

**TEST REPORT**

Report Number: 100649603LEX-002  
Project Number: G100649603

Report Issue Date: 2/23/2012

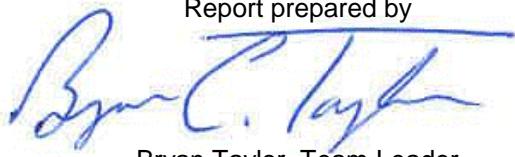
Model: SpotCell 2500X1 Coverage Unit  
FCCID (Coverage Unit): P3YSPOTCELL0102  
Standards: FCC Title 47 Part 27 Subpart C

Tested by:  
Intertek Testing Services NA, Inc.  
731 Enterprise Drive  
Lexington, KY 40510

Client:  
Spotwave Wireless Ltd.  
500 Van Buren Street  
Kemptville ON

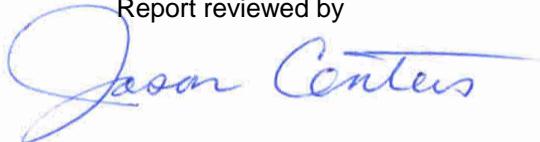
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Report reviewed by



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## 1 Introduction and Conclusion

The tests indicated in section 2 were performed on the product constructed as described in section 3. The remaining test sections are the verbatim text from the actual data sheets used during the investigation. These test sections include the test name, the specified test method, a list of the actual test equipment used, documentation photos, results and raw data. No additions, deviations, or exclusions have been made from the standard(s) unless specifically noted.

Based on the results of our investigation, we have concluded the product tested complied with the requirements of the standard(s) indicated. The results obtained in this test report pertain only to the item(s) tested.

All testing was performed at the Intertek located at 731 Enterprise Drive, Lexington Kentucky, 40510. The radiated emission test site is a 10-meter semi-anechoic chamber. The chamber meets the characteristics of CISPR 16-1 and ANSI C63.4. For measurements, a remotely controlled flush-mount metal-top turntable is used to rotate the EUT a full 360 degrees. A remote controlled non-conductive antenna mast is used to scan the antenna height from one to four meters. The test site is listed with the FCC under registration number 485103. The test site is listed with Industry Canada under site number IC 2042M-1.

## 2 Test Summary

Page	Test full name	FCC Reference	Result
6	Conducted Output Power	§2.1046 & §27.50	Pass
8	Occupied Bandwidth	§2.1049	Pass
13	Conducted Spurious Emissions	§2.1049, §2.1051, § 27.53(c), & § 27.53(f)	Pass
30	Radiated Spurious Emissions (Transmitter)	§2.1053 and § 27.53(c)	Pass
-	Frequency Stability	§2.1055	Not Required <sup>1</sup>

<sup>1</sup> The device does not translate frequency.

### 3 Description of Equipment Under Test

Equipment Under Test	
<b>Manufacturer</b>	Spotwave Wireless Ltd.
<b>Model Number</b>	SpotCell 2500X1 CoverageUnit
<b>Serial Number</b>	Test Sample 1
<b>FCC Identifier (Coverage Unit)</b>	P3YSPOTCELL0102
<b>Receive Date</b>	2/3/2012
<b>Test Start Date</b>	2/3/2012
<b>Test End Date</b>	2/14/2012
<b>Device Received Condition</b>	Good
<b>Test Sample Type</b>	Prototype
<b>Frequency Band</b>	746MHz - 757MHz (Upper Block - Downlink)
<b>Modulation Type</b>	LTE (OFDMA)
<b>Transmission Control</b>	Signal Generator
<b>Maximum Output Power (Conducted)</b>	5.89 dBm (Upper Block - Downlink)
<b>Antenna Type</b>	External, User provided
<b>Operating Voltage</b>	120VAC
<b>Test Channels / Frequencies</b>	<u>Upper Block Downlink</u> Low: 746MHz Mid: 751MHz High: 756MHz

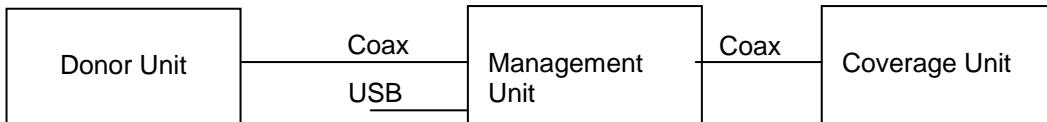
Description of Equipment Under Test	
The test sample was a cell booster device manufactured by Spotwave Wireless Ltd. The coverage units install indoors and the donor units install outdoors. Together they allow for increased wireless signal strength inside office buildings or in other areas where wireless dead spots occur.	

#### Operating modes of the EUT:

No.	Descriptions of EUT Exercising
1	Device was set at max gain and tested at maximum output power at the low, mid and high frequencies in each band. The conducted tests were performed using LTE modulation.
2	Device was set at max gain and tested at maximum output power at the low, mid and high frequencies in each band with a CW for radiated spurious tests.

### 3.1 System setup including cable interconnection details, support equipment and simplified block diagram

#### 3.2 EUT Block Diagram:



Block Diagram of Test Sample (Donor, Management, and Coverage Unit Comprising the SpotCell 2500X1)



Block Diagram for Radiated Tests



Block Diagram for Conducted Tests at the Antenna Port

#### 3.3 Cables:

Description	Length	Shielding	Ferrites	Cables	
				From	To
AC Power Cable	5 ft.	None	None	120 VAC Power Source	AC Input
Signal Source Coax Cable	50 ft.	Yes	None	Signal Source	RF Input
Termination Coax Cable	10 ft.	Yes	None	RF Output	Termination or Spectrum Analyzer
USB Cable	6 ft.	Yes	None	USB Port	Unterminated
Intra System Coax Cables (2)	20 ft	Yes	None	Management Unit	Donor Unit and Coverage Unit

#### 3.4 Support Equipment:

No support equipment was used in this evaluation.

**4 Conducted Output Power****4.1 Test Limits****§ 2.1046**

(a) For transmitters other than single sideband, independent sideband and controlled carrier radiotelephone, power output shall be measured at the RF output terminals when the transmitter is adjusted in accordance with the tune-up procedure to give the values of current and voltage on the circuit elements specified in §2.1033(c)(8).

**4.2 Test Procedure**

The transmitter output was connected to a calibrated coaxial cable, the other end of which was connected to a spectrum analyzer. A vector signal generator was used to generate the desired modulation. The signal generator level was set to obtain the maximum signal channel output from the amplifier. The channel power function of the spectrum analyzer was used to measure the output power. Tests were performed at three frequencies (low, middle, and high channels) in the uplink and downlink bands.

**4.3 Test Equipment Used:**

Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
Spectrum Analyzer	3099	Rohde & Schwarz	FSP7	9/23/2011	9/23/2012
Vector Signal Generator	MY48180569	Agilent	N5182A	1/24/2012	1/24/2013

**4.4 Results:**

Modulation	Band	Channel	Average Power (dBm)
LTE 1.4MHz	Upper Block - Downlink	Low	1.23dBm
		Mid	4.8dBm
		High	5.1dBm
LTE 3MHz	Upper Block - Downlink	Low	1.89dBm
		Mid	2.83dBm
		High	1.35dBm
LTE 5MHz	Upper Block - Downlink	Low	1.2dBm
		Mid	6.1dBm
		High	5.83dBm
LTE 10MHz	Upper Block - Downlink	Mid	5.89dBm

## 5 Occupied Bandwidth

### 5.1 Test Limits

#### §2.1049:

The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission.

### 5.2 Test Procedure

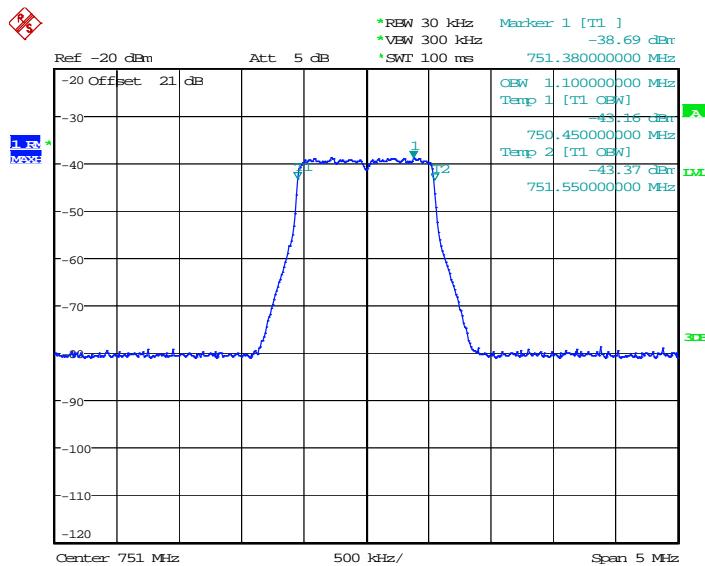
The EUT was connected to a spectrum analyzer using a calibrated coaxial cable. A vector signal generator was used to generate the desired modulation. The occupied bandwidth function of the analyzer was used to automatically generate the occupied bandwidth plots of the input and output signals at the maximum output power.

### 5.3 Test Equipment Used:

Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
Spectrum Analyzer	3099	Rohde & Schwarz	FSP7	9/23/2011	9/23/2012
Vector Signal Generator	MY48180569	Agilent	N5182A	1/24/2012	1/24/2013

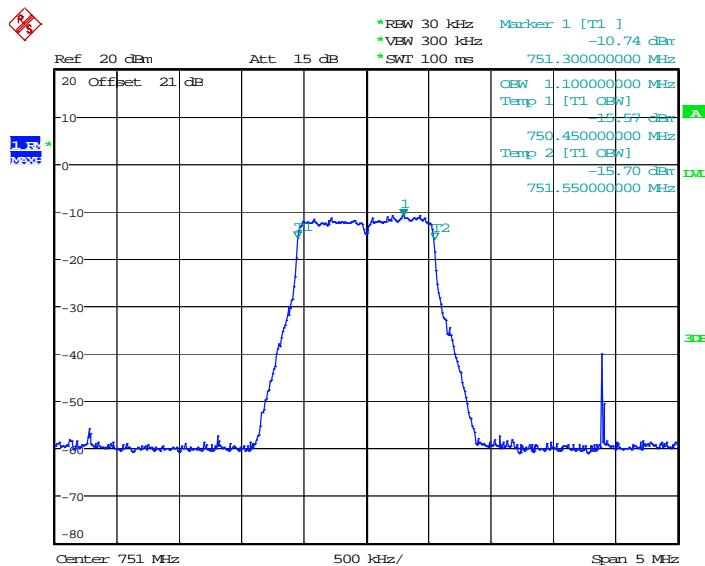
### 5.4 Results:

Modulation	Band	Occupied Bandwidth – Input (MHz)	Occupied Bandwidth – Output (MHz)
LTE	Upper Block – Downlink 1.4MHz	1.1MHz	1.1MHz
LTE	Upper Block – Downlink 3MHz	2.68MHz	2.68MHz
LTE	Upper Block – Downlink 5MHz	4.5MHz	4.54MHz
LTE	Upper Block – Downlink 10MHz	8.96MHz	8.96MHz



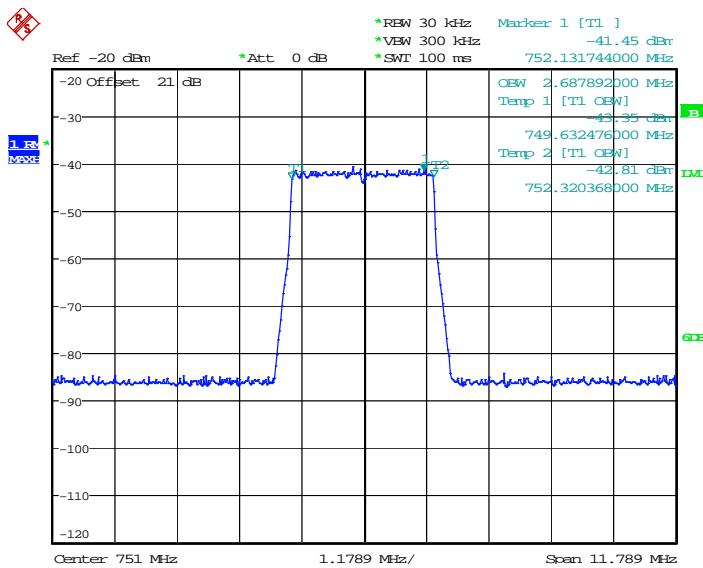
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### Occupied Bandwidth – 1.4MHz Downlink Input Signal



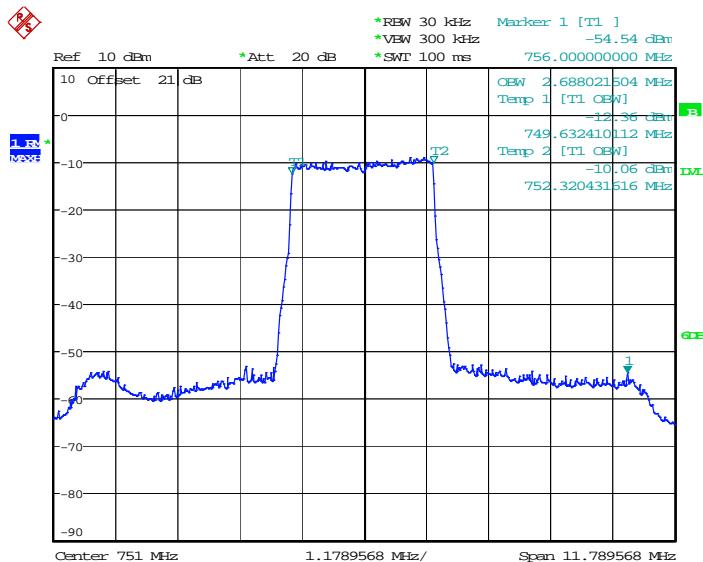
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### Occupied Bandwidth – 1.4MHz Downlink



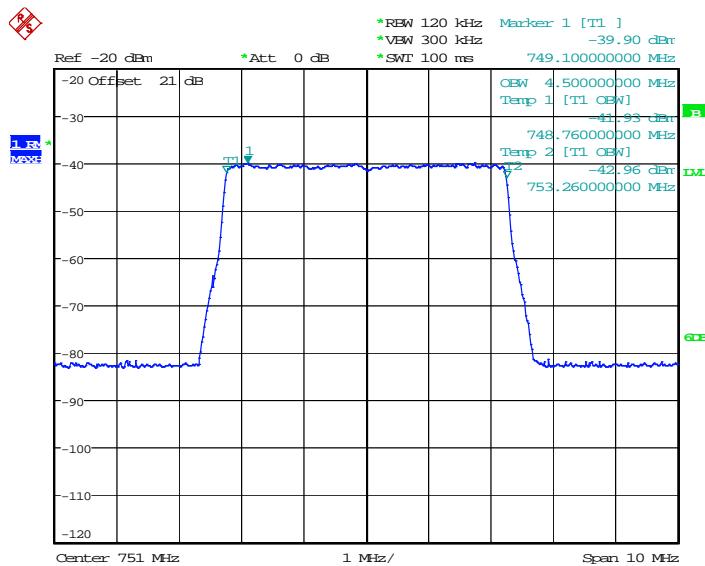
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### Occupied Bandwidth - 3MHz Downlink Input Signal



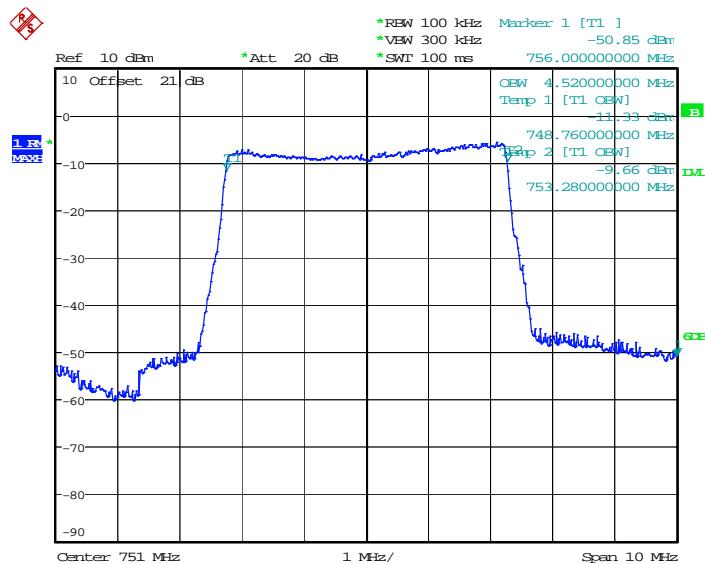
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### Occupied Bandwidth - 3MHz Downlink



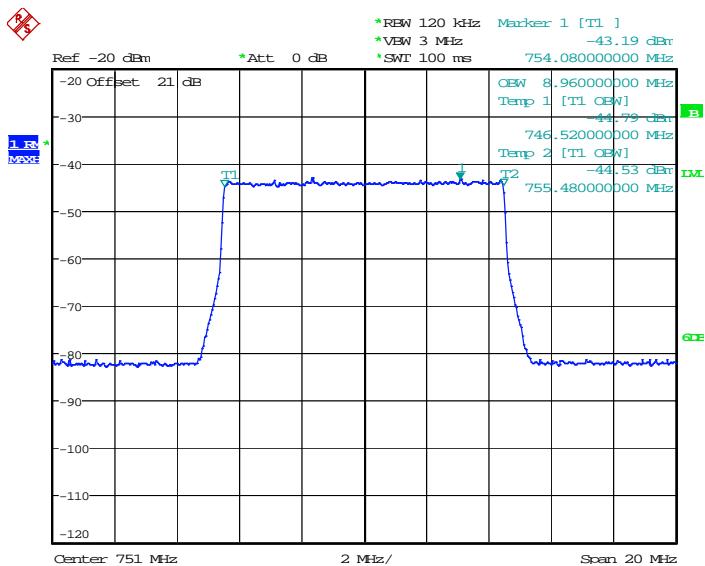
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### Occupied Bandwidth - 5MHz Downlink Input Signal



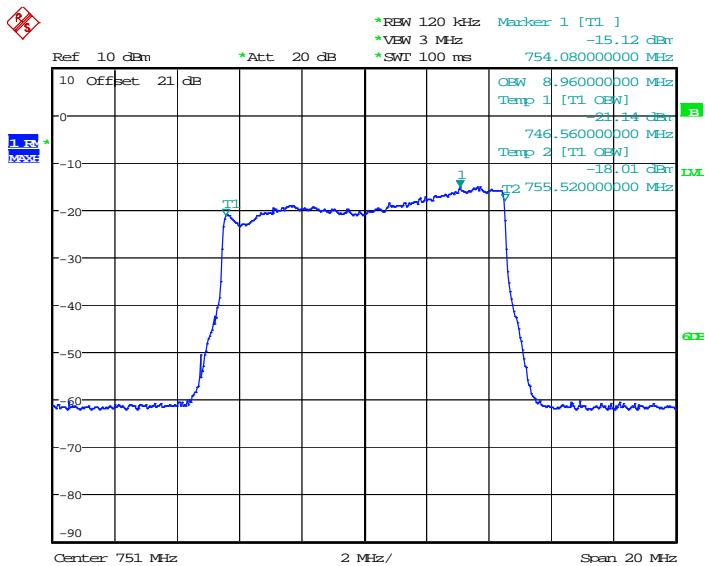
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### Occupied Bandwidth - 5MHz Downlink



Date: 8.FEB.2012 13:36:35

### Occupied Bandwidth - 10MHz Downlink Input Signal



Date: 8.FEB.2012 13:33:43

### Occupied Bandwidth - 10MHz Downlink

**6 Conducted Spurious Emissions at Antenna Terminals****6.1 Test Limits****§ 2.1049**

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured under the following conditions as applicable:

- (h) Transmitters employing digital modulation techniques—when modulated by an input signal such that its amplitude and symbol rate represent the maximum rated conditions under which the equipment will be operated. The signal shall be applied through any filter networks, pseudo-random generators or other devices required in normal service. Additionally, the occupied bandwidth shall be shown for operation with any devices used for modifying the spectrum when such devices are optional at the discretion of the user.

**§ 2.1051**

The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of each harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in §2.1049 as appropriate. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.

**§ 27.53**

c) For operations in the 746–758 MHz band and the 776–788 MHz band, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:

- (1) On any frequency outside the 746–758 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least  $43 + 10 \log (P)$  dB;
- (2) On any frequency outside the 776–788 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least  $43 + 10 \log (P)$  dB;
- (3) On all frequencies between 763–775 MHz and 793–805 MHz, by a factor not less than  $76 + 10 \log (P)$  dB in a 6.25 kHz band segment, for base and fixed stations;
- (5) Compliance with the provisions of paragraphs (c)(1) and (c)(2) of this section is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. However, in the 100 kHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of at least 30 kHz may be employed;
- (6) Compliance with the provisions of paragraphs (c)(3) and (c)(4) of this section is based on the use of measurement instrumentation such that the reading taken with any resolution bandwidth setting should be adjusted to indicate spectral energy in a 6.25 kHz segment.

(f) For operations in the 746–763 MHz, 775–793 MHz, and 805–806 MHz bands, emissions in the band 1559–1610 MHz shall be limited to  $-70$  dBW/MHz equivalent isotropically radiated power (EIRP) for wideband signals, and  $-80$  dBW EIRP for discrete emissions of less than 700 Hz bandwidth. For the purpose of equipment authorization, a transmitter shall be tested with an antenna that is representative of the type that will be used with the equipment in normal operation.

(g) For operations in the 698–746 MHz band, the power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by at least  $43 + 10 \log (P)$  dB. Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kilohertz or greater. However, in the 100 kilohertz bands immediately outside and adjacent to a licensee's frequency block, a resolution bandwidth of at least 30 kHz may be employed.

**6.2 Test Procedure**

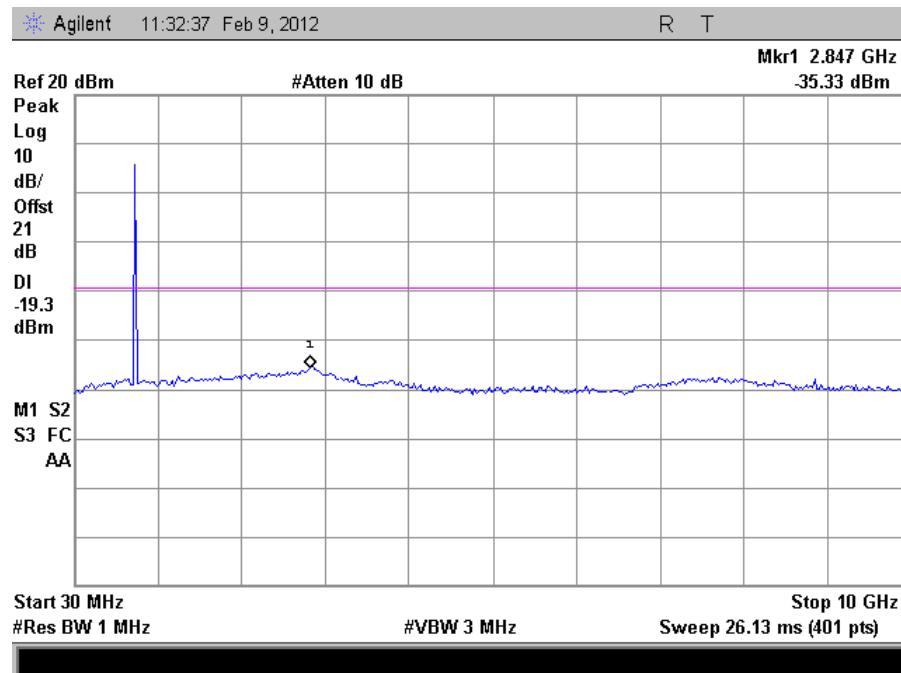
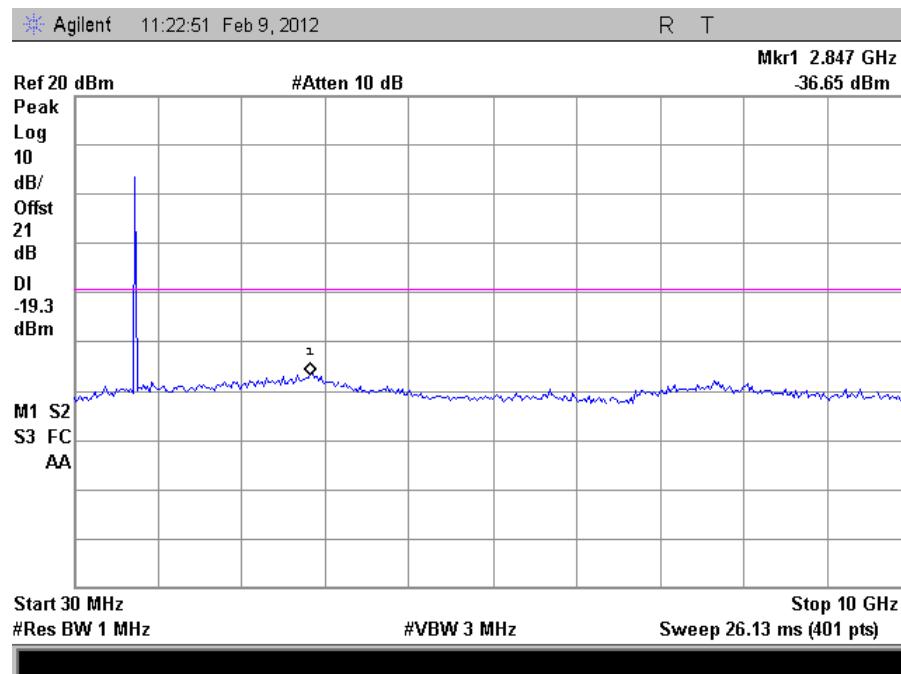
The RF output of the EUT was connected to a spectrum analyzer through appropriate attenuation. A vector signal generator was used to generate the desired modulation. The output of the signal generated was adjusted to obtain the maximum output power of the amplifier. The resolution bandwidth of the spectrum analyzer was set at 1MHz. Sufficient scans were taken to show the out of band emissions if any up to 10th harmonic. Emissions were measured in the public safety band and GNSS band in accordance with procedures in TIA-603C.

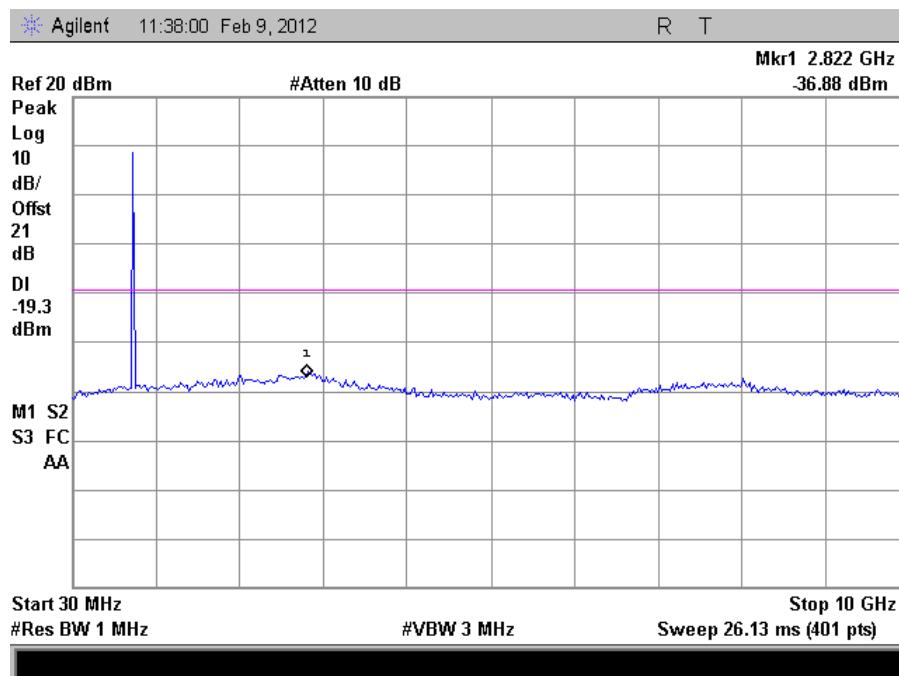
**6.3 Test Equipment Used:**

Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
Spectrum Analyzer	3099	Rohde & Schwarz	FSP7	9/23/2011	9/23/2012
EMC Analyzer	2142	HP	E7405	9/23/2011	9/23/2012
Vector Signal Generator	MY48180569	Agilent	N5182A	1/24/2012	1/24/2013

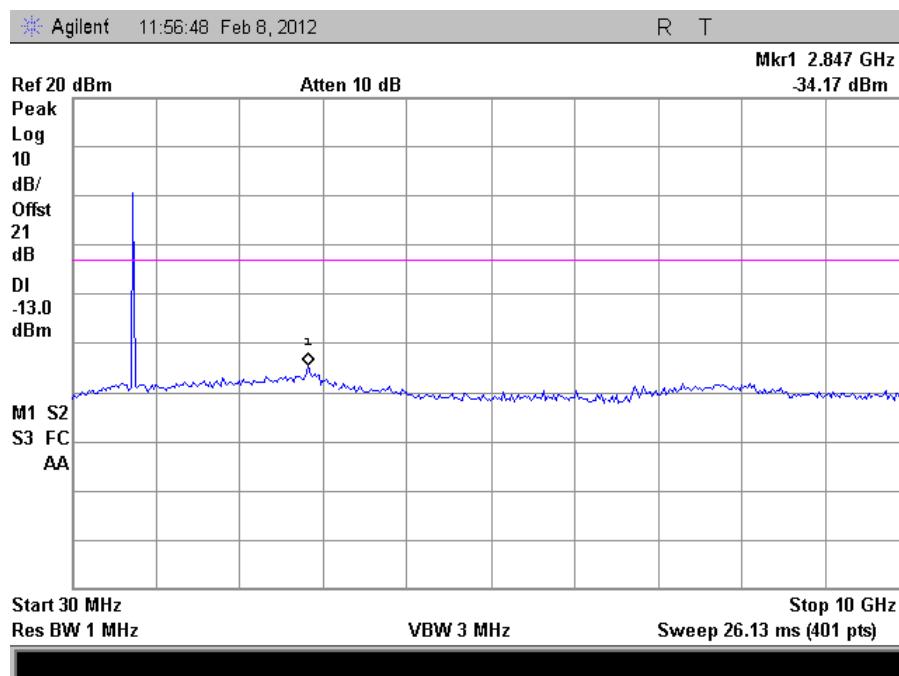
**6.4 Results:**

The following plots show that all spurious emissions are attenuated below the transmitting power (P) by a factor of at least  $43 + 10 \log(P)$  dB. Plots for emissions within 1MHz of the band edge as well as for emission outside of this range are shown.

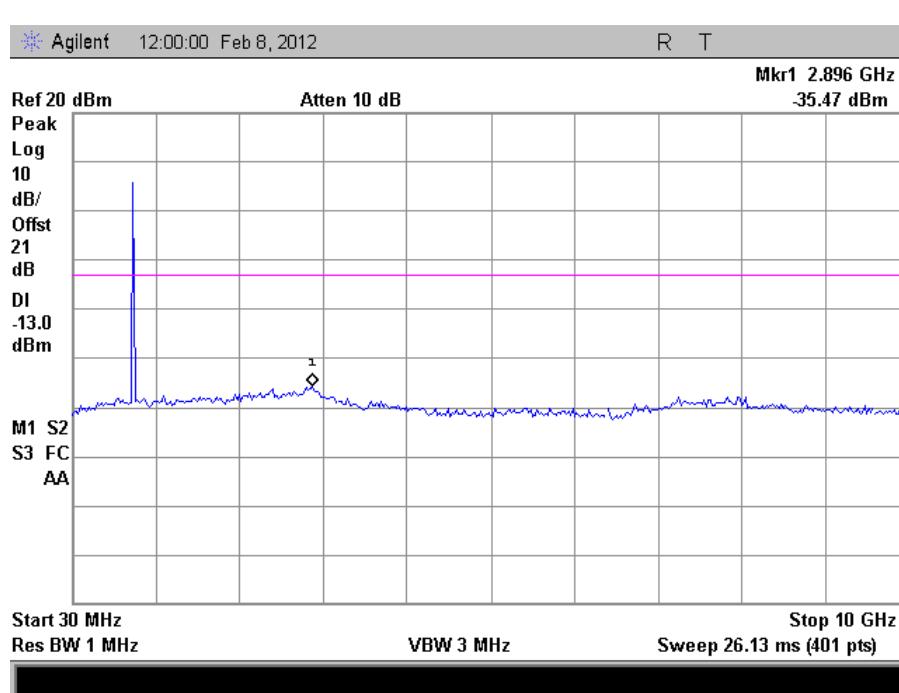
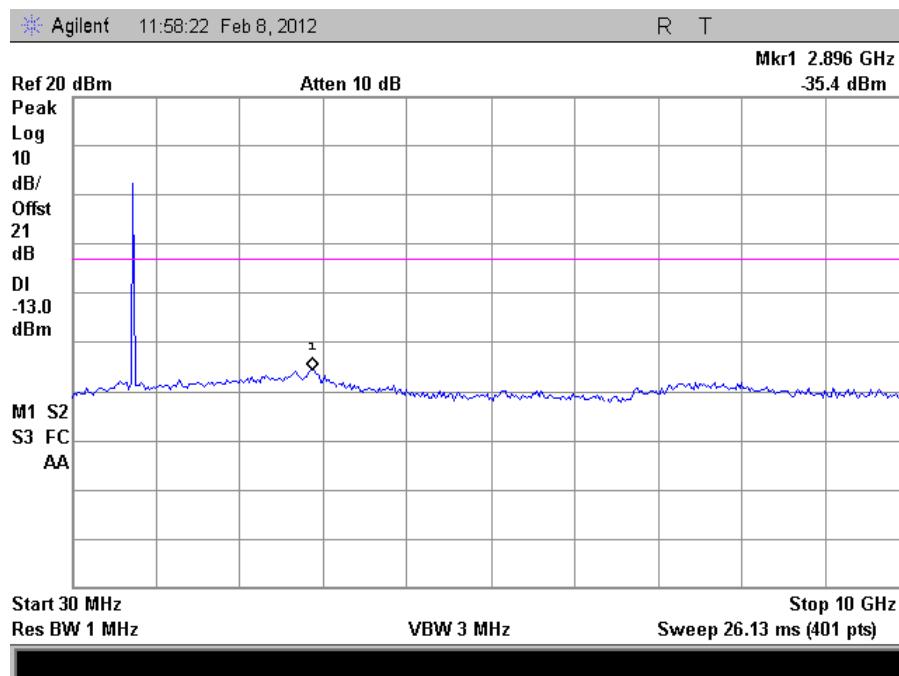
**Plots for emissions more than 1MHz from the band edge:****Upper Block - Downlink, Low Channel – 1.4MHz****Upper Block - Downlink, Mid Channel – 1.4MHz**

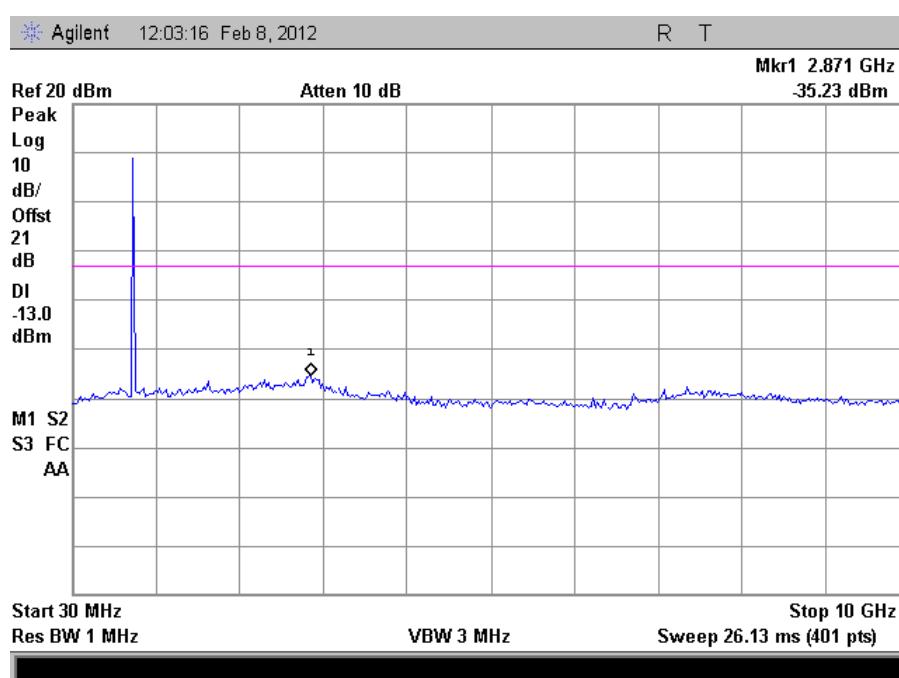
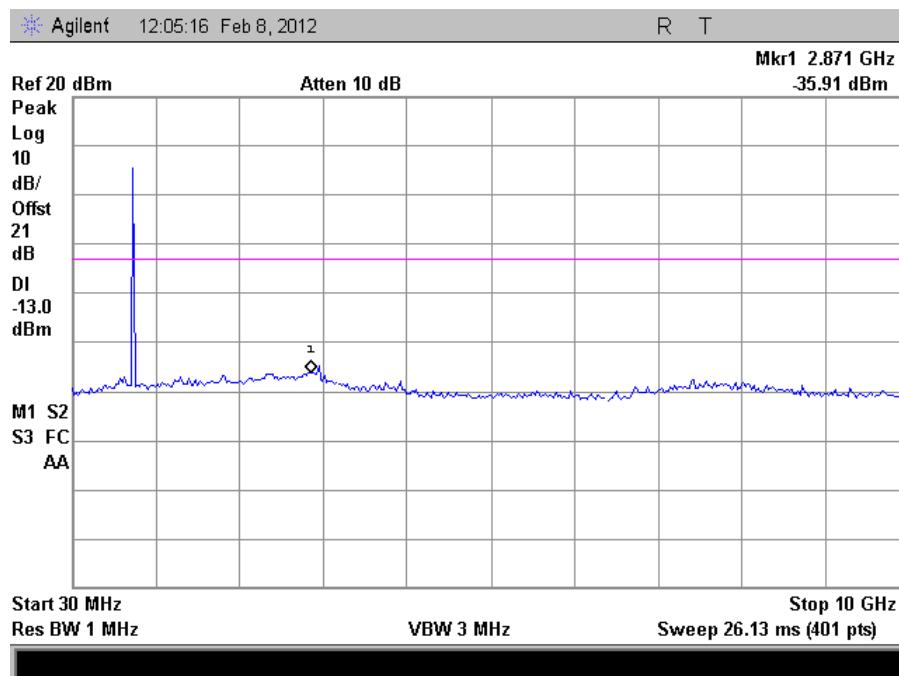


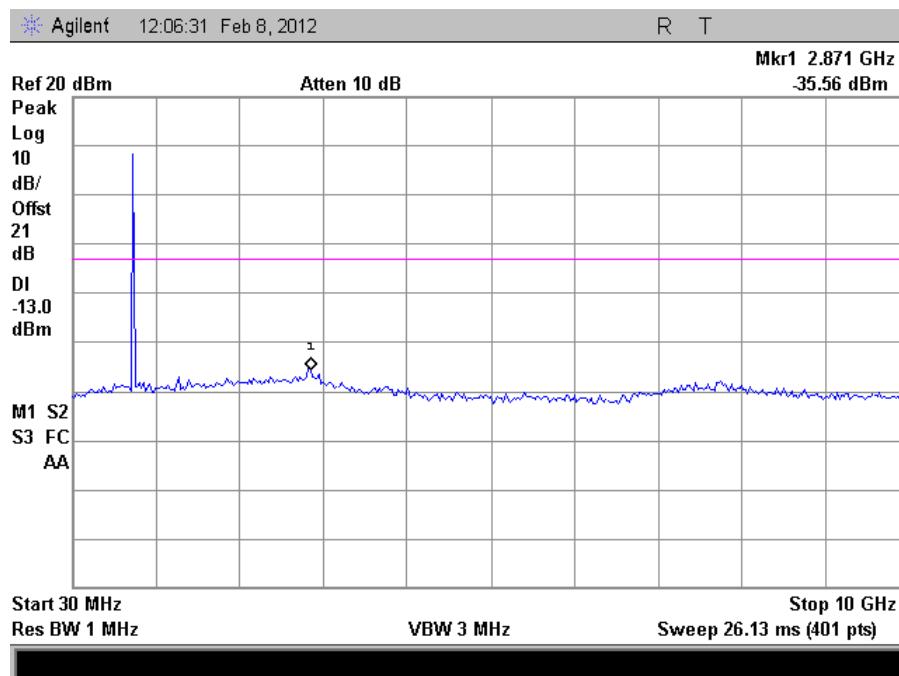
Upper Block - Downlink, High Channel – 1.4MHz



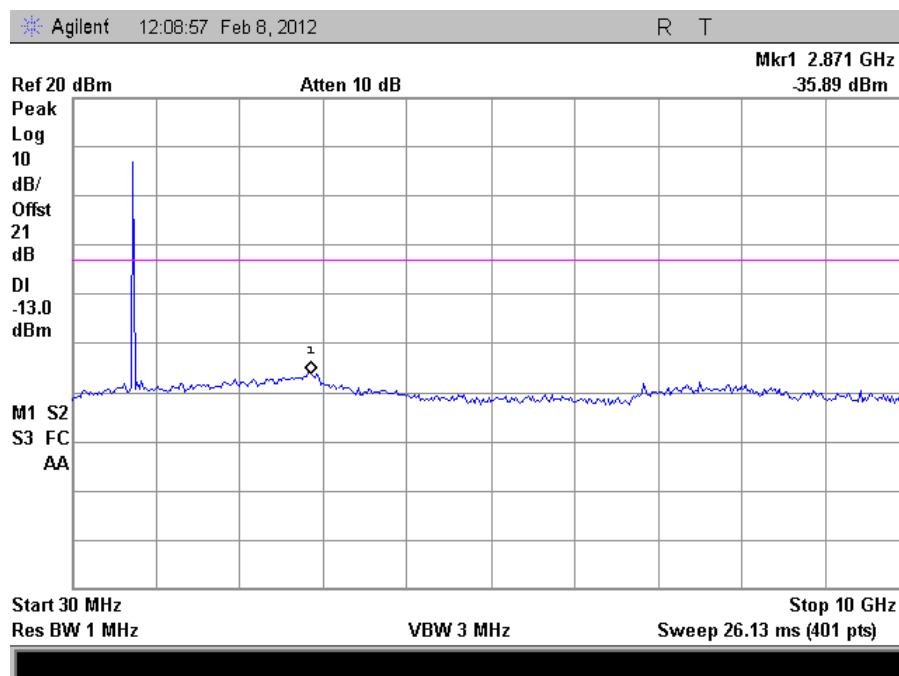
Upper Block - Downlink, Low Channel – 3MHz



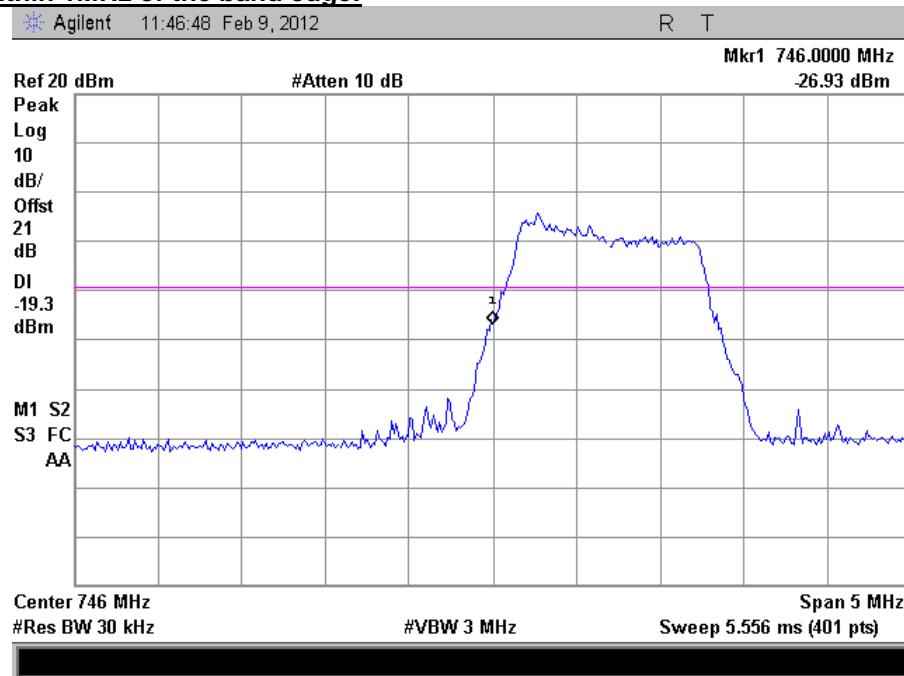
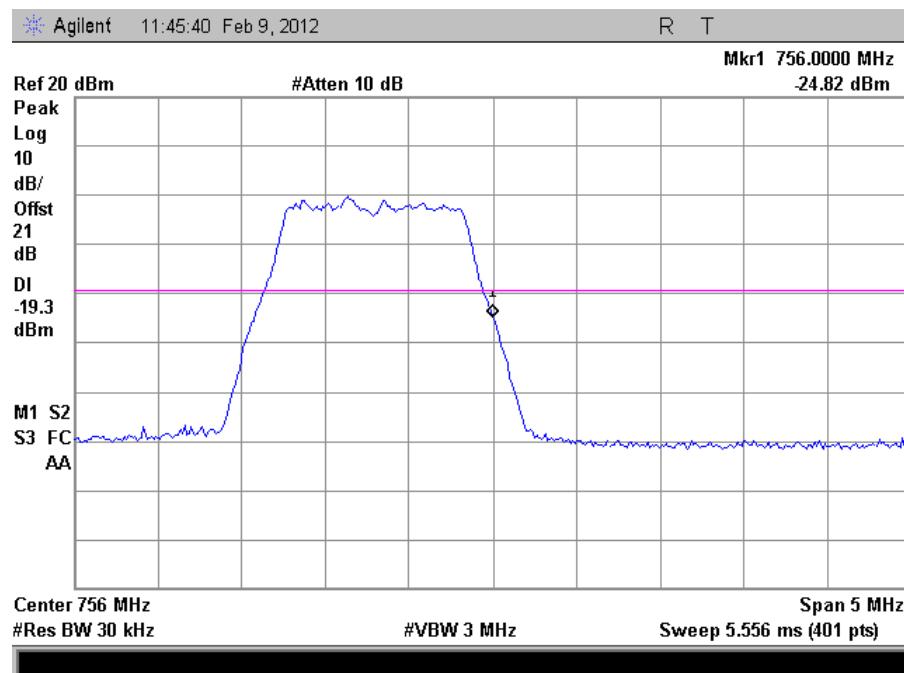


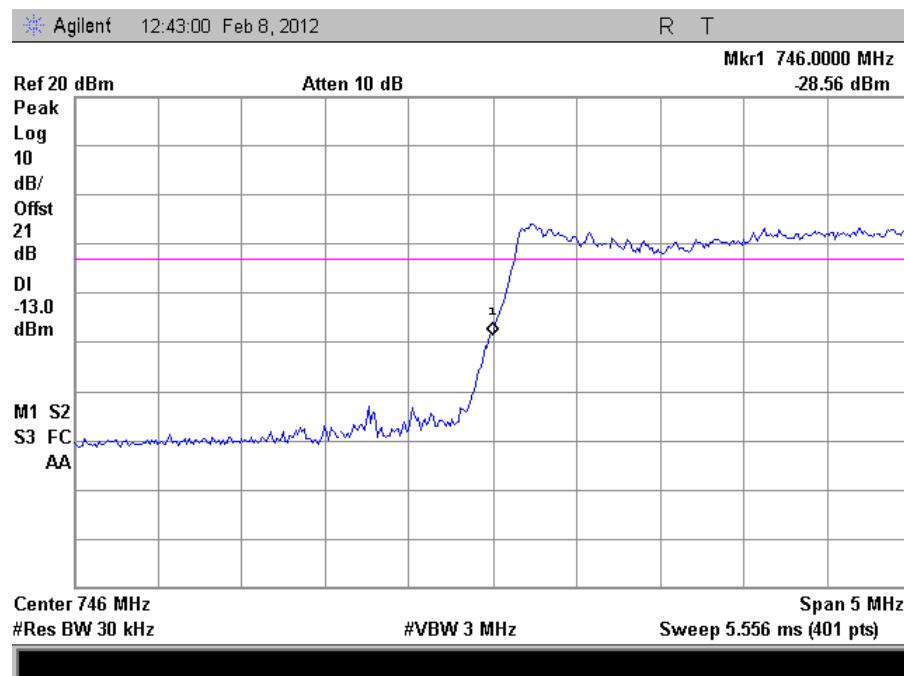
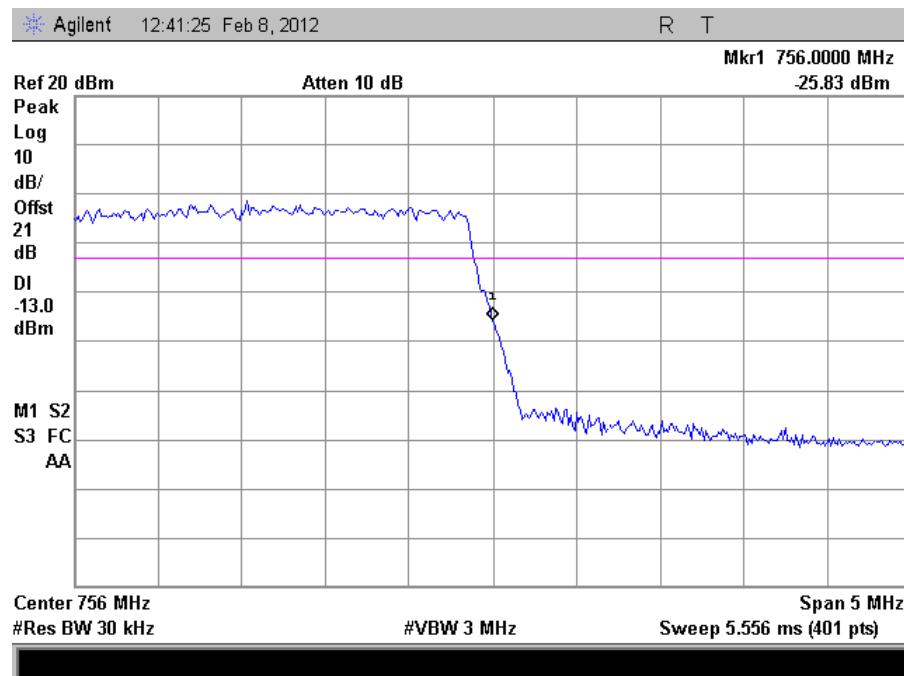


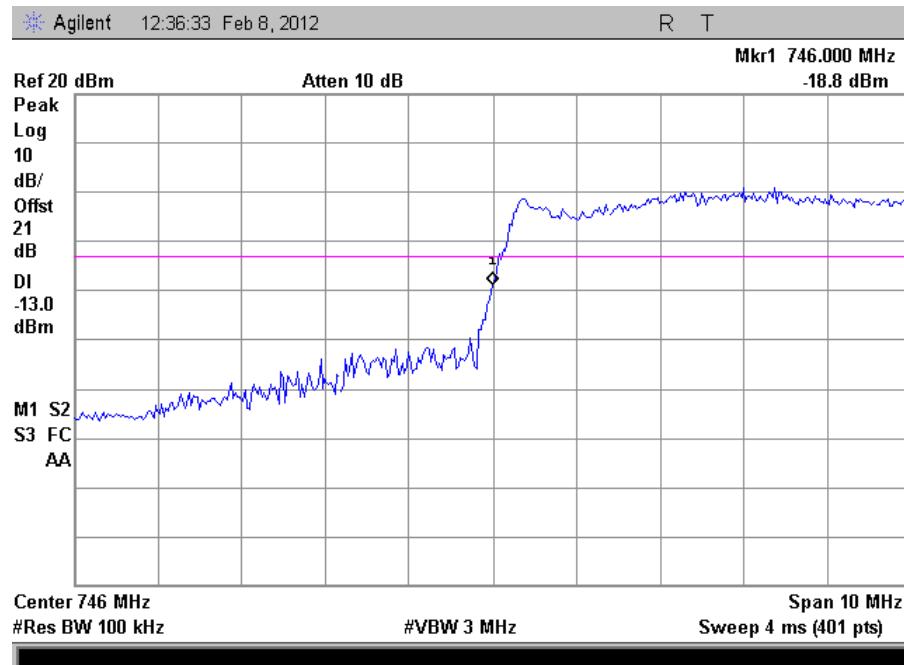
Upper Block - Downlink, High Channel – 5MHz



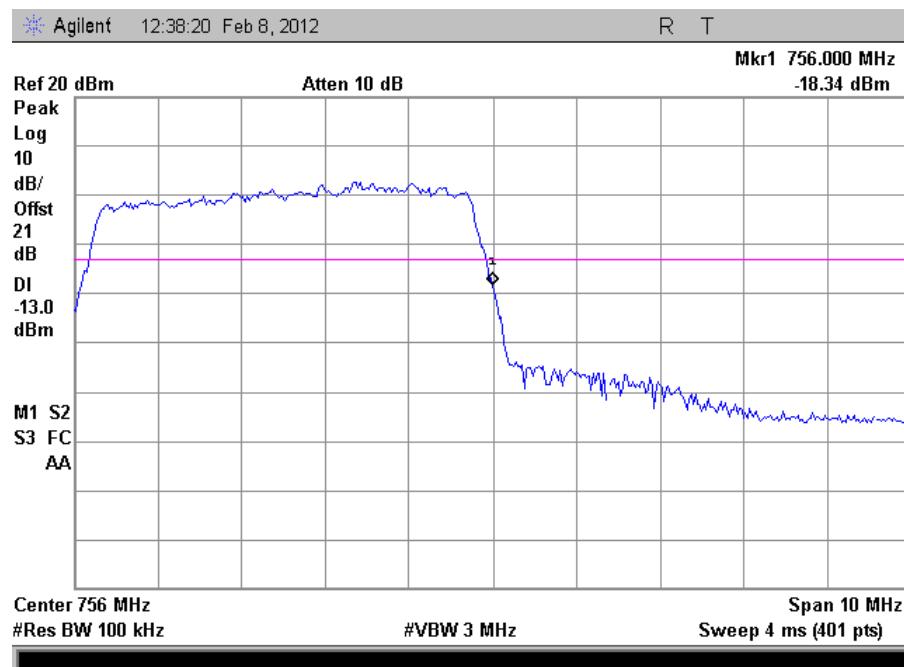
Upper Block - Downlink, Mid Channel – 10MHz

**Emissions within 1MHz of the band edge:****Upper Block - Downlink, Low Band Edge – 1.4MHz****Upper Block - Downlink, High Band Edge – 1.4MHz**

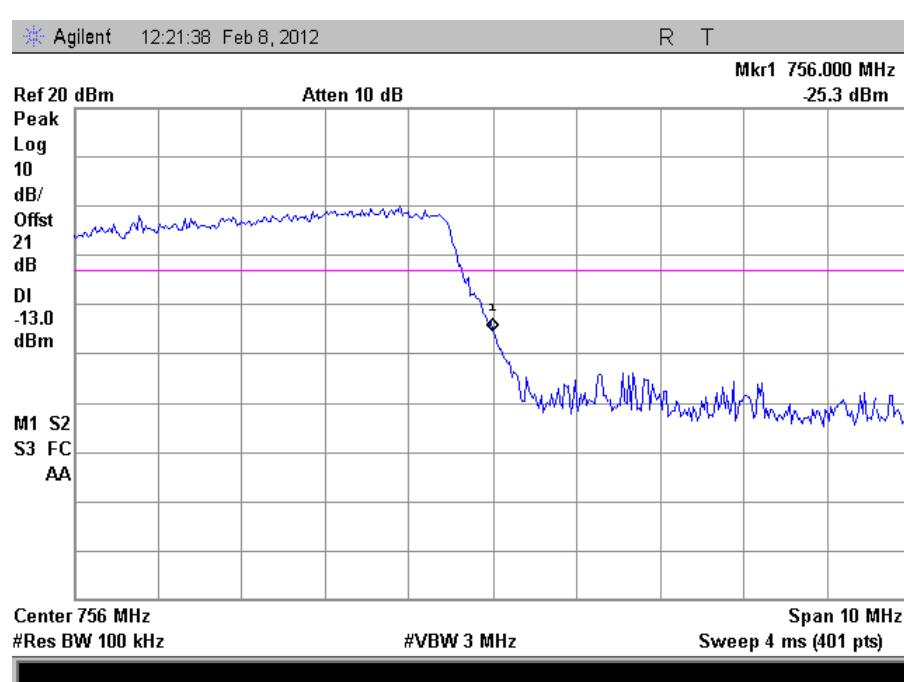
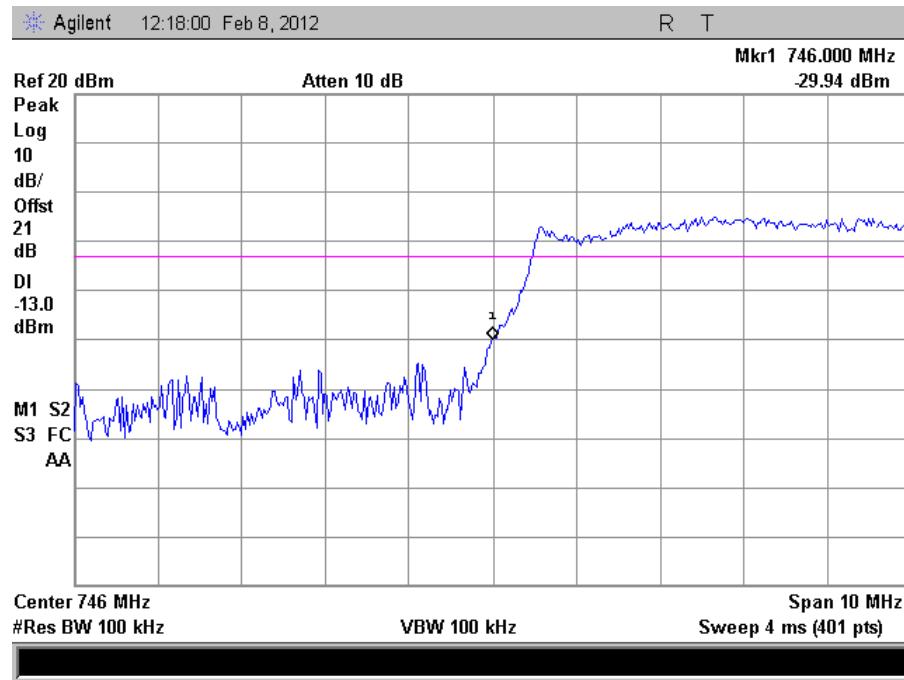
**Upper Block - Downlink, Low Band Edge – 3MHz****Upper Block - Downlink, High Band Edge – 3MHz**

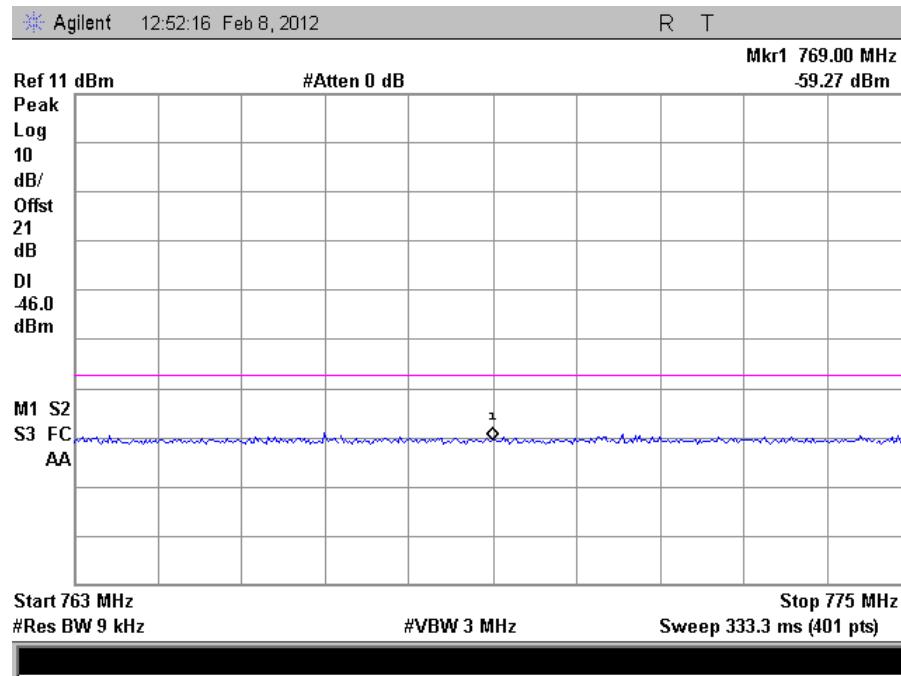


Upper Block - Downlink, Low Band Edge – 5MHz

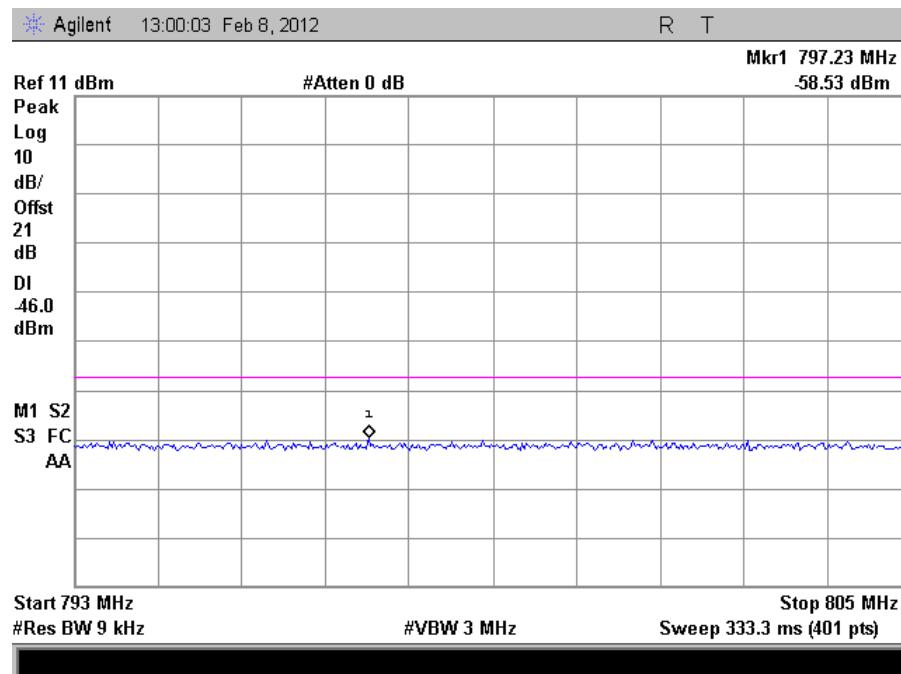


Upper Block - Downlink, High Band Edge – 5MHz

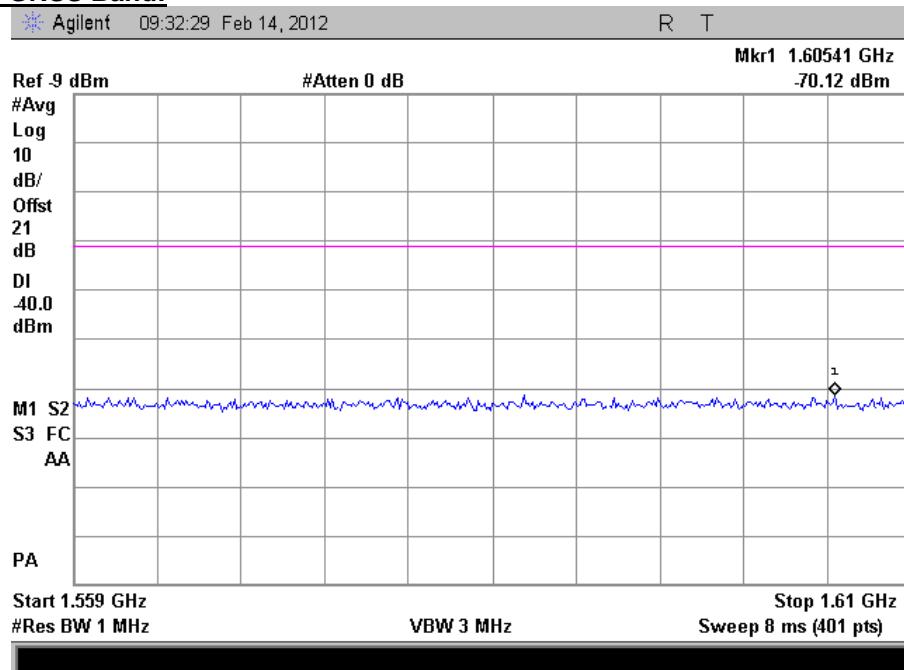


**Emissions in the Public Safety Band:**

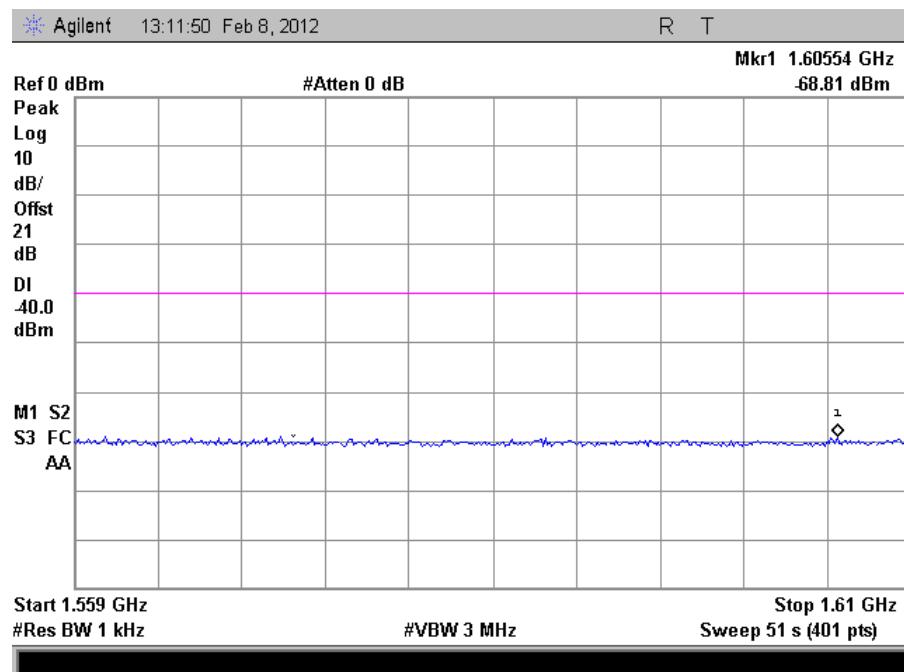
**Emissions in the 763 MHz – 775 MHz Band - Upper Block – Downlink**  
**(Max Hold Scan Showing Low, Mid, and High Channels, 1.4MHz, 3MHz, 5MHz, and 10MHz)**



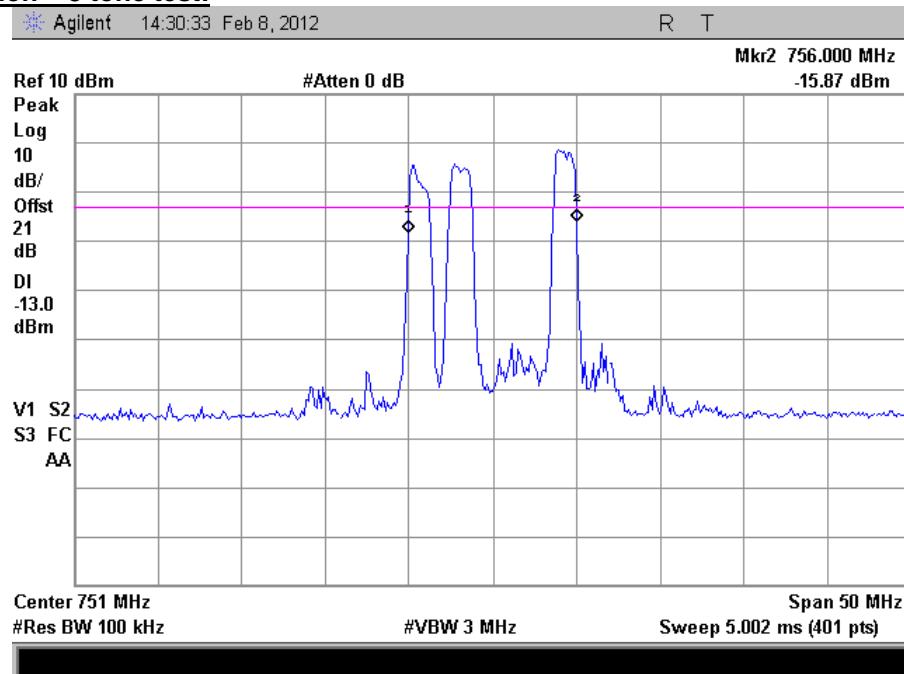
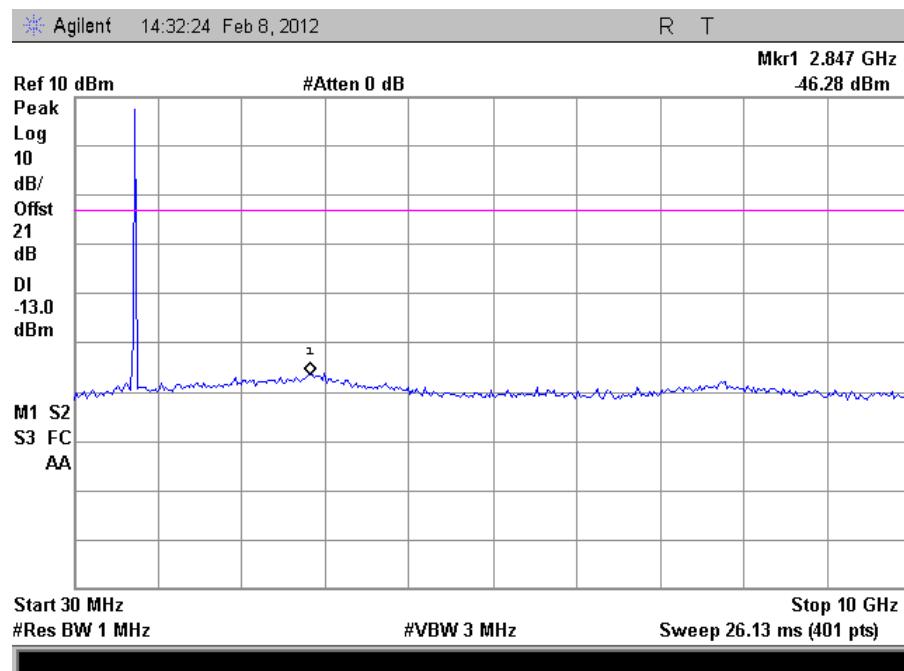
**Emissions in the 793 MHz – 805 MHz Band - Upper Block - Downlink**  
**(Max Hold Scan Showing Low, Mid, and High Channels, 1.4MHz, 3MHz, 5MHz, and 10MHz)**

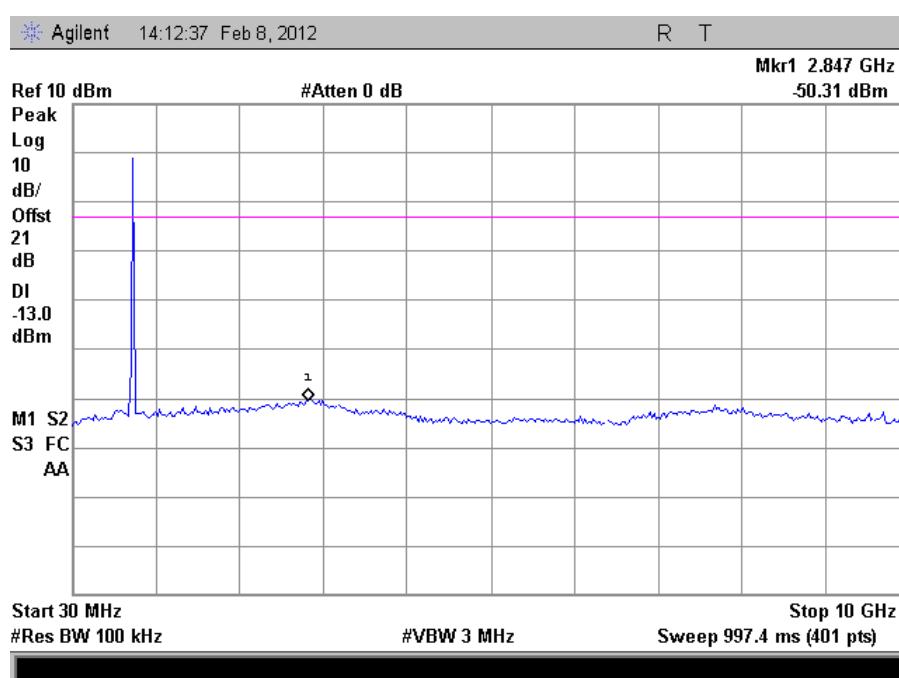
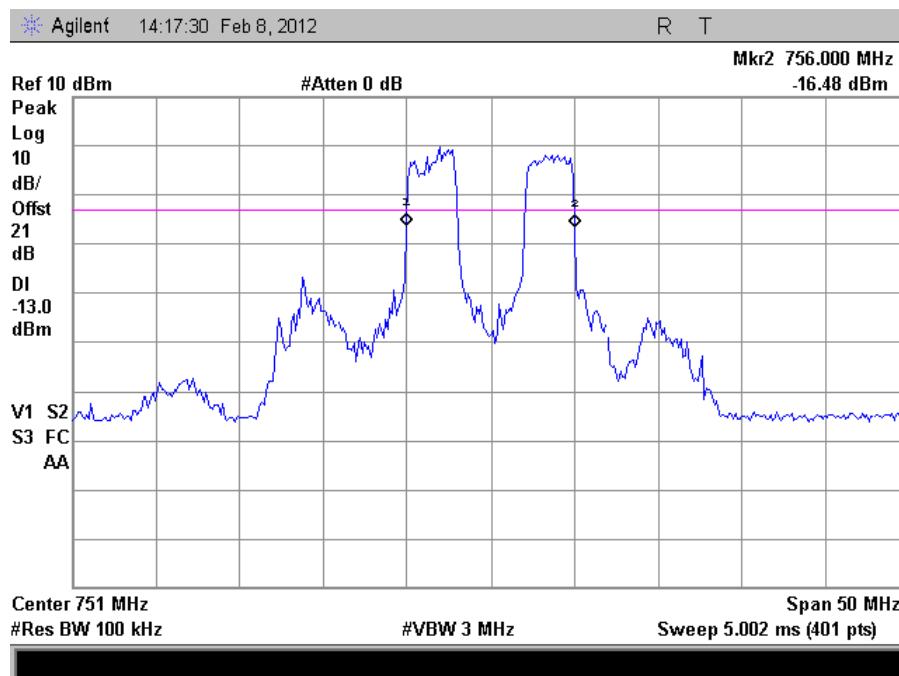
**Emissions in GNSS Band:**

**Wideband Emissions in 1.559 GHz – 1.610 GHz Band - Upper Block – Downlink**  
**(Max Hold Scan Showing Low, Mid, and High Channels, 1.4MHz, 3MHz, 5MHz, and 10MHz)**

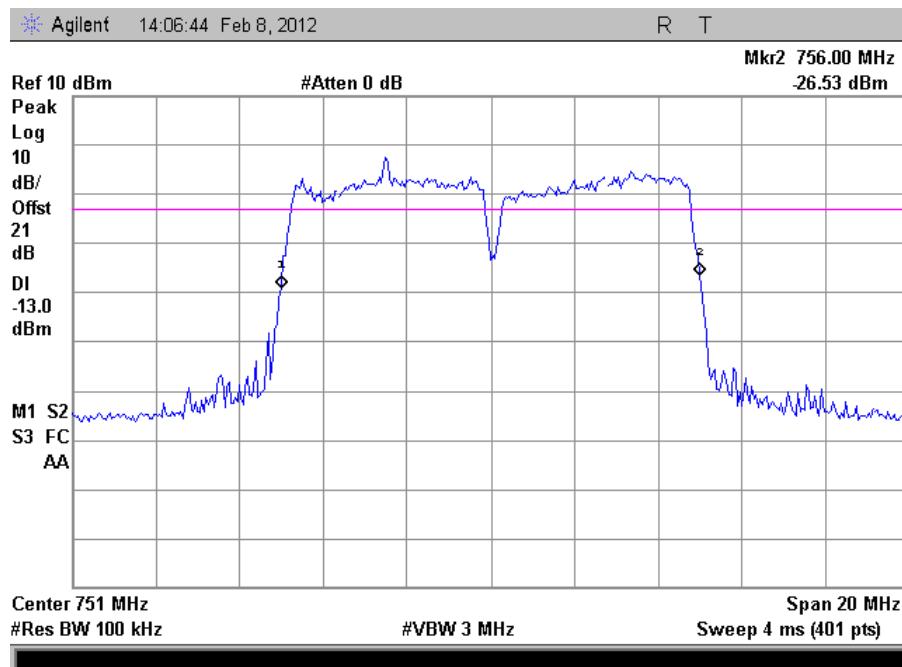
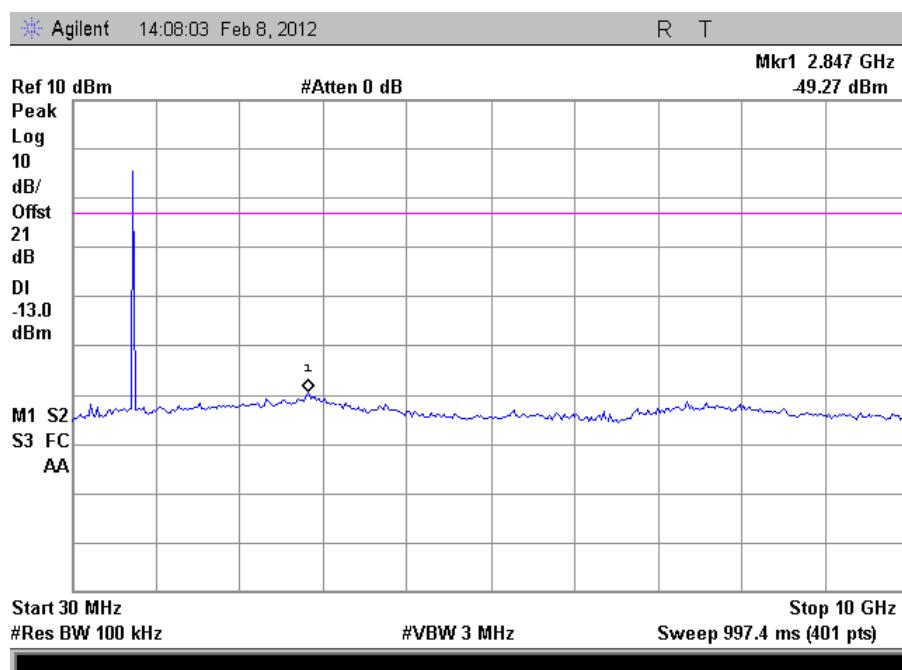


**Narrowband Emissions in 1.559 GHz – 1.610 GHz Band - Upper Block – Downlink**  
**(Max Hold Scan Showing Low, Mid, and High Channels, 1.4MHz, 3MHz, 5MHz, and 10MHz)**

**Intermodulation – 3 tone test:****3 Tone Intermod: Upper Block – Downlink, 1.4MHz****3 Tone Intermod: Upper Block – Downlink, 1.4MHz**



2 Three tones were used for the intermod test (Two adjacent channels near the lower end of the band and one at the upper end of the transmit band.) Due to the transmit band being 10MHz wide and the test signals taking up 3MHz each of that band, it is not possible to discern the three individual tones using the bandwidths needed for this test.

3 Tone Intermod: Upper Block – Downlink, 5MHz<sup>3</sup>

3 Tone Intermod: Upper Block – Downlink, 5MHz

3 Three tones were used for the intermod test (Two adjacent channels near the lower end of the band and one at the upper end of the transmit band.) Due to the transmit band being 10MHz wide and the test signals taking up a 5MHz each of that band, it is not possible to discern the three individual tones using the bandwidths needed for this test.

## 7 Radiated Spurious Emissions (Transmitter)

### 7.1 Test Limits

#### § 2.1053

(a) Measurements shall be made to detect spurious emissions that may be radiated directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation. Curves or equivalent data shall be supplied showing the magnitude of each harmonic and other spurious emission. For this test, single sideband, independent sideband, and controlled carrier transmitters shall be modulated under the conditions specified in paragraph (c) of §2.1049, as appropriate. For equipment operating on frequencies below 890 MHz, an open field test is normally required, with the measuring instrument antenna located in the far-field at all test frequencies. In the event it is either impractical or impossible to make open field measurements (e.g. a broadcast transmitter installed in a building) measurements will be accepted of the equipment as installed. Such measurements must be accompanied by a description of the site where the measurements were made showing the location of any possible source of reflections which might distort the field strength measurements. Information submitted shall include the relative radiated power of each spurious emission with reference to the rated power output of the transmitter, assuming all emissions are radiated from halfwave dipole antennas.

#### § 27.53

(c) For operations in the 746–758 MHz band and the 776–788 MHz band, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:

(1) On any frequency outside the 746–758 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least  $43 + 10 \log (P)$  dB;

(2) On any frequency outside the 776–788 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least  $43 + 10 \log (P)$  dB;

(g) For operations in the 698–746 MHz band, the power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by at least  $43 + 10 \log (P)$  dB. Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kilohertz or greater. However, in the 100 kilohertz bands immediately outside and adjacent to a licensee's frequency block, a resolution bandwidth of at least 30 kHz may be employed.

## 7.2 Test Procedure

The EUT was placed on a non-conductive turntable. The measurement antenna was placed at a distance of 3 meters from the EUT. The EUT was forced to transmit at its maximum output power setting. During the tests, the antenna height and EUT azimuth were varied in order to identify the maximum level of emissions from the EUT.

The frequency range up to tenth harmonic was investigated in order to identify the spurious emission. Once the spurious emissions were identified, the power of the emission was determined using the substitution method described in TIA-603-C. The spurious emissions attenuation was calculated as the difference between radiated power at the fundamental frequency and at the spurious emissions frequency.

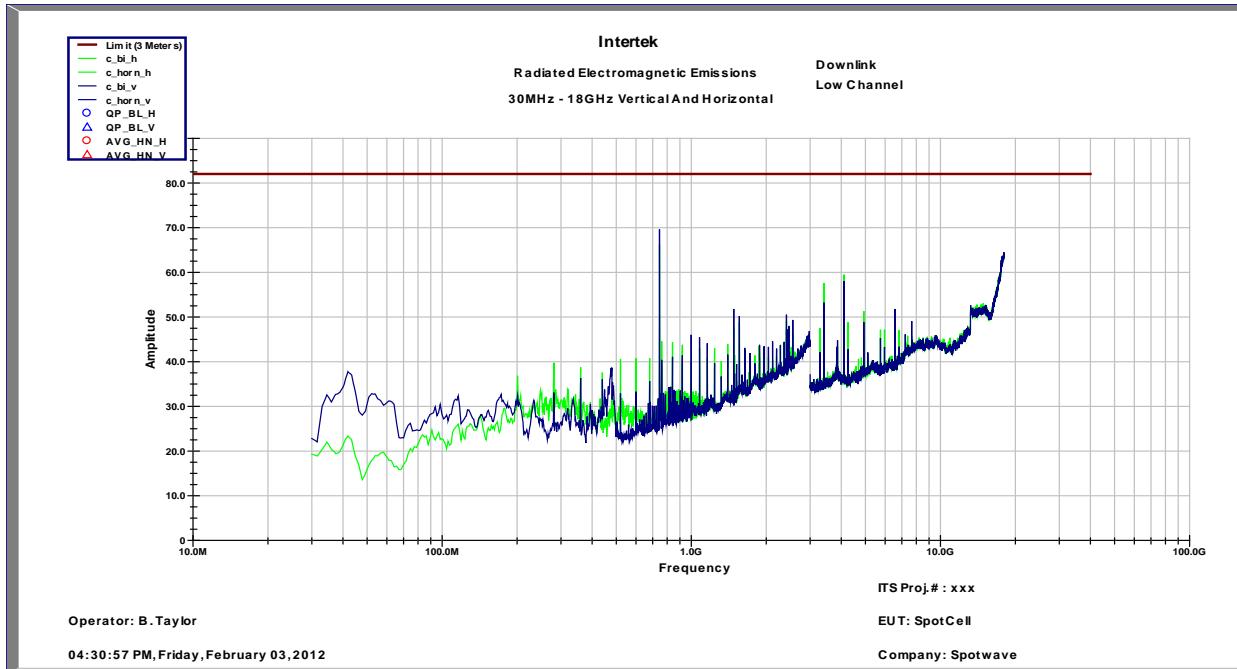
The amplifier was tested using a CW input signal that resulted in the rated output power. The output was connected to a 50Ω termination.

## 7.3 Test Equipment Used:

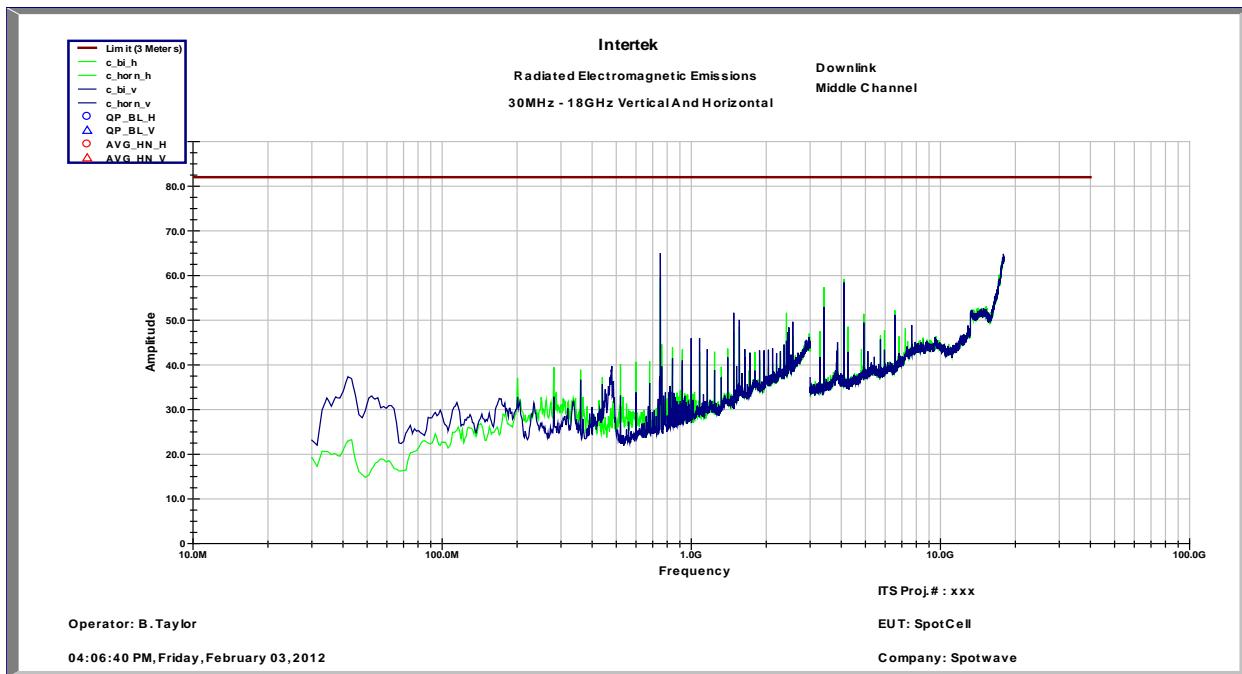
Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
EMI Test Receiver	10887490.26	Rohde & Schwarz	ESI26	6/29/2011	6/29/2012
Preamplifier	987410	Miteq	AFS44-00102000-30-10P-44	9/12/2011	9/12/2012
Preamplifier	SF456200904	Mini-Circuits	ZX60-3018G-S+	9/12/2011	9/12/2012
Biconnilog Antenna	00051864	ETS	3142C	12/20/2011	12/20/2012
Horn Antenna	6556	ETS	3115	7/20/2011	7/20/2012
Horn Antenna	1096	Antenna Research	DRG-118/A	8/24/2011	8/24/2012
System Controller	121701-1	Sunol Sciences	SC99V	Verify at Time of Use	Verify at Time of Use
High Pass Filter	3986-01 DC0408	Microwave Circuits, Inc.	H3G020G2	Verify at Time of Use	Verify at Time of Use
Vector Signal Generator	MY48180569	Agilent	N5182A	1/24/2012	1/24/2013

#### 7.4 Results:

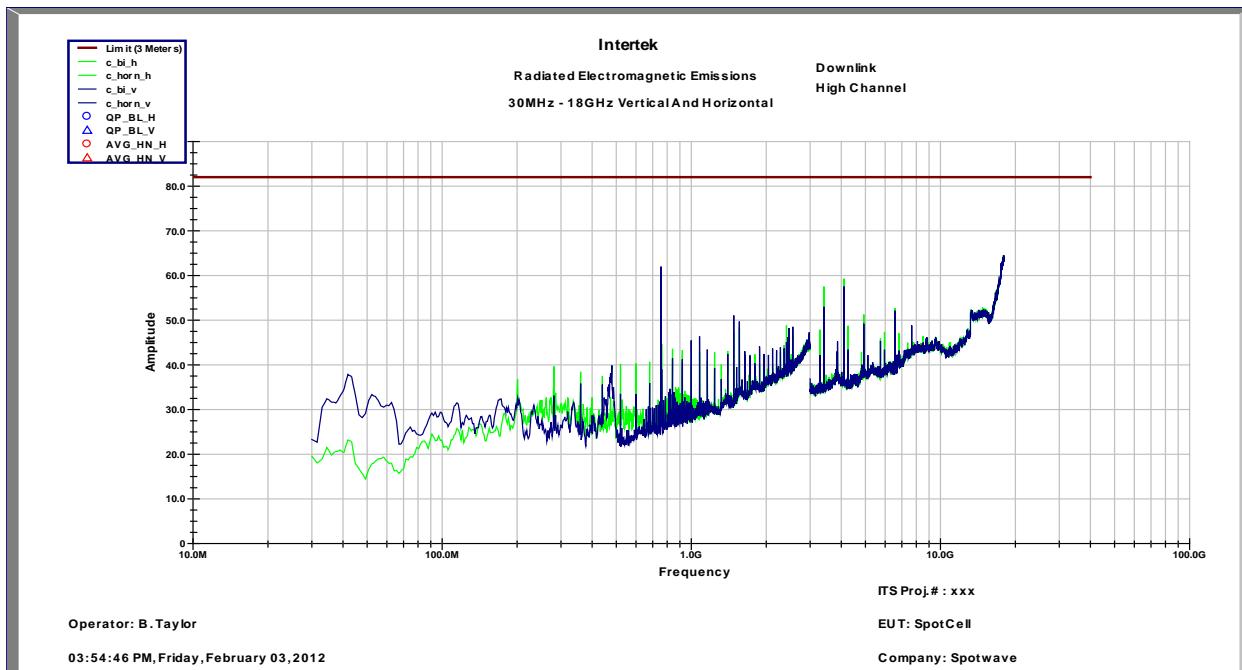
All radiated spurious emissions were attenuated below the transmitting power (P) by a factor of at least  $43 + 10 \log(P)$  dB. Radiated spurious emissions were investigated up to the tenth harmonic of the fundamental transmit frequency. There were no radiated spurious emissions within 20dB of the limit.



Radiated Spurious Emissions – Upper Block - Downlink, Low Channel



### Radiated Spurious Emissions – Upper Block - Downlink, Mid Channel



### Radiated Spurious Emissions – Upper Block - Downlink, High Channel

## 8 Measurement Uncertainty

The measured value related to the corresponding limit will be used to decide whether the equipment meets the requirements.

The measurement uncertainty figures were calculated and correspond to a coverage factor of  $k = 2$ , providing a confidence level of respectively 95.45 % in the case where the distributions characterizing the actual measurement uncertainties are normal (Gaussian).

Measurement uncertainty Table

Parameter	Uncertainty	Notes
Radiated emissions, 30 to 1000 MHz	<u>+3.9dB</u>	
Radiated emissions, 1 to 18 GHz	<u>+4.2dB</u>	
Radiated emissions, 18 to 40 GHz	<u>+4.3dB</u>	
Power Port Conducted emissions, 150kHz to 30 MHz	<u>+2.8dB</u>	

**9 Revision History**

Revision Level	Date	Report Number	Notes
0	2/23/2012	100649603LEX-002	Original Issue