



**FCC Part 95L Certification Test Report**  
**for**  
**CelPlan Technologies, Inc.**  
**Flexi-Radio**  
**FCC ID: TFF-FR-100**

**December 18, 2007**

Prepared for:

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**for the**  
**CelPlan Technologies, Inc.**  
**Flexi-Radio FR-100**

WLL JOB# 9149

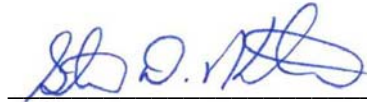
**December 18, 2007**

Prepared by:



Michael Violette  
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Reviewed by:



Steve Koster  
EMC Operations Manager

## **Abstract**

This report has been prepared on behalf of CelPlan Technologies, Inc. to support the attached Application for Equipment Authorization. The test report and application are submitted for a Licensed Non-Broadcast Station Transmitter under Part 95L of the FCC Rules and Regulations. This Federal Communication Commission (FCC) Certification Test Report documents the test configuration and test results for a CelPlan Technologies, Inc. Flexi-Radio operating in the 5.9GHz bands

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. Washington Laboratories, Ltd. has been accepted by the FCC and approved by NIST NVLAP (NVLAP Lab Code: 200066-0) as an independent FCC test laboratory.

The CelPlan Technologies, Inc. complies with the limits for a licensed transmitter under Parts 95L of the FCC Rules and Regulations for

- Intelligent Transportation Systems (ITS) Digital Short Range Communications Systems (DSRC): 5850-5925 MHz

## Table of Contents

Abstract .....	ii
1 Introduction .....	1
1.1 Compliance Statement .....	1
1.2 Test Scope .....	1
1.3 Contract Information .....	1
1.4 Test and Support Personnel .....	1
2 Equipment Under Test .....	1
2.1 EUT Identification & Description .....	1
2.2 Test Configuration .....	2
2.3 Antennas Employed In On Board Units .....	3
2.4 Testing Algorithm .....	3
2.5 Test Location .....	3
2.6 Measurements .....	3
2.6.1 References .....	3
2.7 Measurement Uncertainty .....	4
3 Test Equipment .....	4
4 Test Results .....	5
4.1 FCC Part 95L Intelligent Transportation Systems .....	5
4.1.1 RF Power Output: (FCC Part §2.1046) .....	5
4.1.2 Peak Transmit Power .....	5
4.1.3 Power Spectral Density .....	6
4.1.4 Occupied Bandwidth (FCC Part §2.1049) .....	6
4.1.5 Emissions and emission limitations to §90.210 .....	17
4.1.6 Spurious Emissions .....	28
4.1.7 Radiated Emissions (Unintentional) .....	32
4.1.8 Emission Designator .....	34
4.1.9 Frequency Stability: (FCC Part §2.1055) .....	34

## List of Tables

Table 1. Device Summary.....	2
Table 2: Test Equipment List.....	4
Table 4. Transmit Power Results: On-Board Units .....	5
<b>Table 5. Power Spectral Density Limits.....</b>	<b>6</b>
Table 6. Occupied Bandwidth Results.....	7
Table 7. Radiated Emissions: Digital Emissions .....	32
Table 8. Radiated Emissions: Transmitter Spurious.....	33
<b>Table 9. Frequency Deviation .....</b>	<b>35</b>

## List of Figures

Figure 1. Emission Bandwidth: 5860 MHz; 3 Mbps .....	7
Figure 2. Emission Bandwidth: 5860 MHz; 54 Mbps .....	8
Figure 3. Emission Bandwidth: 5875 MHz; 6 Mbps .....	9
Figure 4. Emission Bandwidth: 5875 MHz; 54 Mbps .....	10
Figure 5. Emission Bandwidth: 5890 MHz; 6 Mbps .....	11
Figure 6. Emission Bandwidth: 5890 MHz; 54 Mbps .....	12
Figure 7. Emission Bandwidth 5905MHz; 6 Mbps .....	13
Figure 8. Emission Bandwidth: 5905 MHz; 54 Mbps .....	14
<b>Figure 9. Emission Bandwidth: 5920 MHz; 6 Mbps.....</b>	<b>15</b>
<b>Figure 10. Emission Bandwidth: 5920 MHz; 54 Mbps.....</b>	<b>16</b>
Figure 11. DSRC Class C Spectrum Mask .....	18
Figure 12. 5860 MHz; 3 MBps w/10 MHz BW .....	19
Figure 13. 5860 MHz; 54 MBps w/10 MHz BW .....	20
Figure 14. 5875 MHz; 3 MBps w/10 MHz BW .....	21
Figure 15. 5875 MHz; 54 MBps w/10 MHz BW .....	22
Figure 16. 5890 MHz; 3 MBps w/10 MHz BW .....	23
Figure 17. 5890 MHz. 27 MBps w/10 MHz BW .....	24
Figure 18. 5905 MHz. 6 MBps w/20 MHz BW .....	25
Figure 19. 5905 MHz. 54 MBps w/20 MHz BW .....	26
Figure 20. 5920 MHz. 6 MBps w/10 MHz BW .....	27
Figure 21. 5920 MHz. 54 MBps w/10 MHz BW .....	28
Figure 22. Spurious Emissions, 30M – 1GHz .....	29
Figure 23. Spurious Emissions, 1-20GHz .....	30
Figure 24. Spurious Emissions, 20-40GHz .....	31



## **1 Introduction**

### **1.1 Compliance Statement**

The CelPlan Technologies, Inc. Flexi-Radio complies with the limits of Part 95L of the FCC Rules and Regulations.

### **1.2 Test Scope**

Tests for radiated and conducted emissions were performed. All measurements were performed according to the 2001 version of ANSI C63.4 and EIA/TIA 603. The measurement equipment conforms to ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation.

### **1.3 Contract Information**

Customer: CelPlan Technologies

Quotation Number: 61944

Test Dates: Testing was performed over the period of March 2006 to January 2007

### **1.4 Test and Support Personnel**

Washington Laboratories: Mike Violette, Steve Dovell, James Ritter, Greg Snyder

CelPlan Technologies: Leonhard Korowajczuk, Nikhil Mathur

## **2 Equipment Under Test**

### **2.1 EUT Identification & Description**

The Flexi-radio is a multi-band, multi-use radio using OFDM technology. It is wide-band tunable and is compliant with 802.11a/b/g communication standards.

The radio operates over the frequency range of 5850 MHz to 5925 MHz. The design of the radio is such that the supplier provides a set of firmware settings that limit and manage the frequency and the output powers at the channels of operation. *The user has no control over these settings.*

Each radio has two antenna ports for diversity. The equipment is professionally-installed with different antenna options. In its final configuration, the radio will either be mobile, fixed to a building, outside in a pole-mounted configuration, and/or on an emergency vehicle, as allowed for in the operation of the FCC Rules and under Licensing provisions (as applicable).

Certification is sought under FCC Part 95L for a modular approval. The hardware will be configured per customer requirements.

In a configuration supplied and configured for a typical user, other radio transmitters (of the same design) will be located in the same chassis, operating either under the unlicensed UNII bands or under the licensed operation of Part 95L for Public Safety and/or Intelligent Transportation Systems.

**Table 1. Device Summary**

ITEM	DESCRIPTION
Manufacturer:	CelPlan Technologies, Inc.
FCC ID:	TFF-FR-100
EUT Name:	Flexi-Radio
Model:	FR-100
<b>FCC Rule Parts:</b>	§95L
<b>Frequency Ranges:</b>	5850-5925 MHz
<b>Maximum Output Power (dBm):</b> 5850-5925 MHz	Part 90M: -2.0 (Conducted-On Board Units) 0.0006W
<b>Modulation:</b>	OFDM
<b>Occupied Bandwidth:</b> 5850-5925 MHz	12.54 MHz
<b>Emissions Designators:</b> §95L 5850-5925 MHz	16MD1D
Keying:	Continuous
Type of Information:	Data
Number of Channels:	Variable, depends on the channel bandwidths Channelization per Part 95
Power Output Level	Fixed
Antenna Connector	Two U u.FL(v) LP-040 connectors for diversity
Antenna Type	Patch, panel and monopole
<b>Antenna Gain (Fixed Installations):</b>	Max:
<b>Antenna Gain (On-board Units):</b> 5850-5925 MHz	0 dBi
Interface Cables:	Ethernet and serial
Power Source & Voltage:	120VAC from host

## 2.2 Test Configuration

The EUT was configured in a host board that was connected via LAN interface to a personal computer. The computer issued commands to change the frequencies and levels during the testing.



## 2.3 Antennas Employed In On Board Units

Type	Characteristics	5.9 GHz
Monopole	Gain (dBi)	0

### Rubber Antennas 2.4 GHz or 5.8 GHz

- Gain: 0 dBi
- Impedance: 50 Ohms
- VSWR:  $\leq 2.0$
- Antenna type: Monopole
- Power radiation: 3 W max.
- Frequency: 2.4 GHz or 5.8 GHz (800 MHz, 900 MHz, 800/1900 MHz or 900/1800 MHz also available)
- Low cost
- WLAN versions:
  - ELRUB08A-2 2.4 GHz Straight SMA Male**
  - ELRUB08A-5 5.8 GHz Straight SMA Male**
  - ELRUB09A-2 2.4 GHz 90° SMA Male**
  - ELRUB09A-5 5.8 GHz 90° SMA male**



ELRUB08A

## 2.4 Testing Algorithm

The FR-100 was set up and operating under external PC control with no chassis. The PC commanded the Flexi-Radio to tune to the particular frequencies and adjust the power output.

Worst case emission levels are provided in the test results data. The settings that are used during compliance testing are stored in a “look-up” table in the radio firmware to assure that the power and frequency selection are maintained for compliance.

## 2.5 Test Location

Radiated measurements 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 NIST NVLAP (NVLAP Lab Code: 200066-0) as an independent FCC test laboratory.

Conducted quantities were measured by Celplan engineers and are reported here.

## 2.6 Measurements

### 2.6.1 References

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

ANSI C63.4 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

## 2.7 Measurement Uncertainty

All results reported herein relate only to the equipment tested. For the purposes of the measurements performed by Washington Laboratories, the measurement uncertainty is  $\pm 2.3$  dB. This has been calculated for a *worst-case situation* (radiated emissions measurements performed on an open area test site).

The following measurement uncertainty calculation is provided:

$$\text{Total Uncertainty} = (A^2 + B^2 + C^2)^{1/2}/(n-1)$$

where:

A = Antenna calibration uncertainty, in dB = 2 dB

B = Spectrum Analyzer uncertainty, in dB = 1 dB

C = Site uncertainty, in dB = 4 dB

n = number of factors in uncertainty calculation = 3

Thus, Total Uncertainty =  $0.5 (2^2 + 1^2 + 4^2)^{1/2} = \pm 2.3$  dB.

## 3 Test Equipment

Table 2 shows a list of the test equipment used for measurements along with the calibration information.

**Table 2: Test Equipment List**

Site 1 List:

Equipment	WLL Asset #	Calibration Due
Sunol JB1 Biconilog Antenna	0382	1/25/2007
ARA DRG118/A Microwave Horn Antenna	0425	1/17/2008
Hewlett-Packard 8568B Spectrum Analyzer	0072	7/3/2007
Hewlett-Packard 91480A Quasi-Peak Adapter	0068	7/3/2007
Hewlett-Packard 85685A RF Preselector	0070	7/3/2007
Hewlett-Packard 8593A Spectrum Analyzer	0074	10/13/2007
Hewlett-Packard 8449B Microwave Preamp	0066	6/22/2007
Solar Electronics 8028-50-TS-24-BNC LISN	0125	1/31/2007
Solar Electronics 8028-50-TS-24-BNC LISN	0126	1/31/2007
Agilent E4440A Spectrum Analyzer	0528	6/20/2007

## 4 Test Results

### 4.1 FCC Part 95L Intelligent Transportation Systems

Test results are for compliance to the requirements for Dedicated Short-Range Communications Service (DSRCS). Measurements were made at the following frequency and test conditions. Data are reported for each of the listed channel bandwidths, representing worst-case data for all conditions.

Under the conditions of operation, controlled by the factory settings, the following channel bandwidths and power levels and can be supported.

Modulations: BPSK, QPSK, 8QAM, 16QAM, 64QAM

The transmitter was operating continuously.

#### 4.1.1 RF Power Output: (FCC Part §2.1046)

#### 4.1.2 Peak Transmit Power

The peak transmit power is measured as a conducted emission over any interval of continuous transmission calibrated in terms of an RMS-equivalent voltage. Data for the measured power is shown here. There is only one antenna intended for this application. The antenna gain is entered into the table and the maximum EIRP levels computed against the limit.

**Table 3. Transmit Power Results: On-Board Units**

**Antenna Gain = 0dBi**

No	CF	BW MHz	Max		Max Measured Power		Ant Gain	EIRP	LIM	P/F	Margin
	MHz	MHz	dB m	Rate	Rate 3/6 Mbps	Rate 27/5 4 Mbps	dB	dBm	dBm		dBm
170	5855	5	20	3/27			12		Res		
172	5865	10	20	3/27	-2.48	-2.0	0	-2	0	P	-2
174	5875	10	20	3/27			0		0		
175	5885	20	20	6/54	-3.81	-2.99	0	-2.99	0	P	-2.99
176	5885	10	20	3/27			0		0		
178	5895	10	20	3/27	-3.98	-2.29	0	-2.29	0	P	-2.29
180	5905	10	20	3/27			0		0		
181	5915	20	20	6/54	-3.23	-2.39	0	-2.39	0	P	-2.39
182	5915	10	20	3/27			0		0		
184	5925	10	20	3/27	-4.55	-4.44	0	-4.44	0	P	-4.44

#### 4.1.3 Power Spectral Density

Power spectral density measurements are shown in the following table

**Table 4. Power Spectral Density Limits**

<b>Frequency (MHz)</b>	<b>Peak Power Spectral density dB/MHz</b>	<b>Limit dBm</b>
5860	-3.6	N/A
5875	-8.9	N/A
5890	-3.1	N/A
5905	-7.7	N/A
5920	-2.2	N/A

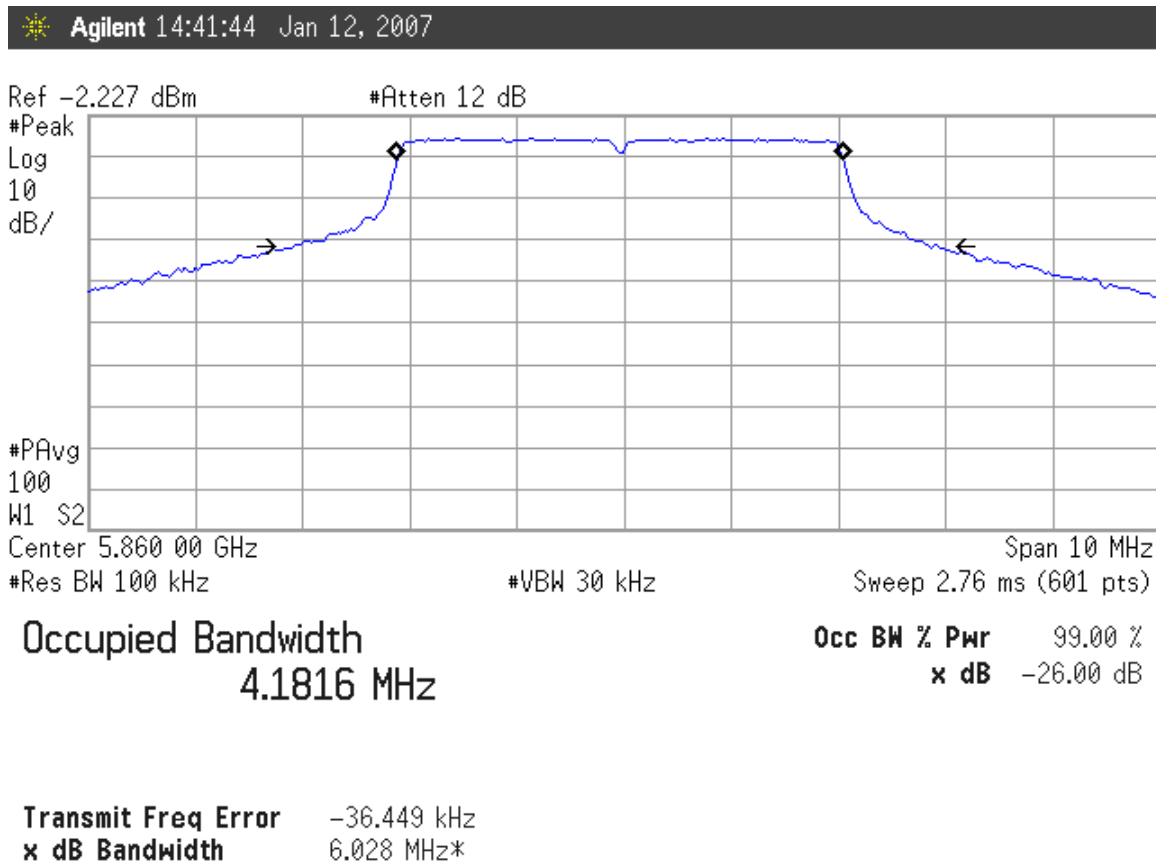
#### 4.1.4 Occupied Bandwidth (FCC Part §2.1049)

Occupied bandwidth was performed by coupling the output of the radio to the input of a spectrum analyzer via an attenuator. Table 5 provides a summary of the Occupied Bandwidth Results. Maximum authorized bandwidth is 20 MHz.

**Table 5. Occupied Bandwidth Results**

Frequency (MHz)	Emission Bandwidth MHz
5860	6.03
5875	11.7
5890	6.1
5905	11.7
5920	6.1

At full modulation, the occupied bandwidth was measured as shown in the following figures, which show a representative measurement for each of the masks. Note that the 26dB bandwidth is reported in the above table.



**Figure 1. Emission Bandwidth: 5860 MHz; 3 Mbps**

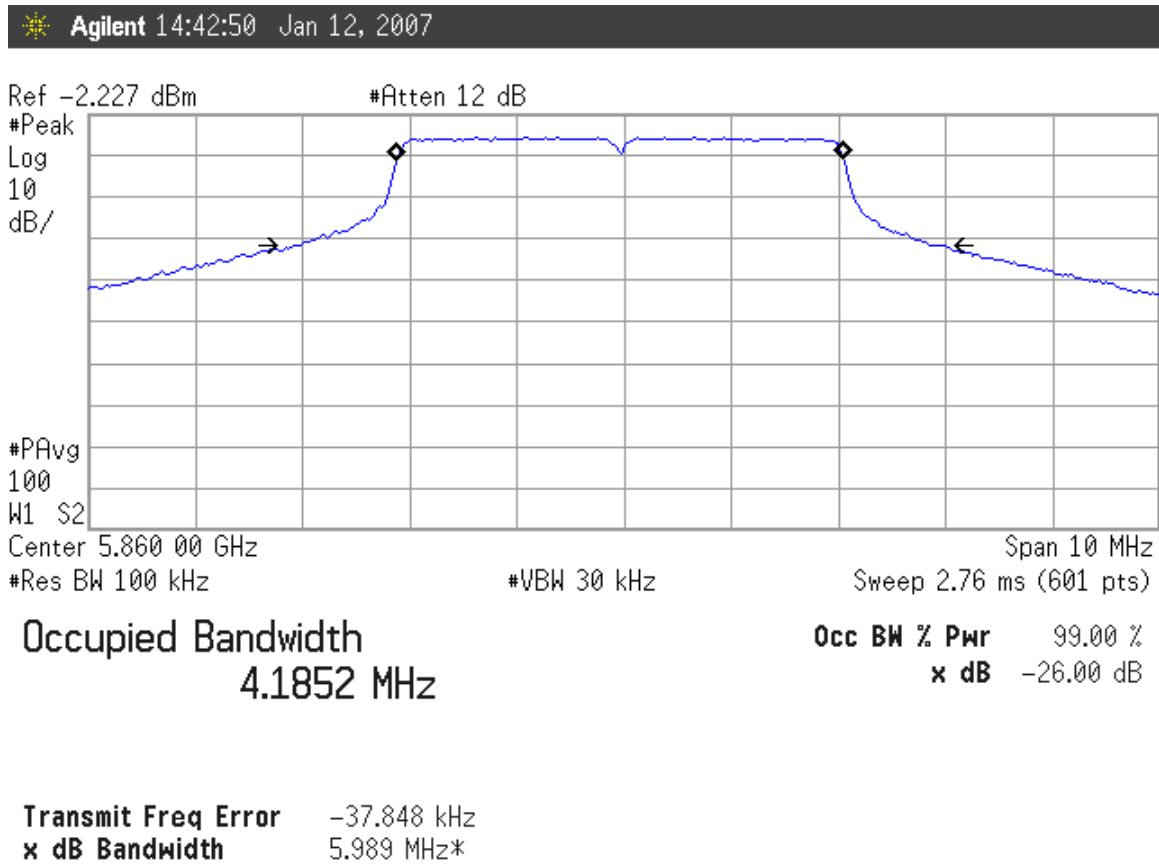


Figure 2. Emission Bandwidth: 5860 MHz; 54 Mbps

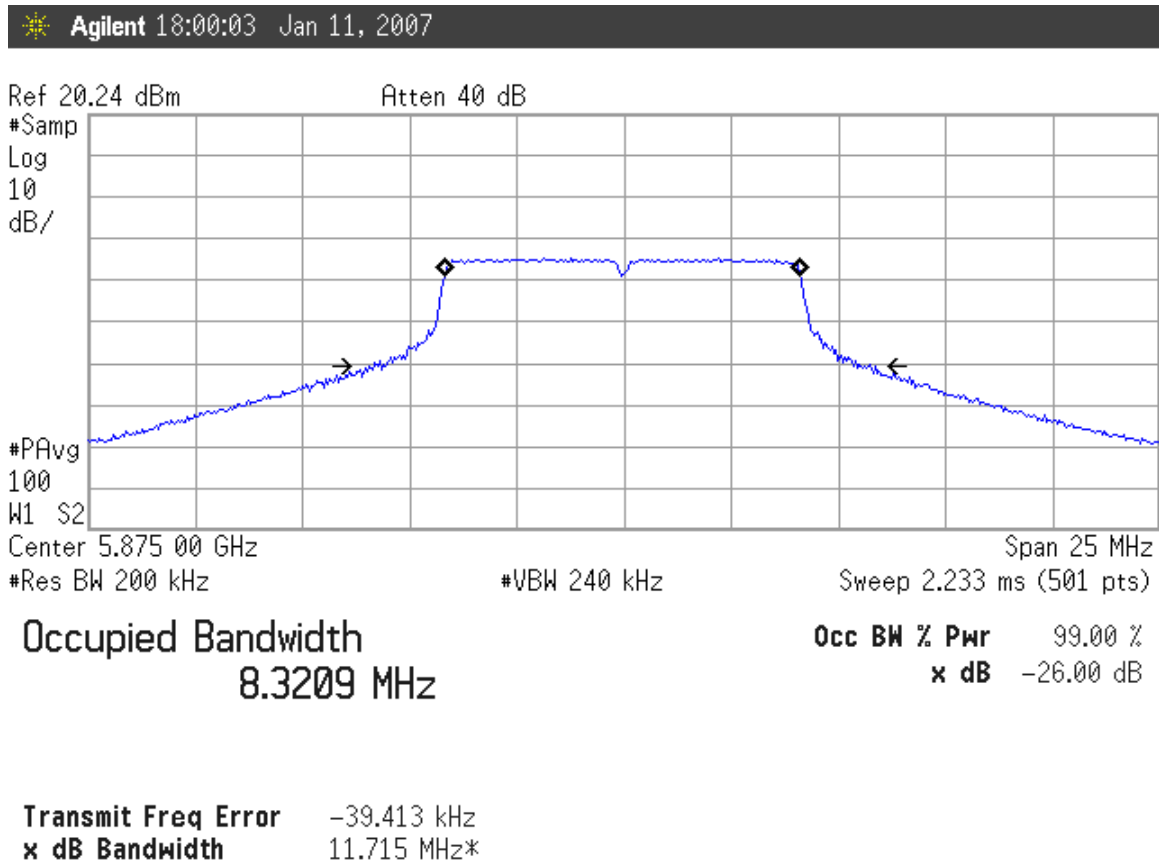


Figure 3. Emission Bandwidth: 5875 MHz; 6 Mbps

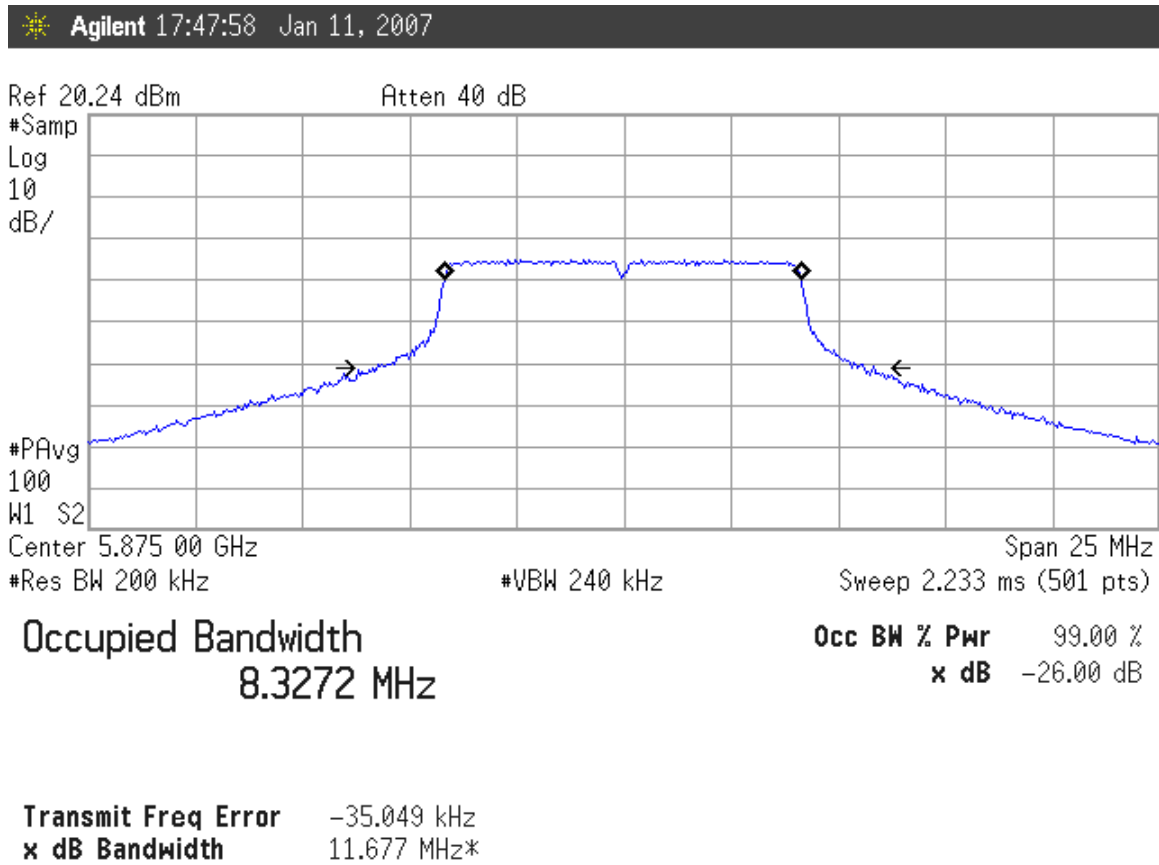


Figure 4. Emission Bandwidth: 5875 MHz; 54 Mbps



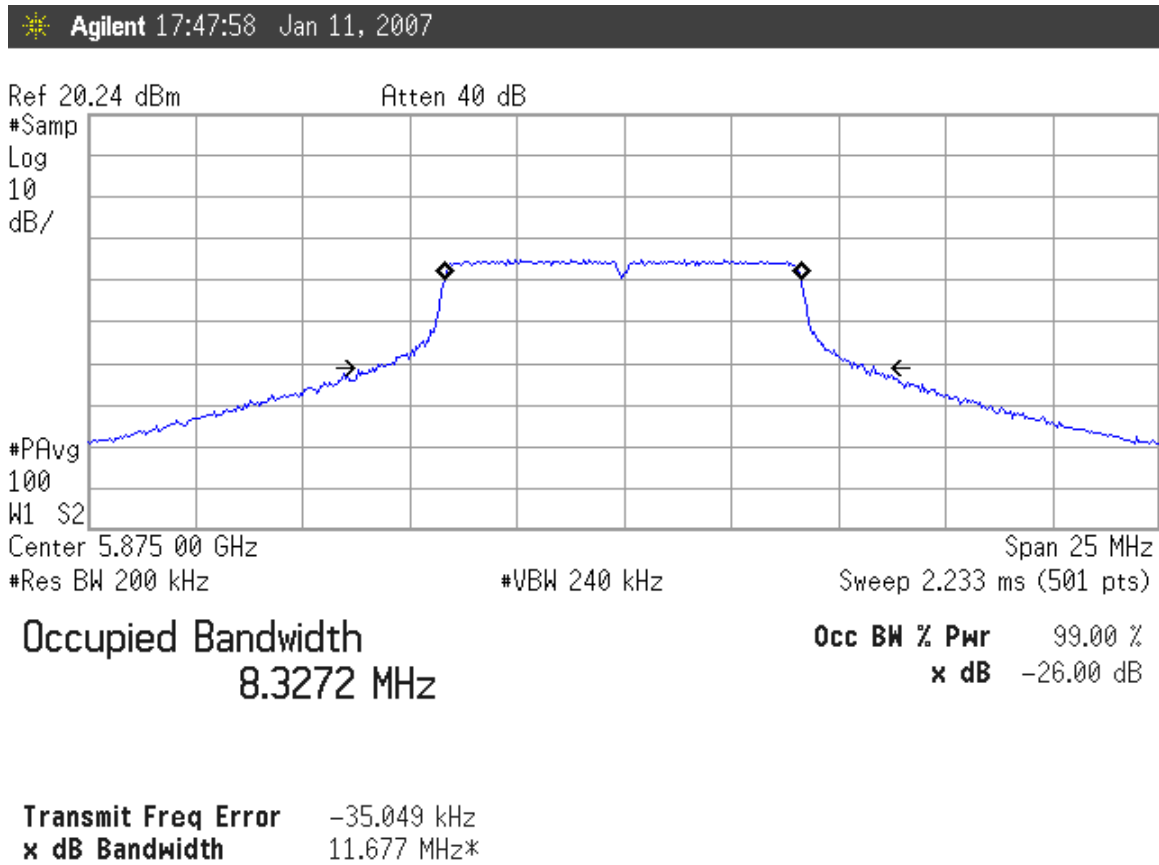


Figure 5. Emission Bandwidth: 5890 MHz; 6 Mbps

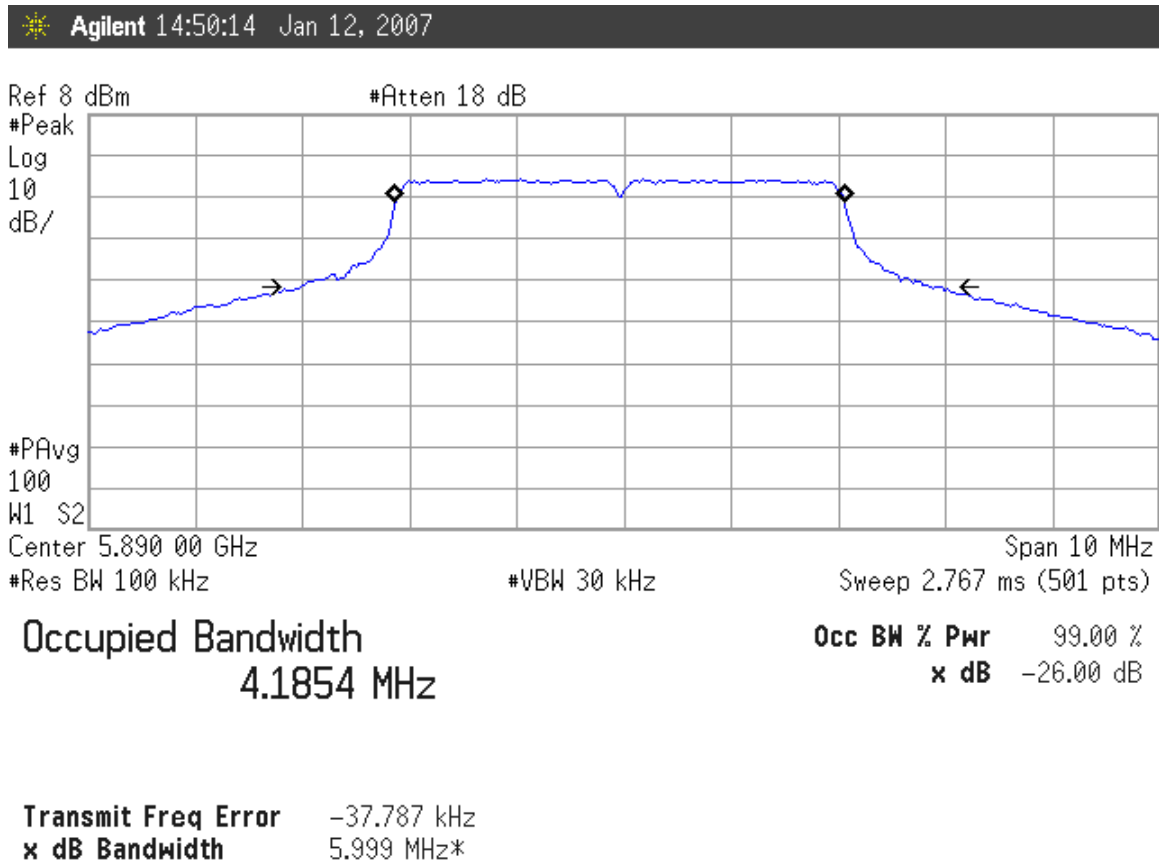


Figure 6. Emission Bandwidth: 5890 MHz; 54 Mbps

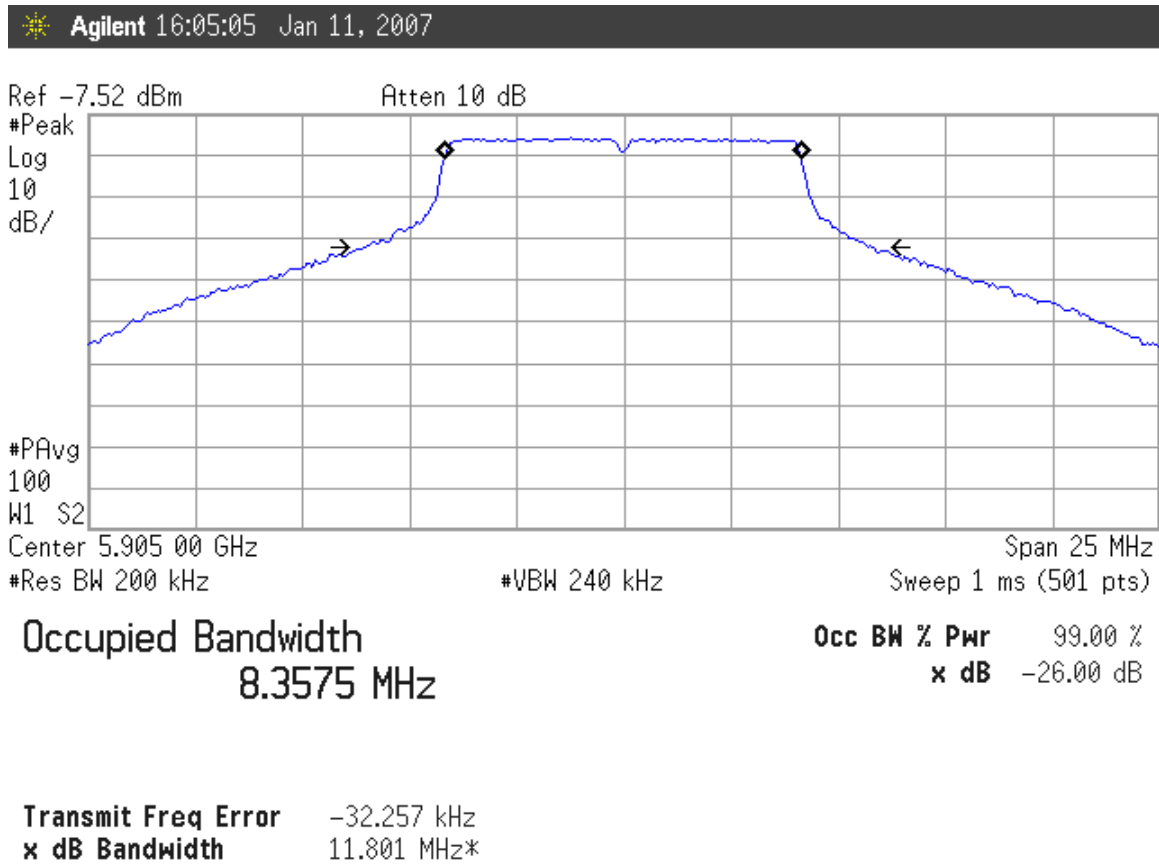


Figure 7. Emission Bandwidth 5905MHz; 6 Mbps

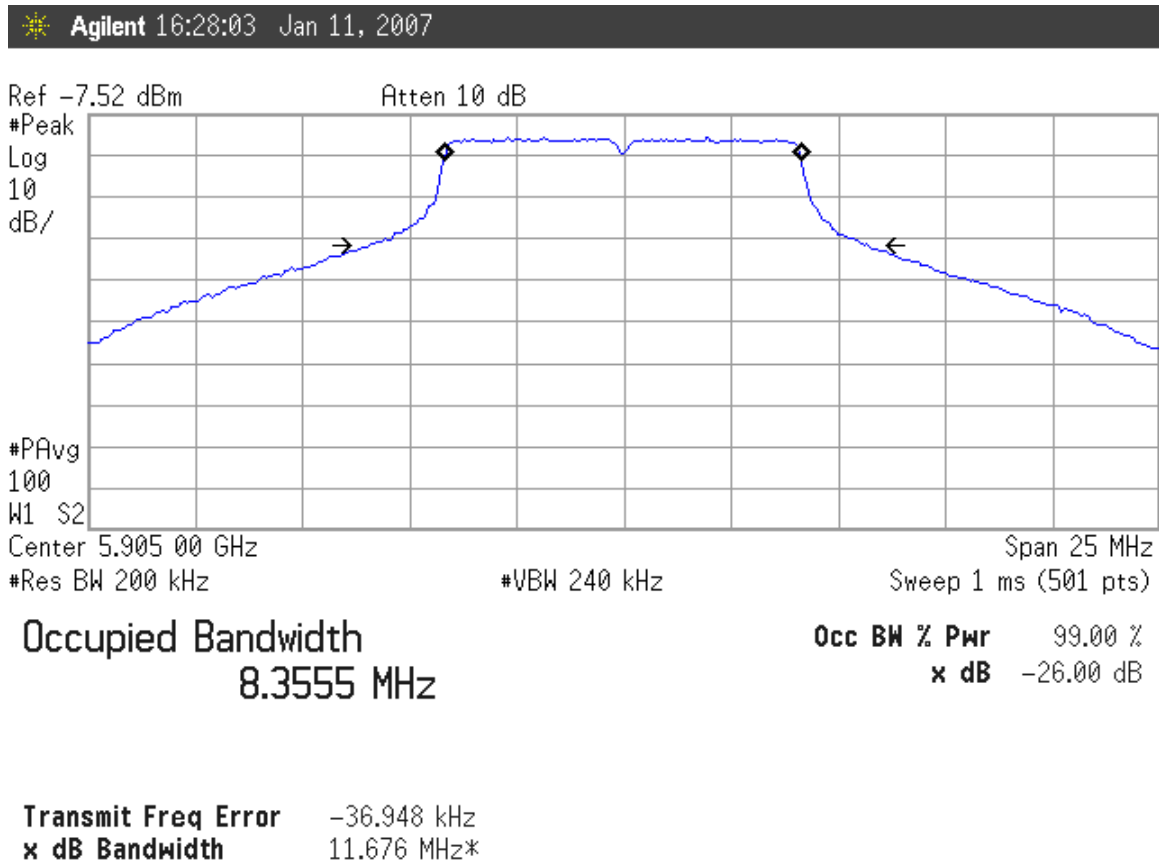


Figure 8. Emission Bandwidth: 5905 MHz; 54 Mbps

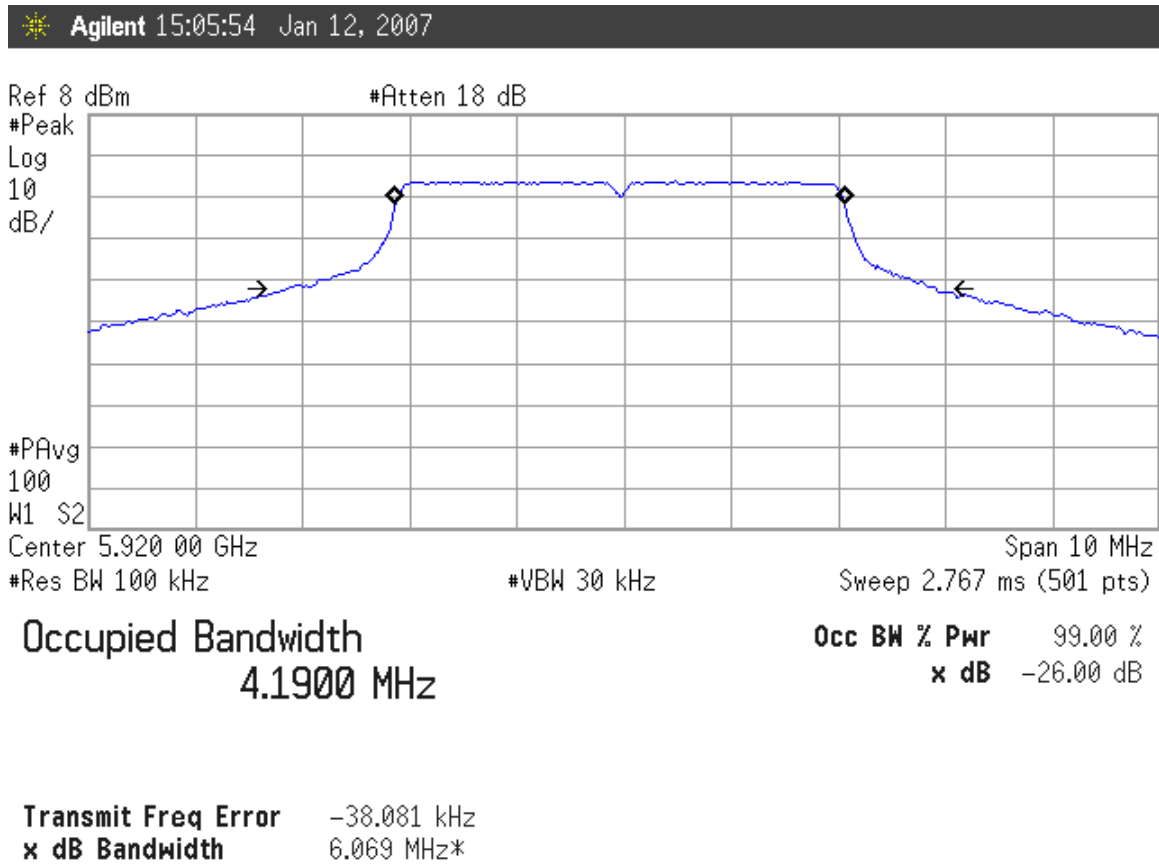


Figure 9. Emission Bandwidth: 5920 MHz; 6 Mbps

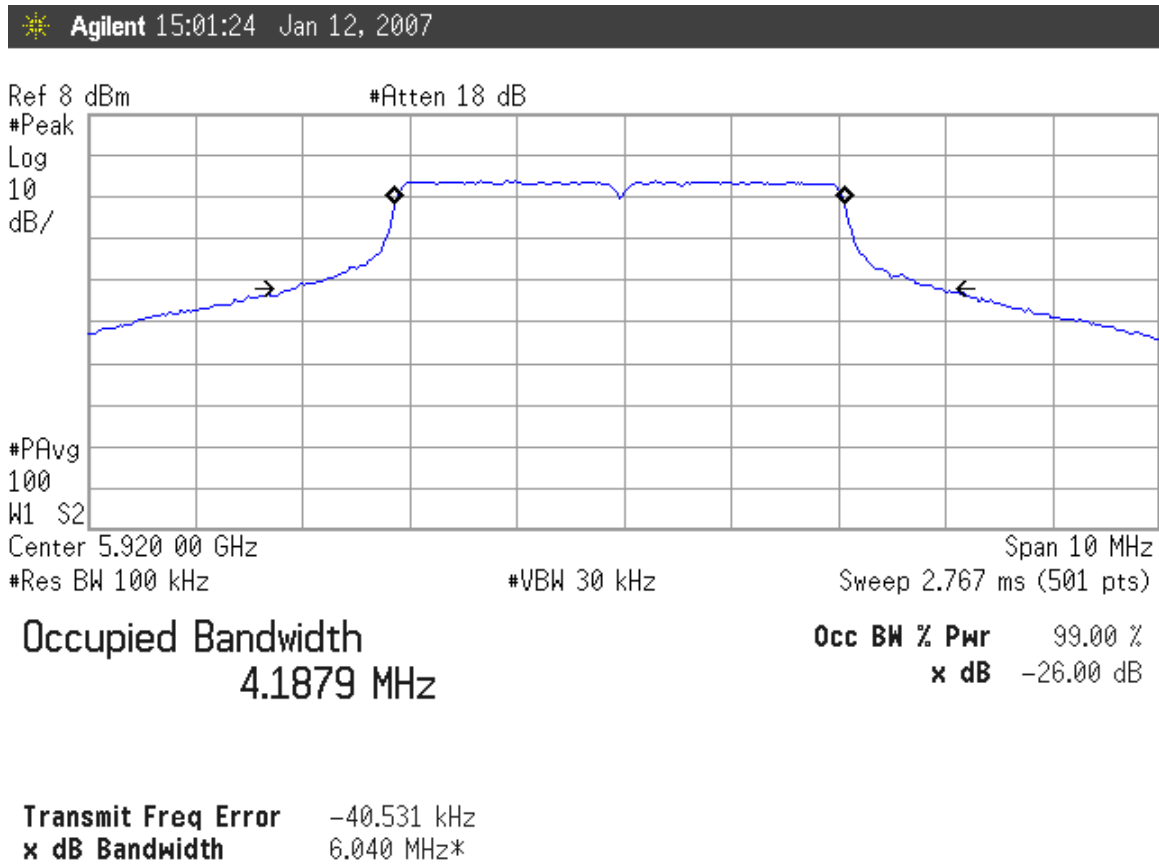


Figure 10. Emission Bandwidth: 5920 MHz; 54 Mbps

#### 4.1.5 Emissions and emission limitations to §90.210

Emissions limitations are specified in §90M and refer to The American Society for Testing and Materials (ASTM) E2213-03, “Standard Specification for Telecommunications and Information Exchange Between Roadside and Vehicle Systems—5 GHz Band Dedicated Short Range Communications (DSRC) Medium Access Control (MAC) and Physical Layer (PHY) Specifications.”

There are several Road Side Units (RSU) classes which are described in §90.375 **RSU license areas, communication zones and registrations** with the appropriate limits listed in §90.375(c) (reproduced below).

RSU class	Max. output power (dBm) \1\	Communications zone (meters)
A.....	0	15
B.....	10	100
C.....	20	400
D.....	28.8	1000

\1\ The ASTM-DSRC Standard is incorporated by reference in accordance with 5 U.S.C. 552(a) and 1 CFR part 51 and approved by The Director of the Federal Register.

Table 9 of ASTM E2213-03 refers to the DSRC Device Classes A through D (reproduced below).

**TABLE 9 DSRC Device Classes and Transmit Power Levels<sup>A</sup>**

Device Class	Maximum Device Output Power, dBm
A	0
B	10
C	20
D	28.8 or more

<sup>A</sup> From IEEE 802.11a. Copyright 1999 IEEE. All rights reserved.

The CelPlan FR-100 radio complies with Device Class C with the attendant emissions mask reproduced from E2213-03 shown below:

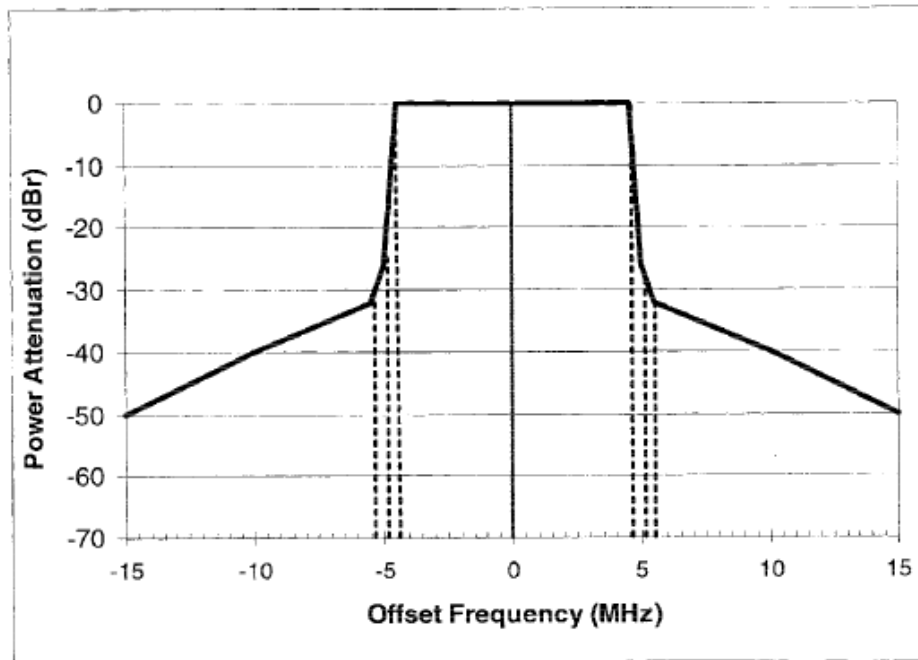


FIG. 14 Class C Transmit Spectrum Mask

### Figure 11. DSRC Class C Spectrum Mask

The results of the emissions masks measurements are provided below.



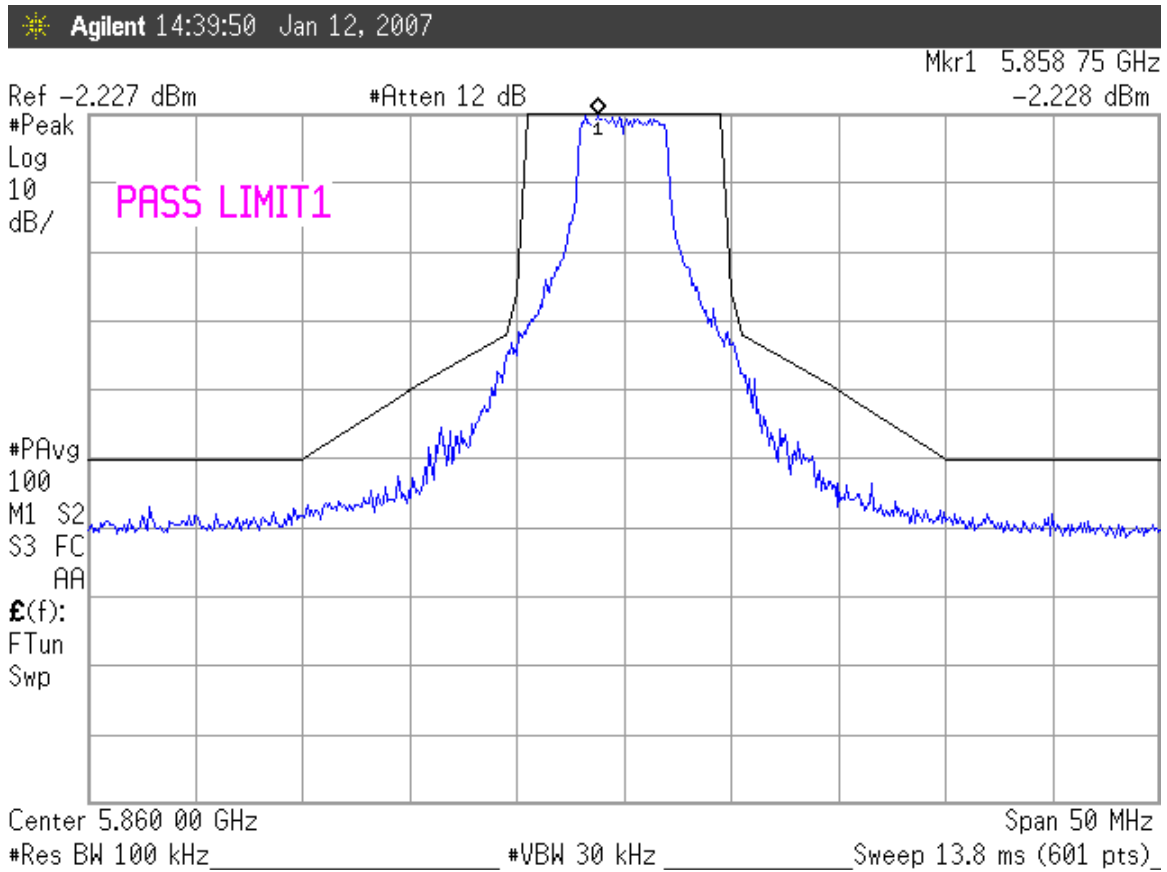


Figure 12. 5860 MHz; 3 MBps w/10 MHz BW

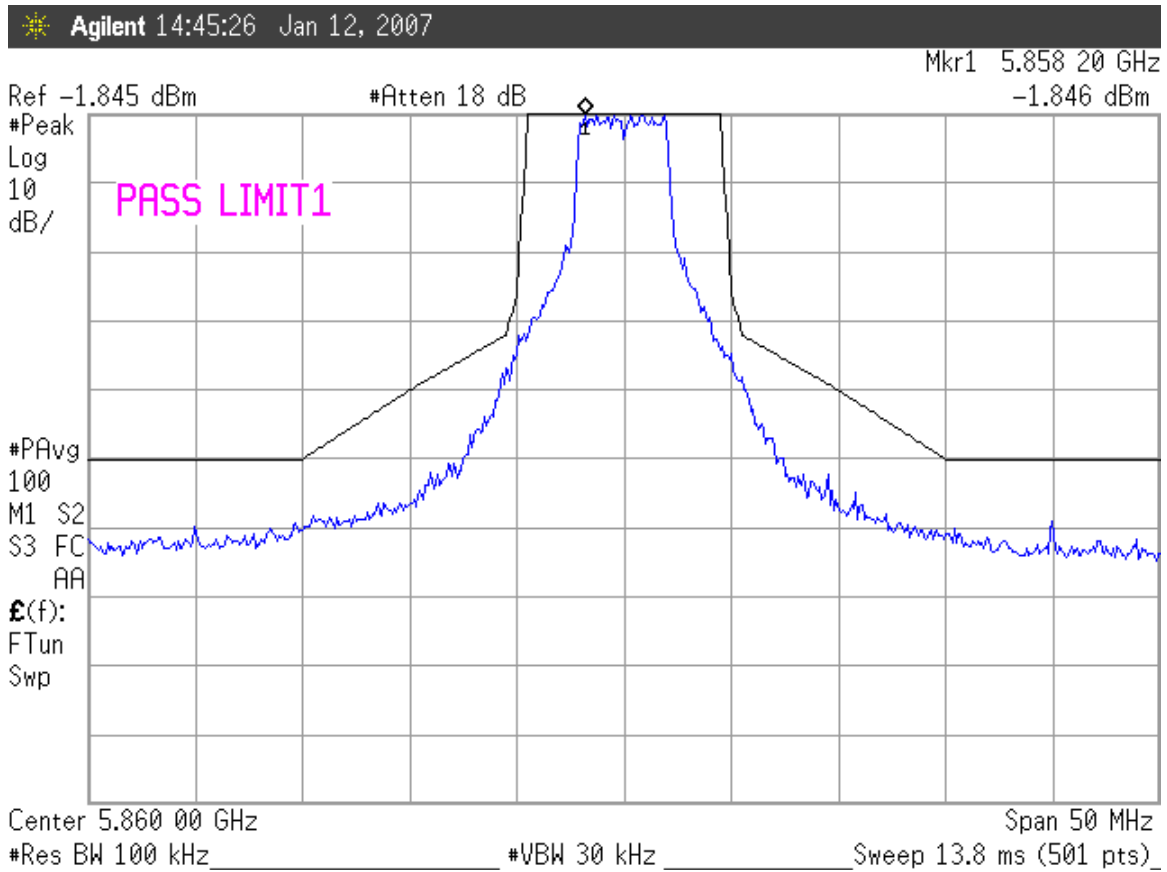


Figure 13. 5860 MHz; 54 MBps w/10 MHz BW

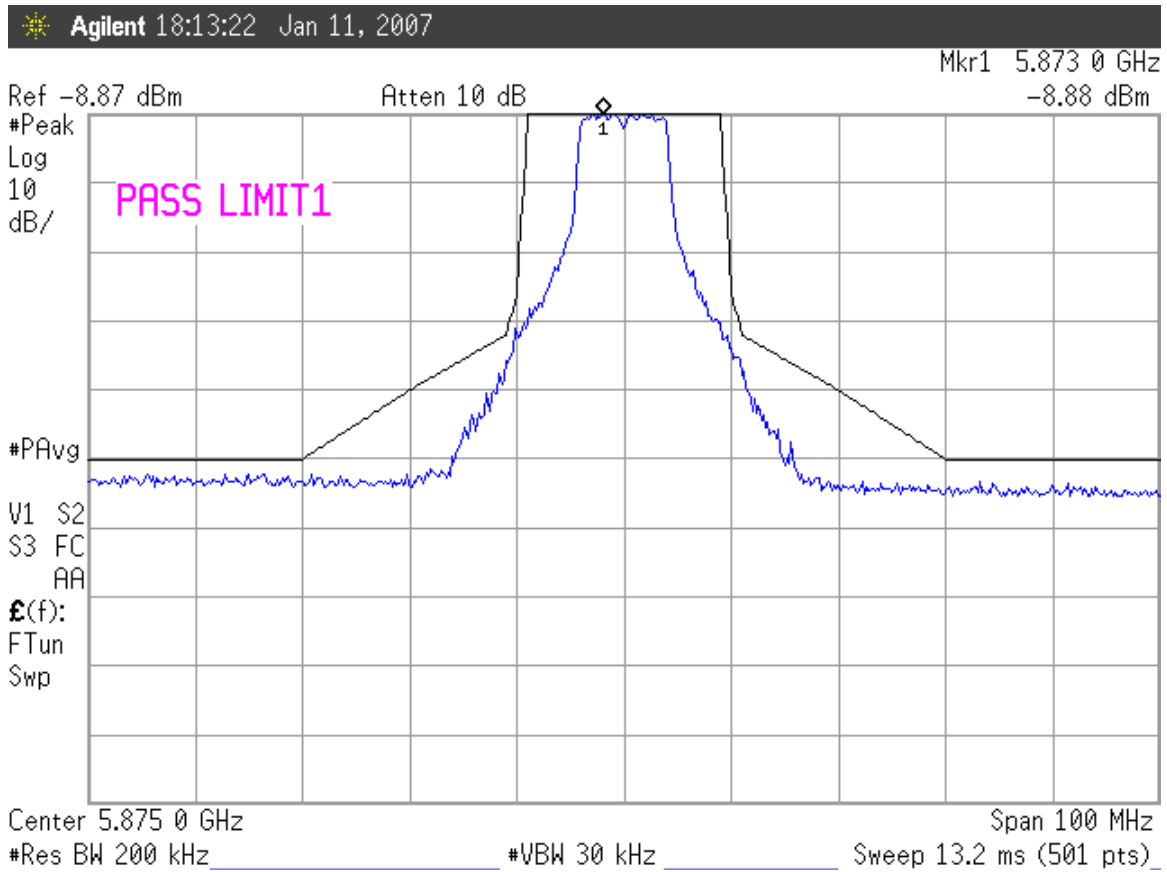


Figure 14. 5875 MHz; 3 MBps w/10 MHz BW

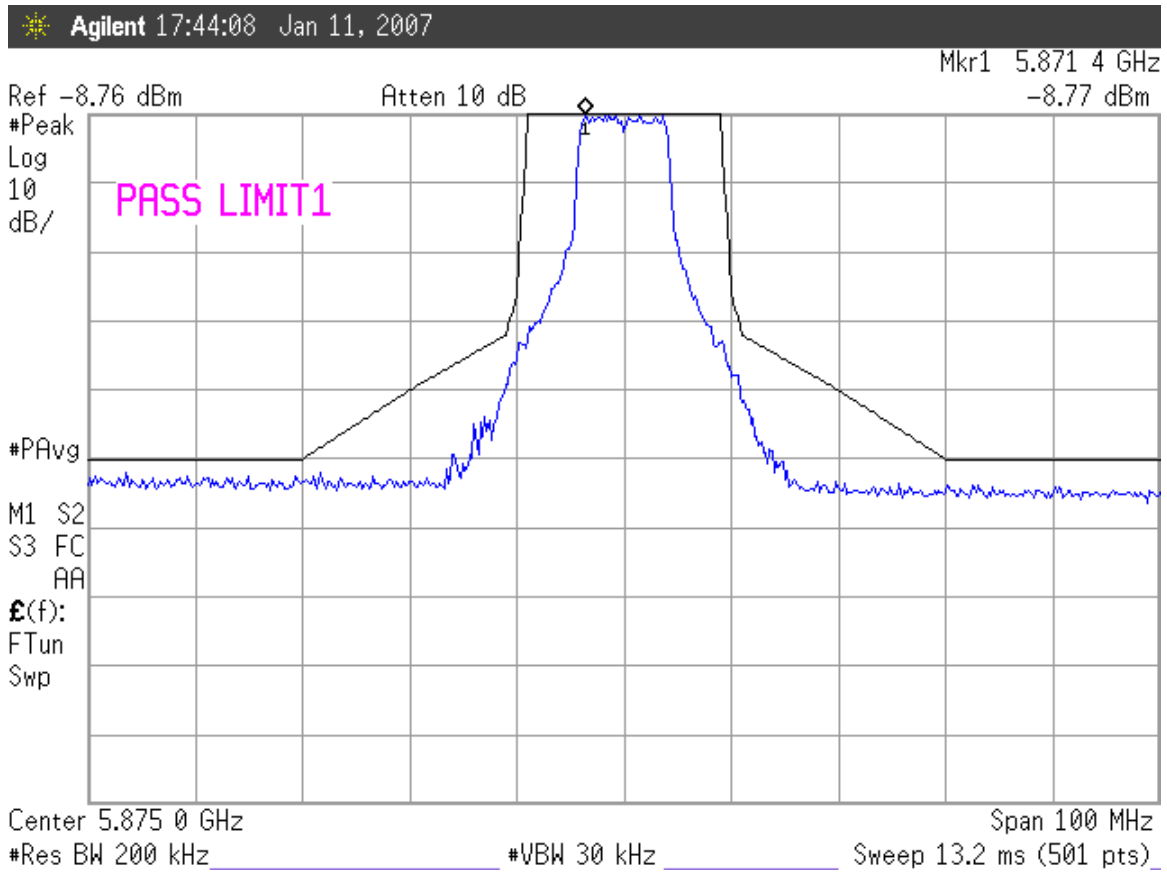


Figure 15. 5875 MHz; 54 MBps w/10 MHz BW

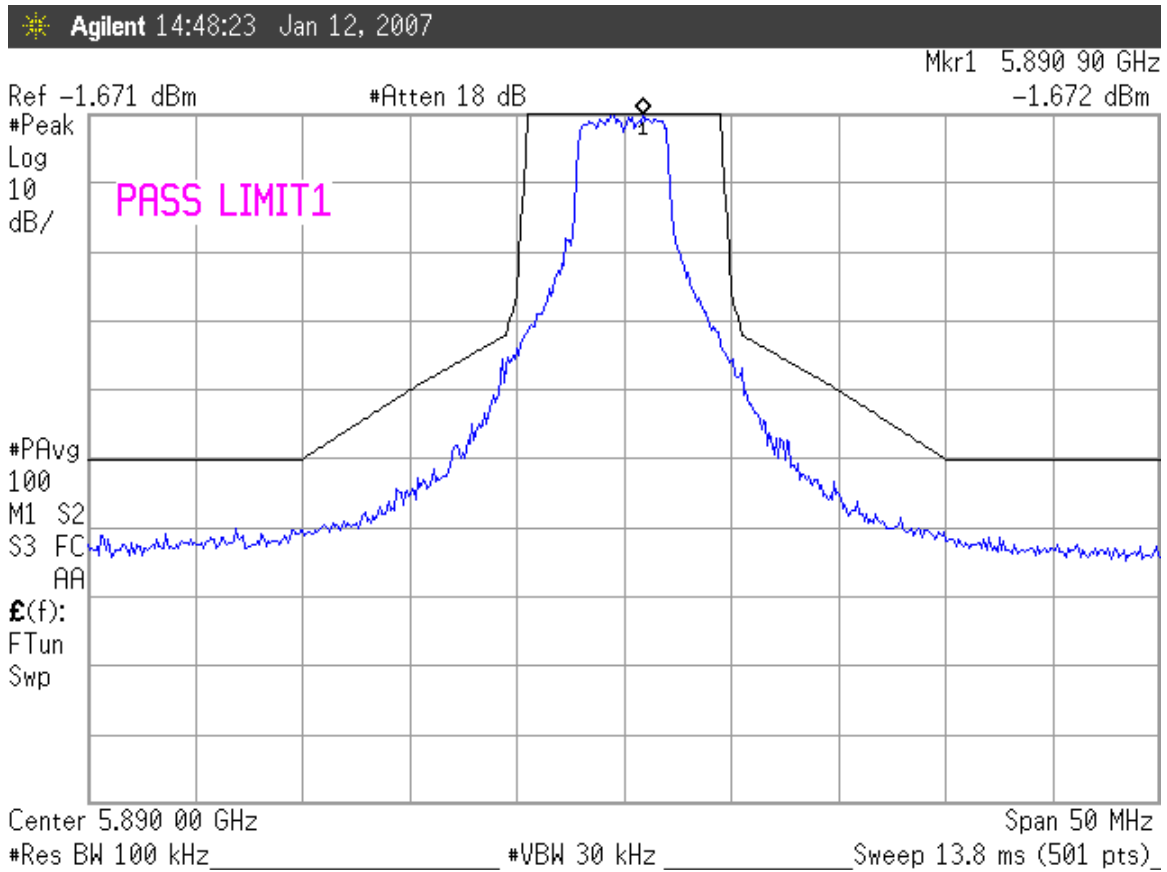


Figure 16. 5890 MHz; 3 MBps w/10 MHz BW

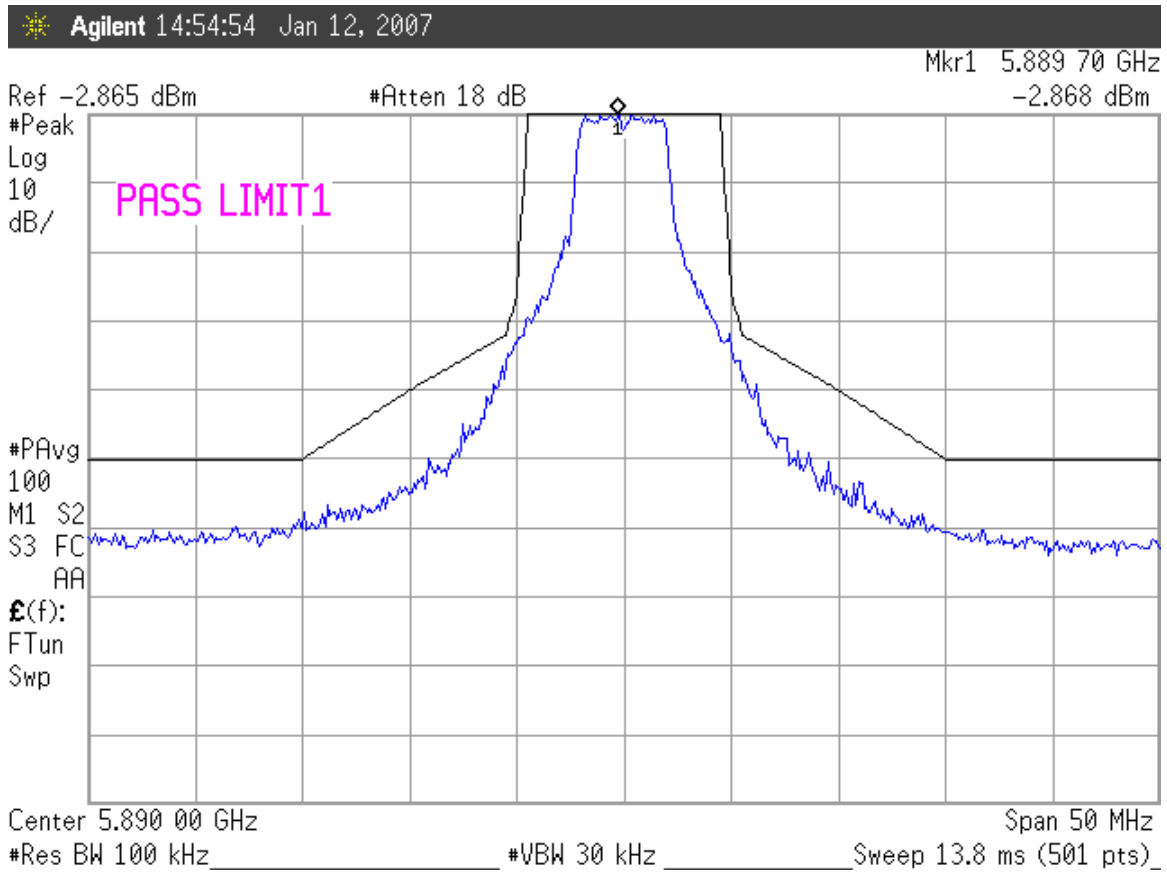


Figure 17. 5890 MHz. 27 MBps w/10 MHz BW

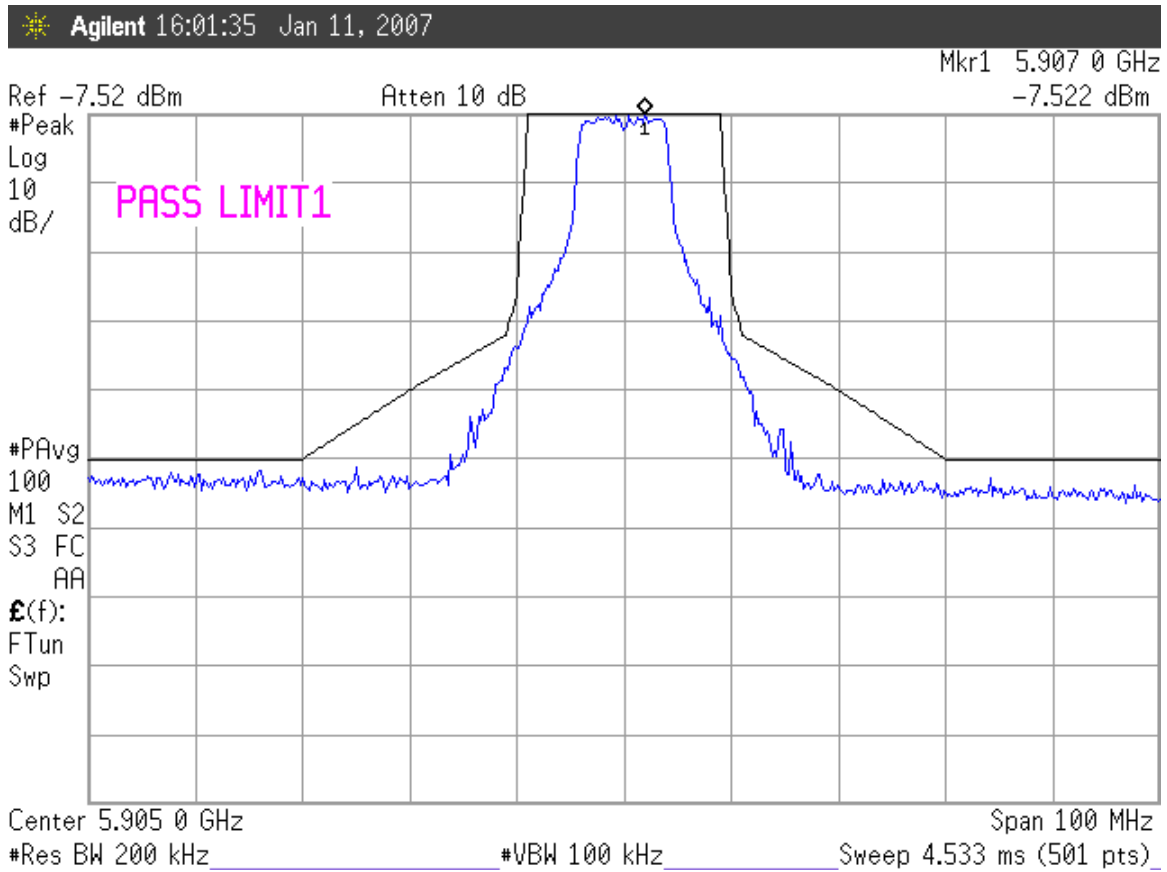


Figure 18. 5905 MHz. 6 MBps w/20 MHz BW

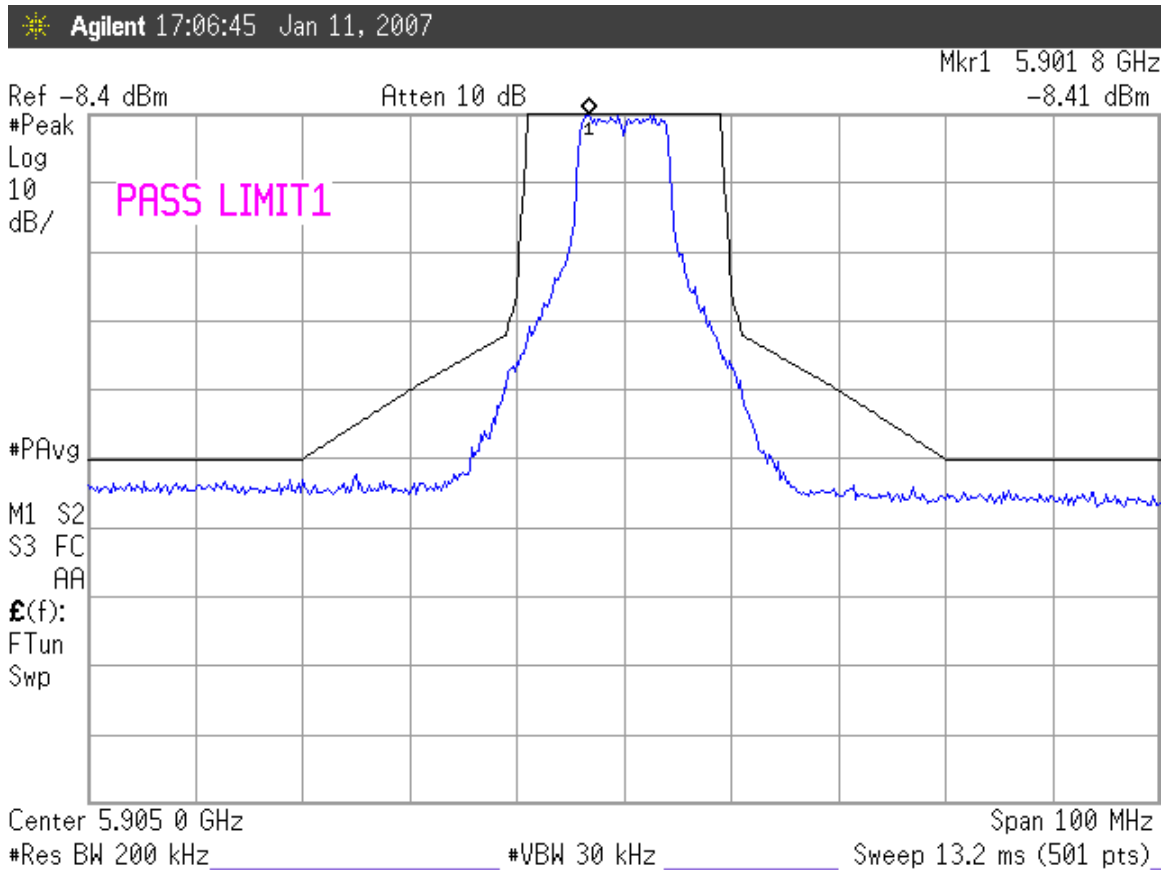


Figure 19. 5905 MHz. 54 MBps w/20 MHz BW



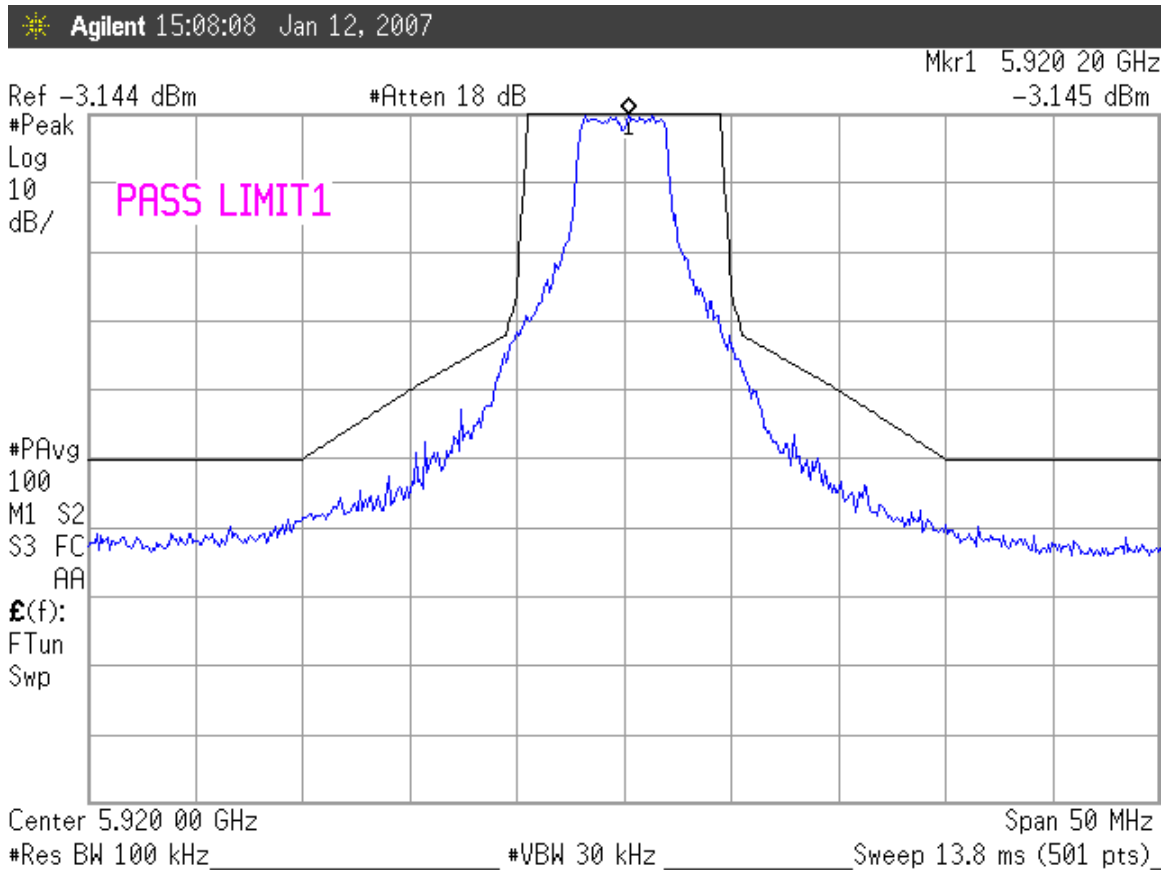
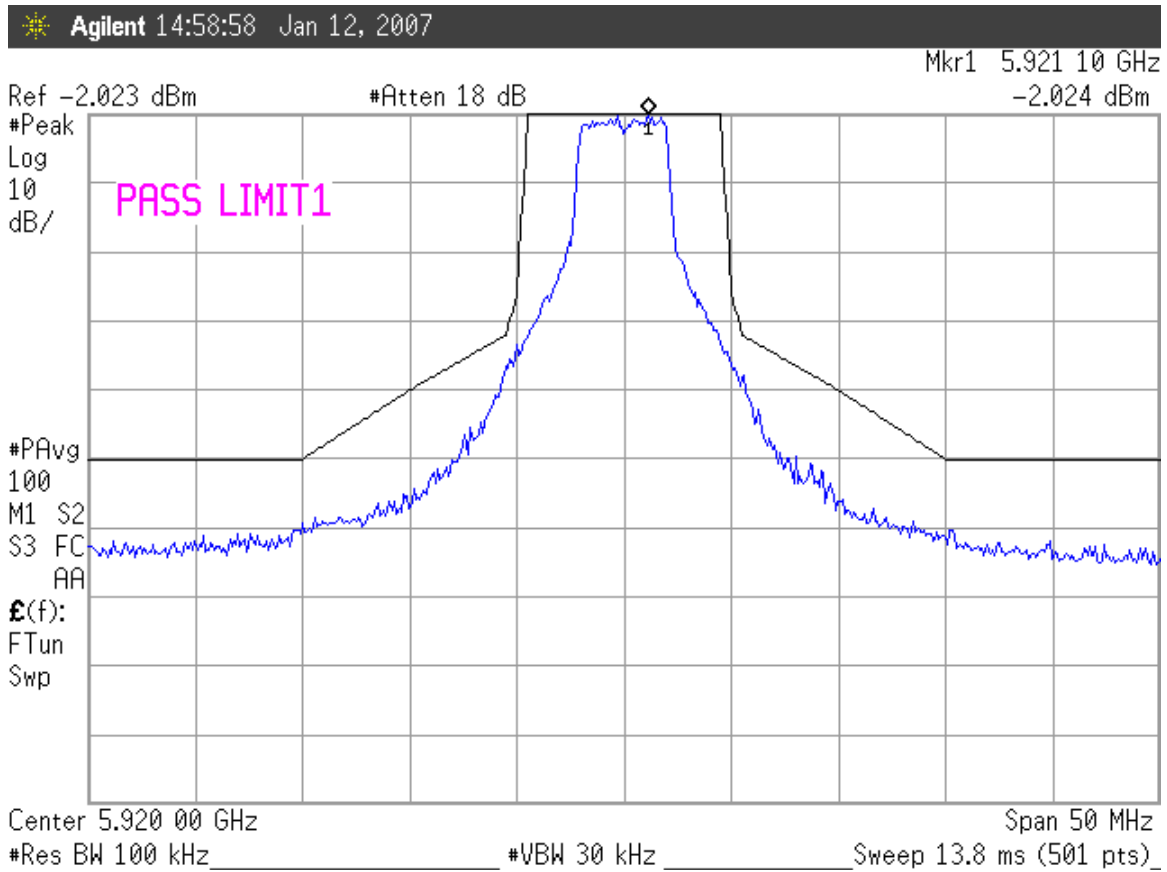


Figure 20. 5920 MHz. 6 MBps w/10 MHz BW



**Figure 21. 5920 MHz. 54 MBps w/10 MHz BW**

#### 4.1.6 Spurious Emissions

The power was set to the maximum power index number and the spurious emissions measured from 30 MHz to 40 GHz. The data are provided in the following figures.

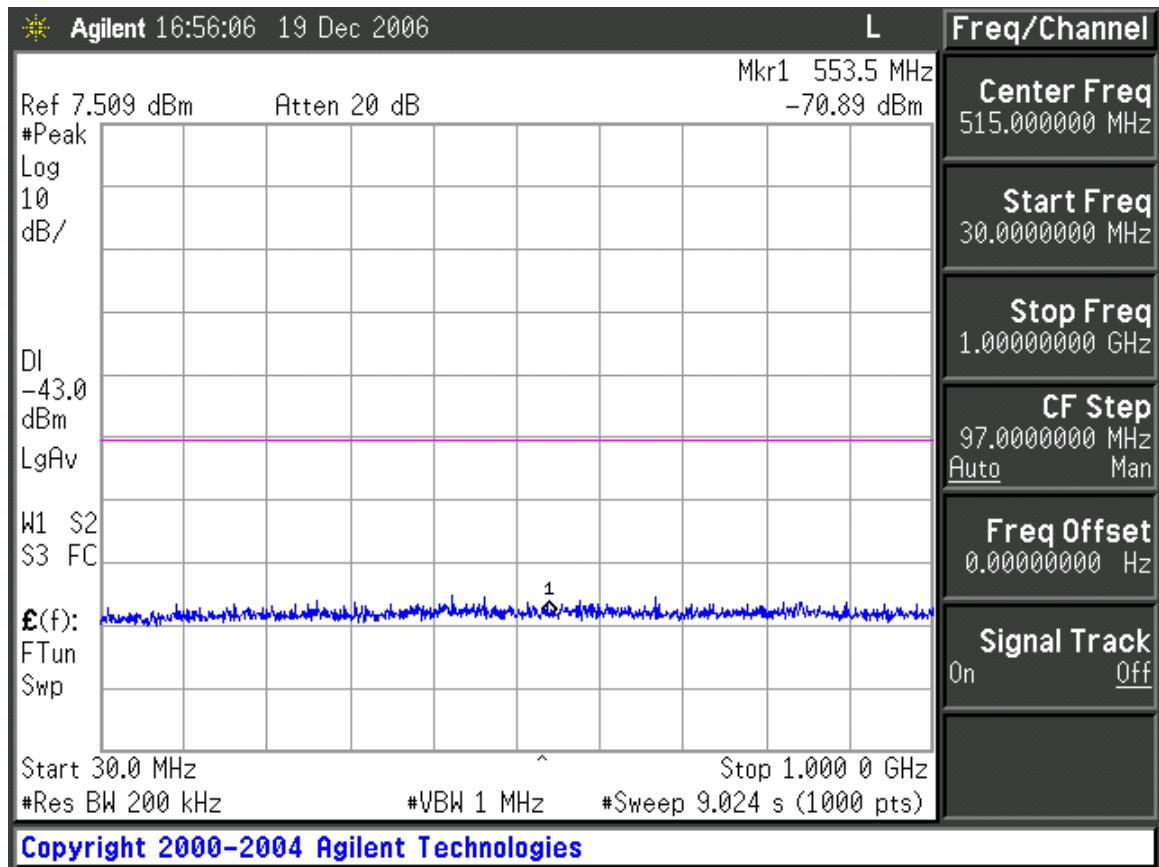


Figure 22. Spurious Emissions, 30M – 1GHz

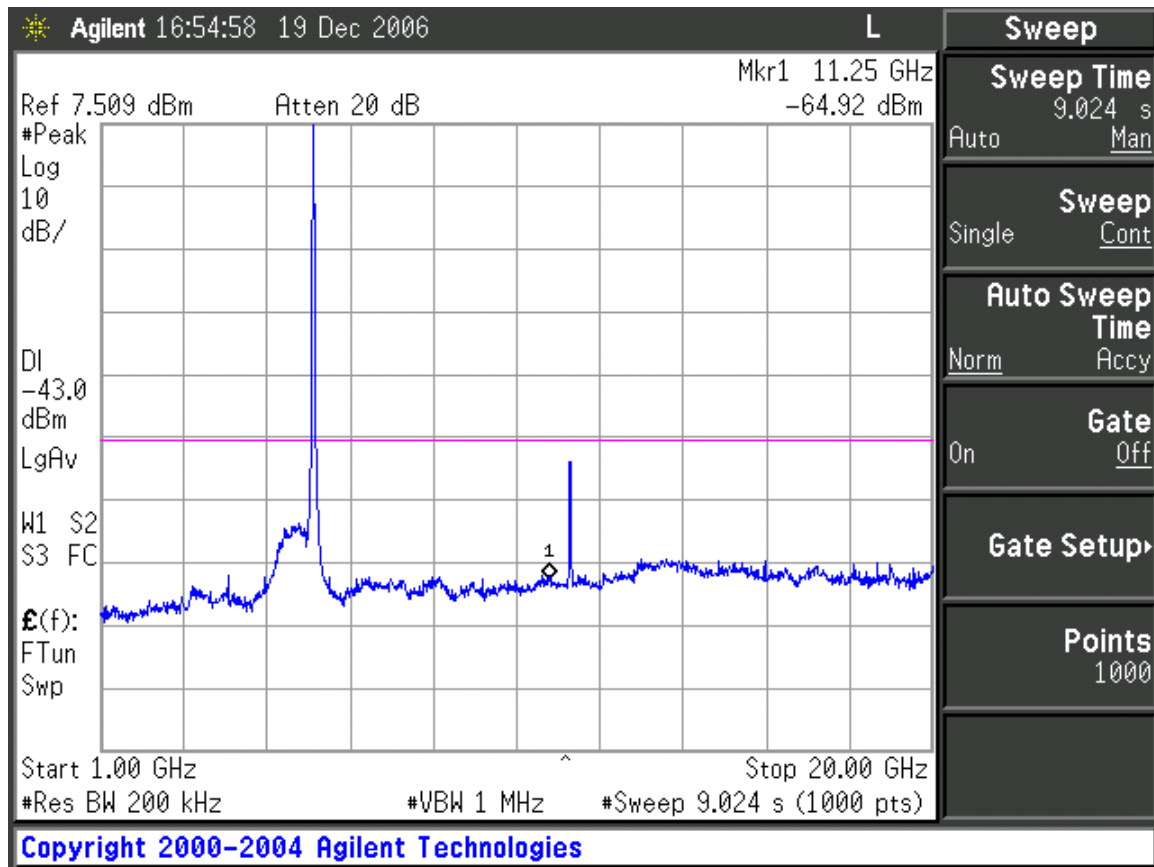


Figure 23. Spurious Emissions, 1-20GHz

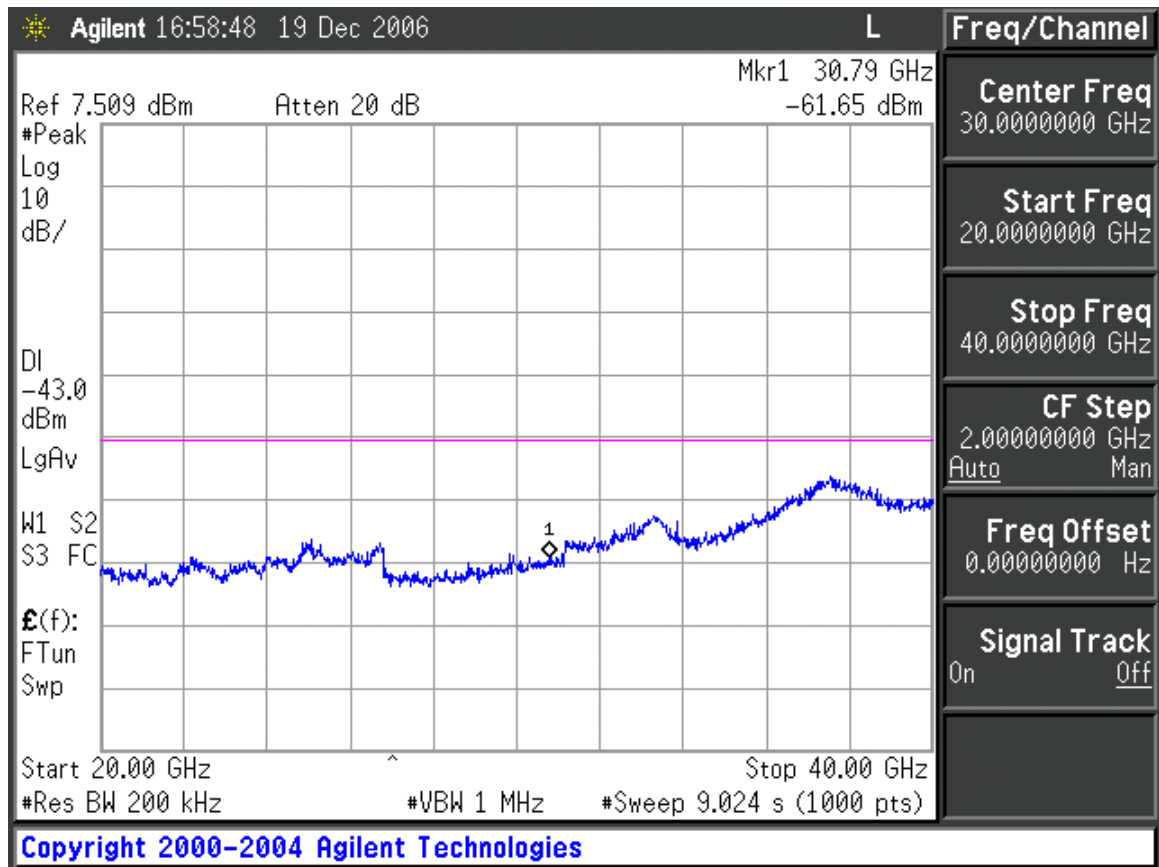


Figure 24. Spurious Emissions, 20-40GHz

#### 4.1.7 Radiated Emissions (Unintentional)

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 C63.4-2001. Cables were varied in position to produce maximum emissions. Both the horizontal and vertical field components were measured.

Where emissions were detected, the EIRP levels were determined using the method of signal substitution.

The frequency range of 30 MHz to 40 GHz was measured. All emissions detected are recorded in Table 6 and Table 7.

**Table 6. Radiated Emissions: Digital Emissions**

<b>Client:</b>	CelPlan	<b>Date:</b>	11/21/2006
<b>Tester:</b>	John Repella	<b>Job #:</b>	9149
<b><u>EUT Information:</u></b>		<b><u>Test Requirements:</u></b>	
<b>EUT:</b>	FR3000	<b>TEST STANDARD:</b>	FCC Part 15
<b>Configuration:</b>	Table-top	<b>DISTANCE:</b>	3m
<b>Clocks:</b>		<b>CLASS:</b>	B
<b><u>Test Equipment (&lt;1GHz):</u></b>		<b><u>Test Equipment (&gt;1GHz):</u></b>	
<b>ANTENNA:</b>	A_00382	<b>ANTENNA:</b>	A_00004
<b>LIMIT:</b>	LFCC_3m_Class_B		
<b>CABLE:</b>	CSITE1_3m	<b>CABLE:</b>	CSITE2_HF

Freq MHz	Pol H/V	Az	Ant Ht m	SA Level QP dBμV	Ant. Corr.dB	Cable Corr. dB	Corr. Level dBμV/m	Level μV/m	Limit μV/m	Margin dB
44.65	V	263	1.5	7.2	10.2	1.3	18.7	8.6	100.0	-21.3
48.02	V	263	1.5	11.0	8.5	1.3	20.8	11.0	100.0	-19.2
50.22	V	263	1.5	12.5	7.6	1.3	21.4	11.7	100.0	-18.6
50.71	V	263	1.5	13.3	7.5	1.3	22.1	12.8	100.0	-17.9
51.80	V	263	1.5	13.9	7.4	1.3	22.6	13.5	100.0	-17.4
52.60	V	263	1.5	13.3	7.3	1.3	21.9	12.5	100.0	-18.1
53.17	V	263	1.5	13.3	7.2	1.3	21.9	12.4	100.0	-18.1
60.95	V	263	1.5	14.7	7.4	1.5	23.6	15.1	100.0	-16.4
61.98	V	263	1.5	12.9	7.5	1.5	21.9	12.4	100.0	-18.1
75.72	V	263	1.5	6.6	8.0	1.6	16.2	6.4	100.0	-23.8
84.35	V	263	1.5	11.6	7.4	1.7	20.7	10.9	100.0	-19.3
109.15	V	263	1.5	2.6	12.5	1.9	17.1	7.1	150.0	-26.5
165.03	V	0.0	2.0	4.8	12.0	2.4	19.2	9.1	150.0	-24.3
198.03	V	306	1.5	9.1	12.2	2.6	23.9	15.6	150.0	-19.6
250.01	V	0.0	2.0	6.1	11.5	3.0	20.6	10.7	200.0	-25.4
264.03	V	306	2.0	5.1	12.6	3.1	20.8	11.0	200.0	-25.2
297.03	V	0.0	2.0	7.7	13.4	3.3	24.5	16.8	200.0	-21.5

Freq MHz	Pol H/V	Az	Ant Ht m	SA Level QP dBμV	Ant. Corr.dB	Cable Corr. dB	Corr. Level dBμV/m	Level μV/m	Limit μV/m	Margin dB
396.03	V	306	2.0	4.0	15.5	3.9	23.4	14.8	200.0	-22.6
462.03	V	306	2.0	5.1	17.3	4.3	26.7	21.5	200.0	-19.4
52.60	H	180	3.5	4.9	7.3	1.3	13.5	4.7	100.0	-26.5
53.17	H	180	3.5	5.9	7.2	1.3	14.5	5.3	100.0	-25.5
60.95	H	180	3.5	11.4	7.4	1.5	20.3	10.3	100.0	-19.7
61.98	H	180	3.5	13.1	7.5	1.5	22.1	12.7	100.0	-17.9
75.72	H	180	3.5	15.2	8.0	1.6	24.8	17.3	100.0	-15.2
84.35	H	263	3.5	6.8	7.4	1.7	15.9	6.3	100.0	-24.1
109.15	H	0.0	3.5	7.1	12.5	1.9	21.6	12.0	150.0	-22.0
165.03	H	107	3.5	7.1	12.0	2.4	21.5	11.9	150.0	-22.0
198.03	H	90	3.5	5.1	12.2	2.6	19.9	9.9	150.0	-23.6
250.03	H	180	3.5	8.2	11.5	3.0	22.8	13.7	200.0	-23.3
264.03	H	180	3.5	5.6	12.6	3.1	21.3	11.6	200.0	-24.7
297.03	H	0.0	3.5	7.2	13.4	3.3	24.0	15.8	200.0	-22.0
396.03	H	180	3.5	2.2	15.5	3.9	21.6	12.1	200.0	-24.4

**Table 7. Radiated Emissions: Transmitter Spurious**

CLIENT: CelPlan  
TESTER: John Repella

DATE: 1/23/2007  
JOB #: 9149

**EUT Information:**

EUT: FR100  
Configuration: Tabletop, Antenna terminated  
TX Frequency: 5890MHz

**Test Requirements:**

TEST STANDARD: FCC Part 90 & 95  
DISTANCE: 3m

**Test Equipment/Limit:**

LIMIT: Part 95L Mask A, B, C, G, H, I

Freq	Polarity	Azimuth	Ant. Height	Spurious Level	Sub. Sig. Gen. Level	Sub. Power Level	Sub. Ant. Factor	Sub. Ant. Gain	EIRP Level	Limit	Margin	Notes
(MHz)	H/V	Degree	(m)	dBμV	dBm	dBm	dB/m	dB	dBm	dBm	dB	
5890.000	V	36.0	1.0	47.58								Fund
11780.00	V	0.0	1.0	32.03	-31.9	-64.0	47.5	4.1	-59.9	-40.0	-19.9	AMB
17670.000	V	0.0	1.0	31.47	-32.2	-64.7	56.9	-1.7	-66.4	-40.0	-26.4	AMB
5890.000	H	270.0	1.0	44.94								Fund
11780.000	H	0.0	1.0	32.49	-31.6	-55.3	47.5	4.1	-51.1	-40.0	-11.1	AMB
17670.000	H	0.0	1.0	32.50	-32.2	-64.7	56.9	-1.7	-66.4	-40.0	-26.4	AMB

#### 4.1.8 Emission Designator

The emission designator is determined from the necessary bandwidth, the type of modulation and the information conveyed in the signal.

For the subject unit, the following Emission Designator has been determined according to Section 2.201 of the FCC Rules and Appendix J of the May 2006 revision of the NTIA Redbook (<http://www.ntia.doc.gov/osmhome/redbook/J.pdf>).

Necessary bandwidth for OFDM Modulation is:

$$B_n = (NS + 16.25)CS$$

where,

NS = Number of Subcarriers

CS = Separation in frequency between adjacent sub-carriers or carriers of a multi-carrier modulation (in MHz)

$$B_n = (48 + 16.25) \times 0.25 = 16.1 \text{ MHz}$$

The necessary bandwidth is 16.1 MHz

The information is data and sent in a single channel with the main carrier being amplitude and angle-modulated in a pre-established sequence.

Hence, the emission designator is 16M1D1D

#### 4.1.9 Frequency Stability: (FCC Part §2.1055)

Frequency as a function of temperature and voltage variation shall be maintained within the FCC-prescribed tolerances.

The temperature stability was measured with the unit in an environmental chamber used to vary the temperature of the sample. The sample was held at each temperature step to allow the temperature of the sample to stabilize.

The frequency stability of the transmitter was examined at the voltage extremes and for the temperature range of -30°C to +50°C. The carrier frequency was measured while the EUT was in the temperature chamber. The reference frequency of the EUT was measured at the ambient room temperature with the frequency counter.

The EUT is powered by the host system.

Transmit frequency tolerance is specified in section 8.9.4 of ASTM E22213-03 and is reproduced below.

*8.9.4 Transmit Center Frequency Tolerance*—The transmitted center frequency tolerance shall be  $\pm 10$  ppm maximum for RSUs and  $\pm 10$  ppm maximum for OBUs. The transmit center



**Table 8. Frequency Deviation**

<b>Job#:</b>	9149
<b>Company:</b>	Celplan
<b>EUT:</b>	FR-100
<b>Standard/Test Level:</b>	Part Part 95L
<b>Test Engineer:</b>	ER
<b>Reviewed by:</b>	MV
<b>Test Start Date:</b>	1/18/2007

**Limit:** 0.001%  
ASTM E22213-03  
Section 8.9.4

Nominal Frequency 5900MHz

Temperature (Centigrade)	Frequency (MHz)	Difference (Hz)	Deviation (%)
Ambient	5899.953600	0.0	0
-30	5899.960500	6900.0	0.000117
-20	5899.964800	11200.0	0.000190
-10	5899.964900	11300.0	0.000192
0	5899.966400	12800.0	0.000217
10	5899.963500	9900.0	0.000168
20	5899.959700	6100.0	0.000103
30	5899.951300	-2300.0	0.000039
40	5899.954100	500.0	0.000008
50	5899.975700	22100.0	0.000375

Voltage (Volts)	Frequency (MHz)	Difference (Hz)	Deviation (%)	Voltage (Volts)
At rated	5899.953600	0	0.0	120VAC
At 85%	5899.955300	-1700	0.000029	102VAC
At 115%	5899.958100	-4500	0.000076	13.8VAC

Notes: Measured in Peak, CW mode