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FCC & ISED Certification Test Report
For the
SwipeSense Inc.
Location Hub

FCC ID: 2AB5RHUB520
ISED: TBD

WLL JOB# 14601-01 Rev 2
Revised June 30, 2016

Prepared for:

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CHICAGO, IL 60640

Prepared By:

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Gaithersburg, Maryland 20879

Testing Certificate AT-1448

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Prepared by:

James Ritter
EMC Compliance Engineer

Reviewed by:

Steven D. Koster
President

Abstract

This report has been prepared on behalf of SwipeSense Inc. to support the attached Application for Equipment Authorization. The test report and application are submitted for a Digital Transmission System (DTS) Transmitter under Part 15.247 (10/2014) of the FCC Rules and Regulations and Spectrum Management and Telecommunications Policy RSS-247 issue 1 of ISED. This Certification Test Report documents the test configuration and test results for the SwipeSense Inc. Location Hub.

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 SwipeSense Inc. Location Hub complies with the limits for a Digital Transmission System (DTS) Transmitter device under FCC Part 15.247 and ISED RSS-247.

Revision History	Description of Change	Date
Rev 0	Initial Release	June 16, 2016
Rev 1	Corrected various typographical errors	June 28,2016
Rev 2	Added Duty Cycle correction statement and added duty cycle correction to radiated emissions results.	June 30,2016

Table of Contents

List of Tables

List of Figures

1 Introduction

1.1 Compliance Statement

The SwipeSense Inc. Location Hub complies with the limits for a Digital Transmission System (DTS) Transmitter device under FCC Part 15.247 (10/2014) and ISED RSS-247 issue 1 May 2015.

1.2 Test Scope

Tests for radiated emissions were performed. All measurements were performed in accordance with "C63.10 American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices". The measurement equipment conforms to ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation.

1.3 Contract Information

Customer:	TEMS Consulting Inc. 140 River Road Georgetown, TX, 78628
On Behalf of:	SwipeSense Inc. 4619 N. Ravenswood Ave. Suite 202 Chicago, IL 60640
Quotation Number:	69498

1.4 Test Dates

Testing was performed on the following date(s):	6/1/2016 to 6/7/2016

1.5 Test and Support Personnel

Washington Laboratories, LTD	James Ritter
Customer Representative	Stephen Berger

Abbreviations

A	**A**mpere
ac	**a**lternating **c**urrent
AM	Amplitude Modulation
Amps	**Amp**ere**s**
b/s	**b**its per **s**econd
BW	**B**and**W**idth
CE	**C**onducted **E**mission
cm	**C**enti**m**eter
CW	**C**ontinuous **W**ave
dB	**decibel**
dc	**d**irect **c**urrent
EMI	**E**lectro**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 location hub is wall mounted and AC powered. It senses the badges in its area and forwards that information through the mesh network.

Table 1: Device Summary

ITEM	DESCRIPTION
Manufacturer:	SwipeSense Inc.
FCC ID:	2AB5RHUB520
ISED:	TBD
Model Number:	HUB520
Model Name:	Location Hub
FCC Rule Parts:	§15.247
ISED:	RSS-247
Frequency Range:	2402-2482MHz
Maximum Output Power:	2.29mW (3.59dBm) conducted
Modulation:	GFSK
Occupied Bandwidth:	701kHz
Keying:	Automatic
Type of Information:	Data
Number of Channels:	Unit is preset to a single channel
Power Output Level	Fixed
Antenna	integral
Antenna Type	+2.06dBi , 3D PIFA (Planar Inverted F Antenna.) Antenna
Interface Cables:	None
Power Source & Voltage:	120VAC
Emission Designator	701KFXD

2.2 Test Configuration

Six devices were submitted for testing, 3 units with the antenna replaced by a temporary antenna port and three with antennas for radiated testing. Each EUT was programmed to transmit at one of 3 frequencies (2402, 2440, & 2482MHz). All units were tested in a stand-alone configuration. All tests were performed in accordance with ANSI C63.10.

2.3 Testing Algorithm

The Location Hub was programmed for DTS operation by the manufacturer. The EUT was set to transmit PRBS packets continuously at the desired transmit frequency. Worst case emission levels are provided in the test results 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 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 ACLASS under Certificate AT-1448 as an independent FCC test laboratory.

2.5 Measurements

2.5.1 References

- ANSI C63.10:2013 American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
- ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation
- RSS-Gen Issue 4 — General Requirements for Compliance of Radio Apparatus
- RSS-247 issue 1 — Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

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 (R2012) 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

$k \leq 2$ 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

Parameter	Uncertainty	Actual (+/-)	Unit
Radio Frequency	$\pm 1 \times 10^{-7}$	8.64E-08	parts
RF Power conducted (up to 160 W)	±0.75 dB	0.3	dB
Conducted RF Power variations using a test fixture	±0.75 dB	0.3	dB
Transmitter transient frequency (frequency difference)	±250 Hz	160.7	Hz
Transmitter transient time	±20 %	9.2	%

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: **Radiated Emissions**			Test Date: **6/7/2016**
Asset #	**Manufacturer/Model**	**Description**	**Cal. Due**
528	AGILENT - E4446A	3HZ - 44GHZ ANALYZER SPECTRUM	7/15/2016
276	ELECTROMETRICS - BPA-1000	PRE-AMPLIFIER RF 50KHZ-1GHZ	9/18/2016
522	HP - 8449B	PRE-AMPLIFIER 1-26.5GHZ	07/30/2016
281	ITC - 21A-3A1	WAVEGUIDE 4.51-10.0GHZ	8/1/2016
432	WLL - NONE	FILTER NOTCH 2.4GHZ-AMP INC.	8/1/2016
382	SUNOL SCIENCES CORPORATION - JB1	ANTENNA BICONLOG	8/31/2017
4	ARA - DRG-118/A	ANTENNA DRG 1-18GHZ	10/8/2016
453	AH SYSTEMS - PAM1840	PRE-AMPLIFIER 18GHZ-40 GHZ	7/30/2016
209	NARDA - V637	HORN STANDARD GAIN	CNR
210	NARDA - V638	HORN STANDARD GAIN	CNR
Test Name: **Bench Tests**			Test Date: **6/1/2016**
Asset #	**Manufacturer/Model**	**Description**	**Cal. Due**
528	AGILENT - E4446A	3HZ - 44GHZ ANALYZER SPECTRUM	7/15/2016
823	AGILENT – N9010A	EXA Spectrum Analyze	8/5/2016
Test Name: **Conducted Emissions Voltage**			Test Date: **06/07/2016**
Asset #	**Manufacturer/Model**	**Description**	**Cal. Due**
125	SOLAR - 8028-50-TS-24-BNC	LISN	10/10/2016
126	SOLAR - 8028-50-TS-24-BNC	LISN	10/10/2016
528	AGILENT - E4446A	3HZ - 44GHZ ANALYZER SPECTRUM	7/15/2016
53	HP - 11947A	LIMITER TRANSIENT	3/1/2017

4 Test Summary

The Table Below shows the results of testing for compliance with a Digital Transmission System in accordance with FCC Part 15.247 10/2014 and RSS47 issue 1, 5/2015. Full results are shown in section 5.

Table 4: Test Summary Table

TX Test Summary (Digital Transmission System (DTS))			
FCC Rule Part	**IC Rule Part**	**Description**	**Result**
15.247(a) (2)	RSS-247 [5.2 (1)]	6dB Bandwidth	Pass
15.247 (b)(3)	RSS-247 [5.4 (4)]	Transmit Output Power	Pass
15.247 (e)	RSS-247 [5.2 (2)]	Power Spectral Density	Pass
15.247 (d)	RSS-247 [5.5]	/Out-of-Band Emissions (Band Edge @ 20dB below)	Pass
15.205 15.209	RSS-Gen 7.2.2	General Field Strength Limits (Restricted Bands & RE Limits)	Pass
15.207	RSS-Gen [7.2.4]	AC Conducted Emissions	Pass

5 Test Results

5.1 Occupied (DTS) Bandwidth:

Occupied bandwidth was performed by monitoring the output of the EUT antenna port with a spectrum analyzer corrected for any cable/attenuator losses.

For Direct Sequence Spread Spectrum Systems, FCC Part 15.247 requires the minimum 6 dB bandwidth be at least 500 kHz.

5.1.1 Measurement Method:

Tests were performed as specified in ANSI C63.10 section 11.8 “DTS bandwidth” Option 1 (11.8.1).

Table 5: Occupied Bandwidth Spectrum Analyzer Settings

Resolution Bandwidth	Video Bandwidth
100kHz	1MHz

At full modulation, the occupied bandwidth was measured as shown in Figures 1-3.

Table 6 provides a summary of the Occupied Bandwidth Results.

Table 6: Occupied Bandwidth Results

Frequency	Bandwidth	Limit	Pass/Fail
Low Channel: 2402MHz	701kHz	≥500kHz	Pass
Center Channel: 2440MHz	688kHz	≥500kHz	Pass
High Channel: 2482MHz	685kHz	≥500kHz	Pass

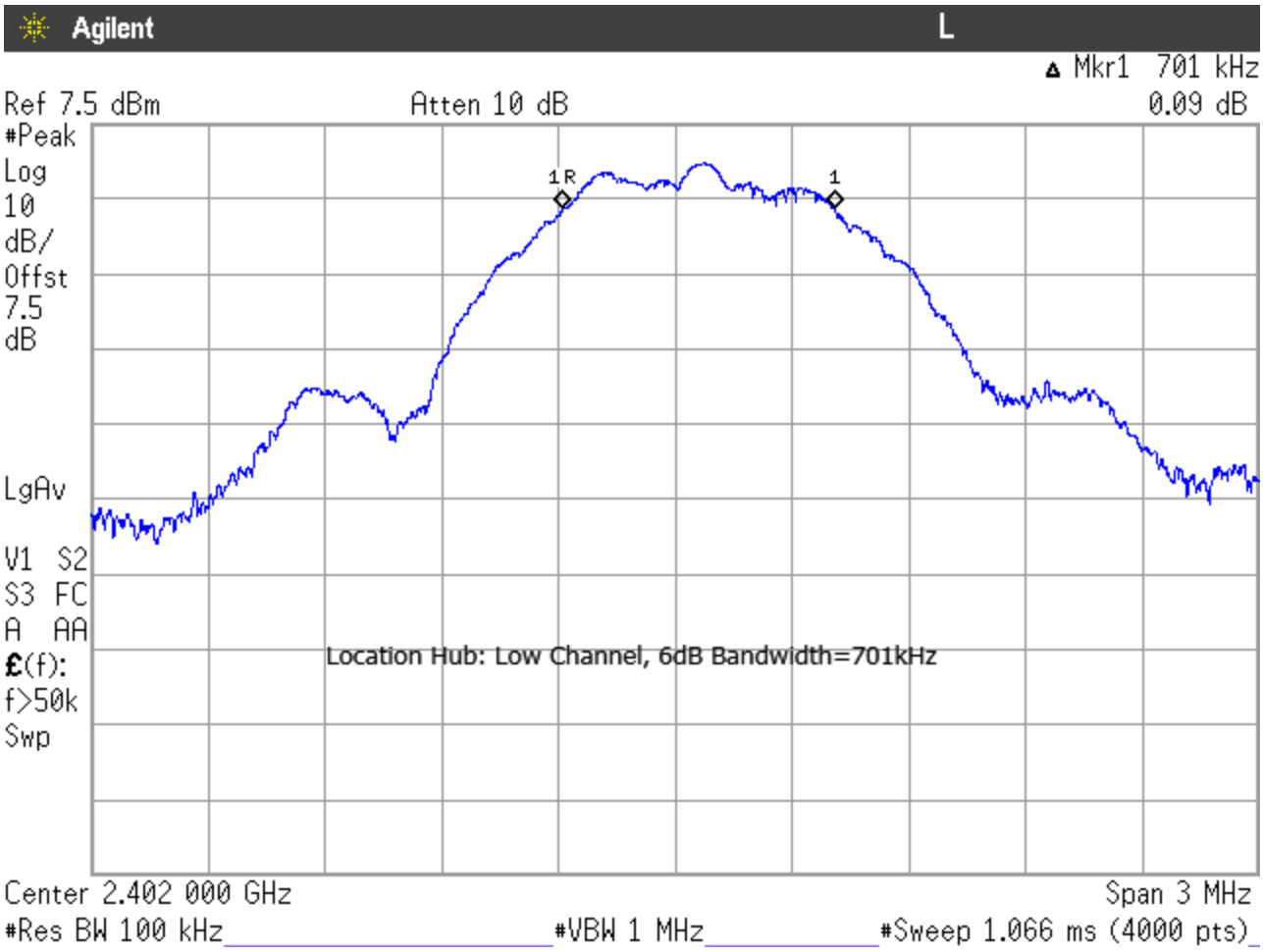

Figure 1: Occupied Bandwidth, Low Channel

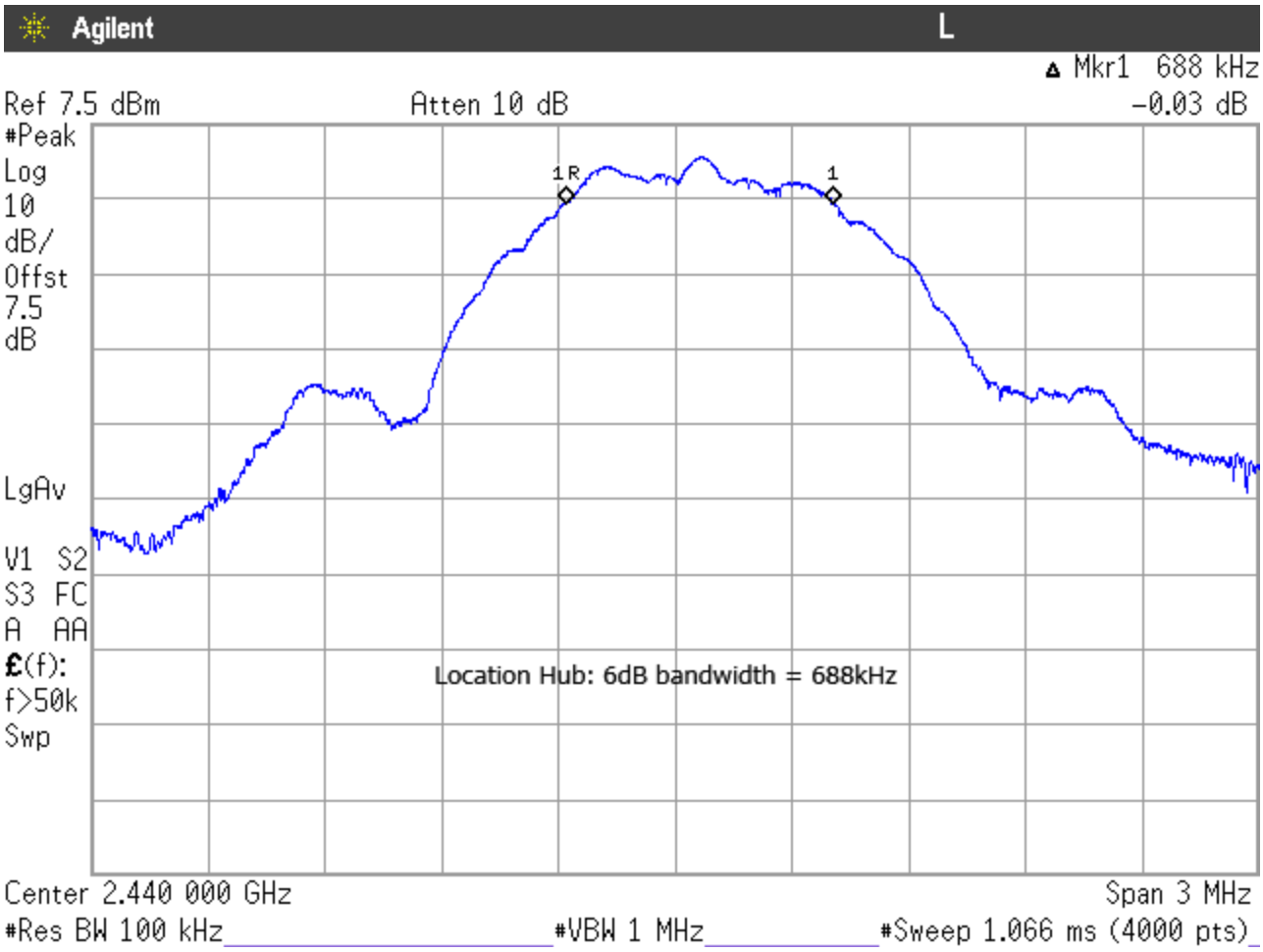

Figure 2: Occupied Bandwidth, Center Channel

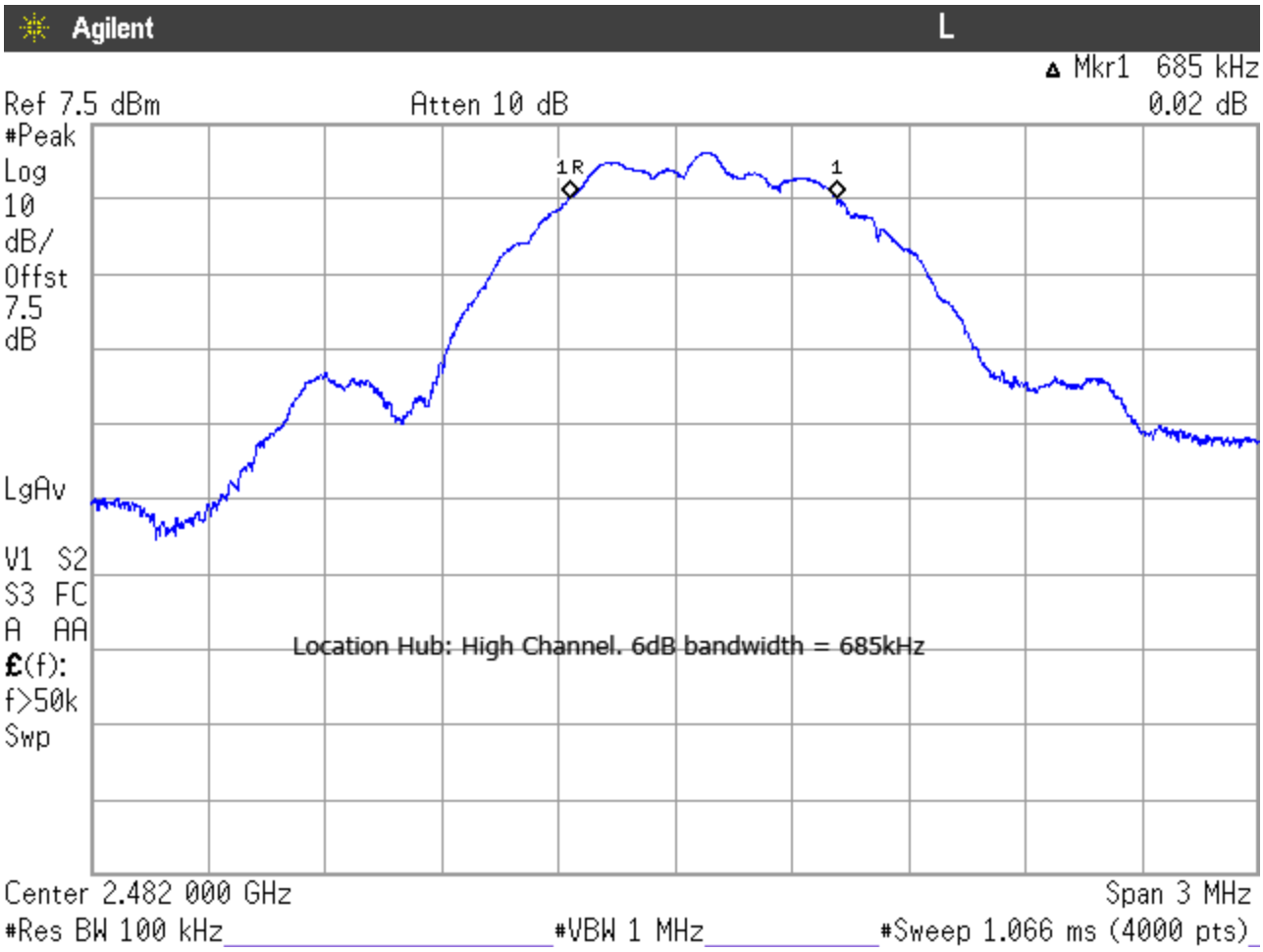

Figure 3: Occupied Bandwidth, High Channel

5.2 RF Power Output:

To measure the output power the unit was set to dwell on the low, high and middle channel. Testing was performed using the method from C63.10 section 11.9.1.1 "RBW ≥ DTS bandwidth" at the antenna port as follows:

a) Set the RBW ≥ DTS bandwidth.

b) Set VBW ≥ [3 × RBW].

c) Set span ≥ [3 × RBW].

d) Sweep time = auto couple.

e) Detector = peak.

f) Trace mode = max hold.

g) Allow trace to fully stabilize.

h) Use peak marker function to determine the peak amplitude level..

5.2.1 Measurement Method:

ANSI C63.10 section "11.9.1 Maximum peak conducted output power" subsection "11.9.1.1 RBW > DTS bandwidth"

Table 7: Spectrum Analyzer Settings

Resolution Bandwidth	Video Bandwidth
1MHz	3MHz

Table 8: RF Power Output Summary

Frequency	Level	Limit	Pass/Fail
Low Channel: 2402MHz	2.99dBm	30 dBm	Pass
Center Channel: 2440MHz	3.27dBm	30 dBm	Pass
High Channel: 2482MHz	3.59dBm	30 dBm	Pass

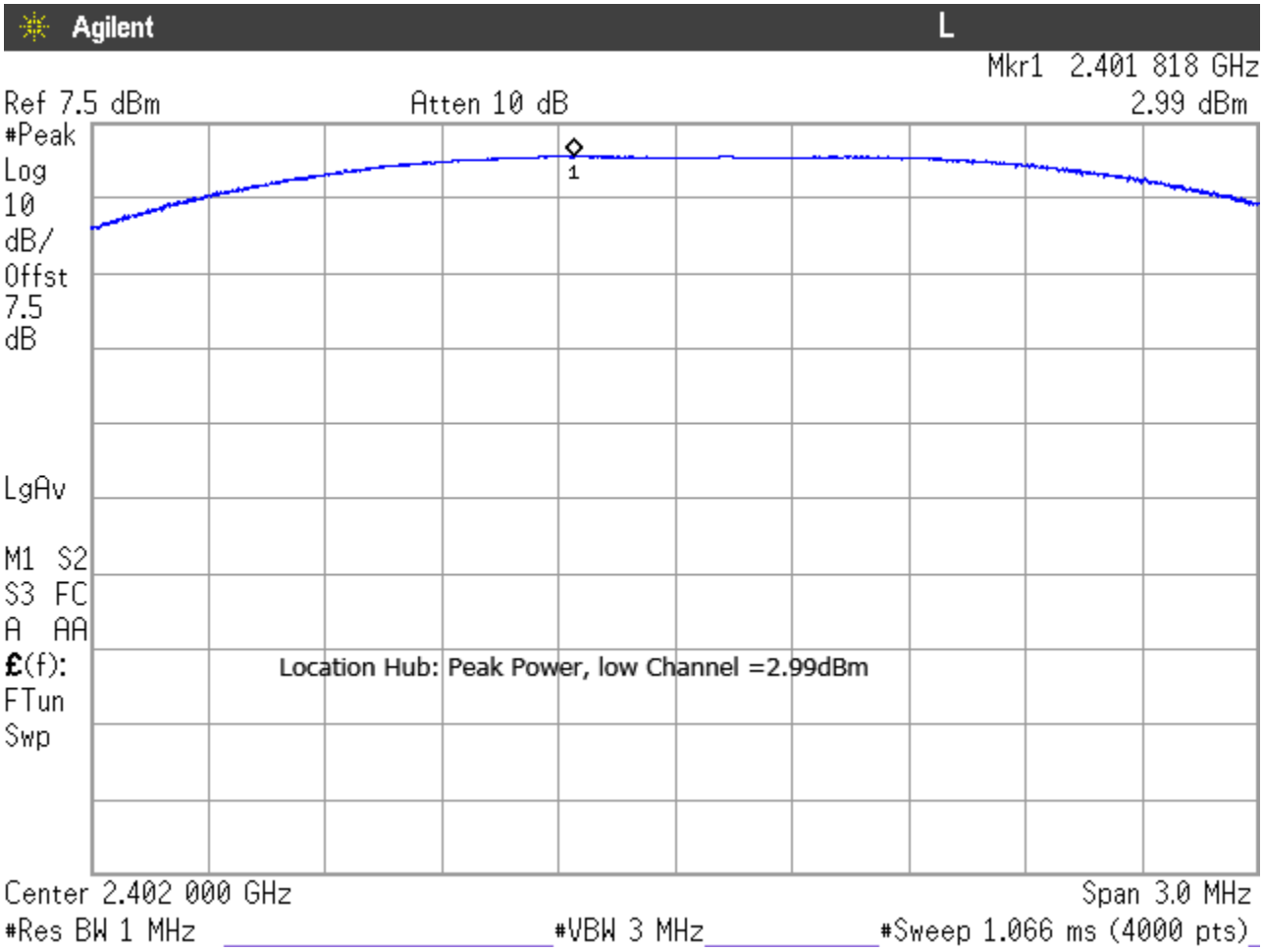

Figure 4: RF Peak Power, Low Channel

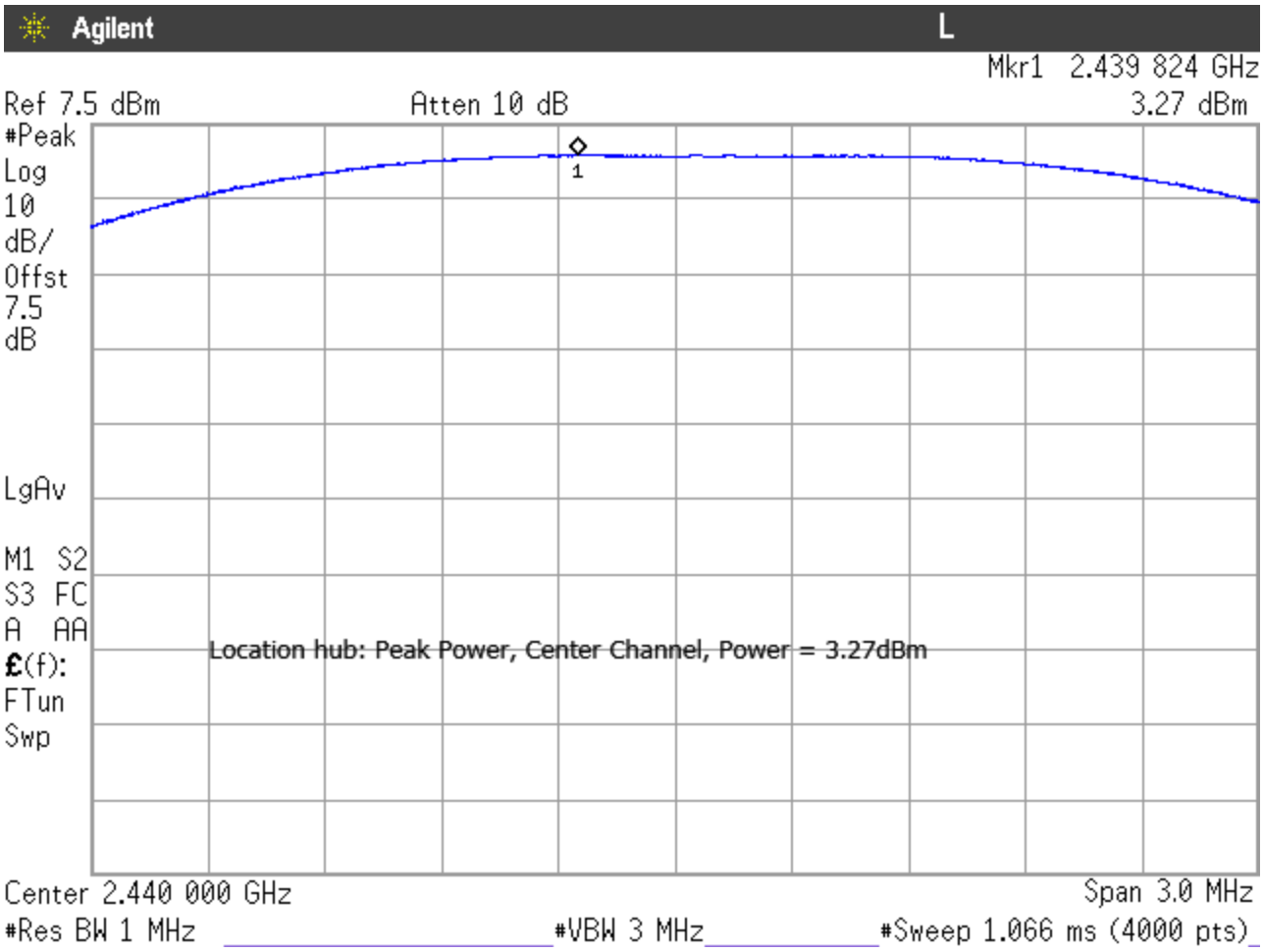

Figure 5: RF Peak Power, Center Channel

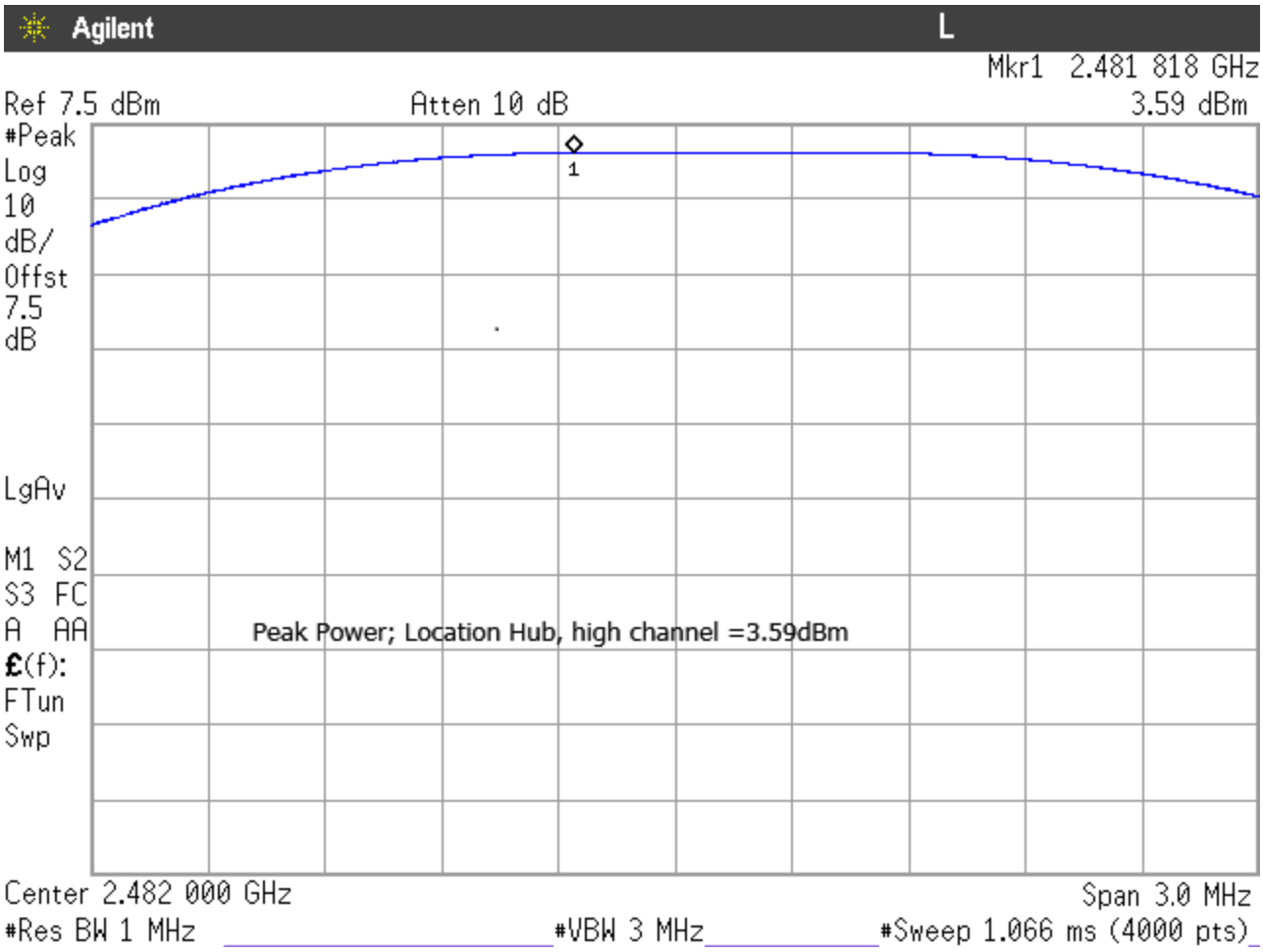

Figure 6: RF Peak Power, High Channel

5.3 Power Spectral Density

Measurements for power spectral density were taken at the antenna port in accordance with ANSI C63.10. The spectrum analyzer was set to peak detect mode with a RBW of 100kHz ,VBW of 300kHz across a span 1.5X the DTS bandwidth using an auto sweep time..

5.3.1 Measurement Method:

ANSI C63.10 SECTION 11.10 "Maximum power spectral density level in the fundamental emission subsection 11.10.2 "Method PKPSD (peak PSD)"

The highest level detected across any 3 kHz band for continuous transmission was then recorded and compared to the limit 8dBm. The following table and plots give the results for power spectral density testing.

Table 9: Power Spectral Density

Frequency	Peak Level	Limit	Pass/Fail
Low Channel: 2402MHz	2.18dBm	8 dBm	Pass
Center Channel: 2440MHz	2.86dBm	8 dBm	Pass
High Channel: 2482MHz	3.55dBm	8 dBm	Pass

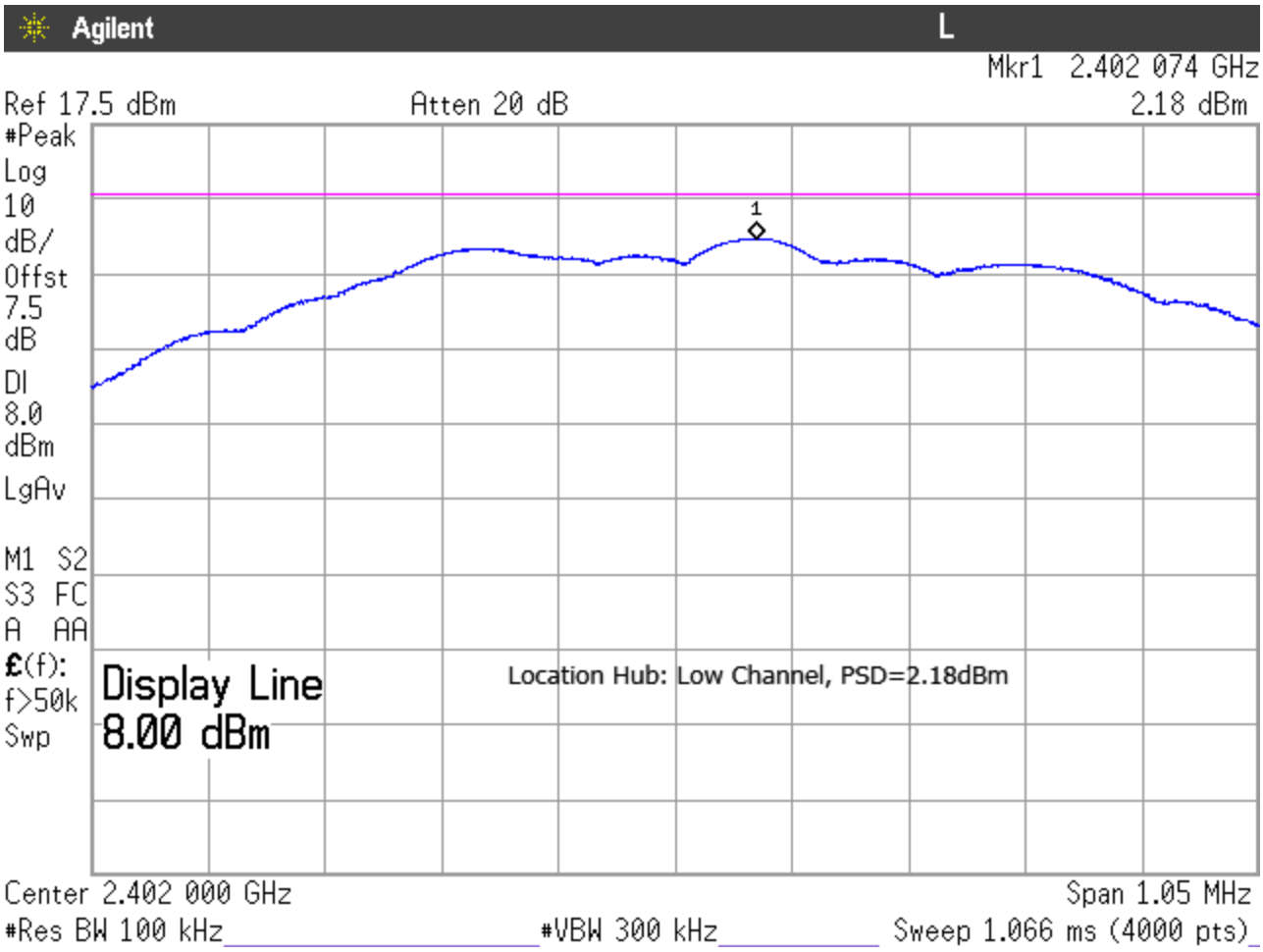

Figure 7: Power Spectral Density, Low Channel

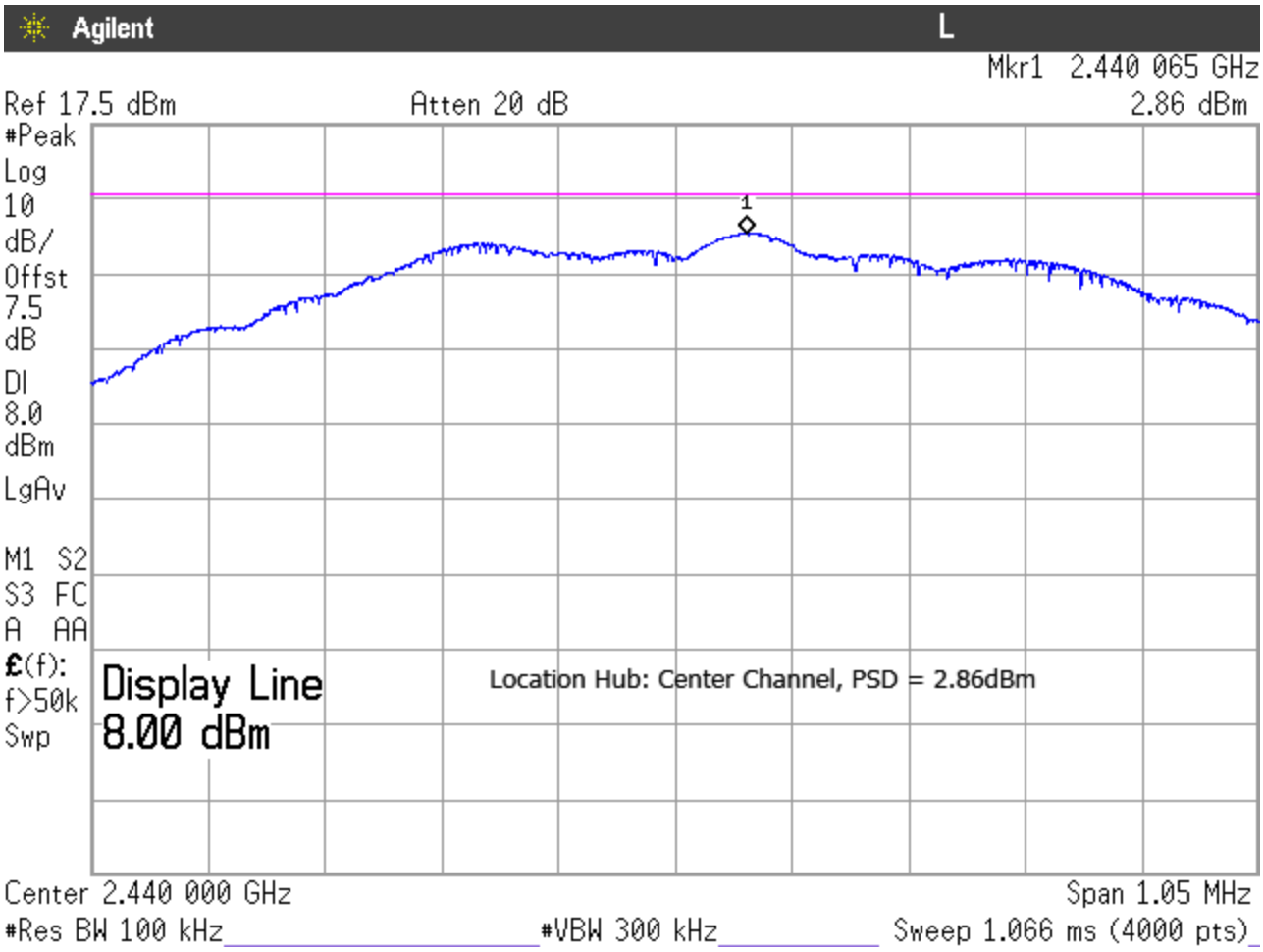

Figure 8: Power Spectral Density, Center Channel

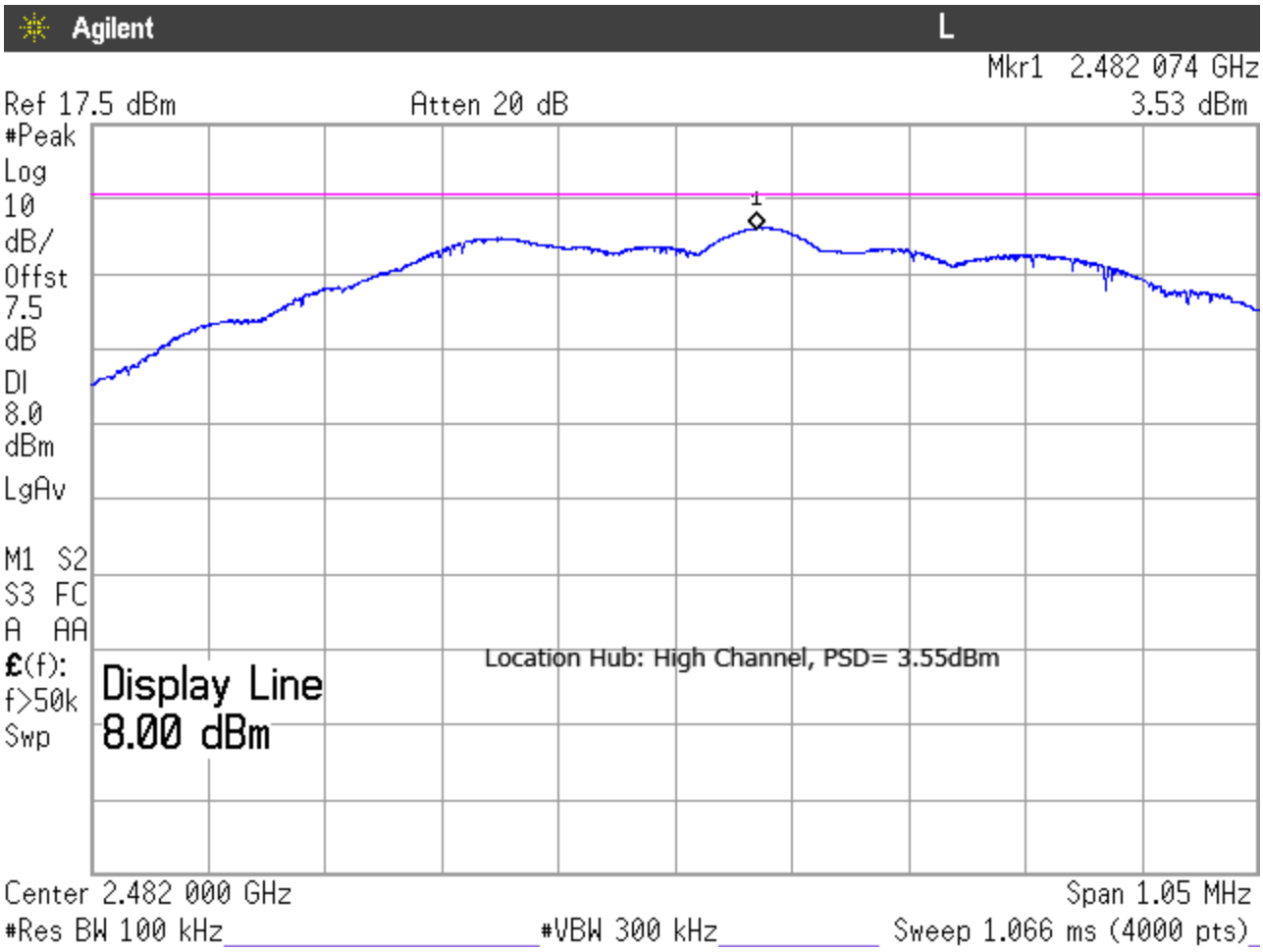

Figure 9: Power Spectral Density, High Channel

5.4 Conducted Spurious Emissions compliance

The EUT must comply with requirements for spurious emissions. Per §15.247(d) all spurious emissions in any 100 kHz bandwidth outside the frequency band in which the spread spectrum device is operating shall be attenuated 20 dB below the highest power level in a 100 kHz bandwidth within the band containing the highest level of the desired power.

Per ANSI C63.10 section 11.11 "Emissions in nonrestricted frequency bands" this test may be performed in an antenna port conducted manner. The spectrum analyzer resolution bandwidth was set to 100 kHz and the video bandwidth was set to 300 kHz. The amplitude of the EUT carrier frequency was measured to determine the emissions limit (20 dB below the carrier frequency amplitude). The emissions outside of the allocated frequency band were then scanned from 30 MHz up to the tenth harmonic of the carrier.

As per ANSI C63.10 section 11.11.2 the high channel has the highest PSD and the limit for all channels was based on this level.

The following table shows the spurious emissions data.

5.4.1 Test Summary

The EUT complied with the requirements for Spurious emissions at the antenna port.

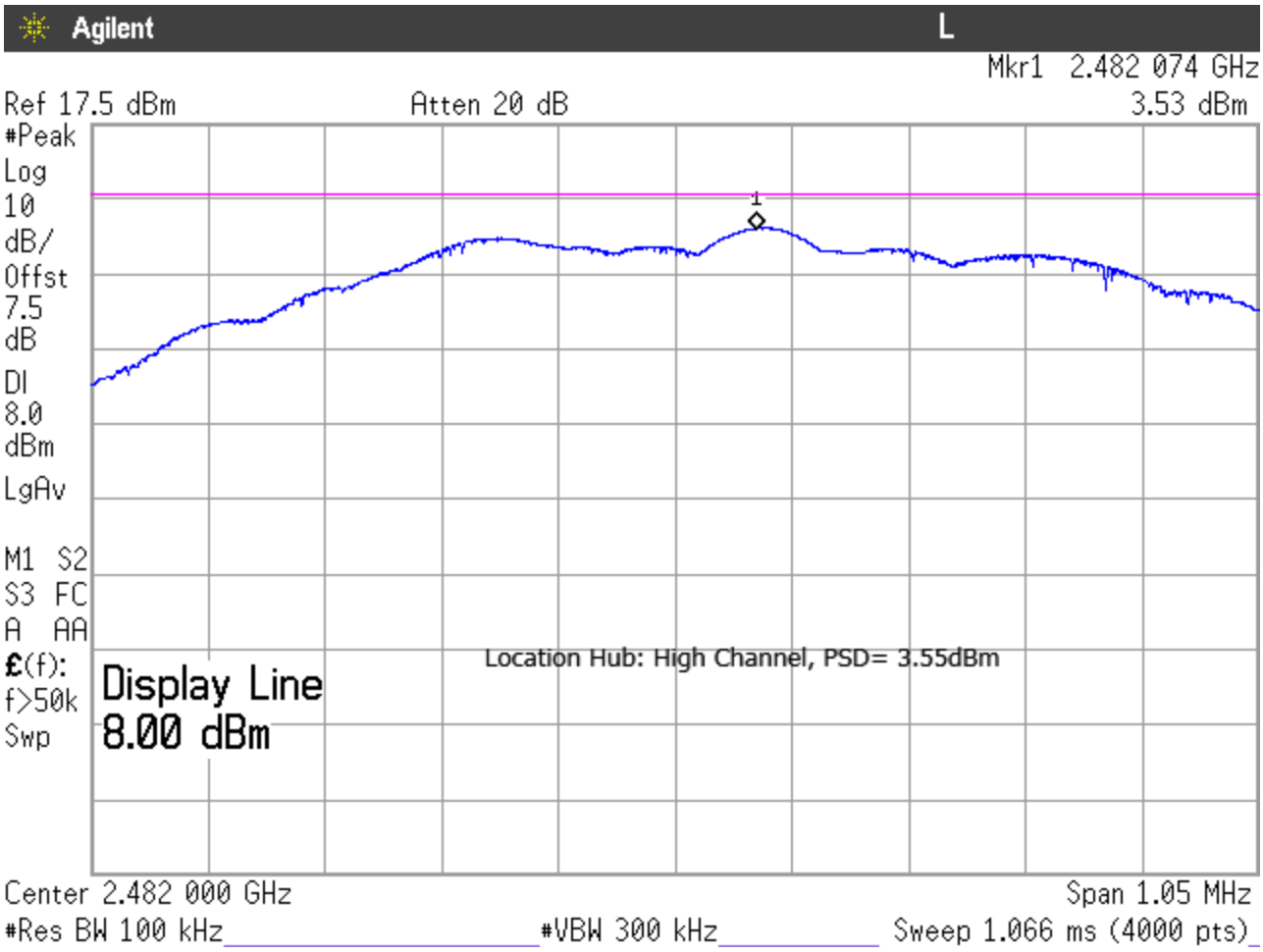

Figure 10: Highest PSD Level (center channel)

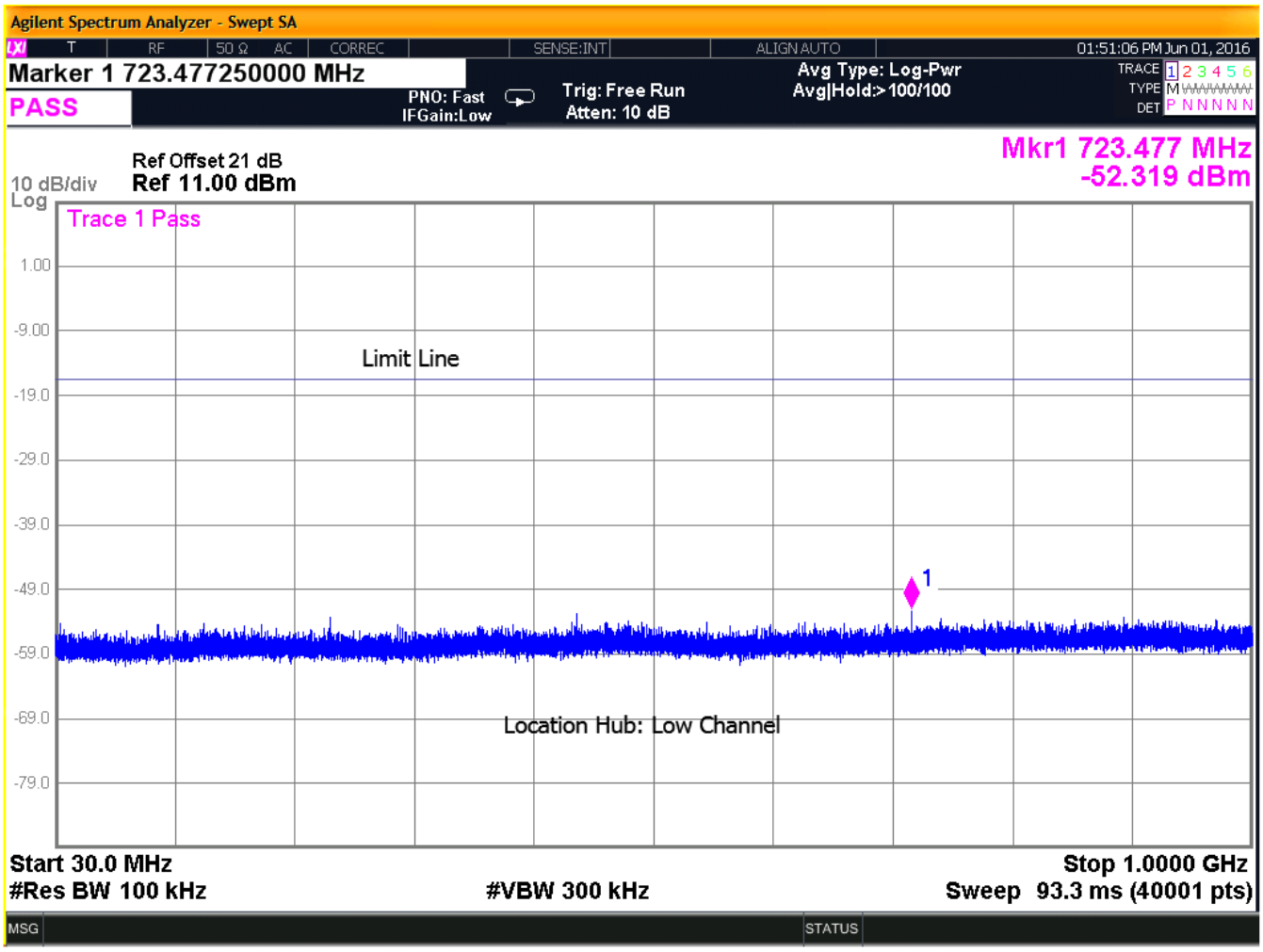

Figure 11: Low Channel Conducted Spurious Plot 1

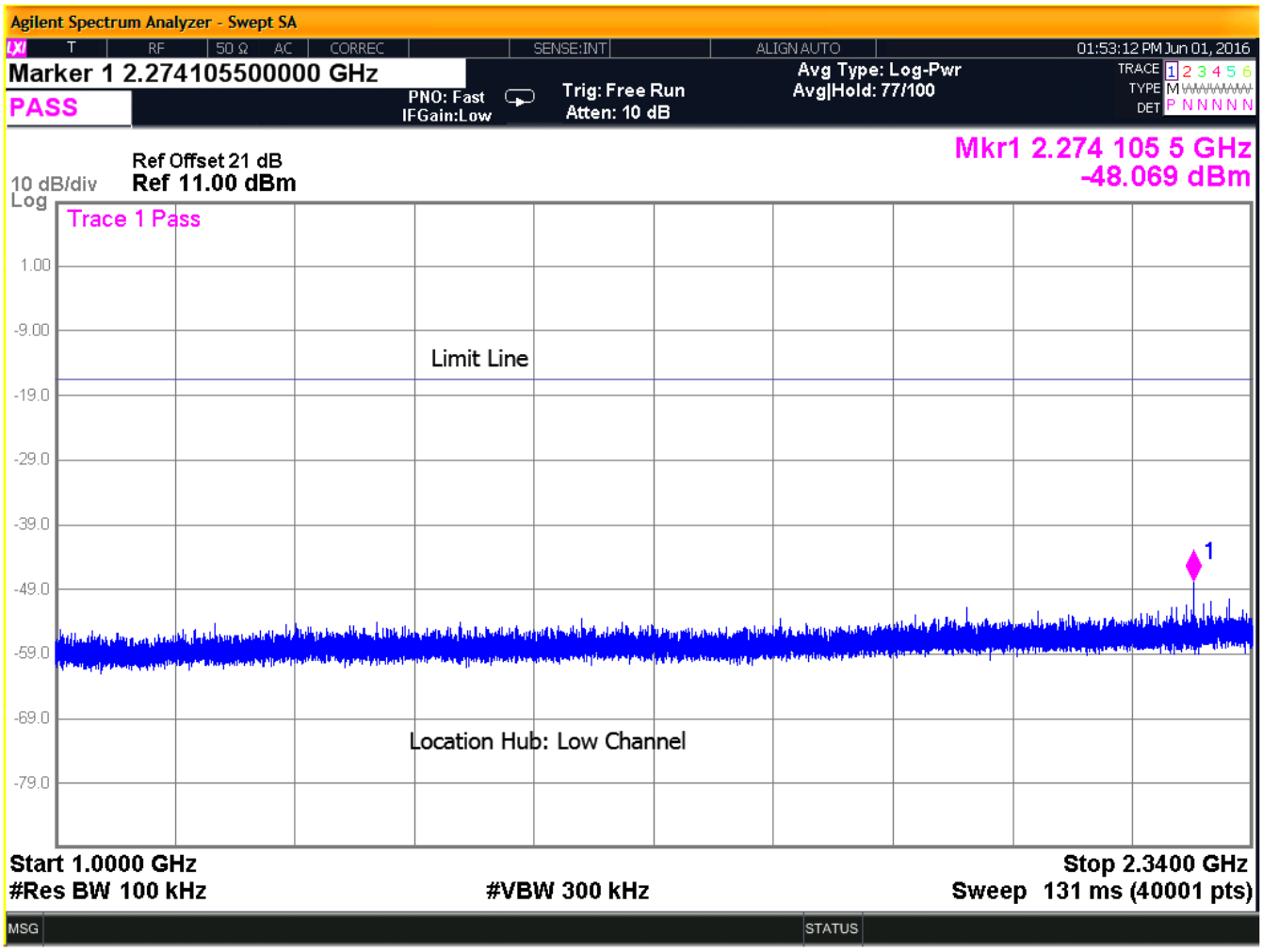

Figure 12: Low Channel Conducted Spurious Plot 2

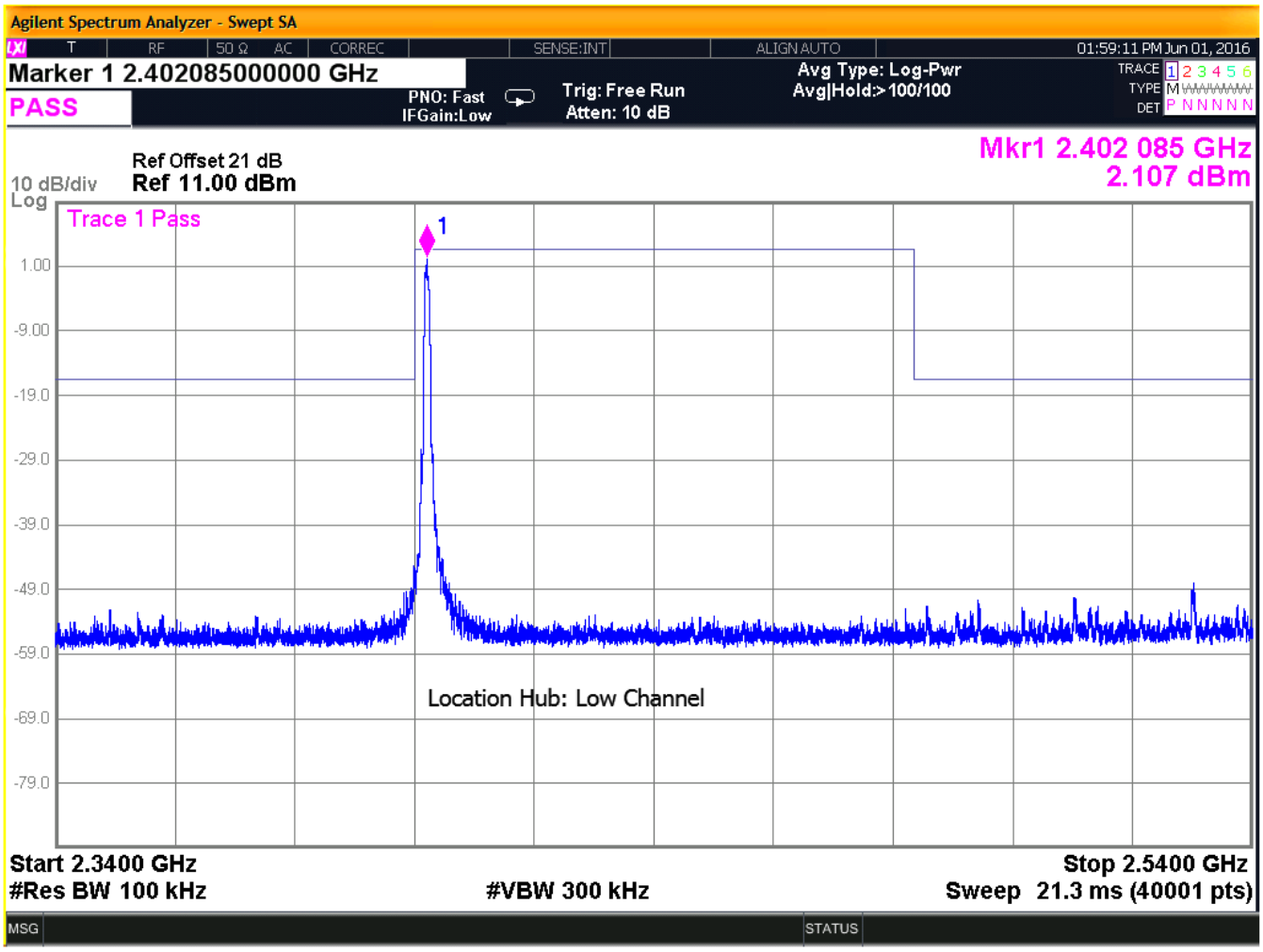

Figure 13: Low Channel Conducted Spurious Plot 3

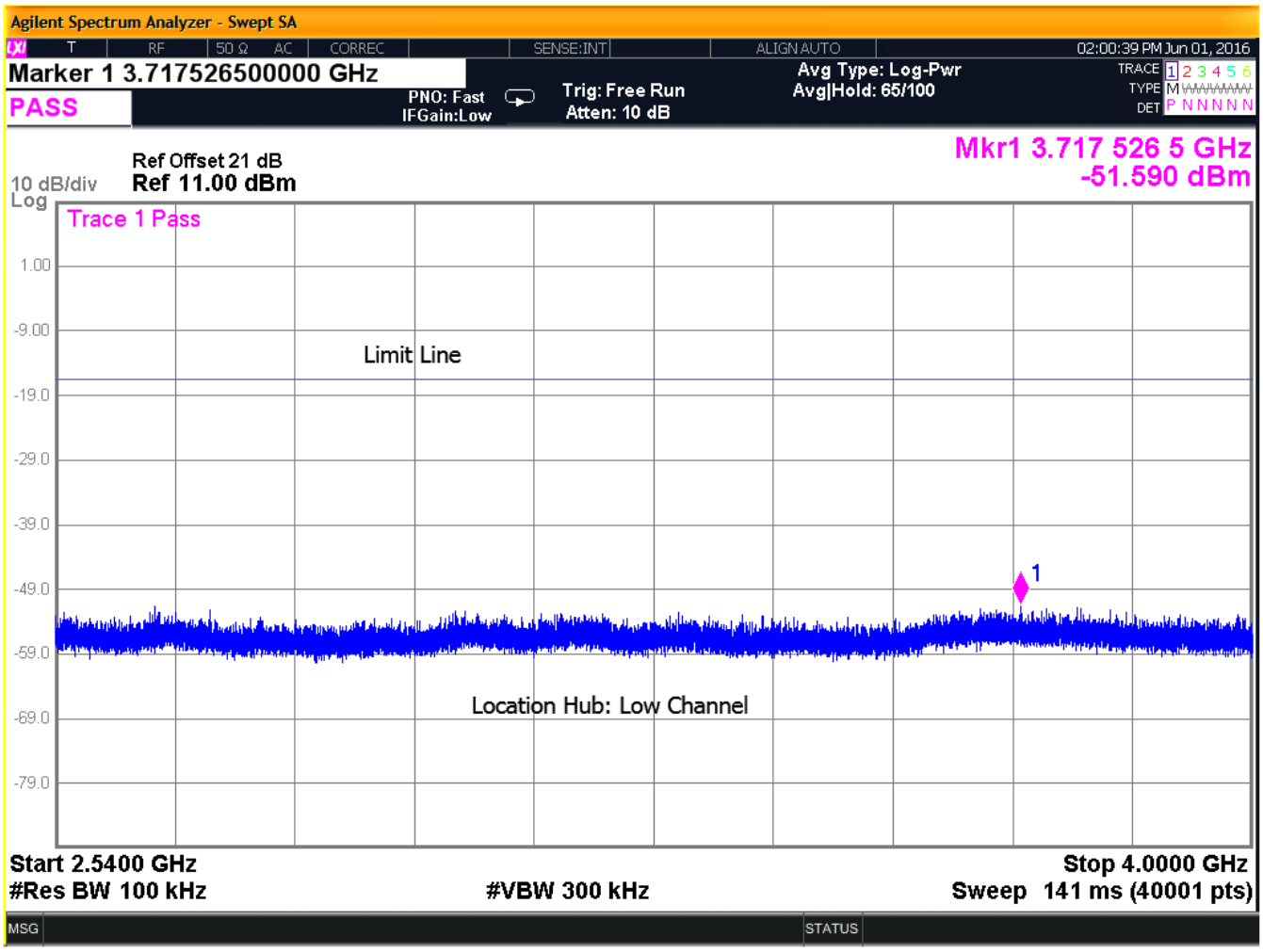

Figure 14: Low Channel Conducted Spurious Plot 4

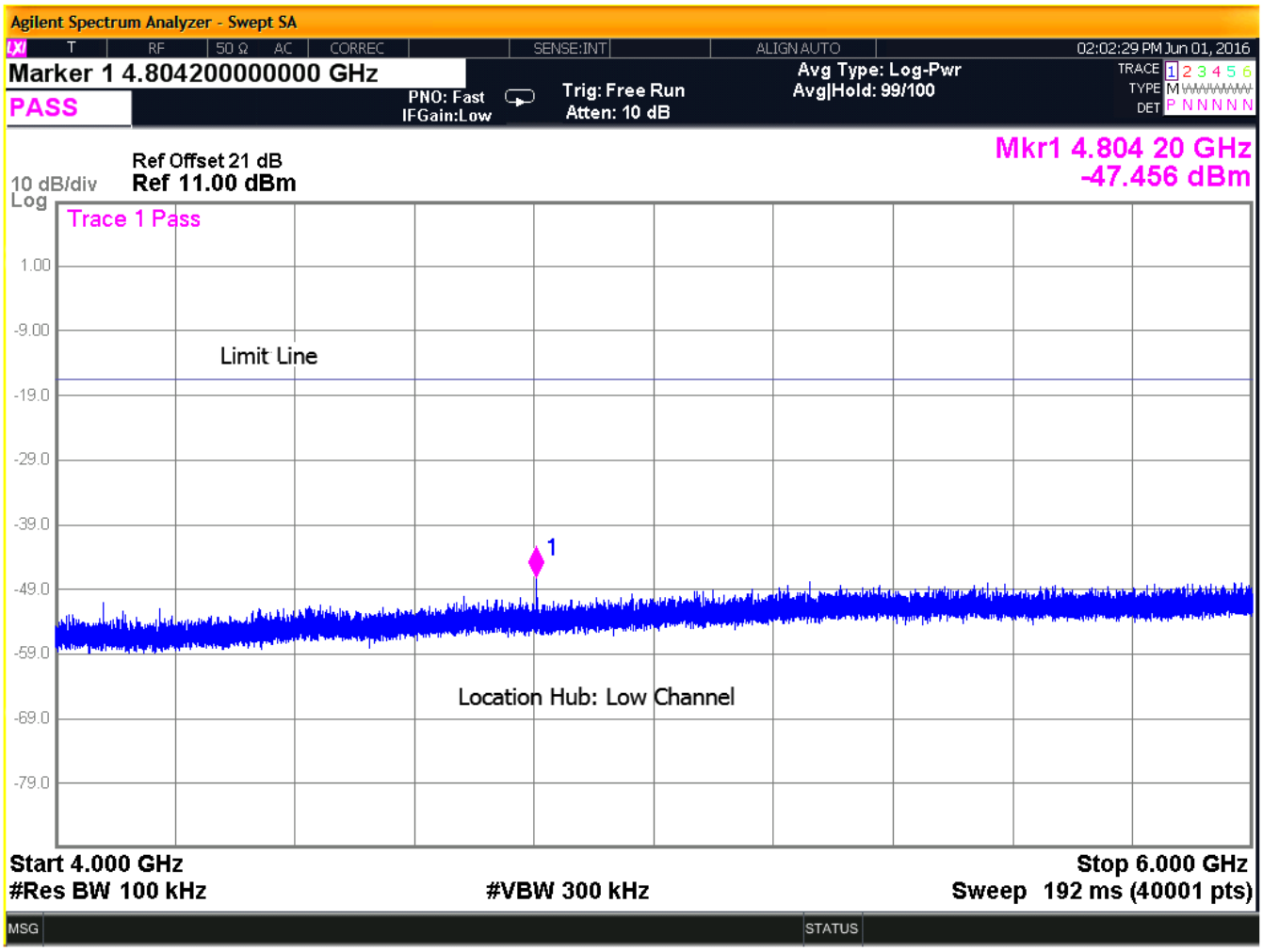

Figure 15: Low Channel Conducted Spurious Plot 5

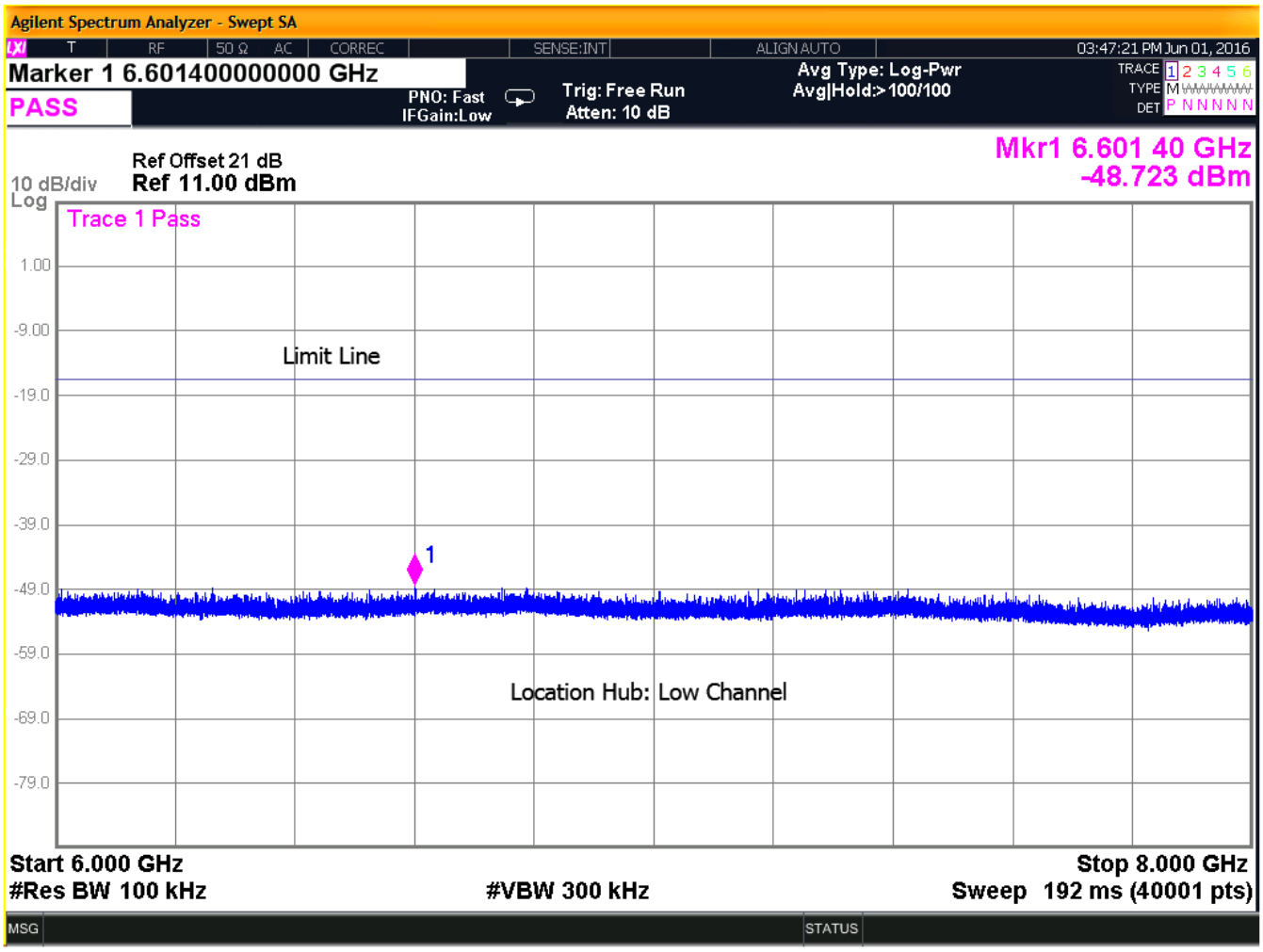

Figure 16: Low Channel Conducted Spurious Plot 6

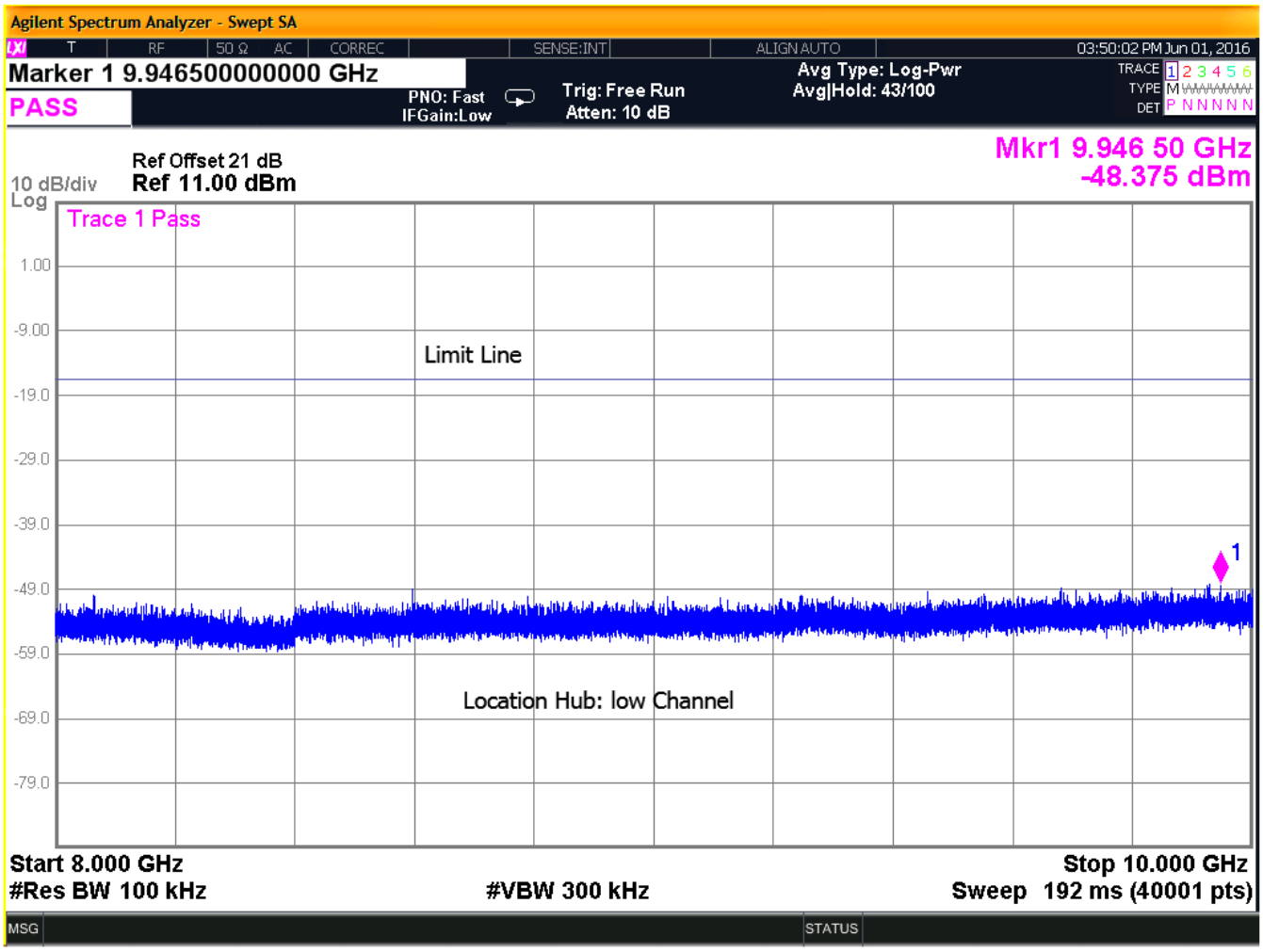

Figure 17: Low Channel Conducted Spurious Plot 7

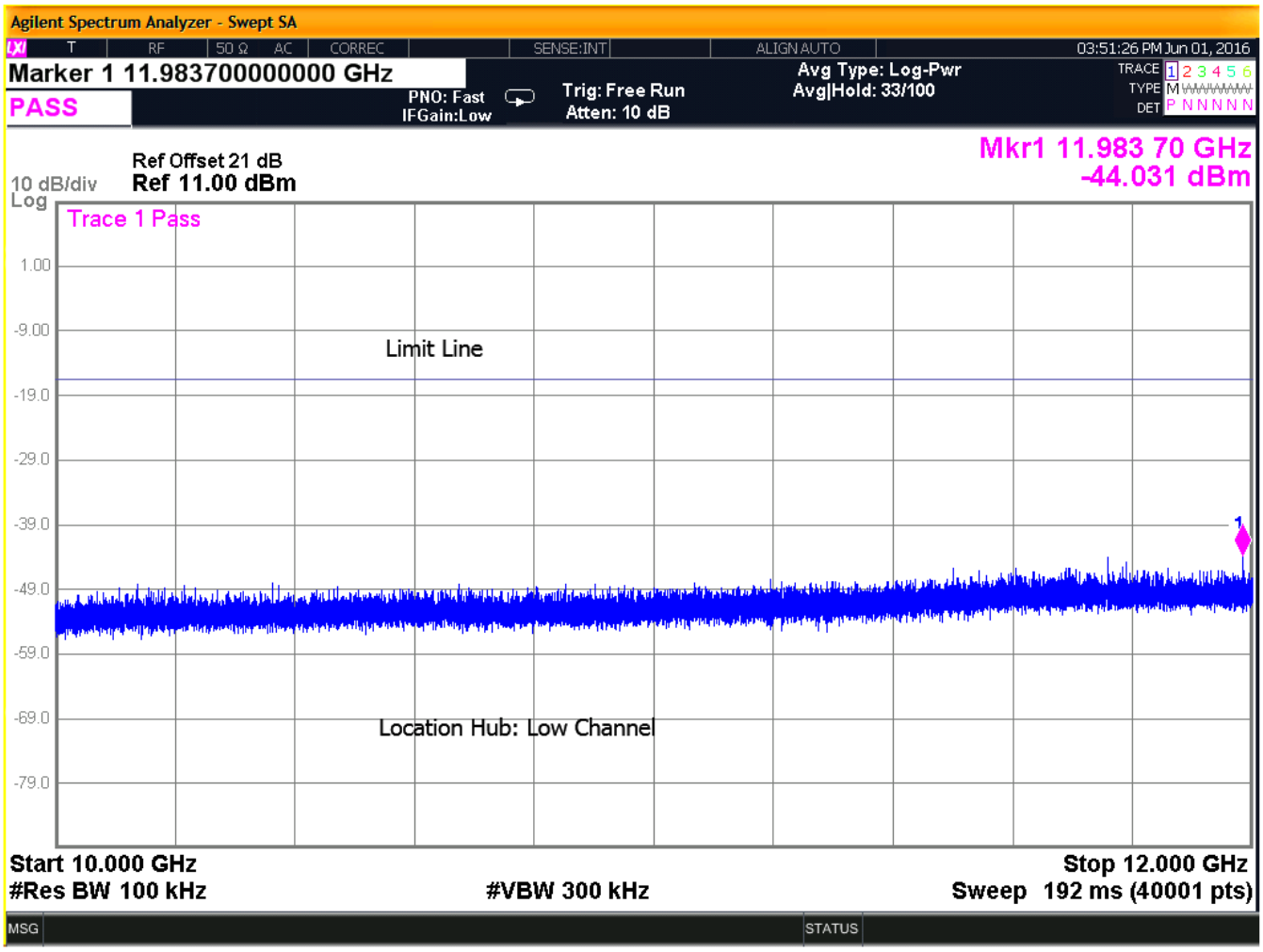

Figure 18: Low Channel Conducted Spurious Plot 8

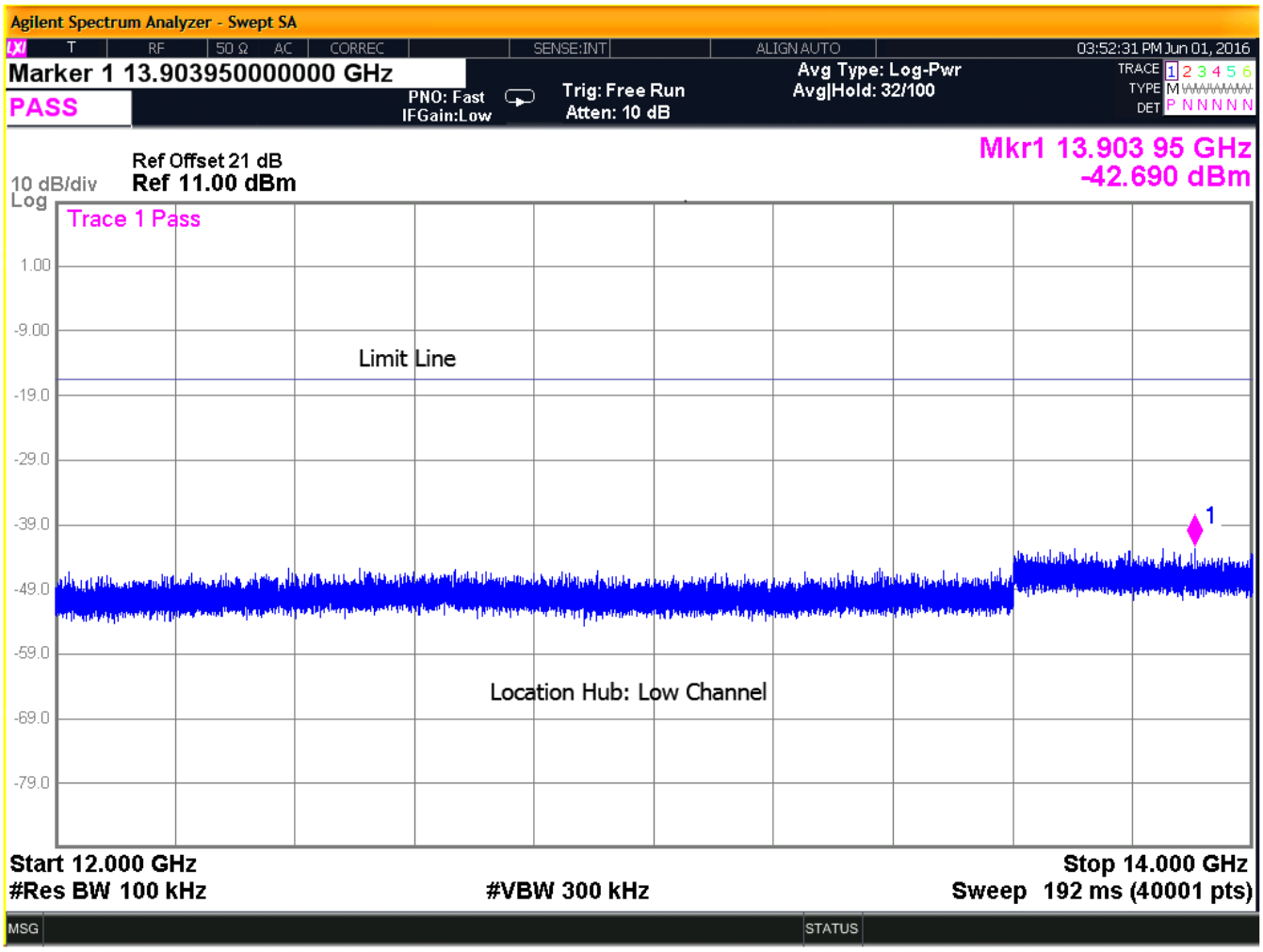

Figure 19: Low Channel Conducted Spurious Plot 9

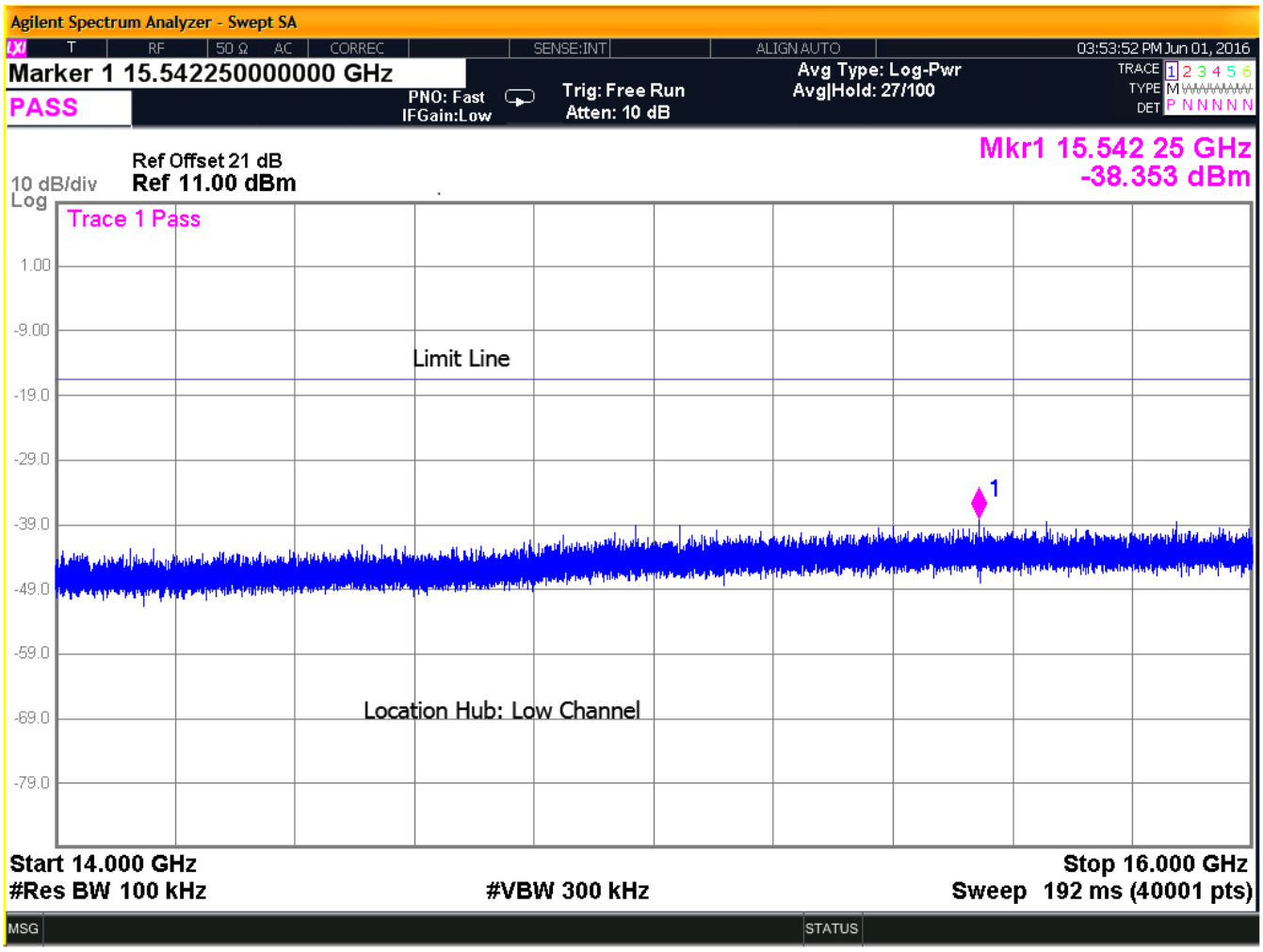

Figure 20: Low Channel Conducted Spurious Plot 10

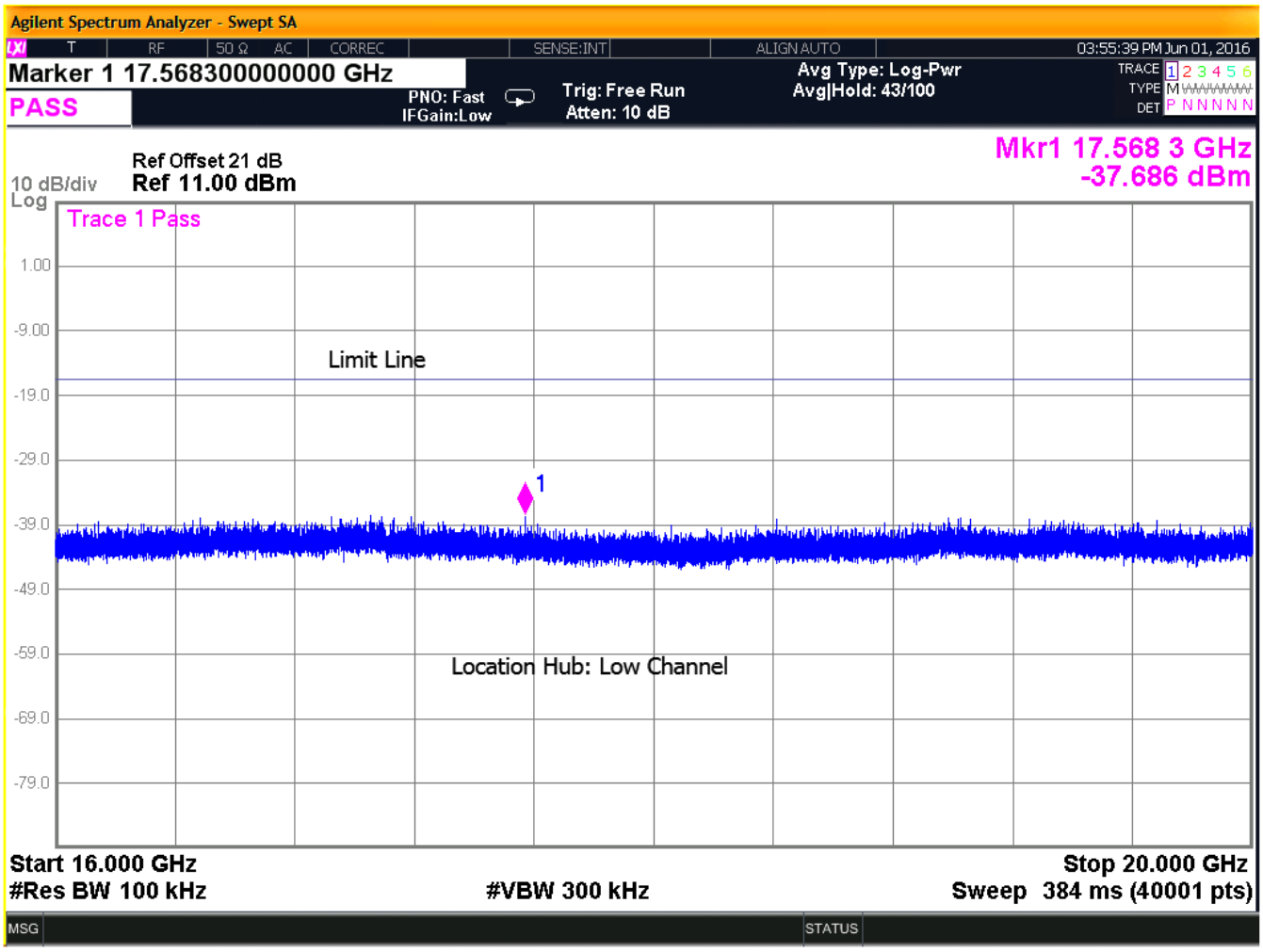

Figure 21: Low Channel Conducted Spurious Plot 11

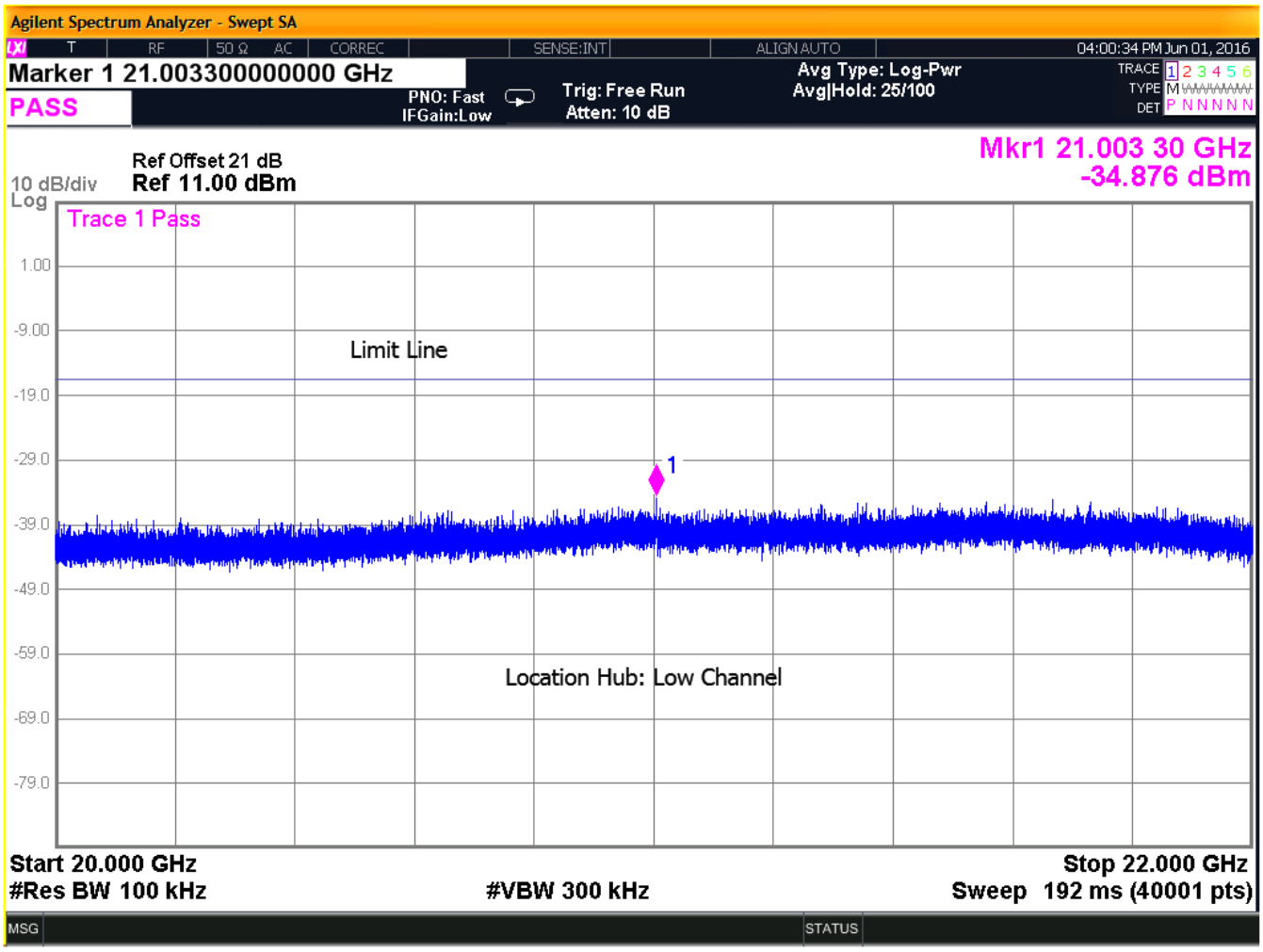

Figure 22: Low Channel Conducted Spurious Plot 12

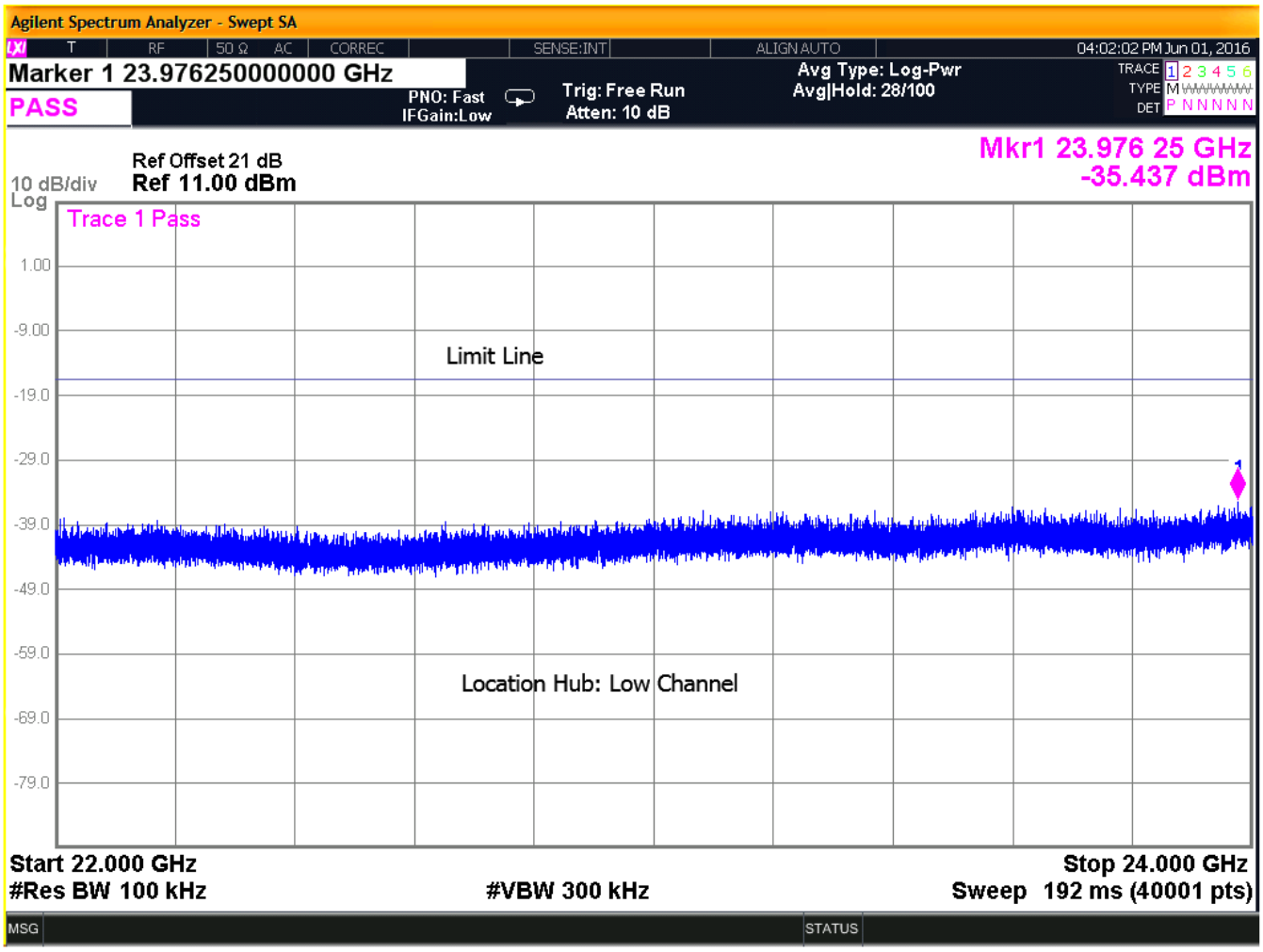

Figure 23: Low Channel Conducted Spurious Plot 13

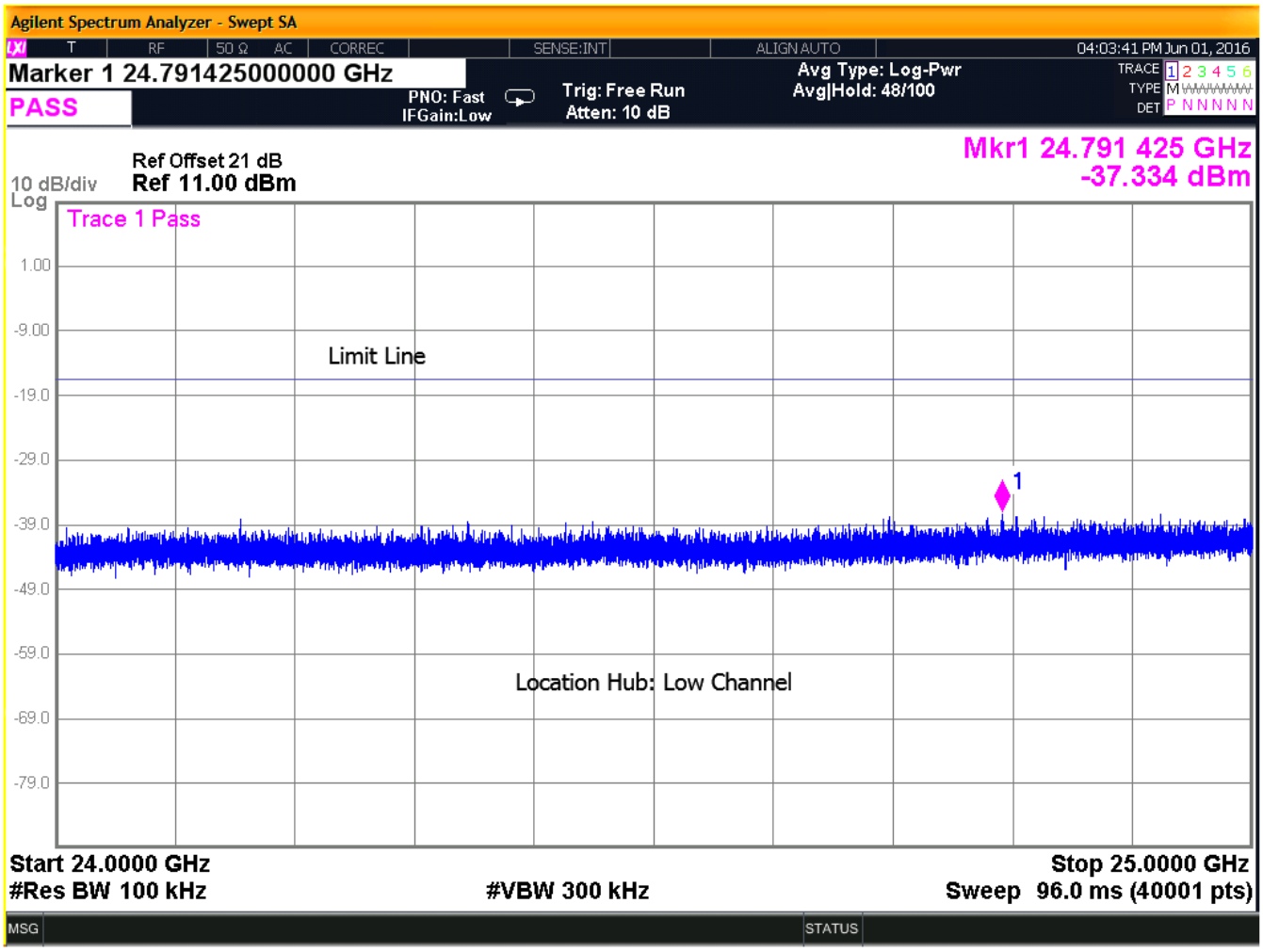

Figure 24: Low Channel Conducted Spurious Plot 14

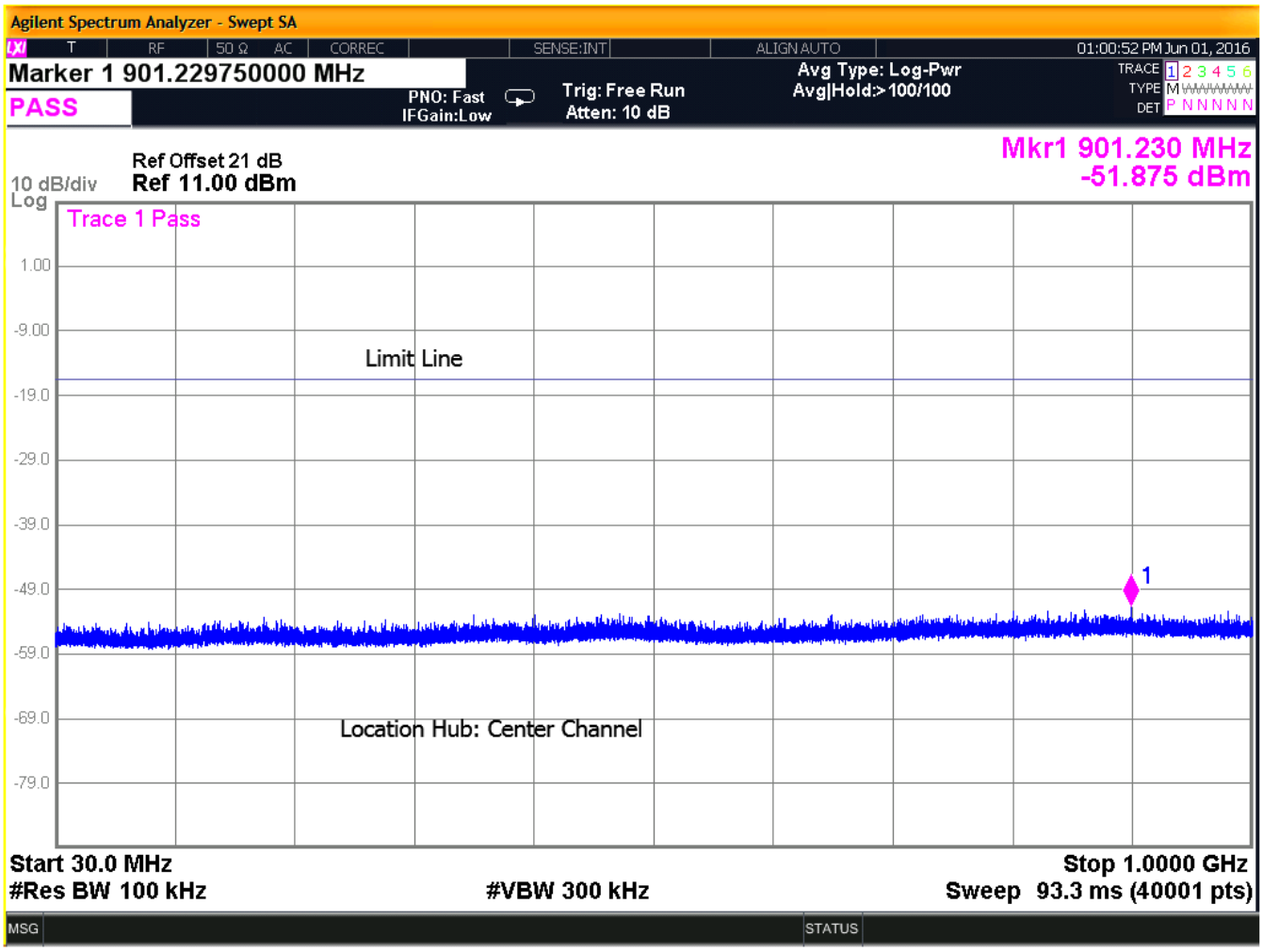

Figure 25: Center Channel Conducted Spurious Plot 1

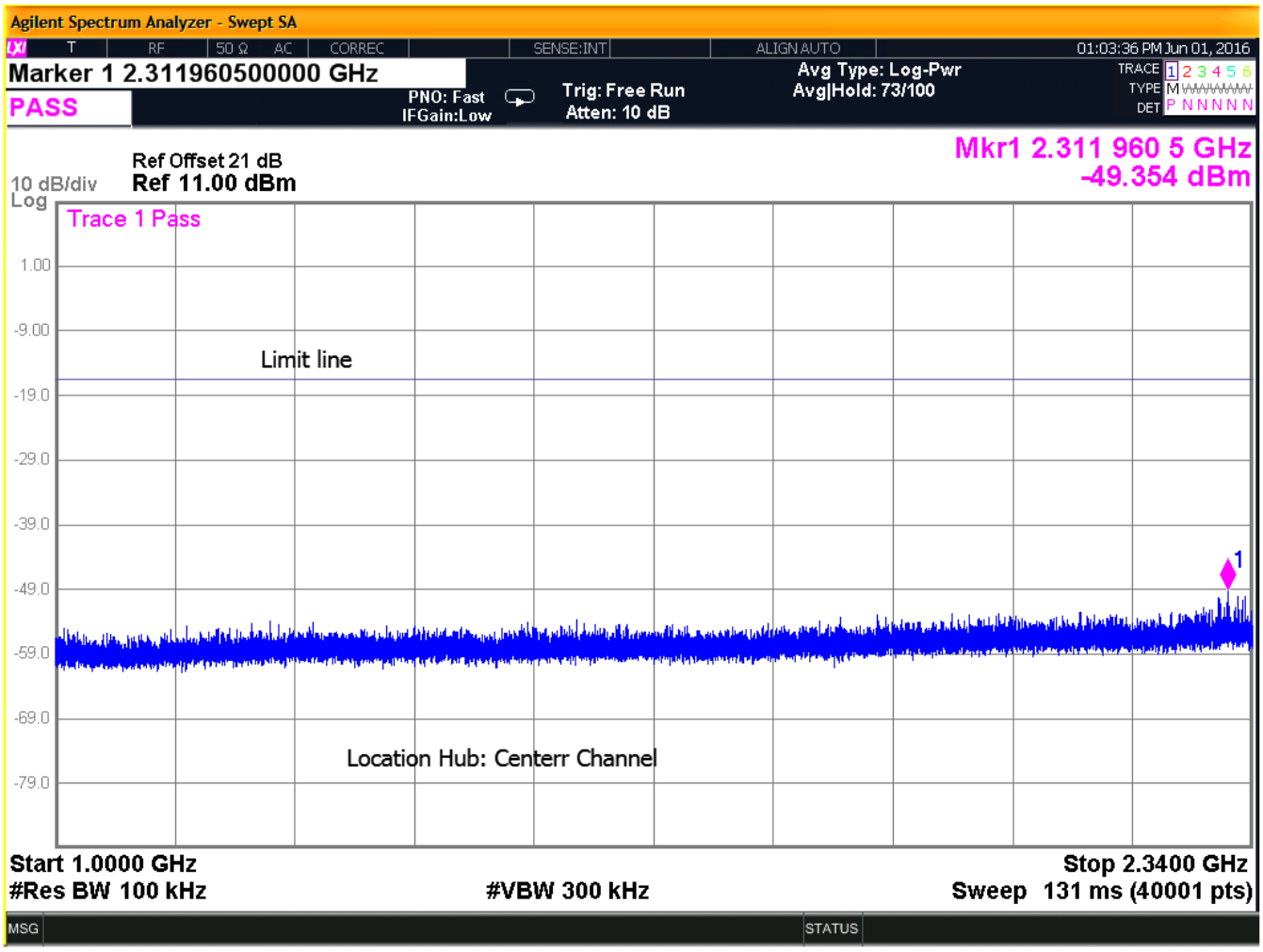

Figure 26: Center Channel Conducted Spurious Plot 2

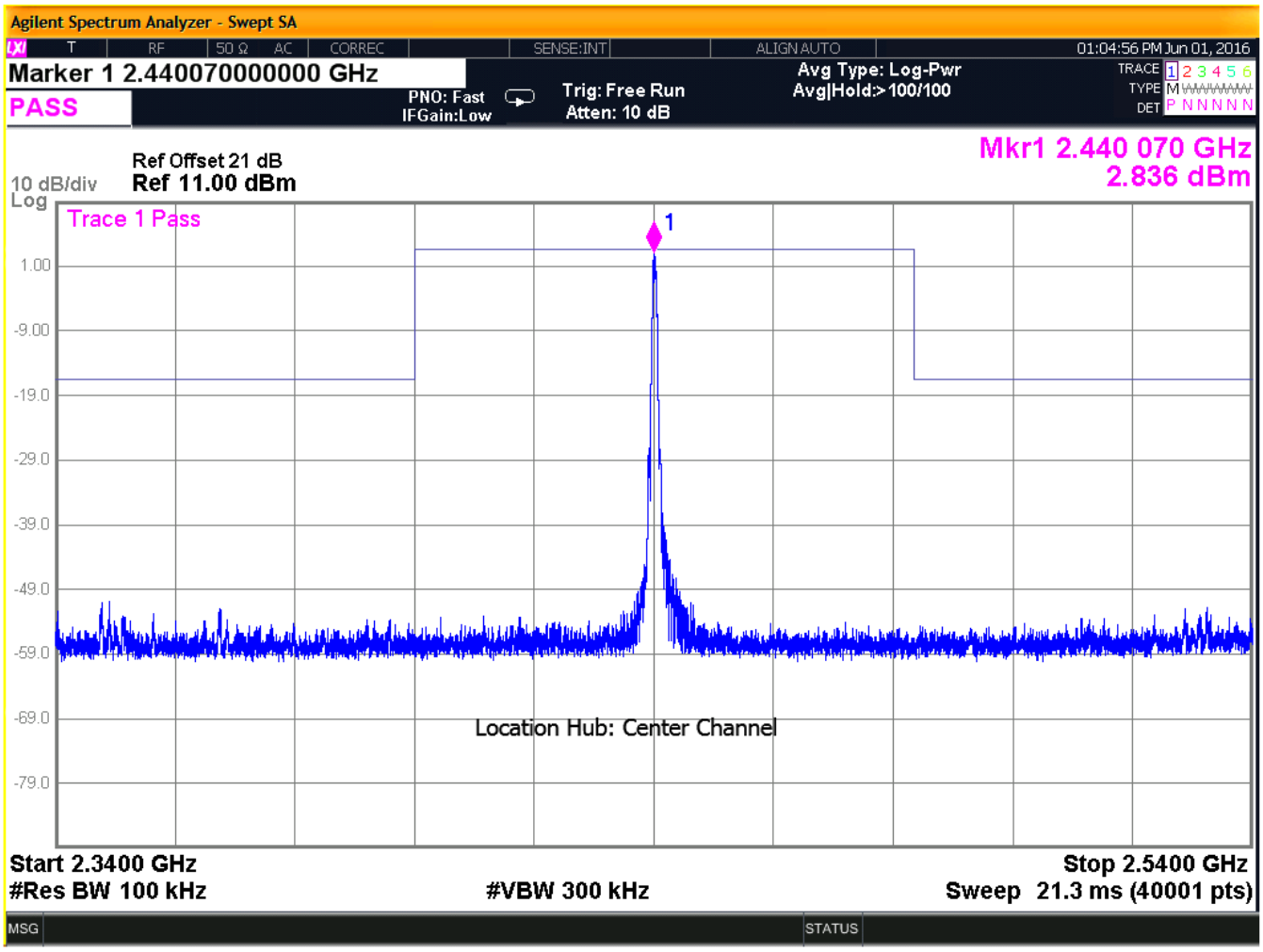

Figure 27: Center Channel Conducted Spurious Plot 3

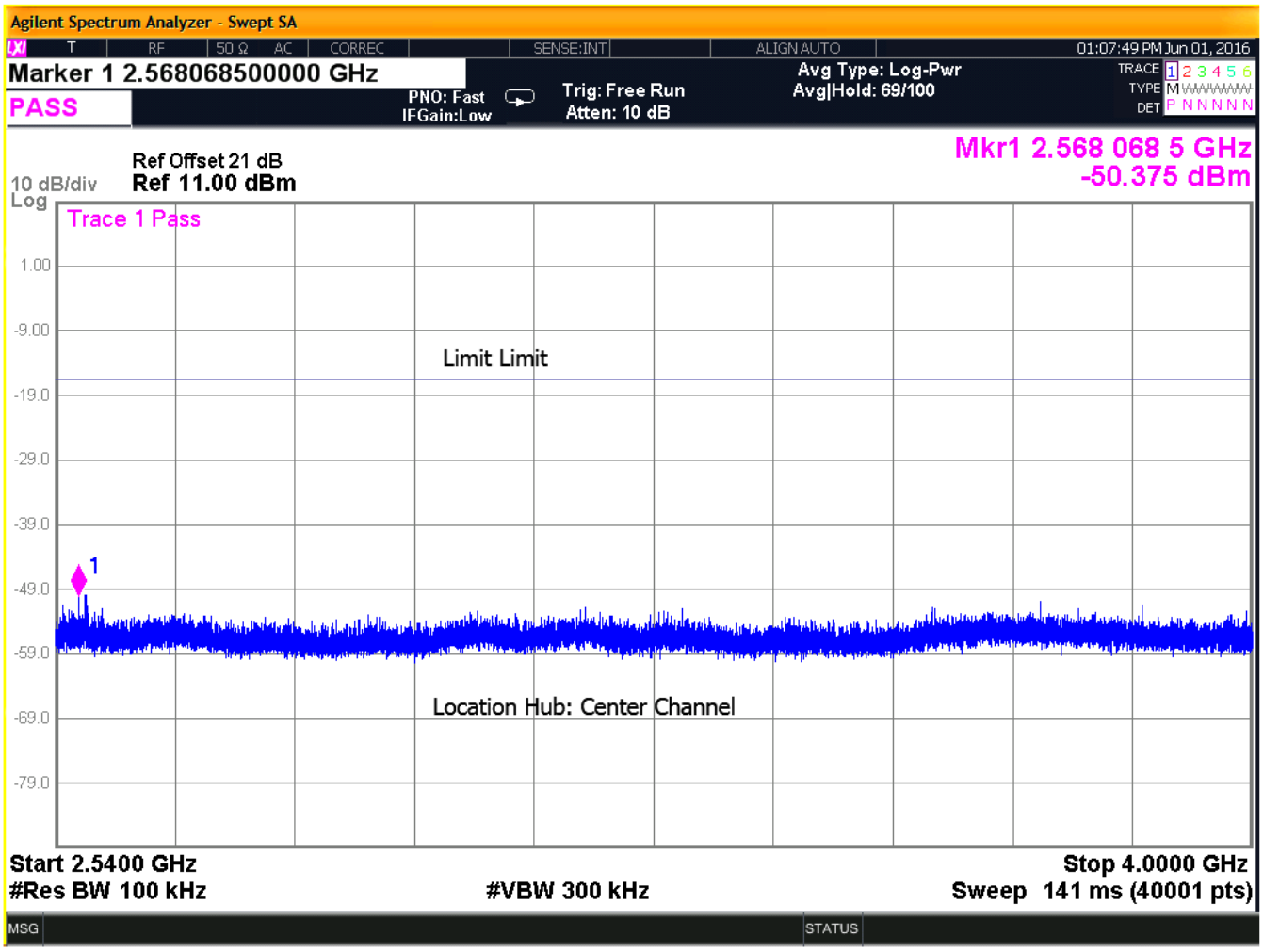

Figure 28: Center Channel Conducted Spurious Plot 4

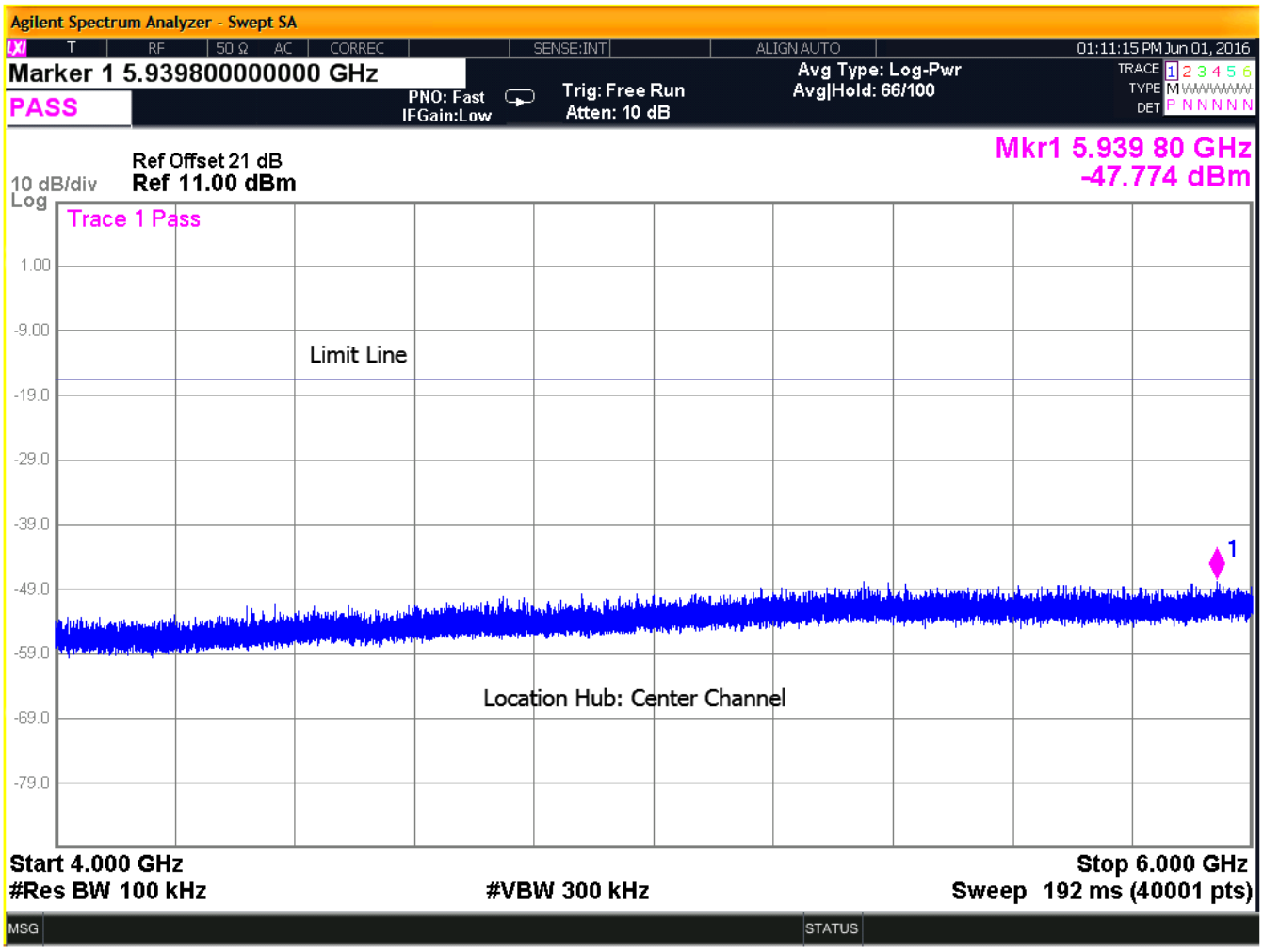

Figure 29: Center Channel Conducted Spurious Plot 5

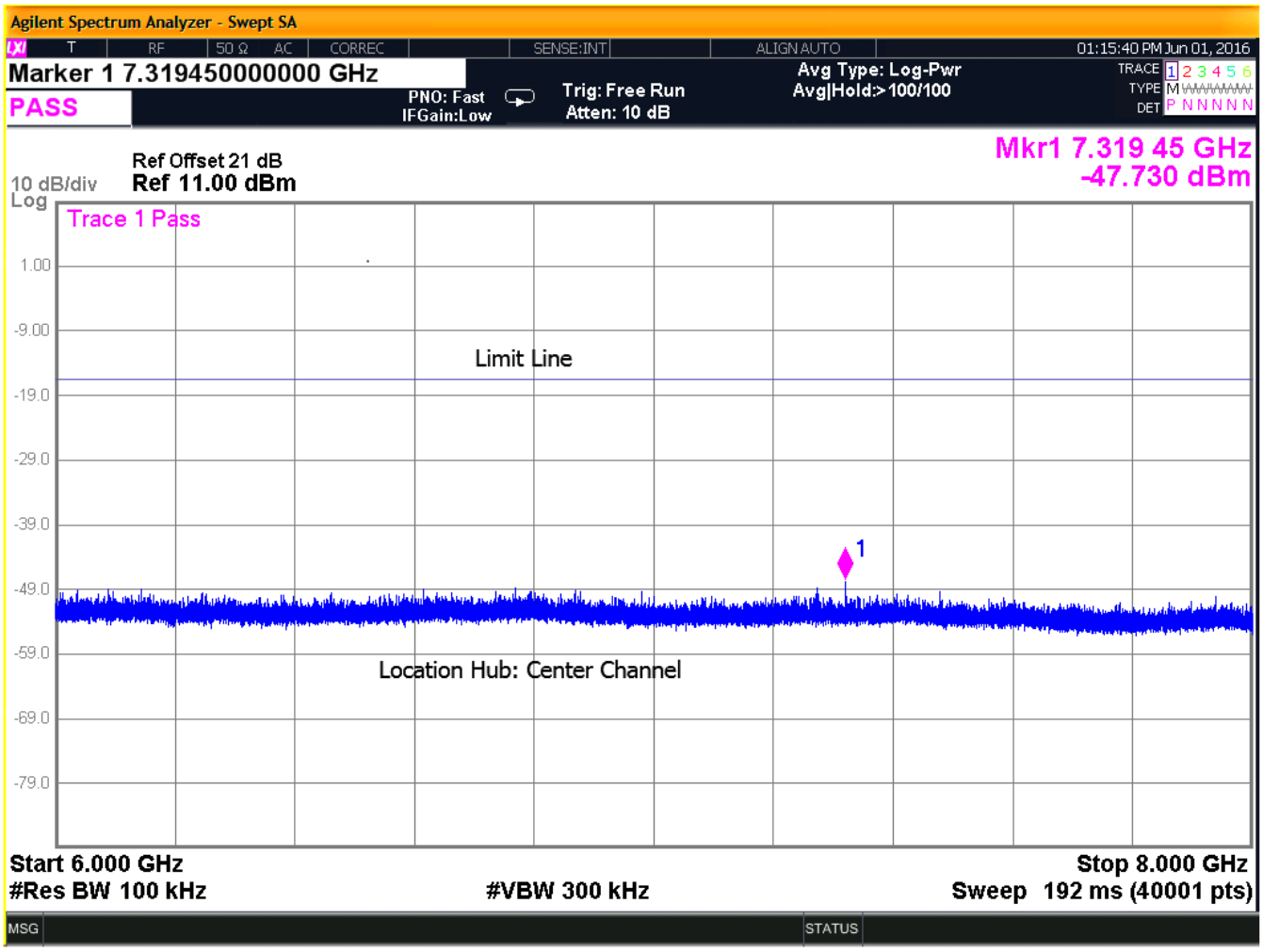

Figure 30: Center Channel Conducted Spurious Plot 6

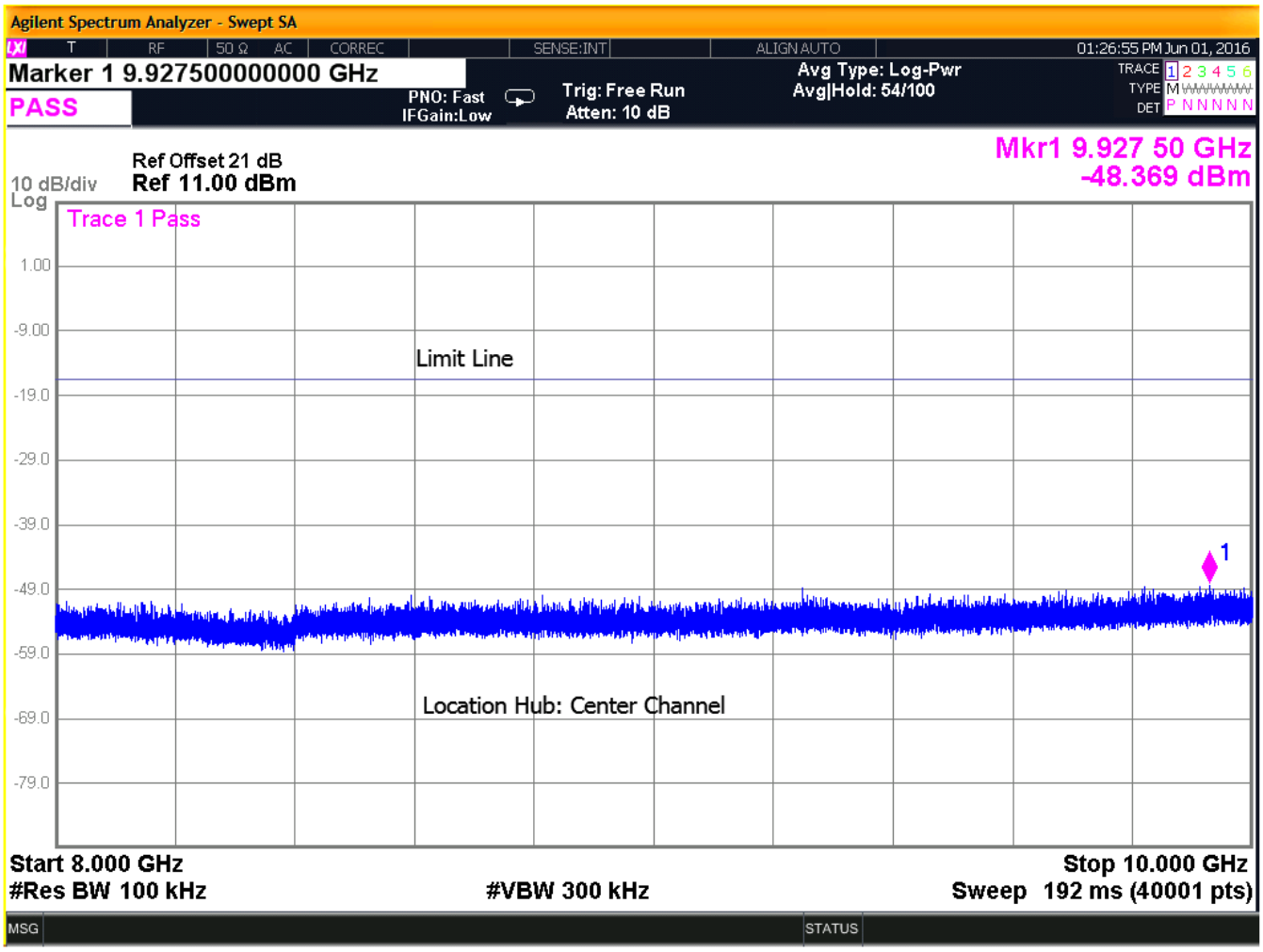

Figure 31: Center Channel Conducted Spurious Plot 7

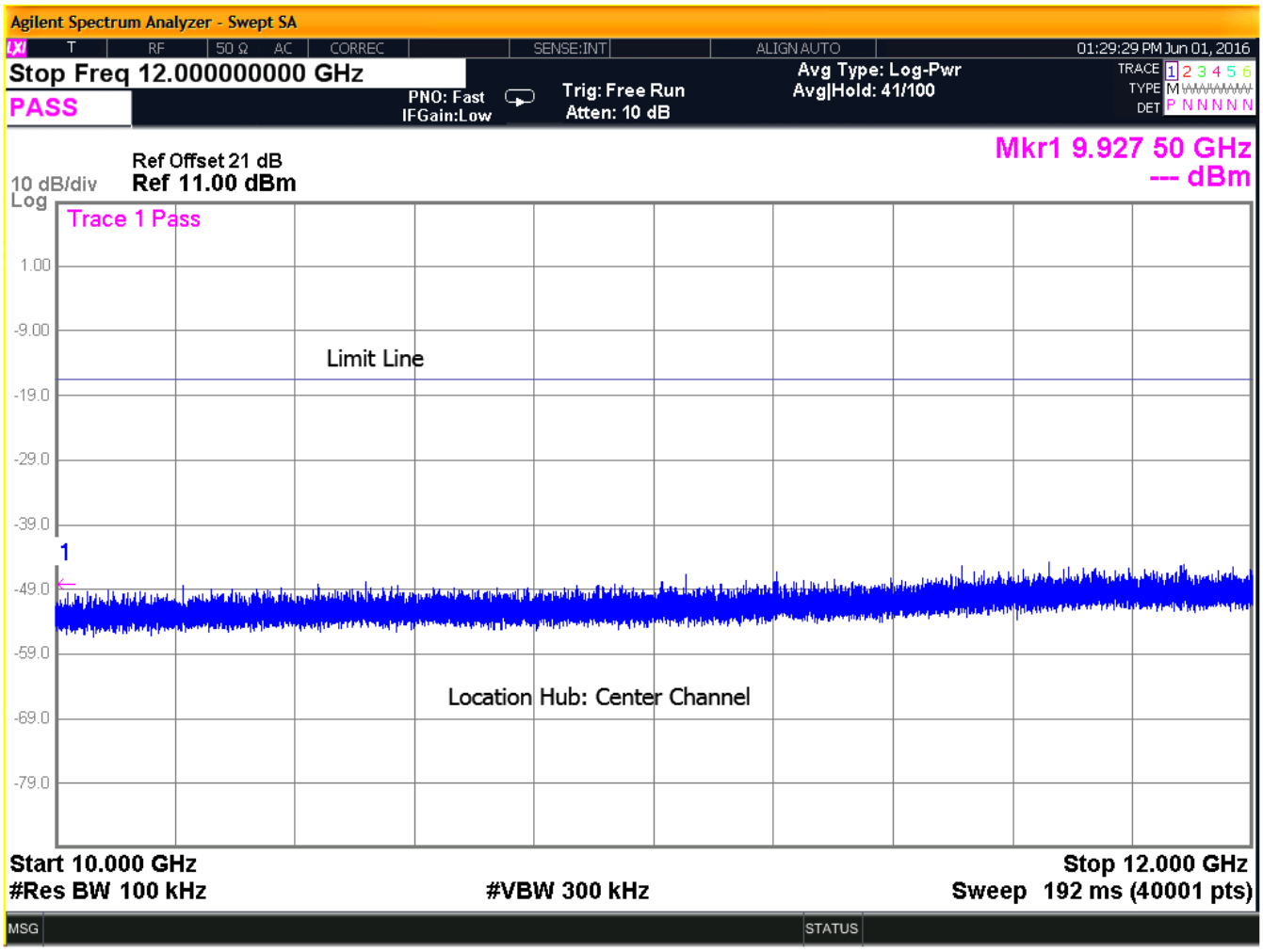

Figure 32: Center Channel Conducted Spurious Plot 8

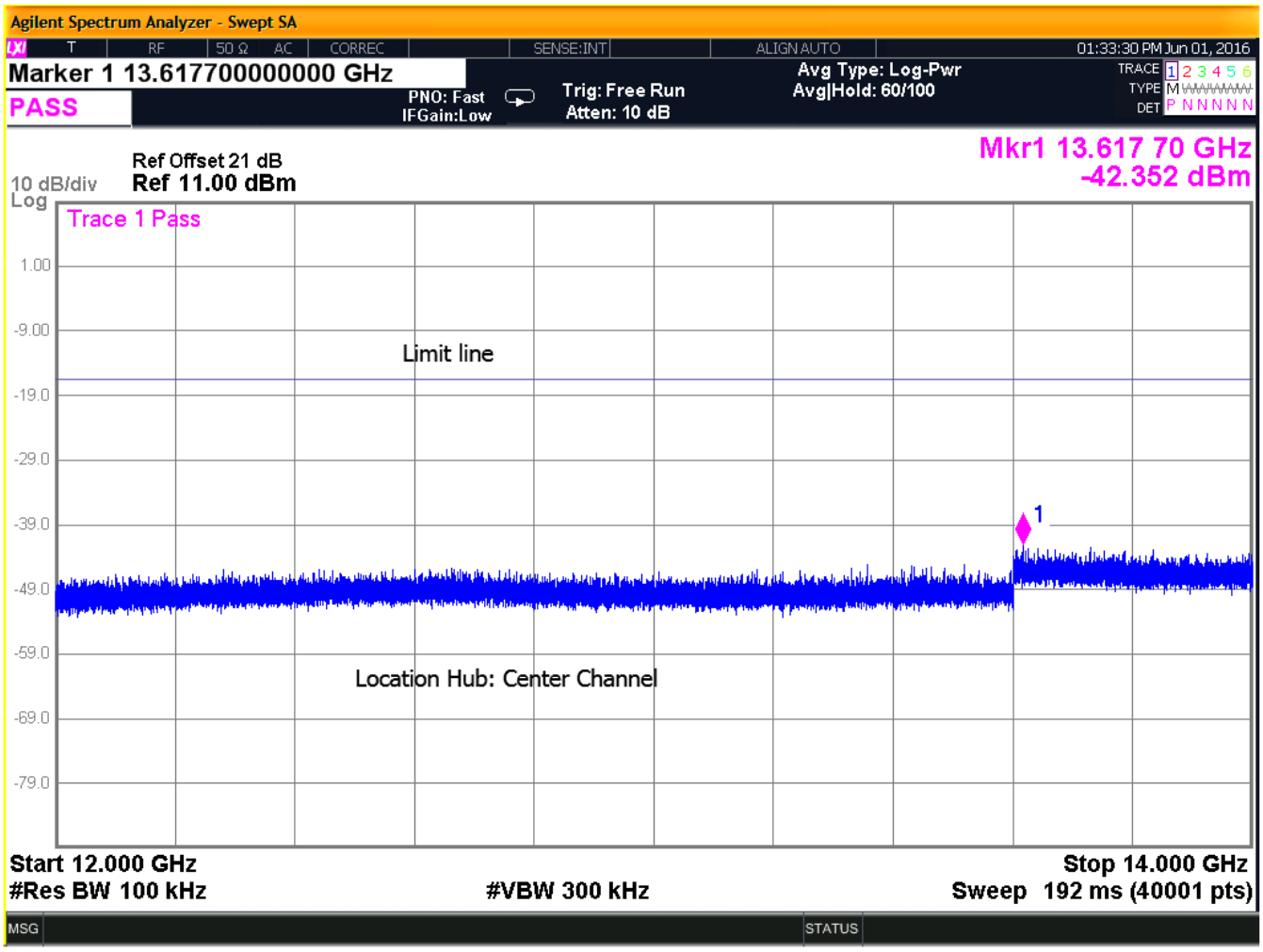

Figure 33: Center Channel Conducted Spurious Plot 9

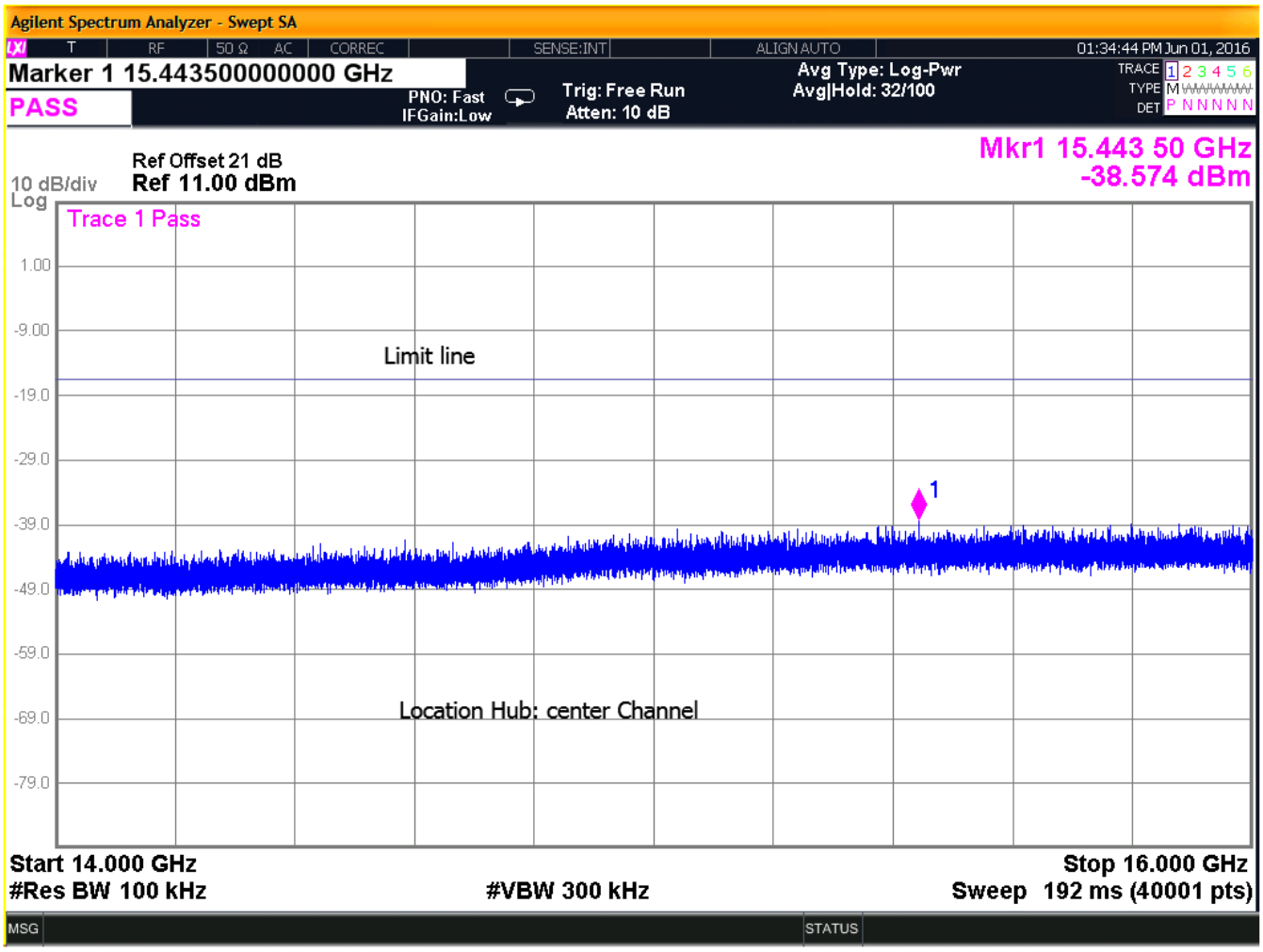

Figure 34: Center Channel Conducted Spurious Plot 10

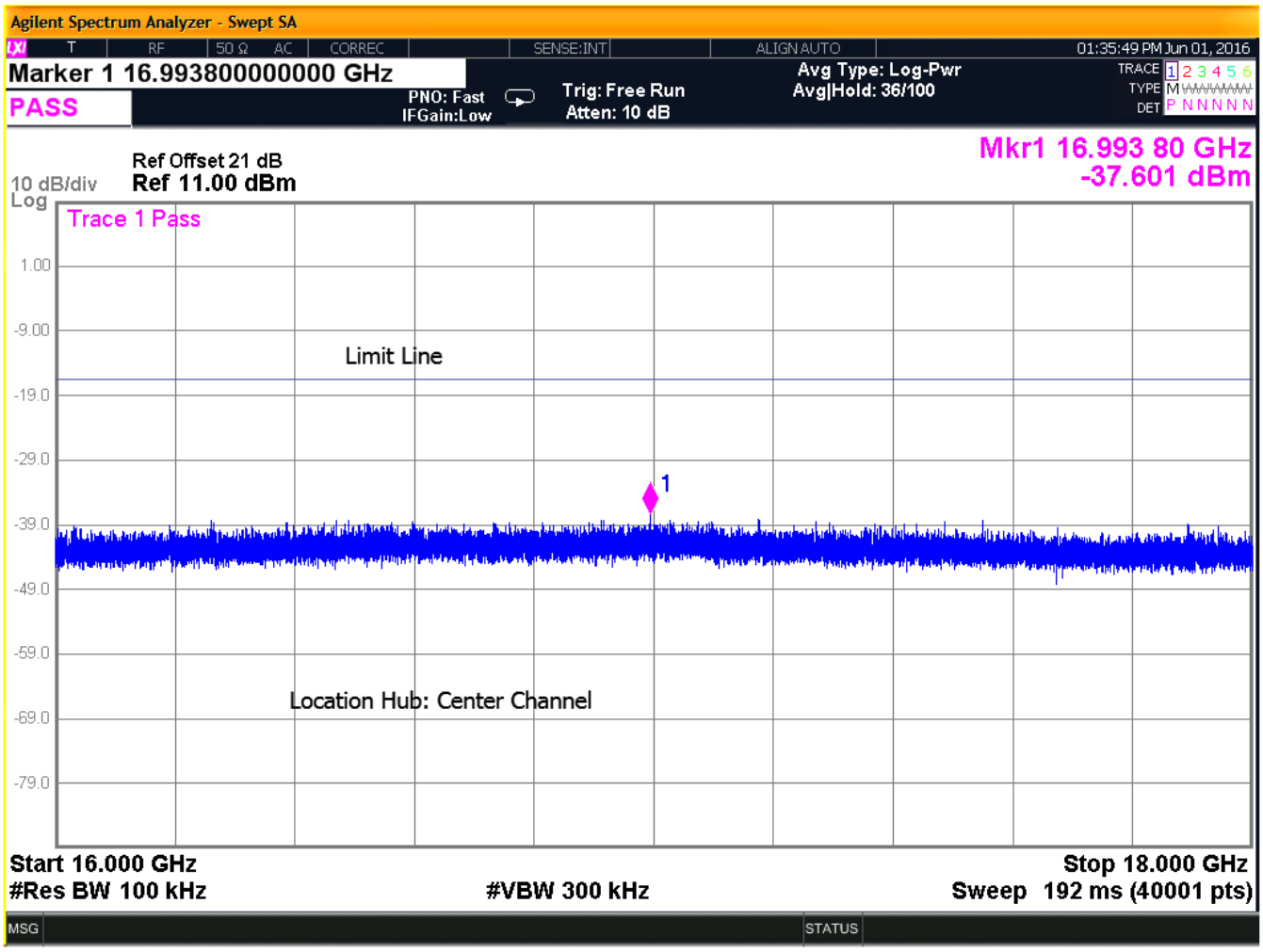

Figure 35: Center Channel Conducted Spurious Plot 11

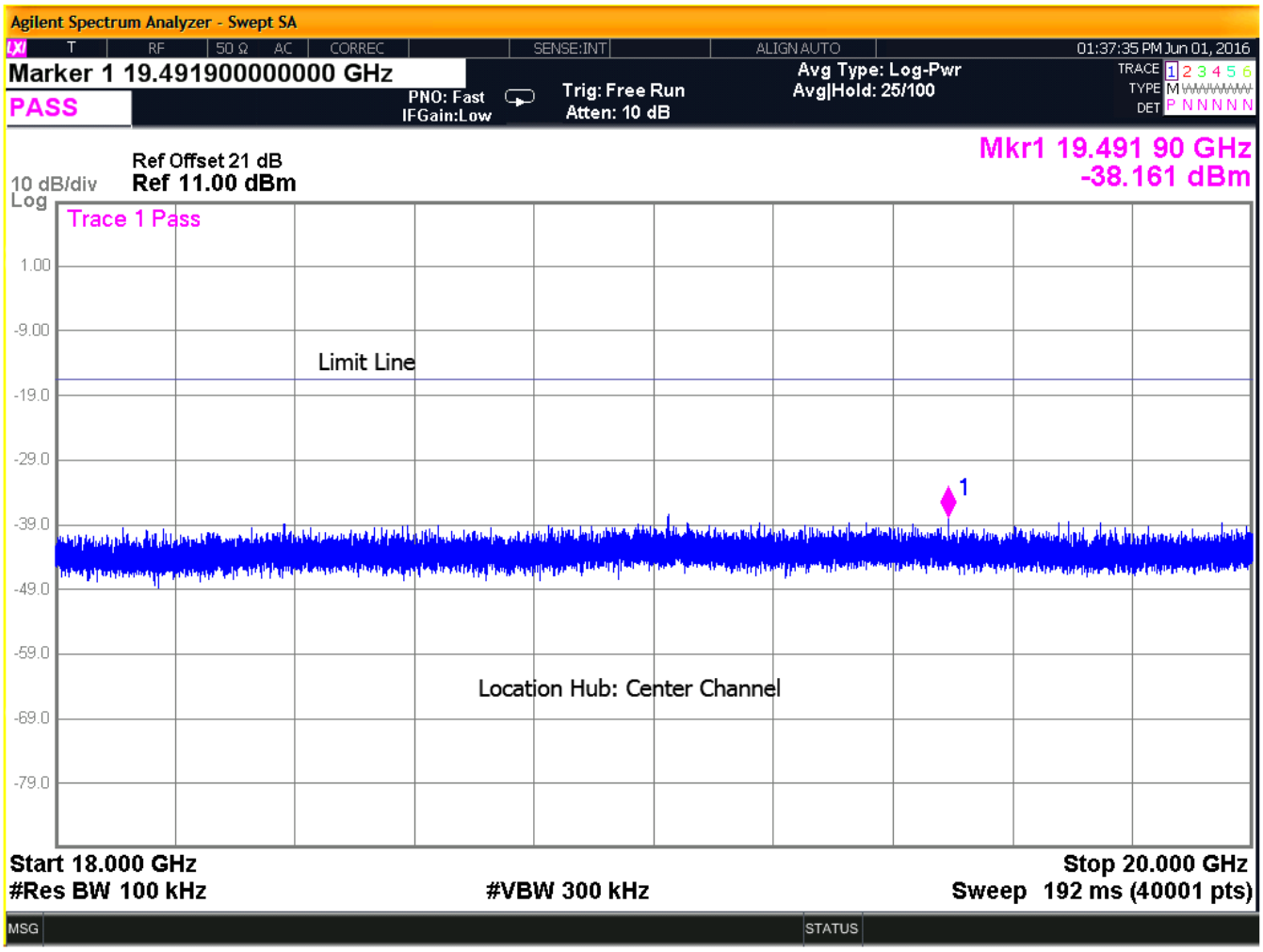

Figure 36: Center Channel Conducted Spurious Plot 12

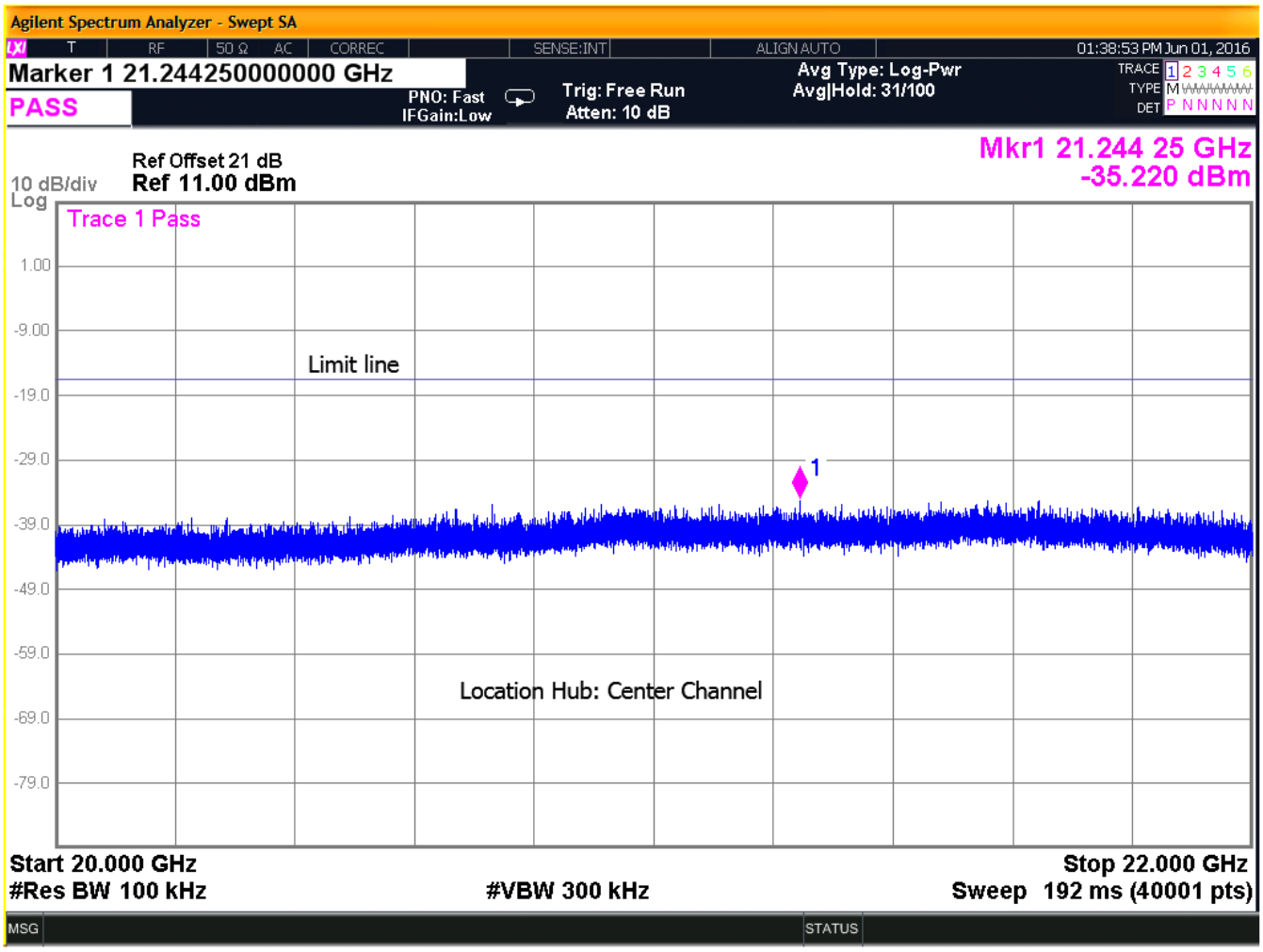

Figure 37: Center Channel Conducted Spurious Plot 13

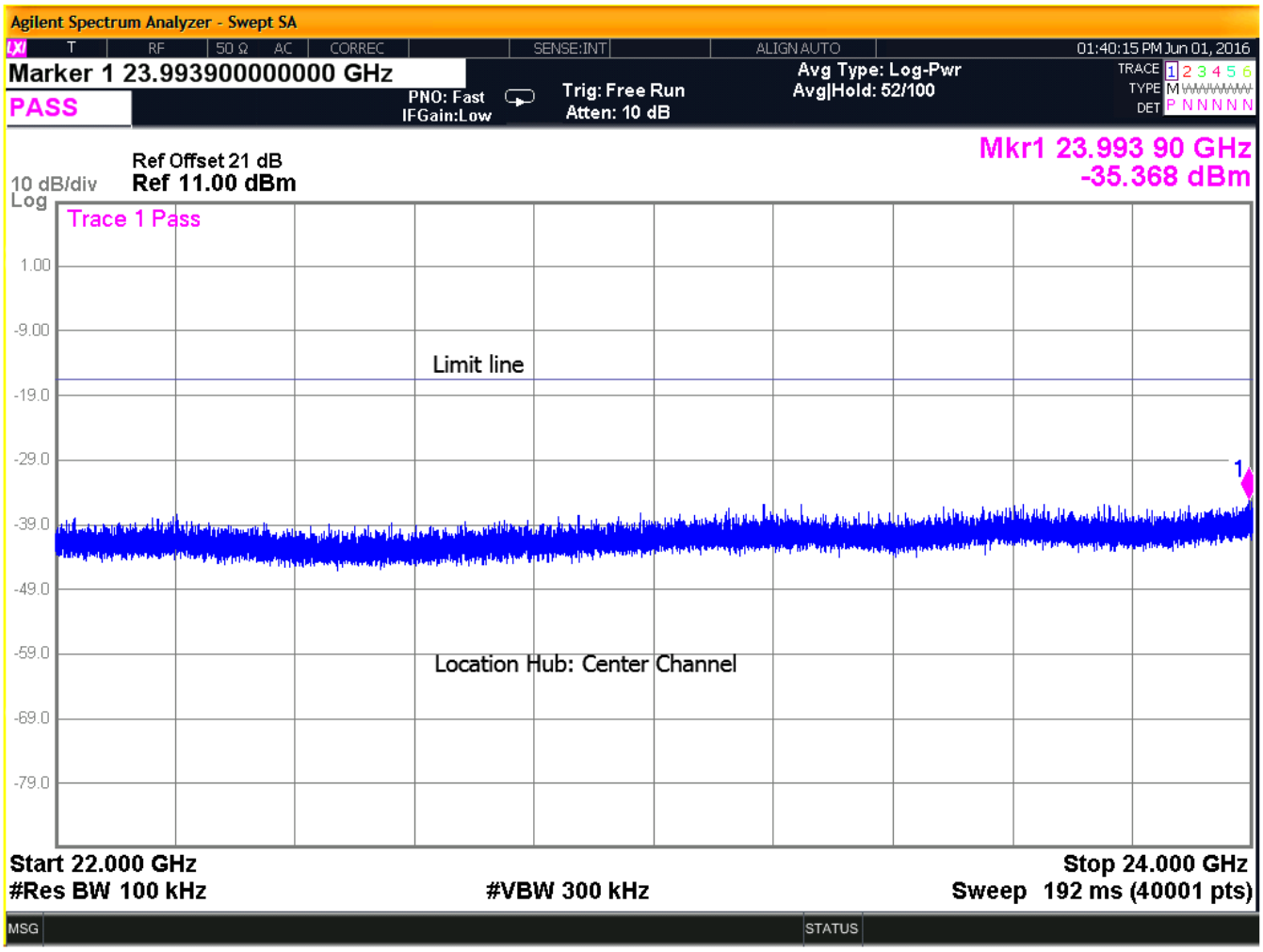

Figure 38: Center Channel Conducted Spurious Plot 14

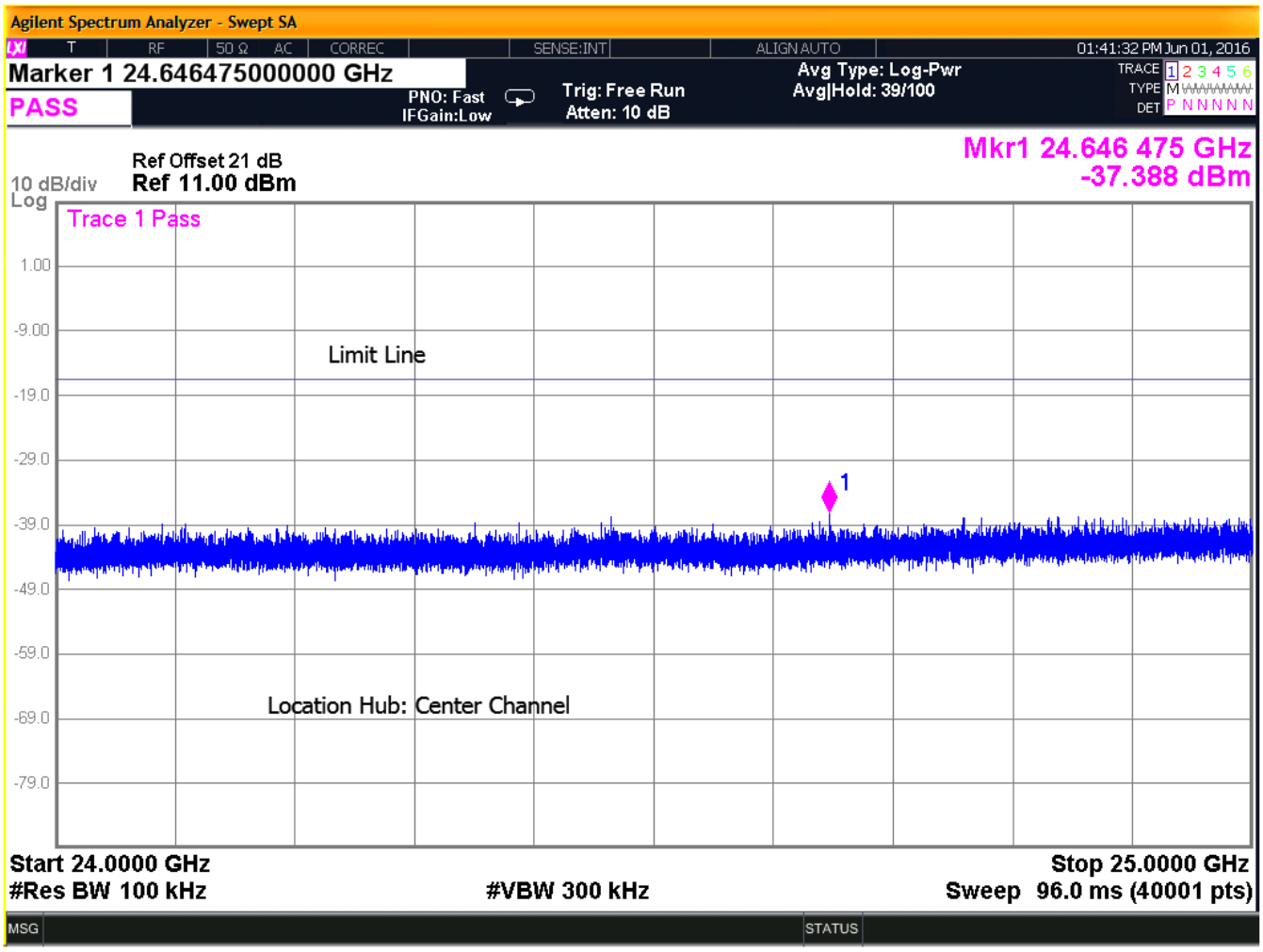

Figure 39: Center Channel Conducted Spurious Plot 15

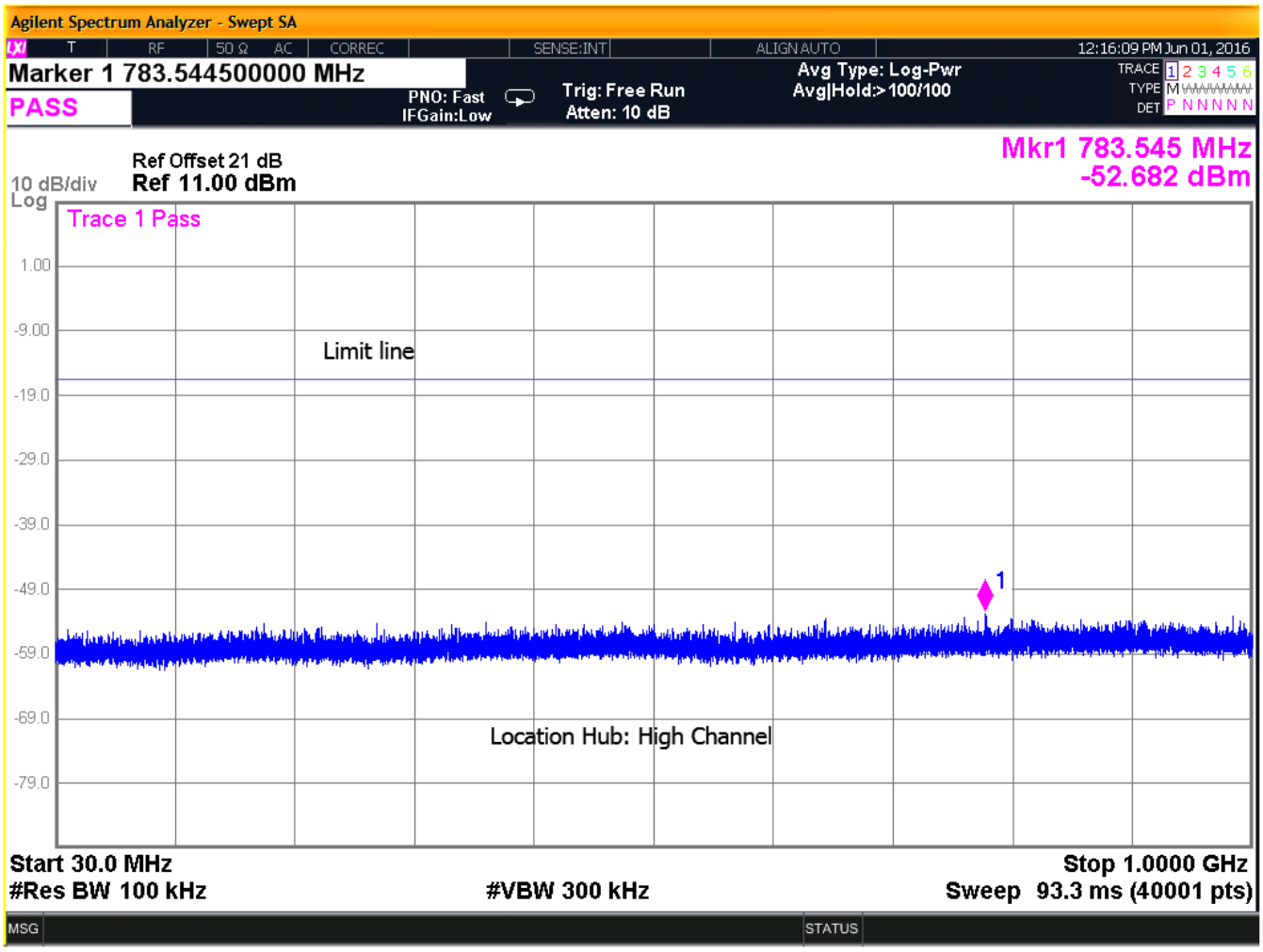

Figure 40: High Channel Conducted Spurious Plot 1

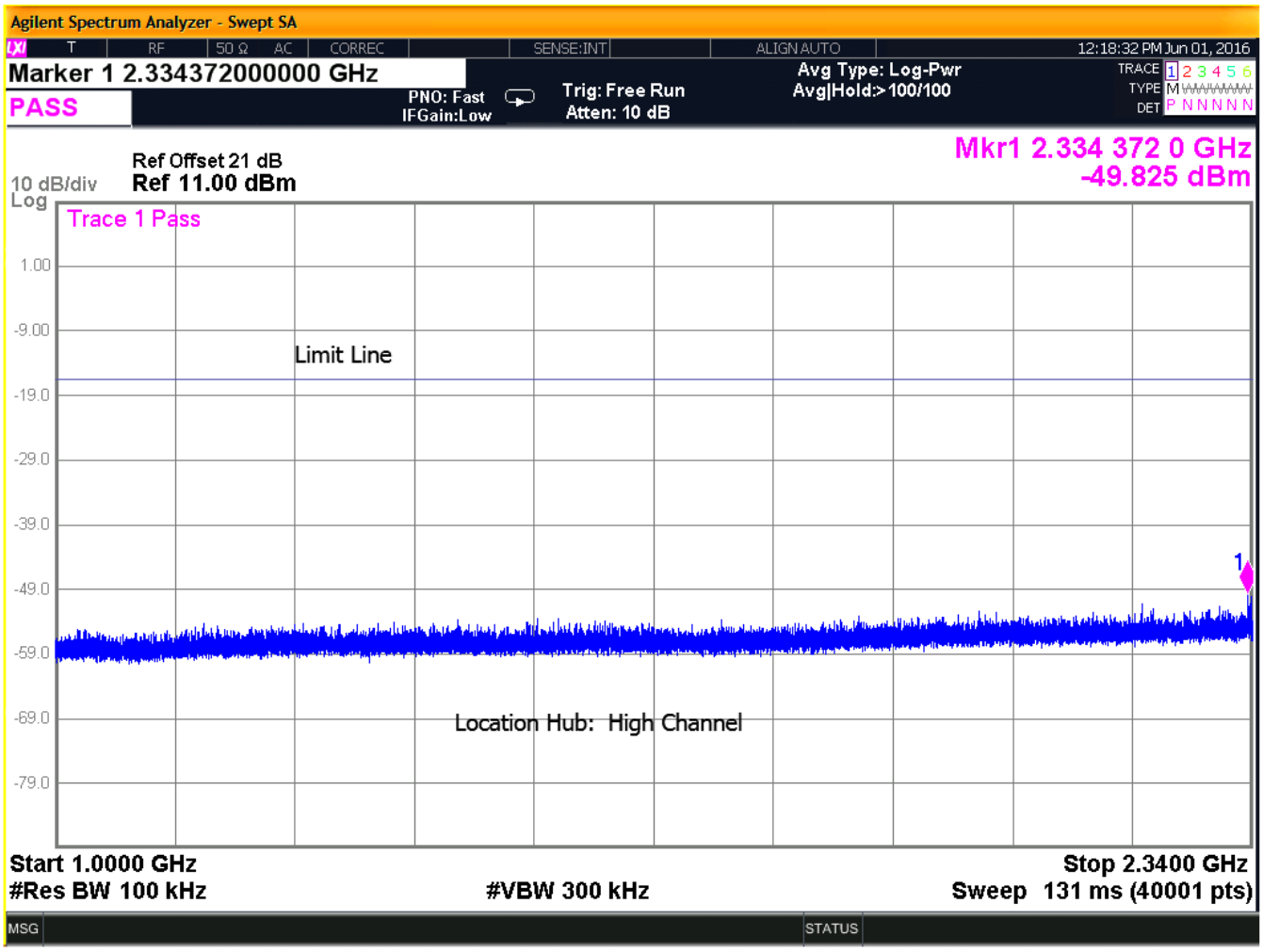

Figure 41: High Channel Conducted Spurious Plot 2

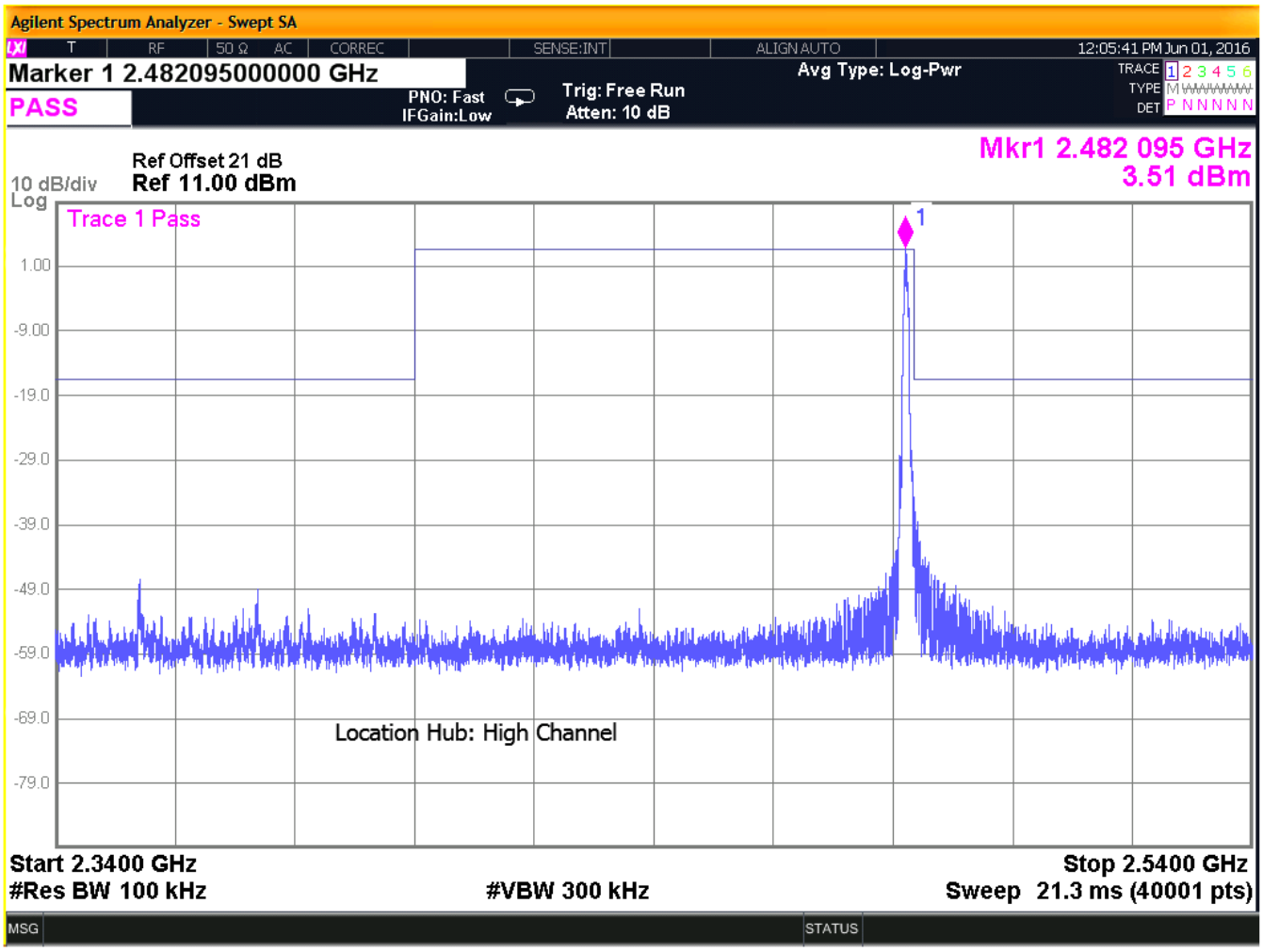

Figure 42: High Channel Conducted Spurious Plot 3

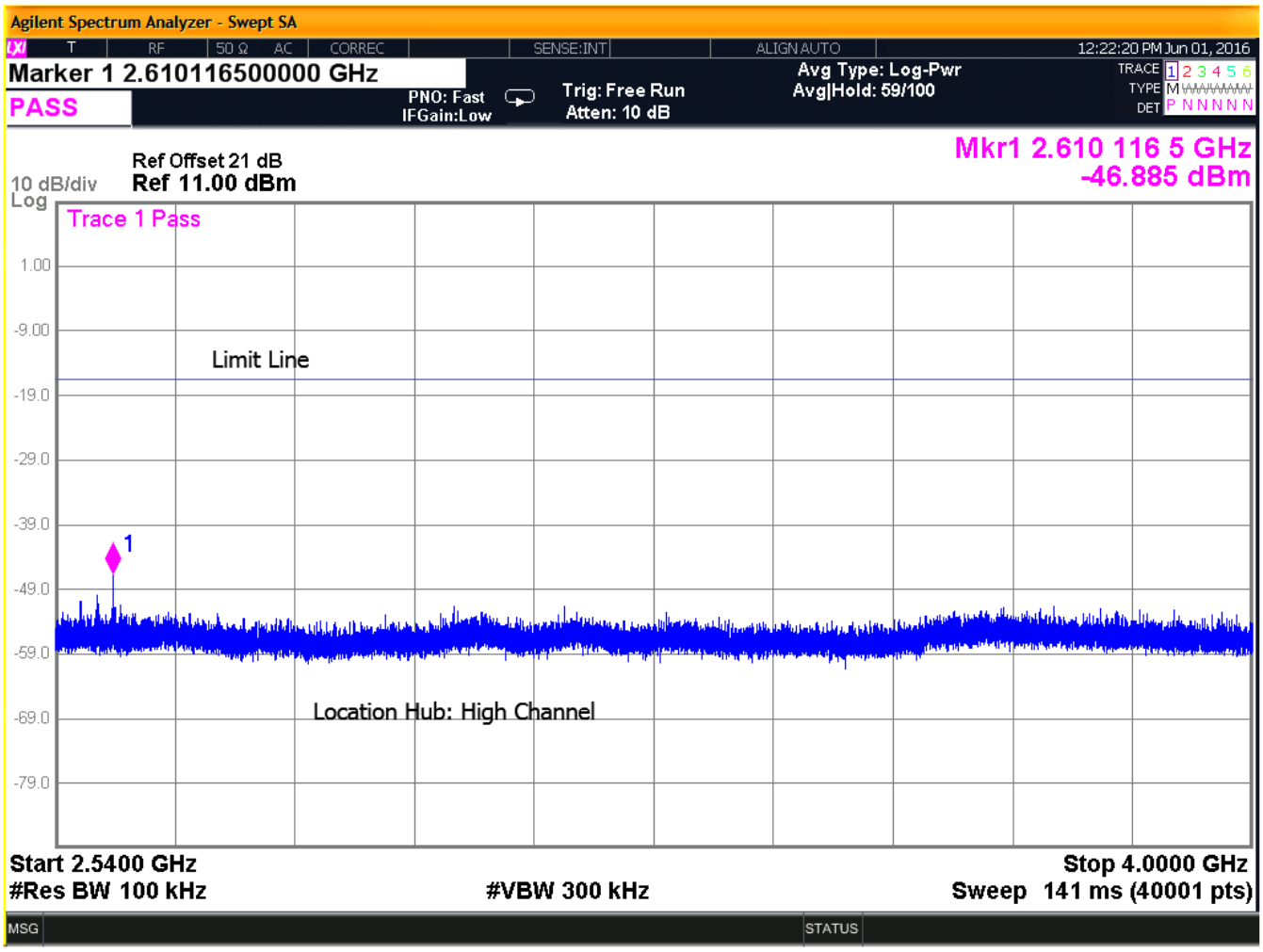

Figure 43: High Channel Conducted Spurious Plot 4

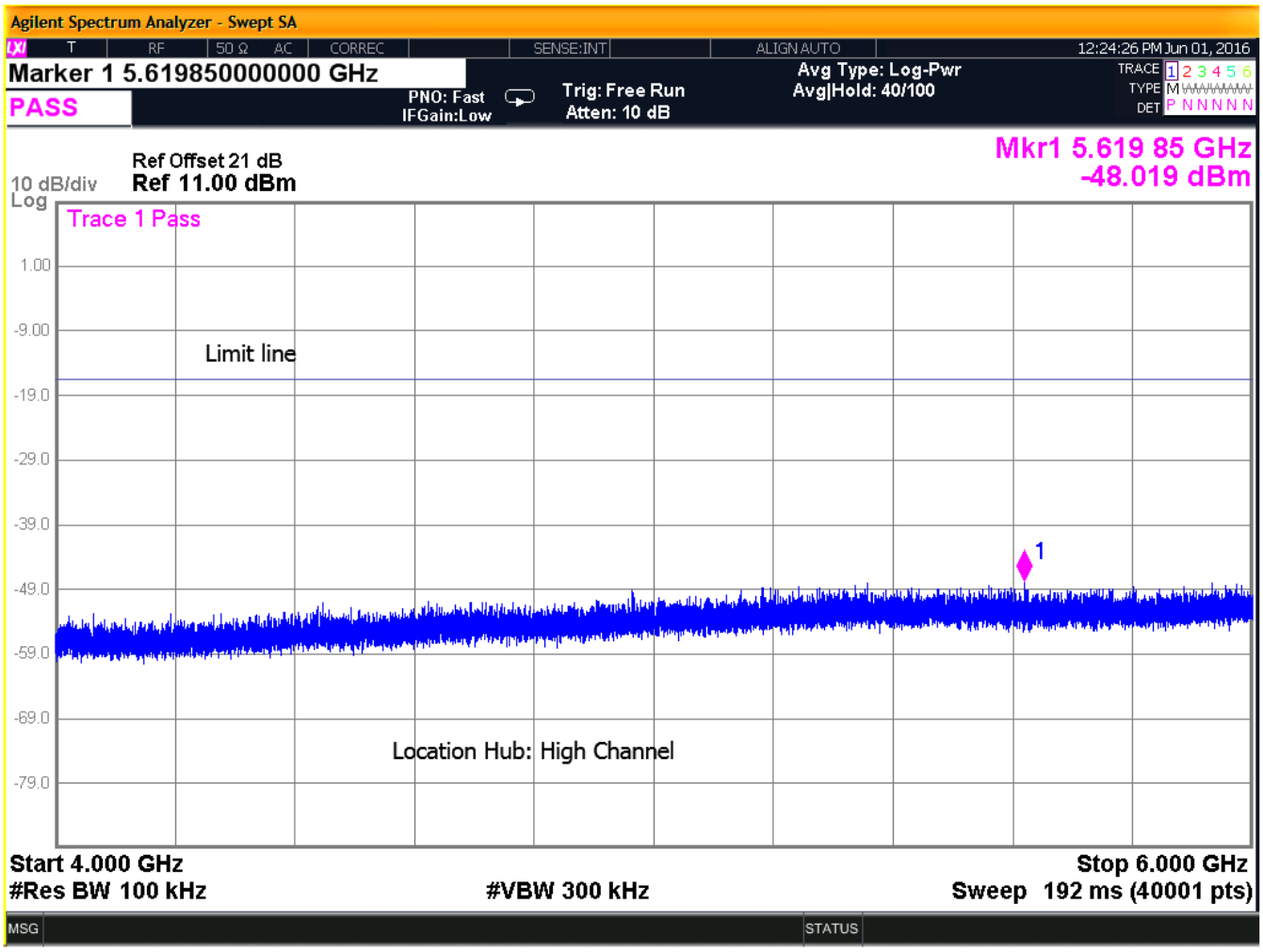

Figure 44: High Channel Conducted Spurious Plot 5

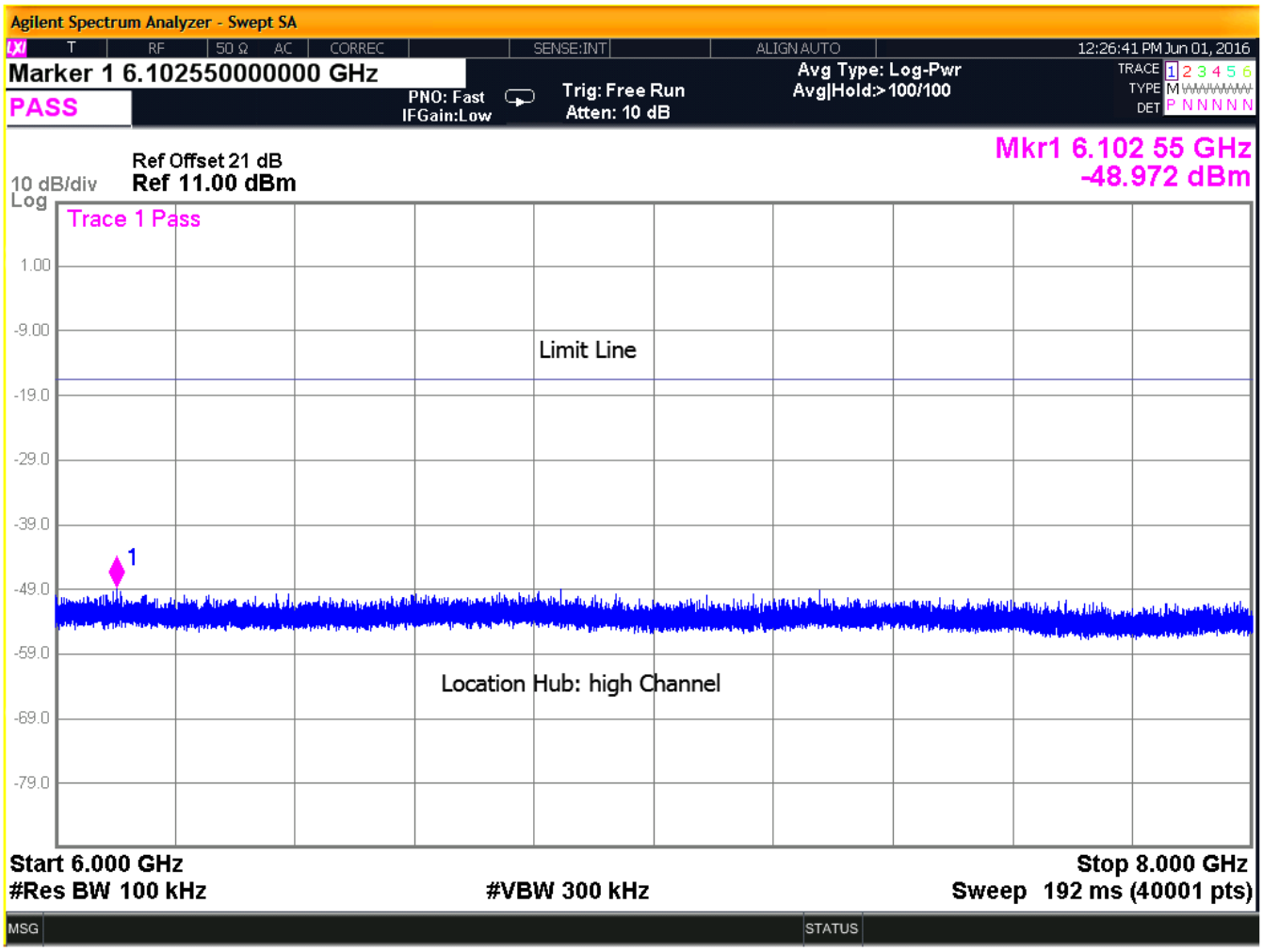

Figure 45: High Channel Conducted Spurious Plot 6

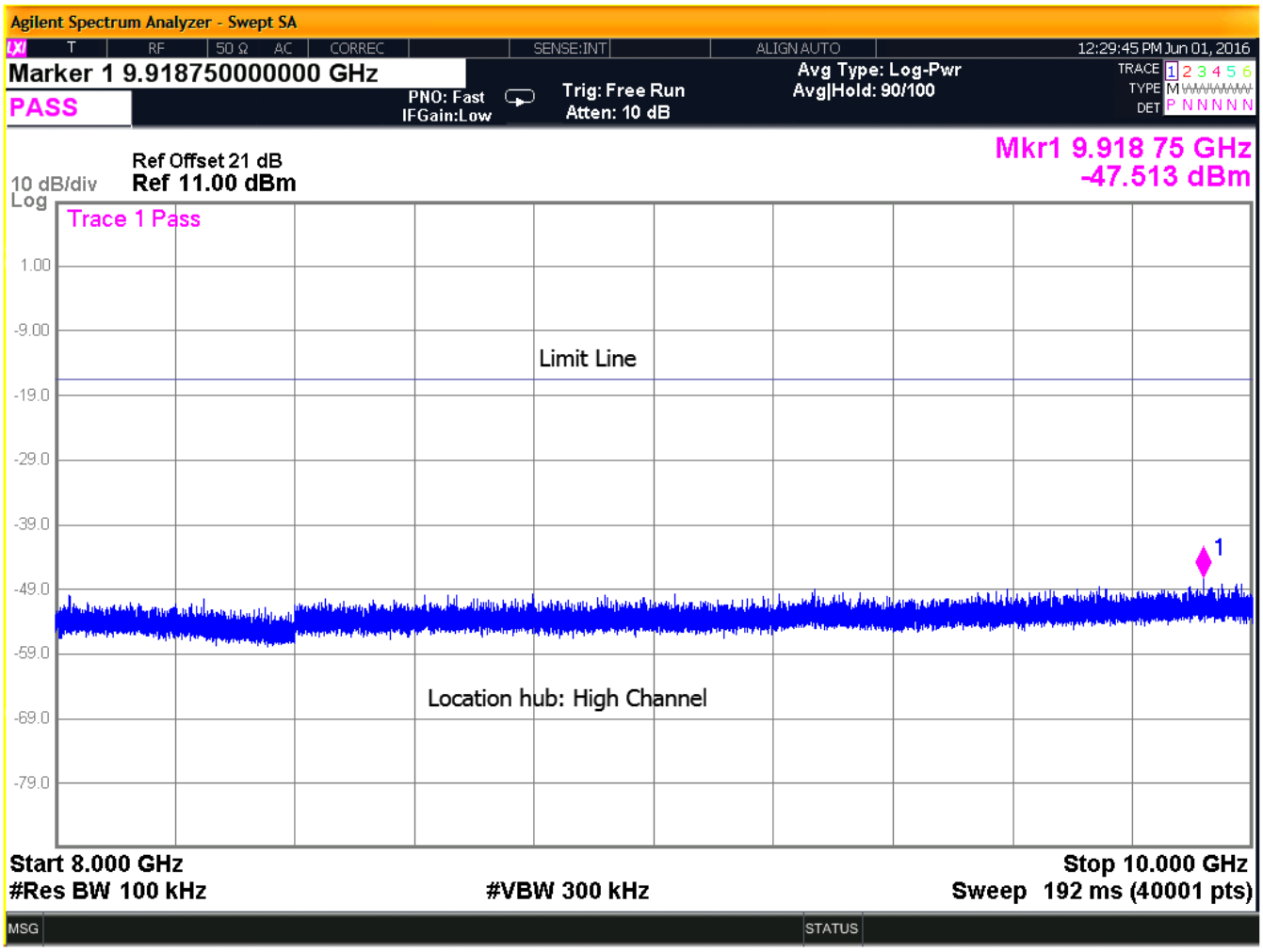

Figure 46: High Channel Conducted Spurious Plot 7

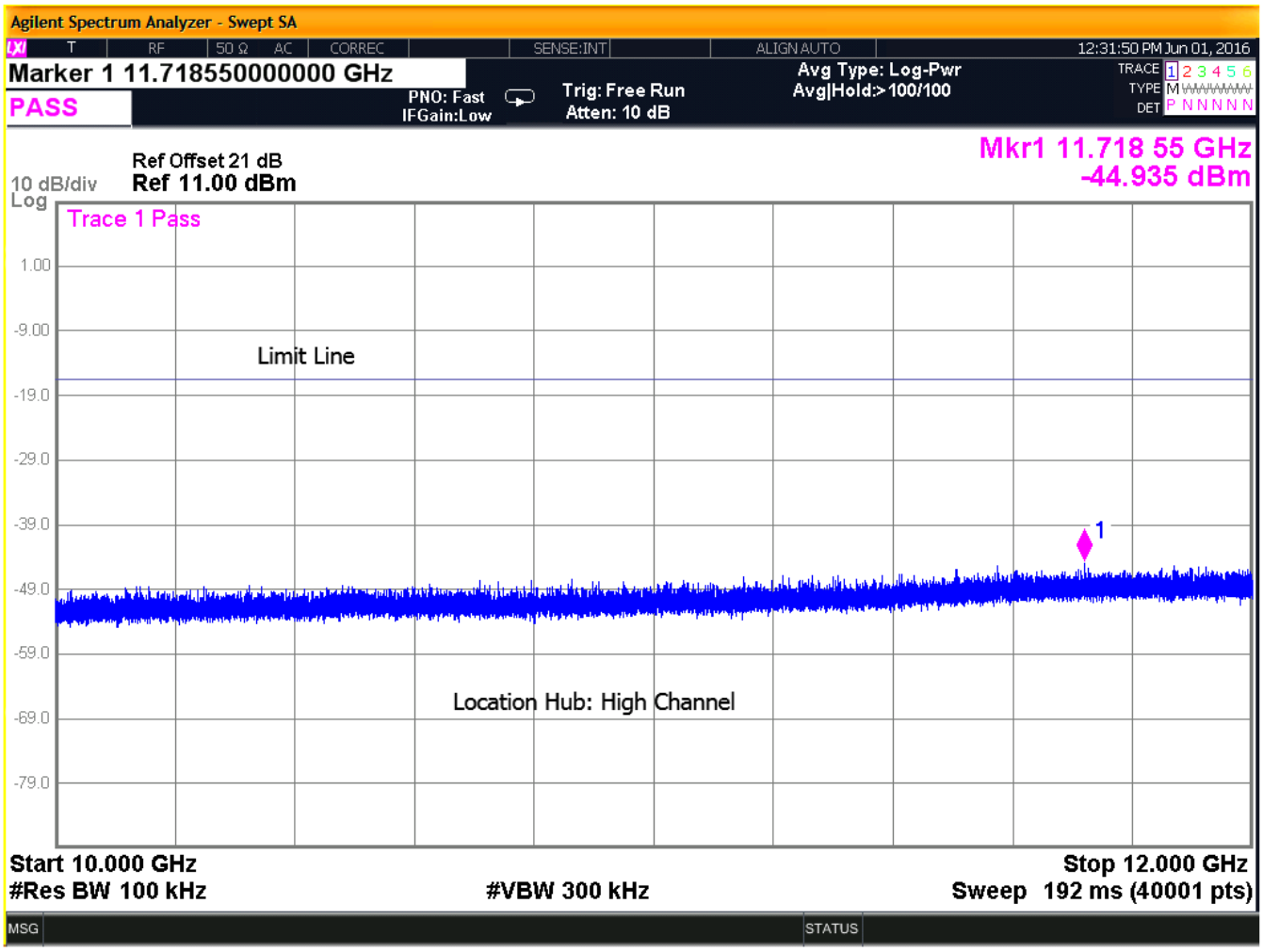

Figure 47: High Channel Conducted Spurious Plot 8

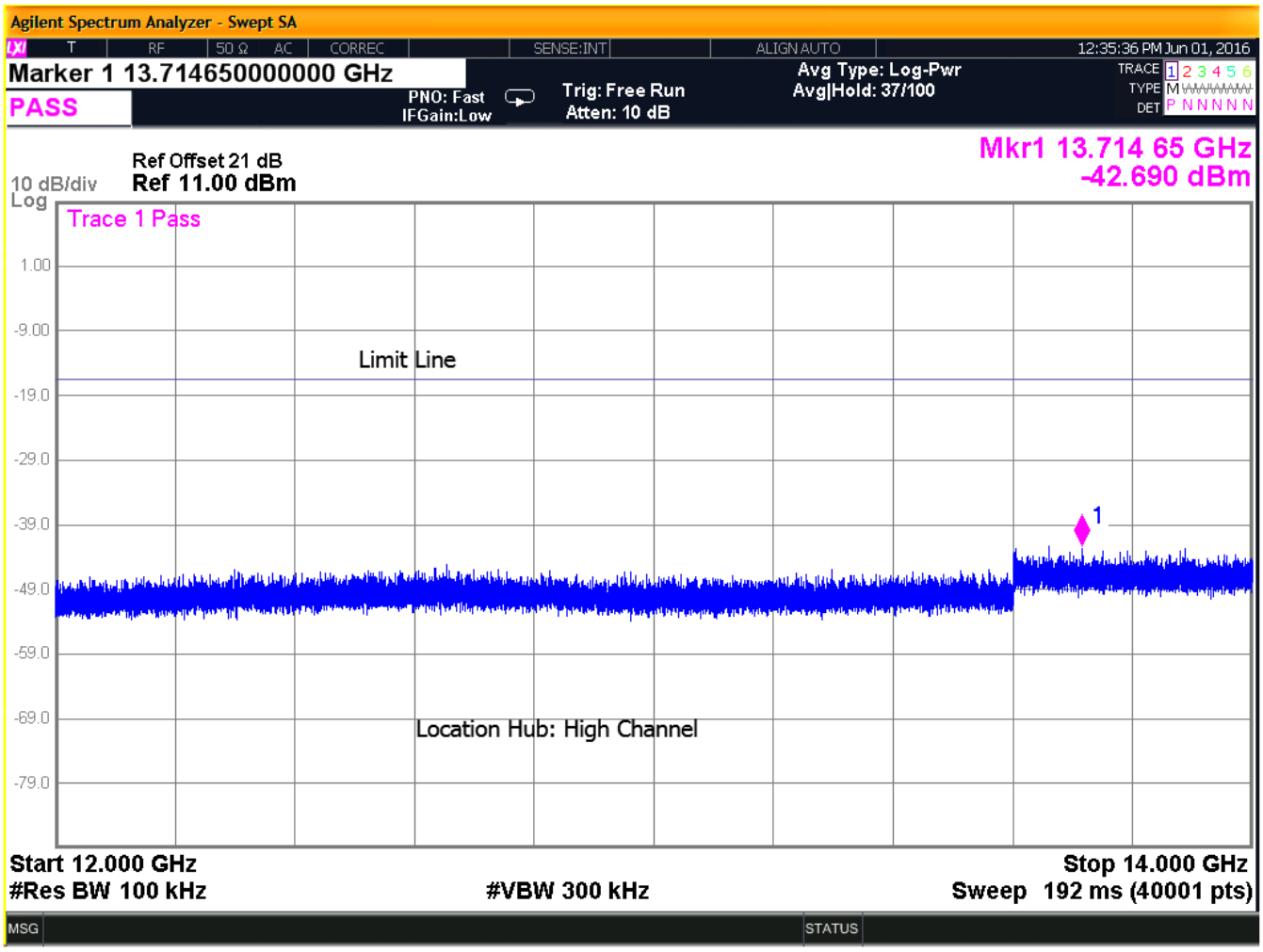

Figure 48: High Channel Conducted Spurious Plot 9

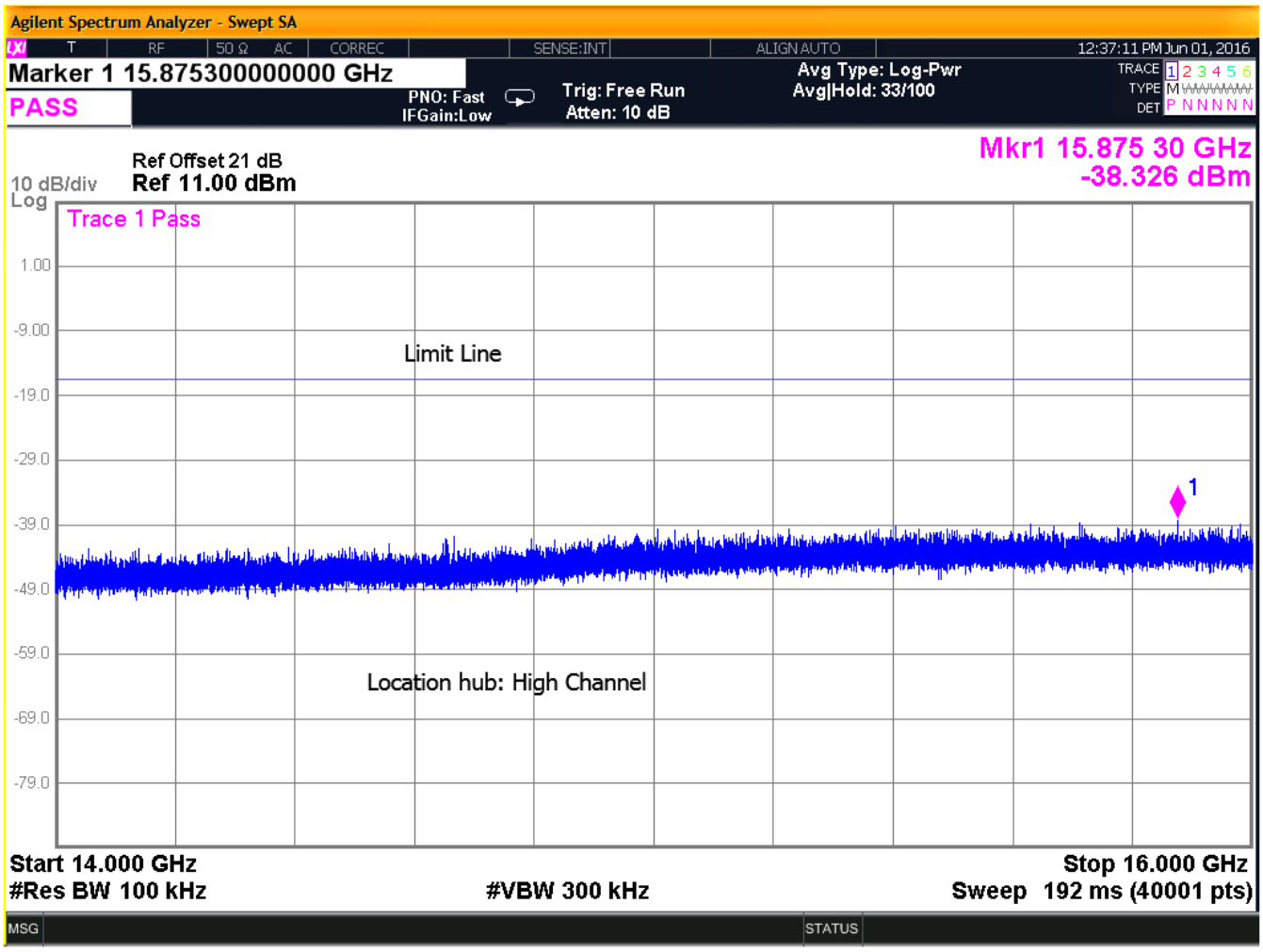

Figure 49: High Channel Conducted Spurious Plot 10

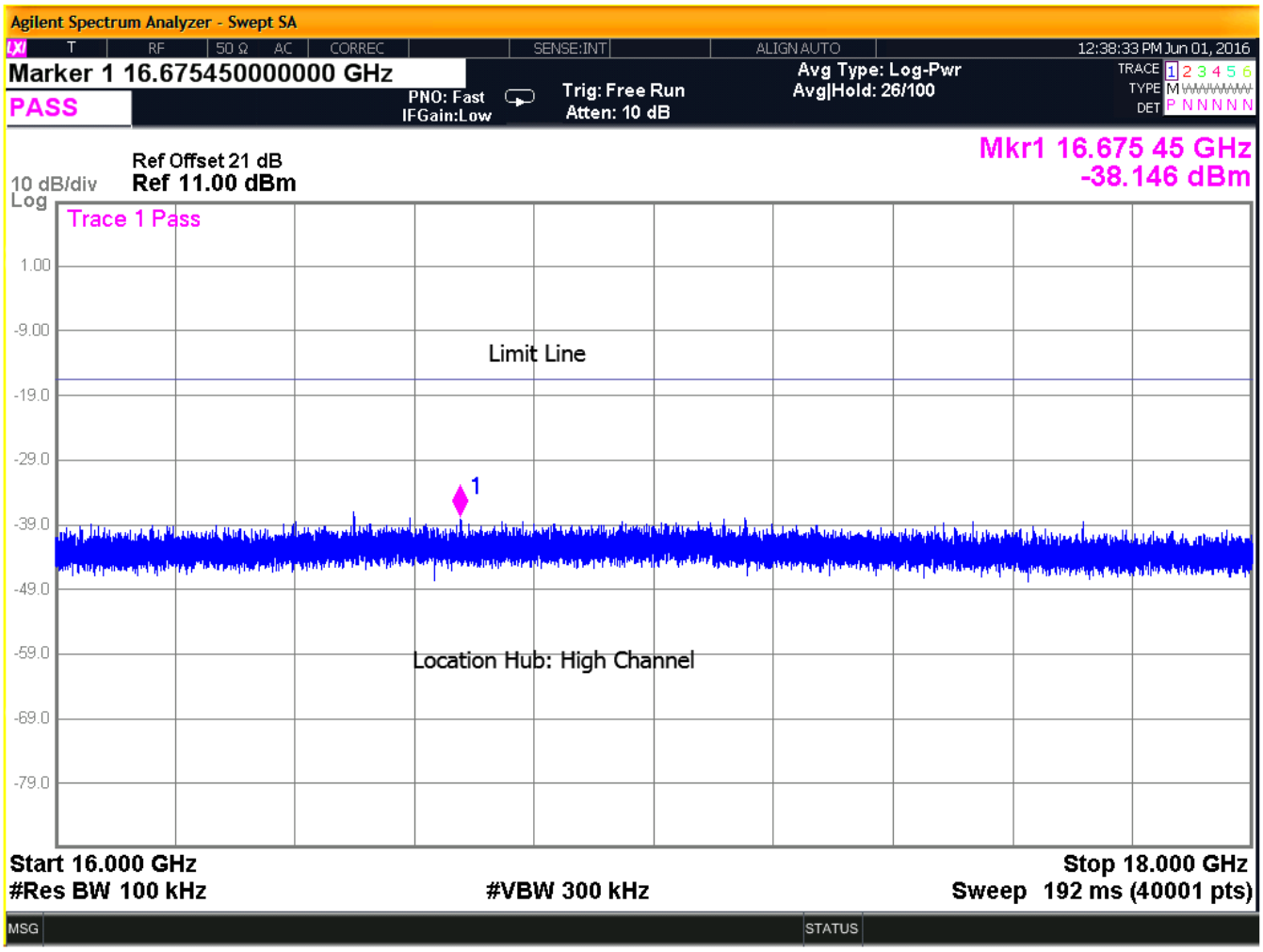

Figure 50: High Channel Conducted Spurious Plot 11

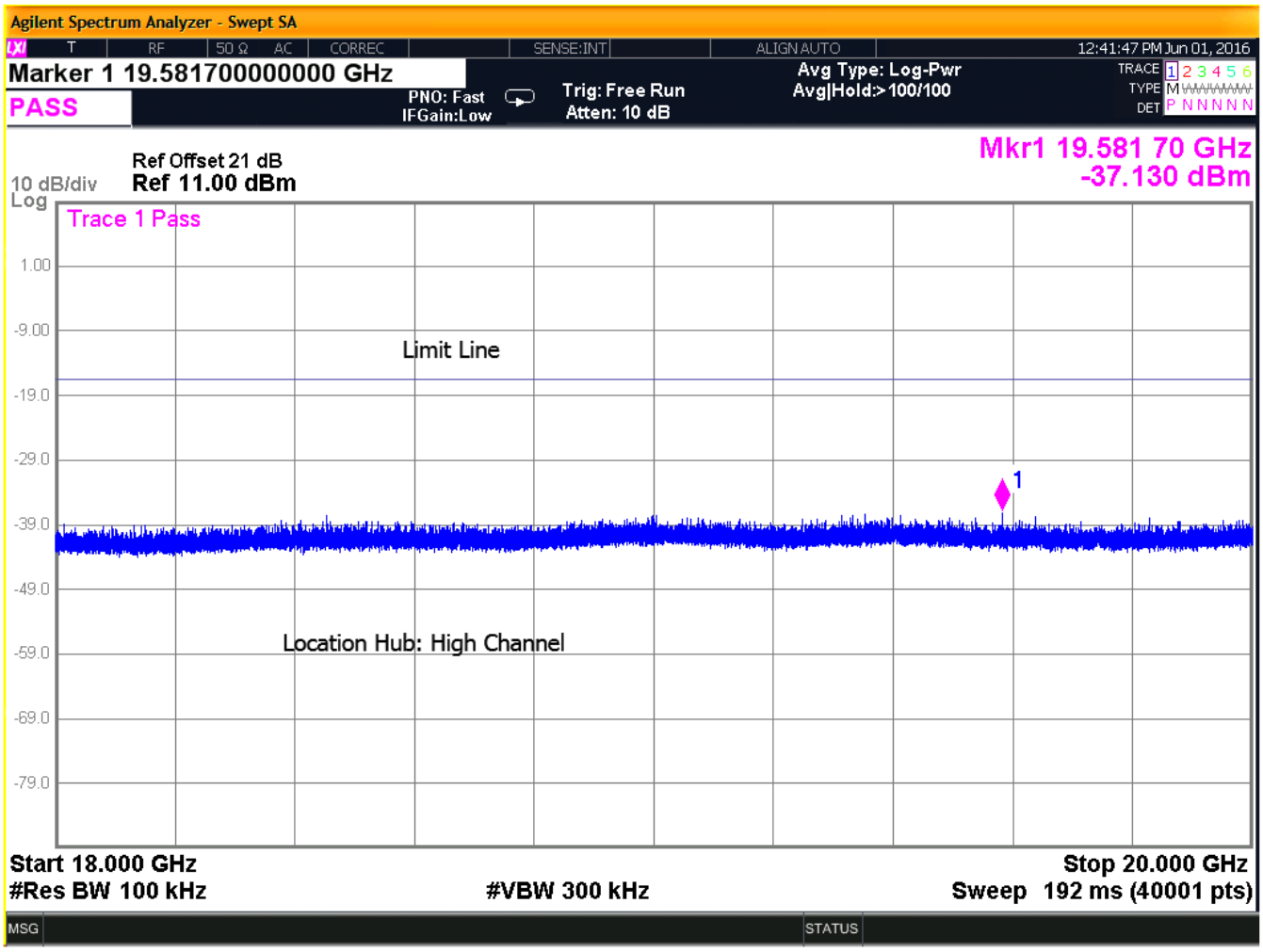

Figure 51: High Channel Conducted Spurious Plot 12

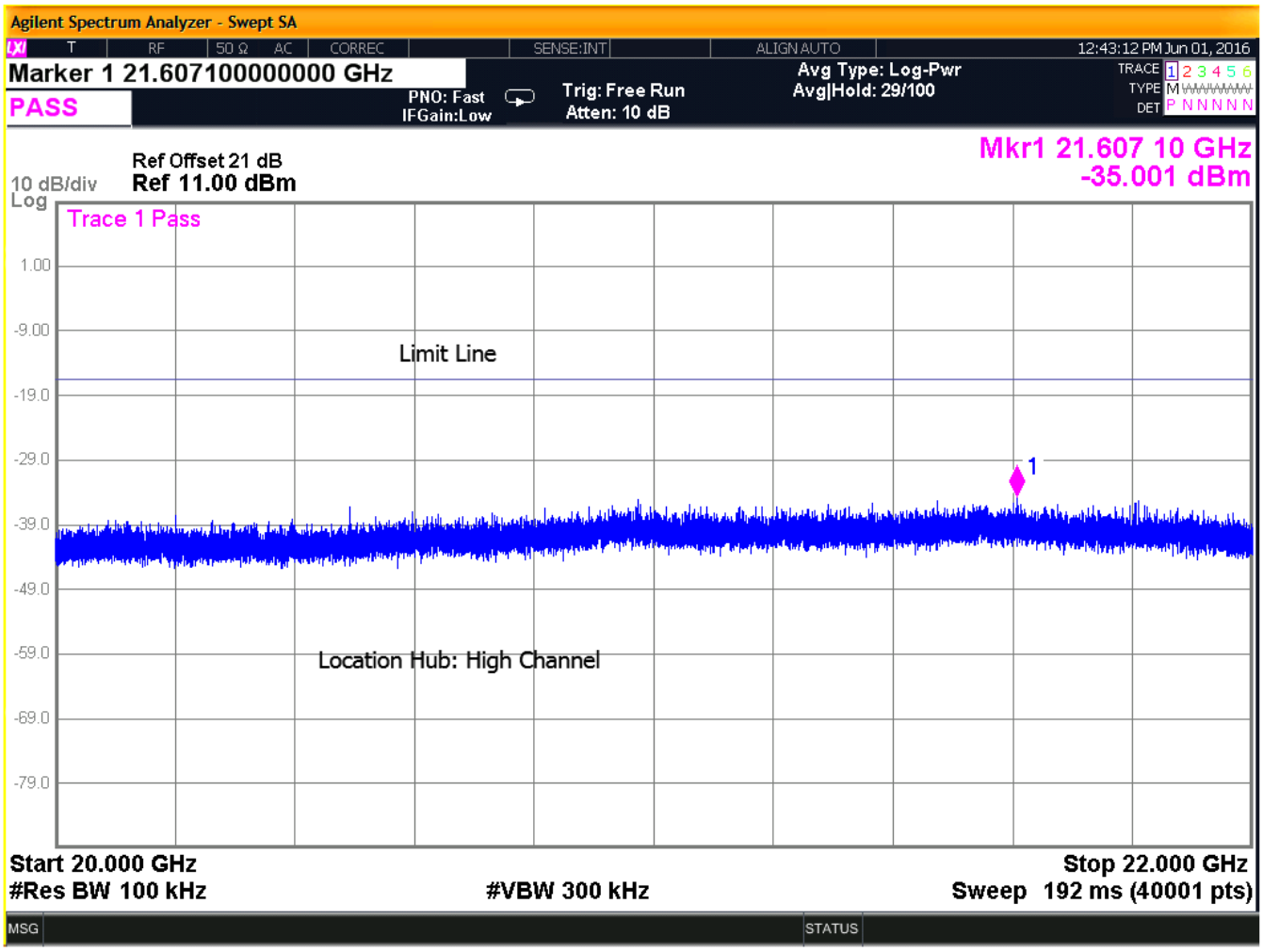

Figure 52: High Channel Conducted Spurious Plot 13

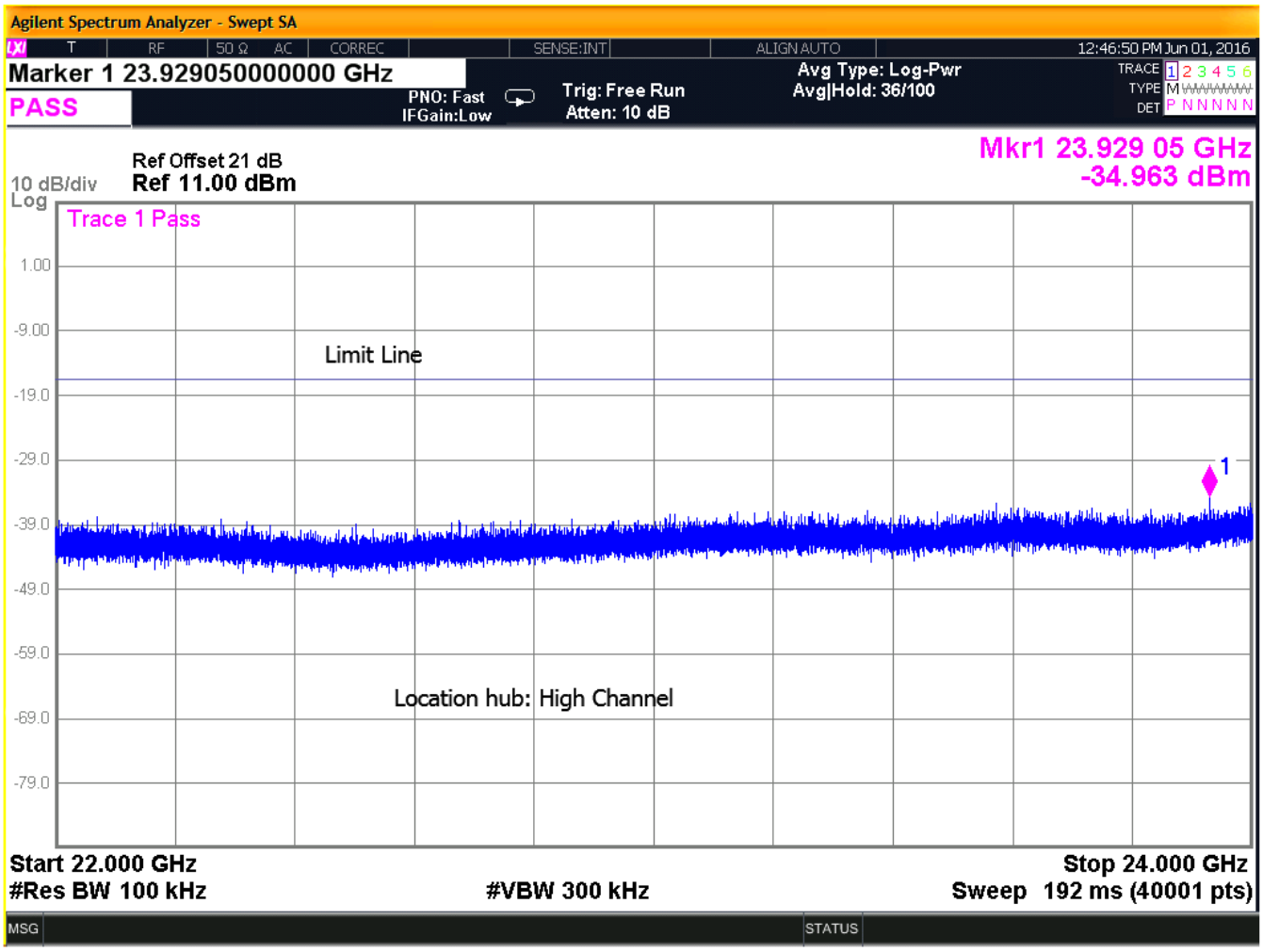

Figure 53: High Channel Conducted Spurious Plot 14

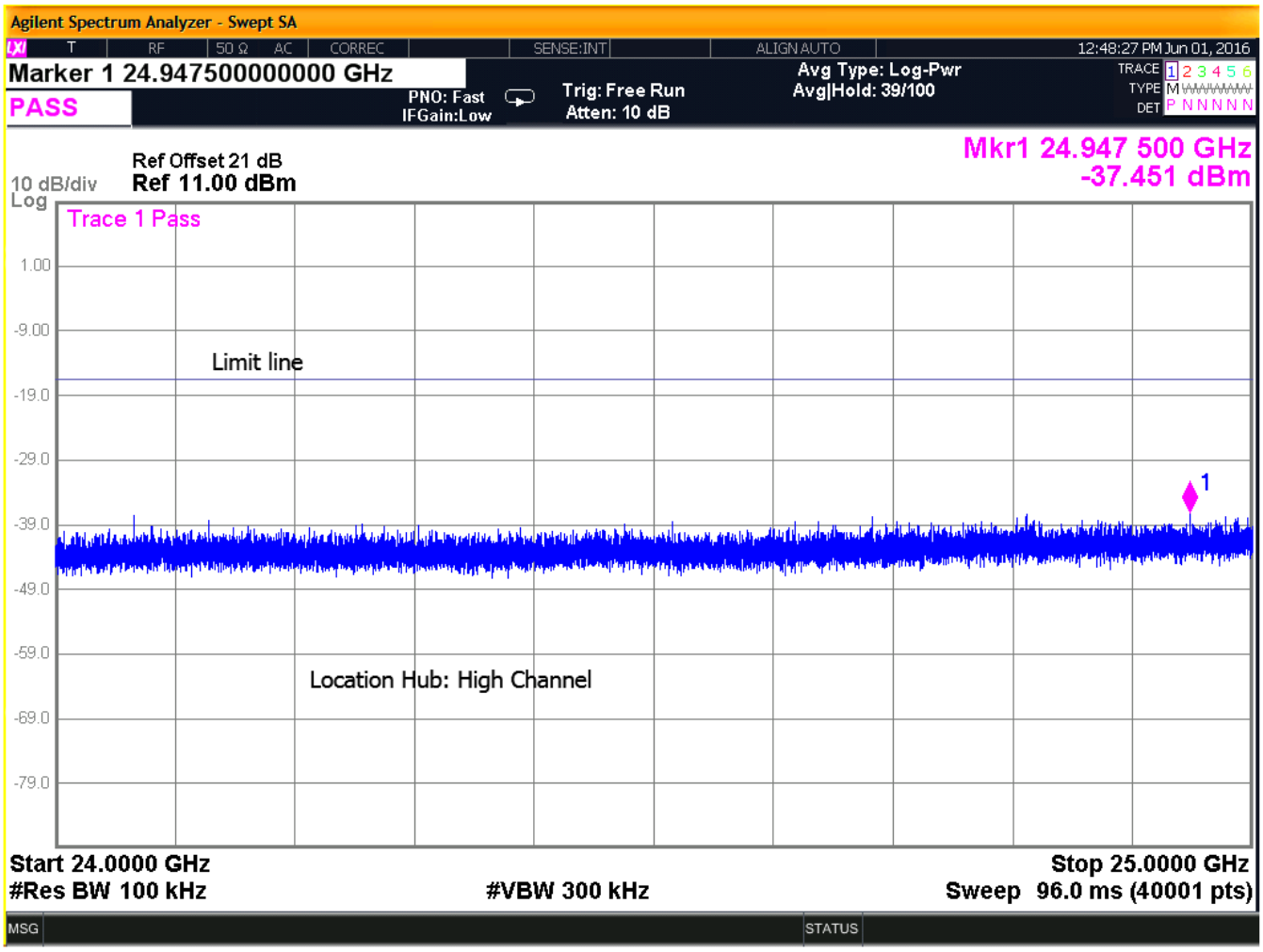

Figure 54: High Channel Conducted Spurious Plot 15

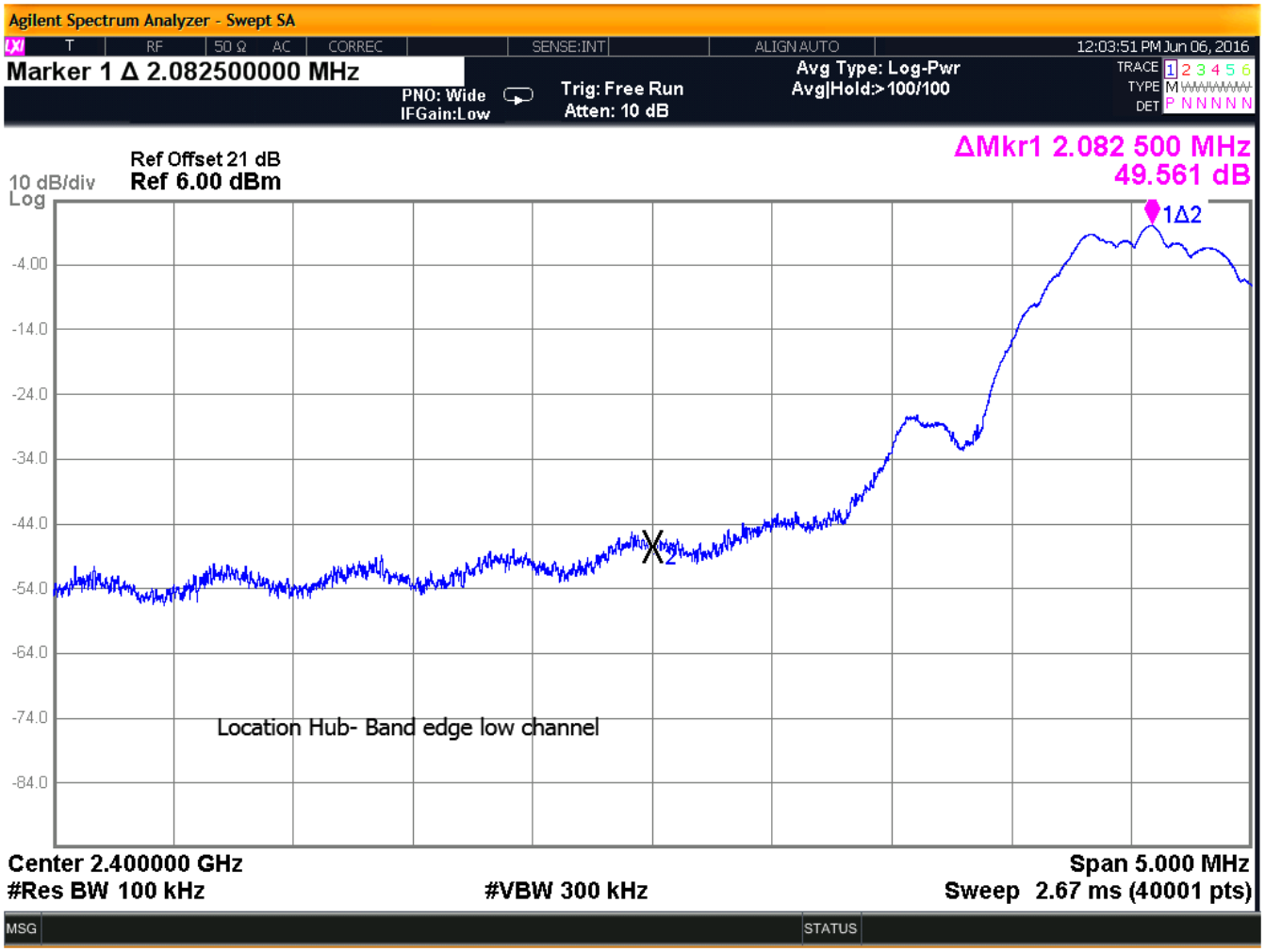

Figure 55: Lower Band Edge Low Channel

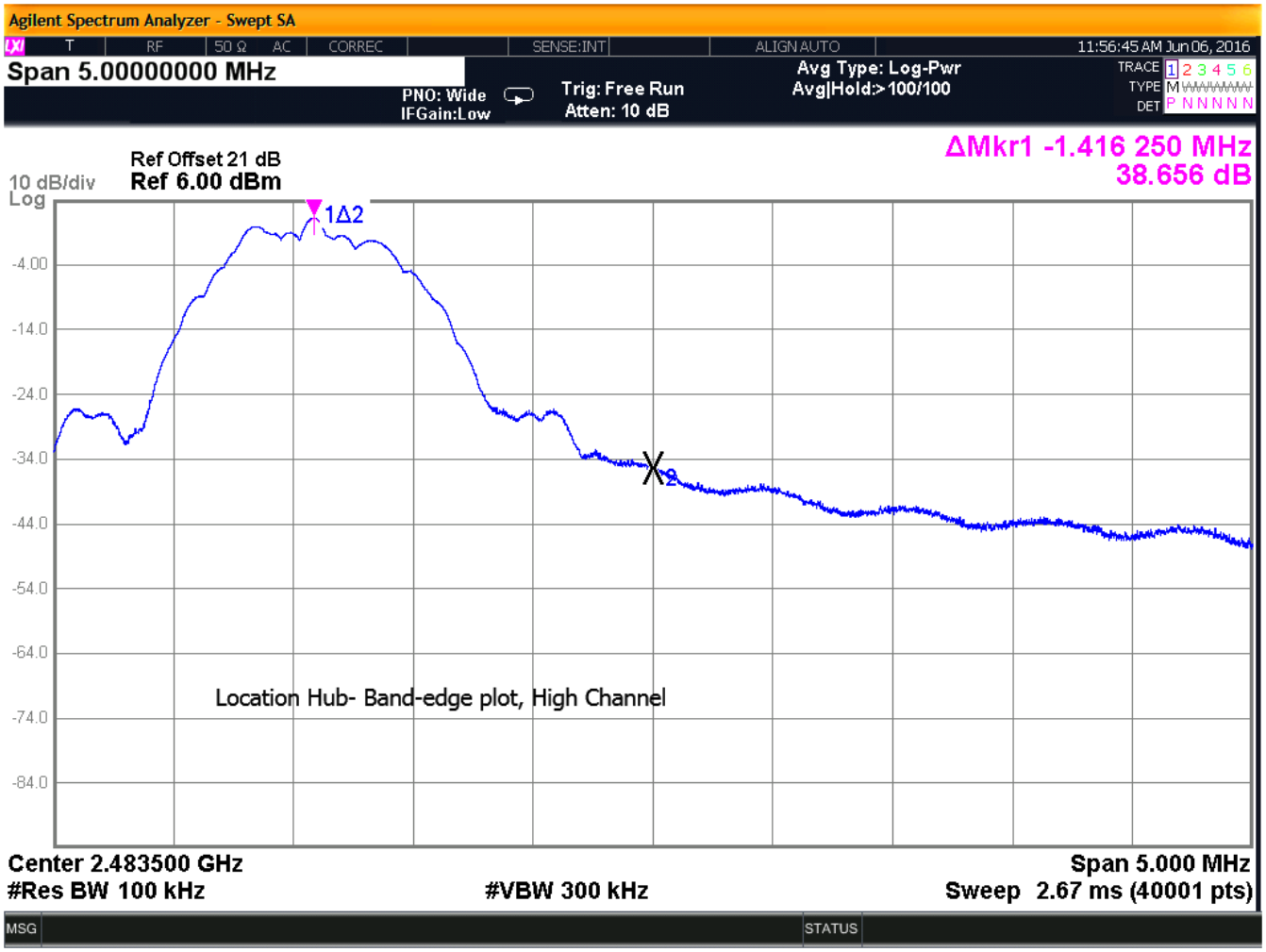

Figure 56: Upper Band Edge High Channel

5.5 Radiated Spurious Emissions:

The EUT must comply with the requirements for radiated spurious emissions that fall within the restricted bands. These emissions must meet the limits specified in §15.209 and §15.35(b) for peak measurements.

5.5.1 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. Both the horizontal and vertical field components were measured.

Above 1GHz the EUT was placed on a 1.5meter table with RF absorber material between the EUT and Receive antenna.

The emissions were measured using the following resolution bandwidths:

Table 10: Spectrum Analyzer Settings

Frequency Range	Resolution Bandwidth	Video Bandwidth
30MHz-1000 MHz	100kHz	300 kHz
>1000 MHz	1 MHz	3 MHz

Average measurements above 1GHz were made with the Spectrum analyzer set to RMS Average. Correction factors were then applied and the resulting value was compared to the limit.

5.5.1.1 Duty Cycle Corrections

A duty cycle correction of 7dB was added to the RMS average readings to compensate for the on time of the EUT in accordance with C63.10 section 11.13.3.4.

Correction Calculation = 10*Log (1/(duty cycle) =10*Log (1/0.2)= 6.98

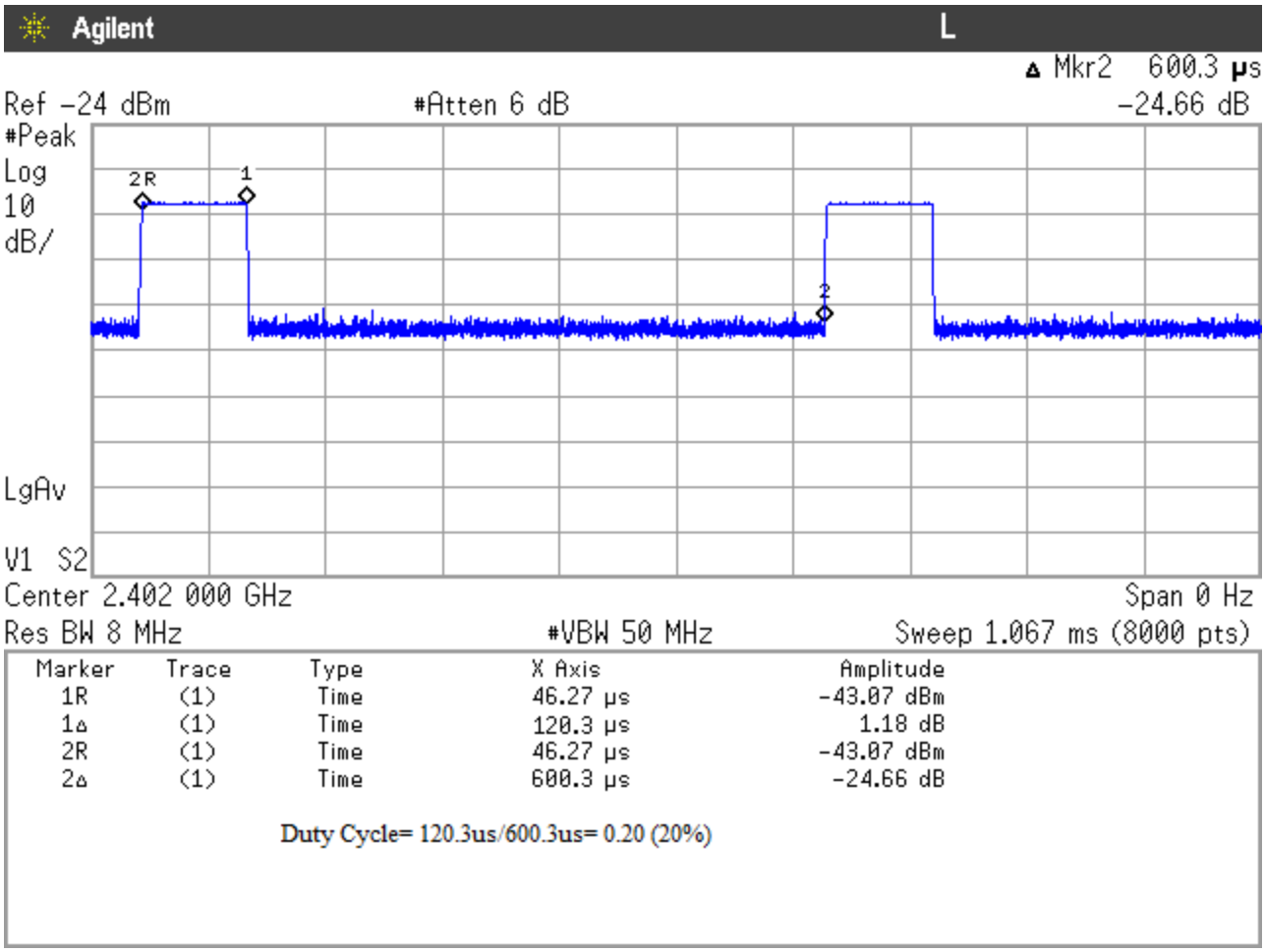

Figure 57: Duty Cycle Calculation

5.5.2 Test Summary

The EUT complied with the requirements for radiated spurious emissions.

Table 11: Radiated Emission Test Data (all Channels)

(Restricted Bands)

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)
38.20	V	180.00	1.00	35.77	-11.2	16.9	100.0	-15.5
75.00	V	180.00	1.20	38.90	-18.0	11.1	100.0	-19.1
115.00	V	190.00	1.48	40.20	-12.3	24.8	150.0	-15.6
150.00	V	180.00	2.10	41.50	-13.2	26.1	150.0	-15.2
242.20	V	45.00	1.80	37.42	-13.1	16.5	200.0	-21.7
37.90	H	190.00	4.00	36.57	-11.0	19.0	100.0	-14.4
121.77	H	0.00	3.80	38.27	-11.7	21.3	150.0	-16.9
150.00	H	45.00	3.80	45.00	-13.2	39.0	150.0	-11.7
244.90	H	90.00	1.90	36.98	-13.0	15.8	200.0	-22.1

Table 12: Radiated Emission Test Data, Low Channel

Low Channel @ 2402MHz

Frequency (MHz)	Polarity H/V	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Duty Cycle Correction (dB)	Corr. Level (uV/m)	Limit (uV/m)	Margin (dB)	Comments
2402.00	V	340.00	3.64	97.66	-3.8	0.0	49108.7	500.0	39.8	Fund pk
2390.00	V	350.00	3.65	54.73	-3.8	0.0	351.5	5000.0	-23.1	Pk
2390.00	V	350.00	3.65	40.86	-3.8	7.0	159.4	500.0	-9.9	Av
4804.00	V	0.00	3.28	46.76	3.5	0.0	324.1	5000.0	-23.8	Pk
4804.00	V	0.00	3.28	39.23	3.5	7.0	304.9	500.0	-4.3	Av
2402.00	H	270.00	3.43	97.60	-3.8	0.0	48770.6	500.0	39.8	Fund pk
2390.00	H	270.00	3.50	57.12	-3.8	0.0	462.9	5000.0	-20.7	Pk
2390.00	H	270.00	3.50	44.93	-3.8	7.0	254.6	500.0	-5.9	Av
4804.00	H	270.00	2.96	47.69	3.5	0.0	360.7	5000.0	-22.8	Pk
4804.00	H	270.00	2.96	40.16	3.5	7.0	339.4	500.0	-3.4	Av

Table 13: Radiated Emission Test Data, Center Channel

Center Channel @ 2440 MHz

Frequency (MHz)	Polarity H/V	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Duty Cycle Correction (dB)	Corr. Level (uV/m)	Limit (uV/m)	Margin (dB)	Comments
2440.00	V	0.00	3.30	97.08	-3.8	0.0	46099.5	500.0	39.3	Fund pk
4880.00	V	180.00	3.08	44.69	3.5	0.0	257.2	5000.0	-25.8	Pk
4880.00	V	180.00	3.08	34.11	3.5	7.0	170.3	500.0	-9.4	Av
7320.00	V	0.00	0.00	46.50	11.4	0.0	784.5	5000.0	-16.1	Pk
7320.00	V	0.00	0.00	32.33	11.4	7.0	343.6	500.0	-3.3	Av
2440.00	H	270.00	3.40	98.20	-3.8	0.0	52444.0	500.0	40.4	Fund pk
4880.00	H	45.00	2.90	45.62	3.5	0.0	286.3	5000.0	-24.8	Pk
4880.00	H	45.00	2.90	40.80	3.5	7.0	368.0	500.0	-2.7	Av
7320.00	H	0.00	3.50	40.98	11.4	0.0	415.5	5000.0	-21.6	Pk
7320.00	H	0.00	3.50	32.64	11.4	7.0	356.1	500.0	-2.9	Av

Table 14: Radiated Emission Test Data, High Channel

High Channel @ 2480MHz

Frequency (MHz)	Polarity H/V	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Duty Cycle Correction (dB)	Corr. Level (uV/m)	Limit (uV/m)	Margin (dB)	Comments
2482.00	V	0.00	3.70	97.51	-3.8	0.0	48625.9	500.0	39.8	Fund pk
2483.50	V	0.00	3.70	55.70	-3.8	0.0	394.8	5000.0	-22.1	Marker Delta Method Band Edge -Pk
2483.50	V	0.00	3.70	48.50	-3.8	7.0	385.9	500.0	-2.3	Marker Delta Method Band Edge -Av
	V									
4964.00	V	90.00	3.65	43.58	3.7	0.0	232.4	5000.0	-26.7	Pk
4964.00	V	90.00	3.65	35.70	3.7	7.0	210.0	500.0	-7.5	Av
	V									
7446.00	V	180.00	2.86	41.64	11.1	0.0	431.1	5000.0	-21.3	Pk
7446.00	V	180.00	2.86	33.70	11.1	7.0	386.9	500.0	-2.2	Av
2482.00	H	270.00	3.42	95.48	-3.8	0.0	38491.8	500.0	37.7	Fund pk
2483.50	H	270.00	3.40	53.59	-3.8	0.0	309.7	5000.0	-24.2	Pk
2483.50	H	270.00	3.40	47.20	-3.8	7.0	332.2	500.0	-3.6	Av
4964.00	H	100.00	2.90	42.70		0.0	136.5	5000.0	-31.3	Pk
4964.00	H	100.00	2.90	36.80	3.7	7.0	238.3	500.0	-6.4	Av
7446.00	H	270.00	3.10	41.49	11.1	0.0	423.8	5000.0	-21.4	Marker Delta Method Band Edge -Pk
7446.00	H	270.00	3.10	33.72	11.1	7.0	387.8	500.0	-2.2	Marker Delta Method Band Edge -Av

5.6 Conducted Emissions

5.6.1 Requirements

Test Arrangement: Table Top

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

5.6.2 Test Procedure

The requirements of FCC Part 15 and RSS-Gen 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 µH 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. 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.

5.6.3 Test Data

The EUT complied with the Class B Conducted Emissions requirements. Table 6 provides the test results for phase and neutral line power line conducted emissions.

5.6.4 Conducted Data Reduction and Reporting

At frequencies where quasi-peak or peak measurements comply with the average limit, no average measurements need be performed. The Conducted emissions level to be compared to the FCC limit is calculated as shown in the following example.

Example:

Spectrum Analyzer Voltage: VdBµV

LISN Correction Factor: LISN dB

Cable Correction Factor: CF dB

Electric Field: EdBµV = V dBµV + LISN dB + CF dB

Table 15: Conducted Emission Test Data

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)
0.150	40.2	22.9	10.2	0.2	50.5	33.2	66.0	56.0	-15.5	-22.8
0.209	35.8	23.8	10.2	0.2	46.2	34.2	63.2	53.2	-17.1	-19.1
0.327	35.1	20.6	10.2	0.3	45.5	31.0	59.5	49.5	-14.0	-18.5
0.480	33.1	18.6	10.2	0.3	43.5	29.0	56.3	46.3	-12.8	-17.3
2.130	29.8	8.6	10.1	0.3	40.2	19.0	56.0	46.0	-15.8	-27.0
5.420	20.2	6.9	10.8	0.1	31.1	17.8	60.0	50.0	-28.9	-32.2

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)
0.156	42.8	26.8	10.2	0.2	53.2	37.2	65.7	55.7	-12.5	-18.5
0.220	40.5	24.8	10.2	0.1	50.7	35.0	62.8	52.8	-12.1	-17.8
0.340	35.3	22.9	10.2	0.3	45.7	33.3	59.2	49.2	-13.5	-15.9
0.480	30.2	18.2	10.2	0.2	40.6	28.6	56.3	46.3	-15.7	-17.7
2.115	30.9	9.2	10.1	0.3	41.3	19.6	56.0	46.0	-14.7	-26.4
7.990	18.7	6.2	11.0	0.1	29.8	17.3	60.0	50.0	-30.2	-32.7