FCC/IC Test Report

FOR

Intel Corporation

Model Number: CZ120

Product Description: HSPA+ Smartphone

FCC ID: O2Z-CZ120
IC ID: 1000W-CZ120

47 CFR Part 15. 407 (NII), 5GHz WLAN (UNII)

IC RSS-210 Issue 8, Annex 9 (LE-LAN)

TEST REPORT #: EMC_INTEL-032-13001_UNII
DATE: 2013-08-28

FCC : Accredited

IC recognized # 3462B-1

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1 Assessment

The following equipment (and as identified in Ch.3 of this test report) was evaluated against the applicable criteria specified in FCC CFR47 Part 15.407, 15.207, 15.209 and Industry Canada Standards RSS-210 Issue 8, Annex 9.
No deviations were ascertained during the course of the tests performed.

Company	Description	Model #
Intel Corporation	HSPA+ Smartphone	CZ120

Responsible for Testing Laboratory:

Date	Section	Name	Signature
2013-08-28	Compliance	Tunji Yusuf (Test Lab Manager)	

Responsible for the Report:

Date	Section	Name	Signature
2013-08-28	Compliance	Zack Gray (EMC Engineer)	2013.08.28 22:33:56 -07'00'

The test results of this test report relate exclusively to the test item specified in Section3.
CETECOM Inc. USA does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item. The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of CETECOM Inc. USA.

2 Administrative Data

2.1 Identification of the Testing Laboratory Issuing the Test Report

Company Name:	CETECOM Inc.
Department:	Compliance
Address:	411 Dixon Landing Road Milpitas, CA 95035 U.S.A.
Telephone:	+1 (408) 586 6200
Fax:	+1 (408) 586 6299
Test Lab Manager:	Tunji Yusuf
Responsible Project Leader:	Zack Gray

2.2 Identification of the Client

Applicant's Name:	Intel Corporation
Street Address:	2200 Mission College MS:SC1-20
City/Zip Code	Santa Clara, CA 94085
Country	USA
Contact Person:	Christine Ryan
Phone No.	+1 (408) 300-2167
e-mail:	Christine.m.ryan@intel.com

2.3 Identification of the Manufacturer

Manufacturer's Name:	Same as client.
Manufacturers Address:	
City/Zip Code	
Country	

3 Equipment under Test (EUT)

3.1 Specification of the Equipment under Test

Model Number:	CZ120
FCC-ID :	O2Z-CZ120
IC ID:	1000W-CZ120
Product Description:	Smartphone with multiband GSM/GPRS/EDGE/UMTS/HSPA+, WLAN 802.11 a/b/g/n, Bluetooth, NFC and GPS
Technology / Type(s) of Modulation:	5 GHz 802.11 a/n: BPSK, QPSK, 16QAM, 64QAM
Modes of Operation	**Client;** **Per manufacturer documentation the device is a client device and does not support active scanning or adhoc modes in DFS bands;** TCP is supported; (though not required when mean EIRP < 27 dBm); 1 transmit and 1 receive chain (no MIMO technology support)
Channel Bandwidths	HT20
Operating Frequency Ranges (MHz) / Channels:	Nominal bands: 5150 – 5250 (band 1), 5250 – 5350 (band 2), 5470 – 5725 (band 3), [(5.725 - 5.825 (band 4) tested under 15.247]; Center to center with HT20: 5180(ch 36) – 5240(ch 48), 5260(ch 52) – 5320(ch 64), 5500(ch 100) – 5700(ch 140), 16 channels in total;
Antenna info:	Internal Monopole; Documented maximum antenna gain (5GHz): -1.83dBi
Max. Output Powers:	**Conducted (Measured)** 802.11 a/n:14.1 dBm (0.023 W) **Radiated –EIRP (Calculated with documented antenna gain)** 802.11 a/n: 12.27 dBm (0.047 W)
Rated Operating Voltage Range:	Vmin: 3.6V/ Vnom: 3.8V/ Vmax: 4.2V
Rated Operating Temperature Range:	Tmin: -10°C/ Tmax: 55°C
Test Sample Status:	Prototype

Other Radios included in the device:	1. Intel XMM 6360 Radio Module • GSM 850/900/1800/1900MHz GPRS / EDGE Multislot class 12 operation • WCDMA / HSPA+ 850/900/1900/2100 Mhz 2. BT 2.1+ EDR Texas Instruments WL 1283 chipset 2.4 GHz band of operation 3. GPS 1575.42 MHz 4. NFC (13.56 MHz)

3.2 Identification of the Equipment Under Test (EUT)

EUT #	Serial Number	Sample	HW/SW Version	Notes
1	RHBEC224430225	Radiated	PR2.0 / RHB JB r42-85	-
2	RHBEC244302204	Conducted	PR2.0 / RHB JB r42-85	-

3.3 Identification of Accessory equipment

STE #	Type	Manufacturer	Model	Serial Number
1	AC/DC Adapter	Solcomp	SC1402	12374000330319

3.4 Environmental conditions during Test:

The following environmental conditions were maintained during the course of testing:
Ambient Temperature: 20-25°C
Relative humidity: 40-60%

3.5 Dates of Testing:

05/09/2013 – 06/13/2013

3.6 Other Testing Notes:

The device was configured with a manufacturer provided test SW, capable of setting the unit in different supported modulation schemes, data rates and channels of operation.

The device was set to continuous framed tx (burst) mode per test SW and could thus be operated with 100% duty cycle during testing.

The EUT was tested on the low, mid and high channels of the tested frequency bands (5GHz sub-bands 1, 2 and 3).

In the 5150-5250 MHz band

Mode	Data Rate
802.11a	6M
802.11n	6.5M

In the 5250-5350 MHz and 5470-5725 MHz bands,

Mode	Data Rate
802.11a	6M
802.11n	6.5M

4 Subject of Investigation

The objective of the measurements applied by CETECOM Inc. was to establish compliance of the EUT as described under Ch. 3 of this Test Report, with the applicable criteria specified in

- FCC CFR47 Parts 15.407
- IC RSS-210 Issue 8

This test report is to support a request for new equipment authorization under the FCC ID**: O2Z-CZX20** and IC ID**: 1000W-CZ120**.

5 Summary of Measurement Results

Test Specification	Test Case	Temperature and Voltage Conditions	Mode	Pass	Fail	NA	NP	Result
§15.407 (a)(1) RSS210 A9.2	Power Spectral Density	Nominal	802.11a/n	■	☐	☐	☐	Complies
N/A	Spectrum Bandwidth	Nominal	802.11a/n	■	☐	☐	☐	Complies
§15.407 (a)(1) RSS210 A9.2	Maximum Output Power	Nominal	802.11a/n	■	☐	☐	☐	Complies
§15.407 (a)(6)	Peak Excursion	Nominal	802.11a/n	■	☐	☐	☐	Complies
§15.407 (b)(1)(2)(3) RSS210 A9.3	TX Spurious emissions-Conducted	Nominal	802.11a/n	■	☐	☐	☐	Complies
§15.205 (a)(c)	Restricted Band Edge-Radiated	Nominal	802.11a/n	■	☐	☐	☐	Complies
§15.407 (b)(1)(2)(3) RSS210 A9.3	TX Spurious emissions-Radiated	Nominal	802.11a/n	■	☐	☐	☐	Complies
§15.209(a) RSS Gen	TX Spurious Emissions Radiated<30MHz	Nominal	802.11a/n	■	☐	☐	☐	Complies
§15.207(a) RSS GEN 7.2.2	Conducted Emissions <30MHz	Nominal	802.11a/n	■	☐	☐	☐	Complies
15.407 (h) RSS-210 A9.4	DFS	Nominal	802.11a/n	■	☐	☐	☐	See Note 1

Note: NA= Not Applicable; NP= Not Performed.

1. Refer test report #EMC_INTEL-032-13001_DFS.

6 Measurements

6.1 Radiated Measurement Procedure

6.2 Measurement Method:

In addition to the related rules in FCC 15.407 and RSS-210 Annex 9 the measurement guidelines in FCC publication KDB789033 D01 General UNII Test Procedures v01r03: Guidelines for Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices Part 15, Subpart E, April 2013 has been applied.

6.3 Radiated Measurement Procedure

ANSI C63.4 (2009) Section 8.3.1.1: Exploratory radiated emission measurements

Exploratory radiated measurements shall be performed at the measurement distance or at a closer distance than that specified for compliance to determine the emission characteristics of the EUT. At near distances, for EUTs of comparably small size, it is relatively easy to determine the spectrum signature of the EUT and, if applicable, the EUT configuration that produces the maximum level of emissions. A shielded room may be used for exploratory testing, but may have anomalies that can lead to significant errors in amplitude measurements. Broadband antennas and a spectrum analyzer or a radio-noise meter with a panoramic display are often useful in this type of testing. It is recommended that either a headset or loudspeaker be connected as an aid in detecting ambient signals and finding frequencies of significant emission from the EUT when the exploratory and final testing is performed in an OATS with strong ambient signals. Caution should be taken if either antenna height between 1 and 4 meters or EUT azimuth is not fully explored. Not fully exploring these parameters during exploratory testing may require complete testing at the OATS or semi-anechoic chamber when the final full spectrum testing is conducted.

The EUT should be set up in its typical configuration and arrangement, and operated in its various modes. For tabletop systems, cables or wires should be manipulated within the range of likely arrangements. For floor-standing equipment, the cables or wires should be located in the same manner as the user would install them and no further manipulation is made. For combination EUTs, the tabletop and floor-standing portions of the EUT shall follow the procedures for their respective setups and cable manipulation. If the manner of cable installation is not known, or if it changes with each installation, cables or wires for floor-standing equipment shall be manipulated to the extent possible to produce the maximum level of emissions.

For each mode of operation required to be tested, the frequency spectrum shall be monitored. Variations in antenna height between 1 and 4 m, antenna polarization, EUT azimuth, and cable or wire placement (each variable within bounds specified elsewhere) shall be explored to produce the emission that has the highest amplitude relative to the limit. A step-by-step technique for determining this emission can be found in Annex C. When measuring emissions above 1 GHz, the frequencies of maximum emission shall be determined by manually positioning the antenna close to the EUT and by moving the antenna over all sides of the EUT while observing a spectral display. It will be advantageous to have prior knowledge of the frequencies of emissions above 1 GHz. If the EUT is a device with dimensions approximately equal to that of the measurement antenna beam width, the measurement antenna shall be aligned with the EUT.

ANSI C63.4 (2009) Section 8.3.1.2: Final radiated emission measurements

Based on the measurement results in 8.3.1.1, the one EUT, cable and wire arrangement, and mode of operation that produces the emission that has the highest amplitude relative to the limit is selected for the final measurement. The final measurement is then performed on a site meeting the requirements of 5.3, 5.4, or 5.5 as appropriate without variation of the EUT arrangement or EUT mode of operation. If the EUT is relocated from an exploratory test site to a final test site, the highest emission shall be re-maximized at the final test location before final radiated emissions measurements are performed. However, antenna height and polarity and EUT azimuth are to be varied. In addition, the full frequency spectrum (for the range to be checked for meeting compliance) shall be investigated.

This investigation is performed with the EUT rotated 360°, the antenna height scanned between 1 m and 4 m, and the antenna rotated to repeat the measurements for both the horizontal and vertical antenna polarizations. During the full frequency spectrum investigation, particular focus should be made on those frequencies found in exploratory testing that were used to find the final test configuration, mode of operation, and arrangement (associated with achieving the least margin with respect to the limit). This full spectrum test constitutes the compliance measurement.

For measurements above 1 GHz, use the cable, EUT arrangement, and mode of operation determined in the exploratory testing to produce the emission that has the highest amplitude relative to the limit. Place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the antenna in the "cone of radiation" from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response. The antenna may have to be higher or lower than the EUT, depending on the EUT's size and mounting height, but the antenna should be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane. If the transmission line for the measurement antenna restricts its range of height and polarization, the steps needed to ensure the correct measurement of the maximum emissions, shall be described in detail in the report of measurements. Data collected shall satisfy the report requirements of Clause 10.

NOTES
1— Where limits are specified by agencies for both average and peak (or quasi-peak) detection, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement.
2—Use of waveguide and flexible waveguide may be necessary at frequencies above 10 GHz to achieve usable signal-to noise ratios at required measurement distances. If so, it may be necessary to restrict the height search of the antenna, and special care should be taken to ensure that maximum emissions are correctly measured.
3—All presently known devices causing emissions above 10 GHz are physically small compared with the beam-widths of typical horn antennas used for EMC measurements. For such EUTs and frequencies, it may be preferable to vary the height and polarization of the EUT instead of the receiving antenna to maximize the measured emissions.

Measurement Uncertainty: ±3dB

6.4 Sample Calculations for Radiated Measurements

6.4.1.1 Field Strength Measurements:

Measurements from the Spectrum Analyzer/ Receiver are used to calculate the Field Strength, taking into account the following parameters:

1. Measured reading in dBµV
2. Cable Loss between the receiving antenna and SA in dB and
3. Antenna Factor in dB/m

FS (dBµV/m) = Measured Value on SA (dBµV) + Cable Loss (dB) + Antenna Factor (dB/m)

Eg:

Frequency (MHz)	Measured SA (dBµV)	Cable Loss (dB)	Antenna Factor Correction (dB)	Field Strength Result (dBµV/m)
1000	80.5	3.5	14	98.0

All radiated measurement plots in this report are taken from a test SW that calculates the Field Strength based on the above equation.

6.4.1.2 Power Measurements using Substitution Procedure:

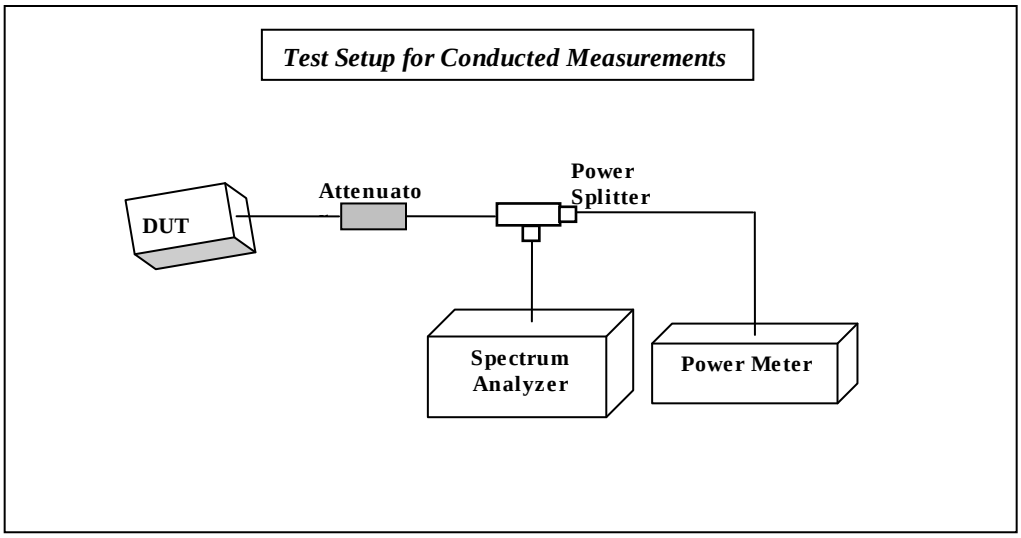
The measurement on the Spectrum Analyzer is used as a basis for the Substitution procedure.
The EUT is replaced with a Signal Generator and an antenna. The setting on the Signal Generator is varied until the Spectrum Analyzer displays the original reading. EIRP is calculated as-

EIRP (dBm)= Signal Generator setting (dBm)- Cable Loss (dB)+ Antenna Gain (dBi)

Eg:

Frequency (MHz)	Measured SA (dBµV)	Signal Generator setting (dBm)	Antenna Gain (dBi)	Dipole Gain (dBd)	Cable Loss (dB)	EIRP (dBm)
1000	95.5	24.5	6.5	0	3.5	27.5

6.5 Conducted Measurement Procedure



1. Connect the equipment as shown in the above diagram.
2. A test SW provided by the manufacturer is used to control the different modulations, data rates and max output power configurations.
3. Measurements are to be performed with the EUT set to the low, middle and high channels for 802.11 a/n modes.

Measurement uncertainty for all conducted measurements: +/-0.5dB

6.6 Maximum Conducted Output Power

6.6.1 Limits: §15.407

The maximum conducted output power shall not exceed the lesser of the following

FCC:
Sub-band 1: 5150-5250MHz: 15.407(a)(1): 50mW(17dBm) or 4dBm + 10log(B),
Sub-band 2: 5250-5350MHz: 15.407(a)(2): 250mW(24dBm) or 11dBm + 10log(B)
Sub-band 3: 5470-5725MHz: 15.407(a)(2): 250mW(24dBm) or 11dBm + 10log(B)
B is the 26–dB emission bandwidth in MHz.
EIRP limit = Conducted Limit + 6dB

IC: (EIRP)
Sub-band 1: 5150-5250MHz: RSS-210 A9.2: 200mW(23dBm) or 10 + 10log(B),
Sub-band 2: 5250-5350MHz: RSS-210 A9.2:1W(30dBm) or 17 + 10log(B)
Sub-band 3: 5470-5725MHz: RSS-210 A9.2: 4W(30dBm) or 23dBm + 10log(B)

6.6.2 Test Conditions:

Tnom: 20ºC; Vnom: 3.8V

6.6.3 Test Procedure used:

General U-NII Test Procedures from FCC Publication #789033

Measurement using a spectrum analyzer (SA)
Method SA-1 (Trace averaging with the EUT Transmitting at full power throughout each sweep):
(i) Set span to encompass the entire emission bandwidth (EBW) of the signal.
(ii) Set RBW = 1 MHz.
(iii) Set VBW ≥ 3 MHz.
(iv) Number of points in sweep ≥ 2 Span / RBW. (This ensures that bin-to-bin spacing is ≤ RBW/2, so that narrowband signals are not lost between frequency bins.)
(v) Sweep time = auto
(vi) Set detector = RMS.
(vii) The EUT must be operated at 100 percent duty cycle.
(viii) Trace average at least 100 traces in power averaging (i.e., RMS) mode.
(ix) Compute power by integrating the spectrum across the 26 dB EBW of the signal using the spectrum analyzer's band power measurement function with band limits set equal to the EBW band edges. If the spectrum analyzer does not have a band power function, sum the spectrum levels (in power units) at 1 MHz intervals extending across the 26 dB EBW of the spectrum.

6.6.4 Test Result:

		Measured Conducted Average Power (dBm)			Calculated EIRP (dBm)		
Frequency (MHz)	**Channel**	**802.11a**	**802.11n/ HT20**	**Limit**	**802.11a**	**802.11n/ HT20**	**Limit**
5180	**36**	12.79	13.13	17	10.96	11.3	23
5200	**40**	13.11	13.24	17	11.28	11.41	23
5240	**48**	13.15	13.25	17	11.32	11.42	23
5260	**52**	13.22	13.28	24	11.39	11.45	27
5300	**60**	12.68	12.60	24	10.85	10.77	27
5320	**64**	12.69	12.81	24	10.86	10.98	27
5500	**100**	13.91	14.10	24	12.08	12.27	27
5600	**120**	12.63	12.84	24	10.8	11.01	27
5700	**140**	12.11	12.32	24	10.28	10.49	27

Note: Plots are available under Sec 6.8
EIRP= Measured conducted output power+ Antenna Gain

6.6.5 Test Verdict:

Pass

6.7 Occupied and Emission Bandwidth

6.7.1 Limits:

None

6.7.2 Test Conditions:

Tnom: 20ºC; Vnom: 3.8V

6.7.3 Test Procedure used:

General U-NII Test Procedures from FCC Publication #789033

Emission bandwidth

1) Set RBW = approximately 1% of the emission bandwidth.
2) Set the VBW > RBW.
3) Detector = Peak.
4) Trace mode = max hold.
5) Measure the maximum width of the emission that is 26 dB down from the peak of the emission. Compare this with the RBW setting of the analyzer. Readjust RBW and repeat measurement as needed until the RBW/EBW ratio is approximately 1%.

99% Occupied Bandwidth

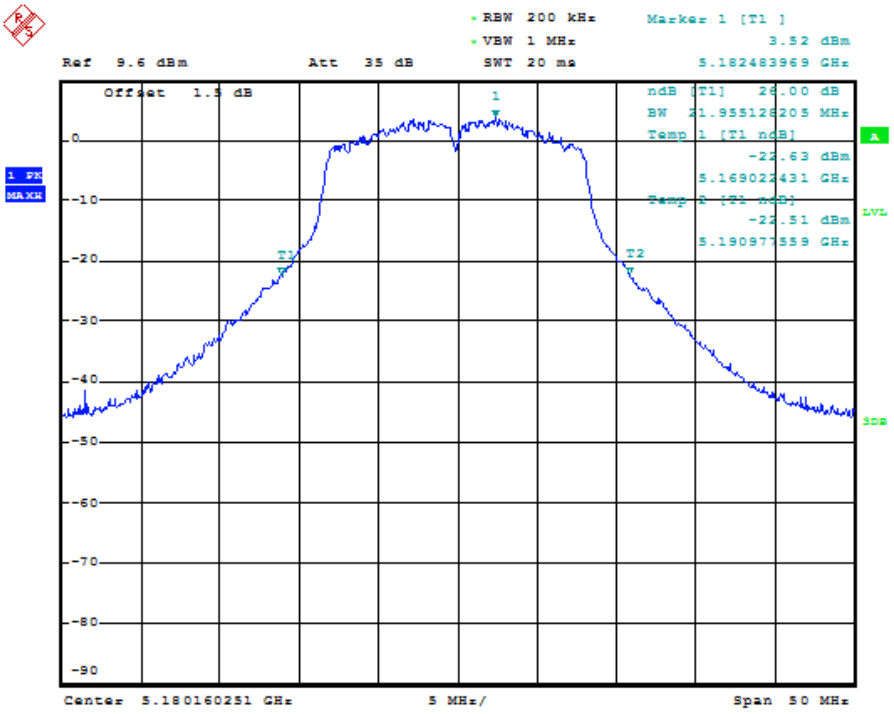
1) Set center frequency to the nominal EUT channel center frequency.
2) Set span = 1.5 times to 5.0 times the OBW.
3) Set RBW = 1 % to 5 % of the OBW
4) Set VBW $\geq 3 \cdot$ RBW
5) Video averaging is not permitted. Where practical, a sample detection and single sweep mode shall be used. Otherwise, peak detection and max hold mode (until the trace stabilizes) shall be used.
6) Use the 99 % power bandwidth function of the instrument (if available).

6.7.4 Test Result:

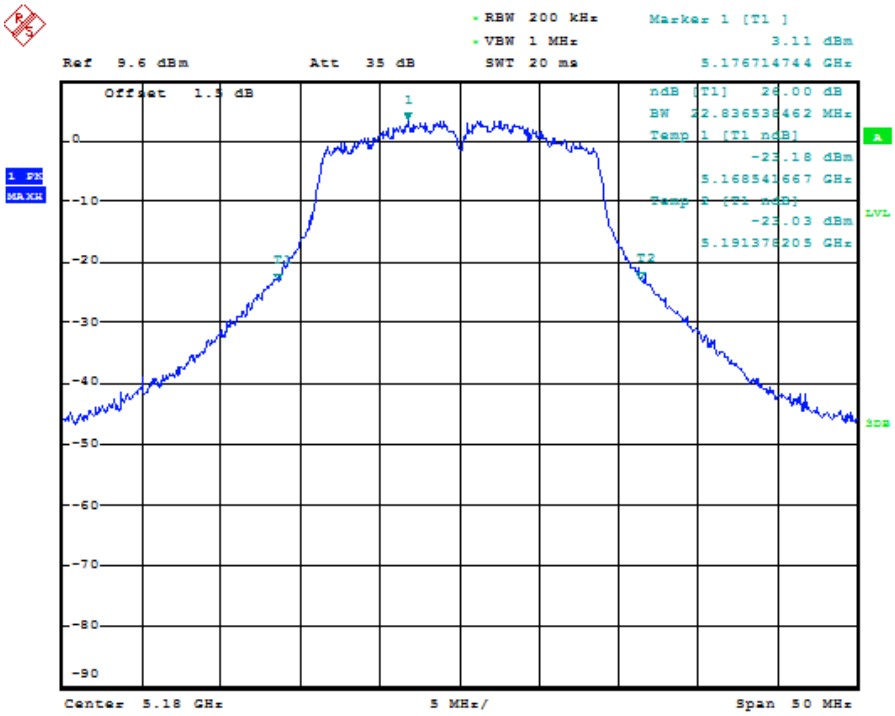
Occupied and Emission Bandwidth (MHz)					
Frequency (MHz)	Channel	802.11a		802.11n/ HT20	
		26 dB	99%	26 dB	99%
5180	36	21.96	16.57	22.84	17.79
5200	40	22.12	16.59	23.48	17.71
5240	48	21.96	16.51	23.24	17.79
5260	52	21.96	16.51	23.16	17.71
5300	60	22.04	16.51	23.08	17.79
5320	64	21.88	16.51	23.16	17.79
5500	100	21.79	16.51	23.32	17.79
5600	120	21.88	16.51	23.00	17.79
5700	140	21.96	16.51	22.92	17.79
Measurement Uncertainty: ±0.01 MHz					

6.7.5 Test Plots:

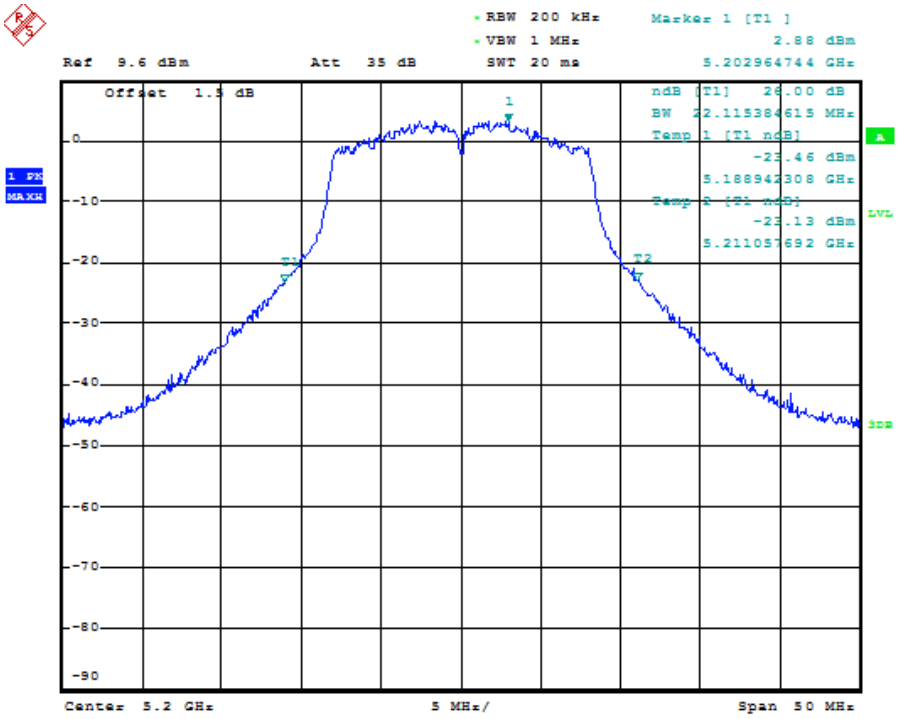
802.11a Channel 36 26dB BW



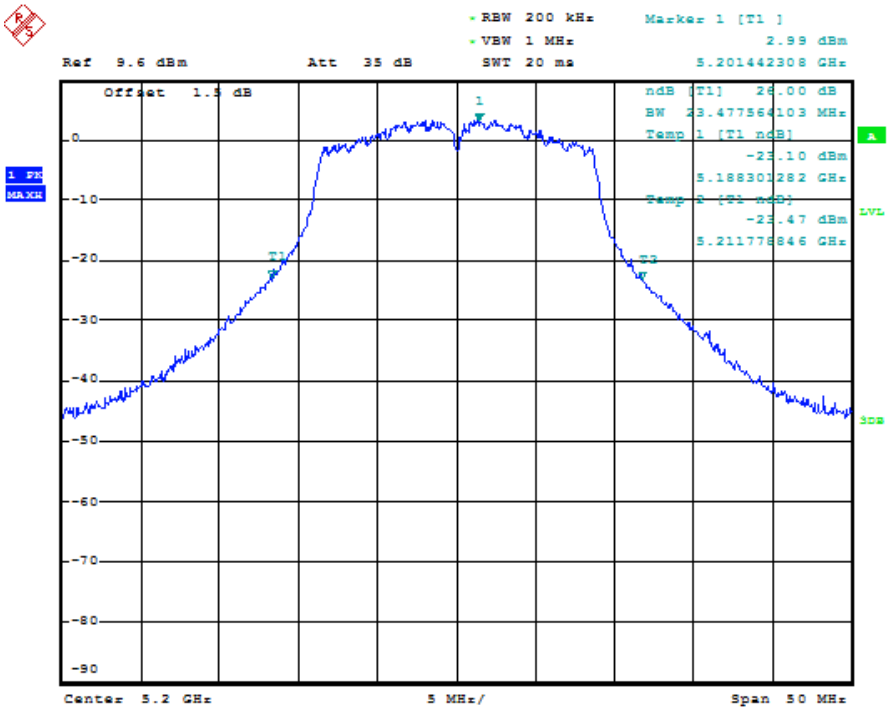
802.11n Channel 36 26dB BW



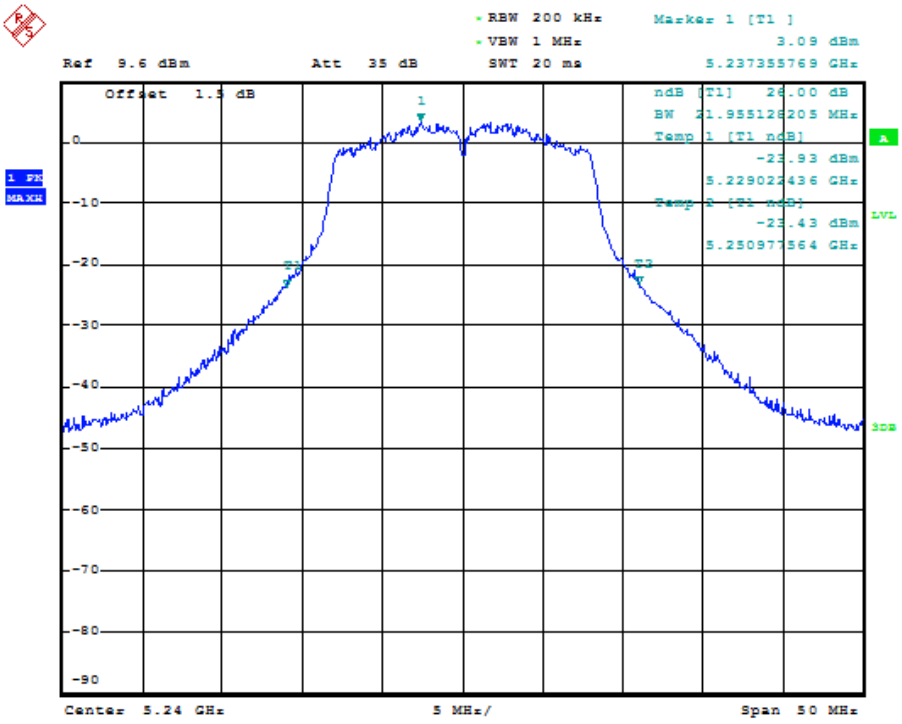
802.11a Channel 40 26dB BW



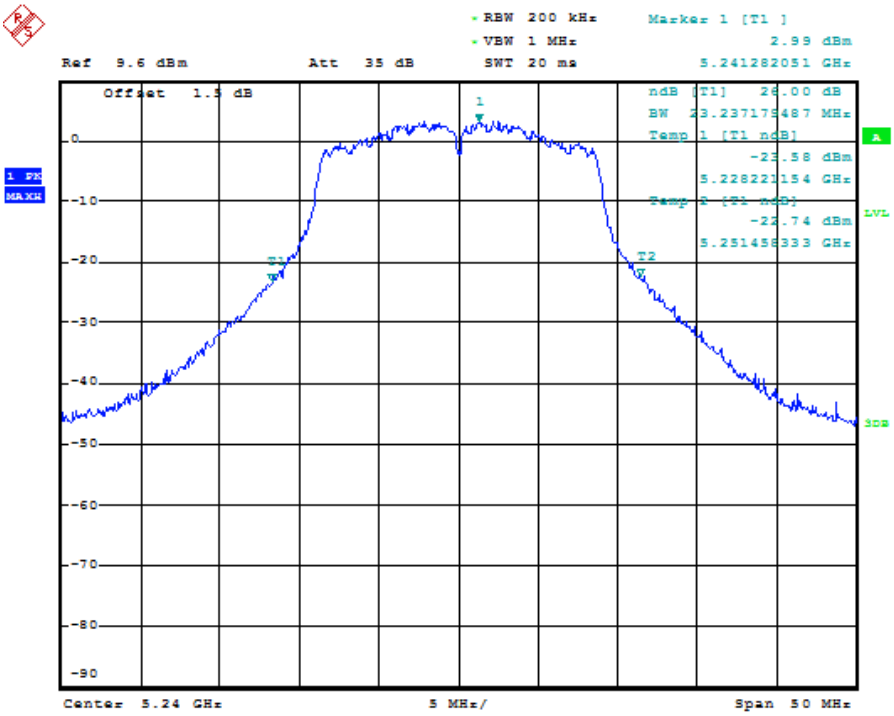
802.11n Channel 40 26dB BW



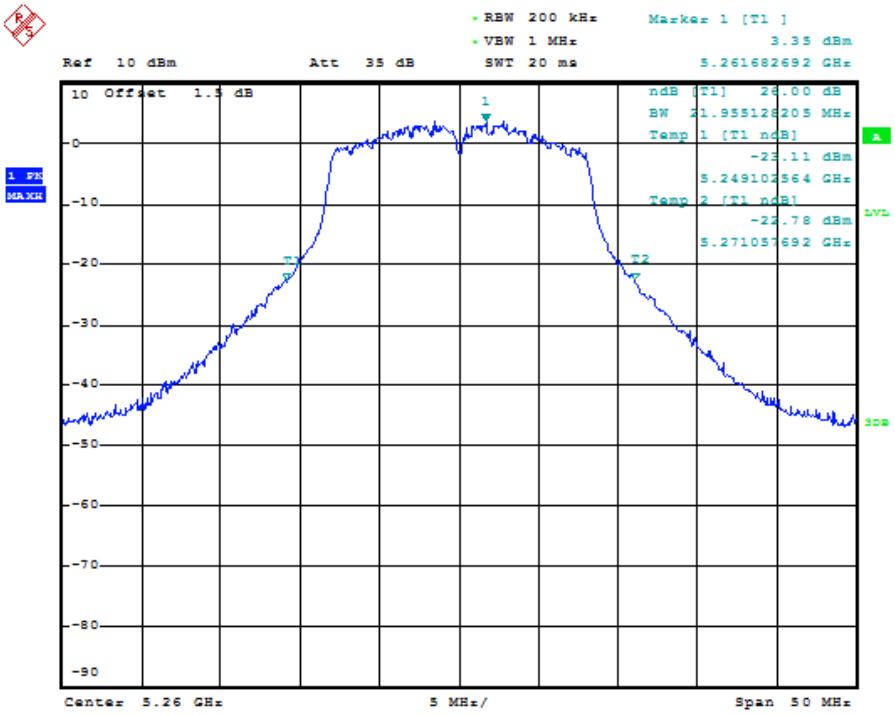
802.11a Channel 48 26dB BW



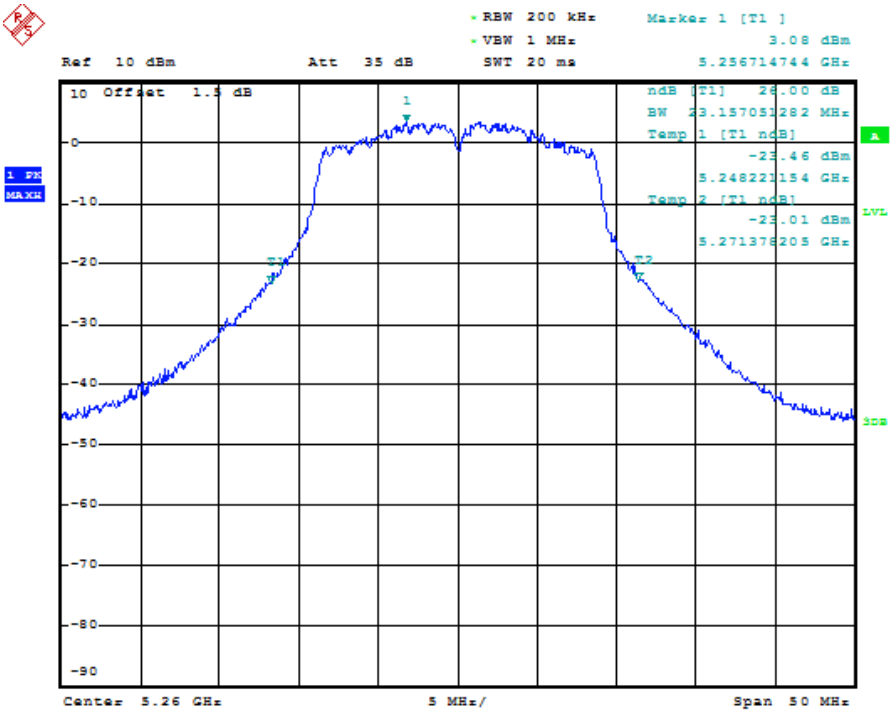
802.11n Channel 48 26dB BW



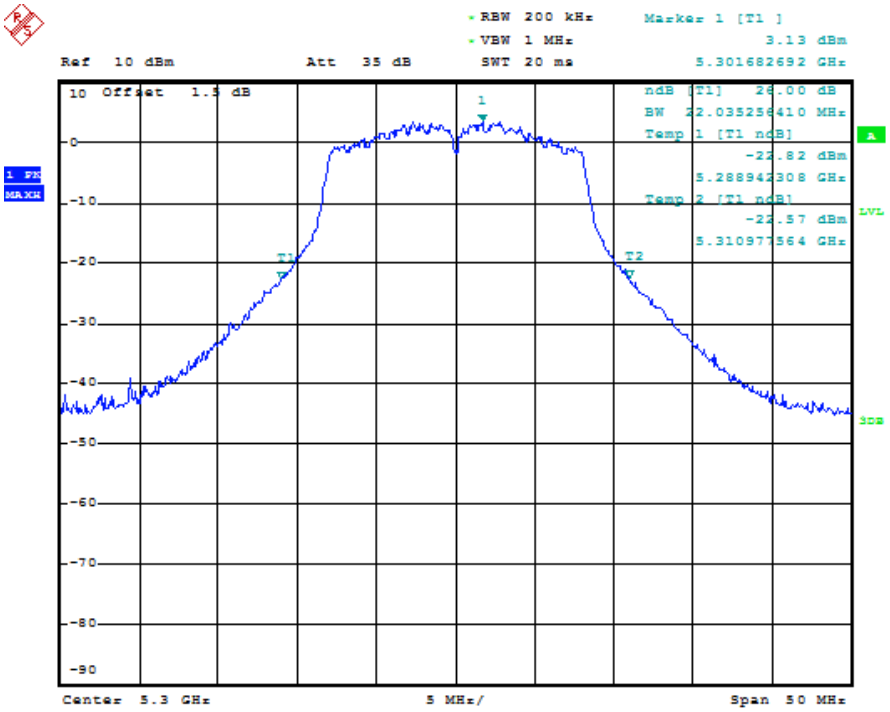
802.11a Channel 52 26dB BW



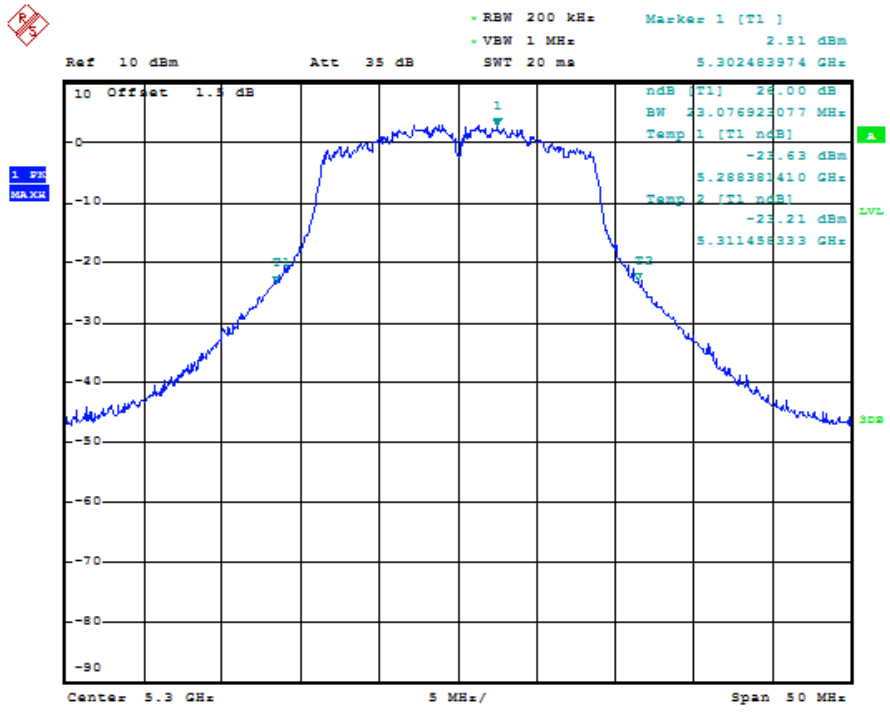
802.11n Channel 52 26dB BW



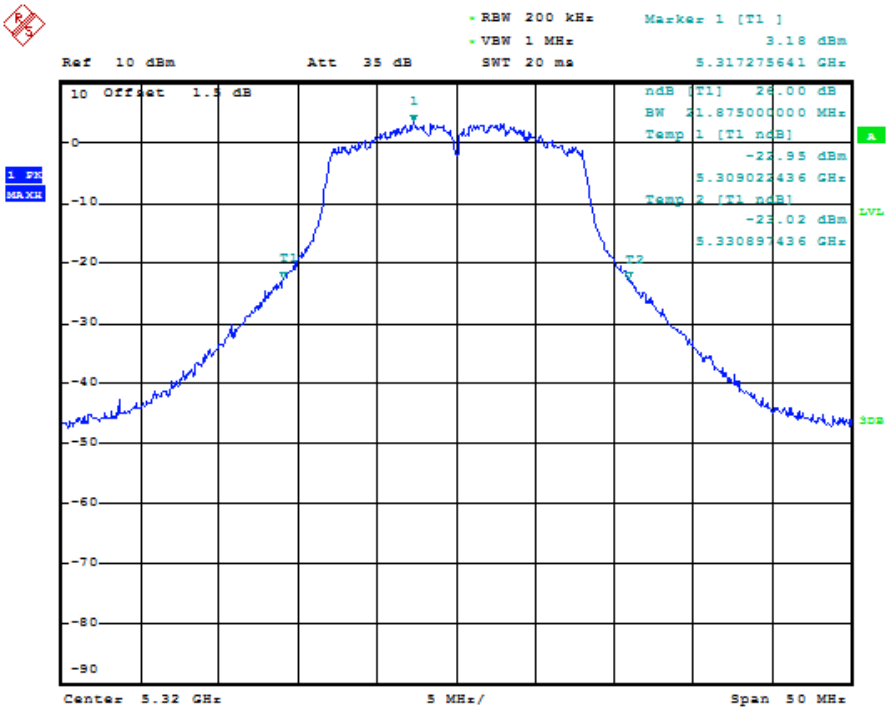
802.11a Channel 60 26dB BW



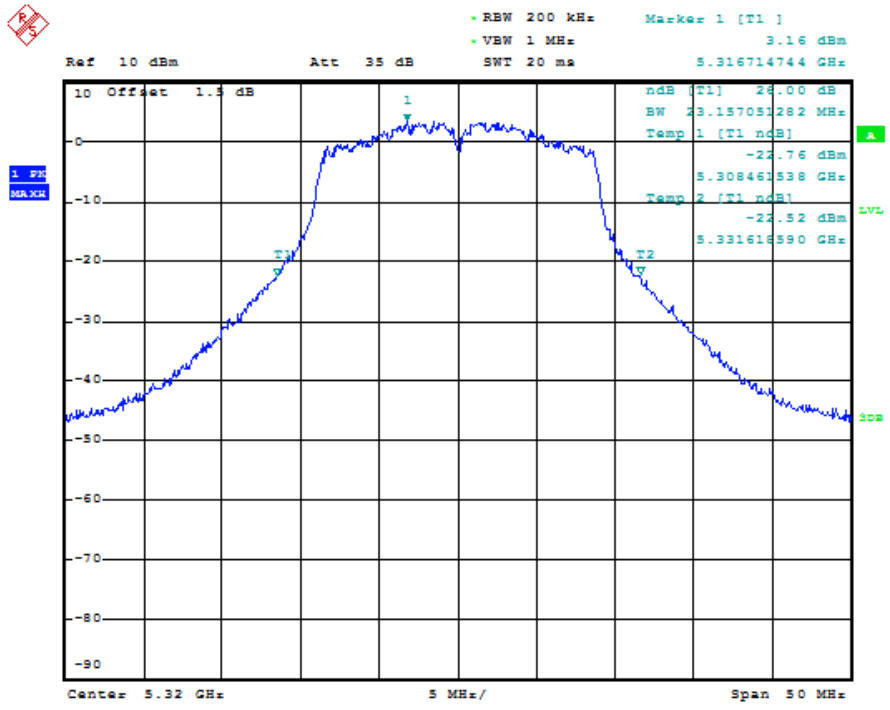
802.11n Channel 60 26dB BW



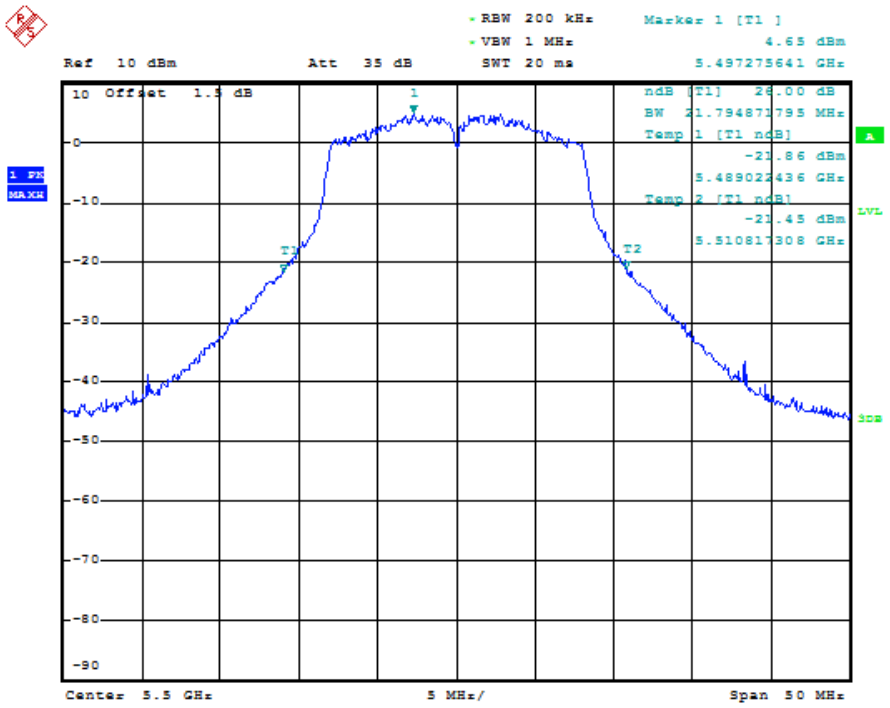
802.11a Channel 64 26dB BW



802.11n Channel 64 26dB BW



802.11a Channel 100 26dB BW



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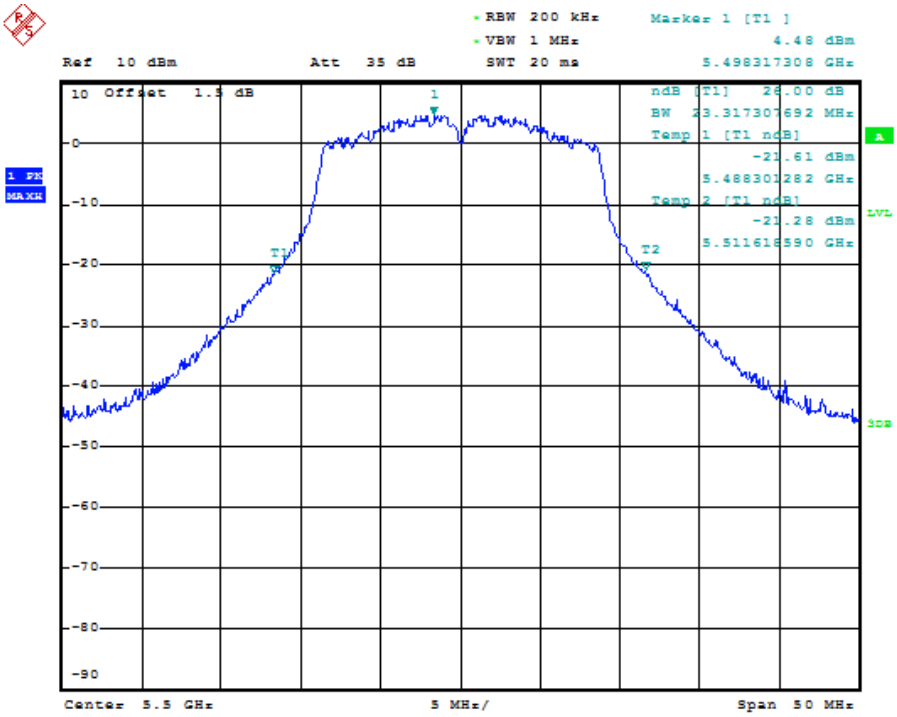
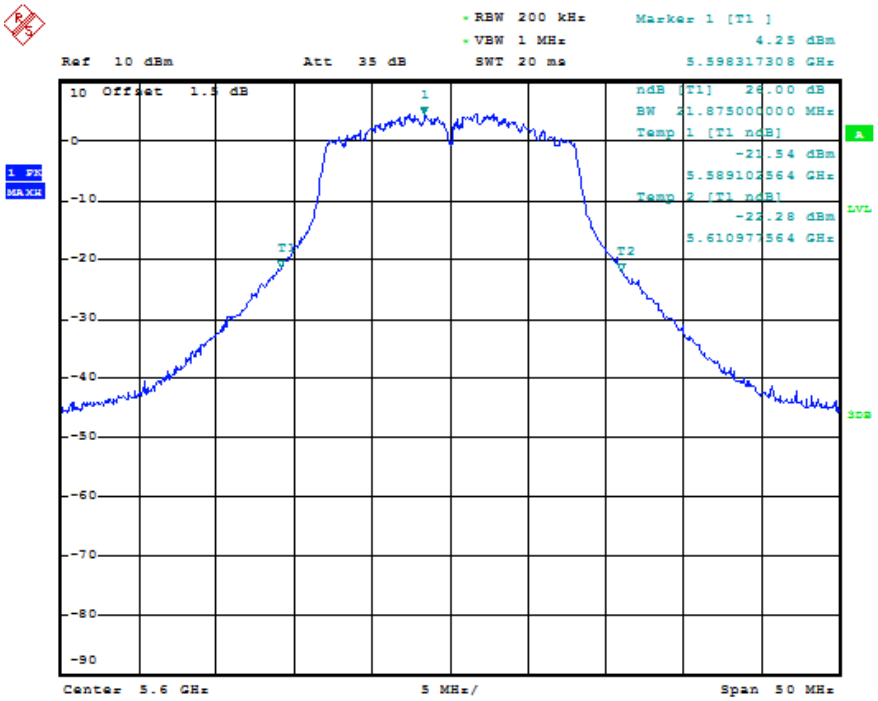


802.11a Channel 120 26dB BW



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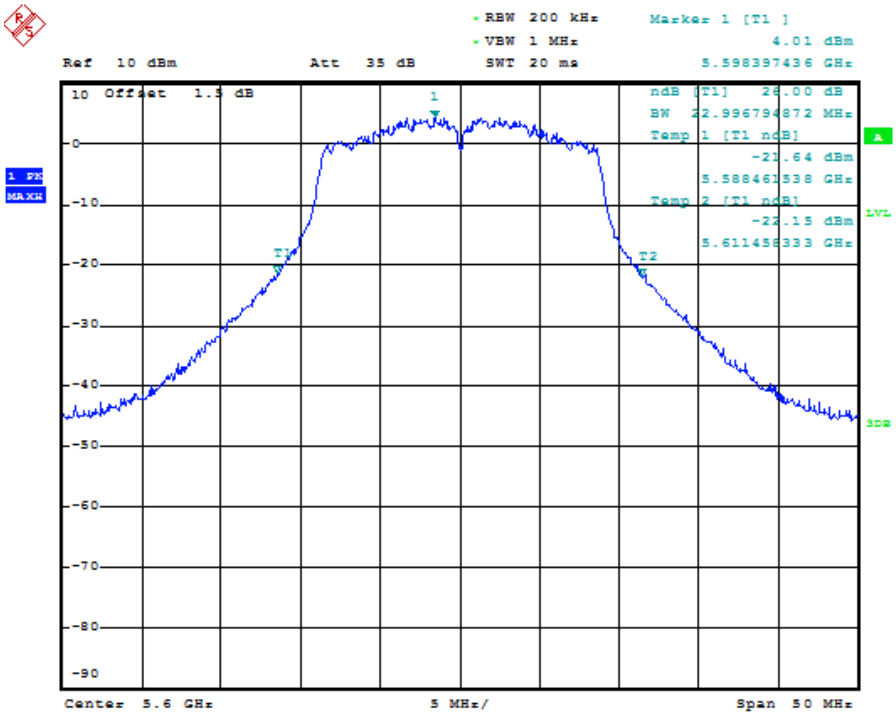

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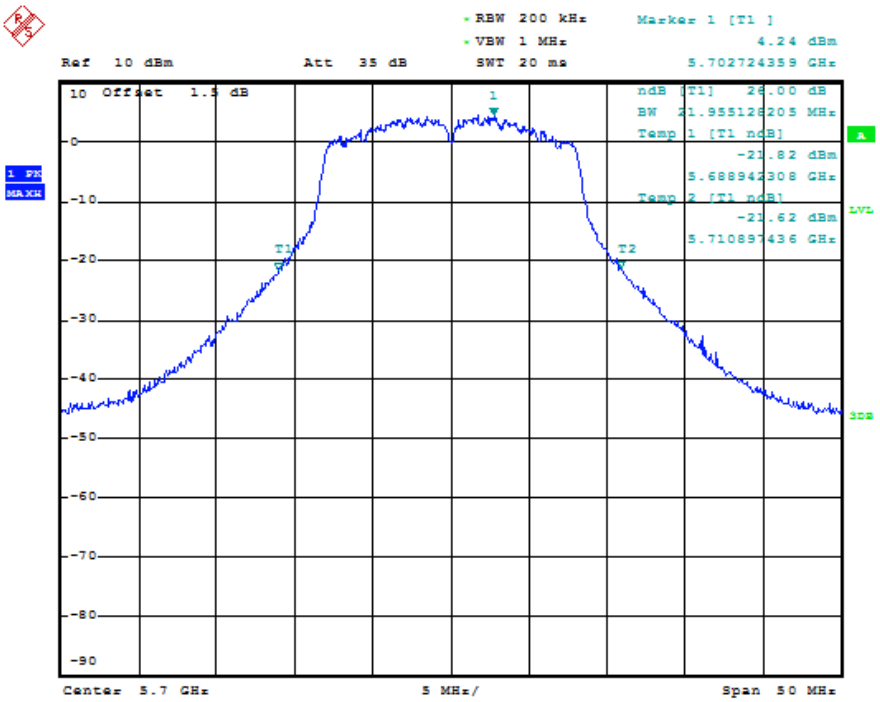

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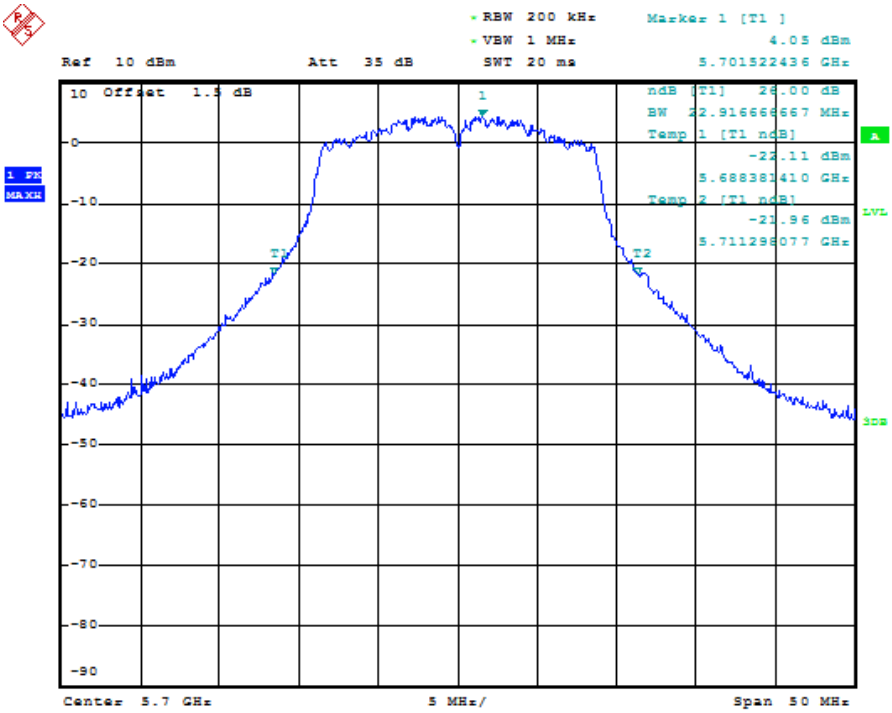
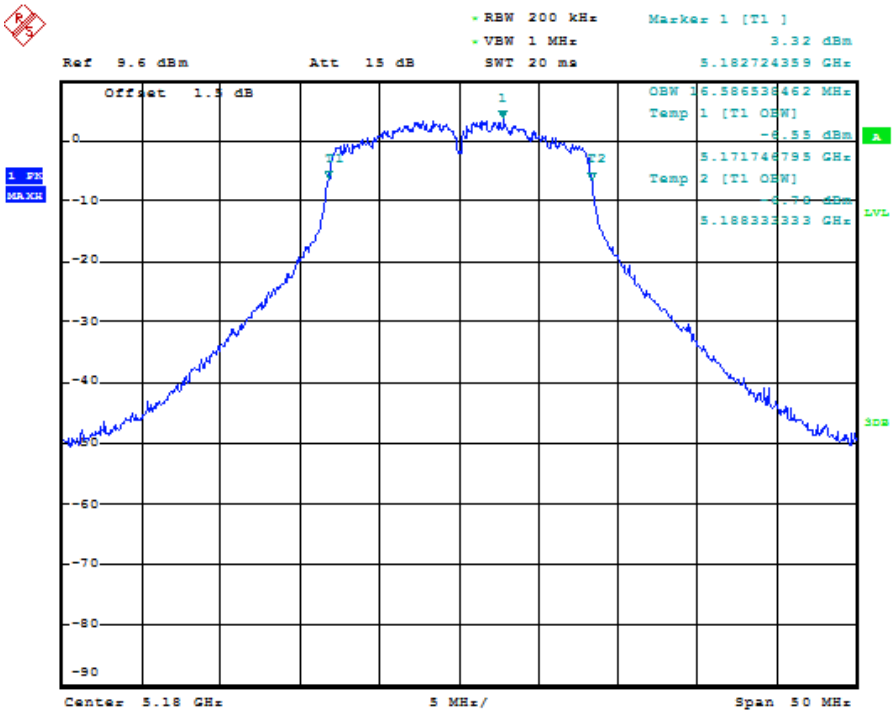


802.11a Channel 36 99% BW



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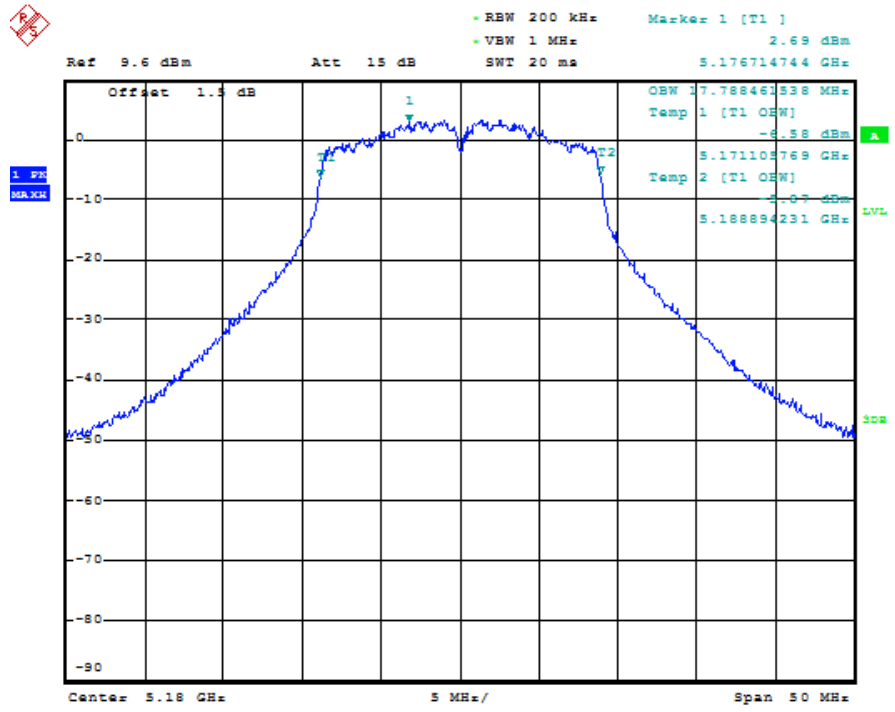
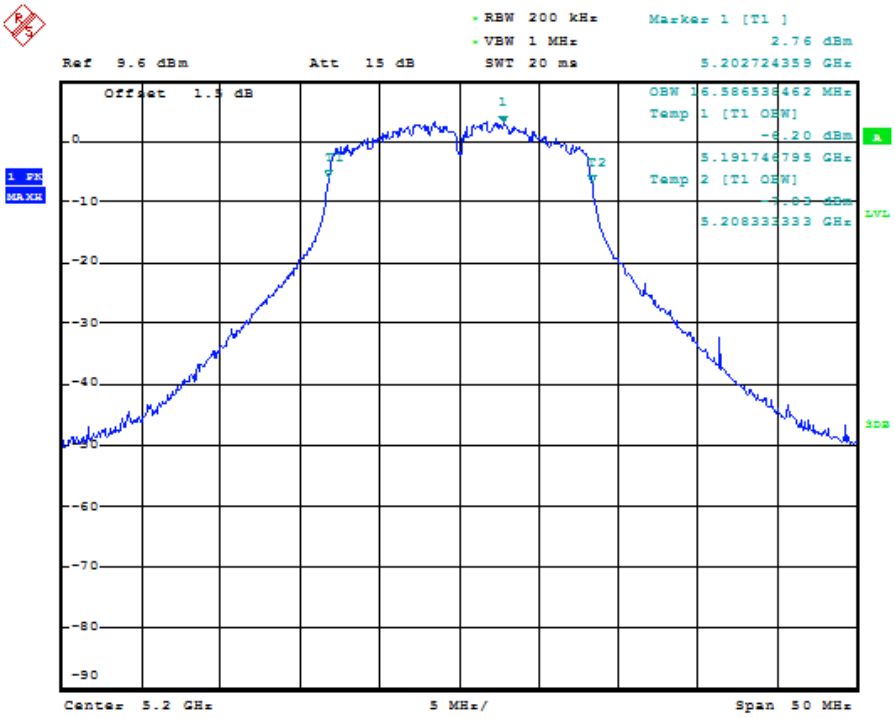


802.11a Channel 40 99% BW



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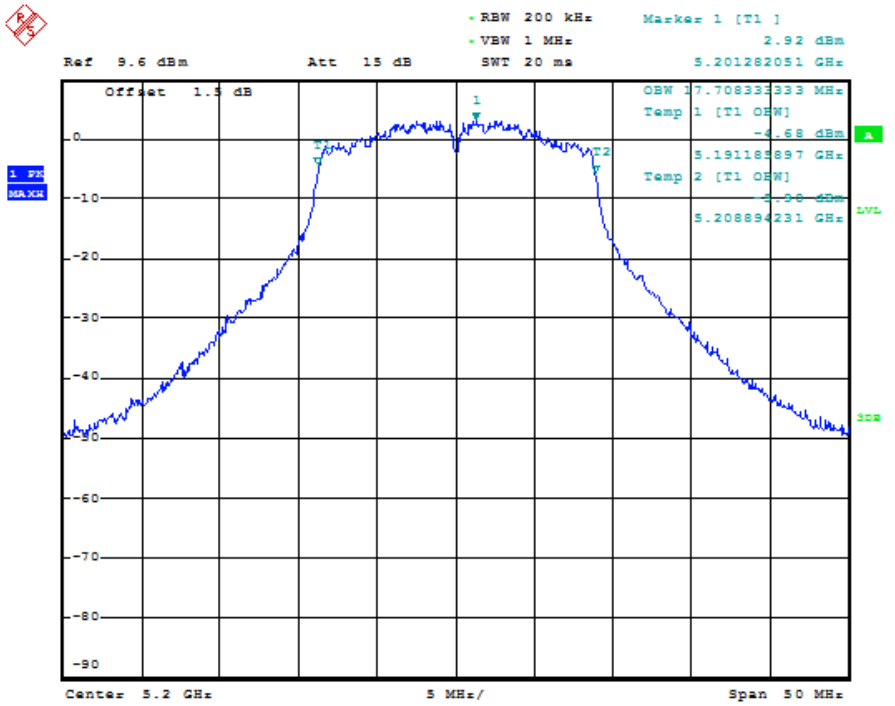
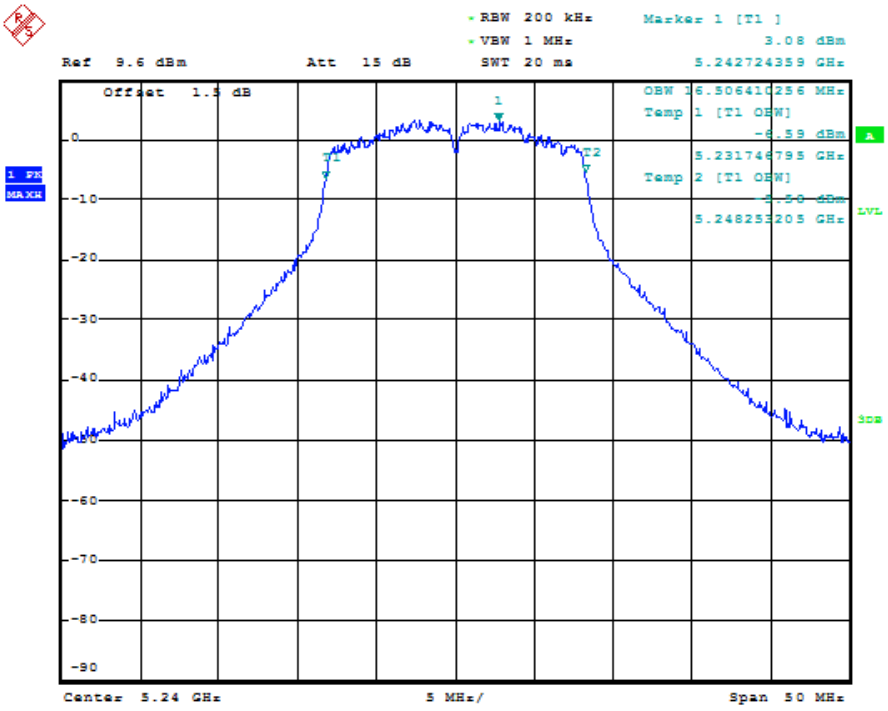


802.11a Channel 48 99% BW



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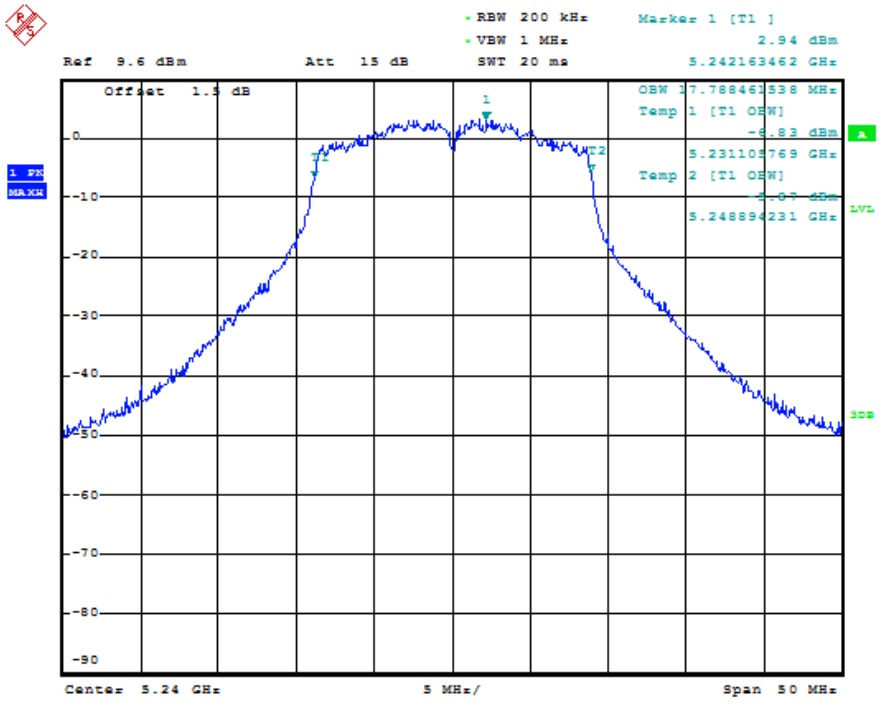
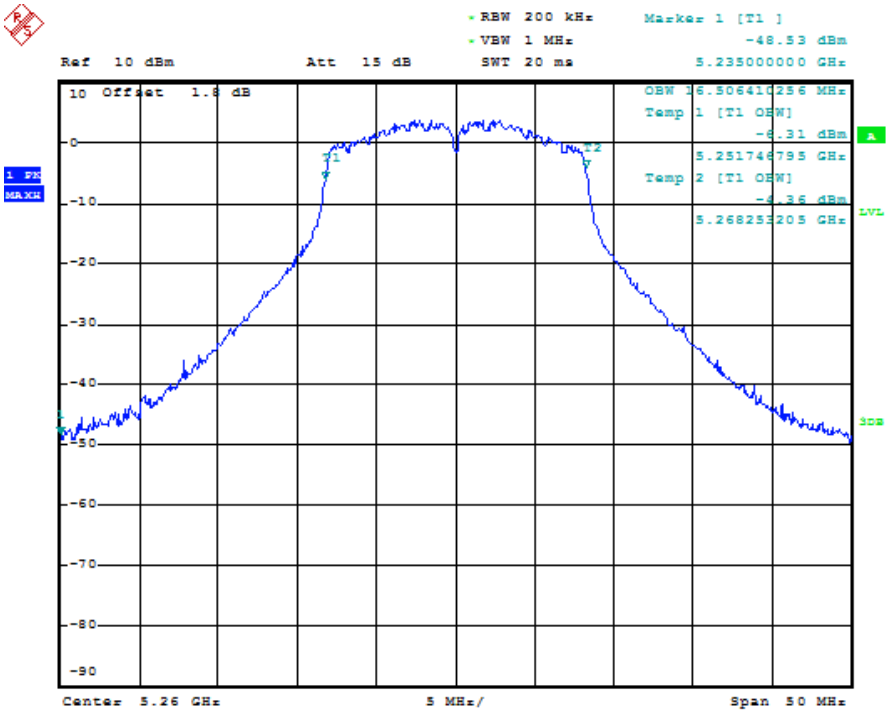


802.11a Channel 52 99% BW



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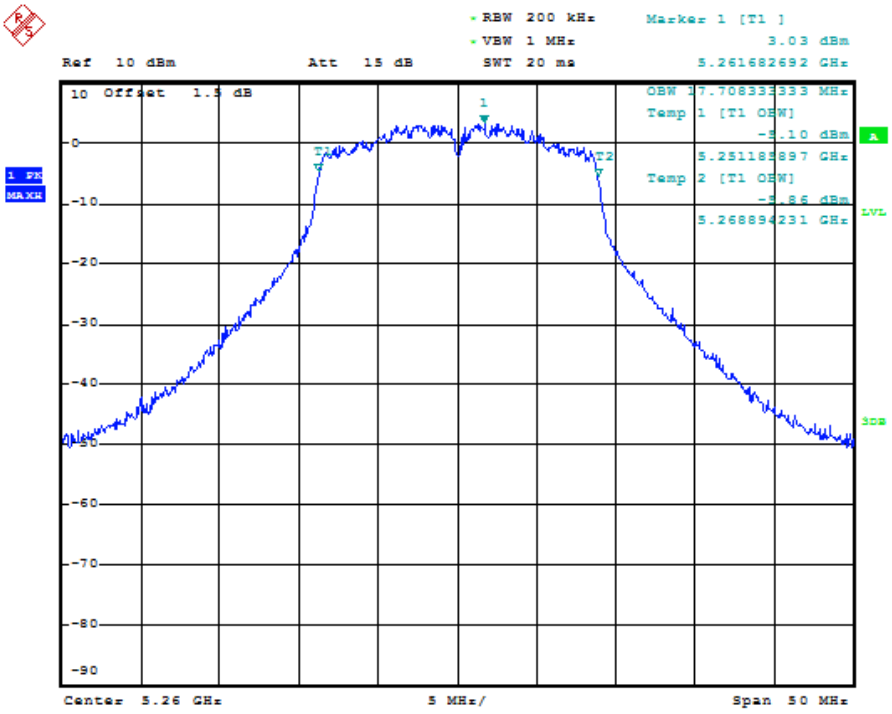

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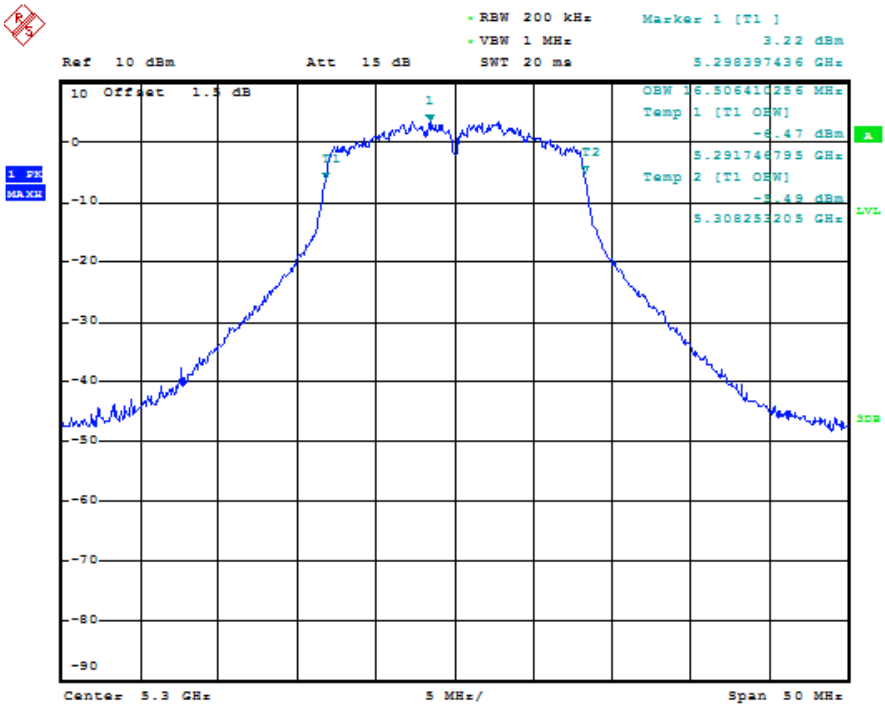

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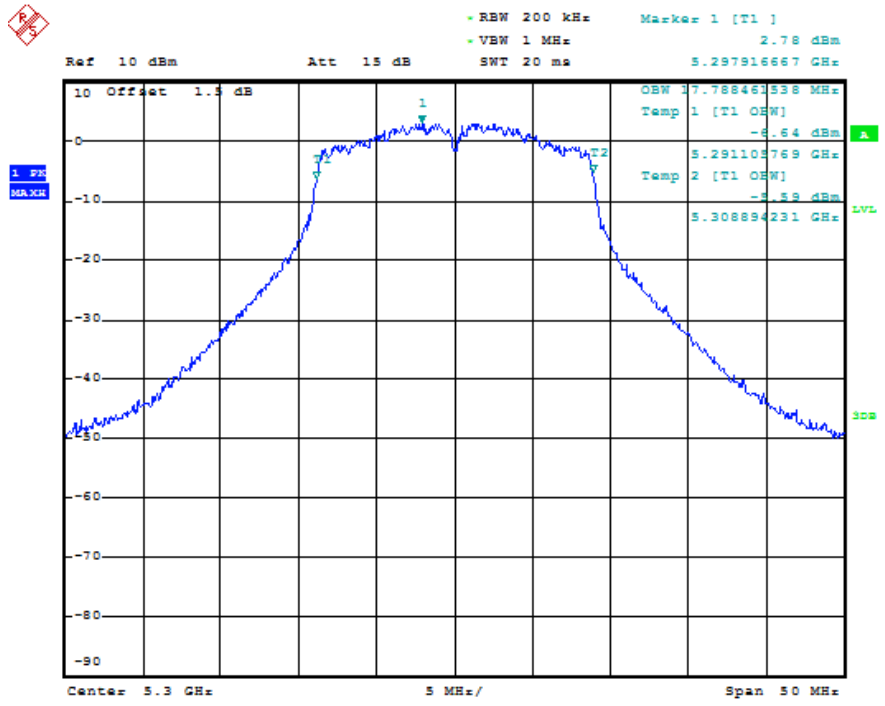

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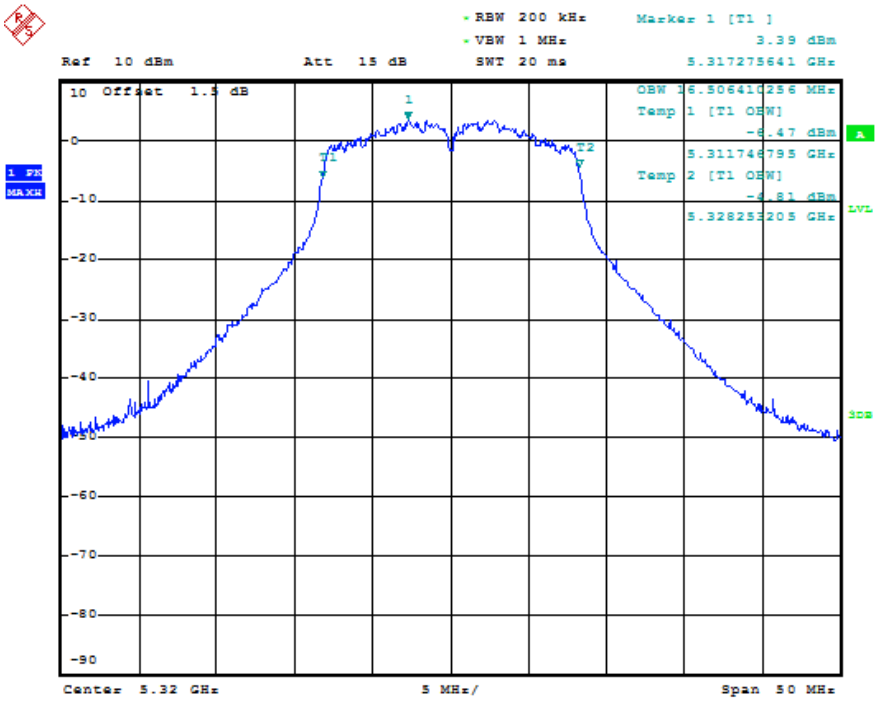

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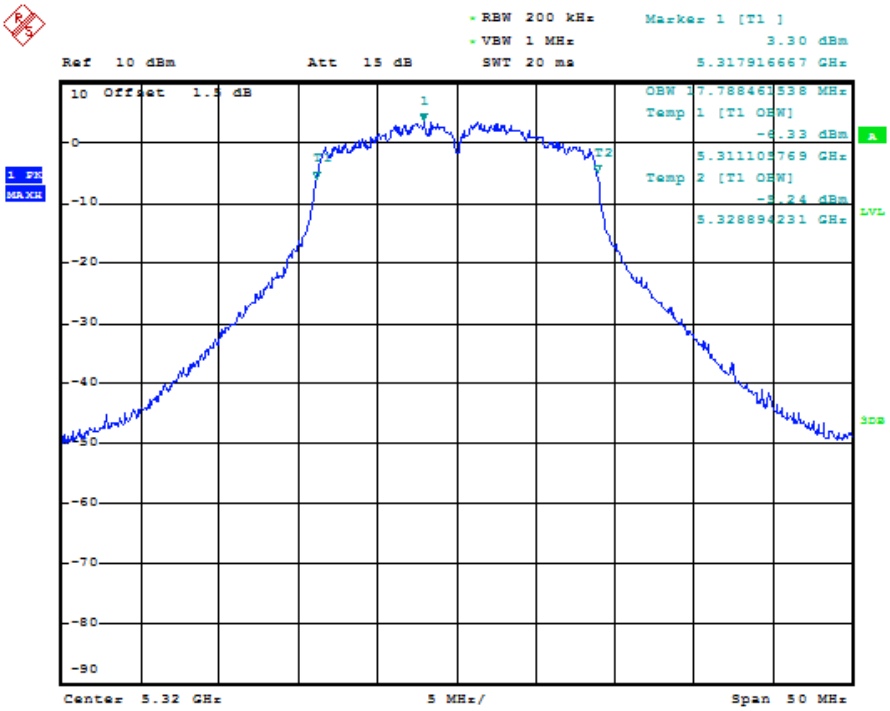
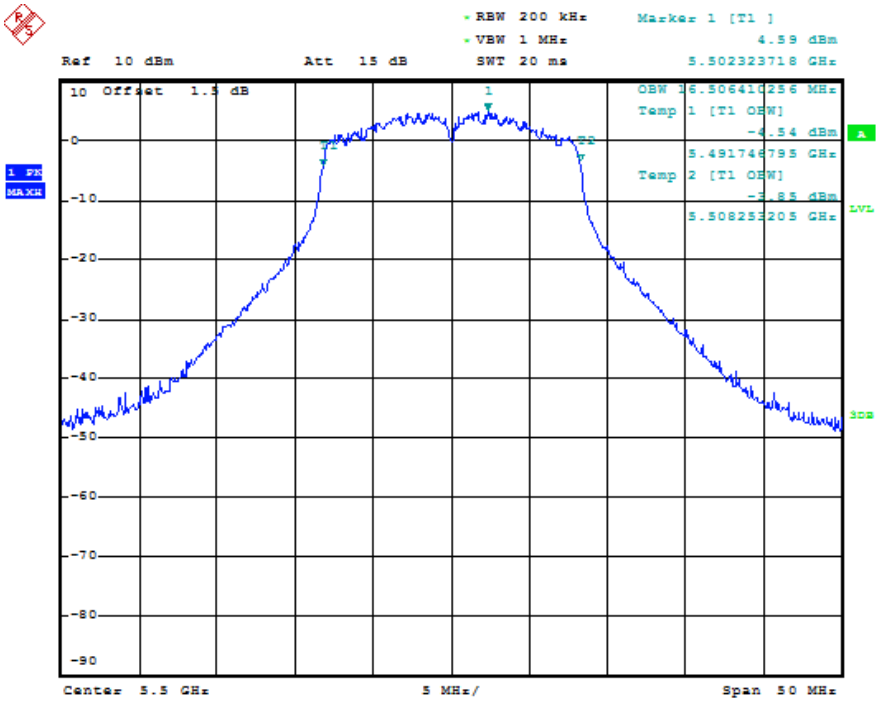


802.11a Channel 100 99% BW



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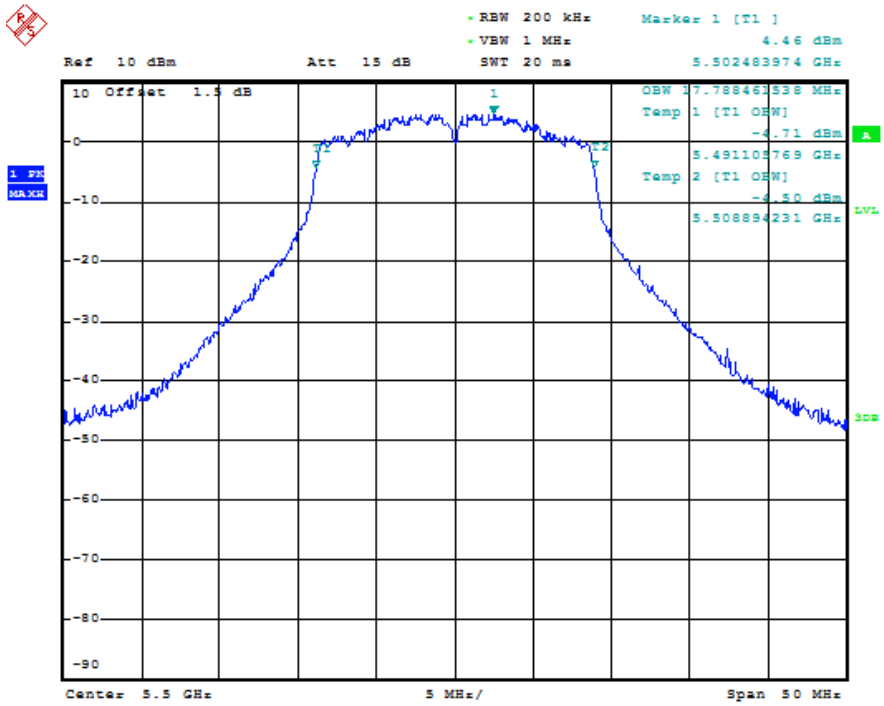
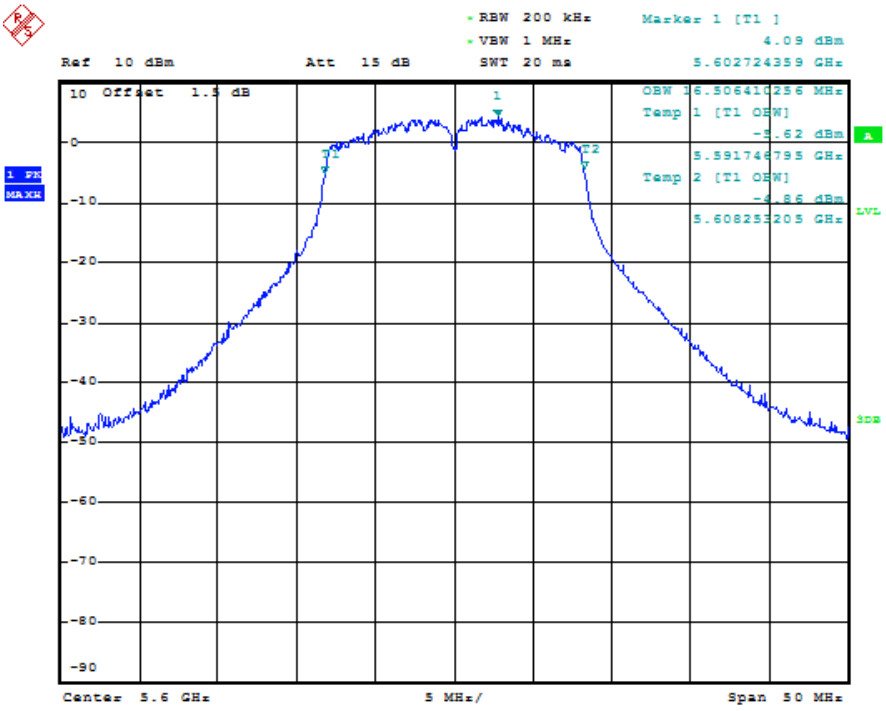


802.11a Channel 120 99% BW



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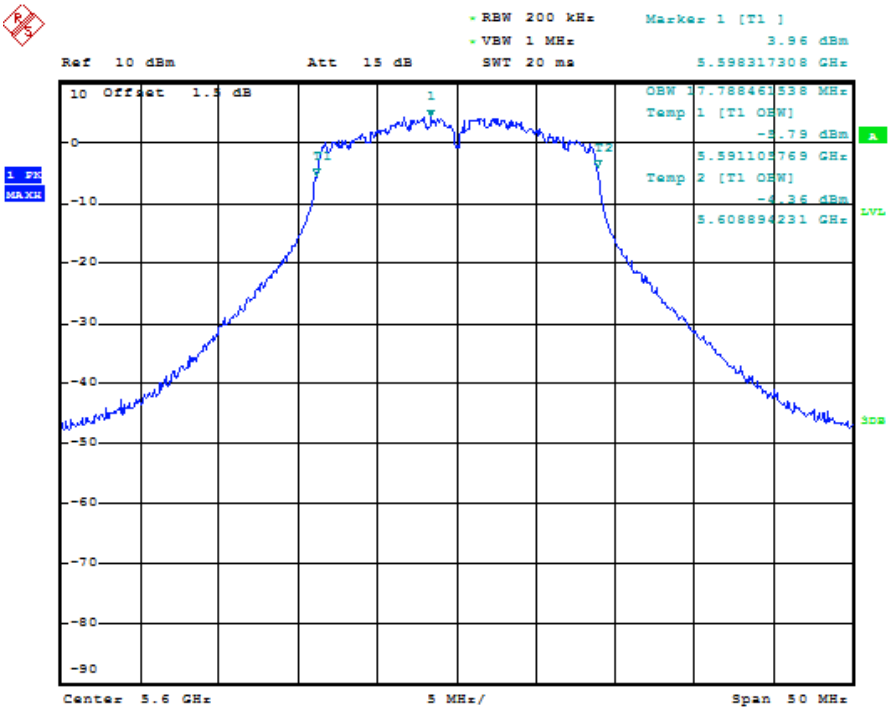
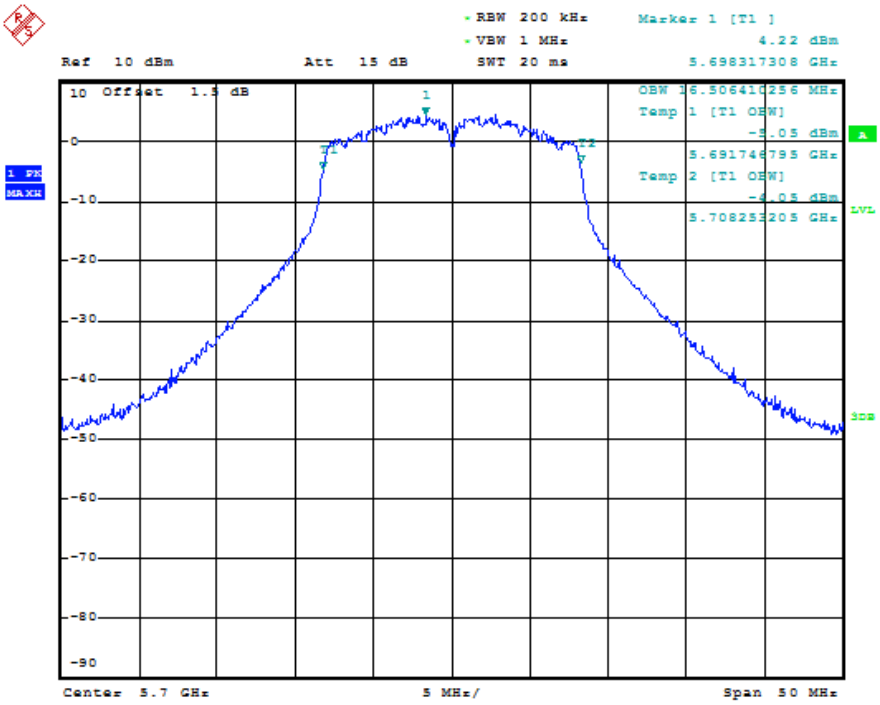


802.11a Channel 140 99% BW



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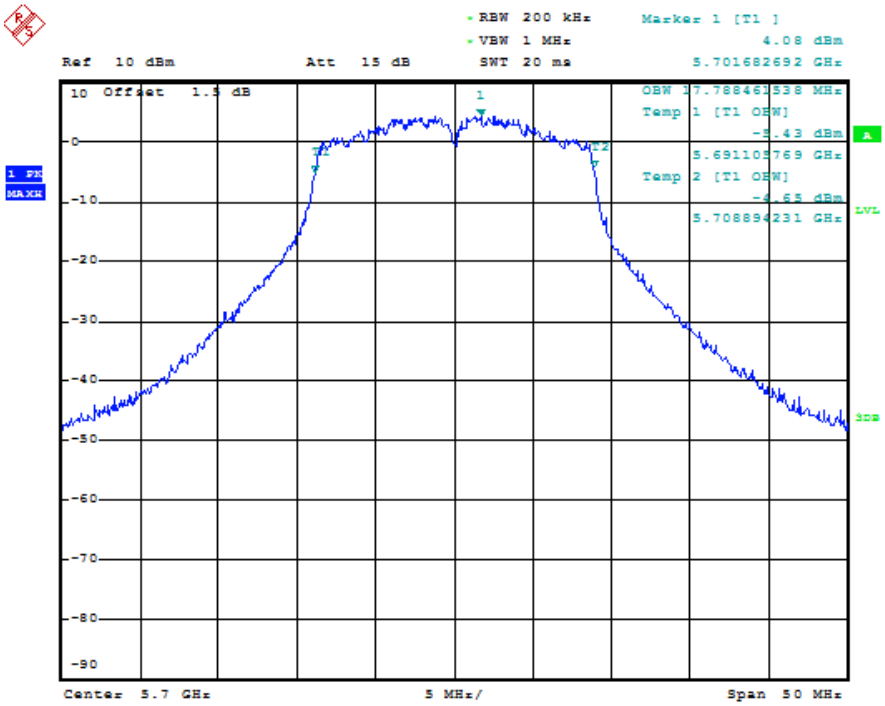


6.8 Peak Power Spectral Density

6.8.1 Limits:

FCC:
Sub-band 1: 5150-5250MHz 15.407(a) (1): 4dBm in any 1–MHz band
Sub-band 2: 5250-5350MHz 15.407(a) (2): 11dBm in any 1–MHz band
Sub-band 3: 5470-5725MHz 15.407(a) (2): 11dBm in any 1–MHz band

IC:
Sub-band 1: 5150-5250MHz RSS-210 A 9.2: 10 dBm in any 1–MHz band- EIRP
Sub-band 2: 5250-5350MHz RSS-210 A 9.2: 11dBm in any 1–MHz band
Sub-band 3: 5470-5725MHz RSS-210 A 9.2: 11dBm in any 1–MHz band

6.8.2 Test Procedure Used:

General U-NII Test Procedures from FCC Publication #789033

Peak Power Spectral Density Measurement:

Method SA-1 (Trace averaging with the EUT transmitting at full power throughout each sweep):
(1) Create an average power spectrum for the EUT operating mode.
(i) Set span to encompass the entire emission bandwidth (EBW) of the signal.
(ii) Set RBW = 1 MHz.
(iii) Set VBW ≥ 3 MHz.
(iv) Number of points in sweep ≥ 2 Span / RBW. (This ensures that bin-to-bin spacing is ≤ RBW/2, so that narrowband signals are not lost between frequency bins.)
(v) Sweep time = auto
(vi) Set detector = RMS.
(vii) The EUT must be operated at ≥ 98 percent duty cycle.
(viii) Trace average at least 100 traces in power averaging (i.e., RMS mode).
2) Use the peak search function on the spectrum analyzer to find the peak of the spectrum.
a) If Method SA-1 was used, the peak of the spectrum is the PPSD.

6.8.3 Test Result:

Peak Power Spectral Density (dBm)							
Frequency (MHz)	Channel	Conducted		EIRP		Limits (Conducted)	
		802.11a	802.11n/ HT20	802.11a	802.11n/ HT20	FCC (dBm)	IC (dBm)
5180	**36**	2.81	3.00	0.98	1.17	4	10*
5200	**40**	3.12	3.14	1.29	1.31	4	10*
5240	**48**	3.10	3.11	1.27	1.28	4	10*
5260	**52**	3.19	3.10	1.36	1.27	11	11
5300	**60**	2.59	2.39	0.76	0.56	11	11
5320	**64**	2.76	2.70	0.93	0.87	11	11
5500	**100**	3.96	4.00	2.13	2.17	11	11
5600	**120**	2.63	3.02	0.8	1.19	11	11
5700	**140**	2.21	2.10	0.38	0.27	11	11

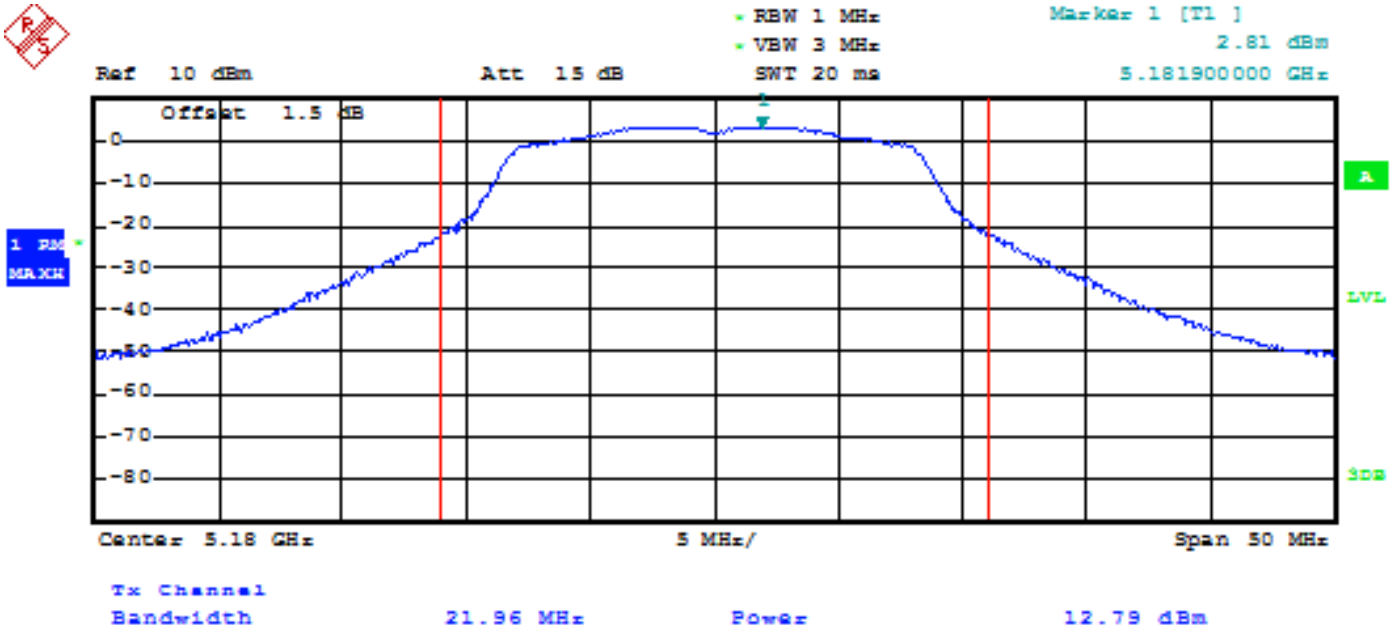
All limits are conducted unless otherwise noted.
*Note: Limit is in E.I.R.P

6.8.4 Test Verdict:

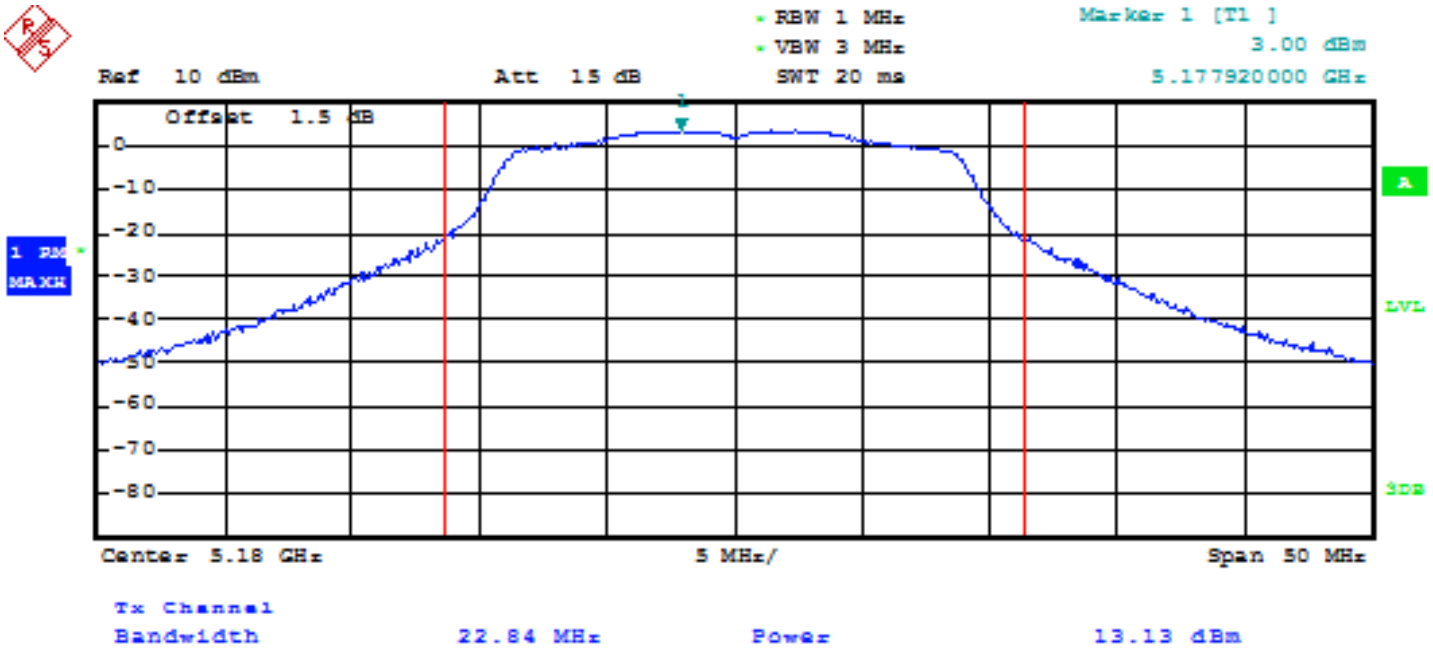
Pass

6.8.5 Test Plots:

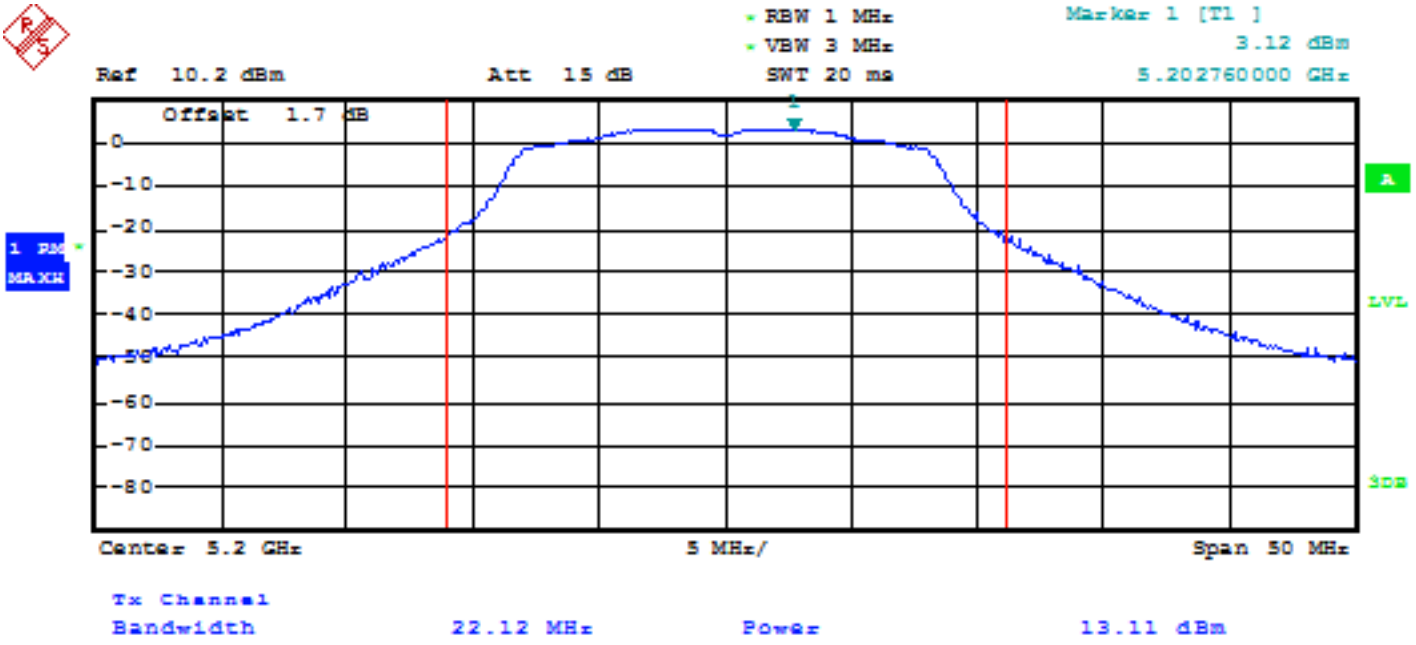
802.11a Ch36



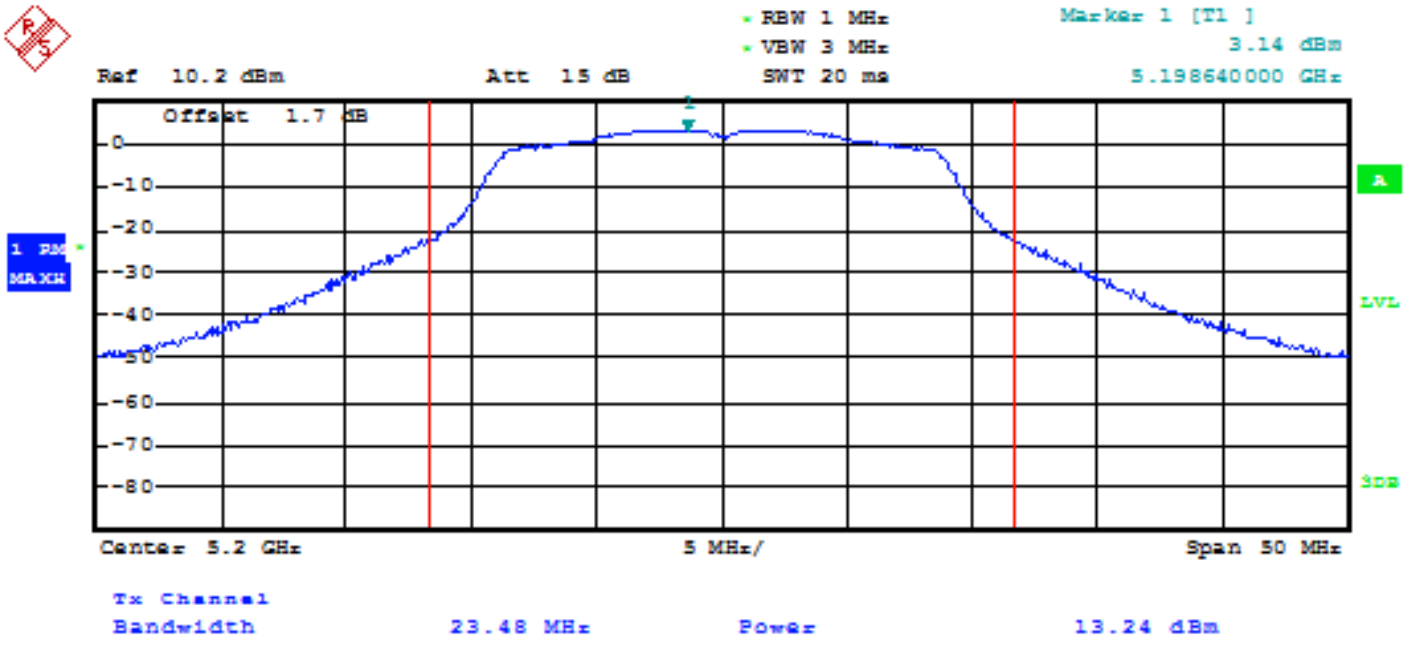
802.11n Ch36



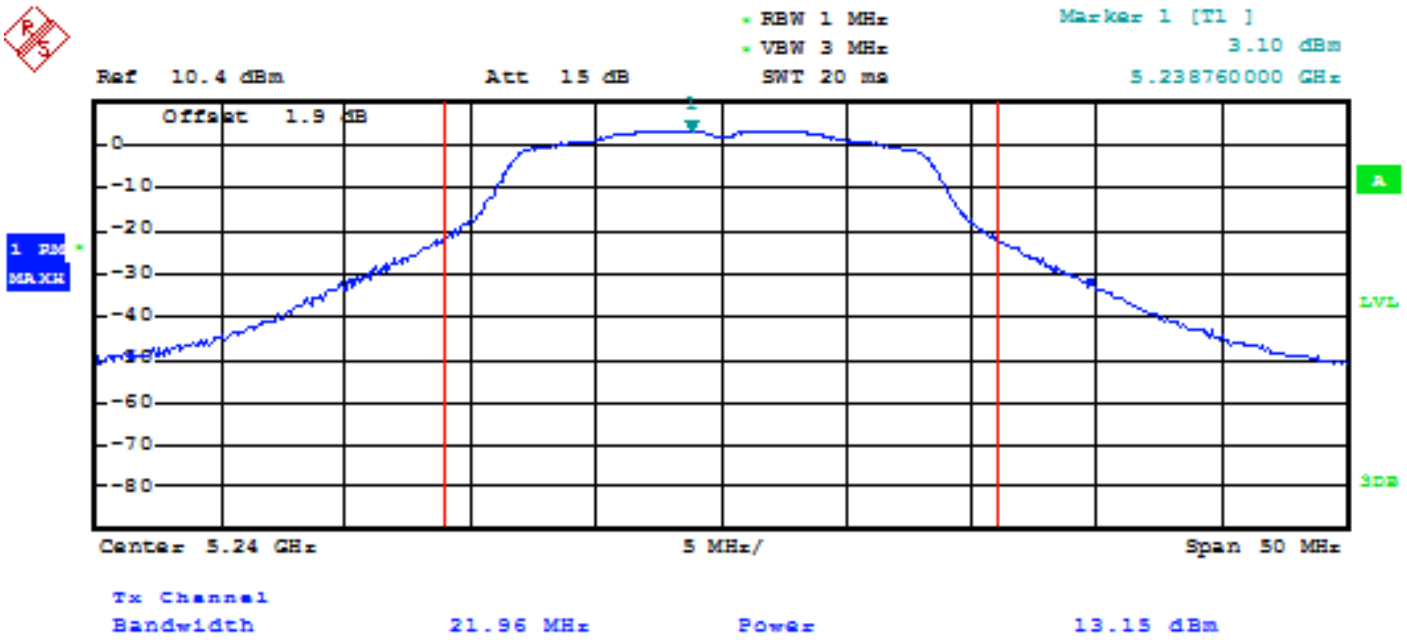
802.11a Ch40



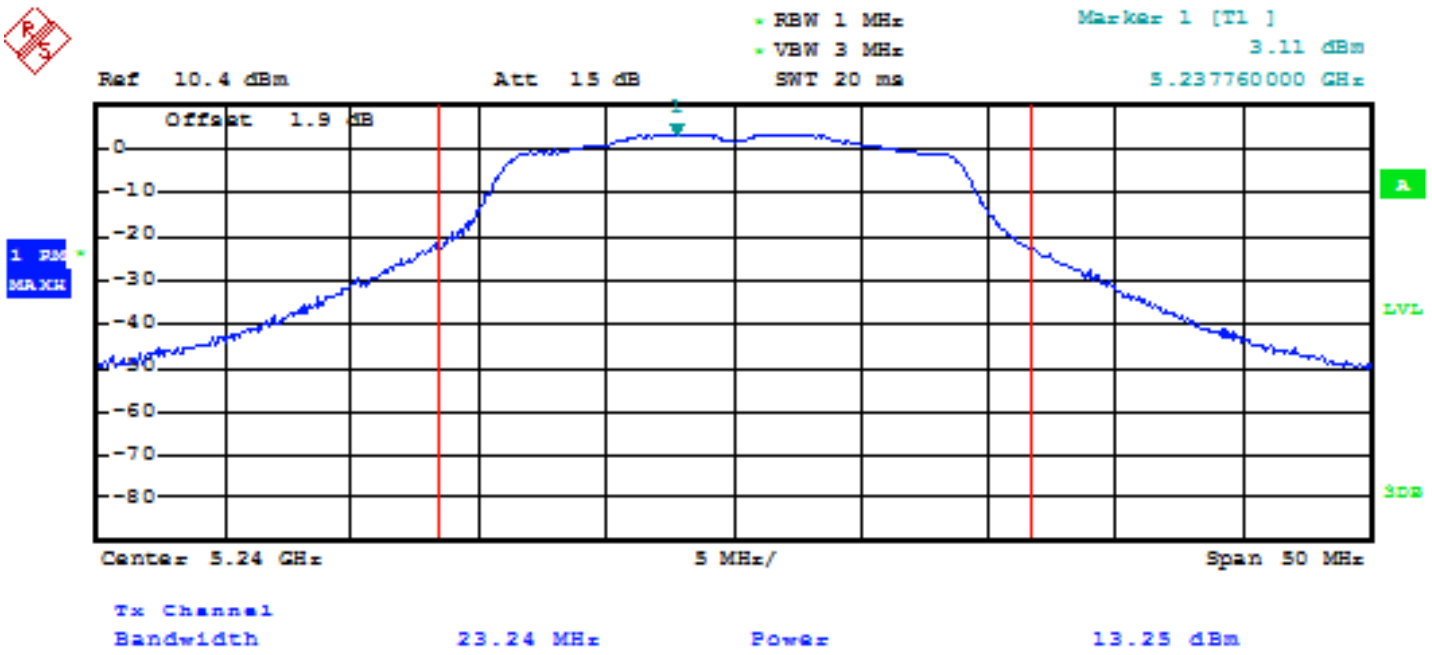
802.11n Ch40



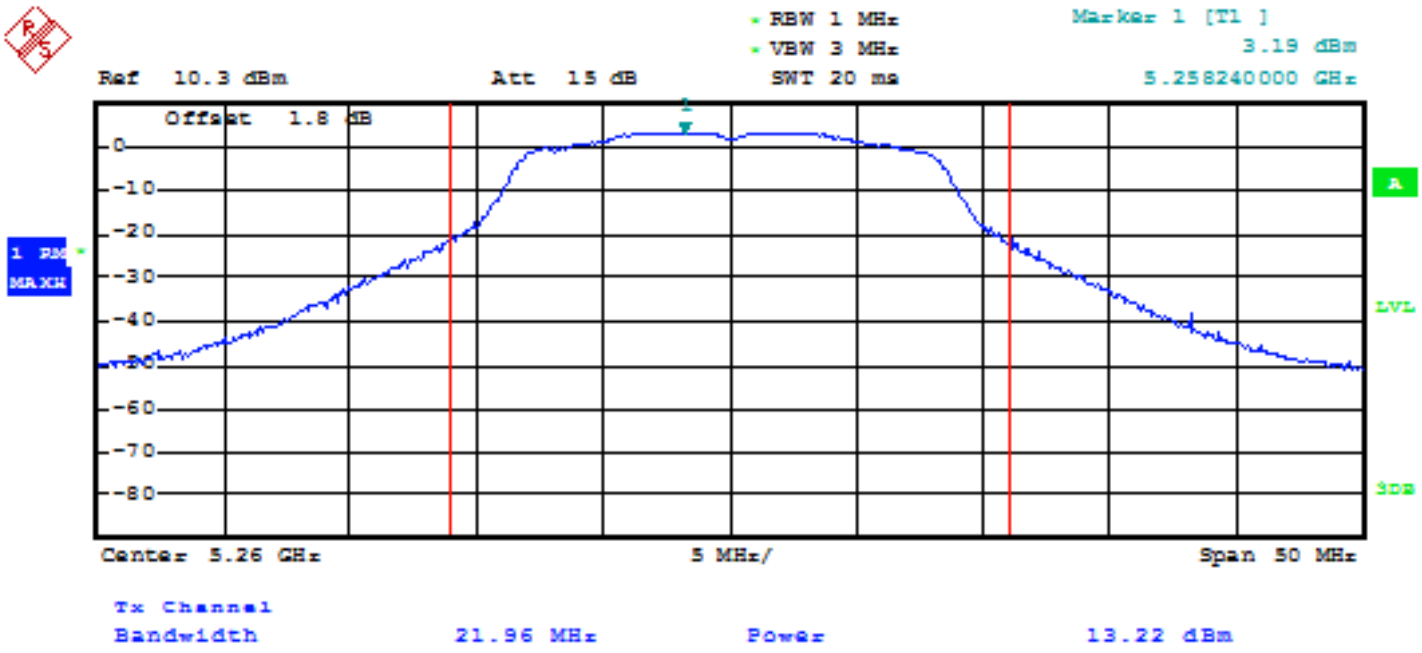
802.11a Ch48



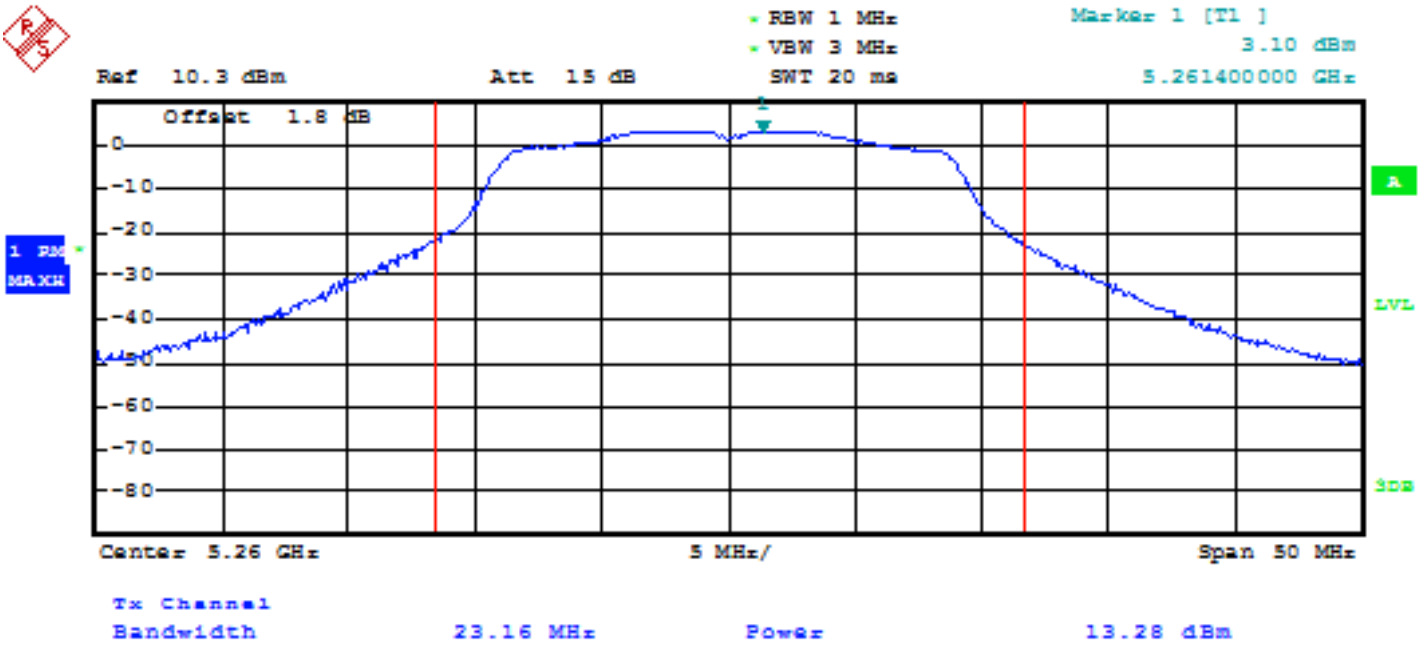
802.11n Ch48



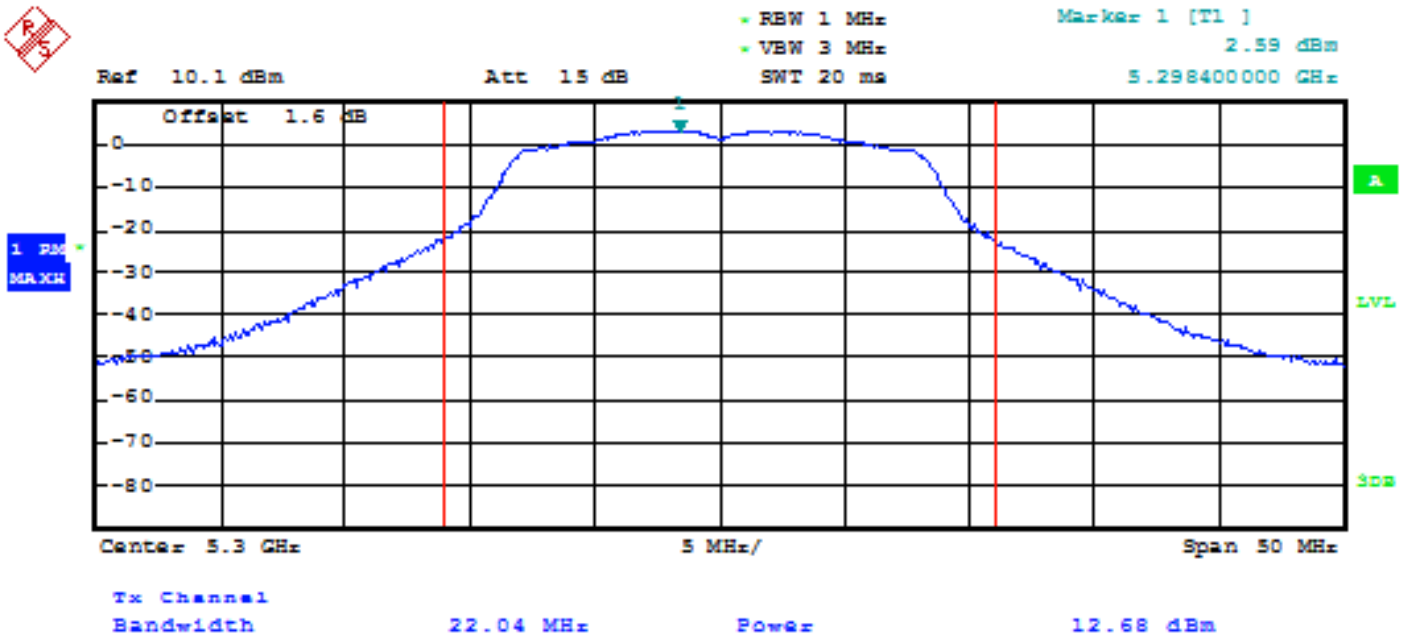
802.11a Ch52



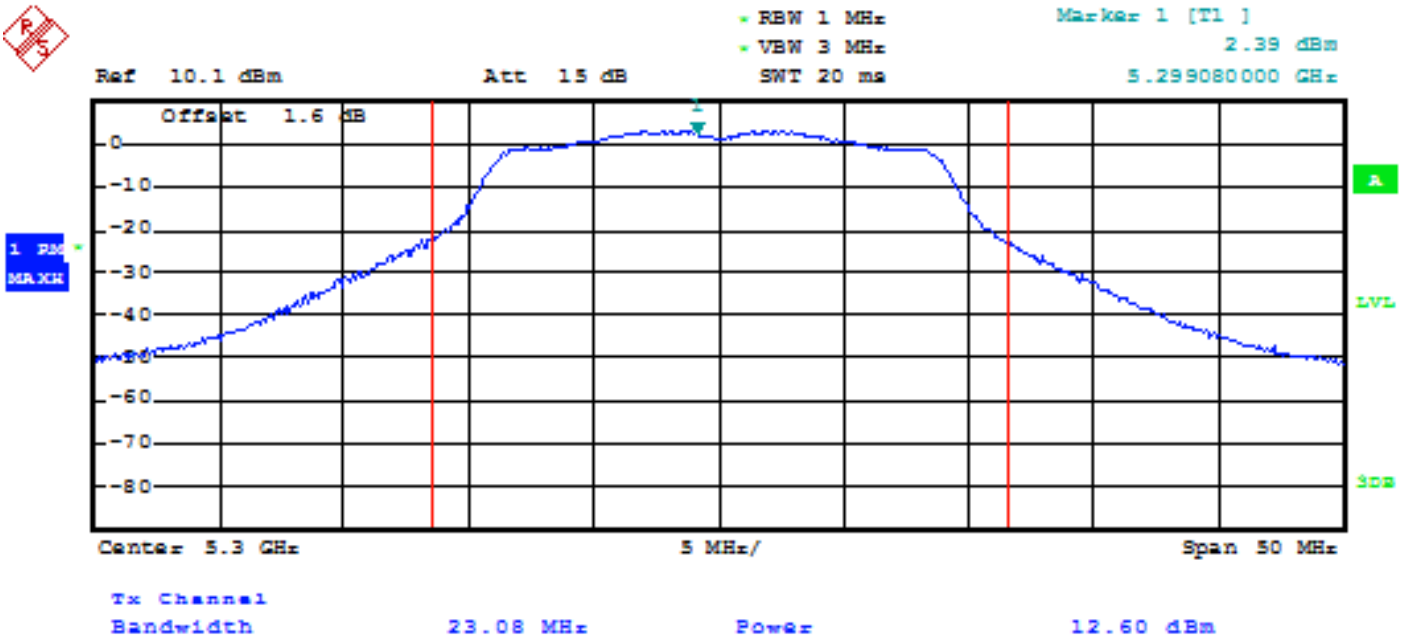
802.11n Ch52



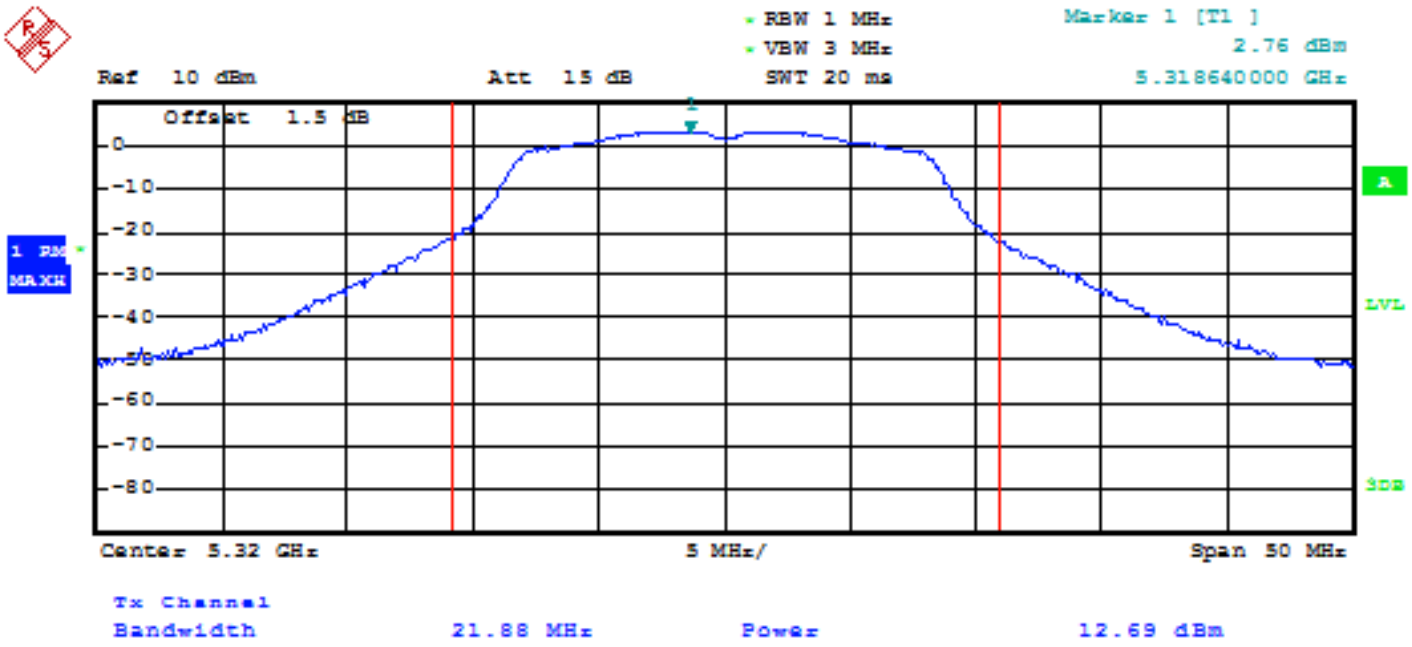
802.11a Ch60



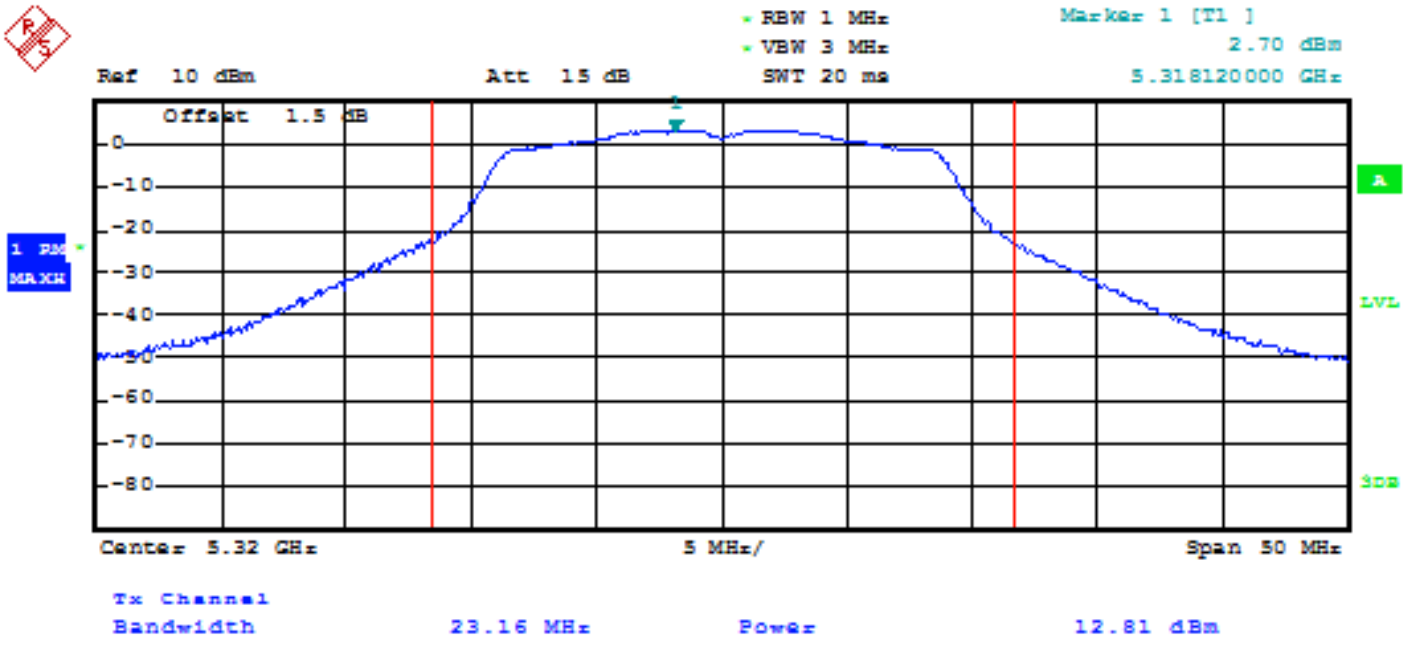
802.11n Ch60



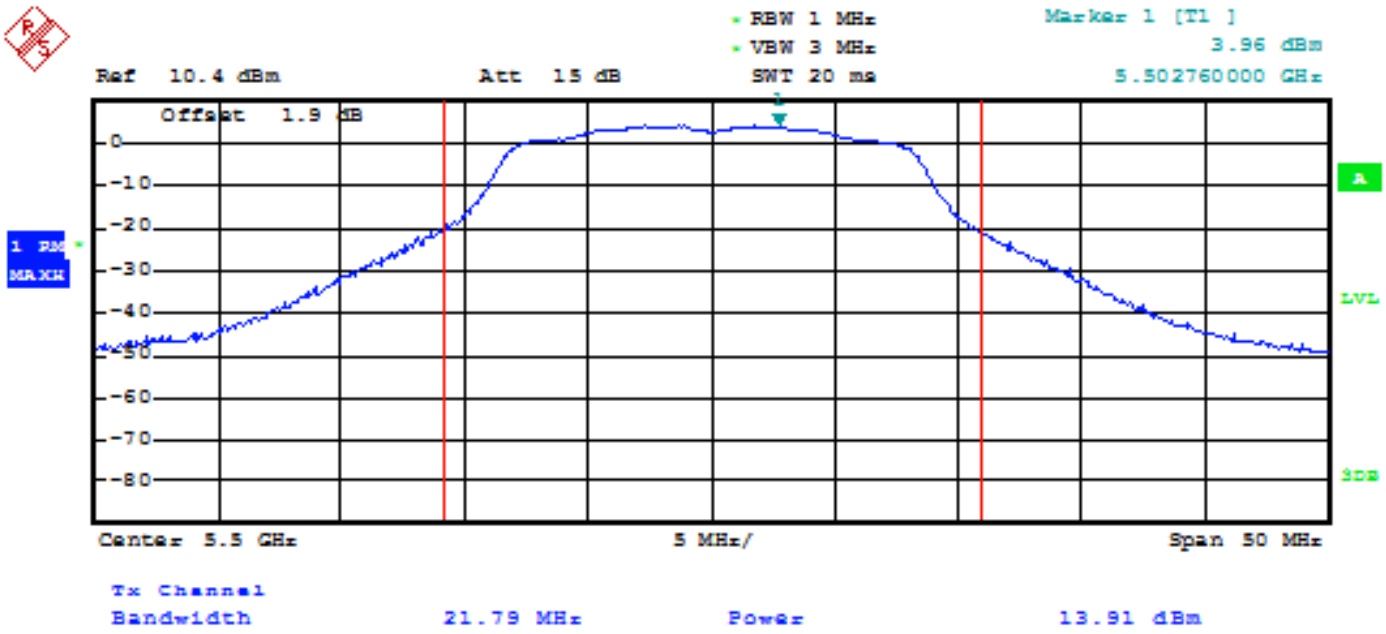
802.11a Ch64



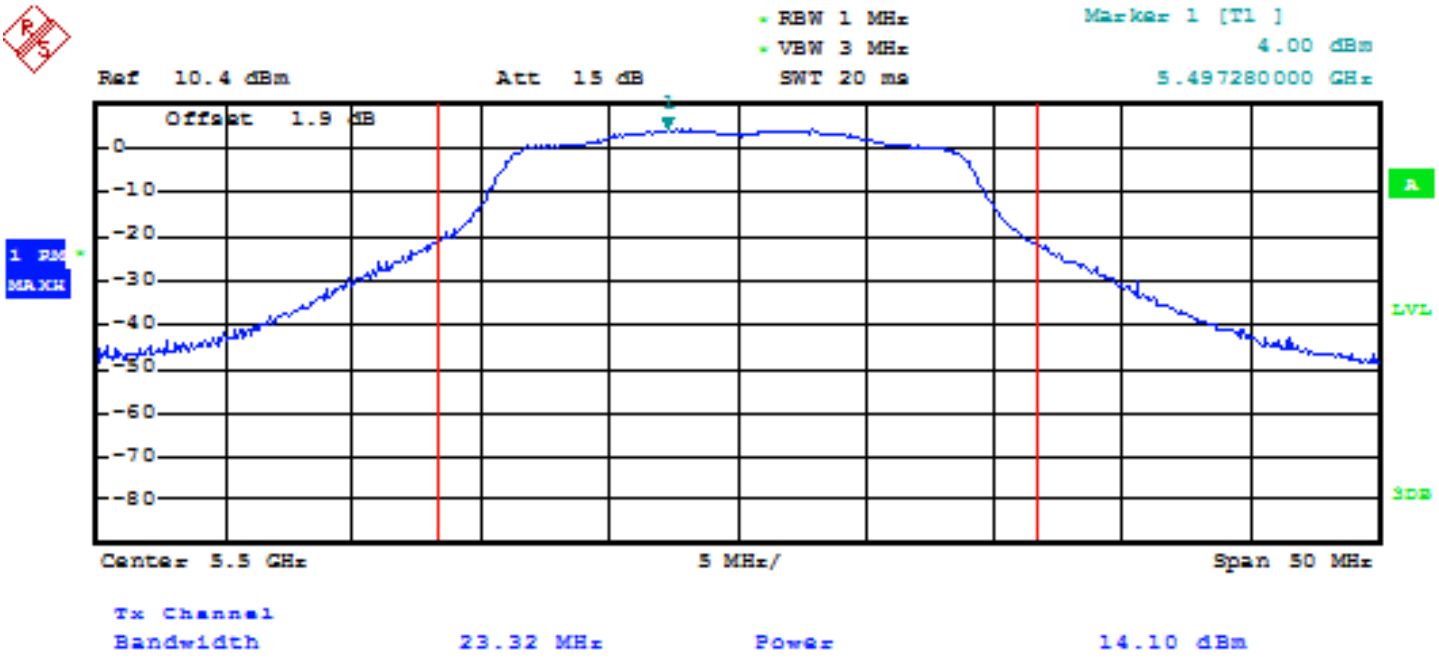
802.11n Ch64



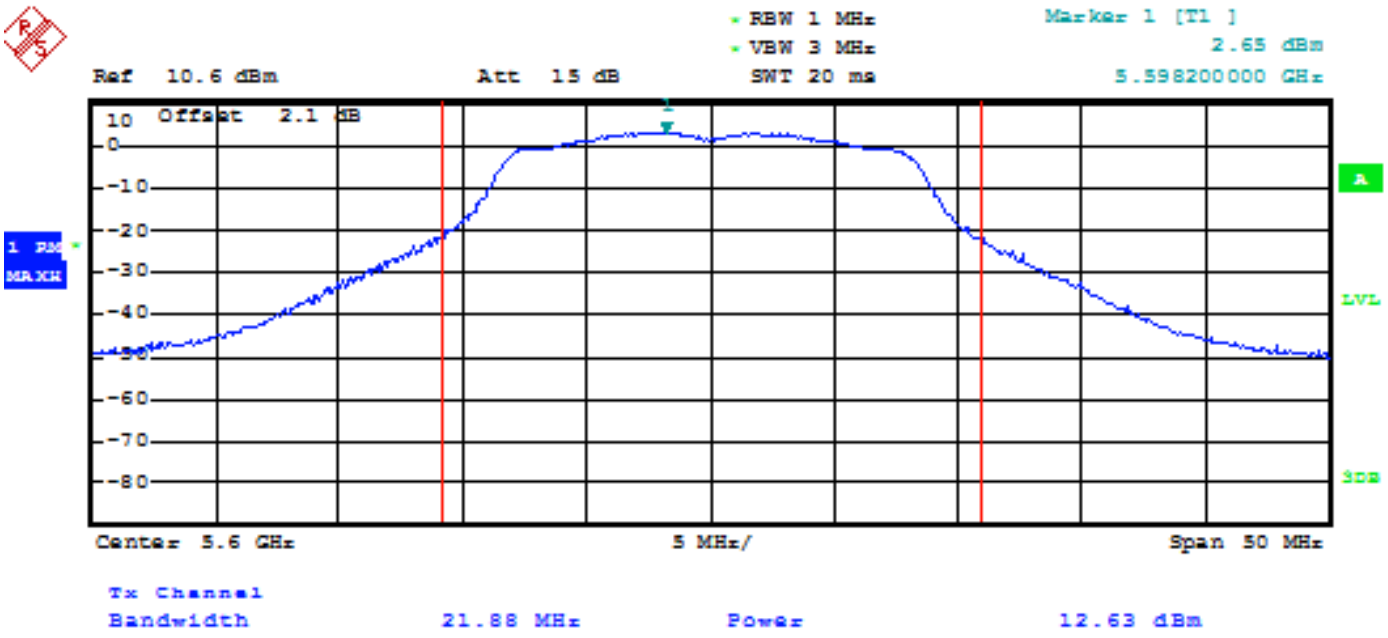
802.11a Ch100



802.11n Ch100



802.11a Ch120



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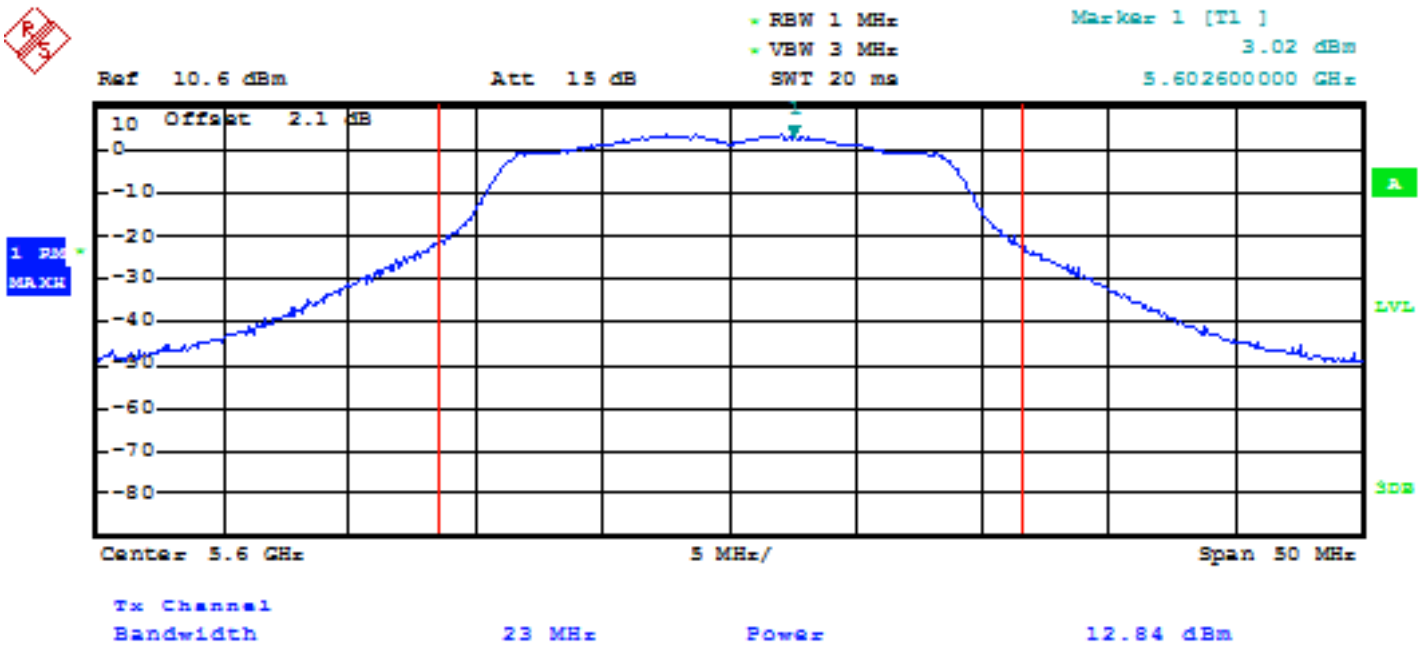
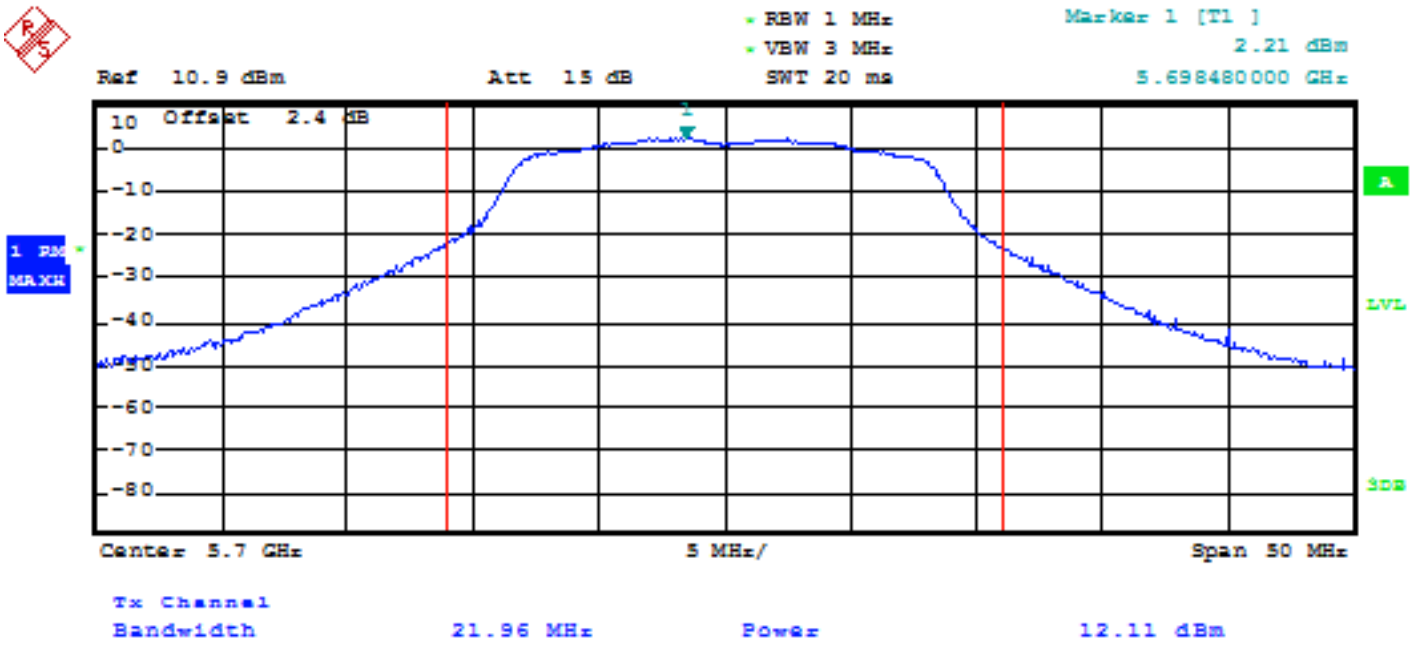
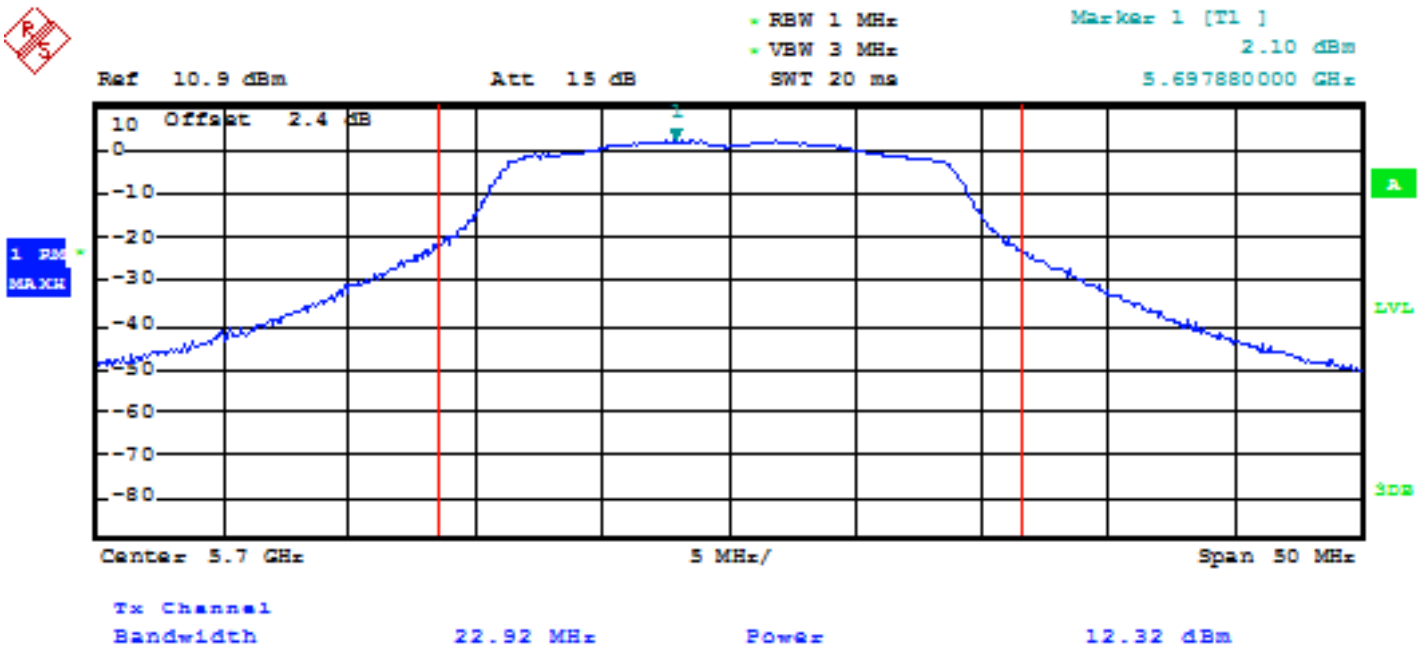


802.11a Ch140



802.11n Ch140



6.9 Peak Excursion

6.9.1 Limit

FCC15.407 (A)(6): The ratio of the peak excursion of the modulation envelope (measured using a peak hold function) to the maximum conducted output power (measured as specified above) shall not exceed 13 dB across any 1 MHz bandwidth or the emission bandwidth whichever is less.

6.9.2 Test Procedure Used:

General U-NII Test Procedures from FCC Publication #789033

Peak excursion measurement

1) Compliance with the peak excursion requirement of 15.407(a)(6) shall be demonstrated by computing the ratio of the maximum of the peak-max-hold spectrum to the maximum of the average spectrum for continuous transmission. (Earlier procedures that required computing the ratio of the two spectra at each frequency can lead to unintended failures at band edges and will no longer be required.)

2) Testing each modulation mode on a single channel in a single operating band is sufficient to demonstrate compliance with the peak excursion requirement. (If all modulation modes are not available on a single channel in a single band, then testing must be extended to other channels and bands as needed to ensure that all modulation modes are tested.)

3) Tests must include all variations in signal structure, such as:

(i) All signal types (e.g., direct sequence spread spectrum (DSSS) and OFDM);

(ii) All modulation types (e.g., BPSK, QPSK, 16-QAM, 64-QAM, and 256-QAM);

(iii) All bandwidth modes;

(iv) All variations in signal parameters (e.g., changes in subcarrier spacing or number of subcarriers).

4) Set the spectrum analyzer span to view the entire emission bandwidth.

5) Find the maximum of the peak-max-hold spectrum.

a) Set RBW = 1 MHz.

b) VBW ≥ 3 MHz.

c) Detector = peak.

d) Trace mode = max-hold.

e) Allow the sweeps to continue until the trace stabilizes.

f) Use the peak search function to find the peak of the spectrum.

6) Use the procedure found under E), or 6.7.2 above, to measure the PPSD.

7) Compute the ratio of the maximum of the peak-max-hold spectrum to the PPSD.

Peak Excursion = Peak-Max-Hold Spectrum – PPSD

6.9.3 Test Result:

All measurements are made with EUT operating on channel 100 (5500 MHz).

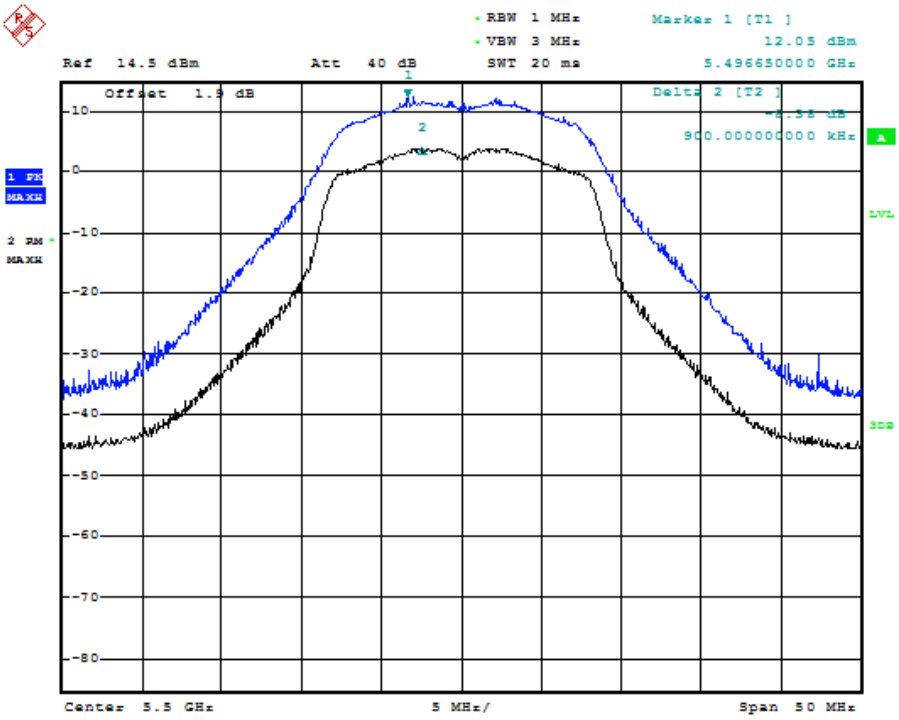
Mode	Modulation	Data Rate (MBPS)	Peak Excursion (dB)
802.11a	BPSK	6	8.38
	QPSK	12	8.07
	16-QAM	24	7.43
	64-QAM	48	7.96
802.11n/ HT20	BPSK	6.5	8.15
	QPSK	13	8.08
	16-QAM	26	8.20
	64-QAM	52	7.78
	64-QAM	72.2	7.95

6.9.4 Test Verdict:

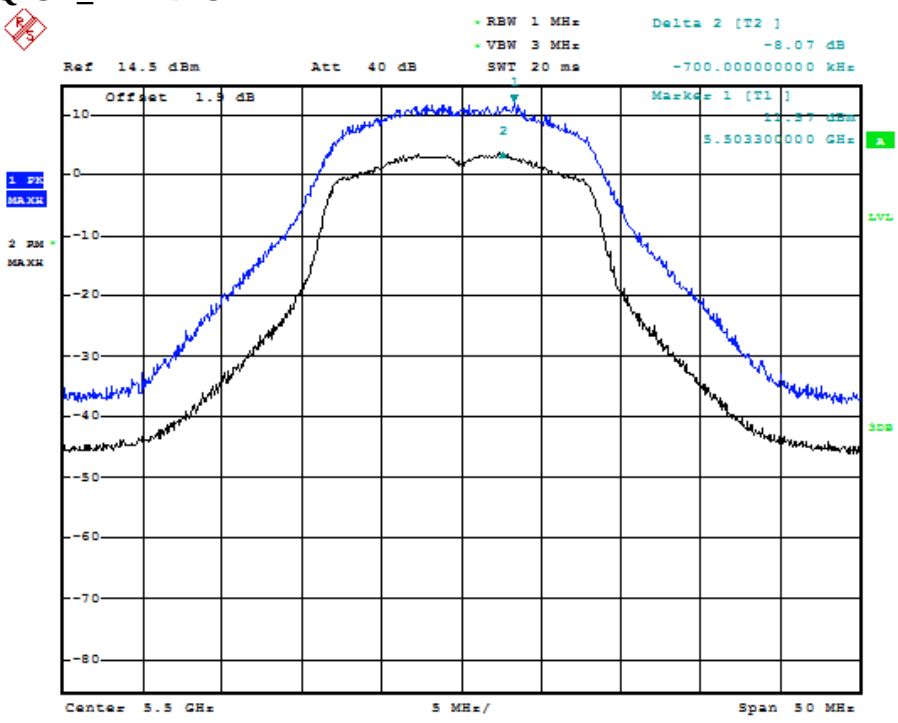
Pass

6.9.5 Test Plots:

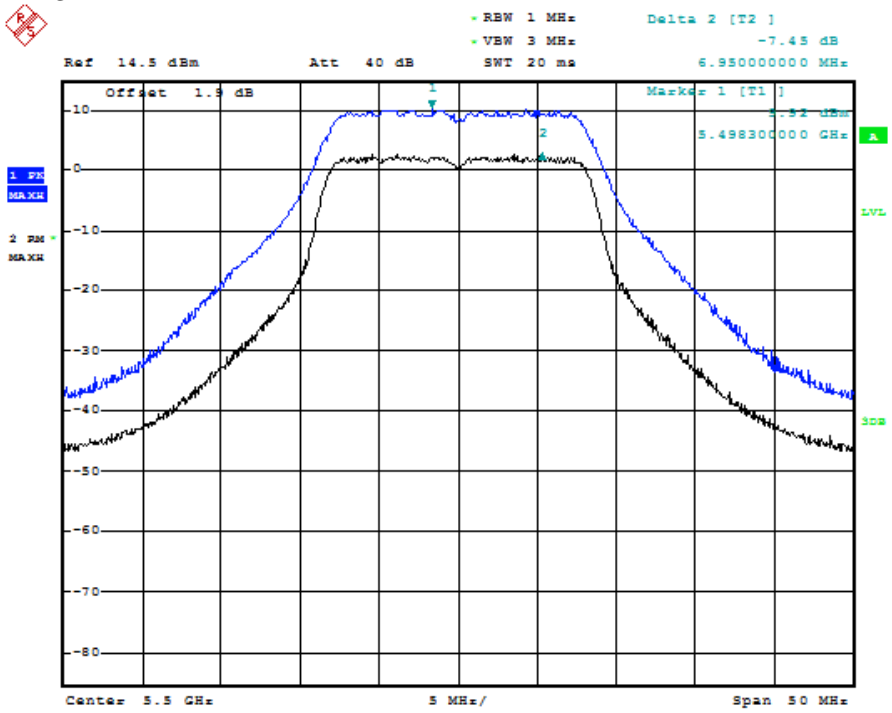
802.11a Ch100_BPSK_6 MBPS



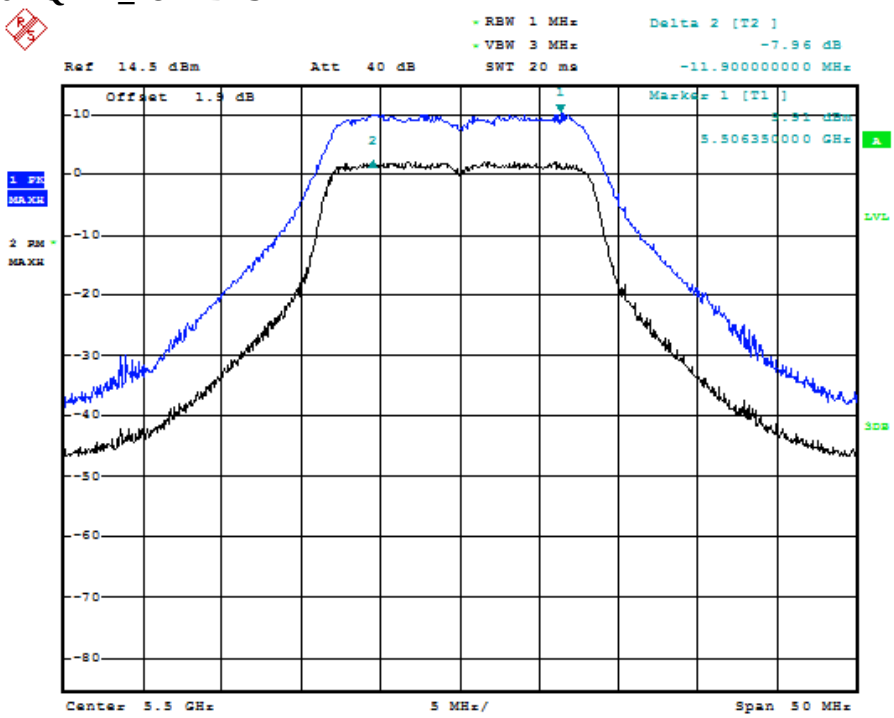
802.11aCh100_QPSK_12 MBPS



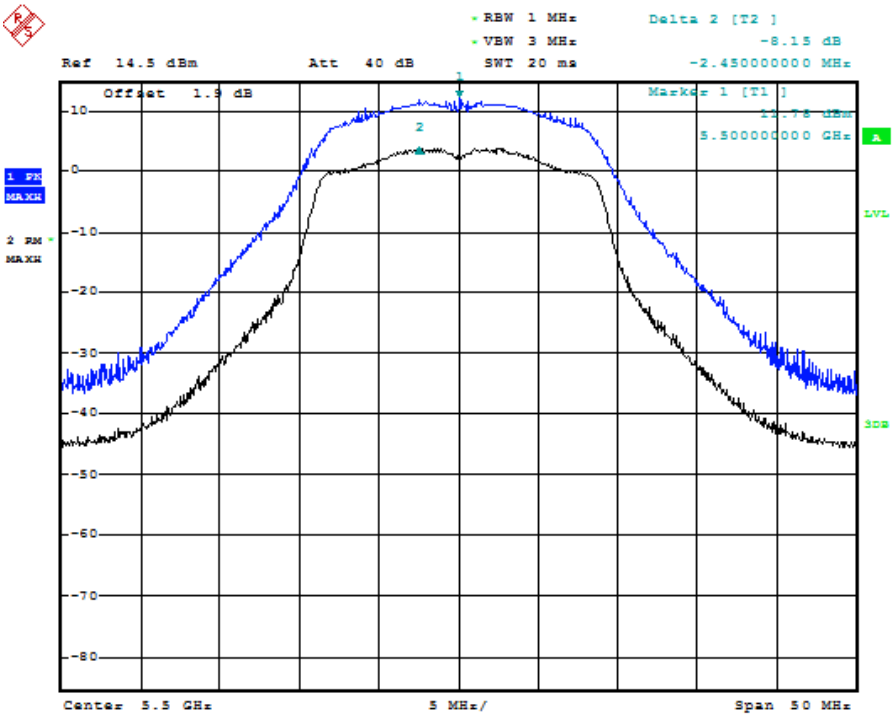
802.11a Ch100_16-QAM_24 MBPS



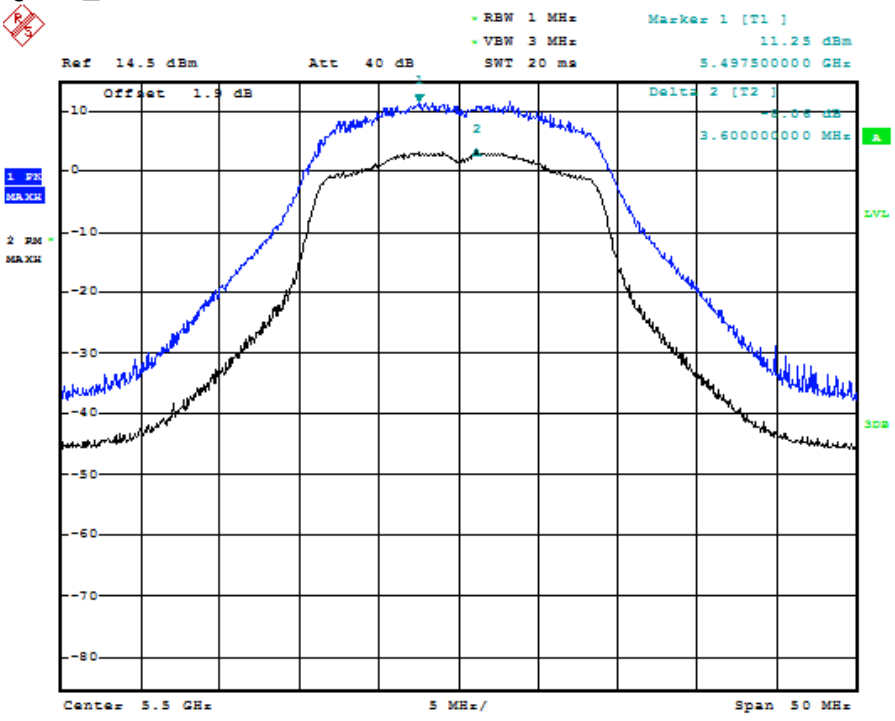
802.11a Ch100_64-QAM_48 MBPS



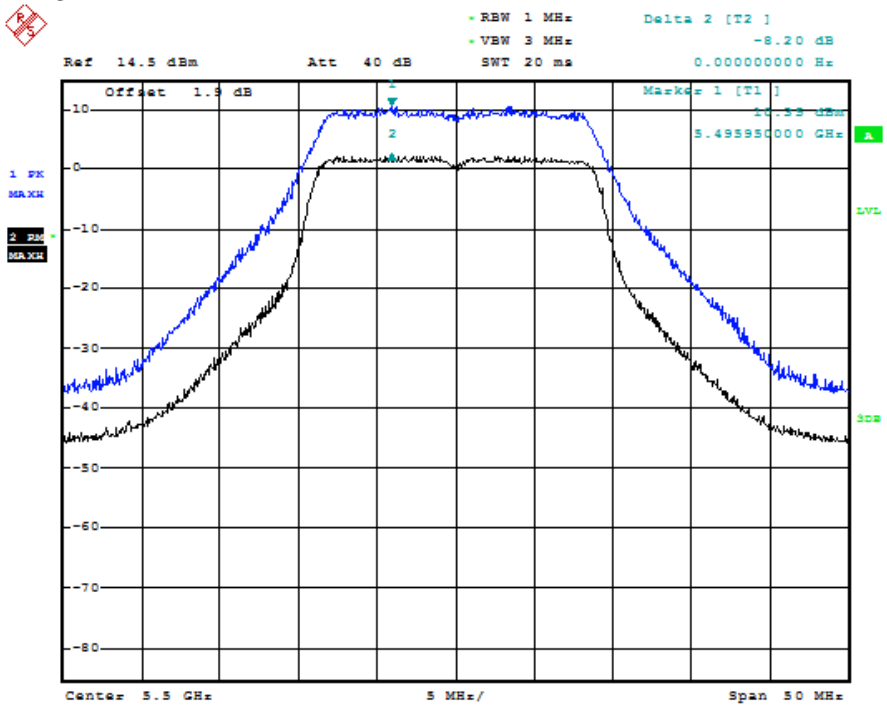
802.11n Ch100_BPSK_6.5 MBPS



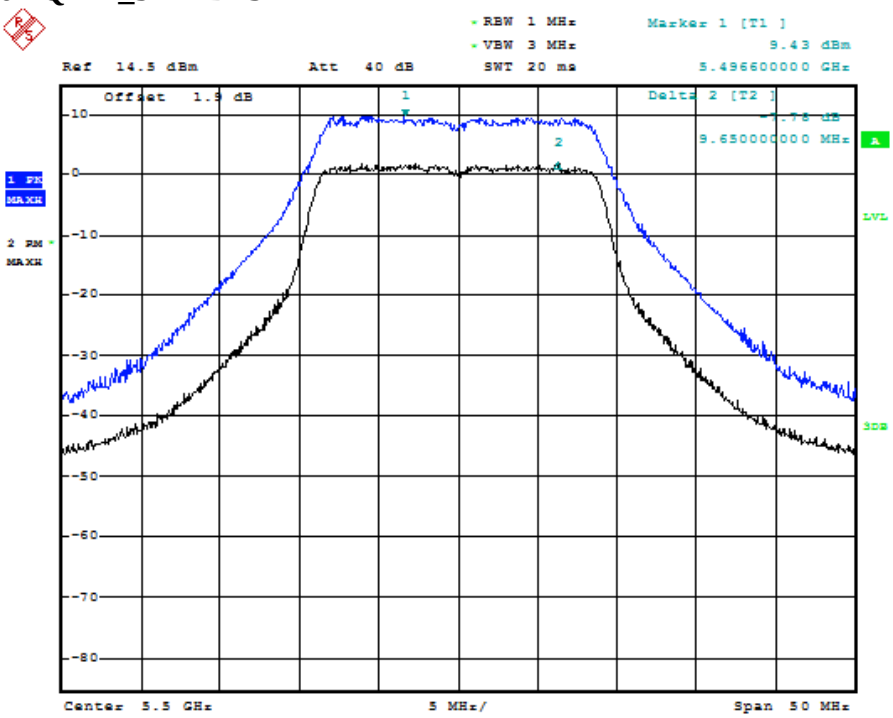
802.11n Ch100_QPSK_13 MBPS



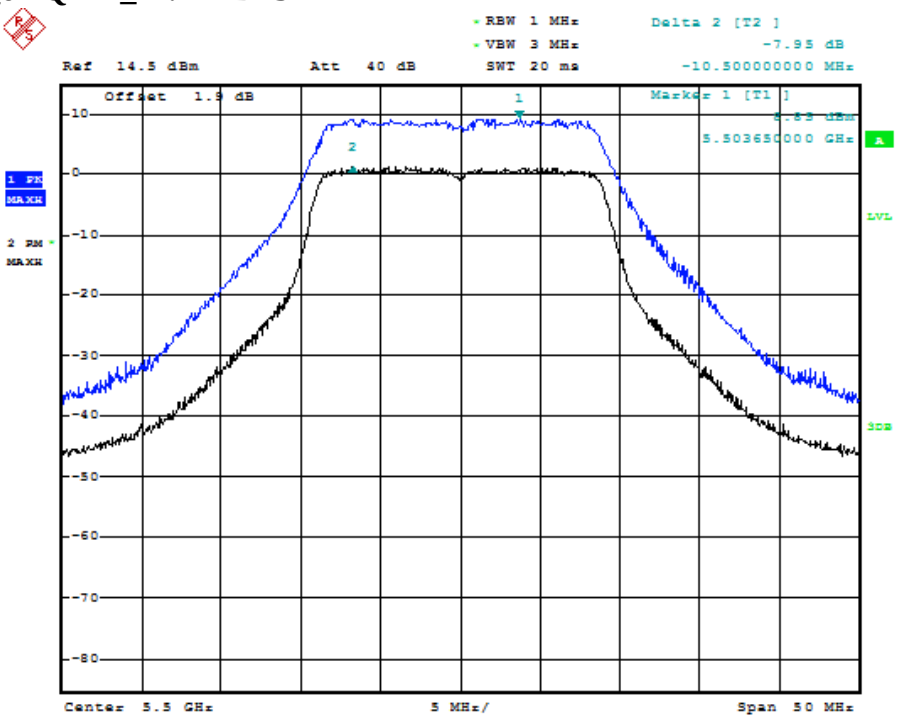
802.11n Ch100_16-QAM_26 MBPS



802.11n Ch100_64-QAM_52 MBPS



802.11n Ch100_64-QAM_72.2 MBPS



6.10 Band Edge Comlpliance – Radiated (Restricted band limits applied)

6.10.1 Limits:

§15.407/15.205/15.209
RSS GEN, ch. 7.7

15.205 (a) Only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
[1]0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 - 156.52525	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	2690 - 2900	22.01 - 23.12
8.41425 - 8.41475	162.0125 - 167.17	3260 - 3267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	240 - 285	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	322 - 335.4	3600 - 4400	([2])
13.36 - 13.41			

15.209 (a) Emission Limits:

The emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (m)
0.009–0.490	2400/F(kHz)	300
0.490–1.705	24000/F(kHz)	30
1.705–30.0	30 (29.5 dBµV/m)	30
30–88	100 (40dBµV/m)	3
88–216	150 (43.5 dBµV/m)	3
216–960	200 (46 dBµV/m)	3
Above 960	500 (54 dBµV/m)	3

6.10.2 Test Conditions:

Tnom: 20ºC; Vnom: 3.8 VDC

6.10.3 Test Procedure:

Peak measurements are made using a peak detector and RBW=1MHz.
*PEAK LIMIT= 74dBµV/m

Average measurements performed using a peak detector and according to video averaging procedure with RBW=1MHz and VBW=10Hz.
*AVG. LIMIT= 54dBµV/m

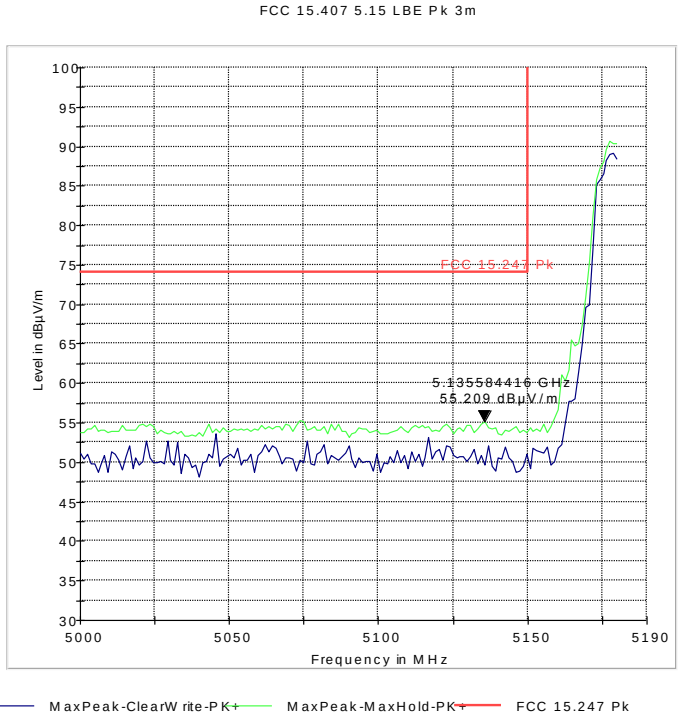
Measurement Uncertainty: ±3.0dB

6.10.3.1 Measurement Result

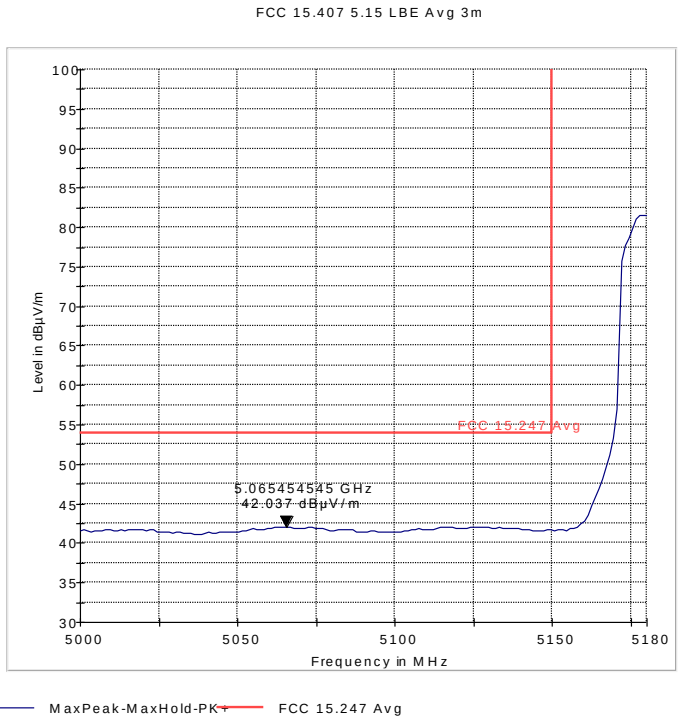
Pass.

6.10.4 Test Data/plots:

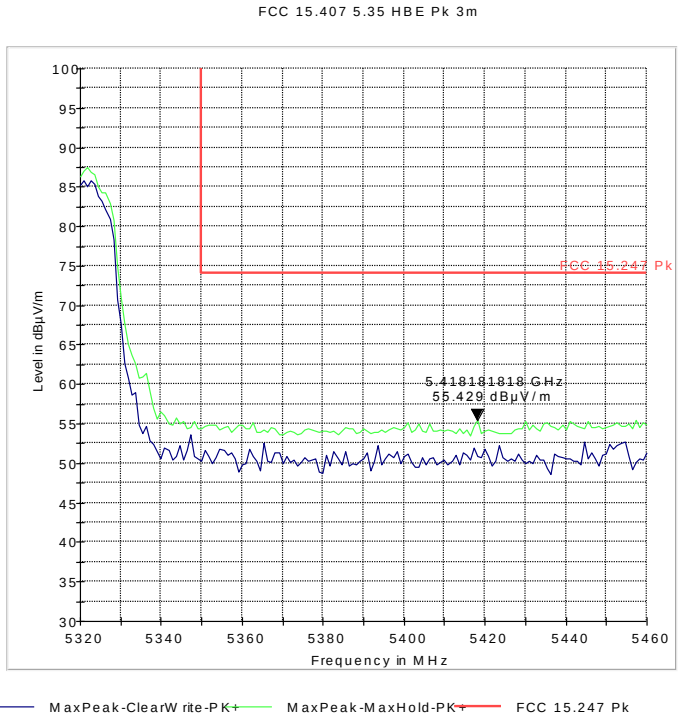
802.11a Channel 36 Low Band Edge Peak measurement



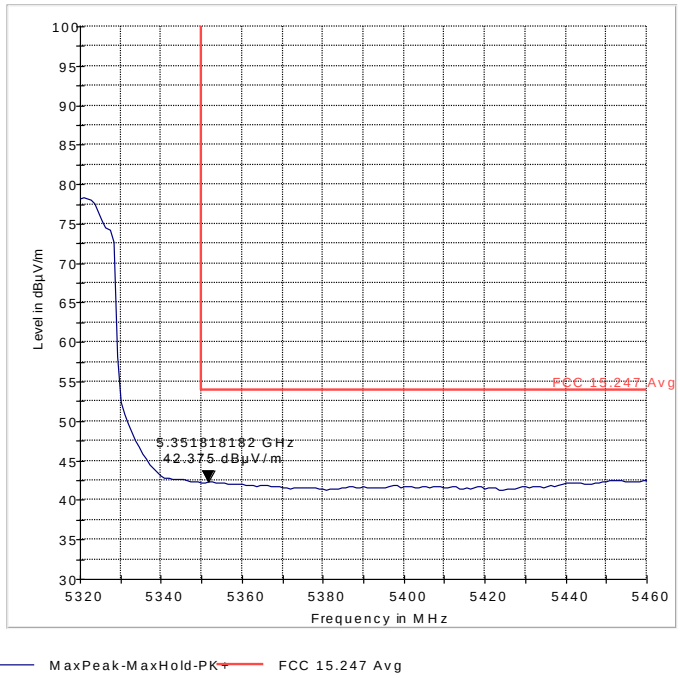
802.11a Channel 36 Low Band Edge Average measurement



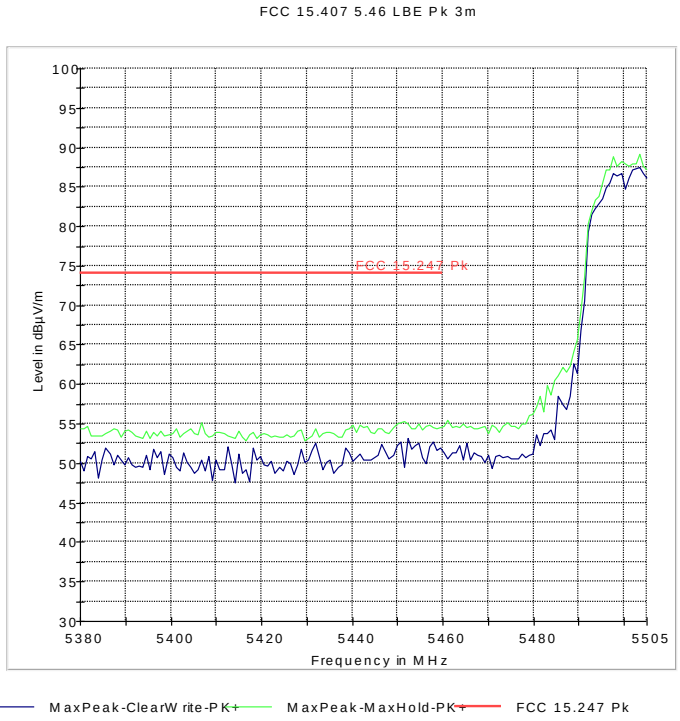
802.11a Channel 64 High Band Edge Peak measurement



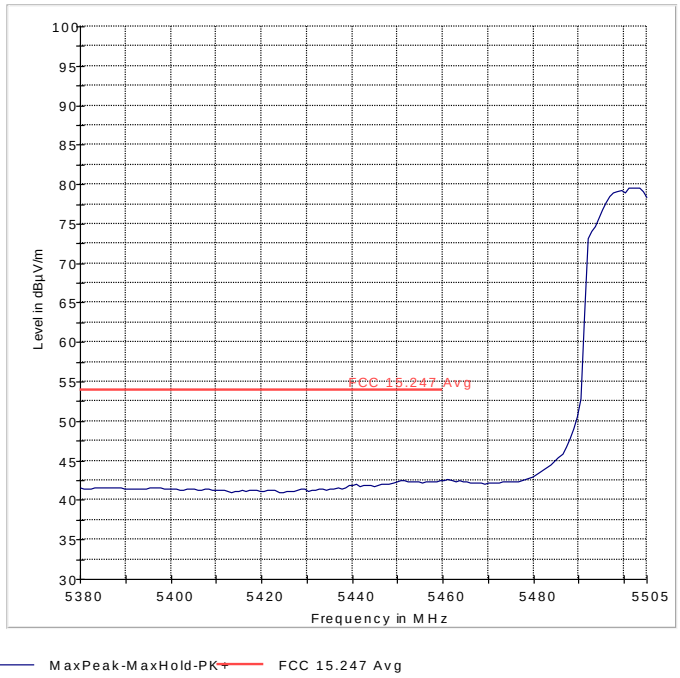
802.11a Channel 64 High Band Edge Average measurement



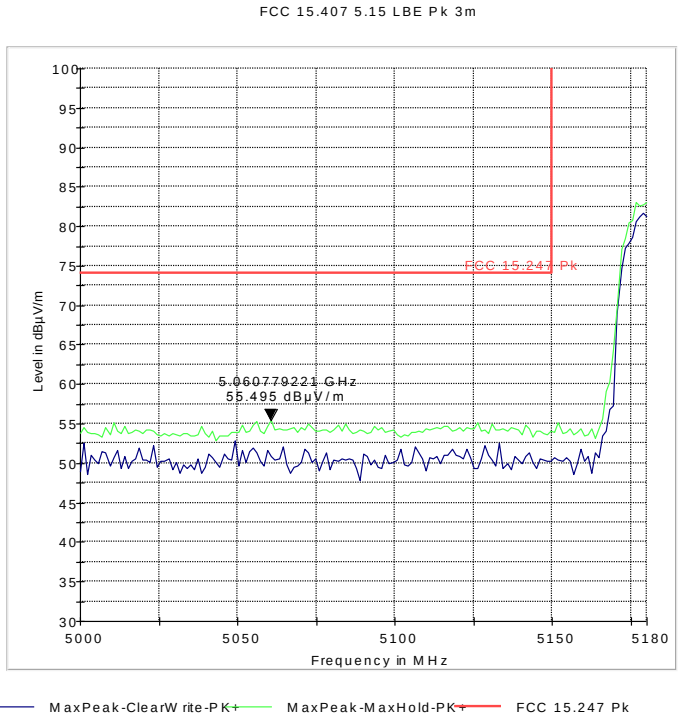
802.11a Channel 100 Low Band Edge Peak measurement



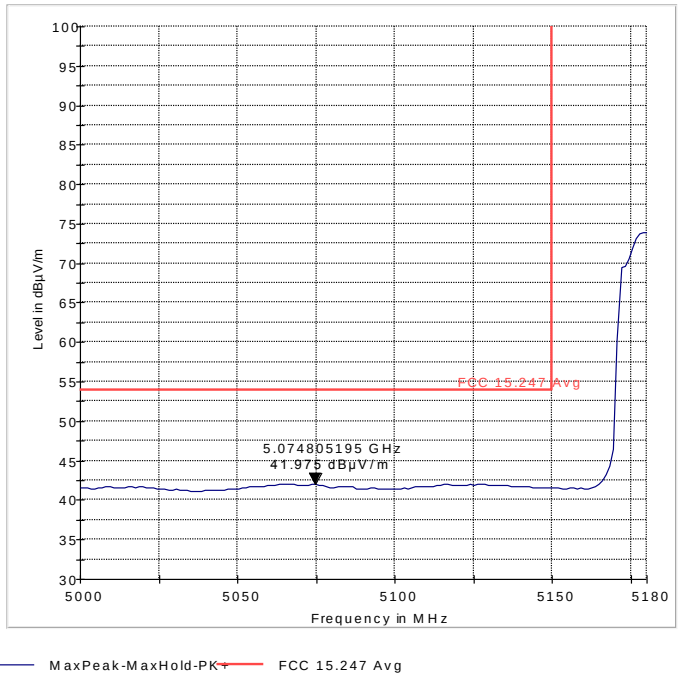
802.11a Channel 100 Low Band Edge Average measurement



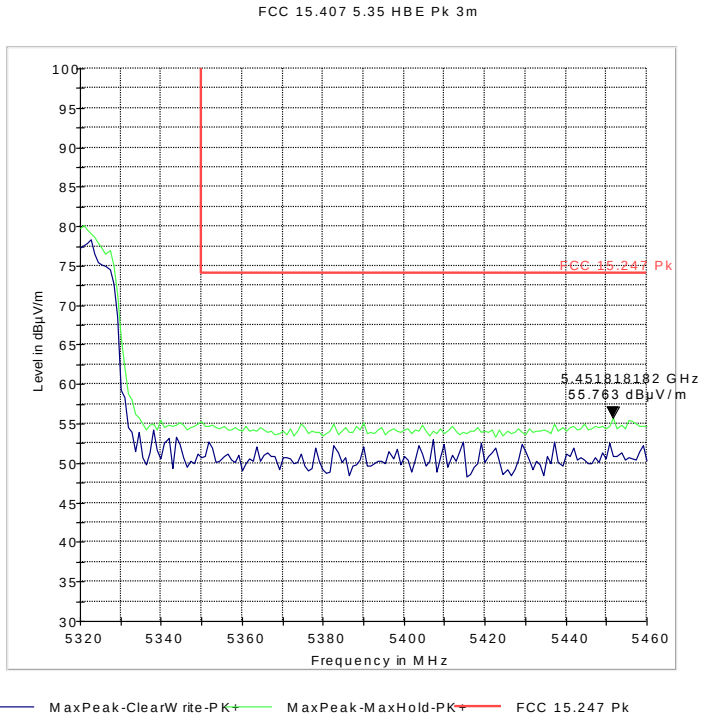
802.11n Channel 36 Low Band Edge Peak measurement



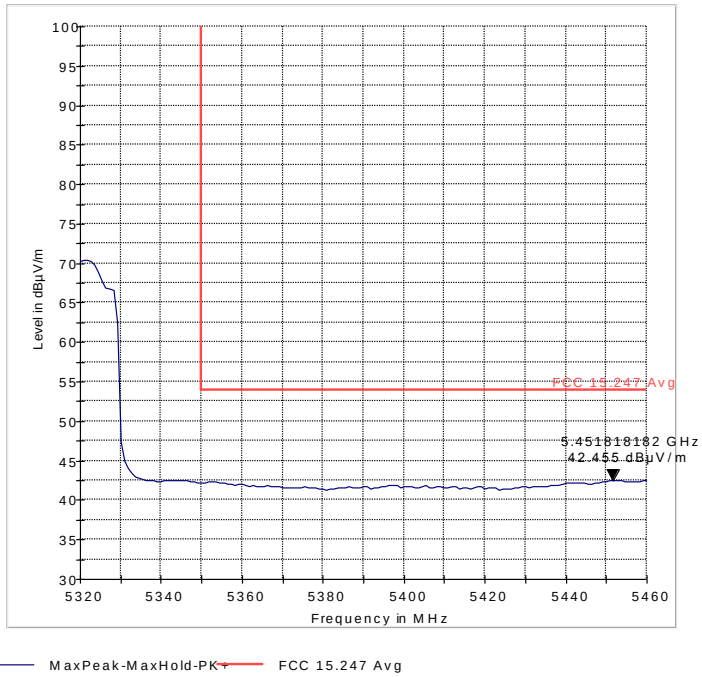
802.11n Channel 36 Low Band Edge Average measurement



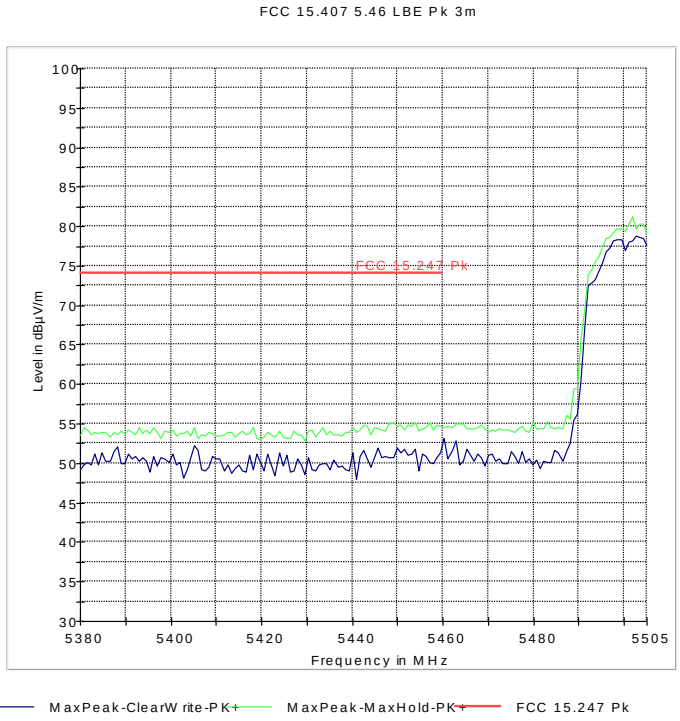
802.11n Channel 64 High Band Edge Peak measurement



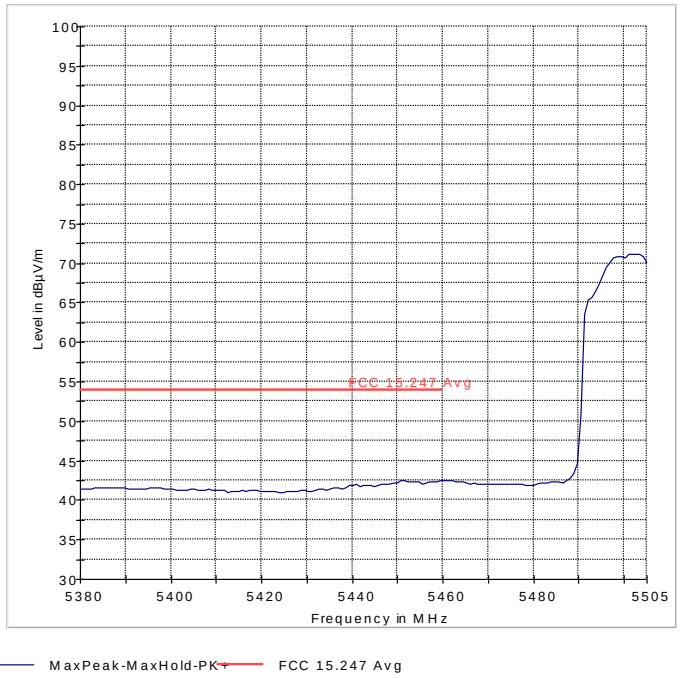
802.11n Channel 64 High Band Edge Average measurement



802.11n Channel 100 Low Band Edge Peak measurement



802.11n Channel 100 Low Band Edge Average measurement



6.11 Unwanted Emissions into Restricted and Non-restricted bands

6.11.1 Requirements / Limits

§15.407/15.205/15.209
RSS-GEN, ch. 7.7

(b) Undesirable emission limits: Except as shown in paragraph (b)(6) of this section, the peak emissions outside of the frequency bands of operation shall be attenuated in accordance with the following limits:

(1) For transmitters operating in the 5.15–5.25 GHz band: all emissions outside of the 5.15–5.35 GHz band shall not exceed an EIRP of –27 dBm/MHz.

(2) For transmitters operating in the 5.25–5.35 GHz band: all emissions outside of the 5.15–5.35 GHz band shall not exceed an EIRP of –27 dBm/MHz. Devices operating in the 5.25–5.35 GHz band that generate emissions in the 5.15–5.25 GHz band must meet all applicable technical requirements for operation in the 5.15–5.25 GHz band (including indoor use) or alternatively meet an out-of-band emission EIRP limit of –27 dBm/MHz in the 5.15–5.25 GHz band.

(3) For transmitters operating in the 5.47–5.725 GHz band: all emissions outside of the 5.47–5.725 GHz band shall not exceed an EIRP of −27 dBm/MHz.

(4) For transmitters operating in the 5.725–5.825 GHz band: all emissions within the frequency range from the band edge to 10 MHz above or below the band edge shall not exceed an EIRP of –17 dBm/MHz; for frequencies 10 MHz or greater above or below the band edge, emissions shall not exceed an EIRP of –27 dBm/MHz.

(6) Unwanted emissions below 1 GHz must comply with the general field strength limits set forth in §15.209.

(7) The provisions of § 15.205 apply to intentional radiators operating under this section.

(8) When measuring the emission limits, the nominal carrier frequency shall be adjusted as close to the upper and lower frequency block edges as the design of the equipment permits.

6.11.2 Limits: §15.209

Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (m)
0.009–0.490	2400/F(kHz)	300[1]
0.490–1.705	24000/F(kHz)	30[1]
1.705–30.0	30 (29.5 dBµV/m)	30[1]
30–88	100 (40dBµV/m)	3
88–216	150 (43.5 dBµV/m)	3
216–960	200 (46 dBµV/m)	3
Above 960	500 (54 dBµV/m)	3

NOTE: The radiated emissions were done with different settings, using the relevant pre-amplifiers for the relevant frequency ranges. This is the reason that the graphs show different noise levels.

1. Measurements made with antenna factors and limits scaled to 3m measurement distance.

6.11.3 Test Conditions:

Tnom: 20ºC; Vnom: 3.8 VDC

Measurement distance: 3m.

6.11.4 Test Result:

Plots reported here represent the worst case emissions for horizontal and vertical antenna polarizations and for three orientations of the EUT.

Unless mentioned otherwise, the emissions outside the limit lines in the plots are from the transmit signal.

Low/Mid/High channels in each sub-band of operation were tested and results reported for both 802.11a and n modes of operation.
Only worst case mid channel test results reported for 9k-1GHz and >18 GHz ranges of test.

Measurement Uncertainty: ±3.0dB

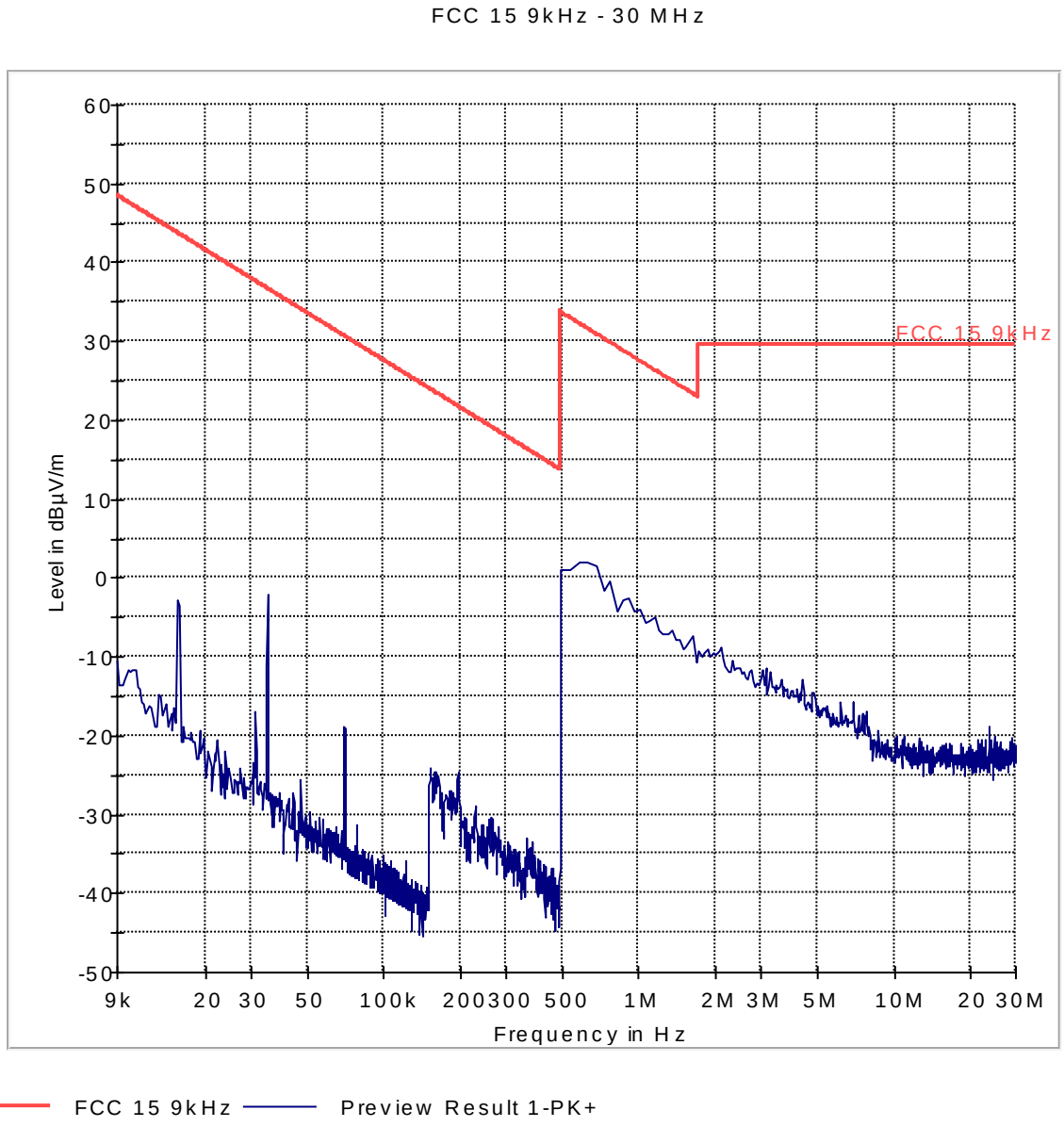
6.11.5 Testing Notes:

For the measurement range up to 30 MHz in the following plots the field strength results from 3m distance measurement are extrapolated to 300m and 30m distance respectively, by 40dB/decade, according to part 15.31(f)(2), per antenna factor scaling. The red limit line shows the 300 m limit up to 490 kHz, the 30m limit up to 30 MHz and 3m limit above 30MHz.

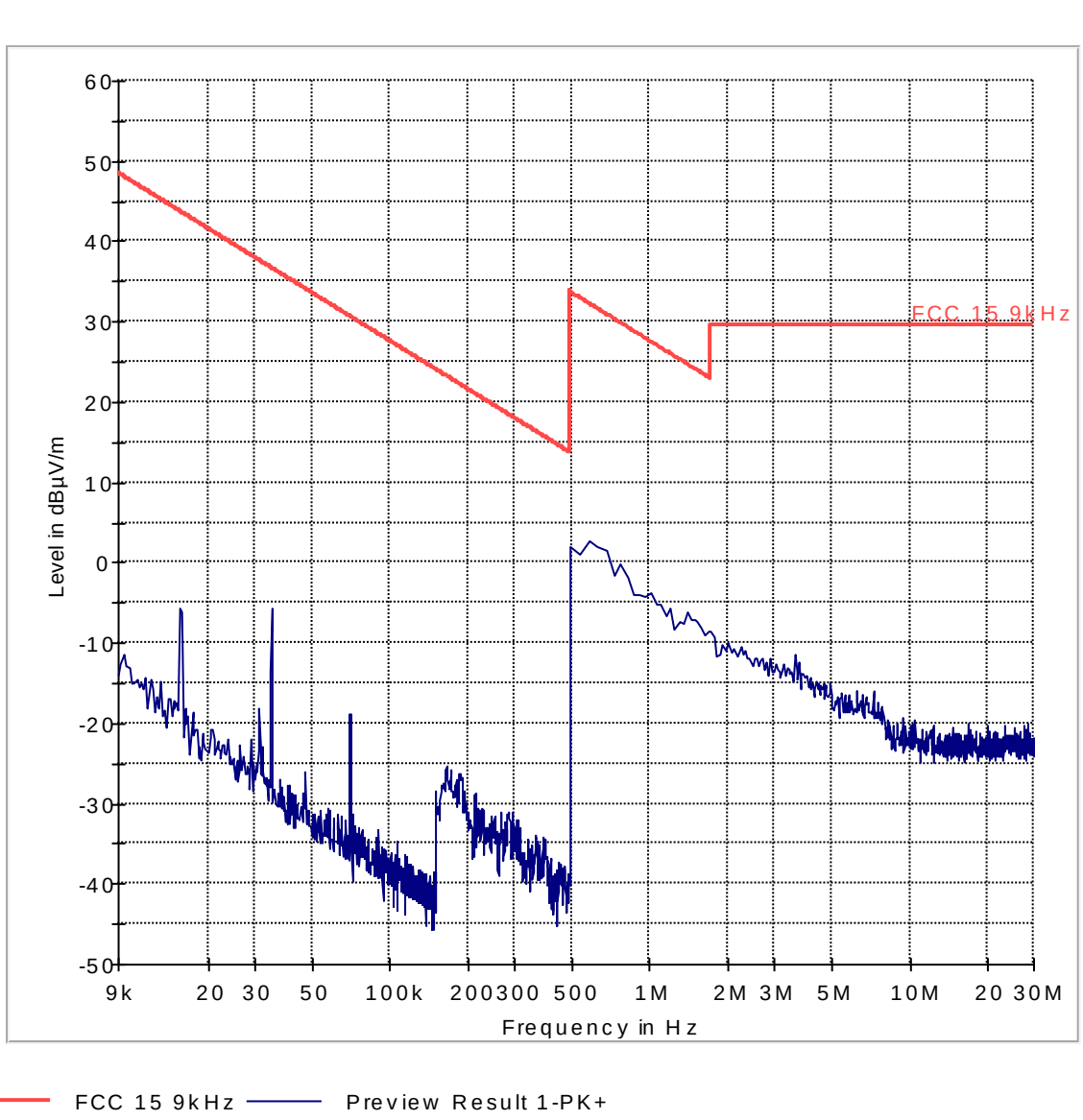
6.11.5.1 Measurement Verdict

Pass.

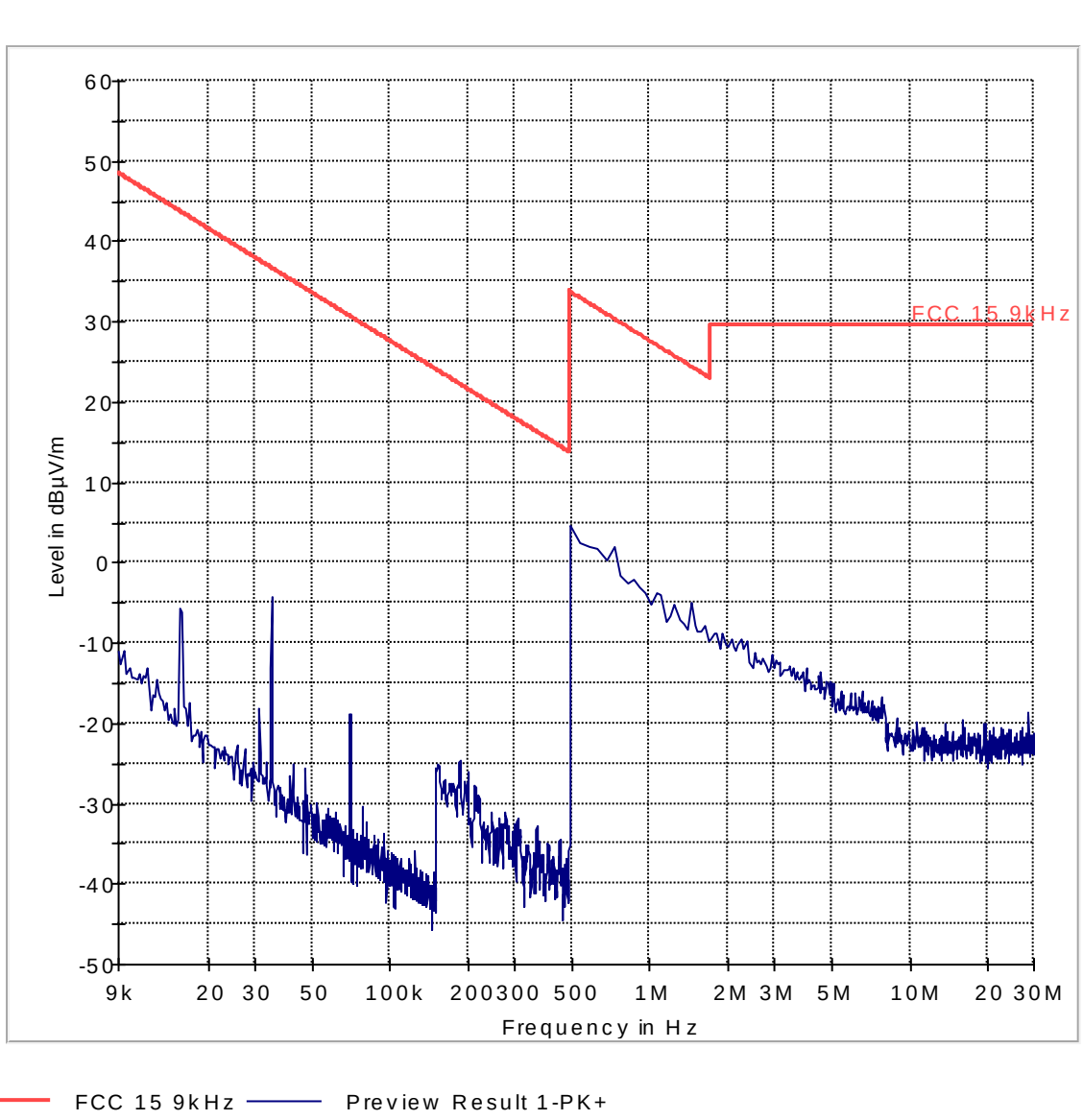
6.11.6 Test data/ plots:
9kHz-30MHz
Mode: 802.11a-Ch40 (Sub-Band 1)



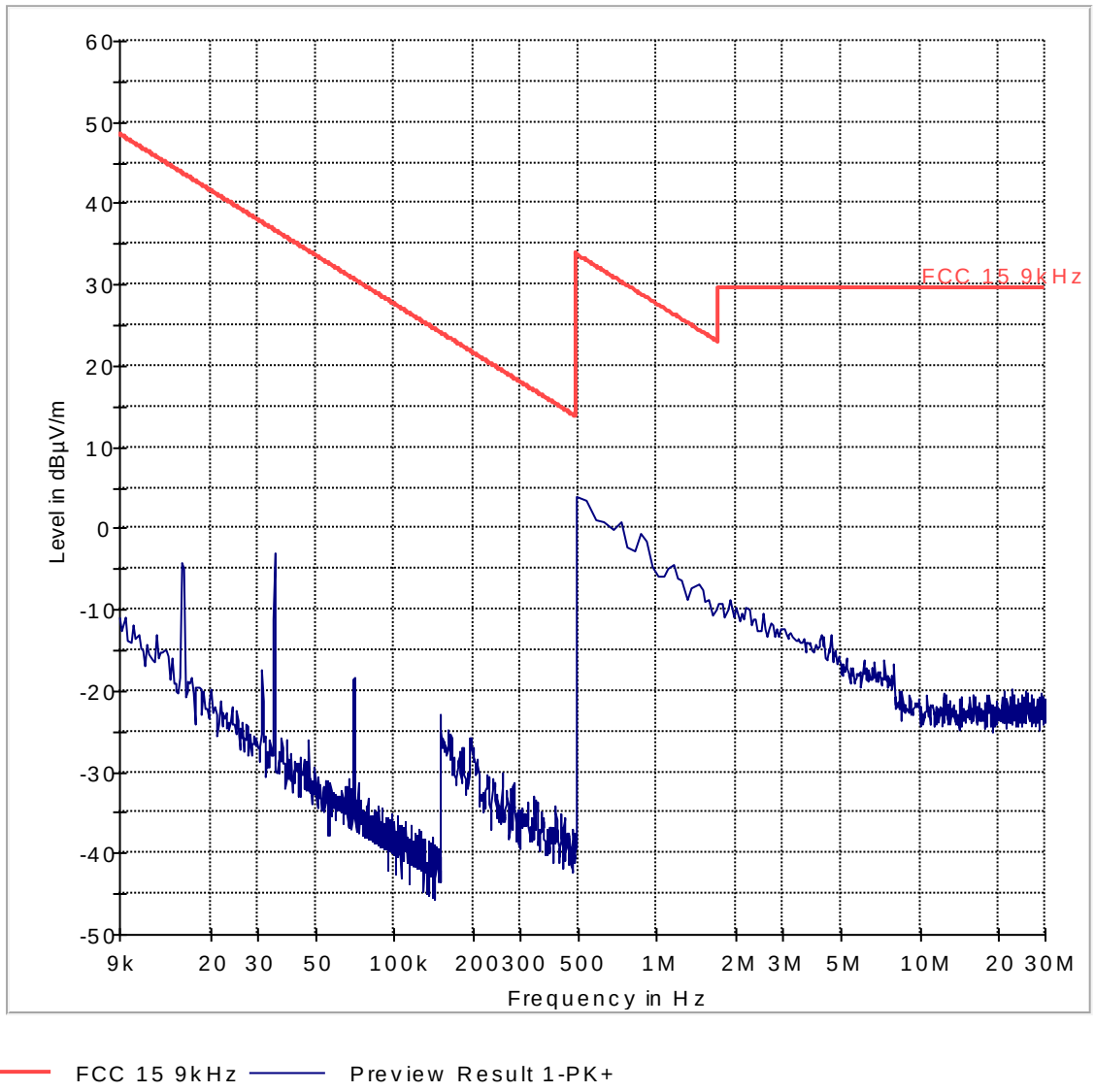
9kHz-30MHz
Mode: 802.11a-Ch60 (Sub-Band 2)



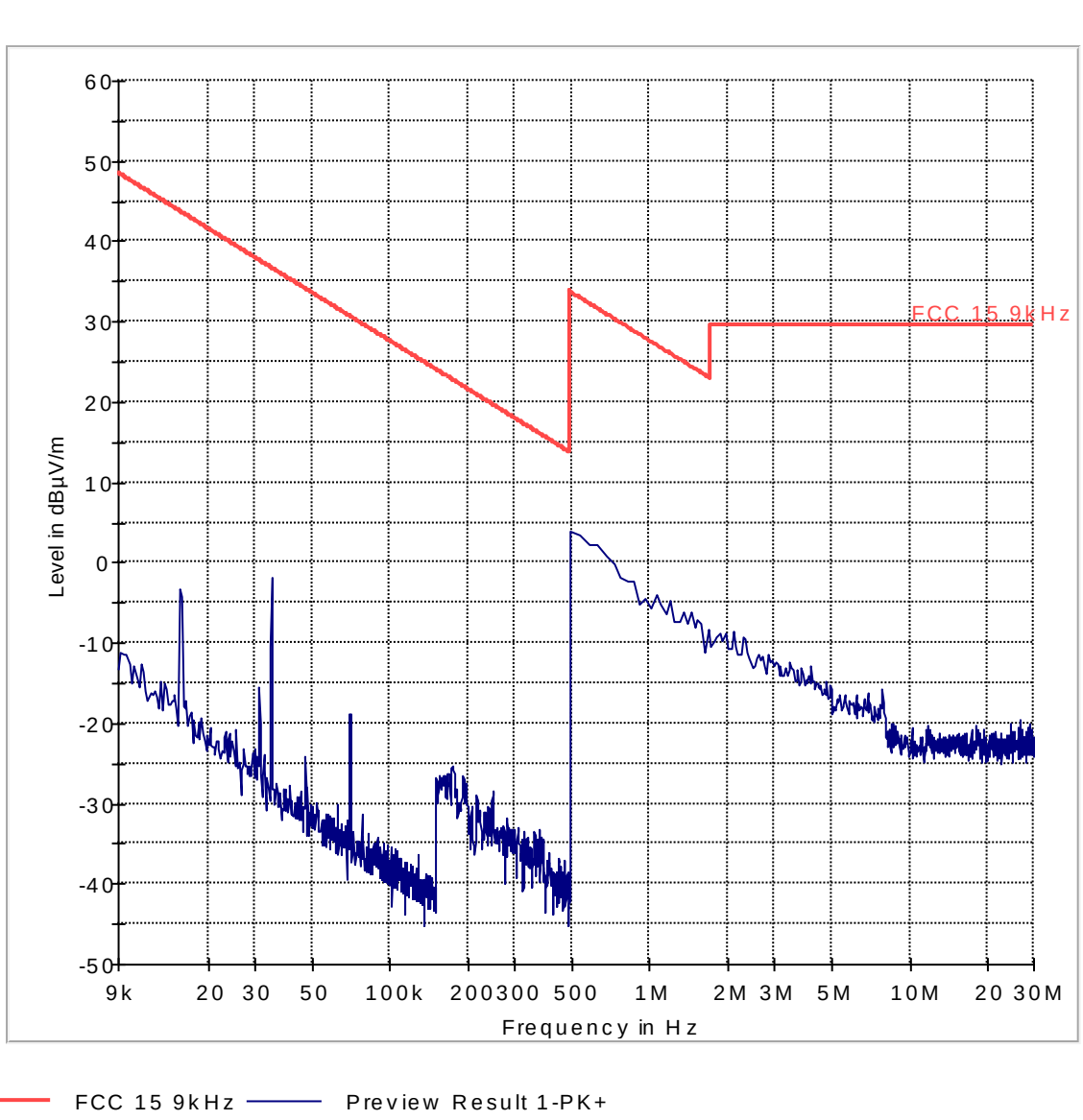
9kHz-30MHz
Mode: 802.11a-Ch120 (Sub-Band 3)



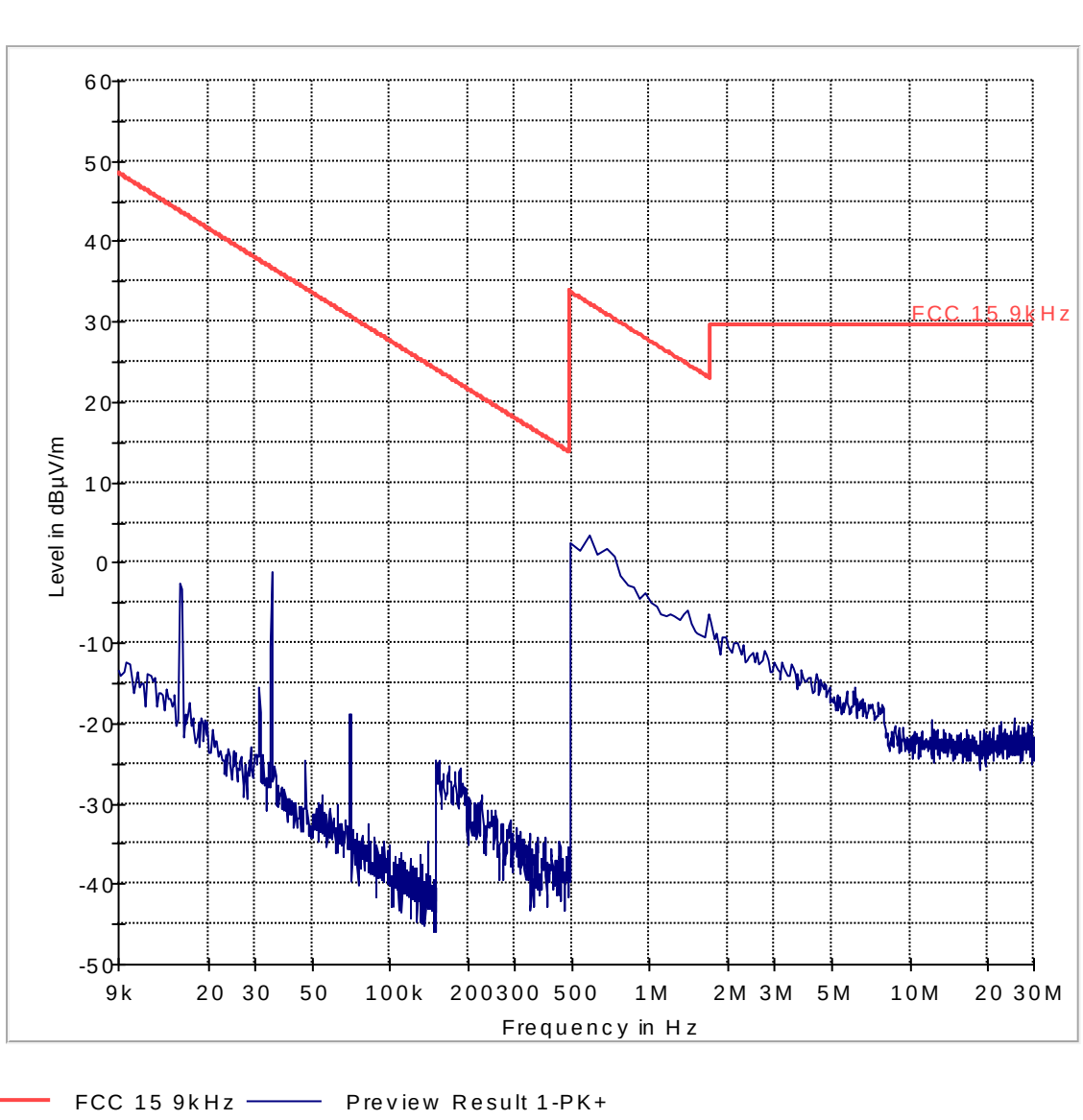
9kHz-30MHz
Mode: 802.11n-Ch40 (Sub-Band 1)



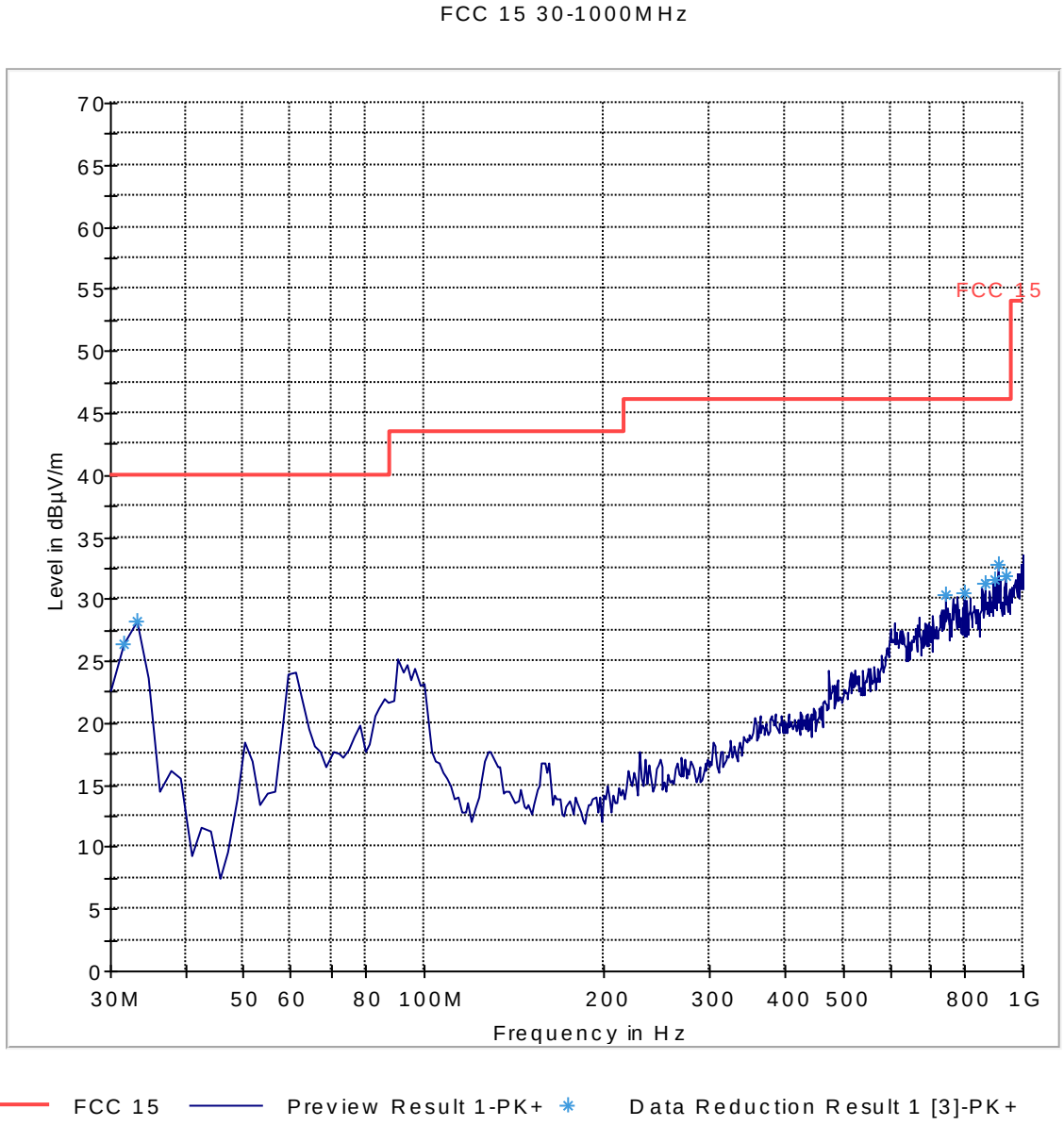
9kHz-30MHz
Mode: 802.11n-Ch60 (Sub-Band 2)



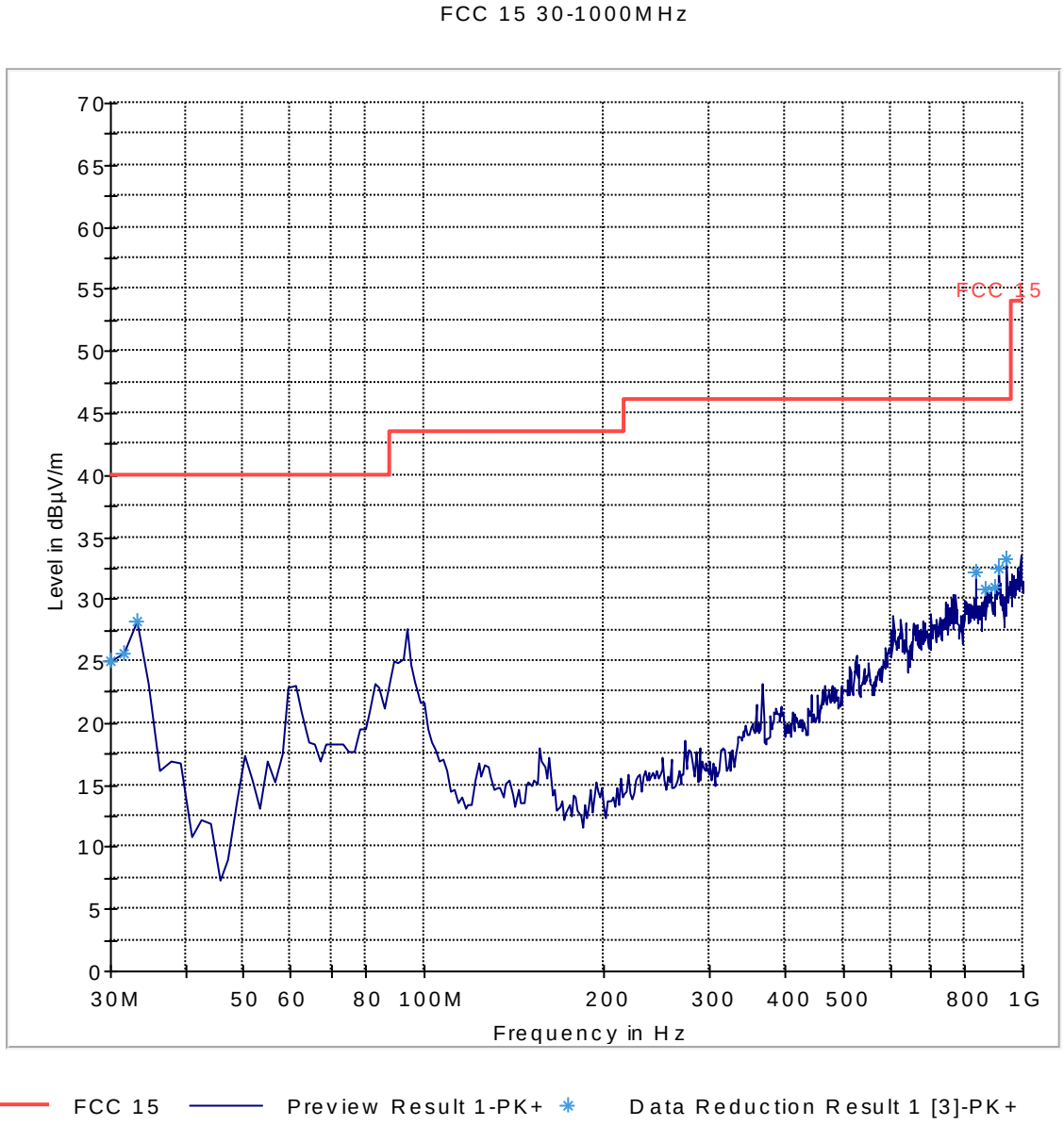
9kHz-30MHz
Mode: 802.11n-Ch120 (Sub-Band 3)



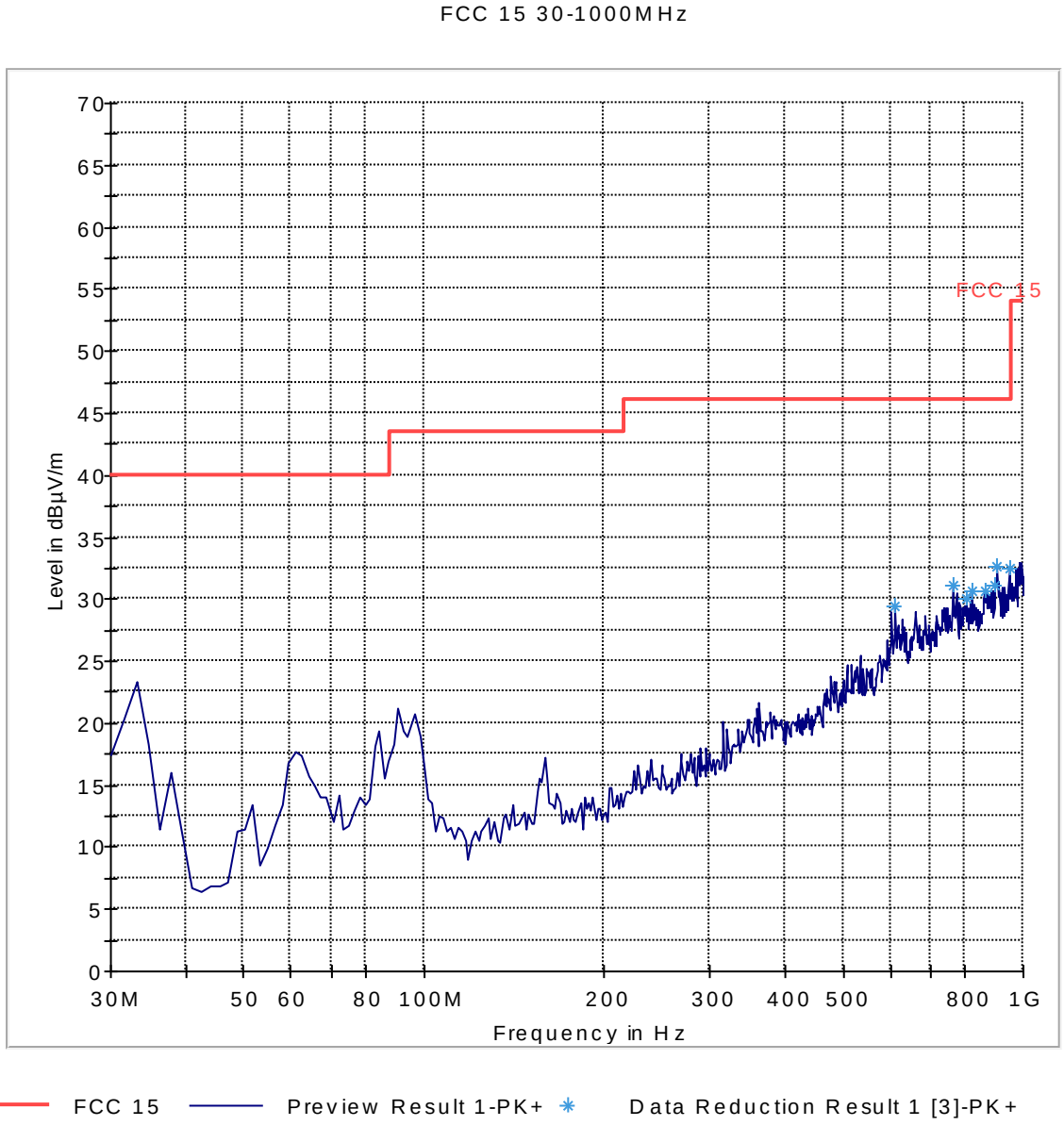
30MHz-1GHz
Mode: 802.11a-Ch40 (Sub-Band 1)



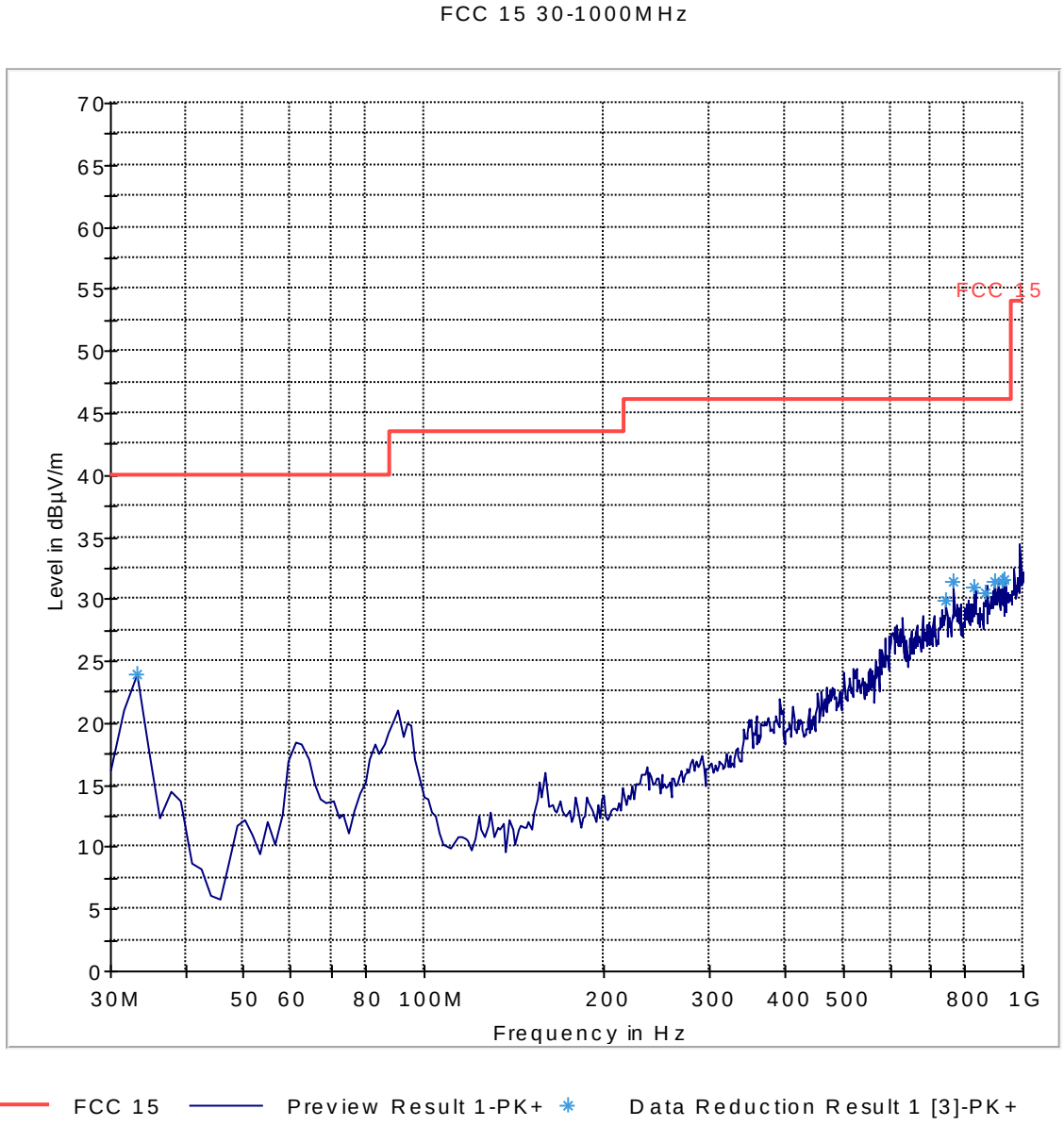
30MHz-1GHz
Mode: 802.11a-Ch60 (Sub-Band 2)



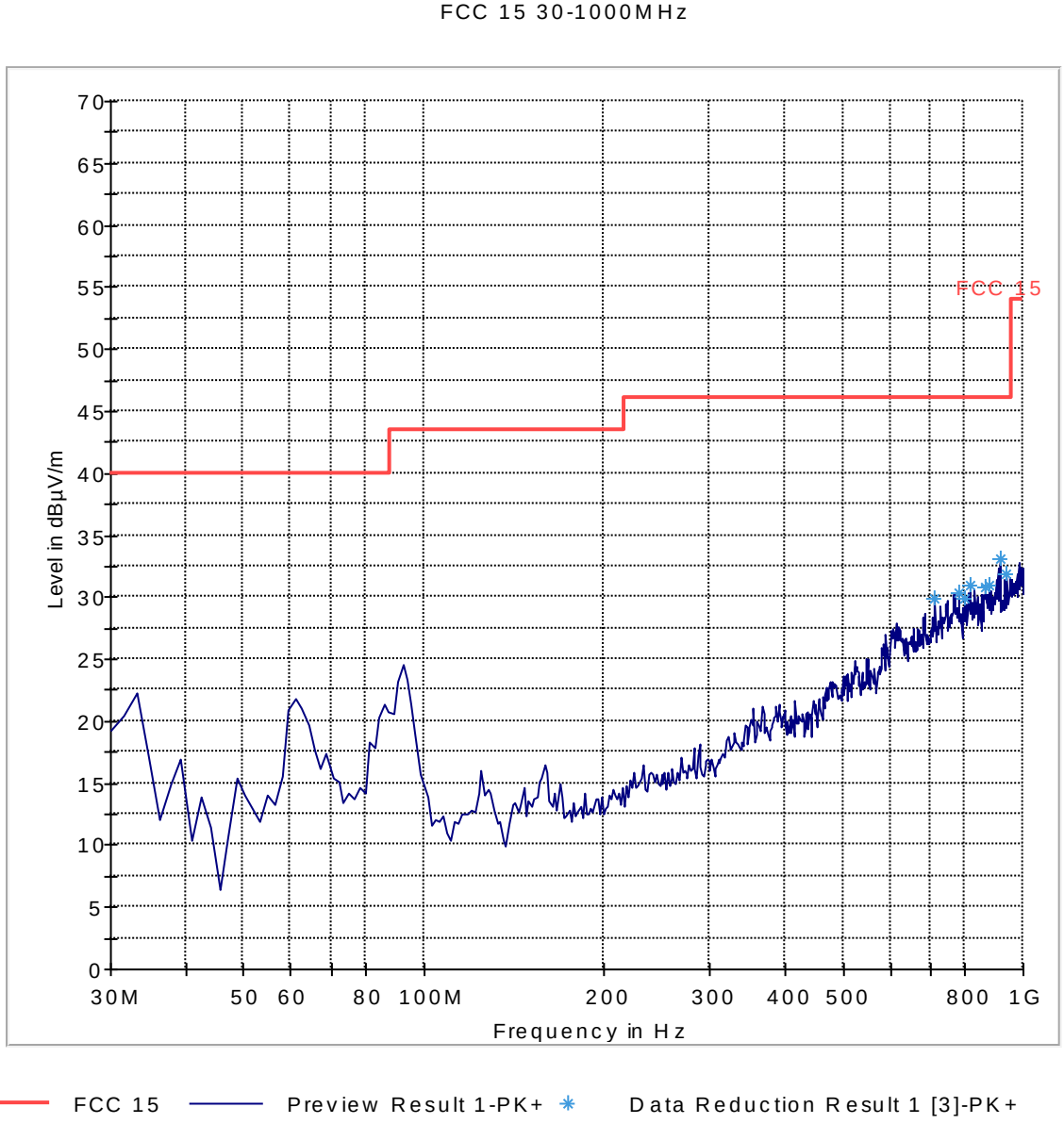
30MHz-1GHz
Mode: 802.11a-Ch120 (Sub-Band 3)



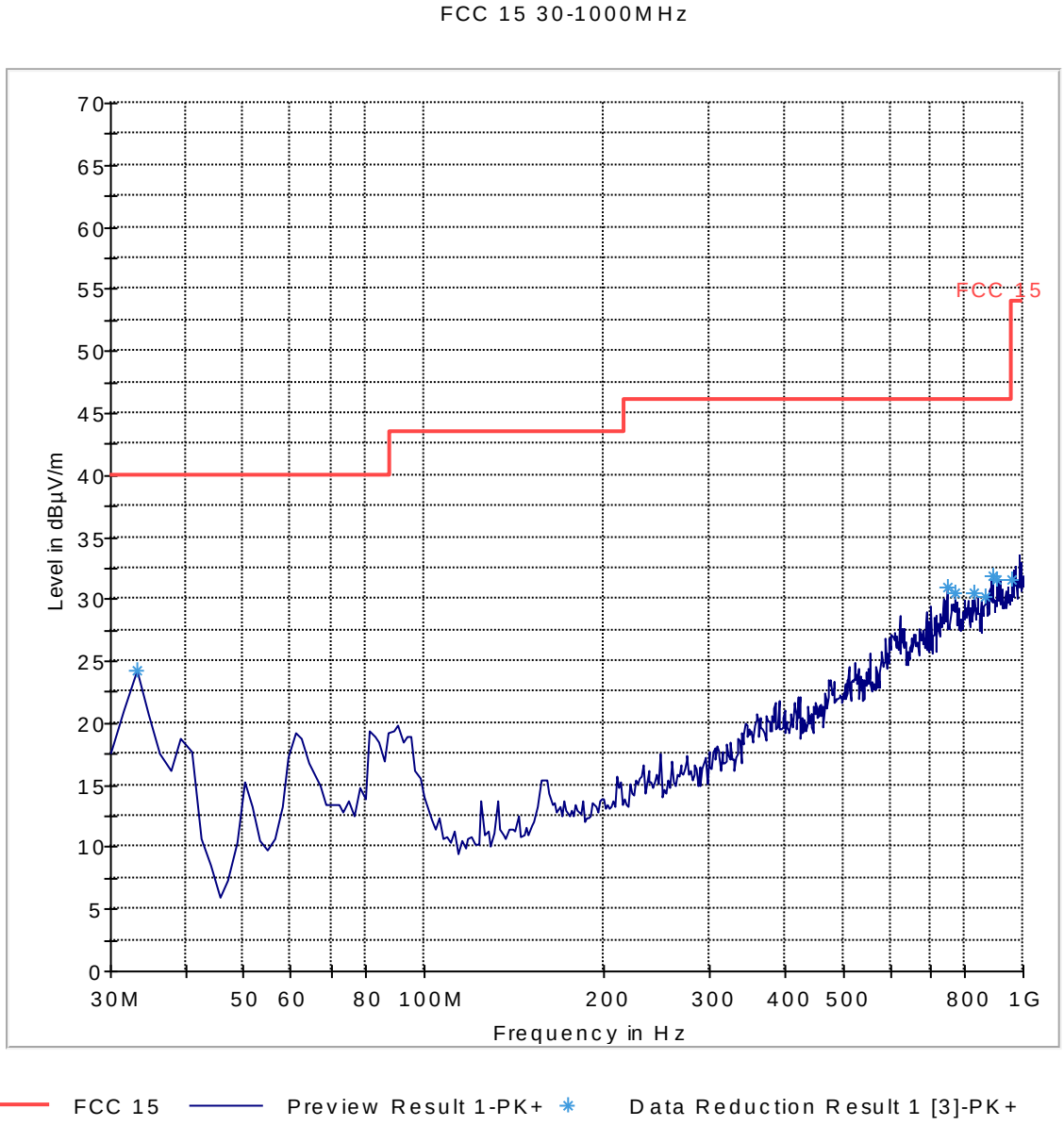
30MHz-1GHz
Mode: 802.11n-Ch40 (Sub-Band 1)



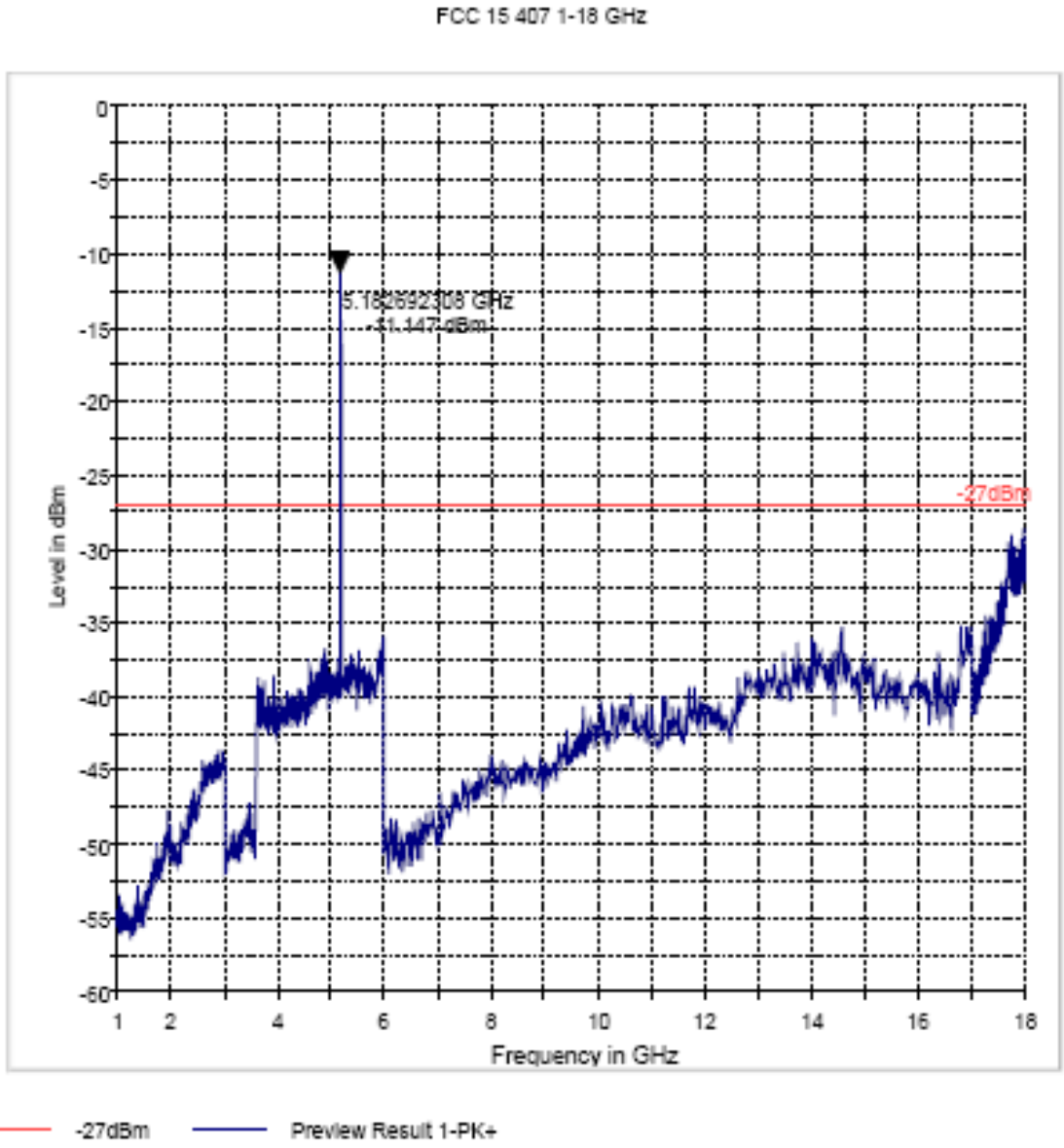
30MHz-1GHz
Mode: 802.11n-Ch60 (Sub-Band 2)



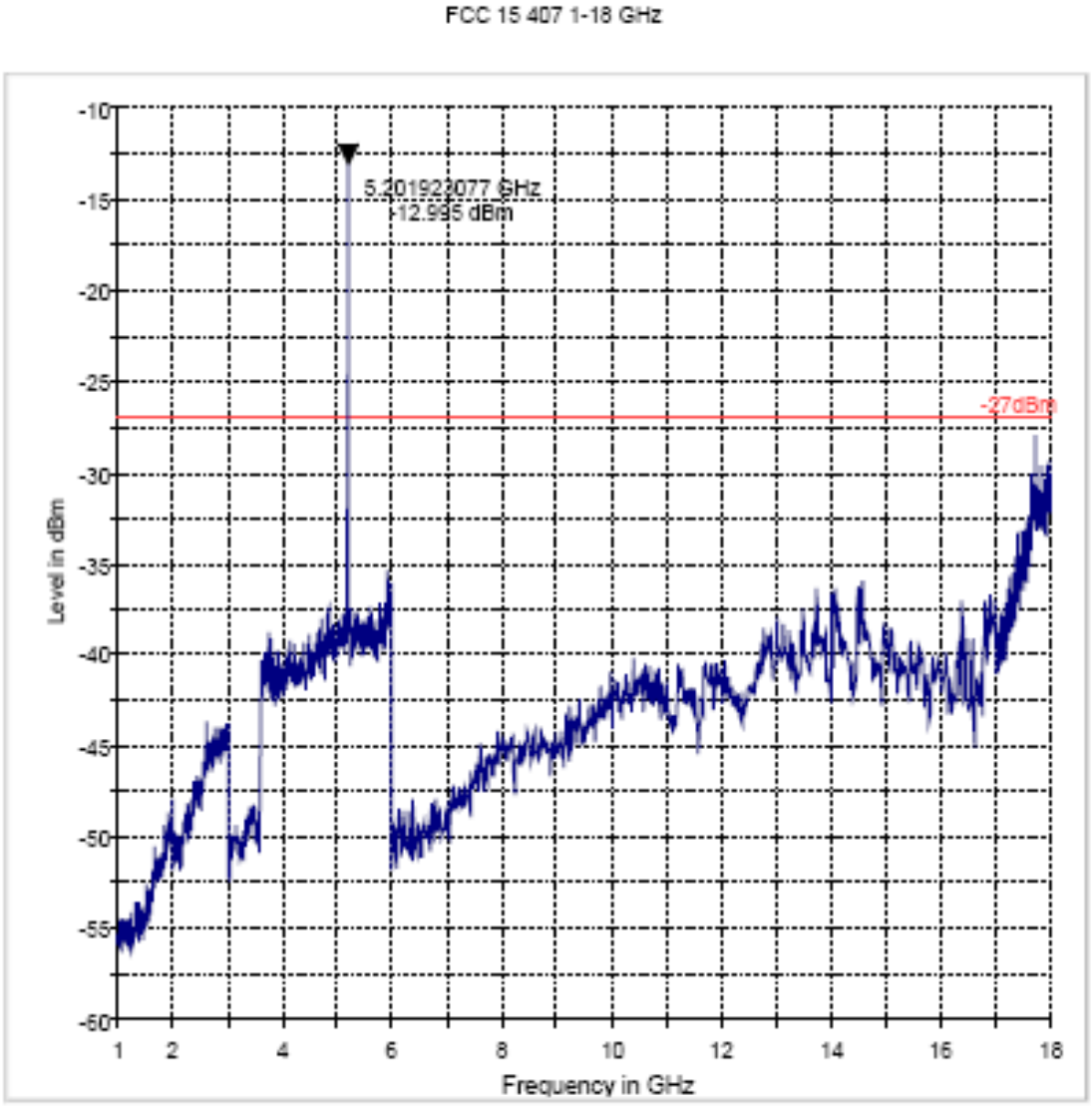
30MHz-1GHz
Mode: 802.11n-Ch120 (Sub-Band 3)



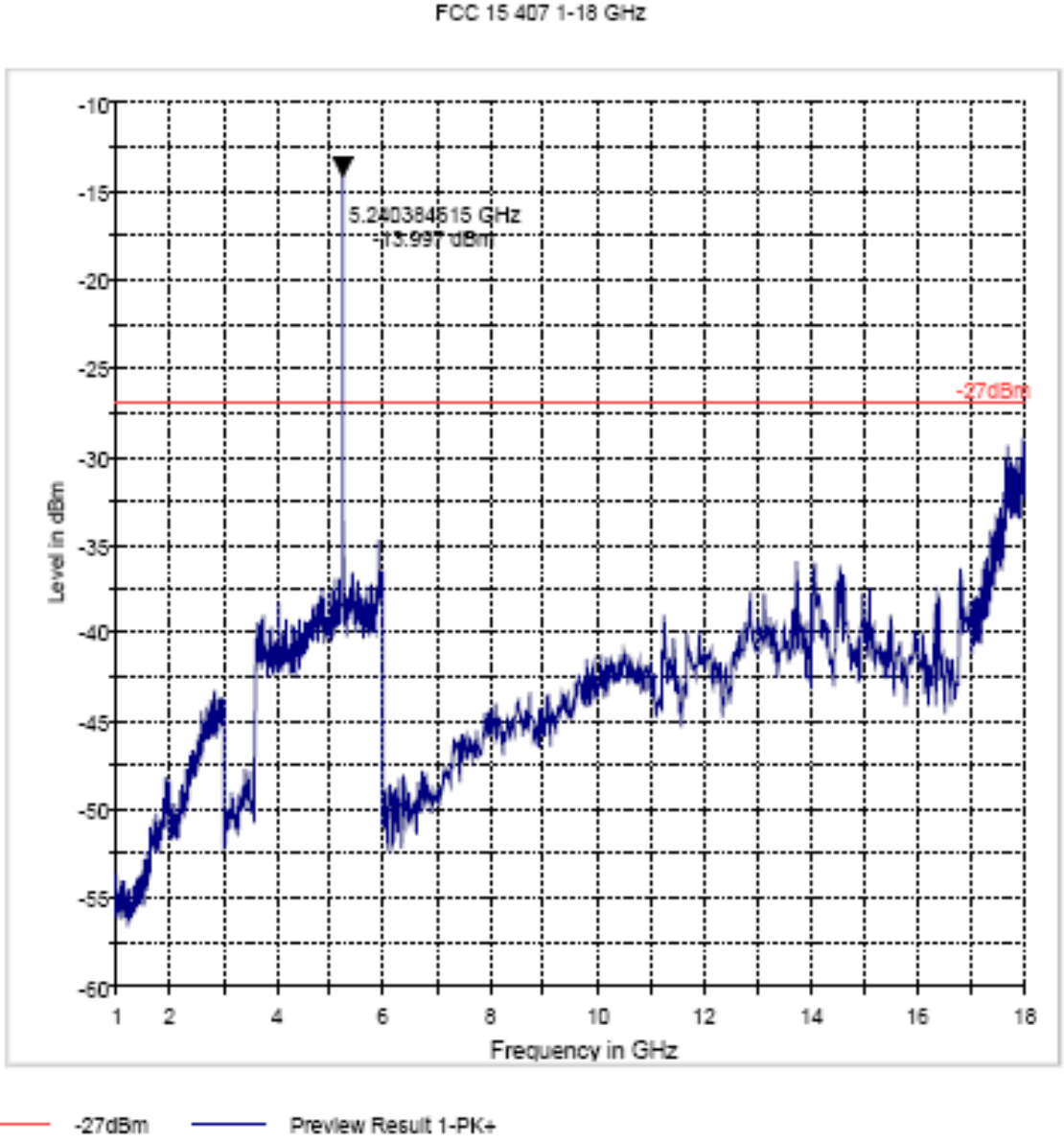
1GHz-18GHz
Mode: 802.11a-Ch36 (Sub-Band 1)



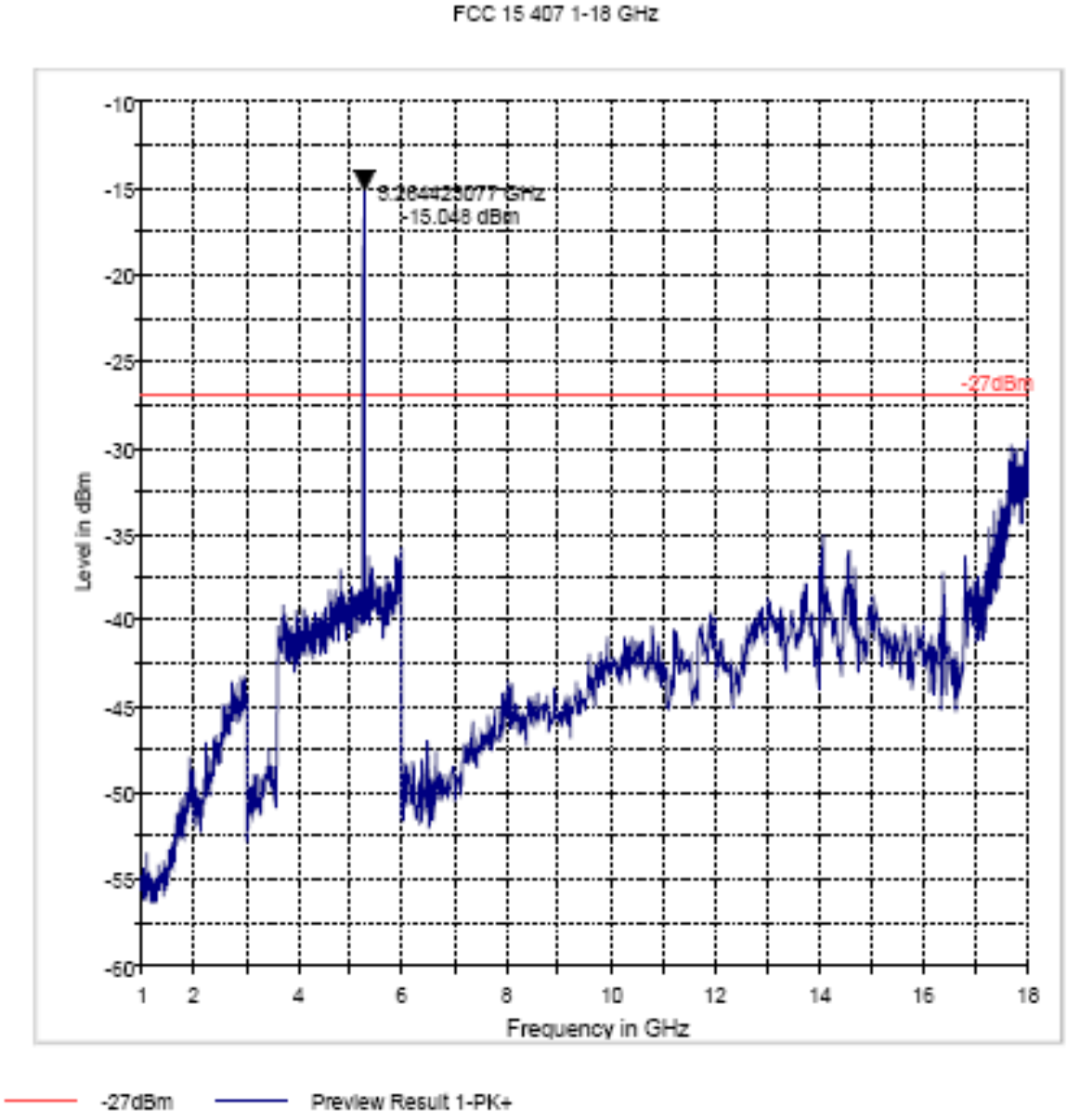
1GHz-18GHz
Mode: 802.11a-Ch40 (Sub-Band 1)



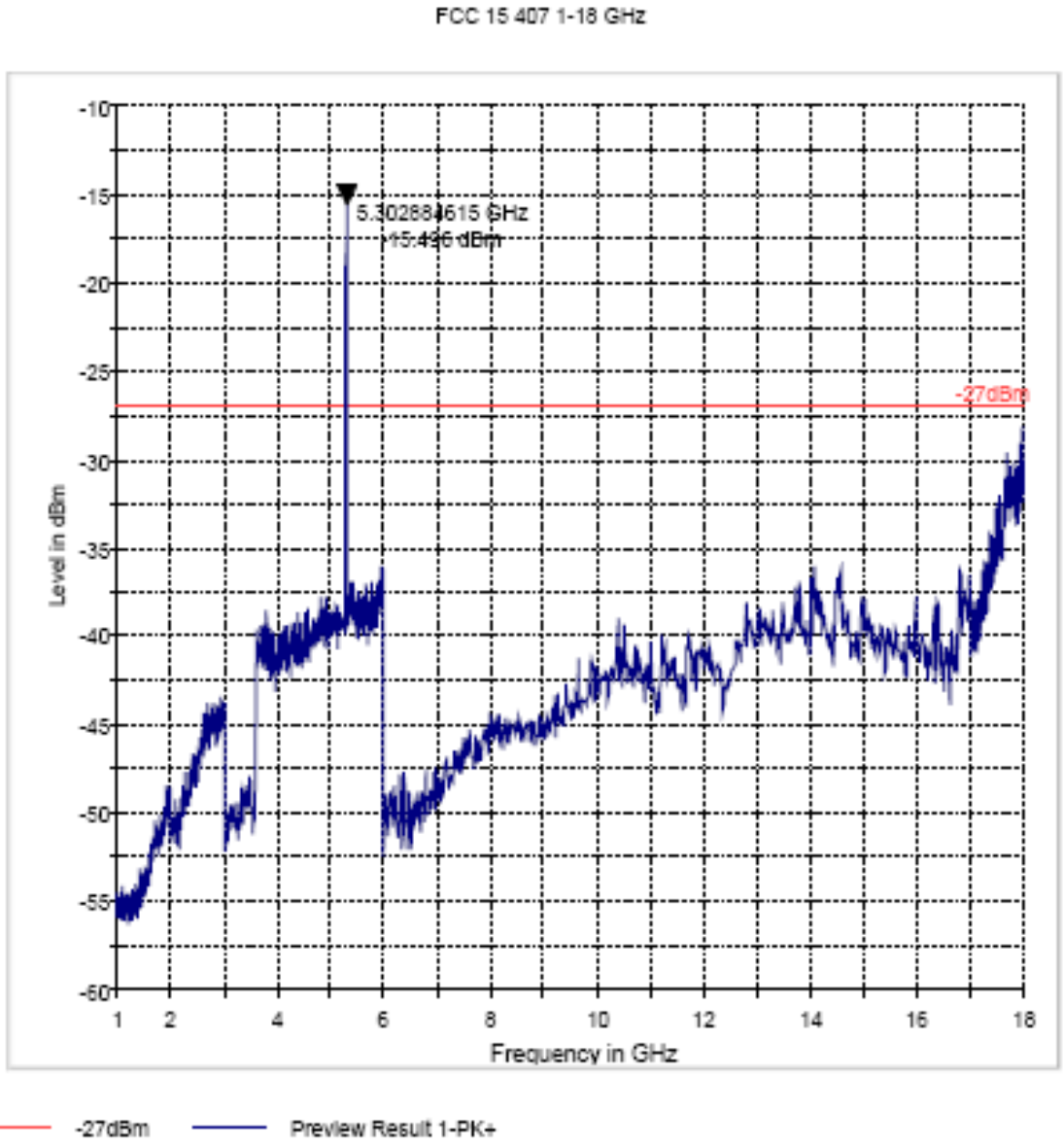
1GHz-18GHz
Mode: 802.11a-Ch48 (Sub-Band 1)



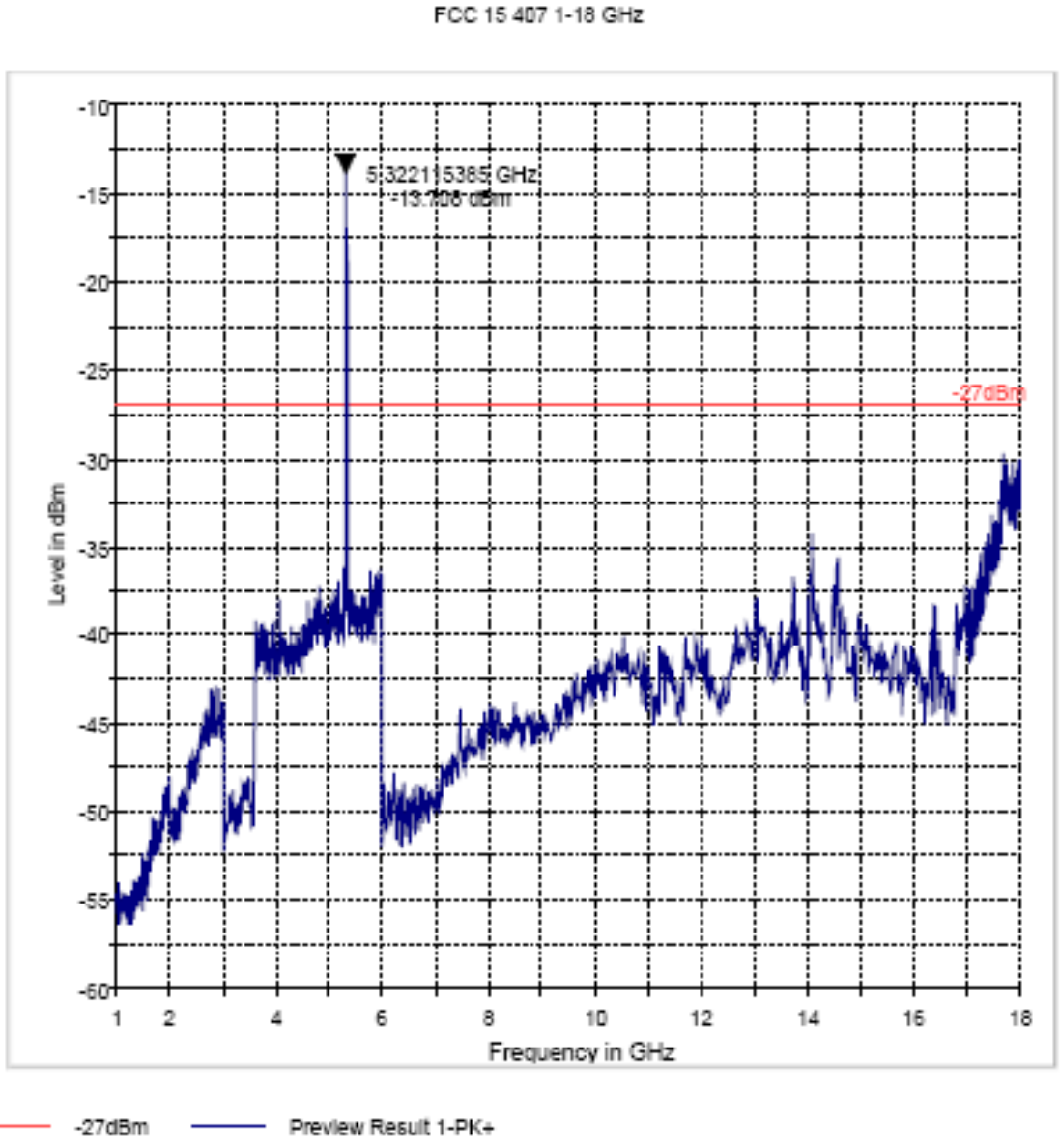
1GHz-18GHz
Mode: 802.11a-Ch52 (Sub-Band 2)



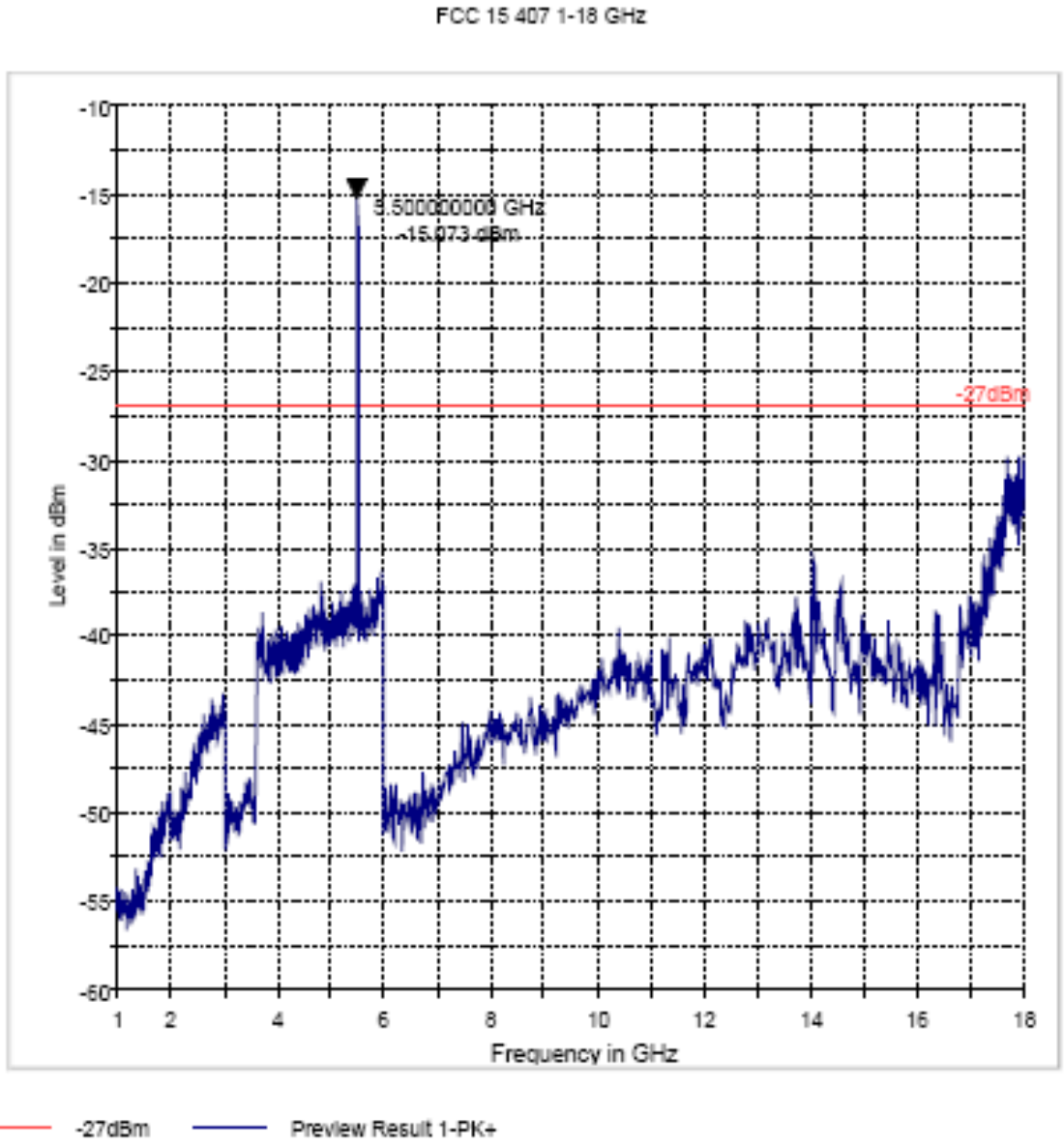
1GHz-18GHz
Mode: 802.11a-Ch60 (Sub-Band 2)



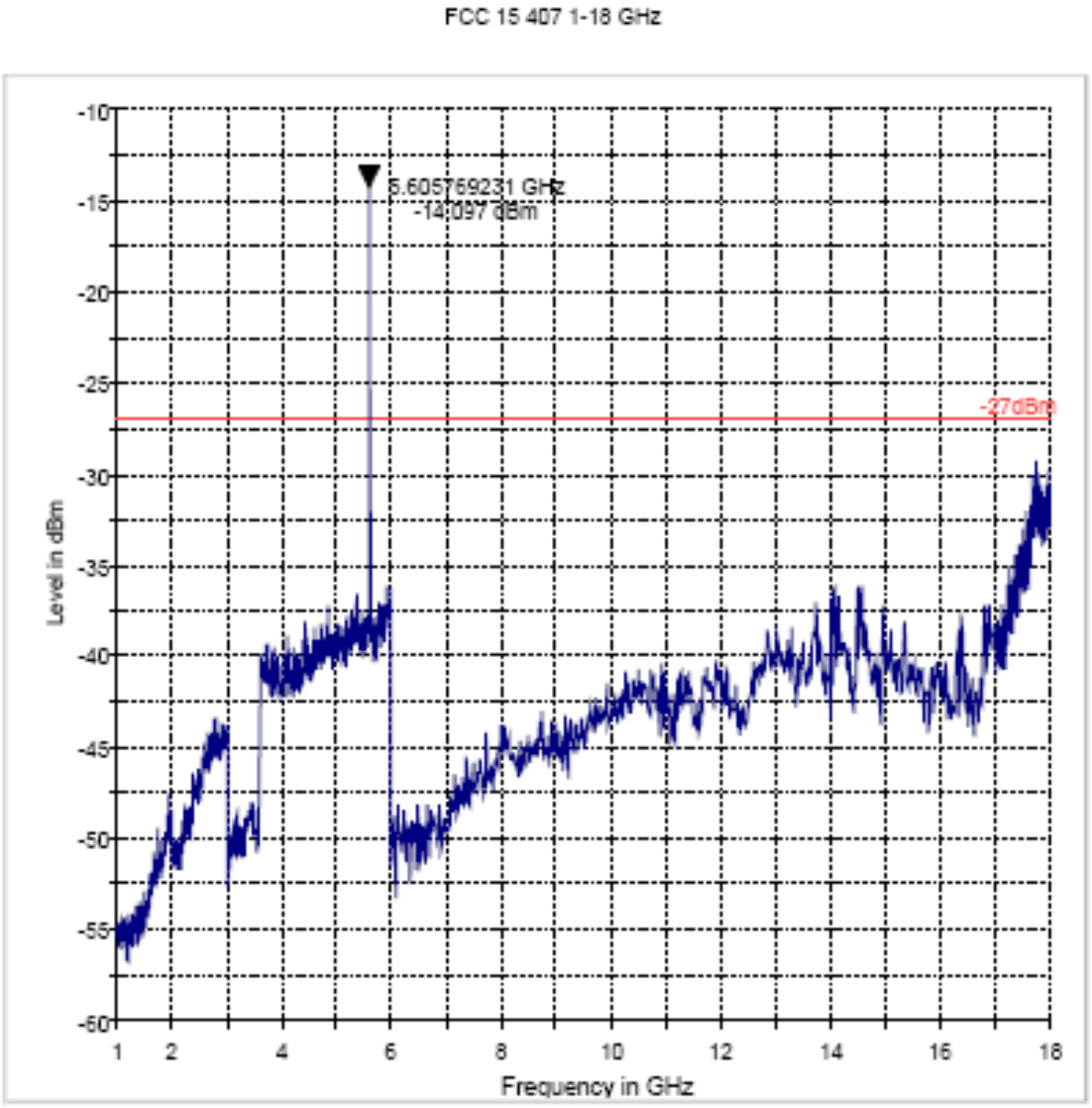
1GHz-18GHz
Mode: 802.11a-Ch64 (Sub-Band 2)



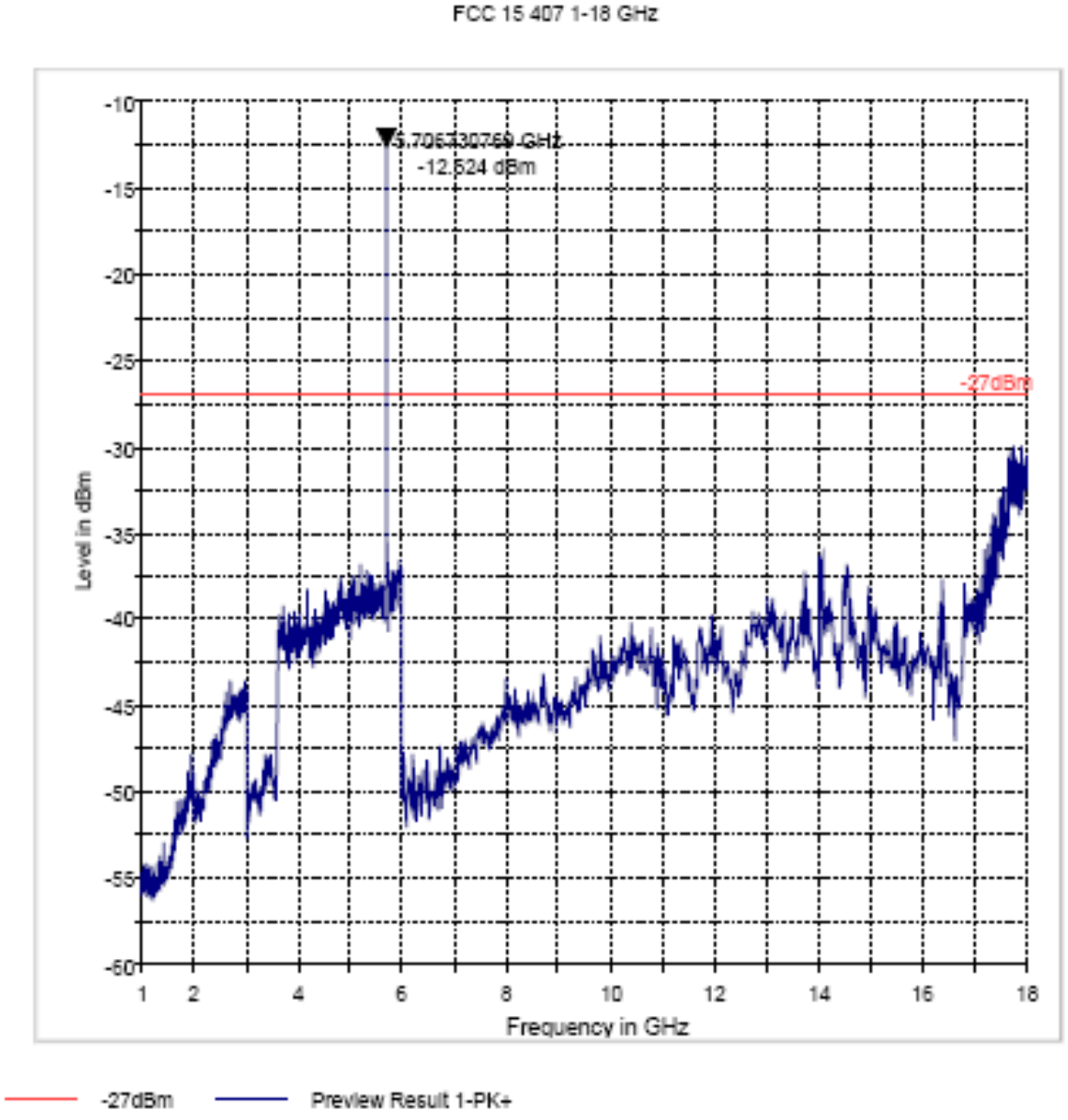
1GHz-18GHz
Mode: 802.11a-Ch100 (Sub-Band 3)



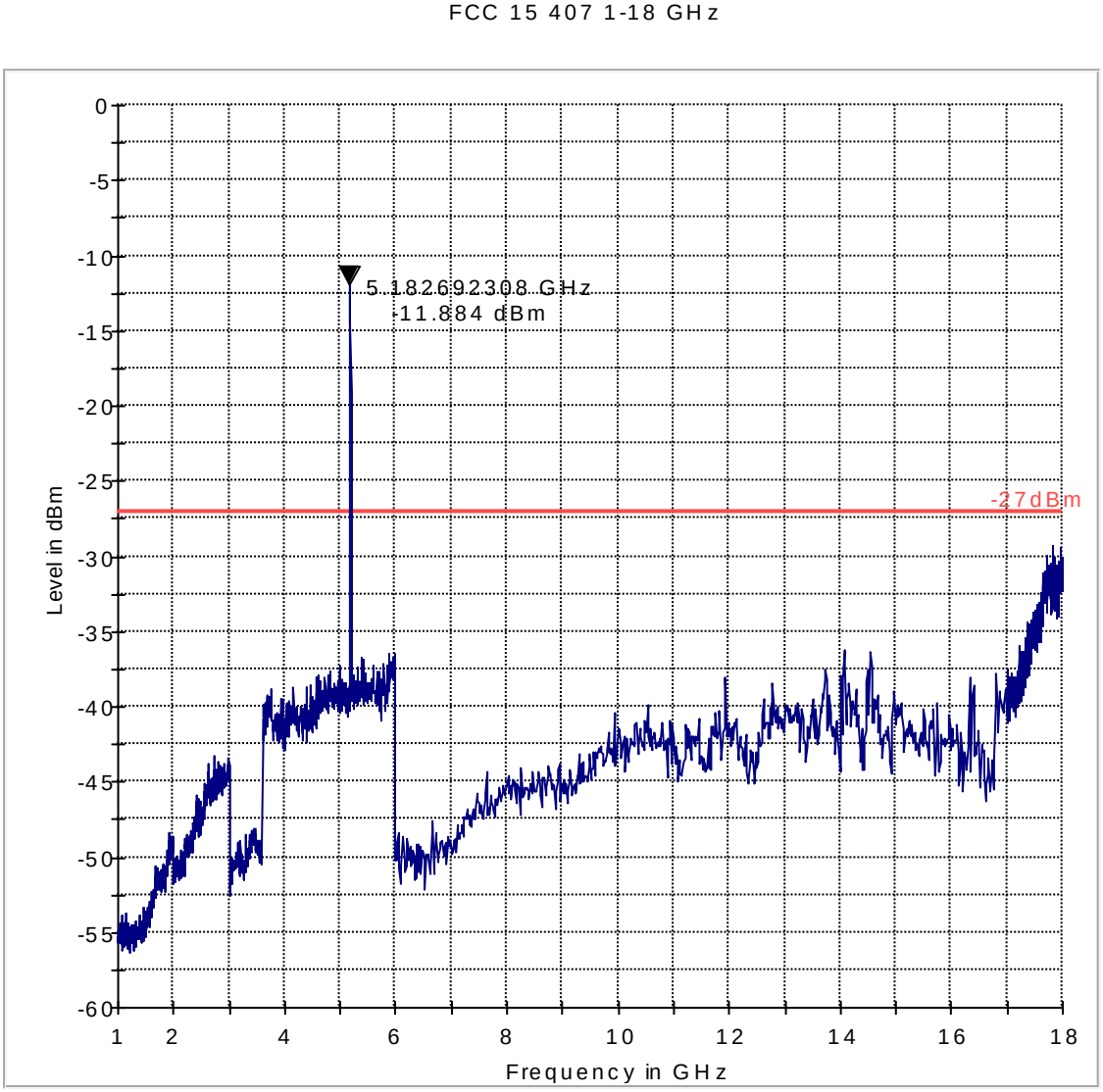
1GHz-18GHz
Mode: 802.11a_Ch120 (Sub-Band 3)



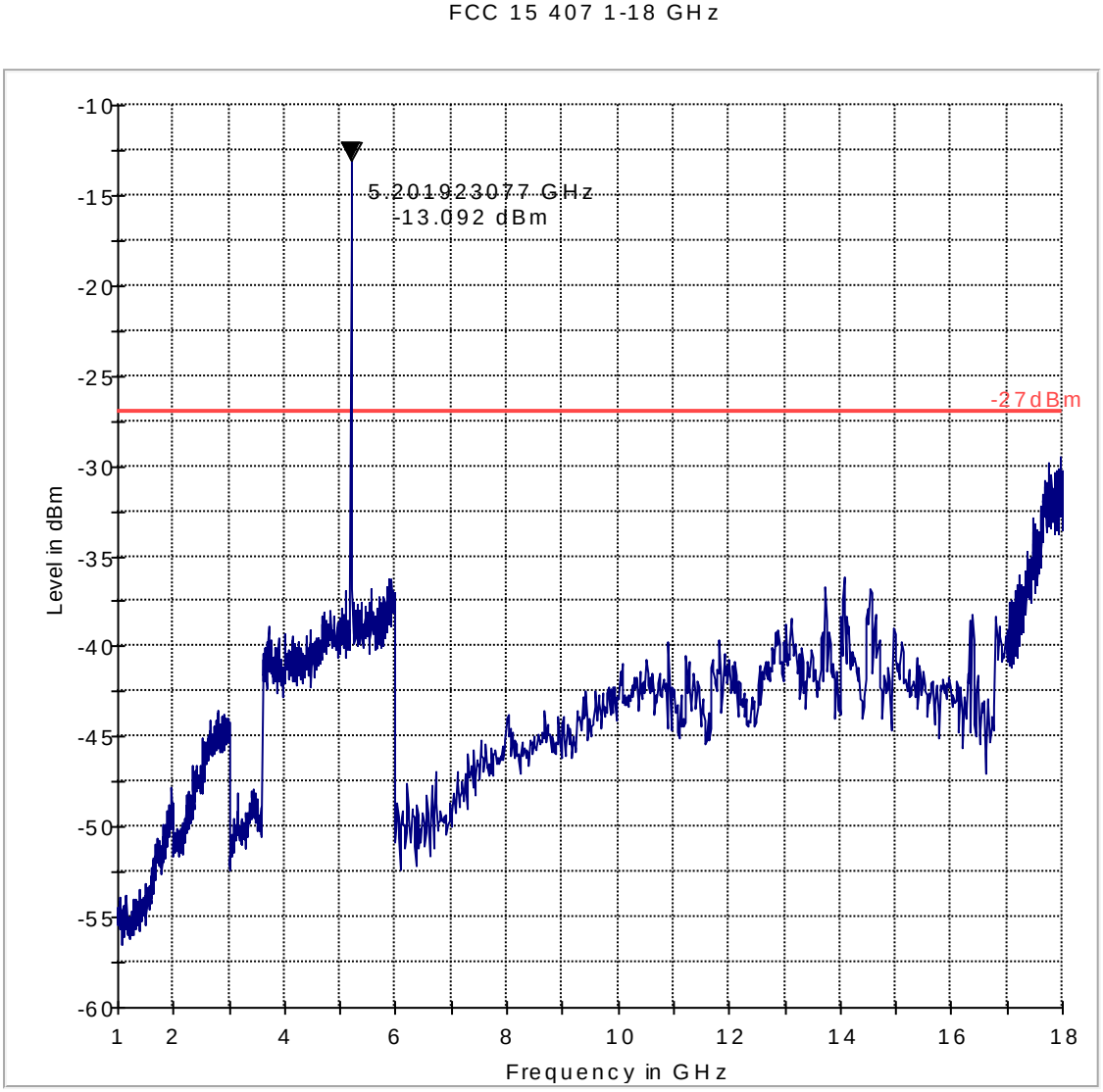
1GHz-18GHz
Mode: 802.11a-Ch140 (Sub-Band 3)



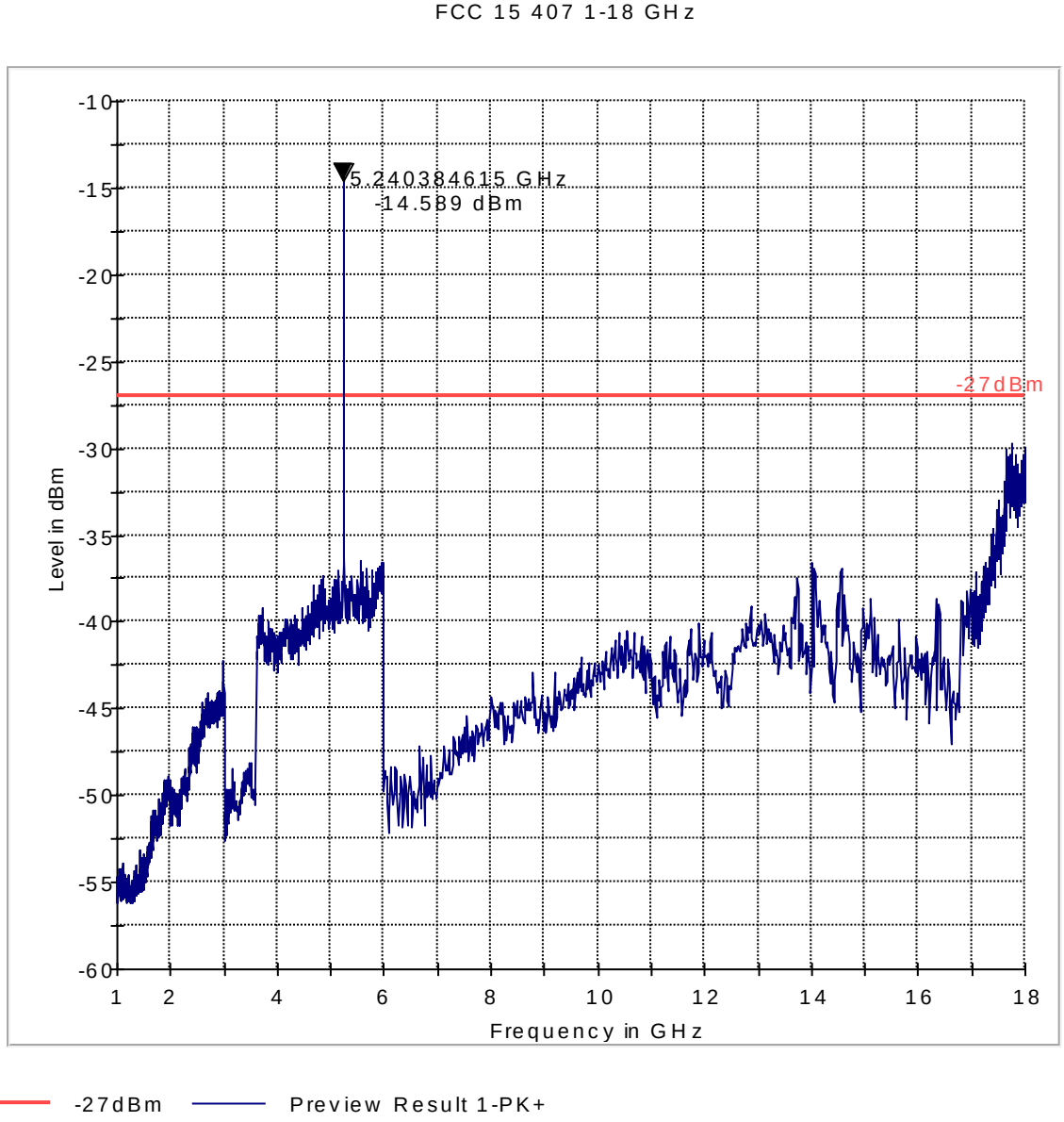
1GHz-18GHz
Mode: 802.11n-Ch36 (Sub-Band 1)



1GHz-18GHz
Mode: 802.11n-Ch40 (Sub-Band 1)

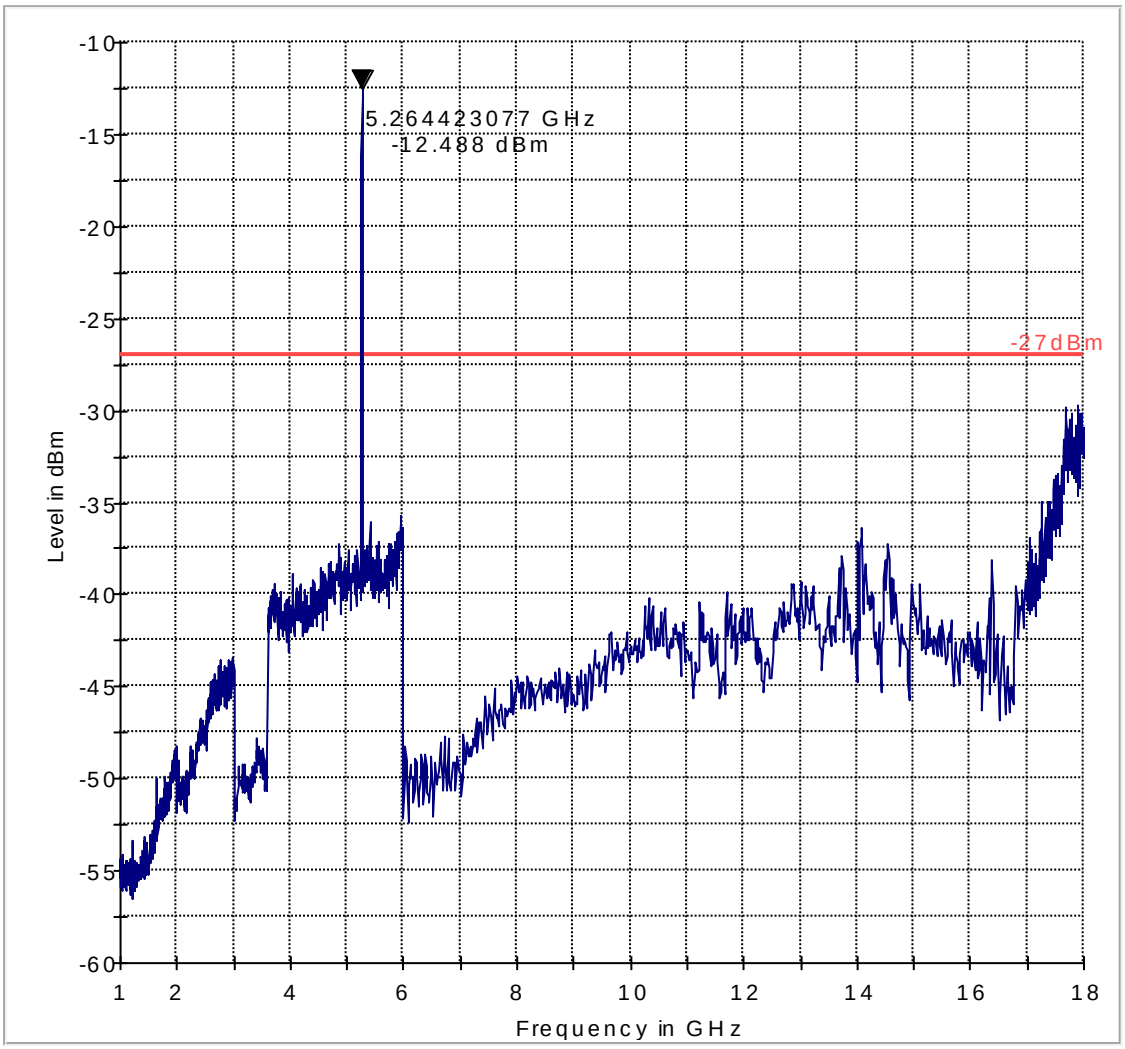


1GHz-18GHz
Mode: 802.11n-Ch48 (Sub-Band 1)



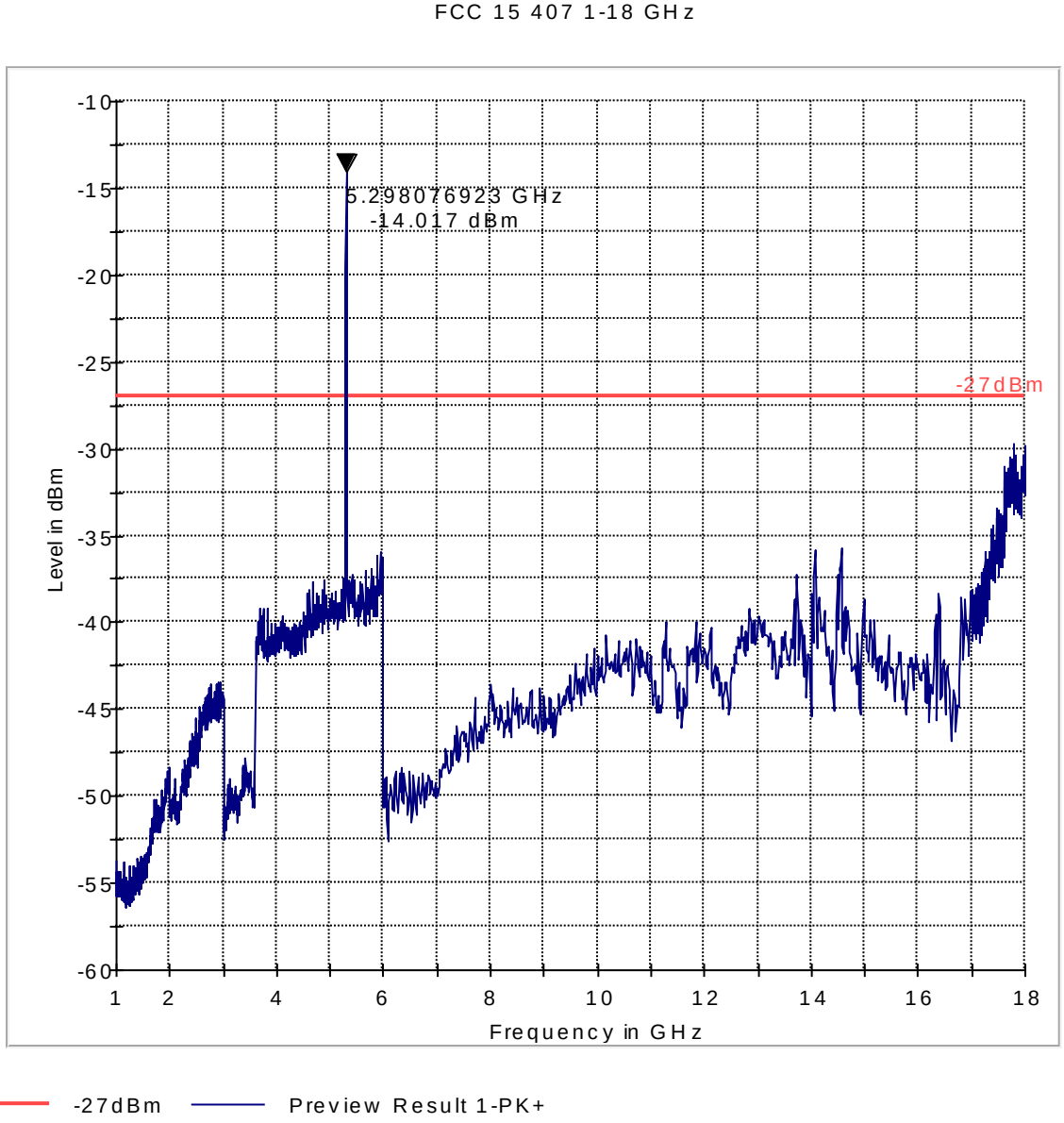
1GHz-18GHz
Mode: 802.11n-Ch52 (Sub Band 2)

FCC 15 407 1-18 GHz

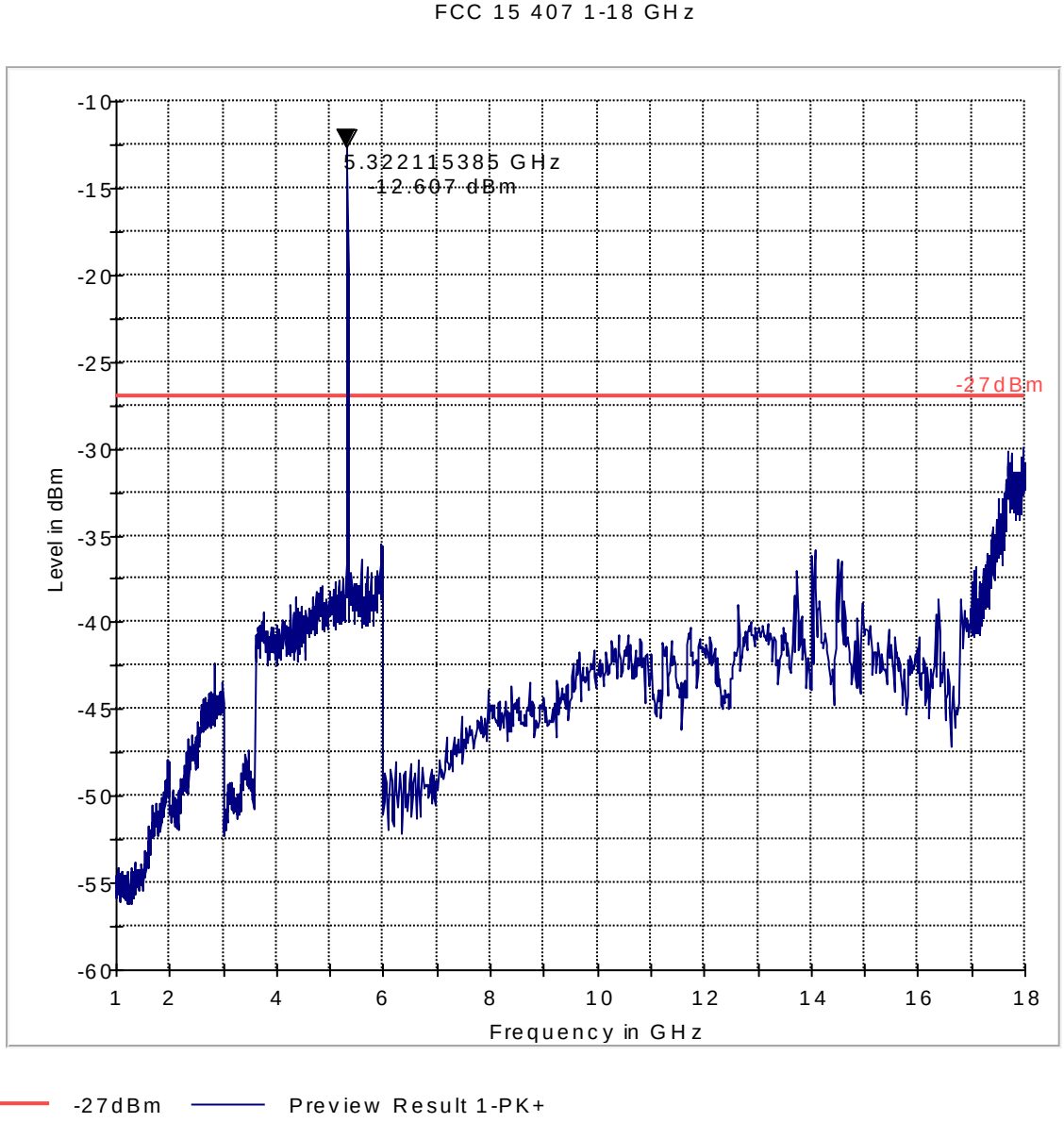


-27dBm Preview Result 1-PK+

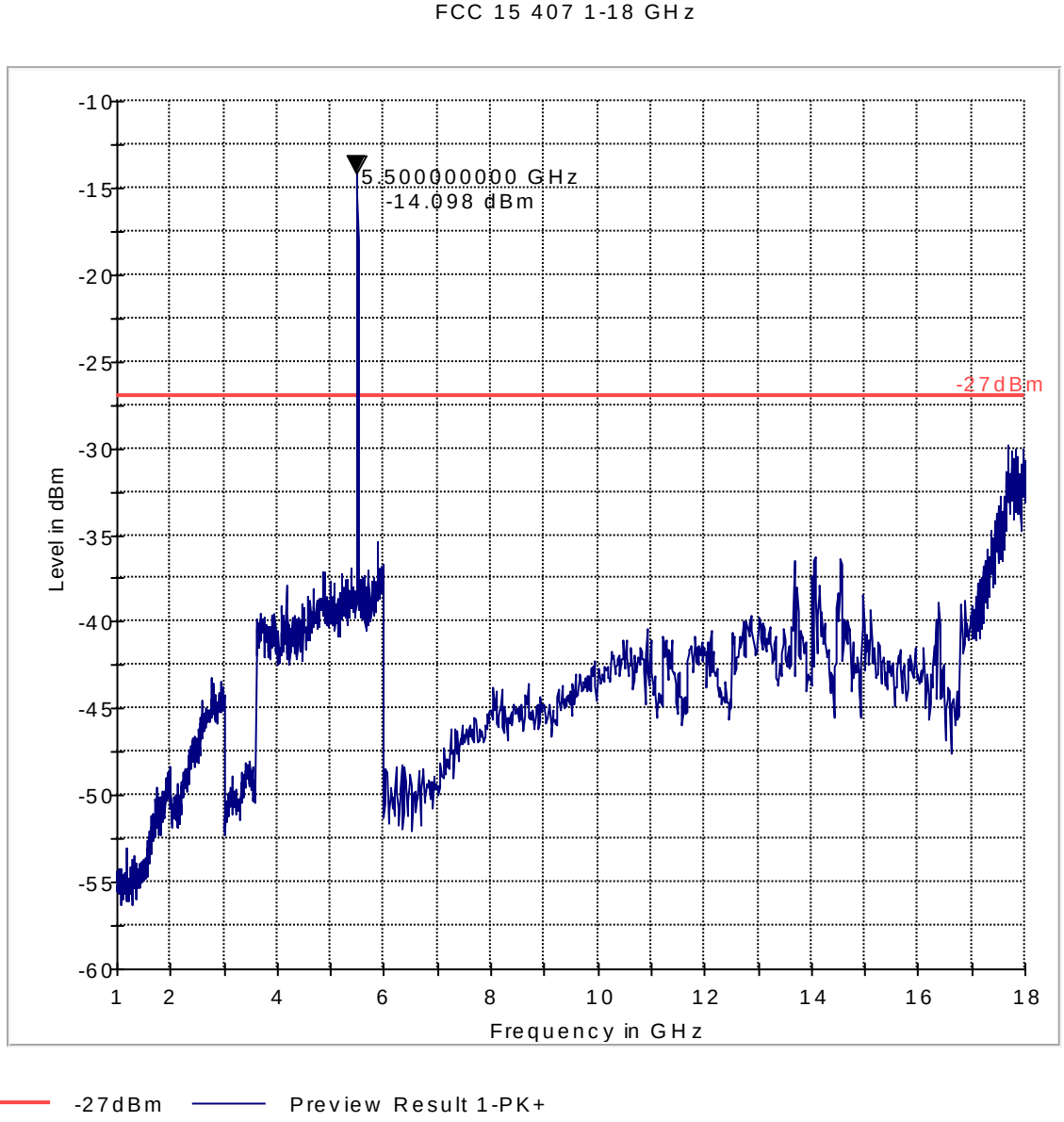
1GHz-18GHz
Mode: 802.11n-Ch60 (Sub-Band 2)



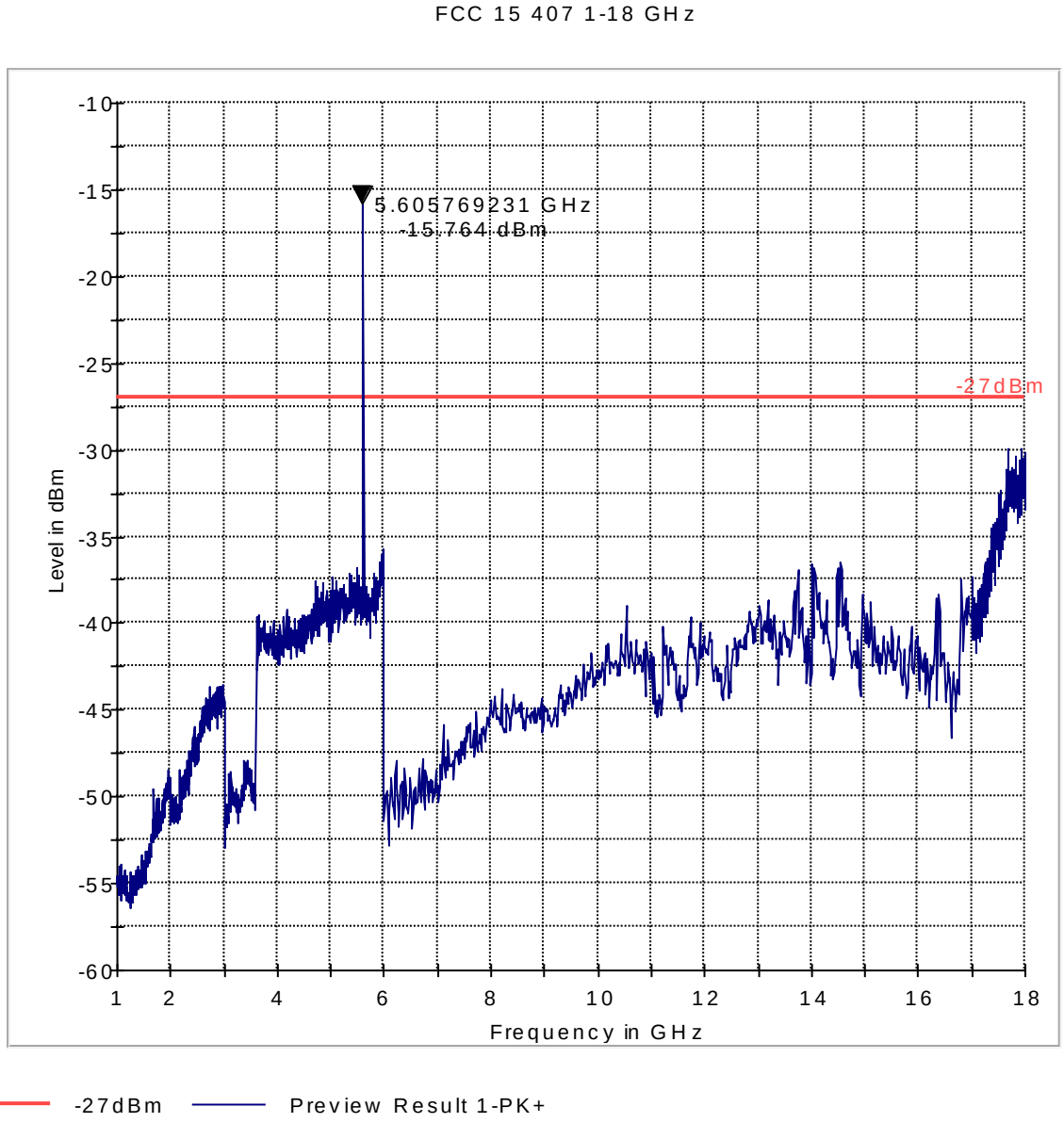
1GHz-18GHz
Mode: 802.11n-Ch64 (Sub-Band 2)



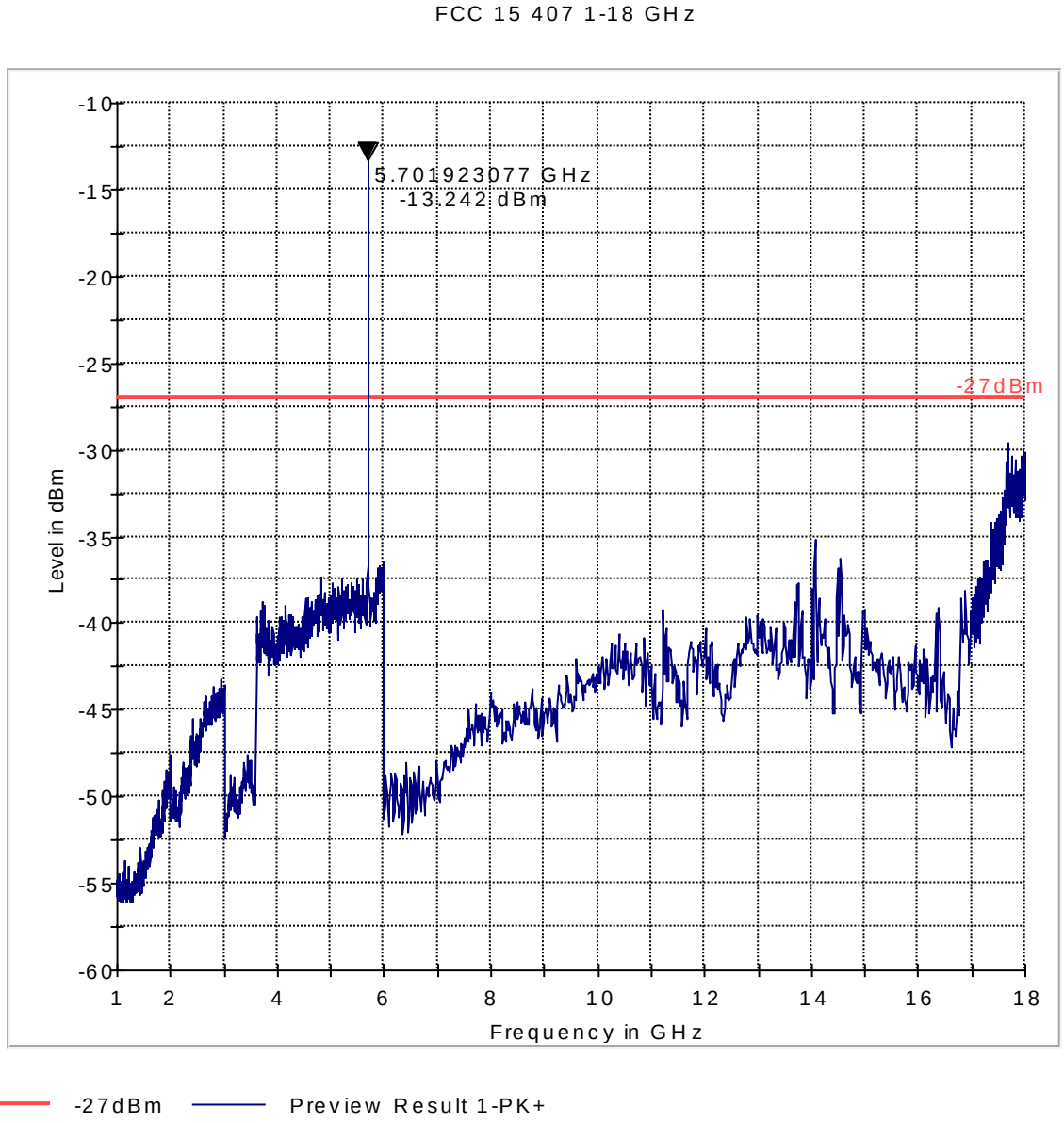
1GHz-18GHz
Mode: 802.11n-Ch100 (Sub-Band 3)



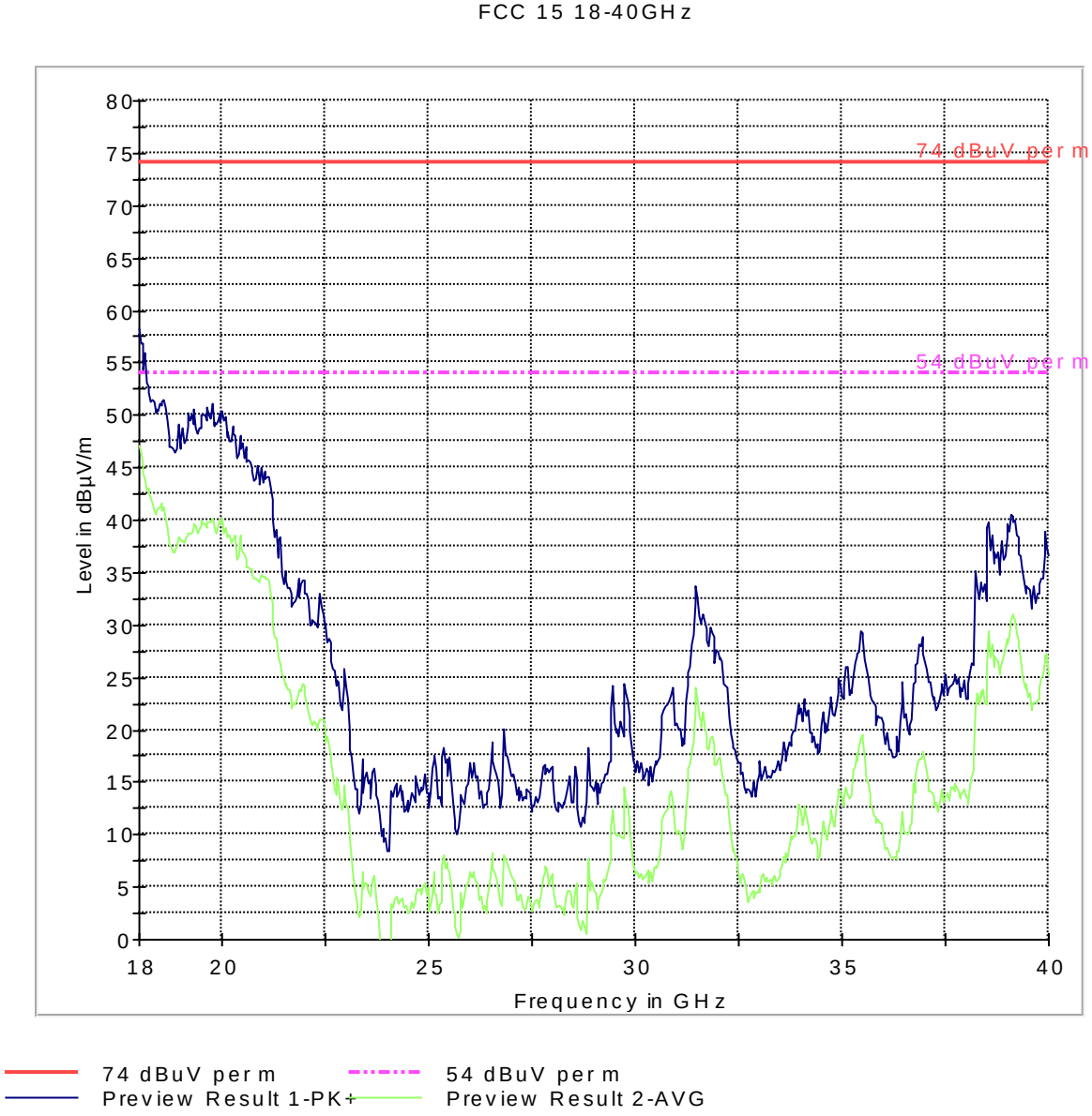
1GHz-18GHz
Mode: 802.11n-Ch120 (Sub-Band 3)



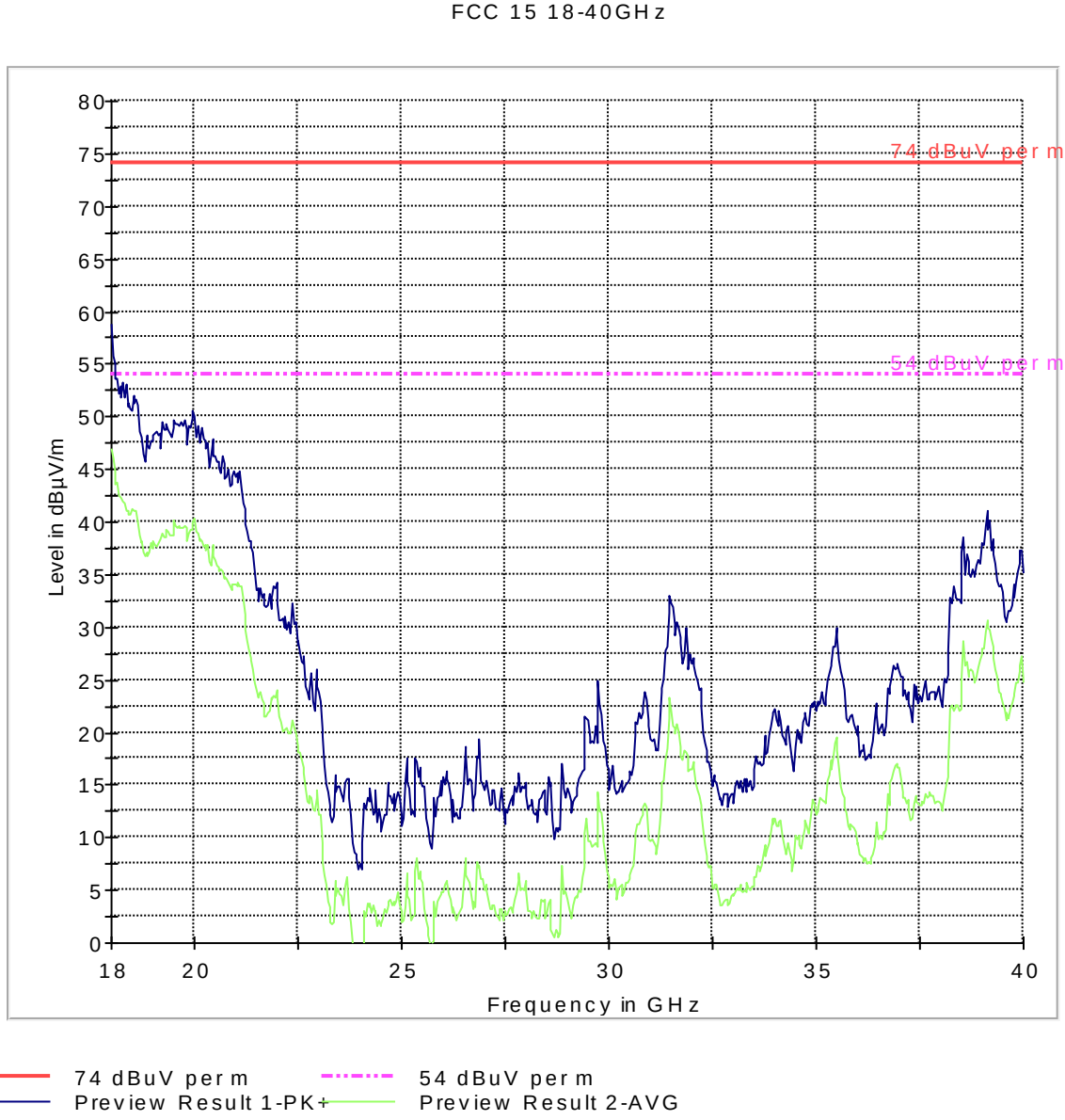
1GHz-18GHz
Mode: 802.11n-Ch140 (Sub-Band 3)



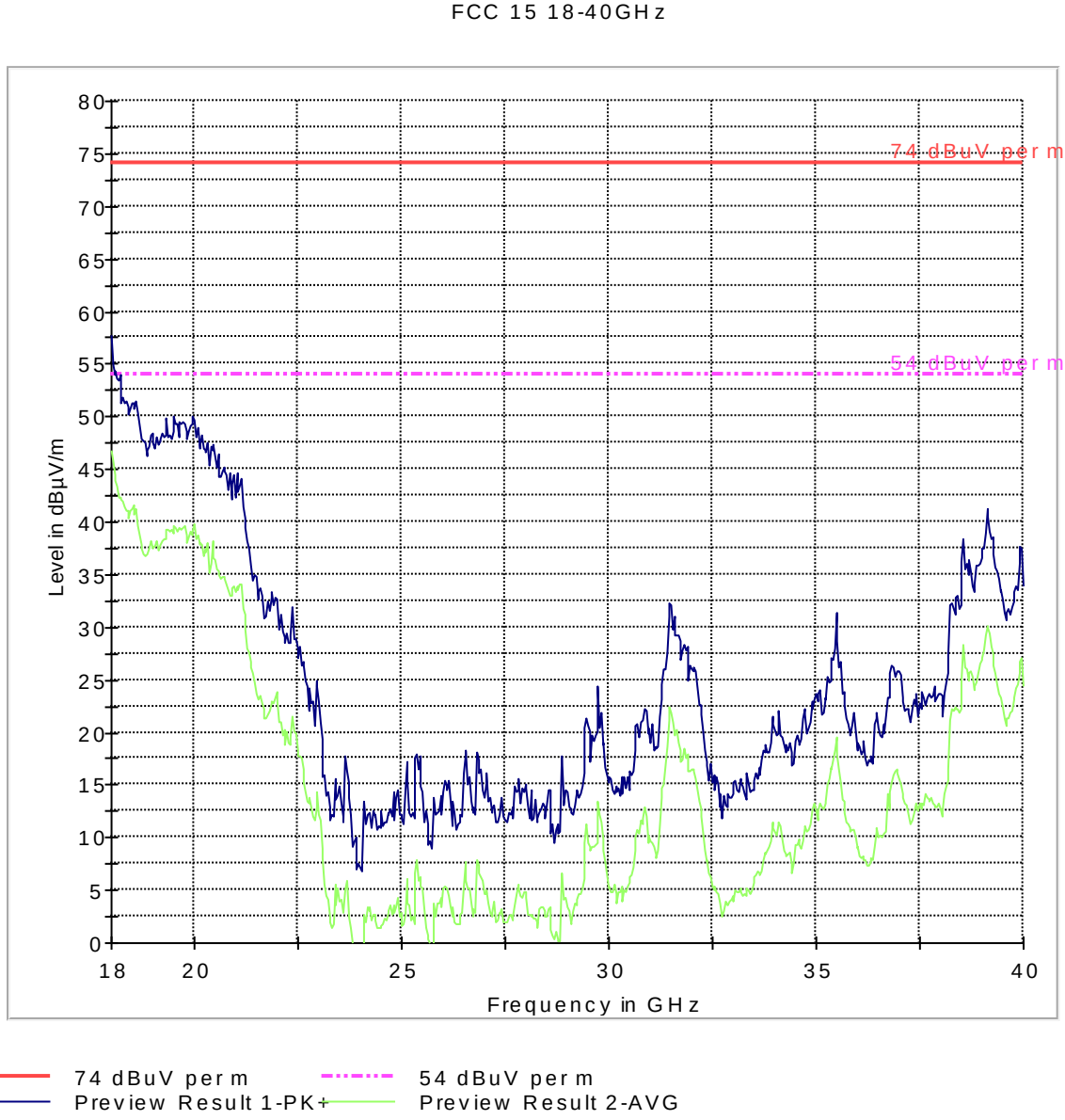
18GHz-40GHz
Mode: 802.11a-Ch40 (Sub-Band 1)



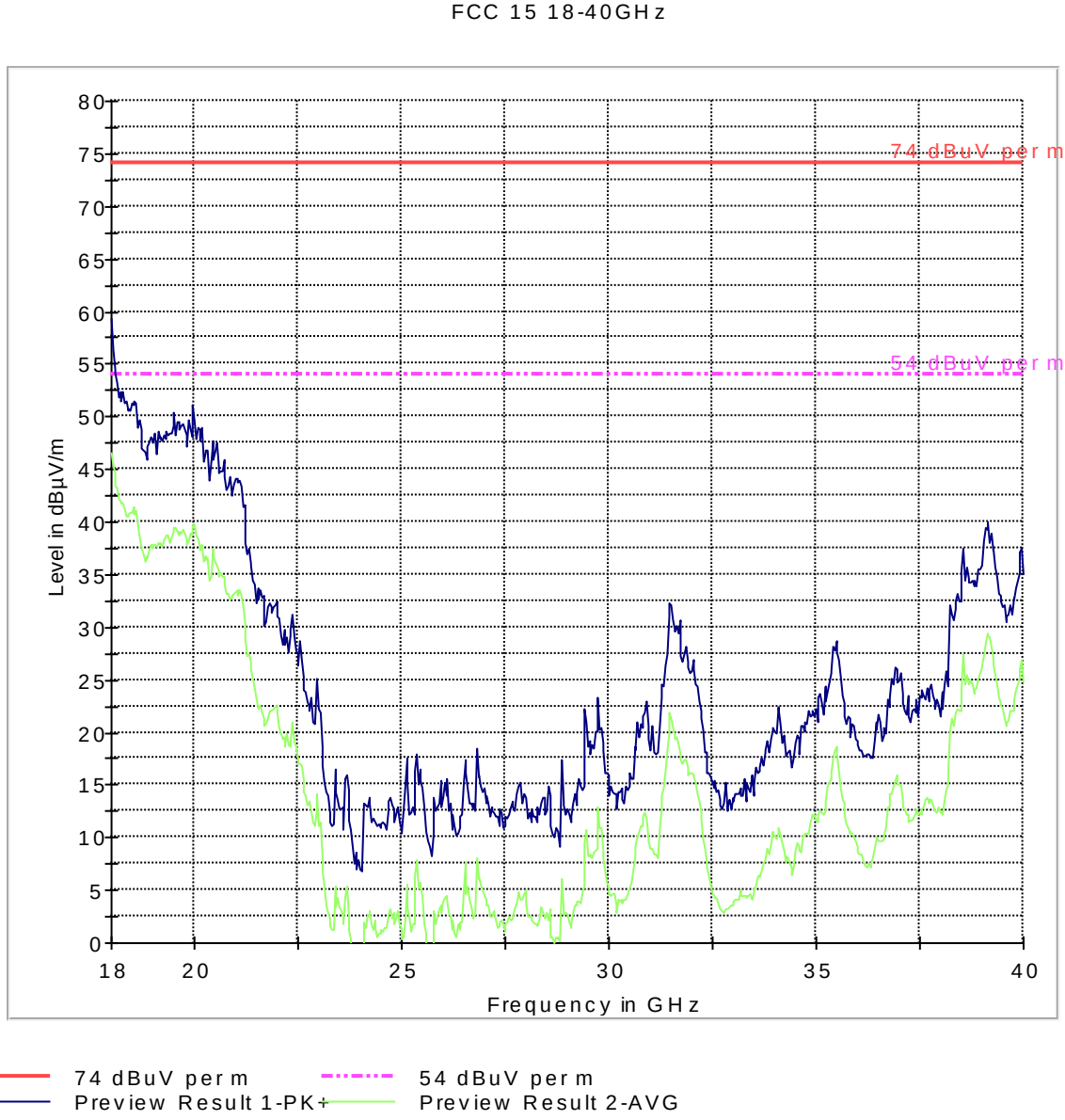
18GHz-40GHz
Mode: 802.11a-Ch60 (Sub-Band 2)



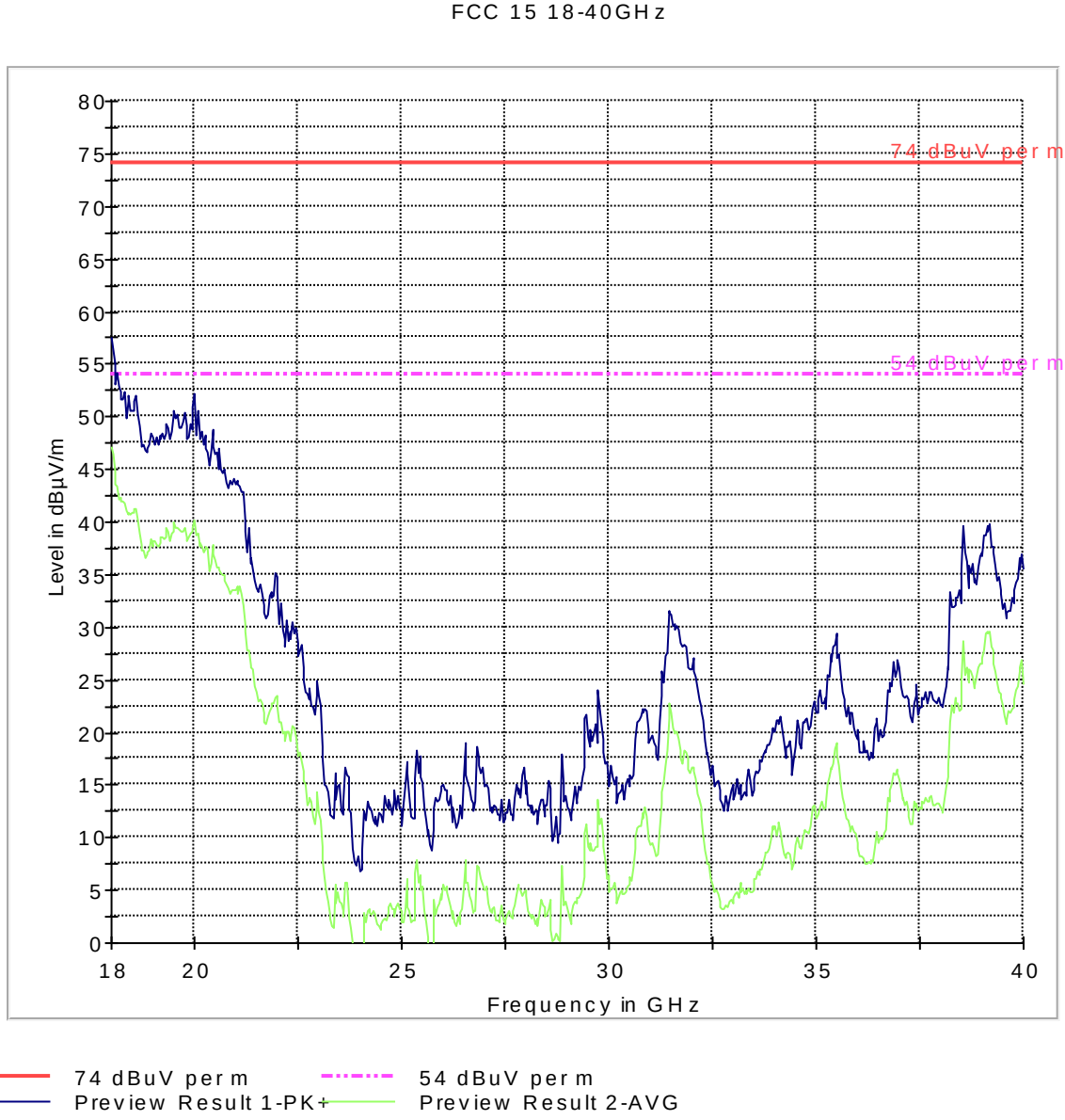
18GHz-40GHz
Mode: 802.11a-Ch120 (Sub-Band 3)



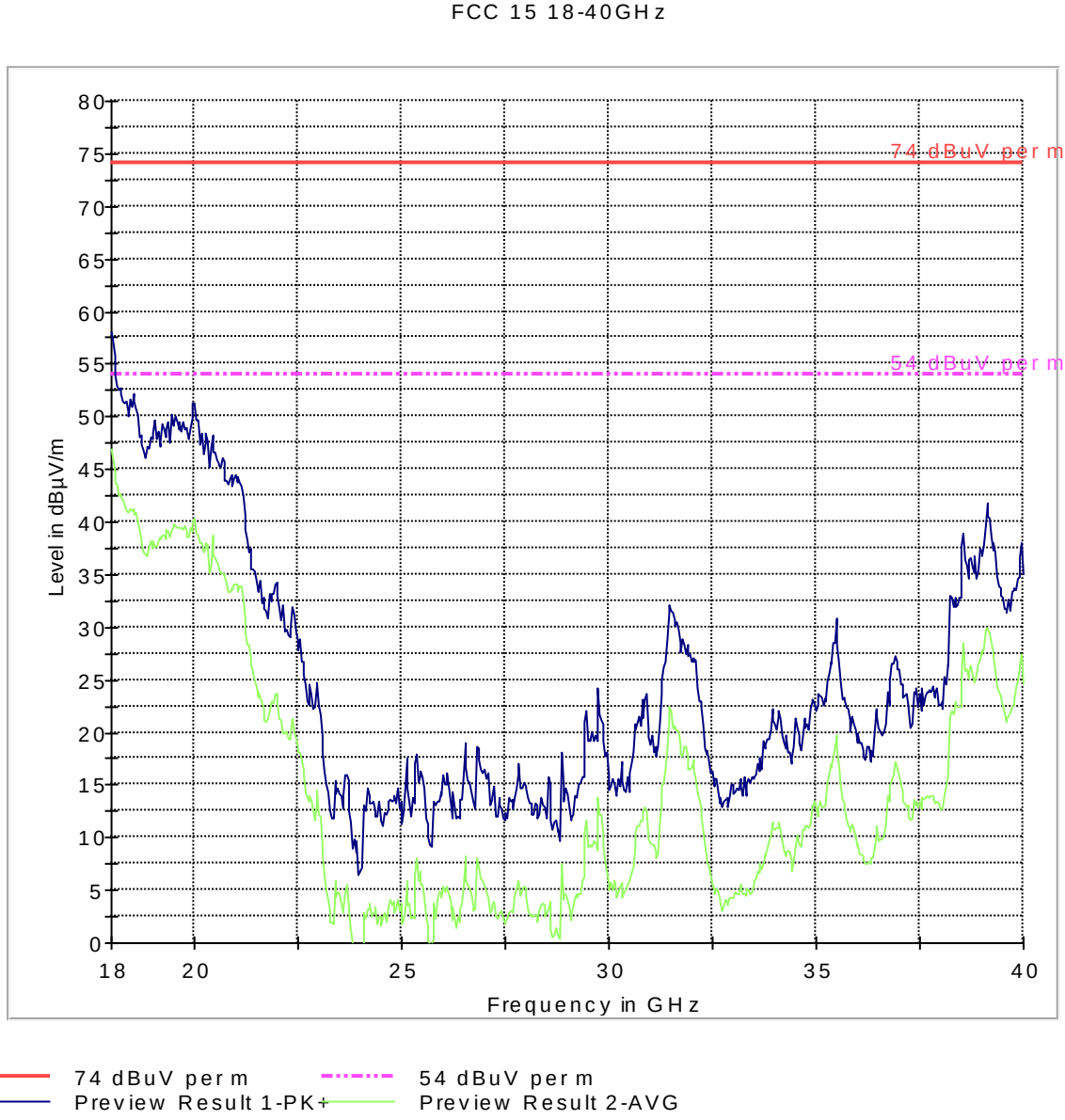
18GHz-40GHz
Mode: 802.11n-Ch40 (Sub-Band 1)



18GHz-40GHz
Mode: 802.11n-Ch60 (Sub-Band 2)



18GHz-40GHz
Mode: 802.11n-Ch120 (Sub-Band 3)



7 AC Power Line Conducted Emissions

7.1.1 References:

FCC: CFR Part 15.207
IC: RSS-Gen Section 7.2.2
The purpose of this test is to measure unwanted radio frequency currents induced in any AC conductor external to the equipment which could conduct interference to other equipment via the AC electrical network.

7.1.2 Limits:

7.1.2.1 §15.207 Conducted limits- Intentional Radiators:

(a) Except as shown in paragraphs (b) and (c) of this section of the CFR, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table (1), as measured using a 50 μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

7.1.2.2 RSS-Gen 7.2.2

Except when the requirements applicable to a given device state otherwise, for any licence-exempt radiocommunication device equipped to operate from the public utility AC power supply, either directly or indirectly, the radio frequency voltage that is conducted back onto the AC power lines in the frequency range of 0.15 MHz to 30 MHz shall not exceed the limits shown below. The tighter limit applies at the frequency range boundaries.

Table 1:

Frequency of emission (MHz)	Conducted limit (dBμV)	
	Quasi-peak	Average
0.15–0.5	66 to 56*	56 to 46*
0.5–5	56	46
5–30	60	50

*Decreases with the logarithm of the frequency.

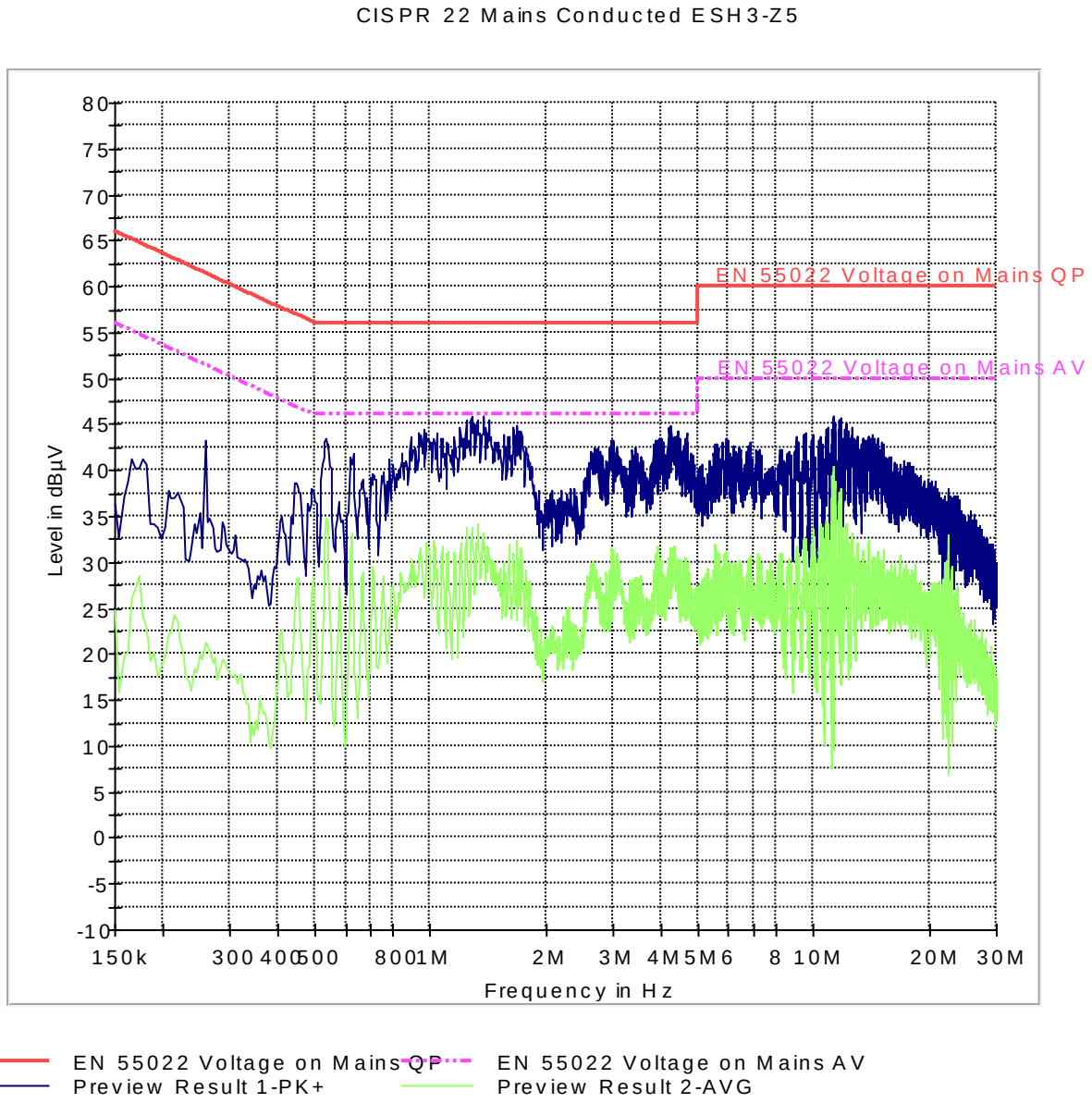
Analyzer Settings: CISPR Bandwidth- 9 KHz.

7.1.3 Test Conditions:

Modulation: 802.11a mode; mid channel of operation.
Measurement Uncertainty: ±3.0dB

Note: Plots shown here represent the combined worse case emissions for power lines, phases and neutral line.

7.1.4 Test Plots:

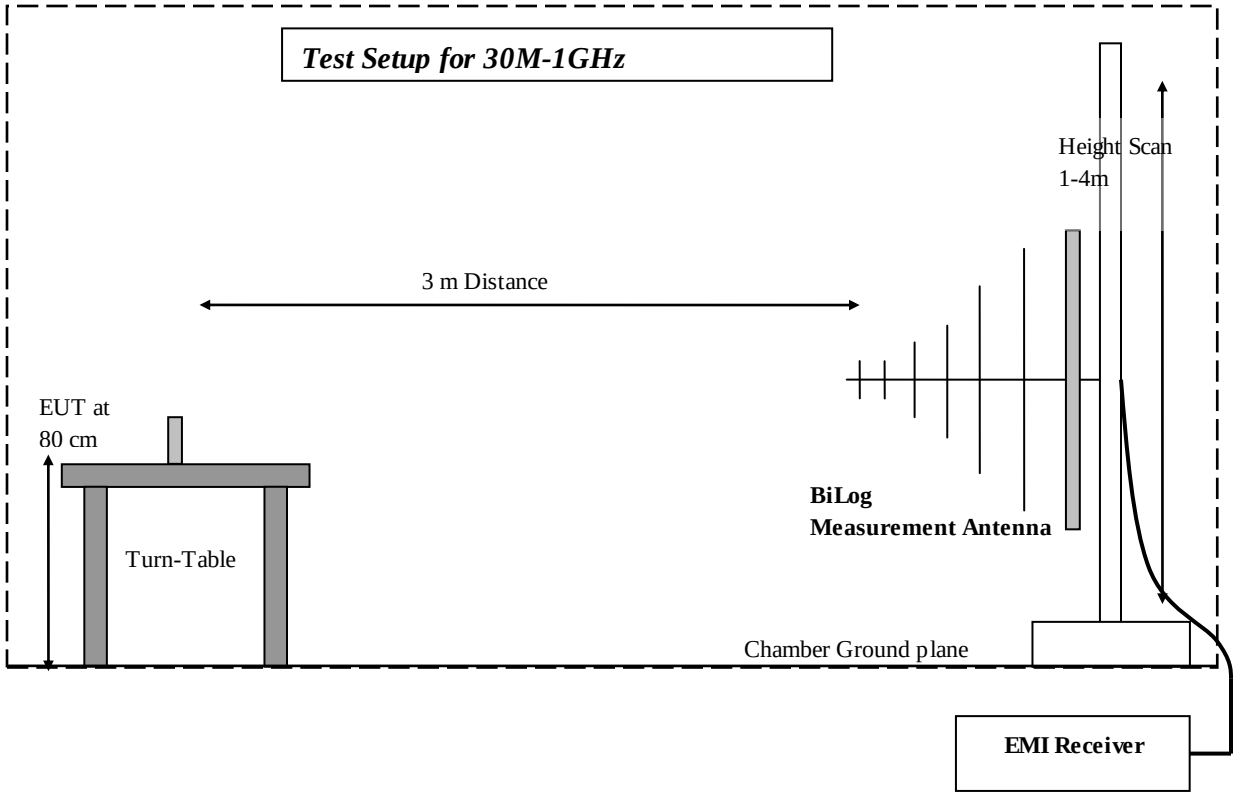


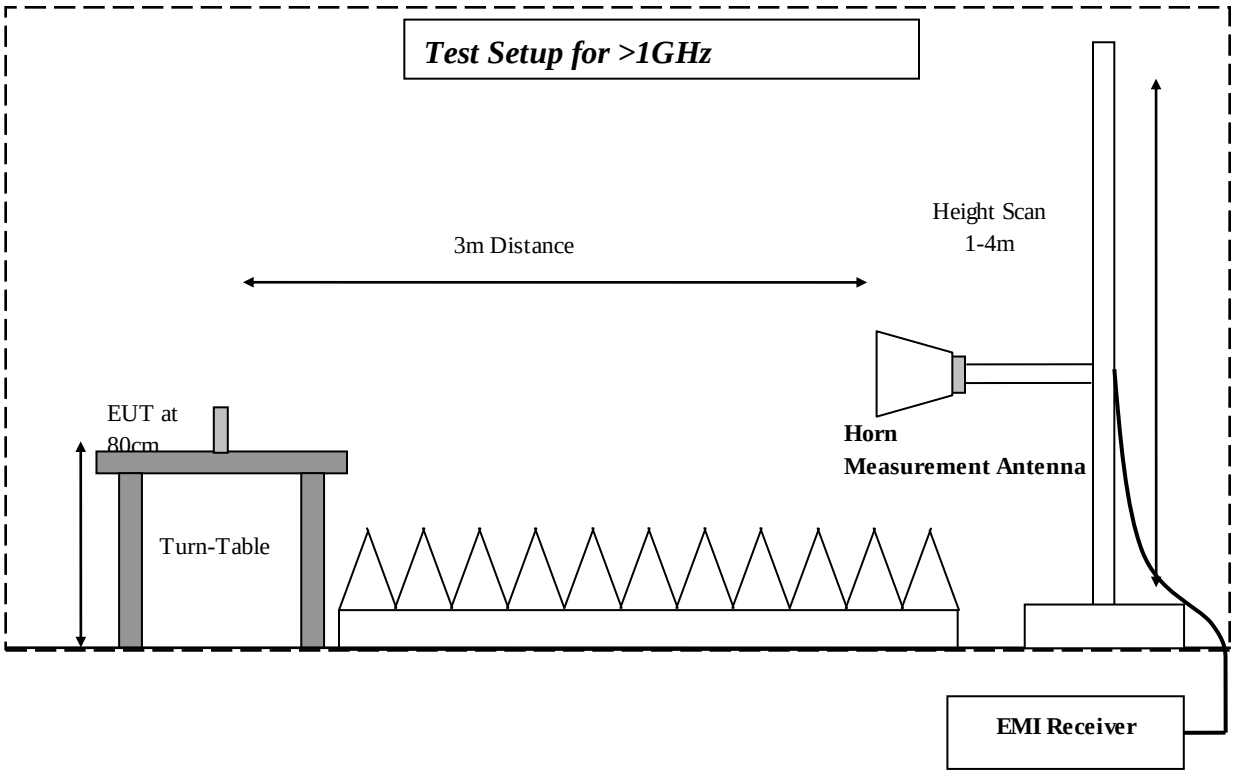
8 Test Equipment and Ancillaries used for tests

No.	Equipment Name	Manufacturer	Type/model	Serial No.	Cal Date	Cal Interval
3m Semi- Anechoic Chamber:						
	Turn table	EMCO	2075	N/A	N/A	N/A
	MAPS Position Controller	ETS Lindgren	2092	0004-1510	N/A	N/A
	Antenna Mast	EMCO	2075	N/A	N/A	N/A
	Relay Switch Unit	Rohde&Schwarz	RSU	338964/001	N/A	N/A
	EMI Receiver/Analyzer	Rohde&Schwarz	ESU 40	100251	Aug 2012	1 Year
	Spectrum Analyzer	Agilent	E4440A	MY46186445	Dec 2012	1 Year
	1500MHz HP Filter	Filtek	HP12/1700	14c48	N/A	N/A
	2800 MHz HP Filter	Filtek	HP12/2800	14C47	N/A	N/A
	Pre-Amplifier	Miteq	JS40010260	340125	N/A	N/A
	Binconilog Antenna	EMCO	3141	0005-1186	Apr 2012	3 Years
	Binconilog Antenna	ETS	3149	J000123908	Feb 2012	3 years
	Horn Antenna	EMCO	3115	35114	Mar 2012	3 Years
	Horn Antenna (18-40GHz)	3116	ETS	00070497	Aug 2011	3 years
	LISN	FCC	50-25-2-08	08014	Jul 2012	1 Year
Ancillary equipment						
	Multimeter	Klein Tools	MM200	001	Apr 2011	2 Years
	Humidity Temperature Logger	Dickson	TM320	03280063	Mar 2012	1 Year
	Digital Barometer	VWR	35519-055	91119547	Nov 2011	2 Years
	DC Power Supply	HP	E3610A	KR83023316	N/A	N/A
	DC Power Supply	Protek	3003B	H012771	N/A	N/A
	Communication Antenna	IBP5-900/1940	Kathrein	N/A	N/A	N/A

Calibration status valid at the time of testing.
Equipment used meets the measurement uncertainty requirements as required per applicable standards for 95% confidence levels.
Calibration due dates, unless defined specifically, falls on the last day of the month.
Items indicated "N/A" for cal status either do not specifically require calibration or is internally characterized before use.

9 Test Setup Diagrams:





10 Revision History

Date	Report Name	Changes to report	Report prepared by
2013-08-28	EMC_INTEL-032-13001_UNII	First Version	Z. Gray