Quality is @ Xetawave

Xeta9

Spectrum Emission Mask

and

Occupied Bandwidth

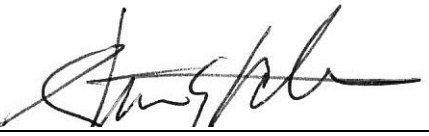
Measurements

10/7/2013

Witnessed by

_____ Date 10/8/2013

Test conducted by



Date 10/8/2013

Introduction

Pursuant to FCC and Industry Canada (IC) conformance, testing was performed to document the performance of the Xeta9m-T DSM modulation for 12.5 kHz channels, a composite or complex modulation of pulse and data modulation constellations. These modes are referred to as radio modes (rm) in the data recording etc. Table 1 shows the modulation vs. rm, and other characteristics.

The composite modulation requires actual 99% occupied bandwidth (OBW) to be measured for the required bandwidth field of the Emissions Designator for each modulation or radio mode and frequency.

The Spectrum Emissions Mask (SEM) was also measured to show part 101 and IC SRSP-505 compliance.

Table 1. Modulation Summary

Item #	Radio Mode	Modulation Type	99% BW (kHz)	Emissions Designator IC	Emissions Designator FCC
1	0	BPSK	12.2	12k2W1WCN	12k2W1W
2	1	QPSK	11.9	11k9W1WDN	11k9W1W
3	2	8QAM	11.9	11k9W1WEN	11k9W1W
4	3	16QAM	11.9	11k9W1WEN	11k9W1W
5	4	32QAM	11.7	11k7W1WFN	11k7W1W

Scope

Testing was performed in accordance with (iaw) FCC Part 101, IC SRSP-505, ANSI C63.4-2003 and TIA-603-C-2004 for demonstrating compliance for both US and Canada requirements at 900 MHz operation in licensed bands, US: 928 to 960MHz and IC: 928 to 953 MHz.

Equipment Under Test (EUT)

The EUT transmitter was a Licensed Radio Transmitter, Model No. Xeta9m-T. production unit, sn E5010317. Xeta9m's operate with frequency settings from 902 to 960 MHz. The following test frequencies were used.

Table 2. Test Frequency List

928.025MHz
942.1MHz
952.495
959.975MHz

Power Input

For test purposes, a DC power supply provided 7.5VDC to the EUT.

Peripheral Equipment

The EUT was supported with serial communications from a Toshiba M304-S5032 sn 8703312H laptop computer. A Serial Gear, CS-42042, USB to four RS-232, serial ports adapter was used to provide serial interface for the laptop.

Software

The radio firmware version used for this testing was trunk.2218. The terminal software was Teraterm version 4.7.8.

Operational Modes

For all transmitter tests, the EUT was set to transmit at the following frequencies and modulation or radio modes:
- 928.025 MHz with 8QAM, 16QAM, 32QAM, BPSK, QPSK modulations, radio modes 0 -4
- 942.1 MHz with , 8QAM,16QAM, 32QAM, BPSK, QPSK modulations, radio modes 0 -4
- 952.495 MHz with 16QAM, 32QAM, BPSK, QPSK modulations, radio modes 0 -4
- 959.975 MHz with 8QAM, 16QAM, 32QAM, BPSK, QPSK modulations, radio modes 0 -4

Signal Input/Output Leads

The EUT was submitted for testing with a 10 wire, 75 cm long cable. Eight (8) of those wires went to the serial port of the Sony laptop computer. The other two (2) wires went to the output of the DC power supply that was used to provide 7.4VDC power to the EUT.

Grounding

The EUT was ungrounded during testing.

Test Conditions

Tests were performed at the Xetawave lab, Boulder, CO at ambient conditions.

Test Setup

Figure1 shows the setup used for both the SEM and OBW Measurements

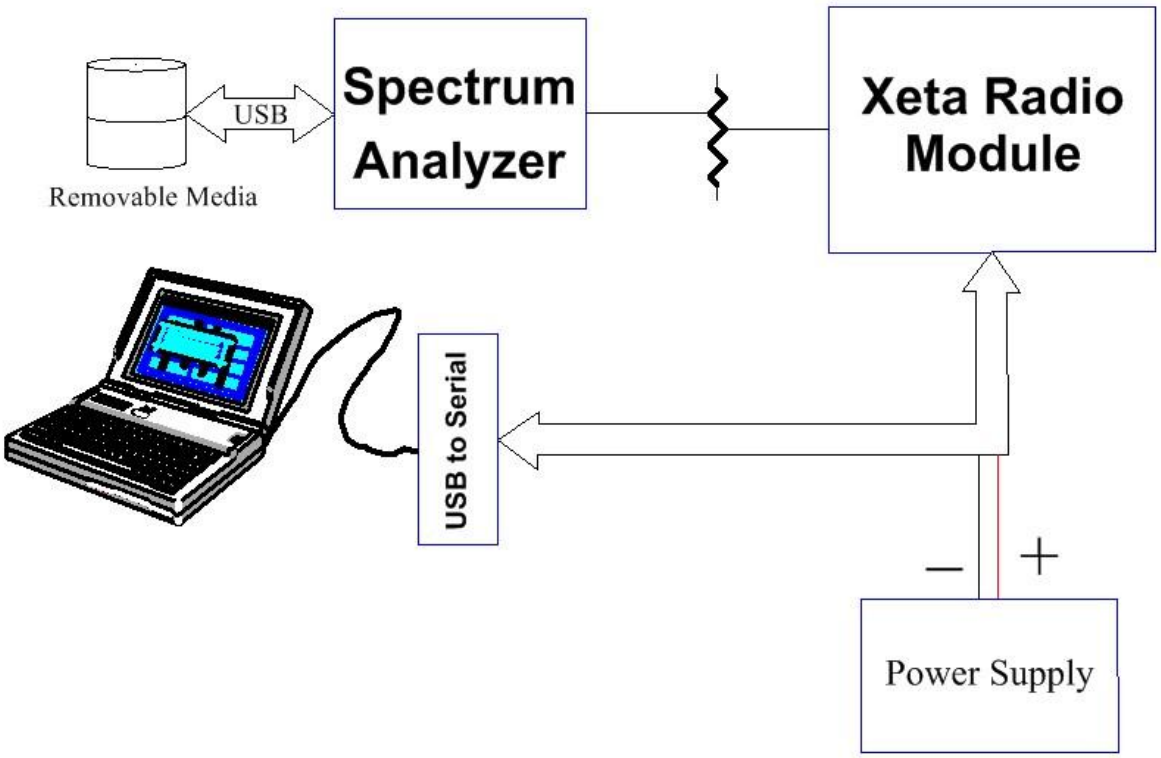


Figure 1. Test Setup

The total attenuation of the cables and attenuators were measured at 26.5 dB. This value was used to correct the data using the analyzer reference level offset function.

Test Procedures and Results

SEM Test

There was an anomaly with the spectrum analyzer SEM standards selections that required a workaround. The standard reported at the top of the screen was edited to the Part 101 emissions mask as can be seen from the table at the bottom of the screen. This is due to a firmware issue in the analyzer. Only the text at the top of the instrument screen is in error. The 802.11a standard appears. There is no way to edit this text but the data in the mask can be edited to hold the requirements listed below.

SEM Requirements

Per 101.111(a)(5), when using transmissions employing digital modulation techniques on the 900 MHz multiple address frequencies with a 12.5 kHz bandwidth, the power of any emission must be attenuated below the unmodulated carrier power of the transmitter (P) in accordance with the following schedule:

On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 2.5 kHz up to and including 6.25 kHz: At least 53 log10 (fd/2.5) decibels;

On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 6.25 kHz up to and including 9.5 kHz: At least 103 log10 (fd/3.9) decibels;

On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 9.5 kHz up to and including 15 kHz: At least 157 log10 (fd/5.3) decibels; and

On any frequency removed from the center of the authorized bandwidth by a displacement frequency greater than 15 kHz: At least 50 plus 10 log10 (P) or 70 decibels, whichever is the lesser attenuation.

Procedure

1) The SEM above was entered into the spectrum analyzer.
2) The antenna port of the EUT was connected to a spectrum analyzer as shown in figure 1.
3) The following spectrum analyzer settings were employed :
   a) center frequency = transmit frequency of the EUT
   b) reference level offset = 26.5 dB
   c) resolution bandwidth = 1 MHz
   d) video bandwidth = resolution bandwidth x 3
   e) frequency span = 100 kHz
   f) sweep = Auto
   g) detector function = peak
   h) trace = max hold
4) The following spectrum analyzer settings were employed for the SEM setup:
   a) resolution bandwidth = 100 Hz
   b) video bandwidth = 300 Hz
   c) sweep = Auto
   d) measure emissions mask
   e) detector function = peak
   f) trace = max hold
5) The EUT was set to transmit.
6) Several sweeps were made with the settings listed above.
7) The spectrum analyzer screen was captured and saved.
8) The EUT was set to stop transmitting
9) Steps 5 through 7 were repeated until all the operational modes were tested.

Results

The spectrum analyzer screen plots of the emissions of the EUT show the limits were not exceeded and the requirements met.

OBW Tests

OBW Requirements

OBW was measured to provide Necessary Bandwidth data for the Emissions Designator Necessary Bandwidth field.

Procedure

1) The antenna port of the EUT was connected to a spectrum analyzer through as shown in figure 1.
2) The following spectrum analyzer settings were employed :
   a) center frequency = transmit frequency of the EUT
   b) reference level offset = 26.5 dB
   c) resolution bandwidth = 1 MHz
   d) video bandwidth = resolution bandwidth x 3
   e) frequency span = 100 kHz
   f) sweep = Auto
   g) detector function = peak
   h) trace = max hold
3) The following spectrum analyzer settings were employed for the OBW setup:
   a) resolution bandwidth = 100 Hz
   b) video bandwidth = 300 Hz
   c) sweep = Auto
   d) measure emissions mask
   e) detector function = peak
   f) trace = max hold
4) The EUT was set to transmit.
5) Several sweeps were made with the settings listed above.
6) The spectrum analyzer screen was captured and saved.
7) The EUT was set to stop transmitting
8) Steps 5 through 7 were repeated until all the operational modes were tested.

Results

The maximum OBW for each mode was used for the Emissions Designator for each radio mode.

Data

Table 3. Raw Data Summary

Radio mode	Frequency (MHz)	Data Power Output Average (dBm)	OBW (kHz)	OBW Total Power (dBm)
0	928.025	20.9	12.2	31.2
1	928.025	20.8	11.9	32.7
2	928.025	20.7	11.7	31.5
3	928.025	21.8	11.9	32.1
4	928.025	21.9	11.4	32.8
0	942.1	22.1	12.0	33.9
1	942.1	22.6	11.8	33.9
2	942.1	19.9	11.9	31.7
3	942.1	20.2	11.7	34.6
4	942.1	21.2	11.5	34.3
0	952.495	22.6	11.9	33.9
1	952.495	23.6	11.9	34.8
2	952.495	19.6	11.6	31.0
3	952.495	23.6	11.7	35
4	952.495	23.2	11.6	34.7
0	959.975	22	11.9	33.2
1	959.975	22.1	11.9	34.1
2	959.975	21.4	11.8	31.5
3	959.975	22.5	11.6	34.4
4	959.975	23.4	11.7	34.7

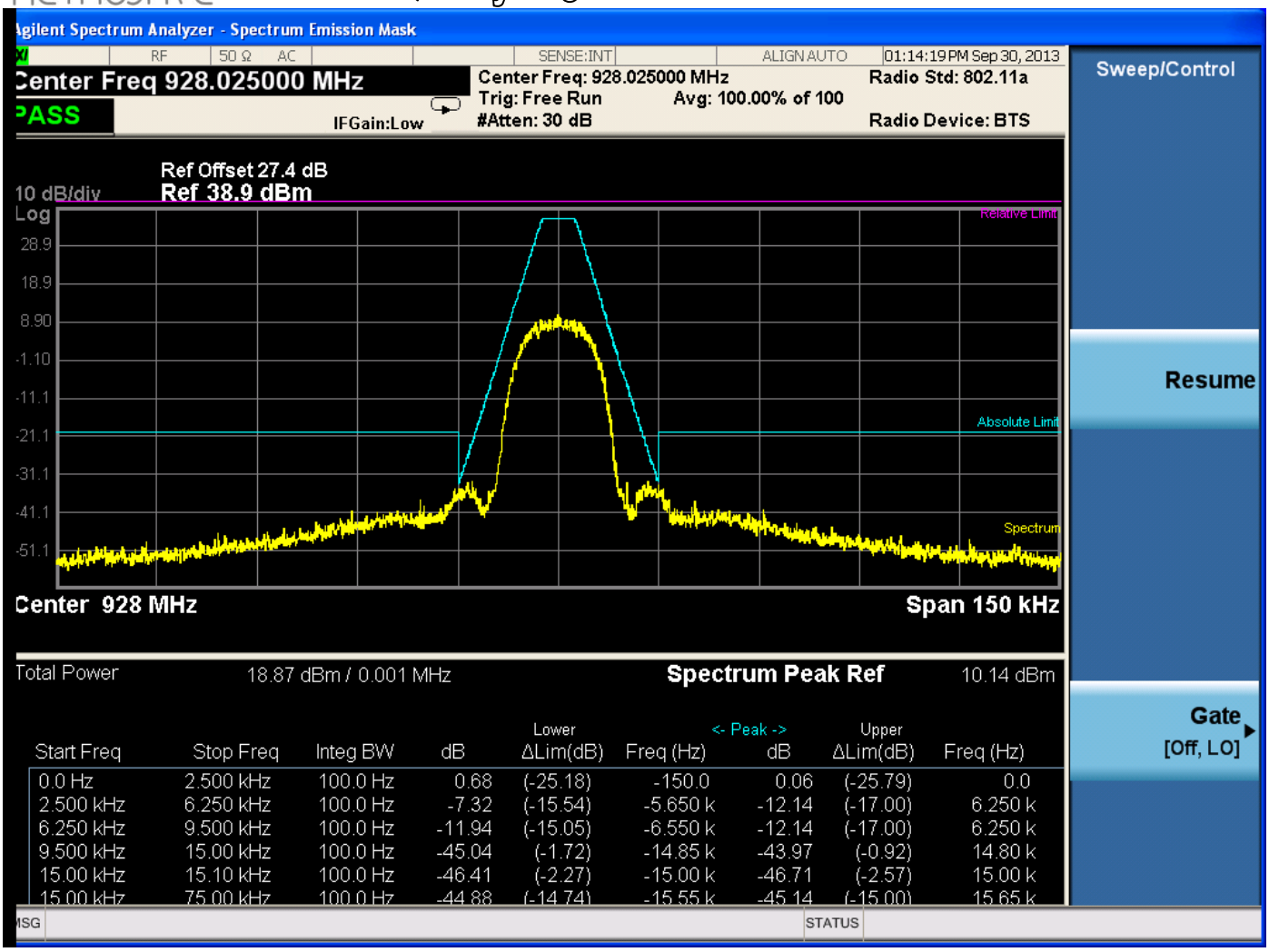


Figure 2. 928.025 MHz, rm0

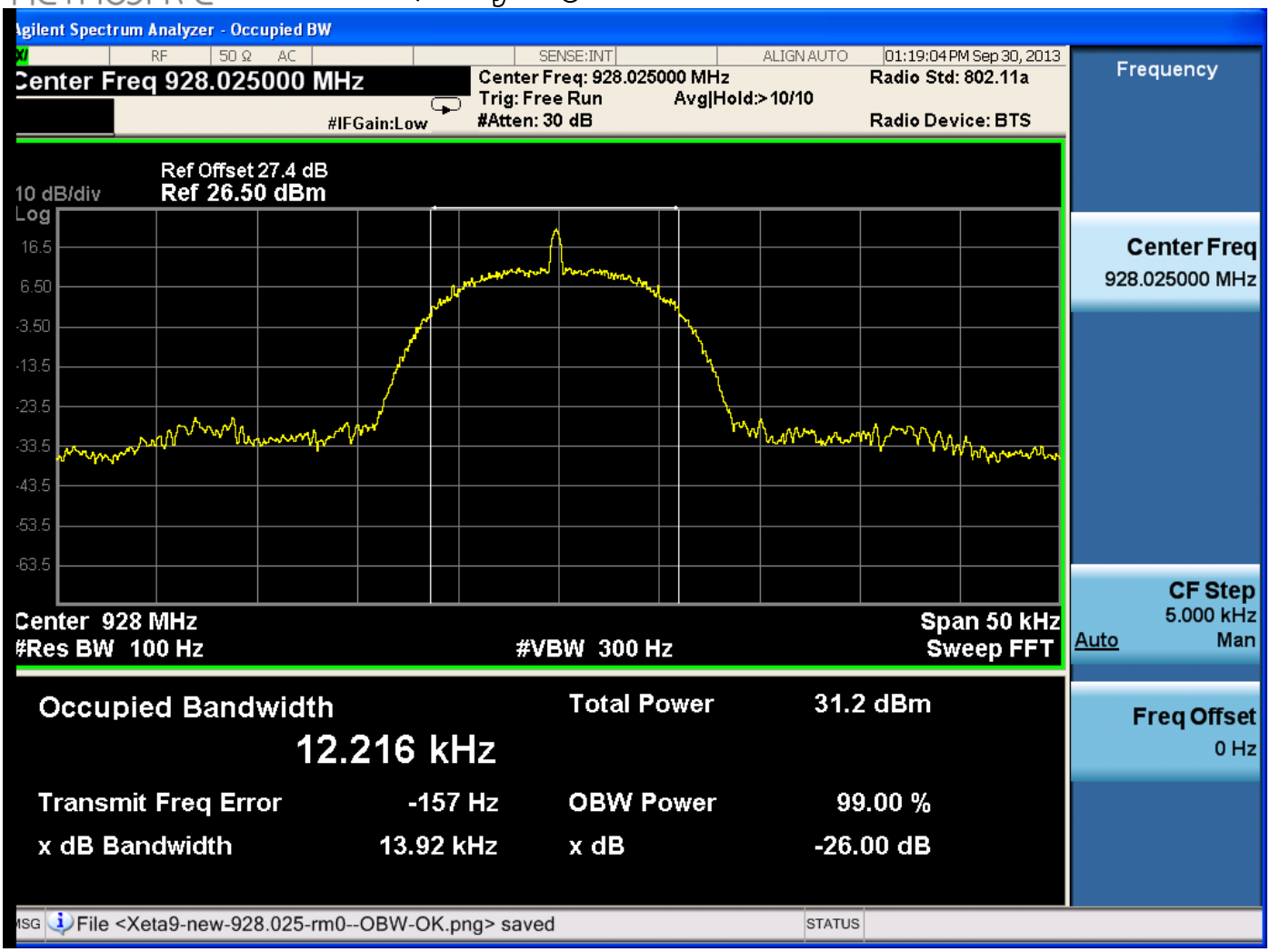


Figure 3. 928.025 MHz, rm0

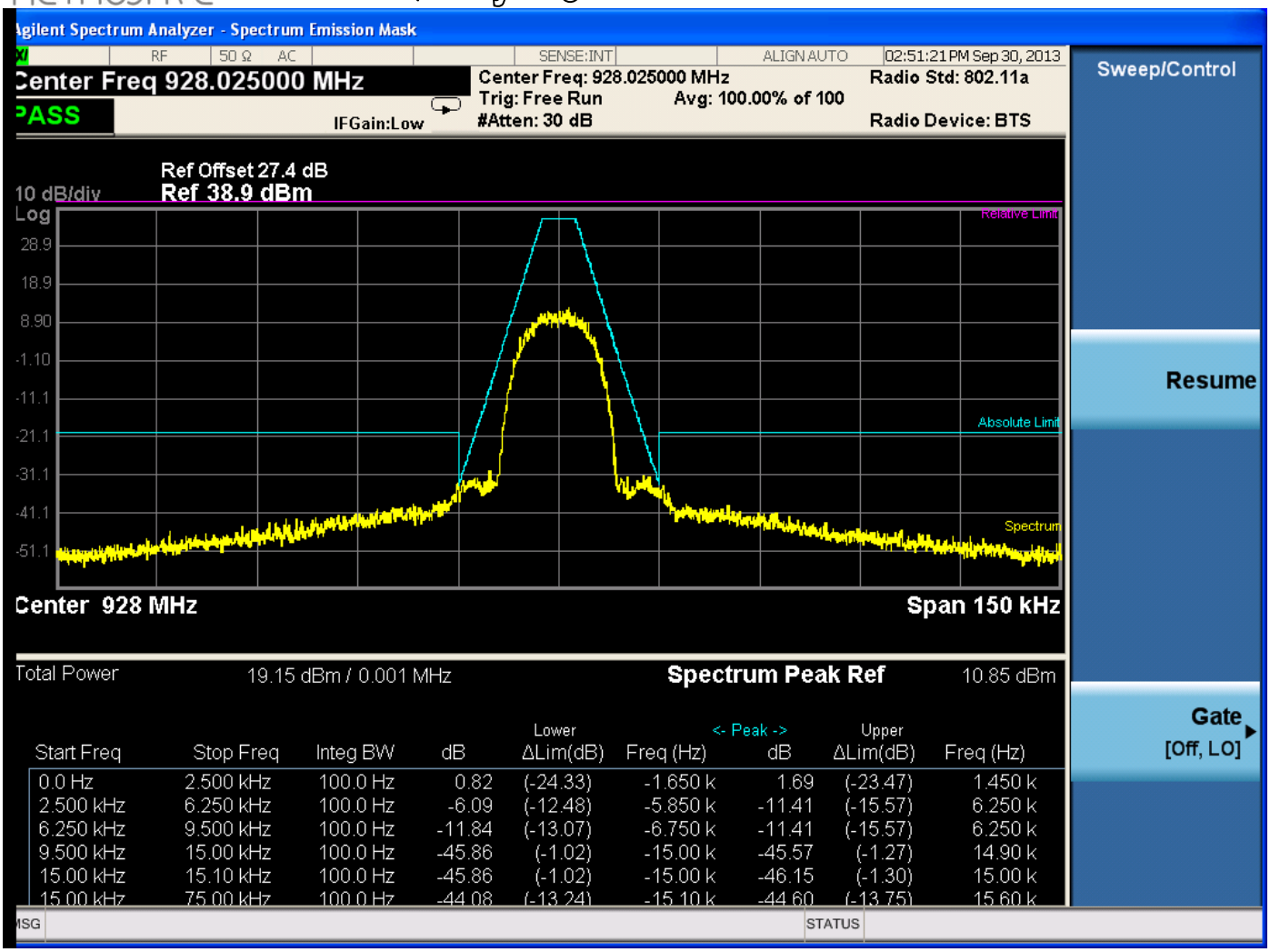


Figure 4. 928.025 MHz, rm1

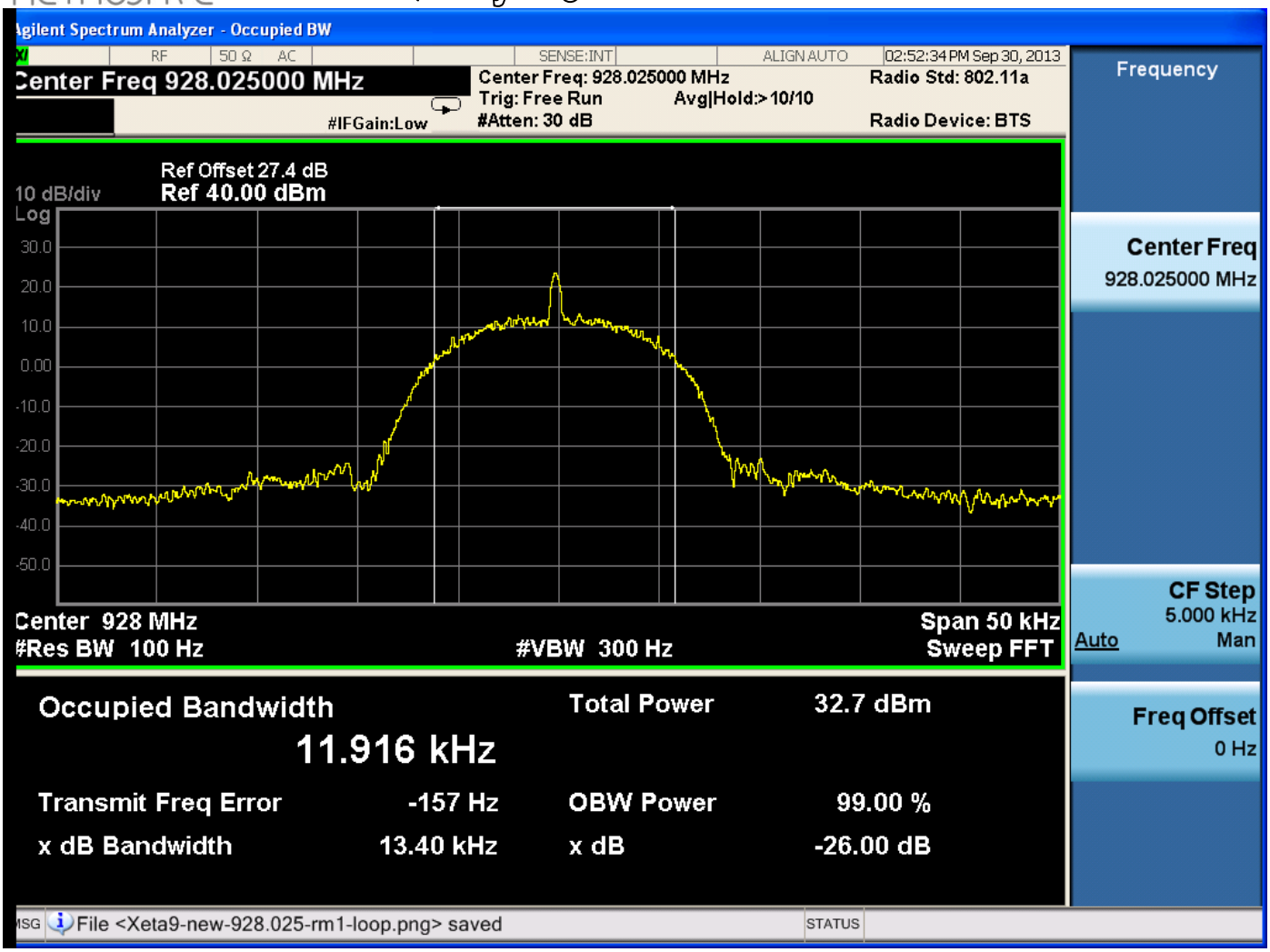


Figure 5. 928.025 MHz, rm1

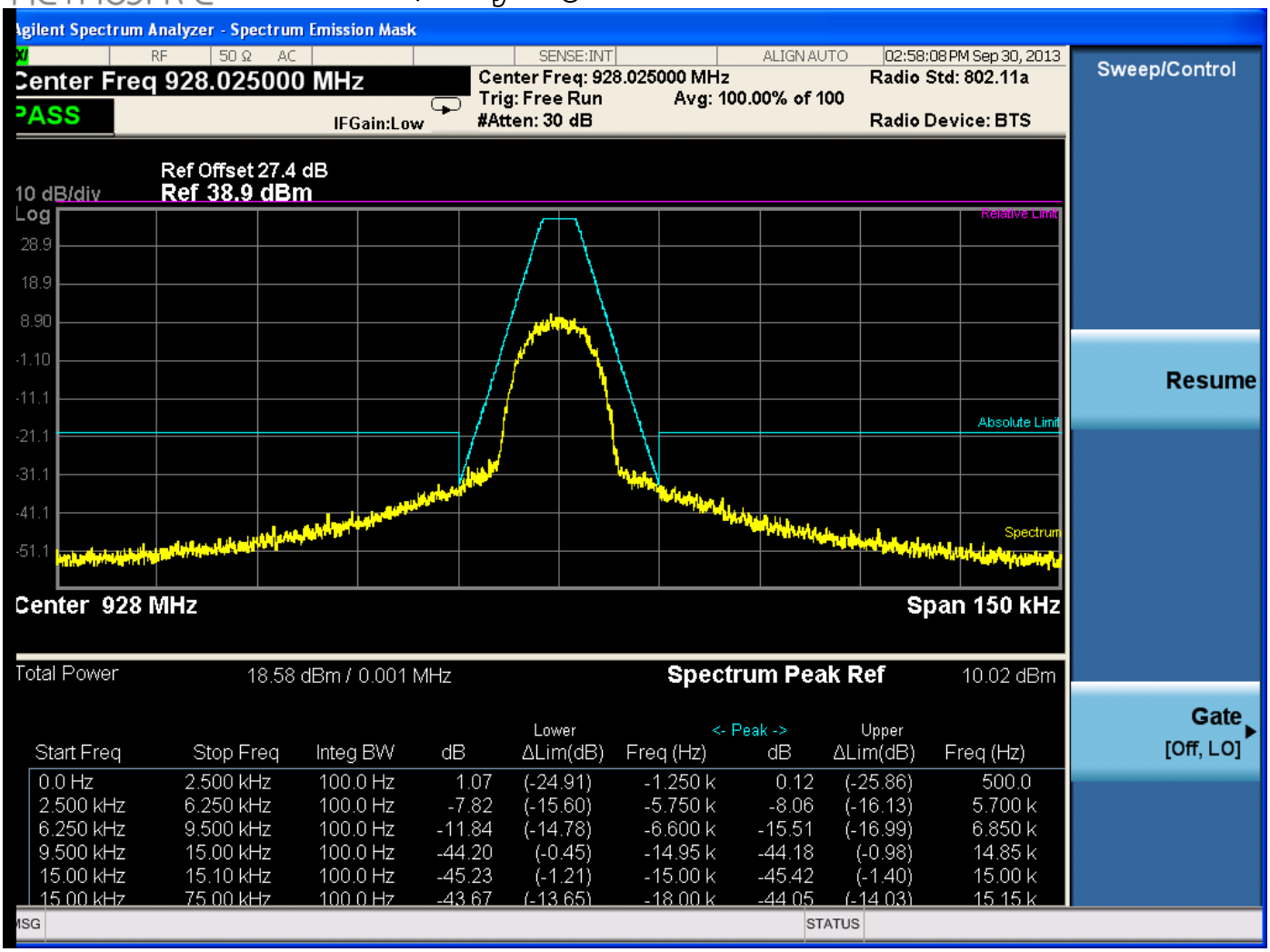


Figure 6. 928.025 MHz, rm2

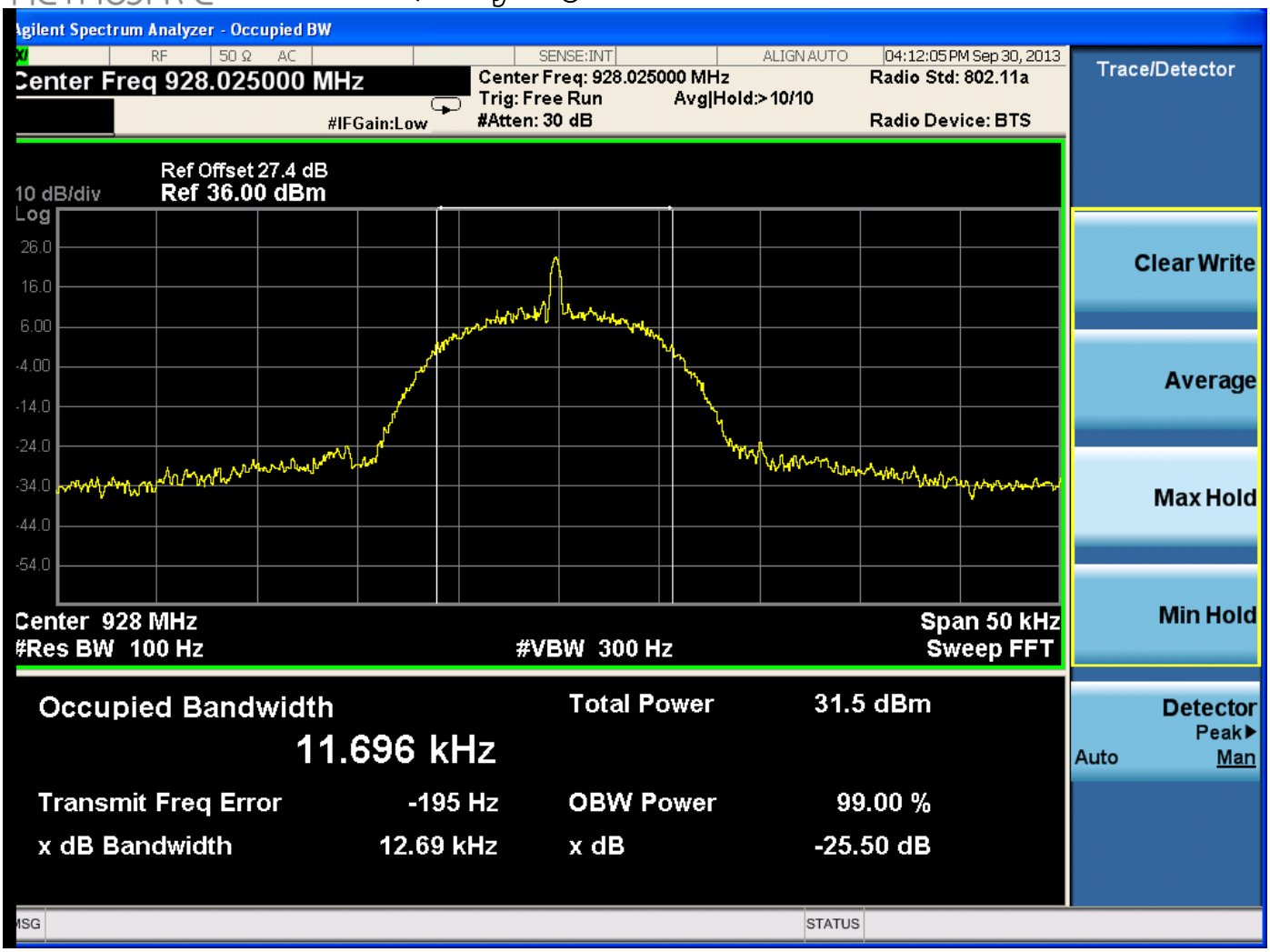


Figure 7. 928.025 MHz, rm2

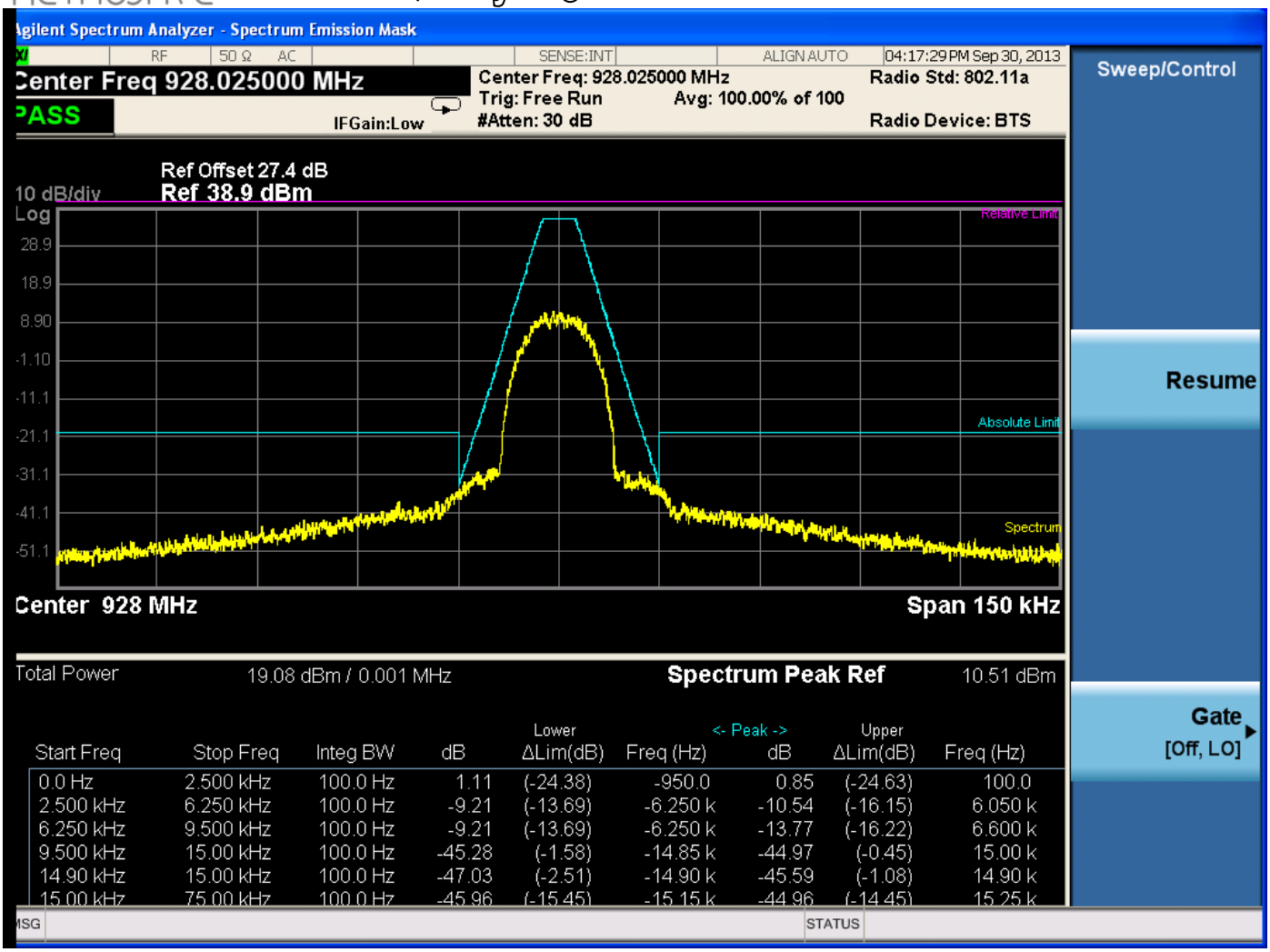


Figure 8. 928.025 MHz, rm3

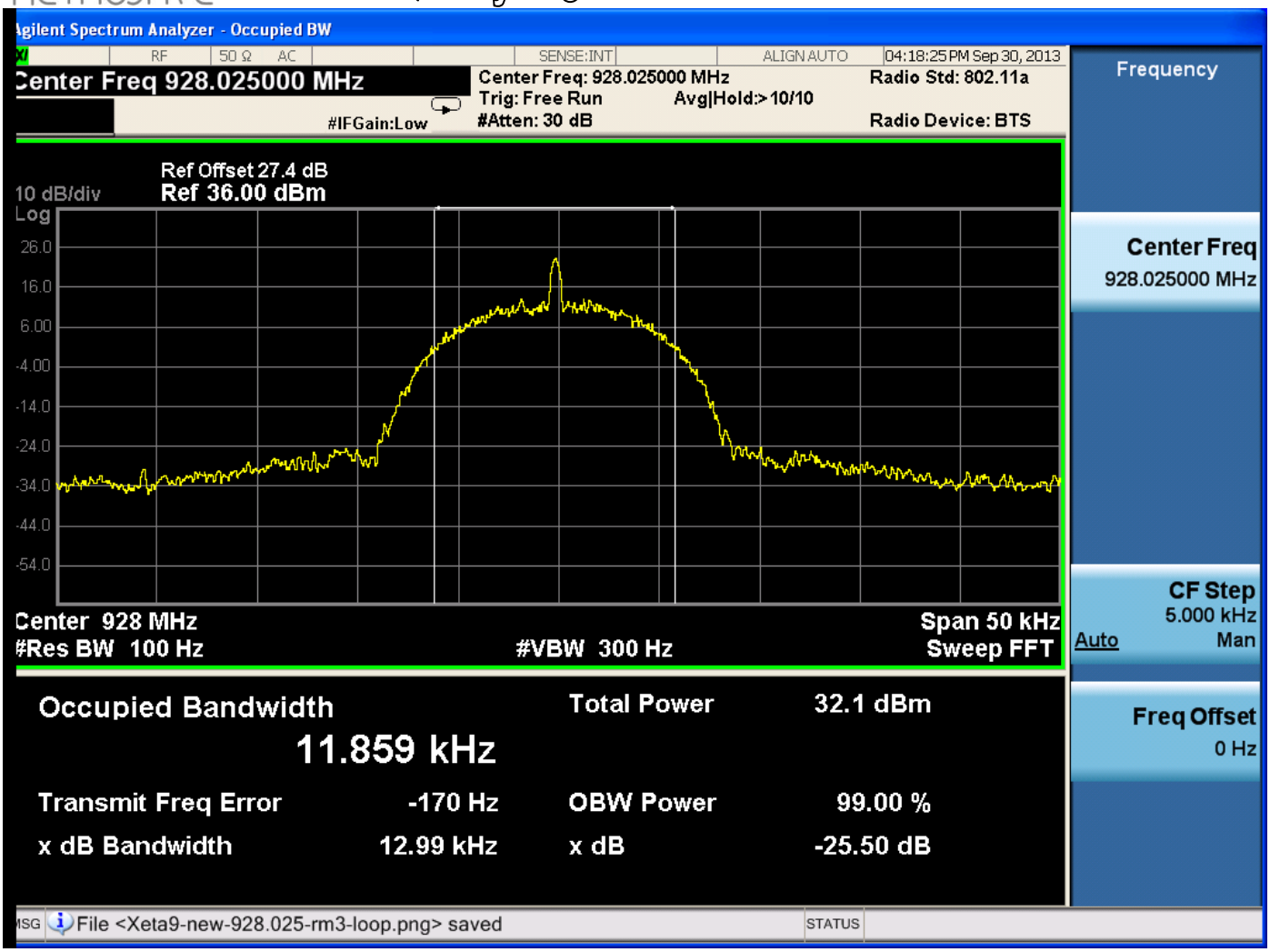


Figure 9. 928.025 MHz, rm3

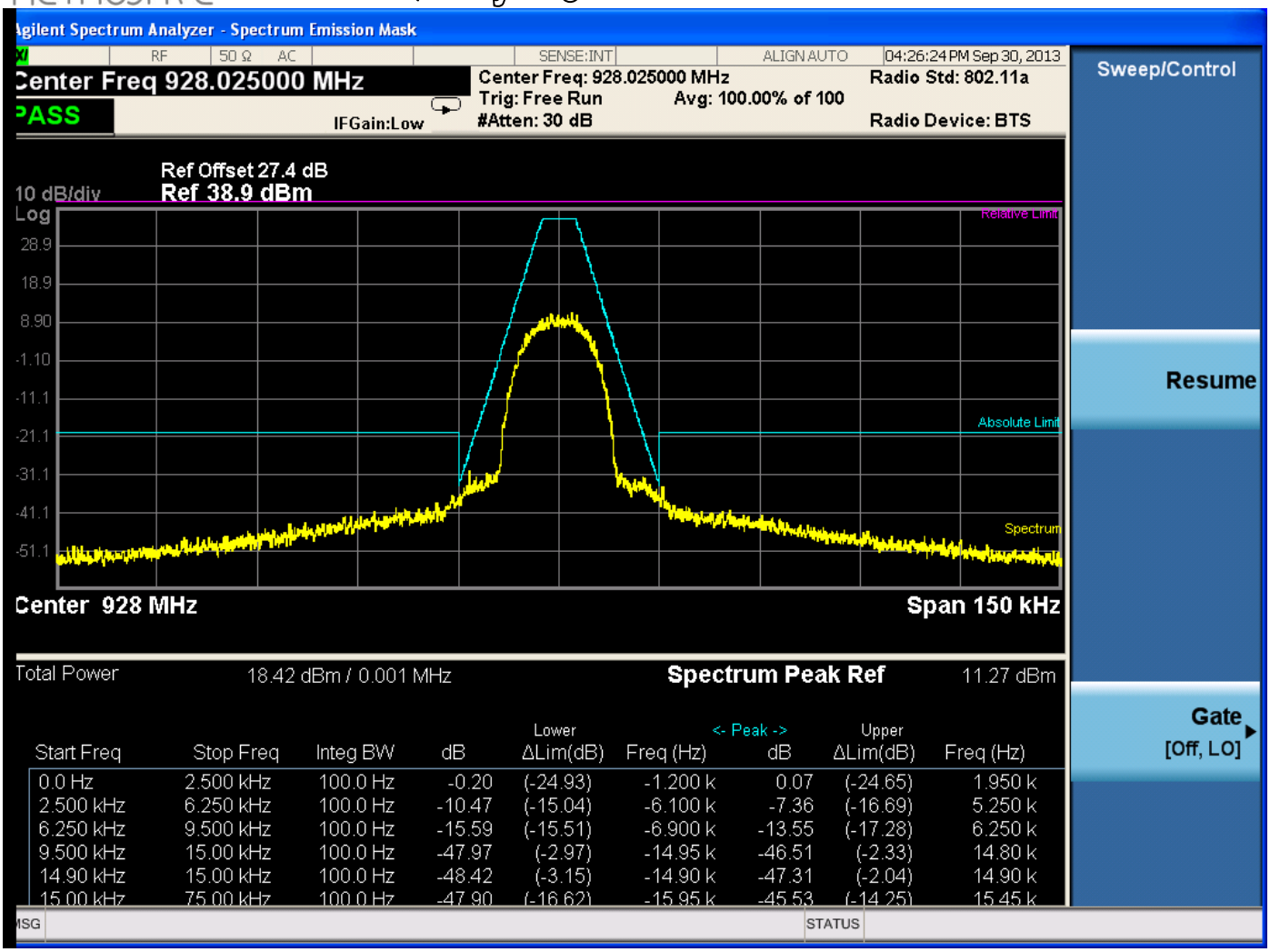


Figure 10. 928.025 MHz, rm4

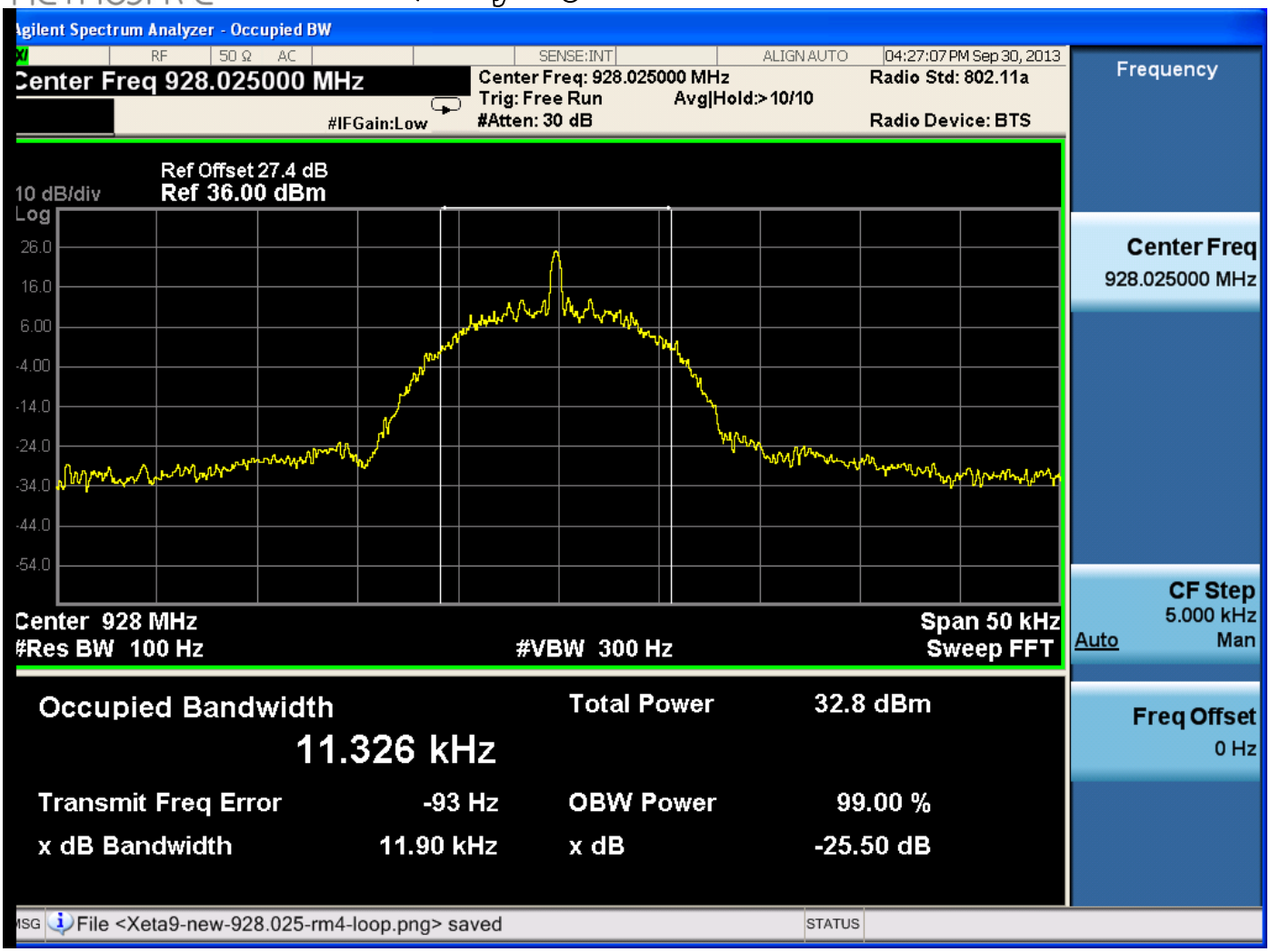


Figure 11. 928.025 MHz, rm4

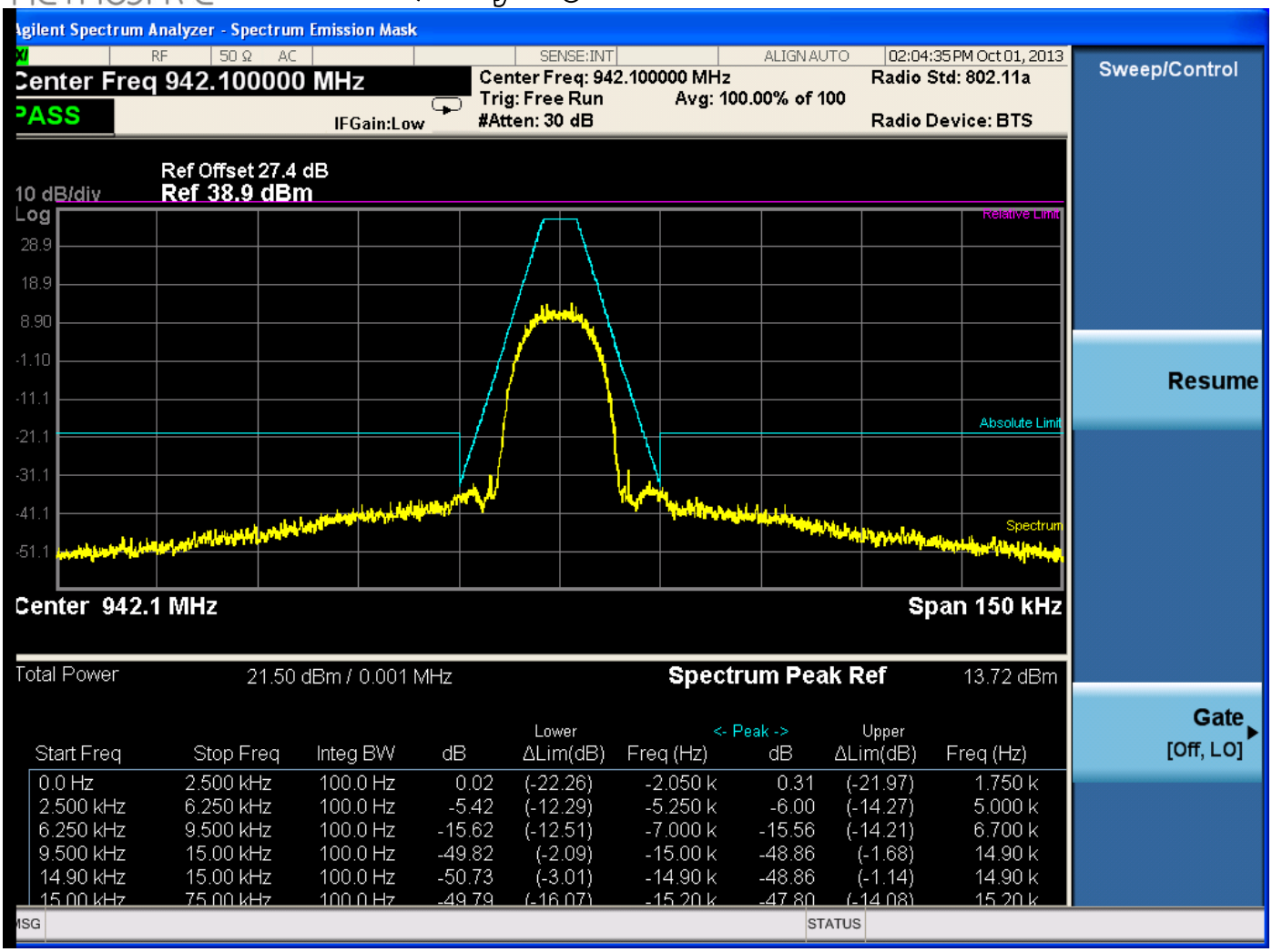


Figure 12. 942.1 MHz, rm0

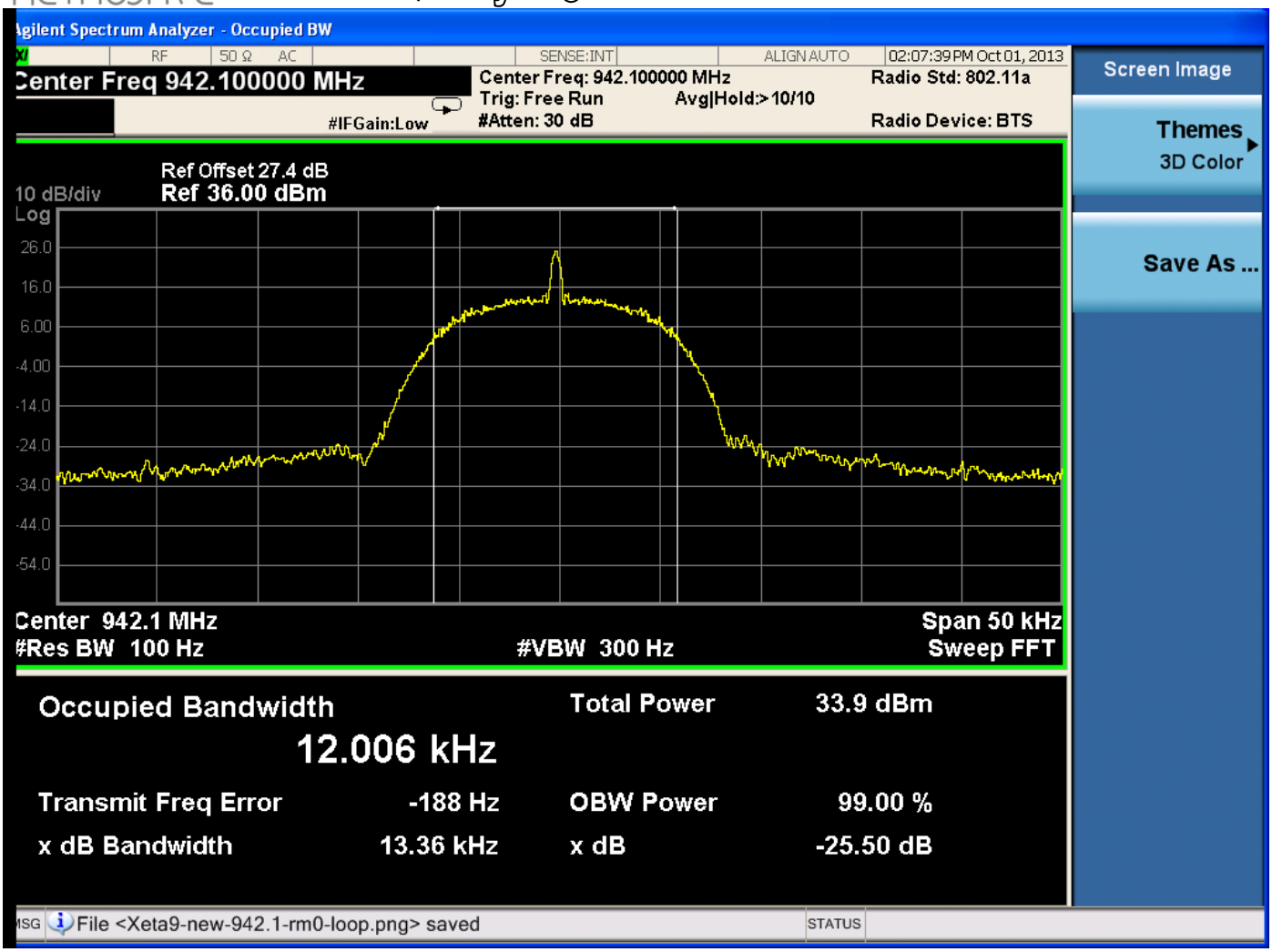


Figure 13. 942.1 MHz, rm0

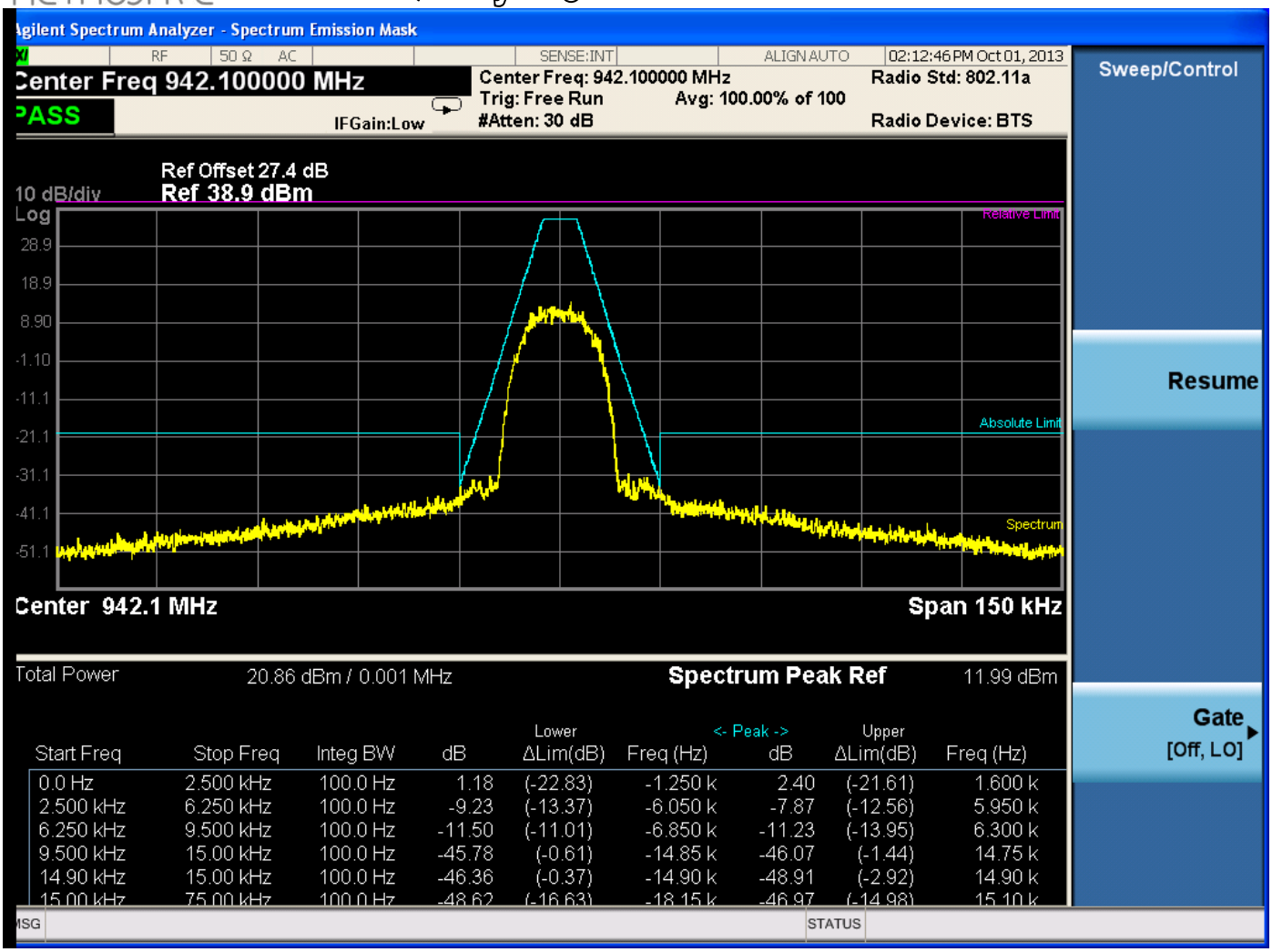


Figure 14. 942.1 MHz, rm1

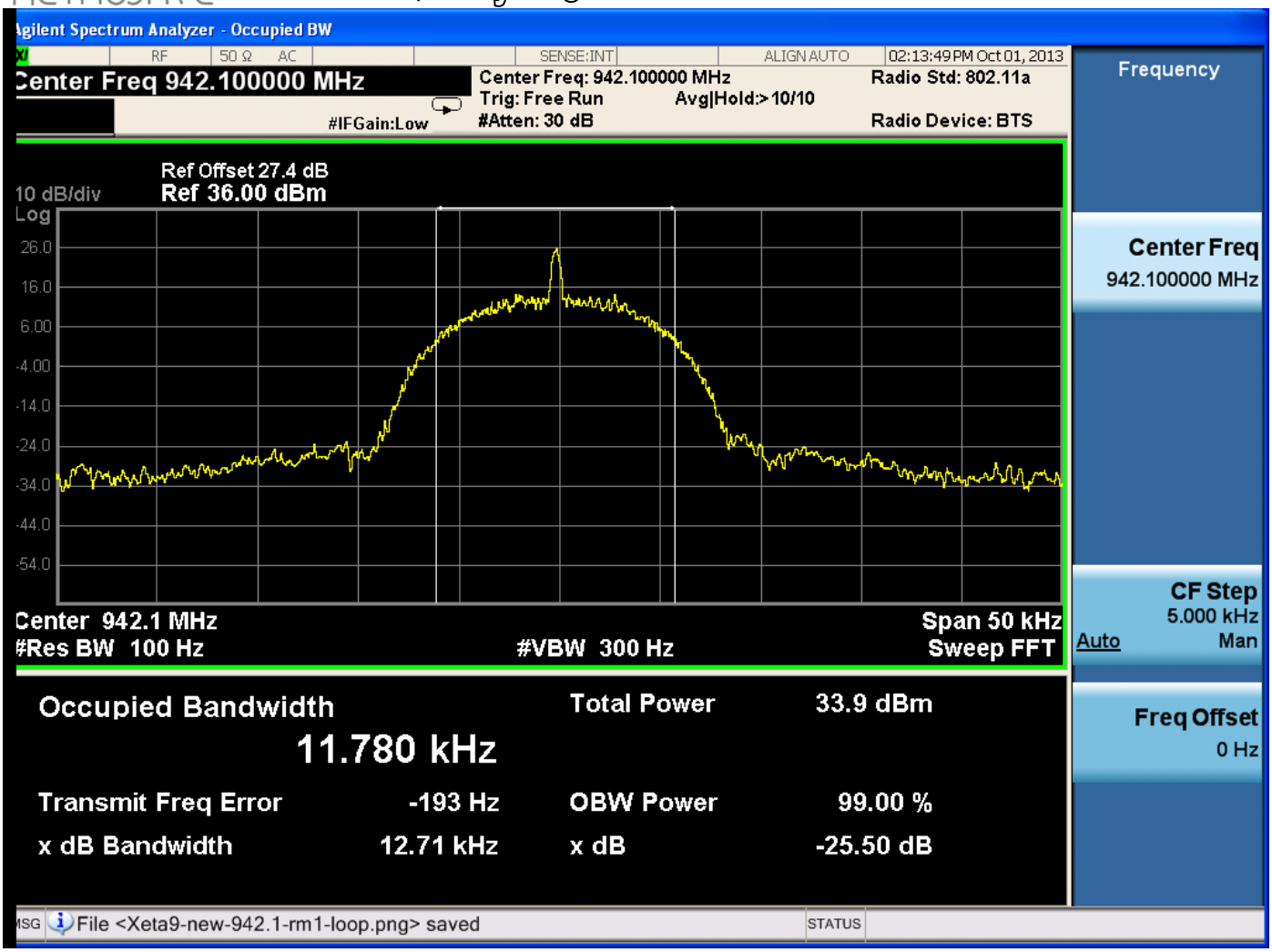


Figure 15. 942.1 MHz, rm1

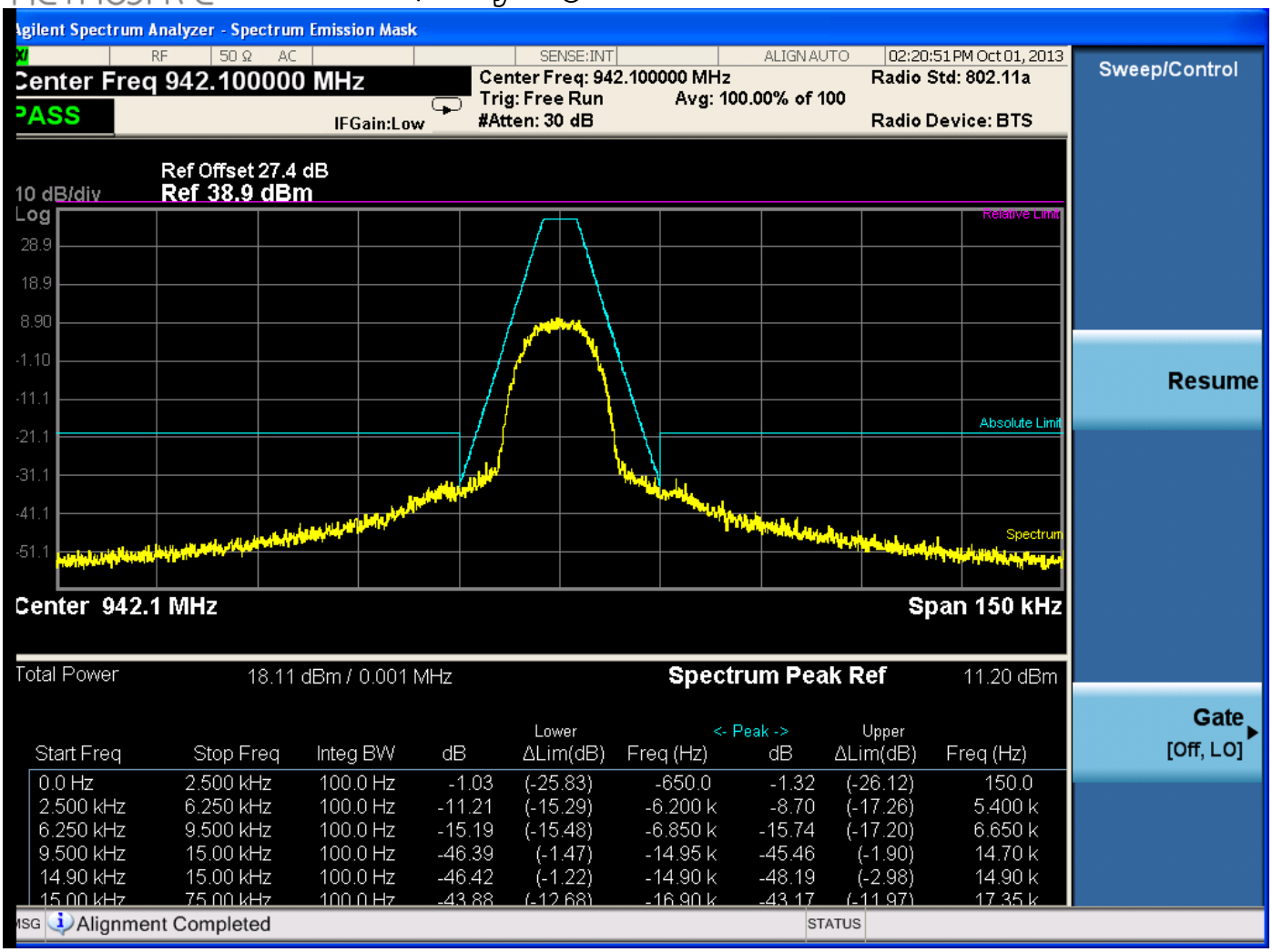


Figure 16. 942.1 MHz, rm2

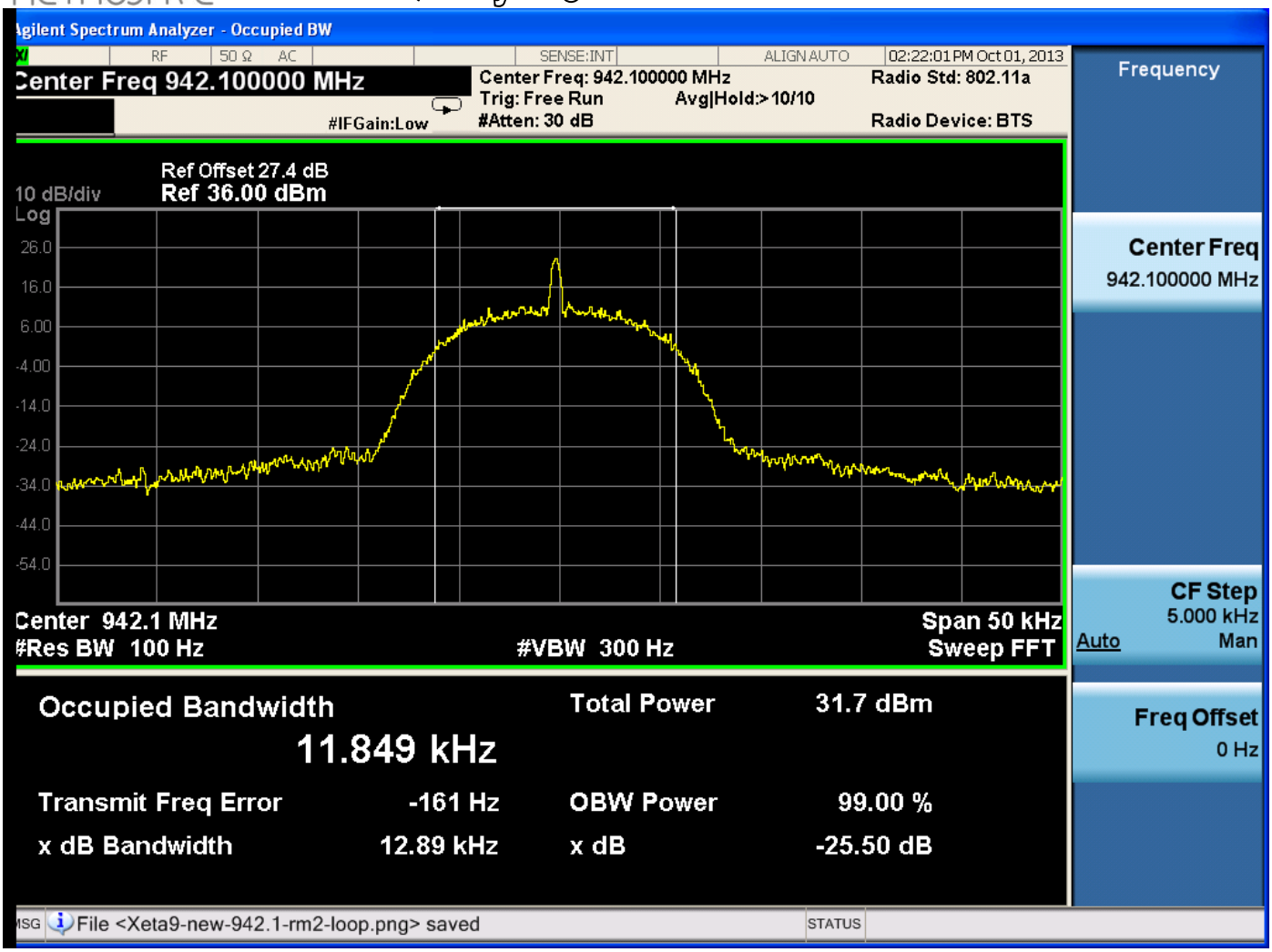


Figure 17. 942.1 MHz, rm2

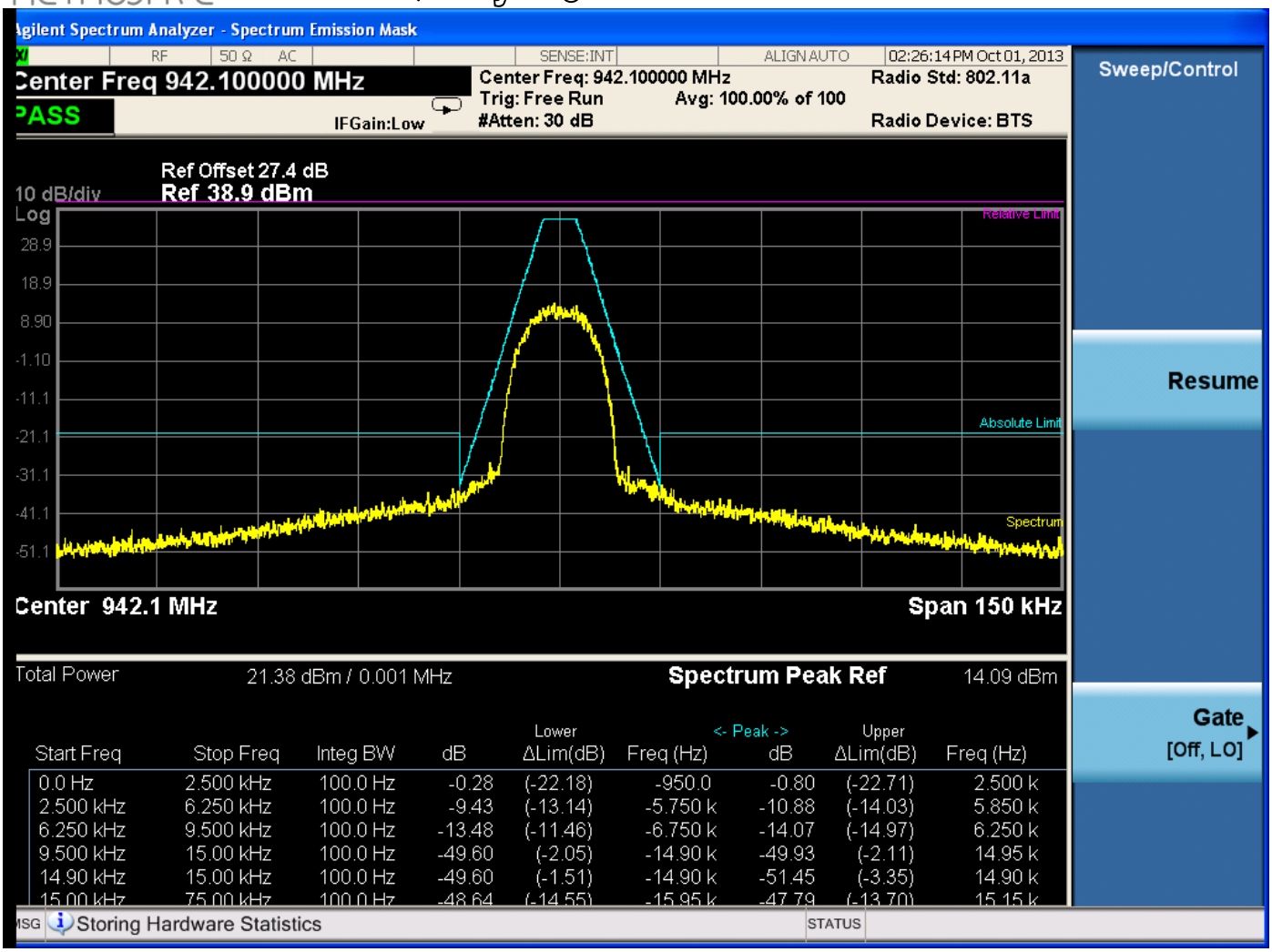


Figure 18. 942.1 MHz, rm3

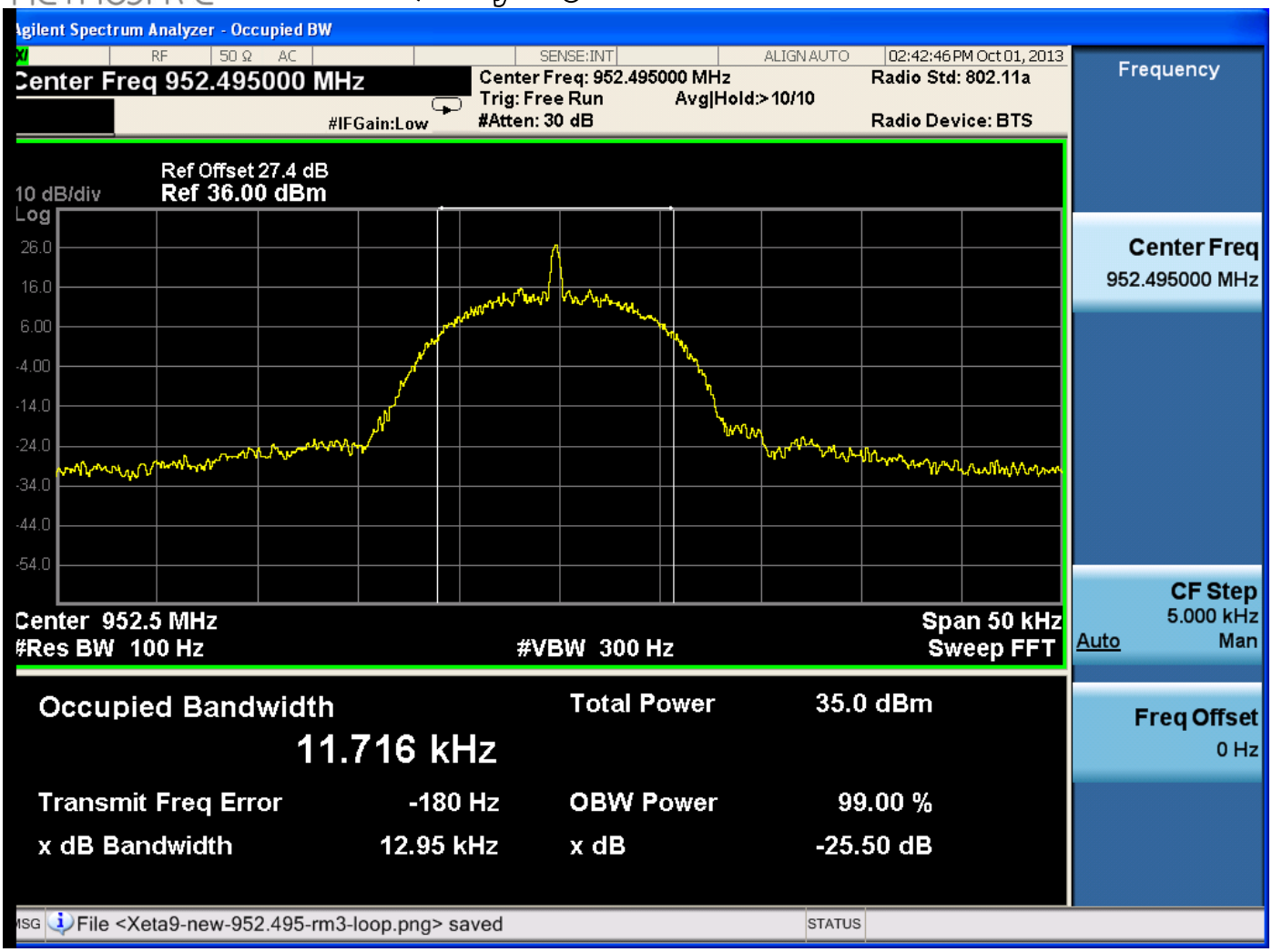


Figure 19. 942.1 MHz, rm3

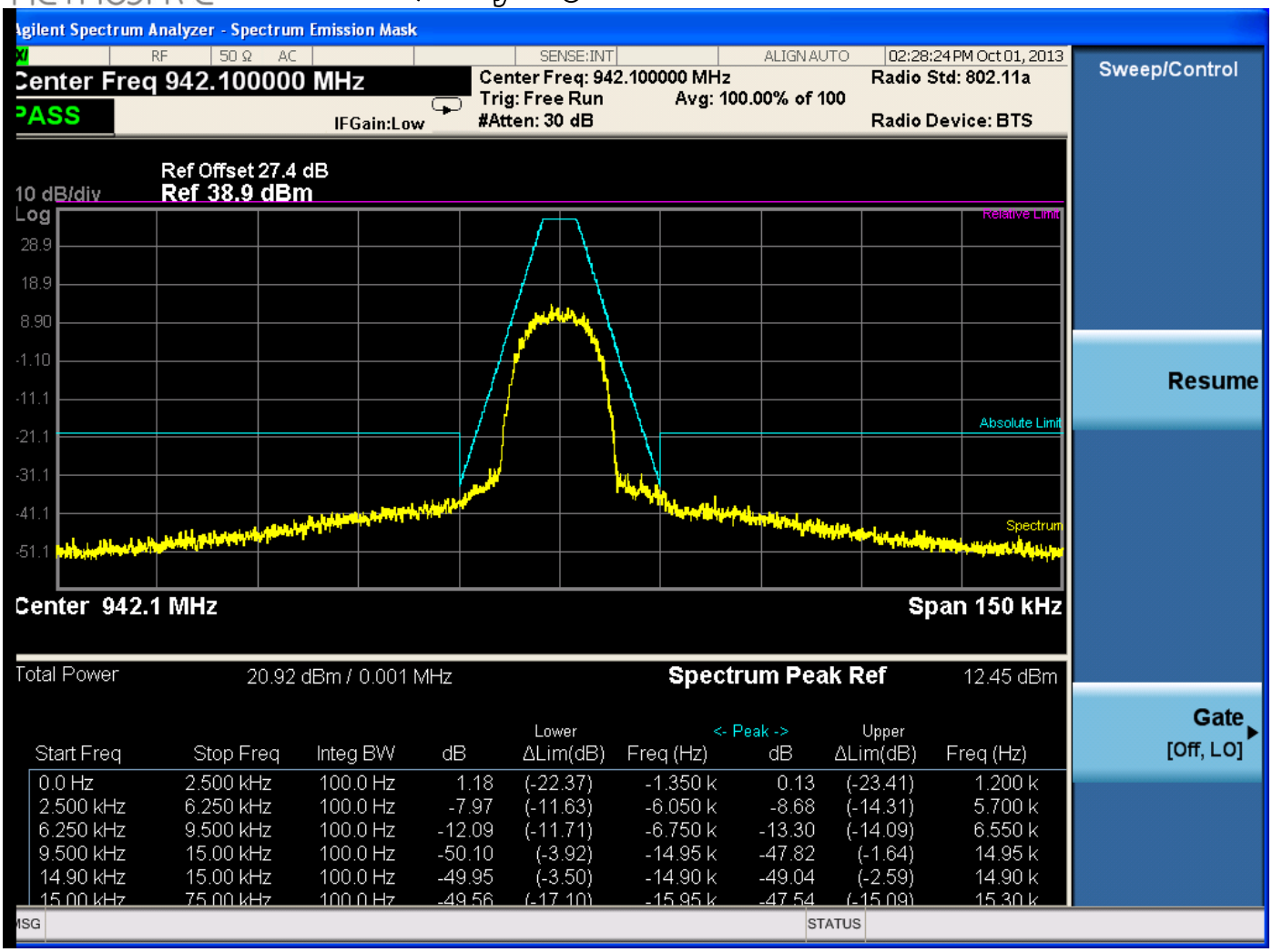


Figure 20. 942.1 MHz, rm4

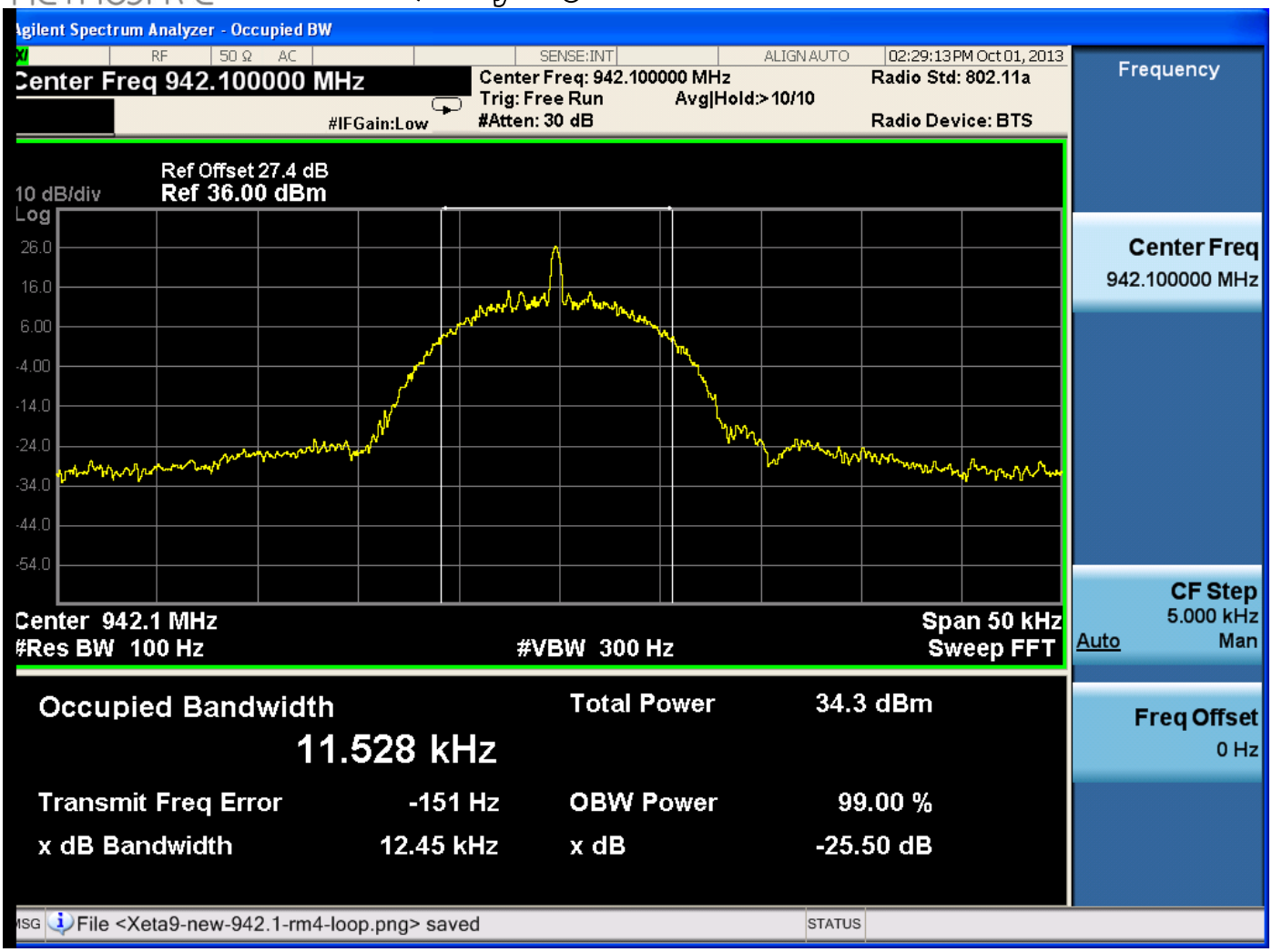


Figure 21. 942.1 MHz, rm4

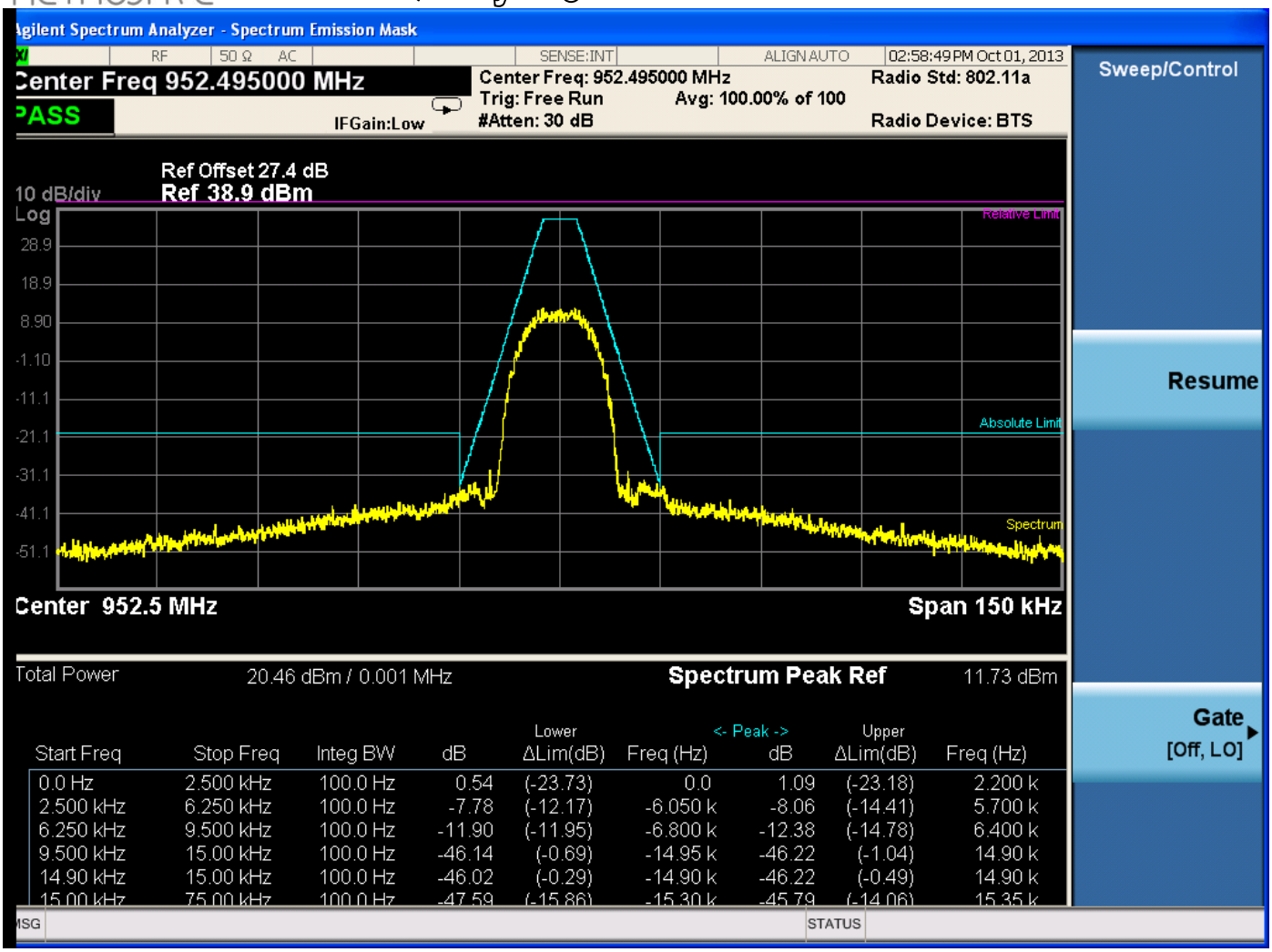


Figure 22. 952.495 MHz, rm0

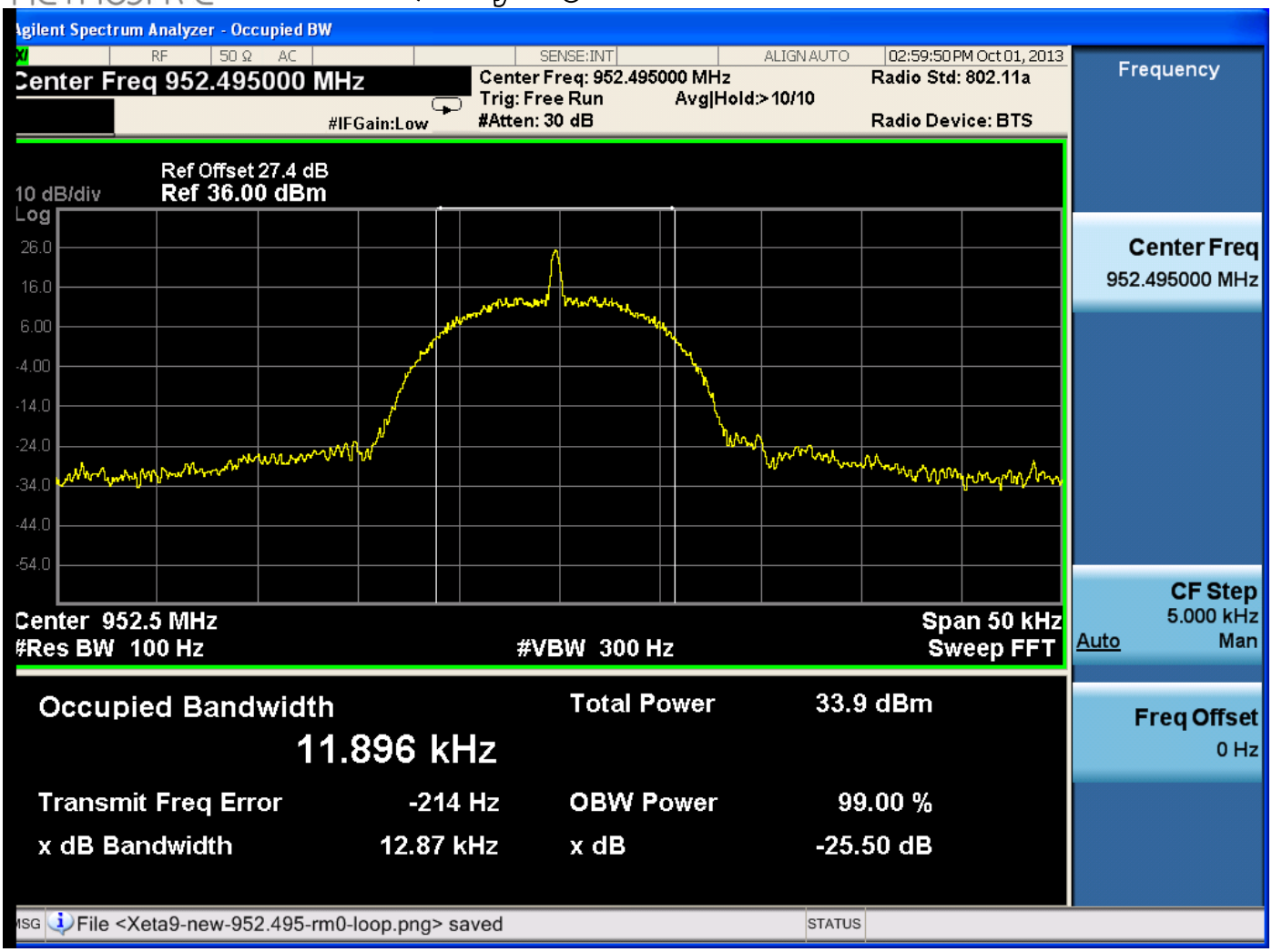


Figure 23. 952.495 MHz, rm0

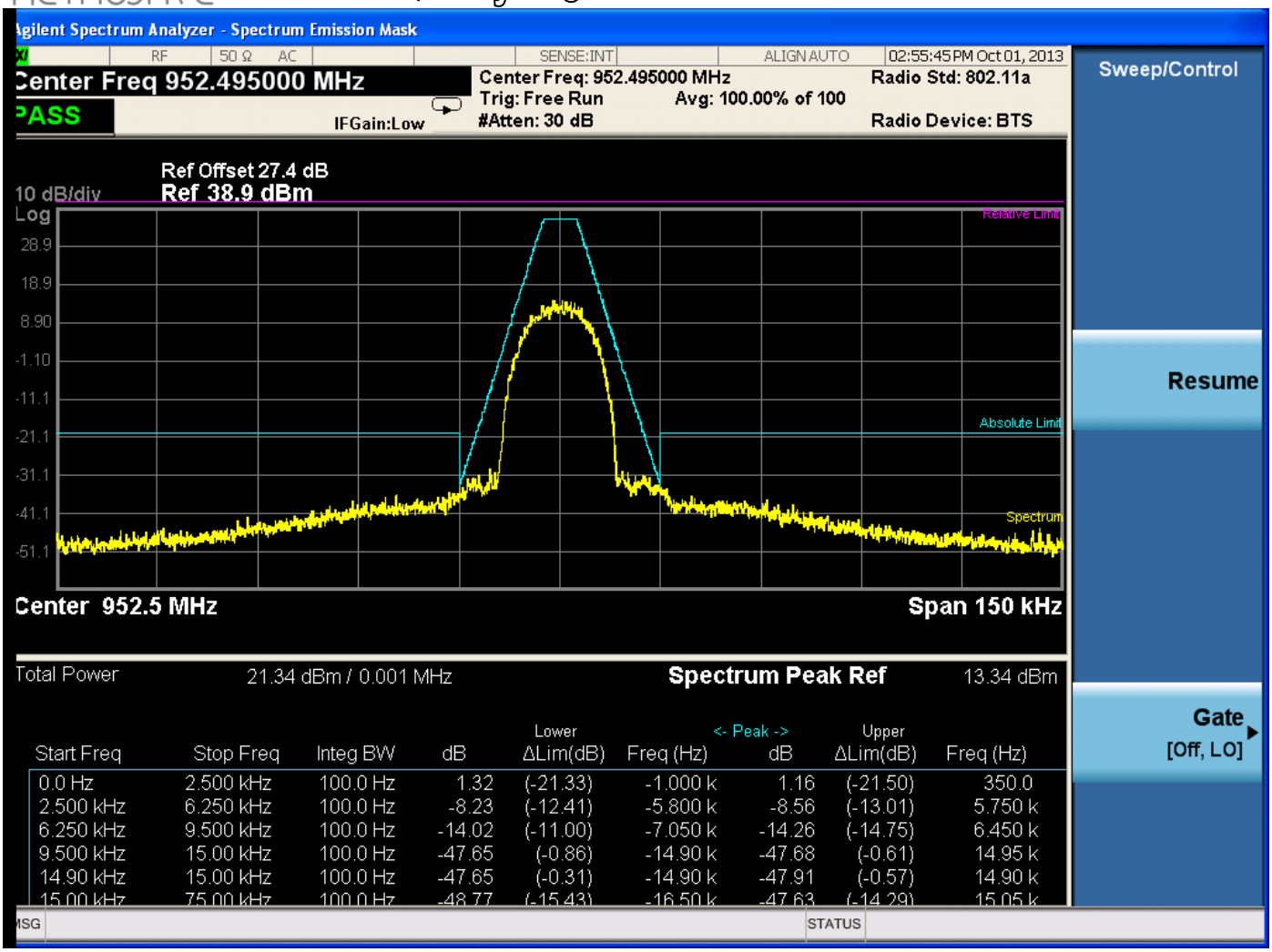


Figure 24. 952.495 MHz, rm1

Figure 25. 952.495 MHz, rm1

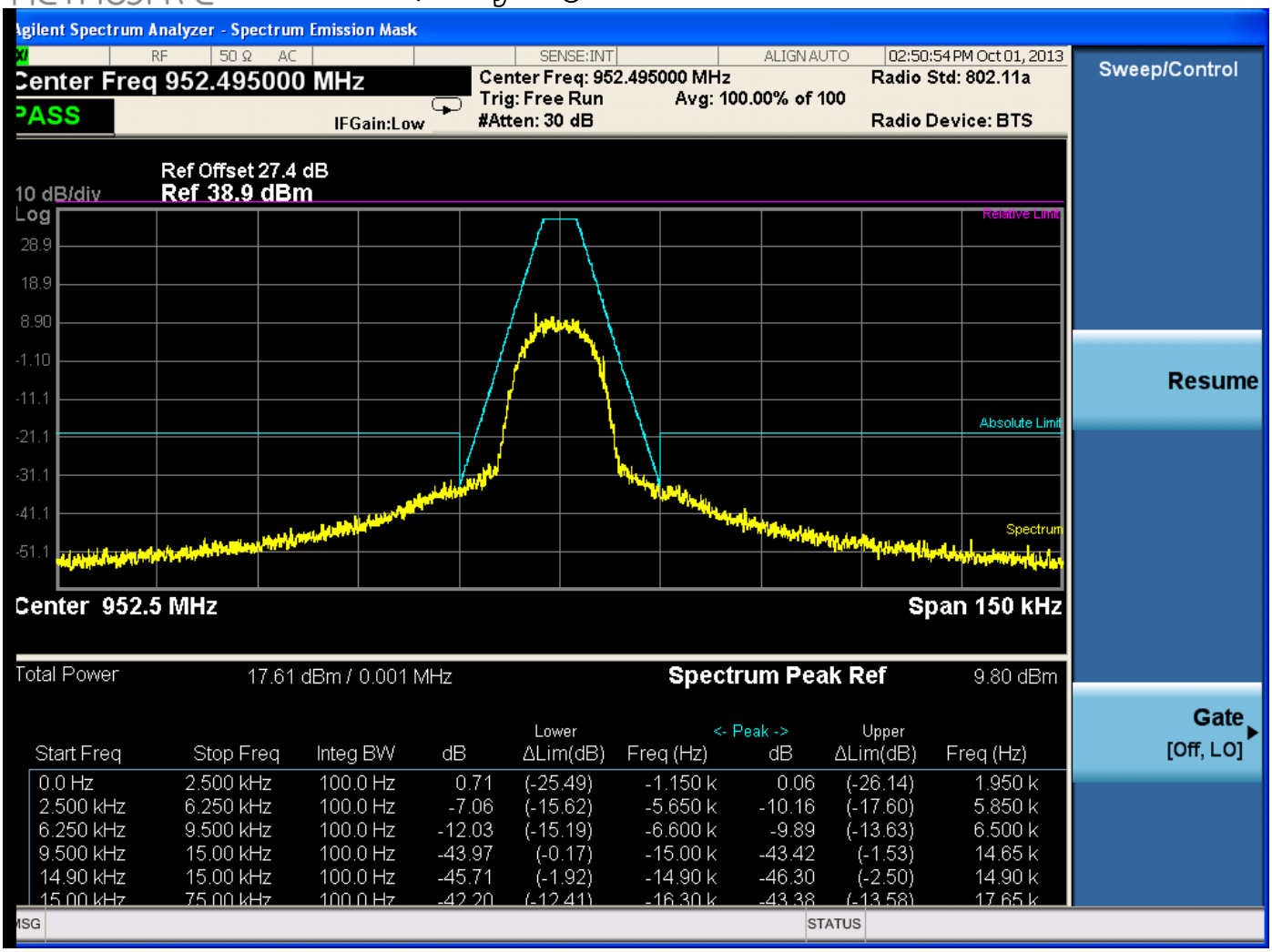


Figure 26. 952.495 MHz, rm2

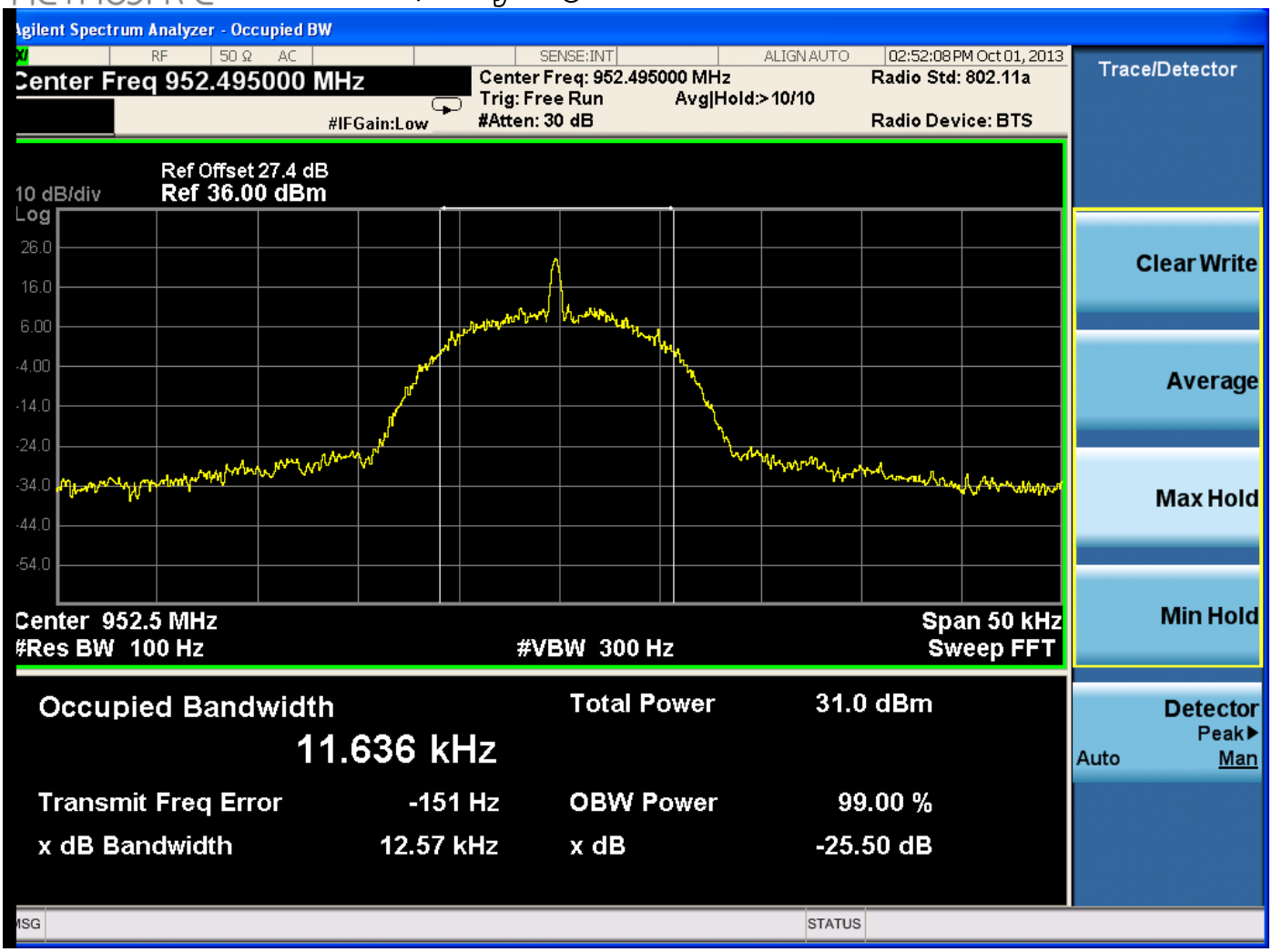


Figure 27. 952.495 MHz, rm2

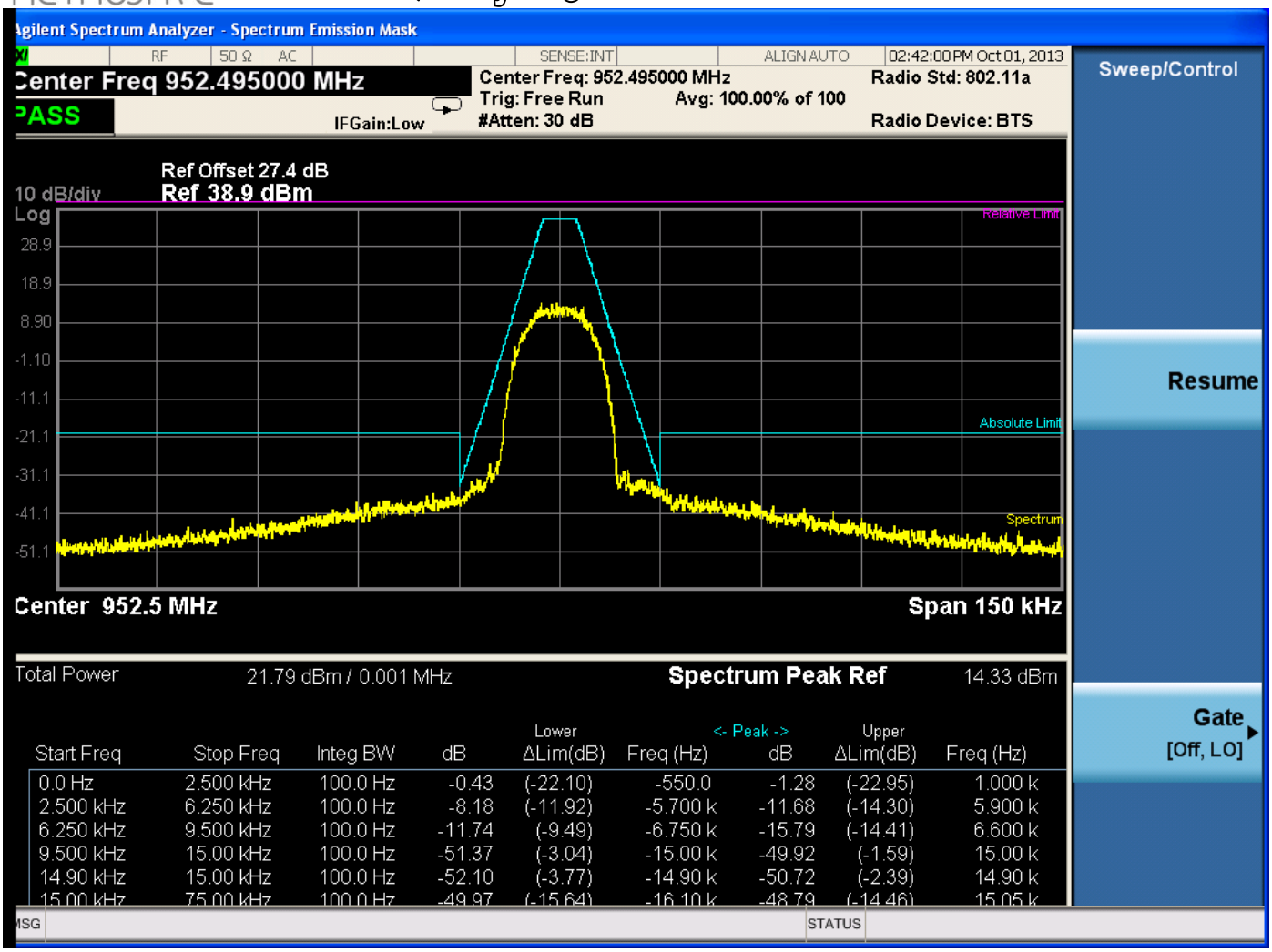


Figure 28. 952.495 MHz, rm3

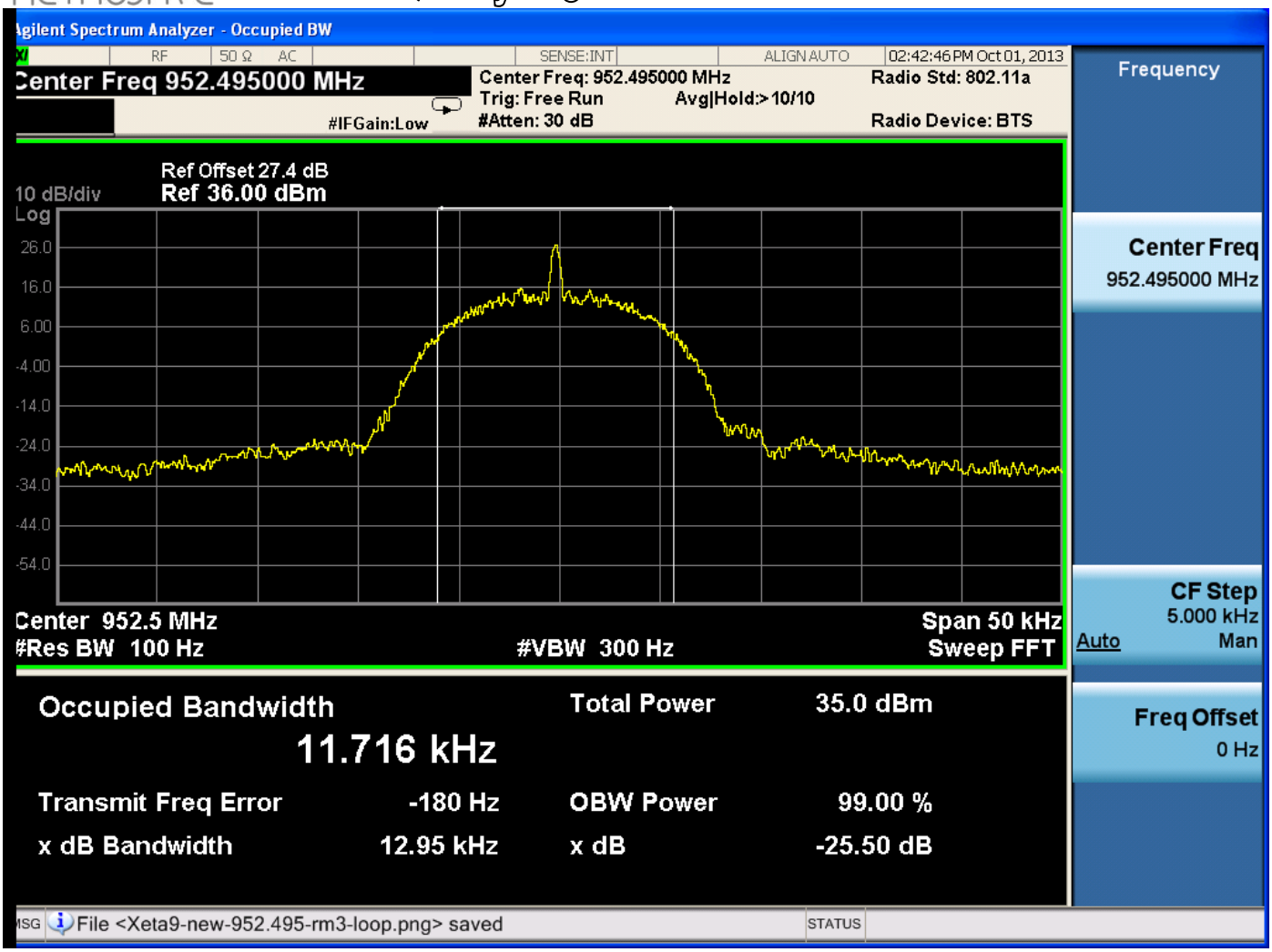


Figure 29. 952.495 MHz, rm3

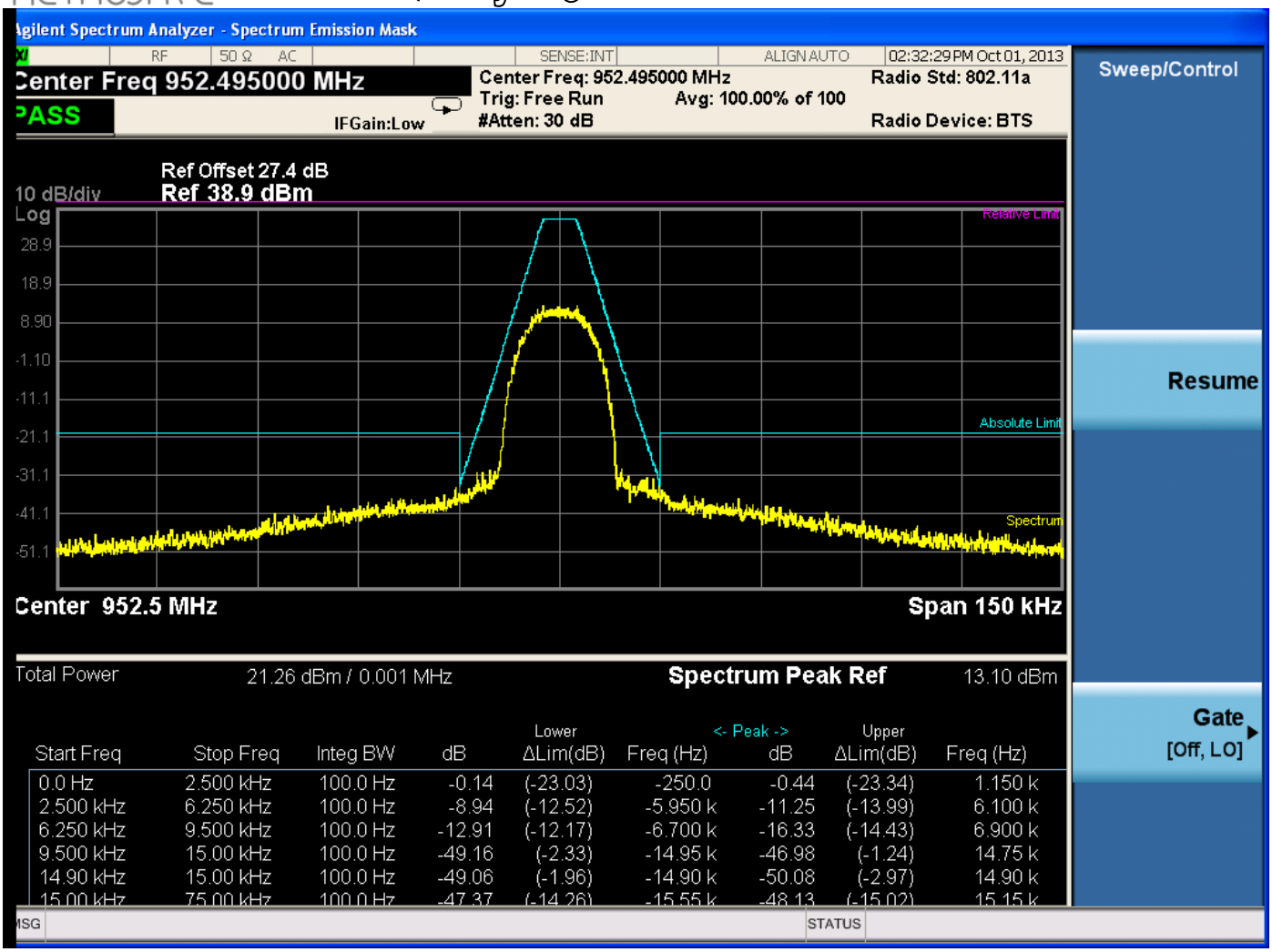


Figure 30. 952.495 MHz, rm4

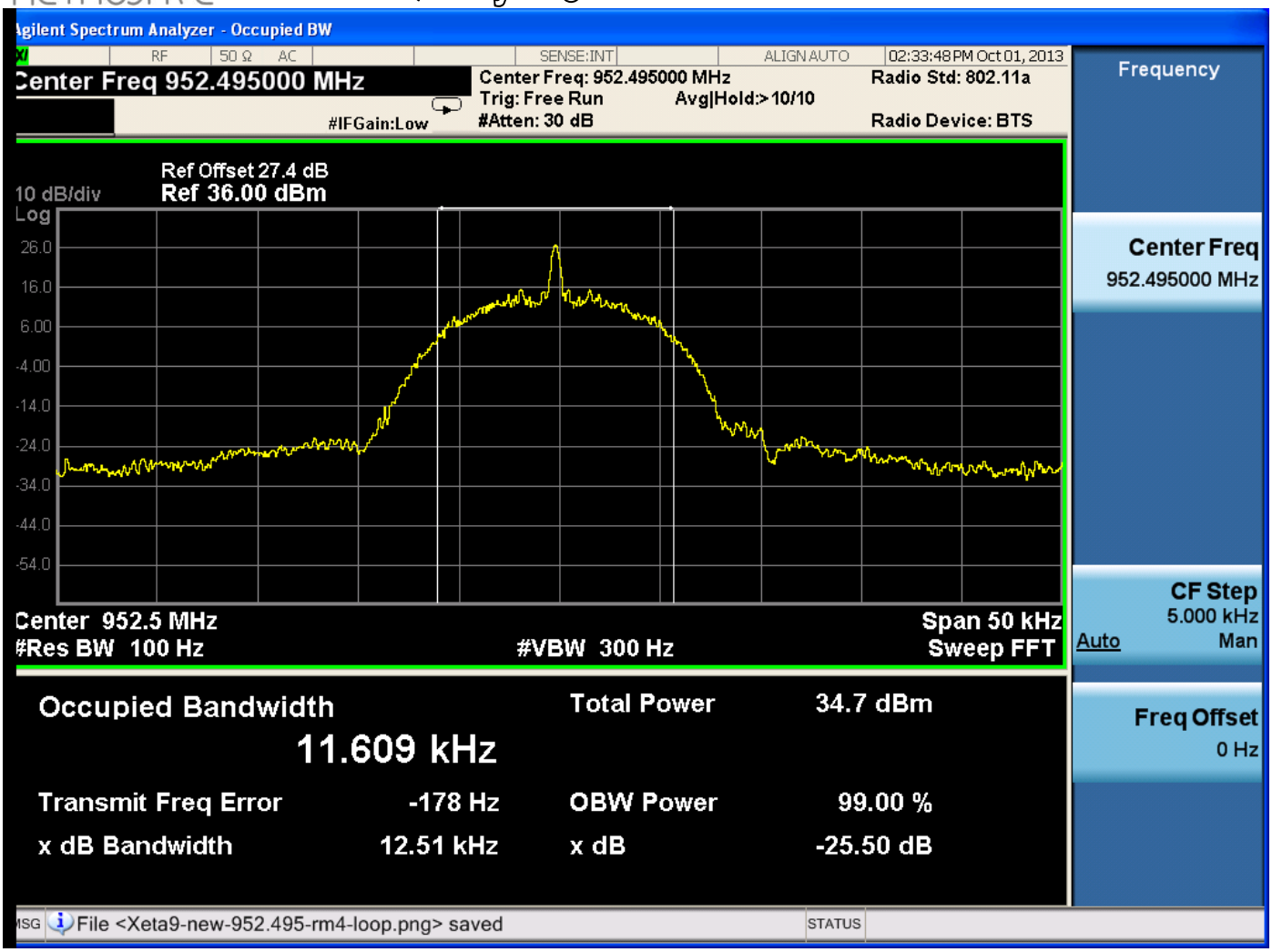


Figure 31. 952.495 MHz, rm4

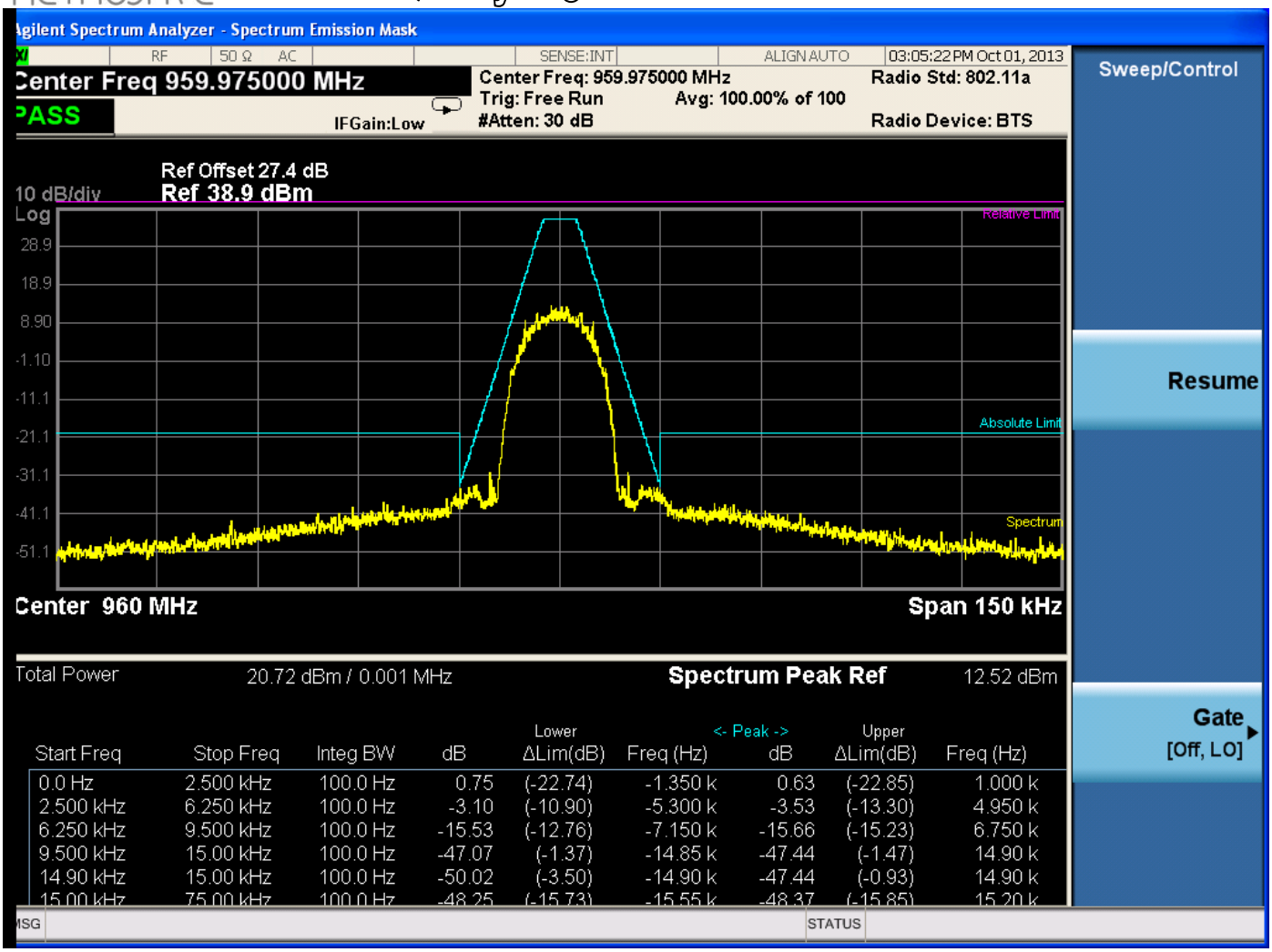


Figure 32. 959.9975 MHz, rm0

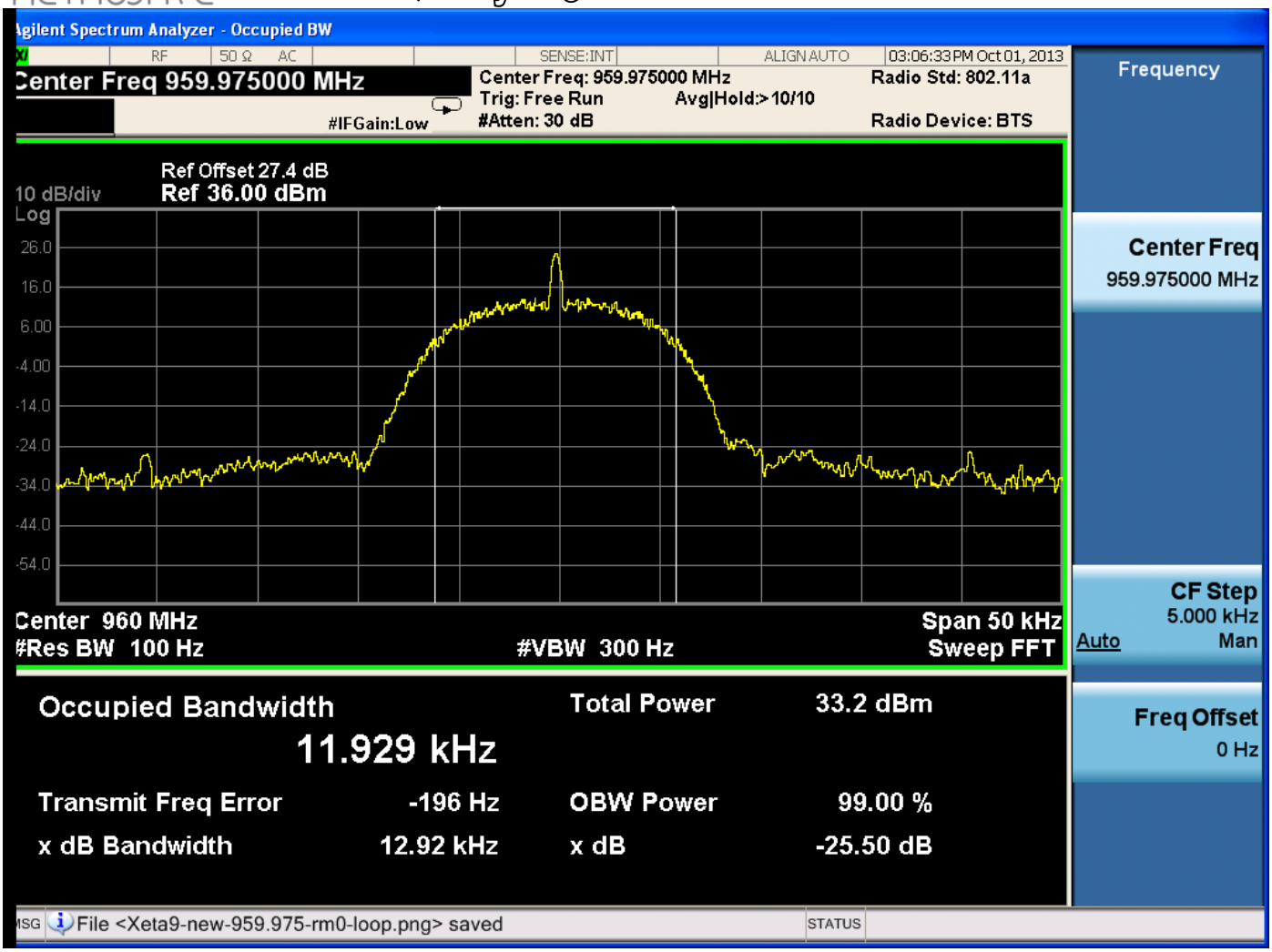


Figure 33. 959.9975 MHz, rm0

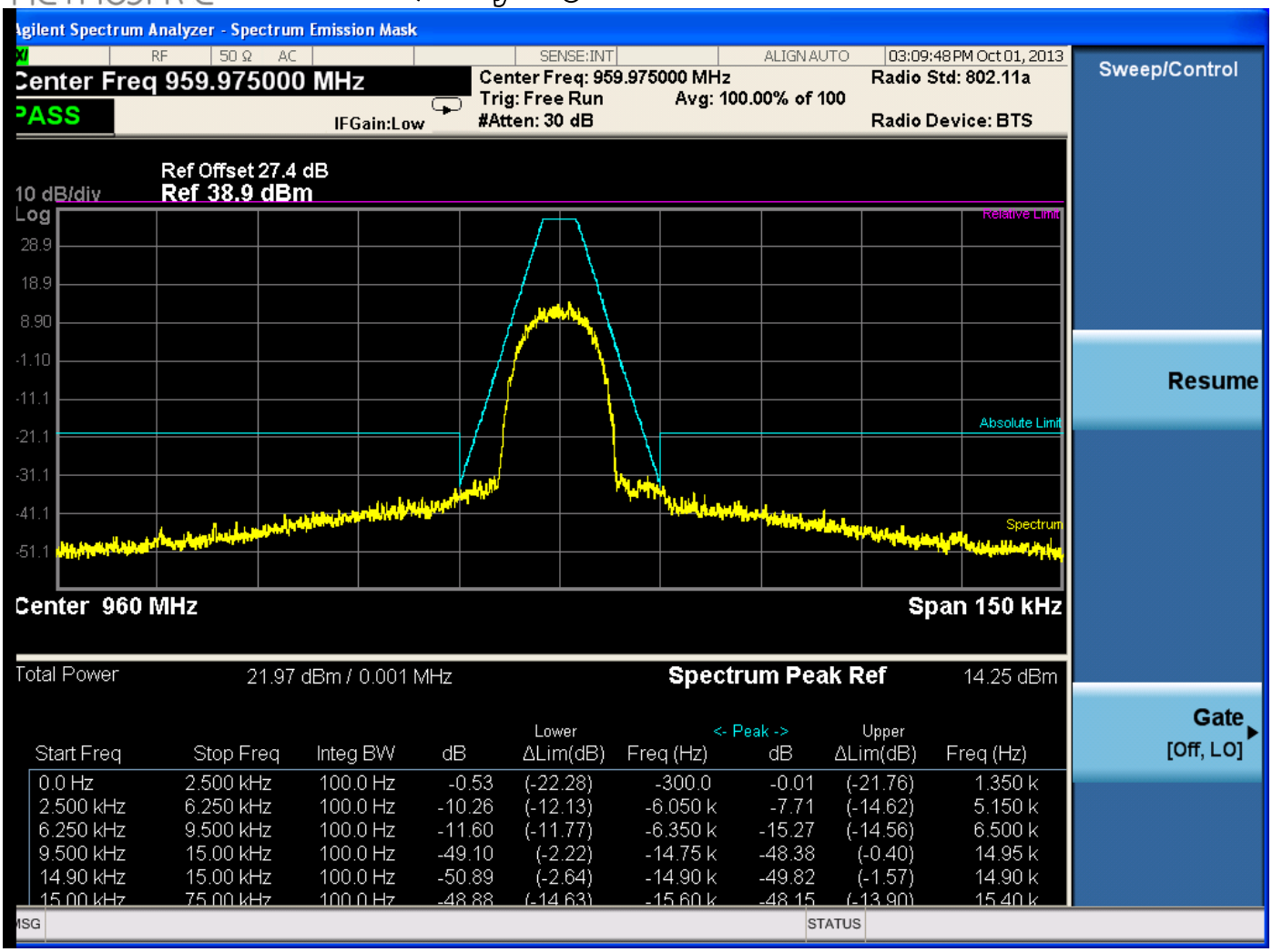


Figure 34. 959.9975 MHz, rm1

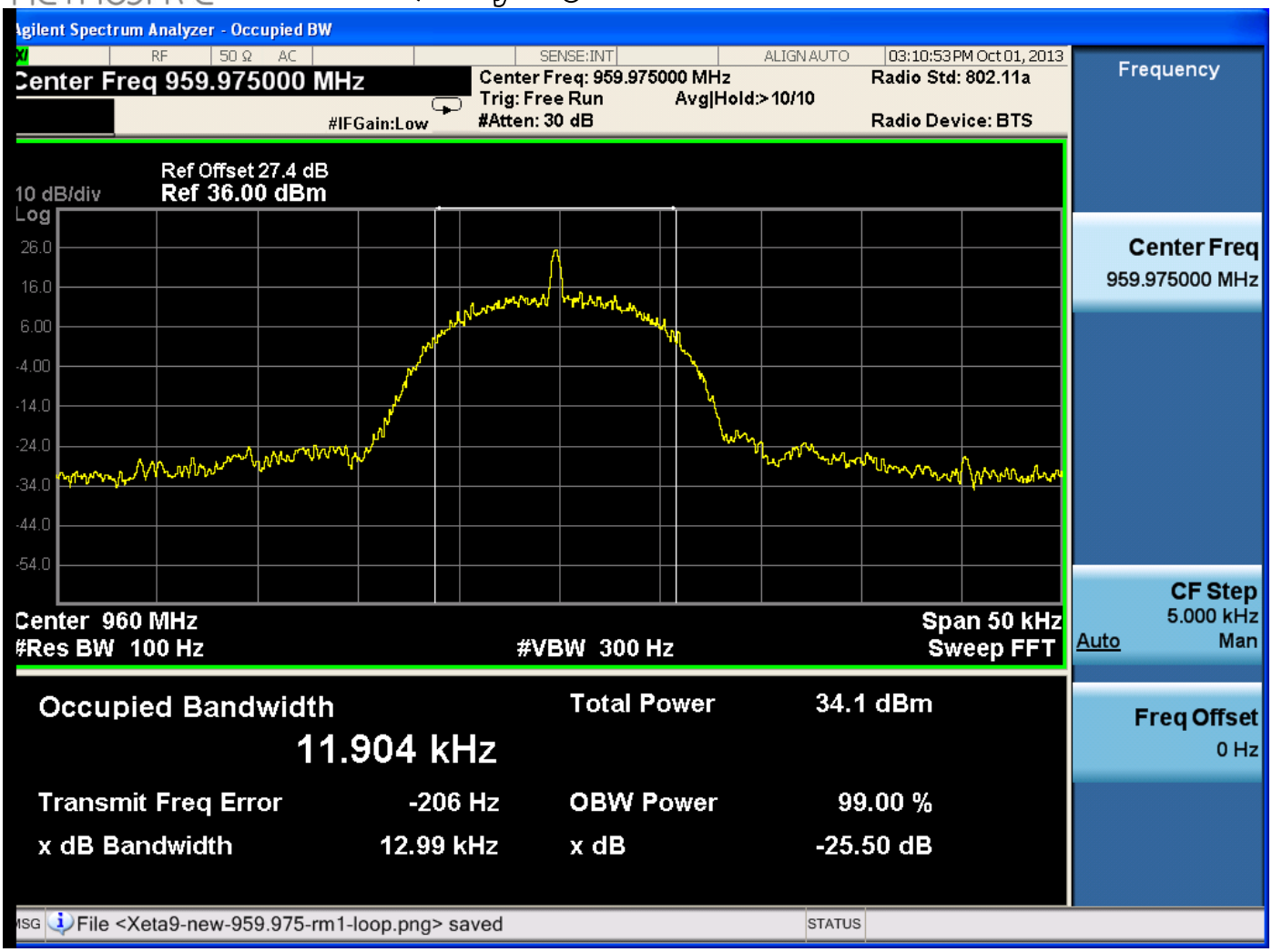


Figure 35. 959.9975 MHz, rm1

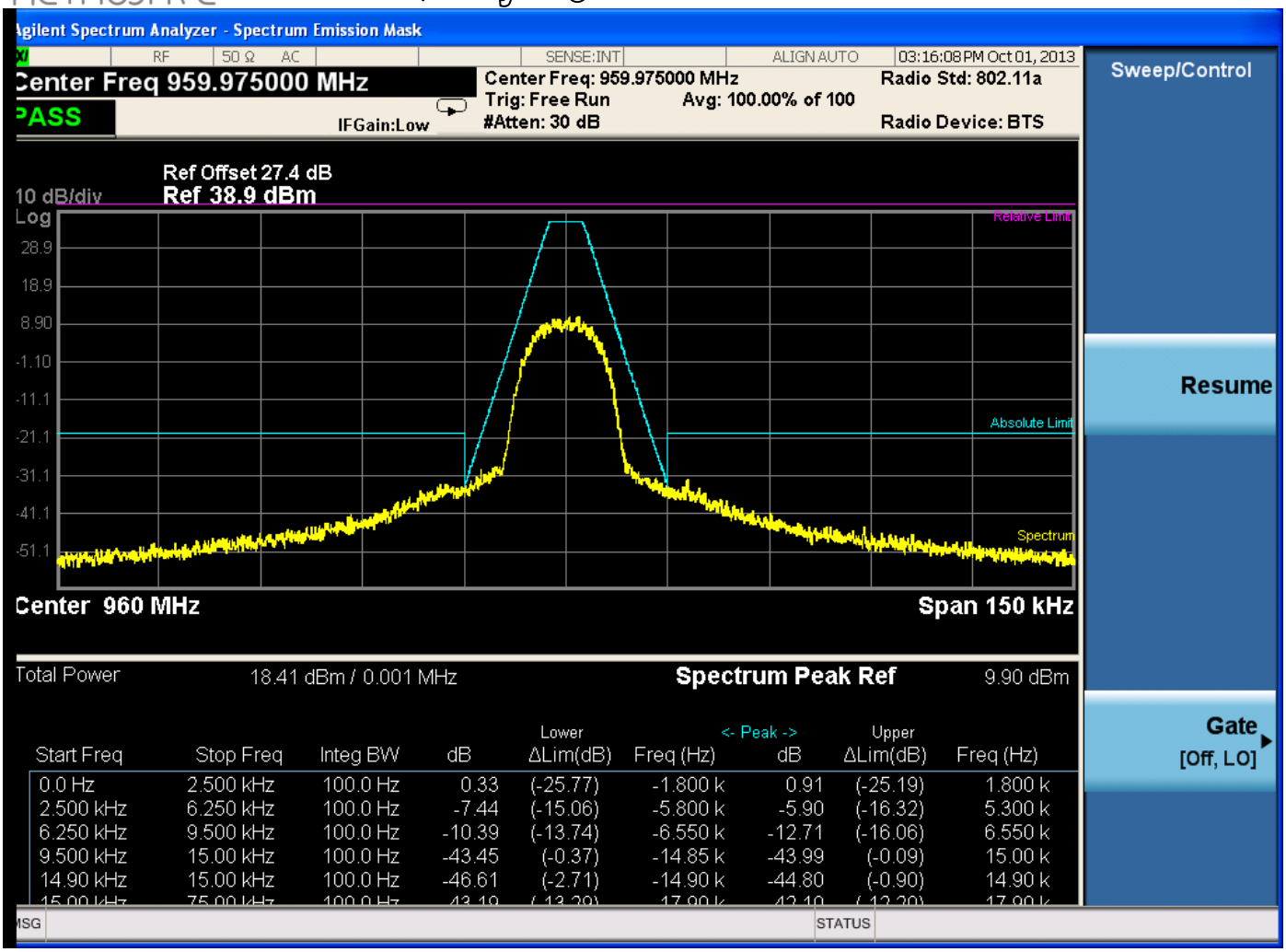


Figure 36. 959.9975 MHz, rm2

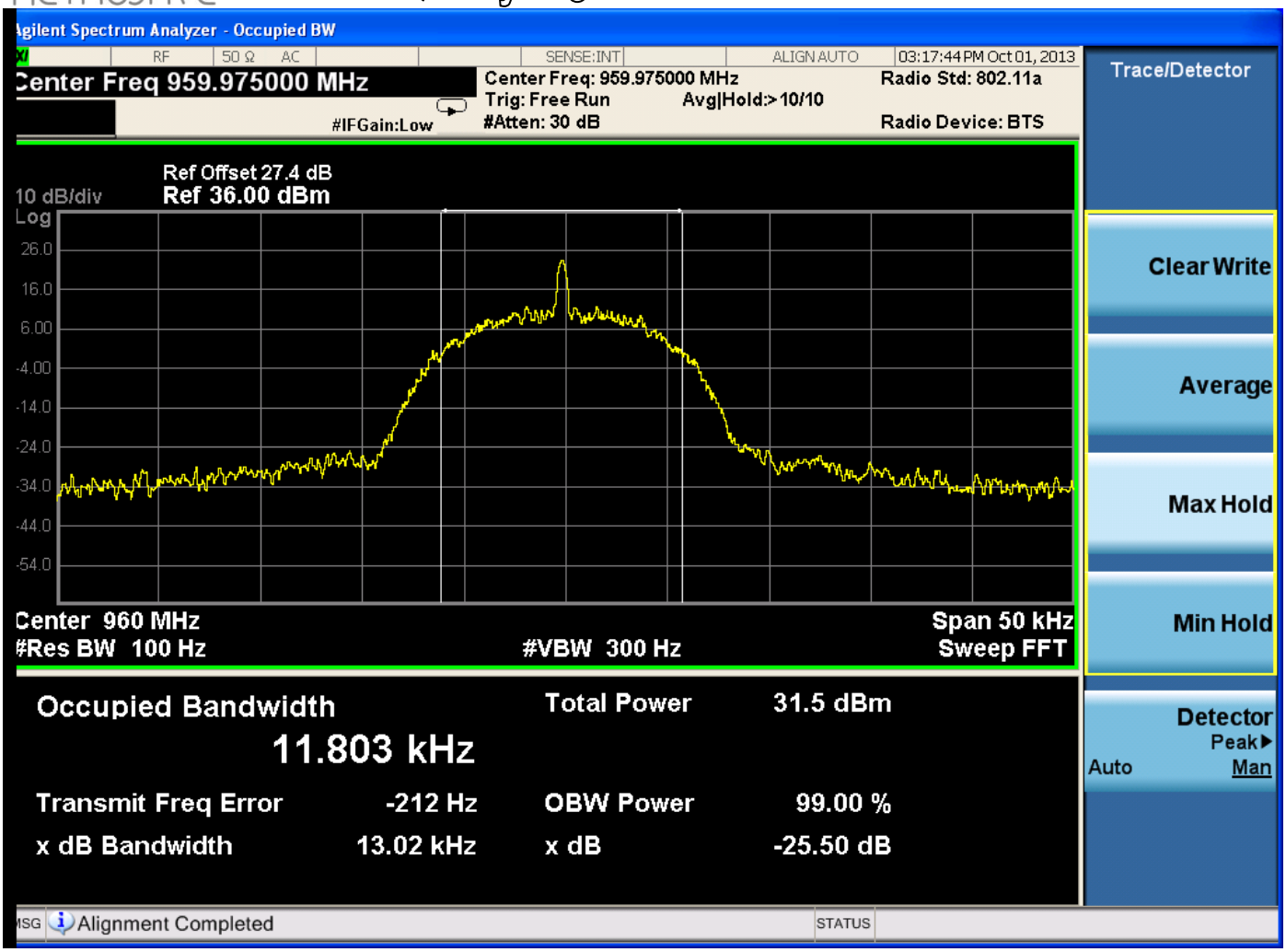


Figure 37. 959.9975 MHz, rm2

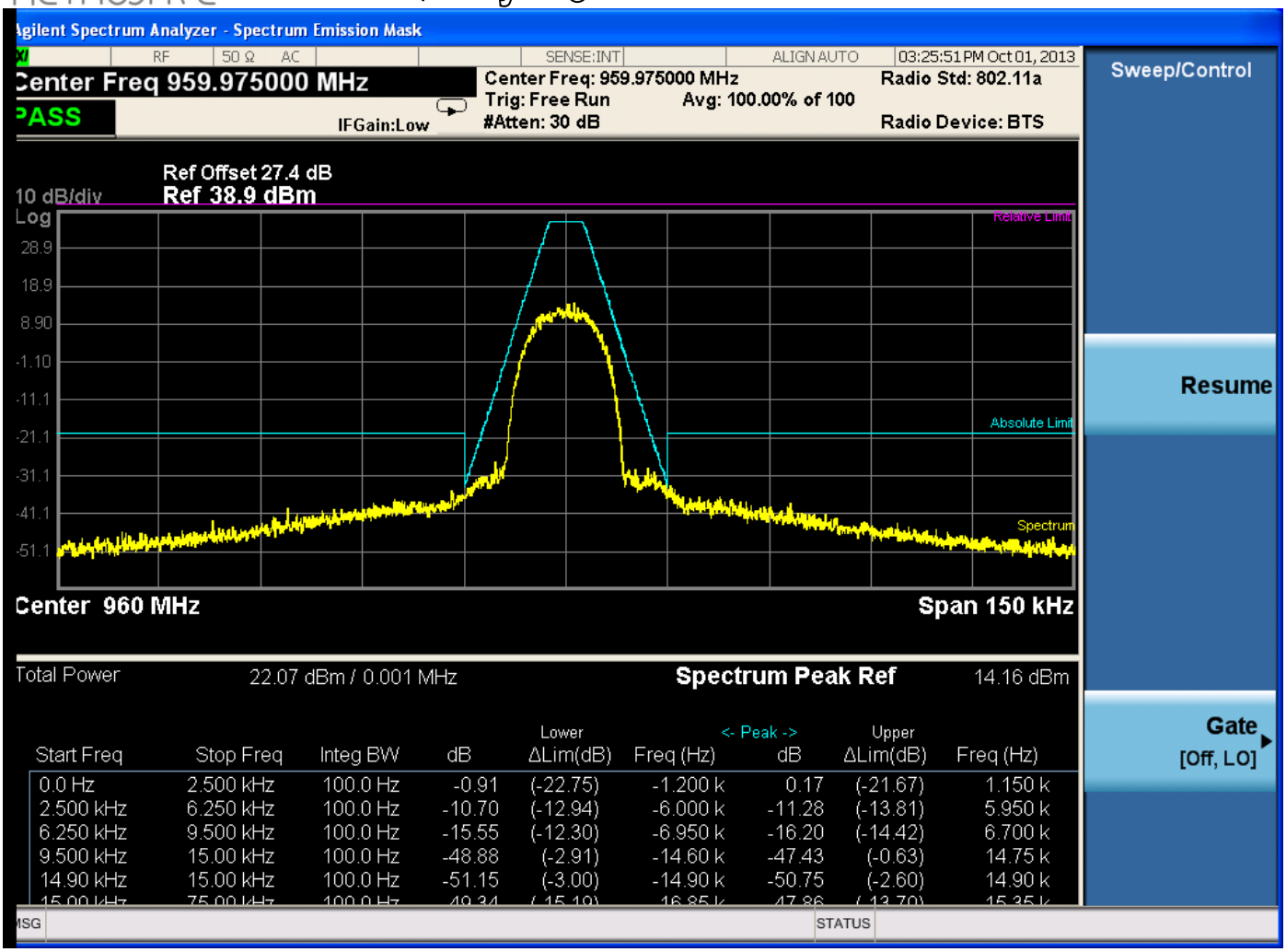


Figure 38. 959.9975 MHz, rm3

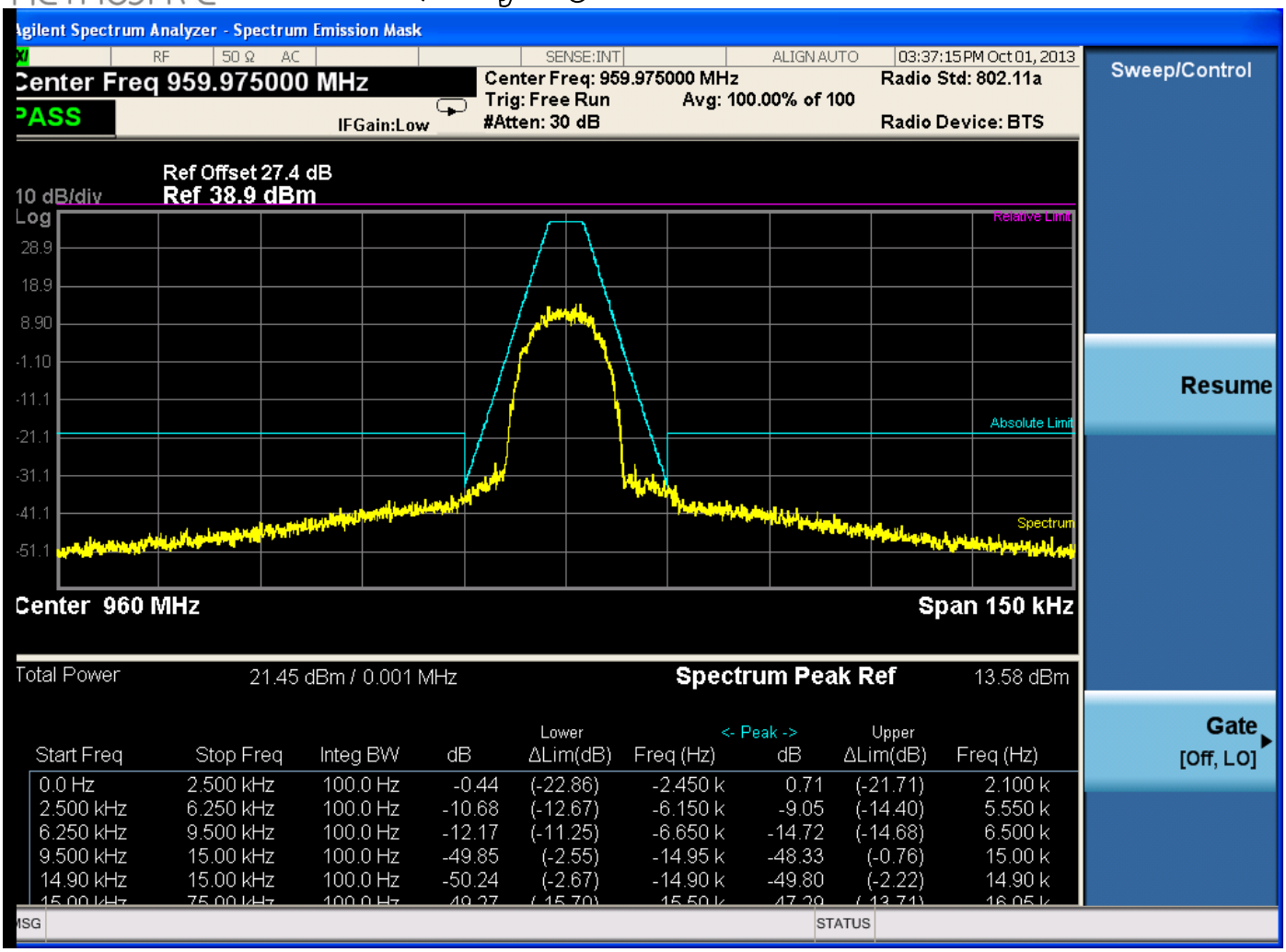


Figure 39. 959.9975 MHz, rm4

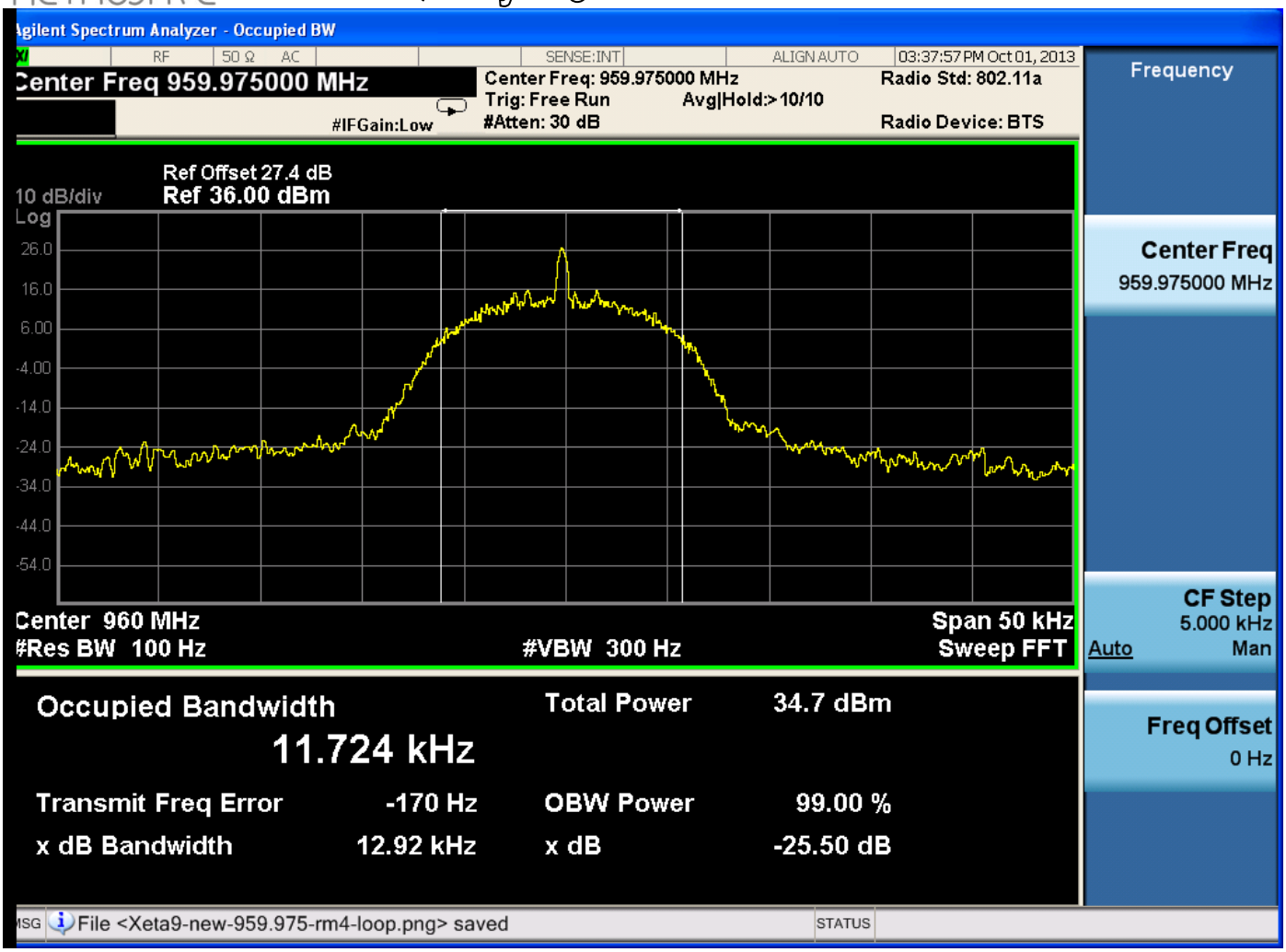


Figure 40. 959.9975 MHz, rm4

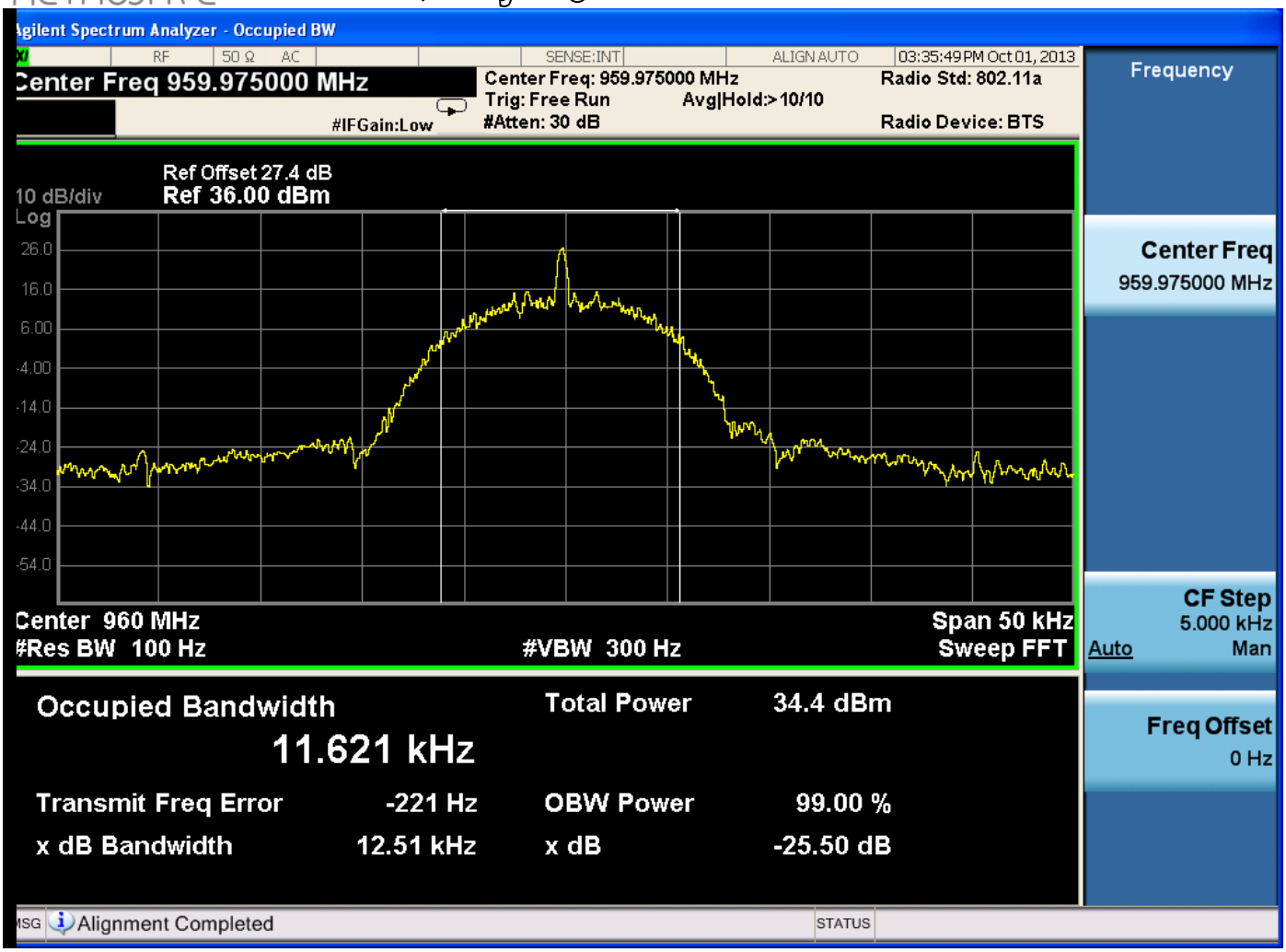


Figure 41. 959.9975 MHz, rm3

Euipment

Eq ID	Equipment Description	Manufacturer	Model No.	Serial No.	Frequency Range	Cal Date	Due Date
EXA	Signal Analyzer	Agilent Technologies	N9010A	MY49060188	9kHz to 26.5GHz	4/24/2012	4/24/2014
	Attenuator,6 dB, 5W	MiniCircuits	BW-S6W5+	na	Dc to 18 GHz	1	1
	Attenuator,20 dB, 1W	MiniCircuits	VAT-20+	na	Dc to 6 GHz	1	1
	RF coaxial cable, RG-316b/s, 7 in	Xetawave	EWX0075TM	na	na		
	RF coaxial cable, RG-316b/s, 12 in	Xetawave	na	na	Dc to 6 GHz	1	1

Notes:
na – not applicable
1. Measured/calibrated as lumped assembly using EXA.

The EXA calibration certification is attached in a separate PDF file, EXA-CalCert.PDF.