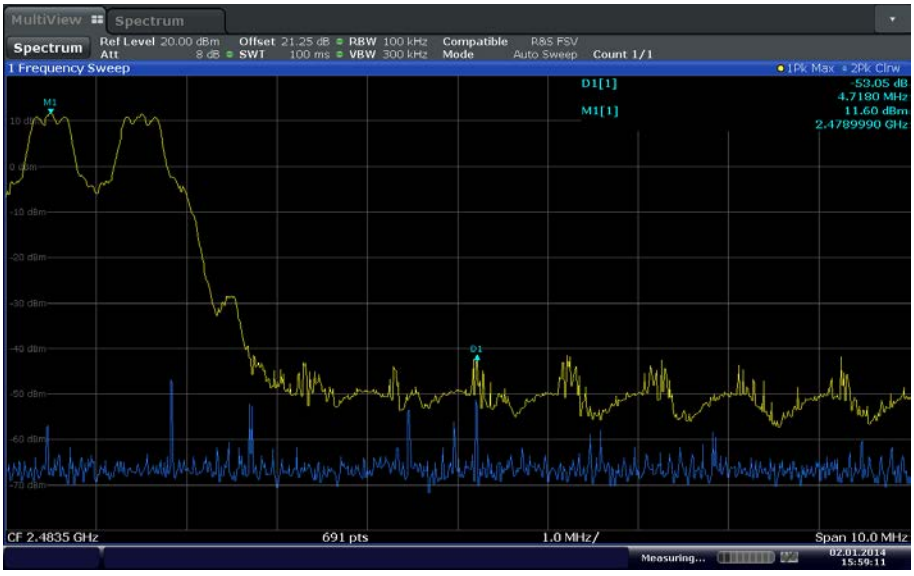


Date: 2.JAN.2014 15:29:39

Hopping lower bandedge (π/4-DQPSK)

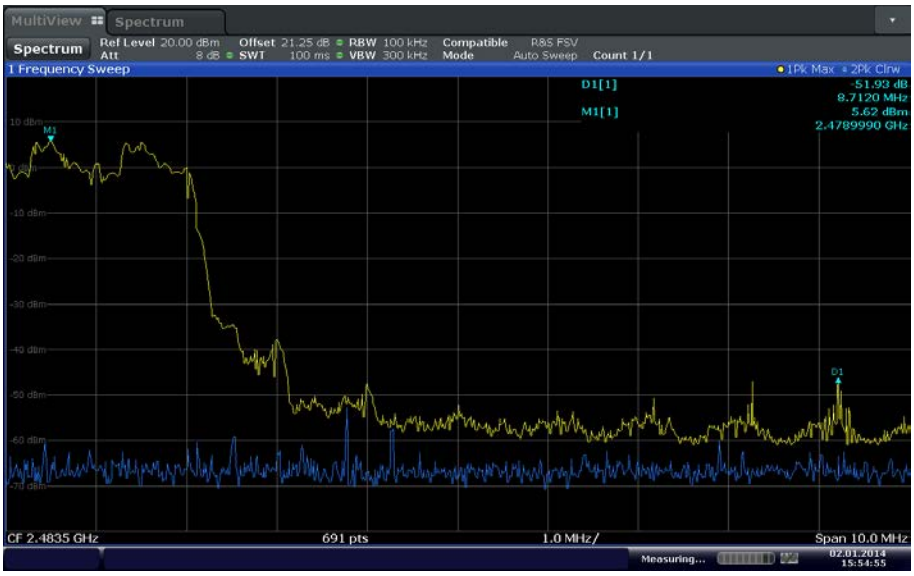
Date: 2.JAN.2014 15:33:15

Hopping lower bandedge (8DPSK)



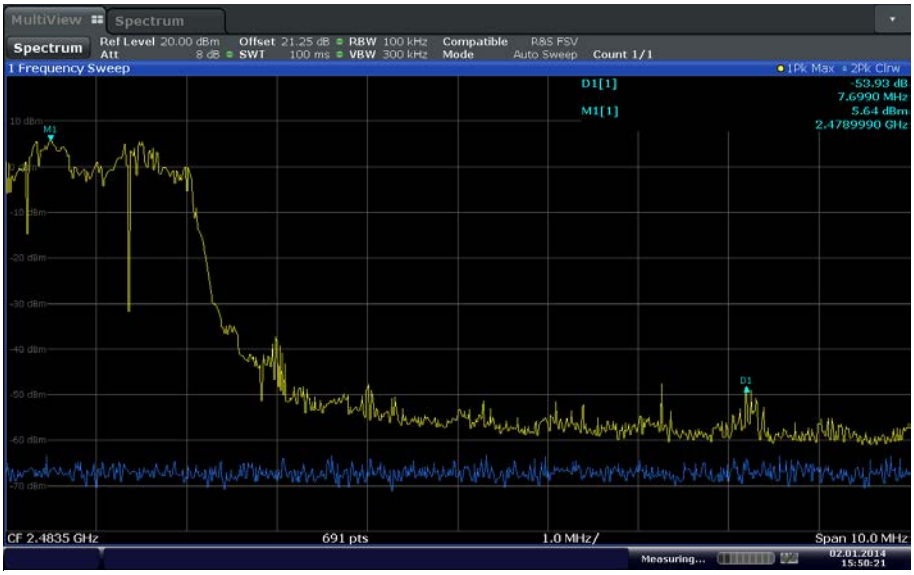
Date: 2.JAN.2014 15:59:11

Hopping upper bandedge (GFSK)



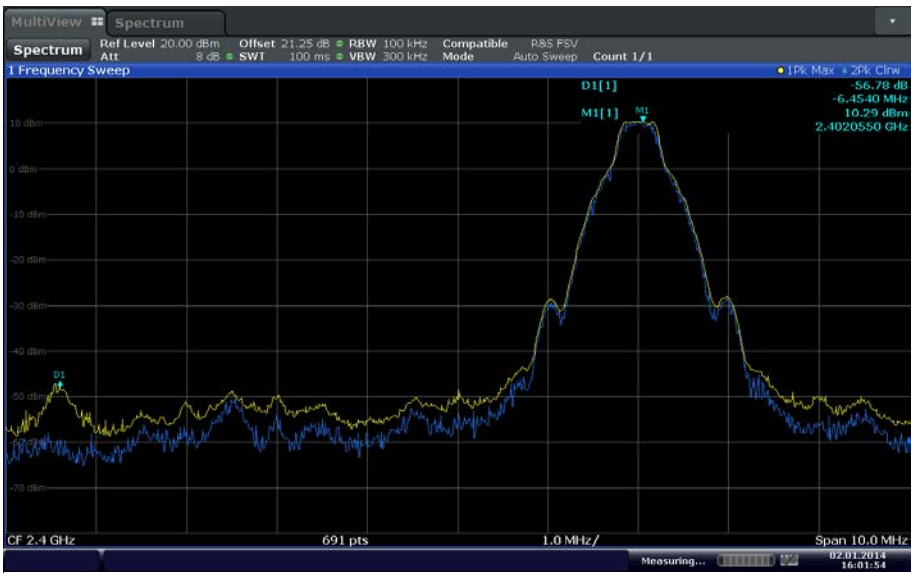
Date: 2 JAN 2014 15:54:55

Hopping upper bandedge (π/4-DQPSK)



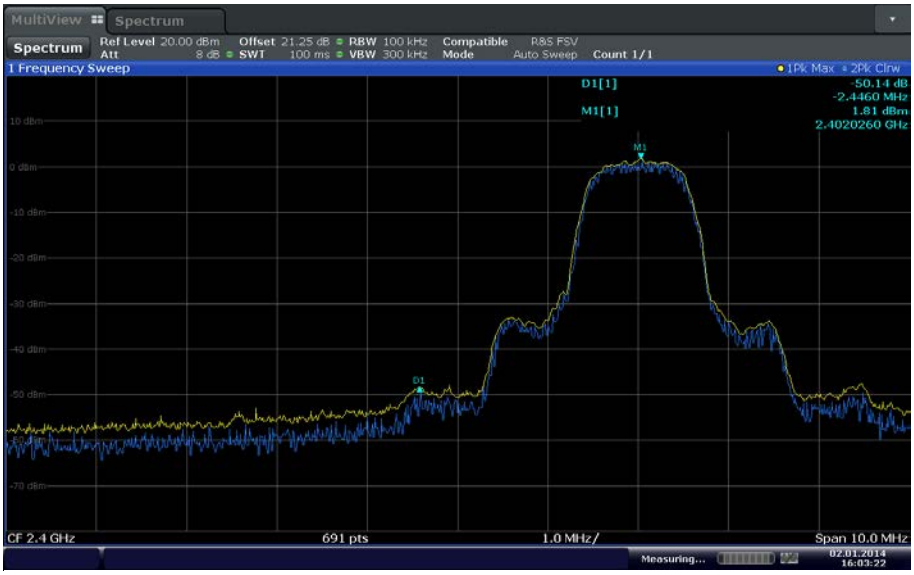
Date: 2 JAN 2014 15:50:21

Hopping upper bandedge (8DPSK)



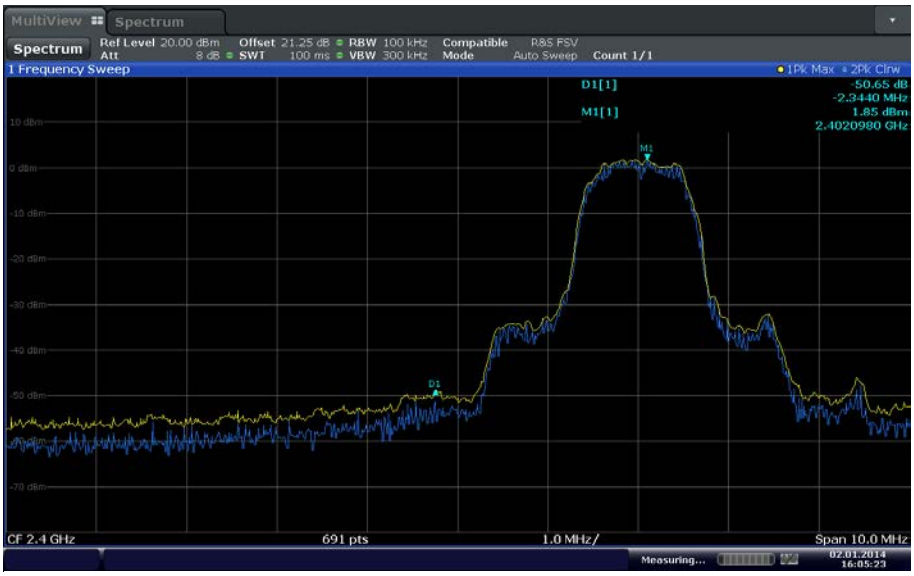
Date: 2.JAN.2014 16:01:54

Non-hopping lower bandedge (GFSK)



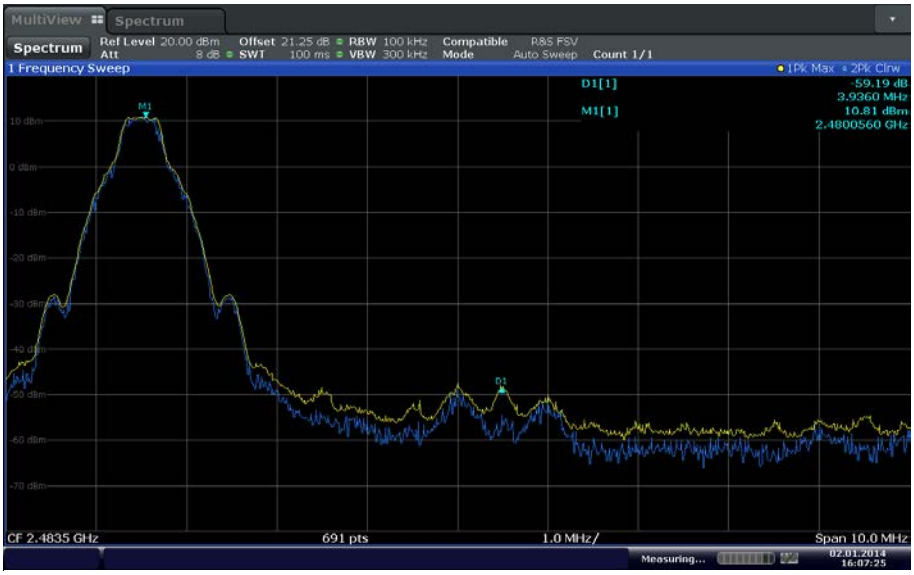
Date: 2.JAN.2014 16:03:22

Non-hopping lower bandedge (π/4-DQPSK)



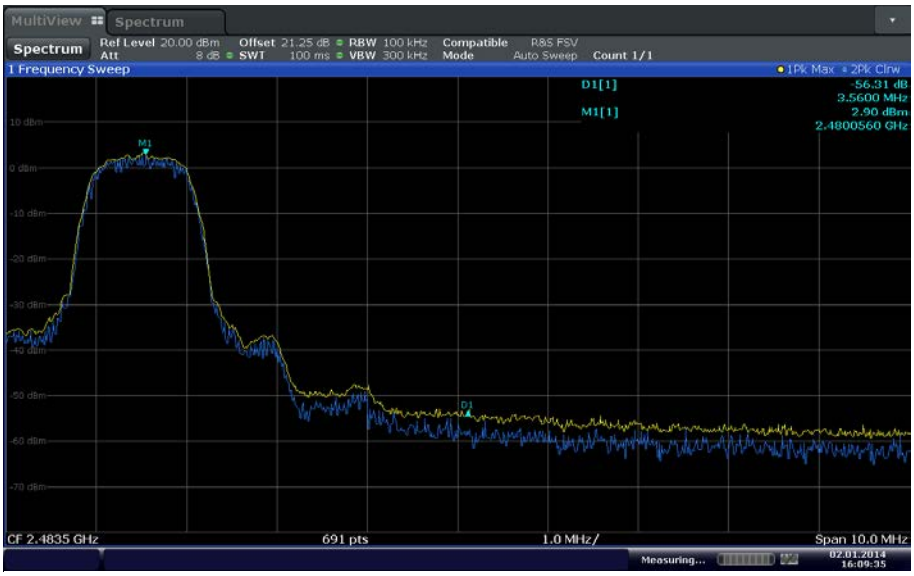
Date: 2.JAN.2014 16:05:23

Non-hopping lower bandedge (8DPSK)



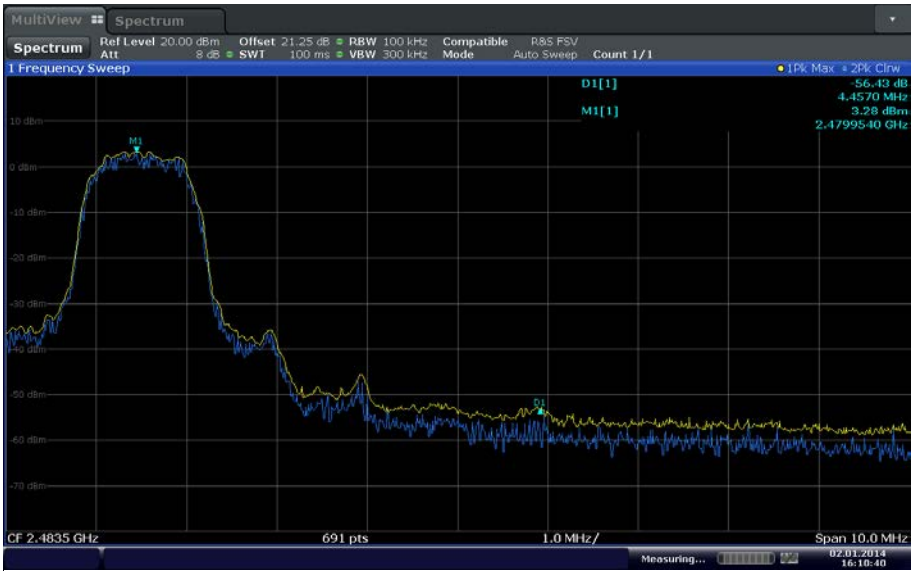
Date: 2.JAN.2014 16:07:25

Non-hopping upper bandedge (GFSK)



Date: 2.JAN.2014 16:09:35

Non-hopping upper bandedge (π/4-DQPSK)



Date: 2.JAN.2014 16:10:40

Non-hopping upper bandedge (8DPSK)

2.9 SPURIOUS RF CONDUCTED EMISSIONS

2.9.1 Specification Reference

Part 15 Subpart C §15.247(d)

2.9.2 Standard Applicable

(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

2.9.3 Equipment Under Test and Modification State

Serial No: 34008112 / Test Configuration A

2.9.4 Date of Test/Initial of test personnel who performed the test

January 02, 2014/FSC

2.9.5 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.9.6 Environmental Conditions

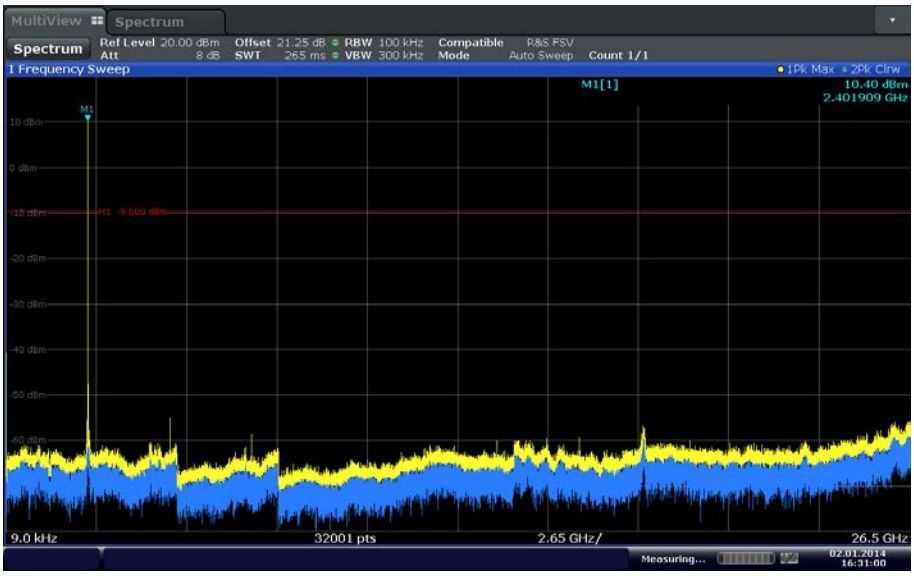
Ambient Temperature	23.8°C
Relative Humidity	26.6%
ATM Pressure	99.4 kPa

2.9.7 Additional Observations

- This is a conducted test.
- An offset of 21.25dB was added to compensate for the external attenuator and cable used.
- Span is from 30MHz up to 26GHz (to cover 10th harmonic of the High Channel).
- Sweep point setting of the spectrum analyzer is set to maximum (32001).
- RBW is 100 kHz, VBW is ≥ RBW.
- Sweep is auto, detector is peak.
- Trace is max hold.

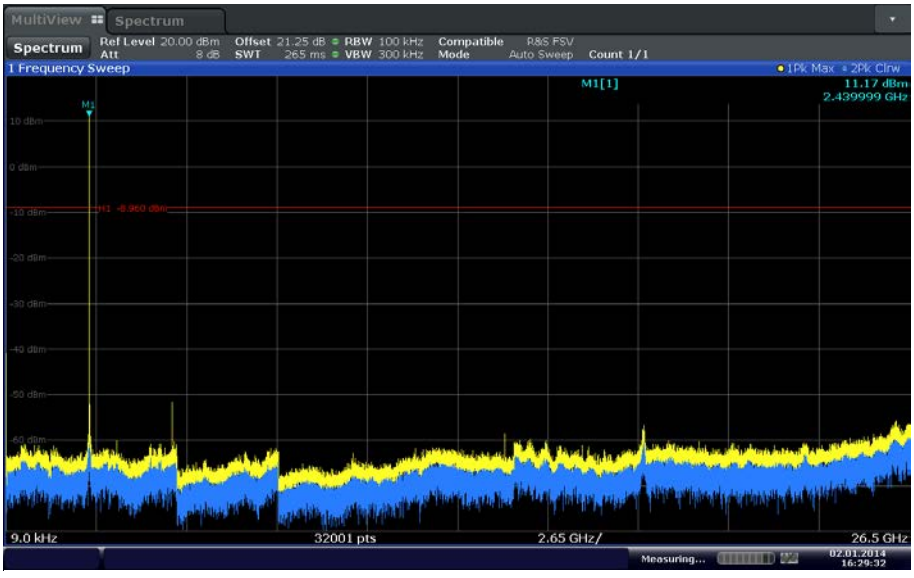
- Trace allowed to stabilize. Maximum spurious emission compared to limit.
- Limit is 20dBc.

2.9.8 Test Results Plots



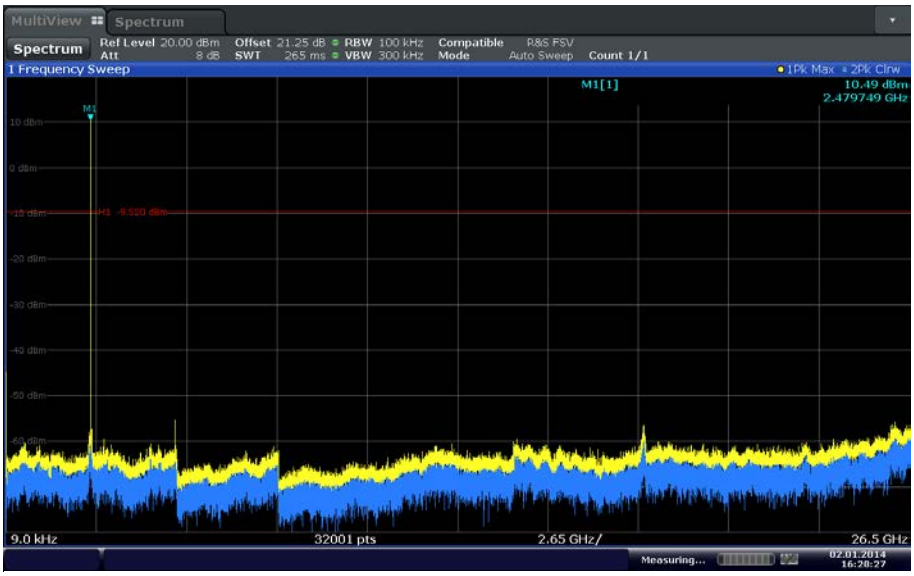
Date: 2.JAN.2014 16:31:00

Low Channel (GFSK)



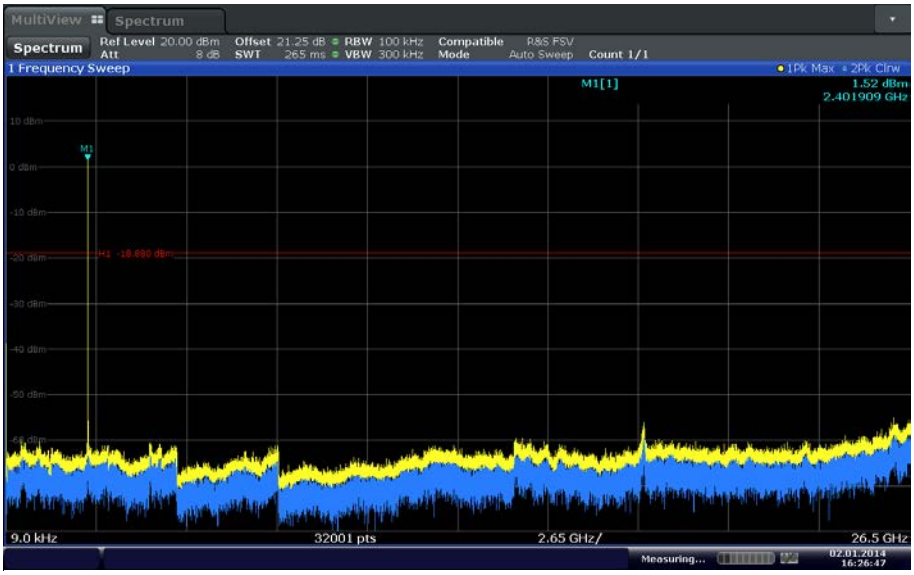
Date: 2.JAN.2014 16:29:32

Mid Channel (GFSK)



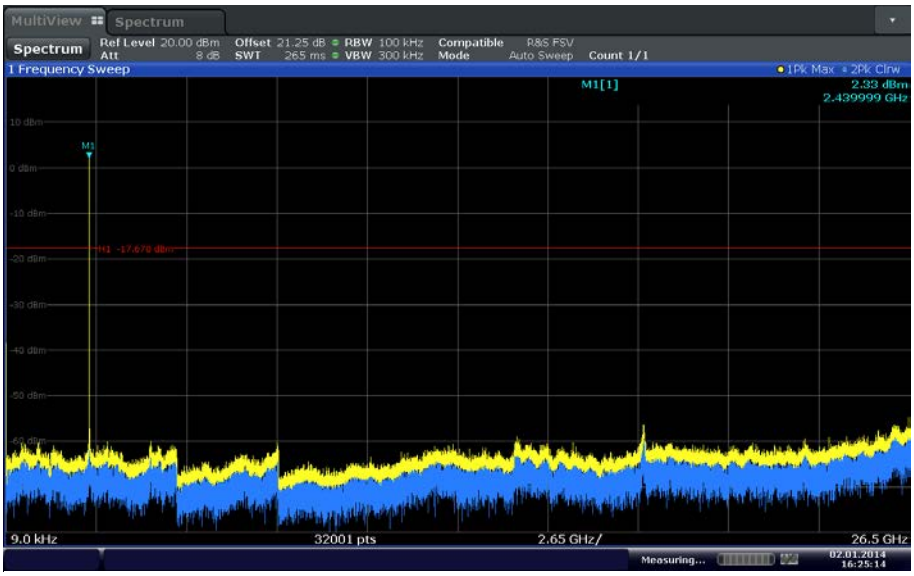
Date: 2.JAN.2014 16:28:27

High Channel (GFSK)



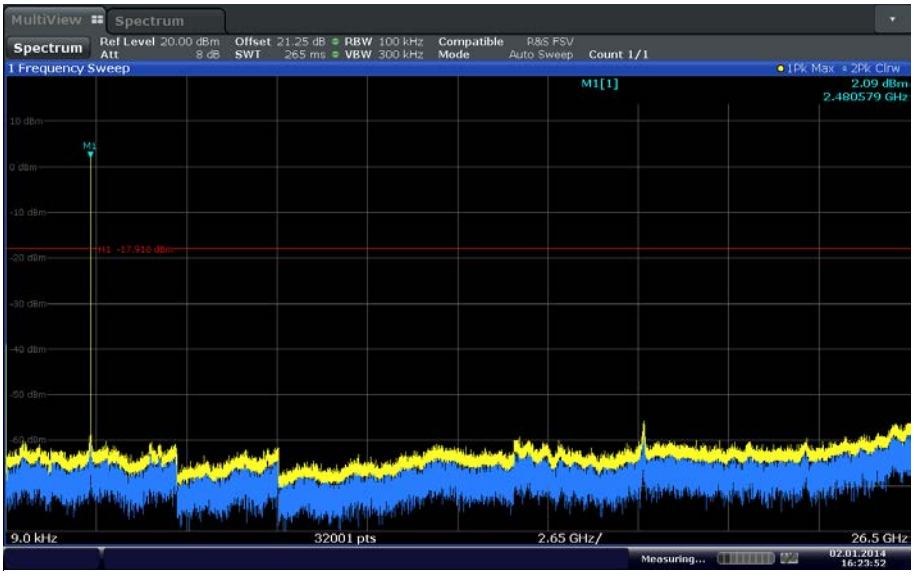
Date: 2.JAN.2014 16:26:47

Low Channel (π/4-DQPSK)



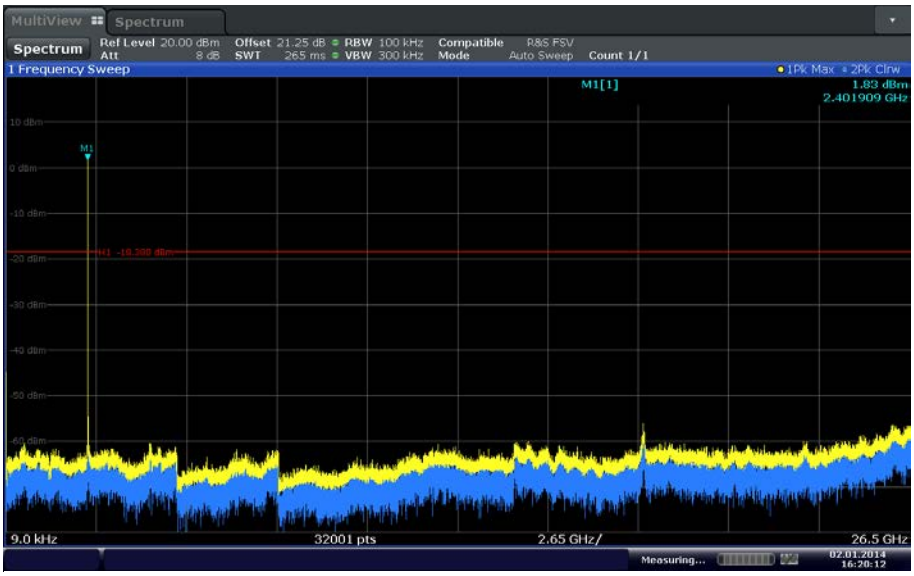
Date: 2.JAN.2014 16:25:14

Mid Channel (π/4-DQPSK)



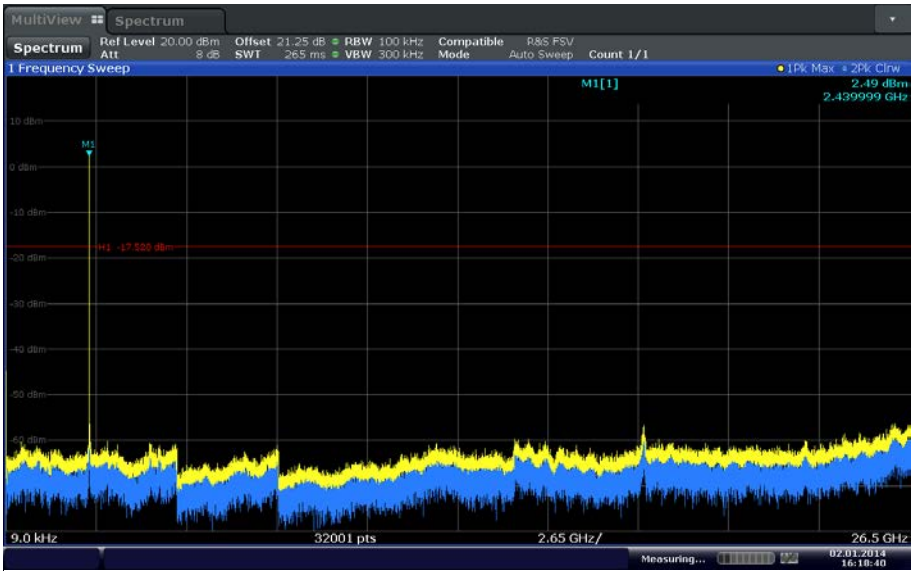
Date: 2.JAN.2014 16:23:52

High Channel (π/4-DQPSK)



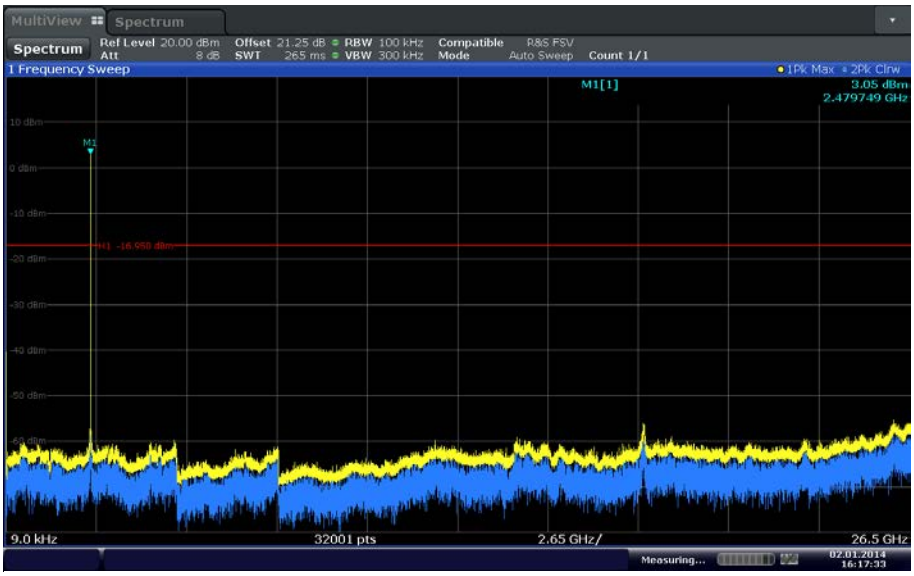
Date: 2.JAN.2014 16:20:12

Low Channel (8DPSK)



Date: 2.JAN.2014 16:18:40

Mid Channel (8DPSK)



Date: 2.JAN.2014 16:17:33

High Channel (8DPSK)

2.10 SPURIOUS RADIATED EMISSIONS

2.10.1 Specification Reference

Part 15 Subpart C §15.247(d)

2.10.2 Standard Applicable

(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

2.10.3 Equipment Under Test and Modification State

Serial No: 34008112 and 34008096/ Test Configuration B

2.10.4 Date of Test/Initial of test personnel who performed the test

December 5 to 24, 2013/FSC

2.10.5 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.10.6 Environmental Conditions

Ambient Temperature	25.4-25.8°C
Relative Humidity	43.5-44.5%
ATM Pressure	98.7-99.0 kPa

2.10.7 Additional Observations

- This is a radiated test. The spectrum was searched from 30MHz to the 10th harmonic (25GHz).
- There are no emissions found that do not comply to the restricted bands defined in FCC Part 15 Subpart C, 15.205 or Part 15.247(d).
- Only the considered worst case configuration (mid channel GFSK) presented for radiated emissions when not hopping. There are no significant differences in radiated emissions between the three modulation types.

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

- Measurement was done using EMC32 automated software. Reported level is the actual level with all the correction factors factored in. Correction Factor column is for informational purposes only. See Section 2.10.8 for sample computation.

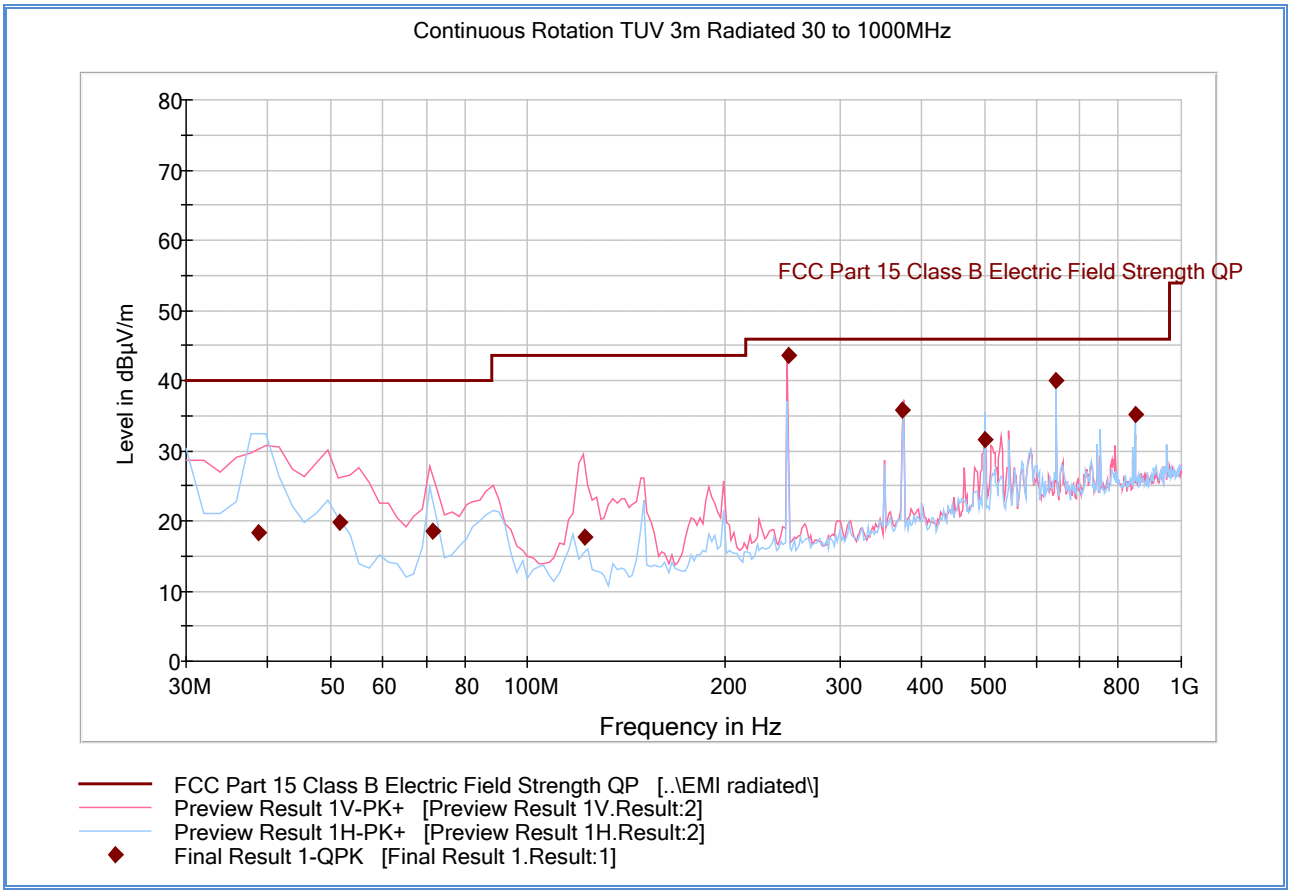
2.10.8 Sample Computation (Radiated Emission)

Measuring equipment raw measurement (dbµV) @ 30 MHz			24.4
Correction Factor (dB)	Asset# 1066 (cable)	0.3	-12.6
	Asset# 1172 (cable)	0.3	
	Asset# 1016 (preamplifier)	-30.7	
	Asset# 1175(cable)	0.3	
	Asset# 1002 (antenna)	17.2	
Reported QuasiPeak Final Measurement (dbµV/m) @ 30MHz			**11.8**

2.10.9 Test Results

See attached plots.

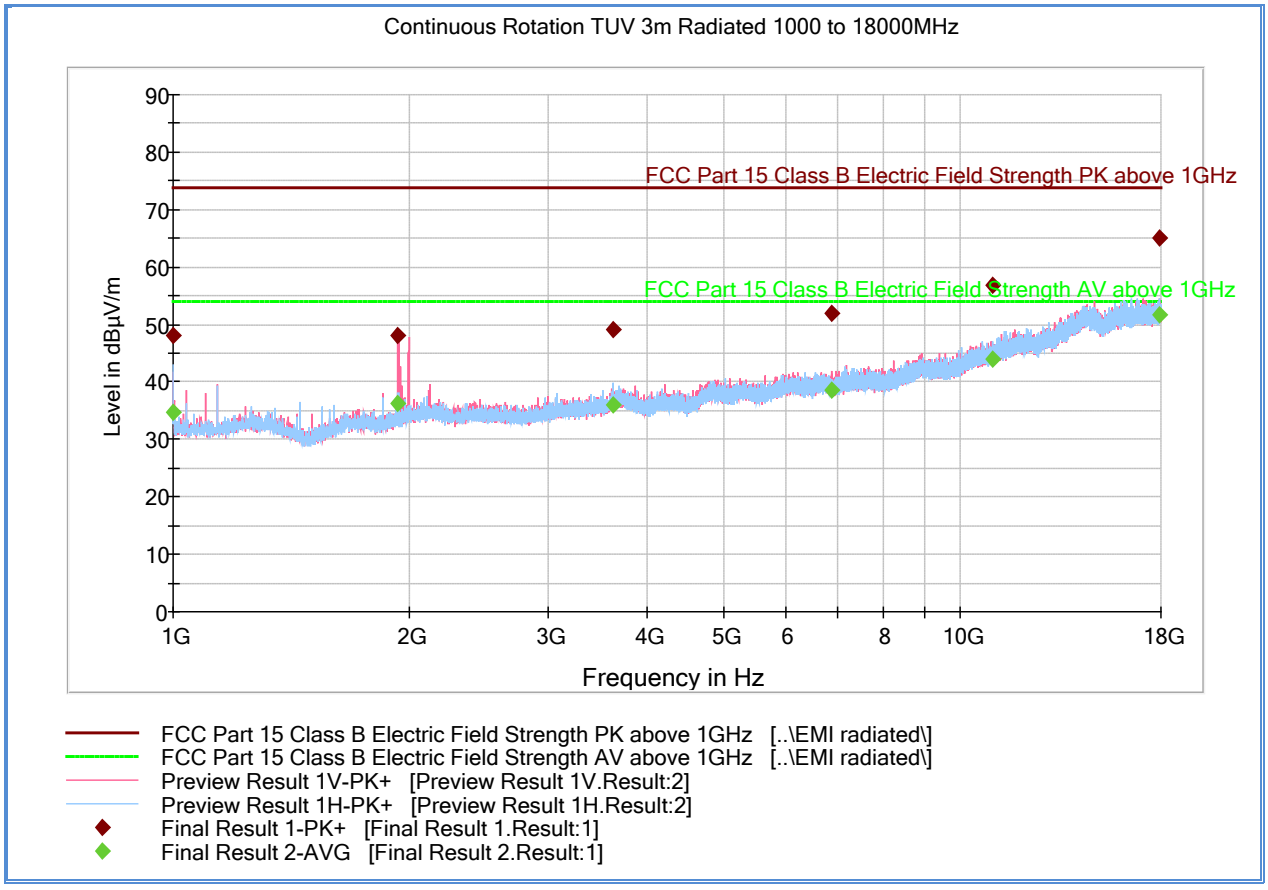
2.10.10 Test Results Below 1GHz (Receive Mode)



Quasi Peak Data

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
38.775551	18.4	1000.0	120.000	283.0	H	342.0	-15.5	21.6	40.0
51.438878	19.8	1000.0	120.000	109.0	V	285.0	-19.4	20.2	40.0
71.581643	18.4	1000.0	120.000	100.0	V	307.0	-21.3	21.6	40.0
122.322725	17.6	1000.0	120.000	106.0	V	-12.0	-19.2	25.9	43.5
250.099319	43.5	1000.0	120.000	100.0	V	46.0	-12.6	2.5	46.0
374.812024	35.8	1000.0	120.000	145.0	V	9.0	-7.9	10.2	46.0
499.940842	31.6	1000.0	120.000	105.0	H	284.0	-5.1	14.4	46.0
643.468537	40.0	1000.0	120.000	105.0	H	213.0	-2.1	6.0	46.0
849.960641	35.1	1000.0	120.000	100.0	H	235.0	1.1	10.9	46.0

2.10.11 Test Results Above 1GHz (Receive Mode)



Peak Data

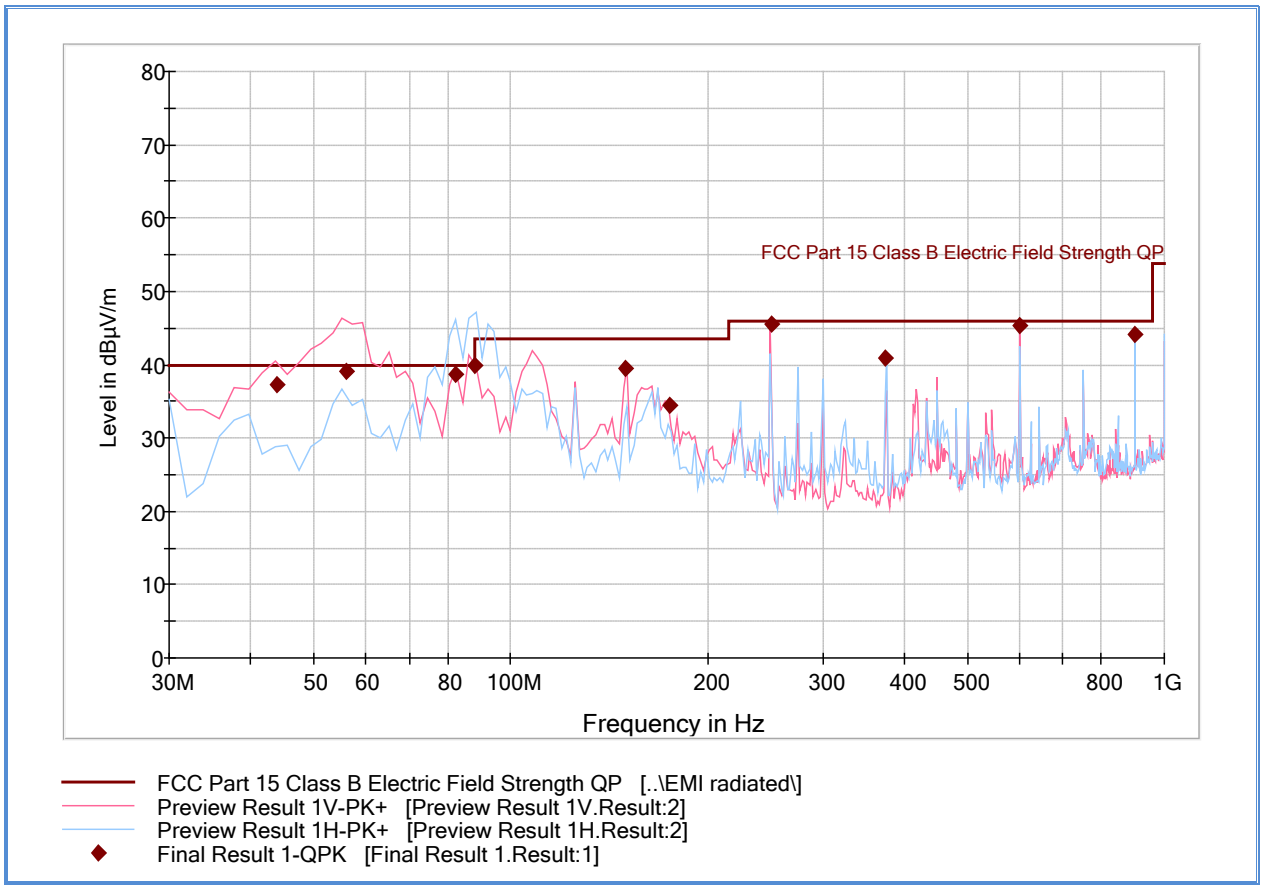
Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1000.000000	48.2	1000.0	1000.000	300.6	H	87.0	-1.0	25.7	73.9
1932.566667	48.2	1000.0	1000.000	257.3	V	178.0	1.8	25.7	73.9
3624.066667	49.2	1000.0	1000.000	260.3	H	-10.0	5.7	24.7	73.9
6866.733333	51.9	1000.0	1000.000	202.4	V	243.0	10.5	22.0	73.9
10998.63333	56.9	1000.0	1000.000	201.4	H	293.0	16.3	17.0	73.9
17902.66666	64.9	1000.0	1000.000	259.3	V	122.0	23.7	9.0	73.9

Average Data

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1000.000000	34.7	1000.0	1000.000	300.6	H	87.0	-1.0	19.2	53.9
1932.566667	36.3	1000.0	1000.000	257.3	V	178.0	1.8	17.6	53.9
3624.066667	35.9	1000.0	1000.000	260.3	H	-10.0	5.7	18.0	53.9
6866.733333	38.6	1000.0	1000.000	202.4	V	243.0	10.5	15.3	53.9
10998.63333	44.0	1000.0	1000.000	201.4	H	293.0	16.3	9.9	53.9
17902.66666	51.6	1000.0	1000.000	259.3	V	122.0	23.7	2.3	53.9

Test Notes: No significant emissions observed above 18GHz.

2.10.12 Test Results Below 1GHz (Bluetooth TX Worst Case – Non-hopping)

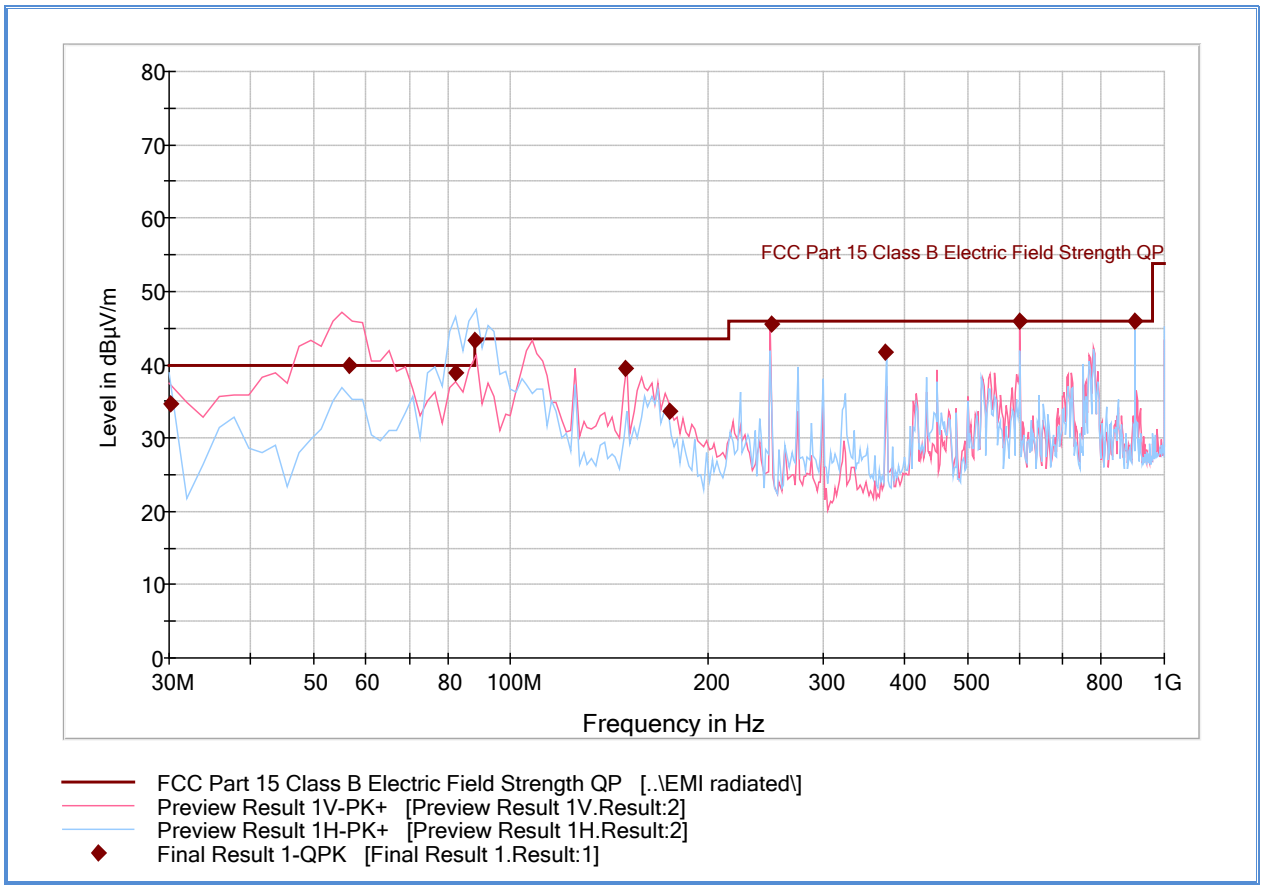


Quasi Peak Data

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
43.783327	37.4	1000.0	120.000	100.0	V	25.0	-17.4	2.6	40.0
55.990541	39.1	1000.0	120.000	100.0	V	132.0	-20.3	0.9	40.0
82.524970	38.8	1000.0	120.000	256.0	H	351.0	-20.7	1.2	40.0
88.172745	39.9	1000.0	120.000	365.0	H	-8.0	-20.1	0.1	43.5
150.001042	39.5	1000.0	120.000	100.0	V	296.0	-17.4	4.0	43.5
175.007695	34.4	1000.0	120.000	100.0	V	167.0	-16.5	9.1	43.5
249.979319	45.6	1000.0	120.000	100.0	V	203.0	-12.6	0.4	46.0
375.012024	40.9	1000.0	120.000	105.0	H	307.0	-7.9	5.1	46.0
600.023006	45.3	1000.0	120.000	100.0	V	165.0	-2.8	0.7	46.0
900.021723	44.1	1000.0	120.000	100.0	H	108.0	2.0	1.9	46.0

Test Notes: Only worst case channel presented for spurious emissions below 1GHz.

2.10.13 Test Results Below 1GHz (Bluetooth TX Worst Case – Hopping)

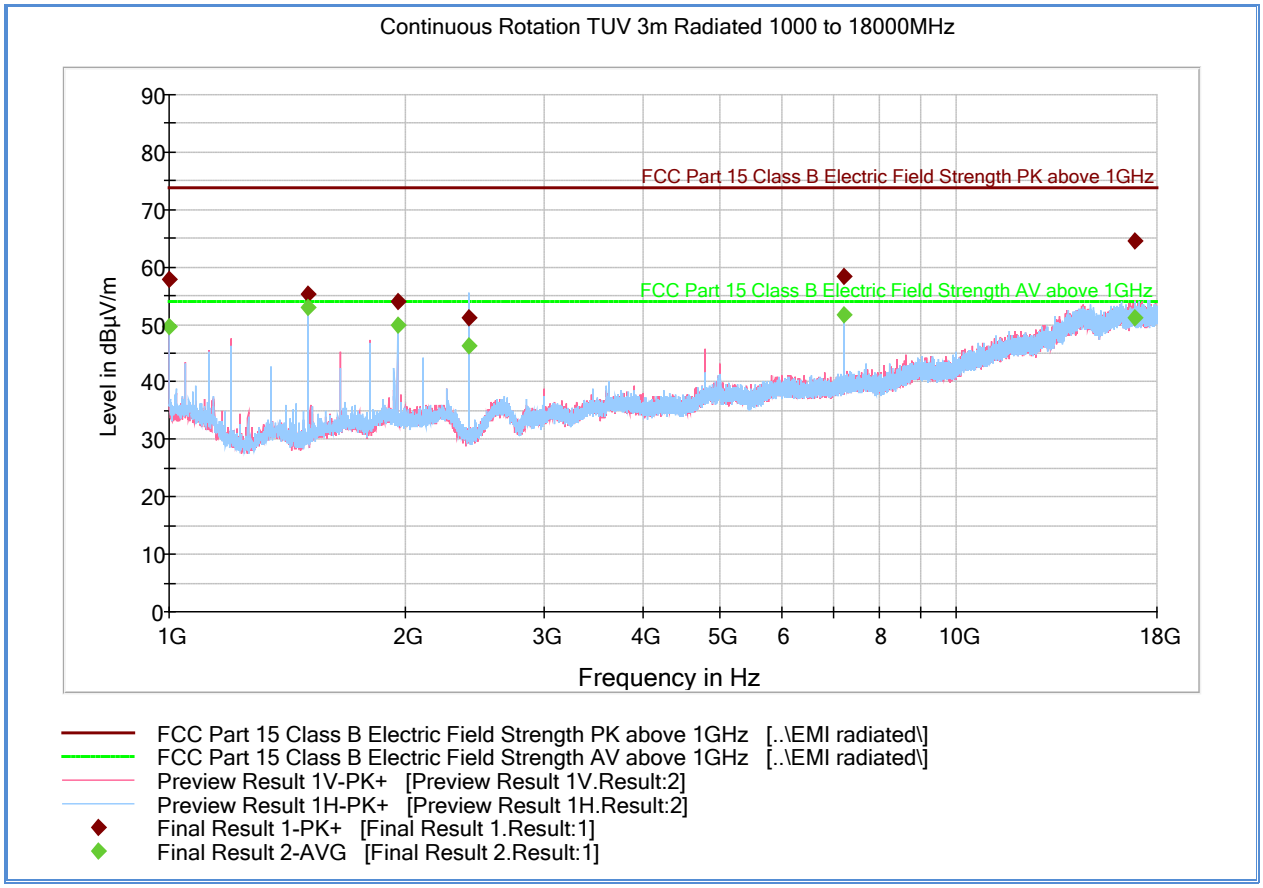


Quasi Peak Data

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
30.200000	34.7	1000.0	120.000	150.0	H	298.0	-10.7	5.3	40.0
56.510541	39.8	1000.0	120.000	100.0	V	245.0	-20.3	0.2	40.0
82.524970	38.9	1000.0	120.000	400.0	H	346.0	-20.7	1.1	40.0
88.172745	43.3	1000.0	120.000	243.0	H	179.0	-20.1	0.2	43.5
150.001042	39.5	1000.0	120.000	100.0	V	308.0	-17.4	4.0	43.5
175.007695	33.7	1000.0	120.000	100.0	V	177.0	-16.5	9.8	43.5
249.979319	45.4	1000.0	120.000	100.0	V	197.0	-12.6	0.6	46.0
375.012024	41.6	1000.0	120.000	100.0	H	47.0	-7.9	4.4	46.0
600.023006	45.9	1000.0	120.000	100.0	V	166.0	-2.8	0.1	46.0
900.021723	45.9	1000.0	120.000	109.0	H	145.0	2.0	0.1	46.0

Test Notes:

2.10.14 Test Results Above 1GHz Low Channel (Bluetooth TX Worst Case)



Peak Data

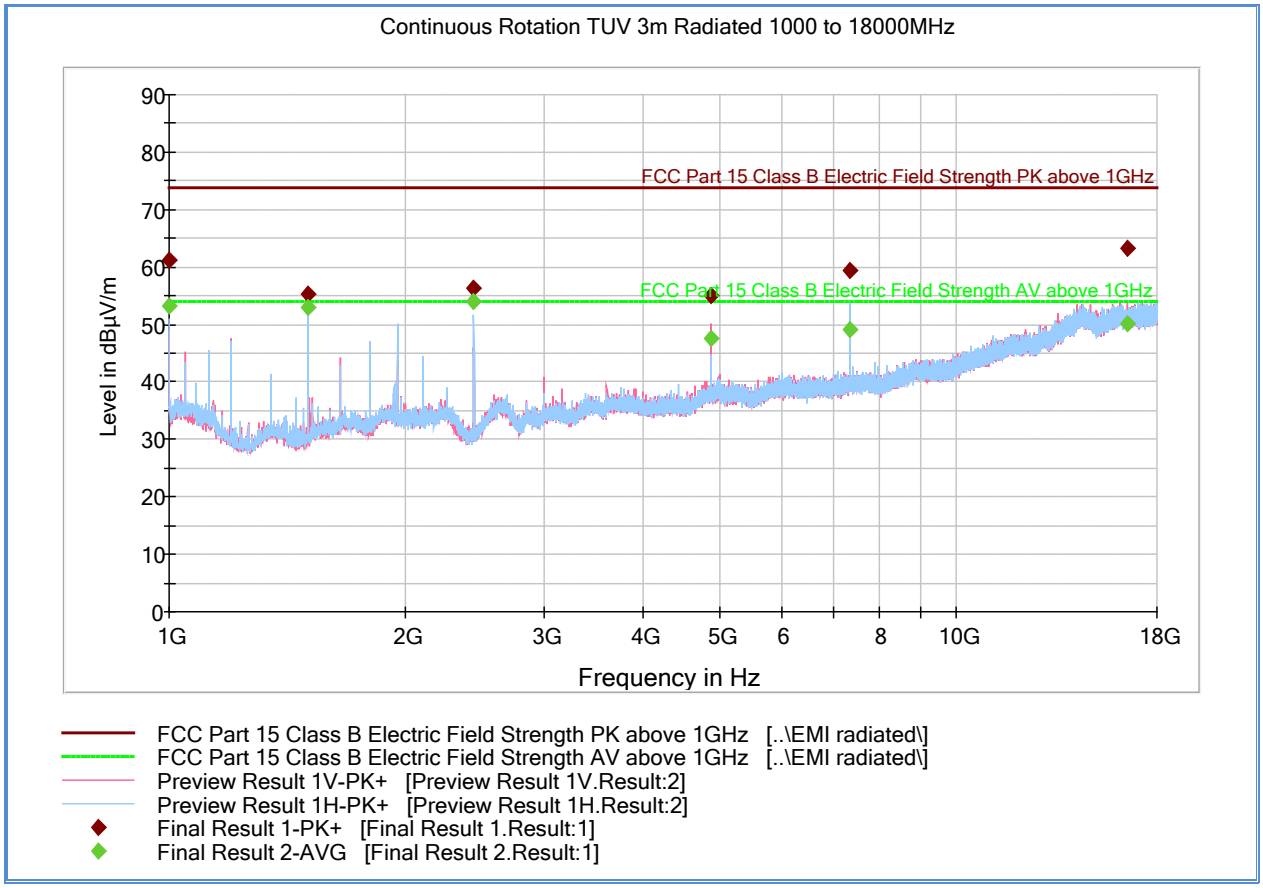
Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1000.000000	57.9	1000.0	1000.000	177.5	V	23.0	-1.0	16.0	73.9
1500.000000	55.4	1000.0	1000.000	99.6	H	200.0	-1.9	18.5	73.9
1950.133333	54.0	1000.0	1000.000	100.6	H	223.0	1.9	19.9	73.9
2401.733333	51.1	1000.0	1000.000	302.2	H	66.0	2.4	22.8	73.9
7205.966667	58.4	1000.0	1000.000	208.4	H	89.0	11.1	15.5	73.9
16845.166667	64.5	1000.0	1000.000	229.4	V	3.0	23.4	9.4	73.9

Average Data

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1000.000000	49.5	1000.0	1000.000	177.5	V	23.0	-1.0	4.4	53.9
1500.000000	52.9	1000.0	1000.000	99.6	H	200.0	-1.9	1.0	53.9
1950.133333	50.0	1000.0	1000.000	100.6	H	223.0	1.9	3.9	53.9
2401.733333	46.3	1000.0	1000.000	302.2	H	66.0	2.4	7.6	53.9
7205.966667	51.7	1000.0	1000.000	208.4	H	89.0	11.1	2.2	53.9
16845.166667	51.2	1000.0	1000.000	229.4	V	3.0	23.4	2.7	53.9

Test Notes: Measurement was performed with a 2.4GHz notch filter. No significant emissions observed above 8GHz. Measurements above 8GHz are noise floor figures.

2.10.15 Test Results Above 1GHz Mid Channel (Bluetooth TX Worst Case)



Peak Data

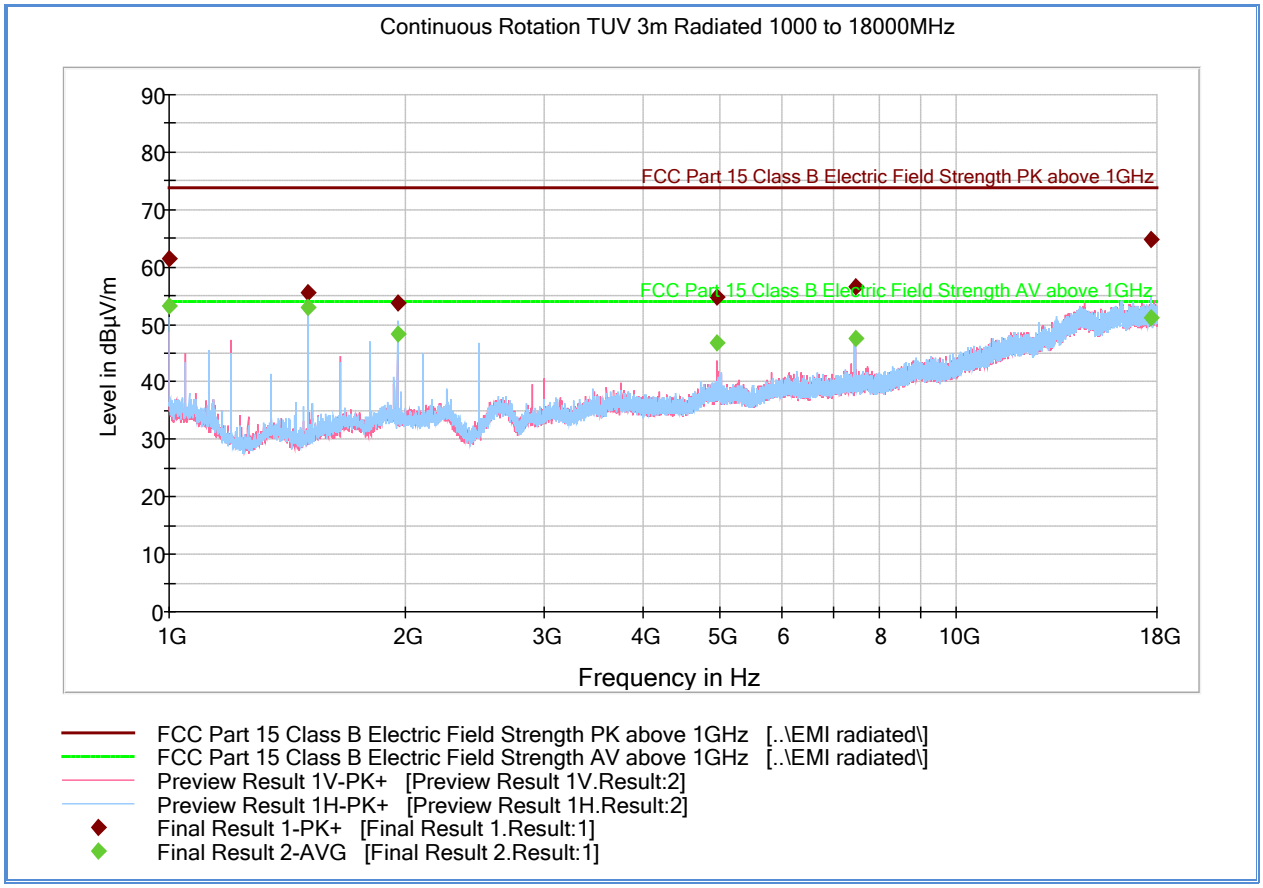
Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1000.000000	61.3	1000.0	1000.000	179.5	H	274.0	-1.0	12.6	73.9
1500.000000	55.4	1000.0	1000.000	99.6	H	201.0	-1.9	18.5	73.9
2440.100000	56.2	1000.0	1000.000	302.2	H	70.0	2.4	17.7	73.9
4880.200000	55.0	1000.0	1000.000	131.6	V	64.0	7.8	18.9	73.9
7320.800000	59.4	1000.0	1000.000	326.1	H	91.0	11.4	14.5	73.9
16526.700000	63.3	1000.0	1000.000	360.1	V	308.0	23.3	10.6	73.9

Average Data

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1000.000000	53.2	1000.0	1000.000	179.5	H	274.0	-1.0	0.7	53.9
1500.000000	52.9	1000.0	1000.000	99.6	H	201.0	-1.9	1.0	53.9
2440.100000	53.9	1000.0	1000.000	302.2	H	70.0	2.4	0.0	53.9
4880.200000	47.5	1000.0	1000.000	131.6	V	64.0	7.8	6.4	53.9
7320.800000	49.2	1000.0	1000.000	326.1	H	91.0	11.4	4.7	53.9
16526.700000	50.1	1000.0	1000.000	360.1	V	308.0	23.3	3.8	53.9

Test Notes: Measurement was performed with a 2.4GHz notch filter. No significant emissions observed above 8GHz. Measurements above 8GHz are noise floor figures.

2.10.16 Test Results Above 1GHz High Channel (Bluetooth TX Worst Case)



Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1000.000000	61.4	1000.0	1000.000	169.5	H	268.0	-1.0	12.5	73.9
1500.000000	55.5	1000.0	1000.000	99.6	H	200.0	-1.9	18.4	73.9
1949.733333	53.8	1000.0	1000.000	100.6	H	222.0	1.9	20.1	73.9
4960.233333	54.7	1000.0	1000.000	123.6	V	61.0	7.9	19.2	73.9
7440.133333	56.5	1000.0	1000.000	217.4	H	148.0	11.4	17.4	73.9
17698.900000	64.8	1000.0	1000.000	303.2	H	13.0	23.4	9.1	73.9

Average Data

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1000.000000	53.1	1000.0	1000.000	169.5	H	268.0	-1.0	0.8	53.9
1500.000000	53.0	1000.0	1000.000	99.6	H	200.0	-1.9	0.9	53.9
1949.733333	48.3	1000.0	1000.000	100.6	H	222.0	1.9	5.6	53.9
4960.233333	46.9	1000.0	1000.000	123.6	V	61.0	7.9	7.0	53.9
7440.133333	47.6	1000.0	1000.000	217.4	H	148.0	11.4	6.3	53.9
17698.900000	51.2	1000.0	1000.000	303.2	H	13.0	23.4	2.7	53.9

Test Notes: Measurement was performed with a 2.4GHz notch filter. No significant emissions observed above 8GHz. Measurements above 8GHz are noise floor figures.

2.11 RADIATED IMMEDIATE RESTRICTED BANDS

2.11.1 Specification Reference

Part 15 Subpart C §15.247(d)

2.11.2 Standard Applicable

(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

2.11.3 Equipment Under Test and Modification State

Serial No: 34008112 and 34008096/ Test Configuration B

2.11.4 Date of Test/Initial of test personnel who performed the test

December 5 to 24, 2013/FSC

2.11.5 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.11.6 Environmental Conditions

Ambient Temperature	25.4-25.8°C
Relative Humidity	43.5-44.5%
ATM Pressure	98.7-99.0 kPa

2.11.7 Additional Observations

- This is a radiated test. The spectrum was searched from 2310MHz to 2390MHz for lower immediate restricted band and 2483.5MHz to 2500MHz for the upper immediate restricted band.
- There are no emissions found that do not comply with the restricted bands defined in FCC Part 15 Subpart C, 15.205.
- Both Non-hopping and Hopping modes presented.

- Measurement was done using EMC32 automated software. Reported level is the actual level with all the correction factors factored in. Correction Factor column is for informational purposes only. See Section 2.11.8 for sample computation.

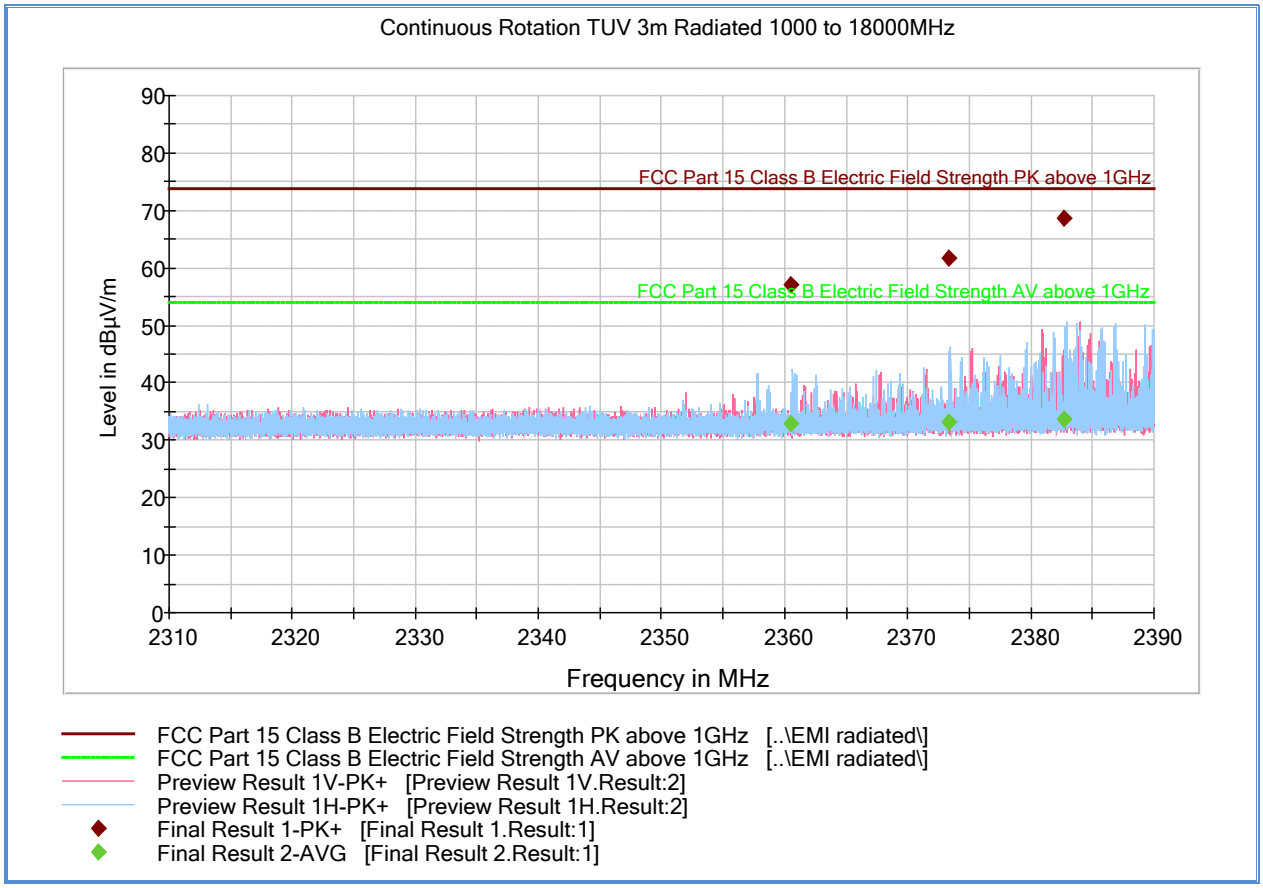
2.11.8 Sample Computation (Radiated Emission)

Measuring equipment raw measurement (dbµV) @ 2400 MHz			53.9
Correction Factor (dB)	Asset# 1153 (cable)	3.4	-0.4
	Asset# 8628(preamplifier)	-36.5	
	Asset#7575 (antenna)	32.7	
Reported Max Peak Final Measurement (dbµV/m) @ 2400 MHz			**53.5**

2.11.9 Test Results

See attached plots.

2.11.10 Test Results Restricted Band 2310MHz to 2390MHz (Hopping)



Peak Data

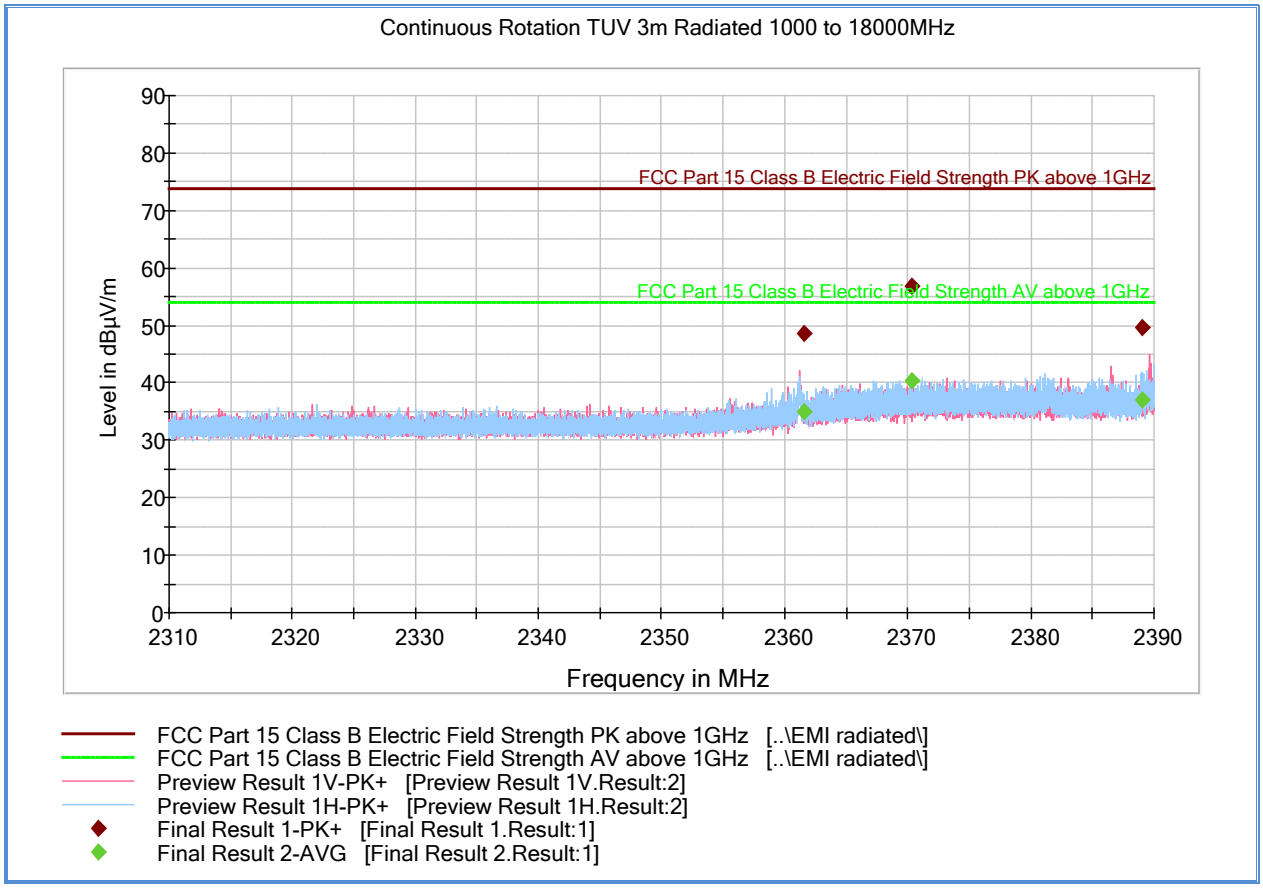
Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2360.472000	57.0	1000.0	1000.000	198.4	H	105.0	2.4	16.9	73.9
2373.306667	61.8	1000.0	1000.000	197.4	H	94.0	2.4	12.1	73.9
2382.701333	68.7	1000.0	1000.000	132.6	H	91.0	2.4	5.2	73.9

Average Data

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2360.472000	32.8	1000.0	1000.000	198.4	H	105.0	2.4	21.1	53.9
2373.306667	33.3	1000.0	1000.000	197.4	H	94.0	2.4	20.6	53.9
2382.701333	33.7	1000.0	1000.000	132.6	H	91.0	2.4	20.2	53.9

Test Notes: 2.4GHz notch filter removed for this test.

2.11.11 Test Results Restricted Band 2310MHz to 2390MHz (Non-Hopping)



Peak Data

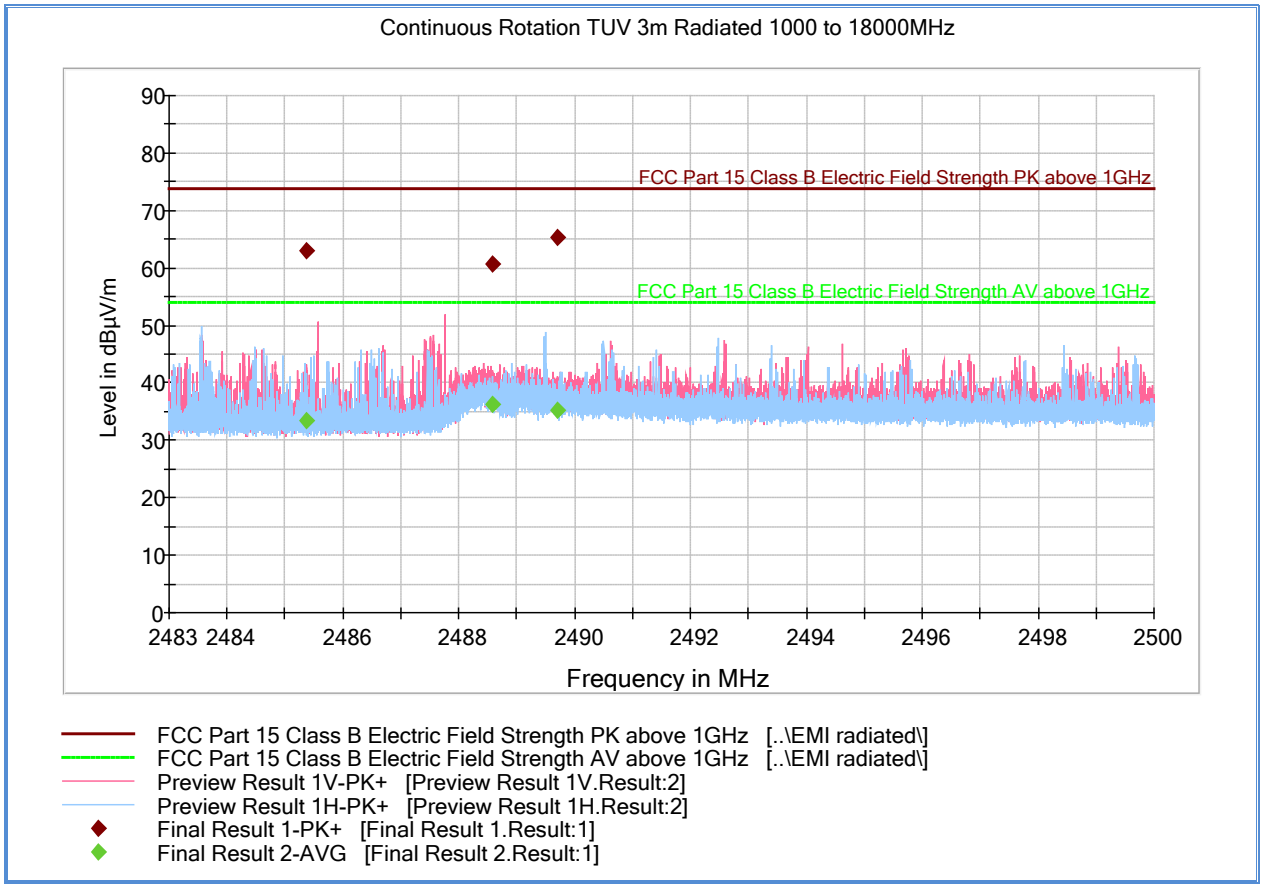
Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2361.592000	48.7	1000.0	1000.000	217.4	V	262.0	2.4	25.2	73.9
2370.381333	56.8	1000.0	1000.000	99.6	H	90.0	2.4	17.1	73.9
2389.037333	49.6	1000.0	1000.000	100.6	V	61.0	2.4	24.3	73.9

Average Data

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2361.592000	34.9	1000.0	1000.000	217.4	V	262.0	2.4	19.0	53.9
2370.381333	40.3	1000.0	1000.000	99.6	H	90.0	2.4	13.6	53.9
2389.037333	36.9	1000.0	1000.000	100.6	V	61.0	2.4	17.0	53.9

Test Notes: 2.4GHz notch filter removed for this test.

2.11.12 Test Results Restricted Band 2483.5MHz to 2500MHz (Hopping)



Peak Data

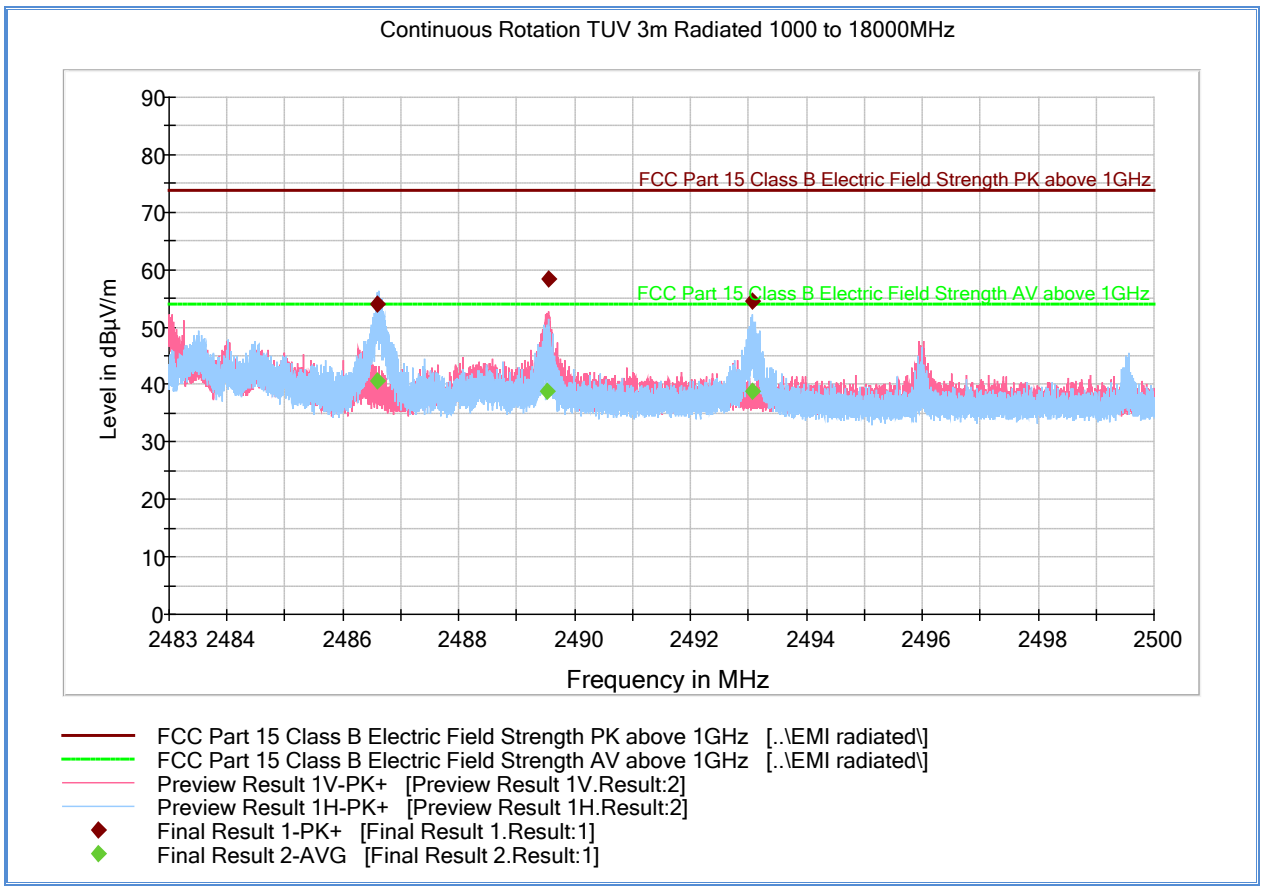
Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2485.362467	63.1	1000.0	1000.000	200.4	V	337.0	2.4	10.8	73.9
2488.574733	60.7	1000.0	1000.000	217.4	V	173.0	2.4	13.2	73.9
2489.694000	65.4	1000.0	1000.000	292.2	H	77.0	2.4	8.5	73.9

Average Data

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2485.362467	33.4	1000.0	1000.000	200.4	V	337.0	2.4	20.5	53.9
2488.574733	36.2	1000.0	1000.000	217.4	V	173.0	2.4	17.7	53.9
2489.694000	35.2	1000.0	1000.000	292.2	H	77.0	2.4	18.7	53.9

Test Notes: 2.4GHz notch filter removed for this test.

2.11.13 Test Results Restricted Band 2483.5MHz to 2500MHz (Non-Hopping)



Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2486.597400	54.1	1000.0	1000.000	291.2	H	84.0	2.4	19.8	73.9
2489.538600	58.4	1000.0	1000.000	406.7	V	44.0	2.4	15.5	73.9
2493.057767	54.6	1000.0	1000.000	302.2	H	74.0	2.4	19.3	73.9

Average Data

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2486.597400	40.7	1000.0	1000.000	291.2	H	84.0	2.4	13.2	53.9
2489.535860	38.9	1000.0	1000.000	302.2	H	74.0	2.4	15.0	53.9
2493.057767	38.9	1000.0	1000.000	302.2	H	74.0	2.4	15.0	53.9

Test Notes: 2.4GHz notch filter removed for this test.

2.12 RECEIVER SPURIOUS EMISSIONS

2.12.1 Specification Reference

RSS-Gen 6.0

2.12.2 Standard Applicable

Receivers shall comply with the limits of spurious emissions set out in this section, measured over the frequency range determined in accordance with Section 4.10 of RSS-Gen.

Table 2: Radiated Limits of Receiver Spurious Emissions

Frequency (MHz)	Field Strength (microvolts/m at 3 metres)*
30-88	100
88-216	150
216-960	200
Above 960	500

*Measurements for compliance with limits in the above table may be performed at distances other than 3 metres, in accordance with Section 7.2.7 of RSS-Gen.

2.12.3 Equipment Under Test and Modification State

Serial No: 34008112 and 34008096/ Test Configuration B

2.12.4 Date of Test/Initial of test personnel who performed the test

December 5 to 24, 2013/FSC

2.12.5 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.12.6 Environmental Conditions

Ambient Temperature	25.4-25.8°C
Relative Humidity	43.5-44.5%
ATM Pressure	98.7-99.0 kPa

2.12.7 Additional Observations

- This is a radiated test. The spectrum was searched from 30MHz to the 3rd harmonic (up to 10th performed).
- Result identical to Section 2.10.10 and 2.10.11 of this test report.
- EUT in RX (Receive) mode configuration.

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SECTION 3

TEST EQUIPMENT USED

3.1 TEST EQUIPMENT USED

List of absolute measuring and other principal items of test equipment.

ID Number (SDGE/SDRB)	Test Equipment	Type	Serial Number	Manufacturer	Cal Date	Cal Due Date
Antenna Conducted Port Setup						
7569	Series Power Meter	N1911A P-	MY45100625	Agilent	04/15/13	04/15/14
7570	50MHz-18GHz Wideband Power Sensor	N1921A	MY45240588	Agilent	05/06/13	05/06/14
7582	Signal/Spectrum Analyzer	FSW26	101614	Rhode & Schwarz	11/19/13	11/19/14
1189	Signal Generator	8648C	3623A03059	Hewlett Packard	08/06/13	08/06/14
-	20dB Attenuator	46-20-34	BK5773	Weinschel Corp.	Verified by 1189 and 7582	
Radiated Test Setup						
1002	Bilog Antenna	3142C	00058717	ETS-Lindgren	01/21/13	01/21/14
7575	Double-ridged waveguide horn antenna	3117	00155511	EMCO	03/25/13	03/25/14
8628	Pre-amplifier	QLJ 01182835-JO	8986002	QuinStar Technologies Inc.	09/03/13	09/03/14
1150	Horn antenna	3160-09	012054-004	ETS	04/26/13	04/26/15
1151	Pre-amplifier	TS-PR26	100026	Rhode & Schwarz	05/02/13	05/02/14
1051	Double-ridged waveguide horn antenna	3115	9408-4329	EMCO	06/11/13	06/11/14
8760	Pre-amplifier	ZKL-2	1001	Mini-Circuits	09/03/13	09/03/14
1153	High-frequency cable	SucoFlex 100 SX	N/A	Suhner	09/03/13	09/03/14
8543	High-frequency cable	Micropore 19057793	N/A	United Microwave Products	09/03/13	09/03/14
1040	EMI Test Receiver	ESIB40	100292	Rhode & Schwarz	07/31/13	07/31/14
1049	EMI Test Receiver	ESU	100133	Rhode & Schwarz	07/24/13	07/24/14
6815	2.4GHz Band Notch Filter	BRM50702	008	Micro-Tronics	Verified by 1189 and 7582	
1016	Pre-amplifier	PAM-0202	187	PAM	10/08/13	10/08/14
Conducted Emissions						
1024	EMI Test Receiver	ESCS 30	847793/001	Rhode & Schwarz	03/11/13	03/11/14
7567	LISN	FCC-LISN-50-25-2-10	120304	Fischer Custom Comm.	06/11/13	06/11/14
7568	LISN	FCC-LISN-50-25-2-10	120305	Fischer Custom Comm.	07/10/13	07/10/14
8789	20dB Attenuator	HAT-20	YUU29001245	Mini Circuits	03/01/13	03/01/14
8792	20dB Attenuator	HAT-20	YUU29001245	Mini Circuits	03/01/13	03/01/14
Miscellaneous						
6452	Multimeter	3478A	2911A52177	Hewlett Packard	08/02/13	08/02/14
7554	Barometer/Temperature /Humidity Transmitter	iBTHX-W	0400706	Omega	04/17/13	04/17/14
1123	DC Power Supply	E3631A	N/A	Hewlett Packard	Verified by 6452	
	Test Software	EMC32	V8.53	Rhode & Schwarz	N/A	

3.2 MEASUREMENT UNCERTAINTY

For a 95% confidence level, the measurement uncertainties for defined systems are:

3.2.1 Radiated Emission Measurements (Below 1GHz)

	Contribution	Probability Distribution Type	Probability Distribution x_i	Standard Uncertainty $u(x_i)$	$[u(x_i)]^2$
1	Receiver/Spectrum Analyzer	Rectangular	0.45	0.26	0.07
2	Cables	Rectangular	0.50	0.29	0.08
3	Preamp	Rectangular	0.50	0.29	0.08
4	Antenna	Rectangular	0.75	0.43	0.19
5	Site	Rectangular	3.89	2.25	5.04
6	EUT Setup	Rectangular	1.00	0.58	0.33
				Combined Uncertainty (u_c):	2.41
				Coverage Factor (k):	2
				Expanded Uncertainty:	4.82

3.2.2 Radiated Emission Measurements (Above 1GHz)

	Contribution	Probability Distribution Type	Probability Distribution x_i	Standard Uncertainty $u(x_i)$	$[u(x_i)]^2$
1	Receiver/Spectrum Analyzer	Rectangular	0.57	0.33	0.11
2	Cables	Rectangular	0.70	0.40	0.16
3	Preamp	Rectangular	0.50	0.29	0.08
4	Antenna	Rectangular	0.37	0.21	0.05
5	Site	Rectangular	3.89	2.25	5.04
6	EUT Setup	Rectangular	1.00	0.58	0.33
				Combined Uncertainty (u_c):	2.40
				Coverage Factor (k):	2
				Expanded Uncertainty:	4.81

3.2.3 Conducted Antenna Port Measurement

	Contribution	Probability Distribution Type	Probability Distribution x_i	Standard Uncertainty $u(x_i)$	$[u(x_i)]^2$
1	Receiver/Spectrum Analyzer	Rectangular	0.57	0.33	0.11
2	Cables	Rectangular	0.50	0.29	0.08
3	EUT Setup	Rectangular	1.00	0.58	0.33
				Combined Uncertainty (u_c):	0.72
				Coverage Factor (k):	2
				Expanded Uncertainty:	1.45

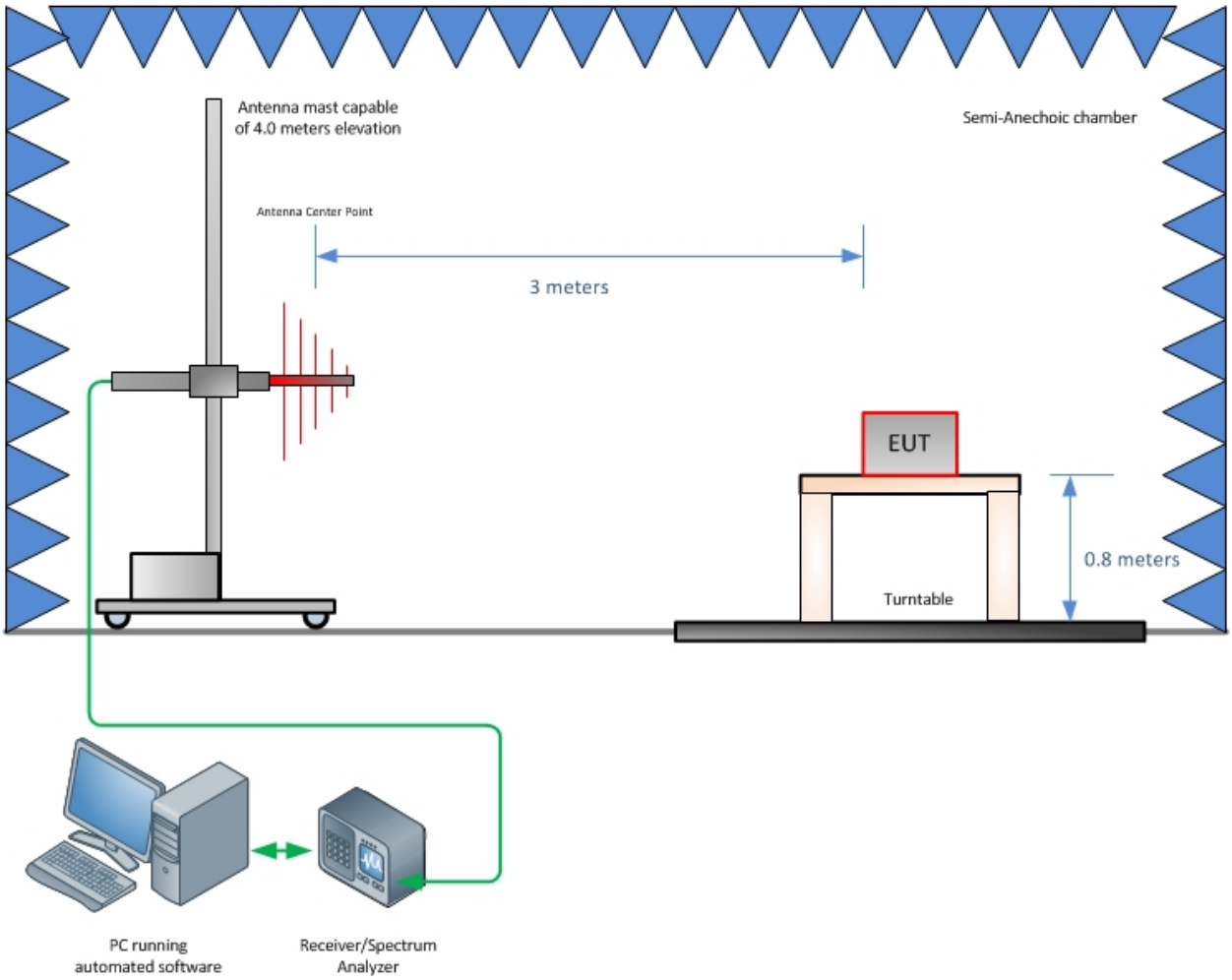
3.2.4 AC Conducted Emissions Measurements

	Contribution	Probability Distribution Type	Probability Distribution x_i	Standard Uncertainty $u(x_i)$	$[u(x_i)]^2$
1	Receiver/Spectrum Analyzer	Rectangular	0.36	0.21	0.04
2	Cables	Rectangular	0.50	0.29	0.08
3	LISN	Rectangular	0.66	0.38	0.15
4	Attenuator	Rectangular	0.30	0.17	0.03
5	EUT Setup	Rectangular	1.00	0.58	0.33
				Combined Uncertainty (u_c):	0.80
				Coverage Factor (k):	2
				Expanded Uncertainty:	1.59

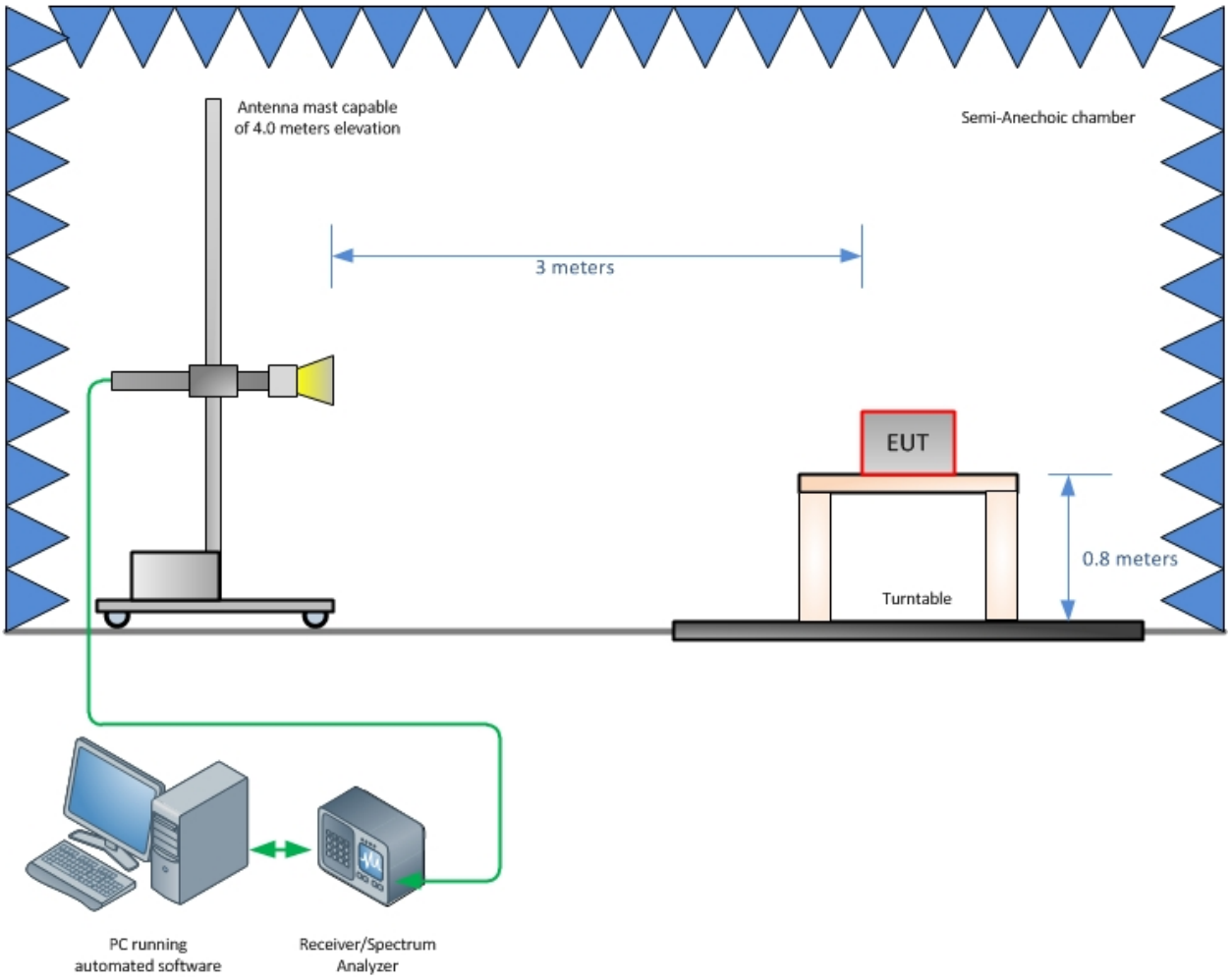
SECTION 4

DIAGRAM OF TEST SETUP

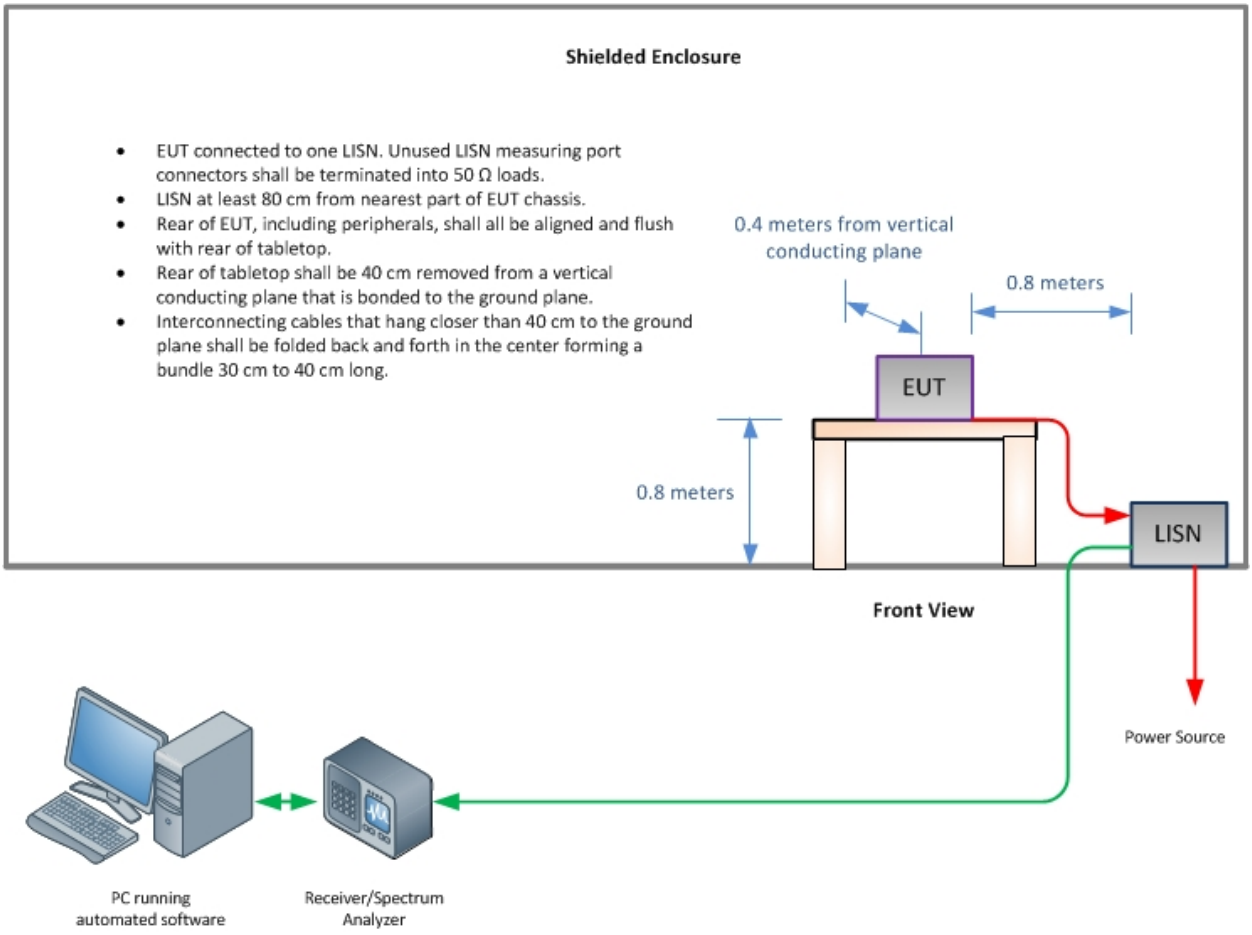
4.1 TEST SETUP DIAGRAM



Radiated Emission Test Setup (Below 1GHz)



Radiated Emission Test Setup (Above 1GHz)



Conducted Emission Test Setup

SECTION 5

ACCREDITATION, DISCLAIMERS AND COPYRIGHT

5.1 ACCREDITATION, DISCLAIMERS AND COPYRIGHT

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