Engineering and Testing for EMC and Safety Compliance

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FCC Part 24
Certification Report

Full Spectrum Inc.
1149 Chestnut Street, Suite 100
Menlo Park, CA 94025
Contact: Menashe Shahar

Models: BS100
MS400

FCC ID: X27-FS-NPCS000

February 4, 2010

Standards Referenced for this Report	
American National Standard Institute	ANSI C63.4-2003: Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
FCC Classification	PCB – Part 24D Narrowband PCS
FCC Rule Part(s)	FCC Rules Part 24: Personal Communications Services (10-01-09)
Digital Interface Information	Digital Interface was found to be compliant

Frequency Range (MHz)	Rated Transmit Power (W) (Conducted)	Frequency Tolerance (ppm)	Emission Designator
901.3-901.75	4	0.2	400KDXW, 450KDXW
930-931	4	0.2	400KDXW
940.3-940.75	4	0.2	400KDXW, 450KDXW
940.3-940.8	4	0.2	500KDXW

Report Prepared By: Daniel Baltzell

Document Number: 2009306

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Table of Contents

Figure Index

Table Index

Plot Index

Appendix Index

Photograph Index

1 General Information

1.1 Scope

This is an original certification application test report.

Applicable Standards:

- FCC Rules Part 24: Personal Communications Services

1.2 Description of EUT

Equipment Under Test	Base Station
Model	BS100
Power Supply	External 28 VDC
Modulation Type	TDD
Frequency Range	901.3-940.8
Antenna Connector Type	N-type
Antenna Type	External

1.3 Test Facility

The open area test site and conducted measurement facility used to collect the radiated data is located at 360 Herndon Parkway, Suite 1400, Herndon, Virginia 20170. This site has been fully described in a report and approved by the Federal Communications Commission to perform AC line conducted and radiated emissions testing (ANSI C63.4-2003).

1.4 Related Submittal(s)/Grant(s)

This is an original application for Full Spectrum Inc., FCC ID: X27-FS-NPCS000, and covers two models, BS100 and MS400, a base station version and a mobile version of the same product that are electrically identical.

1.5 Modifications

None.

2 Test Information

2.1 Description of Test Modes

In accordance with FCC 15.31(m), and because the EUT utilizes an operating band greater than 10 MHz, the following frequencies were tested:

Table 2-1: Channels Tested

Channel	Frequency (MHz)
Low	901.5; 901.55
Middle	930.2; 930.6; 930.8
High	940.5; 940.55

2.2 Exercising the EUT

The EUT was supplied with test software to select various transmit/receive modes (for example, high, mid, and low channel, etc.) for testing. The EUT was tested in all three orthogonal planes in order to determine worst-case emissions. The EUT was provided with software to continuously transmit during testing. The carrier was also checked to verify that information was being transmitted. There were no deviations from the test standard(s) and/or methods. The test results reported relate only to the item tested.

901.55, 930.8, and 940.55 MHz were tested in 400 kHz bandwidths for radiated measurements as representative, based on similarity of conducted antenna port and mask measurements.

2.3 Test Result Summary

Table 2-2: Test Result Summary – FCC Part 24

Standard	Test	Pass/Fail or N/A
FCC 24.132	Maximum Peak Power Output	Pass
FCC 24.133(a)(1)(ii)	Out of Band Emissions (Antenna Conducted Spurious)	Pass
FCC 24.133(a)(1)(ii)	Out of Band Emissions (Radiated Emissions)	Pass
FCC 24.133(a)(1)(i)	In Band Emissions (Masks)	Pass
FCC 24.135	Frequency Stability	Pass

3 Tested System Details

The test sample was received on December 16, 2009. Following are the identifiers and descriptions of all equipment, cables, and internal devices used with the EUT for this test, as applicable.

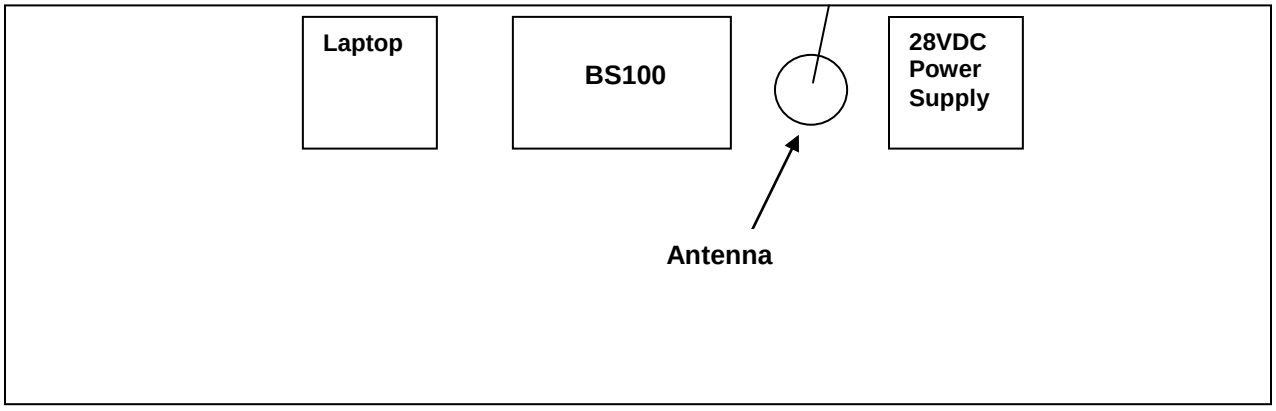
Table 3-1: Equipment Under Test (EUT)

Part	Manufacturer	Model	PN/SN	FCC ID	RTL Bar Code
Radio	Full Spectrum	BS100	BS100	X27-FS-NPCS000	19381
Band Pass Filter	Lark Engineering	N/A	XMC930.5-X1-3GH 29189-02	N/A	19382

Table 3-2: Auxiliary Test Equipment

Part	Manufacturer	Model	PN/SN	FCC ID	RTL Bar Code
Power Supply	Astec	LPS255	26100010410	N/A	19383
Laptop	Hewlett Packard	Mini 1000	CNF9412PJ9	N/A	N/A

Figure 3-1: Configuration of Tested System



4 FCC Rules and Regulations Part 2.1046(a): Conducted RF Power Output; Part 24.132(c)

Base stations transmitting in the 930–931 MHz and 940–941 MHz bands are limited to 3500 watts e.r.p. per authorized channel and are unlimited in antenna height except as provided in paragraph (d) of this section.

4.1 Test Procedure

A conducted power measurement of the EUT was taken using an Agilent power meter.

Procedure: ANSI/TIA/EIA-603-2004, section 2.2.1

The EUT was connected to a coaxial attenuator having a 50 Ω load impedance.

4.2 Test Data

Table 4-1: Power Output Test Data – High Power

Frequency (MHz)	Peak Conducted Power (dBm)
901.5 (400kHz)	36.1
901.55 (400kHz)	36.2
930.2 (400kHz)	36.4
930.6 (400kHz)	36.1
930.8 (400kHz)	36.1
940.5 (400kHz)	36.1
940.55 (400kHz)	36.4
901.525 (450 kHz)	36.4
940.525 (450 kHz)	36.7
940.55 (500 kHz)	36.3

Manufacturers rated output power is 4 W.

Table 4-2: Output Power Test Equipment

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901356	Agilent Technologies	E9323A	Power Sensor	31764-264	11/18/10
901184	Agilent Technologies	E4416A	EPM-P Power Meter, single channel	GB41050573	11/18/10

Test Personnel:

Dan Baltzell		December 16, 2009
EMC Test Engineer	Signature	Date of Test

5 FCC Rules and Regulations Part 2.1051: Spurious Emissions at Antenna Terminals; Part 24.133(a)(1)(ii)

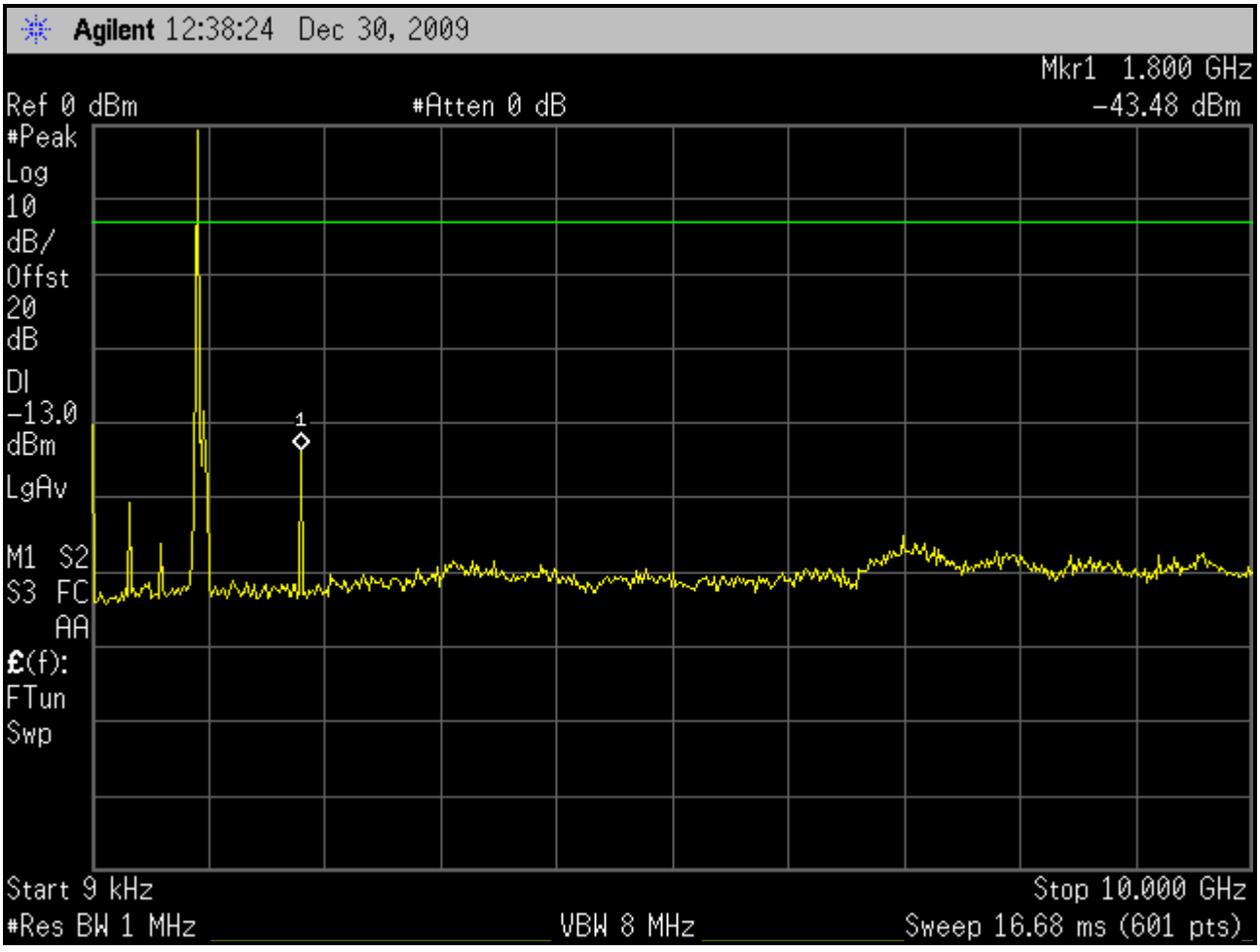
On any frequency outside the authorized bandwidth and removed from the edge of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 40 kHz: at least 43+10 Log10 (P) decibels or 80 decibels, whichever is the lesser attenuation.

5.1 Test Procedure

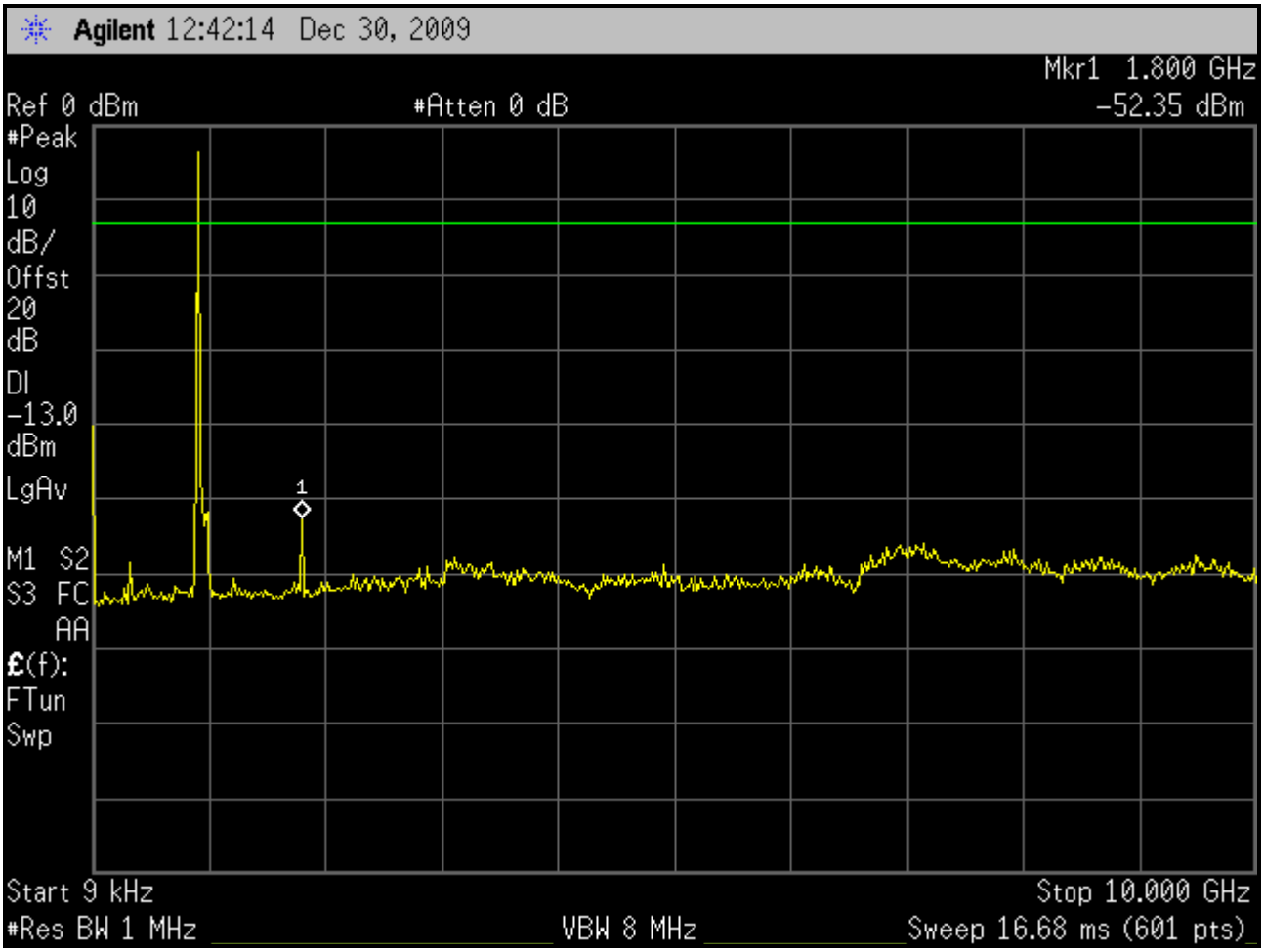
ANSI/TIA/EIA-603-2004, section 2.2.13

5.2 Test Data

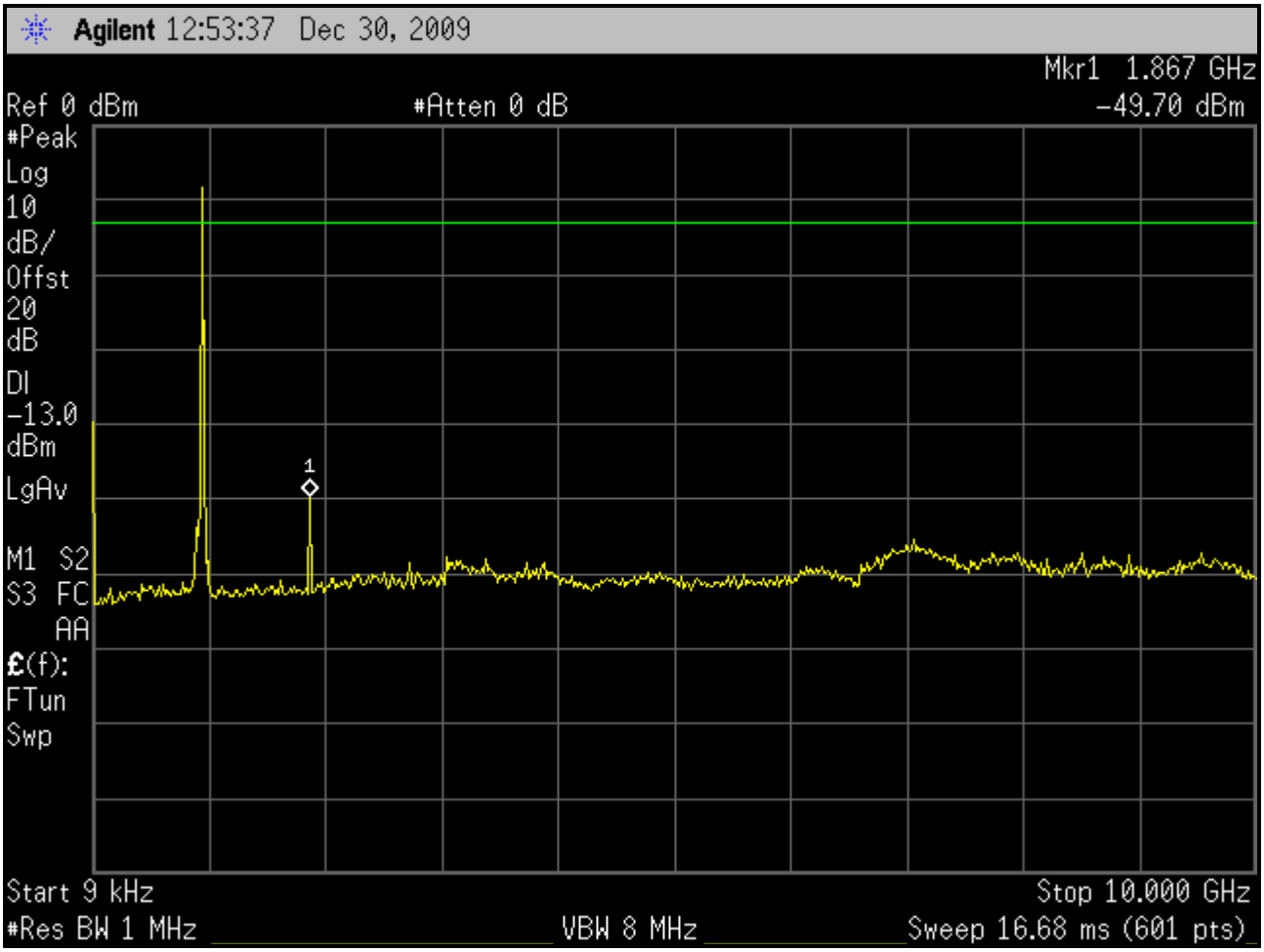
Plot 5-1: Conducted Spurious Emissions; 901.5 MHz, 400 kHz BW



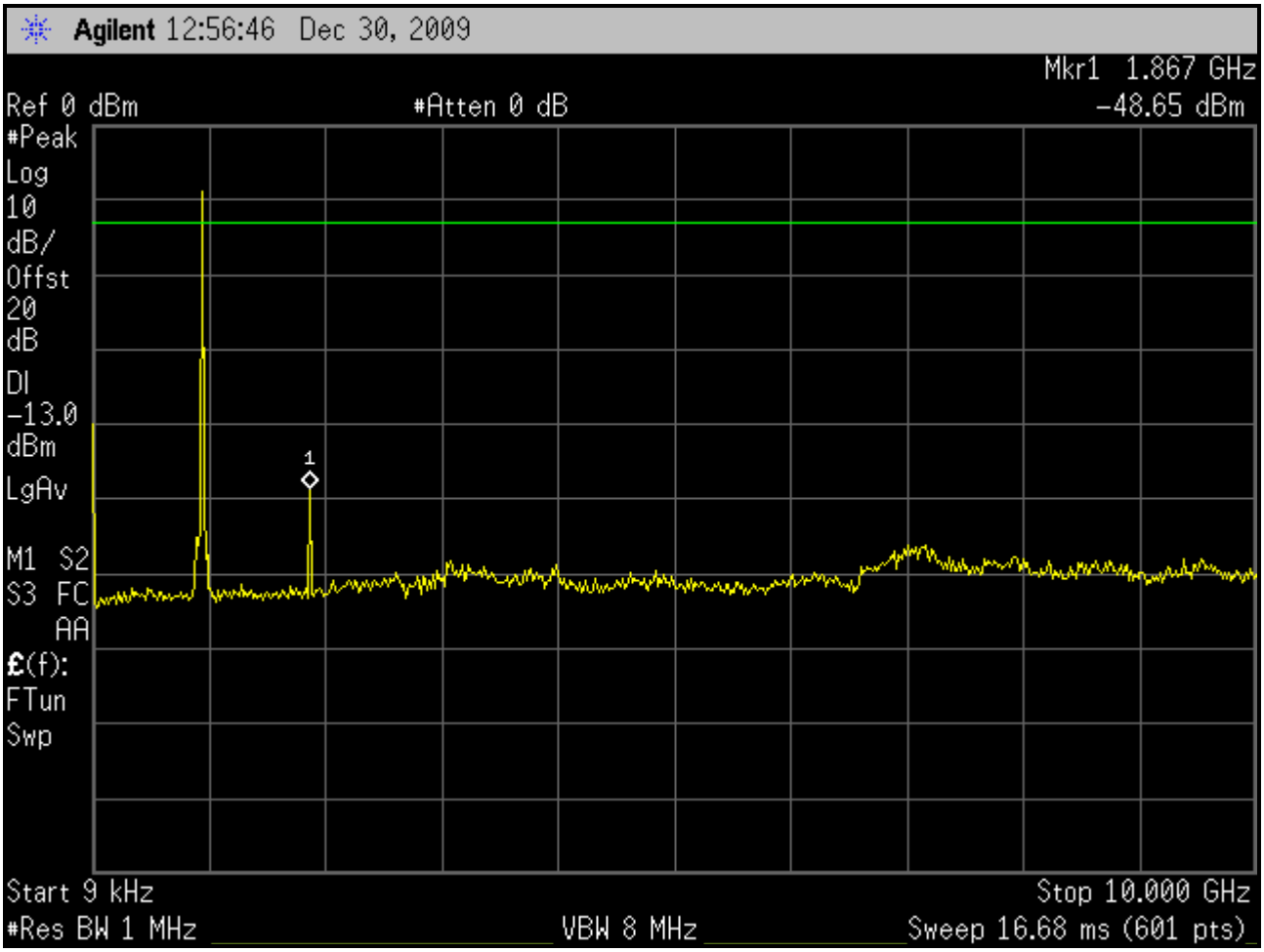
Plot 5-2: Conducted Spurious Emissions; 901.55 MHz, 400 kHz BW



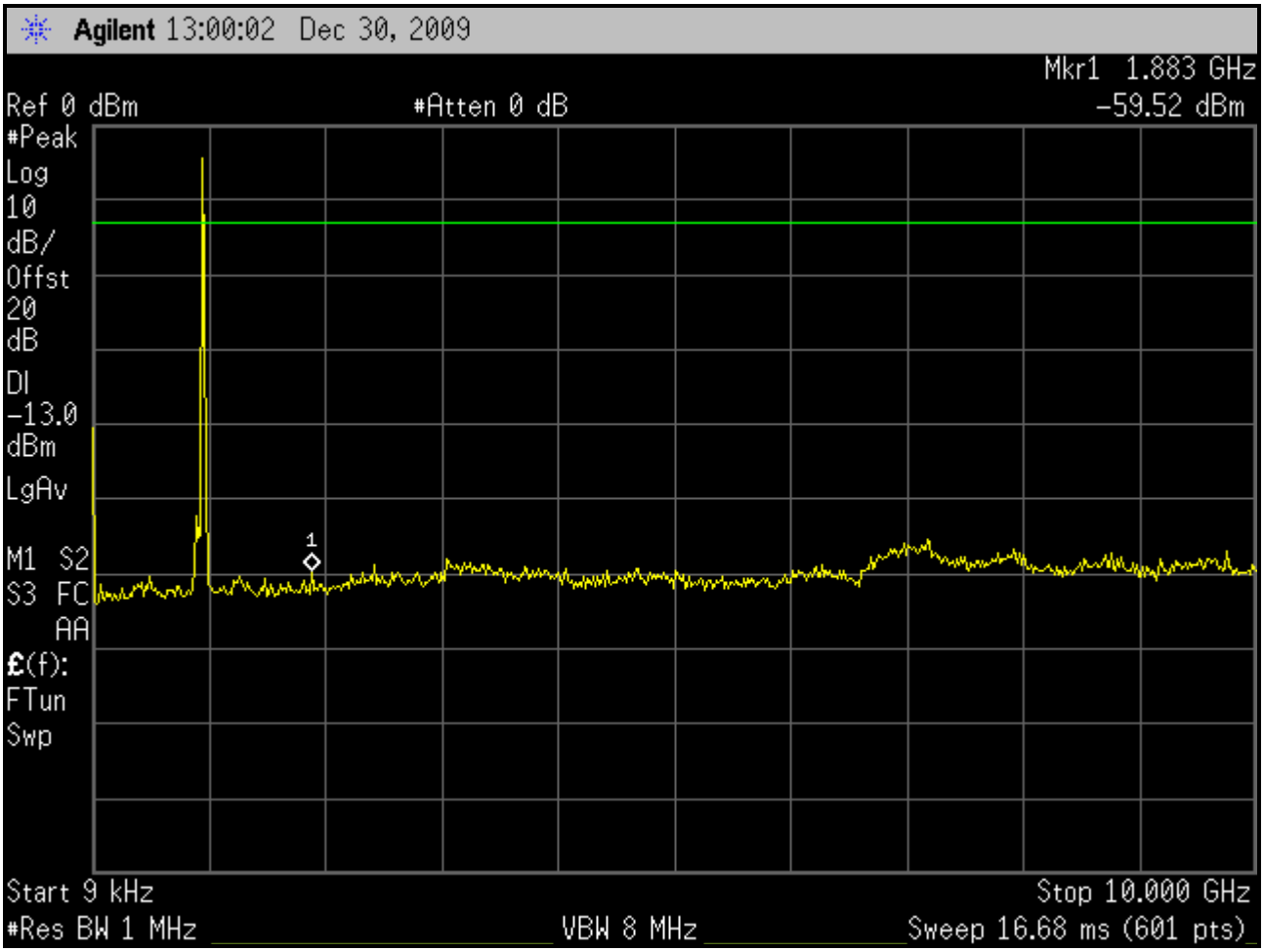
Plot 5-3: Conducted Spurious Emissions; 930.2 MHz, 400 kHz BW



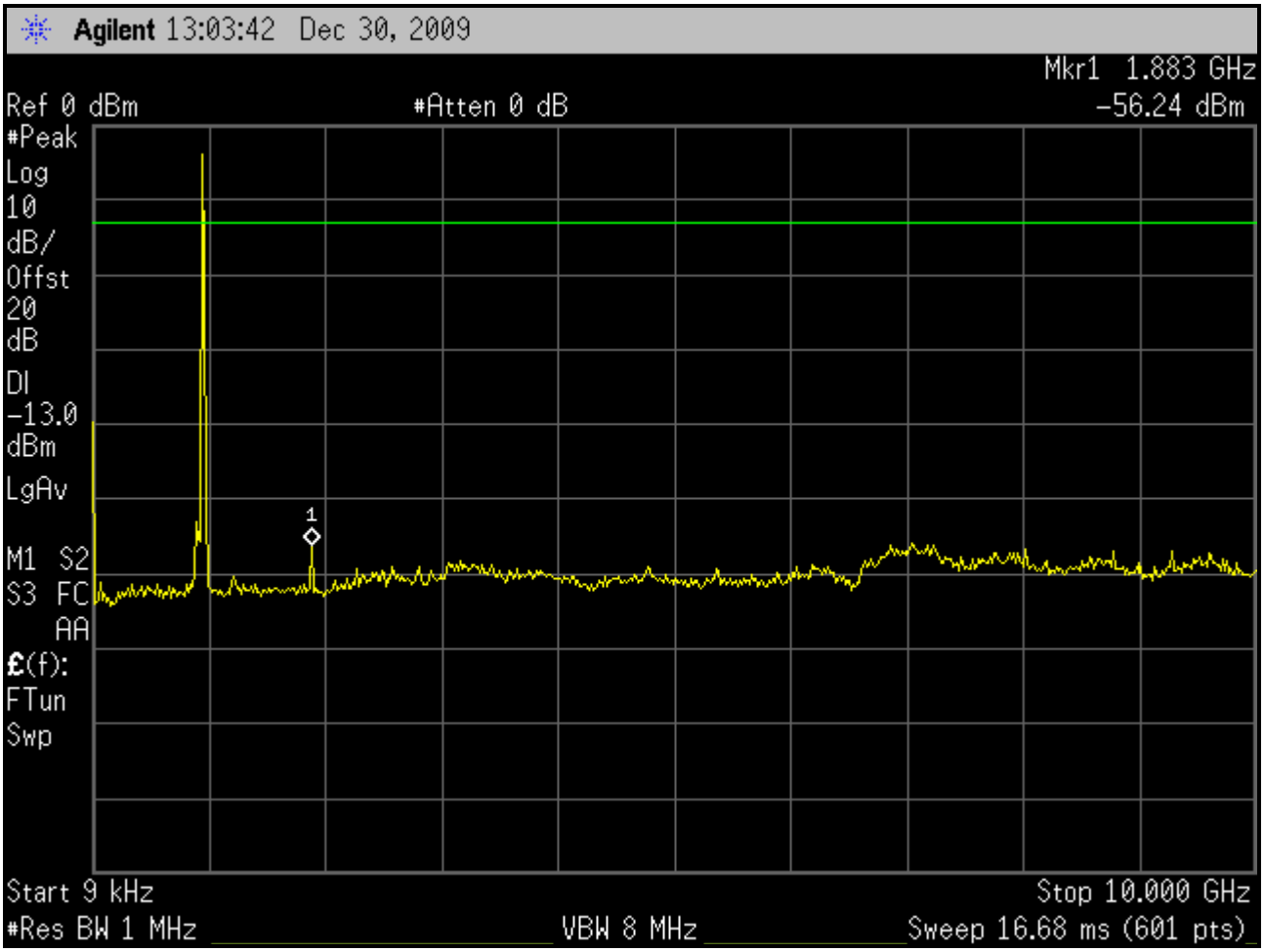
Plot 5-4: Conducted Spurious Emissions; 930.8 MHz, 400 kHz BW



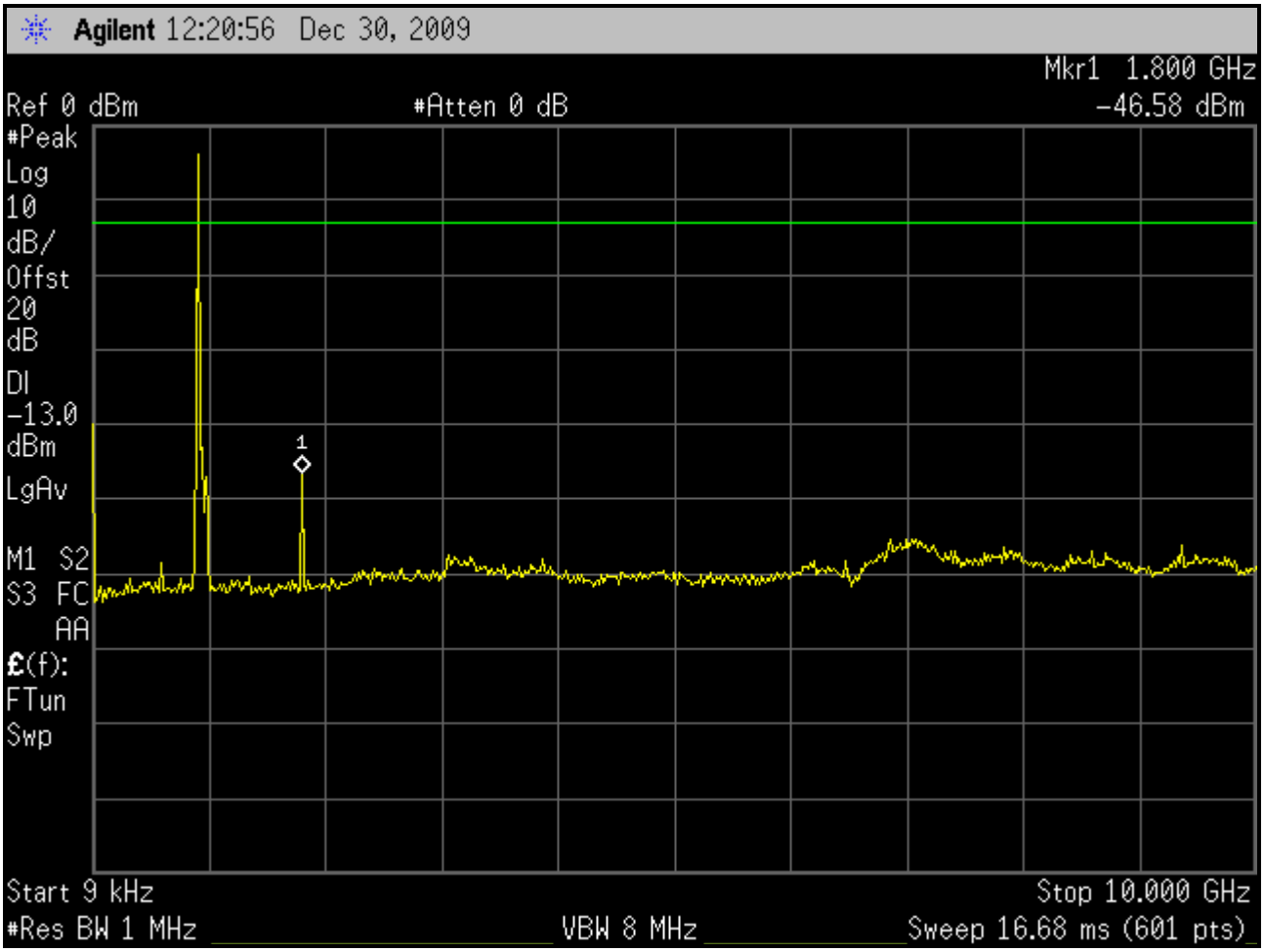
Plot 5-5: Conducted Spurious Emissions; 940.5 MHz, 400 kHz BW



Plot 5-6: Conducted Spurious Emissions; 940.55 MHz, 400 kHz BW



Plot 5-7: Conducted Spurious Emissions; 901.525 MHz, 450 kHz BW



Plot 5-8: Conducted Spurious Emissions; 940.525 MHz, 450 kHz BW

Plot 5-9: Conducted Spurious Emissions; 940.55 MHz, 500 kHz BW

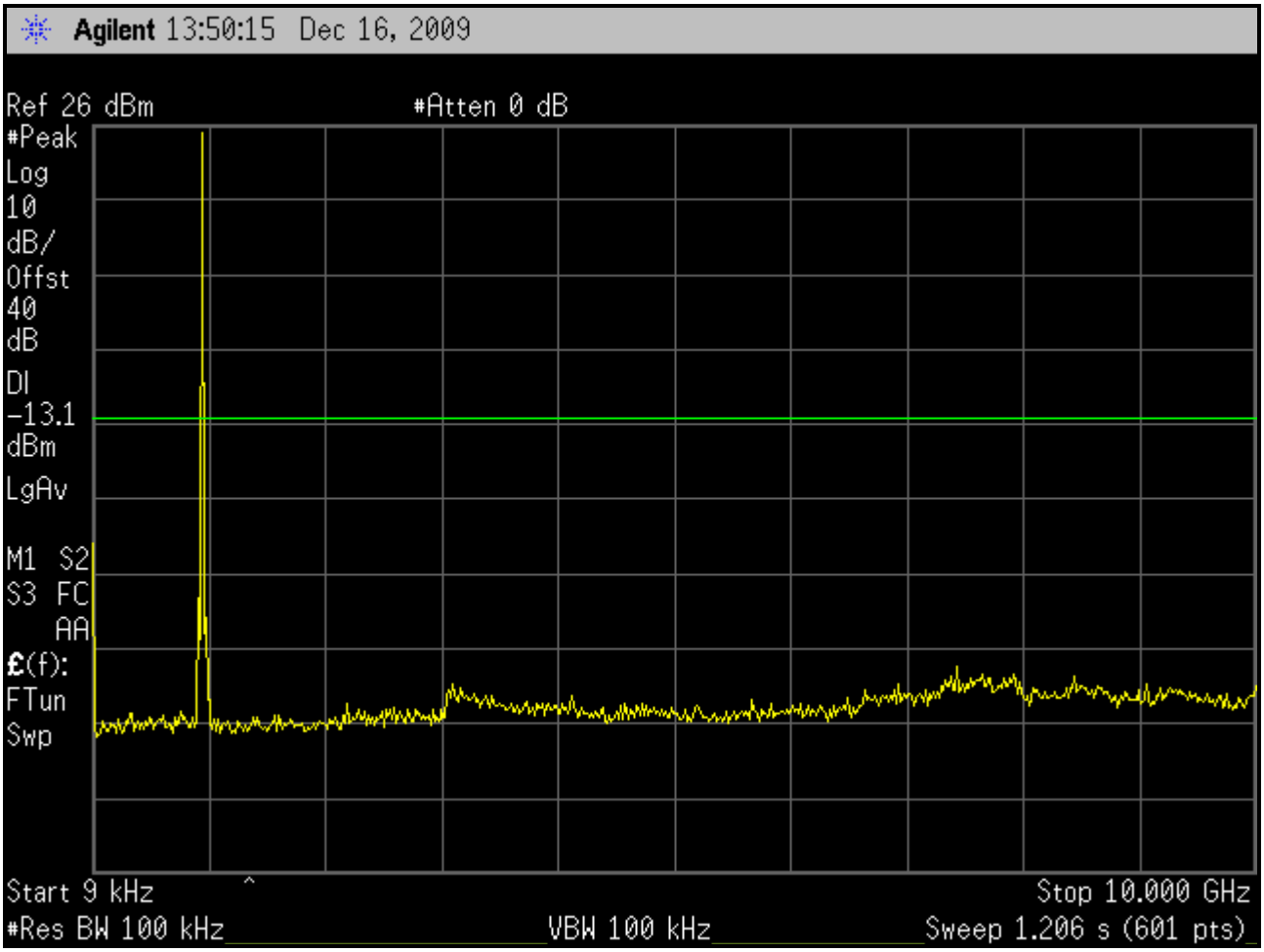


Table 5-1: Antenna Conducted Spurious Test Equipment

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
95448	Agilent Technologies	E4448A	Spectrum Analyzer (3 Hz – 50 GHz)	MY46180621	11/11/10

Test Personnel:

Dan Baltzell	Signature	December 16 and 30, 2009
EMC Test Engineer		Dates of Tests

6 Part 2 §2.1053(a): Field Strength of Spurious Radiation; Part 24.132(a)(1)(ii)

On any frequency outside the authorized bandwidth and removed from the edge of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 40 kHz: at least 43+10 Log10 (P) decibels or 80 decibels, whichever is the lesser attenuation.

6.1 Test Procedure

ANSI/TIA/EIA-603-2004, section 2.2.12

Before final measurements of radiated emissions were made on the open-field three/ten meter range, the EUT was scanned indoors at one and three meter distances. This was done in order to determine its emissions spectrum signature. The physical arrangement of the test system and associated cabling was varied in order to determine the effect on the EUT's emissions in amplitude, direction and frequency. This process was repeated during final radiated emissions measurements on the open-field range, at each frequency, in order to ensure that maximum emission amplitudes were attained. Final radiated emissions measurements were made on the three/ten-meter, open-field test site. The EUT was placed on a non-conductive turntable 0.8 meters above the ground plane. The spectrum was examined from 9 kHz to the 10^{th} harmonic of the highest fundamental transmitter frequency (10 GHz).

At each frequency, the EUT was rotated 360°, and the antenna was raised and lowered from 1 to 4 meters in order to determine the emission's maximum level. Measurements were taken using both horizontal and vertical antenna polarizations. For frequencies between 30 and 1000 MHz, the spectrum analyzer's 6 dB bandwidth was set to 120 kHz, and the analyzer was operated in the CISPR quasi-peak detection mode. For emissions above 1000 MHz, emissions are measured using the average detector function with a minimum resolution bandwidth of 1 MHz. No video filter less than 10 times the resolution bandwidth was used. The highest emission amplitudes relative to the appropriate limit were measured and recorded in this report. The spurious emissions levels were measured, and the device under test was replaced by a substitution antenna connected to a signal generator. This signal generator level was then corrected by subtracting the cable loss from the substitution antenna to the signal generator, and the gain of the antenna (dBi) was added to achieve the EIRP level and compared to the limit.

6.2 Test Data

Table 6-1: Radiated Emissions Harmonics/Spurious – 901.5 MHz

Fundamental Power - 36.1 dBm; 4.074W

Emission Frequency (MHz)	Peak Analyzer Reading (dBuV) (1 MHz RBW/ VBW)	Signal Generator Level (dBm)	Substitution Cable Loss (dB)	Substitution Antenna Gain (dBi)	Peak Corrected Emission Level (dBc)	Limit (dBc)	Average Margin (dB)
1803.000	81.9	-14.9	14.5	6.5	59.1	49.1	-10.0
2704.500	54.1	-44.1	16.7	7.7	89.3	49.1	-40.2
3606.000	53	-38.3	16.9	7.2	84.1	49.1	-35.0
4507.500	36	-48.0	16.6	8.9	91.9	49.1	-42.8
5409.000	35.5	-46.5	16.9	8.5	91.0	49.1	-41.9
6310.500	36.2	-45.7	17.3	9.2	89.9	49.1	-40.8
7212.000	36.9	-41.0	17.6	9.2	85.5	49.1	-36.4
8113.500	40.7	-35.1	17.9	9.2	79.9	49.1	-30.8
9015.000	40.1	-32.9	18.2	9.1	78.1	49.1	-29.0

Table 6-2: Radiated Emissions Harmonics/Spurious – 930.8 MHz

Fundamental Power - 36.1 dBm; 4.074W

Emission Frequency (MHz)	Peak Analyzer Reading (dBuV) (1 MHz RBW/ VBW)	Signal Generator Level (dBm)	Substitution Cable Loss (dB)	Substitution Antenna Gain (dBi)	Peak Corrected Emission Level (dBc)	Limit (dBc)	Average Margin (dB)
1861.600	72.6	-24.6	14.9	6.3	69.3	49.1	-20.2
2792.400	49.8	-45.8	17.2	8.0	91.0	49.1	-41.9
3723.200	47.7	-39.2	16.9	7.0	85.2	49.1	-36.1
4654.000	36.2	-47.4	16.7	9.1	91.1	49.1	-42.0
5584.800	36.3	-47.5	17.1	8.8	91.9	49.1	-42.8
6515.600	40.5	-43.4	17.4	9.7	87.2	49.1	-38.1
7446.400	39.6	-36.9	17.7	8.9	81.8	49.1	-32.7
8377.200	40.8	-34.0	18.0	9.3	78.8	49.1	-29.7
9308.000	41.5	-30.5	18.3	9.5	75.5	49.1	-26.4

Table 6-3: Radiated Emissions Harmonics/Spurious – 940.55 MHz

Fundamental Power - 36.4 dBm; 4.365 W

Emission Frequency (MHz)	Peak Analyzer Reading (dBuV) (1 MHz RBW/ VBW)	Signal Generator Level (dBm)	Substitution Cable Loss (dB)	Substitution Antenna Gain (dBi)	Peak Corrected Emission Level (dBc)	Limit (dBc)	Average Margin (dB)
1881.100	71.6	-23.7	15.0	6.2	68.9	49.4	-19.5
2821.650	54.8	-41.9	17.1	8.0	87.4	49.4	-38.0
3762.200	49.3	-37.7	16.8	7.0	83.9	49.4	-34.5
4702.750	37.5	-46.9	16.7	9.0	91.1	49.4	-41.7
5643.300	36.6	-47.8	17.1	9.0	92.3	49.4	-42.9
6583.850	38.8	-45.3	17.4	9.6	89.5	49.4	-40.1
7524.400	36.6	-39.0	17.7	9.1	84.0	49.4	-34.6
8464.950	42.4	-32.1	18.0	9.2	77.3	49.4	-27.9
9405.500	39.6	-32.4	18.4	9.4	77.8	49.4	-28.4

Table 6-4: Radiated Spurious Emissions Test Equipment

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
900151	Rohde and Schwarz	HFH2-Z2	Loop Antenna (9 kHz - 30 MHz)	827525/019	10/1/12
901365	MITEQ	JS4-00102600-41-5P	Amplifier, 0.1-26 GHz, 30dB gain	N/A	3/4/10
900878	Rhein Tech Laboratories	AM3-1197-0005	3 meter antenna mast, polarizing	OATS1	N/A
901516	Insulated Wire Inc.	KPS-1503-2400-KPS	RF cable, 20'	NA	10/19/10
901517	Insulated Wire Inc.	KPS-1503-360-KPS	RF cable 36"	NA	10/19/10
901242	Rhein Tech Laboratories	WRT-000-0003	Wood rotating table	N/A	N/A
901215	Hewlett Packard	8596EM	Spectrum Analyzer (9 kHz - 12.8 GHz)	3826A00144	10/23/10
900791	Chase	CBL6111B	Bilog Antenna (30 MHz – 2000 MHz)	N/A	12/12/10
900321	EMCO	3161-03	Horn Antennas (4 – 8 GHz)	9508-1020	6/14/10
900323	EMCO	3160-07	Horn Antennas (8.2 – 12 GHz)	9605-1054	6/14/10
900356	EMCO	3160-08	Horn Antennas (12.4 – 18 GHz)	9607-1044	6/14/10
901218	EMCO	3160-09	Horn Antenna (18 - 26 GHz)	960281-003	6/19/10
900772	EMCO	3161-02	Horn Antenna (2 - 4 GHz)	9804-1044	6/14/10

Test Personnel:

Daniel W. Baltzell		December 31, 2009
Test Engineer	Signature	Date Of Test

7 FCC Rules and Regulations Part 2.1049(c)(1): Occupied Bandwidth; Part 24.133(a)(1)(i)

On any frequency outside the authorized bandwidth and removed from the edge of the authorized bandwidth by a displacement frequency (fd in kHz) of up to and including 40 kHz: at least 116 Log10 ((fd+10)/6.1) decibels or 50 plus 10 Log10 (P) decibels or 70 decibels, whichever is the lesser attenuation.

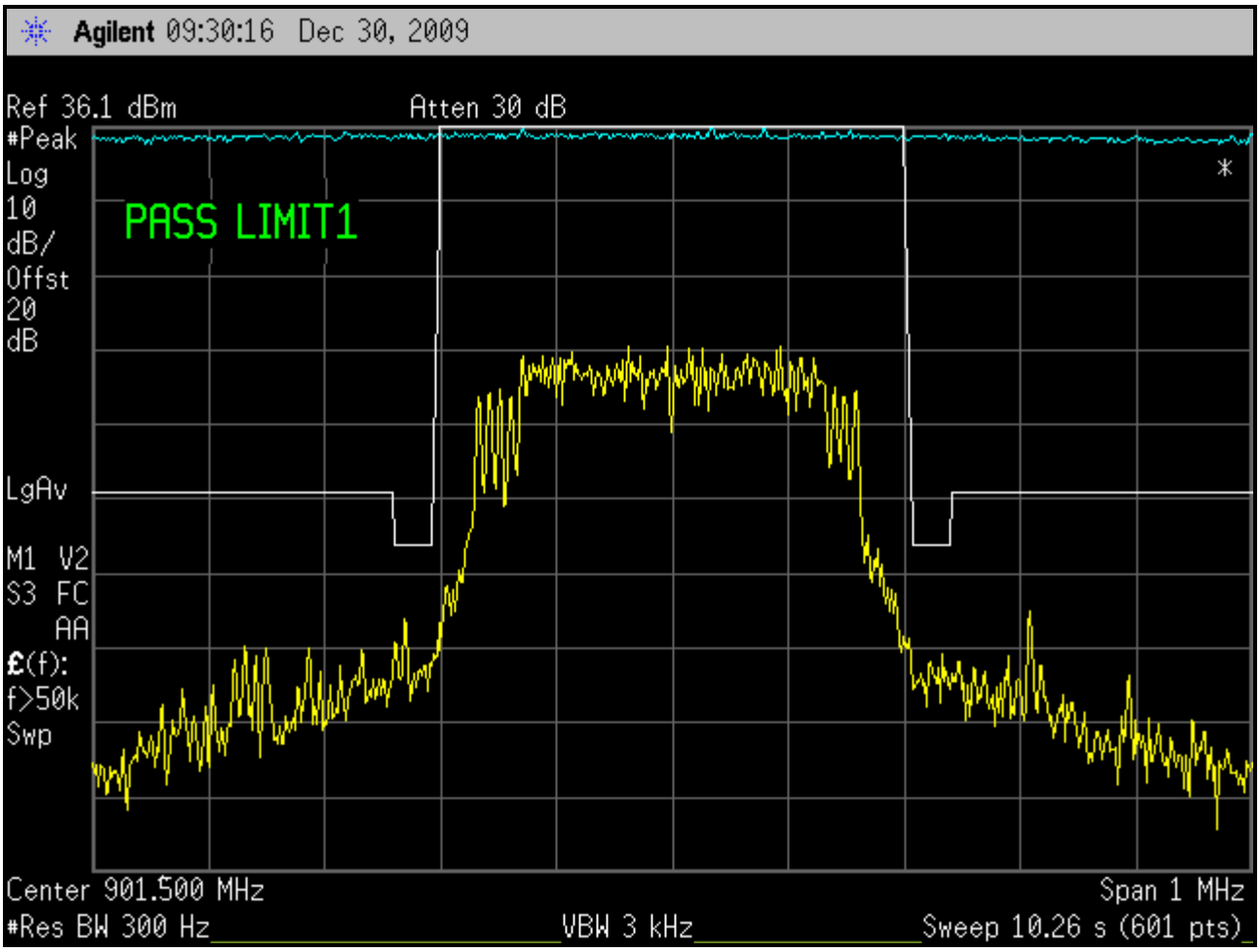
7.1 Test Procedure

ANSI/TIA/EIA-603-2004, section 2.2.11

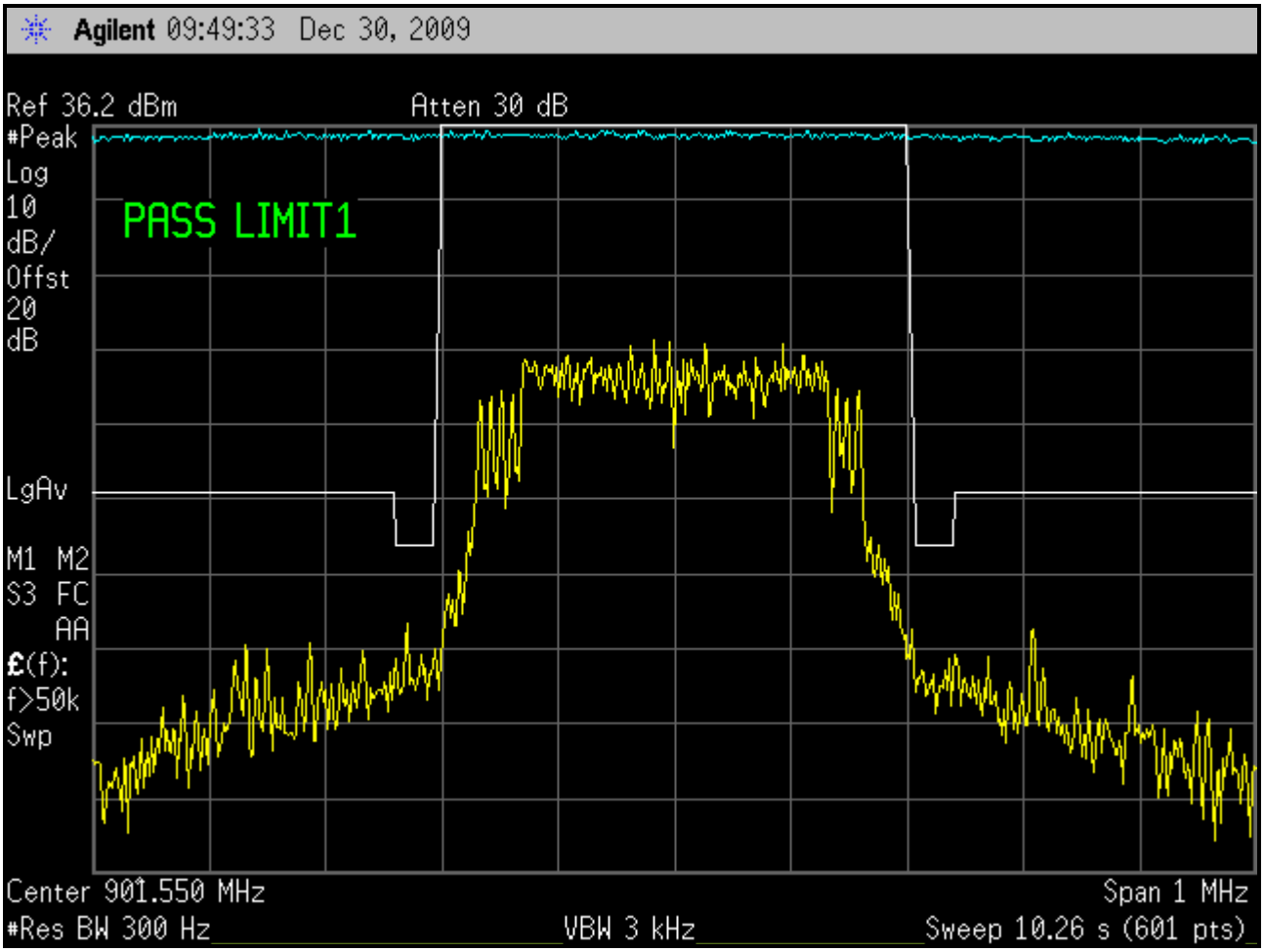
Device with digital modulation: Modulated to its maximum extent

7.2 Test Data

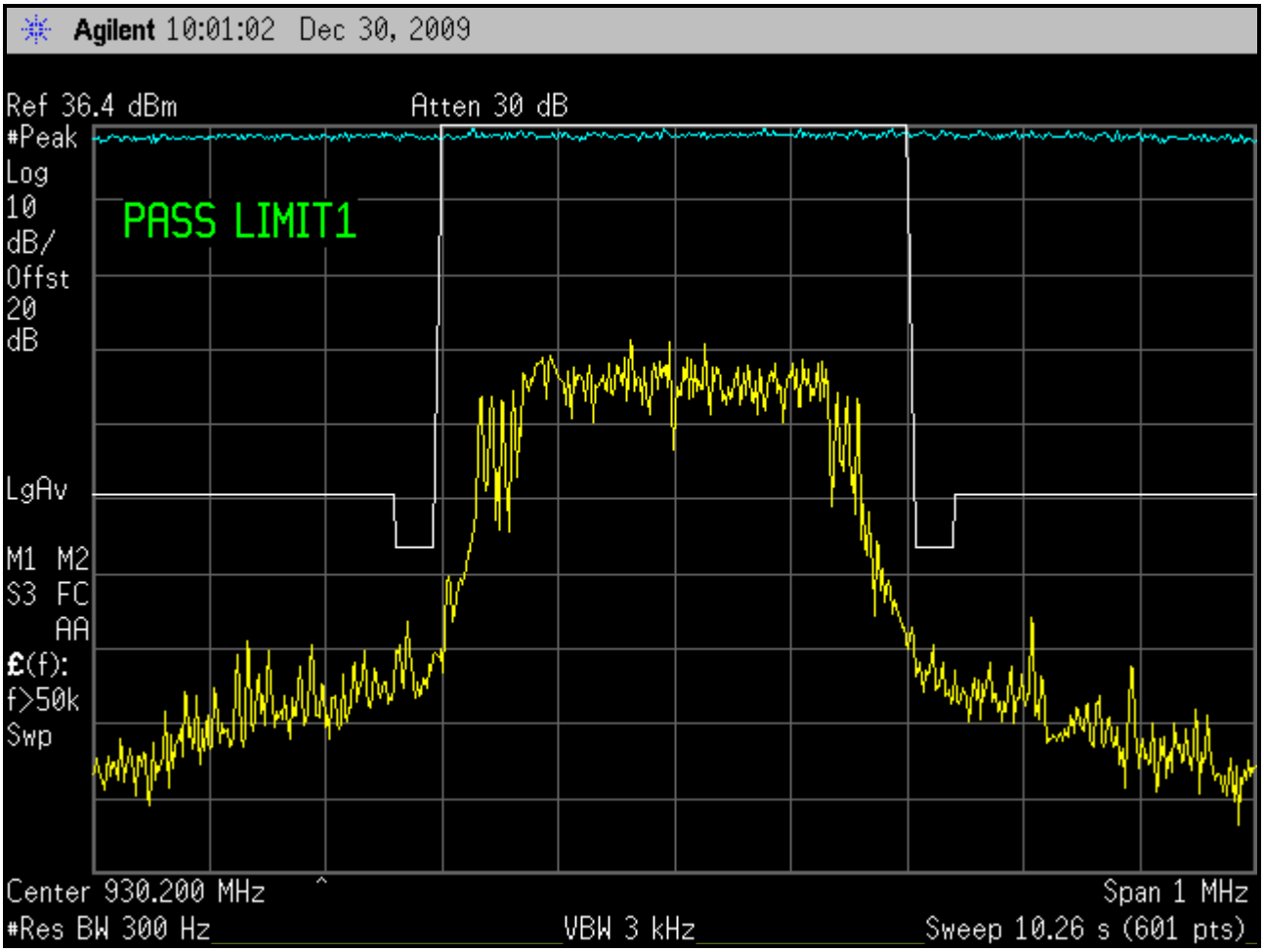
Plot 7-1: In Band Emissions – 901.5 MHz (400 kHz BW)



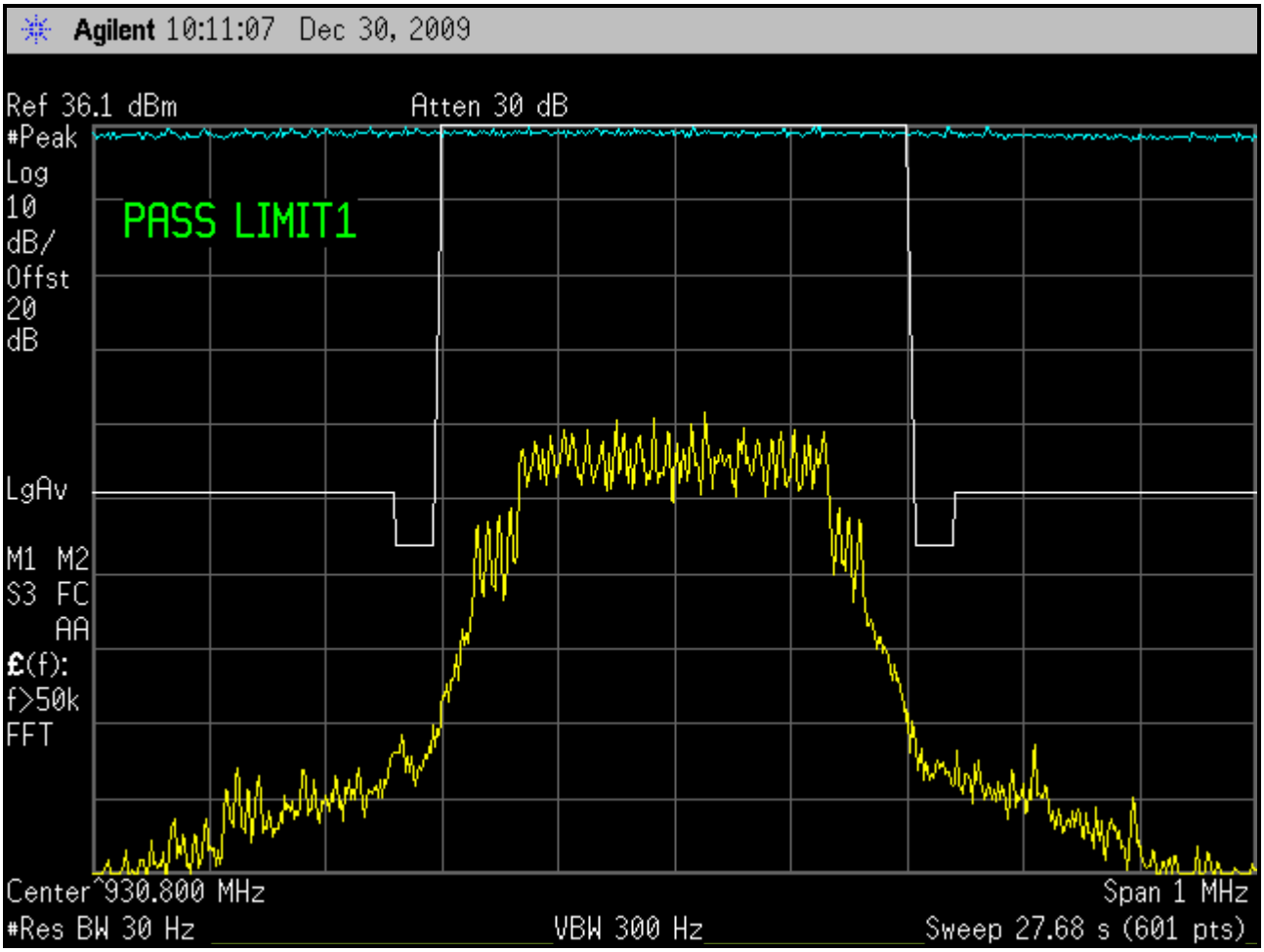
Plot 7-2: In Band Emissions – 901.55 MHz (400 kHz BW)



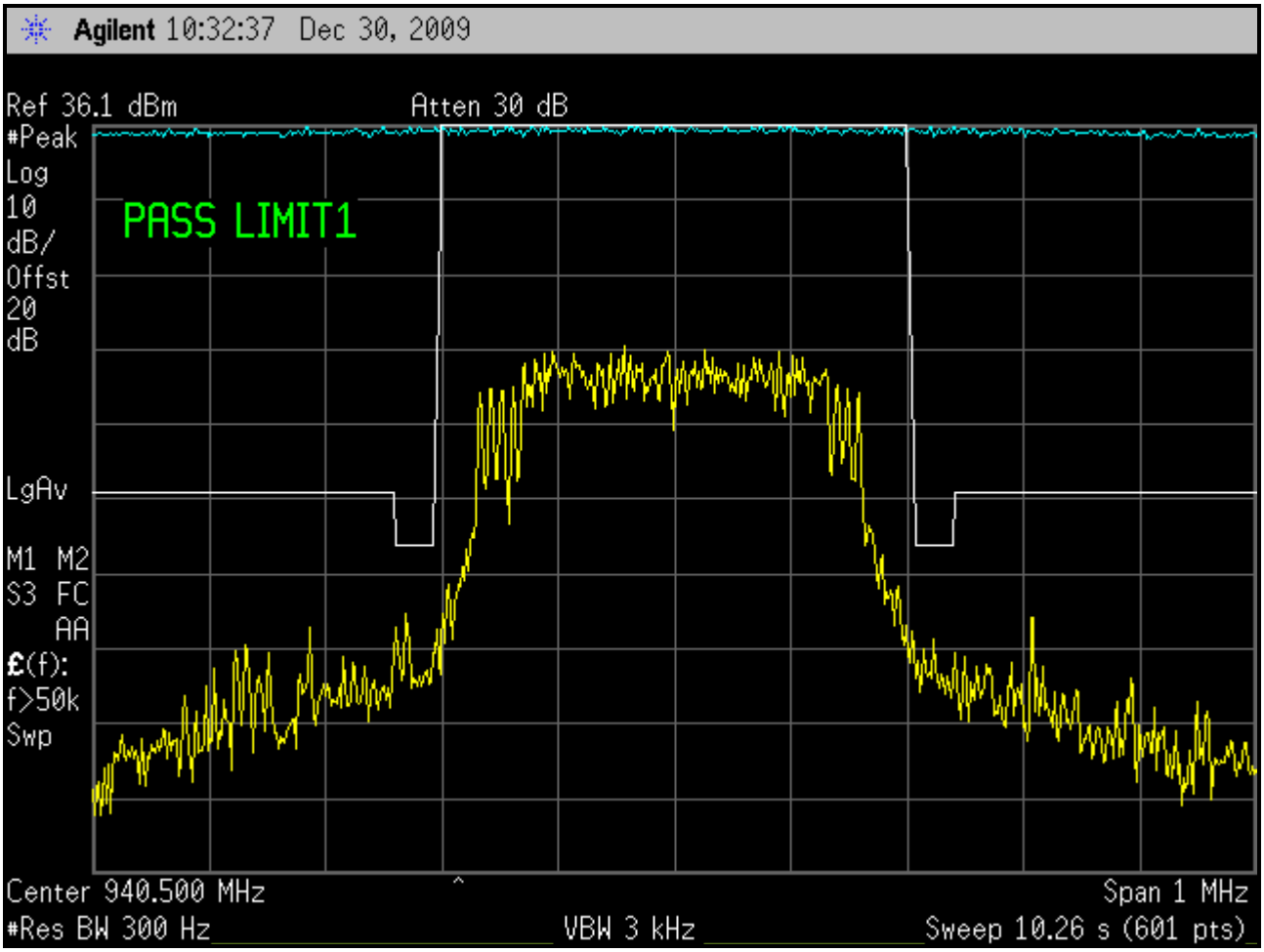
Plot 7-3: In Band Emissions – 930.2 MHz (400 kHz BW)



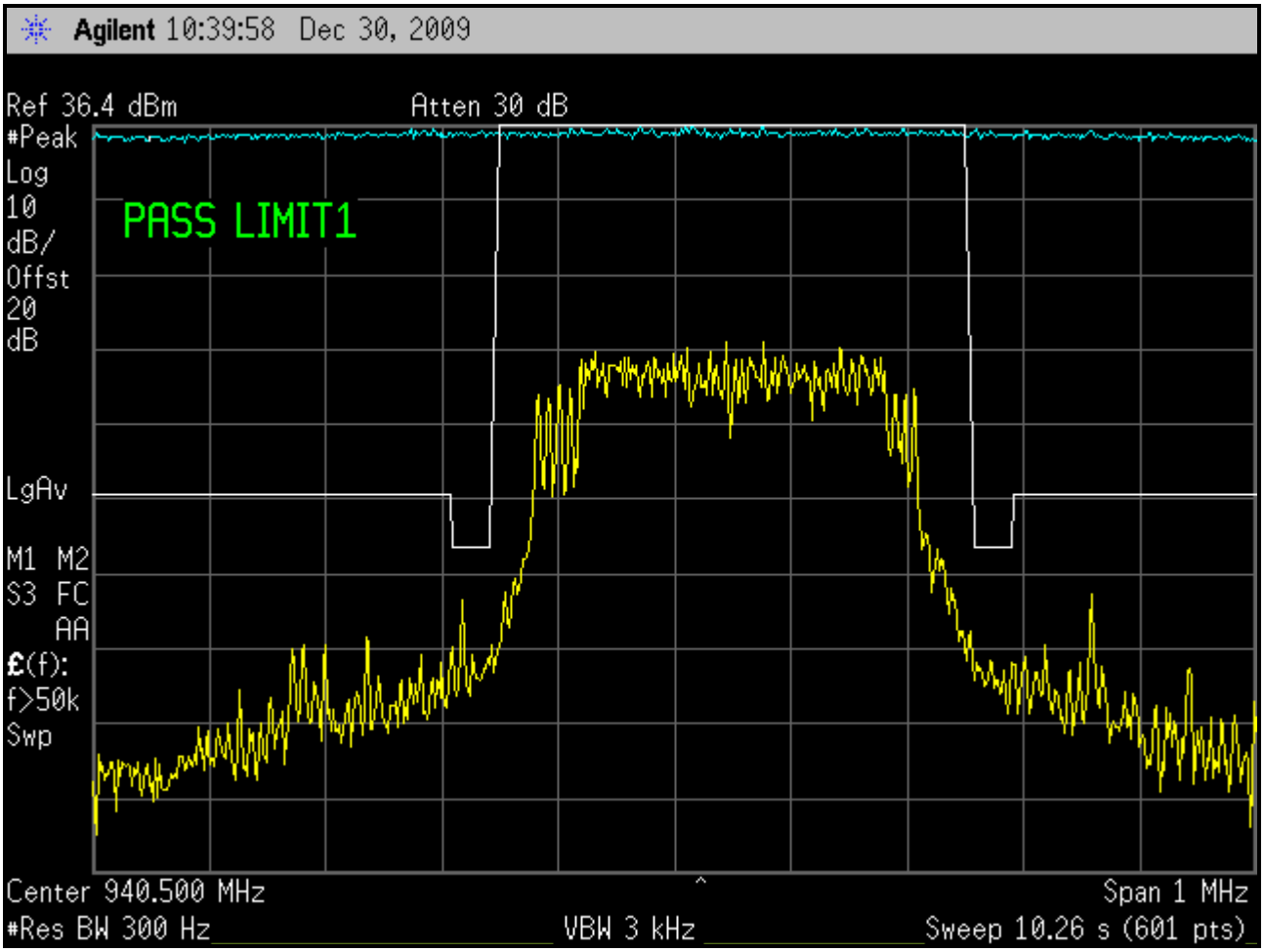
Plot 7-4: In Band Emissions – 930.8 MHz (400 kHz BW)



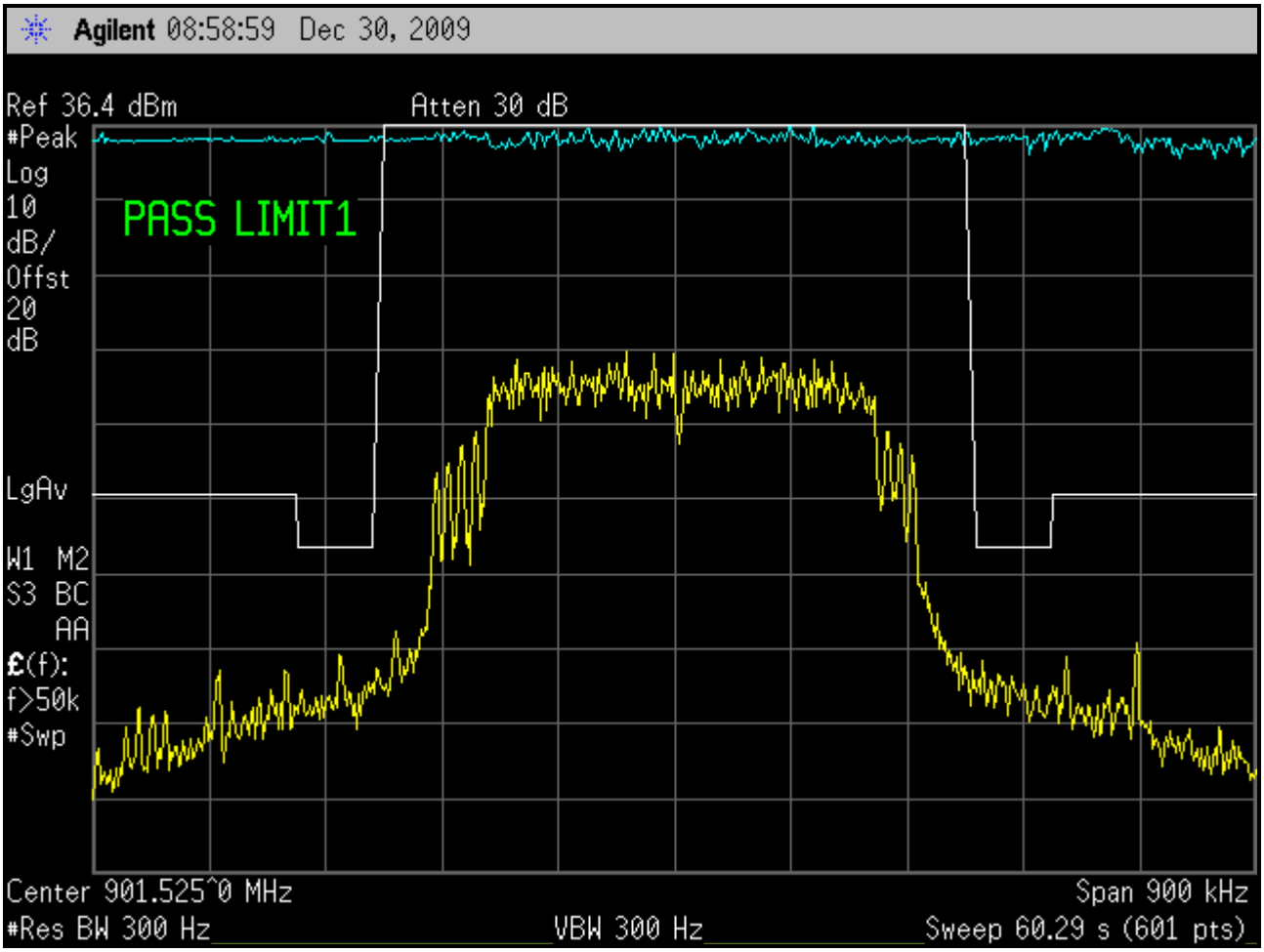
Plot 7-5: In Band Emissions – 940.5 MHz (400 kHz BW)



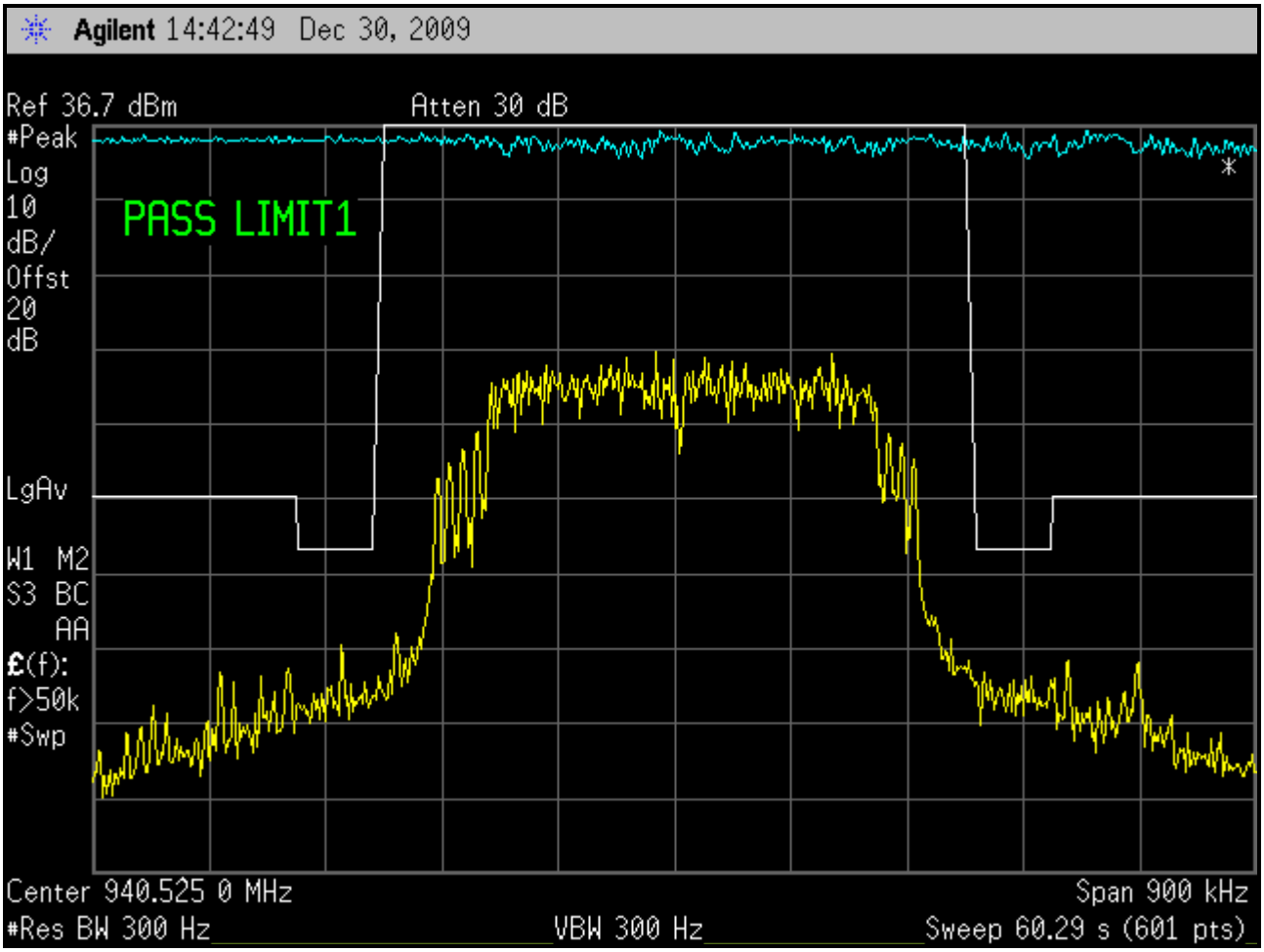
Plot 7-6: In Band Emissions – 940.55 MHz (400 kHz BW)



Plot 7-7: In Band Emissions – 901.525 MHz (450 kHz BW)



Plot 7-8: In Band Emissions – 940.525 MHz (450 kHz BW)



Plot 7-9: In Band Emissions – 940.55 MHz (500 kHz BW)

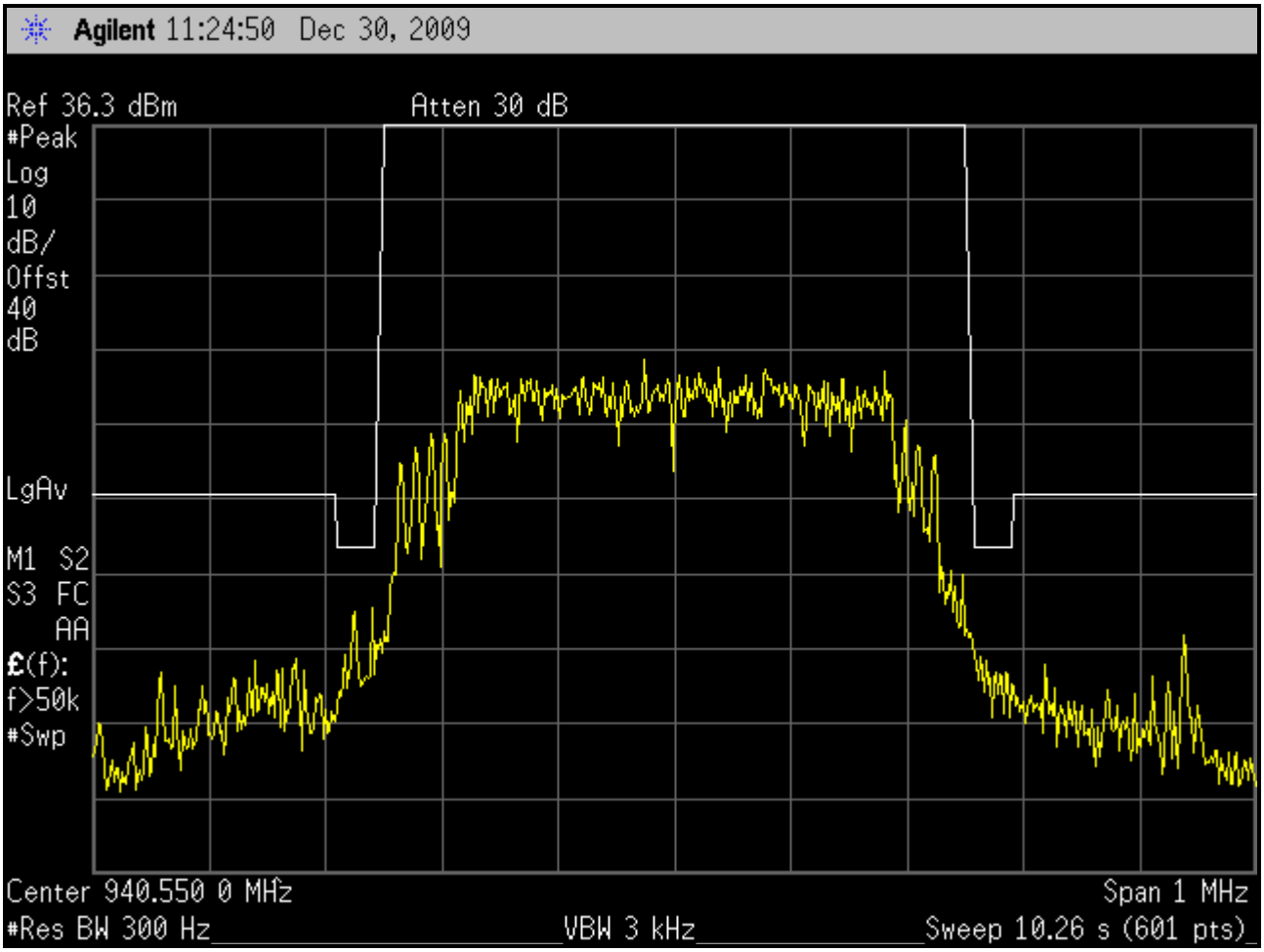


Table 7-1: In Band Emissions Test Equipment

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901413	Agilent Technologies	E4448A	Spectrum Analyzer	US44020346	11/10/10
900819	Weinschel Corp	2	10 dB Attenuator; 5 W	BF0830	12/3/10

Test Personnel:

Daniel Baltzell	Daniel W. Baltzell	December 30, 2009
Test Engineer	Signature	Date Of Test

8 FCC Rules and Regulation Part 2.1055: Frequency Stability; Part 24.135: Frequency Stability

8.1 Test Procedure

ANSI/TIA/EIA-603-2004, section 2.2.2

The carrier frequency stability is the ability of the transmitter to maintain an assigned carrier frequency.

The EUT was evaluated over the temperature range -30°C to +50°C.

The temperature was initially set to -30°C and a 1-hour period was observed for stabilization of the EUT. The frequency stability was measured within one minute after application of primary power to the transmitter. The temperature was raised at intervals of 10 degrees centigrade through the range. A ½-hour period was observed to stabilize the EUT at each measurement step and the frequency stability was measured within one minute after application of primary power to the transmitter. Additionally, the power supply voltage of the EUT was varied +/-15% nominal input voltage.

The frequency stability of the transmitter shall be maintained within +/-0.0001 percent (+/-1 ppm) of the center frequency over a temperature variation of -30° Celsius to +50° Celsius at normal supply voltage, and over a variation in the primary supply voltage of 85 percent to 115 percent of the rated supply voltage at a temperature of 20° Celsius.

8.2 Test Data

Table 8-1: Temperature Frequency Stability

Temperature (°C)	Measured Frequency (Hz)	ppm
-30	940.550050	-0.05
-20	940.550000	0.00
-10	940.549854	0.16
0	940.549884	0.12
10	940.550020	-0.02
20 (reference)	940.550000	0.00
30	940.550000	0.00
40	940.549895	0.11
50	940.550017	-0.02

Result: The EUT is compliant.

Table 8-2: Voltage Frequency Stability

Voltage (VDC)	Measured Frequency (Hz)	ppm
23.8	940.549998	0.002
28	940.550000	0.000
32.2	940.549999	0.001

Table 8-3: Frequency Stability and Voltage Frequency Stability Test Equipment

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
900946	Tenney Engineering, Inc.	TH65	Temperature Chamber with Humidity	11380	7/23/10
901300	Agilent Technologies	53131A	Frequency Counter	MY40001345	6/18/10
900819	Weinschel Corp	2	10 dB Attenuator; 5 W	BF0830	12/3/10

Test Personnel:

Daniel Baltzell		December 18, 2009
EMC Test Engineer	Signature	Date Of Test

9 Conclusion

The data in this measurement report shows that the Full Spectrum Inc., FCC ID: X27-FS-NPCS000, Models, BS100 and MS400, comply with all the applicable requirements of FCC Part 24 and Part 2.