

Shenzhen Chuangwei-RGB Electronics Co., Ltd.

TEST REPORT

SCOPE OF WORK

FCC TESTING–NTUD-U21

REPORT NUMBER

201019017SZN-003

ISSUE DATE

5 November 2020

[REVISED DATE]

[-----]

PAGES

128

DOCUMENT CONTROL NUMBER

FCC ID 247_b

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Shenzhen Chuangwei-RGB Electronics Co., Ltd.

Application
For
Certification

FCC ID: 2ANM3NTUDU21

Wireless Module

Model: NTUD-U21

2.4GHz Wi-Fi Transceiver

Report No.: 201019017SZN-003

We hereby certify that the sample of the above item is considered to comply with the
requirements of FCC Part 15, Subpart C for Intentional Radiator,
mention 47 CFR [10-1-19]

Prepared and Checked by:

Approved by:

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Engineer

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Technical Supervisor
Date: 5 November 2020

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Intertek Testing Services Shenzhen Ltd. Longhua Branch

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MEASUREMENT/TECHNICAL REPORT

This report concerns (check one) Original Grant ☒ Class II Change ☐

Equipment Type: DTS - Part 15 Digital Transmission Systems (Wi-Fi transmitter portion)

Deferred grant requested per 47 CFR 0.457(d)(1)(ii)? Yes ☐ No ☒

If yes, defer until : _____
date

Company Name agrees to notify the Commission by: _____
date

of the intended date of announcement of the product so that the grant can be issued on that date.

Transition Rules Request per 15.37? Yes ☐ No ☒

If no, assumed Part 15, Subpart C for intentional radiator - the new 47 CFR [10-01-19] Edition] provision.

Report prepared by:

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1.0 Summary of Test results

Applicant: Shenzhen Chuangwei-RGB Electronics Co., Ltd.

Applicant Address: 13F-16F, Unit A, Skyworth Building, Shennan Road, Nanshan District, Shenzhen, Guangdong, China

Manufacturer: Shenzhen Chuangwei-RGB Electronics Co., Ltd.

Manufacturer Address: 13F-16F, Unit A, Skyworth Building, Shennan Road, Nanshan District, Shenzhen, Guangdong, China

Model: NTUD-U21

FCC ID: 2ANM3NTUDU21

TEST ITEM	REFERENCE	RESULTS
Max. Output power	15.247(b)(3)	Pass
6 dB Bandwidth	15.247(a)(2)	Pass
Max. Power Density	15.247(e)	Pass
Out of Band Antenna Conducted Emission	15.247(d)	Pass
Radiated Emission in Restricted Bands	15.247(d), 15.209, FCC 15.205	Pass
AC Conducted Emission	15.207	Pass
Antenna Requirement	15.203	Pass (See Notes)

Notes: The EUT uses an Integral Antenna which in accordance to Section 15.203 is considered sufficient to comply with the provisions of this section.

2.0 General Description

2.1 Product Description

The equipment under test (EUT) is a Wireless Module with Bluetooth 5.0 (dual-mode) function operating in 2402-2480MHz, 2.4G WIFI function operating in 2412-2462MHz and 5G WIFI function operating in 5150MHz~5250 MHz, 5250MHz~5350MHz, 5470MHz-5725MHz, 5725MHz~5850MHz. The EUT is powered by DC 3.3V. For more detail information pls. refer to the user manual.

Type of Modulation: BPSK, QPSK, 16QAM, 64QAM for OFDM; CCK, DQPSK, DBPSK for DSSS.

Antenna Type: Integral Antenna

Antenna Gain: 3.1dBi

For electronic filing, the brief circuit description is saved with filename: descri.pdf.

2.2 Related Submittal(s) Grants

This is an application for certification of a transceiver for the Wireless Module which has 2.4GHz WIFI function.

For the classic Bluetooth function was tested and demonstrated in report 201019017SZN-001.

For the BT BLE function was tested and demonstrated in report 201019017SZN-002.

For the 5GHz WIFI function was tested and demonstrated in report 201019017SZN-004.

2.3 Test Methodology

Both AC mains line-conducted and radiated emission measurements were performed according to the procedures in ANSI C63.10 (2013) and KDB 558074 D01 v05r02. Radiated emission measurement was performed in semi-anechoic chamber and conducted emission measurement was performed in shield room. For radiated emission measurement, preliminary scans were performed in the semi-anechoic chamber only to determine the worst case modes. All radiated tests were performed at an antenna to EUT distance of 3 meters, unless stated otherwise in the "**Justification Section**" of this Application.

2.4 Test Facility

The Semi-anechoic chamber and shielded room used to collect the radiated data and conducted data are **Intertek Testing Services Shenzhen Ltd. Longhua Branch** and located at 101, 201, Building B, No. 308 Wuhe Avenue, Zhangkengjing Community, GuanHu Subdistrict, LongHua District, Shenzhen, P.R. China. This test facility and site measurement data have been fully placed on file with File Number: CN1188.

3.0 System Test Configuration

3.1 Justification

For emissions testing, the equipment under test (EUT) setup to transmit continuously to simplify the measurement methodology. Care was taken to ensure proper power supply voltages during testing. During testing, all cables were manipulated to produce worst case emissions. The EUT was powered by DC 3.3V from a laptop during the test.

On 802.11b/g/n-HT20/n-HT40 mode, two antennas are used, and all data rate were tested and only the worst case data is shown in the report.

For maximizing emissions, the EUT was rotated through 360°, the EUT was placed on the styrene turntable with 0.8m up to 1GHz and 1.5 m above 1GHz. The antenna height and polarization are varied during the search for maximum signal level. The antenna height is varied from 1 to 4 meters. Radiated emissions are taken at three meters unless the signal level is too low for measurement at that distance. If necessary, a pre-amplifier is used and/or the test is conducted at a closer distance.

All readings are extrapolated back to the equivalent three meter reading using inverse scaling with distance. Analyzer resolution is 100 kHz or greater for frequencies below 1000 MHz. The resolution is 1 MHz or greater for frequencies above 1000 MHz. The spurious emissions more than 20 dB below the permissible value are not reported.

The rear of unit shall be flushed with the rear of the table.

Radiated emission measurement were performed the lowest radio frequency signal generated in the device which is greater than 9 kHz to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

3.2 EUT Exercising Software

The EUT exercise program (provided by client) used during radiated and conducted testing was designed to exercise the various system components in a manner similar to a typical use. The worst case configuration is used in all specified testing.

The parameters of test software setting:

During the test, Channel and power controlling software provided by the applicant was used to control the operating channel as well as the output power level. The RF output power selection is for the setting of RF output power expected by the application and is going to be fixed on the firmware of the end product.

Test software: MPTool, Version: 9.02

3.3 Special Accessories

N/A.

3.4 Measurement Uncertainty

When determining of the test conclusion, the Measurement Uncertainty of test has been considered.

3.5 Equipment Modification

Any modifications installed previous to testing by Shenzhen Chuangwei-RGB Electronics Co., Ltd. will be incorporated in each production model sold / leased in the United States.

No modifications were installed by Intertek Testing Services Shenzhen Ltd. Longhua Branch.

3.6 Support Equipment List and Description

Description	Manufacturer	Remark
Laptop (Provided by Intertek)	Lenovo	ThinkPad X1
AC ADAPTER	Lenovo	Model: ADLX90NCT3A Input: 100-240VAC 1.2 A max 50-60Hz Output: DC 20 V=4.5 A
ComTool (with cable) (Provided by Applicant)	Provided by Applicant	unshielded, 1m

Applicant: Shenzhen Chuangwei-RGB Electronics Co., Ltd.

Date of Test: 29 October 2020

Model: NTUD-U21

4.0 Measurement Results

4.1 Maximum Conducted Output Power at Antenna Terminals, FCC Rules 15.247(b)(3):

The antenna power of the EUT was connected to the input of a broadband peak RF power meter. The power meter have a video bandwidth that is greater than DTS bandwidth and utilize a fast-responding diode detector. Power was read directly at the EUT antenna terminals with cable loss added.

For antennas with gains of 6 dBi or less, maximum allowed Transmitter output is 1 watt (+30 dBm). 2.4G band Ant gain: 3.1dBi. In MIMO (2Tx), Ant1+Ant2 Directional gain = $G_{ANT} + 10 \log(N)$ dBi = $3.1 + 10 \log(2) = 6.1$ dBi > 6 dBi, So maximum allowed Transmitter output will reduce to 29.9dBm (977.24mW) for conducted TX power.

SISO Mode, Ant1:

IEEE 802.11b (Antenna Gain = 3.1dBi) (CCK, 1Mbps)		
Frequency (MHz)	Output in dBm (Peak Reading)	Output in mWatt
Low Channel: 2412	17.5	56.23
Middle Channel: 2437	17.2	52.48
High Channel: 2462	17.1	51.29

IEEE 802.11g (Antenna Gain = 3.1dBi) (16QAM, 6Mbps)		
Frequency (MHz)	Output in dBm (Peak Reading)	Output in mWatt
Low Channel: 2412	15.6	36.31
Middle Channel: 2437	15.3	33.88
High Channel: 2462	15.1	32.36

IEEE 802.11n-HT20 (Antenna Gain = 3.1dBi) (64QAM, 6Mbps)		
Frequency (MHz)	Output in dBm (Peak Reading)	Output in mWatt
Low Channel: 2412	14.6	28.84
Middle Channel: 2437	14.7	29.51
High Channel: 2462	14.5	28.18

IEEE 802.11n-HT40 (Antenna Gain = 3.1dBi) (64QAM, 13.5Mbps)		
Frequency (MHz)	Output in dBm (Peak Reading)	Output in mWatt
Low Channel: 2422	15.2	33.11
Middle Channel: 2437	15.1	32.36
High Channel: 2452	14.9	30.90

SISO Mode, Ant2:

IEEE 802.11b (Antenna Gain = 3.1dBi) (CCK, 1Mbps)		
Frequency (MHz)	Output in dBm (Peak Reading)	Output in mWatt
Low Channel: 2412	17.1	51.29
Middle Channel: 2437	16.9	48.98
High Channel: 2462	17.2	52.48

IEEE 802.11g (Antenna Gain = 3.1dBi) (16QAM, 6Mbps)		
Frequency (MHz)	Output in dBm (Peak Reading)	Output in mWatt
Low Channel: 2412	15.6	36.31
Middle Channel: 2437	15.7	37.15
High Channel: 2462	16.1	40.74

IEEE 802.11n-HT20 (Antenna Gain = 3.1dBi) (64QAM, 6Mbps)		
Frequency (MHz)	Output in dBm (Peak Reading)	Output in mWatt
Low Channel: 2412	15.2	33.11
Middle Channel: 2437	15.1	32.36
High Channel: 2462	15.3	33.88

IEEE 802.11n-HT40 (Antenna Gain = 3.1 dBi) (64QAM, 13.5Mbps)		
Frequency (MHz)	Output in dBm (Peak Reading)	Output in mWatt
Low Channel: 2422	14.9	30.90
Middle Channel: 2437	14.9	30.90
High Channel: 2452	15.3	33.88

MIMO Mode:

IEEE 802.11n-HT20 (Antenna Gain = 6.1dBi) (64QAM, 6.5Mbps)				
Frequency (MHz)	Output in dBm (Peak Reading)			Output in mWatt
	Ant 1	Ant 2	Total	
Low Channel: 2412	15.1	15.7	18.4	69.18
Middle Channel: 2437	15.0	15.5	18.3	67.61
High Channel: 2462	14.8	15.2	18.0	63.10

IEEE 802.11n-HT40 (Antenna Gain = 6.1dBi) (64QAM, 13.5Mbps)				
Frequency (MHz)	Output in dBm (Peak Reading)			Output in mWatt
	Ant 1	Ant 2	Total	
Low Channel: 2422	15.8	15.6	18.7	74.13
Middle Channel: 2437	15.5	15.7	18.6	72.44
High Channel: 2452	15.7	15.1	18.4	69.18

Cable loss: 1.0 dB External Attenuation: 0 dB

Cable loss, external attenuation has been included in OFFSET function

EUT max. output level = 18.7dBm

EUT max. E.I.R.P = 18.7dBm + 6.1dBi = 24.8dBm = 302mW

For RF Exposure, the information is saved with filename: RF exposure.pdf.

Applicant: Shenzhen Chuangwei-RGB Electronics Co., Ltd.

Date of Test: 29 October 2020

Model: NTUD-U21

4.2 Minimum 6 dB RF Bandwidth, FCC Rule 15.247(a) (2):

The antenna port of the EUT was connected to the input of a spectrum analyzer. Analyzer RES BW was set to 100 KHz according to FCC KDB 558074 D01 v05r02. For each RF output channel investigated, the spectrum analyzer center frequency was set to the channel carrier. A PEAK output reading was taken, a DISPLAY line was drawn 6 dB lower than PEAK level. The 6dB bandwidth was determined from where the channel output spectrum intersected the display line.

Limit: The 6 dB Bandwidth is at least 500 kHz.

IEEE 802.11b (CCK, 1Mbps)	
Frequency (MHz)	6 dB Bandwidth (MHz)
2412	10.170
2437	10.170
2462	10.170

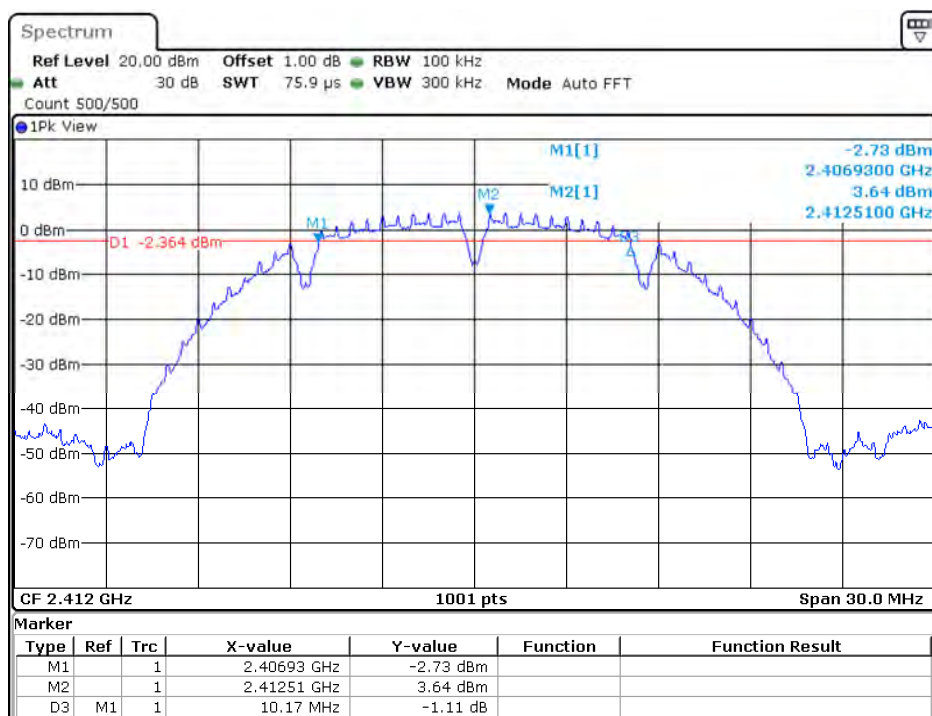
IEEE 802.11g (16QAM, 6Mbps)	
Frequency (MHz)	6 dB Bandwidth (MHz)
2412	16.440
2437	16.440
2462	16.440

IEEE 802.11n-HT20 (64QAM, 6Mbps)	
Frequency (MHz)	6 dB Bandwidth (MHz)
2412	17.670
2437	17.670
2462	17.670

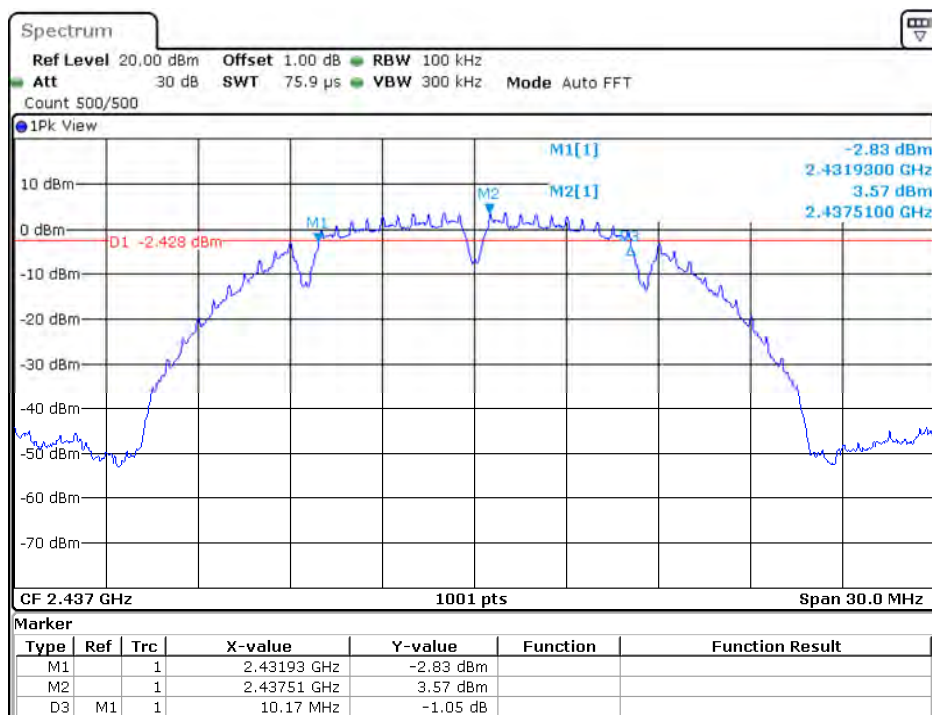
IEEE 802.11n-HT40 (64QAM, 13.5Mbps)	
Frequency (MHz)	6 dB Bandwidth (MHz)
2422	36.480
2437	36.480
2452	36.480

The test plots are attached as below.

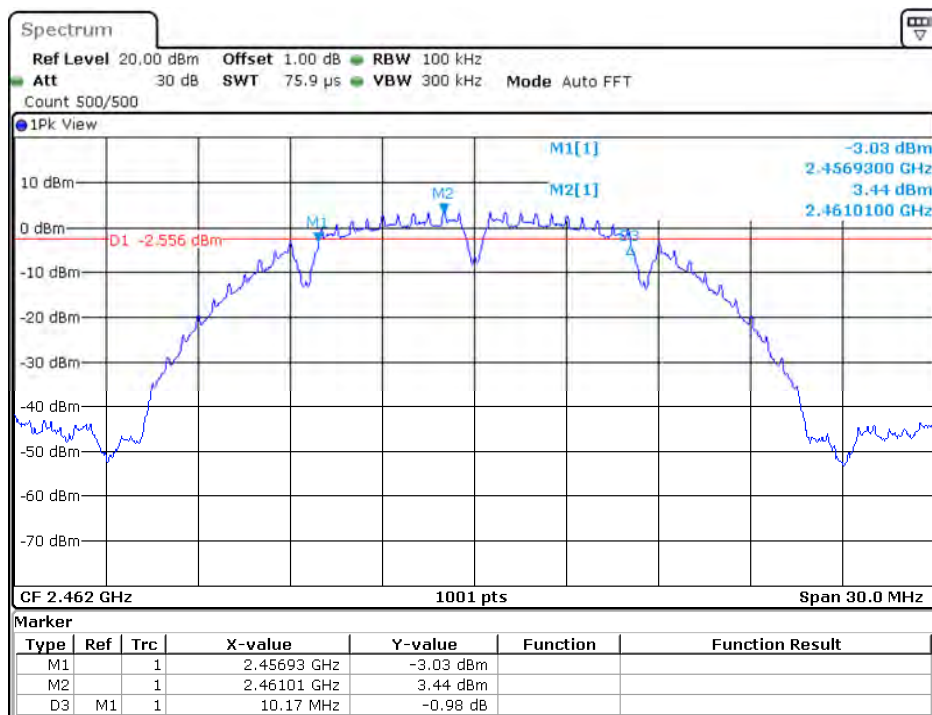
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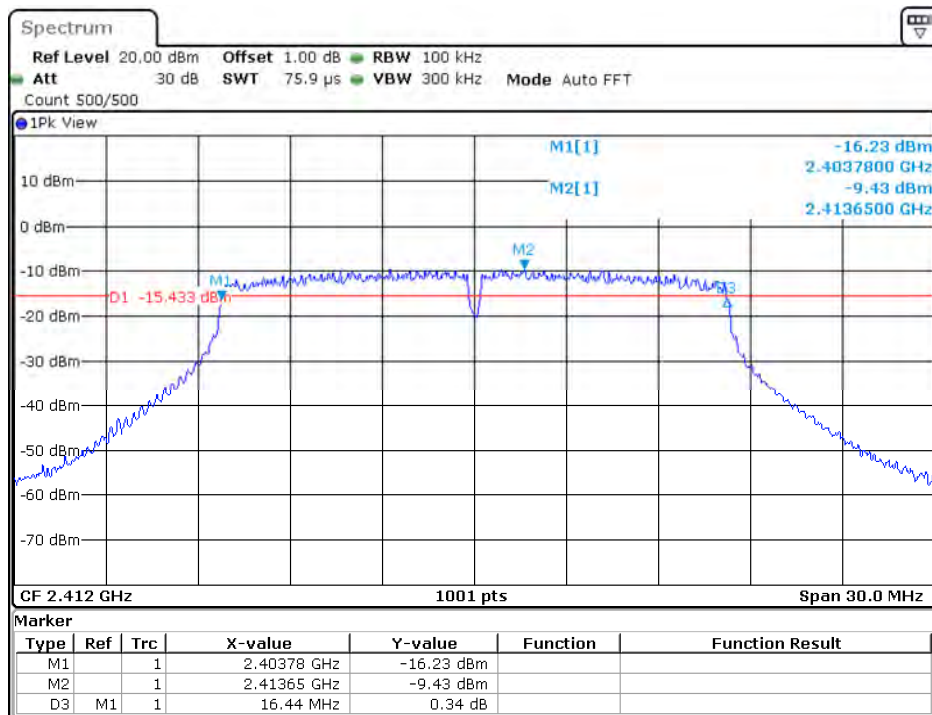


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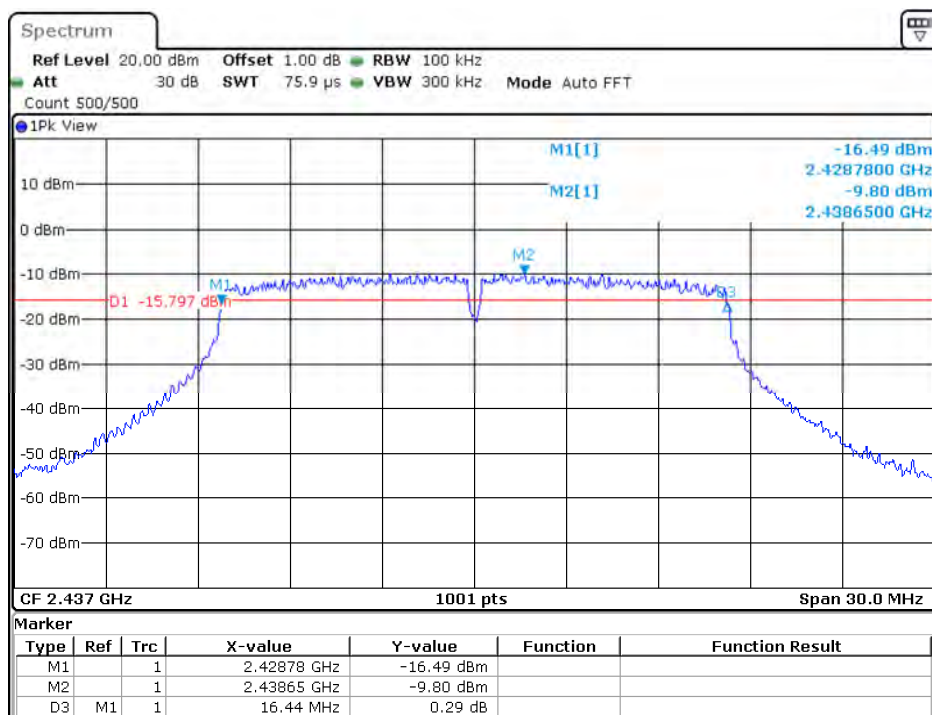


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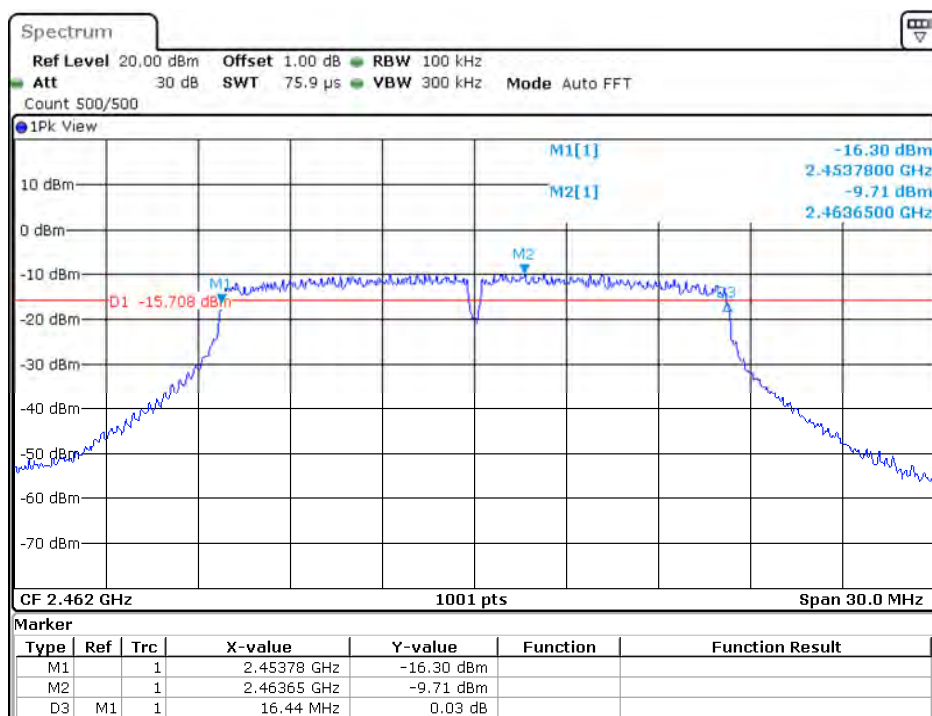
802.11g



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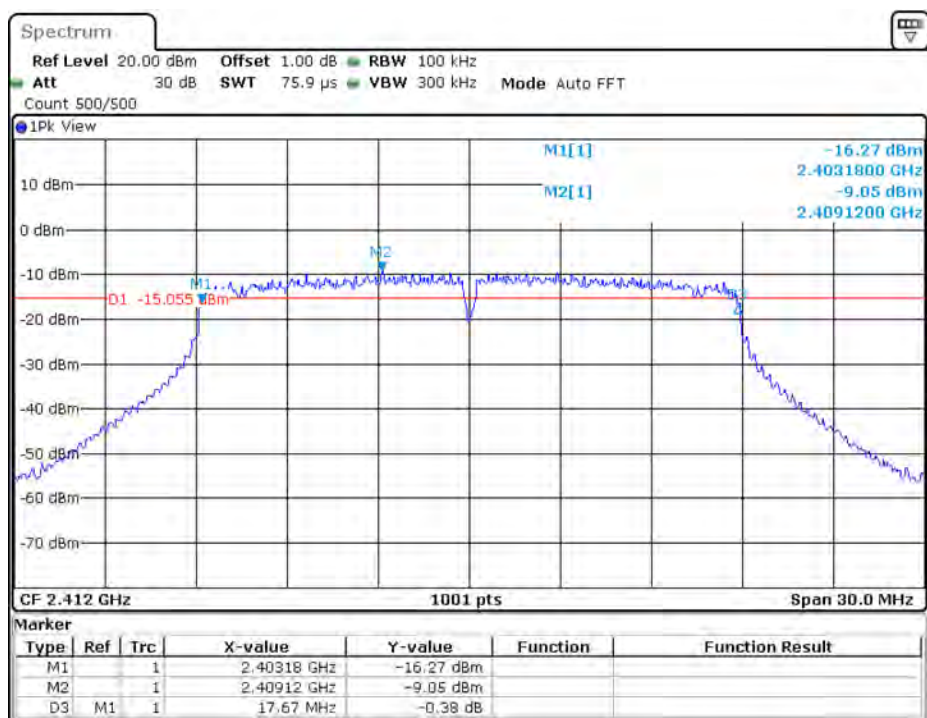


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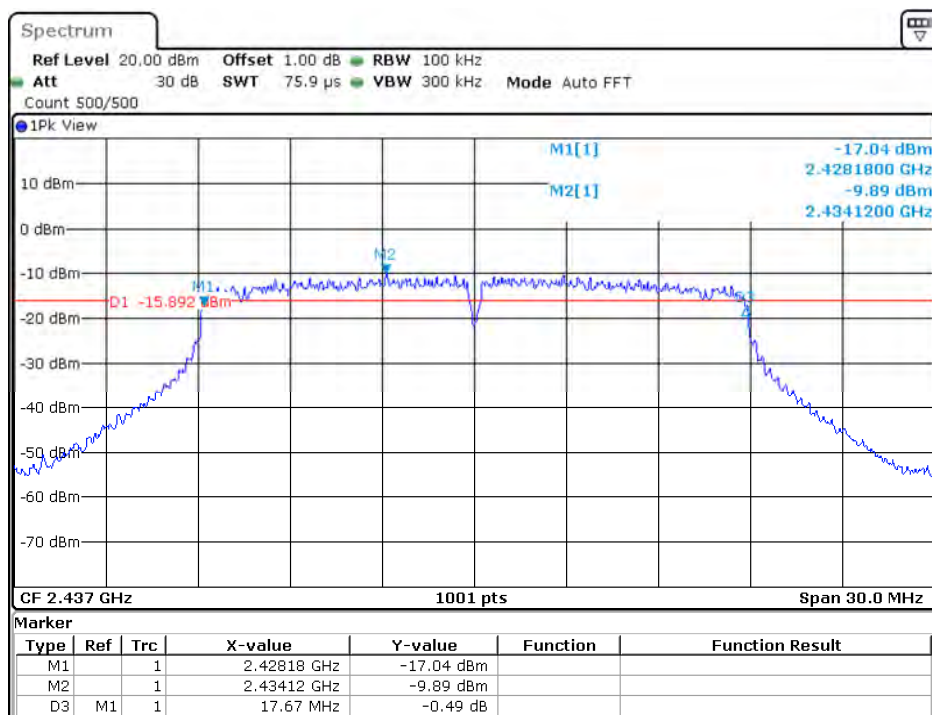


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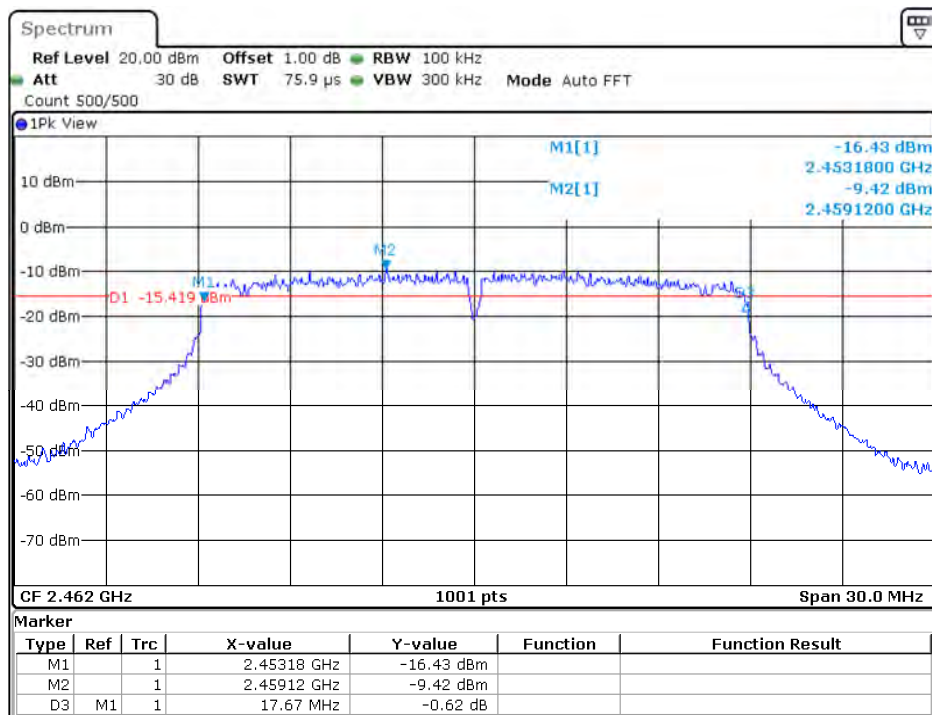
802.11n-HT20



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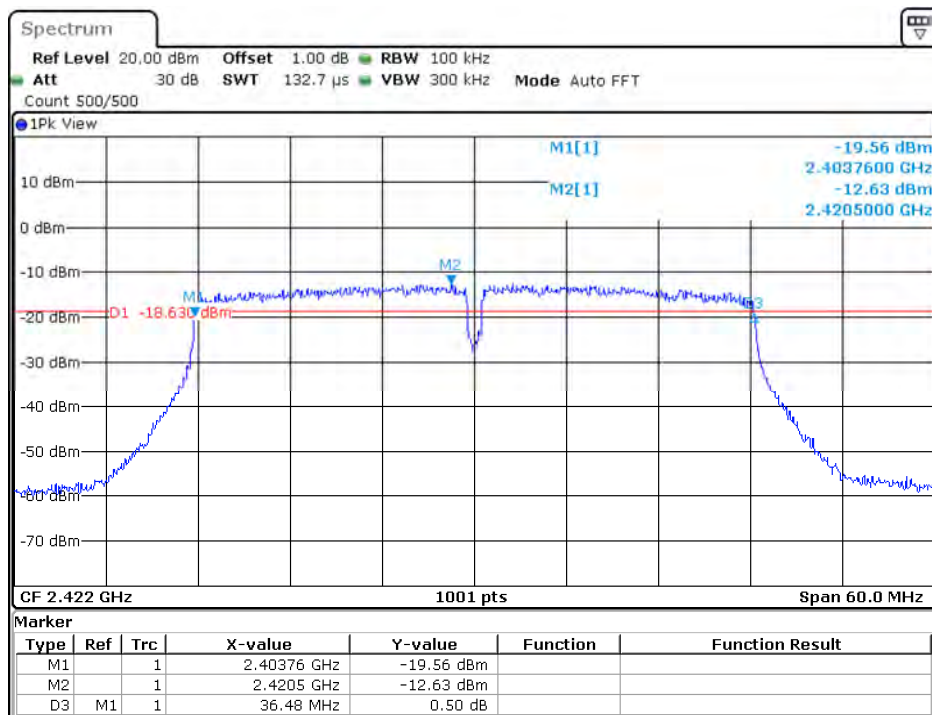


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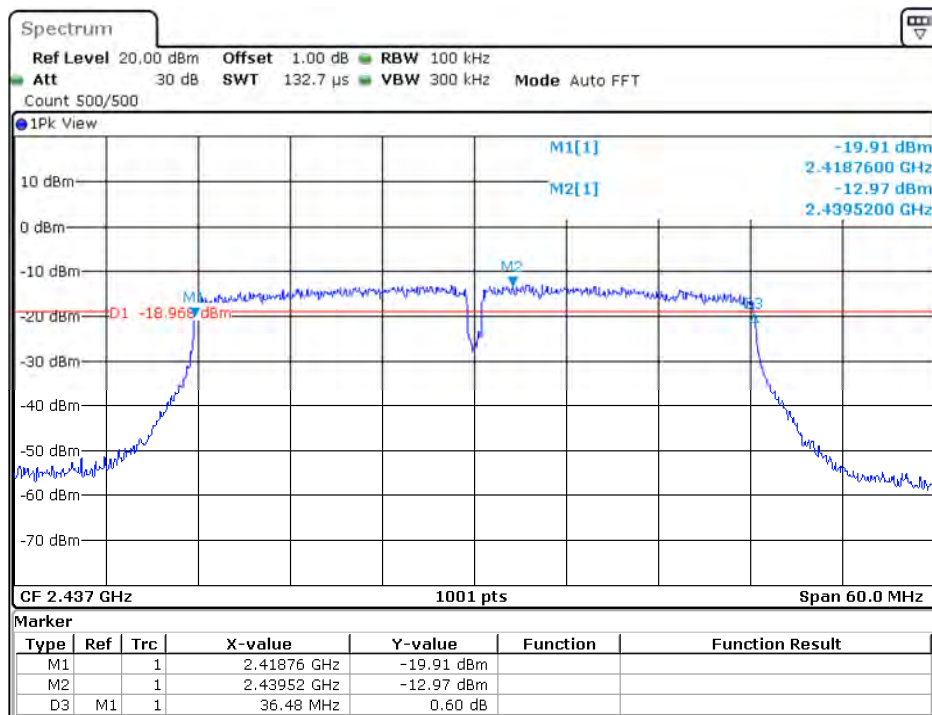


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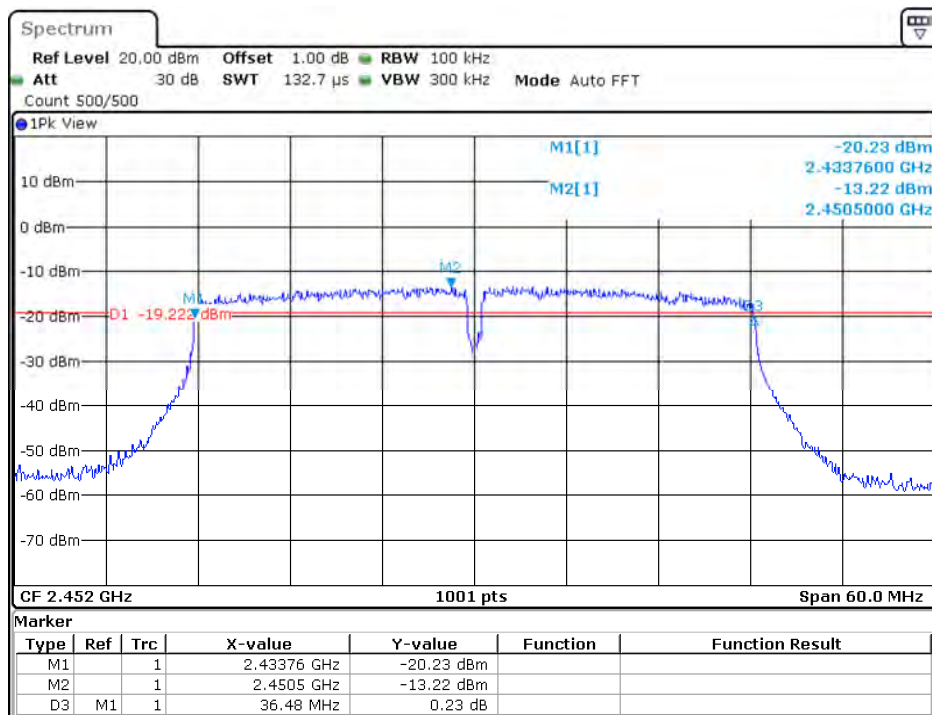
802.11n-HT40



Date: 29.OCT.2020 13:08:01



Date: 29.OCT.2020 13:11:02



Date: 29.OCT.2020 13:13:06

Applicant: Shenzhen Chuangwei-RGB Electronics Co., Ltd.

Date of Test: 29 October 2020

Model: NTUD-U21

4.3 Maximum Power Density Reading, FCC Rule 15.247(e):

The Measurement Procedure PKPSD was set according to the FCC KDB 558074 D01 v05r02.

Antenna output of the EUT was coupled directly to spectrum analyzer; if an external attenuator and/or cable was used, these losses are compensated for with the analyzer OFFSET function.

Limit: The Power Density does not exceed 8dBm/3 kHz.

SISO Mode:

IEEE 802.11b (CCK, 1Mbps)		
Frequency (MHz)	Power Density with RBW 3KHz	
	Ant 1	Ant 2
2412	-17.13	-17.12
2437	-17.28	-17.49
2462	-17.38	-17.89

IEEE 802.11g (16QAM, 6Mbps)		
Frequency (MHz)	Power Density with RBW 3KHz	
	Ant 1	Ant 2
2412	-24.13	-23.45
2437	-24.41	-23.89
2462	-24.44	-24.18

IEEE 802.11n-HT20 (64QAM, 6.5Mbps)		
Frequency (MHz)	Power Density with RBW 3KHz	
	Ant 1	Ant 2
2412	-23.00	-22.29
2437	-23.77	-22.82
2462	-23.36	-23.12

IEEE 802.11n-HT40 (64QAM, 13.5Mbps)		
Frequency (MHz)	Power Density with RBW 3KHz	
	Ant 1	Ant 2
2422	-32.79	-32.42
2437	-33.04	-32.86
2452	-33.52	-33.03

MIMO Mode:

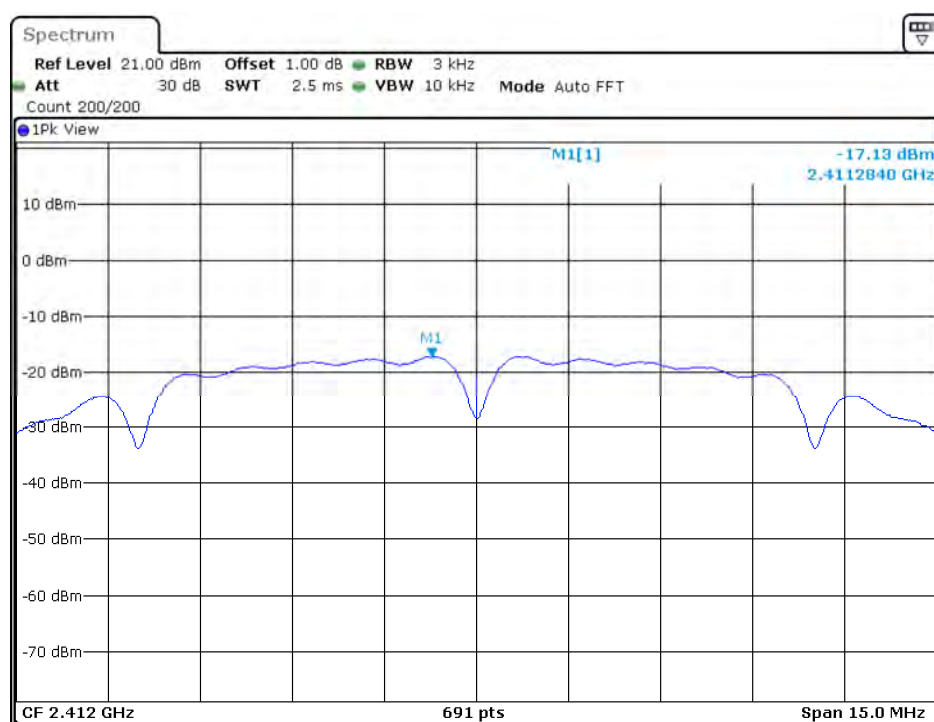
IEEE 802.11n-HT20 (64QAM, 6.5Mbps)			
Frequency (MHz)	Power Density with RBW 3KHz		
	Ant 1	Ant 2	Total
2412	-21.92	-21.65	-18.77
2437	-22.21	-22.18	-19.19
2462	-22.84	-22.48	-19.65

IEEE 802.11n-HT40 (64QAM, 13.5Mbps)			
Frequency (MHz)	Power Density with RBW 3KHz		
	Ant 1	Ant 2	Total
2422	-32.43	-31.79	-29.09
2437	-32.10	-32.21	-29.14
2452	-32.19	-32.37	-29.27

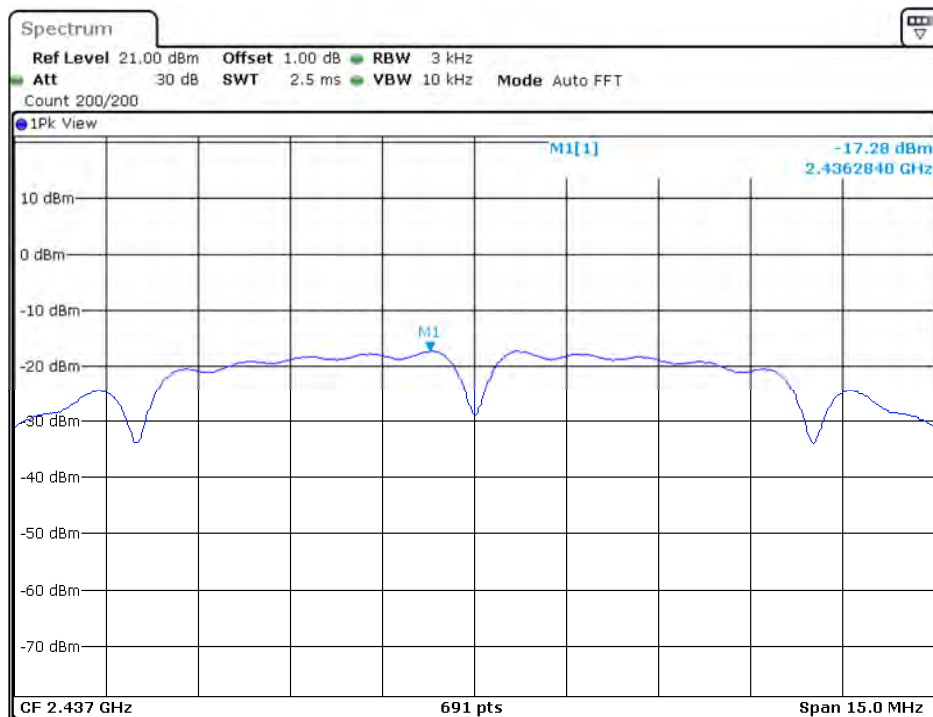
The test plots are attached as below.

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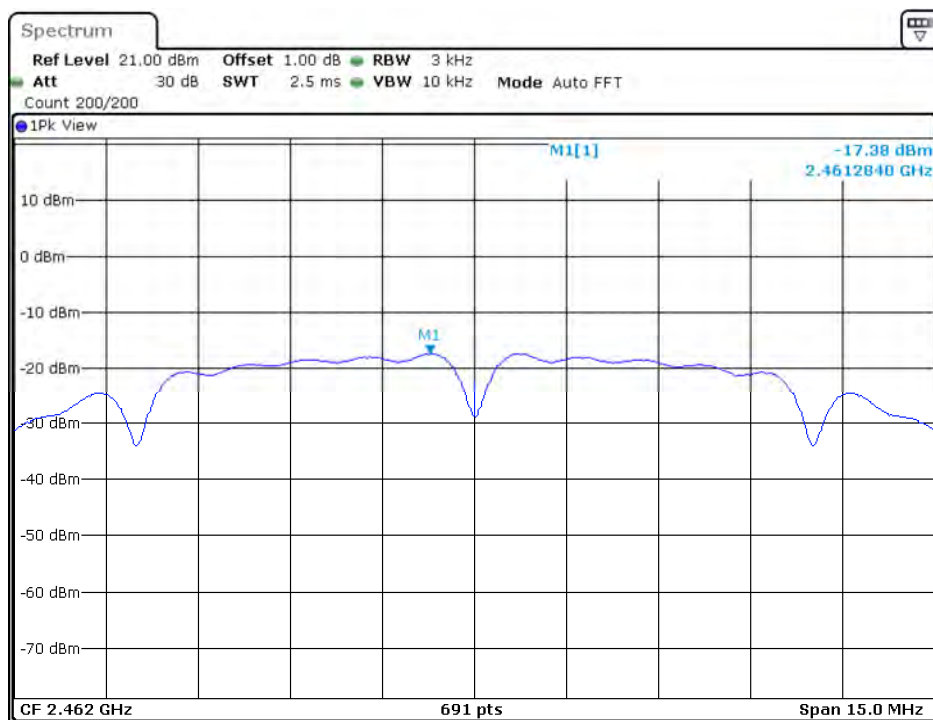
802.11b



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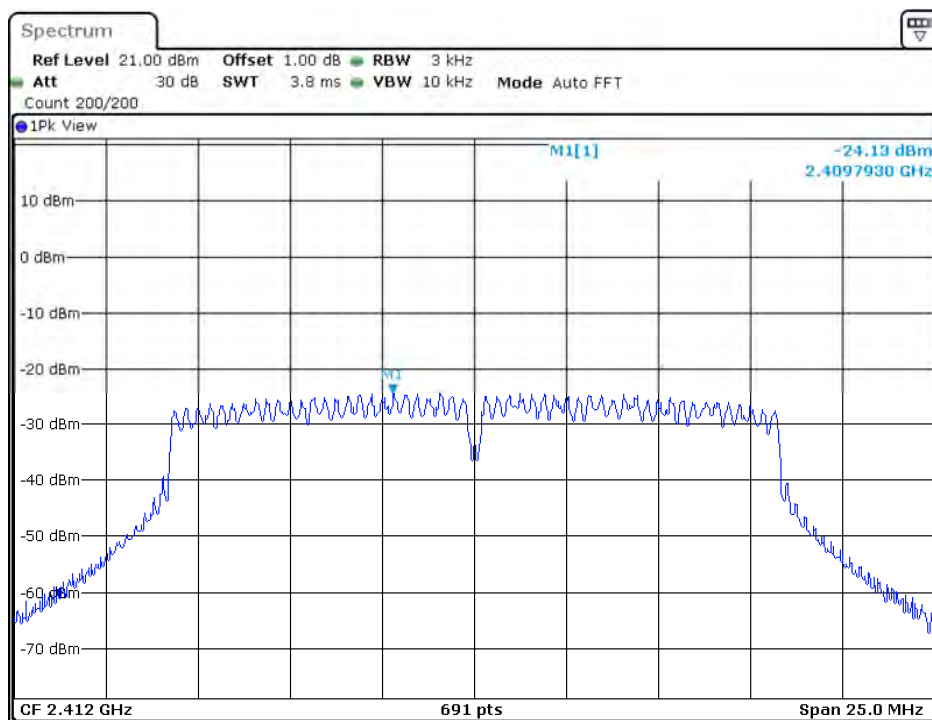


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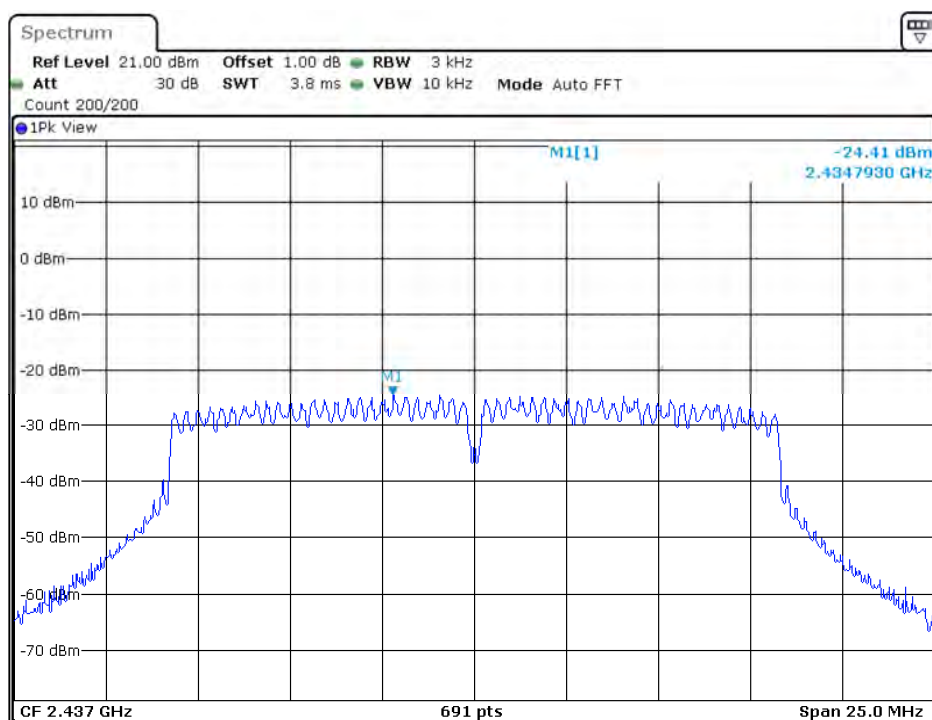


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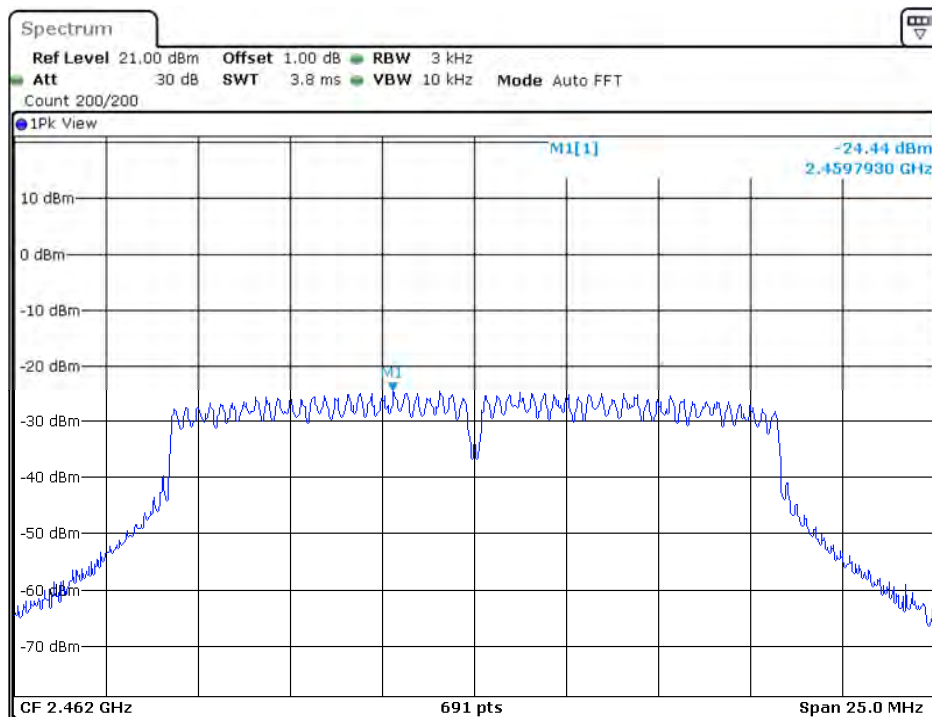
802.11g



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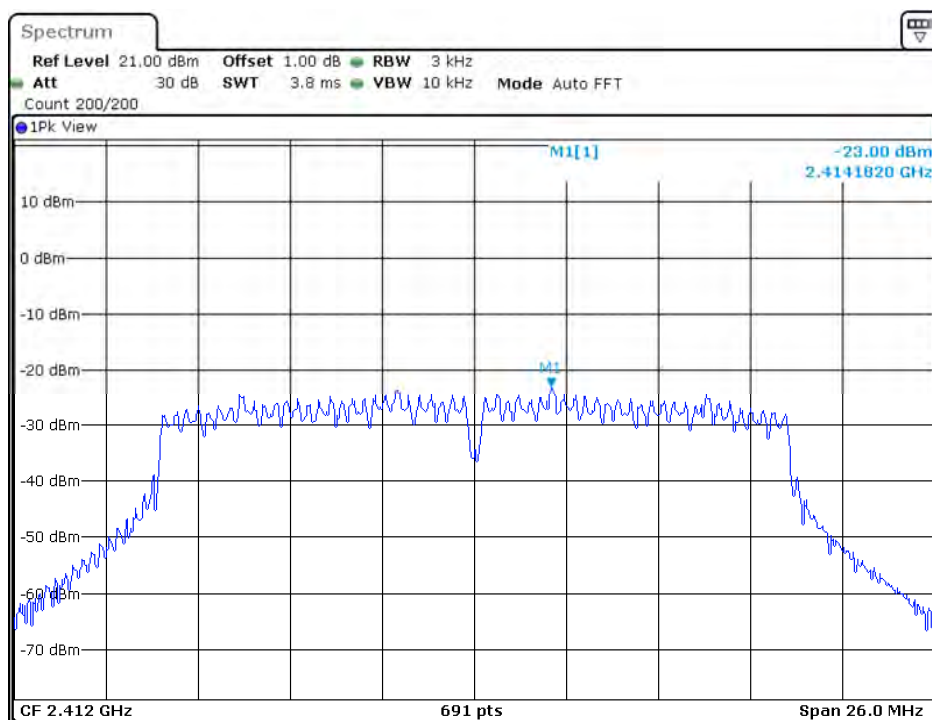


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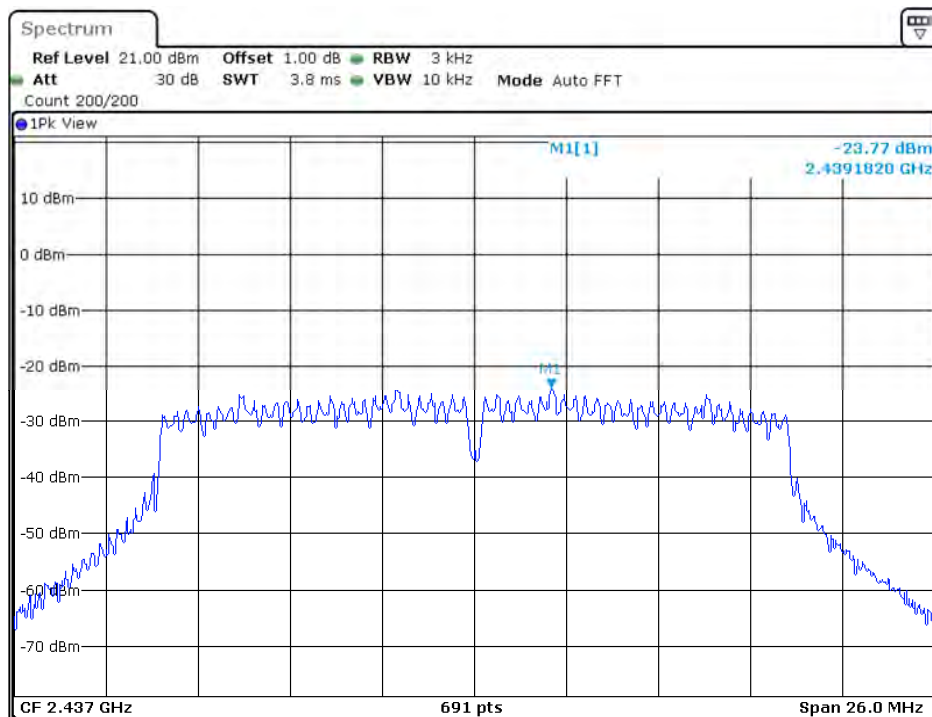


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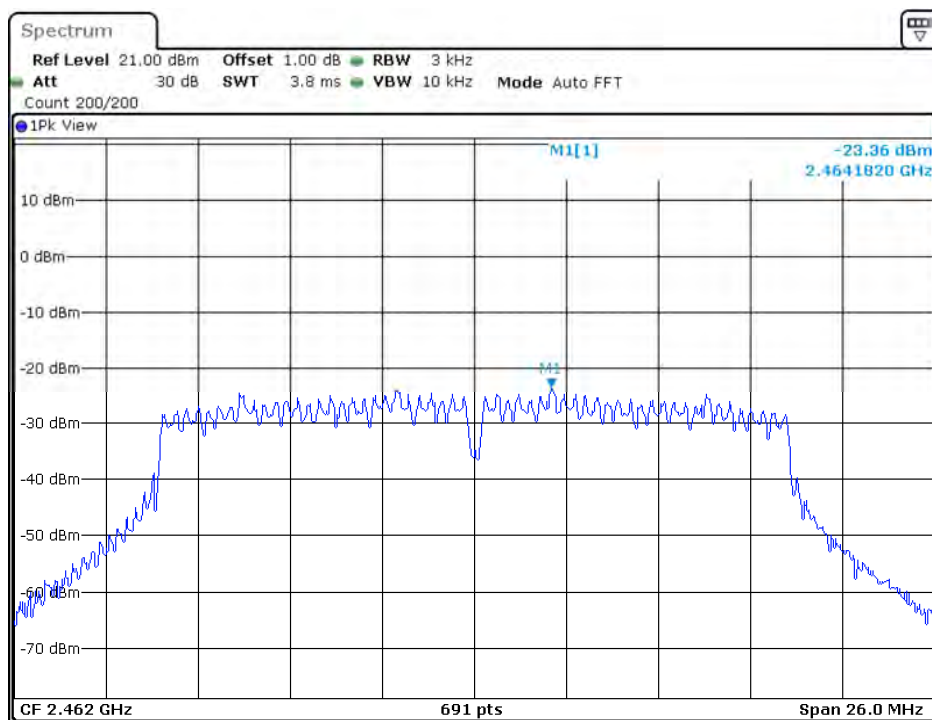
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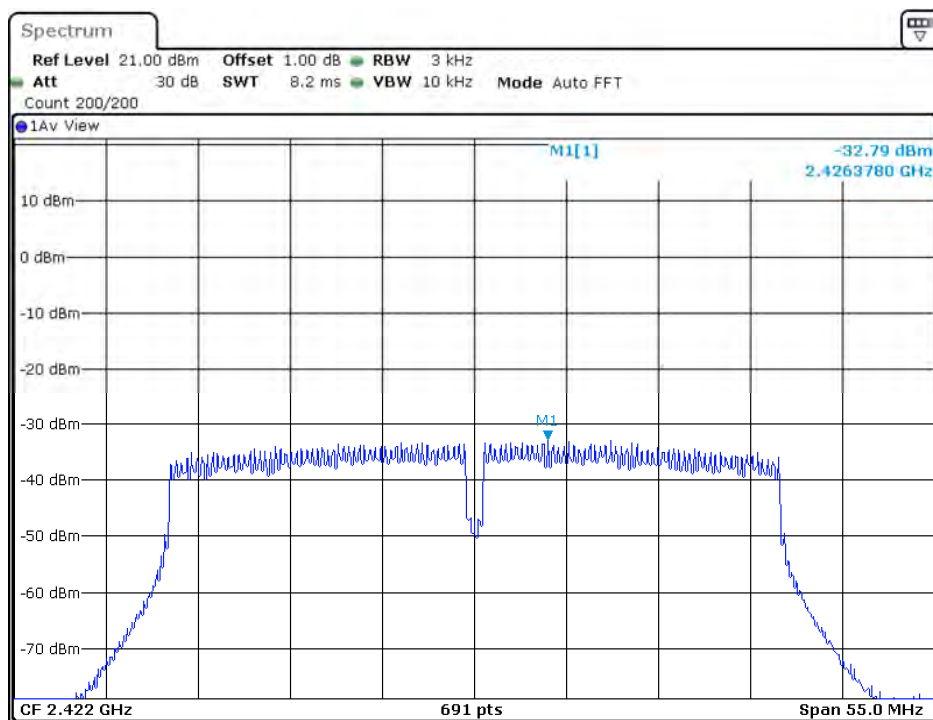


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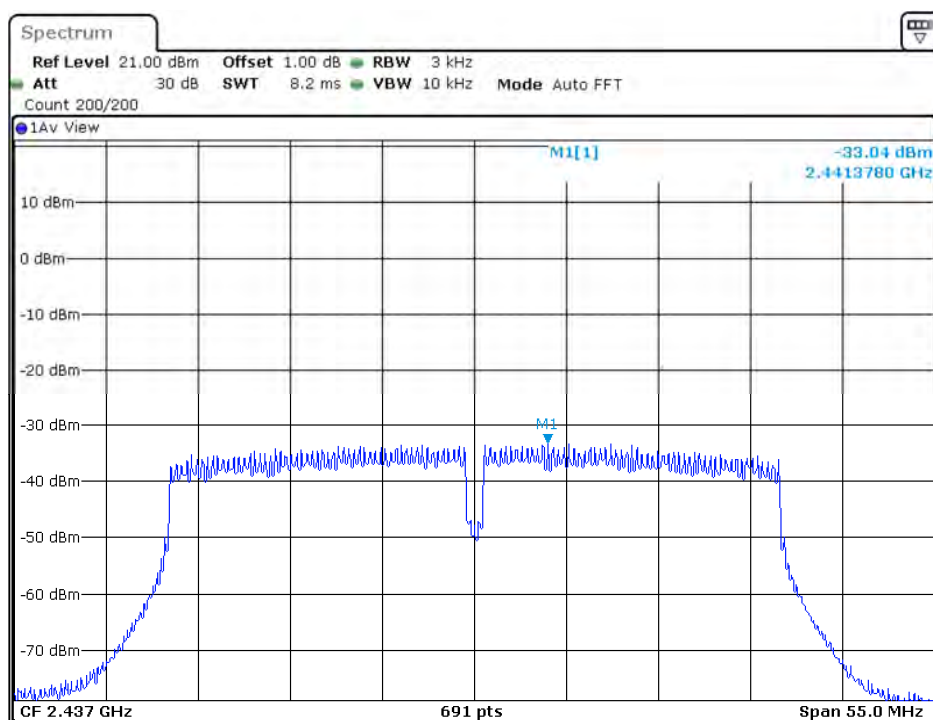


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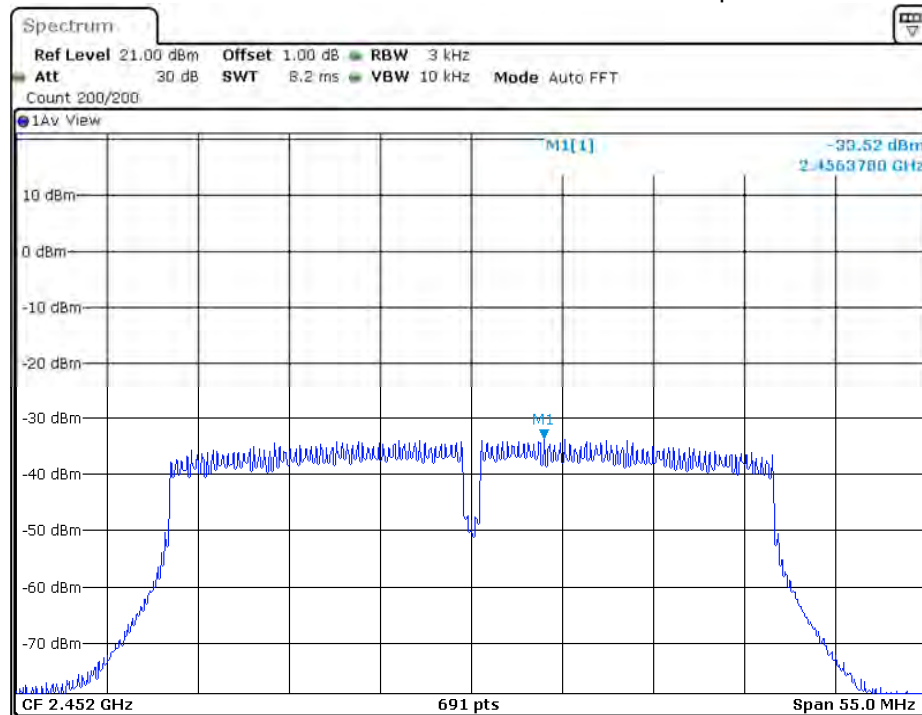
802.11n-HT40



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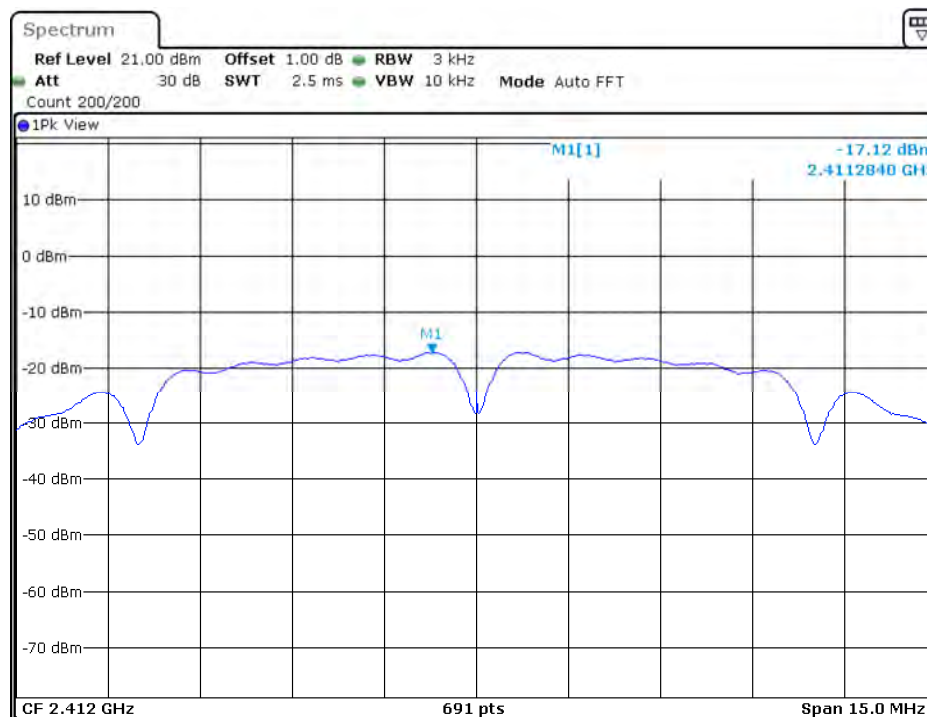
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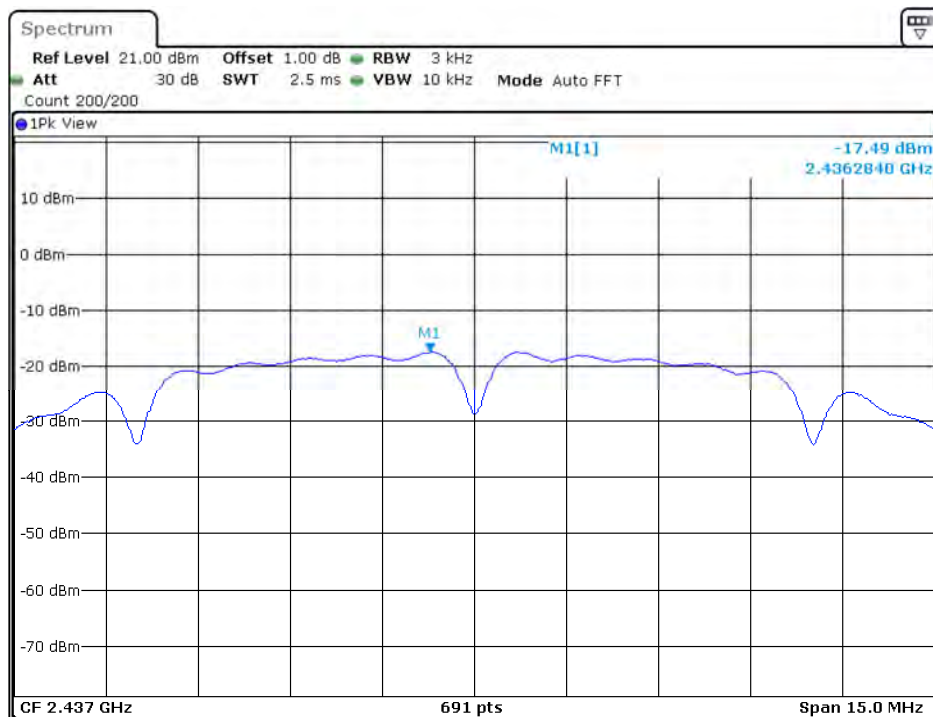
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SISO-ANT 2:

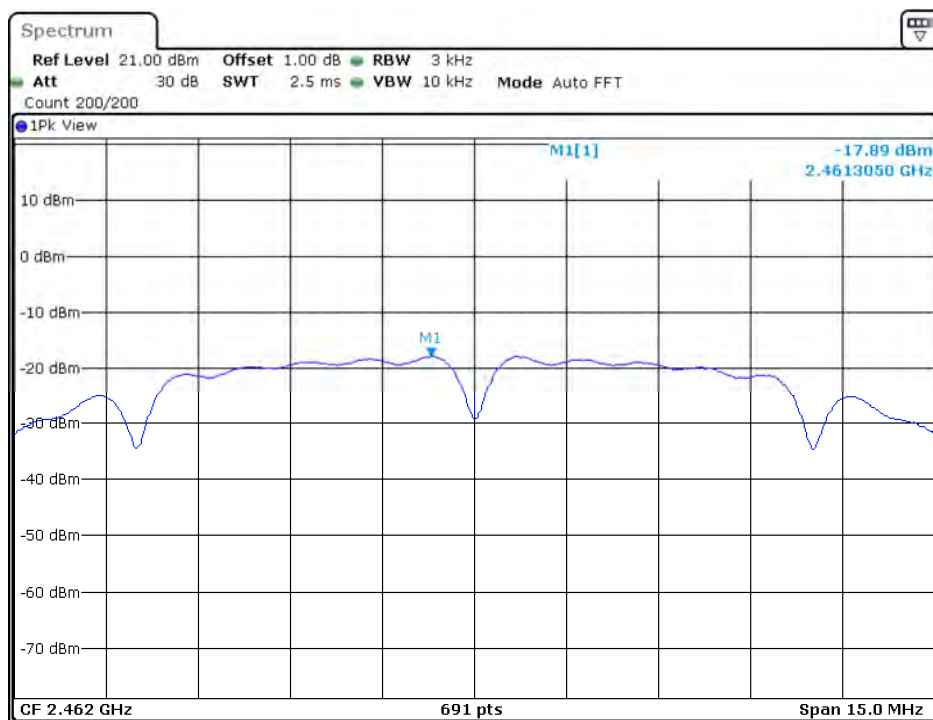
802.11b



Date: 29.OCT.2020 13:18:29

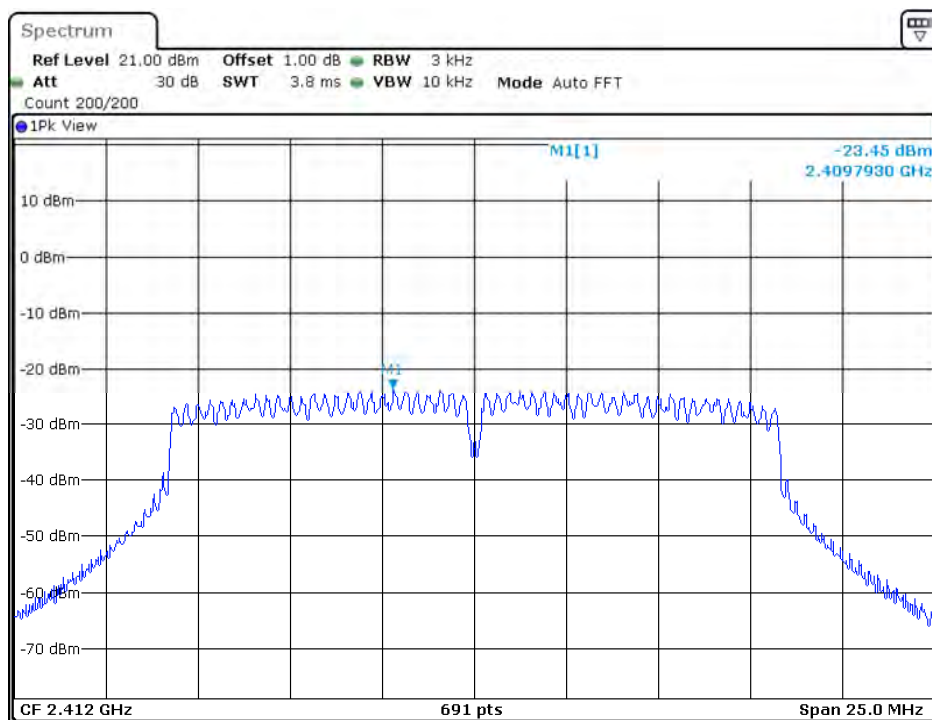


Date: 29.OCT.2020 13:22:09

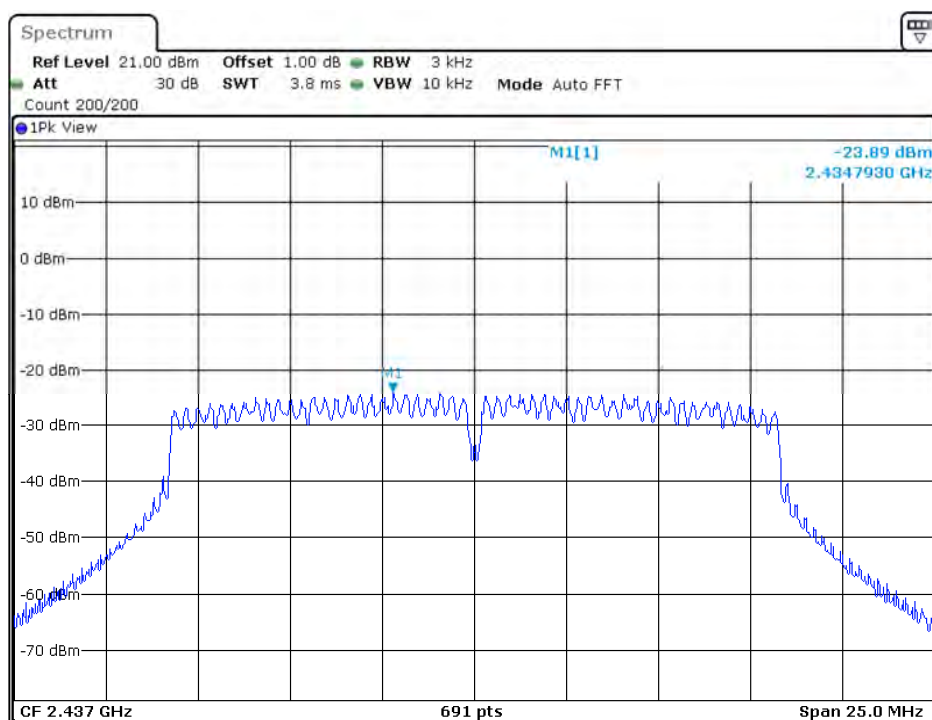


Date: 29.OCT.2020 13:24:19

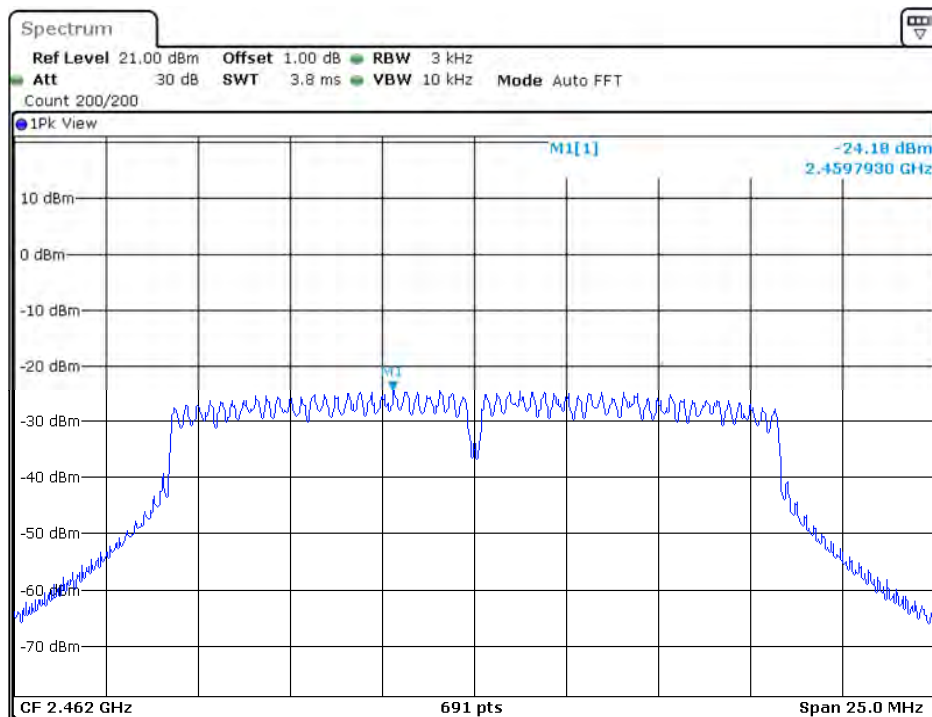
802.11g



Date: 29.OCT.2020 13:26:22

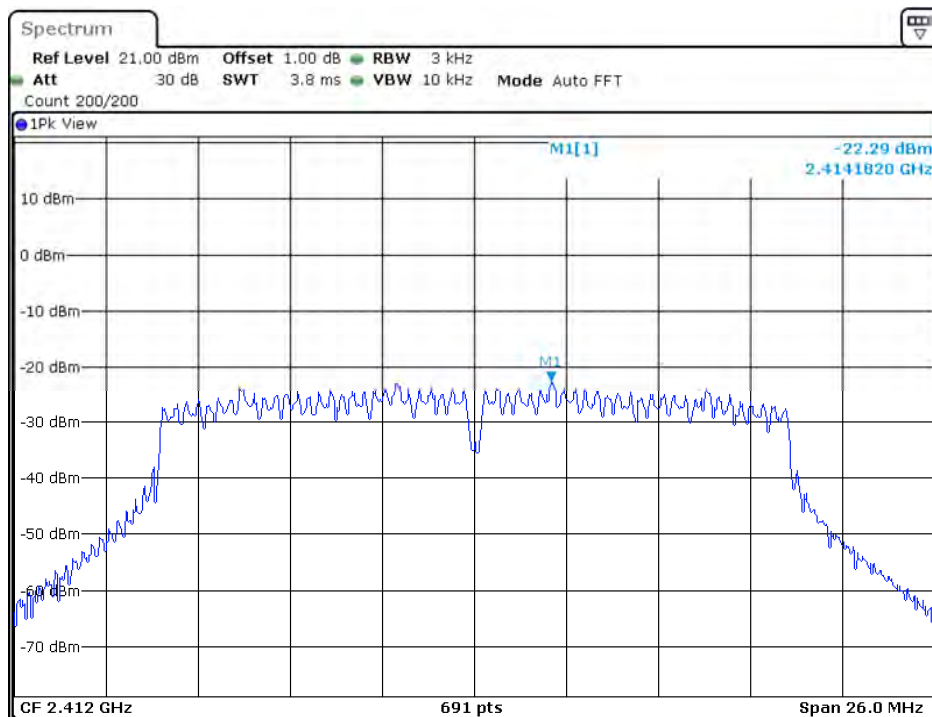


Date: 29.OCT.2020 13:28:32

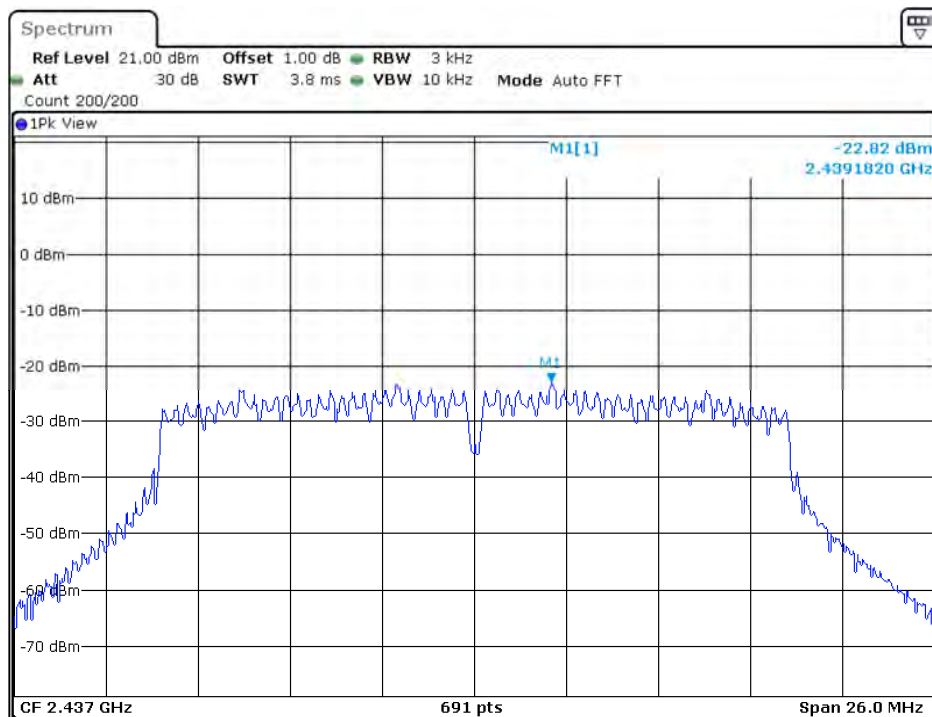


Date: 29.OCT.2020 13:30:18

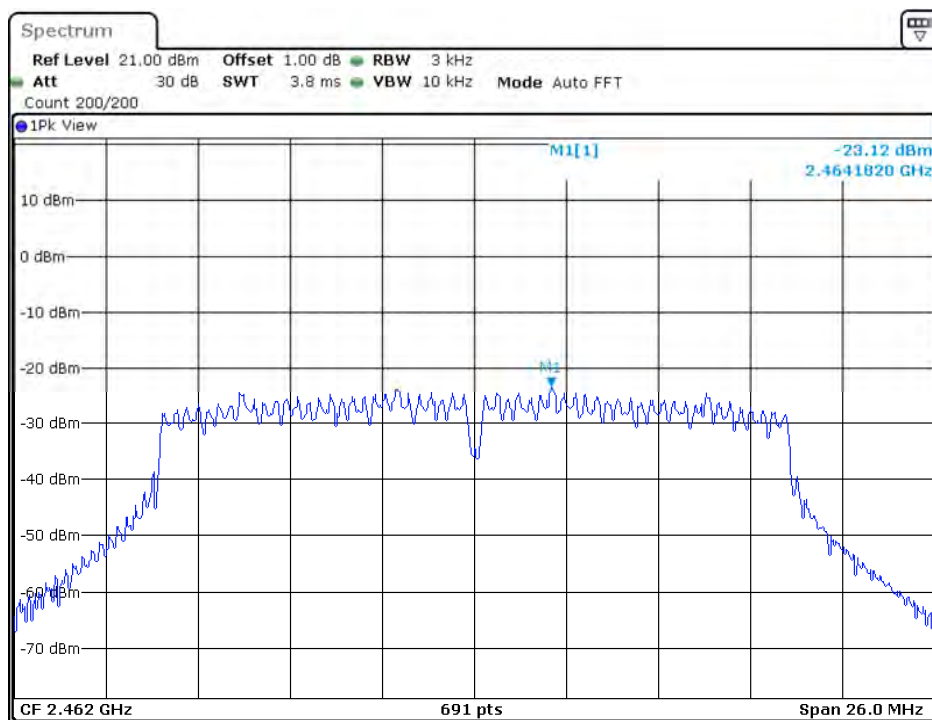
802.11n-HT20



Date: 29.OCT.2020 13:32:22

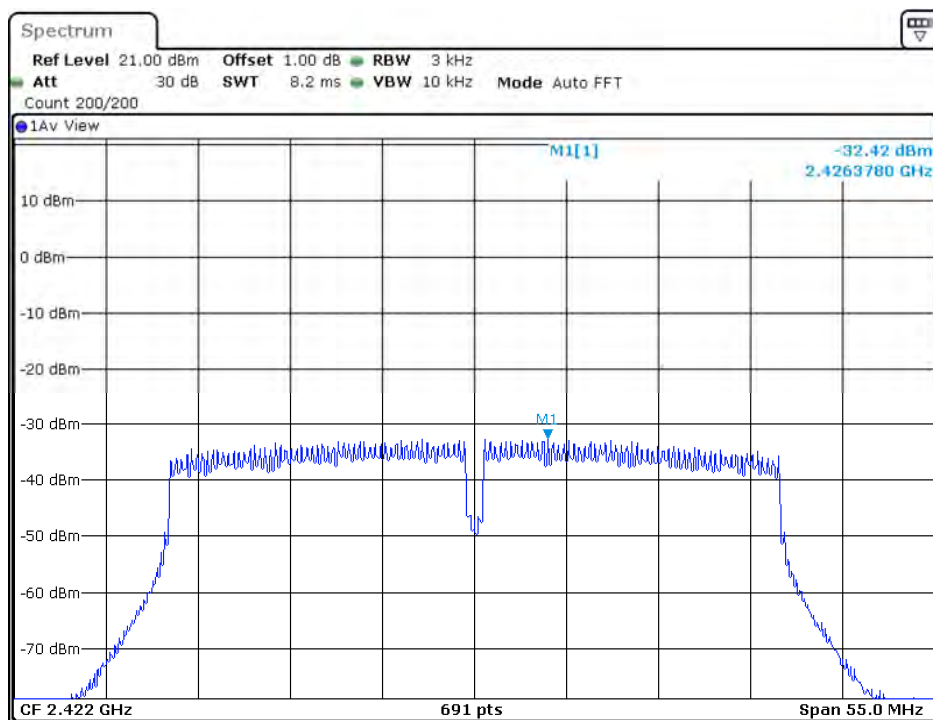


Date: 29.OCT.2020 13:34:14

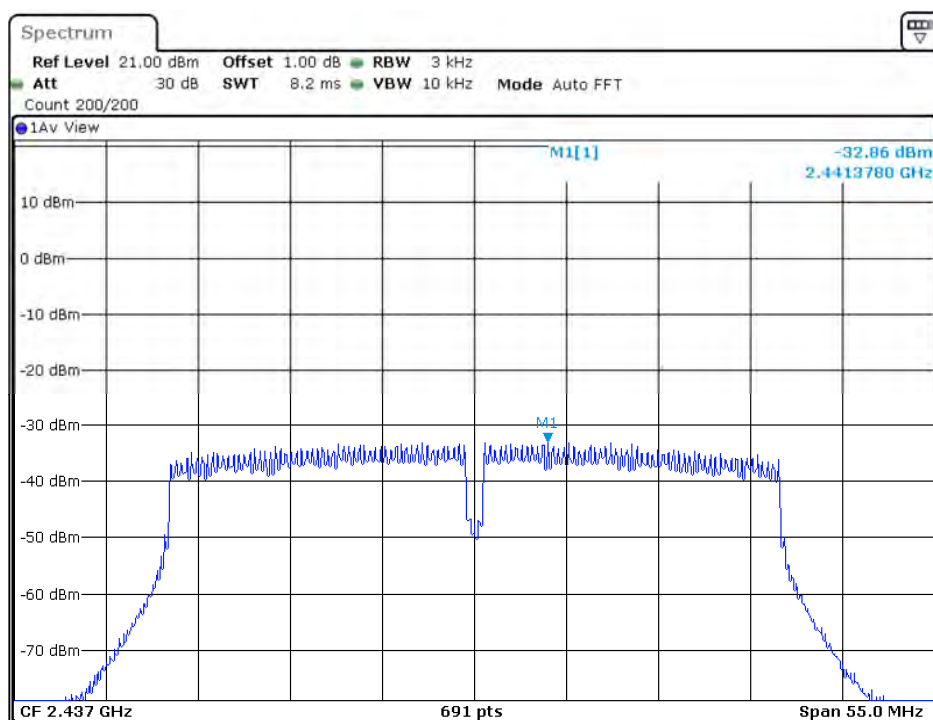


Date: 29.OCT.2020 13:35:44

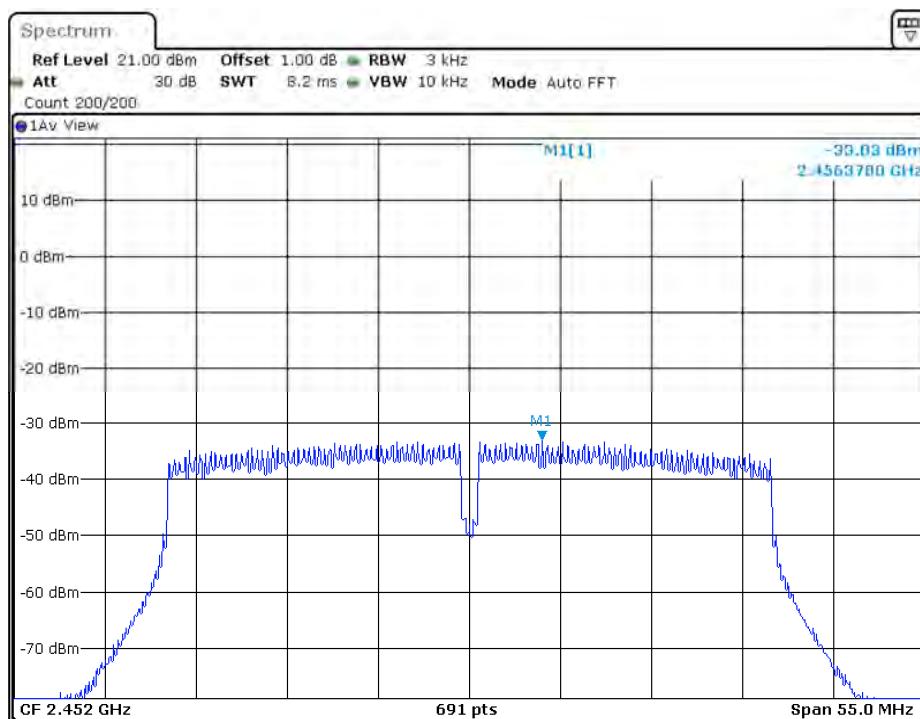
802.11n-HT40



Date: 29.OCT.2020 13:38:43



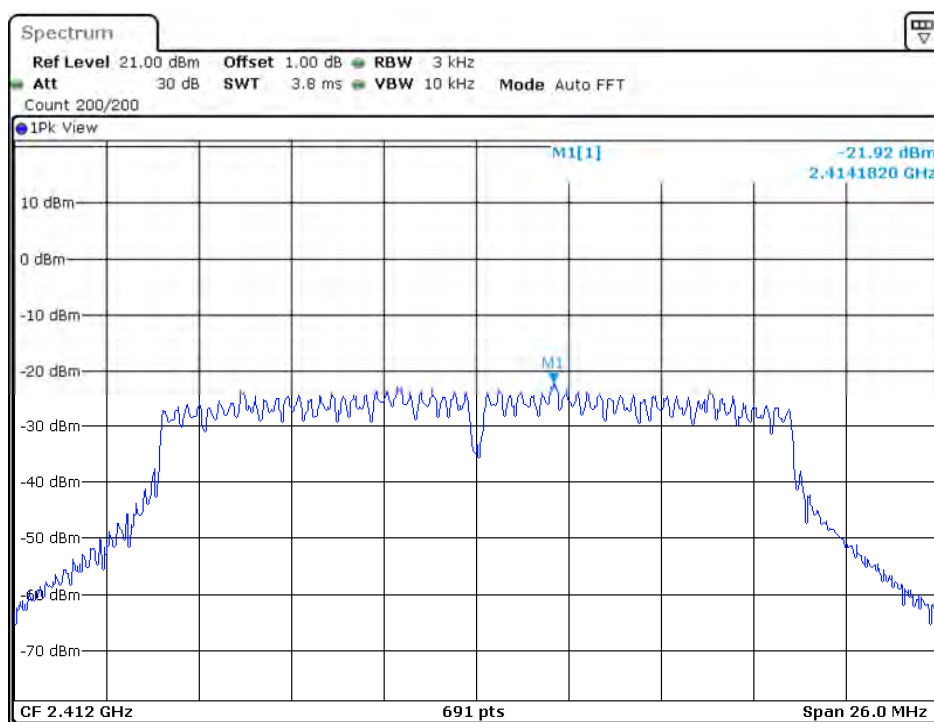
Date: 29.OCT.2020 13:41:32



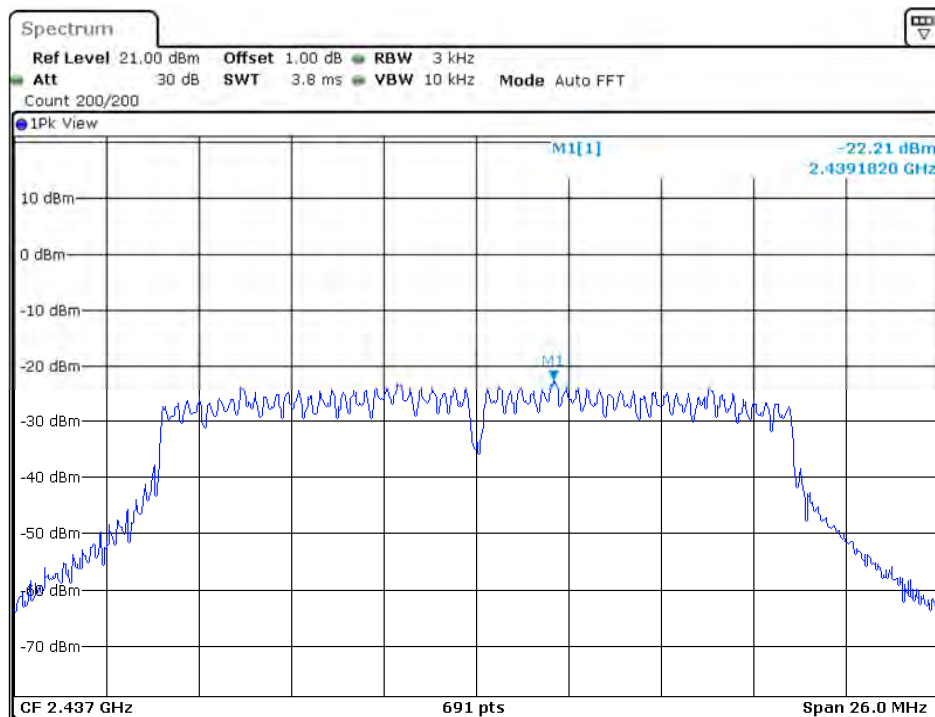
Date: 29.OCT.2020 13:43:51

MIMO-ANT 1:

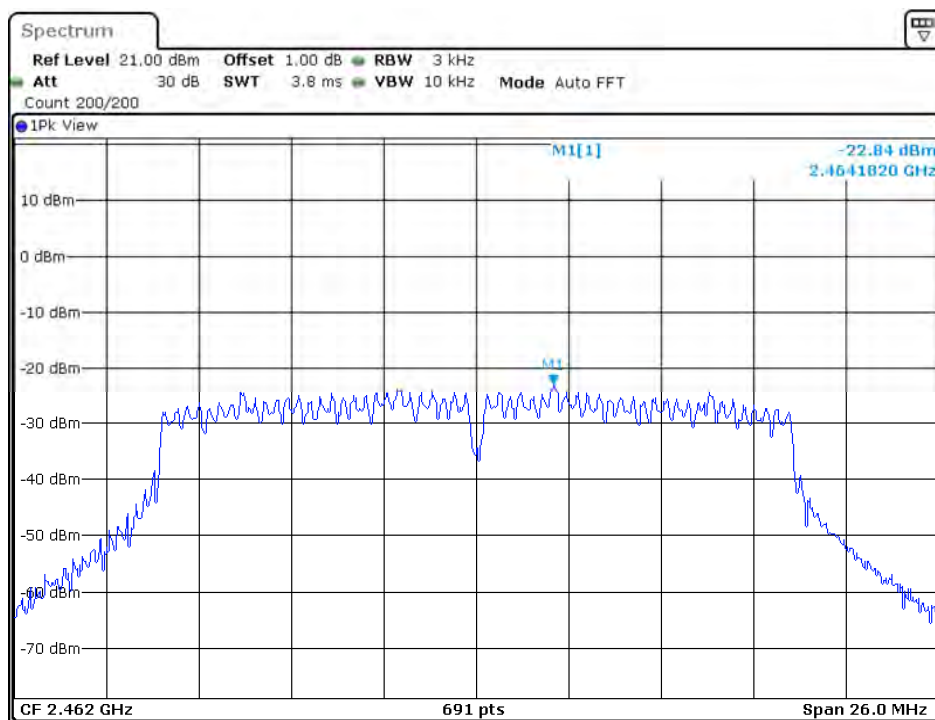
802.11n-HT20



Date: 29.OCT.2020 13:55:12

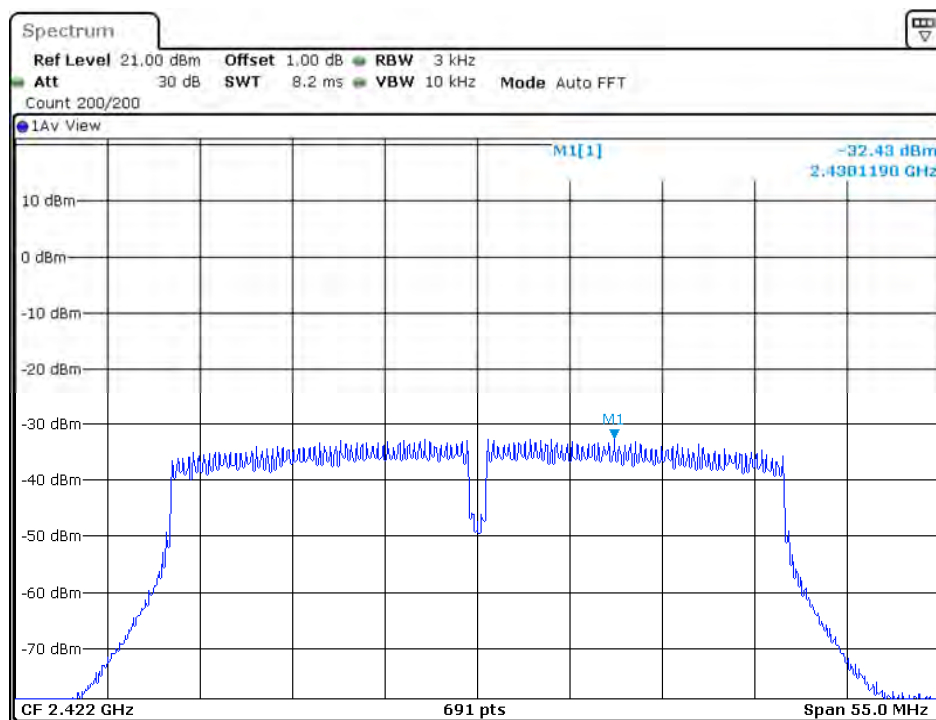


Date: 29.OCT.2020 13:57:07

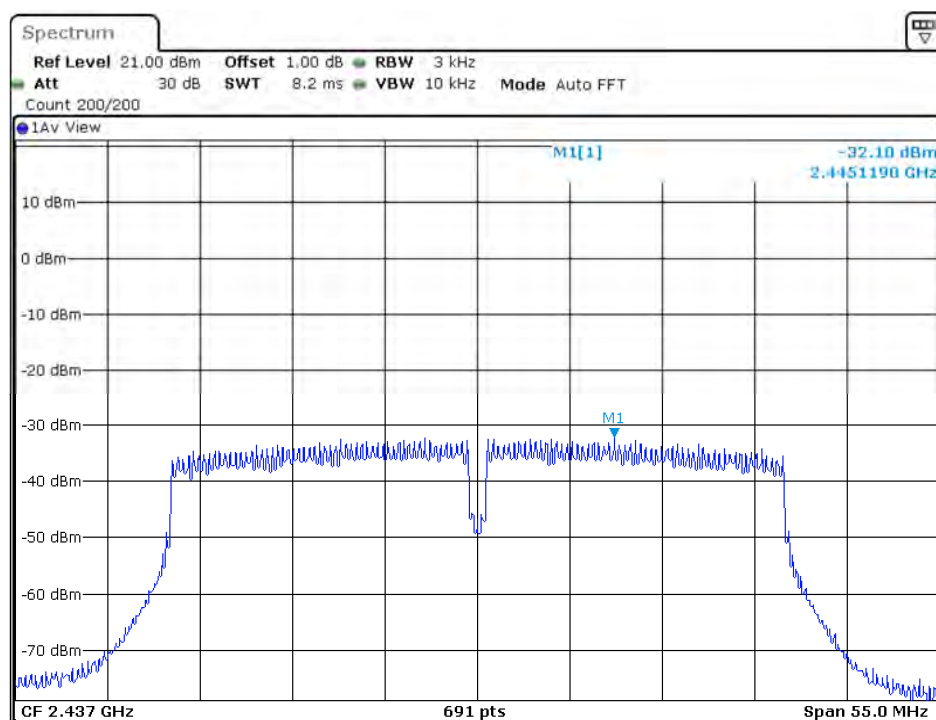


Date: 29.OCT.2020 13:58:45

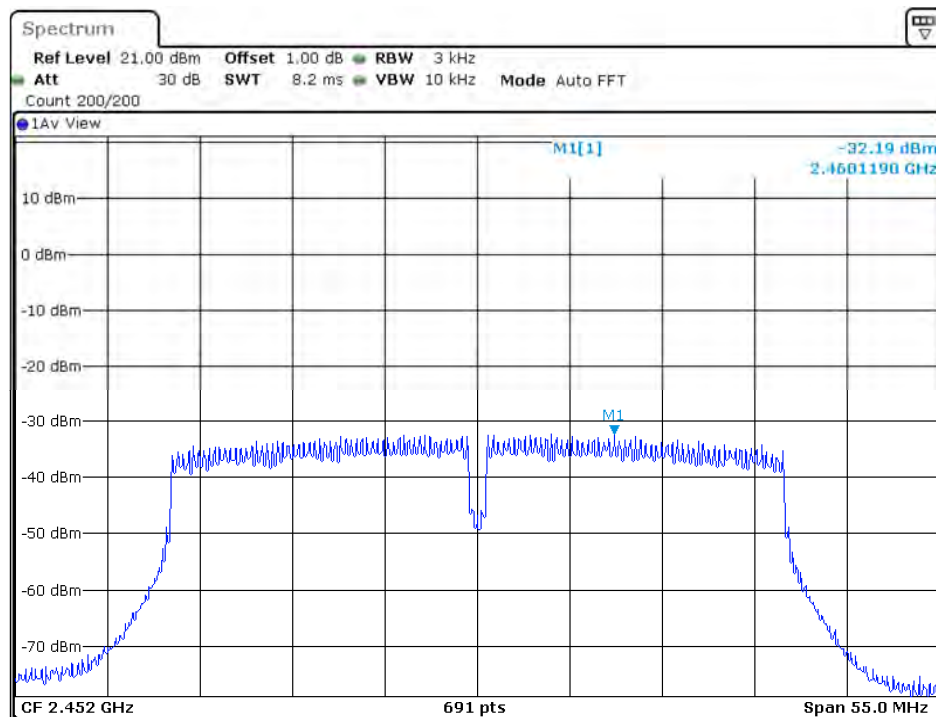
802.11n-HT40



Date: 29.OCT.2020 14:01:18



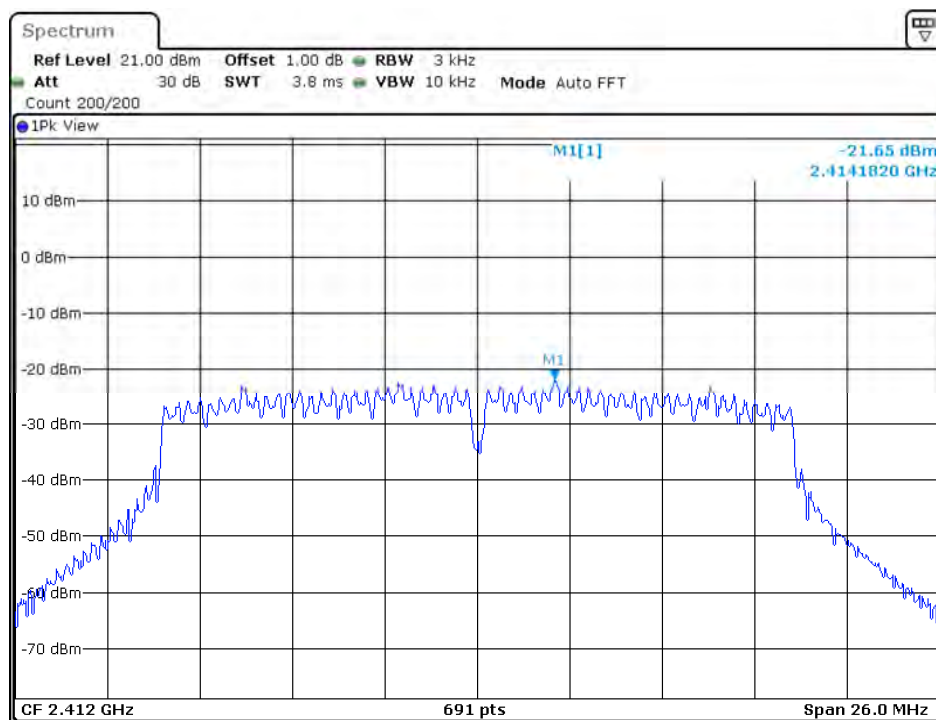
Date: 29.OCT.2020 14:03:47



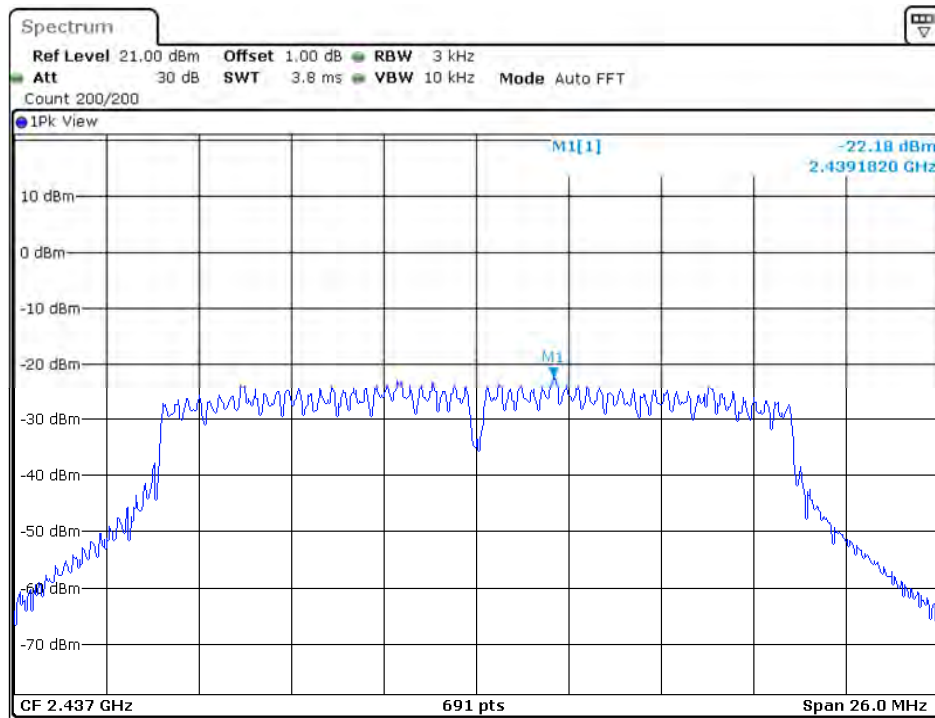
Date: 29.OCT.2020 14:06:13

MIMO-ANT 2:

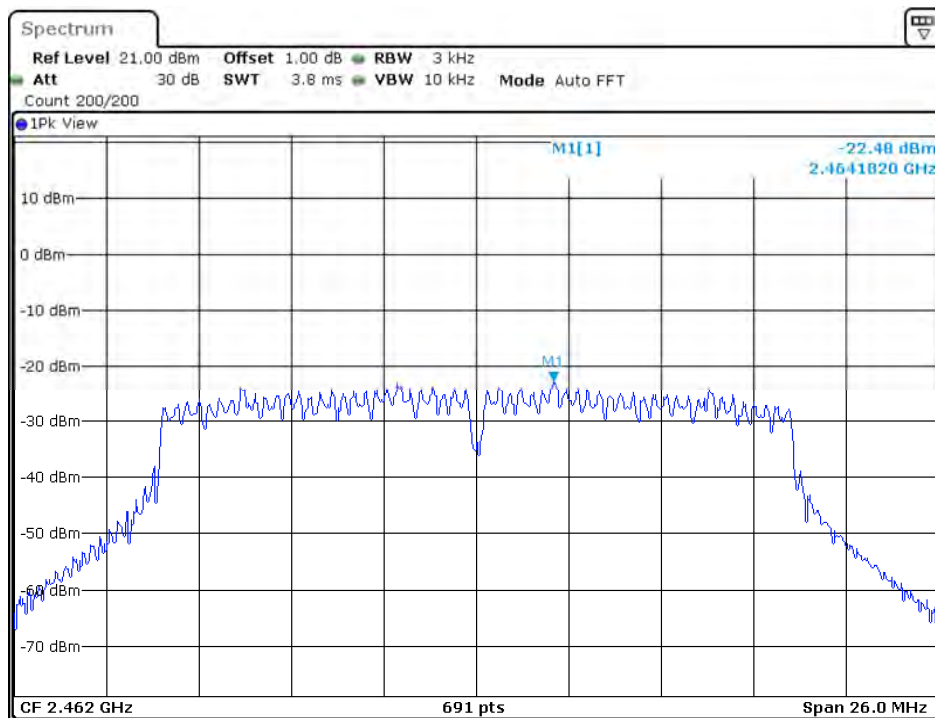
802.11n-HT20



Date: 29.OCT.2020 14:08:29

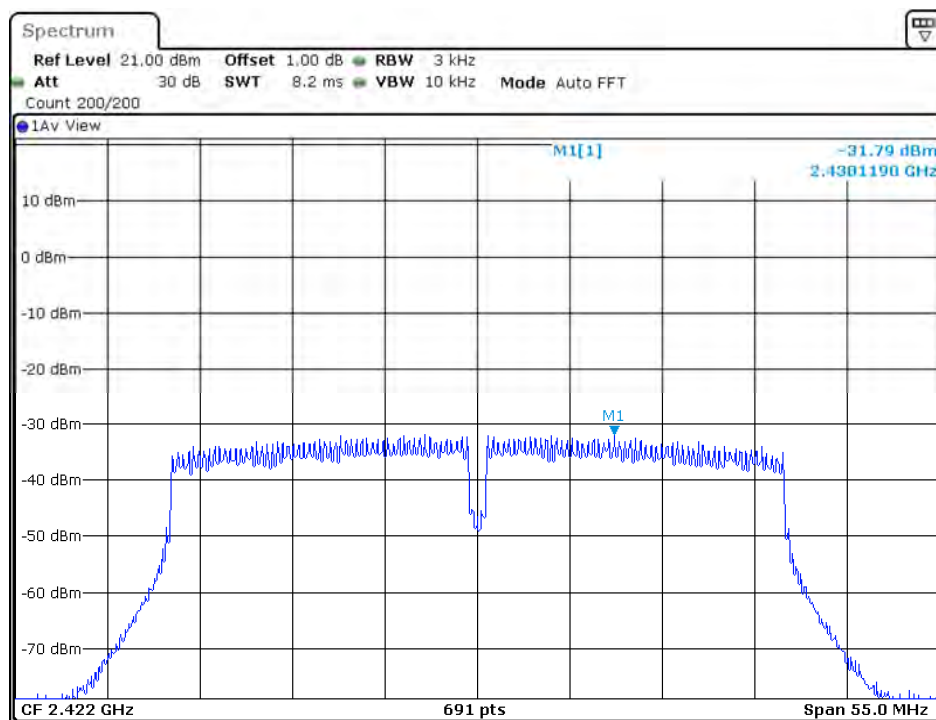


Date: 29.OCT.2020 14:10:27

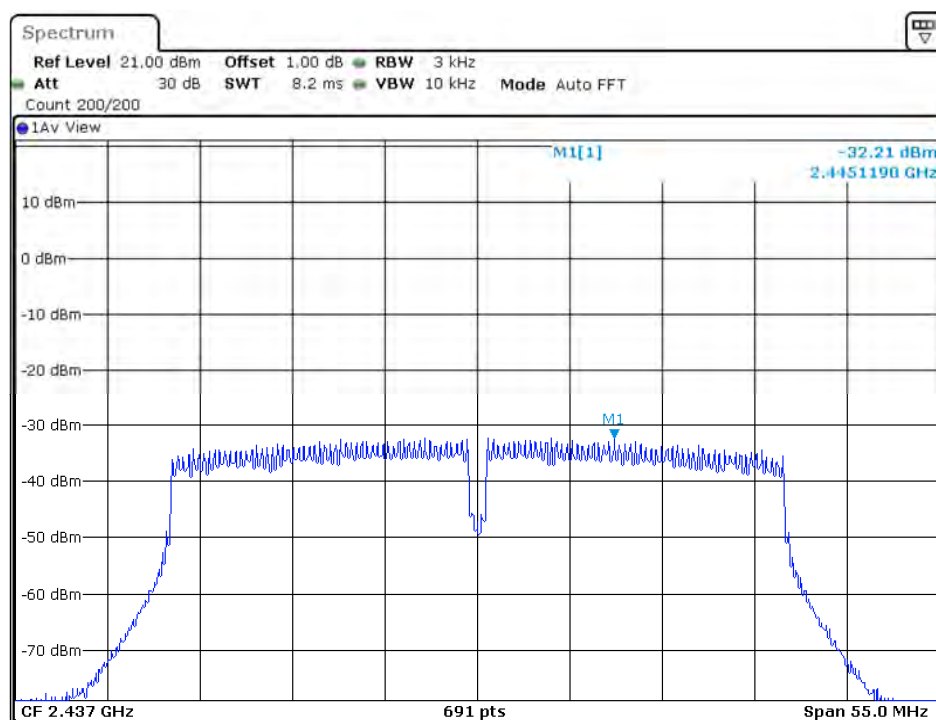


Date: 29.OCT.2020 14:12:03

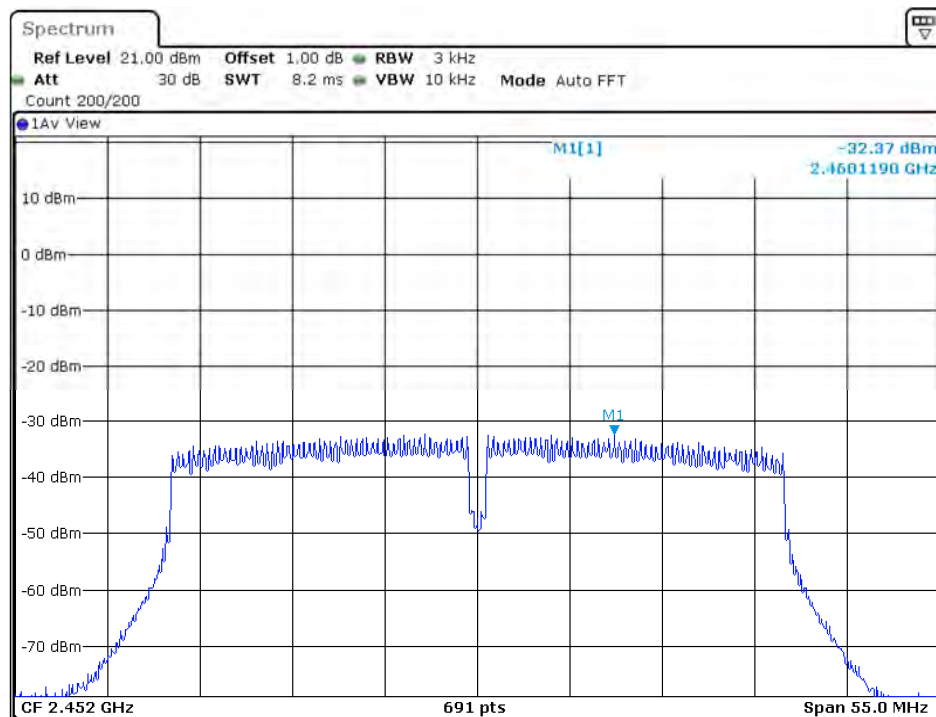
802.11n-HT40



Date: 29.OCT.2020 14:14:40



Date: 29.OCT.2020 14:17:23



Date: 29.OCT.2020 14:19:51

Applicant: Shenzhen Chuangwei-RGB Electronics Co., Ltd.

Date of Test: 29 October 2020

Model: NTUD-U21

4.4 Out of Band Conducted Emissions, FCC Rule 15.247(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. The Measurement Procedure was set according to the FCC KDB 558074 D01 v05r02.

All other types of emissions from the EUT shall meet the general limits for radiated frequencies outside the passband.

Refer to the attached test plots for out of band conducted emissions data with rate of 1Mbps for 802.11b and 6Mbps for 802.11g and 6Mbps for 802.11n-HT20 and 13.5Mbps for 802.11n-HT40.

The test plots showed all spurious emission up to the tenth harmonic were measured and they were found to be at least 20 dB below the highest level of the desired power in the passband.

The test plots are attached as below.

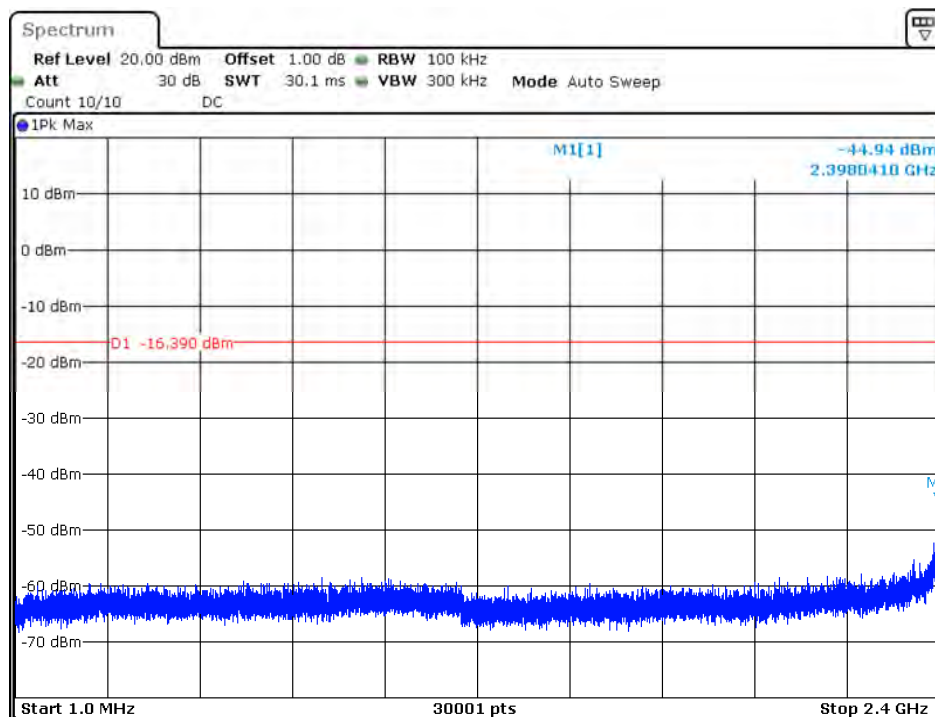
SISO Mode, Ant1

802.11b

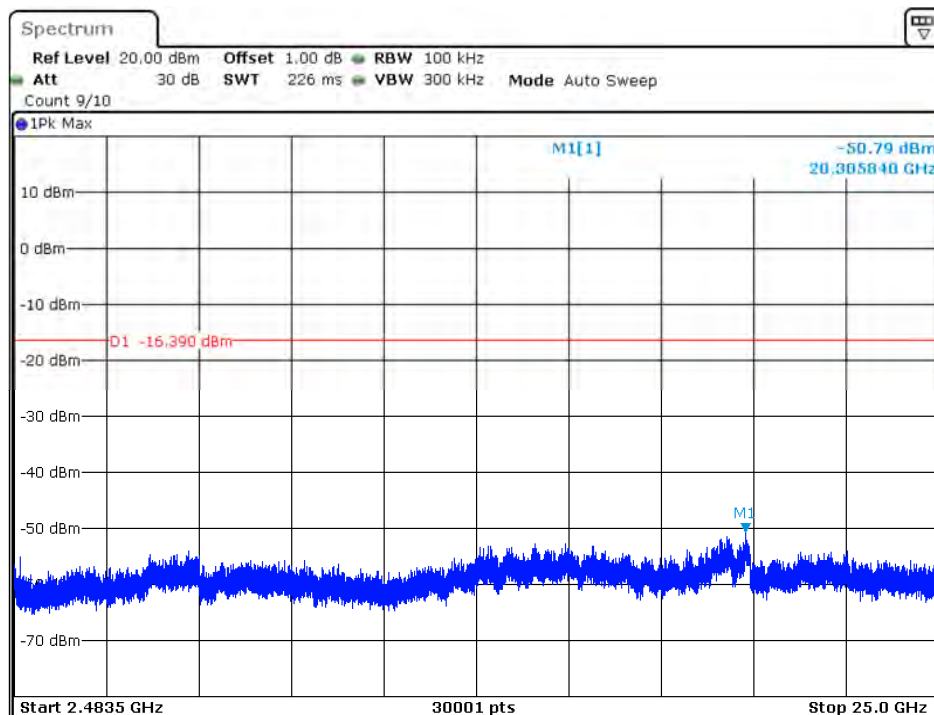
Channel 01 (2412MHz) Reference Level: 3.61dBm



Date: 29.OCT.2020 12:48:26



Date: 29.OCT.2020 12:48:31

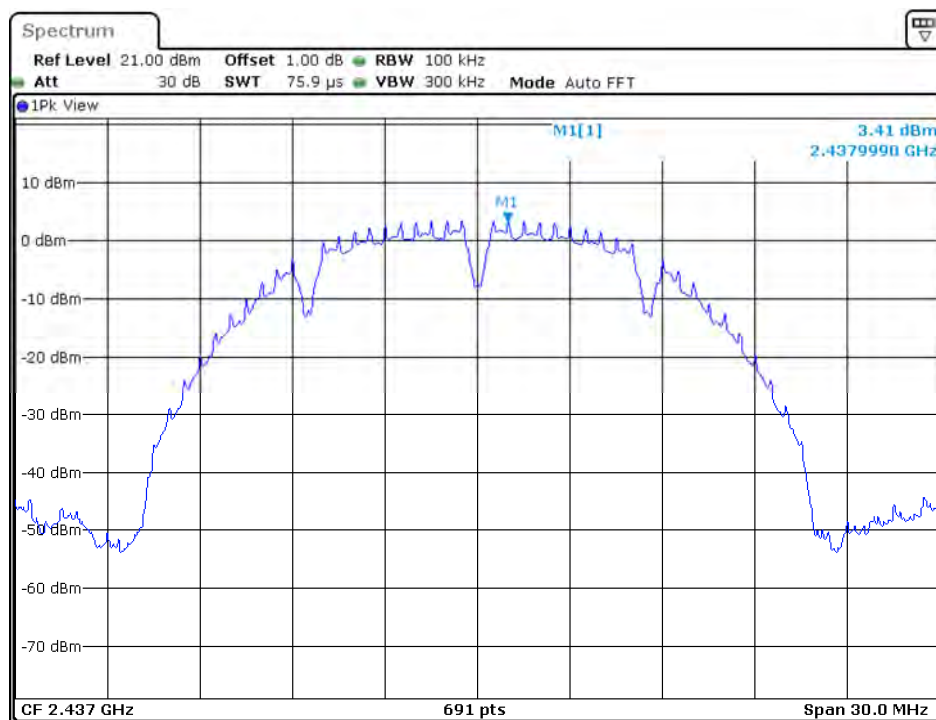


Date: 29.OCT.2020 12:48:38

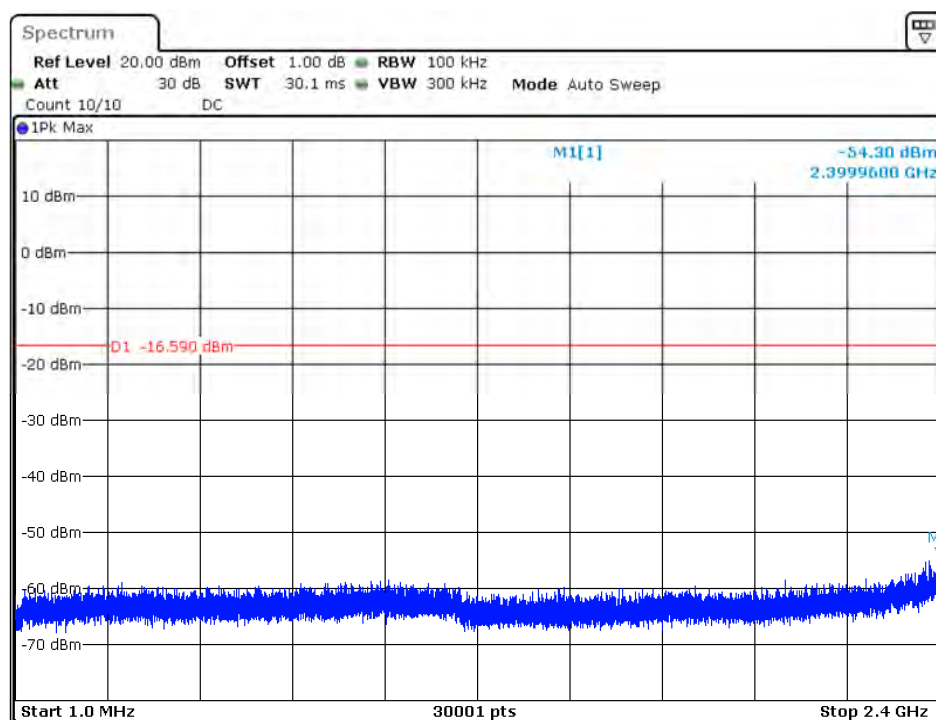


Date: 29.OCT.2020 12:48:14

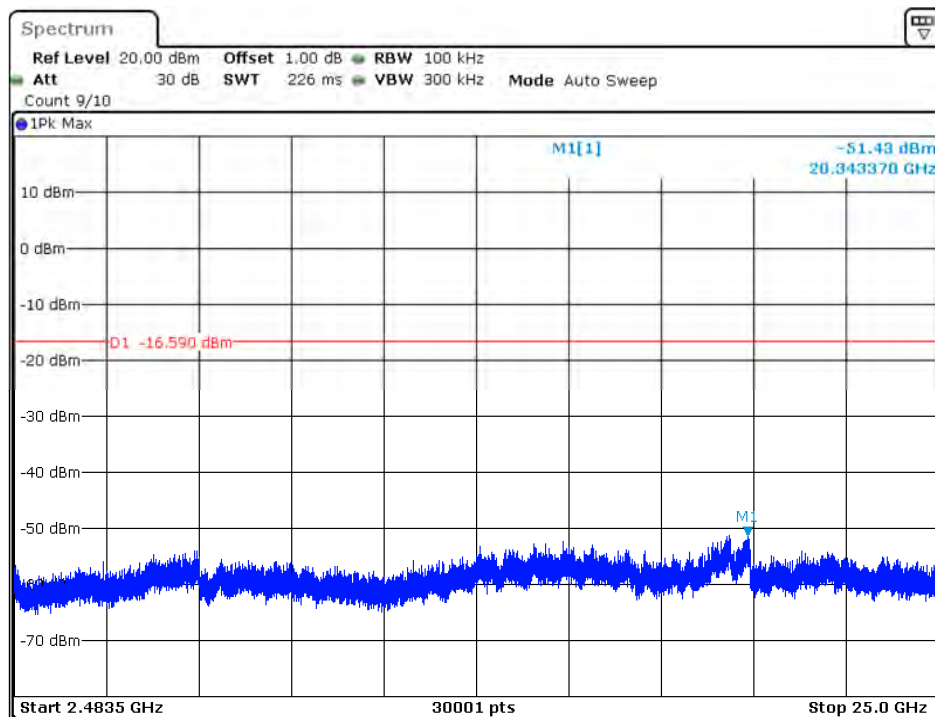
Channel 06 (2437MHz) Reference Level: 3.41dBm



Date: 29.OCT.2020 12:50:37

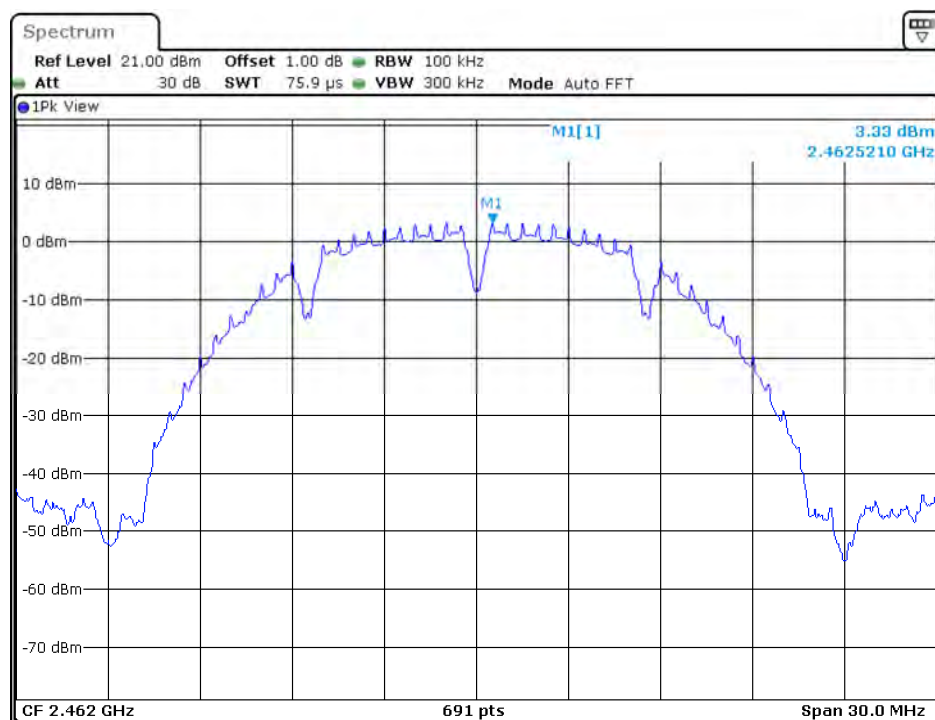


Date: 29.OCT.2020 12:50:42

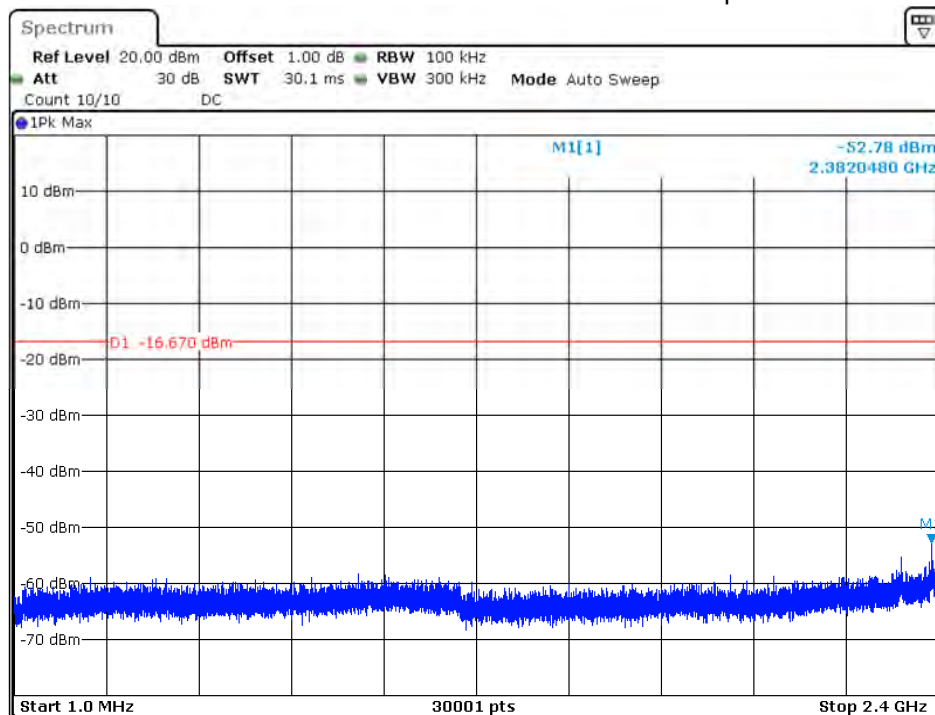


Date: 29.OCT.2020 12:50:49

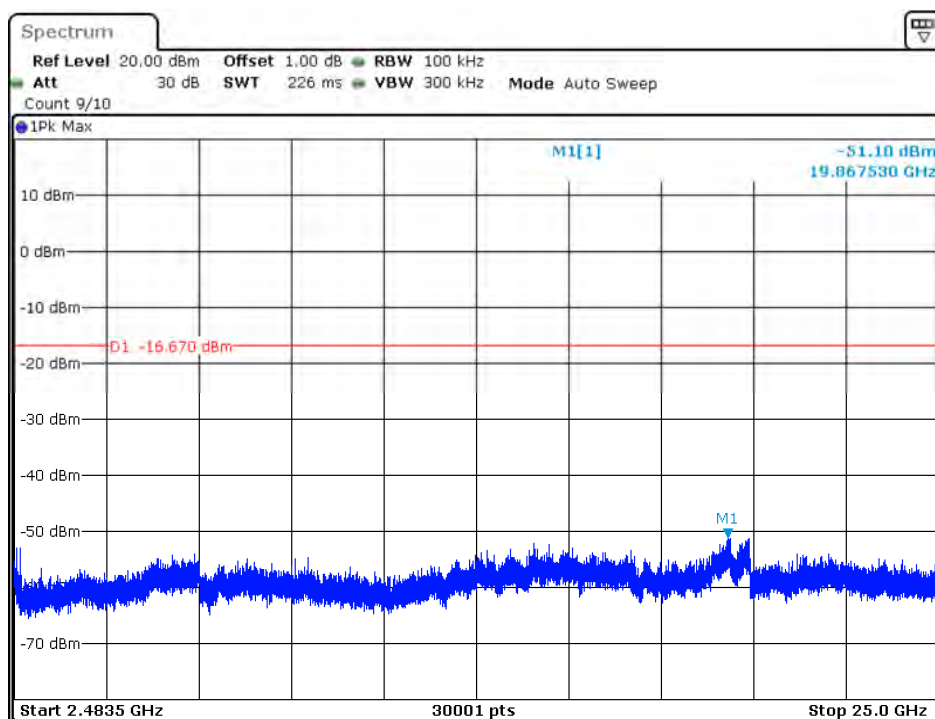
Channel 11 (2462MHz) Reference Level: 3.33dBm



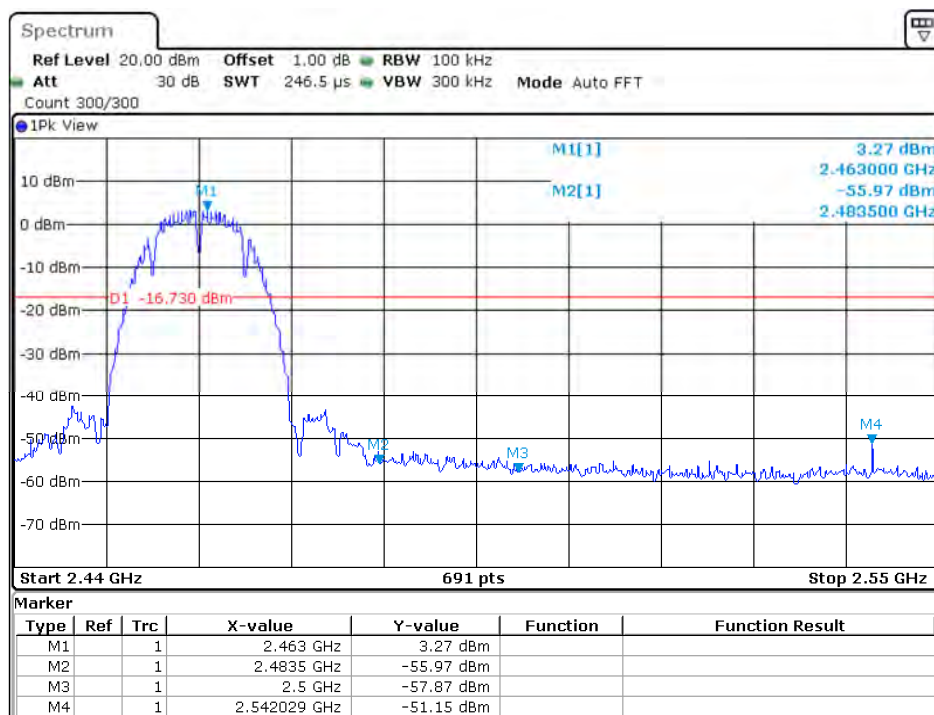
Date: 29.OCT.2020 12:52:40



Date: 29.OCT.2020 12:52:45



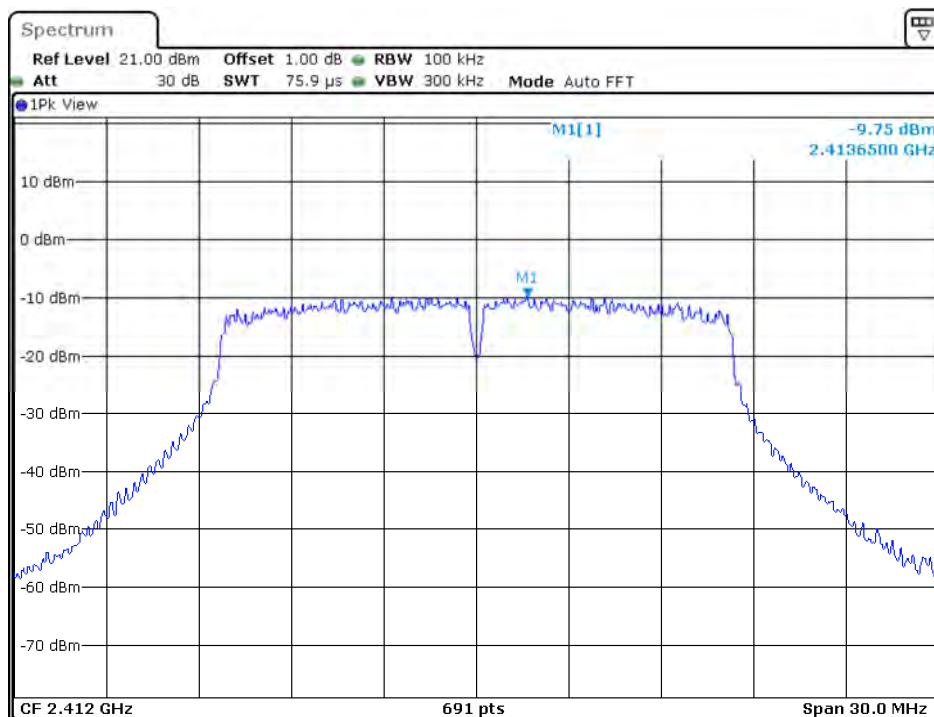
Date: 29.OCT.2020 12:52:52



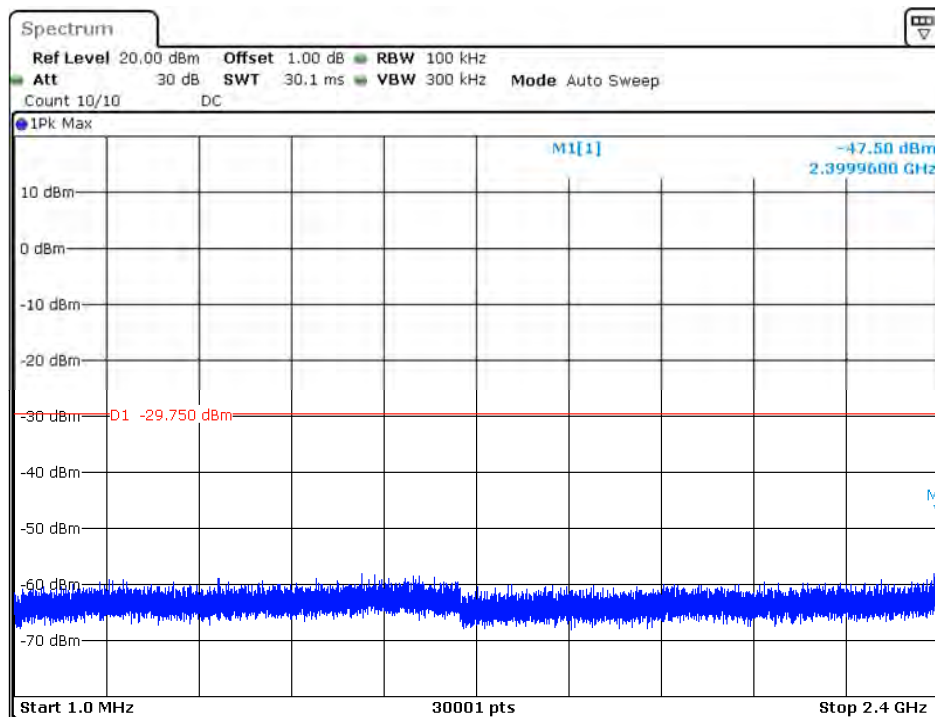
Date: 29.OCT.2020 12:52:29

802.11g

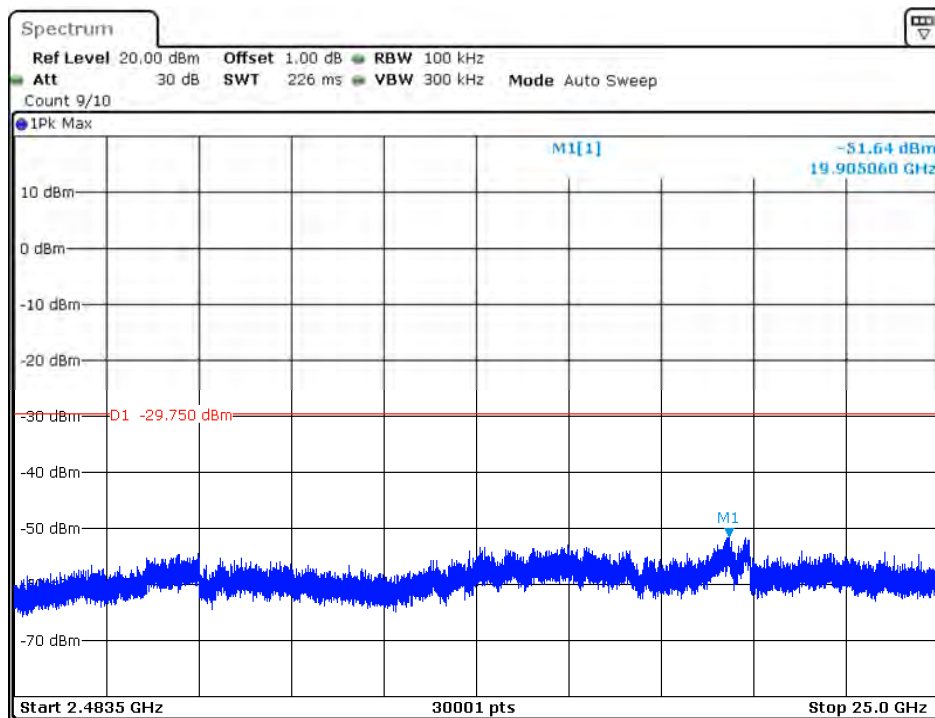
Channel 01 (2412MHz) Reference Level: -9.75dBm



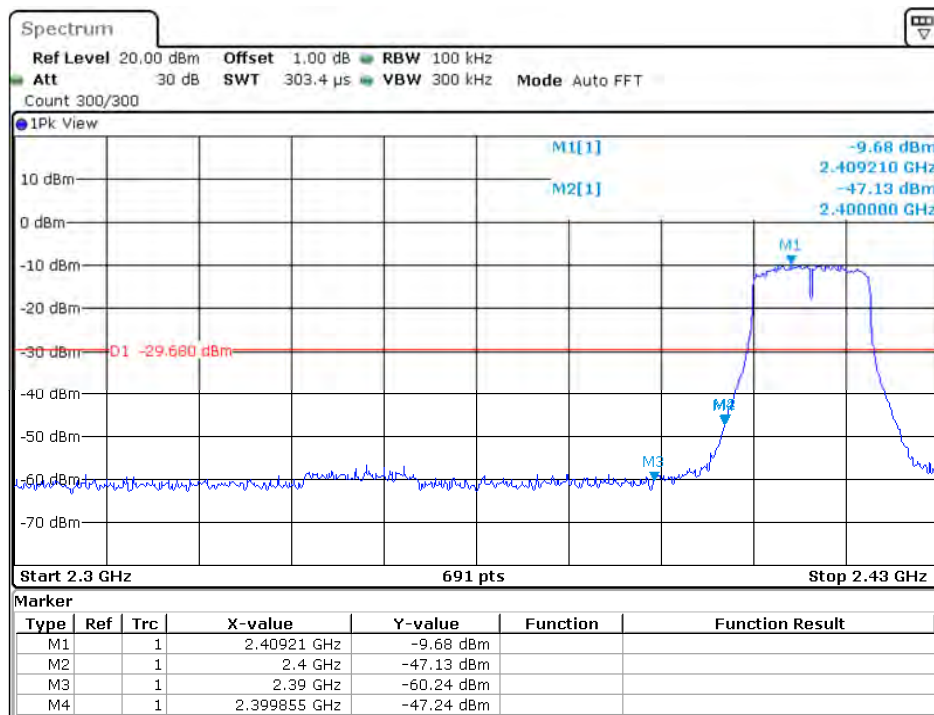
Date: 29.OCT.2020 12:55:12



Date: 29.OCT.2020 12:55:17

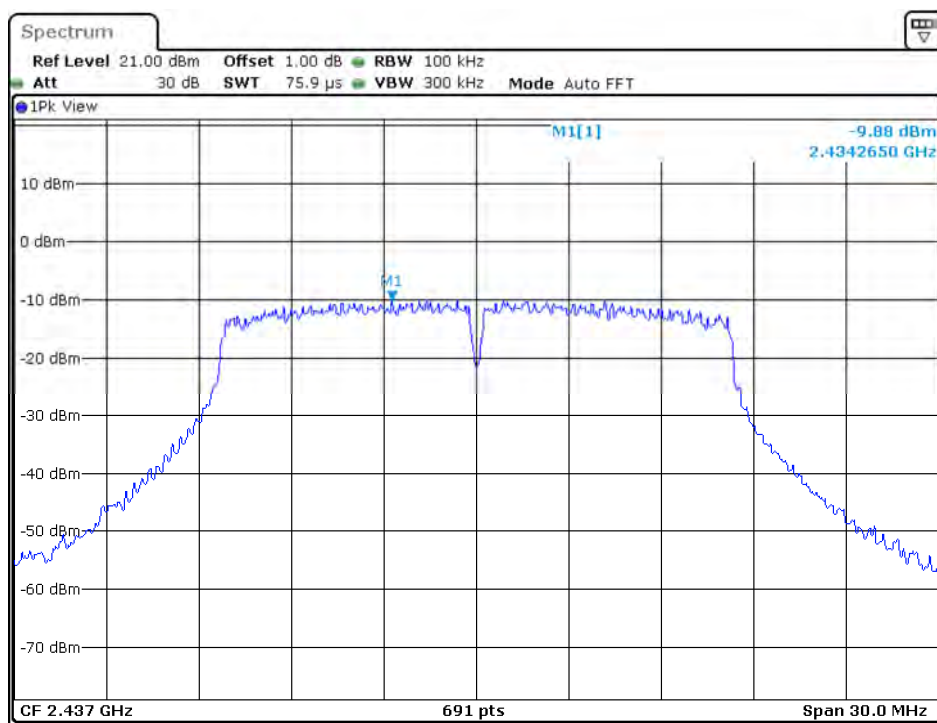


Date: 29.OCT.2020 12:55:24

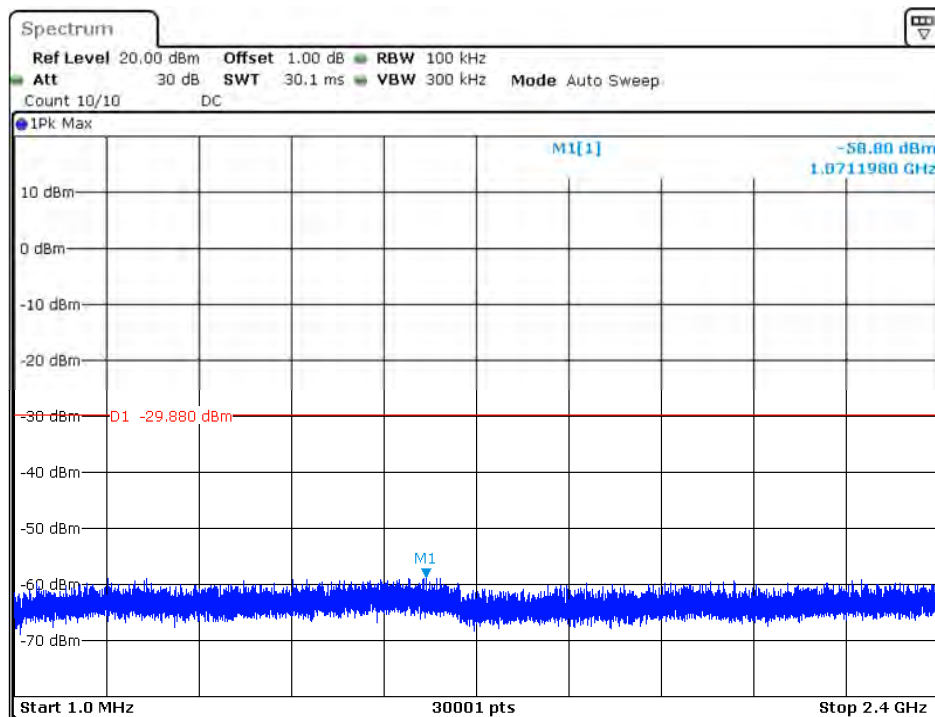


Date: 29.OCT.2020 12:55:01

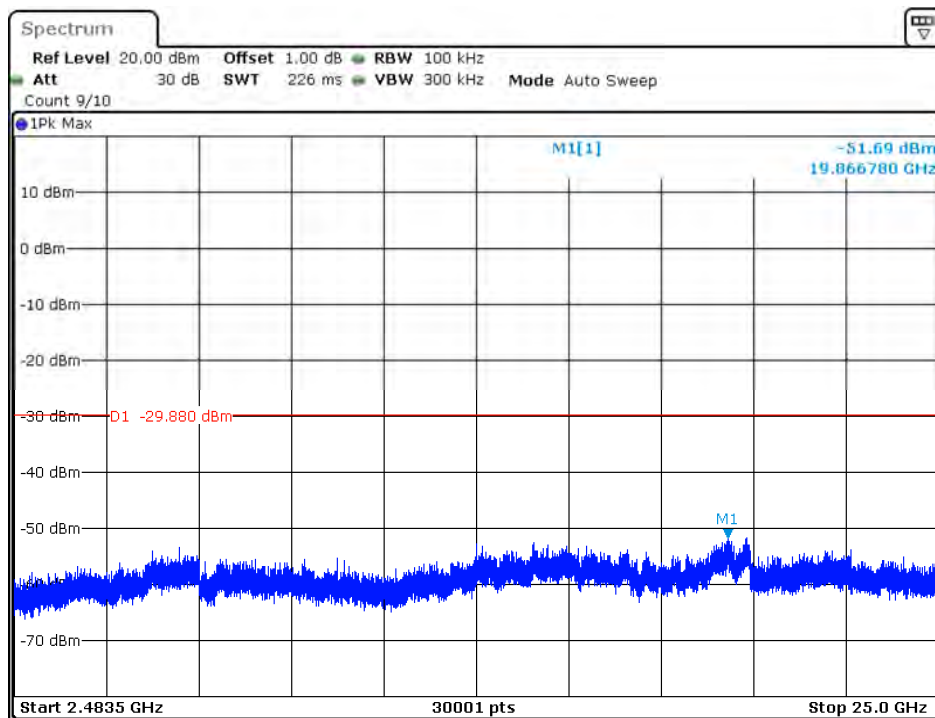
Channel 06 (2437MHz) Reference Level: -9.88dBm



Date: 29.OCT.2020 12:57:12

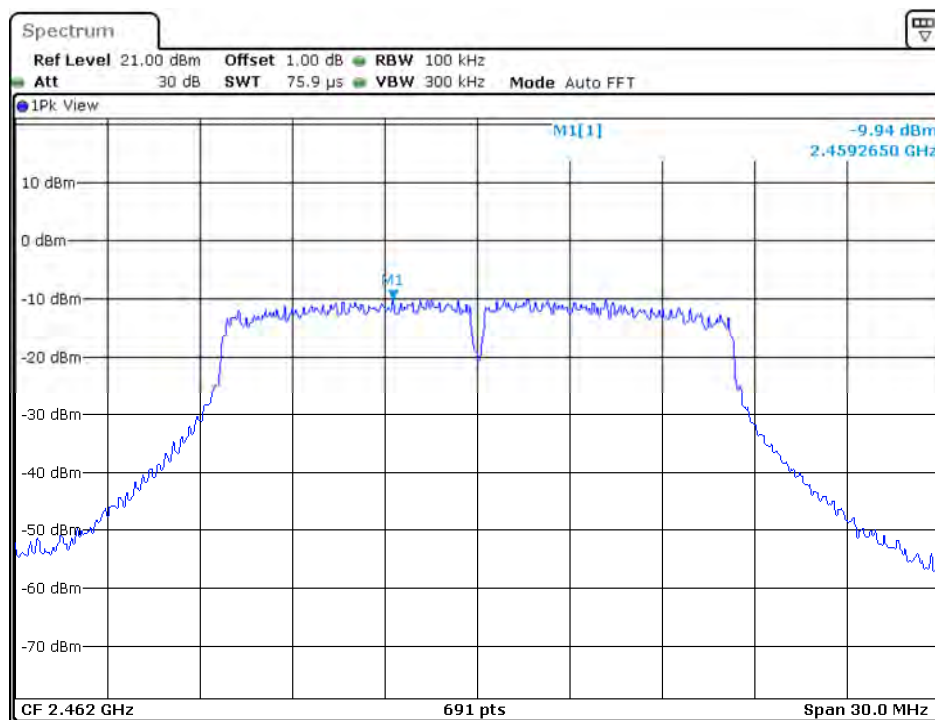


Date: 29.OCT.2020 12:57:17

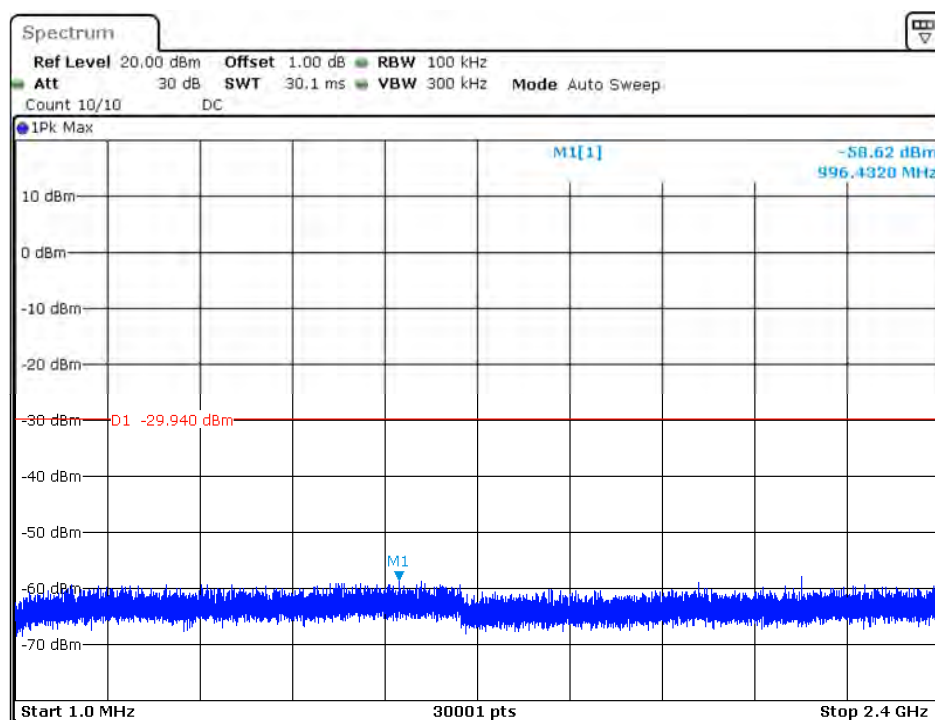


Date: 29.OCT.2020 12:57:24

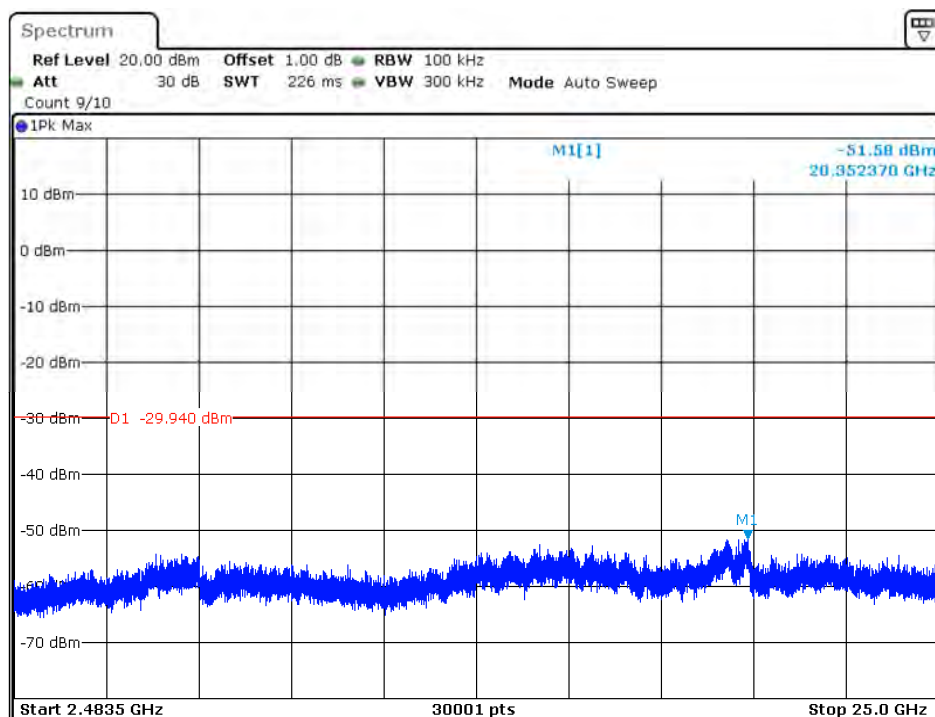
Channel 11 (2462MHz) Reference Level: -9.94dBm



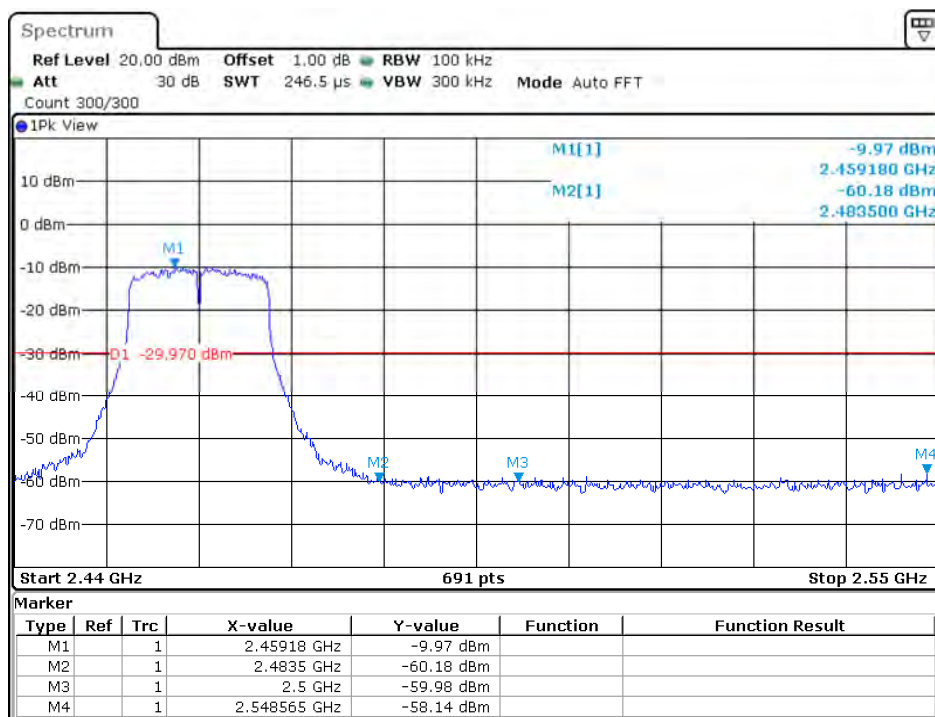
Date: 29.OCT.2020 12:59:26



Date: 29.OCT.2020 12:59:31



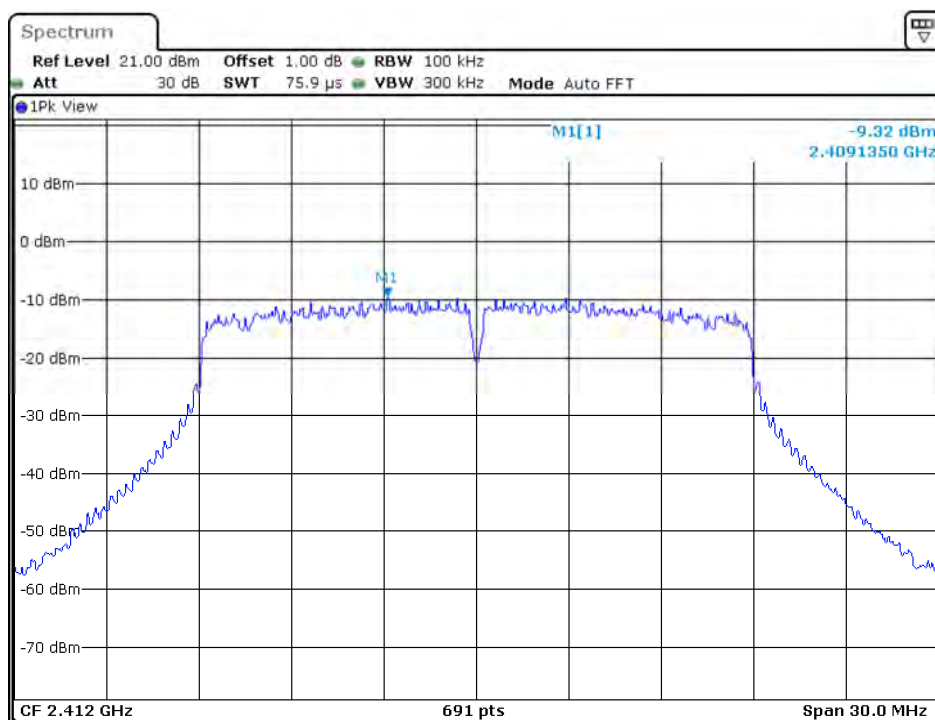
Date: 29.OCT.2020 12:59:38



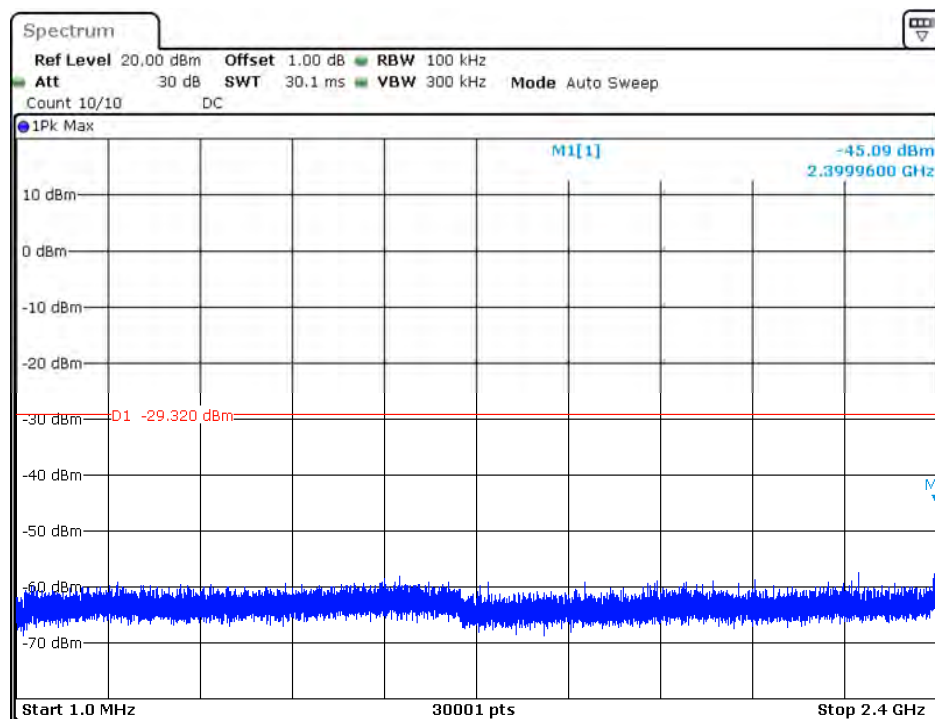
Date: 29.OCT.2020 12:59:14

802.11n-HT20

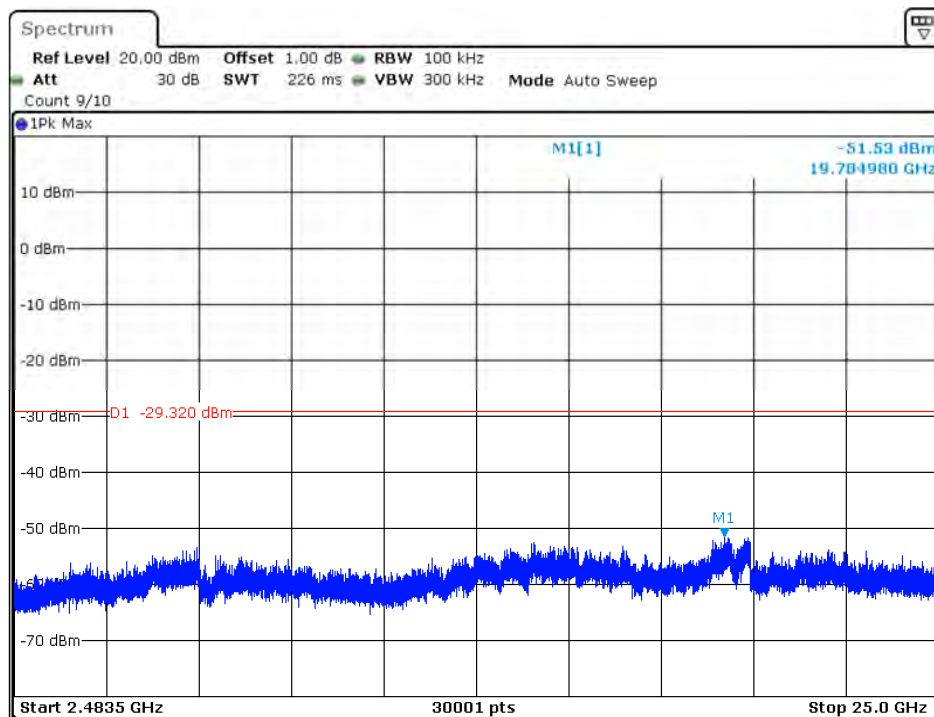
Channel 01 (2412MHz) Reference Level: -9.32dBm



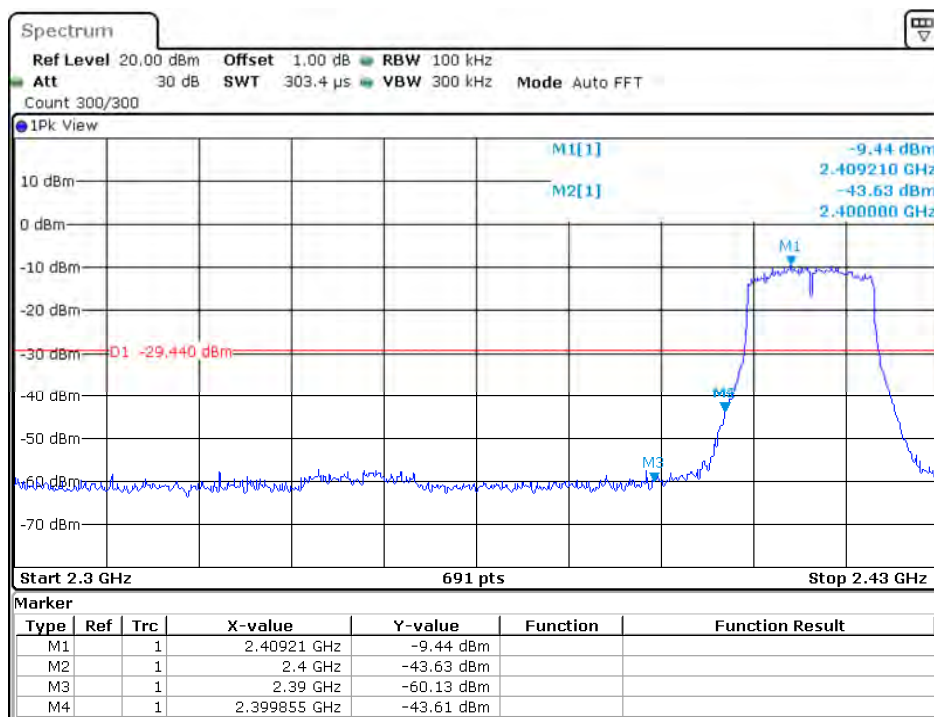
Date: 29.OCT.2020 13:01:19



Date: 29.OCT.2020 13:01:24

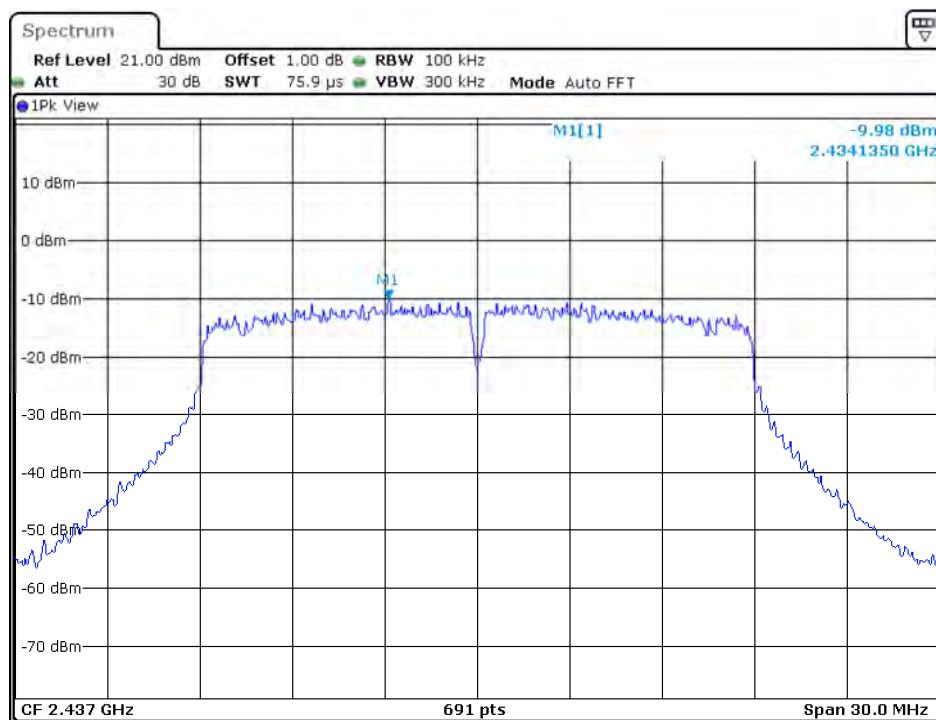


Date: 29.OCT.2020 13:01:31

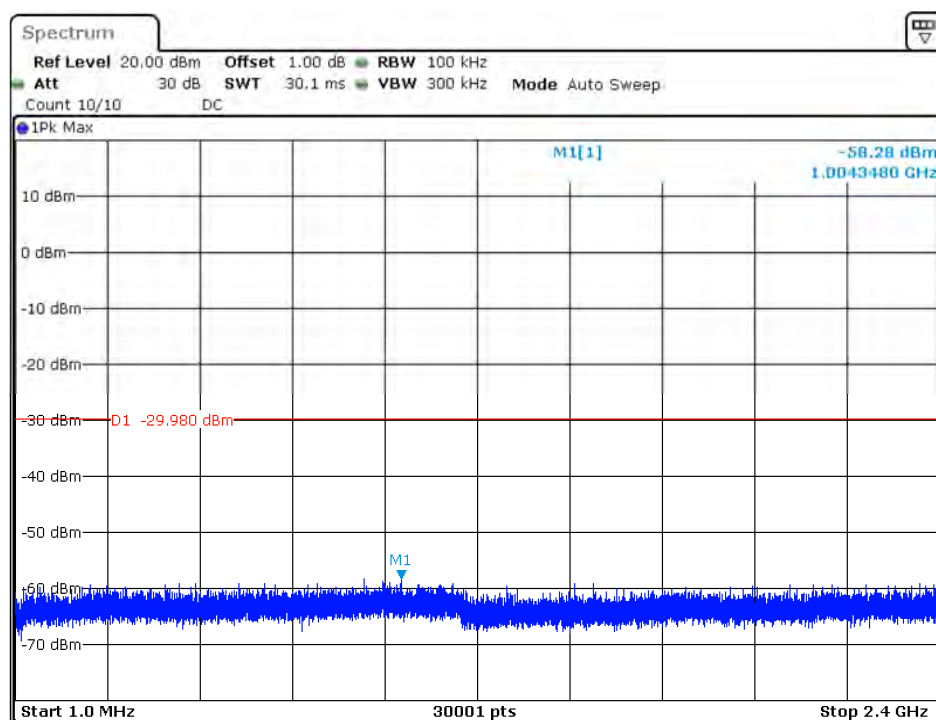


Date: 29.OCT.2020 13:01:06

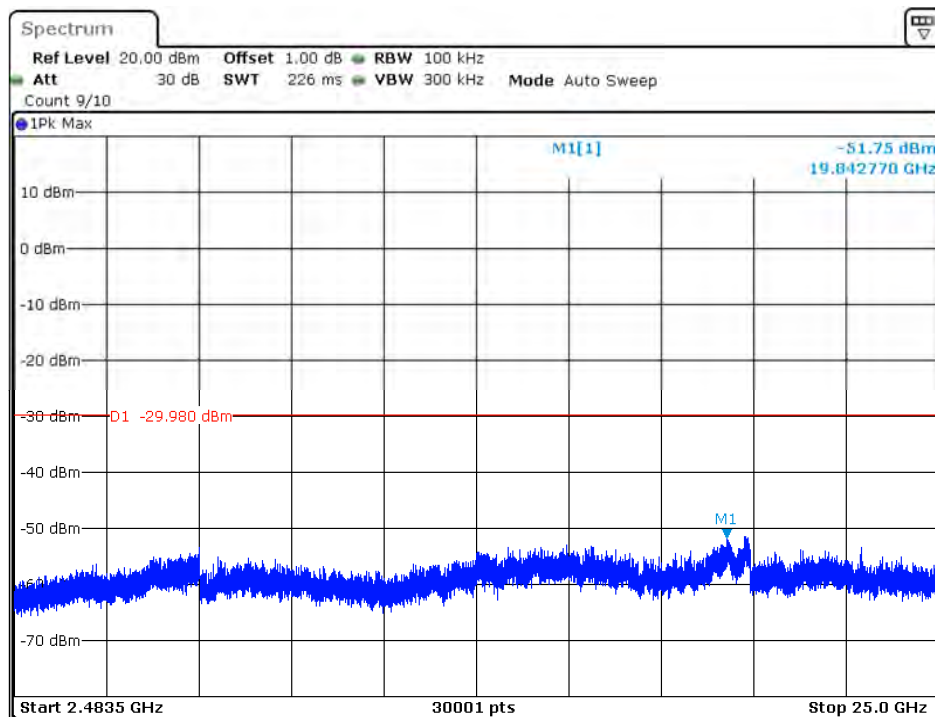
Channel 06 (2437MHz) Reference Level: -9.98dBm



Date: 29.OCT.2020 13:03:41

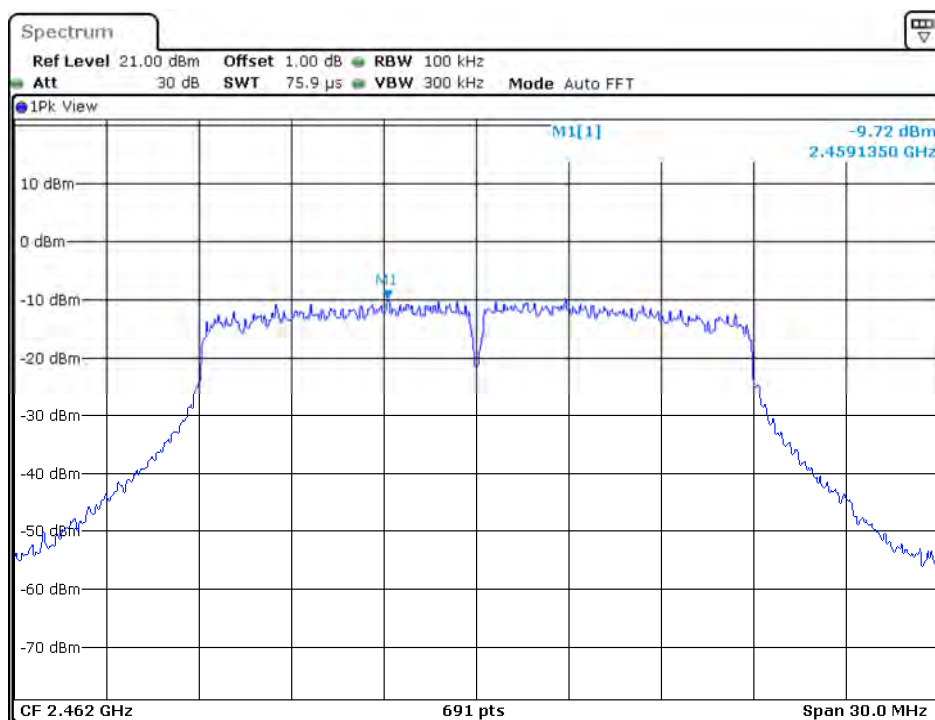


Date: 29.OCT.2020 13:03:46

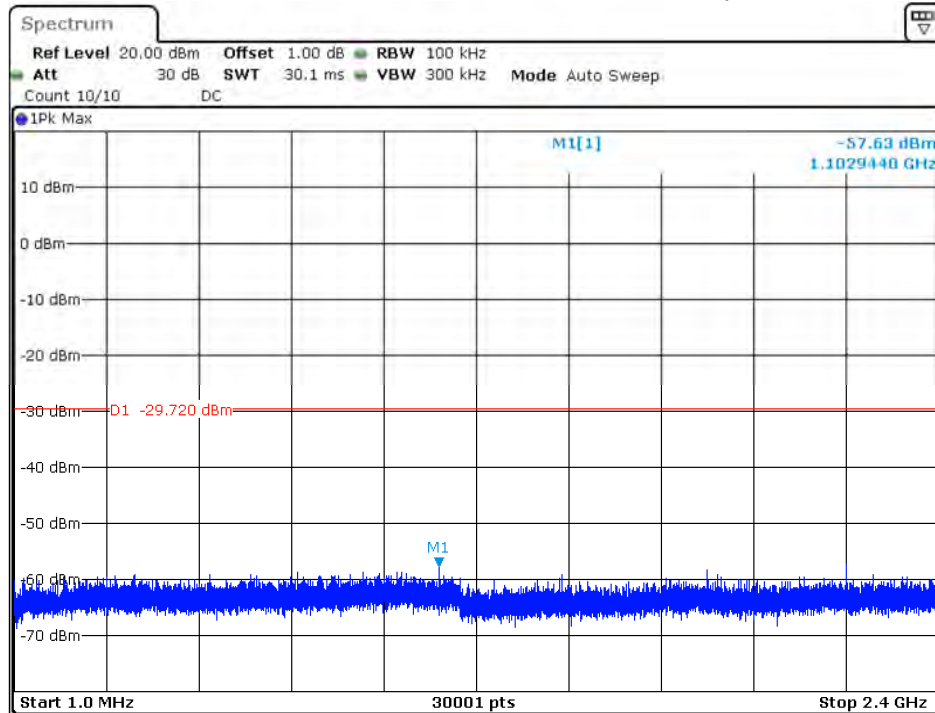


Date: 29.OCT.2020 13:03:53

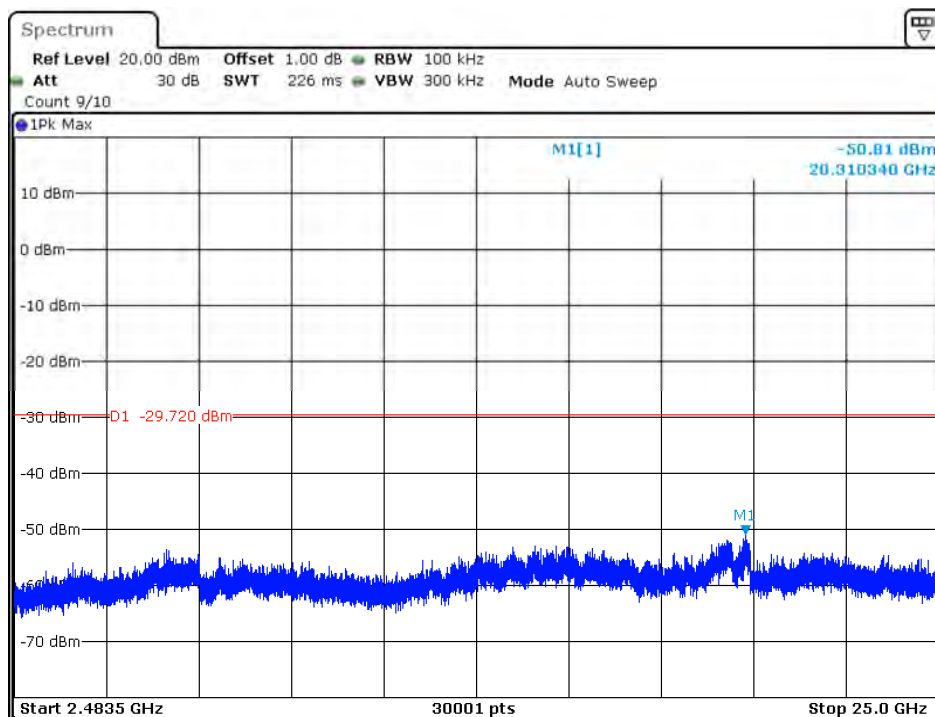
Channel 11 (2462MHz) Reference Level: -9.72dBm



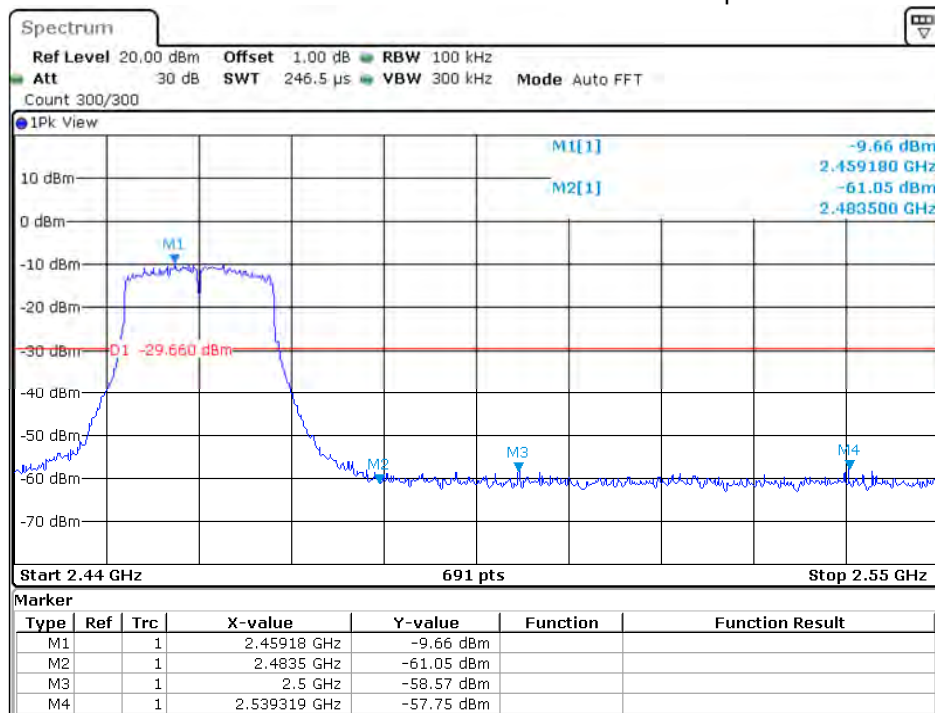
Date: 29.OCT.2020 13:06:58



Date: 29.OCT.2020 13:07:03



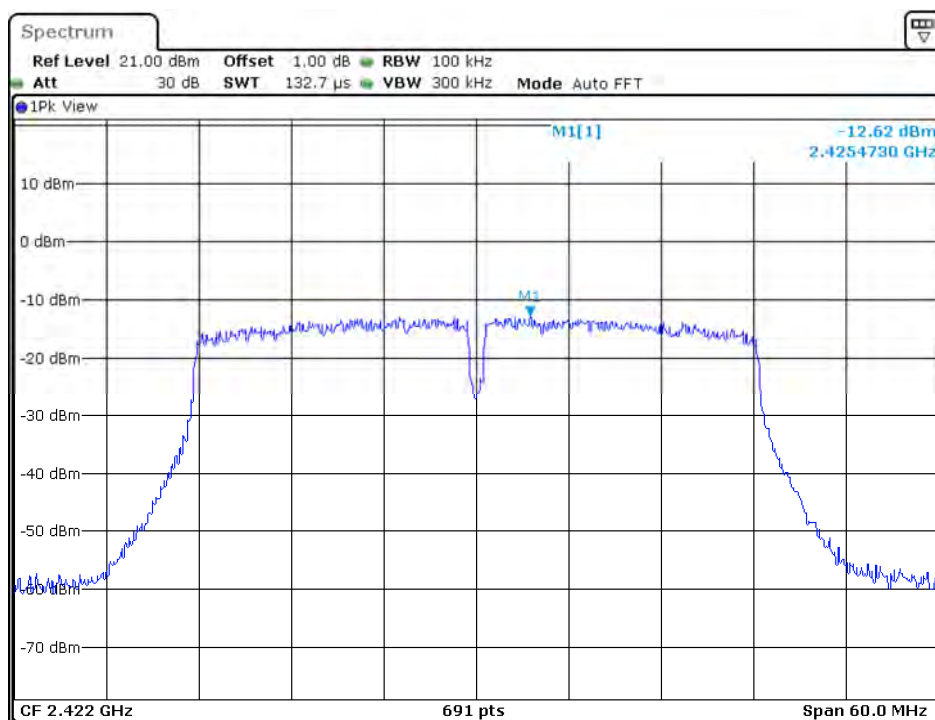
Date: 29.OCT.2020 13:07:10



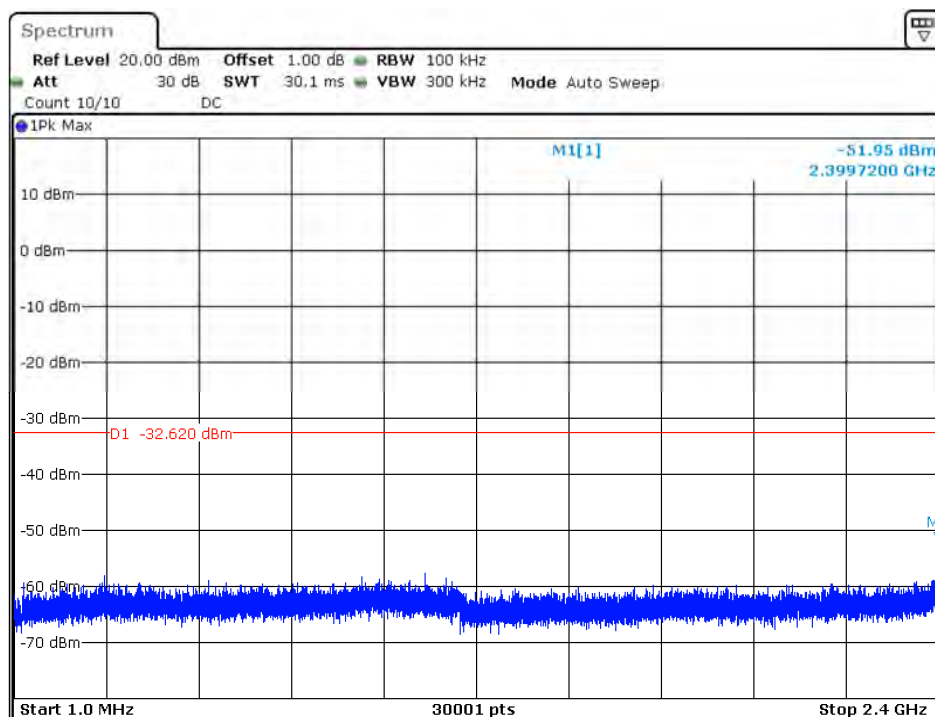
Date: 29.OCT.2020 13:06:47

802.11n-HT40

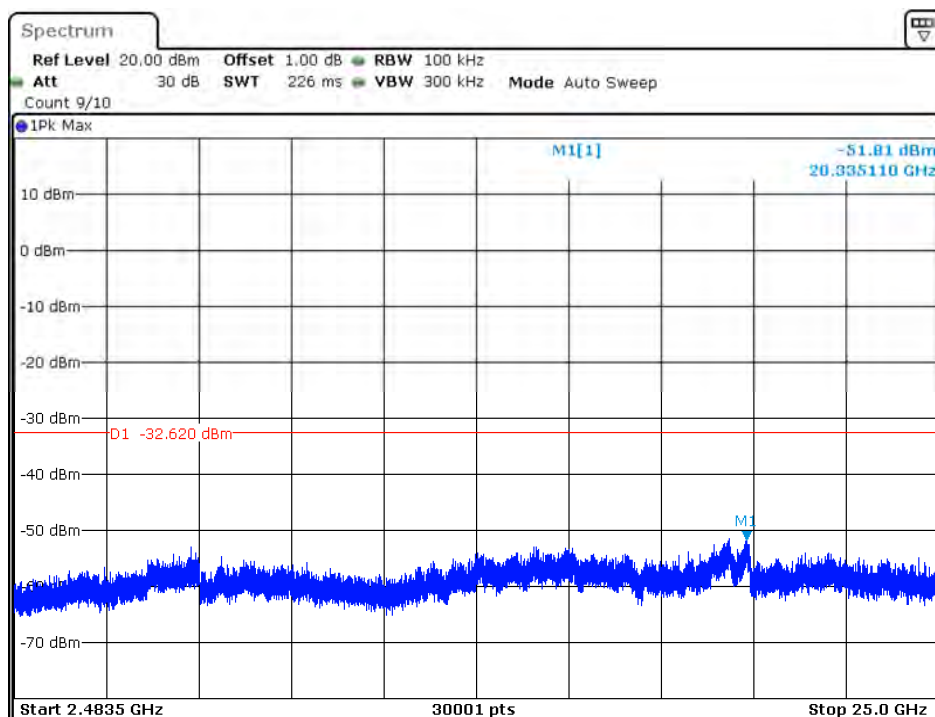
Channel 01 (2422MHz) Reference Level: -12.62dBm



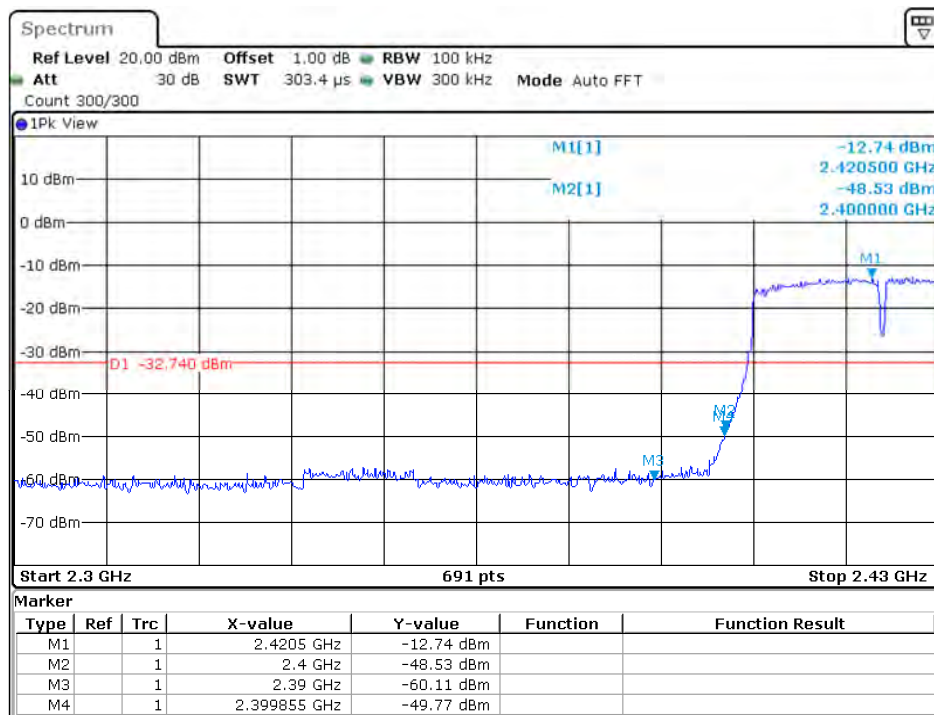
Date: 29.OCT.2020 13:10:08



Date: 29.OCT.2020 13:10:13

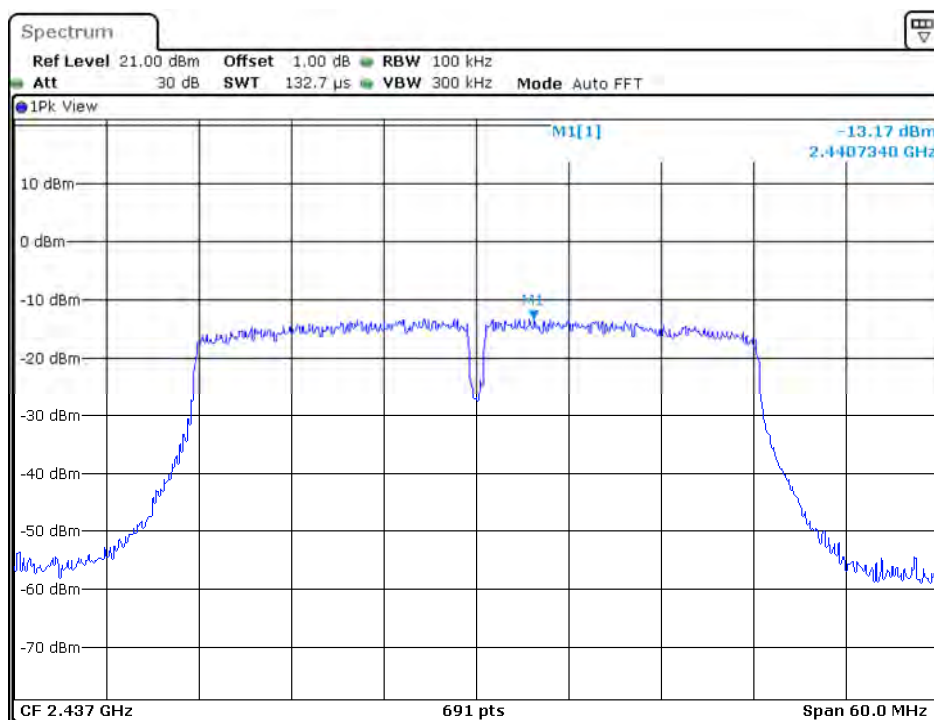


Date: 29.OCT.2020 13:10:20

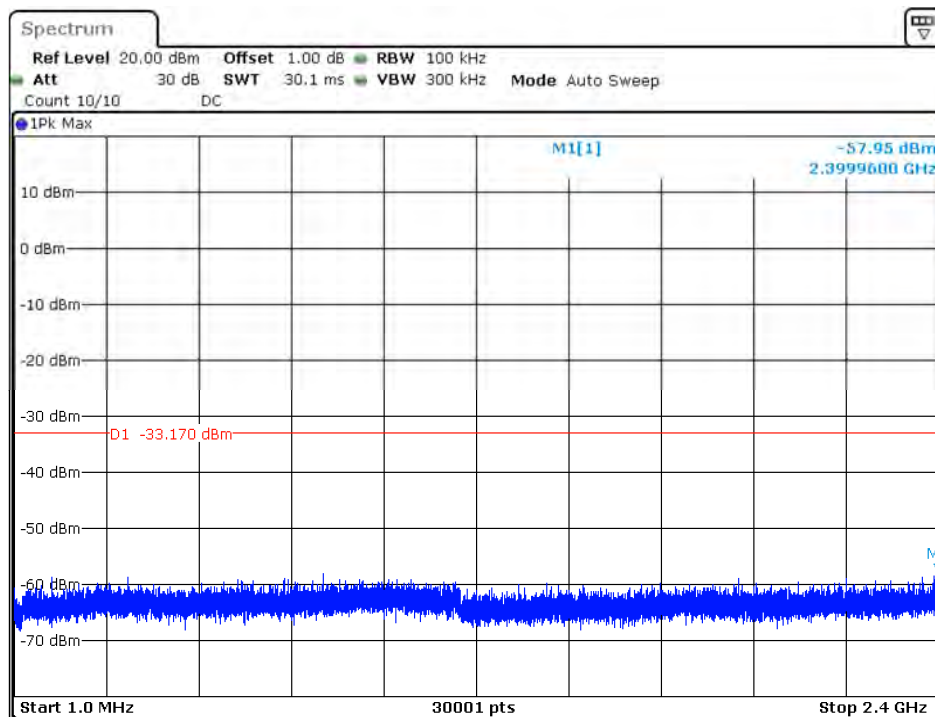


Date: 29.OCT.2020 13:09:17

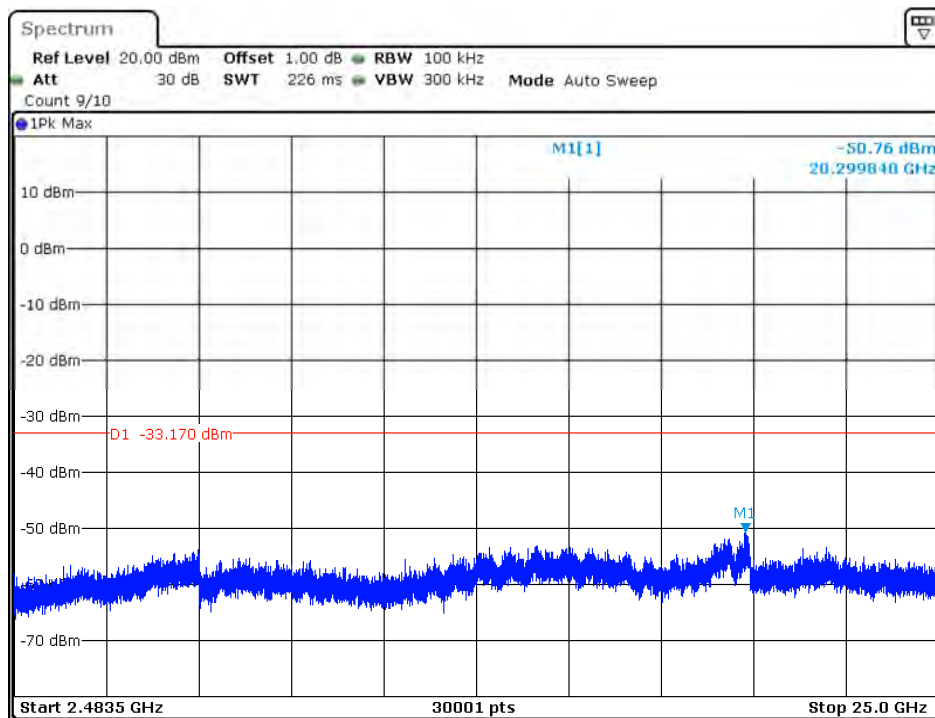
Channel 06 (2437MHz) Reference Level: -13.17dBm



Date: 29.OCT.2020 13:12:12

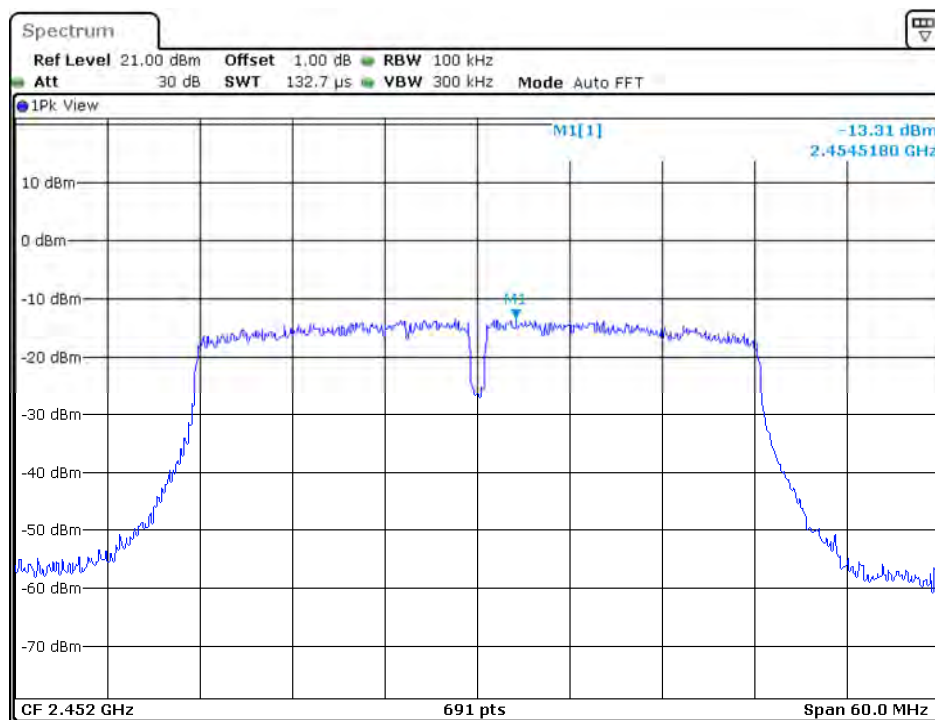


Date: 29.OCT.2020 13:12:17

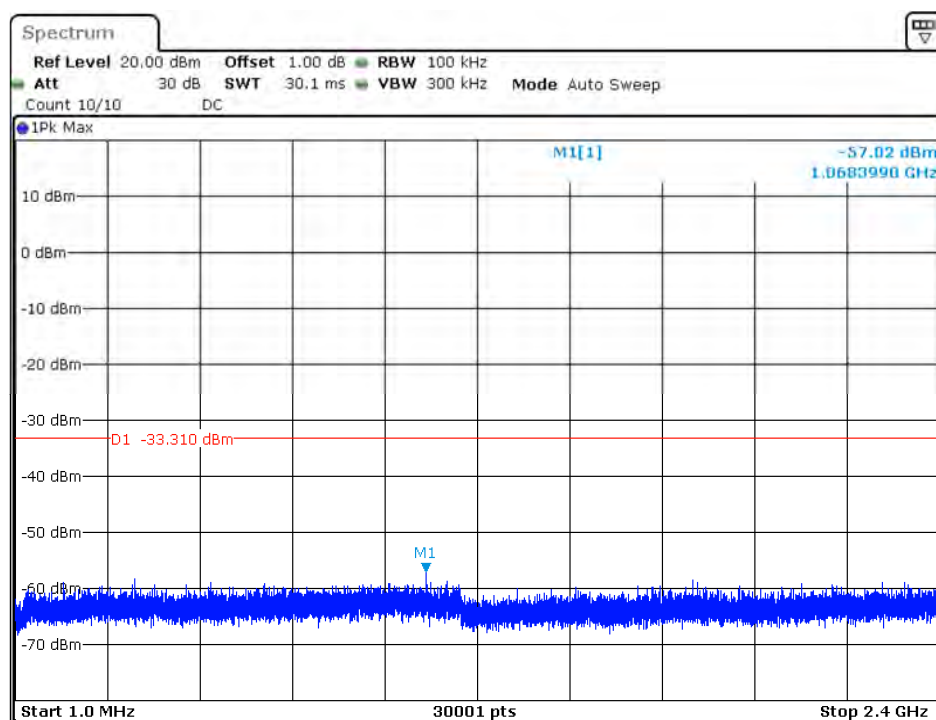


Date: 29.OCT.2020 13:12:24

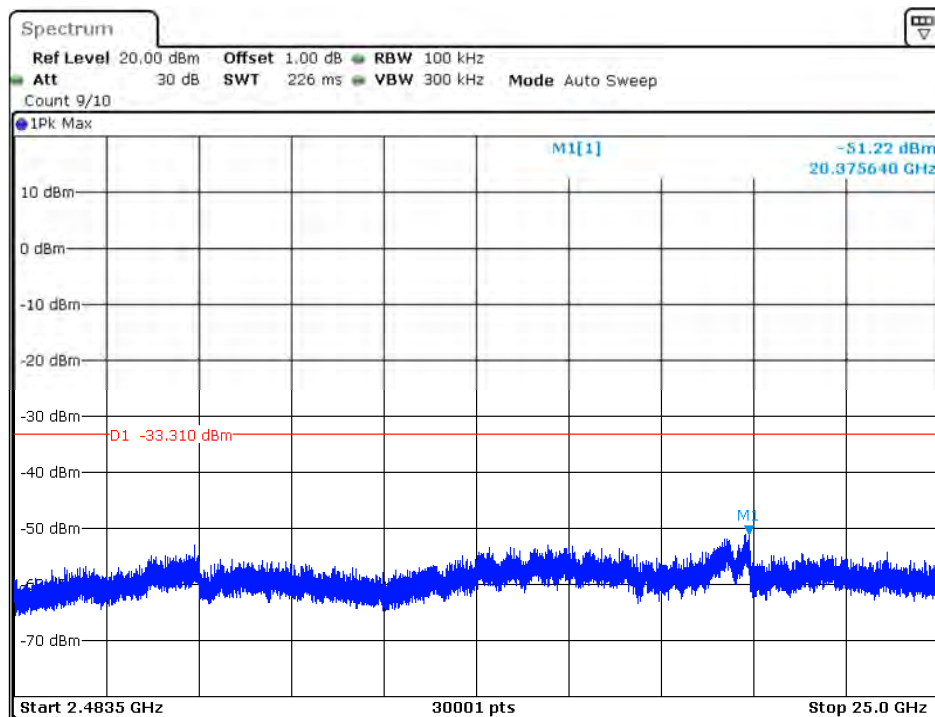
Channel 11 (2452MHz) Reference Level: -13.31dBm



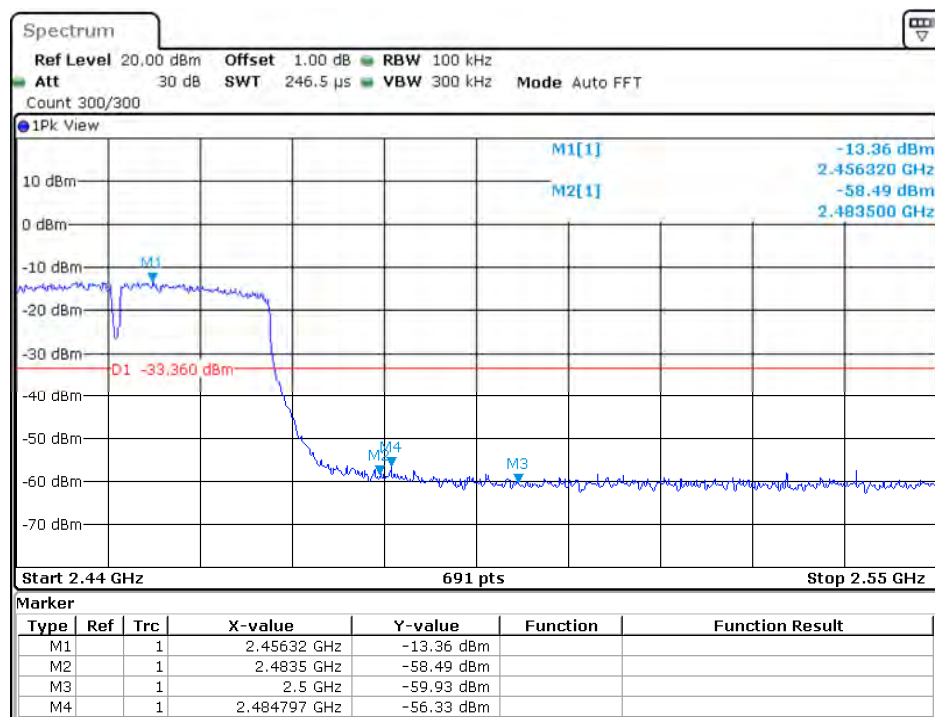
Date: 29.OCT.2020 13:14:34



Date: 29.OCT.2020 13:14:39



Date: 29.OCT.2020 13:14:46

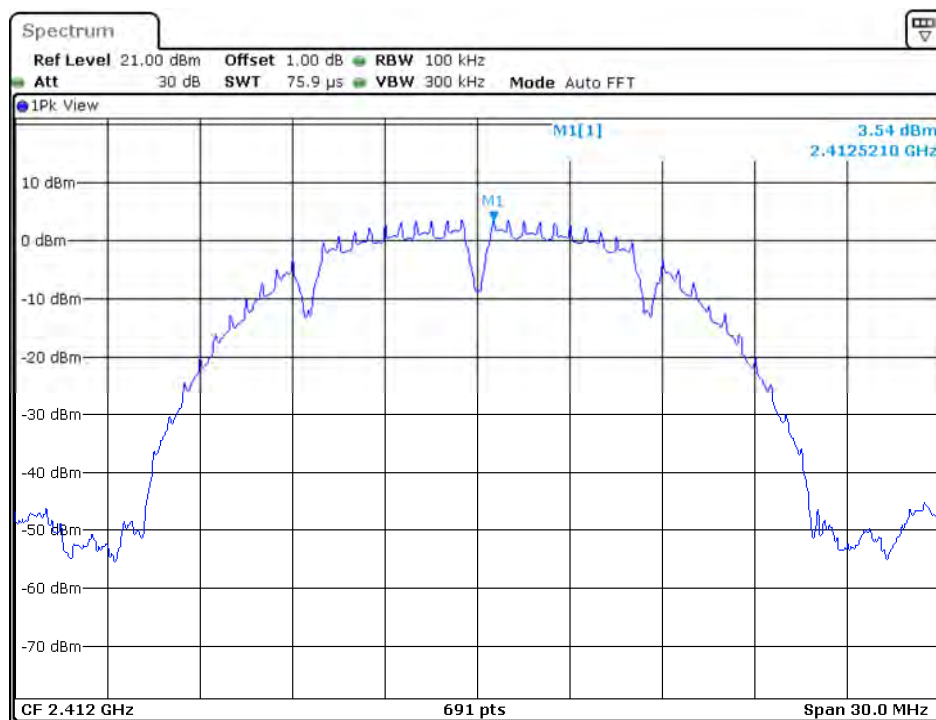


Date: 29.OCT.2020 13:14:22

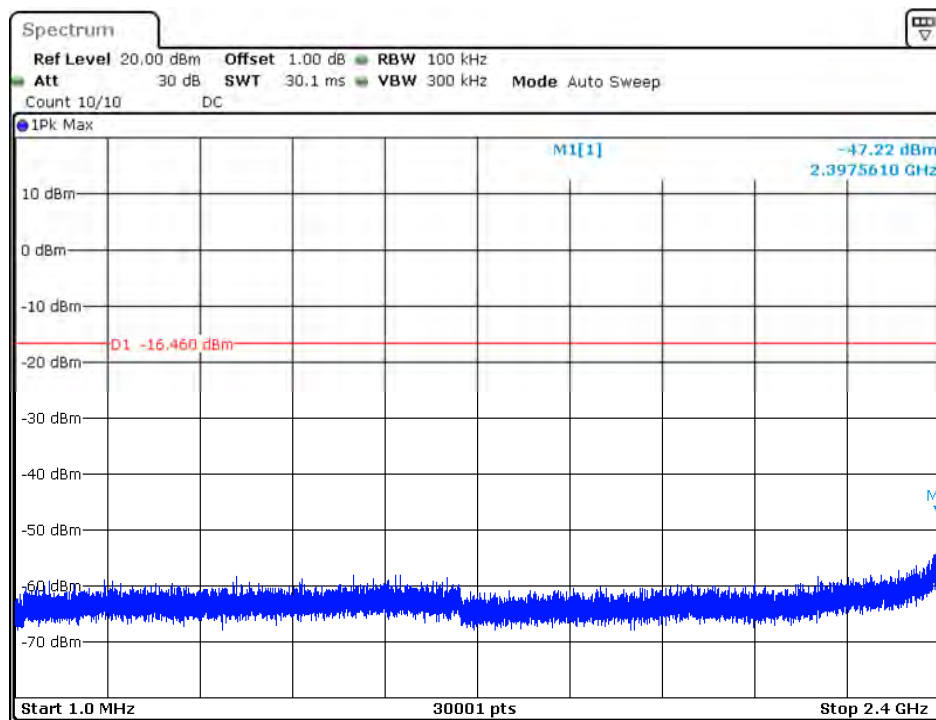
SISO Mode, Ant2

802.11b

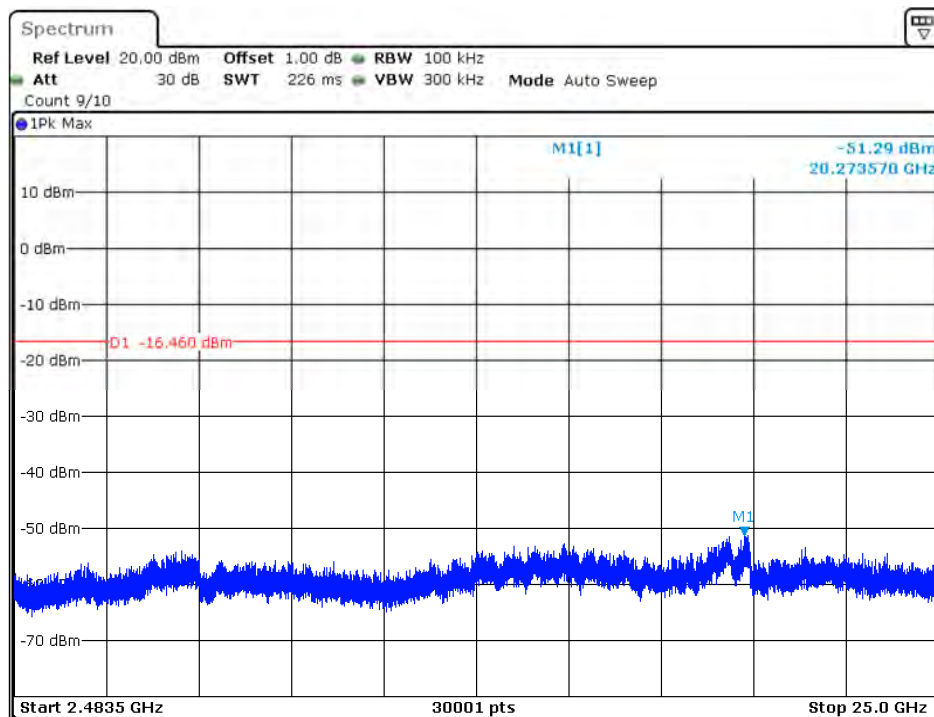
Channel 01 (2412MHz) Reference Level: 3.54dBm



Date: 29.OCT.2020 13:18:57



Date: 29.OCT.2020 13:19:03

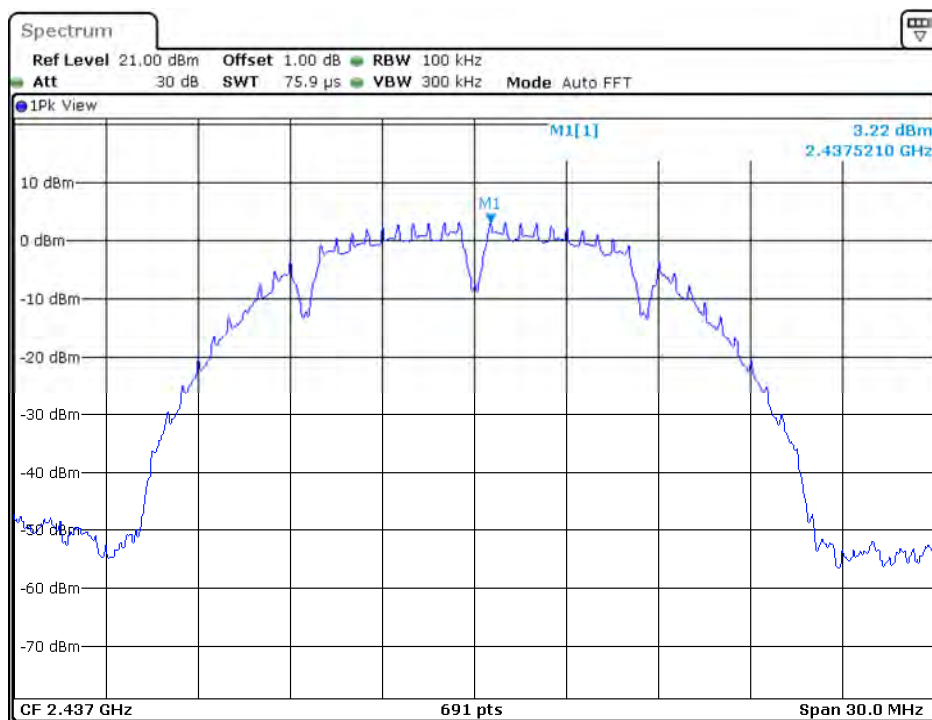


Date: 29.OCT.2020 13:19:10

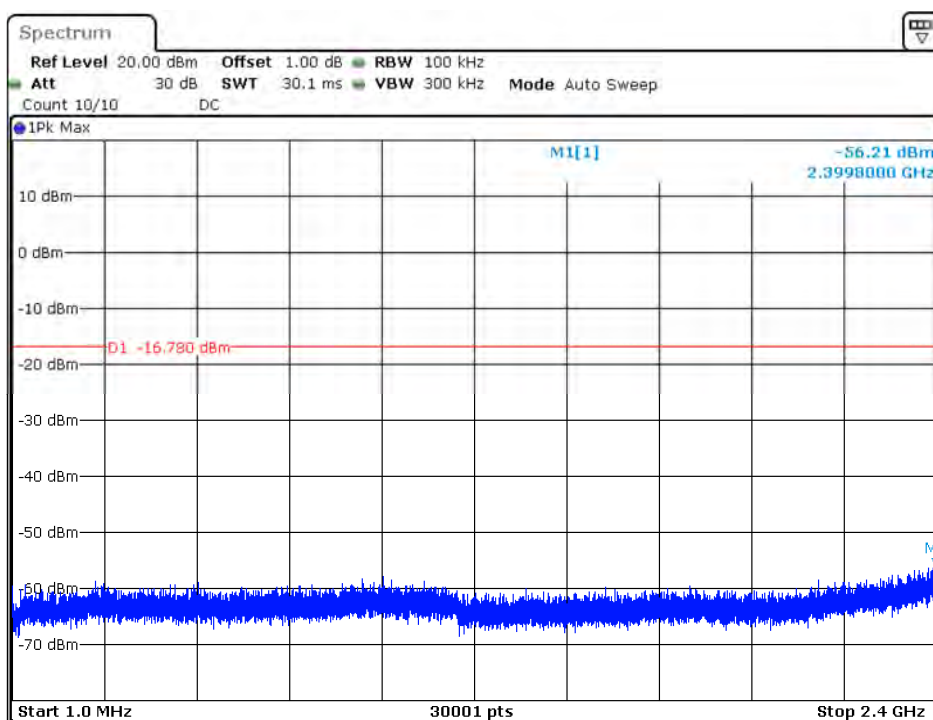


Date: 29.OCT.2020 13:18:46

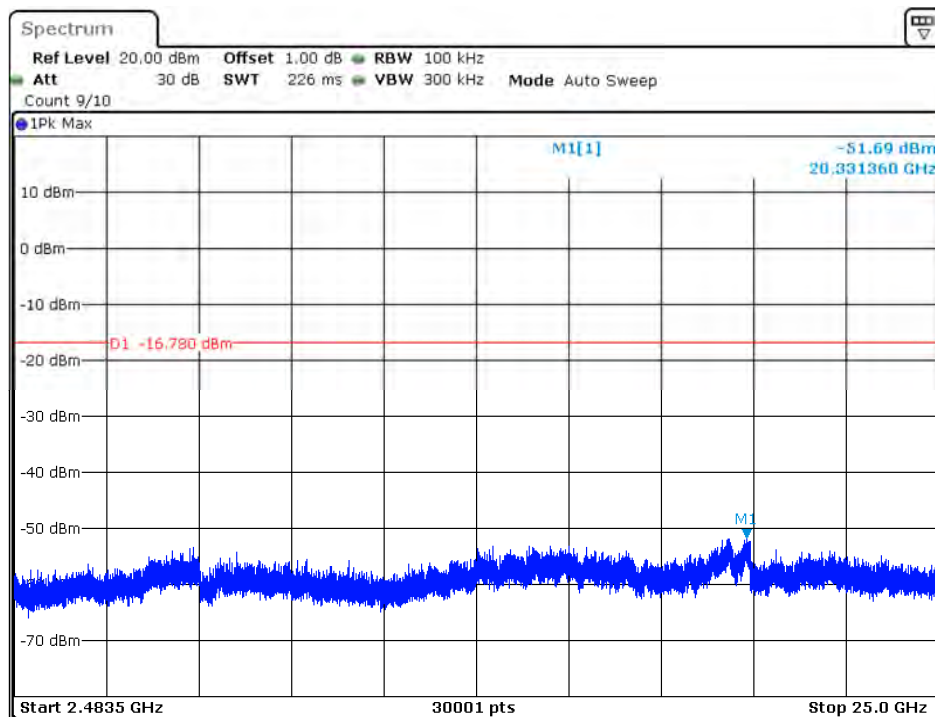
Channel 06 (2437MHz) Reference Level: 3.22dBm



Date: 29.OCT.2020 13:22:40

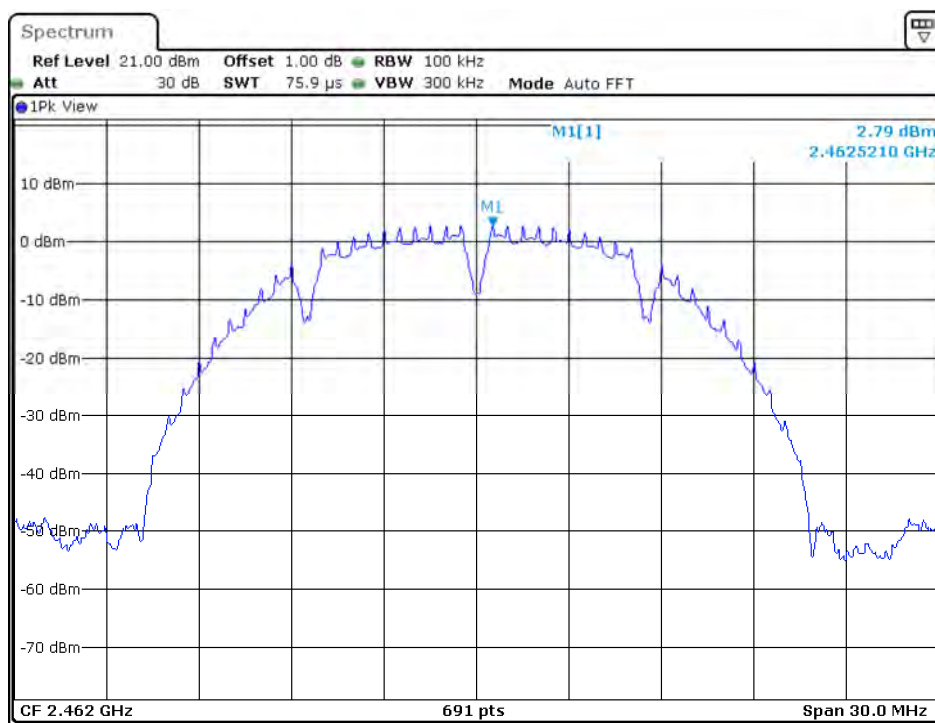


Date: 29.OCT.2020 13:22:46

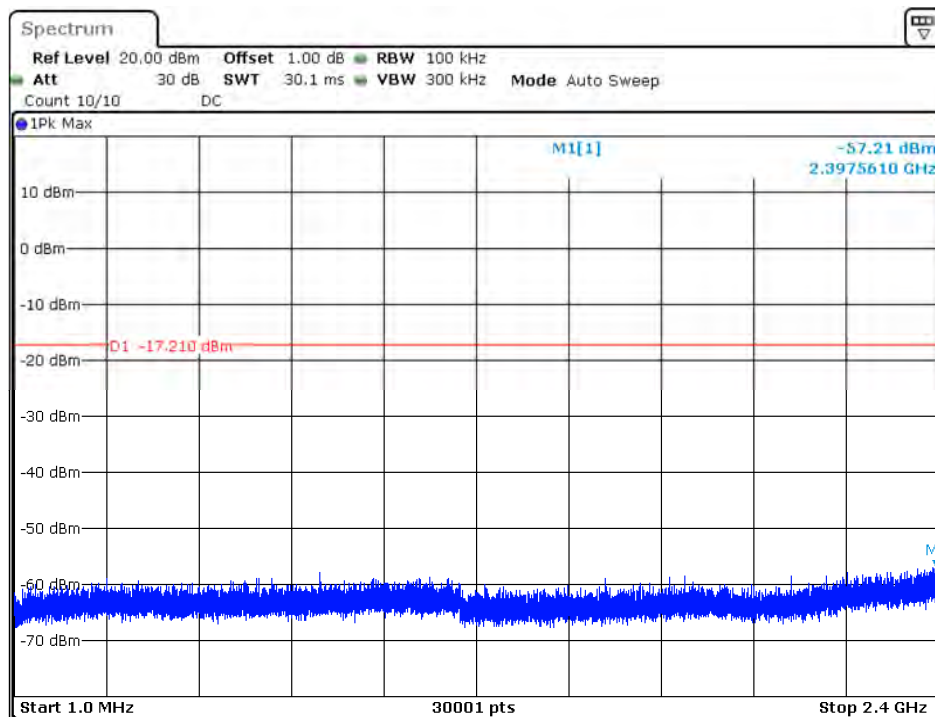


Date: 29.OCT.2020 13:22:53

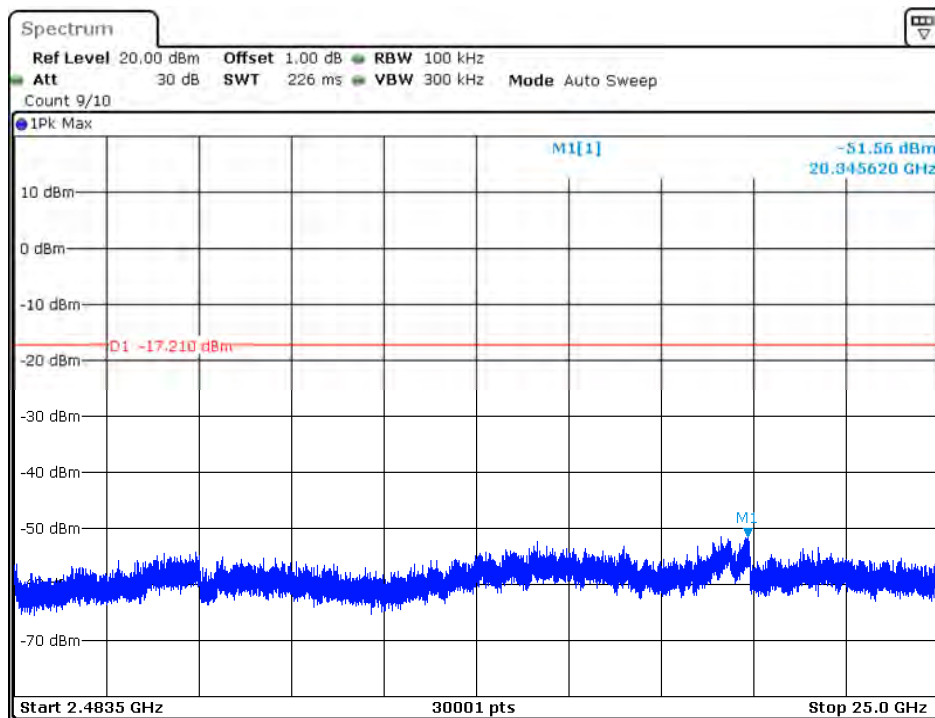
Channel 11 (2462MHz) Reference Level: 2.79dBm



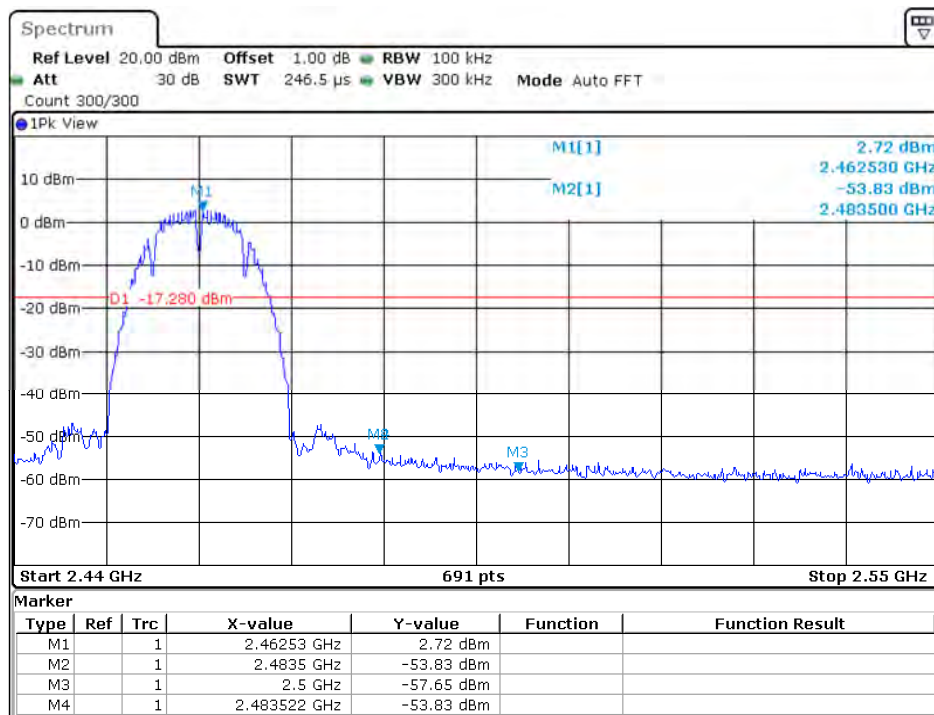
Date: 29.OCT.2020 13:24:48



Date: 29.OCT.2020 13:24:53



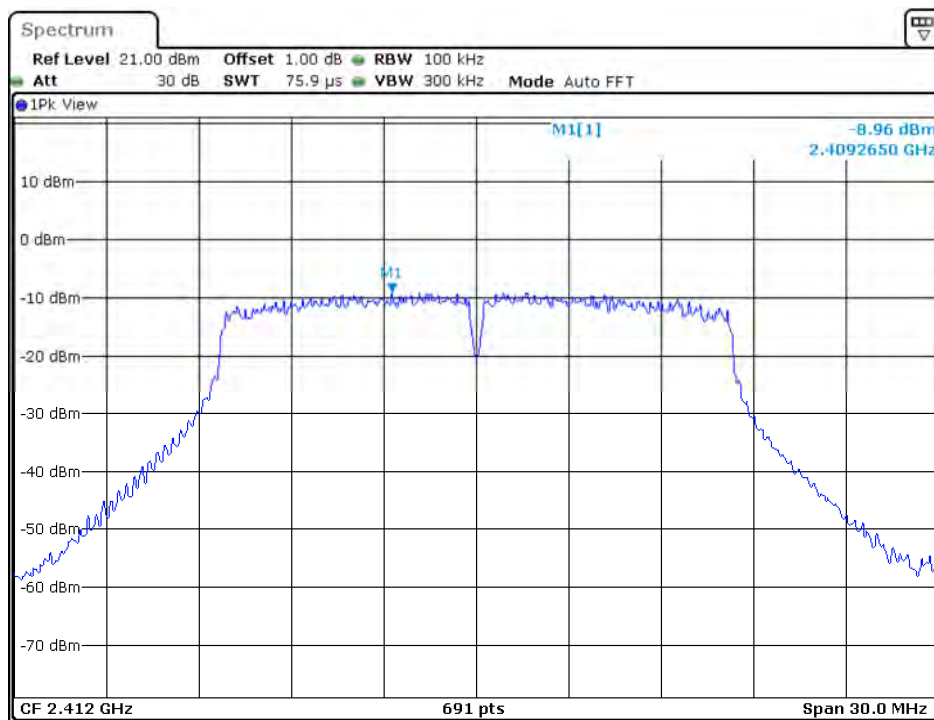
Date: 29.OCT.2020 13:25:00



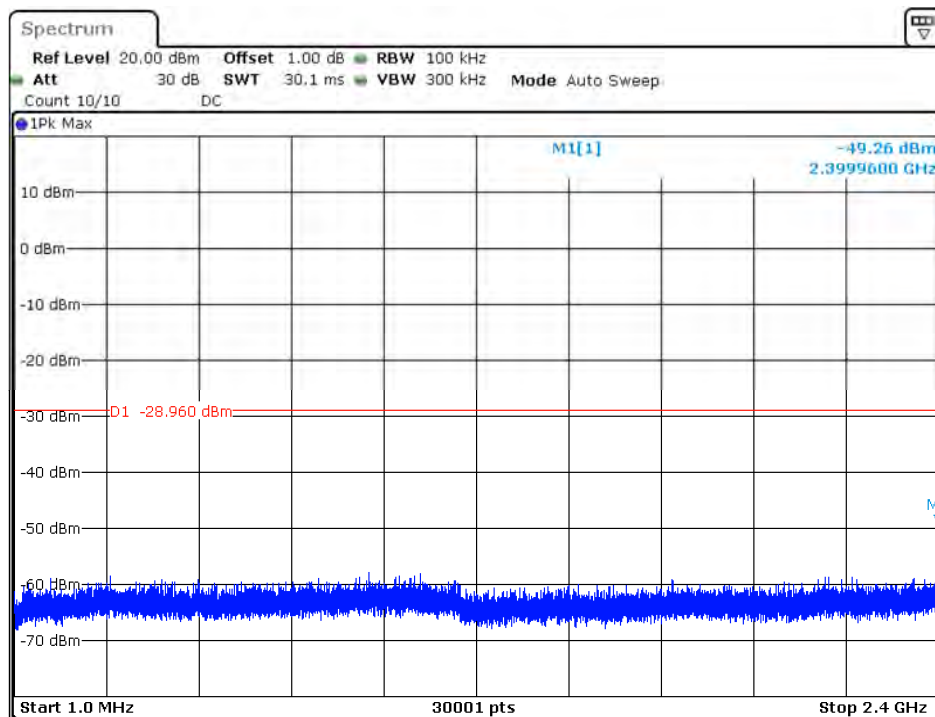
Date: 29.OCT.2020 13:24:36

802.11g

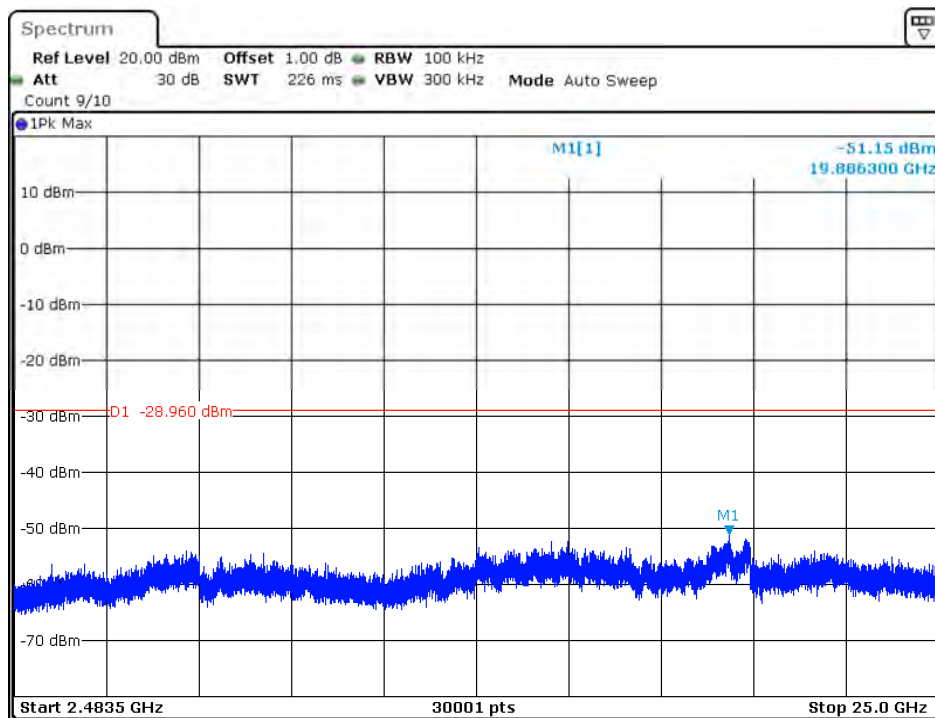
Channel 01 (2412MHz) Reference Level: -8.96dBm



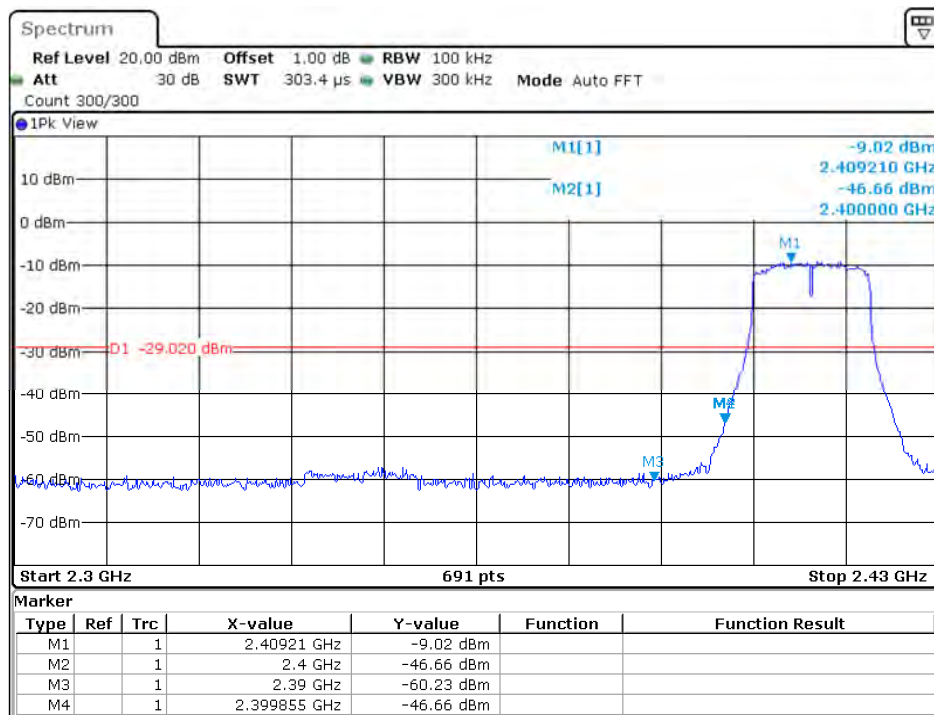
Date: 29.OCT.2020 13:27:12



Date: 29.OCT.2020 13:27:17

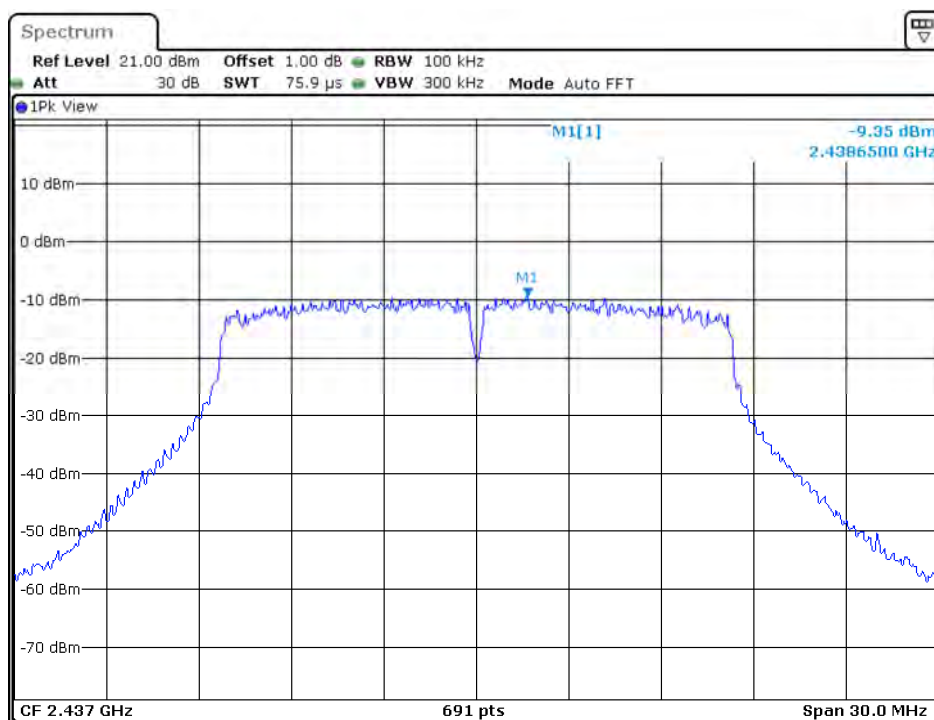


Date: 29.OCT.2020 13:27:24

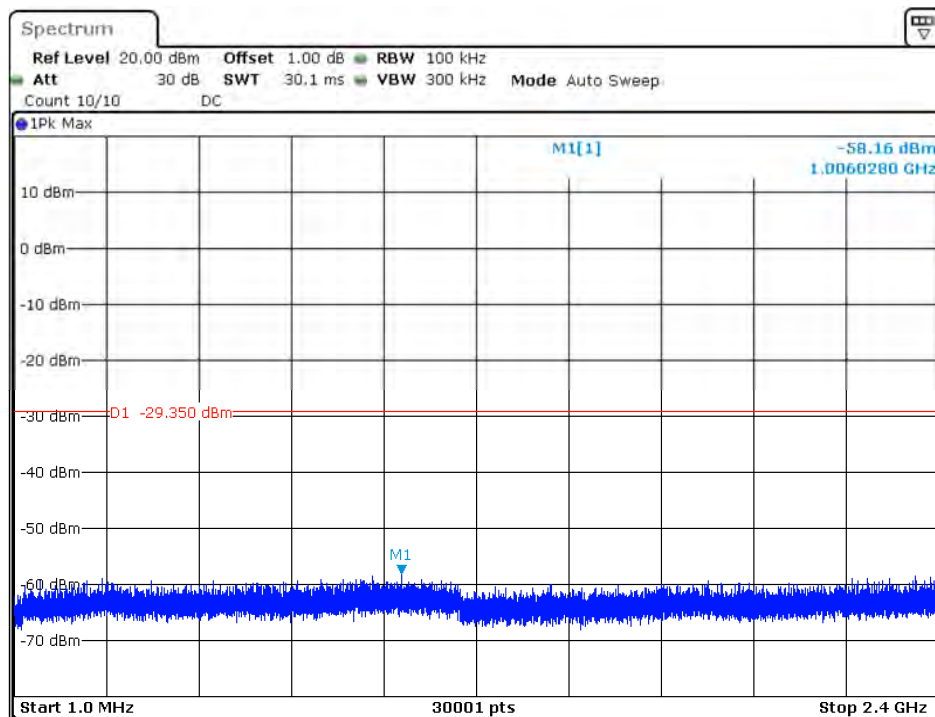


Date: 29.OCT.2020 13:26:39

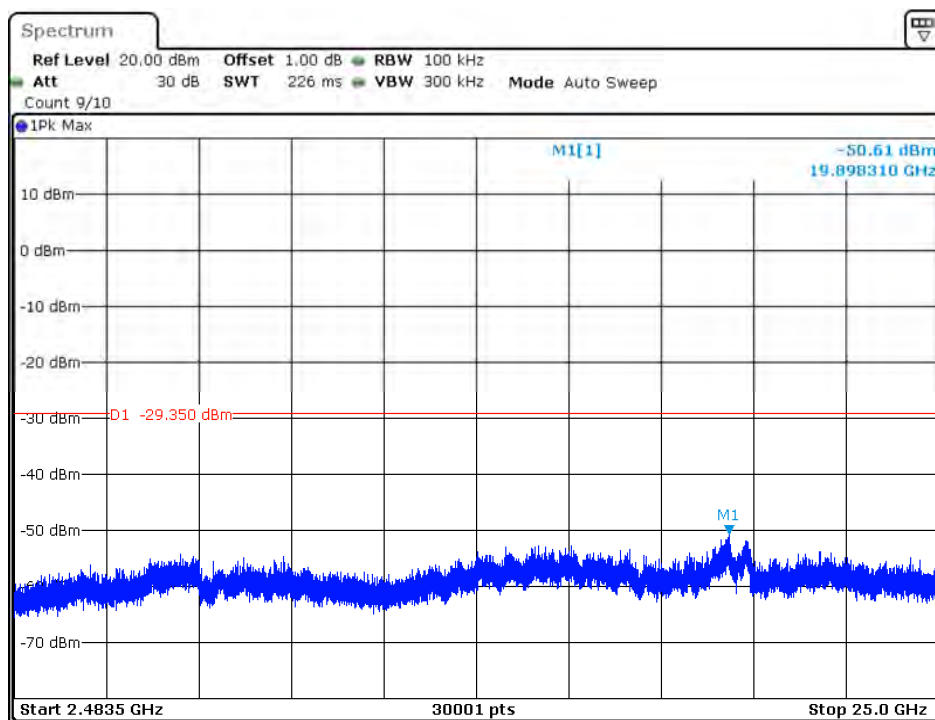
Channel 06 (2437MHz) Reference Level: -9.35dBm



Date: 29.OCT.2020 13:28:47

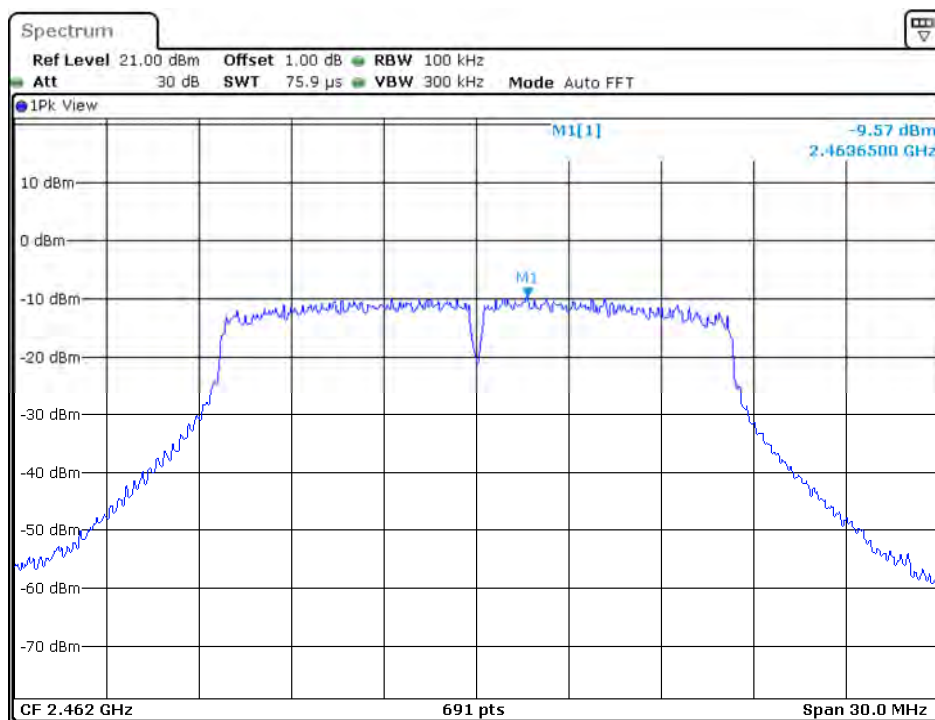


Date: 29.OCT.2020 13:28:52

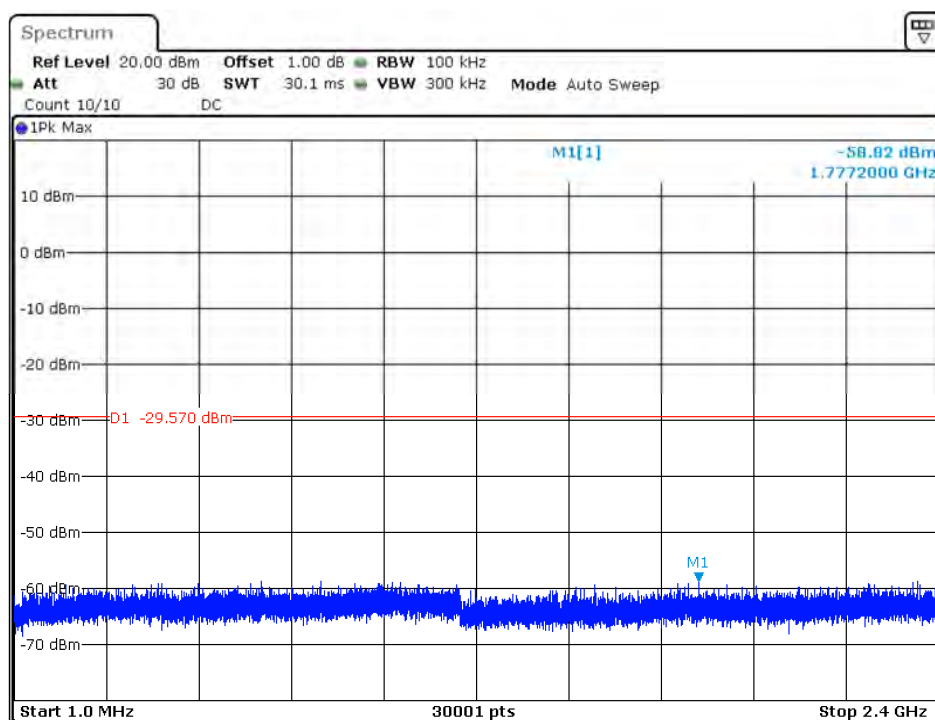


Date: 29.OCT.2020 13:28:59

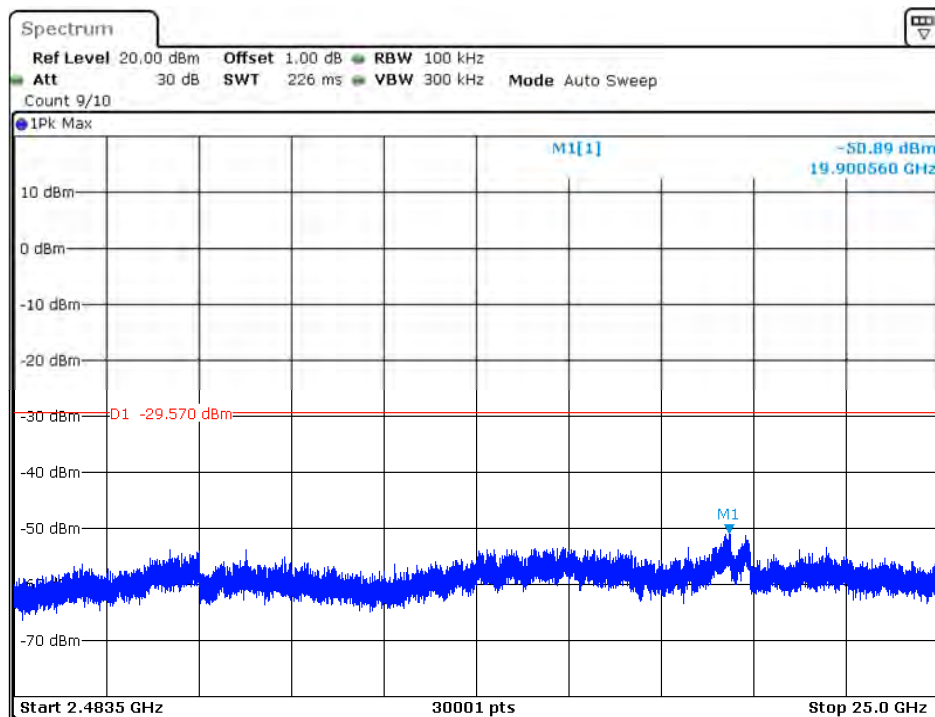
Channel 11 (2462MHz) Reference Level: -9.57dBm



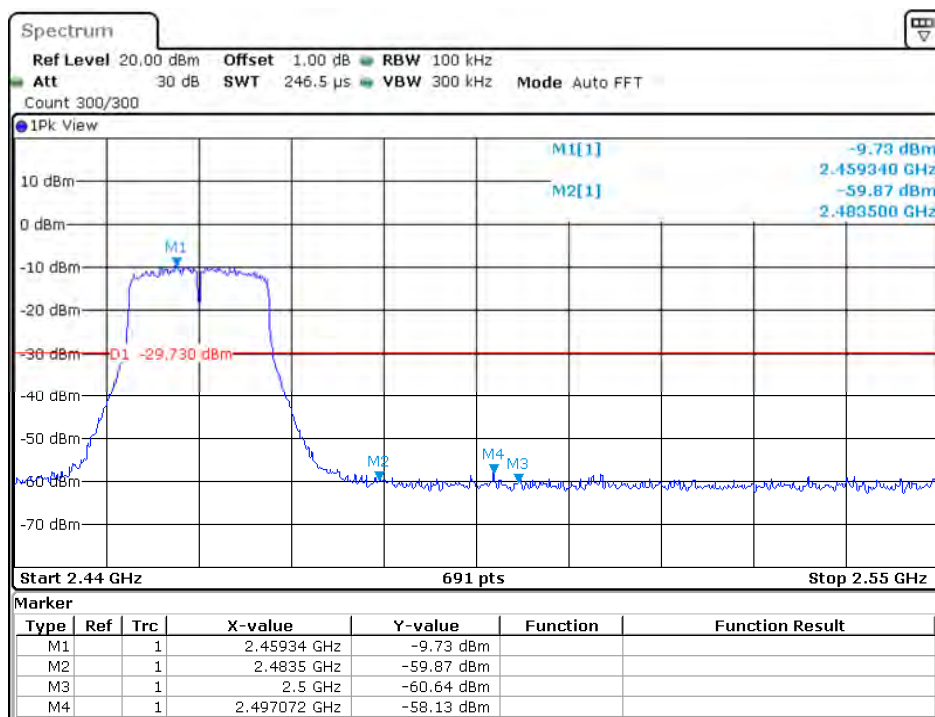
Date: 29.OCT.2020 13:30:46



Date: 29.OCT.2020 13:30:51



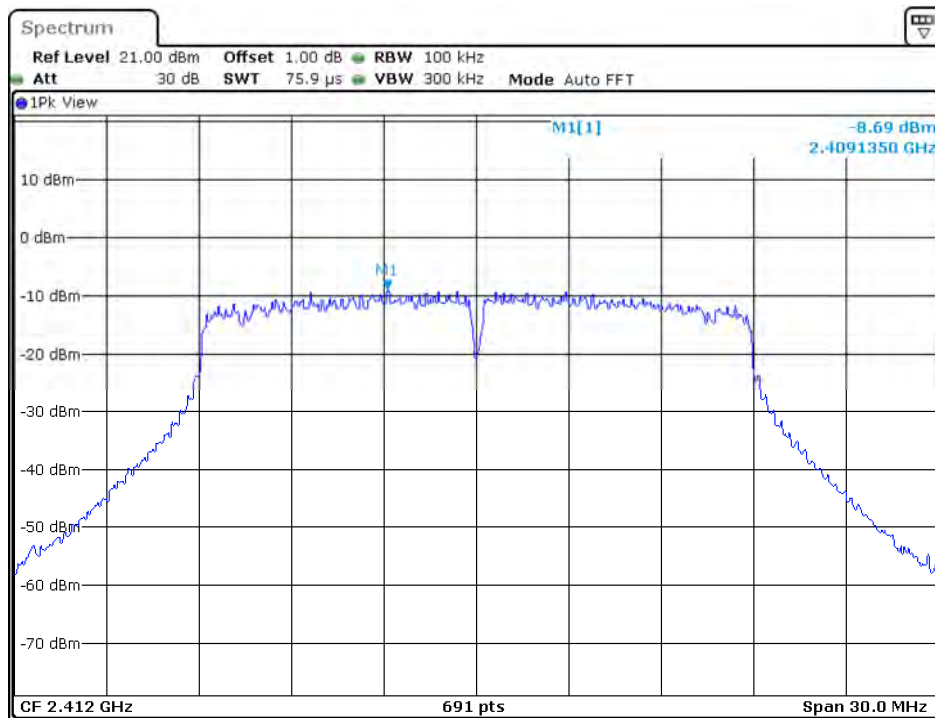
Date: 29.OCT.2020 13:30:58



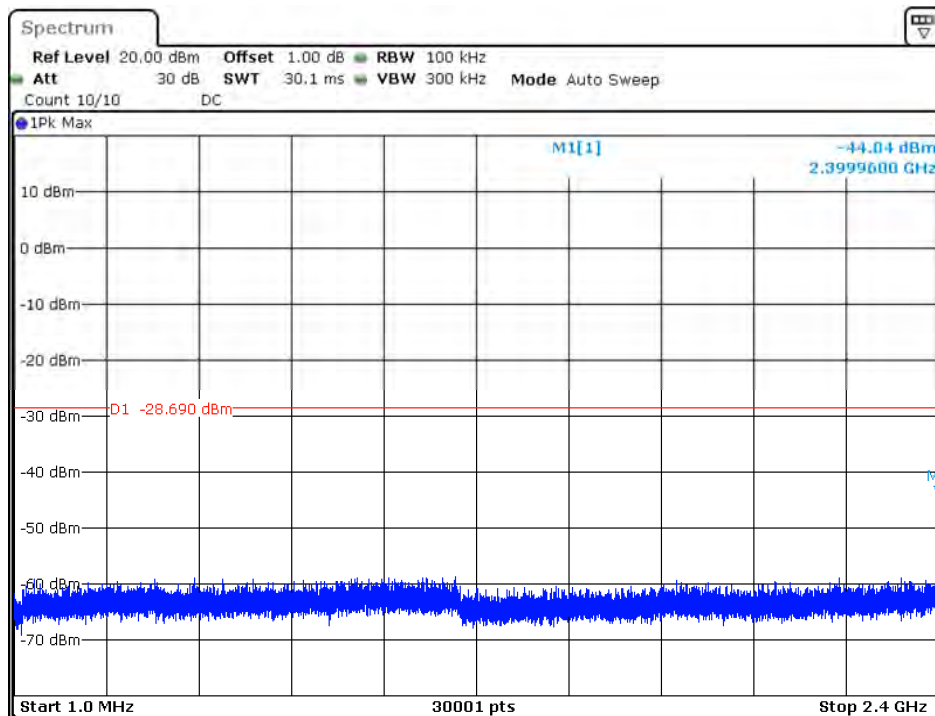
Date: 29.OCT.2020 13:30:35

802.11n-HT20

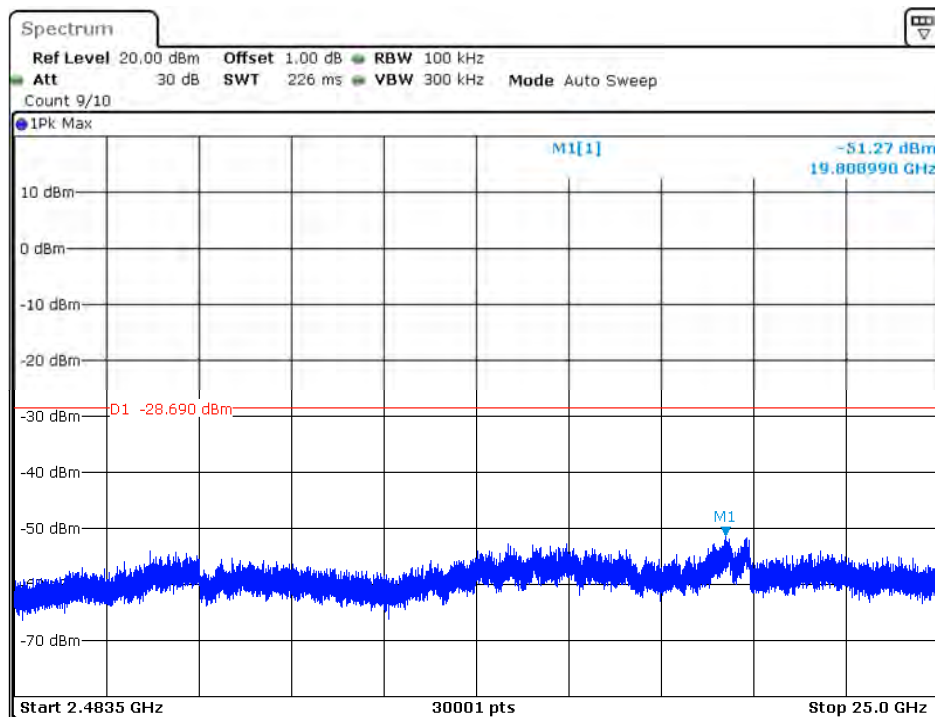
Channel 01 (2412MHz) Reference Level: -8.69dBm



Date: 29.OCT.2020 13:32:53



Date: 29.OCT.2020 13:32:58

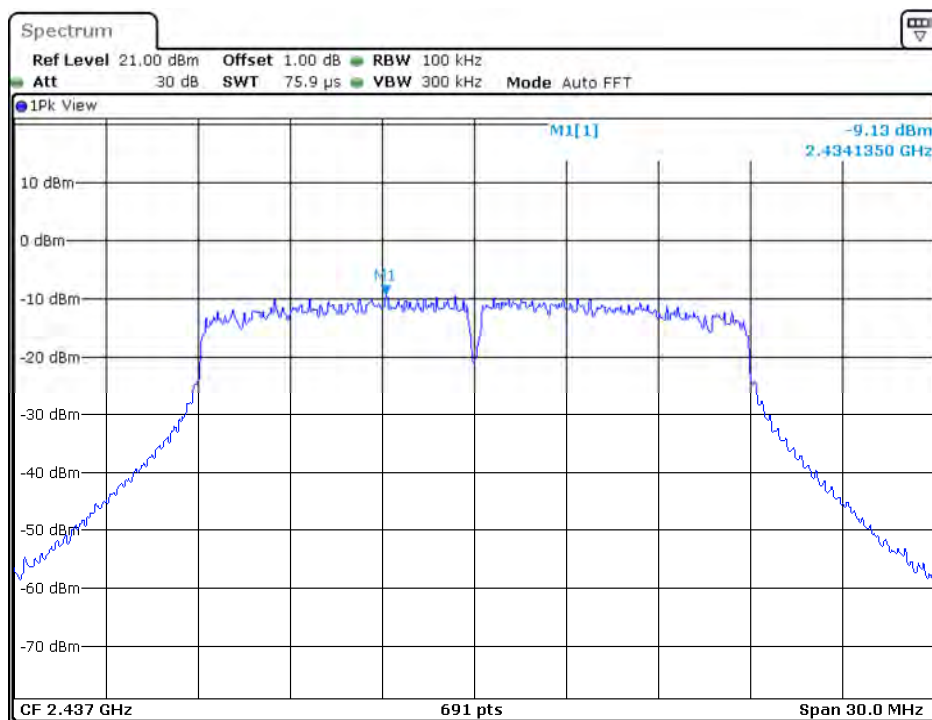


Date: 29.OCT.2020 13:33:05

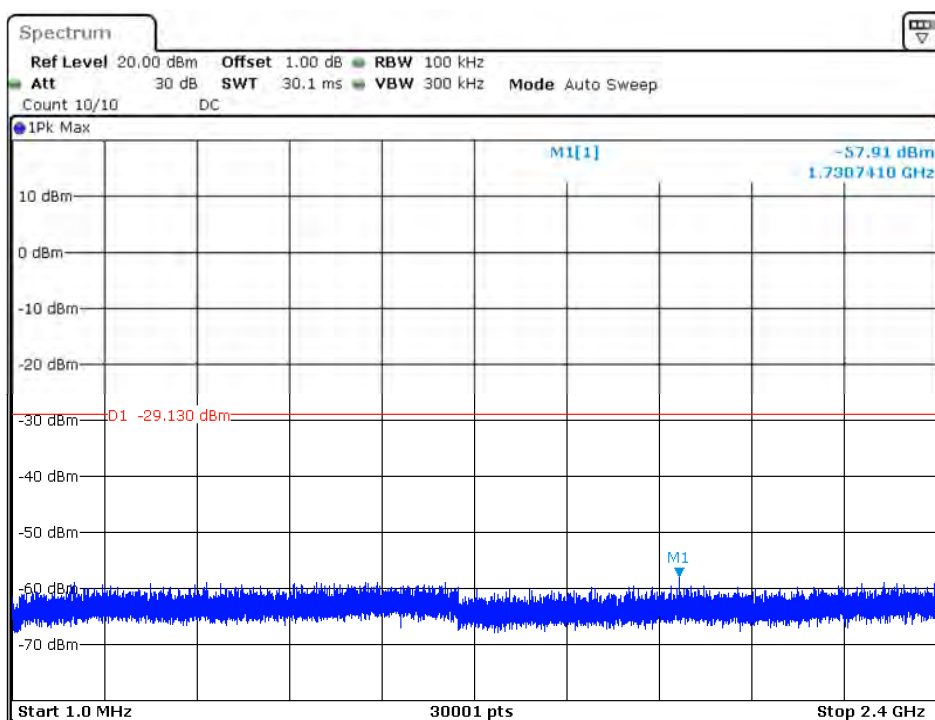


Date: 29.OCT.2020 13:32:39

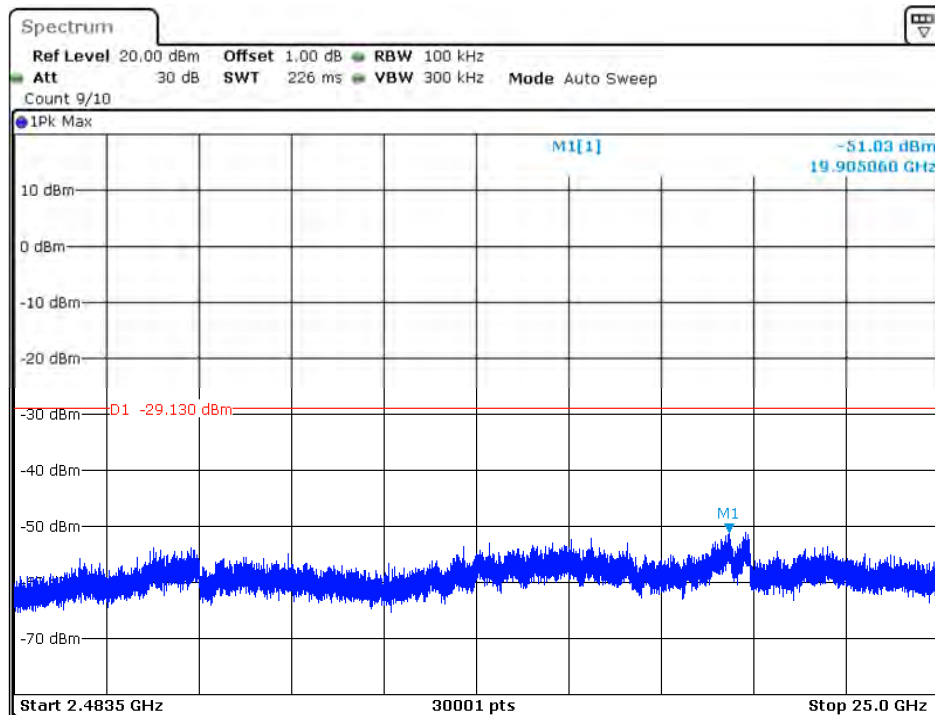
Channel 06 (2437MHz) Reference Level: -9.13dBm



Date: 29.OCT.2020 13:34:25

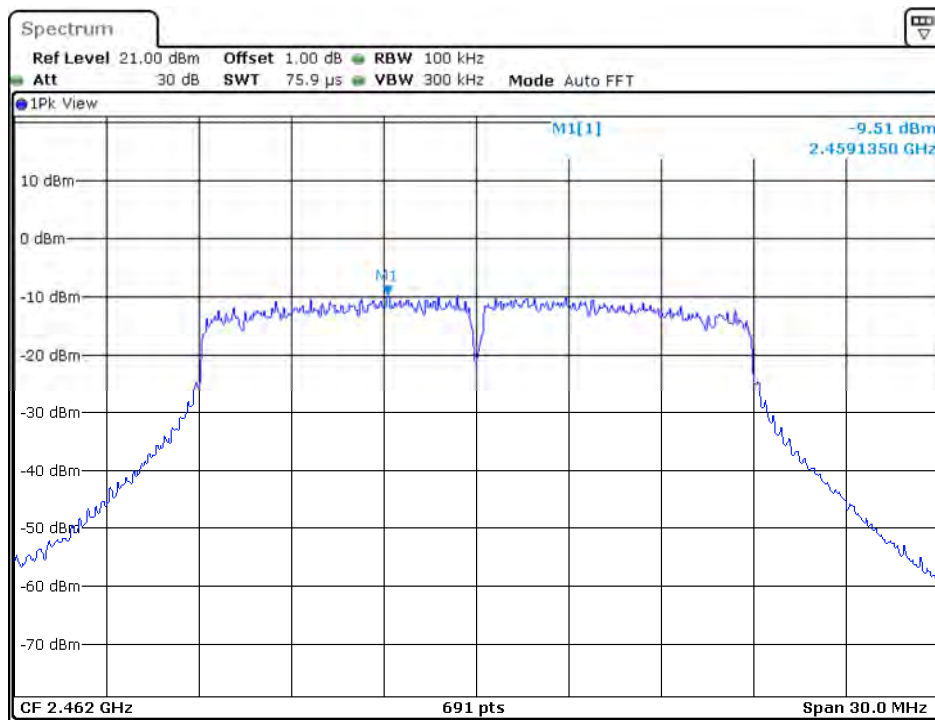


Date: 29.OCT.2020 13:34:30

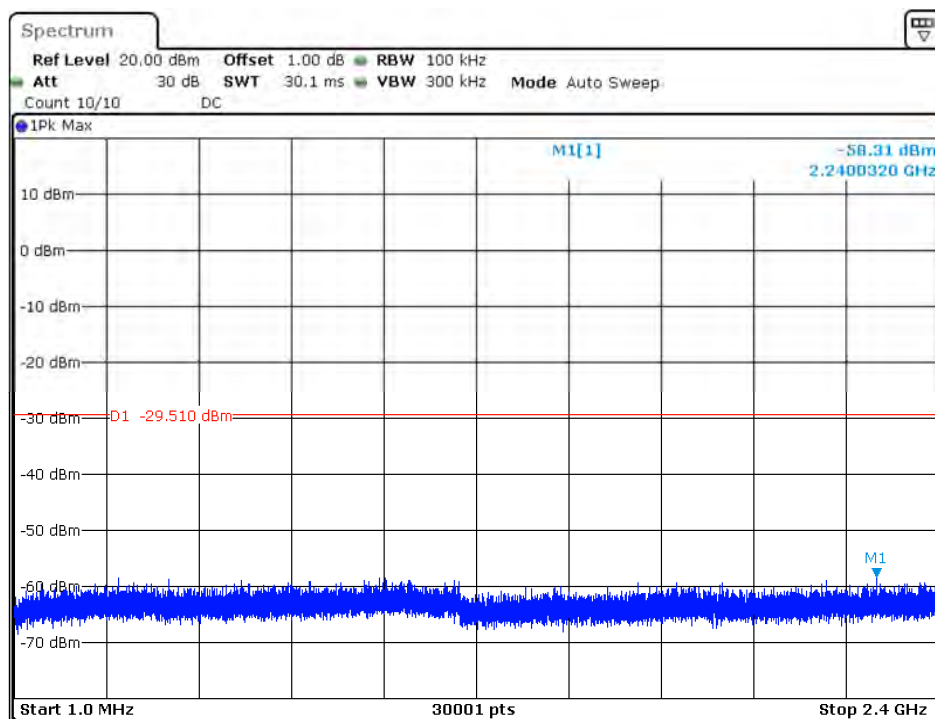


Date: 29.OCT.2020 13:34:38

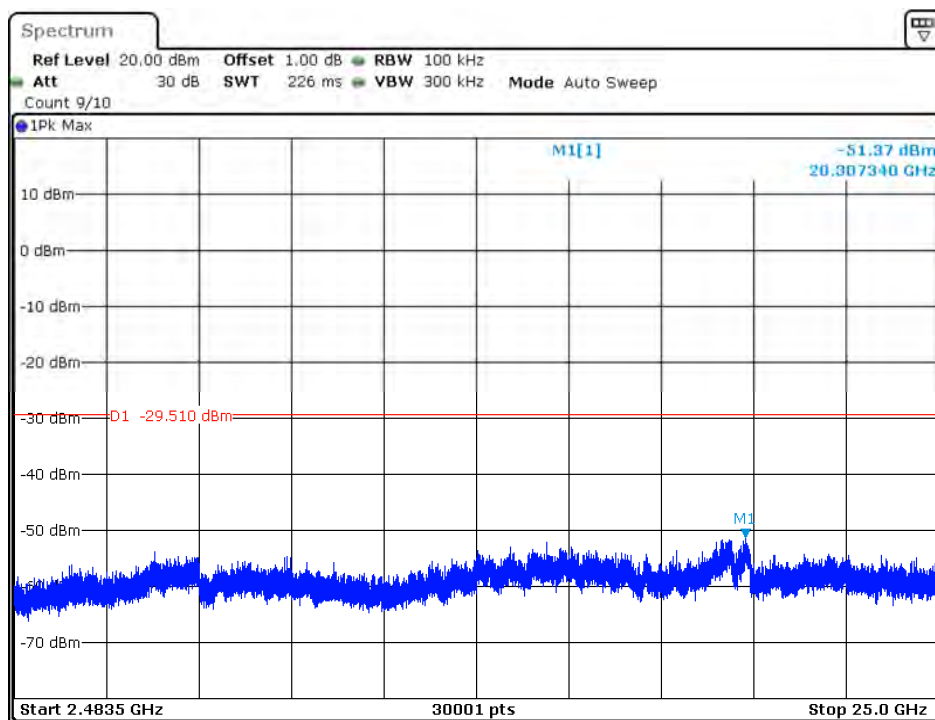
Channel 11 (2462MHz) Reference Level: -9.51dBm



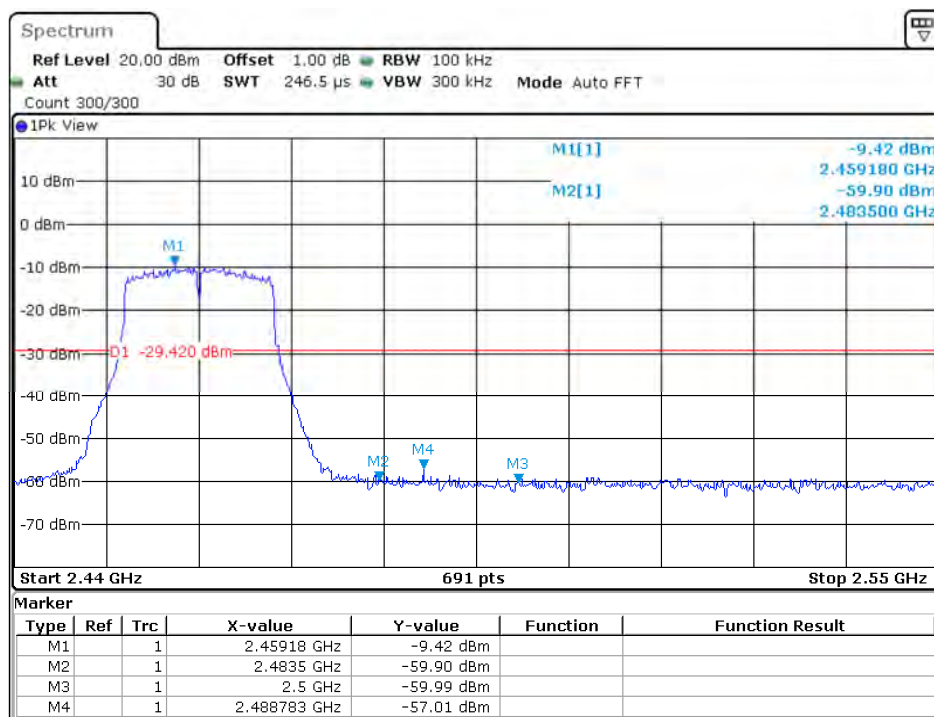
Date: 29.OCT.2020 13:36:16



Date: 29.OCT.2020 13:36:21



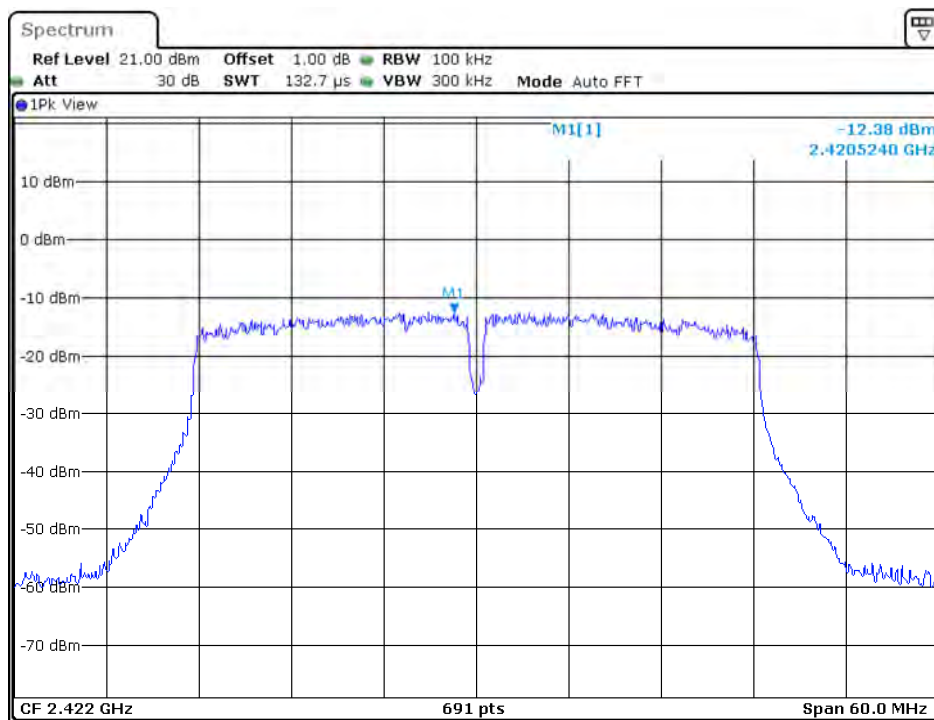
Date: 29.OCT.2020 13:36:28



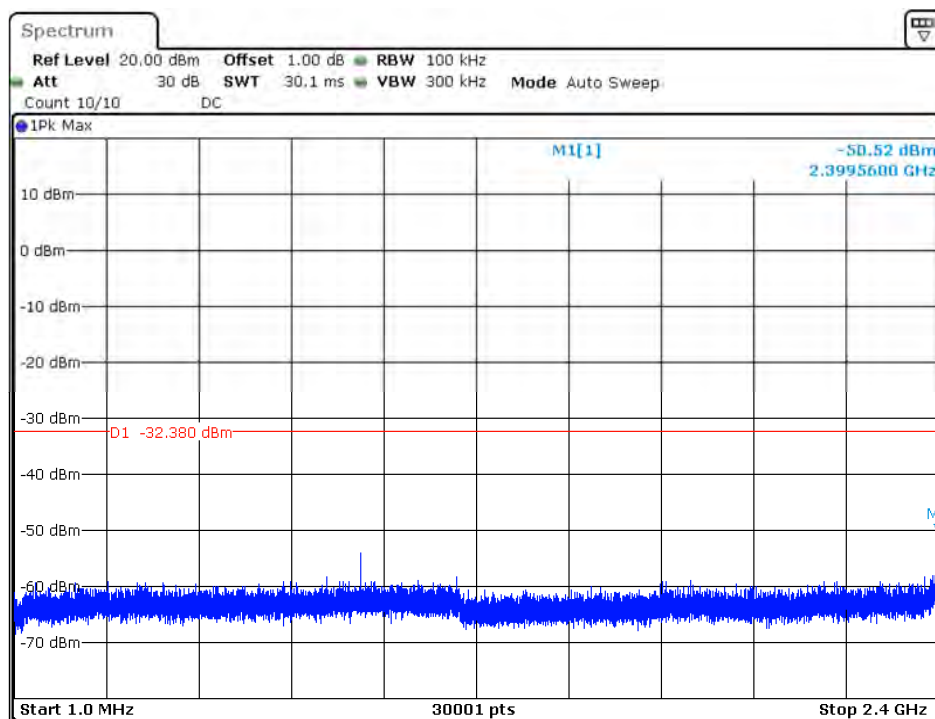
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802.11n-HT40

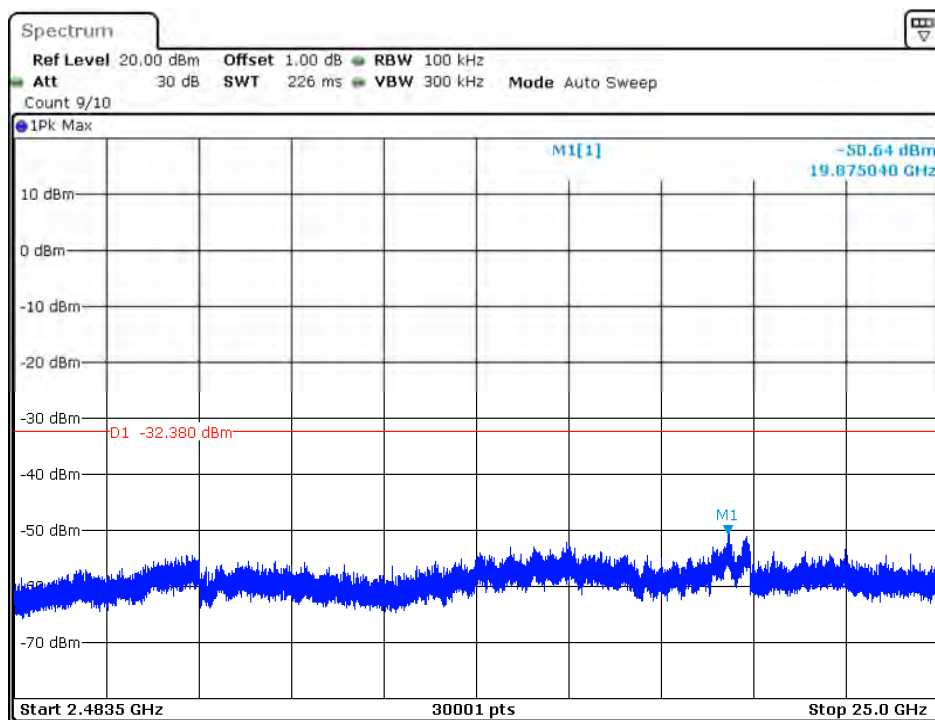
Channel 01 (2422MHz) Reference Level: -12.38dBm



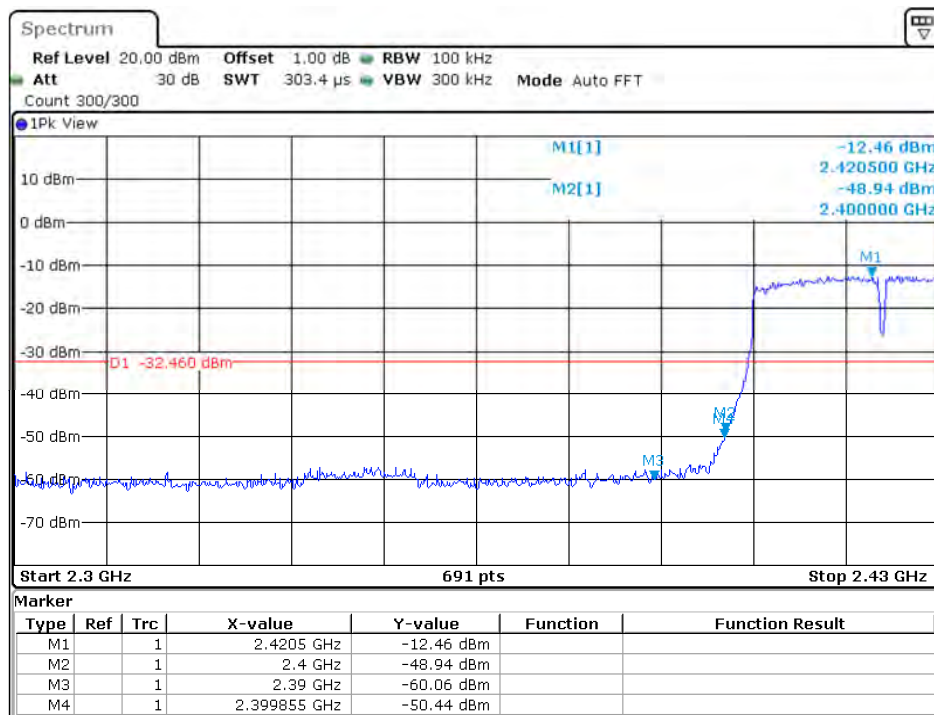
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Date: 29.OCT.2020 13:39:17

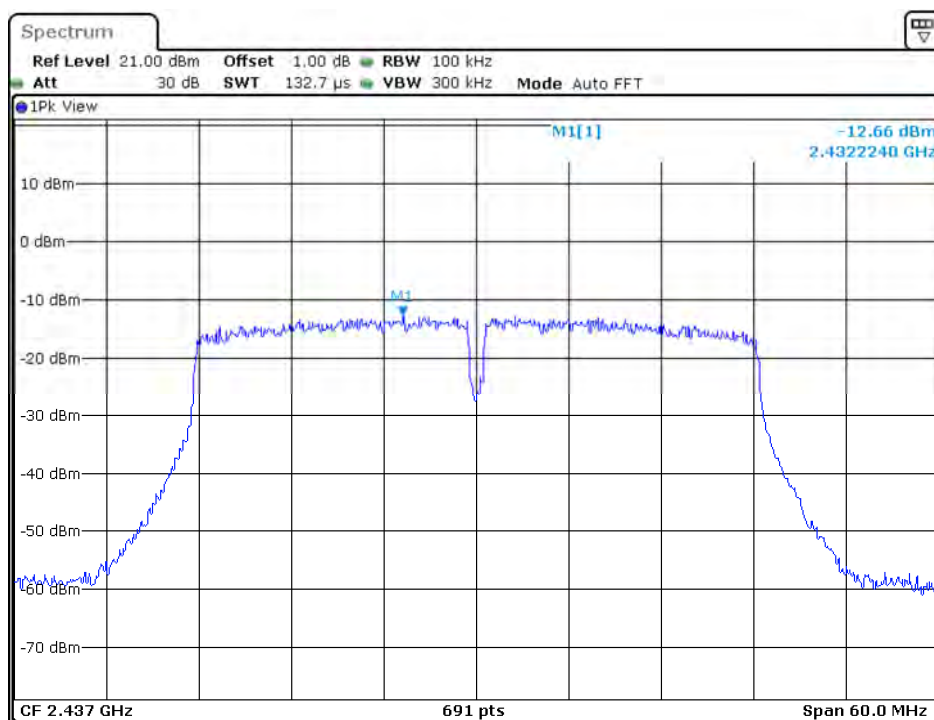


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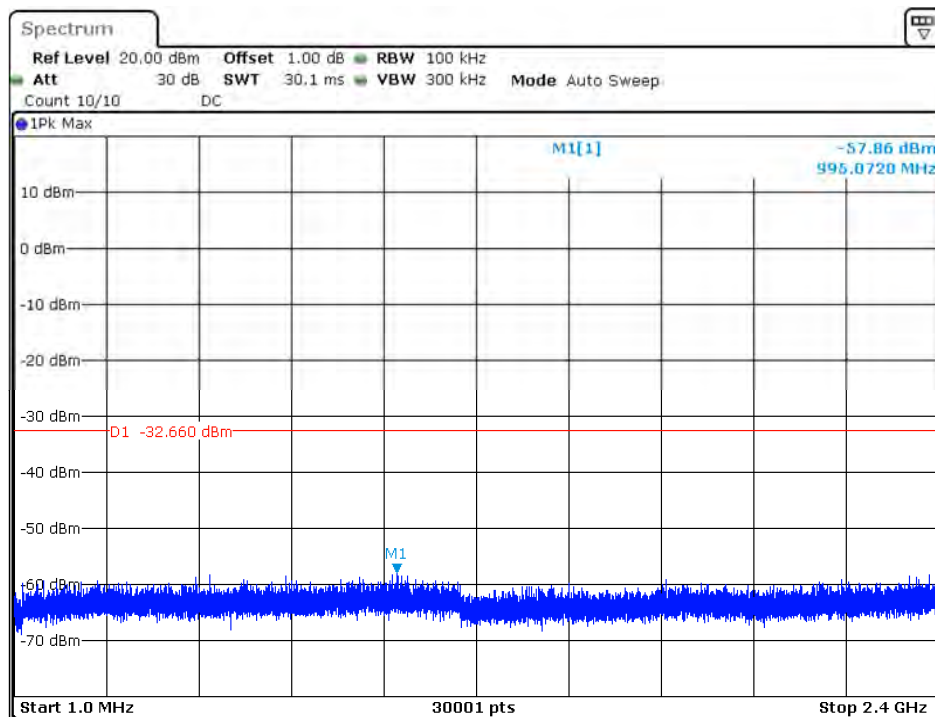


Date: 29.OCT.2020 13:39:00

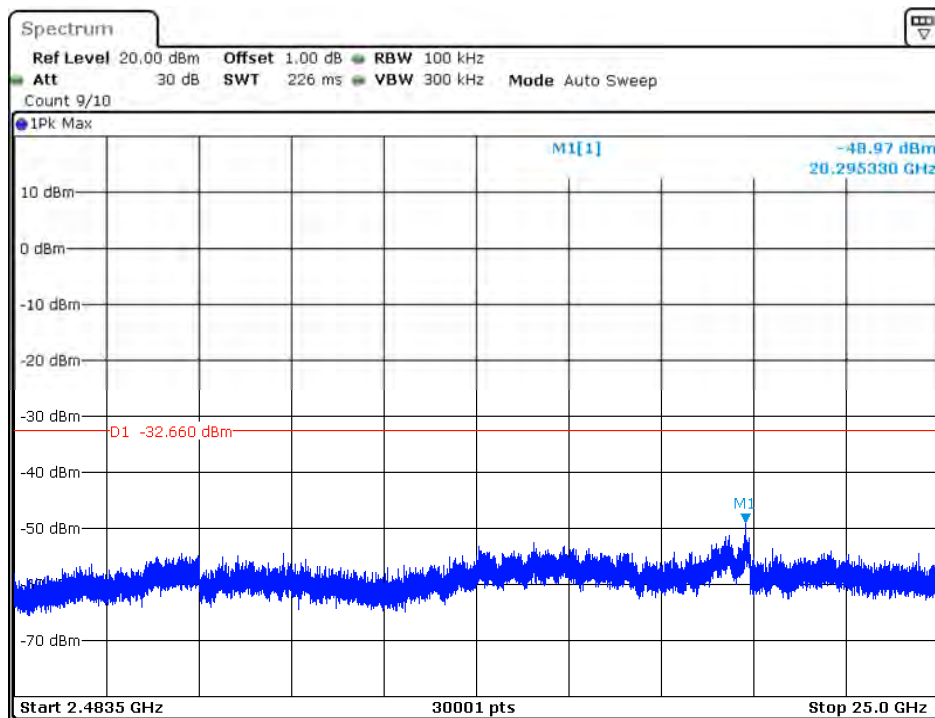
Channel 06 (2437MHz) Reference Level: -12.66dBm



Date: 29.OCT.2020 13:41:46

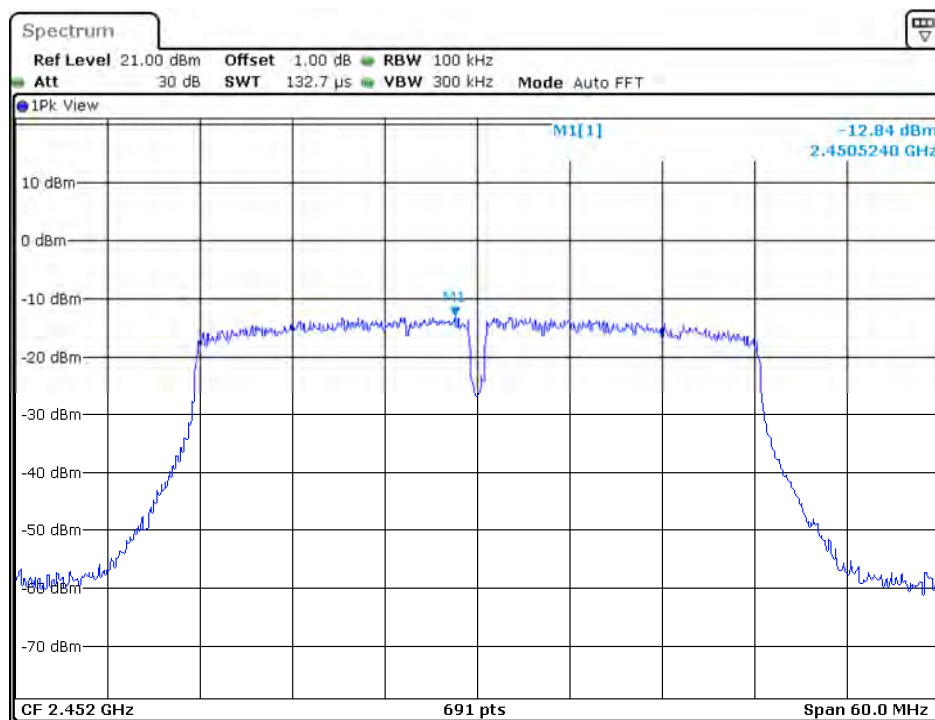


Date: 29.OCT.2020 13:41:51

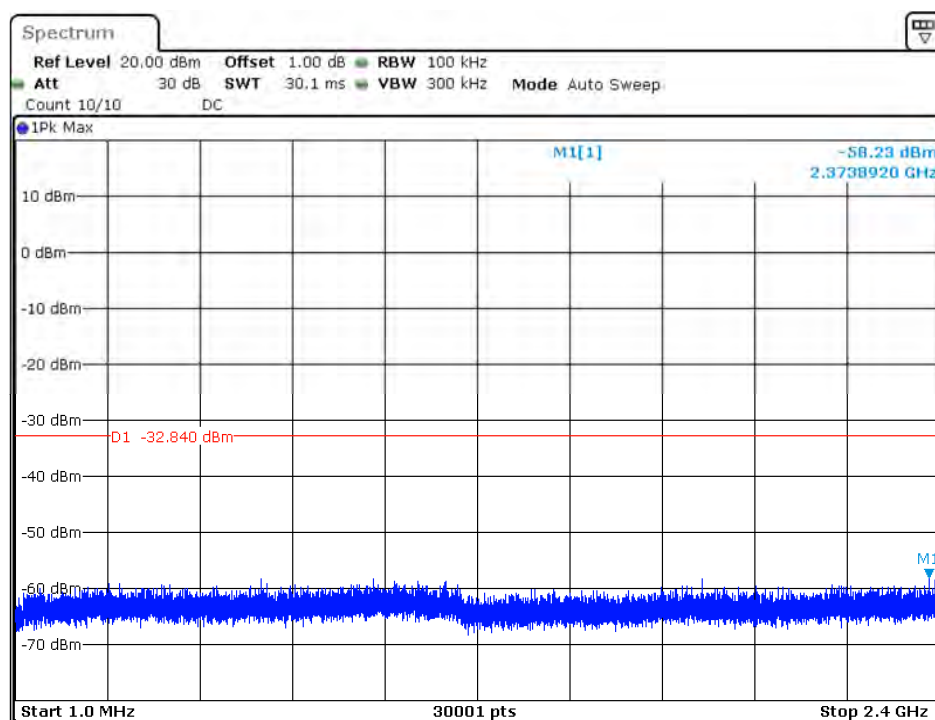


Date: 29.OCT.2020 13:41:59

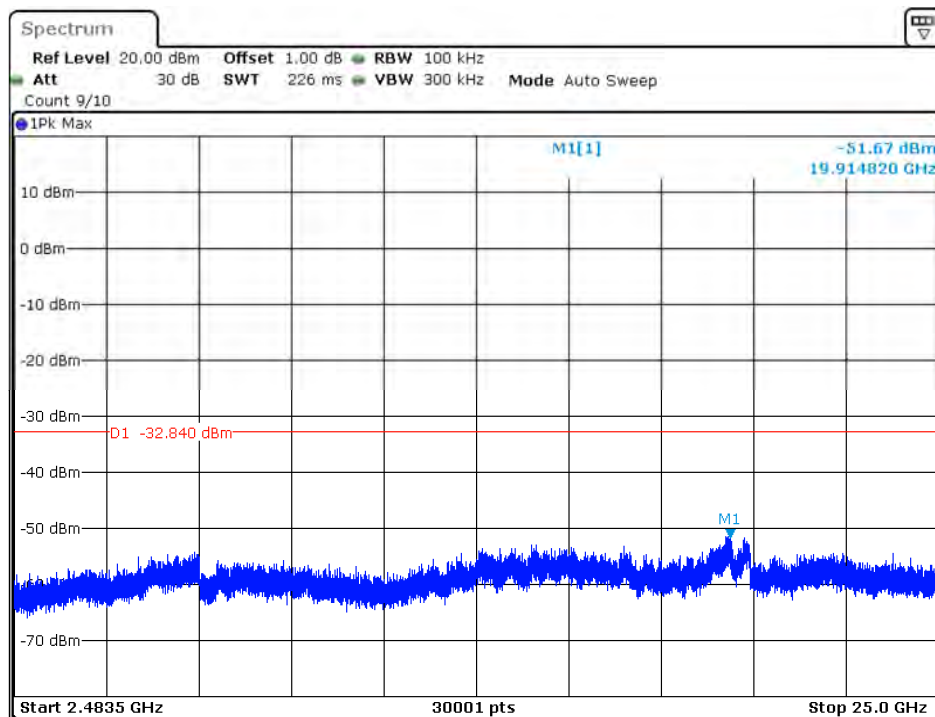
Channel 11 (2452MHz) Reference Level: -12.84dBm



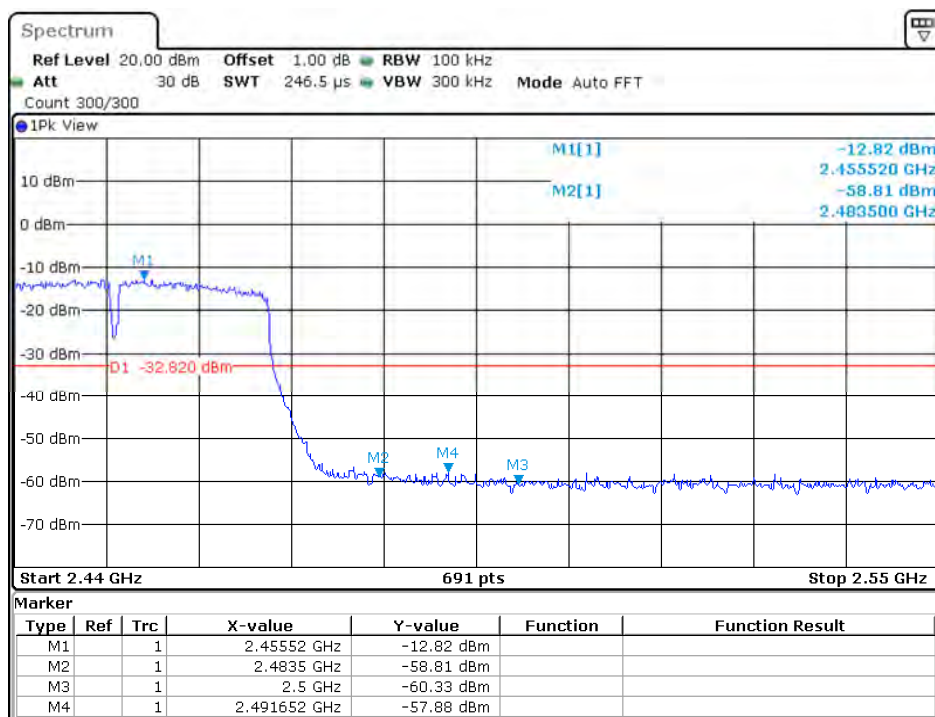
Date: 29.OCT.2020 13:44:28



Date: 29.OCT.2020 13:44:33



Date: 29.OCT.2020 13:44:40

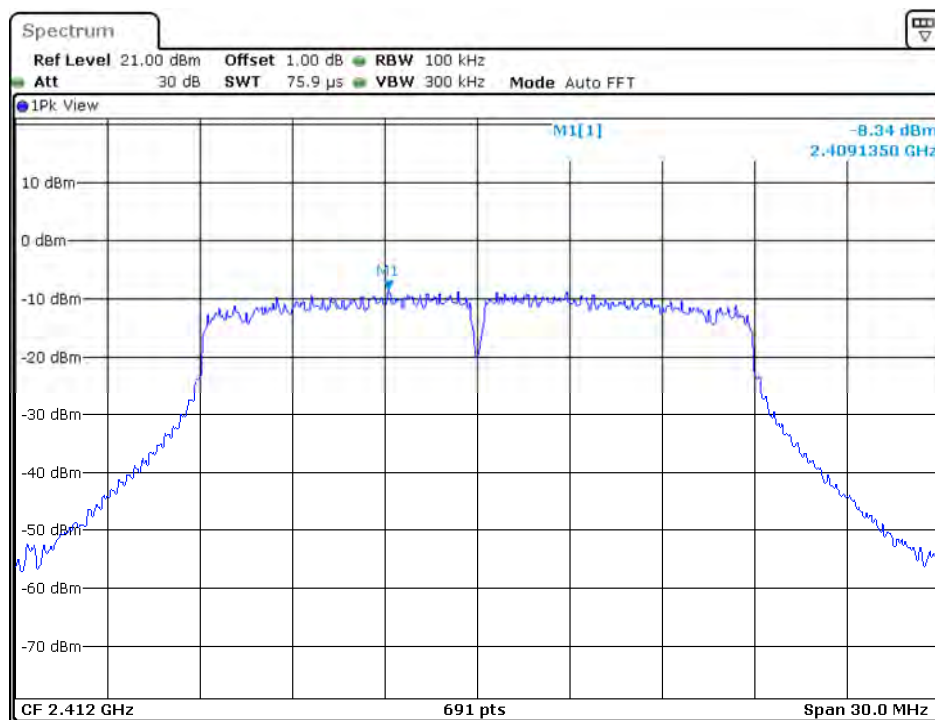


Date: 29.OCT.2020 13:44:09

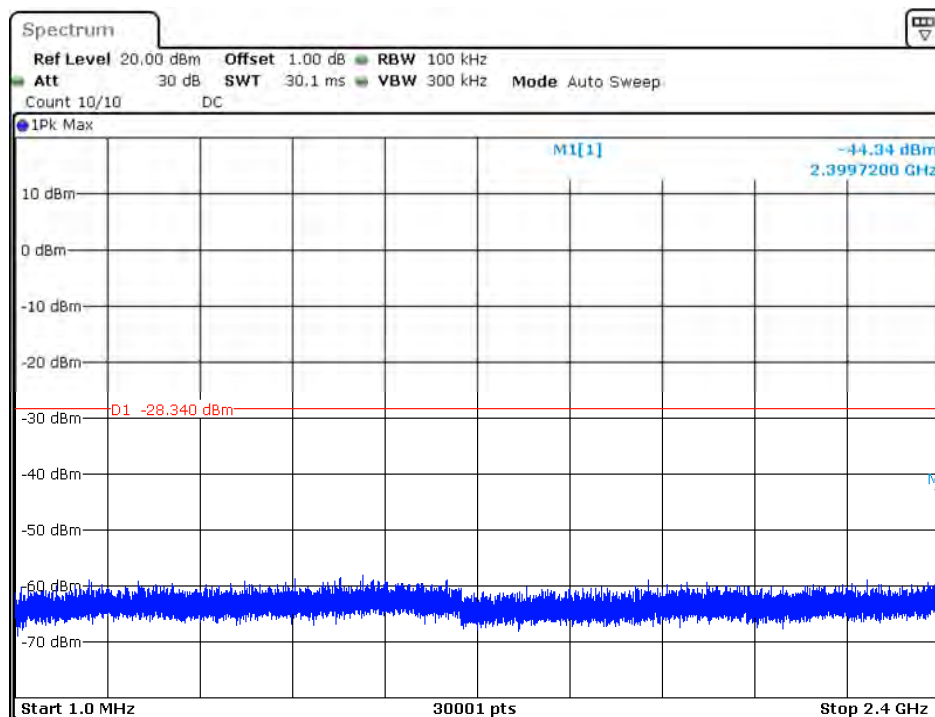
MIMO Mode, Ant1:

802.11n-HT20

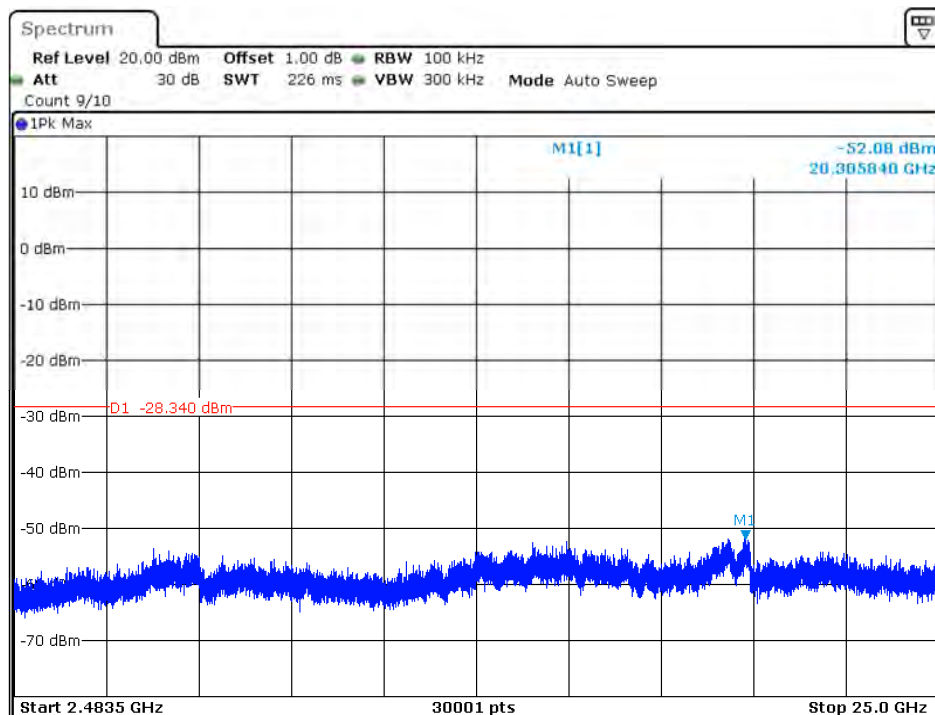
Channel 01 (2412MHz) Reference Level: -8.34dBm



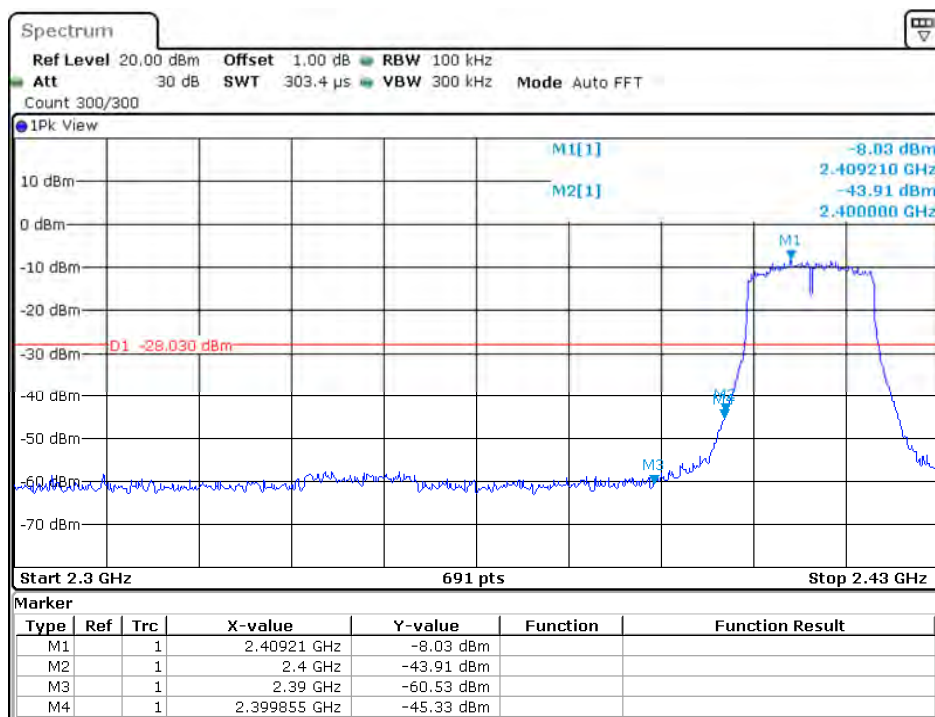
Date: 29.OCT.2020 13:55:40



Date: 29.OCT.2020 13:55:45

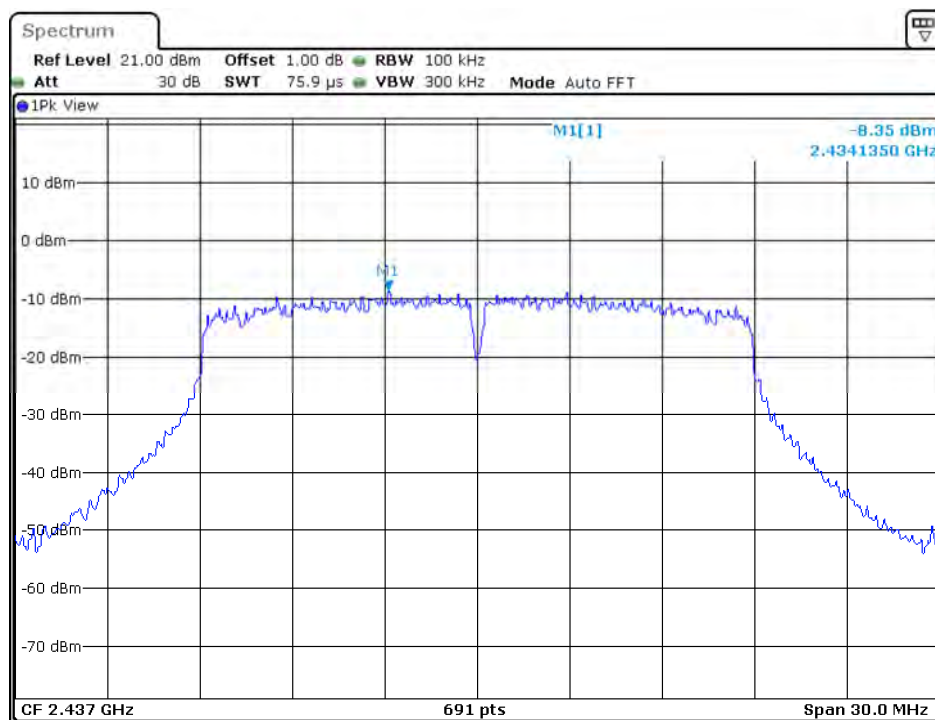


Date: 29.OCT.2020 13:55:52

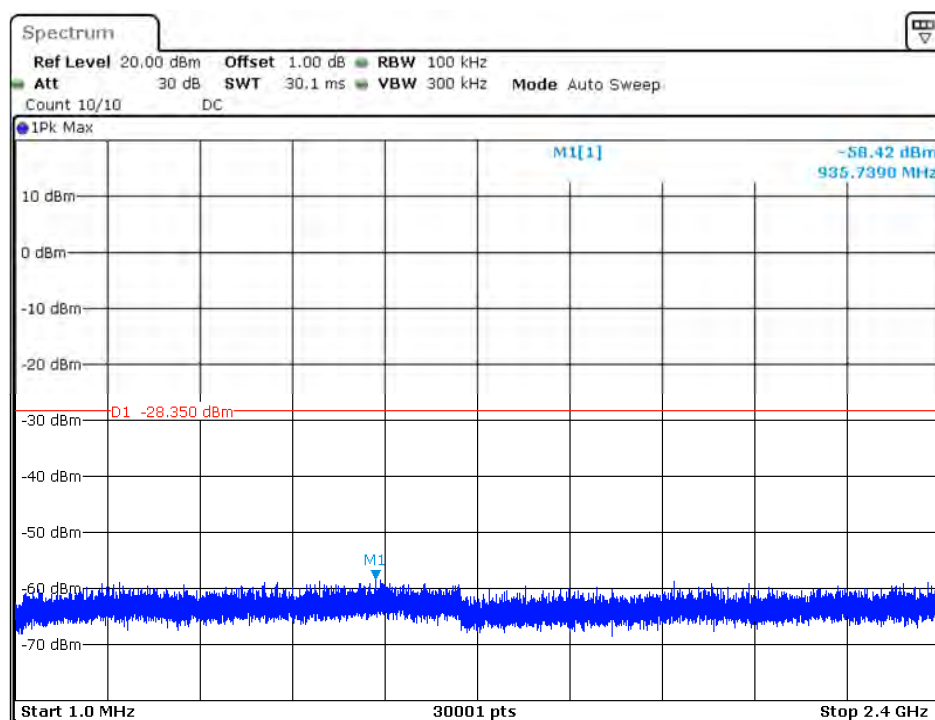


Date: 29.OCT.2020 13:55:29

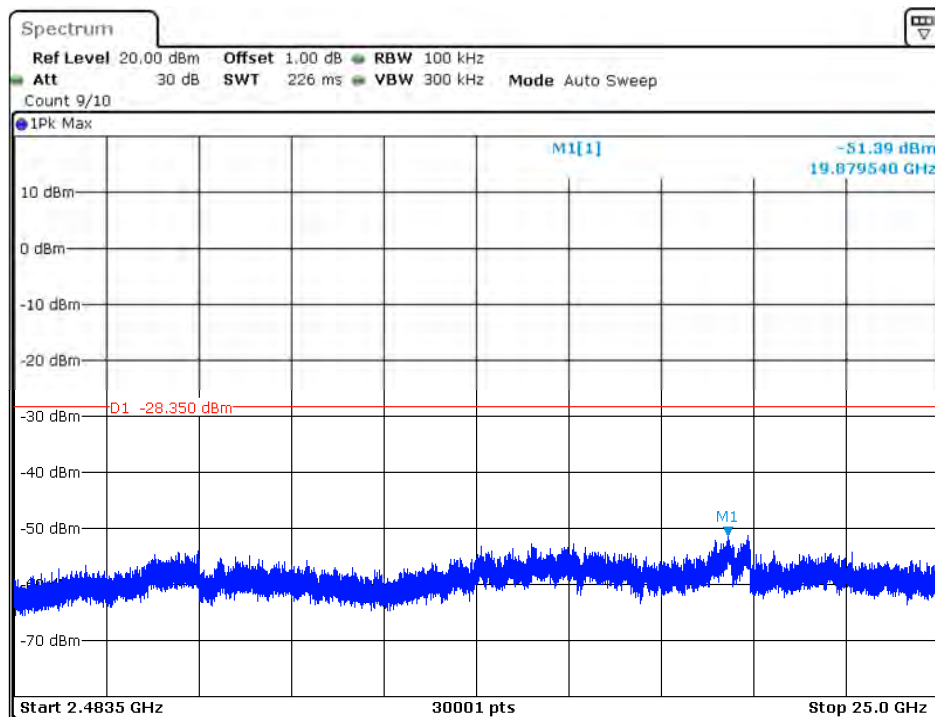
Channel 06 (2437MHz) Reference Level: -8.35dBm



Date: 29.OCT.2020 13:57:18

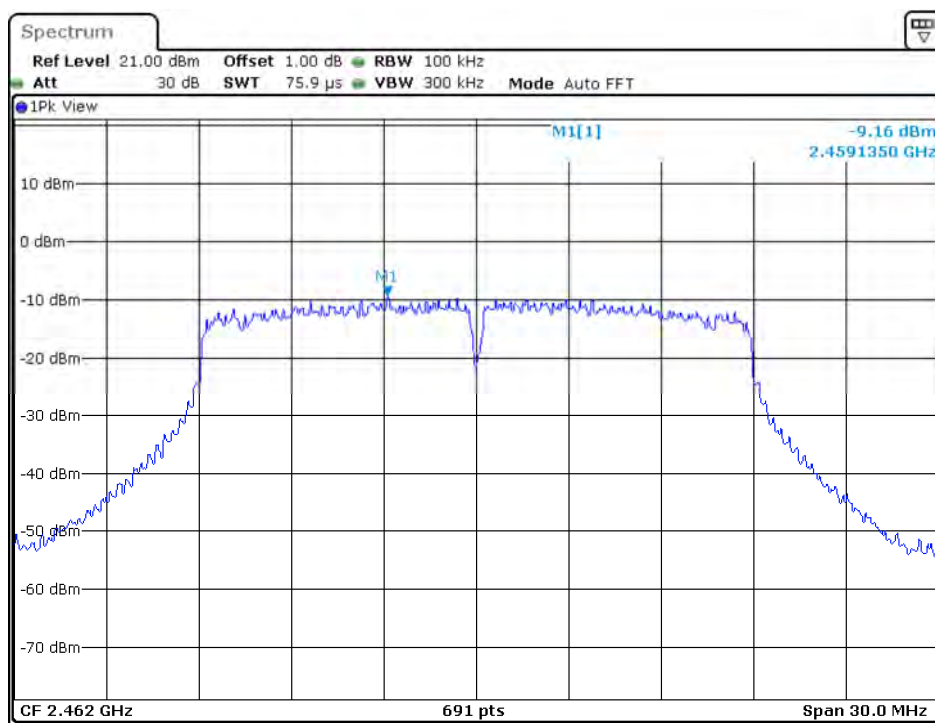


Date: 29.OCT.2020 13:57:23

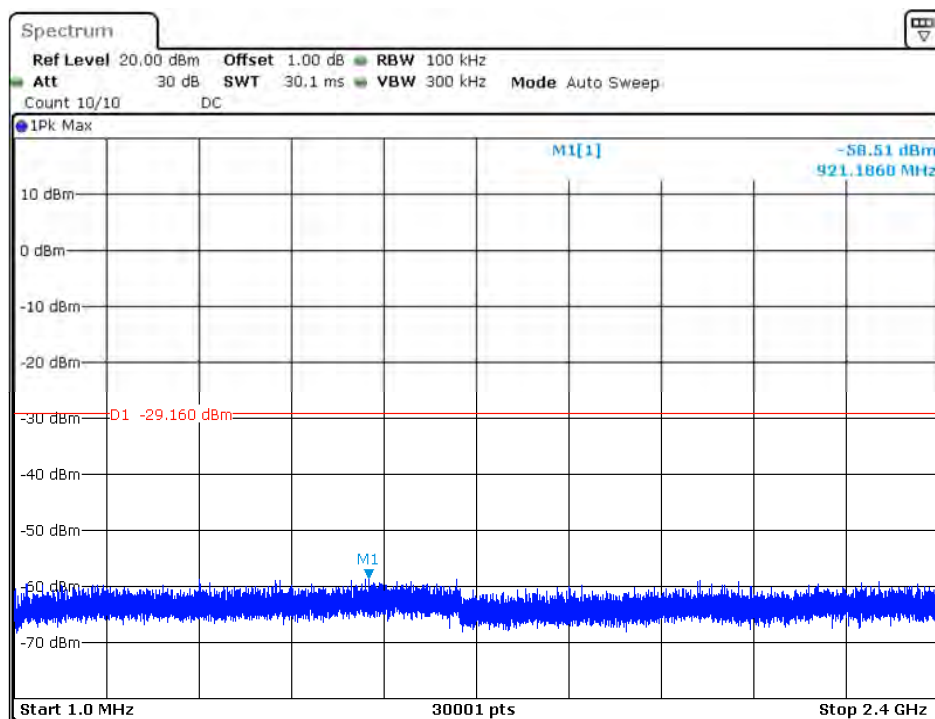


Date: 29.OCT.2020 13:57:30

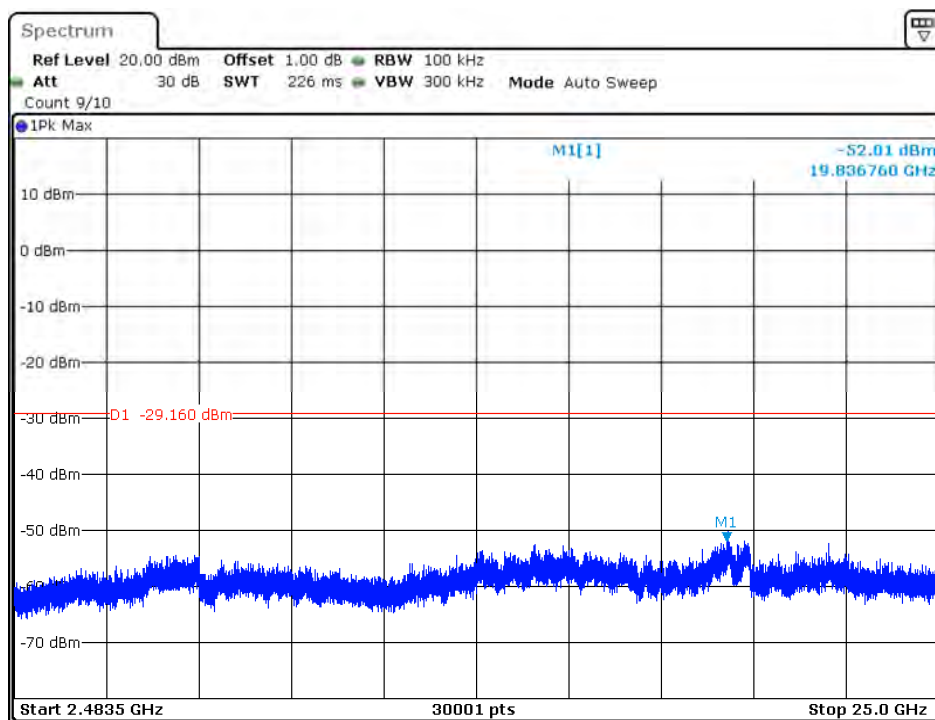
Channel 11 (2462MHz) Reference Level: -9.16dBm



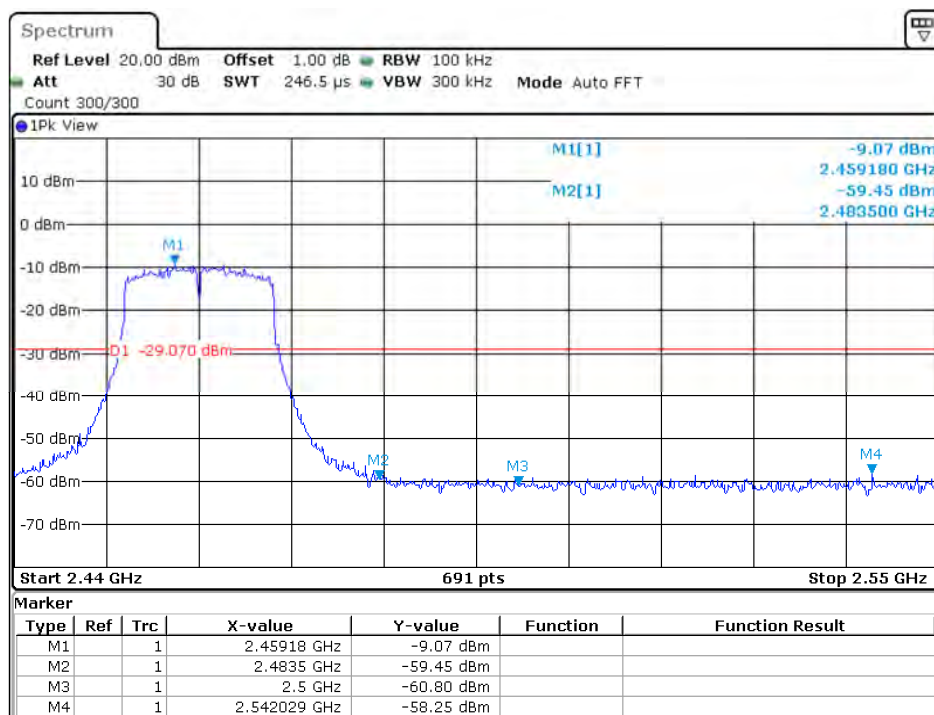
Date: 29.OCT.2020 13:59:13



Date: 29.OCT.2020 13:59:18



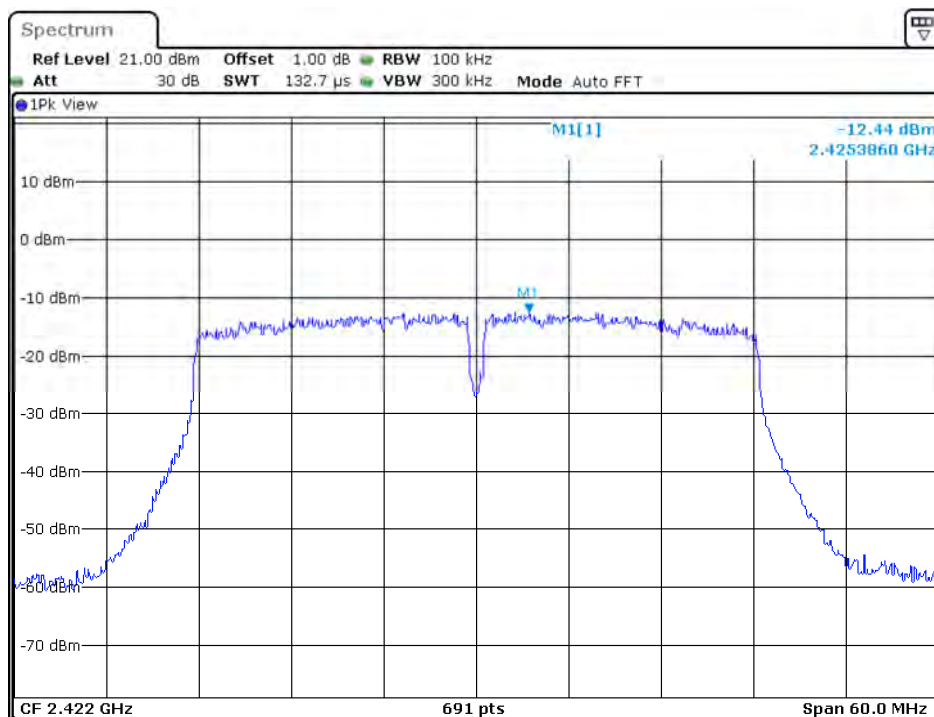
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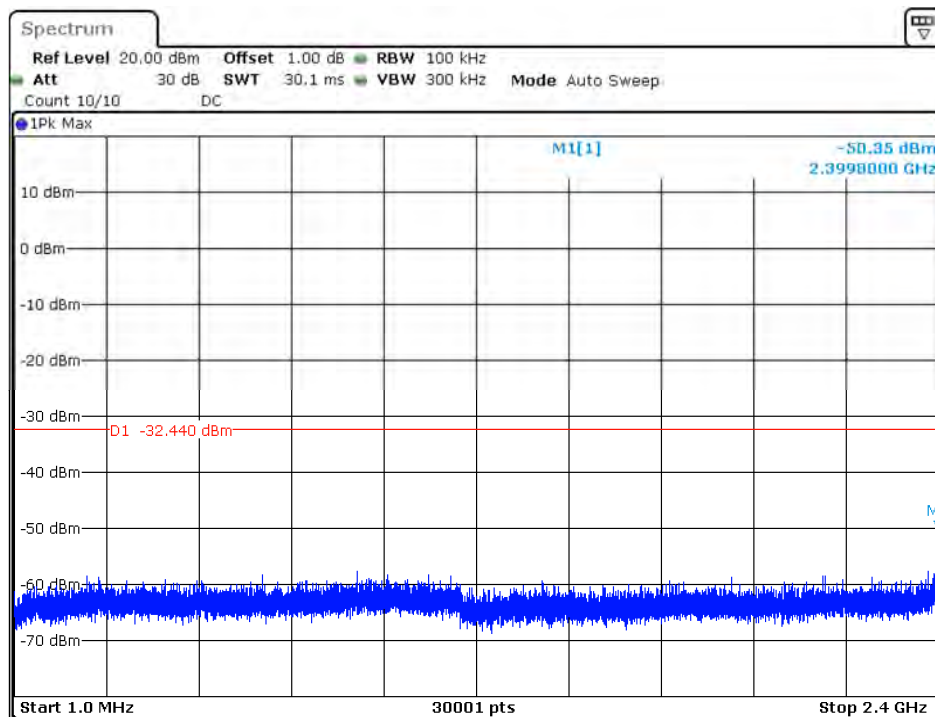
Date: 29.OCT.2020 13:59:02

802.11n-HT40

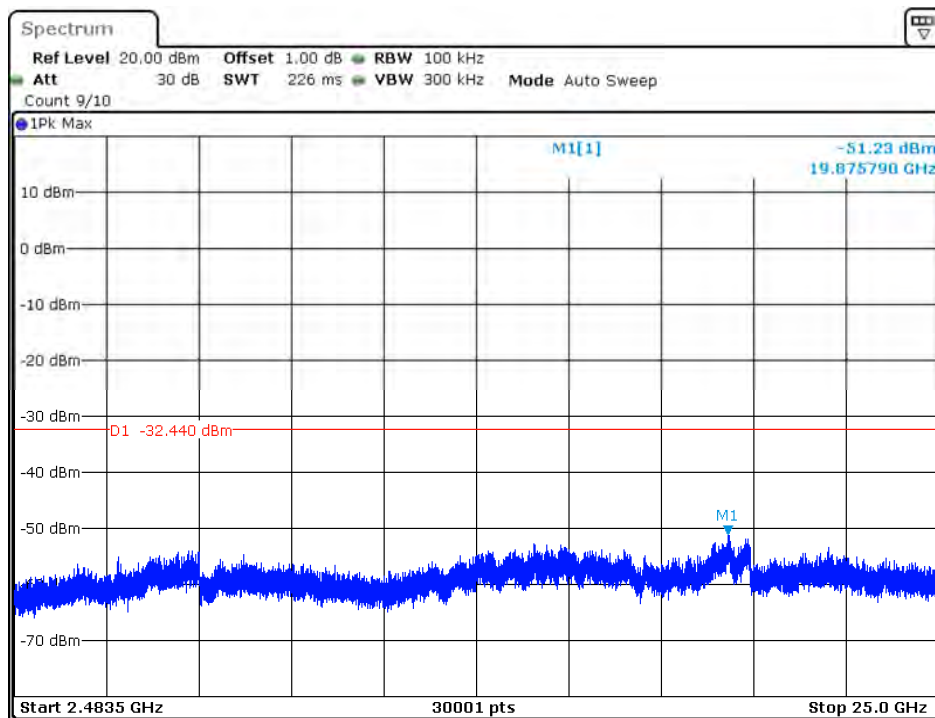
Channel 01 (2422MHz) Reference Level: -12.44dBm



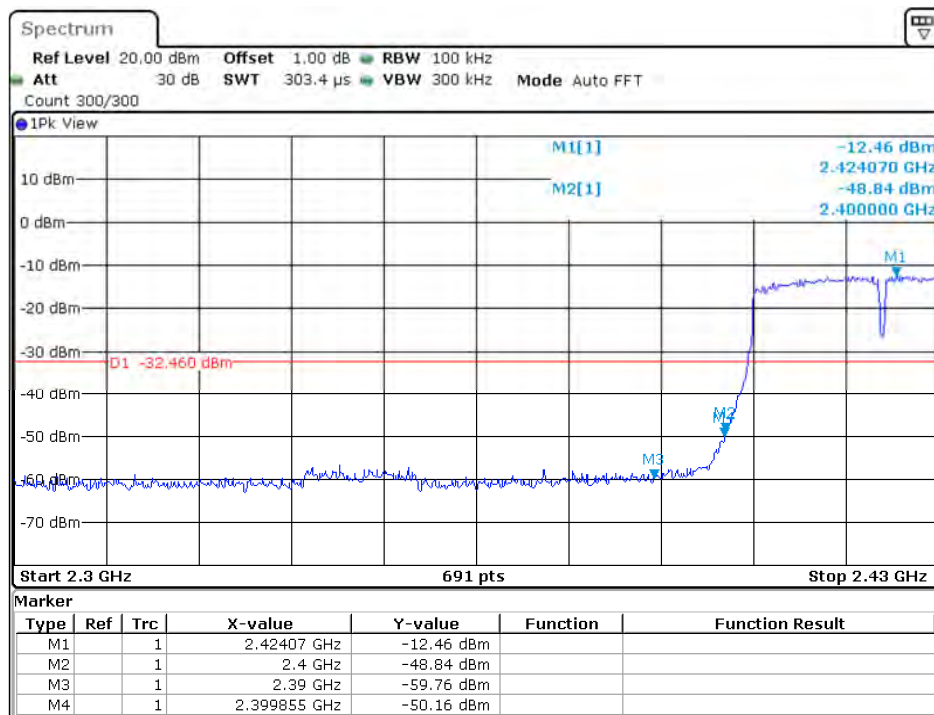
Date: 29.OCT.2020 14:01:48



Date: 29.OCT.2020 14:01:53

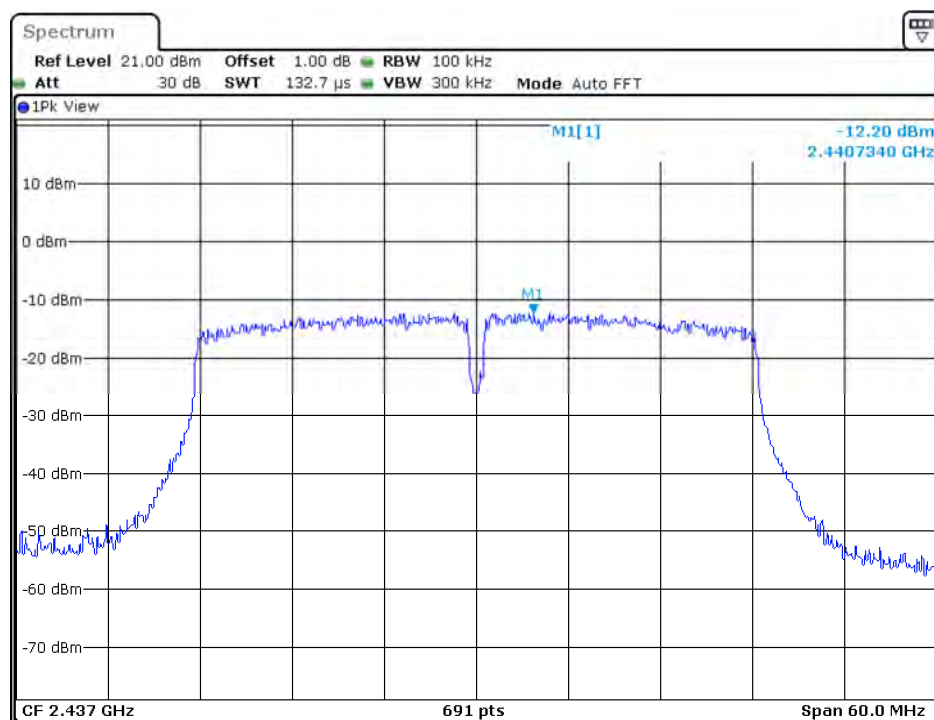


Date: 29.OCT.2020 14:02:00

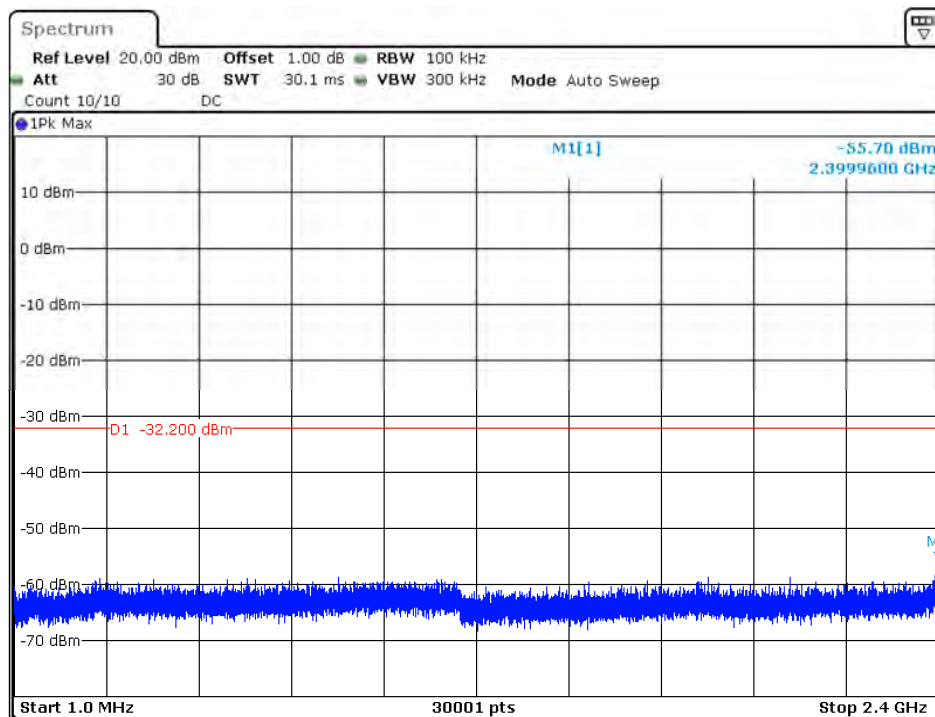


Date: 29.OCT.2020 14:01:35

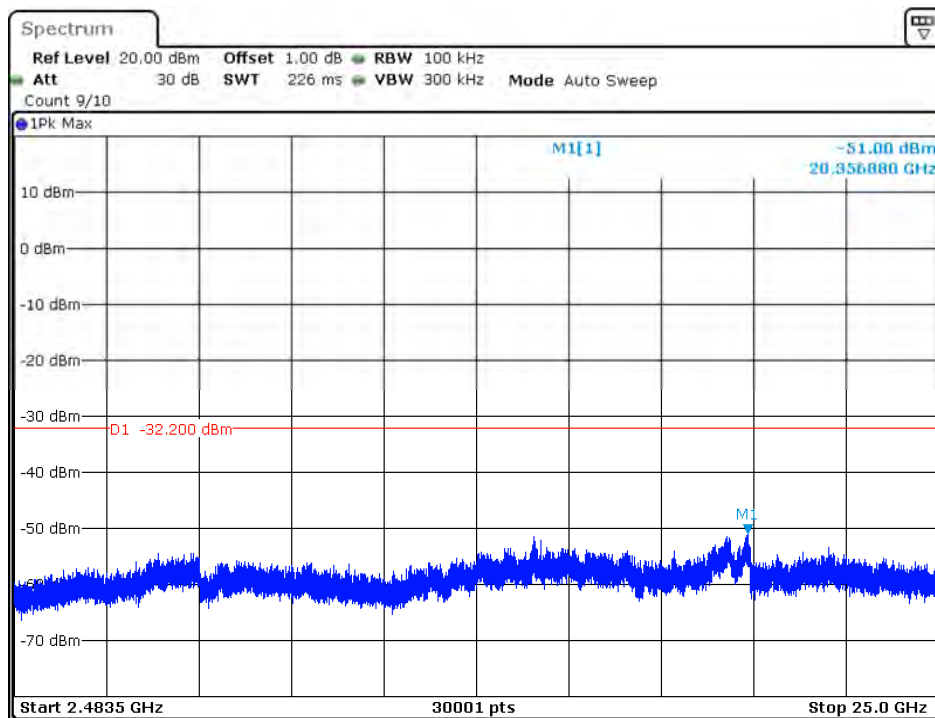
Channel 06 (2437MHz) Reference Level: -12.20dBm



Date: 29.OCT.2020 14:04:00

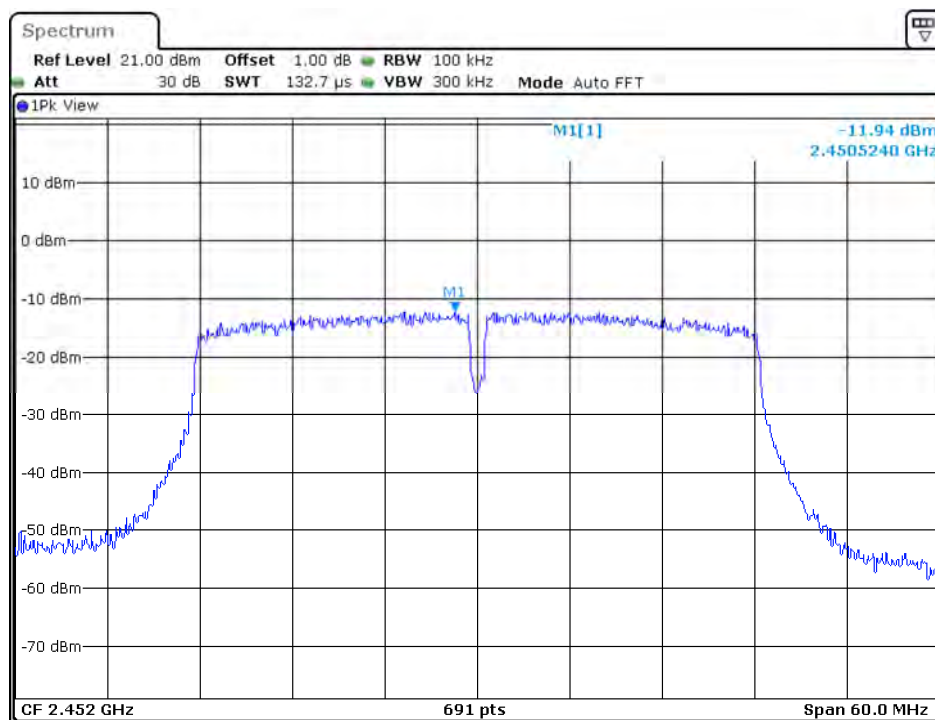


Date: 29.OCT.2020 14:04:05

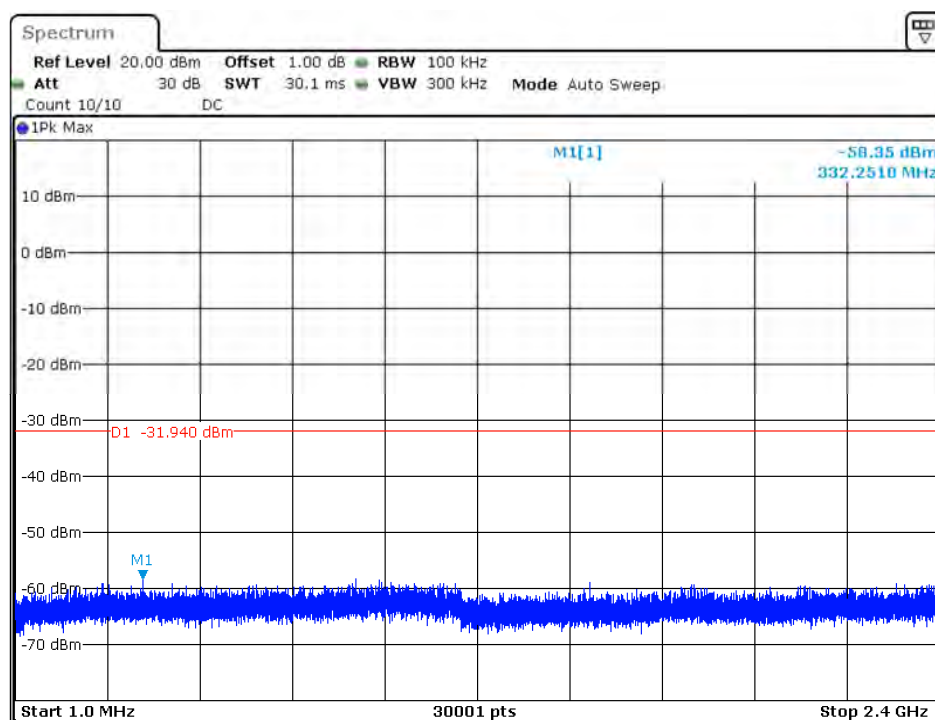


Date: 29.OCT.2020 14:04:13

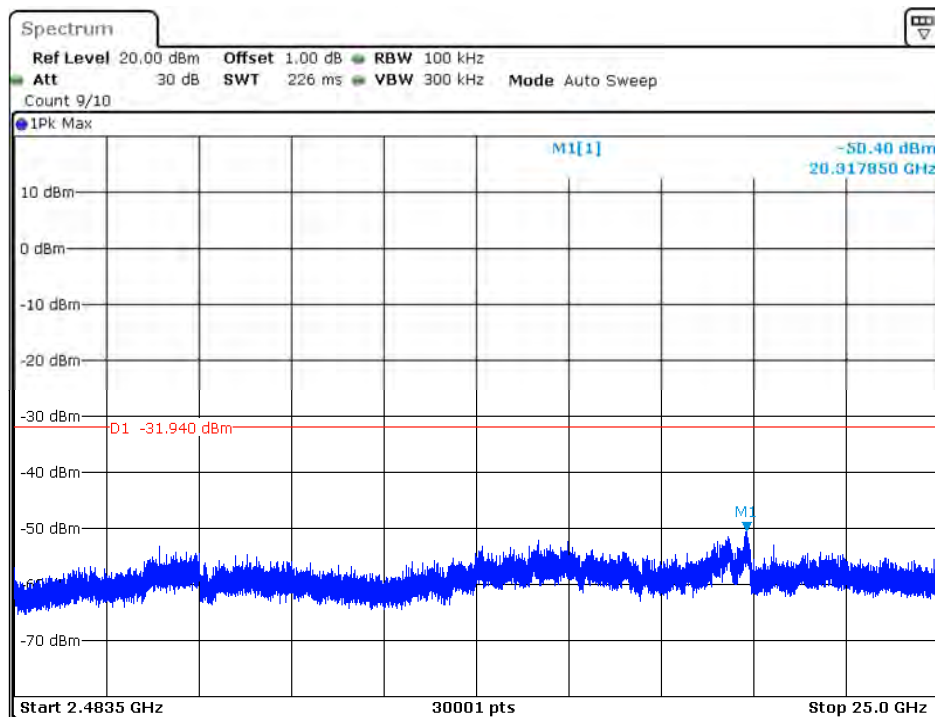
Channel 11 (2452MHz) Reference Level: -11.94dBm



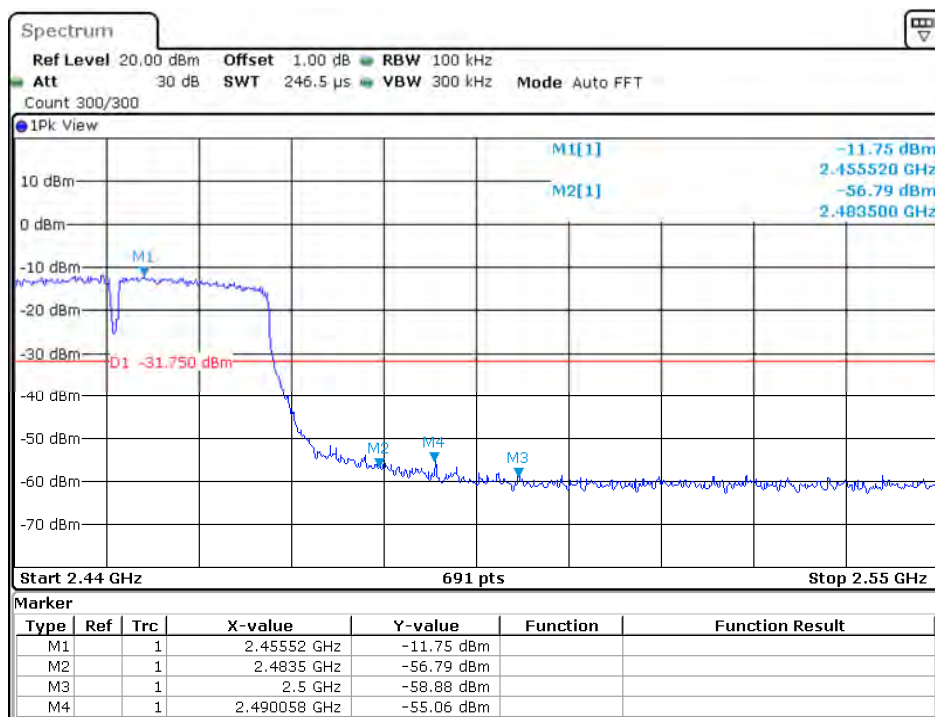
Date: 29.OCT.2020 14:06:42



Date: 29.OCT.2020 14:06:47



Date: 29.OCT.2020 14:06:54

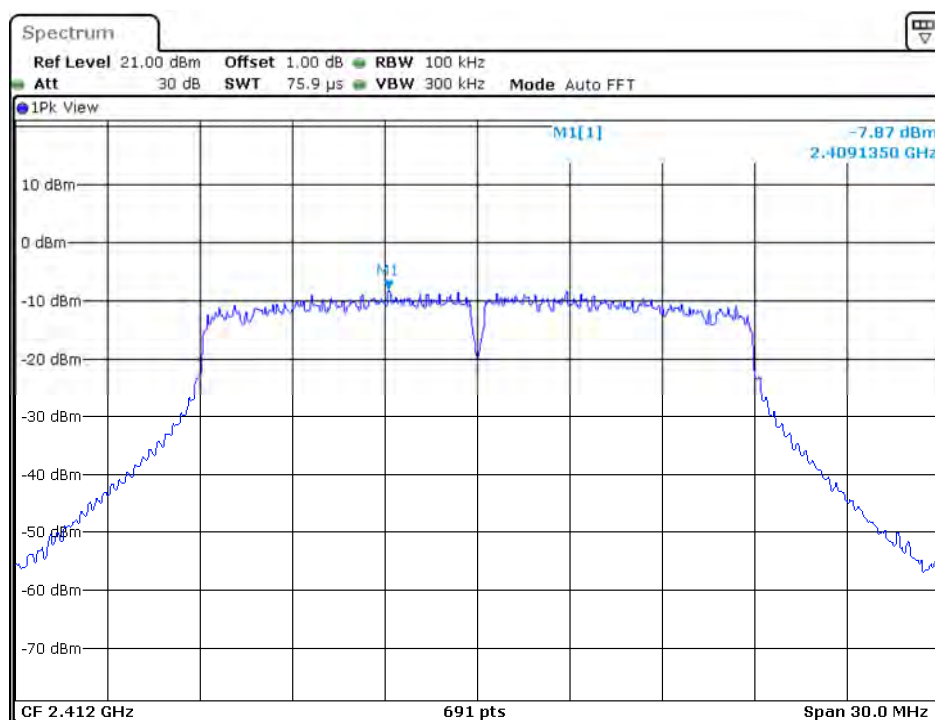


Date: 29.OCT.2020 14:06:30

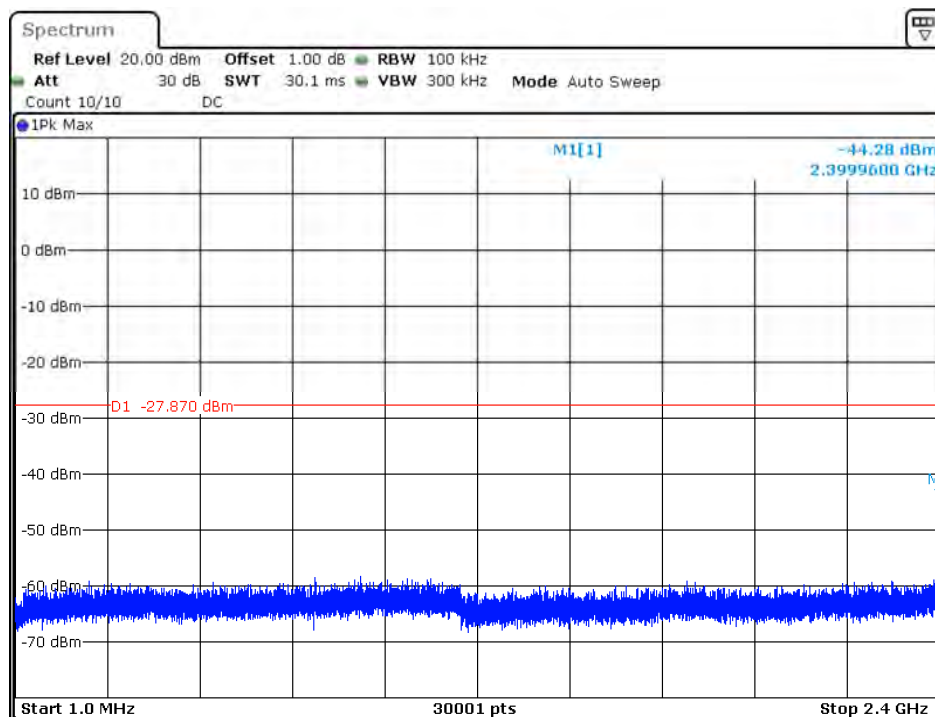
MIMO Mode, Ant2:

802.11n-HT20

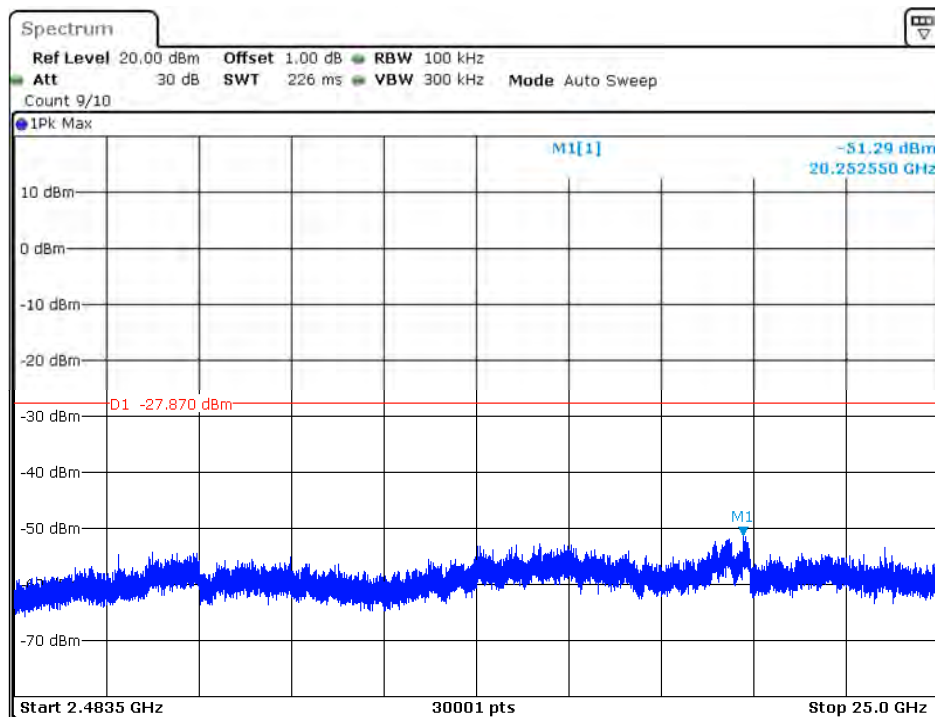
Channel 01 (2412MHz) Reference Level: -7.87dBm



Date: 29.OCT.2020 14:08:57



Date: 29.OCT.2020 14:09:02

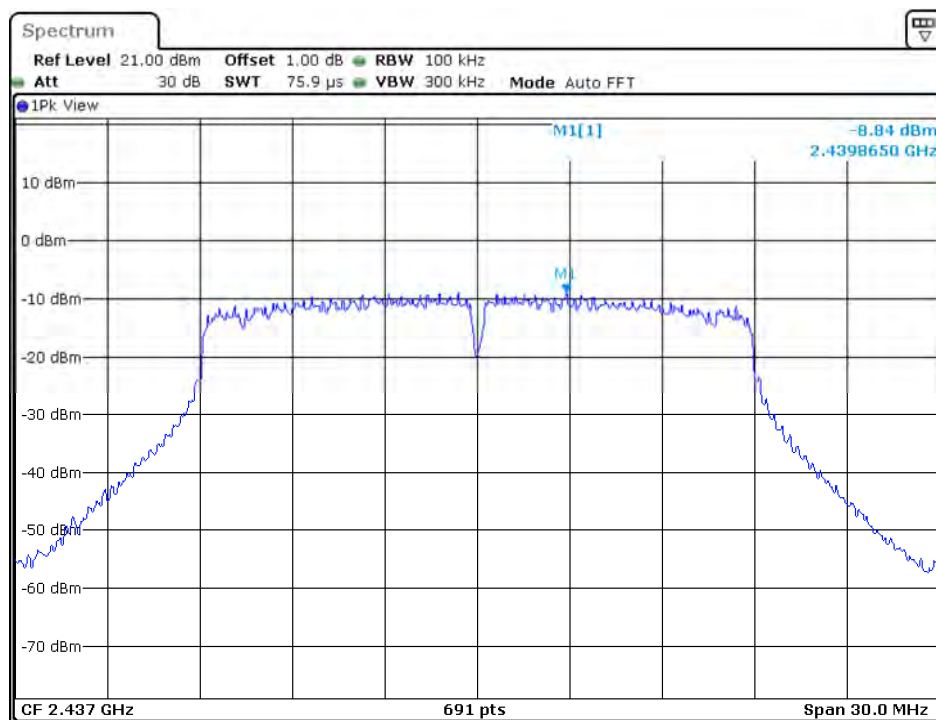


Date: 29.OCT.2020 14:09:09

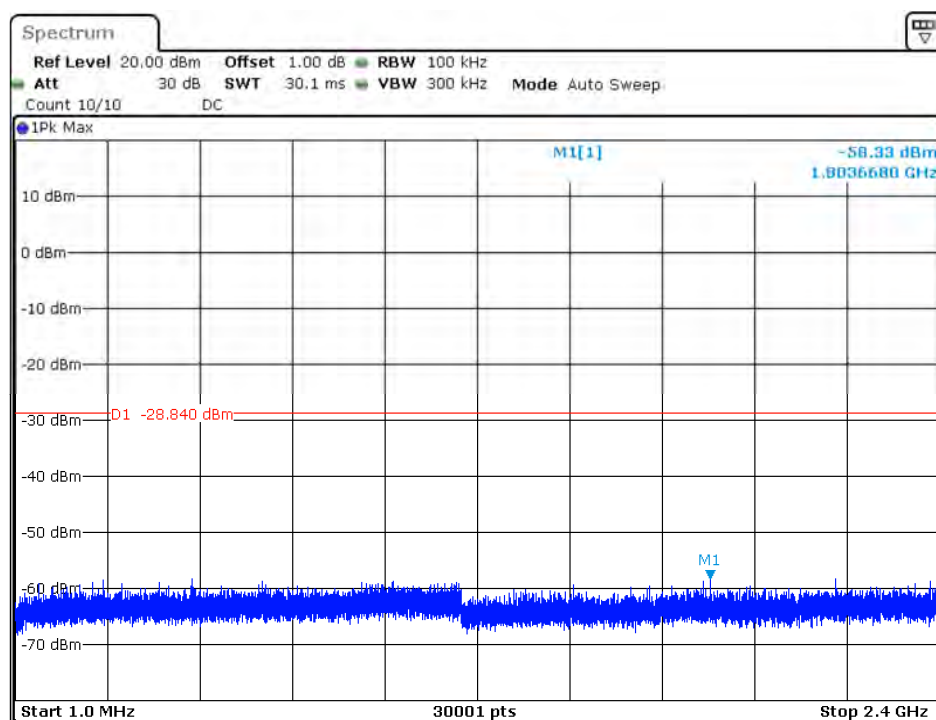


Date: 29.OCT.2020 14:08:46

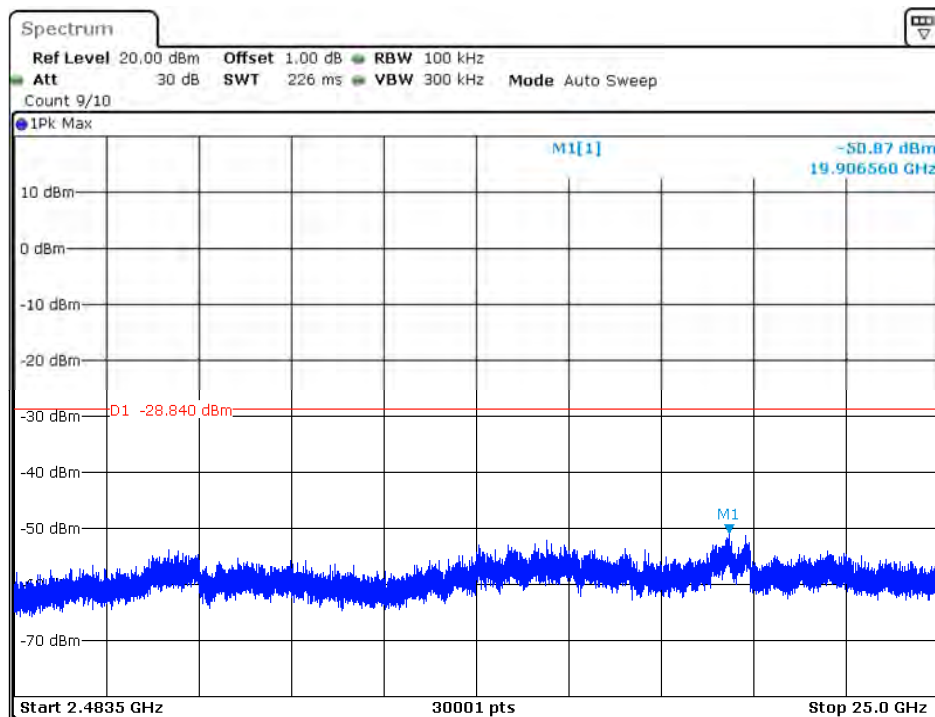
Channel 06 (2437MHz) Reference Level: -8.84dBm



Date: 29.OCT.2020 14:10:38

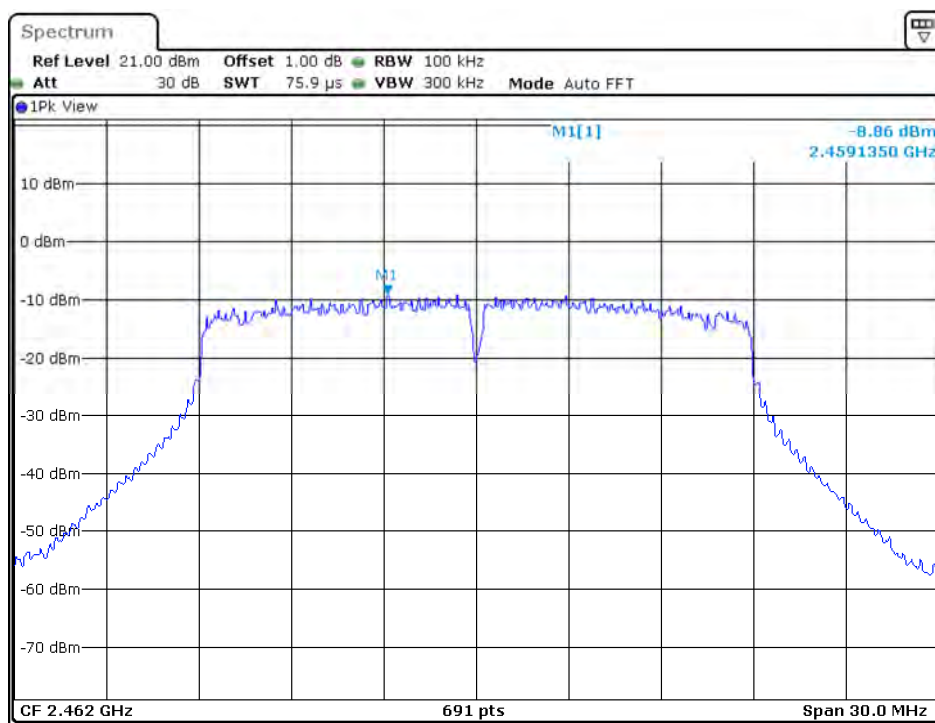


Date: 29.OCT.2020 14:10:43

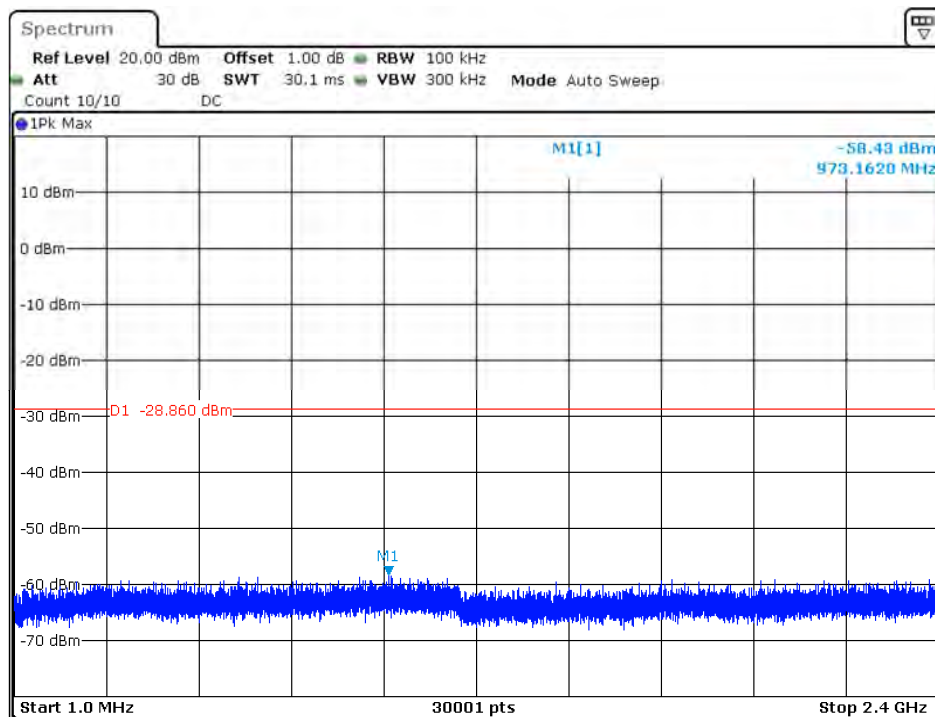


Date: 29.OCT.2020 14:10:50

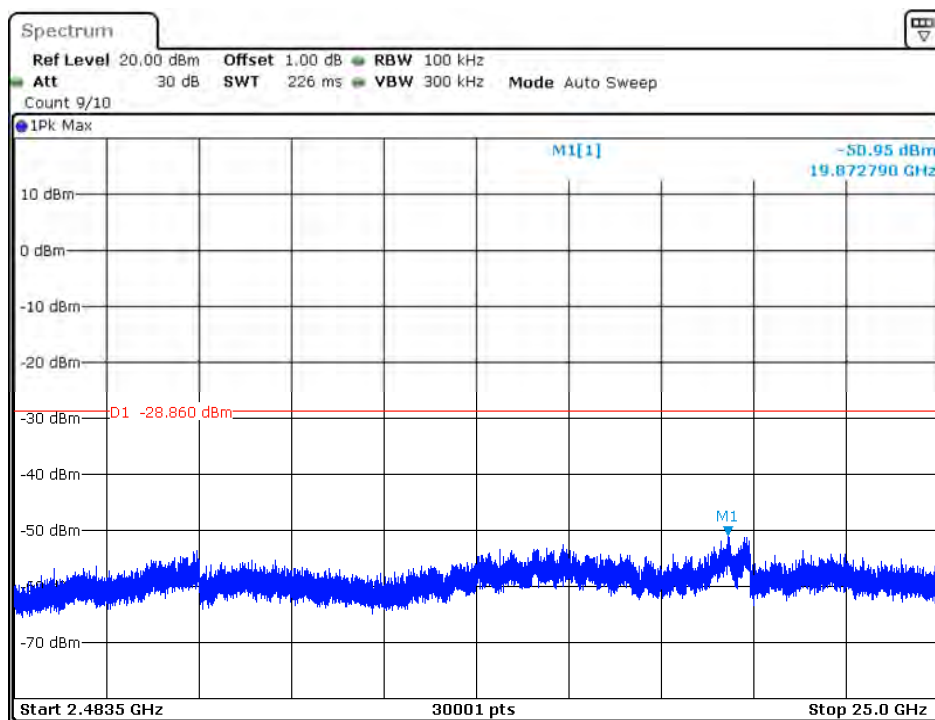
Channel 11 (2462MHz) Reference Level: -8.86dBm



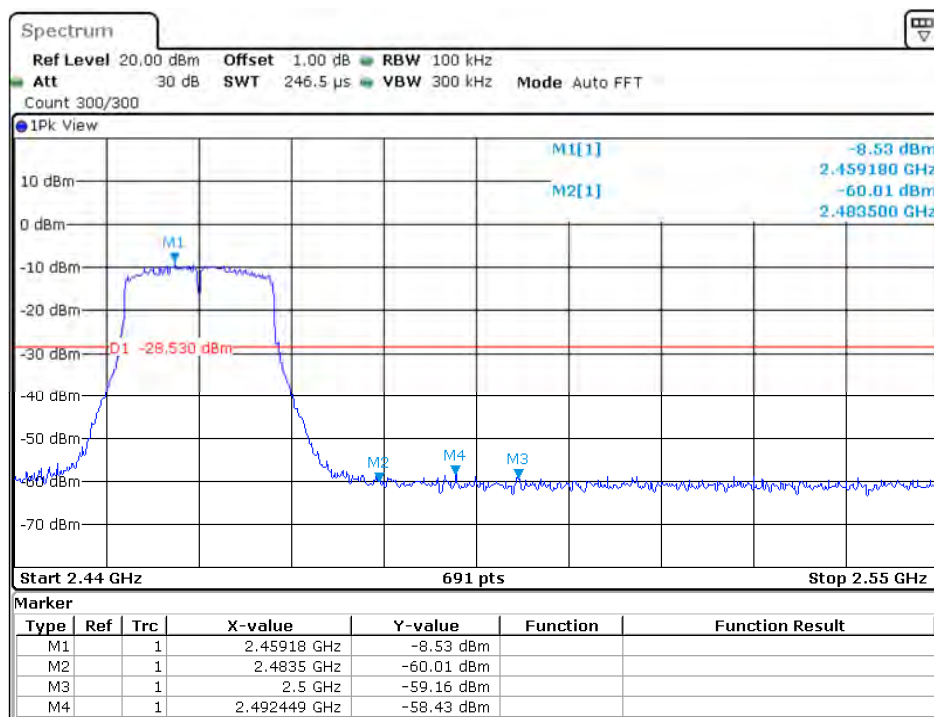
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Date: 29.OCT.2020 14:12:37



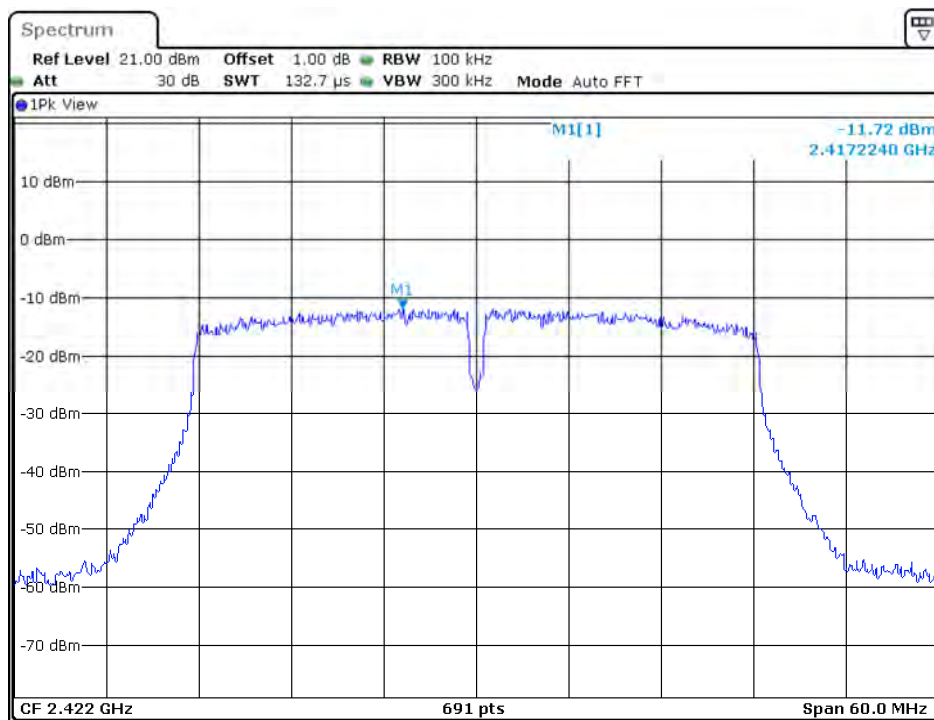
Date: 29.OCT.2020 14:12:44



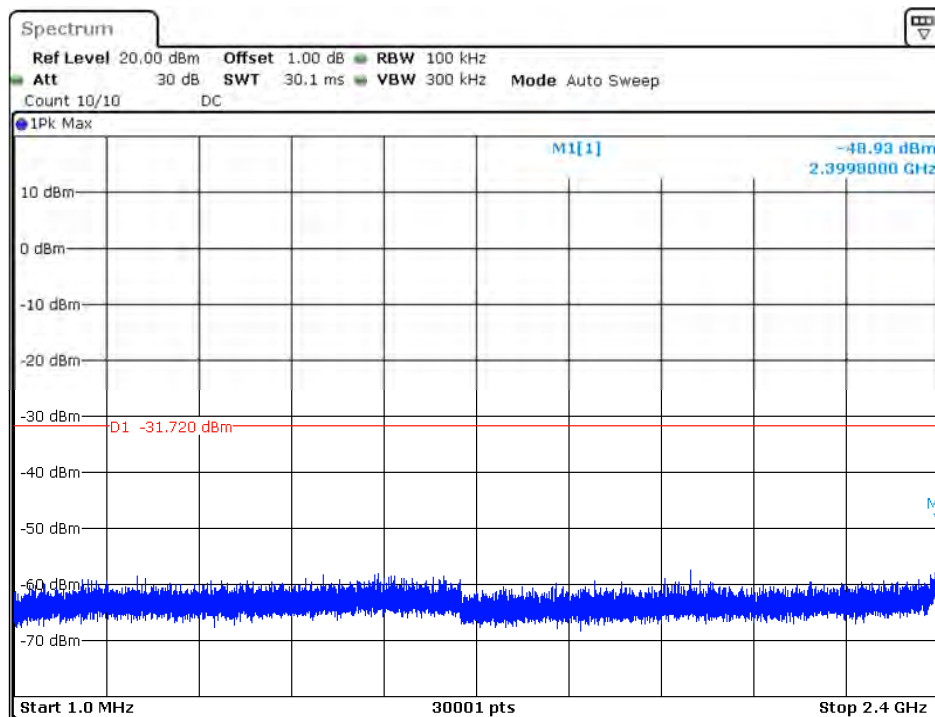
Date: 29.OCT.2020 14:12:20

802.11n-HT40

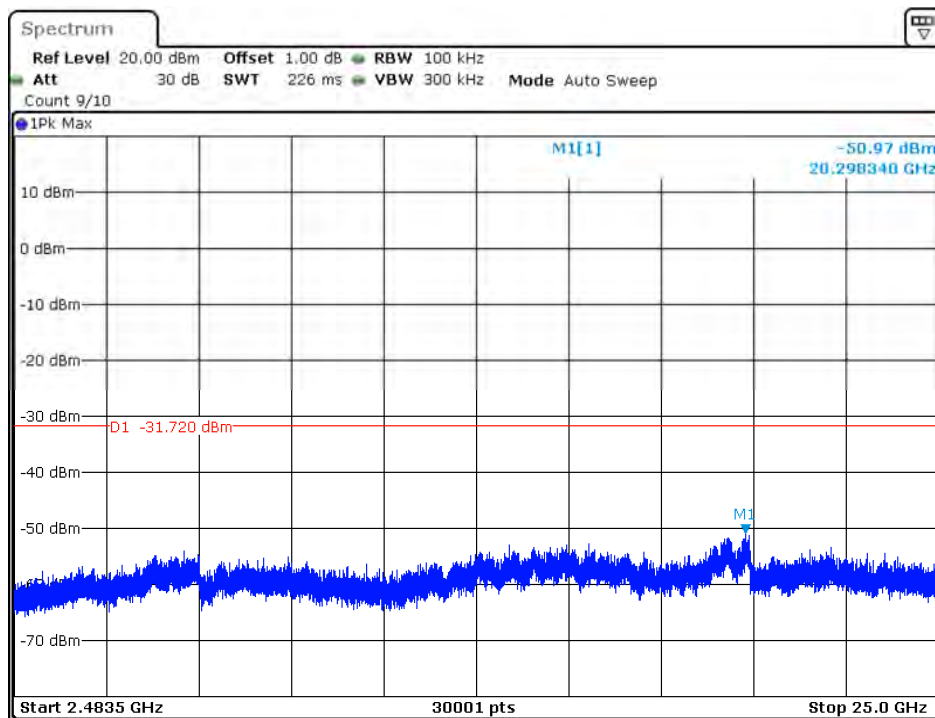
Channel 01 (2422MHz) Reference Level: -11.72dBm



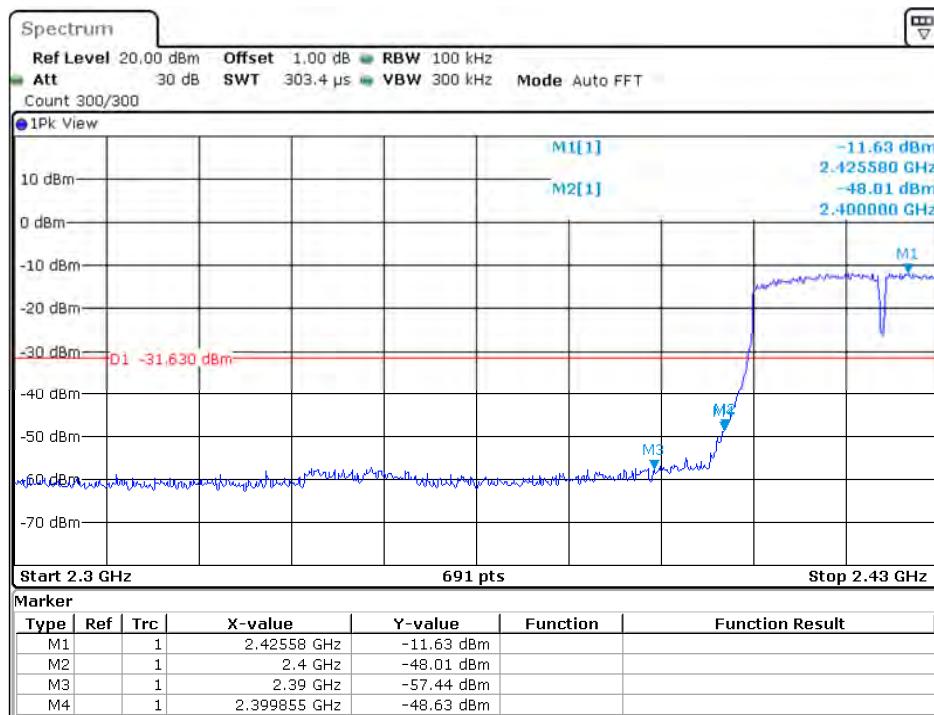
Date: 29.OCT.2020 14:15:17



Date: 29.OCT.2020 14:15:22

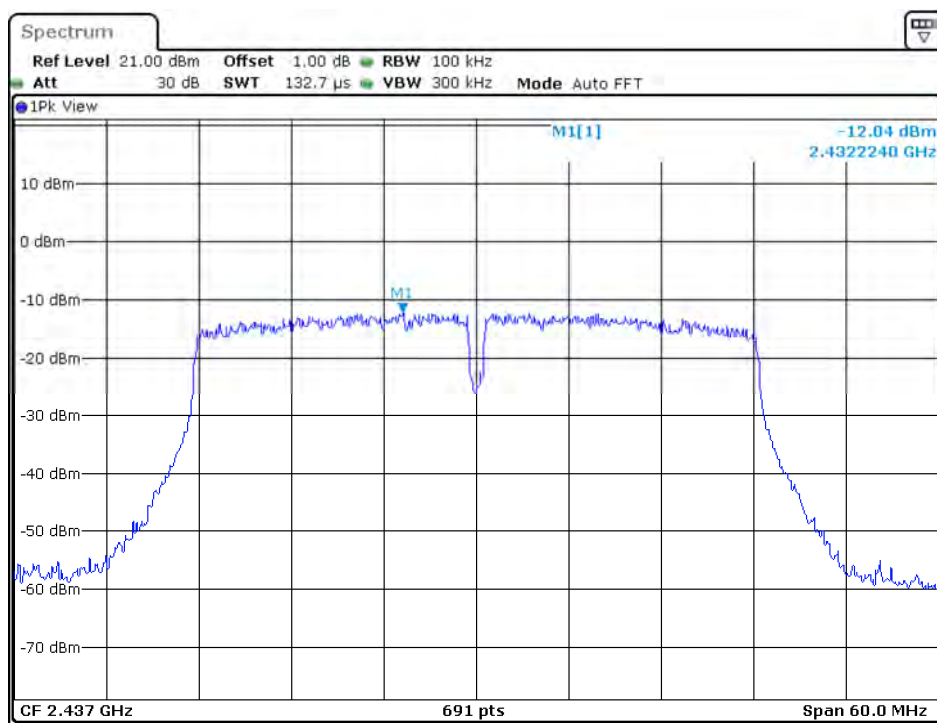


Date: 29.OCT.2020 14:15:29

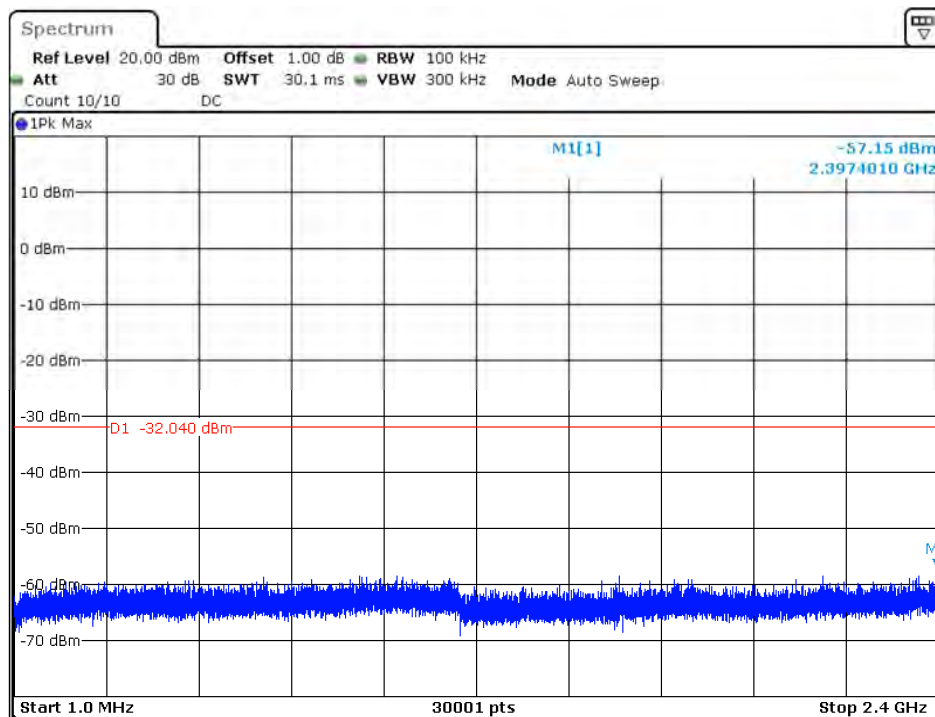


Date: 29.OCT.2020 14:14:57

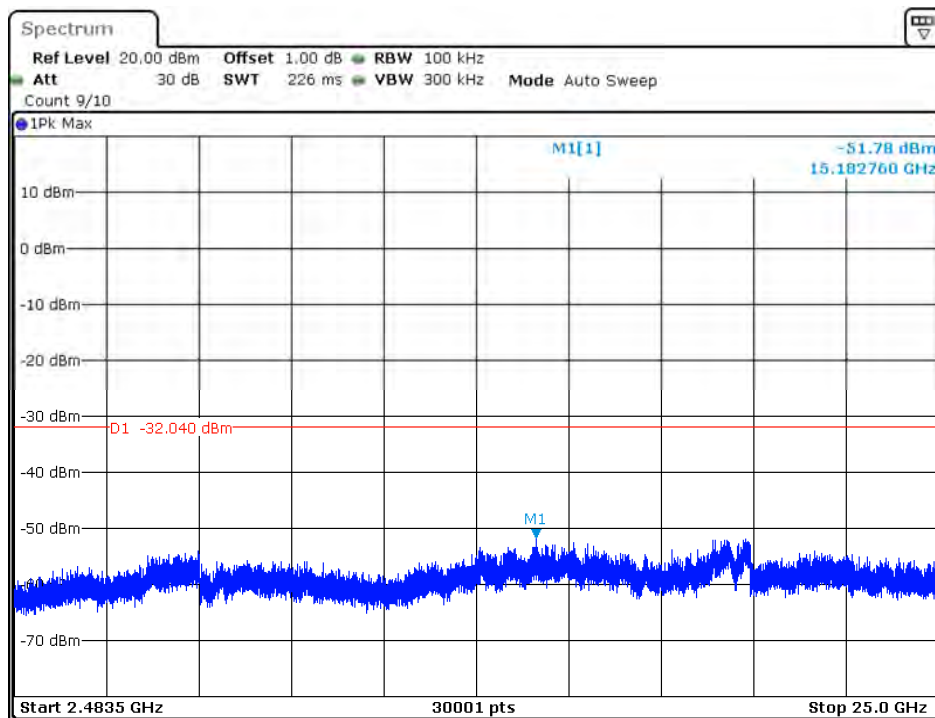
Channel 06 (2437MHz) Reference Level: -12.04dBm



Date: 29.OCT.2020 14:17:35

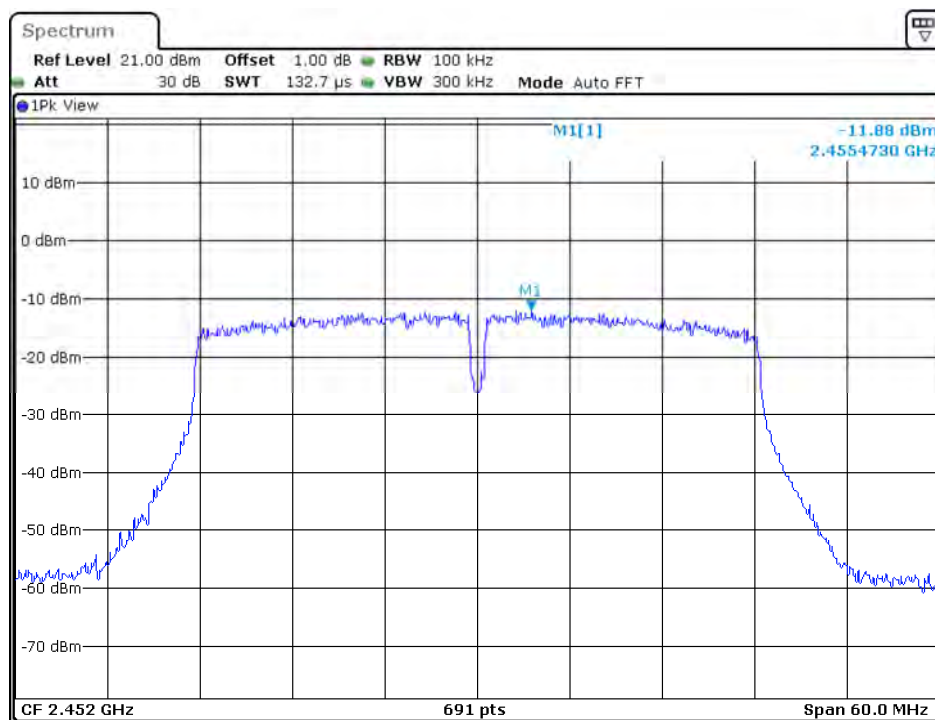


Date: 29.OCT.2020 14:17:40

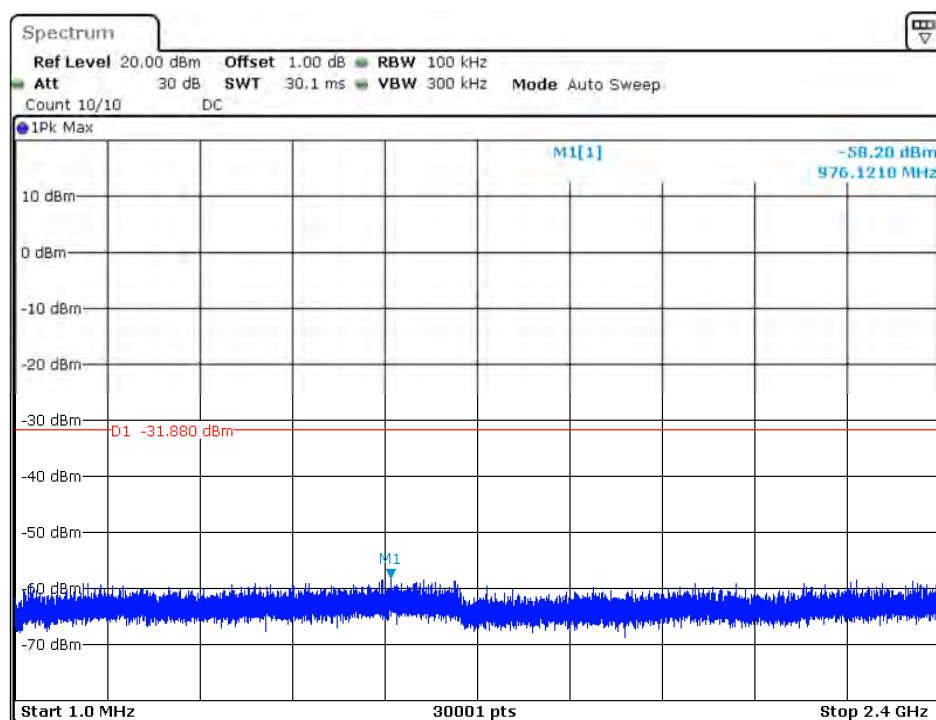


Date: 29.OCT.2020 14:17:47

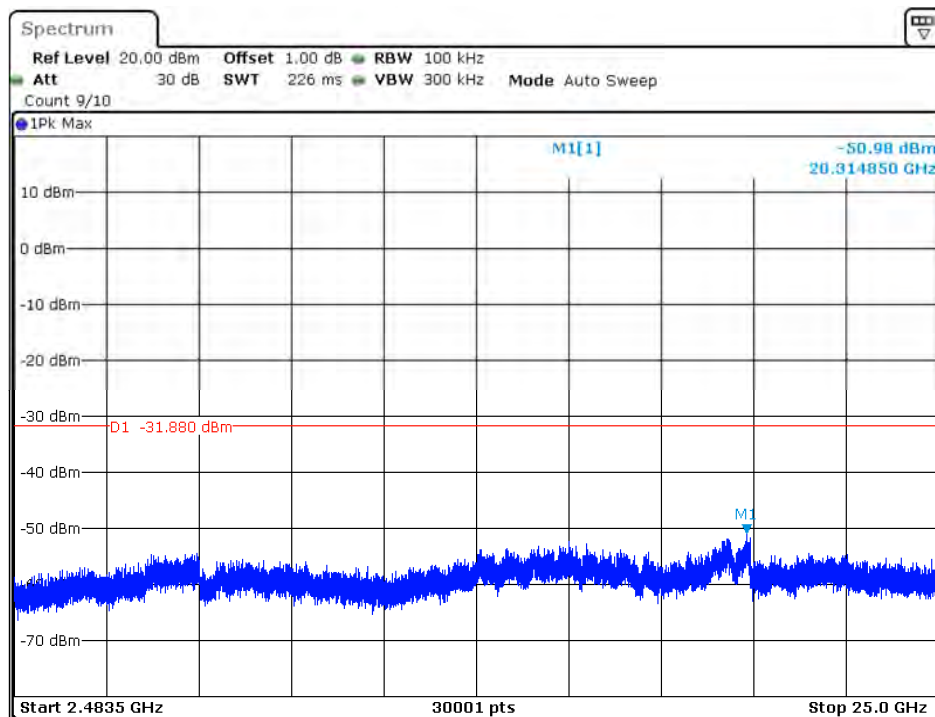
Channel 11 (2452MHz) Reference Level: -11.88dBm



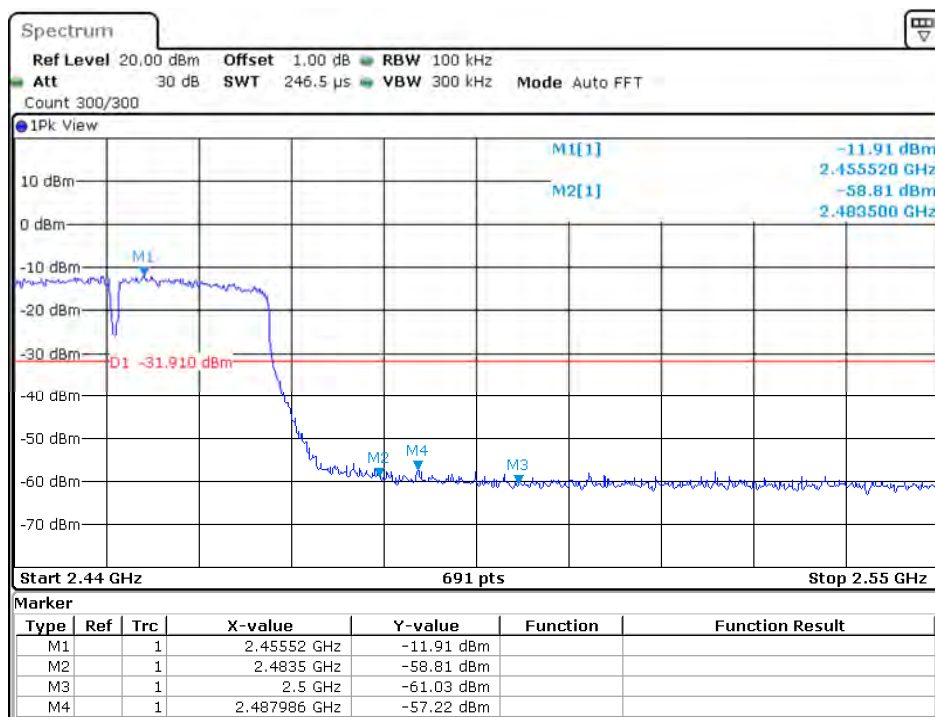
Date: 29.OCT.2020 14:20:19



Date: 29.OCT.2020 14:20:24



Date: 29.OCT.2020 14:20:32



Date: 29.OCT.2020 14:20:08

Applicant: Shenzhen Chuangwei-RGB Electronics Co., Ltd.

Date of Test: 29 October 2020

Model: NTUD-U21

4.5 Out of Band Radiated Emissions (for emissions in 4.4 above that are less than 20dB below carrier), FCC Rule 15.247(d):

For out of band emissions that are close to or that exceed the 20dB attenuation requirement described in the specification, radiated measurements were performed at a 3m separation distance to determine whether these emissions complied with the general radiated emission requirement.

- ☒ Not required, since all emissions are more than 20dB below fundamental
☐ See attached data sheet

Applicant: Shenzhen Chuangwei-RGB Electronics Co., Ltd.

Date of Test: 31 October 2020

Model: NTUD-U21

4.6 Transmitter Radiated Emissions in Restricted Bands, FCC Rule 15.35(b) (c):

Data is included of the worst case configuration (the configuration which resulted in the highest emission levels). A sample calculation, configuration photographs and data tables of the emissions are included. All measurements were performed with peak detection unless otherwise specified.

The data on the following pages list the significant emission frequencies, the limit and the margin of compliance.

Applicant: Shenzhen Chuangwei-RGB Electronics Co., Ltd.

Date of Test: 31 October 2020

Model: NTUD-U21

4.7 Field Strength Calculation

The field strength is calculated by adding the reading on the Spectrum Analyzer to the factors associated with preamplifiers (if any), antennas, cables, pulse desensitization and average factors (when specified limit is in average and measurements are made with peak detectors). A sample calculation is included below.

$$FS = RA + AF + CF - AG + PD$$

Where FS = Field Strength in dB μ V/m
 RA = Receiver Amplitude (including preamplifier) in dB μ V
 CF = Cable Attenuation Factor in dB
 AF = Antenna Factor in dB
 AG = Amplifier Gain in dB
 PD = Pulse Desensitization in dB

In the radiated emission table which follows, the reading shown on the data table may reflect the preamplifier gain. An example of the calculations, where the reading does not reflect the preamplifier gain, follows:

$$FS = RA + AF + CF - AG + PD$$

Example

Assume a receiver reading of 62.0 dB μ V is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted. The pulse desensitization factor of the spectrum analyzer was 0 dB. The net field strength for comparison to the appropriate emission limit is 42 dB μ V/m. This value in dB μ V/m was converted to its corresponding level in μ V/m.

$$RA = 62.0 \text{ dB}\mu\text{V}$$

$$AF = 7.4 \text{ dB}$$

$$CF = 1.6 \text{ dB}$$

$$AG = 29.0 \text{ dB}$$

$$PD = 0 \text{ dB}$$

$$FS = 62 + 7.4 + 1.6 - 29 + 0 = 42 \text{ dB}\mu\text{V/m}$$

$$\text{Level in mV/m} = \text{Common Antilogarithm} [(42 \text{ dB}\mu\text{V/m})/20] = 125.9 \mu\text{V/m}$$

Applicant: Shenzhen Chuangwei-RGB Electronics Co., Ltd.

Date of Test: 31 October 2020

Model: NTUD-U21

4.8 Radiated Spurious Emission

Worst Case Radiated Spurious Emission
at 4824.000MHz
is passed by 3.5dB margin.

For the electronic filing, the worst case radiated emission configuration photographs are saved with filename: radiated photos.pdf. Simultaneous transmission was considered during the test, only the worst case data is recorded in this report.

Applicant: Shenzhen Chuangwei-RGB Electronics Co., Ltd.

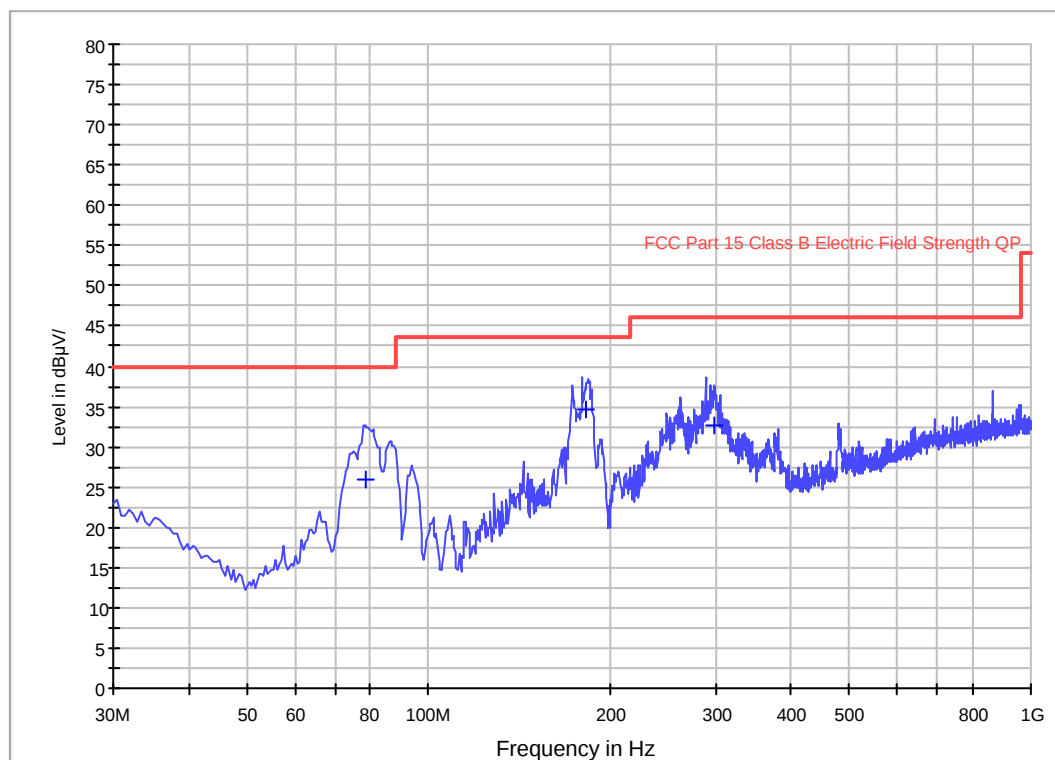
Date of Test: 31 October 2020

Model: NTUD-U21

Worst Case Operating Mode:

Simultaneous transmission

ANT Polarity: Horizontal



Frequency (MHz)	QuasiPeak (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Polarization	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBμV/m)
79.000000	25.9	1000.0	120.000	H	9.0	14.1	40.0
183.260000	34.6	1000.0	120.000	H	12.7	8.9	43.5
297.720000	32.6	1000.0	120.000	H	16.7	13.4	46.0

Remark:

1. Corr. = Antenna Factor (dB/m) + Cable Loss (dB)
2. QuasiPeak (dBμV/m) = Corr. (dB/m) + Read Level (dBμV)
3. Margin (dB) = Limit Line (dBμV/m) – Level (dBμV/m)

Applicant: Shenzhen Chuangwei-RGB Electronics Co., Ltd.

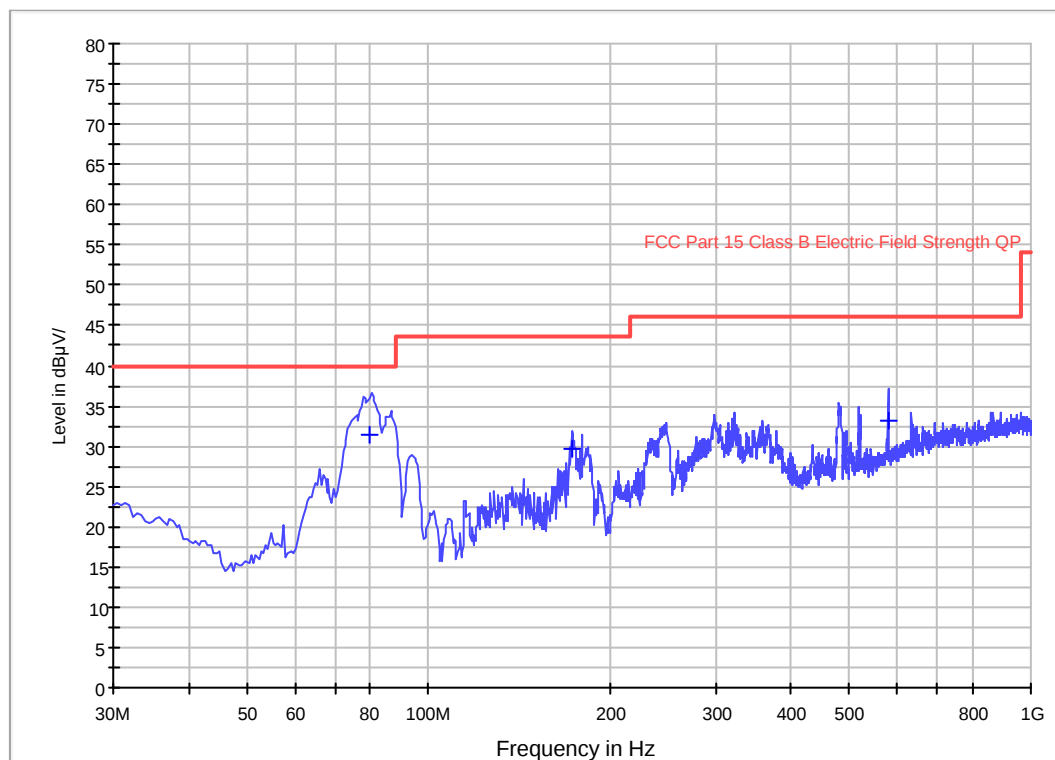
Date of Test: 31 October 2020

Model: NTUD-U21

Worst Case Operating Mode:

Simultaneous transmission

ANT Polarity: Vertical



Frequency (MHz)	QuasiPeak (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Polarization	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBμV/m)
80.000000	31.5	1000.0	120.000	V	9.1	8.5	40.0
173.075000	29.6	1000.0	120.000	V	12.3	13.9	43.5
578.535000	33.2	1000.0	120.000	V	23.8	12.8	46.0

Remark:

1. Corr. = Antenna Factor (dB/m) + Cable Loss (dB)
2. QuasiPeak (dBμV/m) = Corr. (dB/m) + Read Level (dBμV)
3. Margin (dB) = Limit Line (dBμV/m) – Level (dBμV/m)

Applicant: Shenzhen Chuangwei-RGB Electronics Co., Ltd.

Date of Test: 31 October 2020

Model: NTUD-U21

Radiated Emissions (above 1GHz)

Worst Case Operating Mode: SISO-ANT1-Transmitting (802.11b-Channel 01)

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Peak Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	*4824.000	52.4	36.8	33.5	49.1	74.0	-24.9
Horizontal	*2390.000	63.0	36.4	29.1	55.7	74.0	-18.3

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Average Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	*4824.000	43.1	36.8	33.5	39.8	54.0	-14.2
Horizontal	*2390.000	52.6	36.4	29.1	45.3	54.0	-8.7

Worst Case Operating Mode: SISO-ANT1-Transmitting (802.11b-Channel 06)

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Peak Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	*4874.000	52.9	36.7	33.4	49.6	74.0	-24.4
Horizontal	*7311.000	56.1	36.6	35.8	55.3	74.0	-18.7

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Average Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	*4874.000	43.3	36.7	33.4	40.0	54.0	-14.0
Horizontal	*7311.000	46.4	36.6	35.8	45.6	54.0	-8.4

Worst Case Operating Mode: SISO-ANT1-Transmitting (802.11b-Channel 11)

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Peak Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	*4924.000	53.3	36.8	33.3	49.8	74.0	-24.2
Horizontal	*7386.000	62.4	36.5	29.3	55.2	74.0	-18.8

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Average Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	*4924.000	43.2	36.8	33.3	39.7	54.0	-14.3
Horizontal	*7386.000	52.7	36.5	29.3	45.5	54.0	-8.5

Worst Case Operating Mode:

SISO-ANT1-Transmitting (802.11g-Channel 01)

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Peak Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	*4824.000	52.6	36.8	33.5	49.3	74.0	-24.7
Horizontal	*2390.000	62.7	36.4	29.1	55.4	74.0	-18.6

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Average Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	*4824.000	43.2	36.8	33.5	39.9	54.0	-14.1
Horizontal	*2390.000	53.0	36.4	29.1	45.7	54.0	-8.3

Worst Case Operating Mode:

SISO-ANT1-Transmitting (802.11g-Channel 06)

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Peak Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	*4874.000	53.2	36.7	33.4	49.9	74.0	-24.1
Horizontal	*7311.000	55.8	36.6	35.8	55.0	74.0	-19.0

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Average Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	*4874.000	43.6	36.7	33.4	40.3	54.0	-13.7
Horizontal	*7311.000	46.3	36.6	35.8	45.5	54.0	-8.5

Worst Case Operating Mode:

SISO-ANT1-Transmitting (802.11g-Channel 11)

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Peak Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	*4924.000	53.4	36.8	33.3	49.9	74.0	-24.1
Horizontal	*7386.000	62.3	36.5	29.3	55.1	74.0	-18.9

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Average Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	*4924.000	42.9	36.8	33.3	39.4	54.0	-14.6
Horizontal	*7386.000	52.3	36.5	29.3	45.1	54.0	-8.9

Worst Case Operating Mode:

SISO-ANT1-Transmitting (802.11n20-Channel 01)

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Peak Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	*4824.000	51.9	36.8	33.5	48.6	74.0	-25.4
Horizontal	*2390.000	62.4	36.4	29.1	55.1	74.0	-18.9

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Average Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	*4824.000	42.9	36.8	33.5	39.6	54.0	-14.4
Horizontal	*2390.000	53.0	36.4	29.1	45.7	54.0	-8.3

Worst Case Operating Mode:

SISO-ANT1-Transmitting (802.11n20-Channel 06)

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Peak Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	*4874.000	53.0	36.7	33.4	49.7	74.0	-24.3
Horizontal	*7311.000	56.0	36.6	35.8	55.2	74.0	-18.8

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Average Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	*4874.000	42.9	36.7	33.4	39.6	54.0	-14.4
Horizontal	*7311.000	46.0	36.6	35.8	45.2	54.0	-8.8

Worst Case Operating Mode:

SISO-ANT1-Transmitting (802.11n20-Channel 11)

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Peak Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	*4924.000	53.3	36.8	33.3	49.8	74.0	-24.2
Horizontal	*7386.000	62.8	36.5	29.3	55.6	74.0	-18.4

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Average Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	*4924.000	43.3	36.8	33.3	39.8	54.0	-14.2
Horizontal	*7386.000	52.9	36.5	29.3	45.7	54.0	-8.3

Worst Case Operating Mode:

SISO-ANT1-Transmitting (802.11n40-Channel 03)

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Peak Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	*4844.000	53.6	36.8	33.5	50.3	74.0	-23.7
Horizontal	*2390.000	63.2	36.4	29.1	55.9	74.0	-18.1

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Average Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	*4844.000	43.4	36.8	33.5	40.1	54.0	-13.9
Horizontal	*2390.000	53.1	36.4	29.1	45.8	54.0	-8.2

Worst Case Operating Mode:

SISO-ANT1-Transmitting (802.11n40-Channel 06)

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Peak Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	*4874.000	52.9	36.7	33.4	49.6	74.0	-24.4
Horizontal	*7311.000	56.5	36.6	35.8	55.7	74.0	-18.3

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Average Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	*4874.000	43.5	36.7	33.4	40.2	54.0	-13.8
Horizontal	*7311.000	46.6	36.6	35.8	45.8	54.0	-8.2

Worst Case Operating Mode:

SISO-ANT1-Transmitting (802.11n40-Channel 09)

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Peak Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	*4904.000	53.8	36.8	33.3	50.3	74.0	-23.7
Horizontal	*7356.000	62.9	36.5	29.3	55.7	74.0	-18.3

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Average Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	*4904.000	42.9	36.8	33.3	39.4	54.0	-14.6
Horizontal	*7356.000	53.0	36.5	29.3	45.8	54.0	-8.2

Worst Case Operating Mode:
SISO-ANT2-Transmitting (802.11b-Channel 01)

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Peak Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	*4824.000	60.6	36.8	33.5	57.3	74.0	-16.7
Horizontal	*2390.000	62.4	36.4	29.1	55.1	74.0	-18.9

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Average Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	*4824.000	53.8	36.8	33.5	50.5	54.0	-3.5
Horizontal	*2390.000	52.5	36.4	29.1	45.2	54.0	-8.8

Worst Case Operating Mode:
SISO-ANT2-Transmitting (802.11b-Channel 06)

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Peak Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	*4874.000	56.5	36.7	33.4	53.2	74.0	-20.8
Horizontal	*7311.000	55.4	36.6	35.8	54.6	74.0	-19.4

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Average Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	*4874.000	44.9	36.7	33.4	41.6	54.0	-12.4
Horizontal	*7311.000	44.0	36.6	35.8	43.2	54.0	-10.8

Worst Case Operating Mode:
SISO-ANT2-Transmitting (802.11b-Channel 11)

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Peak Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	*4924.000	56.9	36.8	33.3	53.4	74.0	-20.6
Horizontal	*7386.000	61.3	36.5	29.3	54.1	74.0	-19.9

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Average Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	*4924.000	47.5	36.8	33.3	44.0	54.0	-10.0
Horizontal	*7386.000	51.5	36.5	29.3	44.3	54.0	-9.7

Worst Case Operating Mode:

SISO-ANT2-Transmitting (802.11g-Channel 01)

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Peak Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	*4824.000	57.2	36.8	33.5	53.9	74.0	-20.1
Horizontal	*2390.000	63.1	36.4	29.1	55.8	74.0	-18.2

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Average Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	*4824.000	45.1	36.8	33.5	41.8	54.0	-12.2
Horizontal	*2390.000	53.3	36.4	29.1	46.0	54.0	-8.0

Worst Case Operating Mode:

SISO-ANT2-Transmitting (802.11g-Channel 06)

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Peak Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	*4874.000	56.8	36.7	33.4	53.5	74.0	-20.5
Horizontal	*7311.000	54.9	36.6	35.8	54.1	74.0	-19.9

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Average Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	*4874.000	44.0	36.7	33.4	40.7	54.0	-13.3
Horizontal	*7311.000	45.0	36.6	35.8	44.2	54.0	-9.8

Worst Case Operating Mode:

SISO-ANT2-Transmitting (802.11g-Channel 11)

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Peak Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	*4924.000	56.7	36.8	33.3	53.2	74.0	-20.8
Horizontal	*7386.000	61.3	36.5	29.3	54.1	74.0	-19.9

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Average Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	*4924.000	44.0	36.8	33.3	40.5	54.0	-13.5
Horizontal	*7386.000	51.8	36.5	29.3	44.6	54.0	-9.4

Worst Case Operating Mode:

SISO-ANT2-Transmitting (802.11n20-Channel 01)

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Peak Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	*4824.000	57.5	36.8	33.5	54.2	74.0	-19.8
Horizontal	*2390.000	63.0	36.4	29.1	55.7	74.0	-18.3

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Average Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	*4824.000	45.4	36.8	33.5	42.1	54.0	-11.9
Horizontal	*2390.000	53.2	36.4	29.1	45.9	54.0	-8.1

Worst Case Operating Mode:

SISO-ANT2-Transmitting (802.11n20-Channel 06)

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Peak Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	*4874.000	56.9	36.7	33.4	53.6	74.0	-20.4
Horizontal	*7311.000	54.7	36.6	35.8	53.9	74.0	-20.1

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Average Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	*4874.000	44.9	36.7	33.4	41.6	54.0	-12.4
Horizontal	*7311.000	44.6	36.6	35.8	43.8	54.0	-10.2

Worst Case Operating Mode:

SISO-ANT2-Transmitting (802.11n20-Channel 11)

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Peak Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	*4924.000	57.0	36.8	33.3	53.5	74.0	-20.5
Horizontal	*7386.000	61.2	36.5	29.3	54.0	74.0	-20.0

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Average Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	*4924.000	45.3	36.8	33.3	41.8	54.0	-12.2
Horizontal	*7386.000	52.0	36.5	29.3	44.8	54.0	-9.2

Worst Case Operating Mode:

SISO-ANT2-Transmitting (802.11n40-Channel 03)

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Peak Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	*4844.000	56.5	36.8	33.5	53.2	74.0	-20.8
Horizontal	*2390.000	62.4	36.4	29.1	55.1	74.0	-18.9

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Average Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	*4844.000	43.6	36.8	33.5	40.3	54.0	-13.7
Horizontal	*2390.000	52.6	36.4	29.1	45.3	54.0	-8.7

Worst Case Operating Mode:

SISO-ANT2-Transmitting (802.11n40-Channel 06)

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Peak Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	*4874.000	53.9	36.7	33.4	50.6	74.0	-23.4
Horizontal	*7311.000	54.6	36.6	35.8	53.8	74.0	-20.2

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Average Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	*4874.000	43.4	36.7	33.4	40.1	54.0	-13.9
Horizontal	*7311.000	45.0	36.6	35.8	44.2	54.0	-9.8

Worst Case Operating Mode:

SISO-ANT2-Transmitting (802.11n40-Channel 09)

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Peak Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	*4904.000	53.6	36.8	33.3	50.1	74.0	-23.9
Horizontal	*7356.000	61.8	36.5	29.3	54.6	74.0	-19.4

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Average Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	*4904.000	43.7	36.8	33.3	40.2	54.0	-13.8
Horizontal	*7356.000	52.3	36.5	29.3	45.1	54.0	-8.9

Worst Case Operating Mode:
MIMO-Transmitting (802.11n20-Channel 01)

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Peak Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	*4824.000	64.7	36.8	33.5	61.4	74.0	-12.6
Horizontal	*2390.000	66.0	36.4	29.1	58.7	74.0	-15.3

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Average Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	*4824.000	44.8	36.8	33.5	41.5	54.0	-12.5
Horizontal	*2390.000	47.2	36.4	29.1	39.9	54.0	-14.1

Worst Case Operating Mode:
MIMO-Transmitting (802.11n20-Channel 06)

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Peak Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	*4874.000	64.8	36.7	33.4	61.5	74.0	-12.5
Horizontal	*7311.000	61.5	36.6	35.8	60.7	74.0	-13.3

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Average Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	*4874.000	46.7	36.7	33.4	43.4	54.0	-10.6
Horizontal	*7311.000	41.4	36.6	35.8	40.6	54.0	-13.4

Worst Case Operating Mode:
MIMO-Transmitting (802.11n20-Channel 11)

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Peak Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	*4924.000	64.6	36.8	33.3	61.1	74.0	-12.9
Horizontal	*7386.000	65.7	36.5	29.3	58.5	74.0	-15.5

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Average Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	*4924.000	52.6	36.8	33.3	49.1	54.0	-4.9
Horizontal	*7386.000	51.4	36.5	29.3	44.2	54.0	-9.8

Worst Case Operating Mode:
MIMO-Transmitting (802.11n40-Channel 03)

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Peak Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	*4844.000	65.8	36.8	33.5	62.5	74.0	-11.5
Horizontal	*2390.000	63.1	36.4	29.1	55.8	74.0	-18.2

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Average Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	*4844.000	46.7	36.8	33.5	43.4	54.0	-10.6
Horizontal	*2390.000	45.7	36.4	29.1	38.4	54.0	-15.6

Worst Case Operating Mode:
MIMO-Transmitting (802.11n40-Channel 06)

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Peak Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	*4874.000	64.0	36.7	33.4	60.7	74.0	-13.3
Horizontal	*7311.000	55.1	36.6	35.8	54.3	74.0	-19.7

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Average Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	*4874.000	44.0	36.7	33.4	40.7	54.0	-13.3
Horizontal	*7311.000	36.3	36.6	35.8	35.5	54.0	-18.5

Worst Case Operating Mode:
MIMO-Transmitting (802.11n40-Channel 09)

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Peak Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	*4904.000	65.8	36.8	33.3	62.3	74.0	-11.7
Horizontal	*7356.000	63.3	36.5	29.3	56.1	74.0	-17.9

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Average Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	*4904.000	46.6	36.8	33.3	43.1	54.0	-10.9
Horizontal	*7356.000	44.8	36.5	29.3	37.6	54.0	-16.4

NOTES: 1. Peak detector is used, RBW=1MHz/VBW=3MHz for peak value and RBW=1MHz/VBW=10Hz for average value.

2. All measurements were made at 3 meters. Radiated emissions not detected at the 3-meter distance were measured at 0.3-meter and an inverse proportional extrapolation was performed to compare the signal level to the 3-meter limit. No other radiated emissions than those reported were detected at a test distance of 0.3-meter.
3. Negative value in the margin column shows emission below limit.
4. Horn antenna used for the emission over 1000MHz.
- * Emission within the restricted band meets the requirement of section 15.205. The corresponding limit as per 15.209 is based on Quasi peak limit for frequencies below 1000 MHz and average limit for frequencies over 1000 MHz. The radio frequency emissions above 1GHz also meet corresponding 20dB permitted peak limit with a peak detector function.

Applicant: Shenzhen Chuangwei-RGB Electronics Co., Ltd.

Date of Test: 31 October 2020

Model: NTUD-U21

4.9 Conducted Emission

Simultaneous transmission was considered during the test, only the worst case data is recorded in this report.

Worst Case Conducted Emission
at 0.538MHz
is passed by 12.6dB margin.

For the electronic filing, the worst case radiated emission configuration photographs are saved with filename: conducted photos.pdf.

Applicant: Shenzhen Chuangwei-RGB Electronics Co., Ltd.

Date of Test: 31 October 2020

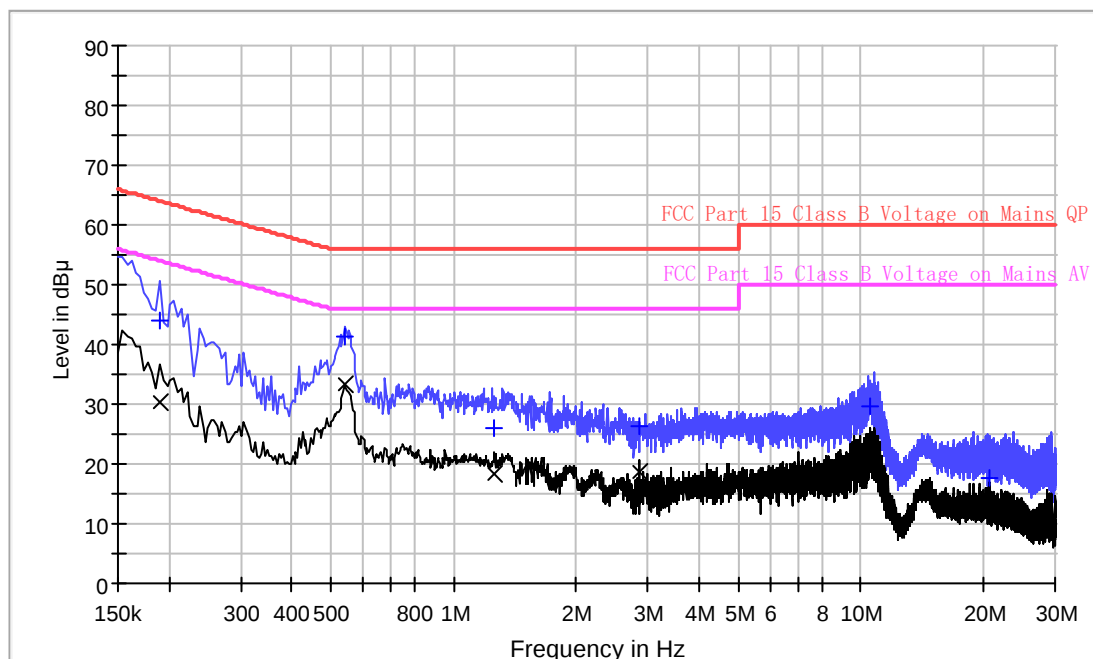
Model: NTUD-U21

Worst Case Operating Mode: Simultaneous transmission

Phase: Live

Graphic / Data Table

Conducted Emissions Pursuant to FCC 15.207: Emissions Requirement



Limit and Margin QP

Frequency (MHz)	QuasiPeak (dBμV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.190500	43.8	9.000	L1	9.7	20.2	64.0
0.538000	41.3	9.000	L1	9.7	14.7	56.0
1.262000	25.9	9.000	L1	9.7	30.1	56.0
2.866000	26.3	9.000	L1	9.7	29.7	56.0
10.542000	29.8	9.000	L1	9.8	30.2	60.0
20.582000	17.5	9.000	L1	10.7	42.5	60.0

Limit and Margin AV

Frequency (MHz)	Average (dBμV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.190500	30.4	9.000	L1	9.7	23.6	54.0
0.538000	33.4	9.000	L1	9.7	12.6	46.0
1.262000	18.4	9.000	L1	9.7	27.6	46.0
2.866000	18.8	9.000	L1	9.7	27.2	46.0
10.542000	22.3	9.000	L1	9.8	27.7	50.0
20.582000	12.0	9.000	L1	10.7	38.0	50.0

Applicant: Shenzhen Chuangwei-RGB Electronics Co., Ltd.

Date of Test: 31 October 2020

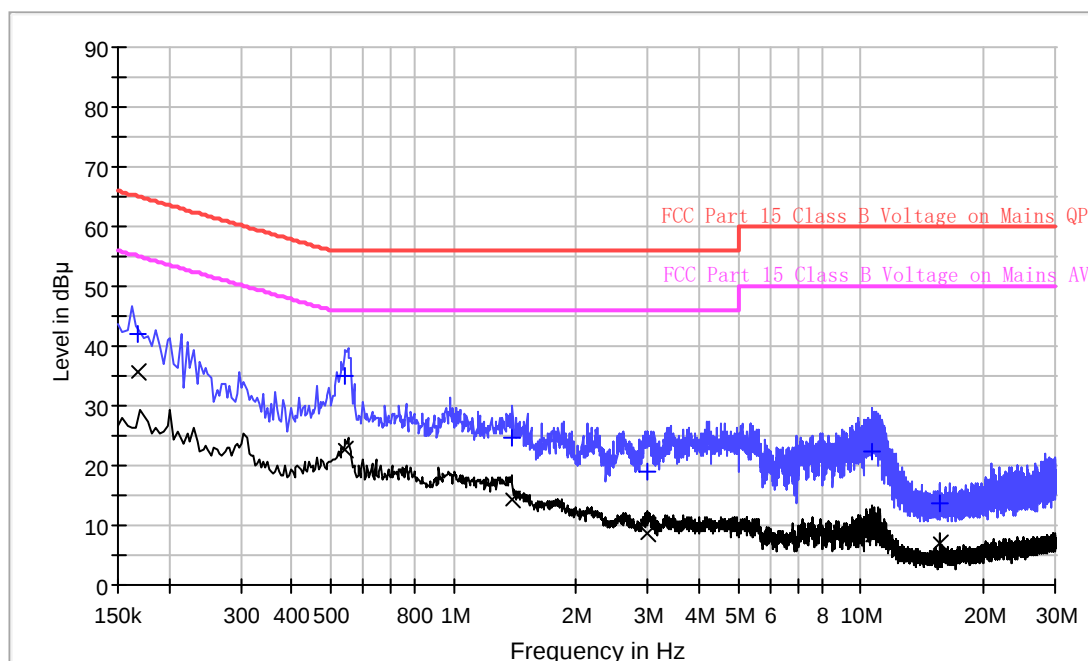
Model: NTUD-U21

Worst Case Operating Mode: Simultaneous transmission

Phase: Neutral

Graphic / Data Table

Conducted Emissions Pursuant to FCC 15.207: Emissions Requirement



Limit and Margin QP

Frequency (MHz)	QuasiPeak (dBuV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBuV)
0.168000	42.0	9.000	N	9.6	23.1	65.1
0.542000	35.0	9.000	N	9.5	21.0	56.0
1.394000	24.7	9.000	N	9.5	31.3	56.0
2.982000	19.2	9.000	N	9.6	36.8	56.0
10.690000	22.3	9.000	N	9.8	37.7	60.0
15.566000	13.6	9.000	N	10.1	46.4	60.0

Limit and Margin AV

Frequency (MHz)	Average (dBuV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBuV)
0.168000	35.6	9.000	N	9.6	19.5	55.1
0.542000	22.5	9.000	N	9.5	23.5	46.0
1.394000	14.2	9.000	N	9.5	31.8	46.0
2.982000	8.7	9.000	N	9.6	37.3	46.0
10.690000	8.2	9.000	N	9.8	41.8	50.0
15.566000	7.0	9.000	N	10.1	43.0	50.0

Applicant: Shenzhen Chuangwei-RGB Electronics Co., Ltd.

Date of Test: 29 October 2020

Model: NTUD-U21

4.10 Radiated Emissions from Digital Section of Transceiver, FCC Ref: 15.109

- ☐ Not required - No digital part
- ☐ Test results are attached
- ☒ Included in the separated report.

Applicant: Shenzhen Chuangwei-RGB Electronics Co., Ltd.
Date of Test: 29 October 2020
Model: NTUD-U21

4.11 Transmitter Duty Cycle Calculation and Measurements, FCC Rule 15.35(b), (c)

The EUT antenna output port was connected to the input of the spectrum analyzer. The analyzer center frequency was set to EUT RF channel carrier. The SWEP function on the analyzer was set to ZERO SPAN. The Transmitter ON time was determined from the resultant time-amplitude display:

	See attached spectrum analyzer chart (s) for Transmitter timing
	See Transmitter timing diagram provided by manufacturer
x	Not applicable, duty cycle was not used.

5.0 Equipment Photographs

For electronic filing, the photographs are saved with filename: external photos.pdf & internal photos.pdf.

6.0 Product Labeling

For electronic filing, the FCC ID label artwork and location is saved with filename: label.pdf.

7.0 Technical Specifications

For electronic filing, the block diagram and circuit diagram are saved with filename: block.pdf and circuit.pdf respectively.

8.0 Instruction Manual

For electronic filing, a preliminary copy of the Instruction Manual is saved with filename: manual.pdf.

This manual will be provided to the end-user with each unit sold/leased in the United States.

9.0 Confidentiality Request

For electronic filing, the confidentiality request of the tested EUT is saved with filename: request.pdf.

10.0 Discussion of Pulse Desensitization

The determination of pulse desensitivity was made in accordance with Hewlett Packard Application Note 150-2, *Spectrum Analysis ... Pulsed RF*.

Pulse desensitivity is not applicable for this device since the transmitter transmits the RF signal continuously.

11.0 Test Equipment List

Equipment No.	Equipment	Manufacturer	Model No.	Serial No.	Cal. Date	Due Date
SZ182-02	RF Power Meter	Anritsu	ML2496A	1302005	2020-05-27	2021-05-27
SZ182-02-01	Power Sensor	Anritsu	MA2411B	1207429	2020-05-27	2021-05-27
SZ061-13	BiConiLog Antenna	ETS	3142E	00217919	2019-06-10	2021-06-10
SZ185-01	EMI Receiver	R&S	ESCI	100547	2019-12-24	2020-12-24
SZ061-08	Horn Antenna	ETS	3115	00092346	2019-09-07	2021-09-07
SZ061-06	Active Loop Antenna	Electro-Metrics	EM-6876	217	2019-05-24	2021-05-24
SZ056-03	Spectrum Analyzer	R&S	FSP 30	101148	2020-05-27	2021-05-27
SZ056-08	Signal Analyzer	R&S	FSV 40	101430	2019-12-24	2020-12-24
SZ181-04	Preamplifier	Agilent	8449B	3008A02474	2020-05-27	2021-05-27
SZ188-01	Anechoic Chamber	ETS	RFD-F/A-100	4102	2018-12-15	2021-12-15
SZ062-02	RF Cable	RADIAL	RG 213U	--	2020-06-12	2020-12-12
SZ062-05	RF Cable	RADIAL	0.04-26.5GHz	--	2020-08-24	2021-02-24
SZ062-12	RF Cable	RADIAL	0.04-26.5GHz	--	2020-08-24	2021-02-24
SZ067-04	Notch Filter	Micro-Tronics	BRM50702-02	--	2020-05-27	2021-05-27
SZ185-02	EMI Test Receiver	R&S	ESCI	100692	2020-10-17	2021-10-17
SZ187-02	Two-Line V-Network	R&S	ENV216	100073	2020-05-27	2021-05-27
SZ188-03	Shielding Room	ETS	RFD-100	4100	2018-12-15	2021-12-15

***** End of Report*****