FCC / ISED Test Report

For:

Garmin International, Inc.

Model Name:

A03675

Product Description:

N/A

FCC ID: IPH-03675
IC ID: 1792A-03675

Applied Rules and Standards:
47 CFR Part 15.247 (DTS)
RSS-247 Issue 2 (DTSs) & RSS-Gen Issue 5

REPORT #: EMC_GARMI-064-19001_15.247_WIFI_DTS_REV6

DATE: 2020-05-22

A2LA Accredited

IC recognized # 3462B-1

***CETECOM* Inc.**
411 Dixon Landing Road ◆ Milpitas, CA 95035 ◆ U.S.A.
Phone: + 1 (408) 586 6200 ◆ Fax: + 1 (408) 586 6299 ◆ E-mail: info@cetecom.com ◆ http://www.cetecom.com
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TABLE OF CONTENTS

1 ASSESSMENT 3

2 ADMINISTRATIVE DATA 4

2.1 IDENTIFICATION OF THE TESTING LABORATORY ISSUING THE EMC TEST REPORT 4
2.2 IDENTIFICATION OF THE CLIENT 4
2.3 IDENTIFICATION OF THE MANUFACTURER 4

3 EQUIPMENT UNDER TEST (EUT) 5

3.1 EUT SPECIFICATIONS 5
3.2 EUT SAMPLE DETAILS 6
3.3 ACCESSORY EQUIPMENT (AE) DETAILS 6
3.4 TEST SAMPLE CONFIGURATION 6
3.5 JUSTIFICATION FOR WORST CASE MODE OF OPERATION 7

4 SUBJECT OF INVESTIGATION 8

5 MEASUREMENT RESULTS SUMMARY 8

6 MEASUREMENT UNCERTAINTY 9

6.1 ENVIRONMENTAL CONDITIONS DURING TESTING: 9
6.2 DATES OF TESTING: 9

7 MEASUREMENT PROCEDURES 10

7.1 RADIATED MEASUREMENT 10
7.2 POWER LINE CONDUCTED MEASUREMENT PROCEDURE 12
7.3 RF CONDUCTED MEASUREMENT PROCEDURE 12

8 TEST RESULT DATA 13

8.1 MAXIMUM CONDUCTED (AVERAGE) OUTPUT POWER 13
8.2 POWER SPECTRAL DENSITY 24
8.3 DUTY CYCLE 44
8.4 BAND EDGE COMPLIANCE 47
8.5 EMISSION BANDWIDTH 6DB AND 99% OCCUPIED BANDWIDTH 62
8.6 RADIATED TRANSMITTER SPURIOUS EMISSIONS AND RESTRICTED BANDS 82

9 TEST SETUP PHOTOS 96

10 TEST EQUIPMENT AND ANCILLARIES USED FOR TESTING 96

11 HISTORY 97

1 Assessment

The following device was evaluated against the applicable criteria specified in FCC rules Parts 15.247 of Title 47 of the Code of Federal Regulations and the relevant ISED Canada standard RSS-247.

No deviations were ascertained.

Company	Description	Model #
Garmin International Inc.	N/A	A03675

Responsible for Testing Laboratory:

Date	Section	Name	Signature
2020-05-22	Compliance	Cindy Li (EMC Lab Manager)	Cindy Li Digitally signed by cindy.li@cetecom.com DN: CN=cindy.li@cetecom.com Reason: I am approving this document Location: Date: 2020-05-22 18:07:17

Responsible for the Report:

Date	Section	Name	Signature
2020-05-22	Compliance	Kevin Wang (EMC Engineer)	Kevin Wang Digitally signed by: Kevin Wang DN: CN = Kevin Wang email = kevin.wang@cetecom.com C = US O = Cetecom Inc. Date: 2020.05.22 17:54:13 -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 EMC Test Report

Company Name:	CETECOM Inc.
Department:	Compliance
Street Address:	411 Dixon Landing Road
City/Zip Code	Milpitas, CA 95035
Country	USA
Telephone:	+1 (408) 586 6200
Fax:	+1 (408) 586 6299
EMC Lab Manager:	Cindy Li
Responsible Project Leader:	Sangeetha Sivaraman

2.2 Identification of the Client

Client's Name:	Garmin International, Inc.
Street Address:	1200 East 151st Street
City/Zip Code	Olathe, KS 66062
Country	USA
Contact Person:	Jeff Hailey
Phone No.	(913) 440-1592
e-mail:	Jeffrey.Hailey@garmin.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 EUT Specifications

Model No:	A03675
HW Version :	1
SW Version :	1.20
FCC-ID :	IPH-03675
IC-ID:	1792A-03675
FWIN:	N/A
HVIN:	A03675
PMN:	N/A
Product Description:	N/A
Frequency Range / number of channels:	Nominal band: 2400 MHz – 2483.5 MHz; Center to center: 2412 MHz (ch 1) – 2462 MHz (ch 11), 11 channels
Radio Information	WLAN (WiFi): • Module Name: Marvell • Module Number: 88W8997 • Modes of Operation: 802.11b,g,n
Antenna Information as declared:	Main Antenna: • Manufacturer: Sinbon • P/N: A9704474 & 9705281 • Type: Flexible angle & IP67 • Location: Internal • Maximum Gain: 3.7 dBi • Frequency Range: 2400 – 2500 MHz
Max. Conducted Output Power:	Average measurement: 13.33 dBm
Power Supply/ Rated Operating Voltage Range:	Vmin: 10 VDC/ Vnom: 12 VDC / Vmax: 32 VDC
Operating Temperature Range	-15ºC to 55 ºC
Other Radios included in the device:	Cellular; GPS; BTLE; ANT
Sample Revision Note 1	☐Prototype Unit; ☐Production Unit; ■Pre-Production

Note 1: Pre-production PCB has a new communication circuit that was made functional using wire mods.
From a radio perspective the units tested are production quality per client communication

3.2 EUT Sample details

EUT #	Serial Number	HW Version	SW Version	Notes/Comments
1	Test Unit C	1	1.20	Conducted RF
2	Test Unit D	1	1.20	Radiated

3.3 Accessory Equipment (AE) details

N/A

3.4 Test Sample Configuration

EUT Set-up #	Combination of AE used for test set up	Comments
1	EUT#1	Conducted Setup: The radio of the EUT was configured using the "Factory Test" software: • Modulation: ○ 1 Mbps (802.11b) ○ 6 Mbps (802.11g) ○ 20 MHz MCS0 (802.11n HT20) • Channel (Fixed): ○ Ch. 1 (Low, 2412 MHz) ○ Ch. 6 (Mid, 2437 MHz) ○ Ch. 11 (High, 2462 MHz) The "Factory Test" software will not be available to the end user. The power was controlled through software updated by the client. The latest software was used for the measurements. The measurement equipment was connected to the 50 ohm RF port of the EUT.

2	EUT#2	<u>Radiated Setup:</u>
		The radio of the EUT was configured using the "Factory Test" software:
		• Modulation:
		  ○ 1 Mbps (802.11b)
		  ○ 6 Mbps (802.11g)
		  ○ 20 MHz MCS0 (802.11n HT20)
		• Channel (Fixed):
		  ○ Ch. 1 (Low, 2412 MHz)
		  ○ Ch. 6 (Mid, 2437 MHz)
		  ○ Ch. 11 (High, 2462 MHz)
		
		The "Factory Test" software will not be available to the end user.
		
		The power was controlled through software updated by the client.
		The latest software was used for the measurements.
		
		The WiFi internal antennas were connected.

3.5 Justification for Worst Case Mode of Operation

During the testing process, the EUT was tested with transmitter sets on low, mid, and high channels. For radiated measurements, all data in this report show the worst case between horizontal and vertical antenna polarizations and for all orientations of the EUT.

4 Subject of Investigation

The objective of the measurements done by CETECOM Inc. was to assess the performance of the EUT according to the relevant requirements specified in FCC rules Part 15.247 of Title 47 of the Code of Federal Regulations and Radio Standard Specification RSS-247 of ISED Canada.

This test report is to support a request for new equipment authorization under the FCC ID: IPH-03675 IC ID: 1792A-03675

Testing procedures are based on 558074 D01 15.247 Meas Guidance v05r02 – "GUIDANCE FOR COMPLIANCE MEASUREMENTS ON DIGITAL TRANSMISSION SYSTEM, FREQUENCY HOPPING SPREAD SPECTRUM SYSTEM, AND HYBRID SYSTEM DEVICES OPERATING UNDER SECTION 15.247 OF THE FCC RULES" - April 2, 2019, by the Federal Communications Commission, Office of Engineering and Technology, Laboratory Division.

5 Measurement Results Summary

Test Specification	Test Case	Temperature and Voltage Conditions	Mode	Pass	NA	NP	Result
§15.247(a)(1) RSS-247 5.2(a)	Emission Bandwidth	Nominal	802.11b,g,n	■	☐	☐	Complies
§15.247(e) RSS-247 5.2(b)	Power Spectral Density	Nominal	802.11b,g,n	■	☐	☐	Complies
§15.247(b)(1) RSS-247 5.4(d)	Maximum Conducted Output Power and EIRP	Nominal	802.11b,g,n	■	☐	☐	Complies
§15.247(d) RSS-247 5.5	Band edge compliance Unrestricted Band Edges	Nominal	802.11b,g,n	■	☐	☐	Complies
§15.247; 15.209; 15.205 RSS-Gen 8.9; 8.10	Band edge compliance Restricted Band Edges	Nominal	802.11b,g,n	■	☐	☐	Complies
§15.247(d); §15.209 RSS-Gen 6.13	TX Spurious emissions-Radiated	Nominal	802.11g	■	☐	☐	Complies
§15.207(a) RSS Gen 8.8	AC Conducted Emissions	Nominal	N/A	☐	☐	■	N/A

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

6 Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus, with 95% confidence interval (in dB delta to result), based on a coverage factor k=1.

Radiated measurement

9 kHz to 30 MHz	±2.5 dB (Magnetic Loop Antenna)
30 MHz to 1000 MHz	±2.0 dB (Biconilog Antenna)
1 GHz to 40 GHz	±2.3 dB (Horn Antenna)

Conducted measurement

150 kHz to 30 MHz	±0.7 dB (LISN)

RF conducted measurement	±0.5 dB

According to TR 102 273 a multiplicative propagation of error is assumed for RF measurement systems. For this reason the RMS method is applied to dB values and not to linear values as appropriate for additive propagation of error.

6.1 Environmental Conditions During Testing:

The following environmental conditions were maintained during the course of testing:

- Ambient Temperature: 20-25° C
- Relative humidity: 40-60%

6.2 Dates of Testing:

02/21/2020 – 05/18/2020

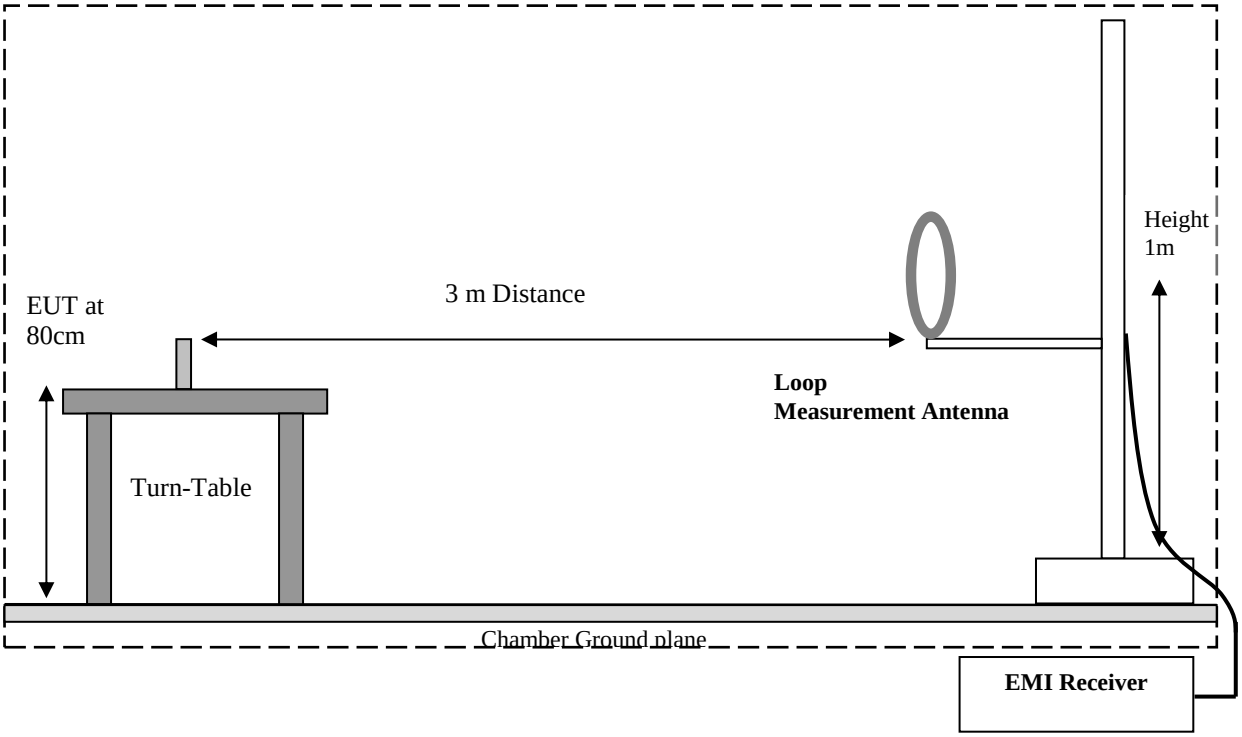
7 Measurement Procedures

7.1 Radiated Measurement

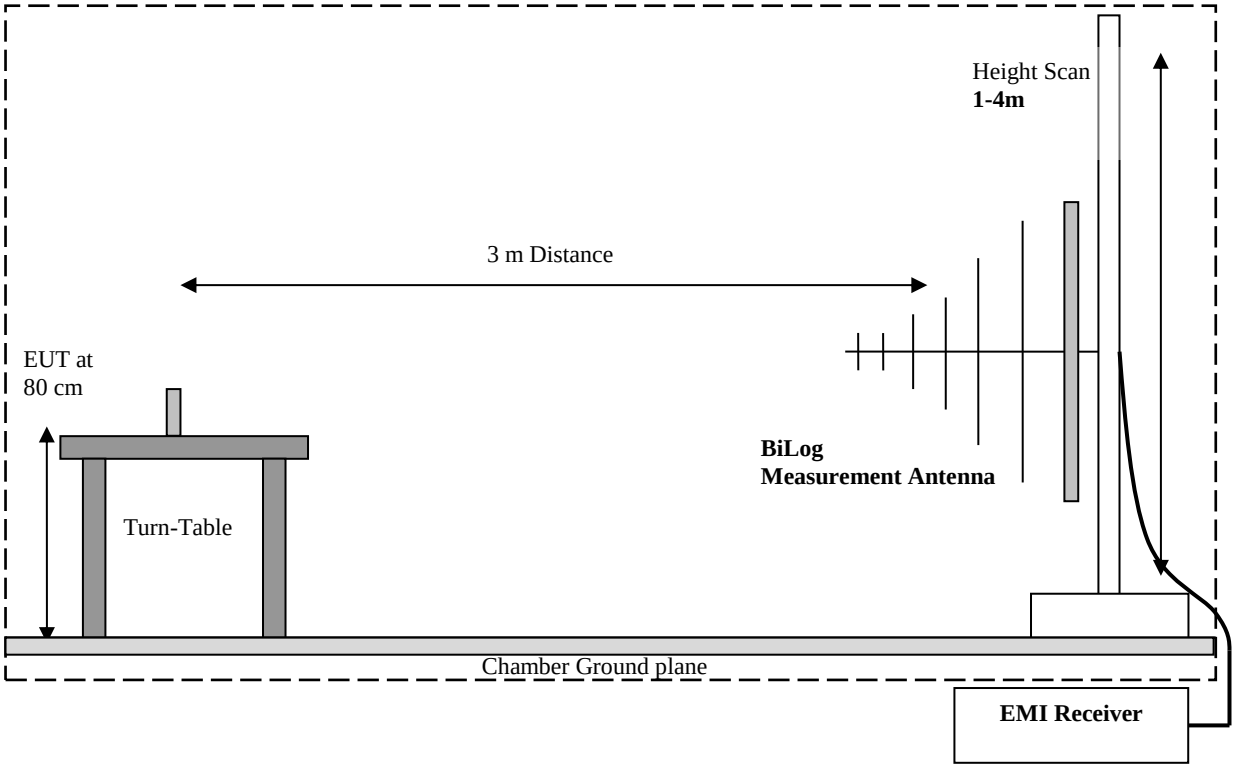
The radiated measurement is performed according to ANSI C63.10 (2013)

- The exploratory measurement is accomplished by running a matrix of 16 sweeps over the required frequency range with R&S Test-SW EMC32 for 4 positions of the turntable, two orthogonal positions of the EUT and both antenna polarizations. This procedure exceeds the requirement of the above standards to cover the 3 orthogonal axis of the EUT. A max peak detector is utilized during the exploratory measurement. The Test-SW creates an overall maximum trace for all 12 sweeps and saves the settings for each point of this trace. The maximum trace is part of the test report.
- The 10 highest emissions are selected with an automatic algorithm of EMC32 searching for peaks in the noise floor and ensuring that broadband signals are not selected multiple times.
- The maxima are then put through the final measurement and again maximized in a 90deg range of the turntable, fine search in frequency domain and height scan between 1m and 4m.
- The above procedure is repeated for all possible ways of power supply to EUT and for all supported modulations.
- In case there are no emissions above noise floor level only the maximum trace is reported as described above.
- The results are split up into up to 4 frequency ranges due to antenna bandwidth restrictions. A magnetic loop is used from 9 kHz to 30 MHz, a Biconilog antenna is used from 30 MHz to 1 GHz, and two different horn antennas are used to cover frequencies up to 40 GHz.

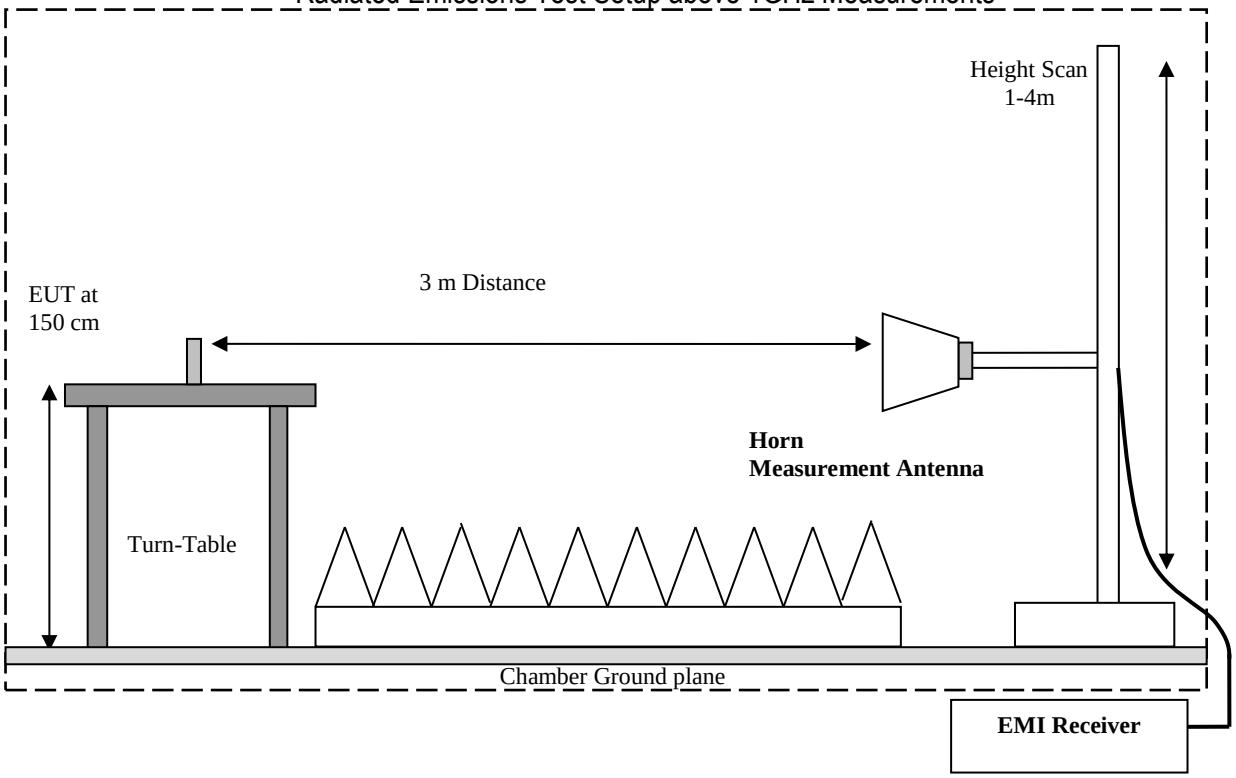
Radiated Emissions Test Setup below 30MHz Measurements



Radiated Emissions Test Setup 30MHz-1GHz Measurements



Radiated Emissions Test Setup above 1GHz Measurements



7.1.1 Sample Calculations for Field Strength Measurements

Field Strength is calculated from the Spectrum Analyzer/ Receiver readings, 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

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

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

Example:

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

7.2 Power Line Conducted Measurement Procedure

AC Power Line conducted emissions measurements performed according to: ANSI C63.4 (2014)

7.3 RF Conducted Measurement Procedure

Testing procedures are based on 558074 D01 15.247 Meas Guidance v05r02 – "GUIDANCE FOR COMPLIANCE MEASUREMENTS ON DIGITAL TRANSMISSION SYSTEM, FREQUENCY HOPPING SPREAD SPECTRUM SYSTEM, AND HYBRID SYSTEM DEVICES OPERATING UNDER SECTION 15.247 OF THE FCC RULES" - April 2, 2019, by the Federal Communications Commission, Office of Engineering and Technology, Laboratory Division.

- Connect the equipment as shown in the above diagram.
- Adjust the settings of the SA (Rohde-Schwarz Spectrum Analyzer) to connect the EUT at the required mode of test.
- Measurements are to be performed with the EUT set to the low, middle and high channels and for worst case modulation schemes.

8 Test Result Data

8.1 Maximum Conducted (Average) Output Power

8.1.1 Measurement according to FCC 558074 D01 15.247 Meas Guidance v05r02

Spectrum Analyzer settings:

- RBW = 1% to 5% of the OBW, not to exceed 1 MHz
- VBW ≥ 3 x RBW
- Span = at least 1.5 times the OBW
- Sweep = Auto couple
- Detector function = RMS
- Trace = Average (at least 100 traces in power averaging (rms) mode)
- Compute power by integrating the spectrum across the OBW of the signal using the instrument's band power measurement function with band limits set equal to the OBW band edges
- Add [10 log (1 / D)], where D is the duty cycle, to the measured power to compute the average power during the actual transmission times

8.1.2 Limits:

Maximum Output Power:

- FCC §15.247 (b)(1): 1 W
- IC RSS-247: 1 W

8.1.3 Test conditions and setup:

Ambient Temperature	EUT Set-Up #	EUT operating mode	Power Input	Antenna Gain
23.8°C	1	802.11b,g,n	12 VDC	3.7 dBi

8.1.4 Measurement result:

Plot #	Frequency (MHz)	EUT Operating Mode	Chain A Output Power* (dBm)	Chain B Output Power* (dBm)	Chain A EIRP** (dBm)	Chain B EIRP** (dBm)	Limit (dBm)	Result
1-2	2412	802.11b	6.75	7.90	10.45	11.6	30 (Avg) / 36 (EIRP)	Pass
3-4	2437	802.11b	6.42	7.49	10.12	11.19	30 (Avg) / 36 (EIRP)	Pass
5-6	2462	802.11b	5.74	6.78	9.44	10.48	30 (Avg) / 36 (EIRP)	Pass
7-8	2412	802.11g	11.59	12.75	15.29	16.45	30 (Avg) / 36 (EIRP)	Pass
9-10	2437	802.11g	10.28	11.41	13.98	15.11	30 (Avg) / 36 (EIRP)	Pass
11-12	2462	802.11g	9.63	10.76	13.33	14.46	30 (Avg) / 36 (EIRP)	Pass

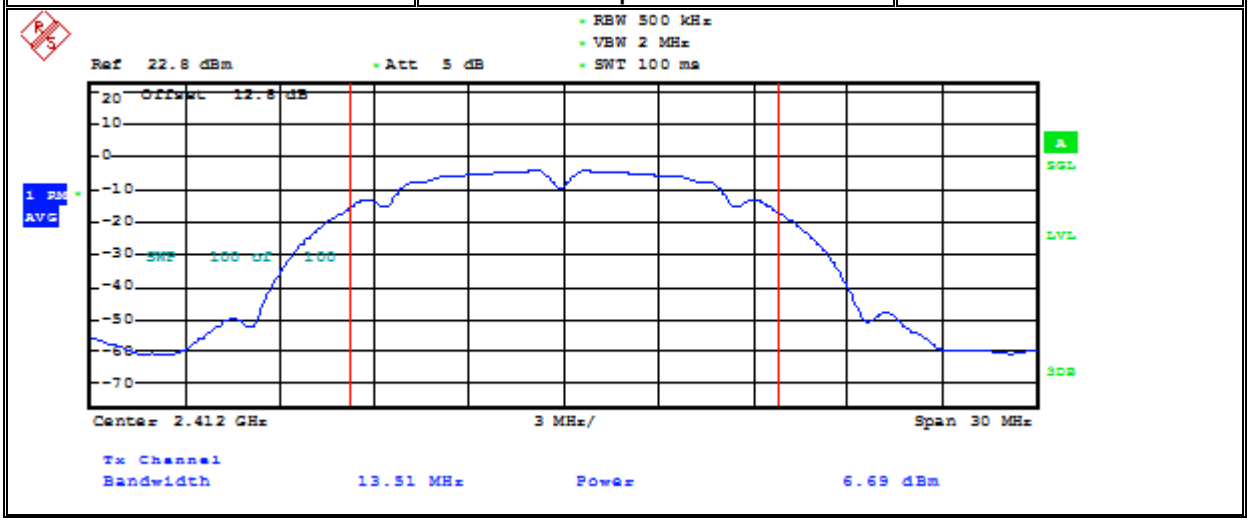
Plot #	Frequency (MHz)	EUT Operating Mode	Output Power Chain A* (dBm)	Output Power Chain B* (dBm)	Chain A+B MIMO (dBm)	Chain A+B EIRP**,*** (dBm)	Limit (dBm)	Result
13-14	2412	802.11n HT20	7.79	9.04	11.47	18.17	30 (Avg) / 36 (EIRP)	Pass
15-16	2437	802.11n HT20	9.35	10.51	12.98	19.68	30 (Avg) / 36 (EIRP)	Pass
17-18	2462	802.11n HT20	9.71	10.85	13.33	20.03	30 (Avg) / 36 (EIRP)	Pass

* Duty cycle correction factor was applied to conducted output power for each operating mode:
- 802.11b: 0.06 dB
- 802.11g: 0.57 dB
- 802.11n HT20: 0.48 dB

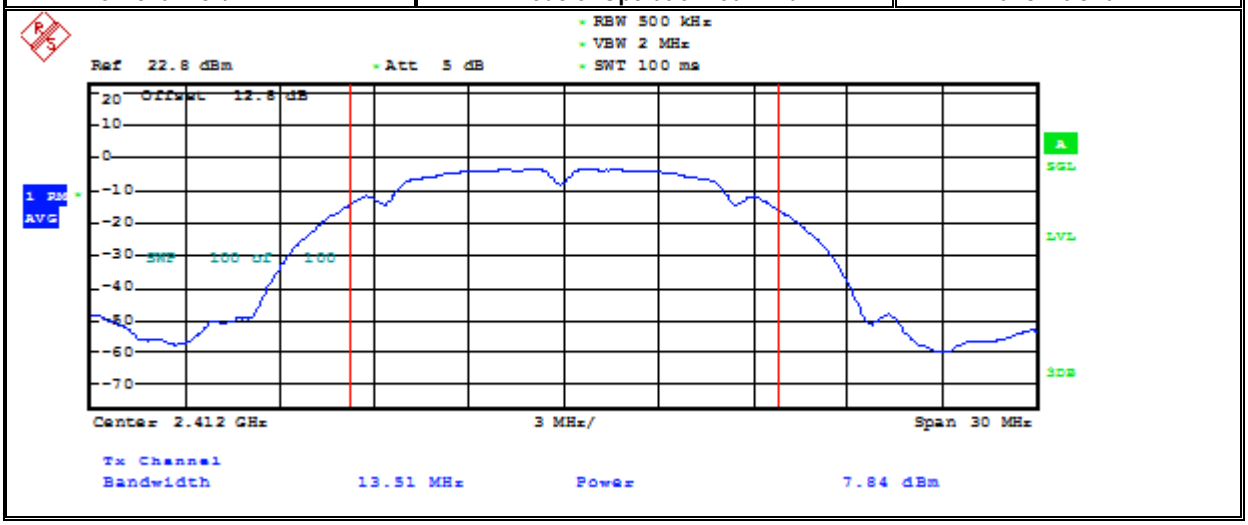
** For all operating modes, 3.7 dBi antenna gain was added
*** For 802.11n HT20 operating mode, 3 dB beamforming gain was applied.

8.1.5 Measurement Plots:

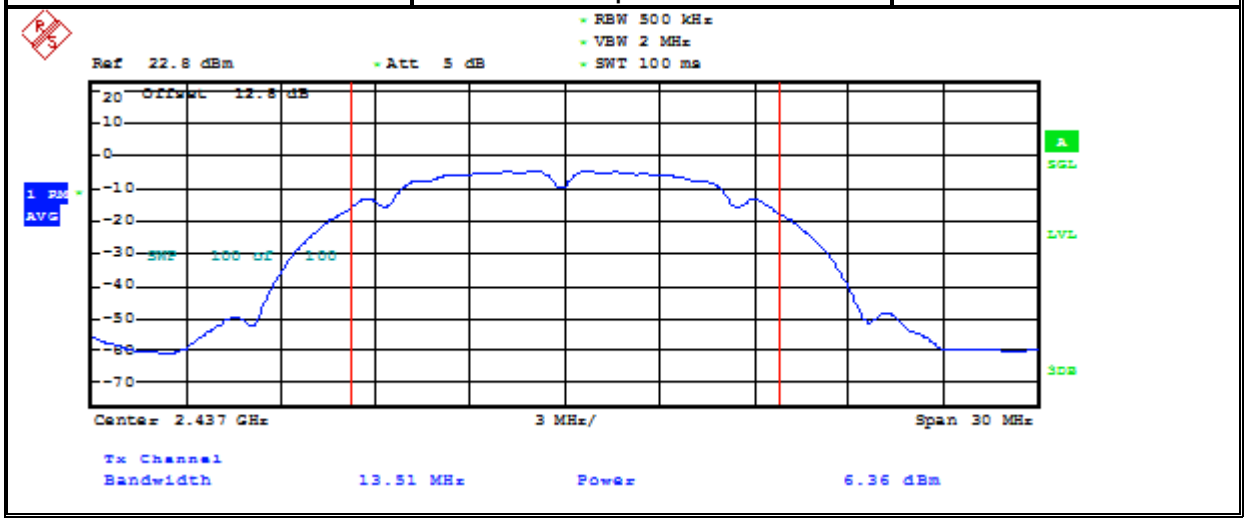
Plot #1		
Low channel / 2412 MHz	Mode of Operation: 802.11b	Transmit Chain A



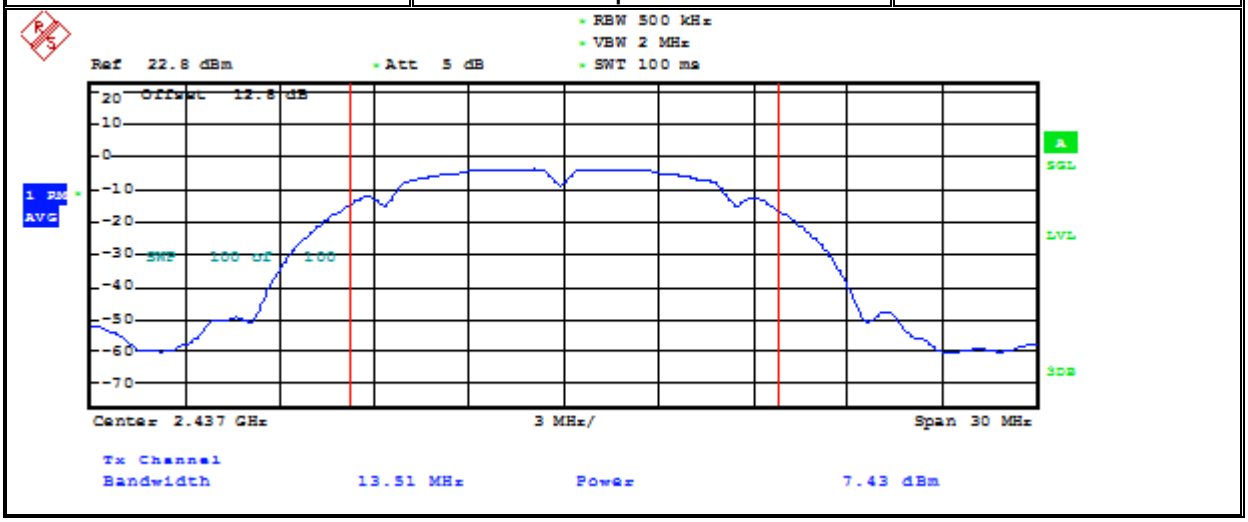
Plot #2		
Low channel / 2412 MHz	Mode of Operation: 802.11b	Transmit Chain B



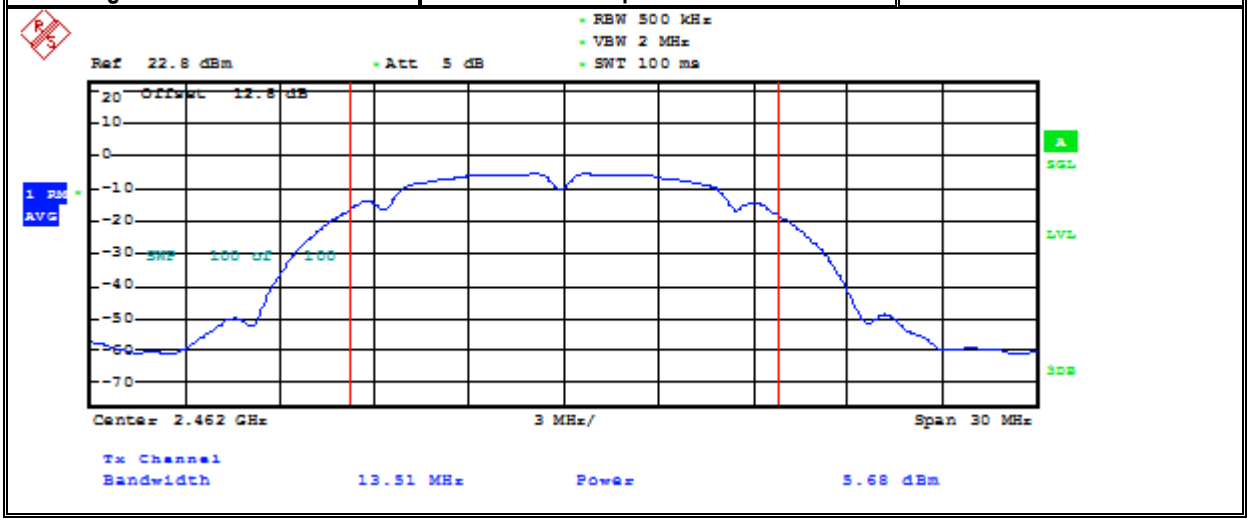
Plot #3		
Mid channel / 2437 MHz	Mode of Operation: 802.11b	Transmit Chain A



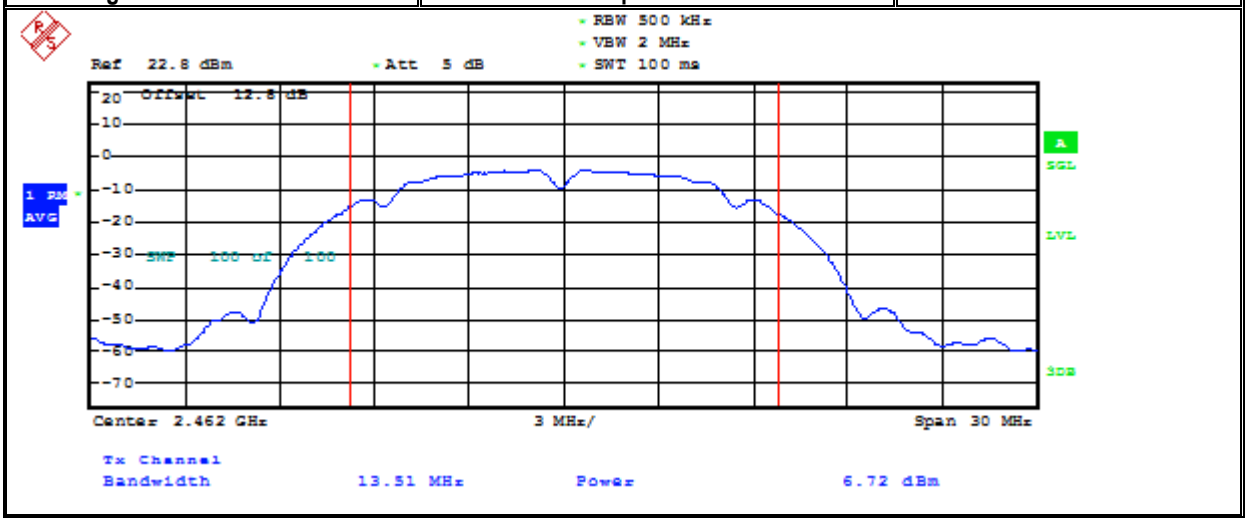
Plot #4		
Mid channel / 2437 MHz	Mode of Operation: 802.11b	Transmit Chain B



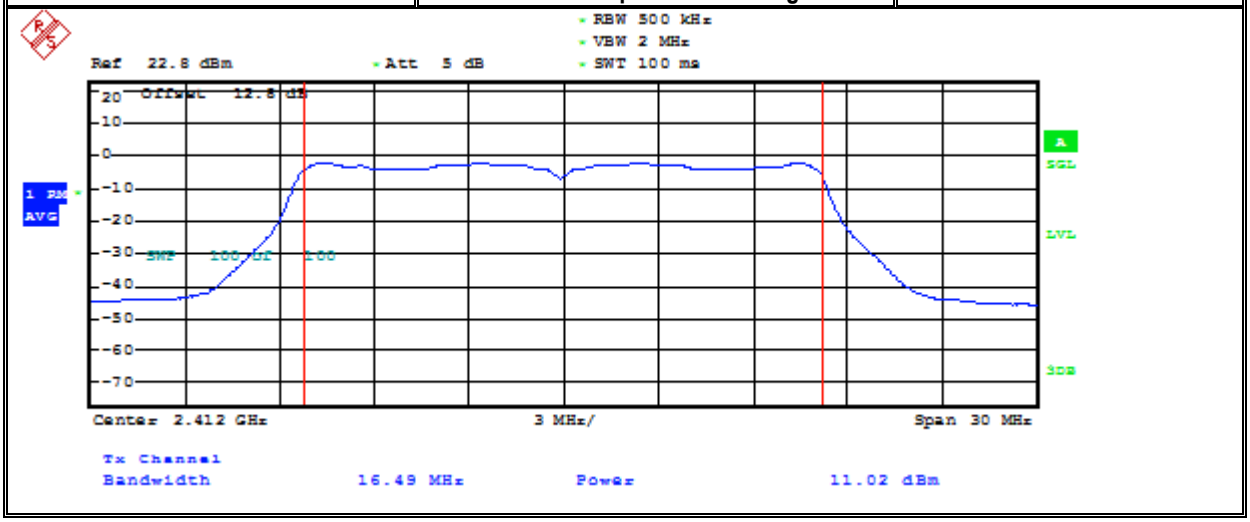
Plot #5		
High channel / 2462 MHz	Mode of Operation: 802.11b	Transmit Chain A



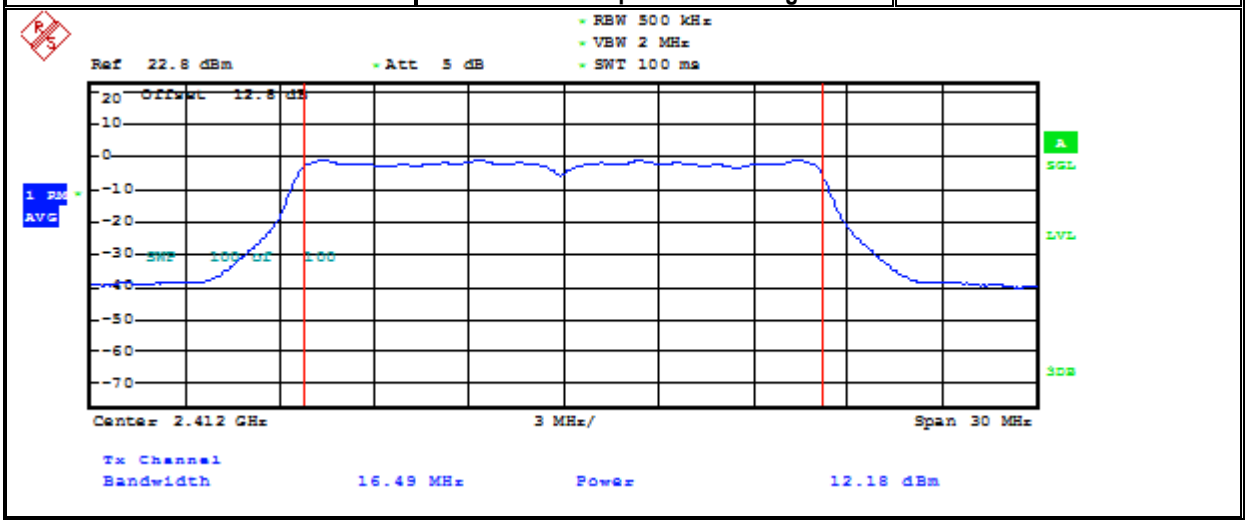
Plot #6		
High channel / 2462 MHz	Mode of Operation: 802.11b	Transmit Chain B



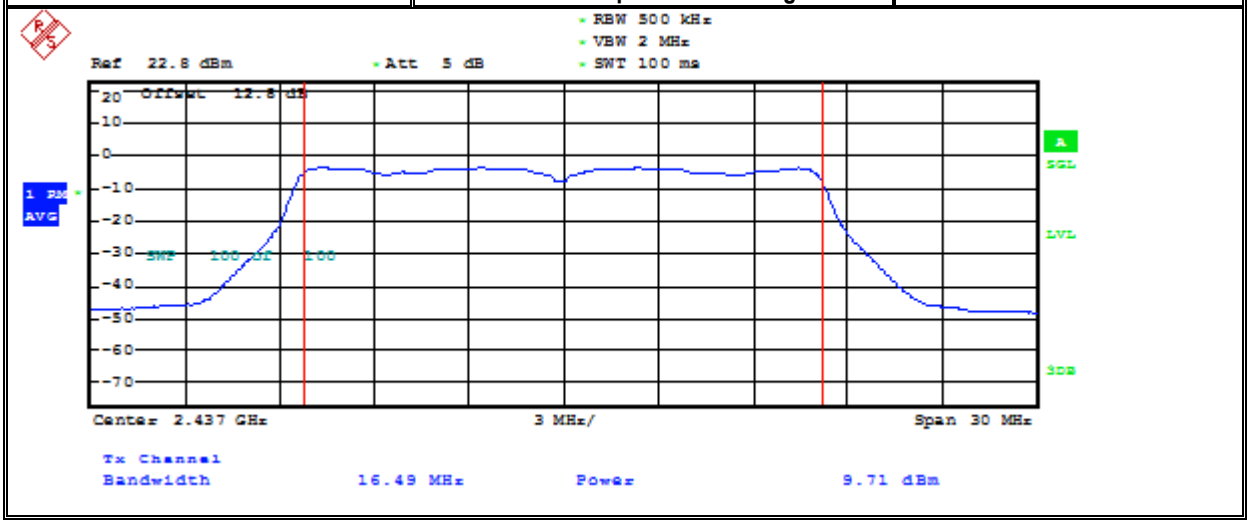
Plot #7		
Low channel / 2412 MHz	Mode of Operation: 802.11g	Transmit Chain A



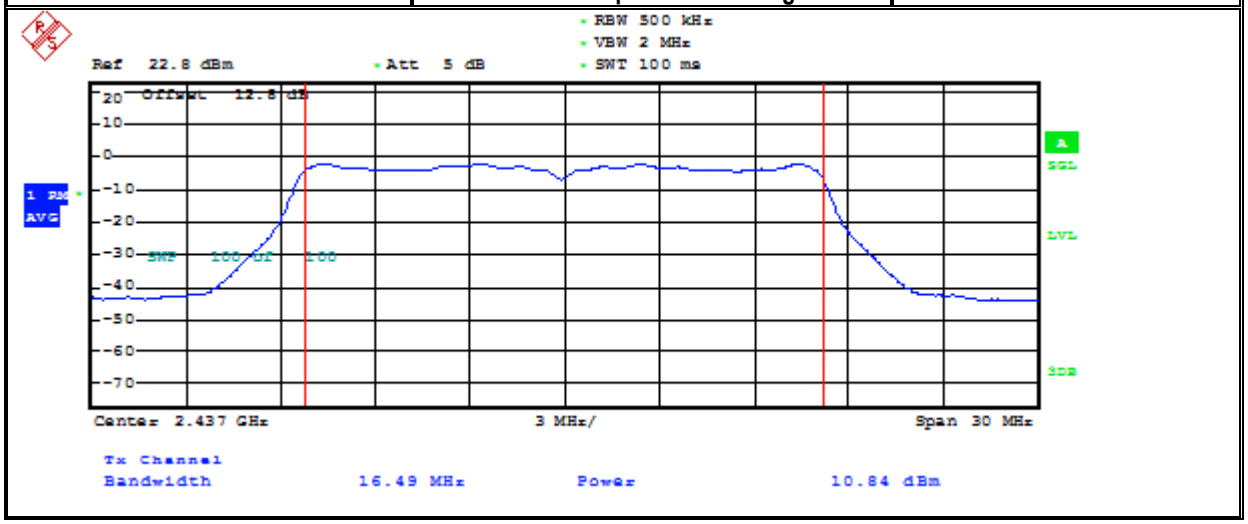
Plot #8		
Low channel / 2412 MHz	Mode of Operation: 802.11g	Transmit Chain B



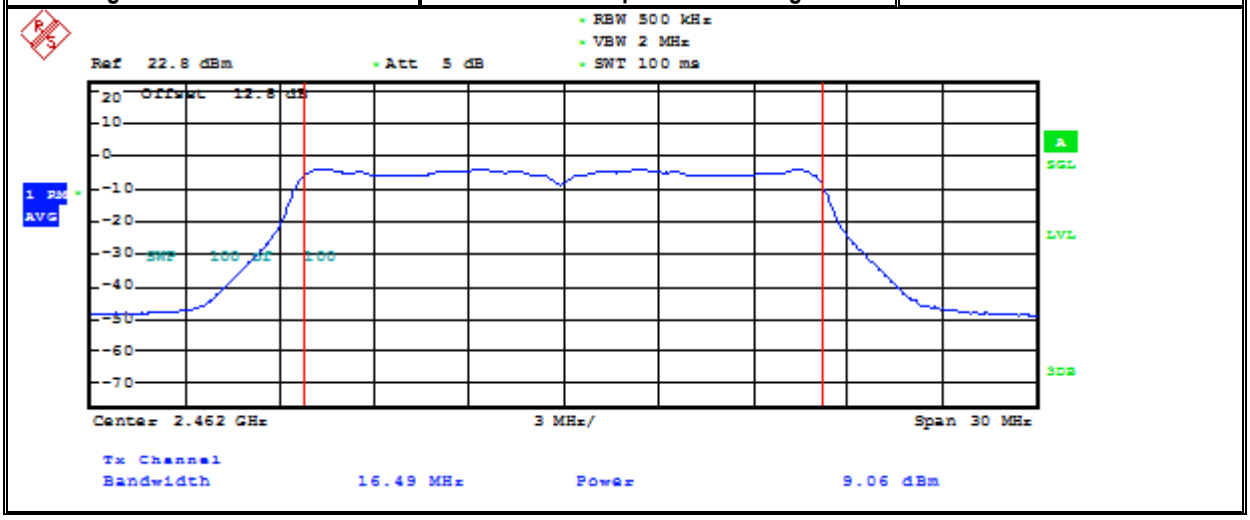
Plot #9		
Mid channel / 2437 MHz	Mode of Operation: 802.11g	Transmit Chain A



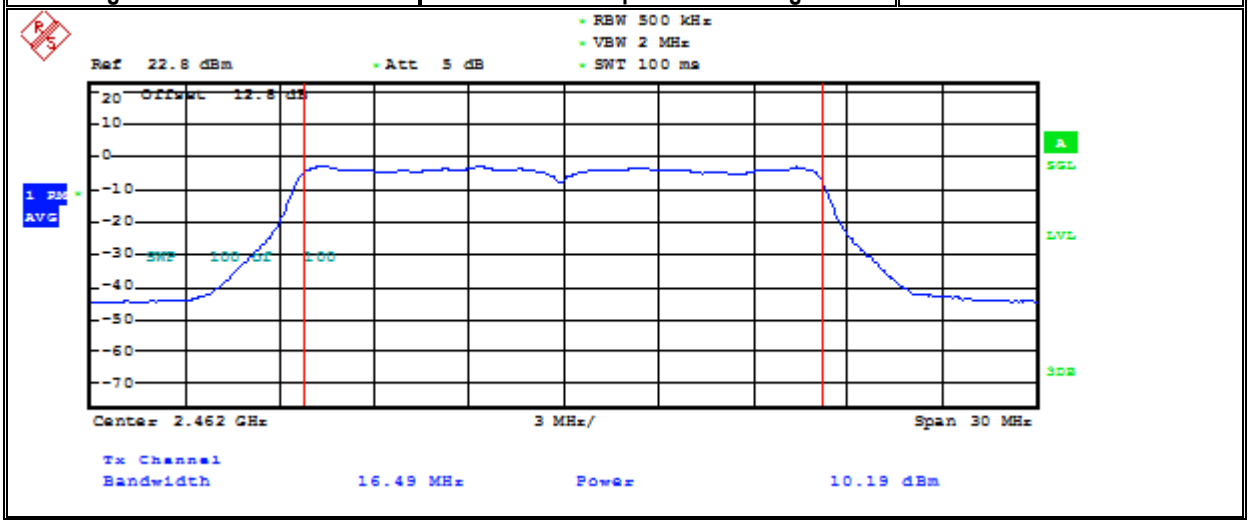
Plot #10		
Mid channel / 2437 MHz	Mode of Operation: 802.11g	Transmit Chain B



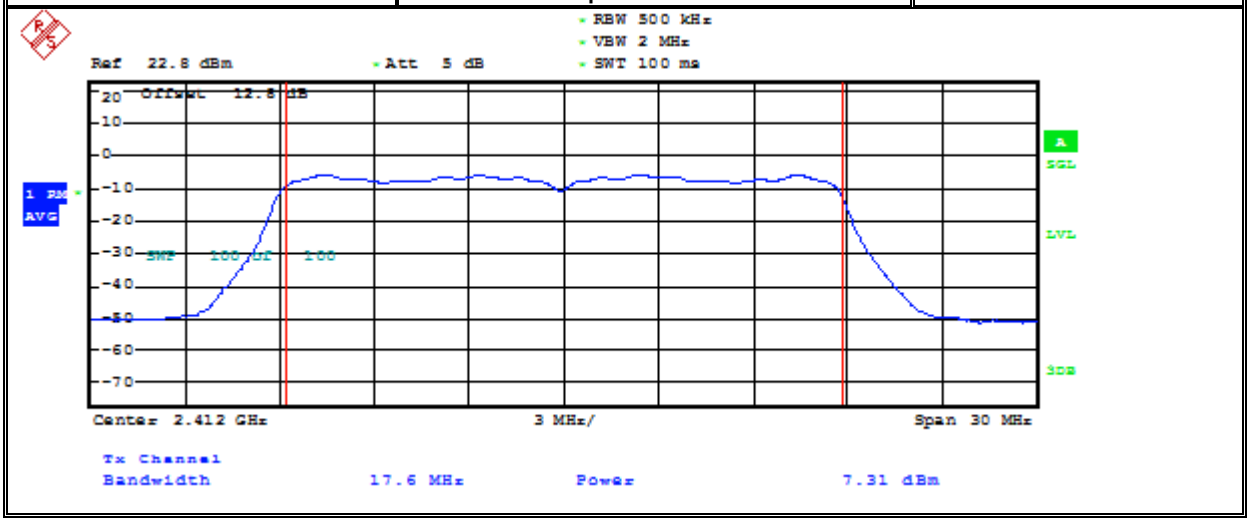
Plot #11		
High channel / 2462 MHz	Mode of Operation: 802.11g	Transmit Chain A



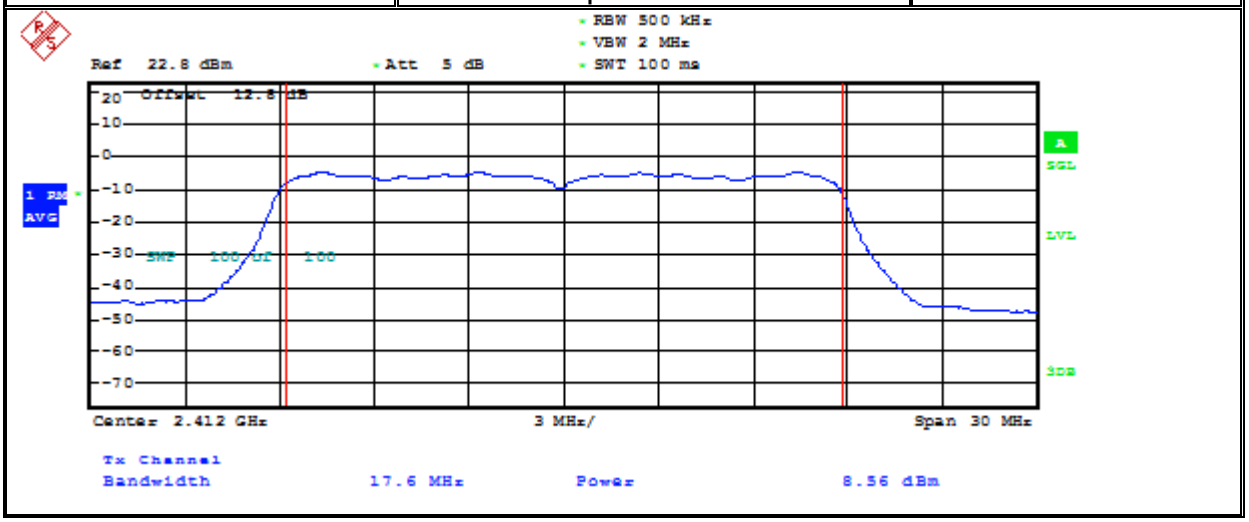
Plot #12		
High channel / 2462 MHz	Mode of Operation: 802.11g	Transmit Chain B



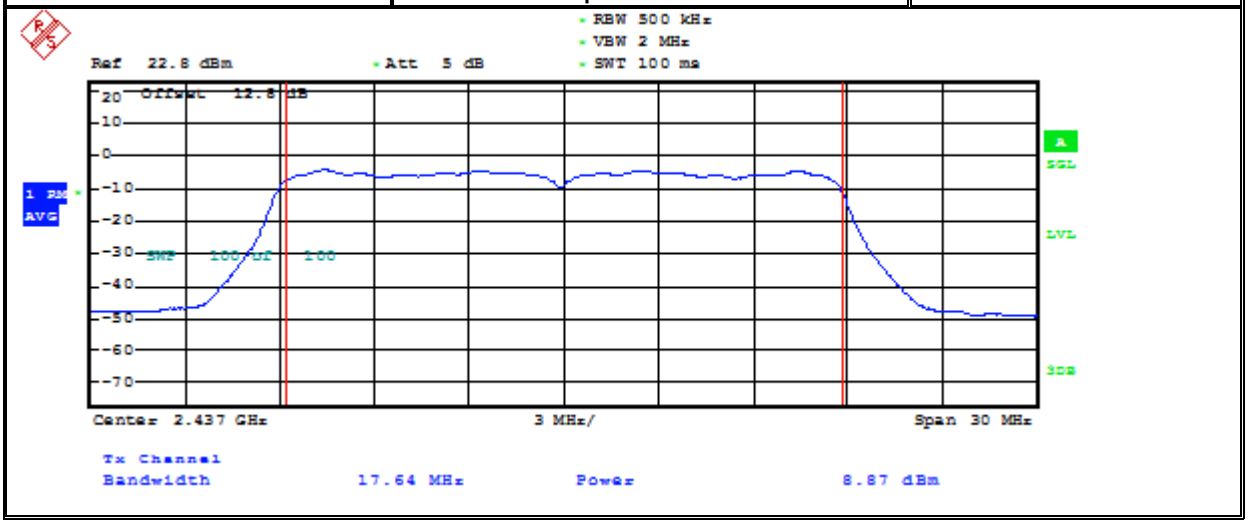
Plot #13		
Low channel / 2412 MHz	Mode of Operation: 802.11n HT20	Transmit Chain A



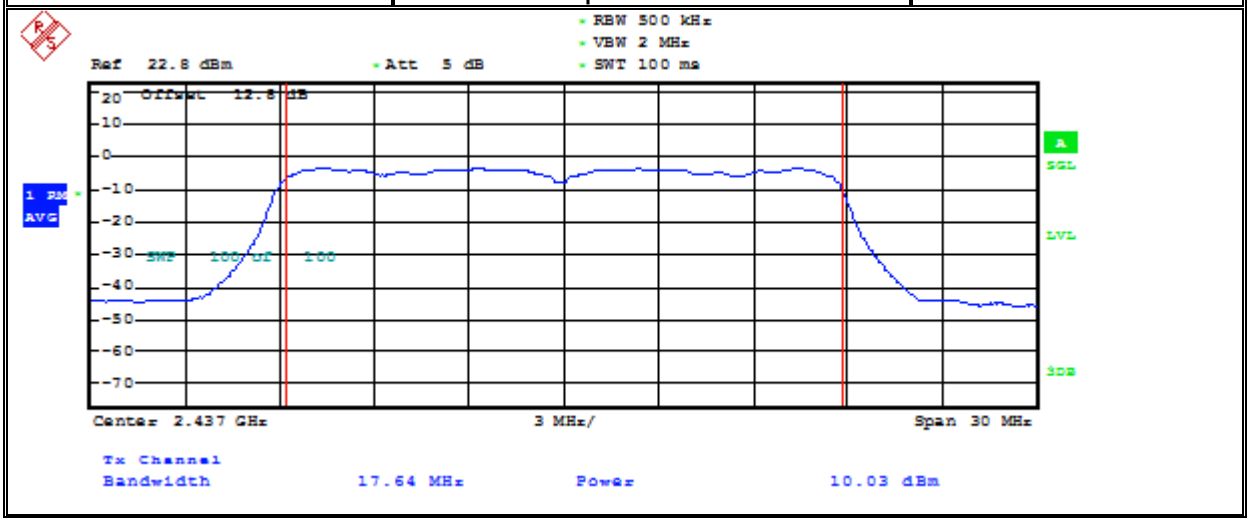
Plot #14		
Low channel / 2412 MHz	Mode of Operation: 802.11n HT20	Transmit Chain B



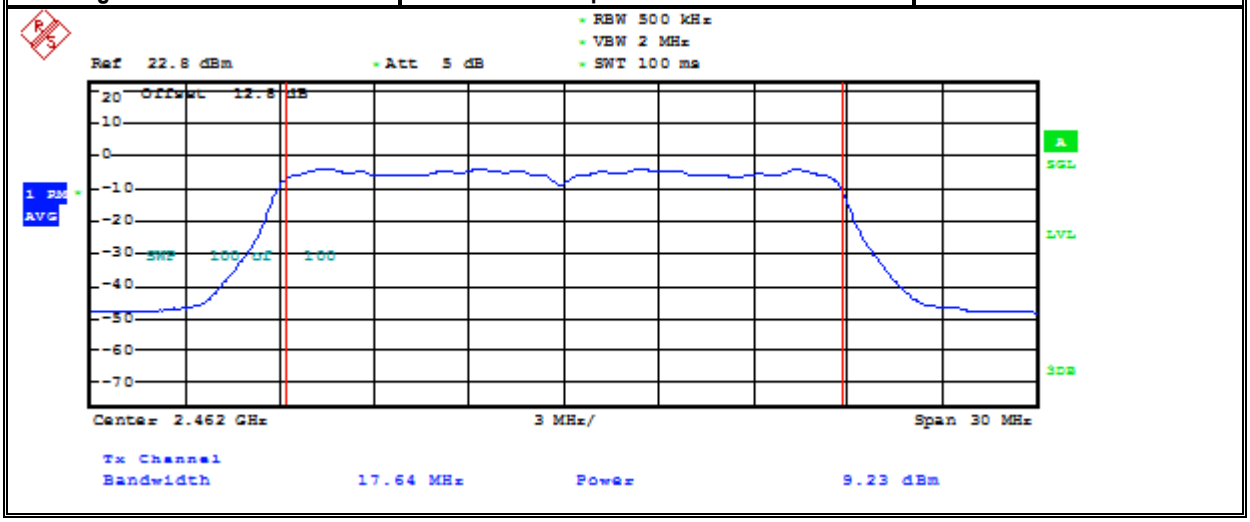
Plot #15		
Mid channel / 2437 MHz	Mode of Operation: 802.11n HT20	Transmit Chain A



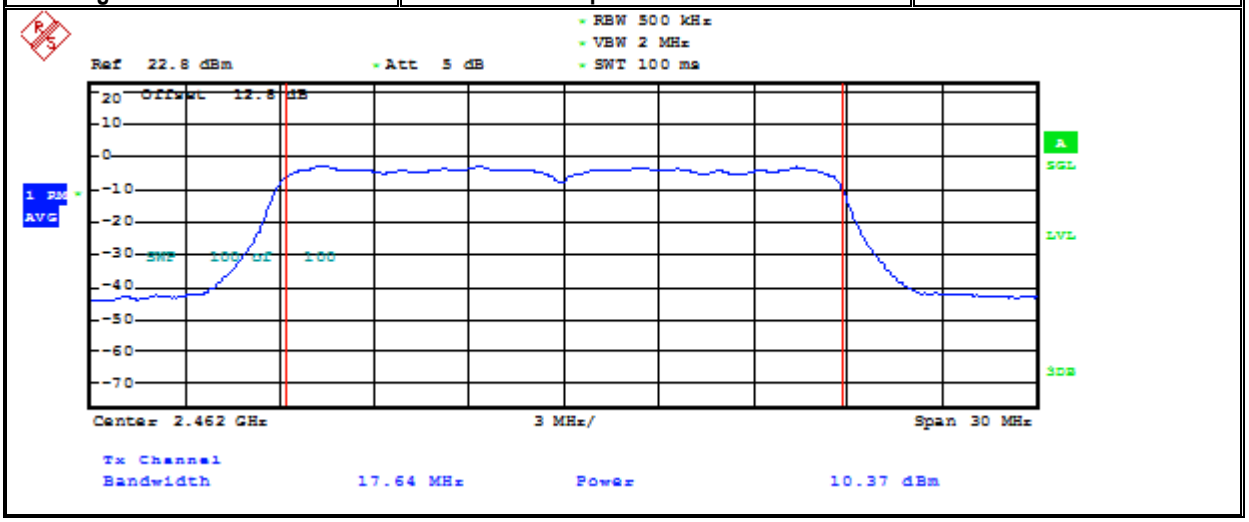
Plot #16		
Mid channel / 2437 MHz	Mode of Operation: 802.11n HT20	Transmit Chain B



Plot #17		
High channel / 2462 MHz	Mode of Operation: 802.11n HT20	Transmit Chain A



Plot #18		
High channel / 2462 MHz	Mode of Operation: 802.11n HT20	Transmit Chain B



8.2 Power Spectral Density

8.2.1 Measurement according to FCC 558074 D01 15.247 Meas Guidance v05r02

Spectrum Analyzer settings for Peak PSD method:

- Set analyzer center frequency to DTS channel center frequency
- Set the span to 1.5 x DTS bandwidth
- Set RBW to: 3 kHz ≤ RBW ≤ 100 kHz
- Set the VBW ≥ 3 x RBW
- Detector = Peak
- Sweep time = Auto couple
- Trace mode = Max hold
- Allow trace to fully stabilize
- Use the peak marker function to determine the maximum amplitude level within the RBW
- If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat

8.2.2 Limits:

FCC§15.247(e) & RSS-247 5.2(2)

- For digitally modulated systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

8.2.3 Test conditions and setup:

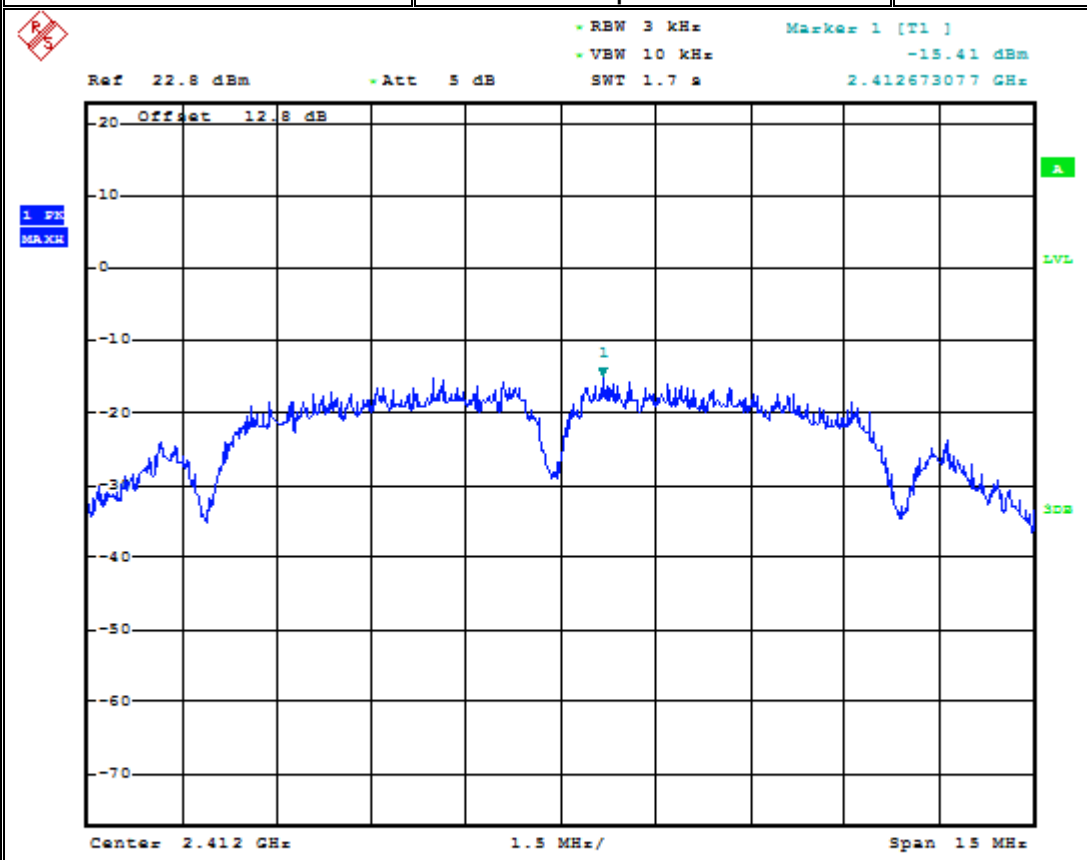
Ambient Temperature	EUT Set-Up #	EUT operating mode	Power Input	Antenna Gain
23.8°C	1	802.11b,g,n	12 VDC	3.7 dBi

8.2.4 Measurement result:

Plot #	Frequency (MHz)	EUT Operating Mode	Chain A PSD (dBm / 3 kHz)	Chain B PSD (dBm / 3 kHz)	Chain A+B MIMO (dBm / 3 kHz)	Limit (dBm / 3 kHz)	Result
1-2	2412	802.11b	-15.41	-15.83	-	8	Pass
3-4	2437	802.11b	-15.90	-16.80	-	8	Pass
5-6	2462	802.11b	-15.94	-17.52	-	8	Pass
7-8	2412	802.11g	-11.43	-11.07	-	8	Pass
9-10	2437	802.11g	-13.01	-13.82	-	8	Pass
11-12	2462	802.11g	-13.13	-14.32	-	8	Pass
13-14	2412	802.11n HT20	-14.93	-16.55	-12.65	8	Pass
15-16	2437	802.11n HT20	-13.92	-14.13	-11.01	8	Pass
17-18	2462	802.11n HT20	-14.07	-15.13	-11.56	8	Pass

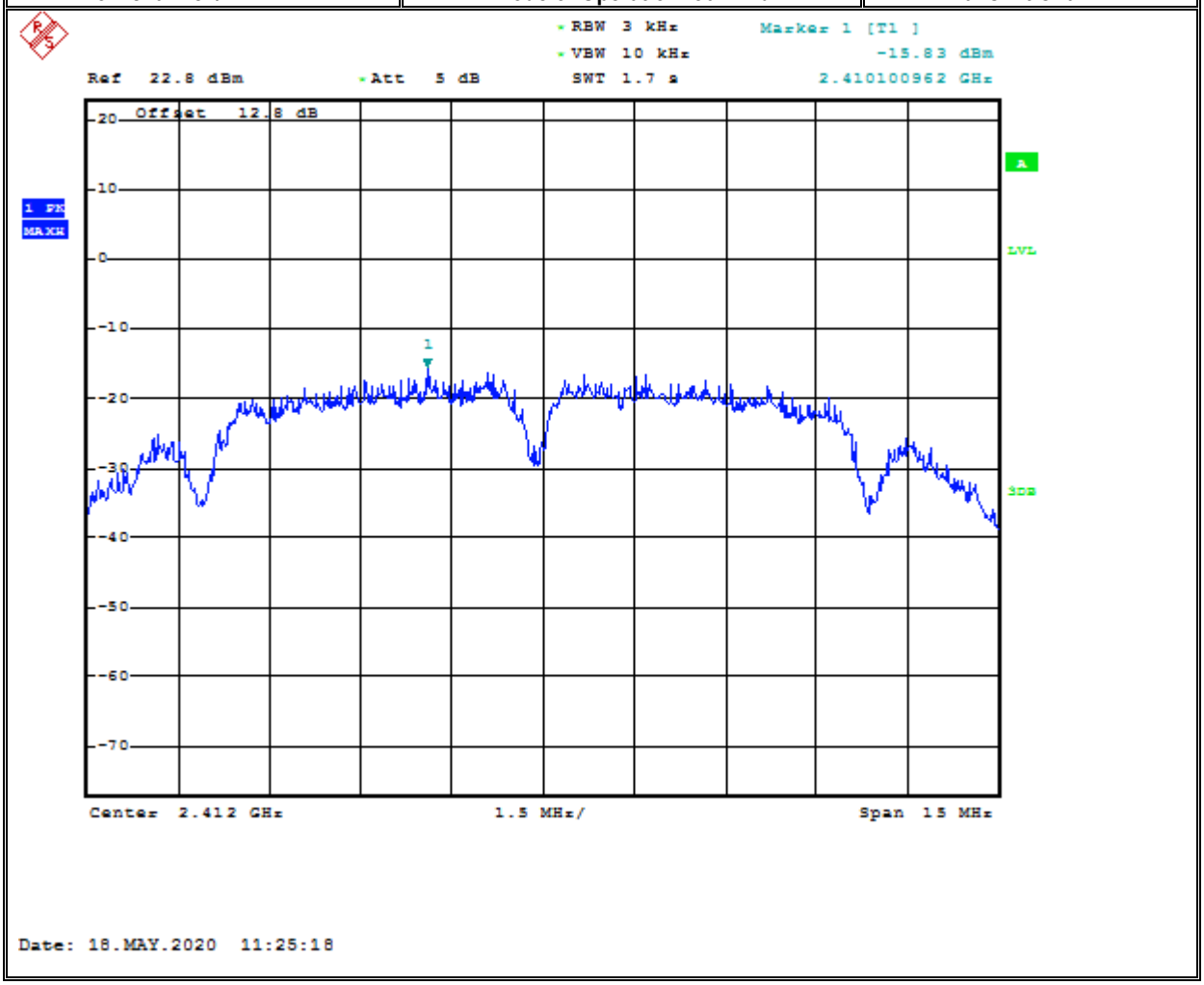
8.2.5 Measurement Plots:

Plot #1		
Low channel / 2412 MHz	Mode of Operation: 802.11b	Transmit Chain A

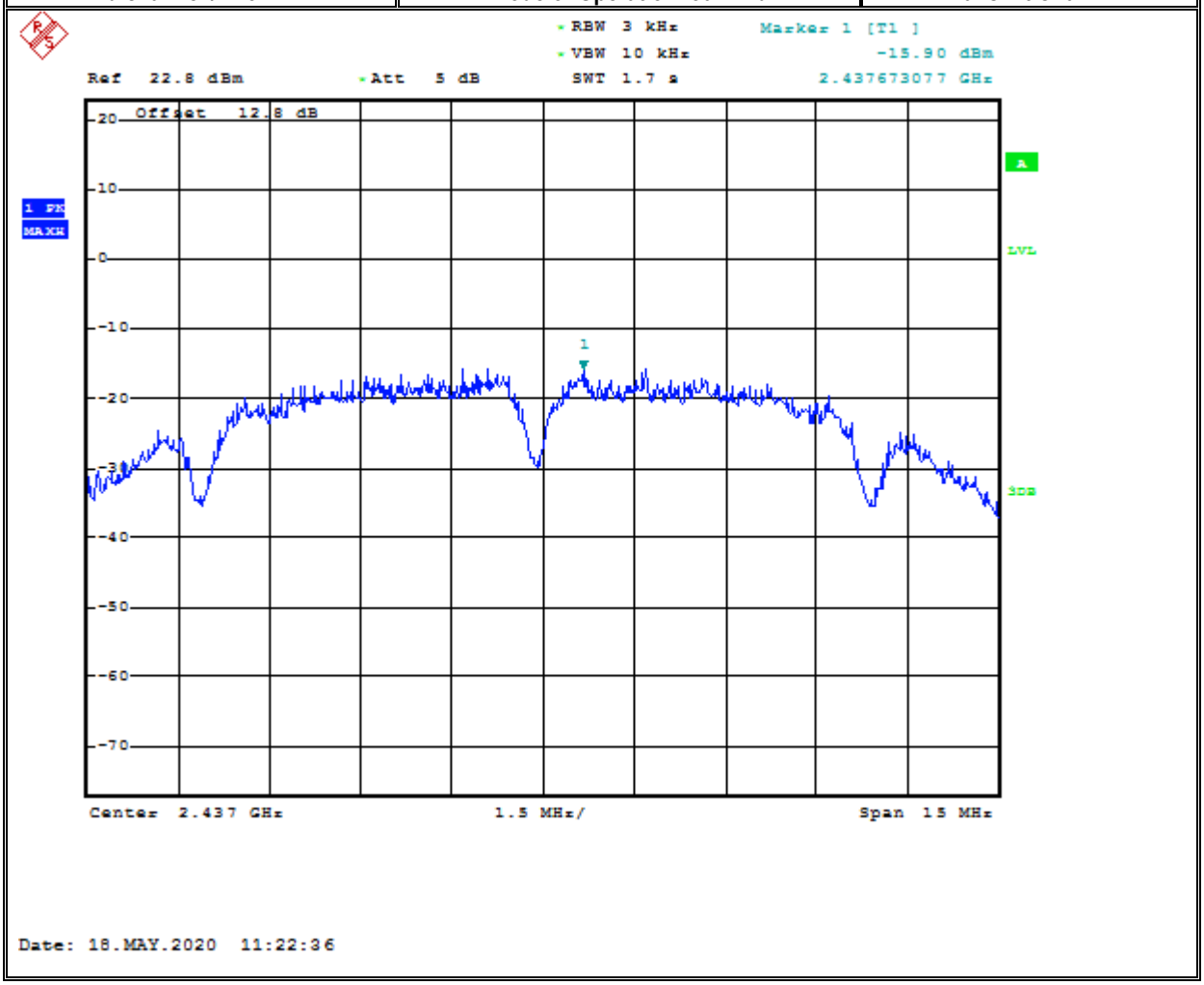


Date: 18.MAY.2020 11:23:59

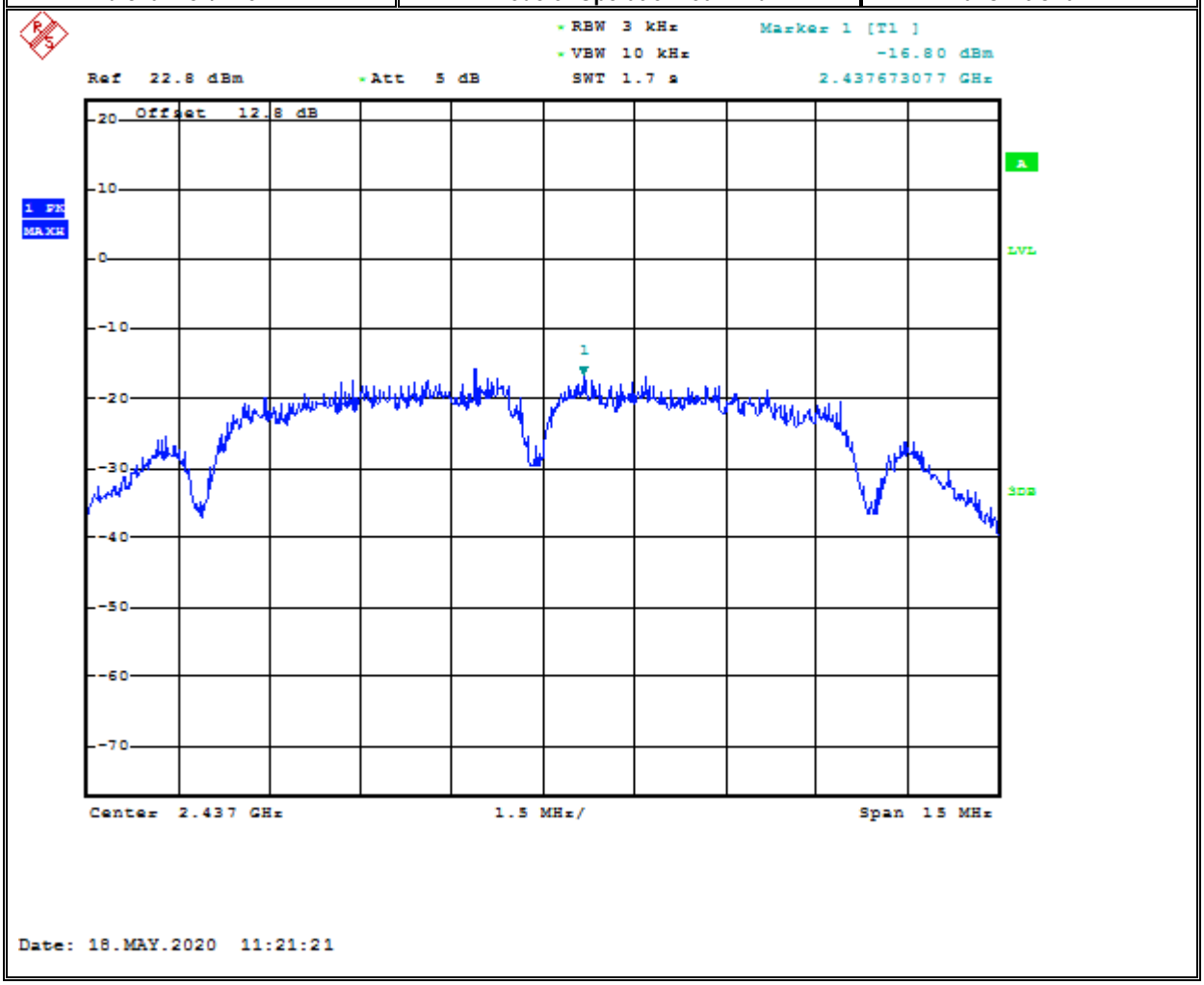
Plot #2		
Low channel / 2412 MHz	Mode of Operation: 802.11b	Transmit Chain B



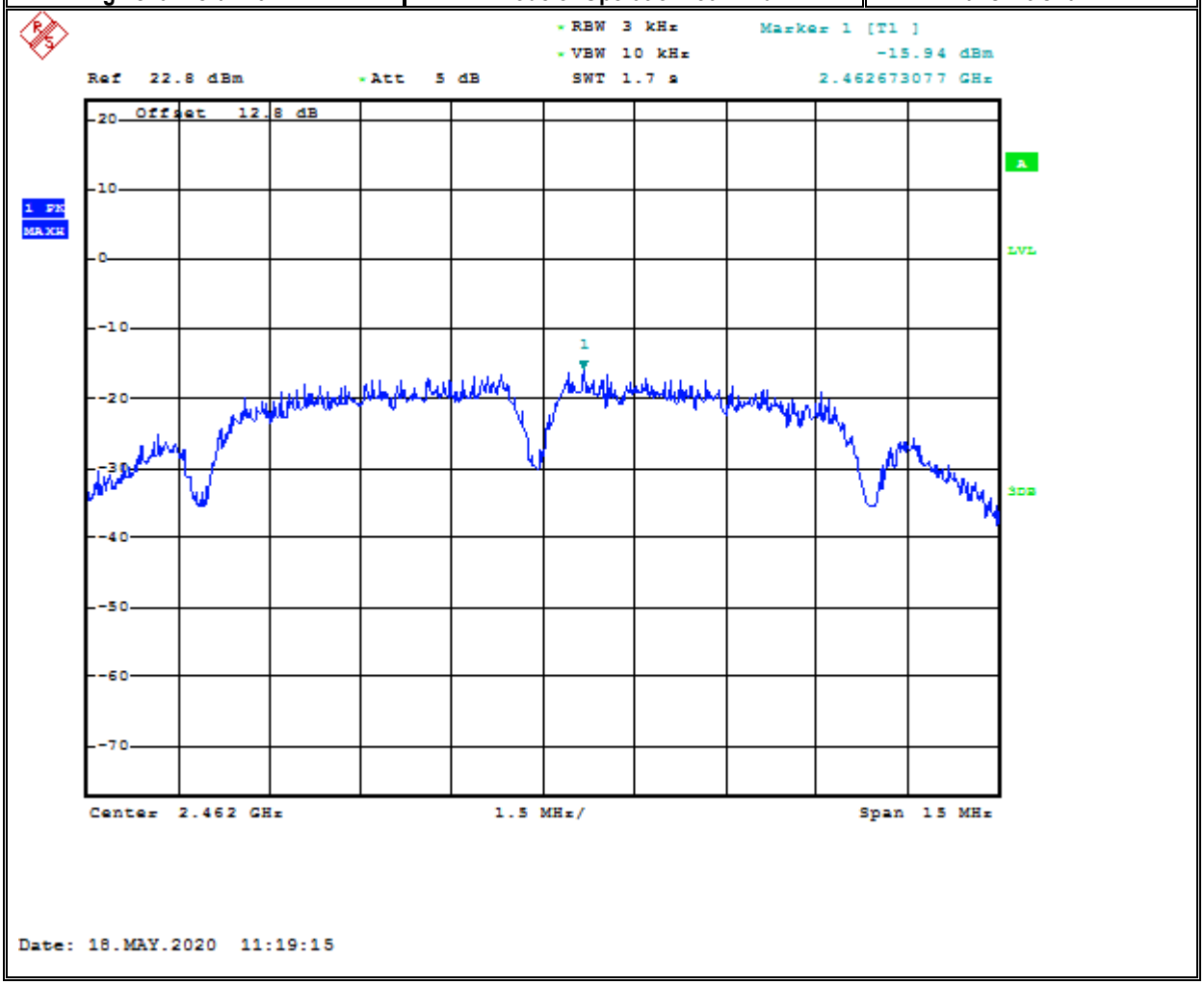
Plot #3		
Mid channel / 2437 MHz	Mode of Operation: 802.11b	Transmit Chain A



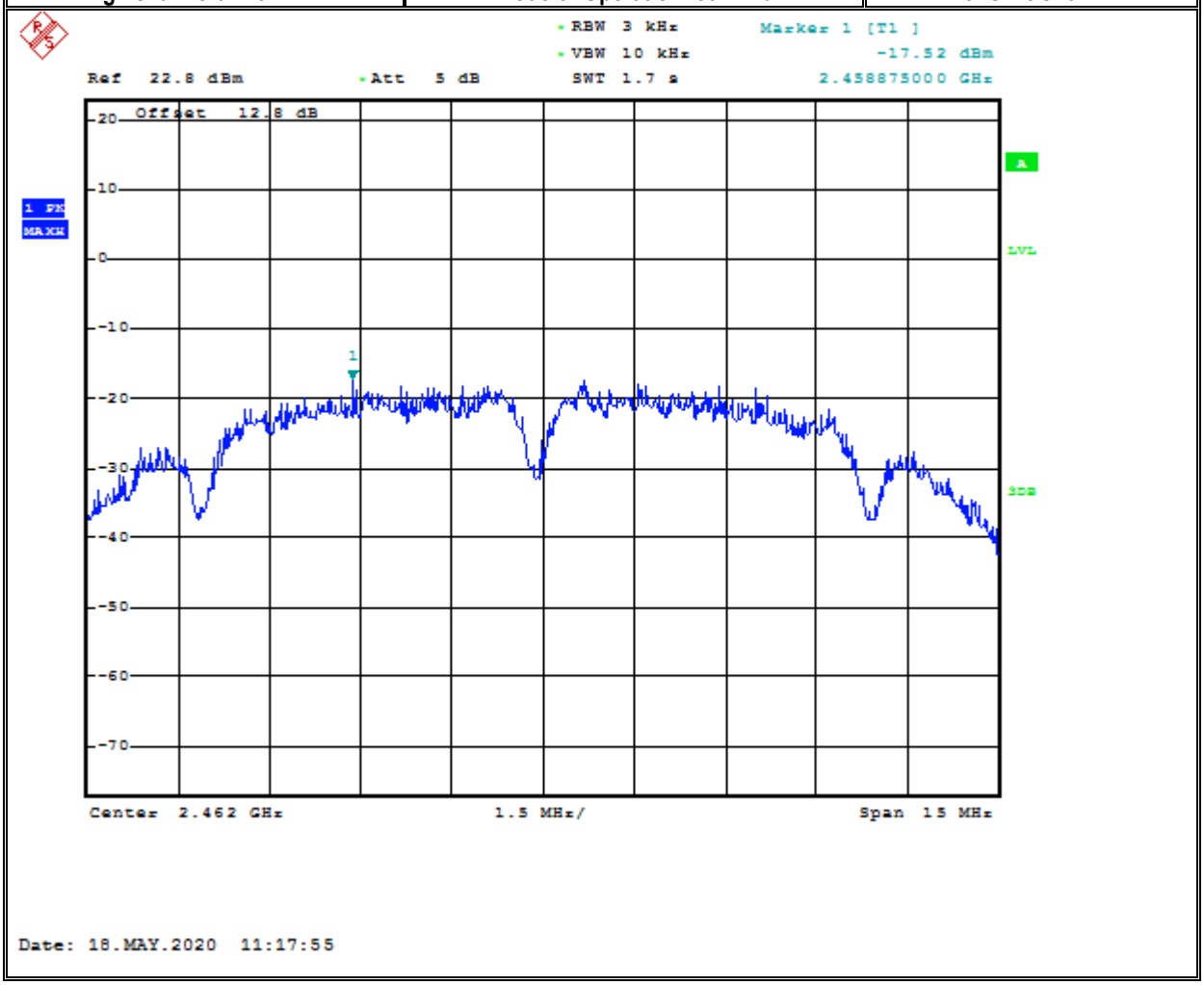
Plot #4		
Mid channel / 2437 MHz	Mode of Operation: 802.11b	Transmit Chain B



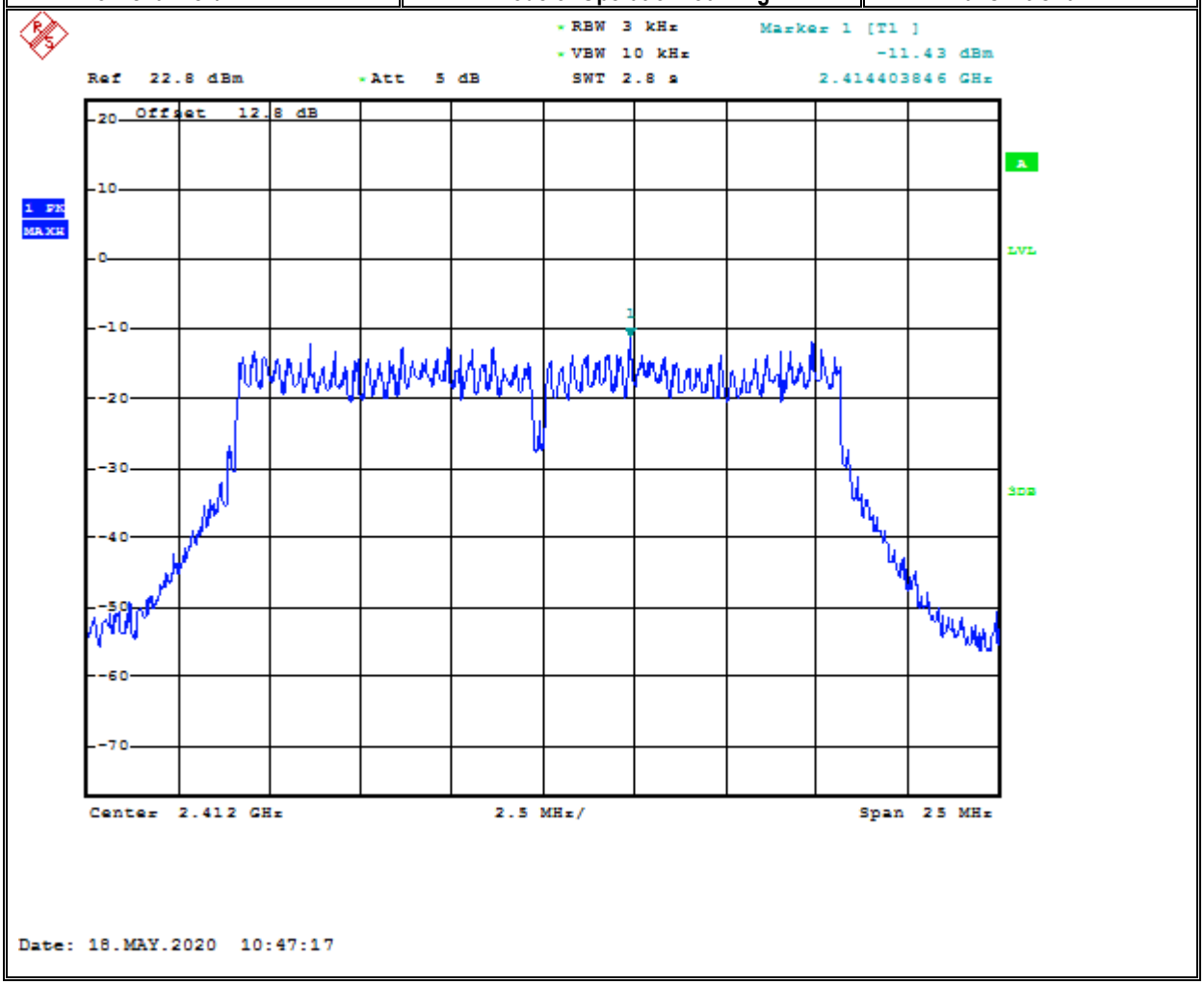
Plot #5		
High channel / 2462 MHz	Mode of Operation: 802.11b	Transmit Chain A



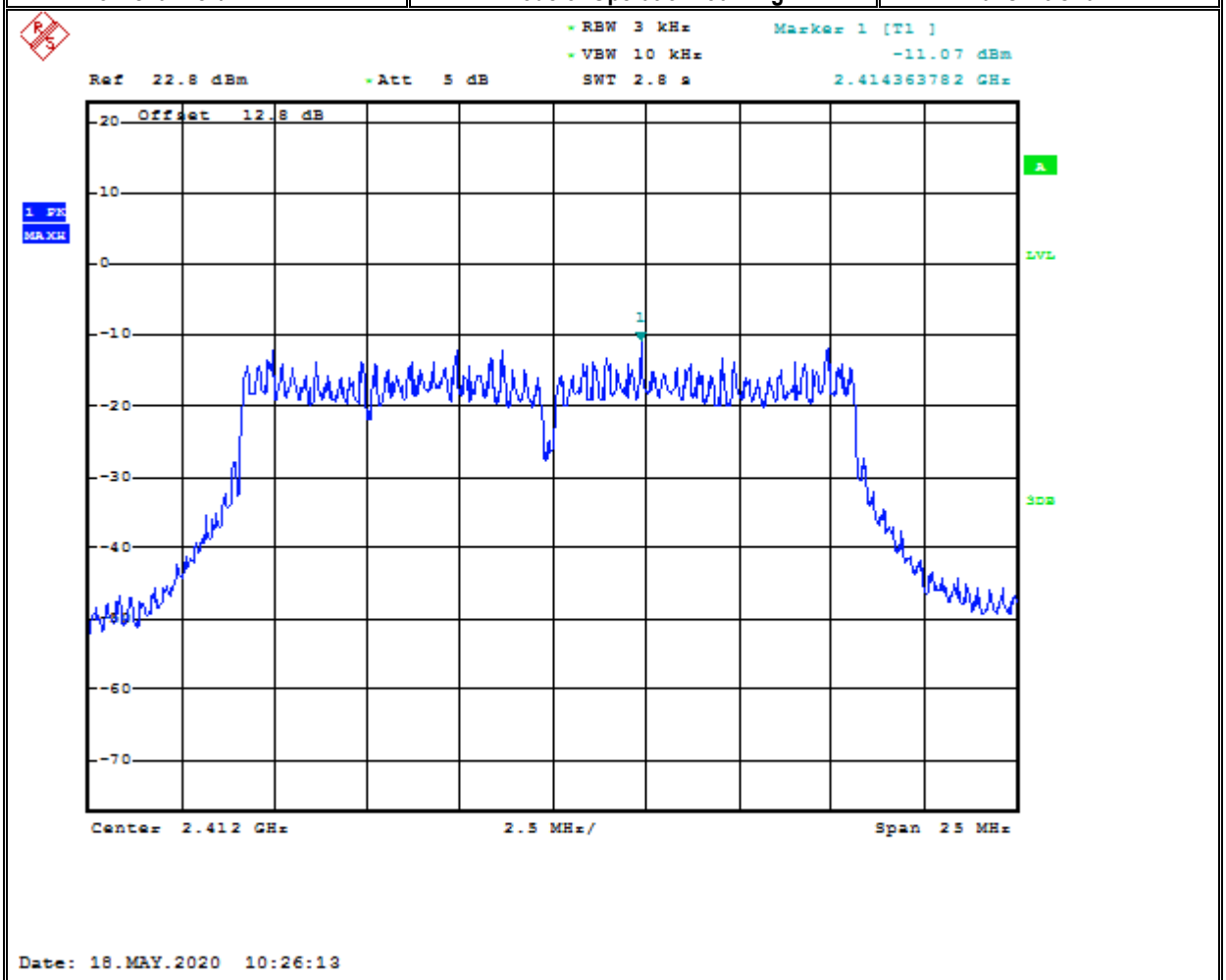
Plot #6		
High channel / 2462 MHz	Mode of Operation: 802.11b	Transmit Chain B



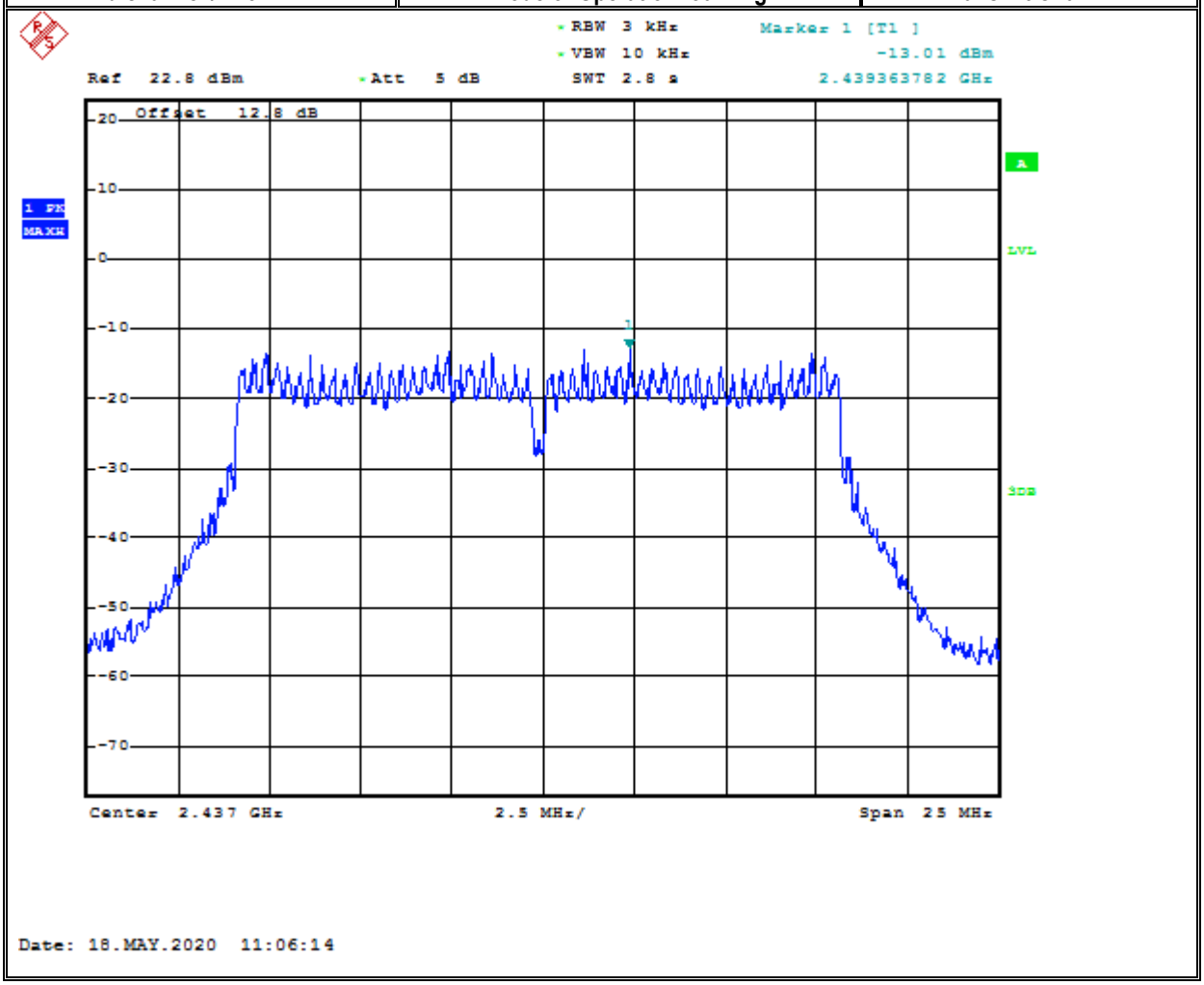
Plot #7		
Low channel / 2412 MHz	Mode of Operation: 802.11g	Transmit Chain A



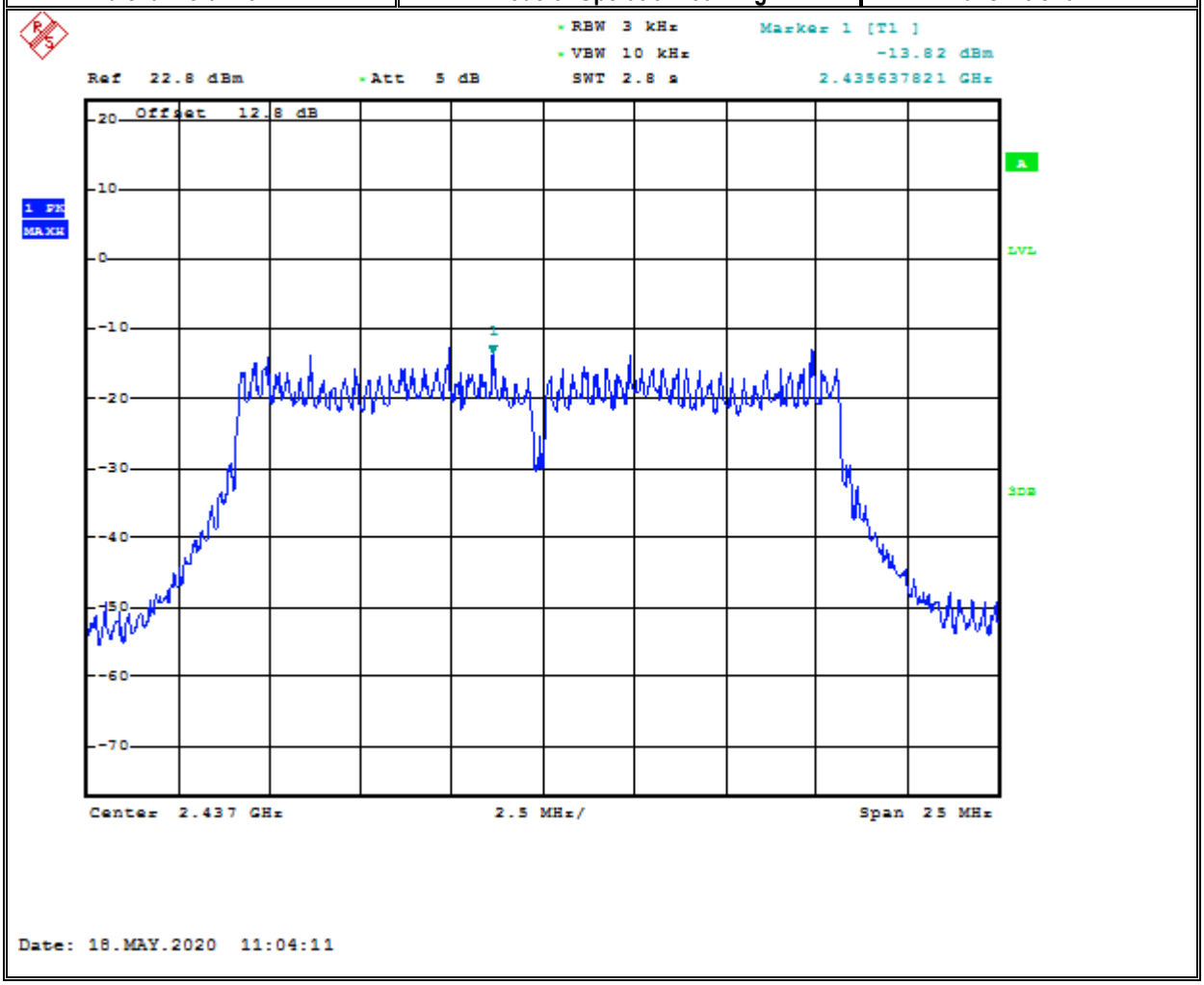
Plot #8		
Low channel / 2412 MHz	Mode of Operation: 802.11g	Transmit Chain B



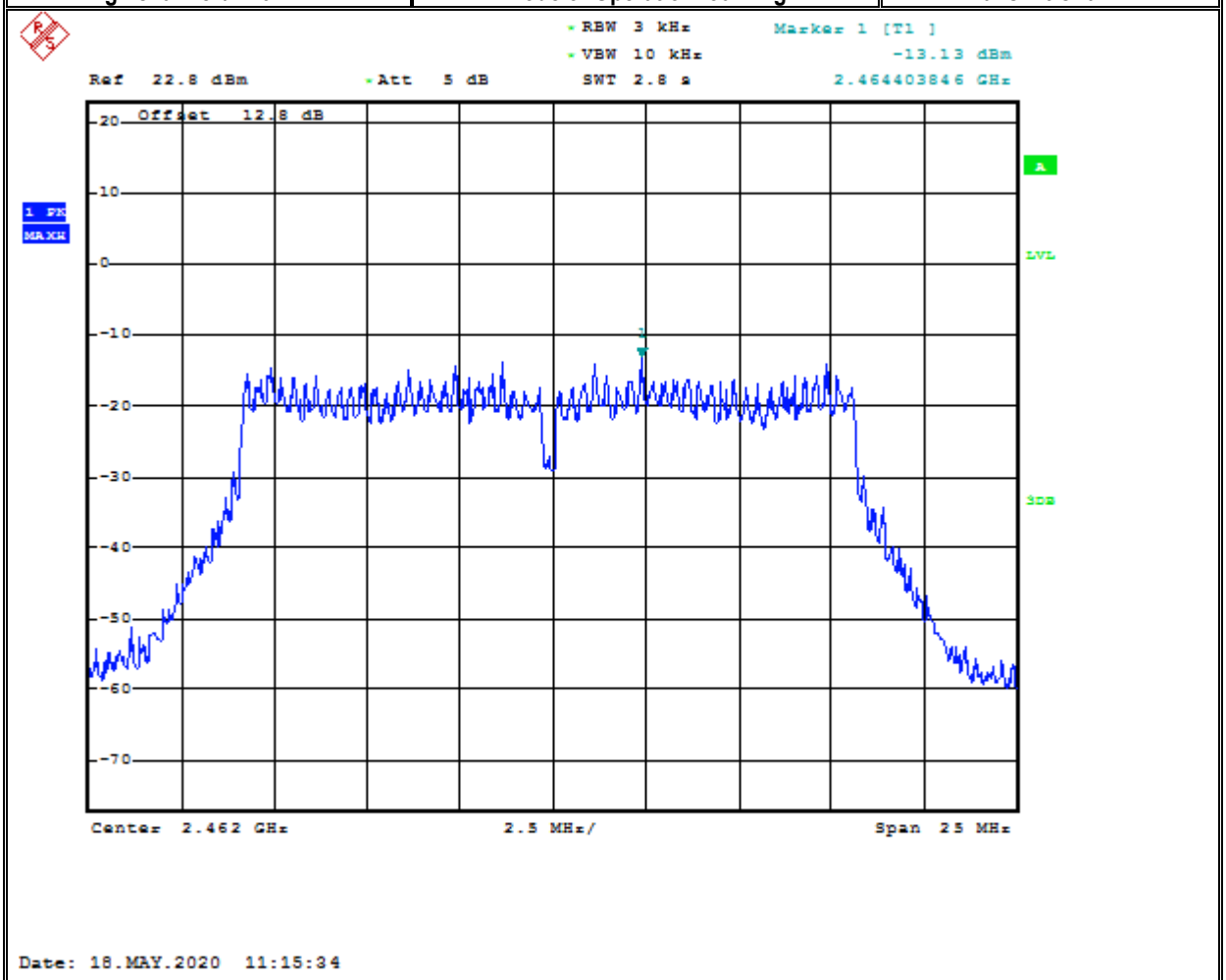
Plot #9		
Mid channel / 2437 MHz	Mode of Operation: 802.11g	Transmit Chain A



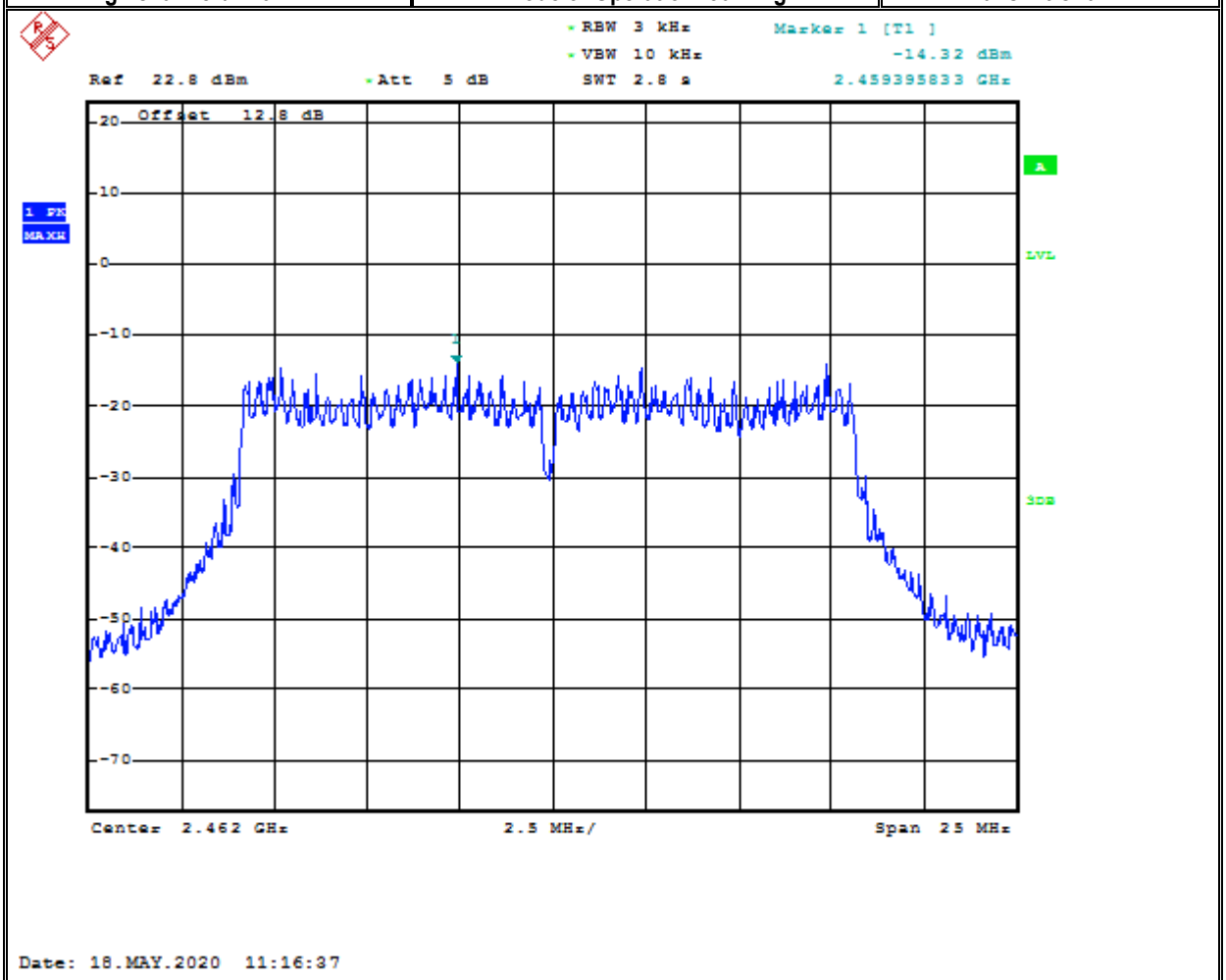
Plot #10		
Mid channel / 2437 MHz	Mode of Operation: 802.11g	Transmit Chain B



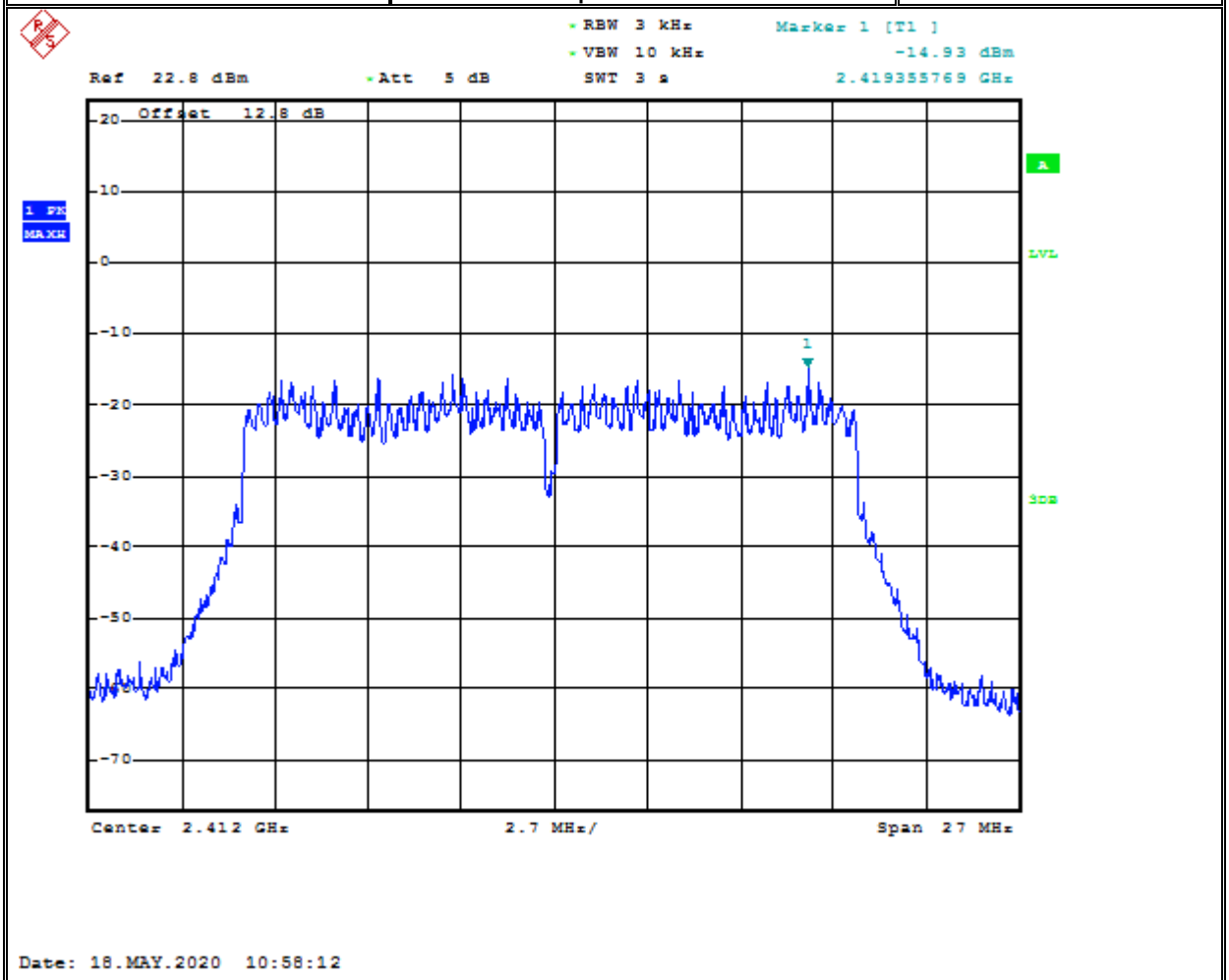
Plot #11		
High channel / 2462 MHz	Mode of Operation: 802.11g	Transmit Chain A



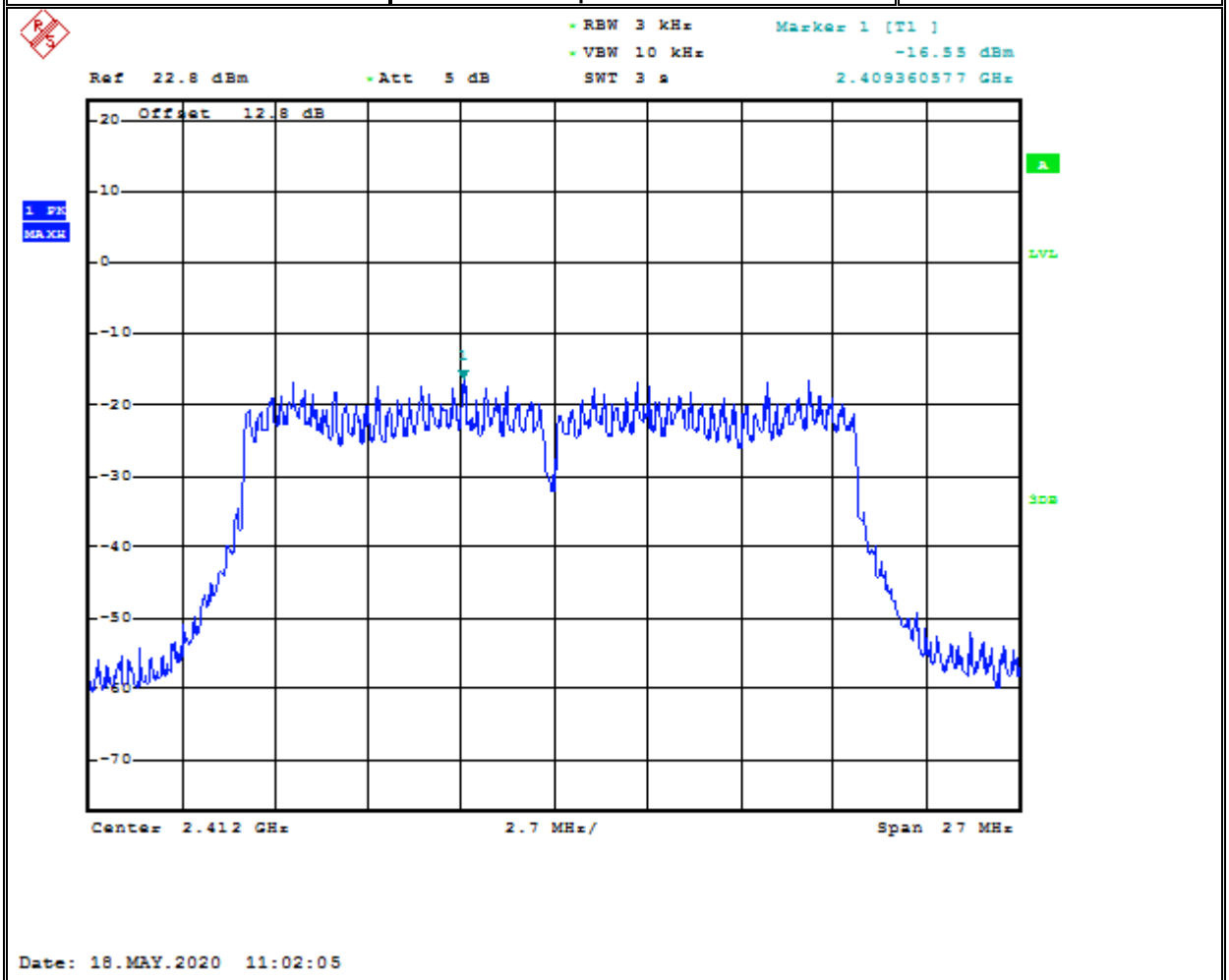
Plot #12		
High channel / 2462 MHz	Mode of Operation: 802.11g	Transmit Chain B



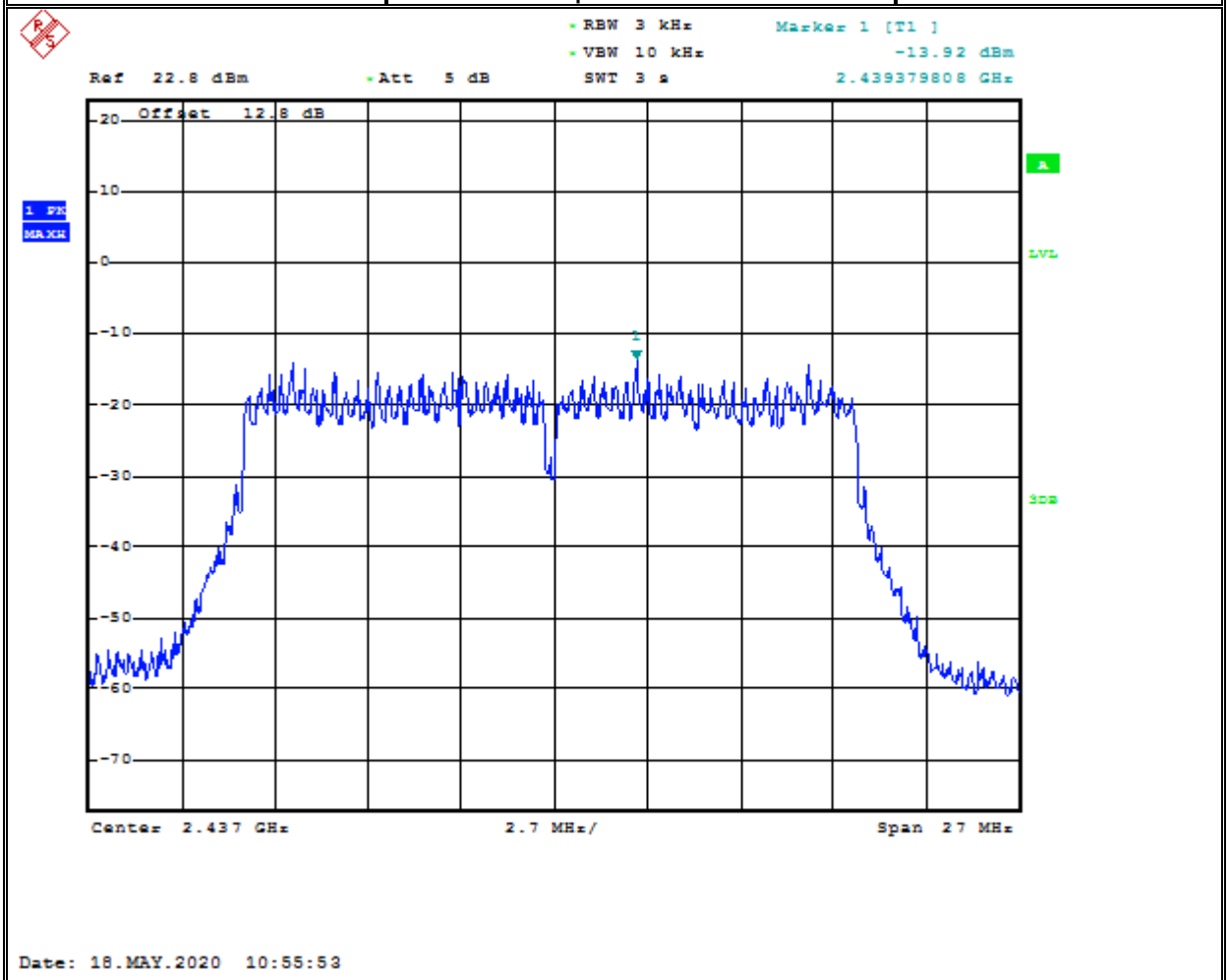
Plot #13		
Low channel / 2412 MHz	Mode of Operation: 802.11n HT20	Transmit Chain A



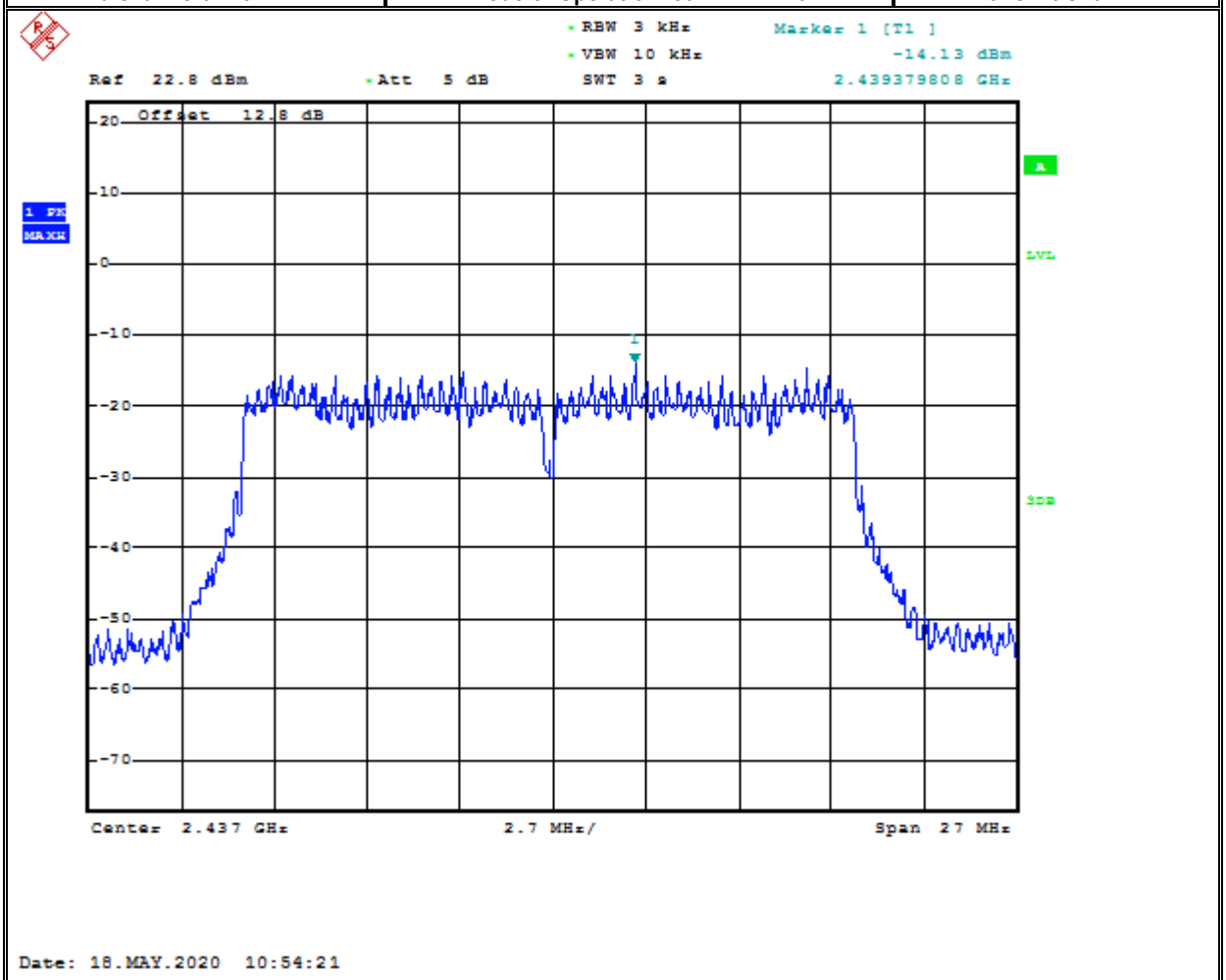
Plot #14		
Low channel / 2412 MHz	Mode of Operation: 802.11n HT20	Transmit Chain B



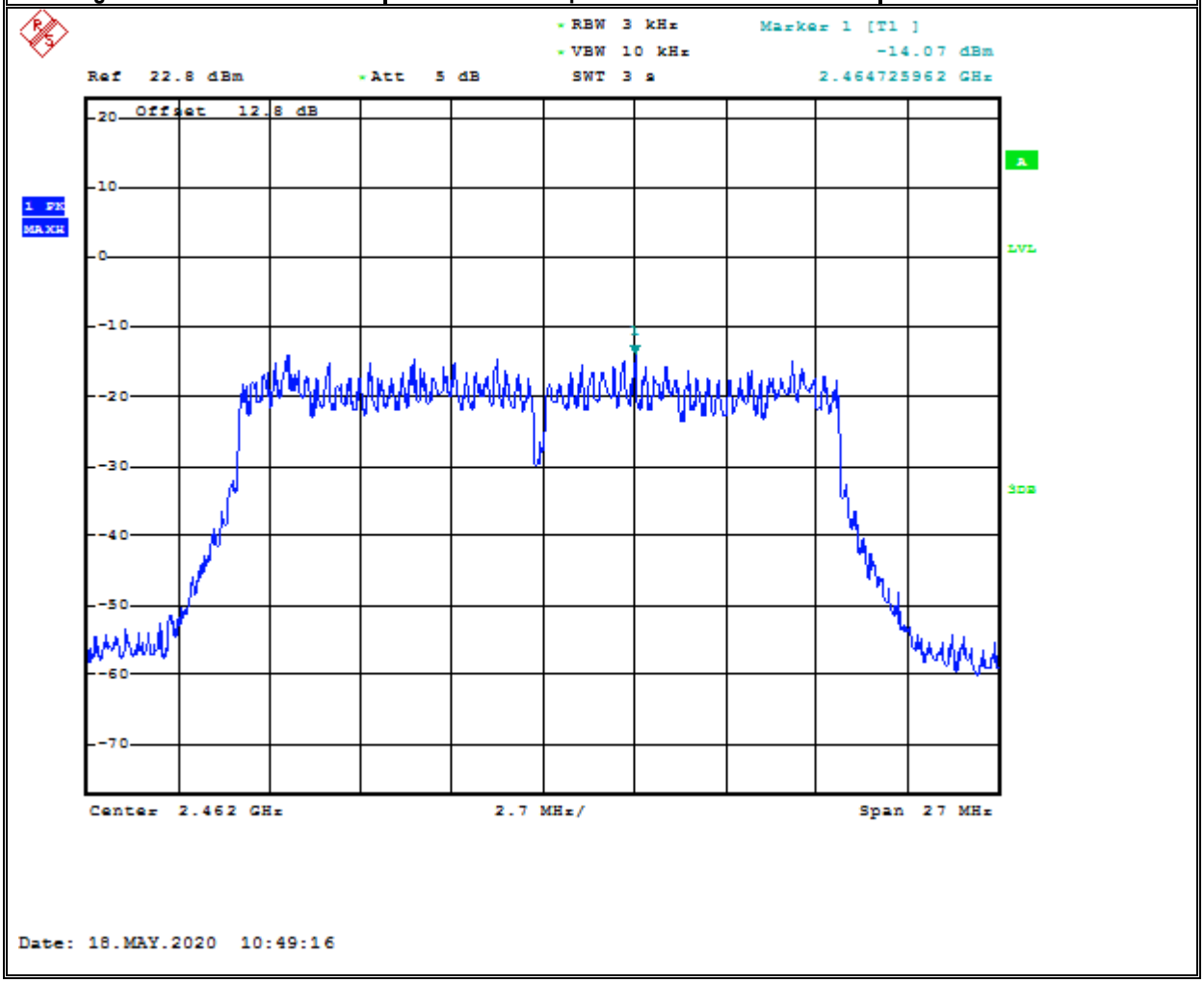
Plot #15		
Mid channel / 2437 MHz	Mode of Operation: 802.11n HT20	Transmit Chain A



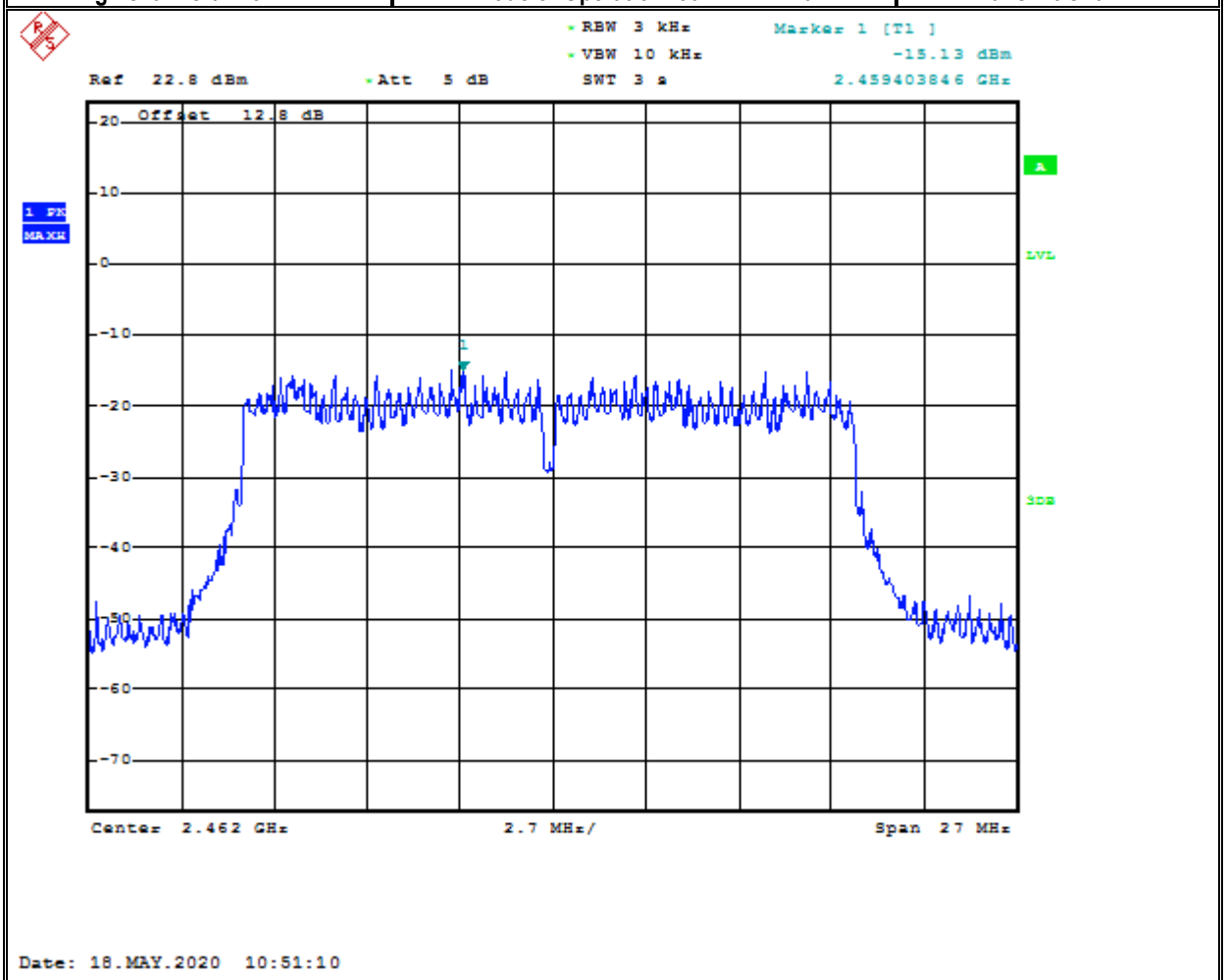
Plot #16		
Mid channel / 2437 MHz	Mode of Operation: 802.11n HT20	Transmit Chain B



Plot #17		
High channel / 2462 MHz	Mode of Operation: 802.11n HT20	Transmit Chain A



Plot #18		
High channel / 2462 MHz	Mode of Operation: 802.11n HT20	Transmit Chain B



8.3 Duty cycle

8.3.1 Measurement according to FCC 558074 D01 15.247 Meas Guidance v05r02

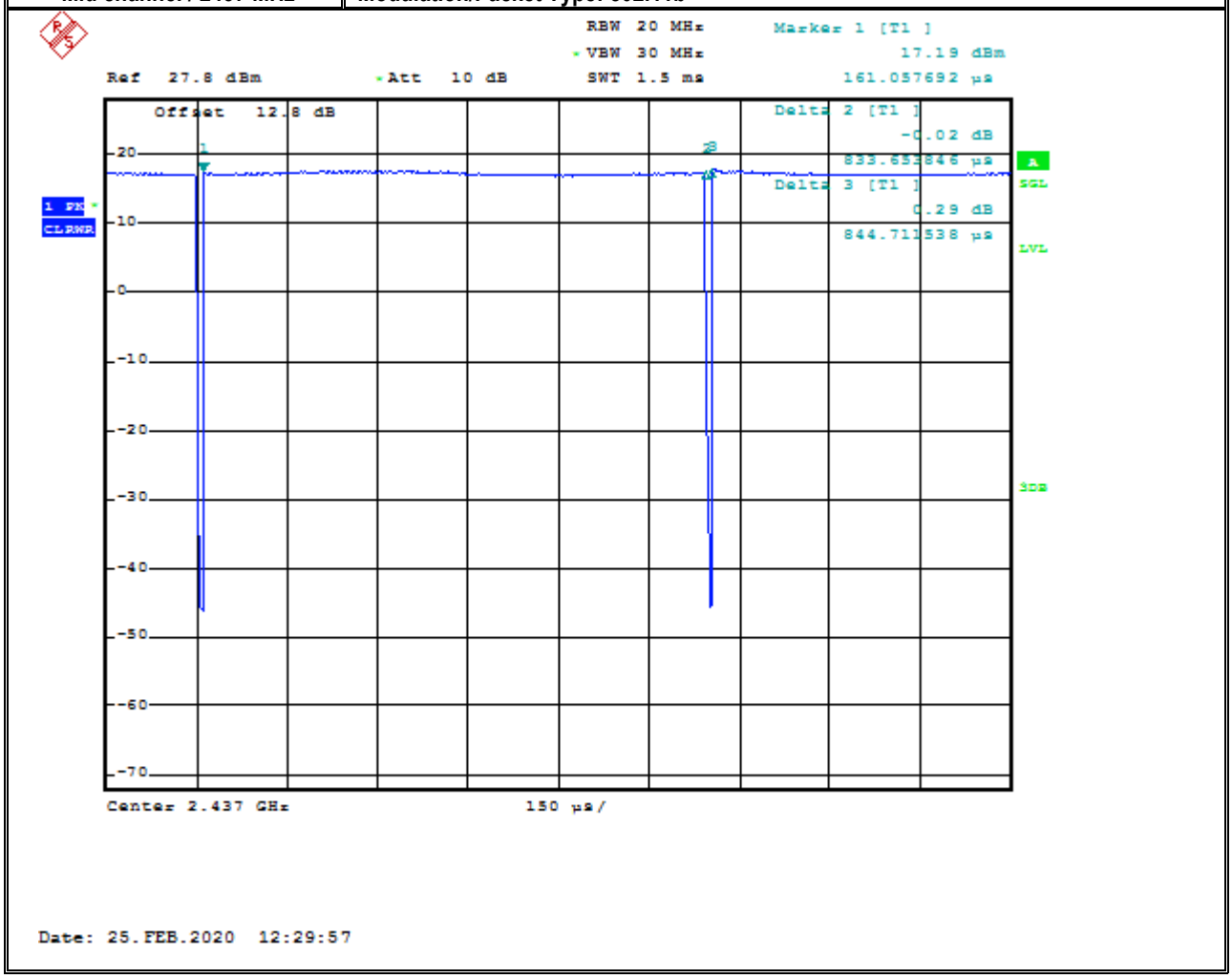
Spectrum Analyzer settings:

- Set the center frequency and of the instrument to the center frequency of the transmission
- Zero span
- Set RBW >=OBW if possible; otherwise, set RBW to the largest available value
- Detector = Peak or average

8.3.2 Measurement result

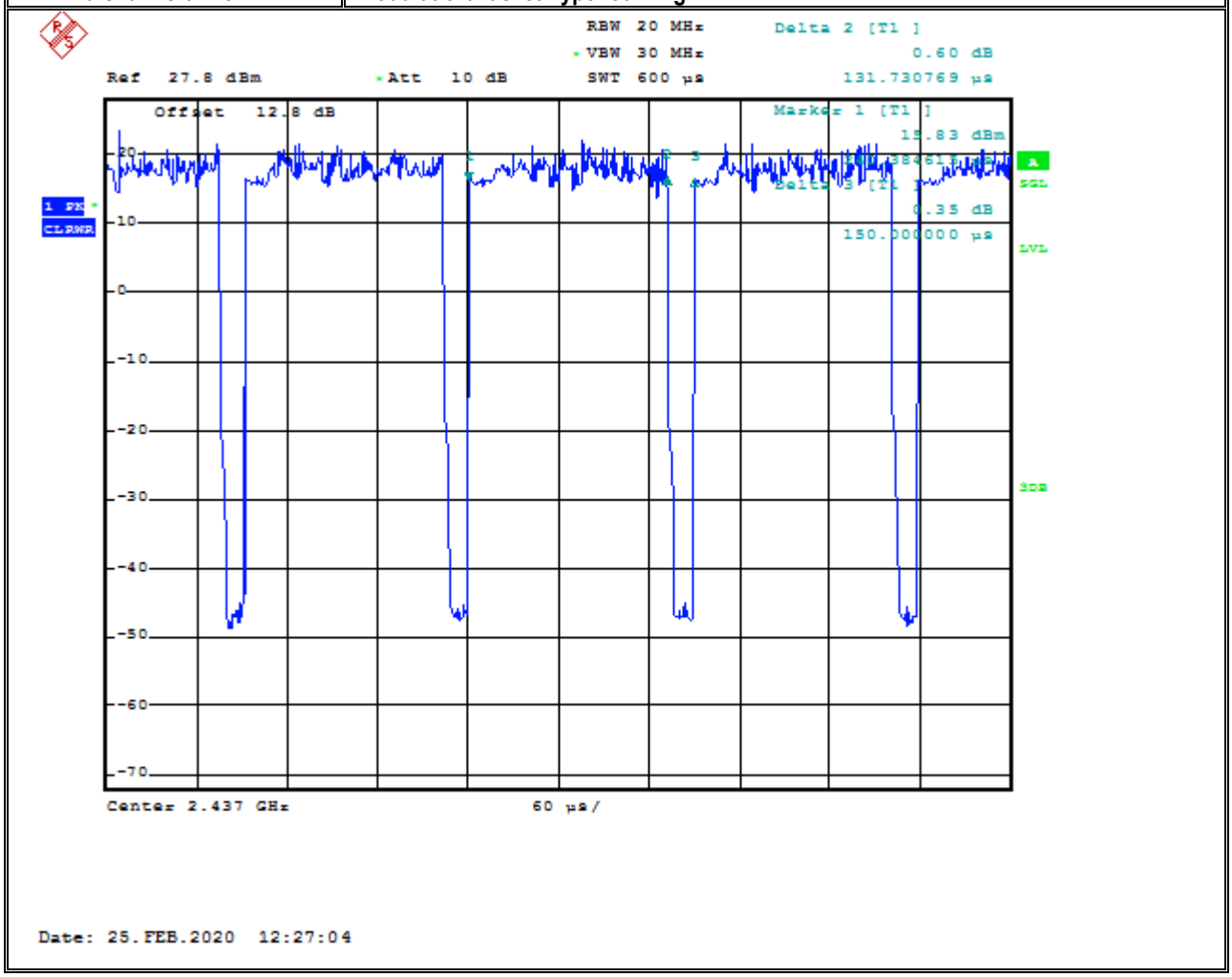
Note: All duty cycle measurements performed on chain A. Performance checks were done for Chain B and yielded identical results.

Duty cycle measurement	
Mid channel / 2437 MHz	**Modulation/Packet Type: 802.11b**



Duty cycle = 98.7%
Duty cycle correction factor = 10*log(1/0.987) = 0.06 dB

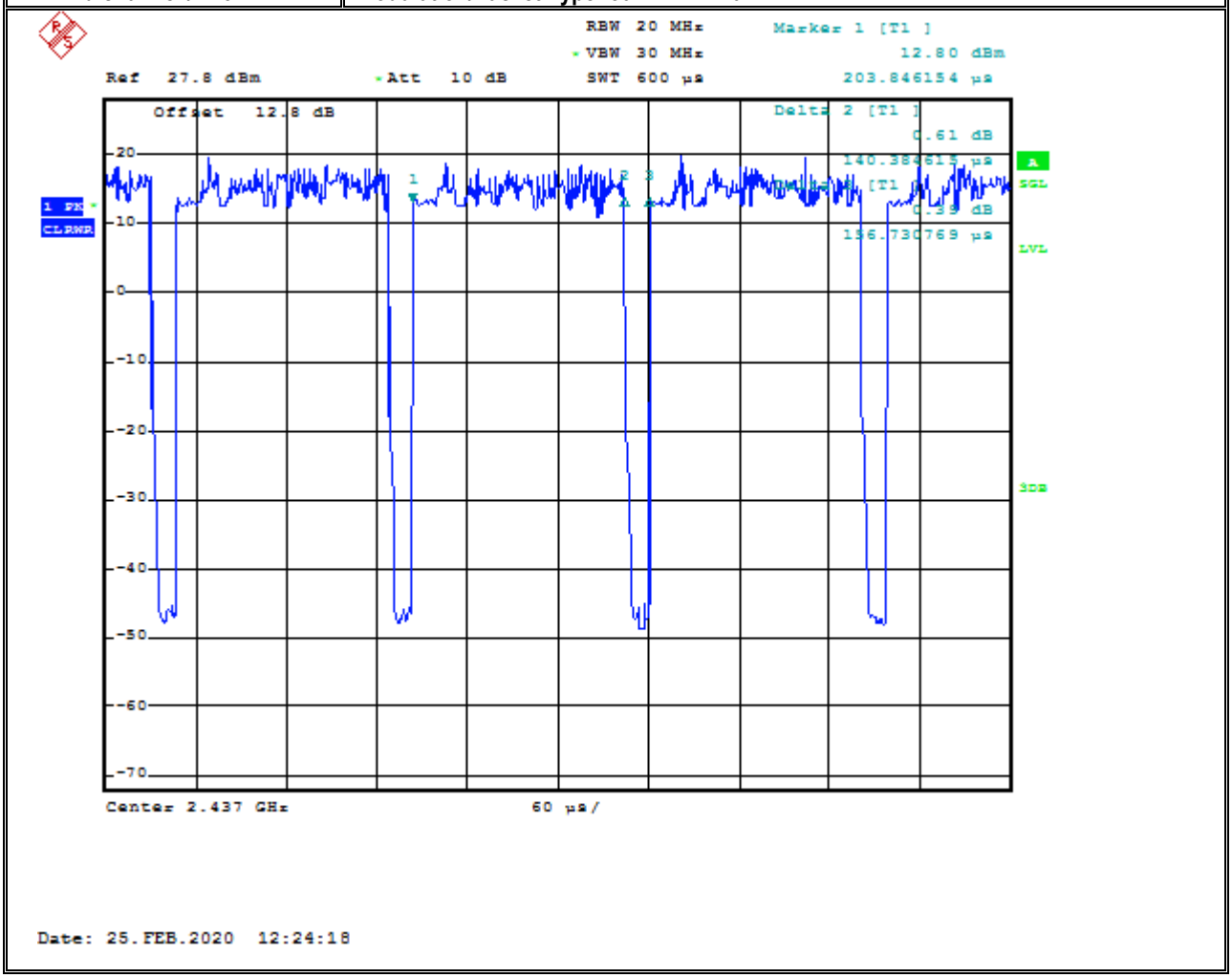
Duty cycle measurement	
Mid channel / 2437 MHz	Modulation/Packet Type: 802.11g



Duty cycle = 87.8%

Duty cycle correction factor = 10*log(1/0.878) = 0.57 dB

Duty cycle measurement	
Mid channel / 2437 MHz	Modulation/Packet Type: 802.11n HT20



Duty cycle = 89.6%

Duty cycle correction factor = 10*log(1/0.896) = 0.48 dB

8.4 Band Edge Compliance

8.4.1 Measurement according to FCC 558074 D01 15.247 Meas Guidance v05r02

Spectrum Analyzer settings for band edge:

- Set the center frequency and span to encompass frequency range to be measured
- RBW = 100 kHz
- VBW ≥ 3 x RBW
- Sweep Time: Auto couple
- Detector = Peak
- Trace = Max hold
- Allow trace to fully stabilize
- Use the peak marker function to determine the maximum amplitude level
- Set the marker on the emission at the band edge, or on the highest modulation product outside of the band, if this level is greater than that at the band edge

8.4.2 Limits non restricted band:

FCC§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, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

RSS-247 5/5

- In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30dB instead of 20dB.

Spectrum Analyzer settings for restricted band:

- Peak measurements are made using a peak detector and RBW=1 MHz

8.4.3 Limits restricted band §15.247/15.209/15.205 and RSS-Gen 8.9/8.10

- *PEAK LIMIT= 74 dBµV/m @3m =-21.23 dBm
- *AVG. LIMIT= 54 dBµV/m @3m =-41.23 dBm
- Start frequency & stop frequency according to frequency range specified in the restricted band table in FCC section 15.205 & RSS-Gen 8.10
- Measurements with a peak detector were used to show compliance to average limits, thus showing compliance to both peak and average limits.

(a) Except as shown in paragraph (d) of this section, 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	Above 38.6
13.36-13.41			

8.4.4 Test conditions and setup:

Non-Restricted Band:

Ambient Temperature	EUT Set-Up #	EUT operating mode	Power Input	Antenna Gain
23.8°C	1	802.11b,g,n	12 VDC	3.7 dBi

Restricted Band:

Ambient Temperature	EUT Set-Up #	EUT operating mode	Power Input	Antenna Gain
23.8°C	2	802.11b,g,n	12 VDC	3.7 dBi

8.4.5 Measurement result:

Plot #	EUT operating mode	Band Edge	Band Edge Delta Chain A (dBc)	Band Edge Delta Chain B (dBc)	Limit (dBc)	Result
1-2	802.11b	Lower, Non-restricted	45.19	44.14	30	Pass
3-4	802.11g	Lower, Non-restricted	33.58	30.32	30	Pass
5-6	802.11n HT20	Lower, Non-restricted	35.49	34.32	30	Pass

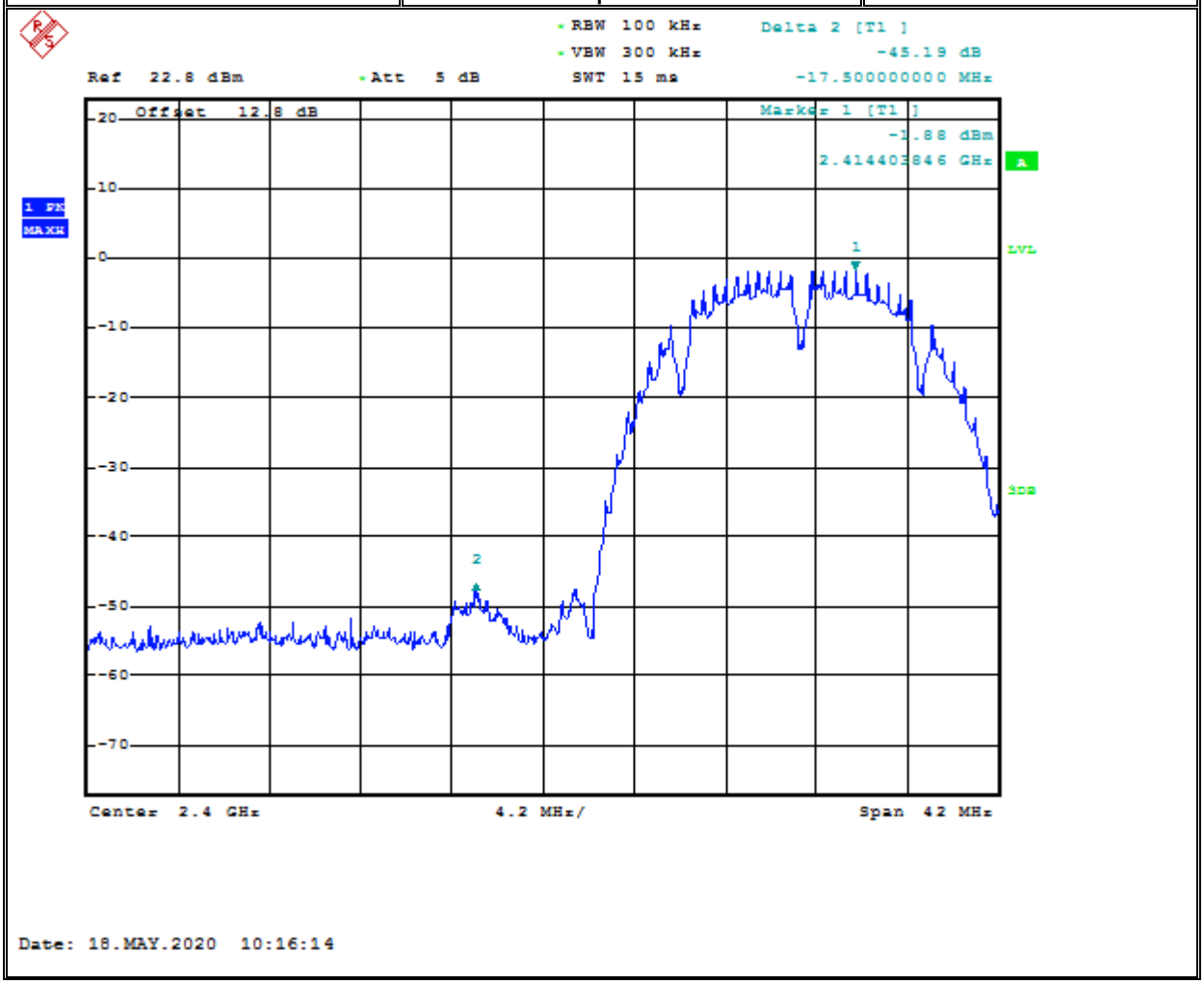
Note: Non-restricted band measurements were performed using conducted method.

Plot #	EUT operating mode	Band Edge	Measured Peak Value (dBµV/m)	Measured Average Value (dBµV/m)	Limit (dBµV/m)	Result
7	802.11b	Lower Restricted Peak and Average	58.01	52.68	See section 8.4.3	Pass
8	802.11g	Lower Restricted Peak and Average	73.14	50.28	See section 8.4.3	Pass
9	802.11n HT20	Lower Restricted Peak and Average	69.58	46.75	See section 8.4.3	Pass
10	802.11b	Upper Restricted Peak and Average	54.57	46.98	See section 8.4.3	Pass
11	802.11g	Upper Restricted Peak and Average	70.74	46.72	See section 8.4.3	Pass
12	802.11n HT20	Upper Restricted Peak and Average	73.78	48.15	See section 8.4.3	Pass

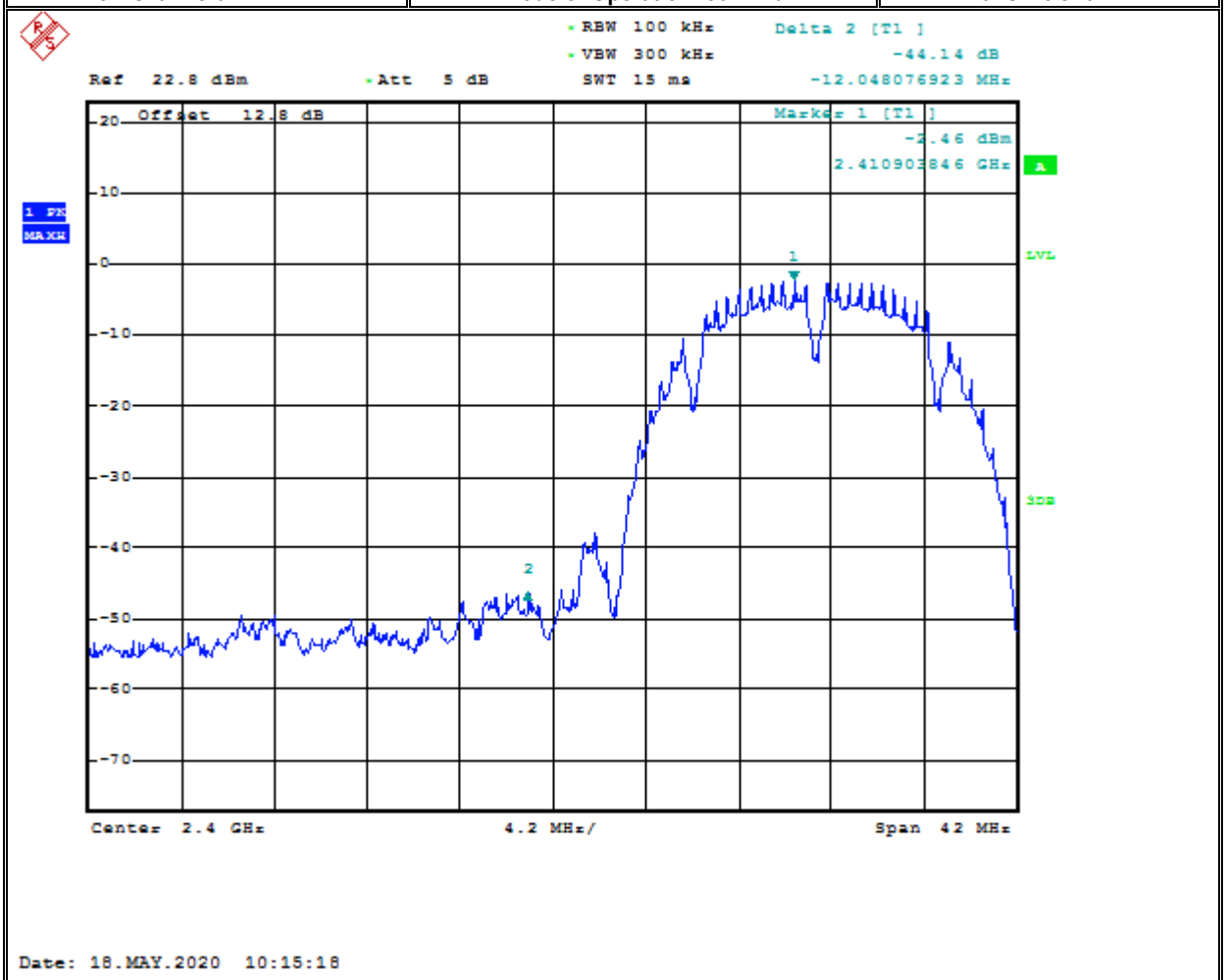
Note: Restricted band peak and average measurements were performed using radiated method.
Both antenna chains (A and B) are transmitting simultaneously for all operating modes.

8.4.6 Measurement Plots:

Plot #1		
Low channel / 2412 MHz	Mode of Operation: 802.11b	Transmit Chain A

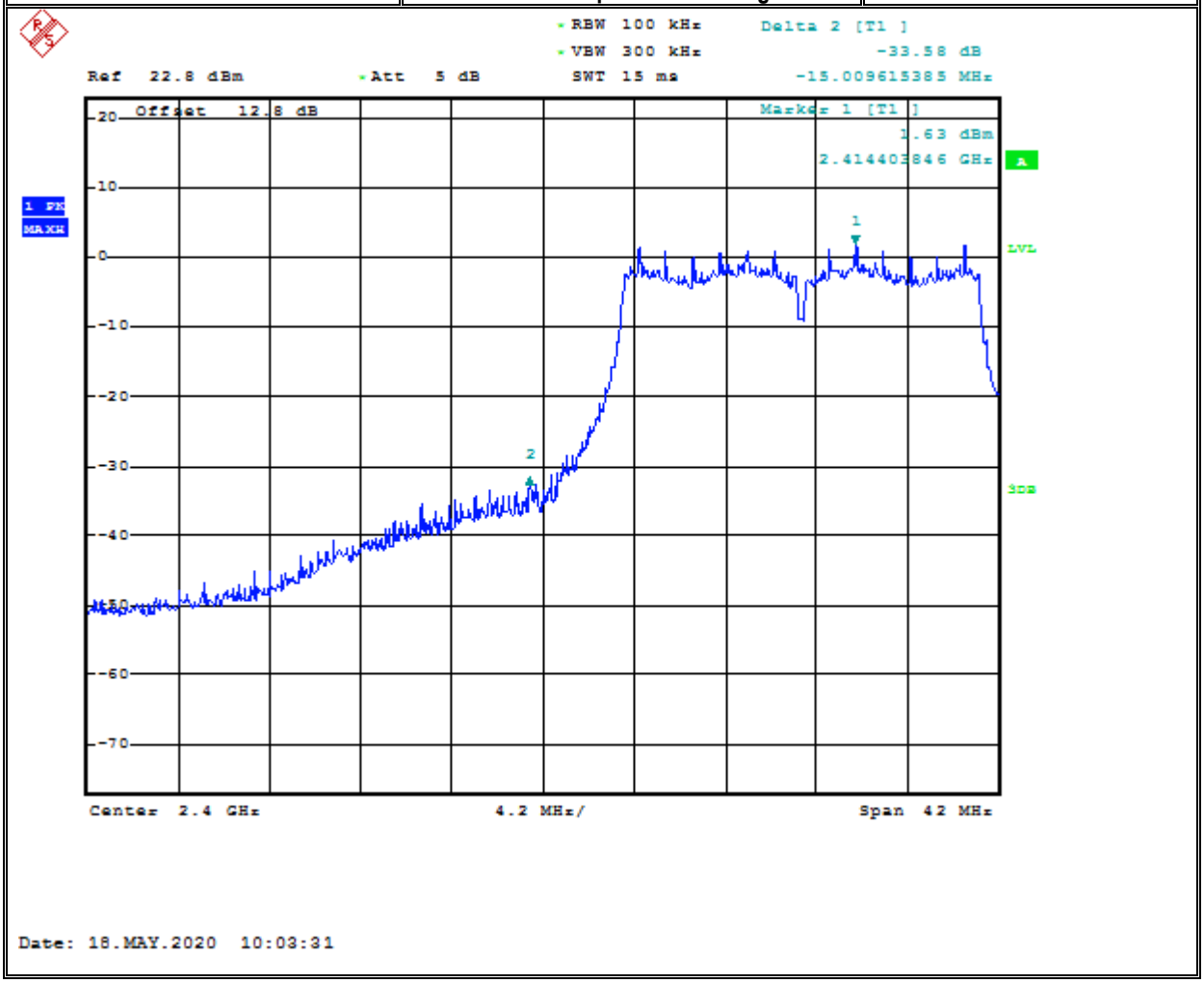


Plot #2		
Low channel / 2412 MHz	Mode of Operation: 802.11b	Transmit Chain B

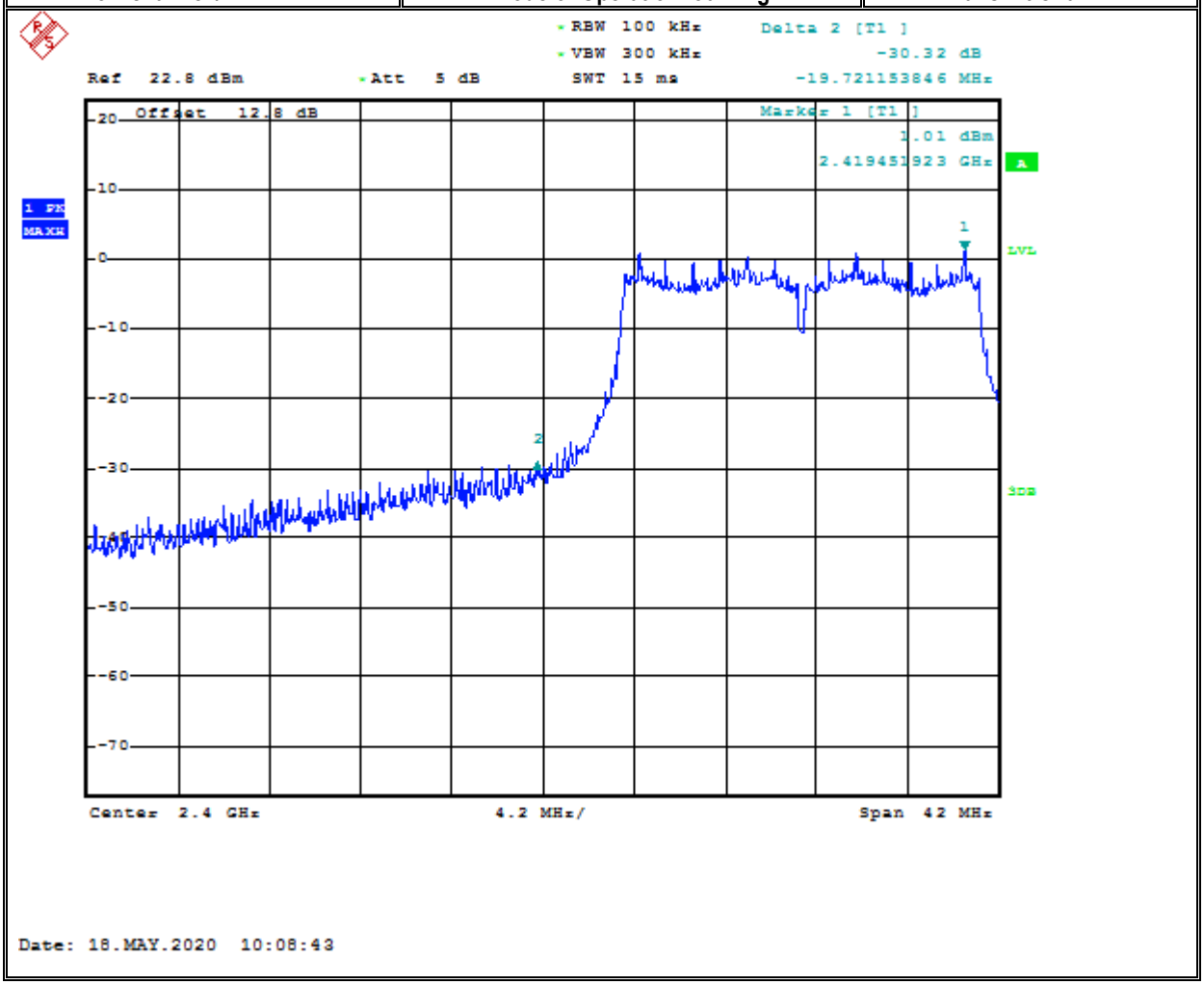


Plot #3

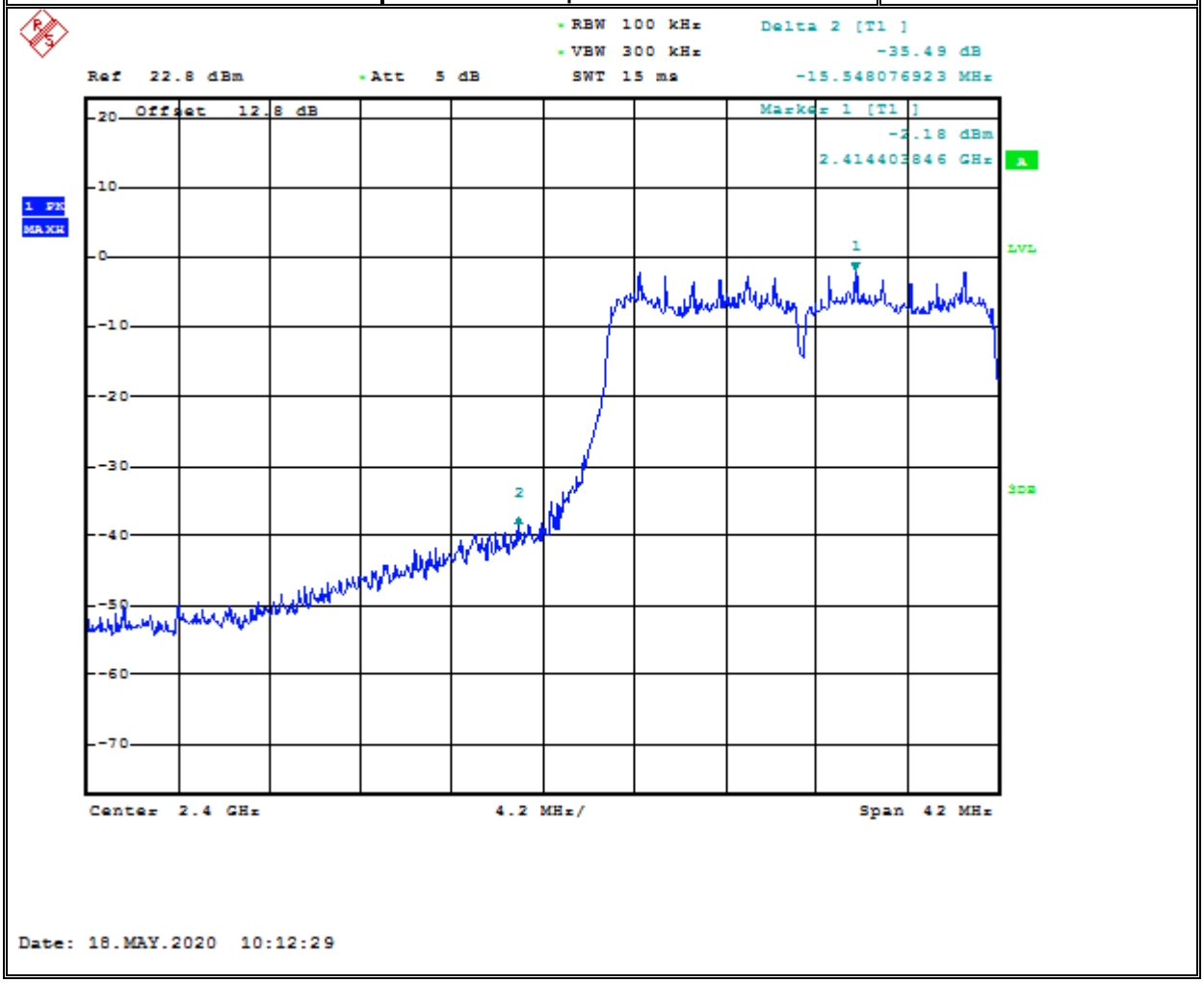
Low channel / 2412 MHz	Mode of Operation: 802.11g	Transmit Chain A



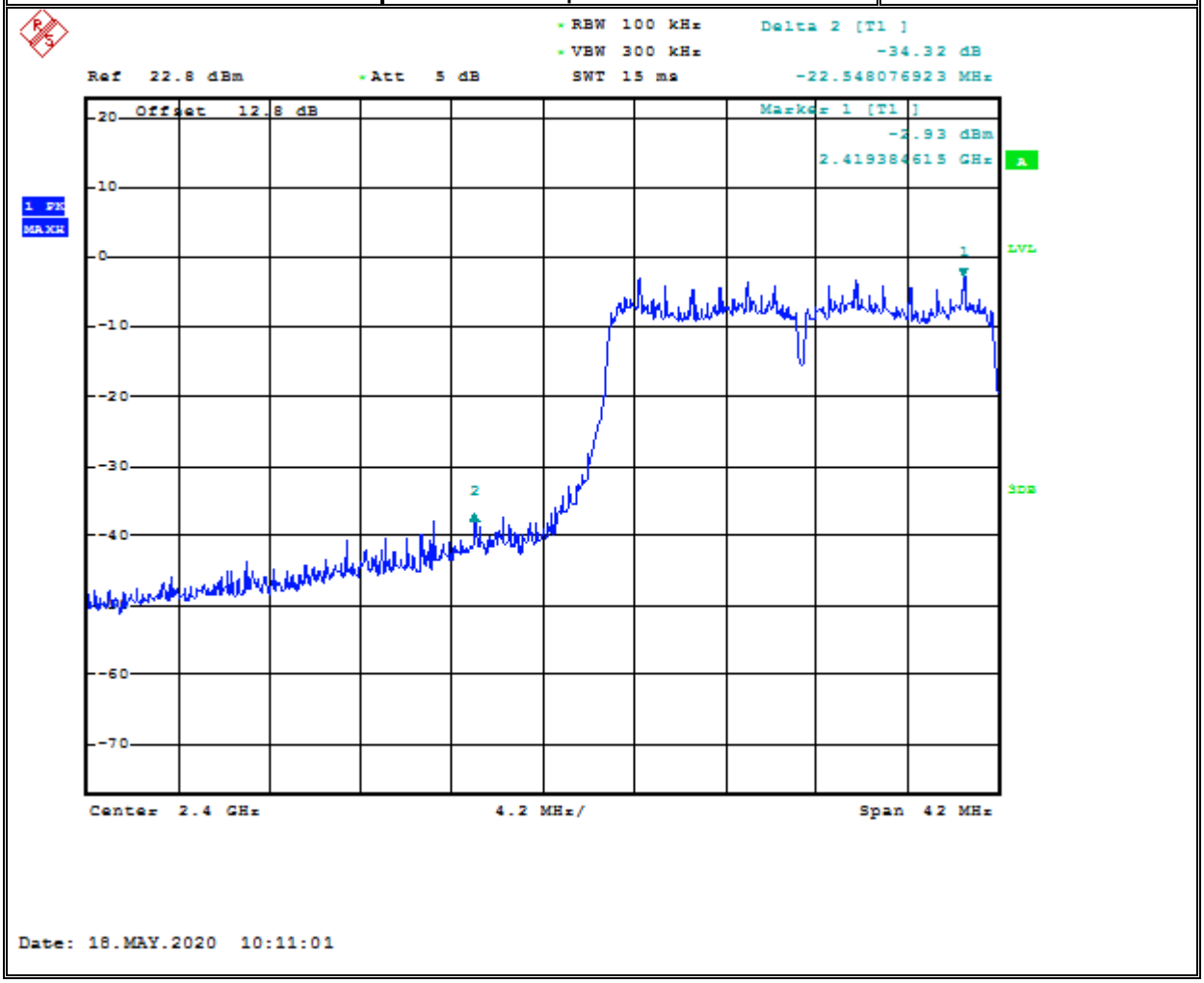
Plot #4		
Low channel / 2412 MHz	Mode of Operation: 802.11g	Transmit Chain B



Plot #5		
Low channel / 2412 MHz	Mode of Operation: 802.11n HT20	Transmit Chain A



Plot #6		
Low channel / 2412 MHz	Mode of Operation: 802.11n HT20	Transmit Chain B



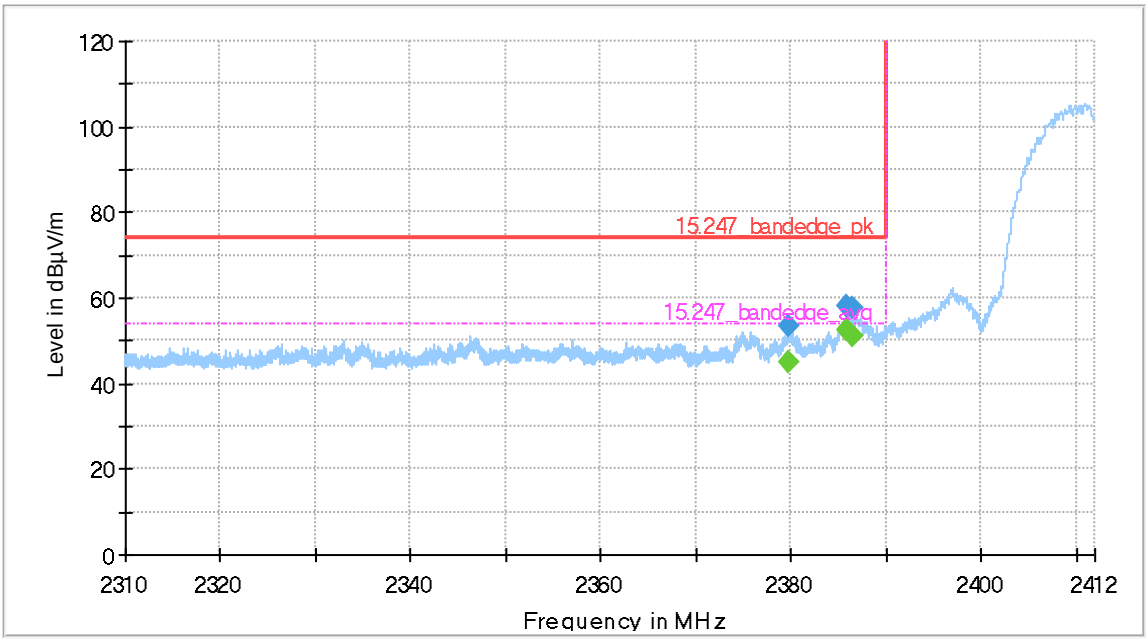
Plot #7

Low channel 2412 MHz	Mode of Operation: 802.11b

Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
2379.810	---	45.22	54.00	8.78	200.0	1000.000	293.0	H
2379.810	53.27	---	74.00	20.73	200.0	1000.000	293.0	H
2385.913	---	52.68	54.00	1.32	200.0	1000.000	229.0	H
2385.913	58.01	---	74.00	15.99	200.0	1000.000	229.0	H
2386.406	---	51.07	54.00	2.93	200.0	1000.000	254.0	H
2386.406	57.58	---	74.00	16.42	200.0	1000.000	254.0	H

Frequency (MHz)	Azimuth (deg)	Corr. (dB/m)
2379.810	261.0	0.6
2379.810	261.0	0.6
2385.913	273.0	0.6
2385.913	273.0	0.6
2386.406	272.0	0.6
2386.406	272.0	0.6



Preview Result 1-PK+ 15.247_bandedge_pk 15.247_bandedge_avg
Final_Result PK+ Final_Result AVG

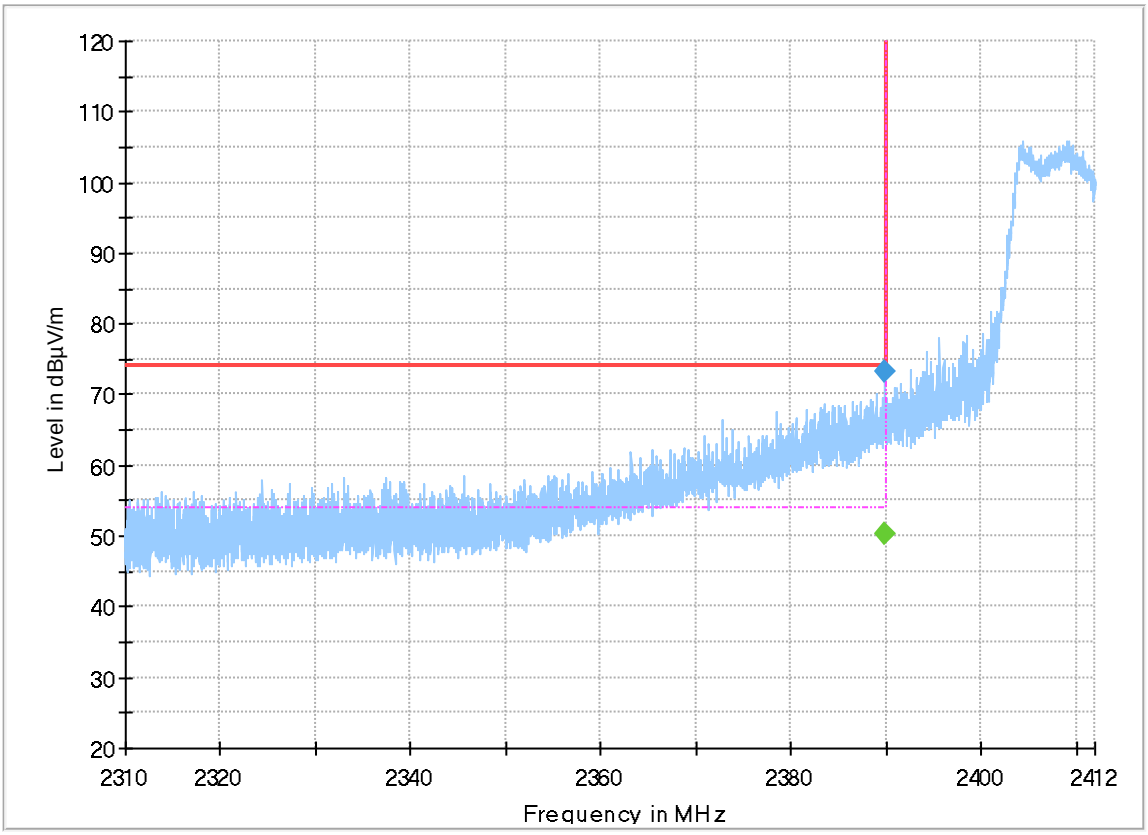
Plot #8

Low channel 2412 MHz	Mode of Operation: 802.11g

Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
2389.955	---	50.28	54.00	3.72	500.0	1000.000	232.0	H
2389.955	73.14	---	74.00	0.86	500.0	1000.000	232.0	H

Frequency (MHz)	Azimuth (deg)	Corr. (dB/m)
2389.955	290.0	-0.7
2389.955	290.0	-0.7



Preview Result 1-PK+ | 15.247_bandedge_pk | 15.247_bandedge_avg
Final_Result PK+ | Final_Result AVG

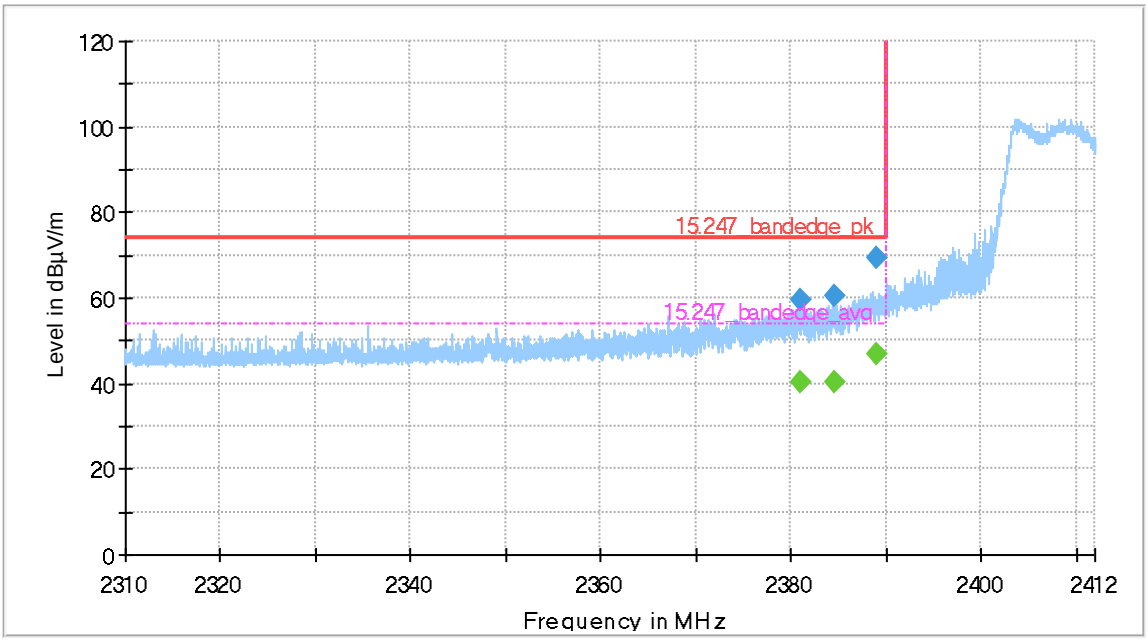
Plot #9

Low channel 2412 MHz	Mode of Operation: 802.11n HT20

Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
2380.994	---	40.52	54.00	13.48	200.0	1000.000	259.0	H
2380.994	59.32	---	74.00	14.68	200.0	1000.000	259.0	H
2384.644	---	40.18	54.00	13.82	200.0	1000.000	298.0	H
2384.644	60.28	---	74.00	13.72	200.0	1000.000	298.0	H
2389.061	---	46.75	54.00	7.25	200.0	1000.000	325.0	H
2389.061	69.58	---	74.00	4.42	200.0	1000.000	325.0	H

Frequency (MHz)	Azimuth (deg)	Corr. (dB/m)	Comment
2380.994	-31.0	0.6	
2380.994	-31.0	0.6	
2384.644	55.0	0.6	
2384.644	55.0	0.6	
2389.061	266.0	0.6	
2389.061	266.0	0.6	



Preview Result 1-PK+ | 15.247_bandedge_pk | 15.247_bandedge_avg
Final_Result PK+ | Final_Result AVG

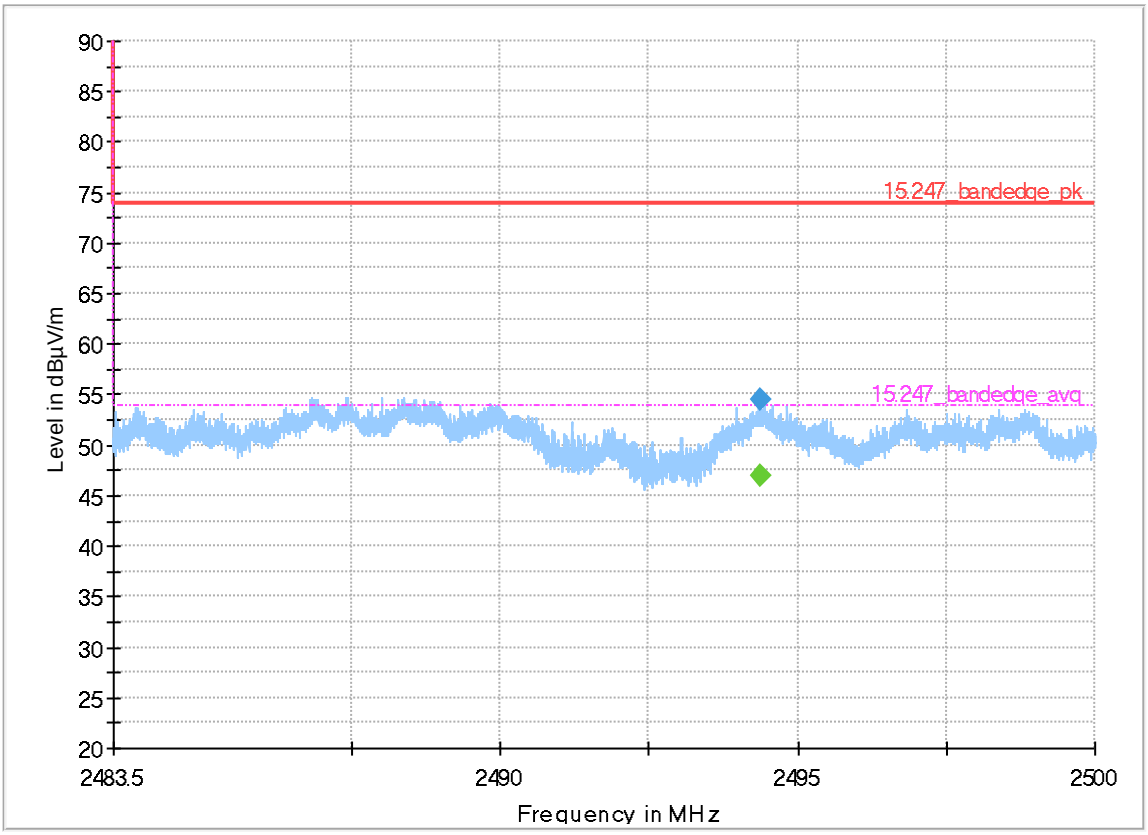
Plot #10

High channel 2462 MHz	Mode of Operation: 802.11b

Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
2494.365	---	46.98	54.00	7.02	200.0	1000.000	215.0	H
2494.365	54.57	---	74.00	19.43	200.0	1000.000	215.0	H

Frequency (MHz)	Azimuth (deg)	Corr. (dB/m)
2494.365	101.0	1.2
2494.365	101.0	1.2



Preview Result 1-PK+ | 15.247_bandedge_pk | 15.247_bandedge_avg
Final_Result PK+ | Final_Result AVG

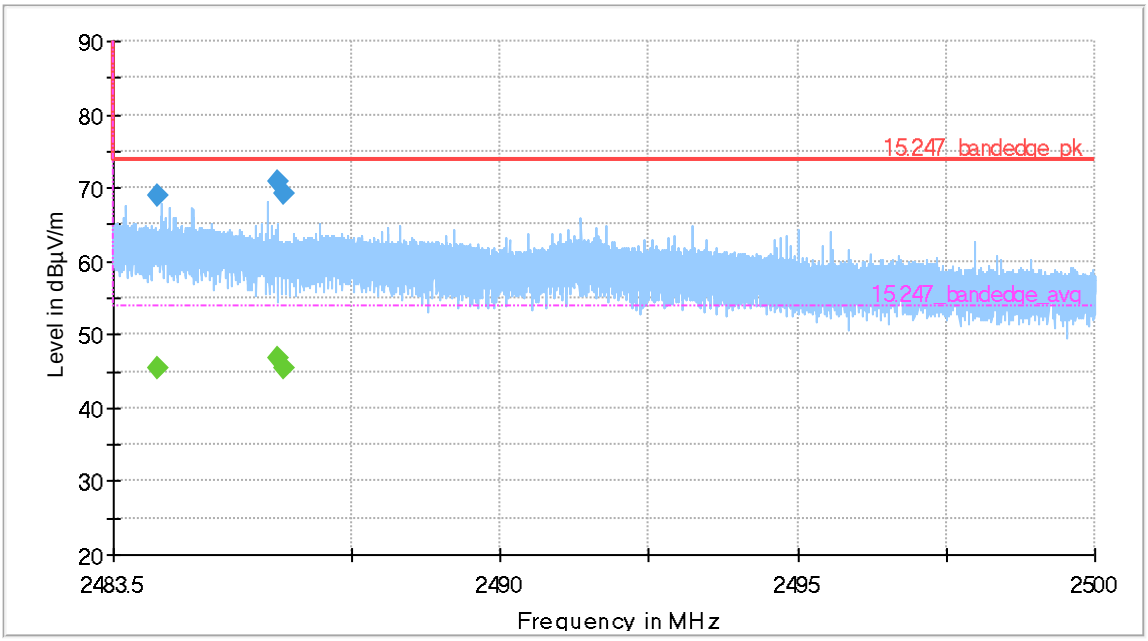
Plot #11

High channel 2462 MHz	Mode of Operation: 802.11g

Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
2484.236	---	45.39	54.00	8.61	200.0	1000.000	172.0	H
2484.236	69.04	---	74.00	4.96	200.0	1000.000	172.0	H
2486.270	---	46.72	54.00	7.29	200.0	1000.000	315.0	H
2486.270	70.74	---	74.00	3.26	200.0	1000.000	315.0	H
2486.359	---	45.33	54.00	8.67	200.0	1000.000	226.0	H
2486.359	69.21	---	74.00	4.79	200.0	1000.000	226.0	H

Frequency (MHz)	Azimuth (deg)	Corr. (dB/m)
2484.236	68.0	1.1
2484.236	68.0	1.1
2486.270	292.0	1.1
2486.270	292.0	1.1
2486.359	284.0	1.1
2486.359	284.0	1.1



Preview Result 1-PK+ 15.247_bandedge_pk 15.247_bandedge_avg
Final_Result PK+ Final_Result AVG

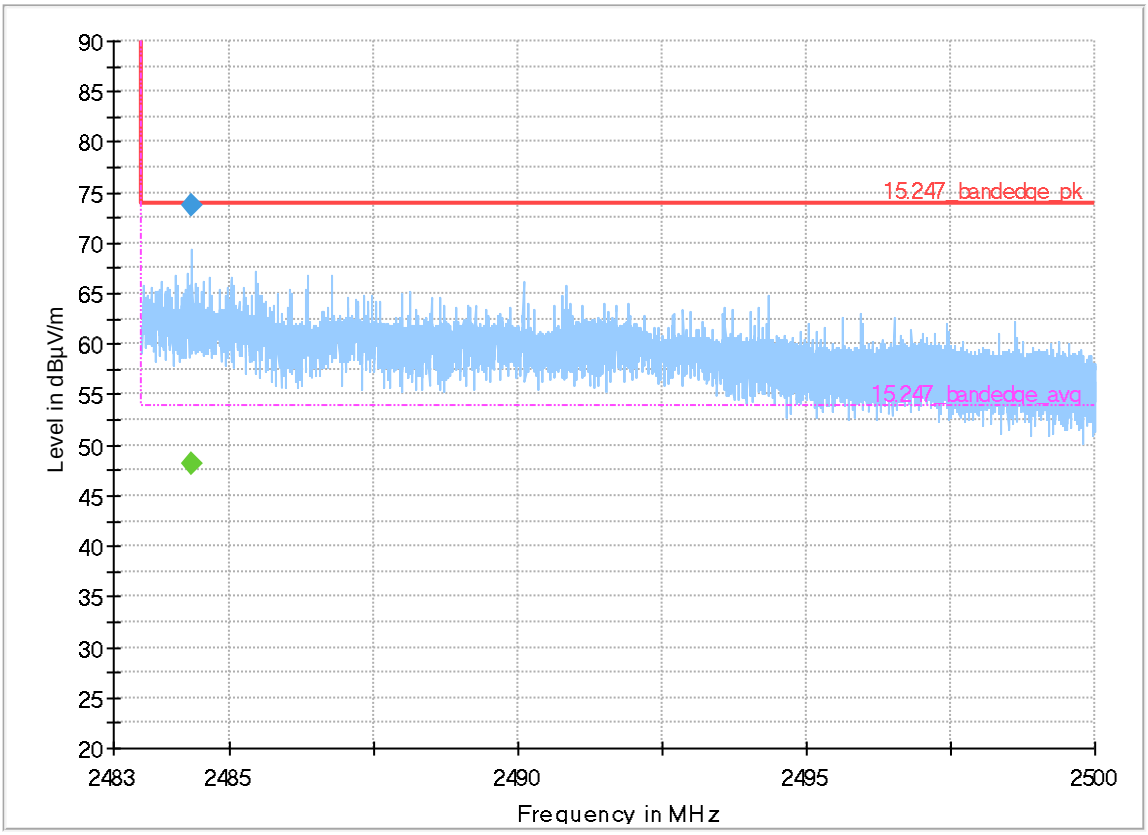
Plot #12

High channel 2462 MHz	Mode of Operation: 802.11n HT20

Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
2484.350	---	48.15	54.00	5.85	500.0	1000.000	168.0	H
2484.350	73.78	---	74.00	0.22	500.0	1000.000	168.0	H

Frequency (MHz)	Azimuth (deg)	Corr. (dB/m)
2484.350	55.0	-0.2
2484.350	55.0	-0.2



Preview Result 1-PK+ 15.247_bandedge_pk 15.247_bandedge_avg
Final_Result PK+ Final_Result AVG

8.5 Emission Bandwidth 6dB and 99% Occupied Bandwidth

8.5.1 Measurement according to FCC 558074 D01 15.247 Meas Guidance v05r02

Spectrum Analyzer settings:

- Set RBW = 100 kHz
- Set the video bandwidth (VBW) ≥ 3 x RBW
- Detector = Peak
- Trace mode = Max hold
- Sweep = Auto couple
- Allow the trace to stabilize
- Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

8.5.2 Limits:

FCC §15.247(a)(1) and RSS-247 5.2(1)

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

8.5.3 Test conditions and setup:

Ambient Temperature	EUT Set-Up #	EUT operating mode	Power Input
23.8°C	1	802.11b,g,n	12 VDC

8.5.4 Measurement result:

Plot #	Frequency (MHz)	EUT Operating Mode	6dB Emission Bandwidth (MHz)	Limit (MHz)	Result
1	2412	802.11b	10.0810	> 0.5	Pass
2	2437	802.11b	10.0396	> 0.5	Pass
3	2462	802.11b	10.0480	> 0.5	Pass
4	2412	802.11g	16.4422	> 0.5	Pass
5	2437	802.11g	16.3432	> 0.5	Pass
6	2462	802.11g	16.3432	> 0.5	Pass
7	2412	802.11n HT20	17.5962	> 0.5	Pass
8	2437	802.11n HT20	17.5783	> 0.5	Pass
9	2462	802.11n HT20	17.5480	> 0.5	Pass

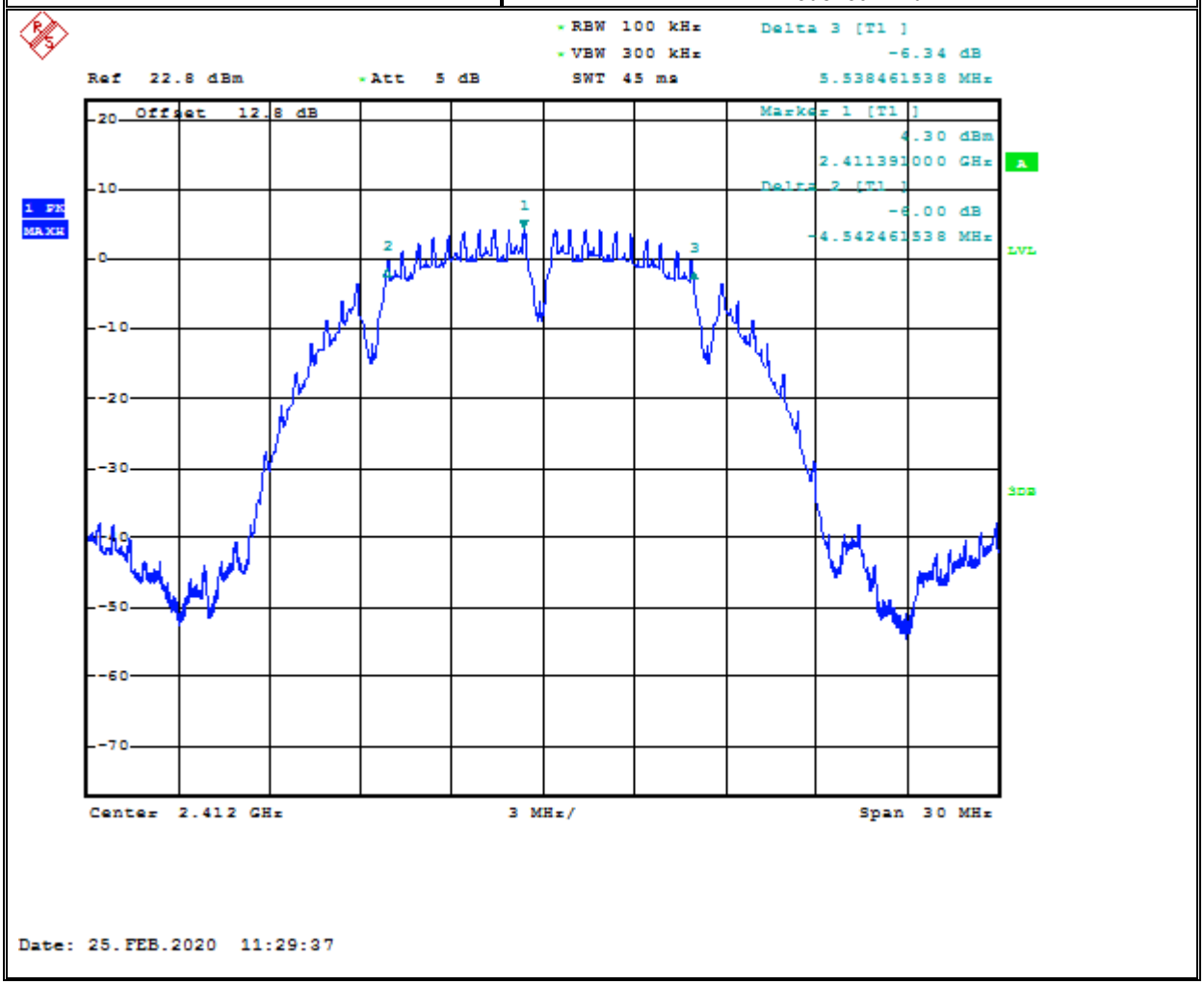
Plot #	Frequency (MHz)	EUT Operating Mode	99% Occupied Bandwidth (MHz)	Limit (MHz)	Result
10	2412	802.11b	13.5096	> 0.5	Pass
11	2437	802.11b	13.5096	> 0.5	Pass
12	2462	802.11b	13.5096	> 0.5	Pass
13	2412	802.11g	16.4904	> 0.5	Pass
14	2437	802.11g	16.4904	> 0.5	Pass
15	2462	802.11g	16.4904	> 0.5	Pass
16	2412	802.11n HT20	17.5962	> 0.5	Pass
17	2437	802.11n HT20	17.6442	> 0.5	Pass
18	2462	802.11n HT20	17.6442	> 0.5	Pass

Note: All bandwidth measurements performed on chain A. According to ANSI C63.10 (2013) Section 5.6.2.1, for multiple-input multiple-output (MIMO) systems, if the measured channel bandwidth on testing the middle channel exceeds the minimum permitted bandwidth by more than 50% on one transmit chain, then it is not necessary to repeat testing on the other chain.

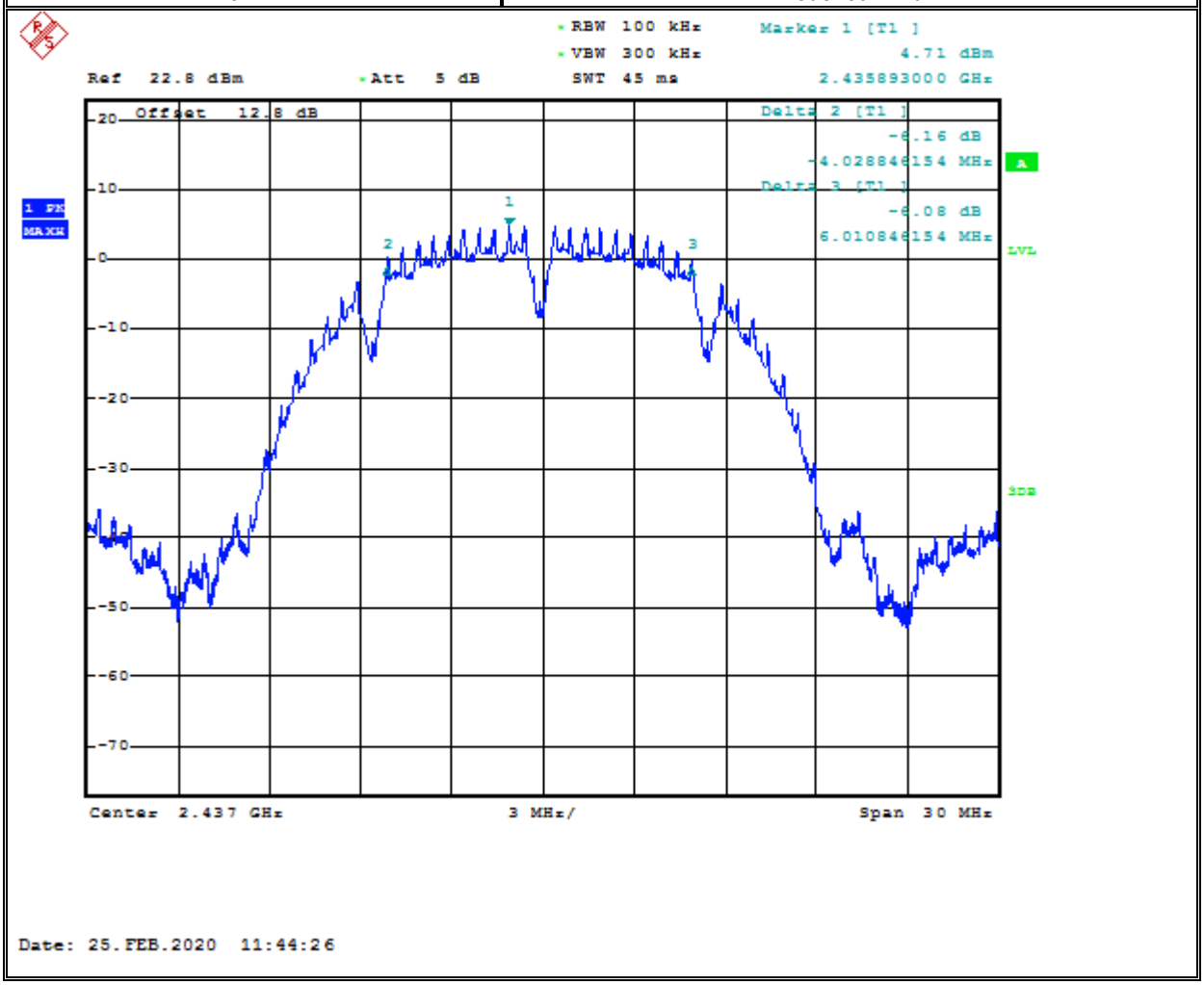
8.5.5 Measurement Plots:

6 dB Emission Bandwidth

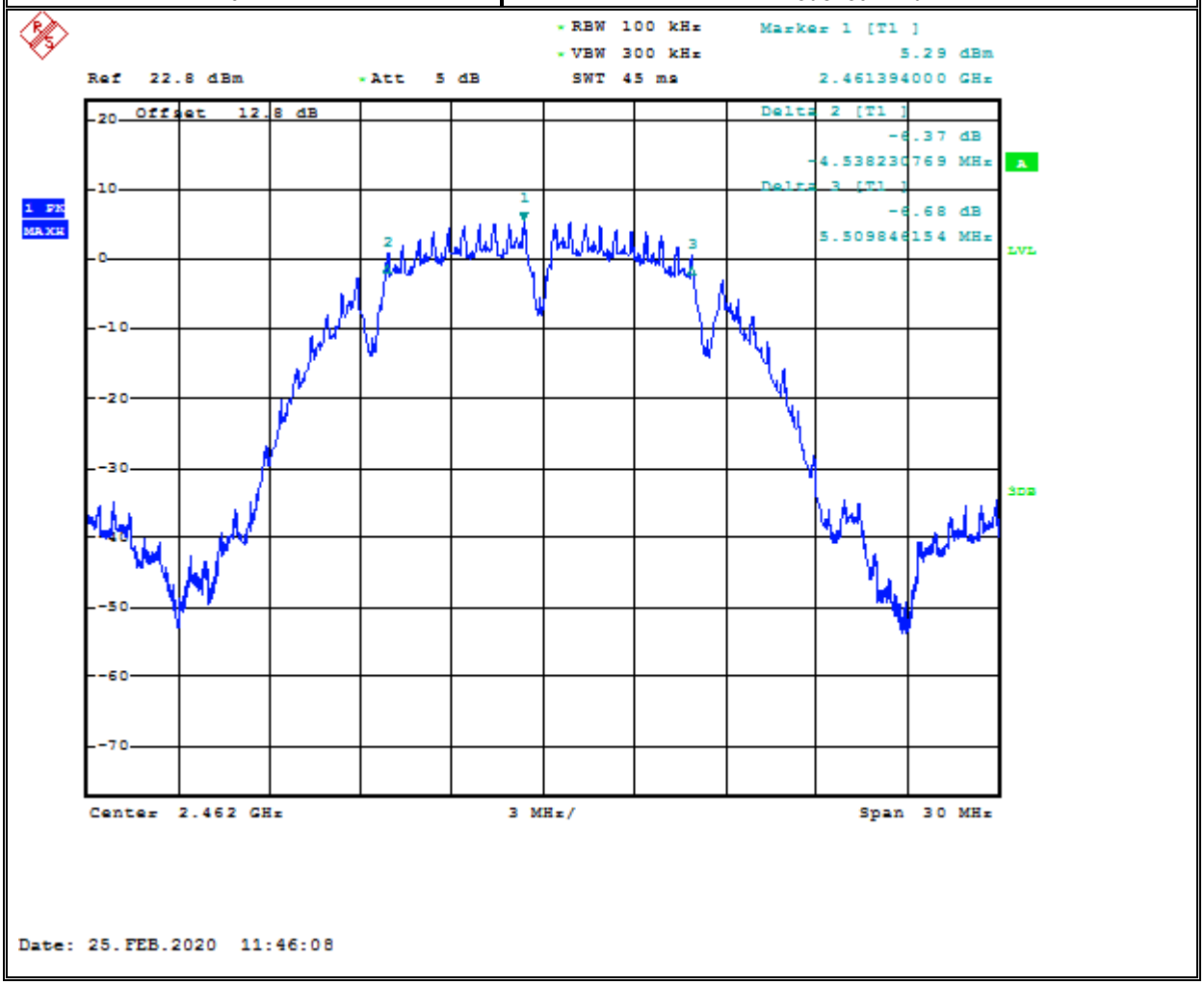
Plot #1	
2412 MHz	Mode: 802.11b



Plot #2	
2437 MHz	Mode: 802.11b

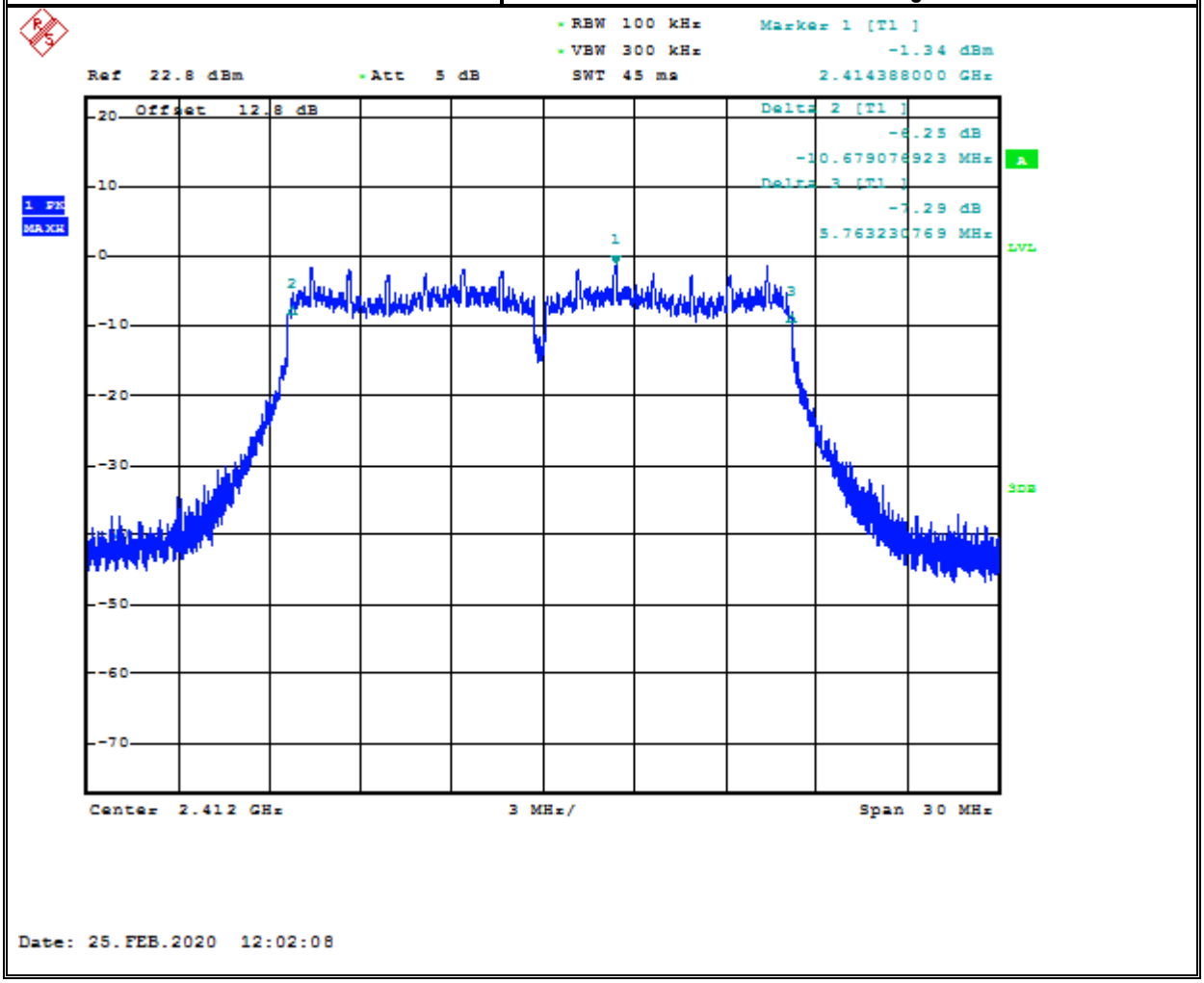


Plot #3	
2462 MHz	Mode: 802.11b



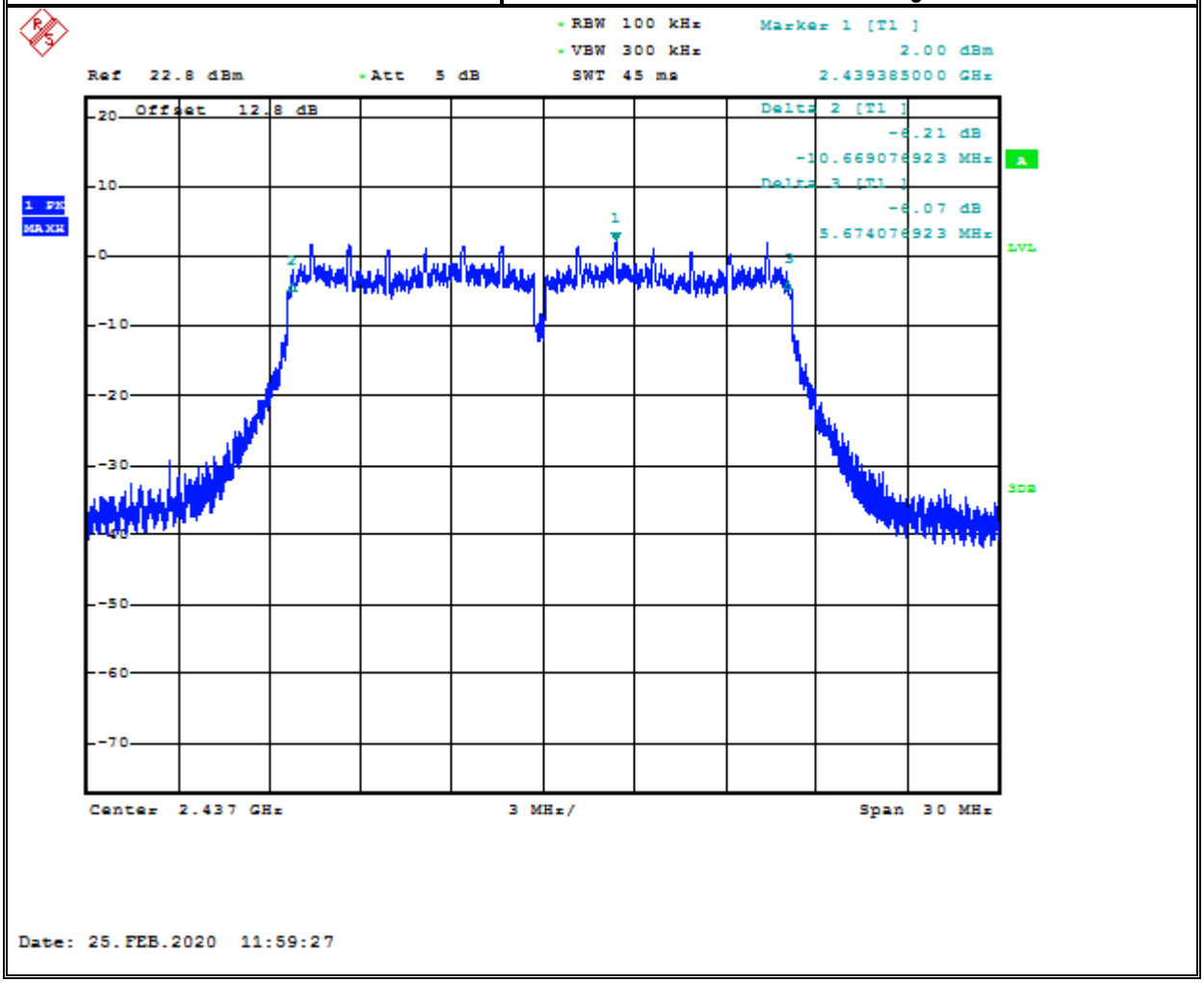
Plot #4

2412 MHz	Mode: 802.11g



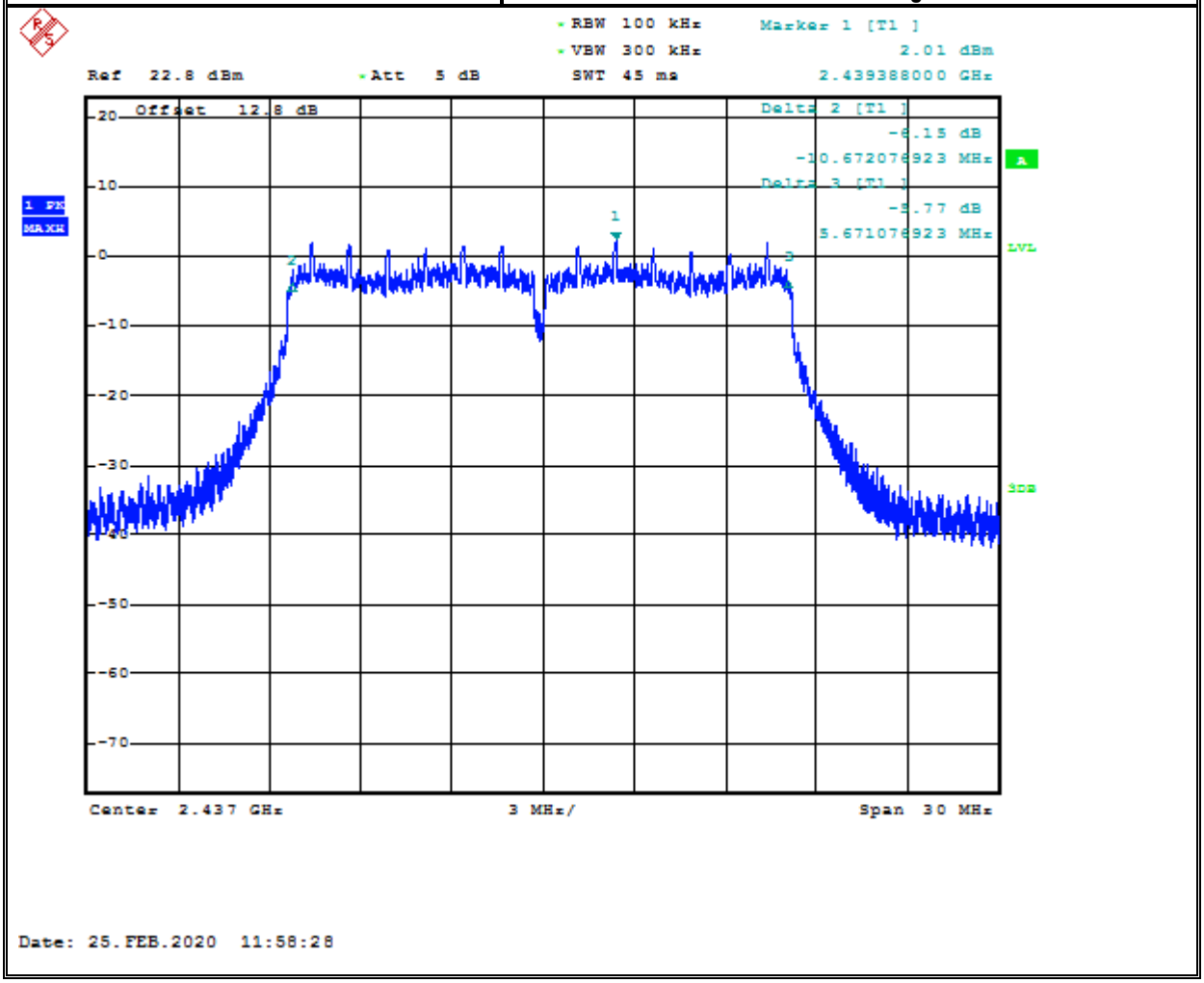
Plot #5

2437 MHz	Mode: 802.11g



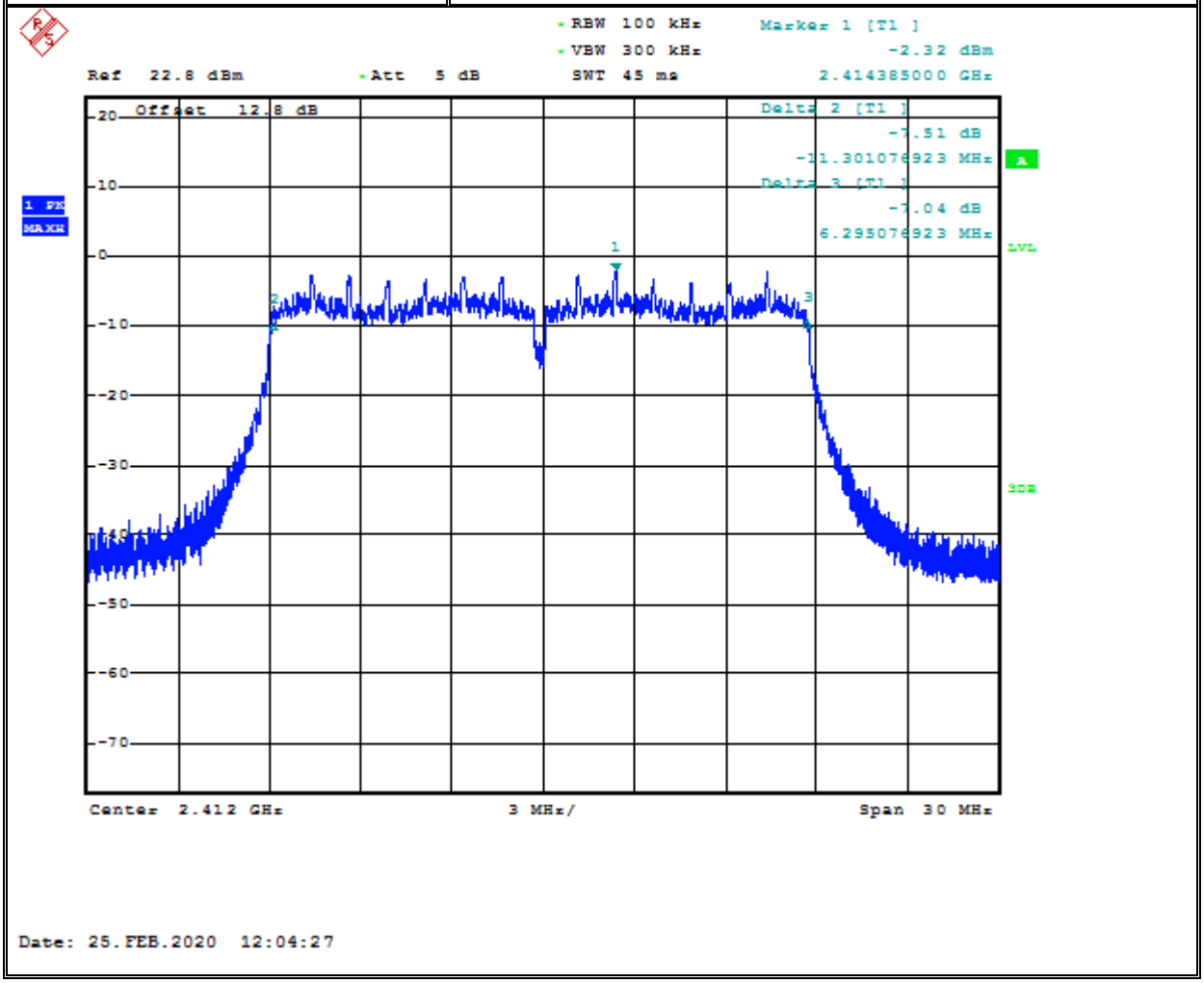
Plot #6

2462 MHz	Mode: 802.11g



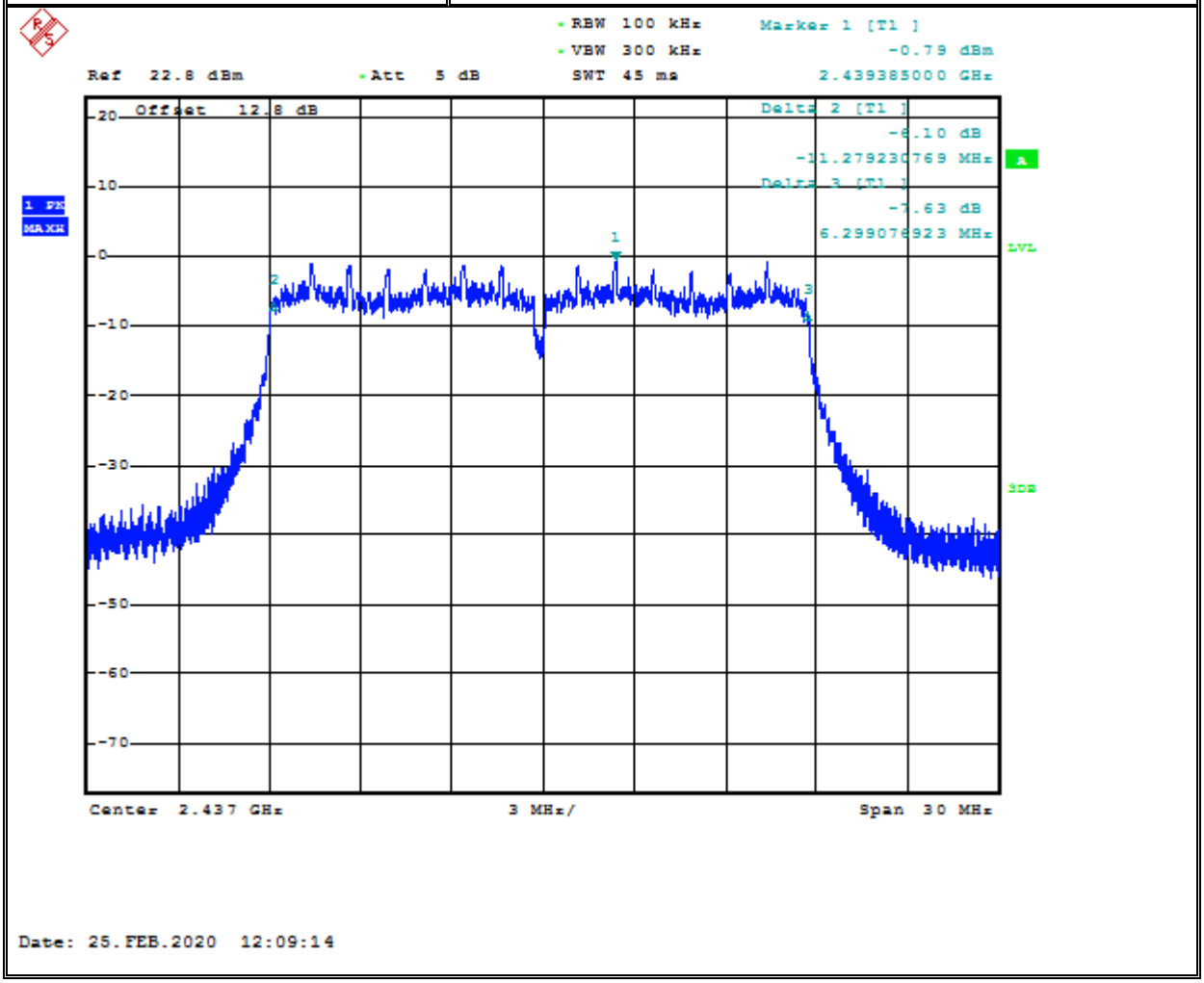
Plot #7

2412 MHz	Mode: 802.11n HT20



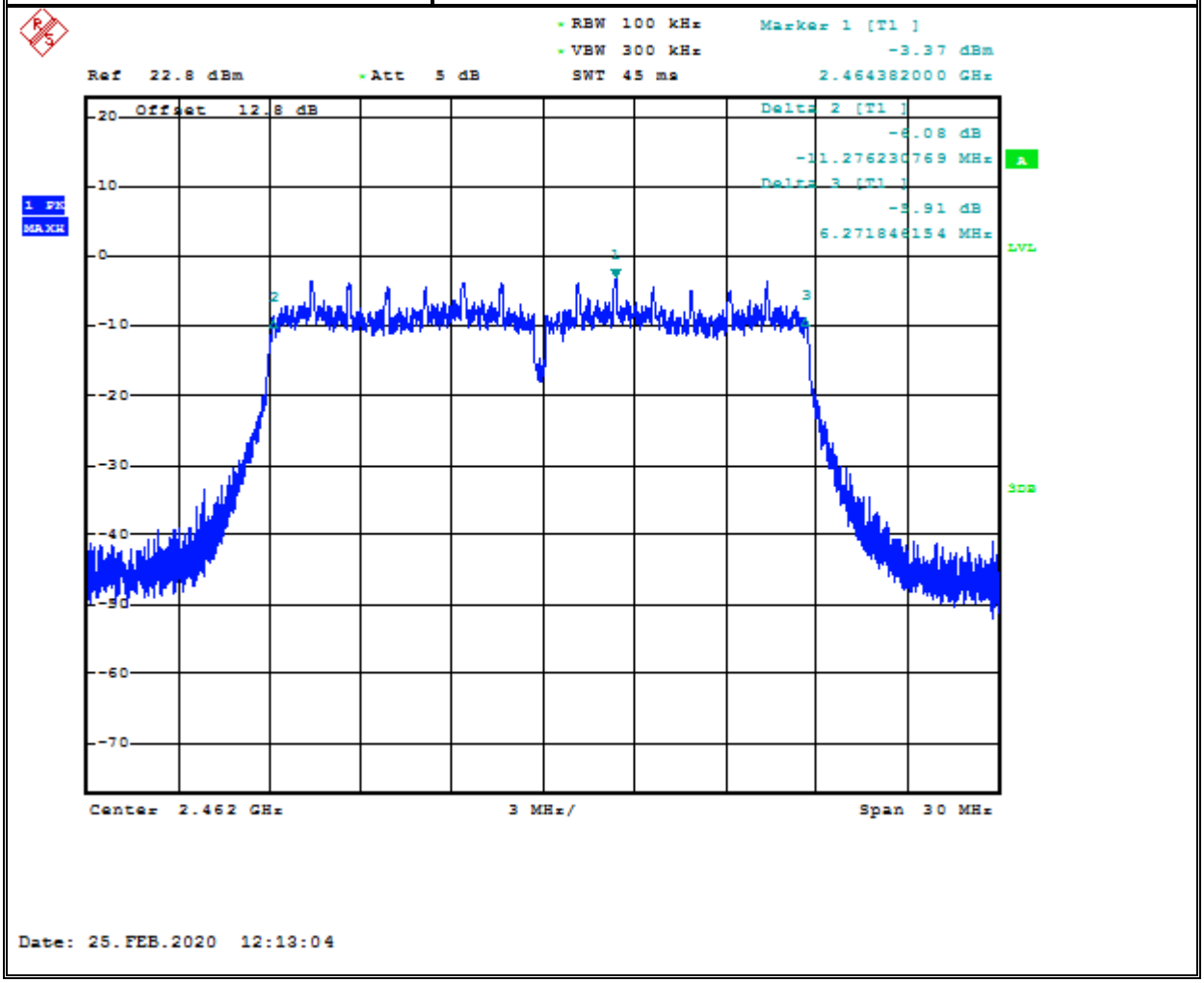
Plot #8

2437 MHz	Mode: 802.11n HT20



Plot #9

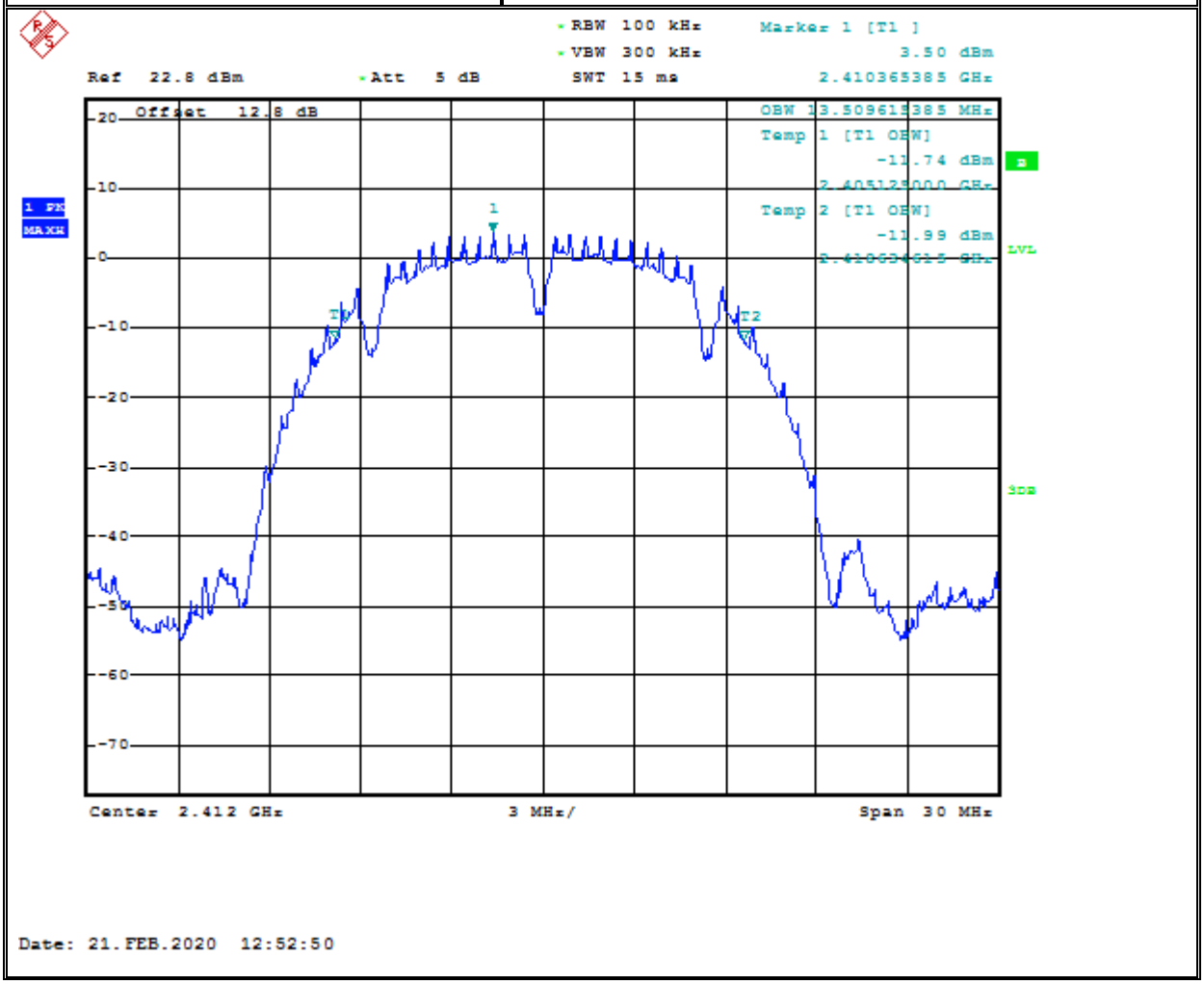
2462 MHz	Mode: 802.11HT20



99% Occupied Bandwidth

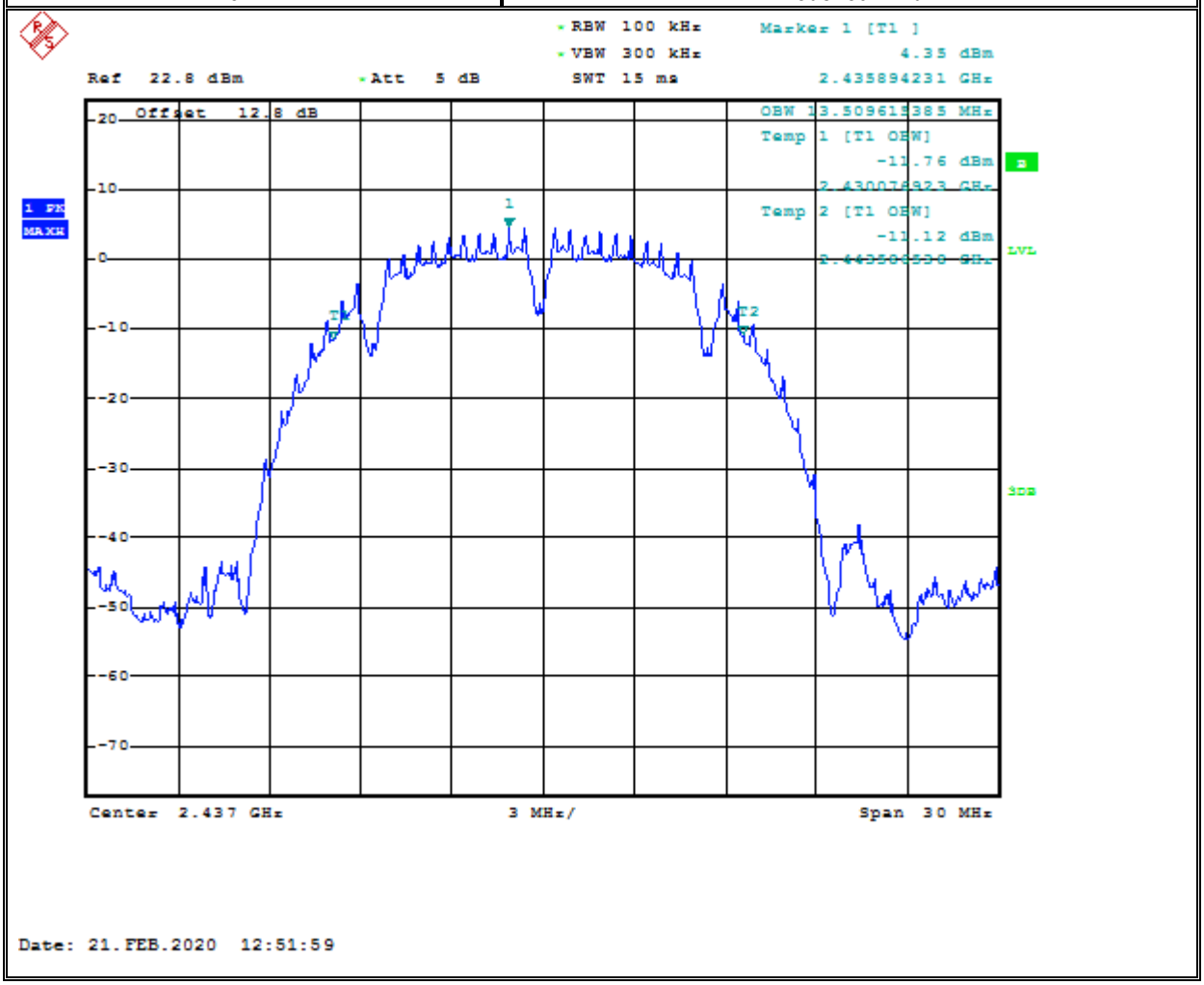
Plot #10

2412 MHz	Mode: 802.11b



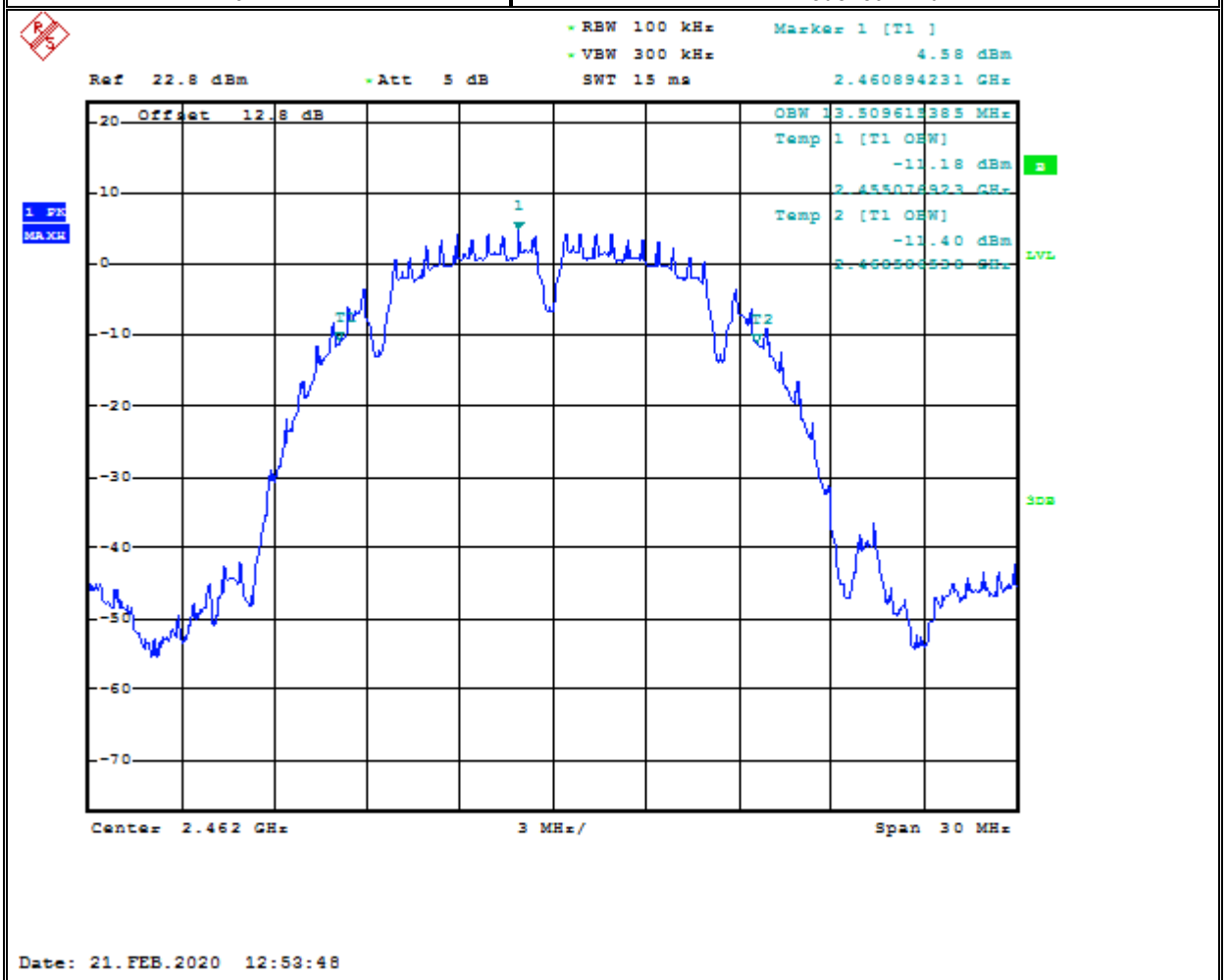
Plot #11

2437 MHz	Mode: 802.11b



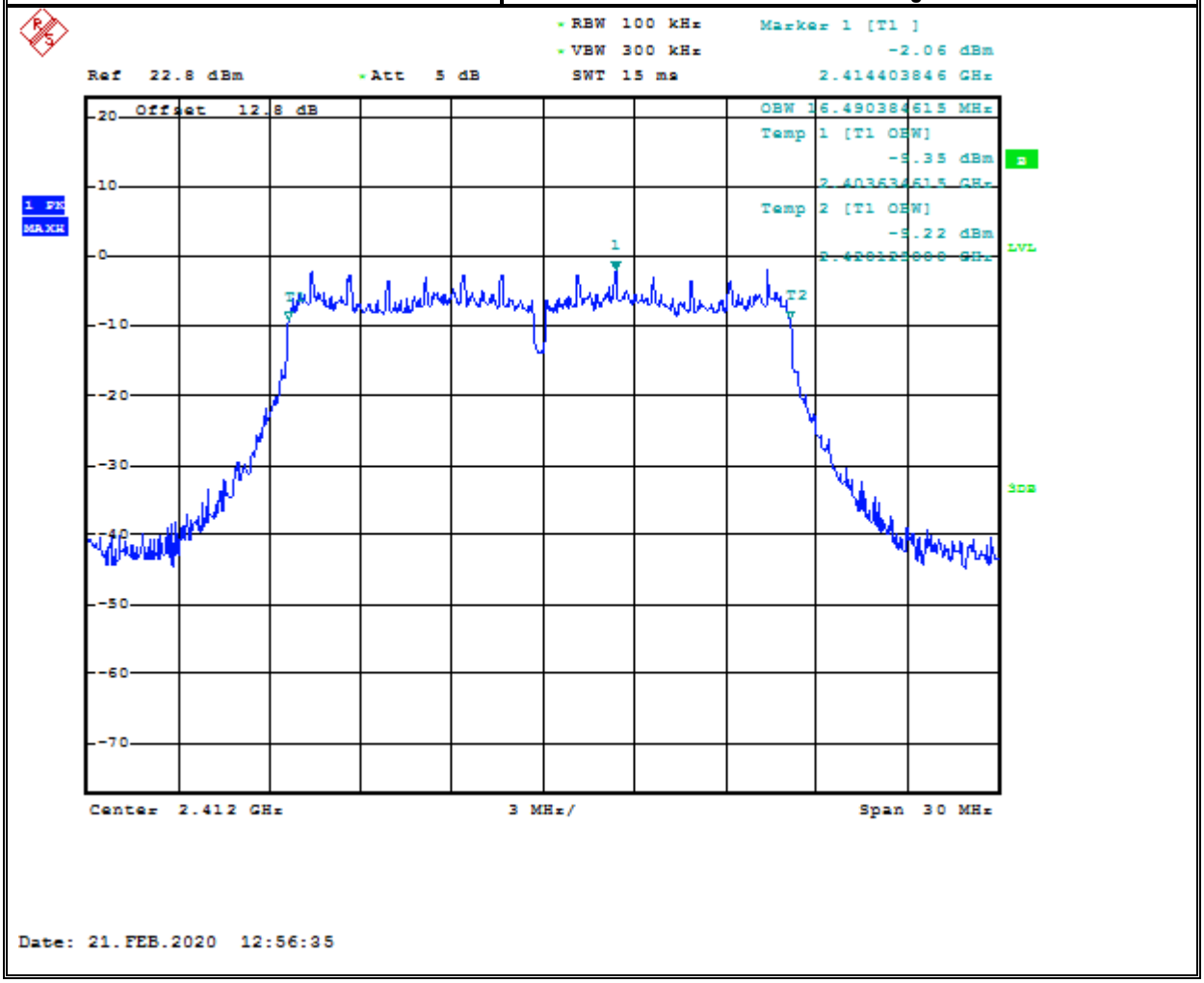
Plot #12

2462 MHz	Mode: 802.11b



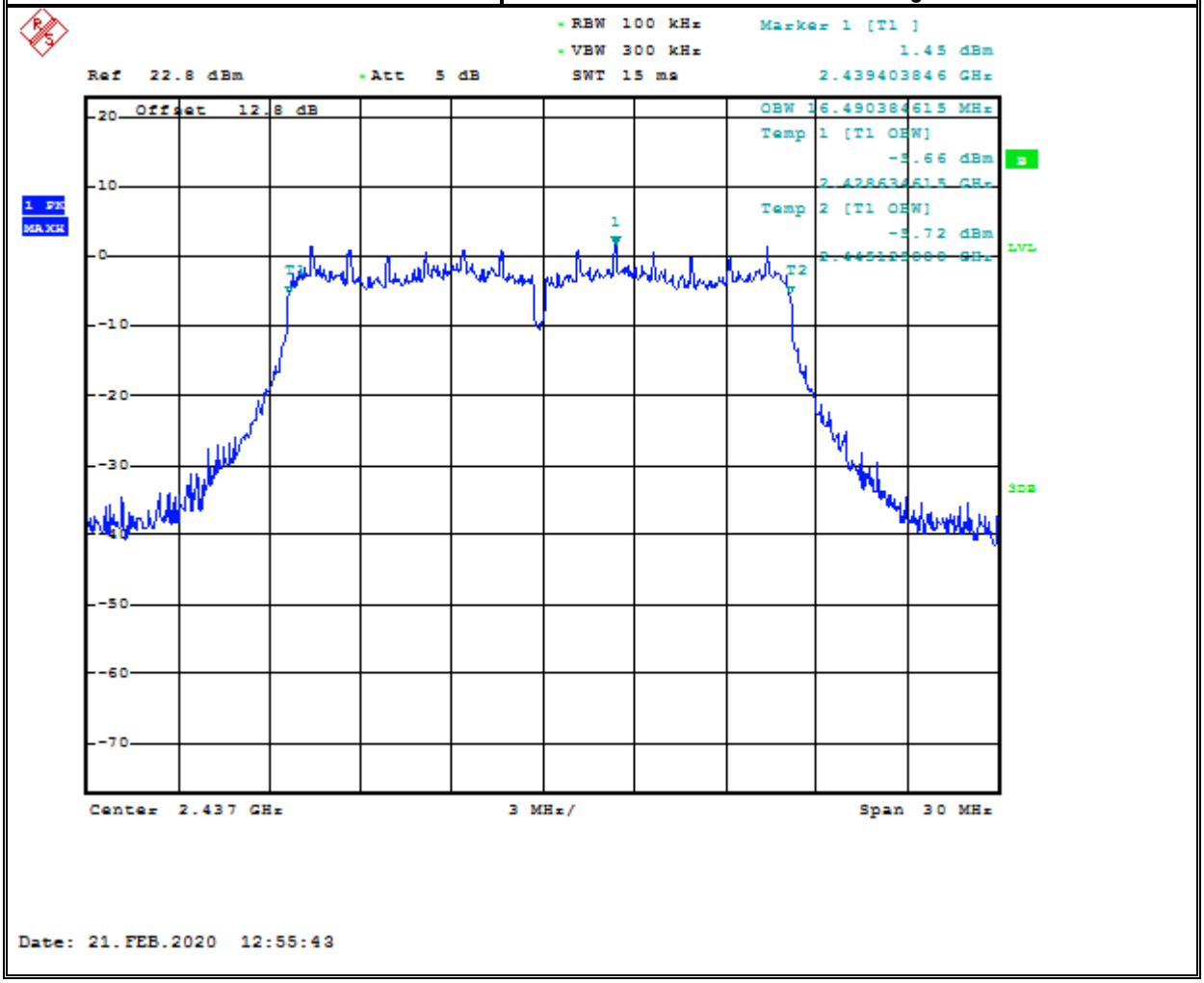
Plot #13

2412 MHz	Mode: 802.11g



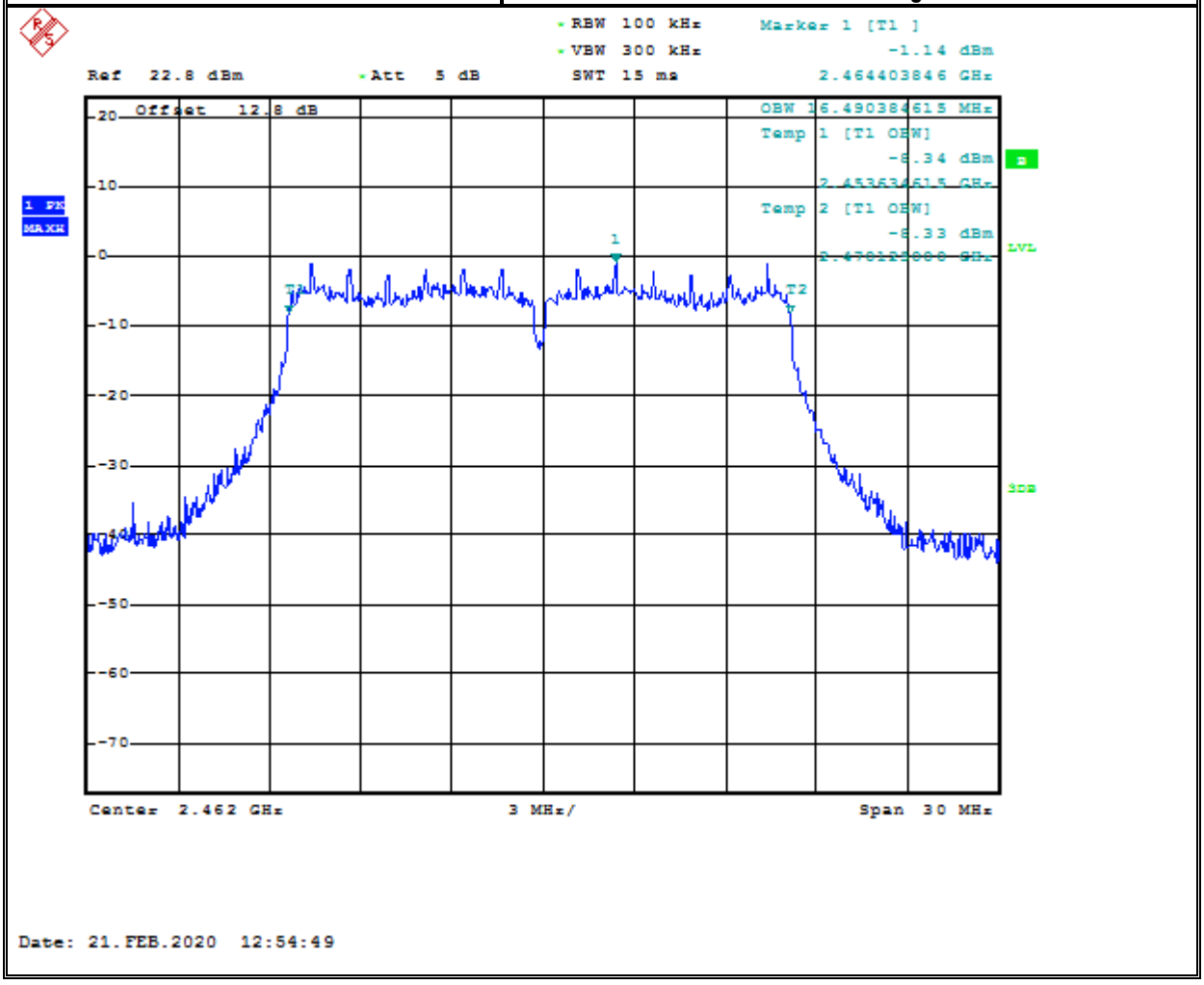
Plot #14

2437 MHz	Mode: 802.11g



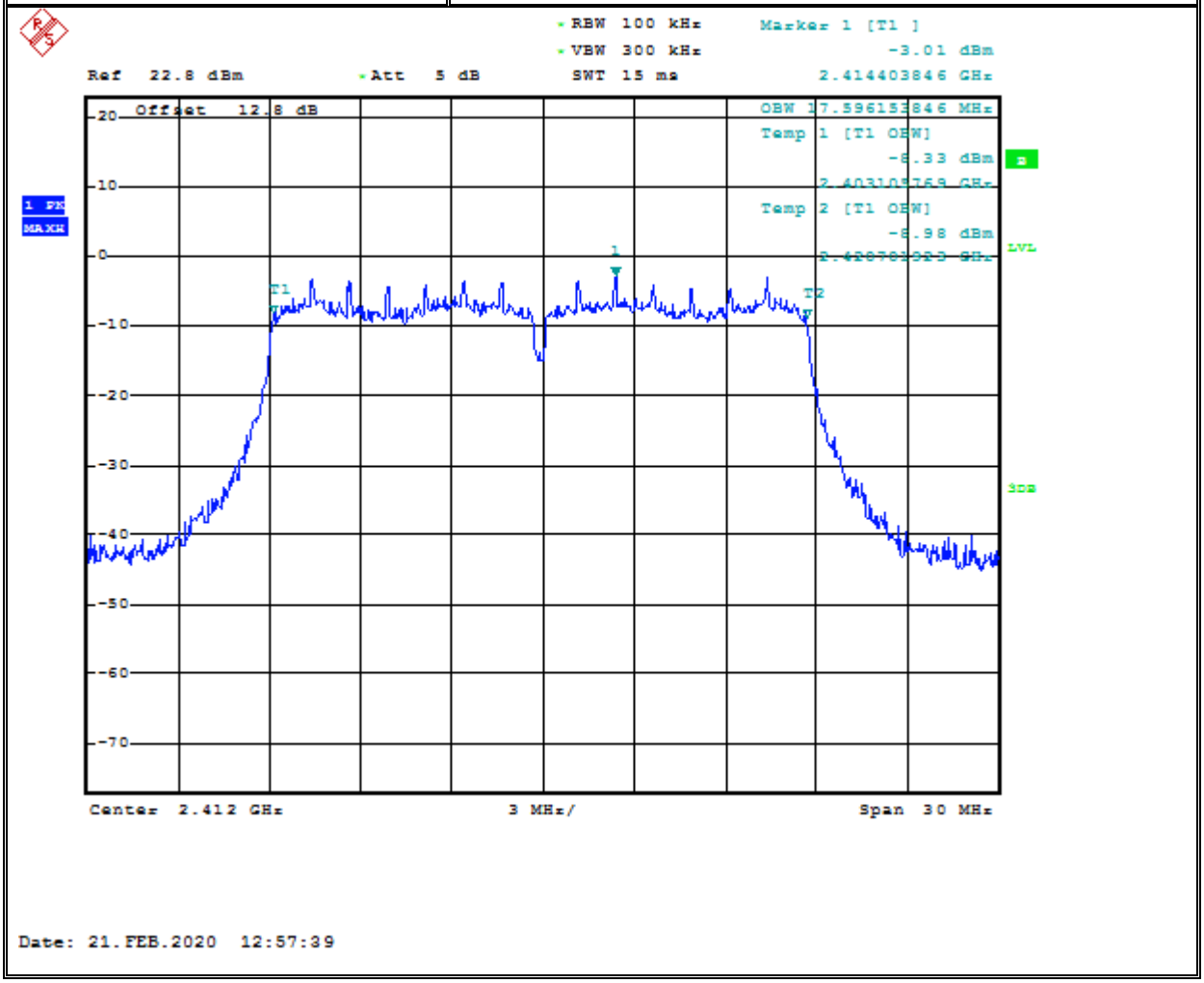
Plot #15

2462 MHz	Mode: 802.11g



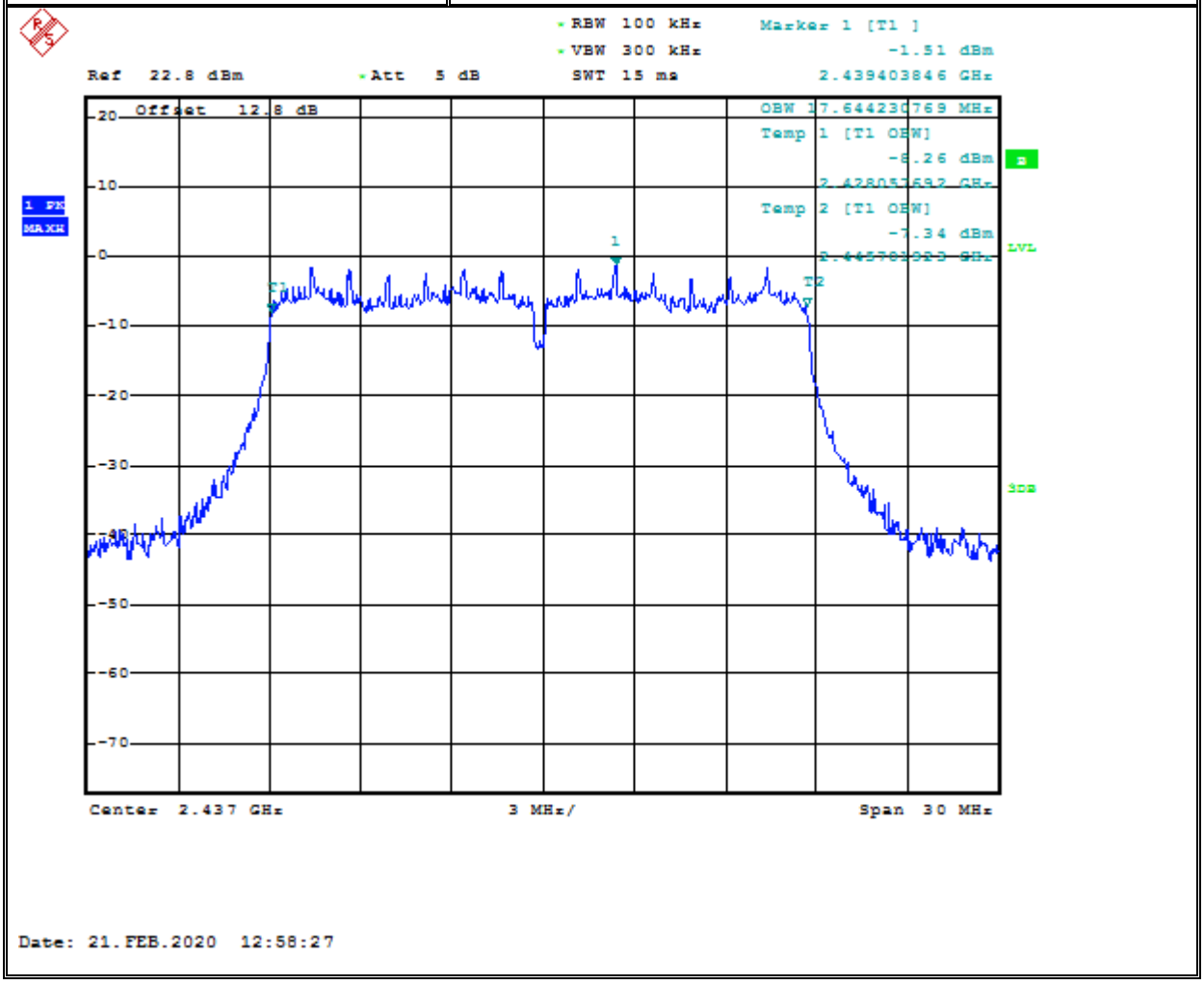
Plot #16

2412 MHz	Mode: 802.11n HT20



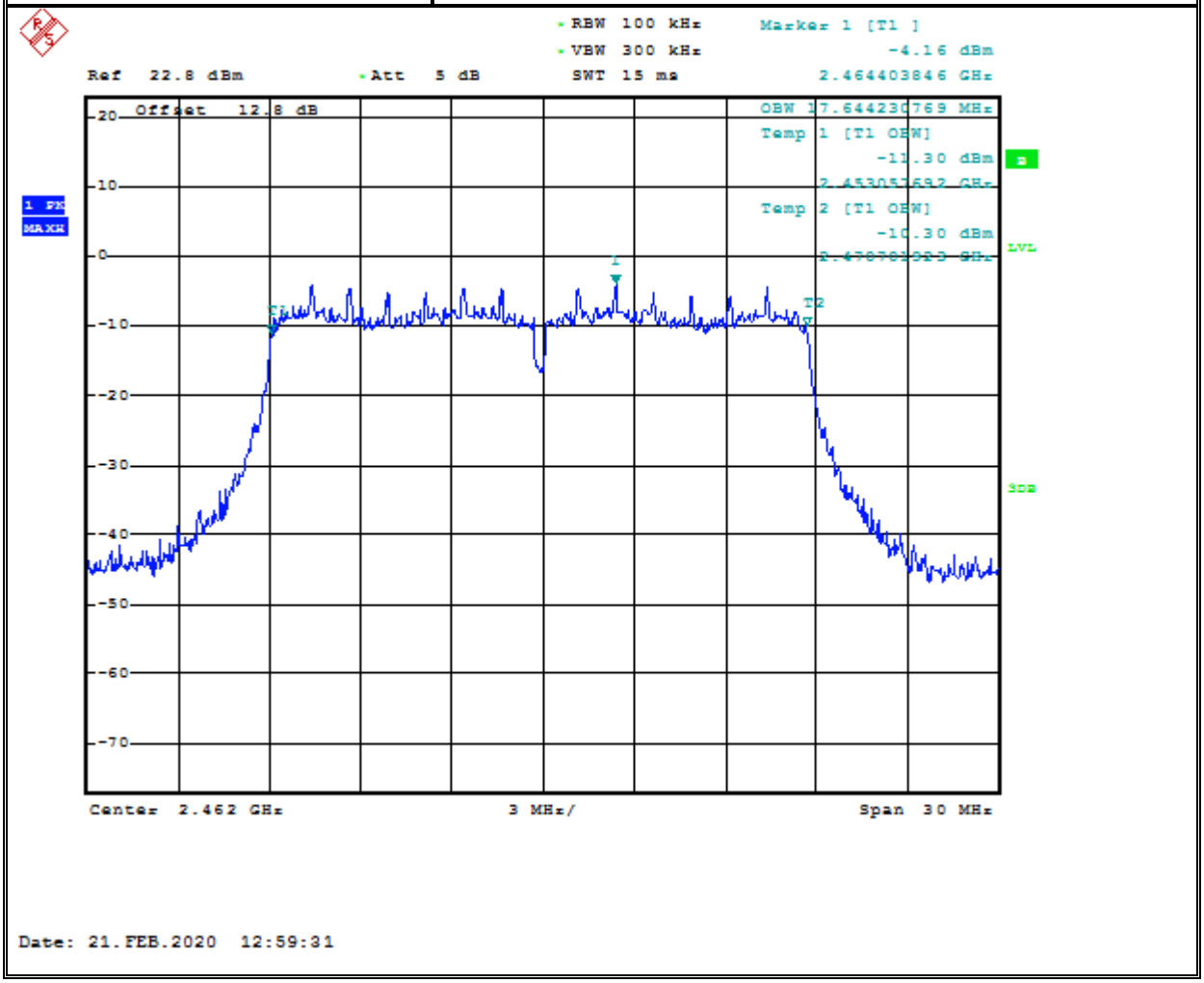
Plot #17

2437 MHz	Mode: 802.11n HT20



Plot #18

2462 MHz	Mode: 802.11HT20



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8.6 Radiated Transmitter Spurious Emissions and Restricted Bands

8.6.1 Measurement according to ANSI C63.10 (2013)

Spectrum Analyzer Settings:

- Frequency = 9 KHz – 30 MHz
- RBW = 9 KHz
- Detector: Peak

- Frequency = 30 MHz – 1 GHz
- Detector = Peak / Quasi-Peak
- RBW= 120 KHz (<1GHz)

- Frequency > 1 GHz
- Detector = Peak / Average
- RBW = 1 MHz

- Radiated spurious emissions shall be measured for the transmit frequencies, transmit power, and data rate for the lowest, middle and highest channel in each frequency band of operation and for the highest gain antenna for each antenna type, and using the appropriate parameters and test requirements.
- The highest (or worst-case) data rate shall be recorded for each measurement.
- For testing at distance other than the specified in the standard, the limit conversion is calculated by using 40 dB/decade extrapolation factor as follow: Conversion factor (CF) = 40 log (D/d) = 40 log (300m / 3m) = 80dB

8.6.2 Limits:

FCC §15.247

- In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

FCC §15.209 & RSS-Gen 8.9

- Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency of emission (MHz)	Field strength (µV/m)	Measurement Distance (m)	Field strength @ 3m (dBµV/m)
0.009–0.490	2400/F(kHz) / ---------	300	-
0.490–1.705	24000/F(kHz) / --------	30	-
1.705–30.0	30 / (29.5)	30	-
30–88	100	3	40 dBµV/m
88–216	150	3	43.5 dBµV/m
216–960	200	3	46 dBµV/m
Above 960	500	3	54 dBµV/m

FCC §15.205 & RSS-Gen 8.10

- Except as shown in paragraph (d) of this section, 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	Above 38.6
13.36-13.41			

- Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).
  *PEAK LIMIT= 74 dBµV/m
  *AVG. LIMIT= 54 dBµV/m

8.6.3 Test conditions and setup:

Ambient Temperature	EUT Set-Up #	EUT operating mode	Power Input
22.0° C	2	802.11g	12 VDC

8.6.4 Measurement result:

Plot #	Channel #	Scan Frequency	Limit	Result
1-3	Low	30 MHz – 18 GHz	See section 8.6.2	Pass
4-8	Mid	9 kHz – 26 GHz	See section 8.6.2	Pass
9-11	High	30 MHz – 18 GHz	See section 8.6.2	Pass

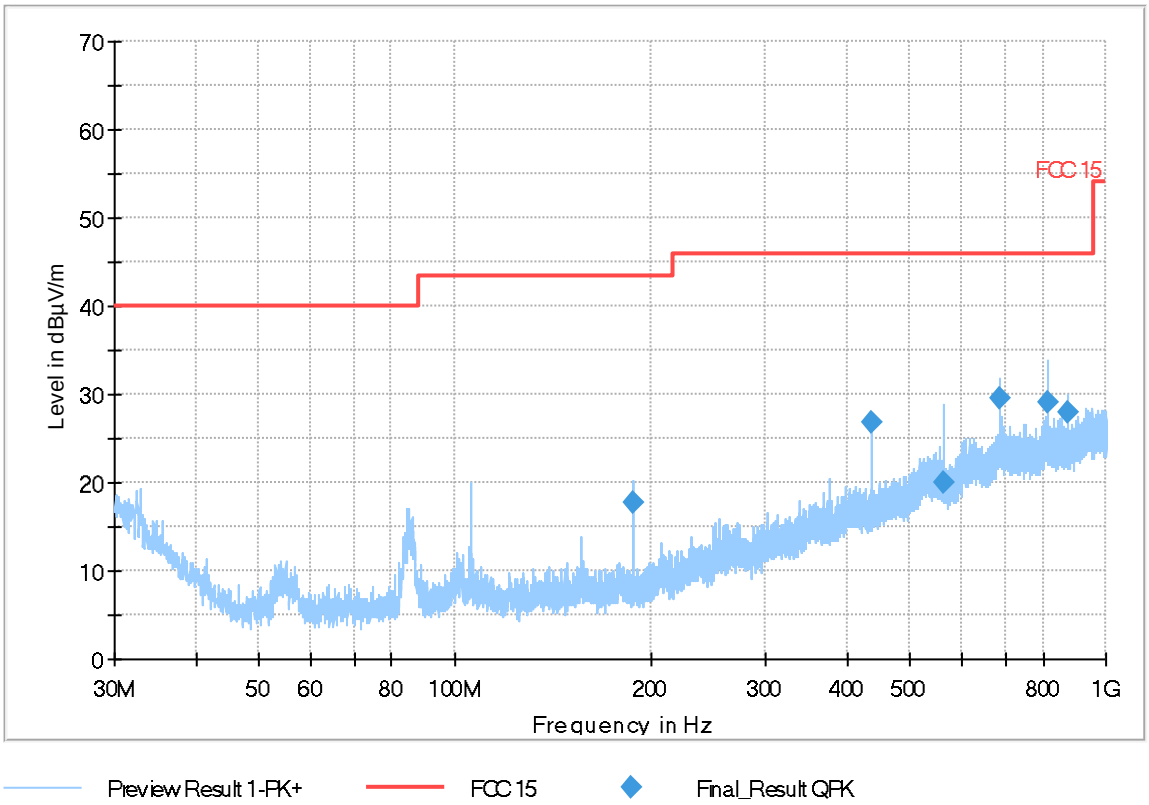
Note: For 802.11g operating mode, both antenna ports (A and B) are active and transmit simultaneously.
Based on pre-scan measurements, 802.11g operating mode yields the worst case harmonics.

8.6.5 Measurement Plots:

Plot #1 Radiated Emissions: 30 MHz – 1GHz		
Modulation: 802.11g	Channel: Low	87.8% Duty Cycle

Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
187.508	17.81	43.52	25.72	200.0	120.000	325.0	V	34.0	11.5
437.515	26.76	46.02	19.26	200.0	120.000	197.0	V	4.0	19.4
562.514	19.98	46.02	26.04	200.0	120.000	282.0	V	44.0	22.3
687.530	29.43	46.02	16.59	200.0	120.000	140.0	V	193.0	26.0
812.581	29.06	46.02	16.96	200.0	120.000	207.0	V	344.0	27.2
875.027	28.01	46.02	18.01	200.0	120.000	290.0	V	172.0	26.4

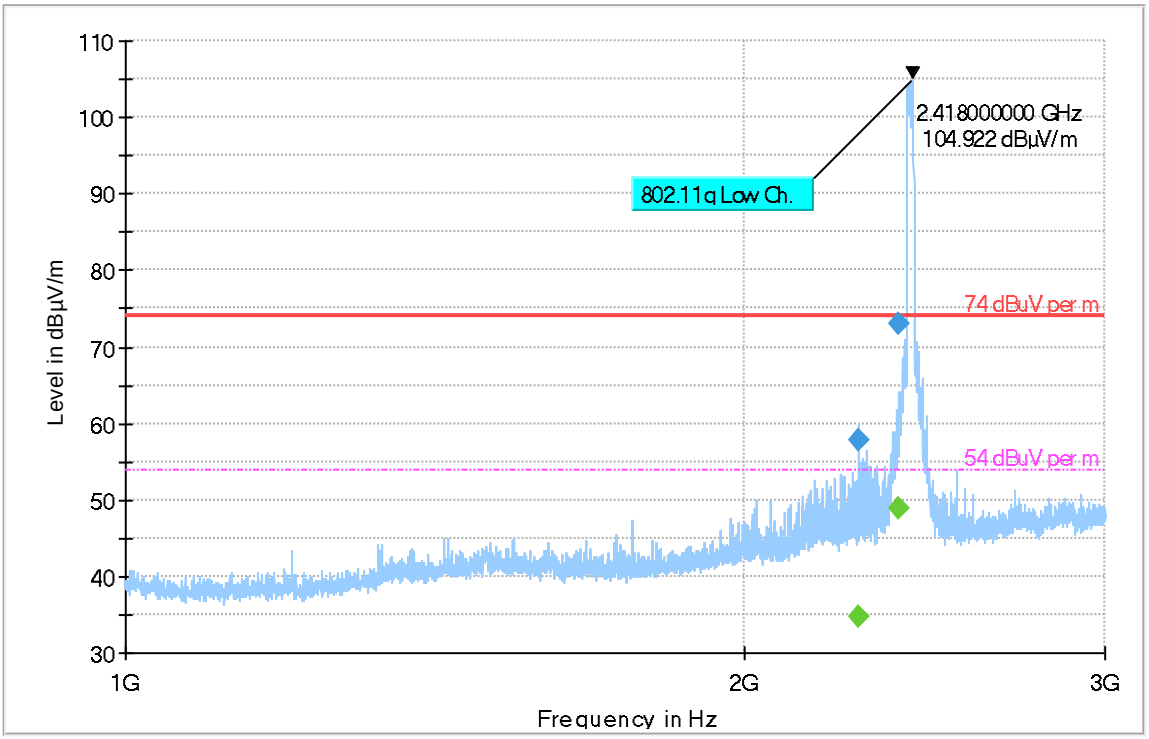


Plot #2 Radiated Emissions: 1-3 GHz		
Modulation: 802.11g	Channel: Low	87.8% Duty Cycle

Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
2275.926	---	34.81	54.00	19.19	200.0	1000.000	246.0	H
2275.926	57.86	---	74.00	16.14	200.0	1000.000	246.0	H
2379.856	---	48.85	54.00	5.15	200.0	1000.000	177.0	H
2379.856	72.95	---	74.00	1.05	200.0	1000.000	177.0	H

Frequency (MHz)	Azimuth (deg)	Corr. (dB/m)	Sig Path (dB)	Preamp (dB)	Trd Corr. (dB/m)	Raw Rec (dBµV)	Comment
2275.926	282.0	0.1	-29.4	0.0	29.5	34.7	12:52:38 PM - 3/27/2020
2275.926	282.0	0.1	-29.4	0.0	29.5	57.8	12:52:37 PM - 3/27/2020
2379.856	275.0	0.6	-29.3	0.0	29.9	48.3	12:54:37 PM - 3/27/2020
2379.856	275.0	0.6	-29.3	0.0	29.9	72.4	12:54:37 PM - 3/27/2020



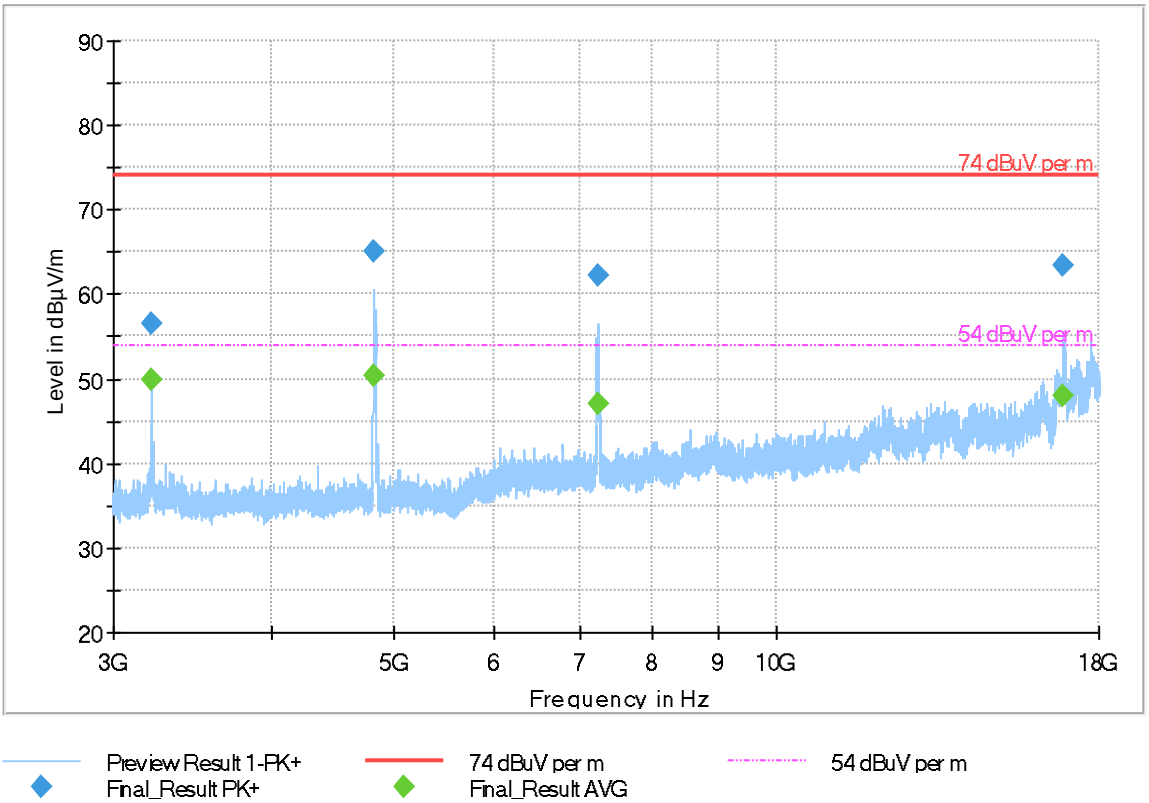
Preview Result 1-PK+ 74 dBuV per m 54 dBuV per m
Final_Result PK+ Final_Result AVG

Plot #3 Radiated Emissions: 3-18 GHz		
Modulation: 802.11g	Channel: Low	87.8% Duty Cycle

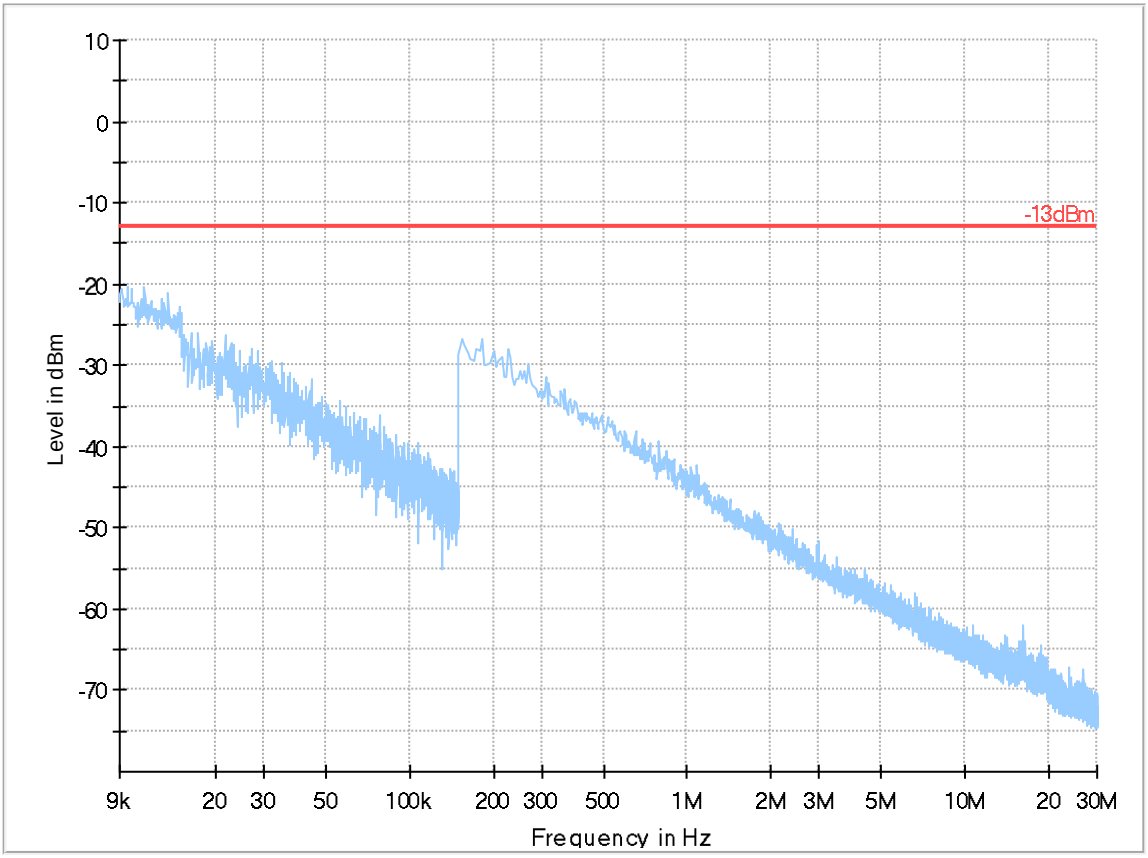
Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
3215.885	---	49.82	54.00	4.18	200.0	1000.000	161.0	H
3215.885	56.56	---	74.00	17.44	200.0	1000.000	161.0	H
4822.499	---	50.38	54.00	3.62	200.0	1000.000	289.0	H
4822.499	65.08	---	74.00	8.92	200.0	1000.000	289.0	H
7236.501	---	47.14	54.00	6.86	200.0	1000.000	203.0	H
7236.501	62.30	---	74.00	11.70	200.0	1000.000	203.0	H
16881.265	---	48.01	54.00	5.99	200.0	1000.000	200.0	H
16881.265	63.31	---	74.00	10.69	200.0	1000.000	200.0	H

Frequency (MHz)	Azimuth (deg)	Corr. (dB/m)
3215.885	99.0	-8.0
3215.885	99.0	-8.0
4822.499	272.0	-4.3
4822.499	272.0	-4.3
7236.501	302.0	0.2
7236.501	302.0	0.2
16881.265	146.0	14.6
16881.265	146.0	14.6



Plot #4 Radiated Emissions: 9 KHz – 30 MHz		
Modulation: 802.11g	**Channel: Mid**	**87.8% Duty Cycle**

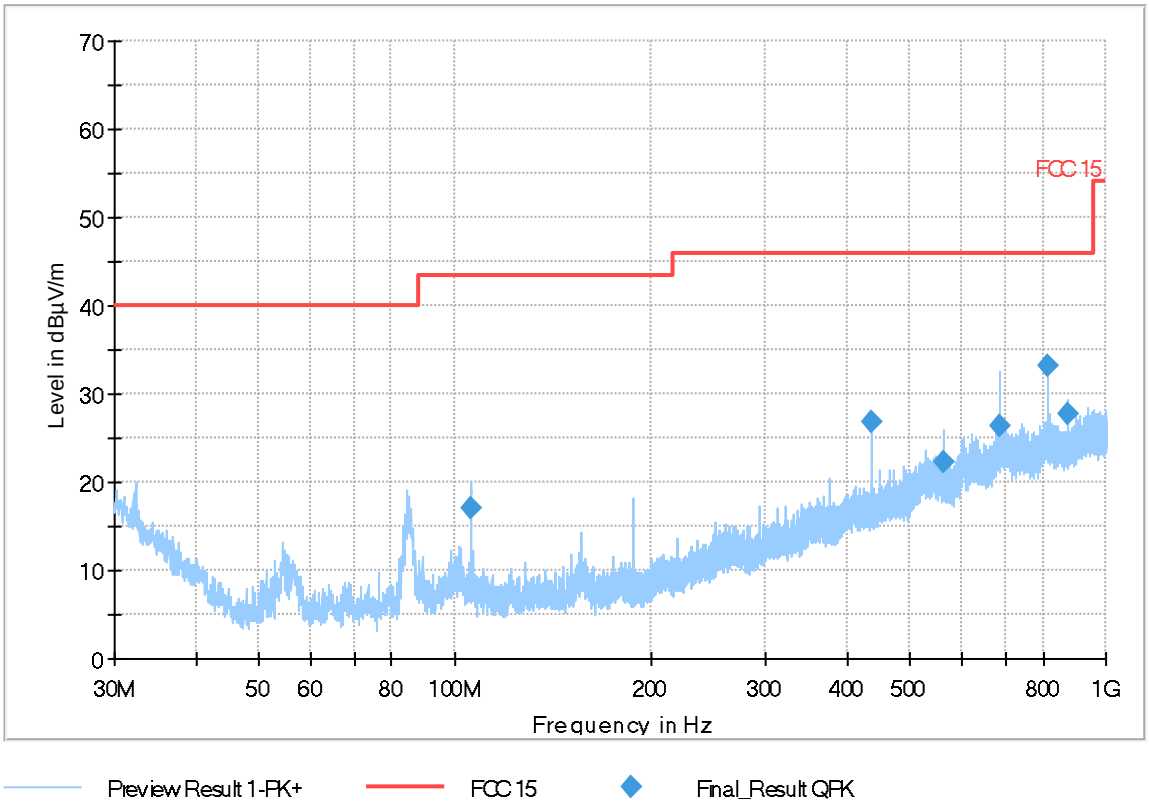


Preview Result 2-QPK
Critical_Freqs PK+
Final_Result QPK
Preview Result 1-PK+
-13dBm
Critical_Freqs QPK
Final_Result PK+

Plot #5 Radiated Emissions: 30 MHz – 1GHz		
Modulation: 802.11g	Channel: Mid	87.8% Duty Cycle

Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
105.699	17.01	43.52	26.51	200.0	120.000	167.0	H	243.0	10.3
437.511	26.73	46.02	19.29	200.0	120.000	189.0	V	-5.0	19.4
562.520	22.29	46.02	23.73	200.0	120.000	157.0	V	1.0	22.3
687.461	26.41	46.02	19.61	200.0	120.000	173.0	V	-40.0	26.0
812.545	33.15	46.02	12.87	200.0	120.000	198.0	V	345.0	27.2
874.994	27.72	46.02	18.30	200.0	120.000	310.0	V	158.0	26.4

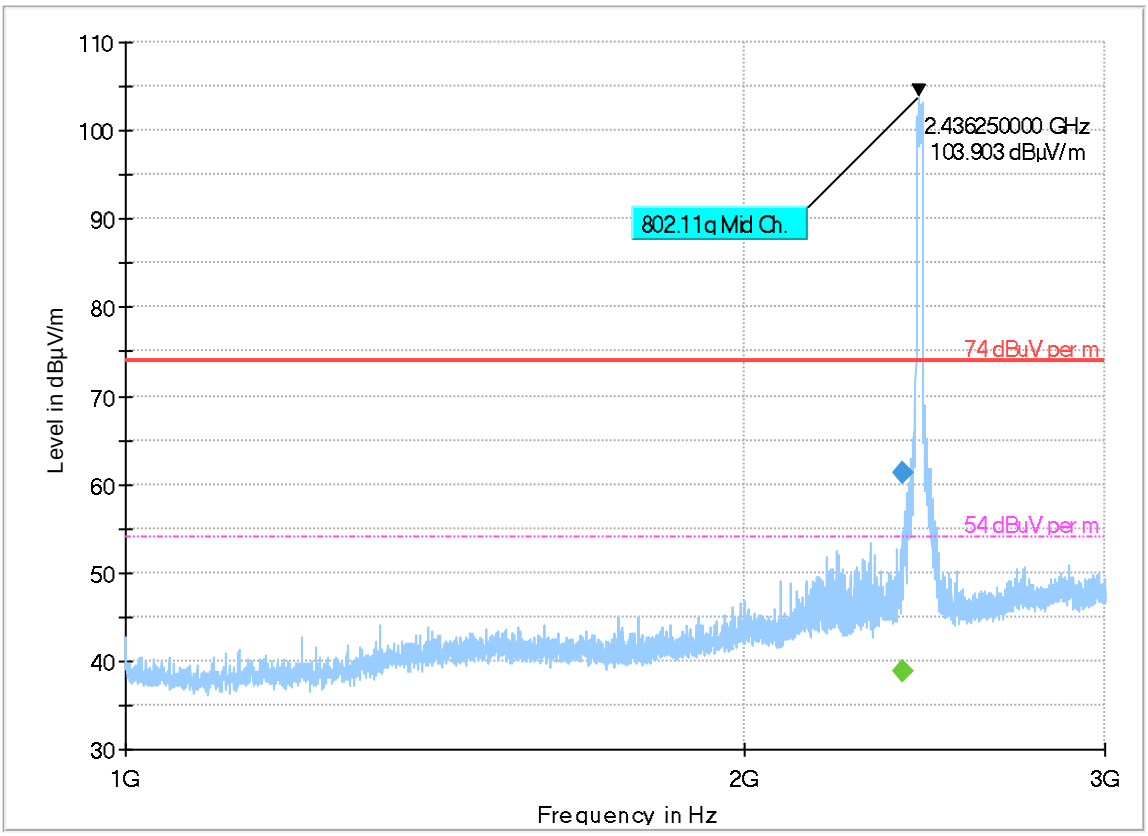


Plot #6 Radiated Emissions: 1-3 GHz		
Modulation: 802.11g	Channel: Mid	87.8% Duty Cycle

Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
2389.729	---	38.73	54.00	15.27	200.0	1000.000	187.0	H
2389.729	61.24	---	74.00	12.76	200.0	1000.000	187.0	H

Frequency (MHz)	Azimuth (deg)	Corr. (dB/m)	Sig Path (dB)	Preamp (dB)	Trd Corr. (dB/m)	Raw Rec (dBµV)	Comment
2389.729	292.0	0.6	-29.3	0.0	29.9	38.1	12:46:33 PM - 3/26/2020
2389.729	292.0	0.6	-29.3	0.0	29.9	60.6	12:46:33 PM - 3/26/2020



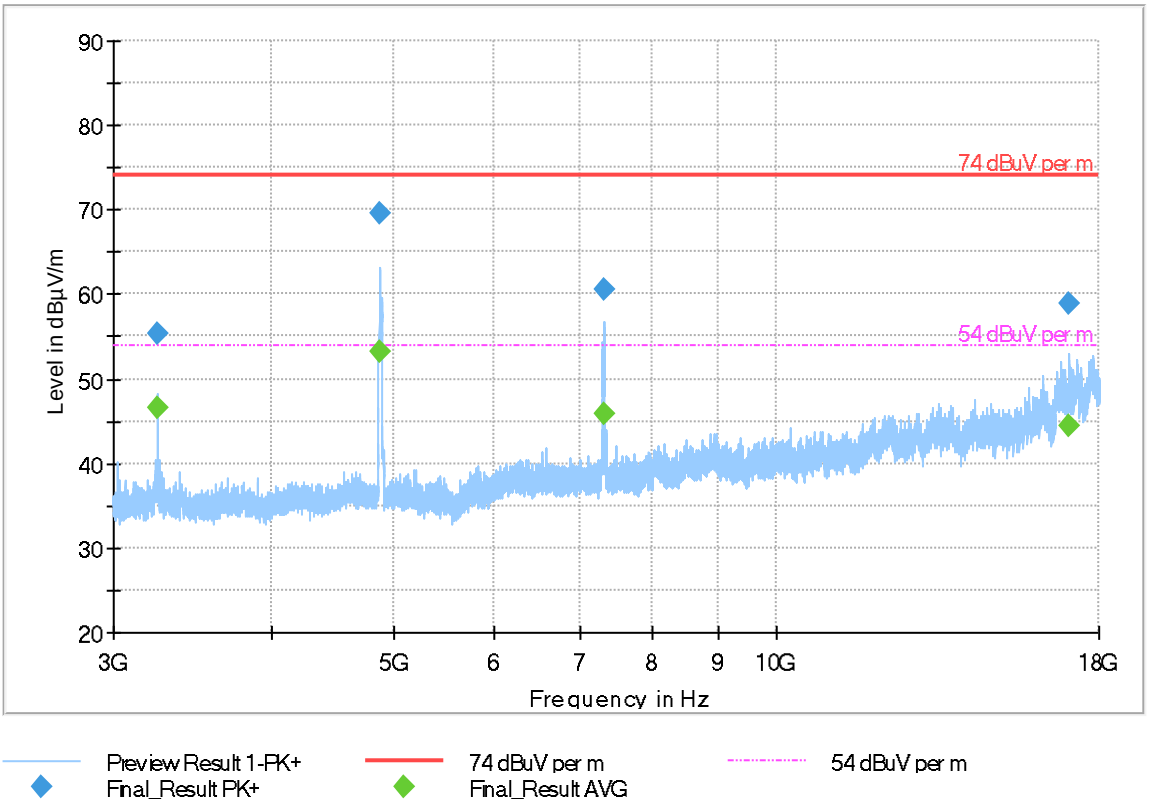
Preview Result 1-PK+ 74 dBuV per m 54 dBuV per m
Final_Result PK+ Final_Result AVG

Plot #7 Radiated Emissions: 3-18 GHz		
Modulation: 802.11g	Channel: Mid	87.8% Duty Cycle

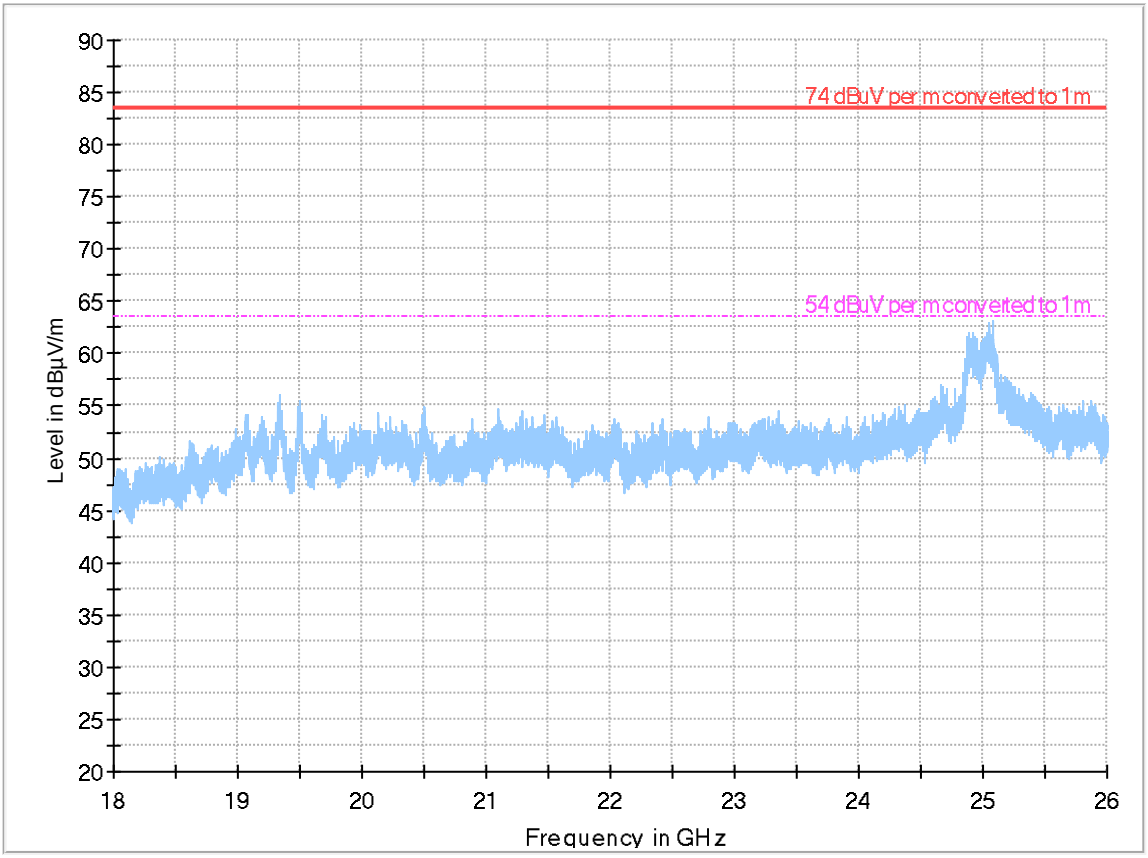
Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
3249.204	55.30	---	74.00	18.70	200.0	1000.000	271.0	H
3249.204	---	46.68	54.00	7.32	200.0	1000.000	271.0	H
4875.872	69.64	---	74.00	4.36	200.0	1000.000	283.0	H
4875.872	---	53.19	54.00	0.81	200.0	1000.000	283.0	H
7310.264	60.57	---	74.00	13.43	200.0	1000.000	158.0	H
7310.264	---	45.89	54.00	8.11	200.0	1000.000	158.0	H
17062.713	58.89	---	74.00	15.11	200.0	1000.000	168.0	H
17062.713	---	44.41	54.00	9.59	200.0	1000.000	168.0	H

Frequency (MHz)	Azimuth (deg)	Corr. (dB/m)
3249.204	116.0	-8.0
3249.204	116.0	-8.0
4875.872	250.0	-4.6
4875.872	250.0	-4.6
7310.264	-58.0	0.4
7310.264	-58.0	0.4
17062.713	213.0	14.0
17062.713	213.0	14.0



Plot #8 Radiated Emissions: 18-26 GHz		
Modulation: 802.11g	**Channel: Mid**	**87.8% Duty Cycle**

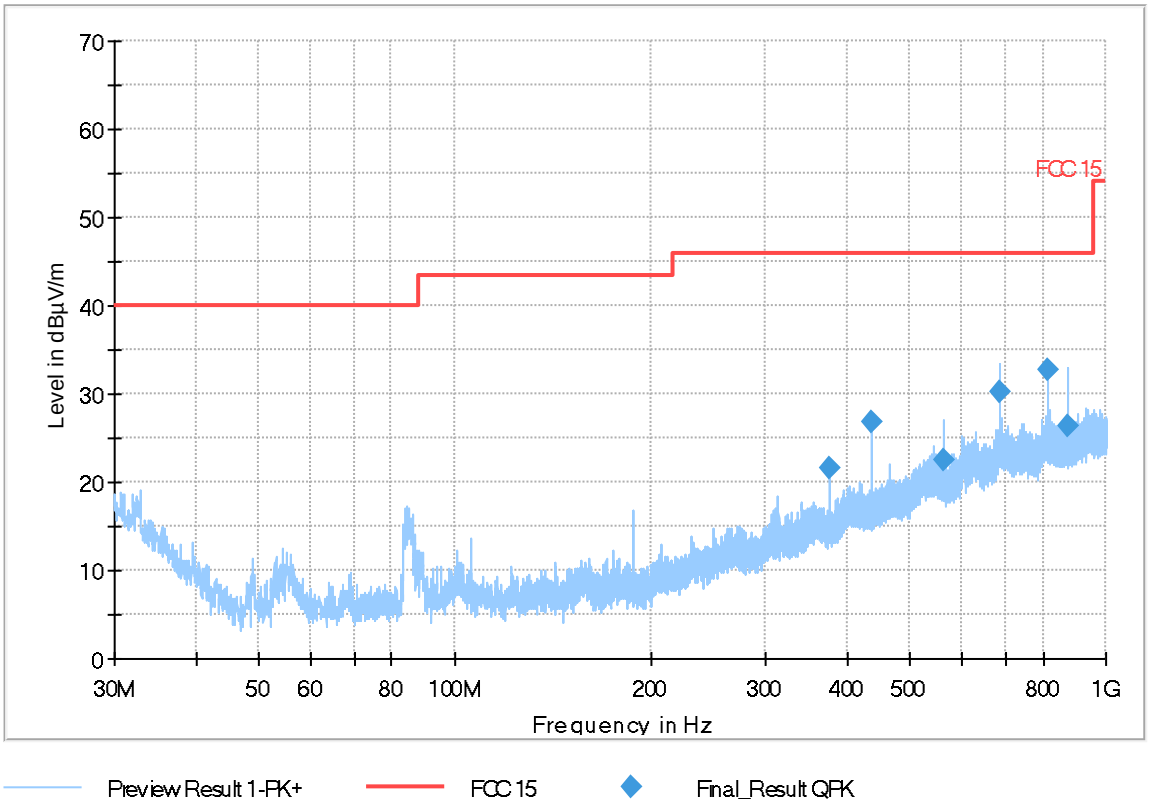


Preview Result 1-PK+
74 dBuV per m converted to 1m
Final_Result PK+
Critical_Freqs PK+
54 dBuV per m converted to 1m
Final_Result AVG

Plot #9 Radiated Emissions: 30 MHz – 1GHz		
Modulation: 802.11g	Channel: High	87.8% Duty Cycle

Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
375.013	21.68	46.02	24.34	200.0	120.000	140.0	V	5.0	17.8
437.517	26.86	46.02	19.16	200.0	120.000	140.0	V	-10.0	19.4
562.519	22.55	46.02	23.47	200.0	120.000	140.0	V	44.0	22.3
687.526	30.16	46.02	15.86	200.0	120.000	186.0	V	40.0	26.0
812.514	32.66	46.02	13.36	200.0	120.000	221.0	V	8.0	27.2
875.082	26.46	46.02	19.56	200.0	120.000	312.0	V	194.0	26.4

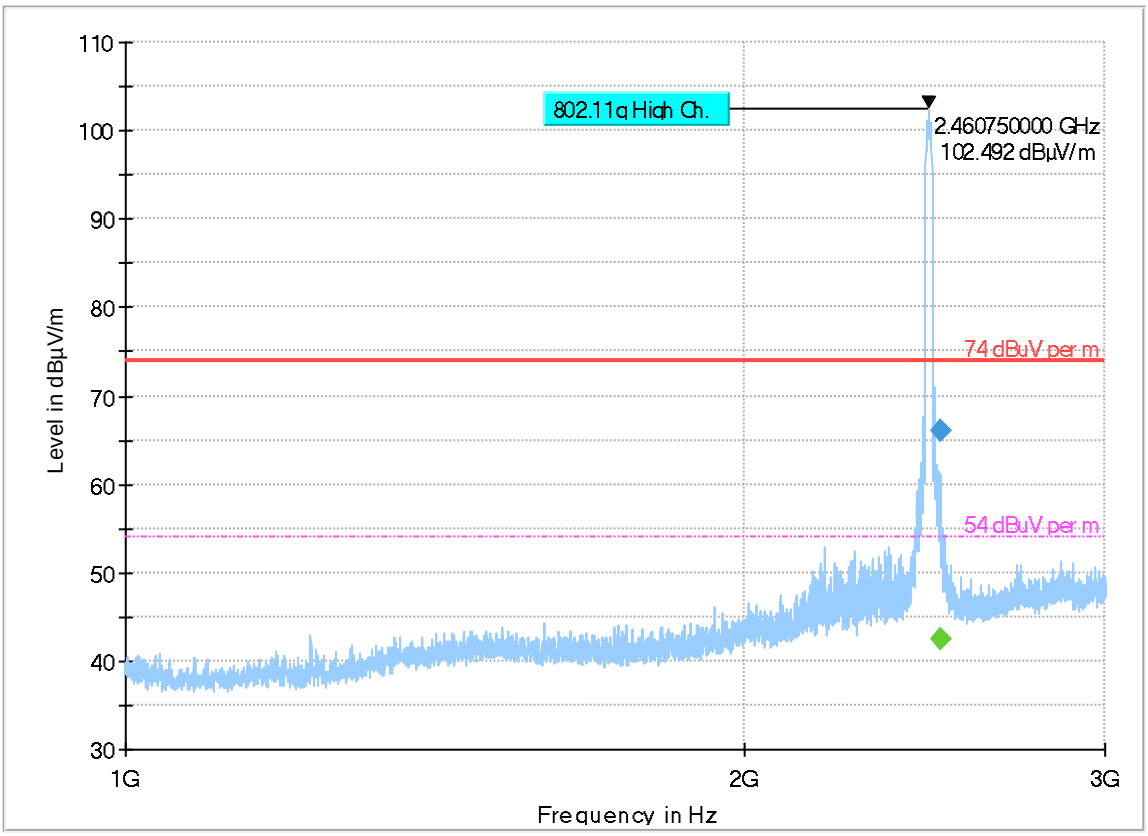


Plot #10 Radiated Emissions: 1-3 GHz		
Modulation: 802.11g	Channel: High	87.8% Duty Cycle

Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
2492.467	---	42.57	54.00	11.43	200.0	1000.000	151.0	H
2492.467	66.11	---	74.00	7.89	200.0	1000.000	151.0	H

Frequency (MHz)	Azimuth (deg)	Corr. (dB/m)	Sig Path (dB)	Preamp (dB)	Trd Corr. (dB/m)	Raw Rec (dBµV)	Comment
2492.467	271.0	1.2	-29.1	0.0	30.3	41.4	4:01:48 PM - 3/23/2020
2492.467	271.0	1.2	-29.1	0.0	30.3	64.9	4:01:48 PM - 3/23/2020



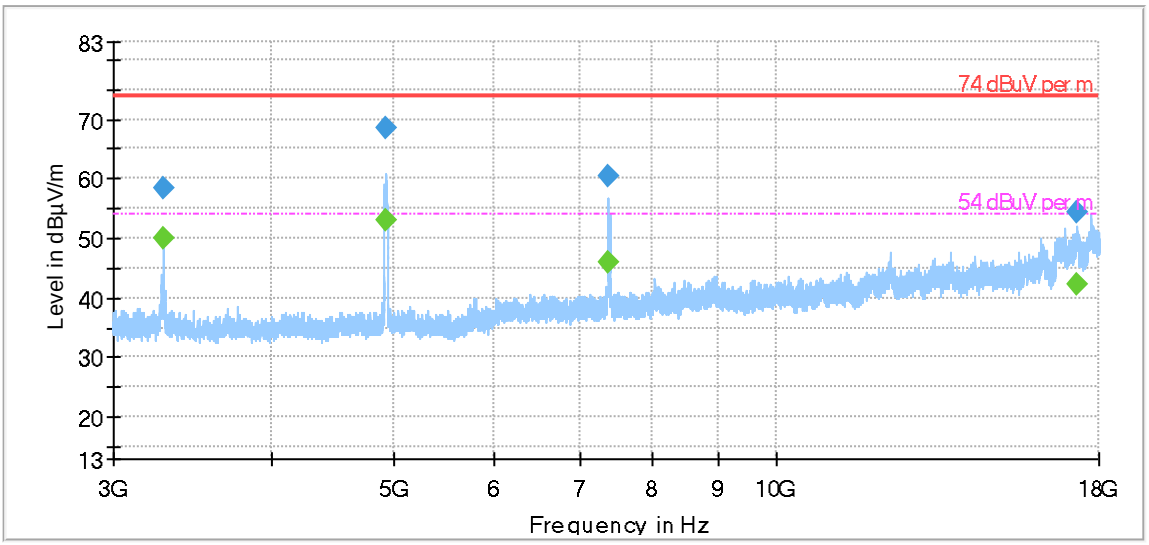
Preview Result 1-PK+ 74 dBuV per m 54 dBuV per m
Final_Result PK+ Final_Result AVG

Plot #11 Radiated Emissions: 3-18 GHz		
Modulation: 802.11g	Channel: High	87.8% Duty Cycle

Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
3282.418	---	49.90	54.00	4.10	200.0	1000.000	291.0	H
3282.418	58.51	---	74.00	15.49	200.0	1000.000	291.0	H
4919.916	68.51	---	74.00	5.49	200.0	1000.000	262.0	H
4919.916	---	53.17	54.00	0.83	200.0	1000.000	262.0	H
7381.559	60.30	---	74.00	13.70	200.0	1000.000	260.0	H
7381.559	---	45.92	54.00	8.08	200.0	1000.000	260.0	H
17296.441	---	42.14	54.00	11.86	200.0	1000.000	140.0	V
17296.441	54.24	---	74.00	19.76	200.0	1000.000	140.0	V

Frequency (MHz)	Azimuth (deg)	Corr. (dB/m)
3282.418	93.0	-8.0
3282.418	93.0	-8.0
4919.916	249.0	-4.3
4919.916	249.0	-4.3
7381.559	309.0	0.6
7381.559	309.0	0.6
17296.441	32.0	16.9
17296.441	32.0	16.9



Preview Result 1-PK+ 74 dBuV per m 54 dBuV per m
Final_Result PK+ Final_Result AVG

9 Test setup photos

Setup photos are included in supporting file name: "EMC_GARMI-064-19001_15.247_WIFI_DTS_Setup_Photos.pdf"

10 Test Equipment And Ancillaries Used For Testing

Equipment Type	Manufacturer	Model	Serial #	Calibration Cycle	Last Calibration Date
Loop Antenna	ETS Lindgren	6507	161344	3 years	10/26/2017
Biconlog Antenna	ETS Lindgren	3142E	166067	3 years	03/12/2020
Horn Antenna	ETS Lindgren	3115	35114	3 years	07/31/2017
Horn Antenna	ETS Lindgren	3117-PA	215984	3 years	01/26/2018
Horn Antenna	ETS Lindgren	3116	70497	3 years	10/31/2017
EMI Test Receiver	R&S	ESW44	101715	3 years	01/06/2020
Spectrum Analyzer	R&S	FSU26	200065	3 years	07/16/2019
Thermometer Humidity Monitor	Control Company	36934-164	191872028	2 years	01/10/2019

Note: 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.

11 History

Date	Report Name	Changes to report	Report prepared by
2020-04-16	EMC_GARMI-064-19001_15.247_WIFI_DTS	Initial Version	Chin Ming Lui
2020-04-20	EMC_GARMI-064-19001_15.247_WIFI_DTS_REV1	Modified sample revision note for pre-production PCB from N2K to communication circuit	Chin Ming Lui
2020-04-30	EMC_GARMI-064-19001_15.247_WIFI_DTS_REV2	Add 3dB beamforming gain to output power for 802.11n HT20 operating mode	Chin Ming Lui
2020-05-06	EMC_GARMI-064-19001_15.247_WIFI_DTS_REV3	Updated test sample configuration, radio & antenna information, and Maximum Conducted Output Power & PSD measurement tables	Chin Ming Lui
2020-05-11	EMC_GARMI-064-19001_15.247_WIFI_DTS_REV4	Updated EUT SW version from Test Rev 7 to 1.20	Chin Ming Lui
2020-05-18	EMC_GARMI-064-19001_15.247_WIFI_DTS_REV5	Updated test sample configuration by adding power control through SW. Re-measured and updated PSD and Non-Restricted Band Edge for 802.11b,g,n. Re-measured and updated Restricted Band Edge for 802.11g Low Ch and 802.11n HT20 High Ch.	Chin Ming Lui
2020-05-22	EMC_GARMI-064-19001_15.247_WIFI_DTS_REV6	Updated WiFi Antenna PN and Antenna Gain	Kevin Wang

<<< The End >>>