FCC & ISED CANADA CERTIFICATION

TEST REPORT

for the

EATON ENERGY AUTOMATION SOLUTION DIVISION

FCC ID: P9X-RFG301

IC ID: 6766A-RFG301

WLL REPORT# 17100-01 REV 1

Prepared for:

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Suite 480 Rockville, Maryland

Prepared By:

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Frederick, Maryland 21703

Testing Certificate AT-1448

FCC & ISED Canada Certification

Test Report

for the

Eaton Energy Products

Zenner Gas node

FCC ID: P9X-RFG301

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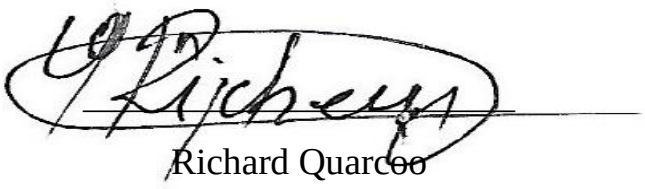
June 25, 2021

WLL Report# 17100-01 Rev 1

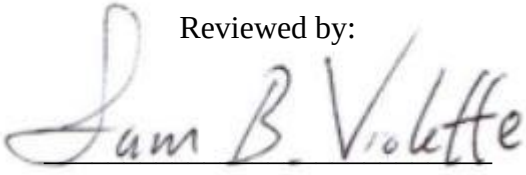
Prepared by:



Richard Quarcoo

Compliance Engineer

Reviewed by:



Samuel B. Violette

VP of Operations

Abstract

This report has been prepared on behalf of Eaton Energy to support the attached Application for Equipment Authorization. The test report and application are submitted for a Frequency Hopping Spread Spectrum (FHSS) Transmitter under Part 15.247 of the FCC Rules and Regulations and Spectrum Management and Telecommunications Policy. This Certification Test Report documents the test configuration and test results for the Zenner Gas Node.

Testing was performed on an Open Area Test Site (OATS) of Washington Laboratories, Ltd, 4840 Winchester Boulevard Frederick, 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. Washington Laboratories, Ltd. has been accepted by the FCC and approved by ANAB under Testing Certificate AT-1448 as an independent FCC test laboratory.

The Zenner Gas Node complies with the limits for a Frequency Hopping Spread Spectrum

(FHSS) Transmitter device under FCC Part 15.247 and Innovation, Science and Economic Development Canada (ISED) RSS-247.

Revision History	Description of Change	Date
Rev 0	Initial Release	June 25, 2021
Rev 1	ACB Comments	July 12, 2021
Rev 2	ACB Comments	July 14, 2021

1 Contents

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2 Introduction

2.1 Compliance Statement

The Eaton Energy Products Zenner Gas node complies with a Frequency Hopping Spread Spectrum device in accordance with FCC Part 15.247 10/2014. Full test results are shown in subsequent sub-sections.

2.2 Test Scope

Tests for radiated and conducted emissions at EUT antenna port were performed as specified in ANSI C63.10:2013"American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices". This includes Frequency Hopping devices. The measurement equipment conforms to ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation.

2.3 Contract Information

Customer:	Eaton Energy Automation Solution
Purchase Order Number:	4513173716
Quotation Number:	72767

2.4 Test and Support Personnel

Washington Laboratories, LTD	Richard Quarcoo
Customer Representative	Steven Seymour

3 Equipment Under Test

3.1 EUT Identification & Description

The Eaton Energy Products Zenner Gas node is a wireless radio module, or Node, designed to be used in gas metering products. The Node enables communication of metering data between the meter and a remotely located Gateway or Relay Node device using an RF-mesh network. It is 3.3V battery powered board that transfers data wirelessly using frequency hopping spread spectrum (FHSS) within 902 MHz-928 MHz spectrum. It operates in 50 channels.

Table 1: Device Summary

Item	Self-contained radio transceiver
Manufacturer:	Eaton Energy
FCC ID:	P9X-RFG301
ISED ID:	6766A-RFG301
Model:	RFG-301
Serial Number of Unit Tested	Not Available
FCC Rule Parts:	§15.247
ISED Rule Part:	RSS 247 Issue 2
Frequency Range:	902-928 MHz
Maximum Output Power:	(23.9dBm) 0.25W
Modulation:	FSK
20 dB Occupied Bandwidth:	462.5 kHz (99%: 443.9kHz)
FCC Emissions Designator:	463KF1DXN
ISED Emissions Designator:	444KF1DXN
Keying:	Automatic
Type of Information:	Data
Number of Channels:	50
Power Output Level	Fixed
Antenna Connector	Hard wired
Antenna Type	Printed Circuit (PCB Embedded F-Type), 0dBi
Interface Cables:	USB

Maximum Data Rate:	153.8 kbps
Firmware;	D_E9810077_210514_1234_Gp
Test Software:	Tera Term V4.106

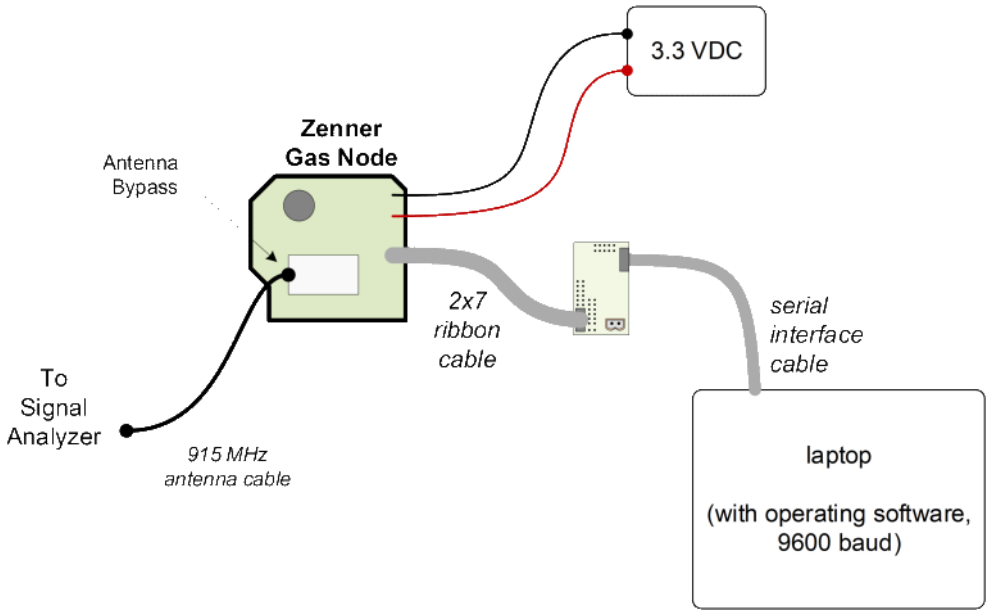
3.2 Test Configuration

The Zenner Gas node was tested via a laptop connection with a support interface board and ribbon cable. Please see Figure 1 for the test configuration.

Table 2: System Configuration List

Name / Description	Model Number	Part Number	Serial Number	Revision
Zenner Gas Node	Zenner Gas node	N/A	FCC-sma	1
Zenner Gas Node	Zenner Gas node	N/A	FCC-ant	1

Figure 1: Test Configuration: The Zenner Gas node



3.3 Support Equipment

Table 3: Support Equipment

Name / Description	Manufacturer	Model Number	Calibration Data
Node-to-Serial Interface Board	Eaton	N/A	N/A
supporting cables	N/A	N/A	N/A
3.3 VDC power supply	MPJA	14601PS	N/A
laptop w/ operating software	Eaton Energy Proprietary Software	N/A	N/A

3.4 Interface Cables

Table 4: Cable Configuration

Port Identification	Connector Type	Cable Length	Shielded (Y/N)	Termination Point
Power Input (3.3Vdc)	wire	<3m	N	Power Supply

3.5 Testing Algorithm

The Zenner Gas node was tested was connected to a laptop pc via a Sparkfun adapter and USB serial connector. HyperTerminal, terminal emulation software was used to send text-based commands via the Serial port connection. Various commands were used to set the power, mode/modulation, and channel. The EUT was programmed for FHSS operation via a laptop. **Worst cast emission levels** are provided in the test results data within this report.

3.6 Test Location

All measurements herein were performed at Washington Laboratories, Ltd. Test site located at 4840 Winchester, Frederick, 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 number for Washington Laboratories, Ltd. is 3035A. Washington Laboratories, Ltd. has been accepted by the FCC and approved by ANAB under Testing Certificate AT-1448 as an independent FCC test laboratory.

3.7 Measurements

3.7.1 References

ANSI C63.2 (Jan-2016) Specifications for Electromagnetic Noise and Field Strength Instrumentation

ANSI C63.4 (Jan 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

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

3.8 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 uc = standard uncertainty
a, b, c,.. = individual uncertainty elements
Diva, 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)
uc = 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 5 below.

Table 5: Expanded Uncertainty List

Scope	Standard(s)	Expanded Uncertainty
Radiated Emissions	FCC Part 15	±4.55 dB

Parameter	Uncertainty	Actual (+/-)
Radio Frequency	±1 x 10^{-7}	8.64E-08
RF Power conducted (up to 160 W)	±0.75 dB	0.3dB
Conducted RF Power variations using a test fixture	±0.75 dB	0.3dB
Radiated RF power	±6 dB	N/A
Average sensitivity (radiated)	±3 dB	N/A

4 Test Equipment

Table 6 shows a list of the test equipment used for measurements along with the calibration information.

Table 6: Test Equipment List

Test Name:	**Conducted Emissions Voltage**	Test Date:	**05/27/2021**
Asset #	**Manufacturer/Model**	**Description**	**Cal. Due**
00528	AGILENT E4446A	3HZ-44GHZ SPECTRUM ANALYZER	3/18/2022
Test Name:	**Radiated Emissions**	Test Date:	**05/28/2021**
Asset #	**Manufacturer/Model**	**Description**	**Cal. Due**
00528	AGILENT E4446A	3HZ-44GHZ SPECTRUM ANALYZER	3/18/2022
00644	SUNOL SCIENCES CORPORATION JB1 925-833-9936	BICONALOG ANTENNA	11/9/2022
00955	JUNKOSHA USA MWX322-18000AMSNMS/B	18M HF COAXIAL, SMA/N	5/10/2022
00425	ARA DRG-118/A	ANTENNA DRG 1-18GHZ	8/18/2022
00559	HP 8447D	AMPLIFIER	6/3/2022

5 Test Results

Table 7: Test results

Frequency Hopping Spread Spectrum - TX Test Summary			
FCC Rule Part	**IC Rule Part**	**Description**	**Result**
15.247 (a)(1)	RSS-247 [5.1a]	20dB Bandwidth	Pass
15.247 (b)	RSS-247 [5.4(a/b/c)]	Transmit Output Power	Pass
15.247 (a)(1)	RSS-247 [5.1b]	Channel Separation	Pass
15.247 (a)(1)	RSS-247 [5.4(c/d/e)]	Number of Channels	Pass
15.247 (a)(1)	RSS-247 [5.1(c/d/e)]	Time of Occupancy	Pass
15.247 (d)	RSS-247 [5.5]	Occupied BW / Out-of-Band Emissions (Band Edge @ 20dB below)	Pass
15.205 15.209	RSS-Gen [8.9/8.10]	General Field Strength Limits (Restricted Bands & RE Limits)	Pass
Frequency Hopping Spread Spectrum - RX/Digital Test Summary			
FCC Rule Part	**IC Rule Part**	**Description**	**Result**
15.209	RSS-Gen	General Field Strength Limits	Pass

5.1 Time Of Occupancy

Dwell time was measured by capturing on a spectrum analyzer a single pulse of the impulse train generated by 914.75MHz carrier signal. The latter spectrum of the hopping signal is displayed at zero span. Figure 2 shows the dwell time of the pulse. Figure 3 shows the impulse train within 100ms.

FCC part 15.247 also requires that for hopping signals with an occupied bandwidth of greater than 250kHz the total transmit dwell time must be no more than 0.4 seconds per 10 seconds. The occupy bandwidth of the transmitter under test is greater than 250kHz. Table 9 shows the result of the test.

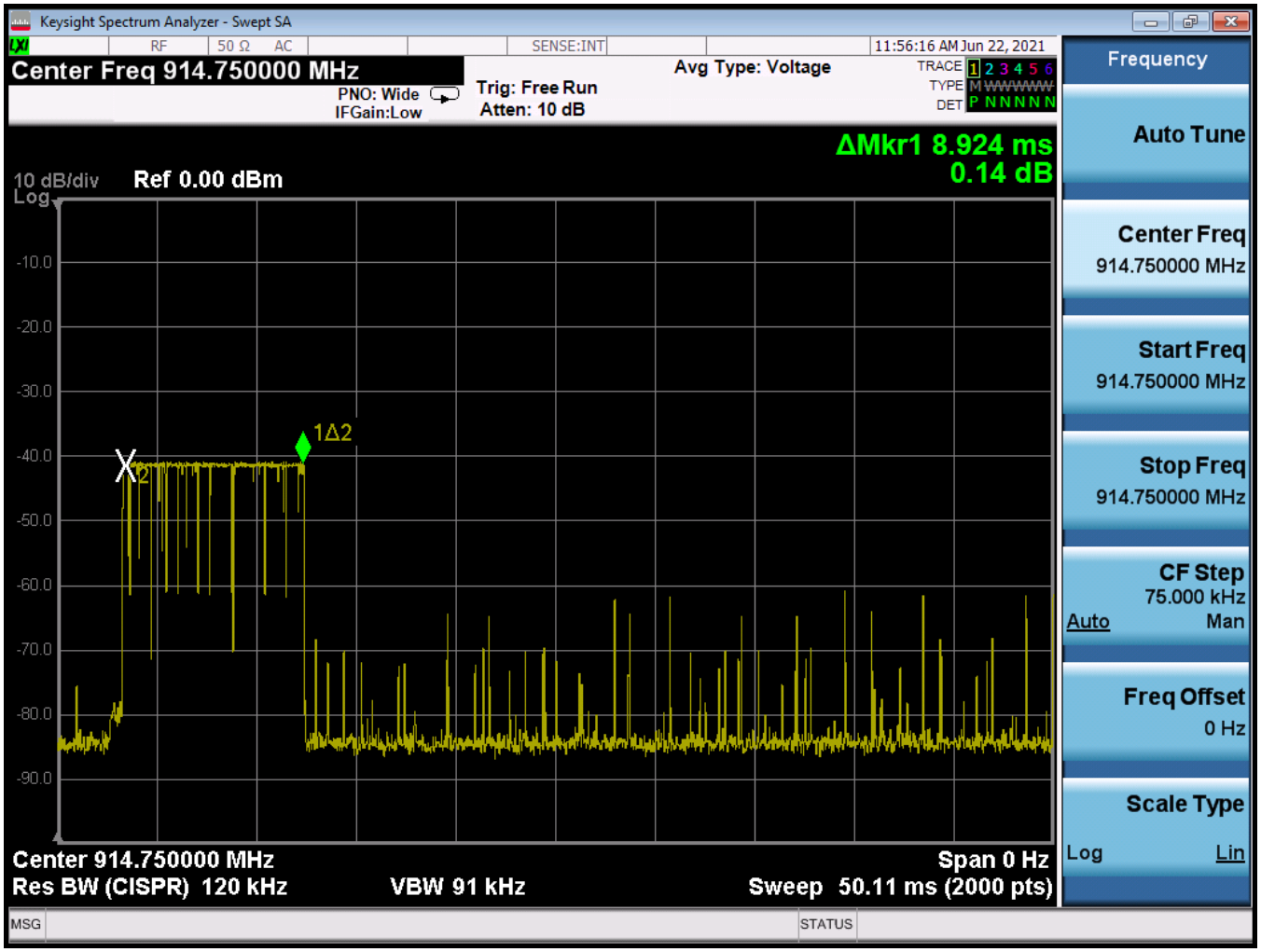


Figure 2 : Duty Cycle: Single Pulse

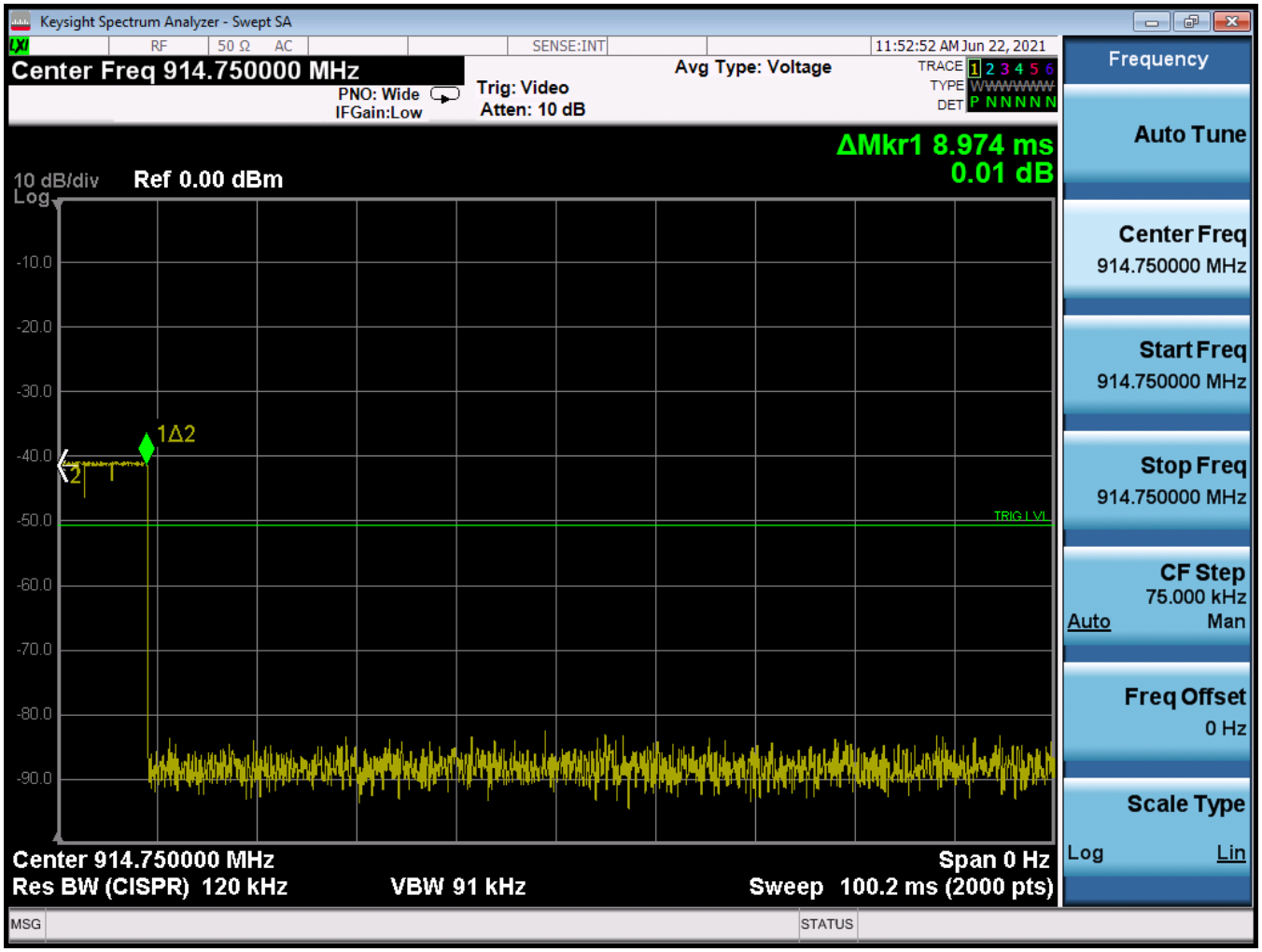


Figure 3 : Duty Cycle: Pulses in 100ms

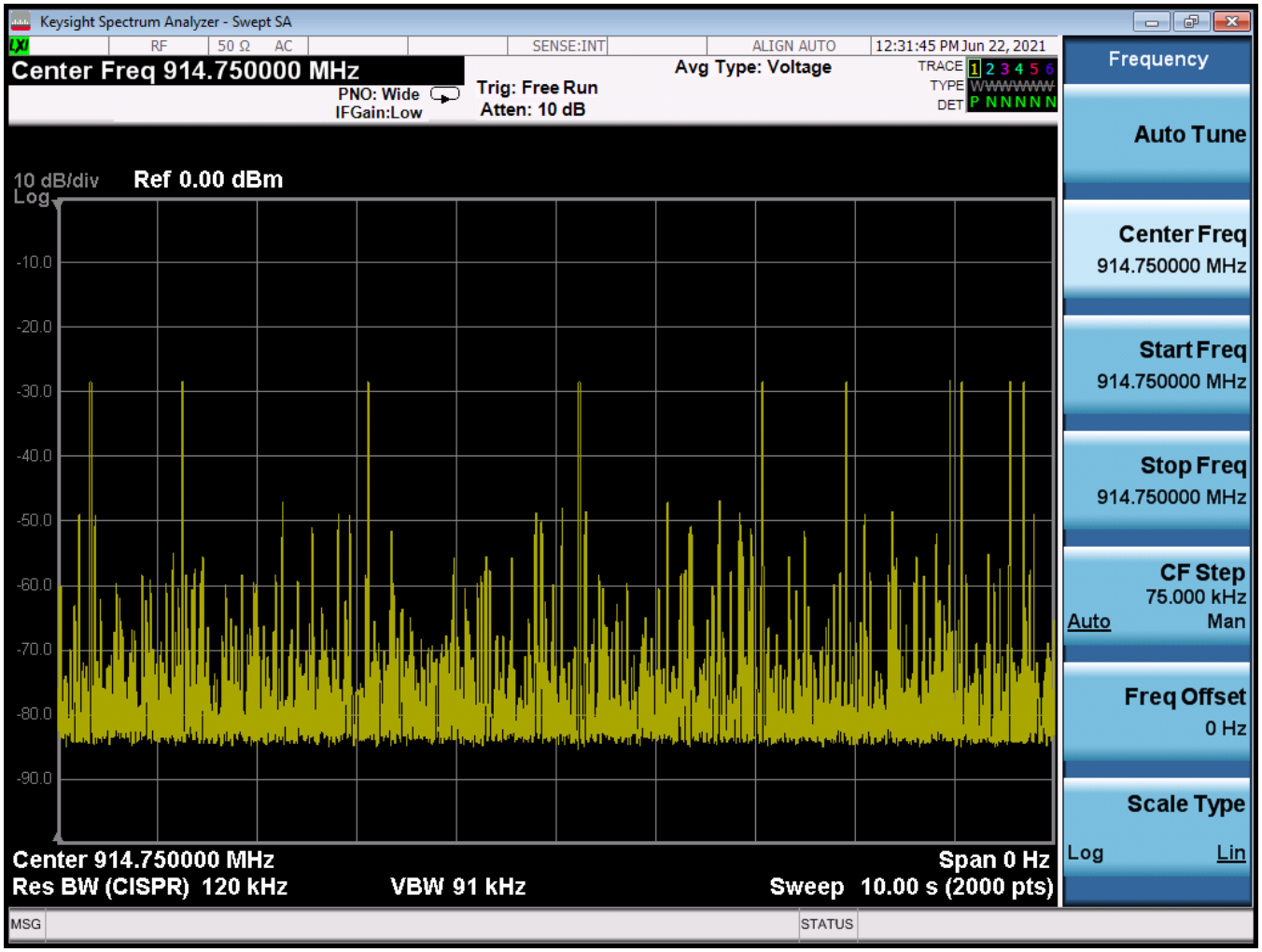


Table 8 : Time of Occupancy in 10 second sweep

Table 9: Time of Occupancy Test Results

Test	Result	Limit	Pass
Dwell time per Hop	8.9ms	NA	N/A
Dwell time per 100ms	8.9ms	N/A	N/A
Time of Occupancy	0.089/10seconds	0.4/10seconds	Pass

*Data rate of (153.6kb/s) setting was used to determine compliance.

5.2 RF Power Output: (FCC Part §2.1046)

To measure the output power, the EUT transmitter was set to transmit in CW mode only for maximum output power determination. The output of the transmitter was connected to a spectrum analyzer via an attenuator and a cable. The analyzer offset was adjusted to compensate for losses. For each power measurement, spectrum analyzer center frequency was set respectively to low, center, and high channels frequencies. Below are the recorded power levels.

Table 10: RF Output Power Test Data – with FSK

Frequency	Power Setting	Level (dBm)	Limit (dBm)	Pass/Fail
Low Channel: 902.75MHz	High	23.9	30	Pass
Center Channel: 914.75MHz	High	23.7	30	Pass
High Channel: 927.25MHz	High	23.8	30	Pass

*To demonstrate compliance on a worst-case basis, the EUT was set to the highest TX power.

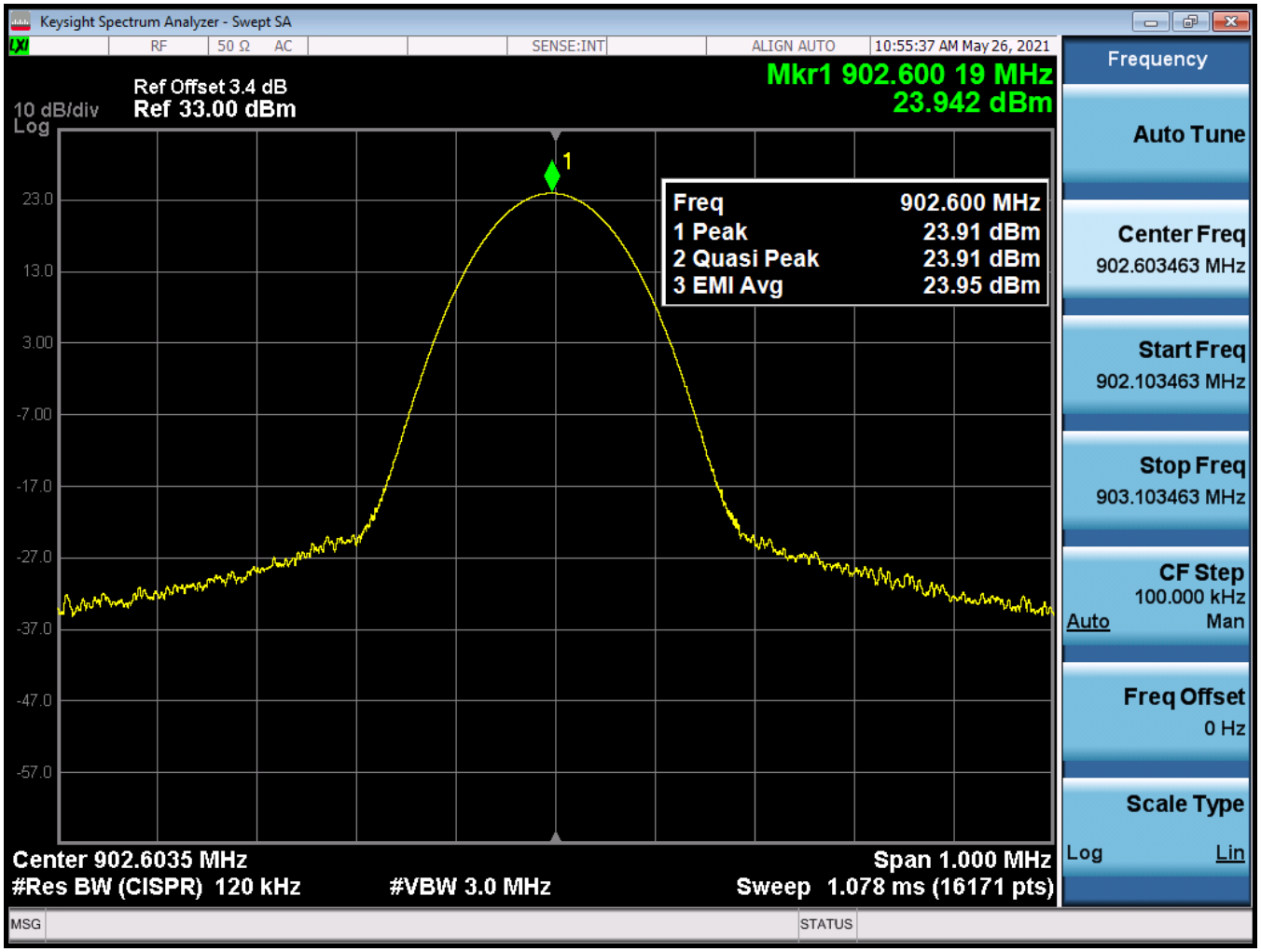


Figure 4: Low Channel, Conducted TX Power, High

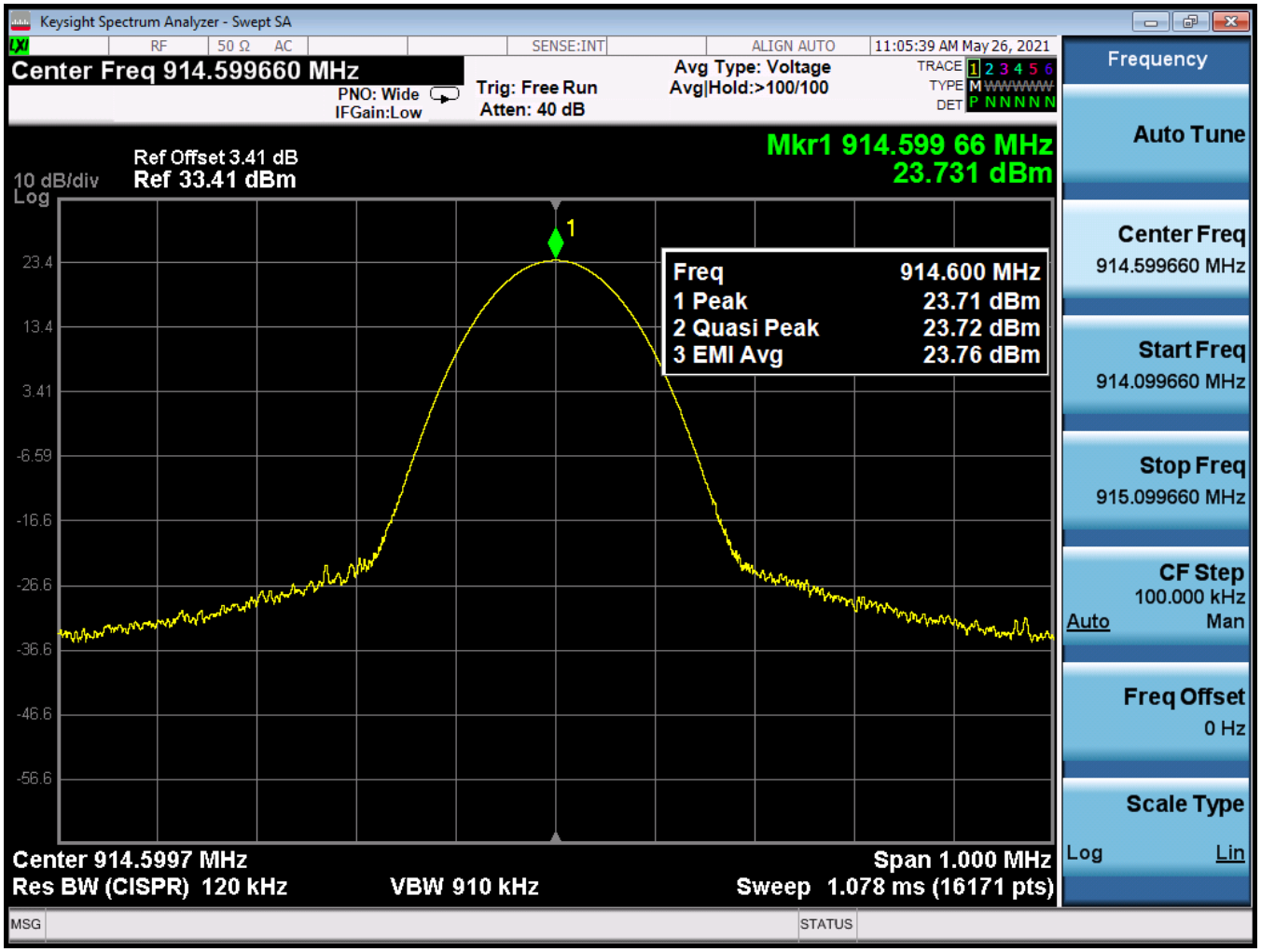


Figure 5: Middle Channel, Conducted TX Power, High

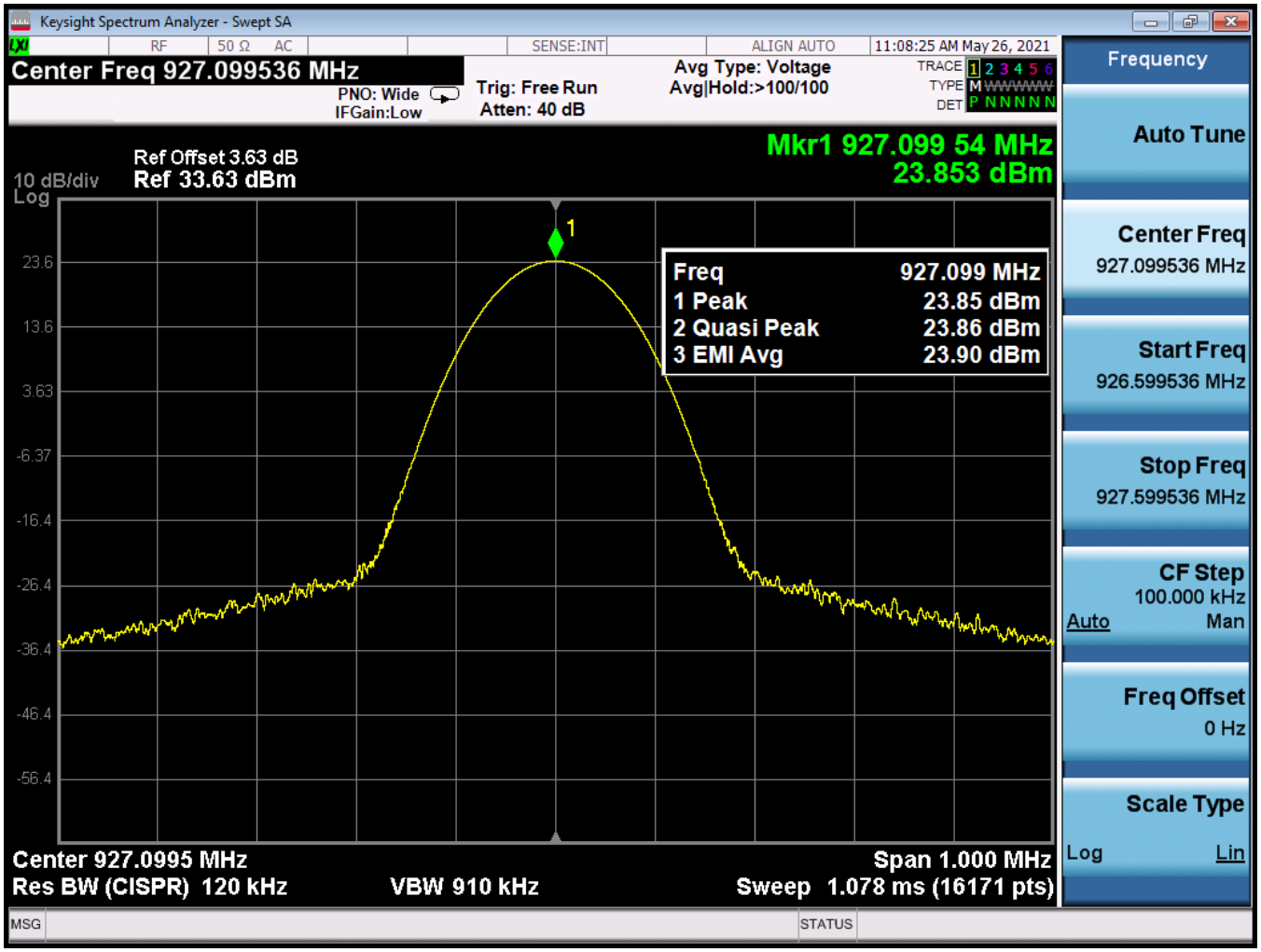


Figure 6: High Channel, Conducted TX Power, High

5.3 Occupied Bandwidth (FCC PART §2.1049)

For Frequency Hopping Spread Spectrum Systems, FCC Part 15.247 requires the maximum 20 dB bandwidth not to exceed 500 kHz.

To capture the occupied bandwidth on the spectrum analyzer, the Zenner Gas node antenna terminal was coupled to the spectrum input. Using an operating software, at full modulation with transmission data rate set at 153.6kb/s, the occupied bandwidth was measured as shown below in Figure 4 through Figure 6. Table 9 shows Occupied bandwidth results.

Figure 7: Occupied bandwidth, Low Channel

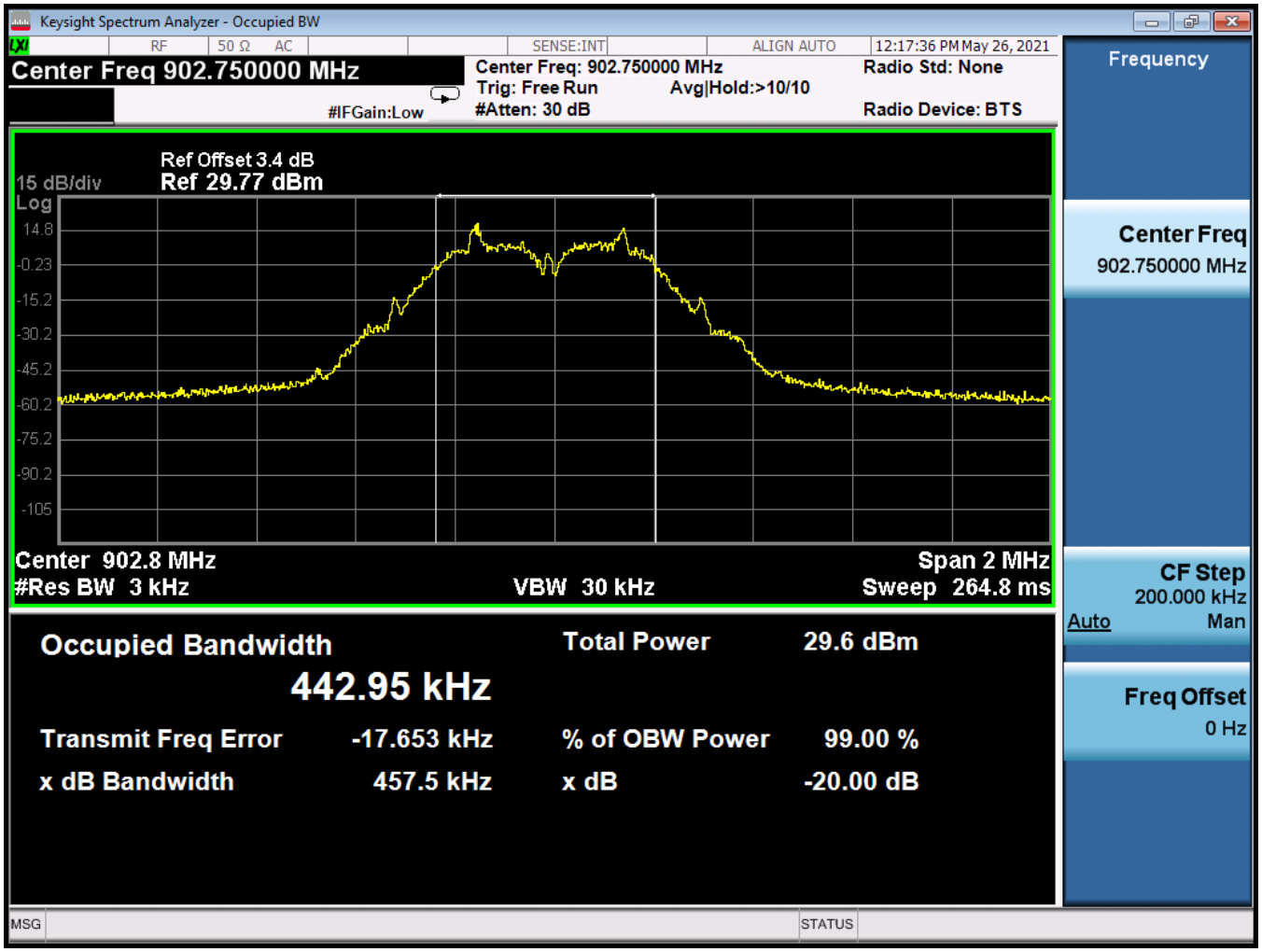


Figure 8: Occupied bandwidth, Mid Channel

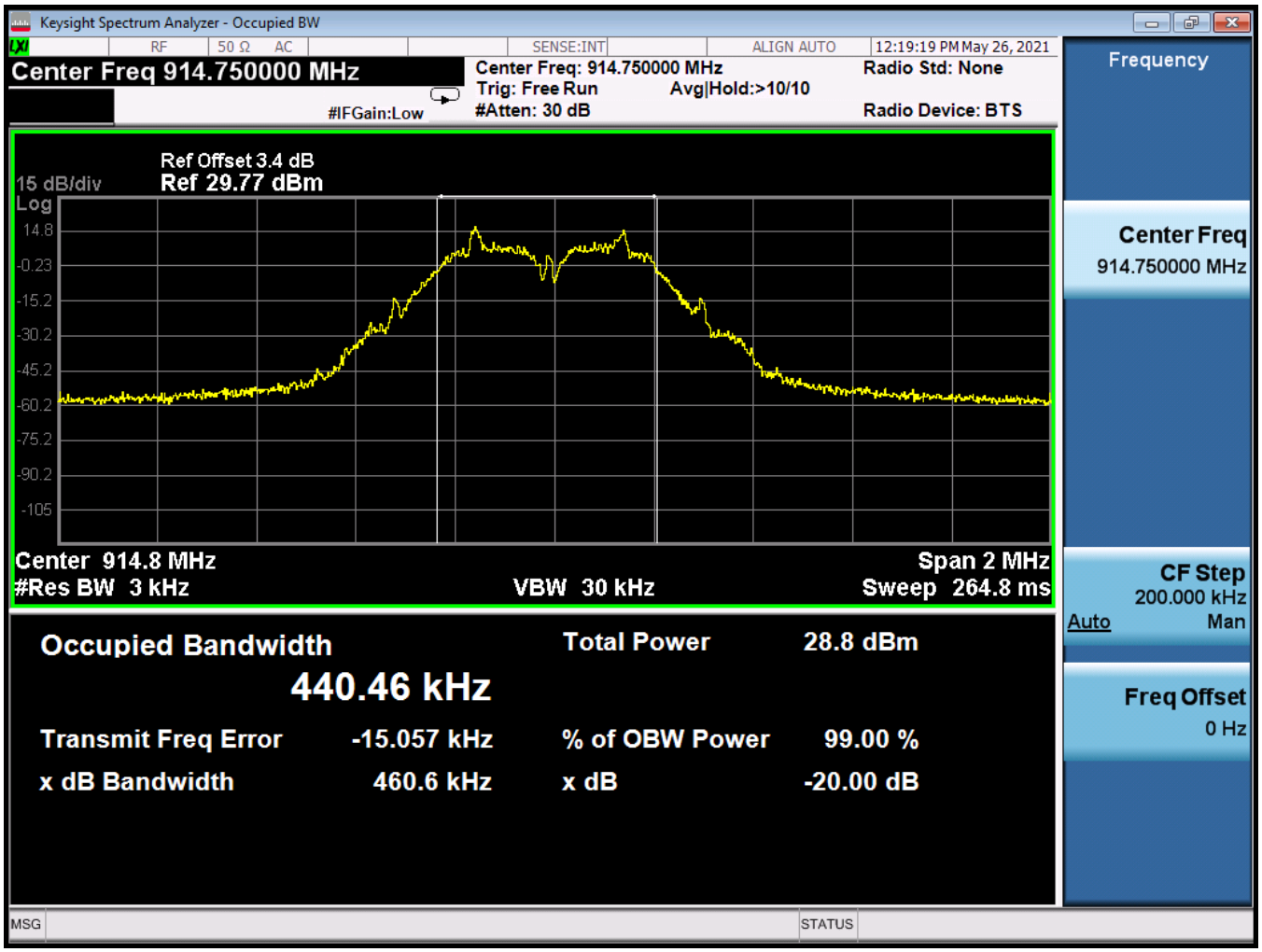


Figure 9: Occupied bandwidth, Upper Channel

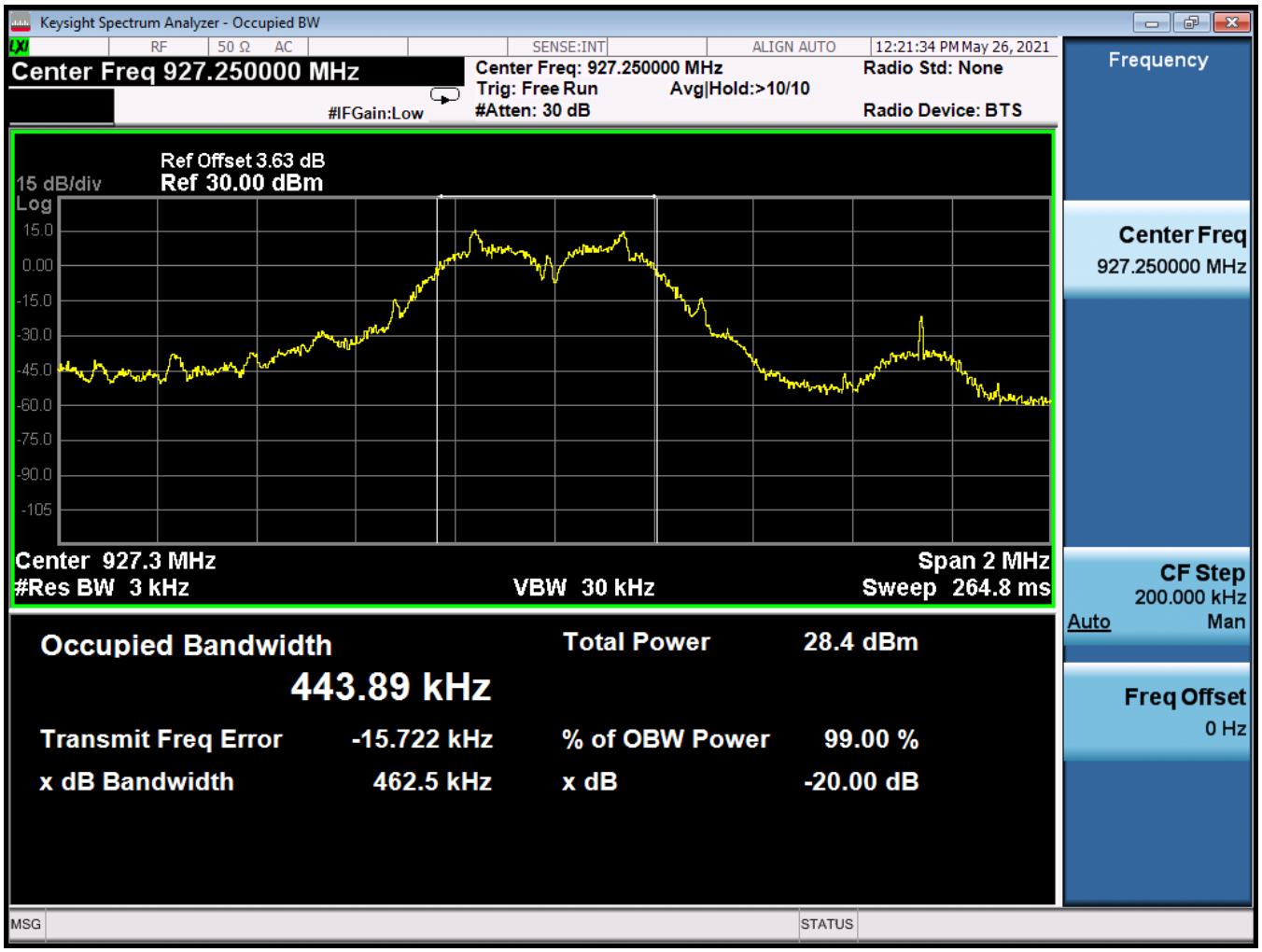


Table 11 : Occupied bandwidth results

Frequency	Bandwidth (kHz)	Limit (kHz)	Pass
Low Channel: 902.75MHz	457.5	500	Pass
Mid Channel: 914.75Hz	460.6	500	Pass
Upper Channel: 927.25MHz	462.5	500	Pass

5.4 Channel Spacing and number of Hop Channels (FCC PART §15.247(A)(1)

With the spectrum analyzer resolution bandwidth set to 100 kHz and the video bandwidth set to 1MHz, 2 adjacent channels spacing was measured using appropriate span setting.

Per the FCC requirements, frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 250 kHz or the 20dB bandwidth, whichever is greater. The maximum 20dB bandwidth measured for the EUT is 462.5kHz thus the channel spacing must be more than 462.5 kHz.

The maximum 20dB bandwidth measured for the EUT is 462.5kHz thus the channel spacing must be more than 462.5kHz.

Table 12 : Channel Spacing & Number of required hopping channels.

Frequency	Result	Limit	Pass
Channel Spacing	505~500kHz	250 kHz Minimum	Pass
Number of channels	50 Channels	≥50 Channels	Pass

Figure 10**:** Channel Spacing

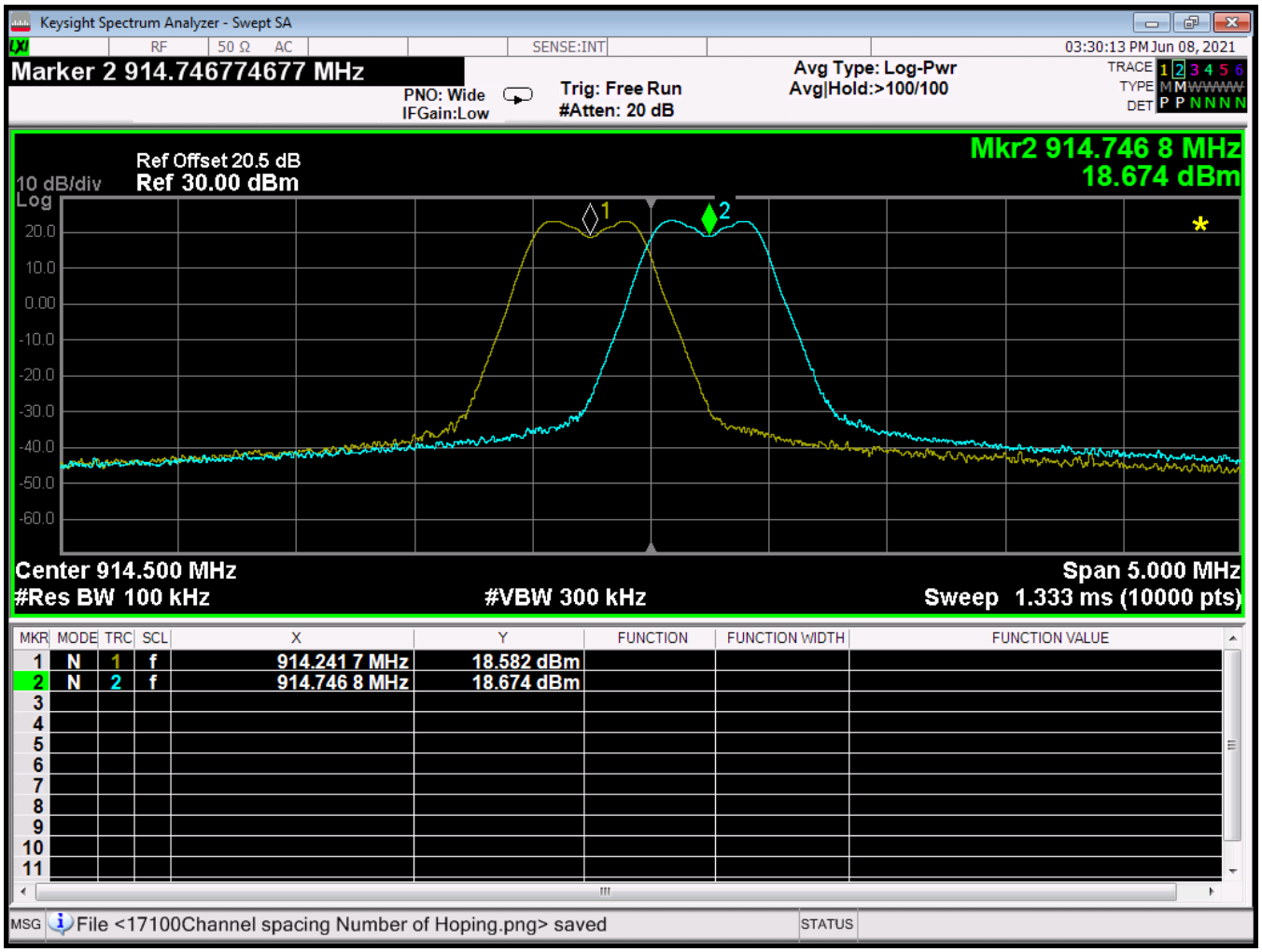
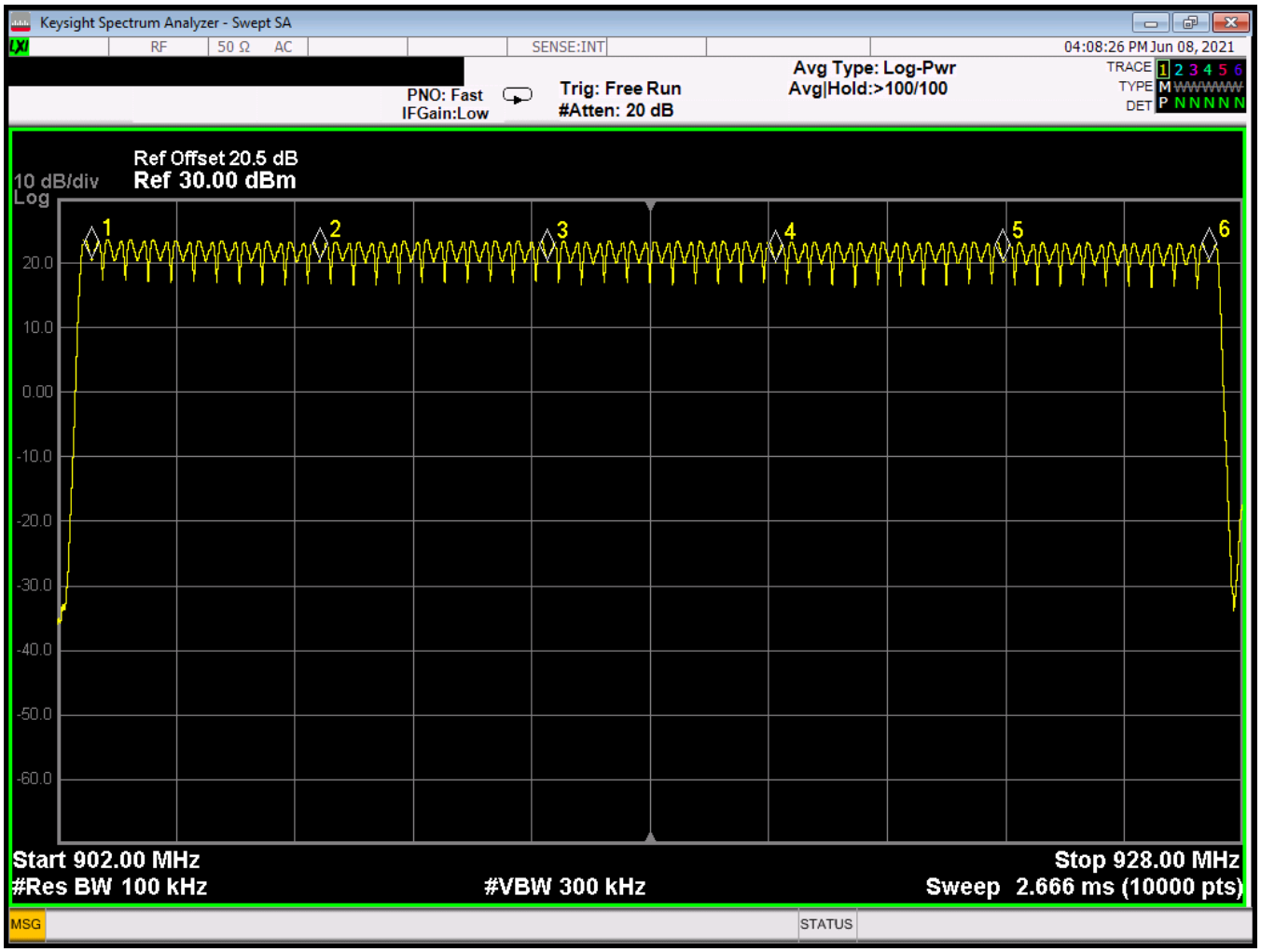


Figure 11 **:** Number of Hoping Channel



5.5 Conducted Spurious Emissions at the Antenna Port (FCC PART §2.1051)

The EUT must comply with requirements for spurious emissions at antenna terminals. Per §15.247(c) 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.

Prior to connecting the EUT antenna port to the spectrum analyzer, cable loss was determined by connecting a cable to the output of a signal generator and to the input of a spectrum analyzer via an attenuator. A reference offset was entered into the spectrum analyzer to compensate for the loss of the external attenuator and other connectors. 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.

The following are plots of the conducted spurious emissions using the highest data rate & transmit power.

Figure 12: Conducted Spurious Emissions Low Channel 30 –900MHz

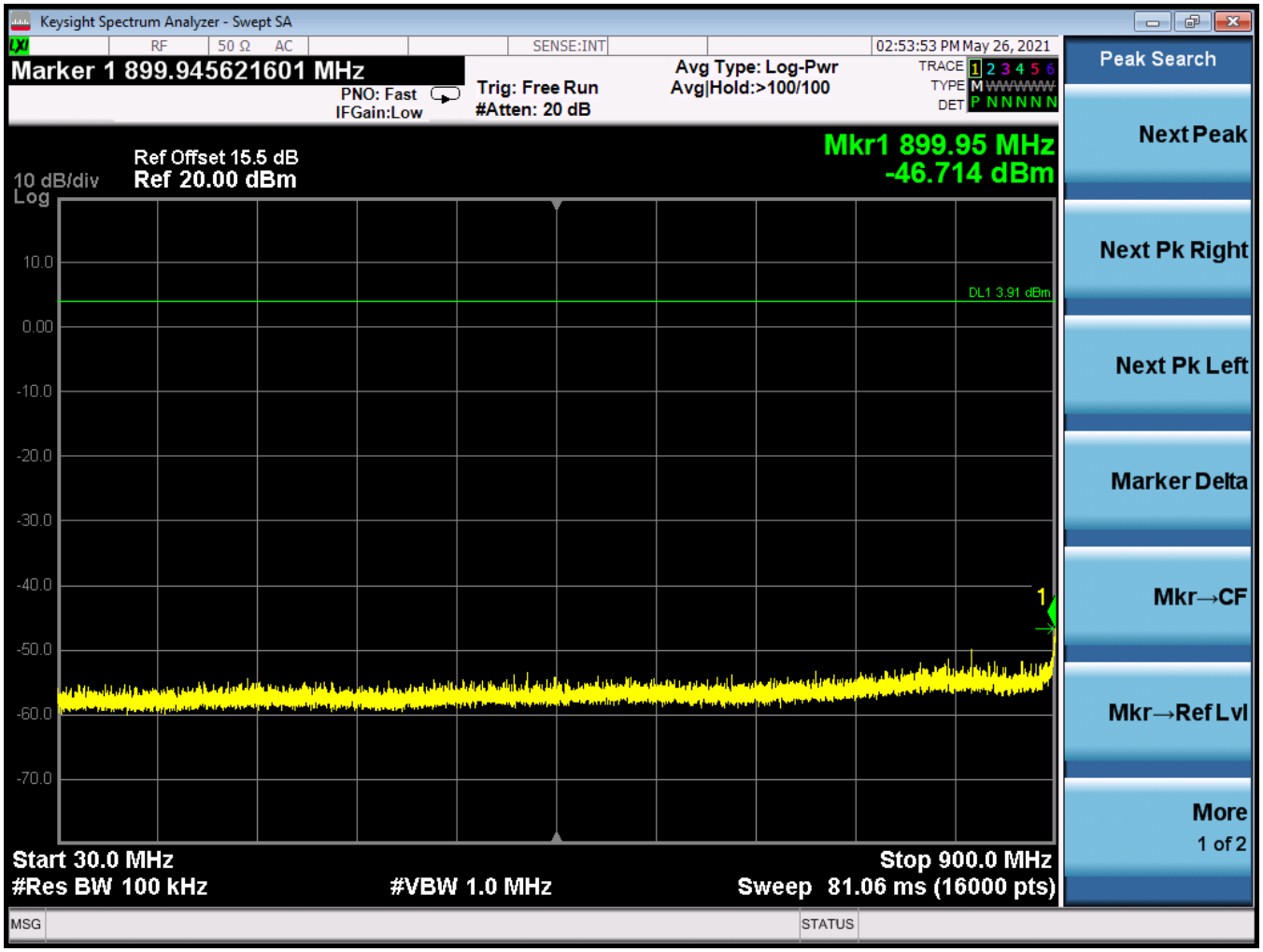


Figure 13 : Conducted Spurious Emissions Low Channel 900 –930MHz

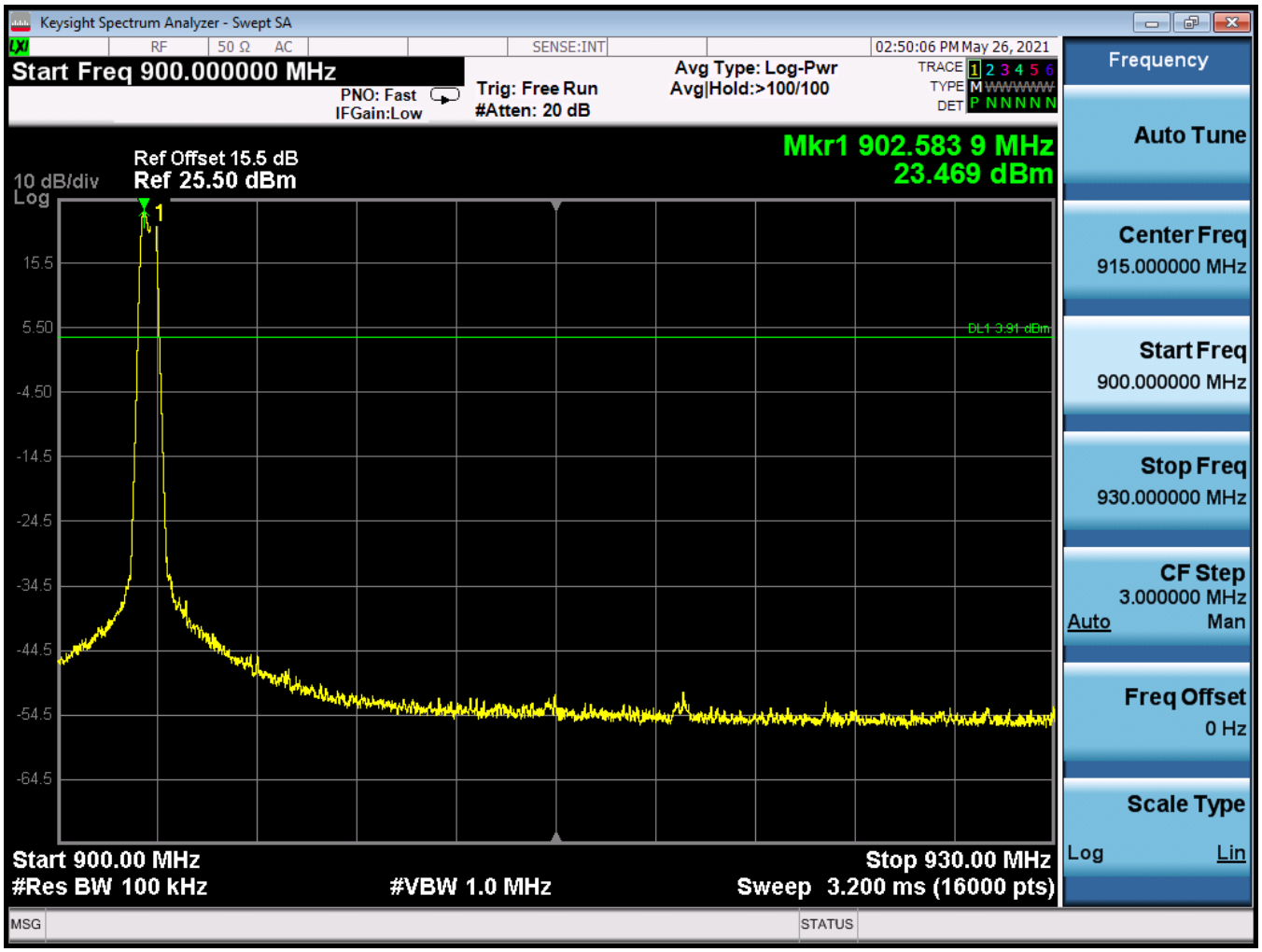


Figure 14: Conducted Spurious Emissions Low Channel 930 –5GHz

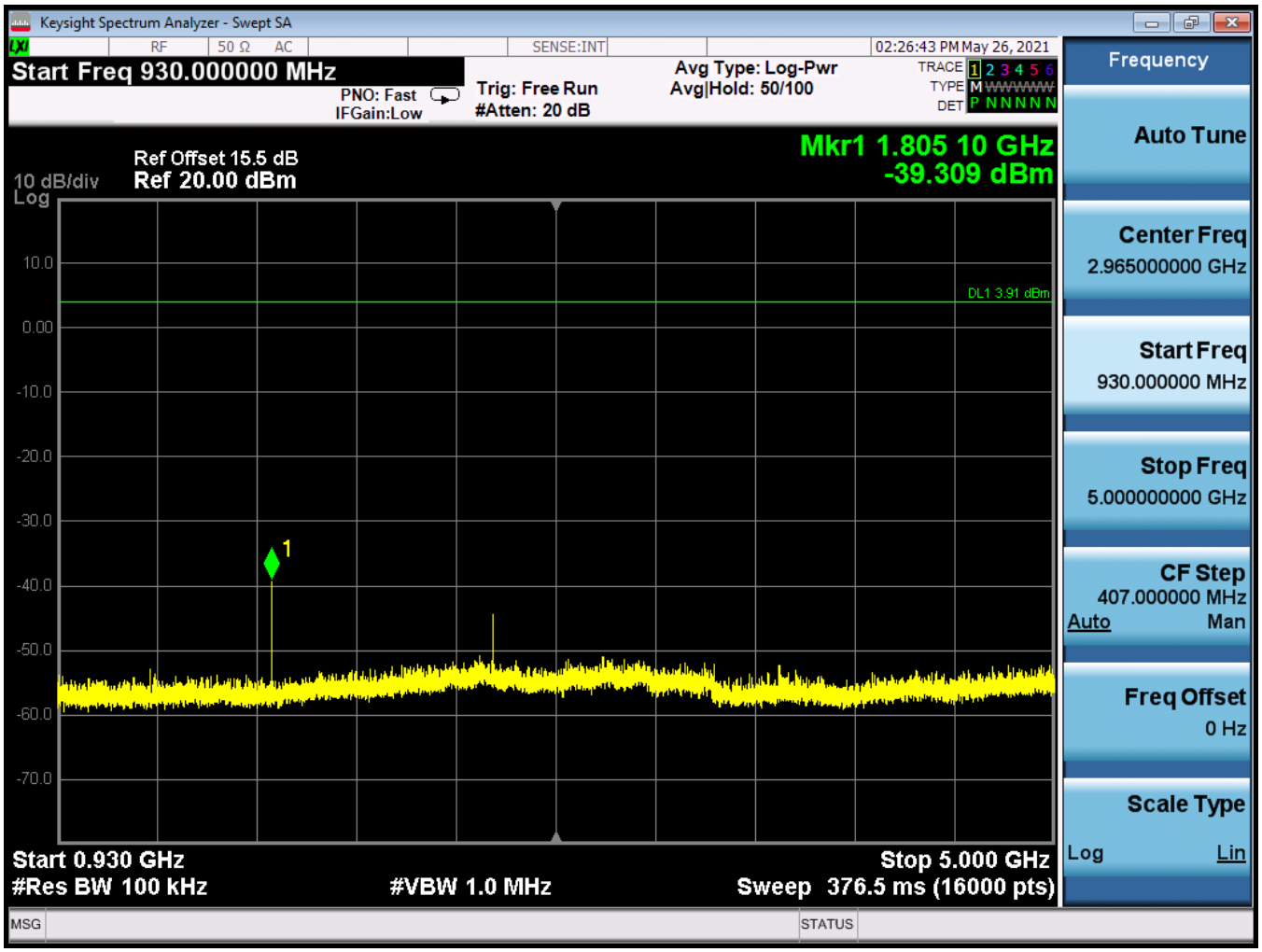


Figure 15 : Conducted Spurious Emissions Low Channel 5–10GHz

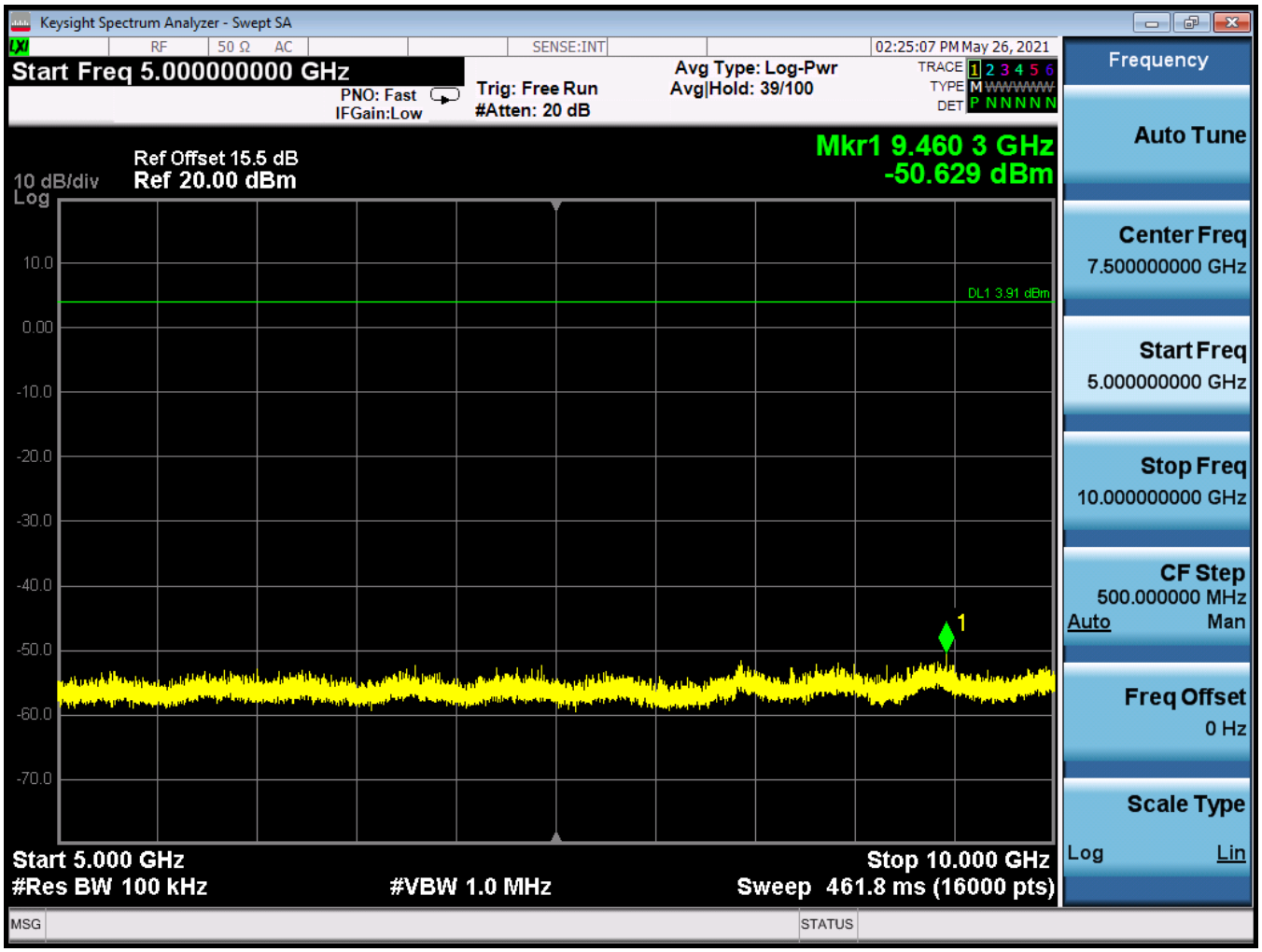


Figure 16 : Conducted Spurious Emissions Mid Channel 30 –900MHz

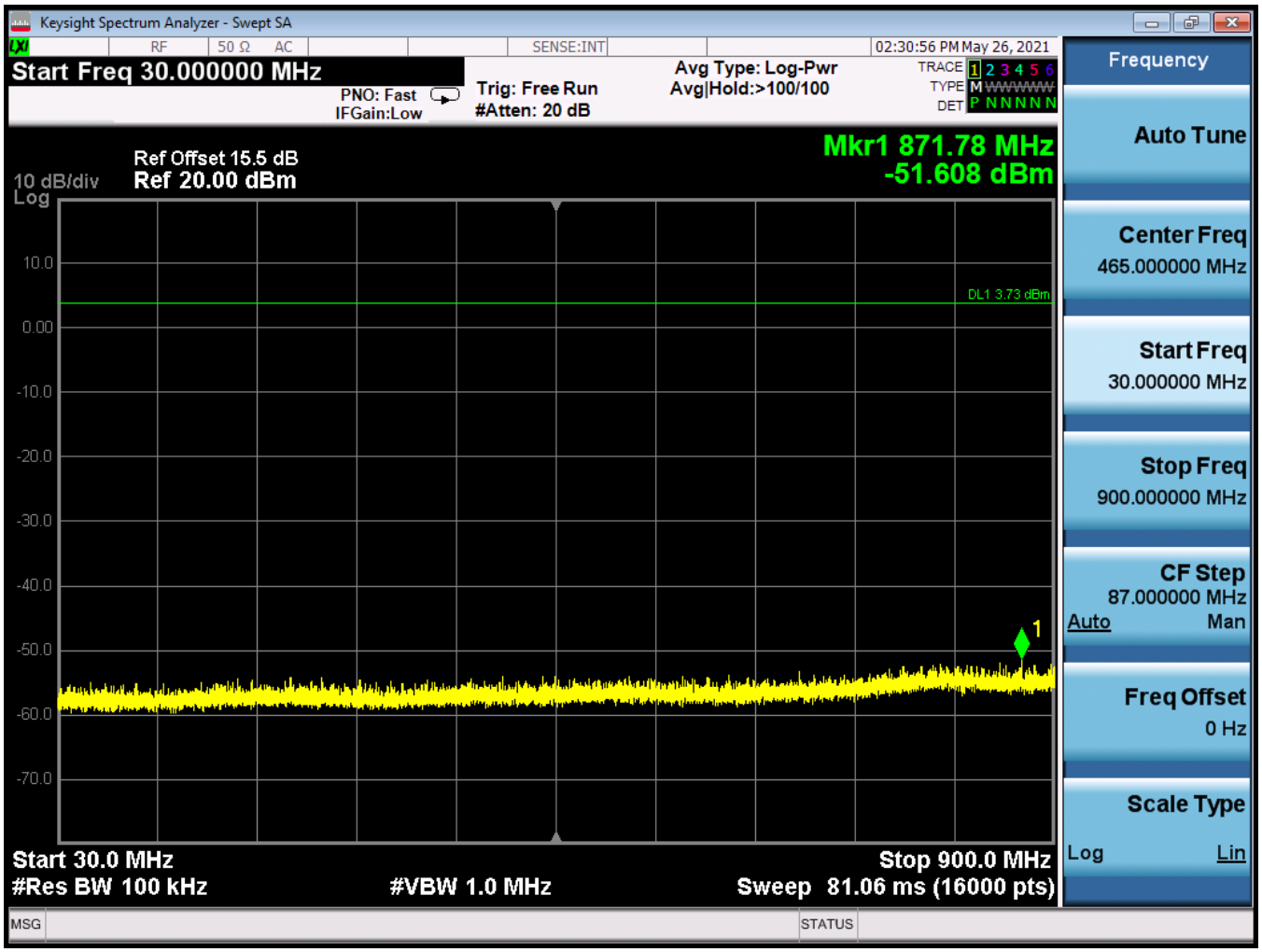


Figure 17 : Conducted Spurious Emissions Mid Channel 900 –930MHz

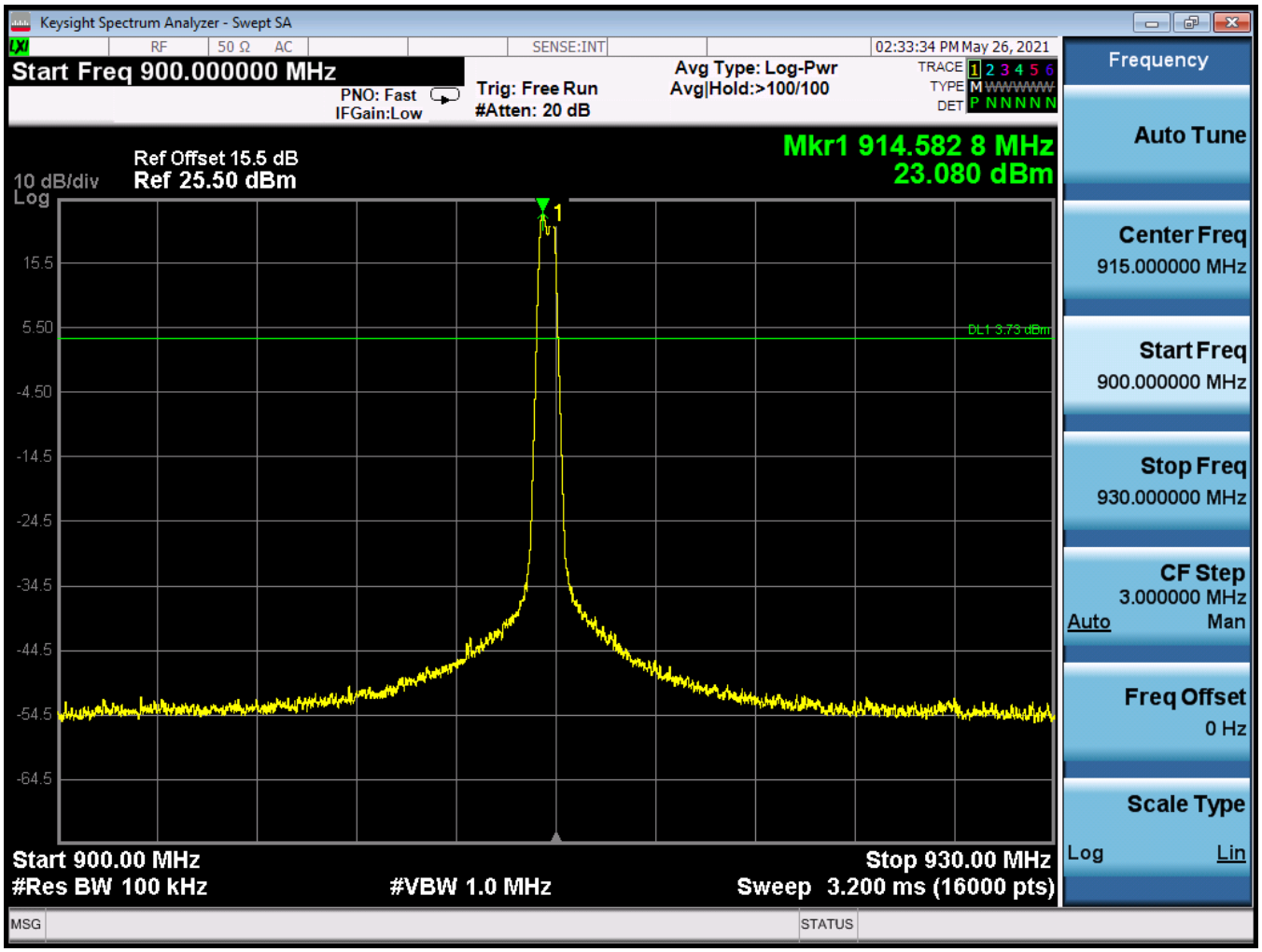


Figure 18 : Conducted Spurious Emissions Mid Channel 930 –5GHz

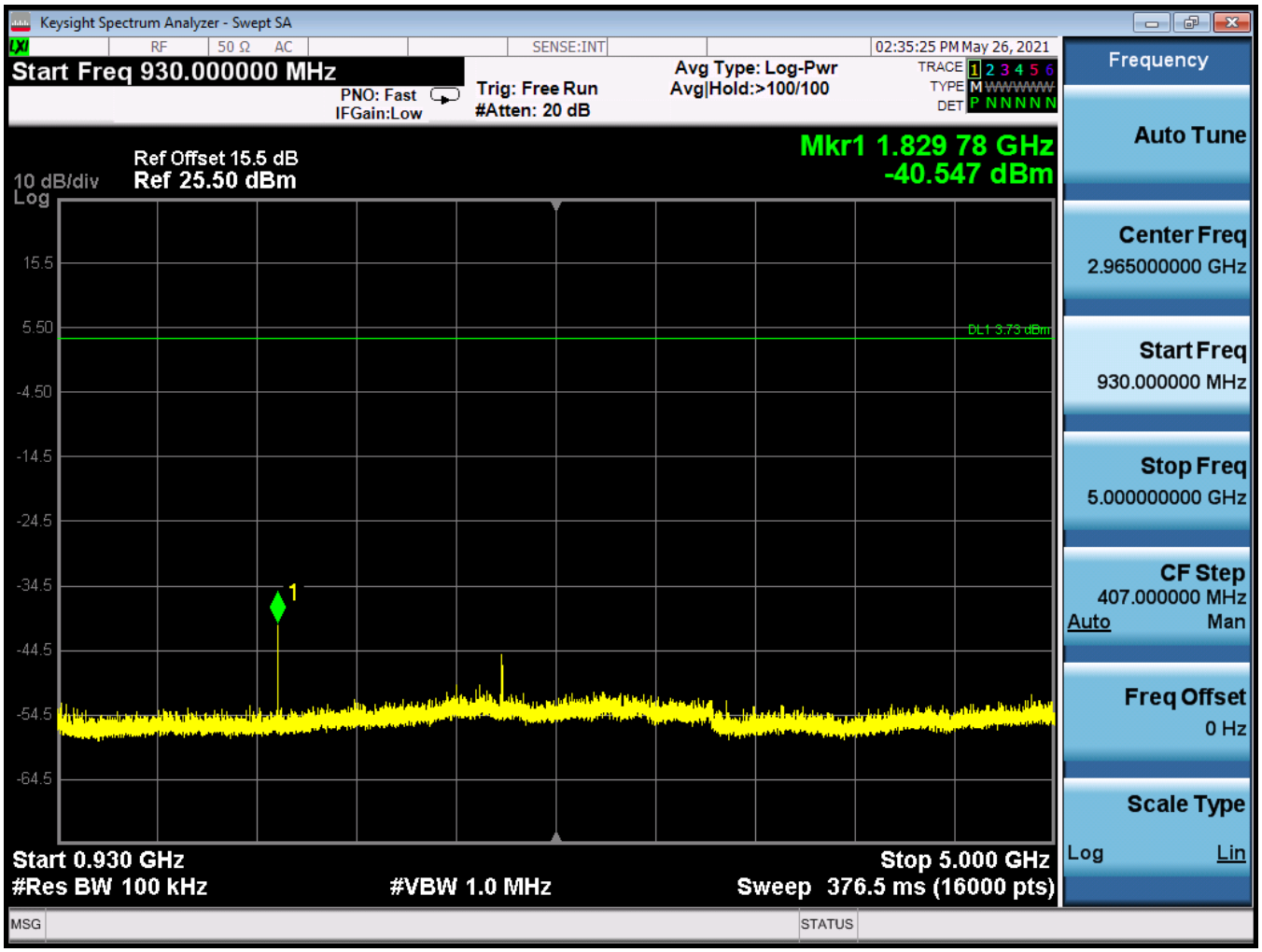


Figure 19 : Conducted Spurious Emissions Mid Channel 5–10GHz

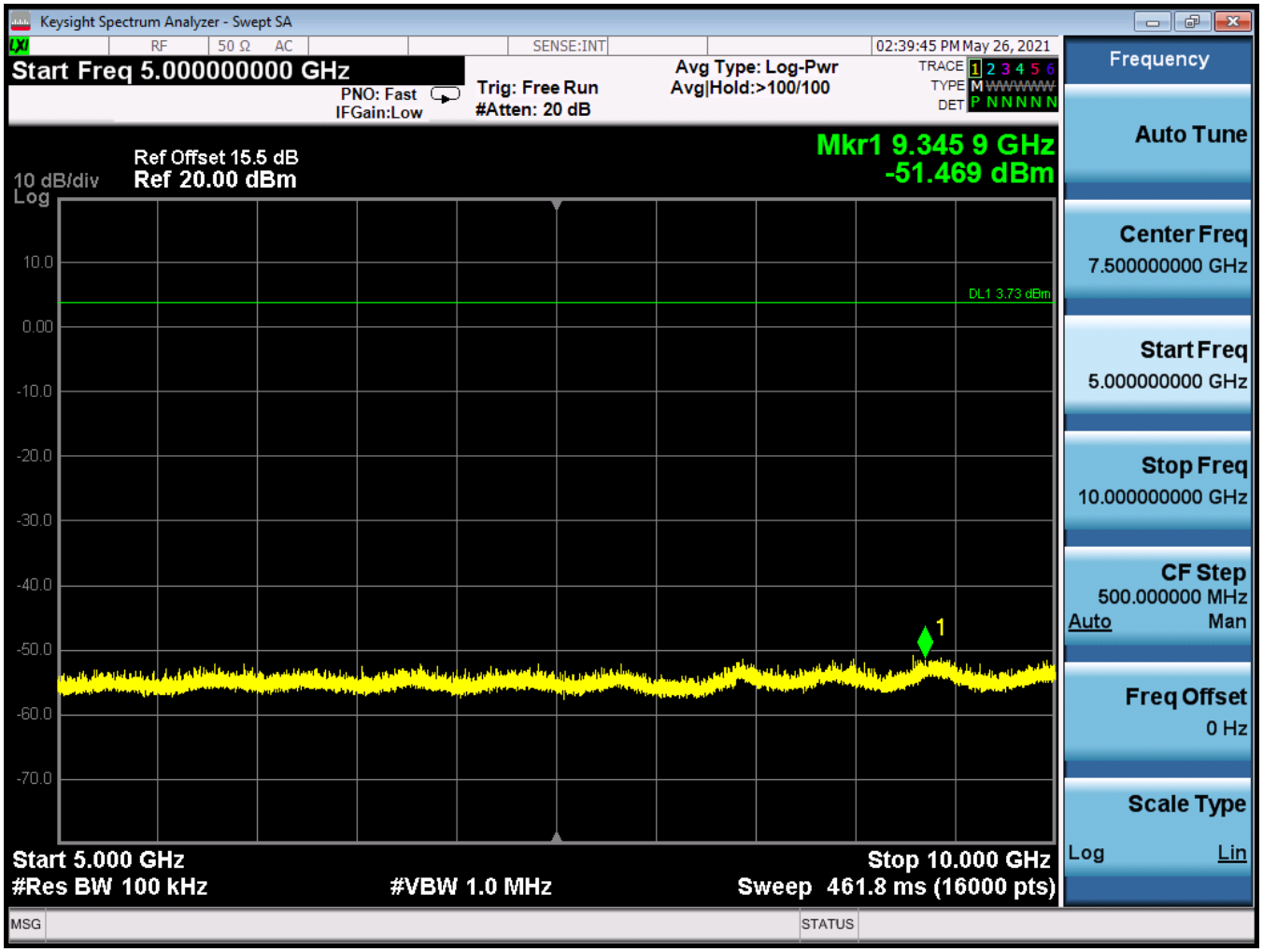


Figure 20 : Conducted Spurious Emissions Upper Channel 30 –900MHz

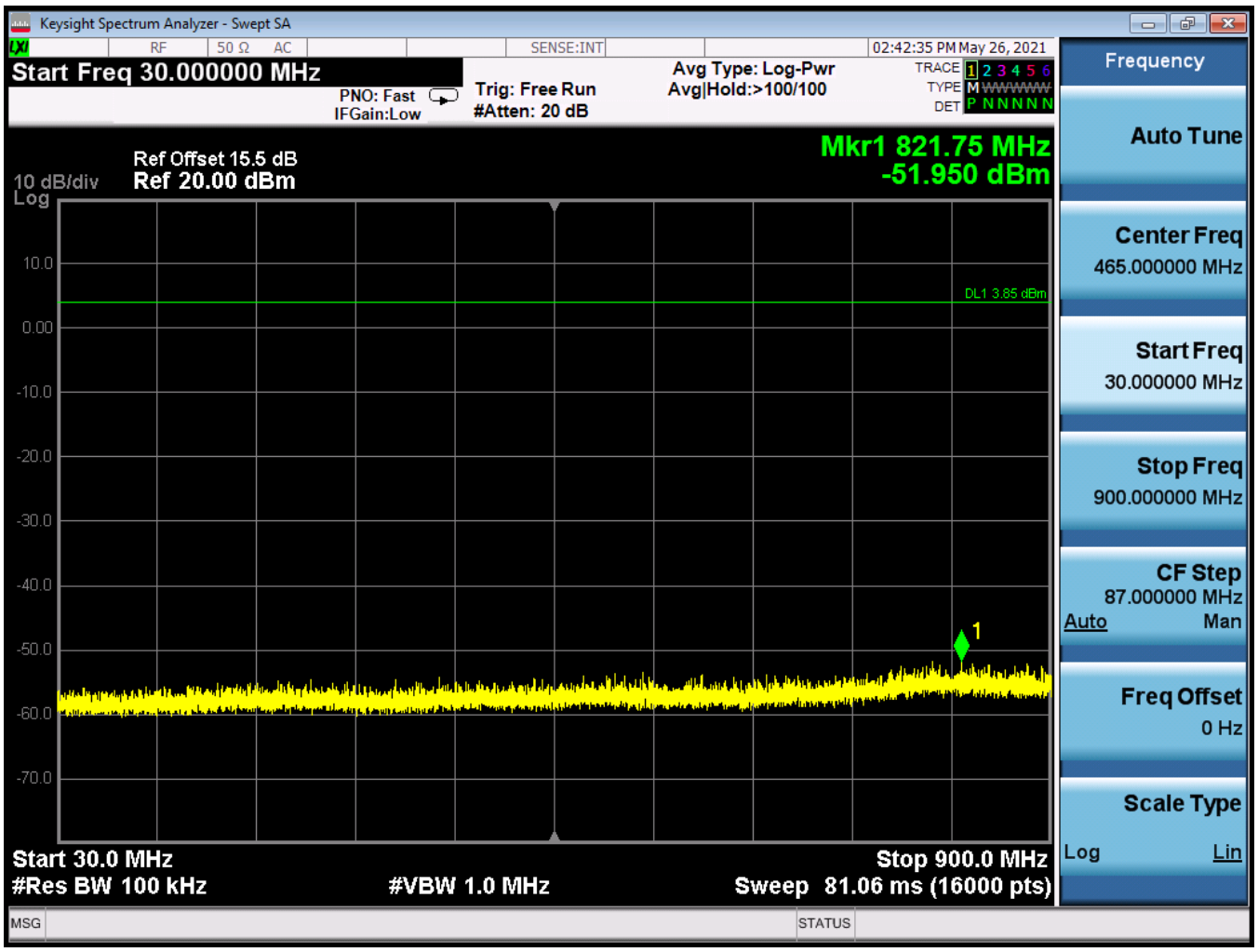


Figure 21: Conducted Spurious Emissions Upper Channel 900–930MHz

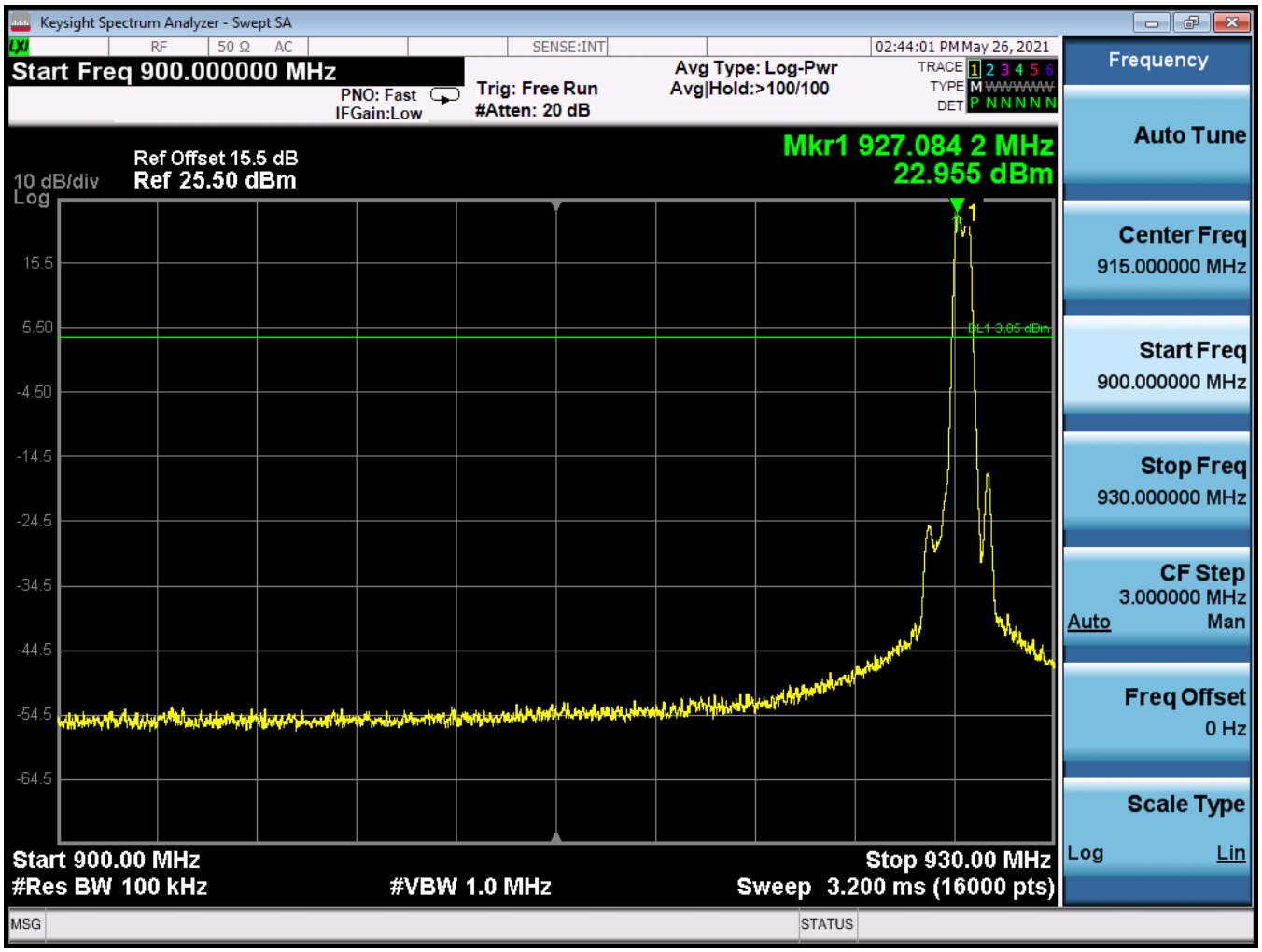


Figure 22 : Conducted Spurious Emissions Upper Channel 930–5GHz

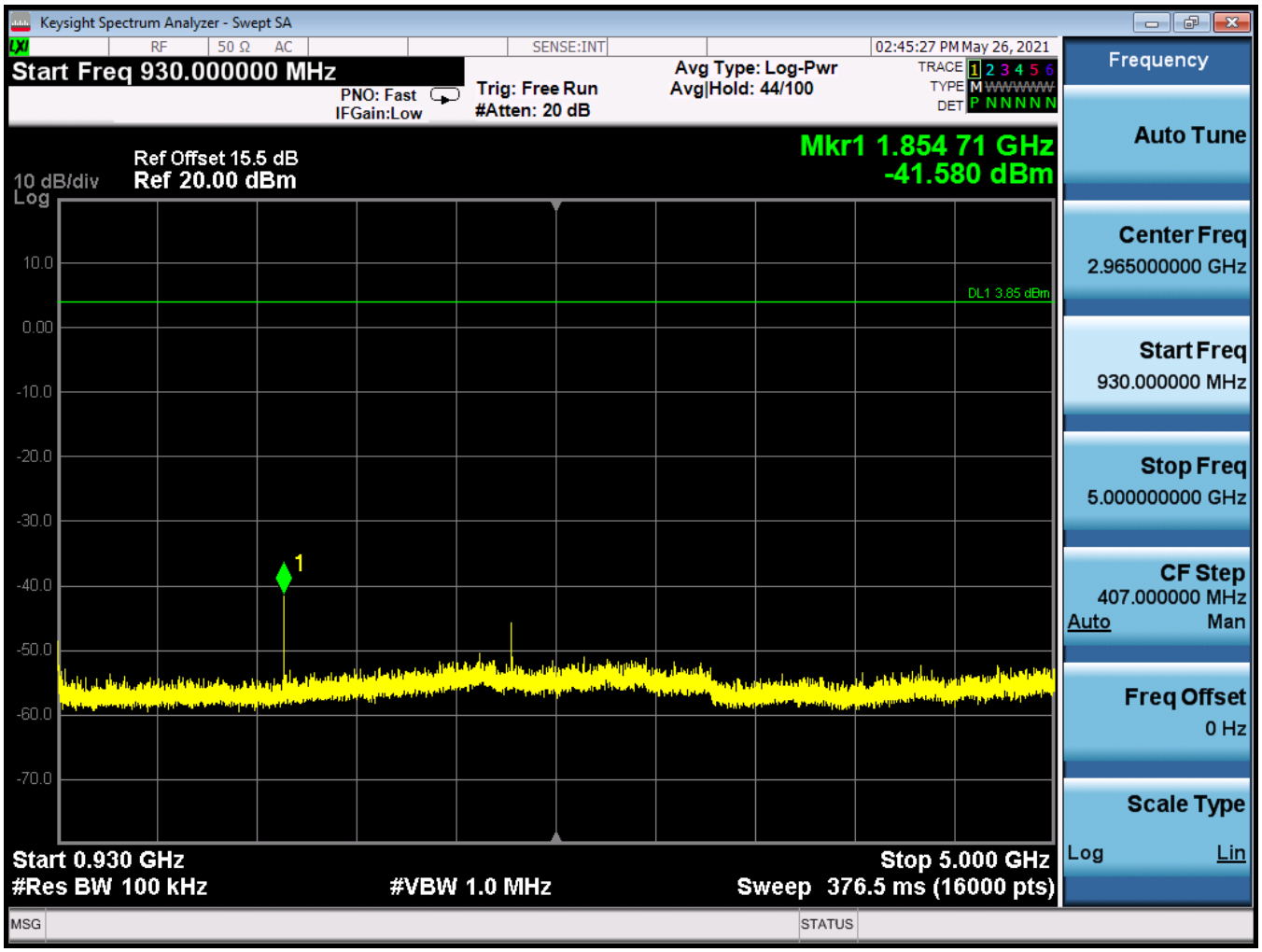
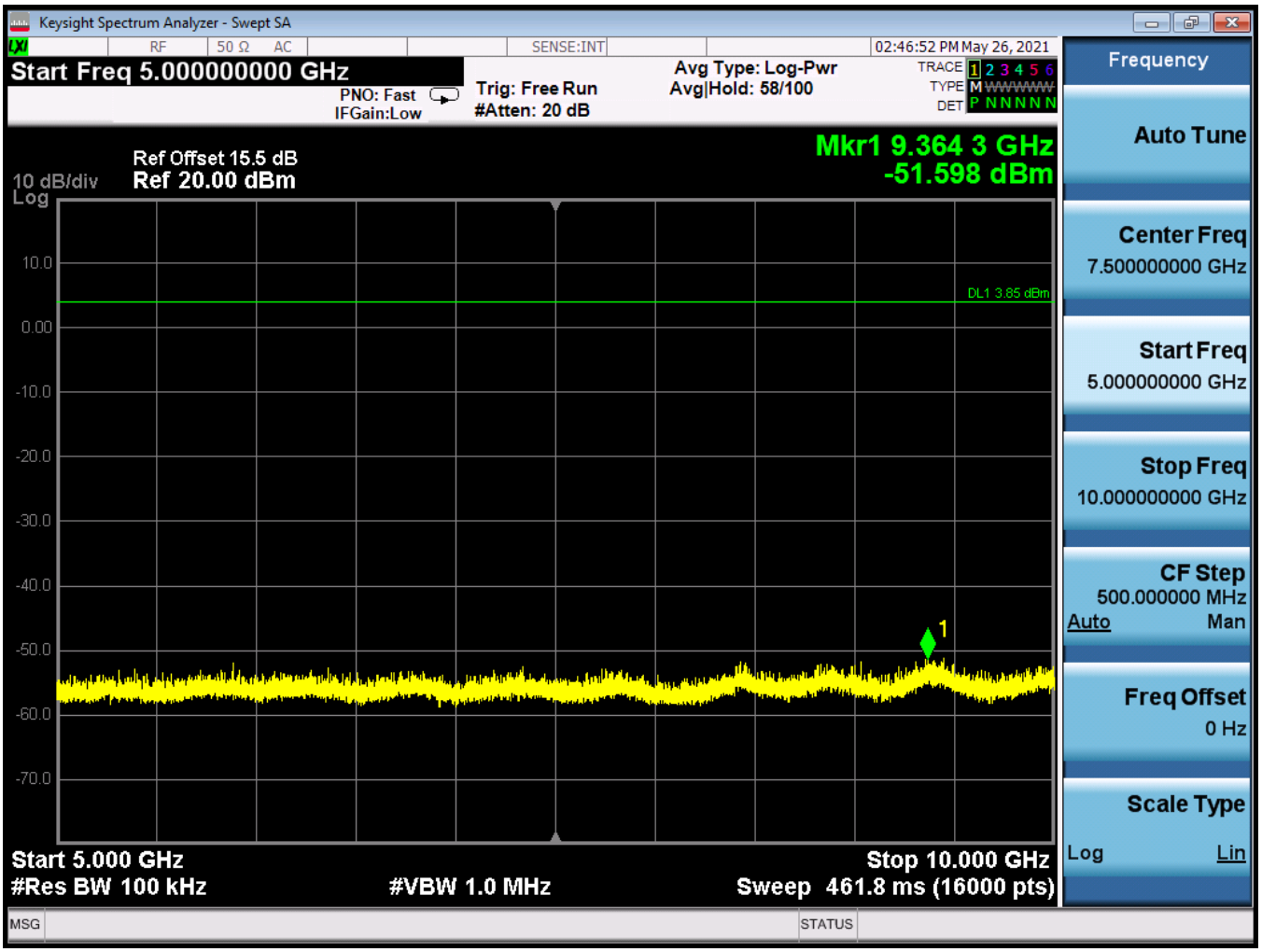


Figure 23 : Conducted Spurious Emissions Upper Channel 5–10GHz



5.6 Band Edge Compliance

In accordance with C63.10, the marker delta method was used to demonstrate band edge compliance. Below are the Upper and lower 902-928MHz Band-edges. Frequencies are set at the lower and upper channels. Plots are also provided with the EUT hopping functions enabled. Emissions must be attenuated 20dB from the peak emission outside of the 902-928 Band.

Figure 24 : Lower Band-edge, Hopping Mode.

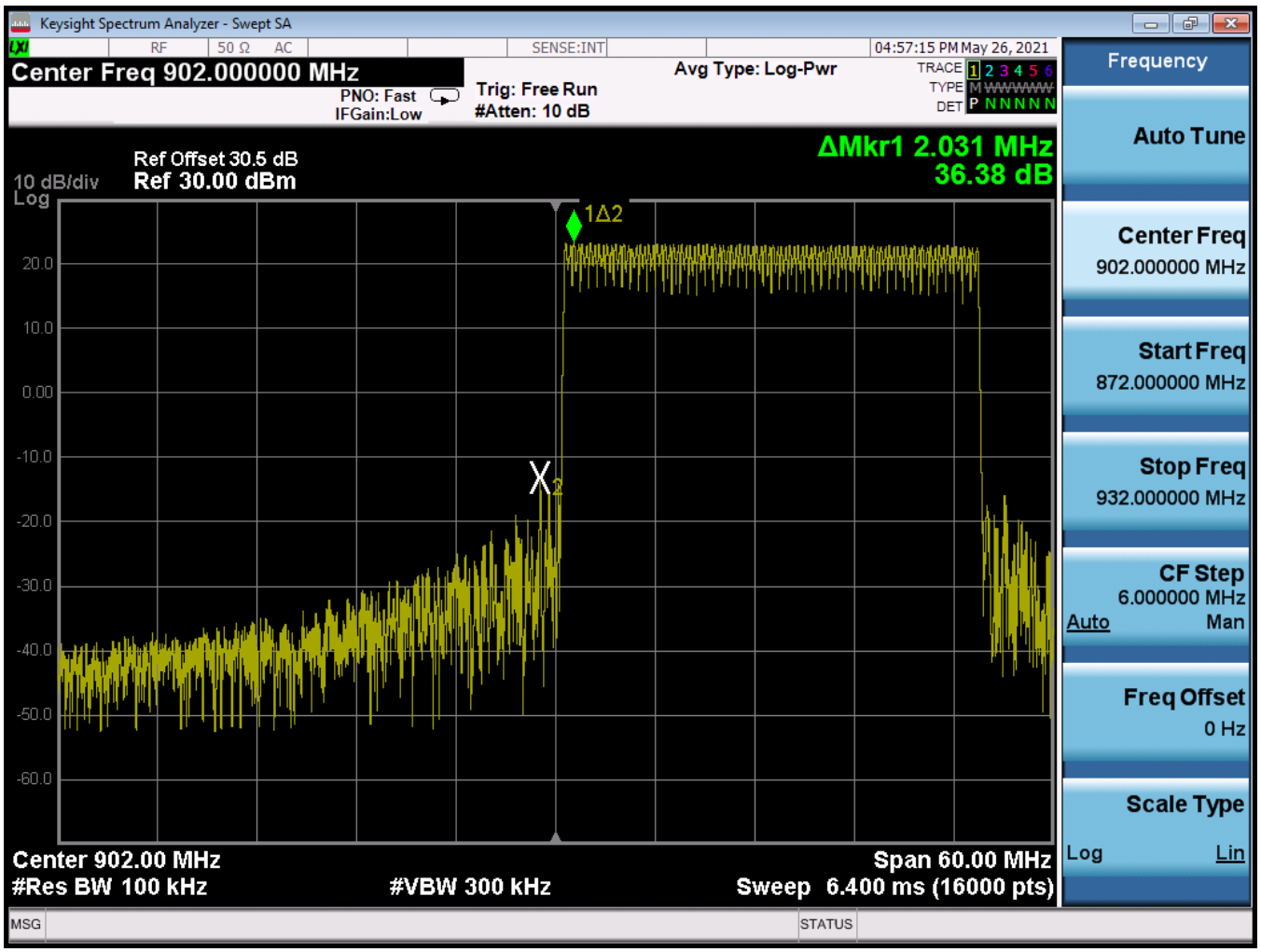


Figure 25: Upper Band-edge, Hopping Mode.

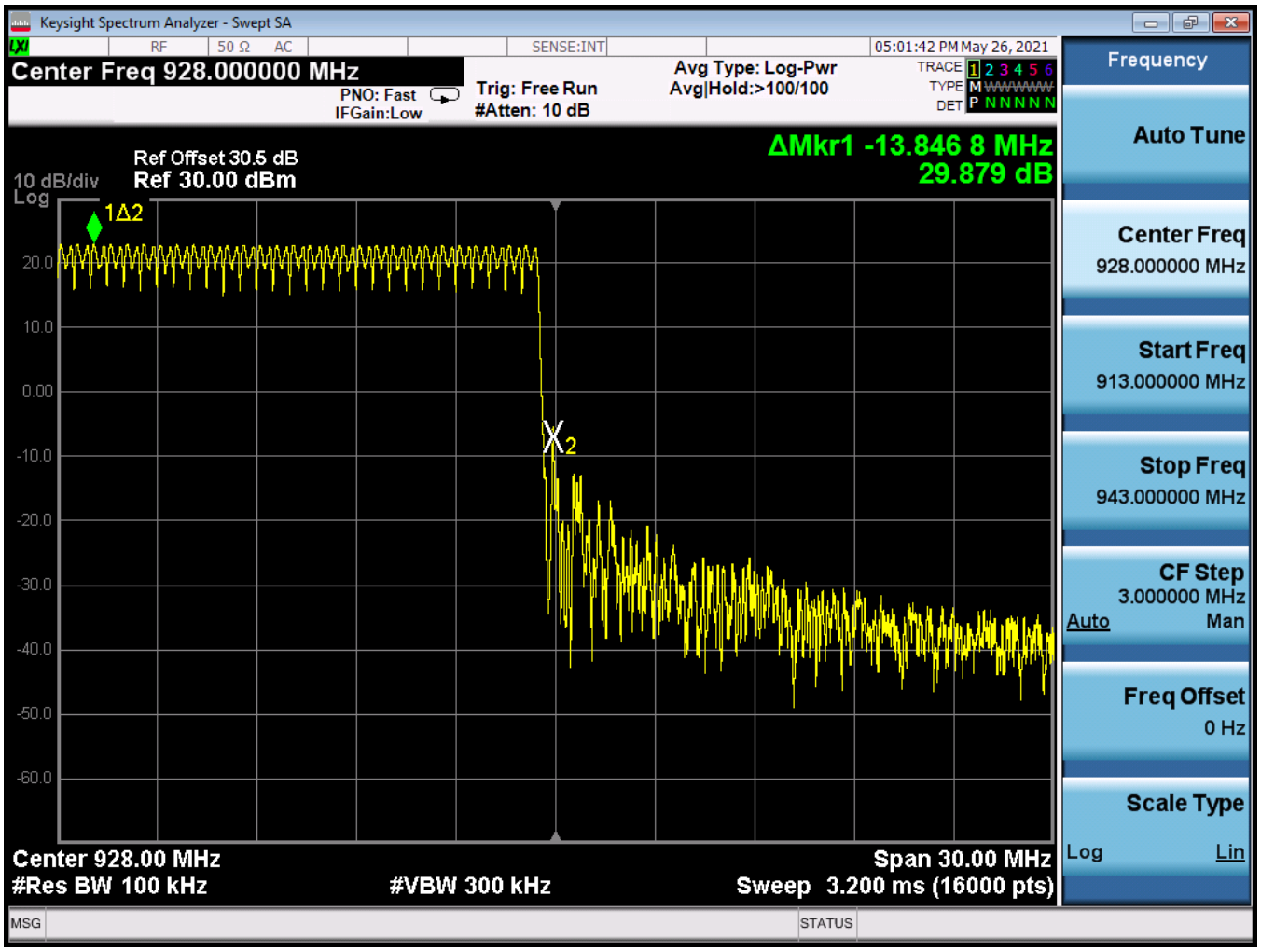


Figure 26: Lower Band-edge, Non-Hopping Mode

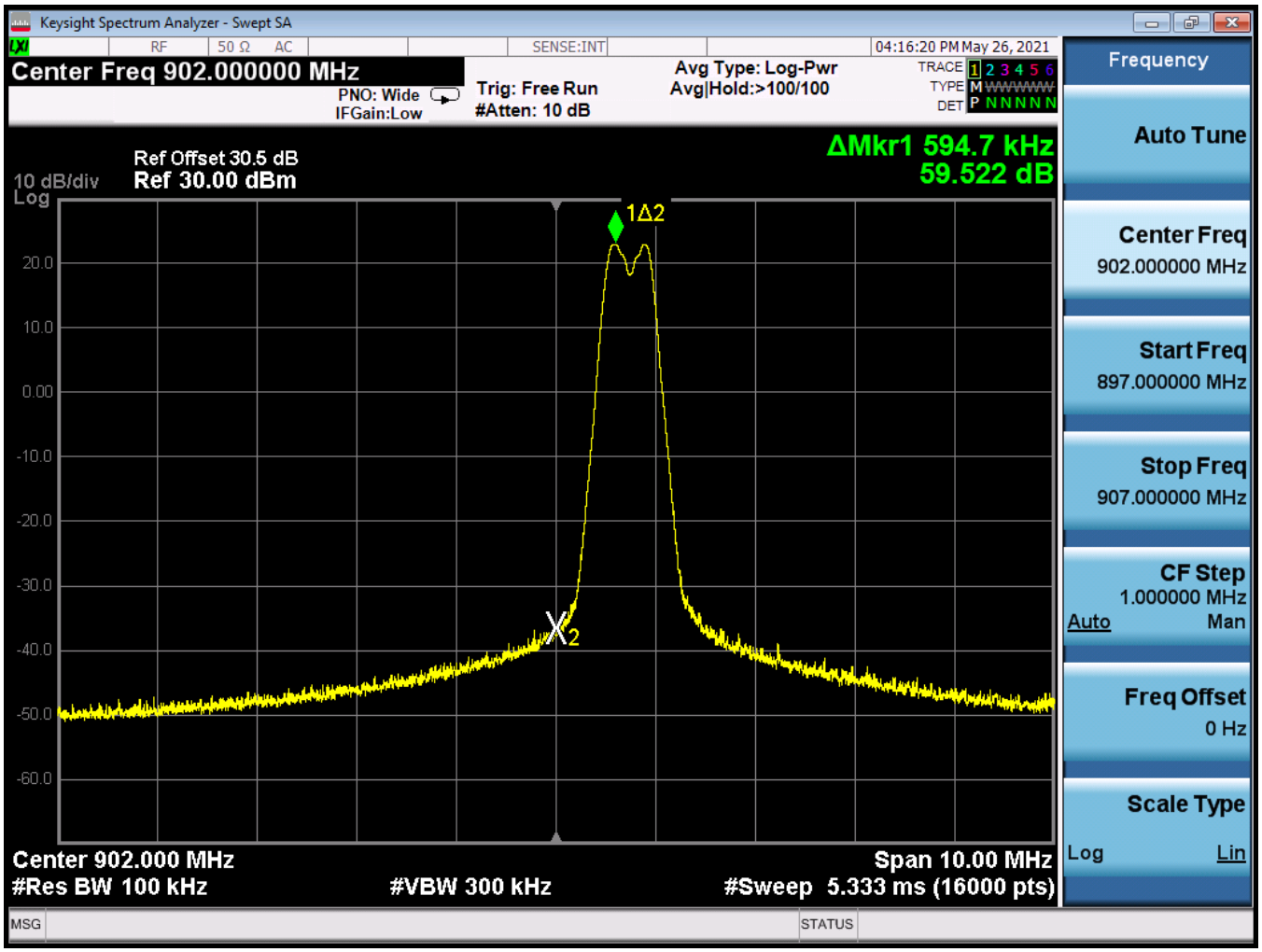
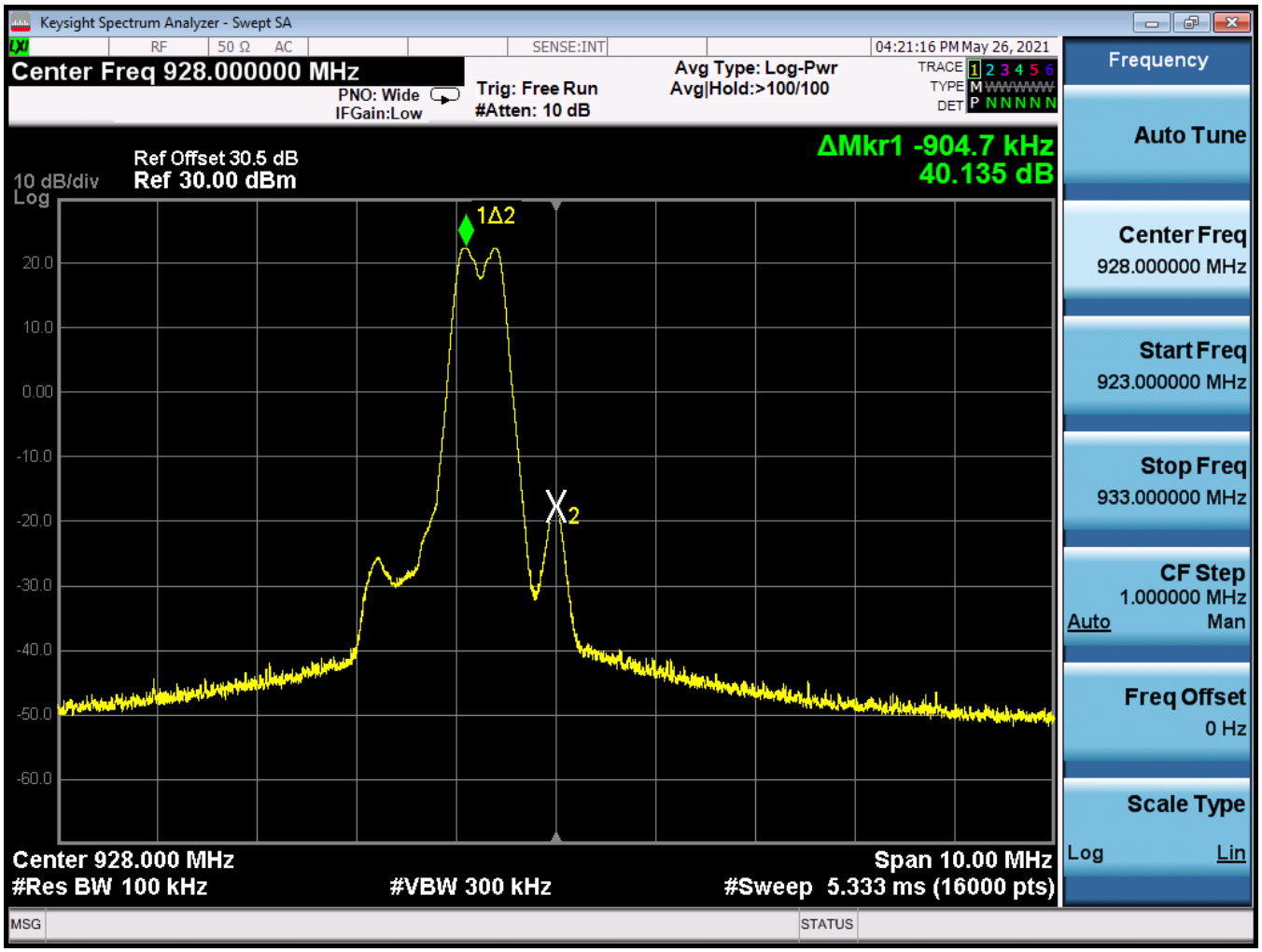


Figure 27: Upper Band-edge, Non-Hopping Mode



5.7 Radiated Spurious Emissions: (FCC Part §15.231(a), RSS210 A.1.2)

5.7.1 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. The peripherals were placed on the table in accordance with ANSI C63.4-2014. Cables were varied in position to produce maximum emissions.

Prior to taken measurements, worst case emission of EUT in X, Y and Z orientations was determined before both the horizontal and vertical field components were measured.

The emissions were measured using the following resolution bandwidths:

Table 13: Spectrum Analyzer Settings

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

Table 14 : Radiated Emission Test Data, Low Channel <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)	Detector Type
43.90	V	180.0	1.0	44.7	-13.4	36.8	100.0	-8.7	QP
52.00	V	180.0	1.0	36.7	-17.5	9.1	100.0	-20.8	QP
78.00	V	180.0	1.0	32.8	-17.0	6.2	100.0	-24.2	QP
120.00	V	180.0	1.0	35.0	-11.2	15.4	150.0	-19.7	QP
240.00	V	180.0	1.2	34.7	-12.8	12.4	200.0	-24.1	QP
292.00	V	270.0	1.0	30.5	-10.8	9.7	200.0	-26.3	QP
333.28	V	180.0	1.4	29.6	-9.9	9.6	200.0	-26.3	QP
838.00	V	90.0	1.0	27.7	-1.2	21.1	200.0	-19.5	QP
33.28	H	90.0	1.0	41.6	-5.8	61.2	100.0	-4.3	QP
57.00	H	90.0	1.4	35.9	-17.9	7.9	100.0	-22.0	QP
78.00	H	90.0	1.0	34.3	-17.0	7.3	100.0	-22.7	QP
120.00	H	90.0	1.4	34.4	-11.2	14.4	150.0	-20.4	QP

240.00	H	180.0	1.2	35.7	-12.8	13.9	200.0	-23.2	QP
292.00	H	0.0	1.0	28.6	-10.8	7.8	200.0	-28.2	QP
333.28	H	90.0	1.0	29.4	-9.9	9.4	200.0	-26.6	QP
838.00	H	180.0	1.0	29.4	-1.2	25.8	200.0	-17.8	QP

Table 15 : Radiated Emission Test Data, Mid Channel <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)	Detector Type
43.90	V	180.0	1.0	48.0	-13.4	53.9	100.0	-5.4	QP
52.00	V	180.0	1.0	36.4	-17.5	8.8	100.0	-21.2	QP
78.00	V	180.0	1.2	34.3	-17.0	7.4	100.0	-22.6	QP
120.00	V	180.0	1.2	39.2	-11.2	25.1	150.0	-15.5	QP
240.00	V	180.0	1.2	35.9	-12.8	14.2	200.0	-23.0	QP
292.00	V	90.0	1.0	31.2	-10.8	10.5	200.0	-25.6	QP
333.28	V	180.0	1.0	31.1	-9.9	11.5	200.0	-24.8	QP
838.00	V	90.0	1.0	32.1	-1.2	35.0	200.0	-15.1	QP
43.90	H	90.0	1.2	35.5	-13.4	12.8	100.0	-17.9	QP
57.00	H	270.0	1.4	33.8	-17.9	6.2	100.0	-24.1	QP
78.00	H	90.0	1.0	32.6	-17.0	6.0	100.0	-24.4	QP
120.00	H	90.0	1.2	37.3	-11.2	20.2	150.0	-17.4	QP
240.00	H	180.0	1.0	38.2	-12.8	18.6	200.0	-20.6	QP
292.00	H	0.0	1.0	33.7	-10.8	14.0	200.0	-23.1	QP
333.28	H	90.0	1.2	35.7	-9.9	19.4	200.0	-20.3	QP
838.00	H	90.0	1.0	30.7	-1.2	30.0	200.0	-16.5	QP

Table 16 : Radiated Emission Test Data, Upper Channel <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)	Detector Type
43.90	V	180.0	1.0	48.5	-13.4	57.1	100.0	-4.9	QP
52.00	V	180.0	1.0	38.3	-17.5	11.0	100.0	-19.2	QP
78.00	V	180.0	1.0	34.2	-17.0	7.2	100.0	-22.8	QP
120.00	V	180.0	1.0	34.5	-11.2	14.6	150.0	-20.2	QP
240.00	V	180.0	1.2	35.6	-12.8	13.8	200.0	-23.2	QP
292.00	V	270.0	1.0	32.6	-10.8	12.4	200.0	-24.2	QP
333.28	V	180.0	1.4	37.5	-9.9	24.0	200.0	-18.4	QP
33.28	H	90.0	1.0	31.1	-5.8	18.3	100.0	-14.7	QP
57.00	H	90.0	1.4	32.9	-17.9	5.6	100.0	-25.0	QP
78.00	H	90.0	1.0	32.9	-17.0	6.3	100.0	-24.1	QP
120.00	H	90.0	1.4	36.9	-11.2	19.3	150.0	-17.8	QP
240.00	H	180.0	1.2	37.9	-12.8	17.9	200.0	-21.0	QP
292.00	H	0.0	1.0	32.3	-10.8	12.0	200.0	-24.5	QP
333.28	H	90.0	1.0	31.6	-9.9	12.2	200.0	-24.3	QP
838.00	H	180.0	1.0	34.0	-1.2	43.9	200.0	-13.2	QP

Table 17 : Radiated Emission Test Data, Low Channel >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)	Detector Type
1805.50	H	180.0	1.5	60.4	-19.0	118.1	5000.0	-32.5	Peak
1805.50	H	90.0	1.5	48.2	-19.0	29.0	500.0	-24.7	AVG
2708.25	H	135.0	1.5	66.9	-14.1	438.4	5000.0	-21.1	Peak
2708.25	H	90.0	1.5	48.0	-14.1	49.6	500.0	-20.1	AVG
3611.00	H	270.0	1.5	69.1	-11.8	732.0	5000.0	-16.7	Peak
3611.00	H	90.0	1.5	61.1	-11.8	292.4	500.0	-4.7	AVG
4513.75	H	90.0	1.5	58.3	-7.2	356.5	5000.0	-22.9	Peak
4513.75	H	90.0	1.5	46.1	-7.2	87.6	500.0	-15.1	AVG
5416.50	H	0.0	1.5	57.1	-5.6	372.9	5000.0	-22.5	Peak
5416.50	H	180.0	1.5	44.3	-5.6	85.7	500.0	-15.3	AVG
6319.25	H	270.0	1.5	58.5	-4.2	520.9	5000.0	-19.6	Peak
6319.25	H	90.0	1.5	45.3	-4.2	114.1	500.0	-12.8	AVG
7222.00	H	90.0	1.5	56.5	-0.6	623.9	5000.0	-18.1	Peak
7222.00	H	90.0	1.5	43.7	-0.6	142.9	500.0	-10.9	AVG
8124.75	H	90.0	1.5	57.9	-0.3	757.8	5000.0	-16.4	Peak
8124.75	H	90.0	1.5	44.0	-0.3	153.5	500.0	-10.3	AVG
9930.25	H	90.0	1.5	55.9	4.3	1021.0	5000.0	-13.8	Peak
9930.25	H	90.0	1.5	42.5	4.3	218.8	500.0	-7.2	AVG
10833.00	H	90.0	1.5	54.9	-21.2	48.3	5000.0	-40.3	Peak
10833.00	H	90.0	1.5	42.8	-21.2	12.0	500.0	-32.4	AVG

Table 18 : Radiated Emission Test Data, Mid Channel >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)	Detector Type
1829.50	H	90.0	1.5	70.7	-18.8	395.2	5000.0	-22.0	Peak
1829.50	H	180.0	1.5	67.5	-18.8	273.7	500.0	-5.2	AVG
2744.25	H	270.0	1.5	71.3	-14.0	737.9	5000.0	-16.6	Peak
2744.25	H	90.0	1.5	65.8	-14.0	391.7	500.0	-2.1	AVG
3659.00	H	270.0	1.5	67.1	-11.7	585.7	5000.0	-18.6	Peak
3659.00	H	90.0	1.5	58.1	-11.7	207.3	500.0	-7.6	AVG
4573.75	H	90.0	1.5	58.9	-7.3	378.7	5000.0	-22.4	Peak
4573.75	H	90.0	1.5	46.3	-7.3	89.4	500.0	-15.0	AVG
5488.50	H	0.0	1.5	55.7	-5.6	321.0	5000.0	-23.8	Peak
5488.50	H	180.0	1.5	43.5	-5.6	78.8	500.0	-16.0	AVG
6403.25	H	270.0	1.5	57.0	-4.0	444.8	5000.0	-21.0	Peak
6403.25	H	90.0	1.5	43.5	-4.0	93.7	500.0	-14.5	AVG
7318.00	H	90.0	1.5	58.0	-0.6	736.1	5000.0	-16.6	Peak
7318.00	H	90.0	1.5	45.0	-0.6	164.8	500.0	-9.6	AVG
8232.75	H	90.0	1.5	51.4	-0.1	367.7	5000.0	-22.7	Peak
8232.75	H	90.0	1.5	43.4	-0.1	146.2	500.0	-10.7	AVG
9147.50	H	270.0	1.5	55.7	2.3	796.7	5000.0	-16.0	Peak
9147.50	H	90.0	1.5	43.5	2.3	194.4	500.0	-8.2	AVG
10062.25	H	270.0	1.5	55.0	-21.7	46.4	5000.0	-40.7	Peak
10062.25	H	90.0	1.5	42.4	-21.7	10.9	500.0	-33.3	AVG

Table 19 : Radiated Emission Test Data, Upper Channel >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)	Detector Type
1854.50	H	180.0	1.5	71.9	-18.6	232.0	5000.0	-26.7	Peak
1854.50	H	90.0	1.5	61.8	-18.6	144.9	500.0	-10.8	AVG
2781.75	H	90.0	1.5	70.2	-13.8	659.6	5000.0	-17.6	Peak
2781.75	H	90.0	1.5	64.8	-13.8	352.6	500.0	-3.0	AVG
3709.00	H	90.0	1.5	66.0	-11.6	521.9	5000.0	-19.6	Peak
3709.00	H	270.0	1.5	57.0	-11.6	185.0	500.0	-8.6	AVG
4636.25	H	90.0	1.5	60.2	-6.9	460.1	5000.0	-20.7	Peak
4636.25	H	90.0	1.5	49.5	-6.9	134.9	500.0	-11.4	AVG
5558.50	H	135.0	1.5	57.5	-5.6	390.7	5000.0	-22.1	Peak
5558.50	H	180.0	1.5	44.0	-5.6	83.0	500.0	-15.6	AVG
6490.75	H	270.0	1.5	55.7	-3.7	398.3	5000.0	-22.0	Peak
6490.75	H	90.0	1.5	43.8	-3.7	100.6	500.0	-13.9	AVG
7148.00	H	90.0	1.5	57.9	-0.6	728.1	5000.0	-16.7	Peak
7148.00	H	90.0	1.5	44.9	-0.6	163.4	500.0	-9.7	AVG
8345.25	H	90.0	1.5	57.0	0.2	731.3	5000.0	-16.7	Peak
8345.25	H	90.0	1.5	43.9	0.2	160.2	500.0	-9.9	AVG
9272.50	H	90.0	1.5	55.7	2.9	846.9	5000.0	-15.4	Peak
9272.50	H	0.0	1.5	43.0	2.9	196.3	500.0	-8.1	AVG
10199.75	H	180.0	1.5	56.1	5.1	1148.4	5000.0	-12.8	Peak
10199.75	H	270.0	1.5	43.7	5.1	274.5	500.0	-5.2	AVG

Table 20 : 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
1833.00	V	180.0	1.8	43.1	1.1	162.4	5000.0	-29.8	PK
1833.00	V	135.0	1.8	30.3	1.1	37.2	500.0	-22.6	AVG
2749.00	V	90.0	1.8	1.8	6.8	2.7	5000.0	-65.3	PK
2749.00	V	180.0	1.8	30.6	6.8	74.4	500.0	-16.5	AVG
3666.00	V	180.0	1.8	45.0	10.9	620.7	5000.0	-18.1	PK
3666.00	V	270.0	1.8	30.1	10.9	111.7	500.0	-13.0	AVG
4582.00	V	0.0	1.8	42.9	14.8	767.8	5000.0	-16.3	PK
4582.00	V	135.0	1.8	30.2	14.8	177.9	500.0	-9.0	AVG
5499.00	V	90.0	1.8	43.4	18.7	1268.6	5000.0	-11.9	PK
5499.00	V	180.0	1.8	29.5	18.7	256.1	500.0	-5.8	AVG
6415.00	V	135.0	1.8	41.6	20.7	1299.2	5000.0	-11.7	PK
6415.00	V	180.0	1.8	29.7	20.7	330.1	500.0	-3.6	AVG
1833.00	H	180.0	1.8	44.2	1.1	184.4	5000.0	-28.7	PK
1833.00	H	90.0	1.8	31.5	1.1	42.7	500.0	-21.4	AVG
2749.00	H	135.0	1.8	43.5	6.8	328.7	5000.0	-23.6	PK
2749.00	H	90.0	1.8	30.6	6.8	74.4	500.0	-16.5	AVG
3666.00	H	135.0	1.8	42.3	10.9	454.9	5000.0	-20.8	PK
3666.00	H	90.0	1.8	30.0	10.9	110.4	500.0	-13.1	AVG
4582.00	H	180.0	1.8	42.7	14.8	750.3	5000.0	-16.5	PK
4582.00	H	180.0	1.8	30.3	14.8	178.9	500.0	-8.9	AVG
5499.00	H	270.0	1.8	42.1	18.7	1092.3	5000.0	-13.2	PK
5499.00	H	0.0	1.8	29.7	18.7	262.0	500.0	-5.6	AVG
6415.00	H	180.0	1.8	42.1	20.7	1376.2	5000.0	-11.2	PK
6415.00	H	270.0	1.8	29.6	20.7	326.3	500.0	-3.7	AVG

Figure 28 : Bench Test Setup

Figure 29: Radiated Emission Front View

Figure 30: Radiated Emission Rear View