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Report On

Application for Grant of Equipment Authorization of the
Bruker Elemental Inc.

Tracer 5i Handheld XRF Spectrometer

FCC Part 15 Subpart C §15.247 (DTS)

Report No. SD72118943-0716B

January 2017



REPORT ON Radio Testing of the
Bruker Elemental Inc.
Handheld XRF Spectrometer

TEST REPORT NUMBER SD72118943-0716B

PREPARED FOR Bruker Elemental Inc.
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A black ink signature of Nikolay Shtin, consisting of stylized, overlapping loops and horizontal strokes.

PREPARED BY Nikolay Shtin
Name
Authorized Signatory
Title: EMC/Wireless Test Engineer

A blue ink signature of Juan Manuel Gonzalez, featuring a large, sweeping loop and several smaller, connected strokes.

APPROVED BY Juan Manuel Gonzalez
Name
Authorized Signatory
Title: EMC SL Manager West Region

DATED January 12, 2017



Revision History

SD72118943-0716B Bruker Elemental Inc. Tracer 5i Handheld XRF Spectrometer					
DATE	OLD REVISION	NEW REVISION	REASON	PAGES AFFECTED	APPROVED BY
01/12/2017	Initial Release				Juan Manuel Gonzalez

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SECTION 1

REPORT SUMMARY

Radio Testing of the
Bruker Elemental Inc.
Tracer 5i
Handheld XRF Spectrometer



1.1 INTRODUCTION

The information contained in this report is intended to show verification of the Bruker Elemental Inc. Tracer 5i Handheld XRF Spectrometer to the requirements of FCC Part 15 Subpart C §15.247.

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	Bruker Elemental Inc.
Product Marketing Name	Tracer 5i
Model Number(s)	Tracer 5i
FCC ID Number	2AKJ9HMP001
Serial Number(s)	900F4108
Number of Samples Tested	1
Test Specification/Issue/Date	• FCC Part 15 Subpart C §15.247 (October 1, 2016). • 558074 D01 DTS Meas Guidance v03r05, (April 08, 2016) Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247. • ANSI C63.10-2013. American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
Start of Test	December 08, 2016
Finish of Test	December 27, 2016
Name of Engineer(s)	Nikolay Shtin
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 is shown below.

Section	FCC Spec Clause	Test Description	Result	Comments/Base Standard
2.1	§15.247(b)(3)	Peak Output Power	Compliant	
2.2	§15.207(a)	Conducted Emissions	Compliant	
2.3	§2.202(a)	99% Emission Bandwidth	As Reported	
2.4	§15.247(a)(2)	Minimum 6 dB RF Bandwidth	Compliant	
2.5	§15.247(d)	Out-of-Band Emissions - Conducted	Compliant	
2.6	§15.247(d)	Band-edge Compliance of RF Conducted Emissions	Compliant	
2.7	§15.205, §15.247(d)	Spurious Radiated Emissions	Compliant	
2.8	§15.247(e)	Power Spectral Density for Digitally Modulated Device	Compliant	



1.3 PRODUCT INFORMATION

1.3.1 Technical Description

The Equipment Under Test (EUT) was a Bruker Elemental Inc. Tracer 5i Handheld XRF Spectrometer. The EUT supports 802.11b, 802.11g and 802.11n in the 2.400-2.4835 GHz band.

1.3.2 EUT General Description

EUT Description	Handheld XRF Spectrometer						
Product Marketing Name	Tracer 5i						
Model Number(s)	Tracer 5i						
Rated Voltage	9VDC from AC Adapter (Model: TRG36A09, Input: 100-240V/1.0A, Output: 9V/3A) or 7.2V from internal rechargeable Li-Ion Battery.						
Mode Verified	802.11b, 802.11g and 802.11n in 2.4GHz band						
Capability	802.11b, 802.11g, 802.11n						
Primary Unit (EUT)	☐ Production ☒ Pre-Production ☐ Engineering						
Antenna Type	Multilayer inverted-F antenna						
Antenna Manufacturer	Taiyo Yuden						
Antenna Model Number	AH104F2450S1-T						
Antenna Gain	<table border="1"> <tr> <td>2400 MHz</td><td>1.9 dBi</td></tr> <tr> <td>2450 MHz</td><td>1.7 dBi</td></tr> <tr> <td>2500 MHz</td><td>1.8 dBi</td></tr> </table>	2400 MHz	1.9 dBi	2450 MHz	1.7 dBi	2500 MHz	1.8 dBi
2400 MHz	1.9 dBi						
2450 MHz	1.7 dBi						
2500 MHz	1.8 dBi						

1.3.3 Maximum Conducted Output Power

Mode	Frequency Range (MHz)	Output Power (dBm)	Output Power (mW)
802.11b	2412-2462	14.87	30.69
802.11g	2412-2462	13.86	24.32
802.11n	2412-2462	14.07	25.53

1.4 EUT TEST CONFIGURATION

1.4.1 Test Configuration Description

Test Configuration	Description
A	Antenna Conducted Port Test Setup. EUT transmitting continuously with Duty Cycle greater than 98 % with antenna port connected directly to the Spectrum Analyzer through 20dB external attenuator.
B	Radiated Test Setup. EUT programmed using worst case configuration transmitting continuously from the integral antenna on Low, Mid and High channels.
C	AC Conducted Emissions Test Setup. The EUT powered from the provided AC adapter was programmed to transmit continuously using worst case configuration.

1.4.2 EUT Exercise Software

The EUT is connected to the support laptop via USB port. Bruker RemoteCtrl software (version 4.05) was used to communicate with the EUT. RF settings were loaded to EUT using TI Command Line Interface. EUT was loaded with FW Version is 6.1.0.0.289.

1.4.3 Support Equipment and I/O cables

Manufacturer	Equipment/Cable	Description
Compaq	Support Laptop Presario CQ62	M/N CQ62-410US S/N CNF1170Q1J
HP	AC Adapter	M/N: PPP009H S/N F12921102202264
Monoprice	USB (EUT to Support Laptop)	Type A to Type C USB 2.0 Cable

1.4.4 Worst Case Configuration

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

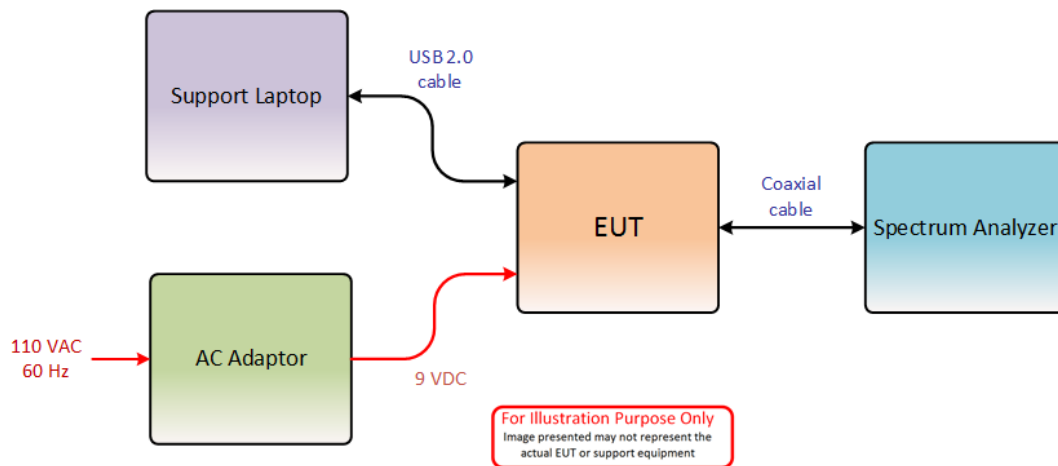
Mode	Channel	Data Rate
802.11b	11 (High Channel)	1Mbps
802.11g	11 (High Channel)	6 Mbps
802.11n	11 (High Channel)	MCS 0

The EUT is a portable device. For radiated measurements, X, Y and Z orientations were verified during initial prescan to verify the worst axis. No major variation in emissions observed between the three (3) orientations. Verifications performed using "Z" configuration. The photos presented here are for reference only.

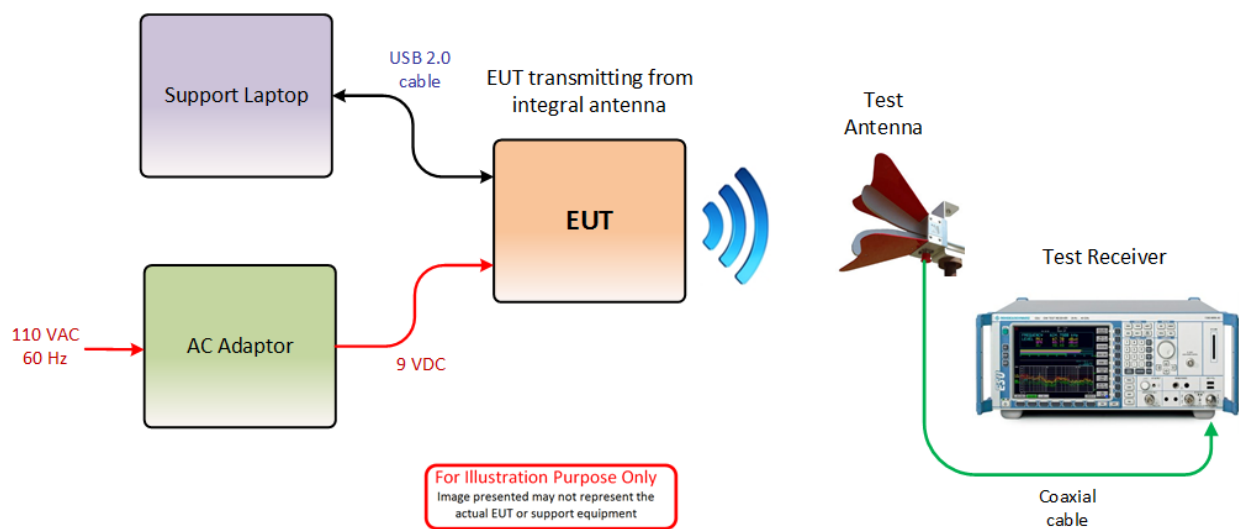


1.4.5 Simplified Test Configuration Diagram

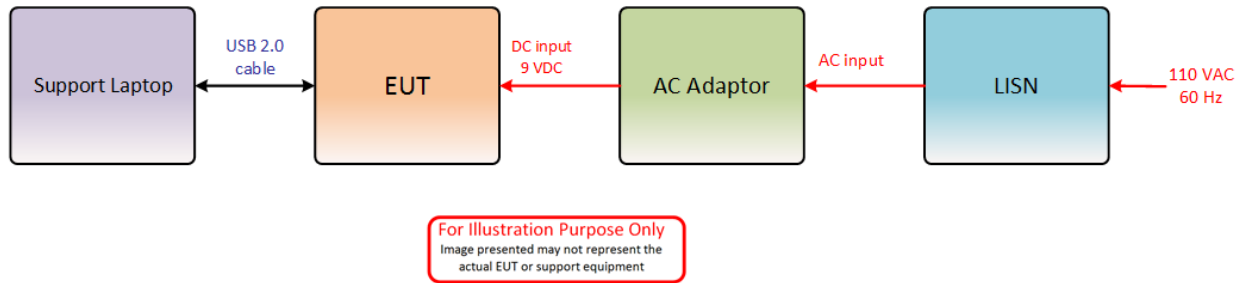
Test Configuration A



Test Configuration B



Test Configuration C





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 C63.10-2013. American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

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 C63.4-2014. 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)

16936 Via Del Campo, 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 Innovation, Science and Economic Development Canada Registration No.: 3067A

The 10m Semi-anechoic chamber of TÜV SÜD America Inc. (San Diego) has been registered by Certification and Engineering Bureau of Innovation, Science and Economic Development Canada for radio equipment testing with Registration No. 3067A.



SECTION 2

TEST DETAILS

Radio Testing of the
Bruker Elemental Inc.
Tracer 5i
Handheld XRF Spectrometer

2.1 MAXIMUM CONDUCTED OUTPUT POWER

2.1.1 Specification Reference

Part 15 Subpart C §15.247(b)(3)

2.1.2 Standard Applicable

(3) For systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

2.1.3 Equipment Under Test and Modification State

Serial No: 900F4108 / Test Configuration A

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

December 08, 12, 20, 22 and 27, 2016/NS

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	23.8-24.7 °C
Relative Humidity	40.8-48.8 %
ATM Pressure	99.1-99.5 kPa

2.1.7 Additional Observations

- This is a conducted test (Maximum conducted [average] output power) using direct connection to spectrum analyzer.
- TDF (Transducer Factor) was used to compensate for the external attenuator and cable used from the antenna port to the spectrum analyzer.
- Test methodology is per Clause 9.2.2.2 of KDB 558074 D01 (DTS Meas Guidance v03r05, April 08, 2016). All conditions under this Clause are satisfied.
- EUT complies with the 30dBm limit.

2.1.8 Test Results

WLAN Mode	Channel	Data Rates (Mbps)	Maximum Conducted Output Power (dBm)	Limit (dBm)
802.11b	1 (2412 MHz)	1	14.19	30
		2	13.26	
		5.5	13.86	
		11	14.14	
	6 (2437 MHz)	1	14.35	
		2	14.27	
		5.5	14.34	
		11	14.35	
	11 (2462 MHz)	1	14.87	
		2	14.69	
		5.5	14.49	
		11	14.69	

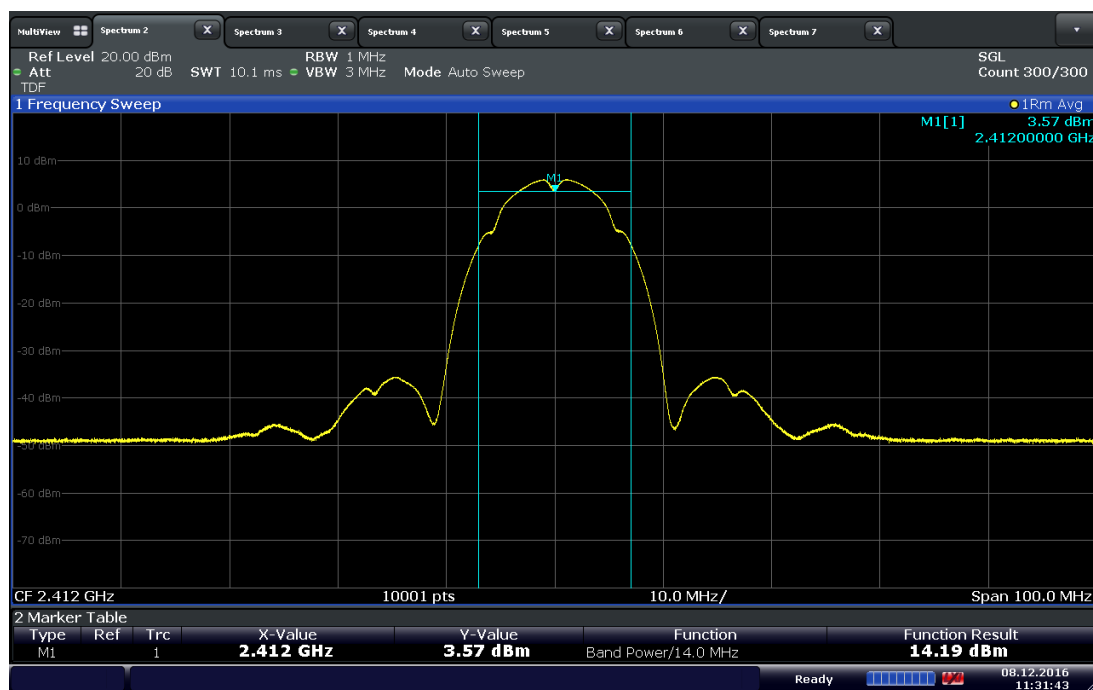
WLAN Mode	Channel	Data Rates (Mbps)	Maximum Conducted Output Power (dBm)	Limit (dBm)
802.11g	1 (2412 MHz)	6	13.43	30
		9	13.34	
		12	11.47	
		18	11.49	
		24	10.90	
		36	10.97	
		48	9.65	
		54	9.56	
	6 (2437 MHz)	6	13.59	
		9	13.57	
		12	11.96	
		18	11.72	
		24	11.28	

802.11g	6 (2437 MHz)	36	11.28	
		48	10.02	
		54	9.97	
	11 (2462 MHz)	6	13.86	
		9	13.73	
		12	12.01	
		18	11.96	
		24	11.53	
		36	11.55	
		48	10.33	
		54	10.16	

WLAN Mode	Channel	MCS Index	Maximum Conducted Output Power (dBm)	Limit (dBm)
802.11n	1 (2412 MHz)	mcs 0	13.53	30
		mcs 1	11.33	
		mcs 2	11.55	
		mcs 3	11.21	
		mcs 4	11.15	
		mcs 5	9.60	
		mcs 6	9.74	
		mcs 7	7.06	
	6 (2437 MHz)	mcs 0	13.74	
		mcs 1	11.81	
		mcs 2	11.78	
		mcs 3	11.35	
		mcs 4	11.33	
		mcs 5	9.80	
		mcs 6	9.82	
		mcs 7	7.37	
	11 (2462 MHz)	mcs 0	14.07	
		mcs 1	12.13	
		mcs 2	12.11	
		mcs 3	11.69	

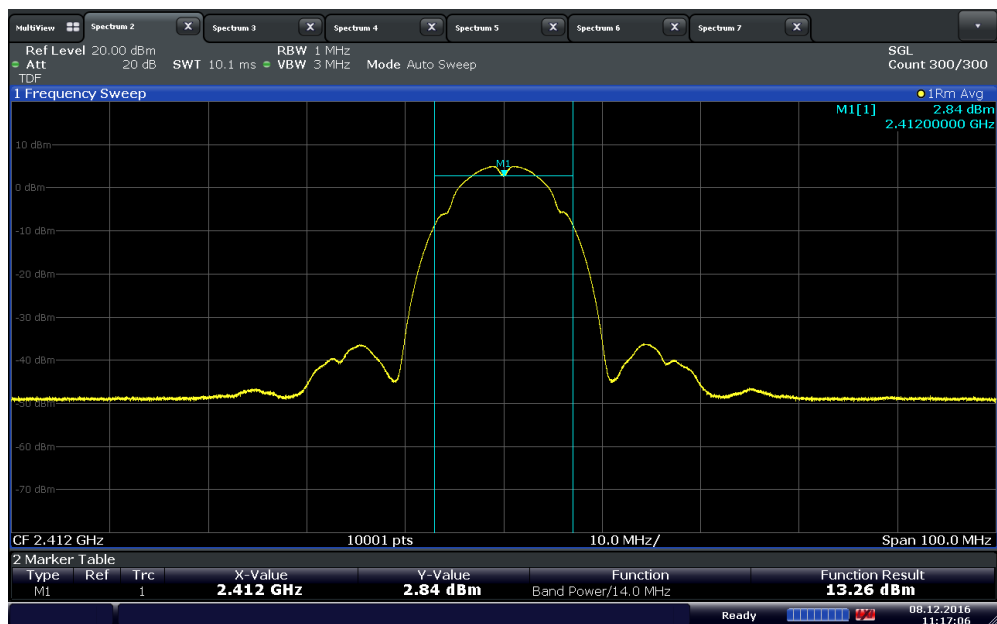
802.11n	11 (2462 MHz)	mcs 4	11.57	30
		mcs 5	10.30	
		mcs 6	10.29	
		mcs 7	7.42	

2.1.9 Test Plots



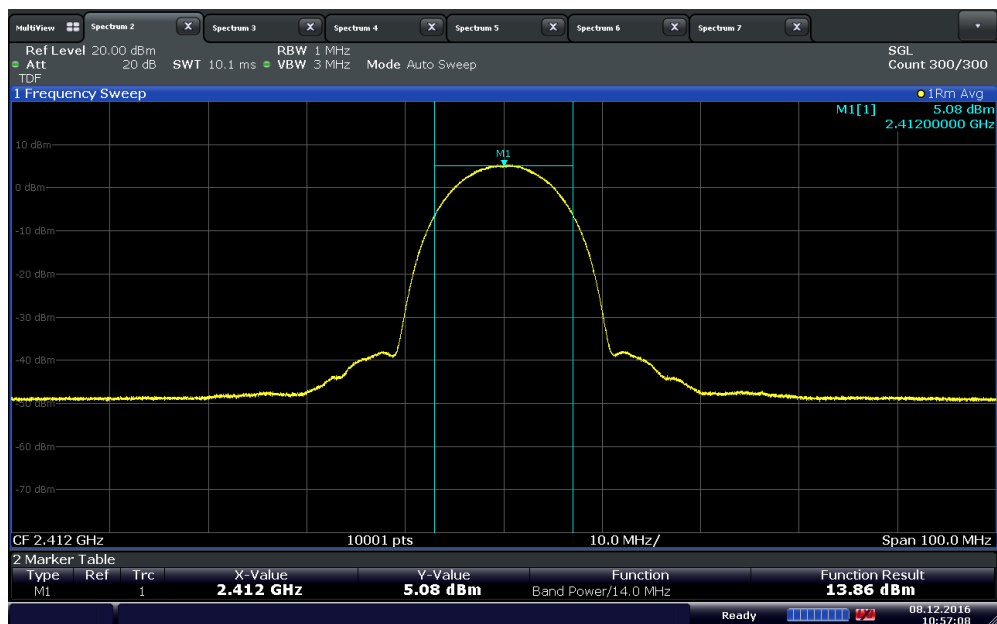
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Low Channel 802.11b 1Mbps



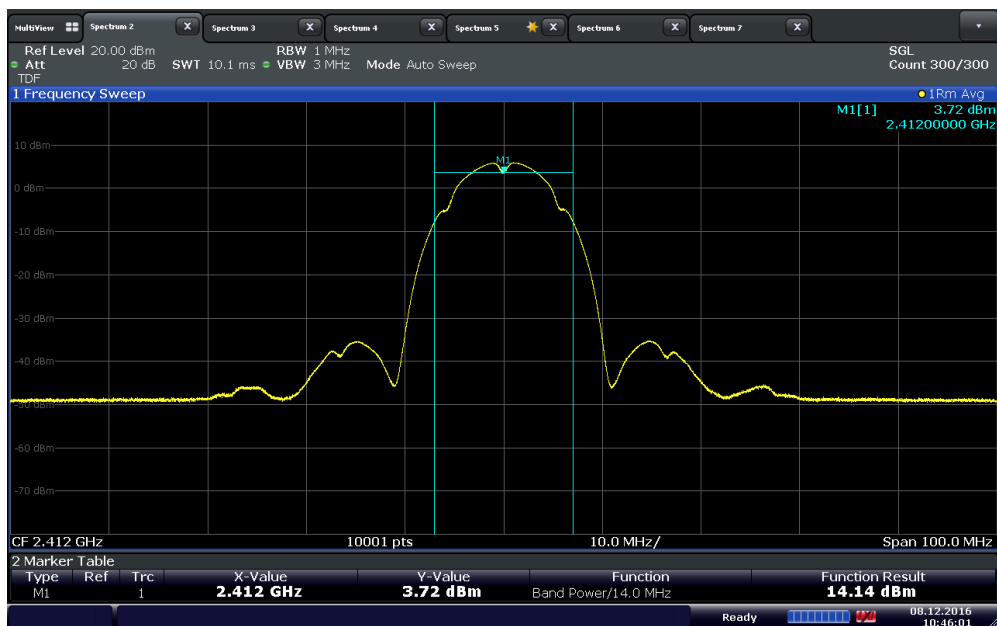
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Low Channel 802.11b 2Mbps



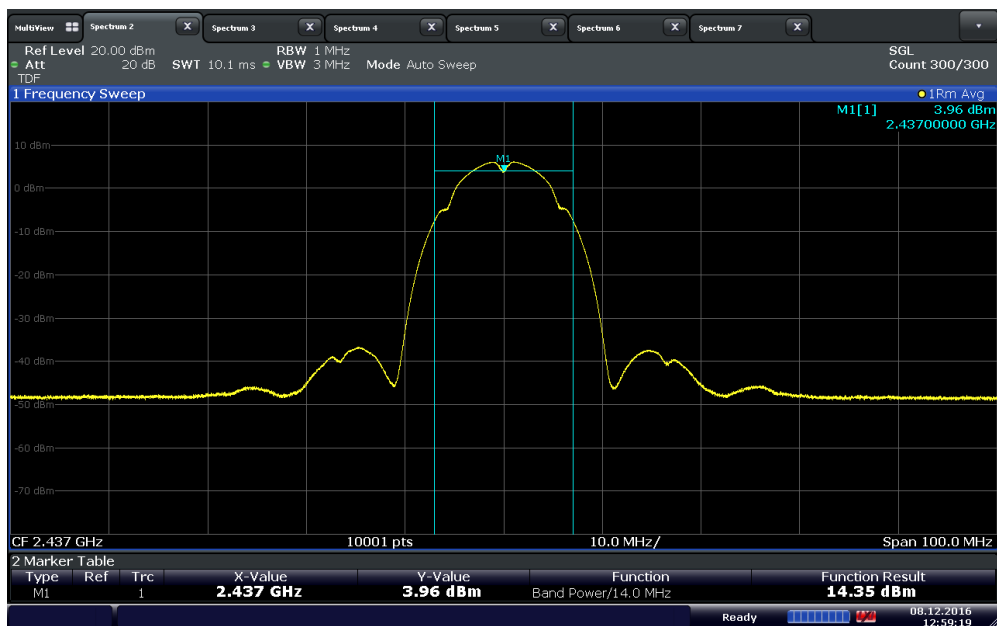
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Low Channel 802.11b 5.5Mbps



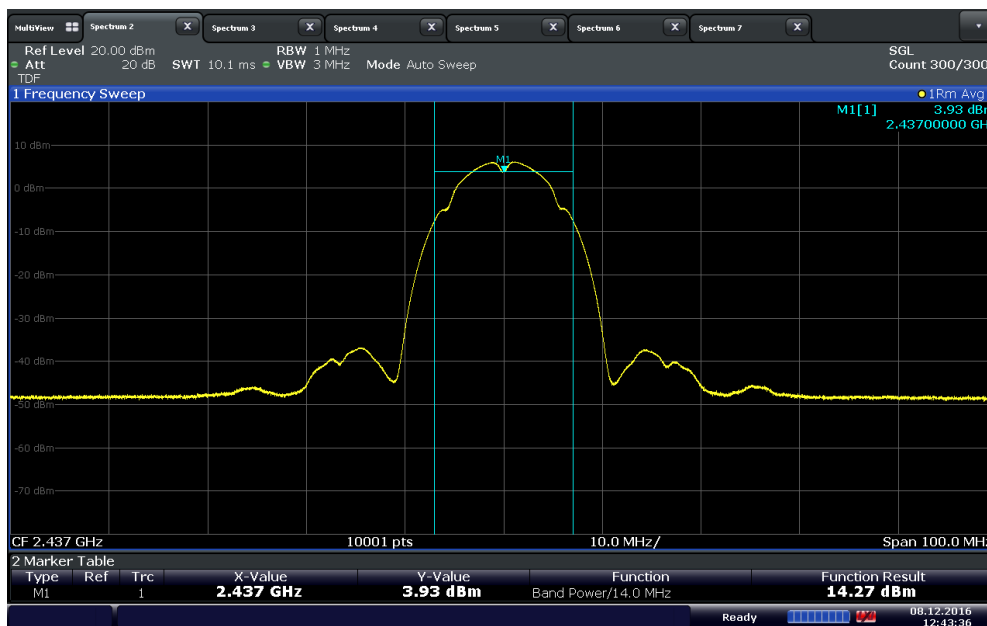
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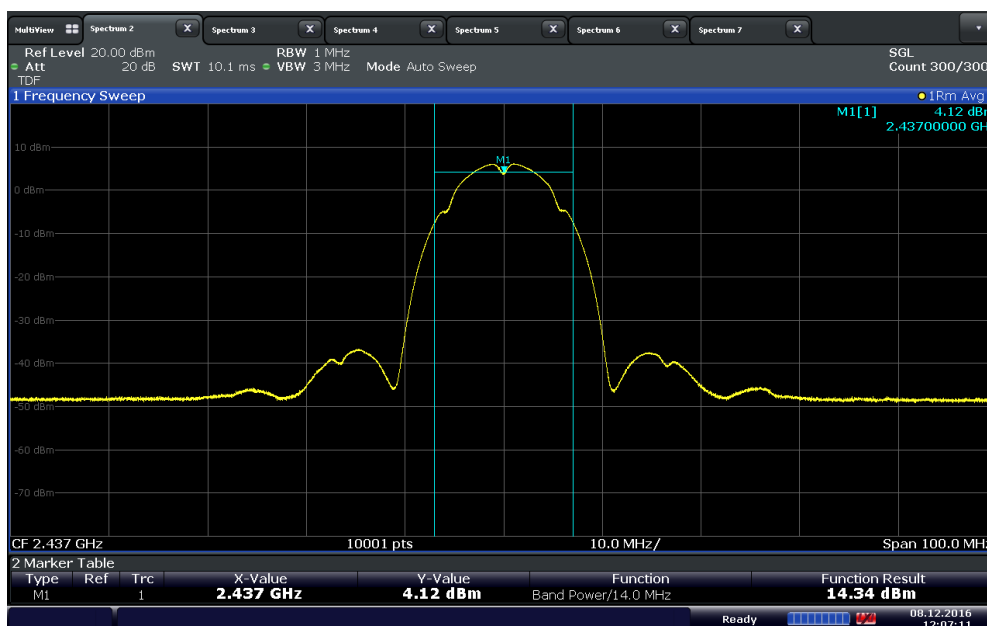
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Mid Channel 802.11b 1Mbps



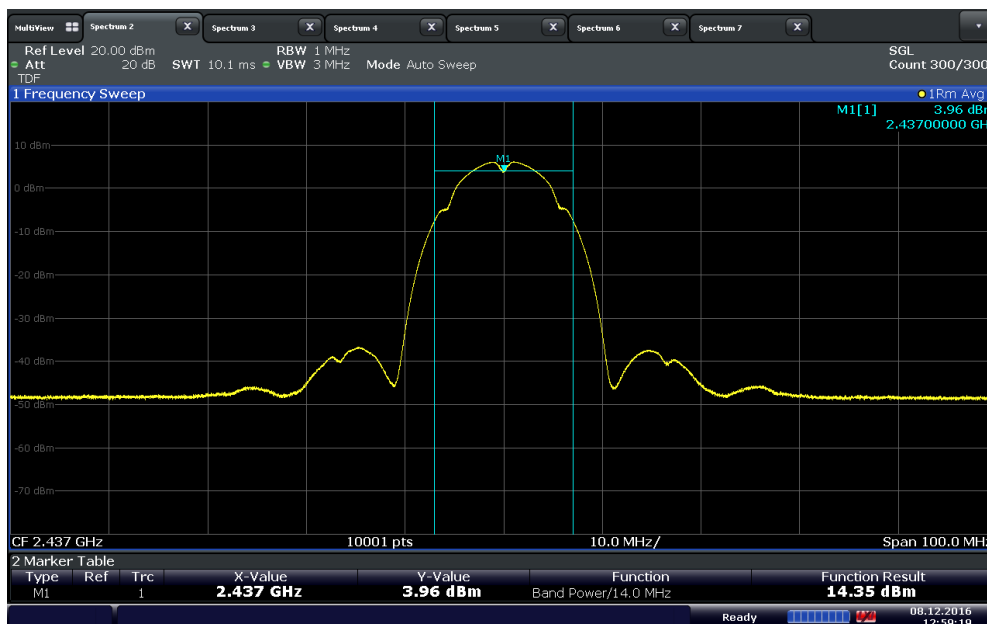
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Mid Channel 802.11b 2Mbps



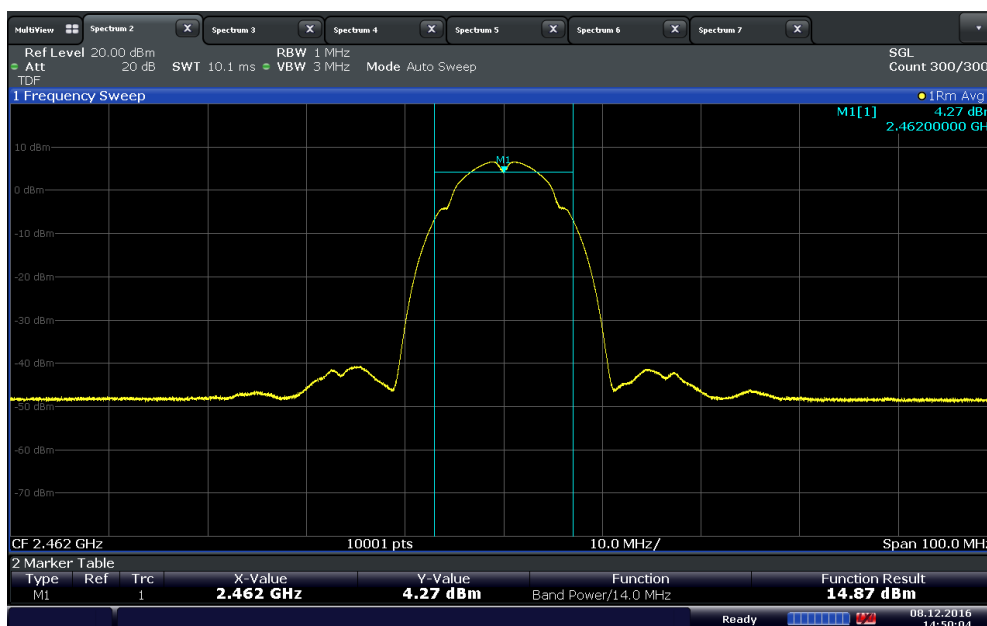
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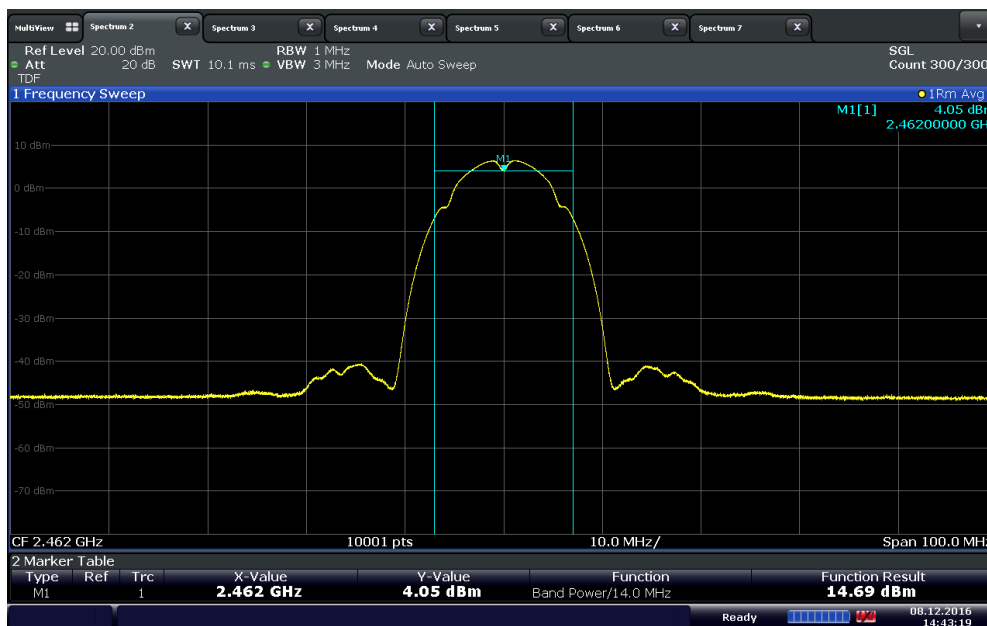
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Mid Channel 802.11b 11Mbps



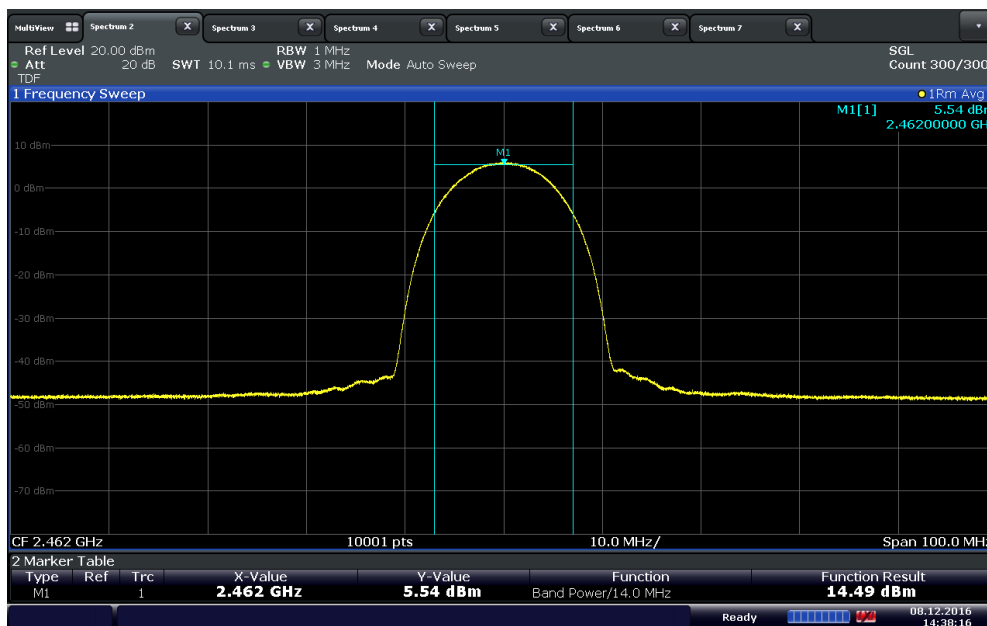
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High Channel 802.11b 1Mbps



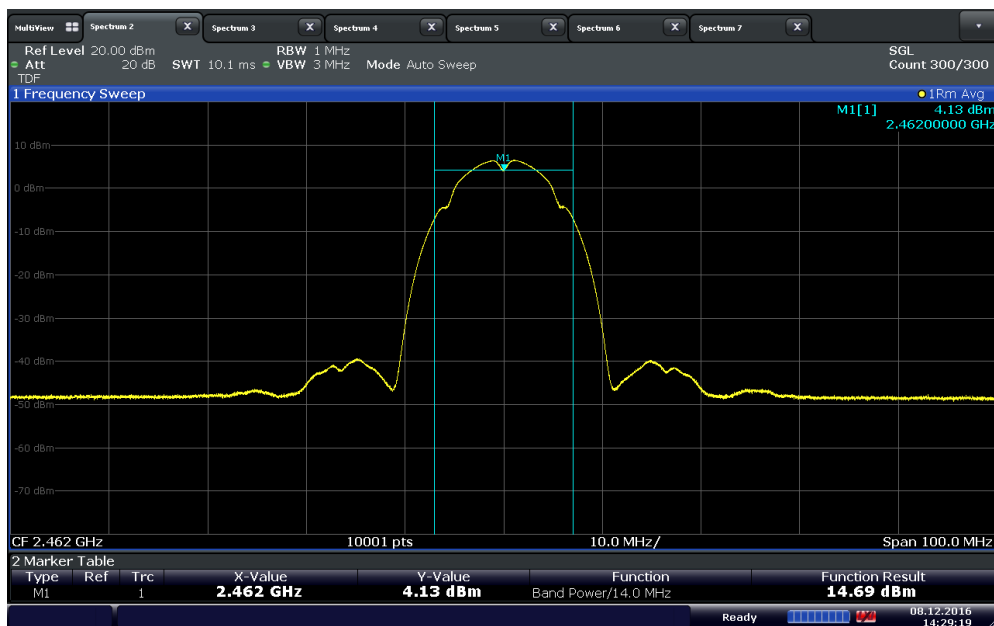
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High Channel 802.11b 2Mbps



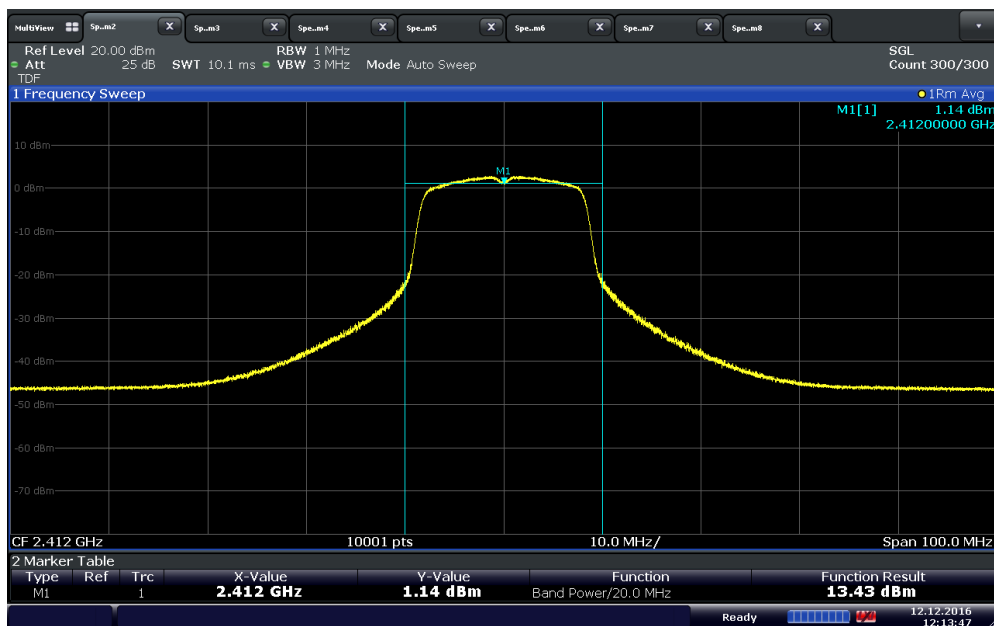
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High Channel 802.11b 5.5Mbps



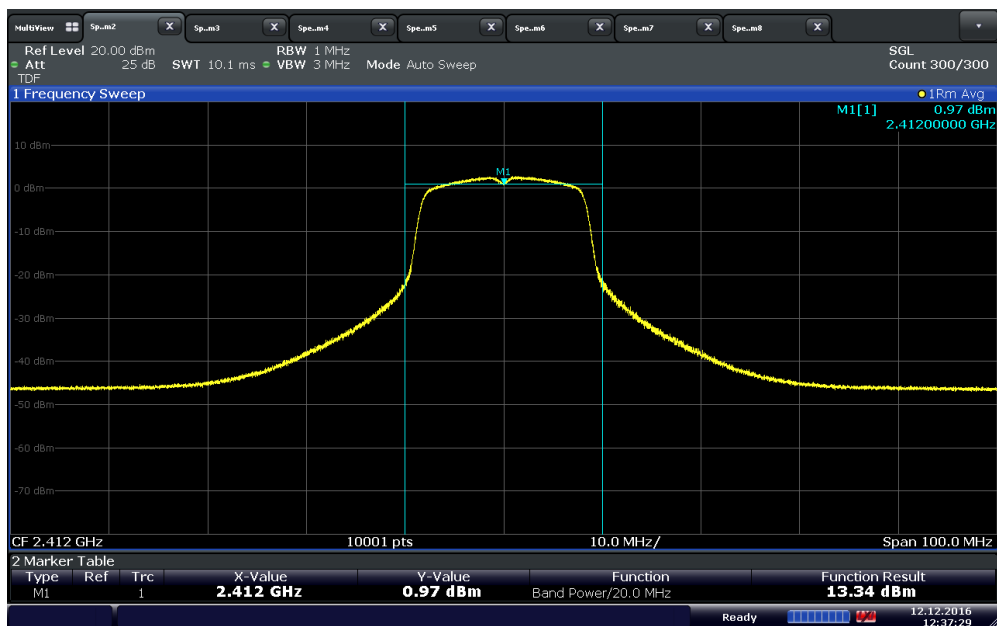
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High Channel 802.11b 11Mbps



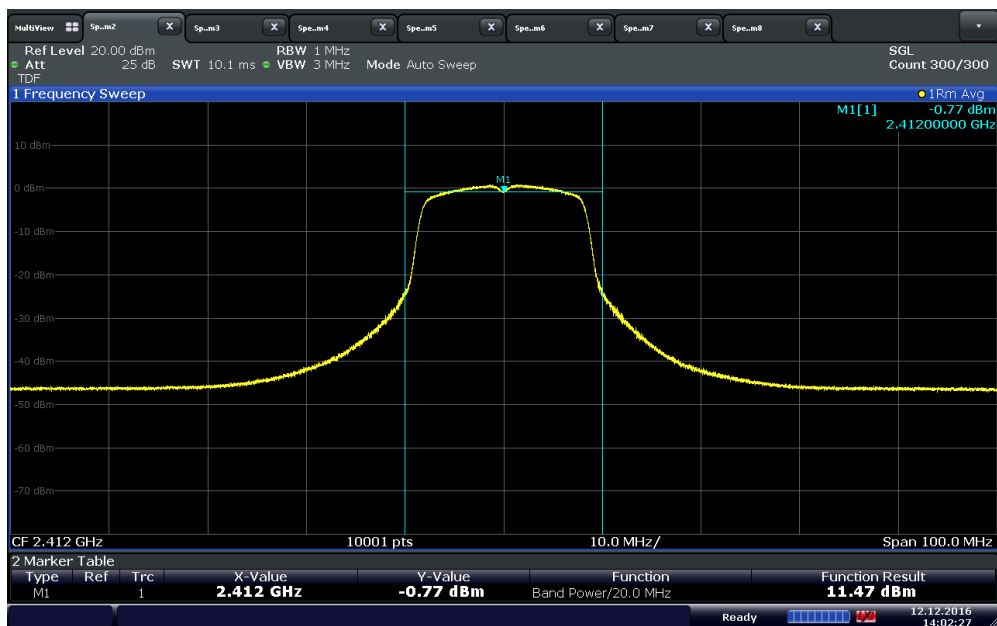
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Low Channel 802.11g 6Mbps



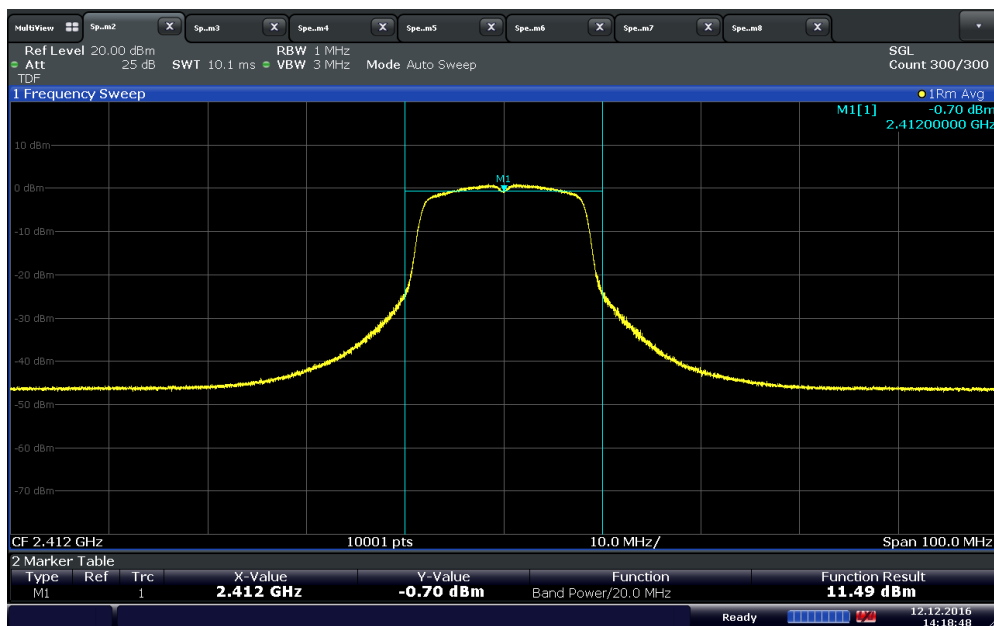
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Low Channel 802.11g 9Mbps



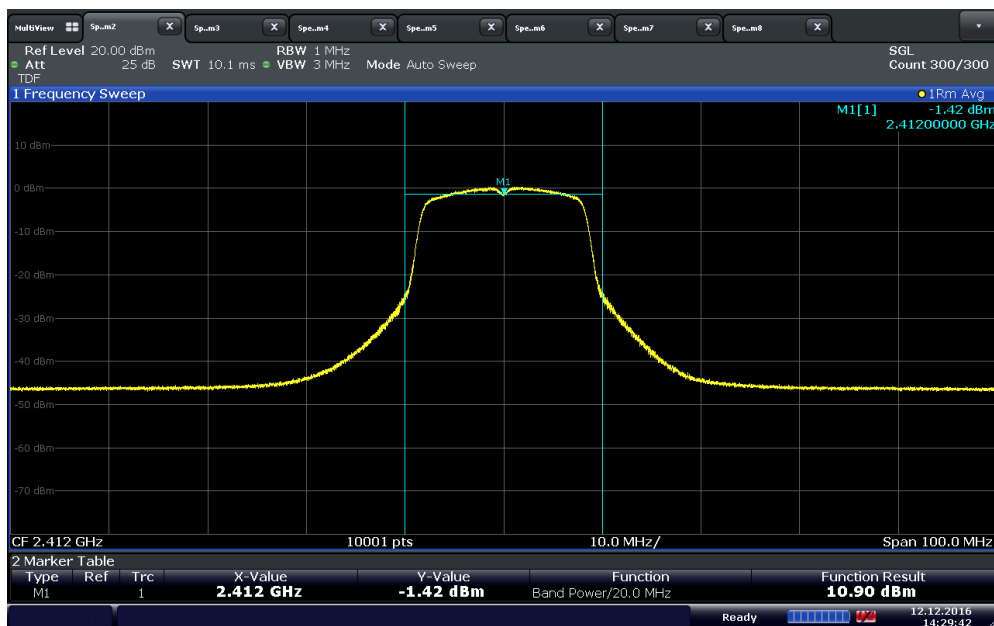
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Low Channel 802.11g 12Mbps



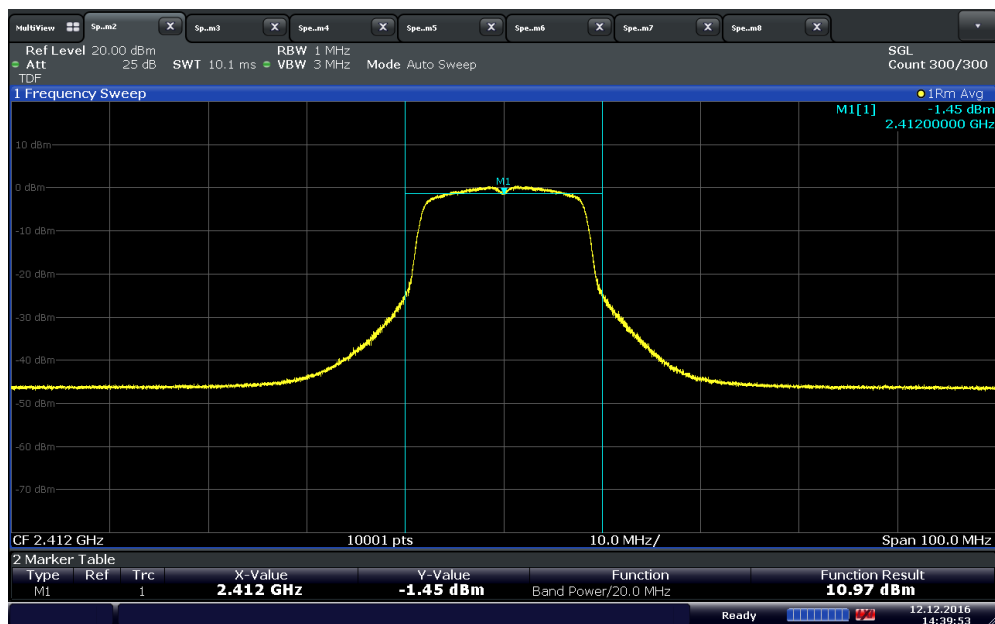
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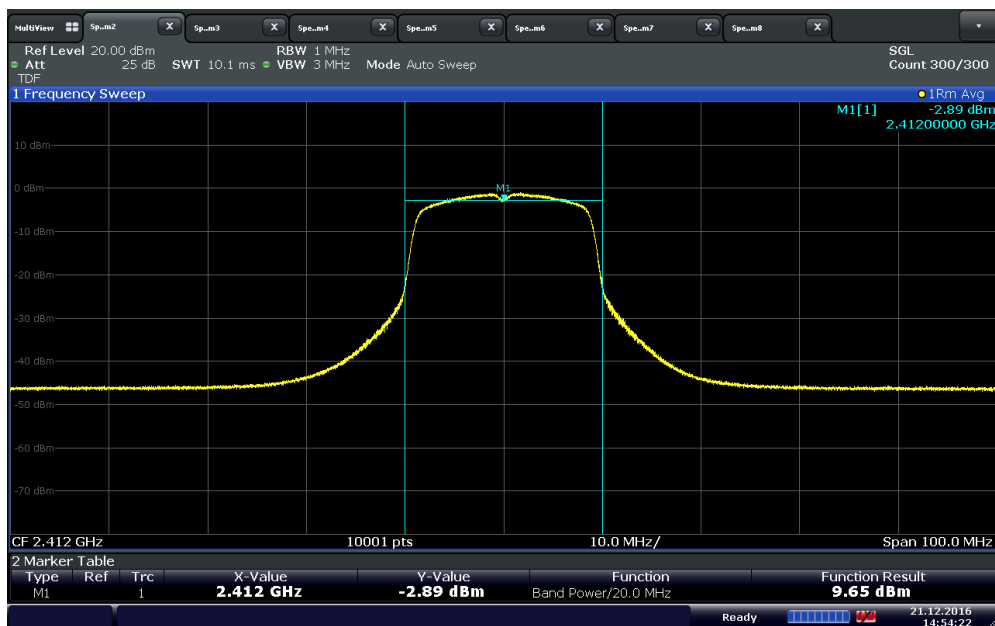
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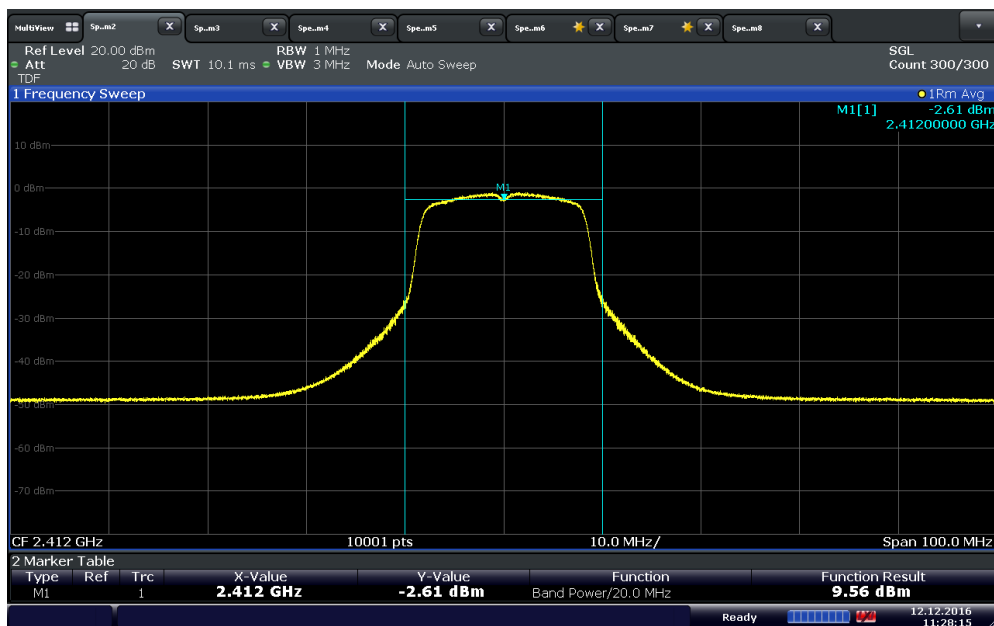
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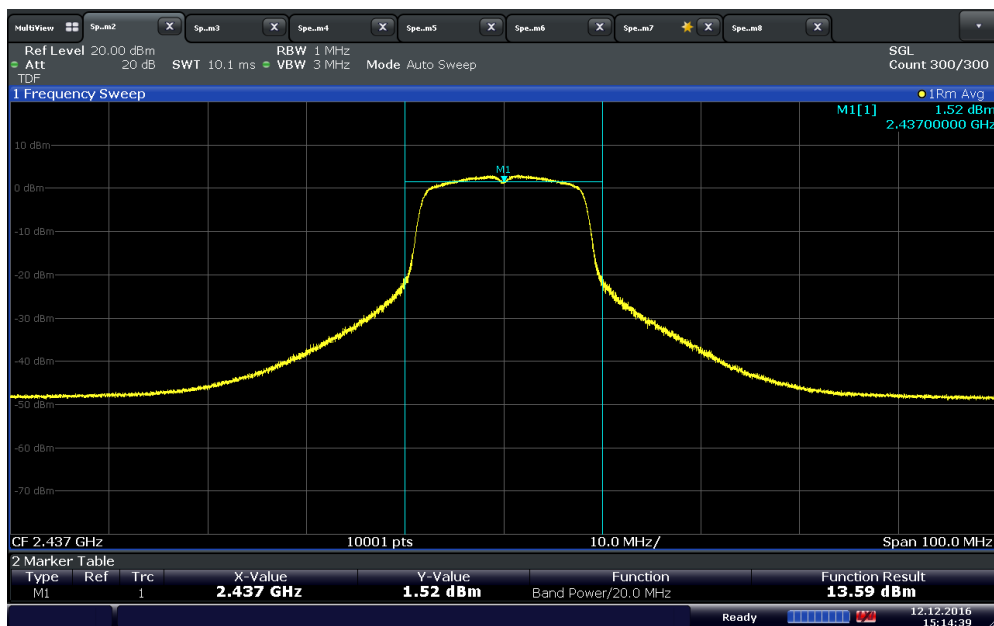
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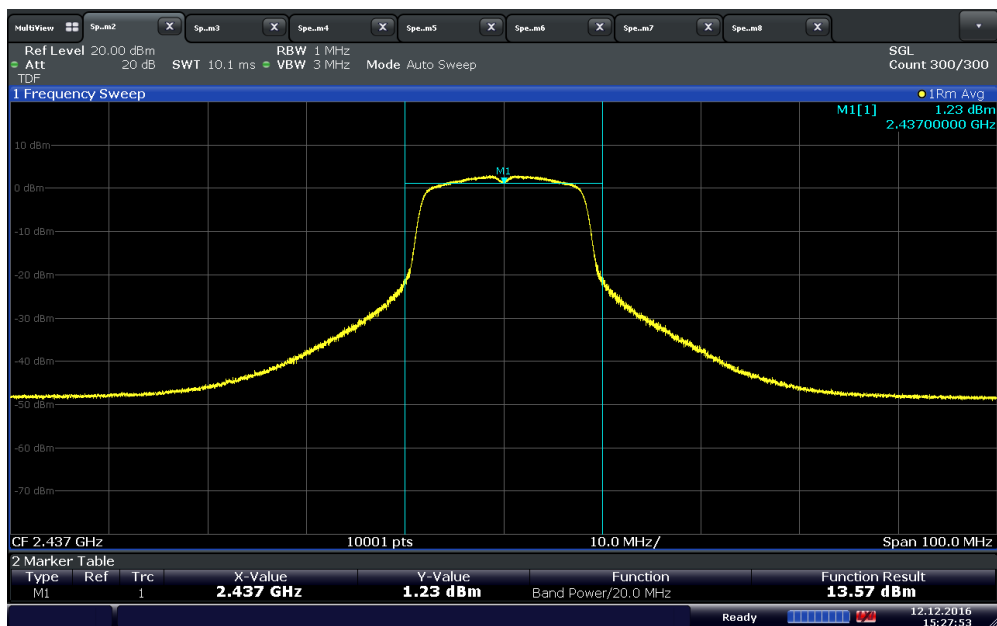
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Low Channel 802.11g 54Mbps



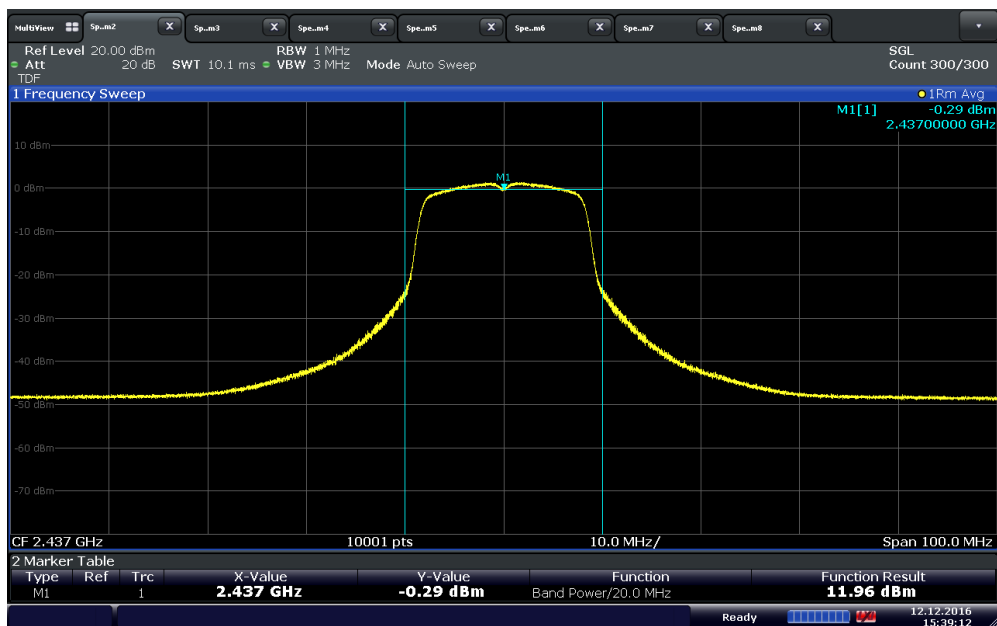
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Mid Channel 802.11g 6Mbps



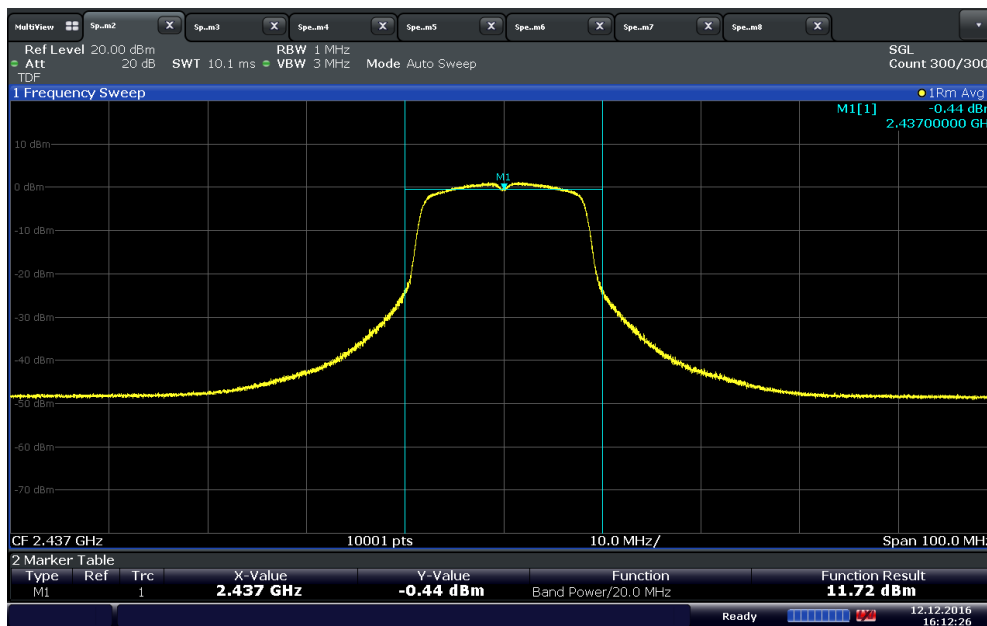
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Mid Channel 802.11g 9Mbps



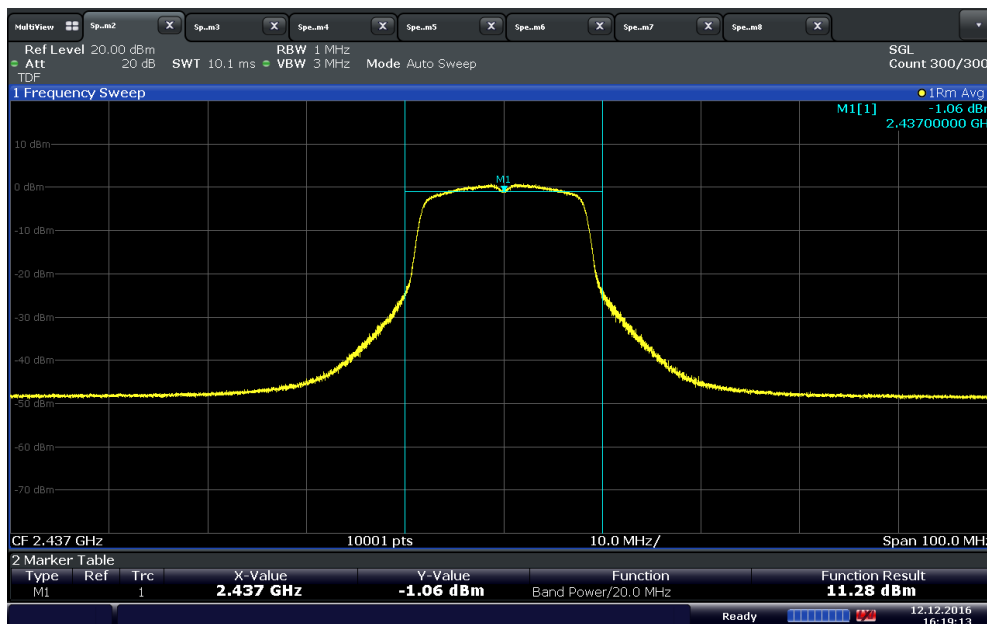
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Mid Channel 802.11g 12Mbps



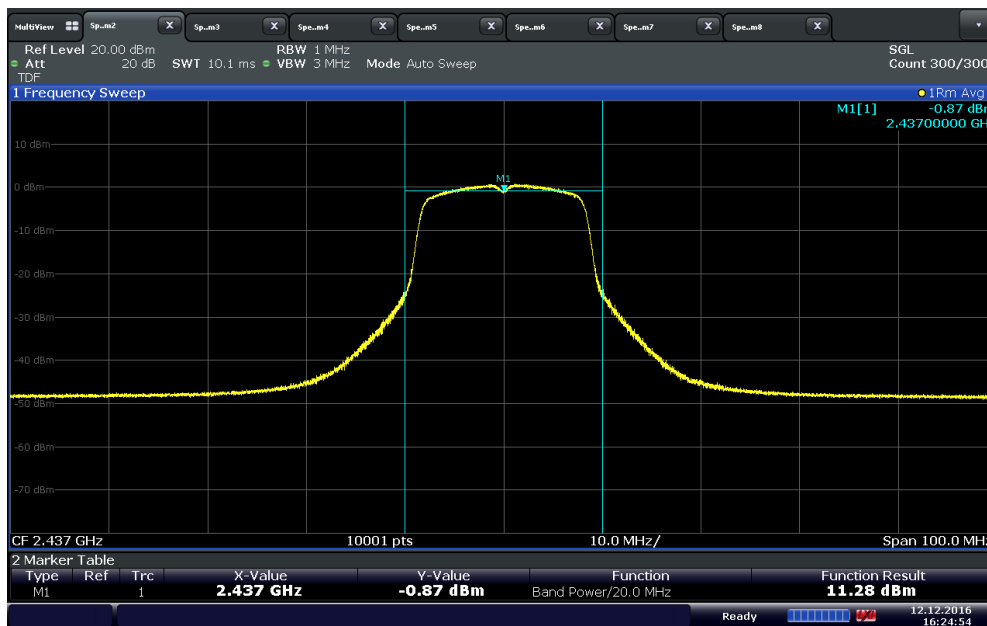
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Mid Channel 802.11g 18Mbps



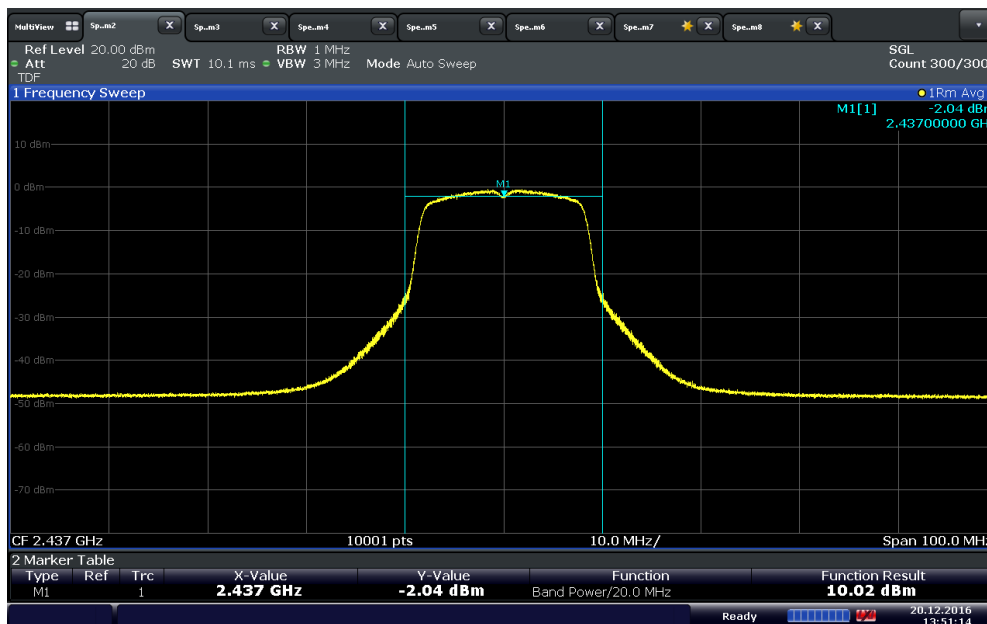
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Mid Channel 802.11g 24Mbps



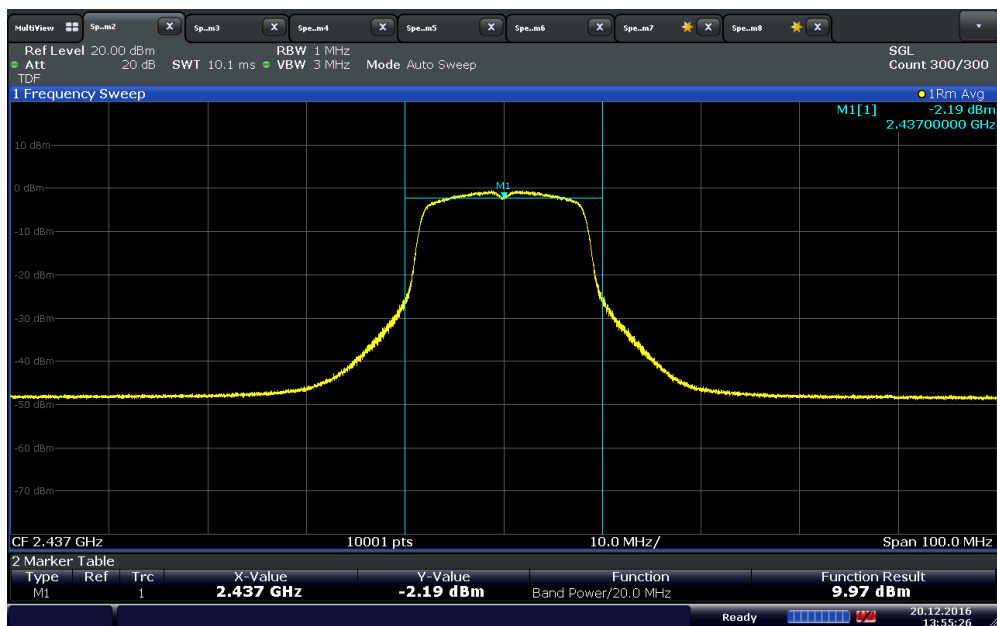
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Mid Channel 802.11g 36Mbps



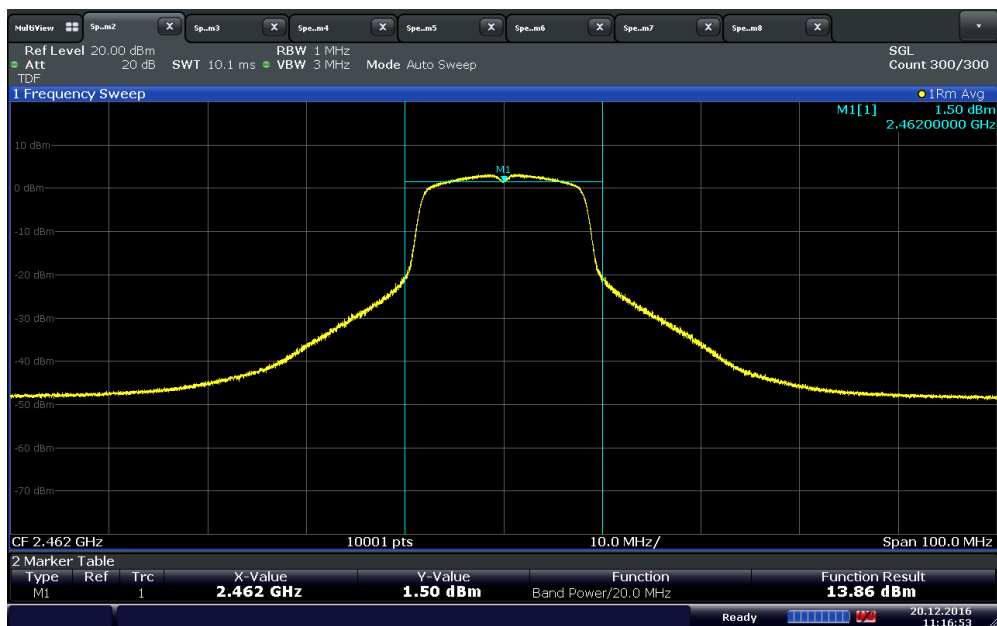
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Mid Channel 802.11g 48Mbps



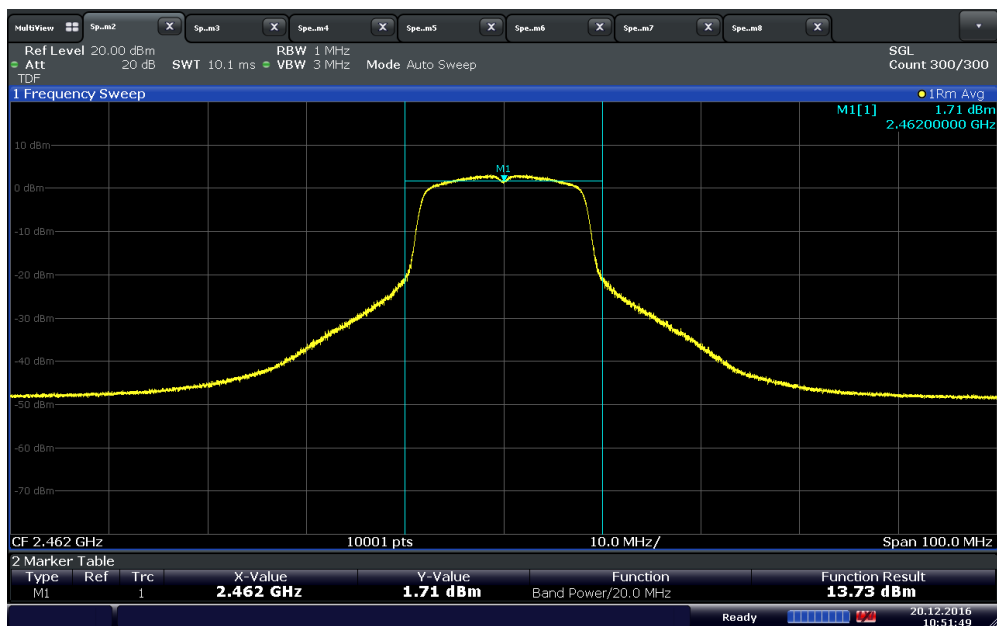
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Mid Channel 802.11g 54Mbps



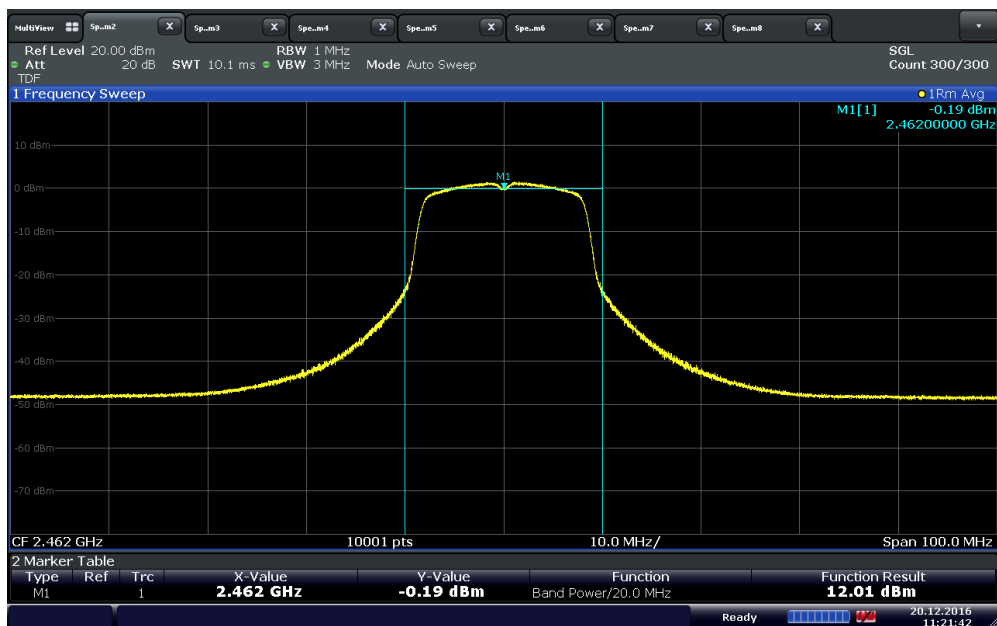
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High Channel 802.11g 6Mbps



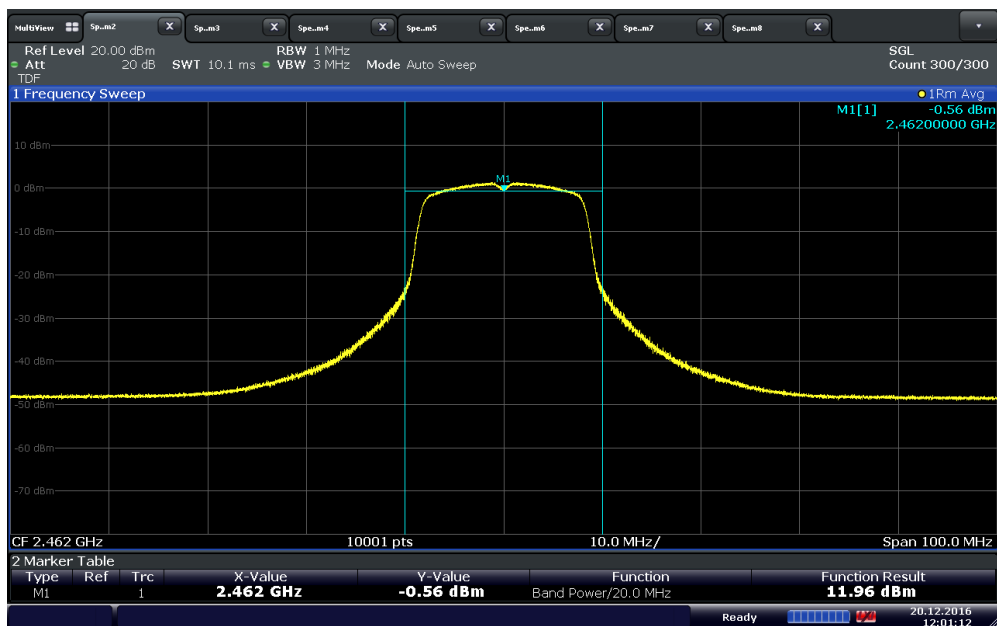
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High Channel 802.11g 9Mbps



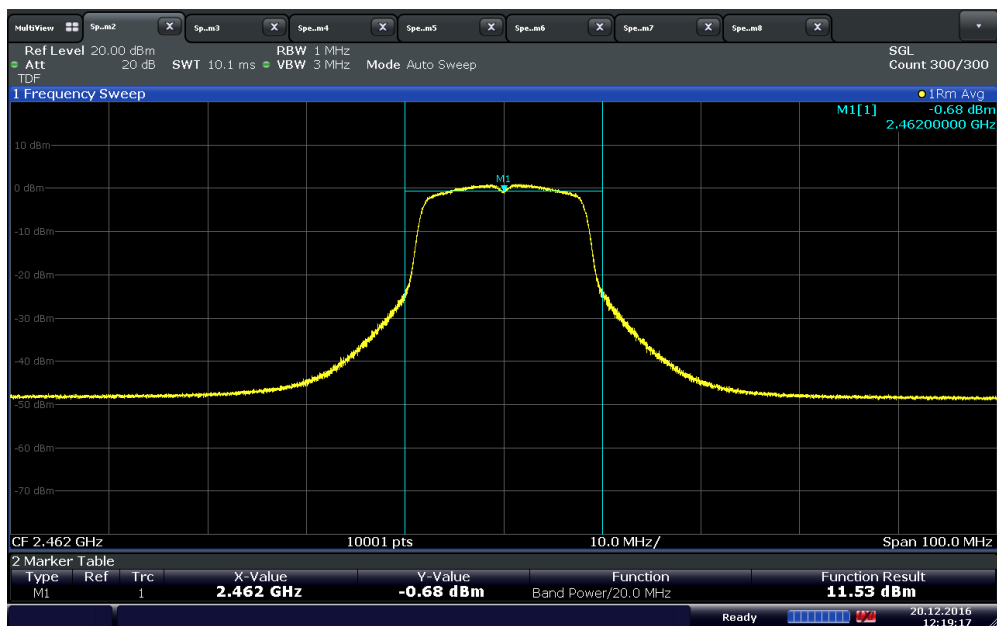
11:21:43 20.12.2016

High Channel 802.11g 12Mbps



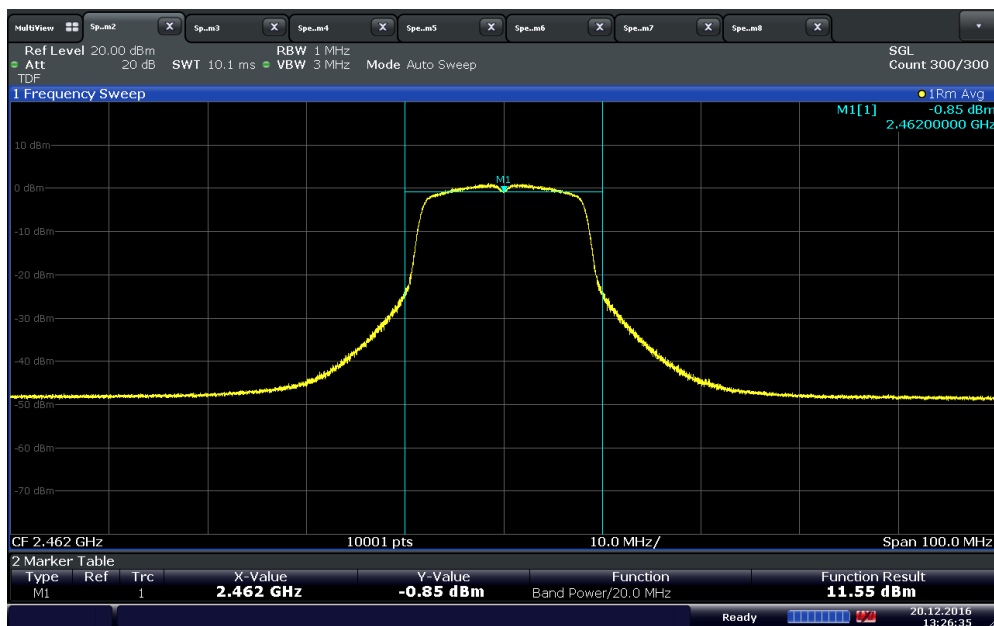
12:01:12 20.12.2016

High Channel 802.11g 18Mbps



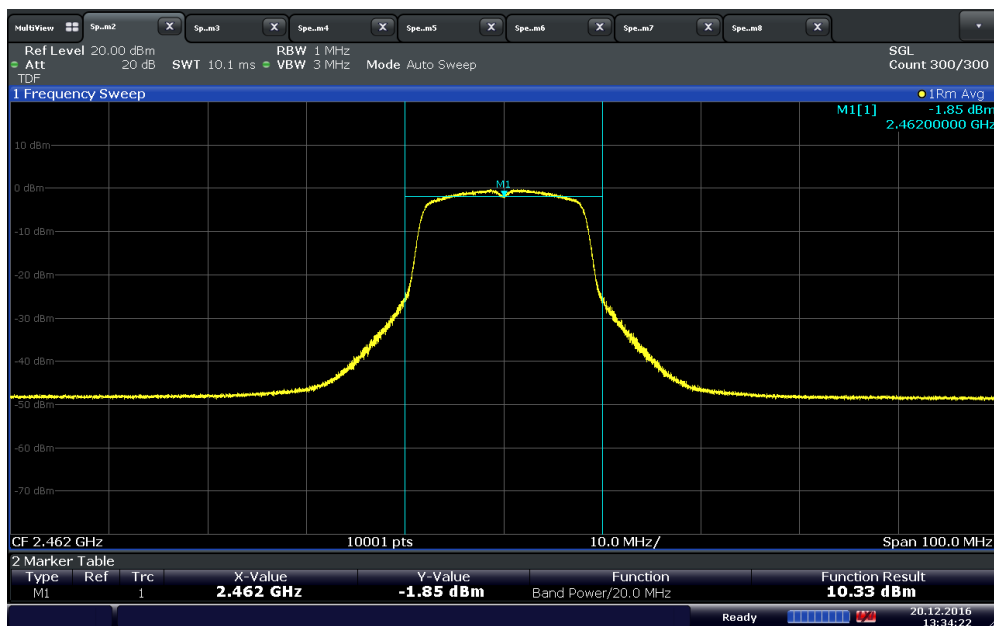
12:19:17 20.12.2016

High Channel 802.11g 24Mbps



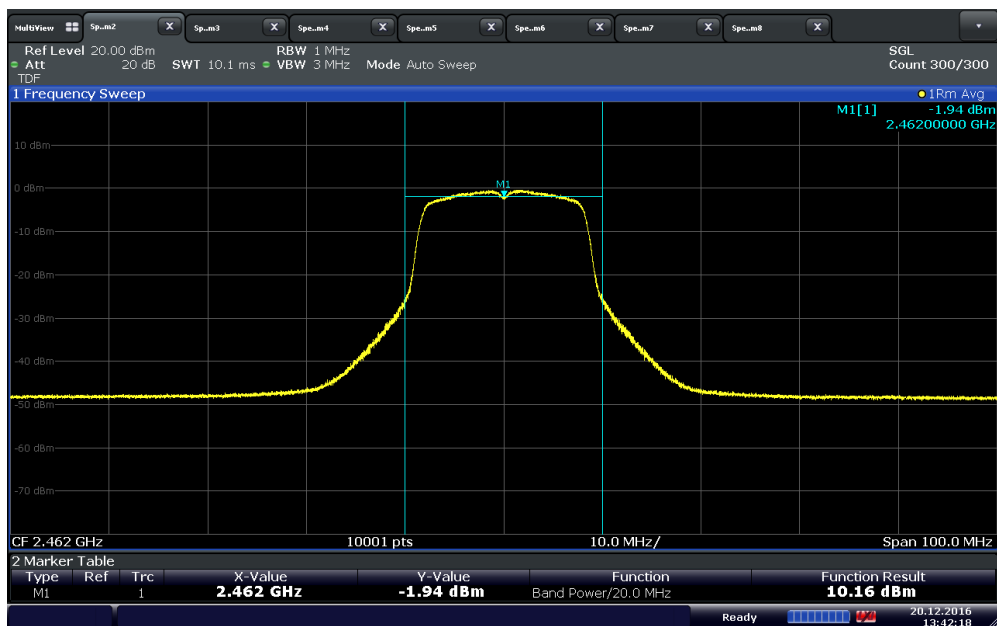
13:26:35 20.12.2016

High Channel 802.11g 36Mbps



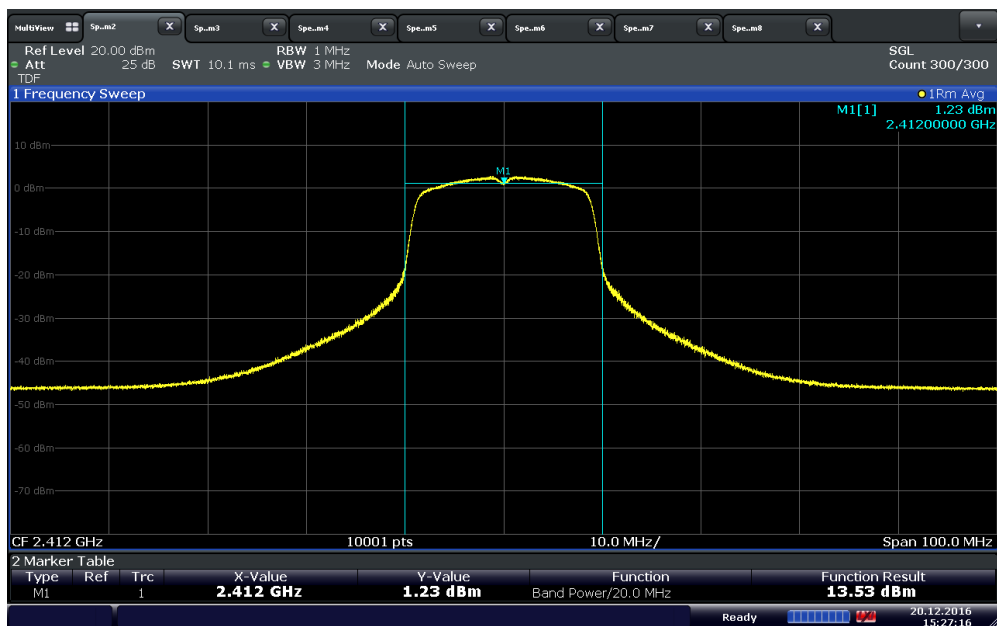
13:34:23 20.12.2016

High Channel 802.11g 48Mbps



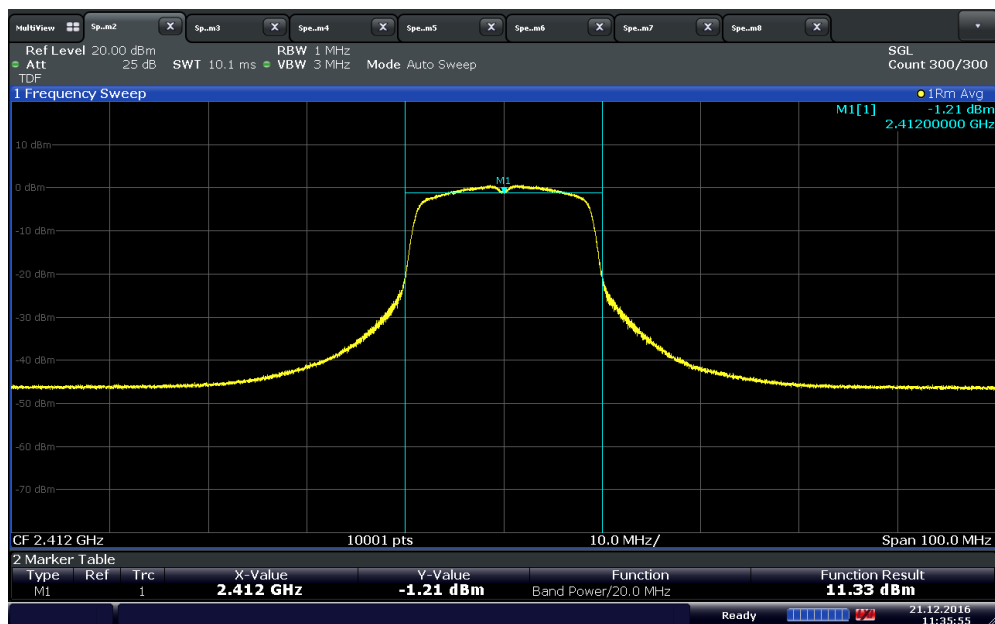
13:42:19 20.12.2016

High Channel 802.11g 54Mbps



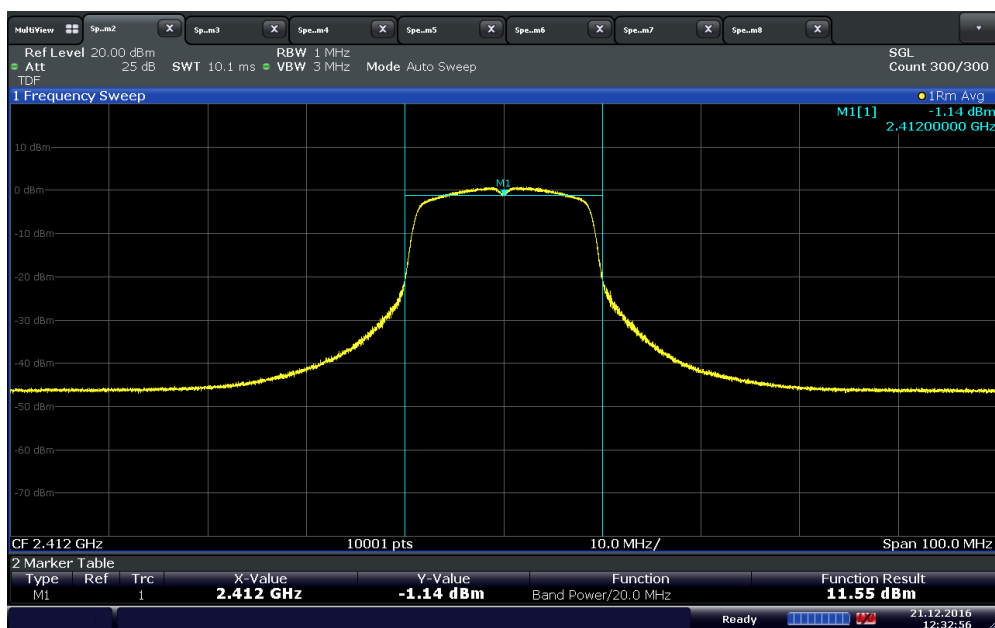
15:27:17 20.12.2016

Low Channel 802.11n MCS0



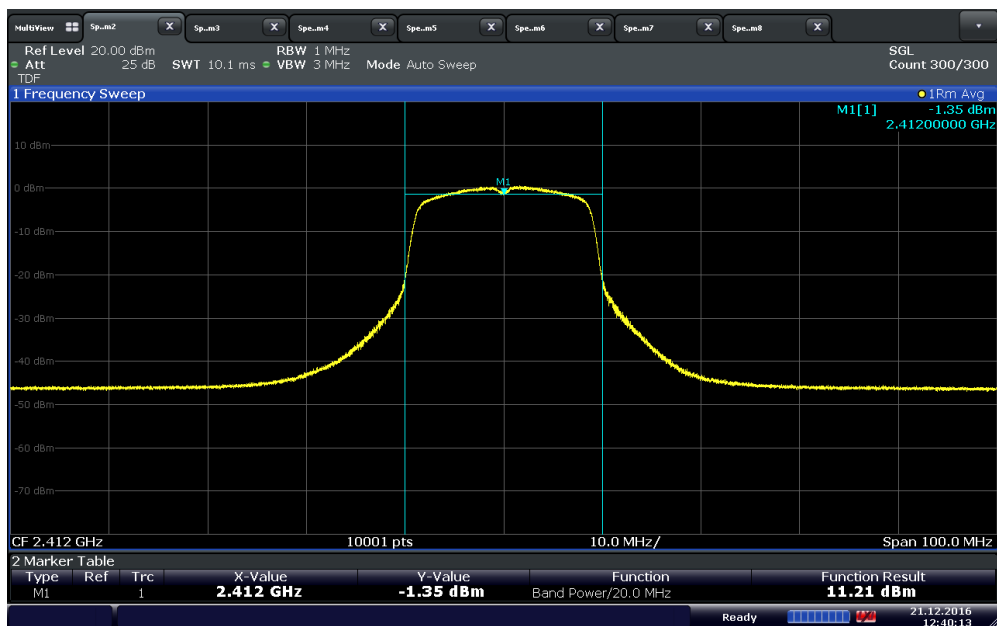
11:35:55 21.12.2016

Low Channel 802.11n MCS1



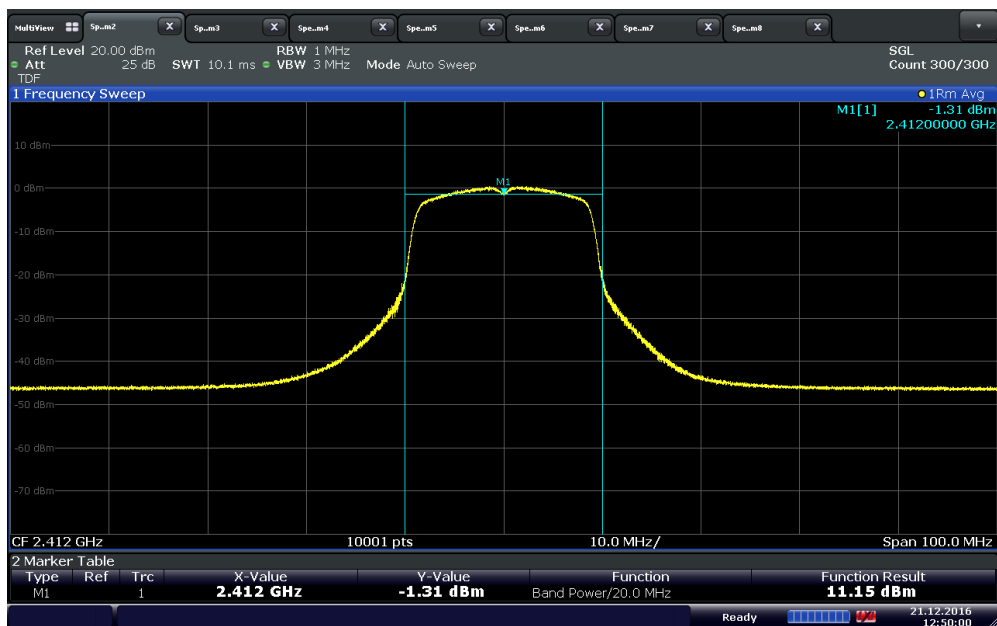
12:32:57 21.12.2016

Low Channel 802.11n MCS2



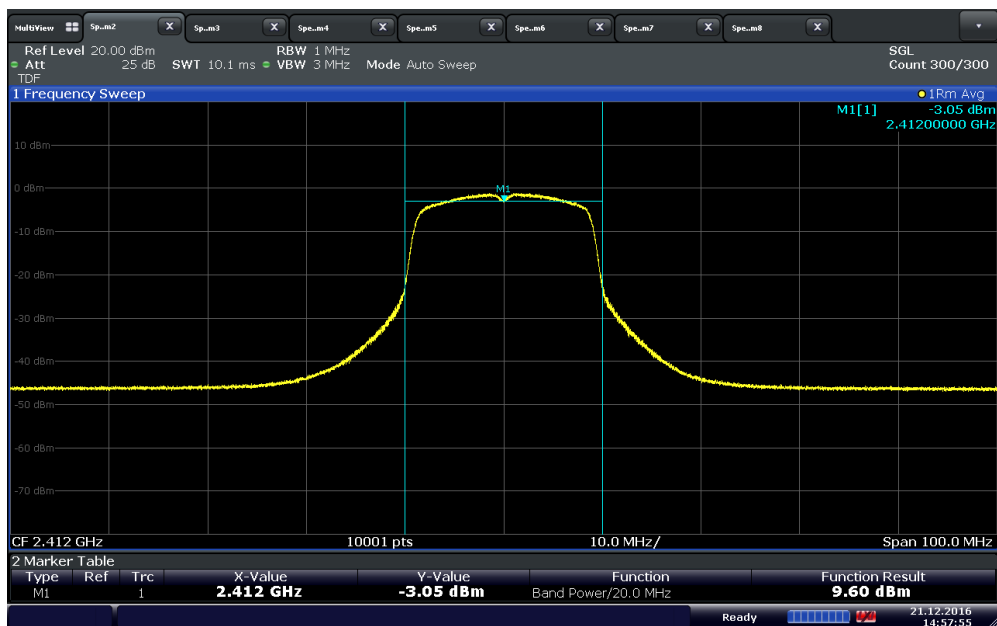
12:40:14 21.12.2016

Low Channel 802.11n MCS3



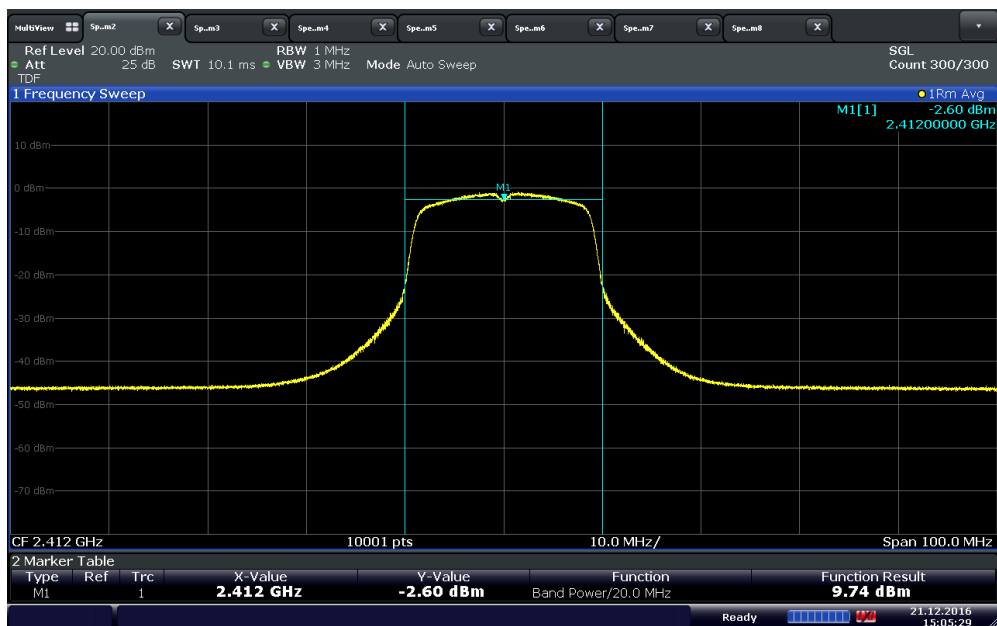
12:50:01 21.12.2016

Low Channel 802.11n MCS4



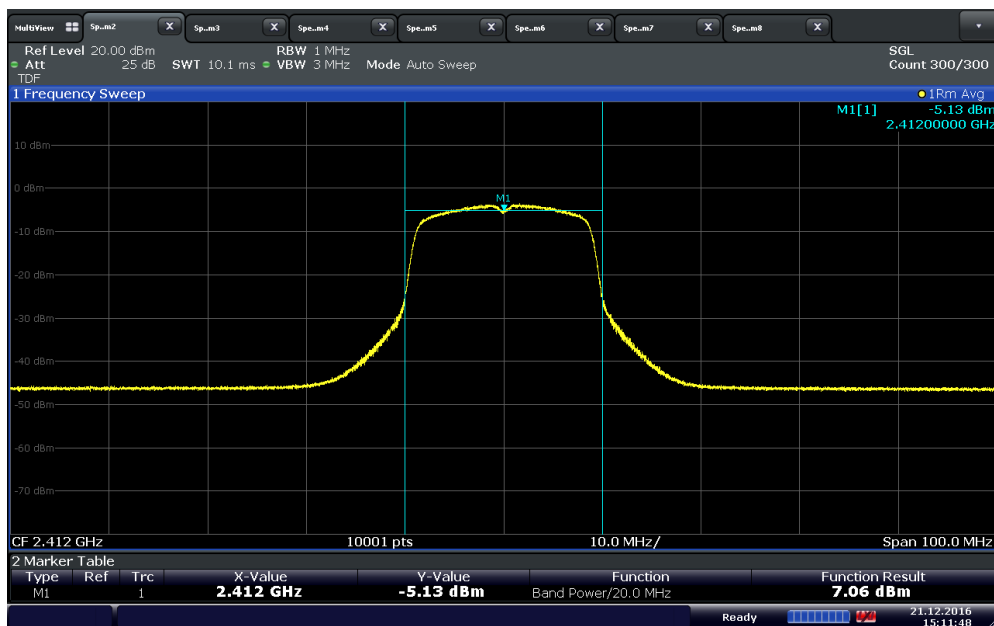
14:57:56 21.12.2016

Low Channel 802.11n MCS5



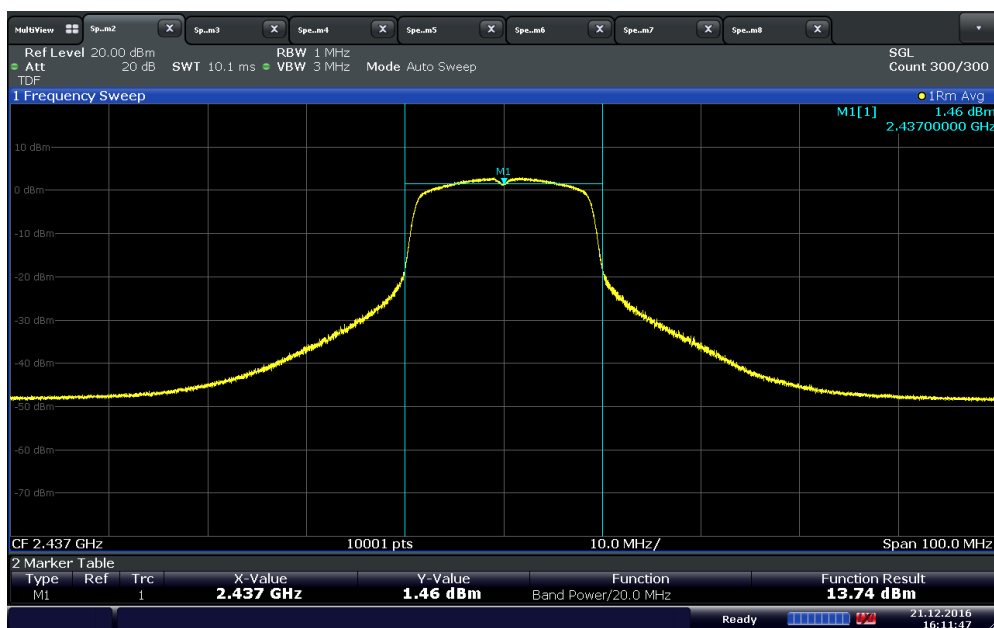
15:05:29 21.12.2016

Low Channel 802.11n MCS6



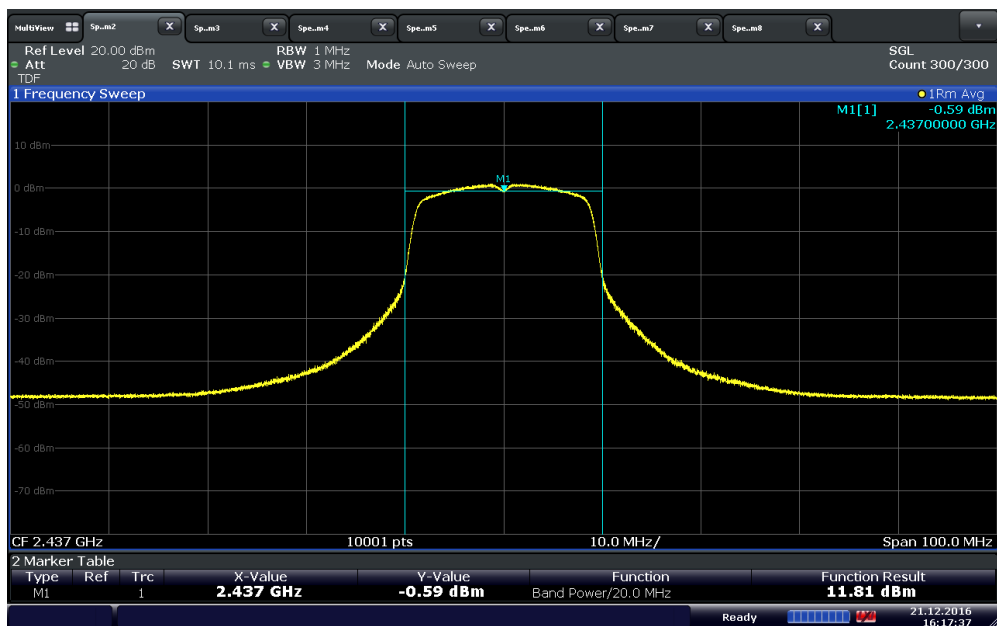
15:11:49 21.12.2016

Low Channel 802.11n MCS7



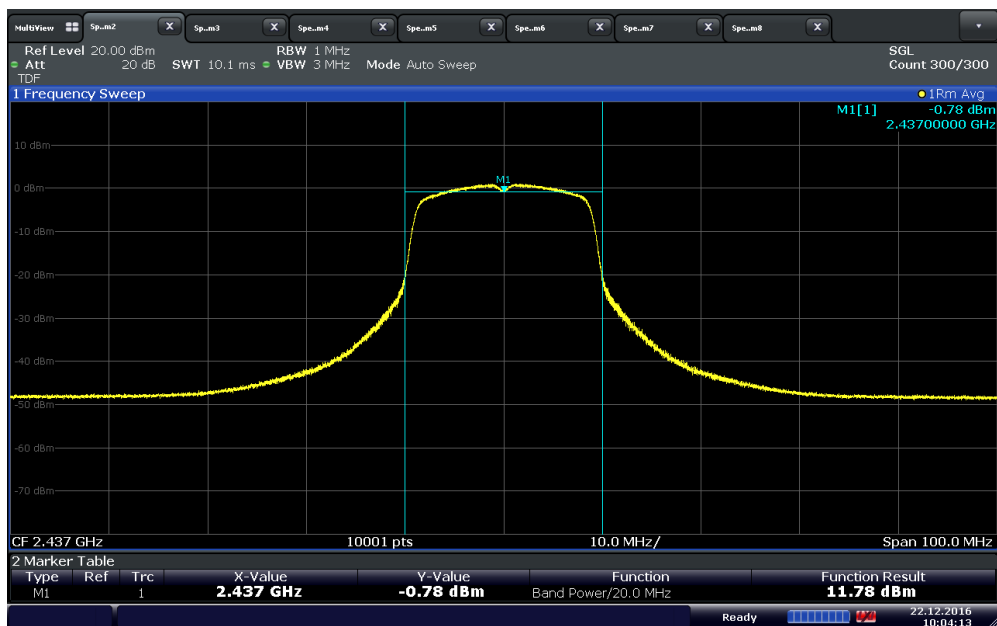
16:11:48 21.12.2016

Mid Channel 802.11n MCS0



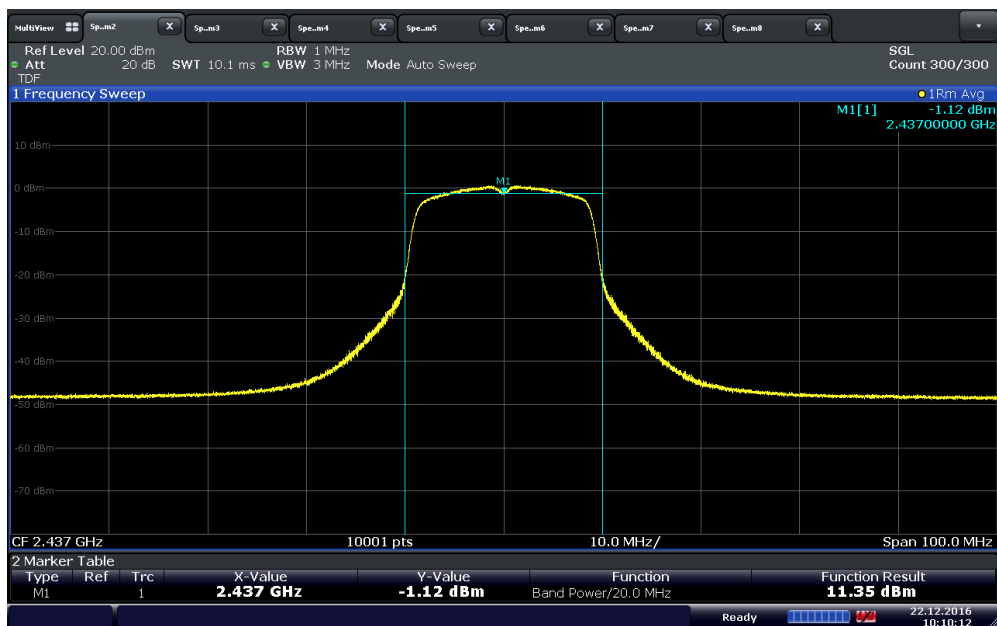
16:17:37 21.12.2016

Mid Channel 802.11n MCS1



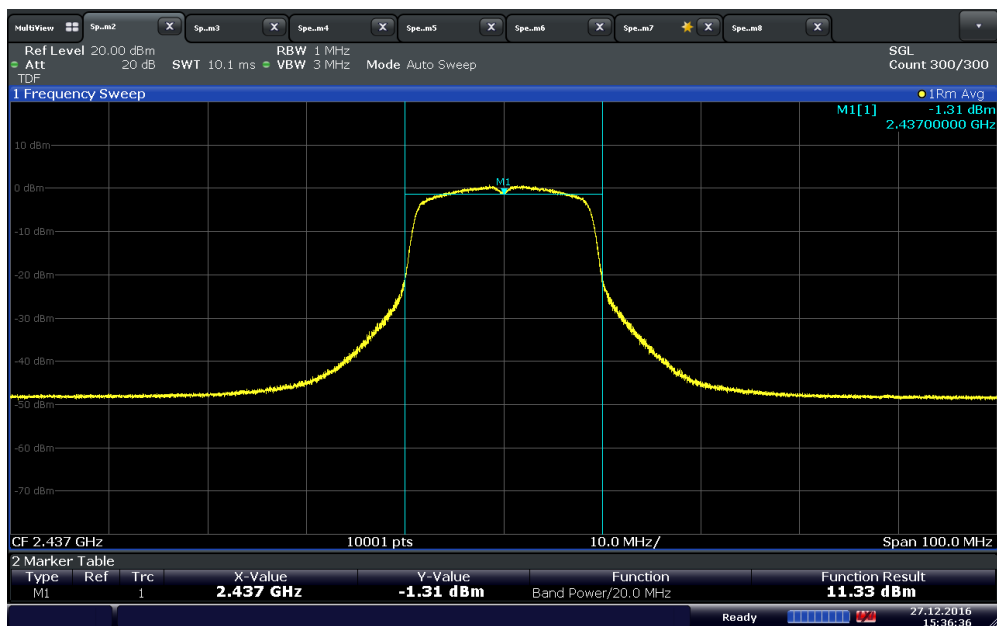
10:04:13 22.12.2016

Mid Channel 802.11n MCS2



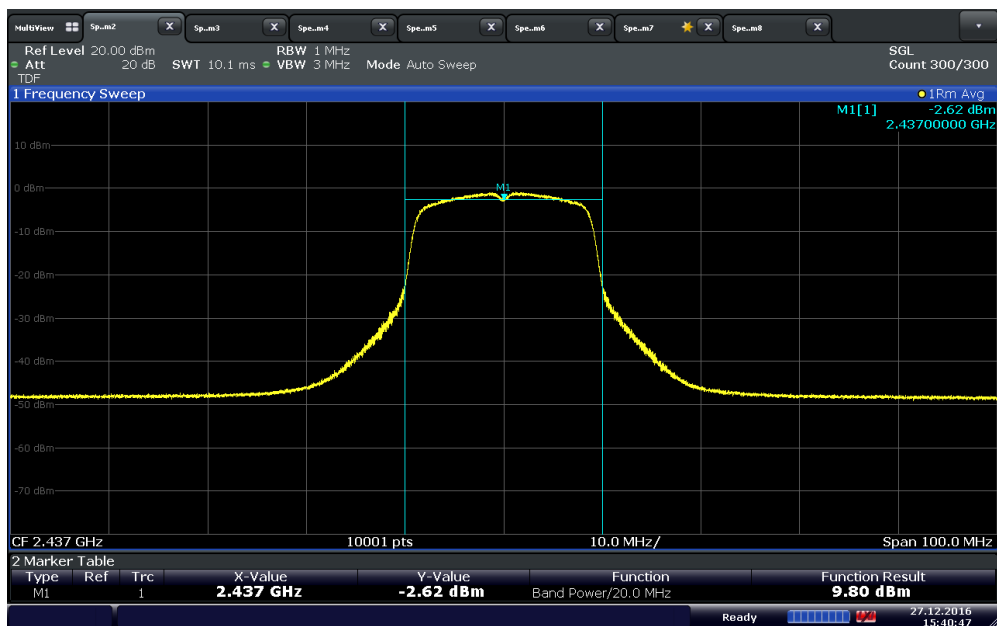
10:10:12 22.12.2016

Mid Channel 802.11n MCS3



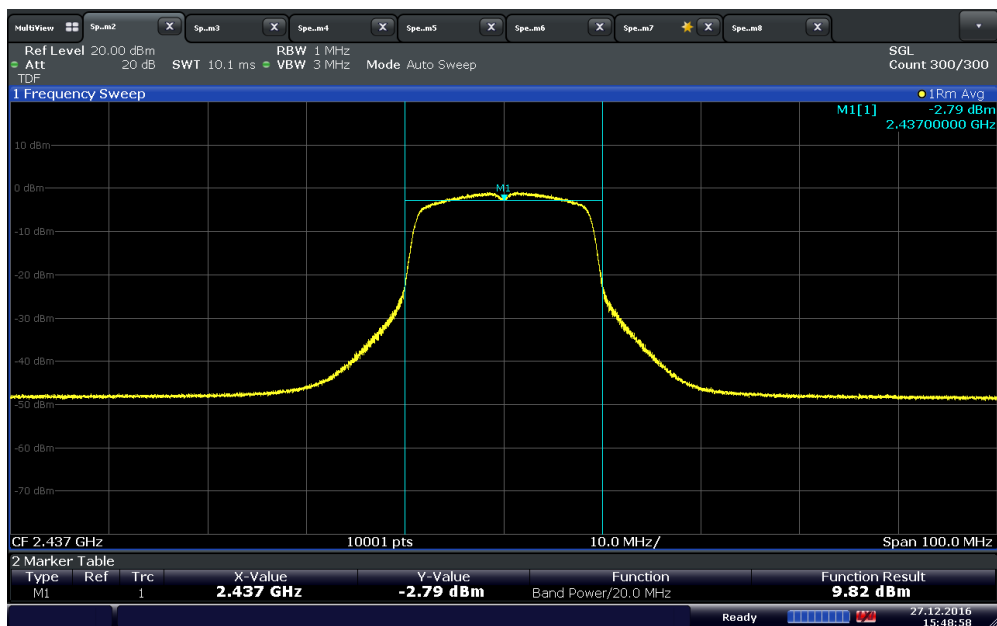
15:36:37 27.12.2016

Mid Channel 802.11n MCS4



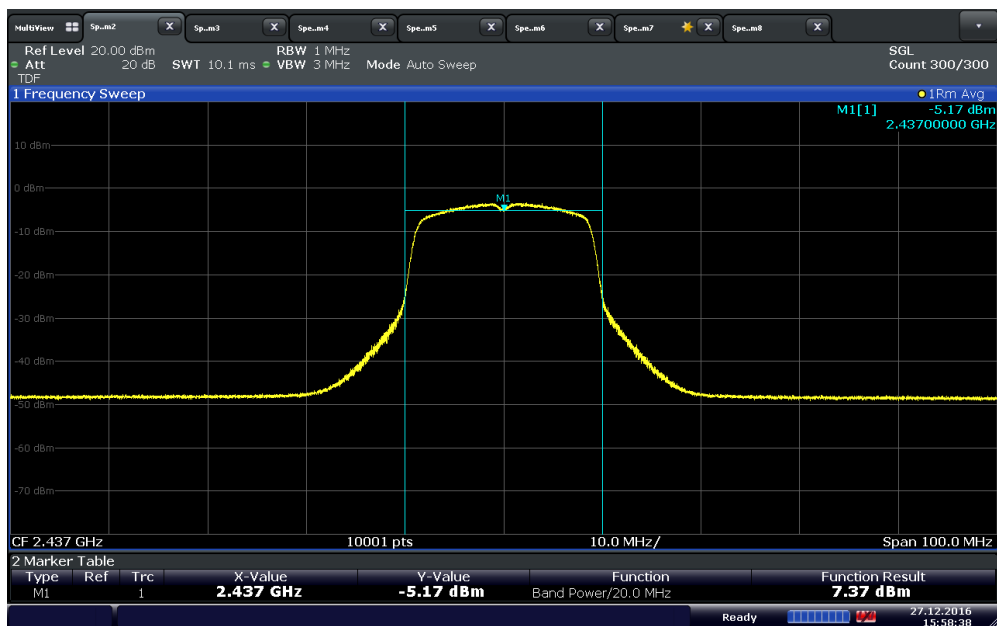
15:40:47 27.12.2016

Mid Channel 802.11n MCS5



15:48:58 27.12.2016

Mid Channel 802.11n MCS6



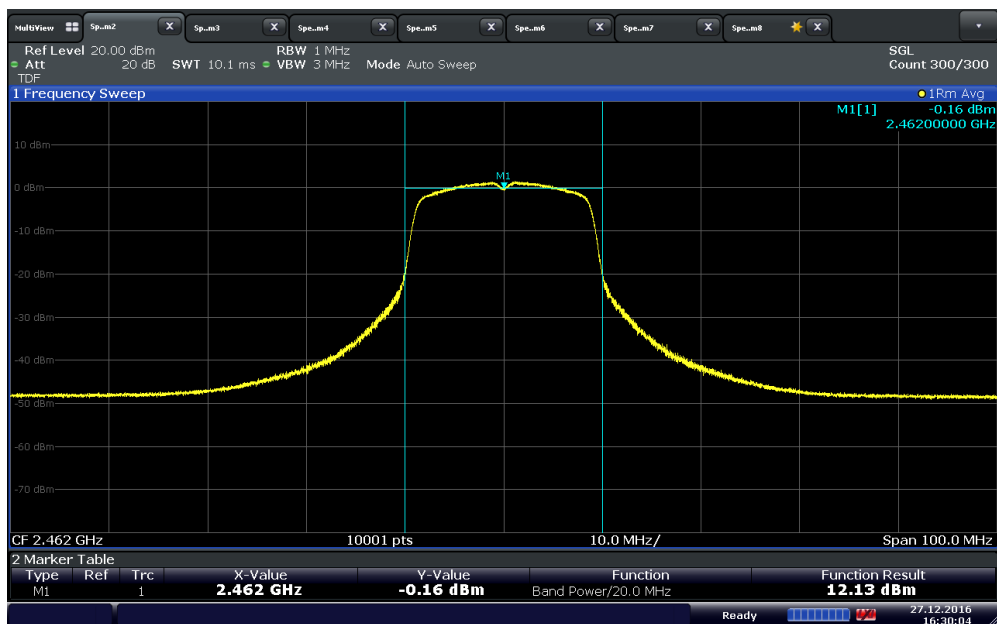
15:58:38 27.12.2016

Mid Channel 802.11n MCS7



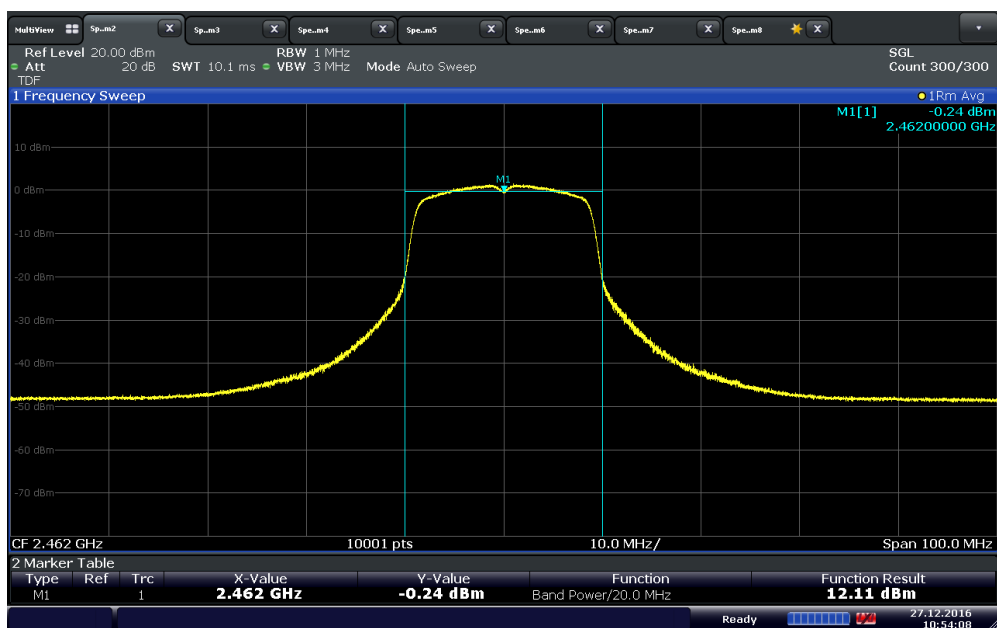
16:11:36 27.12.2016

High Channel 802.11n MCS0



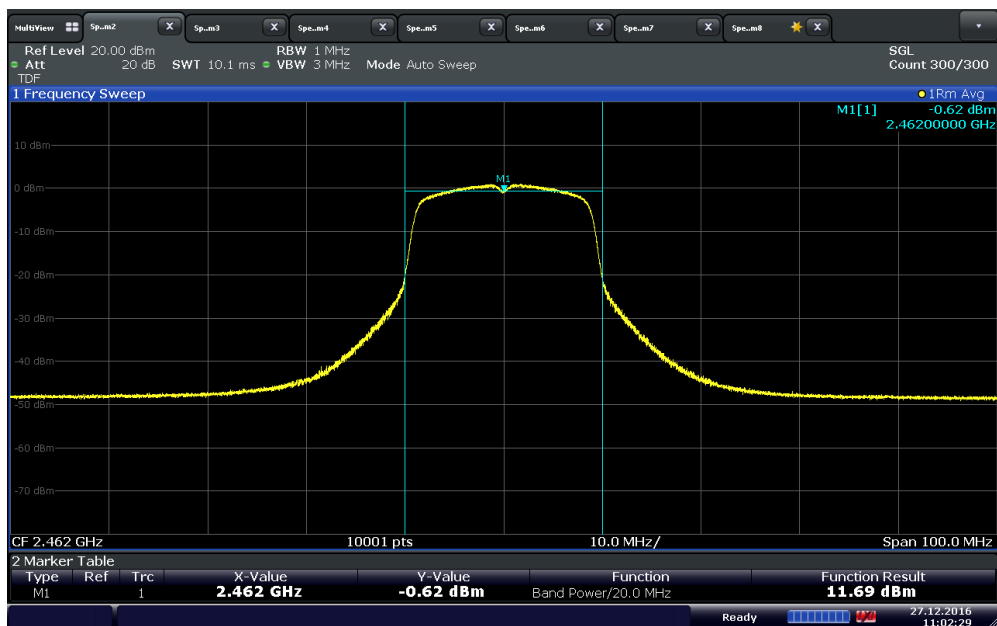
16:30:05 27.12.2016

High Channel 802.11n MCS1



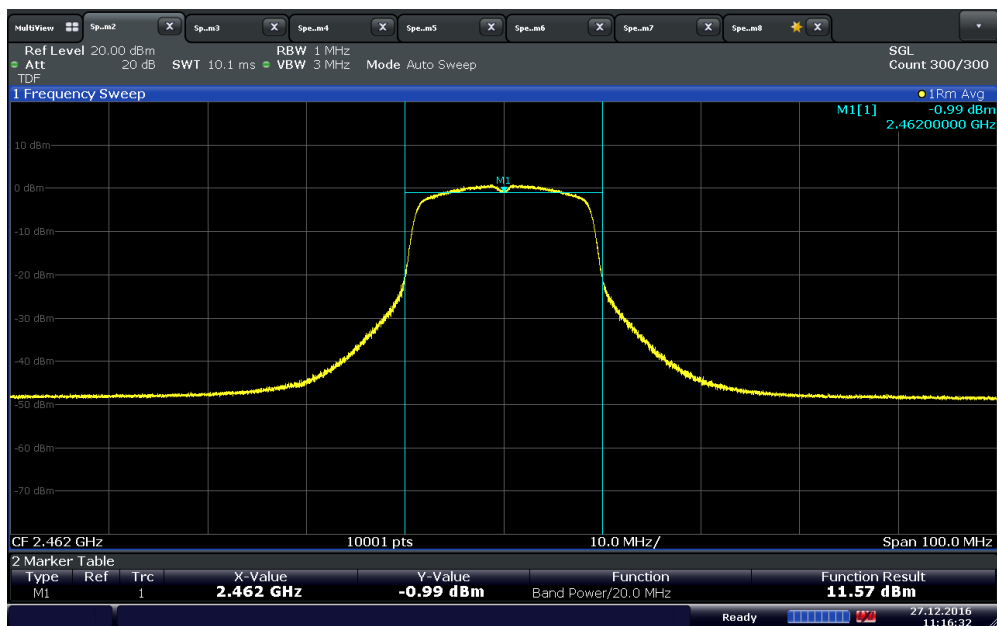
10:54:09 27.12.2016

High Channel 802.11n MCS2



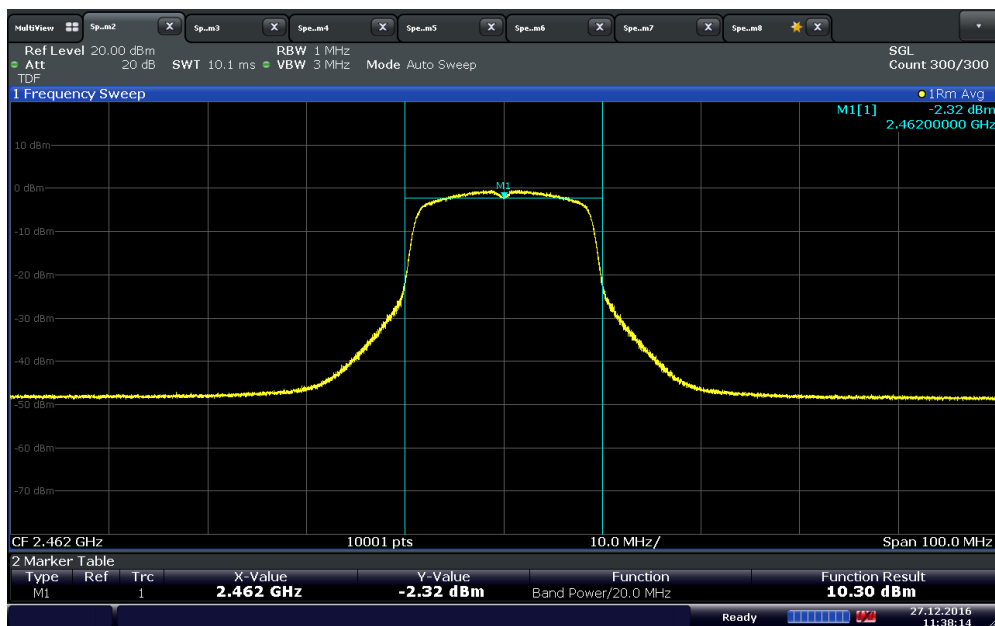
11:02:30 27.12.2016

High Channel 802.11n MCS3



11:16:33 27.12.2016

High Channel 802.11n MCS4



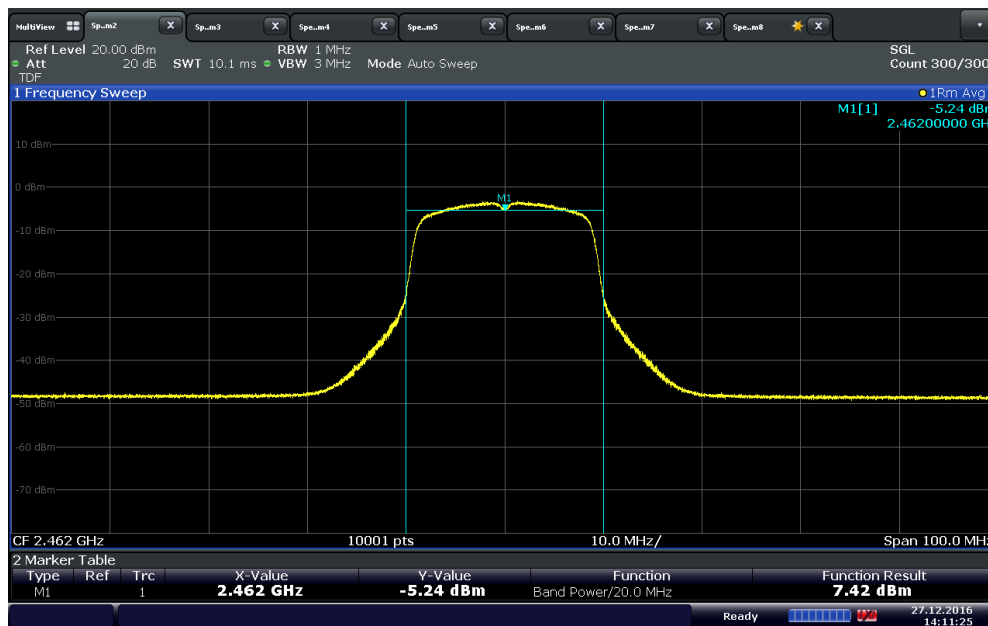
11:38:14 27.12.2016

High Channel 802.11n MCS5



11:44:34 27.12.2016

High Channel 802.11n MCS6



14:11:26 27.12.2016

High Channel 802.11n MCS7

2.2 CONDUCTED EMISSIONS

2.2.1 Specification Reference

Part 15 Subpart C §15.207(a)

2.2.2 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 μ H/50 ohms line impedance stabilization network (LISN).

Frequency of emission (MHz)	Conducted limit (dB μ V)	
	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.

2.2.3 Equipment Under Test and Modification State

Serial No: 900F4108/Test Configuration C

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

December 27, 2016/NS

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 Location

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	24.3 °C
Relative Humidity	40.8 %
ATM Pressure	99.5 kPa

2.2.7 Additional Observations

Measurement was done using EMC32 V8.53 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 2.2.8 for sample computation.

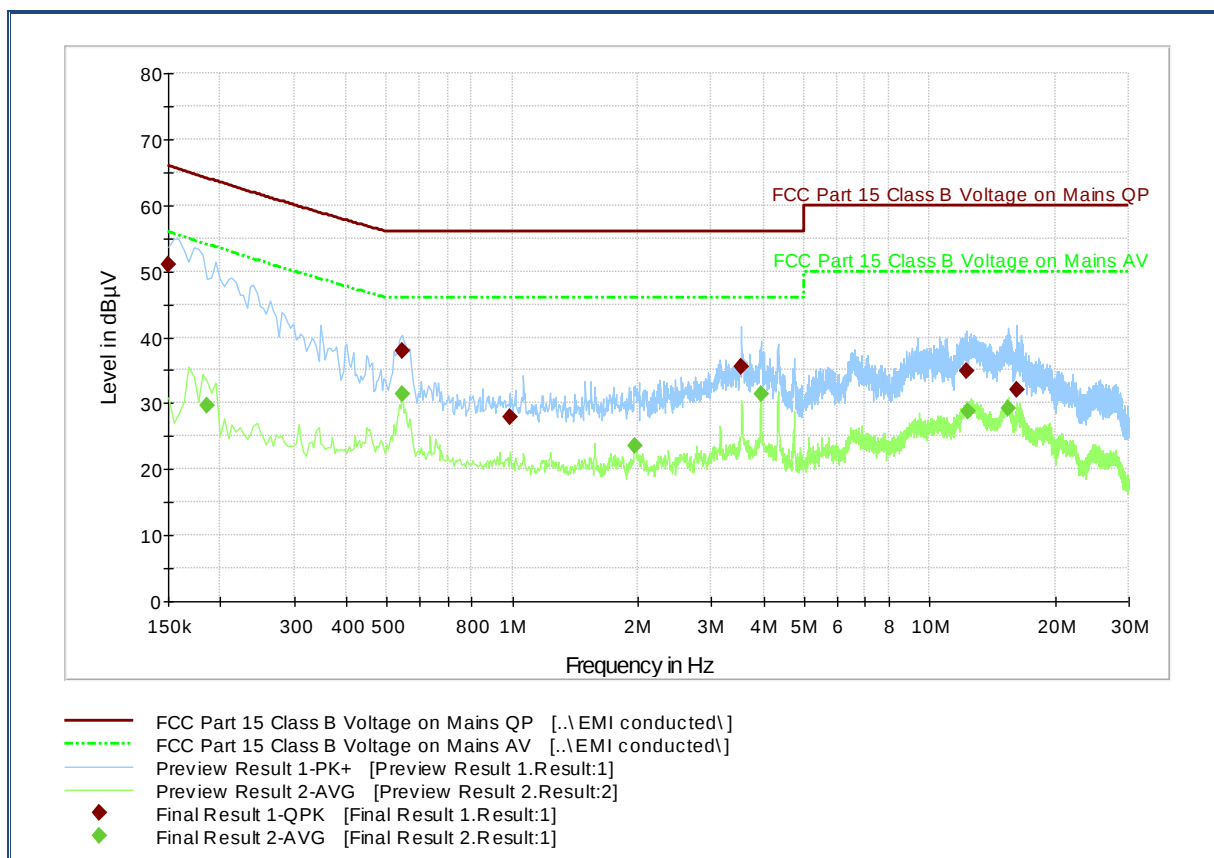
2.2.8 Sample Computation (Conducted Emission – Quasi Peak)

Measuring equipment raw measurement (db μ V) @ 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# 7568 (LISN)	0.30	
Reported QuasiPeak Final Measurement (db μ V) @ 150kHz			26.2

2.2.9 Test Results

Compliant. See attached plots and tables.

2.2.10 Line 1 (Hot)



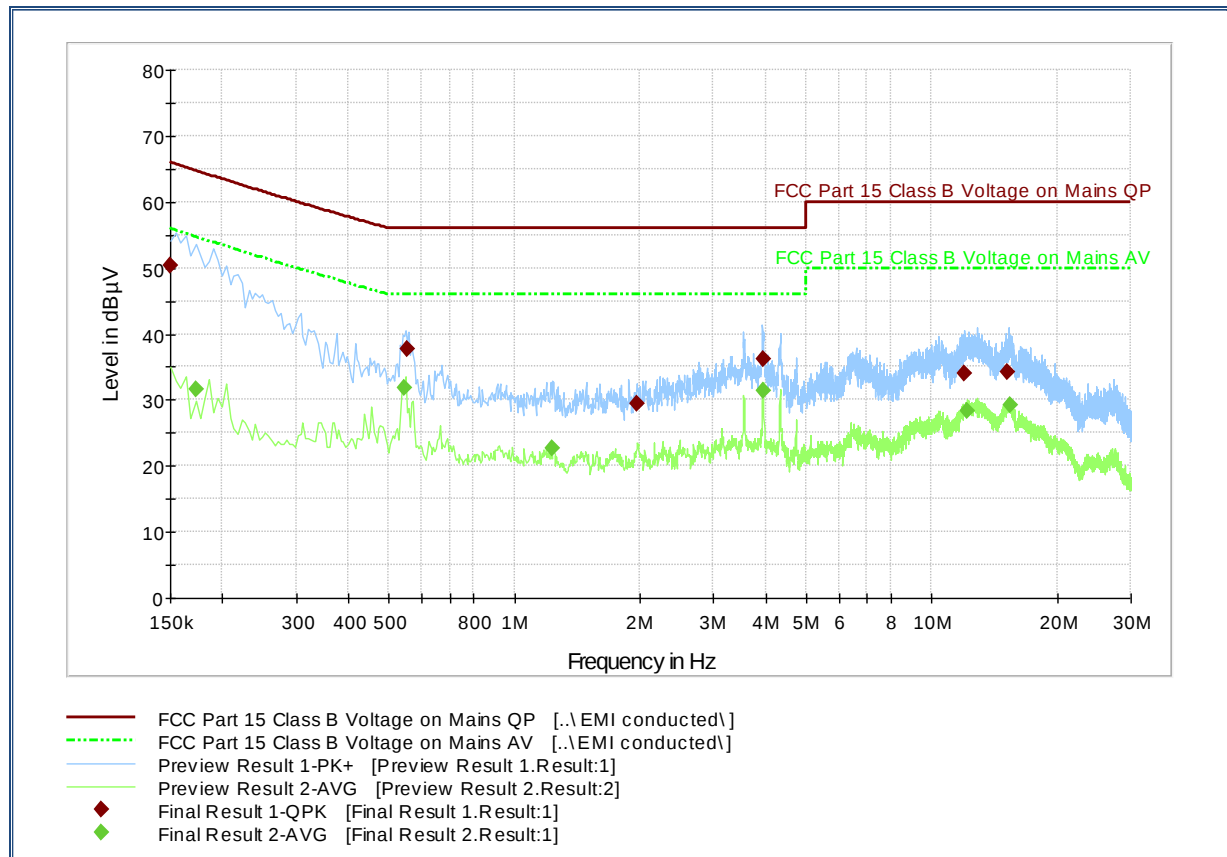
Quasi Peak

Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)
0.150000	50.9	1000.0	9.000	Off	L1	20.2	15.1	66.0
0.546000	38.0	1000.0	9.000	Off	L1	20.0	18.0	56.0
0.991500	27.9	1000.0	9.000	Off	L1	20.0	28.1	56.0
3.547500	35.6	1000.0	9.000	Off	L1	20.1	20.4	56.0
12.304500	34.9	1000.0	9.000	Off	L1	20.2	25.1	60.0
16.179000	32.1	1000.0	9.000	Off	L1	20.3	27.9	60.0

Average

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - Ave (dB)	Limit - Ave (dBµV)
0.186000	29.6	1000.0	9.000	Off	L1	20.1	24.5	54.1
0.546000	31.3	1000.0	9.000	Off	L1	20.0	14.7	46.0
1.968000	23.6	1000.0	9.000	Off	L1	20.0	22.4	46.0
3.943500	31.4	1000.0	9.000	Off	L1	20.1	14.6	46.0
12.322500	28.7	1000.0	9.000	Off	L1	20.2	21.3	50.0
15.391500	29.3	1000.0	9.000	Off	L1	20.3	20.7	50.0

2.2.11 Line 2 (Neutral)



Quasi Peak

Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)
0.150000	50.5	1000.0	9.000	Off	N	20.2	15.5	66.0
0.555000	37.8	1000.0	9.000	Off	N	20.0	18.2	56.0
1.968000	29.3	1000.0	9.000	Off	N	20.0	26.7	56.0
3.943500	36.1	1000.0	9.000	Off	N	20.1	19.9	56.0
11.953500	34.1	1000.0	9.000	Off	N	20.2	25.9	60.0
15.220500	34.1	1000.0	9.000	Off	N	20.3	25.9	60.0

Average

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - Ave (dB)	Limit - Ave (dBµV)
0.172500	31.7	1000.0	9.000	Off	N	20.1	23.1	54.7
0.546000	31.9	1000.0	9.000	Off	N	20.0	14.1	46.0
1.234500	22.8	1000.0	9.000	Off	N	20.0	23.2	46.0
3.939000	31.3	1000.0	9.000	Off	N	20.1	14.7	46.0
12.192000	28.4	1000.0	9.000	Off	N	20.2	21.6	50.0
15.409500	29.3	1000.0	9.000	Off	N	20.3	20.7	50.0

2.3 99% EMISSION BANDWIDTH

2.3.1 Specification Reference

Part 2 Subpart C §2.202(a)

2.3.2 Standard Applicable

(a) Occupied bandwidth. The frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission. In some cases, for example multichannel frequency-division systems, the percentage of 0.5 percent may lead to certain difficulties in the practical application of the definitions of occupied and necessary bandwidth; in such cases a different percentage may prove useful.

2.3.3 Equipment Under Test and Modification State

Serial No: 900F4108 / Test Configuration A

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

December 08, 12, 20, 22 and 27, 2016/NS

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 Location

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	23.8-24.7 °C
Relative Humidity	40.8-43.8 %
ATM Pressure	99.1-99.5 kPa

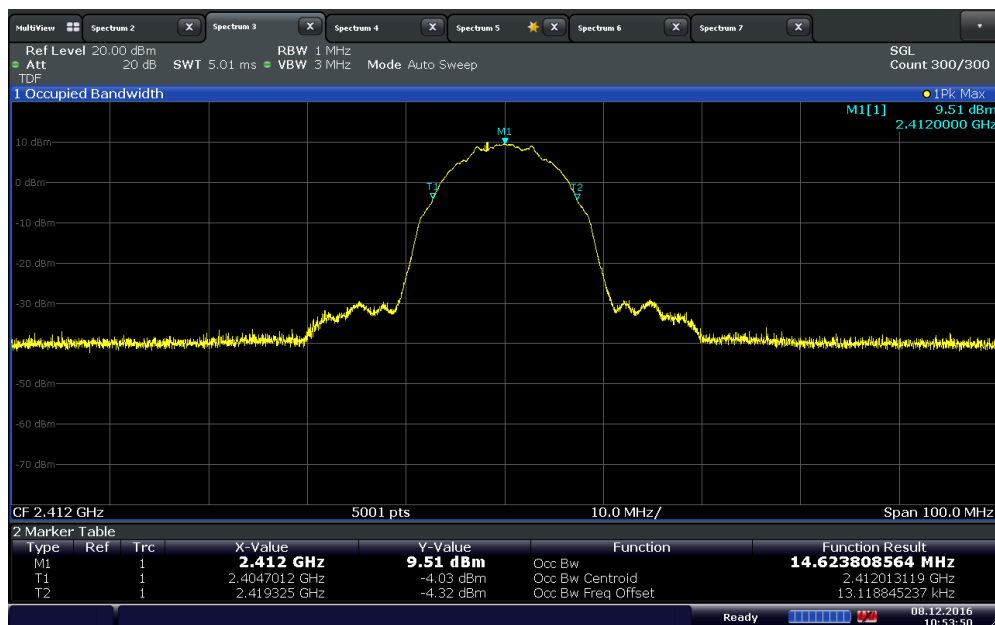
2.3.7 Additional Observations

- This is a conducted test.
- TDF (Transducer Factor) was used 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 analyser was set to 99% (default).
- The Channel Bandwidth measurement function of the spectrum analyser was used for this test.

2.3.8 Test Results (For reporting purposes only)

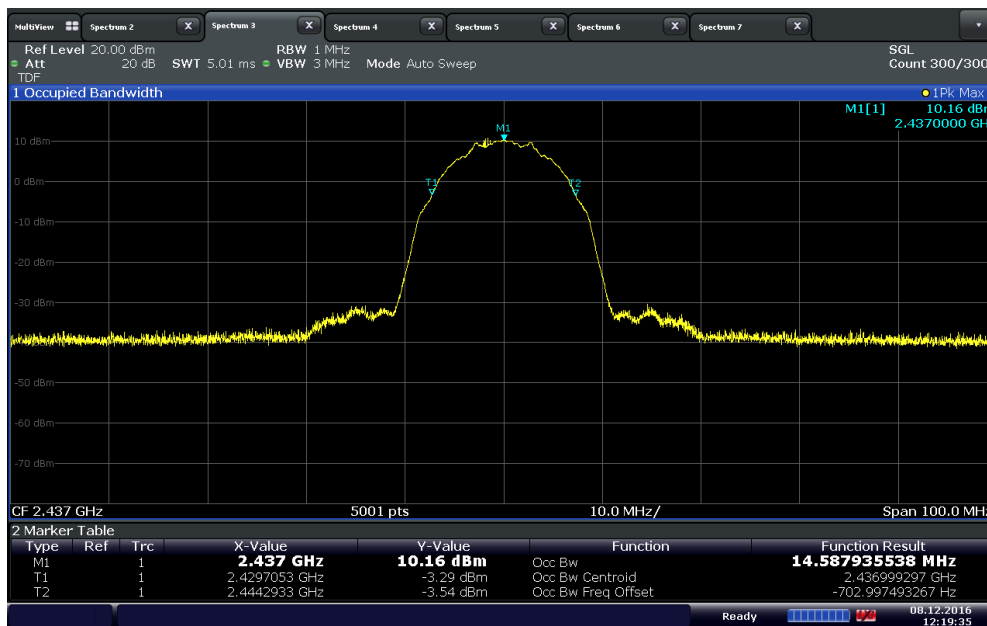
Mode	Channel	Measured 99% Bandwidth (MHz)
802.11b	1 (2412 MHz)	14.624
	6 (2437 MHz)	14.588
	11 (2462 MHz)	14.558
802.11g	1 (2412 MHz)	18.412
	6 (2437 MHz)	18.498
	11 (2462 MHz)	18.701
802.11n	1 (2412 MHz)	19.356
	6 (2437 MHz)	19.507
	11 (2462 MHz)	19.676

2.3.9 Sample Test Results Plots



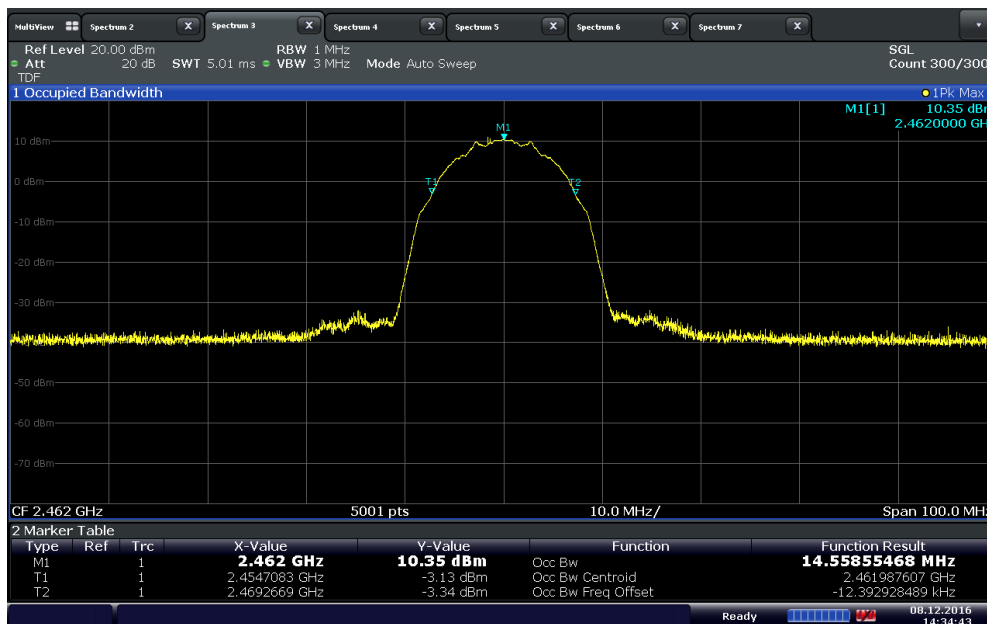
10:53:50 08.12.2016

802.11b Low Channel



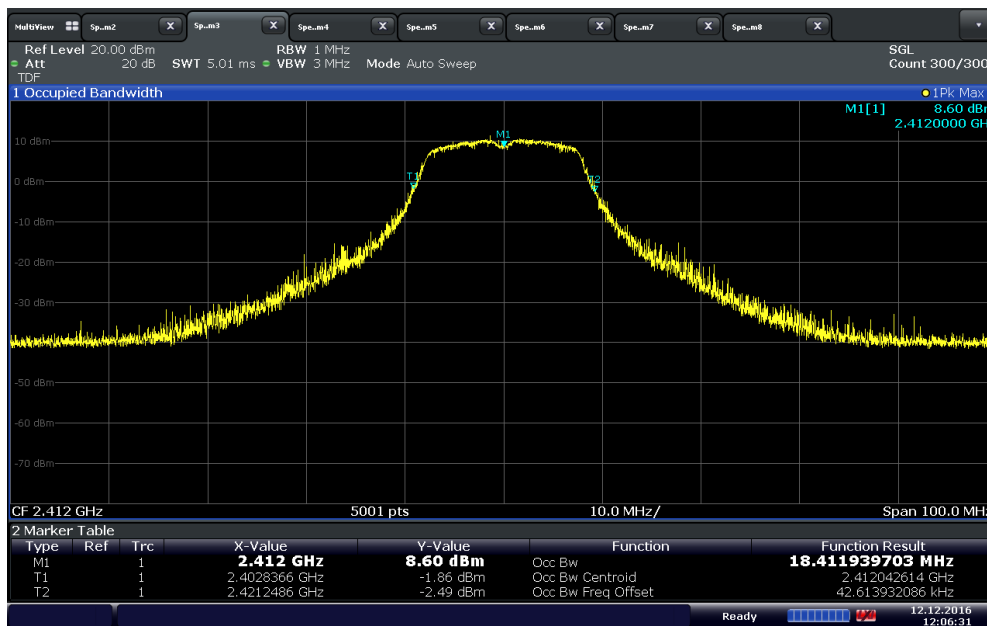
12:19:35 08.12.2016

802.11b Mid Channel



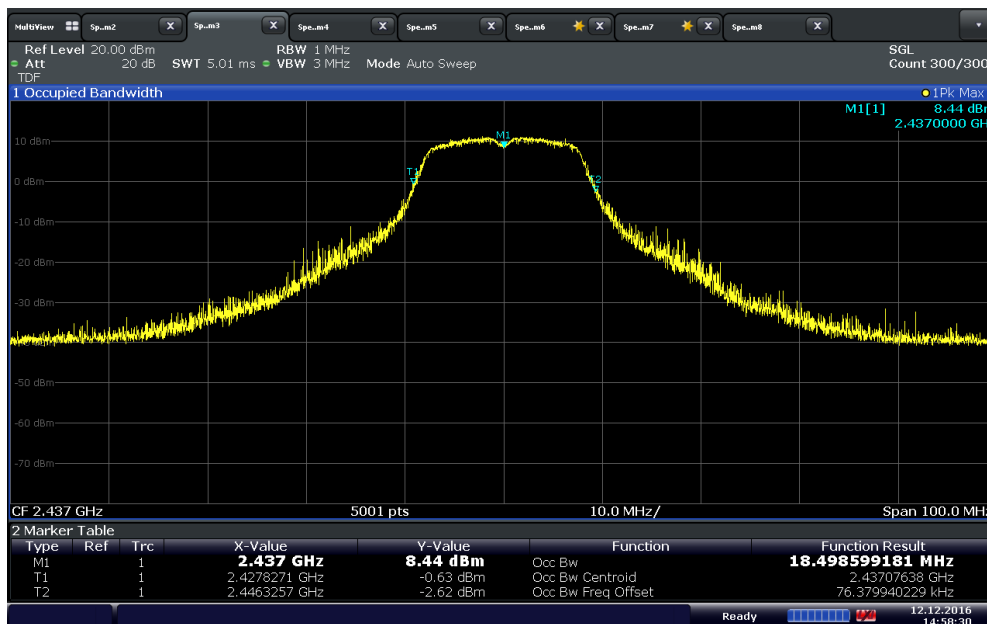
14:34:43 08.12.2016

802.11b High Channel



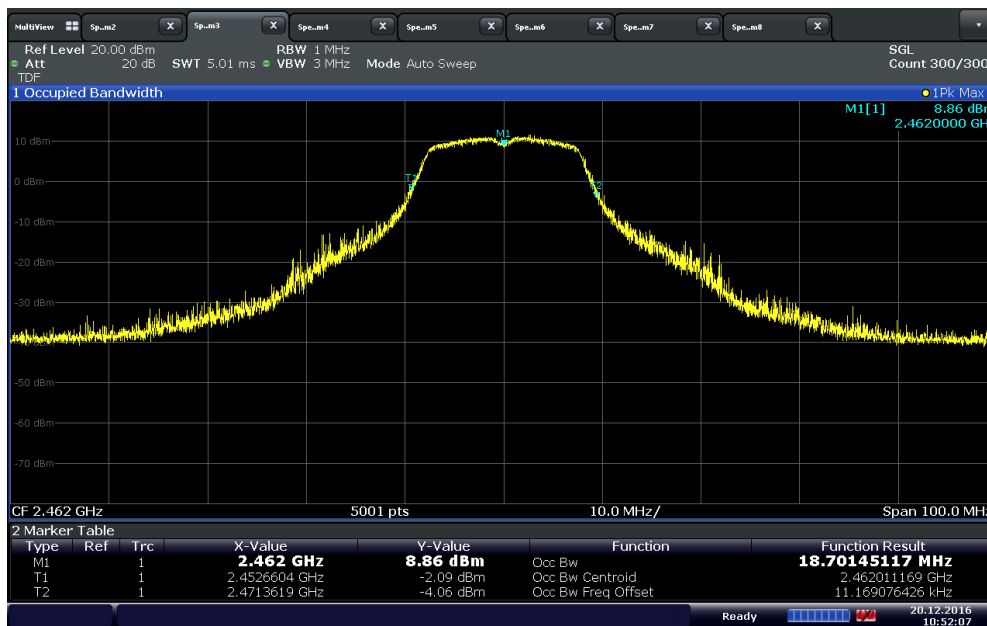
12:06:31 12.12.2016

802.11g Low Channel



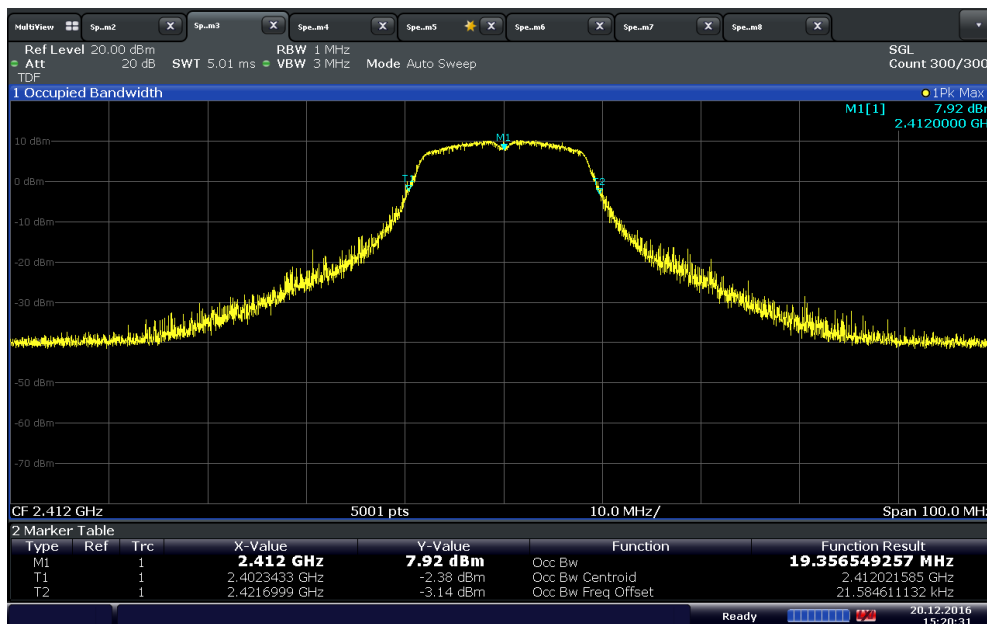
14:58:31 12.12.2016

802.11g Mid Channel



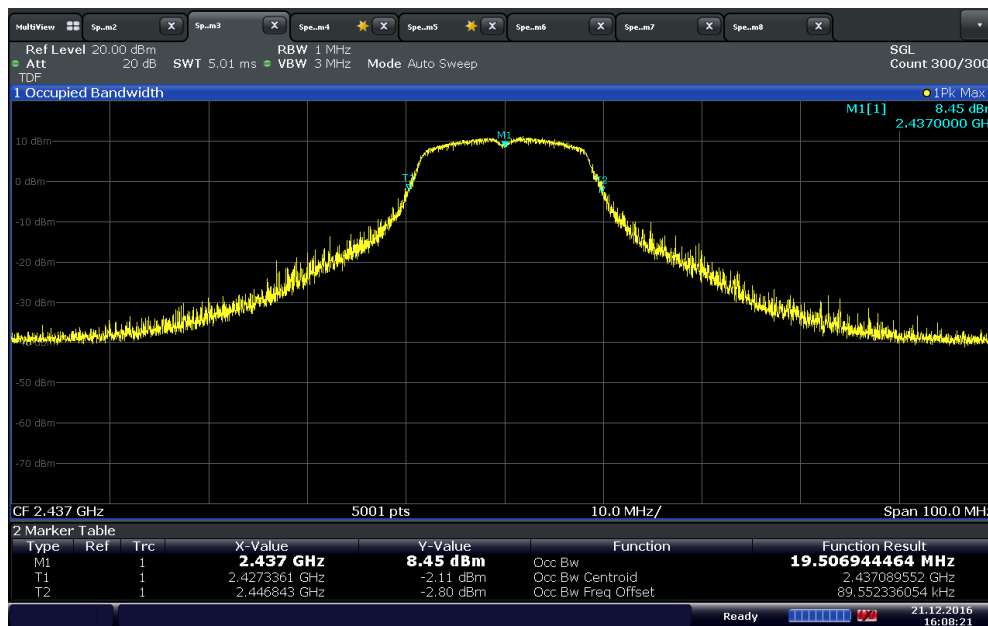
10:52:08 20.12.2016

802.11g High Channel



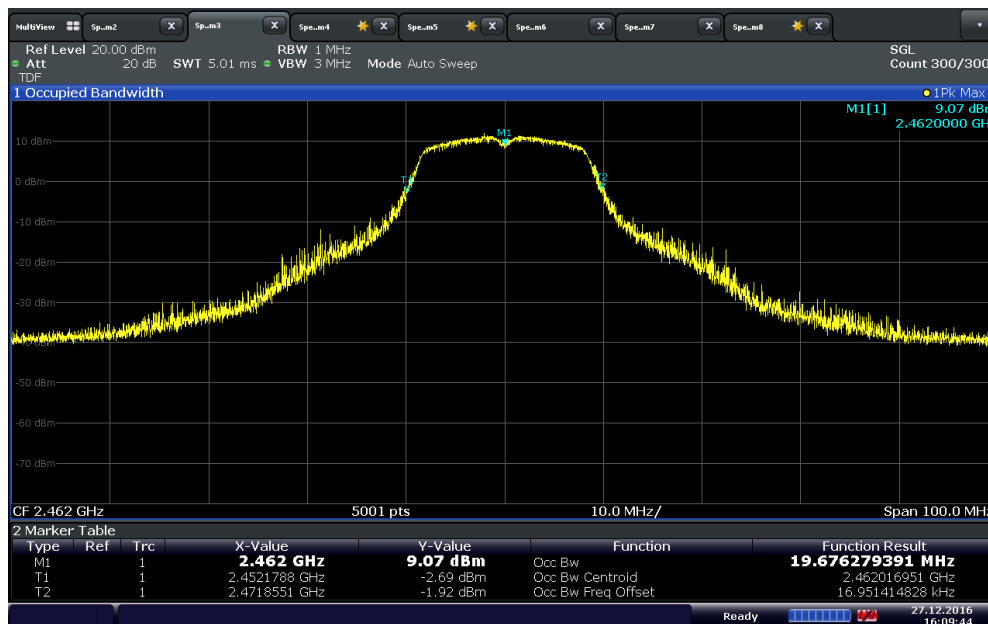
15:20:32 20.12.2016

802.11n Low Channel



16:08:22 21.12.2016

802.11n Mid Channel



16:09:44 21.12.2016

802.11n High Channel



2.4 MINIMUM 6 DB RF BANDWIDTH

2.4.1 Specification Reference

Part 15 Subpart C §15.247(a)(2)

2.4.2 Standard Applicable

(2) Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

2.4.3 Equipment Under Test and Modification State

Serial No: 900F4108 / Test Configuration A

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

December 08, 12, 20, 22 and 27, 2016/NS

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 Location

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	23.8-24.7 °C
Relative Humidity	40.8-48.8 %
ATM Pressure	99.1-99.5 kPa

2.4.7 Additional Observations

- This is a conducted test.
- TDF (Transducer Factor) was used to compensate for the external attenuator and cable used.
- Span is wide enough to capture the channel transmission.
- RBW was set to 100 kHz while VBW is $\geq 3X$ RBW.
- Sweep is auto while Detector used is peak.
- If the “n” dB down marker function of the spectrum analyser is not appropriate for the type of signal being measured. The BW will be measured using the outermost points where the signal is 6 dB down from the peak measurement.

2.4.8 Test Results

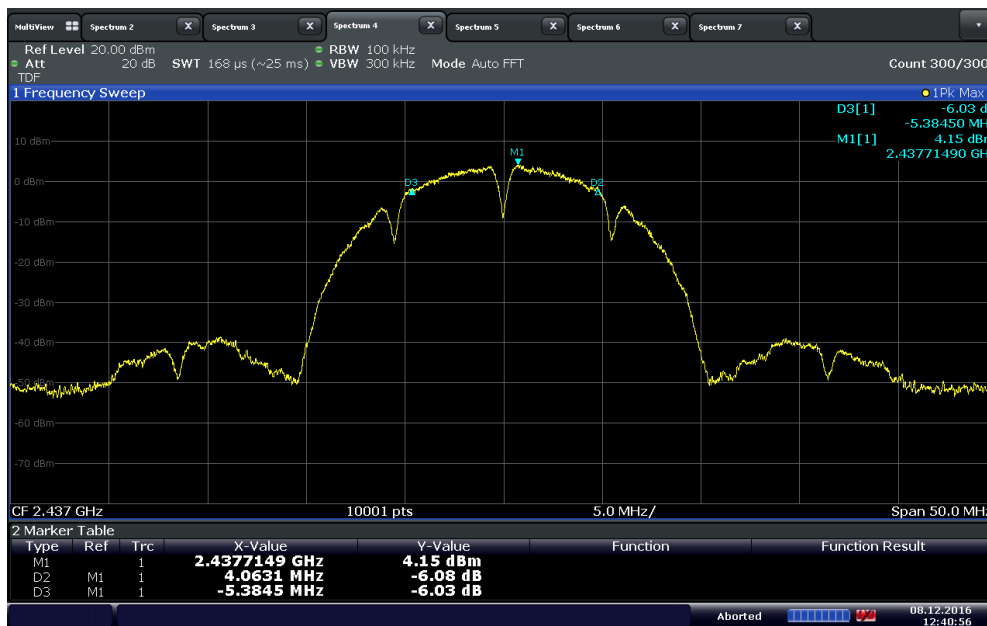
Mode	Channel	Measured Bandwidth (MHz)	Minimum Bandwidth (MHz)	Compliance
802.11b	1 (2412 MHz)	9.2051	0.500	Complies
	6 (2437 MHz)	9.4476	0.500	Complies
	11 (2462 MHz)	9.0501	0.500	Complies
802.11g	1 (2412 MHz)	16.3394	0.500	Complies
	6 (2437 MHz)	16.0669	0.500	Complies
	11 (2462 MHz)	16.0459	0.500	Complies
802.11n	1 (2412 MHz)	17.5642	0.500	Complies
	6 (2437 MHz)	17.5468	0.500	Complies
	11 (2462 MHz)	17.4857	0.500	Complies

2.4.9 Test Results Plots



11:28:17 08.12.2016

802.11b Low Channel



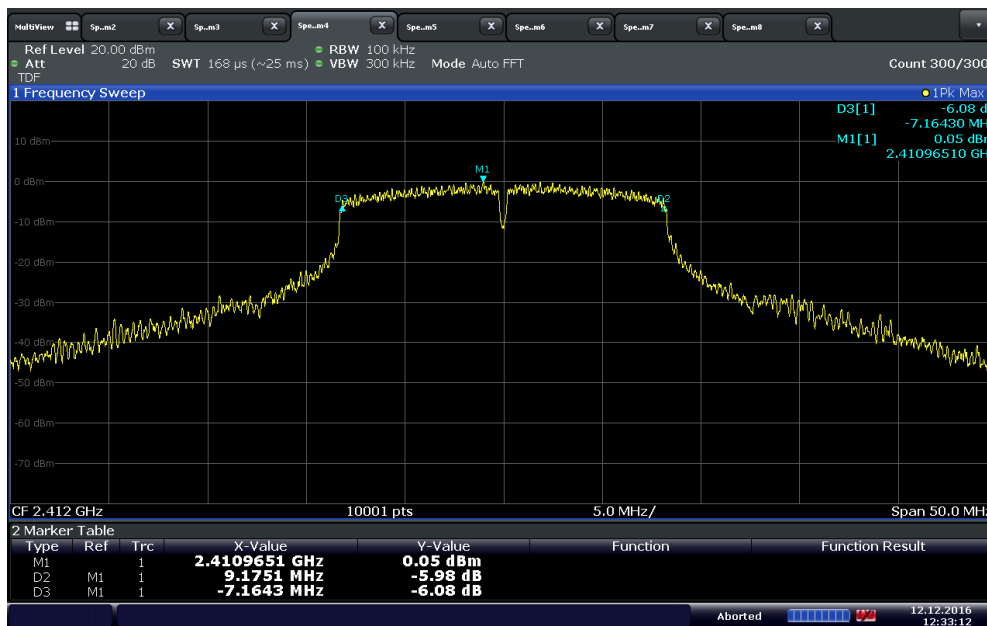
12:40:57 08.12.2016

802.11b Mid Channel



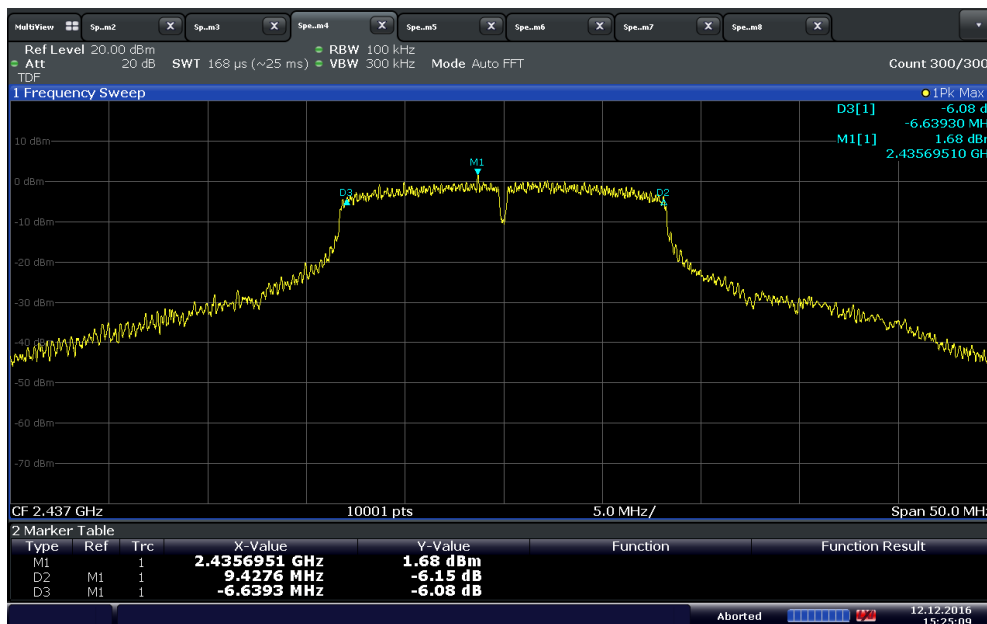
14:48:46 08.12.2016

802.11b High Channel



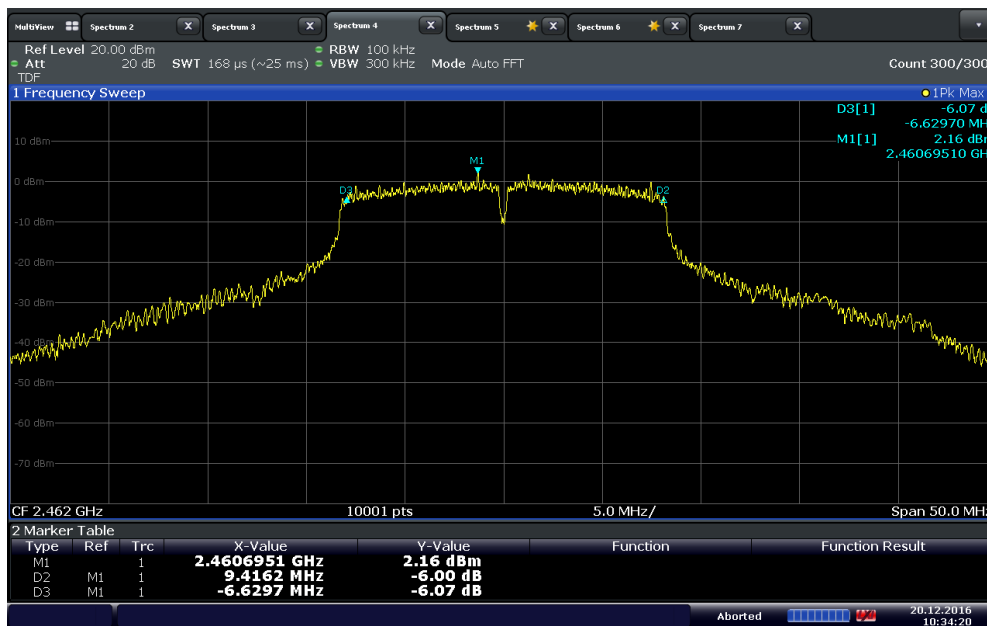
12:33:13 12.12.2016

802.11g Low Channel



15:25:10 12.12.2016

802.11g Mid Channel



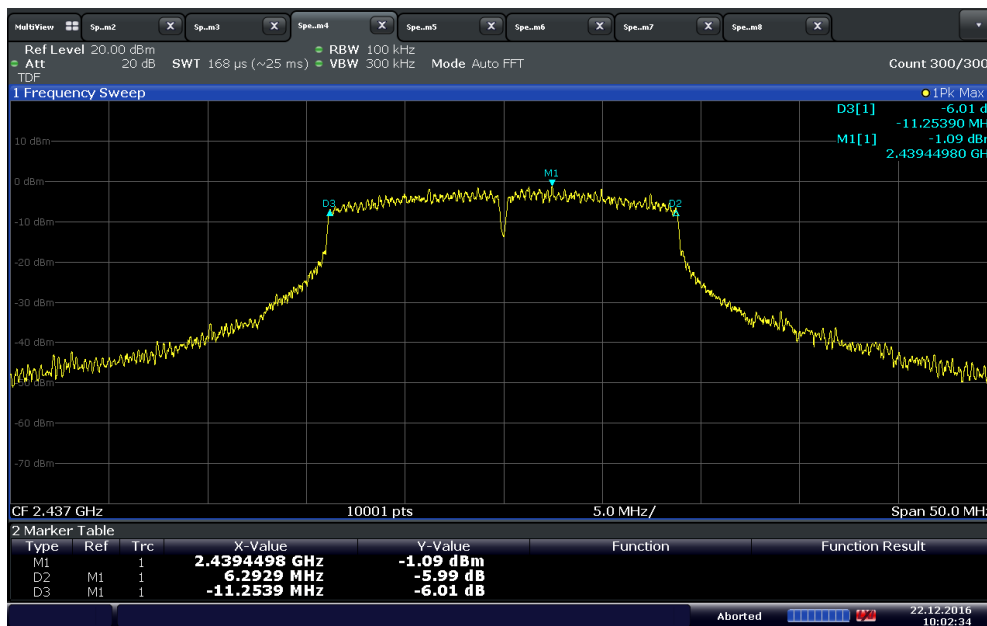
10:34:21 20.12.2016

802.11g High Channel



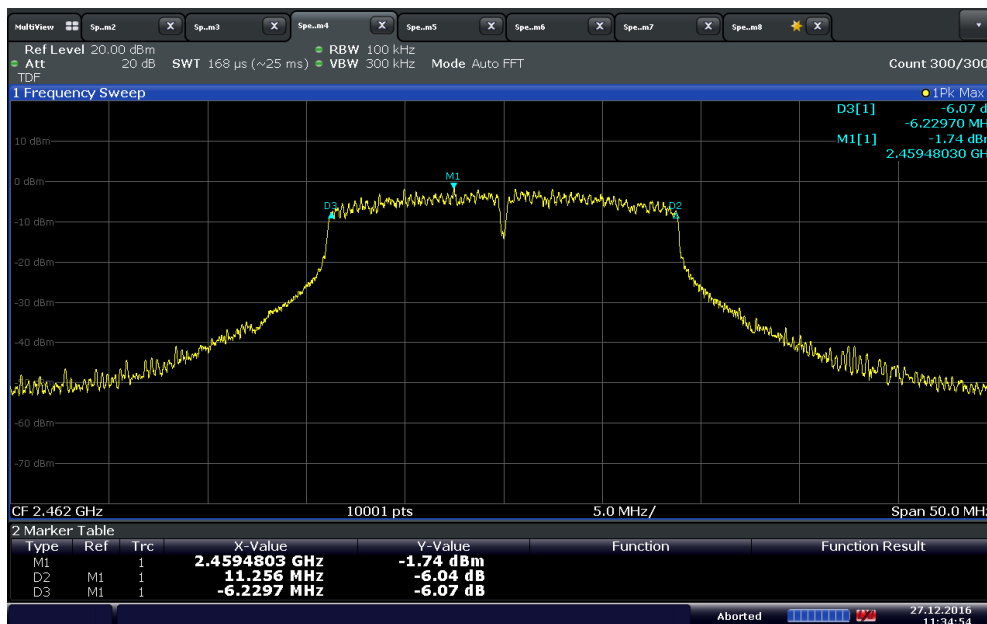
15:25:17 20.12.2016

802.11n Low Channel



10:02:35 22.12.2016

802.11n Mid Channel



11:34:54 27.12.2016

802.11n High Channel



2.5 OUT-OF-BAND EMISSIONS - CONDUCTED

2.5.1 Specification Reference

Part 15 Subpart C §15.247(d)

2.5.2 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)).

2.5.3 Equipment Under Test and Modification State

Serial No: 900F4108 / Test Configuration A

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

December 08, 12, 20-21 and 27, 2016/NS

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 Location

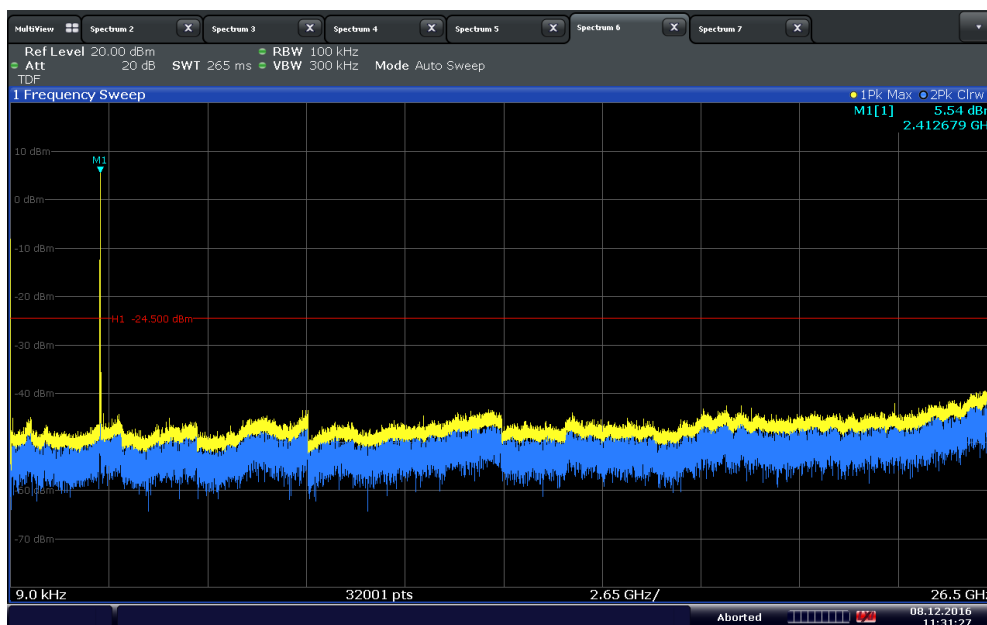
Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	23.8-24.7 °C
Relative Humidity	40.8-48.8 %
ATM Pressure	99.1-99.5 kPa

2.5.7 Additional Observations

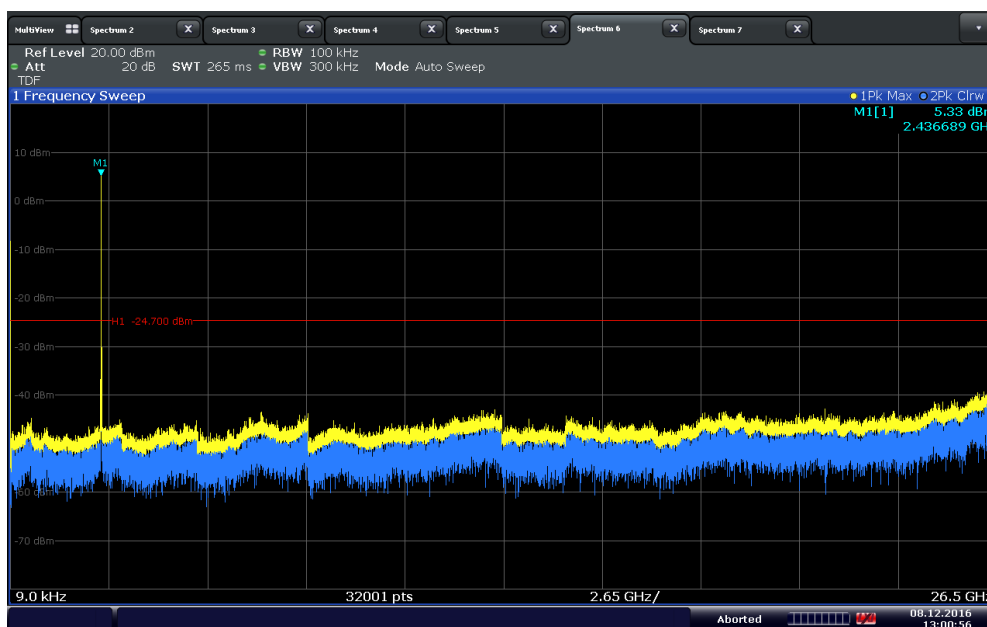
- This is a conducted test.
- TDF (Transducer Factor) was used to compensate for the external attenuator and cable used.
- RBW is 100kHz.VBW is 3X RBW.
- Sweep is auto. Detector is peak. Trace is max hold.
- Initial scan was performed to determine the highest level of the desired power within the band. Limit (display line) was drawn 30dB below this level (worst case).
- Spectrum was searched from 9 kHz up to 26.5GHz.

2.5.8 Test Results Plots



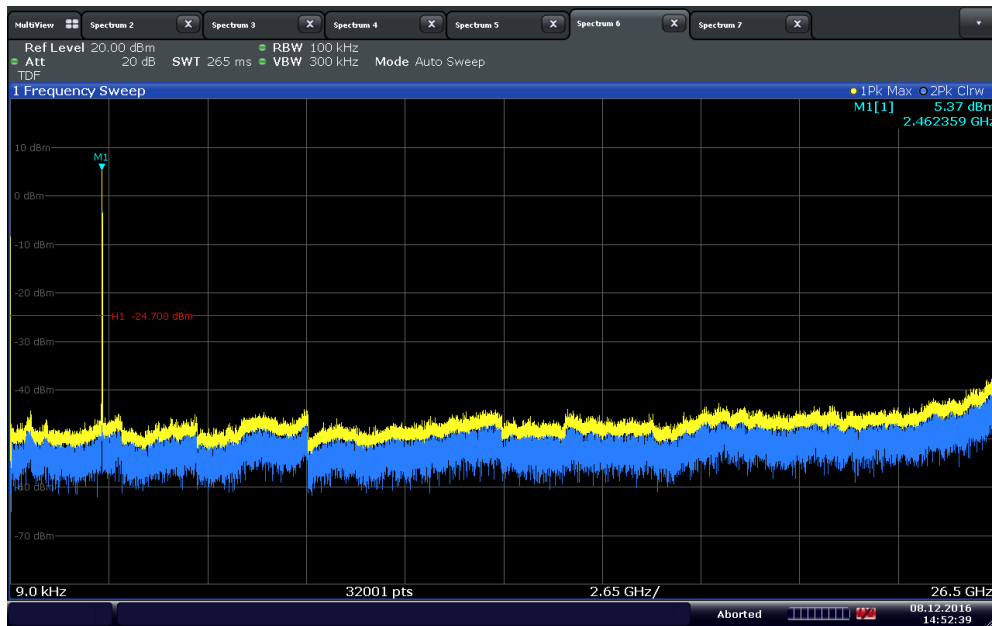
11:31:27 08.12.2016

802.11b Low Channel



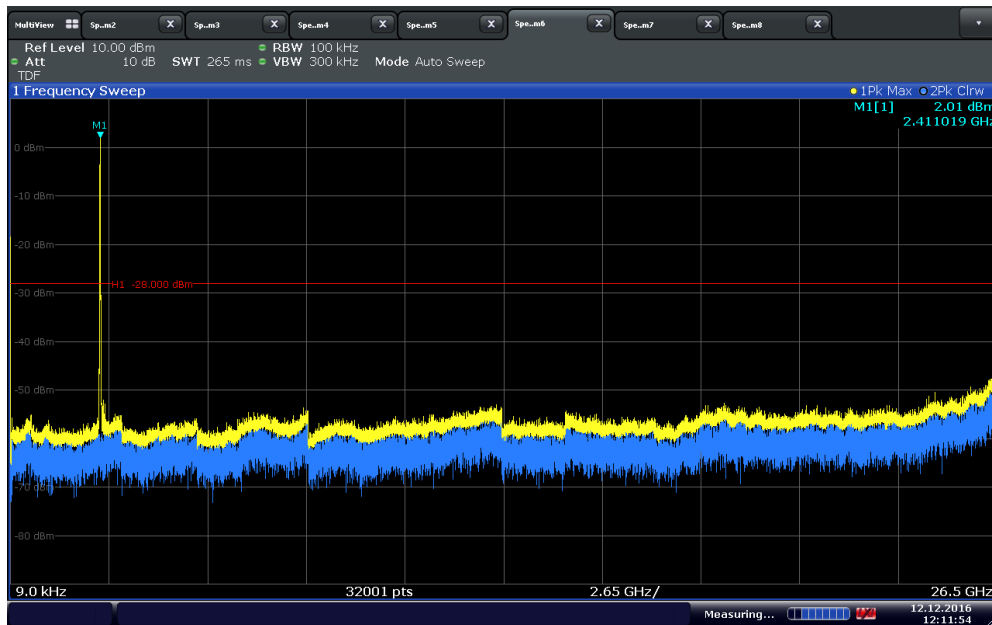
13:00:56 08.12.2016

802.11b Mid Channel



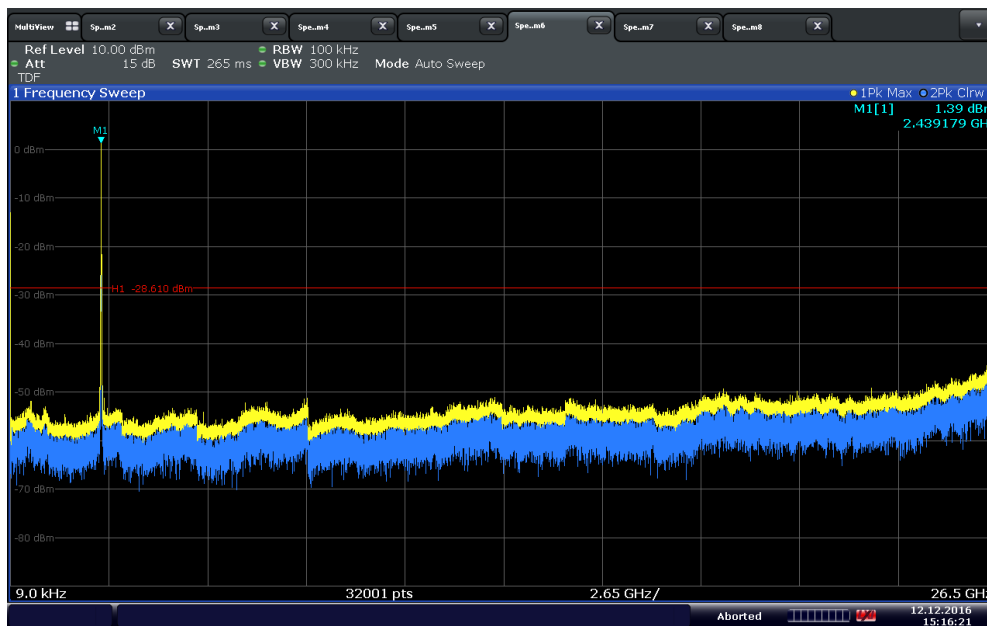
14:52:40 08.12.2016

802.11b High Channel



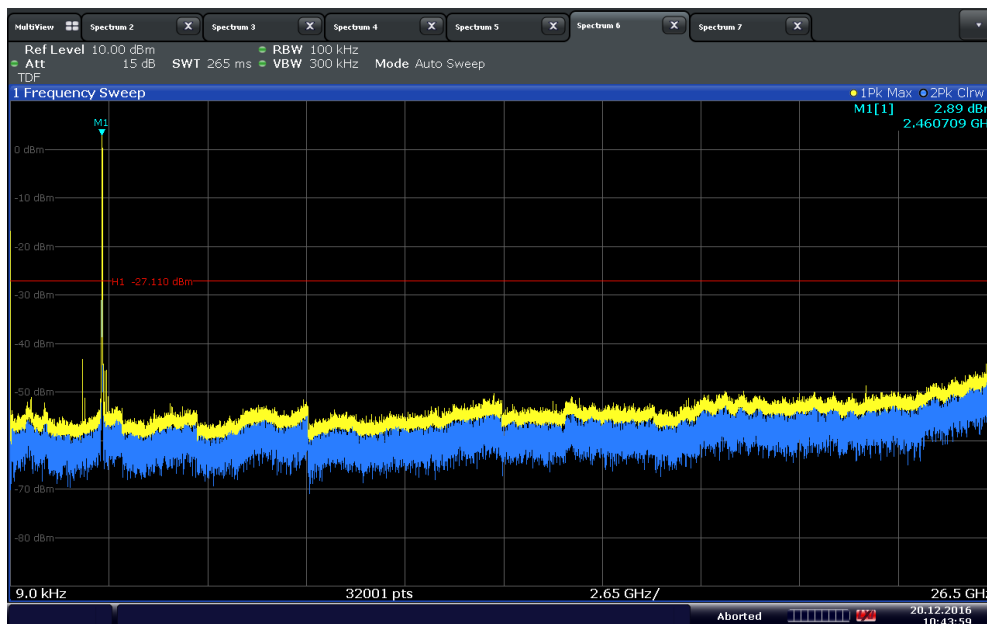
12:11:54 12.12.2016

802.11g Low Channel



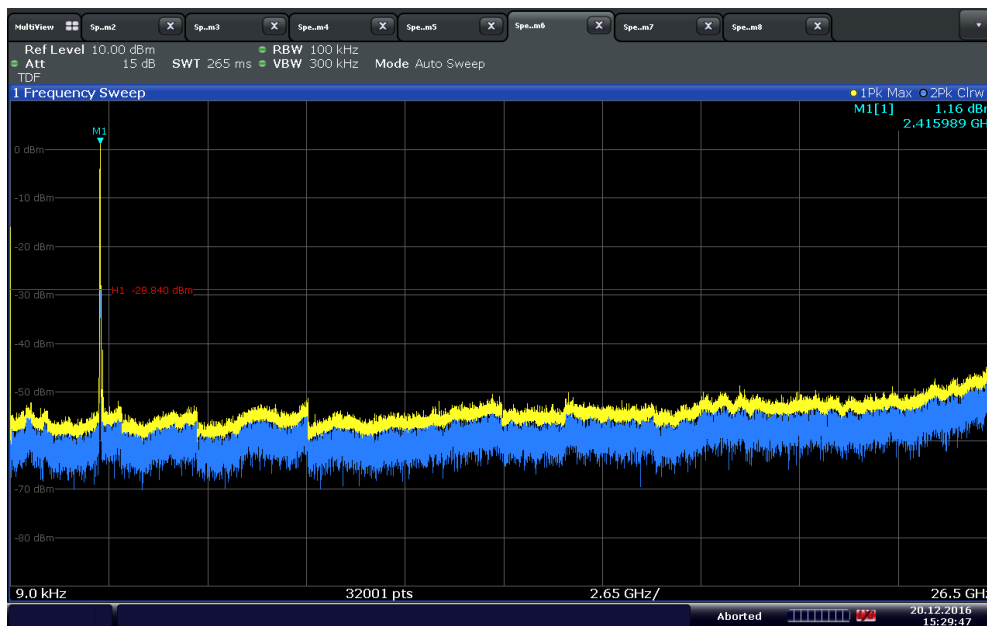
15:16:22 12.12.2016

802.11g Mid Channel



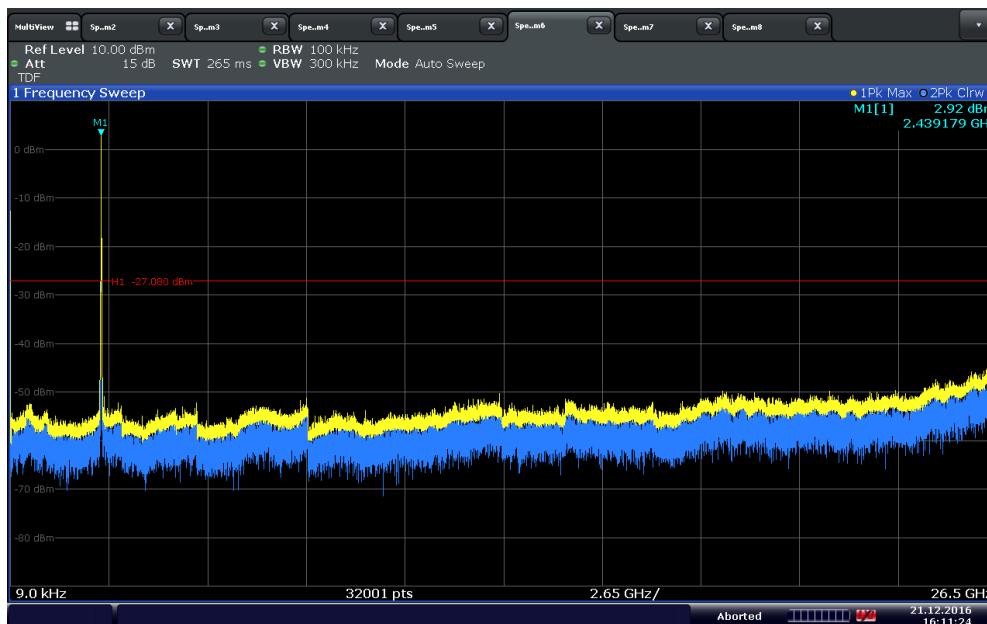
10:44:00 20.12.2016

802.11g High Channel



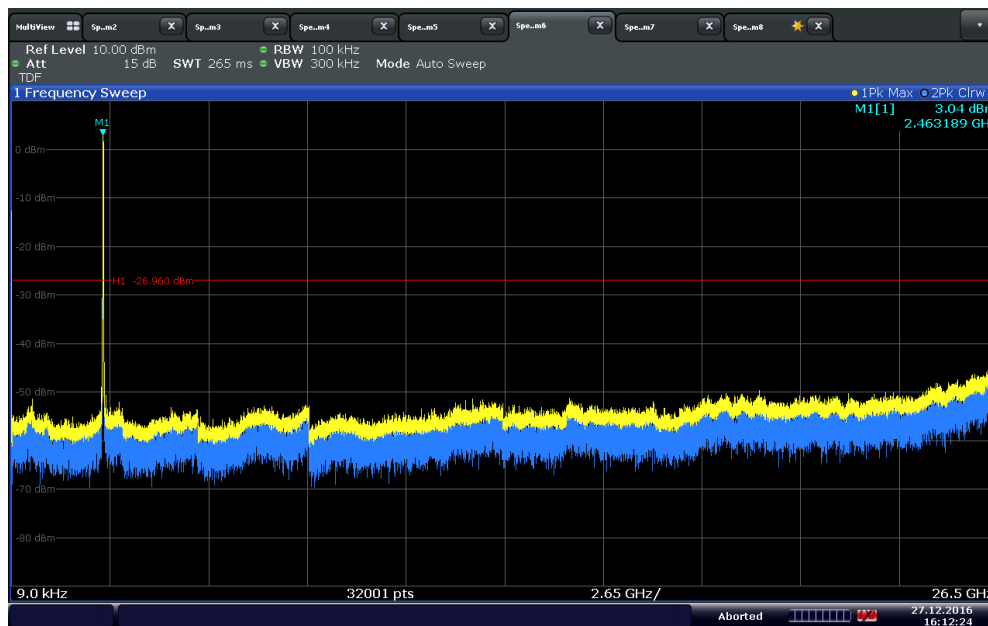
15:29:47 20.12.2016

802.11n Low Channel



16:11:25 21.12.2016

802.11n Mid Channel



16:12:25 27.12.2016

802.11n High Channel

2.6 BAND-EDGE COMPLIANCE OF RF CONDUCTED EMISSIONS

2.6.1 Specification Reference

Part 15 Subpart C §15.247(d)

2.6.2 Standard Applicable

See previous test.

2.6.3 Equipment Under Test and Modification State

Serial No: 900F4108 / Test Configuration A

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

December 12 and 21, 2016/NS

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 Location

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

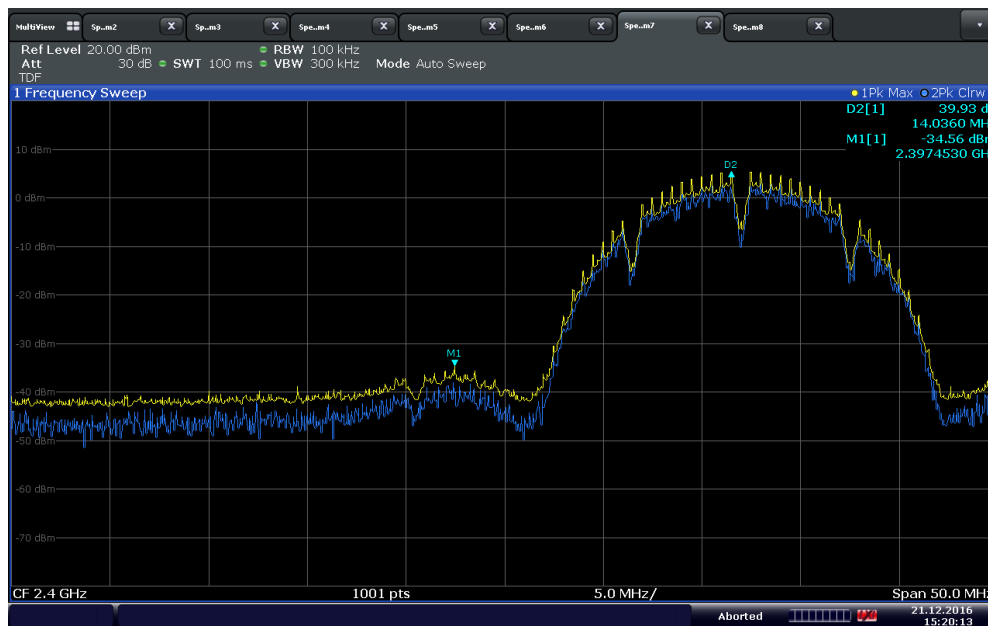
Ambient Temperature	23.8 - 24.3 °C
Relative Humidity	40.8 – 48.8 %
ATM Pressure	99.1 – 99.5 kPa

2.6.7 Additional Observations

- This is a conducted test.
- TDF (Transducer Factor) was used to compensate for the external attenuator and cable used.
- Procedure is per Clause 11 of KDB558074.
- Only the results for lower Band Edge are presented under this section. The upper Band Edge emissions comply with the general limits specified in § 15.209(a) as shown in the sections 2.7.19-2.7.21 of this test report.

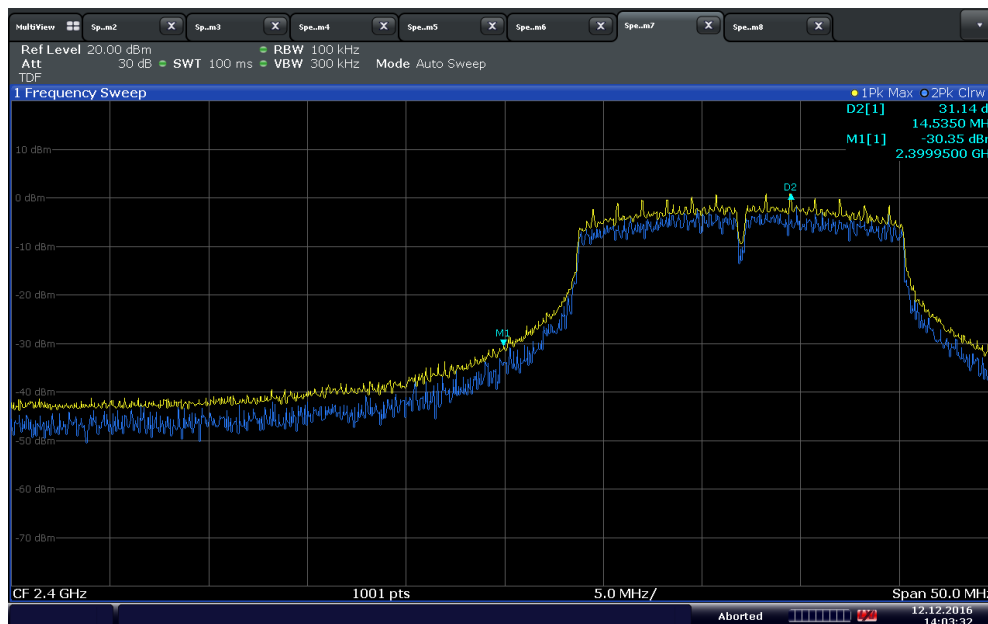
2.6.8 Test Results

Complies. See attached plots.



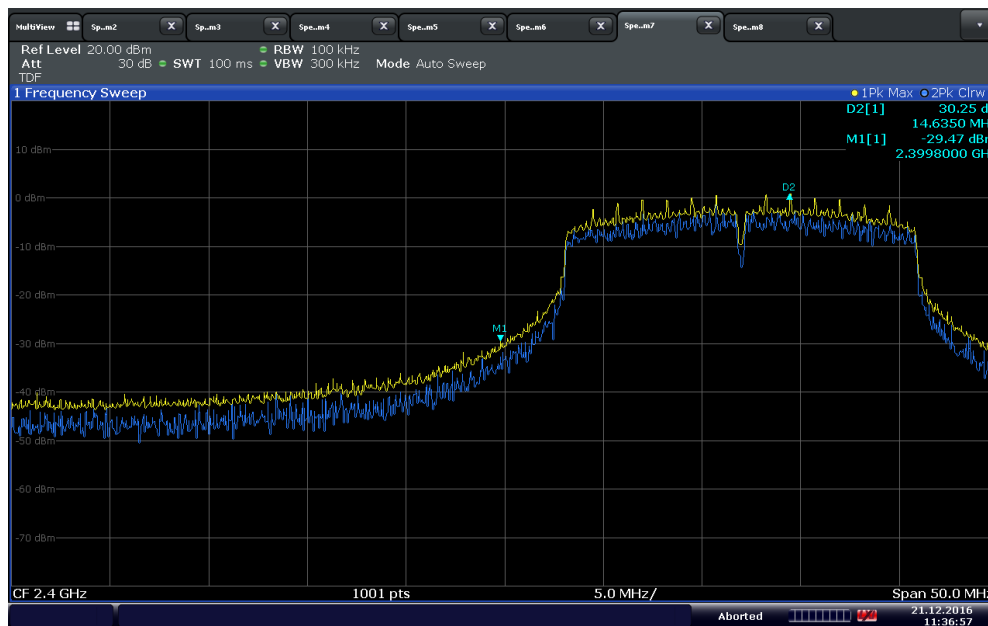
15:20:13 21.12.2016

802.11b Low Channel (2412 MHz)



14:03:32 12.12.2016

802.11g Low Channel (2412 MHz)



11:36:57 21.12.2016

802.11n Low Channel (2412 MHz)