Testing Tomorrow's Technology

Class II Permissive Change Application

For

Part 2, Subpart J, Paragraph 2.907 Equipment Authorization of Certification for an Intentional Radiator per Part 15, Subpart C, paragraphs 15.207, 15.209 and 15.247

And

Innovation, Science, and Economic Development Canada Certification Per
IC RSS-Gen General Requirements for Radio Apparatus (Issue 5)
And
RSS-247Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSS) and License-Exempt Local Area Network (LE-LAN) Devices (Issue 2)

For the

Inventek Systems

Model Number: ISM4343-X

FCC ID: O7P-4343
IC: 10147A-4343

UST Project: 22-0116
Issue Date: April 4, 2022

Total Pages:73

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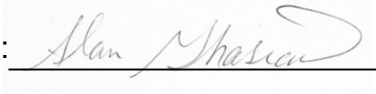
I certify that I am authorized to sign for the Test Agency and that all of the statements in this report and in the Exhibits attached hereto are true and correct to the best of my knowledge and belief:

US TECH (Agent Responsible For Test):

By: Alan Ghasiani

Name: 

Title: Compliance Engineer – President

Date: April 4, 2022

NVLAP LAB CODE 200162-0

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MEASUREMENT TECHNICAL REPORT

COMPANY NAME: Inventek Systems
MODEL: ISM4343-X
FCC ID: O7P-4343
IC: 10147A-4343
DATE: April 4, 2022

This report concerns (check one): Original grant
Class II change X

Equipment type: 2.4 GHz Transmitter Module

Deferred grant requested per 47 CFR 0.457(d)(1)(ii)? yes_____ No X

If yes, defer until:_____N/A_____
date
agrees to notify the Commission by N/A
date
of the intended date of announcement of the product so that the grant can be issued on that date.

Report prepared by:

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1 General Information

1.1 Purpose of this Report

This report is generated to include the addition of two sub-model variants for this radio module. The two sub-models are identical to the originally certified module. The only difference is that the antenna path circuity will be a trace design to allow the module to be sold as a SIP module. Additional details regarding the trace design will provided to support the trace design approval. No other changes are made. The new sub-models remain electrically identical to the originally certified module therefore no additional testing was deemed necessary.

The previous test results are presented below so that it can be used as representative test data for the two sub models.

The sub-model numbers are: ISM4343-WBM-L151 and ISM4343-WB-L151.

1.2 Characterization of Test Sample

The sample used for testing was received by US Tech on September 15, 2018 in good operating condition.

1.3 Product Description

The Equipment Under Test (EUT) is the Inventek eS-WiFi SIP/Module:

- Models
  - ISM4343-X
  - ISM4343-WBM-L54
  - ISM4343-WBM-L151
  - ISM4343-WB-L151

The ISM4343-WBM-L54, ISM4343-WBM-L151 and ISM4343-WB-L151 is part of the Inventek Systems eS-WiFi family of SIPs/Modules targeting embedded Wi-Fi 802.11 b/g/n and BT/BLE applications. Inventek eS-WiFi SIPs/Modules offer a plug-and-play solutions that enables the embedded sector to integrated Wi-Fi and BT/BLE. The eS-WiFi SIP hardware system consists of Infineon CYW4343W Wi-Fi/BT/BLE radio, and a ST Micro host MCU. The module provides SPI and UART interfaces, enabling easy connection to an embedded design.

eS-WiFi ISM4343-X SIPs/Modules are offered in multiple configurations:

1. SIP, 10mm x10mm, must use same antenna designs (per Layout Guidelines, DOC-AN-20117) as the -C and -U modules below
    a. ISM4343-WBM-L151
        i. WiFi/BT/BLE with integrated MCU
    b. ISM4343-WB-L151
        i. WiFi/BT/BLE no integrated MCU
2. Module (SIP with Antenna), 15mm x 34mm, both configurations use ISM4343-WBM-L151 core
    a. ISM4343-WBM-L54-C
        i. WiFi/BT/BLE module with integrated antenna.
        ii. Uses chip antenna with Inventek P/N W245-SC.
    b. ISM4343-WBM-L54-U
        i. WiFi/BT/BLE module with U.FL connector.
        ii. Designs must use the Inventek W24P-U external antenna.

In addition, Inventek offers an evaluation board (ISMART4343) for customer evaluation and integration of the eS-WiFi module into their system.

1.4 Configuration of Tested System

The Test Sample was tested per *ANSI C63.10:2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices* for the intentional radiator aspect of the device and *ANSI C63.4:2014, Methods of Measurement of Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (2014)* for the unintentional radiator aspect of the device as well as FCC subpart B and C of Part 15 and per FCC KDB Publication number 558074 v03r05 for Digital Transmission Systems Operating Under section 15.247.

Digital RF conducted and radiated emissions data below 1 GHz were taken with the measuring receiver (or spectrum analyzer's) resolution bandwidth adjusted to 9 kHz and 120 kHz, respectively. All measurements performed above 1.0 GHz were made with a RBW of 1 MHz. All measurements are peak unless stated otherwise. The video filter associated with the spectrum analyzer was set to 3 times the RBW or as required per the standard throughout the evaluation process.

A list of EUT and Peripherals is found in Table 1 below. A block diagram of the tested system is shown in Figure 1. Test configuration photographs for spurious and fundamental emissions are provided in separate Appendices.

1.5 Test Facility

Testing was performed at US Tech's measurement facility at 3505 Francis Circle, Alpharetta, GA 30004. This site has been fully described and registered with the FCC. Its designation number is US5301. Additionally this site has also been fully described and submitted to Industry Canada (IC), and has been approved under file number 9900A-1.

1.6 Related Submittal(s)/Grant(s)

The EUT is subject to the following FCC Equipment Authorizations:

a) Certification of the transmitter incorporated within the EUT, see test data presented herein.

Table 1. EUT and Peripherals

PERIPHERAL MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	FCC/IC ID	CABLES P/D
Inventek	ISM4343-WBM-L151 and ISM4343-WB-L151	Engineering Sample	FCC ID: O7P-4343 IC ID: 10147A-4343 (pending)	UD
Hewlett-Packard (Laptop)	EliteBook 8530p	2CE010000TG	Unknown	-
Hewlett-Packard (Power Supply Adapter)	384020-001	PA-1900-08H2	Not Applicable	3.0 m UP
Antenna See antenna details	--	--	--	--

U= Unshielded
S= Shielded
P= Power
D= Data

2 Tests and Measurements

2.1 Test Equipment

The table below lists test equipment used to evaluate this product. Model numbers, serial numbers and their calibration status are included herein.

Table 2. Test Instruments

TEST INSTRUMENT	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	CALIBRATION DUE DATE
Spectrum Analyzer	Agilent	E4407B	US41442935	8/17/2020
Spectrum Analyzer	Rigol	*DSA815	DSA8A180300138	10/11/2018
Rf Preamp 100 kHz to 1.3 GHz	Hewlett-Packard	8447D	1937A02980	3/7/2019
Preamp 1.0 GHz to 26.0 GHz	Hewlett-Packard	8449B	3008A00480	2/28/2019
Loop Antenna	A. H. Systems	SAS-200/562	142	1/22/2020 2 yr.
Biconical Antenna	EMCO	3110B	9307-1431	5/2/2019 2 yr
Log Periodic Antenna	EMCO	3146	9305-3600	5/1/2019 2 yr
Horn Antenna	EMCO	3115	9107-3723	9/22/2018 2 yr
High Pass Filter	Microwave Chircuits	H3R020G2	001DC9528	3/08/2019
8 Db ATTENUATOR	Mini-Circuits	VAT-8 15542	30519	3/8/2019

Note: The calibration interval of the above test instruments are 12 months unless stated otherwise and all calibrations are traceable to NIST/USA.
(*)= used for power line conducted emissions testing

2.2 Modifications to EUT Hardware

No modifications were made by US Tech to bring the EUT into compliance with FCC Part 15.247 or IC RSS-210 requirements.

2.3 Number of Measurements for Intentional Radiators (15.31(m), RSS-Gen 6.8)

Measurements of intentional radiators or receivers shall be performed and reported for each band in which the device can be operated, with the device operating at the number of frequencies in each band specified in Table 3 as follows:

Table 3. Number of Test Frequencies for Intentional Radiators

Frequency Range over which the device operates	Number of Frequencies	Location in the Range of operation
1 MHz or less	1	Middle
1 to 10 MHz	2	1 near the top 1 near the bottom
Greater than 10 MHz	3	1 near top 1 near middle 1 near bottom

Because the EUT operates over 2.4 GHz to 2.4835 GHz, 3 test frequencies will be used.

2.4 Frequency Range of Radiated Measurements (Part 15.33, RSS-Gen 6.13)

2.4.1 Intentional Radiator

The spectrum shall be investigated for the intentional radiator from the lowest RF signal generated in the EUT, without going below 9 kHz to the 10th harmonic of the highest fundamental frequency generated or 40 GHz, whichever is the lowest.

2.4.2 Unintentional Radiator

For the digital device, an unintentional radiator, the frequency range shall be 30 MHz to 1000 MHz, or to the range specified in 2.4.1 above, whichever is the higher range of investigation.

2.5 Measurement Detector Function and Bandwidth (CFR 15.35, RSS-Gen 6.9, 6.13)

The radiated and conducted emissions limits shown herein are based on the following:

2.5.1 Detector Function and Associated Bandwidth

On frequencies below 1000 MHz, the limits herein are based upon measurement equipment employing a CISPR Quasi-peak detector function and related measurement bandwidths (i.e. 9 kHz from 150 kHz to 30 MHz and 120 kHz from 30 MHz to 1000 MHz). Alternatively, measurements may be made with equipment employing a peak detector function as long as the same bandwidths specified for the Quasi-peak device are used.

2.5.2 Corresponding Peak and Average Requirements

Above 1000 MHz, radiated limits are based on measuring instrumentation employing an average detector function. When average radiated emissions are specified there is also a corresponding Peak requirement, as measured using a peak detector, of 20 dB greater than the average limit. For all measurements above 1000 MHz the Resolution Bandwidth shall be at least 1 MHz.

2.6 EUT Antenna Requirements (CFR 15.203, RSS-Gen 6.7)

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. Only the antenna(s) listed in Table 4 will be used with this module.

Table 4. Allowed Antenna(s)

REPORT REFERENCE	MANUFACTURER	TYPE OF ANTENNA	MODEL	GAIN dB_i	TYPE OF CONNECTOR
Chip Antenna	Inventek Systems	Chip	W245-SC	+1.4	Chip

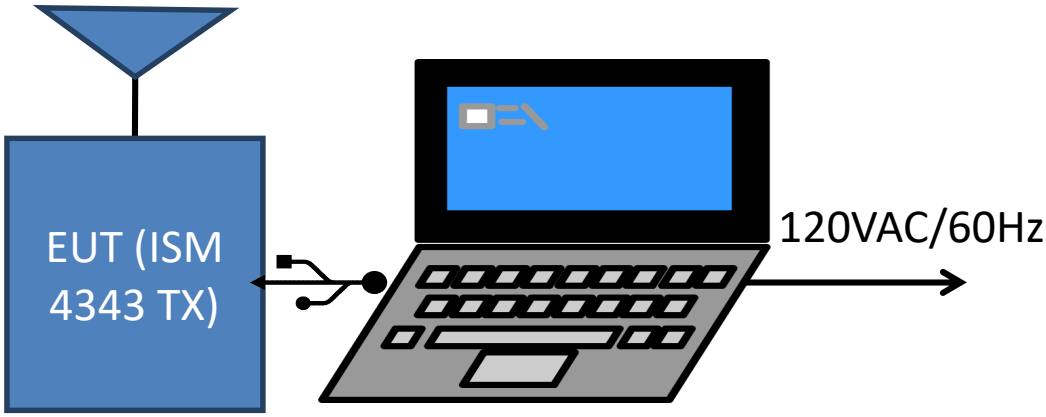

Figure 1. Block Diagram of Test Configuration

Note: The laptop is used for programming the radio module only.

2.7 Restricted Bands of Operation (Part 15.205, RSS-Gen 8.10)

Only spurious emissions can fall in the frequency bands of CFR 15.205. The field strength of these spurious cannot exceed the limits of 15.209. Radiated harmonics and other Spurious are examined for this requirement see paragraph 2.10.

2.8 Transmitter Duty Cycle (Part15.35 (c), RSS-Gen 6.10)

The EUT employs pulse transmission however for testing purpose the EUT was programmed to transmit at a rate >98%. The pulse transmission requirements of this subpart were acknowledge and considered during testing.

When the radiated emissions limit is expressed as an average value, and the transmitter is pulsed, the measured field strength shall be determined by applying a Duty Cycle Correction Factor based upon dividing the total ON time during the first 100 ms period by 100 ms (or by the period if less than 100 ms). The duty cycle may also be expressed logarithmically in dB.

2.9 Antenna Conducted Intentional and Spurious Emissions (CFR 15.209, 15.247(d)) (IC RSS 247, 5.5))

The EUT was put into a continuous-transmit mode of operation and tested per ANSI C63.10-2013 for conducted out of band emissions emanating from the antenna port over the frequency range of 30 MHz to ten times the highest clock frequency generate or used in this case, 25 GHz. A conducted scan was performed on the EUT to identify and record spurious signals that were related to the transmitter. Antenna Conducted Emissions of a significant magnitude that fell within restricted bands were then measured as radiated emissions on the OATS. The conducted emissions graphs are found in Figures 3through 8below.The limit for antenna conducted power is 1 Watt (30 dBm) per 15.247 (b)(3).

For Conducted RF antenna tests, the RBW was set to 100 kHz, video bandwidth (VBW)> RBW, scan up through the 10^{th} harmonic of the fundamental frequency. All harmonics/spurs must be at least 20 dB down from the highest emission level within the authorized band.

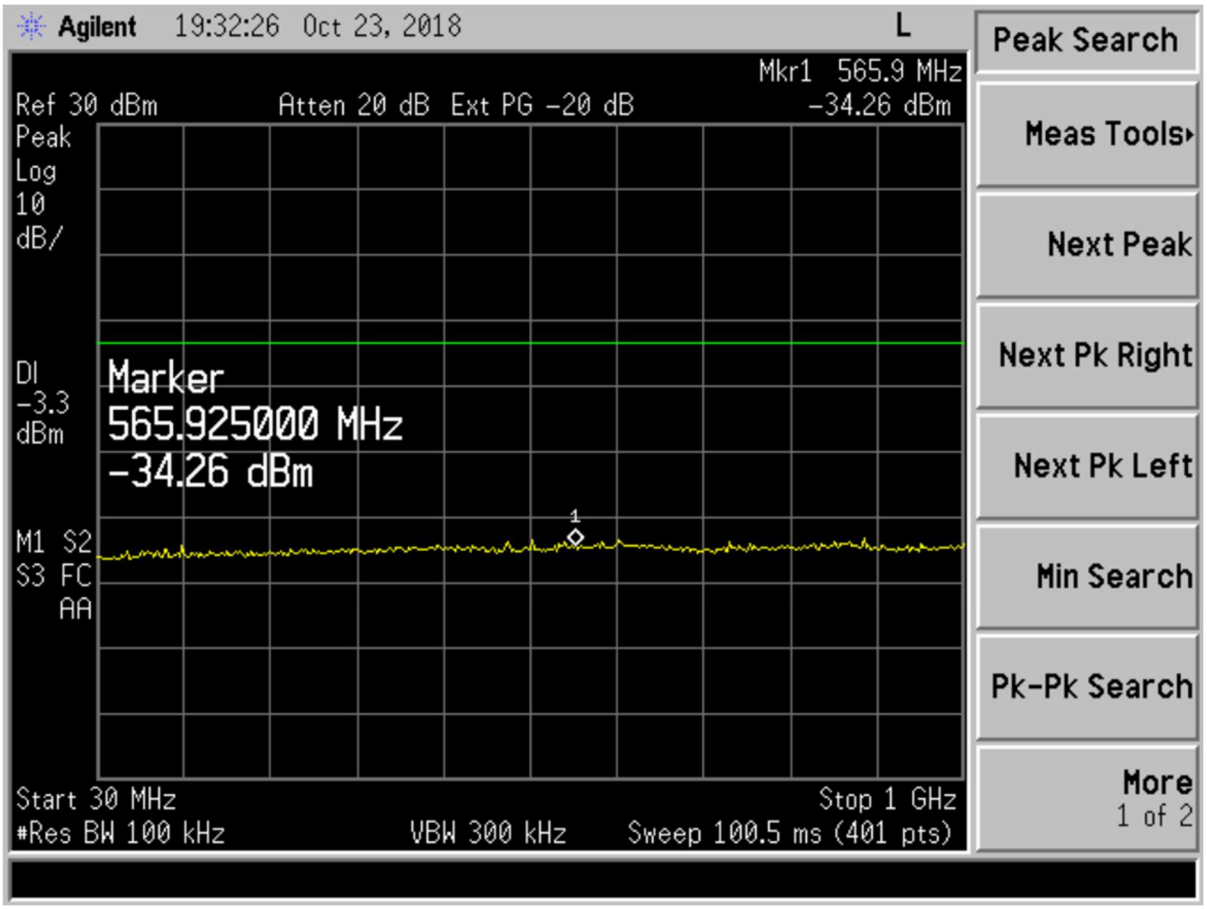

Figure 2. 802.11b, Channel 1, 30-1000 MHz

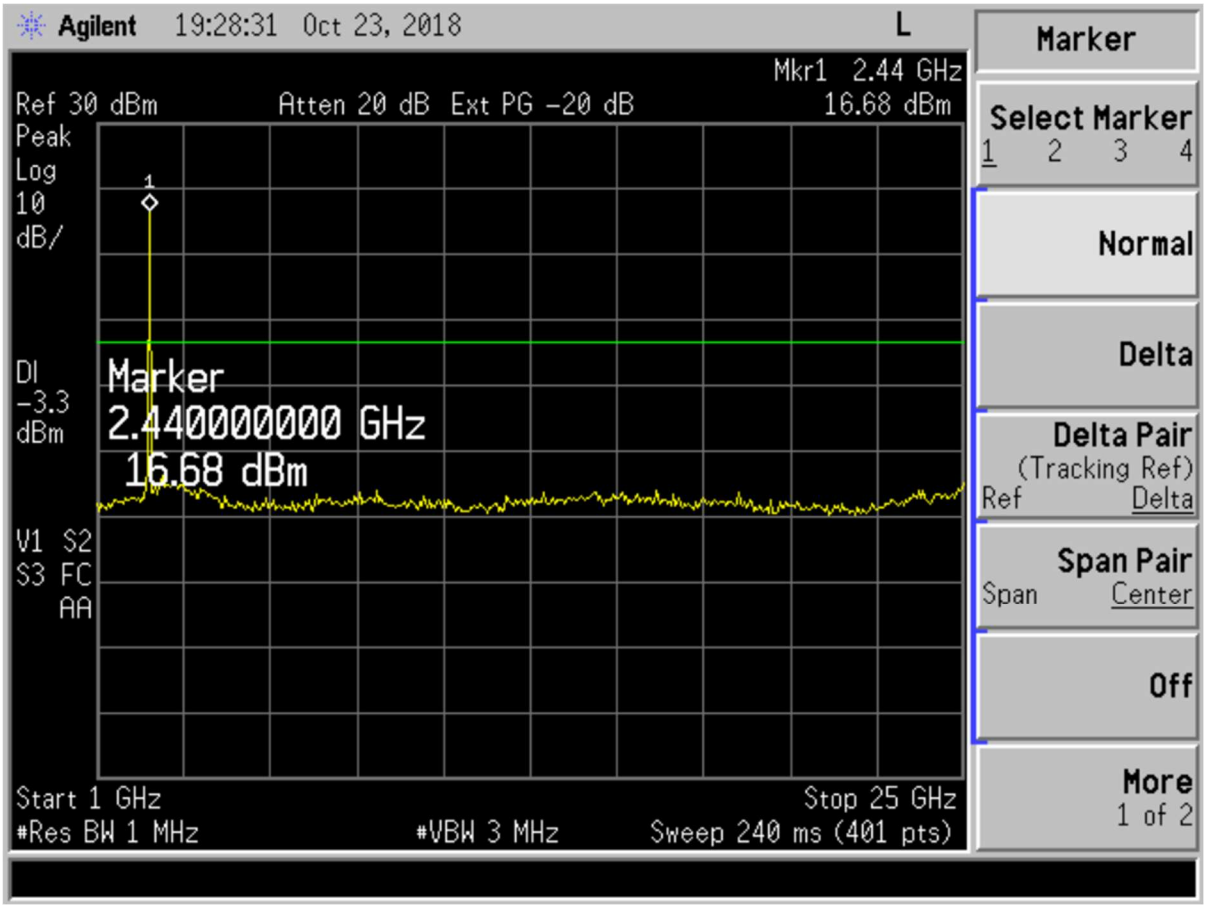

Figure 3. 802.11b, Channel 1, 1 – 25 GHz

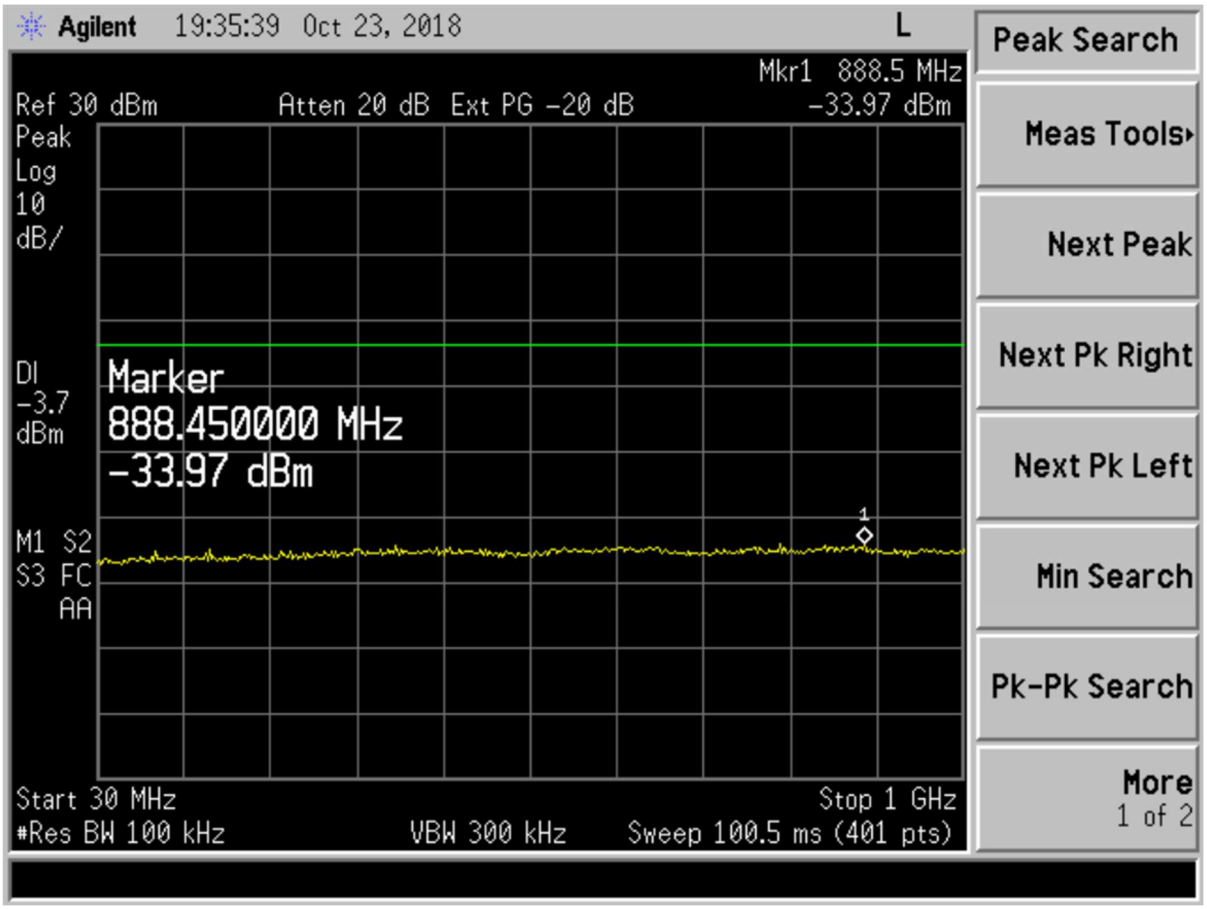

Figure 4. 802.11b, Channel 6, 30-1000 MHz

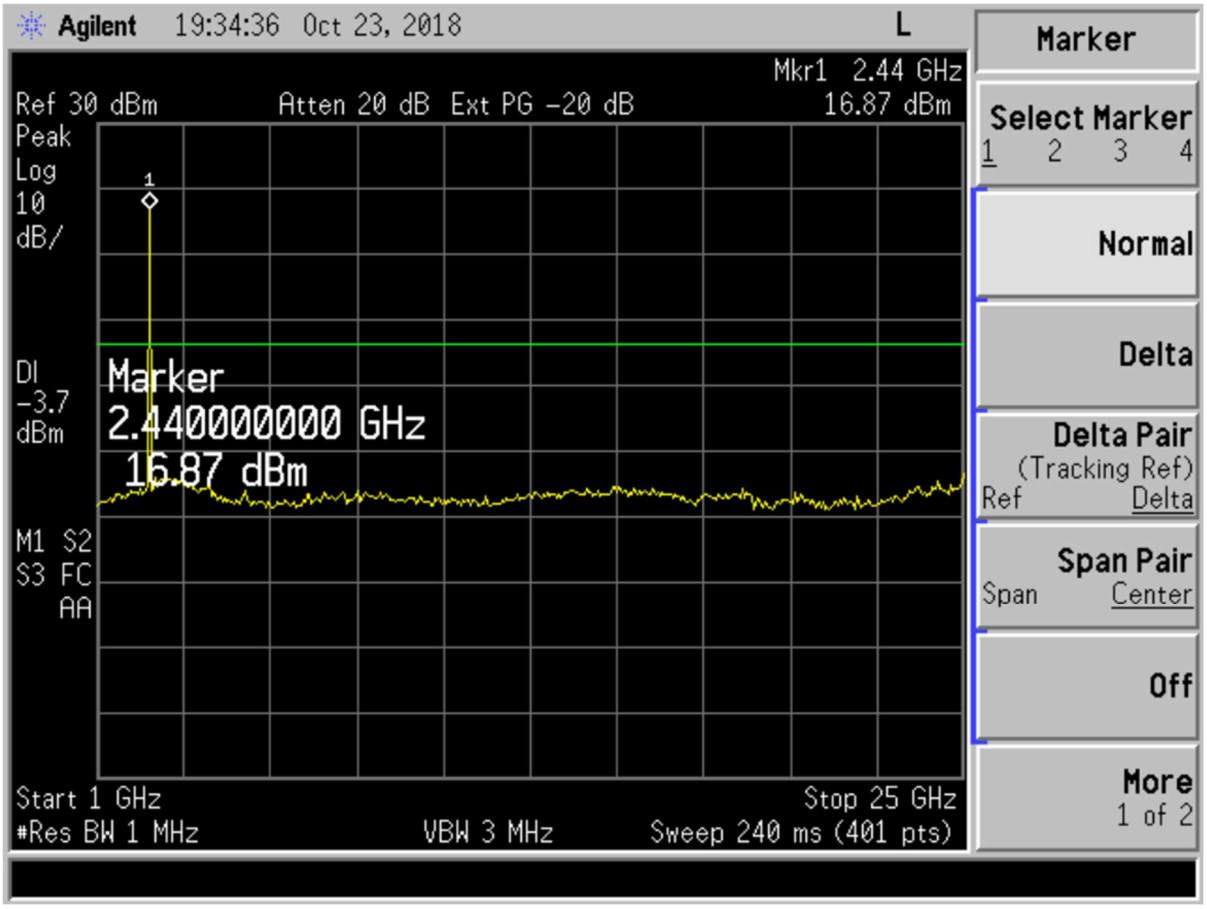

Figure 5. 802.11b, Channel 6, 1 – 25 GHz

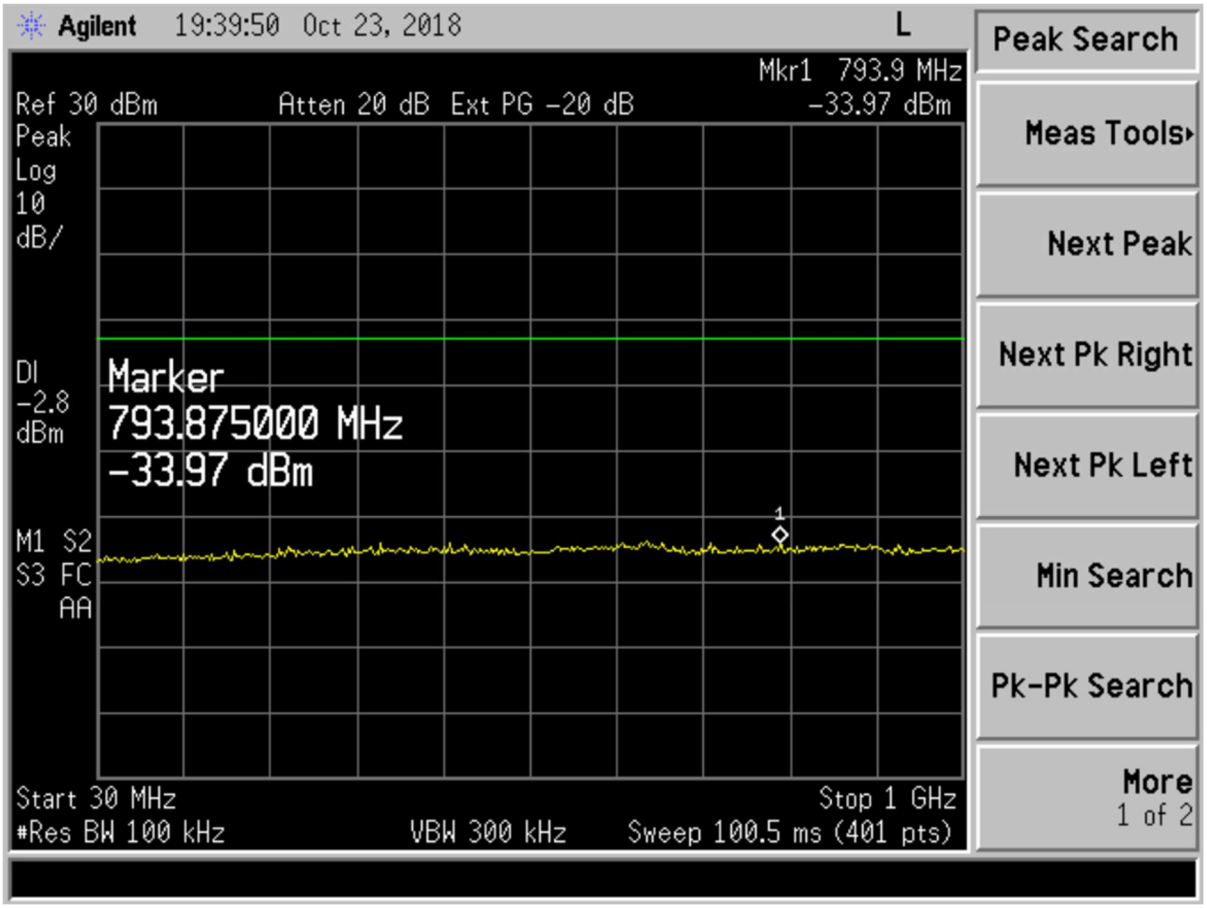

Figure 6. 802.11b, Channel 11, 30-1000 MHz

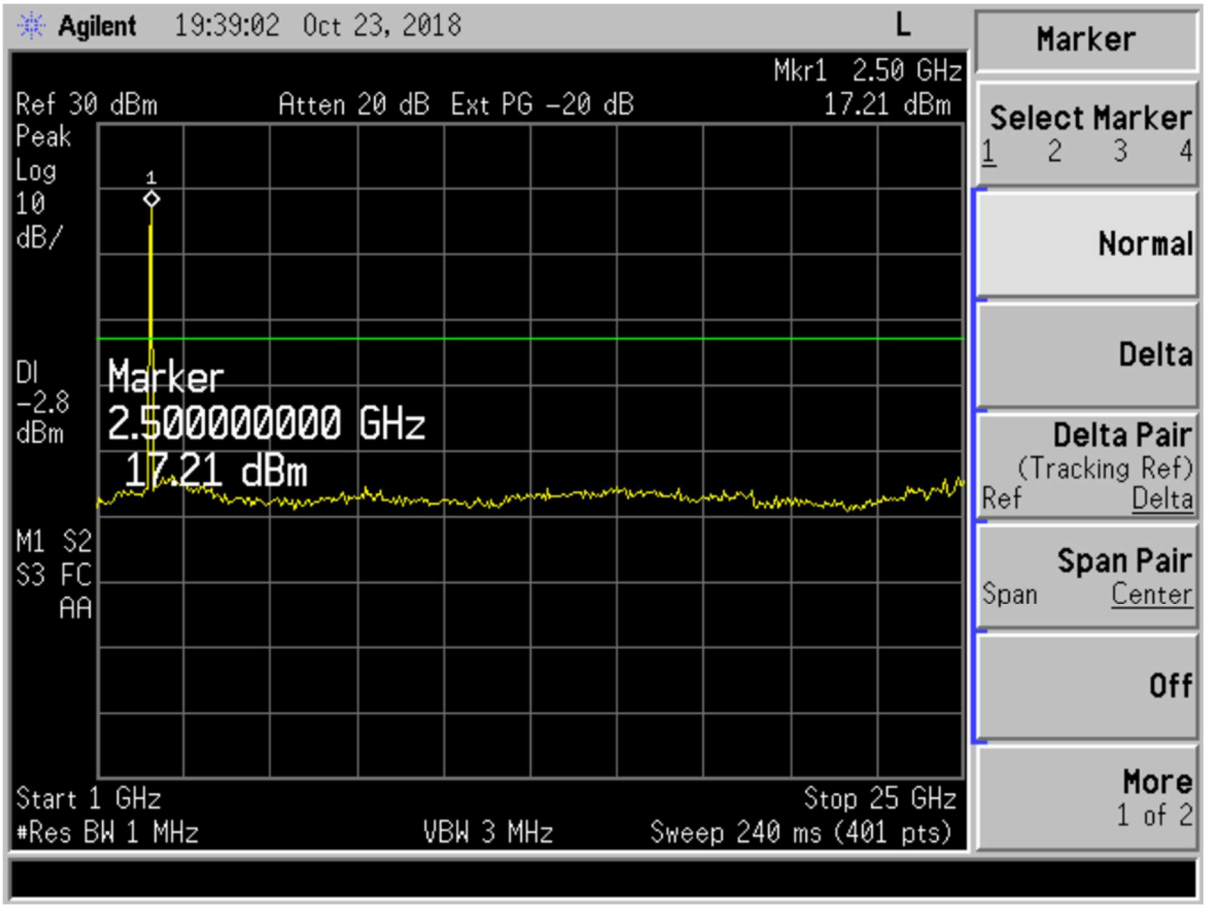

Figure 7. 802.11b, Channel 11, 1 - 25 GHz

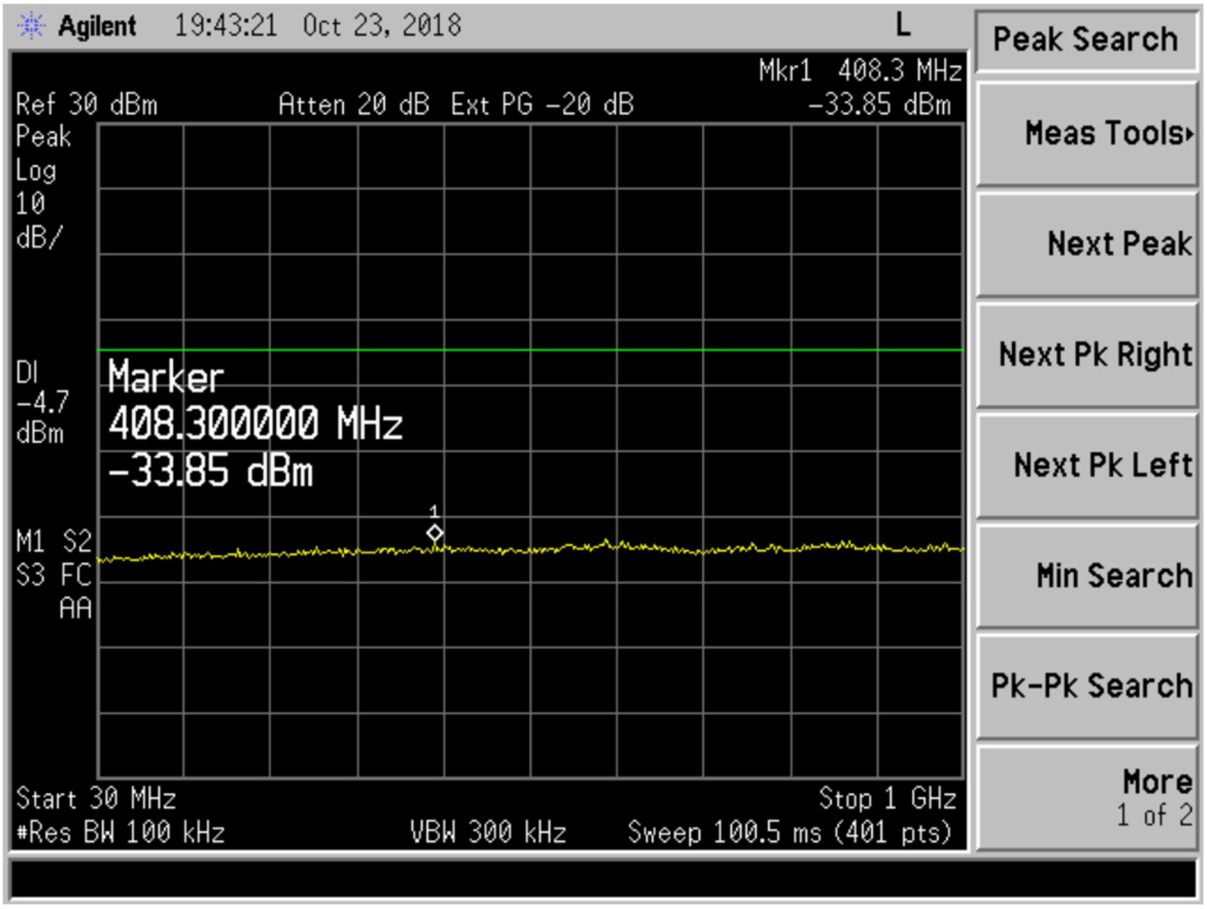

Figure 8. 802.11g, Channel 1, 30-1000 MHz

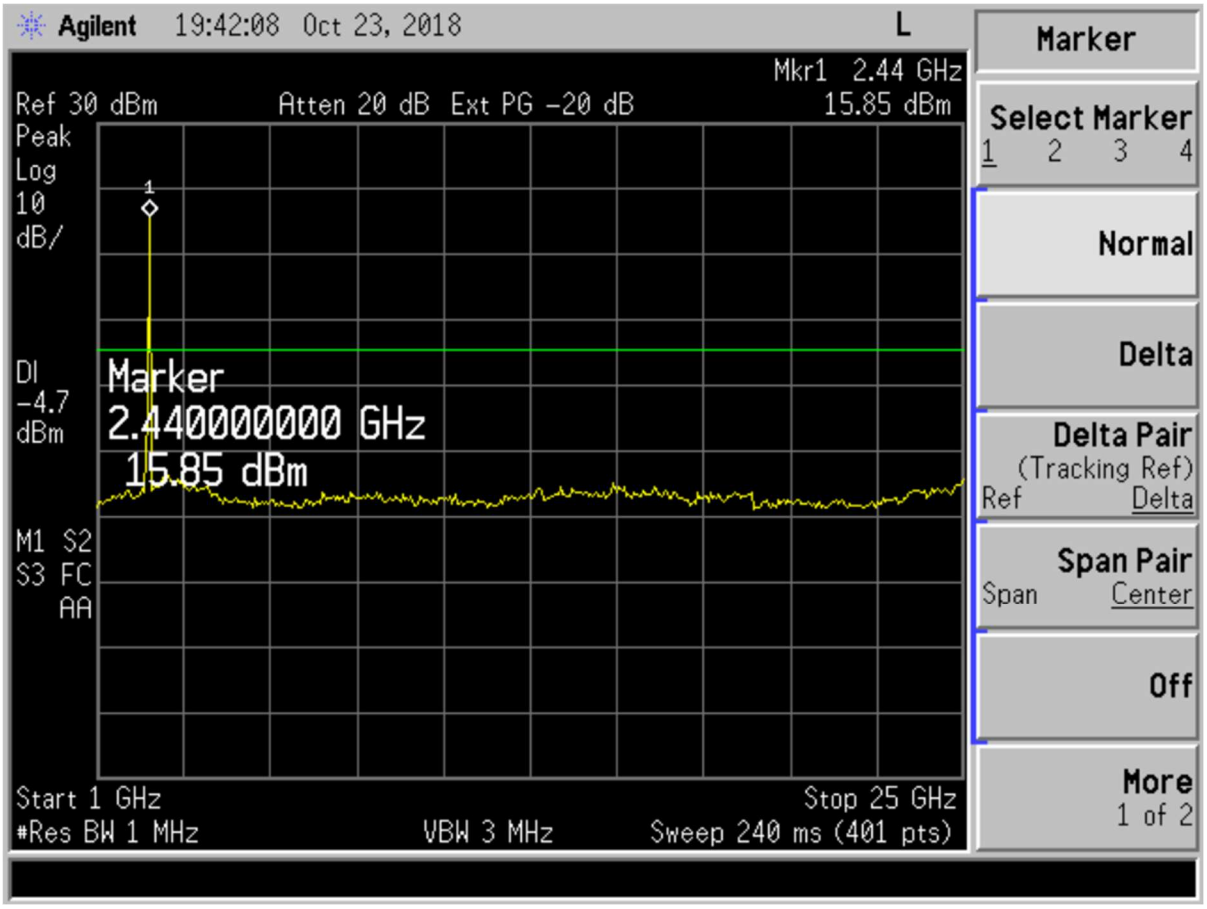

Figure 9. 802.11g, Channel 1, 1 – 25 GHz

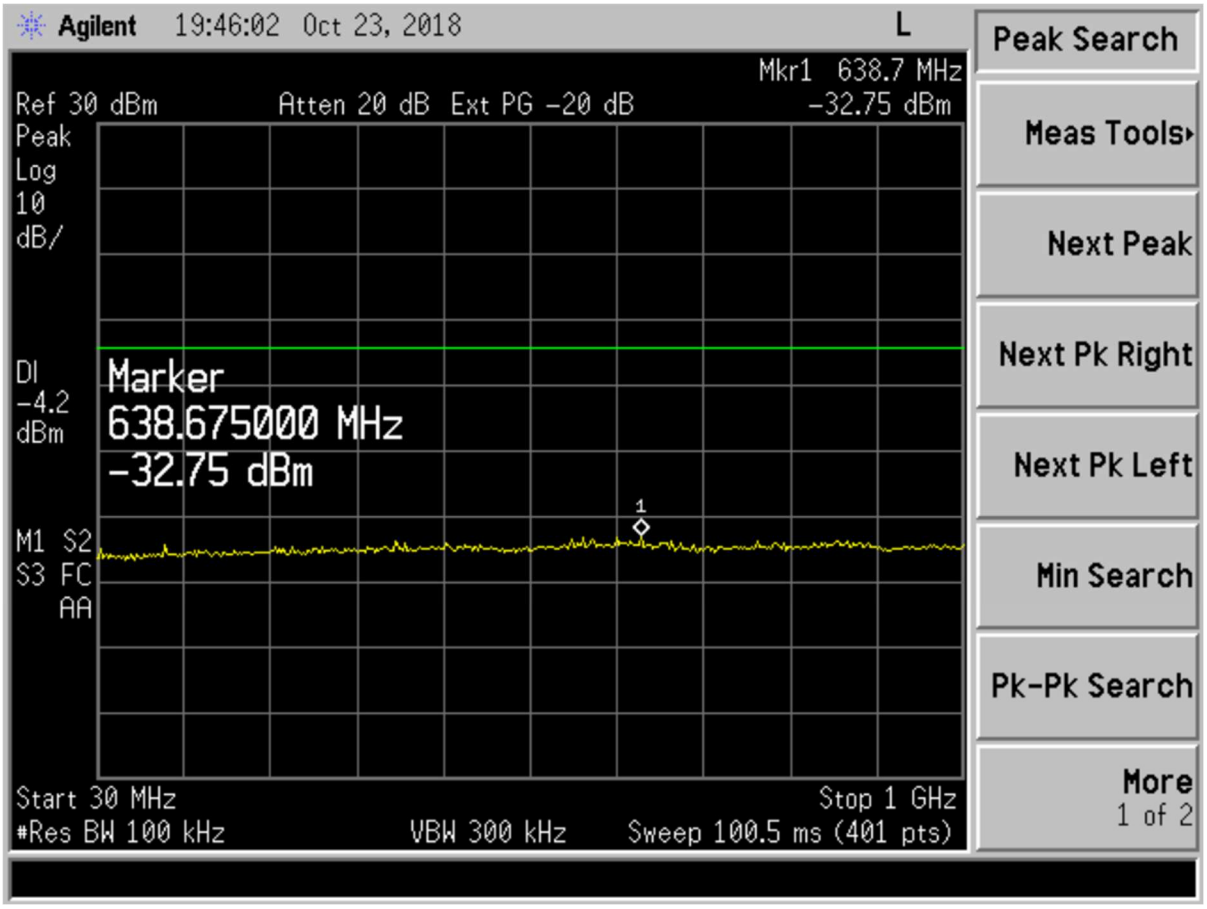

Figure 10. 802.11g, Channel 6, 30-1000 MHz

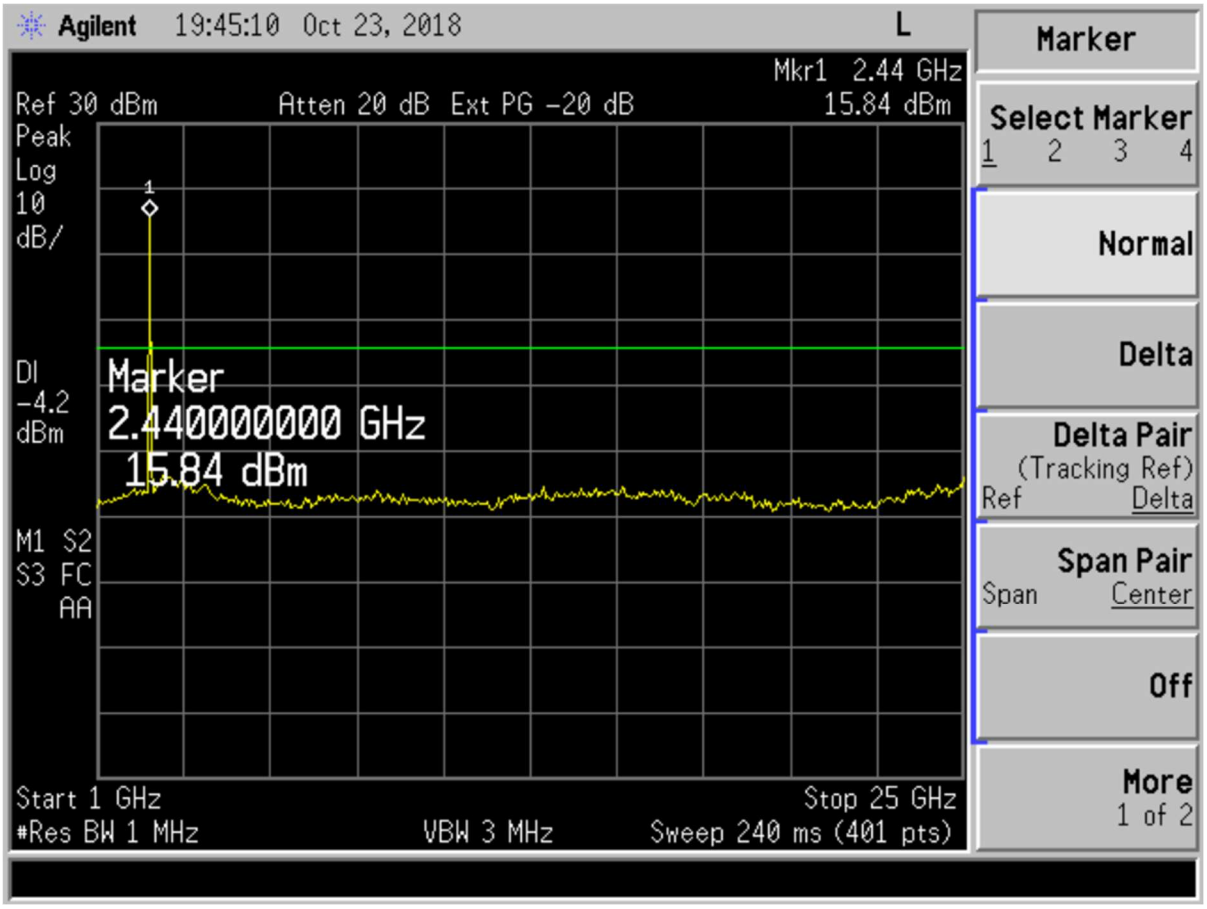

Figure 11. 802.11g, Channel 6, 1 - 25 GHz

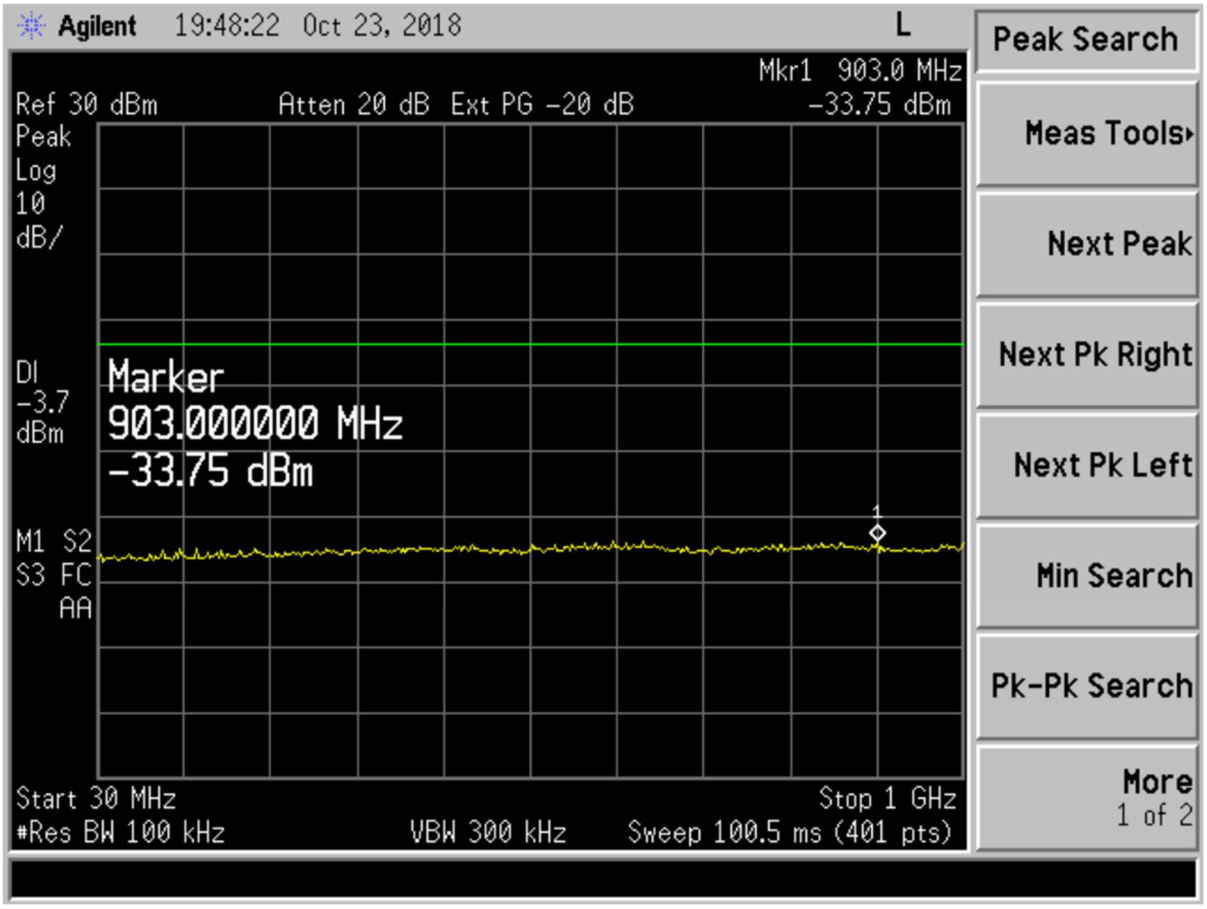

Figure 12. 802.11g, Channel 11, 30-1000 MHz

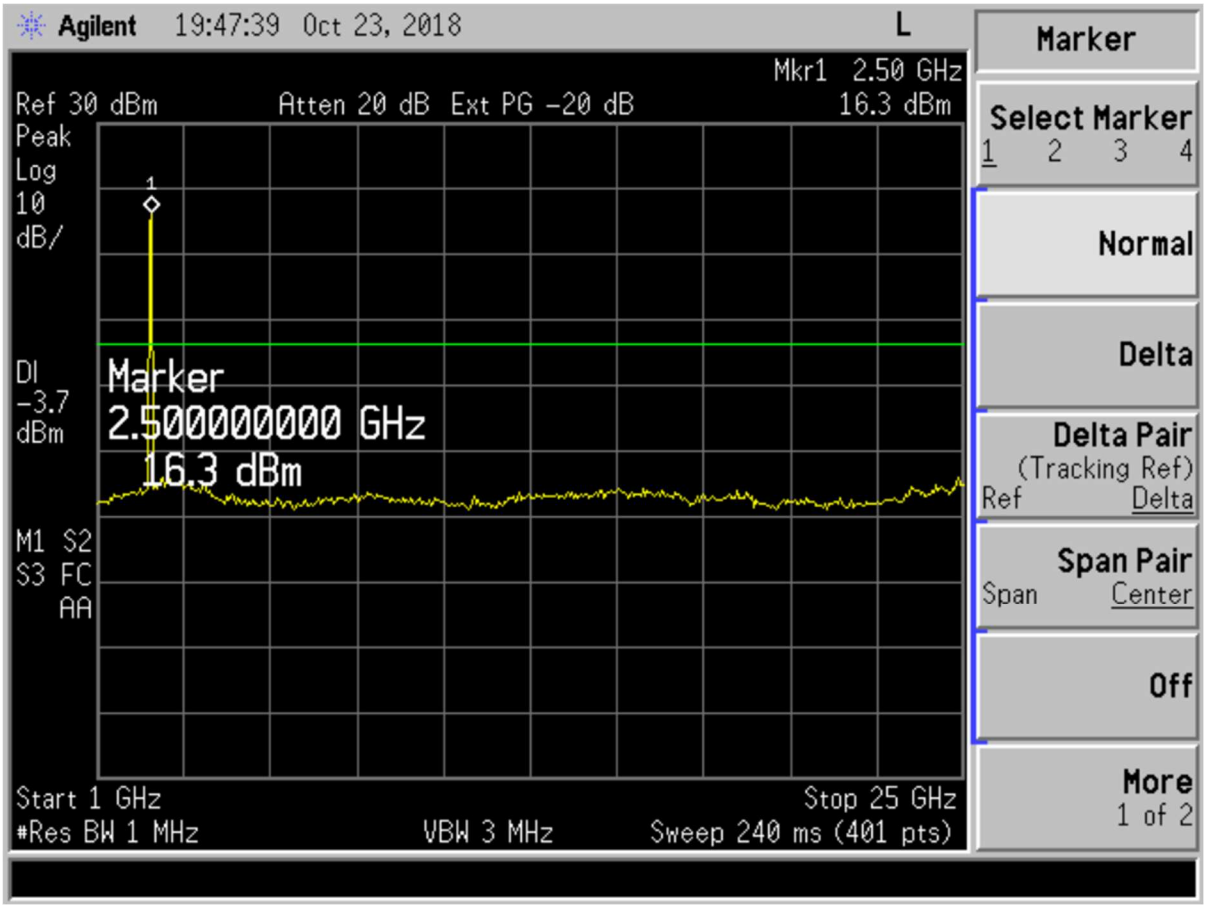

Figure 13. 802.11g, Channel 11, 1 – 25 GHz

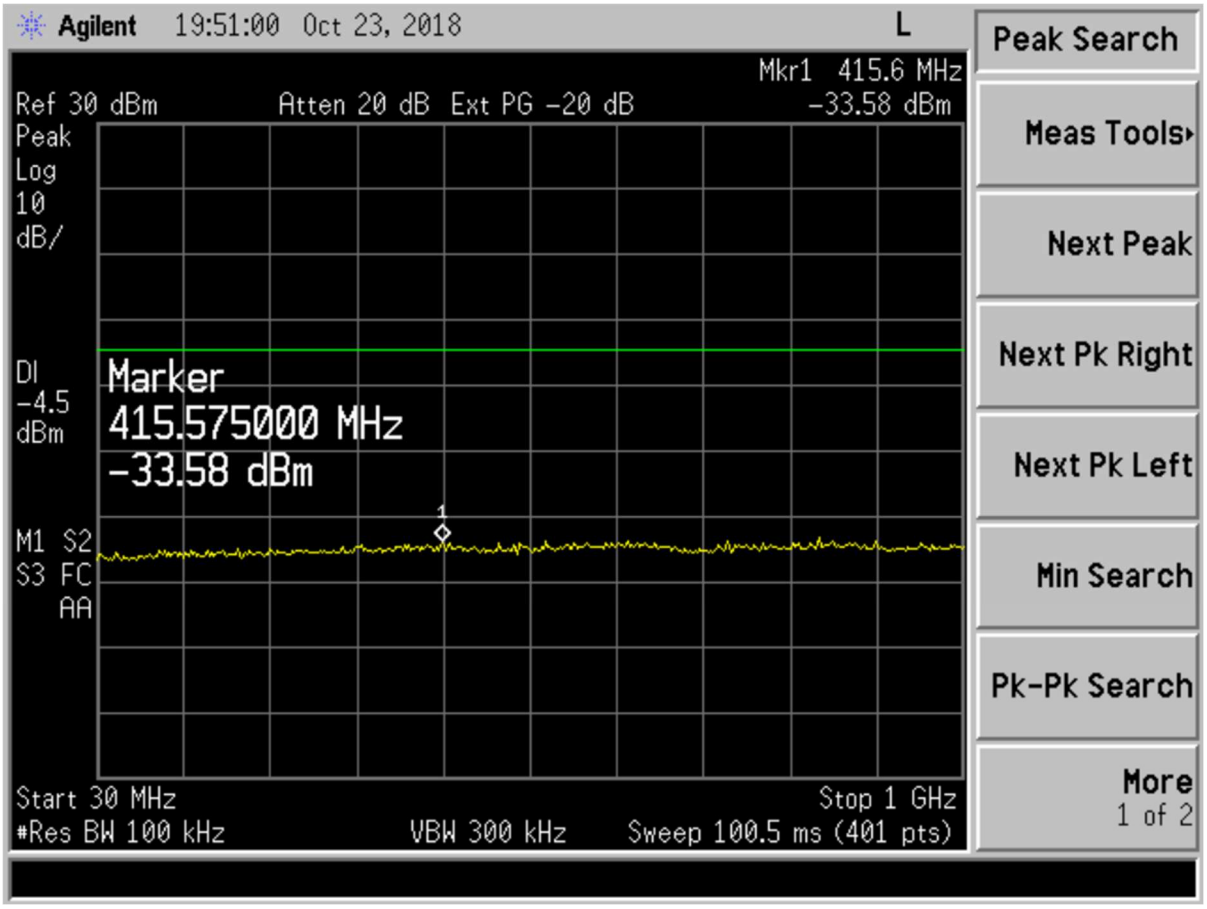

Figure 14. 802.11n, Channel 1, 30-1000 MHz

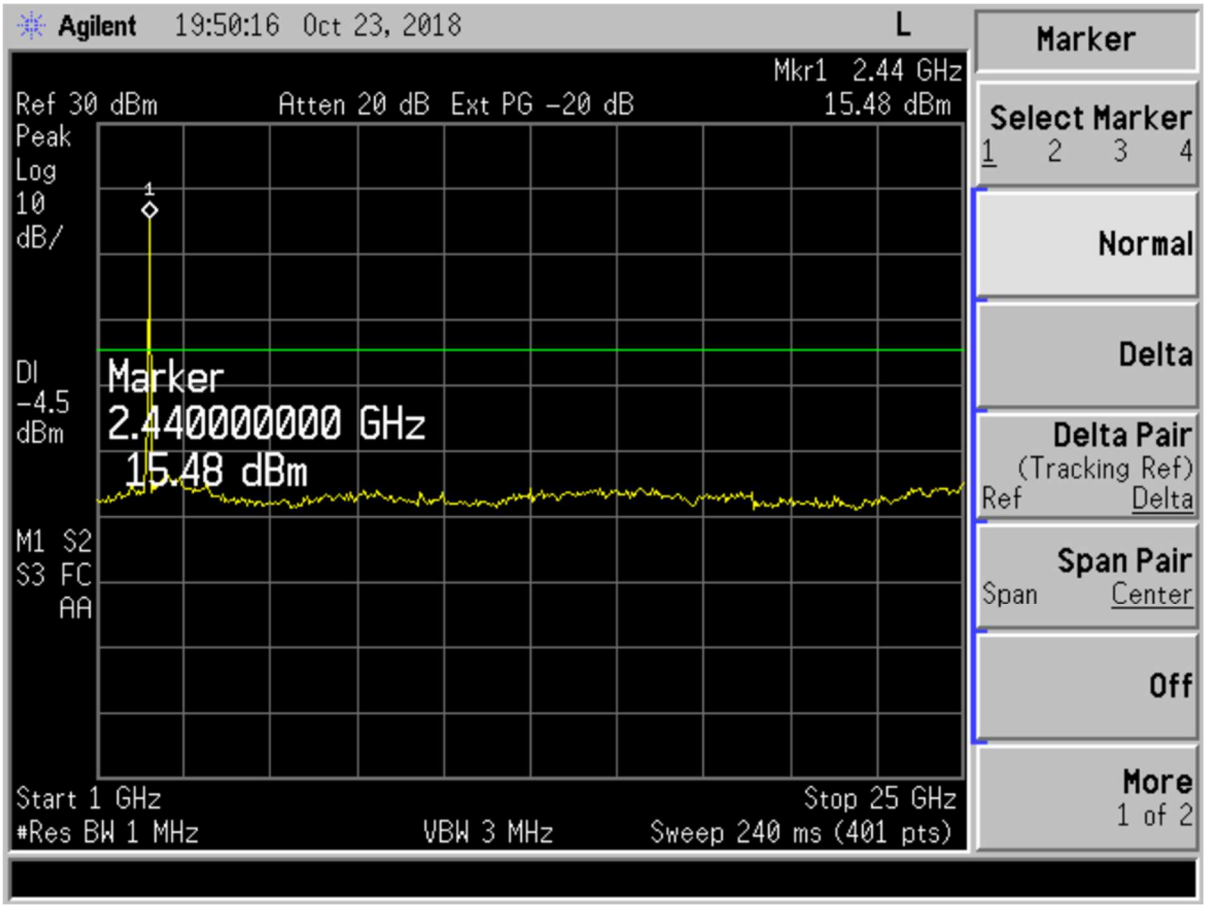

Figure 15. 802.11n, Channel 1, 1- 25 GHz

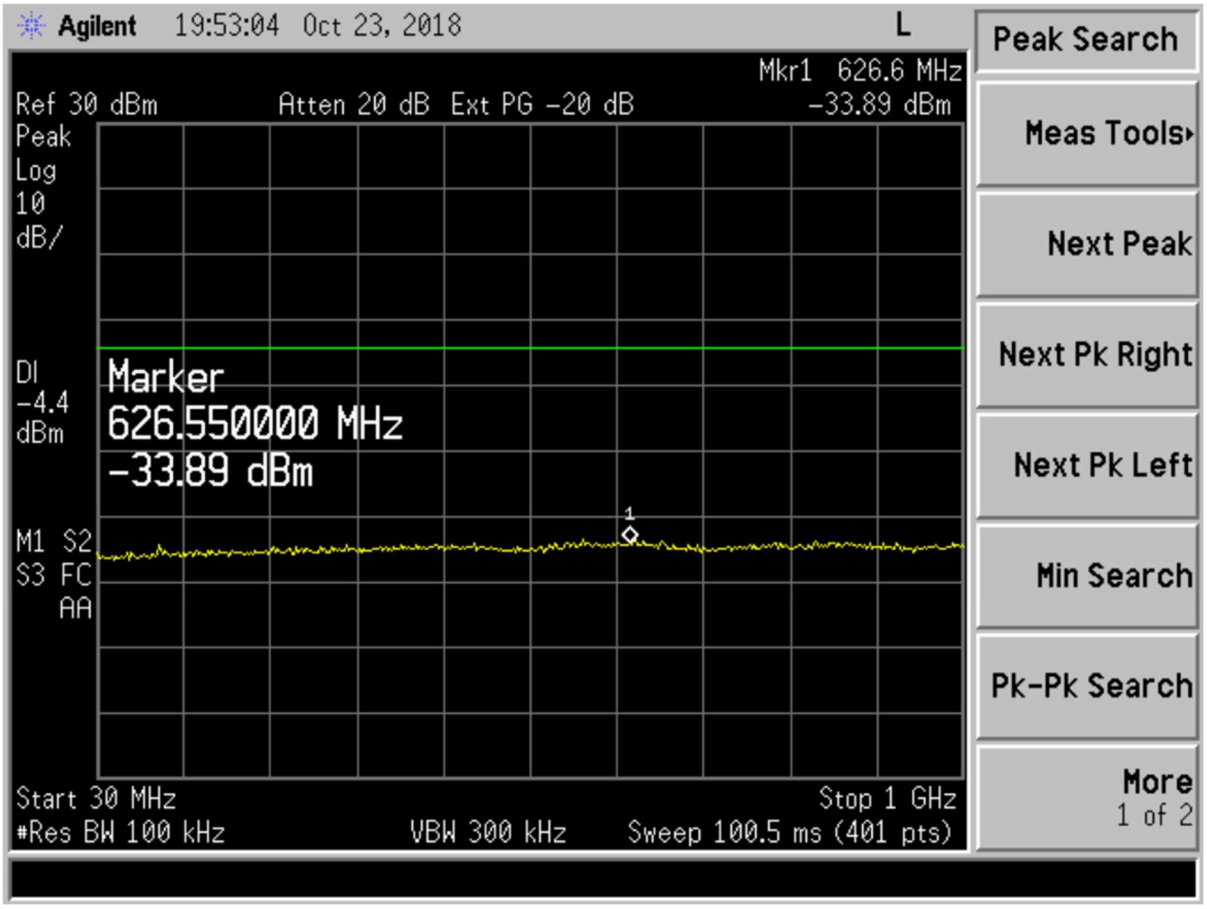

Figure 16. 802.11n, Channel 6, 30-1000 MHz

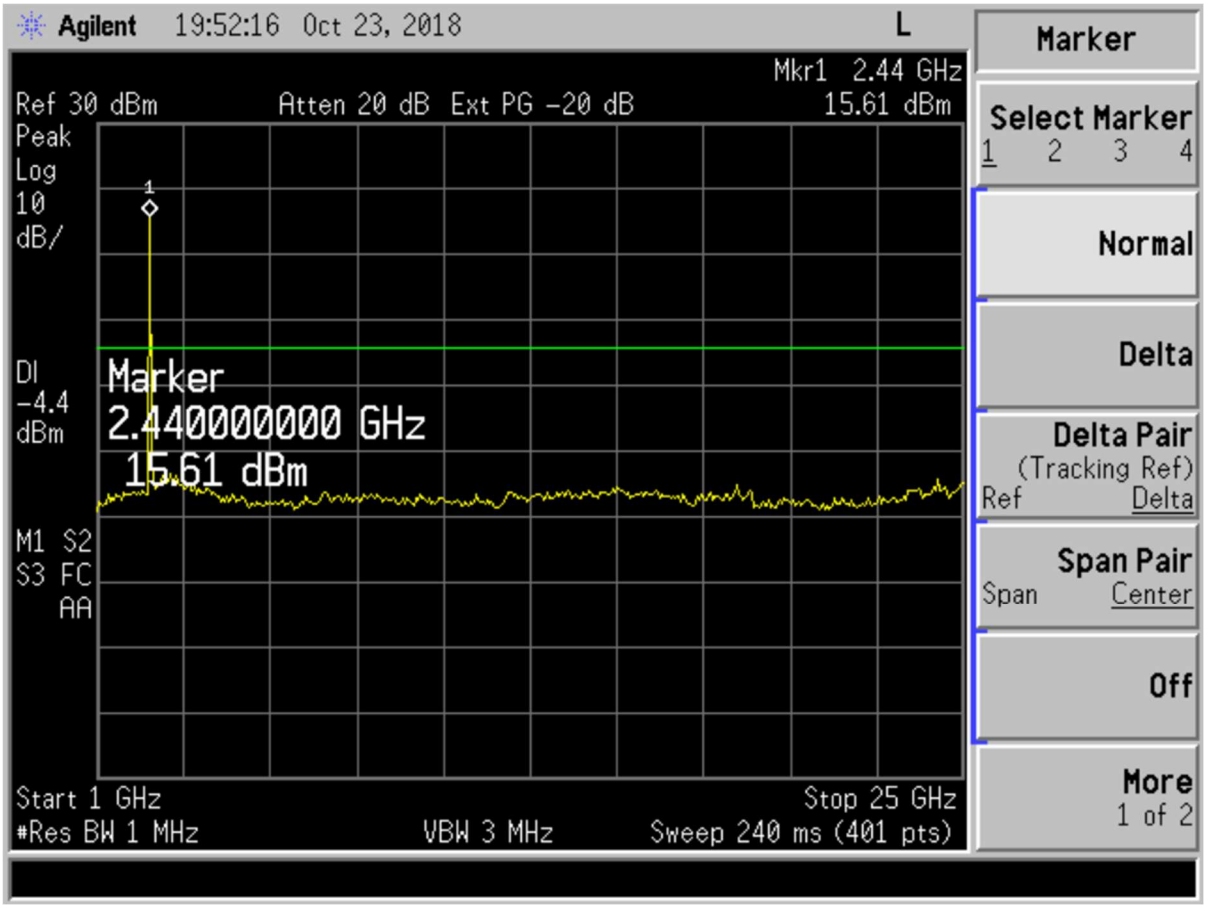

Figure 17. 802.11n, Channel 6, 1 – 25 GHz

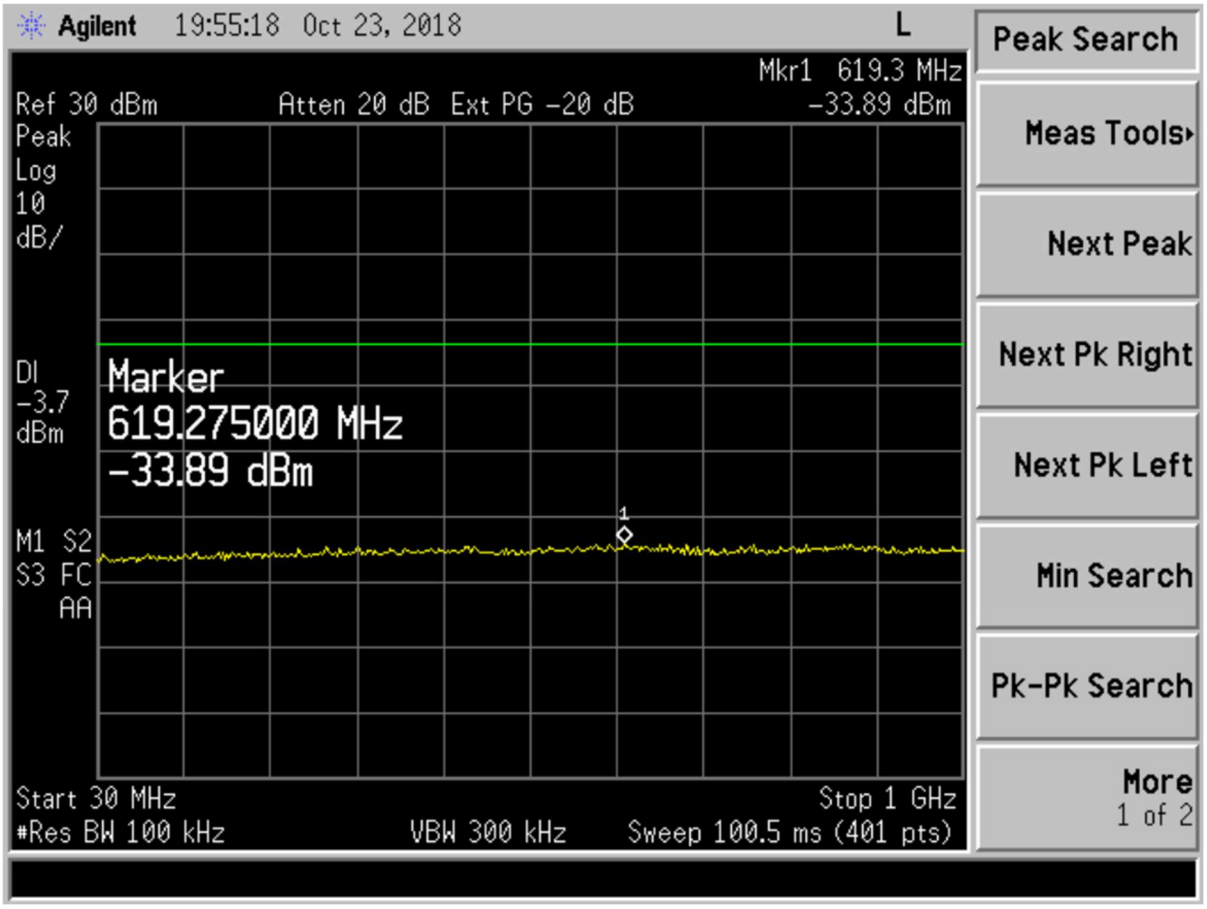

Figure 18. 802.11n, Channel 11, 30-1000 MHz

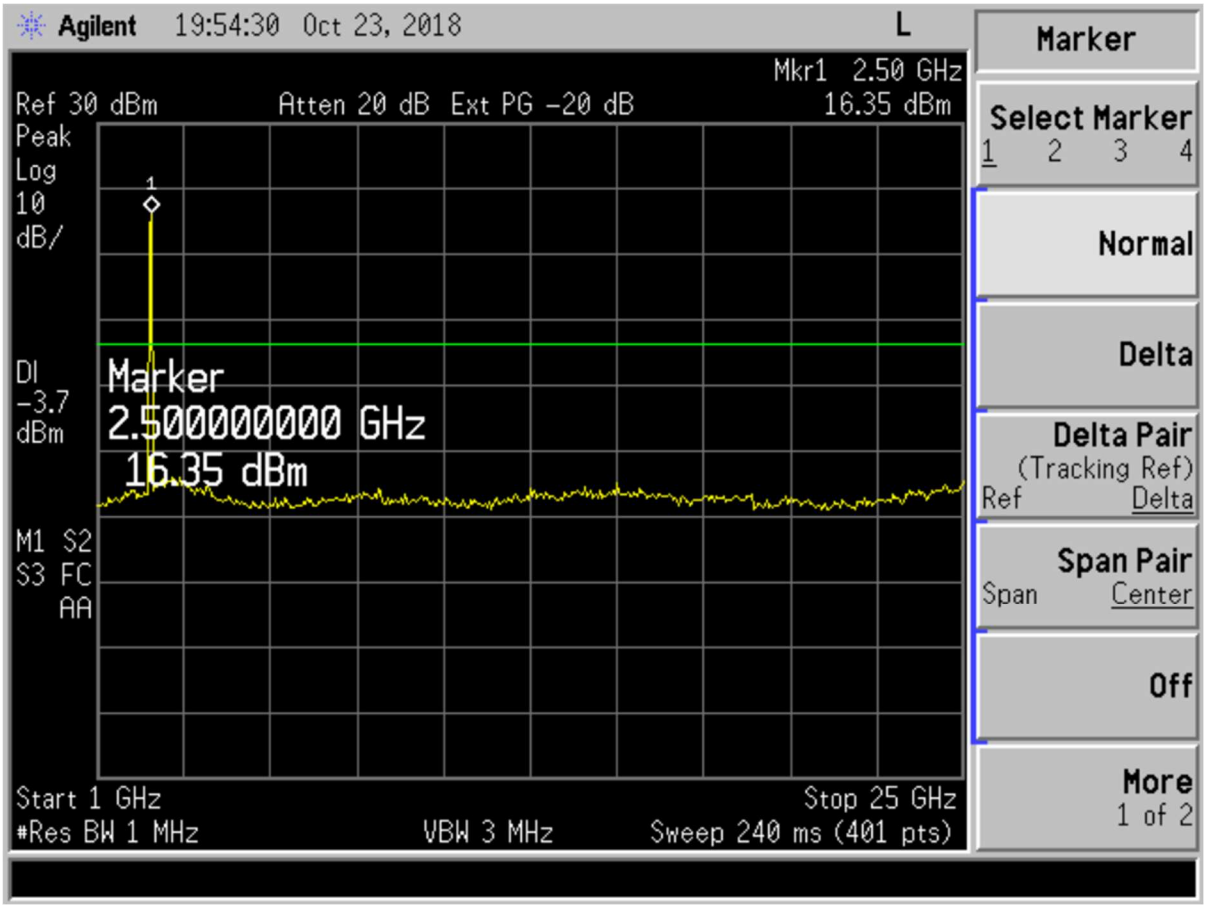

Figure 19. 802.11n, Channel 11, 1 – 25 GHz