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FCC & Industry Canada Certification Test Report
For the
Hamlet Inc.
Lively 1.0 Hub

FCC ID: R6N-0001
IC ID: 11045A-0001

WLL JOB# **13474-01 Rev 2**
June 19, 2014
Revised August 25, 2014

Prepared for:

HAMLET INC.
682 SCHOFIELD ROAD
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Prepared By:

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Testing Certificate AT-1448

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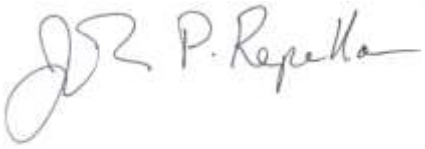

John P. Repella
Compliance Engineer

Reviewed by:

James Ritter
EMC Compliance Engineer

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Abstract

This report has been prepared on behalf of Hamlet 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 (10/2013) of the FCC Rules and Regulations and Spectrum Management and Telecommunications Policy RSS-210 issue 8 of Industry Canada. This Certification Test Report documents the test configuration and test results for the Hamlet Inc. Lively 1.0 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 Industry 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 ACLASS under Certificate AT-1448 as an independent FCC test laboratory.

The Hamlet Inc. Lively 1.0 Hub complies with the limits for a Digital Transmission System (DTS) Transmitter device under FCC Part 15.247 and Industry Canada RSS-210.

Revision History	Description of Change	Date
Rev 0	Initial Release	July 2, 2014
Rev 1	Corrected EUT Name from Lively 1.0 Hub to Lively 1.0 Hub	August 20, 2014 JR
Rev 2	Corrected Customer name to Hamlet Inc,	August 25, 2014 JR

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1 Introduction

1.1 Compliance Statement

The Hamlet Inc. Lively 1.0 Hub complies with the limits for a Digital Transmission System (DTS) Transmitter device under FCC Part 15.247 (10/2013) and Industry Canada RSS-210 issue 8 December 2010.

1.2 Test Scope

Tests for radiated and conducted (at antenna terminal) emissions were performed. All measurements were performed in accordance with "558074 D01 DTS Meas Guidance v03r02" June 2014. The measurement equipment conforms to ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation.

1.3 Contract Information

Customer:	TEM Consulting 140 River Road Georgetown, TX 78628 USA
On Behalf Of:	HAMLET INC. 682 Schofield Road San Francisco, Ca, 94129
Purchase Order Number:	Credit Card Payment
Quotation Number:	67859A

1.4 Test Dates

Testing was performed on the following date(s):	5/29/2014, 6/9/2014-6/11-2014

1.5 Test and Support Personnel

Washington Laboratories, LTD	Elmer Rodriguez, John P. Repella
Customer Representative	Steven Berger

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Abbreviations

A	**A**mpere
ac	**a**lternating **c**urrent
AM	Amplitude Modulation
Amps	**Amp**eres
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	**d**eci**B**el
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

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2 Equipment Under Test

2.1 EUT Identification & Description

The Hamlet Inc. Lively 1.0 Hub is a Low Energy Bluetooth Module

Table 1: Device Summary

ITEM	DESCRIPTION
Manufacturer:	Hamlet Inc.
FCC ID:	R6N-0001
IC:	11045A-0001
Model:	Lively 1.0 Hub
FCC Rule Parts:	§15.247
Industry Canada:	RSS210
Frequency Range:	2402-2480MHz
Maximum Output Power:	1.96 mW (2.93 dBm)
Modulation:	PSK
Occupied Bandwidth:	707.6kHz
Keying:	Automatic, Manual
Type of Information:	Data
Number of Channels:	40
Power Output Level	Fixed
Antenna Connector	Trace
Antenna Type	Chip/Patch
Interface Cables:	Power Cable
Power Source & Voltage:	AC/DC Power Supply providing 5VDC
Emission Designator	707KFXD
Highest TX spurious Emission	61.01dBuV/m @ 2400MHz
Highest RX Spurious Emission	17.70dBuV/m @ 77.18MHz

2.2 Test Configuration

The Lively 1.0 Hub was place on a test-bed and connected to an external power supply and laptop for configuration and operation.

2.3 Testing Algorithm

The Lively 1.0 Hub was programmed for DTS operation via laptop connection and USB cable.

Worst case emission levels are provided in the test results data.

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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 Industry 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 ACLASS under Certificate AT-1448 as an independent FCC test laboratory.

2.5 Measurements

2.5.1 References

558074 DTS Measurement Guidance v03r01 "Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247"

ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation

ANSI C63.4: Methods of Measurement of Radio Noise 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(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

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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

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	%

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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:	**06/11/2014**
Asset #	**Manufacturer/Model**	**Description**	**Cal. Due**
69	HP - 85650A	ADAPTER QP	1/9/2015
802	HP - 8568B	SPECTRUM ANALYZER	1/9/2015
71	HP - 85685A	PRESELECTOR RF	1/9/2015
125	SOLAR - 8028-50-TS-24-BNC	LISN	7/31/2014
126	SOLAR - 8028-50-TS-24-BNC	LISN	7/31/2014
Test Name:	**Radiated Emissions**	Test Date:	**06/10/2014**
Asset #	**Manufacturer/Model**	**Description**	**Cal. Due**
4	ARA - DRG-118/A	ANTENNA DRG 1-18GHZ	2/20/2015
823	AGILENT - N9010A	EXA SPECTRUM ANALYZER	12/6/2014
627	AGILENT - 8449B	AMPLIFIER 1-26GHZ	5/13/2014
807	WLL - UNITED MICROWAVE MICROFLEX	SMA- SMA	1/6/2015
770	MEGAPHASE - EM18-NK5S1-600	50 FT HIGH FREQUENCY CABLE 1 - 18GHZ	7/5/2014
644	SUNOL SCIENCES CORPORATION - JB1 925-833-9936	BICONALOG ANTENNA	1/17/2016
69	HP - 85650A	ADAPTER QP	1/9/2015
802	HP - 8568B	SPECTRUM ANALYZER	1/9/2015
71	HP - 85685A	PRESELECTOR RF	1/9/2015

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4 Test Summary

The Table Below shows the results of testing for compliance with a Frequency Hopping System in accordance with FCC Part 15.247 10/2013 and RSS210 issue 8, 12/2010. 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 (2)	RSS-210 [A8. 2 (a)]	6dB Bandwidth	Pass
15.247 (2)(b)(3)	RSS-210 [A8.4 (4)]	Transmit Output Power	Pass
15.247 (e)	RSS-210 [A8.2 (b)]	Power Spectral Density	Pass
15.247 (d)	RSS-210 [A8. 5]	Occupied BW / Out-of-Band Emissions (Band Edge @ 20dB below)	Pass
15.205 15.209	RSS-210 Sect.2.2 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
RX/Digital Test Summary (Digital Transmission System (DTS))			
FCC Rule Part	**IC Rule Part**	**Description**	**Result**
15.207	RSS-Gen [7.2.4]	AC Conducted Emissions	Pass
15.209	RSS-210 sect 2.5 RSS-Gen [4.1]	General Field Strength Limits	Pass

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5 Test Results

5.1 Occupied Bandwidth:

Occupied bandwidth was performed by coupling the output of the EUT to the input of a spectrum analyzer.

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:

558074 D01 DTS Measurement Guidance v03r02
Section 8.1 Option 1

Table 5: Occupied Bandwidth Spectrum Analyzer Settings

Resolution Bandwidth	Video Bandwidth
100kHz	300kHz

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	700.0kHz	≥500kHz	Pass
Mid Channel: 2440MHz	707.4kHz	≥500kHz	Pass
High Channel: 2480MHz	704.6kHz	≥500kHz	Pass

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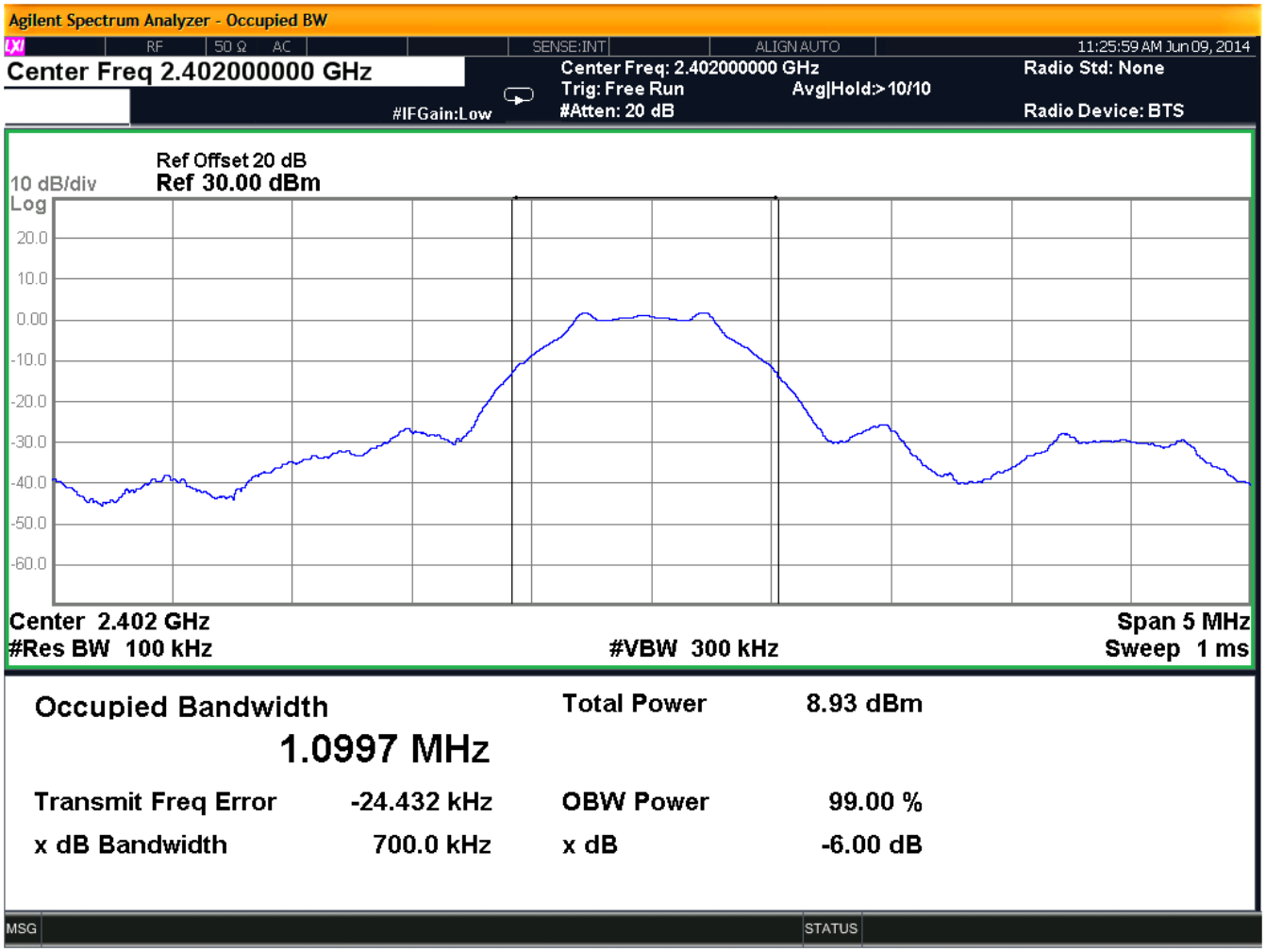

Figure 1: Occupied Bandwidth, Low Channel

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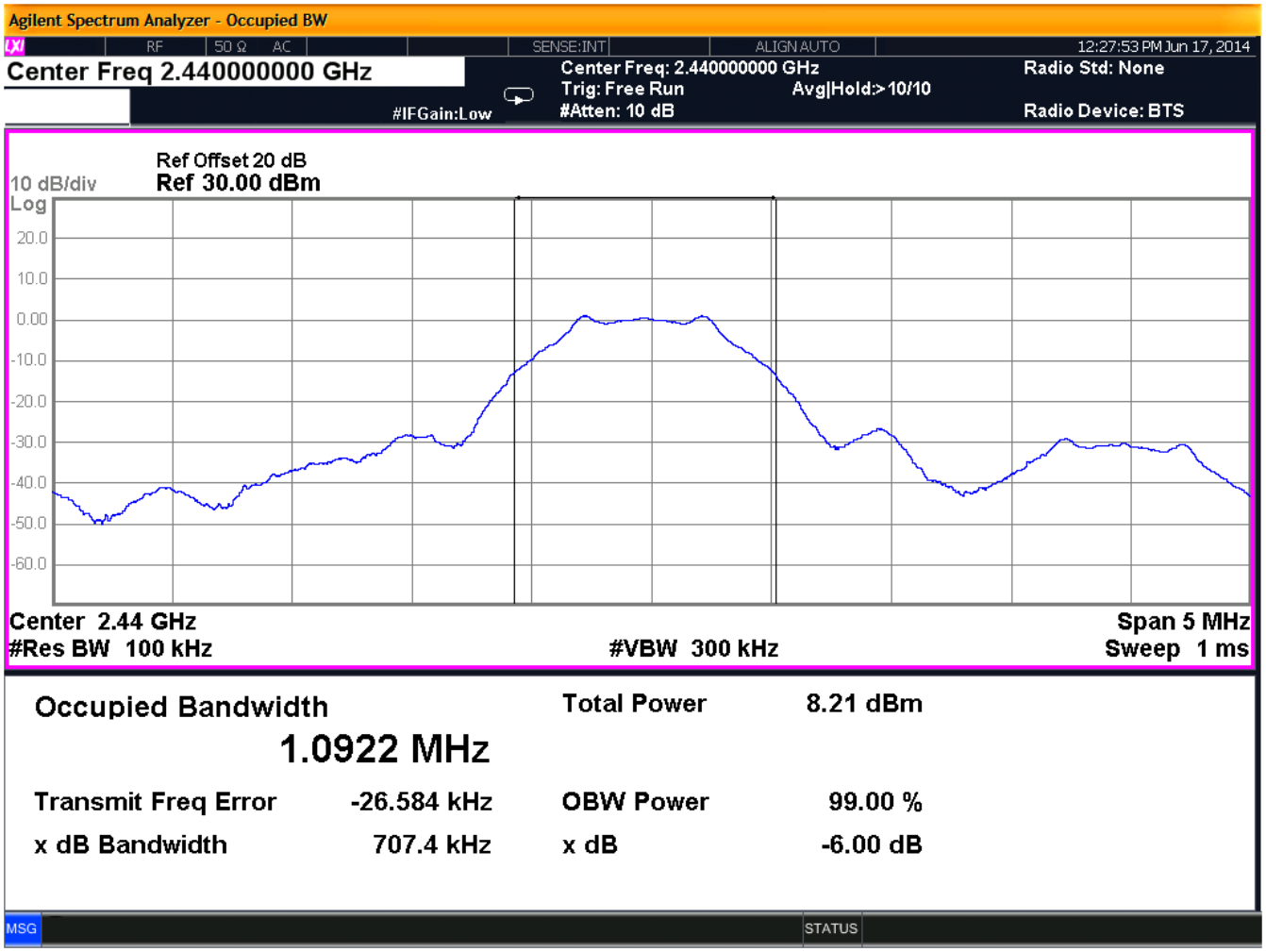

Figure 2: Occupied Bandwidth, Mid Channel

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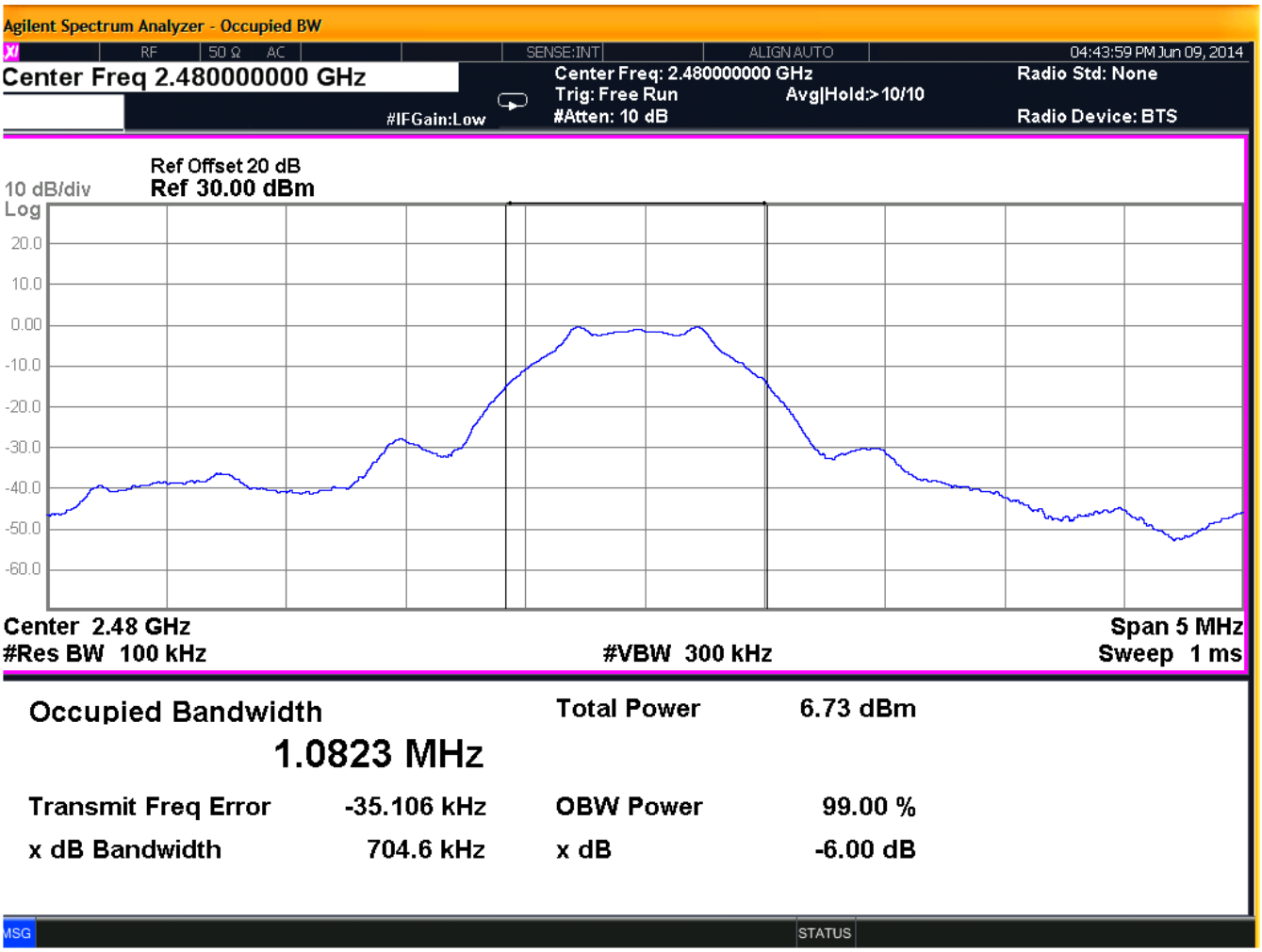

Figure 3: Occupied Bandwidth, High Channel

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5.2 RF Power Output:

To measure the output power the hopping sequence was stopped while the frequency dwelled on a low, high and middle channel. The output from the transmitter was connected to an attenuator and then to the input of the RF Spectrum Analyzer. The analyzer offset was adjusted to compensate for the attenuator and other losses in the system.

5.2.1 Measurement Method:

558074 D01 DTS Measurement Guidance v03r02

Section 9.1.1 RBW $\geq$ DTS Bandwidth

Table 7: Spectrum Analyzer Settings

Resolution Bandwidth	Video Bandwidth
1MHz	3MHz

Table 8: RF Power Output

Frequency	Level	Limit	Pass/Fail
Low Channel: 2402MHz	2.932 dBm	30 dBm	Pass
Mid Channel: 2440MHz	2.692 dBm	30 dBm	Pass
High Channel: 2480MHz	2.281 dBm	30 dBm	Pass

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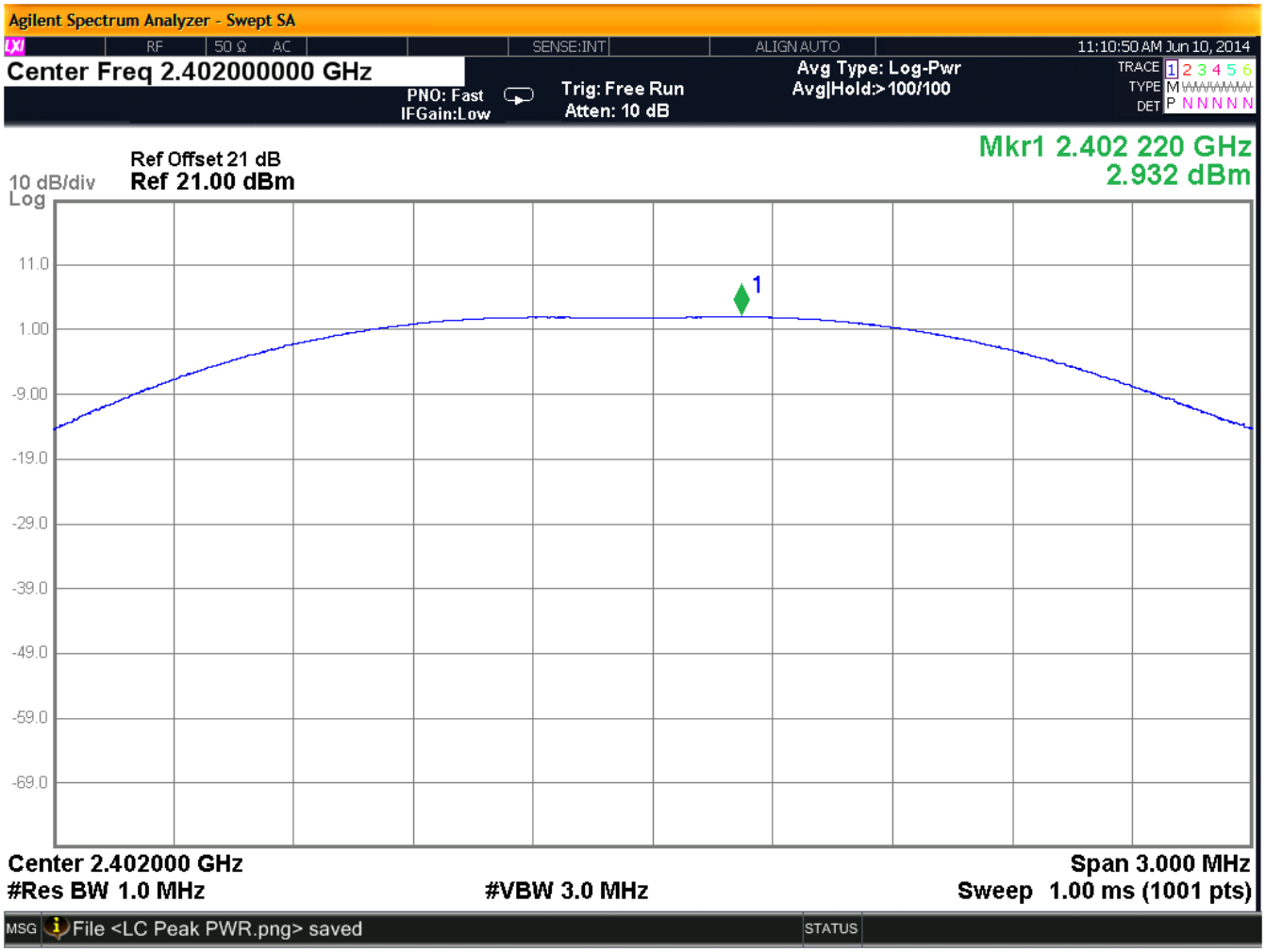

Figure 4: RF Peak Power, Low Channel

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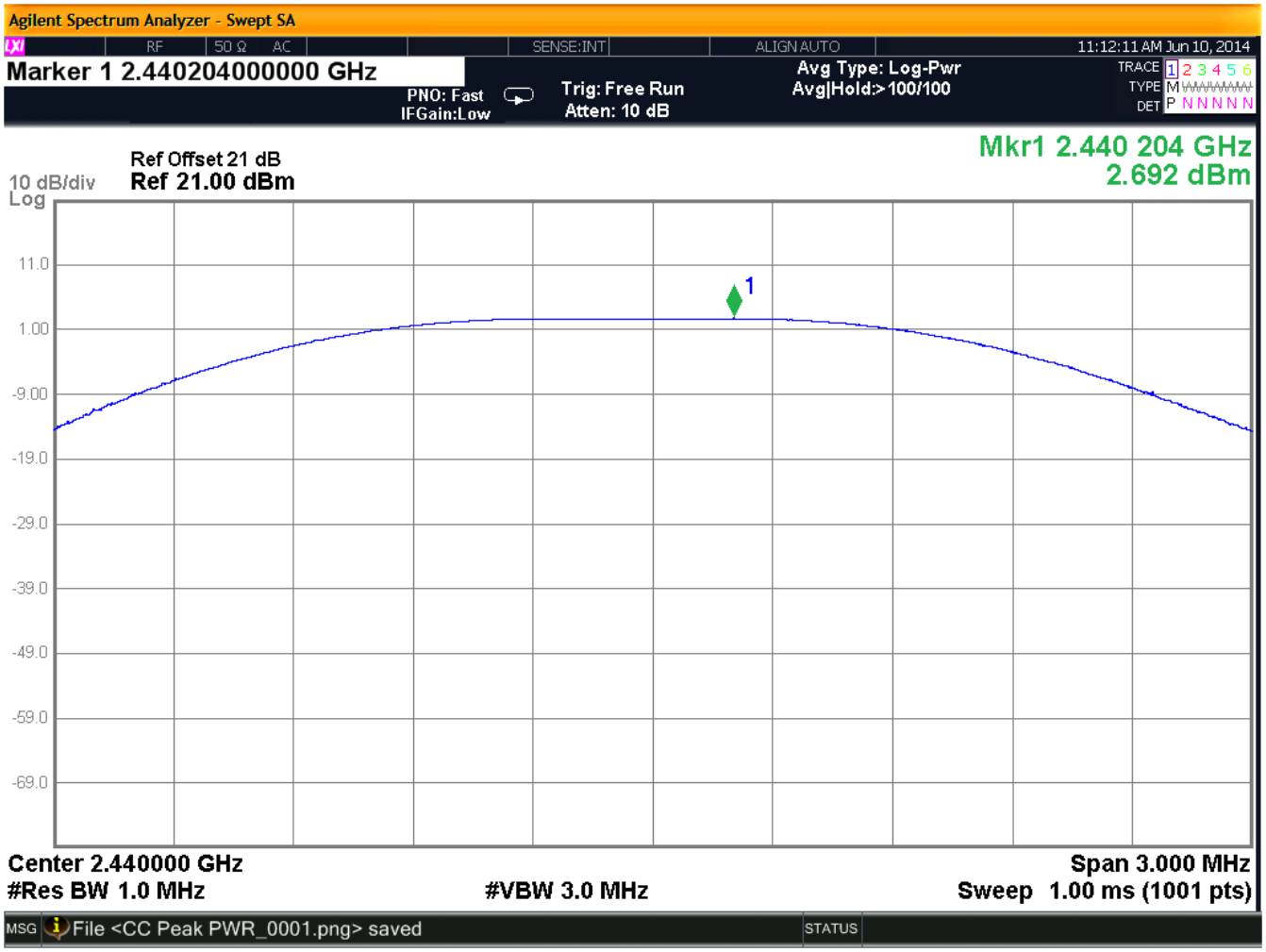

Figure 5: RF Peak Power, Mid Channel

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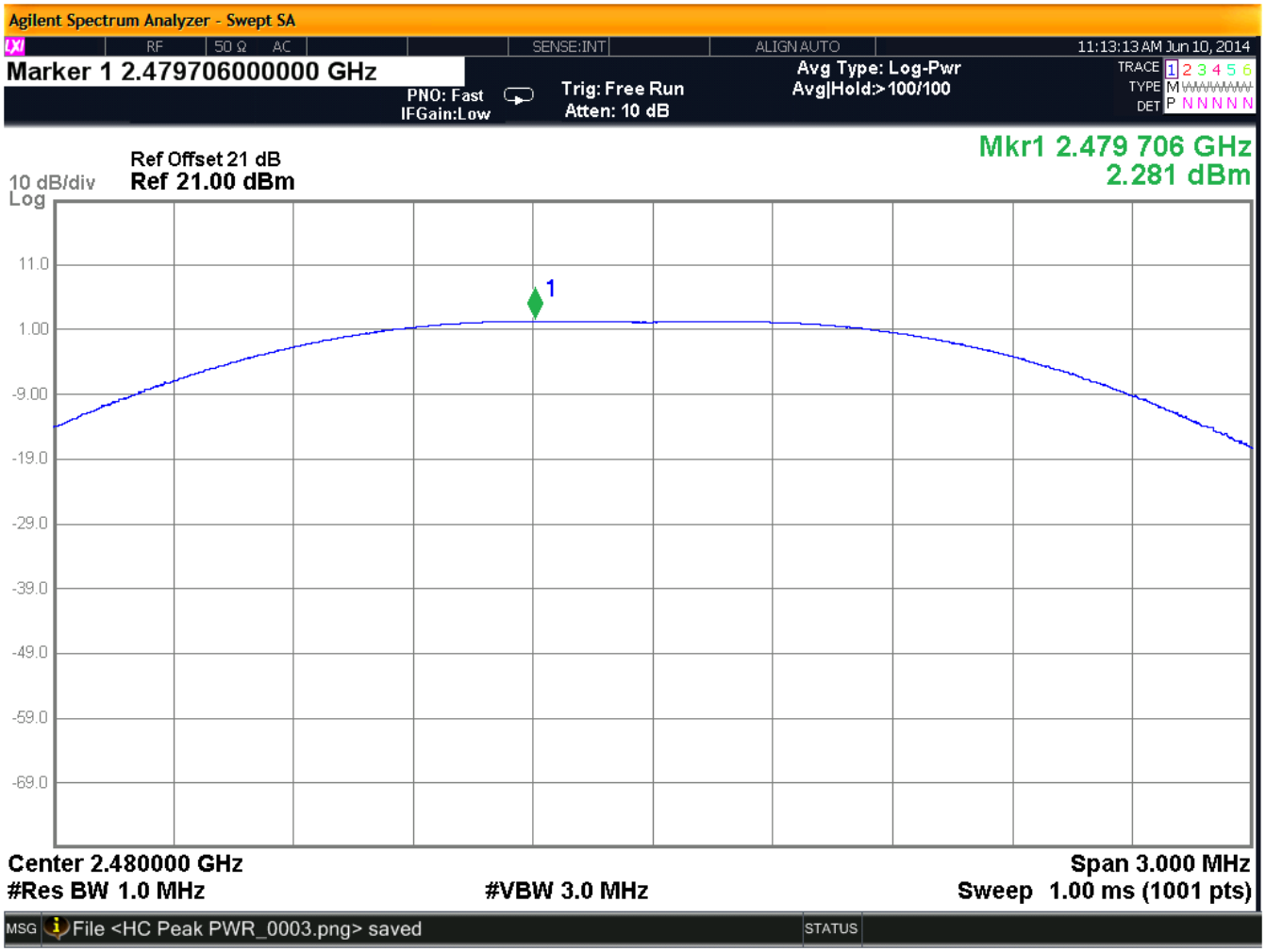

Figure 6: RF Peak Power, High Channel

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5.3 Power Spectral Density

Measurements for power spectral density were taken in accordance with 15.247(e). The spectrum analyzer was set to peak detect mode with a RBW of 3kHz ,VBW of 10kHz across a 1.1MHz span using an auto sweep time.

5.3.1 Measurement Method:

558074 D01 DTS Measurement Guidance v03r02

Section 10.2 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	-9.529dBm	8 dBm	Pass
Center Channel: 2440MHz	-9.349dBm	8 dBm	Pass
High Channel: 2480MHz	-10.177dBm	8 dBm	Pass

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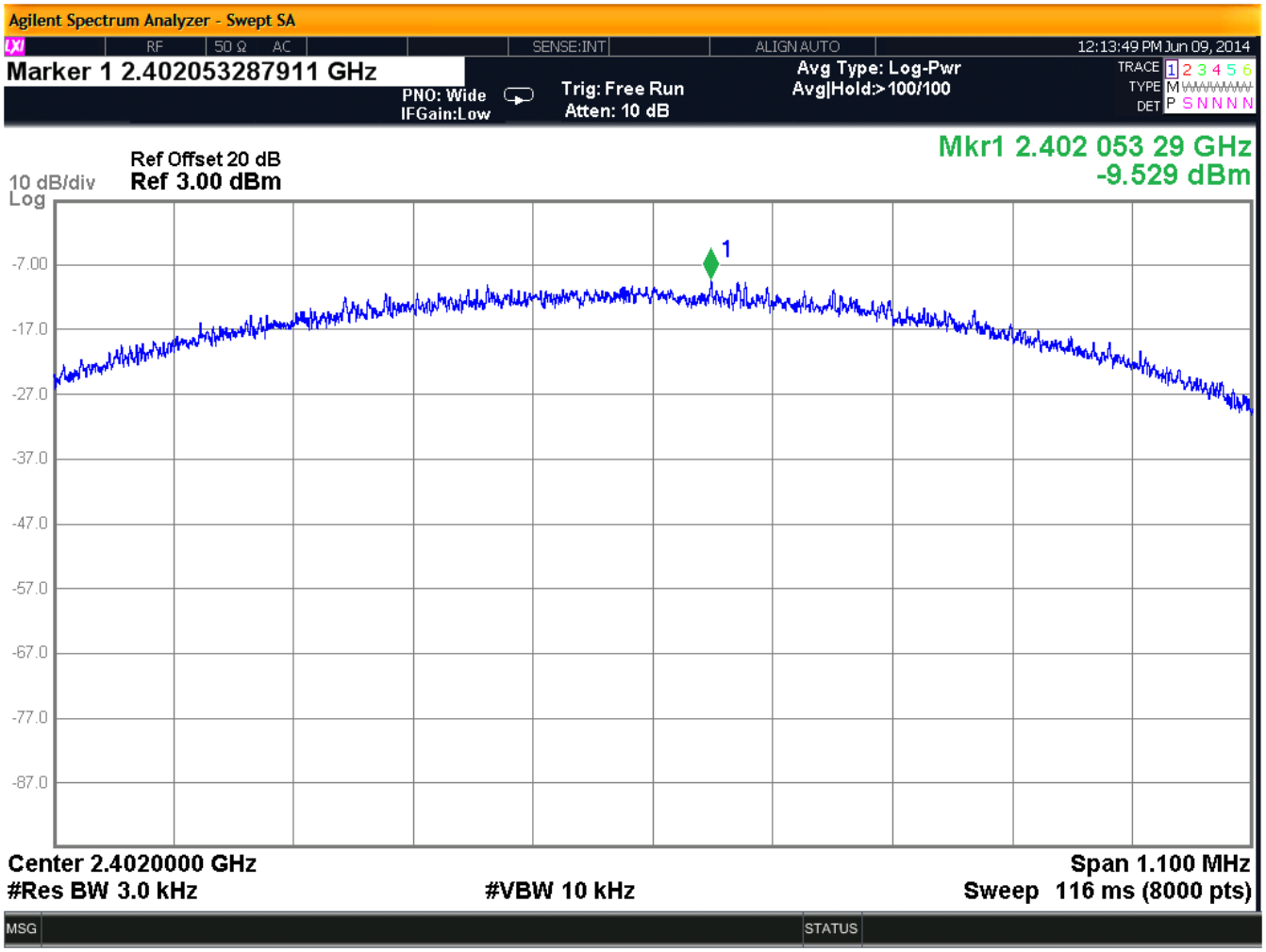

Figure 7: Power Spectral Density, Low Channel

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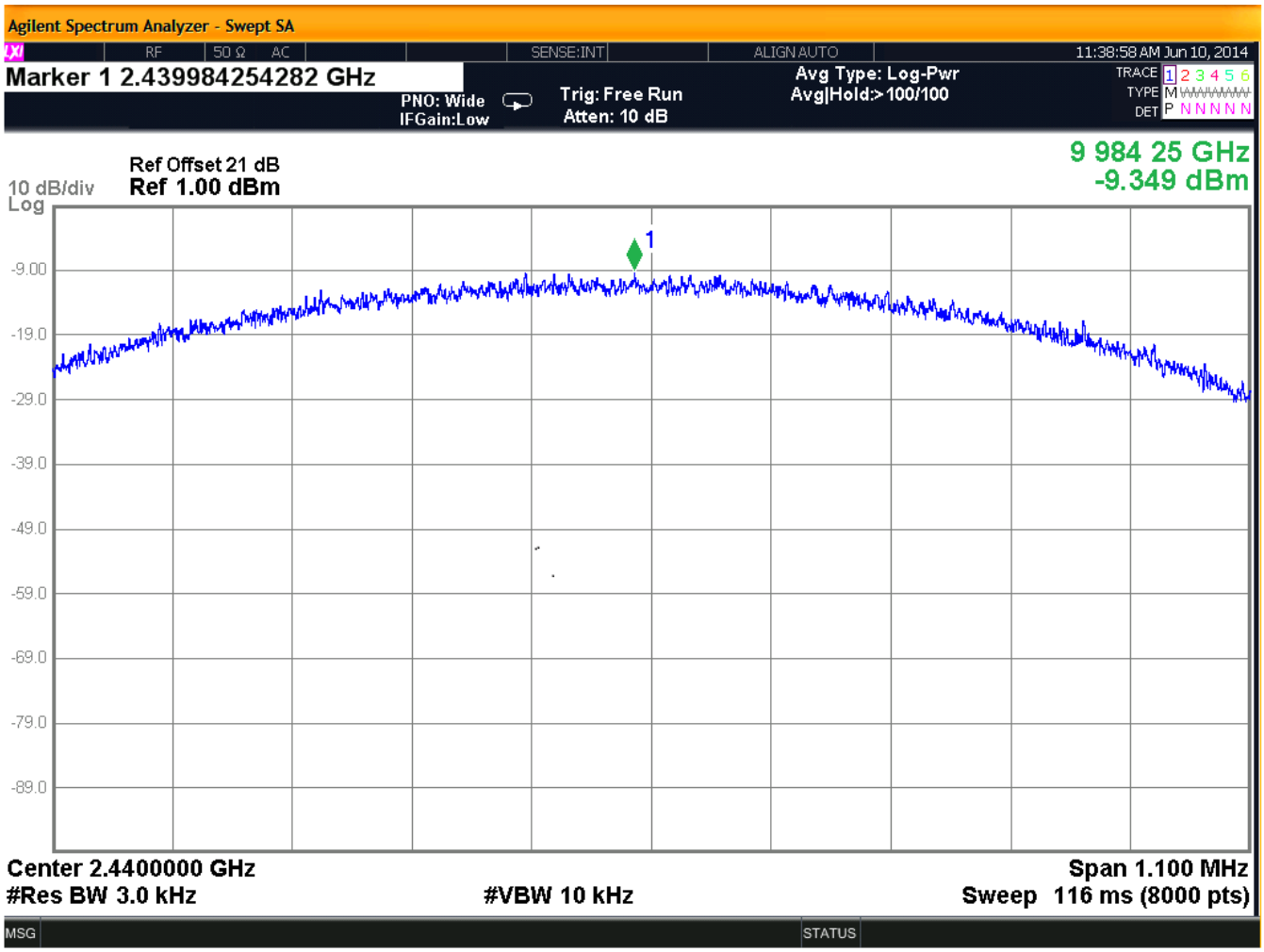

Figure 8: Power Spectral Density, Center Channel

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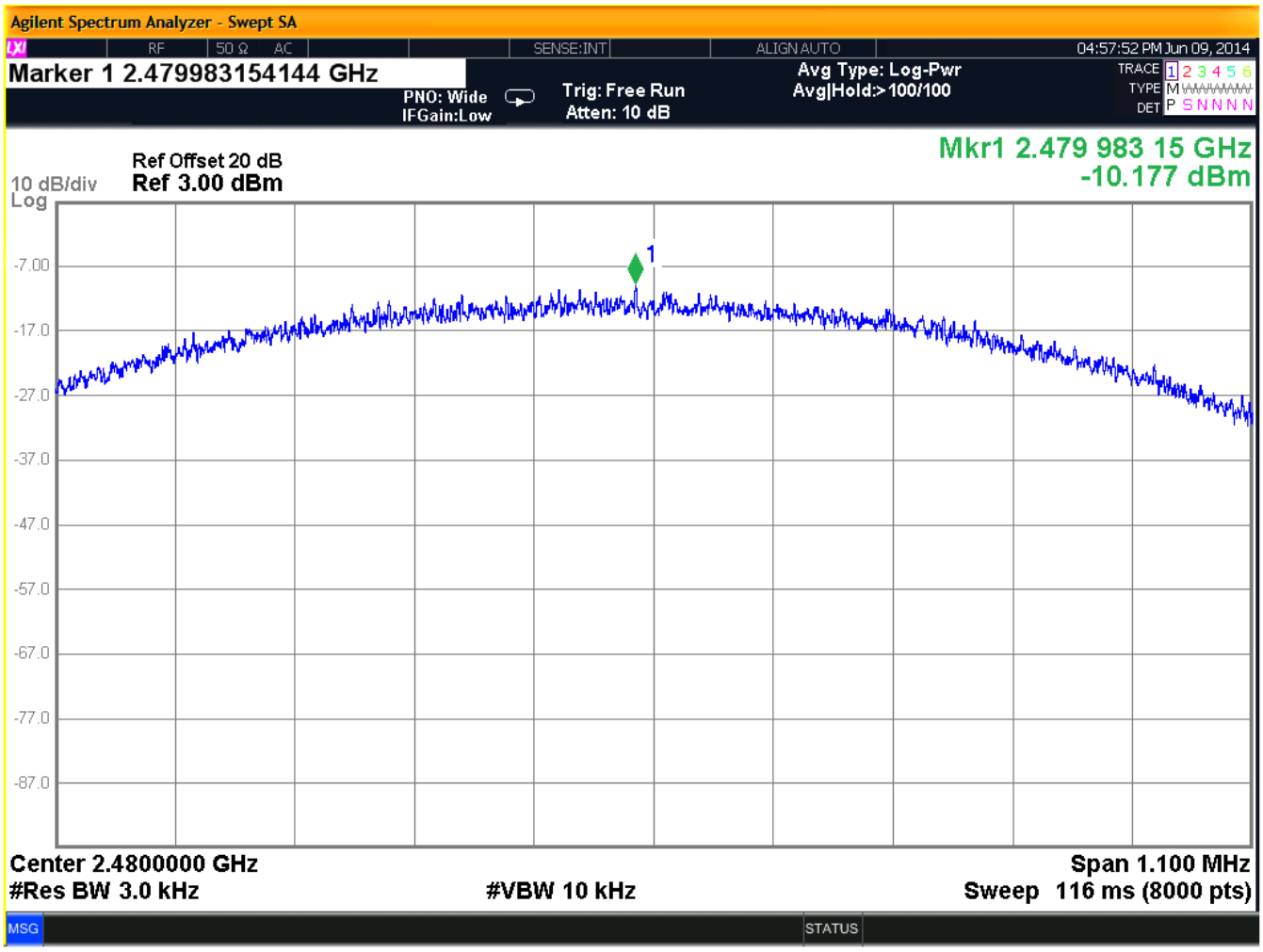

Figure 9: Power Spectral Density, High Channel

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5.4 Conducted Spurious Emissions at Antenna Terminals

The EUT must comply with requirements for spurious emissions at antenna terminals. 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.

The EUT antenna was removed and the cable was connected directly into a spectrum analyzer through a 10 dB attenuator. An offset was programmed into the spectrum analyzer to compensate for the loss of the external attenuator. The spectrum analyzer resolution bandwidth was set to 100 kHz and the video bandwidth was set to 100 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.

The following are plots of the conducted spurious emissions data.

Table 10: Conducted Spurious Spectrum Analyzer Settings

Resolution Bandwidth	Video Bandwidth
100kHz	1MHz

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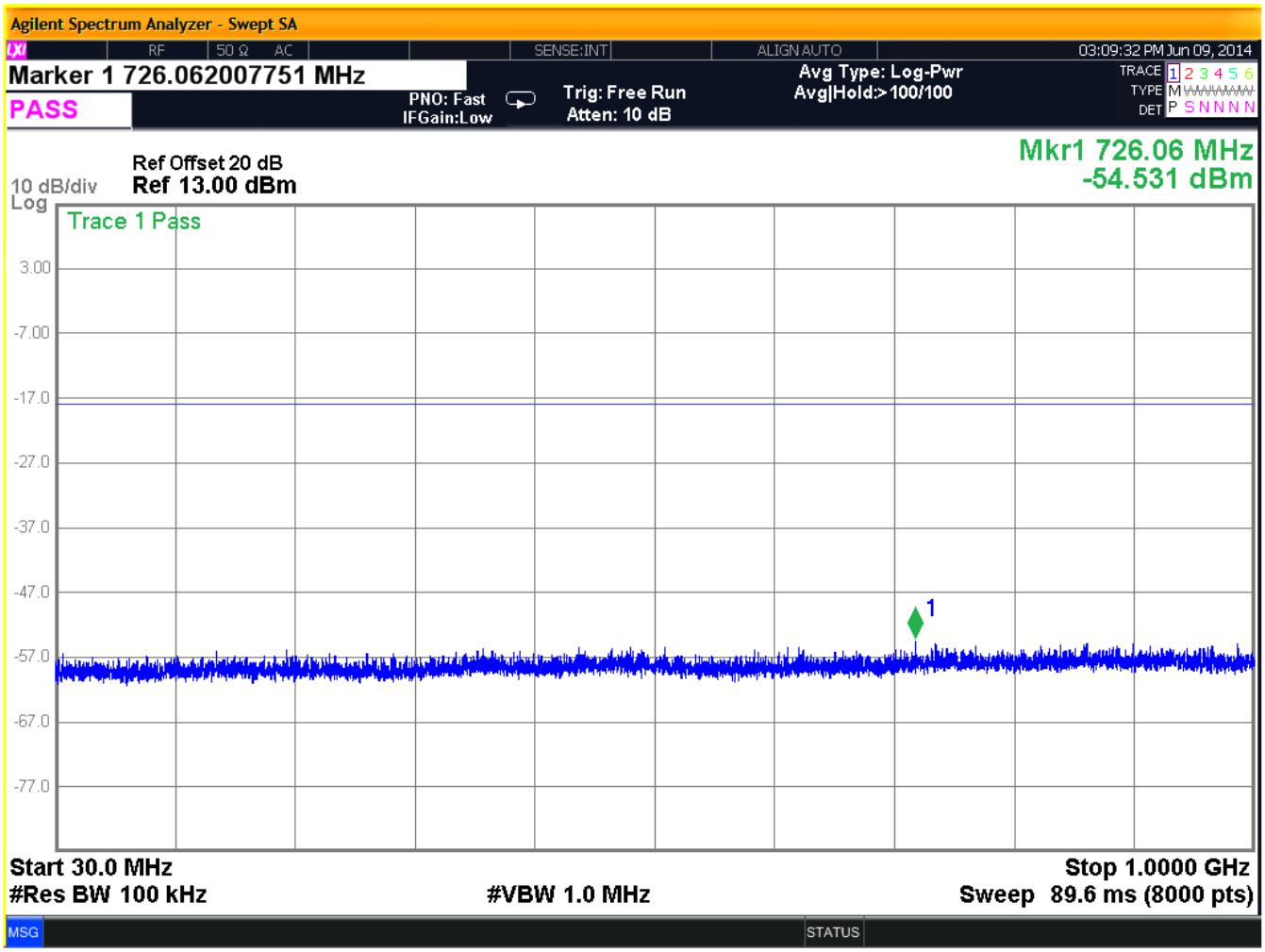

Figure 10: Conducted Spurious Emissions, Low Channel 30 - 1000MHz

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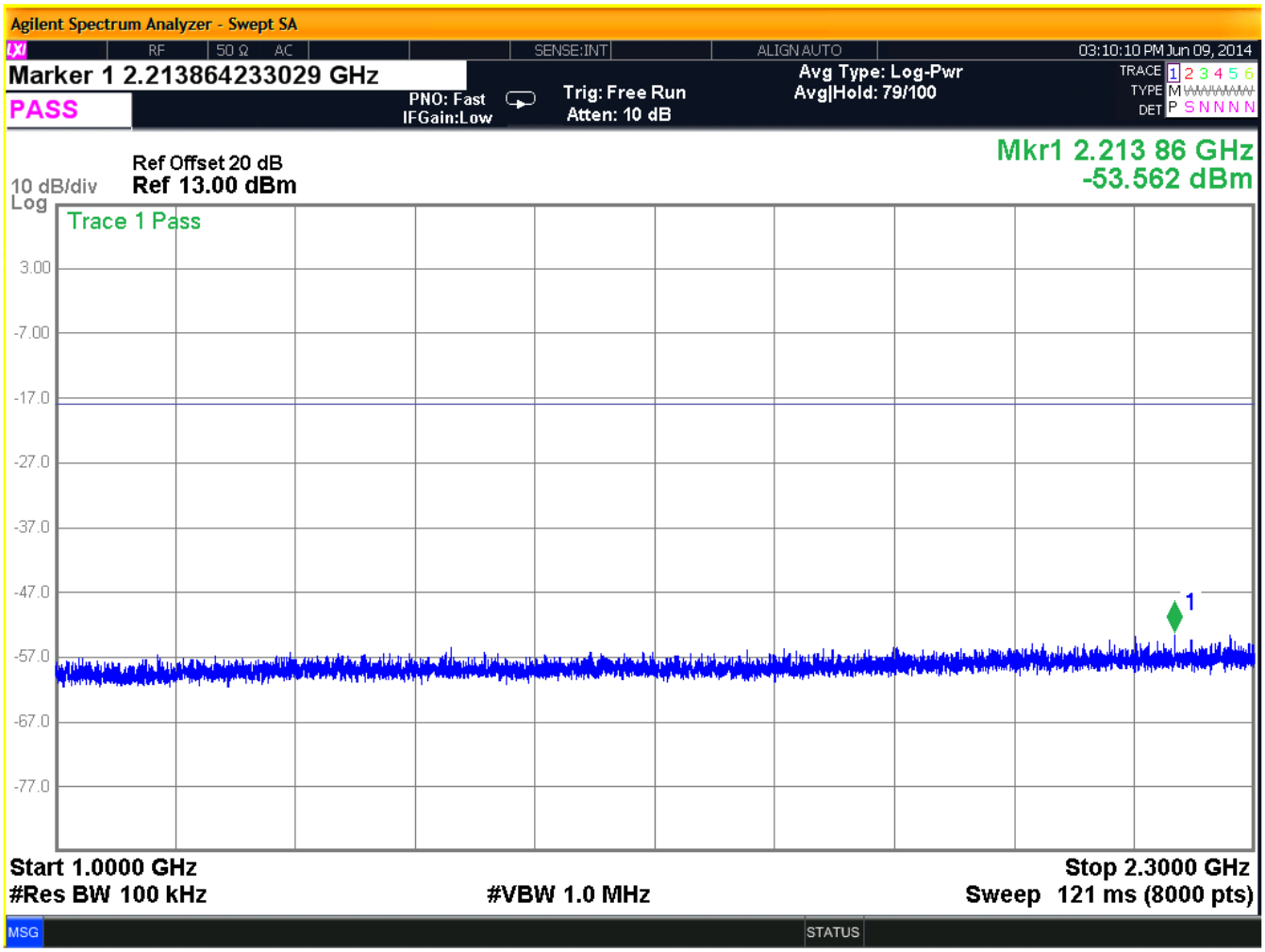

Figure 11: Conducted Spurious Emissions, Low Channel 1 – 2.3GHz

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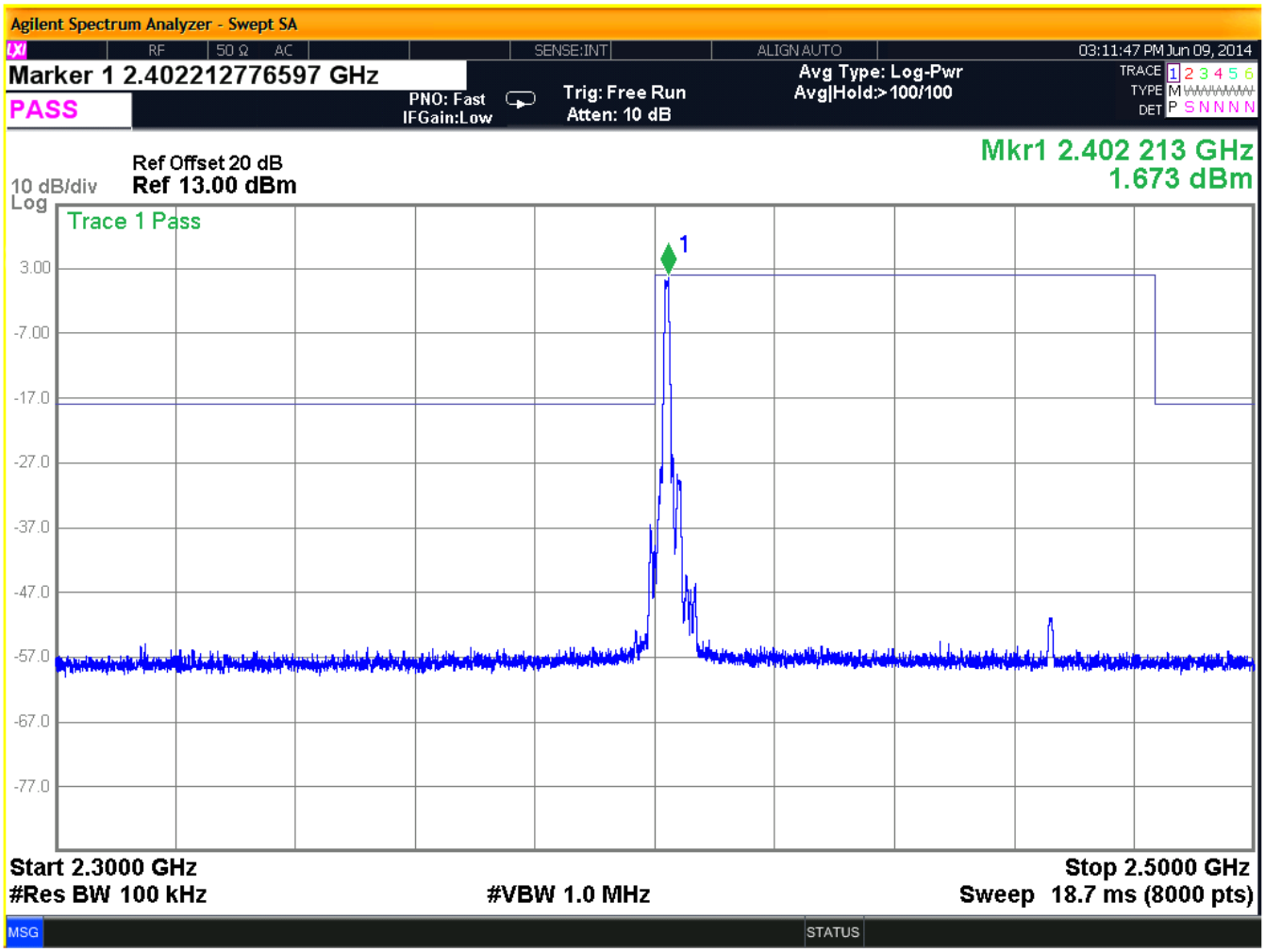

Figure 12: Conducted Spurious Emissions, Low Channel 2.3 – 2.5GHz

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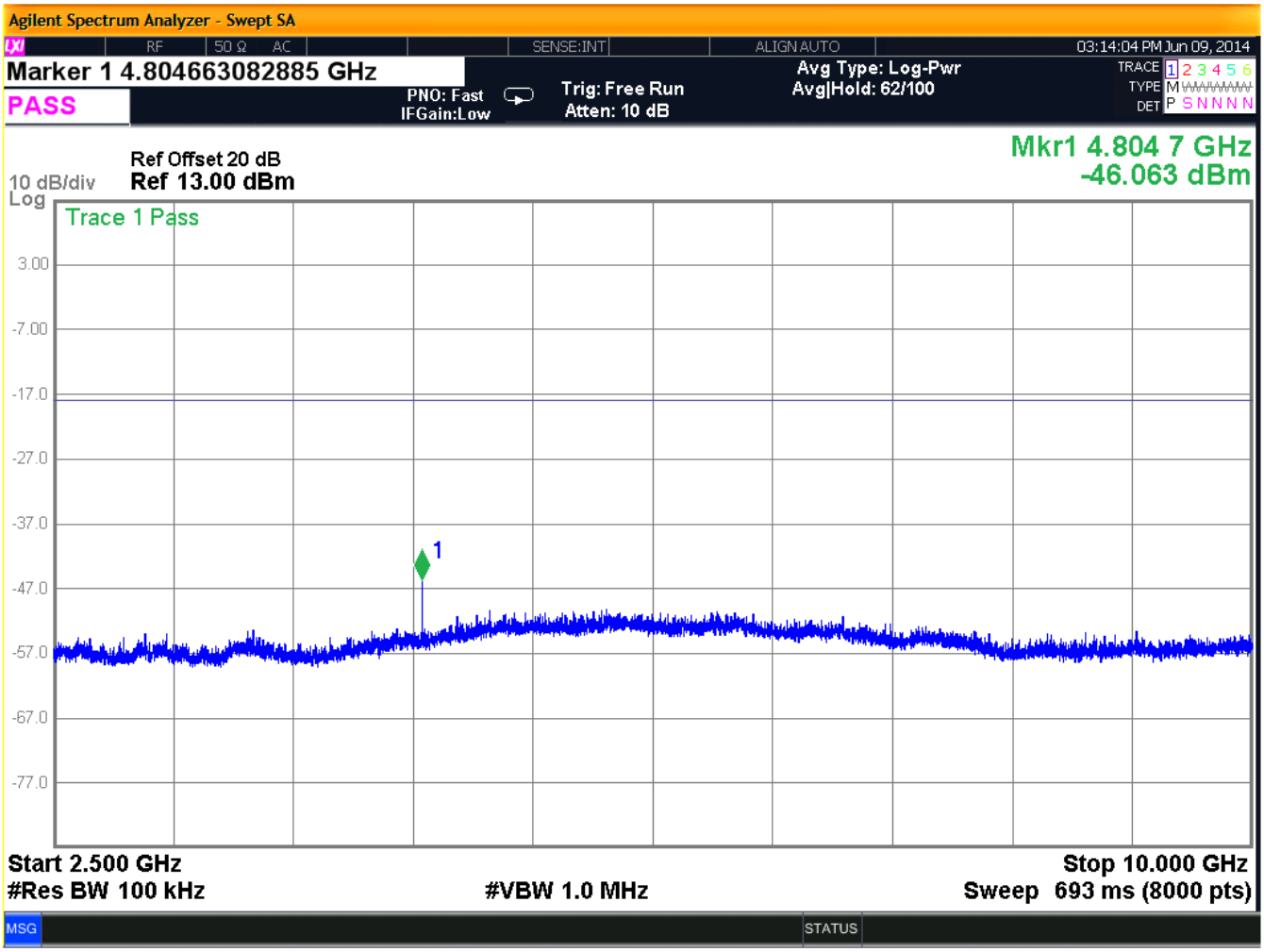

Figure 13: Conducted Spurious Emissions, Low Channel 2.5 - 10GHz

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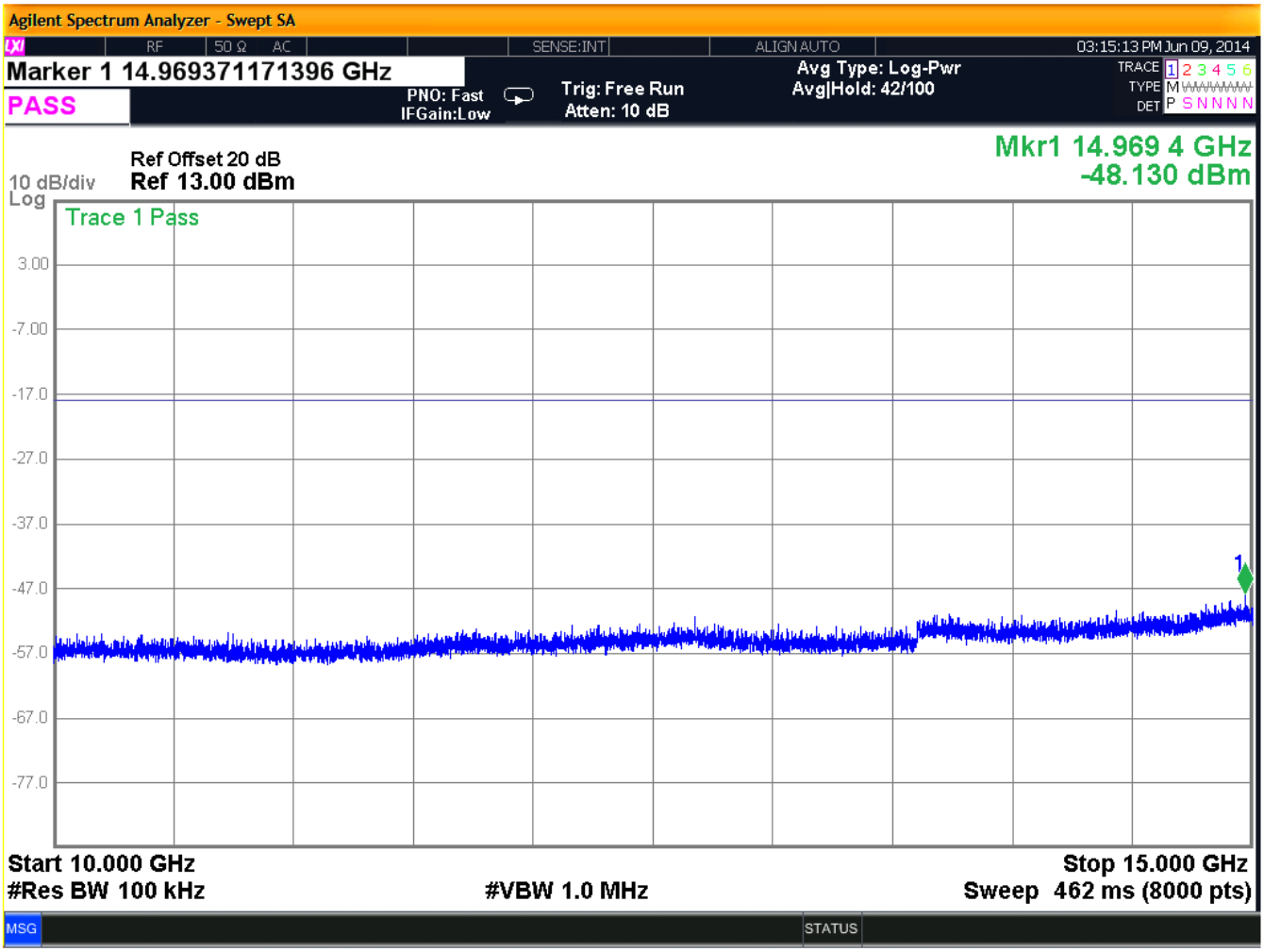

Figure 14: Conducted Spurious Emissions, Low Channel 10 - 15GHz

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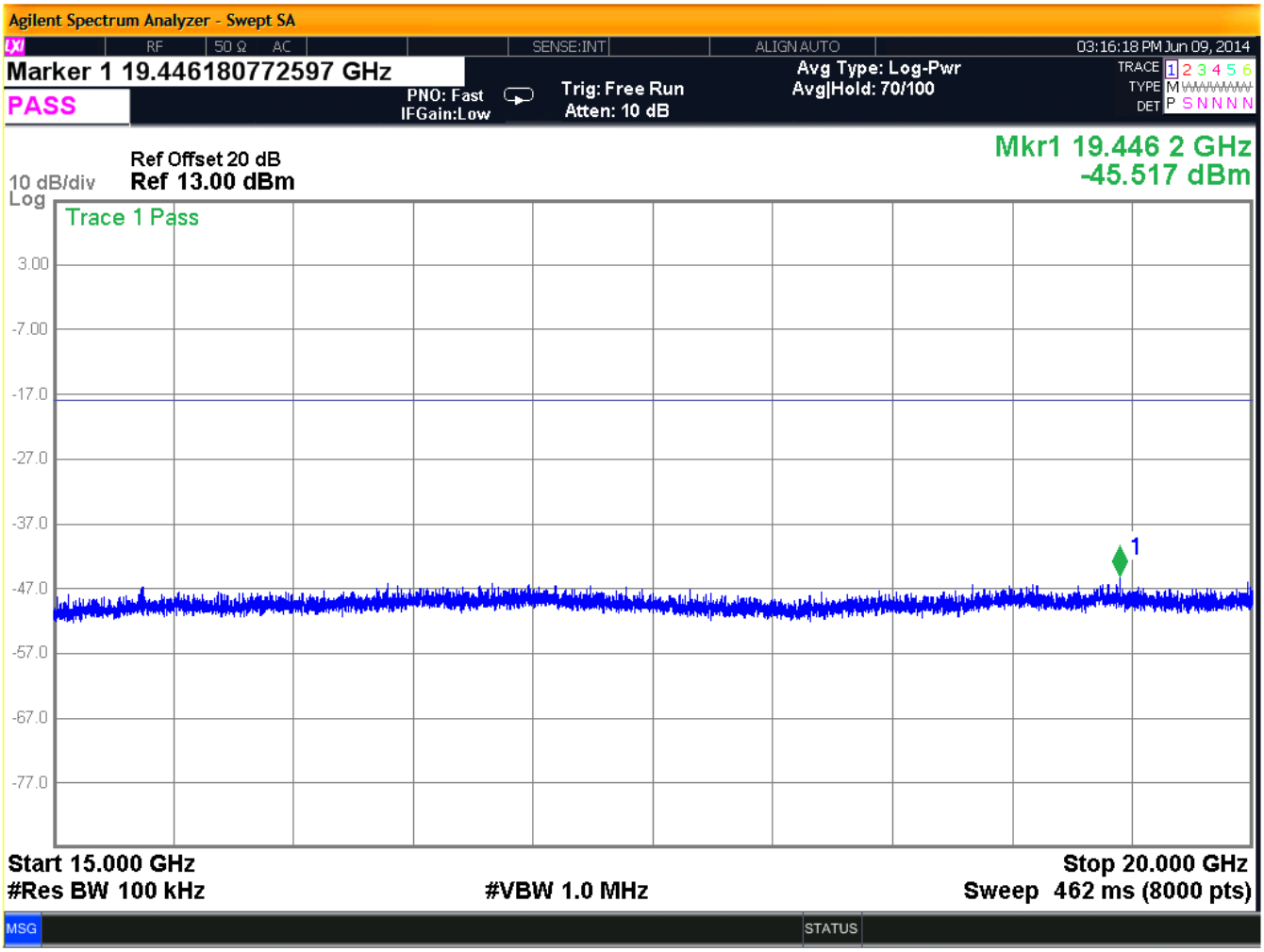

Figure 15: Conducted Spurious Emissions, Low Channel 15 - 20GHz

 © 2014 Washington Laboratories, Ltd.

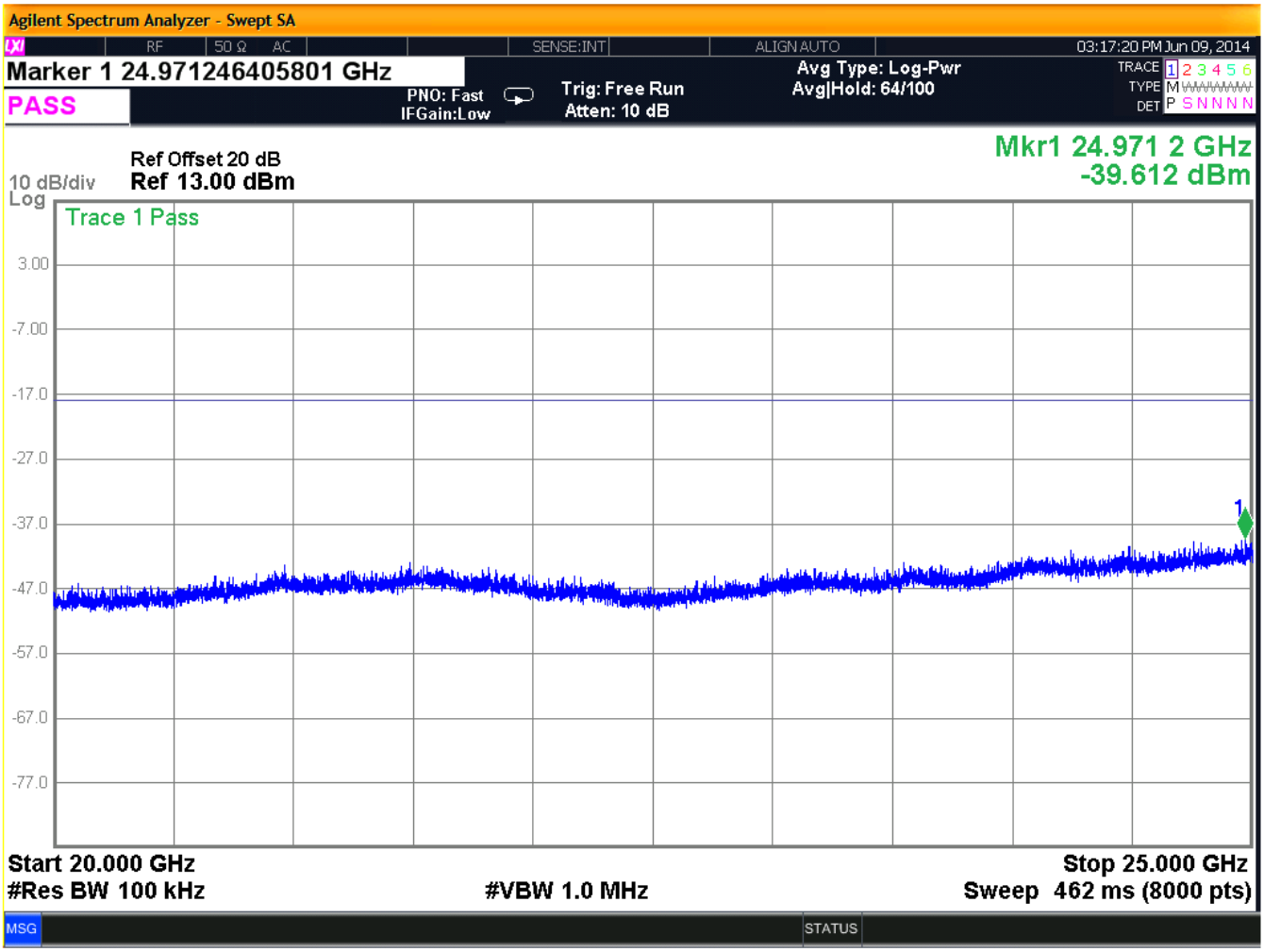

Figure 16: Conducted Spurious Emissions, Low Channel 20 - 25GHz

 © 2014 Washington Laboratories, Ltd.

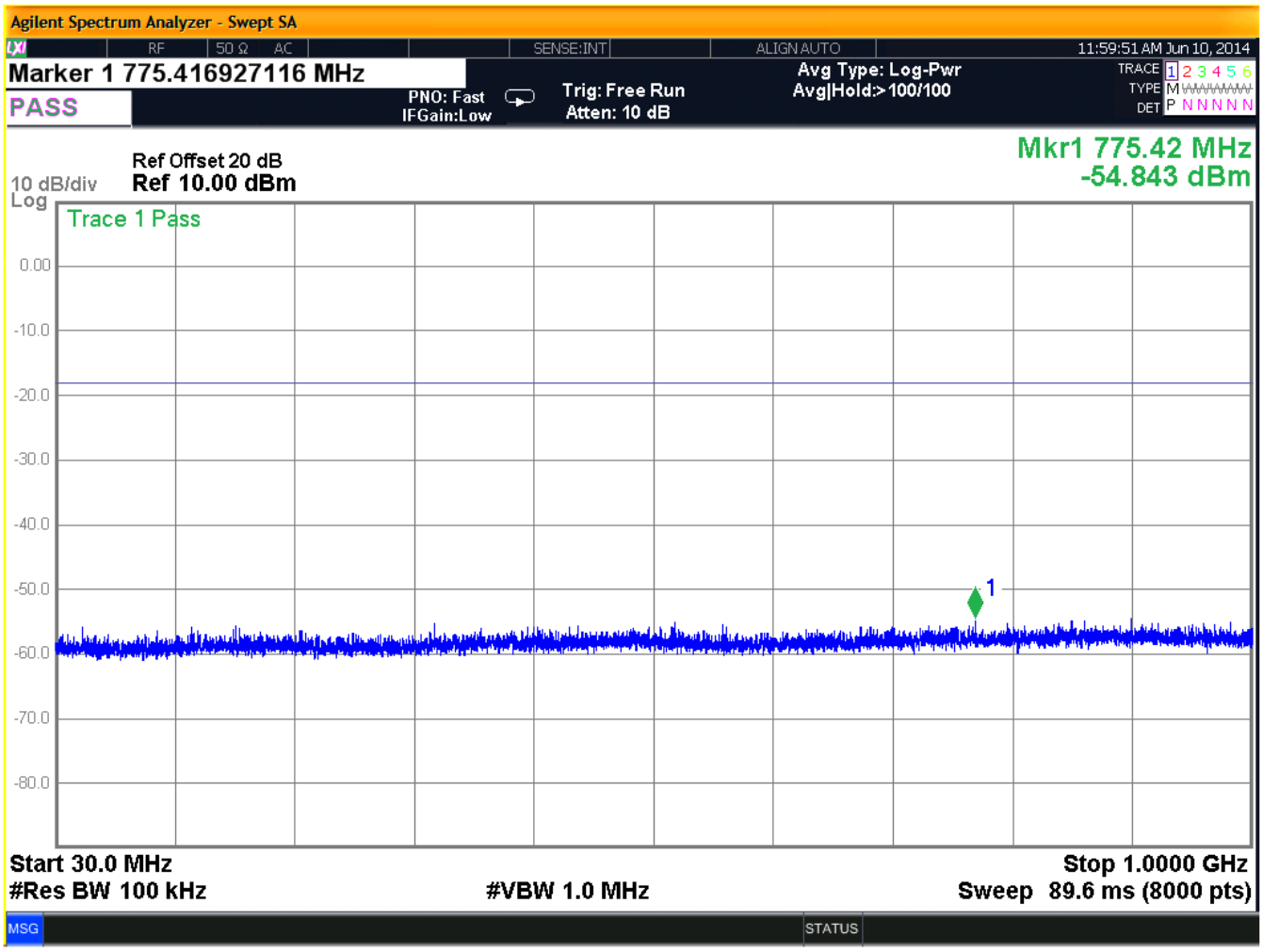

Figure 17: Conducted Spurious Emissions, Mid Channel 30 - 1000MHz

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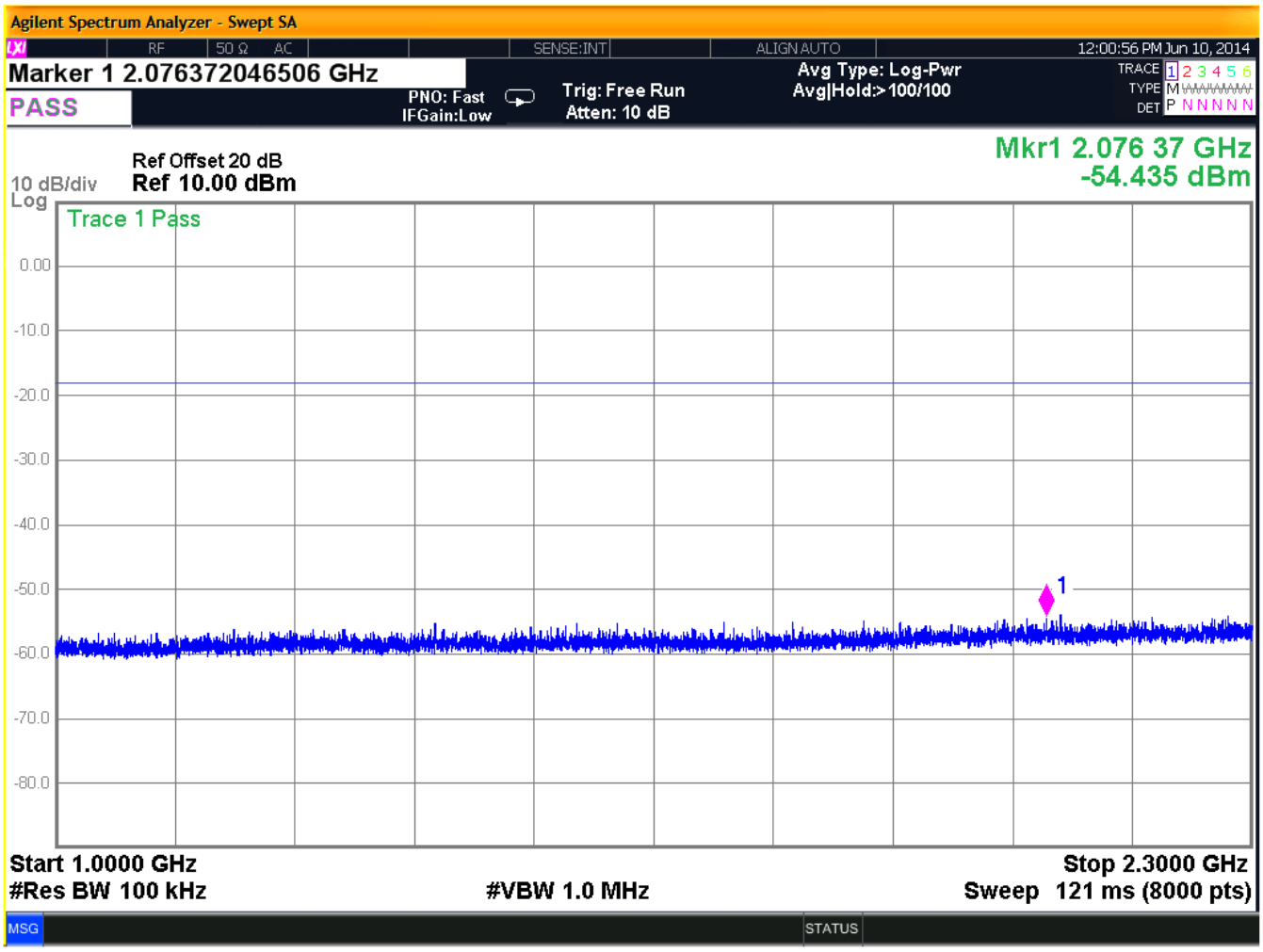

Figure 18: Conducted Spurious Emissions, Mid Channel 1 – 2.3GHz

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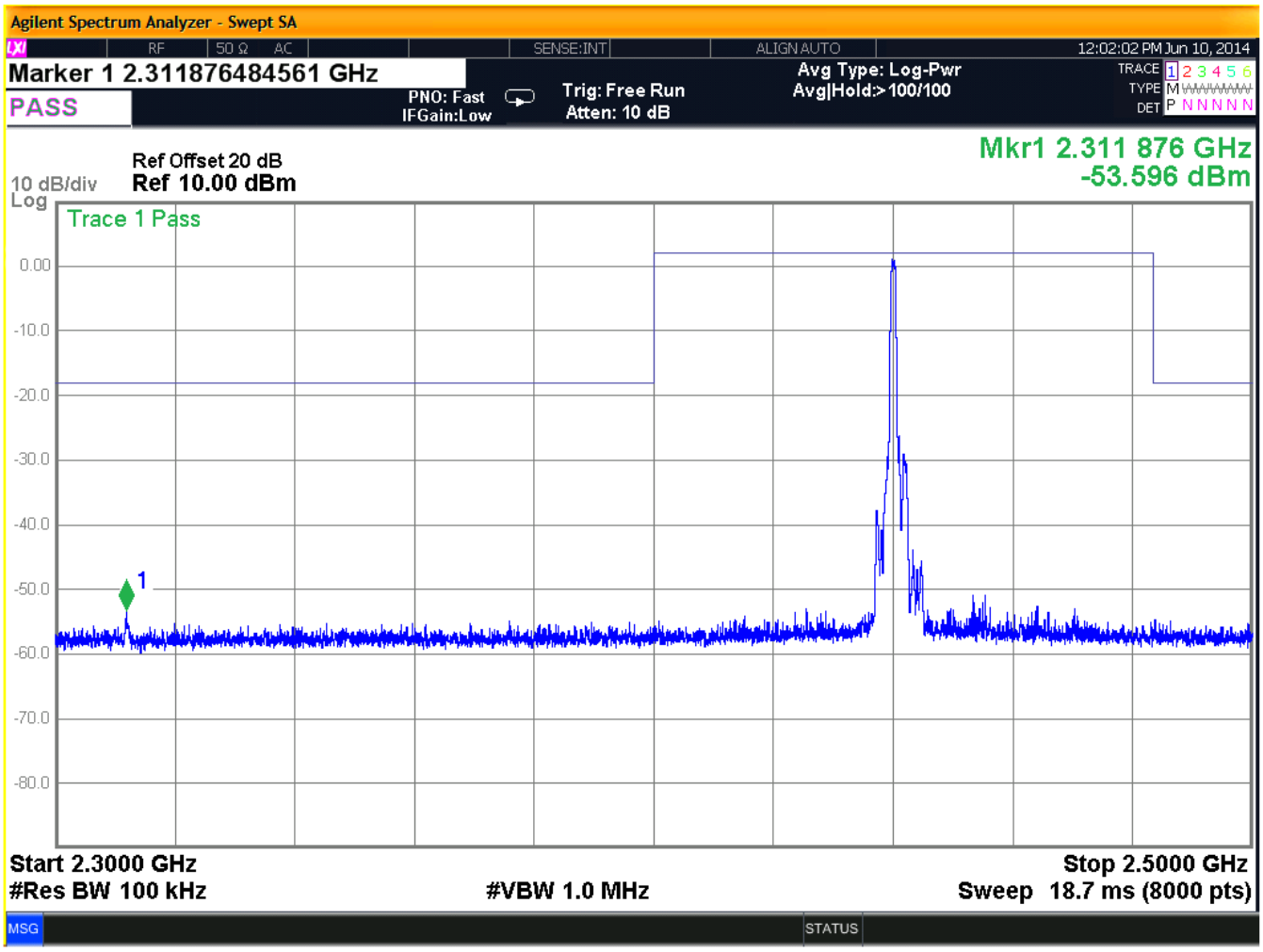

Figure 19: Conducted Spurious Emissions, Mid Channel 2.3 – 2.5GHz

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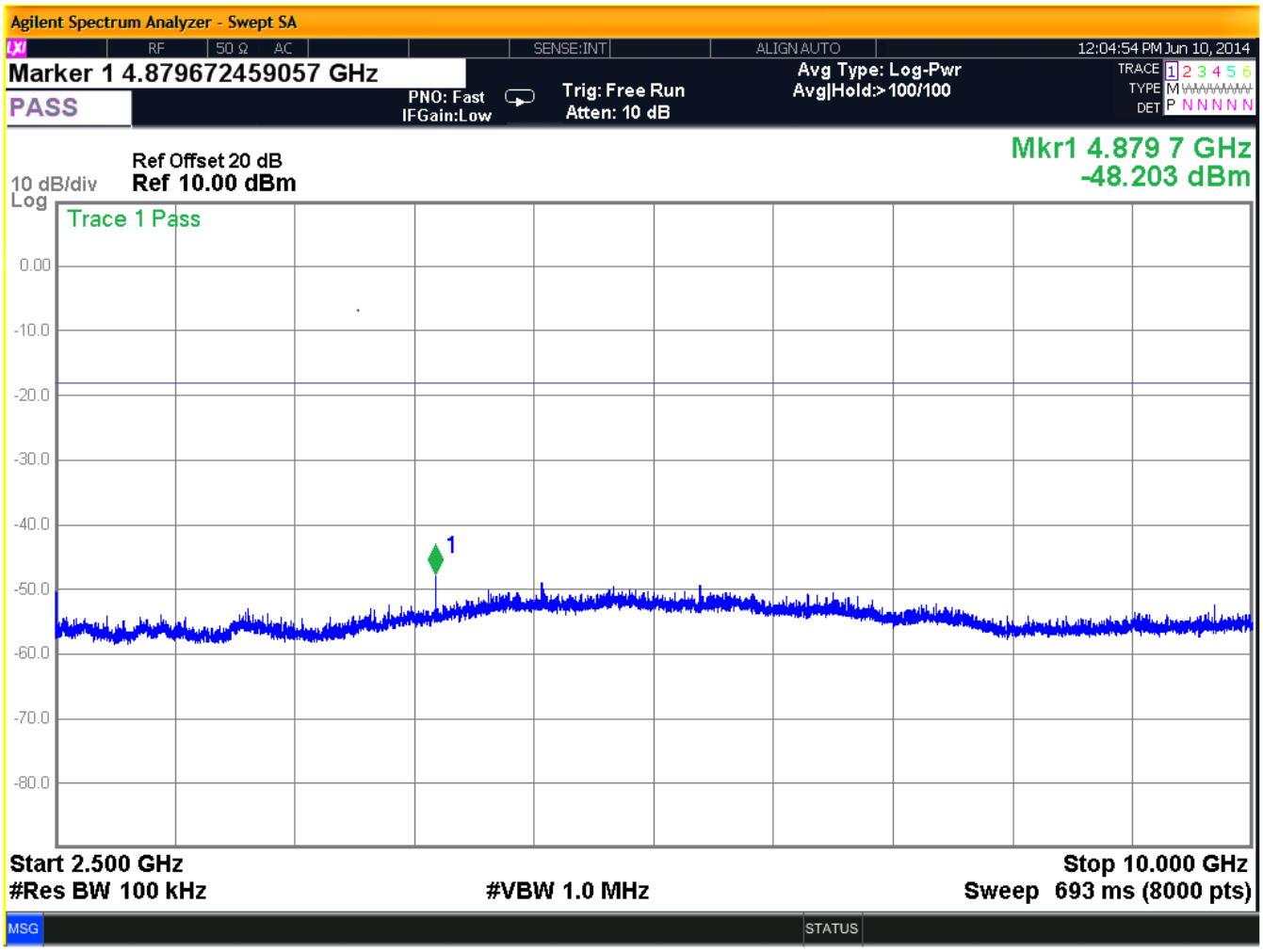

Figure 20: Conducted Spurious Emissions, Mid Channel 2.5 - 10GHz

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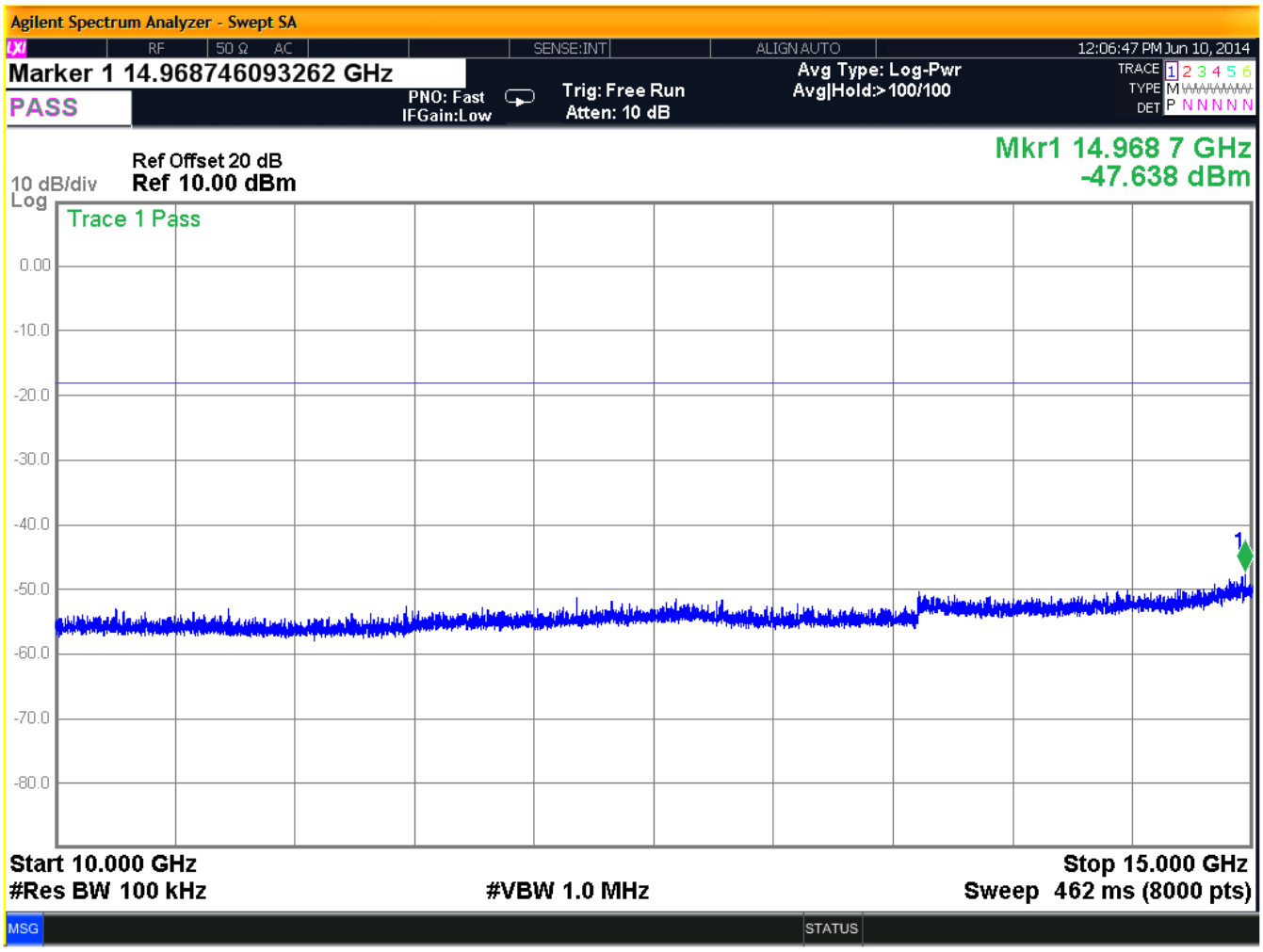

Figure 21: Conducted Spurious Emissions, Mid Channel 10 - 15GHz

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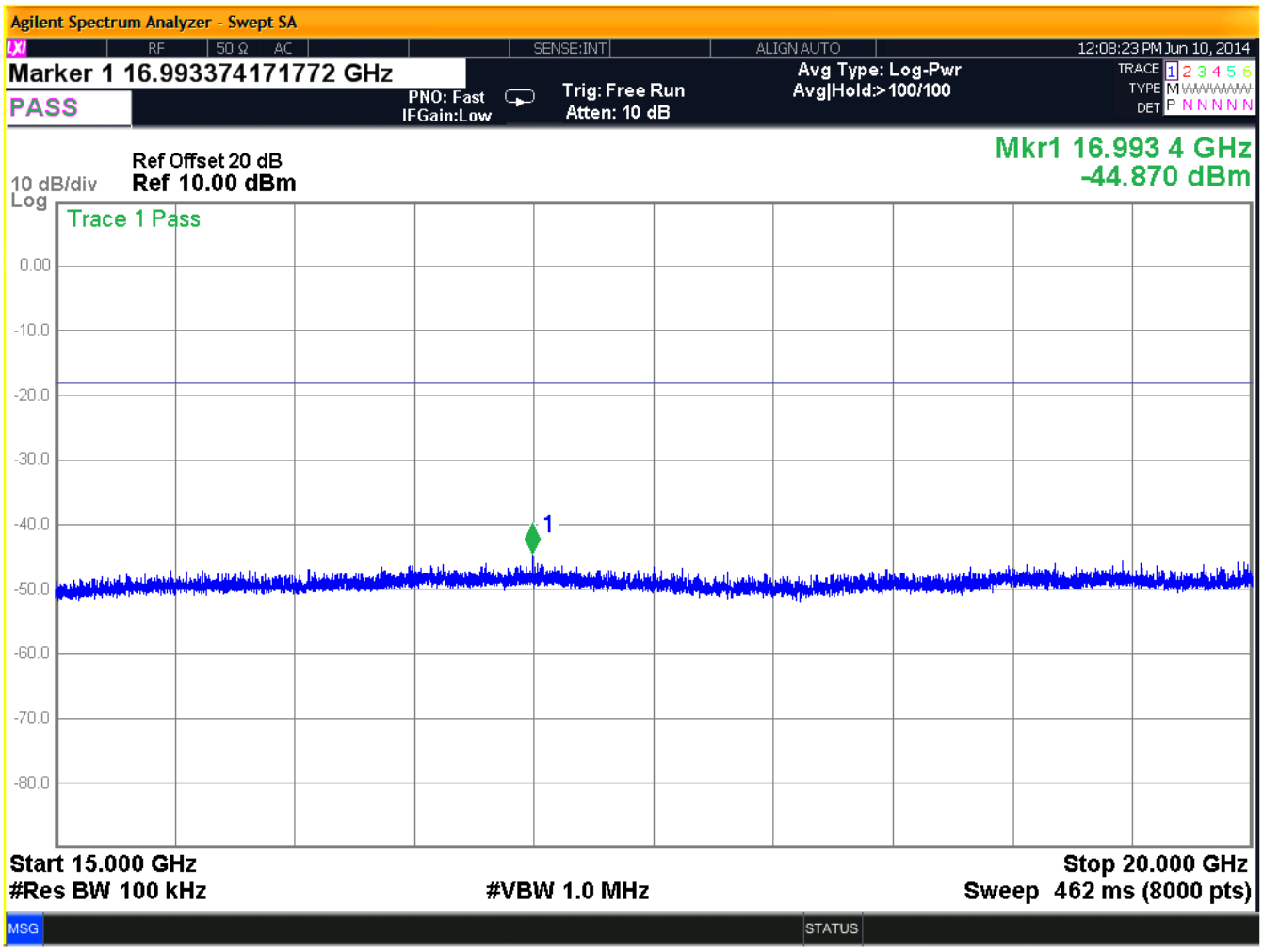

Figure 22: Conducted Spurious Emissions, Mid Channel 15 - 20GHz

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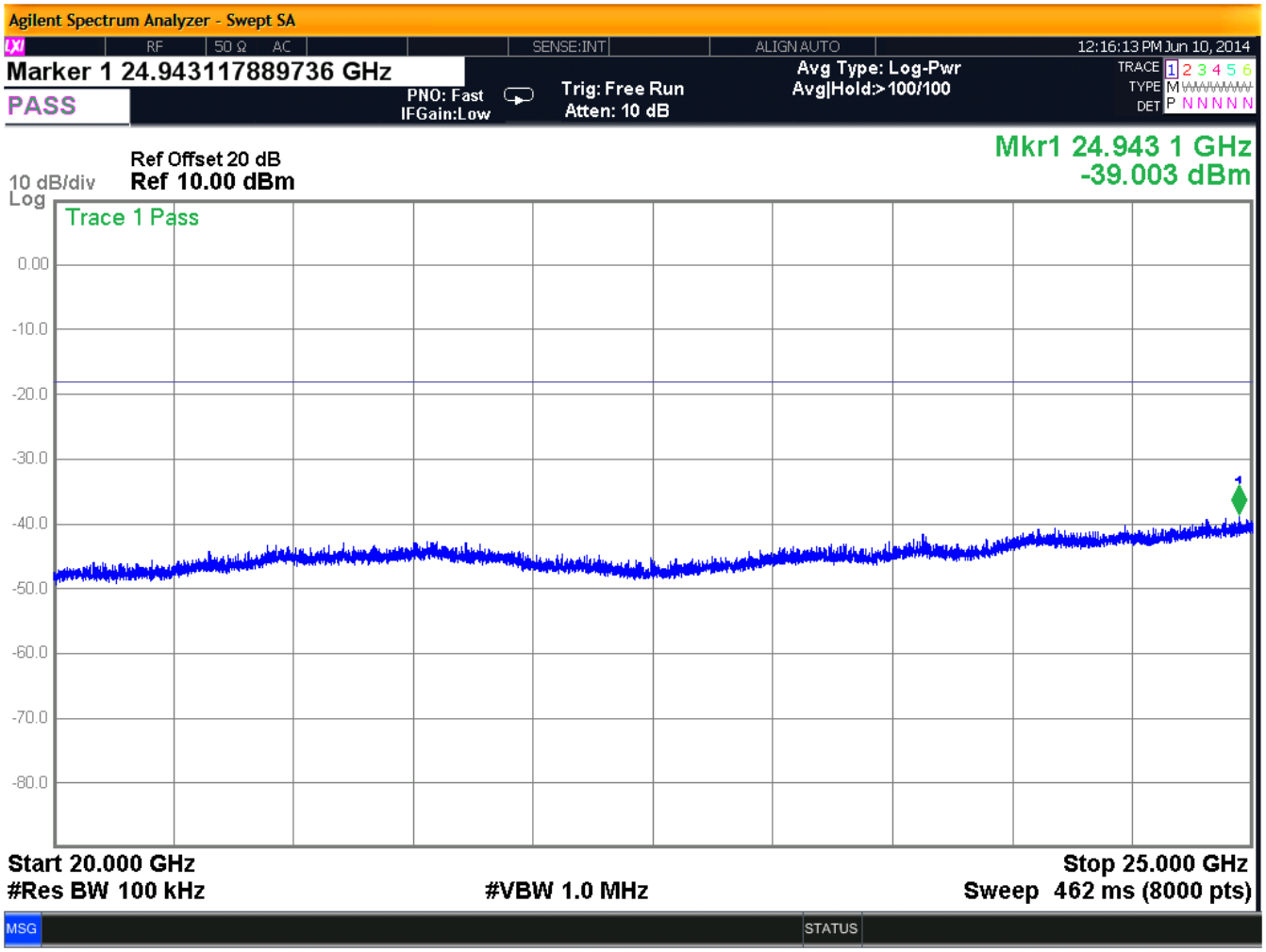

Figure 23: Conducted Spurious Emissions, Mid Channel 20 - 25GHz

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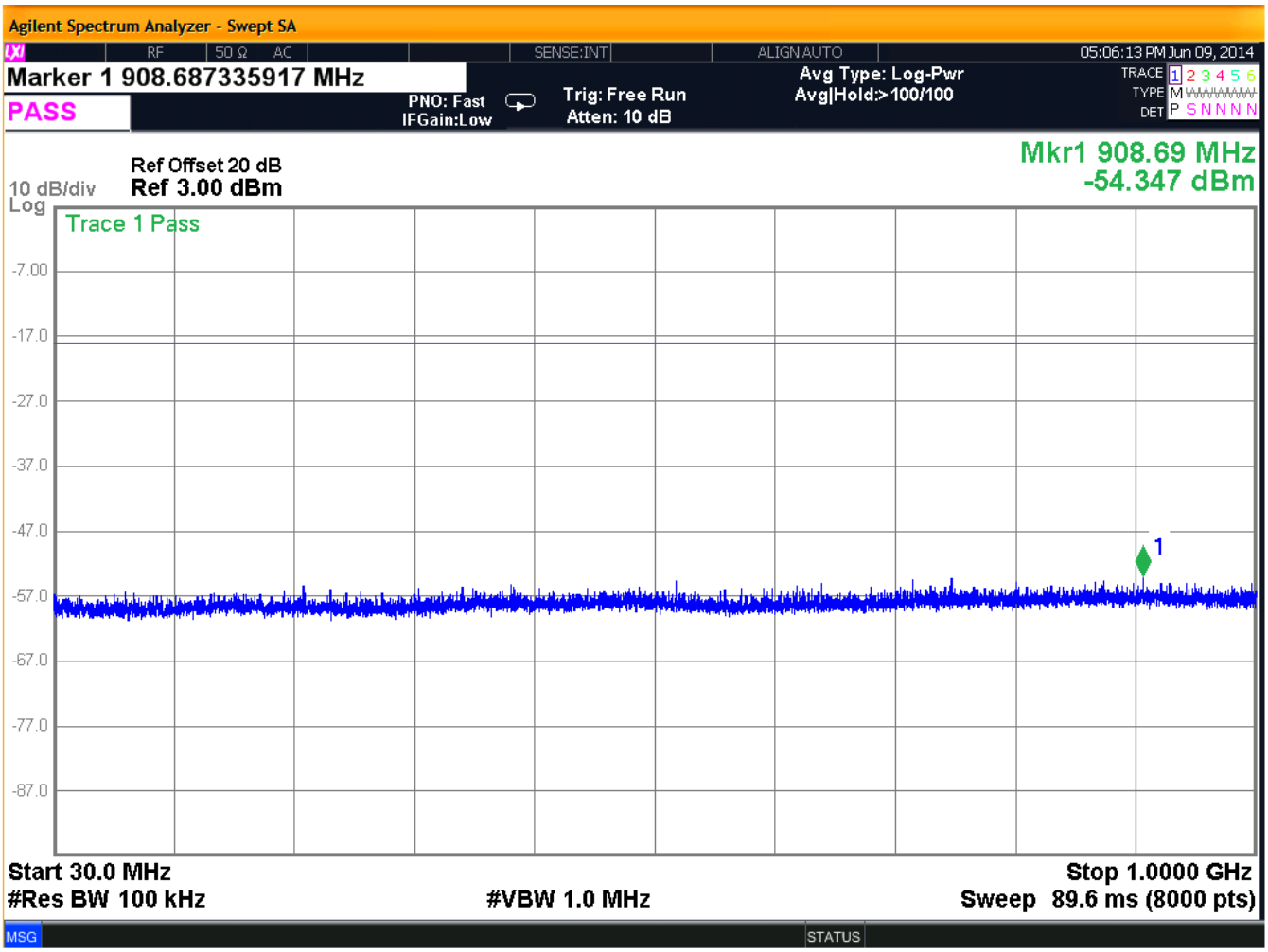

Figure 24: Conducted Spurious Emissions, High Channel 30 - 1000MHz

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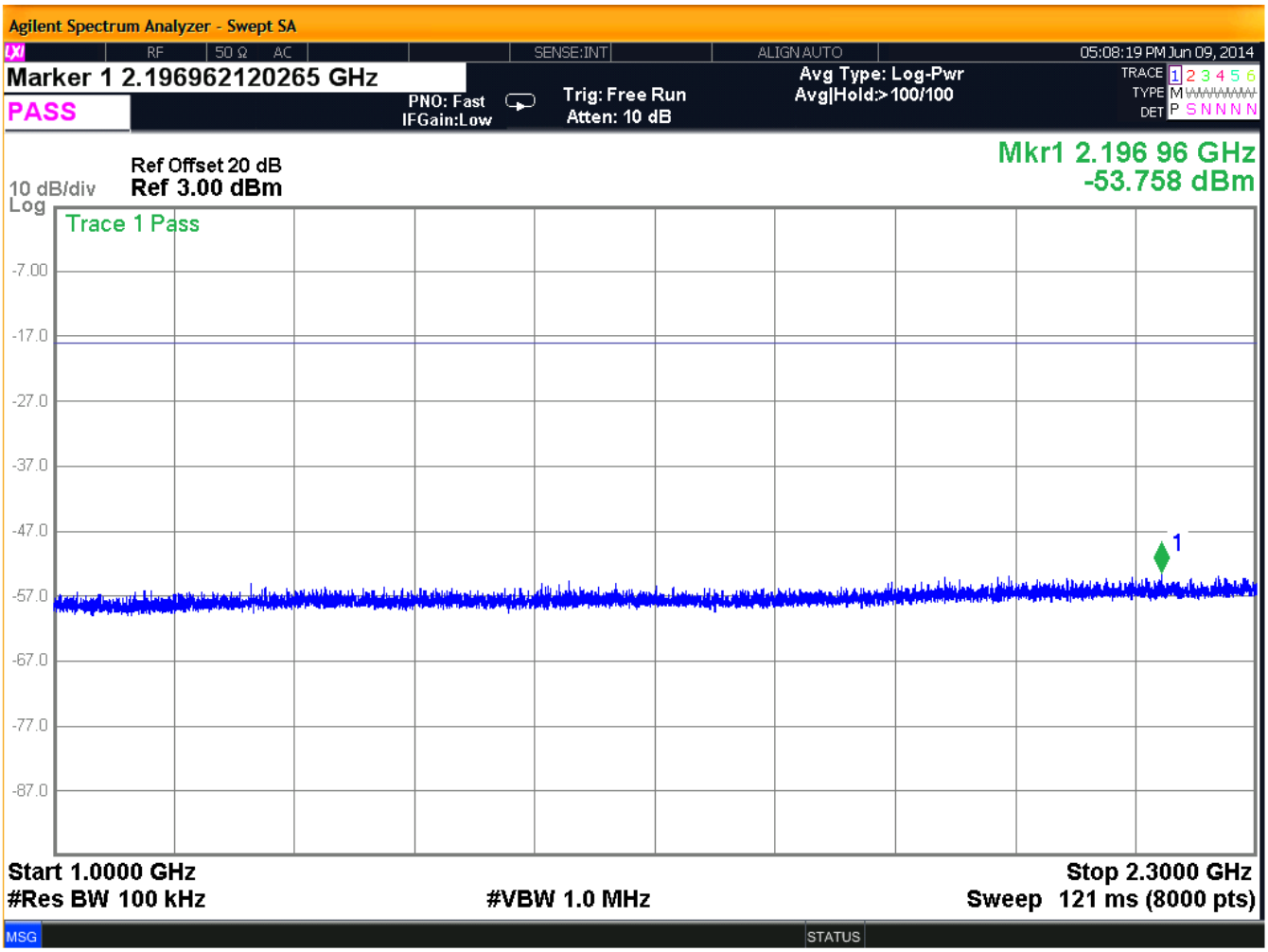

Figure 25: Conducted Spurious Emissions, High Channel 1 – 2.3GHz

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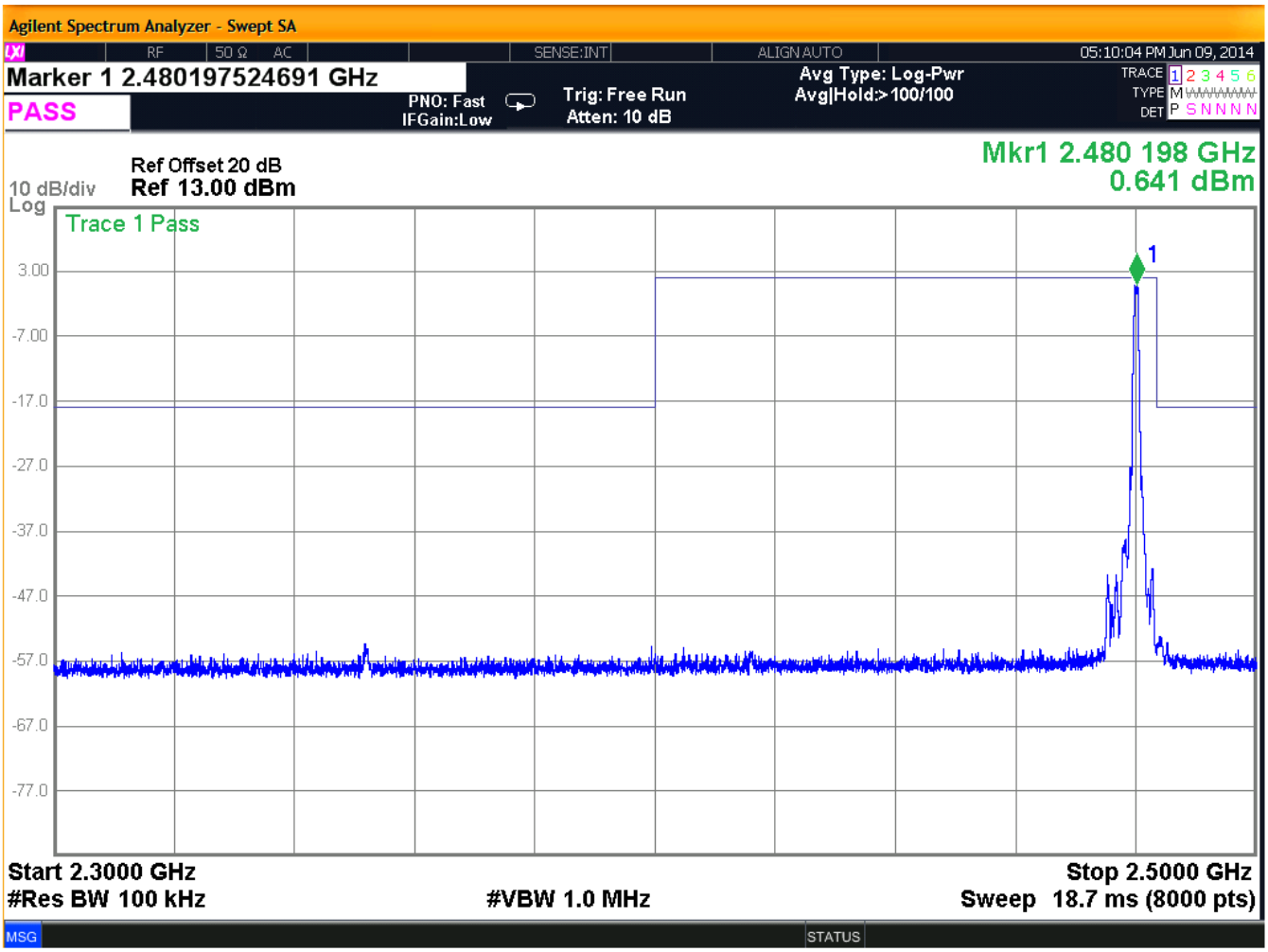

Figure 26: Conducted Spurious Emissions, High Channel 2.3 – 2.5GHz

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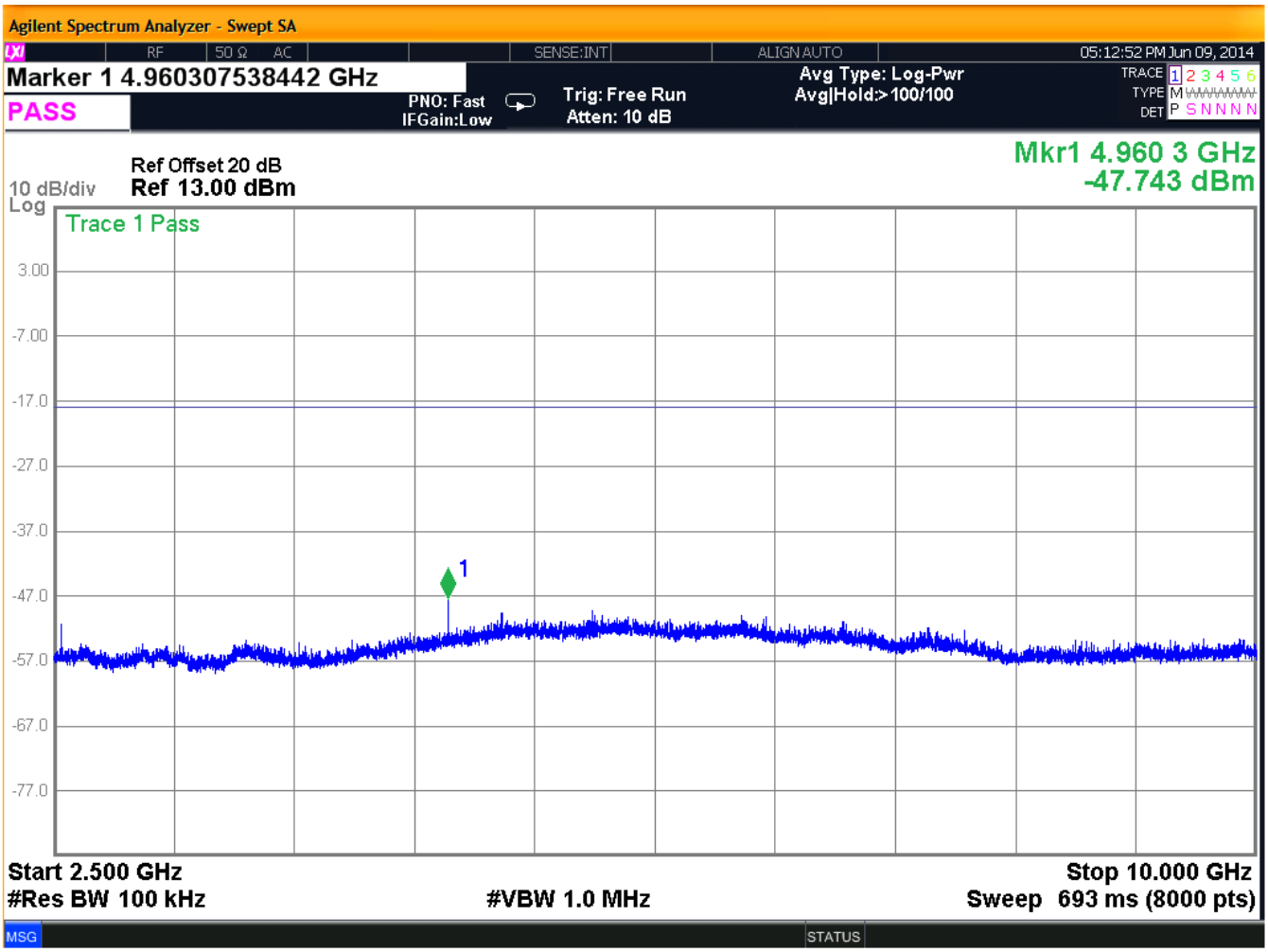

Figure 27: Conducted Spurious Emissions, High Channel 2.5 - 10GHz

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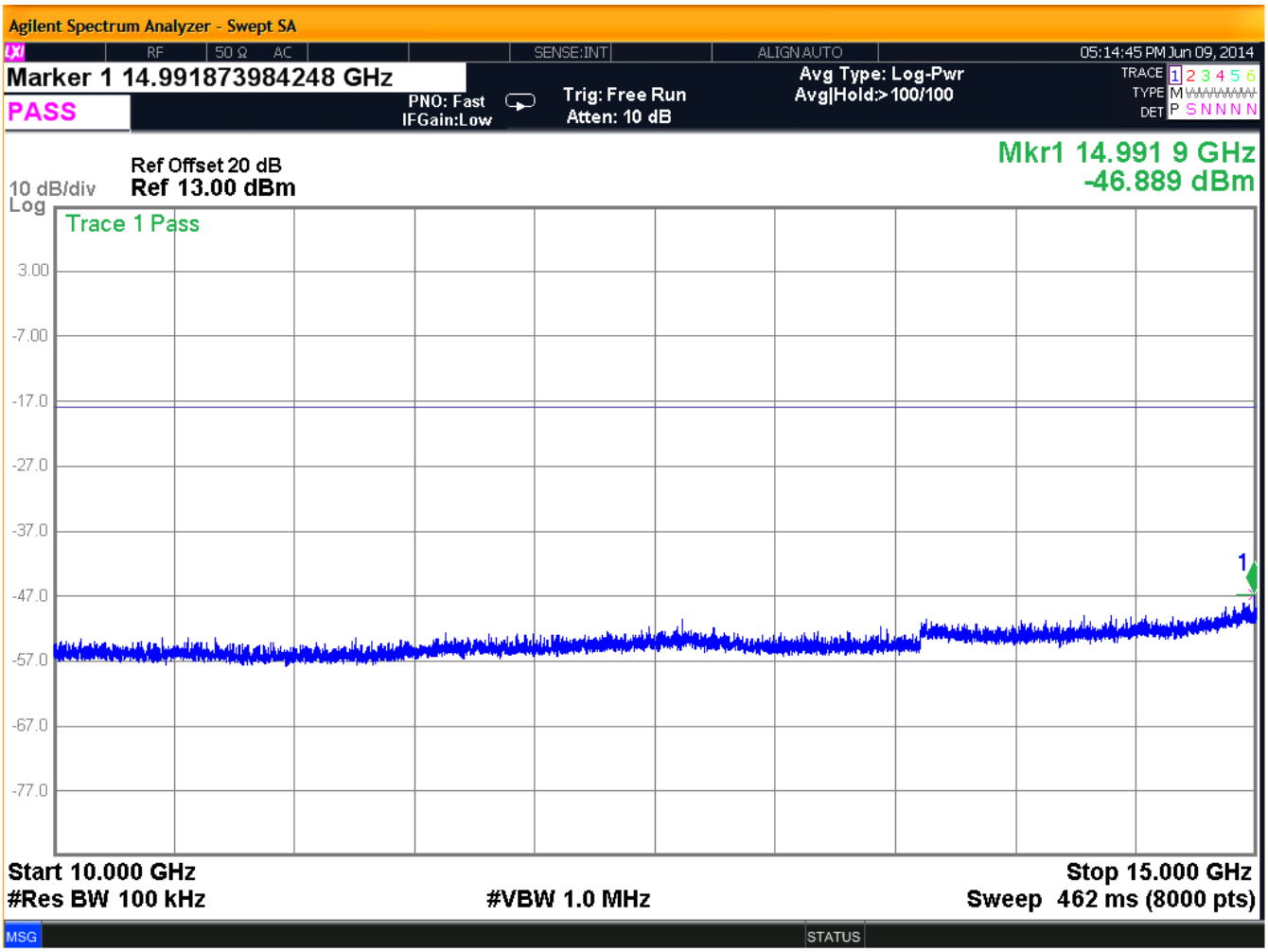

Figure 28: Conducted Spurious Emissions, High Channel 10 - 15GHz

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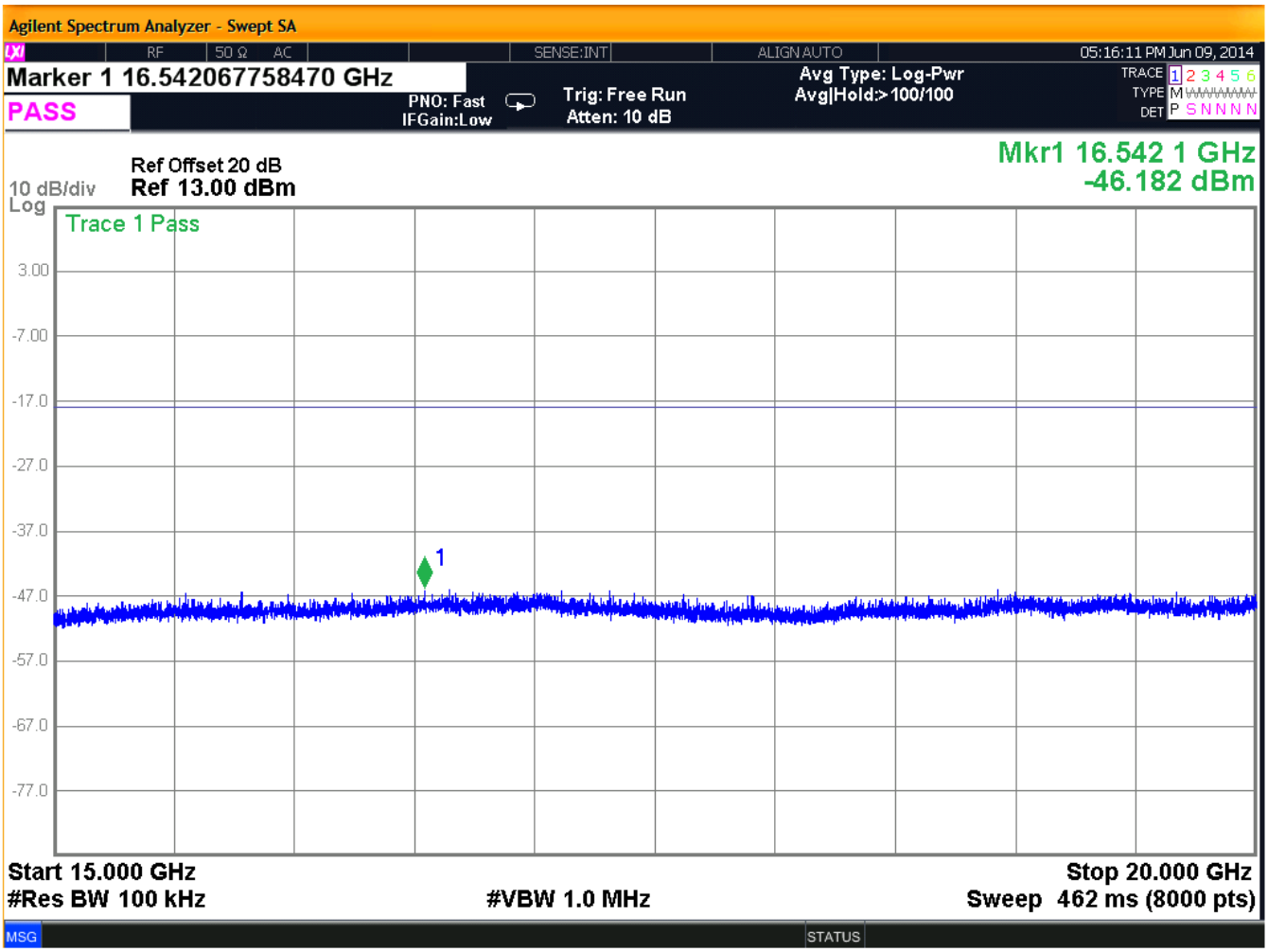

Figure 29: Conducted Spurious Emissions, High Channel 15 - 20GHz

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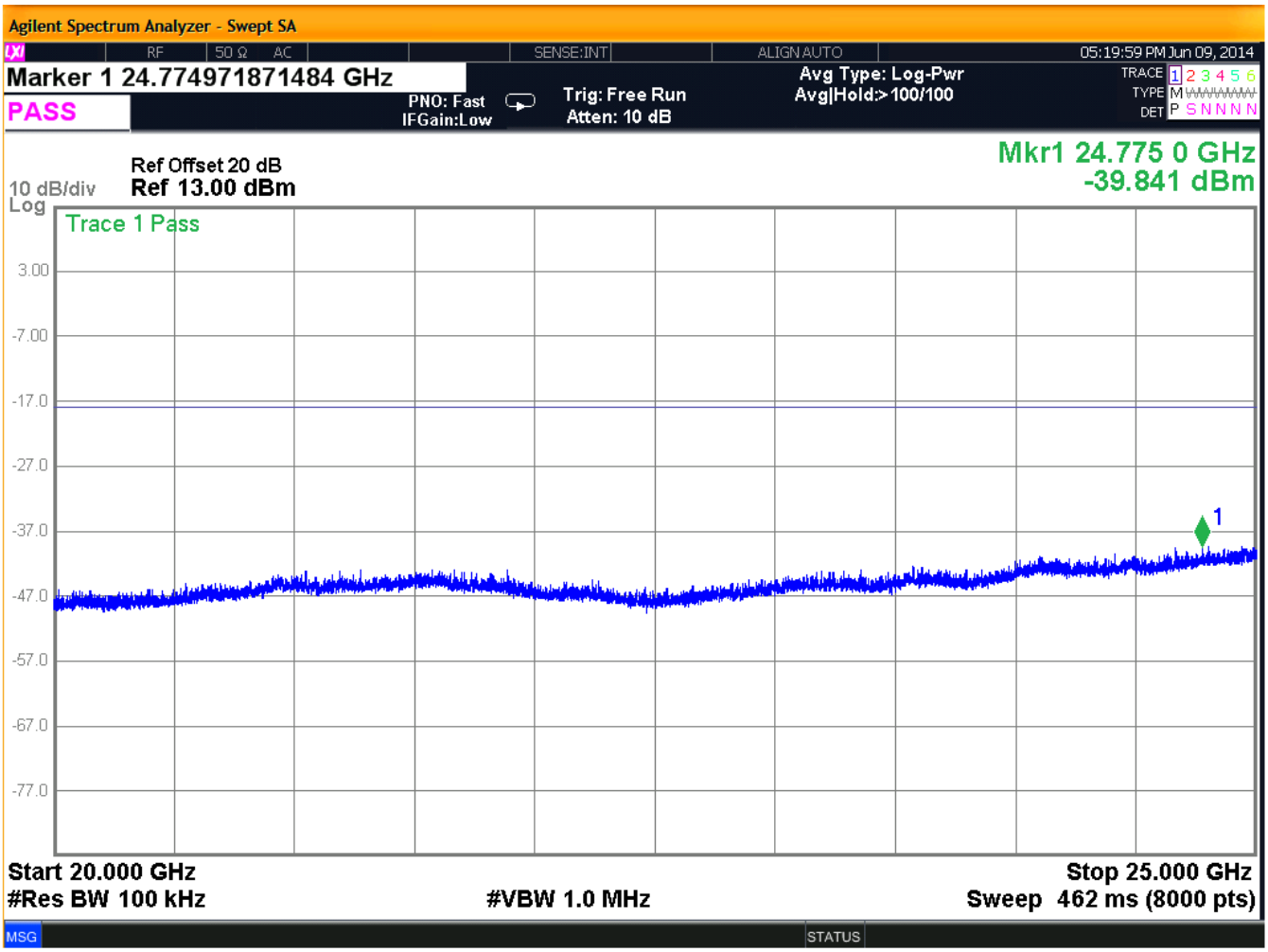

Figure 30: Conducted Spurious Emissions, High Channel 20 - 25GHz

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5.4.1 Band Edge Compliance

Close-up plots of the upper and lower channels with respect to the nearest authorized band-edges are provided below. The tests were performed in the same manner as the above conducted spurious emissions tests

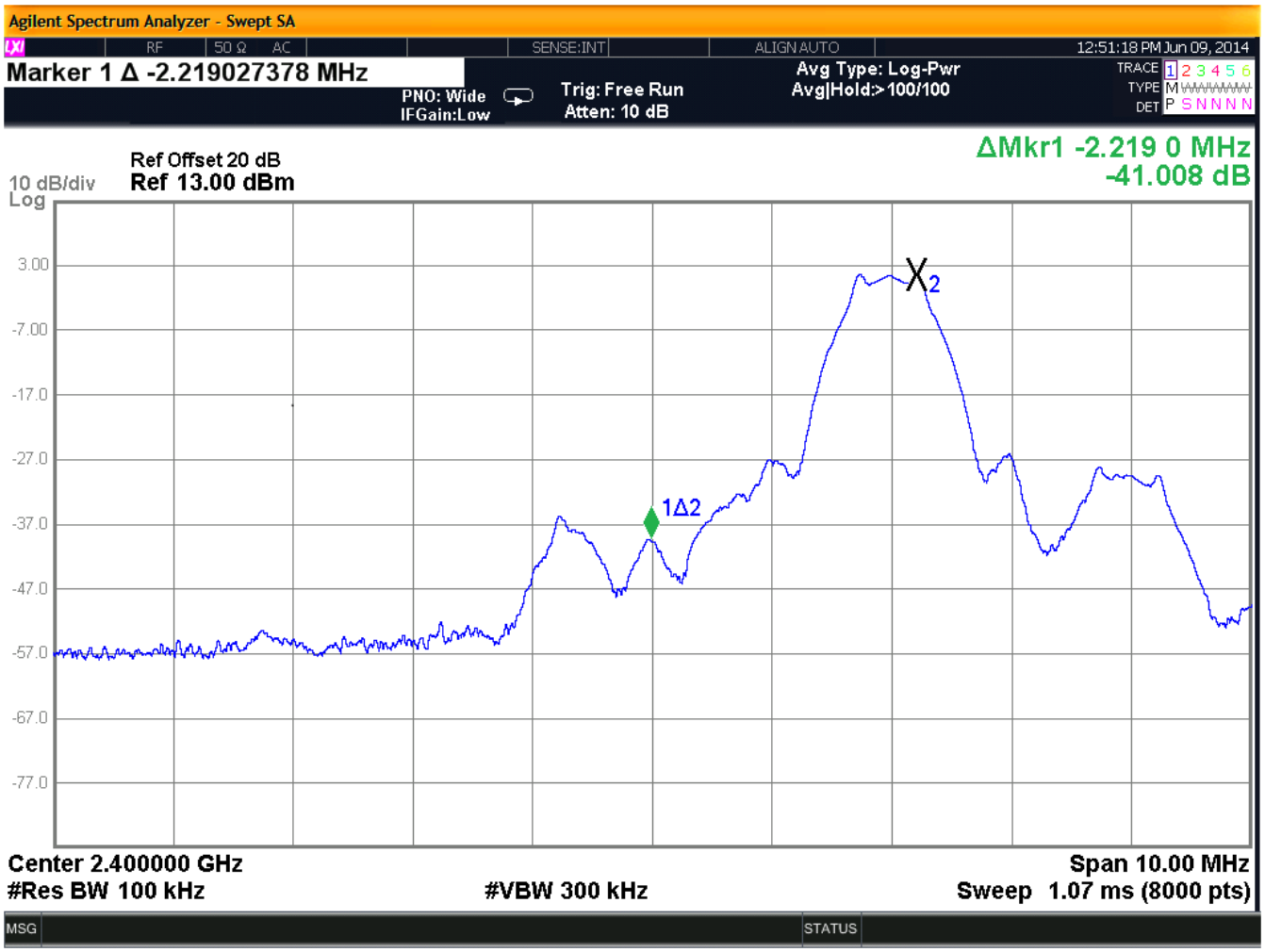

Figure 31: Lower Band-edge, Low Channel

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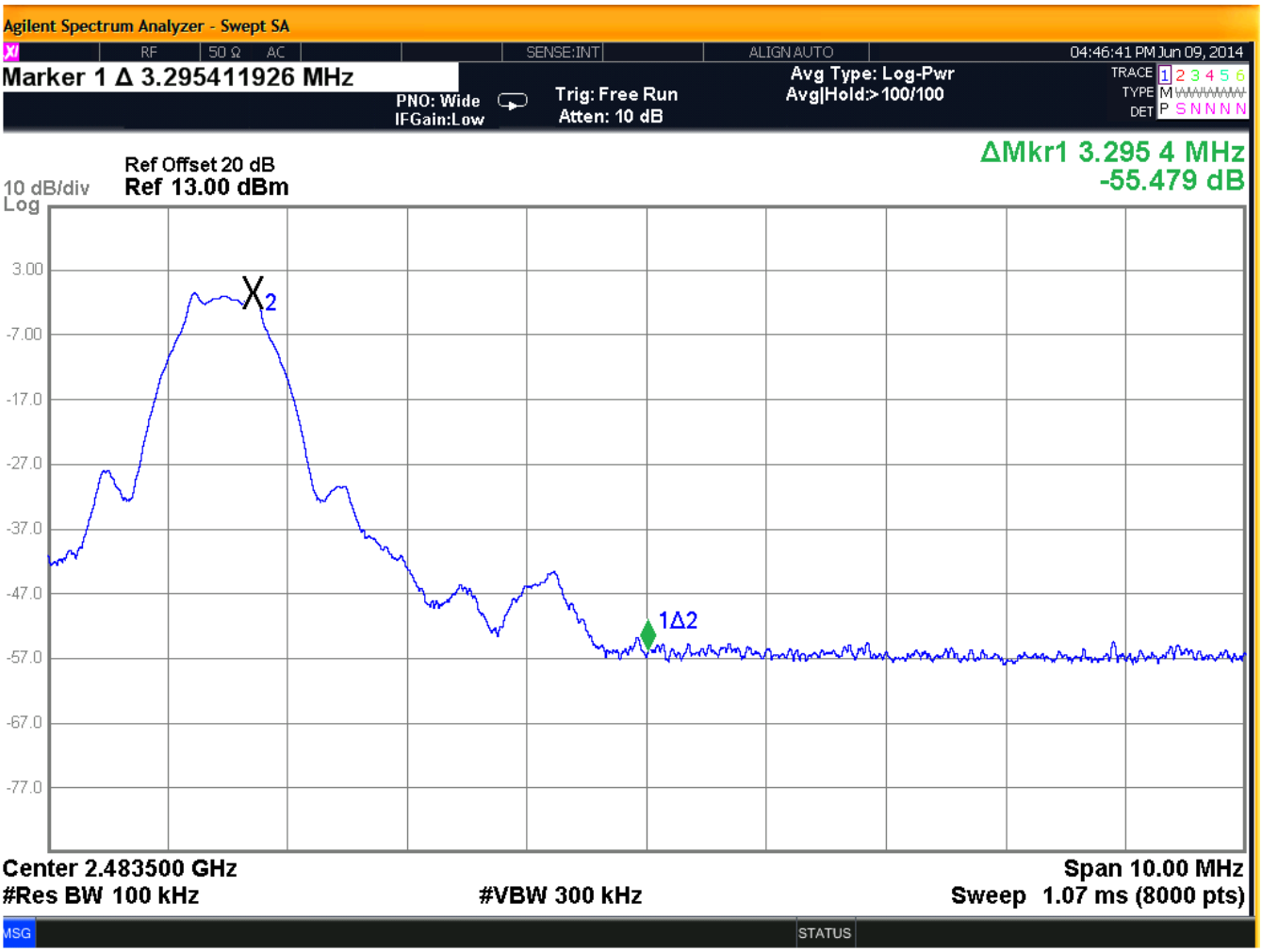

Figure 32: Upper Band-edge, High Channel

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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. The peripherals were placed on the table in accordance with ANSI C63.4-2003. Cables were varied in position to produce maximum emissions. Both the horizontal and vertical field components were measured.

The emissions were measured using the following resolution bandwidths:

Table 11: Spectrum Analyzer Settings

Frequency Range	Resolution Bandwidth	Video Bandwidth
30MHz-1000 MHz	120kHz	>100 kHz
>1000 MHz	1 MHz	10 Hz (Avg.), 1MHz (Peak)

Average measurements above 1GHz were made with the Spectrum analyzer set to the linear mode with a Video bandwidth of 10Hz, and the resultant reading mathematically converted to dBuV. Correction factors were then applied and the resulting value was compared to the limit.

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Table 12: Radiated Emission Test Data, (<1GHz)

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)	Comments
43.79	V	180.00	1.00	12.10	12.2	16.4	100.0	-15.7	
63.18	V	90.00	1.00	17.30	8.6	19.8	100.0	-14.1	
77.18	V	90.00	1.00	17.70	9.3	22.3	100.0	-13.0	
109.51	V	90.00	1.00	13.20	14.2	23.4	150.0	-16.1	
143.37	V	0.00	1.00	7.20	14.4	12.1	150.0	-21.9	
165.22	V	0.00	1.00	7.80	13.8	12.0	150.0	-22.0	
204.43	V	0.00	1.00	9.00	13.0	12.6	150.0	-21.5	
262.79	V	0.00	1.00	8.50	14.5	14.1	200.0	-23.0	
301.81	V	315.00	1.00	6.60	15.4	12.7	200.0	-24.0	
321.35	V	180.00	1.10	5.10	16.0	11.3	200.0	-24.9	
400.00	V	315.00	1.30	8.50	18.1	21.4	200.0	-19.4	
52.73	H	180.00	3.80	8.60	8.1	6.9	100.0	-23.3	
58.35	H	135.00	3.80	7.80	8.1	6.2	100.0	-24.1	
77.18	H	135.00	3.80	4.70	9.3	5.0	100.0	-26.0	
165.22	H	180.00	3.50	4.90	13.8	8.6	150.0	-24.9	
204.43	H	180.00	3.50	5.40	13.0	8.4	150.0	-25.1	
263.71	H	225.00	3.10	4.40	14.6	8.9	200.0	-27.0	
321.35	H	225.00	3.10	4.50	16.0	10.6	200.0	-25.5	
400.00	H	225.00	2.80	6.90	18.1	17.8	200.0	-21.0	

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Table 13: Radiated Emission Test Data, (>1GHz), EUT Flat (Restricted Bands/Band Edge)

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)	Comments
2390.00	V	180.00	1.00	57.53	-17.5	100.8	5000.0	-33.9	Restricted Band
2390.00	V	180.00	1.00	47.30	-17.5	31.0	500.0	-24.1	Restricted Band
2400.00	V	180.00	1.00	66.06	-17.4	269.9	5000.0	-25.4	Band Edge
2400.00	V	180.00	1.00	59.91	-17.4	133.0	500.0	-11.5	Band Edge
2402.00	V	180.00	1.00	96.79	-17.4	9308.6			Fc
2440.00	V	0.00	0.00	96.85	-17.0	9779.2			Fc
2480.00	V	180.00	1.00	97.06	-16.7	10473.3			Fc
2483.50	V	180.00	1.00	58.57	-16.6	125.0	5000.0	-32.0	Restricted Band/BE
2483.50	V	180.00	1.00	48.30	-16.6	38.3	500.0	-22.3	Restricted Band/BE
2390.00	H	45.00	1.00	57.83	-17.5	104.4	5000.0	-33.6	Restricted Band
2390.00	H	45.00	1.00	47.40	-17.5	31.4	500.0	-24.0	Restricted Band
2400.00	H	45.00	1.00	68.38	-17.4	352.6	5000.0	-23.0	Band Edge
2400.00	H	45.00	1.00	61.01	-17.4	151.0	500.0	-10.4	Band Edge
2402.00	H	45.00	1.00	98.61	-17.4	11481.2			Fc
2440.00	H	45.00	1.00	98.50	-17.0	11825.1			Fc
2480.00	H	45.00	1.00	98.63	-16.7	12542.5			Fc
2483.50	H	45.00	1.00	58.32	-16.6	121.5	5000.0	-32.3	Restricted Band/BE
2483.50	H	45.00	1.00	48.49	-16.6	39.2	500.0	-22.1	Restricted Band/BE

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Table 14: Radiated Emission Test Data, (>1GHz), EUT on Side, Long Edge (Restricted Bands/Band Edge)

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)	Comments
2390.00	V	90.00	1.00	56.50	-17.5	89.5	5000.0	-34.9	Restricted Band
2390.00	V	90.00	1.00	46.90	-17.5	29.6	500.0	-24.5	Restricted Band
2400.00	V	90.00	1.00	65.20	-17.4	244.6	5000.0	-26.2	Band Edge
2400.00	V	90.00	1.00	58.60	-17.4	114.4	500.0	-12.8	Band Edge
2402.00	V	90.00	1.00	94.60	-17.4	7234.1			Fc
2440.00	V	0.00	0.00	95.40	-17.0	8275.7			Fc
2480.00	V	90.00	1.00	95.20	-16.7	8450.6			Fc
2483.50	V	90.00	1.00	56.80	-16.6	102.0	5000.0	-33.8	Restricted Band/BE
2483.50	V	90.00	1.00	47.75	-16.6	36.0	500.0	-22.9	Restricted Band/BE
2390.00	H	180.00	1.00	56.80	-17.5	92.7	5000.0	-34.6	Restricted Band
2390.00	H	180.00	1.00	46.80	-17.5	29.3	500.0	-24.6	Restricted Band
2400.00	H	180.00	1.00	67.50	-17.4	318.7	5000.0	-23.9	Band Edge
2400.00	H	180.00	1.00	60.80	-17.4	147.4	500.0	-10.6	Band Edge
2402.00	H	180.00	1.00	96.40	-17.4	8899.9			Fc
2440.00	H	180.00	1.00	96.50	-17.0	9393.0			Fc
2480.00	H	180.00	1.00	96.27	-16.7	9558.4			Fc
2483.50	H	180.00	1.00	57.93	-16.6	116.2	5000.0	-32.7	Restricted Band/BE
2483.50	H	180.00	1.00	48.20	-16.6	37.9	500.0	-22.4	Restricted Band/BE

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Table 15: Radiated Emission Test Data, (>1GHz), EUT on Side, Short Edge (Restricted Bands/Band Edge)

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)	Comments
2390.00	V	90.00	1.00	56.30	-17.5	87.5	5000.0	-35.1	Restricted Band
2390.00	V	90.00	1.00	46.80	-17.5	29.3	500.0	-24.6	Restricted Band
2400.00	V	90.00	1.00	65.30	-17.4	247.4	5000.0	-26.1	Band Edge
2400.00	V	90.00	1.00	58.30	-17.4	110.5	500.0	-13.1	Band Edge
2402.00	V	90.00	1.00	94.80	-17.4	7402.6			Fc
2440.00	V	0.00	0.00	95.70	-17.0	8566.5			Fc
2480.00	V	90.00	1.00	95.60	-16.7	8848.8			Fc
2483.50	V	90.00	1.00	56.40	-16.6	97.4	5000.0	-34.2	Restricted Band/BE
2483.50	V	90.00	1.00	47.60	-16.6	35.4	500.0	-23.0	Restricted Band/BE
2390.00	H	180.00	1.00	56.90	-17.5	93.8	5000.0	-34.5	Restricted Band
2390.00	H	180.00	1.00	46.80	-17.5	29.3	500.0	-24.6	Restricted Band
2400.00	H	180.00	1.00	67.40	-17.4	315.1	5000.0	-24.0	Band Edge
2400.00	H	180.00	1.00	60.60	-17.4	144.0	500.0	-10.8	Band Edge
2402.00	H	180.00	1.00	96.60	-17.4	9107.2			Fc
2440.00	H	180.00	1.00	96.60	-17.0	9501.8			Fc
2480.00	H	180.00	1.00	96.80	-16.7	10159.8			Fc
2483.50	H	180.00	1.00	57.60	-16.6	111.8	5000.0	-33.0	Restricted Band/BE
2483.50	H	180.00	1.00	48.00	-16.6	37.0	500.0	-22.6	Restricted Band/BE

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5.6 Receiver 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.

5.6.1 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. The peripherals were placed on the table in accordance with ANSI C63.4-2003. Cables were varied in position to produce maximum emissions. Both the horizontal and vertical field components were measured.

The emissions were measured using the following resolution bandwidths:

Table 16: Spectrum Analyzer Settings

Frequency Range	Resolution Bandwidth	Video Bandwidth
30MHz-1000 MHz	120kHz	>100 kHz
>1000 MHz	1 MHz	10 Hz (Avg.), 1MHz (Peak)

Average measurements above 1GHz were made with the Spectrum analyzer set to the linear mode with a Video bandwidth of 10Hz, and the resultant reading mathematically converted to dBuV. Correction factors were then applied and the resulting value was compared to the limit.

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Table 17: Radiated Emission Test Data, Receiver

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)	Comments
43.79	V	180.00	1.00	12.10	12.2	16.4	100.0	-15.7	
63.18	V	90.00	1.00	17.30	8.6	19.8	100.0	-14.1	
77.18	V	90.00	1.00	17.70	9.3	22.3	100.0	-13.0	
109.51	V	90.00	1.00	13.20	14.2	23.4	150.0	-16.1	
143.37	V	0.00	1.00	7.20	14.4	12.1	150.0	-21.9	
165.22	V	0.00	1.00	7.80	13.8	12.0	150.0	-22.0	
204.43	V	0.00	1.00	9.00	13.0	12.6	150.0	-21.5	
262.79	V	0.00	1.00	8.50	14.5	14.1	200.0	-23.0	
301.81	V	315.00	1.00	6.60	15.4	12.7	200.0	-24.0	
321.35	V	180.00	1.10	5.10	16.0	11.3	200.0	-24.9	
400.00	V	315.00	1.30	8.50	18.1	21.4	200.0	-19.4	
52.73	H	180.00	3.80	8.60	8.1	6.9	100.0	-23.3	
58.35	H	135.00	3.80	7.80	8.1	6.2	100.0	-24.1	
77.18	H	135.00	3.80	4.70	9.3	5.0	100.0	-26.0	
165.22	H	180.00	3.50	4.90	13.8	8.6	150.0	-24.9	
204.43	H	180.00	3.50	5.40	13.0	8.4	150.0	-25.1	
263.71	H	225.00	3.10	4.40	14.6	8.9	200.0	-27.0	
321.35	H	225.00	3.10	4.50	16.0	10.6	200.0	-25.5	
400.00	H	225.00	2.80	6.90	18.1	17.8	200.0	-21.0	

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5.7 AC Conducted Emissions

5.7.1 Requirements

Test Arrangement: Table Top

Compliance Standard: FCC Class B

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

5.7.2 Test Procedure

The EUT was 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 C63.4-2003. 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.

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

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5.7.3 Test Data

The EUT complied with the Class B Conducted Emissions requirements. This system runs off of 120VAC or 230VAC. The following tables provide the test results for phase and neutral line power line conducted emissions.

Conducted Emissions was tested with the radio in the "transmit on" state.

Table 18: Conducted Emissions Data 120VAC, Transmit On

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)
0.186	30.2	17.0	10.1	0.2	40.6	27.3	64.2	54.2	-23.6	-26.9
0.226	24.5	14.7	10.1	0.2	34.8	25.1	62.6	52.6	-27.8	-27.5
0.649	17.8	8.7	10.1	0.4	28.3	19.1	56.0	46.0	-27.7	-26.9
0.672	20.7	9.9	10.1	0.4	31.2	20.4	56.0	46.0	-24.8	-25.6
1.607	13.7	6.2	10.4	0.3	24.4	16.9	56.0	46.0	-31.6	-29.1
1.860	13.9	6.3	10.4	0.3	24.7	17.1	56.0	46.0	-31.3	-28.9

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)
0.186	29.5	18.1	10.1	0.1	39.6	28.2	64.2	54.2	-24.6	-26.0
0.226	28.0	16.1	10.1	0.1	38.2	26.3	62.6	52.6	-24.4	-26.3
0.649	26.0	19.7	10.1	0.4	36.5	30.2	56.0	46.0	-19.5	-15.8
0.672	29.1	23.4	10.1	0.4	39.6	33.9	56.0	46.0	-16.4	-12.1
1.607	21.8	15.5	10.4	0.3	32.4	26.1	56.0	46.0	-23.6	-19.9
1.860	21.4	14.9	10.4	0.3	32.1	25.7	56.0	46.0	-23.9	-20.3

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