
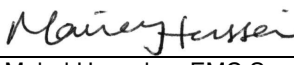




**BUREAU  
VERITAS**

Curtis-Straus LLC, a wholly owned subsidiary of BV CPS

# Test Report

Report No	EM2588-1
Client	Airvana
Address	19 Alpha Road Chelmsford, MA 01824
Phone	978-250-2622
Item tested	Femto Cell 750703
FCC ID	QHYHUBBUBC4001-RT
FRN	0021466594
Equipment Type	PCS Licensed Transmitter
Equipment Code	PCB
Emission Designator	1M27D7D
FCC Rule Parts	47 CFR 22 Subpart H 47 CFR 24 Subpart E 47 CFR 90 Subpart S
Test Dates	October 29, 30, & 31, 2012 and November 1, 6, & 7, 2012
Results	As detailed within this report
Prepared by	 Arik Zwirner
Authorized by	 Mairaj Hussain – EMC Supervisor
Issue Date	March 25, 2013

Curtis-Straus LLC is accredited by the American Association for Laboratory Accreditation for the specific scope of accreditation under Certificate Number 1627-01. This report may contain data which is not covered by the A2LA accreditation.



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## Summary

This test report supports an application for certification of a transmitter operating pursuant to 47 CFR 22 Subpart H, 47 CFR 24 Subpart E, and 47 CFR 90 Subpart S.

The product is the Femto Cell 750703. It is a transceiver that operates in the ranges 862-869MHz, 869-894MHz, and 1930-1990MHz.

We found that the product met the above requirements without modification. The test sample was received in good condition.

## Test Methodology

Radiated emission testing was performed according to the procedures specified in ANSI C63.4 (2003) and TIA-603-C. Radiated Emissions were maximized by rotating the device around its upright axes as well as varying the test antenna's height and polarity.

Conducted measurements at the antenna port were performed.

The EUT operating voltage is 120Vac 60Hz.

The Femto Cell 750703 has five transmitters, identified as One-X, EVDO, Beacon BC0, Beacon BC1, and Beacon BC10. Three of these transmitters, One-X, EVDO, & Beacon BC1, operate in the 1930-1990MHz band and were tested for Part 24. The Beacon BC0 operates in the 869-894MHz band and was tested for Part 22. The Beacon BC10 operates in the 862-869MHz band and was tested for Part 90.

Per Airvana, the device under test prevents the operation of 3 transmit channels operating on the same frequency at the same time. Thus it is not allowed for the One-X, EVDO, & Beacon BC1 to simultaneously operate at the same frequency.

Modulation is QAM -16 for each of the different types of channels.

For Part 22, the lowest and highest operating frequencies are 870.03MHz and 889.2MHz, respectively. For Part 24, the lowest and highest operating frequencies are 1931.25MHz and 1988.75MHz, respectively. For Part 90, the lowest and highest operating frequencies are 862.9MHz and 867.9MHz, respectively.

During line conducted emissions and radiated spurious measurements, the product was removed from the plastic enclosure which should have no effects on EMI results.

For antenna port conducted spurious emissions testing 30MHz-20GHz range was checked..

### Release Control Record

Issue No.	Reason for change	Date Issued
1	Original Release	March 4, 2013



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Radiated spurious emissions emission were performed in the frequency range of 30MHz-20GHz. Transmit chain which produced the highest EIRP was used for spurious emission scan.

The substitution method is used for ERP and EIRP measurements. The method is performed as follows. When performing ERP or EIRP measurements, the fundamental emission of the EUT is measured in terms of field strength. The EUT is then substituted with a calibrated antenna, cable, and signal generator. The initially measured field strength is reproduced and matched by the substituting equipment. The power of the substitution source (the signal generator) is noted and this value is then corrected for the cable loss and the antenna gain (dBi) to determine the ERP or EIRP of the EUT.



## Product Tested - Configuration Documentation

EUT Configuration																	
<b>Work Order:</b> M2588 <b>Company:</b> Airvana <b>Company Address:</b> 19 Alpha Road Chelmsford, MA 01824 <b>Contact:</b> Stuart MacEachern <b>Person Present:</b> Stuart MacEachern																	
<b>MN</b>						<b>SN</b>											
<b>EUT:</b> 750703						Sample 1											
<b>power supply:</b> MPBS-12020000						Sample 1											
<b>EUT Description:</b> Femto Cell, Train 5																	
<b>EUT Max Frequency:</b> 1990MHz																	
<b>Support Equipment:</b>						<b>MN</b>						<b>SN</b>					
Litepoint iQnav GPS simulator						iQnav						IQN00962					
Dell laptop computer						D610						not listed					
<b>EUT Ports:</b>																	
Port Label	Port Type	No. of ports	No. Populated	Cable Type	Shielded	Ferrites	Length	Max Length	In/Out	NEBS Type	Unpopulated Reason						
AC Mains	two-pin	1	1	AC	no	none	n/a	n/a	Out								
DC power	two-wire	1	1	two-wire	no	none	1.5m	1.5m	In								
Ethernet	RJ45	3	3	Cat. 5	no	none	3m	100m	In								
GPS	coax.	1	1	coax.	yes	none	10m	10m	Out								
<b>Software / Operating Mode Description:</b>																	
All five transceivers (One-X, EVDO, Beacon BC0, Beacon BC1, Beacon BC10) are active. The EUT receives a simulated GPS signal from the iQnav.																	



## Statement of Conformity

The Femto Cell 750703 has been found to conform to the following parts of 47 CFR 22, 47 CFR 24, & 47 CFR 90 as detailed below:

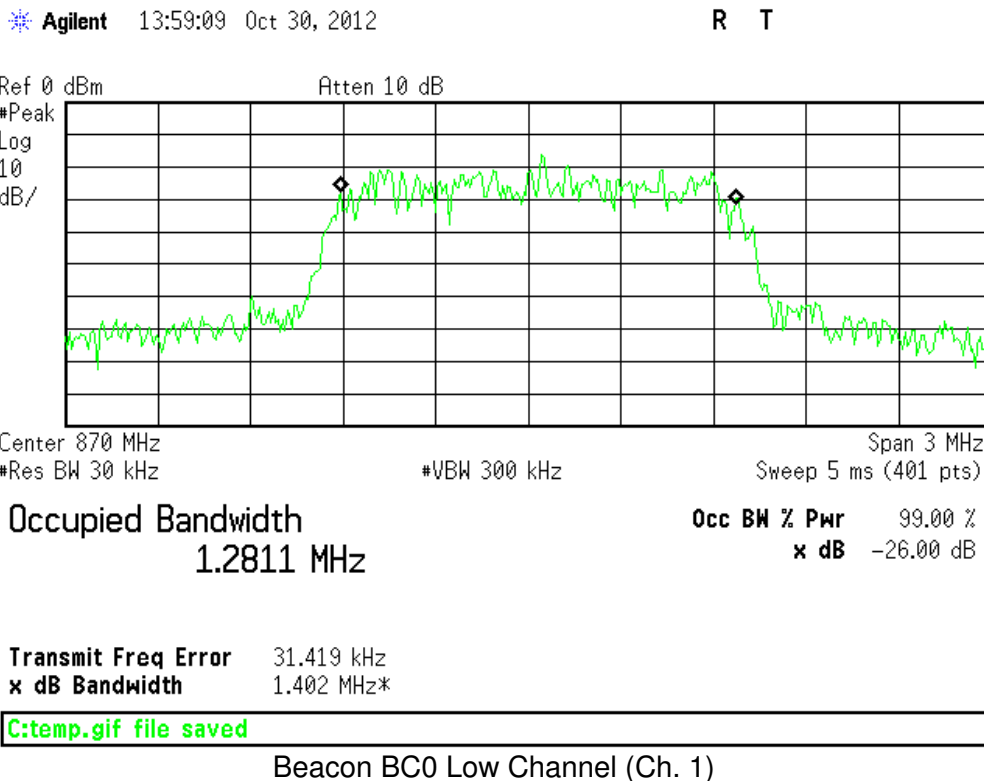
Part 2	Part 22, 24, 90	Comments
2.1033(c)(4)		CDMA is the type of RF modulation.
2.1033(c)(6)		RF output power is not adjustable to end users.
2.1049(l)		Occupied bandwidth measured
2.1033(c)(9)		The Femto Cell 705703 does not require a tune-up procedure.
2.1055(a)(d)		Frequency stability within 1.5ppm
	<b>Part 22</b>	
	22.913(a)(2)	Meets ERP limit: 7W
	22.359	Band edge
	22.917(a)	Spurious emissions within limit of -13dBm
	<b>Part 24</b>	
2.1033(c)(7)	24.232(c)	Meets power limit: 2W EIRP.
	24.235	Fundamental is within authorized frequency block
	<b>Part 90</b>	
2.1051	90.691(a)	Spurious emissions within limit of -13dBm
2.1053	90.691(a)	Spurious emissions within limit of -13dBm
	90.213(a)	Frequency stability within 1.5ppm
	90.635	Meets power limit: 100W ERP

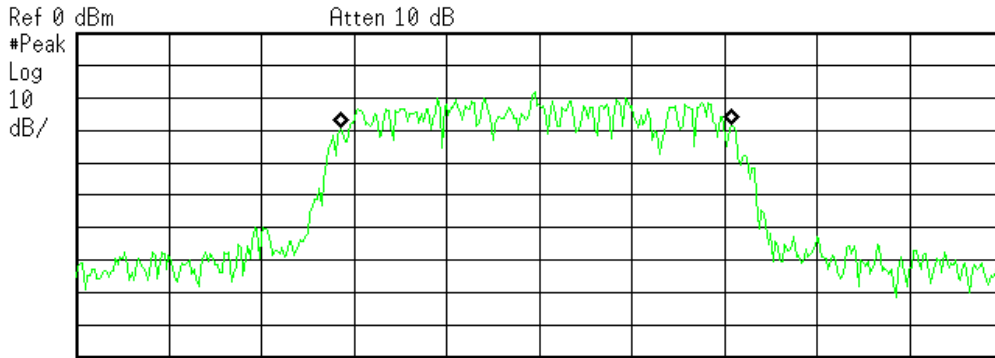


## Tests Specific to Part 22

### Bandwidth

Bandwidth Measurements				
Date: 30-Oct-12		Company: Airvana		Work Order: M2588
Engineer: Arik Zwirner		EUT Desc: 750703 Femto Cell		EUT Power: 120Vac/60Hz
Temp: 23°C		Humidity: 34%		Pressure: 999mbar
Frequency Range: 869-894MHz, FCC Part 22				
Notes:				
OUTPUT	CHANNEL POSITION	CHANNEL NUMBER	FREQUENCY (MHz)	26dB BANDWIDTH (MHz)
Beacon BC0	Low	1	870.03	1.402
	Mid	320	879.6	1.398
	High	640	889.2	1.412
Test Site: 1DCC-OATS-3M-I			Spectrum Analyzer: Gold	





Center 879.6 MHz Span 3 MHz  
 #Res BW 30 kHz #VBW 300 kHz Sweep 5 ms (401 pts)

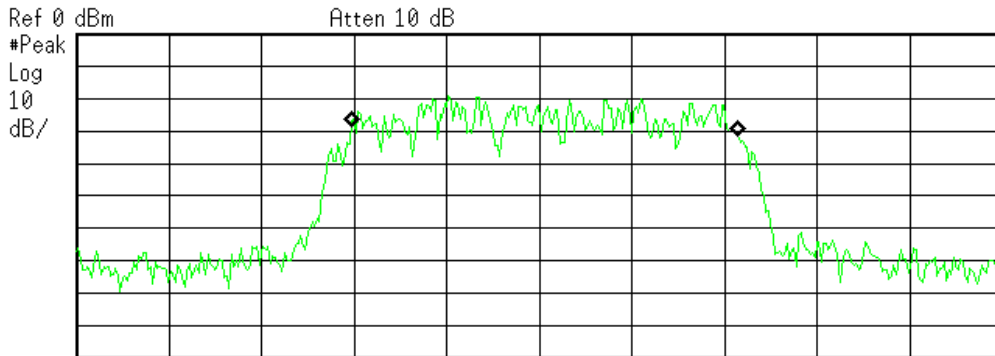
**Occupied Bandwidth**  
 1.2698 MHz

**Occ BW % Pwr** 99.00 %  
**x dB** -26.00 dB

**Transmit Freq Error** -9.304 kHz  
**x dB Bandwidth** 1.398 MHz\*

C:\temp.gif file saved

Beacon BC0 Mid Channel (Ch. 320)



Center 889.2 MHz Span 3 MHz  
 #Res BW 30 kHz #VBW 300 kHz Sweep 5 ms (401 pts)

**Occupied Bandwidth**  
 1.2513 MHz

**Occ BW % Pwr** 99.00 %  
**x dB** -26.00 dB

**Transmit Freq Error** 16.382 kHz  
**x dB Bandwidth** 1.412 MHz\*

C:\temp.gif file saved

Beacon BC0 High Channel (Ch. 640)





# ERP

ERP Using Substitution Method								
Date: 07-Nov-12			Company: Airvana			Work Order: M2258		
Engineer: Arik Zwirner			EUT Desc: 750703 Femto Cell			EUT Operating Voltage/Frequency: 120Vac/60Hz		
Temp: 21 °C			Humidity: 22%			Pressure: 1001mbar		
Frequency Range: Part 22 ERP measurements					Measurement Distance: 3 m			
Notes: Beacon BC0 7W =38.45 dBm								
Antenna Polarization (H/V)	Frequency (MHz)	Signal Generator Power Output (dBm)				FCC 22.913 (a)		
			Tx Cable (dB)	Tx Ant Gain (dBi)	Adjusted ERP (dBm)	Limit (dBm)	Margin (dB)	Result (Pass/Fail)
Channel 1			---	---	---	---	---	---
V	870.03	0.9	0.3	0.0	0.6	38.45	-37.9	Pass
H	870.03	5.3	0.3	0.0	5.0	38.45	-33.5	Pass
Channel 320			---	---	---	---	---	---
V	879.6	1.3	0.2	0.0	1.1	38.45	-37.4	Pass
H	879.6	5.3	0.2	0.0	5.1	38.45	-33.4	Pass
Channel 640			---	---	---	---	---	---
V	889.2	2.7	0.2	0.0	2.5	38.45	-36.0	Pass
H	889.2	6.2	0.2	0.0	6.0	38.45	-32.5	Pass
Test Site: 1DCC-OATS-3M-I			Signal Generato: Rental Sweeper			Receive Cable: EMIR-HIGH-21		
Analyzer: Rental #1			Receive Antenna: Green			Transmit Cable: Asset 1522		
			Transmit Antenna: Dipole					



## ***Band Edge Measurements***

### **LIMITS**

§ 22.359 Emission limitations.

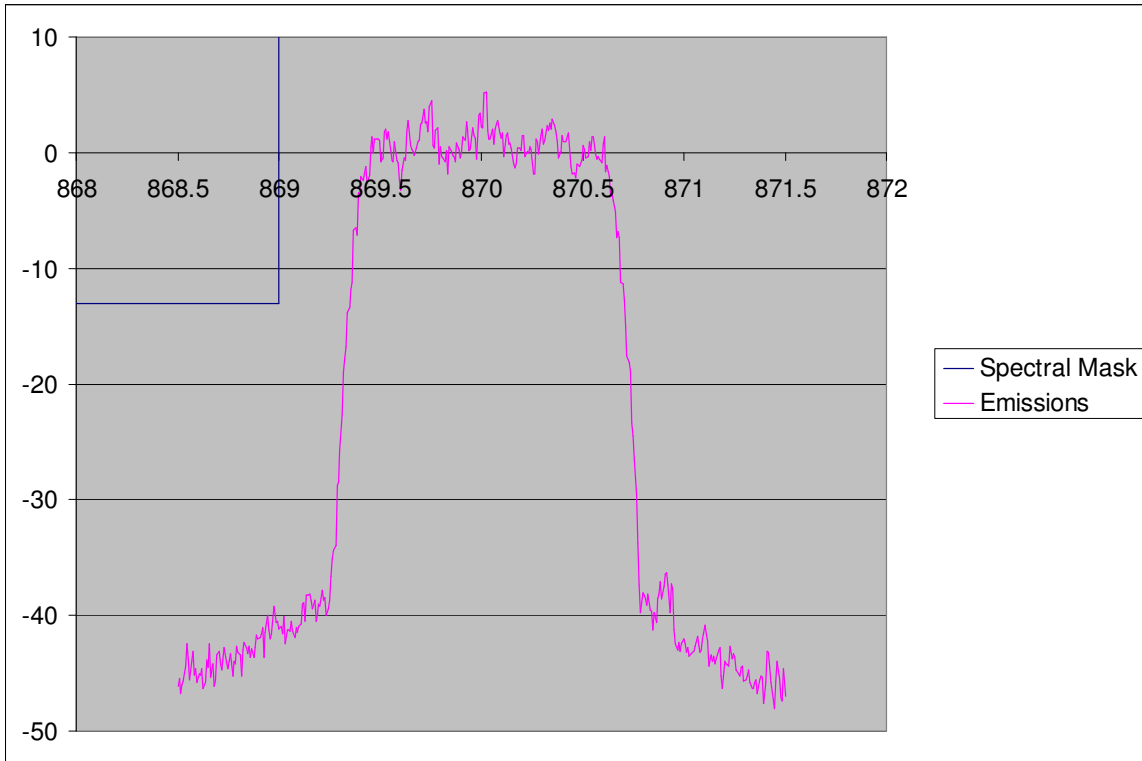
(a) *Out of band emissions.* The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least  $43 + 10 \log (P)$  dB.

### **MEASUREMENTS / RESULTS**

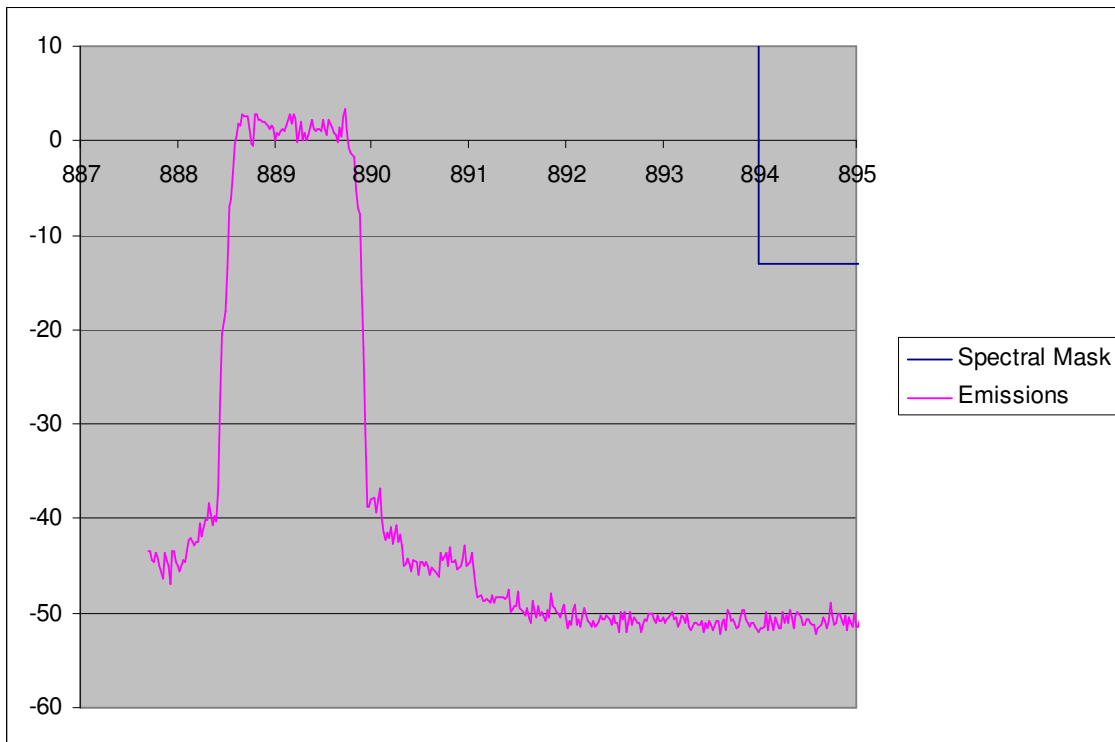
Limit =  $10 \cdot \log(P[\text{mW}]) - (43 + 10 \cdot \log(P[\text{W}])) = -13\text{dBm}$

Note: Mask lines are set to -13dBm at 869MHz and 894MHz.





Beacon BC0 Low Channel



Beacon BC0 High Channel



## ***Conducted Spurious Emissions at Antenna Port*** **LIMITS**

§ 22.359 Emission limitations.

(a) *Out of band emissions.* The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least  $43 + 10 \log (P)$  dB.

## **MEASUREMENTS / RESULTS**

Limit =  $10 \cdot \log(P[\text{mW}]) - (43 + 10 \cdot \log(P[\text{W}])) = -13\text{dBm}$

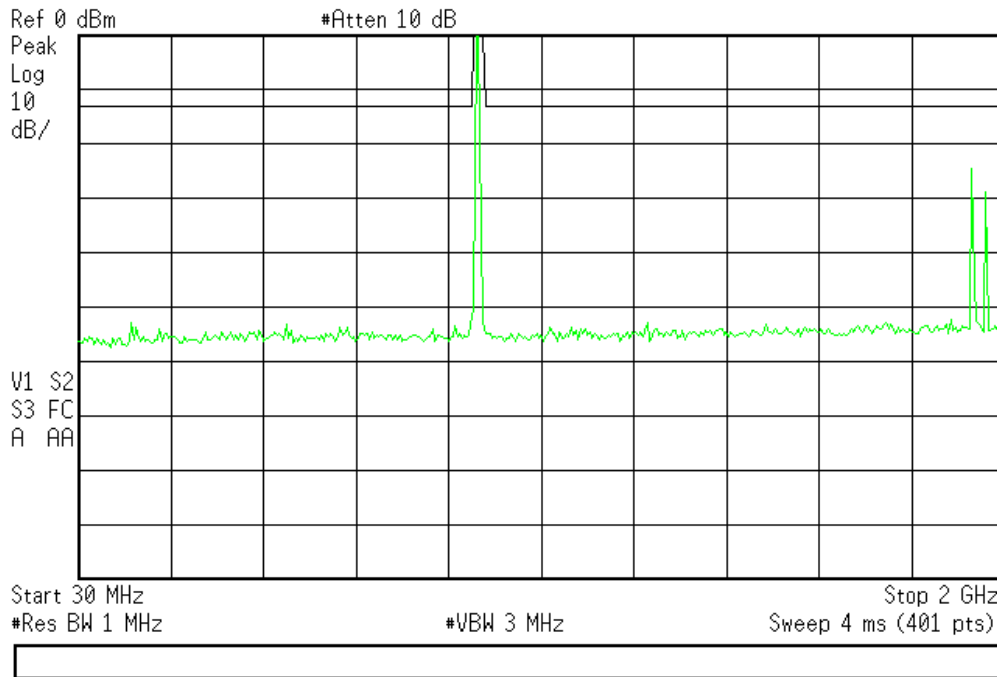
Note: Limit lines are set to -13dBm at 30-869MHz and 894-20000MHz.



# PLOTS

Agilent

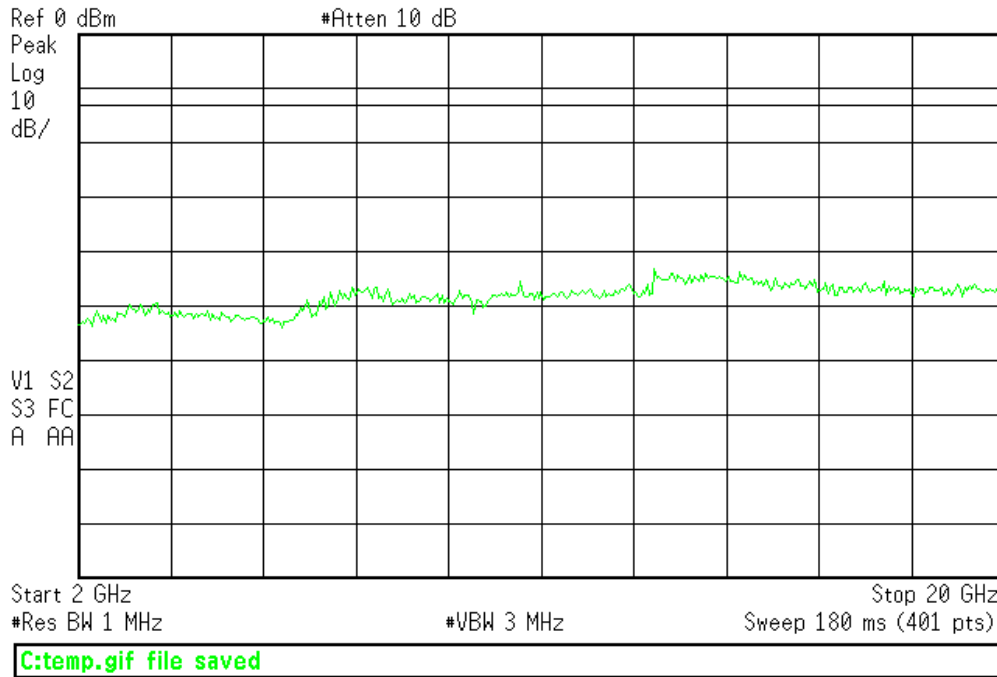
R T



Beacon BC0, 30-2000MHz

Agilent

R T



Beacon BC0, 2-20GHz



## Tests Specific to Part 24

### Bandwidth

#### LIMIT

"The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power." [24.238(b)]

### MEASUREMENTS / RESULTS

Bandwidth Measurements				
Date: 30-Oct-12		Company: Airvana		Work Order: M2588
Engineer: Arik Zwirner		EUT Desc: 750703 Femto Cell		EUT Power: 120Vac/60Hz
Temp: 23°C		Humidity: 34%		Pressure: 999mbar
Frequency Range: 1930-1990MHz, FCC Part 24 E				
Notes:				
OUTPUT	CHANNEL POSITION	CHANNEL NUMBER	FREQUENCY (MHz)	26dB BANDWIDTH (MHz)
EVDO	Low	25	1931.25	1.193
	Mid	525	1956.25	1.390
	High	1075	1983.75	1.192
One-X	Low	25	1931.25	1.424
	Mid	525	1956.25	1.388
	High	1075	1983.75	1.411
Beacon BC1	Low	25	1931.25	1.398
	Mid	525	1956.25	1.403
	High	1075	1983.75	1.396
Test Site: 1DCC-OATS-3M-I			Spectrum Analyzer: Gold	

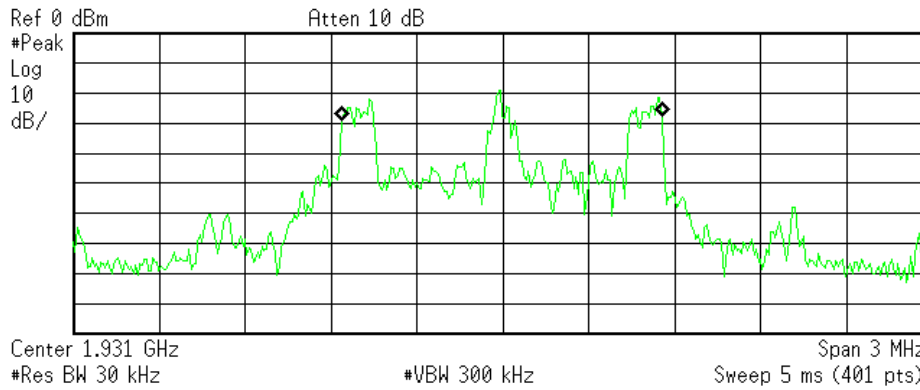
Note that at the time of this test, the highest known operating frequency of this band was 1983.75 (Channel 1075), while in subsequent tests, this frequency was updated to 1988.75MHz (Channel 1175).



# EVDO

Agilent 13:54:35 Oct 30, 2012

R T



Occupied Bandwidth  
1.1171 MHz

Occ BW % Pwr 99.00 %  
x dB -26.00 dB

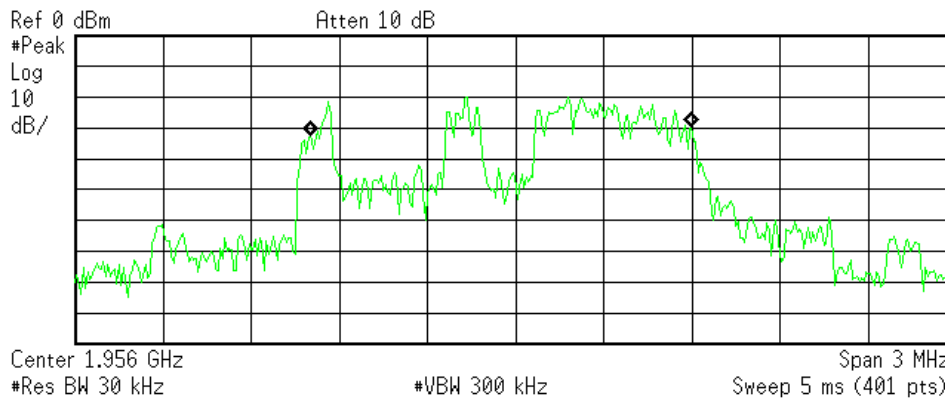
Transmit Freq Error -3.566 kHz  
x dB Bandwidth 1.193 MHz\*

C:\temp.gif file saved

EVDO Low Channel

Agilent 13:51:14 Oct 30, 2012

R T



Occupied Bandwidth  
1.3004 MHz

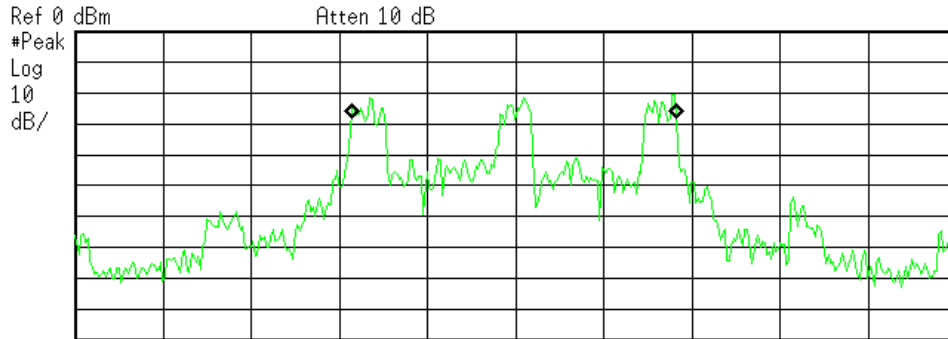
Occ BW % Pwr 99.00 %  
x dB -26.00 dB

Transmit Freq Error -50.609 kHz  
x dB Bandwidth 1.390 MHz\*

C:\temp.gif file saved

EVDO Mid Channel





Center 1.984 GHz Span 3 MHz  
 #Res BW 30 kHz #VBW 300 kHz Sweep 5 ms (401 pts)

Occupied Bandwidth  
 1.1050 MHz

Occ BW % Pwr 99.00 %  
 x dB -26.00 dB

Transmit Freq Error -5.704 kHz  
 x dB Bandwidth 1.192 MHz\*

C:\temp.gif file saved

EVDO High Channel

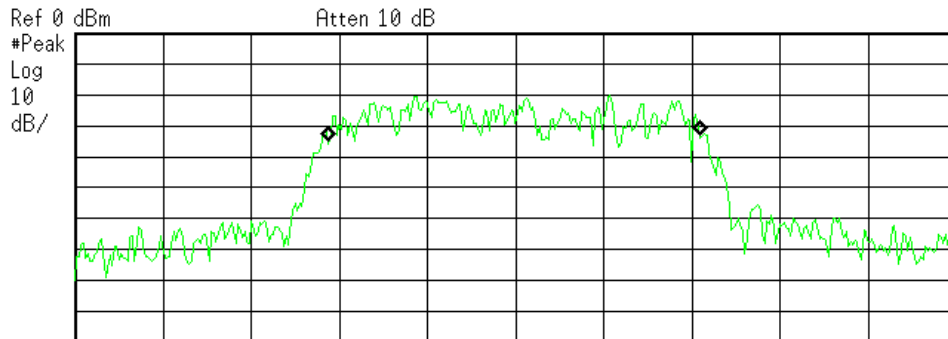




# One-X

Agilent 11:52:01 Oct 30, 2012

R T



Center 1.931 GHz Span 3 MHz  
 #Res BW 30 kHz #VBW 300 kHz Sweep 5 ms (401 pts)

Occupied Bandwidth  
 1.2667 MHz

Occ BW % Pwr 99.00 %  
 x dB -26.00 dB

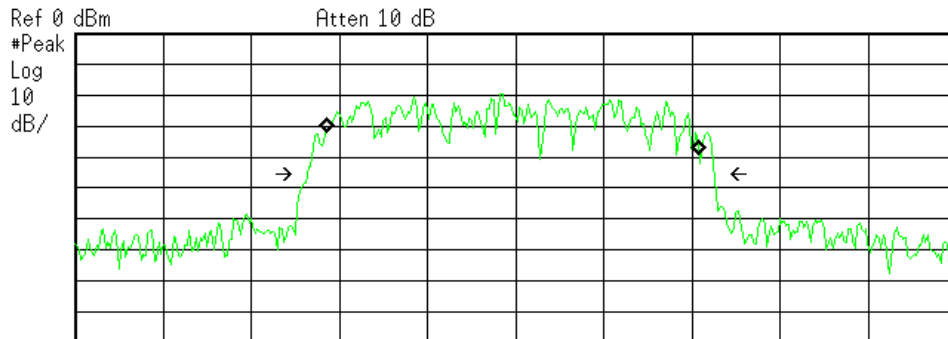
Transmit Freq Error -5.598 kHz  
 x dB Bandwidth 1.424 MHz\*

C:\STATE039.STA file saved

One-X Low Channel

Agilent 12:01:31 Oct 30, 2012

R T



Center 1.956 GHz Span 3 MHz  
 #Res BW 30 kHz #VBW 300 kHz Sweep 5 ms (401 pts)

Occupied Bandwidth  
 1.2734 MHz

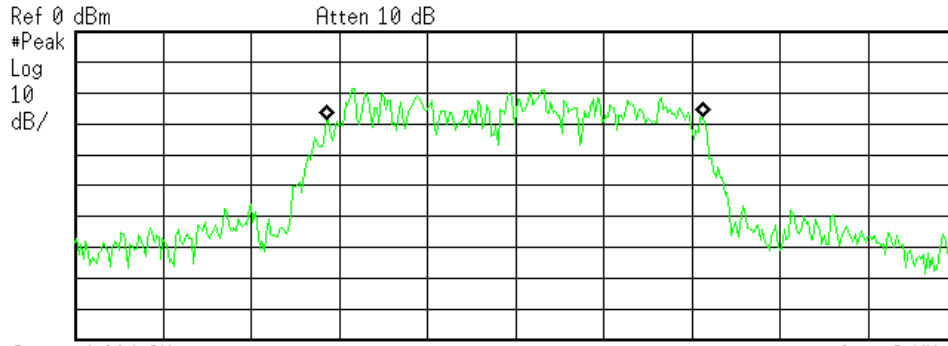
Occ BW % Pwr 99.00 %  
 x dB -26.00 dB

Transmit Freq Error -10.541 kHz  
 Occupied Bandwidth 1.388 MHz\*

C:\temp.gif file saved

One-X Mid Channel





Center 1.984 GHz      Span 3 MHz  
 #Res BW 30 kHz      #VBW 300 kHz      Sweep 5 ms (401 pts)

Occupied Bandwidth  
 1.2768 MHz

Occ BW % Pwr      99.00 %  
 x dB      -26.00 dB

Transmit Freq Error      -3.009 kHz  
 x dB Bandwidth      1.411 MHz\*

C:\temp.gif file saved

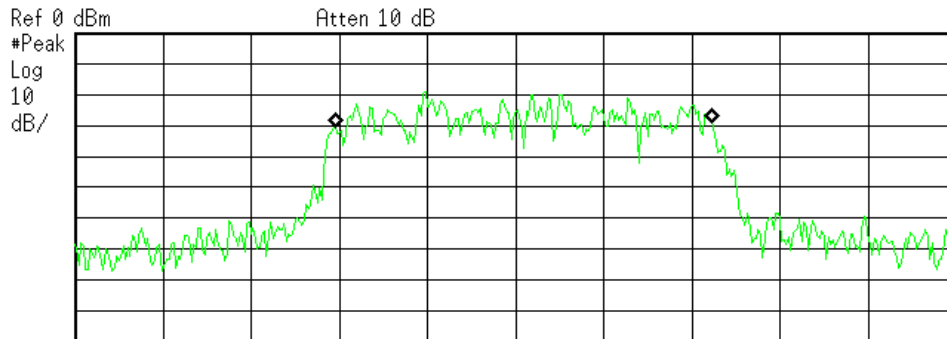
One-X High Channel



# Beacon BC1

Agilent 13:30:05 Oct 30, 2012

R T



Center 1.931 GHz Span 3 MHz  
 #Res BW 30 kHz #VBW 300 kHz Sweep 5 ms (401 pts)

Occupied Bandwidth  
 1.2871 MHz

Occ BW % Pwr 99.00 %  
 x dB -26.00 dB

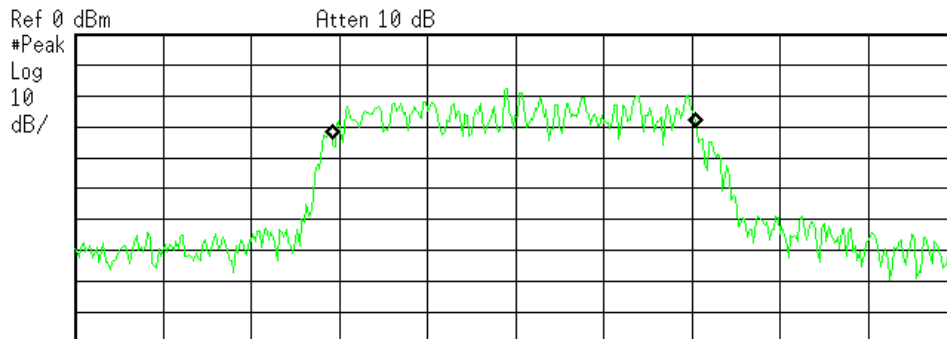
Transmit Freq Error 25.272 kHz  
 x dB Bandwidth 1.398 MHz\*

C:\temp.gif file saved

Beacon BC1 Low Channel

Agilent 13:44:31 Oct 30, 2012

R T



Center 1.956 GHz Span 3 MHz  
 #Res BW 30 kHz #VBW 300 kHz Sweep 5 ms (401 pts)

Occupied Bandwidth  
 1.2425 MHz

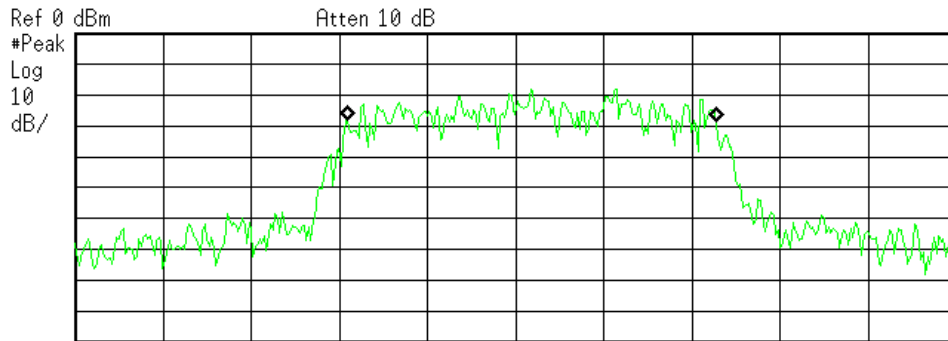
Occ BW % Pwr 99.00 %  
 x dB -26.00 dB

Transmit Freq Error -4.638 kHz  
 x dB Bandwidth 1.403 MHz\*

C:\temp.gif file saved

Beacon BC1 Mid Channel





Center 1.984 GHz Span 3 MHz  
#Res BW 30 kHz #VBW 300 kHz Sweep 5 ms (401 pts)

Occupied Bandwidth  
1.2549 MHz

Occ BW % Pwr 99.00 %  
x dB -26.00 dB

Transmit Freq Error 55.075 kHz  
x dB Bandwidth 1.396 MHz\*

C:\temp.gif file saved

Beacon BC1 High Channel



# EIRP

“Mobile and portable stations are limited to 2 watts EIRP and the equipment must employ a means for limiting power to the minimum necessary for successful communications.”  
 [24.232 (c)]

EIRP Using Substitution Method								
Date: 31-Oct-12		Company: Airvana		Work Order: M2258				
Engineer: Arik Zwirner		EUT Desc: 750703 Femto Cell		EUT Operating Voltage/Frequency: 120Vac/60Hz				
Temp: 23°C		Humidity: 34%		Pressure: 999mbar				
Frequency Range: Part 24 E, EIRP measurements				Measurement Distance: 3 m				
Notes: 2W = 33dBm								
Antenna Polarization (H / V)	Frequency (MHz)	Signal Generator Power Output (dBm)	FCC 24.232 section c			Limit (dBm)	Margin (dB)	Result (Pass/Fail)
			Tx Cable (dB)	Tx Ant Gain (dBi)	Adjusted EIRP (dBm)			
EVDO Ch. 25			---	---	---	---	---	---
H	1931.25	5.3	1.2	7.6	11.7	33.0	-21.3	Pass
V	1931.25	2.2	1.2	7.6	8.6	33.0	-24.4	Pass
EVDO Ch. 525			---	---	---	---	---	---
H	1956.25	9.0	1.2	7.6	15.4	33.0	-17.6	Pass
V	1956.25	6.7	1.2	7.6	13.1	33.0	-19.9	Pass
EVDO Ch. 1175			---	---	---	---	---	---
H	1988.75	6.4	1.2	7.6	12.8	33.0	-20.2	Pass
V	1988.75	7.7	1.2	7.6	14.1	33.0	-18.9	Pass
One-X Ch. 25			---	---	---	---	---	---
H	1931.25	2.0	1.2	7.6	8.4	33.0	-24.6	Pass
V	1931.25	0.9	1.2	7.6	7.3	33.0	-25.7	Pass
One-X Ch. 525			---	---	---	---	---	---
H	1956.25	0.4	1.2	7.6	6.8	33.0	-26.2	Pass
V	1956.25	3.2	1.2	7.6	9.6	33.0	-23.4	Pass
One-X Ch. 1175			---	---	---	---	---	---
H	1988.75	2.5	1.2	7.6	8.9	33.0	-24.1	Pass
V	1988.75	2.7	1.2	7.6	9.1	33.0	-23.9	Pass
Beacon BC1 Ch. 25			---	---	---	---	---	---
H	1931.25	5.4	1.2	7.6	11.8	33.0	-21.2	Pass
V	1931.25	4.7	1.2	7.6	11.1	33.0	-21.9	Pass
Beacon BC1 Ch. 525			---	---	---	---	---	---
H	1956.25	7.1	1.2	7.6	13.5	33.0	-19.5	Pass
V	1956.25	5.0	1.2	7.6	11.4	33.0	-21.6	Pass
Beacon BC1 Ch. 1175			---	---	---	---	---	---
H	1988.75	5.3	1.2	7.6	11.7	33.0	-21.3	Pass
V	1988.75	7.1	1.2	7.6	13.5	33.0	-19.5	Pass

Test Site: 1DCC-OATS-3M-I  
 Analyzer: Gold

Signal Generato: Rental Sweeper  
 Receive Antenna: Yellow Horn  
 Transmit Antenna: Black Horn

Receive Cable: EMIR-HIGH-21  
 Transmit Cable: Asset 1507



## ***Band Edge Measurements***

### **LIMITS**

*“The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least  $43 + 10 \log(P)$  dB.”*

[24.238(a)]

*“A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy provided the measured power is integrated over the full required measurement bandwidth (i.e. 1MHz or 1 percent of emission bandwidth, as specified).”* [24.238(b)]

### **MEASUREMENTS / RESULTS**

Note: Mask lines are set to -13dBm at 1930MHz and 1990MHz.

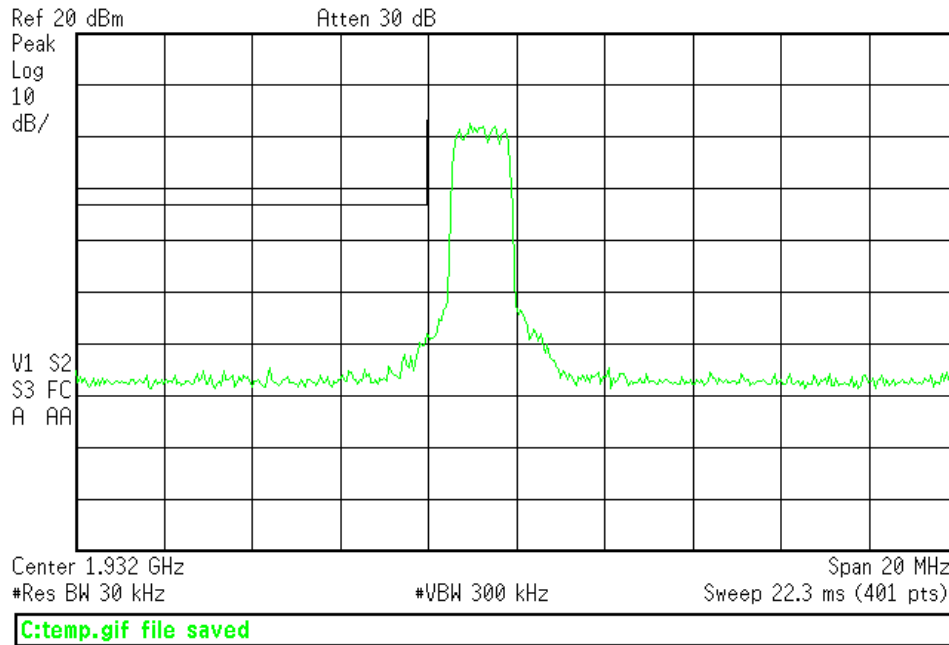
Spectrum analyzer screen plots for EVDO, One-X, and Beacon BC1 are shown on the following pages.



# EVDO

Agilent 15:39:25 Oct 30, 2012

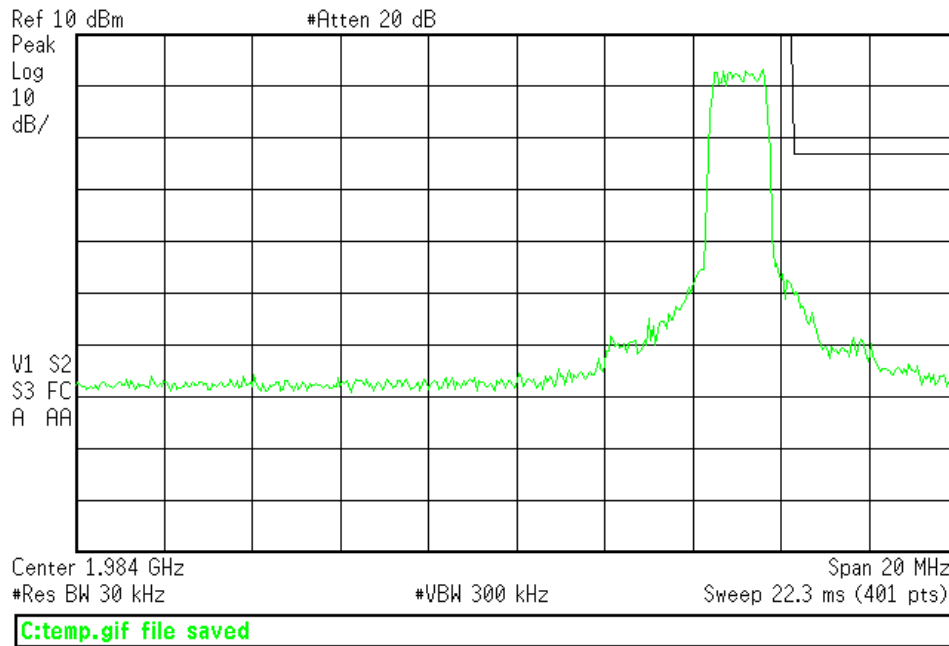
R T



EVDO Low Channel

Agilent 15:45:24 Oct 30, 2012

R T



EVDO High Channel

(The center frequency is displayed as 1.984GHz when it was in fact 1.98375GHz. This places the vertical mask line at 1990MHz.)

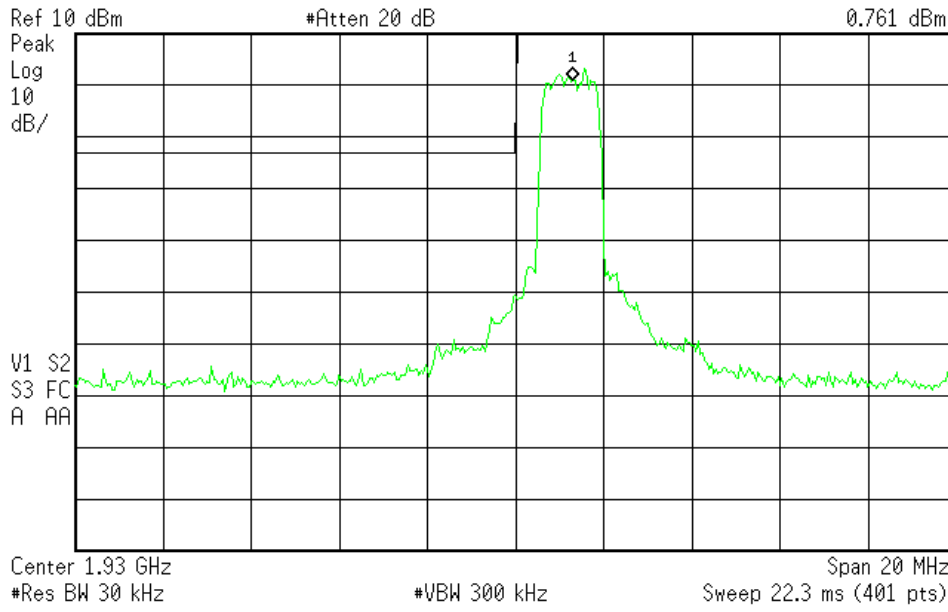


# One-X

Agilent 16:00:41 Oct 30, 2012

R T

Mkr1 1.93130 GHz  
0.761 dBm

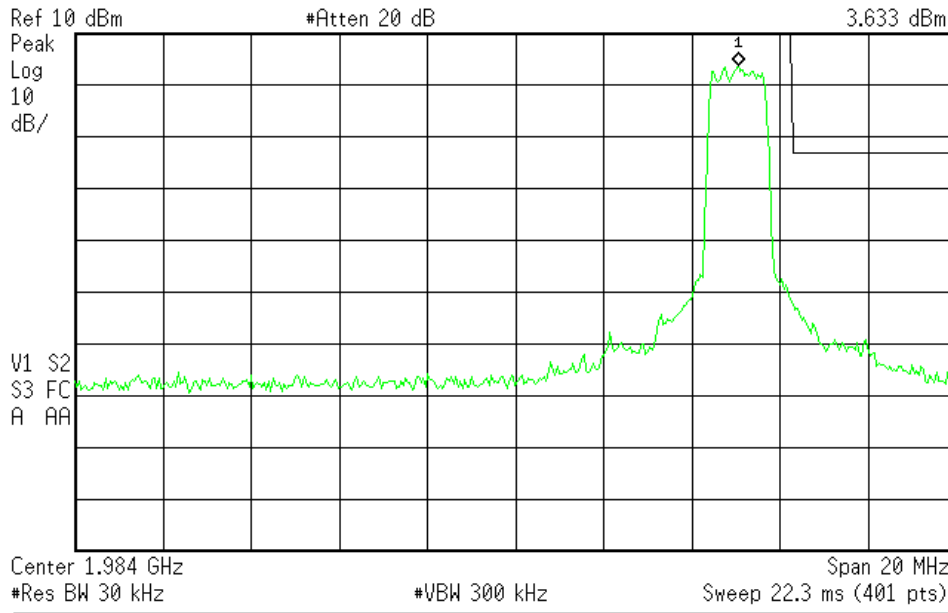


One-X Low Channel

Agilent 15:55:18 Oct 30, 2012

R T

Mkr1 1.98875 GHz  
3.633 dBm



One-x High Channel

(The center frequency is displayed as 1.984GHz when it was in fact 1.98375GHz. This places the vertical mask line at 1990MHz.)



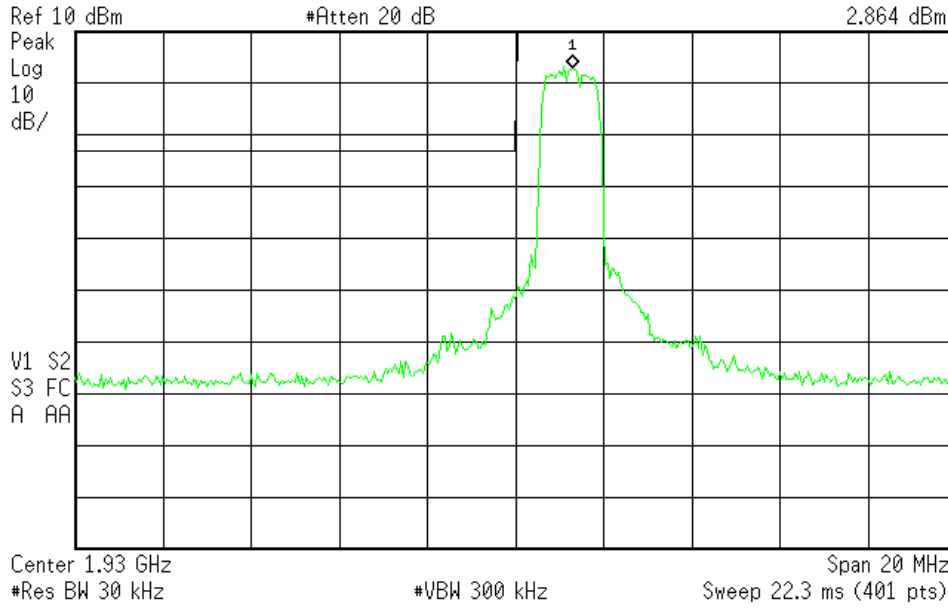


# Beacon BC1

Agilent 15:59:13 Oct 30, 2012

R T

Mkr1 1.93130 GHz  
2.864 dBm

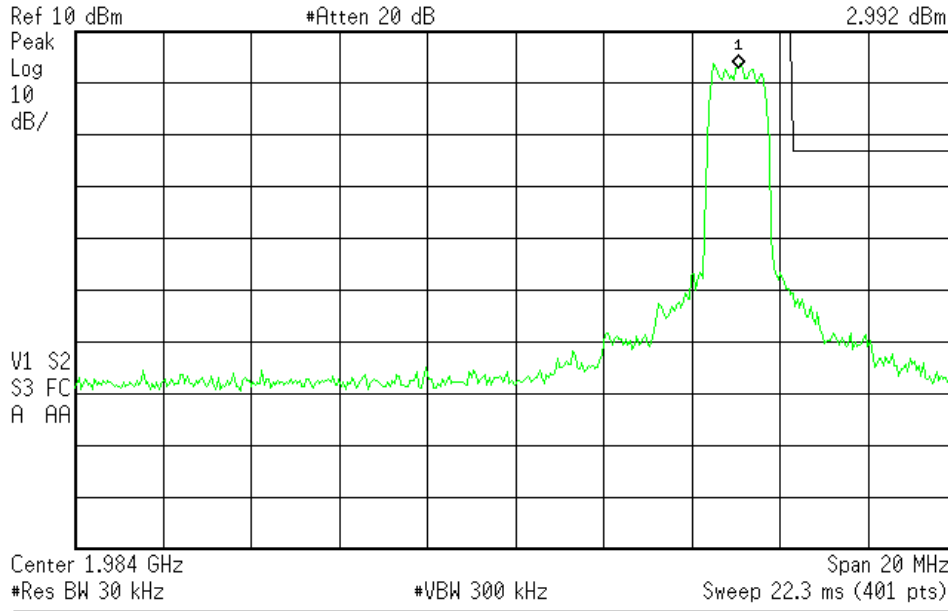


Beacon BC1 Low Channel

Agilent 15:56:25 Oct 30, 2012

R T

Mkr1 1.98875 GHz  
2.992 dBm



Beacon BC1 High Channel

(The center frequency is displayed as 1.984GHz when it was in fact 1.98375GHz. This places the vertical mask line at 1990MHz.)



## ***Conducted Spurious Emissions at Antenna Port***

### **LIMITS**

*“The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least  $43 + 10 \log(P)$  dB.”*  
[24.238(a)]

$$\text{Limit} = 10 \cdot \log(P[\text{mW}]) - (43 + 10 \cdot \log(P[\text{W}])) = -13\text{dBm}$$

Spectrum analyzer screen plots for EVDO, One-X, and Beacon BC1 are shown on the following pages.

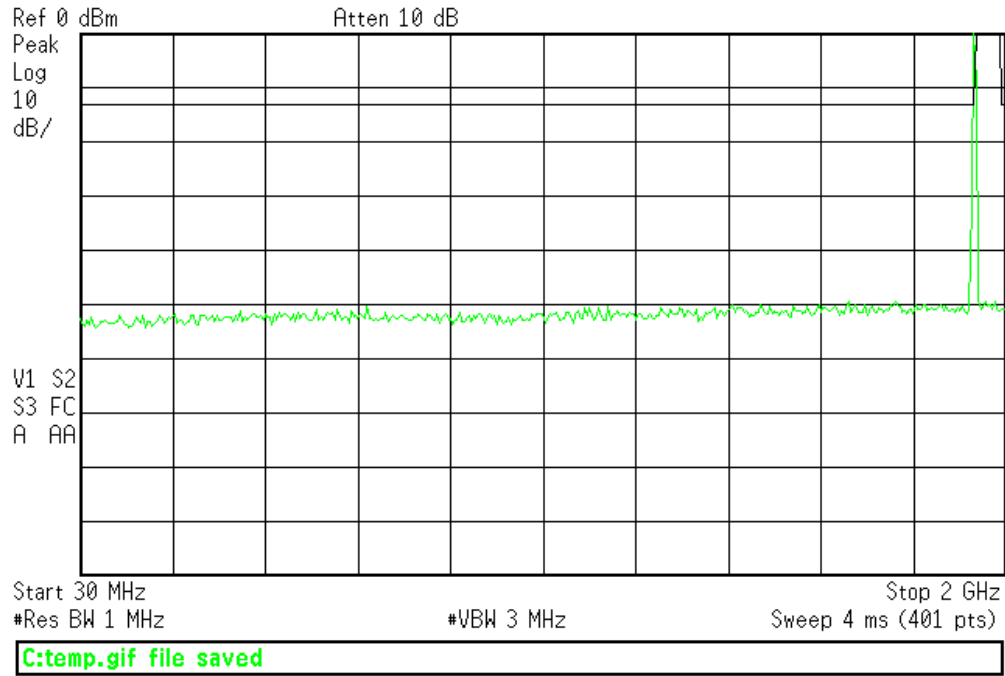


# PLOTS

## EVDO

Agilent 15:58:19 Oct 30, 2012

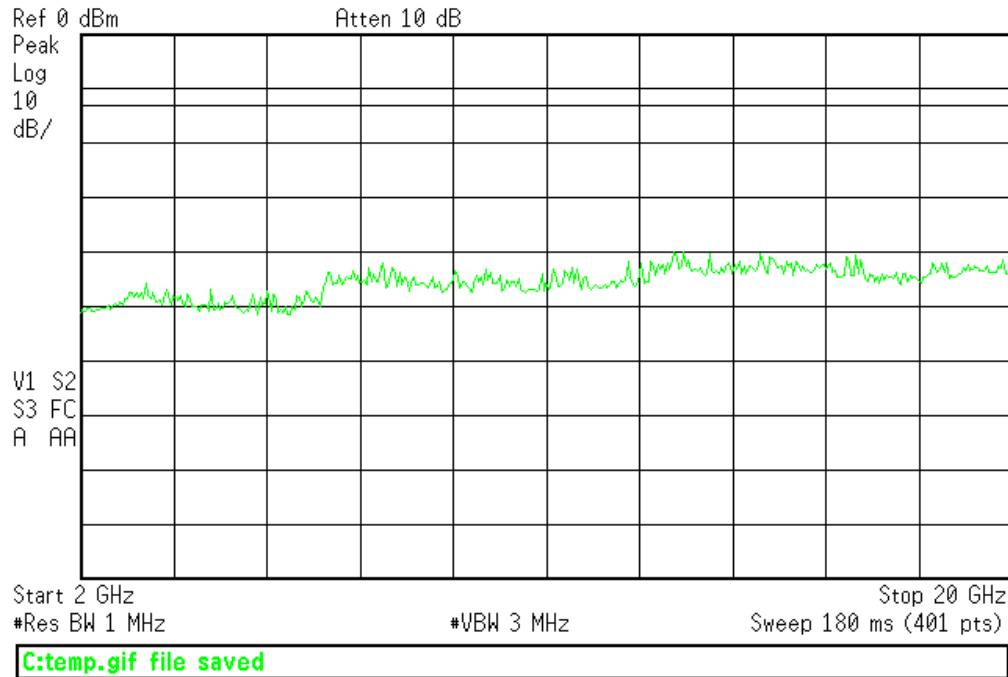
R T



EVDO 30MHz to 2GHz

Agilent 15:58:56 Oct 30, 2012

R T



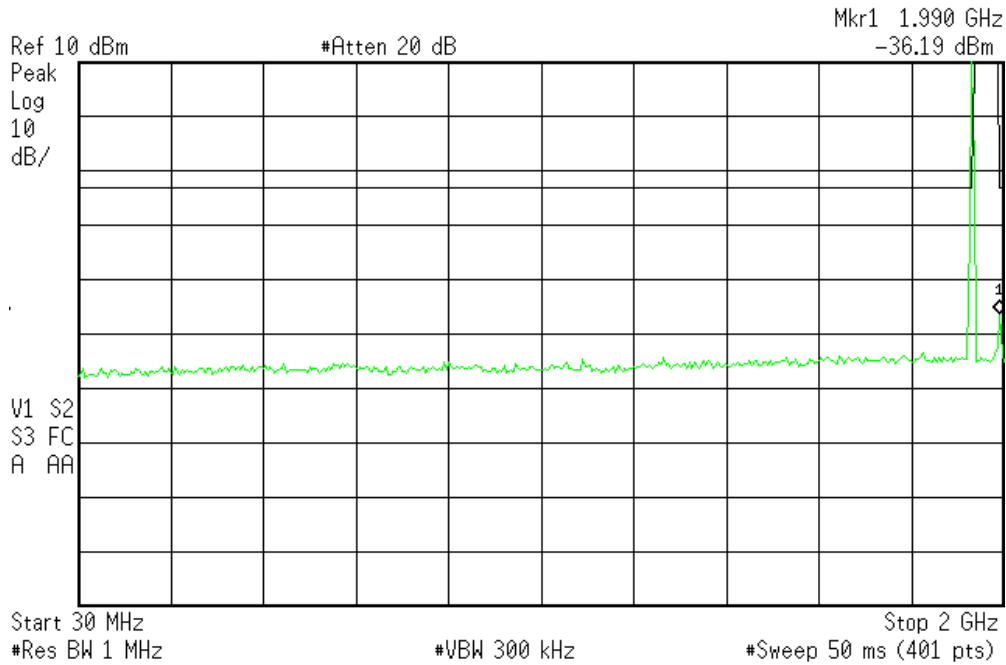
EVDO 2GHz to 20GHz



# One-X

Agilent 16:22:41 Oct 30, 2012

R T

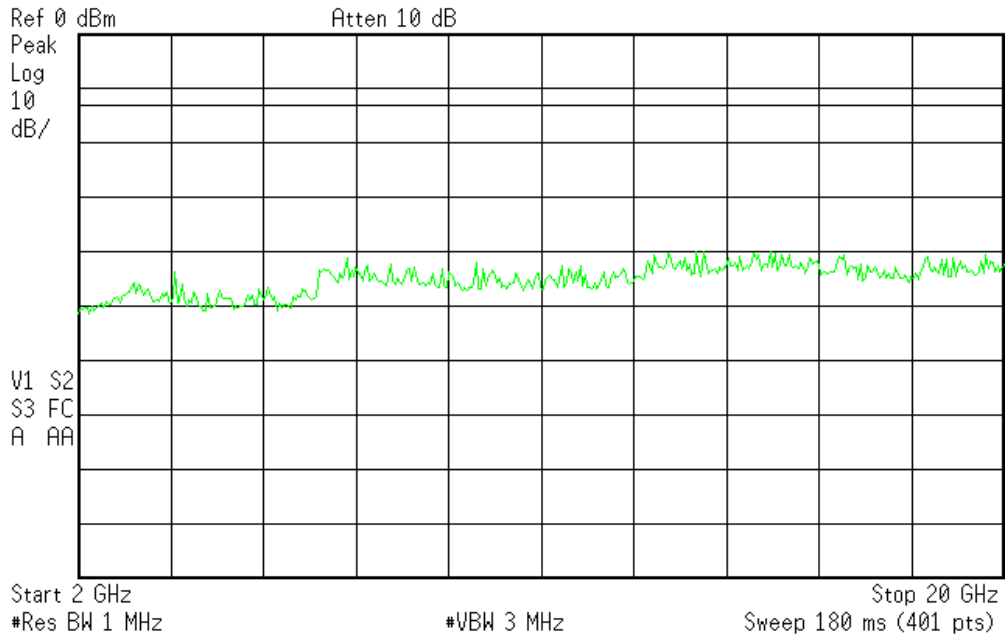


C:\temp.gif file saved

One-X 30MHz to 2GHz

Agilent 15:54:44 Oct 30, 2012

R T



C:\temp.gif file saved

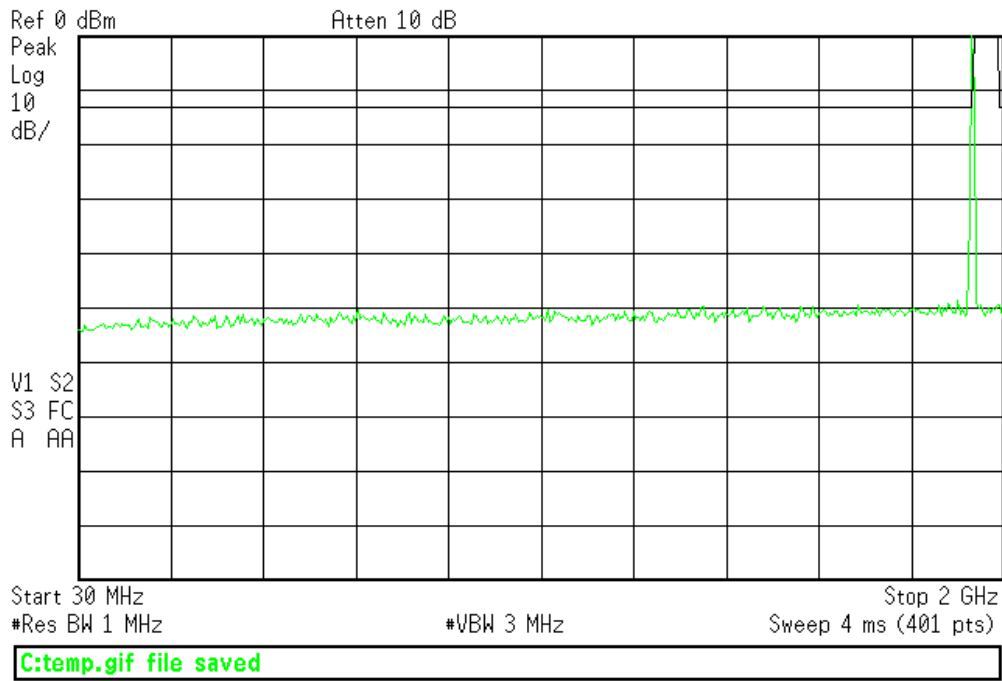
One-X 2GHz to 20GHz



# Beacon BC1

Agilent 15:57:17 Oct 30, 2012

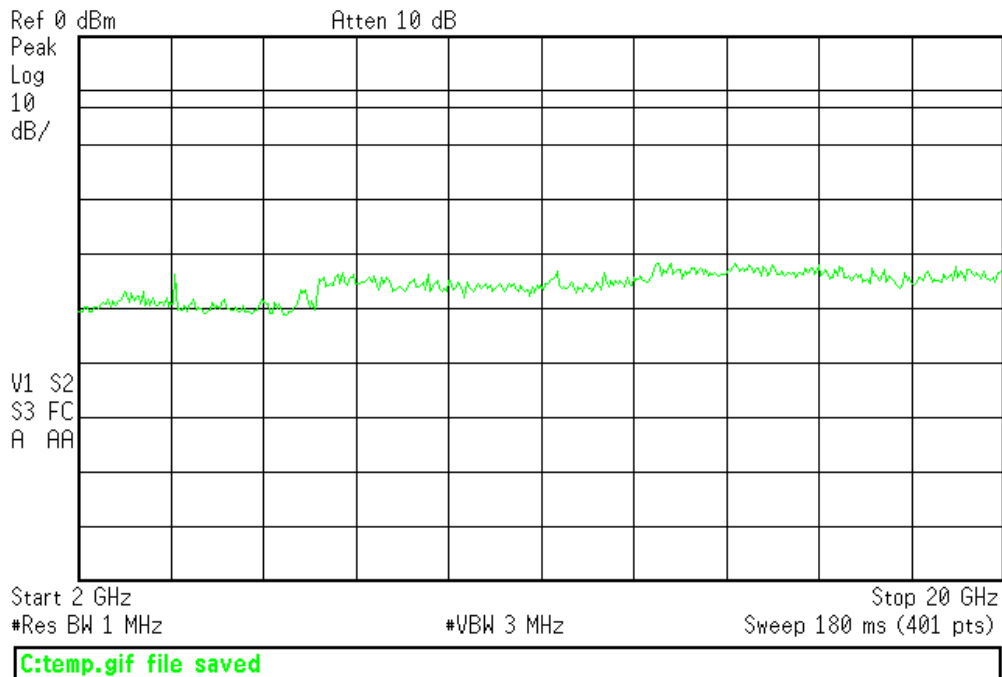
R T



Beacon BC1 30MHz to 2GHz

Agilent 15:56:47 Oct 30, 2012

R T



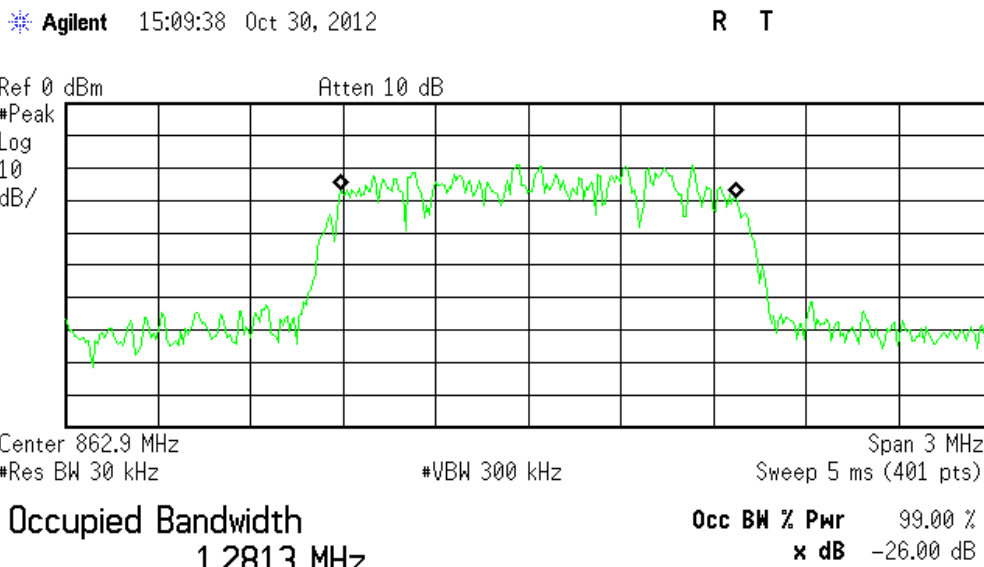
Beacon BC1 2GHz to 20GHz



## Tests Specific to Part 90

### Occupied Bandwidth

Bandwidth Measurements				
Date: 30-Oct-12		Company: Airvana		Work Order: M2588
Engineer: Arik Zwirner		EUT Desc: 750703 Femto Cell		EUT Power: 120Vac/60Hz
Temp: 23°C		Humidity: 34%		Pressure: 999mbar
Frequency Range: 862-869MHz, FCC Part 90				
Notes:				
OUTPUT	CHANNEL POSITION	CHANNEL NUMBER	FREQUENCY (MHz)	26dB BANDWIDTH (MHz)
Beacon BC10	Low	476	862.90	1.423
	Mid	576	865.4	1.372
	High	676	867.9	1.413
Test Site: 1DCC-OATS-3M-I			Spectrum Analyzer: Gold	

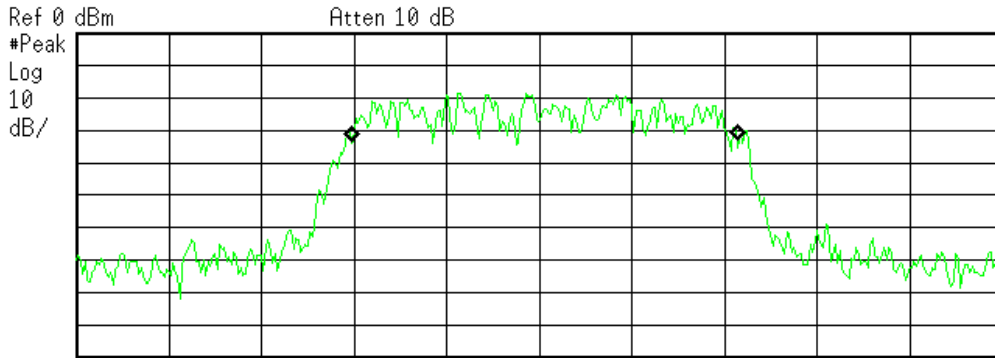


Transmit Freq Error 31.510 kHz  
 x dB Bandwidth 1.423 MHz\*

C:\temp.gif file saved

Beacon BC10 Low Channel (Ch. 476)





Center 865.4 MHz Span 3 MHz  
 #Res BW 30 kHz #VBW 300 kHz Sweep 5 ms (401 pts)

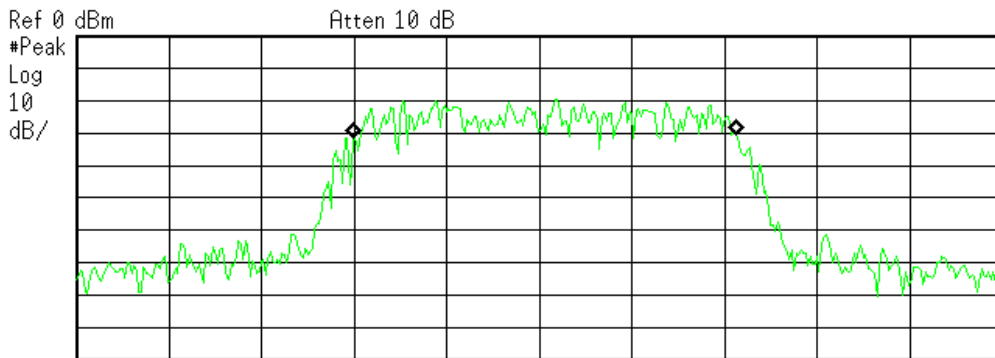
**Occupied Bandwidth**  
 1.2462 MHz

**Occ BW % Pwr** 99.00 %  
**x dB** -26.00 dB

**Transmit Freq Error** 19.201 kHz  
**x dB Bandwidth** 1.372 MHz\*

C:\temp.gif file saved

Beacon BC10 Mid Channel (Ch. 576)



Center 867.9 MHz Span 3 MHz  
 #Res BW 30 kHz #VBW 300 kHz Sweep 5 ms (401 pts)

**Occupied Bandwidth**  
 1.2334 MHz

**Occ BW % Pwr** 99.00 %  
**x dB** -26.00 dB

**Transmit Freq Error** 19.464 kHz  
**x dB Bandwidth** 1.413 MHz\*

C:\temp.gif file saved

Beacon BC10 High Channel (Ch. 676)



# ERP

ERP Using Substitution Method								
Date: 01-Nov-12			Company: Airvana			Work Order: M2258		
Engineer: Arik Zwirner			EUT Desc: 750703 Femto Cell			EUT Operating Voltage/Frequency: 120Vac/60Hz		
Temp: 21 °C			Humidity: 31%			Pressure: 1007mbar		
Frequency Range: 862-869MHz, FCC Part 90					Measurement Distance: 3 m			
Notes: Beacon BC10 is under test. 20dBW = 100W = 50dBm								
Antenna Polarization (H / V)	Frequency (MHz)	Signal Generator Power Output (dBm)				FCC 90.635 (b)		
			Tx Cable (dB)	Tx Ant Gain (dBi)	Adjusted ERP (dBm)	Limit (dBm)	Margin (dB)	Result (Pass/Fail)
Channel 476			---	---	---	---	---	---
V	862.9	4.5	0.9	0.0	3.6	50.0	-46.4	Pass
H	862.9	2.8	0.9	0.0	1.9	50.0	-48.1	Pass
Channel 576			---	---	---	---	---	---
V	865.4	4.2	0.9	0.0	3.3	50.0	-46.7	Pass
H	865.4	2.0	0.9	0.0	1.1	50.0	-48.9	Pass
Channel 676			---	---	---	---	---	---
V	867.9	3.8	0.9	0.0	2.9	50.0	-47.1	Pass
H	867.9	-0.5	0.9	0.0	-1.4	50.0	-51.4	Pass
Test Site: 1DCC-OATS-3M-I			Signal Generator: Rental Sweeper			Receive Cable: EMIR-HIGH-21		
Analyzer: Gold			Receive Antenna: Green			Transmit Cable: Asset 1507		
			Transmit Antenna: Dipole					





## ***Emission Mask***

### **LIMITS**

47 CFR 90.961:

(a) Out-of-band emission requirement shall apply only to the “outer” channels included in an EA license and to spectrum adjacent to interior channels used by incumbent licensees. The emission limits are as follows:

(1) For any frequency removed from the EA licensee's frequency block by up to and including 37.5 kHz, the power of any emission shall be attenuated below the transmitter power (P) in watts by at least  $116 \text{ Log}_{10} (f/6.1)$  decibels or  $50 + 10 \text{ Log}_{10} (P)$  decibels or 80 decibels, whichever is the lesser attenuation, where f is the frequency removed from the center of the outer channel in the block in kilohertz and where f is greater than 12.5 kHz.

(2) For any frequency removed from the EA licensee's frequency block greater than 37.5 kHz, the power of any emission shall be attenuated below the transmitter power (P) in watts by at least  $43 + 10 \text{ Log}_{10} (P)$  decibels or 80 decibels, whichever is the lesser attenuation, where f is the frequency removed from the center of the outer channel in the block in kilohertz and where f is greater than 37.5 kHz.

### **MEASUREMENTS / RESULTS**

Spectrum Analyzer settings:

Resolution Bandwidth: 30kHz  
Video Bandwidth: 300kHz  
Peak detector

Emission Mask:

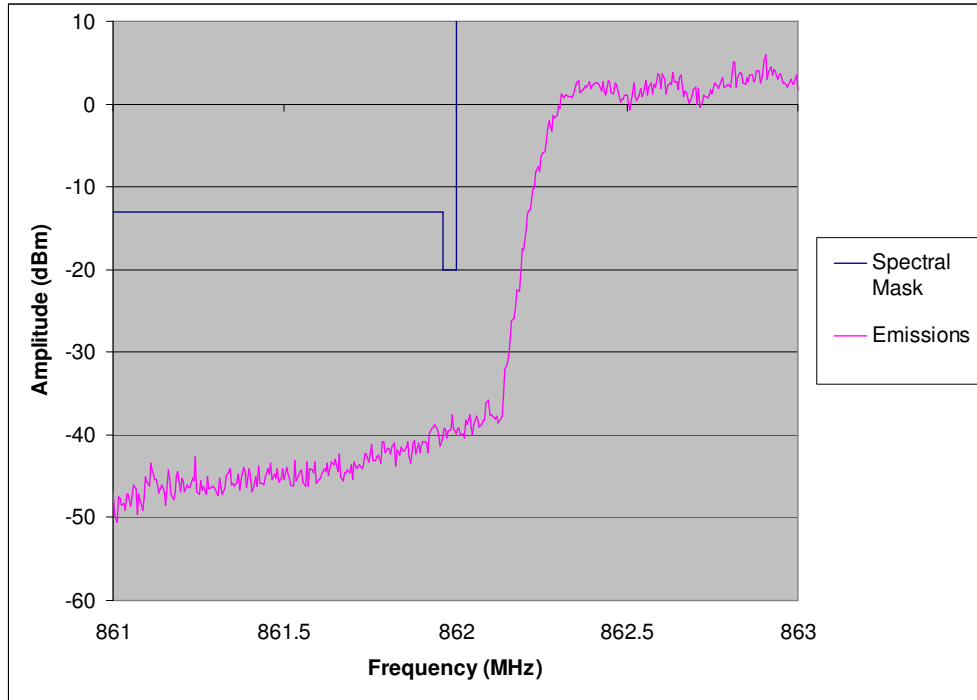
The following limits are applied in the spectral plots:

Attenuation within 37.5kHz of band:  $50 + 10 \text{ Log}(P)$ , resulting in -20dBm

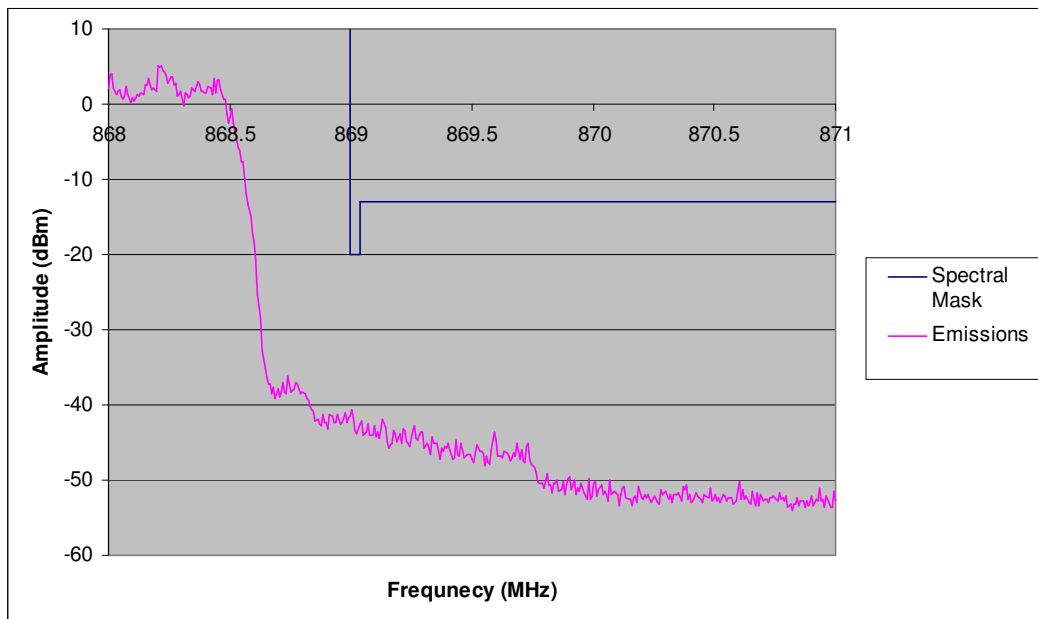
Attenuation beyond 37.5kHz from band:  $43 + 10 \text{ Log}(P)$ , resulting in -13dBm



# PLOTS



Beacon BC10 Low Channel



Beacon BC10 High Channel



## Conducted Spurious Emissions at Antenna Port

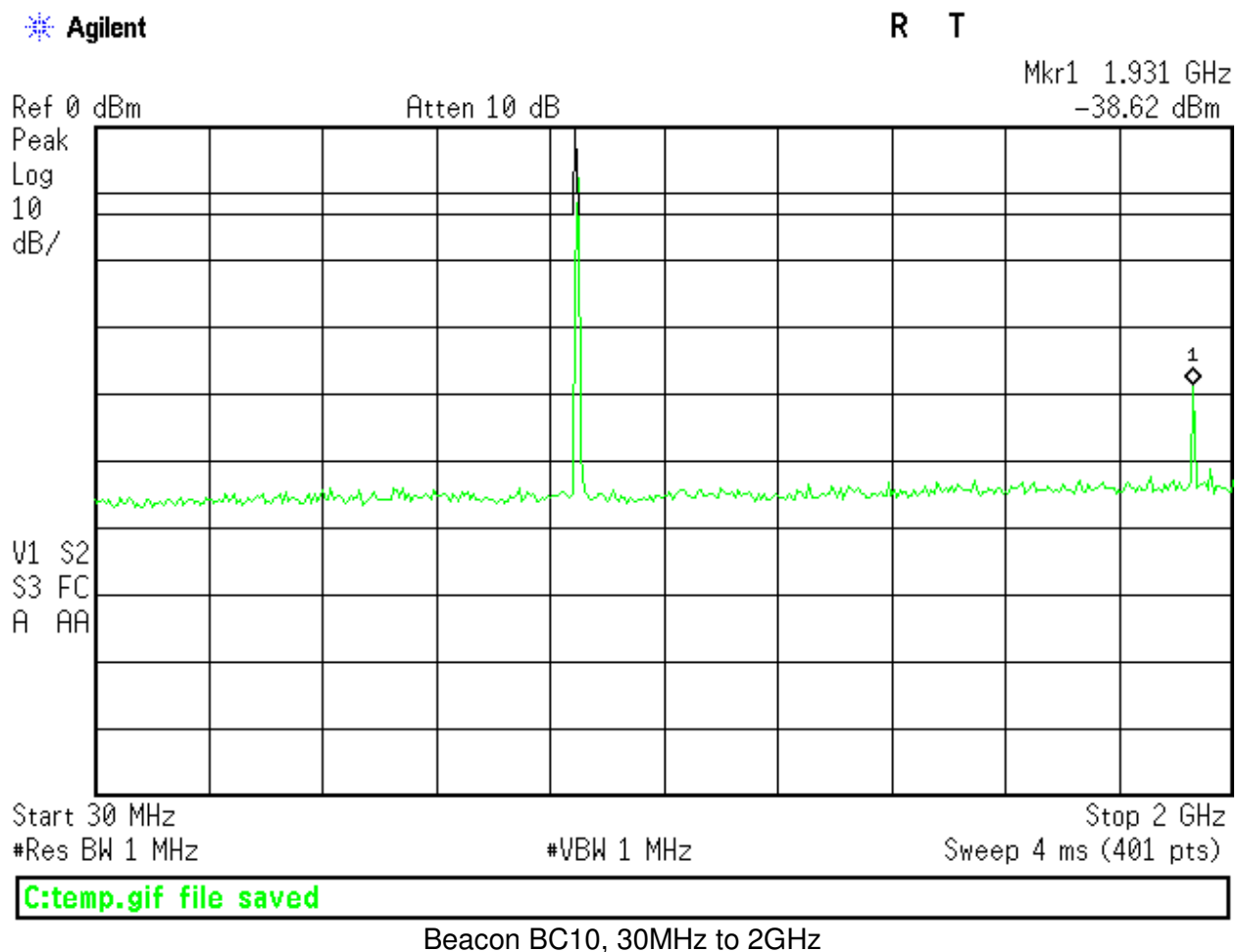
### LIMITS

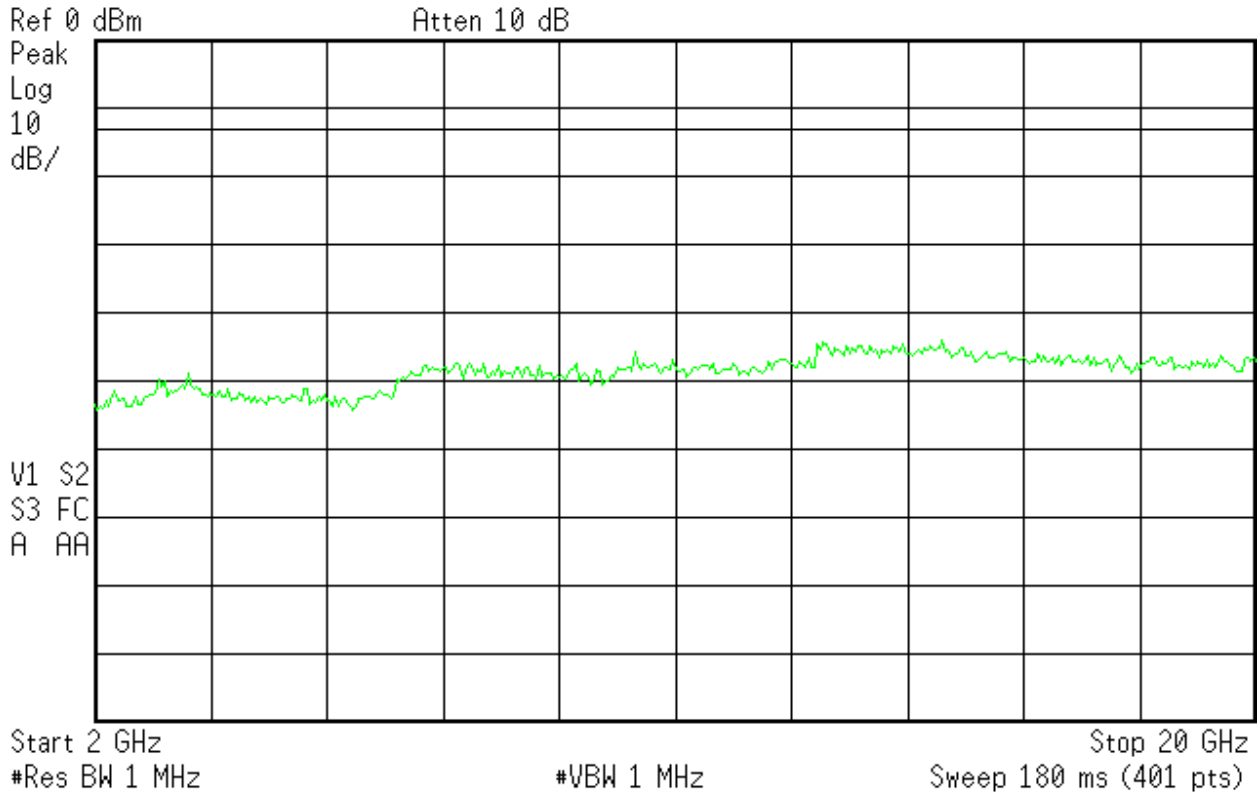
90.669 Emission limits.

(a) On any frequency in an MTA licensee's spectrum block that is adjacent to a non-MTA frequency, the power of any emission shall be attenuated below the transmitter power (P) by at least 43 plus  $10 \log_{10}(P)$  decibels or 80 decibels, whichever is the lesser attenuation.

$$\text{Limit} = 10 \cdot \log(P[\text{mW}]) - (43 + 10 \cdot \log(P[\text{W}])) = -13\text{dBm}$$

### PLOTS





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Beacon BC10, 2-20GHz



# Tests for Parts 22, 24, & 90: Spurious Emissions and Frequency Stability

## Radiated Spurious Emissions Measurements

### MEASUREMENTS / RESULTS

Note that the EUT passes the FCC Class B limit, which is much lower than the -13dBm limit (82.158dBuV/m at 3 meters) for licensed transmitter spurious emissions. Only worst-case radiated spurious data is presented.

Radiated Emissions Table												
Date: 29-Oct-12			Company: Airvana				Work Order: M2588					
Engineer: Arik Zwirner			EUT Desc: 750703 Femto Cell				EUT Operating Voltage/Frequency: 120Vac/60Hz					
Temp: 22°C			Humidity: 25%				Pressure: 993mBar					
Frequency Range: 30-1000MHz							Measurement Distance: 3 m					
Notes:											EUT Max Freq: 1GHz digital / 1.8GHz xmitter	
Antenna Polarization (H / V)	Frequency (MHz)	Reading (dBuV)	Preamp Factor (dB)	Antenna Factor (dB/m)	Cable Factor (dB)	Adjusted Reading (dBuV/m)	---			FCC Class B		
							Limit (dBuV/m)	Margin (dB)	Result (Pass/Fail)	Limit (dBuV/m)	Margin (dB)	Result (Pass/Fail)
V	30.0	37.1	22.5	21.2	0.5	36.3	---	---	---	40.0	-3.7	Pass
V	43.8	43.5	22.5	11.1	0.5	32.6	---	---	---	40.0	-7.4	Pass
V	44.7	41.4	22.5	10.5	0.5	29.9	---	---	---	40.0	-10.1	Pass
V	57.6	49.8	22.5	7.3	0.6	35.2	---	---	---	40.0	-4.8	Pass
V	74.6	46.5	22.5	8.0	0.7	32.7	---	---	---	40.0	-7.3	Pass
V	88.9	51.7	22.5	7.5	0.8	37.5	---	---	---	43.5	-6.0	Pass
V	90.4	51.8	22.5	7.6	0.8	37.7	---	---	---	43.5	-5.8	Pass
V	182.0	42.2	22.5	10.6	1.2	31.5	---	---	---	43.5	-12.0	Pass
V	200.0	48.8	22.5	12.1	1.3	39.7	---	---	---	43.5	-3.8	Pass
H	250.0	54.7	22.5	11.5	1.4	45.1	---	---	---	46.0	-0.9	Pass
H	375.0	46.3	22.4	15.0	1.7	40.6	---	---	---	46.0	-5.4	Pass
H	400.0	41.0	22.4	15.4	1.8	35.8	---	---	---	46.0	-10.2	Pass
V	475.0	37.7	22.3	17.5	2.2	35.1	---	---	---	46.0	-10.9	Pass
V	500.0	40.8	22.4	17.6	2.1	38.1	---	---	---	46.0	-7.9	Pass
H	625.0	39.5	22.1	19.2	2.4	39.0	---	---	---	46.0	-7.0	Pass
H	750.0	41.3	22.1	20.6	2.5	42.3	---	---	---	46.0	-3.7	Pass
V	875.0	40.9	22.0	21.9	2.8	43.6	---	---	---	46.0	-2.4	Pass
H	1000.0	35.5	21.9	23.0	2.9	39.5	---	---	---	54.0	-14.5	Pass
<b>Table Result:</b> Pass by -0.9 dB							<b>Worst Freq:</b> 250.0 MHz					
Test Site: EMI Chamber 1			Cable 1: Asset #1505				Cable 2: Asset #1507					
Analyzer: Gold			Preamp: Blue				Antenna: Red-Black					

Radiated Emissions Table														
Date: 29-Oct-12			Company: Airvana				Work Order: M2588							
Engineer: Arik Zwirner			EUT Desc: 750703 Femto Cell				EUT Operating Voltage/Frequency: 120Vac/60Hz							
Temp: 22°C			Humidity: 25%				Pressure: 993mBar							
Frequency Range: 1-6GHz							Measurement Distance: 3 m							
Notes:											EUT Max Freq: 1GHz digital / 1.8GHz xmitter			
Antenna Polarization (H / V)	Frequency (MHz)	Peak Reading (dBuV)	Average Reading (dBuV)	Preamp Factor (dB)	Antenna Factor (dB/m)	Cable Factor (dB)	Adjusted Peak Reading (dBuV/m)	Adjusted Avg Reading (dBuV/m)	FCC Class A High Frequency - Peak			FCC Class A High Frequency - Average		
									Limit (dBuV/m)	Margin (dB)	Result (Pass/Fail)	Limit (dBuV/m)	Margin (dB)	Result (Pass/Fail)
V	1433.0	65.0	54.4	41.0	25.7	3.4	53.1	42.5	80.0	-26.9	Pass	60.0	-17.5	Pass
H	3155.0	50.8	42.6	40.3	30.6	5.2	46.3	38.1	80.0	-33.7	Pass	60.0	-21.9	Pass
H	3920.0	56.0	49.3	39.9	32.7	5.9	54.7	48.0	80.0	-25.3	Pass	60.0	-12.0	Pass
H	3975.0	54.7	47.9	39.8	32.7	5.7	53.3	46.5	80.0	-26.7	Pass	60.0	-13.5	Pass
H	4125.0	50.6	41.1	39.7	32.3	5.4	48.6	39.1	80.0	-31.4	Pass	60.0	-20.9	Pass
V	5880.0	52.4	48.8	39.1	33.9	6.6	53.8	50.2	80.0	-26.2	Pass	60.0	-9.8	Pass
<b>Table Result:</b> Pass by -9.8 dB							<b>Worst Freq:</b> 5880.0 MHz							
Test Site: EMI Chamber 1			Cable 1: Asset #1505				Cable 2: Asset #1507							
Analyzer: Gold			Preamp: Red-Green				Antenna: Orange Horn							



Radiated Emissions Table															
Date: 29-Oct-12				Company: Airvana				Work Order: M2588							
Engineer: Arik Zwirner				EUT Desc: 750703 Femto Cell				EUT Operating Voltage/Frequency: 120Vac/60Hz							
Temp: 22°C				Humidity: 25%				Pressure: 993mBar				Measurement Distance: 1 m			
Frequency Range: 6-18GHz										EUT Max Freq: 1GHz digital / 1.8GHz xmitter					
Notes:															
Antenna Polarization (H / V)	Frequency (MHz)	Peak Reading (dBµV)	Average Reading (dBµV)	Preamp Factor (dB)	Antenna Factor (dB/m)	Cable Factor (dB)	Adjusted Peak Reading (dBµV/m)	Adjusted Avg Reading (dBµV/m)	FCC Class A High Frequency - Peak			FCC Class A High Frequency - Average			
									Limit (dBµV/m)	Margin (dB)	Result (Pass/Fail)	Limit (dBµV/m)	Margin (dB)	Result (Pass/Fail)	
V	8625.0	51.2	42.7	39.5	37.9	8.7	58.3	49.8	89.5	-31.2	Pass	69.5	-19.7	Pass	
<b>Table Result:</b> Pass by -19.7 dB <b>Worst Freq:</b> 8625.0 MHz															
Test Site: EMI Chamber 1				Cable 1: Asset #1505				Cable 2: Asset #1507							
Analyzer: Gold				Preamp: Red-Green				Antenna: Orange Horn							

Radiated Emissions Table															
Date: 29-Oct-12				Company: Airvana				Work Order: M2588							
Engineer: Arik Zwirner				EUT Desc: 750703 Femto Cell				EUT Operating Voltage/Frequency: 120Vac/60Hz							
Temp: 22°C				Humidity: 25%				Pressure: 993mBar				Measurement Distance: 0.3 m			
Frequency Range: 18-20GHz										EUT Max Freq: 1GHz digital / 1.8GHz xmitter					
Notes:															
Antenna Polarization (H / V)	Frequency (MHz)	Peak Reading (dBµV)	Average Reading (dBµV)	Preamp Factor (dB)	Antenna Factor (dB/m)	Cable Factor (dB)	Adjusted Peak Reading (dBµV/m)	Adjusted Avg Reading (dBµV/m)	FCC Class A High Frequency - Peak			FCC Class A High Frequency - Average			
									Limit (dBµV/m)	Margin (dB)	Result (Pass/Fail)	Limit (dBµV/m)	Margin (dB)	Result (Pass/Fail)	
NO EMISSIONS WERE FOUND IN THIS RANGE.															
Test Site: EMI Chamber 1				Cable 1: Asset #1507				Antenna: 18-26.5GHz Horn							
Analyzer: Gold				Preamp: 18-26.5GHz											



## ***Frequency Stability*** **REQUIREMENTS**

Part 22:

Per 22.355, Table C-1, the frequency stability shall remain within 1.5ppm for this device.

Part 24:

*“The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block.” [24.235]*

Part 90:

Per 90.213(a), the frequency stability shall remain within 1.5ppm for this device.

## **MEASUREMENTS / RESULTS**

<b>Frequency Stability</b>			<b><i>Curtis-Straus LLC</i></b>
<b>Engineer:</b> Arik Zwirner		<b>Company:</b> Airvana	
<b>Date:</b> 6-Nov-12		<b>EUT:</b> Femto Cell 750703	
<b>Spectrum Analyzer:</b> Rental #1		<b>Work Order:</b> M2588	
<b>Cable:</b> EMIR-High-21			
<b>Notes:</b> Reference Conditions: 110Vac/60Hz, 20 °C			
<b>Temperature</b> (°C)	<b>Supply Voltage</b> (60Hz)	<b>Center Frequency</b> (Hz)	<b>Frequency Deviation</b> (ppm)
-30	110Vac	1956250000	0.0
-20	110Vac	1956250000	0.0
-10	110Vac	1956250000	0.0
0	110Vac	1956250000	0.0
10	110Vac	1956250000	0.0
20	93.5Vac	1956250000	0.0
20	110Vac	1956250000	0.0
20	126.5Vac	1956250000	0.0
30	110Vac	1956250000	0.0
40	110Vac	1956250000	0.0
50	110Vac	1956250000	0.0
<p><i>The EUT has an intentional transmitter that operates at both 800 and 1900MHz bands. The hardware utilized for both bands is the same while the software controls the different bands. Testing was performed at the 1900MHz band only to satisfy the 800MHz band requirements as a single oscillator is used as the source for both.</i></p>			



# Test Equipment Used

Rev. 12/5/2012

<b>Spectrum Analyzers / Receivers / Preselectors</b>							
	<b>Range</b>	<b>MN</b>	<b>Mfr</b>	<b>SN</b>	<b>Asset</b>	<b>Cat</b>	<b>Calibration Due</b>
Black	9kHz-12.8GHz	8596E	Agilent	3710A00944	337	I	1/2/2013
Gold	100Hz-26.5 GHz	E4407B	Agilent	MY45113816	1284	I	2/3/2013
Rental SA #1 (Brown)	9kHz-26.5GHz	E4407B	Agilent	SG44210511	1510	I	2/14/2013
<b>Radiated Emissions Sites</b>							
	<b>FCC Code</b>	<b>IC Code</b>	<b>VCCI Code</b>			<b>Cat</b>	<b>Calibration Due</b>
1DCC-OATS-3M-I	719150	2762A-8	A-0015			II	12/7/2012
EMI Chamber 1	719150	2762A-6	A-0015			II	2/16/2014
<b>Preamps /Couplers Attenuators / Filters</b>							
	<b>Range</b>	<b>MN</b>	<b>Mfr</b>	<b>SN</b>	<b>Asset</b>	<b>Cat</b>	<b>Calibration Due</b>
Blue	0.009-2000MHz	ZFL-1000-LN	CS	N/A	759	II	6/5/2013
Red-Green	1-20GHz	PM2-38-218-4R5-17-15-SFF	CS	N/A	1256	II	6/18/2013
HF (Yellow)	18-26.5GHz	AFS4-18002650-60-8P-4	CS	467559	1266	I	10/13/2013
<b>Antennas</b>							
	<b>Range</b>	<b>MN</b>	<b>Mfr</b>	<b>SN</b>	<b>Asset</b>	<b>Cat</b>	<b>Calibration Due</b>
Green Bilog	30-2000MHz	CBL6112B	Chase	2742	620	I	1/28/2013
Red-Black Bilog	30-2000MHz	JB1	Sunol	A091604-2	1106	I	1/3/2013
Yellow Horn	1-18GHz	3115	EMCO	9608-4898	37	I	6/17/2013
Black Horn	1-18GHz	3115	EMCO	9703-5148	56	I	6/29/2013
Orange Horn	1-18GHz	3115	EMCO	0004-6123	390	I	7/27/2013
HF (White) Horn	18-26.5GHz	801-WLM	Waveline	758	758	I	Verify before Use
Adjustable Dipole	30-1000MHz	3121C	EMCO	1370	757	I	12/1/2012
<b>Meteorological Meters</b>							
		<b>MN</b>	<b>Mfr</b>	<b>SN</b>	<b>Asset</b>	<b>Cat</b>	<b>Calibration Due</b>
Temp./Humidity/Atm. Pressure Gauge		7400 Perception II	Davis	N/A	965	I	4/4/2013
CEM13 Thermohygrometer		35519-044	Control Company	72457729	1338	II	8/19/2013
1DCC-OATS-3M-I Thermohygrometer		35519-044	Control Company	72457635	1334	II	8/19/2013
CHAMBER1 Thermohygrometer		35519-044	Control Company	72457642	1345	II	8/19/2013
<b>Cables</b>							
	<b>Range</b>		<b>Mfr</b>			<b>Cat</b>	<b>Calibration Due</b>
Asset #1505	9kHz - 18GHz		Florida RF			II	2/9/2013
Asset #1507	9kHz - 26.5GHz		Florida RF			II	1/31/2013
Asset #1522	9kHz - 26.5GHz		Florida RF			II	2/8/2013
CEM1-07	9kHz - 2GHz		C-S			II	5/1/2013
REMI-High-21	9kHz - 26.5GHz		C-S			II	1/31/2013
<b>Attenuators</b>							
	<b>Range</b>	<b>MN</b>	<b>Mfr</b>	<b>SN</b>	<b>Asset</b>	<b>Cat</b>	<b>Calibration Due</b>
20dB Atten-4	9kHz-2GHz			N/A		II	12/6/2013
<b>LISNs/Measurement Probes</b>							
	<b>Range</b>	<b>MN</b>	<b>Mfr</b>	<b>SN</b>	<b>Asset</b>	<b>Cat</b>	<b>Calibration Due</b>
Green LISN	9kHz-50MHz	8012-50-R-24-BNC	Solar	411658	987	I	5/10/2013
<b>Conducted Test Sites (Mains / Telco)</b>							
	<b>FCC Code</b>		<b>VCCI Code</b>			<b>Cat</b>	<b>Calibration Due</b>
CEM1 3	719150		A-0015			III	NA

All equipment is calibrated using standards traceable to NIST or other nationally recognized calibration standard.



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## Conducted Spurious Emissions on AC Mains

AC Conducted Emissions Data Table														
Date: 07-Nov-12				Company: Airvana				Work Order: M2588						
Engineer: Arik Zwirner				EUT Desc: Femto Cell				Humidity: 22%						
Temp: 22.0 °C				Pressure: 1001 mBar				Notes:						
Frequency Range: 0.15-30MHz							EUT Input Voltage/Frequency: 120Vac/60Hz							
Frequency (MHz)	Quasi-Peak Readings		Average Readings		LISN Factors		Cable Factor (dB)	ATTN Factor (dB)	FCC/CISPR Class B			FCC/CISPR Class B		
	QP1 (dBuV)	QP2 (dBuV)	AVG1 (dBuV)	AVG2 (dBuV)	L1 (dB)	L2 (dB)			QP Limit (dB)	Margin (dB)	Result (Pass/Fail)	AVG Limit (dB)	Margin (dB)	Result (Pass/Fail)
0.15	9.6	8.7	3.4	2.9	-0.3	-0.6	-0.1	-20.8	66.0	-35.2	Pass	56.0	-31.4	Pass
0.30	16.1	15.5	11.0	9.8	-0.1	-0.4	-0.1	-20.8	60.3	-23.2	Pass	50.3	-18.3	Pass
0.50	3.9	3.8	-1.1	-0.9	-0.1	-0.2	-0.1	-20.8	56.0	-31.1	Pass	46.0	-25.8	Pass
4.35	2.3	1.7	-3.0	-3.6	-0.1	-0.1	-0.1	-20.8	56.0	-32.7	Pass	46.0	-28.0	Pass
13.35	2.1	1.6	-3.3	4.0	-0.1	-0.1	-0.2	-20.8	60.0	-36.8	Pass	50.0	-24.9	Pass
22.80	2.0	0.8	-4.0	-6.1	-0.1	-0.1	-0.3	-20.8	60.0	-36.8	Pass	50.0	-32.8	Pass
<b>Result:</b> Pass				<b>Worst Margin:</b> -18.3 dB				<b>Frequency:</b> 0.30 MHz						
Measurement Device: Green LISN				Cable: CEMI-07				Spectrum Analyzer: Black						
				Attenuator: 20dB Atten-4				Site: CEMI 3						



## Conditions Of Testing

[Bureau Veritas Consumer Products Services, Inc., a Massachusetts corporation], and/or its affiliates (collectively, the "Company") will conduct, at the request of the Submitter ("Client"), the tests specified on the submitted Test Request Form or equivalent in accordance with, and subject to, the following terms and conditions (collectively, "Conditions"):

1. All orders for tests are subject to acceptance by the Company, and no order will constitute a binding commitment of the Company unless and until such order is accepted by it, as evidenced by the issuance of a written report ("Test Report") by the Company. The Test Report is issued solely by the Company, is intended for the exclusive use of Client and shall not be published, used for advertising purposes, copied or replicated for distribution to any other person or entity or otherwise publicly disclosed without the prior written consent of the Company. By submitting a request for services to the Company, Client consents to the disclosure to accreditation bodies of those records of Client relevant to the accreditation body's assessment of the Company's competence and compliance with relevant accreditation criteria. The Company shall not be liable for any loss or damage whatsoever resulting from the failure of the Company to provide its services within any time period for completion estimated by the Company. If Client anticipates using the Test Report in any legal proceeding, arbitration, dispute resolution forum or other proceeding, it shall so notify the Company prior to submitting the Test Report in such proceeding. The Company has no obligation to provide a fact or expert witness at such proceeding unless the Company agrees in advance to do so for a separate and additional fee.

2. The Test Report will set forth the findings of the Company solely with respect to the test samples identified therein. Unless specifically and expressly indicated in the Test Report, the results set forth in such Test Report are not intended to be indicative or representative of the quality or characteristics of the lot from which a test sample is taken, and Client shall not rely upon the Test Report as being so indicative or representative of the lot or of the tested product in general. The Test Report will reflect the findings of the Company at the time of testing only, and the Company shall have no obligation to update the Test Report after its issuance. The Test Report will set forth the results of the tests performed by the Company based upon the written information provided to the Company. The Test Report will be based solely on the samples and written information submitted to the Company by Client, and the Company shall not be obligated to conduct any independent investigation or inquiry with respect thereto.

3. The Company may, in its sole discretion, destroy samples which have been furnished to the Company for testing and which have not been destroyed in the course of testing. The Company may delegate the performance of all or a portion of the services contemplated hereunder to an affiliate, agent or subcontractor of the Company, and Client consents to such delegation.

4. These Conditions and the Test Report represent the entire understanding of the parties hereto with respect to the subject matter hereof and of the Test Report, and no modification, variance or extrapolation with respect thereto shall be permitted without the prior written consent of the Company.

5. The names, service marks, trademarks and copyrights of the Company and its affiliates, including the names "BUREAU VERITAS," "BUREAU VERITAS CONSUMER PRODUCTS SERVICES," "BVCPS," "MTL," "ACTS," "MTL-ACTS" and "CURTIS-STRAUS" (collectively, the "Marks") are and shall remain the sole property of the Company or its affiliates and shall not be used by Client except solely to the extent that Client obtains the prior written approval of the Company and then only in the manner prescribed by the Company. Client shall not contest the validity of the Marks or take any action that might impair the value or goodwill associated with the Marks or the image or reputation of the Company or its affiliates.

6. Payment in full shall be due 30 days after the date of invoice. Interest shall be due on overdue amounts from the due date until paid at an interest rate of 1.5% per month or, if less, the maximum rate permitted by law. The Company reserves the right, at any time and from time to time, to revoke any credit extended to Client. Client shall reimburse the Company for any costs it incurs in collecting past due amounts, including court costs and fees and expenses of attorneys and collection agencies. The Test Report may not be used or relied upon by Client if and for so long as Client fails to pay when due any invoice issued by the Company or any affiliate of it to Client or any affiliate or subsidiary of Client together with interest and penalties, if any, accrued thereon.

7. The Company disclaims any and all responsibility or liability arising out of or in connection with e-mail transmissions of such information.

8. Client understands and agrees that the Company is neither an insurer nor a guarantor, that the Company does not take the place of Client or any designer, manufacturer, agent, buyer, distributor or transportation or shipping company, and that the Company disclaims all liability in such capacities. Client further understands that if it seeks assurance against loss or damage, it should obtain appropriate insurance.

9. Client agrees that the Company, by providing the services, does not take the place of Client nor any third party, nor does the Company release them from any of their obligations, nor does the Company otherwise assume, abridge, abrogate or undertake to discharge any duty of any third party to Client or any duty of Client or any third party to any other third party, and Client will not release any third party from its obligations and duties with respect to the tested goods.

10. Client shall, on a timely basis, (a) provide adequate instructions to the Company in order to enable the Company to perform properly its services, (b) provide, or cause Client's suppliers and contractors to provide, the Company with all documents necessary to enable the Company to perform its services, (c) furnish the Company with all relevant information regarding Client's intended use and purposes of the tested goods, (d) advise the Company of essential dates and deadlines relevant to the tested goods and (e) fully exercise all rights and remedies available to Client against third parties in respect of the tested goods.

11. The Company shall undertake due care and ordinary skill in the performance of its services to Client, and the Company shall accept responsibility only where such skill has not been exercised and, even in such event, only to the extent of the limitation of liability set forth herein.

12. If Client desires to assert a claim arising from or relating to (i) the performance, purported performance or non-performance of any services by the Company or (ii) the sale, resale, manufacture, distribution or use of any tested goods, it must submit that claim to the Company in a writing that sets forth with particularity the basis for such claim within 60 days from discovery of the potential claim and not more than six months after the date of issuance of the Test Report to Client. Client waives any and all such claims including, without limitation, claims that the Test Report is inaccurate, incomplete or misleading or that additional or different testing is required, unless and then only to the extent that Client submits a written claim to the Company within both such time periods.

13. CLIENT SHALL, EXCEPT TO THE EXTENT OF COMPANY'S LIABILITY TO CLIENT HEREUNDER (WHICH IN NO EVENT SHALL EXCEED THE LIMITATION OF LIABILITY HEREIN), HOLD HARMLESS AND INDEMNIFY THE COMPANY, ITS AFFILIATES AND THEIR RESPECTIVE DIRECTORS, OFFICERS, EMPLOYEES, AGENTS AND SUBCONTRACTORS AGAINST



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ALL ACTUAL OR ALLEGED THIRD PARTY CLAIMS FOR LOSS, DAMAGE OR EXPENSE OF WHATSOEVER NATURE AND HOWSOEVER ARISING FROM OR RELATING TO (i) THE PERFORMANCE, PURPORTED PERFORMANCE OR NON-PERFORMANCE OF ANY SERVICES BY THE COMPANY OR (ii) THE SALE, RESALE, MANUFACTURE, DISTRIBUTION OR USE OF ANY TESTED GOODS.

14. EXCEPT AS MAY OTHERWISE BE EXPRESSLY AGREED TO IN WRITING BY THE COMPANY AND NOTWITHSTANDING ANY PROVISION TO THE CONTRARY CONTAINED HEREIN OR IN ANY TEST REPORT, NO WARRANTY OR GUARANTEE, EXPRESS OR IMPLIED, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR USE, IS MADE.

15. (A) IN NO EVENT WHATSOEVER SHALL THE COMPANY BE LIABLE FOR ANY CONSEQUENTIAL, SPECIAL, INCIDENTAL, EXEMPLARY OR PUNITIVE DAMAGES IN CONNECTION WITH, RELATING TO OR ARISING OUT OF THE TEST REPORT OR THE SERVICES PROVIDED BY THE COMPANY HEREUNDER, INCLUDING WITHOUT LIMITATION LOSS OF OR DAMAGE TO PROPERTY; LOSS OF INCOME, PROFIT OR USE; OR ANY CLAIMS OR DEMANDS MADE AGAINST CLIENT OR ANY OTHER PERSON BY ANY THIRD PARTY IN CONNECTION WITH, RELATING TO OR ARISING OUT OF THE SERVICES PROVIDED BY THE COMPANY HEREUNDER.

(B) NOTWITHSTANDING ANY PROVISION TO THE CONTRARY CONTAINED HEREIN, AND IN RECOGNITION OF THE RELATIVE RISKS AND BENEFITS TO CLIENT AND THE COMPANY ASSOCIATED WITH THE TESTING SERVICES CONTEMPLATED HEREBY, THE RISKS HAVE BEEN ALLOCATED SUCH THAT UNDER NO CIRCUMSTANCES WHATSOEVER SHALL THE LIABILITY OF THE COMPANY TO CLIENT OR ANY THIRD PARTY IN RESPECT OF ANY CLAIM FOR LOSS, DAMAGE OR EXPENSE, OF WHATSOEVER NATURE OR MAGNITUDE, AND HOWSOEVER ARISING, EXCEED AN AMOUNT EQUAL TO FIVE (5) TIMES THE AMOUNT OF THE FEES PAID TO THE COMPANY FOR THE SPECIFIC SERVICES WHICH GAVE RISE TO SUCH CLAIM OR U.S.\$10,000, WHICHEVER IS THE LESSER AMOUNT.

16. The Company shall not be liable for any loss or damage resulting from any delay or failure in performance of its obligations hereunder resulting directly or indirectly from any event of force majeure or any event outside the control of the Company. If any such event occurs, the Company may immediately cancel or suspend its performance hereunder without incurring any liability whatsoever to Client.

17. Company's services, including these Conditions, shall be governed by, and construed in accordance with, the local laws of the country where the Company performs the tests or, in the case of tests performed in the United States of America, the laws of Massachusetts without regard to conflicts of laws principles. If any aspect(s) of these Conditions is found to be illegal or unenforceable, the validity, legality and enforceability of all remaining aspects of these Conditions shall not in any way be affected or impaired thereby. Any proceeding related to the subject matter hereof shall be brought, if at all, in the courts of the country where the Company performs the tests or, in the case of tests performed in the United States of America, in the courts of Massachusetts. Client waives the right to interpose any counterclaim or setoffs of any nature in any litigation arising hereunder.

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