Excellence in Compliance Testing

Certification Test Report

FCC ID: Z4D173503
IC: 9973A-173503

FCC Rule Part: 15.247
IC Radio Standards Specification: RSS-210

ACS Report Number: 14-2023.W06.1A

Applicant: Sunbeam Products, Inc. d/b/a Jarden Consumer Solutions
Model(s): 173503

Test Begin Date: **February 14, 2014**
Test End Date: **April 10, 2014**

Report Issue Date: April 11, 2014

ACCREDITED TESTING

FOR THE SCOPE OF ACCREDITATION UNDER CERTIFICATE NUMBER AT-1533

This report must not be used by the client to claim product certification, approval, or endorsement by ACLASS, ANSI, or any agency of the Federal Government.

Project Manager:

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Reviewed by:

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This report contains 82 pages

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1 GENERAL

1.1 Purpose

The purpose of this report is to demonstrate compliance with Part 15 Subpart C of the FCC's Code of Federal Regulations and Industry Canada's Radio Standards Specification RSS-210 for a limited modular approval.

1.2 Applicant Information

Sunbeam Products, Inc. d/b/a Jarden Consumer Solutions
2381 NW Executive ctr dr.
Boca Raton, FL 33433

1.3 Product Description

The model 173503, WeMo SMART module, is an 2.4 GHz IEEE 802.11b/g/n transceiver. The device is designed to provide some wireless functionality to appliances using Belkin's WASP (WeMo Appliance Software Protocol).

Technical Details

Mode of Operation:	WLAN 802.11b/g/n
Frequency Range:	802.11b/g: 2412 MHz - 2462 MHz
	802.11n 20 MHz: 2412 MHz - 2462 MHz
	802.11n 40 MHz: 2422 MHz - 2452 MHz
Number of Channels:	802.11b/g: 11
	802.11n 20 MHz: 11
	802.11n 40 MHz: 7
Channel Separation:	5 MHz
Modulations:	802.11b: CCK
	802.11g/n: OFDM
Antenna Type/Gain:	Printed Inverted F Antenna, 1.4 dBi
Input Power:	5 VDC

Model Number: 173503

Test Sample Serial Number(s): 221351S0000062

Test Sample Condition: The equipment was provided in good condition without any physical damage.

1.4 Test Methodology and Considerations

The EUT was configured with an RS232 and a LAN cable adapter for programming purposes. A FAIR-RITE model 0431173951 ferrite was used to reduce the emissions for these cables.

The EUT was evaluated for radiated, power line and RF conducted emissions for all modes of operations. Preliminary evaluation was performed to determine the worst case data rate configuration for each mode based on RF output power measurement. Where applicable, the results are provided for the worst case, based on the RF output power measurements..

The equipment is designed to be integrated inside specific hosts. The radiated and power line conducted emissions evaluations was performed with the equipment integrated inside of a slow cooker, as described in this document. The digital circuit of the slow cooker was in the idle state during the evaluation. In

order for the host to comply to the power line conducted emission requirements, it was modified with a 0.22 uF capacitor (Carli 22K275V-X2) on the AC Line.

The EUT was programmed through the RS232 cable addapter using Hyperterminal communication. The settings and configurations for the final evaluation are provided below.

Table 1.4-1: 802.1b/g/n Radio Test Configuration

Mode of Operation	Frequency (MHz)	Channel	Test Software Power Setting	Data Rate Setting)
802.11b	2412	1	14	MCS 3
	2437	6		
	2462	11		
802.11g	2412	1	15	MCS 0
	2437	6		
	2462	11		
802.11n 20 MHz	2412	1	10	
	2437	6		
	2462	11		
802.11n 40 MHz	2422	3		
	2437	6		
	2452	9		

Per the applicant, the implementation of the module is limited to appliances exclusively. Therefore, the equipment is exempted from the requirements of FCC 15.109 and Industry Canada ICES-003, in accordance to FCC Section 15.103(d) and ICES-003 Section 4(d), respectively.

2 TEST FACILITIES

2.1 Location

The radiated and conducted emissions test sites are located at the following address:

Advanced Compliance Solutions, Inc.
3998 FAU Blvd, Suite 310
Boca Raton, Florida 33431
Phone: (561) 961-5585
Fax: (561) 961-5587
www.acstestlab.com

FCC Test Firm Registration #: 475089
Industry Canada Lab Code: 4175C

2.2 Laboratory Accreditations/Recognitions/Certifications

ACS is accredited to ISO/IEC 17025 by ANSI-ASQ National Accreditation Board under their ACLASS program and has been issued certificate number AT-1533 in recognition of this accreditation. Unless otherwise specified, all test methods described within this report are covered under the ISO/IEC 17025 scope of accreditation.

2.3 Radiated & Conducted Emissions Test Site Description

2.3.1 Semi-Anechoic Chamber Test Site

The EMC radiated test facility consists of an RF-shielded enclosure. The interior dimensions of the indoor semi-anechoic chamber are approximately 48 feet (14.6 m) long by 36 feet (10.8 m) wide by 24 feet (7.3 m) high and consist of rigid, 1/8 inch (0.32 cm) steel-clad, wood core modular panels with steel framing. In the shielded enclosure, the faces of the panels are galvanized and the chamber is self-supporting. 8-foot RF absorbing cones are installed on 4 walls and the ceiling. The steel-clad ground plane is covered with vinyl floor.

The turntable is driven by pneumatic motor, which is capable of supporting a 2000 lb. load. The turntable is flushed with the chamber floor which it is connected to, around its circumference, with a continuous metallic loaded spring. An EMCO Model 1050 Multi-device Controller controls the turntable position.

A pneumatic motor is used to control antenna polarizations and height relative to the ground. The height information is displayed on the control unit EMCO Model 1050.

The control room is an RF shielded enclosure attached to the semi-anechoic chamber with two bulkhead panels for connecting RF, and control cables. The dimension of the room is 7.3 m x 4.9 m x 3 m high and the entrance doors of both control and conducted rooms are 3 feet (0.91 m) by 7 feet (2.13 m).

A diagram of the Semi-Anechoic Chamber Test Site is shown in Figure 2.3.1-1 below:

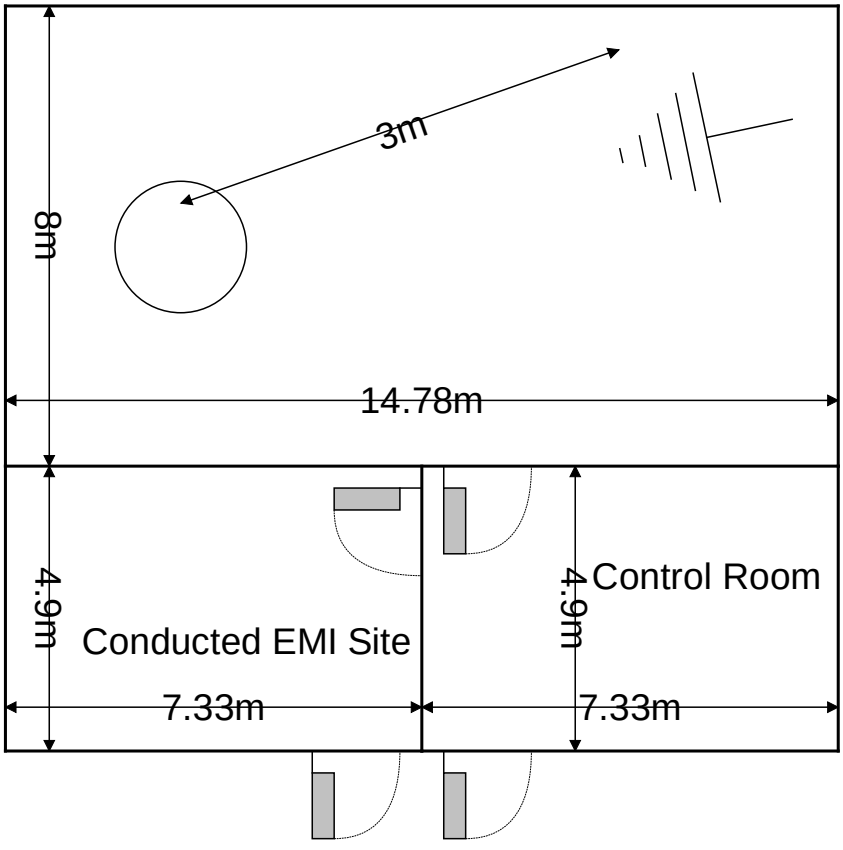


Figure 2.3.1-1: Semi-Anechoic Chamber Test Site

2.3.2 Conducted Emissions Test Site Description

The dimensions of the shielded conducted room are 7.3 x 4.9 x 3 m^3. As per ANSI C63.4 2003 requirements, the data were taken using two LISNs; a Solar Model 8028-50 50 Ω/50 µH and an EMCO Model 3825, which are installed as shown in Photograph 3. For 220 V, 50 Hz, a Polarad LISN (S/N 879341/048) is used in conjunction with a 1 kVA, 50 Hz/220 V EDGAR variable frequency generator, Model 1001B, to filter conducted noise from the generator.

A diagram of the room is shown below in figure 2.3.2-1:

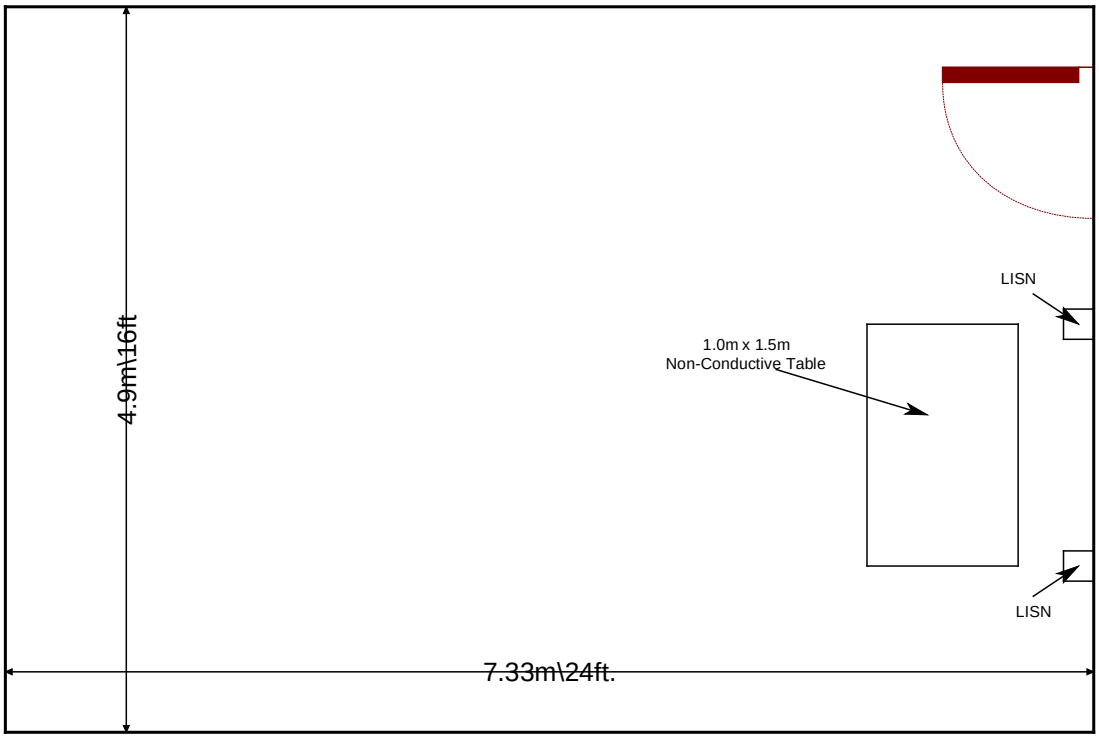


Figure 2.3.2-1: AC Mains Conducted EMI Site

3 APPLICABLE STANDARD REFERENCES

The following standards were used:

- ANSI C63.4-2003: Method of Measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the 9 kHz to 40 GHz.
- ANSI C63.10-2009: American National Standard for Testing Unlicensed Wireless Devices.
- US Code of Federal Regulations (CFR): Title 47, Part 2, Subpart J: Equipment Authorization Procedures, 2014.
- US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2014
- KDB Publication No. 558074 D01 DTS Meas Guidance v03r01 – Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under 15.247, April 9, 2013.
- Industry Canada Radio Standards Specification: RSS-210 - Low-power License-exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment, Issue 8 December 2010.
- Industry Canada Radio Standards Specification: RSS-GEN – General Requirements and Information for the Certification of Radiocommunication Equipment, Issue 3, December 2010.

4 LIST OF TEST EQUIPMENT

The calibration interval of test equipment is annually or the manufacturer's recommendations. Where the calibration interval deviates from the annual cycle based on the instrument manufacturer's recommendations, it shall be stated below.

Table 4-1: Test Equipment

AssetID	Manufacturer	Model #	Equipment Type	Serial #	Last Calibration Date	Calibration Due Date
523	Agilent	E7405	Spectrum Analyzers	MY45103293	1/8/2013	1/8/2015
2002	EMCO	3108	Antennas	2147	11/22/2013	11/22/2015
2004	EMCO	3146	Antennas	1385	11/22/2013	11/22/2015
2006	EMCO	3115	Antennas	2573	4/24/2013	4/24/2015
2008	COM-Power	AH-826	Antennas	81009	NCR	NCR
2011	Hewlett-Packard	HP 8447D	Amplifiers	2443A03952	12/31/2013	12/31/2014
2037	ACS Boca	Chamber EMI Cable Set	Cable Set	2037	1/1/2014	1/1/2015
2044	QMI	N/A	Cables	2044	12/31/2013	12/31/2014
2070	Mini Circuits	VHF-8400+	Filter	2070	1/1/2014	1/1/2015
2072	Mini Circuits	VHF-3100+	Filter	30737	1/1/2014	1/1/2015
2075	Hewlett Packard	8495B	Attenuators	2626A11012	1/2/2014	1/2/2015
2082	Teledyne Storm Products	90-010-048	Cables	2082	5/31/2013	5/31/2014
2086	Merrimac	FAN-6-10K	Attenuators	23148-83-1	12/31/2013	12/31/2014
2089	Agilent Technologies, Inc.	83017A	Amplifiers	3123A00214	12/16/2013	12/16/2014
2095	ETS Lindgren	TILE4! - Version 4.2.A	Software	85242	NCR	NCR
2022	EMCO	LISN3825/2R	LISN	1095	9/9/2013	9/9/2015
2045	QMI	N/A	Cables	2044	12/31/2013	12/31/2014
2095	ETS Lindgren	TILE4! - Version 4.2.A	Software	85242	NCR	NCR
3002	Rohde & Schwarz	ESU40	Receiver	100346	11/5/2013	11/5/2014
3004	Teseq	CFL 9206A	Attenuators	34720	10/21/2013	10/21/2015

NCR = No Calibration Required

5 SUPPORT EQUIPMENT

Table 5-1: EUT and Support Equipment – Radiated and Power Line Emission Setup

Item #	Type Device	Manufacturer or Responsible Party	Model/Part #	Serial #
1	EUT	Belkin	173503	221351S0000062
2	Slow Cooker	Jarden Consumer Solutions	SCCPWM600-V1	N/A
3	Ferrite	Fair-Rite	0431173951	N/A
4	Ethernet Jack	Mikroelektronika	HW Rev. 1.02	N/A
5	Isolation Transformer	Tripp-Lite	IS250	A420102B2

Notes:
The slow cooker is marketed in the US under the model SCCPWM600-V1 and in Canada under the model SCCPWM600-V1-033.
The isolation transformer was used per the manufacturer request to allow programming of the module in the host configuration. For the power line conducted emissions of evaluation, the isolation transformer was on the AC mains input side of the LISN.

Table 5-2: Cable Description – Radiated and Power Line Emission Setup

Cable #	Cable Type	Length	Shield	Termination
A	Power Cord	0.7m	No	EUT to Extension
B	Extension power cord	1.82 m	No	Extension to Power Supply
C	Power Cord	2 m	No	Power Supply to AC Mains
D	RS232 3-Wire cable	0.07 m	No	None
E	Ethernet Adapter Wires	0.1 m	No	EUT to Ethernet Jack

Note: Cable D and E were implemented on the EUT for programming purposes only. They are not a representative configuration of the equipment.

Table 5-3: EUT and Support Equipment – RF Conducted Setup

Item #	Type Device	Manufacturer	Model/Part #	Serial #
1	EUT	Belkin	173503	221351S0000062
2	WeMo Smart Test Fixture	Belkin	N/A	N/A
3	Ethernet Jack	Mikroelektronika	HW Rev. 1.02	N/A
4	Laptop	Dell	PP04X	CN-0XM006-48643-789-2125
5	AC Adapter	V-Infinity	EPS050100	N/A

Table 5-4: Cable Description– RF Conducted Setup

Cable #	Cable Type	Length	Shield	Termination
A	USB Cable	1.74 m	No	None
B	Power Cord	1.74 m	No	Test Fixture to AC Adapter
C	Ethernet Adapter Wires	0.1 m	No	EUT to Ethernet Jack
D	RS232 3-wire cable	0.07 m	No	EUT to USB Cable
E	USB cable	1.8 m	No	USB Port to Laptop

Note: Cable C and D were implemented on the EUT for programming purposes only. They are not a representative configuration of the equipment.
The USB cable # E is used for programming only.

6 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM

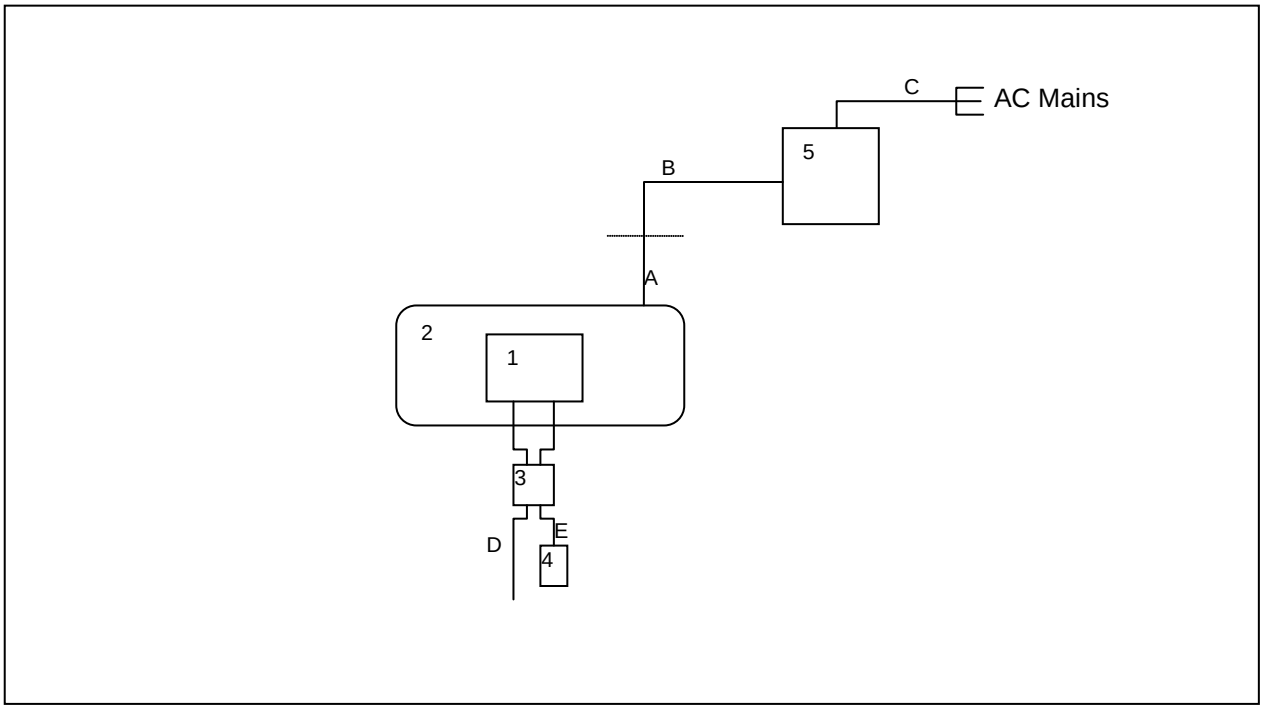


Figure 6-1: Radiated and Power Line Emission Setup

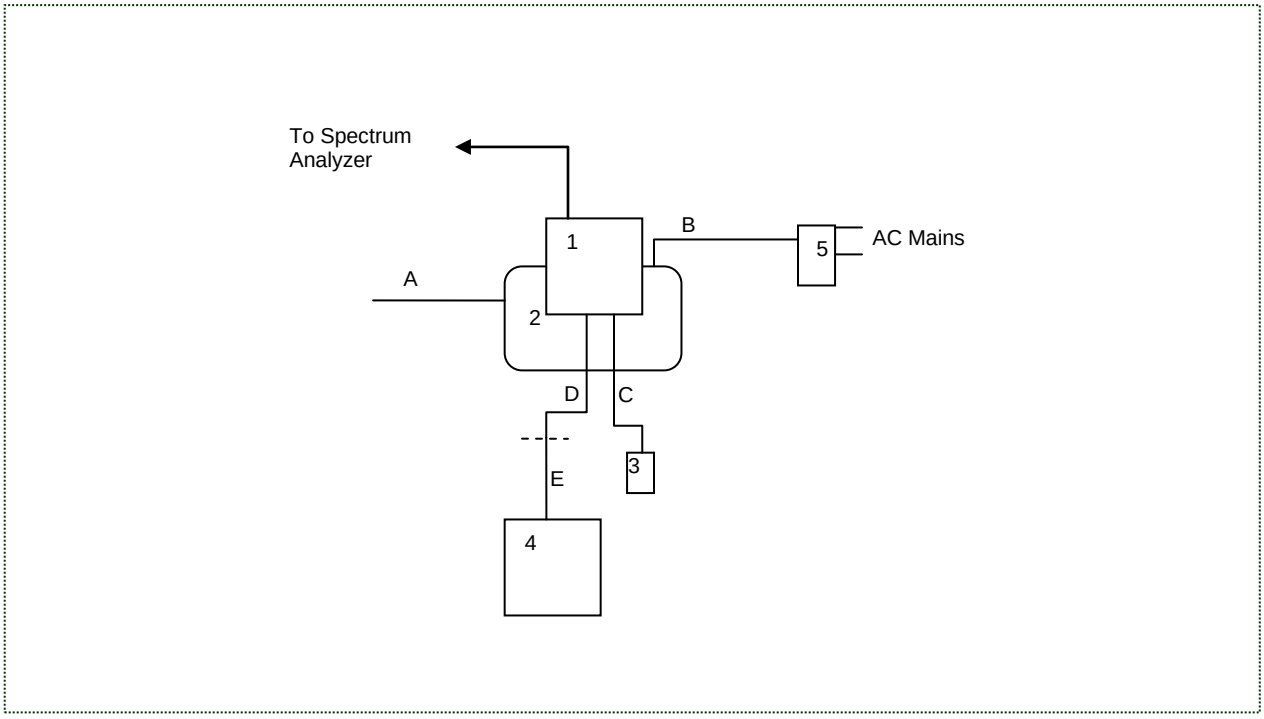


Figure 6-2: RF Conducted Setup

7 SUMMARY OF TESTS

Along with the tabular data shown below, plots were taken of all signals deemed important enough to document.

7.1 Antenna Requirement – FCC: Section 15.203

The model 173503 uses a printed inverted F antenna that is etched on the PCB. The antenna cannot be removed without permanently damaging the unit, thus meeting the requirements of FCC section 15.203.

7.2 6 dB Bandwidth - FCC: Section 15.247(a)(2) 99% Bandwidth IC: RSS-210 A8.2(a)

7.2.1 Measurement Procedure

The 6dB bandwidth was measured in accordance with the FCC KDB Publication No. 558074 “Guidance for Performing Compliance Measurements on Digital Transmission Systems (47 CFR 15.247)” DTS 6-dB Signal Bandwidth Option 1. The RBW of the spectrum analyzer was set to 100 kHz and VBW 300 kHz. Span was set large enough to capture the entire emissions and >> RBW.

The 99% occupied bandwidth was measured with the spectrum analyzer span set to fully display the emission, including the emissions skirts. The RBW was to 1% of the span. The occupied 99% bandwidth was measured using the occupied bandwidth function of the analyzer.

7.2.2 Measurement Results

Results are shown below.

802.11b

Table 7.2.2-1: 6dB / 99% Bandwidth

Frequency [MHz]	6dB Bandwidth [MHz]	99% Bandwidth (MHz)
2412	11.1812	14.8000
2437	10.9615	14.8167
2462	11.6346	14.8167

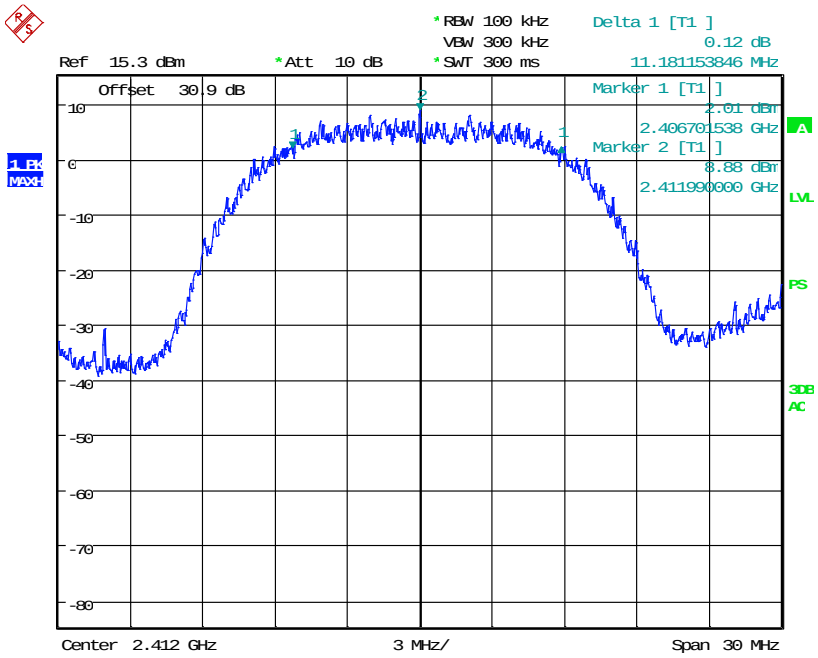


Figure 7.2.2-1: 6dB BW - Low Channel

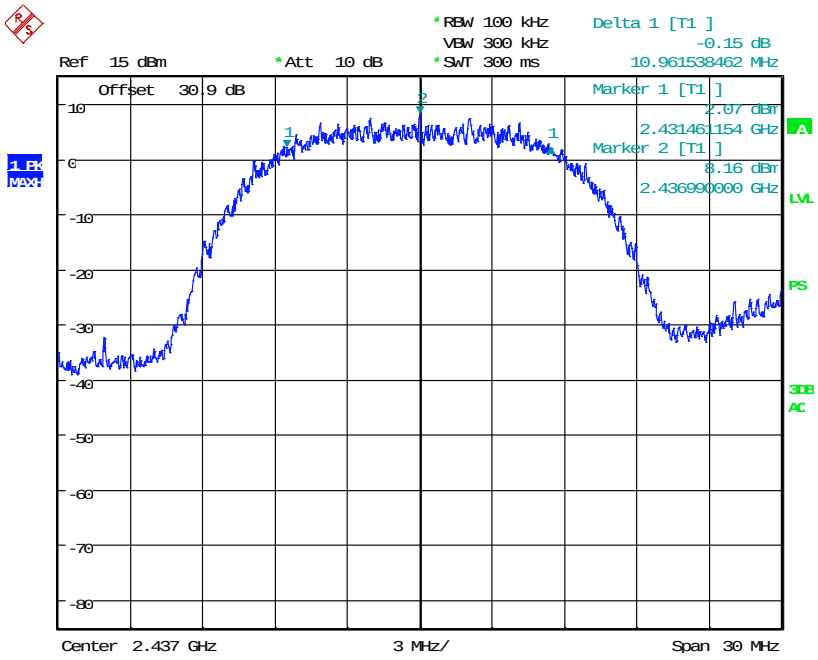


Figure 7.2.2-2: 6dB BW - Middle Channel

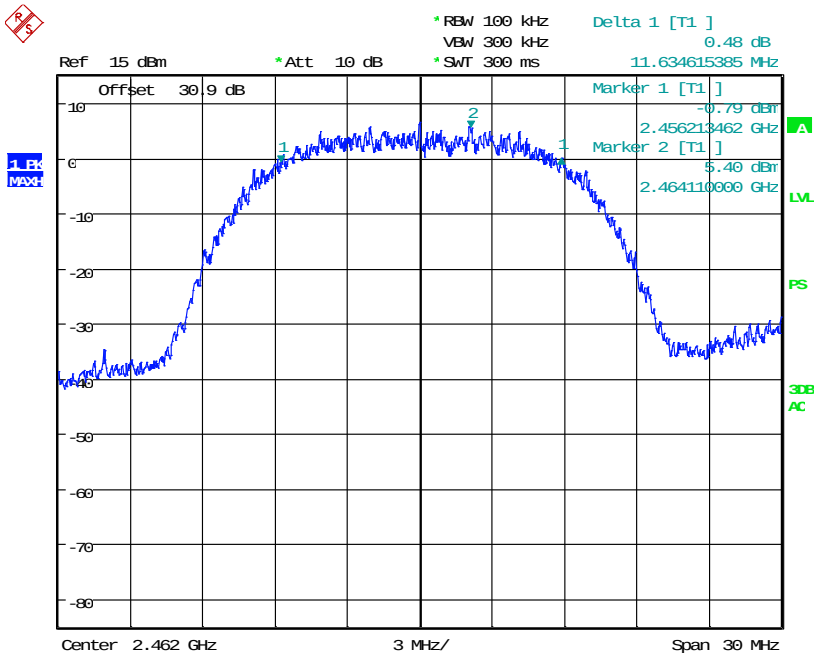


Figure 7.2.2-3: 6dB BW - High Channel

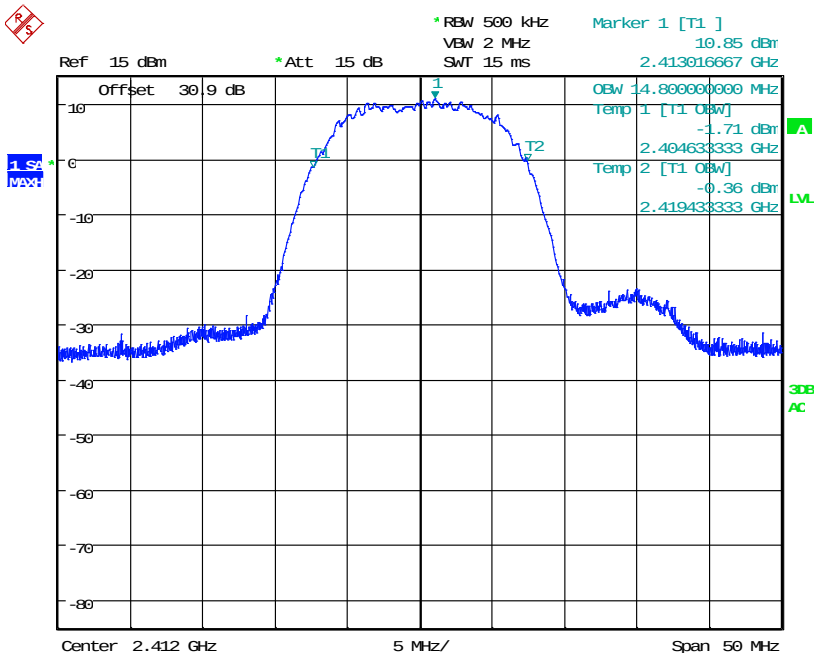


Figure 7.2.2-4: 99% OBW - Low Channel

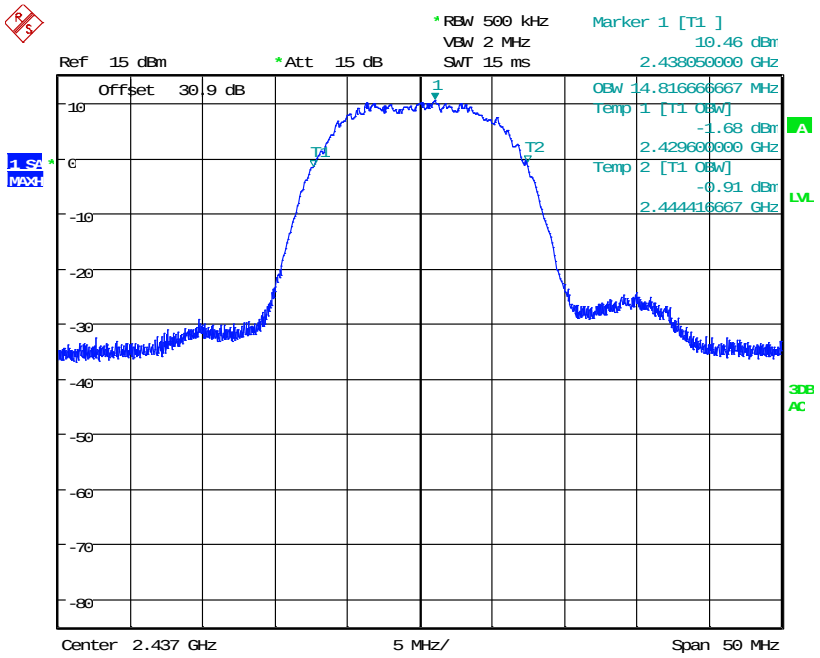


Figure 7.2.2-5: 99% OBW - Middle Channel

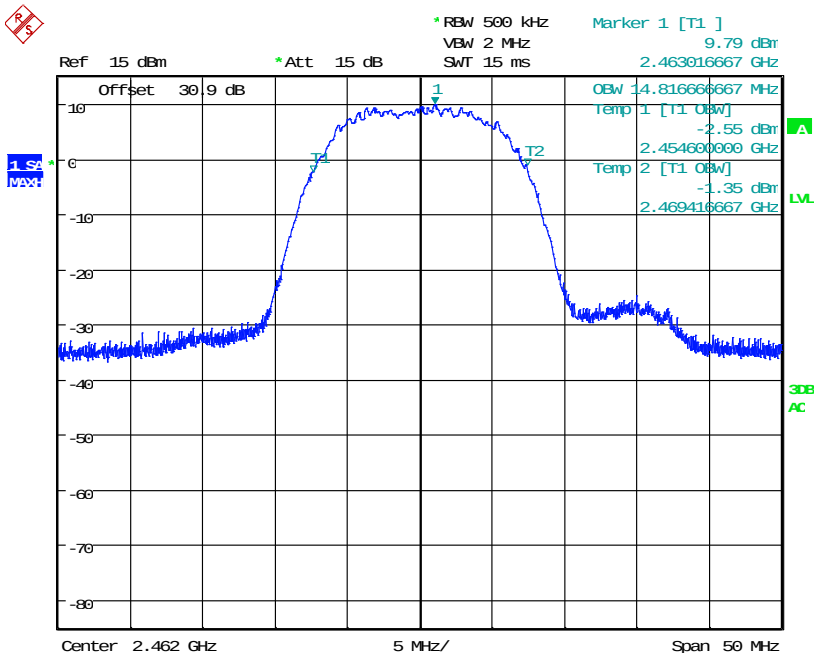


Figure 7.2.2-6: 99% OBW - High Channel

802.11g

Table 7.2.2-2: 6dB / 99% Bandwidth

Frequency [MHz]	6dB Bandwidth [MHz]	99% Bandwidth (MHz)
2412	16.3869	18.4333
2437	16.3942	18.1000
2462	16.3942	18.1667

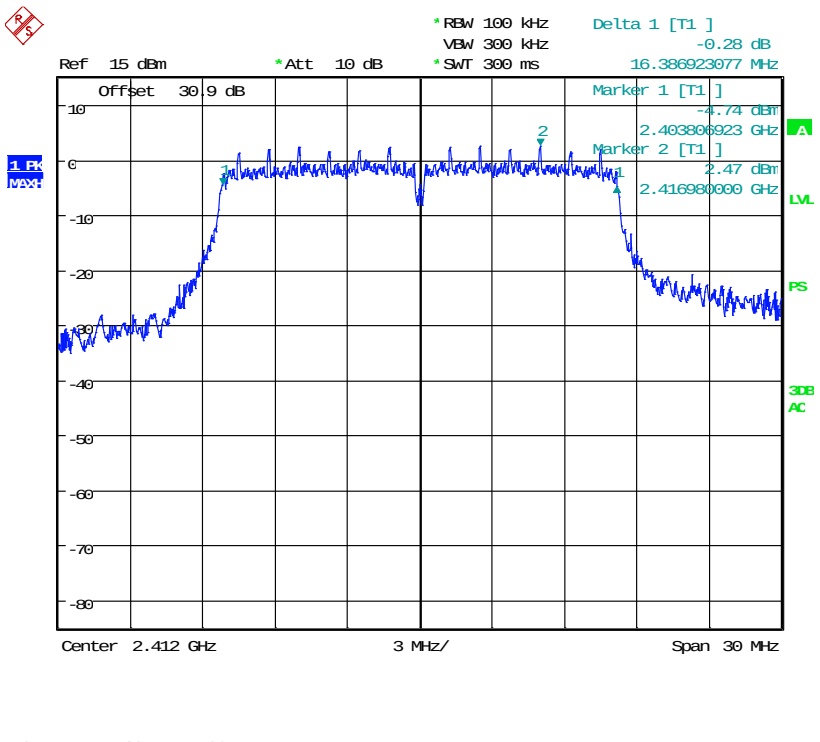


Figure 7.2.2-7: 6dB BW - Low Channel

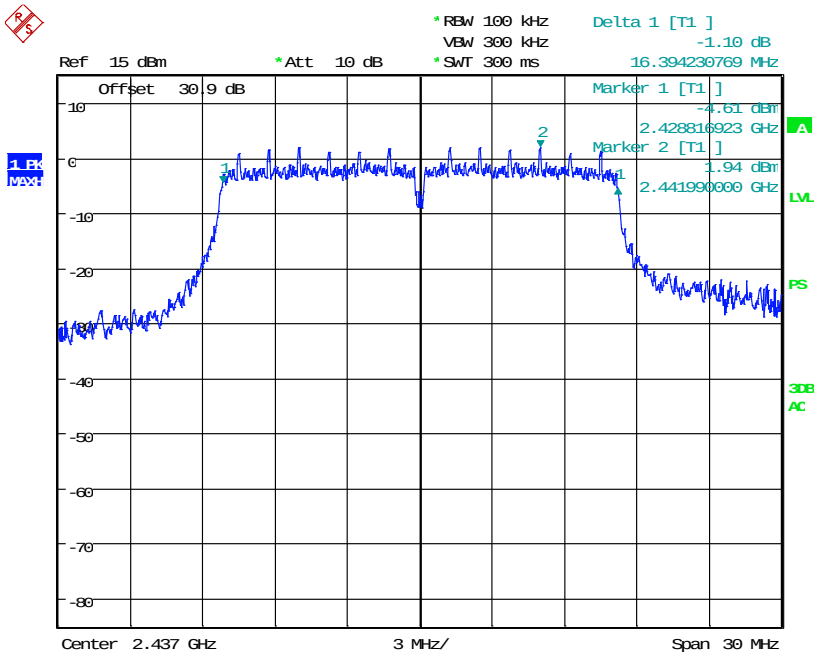


Figure 7.2.2-8: 6dB BW - Middle Channel

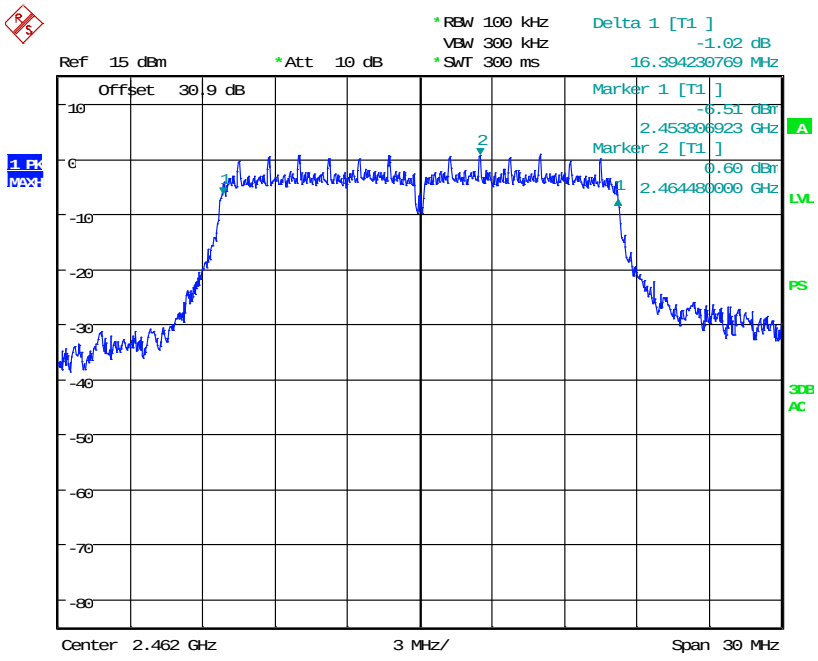


Figure 7.2.2-9: 6dB BW - High Channel

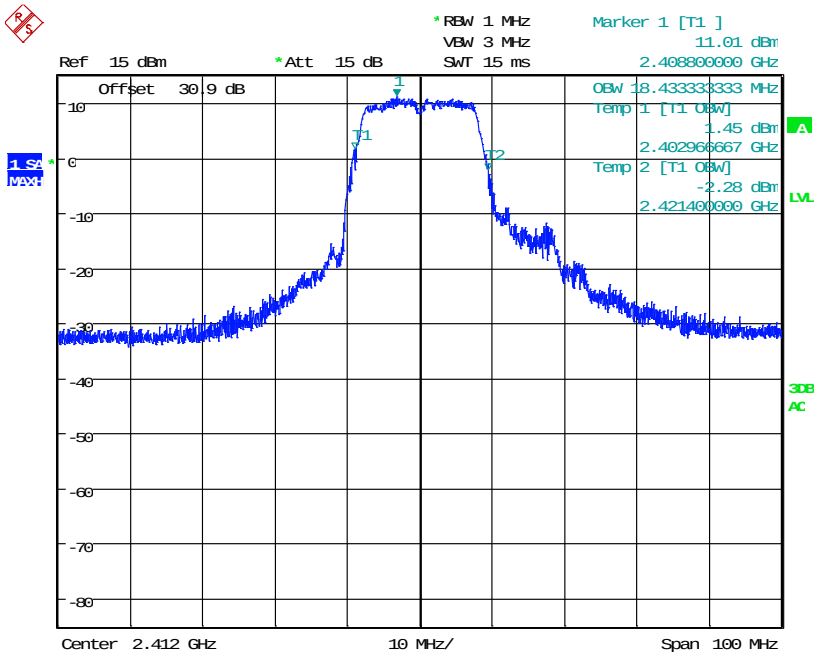


Figure 7.2.2-10: 99% OBW - Low Channel

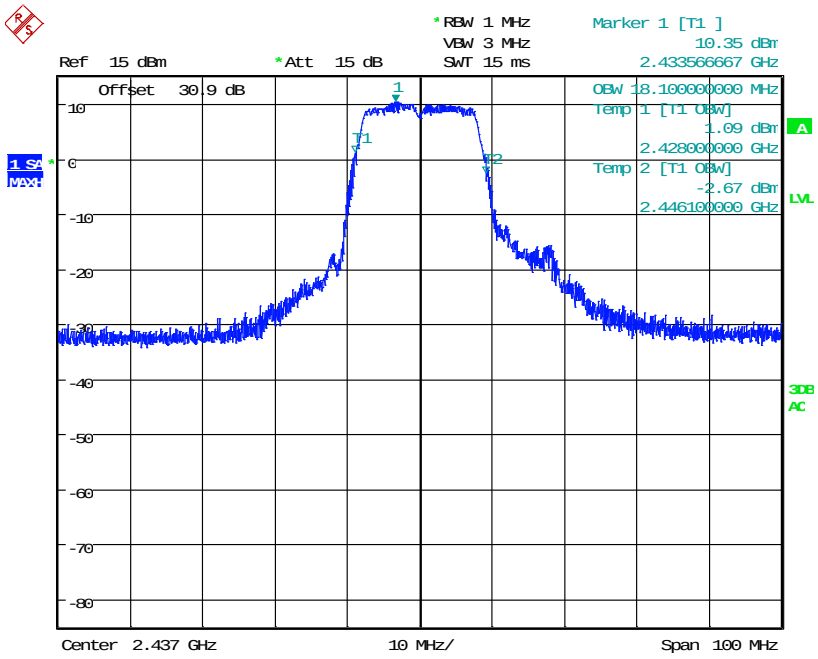


Figure 7.2.2-11: 99% OBW - Middle Channel

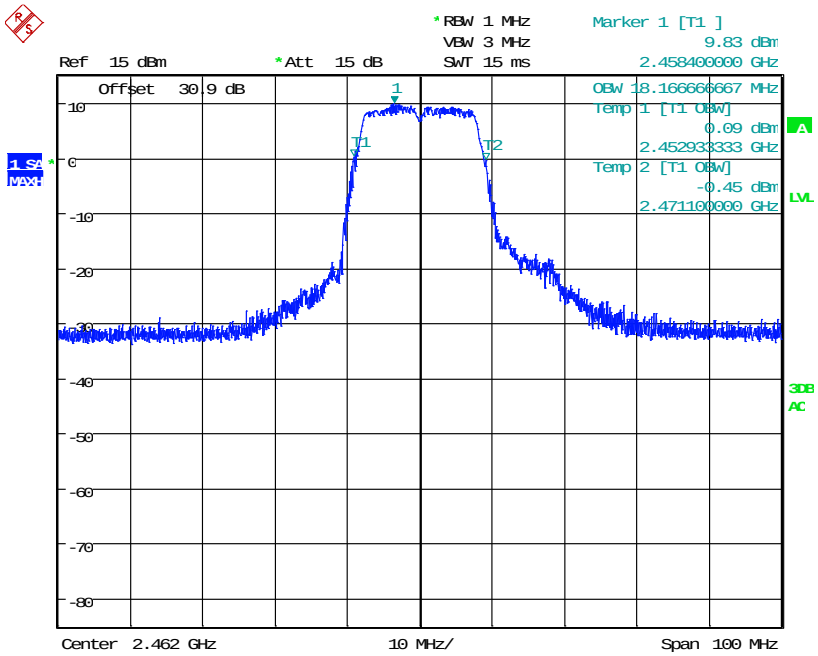


Figure 7.2.2-12: 99% OBW - High Channel

802.11n 20 MHz

Table 7.2.2-3: 6dB / 99% Bandwidth

Frequency [MHz]	6dB Bandwidth [MHz]	99% Bandwidth (MHz)
2412	17.1154	18.2692
2437	17.1923	18.2692
2462	17.1635	18.2692

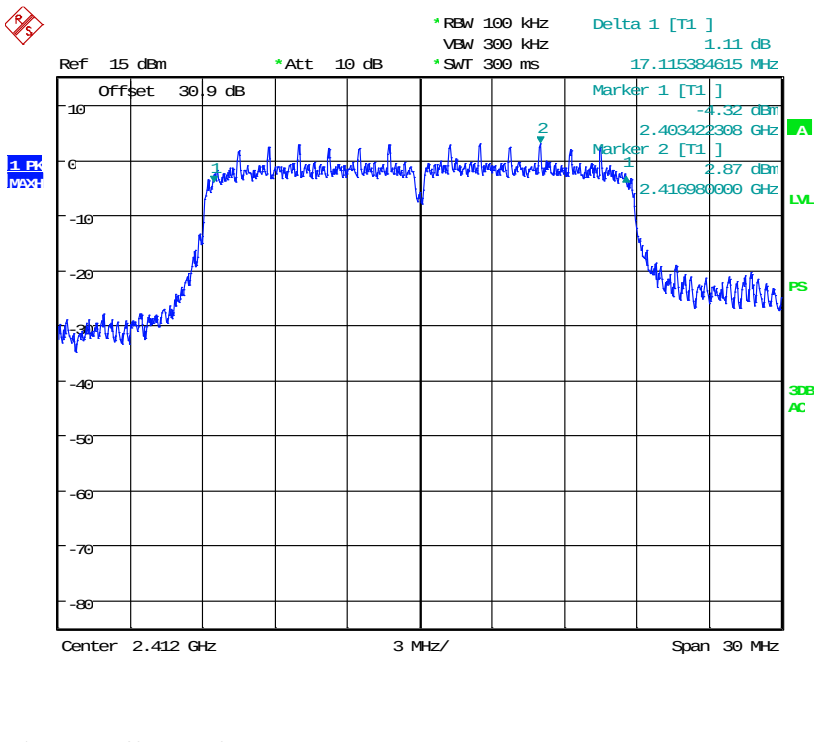


Figure 7.2.2-13: 6dB BW - Low Channel

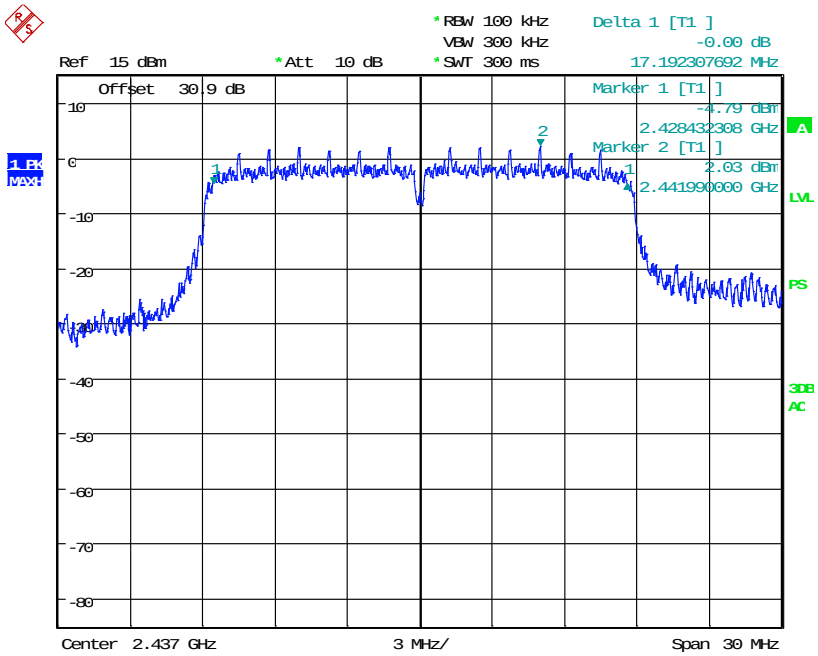


Figure 7.2.2-14: 6dB BW - Middle Channel

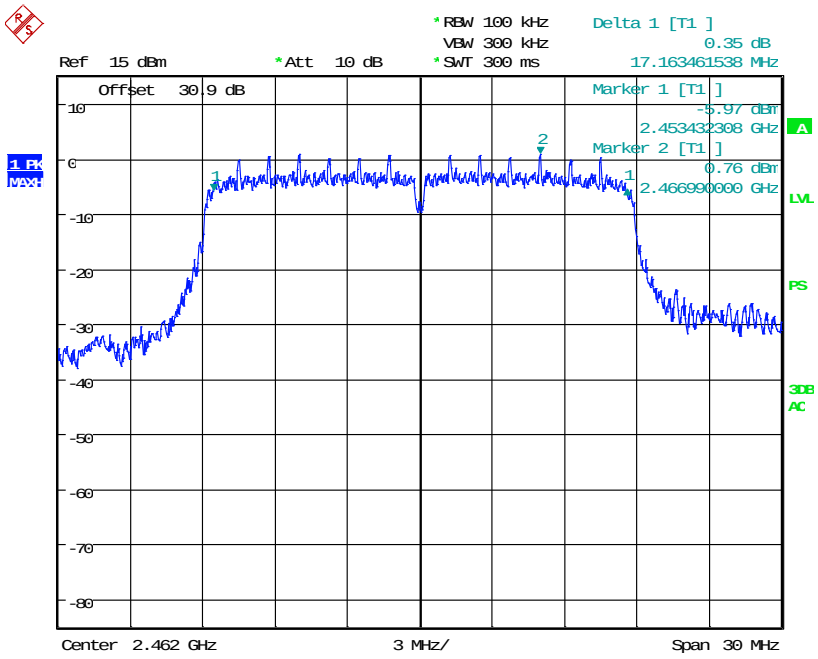


Figure 7.2.2-15: 6dB BW - High Channel

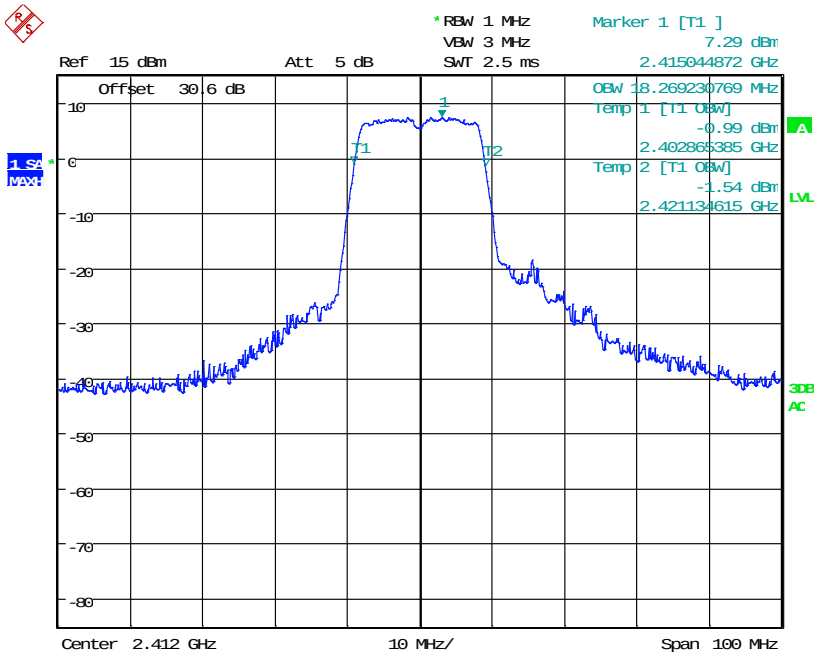


Figure 7.2.2-16: 99% OBW - Low Channel

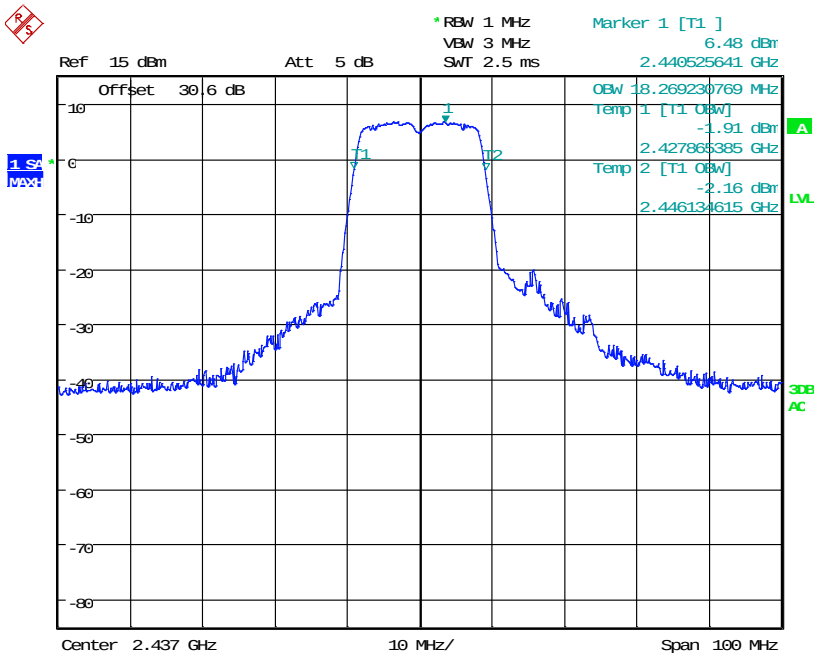


Figure 7.2.2-17: 99% OBW - Middle Channel

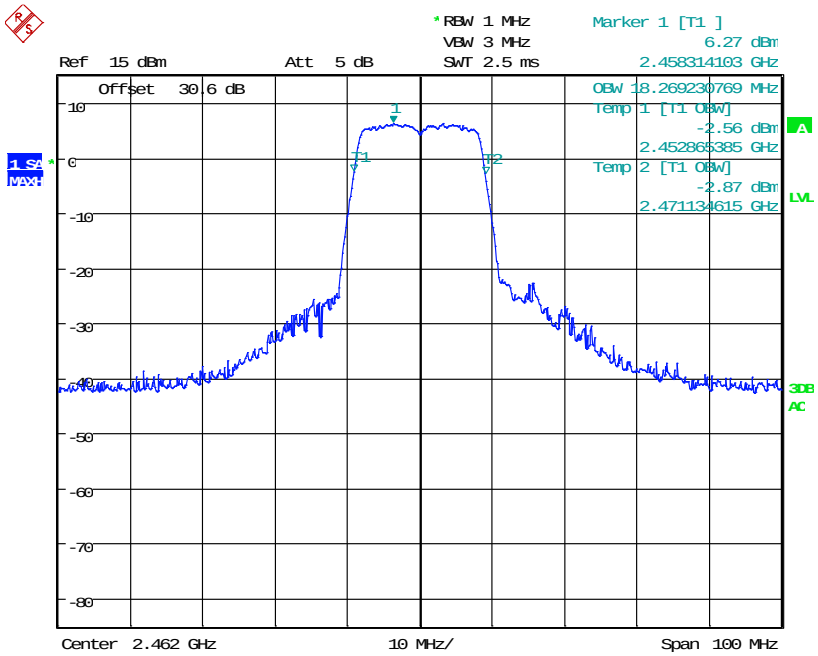


Figure 7.2.2-18: 99% OBW - High Channel

802.11n 40 MHz

Table 7.2.2-4: 6dB / 99% Bandwidth

Frequency [MHz]	6dB Bandwidth [MHz]	99% Bandwidth (MHz)
2422	35.5923	37.5000
2437	35.6417	37.5000
2452	35.2878	37.1795

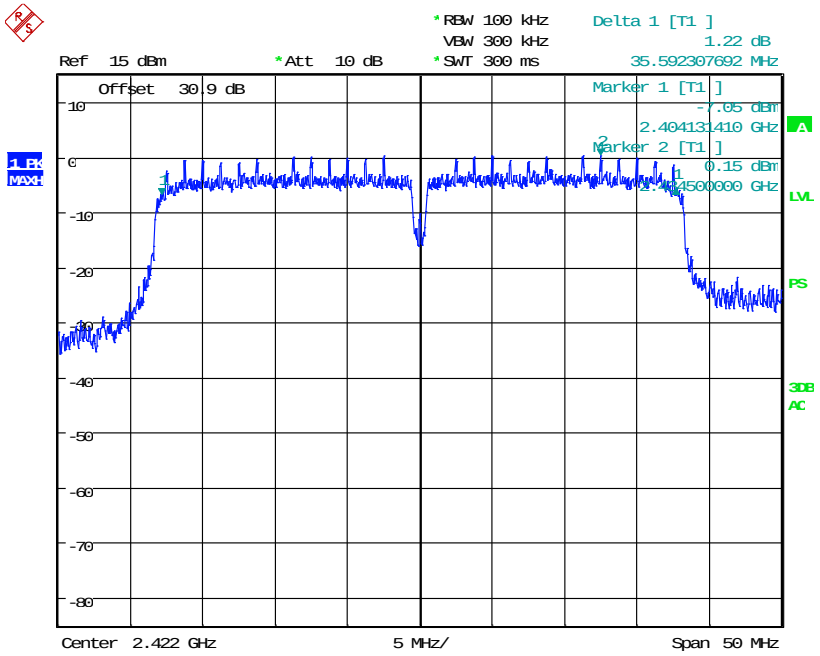


Figure 7.2.2-19: 6dB BW - Low Channel

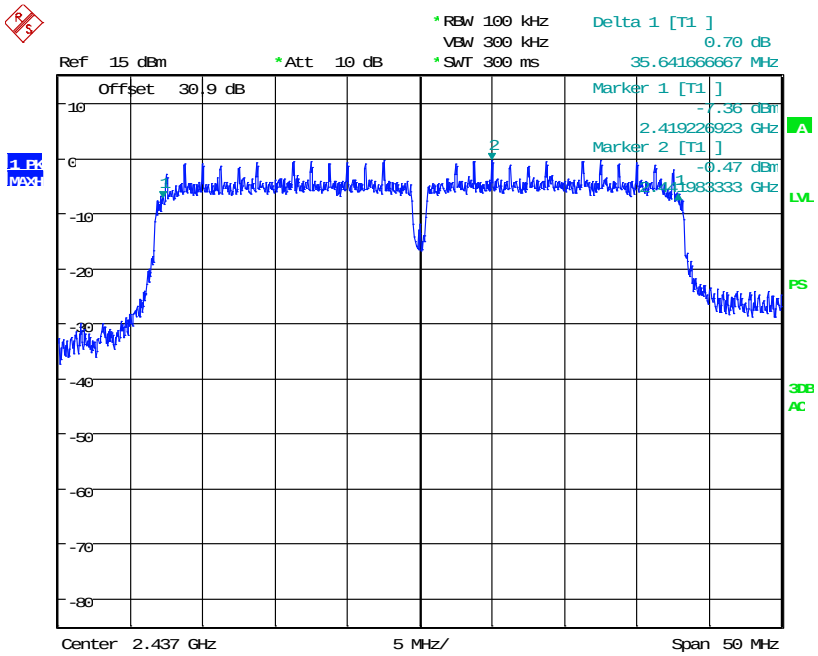


Figure 7.2.2-20: 6dB BW - Middle Channel

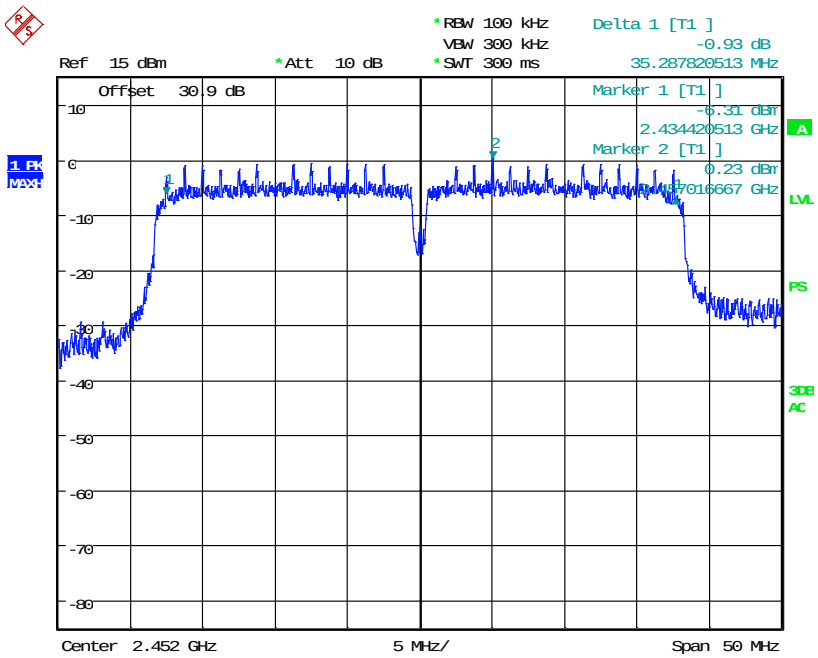


Figure 7.2.2-21: 6dB BW - High Channel

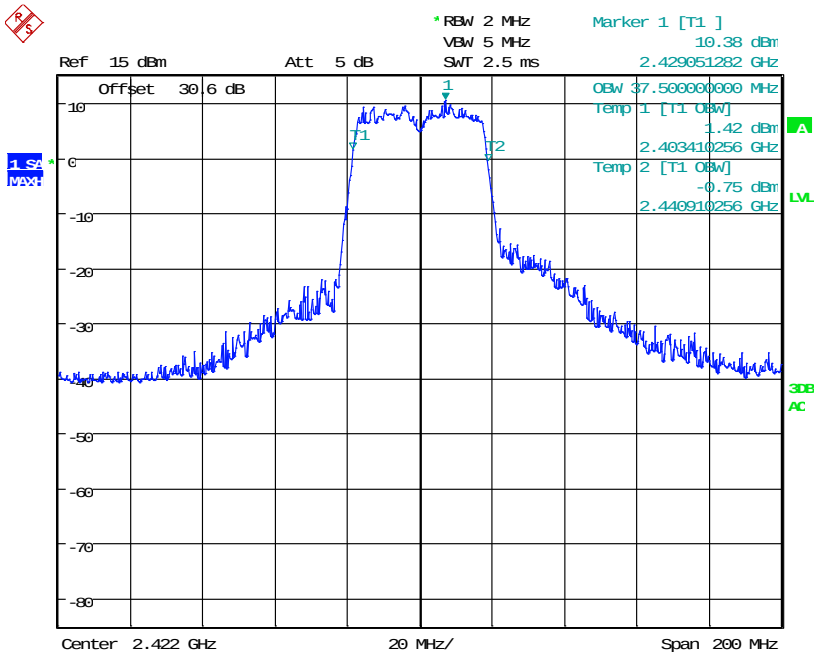


Figure 7.2.2-22: 99% OBW - Low Channel

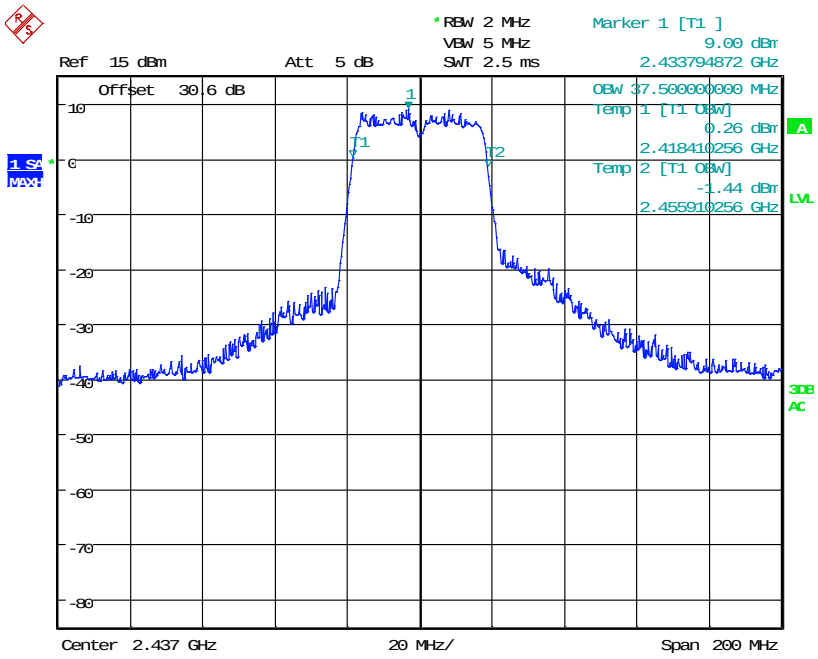


Figure 7.2.2-23: 99% OBW - Middle Channel

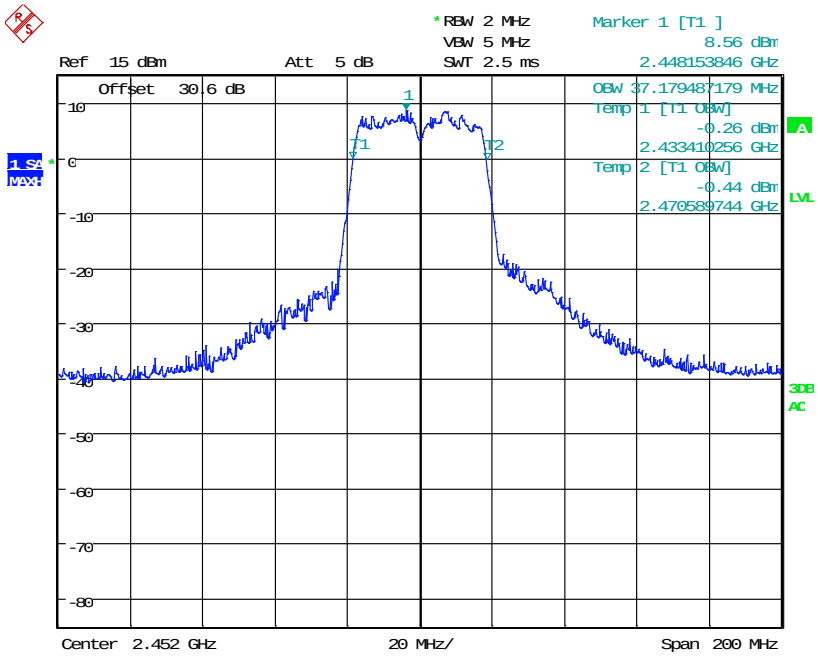


Figure 7.2.2-24: 99% OBW - High Channel

7.3 Peak Output Power - FCC Section 15.247(b)(3) IC: RSS-210 A8.4(4)

7.3.1 Measurement Procedure (Conducted Method)

The Peak Output Power was measured in accordance with the FCC KDB Publication No. 558074 "Guidance for Performing Compliance Measurements on Digital Transmission Systems (47 CFR 15.247)" Section 9.1.2 Integrated Band Power Method. The RF output of the equipment under test was directly connected to the input of the spectrum analyzer through suitable attenuation.

7.3.2 Measurement Results

Results are shown below.

802.11b

Table 7.3.2-1: RF Output Power

Frequency [MHz]	Level [dBm]
2412	22.25
2437	22.04
2462	21.76

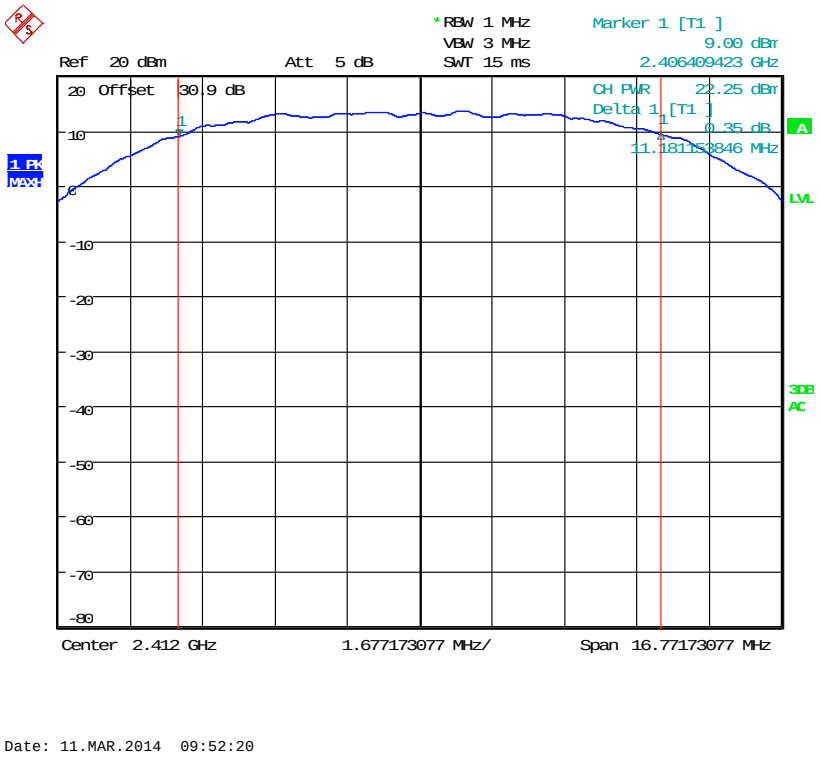


Figure 7.3.2-1: RF Output Power - Low Channel

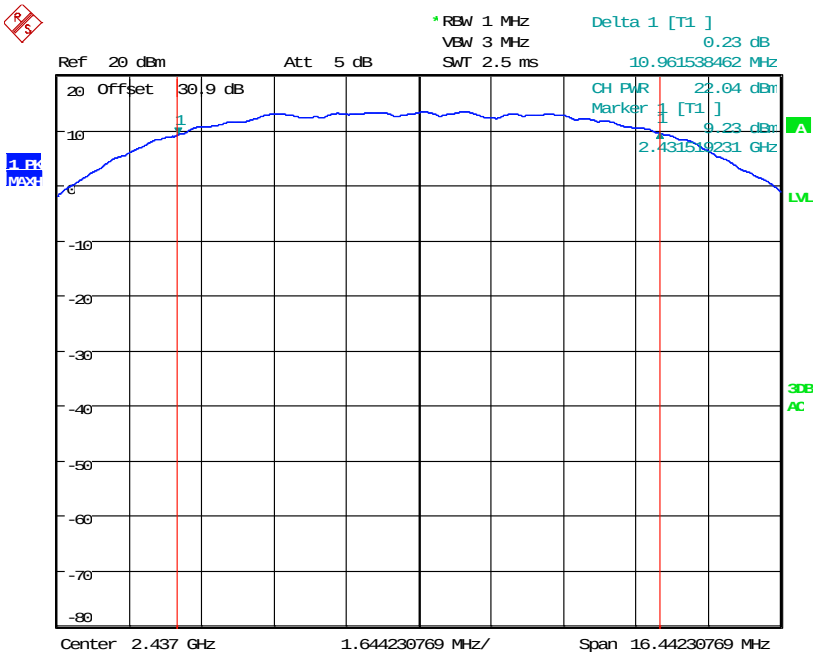


Figure 7.3.2-2: RF Output Power - Middle Channel

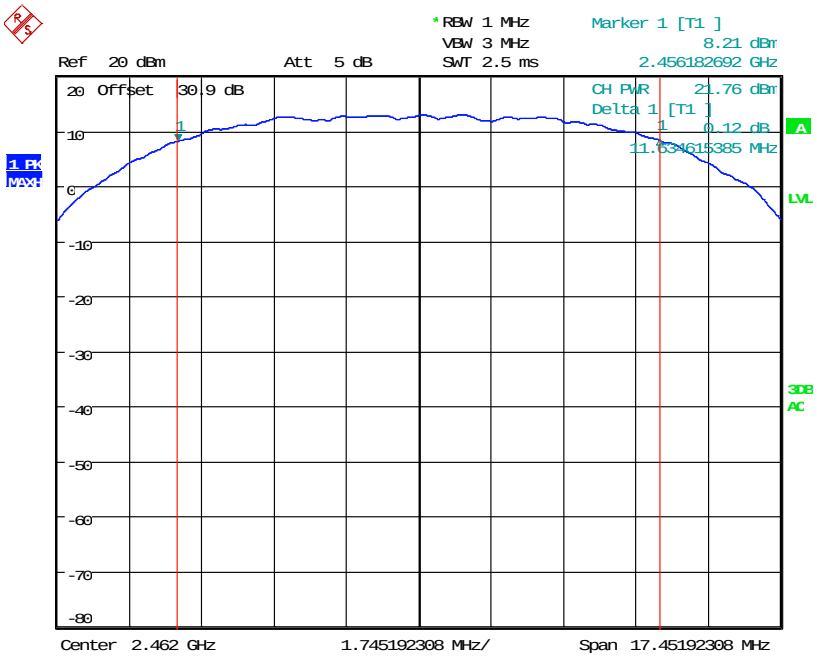


Figure 7.3.2-3: RF Output Power - High Channel

802.11g

Table 7.3.2-2: RF Output Power

Frequency [MHz]	Level [dBm]
2412	21.02
2437	21.18
2462	20.97

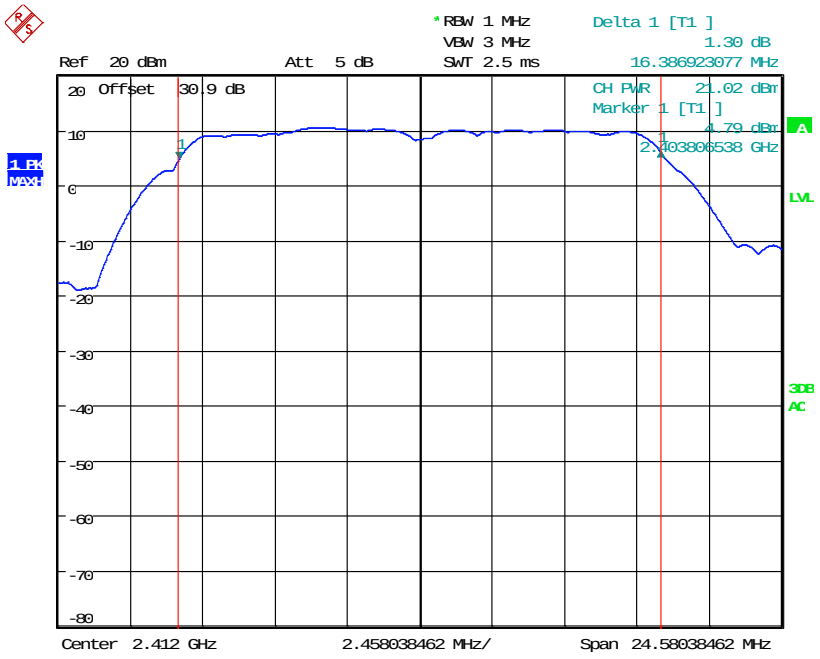


Figure 7.3.2-4: RF Output Power - Low Channel

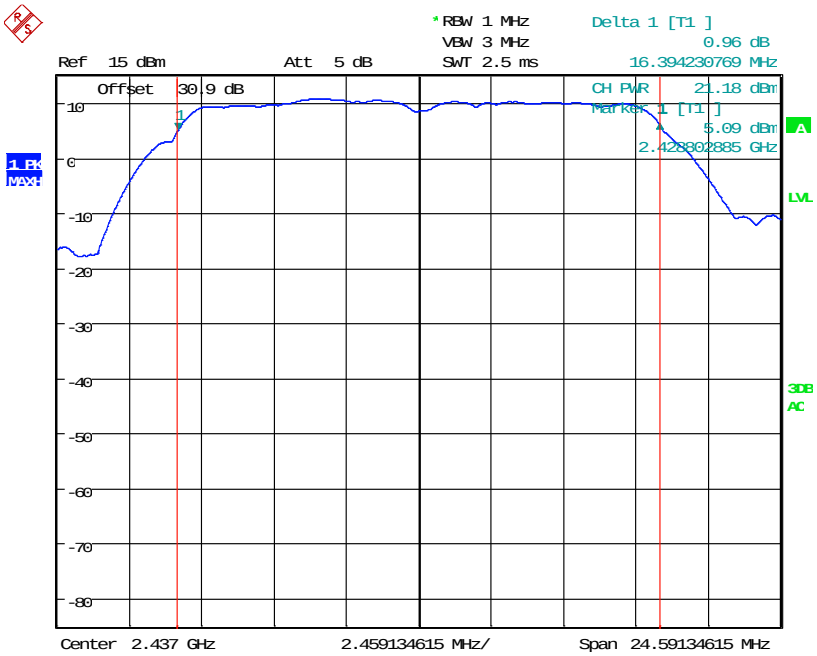


Figure 7.3.2-5: RF Output Power - Middle Channel

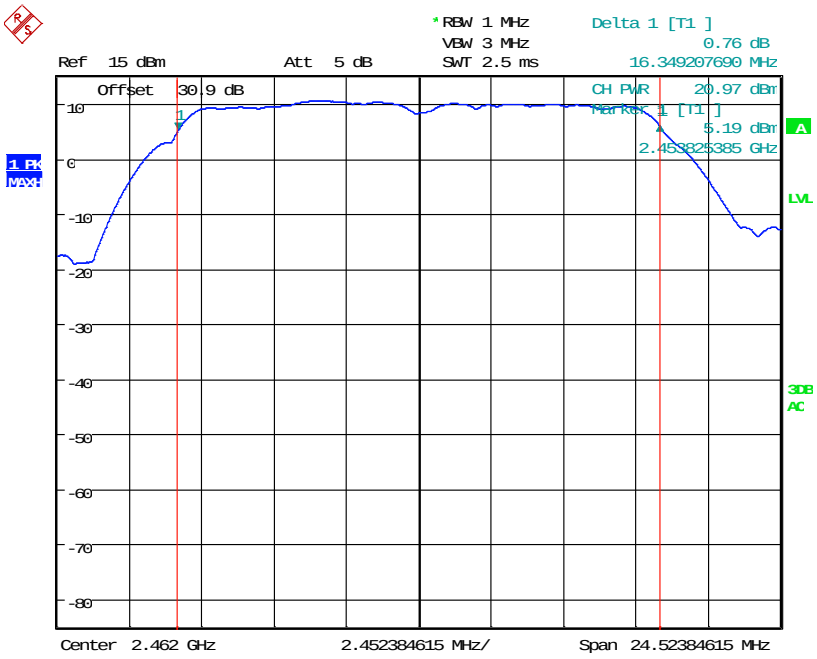


Figure 7.3.2-6: RF Output Power - High Channel

802.11n 20 MHz

Table 7.3.2-3: RF Output Power

Frequency [MHz]	Level [dBm]
2412	18.60
2437	18.77
2462	18.56

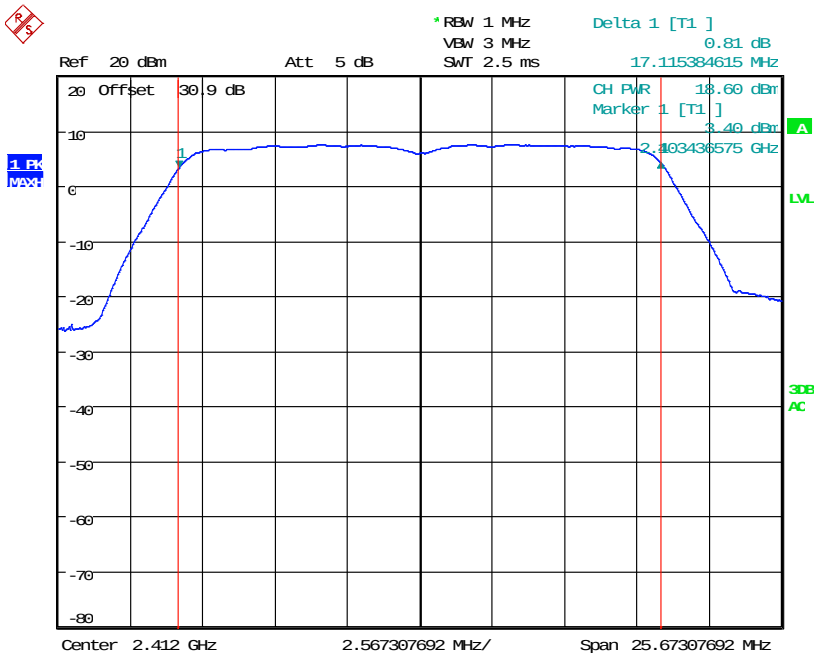


Figure 7.3.2-7: RF Output Power - Low Channel

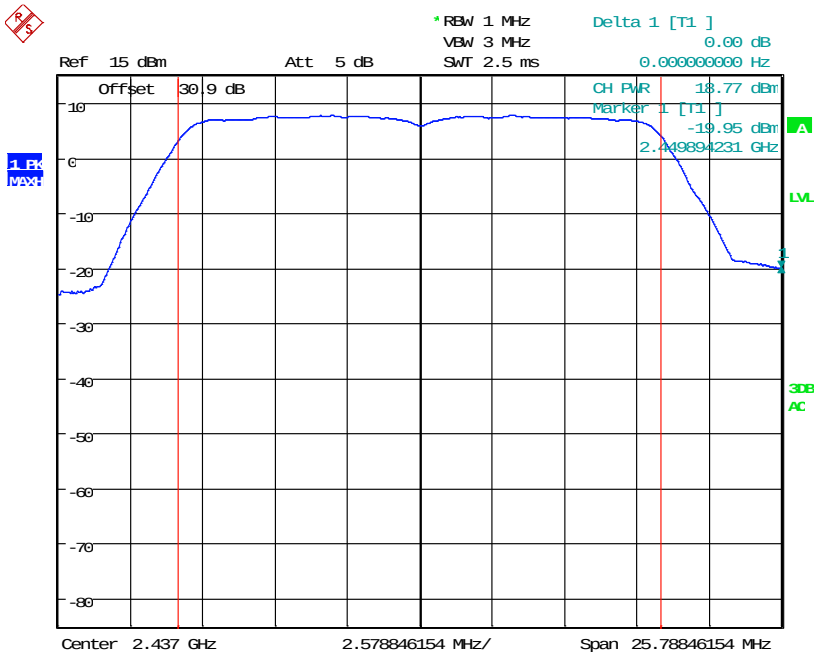


Figure 7.3.2-8: RF Output Power - Middle Channel

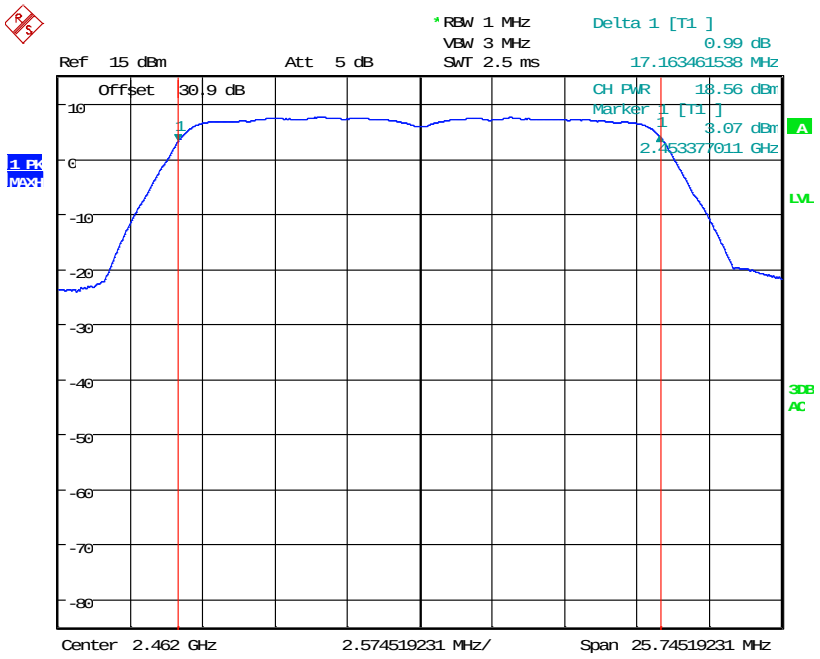


Figure 7.3.2-9: RF Output Power - High Channel

802.11n 40 MHz

Table 7.3.2-4: RF Output Power

Frequency [MHz]	Level [dBm]
2422	18.81
2437	18.87
2452	18.80

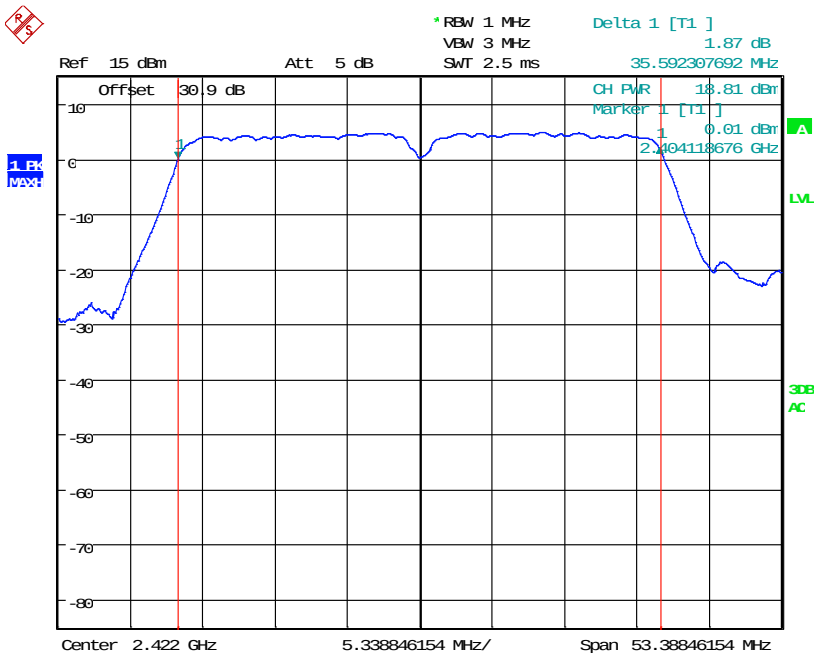


Figure 7.3.2-10: RF Output Power - Low Channel

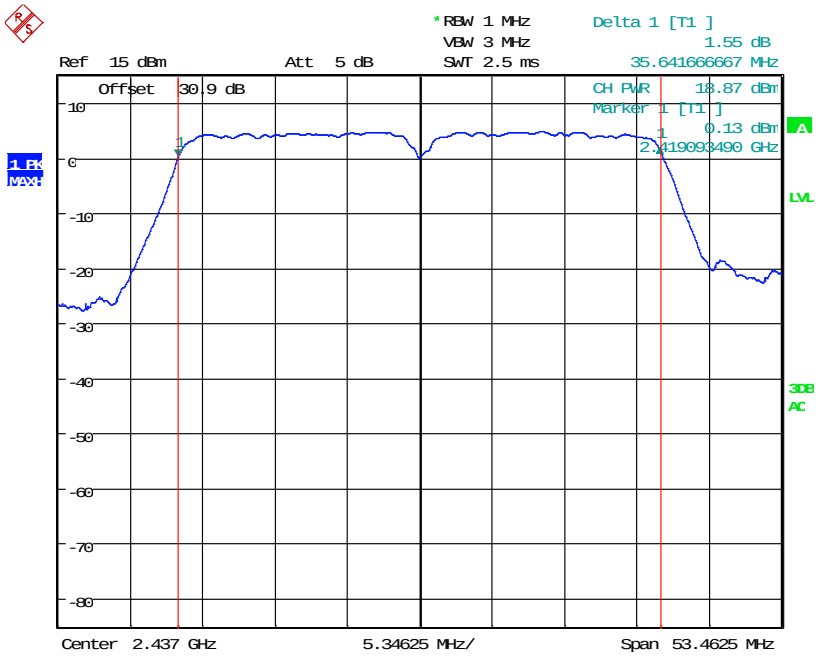


Figure 7.3.2-11: RF Output Power - Middle Channel

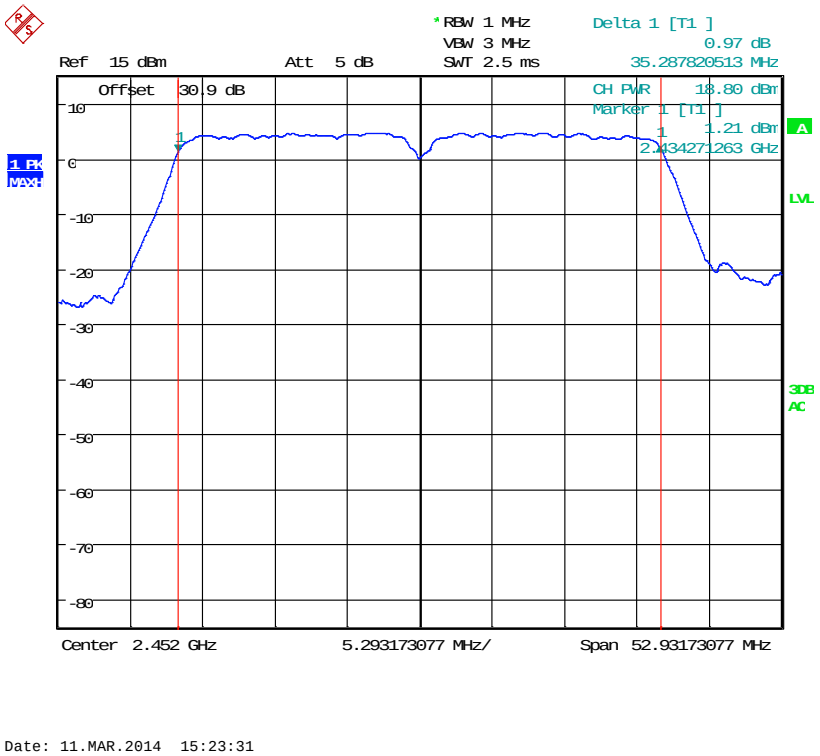


Figure 7.3.2-12: RF Output Power - High Channel

7.4 Band-Edge Compliance and Spurious Emissions-FCC 15.247(d) IC: RSS-210 A8.5

7.4.1 Band-Edge Compliance of RF Conducted Emissions

7.4.1.1 Measurement Procedure

The RF output port of the EUT was directly connected to the input of the spectrum analyzer via suitable attenuation. The EUT was investigated at the lowest and highest channel available to determine band-edge compliance. For each measurement the spectrum analyzer's RBW was set to 100 kHz, and the VBW was set to 300 kHz.

7.4.1.2 Measurement Results

Results are shown below.

802.11b

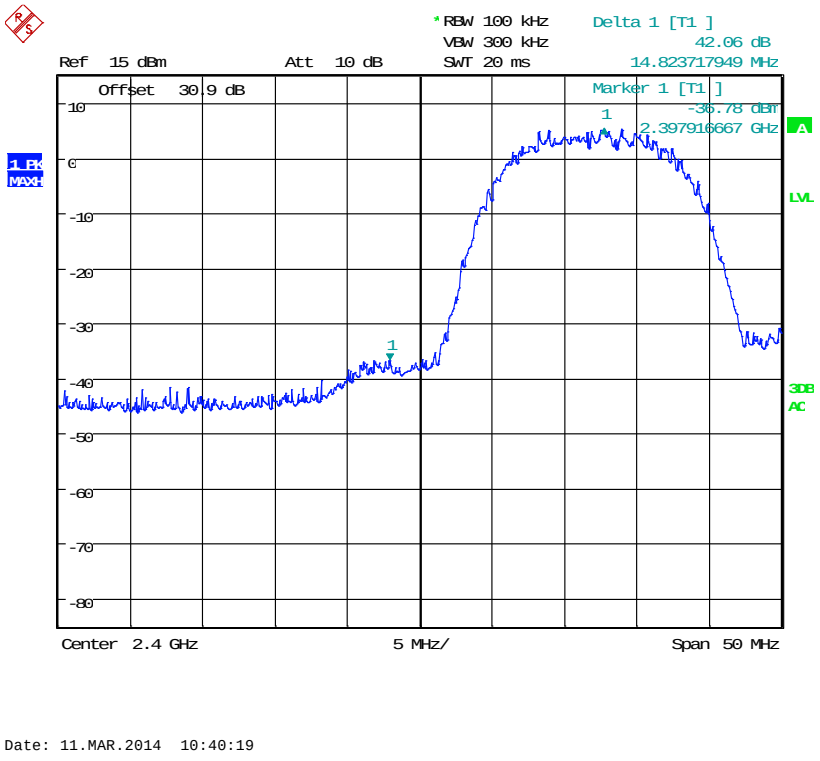


Figure 7.4.1.2-1: Lower Band-edge

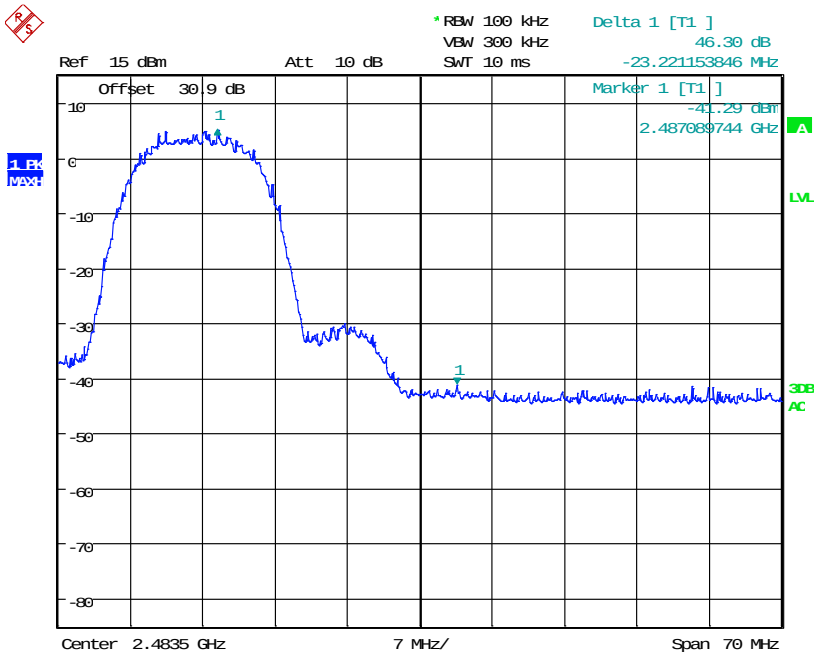


Figure 7.4.1.2-2: Upper Band-edge

802.11g

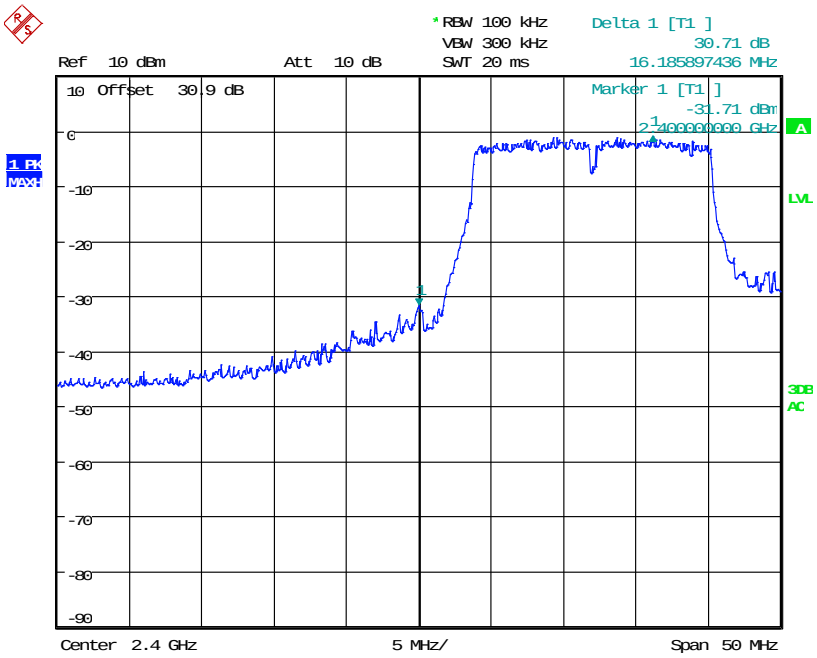


Figure 7.4.1.2-3: Lower Band-edge

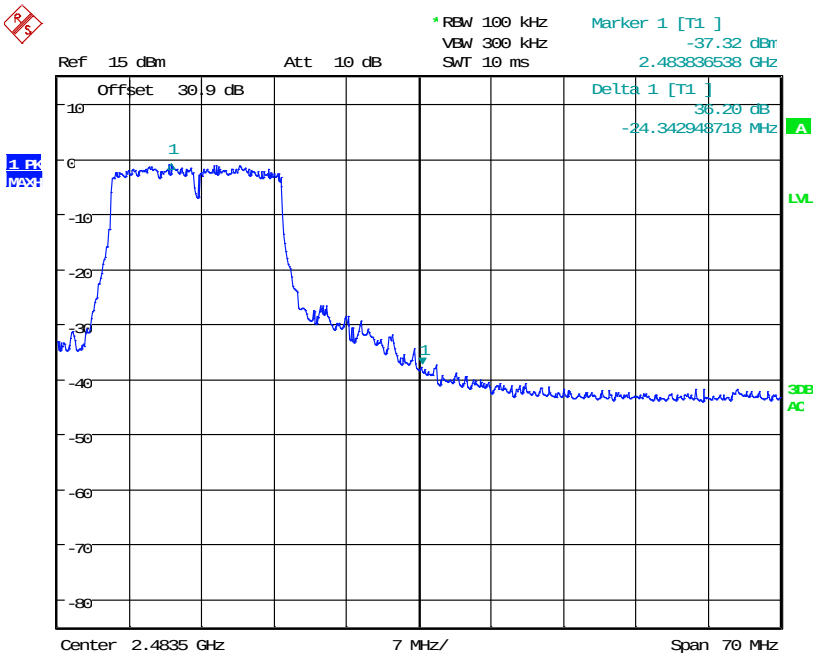


Figure 7.4.1.2-4: Upper Band-edge

802.11n 20 MHz

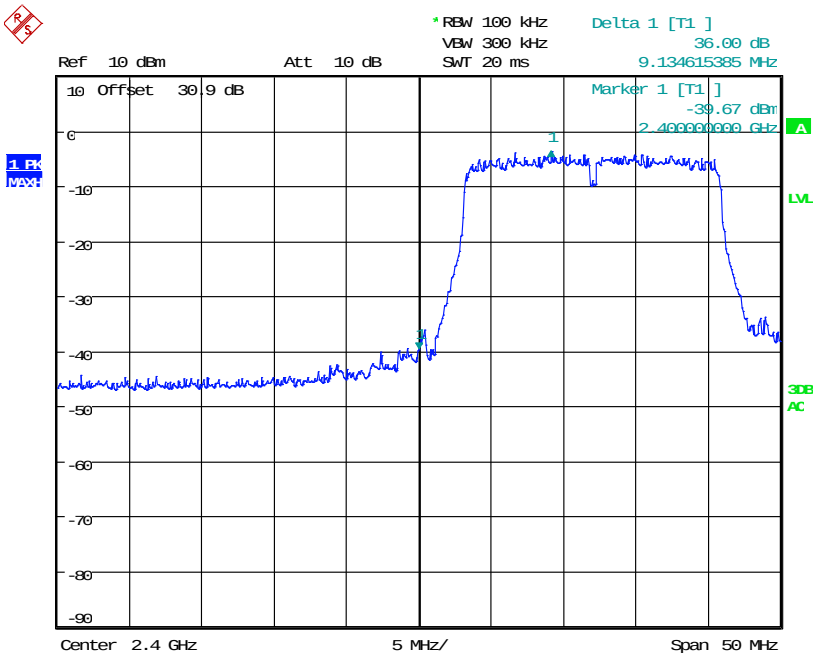


Figure 7.4.1.2-5: Lower Band-edge

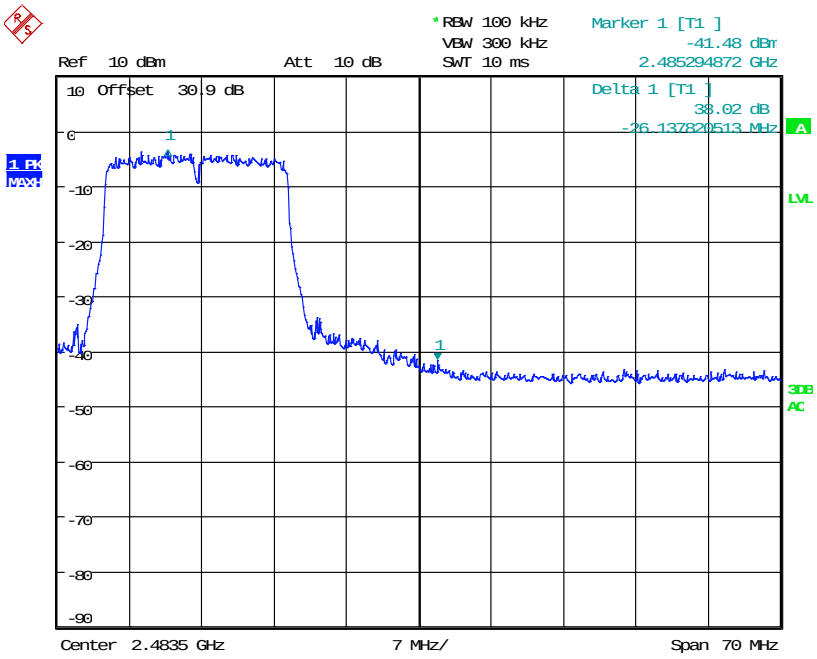


Figure 7.4.1.2-6: Upper Band-edge

802.11n 40 MHz

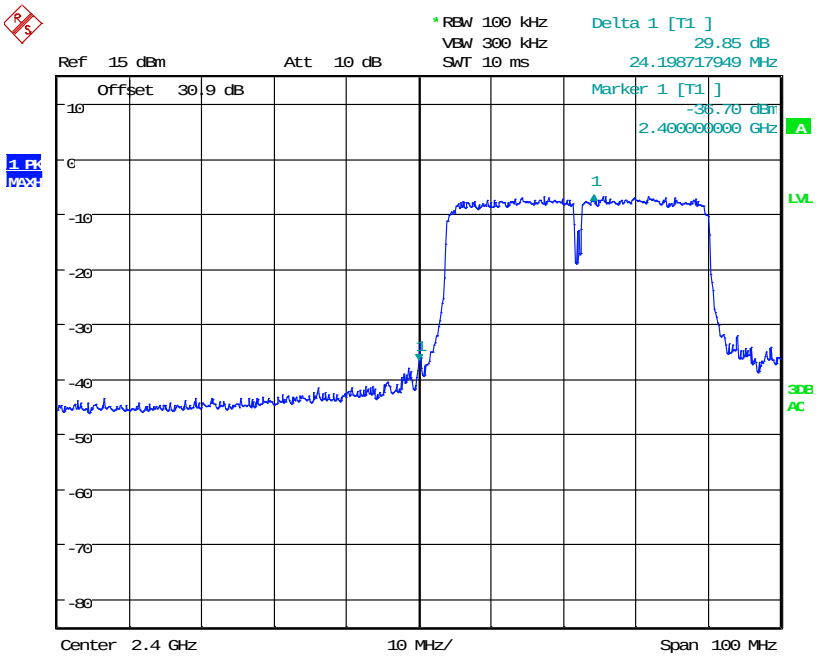


Figure 7.4.1.2-7: Lower Band-edge

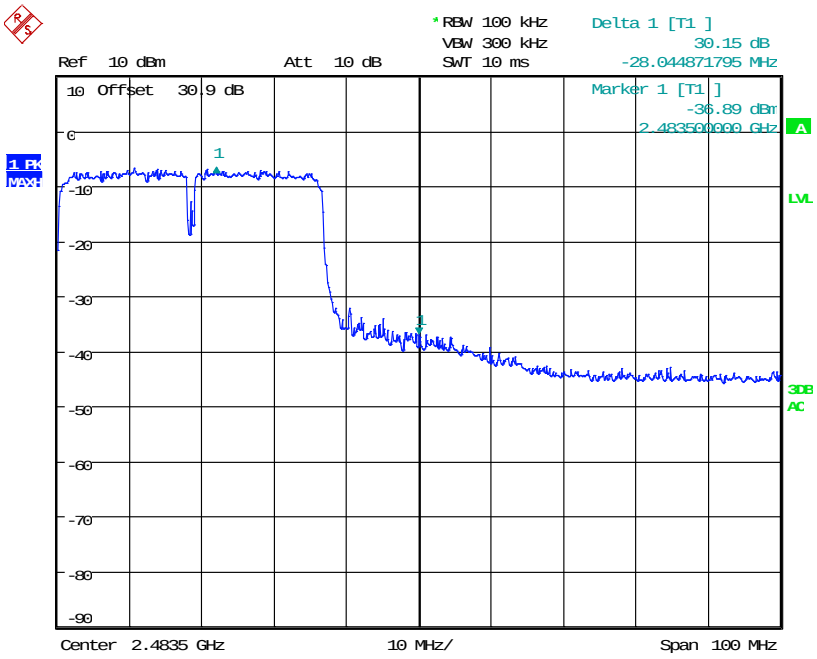


Figure 7.4.1.2-8: Upper Band-edge

7.4.2 RF Conducted Spurious Emissions

7.4.2.1 Measurement Procedure

The RF Conducted Spurious Emissions were measured in accordance with the FCC KDB Publication No. 558074 “Guidance for Performing Compliance Measurements on Digital Transmission Systems (47 CFR 15.247)”. The RF output port of the equipment under test was directly connected to the input of the spectrum analyzer. The EUT was investigated for conducted spurious emissions from 30MHz to 26 GHz, 10 times the highest fundamental frequency. Measurements were made at the low, center and high channels of the EUT. For each measurement, the spectrum analyzer’s RBW was set to 100 kHz and the VBW was set to 300 kHz. The peak Max Hold function of the analyzer was utilized. The reference level was determined by measuring the Peak PSD level in any 100 kHz bandwidth within the DTS channel bandwidth.

7.4.2.2 Measurement Results

Results are shown below.

802.11b

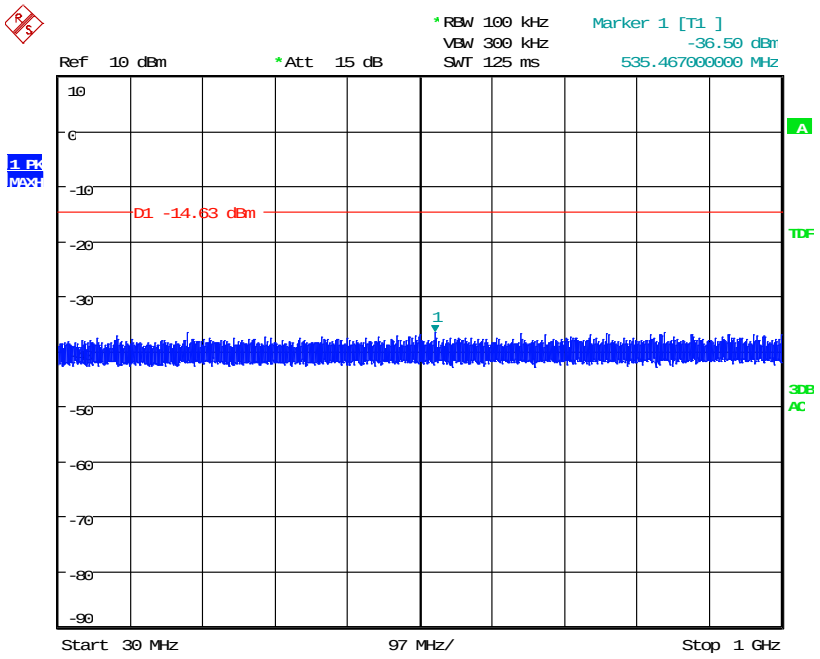


Figure 7.4.2.2-1: 30 MHz – 1 GHz – Low Channel

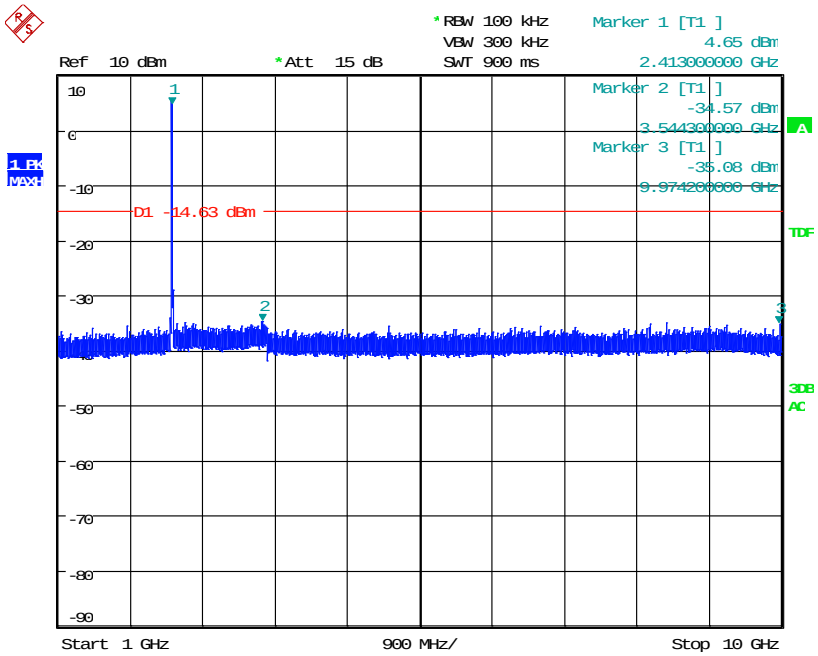


Figure 7.4.2.2-2: 1 GHz – 10 GHz – Low Channel

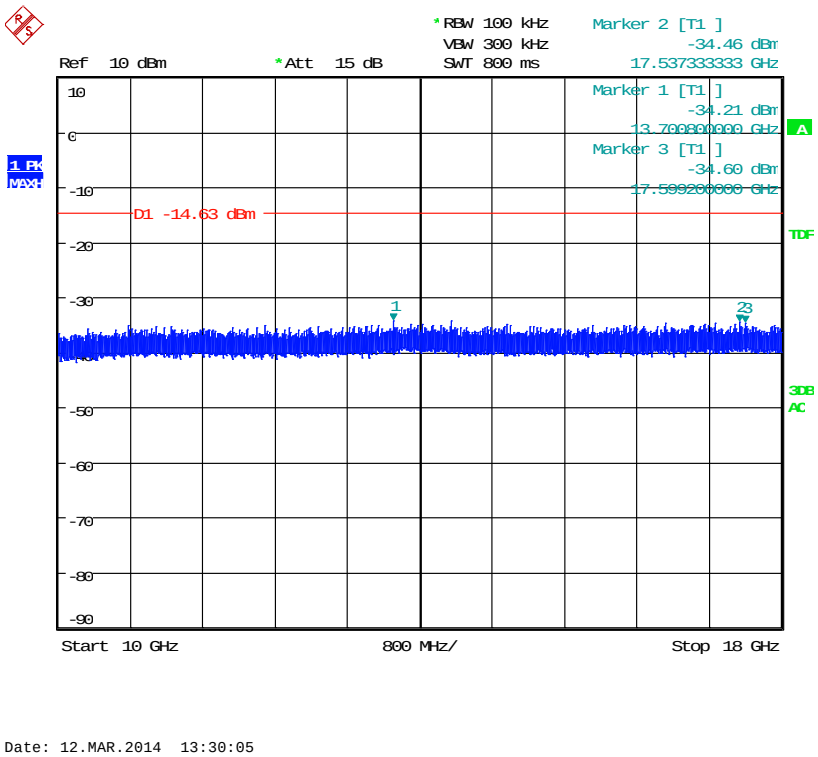


Figure 7.4.2.2-3: 10 GHz – 18 GHz – Low Channel

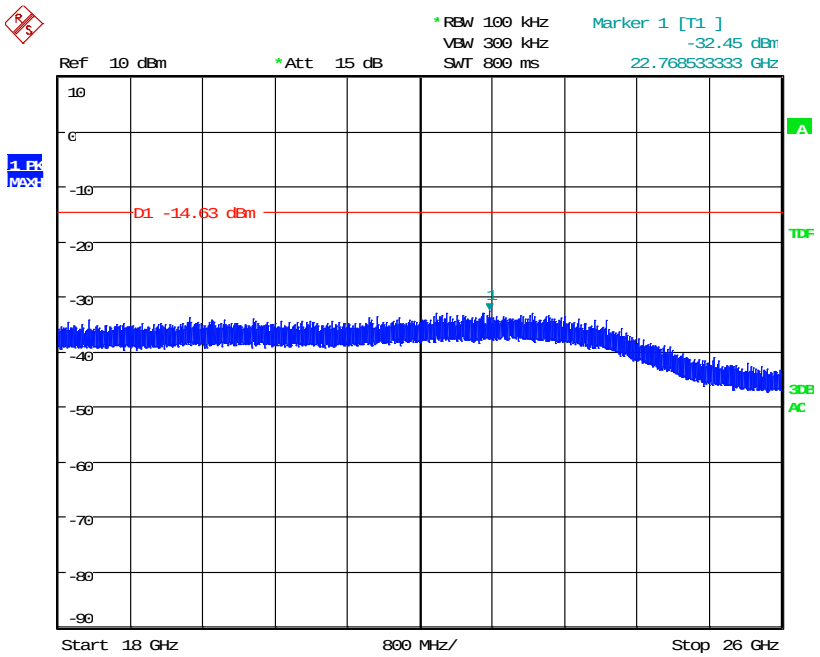


Figure 7.4.2.2-4: 18 GHz – 26 GHz – Low Channel

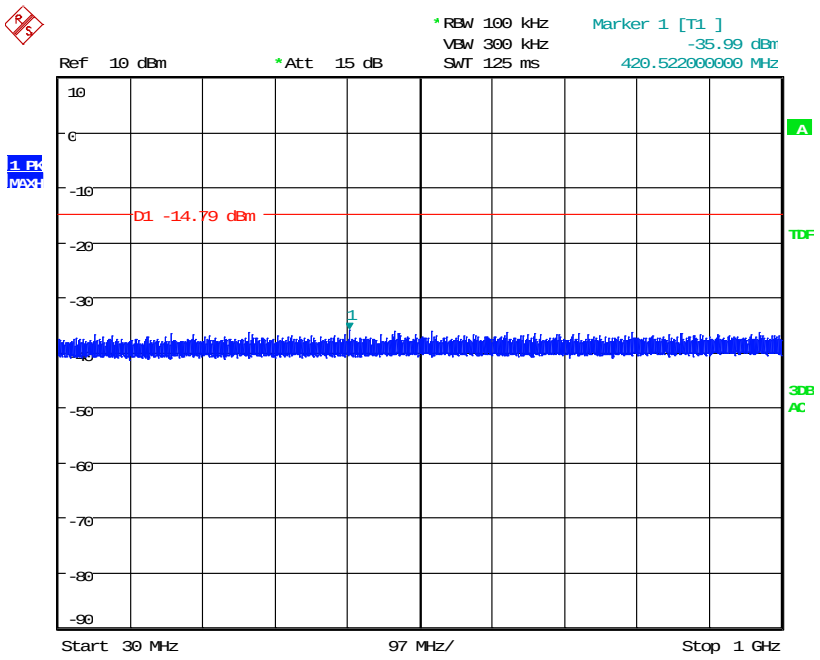
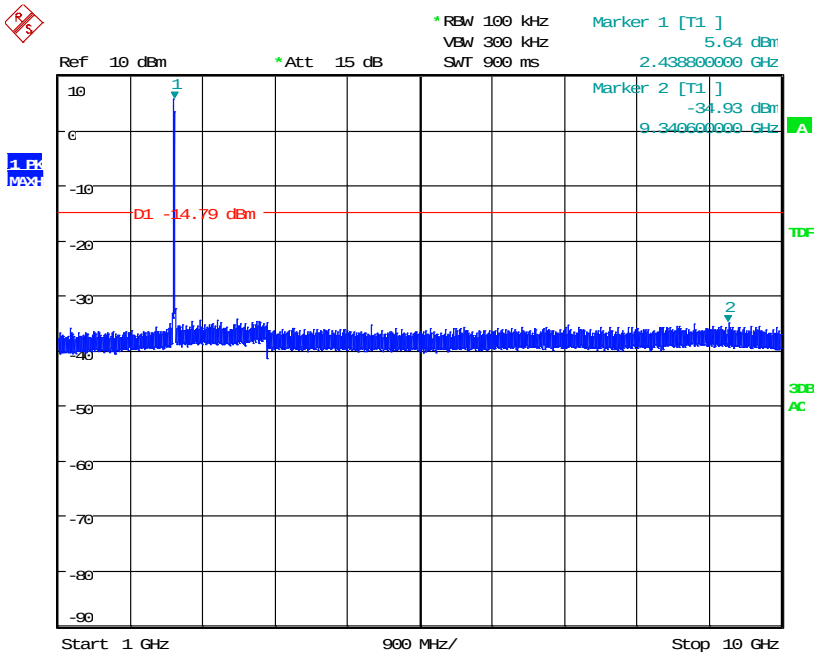
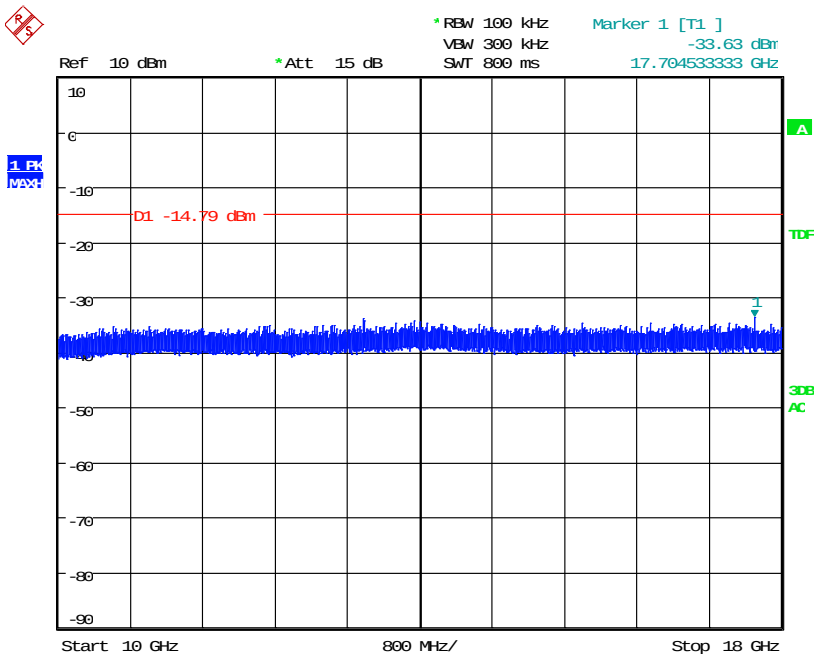


Figure 7.4.2.2-5: 30 MHz – 1 GHz –Middle Channel



Date: 12.MAR.2014 13:45:09

Figure 7.4.2.2-6: 1 GHz – 10 GHz – Middle Channel



Date: 12.MAR.2014 13:47:07

Figure 7.4.2.2-7: 10 GHz – 18 GHz – Middle Channel

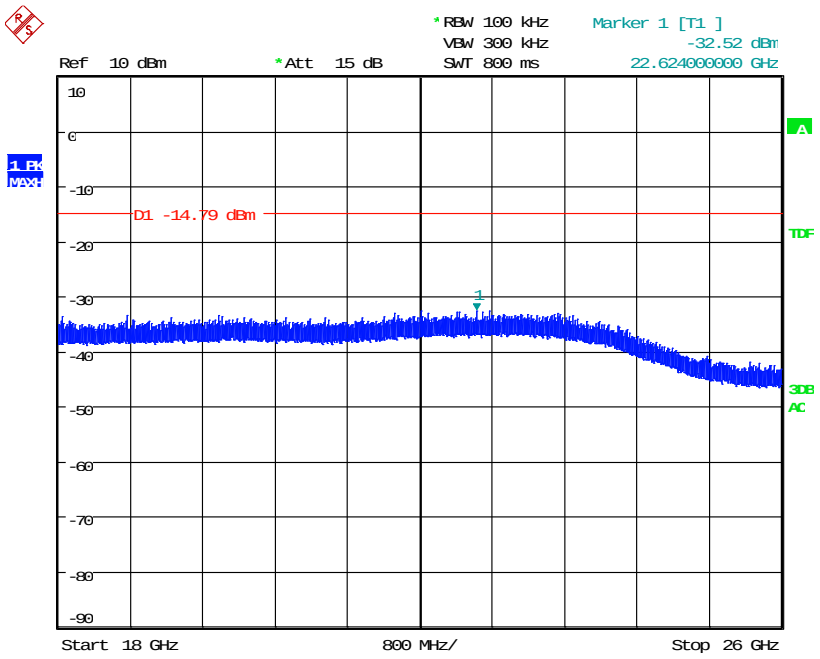


Figure 7.4.2.2-8: 18 GHz – 26 GHz – Middle Channel

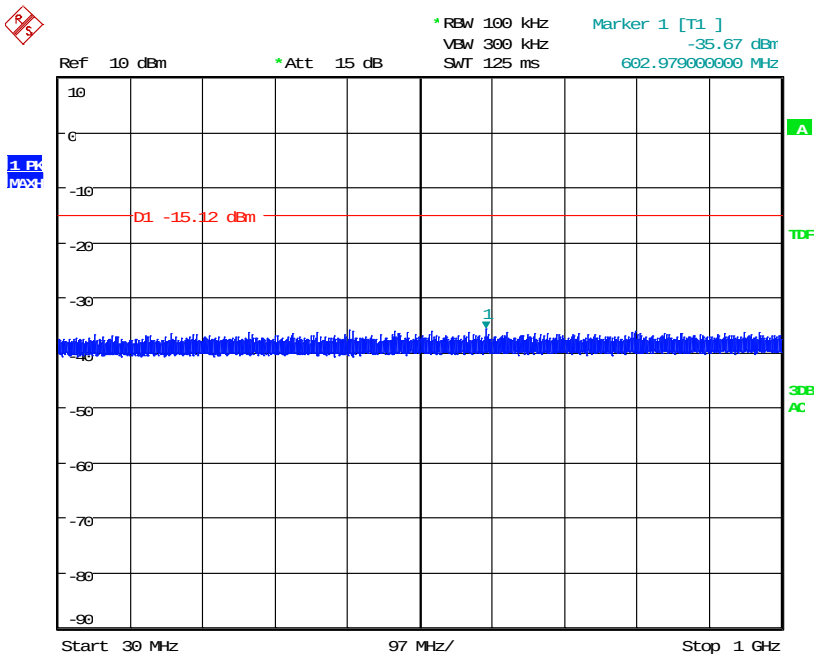


Figure 7.4.2.2-9: 30 MHz – 1 GHz – High Channel

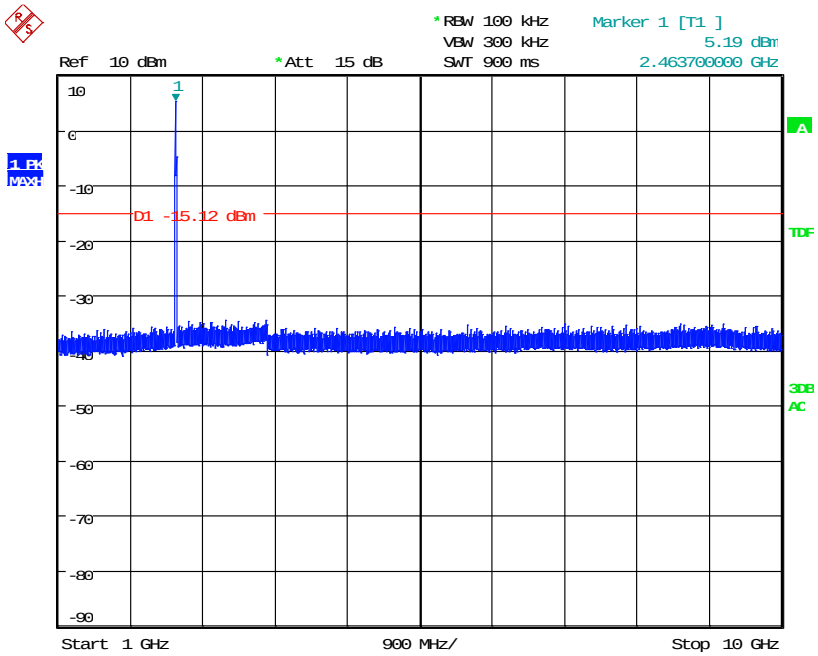


Figure 7.4.2.2-10: 1 GHz – 10 GHz –High Channel

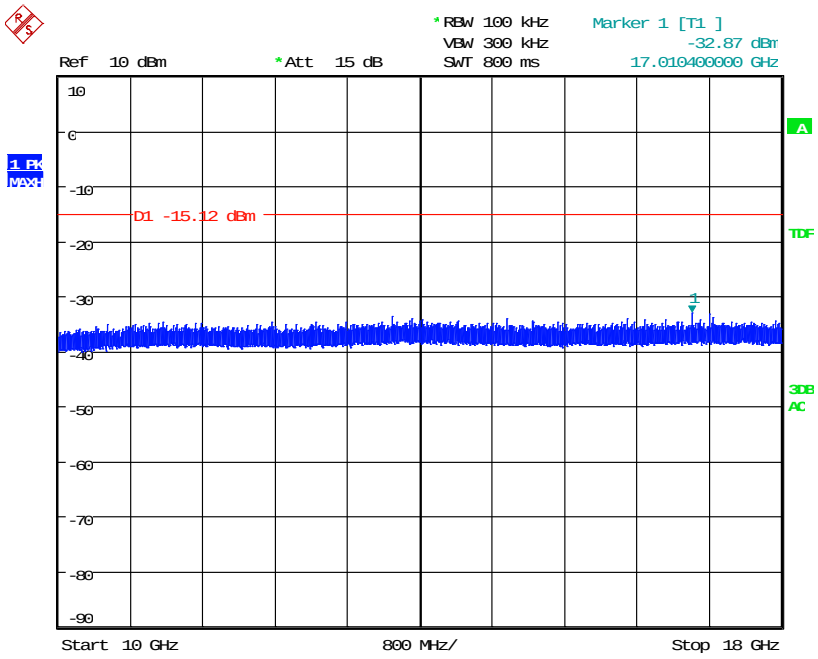


Figure 7.4.2.2-11: 10 GHz – 18 GHz –High Channel

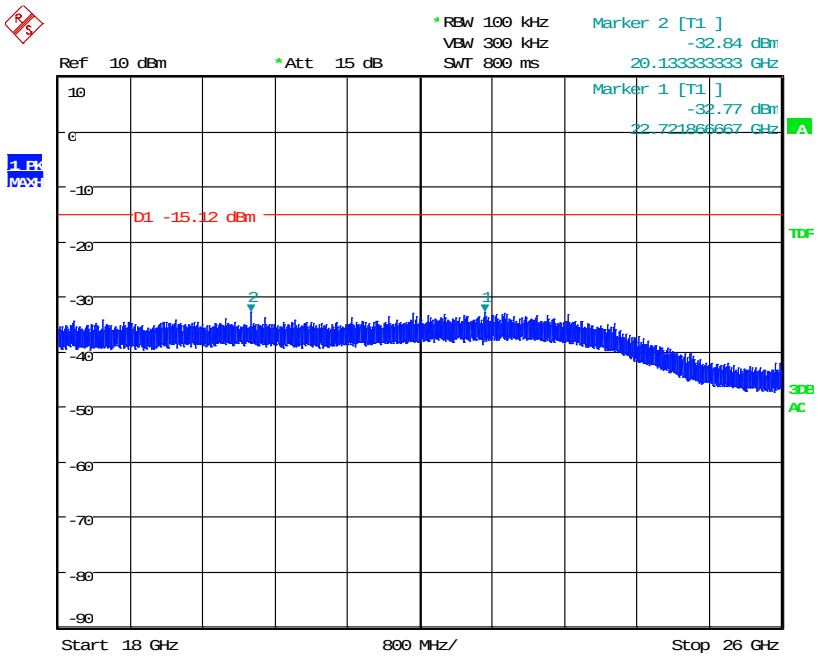


Figure 7.4.2.2-12: 18 GHz – 26 GHz –High Channel

802.11g

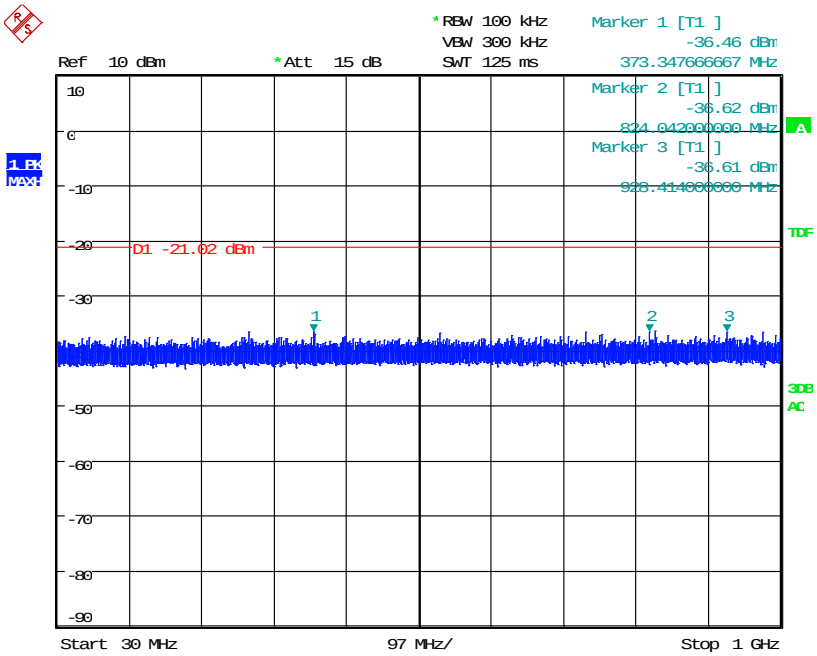


Figure 7.4.2.2-13: 30 MHz – 1 GHz – Low Channel

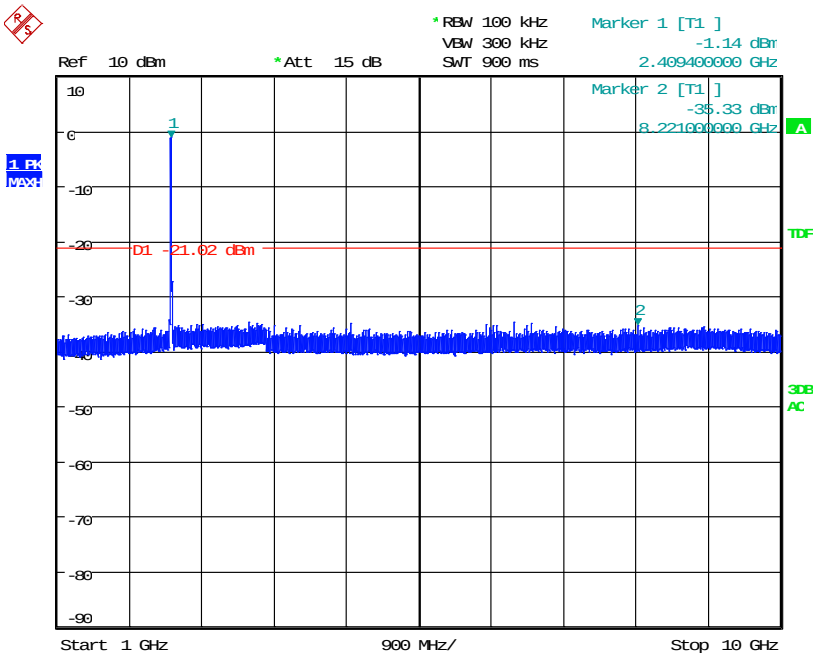


Figure 7.4.2.2-14: 1 GHz – 10 GHz – Low Channel

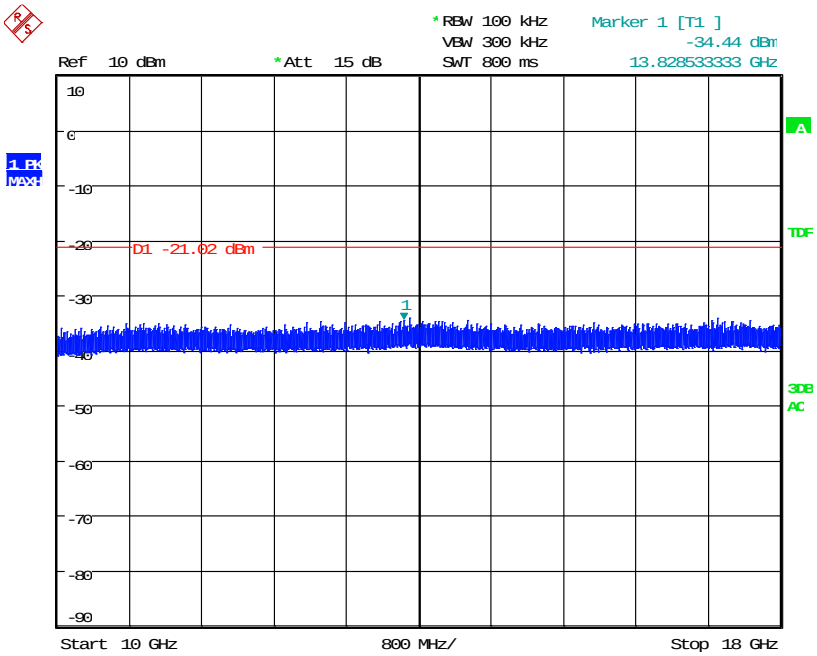


Figure 7.4.2.2-15: 10 GHz – 18 GHz – Low Channel

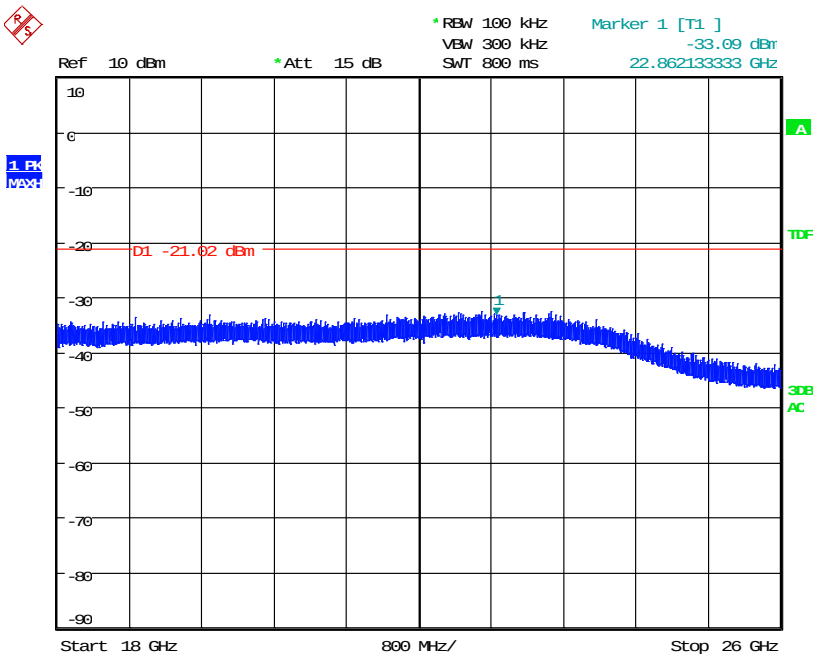


Figure 7.4.2.2-16: 18 GHz – 26 GHz – Low Channel

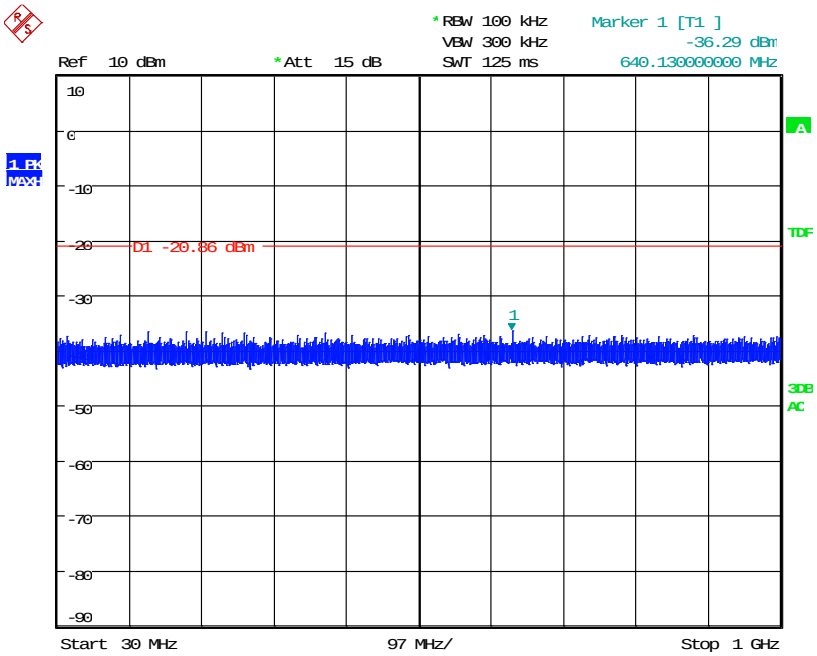


Figure 7.4.2.2-17: 30 MHz – 1 GHz –Middle Channel

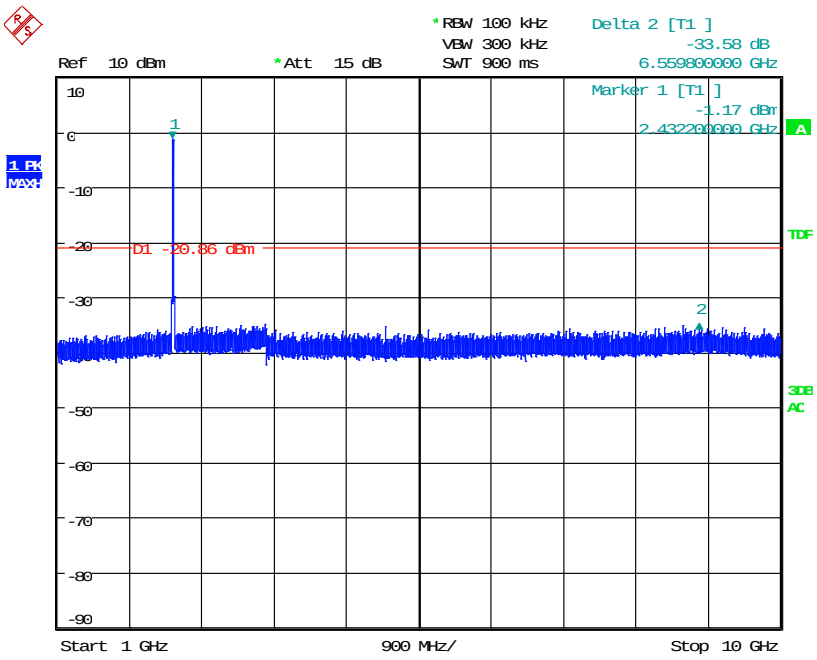


Figure 7.4.2.2-18: 1 GHz – 10 GHz – Middle Channel

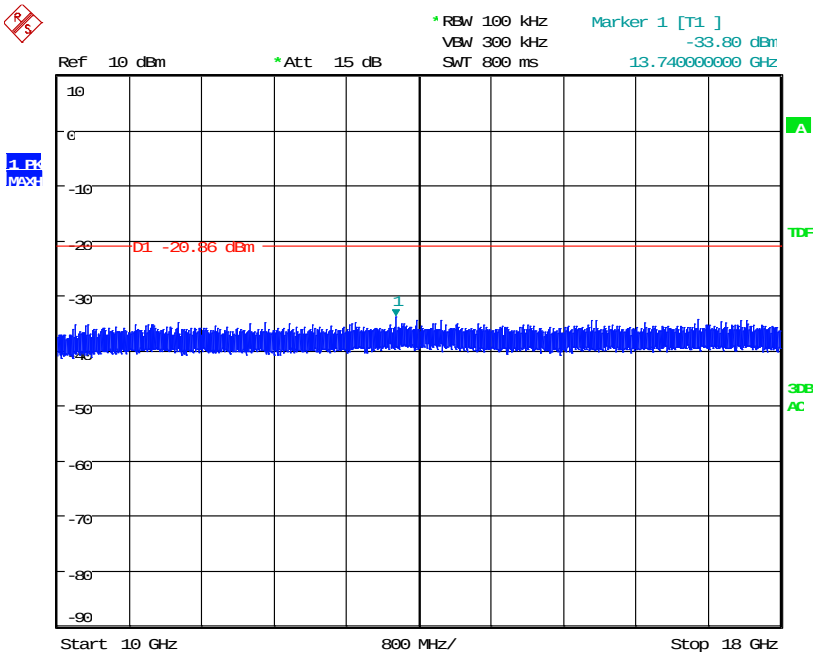


Figure 7.4.2.2-19: 10 GHz – 18 GHz – Middle Channel

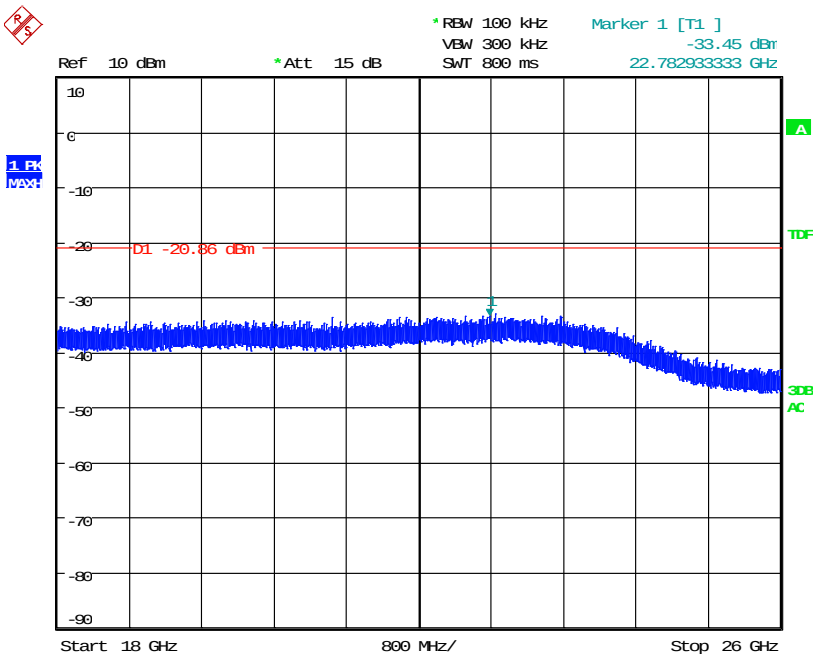


Figure 7.4.2.2-20: 18 GHz – 26 GHz – Middle Channel

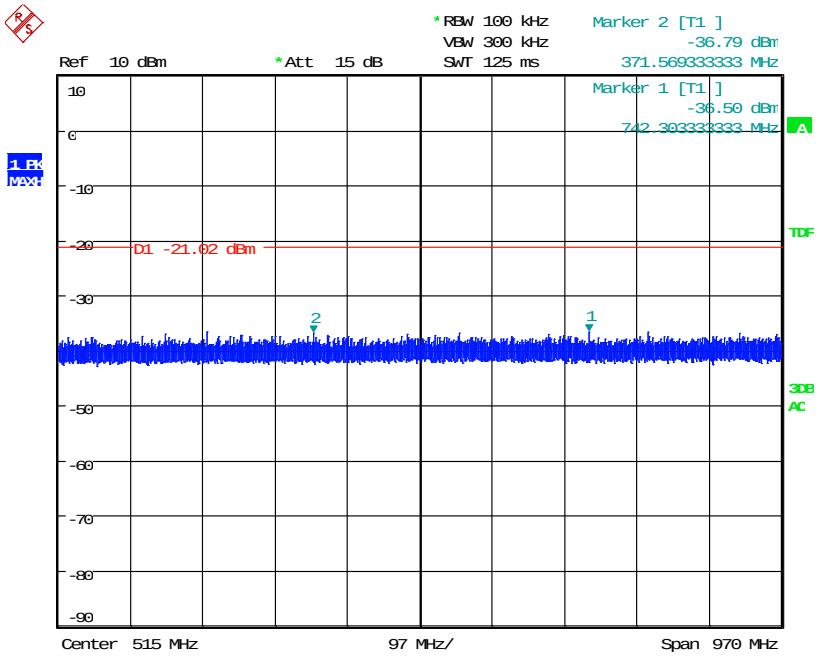


Figure 7.4.2.2-21: 30 MHz – 1 GHz – High Channel

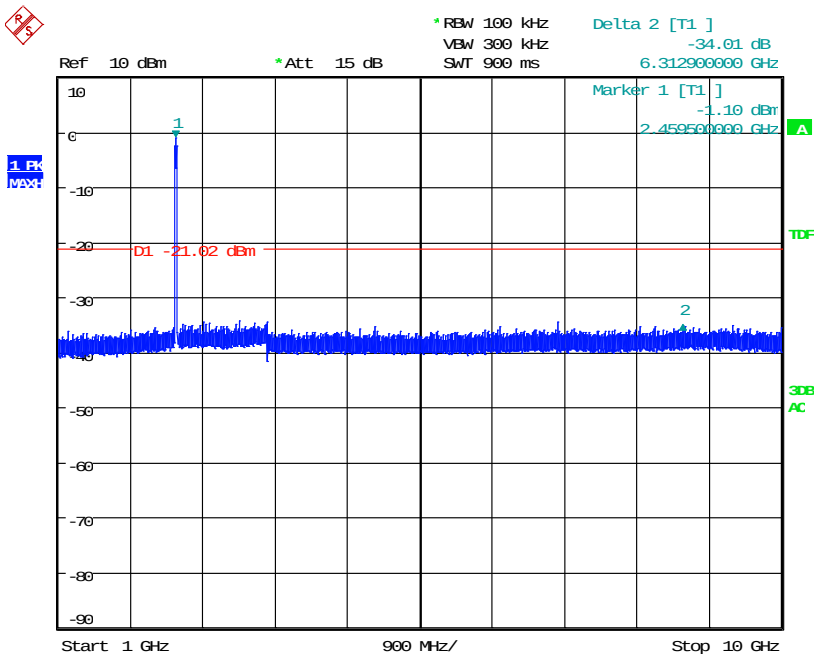


Figure 7.4.2.2-22: 1 GHz – 10 GHz –High Channel

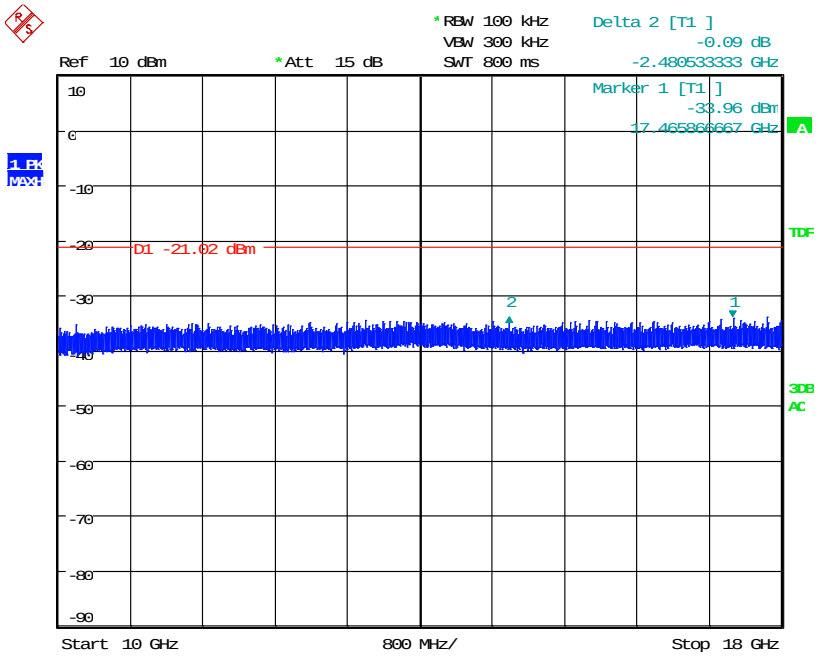


Figure 7.4.2.2-23: 10 GHz – 18 GHz –High Channel

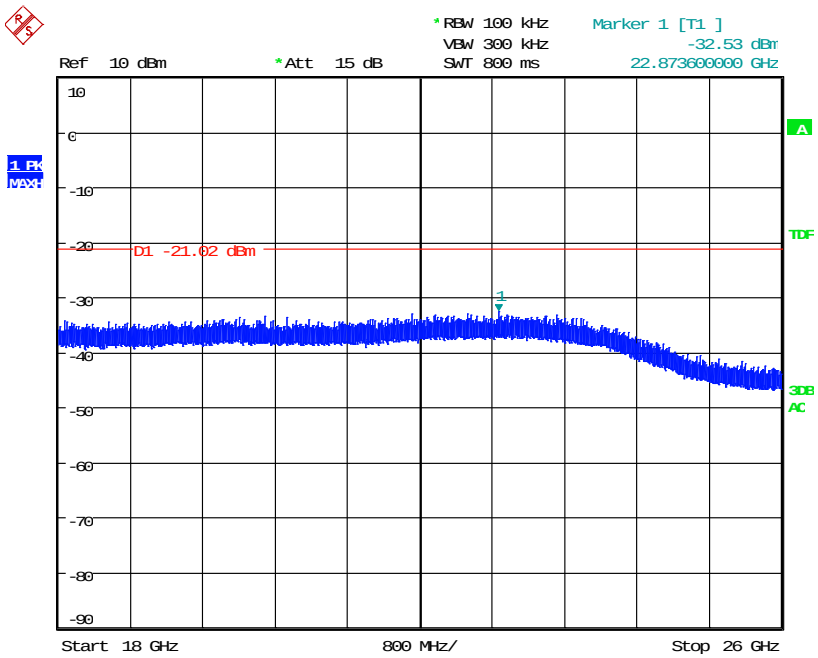


Figure 7.4.2.2-24: 18 GHz – 26 GHz –High Channel

802.11n 20 MHz

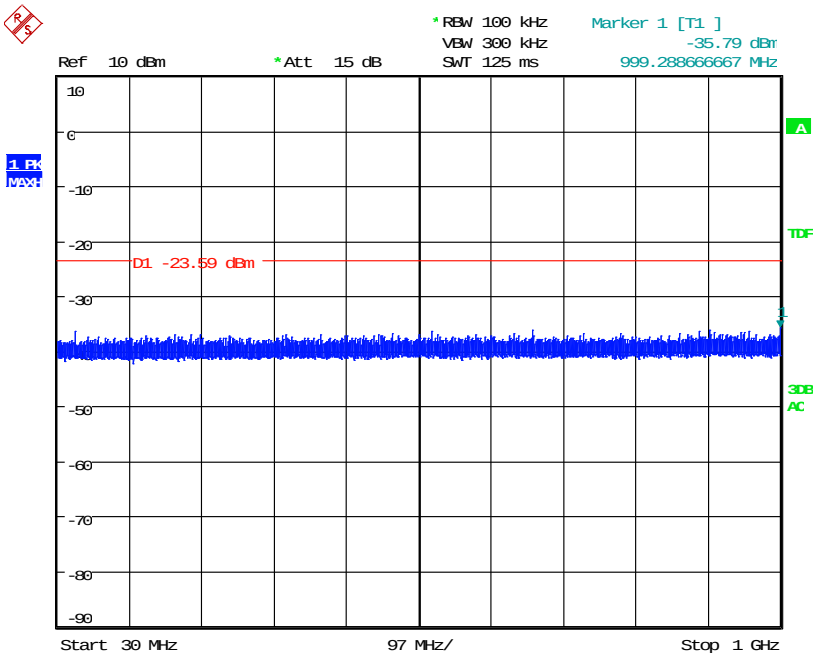


Figure 7.4.2.2-25: 30 MHz – 1 GHz – Low Channel

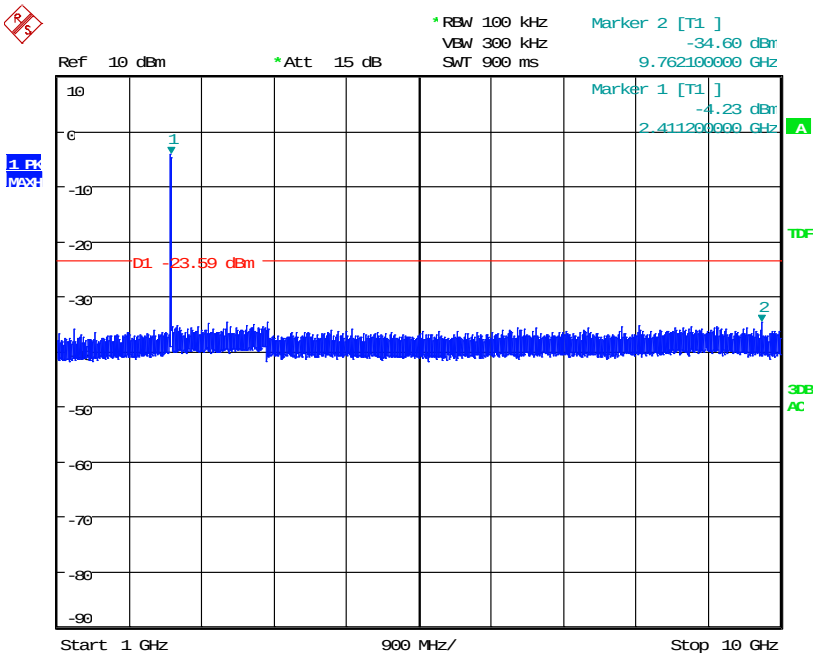


Figure 7.4.2.2-26: 1 GHz – 10 GHz – Low Channel

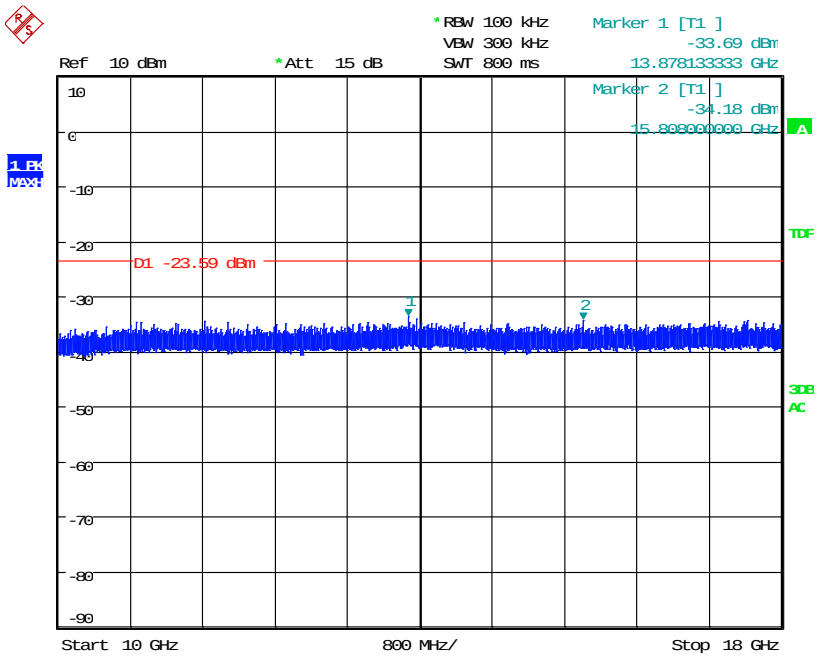


Figure 7.4.2.2-27: 10 GHz – 18 GHz – Low Channel

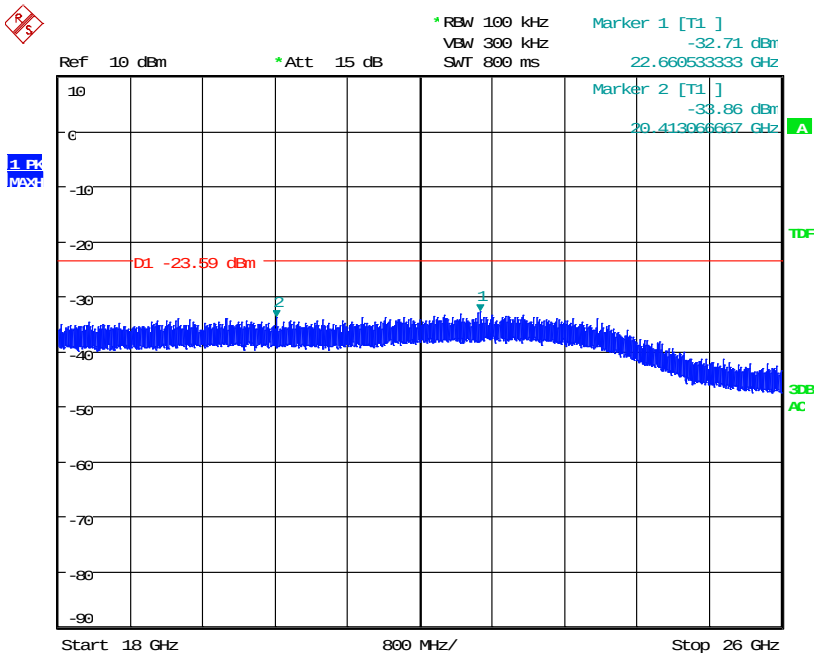


Figure 7.4.2.2-28: 18 GHz – 26 GHz – Low Channel

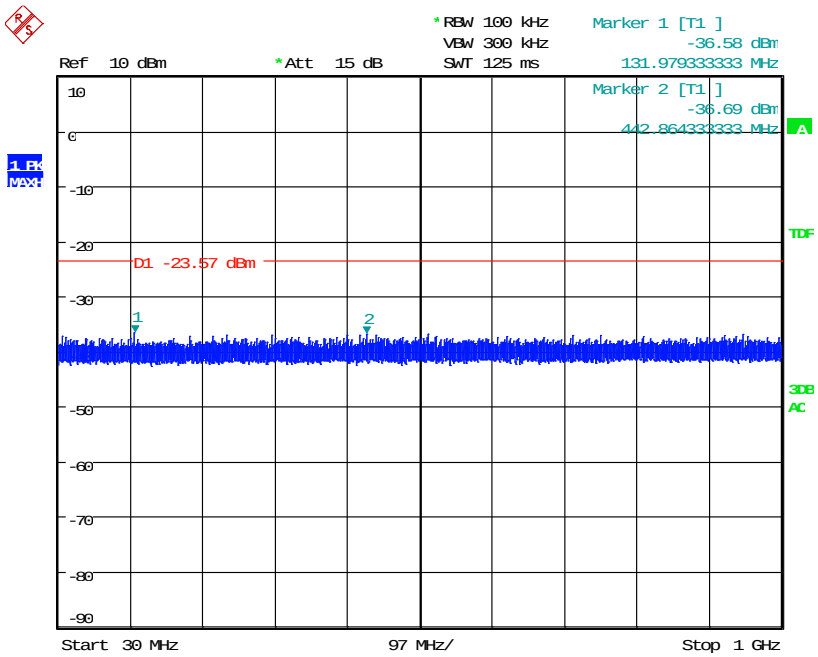


Figure 7.4.2.2-29: 30 MHz – 1 GHz –Middle Channel

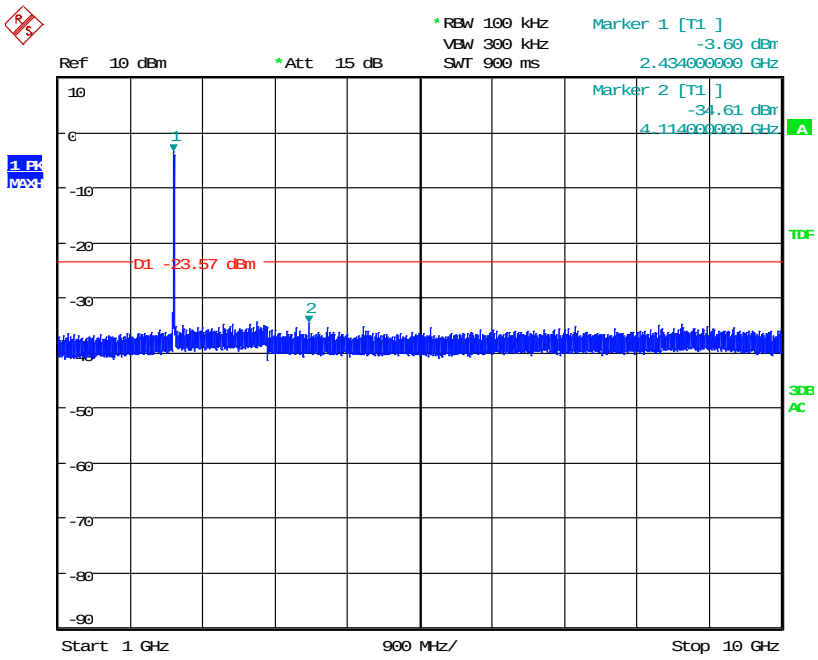


Figure 7.4.2.2-30: 1 GHz – 10 GHz – Middle Channel

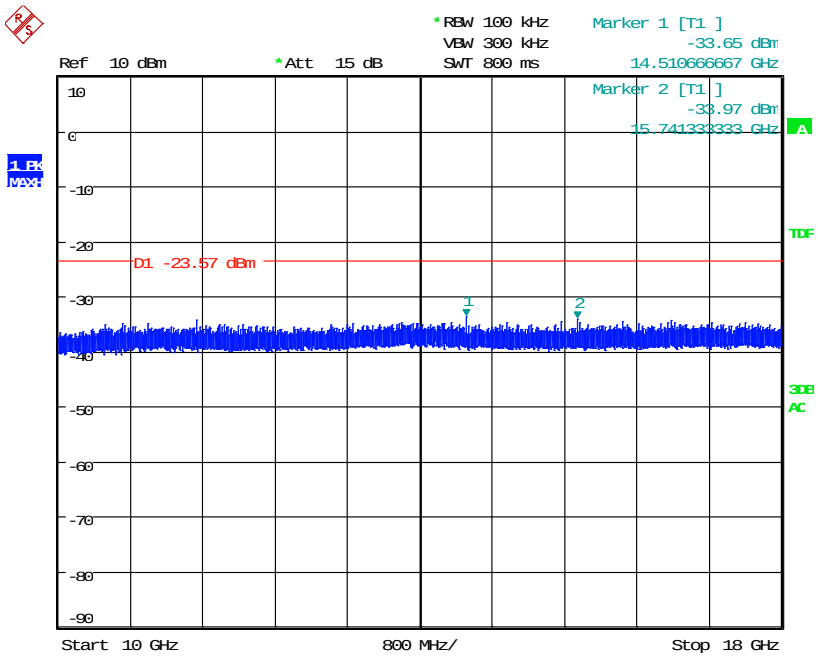


Figure 7.4.2.2-31: 10 GHz – 18 GHz – Middle Channel

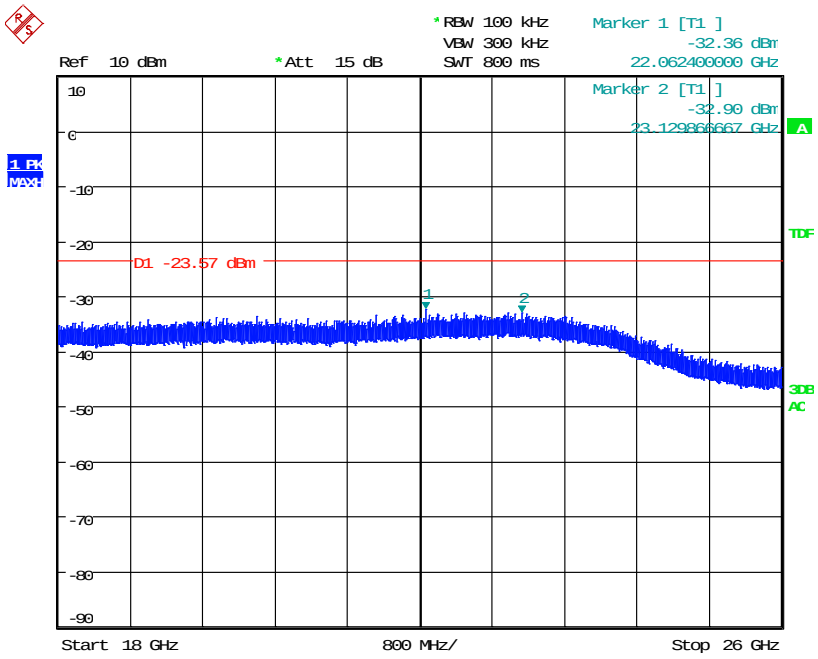


Figure 7.4.2.2-32: 18 GHz – 26 GHz – Middle Channel

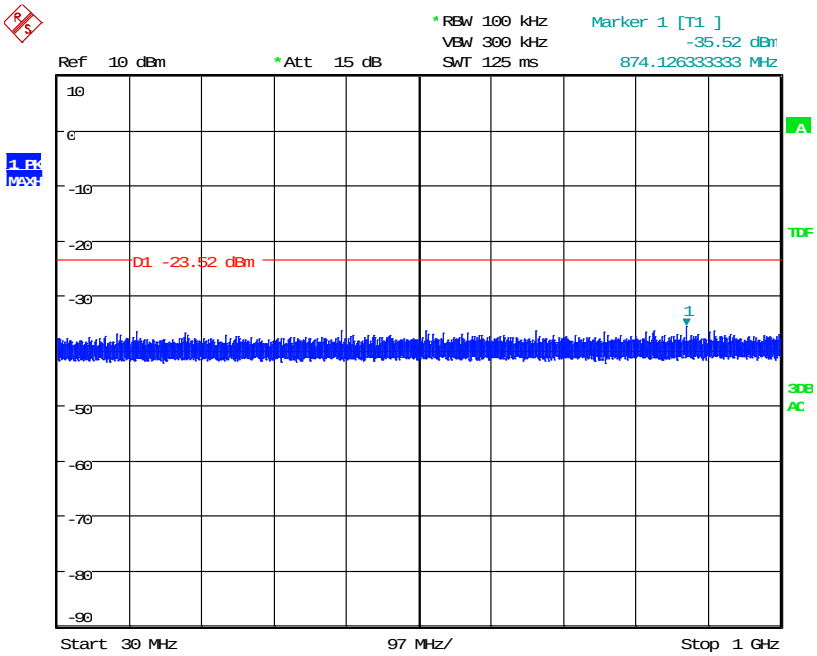


Figure 7.4.2.2-33: 30 MHz – 1 GHz – High Channel

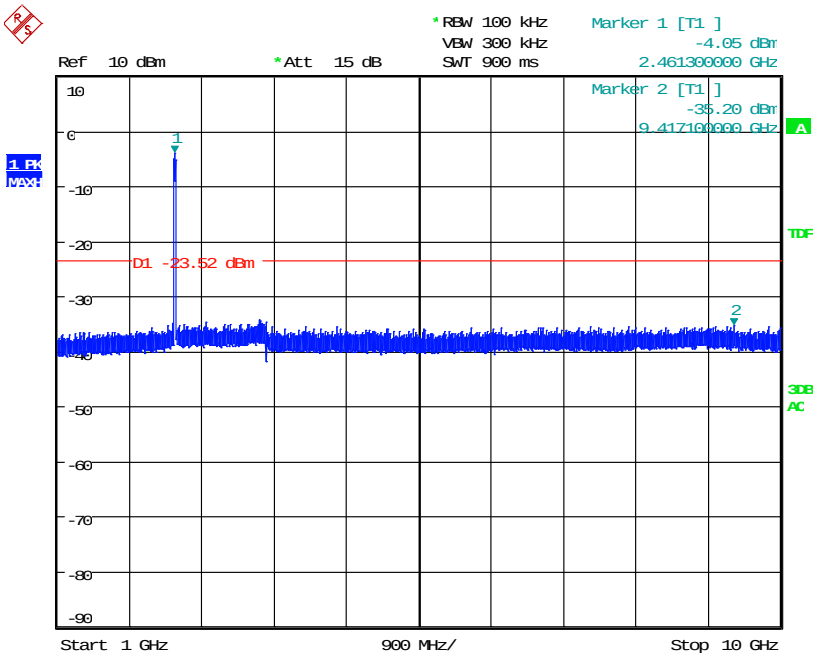


Figure 7.4.2.2-34: 1 GHz – 10 GHz –High Channel

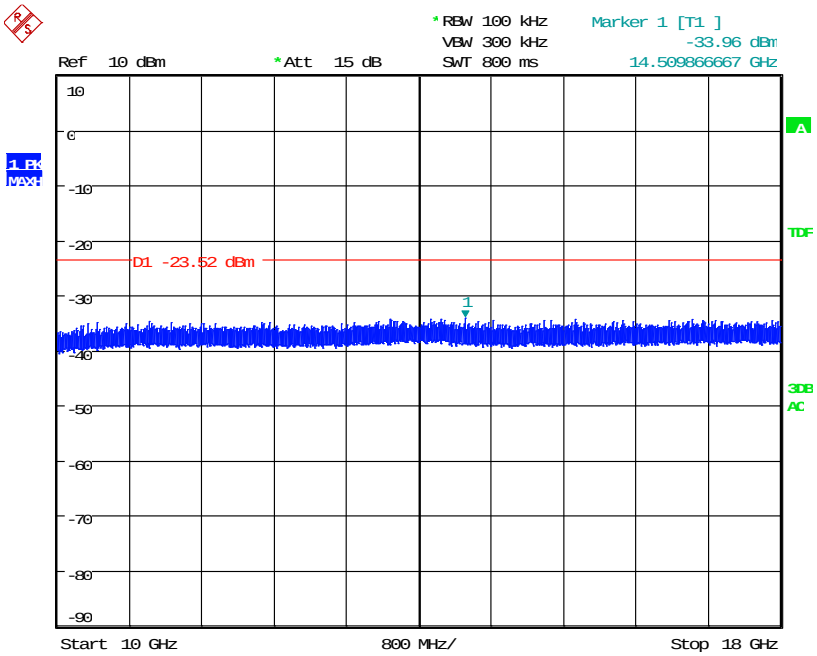


Figure 7.4.2.2-35: 10 GHz – 18 GHz –High Channel

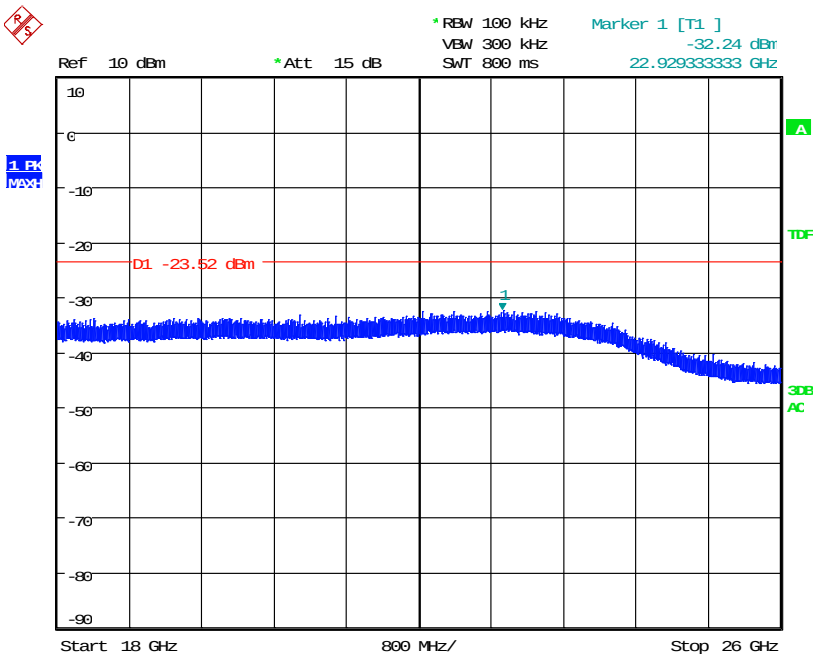


Figure 7.4.2.2-36: 18 GHz – 26 GHz –High Channel

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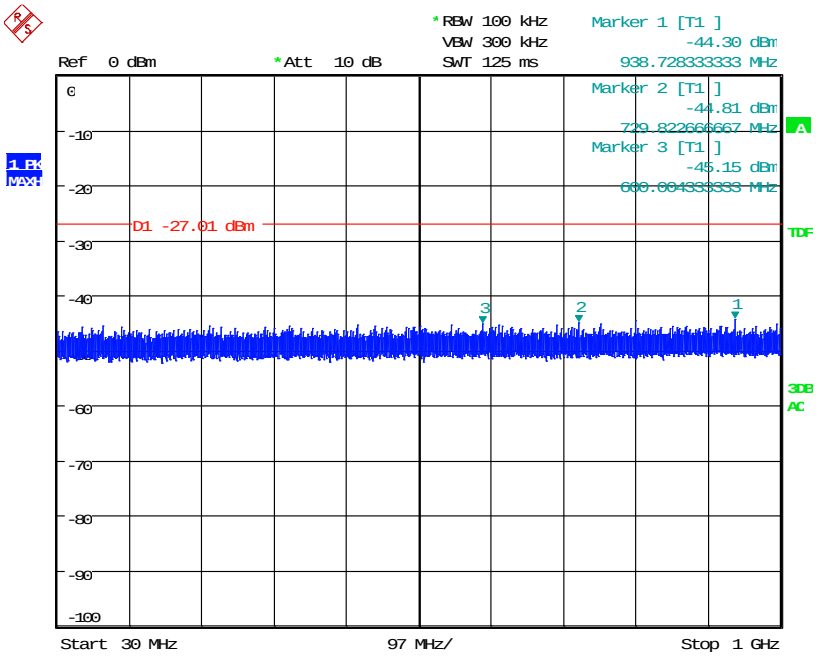

Figure 7.4.2.2-37: 30 MHz – 1 GHz – Low Channel

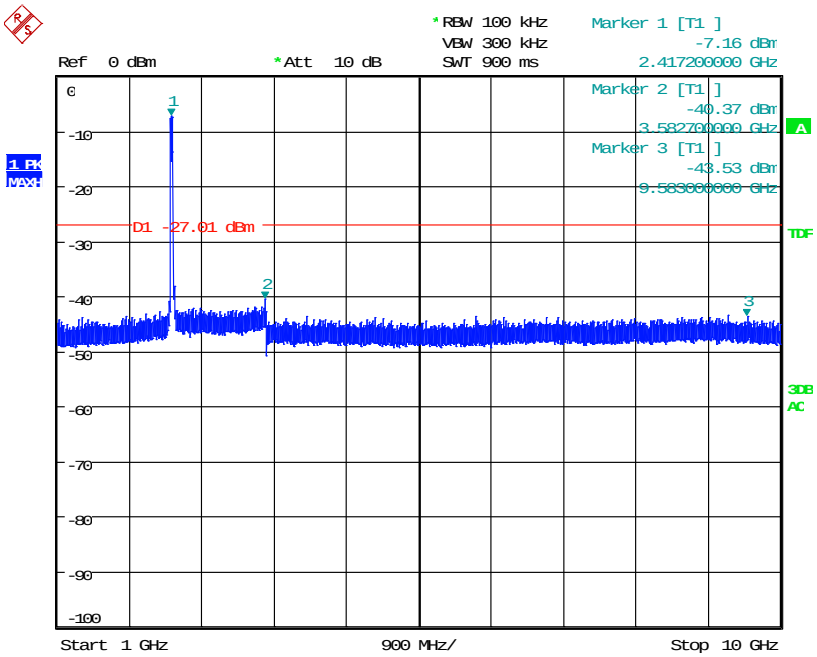

Figure 7.4.2.2-38: 1 GHz – 10 GHz – Low Channel

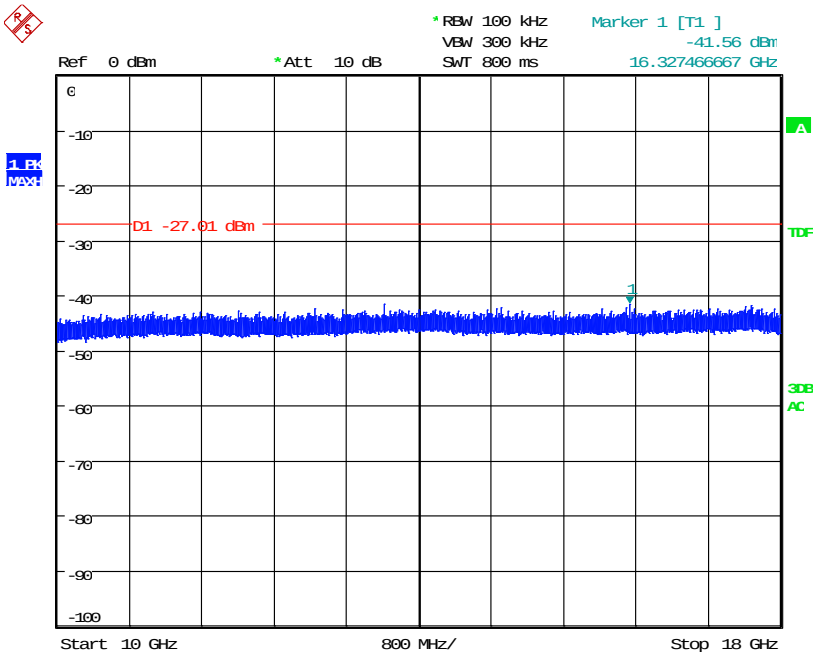

Figure 7.4.2.2-39: 10 GHz – 18 GHz – Low Channel

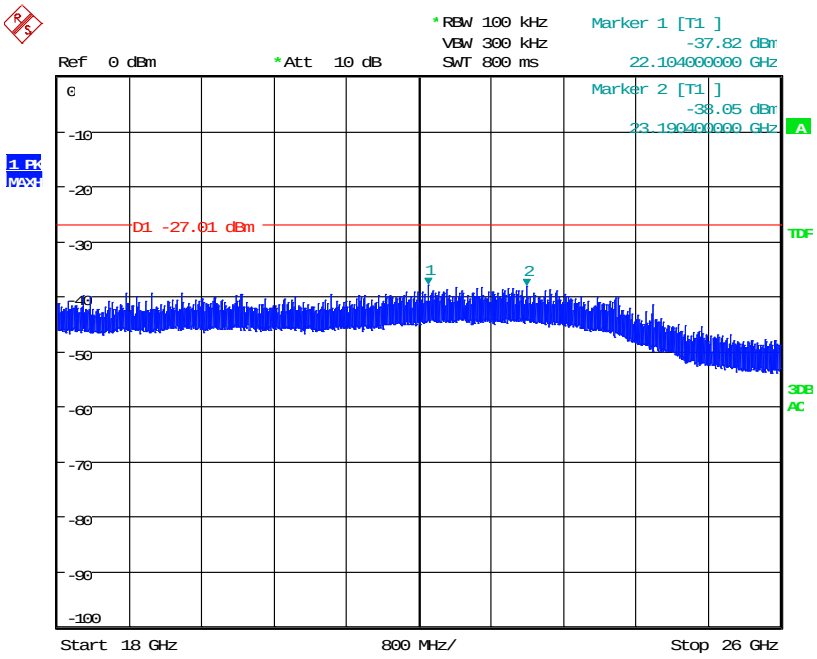

Figure 7.4.2.2-40: 18 GHz – 26 GHz – Low Channel

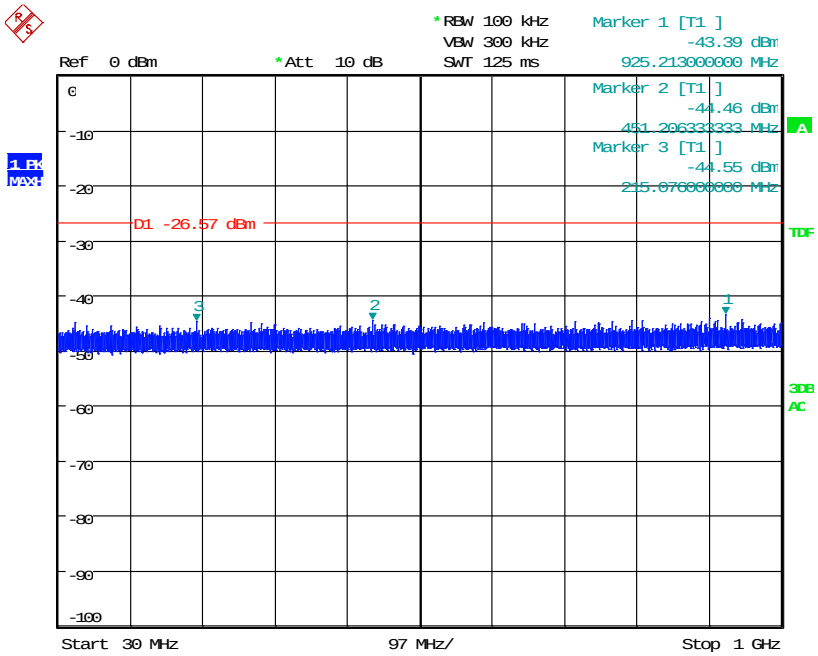

Figure 7.4.2.2-41: 30 MHz – 1 GHz –Middle Channel

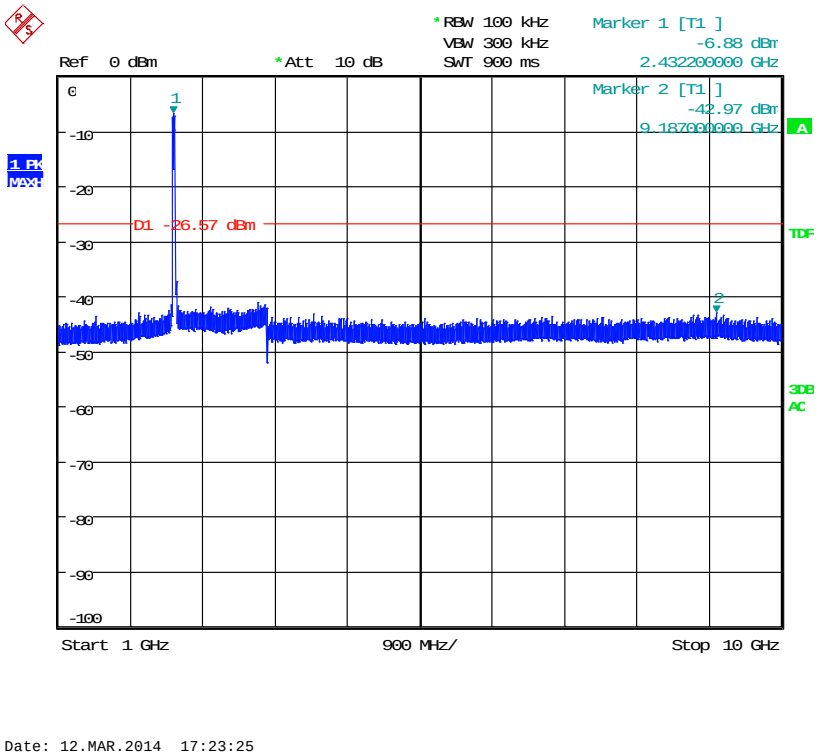

Figure 7.4.2.2-42: 1 GHz – 10 GHz – Middle Channel

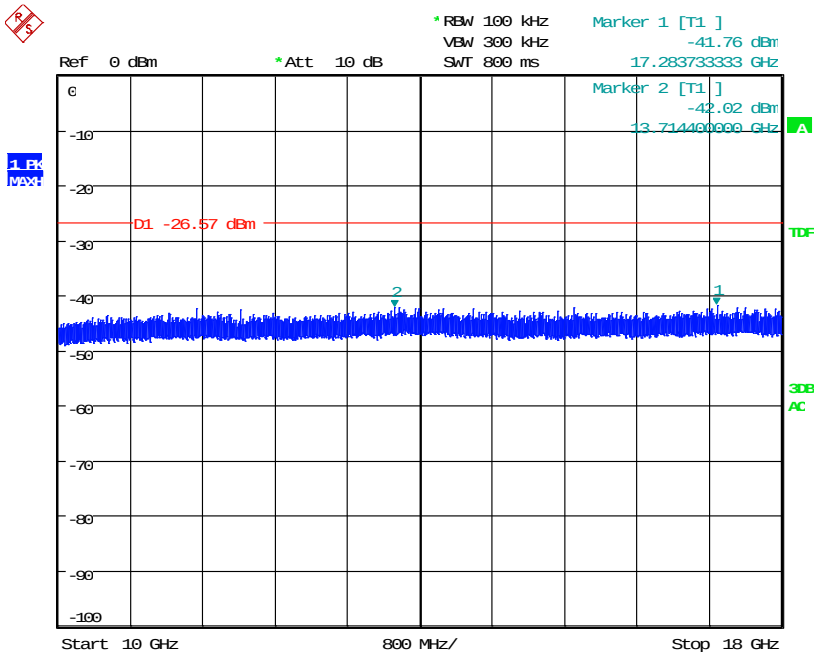

Figure 7.4.2.2-43: 10 GHz – 18 GHz – Middle Channel

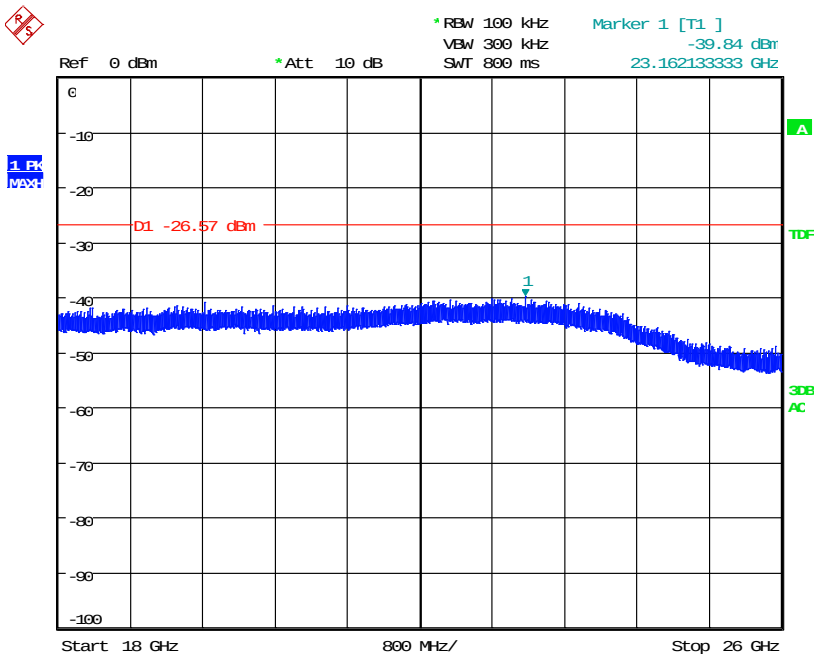

Figure 7.4.2.2-44: 18 GHz – 26 GHz – Middle Channel

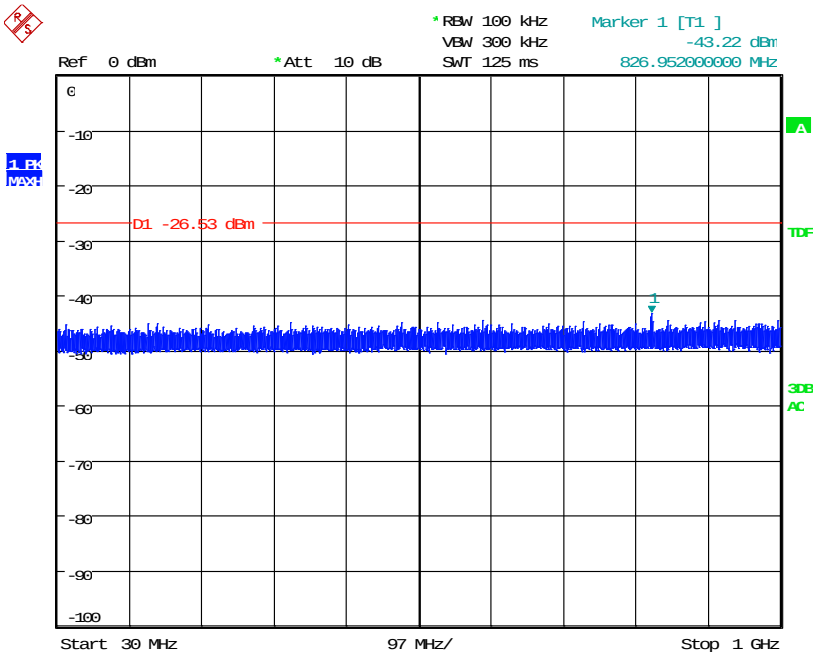

Figure 7.4.2.2-45: 30 MHz – 1 GHz – High Channel

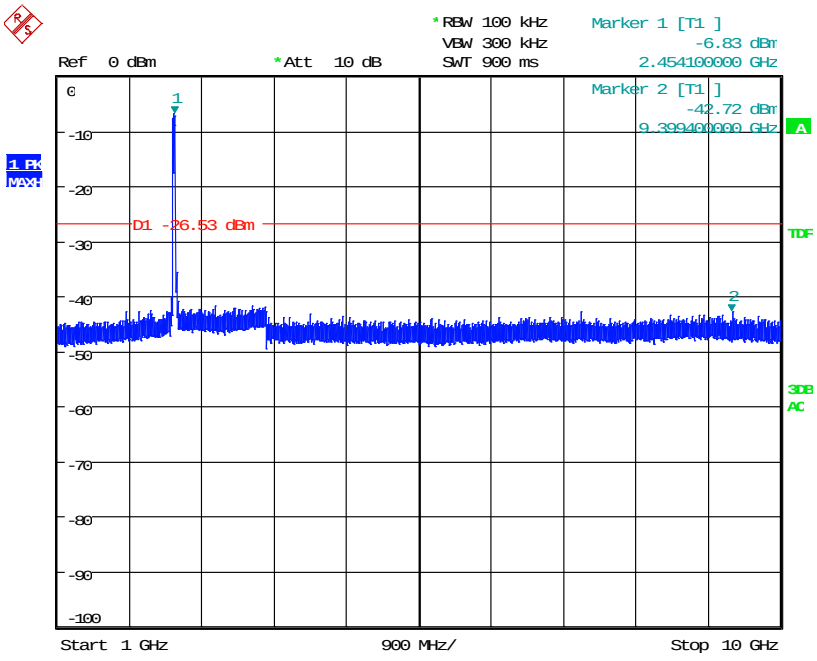

Figure 7.4.2.2-46: 1 GHz – 10 GHz –High Channel

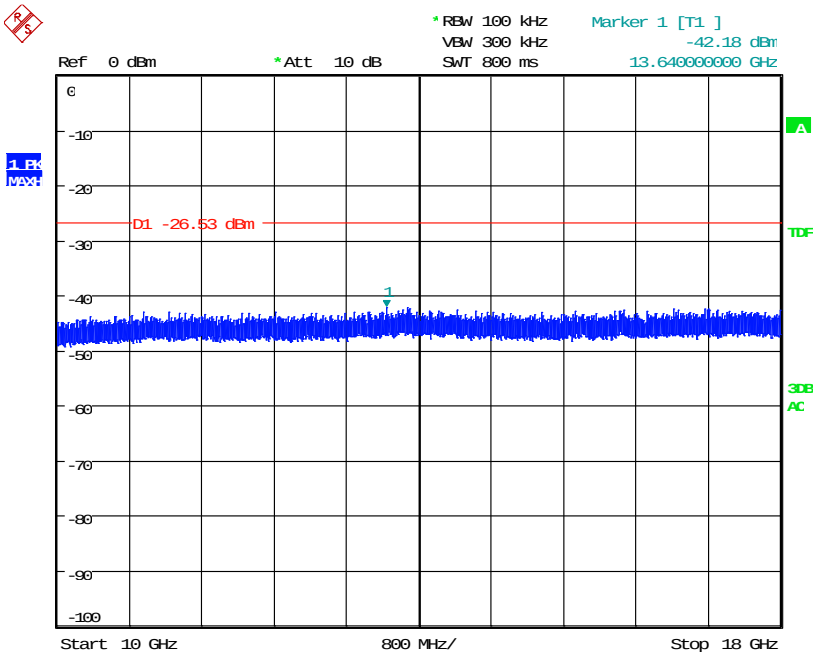

Figure 7.4.2.2-47: 10 GHz – 18 GHz –High Channel

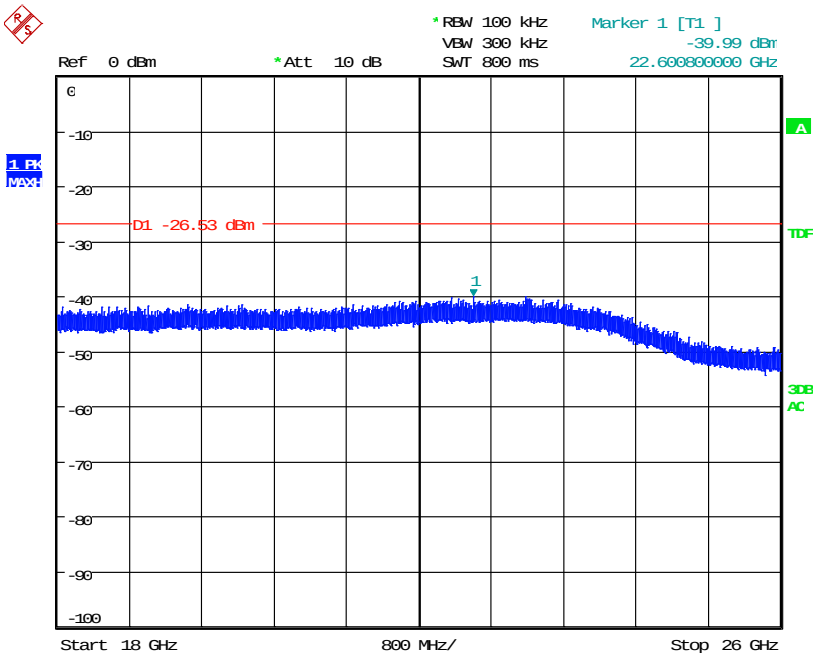

Figure 7.4.2.2-48: 18 GHz – 26 GHz –High Channel

7.4.3 Radiated Spurious Emissions into Restricted Frequency Bands - FCC 15.205, 15.209; IC: RSS-210 2.2, RSS-Gen 7.2.2, 7.2.5

7.4.3.1 Measurement Procedure

Radiated emissions tests were made over the frequency range of 30 MHz to 26 GHz, 10 times the highest fundamental frequency. Each emission found to be in a restricted band as defined by section 15.205, including any emission at the operational band-edge, was compared to the radiated emission limits as defined in section 15.209.

The EUT was rotated through 360° and the receive antenna height was varied from 1m to 4m so that the maximum radiated emissions level would be detected. For frequencies below 1000MHz, quasi-peak measurements were made using a resolution bandwidth RBW of 120 kHz and a video bandwidth VBW of 300 kHz. For frequencies above 1000 MHz, peak measurements are made with RBW of 1 MHz and VBW of 3 MHz. Average measurements are performed in the linear scale using VBW of 30 Hz over a 5 second sweep.

7.4.3.2 Measurement Results

Radiated band-edge and spurious emissions found in the restricted frequency bands of 30MHz to 26 GHz are reported in the tables below.

Table 7.4.3.2-1: Radiated Emissions Below 1 GHz

Frequency (MHz)	Level (dBuV)		Antenna Polarity	Correction Factors	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg	(H/V)	(dB)	pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
74.8	--------	36.95	H	-18.02	---------	18.93	--------	40.0	---------	21.1
74.8	--------	40.18	V	-18.02	---------	22.16	--------	40.0	---------	17.8
120	--------	45.04	H	-14.81	---------	30.23	--------	43.5	---------	13.3
120	--------	51.24	V	-14.81	---------	36.43	--------	43.5	---------	7.1
240	--------	48.86	H	-13.76	---------	35.10	--------	46.0	---------	10.9
240	--------	41.92	V	-13.76	---------	28.16	--------	46.0	---------	17.8
960	--------	36.32	H	1.20	---------	37.52	--------	54.0	---------	16.5
960	--------	31.59	V	1.20	---------	32.79	--------	54.0	---------	21.2

Note: These emissions found in the restricted bands below 1 GHz were observed to be independent of the mode of operation of the module.

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Table 7.4.3.2-2: Radiated Spurious Emissions Tabulated Data

Frequency (MHz)	Level (dBuV)		Antenna Polarity	Correction Factors	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg	(H/V)	(dB)	pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
Low Channel = 2412 MHz										
2390	63.60	51.09	H	-8.00	55.60	43.09	74.0	54.0	18.4	10.9
2390	62.82	50.70	V	-8.00	54.82	42.70	74.0	54.0	19.2	11.3
4824	50.96	37.23	H	-0.21	50.75	37.02	74.0	54.0	23.3	17.0
4824	51.28	36.32	V	-0.21	51.07	36.11	74.0	54.0	22.9	17.9
Middle Channel = 2437 MHz										
4874	51.90	37.77	H	-0.06	51.84	37.71	74.0	54.0	22.2	16.3
4874	50.82	34.80	V	-0.06	50.76	34.74	74.0	54.0	23.2	19.3
7311	47.33	34.61	H	5.54	52.87	40.15	74.0	54.0	21.1	13.8
7311	47.24	34.55	V	5.54	52.78	40.09	74.0	54.0	21.2	13.9
High Channel = 2462 MHz										
2483.5	62.95	51.17	H	-7.61	55.34	43.56	74.0	54.0	18.7	10.4
2483.5	60.67	48.70	V	-7.61	53.06	41.09	74.0	54.0	20.9	12.9
4924	51.86	36.21	H	0.09	51.95	36.30	74.0	54.0	22.0	17.7
4924	51.30	35.44	V	0.09	51.39	35.53	74.0	54.0	22.6	18.5
7386	46.83	33.67	V	5.81	52.64	39.48	74.0	54.0	21.4	14.5

Note: All emissions above 7386 MHz were attenuated below the limits and the noise floor of the measurement equipment.

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Table 7.4.3.2-3: Radiated Spurious Emissions Tabulated Data

Frequency (MHz)	Level (dBuV)		Antenna Polarity	Correction Factors	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg	(H/V)	(dB)	pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
Low Channel = 2412 MHz										
2390	71.82	53.15	H	-8.00	63.82	45.15	74.0	54.0	10.2	8.8
2390	71.16	52.47	V	-8.00	63.16	44.47	74.0	54.0	10.8	9.5
4824	48.32	34.84	H	-0.60	47.72	34.24	74.0	54.0	26.3	19.8
4824	46.13	33.79	V	-0.60	45.53	33.19	74.0	54.0	28.5	20.8
Middle Channel = 2437 MHz										
4874	46.40	33.74	H	-0.45	45.95	33.29	74.0	54.0	28.0	20.7
4874	47.44	33.75	V	-0.45	46.99	33.30	74.0	54.0	27.0	20.7
High Channel = 2462 MHz										
2483.5	74.31	53.92	H	-7.61	66.70	46.31	74.0	54.0	7.3	7.7
2483.5	70.34	50.81	V	-7.61	62.73	43.20	74.0	54.0	11.3	10.8
4924	47.70	34.16	H	-0.30	47.40	33.86	74.0	54.0	26.6	20.1
4924	49.58	33.85	V	-0.30	49.28	33.55	74.0	54.0	24.7	20.5

Note: All emissions above 4924 MHz were attenuated below the limits and the noise floor of the measurement equipment.

802.11n 20 MHz

Table 7.4.3.2-4: Radiated Spurious Emissions Tabulated Data

Frequency (MHz)	Level (dBuV)		Antenna Polarity	Correction Factors	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg	(H/V)	(dB)	pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
Low Channel = 2412 MHz										
2390	75.04	54.56	H	-8.00	67.04	46.56	74.0	54.0	7.0	7.4
2390	74.21	54.11	V	-8.00	66.21	46.11	74.0	54.0	7.8	7.9
4824	46.39	33.32	H	-0.60	45.79	32.72	74.0	54.0	28.2	21.3
4824	45.62	32.89	V	-0.60	45.02	32.29	74.0	54.0	29.0	21.7
Middle Channel = 2437 MHz										
4874	44.90	32.53	H	-0.45	44.45	32.08	74.0	54.0	29.5	21.9
4874	44.85	32.64	V	-0.45	44.40	32.19	74.0	54.0	29.6	21.8
High Channel = 2462 MHz										
2483.5	76.19	56.80	H	-7.61	68.58	49.19	74.0	54.0	5.4	4.8
2483.5	73.86	54.47	V	-7.61	66.25	46.86	74.0	54.0	7.7	7.1
4924	45.68	32.84	H	-0.30	45.38	32.54	74.0	54.0	28.6	21.5
4924	44.76	32.43	V	-0.30	44.46	32.13	74.0	54.0	29.5	21.9

Note: All emissions above 4924 MHz were attenuated below the limits and the noise floor of the measurement equipment.

802.11n 40 MHz

Table 7.4.3.2-5: Radiated Spurious Emissions Tabulated Data

Frequency (MHz)	Level (dBuV)		Antenna Polarity	Correction Factors	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg	(H/V)	(dB)	pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
Low Channel = 2422 MHz										
2390	76.82	59.77	H	-8.00	68.82	51.77	74.0	54.0	5.2	2.2
2390	76.89	59.45	V	-8.00	68.89	51.45	74.0	54.0	5.1	2.5
4844	45.65	32.66	H	-0.54	45.11	32.12	74.0	54.0	28.9	21.9
Middle Channel = 2437 MHz										
4874	44.45	32.62	H	-0.45	44.00	32.17	74.0	54.0	30.0	21.8
4874	45.03	32.55	V	-0.45	44.58	32.10	74.0	54.0	29.4	21.9
High Channel = 2452 MHz										
2483.5	77.48	59.78	H	-7.61	69.87	52.17	74.0	54.0	4.1	1.8
2483.5	72.29	54.76	V	-7.61	64.68	47.15	74.0	54.0	9.3	6.8
4904	55.96	42.49	V	0.03	55.99	42.52	74.0	54.0	18.0	11.5
7356	43.17	43.11	H	5.70	48.87	48.81	74.0	54.0	25.1	5.2

Note: All emissions above 7356 MHz were attenuated below the limits and the noise floor of the measurement equipment.

7.4.3.3 Sample Calculation:

$R_C = R_U + CF_T$

Where:

CF_T	=	Total Correction Factor (AF+CA+AG)-DC (Average Measurements Only)
R_U	=	Uncorrected Reading
R_C	=	Corrected Level
AF	=	Antenna Factor
CA	=	Cable Attenuation
AG	=	Amplifier Gain
DC	=	Duty Cycle Correction Factor

Example Calculation: Peak
Corrected Level: 63.6+ (-8.0) = 55.6 dBµV/m
Margin: 74 dBµV/m – 55.6 dBµV/m = 18.4 dB

Example Calculation: Average
Corrected Level: 51.09 + (-8.0) = 43.09 dBµV/m
Margin: 54 dBµV/m – 43.09 dBµV/m = 10.9 dB

7.5 Power Spectral Density - FCC Section 15.247(e) IC: RSS-210 A8.2(b)

7.5.1 PSD Measurement Procedure (Conducted Method)

The power spectral density was measured in accordance with the FCC KDB Publication No. 558074 "Guidance for Performing Compliance Measurements on Digital Transmission Systems (47 CFR 15.247)" Section 10.2 Method PKPSD (peak PSD). The RF output port of the EUT was directly connected to the input of the spectrum analyzer. Offset values were input for cable and external attenuation. The spectrum analyzer RBW was set to 100 kHz and VBW 300 kHz. Span was adjusted to 1.5 times the 6 dB bandwidth and the sweep time was set to auto.

7.5.2 Measurement Results

Results are shown below.

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Table 7.5.2-1: Power Spectral Density

Frequency (MHz)	PSD (dBm)	Limit (dBm)	Margin (dB)
2412	5.37	8.0	2.63
2437	5.21	8.0	2.79
2462	4.88	8.0	3.12

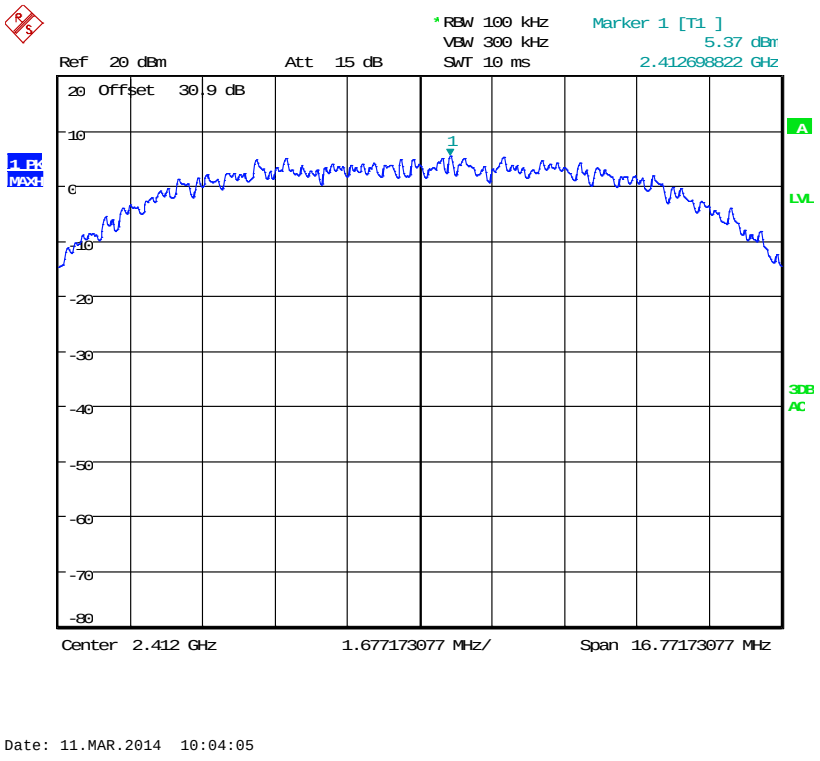

Figure 7.5.2-1: Power Spectral Density - Low Channel

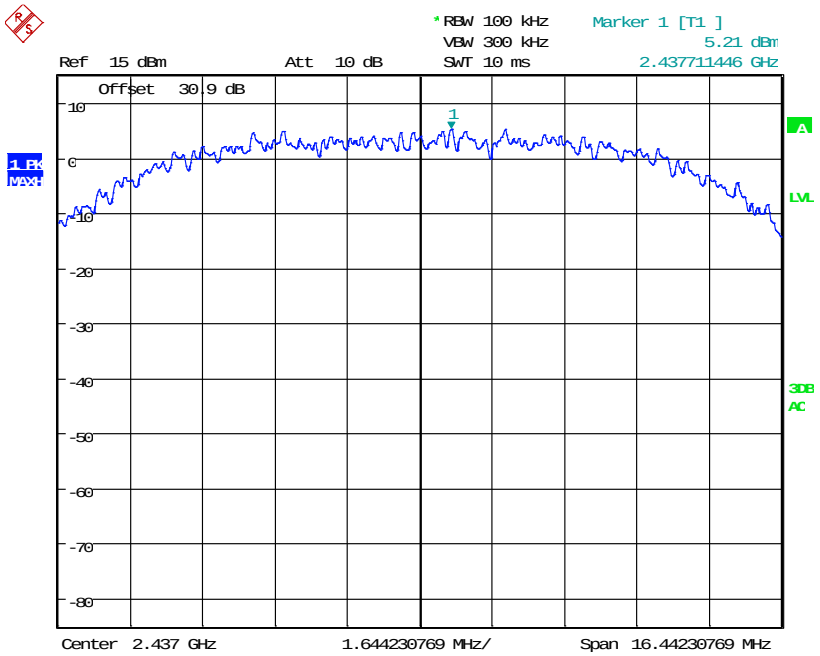

Figure 7.5.2-2: Power Spectral Density - Middle Channel

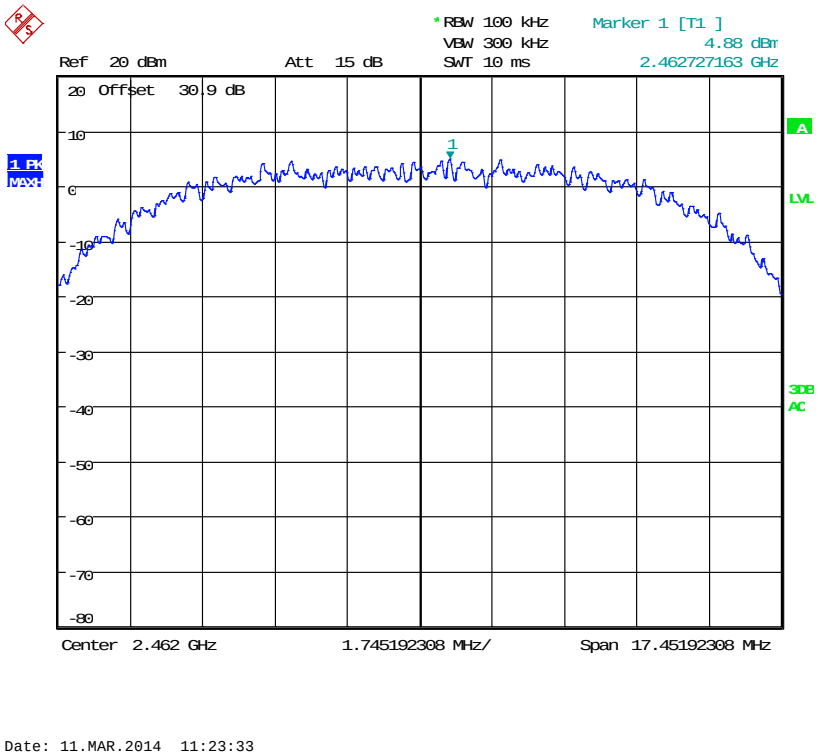

Figure 7.5.2-3: Power Spectral Density – High Channel

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Table 7.5.2-2: Power Spectral Density

Frequency (MHz)	PSD (dBm)	Limit (dBm)	Margin (dB)
2412	-1.02	8.0	9.02
2437	-0.86	8.0	8.86
2462	-1.02	8.0	9.02

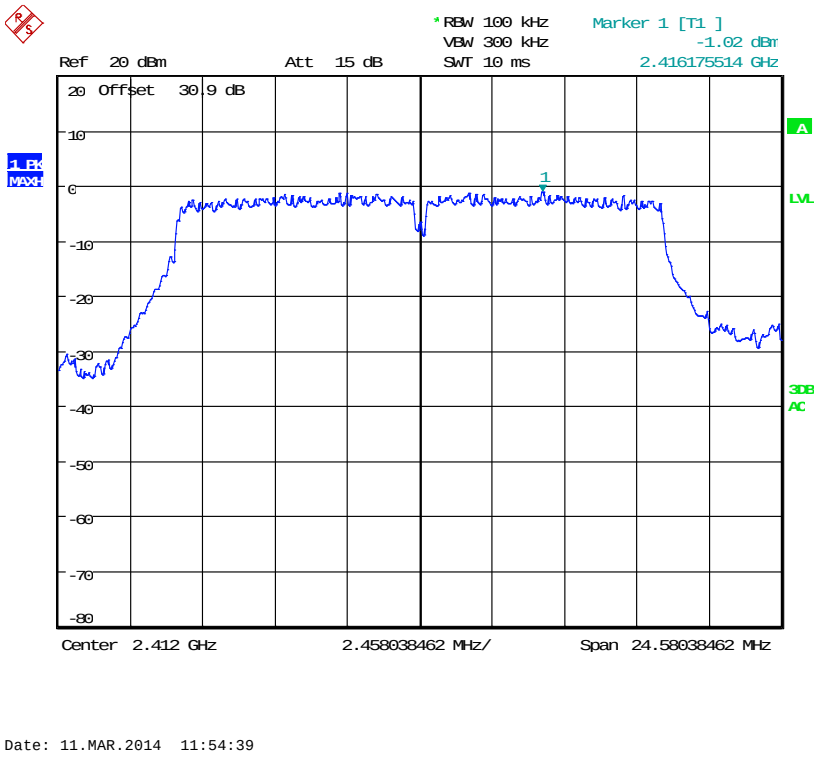

Figure 7.5.2-4: Power Spectral Density - Low Channel

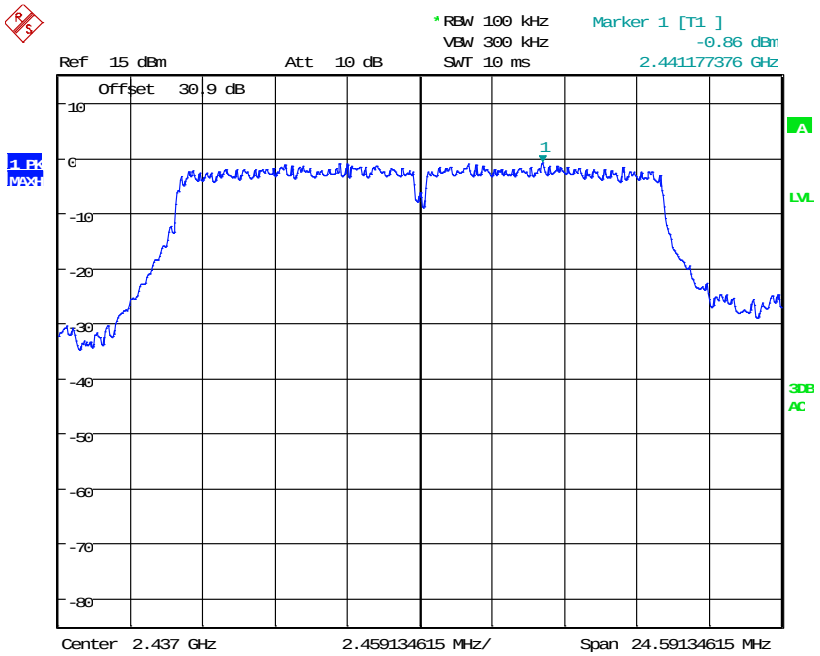

Figure 7.5.2-5: Power Spectral Density - Middle Channel

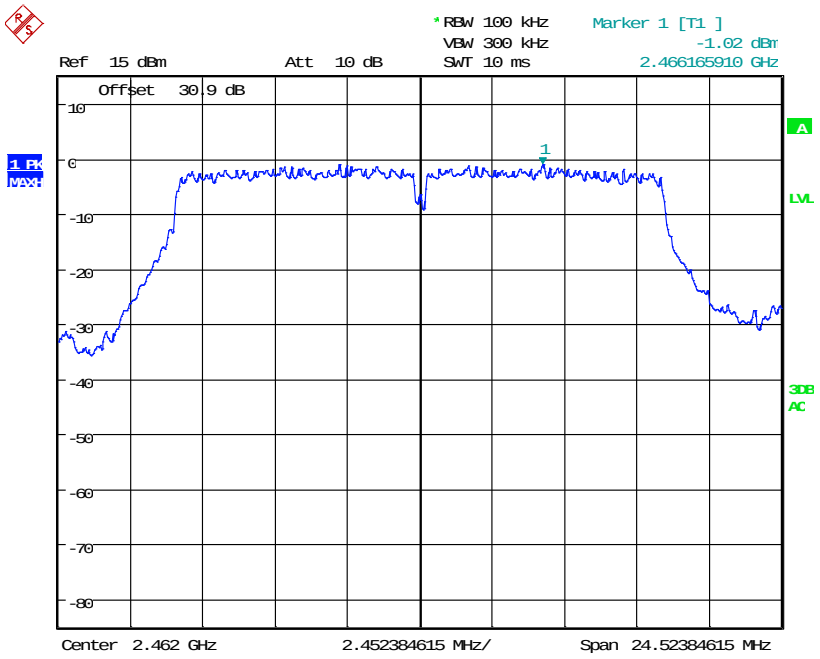

Figure 7.5.2-6: Power Spectral Density – High Channel

802.11n 20 MHz

Table 7.5.2-3: Power Spectral Density

Frequency (MHz)	PSD (dBm)	Limit (dBm)	Margin (dB)
2412	-3.59	8.0	11.59
2437	-3.57	8.0	11.57
2462	-3.52	8.0	11.52

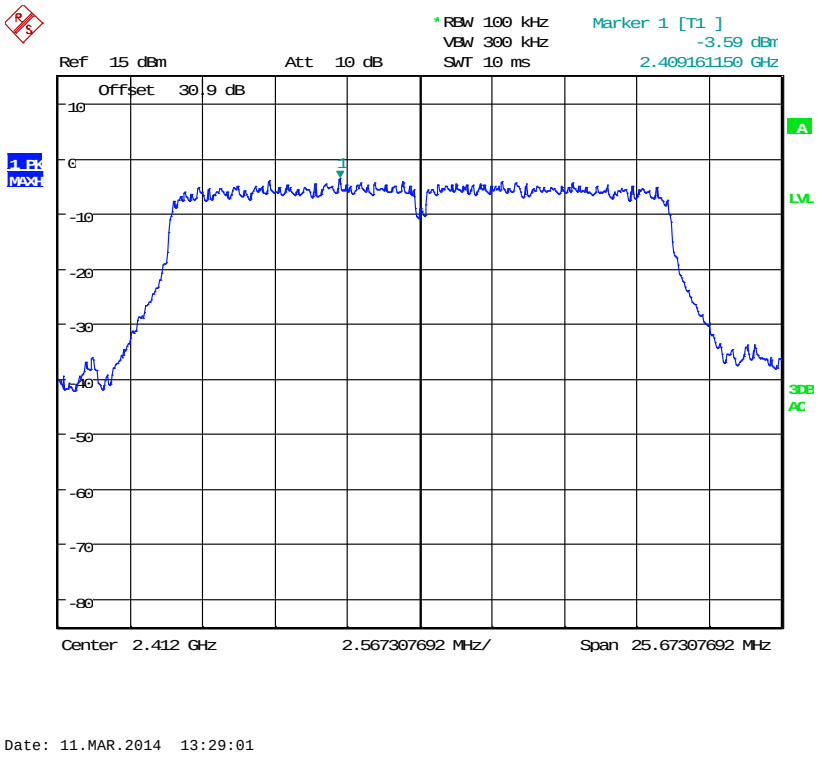

Figure 7.5.2-7: Power Spectral Density - Low Channel

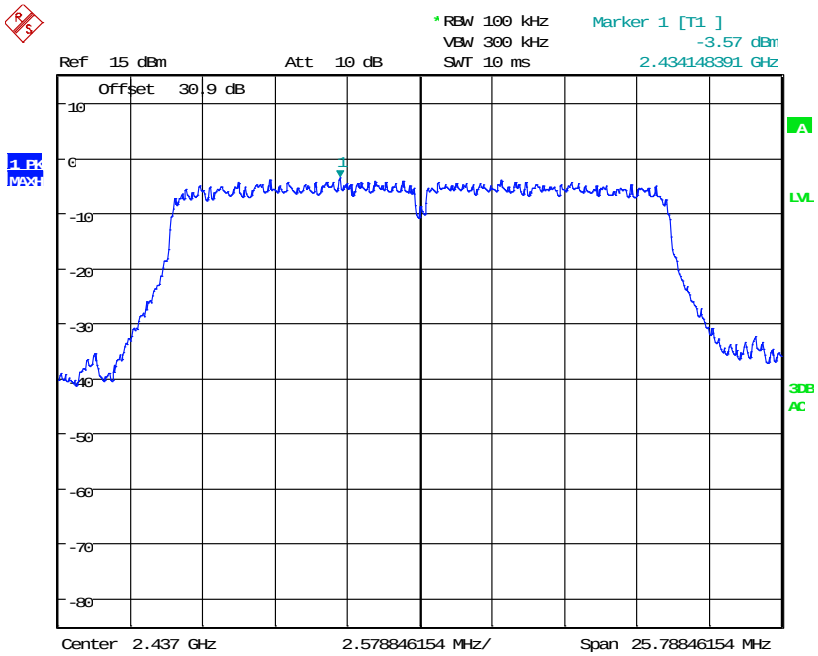

Figure 7.5.2-8: Power Spectral Density - Middle Channel

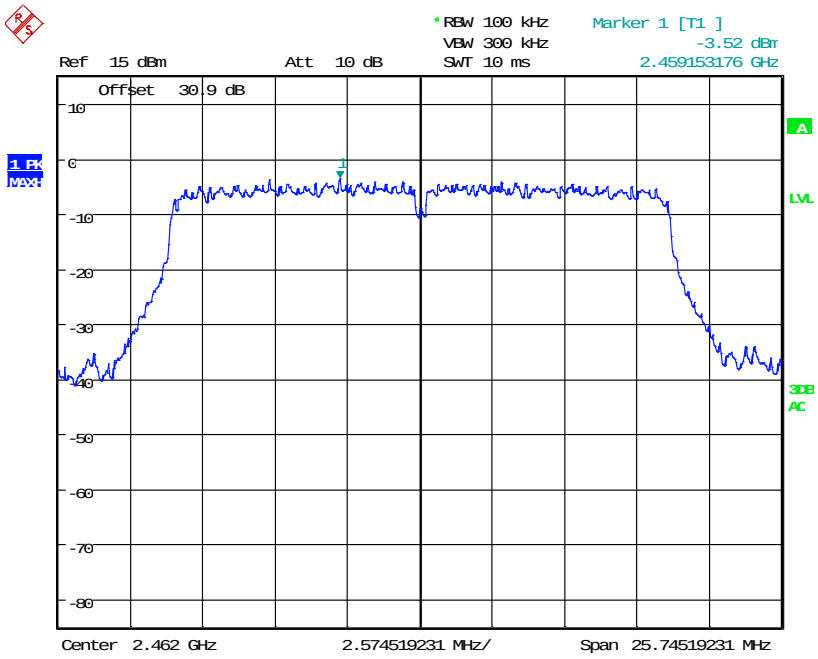

Figure 7.5.2-9: Power Spectral Density – High Channel

802.11n 40 MHz

Table 7.5.2-4: Power Spectral Density

Frequency (MHz)	PSD (dBm)	Limit (dBm)	Margin (dB)
2422	-7.01	8.0	15.01
2437	-6.57	8.0	14.57
2452	-6.53	8.0	14.53

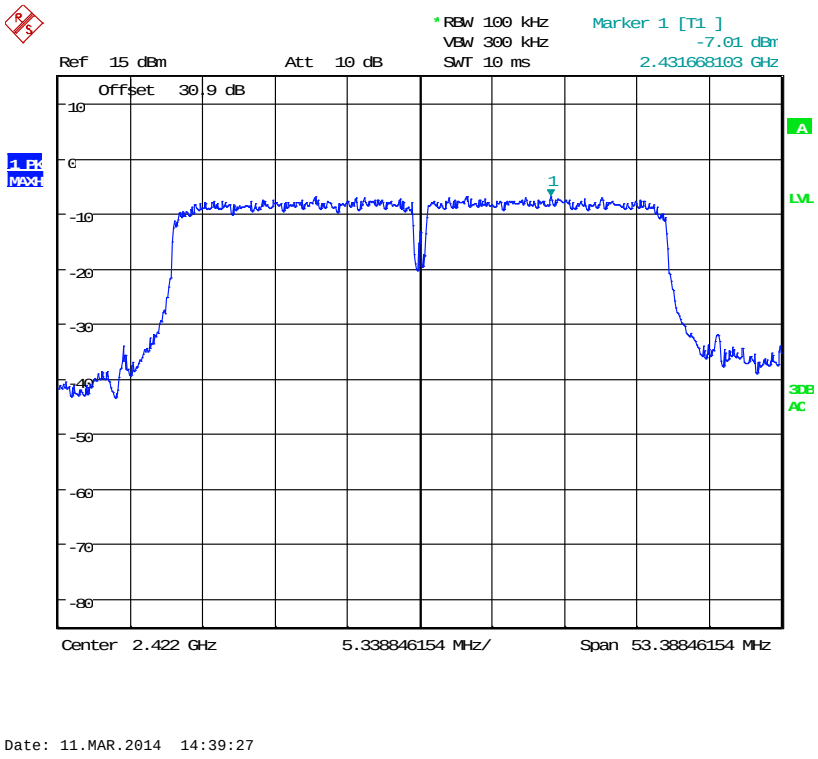

Figure 7.5.2-10: Power Spectral Density - Low Channel

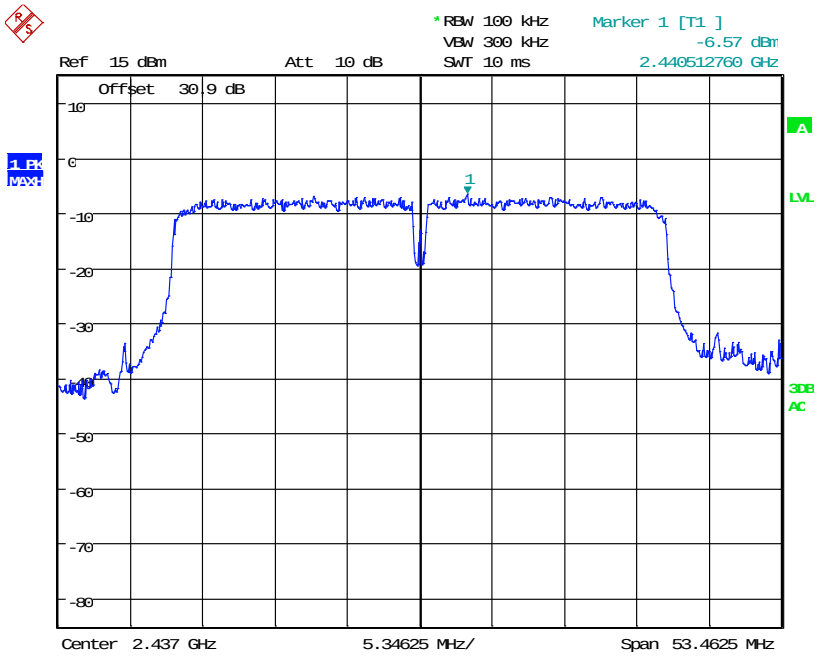

Figure 7.5.2-11: Power Spectral Density - Middle Channel

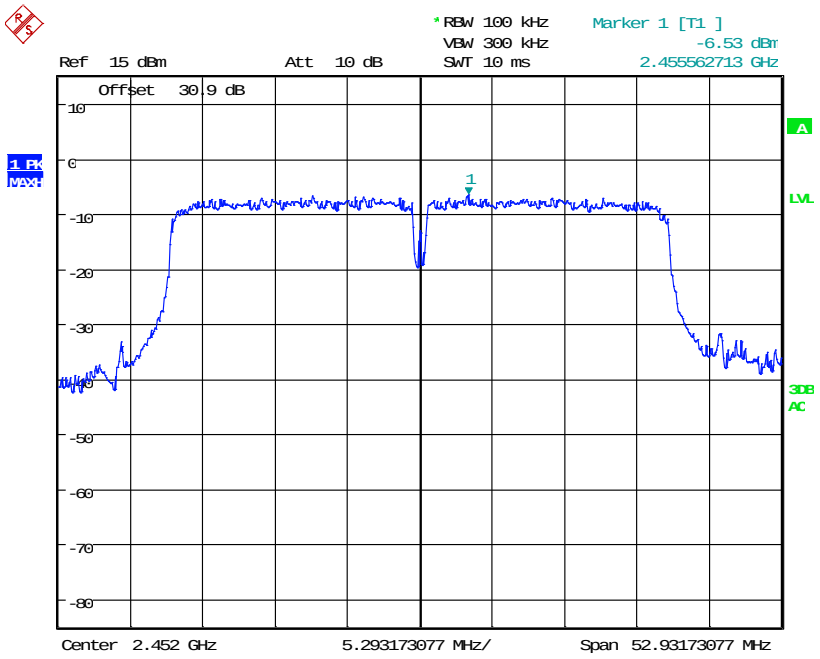

Figure 7.5.2-12: Power Spectral Density – High Channel

7.6 Power Line Conducted Emissions – FCC: Section 15.207 IC: RSS-Gen 7.2.4

7.6.1 Measurement Procedure

ANSI C63.4 sections 6 and 7 were the guiding documents for this evaluation. Conducted emissions were performed from 150 kHz to 30 MHz with the spectrum analyzer's resolution bandwidth set to 9 kHz and the video bandwidth set to 30 kHz. The calculation for the conducted emissions is as follows:

Corrected Reading = Analyzer Reading + LISN Loss + Cable Loss
Margin = Applicable Limit - Corrected Reading

7.6.2 Measurement Results

Results are shown below.

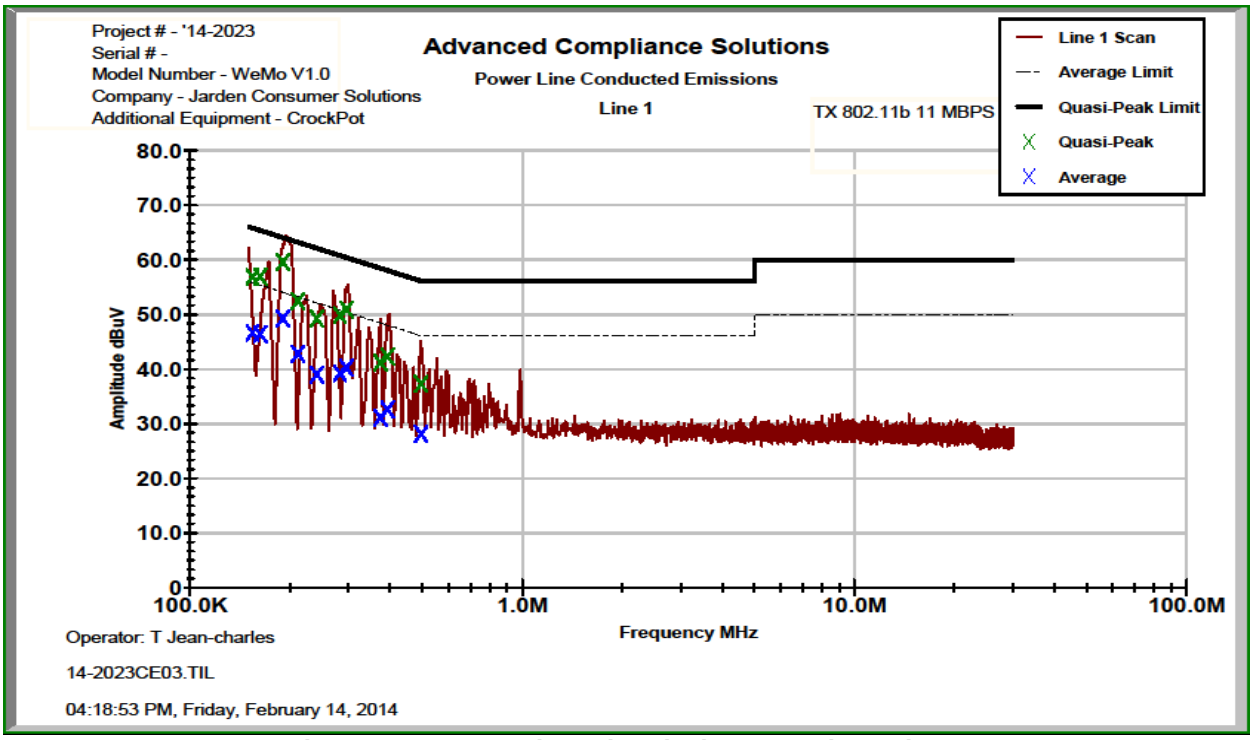

Figure 7.6.2-1: Conducted Emissions Results – Line 1

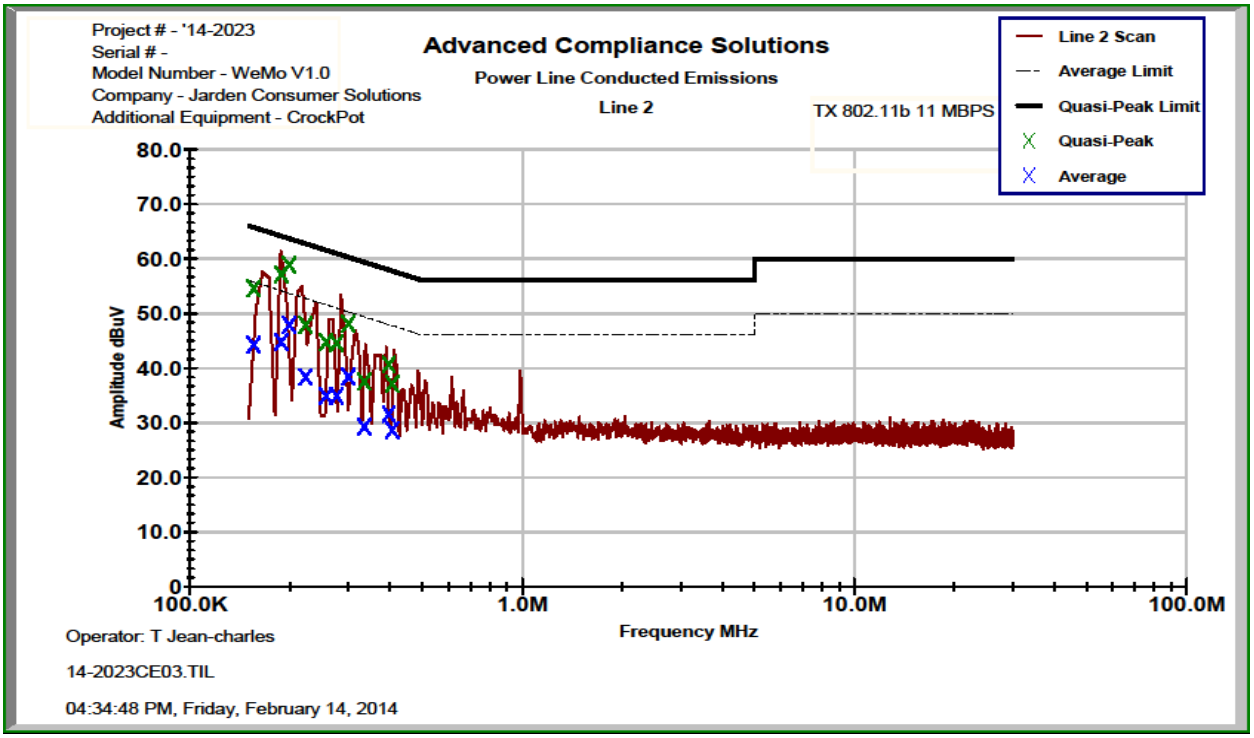

Figure 7.6.2-2: Conducted Emissions Results – Line 2

Table 7.6.2-1: Conducted EMI Results

☒ Line 1 ☒ Line 2 ☐ Line 3
☐ Line 4
☐ To Ground ☒ Floating
☐ Telecom Port _____
☒ dBµV ☐ dBµA

Plot Number: 14-2023CE03
Power Supply Description: N/A

Frequency (MHz)	Uncorrected Reading		Total Correction Factor (dB)	Corrected Level		Limit		Margin (dB)	
	Quasi-Peak	Average		Quasi-Peak	Average	Quasi-Peak	Average	Quasi-Peak	Average
Line 1									
0.153978	46.755	36.49	10.10	56.85	46.59	65.78	55.78	8.9	9.2
0.162338	46.789	36.291	10.10	56.88	46.39	65.34	55.34	8.5	9.0
0.190124	49.493	39.161	10.09	59.58	49.25	64.03	54.03	4.5	4.8
0.211024	42.377	32.715	10.10	52.47	42.81	63.16	53.16	10.7	10.4
0.240312	39.091	28.899	10.10	49.19	39.00	62.09	52.09	12.9	13.1
0.28215	39.733	29.131	10.08	49.81	39.21	60.75	50.75	10.9	11.5
0.2954	40.821	30.135	10.08	50.90	40.21	60.37	50.37	9.5	10.2
0.373324	31.115	21.041	10.08	41.19	31.12	58.43	48.43	17.2	17.3
0.392512	32.172	22.5	10.08	42.25	32.58	58.01	48.01	15.8	15.4
0.495924	27.142	17.996	10.08	37.22	28.08	56.07	46.07	18.8	18.0
Line 2									
0.155275	44.422	34.117	10.08	54.50	44.19	65.71	55.71	11.2	11.5
0.187913	47.092	34.659	10.07	57.16	44.73	64.13	54.13	7.0	9.4
0.198663	48.746	37.773	10.07	58.81	47.84	63.67	53.67	4.9	5.8
0.222349	37.746	28.243	10.08	47.83	38.33	62.73	52.73	14.9	14.4
0.256387	34.65	24.767	10.07	44.72	34.84	61.55	51.55	16.8	16.7
0.275975	34.5	24.815	10.07	44.57	34.89	60.94	50.94	16.4	16.0
0.299575	38.027	28.309	10.07	48.10	38.38	60.25	50.25	12.2	11.9
0.334213	27.444	19.149	10.06	37.50	29.21	59.35	49.35	21.8	20.1
0.39615	30.59	21.491	10.05	40.64	31.54	57.93	47.93	17.3	16.4
0.405538	27.03	18.59	10.05	37.08	28.64	57.74	47.74	20.7	19.1

8 CONCLUSION

In the opinion of ACS, Inc., the model 173503 meets the requirements of FCC Part 15 subpart C and Industry Canada's Radio Standards Specification RSS-210 for the test procedures documented in the test report.

END REPORT