Quality is @ Xetawave

Xeta4

Occupied Bandwidth

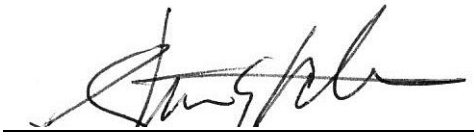
Measurements

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 Xeta4m 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.

Table 1. Modulation Summary

Item #	Radio Mode	Throughput (kbps)	Modulation Type	Measured 99% BW (kHz)	Emissions Designator IC	Emissions Designator FCC
1	0	10.2	BPSK	11.4	11k4W1WCN	11k4W1W
2	1	20.4	QPSK	11.3	11k3W1WDN	11k3W1W
3	2	30.6	8QAM	10.9	10k9W1WEN	10k9W1W
4	3	40.8	16QAM	11.8	11k8W1WEN	11k8W1W
5	4	51	32QAM	11.6	11k6W1WFN	11k6W1W

Scope

Testing was performed in accordance with (iaw) FCC Part 90, IC SRSP-501, ANSI C63.4-2003 and TIA-603-C-2004 for demonstrating compliance for both US and Canada requirements at 400 MHz operation in licensed bands, US: 421 to 430 and 450 to 470 MHz; IC: 406.1 to 430 and 450 to 470 MHz.

Equipment Under Test (EUT)

The EUT transmitter was a Licensed Radio Transmitter, Model No. Xeta4m-R. production unit, sn E50115A7. Xeta4m's operate with frequency settings from 406.1 to 470 MHz. The following test frequencies were used.

Table 2. Test Frequency List

406.1065
418
429.99375
450.00625
460.65
469.99375

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:

- 406.10625 MHz with 8QAM, 16QAM, 32QAM, BPSK, QPSK modulations, radio modes 0 -4
- 418 MHz with , 8QAM,16QAM, 32QAM, BPSK, QPSK modulations, radio modes 0 -4
- 429.99375 MHz with 16QAM, 32QAM, BPSK, QPSK modulations, radio modes 0 -4
- 450.00625 MHz with 8QAM, 16QAM, 32QAM, BPSK, QPSK modulations, radio modes 0 -4
- 460.65 MHz with 8QAM, 16QAM, 32QAM, BPSK, QPSK modulations, radio modes 0 -4
- 460.65MHz 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

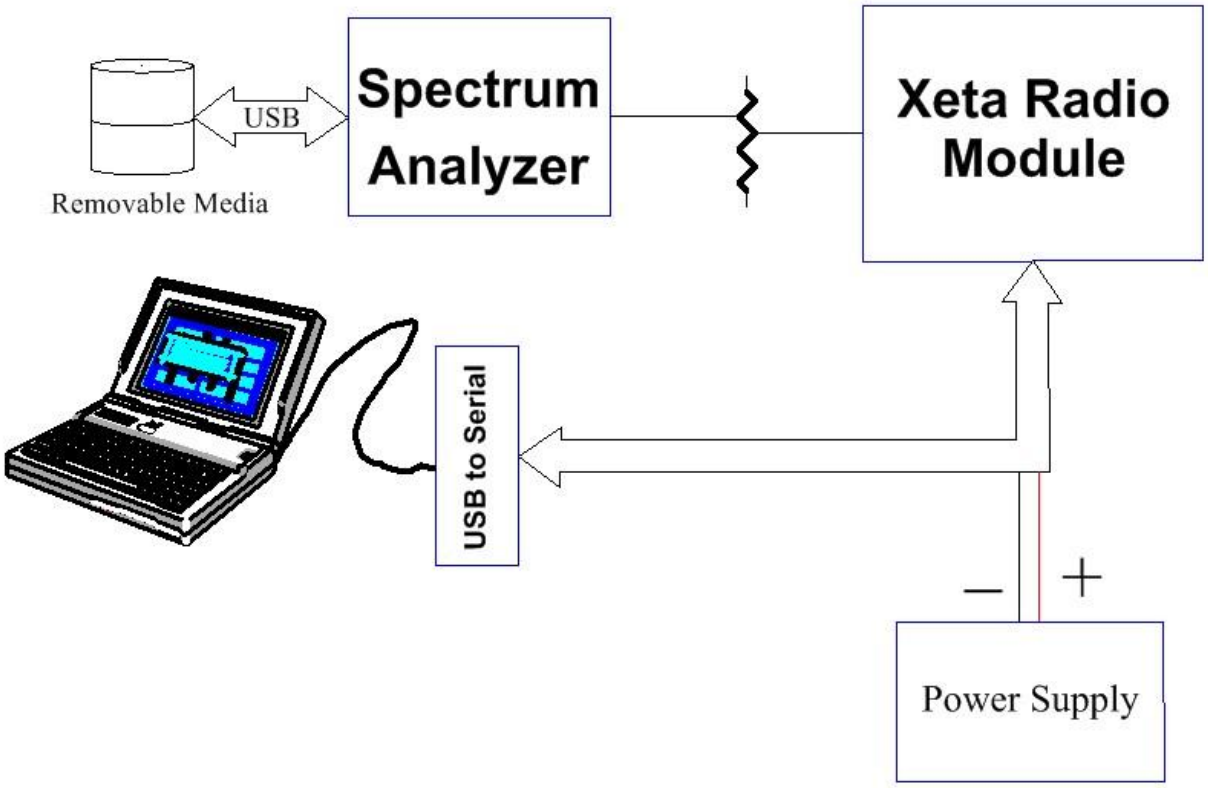


Figure 1. Test Setup

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

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 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	Modulation	Frequency (MHz)	Data Power Output Average (dBm)	OBW (kHz)	OBW Total Power (dBm)
0	BPSK	401.10625	17.0	10.7	31.0
1	QPSK	401.10625	17.0	10.4	30.9
2	8QAM	401.10625	17.8	10.4	31.0
3	16QAM	401.10625	15.4	10.4	31.2
4	32QAM	401.10625	15.4	10.0	30.8
0	BPSK	418	20.1	11.4	32.4
1	QPSK	418	20.4	11.3	32.7
2	8QAM	418	18.5	10.5	31.4
3	16QAM	418	21.3	11.3	32.8
4	32QAM	418	20.3	10.9	32.5
0	BPSK	429.99375	20.5	11.3	32.6
1	QPSK	429.99375	20.9	11.3	32.9
2	8QAM	429.99375	18.8	10.9	31.9
3	16QAM	429.99375	23.7	11.8	34.8
4	32QAM	429.99375	22.8	11.6	34.3
0	BPSK	450.00625	20.8	11.2	33.0
1	QPSK	450.00625	20.7	11.1	33.4
2	8QAM	450.00625	18.4	10.5	32.4
3	16QAM	450.00625	20.7	11.0	33.1
4	32QAM	450.00625	21.2	11.3	33.6
0	BPSK	460.65	20.9	11.4	33.8
1	QPSK	460.65	21.1	11.1	33.3
2	8QAM	460.65	18.7	10.6	32.9
3	16QAM	460.65	21.1	11.0	33.5
4	32QAM	460.65	20.0	10.7	33.3
0	BPSK	469.99375	20.9	11.4	32.6
1	QPSK	469.99375	21.0	11.1	33.6
2	8QAM	469.99375	18.5	10.4	33.0
3	16QAM	469.99375	20.0	10.7	33.2
4	32QAM	469.99375	20.4	10.9	33.5

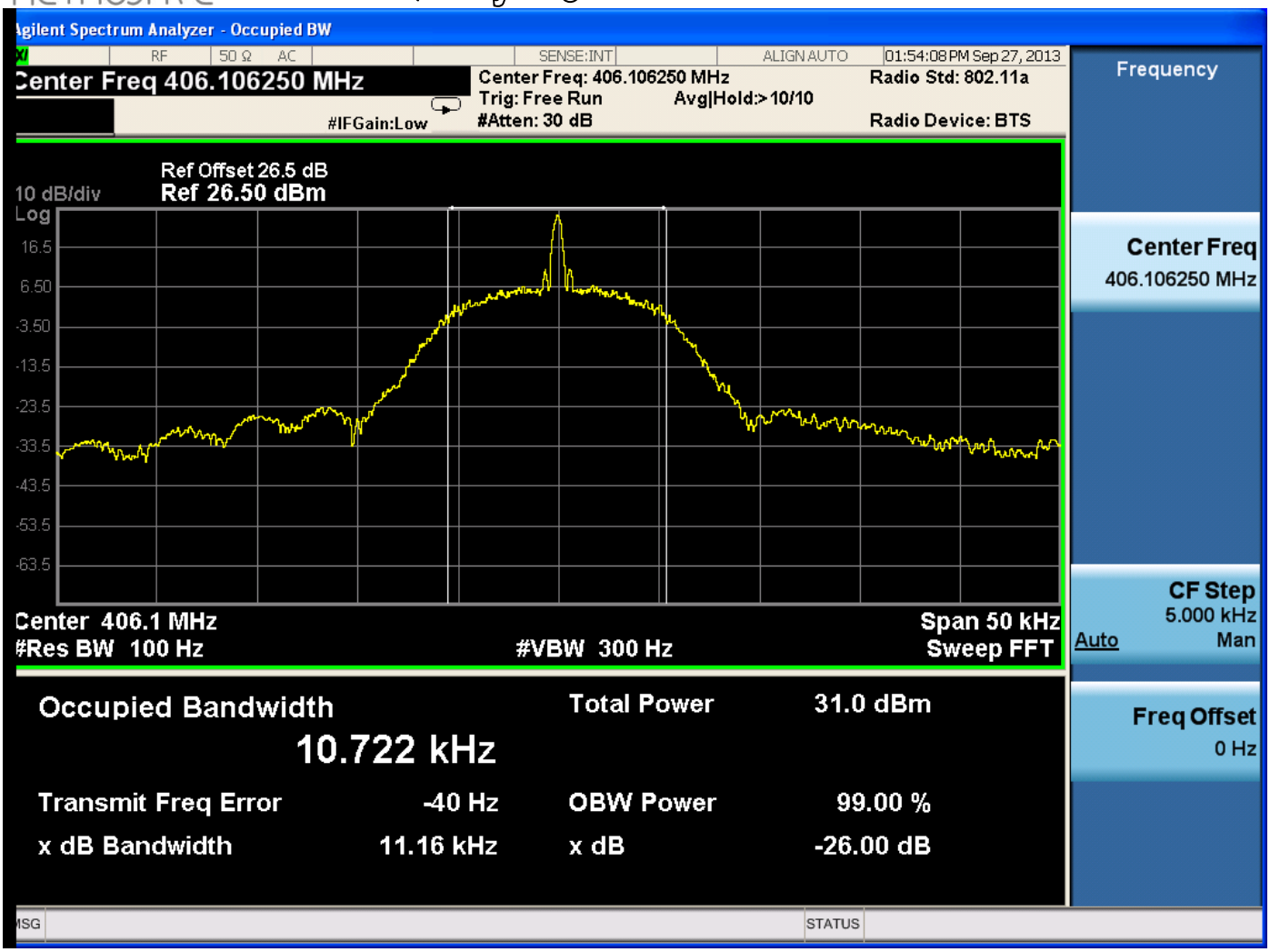


Figure 2. 406.10625 MHz, Rm0

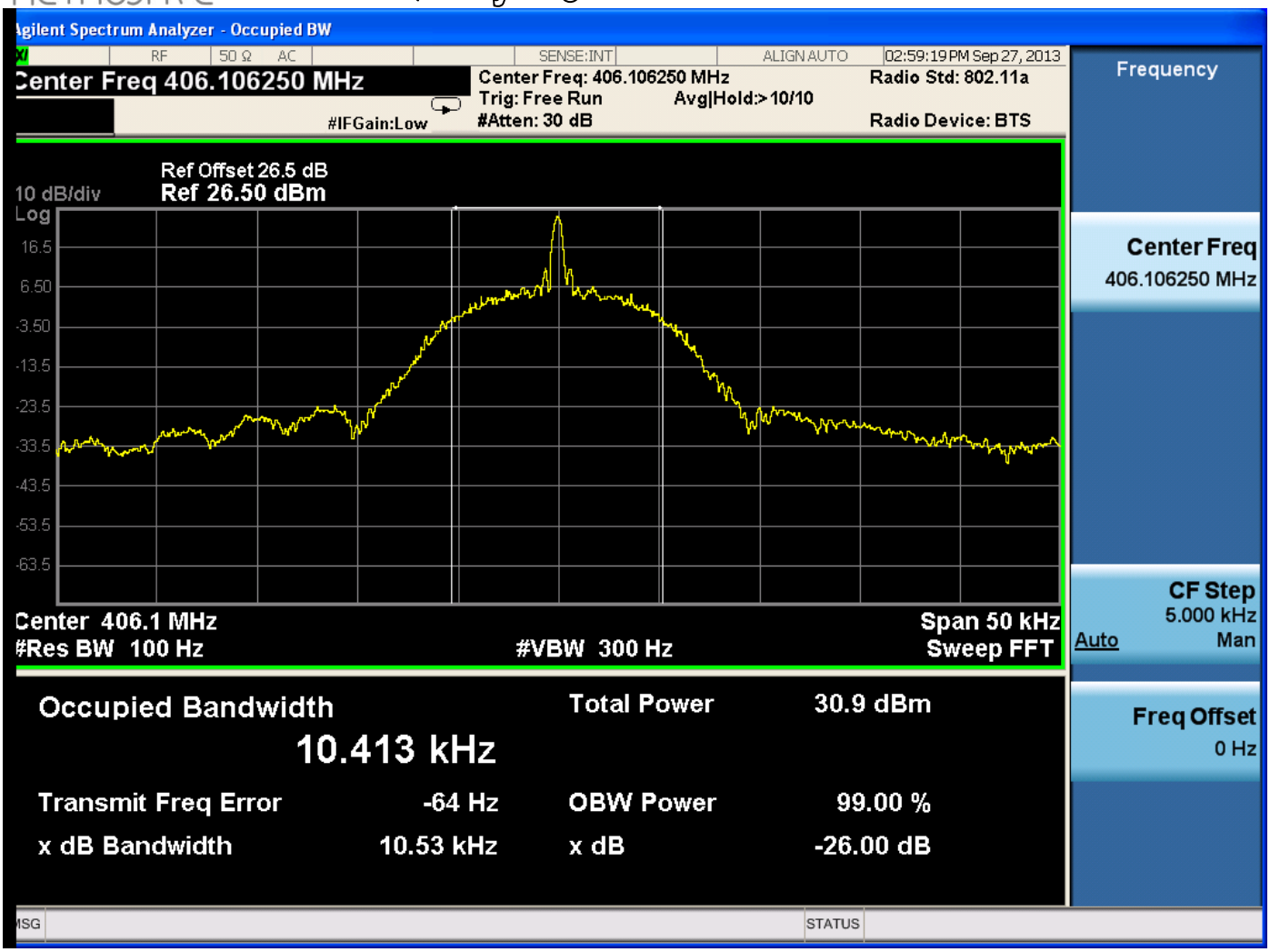


Figure 3. 406. 10625 MHz, Rm1

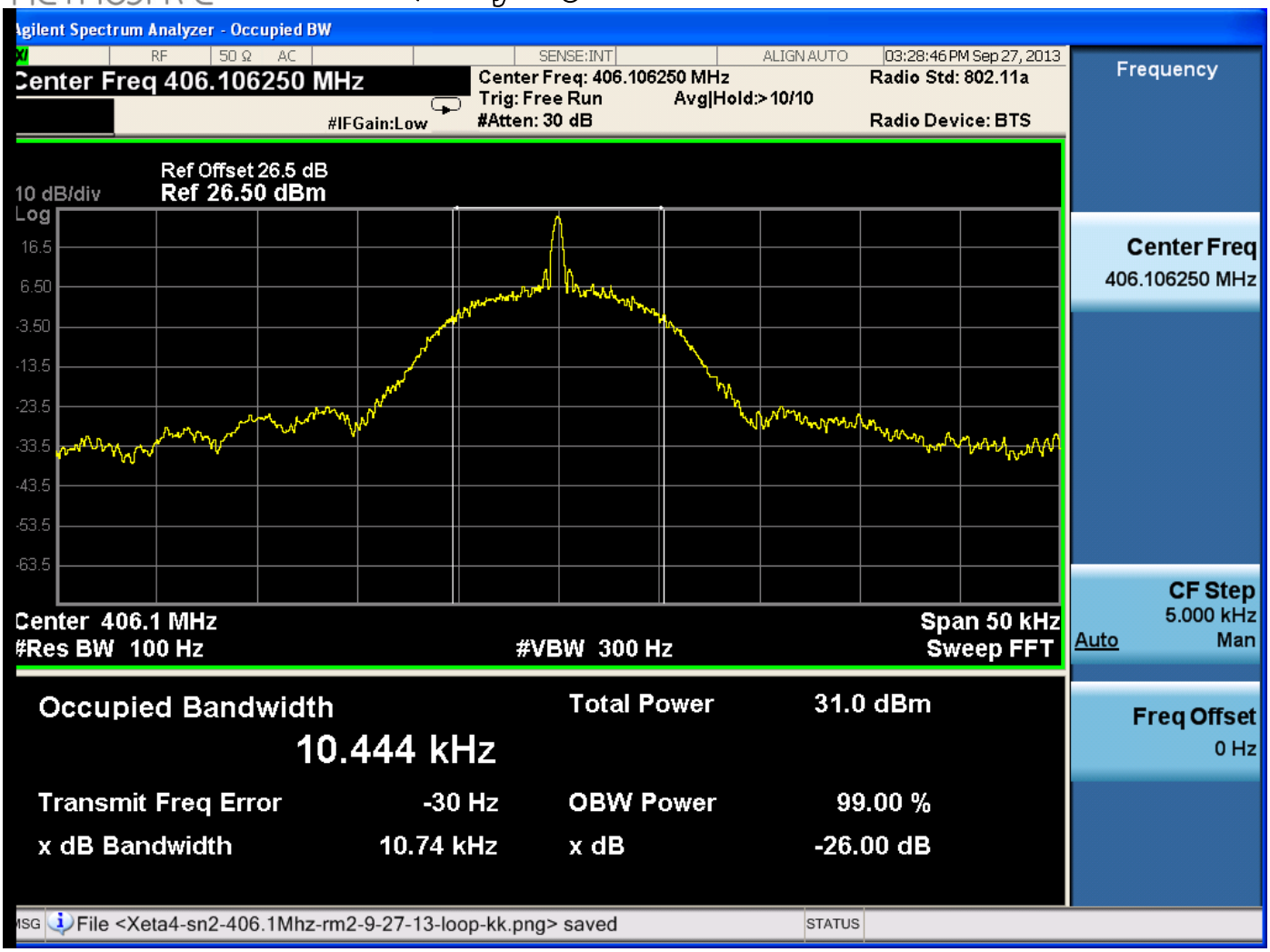


Figure 4. 406. 10625 MHz, Rm2

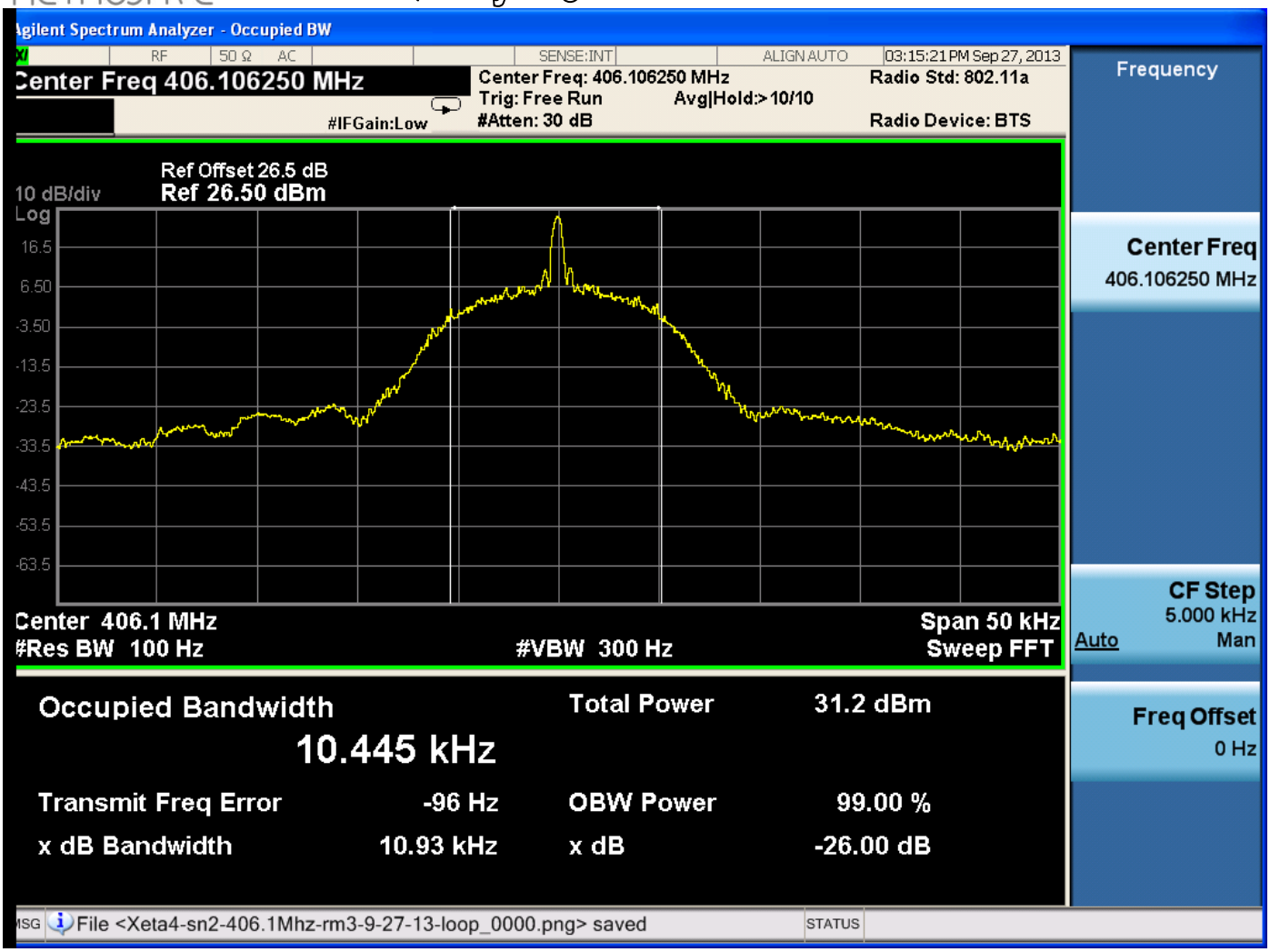


Figure 5. 406. 10625 MHz, Rm3

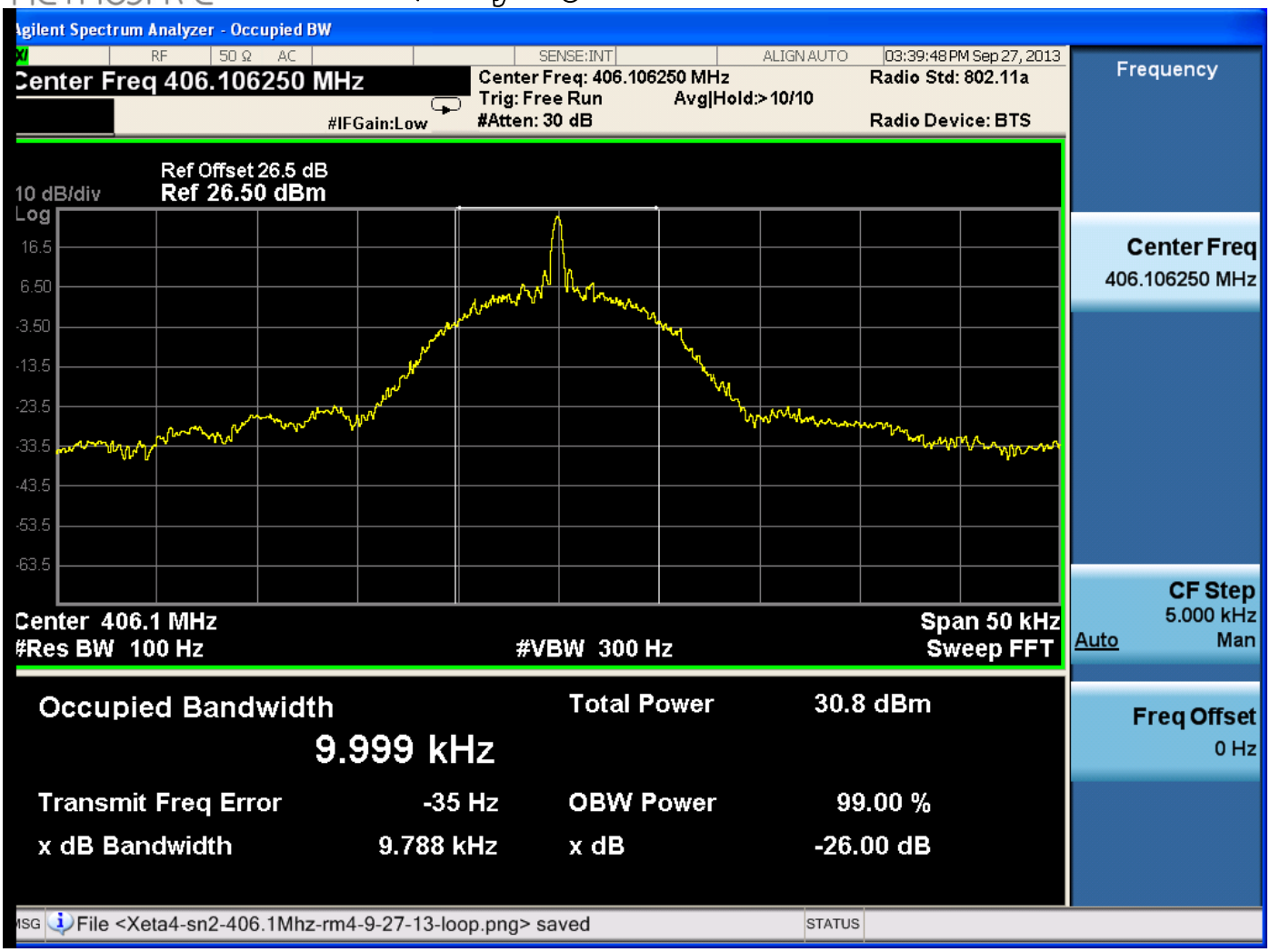


Figure 6. 406. 10625 MHz, Rm4

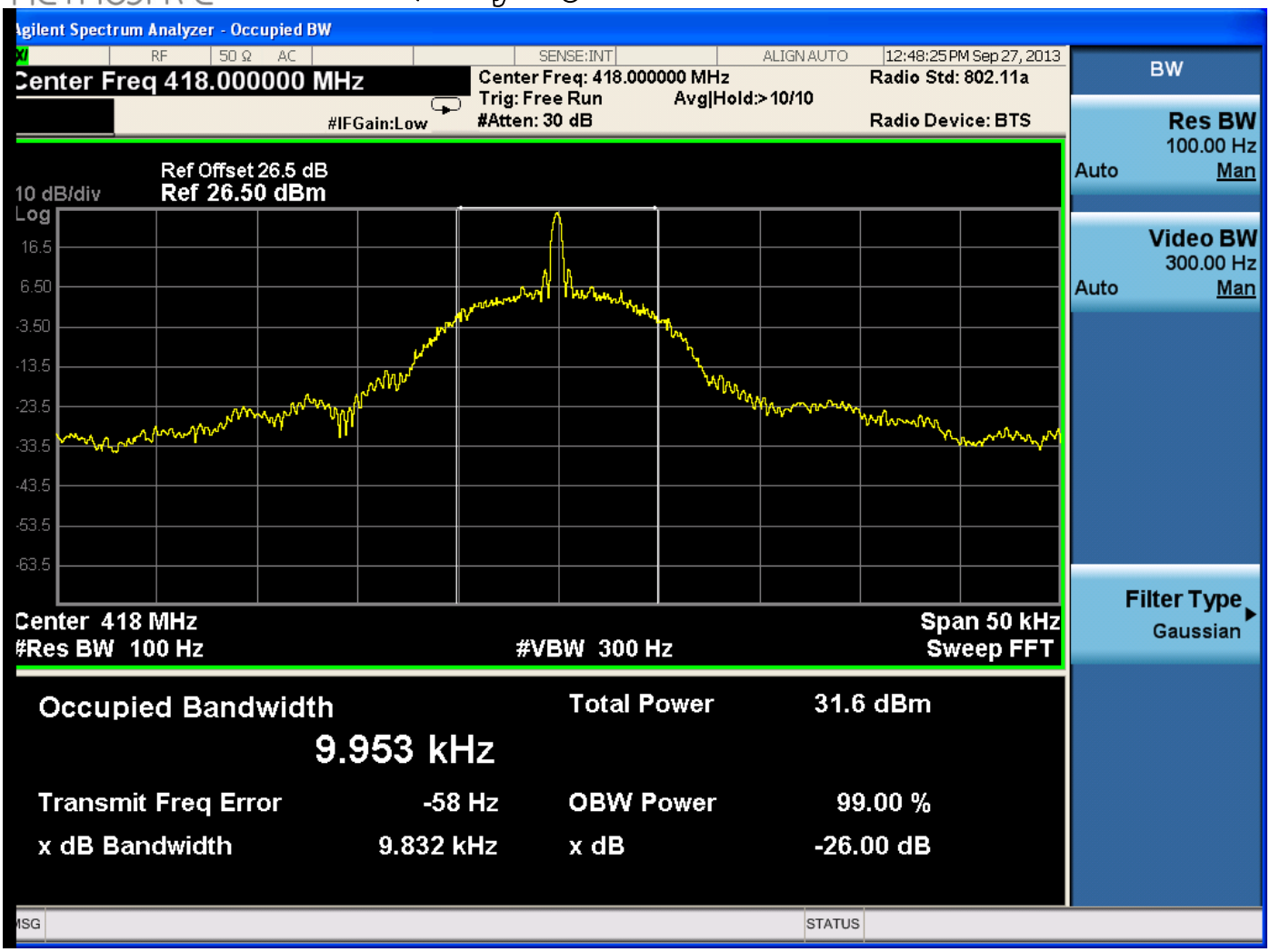


Figure 7. 418 MHz Rm0

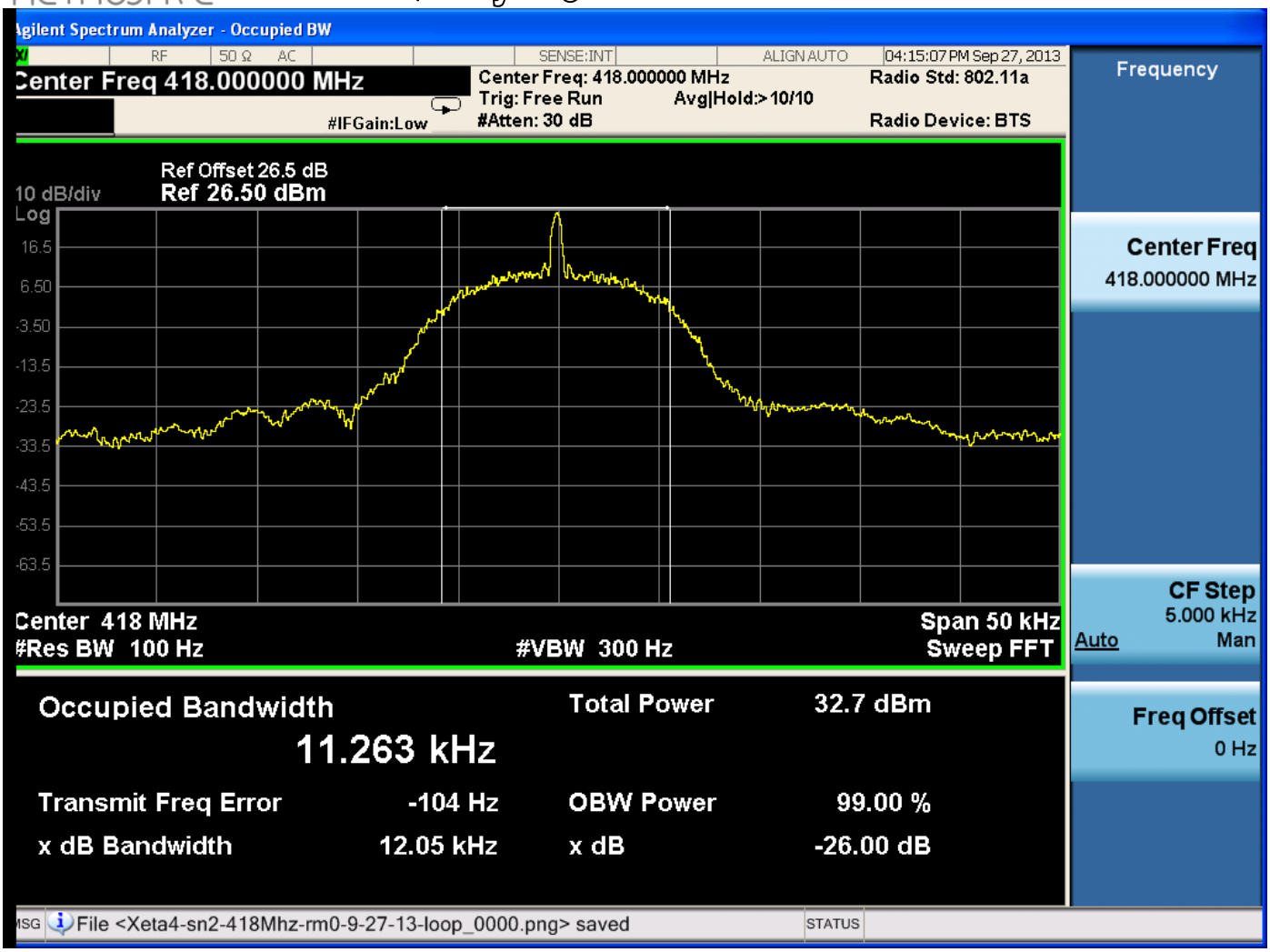


Figure 8. 418 MHz Rm1

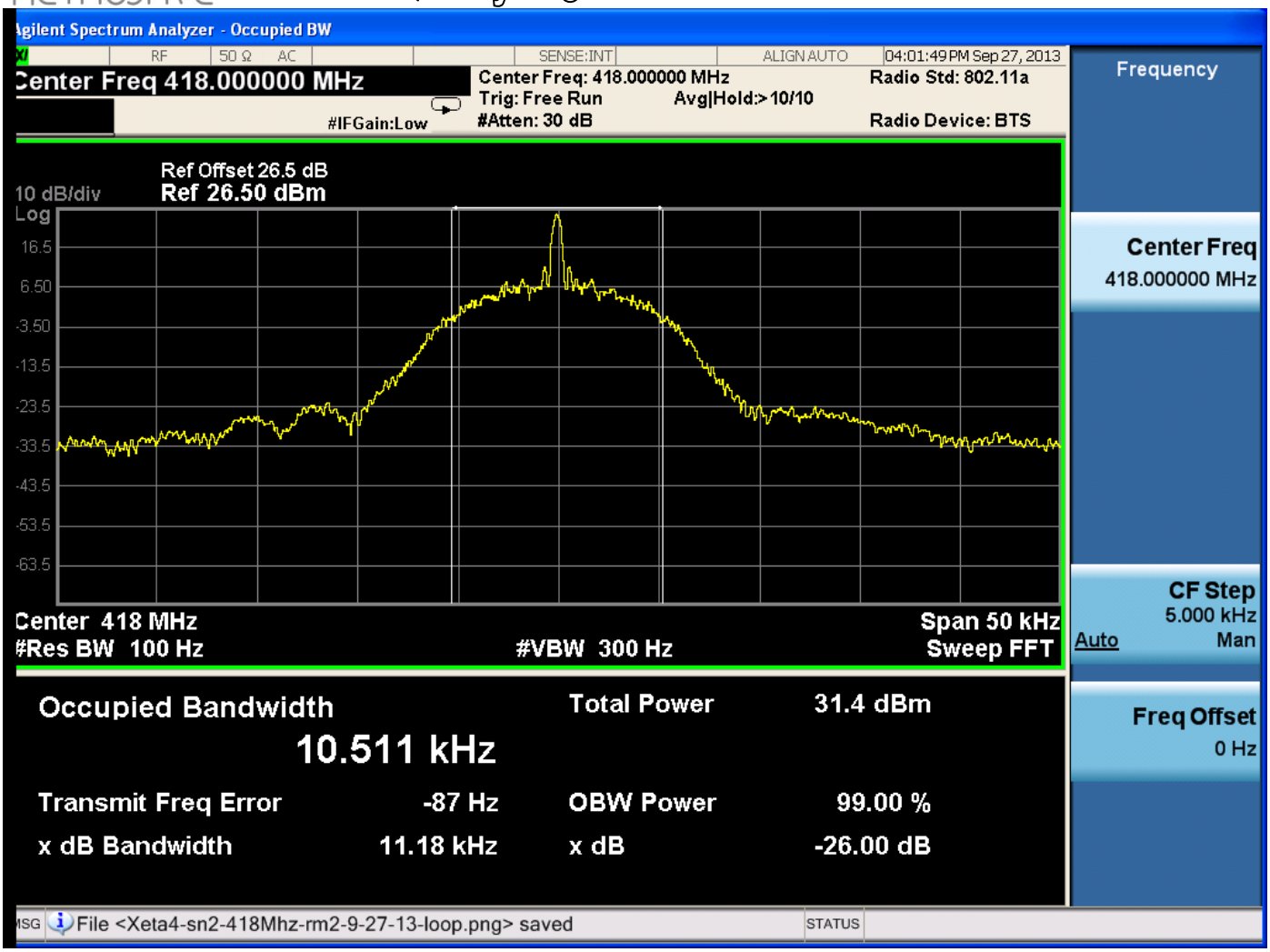


Figure 9. 418 MHz Rm2

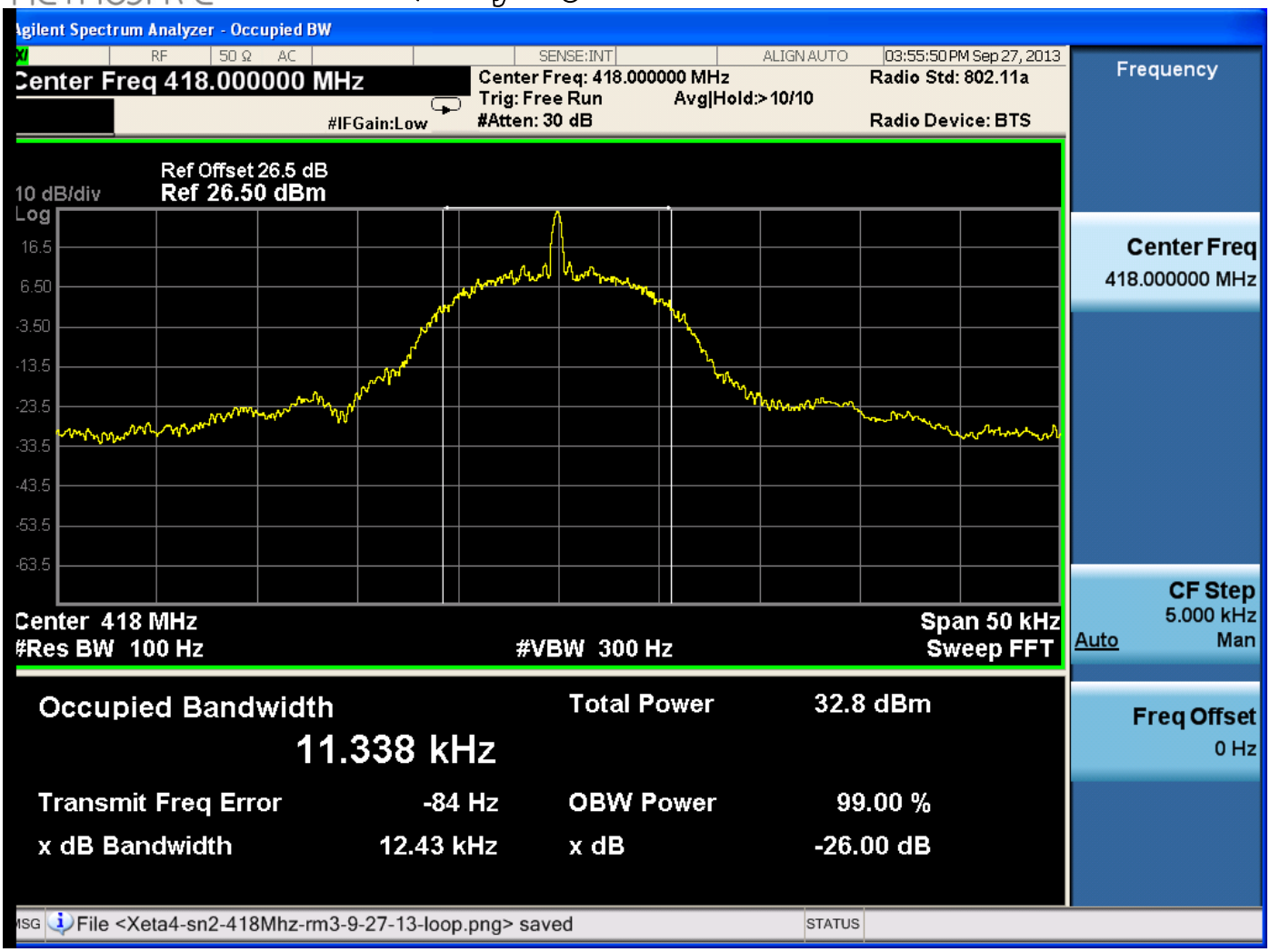


Figure 10. 418 MHz Rm3

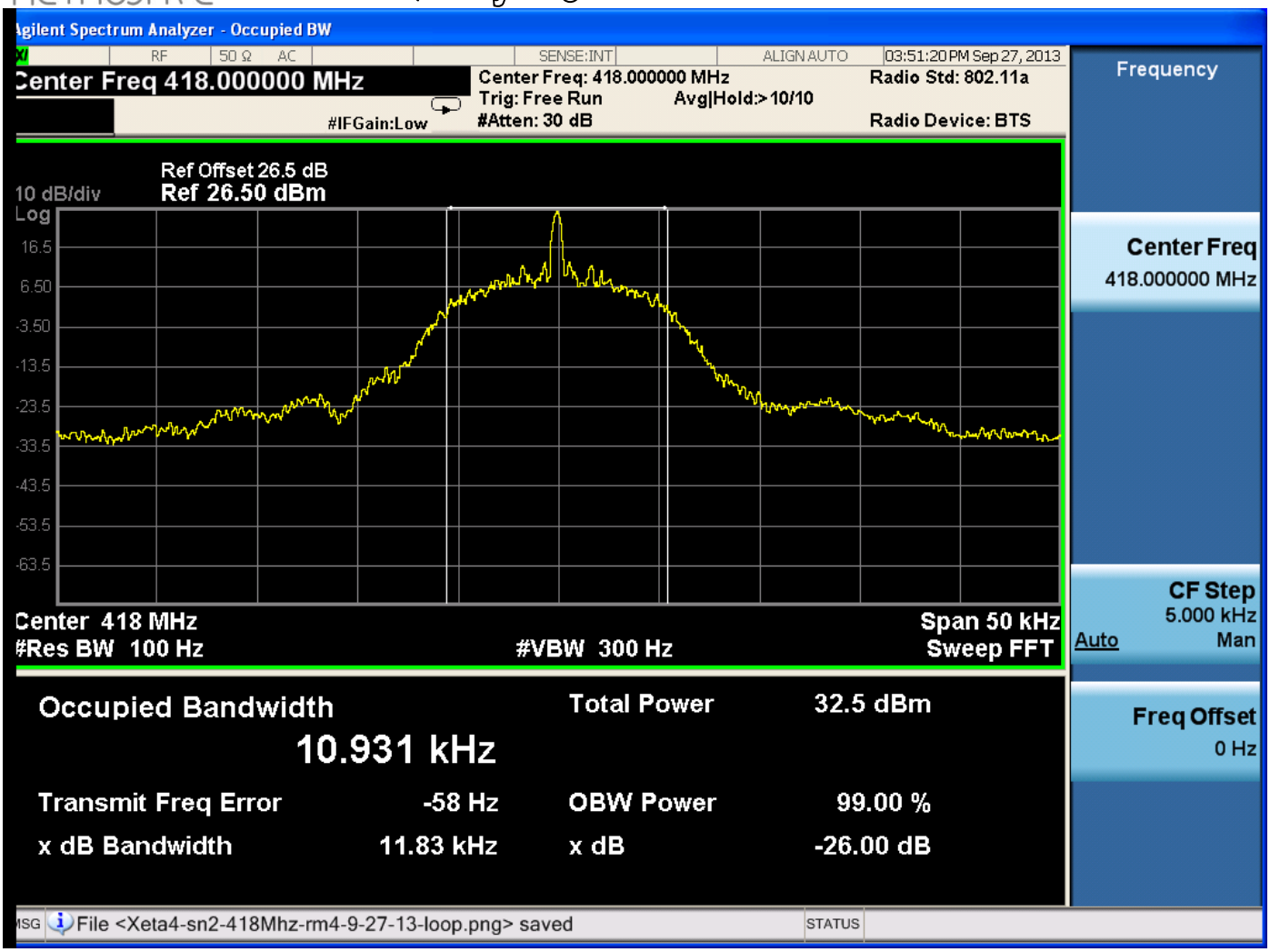


Figure 11. 418 MHz Rm4

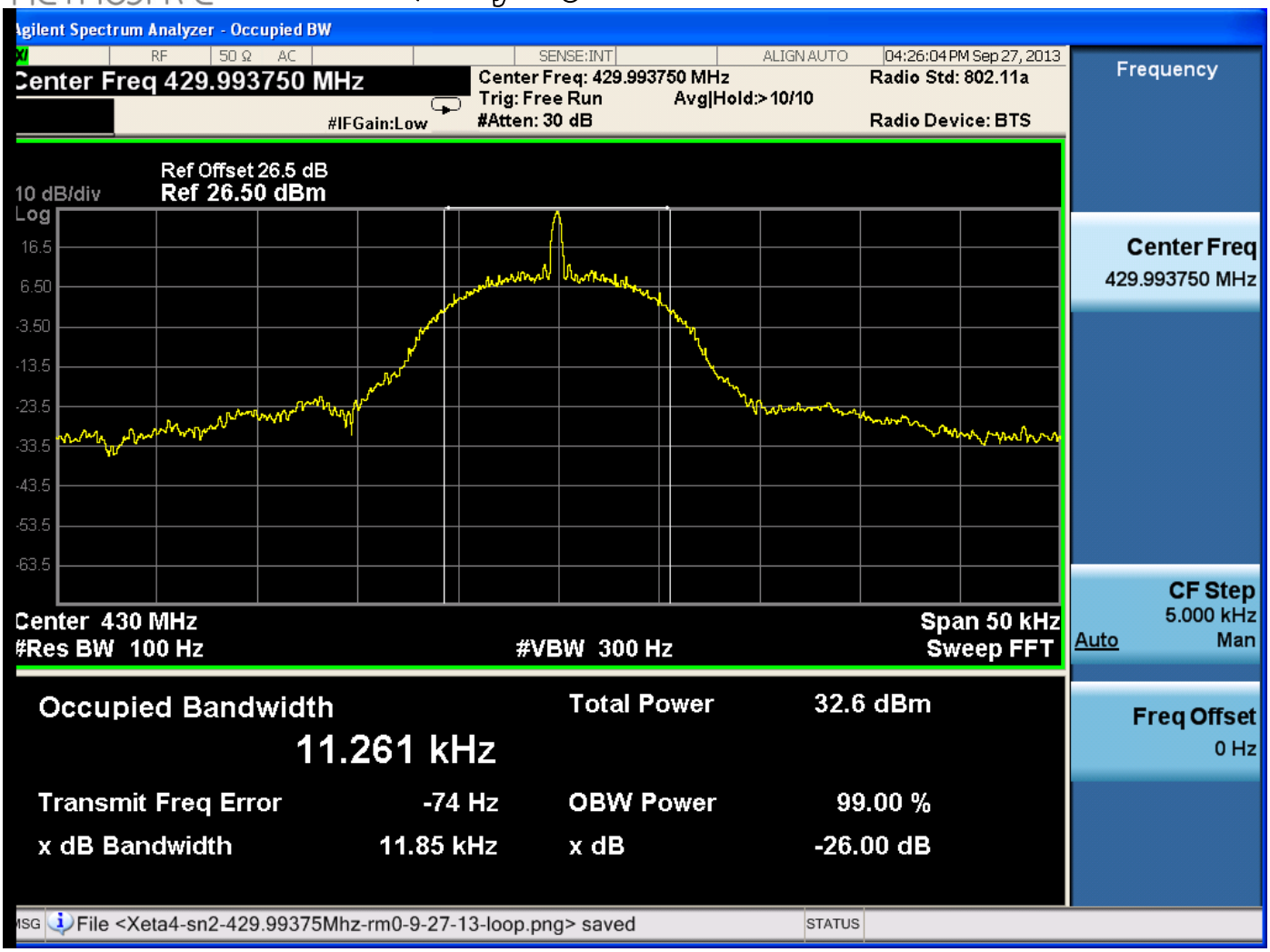


Figure 12. 429.99375Mhz-rm0

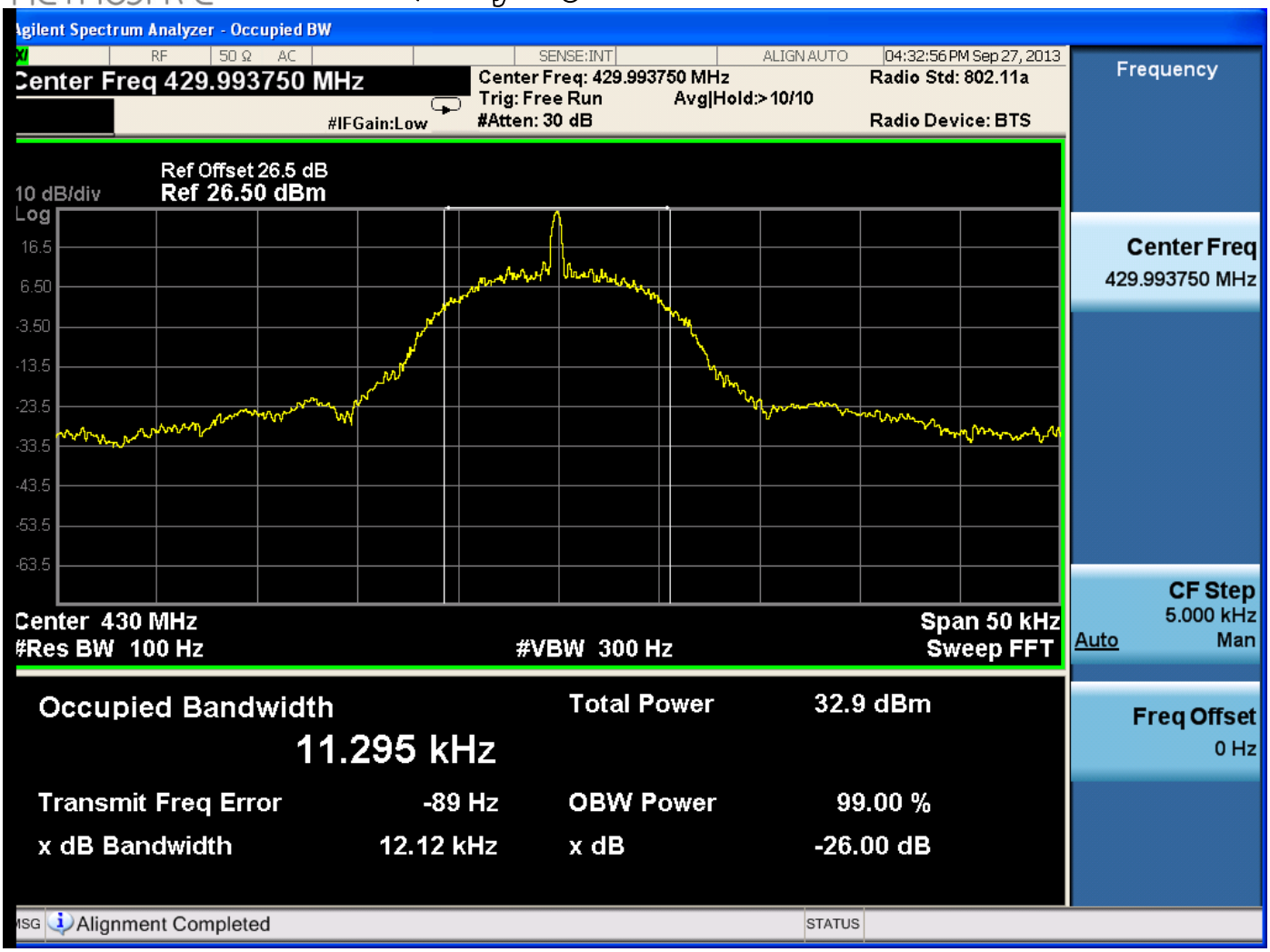


Figure 13. 429.99375Mhz-rm1

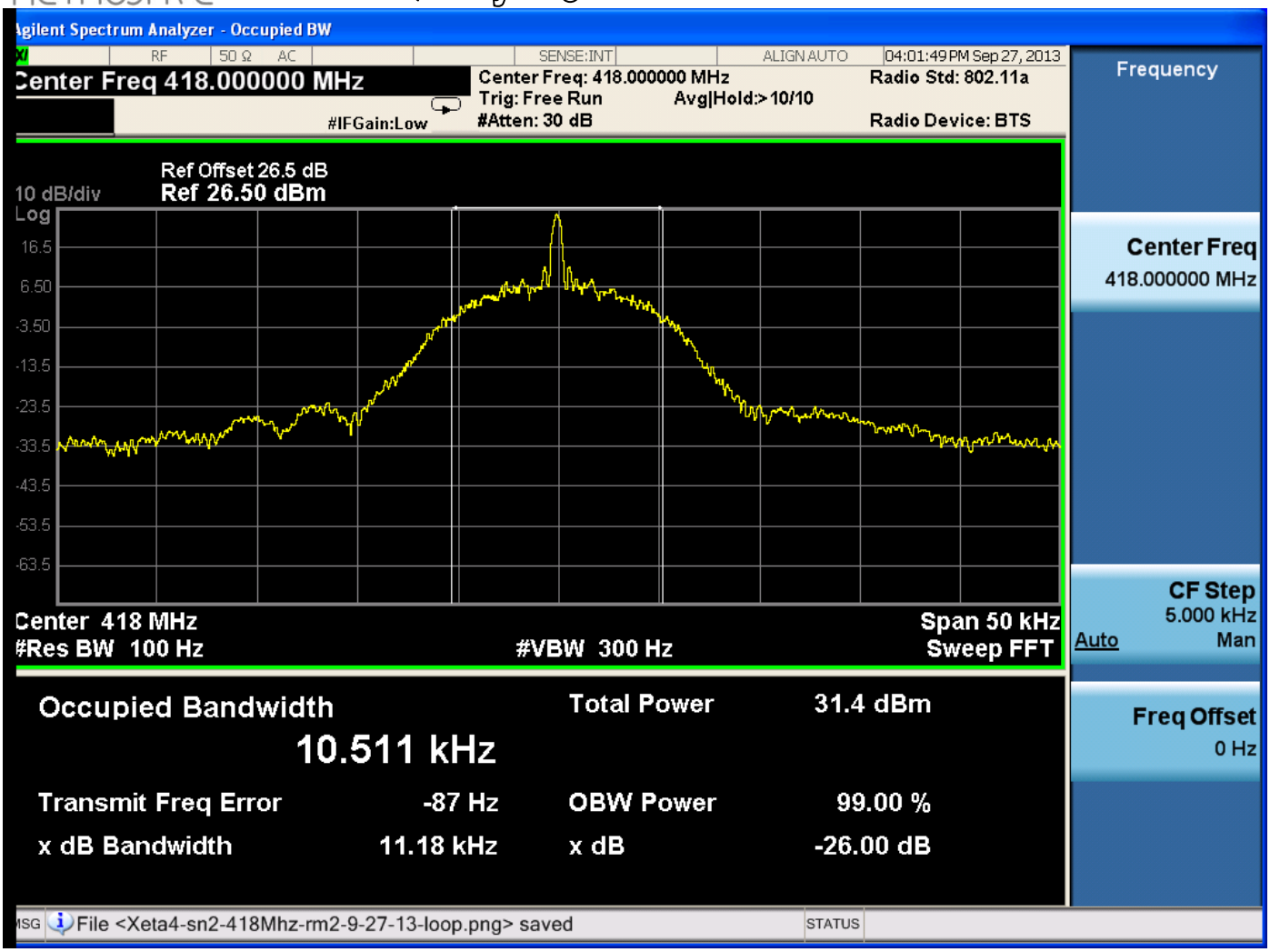


Figure 14. 429.99375Mhz-rm2

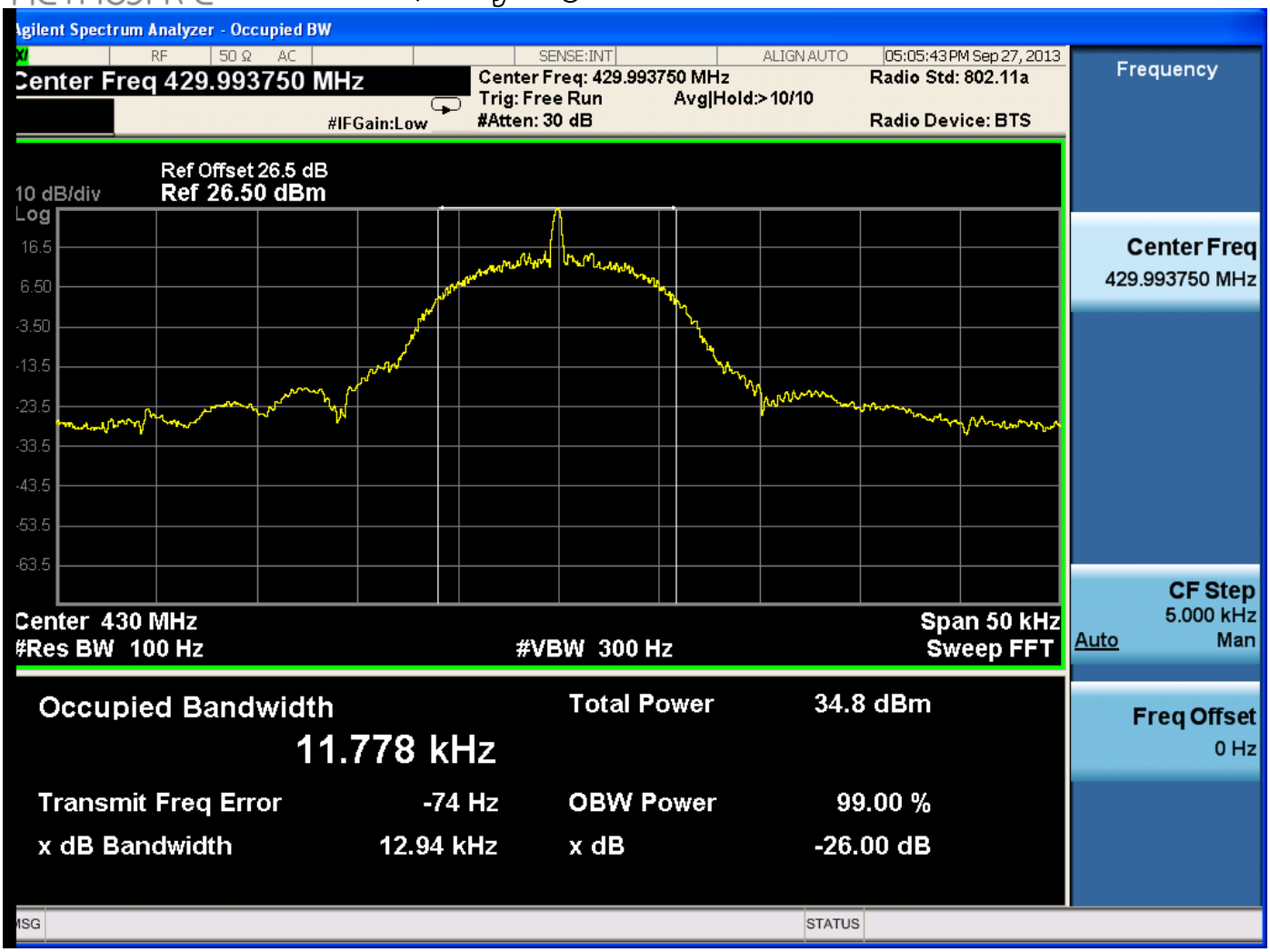


Figure 15. 429.99375Mhz-rm3

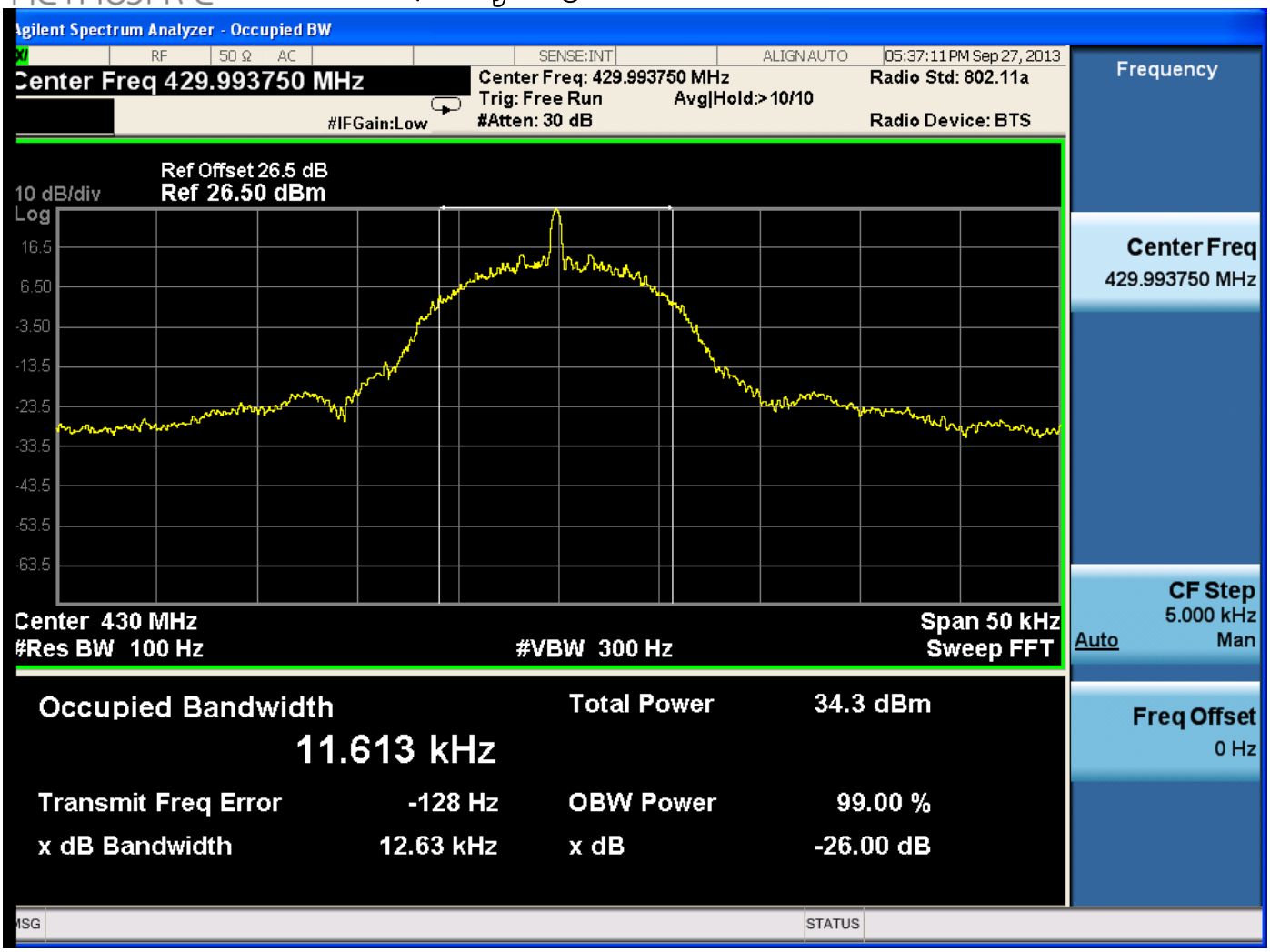


Figure 16. 429.99375Mhz-rm4

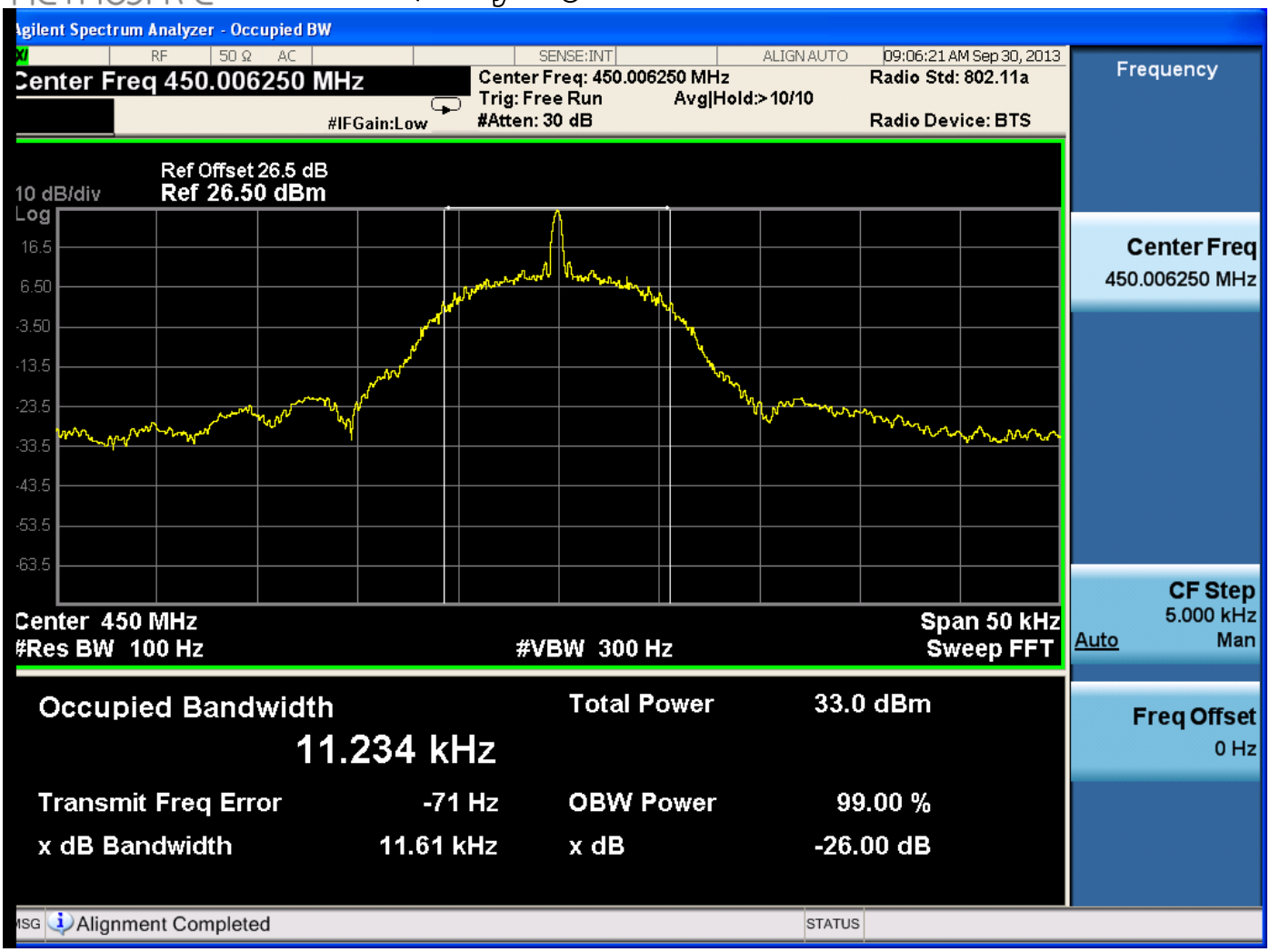


Figure 17. 450.00625 Mhz, rm0

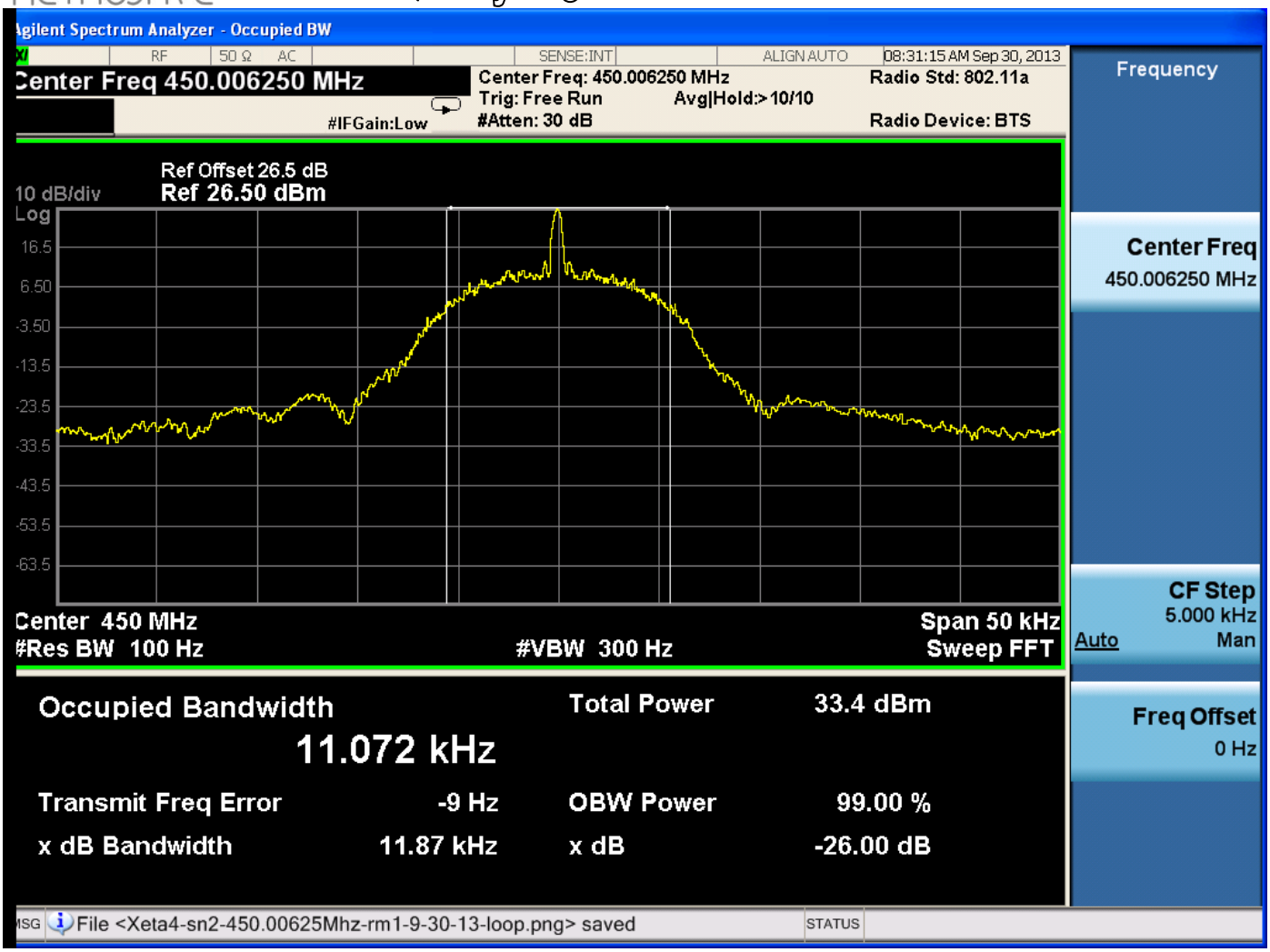


Figure 18. 450.00625 Mhz, rm1

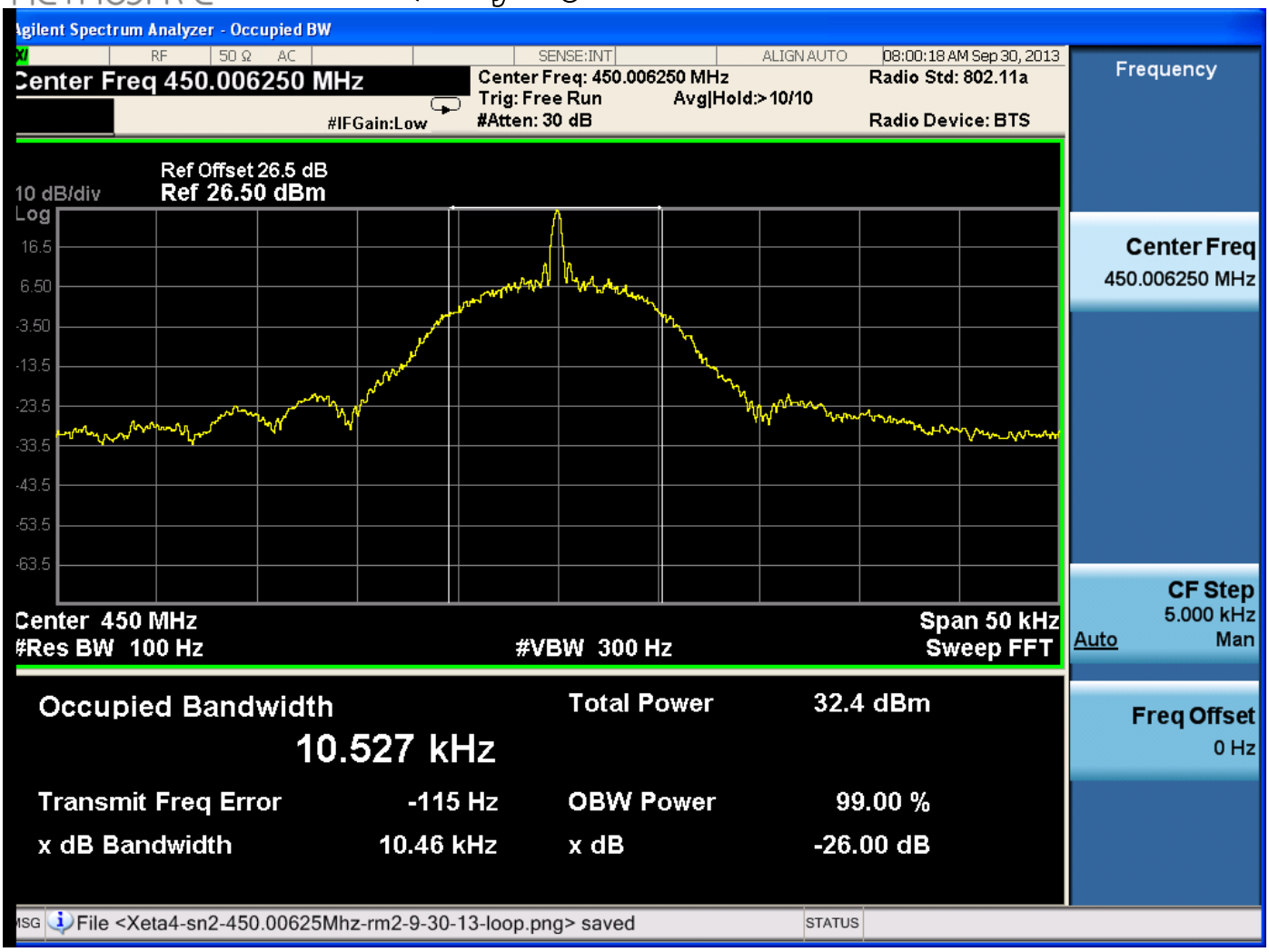


Figure 19. 450.00625 Mhz, rm2

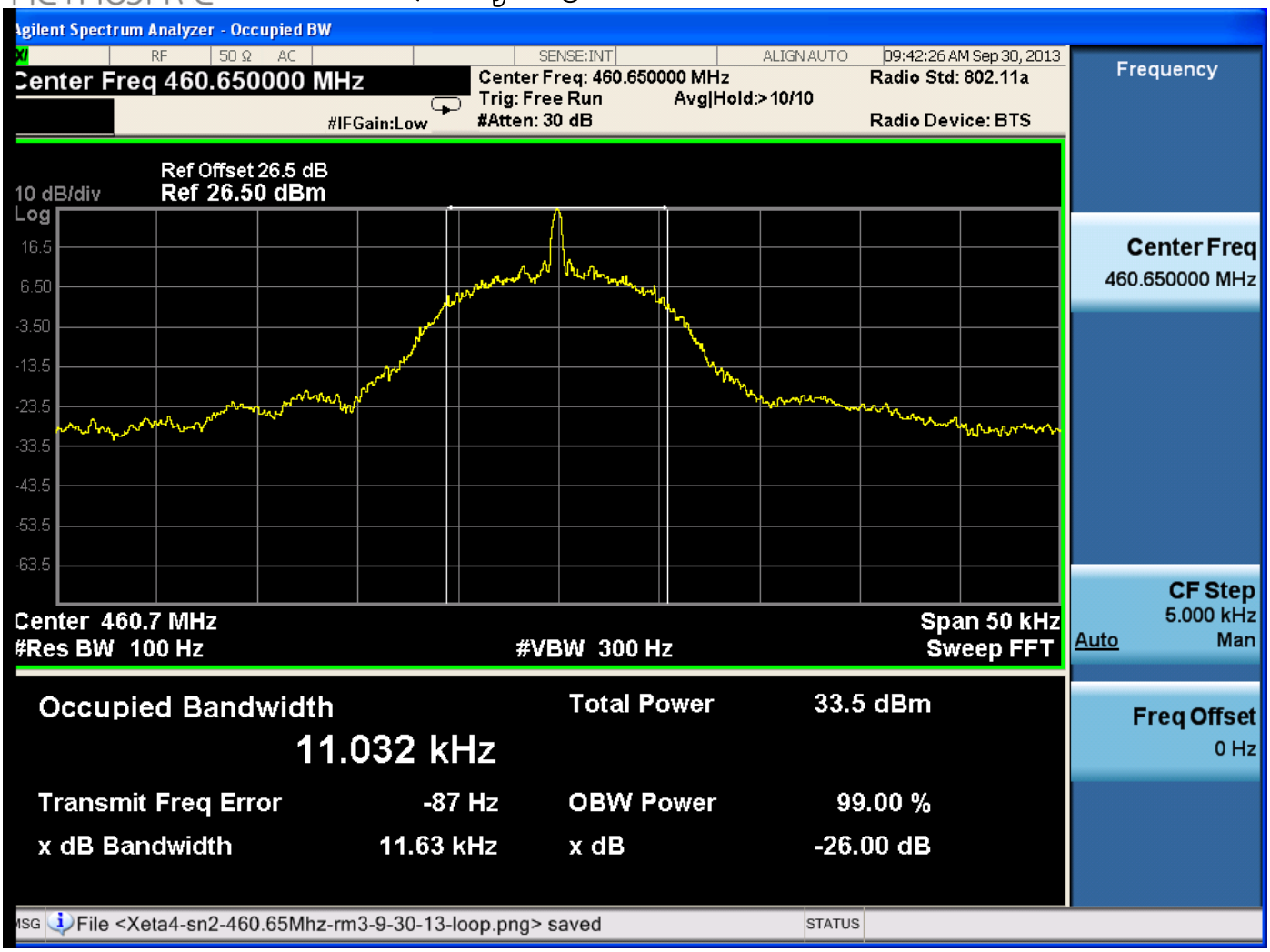


Figure 20. 450.00625 Mhz, rm3

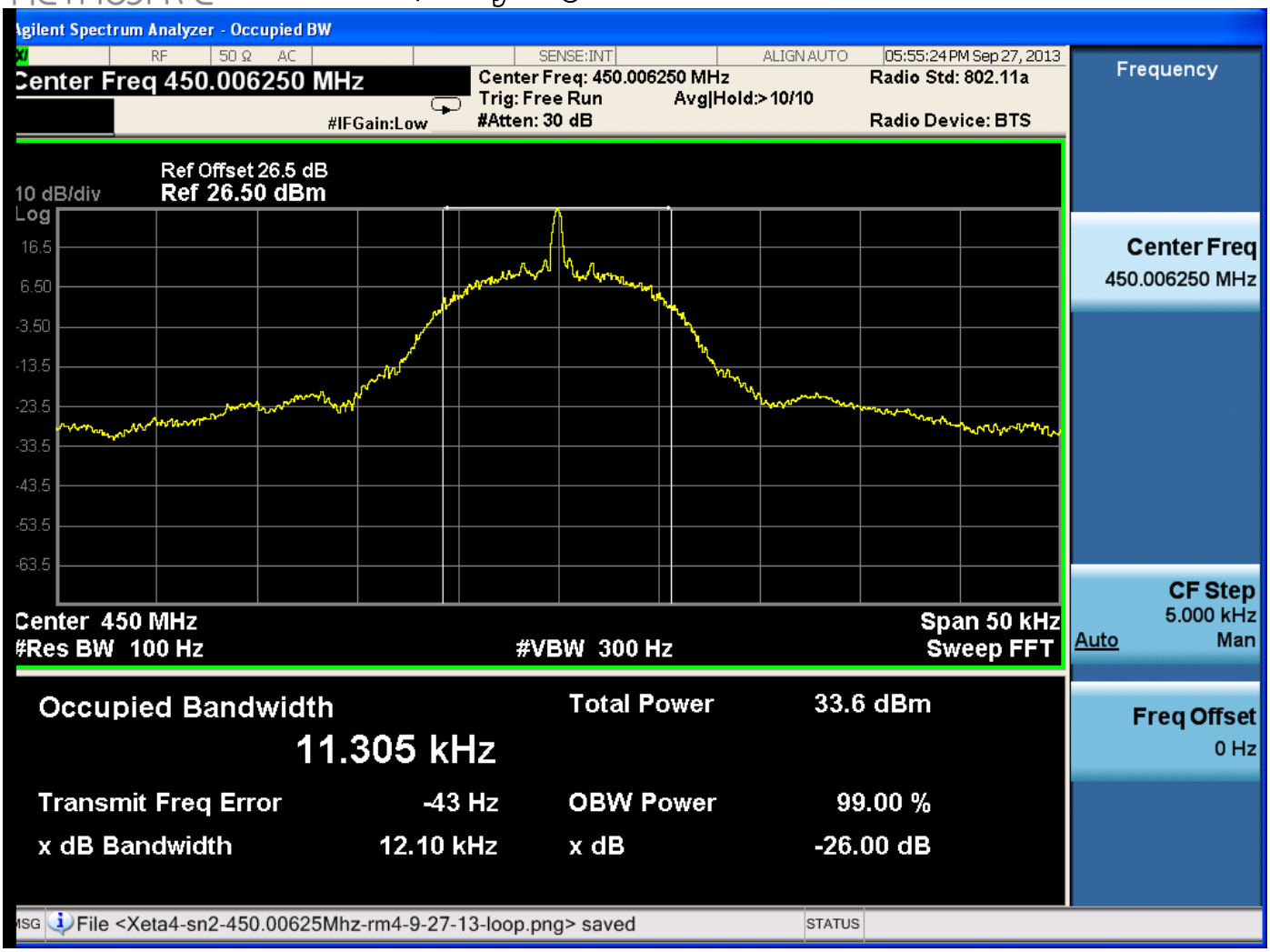


Figure 21. 450.00625 Mhz, rm4

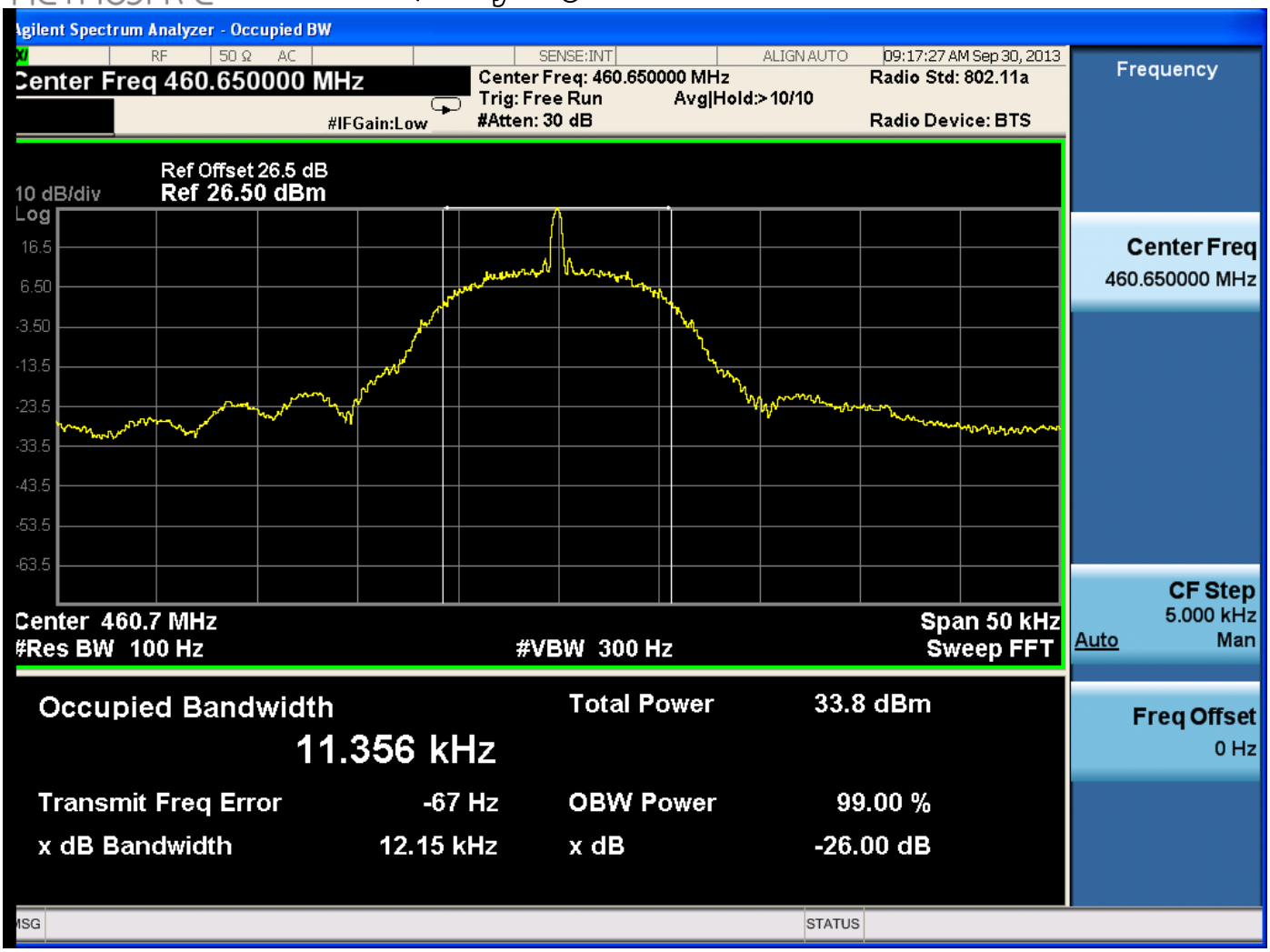


Figure 22. 460.65 Mhz, rm0

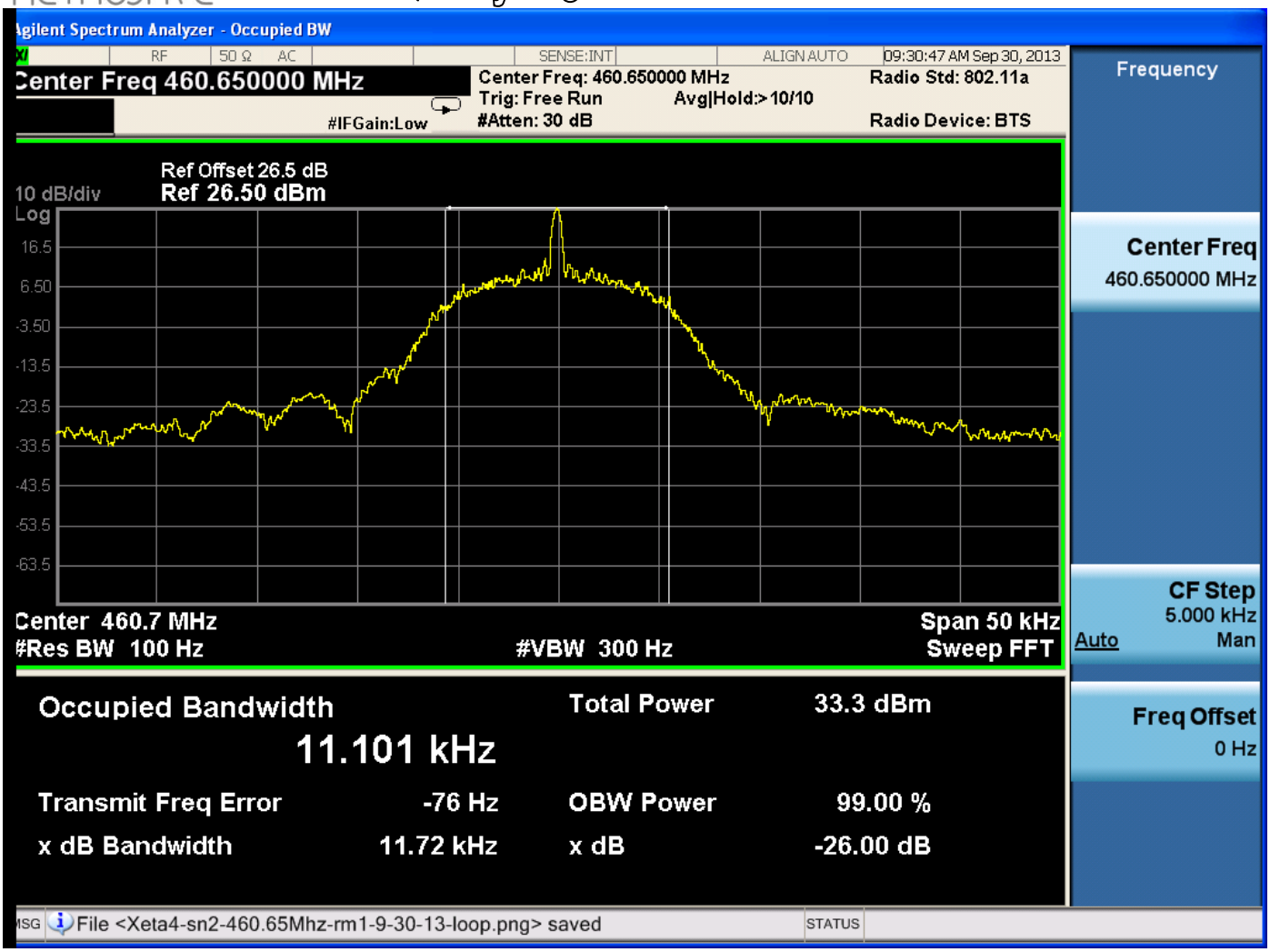


Figure 23. 460.65 Mhz, rm1

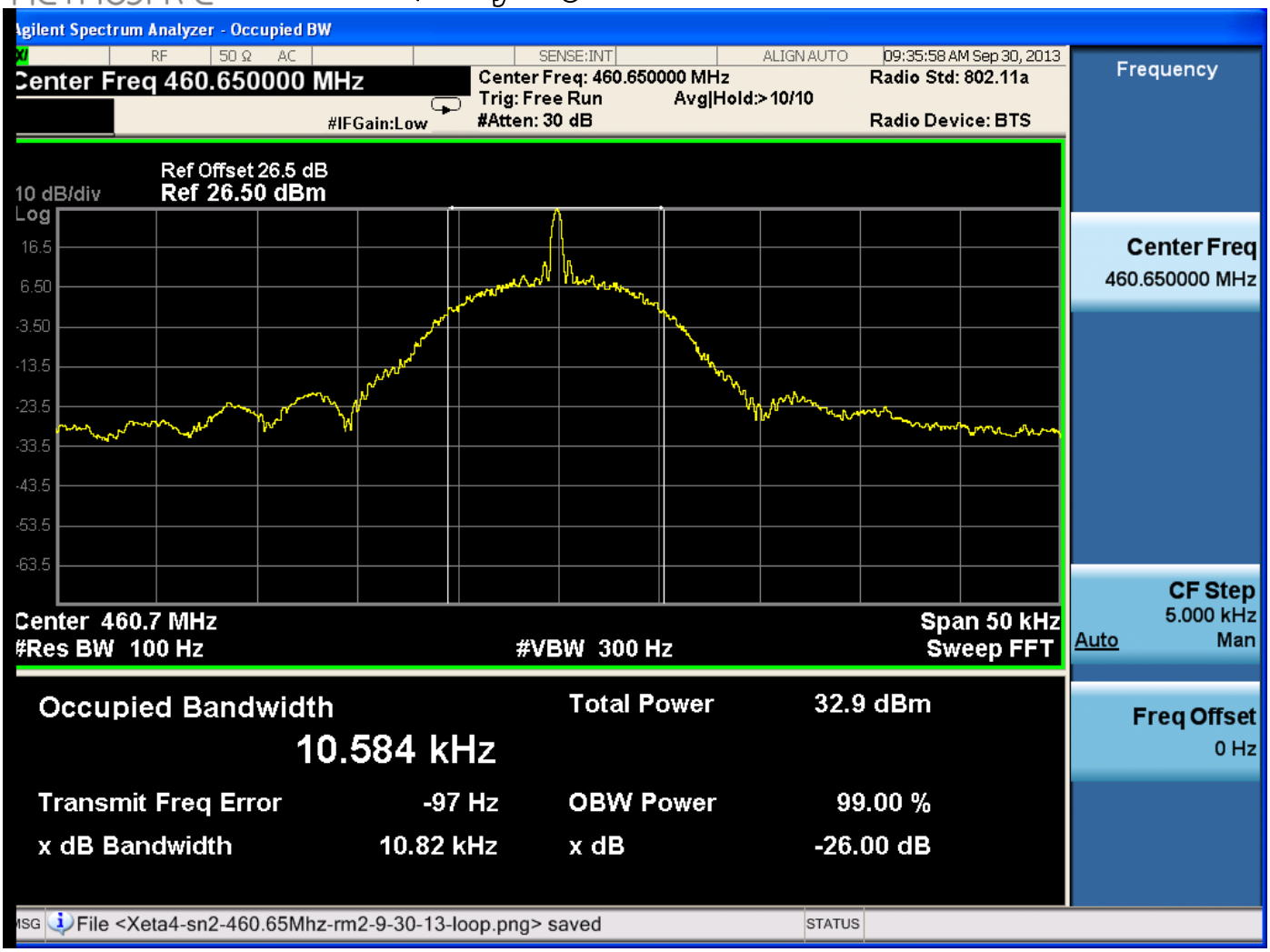


Figure 24. 460.65 Mhz, rm2

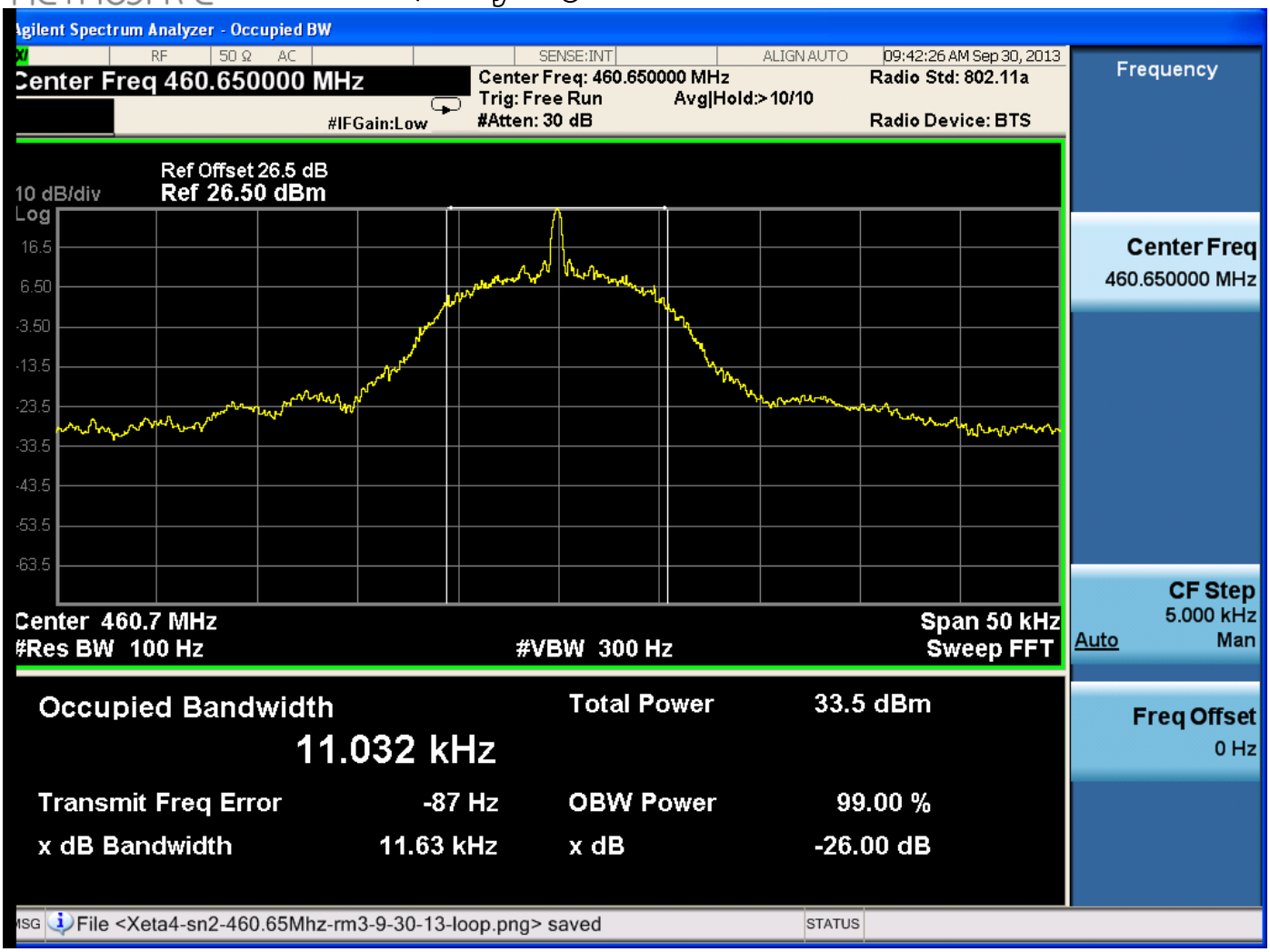


Figure 25. 460.65 Mhz, rm3

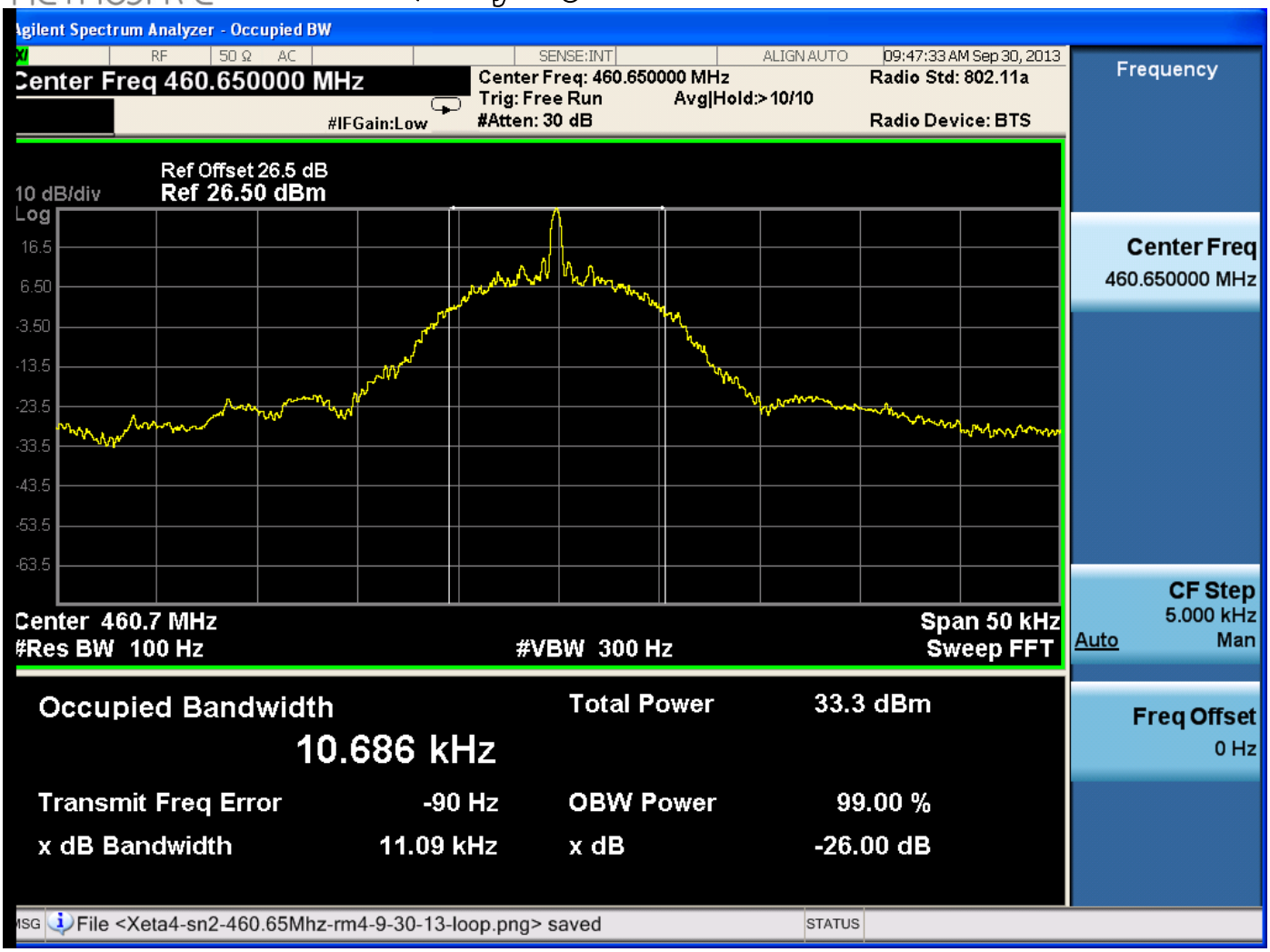


Figure 26. 460.65 Mhz, rm4

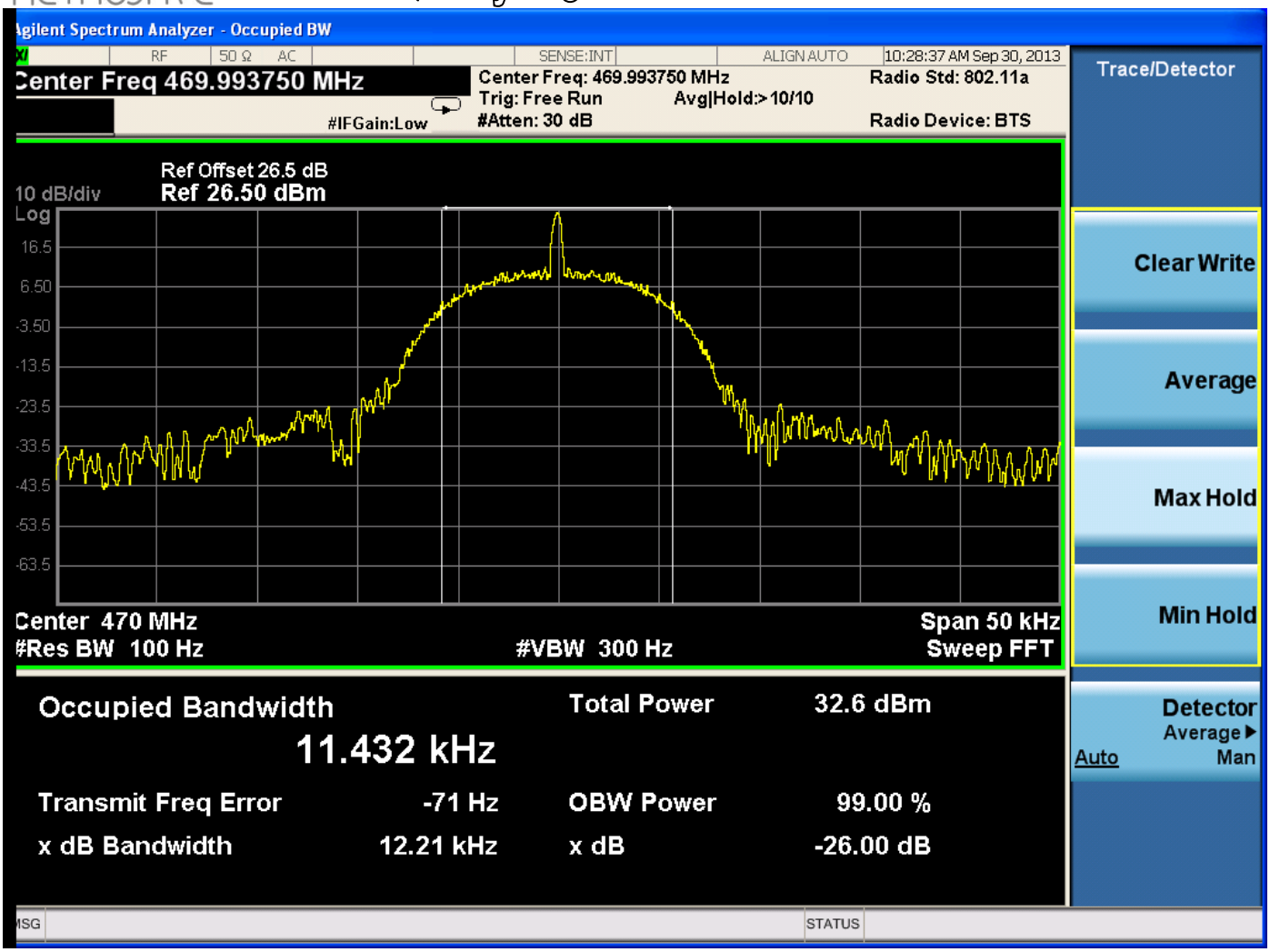


Figure 27. 469.99375Mhz-rm0

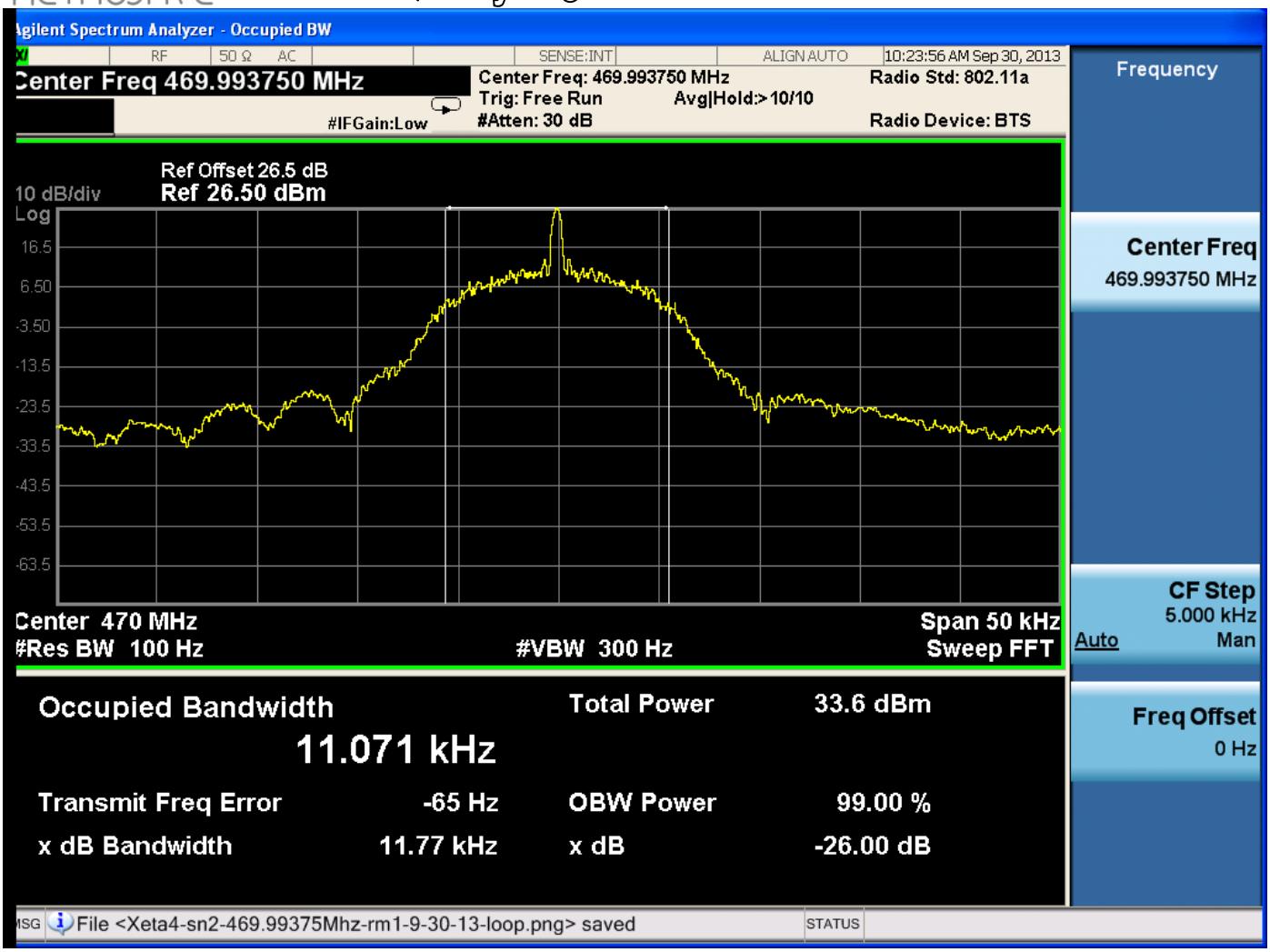


Figure 28. 469.99375Mhz-rm1

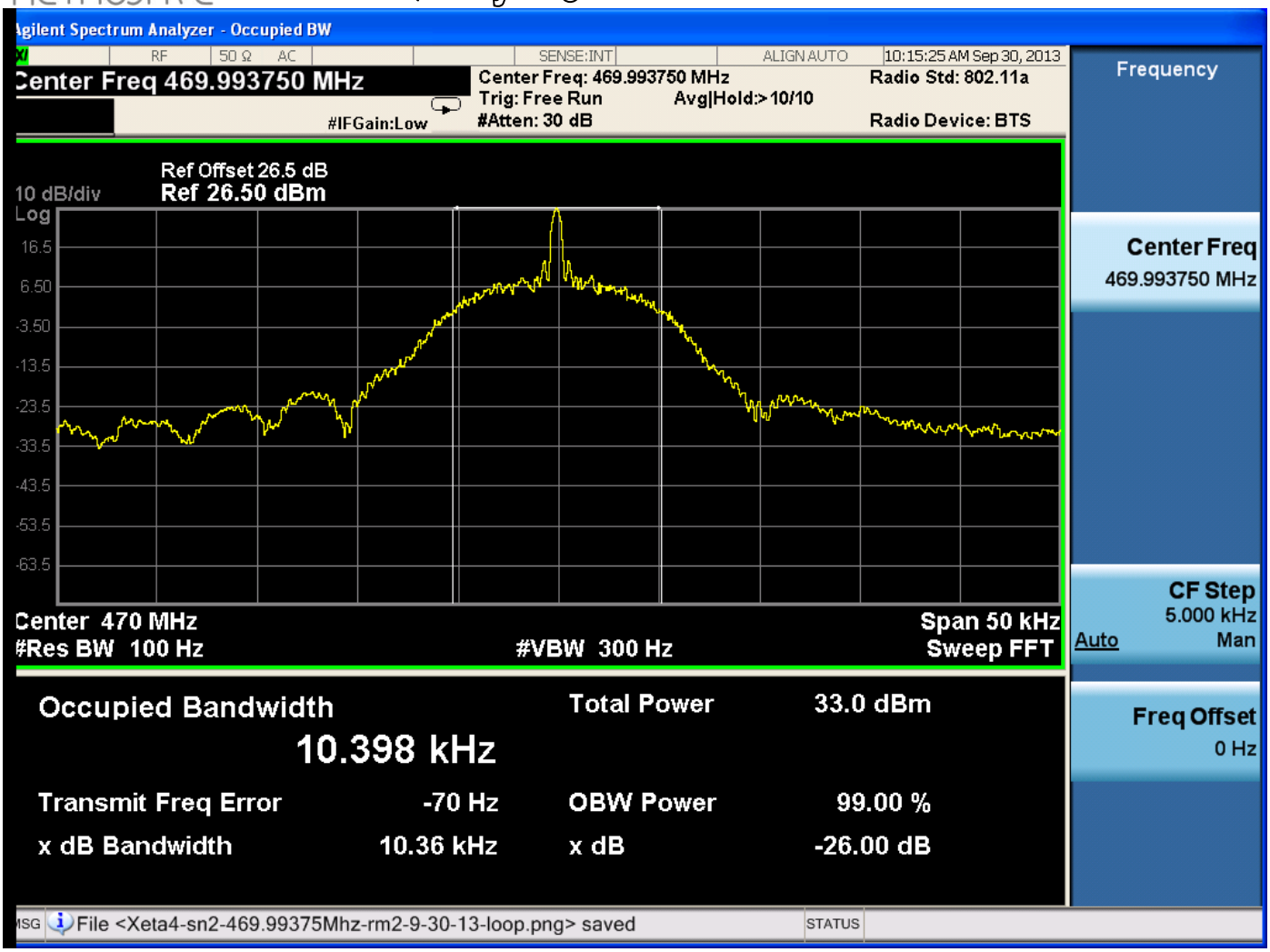


Figure 29. 469.99375Mhz-rm2

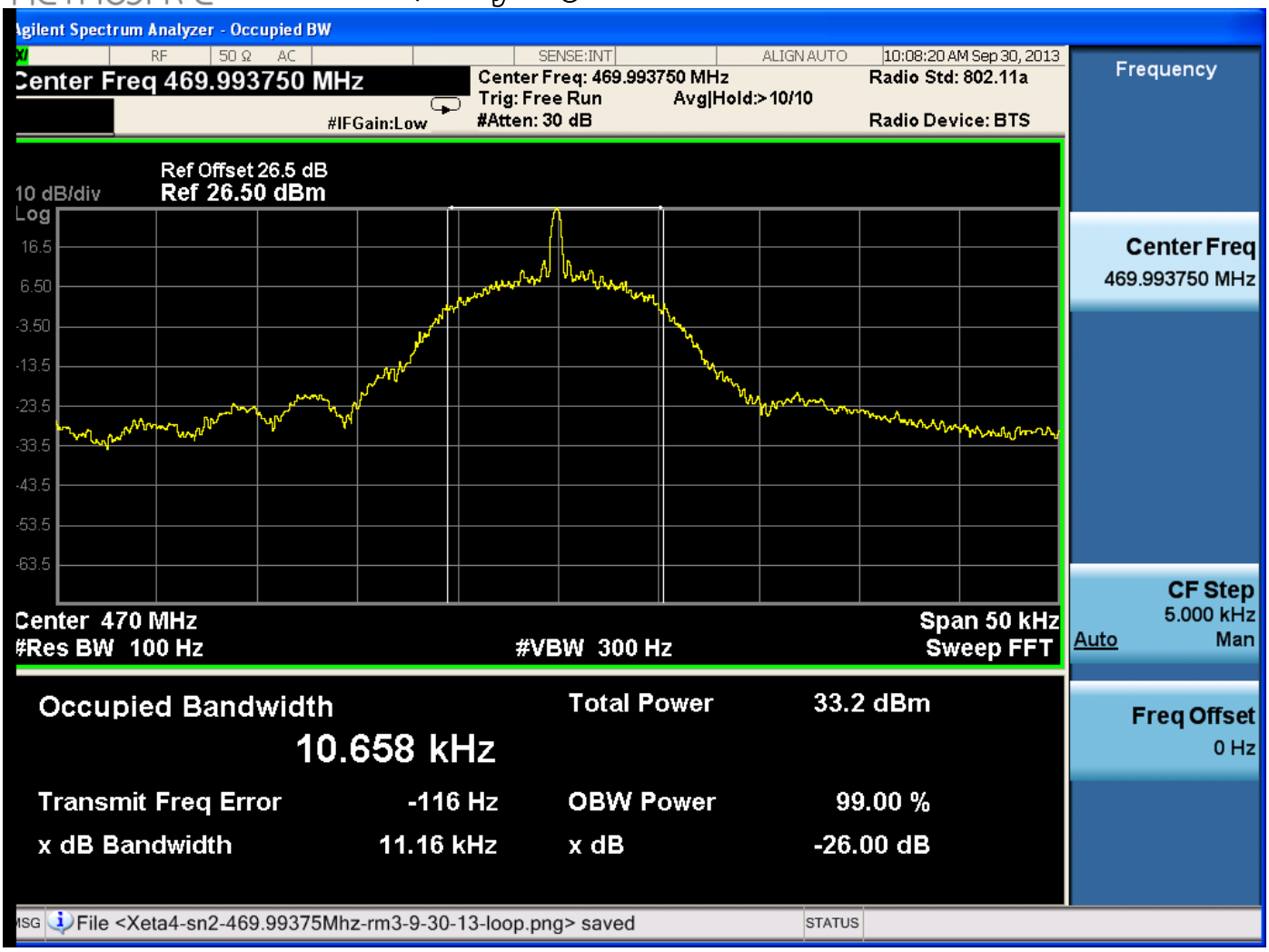


Figure 30. 469.99375Mhz-rm3

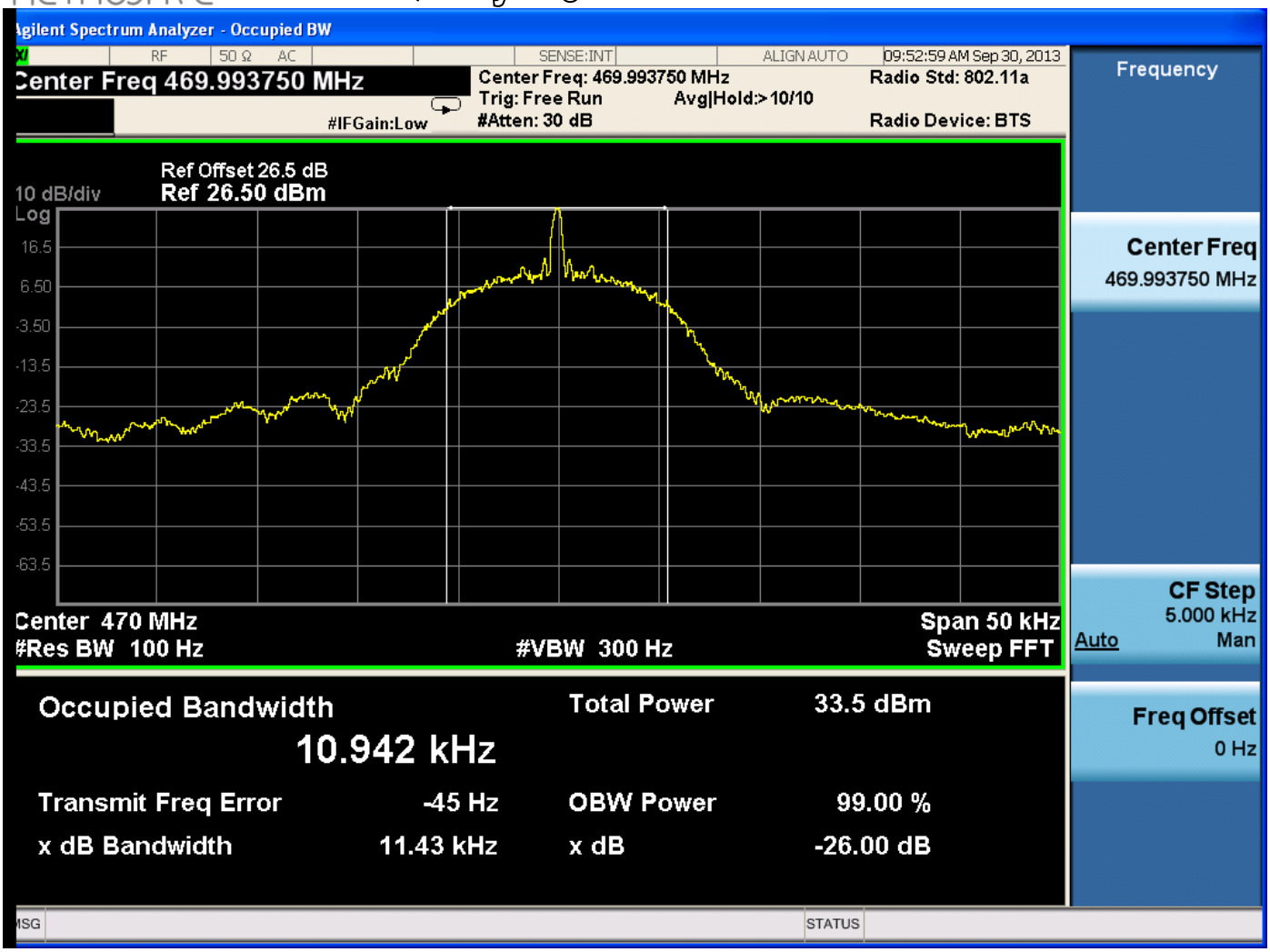


Figure 31. 469.99375Mhz-rm4

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.