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Report On

Application for Grant of Equipment Authorization of the
Lantronix, Inc.
Wireless Print Solutions Adapter; xPrintServer Wi-Fi Professional and xPrintServer Wi-Fi Essential Ethernet to Wireless Print Server

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

Report No. SD72105305-0415D May 2015

REPORT ON	Radio Testing of the Lantronix, Inc. Ethernet to Wireless Print Server
TEST REPORT NUMBER	SD72105305-0415D
PREPARED FOR	Lantronix, Inc. 7535 Irvine Center Drive, Suite 100 Irvine, CA
CONTACT PERSON	Michael Simonsen Engineering Supervisor (949) 453-7109 Michael.Simonsen@Lantronix.com
PREPARED BY	Ferdinand S. Custodio **Name** Authorized Signatory Title: EMC/Senior Wireless Test Engineer
APPROVED BY	Chip R. Fleury Name Authorized Signatory Title: West Coast EMC Manager
DATED	June 10, 2015

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

Revision History

SD72105305-0415D Lantronix, Inc. Wireless Print Solutions Adapter; xPrintServer Wi-Fi Professional and xPrintServer Wi-Fi Essential Ethernet to Wireless Print Server					
DATE	OLD REVISION	NEW REVISION	REASON	PAGES AFFECTED	APPROVED BY
06/10/2015	Initial Release				Chip R. Fleury

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

CONTENTS

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

SECTION 1

REPORT SUMMARY

Radio Testing of the
Lantronix, Inc.
Ethernet to Wireless Print Server

1.1 INTRODUCTION

The information contained in this report is intended to show verification of the Lantronix, Inc. Wireless Print Solutions Adapter; xPrintServer Wi-Fi Professional and xPrintServer Wi-Fi Essential Ethernet to Wireless Print Server 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	Lantronix, Inc.
Model Number(s)	WPSA-100 (Xerox); XPS2140201S (Lantronix) and XPS2140101S (Lantronix)
FCC ID Number	R68XPSWF
IC Number	3867A-XPSWF
Serial Number(s)	N/A
Number of Samples Tested	2
Test Specification/Issue/Date	• FCC Part 15 Subpart C §15.247 (October 1, 2014). • RSS-210 - Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment (Issue 8, December 2010). • RSS-Gen - General Requirements for Compliance of Radio Apparatus (Issue 4, November 2014). • Public Notice (DA 00-705 Released March 30, 2000) Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems.
Start of Test	May 12, 2015
Finish of Test	May 14, 2014
Name of Engineer(s)	Ferdinand Custodio
Related Document(s)	• Continuous TX test instructions.rtf • Supporting documents for EUT certification are separate exhibits.

1.2 BRIEF SUMMARY OF RESULTS

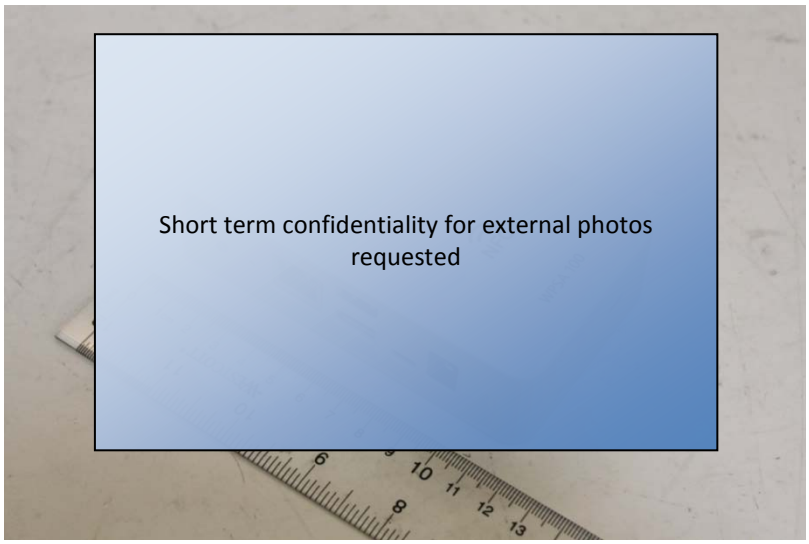
A brief summary of the tests carried out in accordance with FCC Part 15 Subpart C §15.247 with cross-reference to the corresponding IC RSS standard is shown below.

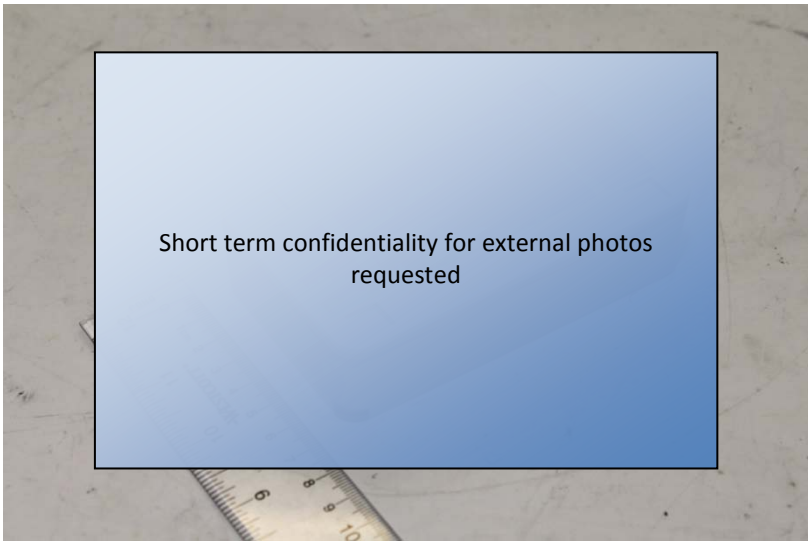
Section	§15.247 Spec Clause	RSS	Test Description	Result	Comments/ Base Standard
2.1	§15.207 (a)	RSS-Gen 8.8	Conducted Emissions	Compliant	
2.2	§15.247(a)(1)	RSS-210 A8.1(b)	Carrier Frequency Separation	Compliant	
2.3	§15.247(a)(1) (iii)	RSS-210 A8.1(d)	Number of Hopping Frequencies	Compliant	
2.4	§15.247(a)(1) (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 6.6	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 7.1	Receiver Spurious Emissions	Compliant	

1.3 PRODUCT INFORMATION

1.3.1 Technical Description

The Equipment Under Test (EUT) was a Lantronix, Inc. Wireless Print Solutions Adapter; xPrintServer Wi-Fi Professional and xPrintServer Wi-Fi Essential Ethernet to Wireless Print Server as shown in the photograph below. The EUT is a device intended to support Ethernet to Wi-Fi bridging in mobile printing applications. The device is intended to be connected to a printer over the Ethernet and/or Wireless networks. The device includes an NFC interface to allow tap to print transactions between a tablet or cell phone device. The NFC would provide the network configuration to the phone and the Ethernet and Wi-Fi would provide the high band width channel for print jobs. The Wireless Print Solutions Adaptor version will be marketed by Xerox. The XPrintServer2 product with dual Type A USB host connector will be directly sold and marketed by Lantronix. The only difference between the "Professional" and "Essential" is the software app. Lantronix controls the manufacturing for both versions. Lantronix controls the manufacturing for both versions. The classic BT function of the EUT was verified in this test report.





Equipment Under Test

1.3.2 EUT General Description

EUT Description	Ethernet to Wireless Print Server
Model Name	Wireless Print Solutions Adapter; xPrintServer Wi-Fi Professional and xPrintServer Wi-Fi Essential
Model Number(s)	WPSA-100 (Xerox); XPS2140201S (Lantronix) and XPS2140101S (Lantronix)
Rated Voltage	5VDC via AC Adapter (TOP Switching Power Supply P/N W050010GPX1 L1 Input: 100-240VAV 50/60Hz @0.2A Output: 5VDC @ 1.0A).
Mode Verified	Bluetooth EDR (FHSS)
Capability	802.11 b/g/n/AC WLAN (DTS/U-NII), NFC and Bluetooth 4.0+EDR
Primary Unit (EUT)	☐ Production ☒ Pre-Production ☐ Engineering
Antenna Type	Savvi™ Embedded Ceramic WLAN 802.11 a/b/g Antenna 2.4 to 2.5 and 4.9 to 5.8 GHz (P/N M830510)
Antenna Gain	1.1 dBi (2.4GHz) 3.2 dBi (5GHz)

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	0.25	6.06	4.04
π/4-DQPSK	2402-2480	-2.51	4.97	3.14
8DPSK	2402-2480	-5.84	5.05	3.20

1.4 EUT TEST CONFIGURATION

1.4.1 Test Configuration Description

Test Configuration	Description
A	Antenna conducted port test configuration. A modified sample was provided for this setup. The integral antenna was removed and an on-board U.FL SMT surface mount connector was installed on the main PCB. RF configurations of the EUT were modified using Tera Term via Ethernet connection. Manufacturer provided instructions (Continuous TX test instructions.rtf) to configure WLAN mode, channel, modulation and power. For Bluetooth, the mode and channels were configurable.
B	Radiated emissions test configuration. Identical programming procedure as Test Configuration A. EUT transmitting through the integral antenna.

1.4.2 EUT Exercise Software

EUT is configured via TCP/IP (Ethernet). IP assigned address is first determined on the support laptop via tftpd32. This IP address will be used to connect to the EUT via Tera Term. Once connected, corresponding instructions were issued using vi (visual editor) as referenced in the instructions provided.

1.4.3 Support Equipment and I/O cables

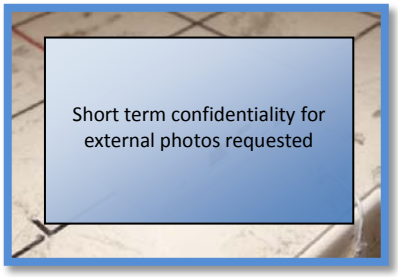
Manufacturer	Equipment/Cable	Description
Topmicro.com	EUT AC Adapter (Switching Power Supply)	P/N W050010GPX1 L1 (5VDC @ 1A)
HP	Support Laptop (NC6220)	P/N PZ064UA#ABA S/N CNU62315QR
HP	Support Laptop AC Adapter	P/N 380467-003 S/N 592C60AYMSO26N
Pan International	Patch Cord (Ethernet EUT to Laptop)	1.5 meters, unshielded CAT5 patch cord

1.4.4 Worst Case Configuration

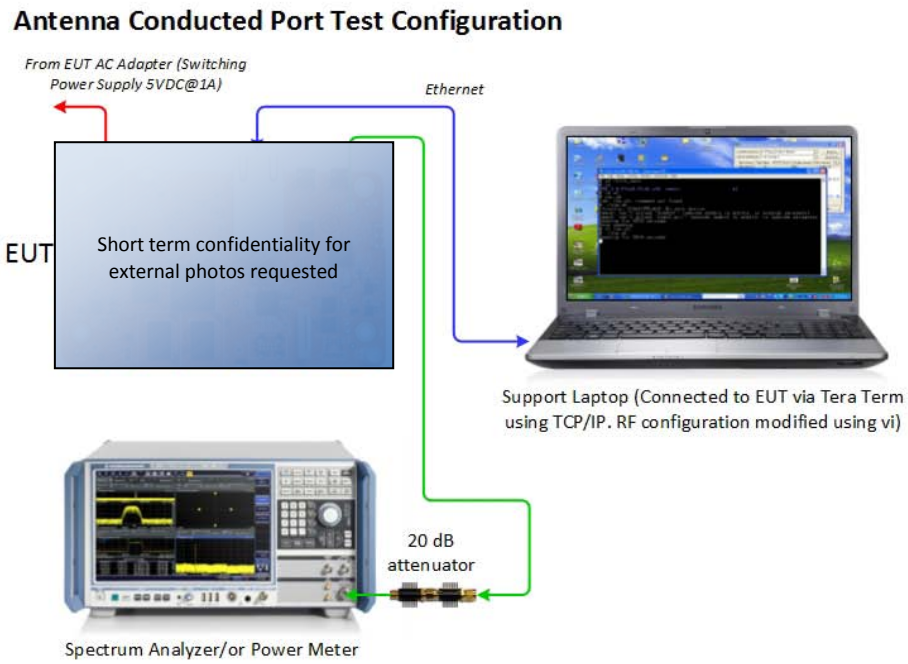
Worst-case configuration used in this test report as per maximum conducted output power measurements:

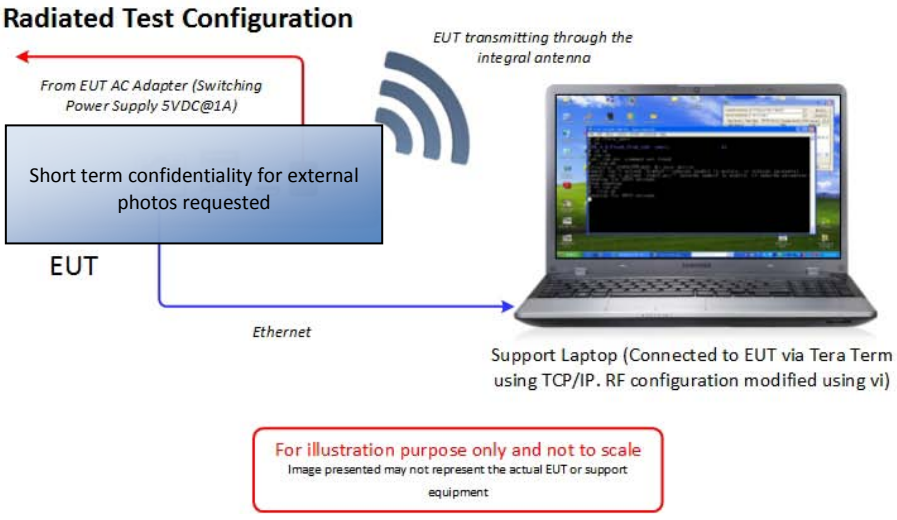
Modulation	Channel/Packet Type	Mode
GFSK	38 (Mid Channel)	Non-hopping
GFSK	-	Hopping

EUT is a mobile device. For radiated measurements, the EUT was verified representing typical usage (horizontal placement).



1.4.5 Simplified Test Configuration Diagram





For illustration purpose only and not to scale
Image presented may not represent the actual EUT or support equipment

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		
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 LOCATION

1.8.1 TÜV SÜD America Inc. (Mira Mesa)

10040 Mesa Rim Road, San Diego, CA 92121-2912 (32.901268,-117.177681). Phone: 858 678 1400 FAX: 858-546 0364

1.8.2 TÜV SÜD America Inc. (Rancho Bernardo)

Sony Electronics Inc., Building #8 16530 Via Esprillo, San Diego, CA 92127-1708 (33.018644,-117.092409). Phone: 858 942 5542 FAX: 858-546 0364

1.9 TEST FACILITY REGISTRATION

1.9.1 FCC – Registration No.: US1146

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 §2.948 of the FCC rules. The acceptance letter from the FCC is maintained in our files and the Registration is US1146.

1.9.2 **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.

SECTION 2

TEST DETAILS

Radio Testing of the
Lantronix, Inc.
Ethernet to Wireless Print Server

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

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: N/A /Test Configuration B

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

May 01, 2015/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

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility.

Ambient Temperature	24.8 °C
Relative Humidity	57.1 %
ATM Pressure	99.1 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).

- 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.

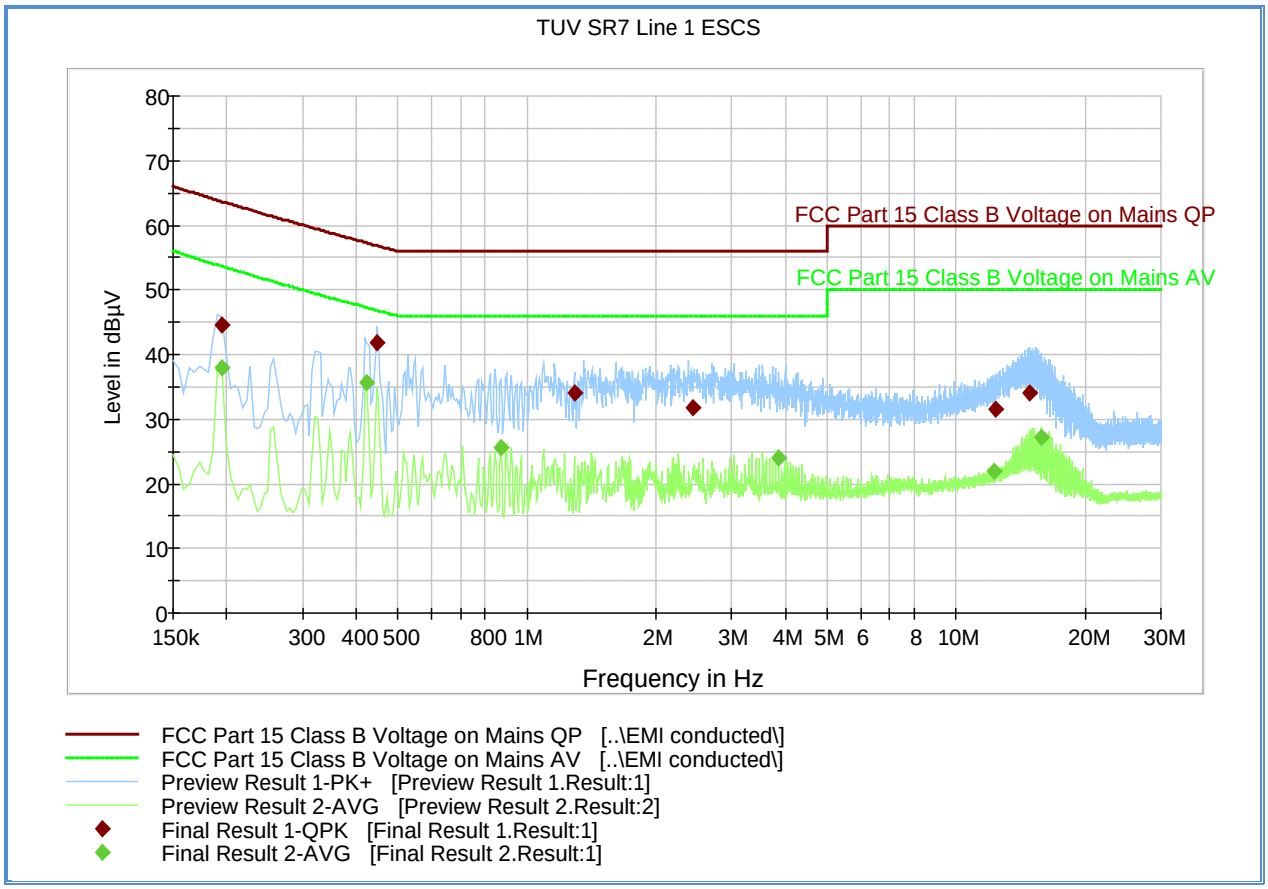
2.1.8 Sample Computation (Conducted Emission – Quasi Peak)

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



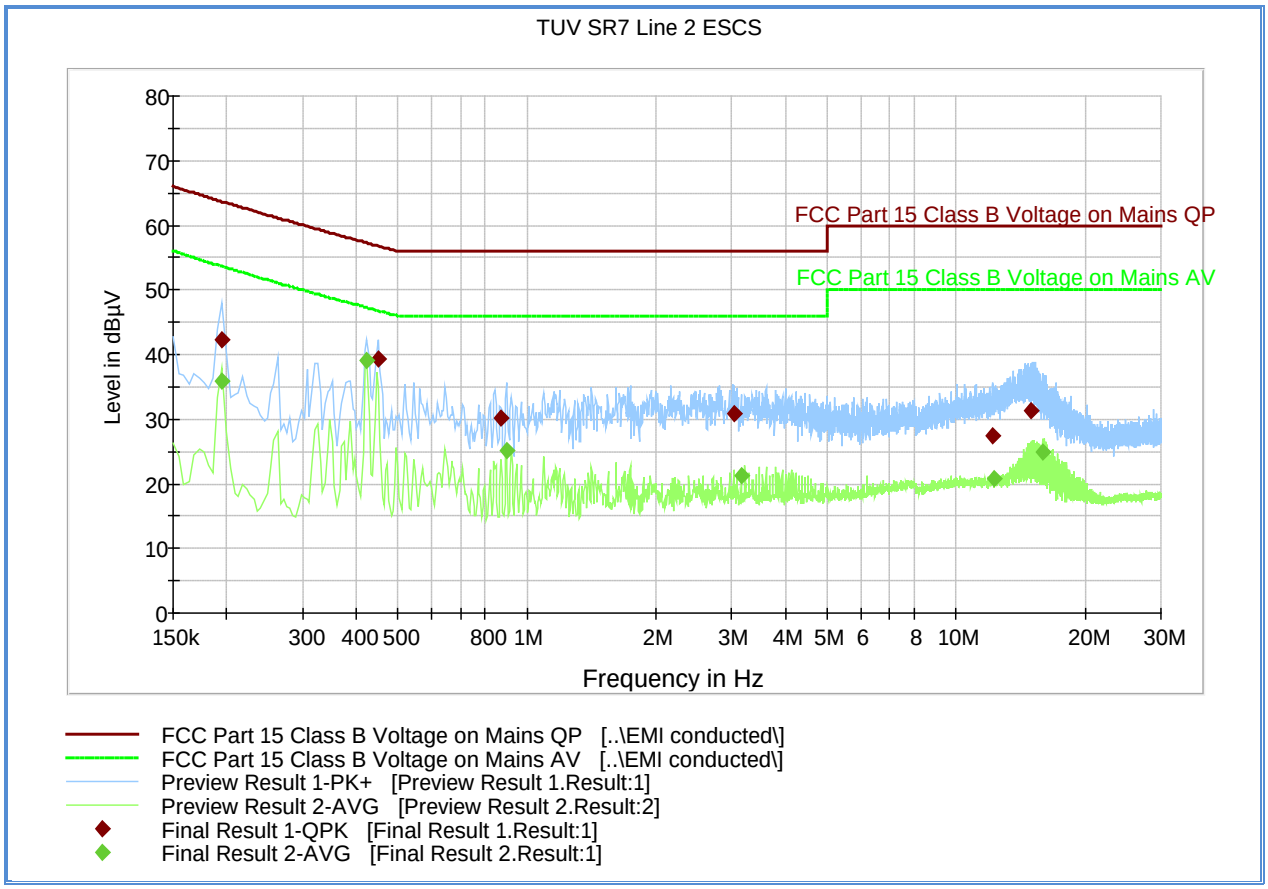
Quasi Peak

Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)
0.195000	44.6	1000.0	9.000	Off	L1	20.1	19.1	63.7
0.447000	41.8	1000.0	9.000	Off	L1	20.2	15.1	56.9
1.288500	34.0	1000.0	9.000	Off	L1	20.2	22.0	56.0
2.445000	31.8	1000.0	9.000	Off	L1	20.5	24.2	56.0
12.322500	31.6	1000.0	9.000	Off	L1	20.8	28.4	60.0
14.824500	34.1	1000.0	9.000	Off	L1	20.9	25.9	60.0

Average

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - Ave (dB)	Limit - Ave (dBµV)
0.195000	37.9	1000.0	9.000	Off	L1	20.1	15.7	53.7
0.424500	35.6	1000.0	9.000	Off	L1	20.2	11.6	47.2
0.870000	25.6	1000.0	9.000	Off	L1	20.1	20.4	46.0
3.867000	24.1	1000.0	9.000	Off	L1	20.5	21.9	46.0
12.241500	21.8	1000.0	9.000	Off	L1	20.8	28.2	50.0
15.846000	27.1	1000.0	9.000	Off	L1	20.9	22.9	50.0

2.1.11 FCC Conducted Emissions Line 2 – Neutral



Quasi Peak

Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)
0.195000	42.3	1000.0	9.000	Off	N	20.1	21.4	63.7
0.451500	39.2	1000.0	9.000	Off	N	20.1	17.6	56.8
0.870000	30.2	1000.0	9.000	Off	N	20.1	25.8	56.0
3.030000	30.9	1000.0	9.000	Off	N	20.4	25.1	56.0
12.187500	27.5	1000.0	9.000	Off	N	20.7	32.5	60.0
14.977500	31.4	1000.0	9.000	Off	N	20.7	28.6	60.0

Average

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - Ave (dB)	Limit - Ave (dBµV)
0.195000	35.9	1000.0	9.000	Off	N	20.1	17.7	53.7
0.424500	39.0	1000.0	9.000	Off	N	20.1	8.2	47.2
0.897000	25.2	1000.0	9.000	Off	N	20.1	20.8	46.0
3.156000	21.3	1000.0	9.000	Off	N	20.5	24.7	46.0
12.268500	20.8	1000.0	9.000	Off	N	20.7	29.2	50.0
15.918000	24.8	1000.0	9.000	Off	N	20.7	25.2	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: N/A /Test Configuration B

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

May 14, 2015/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

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility.

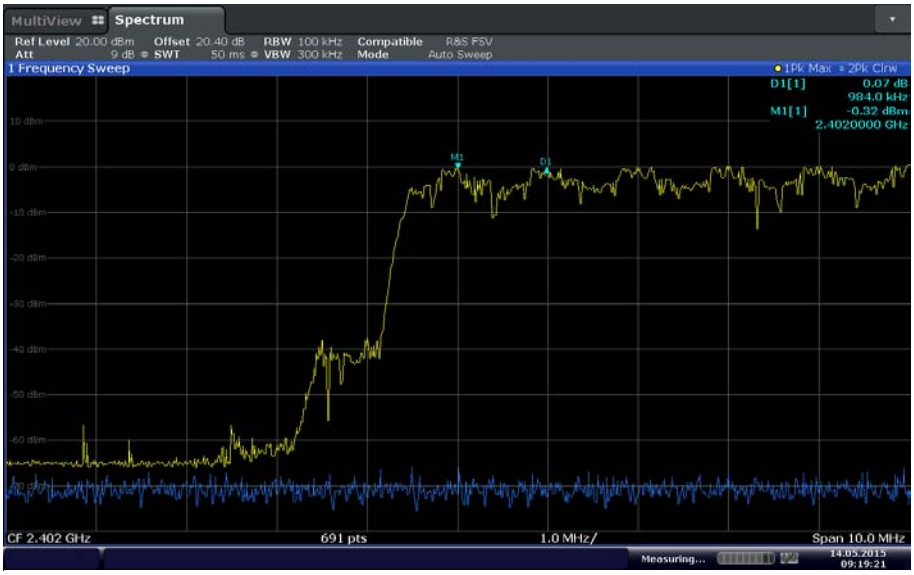
Ambient Temperature	24.8 °C
Relative Humidity	57.1 %
ATM Pressure	99.1 kPa

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 20.4dB 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 >946.67 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 = 0.984 MHz (**Complies**. Greater than 946.67 kHz, this is 2/3 of 1.42MHz 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: N/A /Test Configuration B

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

May 14, 2015/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

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility.

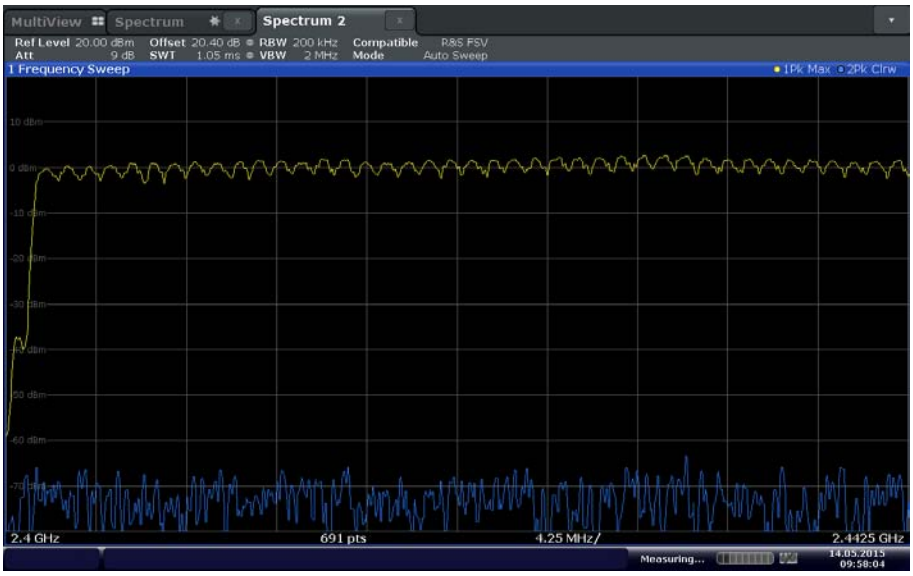
Ambient Temperature	24.8 °C
Relative Humidity	57.1 %
ATM Pressure	99.1 kPa

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.
- Sweep is auto
- Detector is peak, trace is max hold.
- An offset of 20.4dB 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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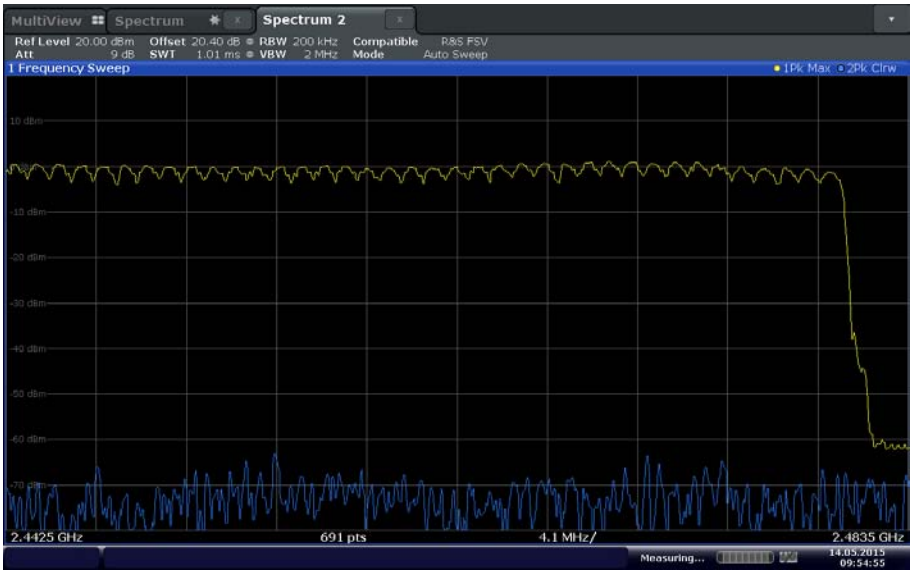
Plot #1



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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: N/A /Test Configuration B

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

May 14, 2015/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

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility.

Ambient Temperature	24.8 °C
Relative Humidity	57.1 %
ATM Pressure	99.1 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 using the instructions provided by the manufacturer. Modulation type was PRBS9, logical channel were between ACL EDR and ACL Basic, packet type used were DH1, 2DH3 and 3DH1. Packet length was set to default value of 1000.

2.4.8 Test Results

Modulation	Measured time of occupancy	Requirement
GFSK	5.7400 ms	<400 ms
π/4-DQPSK	98.609 ms	<400 ms
8DPSK	55.188 ms	<400 ms

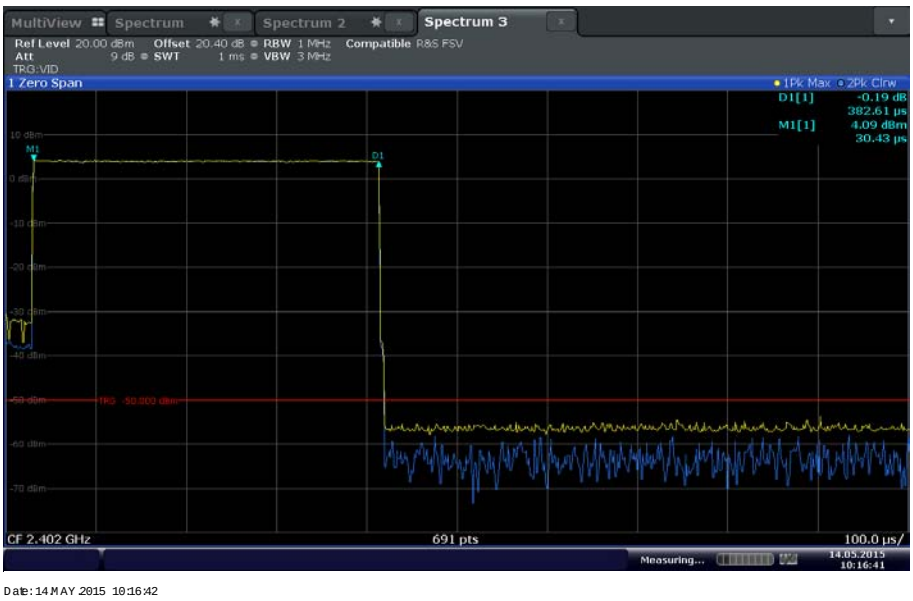
2.4.9 Sample Computation (8DPSK)

Width of single pulse = 0.0003942 second
Observed occurrence = 14 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
= 0.0003942 second x 14x 10
= 0.055188 second

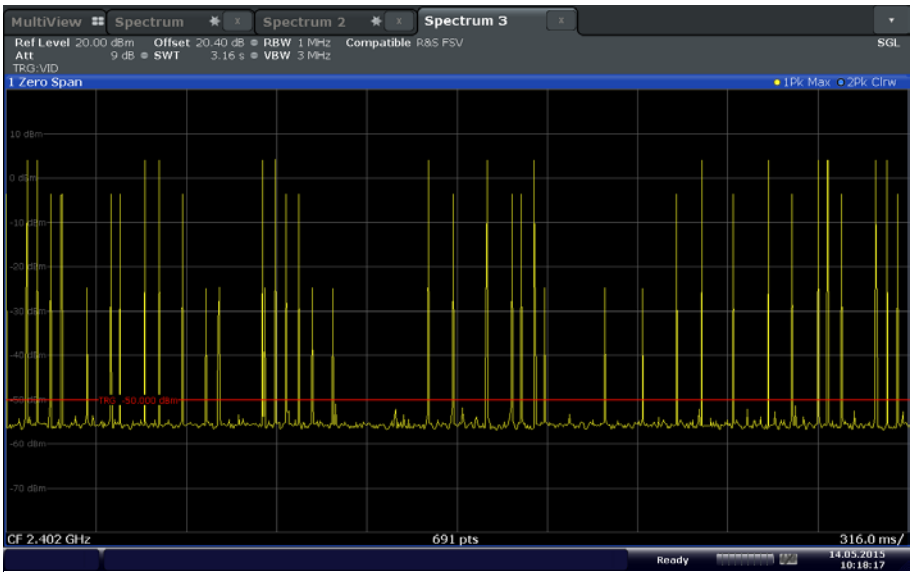
Compliance = Complies. 0.055188 second < 0.4 second

2.4.10 Test Results Plots



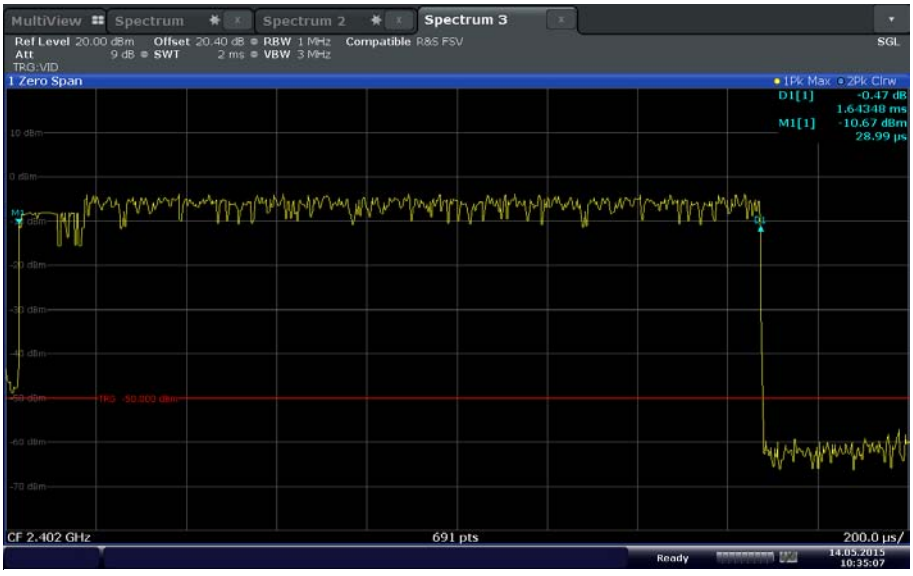
Date: 14.MAY.2015 10:16:42

GFSK width of single pulse (0.38261ms)



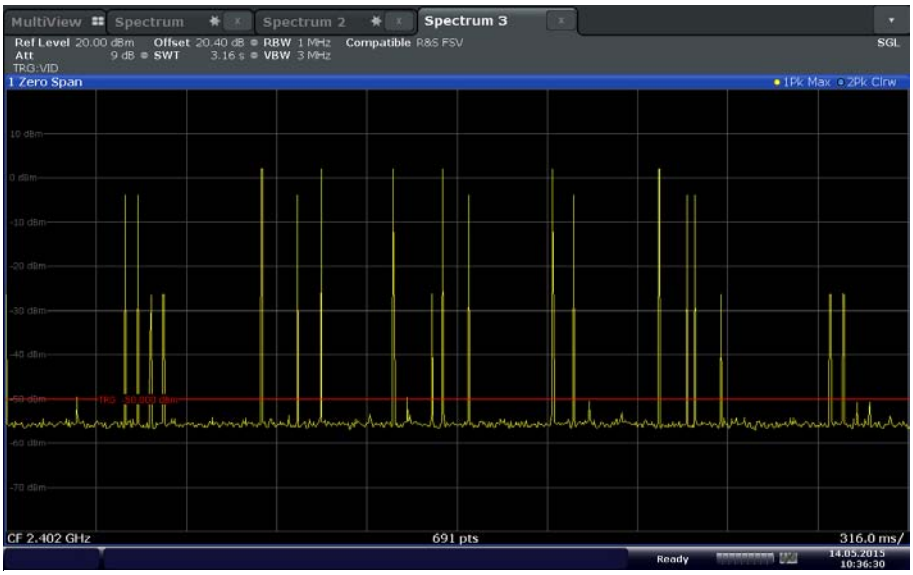
Date: 14.MAY.2015 10:18:17

15 pulses/3.16 seconds (DH1)



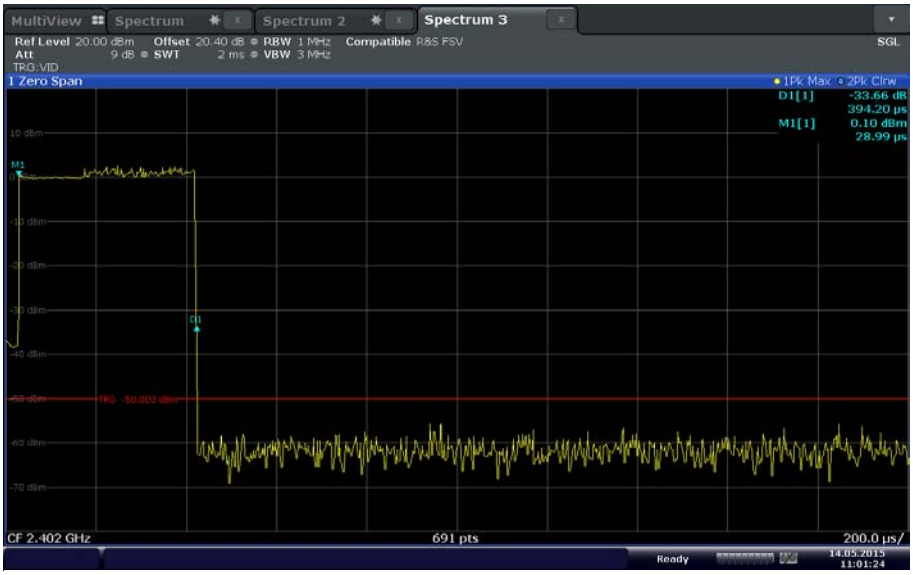
Date: 14.MAY.2015 10:35:07

π/4-DQPSK width of single pulse (1.64348 ms)



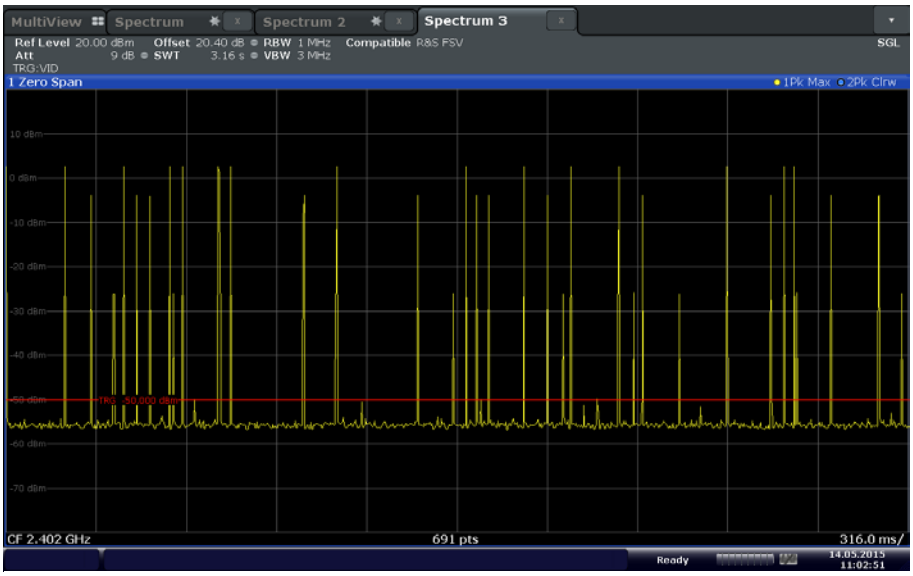
Date: 14 MAY 2015 10:36:30

6 pulses/3.16 seconds (π/4-DQPSK)



Date: 14 MAY 2015 11:01:24

8DPSK width of single pulse (0.3942 ms)



Date: 14.MAY.2015 11:02:51

14 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: N/A /Test Configuration B

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

May 14, 2015/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

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility.

Ambient Temperature	24.8 °C
Relative Humidity	57.1 %
ATM Pressure	99.1 kPa

2.5.7 Additional Observations

- This is a conducted test.
- An offset of 20.4dB 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.

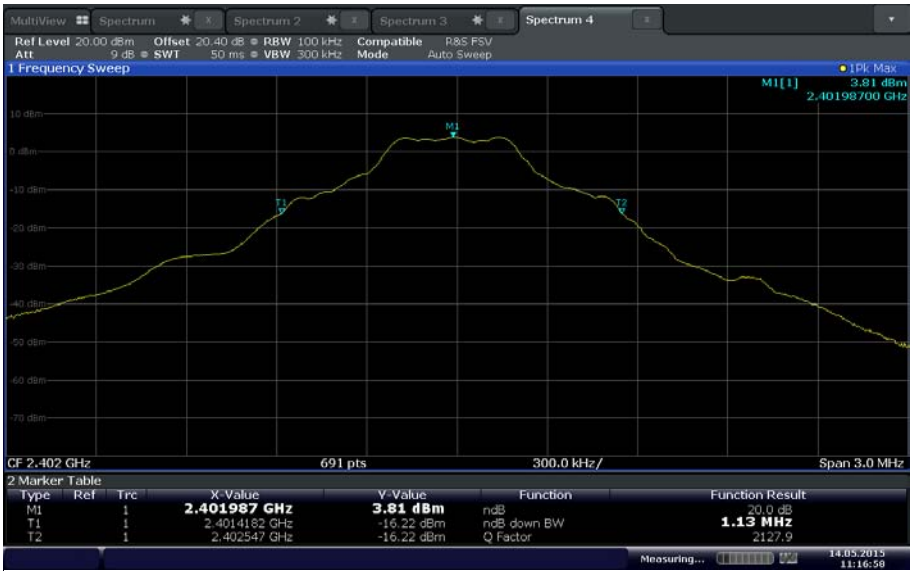
2.5.8 Test Results

Modulation	Channel	Frequency (MHz)	Measured 20dB Bandwidth (MHz)
GFSK	0	2402	1.13
	38	2440	1.13
	78	2480	1.13
π/4-DQPSK	0	2402	1.42
	38	2440	1.42
	78	2480	1.42
8DPSK	0	2402	1.40
	38	2440	1.40
	78	2480	1.40

Worst case configuration (π/4-DQPSK)
2402 MHz – (20dB BW/2) = 2401.29 MHz (within the frequency band - **Compliant**)

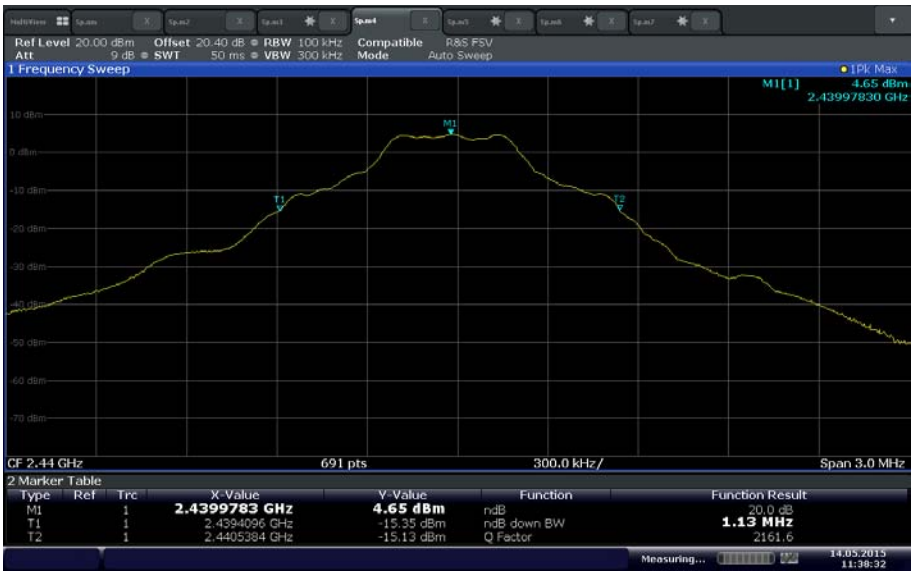
Worst case configuration (π/4-DQPSK)
2480 MHz + (20dB BW/2) = 2480.71 MHz (within the frequency band - **Compliant**)

2.5.9 Test Results Plots



Date: 14.MAY.2015 11:16:58

GFSK Low Channel



Date: 14.MAY.2015 11:38:33

GFSK Mid Channel

Date: 14.MAY.2015 11:46:52

GFSK High Channel

Date: 14.MAY.2015 12:42:52

π/4-DQPSK Low Channel

Date: 14.MAY.2015 12:51:40

π/4-DQPSK Mid Channel

Date: 14.MAY.2015 12:57:50

π/4-DQPSK High Channel

Date: 14.MAY.2015 13:28:33

8DPSK Low Channel

Date: 14.MAY.2015 13:36:17

8DPSK Mid Channel

Date: 14.MAY.2015 13:41:51

8DPSK High Channel

2.6 99% EMISSION BANDWIDTH

2.6.1 Specification Reference

RSS-Gen Clause 6.6

2.6.2 Standard Applicable

The emission bandwidth (x dB) is defined as the frequency range between two points, one above and one below the carrier frequency, at which the spectral density of the emission is attenuated x dB below the maximum in-band spectral density of the modulated signal. Spectral density (power per unit bandwidth) is to be measured with a detector of resolution bandwidth in the range of 1% to 5% of the anticipated emission bandwidth, and a video bandwidth at least 3x the resolution bandwidth.
When the occupied bandwidth limit is not stated in the applicable RSS or reference measurement method, the transmitted signal bandwidth shall be reported as the 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 (RBW) shall be in the range of 1% to 5% of the occupied bandwidth (OBW) and video bandwidth (VBW) shall be approximately 3x RBW.

Note: Video averaging is not permitted.
A peak, or peak hold, may be used in place of the sampling detector as this may produce a wider bandwidth than the actual bandwidth (worst-case measurement). Use of a peak hold may be necessary to determine the occupied bandwidth if the device is not transmitting continuously.
The trace data points are recovered and are directly summed in linear power level 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 (starting at the highest frequency, at the right side of the span, and going down in frequency). This frequency is then recorded.
The difference between the two recorded frequencies is the 99% occupied bandwidth.

2.6.3 Equipment Under Test and Modification State

Serial No: N/A /Test Configuration B

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

May 14, 2015/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

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility.

Ambient Temperature	24.8 °C
Relative Humidity	57.1 %
ATM Pressure	99.1 kPa

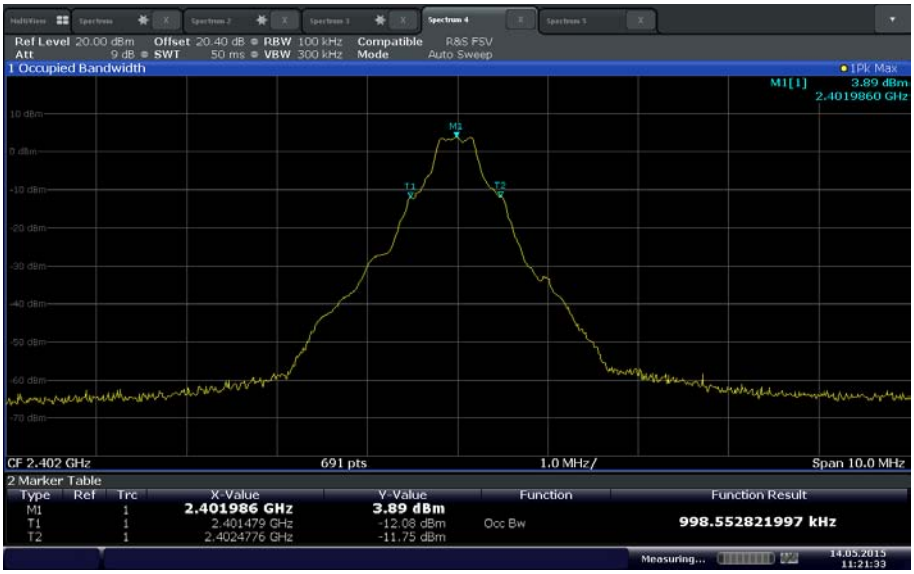
2.6.7 Additional Observations

- This is a conducted test.
- An offset of 20.4dB 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)

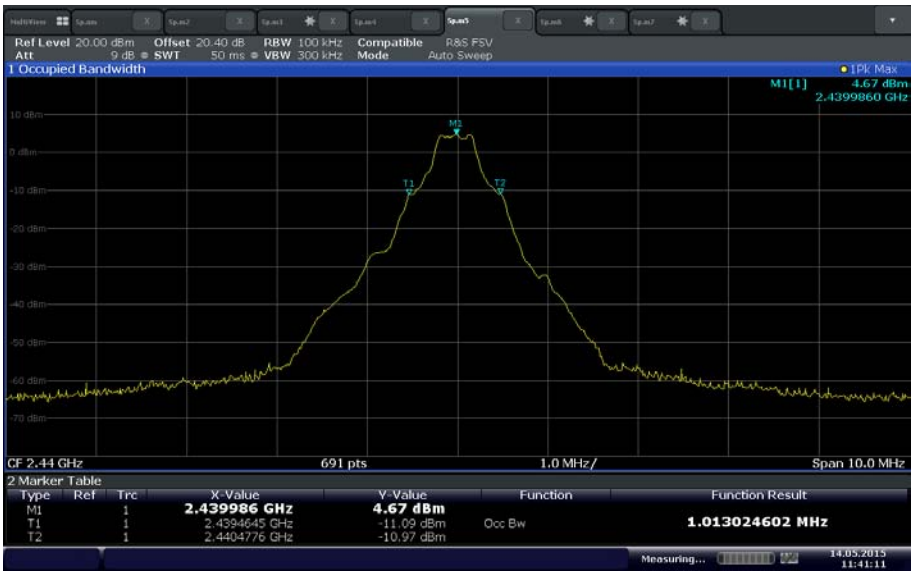
Modulation	Channel	Frequency (MHz)	Measured 20dB Bandwidth (MHz)
GFSK	0	2402	0.998
	38	2440	1.013
	78	2480	0.998
π/4-DQPSK	0	2402	1.230
	38	2440	1.244
	78	2480	1.230
8DPSK	0	2402	1.230
	38	2440	1.230
	78	2480	1.230

2.6.9 **Test Results Plots**



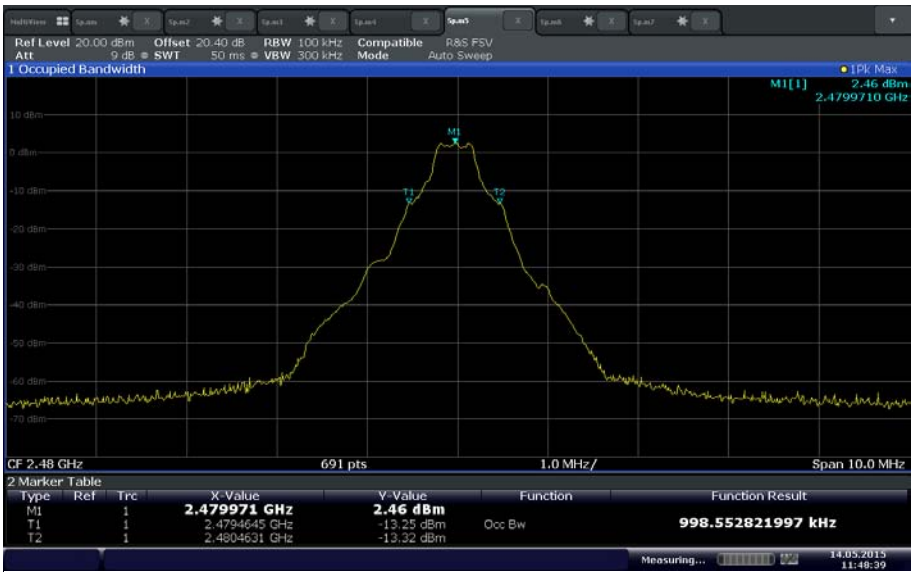
Date: 14.MAY.2015 11:21:34

GFSK Low Channel



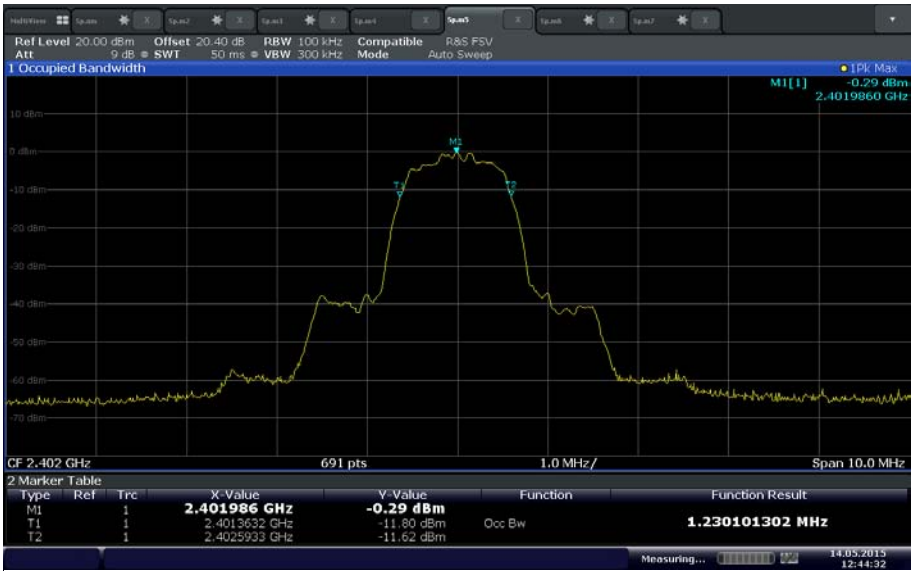
Date: 14.MAY.2015 11:41:11

GFSK Mid Channel



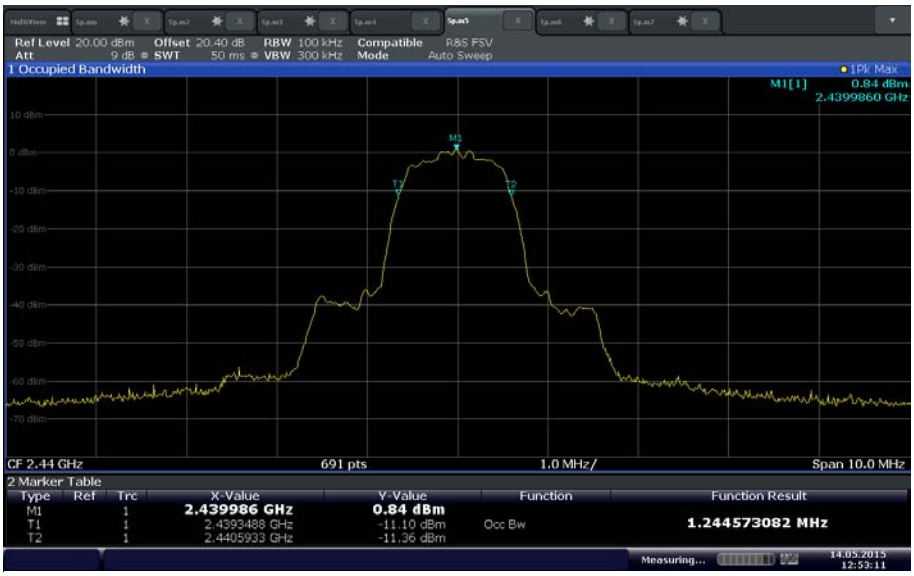
Date: 14.MAY.2015 11:48:39

GFSK High Channel



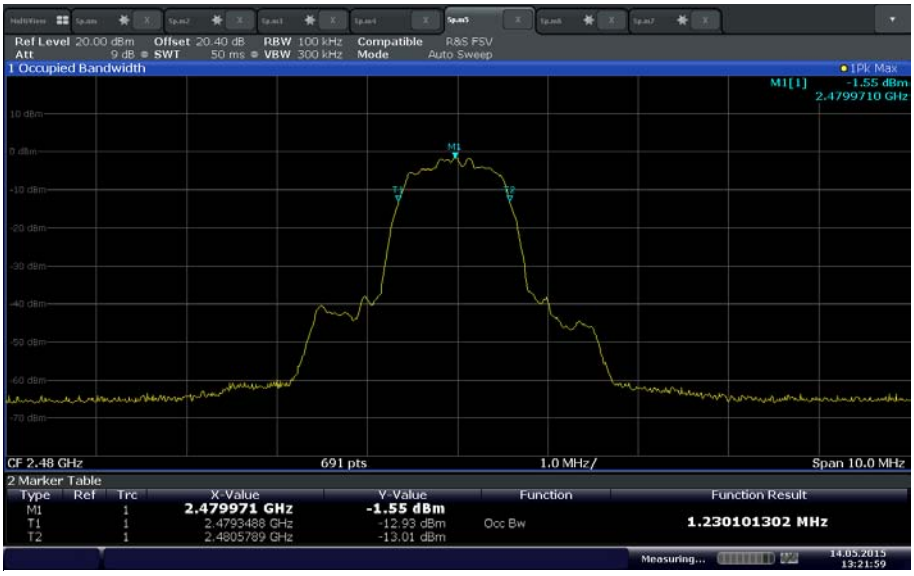
Date: 14.MAY.2015 12:44:32

π/4-DQPSK Low Channel



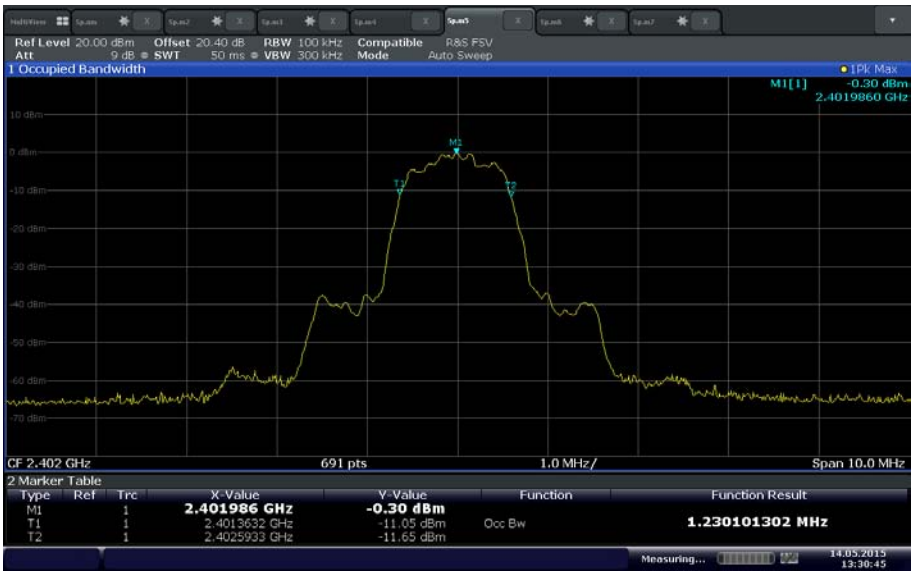
Date: 14.MAY.2015 12:53:11

π/4-DQPSK Mid Channel



Date: 14.MAY.2015 13:22:00

π/4-DQPSK High Channel



Date: 14.MAY.2015 13:30:46

8DPSK Low Channel

Date: 14.MAY.2015 13:37:39

8DPSK Mid Channel

Date: 14.MAY.2015 13:42:56

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: N/A /Test Configuration B

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

May 14, 2015/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

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility.

Ambient Temperature	24.8 °C
Relative Humidity	57.1 %
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)

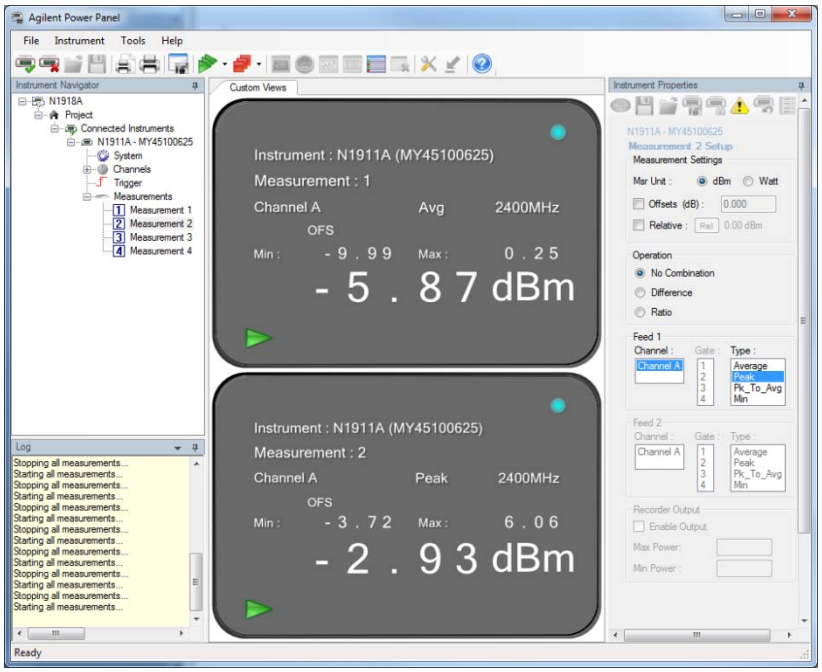
Modulation	Channel	Frequency (MHz)	Measured Average Output Power (dBm)	Measured Peak Output Power (dBm)	Measured Peak Output Power (mW)	Limit (mW)
GFSK	0	2402	0.10	5.44	3.50	1000.0
	38	2440	0.25	6.06	4.04	1000.0
	78	2480	-0.70	4.58	2.87	1000.0
π/4-DQPSK	0	2402	-3.88	4.04	2.54	1000.0
	38	2440	-2.51	4.97	3.14	1000.0
	78	2480	-6.24	3.29	2.13	1000.0

8DPSK	0	2402	-9.46	4.21	2.64	1000.0
	38	2440	-5.84	5.05	3.20	1000.0
	78	2480	-9.56	3.71	2.35	1000.0

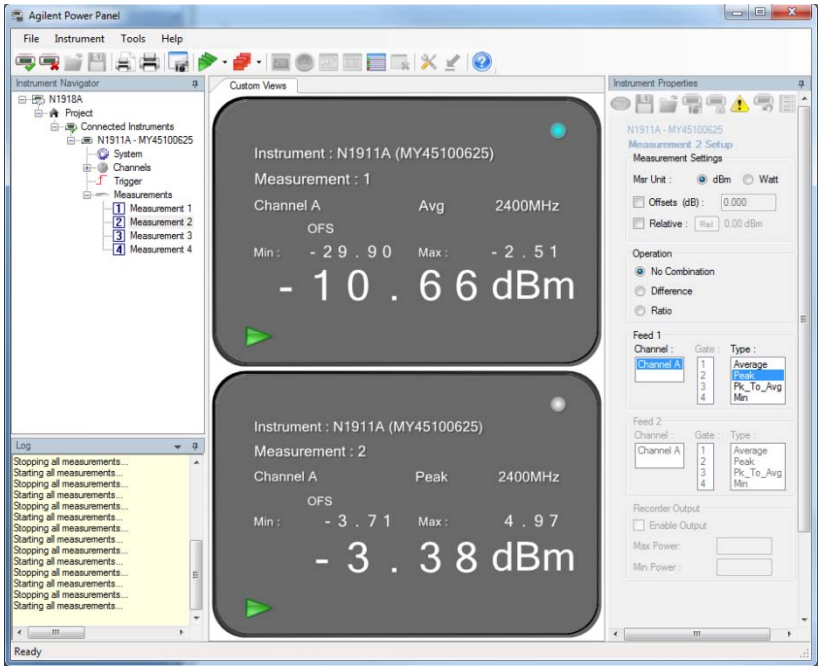
2.7.9 Test Results (*De Facto* EIRP Limit)

Modulation	Channel	Frequency (MHz)	Measured Peak Output Power (dBm))	Antenna Gain (dBi)	Calculated Peak Output Power EIRP (dBm))	Limit (dBm))
GFSK	38	2440	6.06	1.1	7.16	30
π/4-DQPSK	38	2440	4.97	1.1	6.07	30
8DPSK	38	2440	5.05	1.1	6.15	30

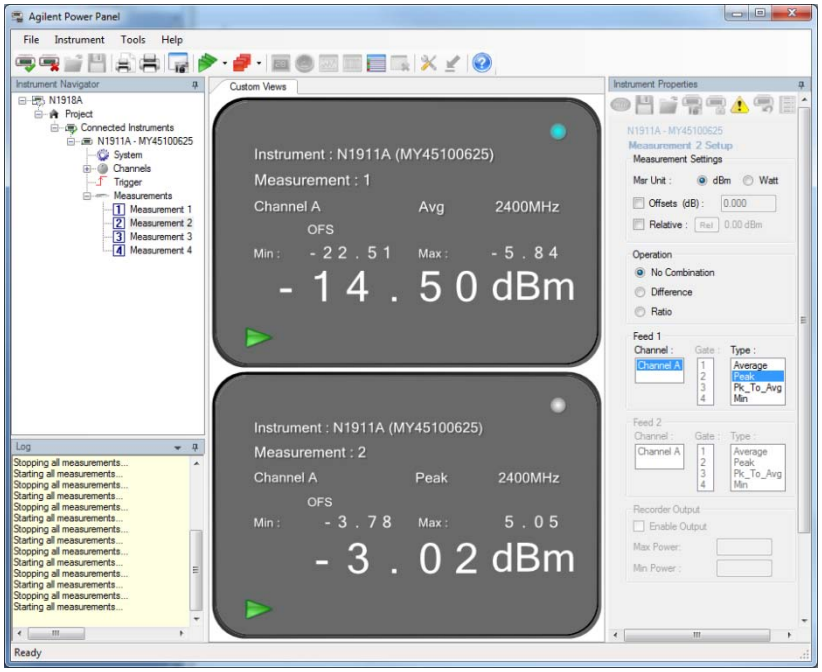
2.7.10 Sample Test Display



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: N/A /Test Configuration B

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

May 14, 2015/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

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility.

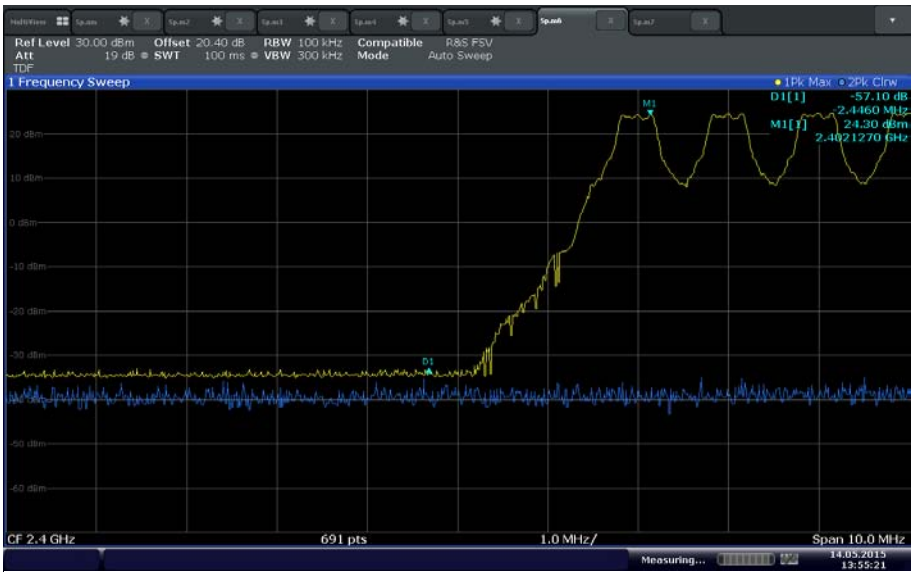
Ambient Temperature	24.8 °C
Relative Humidity	57.1 %
ATM Pressure	99.1 kPa

2.8.7 Additional Observations

- This is a conducted test.
- An offset of 20.4dB 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.

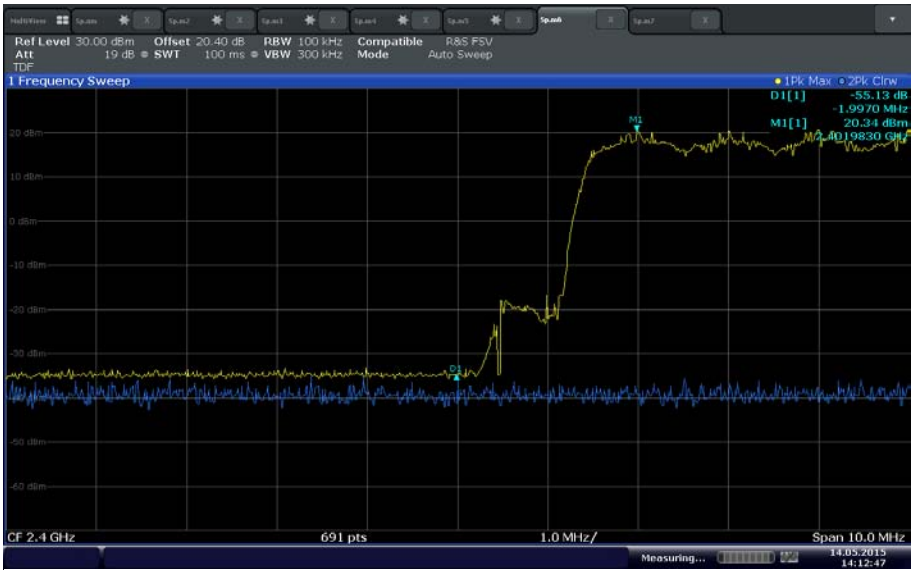
- Limit is 20dBc.
- Both Hopping and Non-Hopping mode verified.

2.8.8 **Test Results**



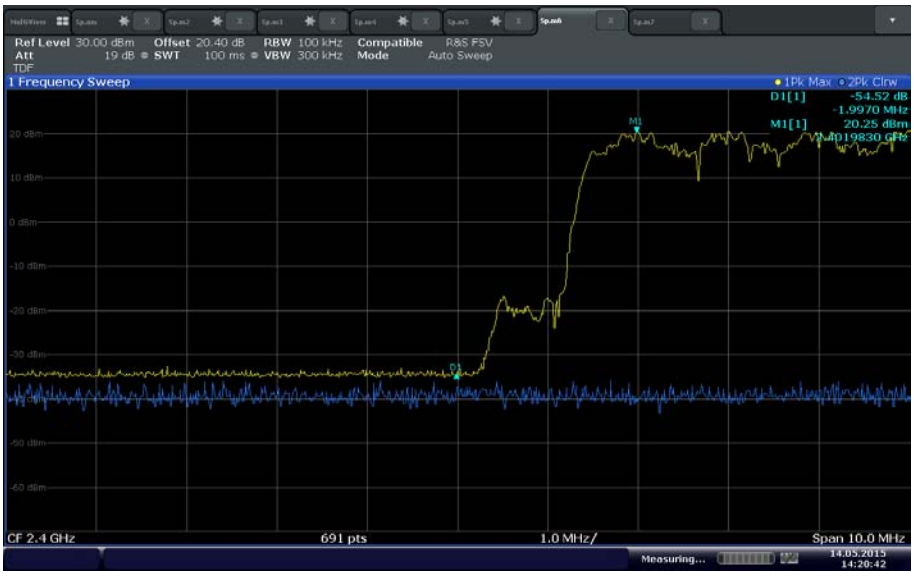
Date: 14.MAY.2015 13:55:21

Hopping lower bandedge (GFSK)



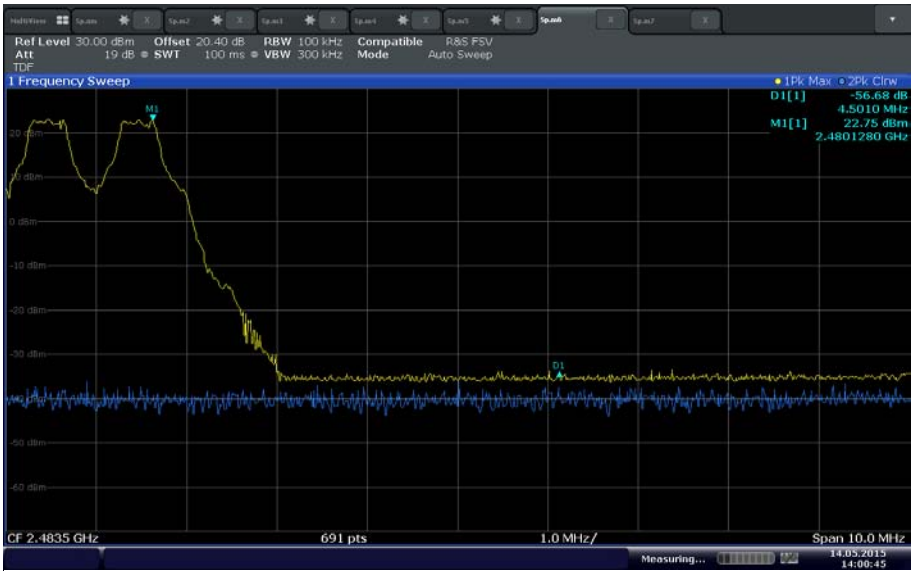
Date: 14.MAY.2015 14:12:47

Hopping lower bandedge (π/4-DQPSK)



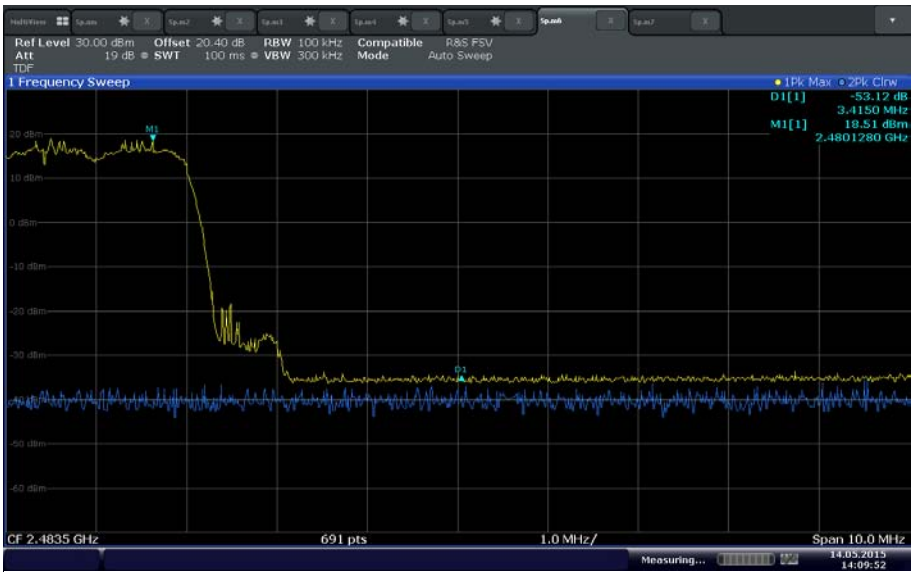
Date: 14.MAY.2015 14:20:42

Hopping lower bandedge (8DPSK)



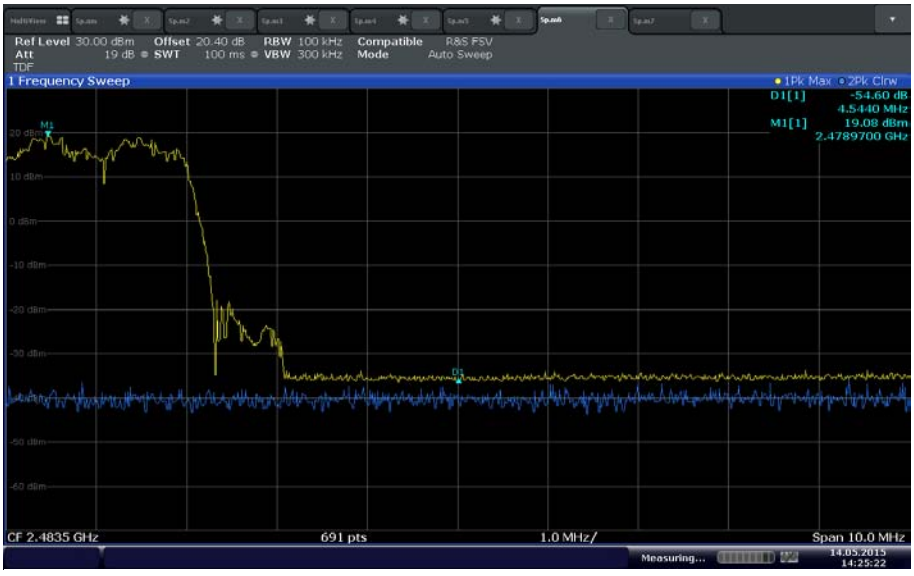
Date: 14.MAY.2015 14:00:45

Hopping upper bandedge (GFSK)



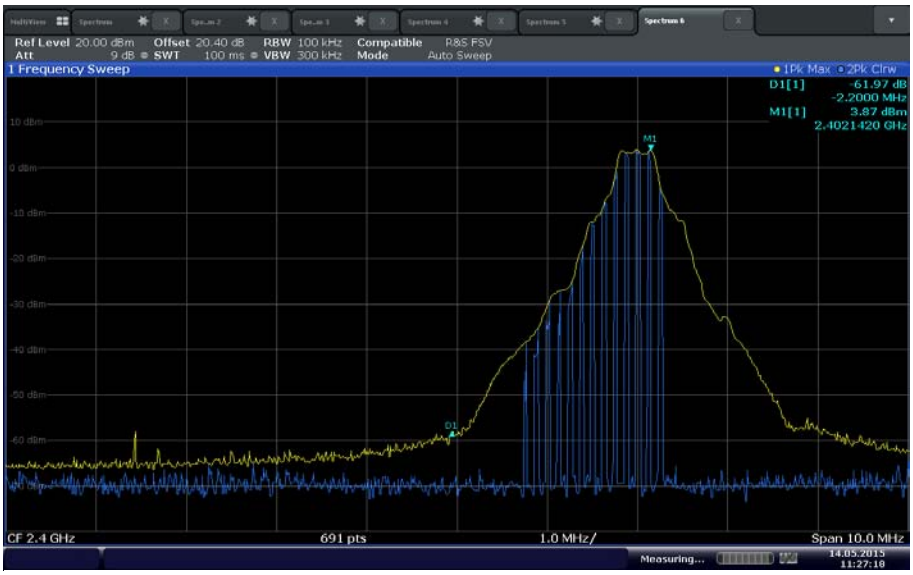
Date: 14.MAY.2015 14:09:52

Hopping upper bandedge (π/4-DQPSK)



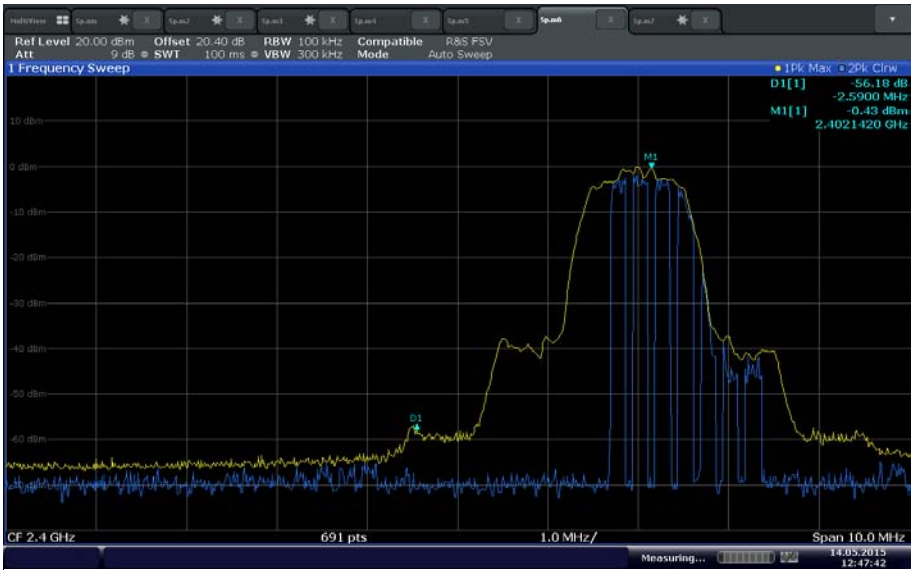
Date: 14.MAY.2015 14:25:22

Hopping upper bandedge (8DPSK)



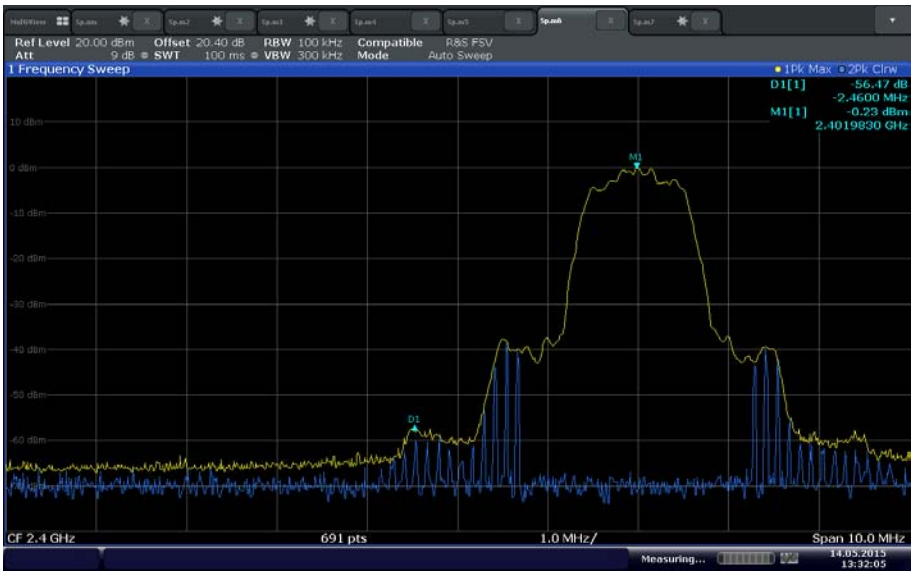
Date: 14.MAY.2015 11:27:18

Non-hopping lower bandedge (GFSK)



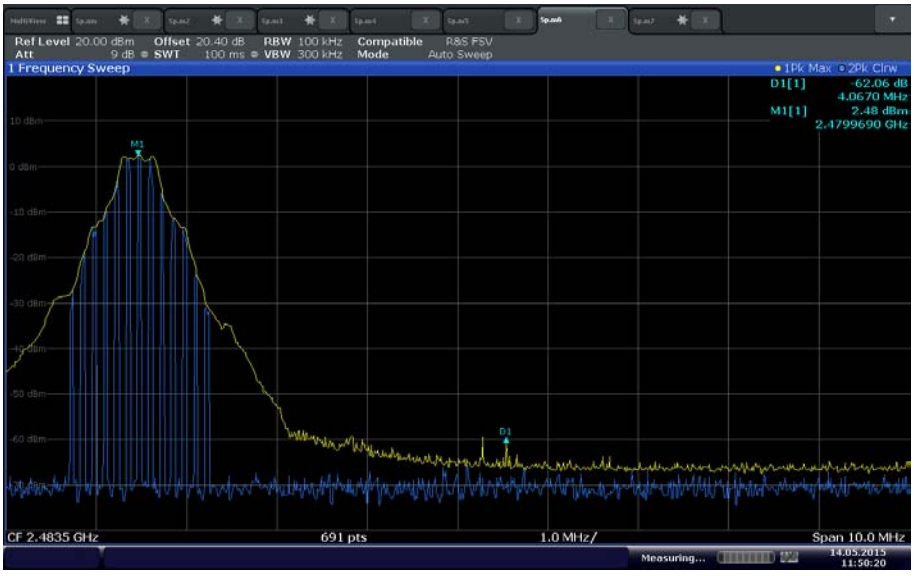
Date: 14.MAY.2015 12:47:42

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



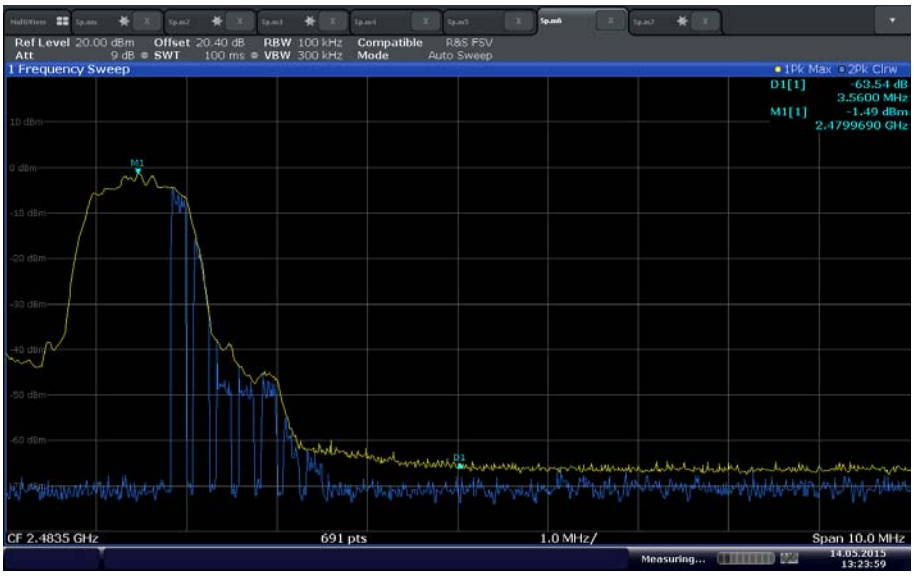
Date: 14.MAY.2015 13:32:05

Non-hopping lower bandedge (8DPSK)



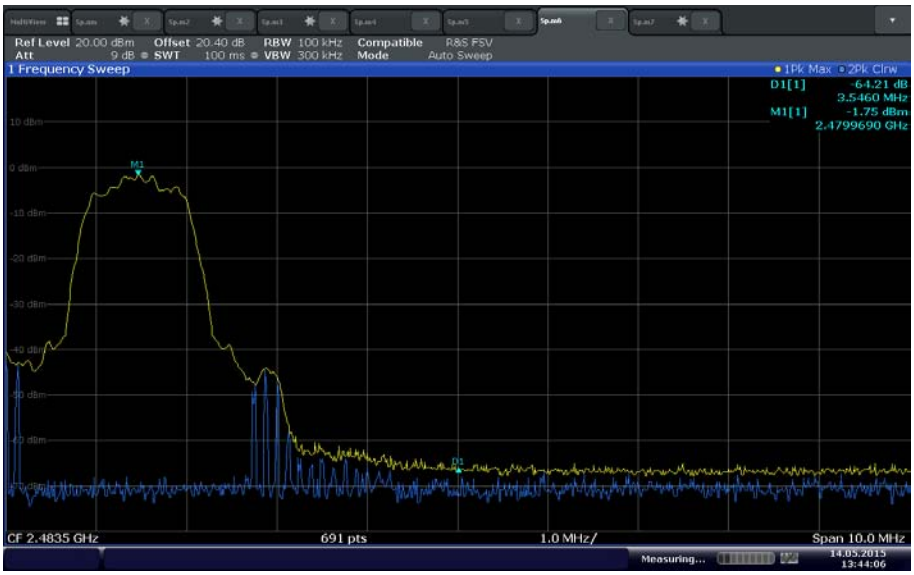
Date: 14.MAY.2015 11:50:20

Non-hopping upper bandedge (GFSK)



Date: 14.MAY.2015 13:23:59

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



Date: 14.MAY.2015 13:44:07

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: N/A /Test Configuration B

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

May 14, 2015/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

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility.

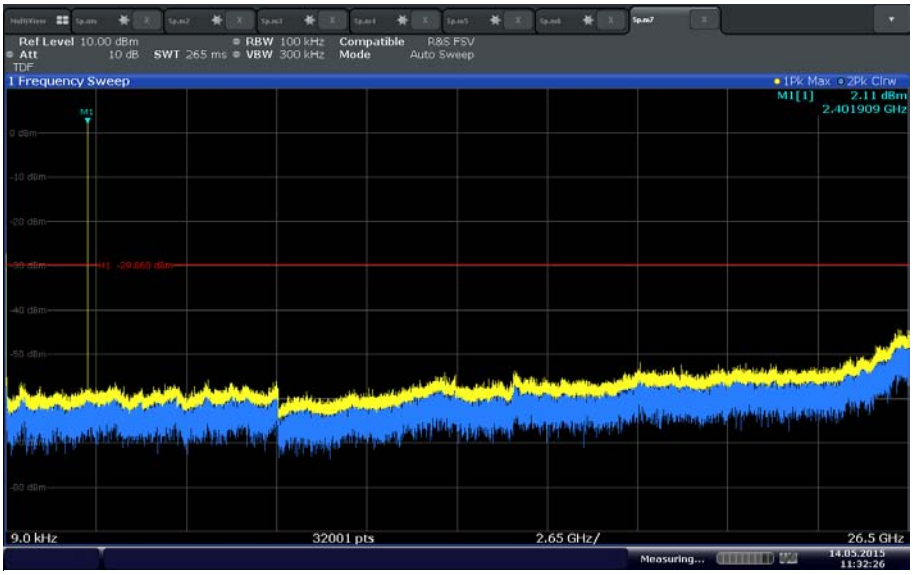
Ambient Temperature	24.8 °C
Relative Humidity	57.1 %
ATM Pressure	99.1 kPa

2.9.7 Additional Observations

- This is a conducted test.
- A TDF factor was used to compensate for the external attenuator and cable used within the frequency band.
- Span is from 9 kHz up to 26.5GHz (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.

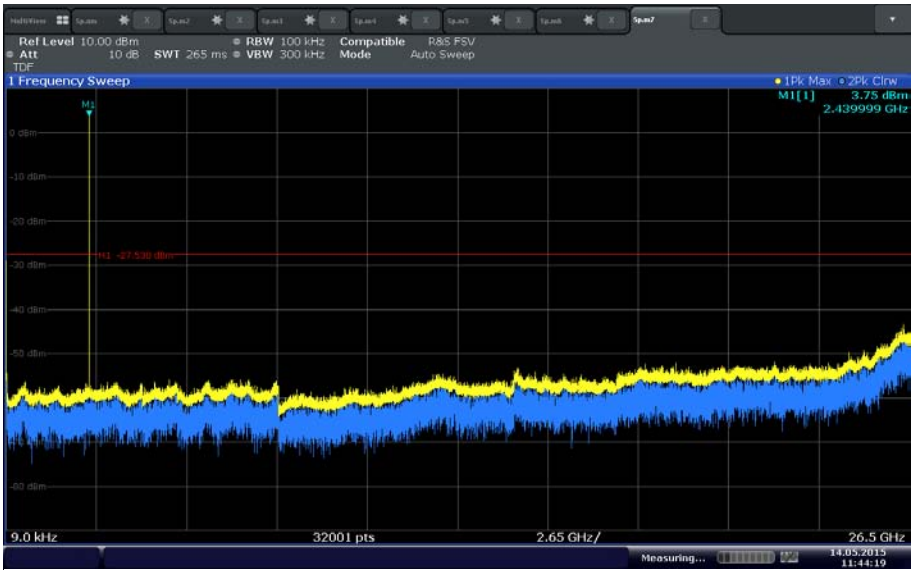
- Trace is max hold.
- Trace allowed to stabilize. Maximum spurious emission compared to limit.
- Limit is 20dBc (30dBc presented, worst case).

2.9.8 **Test Results Plots**



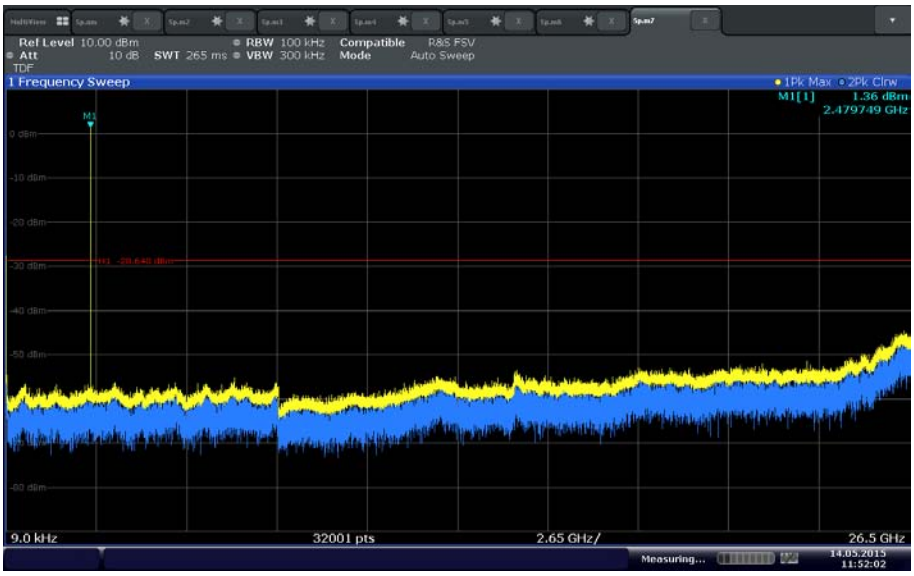
Date: 14.MAY.2015 11:32:26

Low Channel (GFSK)



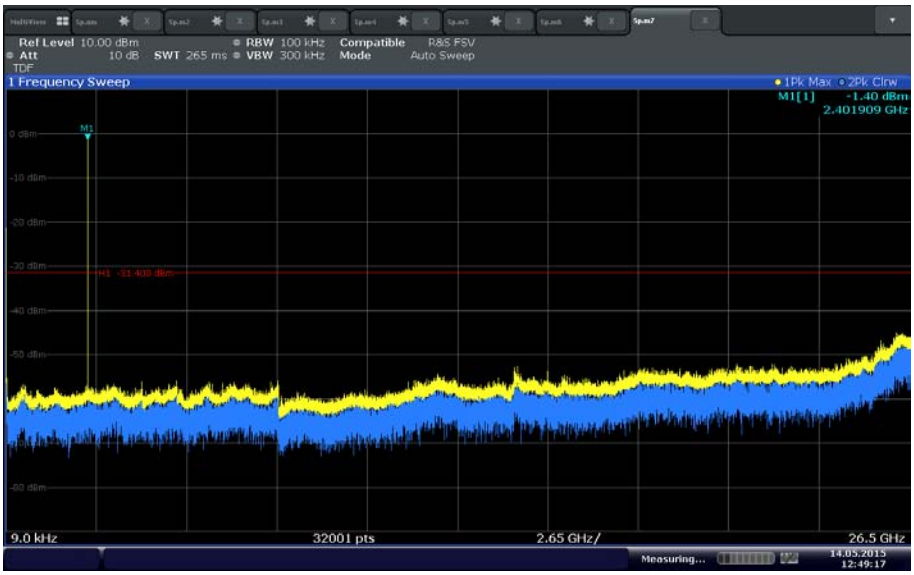
Date: 14.MAY.2015 11:44:19

Mid Channel (GFSK)



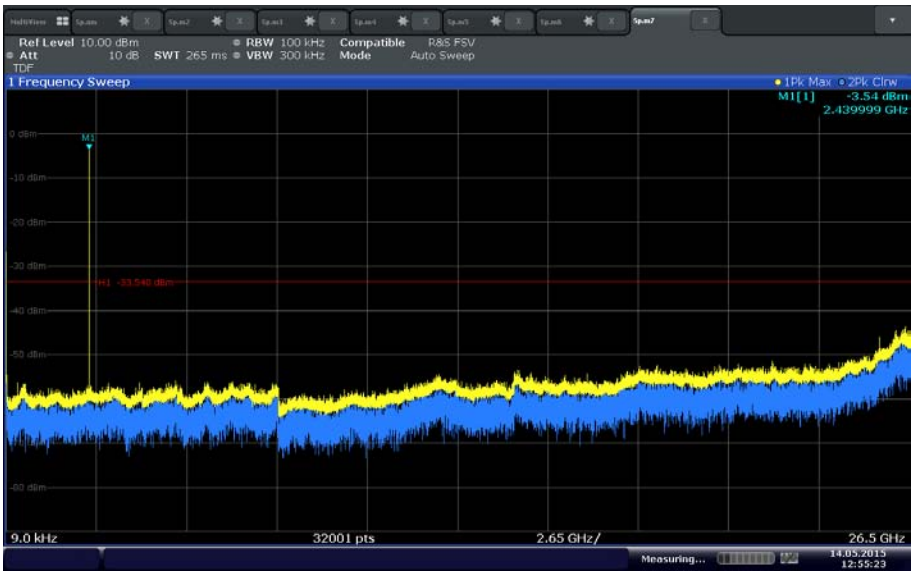
Date: 14.MAY.2015 11:52:03

High Channel (GFSK)



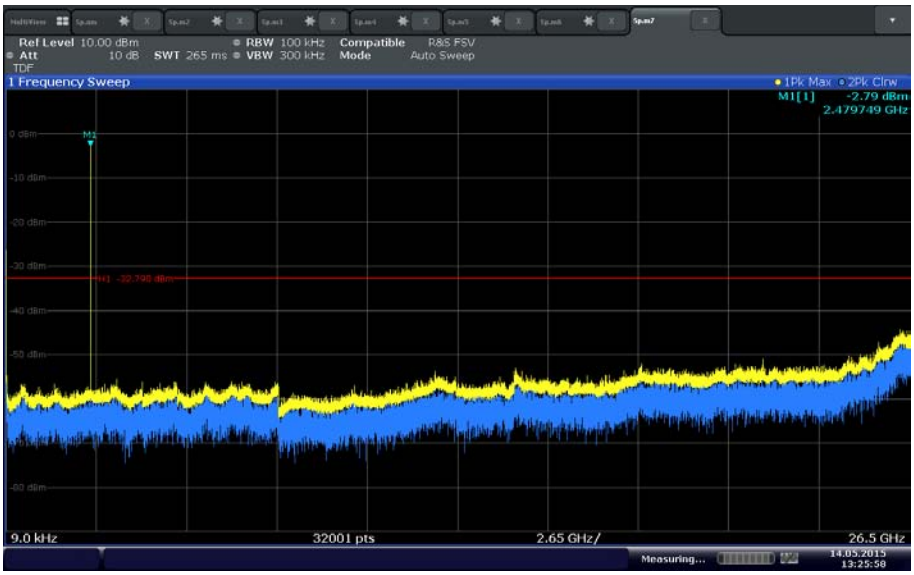
Date: 14.MAY.2015 12:49:18

Low Channel (π/4-DQPSK)



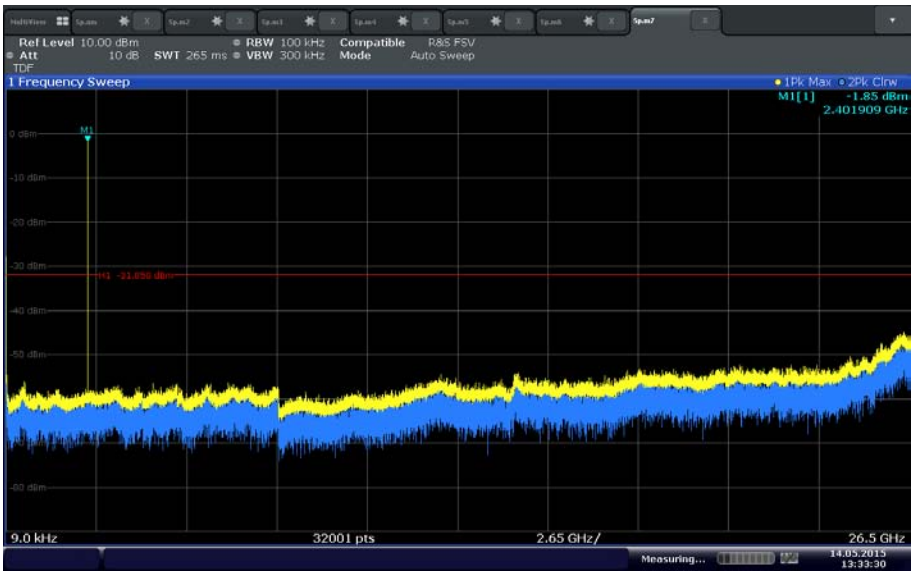
Date: 14.MAY.2015 12:55:23

Mid Channel (π/4-DQPSK)



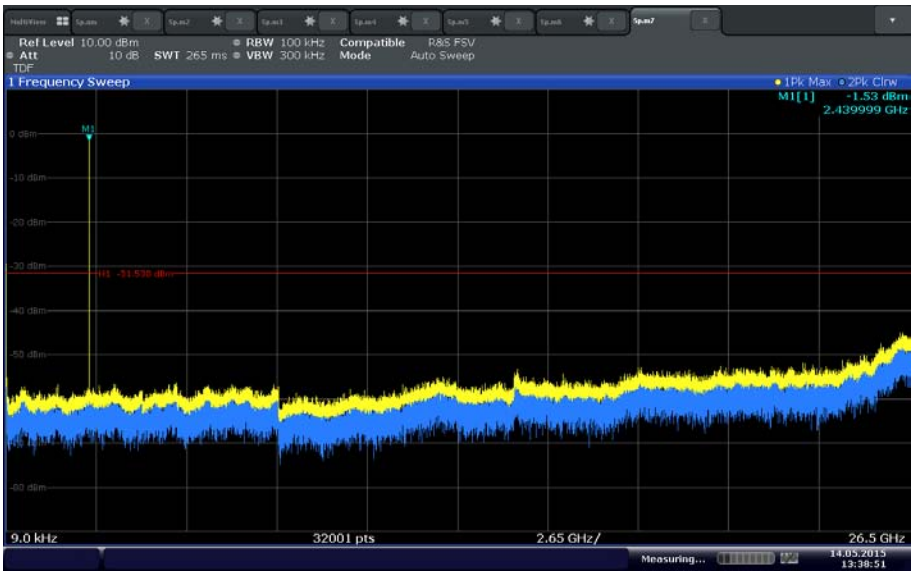
Date: 14.MAY.2015 13:25:59

High Channel (π/4-DQPSK)



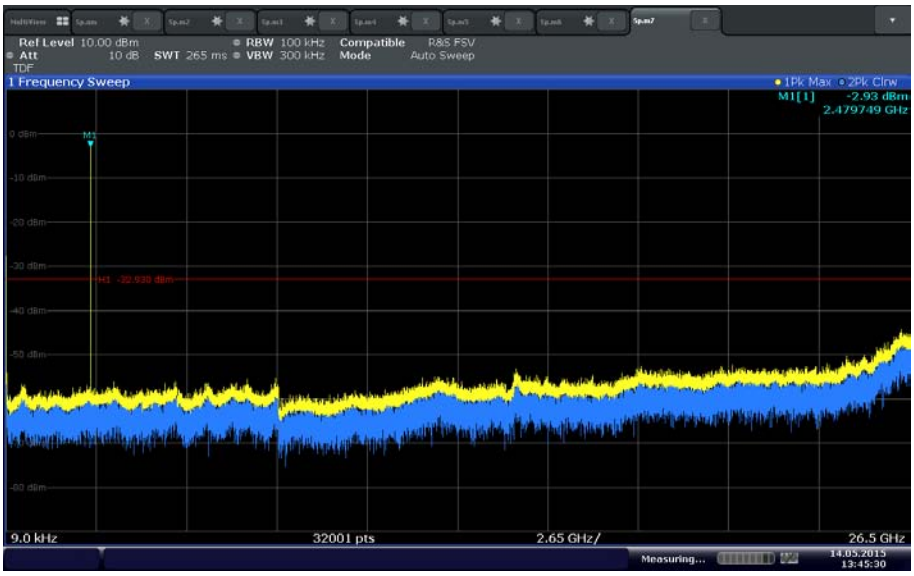
Date: 14.MAY.2015 13:33:30

Low Channel (8DPSK)



Date: 14.MAY.2015 13:38:52

Mid Channel (8DPSK)



Date: 14.MAY.2015 13:45:30

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: N/A / Test Configuration B

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

May 12, 2015/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

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	24.2-24.6°C
Relative Humidity	48.2-49.5%
ATM Pressure	98.6-98.9 kPa

2.10.7 Additional Observations

- This is a radiated test. The spectrum was searched from 30MHz to the 10th harmonic.
- 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.

- Only noise floor measurements observed above 18GHz.
- 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.

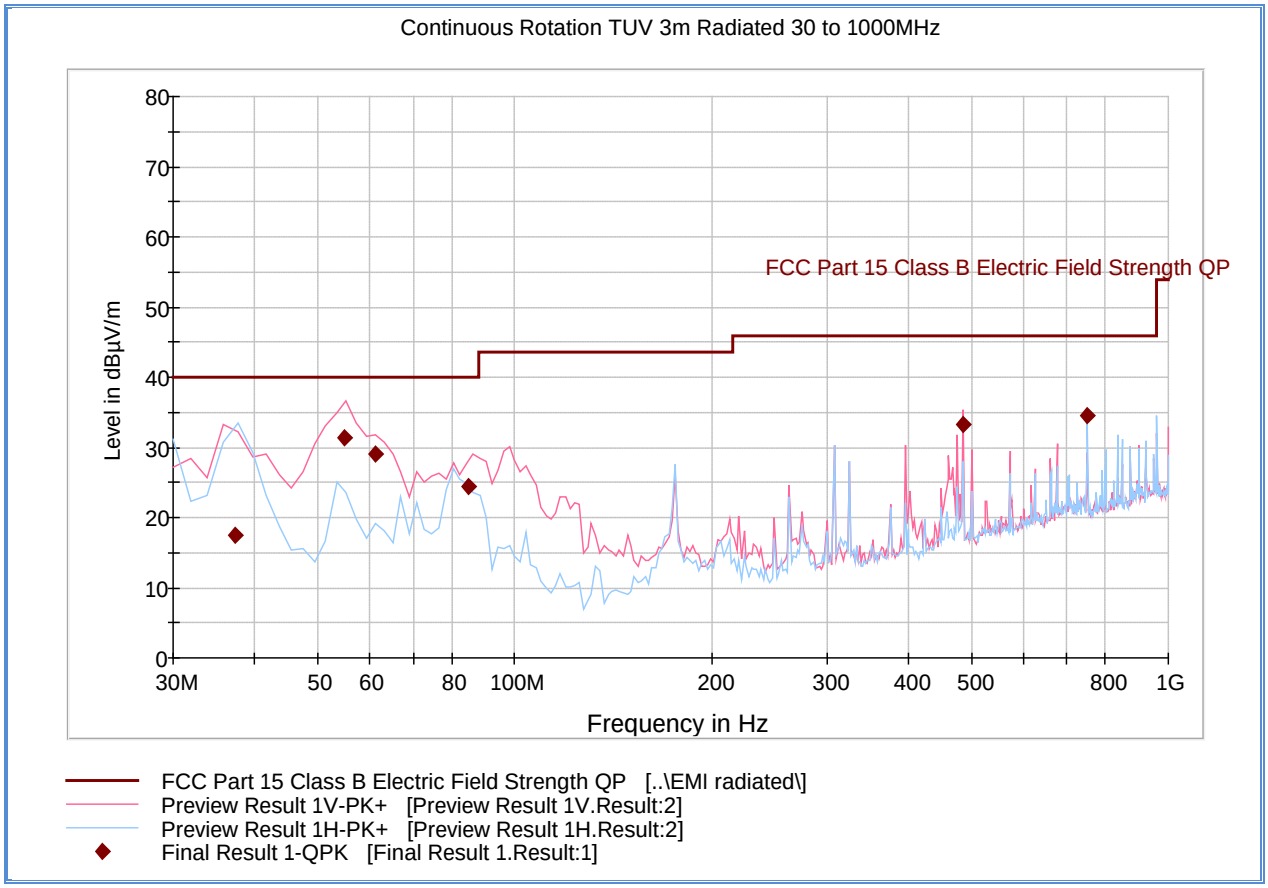
2.10.8 Sample Computation (Radiated Emission)

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.

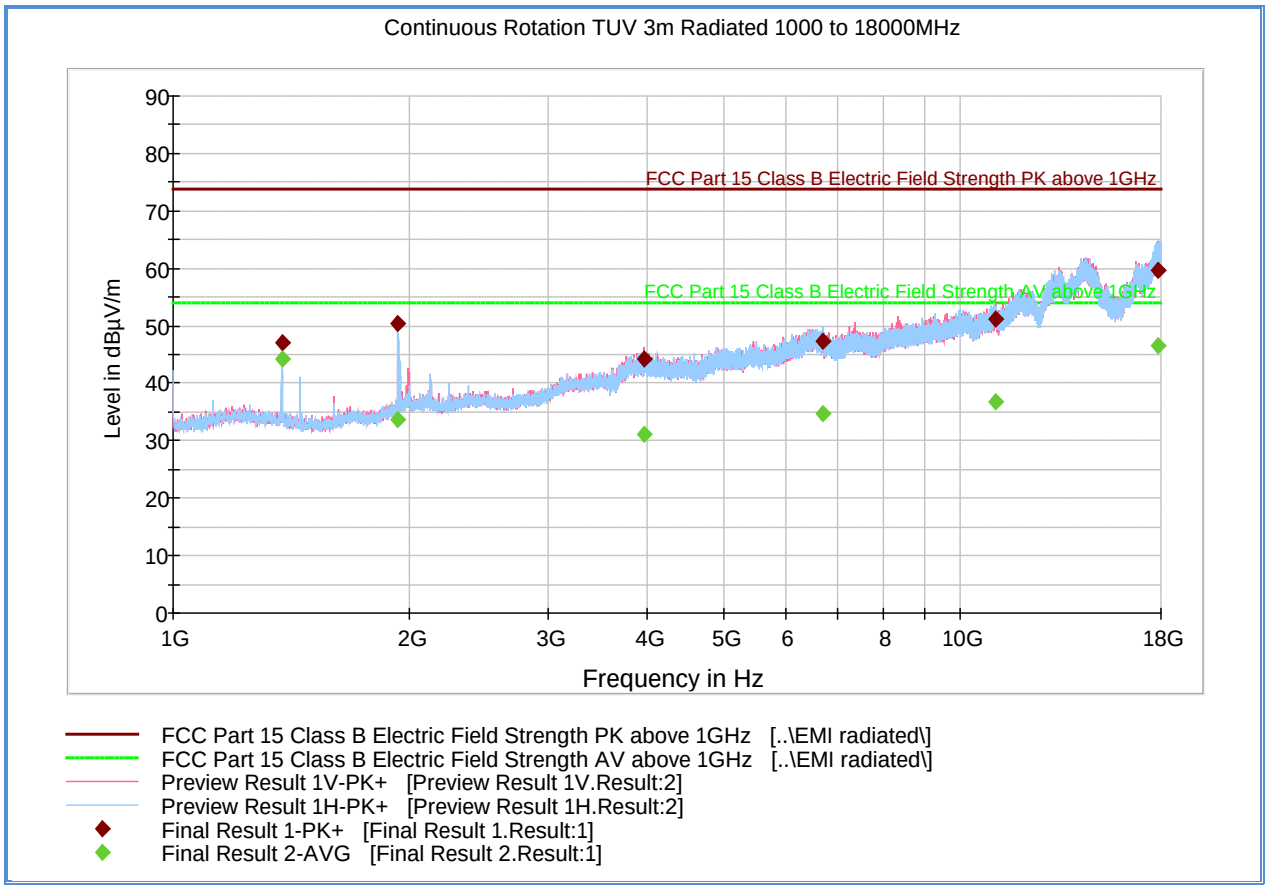
2.10.10 **Test Results Below 1GHz (Receive Mode)**



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)
37.375551	17.5	1000.0	120.000	400.0	H	11.0	-15.3	22.5	40.0
54.750541	31.3	1000.0	120.000	100.0	V	232.0	-21.0	8.7	40.0
61.262204	29.0	1000.0	120.000	100.0	V	165.0	-22.0	11.0	40.0
84.972745	24.3	1000.0	120.000	110.0	V	291.0	-21.6	15.7	40.0
483.989739	33.2	1000.0	120.000	139.0	V	318.0	-6.9	12.8	46.0
749.982365	34.6	1000.0	120.000	100.0	H	83.0	-2.0	11.4	46.0

2.10.11 Test Results Above 1GHz (Receive Mode)



Peak Data

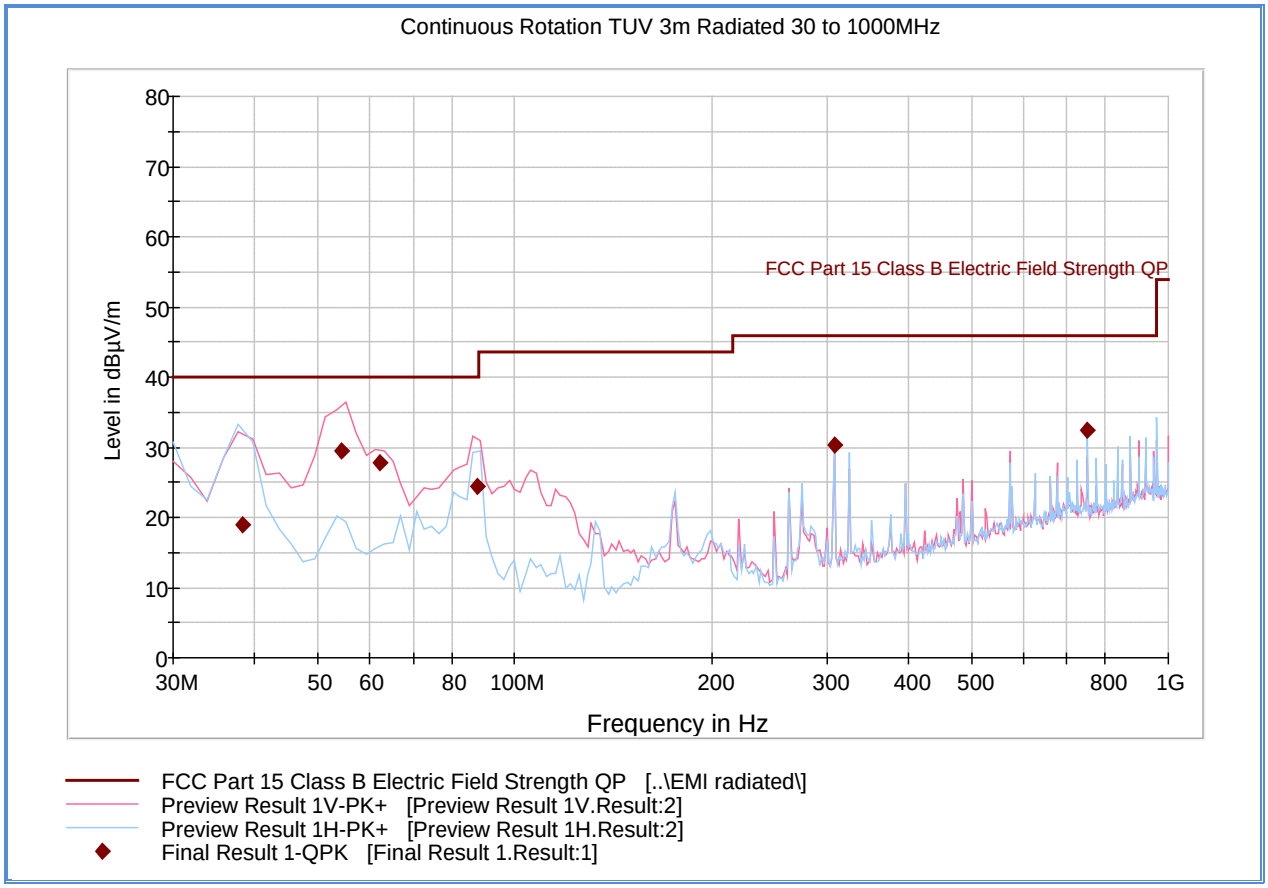
Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1375.166667	47.2	1000.0	1000.000	117.7	H	217.0	-9.0	26.7	73.9
1932.566667	50.5	1000.0	1000.000	402.6	H	3.0	-5.9	23.4	73.9
3965.333333	44.3	1000.0	1000.000	148.7	V	114.0	3.8	29.6	73.9
6684.200000	47.4	1000.0	1000.000	350.6	H	197.0	9.9	26.5	73.9
11071.33333	51.2	1000.0	1000.000	390.1	V	326.0	14.9	22.7	73.9
17823.56666	59.6	1000.0	1000.000	332.2	V	0.0	26.2	14.3	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)
1375.166667	44.3	1000.0	1000.000	117.7	H	217.0	-9.0	9.6	53.9
1932.566667	33.7	1000.0	1000.000	402.6	H	3.0	-5.9	20.2	53.9
3965.333333	31.0	1000.0	1000.000	148.7	V	114.0	3.8	22.9	53.9
6684.200000	34.8	1000.0	1000.000	350.6	H	197.0	9.9	19.1	53.9
11071.33333	36.8	1000.0	1000.000	390.1	V	326.0	14.9	17.1	53.9
17823.56666	46.4	1000.0	1000.000	332.2	V	0.0	26.2	7.5	53.9

Test Notes: No significant emissions observed above 3GHz.

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

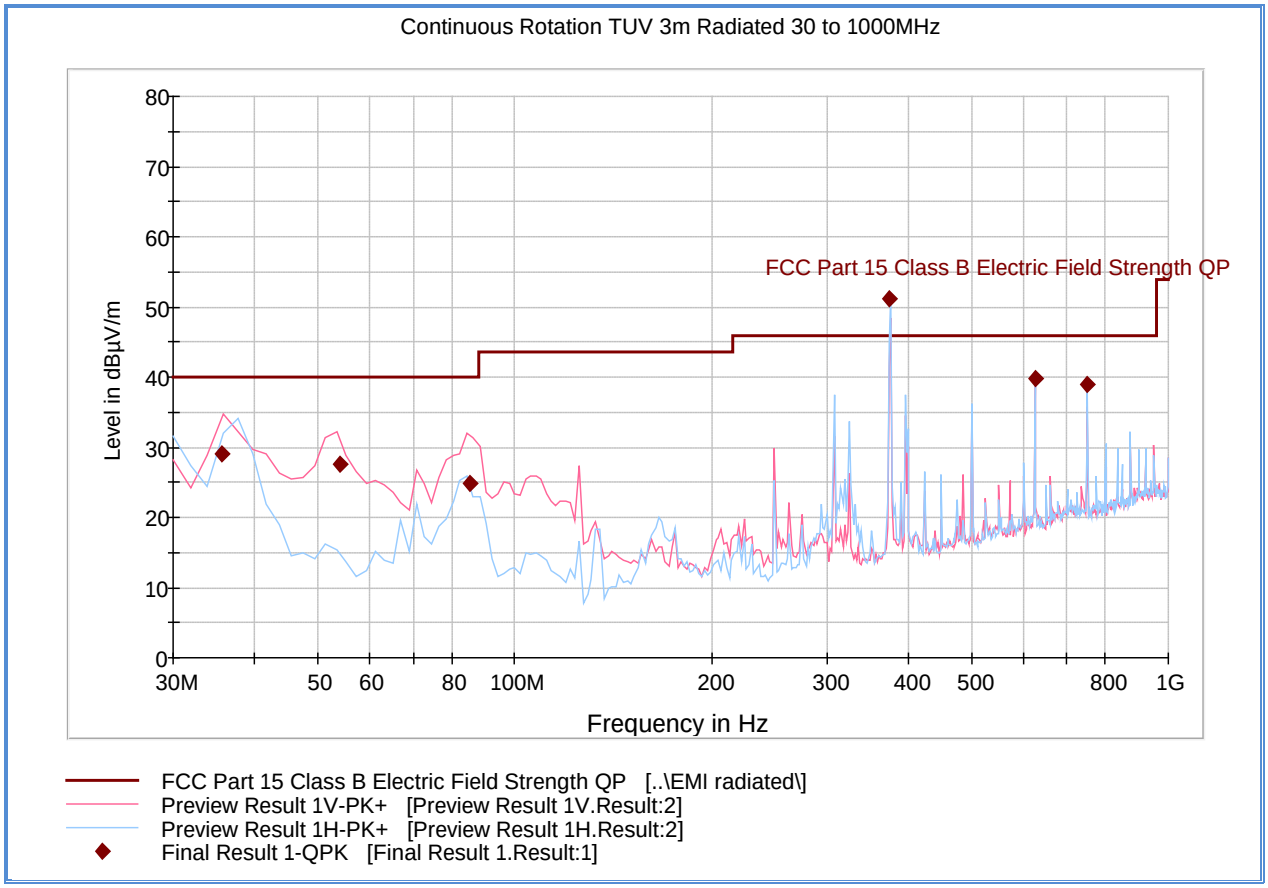


Quasi Peak Data

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
38.215551	19.0	1000.0	120.000	393.0	H	11.0	-15.8	21.0	40.0
54.150541	29.4	1000.0	120.000	100.0	V	219.0	-20.8	10.6	40.0
62.062204	27.8	1000.0	120.000	115.0	V	175.0	-22.0	12.2	40.0
87.692745	24.5	1000.0	120.000	100.0	V	6.0	-21.3	15.5	40.0
308.015952	30.2	1000.0	120.000	100.0	H	47.0	-12.2	15.8	46.0
749.982365	32.4	1000.0	120.000	100.0	H	348.0	-2.0	13.6	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)

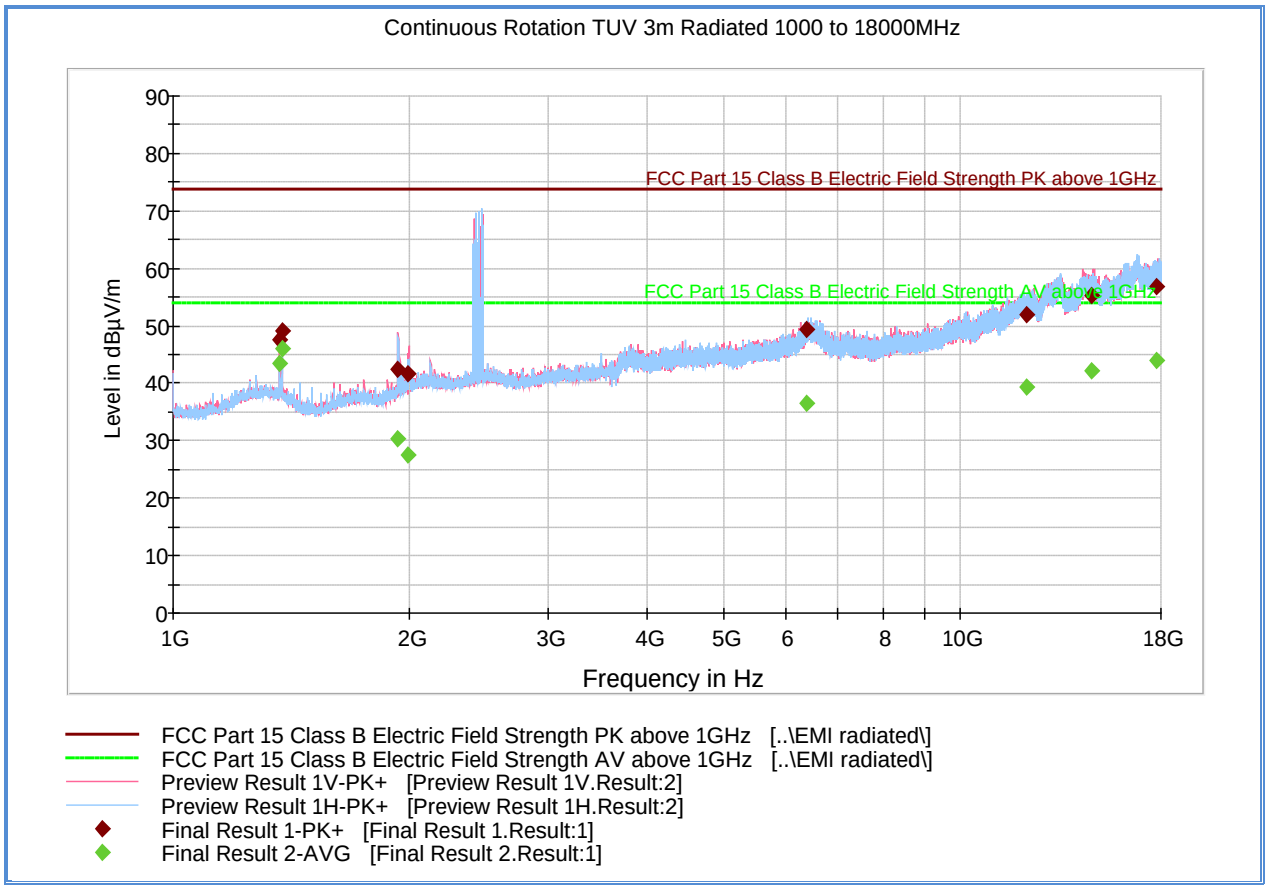


Quasi Peak Data

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
35.711663	29.2	1000.0	120.000	115.0	V	148.0	-14.5	10.9	40.0
54.126653	27.5	1000.0	120.000	100.0	V	51.0	-20.8	12.5	40.0
85.388858	24.8	1000.0	120.000	100.0	V	-11.0	-21.5	15.2	40.0
375.012024	51.1	1000.0	120.000	100.0	H	188.0	-9.6	51.29	102.39
624.989659	39.9	1000.0	120.000	100.0	V	99.0	-3.5	6.1	46.0
749.982365	39.0	1000.0	120.000	100.0	H	133.0	-2.0	7.0	46.0

Test Notes: 375MHz is not within the restricted band thus not subjected to FCC Part 15 Subpart C, 15.205 limits instead to 20dBc limit of Part 15 Subpart C §15.247(d). The limit of 102.39 dbµV/m @ 3 meters is from Section 2.7.9 of this test report.

2.10.14 Test Results Above 1GHz (Bluetooth TX Worst Case – Hopping)



Peak Data

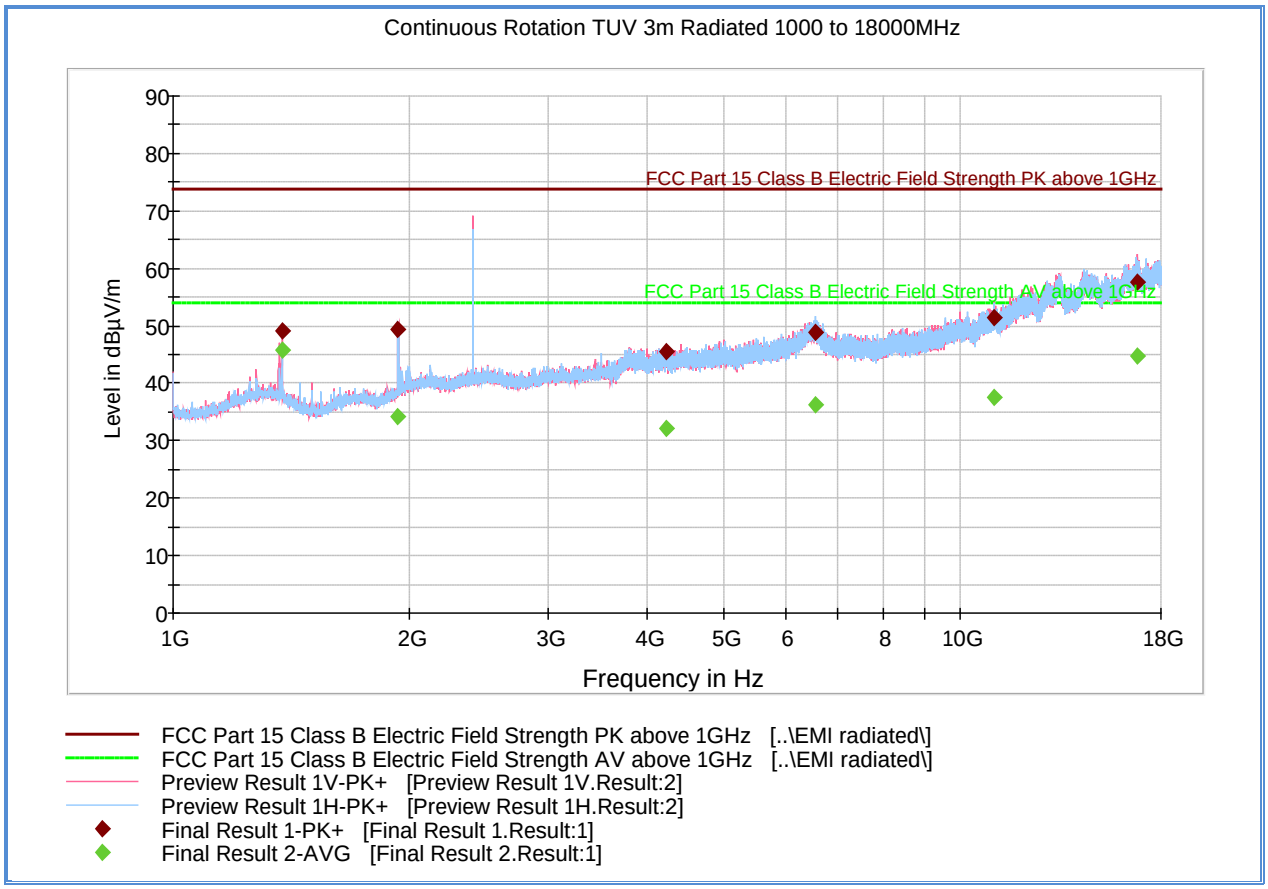
Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1364.033333	47.6	1000.0	1000.000	238.4	V	180.0	-5.3	26.3	73.9
1374.966667	49.2	1000.0	1000.000	249.4	V	180.0	-5.4	24.7	73.9
1932.566667	42.4	1000.0	1000.000	123.7	V	307.0	-2.3	31.5	73.9
1991.233333	41.5	1000.0	1000.000	201.3	V	253.0	-1.9	32.4	73.9
6390.333333	49.4	1000.0	1000.000	146.7	V	174.0	11.1	24.5	73.9
12123.533333	52.0	1000.0	1000.000	101.7	H	329.0	17.1	21.9	73.9
14662.700000	55.2	1000.0	1000.000	390.1	V	70.0	20.9	18.7	73.9
17755.600000	56.7	1000.0	1000.000	403.0	H	352.0	23.0	17.2	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)
1364.033333	43.4	1000.0	1000.000	238.4	V	180.0	-5.3	10.5	53.9
1374.966667	46.1	1000.0	1000.000	249.4	V	180.0	-5.4	7.8	53.9
1932.566667	30.4	1000.0	1000.000	123.7	V	307.0	-2.3	23.5	53.9
1991.233333	27.6	1000.0	1000.000	201.3	V	253.0	-1.9	26.3	53.9
6390.333333	36.4	1000.0	1000.000	146.7	V	174.0	11.1	17.5	53.9
12123.533333	39.4	1000.0	1000.000	101.7	H	329.0	17.1	14.5	53.9
14662.700000	42.2	1000.0	1000.000	390.1	V	70.0	20.9	11.7	53.9
17755.600000	43.9	1000.0	1000.000	403.0	H	352.0	23.0	10.0	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 Low Channel (Bluetooth TX Worst Case)



Peak Data

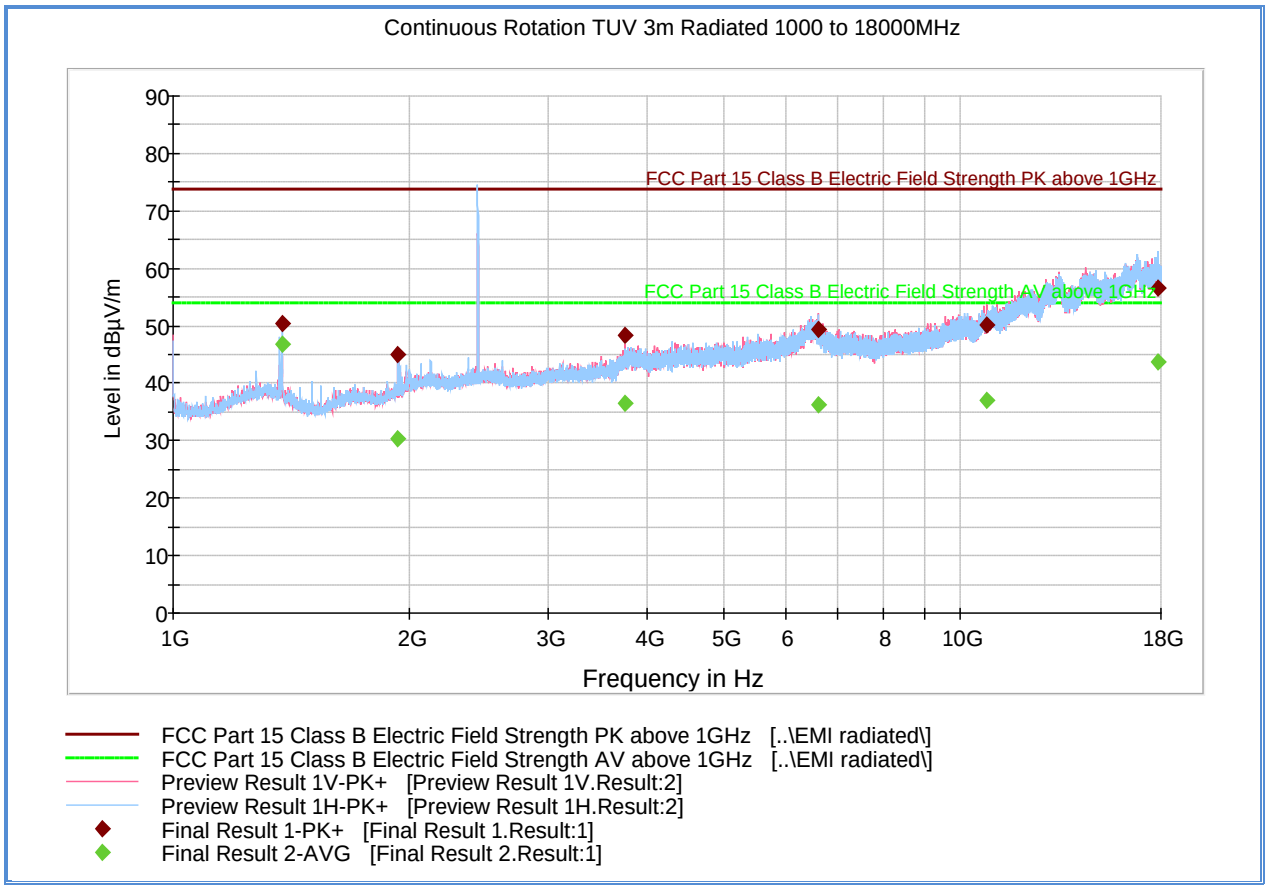
Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1374.966667	49.2	1000.0	1000.000	117.7	V	182.0	-5.4	24.7	73.9
1932.533333	49.5	1000.0	1000.000	403.0	V	10.0	-2.3	24.4	73.9
4229.400000	45.6	1000.0	1000.000	323.2	H	257.0	5.1	28.3	73.9
6539.166667	48.8	1000.0	1000.000	403.0	H	227.0	11.2	25.1	73.9
11030.800000	51.4	1000.0	1000.000	403.0	V	100.0	14.8	22.5	73.9
16812.133333	57.6	1000.0	1000.000	182.6	V	-3.0	23.7	16.3	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)
1374.966667	45.9	1000.0	1000.000	117.7	V	182.0	-5.4	8.0	53.9
1932.533333	34.1	1000.0	1000.000	403.0	V	10.0	-2.3	19.8	53.9
4229.400000	32.3	1000.0	1000.000	323.2	H	257.0	5.1	21.6	53.9
6539.166667	36.2	1000.0	1000.000	403.0	H	227.0	11.2	17.7	53.9
11030.800000	37.6	1000.0	1000.000	403.0	V	100.0	14.8	16.3	53.9
16812.133333	44.7	1000.0	1000.000	182.6	V	-3.0	23.7	9.2	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 Mid Channel (Bluetooth TX Worst Case)



Peak Data

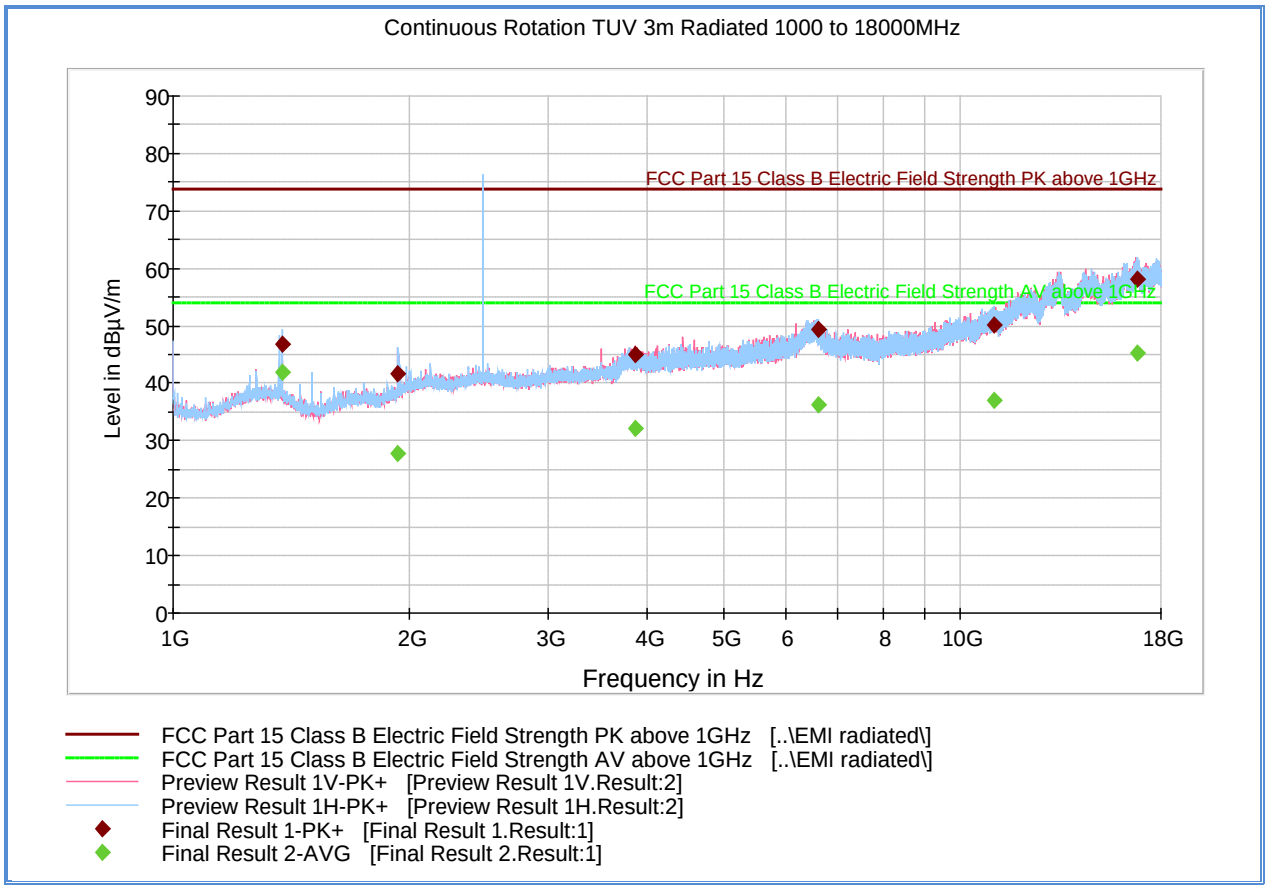
Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1375.166667	50.4	1000.0	1000.000	116.7	H	162.0	-5.4	23.5	73.9
1932.600000	45.1	1000.0	1000.000	355.1	H	152.0	-2.3	28.8	73.9
3749.700000	48.4	1000.0	1000.000	352.7	V	27.0	4.5	25.5	73.9
6612.866667	49.3	1000.0	1000.000	202.5	V	320.0	11.0	24.6	73.9
10807.666667	50.0	1000.0	1000.000	402.9	V	-20.0	14.2	23.9	73.9
17809.433333	56.6	1000.0	1000.000	302.2	H	89.0	23.0	17.3	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)
1375.166667	46.8	1000.0	1000.000	116.7	H	162.0	-5.4	7.1	53.9
1932.600000	30.4	1000.0	1000.000	355.1	H	152.0	-2.3	23.5	53.9
3749.700000	36.6	1000.0	1000.000	352.7	V	27.0	4.5	17.3	53.9
6612.866667	36.3	1000.0	1000.000	202.5	V	320.0	11.0	17.6	53.9
10807.666667	37.1	1000.0	1000.000	402.9	V	-20.0	14.2	16.8	53.9
17809.433333	43.7	1000.0	1000.000	302.2	H	89.0	23.0	10.2	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.

2.10.17 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)
1375.166667	46.7	1000.0	1000.000	124.7	H	198.0	-5.4	27.2	73.9
1932.366667	41.8	1000.0	1000.000	344.1	H	116.0	-2.3	32.1	73.9
3870.533333	45.0	1000.0	1000.000	202.3	V	301.0	4.9	28.9	73.9
6605.466667	49.4	1000.0	1000.000	250.3	H	40.0	11.1	24.5	73.9
11066.633333	50.0	1000.0	1000.000	351.6	H	166.0	14.6	23.9	73.9
16792.233333	58.0	1000.0	1000.000	350.6	H	343.0	23.8	15.9	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)
1375.166667	41.8	1000.0	1000.000	124.7	H	198.0	-5.4	12.1	53.9
1932.366667	27.9	1000.0	1000.000	344.1	H	116.0	-2.3	26.0	53.9
3870.533333	32.1	1000.0	1000.000	202.3	V	301.0	4.9	21.8	53.9
6605.466667	36.2	1000.0	1000.000	250.3	H	40.0	11.1	17.7	53.9
11066.633333	37.0	1000.0	1000.000	351.6	H	166.0	14.6	16.9	53.9
16792.233333	45.3	1000.0	1000.000	350.6	H	343.0	23.8	8.6	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: N/A / Test Configuration B

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

May 12, 2015/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

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	24.2-24.6°C
Relative Humidity	48.2-49.5%
ATM Pressure	98.6-98.9 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.

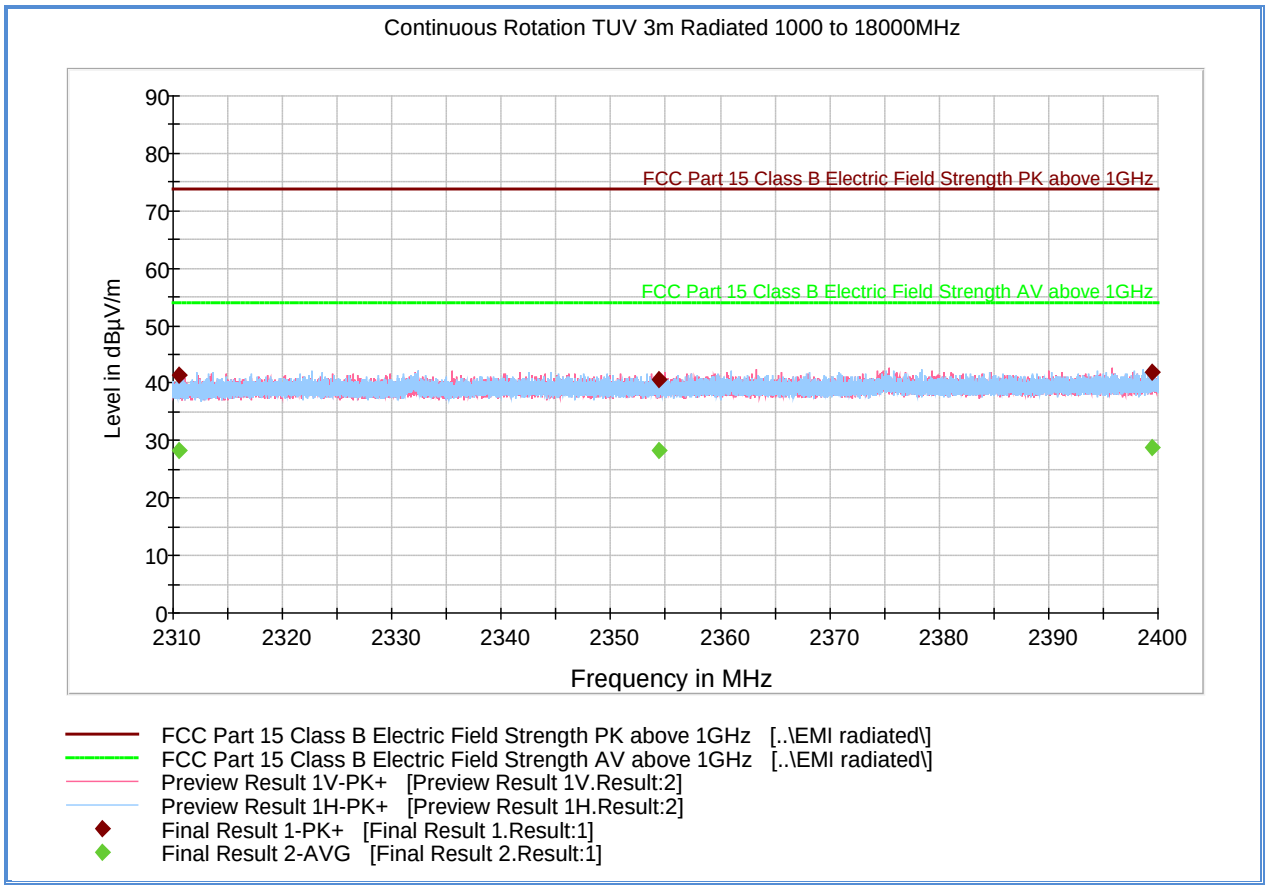
2.11.8 Sample Computation (Radiated Emission)

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

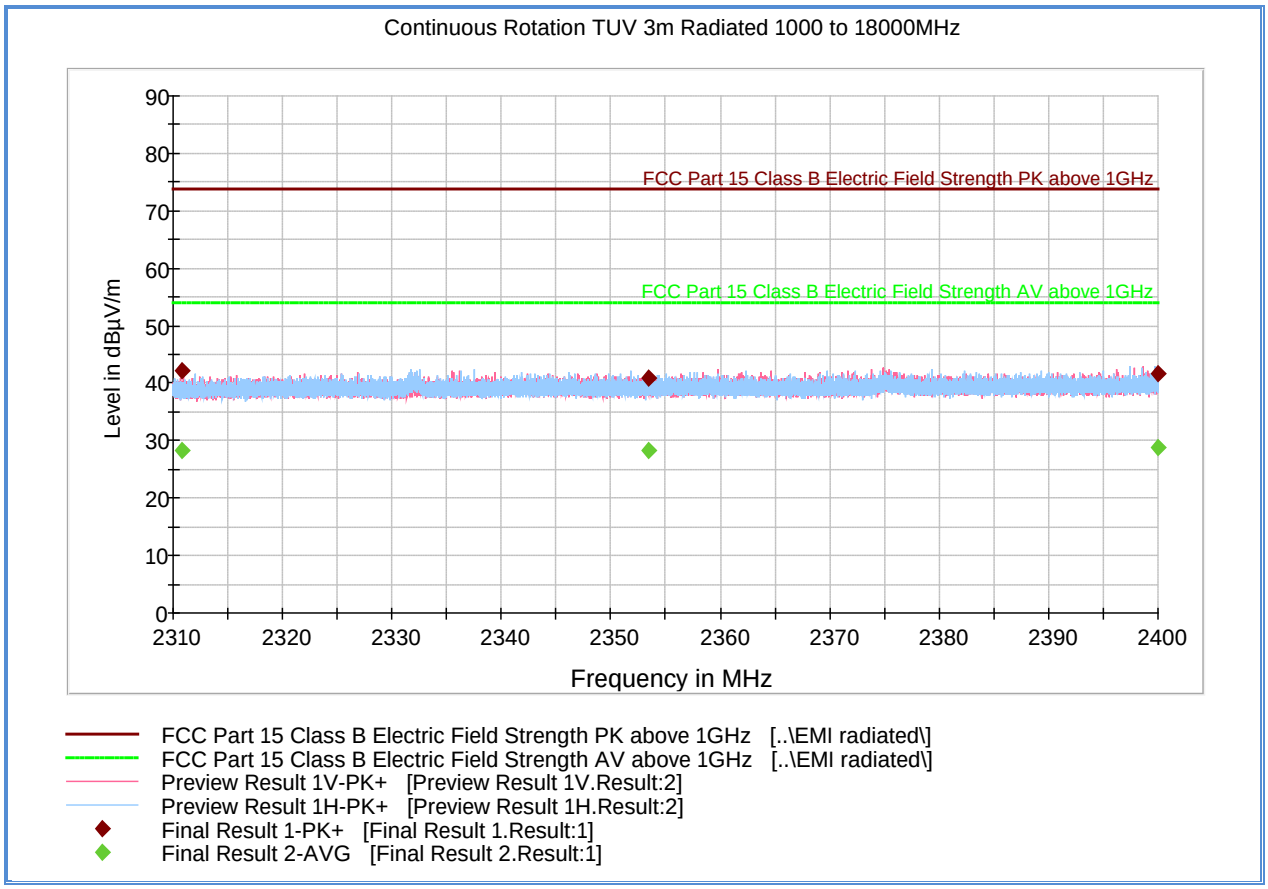
Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2310.500000	41.4	1000.0	1000.000	367.1	V	-16.0	-0.8	32.5	73.9
2354.431000	40.6	1000.0	1000.000	343.2	V	249.0	-0.7	33.3	73.9
2399.500000	42.0	1000.0	1000.000	403.0	V	283.0	-0.6	31.9	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)
2310.500000	28.2	1000.0	1000.000	367.1	V	-16.0	-0.8	25.7	53.9
2354.431000	28.3	1000.0	1000.000	343.2	V	249.0	-0.7	25.6	53.9
2399.500000	28.9	1000.0	1000.000	403.0	V	283.0	-0.6	25.0	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

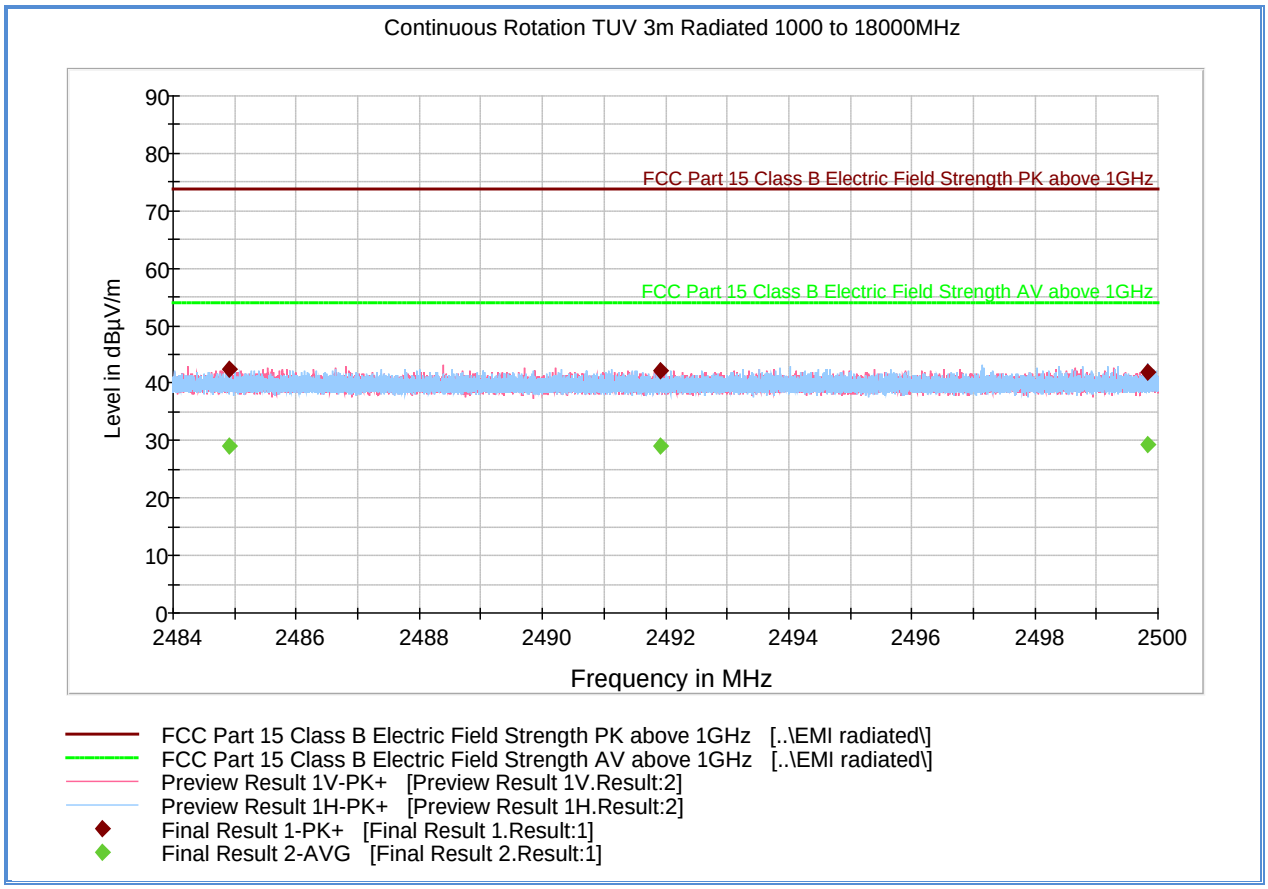
Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2310.869000	42.2	1000.0	1000.000	333.1	H	71.0	-0.8	31.7	73.9
2353.513000	41.0	1000.0	1000.000	183.5	V	10.0	-0.8	32.9	73.9
2400.000000	41.6	1000.0	1000.000	259.3	V	126.0	-0.6	32.3	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)
2310.869000	28.2	1000.0	1000.000	333.1	H	71.0	-0.8	25.7	53.9
2353.513000	28.2	1000.0	1000.000	183.5	V	10.0	-0.8	25.7	53.9
2400.000000	28.9	1000.0	1000.000	259.3	V	126.0	-0.6	25.0	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

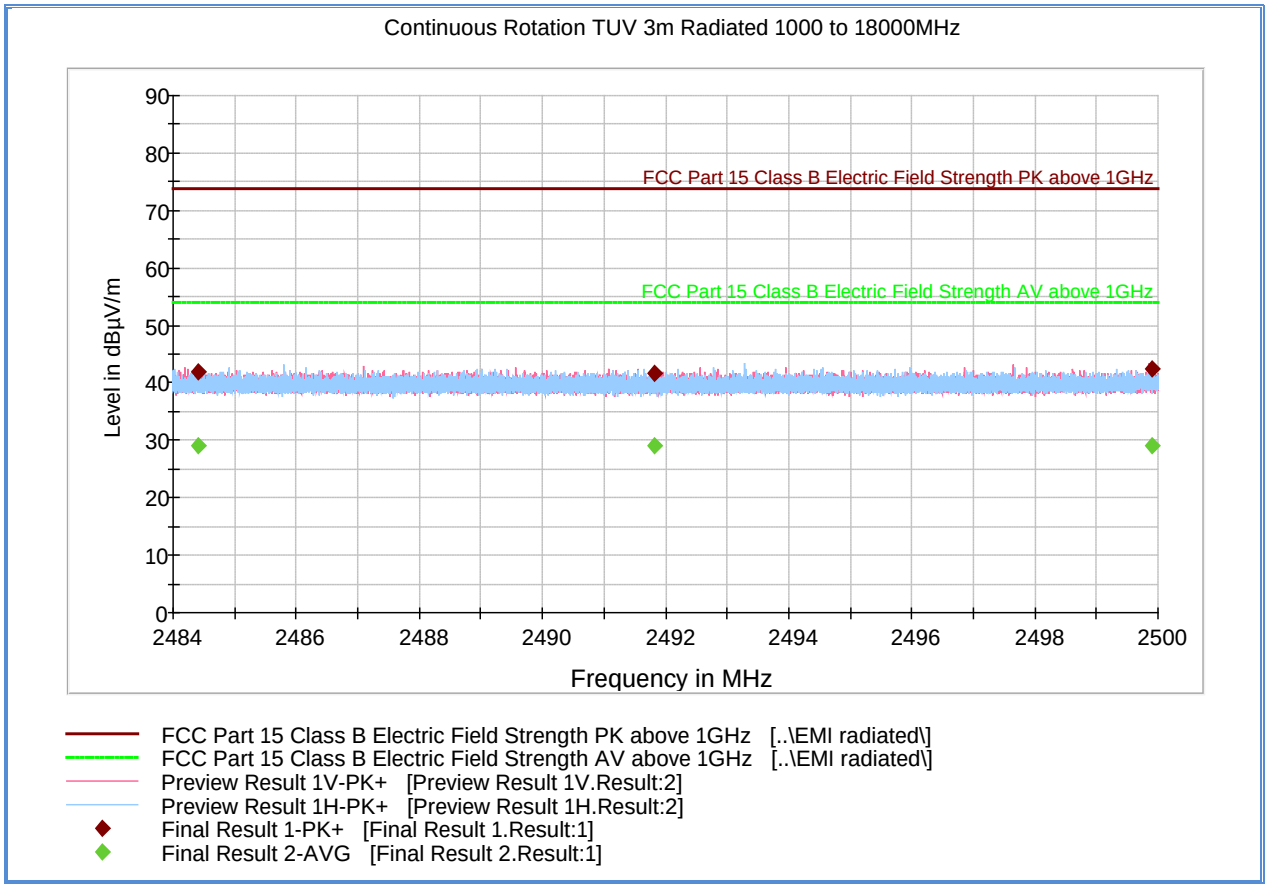
Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2484.900000	42.4	1000.0	1000.000	149.6	V	349.0	-0.1	31.5	73.9
2491.915200	42.1	1000.0	1000.000	140.7	V	232.0	-0.1	31.8	73.9
2499.837867	42.0	1000.0	1000.000	229.4	H	318.0	-0.1	31.9	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)
2484.900000	29.1	1000.0	1000.000	149.6	V	349.0	-0.1	24.8	53.9
2491.915200	29.1	1000.0	1000.000	140.7	V	232.0	-0.1	24.8	53.9
2499.837867	29.2	1000.0	1000.000	229.4	H	318.0	-0.1	24.7	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)
2484.400000	41.8	1000.0	1000.000	322.2	V	128.0	-0.1	32.1	73.9
2491.825067	41.8	1000.0	1000.000	103.7	V	308.0	-0.1	32.1	73.9
2499.900000	42.4	1000.0	1000.000	238.4	V	20.0	-0.1	31.6	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)
2484.400000	29.1	1000.0	1000.000	322.2	V	128.0	-0.1	24.8	53.9
2491.825067	29.0	1000.0	1000.000	103.7	V	308.0	-0.1	24.9	53.9
2499.900000	29.2	1000.0	1000.000	238.4	V	20.0	-0.1	24.7	53.9

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

2.12 RECEIVER SPURIOUS EMISSIONS

2.12.1 Specification Reference

RSS-Gen 7.1

2.12.2 Standard Applicable

Spurious emissions from receivers shall not exceed the radiated limits shown in Table 2 below:

Table 2: Receiver Radiated Limits

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 6.5 of RSS-Gen.

2.12.3 Equipment Under Test and Modification State

Serial No: **Error! Reference source not found.** / Test Configuration B

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

May 12, 2015/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

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	24.2-24.6°C
Relative Humidity	48.2-49.5%
ATM Pressure	98.6-98.9 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.

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

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	04/22/14	0522/15
7570	50MHz-18GHz Wideband Power Sensor	N1921A	MY45240588	Agilent	04/09/14	05/09/15
7611	Signal/Spectrum Analyzer	FSW26	102017	Rhode & Schwarz	03/25/15	03/25/16
1003	Signal Generator	SMR-40	1104.0002.40	Rhode & Schwarz	04/29/15	04/29/16
8825	20dB Attenuator	46-20-34	BK5773	Weinschel Corp.	Verified by 1003 and 7611	
Radiated Test Setup						
1002	Bilog Antenna	3142C	00058717	ETS-Lindgren	01/30/14	01/30/16
1040	EMI Test Receiver	ESIB40	100292	Rhode & Schwarz	08/29/14	08/29/15
1016	Pre-amplifier	PAM-0202	187	PAM	12/10/14	12/10/15
1051	Double-ridged waveguide horn antenna	3115	9408-4329	EMCO	02/28/14	02/28/16
1049	EMI Test Receiver	ESU	100133	Rhode & Schwarz	03/11/15	03/11/16
8628	Pre-amplifier	QLJ 01182835-JO	8986002	QuinStar Technologies Inc.	03/20/15	03/20/16
1150	Horn antenna	3160-09	012054-004	ETS	04/26/13	05/26/15
1151	Pre-amplifier	TS-PR26	100026	Rhode & Schwarz	05/02/13	06/02/15
1153	High-frequency cable	SucoFlex 100 SX	N/A	Suhner	Verified by 1003 and 7611	
8543	High-frequency cable	Micropore 19057793	N/A	United Microwave Products	Verified by 1003 and 7611	
6815	2.4GHz Band Notch Filter	BRM50702	008	Micro-Tronics	Verified by 1003 and 7611	
Conducted Emissions						
1024	EMI Test Receiver	ESCS 30	847793/001	Rhode & Schwarz	04/10/15	04/10/16
7567	LISN	FCC-LISN-50-25-2-10	120304	Fischer Custom Comm.	07/01/14	07/01/15
8822	20dB Attenuator	34-20-34	N/A	MCE / Weinschel	02/20/15	02/20/16
8824	20dB Attenuator	34-20-34	N/A	MCE / Weinschel	02/20/15	02/20/16
Miscellaneous						
6792	Multimeter	3478A	2911A70964	Hewlett Packard	08/12/14	08/12/15
11312	Mini Environmental Quality Meter	850027	CF099-56010-340	Sper Scientific	04/09/15	04/09/16
	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

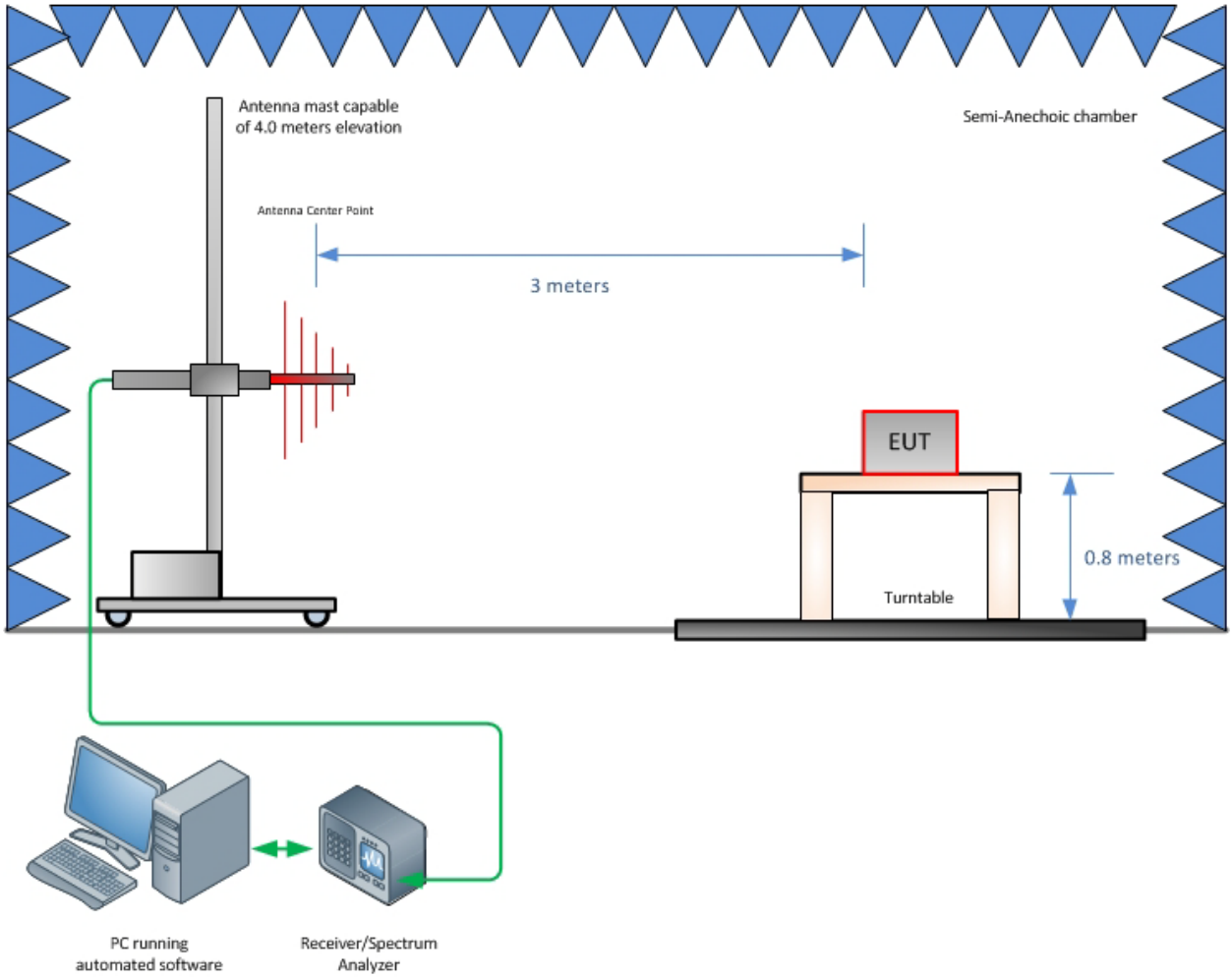
3.2.1 AC Conducted Measurements

	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

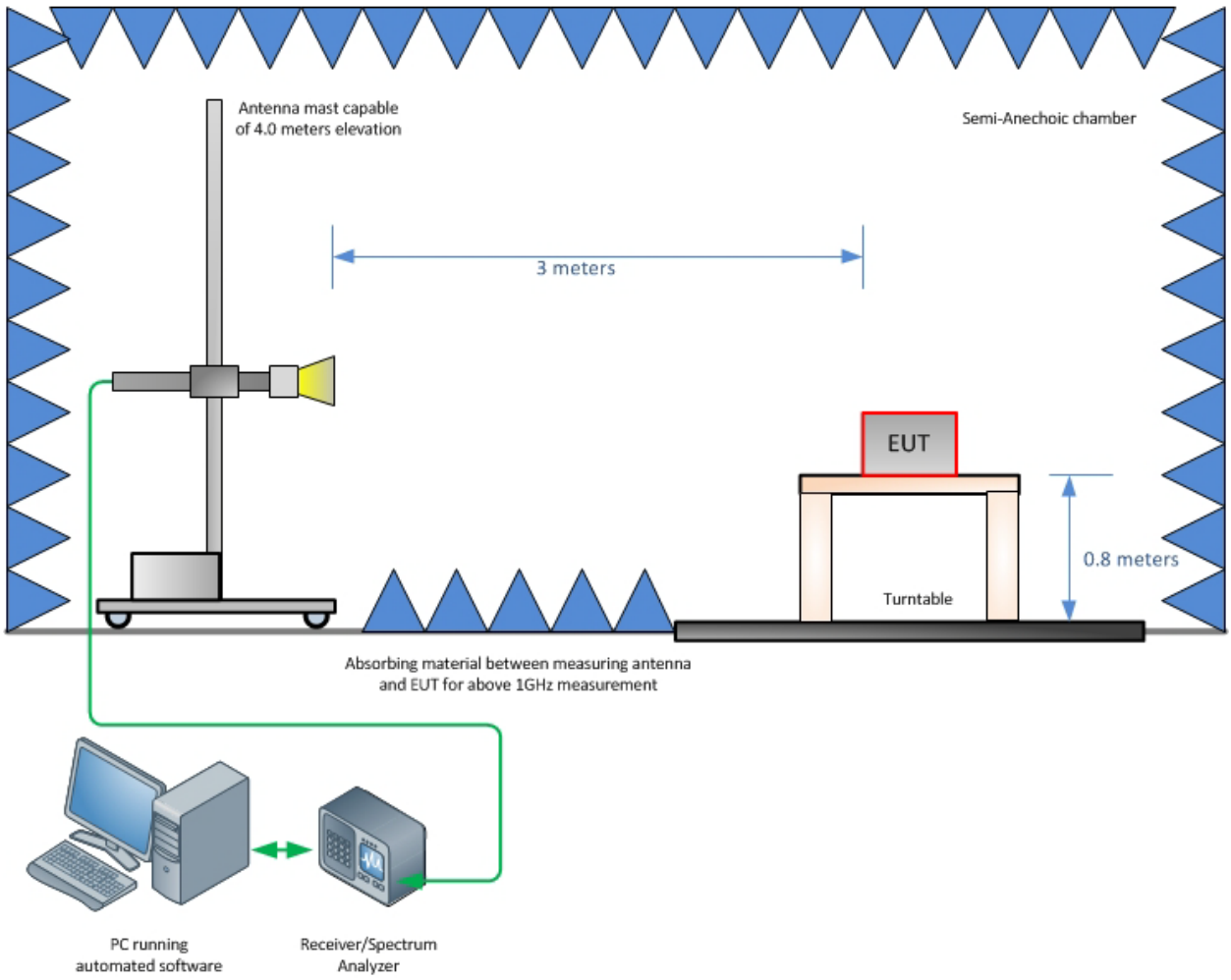
SECTION 4

DIAGRAM OF TEST SETUP

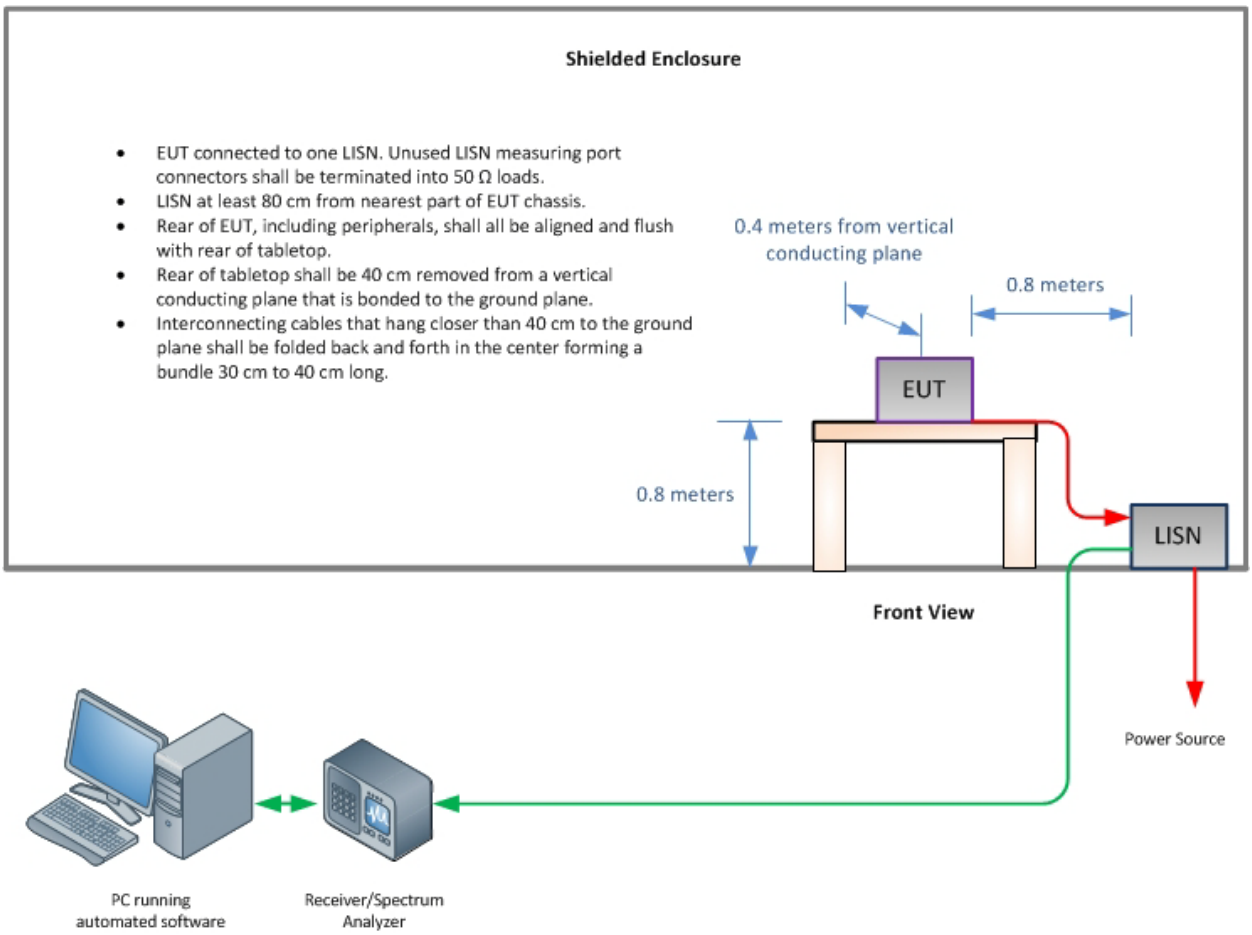
4.1 TEST SETUP DIAGRAM



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