MAY 2017

FCC & ISED CANADA CERTIFICATION TEST REPORT

for the

SOLOSHOT3 Base with WiFi operation

FCC ID: 2ALGWRJSS3B

IC ID: 22498-RJSS3B

WIFI TEST REPORT

REPORT# 14971-01 REV 2

Prepared for:

SOLOSHOT, Inc.

520 S El Camino Real, Suite 816

San Mateo, CA 94402

Prepared By:

Washington Laboratories, Ltd.

7560 Lindbergh Drive

Gaithersburg, Maryland 20879

Testing Certificate AT-1448

FCC & ISED Canada Certification Test Report

for the

SOLOSHOT, Inc.

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May 2017

Re-issued May 25, 2017

WLL REPORT# 14971-01 Rev 2

Prepared by:

Michael Violette, P.E.

Test Engineer

Reviewed by:

Steven D. Koster

President

Revision History	Description of Change	Date
Rev 0	Initial Release	May 2017
Rev 1	Edited to address ACB Comments	May 25, 2017

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1 INTRODUCTION

1.1 COMPLIANCE STATEMENT

This report has been prepared on behalf of SOLOSHOT, Inc. to support the attached Application for Equipment Authorization. The test report and application are submitted for an Intentional Radiator under Part 15.247 (10/2014) of the FCC Rules and Regulations and Spectrum Management and Telecommunications Policy and under RSS-247 issue 2 of Innovation, Science and Economic Development Canada (ISED). This Certification Test Report documents the test configuration and test results for the SOLOSHOT3 **Base with WiFi Operation**.

Testing was performed on an Open Area Test Site (OATS) of Washington Laboratories, Ltd, 7560 Lindbergh Drive, Gaithersburg, MD 20879. Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch at the FCC laboratory in Columbia, MD. The ISED OATS numbers are 3035A-1 and 3035A-2 for Washington Laboratories, Ltd. Site 1 and Site 2, respectively. Washington Laboratories, Ltd. has been accepted by the FCC and approved by ANAB under Certificate AT-1448 as an independent FCC test laboratory.

The SOLOSHOT, Inc. SOLOSHOT3 Base with WiFi operation complies with the limits for a Digital Transmission System (DTS) Transmitter device under FCC Part 15.247 and Innovation, Science and Economic Development Canada (ISED) RSS-247.

1.2 CONTRACT INFORMATION

Customer:	SOLOSHOT, Inc.
Address	520 S El Camino Real, Suite 816
	San Mateo, CA 94402
Purchase Order Number:	Per MV
Quotation Number:	69996

1.3 TEST DATES

Testing was performed on the following date(s): 3/10/2017-3/16/2017

1.4 TEST AND SUPPORT PERSONNEL

Washington Laboratories, LTD	Mike Violette
Customer Representative	Alex Sammons

1.5 ABBREVIATIONS

A	**A**mpere
ac	**a**lternating **c**urrent
AM	Amplitude Modulation
Amps	Amperes
b/s	**b**its per **s**econd
BW	**B**and**W**idth
CE	**C**onducted **E**mission
cm	Centi**m**eter
CW	**C**ontinuous **W**ave
dB	**d**eci**B**el
dc	**d**irect **c**urrent
EMI	Electro**m**agnetic **I**nterference
EUT	**E**quipment **U**nder **T**est
FM	**F**requency **M**odulation
G	**g**iga – prefix for 10^9 multiplier
Hz	**H**ertz
IF	**I**ntermediate **F**requency
k	**k**ilo – prefix for 10^3 multiplier
LISN	**L**ine **I**mpedance **S**tabilization **N**etwork
M	**M**ega – prefix for 10^6 multiplier
m	**M**eter
μ	**m**icro – prefix for 10^{-6} multiplier
NB	**N**arrow**b**and
QP	**Q**uasi-**P**eak
RE	**R**adiated **E**missions
RF	**R**adio **F**requency
rms	**r**oot-**m**ean-**s**quare
SN	**S**erial **N**umber
S/A	**S**pectrum **A**nalyzer
V	**V**olt

2 EQUIPMENT UNDER TEST

2.1 EUT IDENTIFICATION & DESCRIPTION

The SOLOSHOT, Inc. SOLOSHOT3 Base with WiFi operation is used in conjunction with a transmit beacon **Tag** (FCC ID: 2ALGWRJSS3T, ISED ID: 22498-RJSS3T). The SOLOSHOT3 Base is fitted with a HD camera that is controlled and streams HDMI to the screen on the unit as well as to an internal mini-SD card. The SOLOSHOT3 Base tracks the position of the Tag, which provides an 802.15 modulated signal that is received by the SOLOSHOT3 Base. The SOLOSHOT3 Base continuously tracks the position of the Tag and allows the camera to follow a moving subject.

The Bluetooth and WiFi radios share the same antenna, however, **they do not operate simultaneously.**

Table 1: Device Summary WiFi Operation

Item	SOLOSHOT3 Base used with Soloshot Camera
Manufacturer:	SOLOSHOT, Inc.
FCC ID:	2ALGWRJSS3B
ISED ID:	22498-RJSS3B
Model:	SOLOSHOT3 Base with WiFi operation
Serial Number of Unit Tested	N/A
FCC Rule Parts:	§15.247
Innovation, Science and Economic Development Canada:	RSS-247
Frequency Range:	2412-2464MHz
Maximum Output Power:	0.0489W (16.9dBm) @ 2437MHz in 802.11N mode
Modulation:	802.11 A/B/G/N
Occupied Bandwidth:	17.9 MHz in 802.11N Mode
Keying:	Automatic
Type of Information:	Data
Number of Channels:	11 Channels
Power Output Level	Fixed
Antenna Connector	Internal, not accessible to user
Antenna Type & Maximum Gain	Omni, 3.15 dBi
Manufacturer & Model	Molex GPS/WiFi (2.4/5GHz) Combo Balance Flex Antenna 1461860100
Interface Cables:	USB for programming, Mini-USB for charging
Maximum Data Rate	74Mbps
Power Source & Voltage:	Internal battery charged with USB charger

2.2 TEST CONFIGURATION

The SOLOSHOT3 Base with WiFi operation was configured with a detachable camera and set to transmit using the Qualcomm Radio Test Communications (QRTC) software, which allowed the selection of different modulations, frequencies and modes of operation.

2.3 TESTING ALGORITHM

The SOLOSHOT3 Base with WiFi operation was tested by configuring the various channels for measurement of the RF parameters.

Once connected to the SOLOSHOT3 Base, commands were sent over the USB connection from a PC. The following modes were tested:

1. WiFi in the 802.11a/b/g/n modes at the lower, middle and highest channel. Various modes and data rates were measured during the testing. The data in this report represent worst-case conditions for conducted and radiate emissions data.

2.4 TEST LOCATION

All measurements herein were performed at Washington Laboratories, Ltd. test center in Gaithersburg, MD. Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch at the FCC laboratory in Columbia, MD. The ISED Canada OATS numbers are 3035A-1 and 3035A-2 for Washington Laboratories, Ltd. Site 1 and Site 2, respectively. Washington Laboratories, Ltd. has been accepted by the FCC and approved by ANAB under Certificate AT-1448 as an independent FCC test laboratory.

2.5 MEASUREMENTS

2.5.1 References

ANSI C63.2-2016 Specifications for Electromagnetic Noise and Field Strength Instrumentation in the Frequency Range 9 kHz to 40 GHz

ANSI C63.10-2013 American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

ANSI C63.4-2014 American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz

2.6 MEASUREMENT UNCERTAINTY

All results reported herein relate only to the equipment tested. The basis for uncertainty calculation uses ANSI/NCSL Z540-2-1997 (R2002) with a type B evaluation of the standard uncertainty. Elements contributing to the standard uncertainty are combined using the method described in Equation 1 to arrive at the total standard uncertainty. The standard uncertainty is multiplied by the coverage factor to determine the expanded uncertainty which is generally accepted for use in commercial, industrial, and regulatory applications and when health and safety are concerned (see Equation 2). A coverage factor was selected to yield a 95% confidence in the uncertainty estimation.

Equation 1: Standard Uncertainty

$$u_c = \pm\sqrt{\frac{a^2}{div_a{}^2} + \frac{b^2}{div_b{}^2} + \frac{c^2}{div_c{}^2} + ...}$$

Where u_c = standard uncertainty

a, b, c,.. = individual uncertainty elements

$Div_{a, b, c}$ = the individual uncertainty element divisor based on the probability distribution

Divisor = 1.732 for rectangular distribution

Divisor = 2 for normal distribution

Divisor = 1.414 for trapezoid distribution

Equation 2: Expanded Uncertainty

$$U = ku_c$$

Where U = expanded uncertainty

k = coverage factor

k ≤ 2 for 95% coverage (ANSI/NCSL Z540-2 Annex G)

u_c = standard uncertainty

The measurement uncertainty complies with the maximum allowed uncertainty from CISPR 16-4-2. Measurement uncertainty is not used to adjust the measurements to determine compliance. The expanded uncertainty values for the various scopes in the WLL accreditation are provided in Table 2 below.

Table 2: Expanded Uncertainty List

Scope	Standard(s)	Expanded Uncertainty
Conducted Emissions	CISPR11, CISPR22, CISPR14, FCC Part 15	±2.63 dB
Radiated Emissions	CISPR11, CISPR22, CISPR14, FCC Part 15	±4.55 dB

3 TEST EQUIPMENT

Table *3* shows a list of the test equipment used for measurements along with the calibration information.

Table 3: Test Equipment List

Test Name:	**Conducted Emissions Voltage**	Test Date:	**March 6, 2017**
Asset #	**Manufacturer/Model**	**Description**	**Cal. Due**
125	SOLAR - 8028-50-TS-24-BNC	LISN	**2/16/2018**
126	SOLAR - 8028-50-TS-24-BNC	LISN	**2/16/2018**
823	AGILENT - N9010A	EXA SPECTRUM ANALYZER	**12/21/2017**
Test Name:	**Radiated Emissions**	Test Date:	**March 6 2017**
Asset #	**Manufacturer/Model**	**Description**	**Cal. Due**
4	ARA - DRG-118/A	ANTENNA DRG 1-18GHZ	**12/14/2018**
66	B&Z (HP) - BZ-01002650-401545-282525	HF PRE-AMPLIFIER 1-26.5GHZ (MODIFIED)	**2/14/2018**
823	AGILENT - N9010A	EXA SPECTRUM ANALYZER	**12/21/2017**
382	SUNOL SCIENCES CORPORATION - JB1	ANTENNA BICONLOG	**8/31/2017**
626	ARA - DRG-118/A	ANTENNA HORN	**4/7/2018**
210	NARDA - V638	HORN STANDARD GAIN	**CNR**
453	AH SYSTEMS - PAM1840	PRE-AMPLIFIER 18GHZ-40 GHZ	**5/11/2019**
280	ITC - 21C-3A1	WAVEGUIDE 3.45-11.0GHZ	**8/1/2017**
281	ITC - 21A-3A1	WAVEGUIDE 4.51-10.0GHZ	**8/1/2017**
282	ITC - 21X-3A1	WAVEGUIDE 6.8-15GHZ	**10/22/2017**

4 Test Results

4.1 Conducted Emissions

4.1.1 AC Conducted Emissions

Test Arrangement: Table-top/tripod mount

Compliance Standard: FCC Part 15 (10/2014), Class B

FCC Compliance Limits		
Frequency	Quasi-peak	Average
0.15-0.5MHz	66 to 56dBµV	56 to 46dBµV
0.5 to 5MHz	56dBµV	46dBµV
0.5-30MHz	60dBµV	50dBµV

4.1.2 Test Procedure Summary

The requirements of FCC Part 15B and ICES-003 call for the EUT to be placed on an 80 cm high 1 X 1.5 m non-conductive table above a ground plane. Power to the EUT was provided through a Solar Corporation 50 Ω/50 uH Line Impedance Stabilization Network bonded to a 3 X 2 meter ground plane. The LISN has its AC input supplied from a filtered AC power source. Power was supplied to the peripherals through a second LISN. The peripherals were placed on the table in accordance with ANSI C63.4-2014. Power and data cables were moved about to obtain maximum emissions.

The 50 Ω output of the LISN was connected to the input of the spectrum analyzer and the emissions in the frequency range of 150 kHz to 30 MHz were measured. The detector function was set to quasi-peak, peak, or average as appropriate, and the resolution bandwidth during testing was at least 9 kHz, with all post-detector filtering no less than 10 times the resolution bandwidth. For average measurements the post-detector filter was set to 10 Hz.

At frequencies where quasi-peak or peak measurements comply with the average limit, no average measurements need be performed.

4.1.3 Measurement Method

All emission measurements herein were performed according to the referenced standard. Calibration checks are made periodically to verify proper performance of the measuring instrumentation.

4.1.4 Conducted Data Reduction and Reporting

To convert the raw spectrum analyzer conducted data into a form that can be compared with the limits, it is necessary to account for various calibration factors that are supplied with the LISNs and other measurement accessories. These factors are included into the LISN correction factor (LISN corr.) column of the table and in the cable factor (Cable Loss) column of the table. The LISN correction (in dB) and the Cable Loss (in dB) is algebraically added to the raw Spectrum Analyzer Voltage in dBµV to obtain the Conducted RF Electric Voltage in dBµV. This level is then compared to the limit.

Example:

Spectrum Analyzer Voltage:	VdBµV
LISN Correction Factor:	LISN Correction dB
Cable Correction Factor:	Cable Loss dB
RF Electric Voltage Level:	EdBuV = V dBµV + LISN Correction dB + Cable Loss dB

4.1.5 Results Summary

The system complied with the emission requirements throughout the test.

Testing was performed by powering the unit on and set the transmitter to enabled.

Test Date(s): March 13, 2017

Test Engineer/Technician: Mike Violette

4.1.6 Areas of Concern

None

4.1.7 Test Data

Table 5 provides the test results for phase and neutral line power line conducted emissions. Charging power the unit is provided by the Base.

Table 4: Conducted Emissions Limits

NEUTRAL

Frequency (MHz)	Level QP (dBµV)	Level AVG (dBµV)	Cable Loss (dB)	LISN Corr (dB)	Level QP Corr (dBµV)	Level Corr Avg (dBµV)	Limit QP (dBµV)	Limit AVG (dBµV)	Margin QP (dB)	Margin AVG (dB)
0.180	44.0	31.0	10.2	0.3	54.4	41.4	64.5	54.5	-10.1	-13.1
0.326	31.4	12.5	10.2	0.3	41.8	22.9	59.6	49.6	-17.7	-26.6
1.000	35.0	12.8	10.3	0.3	45.6	23.4	56.0	46.0	-10.4	-22.6
1.600	34.8	17.2	10.2	0.3	45.3	27.7	56.0	46.0	-10.7	-18.3
5.000	33.3	19.9	10.7	0.2	44.2	30.8	60.0	50.0	-15.8	-19.2
10.000	33.3	19.5	11.1	0.1	44.5	30.7	60.0	50.0	-15.5	-19.3
29.900	25.5	16.0	12.0	1.3	38.8	29.3	60.0	50.0	-21.2	-20.7

PHASE

Frequency (MHz)	Level QP (dBµV)	Level AVG (dBµV)	Cable Loss (dB)	LISN Corr (dB)	Level QP Corr (dBµV)	Level Corr Avg (dBµV)	Limit QP (dBµV)	Limit AVG (dBµV)	Margin QP (dB)	Margin AVG (dB)
0.180	42.4	28.3	10.2	0.1	52.7	38.6	64.5	54.5	-11.8	-15.9
0.326	33.9	15.3	10.2	0.2	44.3	25.7	59.6	49.6	-15.3	-23.9
1.000	38.8	24.5	10.3	0.2	49.3	35.0	56.0	46.0	-6.7	-11.0
1.600	35.1	19.9	10.2	0.3	45.6	30.4	56.0	46.0	-10.4	-15.6
5.000	34.1	20.2	10.7	0.2	45.0	31.1	60.0	50.0	-15.0	-18.9
10.000	33.7	19.2	11.1	0.2	45.0	30.5	60.0	50.0	-15.0	-19.5
29.900	29.4	15.7	12.0	1.5	42.9	29.2	60.0	50.0	-17.1	-20.8

4.2 Conducted Emissions at Antenna Terminals

The general procedure for measuring the conducted energy at the antenna terminals of the device consisted of connecting the output of the EUT to the input of a spectrum analyzer via attenuator pads and bandpass filters, as appropriate for the measurement.

4.3 OUTPUT POWER (FCC PART §2.1049)

Output power was measured by coupling the output of the EUT to the input of a spectrum analyzer. The spectrum analyzer was set with the RBW = 1MHz and the VBW > RBW.

Table 5. 802.11b Output Power

B Mode			
Frequency MHz	Output Power dBm	Limit dBm	Pass/Fail
2412	9.2	30	Pass
2437	15.1	30	Pass
2462	10.5	30	Pass

Note: Target powers were adjusted to comply with band edge requirements.

Figure 1: Output Power Lower Channel WiFi B Mode

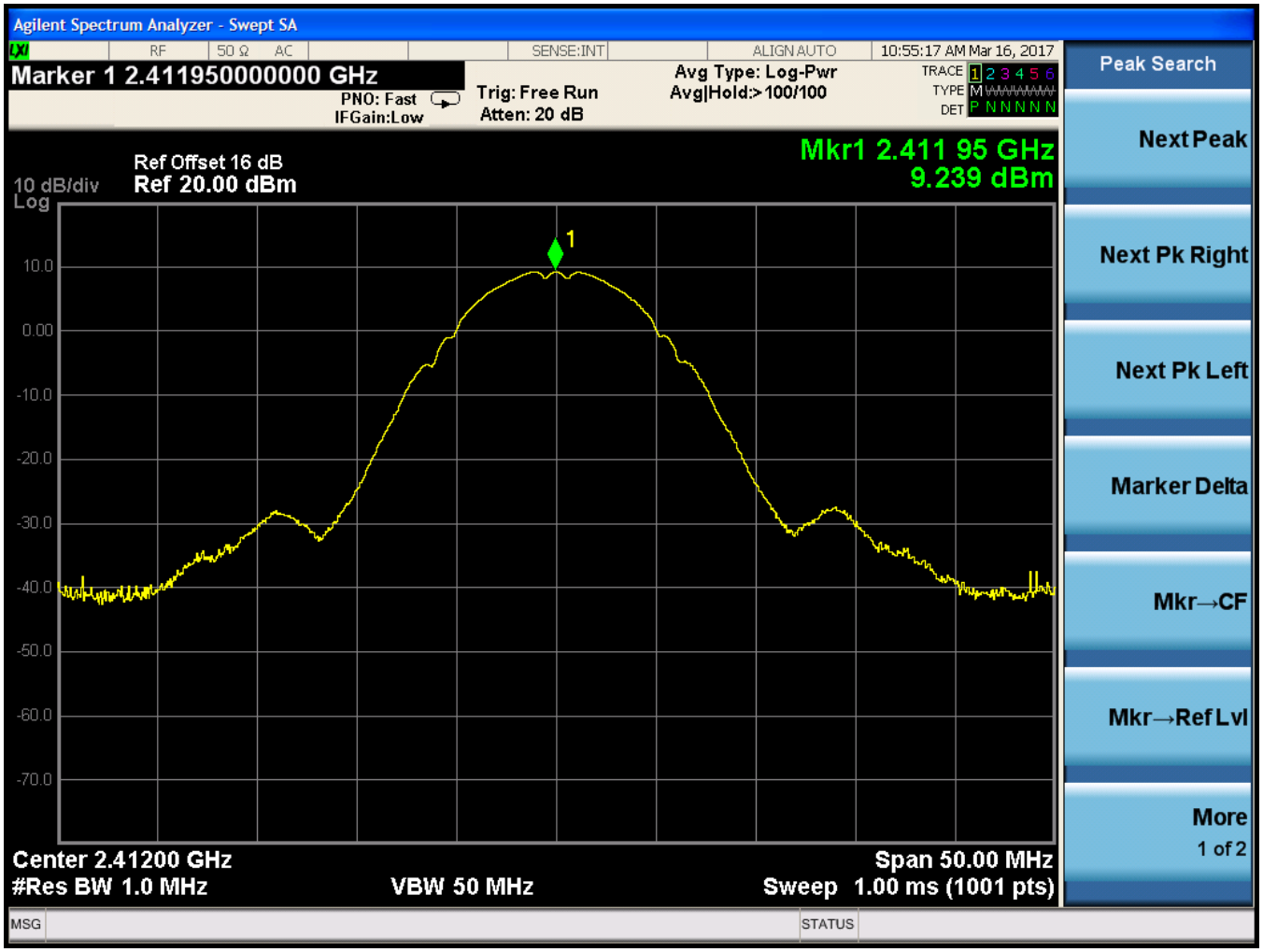


Figure 2: Output Power Middle Channel WiFi B Mode

Figure 3: Output Power Upper Channel WiFi B Mode

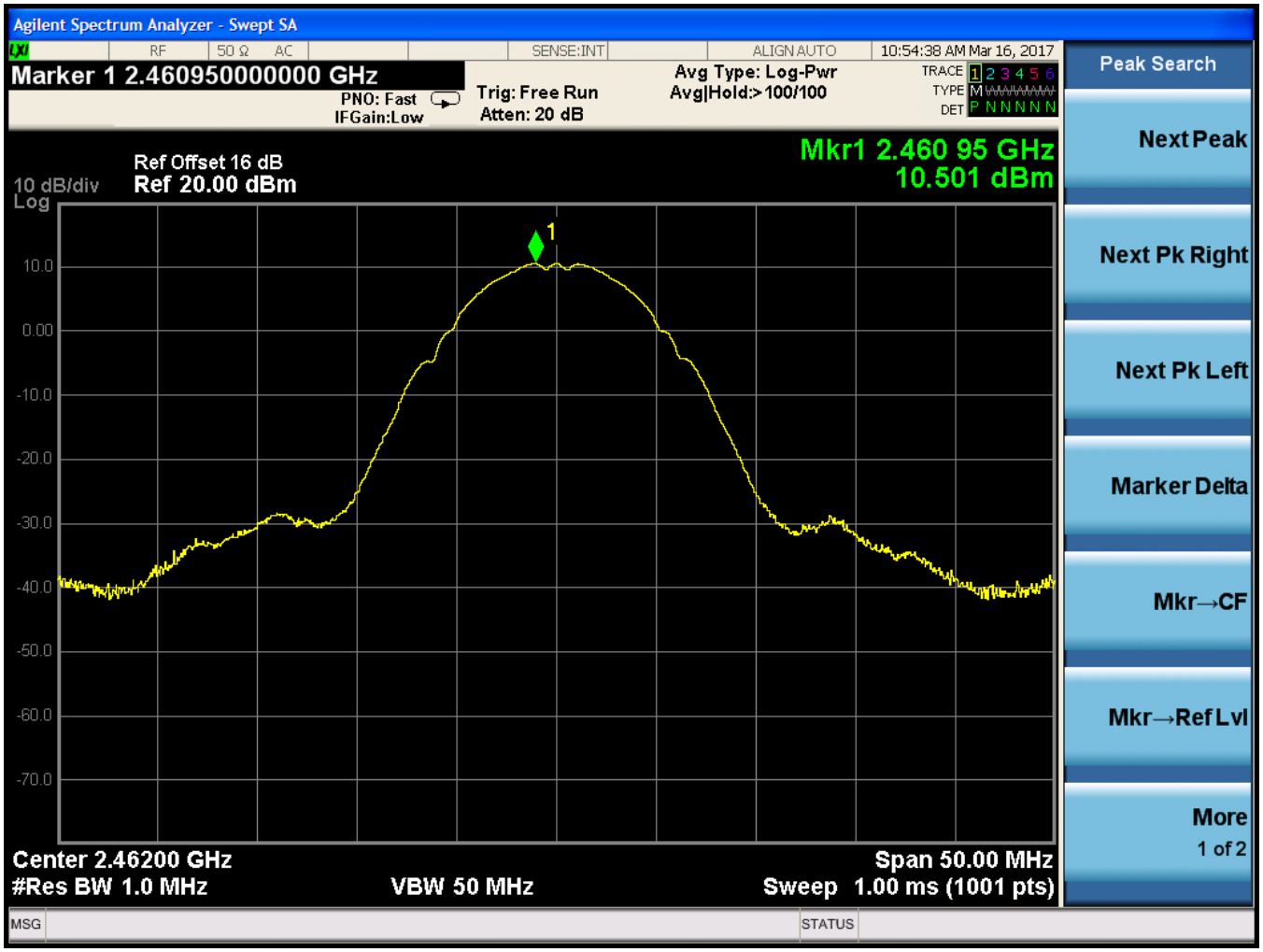


Table 6. 802.11a/g Output Power

A/G Mode			
Frequency MHz	Output Power dBm	Limit dBm	Pass/Fail
2412	3.3	30	Pass
2427	10.1	30	Pass
2432	14.1	30	Pass
2437	16.6	30	Pass
2462	4.9	30	Pass

Note: Target powers were adjusted to comply with band edge requirements.

Figure 4: Output Power Lower Channel WiFi A/G Mode

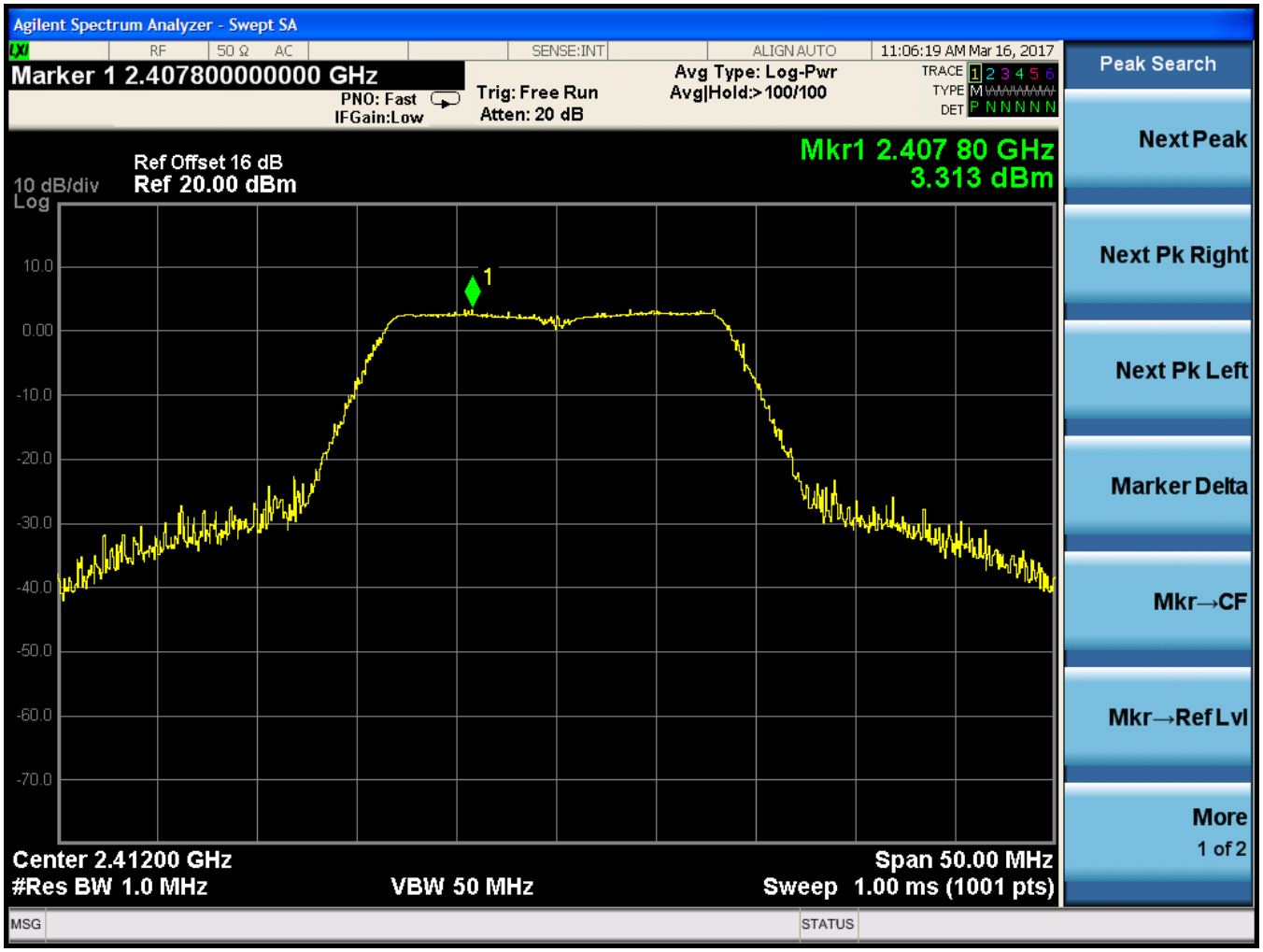


Figure 5: Output Power Middle Channel WiFi A/G Mode

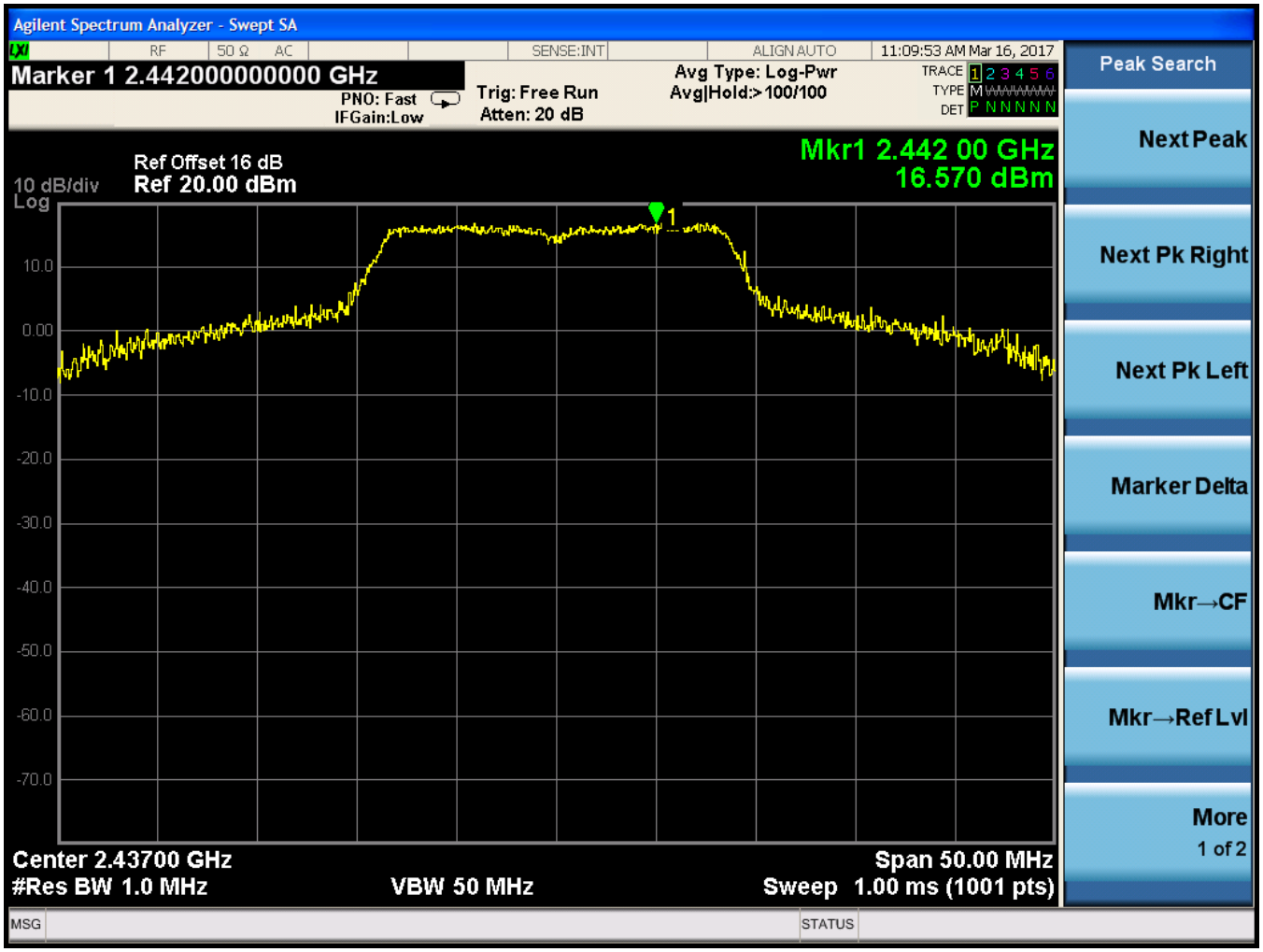


Figure 6: Output Power Upper Channel WiFi A/G Mode

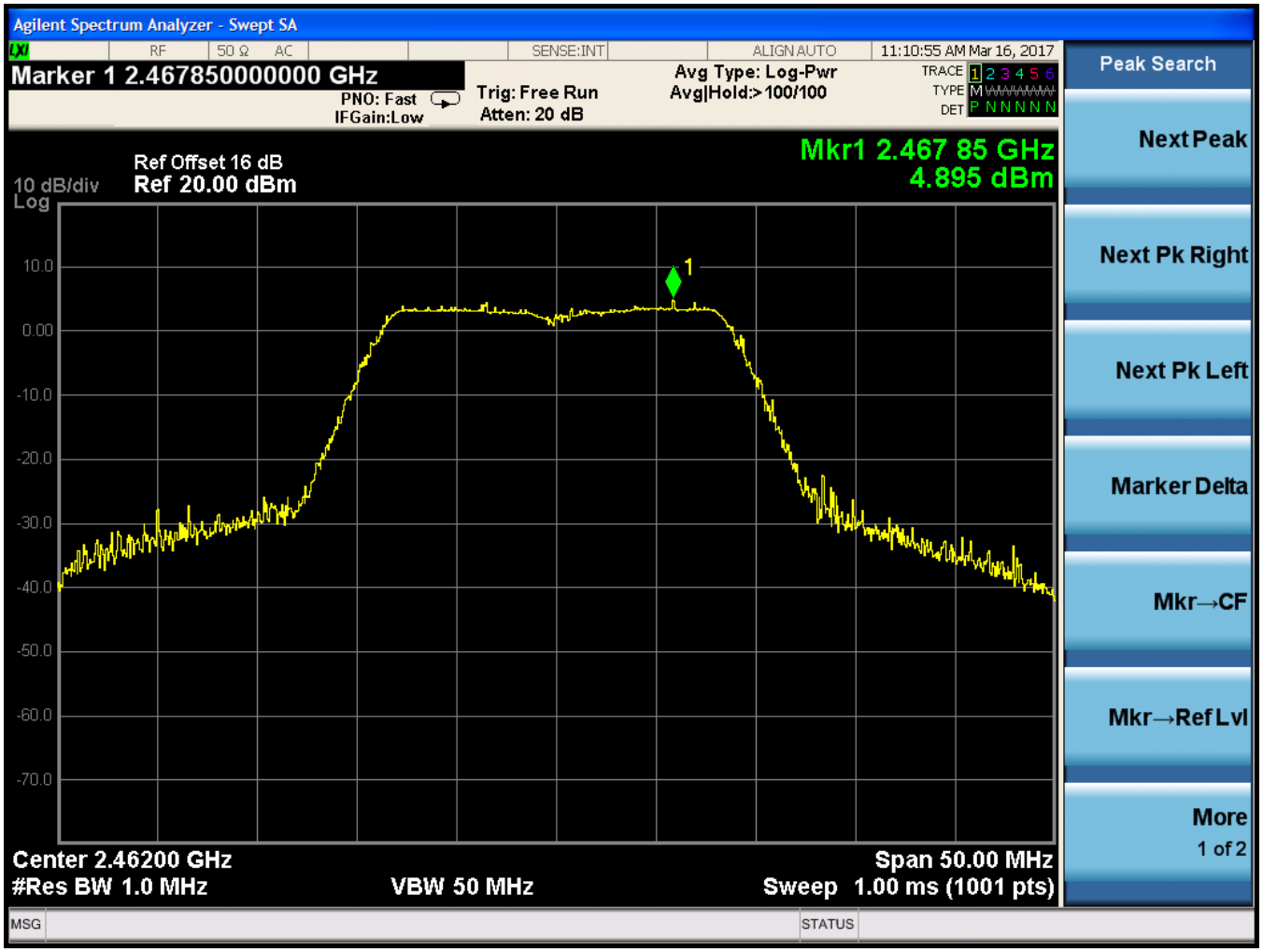


Table 7. 802.11n Output Powers

N Mode			
Frequency MHz	Output Power dBm	Limit dBm	Pass/Fail
2412	3.9	30	Pass
2427	10.2	30	Pass
2432	13.8	30	Pass
2437	16.9	30	Pass
2462	4.6	30	Pass

Note: Target powers were adjusted to comply with band edge requirements.

Figure 7: Output Power Lower Channel WiFi N Mode

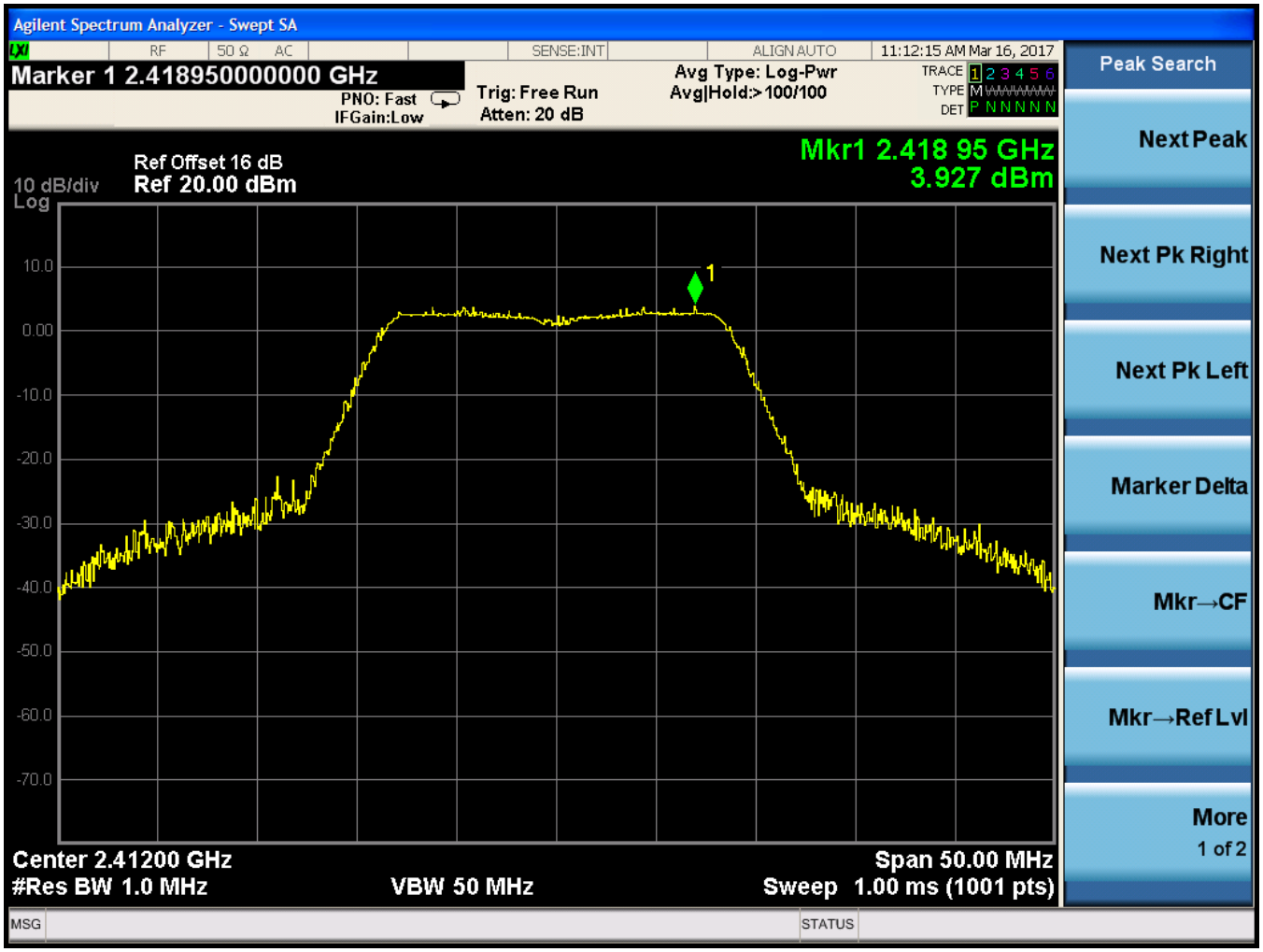


Figure 8: Output Power Lower Channel WiFi N Mode

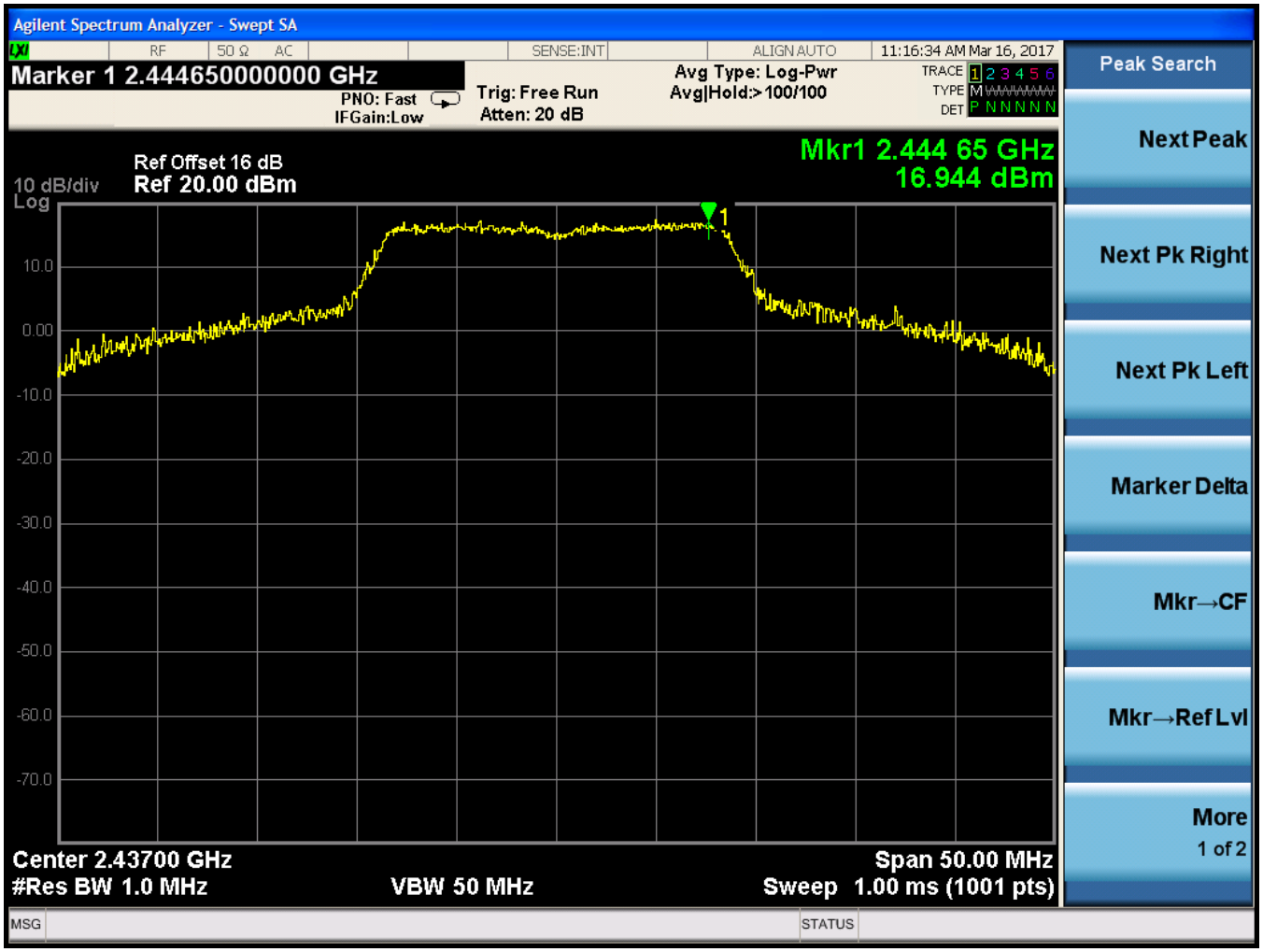
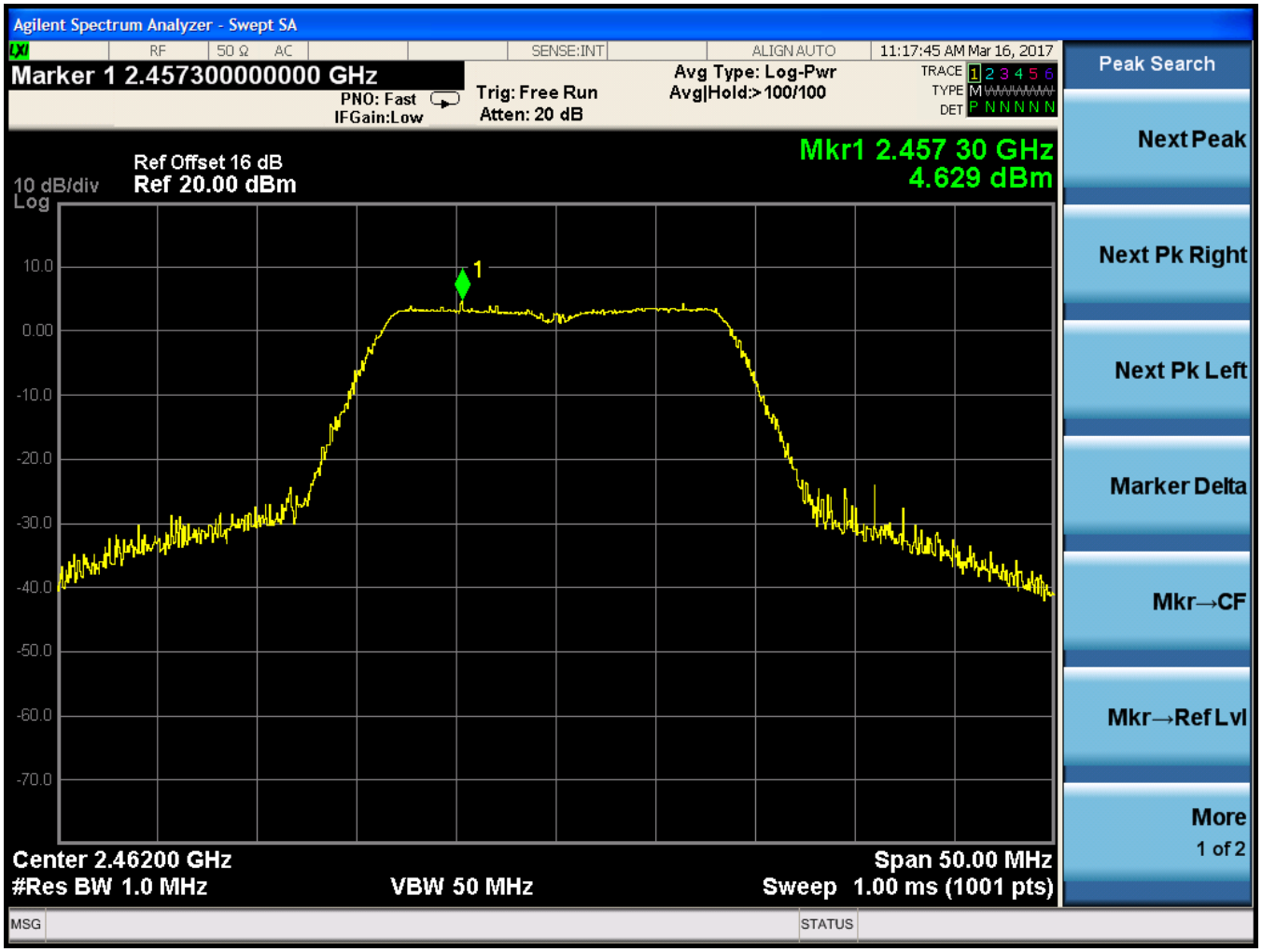


Figure 9: Output Power Upper Channel WiFi N Mode



4.4 Occupied Bandwidth: (FCC Part §2.1049)

Occupied bandwidth was performed by coupling the output of the EUT to the input of a spectrum analyzer. **Table *8*** provides summaries of the Occupied Bandwidth Results.

Table 8: Occupied Bandwidth Results: B Mode

B Mode			
Frequency MHz	Bandwidth MHz	Bit Rate Mbps	Pass/Fail
2412	9.2	11	Pass
2437	8.4	1	Pass
2462	9.7	2	Pass

At full modulation, the occupied bandwidth was measured as shown:

Figure 10: Occupied Bandwidth Lower Channel WiFi B Mode

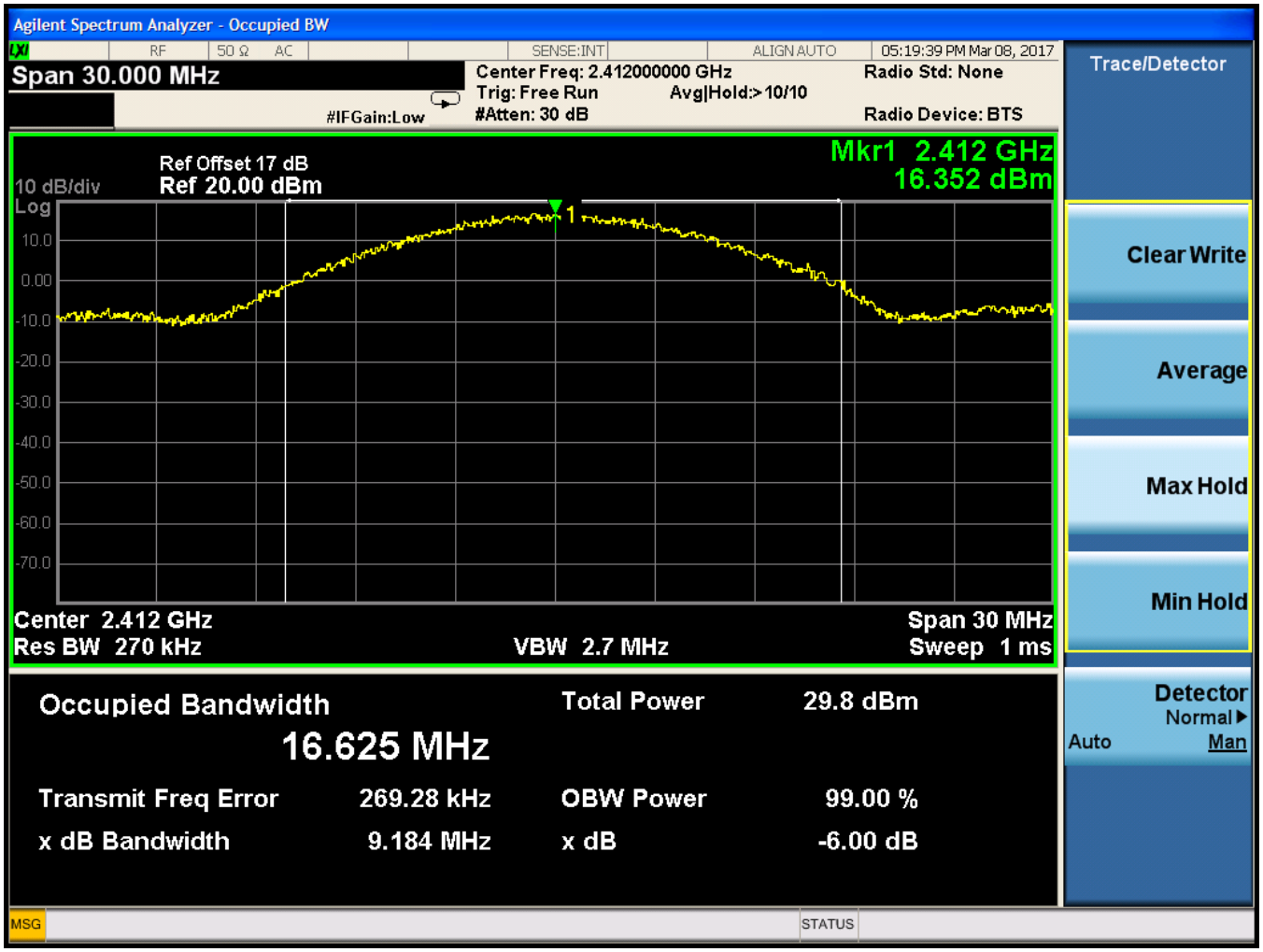


Figure 11: Occupied Bandwidth Middle Channel WiFi B Mode

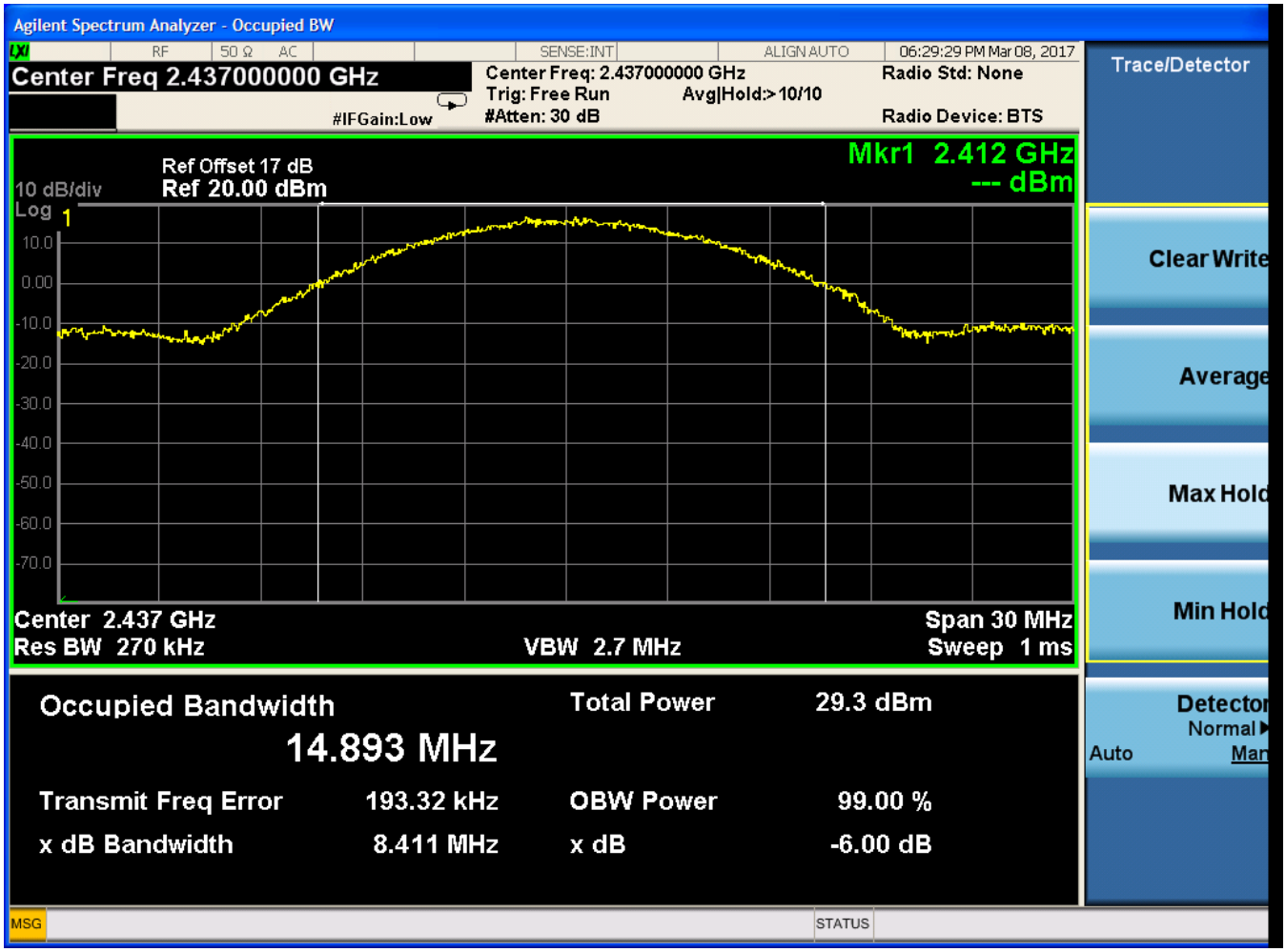


Figure 12: Occupied Bandwidth Upper Channel WiFi B Mode

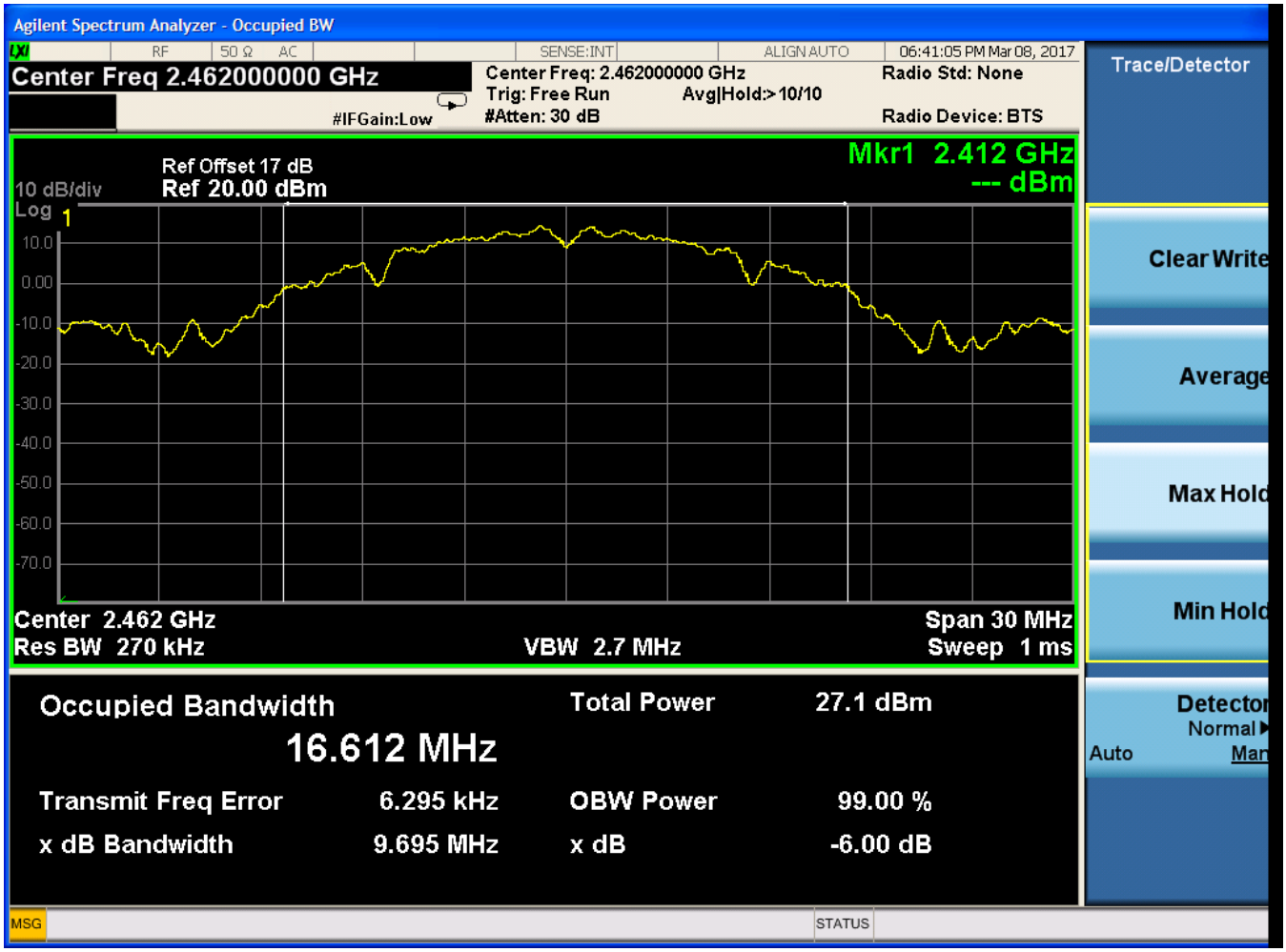


Table 9: Occupied Bandwidth Results: A/G Modes

A/G Modes			
Frequency MHz	Bandwidth MHz	Bit Rate Mbps	Pass/Fail
2412	17.9	6	Pass
2437	16.6	6	Pass
2462	16.7	6	Pass

At full modulation, the occupied bandwidth was measured as shown:

Figure 13: Occupied Bandwidth Lower Channel WiFi A/G Mode

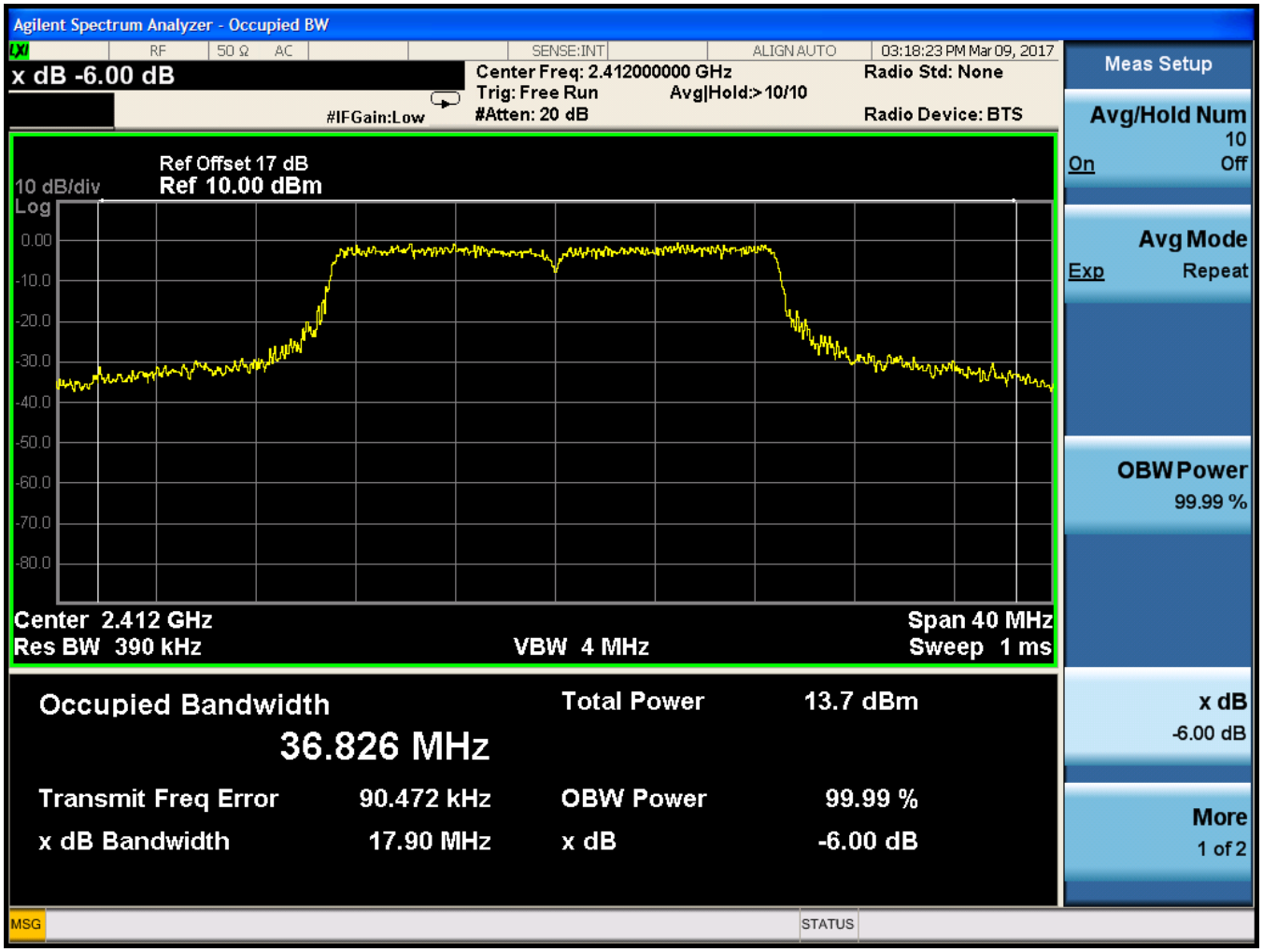


Figure 14: Occupied Bandwidth Middle Channel WiFi A/G Mode

Figure 15: Occupied Bandwidth Upper Channel WiFi A/G Mode

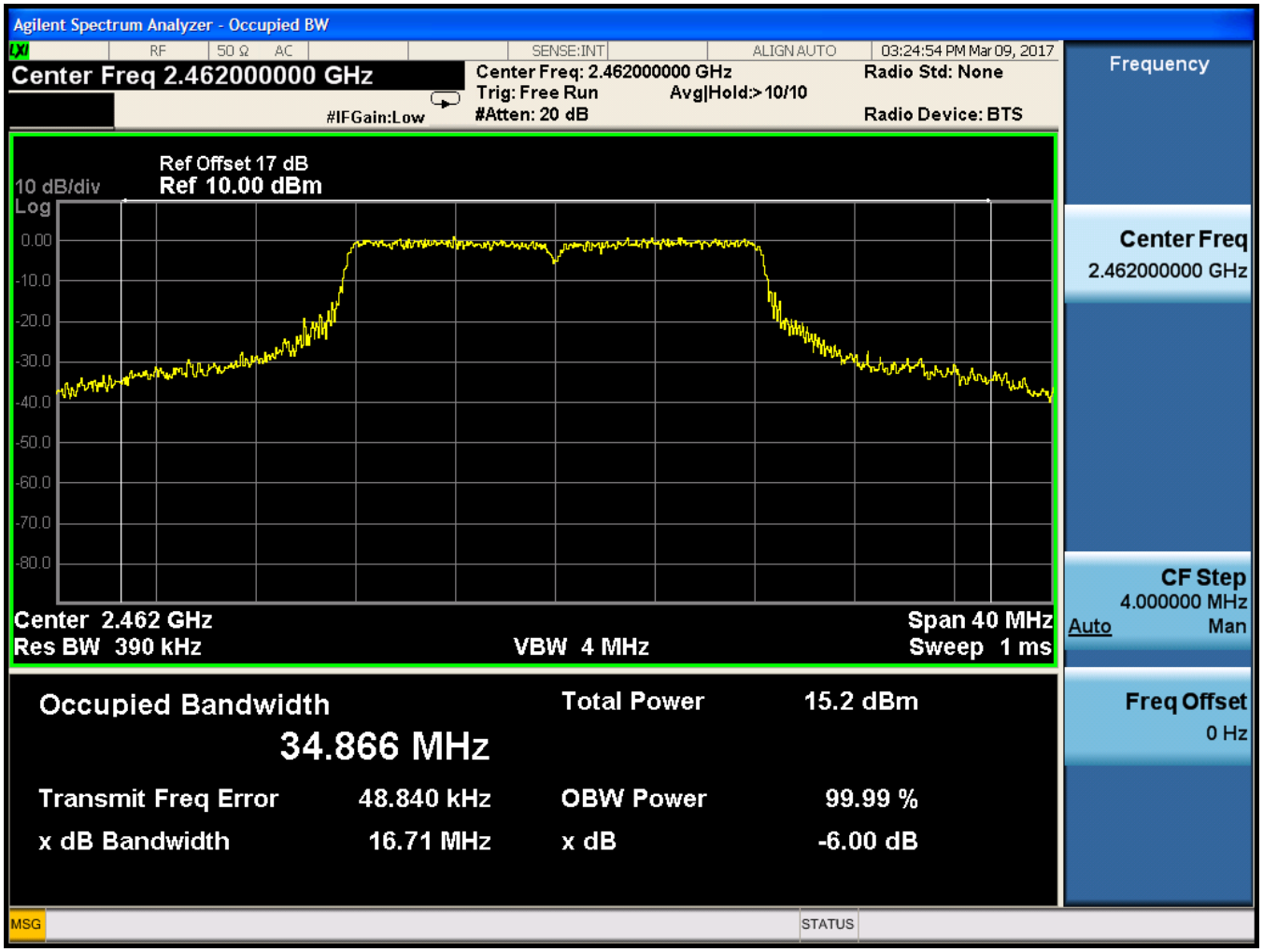


Table 10: Occupied Bandwidth Results: N Mode

N Mode			
Frequency MHz	Bandwidth MHz	Bit Rate Mbps	Pass/Fail
2412	16.7	6.5	Pass
2437	17.9	6.5	Pass
2464	17.9	6.5	Pass

Figure 16: Occupied Bandwidth Lower Channel WiFi N Mode

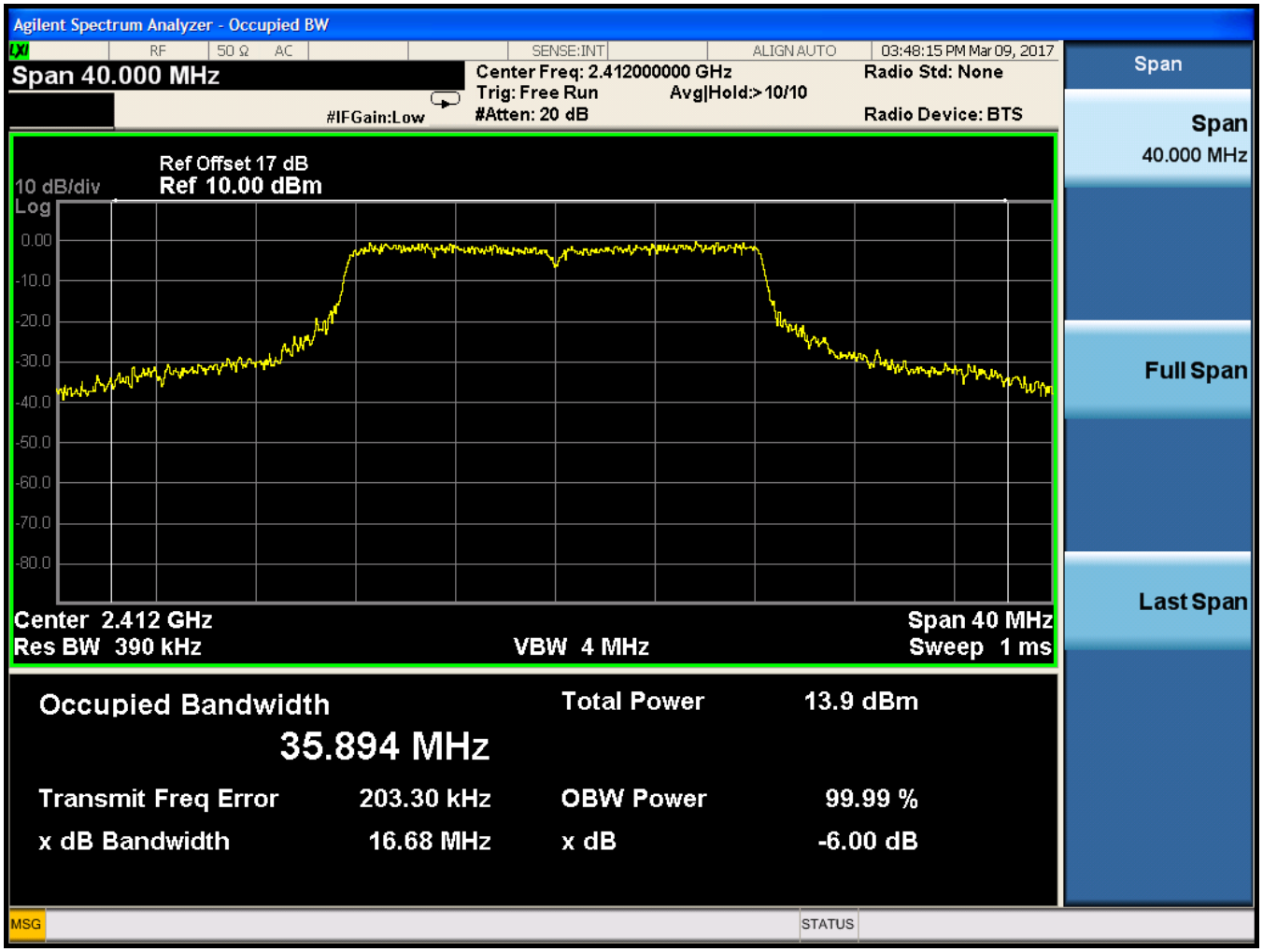


Figure 17: Occupied Bandwidth Middle Channel WiFi N Mode

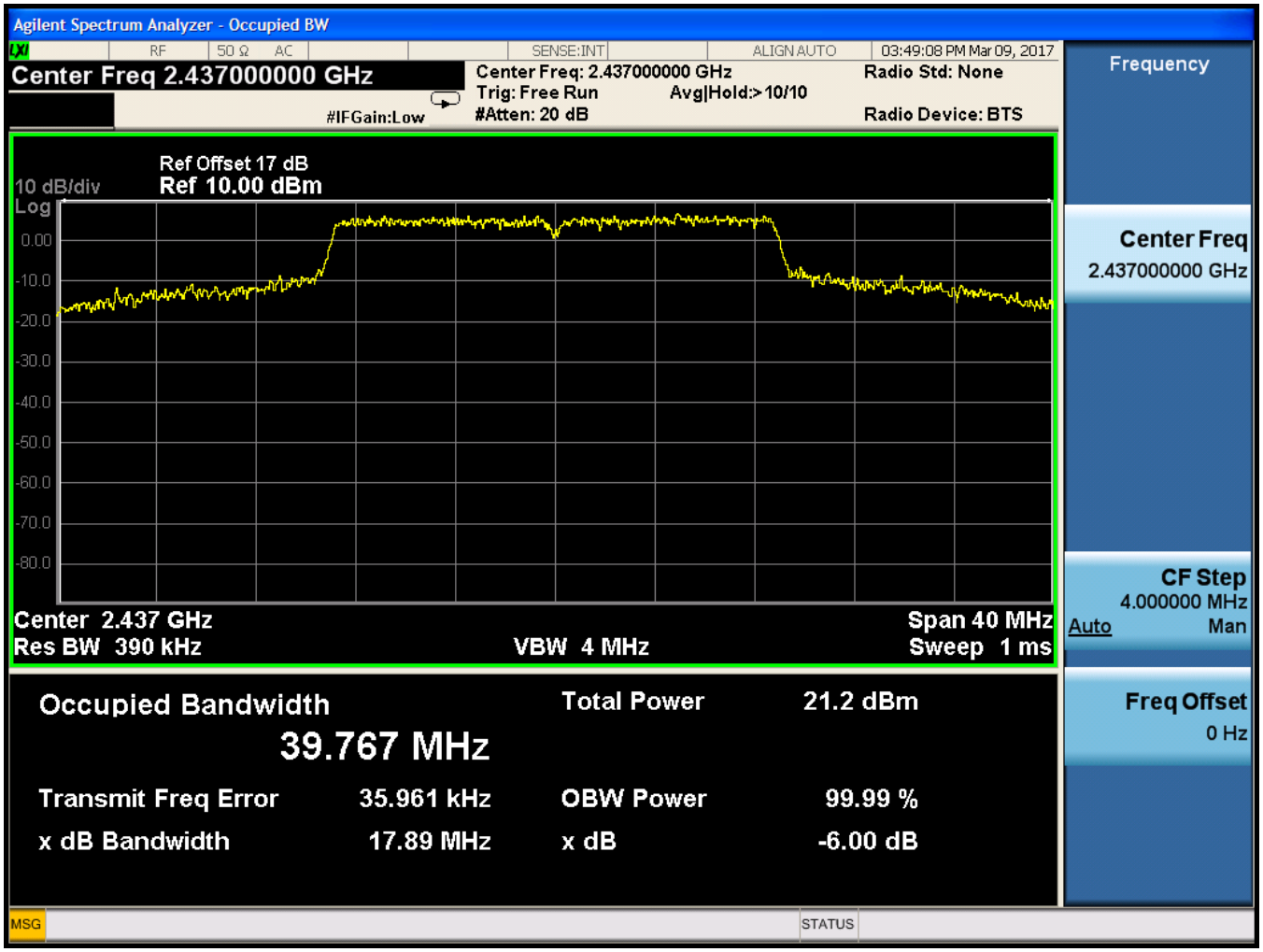
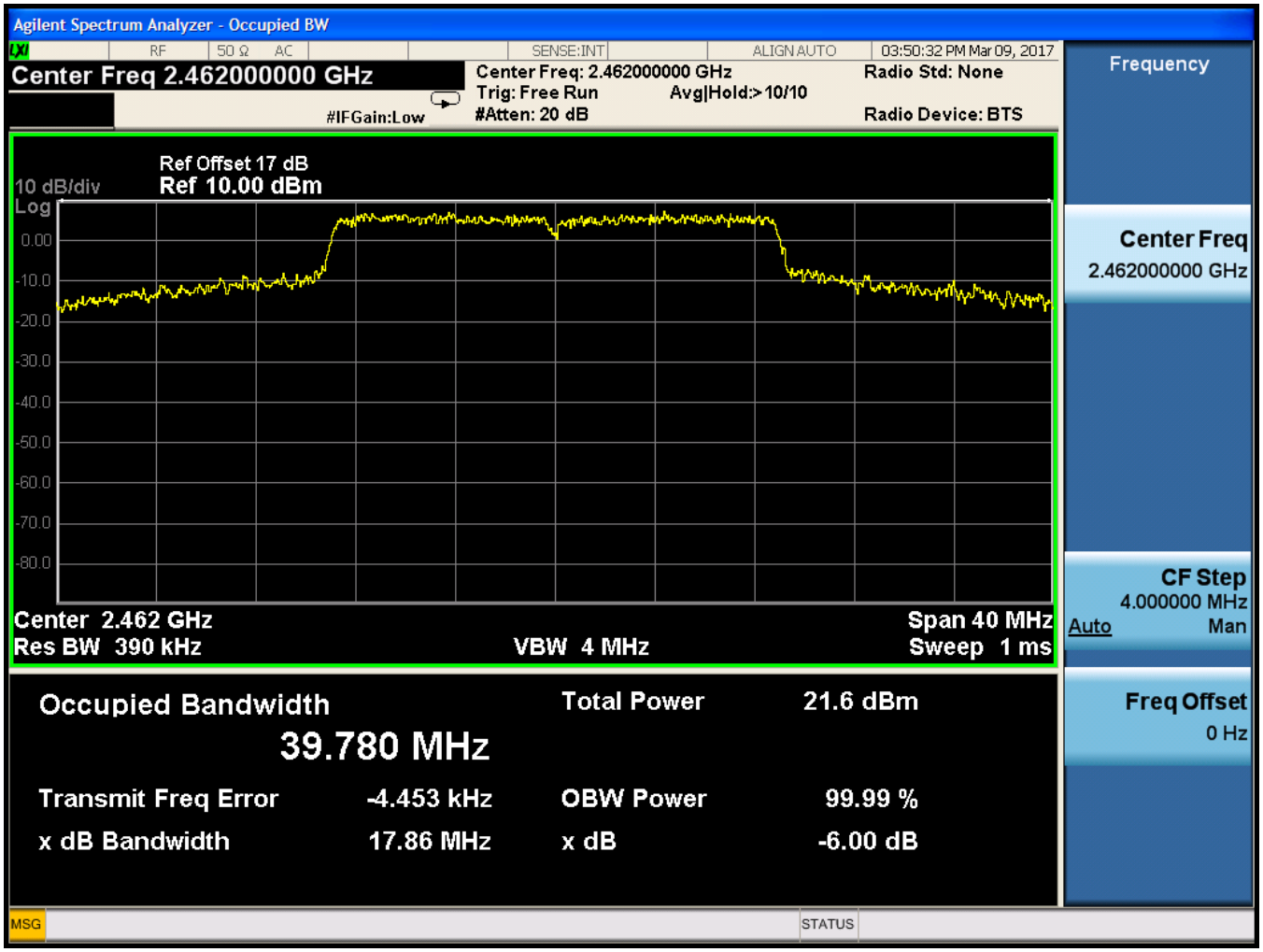


Figure 18: Occupied Bandwidth Upper Channel WiFi N Mode



4.5 Spurious Emissions at Antenna Terminals (FCC Part §2.1051) and Band Edge Compliance

Spurious emissions at the antenna terminals were collected over the frequency range of 30MHz to 24.835GHz.

In addition, it is necessary for all emissions at the band edges be 20dB below the peak energy measured in a 100 kHz bandwidth. These data are shown in the following collection of plots.

The levels were also verified using the Marker-Delta procedure called out in ANSI C63.10 on a radiated test site.

The power levels were adjusted to comply with the radiated band edge requirements (see Table *12* to Table 17. No plots were taken.

Table 11: Target Power Levels Required for Compliance with Band Edge

B MODE

CHANNEL	RF GAIN	OUTPUT PWR dBm
1	10	11.5
6	31	15.3
11	10	12.9

A/G MODE

CHANNEL	RF GAIN	OUTPUT PWR dBm
1	3	3.3
4	10	10.1
5	15	14.1
6	20	16.6
11	3	4.9

N MODE

CHANNEL	RF GAIN	OUTPUT PWR dBm
1	3	3.9
4	10	10.2
5	15	13.8
6	20	16.9
11	3	4.6

Figure 19: Spurious Emissions WiFi B Mode Channel 1

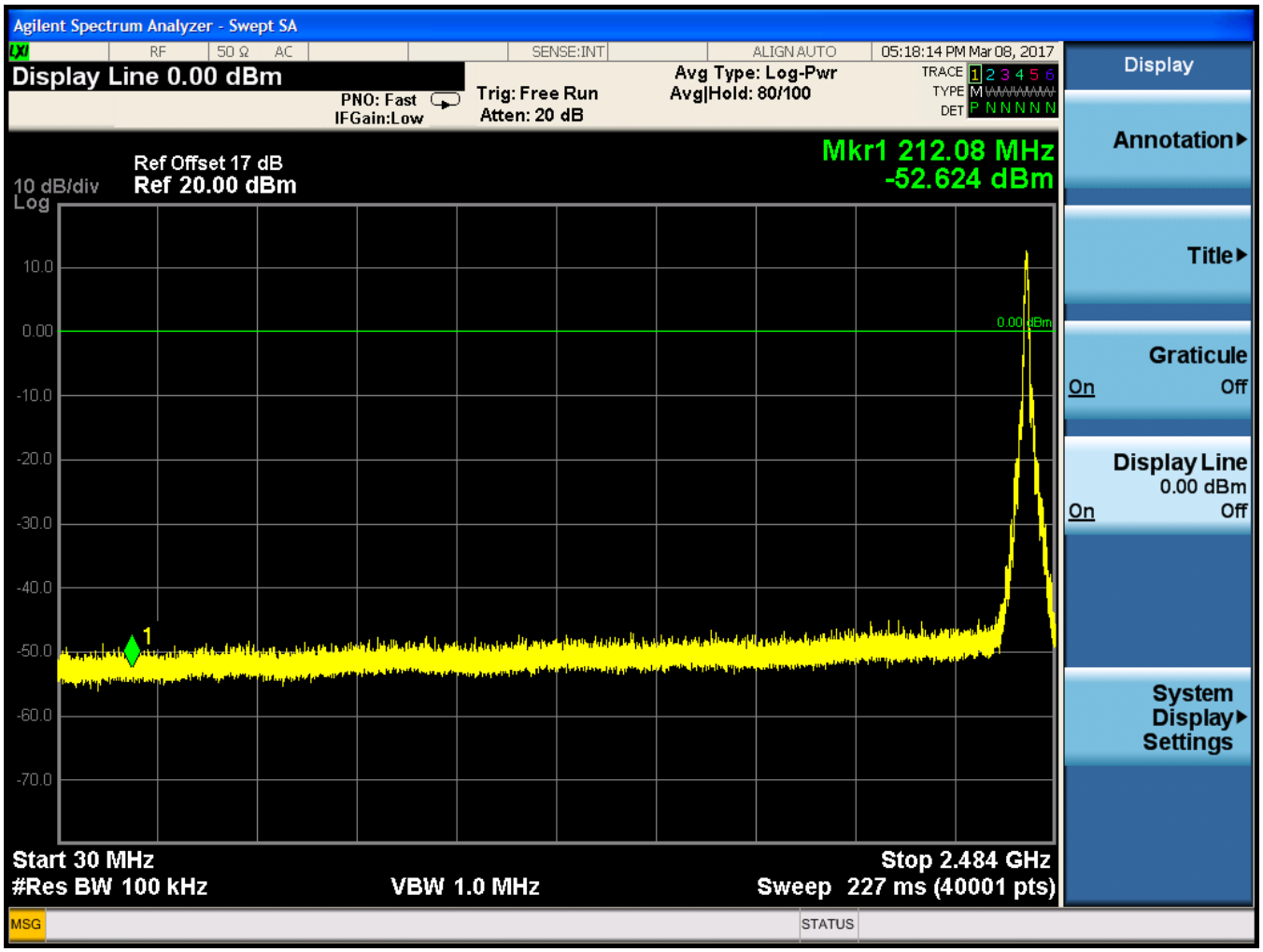


Figure 20: Spurious Emissions WiFi B Mode Channel 1

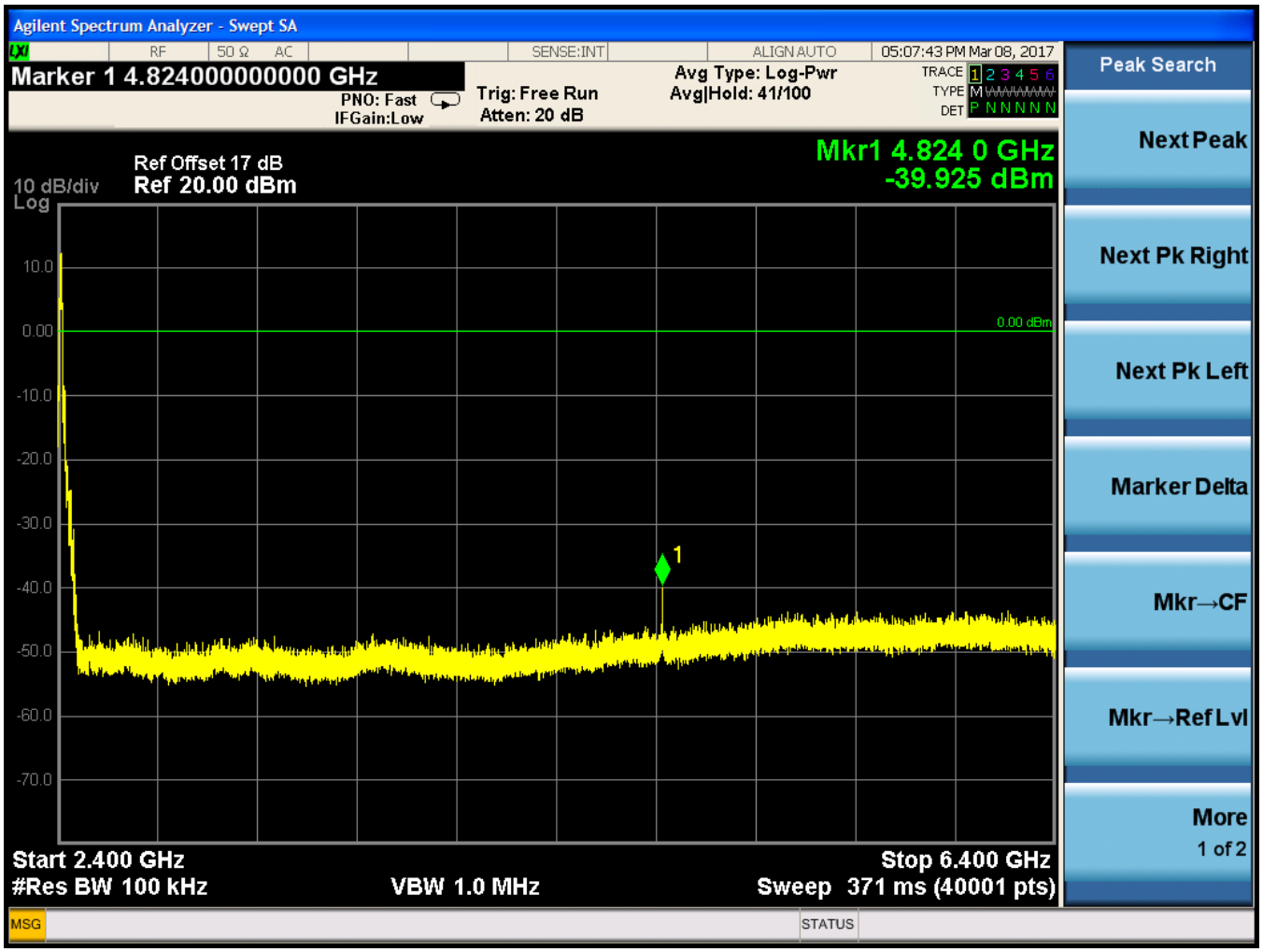


Figure 21: Spurious Emissions WiFi B Mode Channel 1

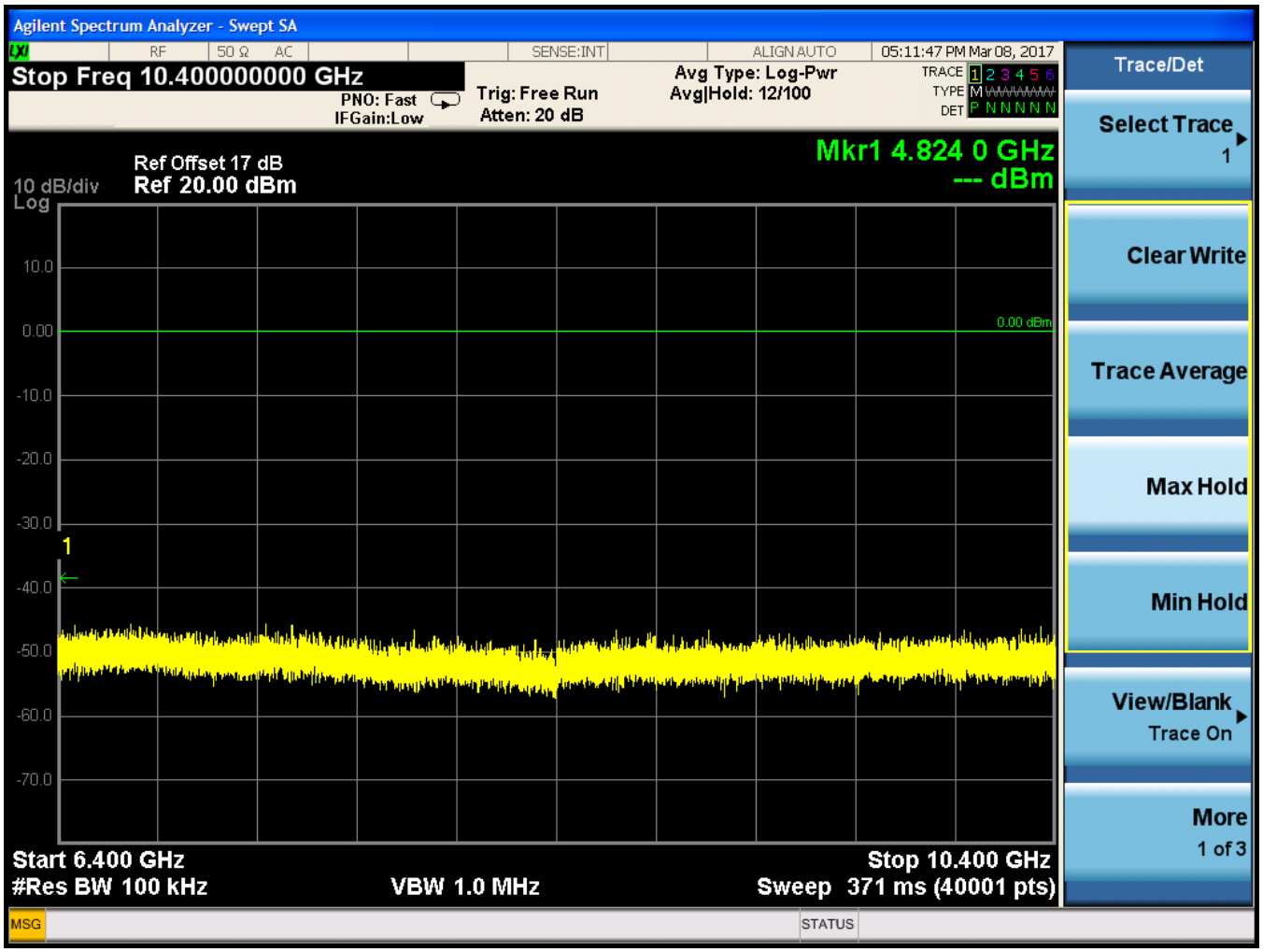


Figure 22: Spurious Emissions WiFi B Mode Channel 1

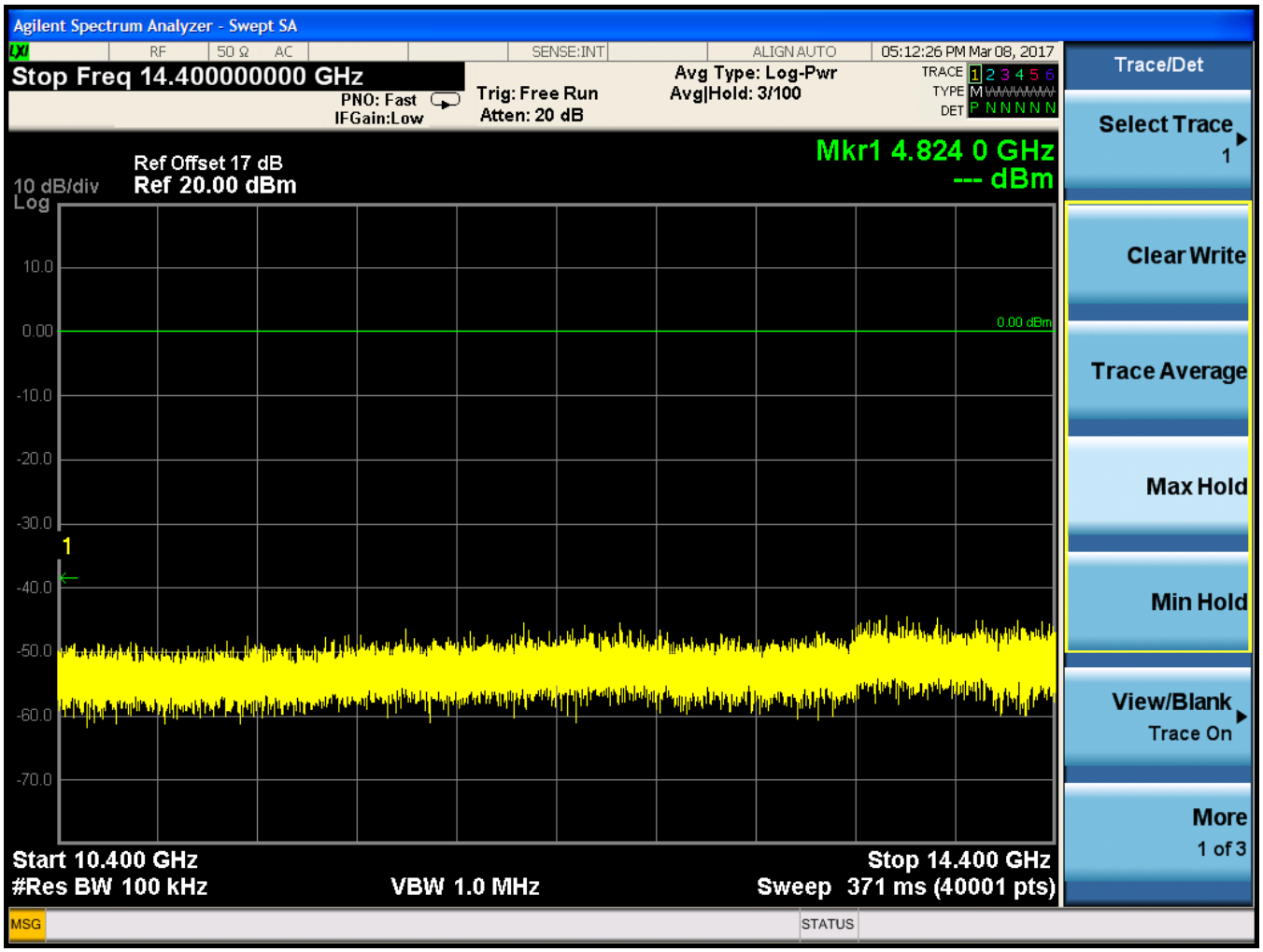


Figure 23: Spurious Emissions WiFi B Mode Channel 1

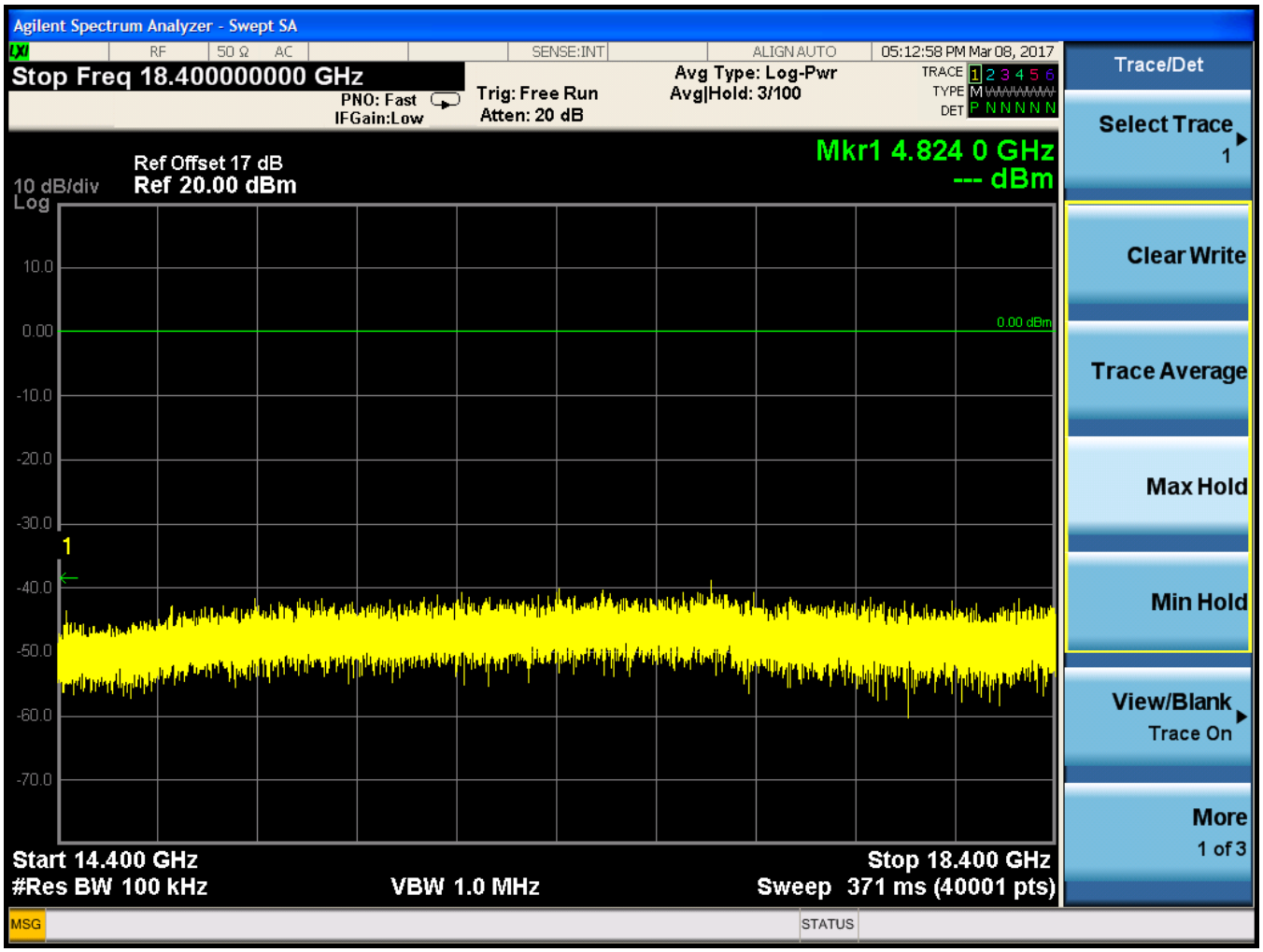


Figure 24: Spurious Emissions WiFi B Mode Channel 1

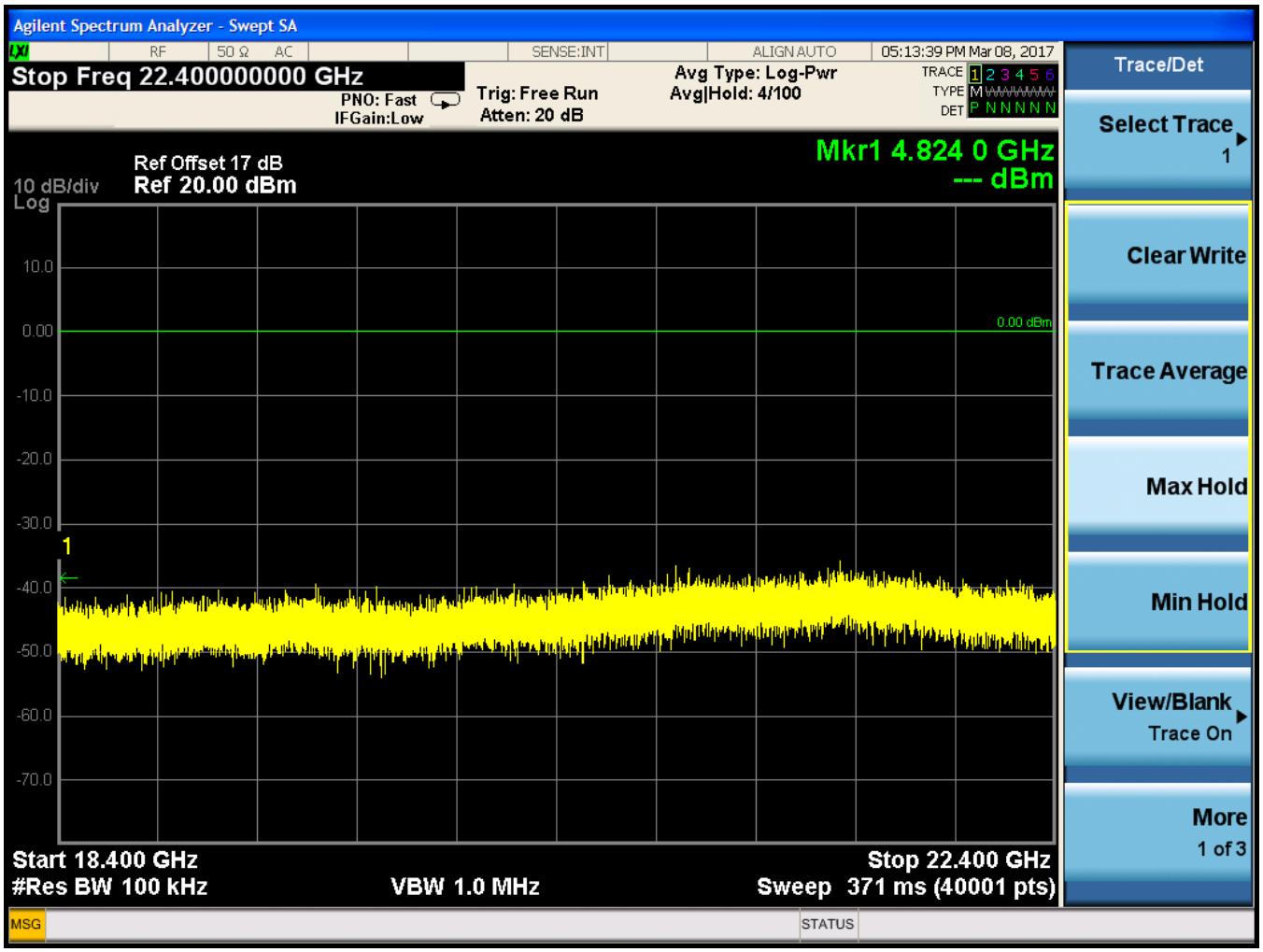


Figure 25: Band Edge WiFi B Mode Channel 1

Figure 26: Spurious Emissions WiFi B Mode Channel 11

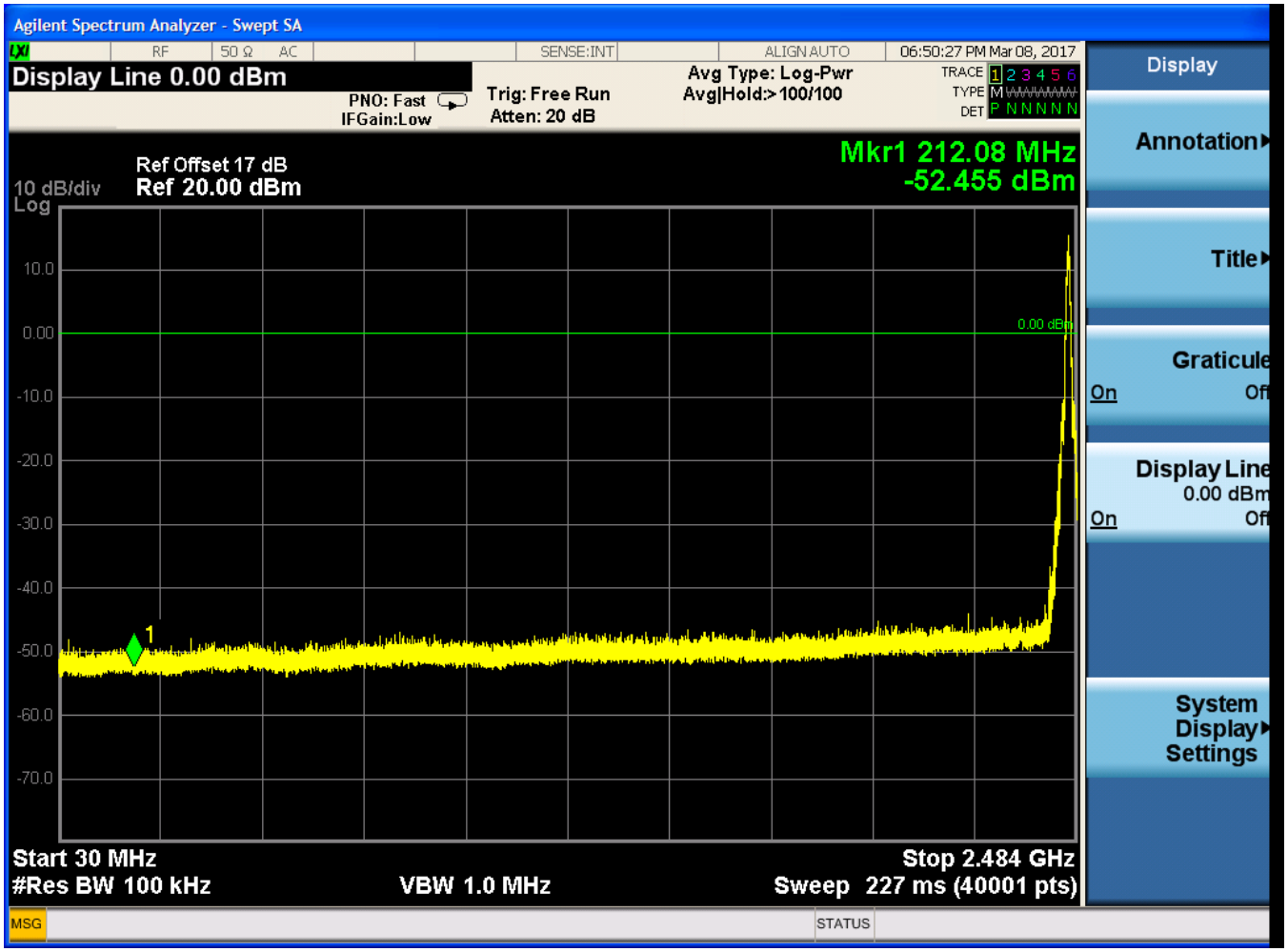


Figure 27: Spurious Emissions WiFi B Mode Channel 11

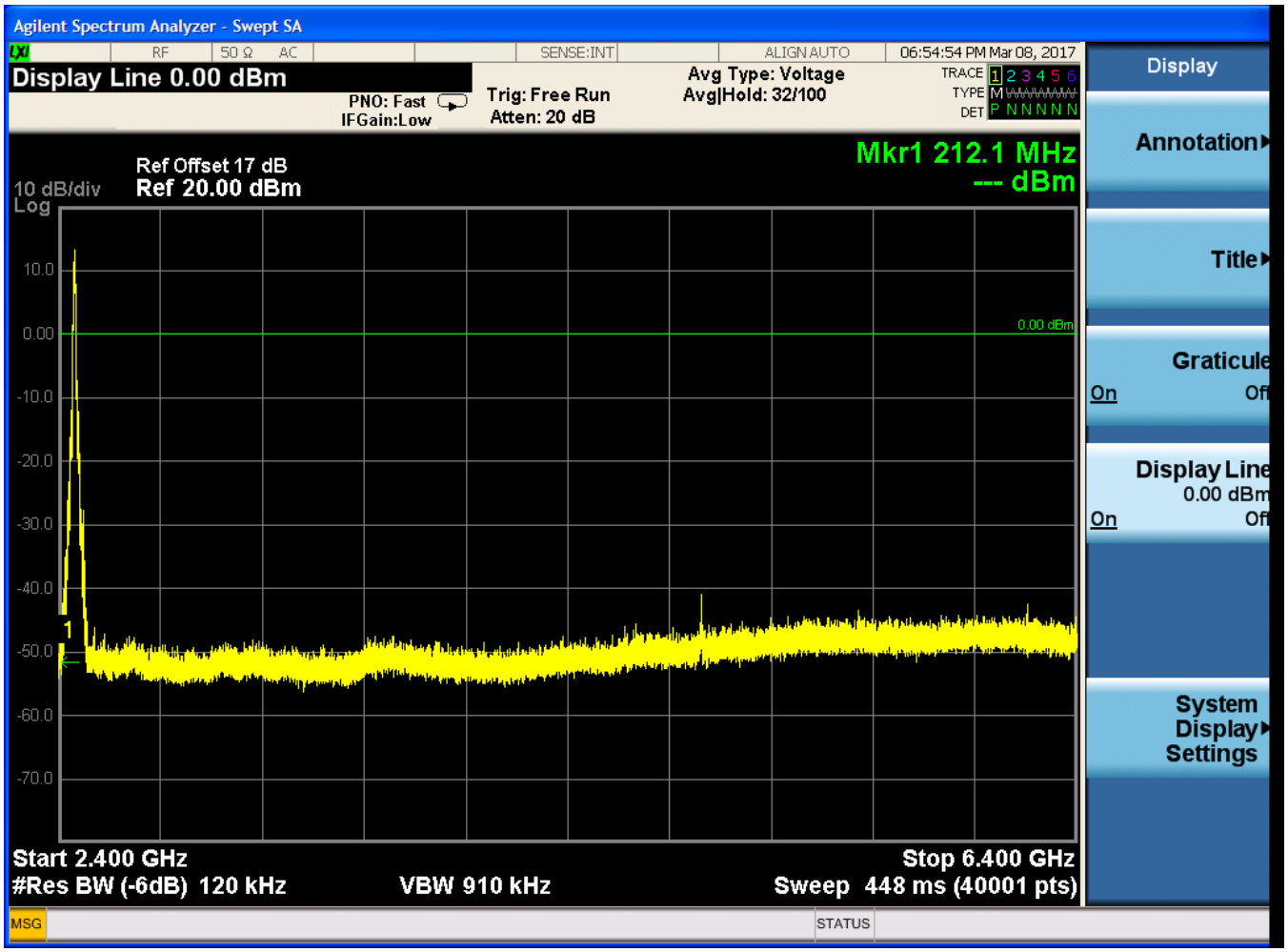


Figure 28: Spurious Emissions WiFi B Mode Channel 11

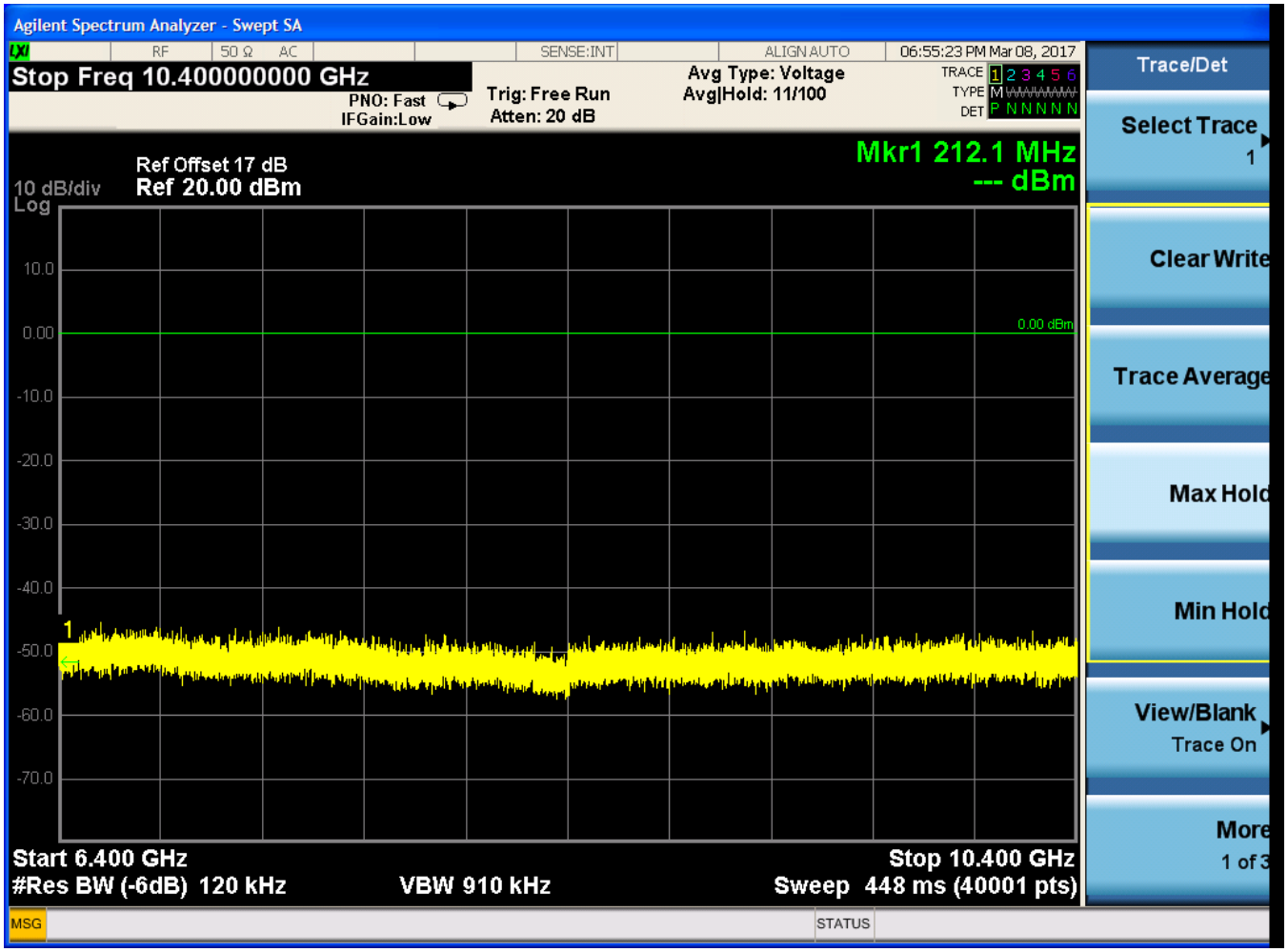


Figure 29: Spurious Emissions WiFi B Mode Channel 11

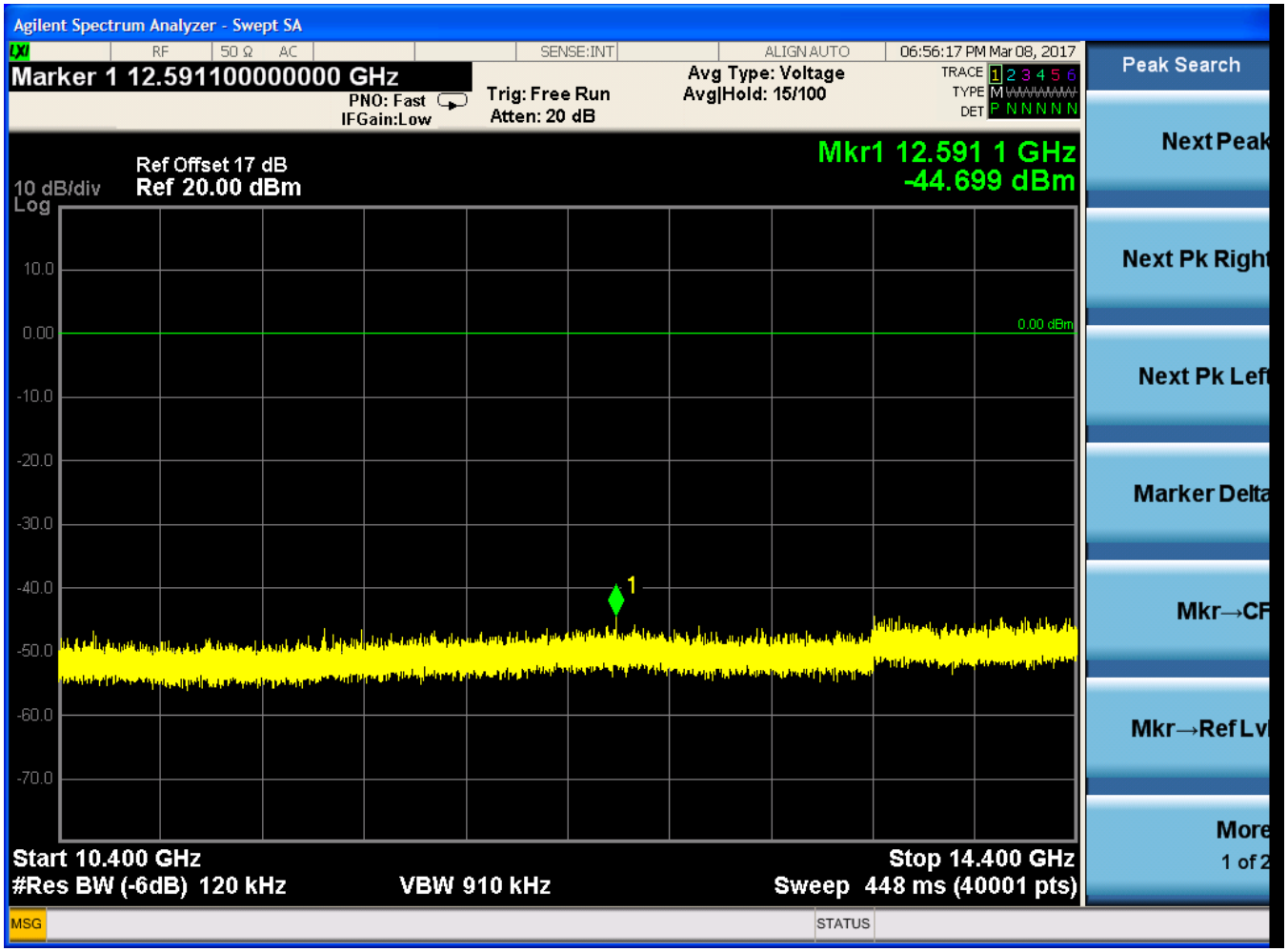


Figure 30: Spurious Emissions WiFi B Mode Channel 11

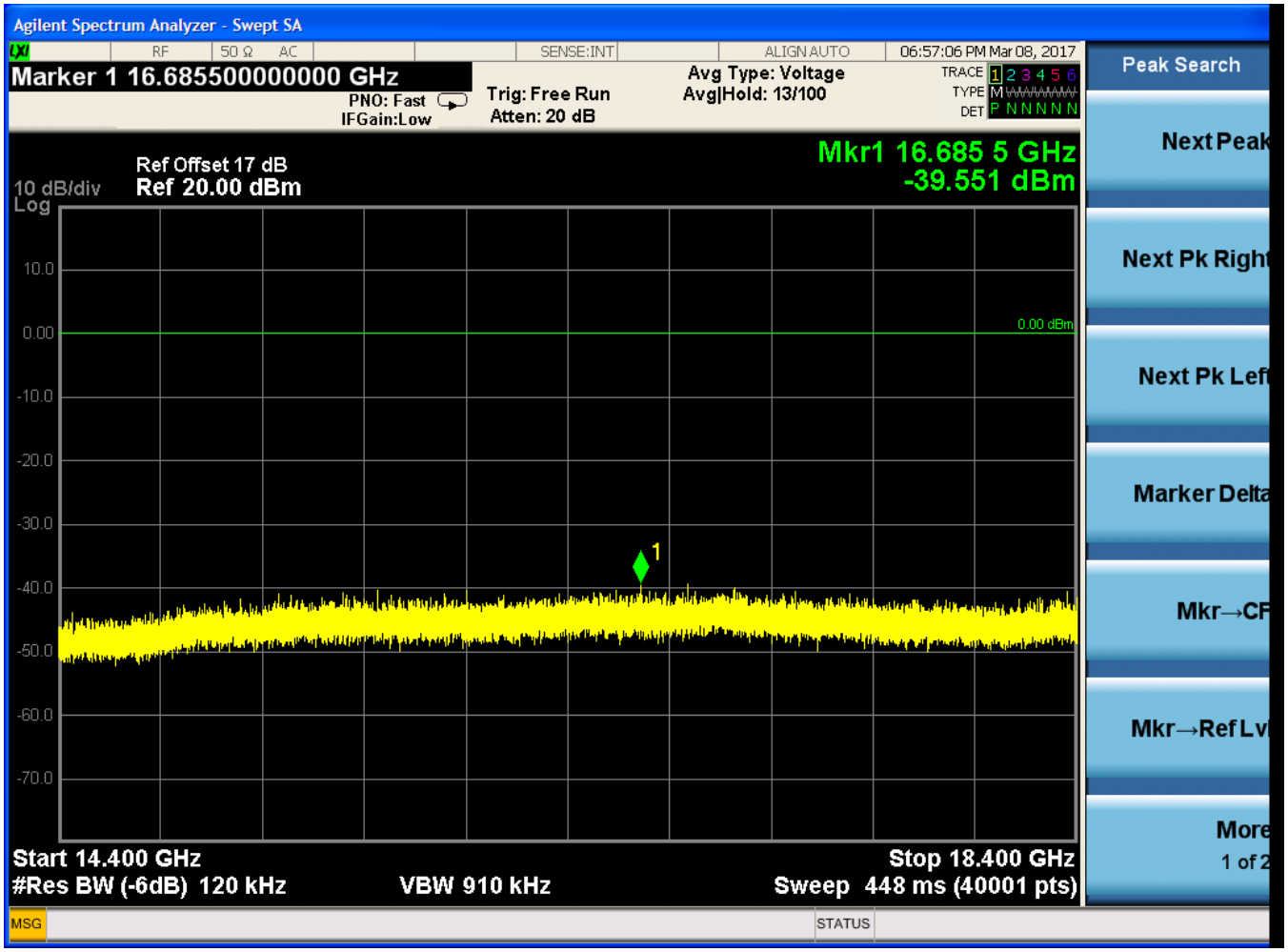


Figure 31: Spurious Emissions WiFi B Mode Channel 11

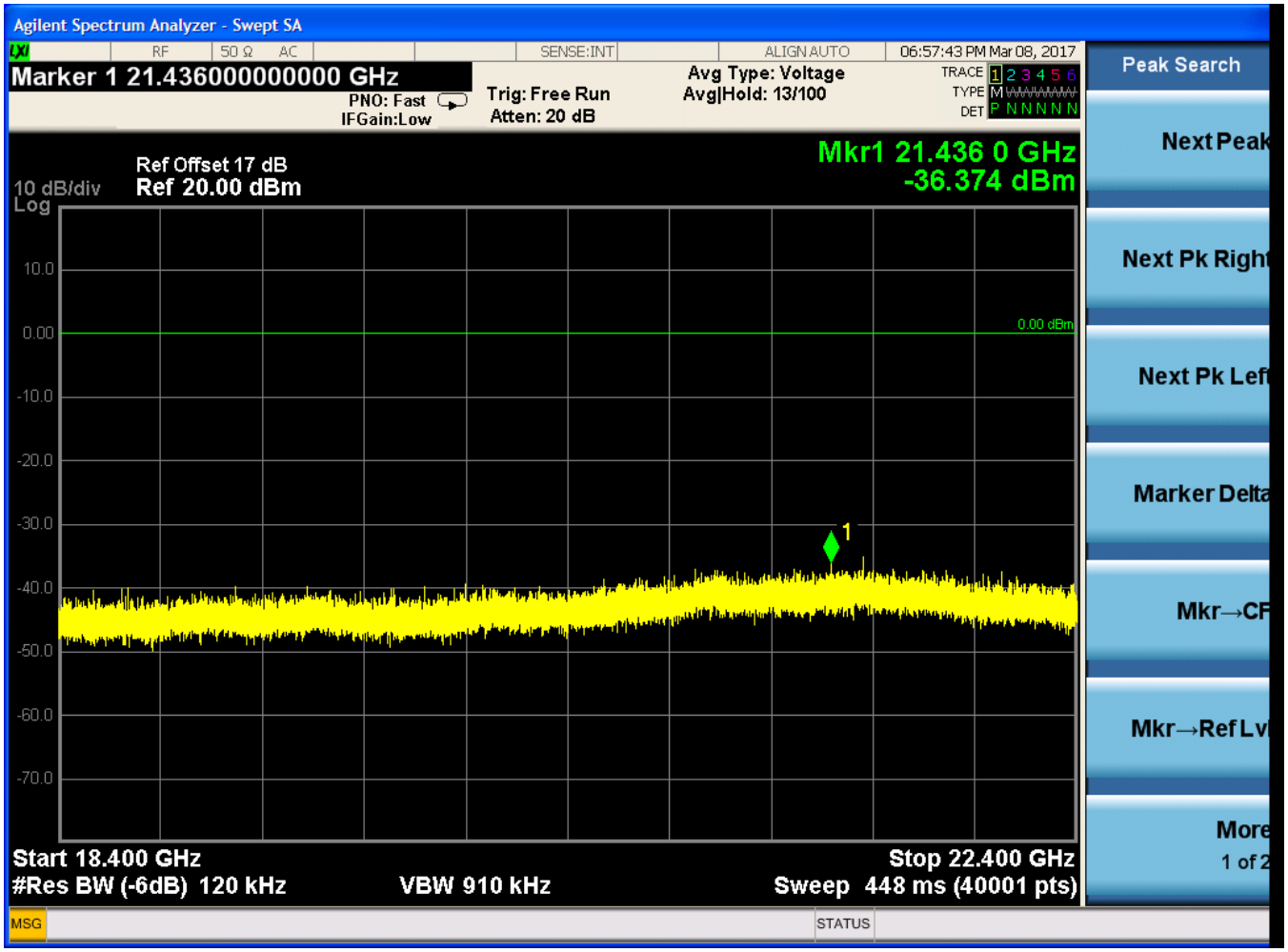


Figure 32: Spurious Emissions WiFi B Mode Channel 11

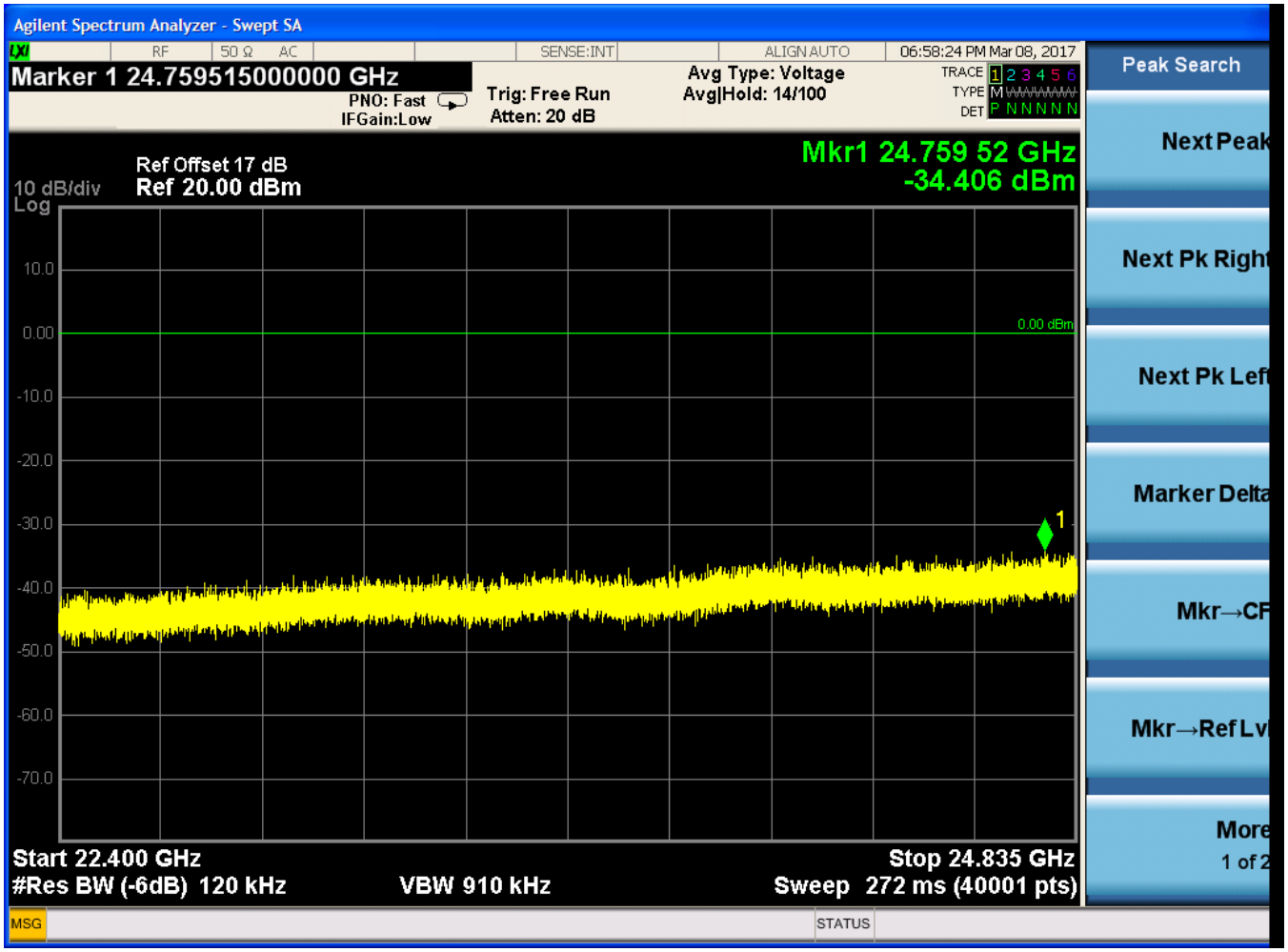
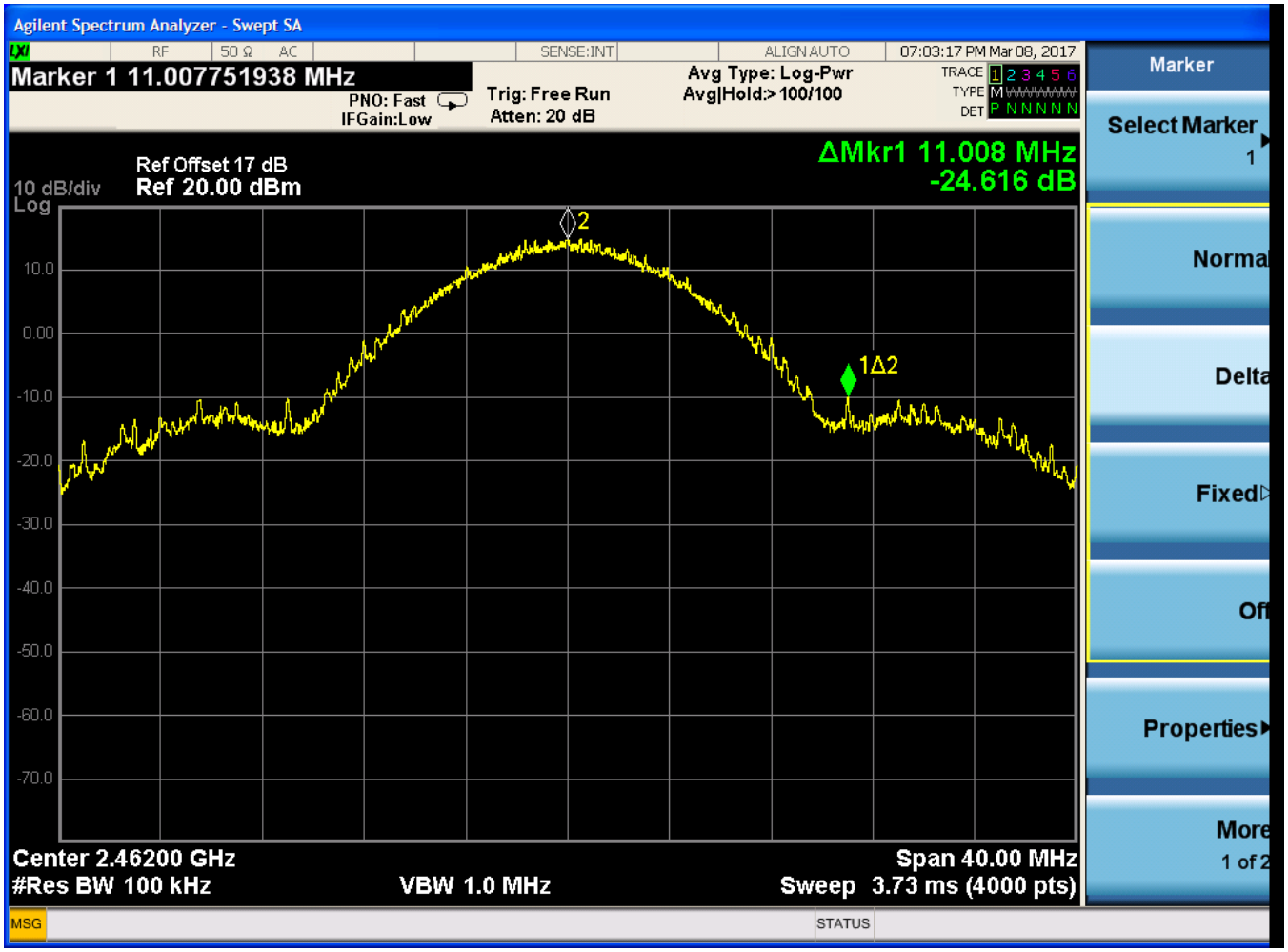


Figure 33: Band Edge WiFi B Mode Channel 11



Spurious emissions in the A/G mode were collected at the center channel.

Figure 34: Spurious Emissions WiFi N Mode Channel 6

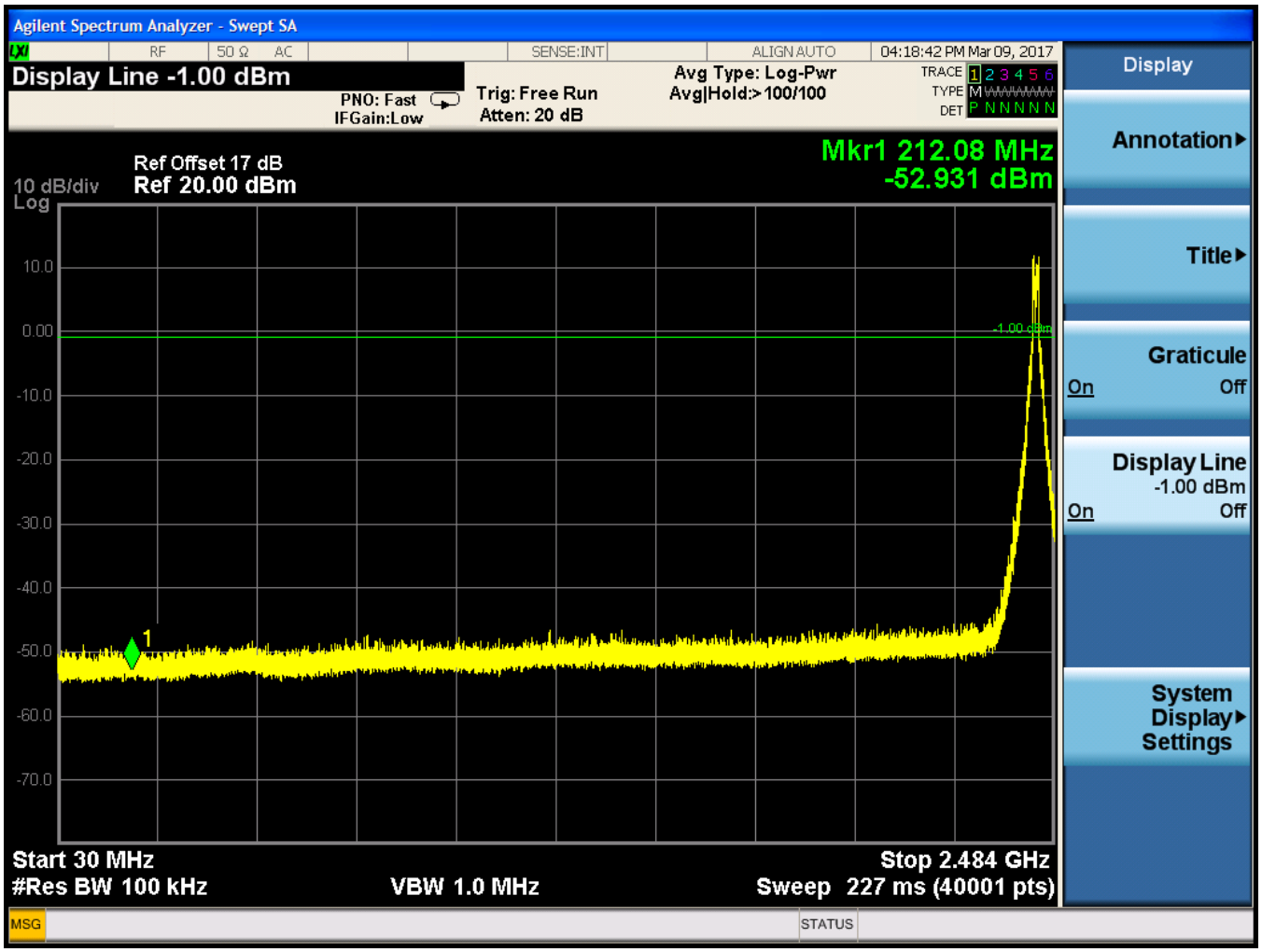


Figure 35: Spurious Emissions WiFi N Mode Channel 6

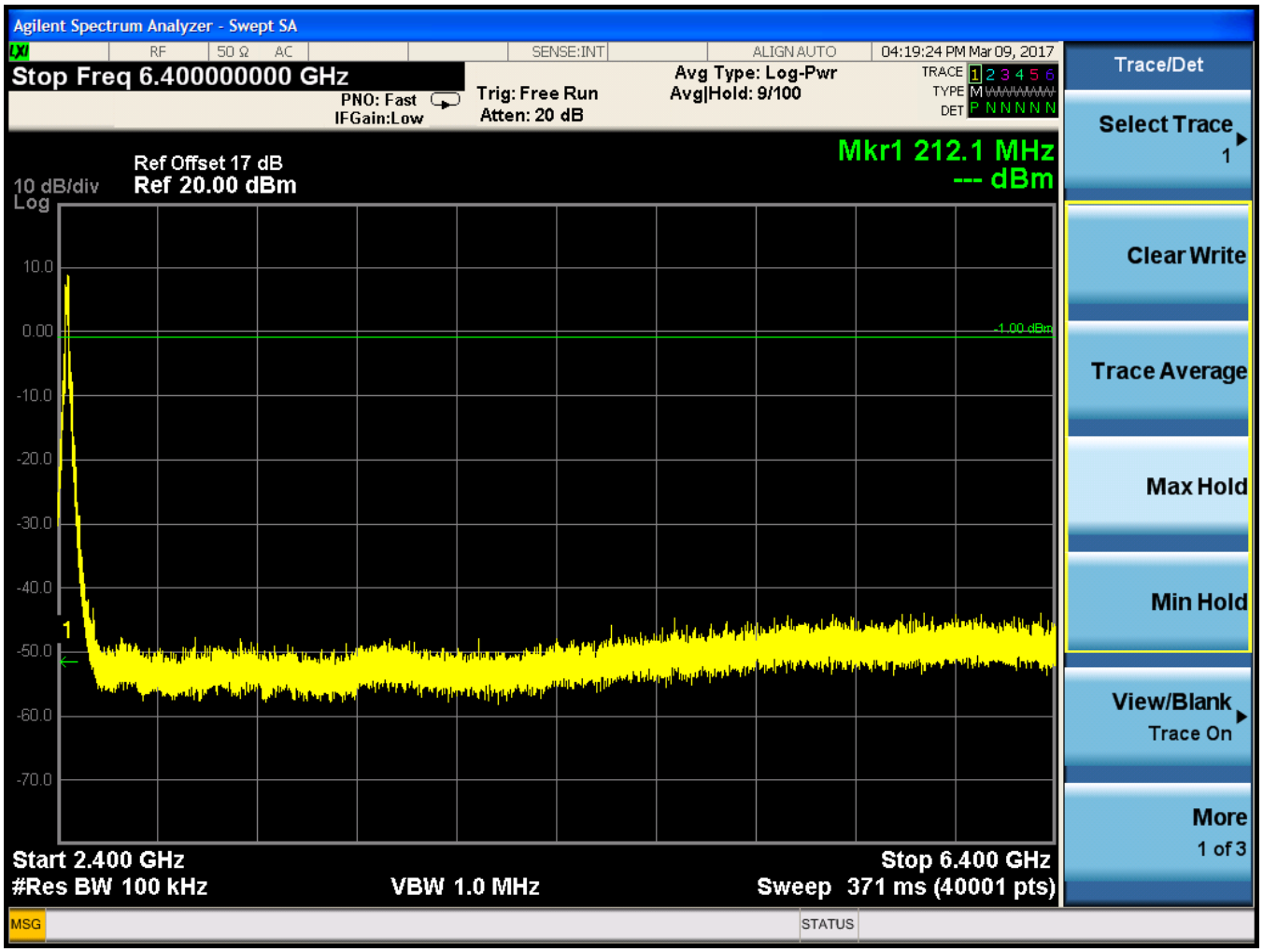


Figure 36: Spurious Emissions WiFi N Mode Channel 6

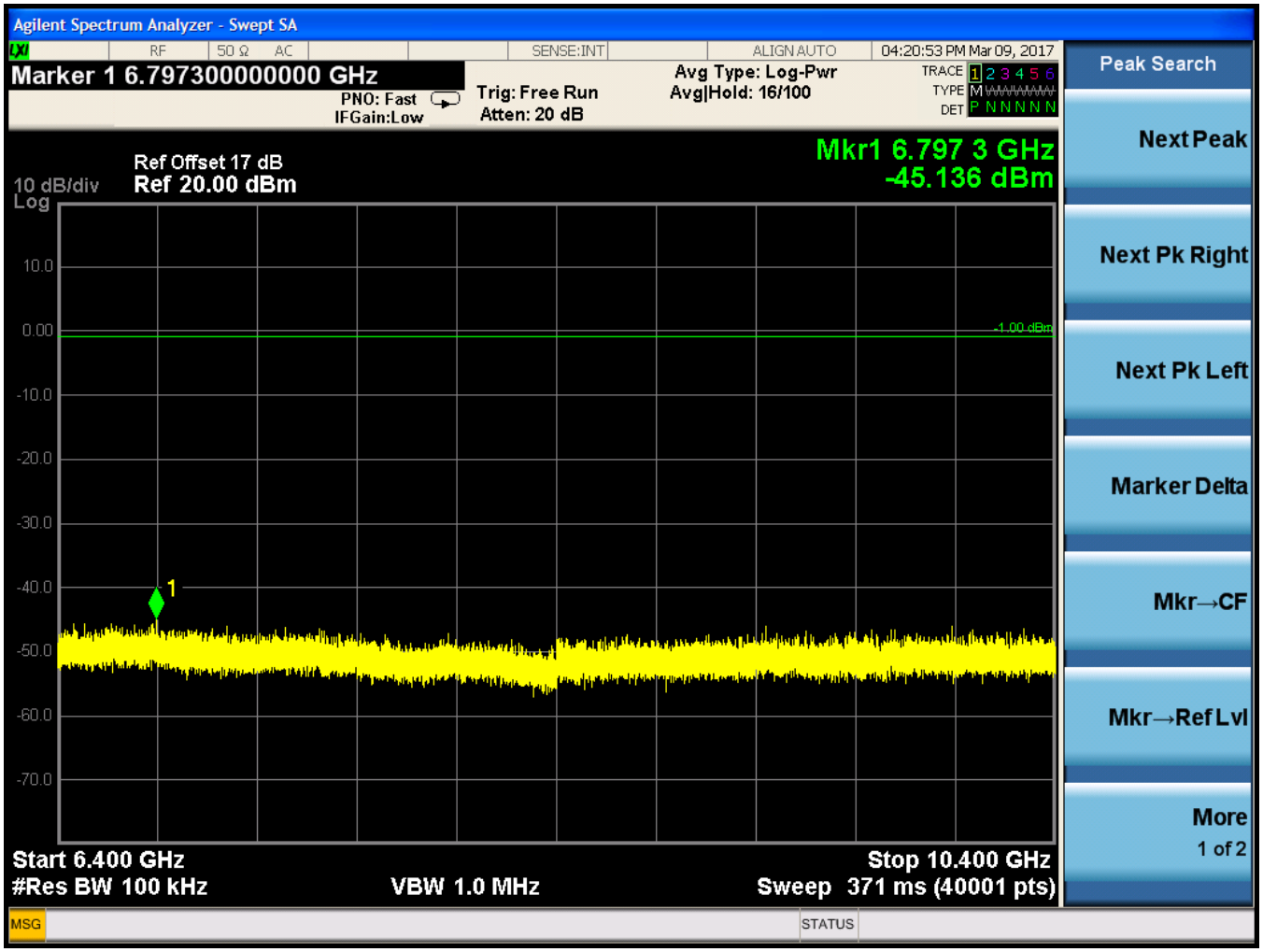


Figure 37: Spurious Emissions WiFi N Mode Channel 6

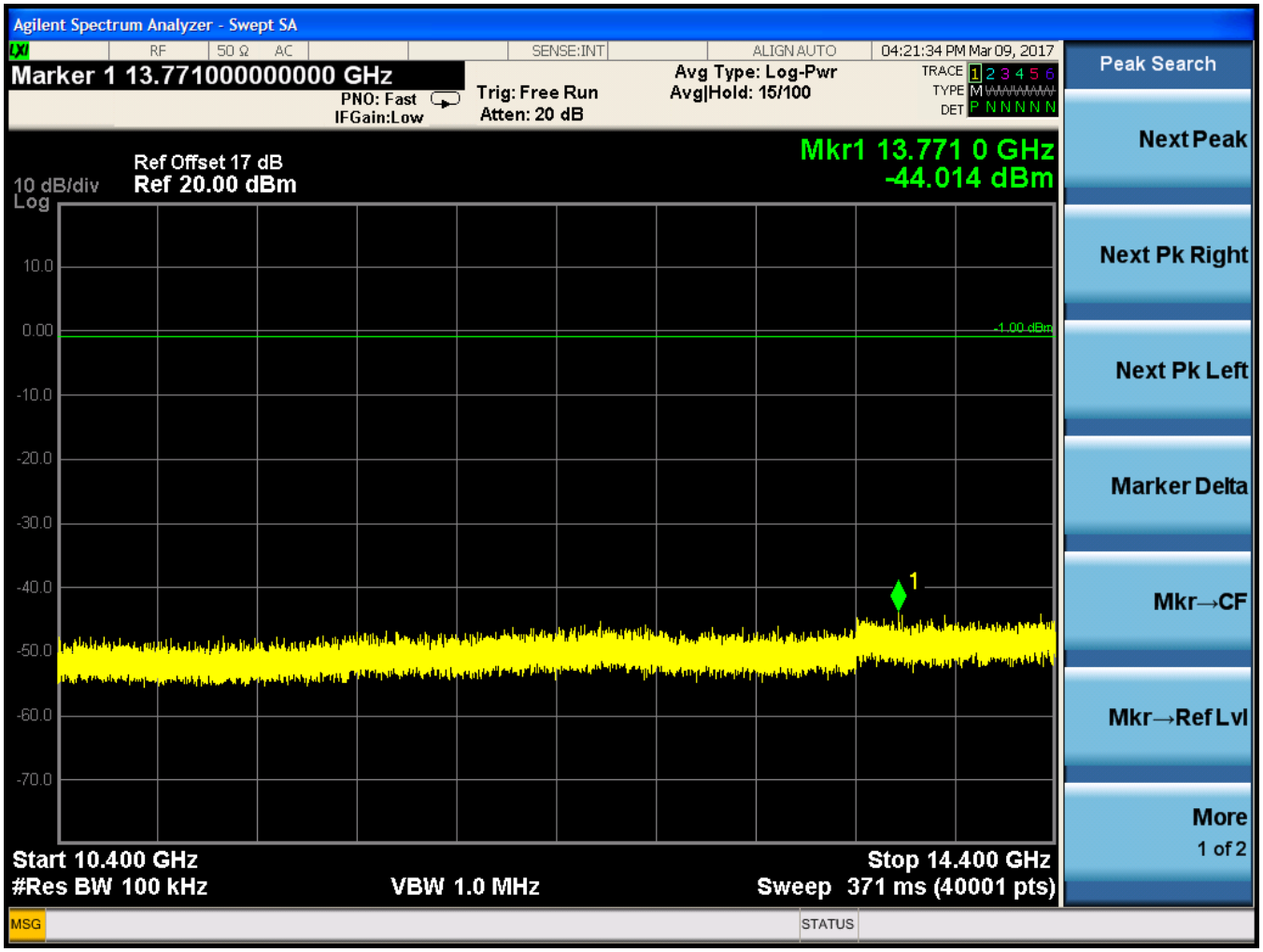


Figure 38: Spurious Emissions WiFi N Mode Channel 6

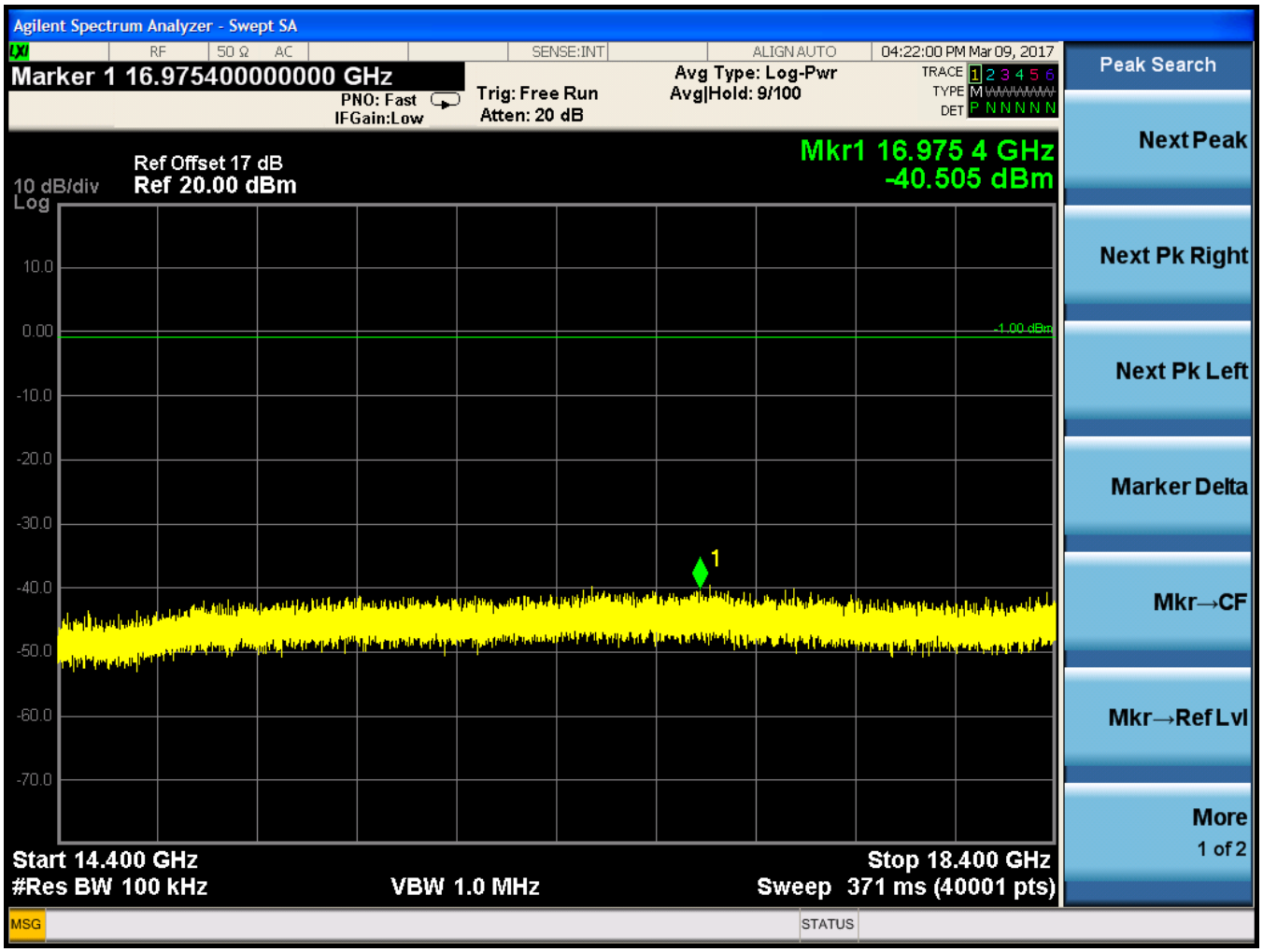


Figure 39: Spurious Emissions WiFi N Mode Channel 6

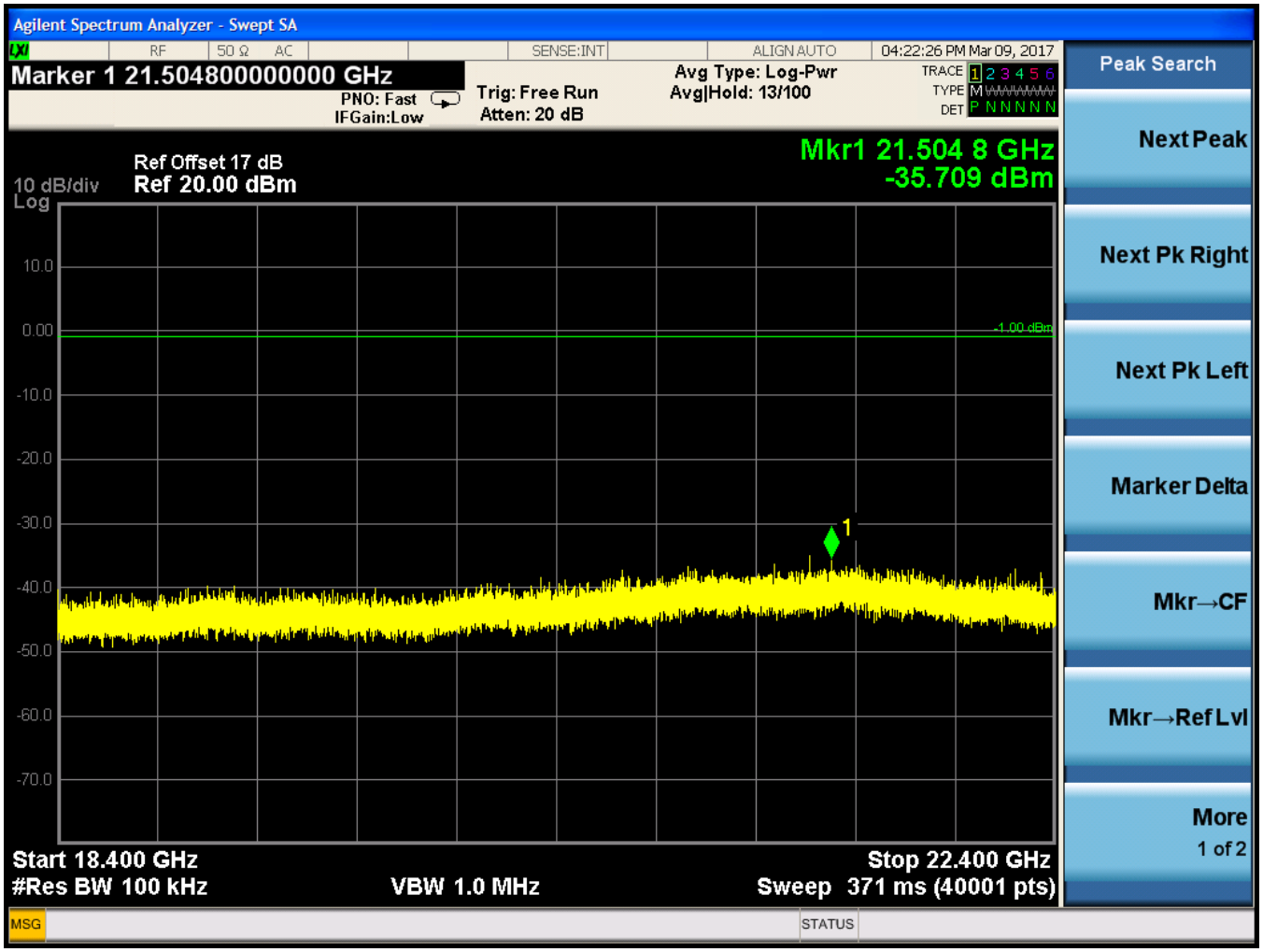


Figure 40: Spurious Emissions WiFi N Mode Channel 6

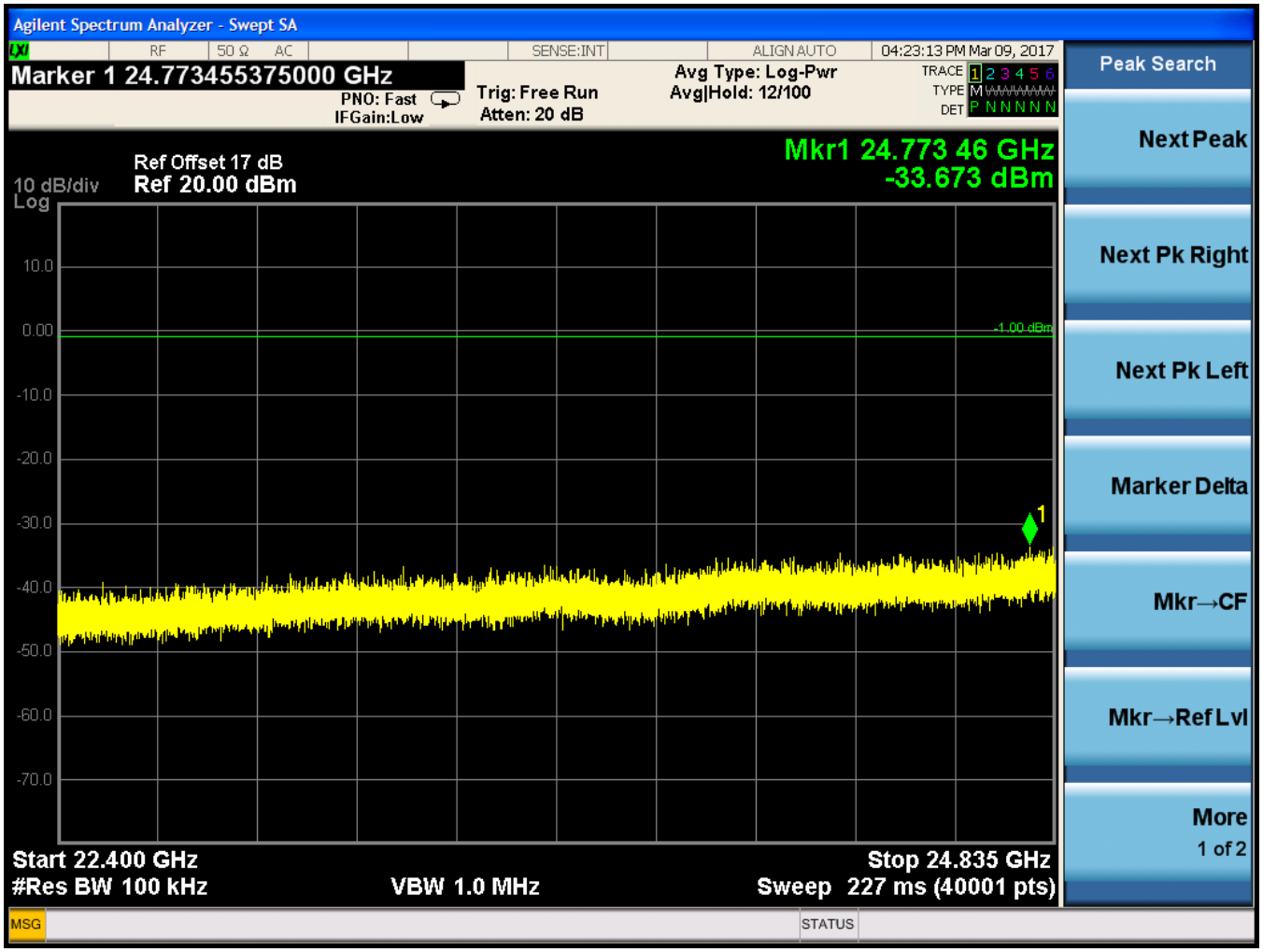


Figure 41: Band Edge WiFi AG Mode

Figure 42: Band Edge WiFi AG Mode

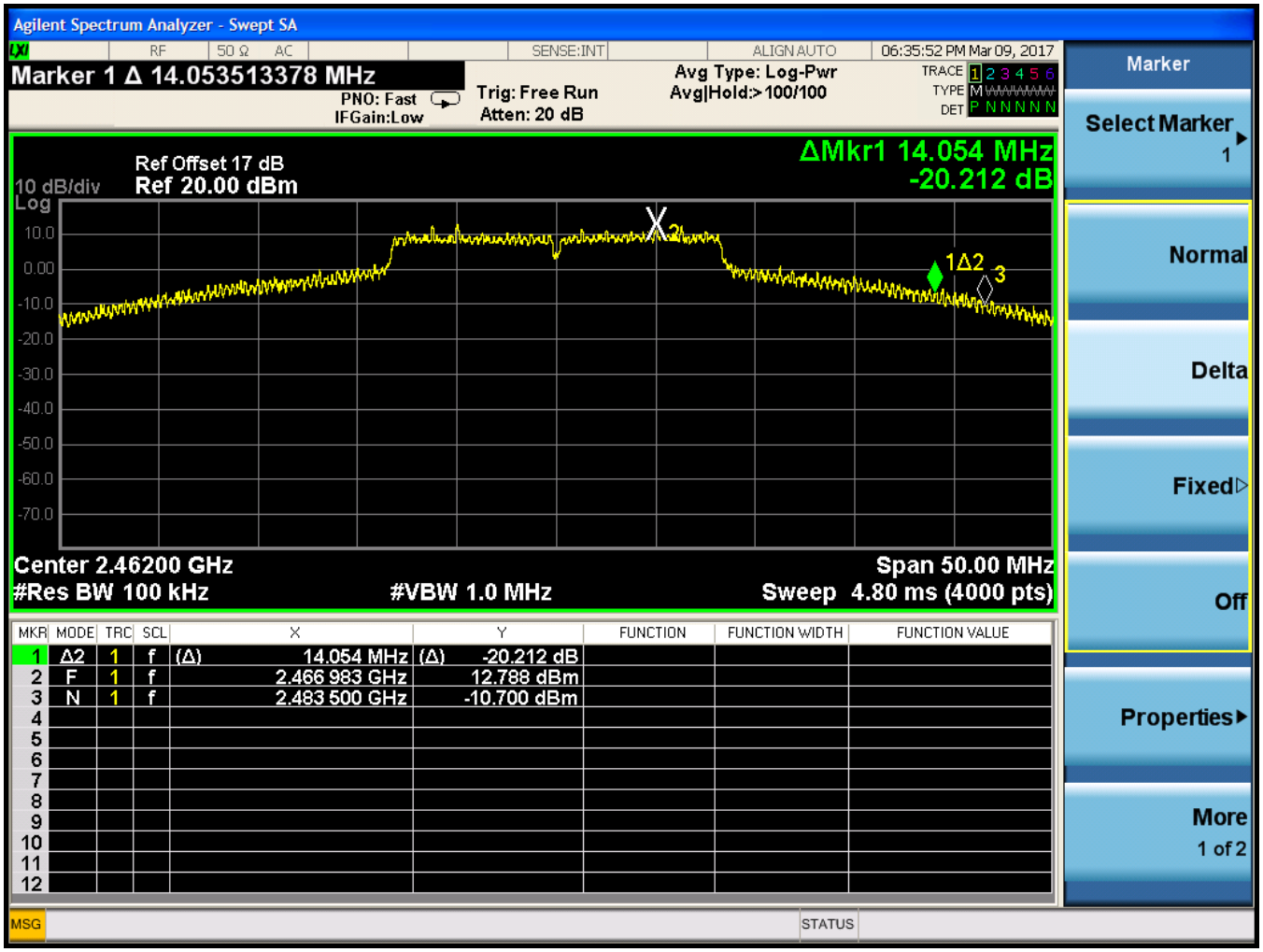


Figure 43: Spurious Emissions WiFi N Mode Channel 6

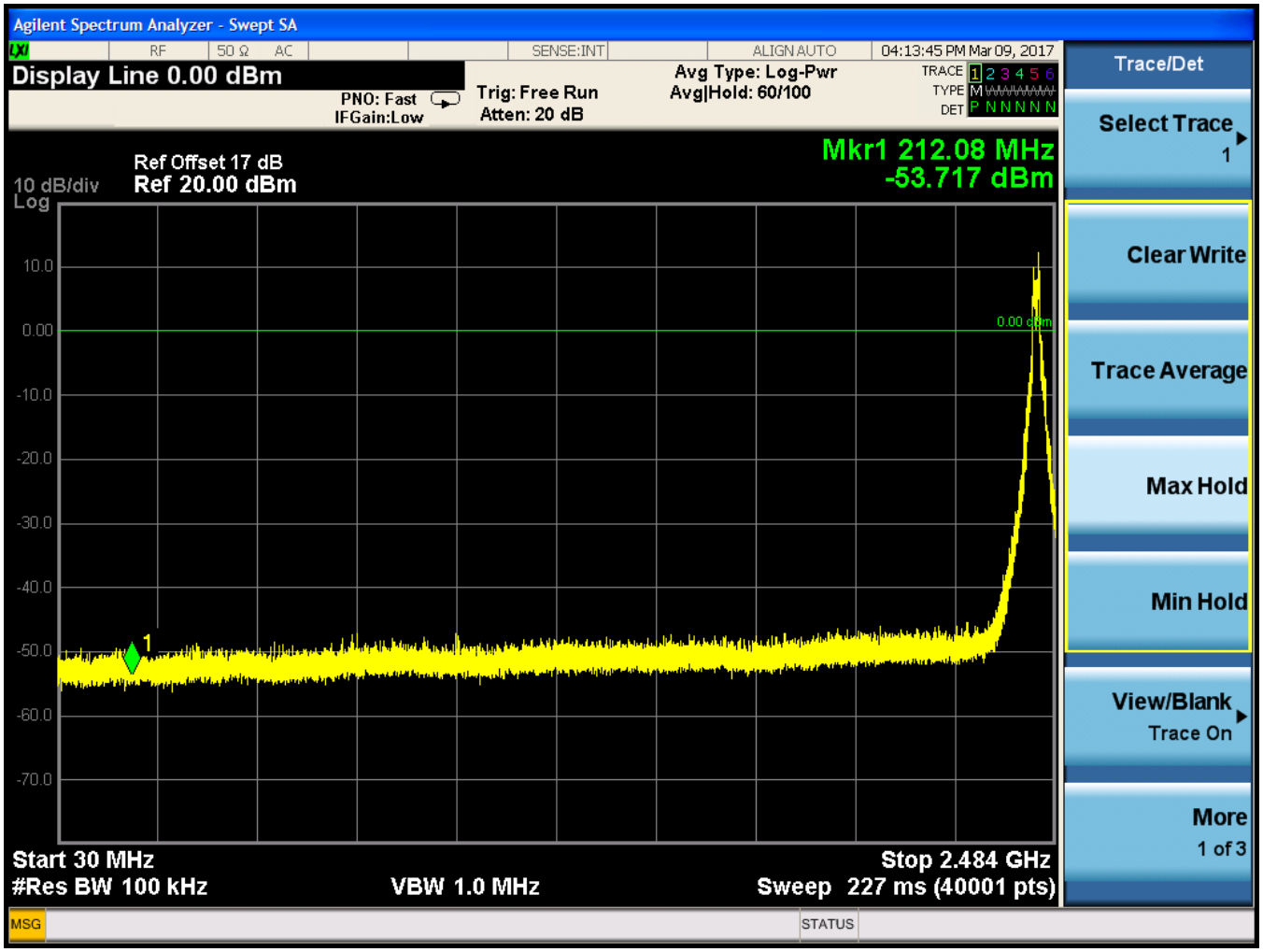


Figure 44: Spurious Emissions WiFi N Mode Channel 6

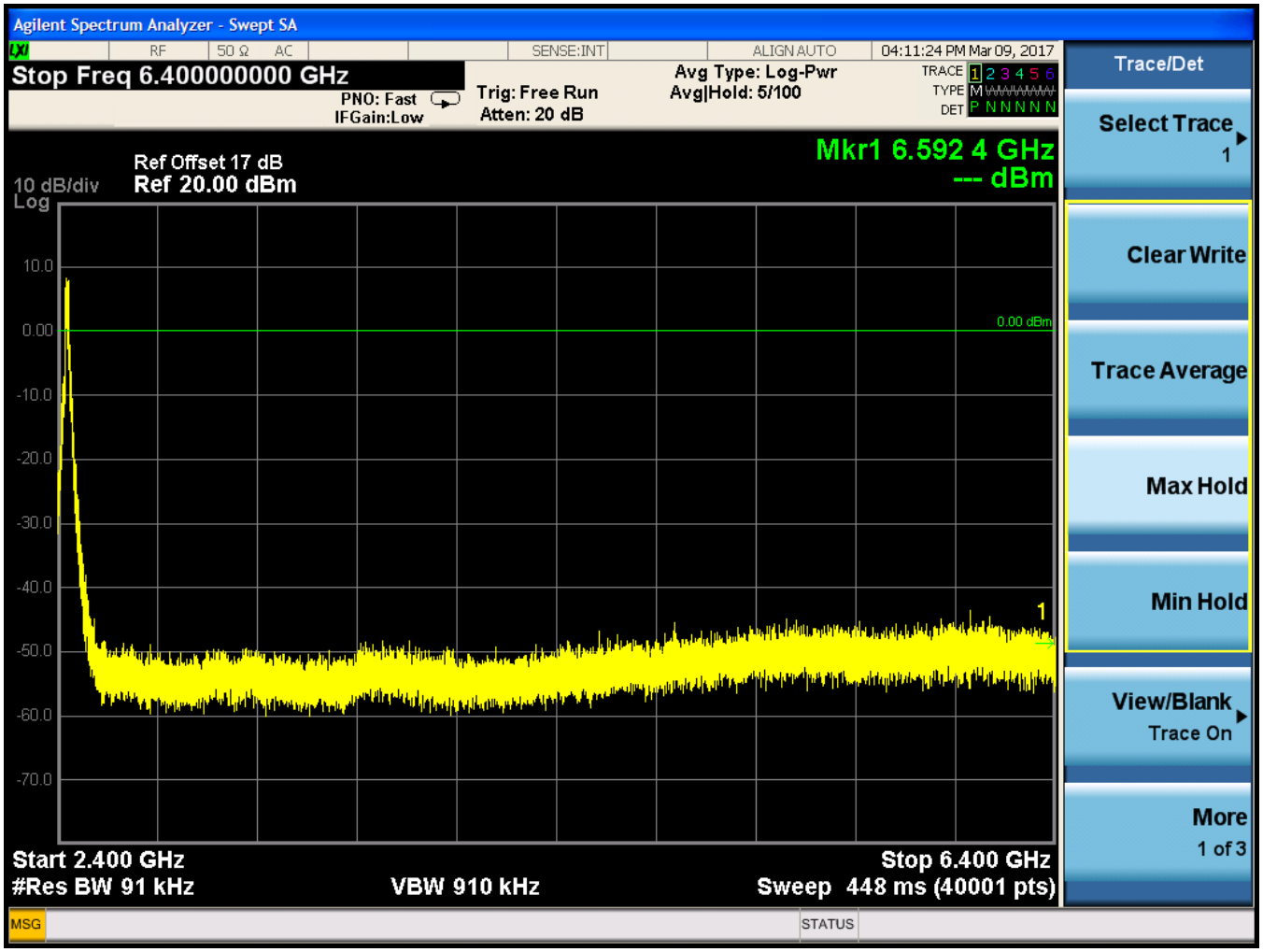


Figure 45: Spurious Emissions WiFi N Mode Channel 6

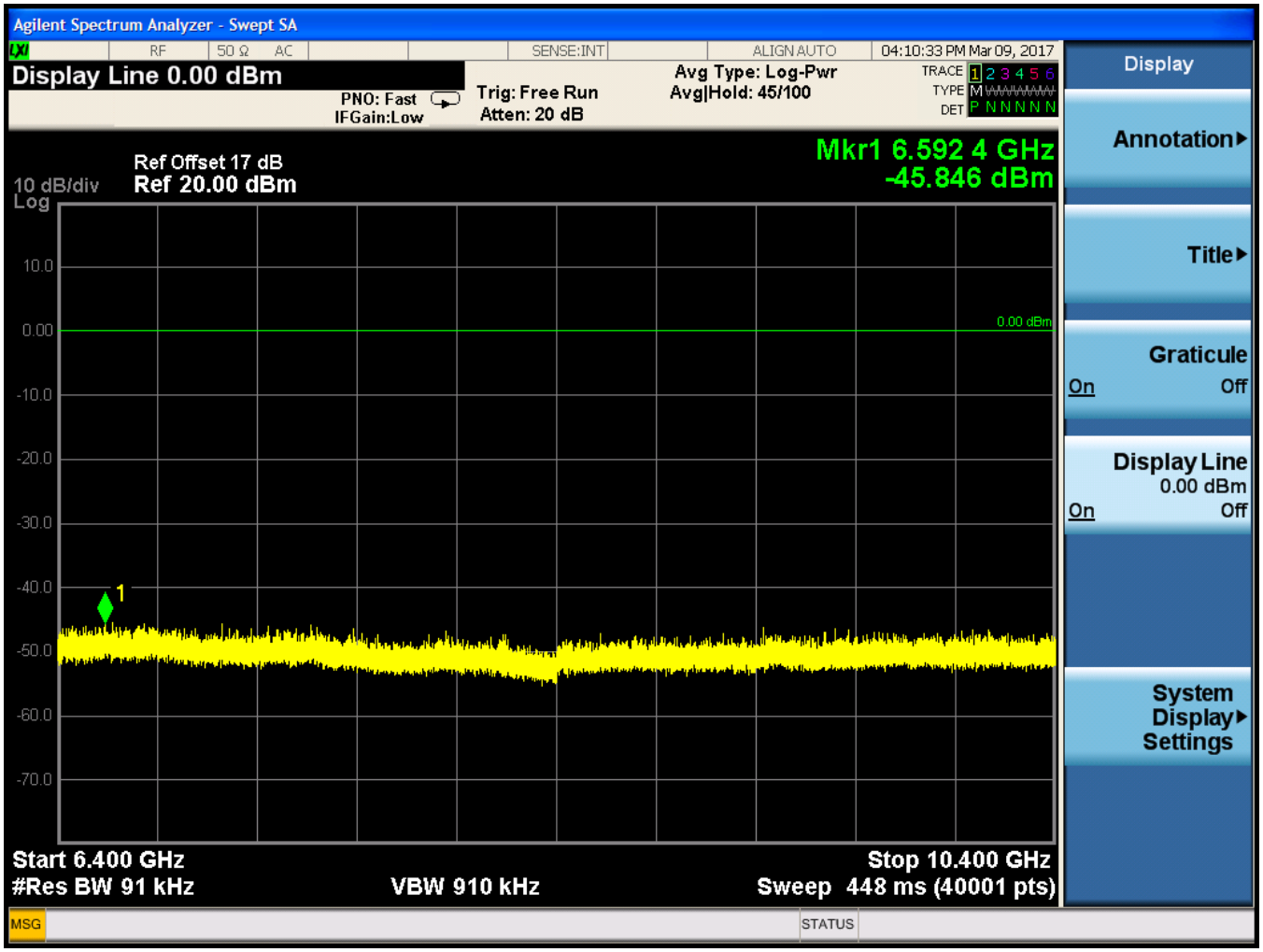


Figure 46: Spurious Emissions WiFi N Mode Channel 6

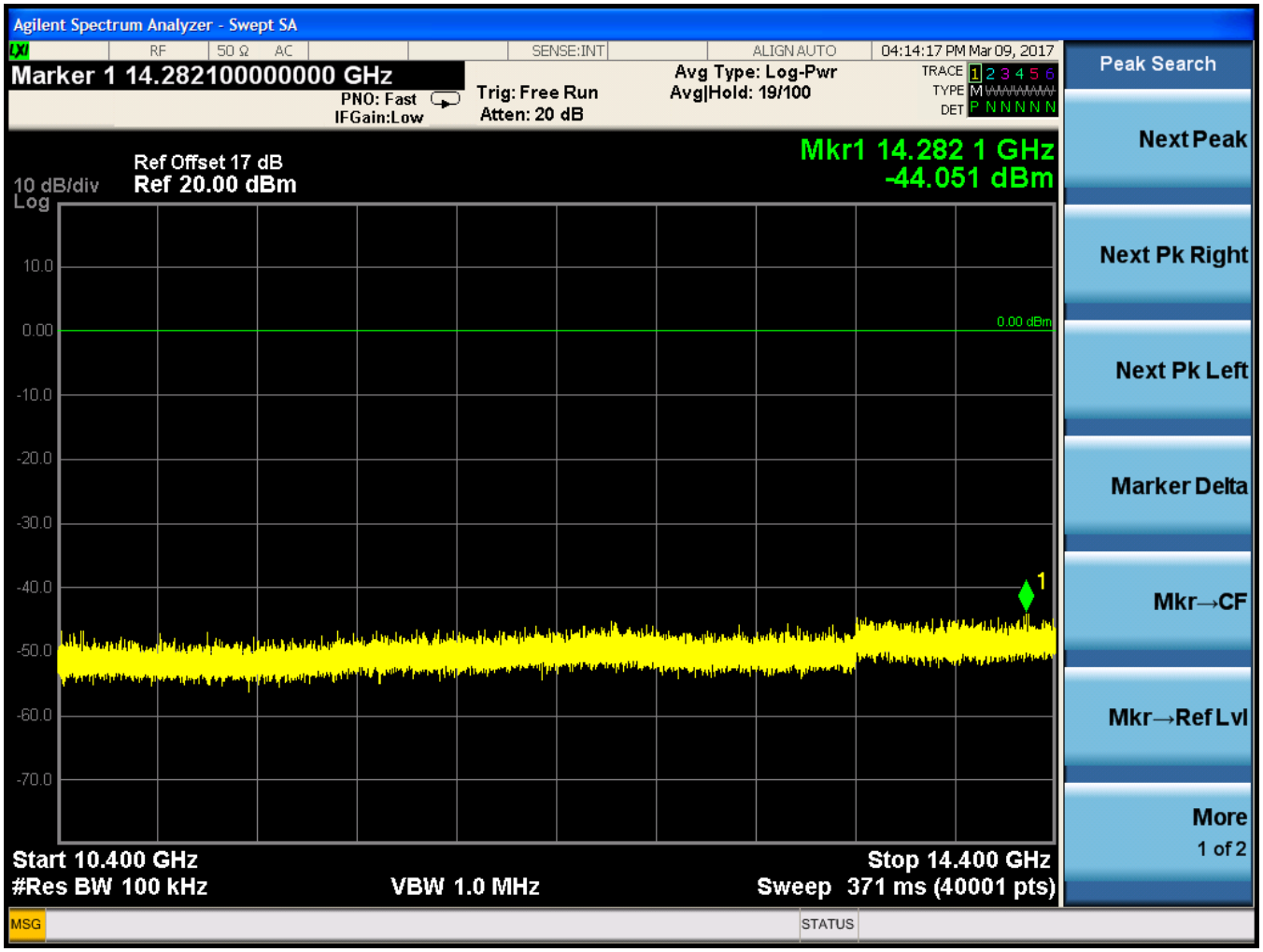


Figure 47: Spurious Emissions WiFi N Mode Channel 6

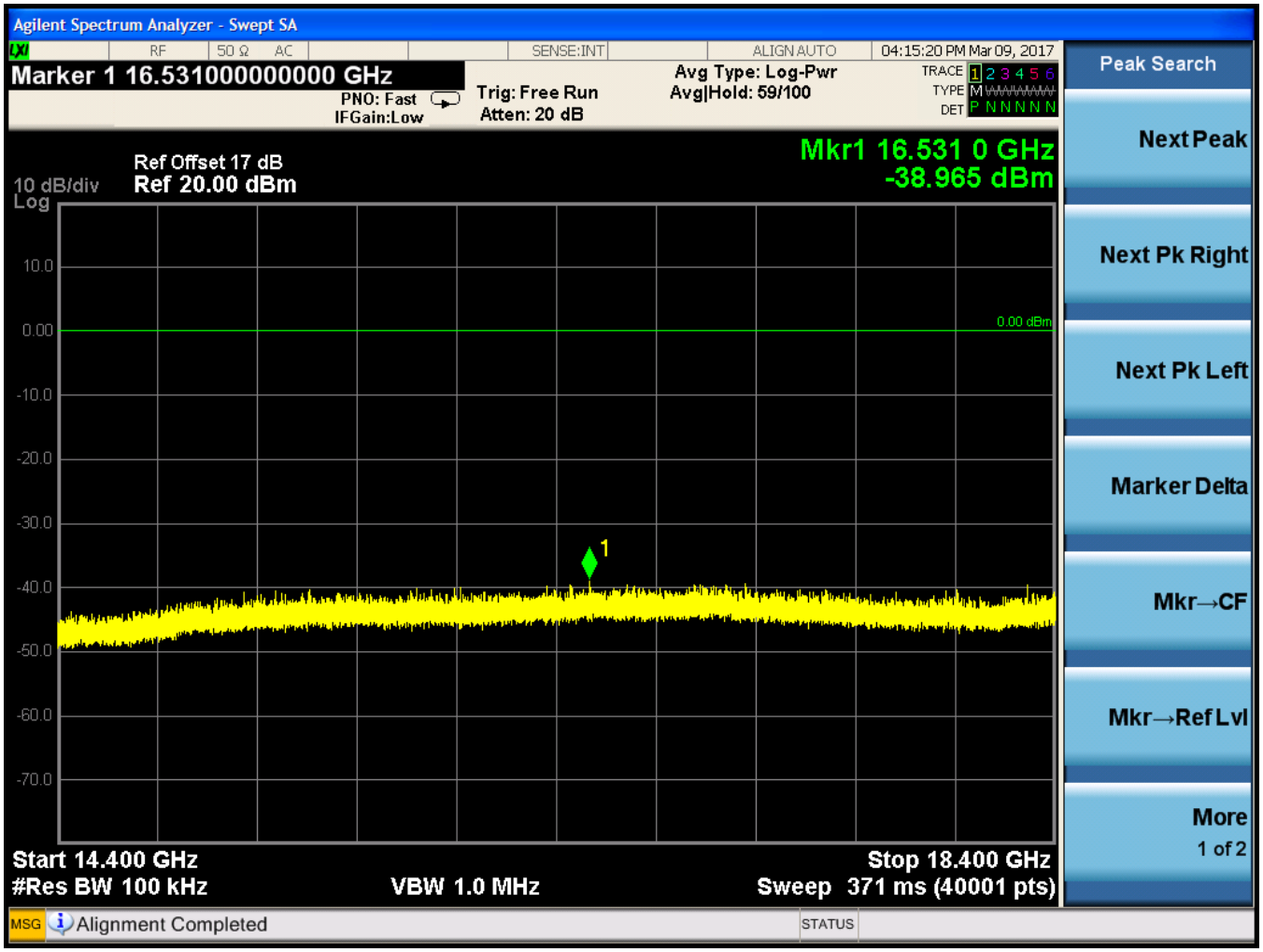


Figure 48: Spurious Emissions WiFi N Mode Channel 6

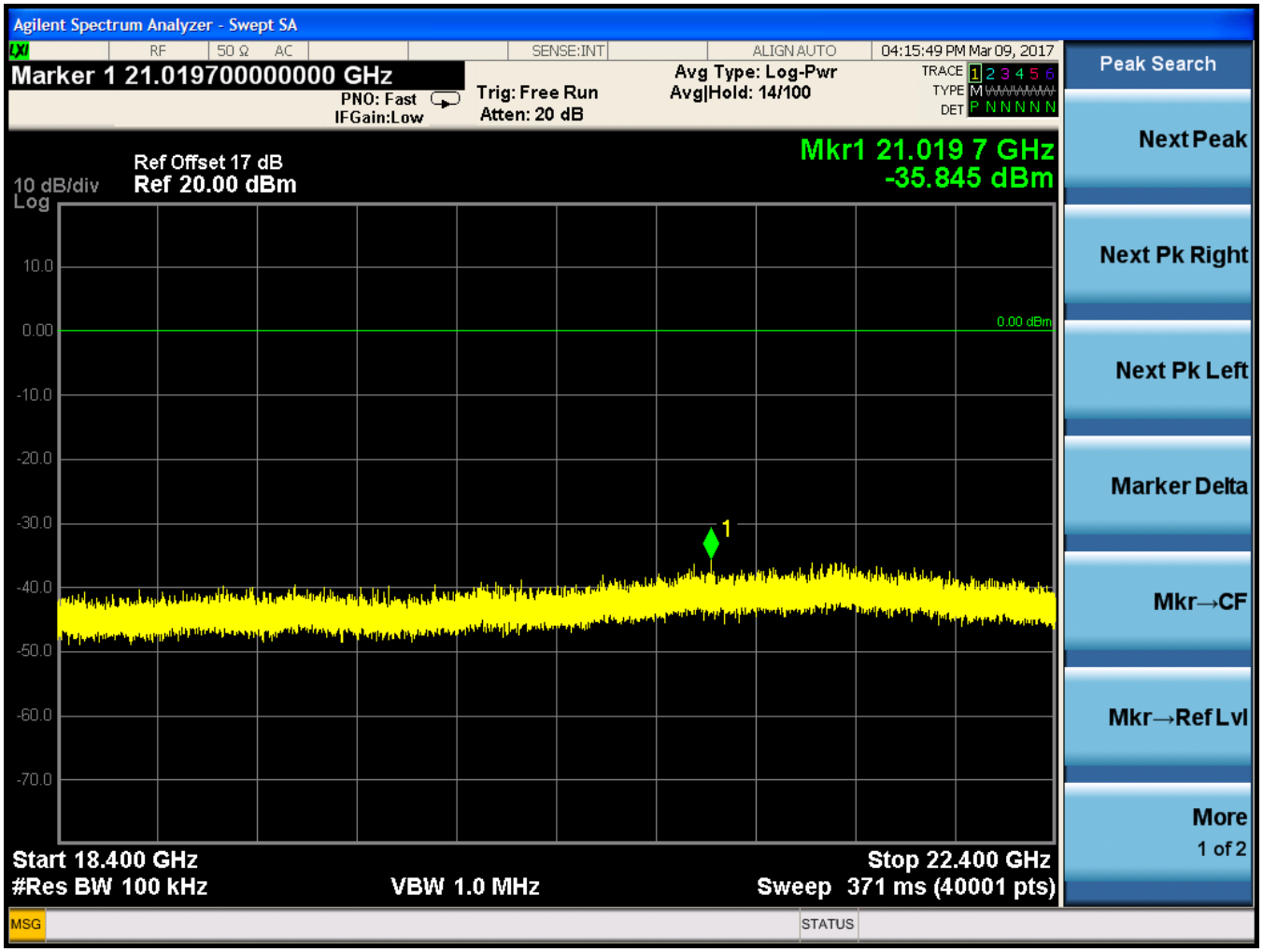


Figure 49: Spurious Emissions WiFi N Mode Channel 6

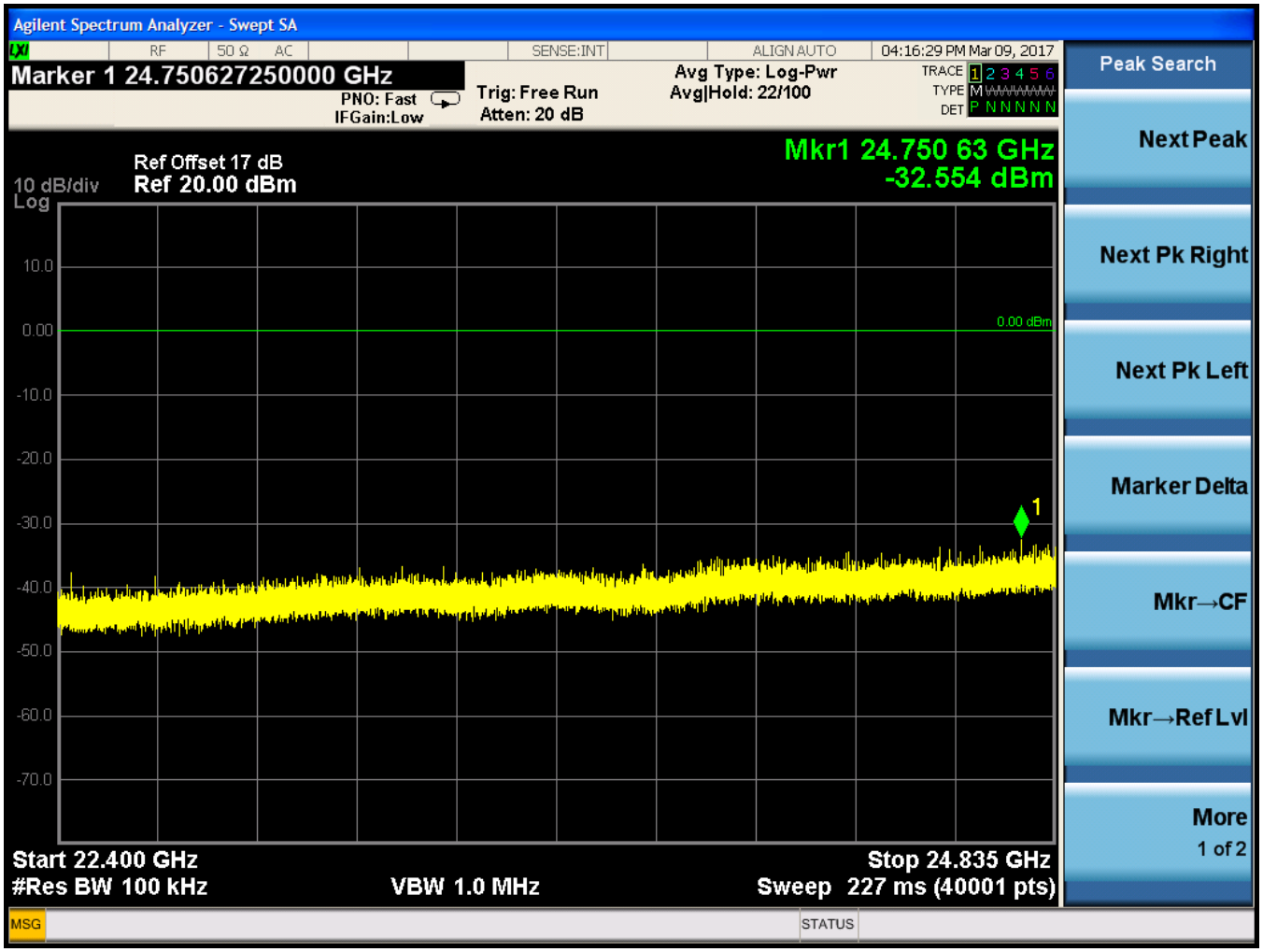
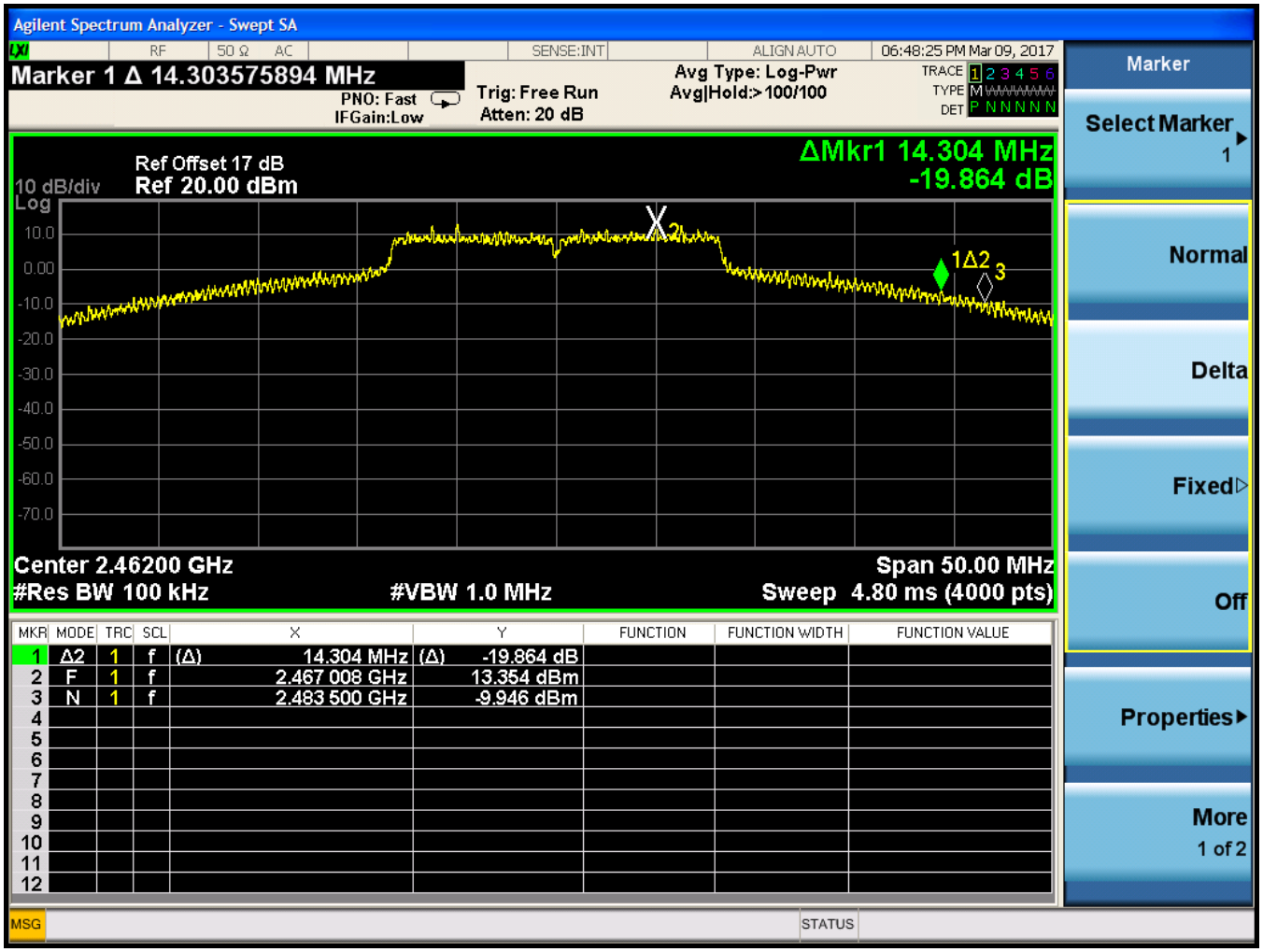


Figure 50: Band Edge WiFi N Mode

Figure 51: Band Edge WiFi N Mode



4.6 Power Spectral Density (FCC Part §15.247(e))

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

The output of the EUT was connected to the input of a spectrum analyzer.

The peak output of the low, medium and high channels were measured with a/g, b and n modes. The highest level of each of the modes is shown in the following figures.

Figure 52: Maximum PSD a/g Mode

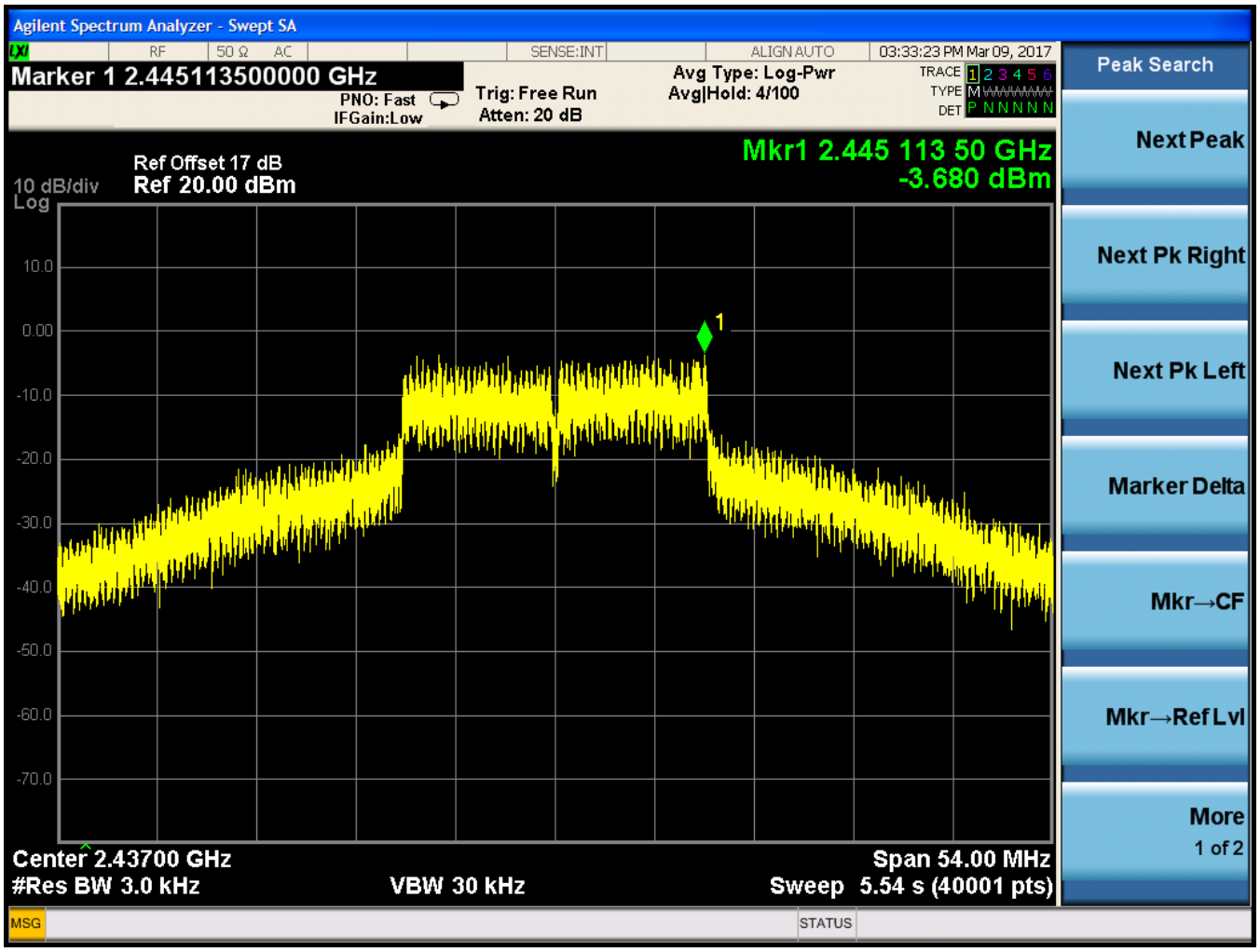


Figure 53: Maximum PSD b Mode

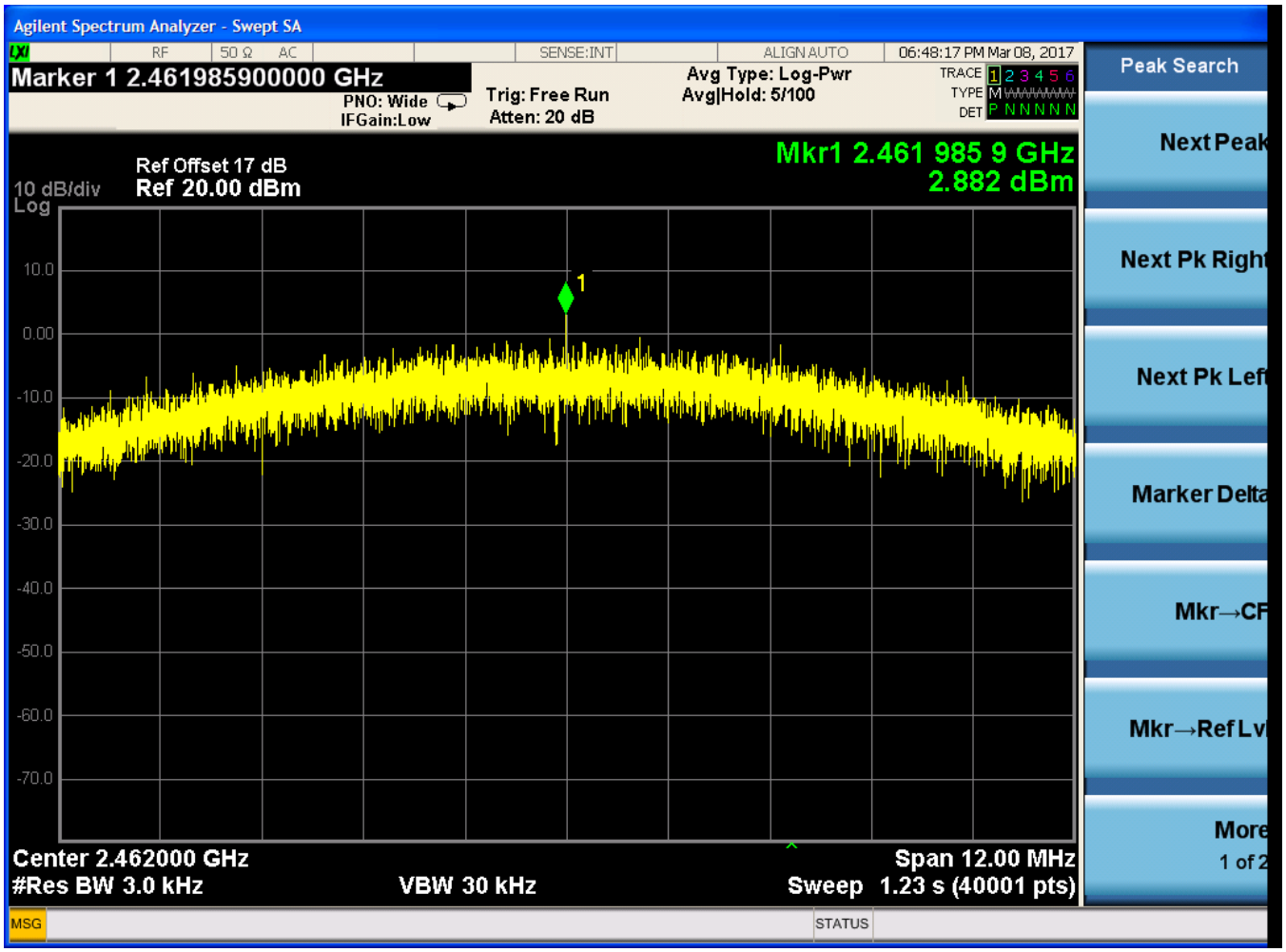
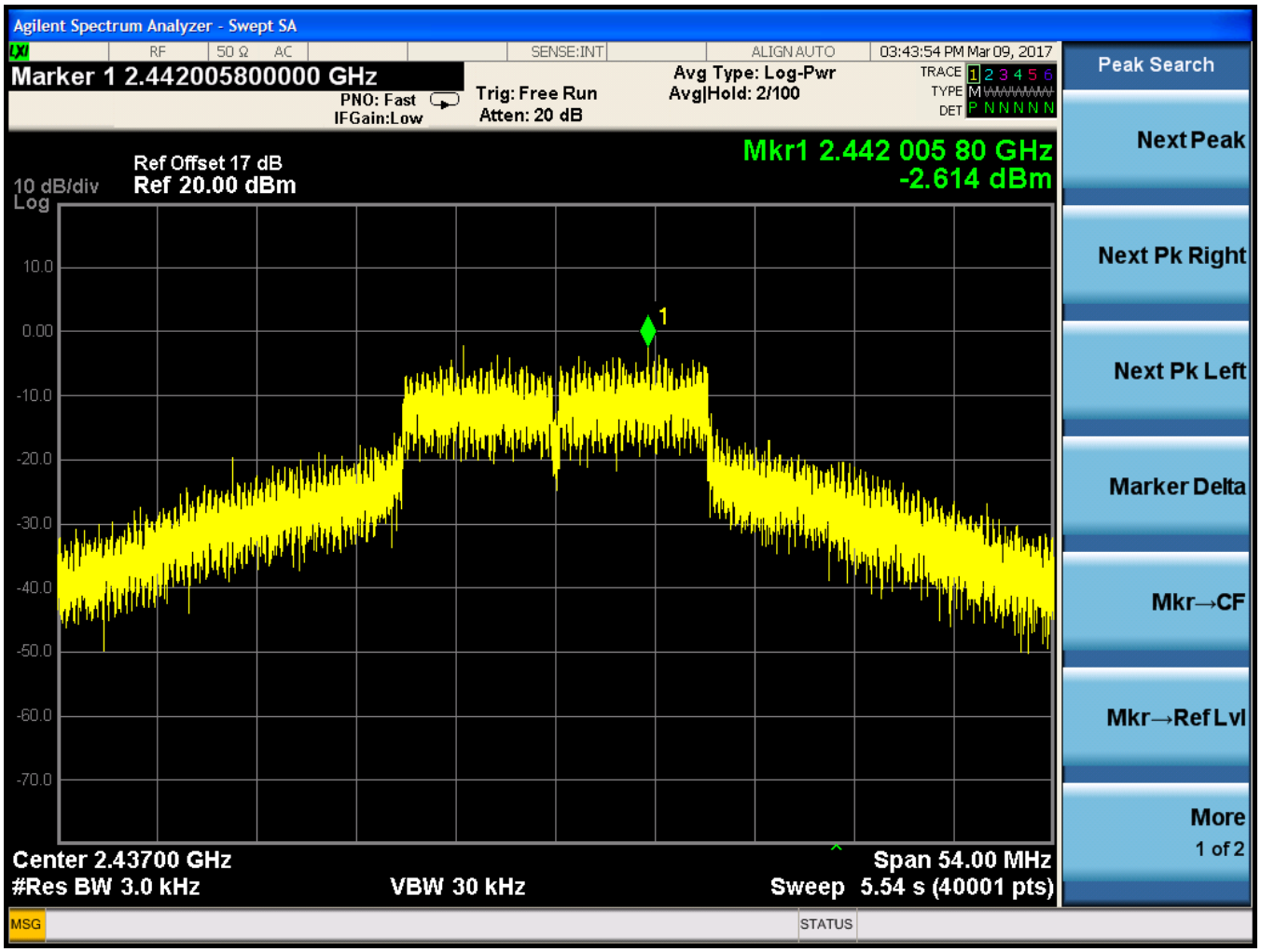


Figure 54: Maximum PSD n Mode



4.7 Radiated Emissions: (FCC Part §2.1053)

The EUT must comply with the radiated emission limits of 15.209. The limits are as shown in the following table. These data also show the band edge compliance for the various modes, performed per ANSI C63.10. No plots were taken of the radiated emissions.

4.7.1 Test Procedure

The EUT was placed on motorized turntable for radiated testing on a 3-meter open field test site. The emissions from the EUT were measured continuously at every azimuth by rotating the turntable. Receiving antennas were mounted on an antenna mast to determine the height of maximum emissions. The height of the antenna was varied between 1 and 4 meters. Cables were varied in position to produce maximum emissions. Both the horizontal and vertical field components were measured. Readings under 1000MHz were performed using a Quasi-Peak

Detector function. Average readings were calculated based on the peak reading minus the Duty Cycle correction.

The emissions were measured using the following resolution bandwidths:

Frequency Range	Resolution Bandwidth	Video Bandwidth
30MHz-1000 MHz	120kHz	>100 kHz
>1000 MHz	1 MHz	1MHz (Peak)

Emissions were measured to the 10th harmonic of the transmit frequency. Worst-case emission levels are reported.

Emissions were also scanned from 30 MHz to 10X fundamental and compared with the 15.209 limits. **No detectable emissions were found aside from harmonics of the transmit frequency shown in the following table.**

The following is a sample calculation used in the data tables for calculating the final field strength of spurious emissions and comparing these levels to the specified limits.

Sample Calculation:

Spectrum Analyzer Voltage (SA Level): V dBµV

Antenna Factor (Ant Corr): AFdB/m

Cable Loss Correction (Cable Corr): CCdB

Duty Cycle Correction (Average) DCCdB

Amplifier Gain: GdB

Electric Field (Corr Level): EdBµV/m = VdBµV + AFdB/m + CCdB + DCCdB - GdB

Table 12: Radiated Emission Test Data. WiFi B Mode Low Channel

Frequency (MHz)	Polarity H/V	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Corr. Level (uV/m)	Limit (uV/m)	Margin (dB)
2400.00	V	90.00	1.00	59.00	-15.2	155.5	500.0	-10.1
2483.50	V	90.00	1.00	58.50	-16.0	134.0	500.0	-11.4
4824.00	V	90.00	1.00	53.00	-8.4	170.3	500.0	-9.4
7236.00	V	90.00	1.00	43.70	-0.3	148.3	500.0	-10.6
2400.00	H	0.00	0.00	63.00	-15.2	246.5	500.0	-6.1
2483.50	H	0.00	1.00	59.00	-16.0	142.0	500.0	-10.9
4824.00	H	0.00	0.00	50.10	-8.4	122.0	500.0	-12.3
7236.00	H	0.00	0.00	42.30	-0.3	126.2	500.0	-12.0

Table 13: Radiated Emission Test Data. WiFi B Mode Middle Channel

Frequency (MHz)	Polarity H/V	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Corr. Level (uV/m)	Limit (uV/m)	Margin (dB)
2400.00	V	90.00	1.00	68.00	-15.2	438.3	500.0	-1.1
2483.50	V	90.00	1.00	62.50	-16.0	212.4	500.0	-7.4
4874.00	V	90.00	1.00	46.00	-8.1	78.2	500.0	-16.1
7311.00	V	90.00	1.00	47.00	-0.5	212.3	500.0	-7.4
2400.00	H	90.00	1.00	62.00	-15.2	219.7	500.0	-7.1
2483.50	H	90.00	1.00	59.20	-16.0	145.3	500.0	-10.7
4874.00	H	90.00	1.00	43.00	-8.1	55.4	500.0	-19.1
7311.00	H	90.00	1.00	45.00	-0.5	168.6	500.0	-9.4

Table 14: Radiated Emission Test Data. WiFi B Mode High Channel

Frequency (MHz)	Polarity H/V	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Corr. Level (uV/m)	Limit (uV/m)	Margin (dB)
2400.00	V	90.00	1.00	58.60	-15.2	148.5	500.0	-10.5
2483.50	V	0.00	0.00	58.90	-16.0	140.4	500.0	-11.0
4924.00	V	90.00	1.00	46.60	-7.9	86.0	500.0	-15.3
7386.00	V	90.00	1.00	49.50	-0.5	280.7	500.0	-5.0
2400.00	H	90.00	1.00	58.60	-15.2	148.5	500.0	-10.5
2483.50	H	90.00	1.00	59.60	-16.0	152.1	500.0	-10.3
4924.00	H	0.00	0.00	46.00	-7.9	80.3	500.0	-15.9
7386.00	H	0.00	0.00	48.00	-0.5	236.2	500.0	-6.5

Table 15: Radiated Emission Test Data. WiFi B/G/N Mode Low Channel

Frequency (MHz)	Polarity H/V	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Corr. Level (uV/m)	Limit (uV/m)	Margin (dB)
2400.00	V	90.00	1.00	66.00	-15.2	348.2	500.0	-3.1
2483.50	V	90.00	1.00	59.30	-16.0	147.0	500.0	-10.6
4824.00	V	90.00	0.00	43.00	-8.4	53.9	500.0	-19.4
7236.00	V	90.00	0.00	40.00	-0.3	96.9	500.0	-14.3
2400.00	H	0.00	0.00	65.60	-15.2	332.5	500.0	-3.5
2483.50	H	0.00	1.00	59.40	-16.0	148.7	500.0	-10.5
4824.00	H	90.00	1.00	43.00	-8.4	53.9	500.0	-19.4
7236.00	H	90.00	1.00	40.40	-0.3	101.4	500.0	-13.9

Table 16: Radiated Emission Test Data. WiFi B/G/N Mode Middle Channel

Frequency (MHz)	Polarity H/V	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Corr. Level (uV/m)	Limit (uV/m)	Margin (dB)
2400.00	V	0.00	0.00	67.70	-15.2	423.4	500.0	-1.4
2483.50	V	0.00	0.00	66.55	-16.0	338.6	500.0	-3.4
4874.00	V	90.00	1.00	44.10	-8.1	62.9	500.0	-18.0
7311.00	V	90.00	1.00	49.20	-0.5	273.5	500.0	-5.2
2400.00	H	0.00	0.00	66.30	-15.2	360.4	500.0	-2.8
2483.50	H	0.00	1.00	66.30	-16.0	329.0	500.0	-3.6
4874.00	H	0.00	0.00	45.00	-8.1	69.7	500.0	-17.1
7311.00	H	90.00	1.00	44.80	-0.5	164.8	500.0	-9.6

Table 17: Radiated Emission Test Data. WiFi B/G/N Mode High Channel

Frequency (MHz)	Polarity H/V	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Corr. Level (uV/m)	Limit (uV/m)	Margin (dB)
2400.00	V	90.00	1.00	59.00	-15.2	155.5	500.0	-10.1
2483.50	V	90.00	1.00	61.80	-16.0	196.0	500.0	-8.1
4924.00	V	90.00	1.00	41.00	-7.9	45.1	500.0	-20.9
7386.00	V	90.00	1.00	40.80	-0.5	103.1	500.0	-13.7
2400.00	H	90.00	1.00	59.30	-15.2	161.0	500.0	-9.8
2483.50	H	90.00	1.00	60.40	-16.0	166.8	500.0	-9.5
4924.00	H	90.00	1.00	40.60	-7.9	43.1	500.0	-21.3
7386.00	H	90.00	1.00	40.50	-0.5	99.6	500.0	-14.0

Table 18: Digital Emissions to FCC 15.209

Mode: Camera streaming to base										
Frequency (MHz)	Polarity (H/V)	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Corr. Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Peak or Average	Note
50.20	V	0.0	1.0	39.3	-18.9	20.4	30.0	-9.6	Peak	BB
54.80	V	0.0	1.0	40.8	-19.6	21.3	30.0	-8.7	QP	BB
63.60	V	0.0	1.0	42.7	-18.9	23.8	30.0	-6.2	QP	BB
288.00	V	0.0	3.0	39.1	-11.0	28.1	37.0	-8.9	QP	
336.00	V	0.0	2.0	26.4	-10.1	16.3	37.0	-20.7	QP	
360.00	V	90.0	1.0	39.0	-9.2	29.8	37.0	-7.2	QP	
384.00	V	0.0	1.0	33.3	-8.9	24.4	37.0	-12.6	QP	
504.00	V	270.0	1.0	27.0	-5.3	21.7	37.0	-15.3	QP	
576.00	V	0.0	1.0	29.3	-3.5	25.8	37.0	-11.2	QP	
371.00	V	0.0	2.0	33.2	-8.8	24.4	37.0	-12.6	QP	
50.20	V	0.0	2.0	37.6	-18.9	18.7	30.0	-11.3	QP	QP
54.80	V	90.0	2.0	37.6	-19.6	18.0	30.0	-12.0	QP	BB
63.60	V	90.0	2.0	40.4	-18.9	21.5	30.0	-8.5	QP	BB
68.80	V	0.0	2.0	37.6	-18.4	19.2	30.0	-10.8	QP	BB
124.80	V	0.0	2.0	34.4	-11.9	22.5	30.0	-7.5	QP	BB
129.60	V	0.0	2.0	33.8	-12.2	21.6	30.0	-8.4	QP	BB
138.80	V	180.0	2.0	31.5	-12.9	18.6	30.0	-11.4	QP	BB
352.90	V	270.0	1.0	31.6	-9.6	22.0	37.0	-15.0	QP	
432.00	V	0.0	1.0	31.5	-7.1	24.4	37.0	-12.6	QP	
50.20	H	0.0	1.0	31.7	-18.9	12.8	30.0	-17.2	Peak	BB
54.80	H	0.0	1.0	34.2	-19.6	14.6	30.0	-15.4	Peak	BB
63.60	H	180.0	1.0	38.2	-18.9	19.2	30.0	-10.8	Peak	BB
68.80	H	90.0	1.5	38.2	-18.4	19.8	30.0	-10.2	Peak	BB
288.00	H	0.0	2.0	38.2	-11.0	27.1	37.0	-9.9	Peak	
336.00	H	0.0	1.0	25.0	-10.1	14.9	37.0	-22.1	Peak	
360.00	H	90.0	2.5	40.8	-9.2	31.6	37.0	-5.4	Peak	
384.00	H	90.0	1.0	31.9	-8.9	23.0	37.0	-14.0	Peak	
504.00	H	45.0	1.0	27.5	-5.3	22.2	37.0	-14.8	Peak	
576.00	H	180.0	1.0	35.0	-3.5	31.5	37.0	-5.5	Peak	
114.70	H	90.0	2.0	33.5	-12.6	20.9	30.0	-9.1	Peak	BB
118.70	H	270.0	1.0	28.1	-12.0	16.1	30.0	-13.9	Peak	BB
138.80	H	0.0	2.0	31.6	-12.9	18.7	30.0	-11.3	Peak	BB

