



## FCC PART 27

# TEST AND MEASUREMENT REPORT

For

## ADC Telecommunications Inc.

P.O.Box 1101, Minneapolis, MN 55440-1101, USA

**FCC ID: NOO-F0693-012**

<b>Report Type:</b> Original Report	<b>Product Type:</b> Remote Access Unit for InterReach Fusion System
<b>Test Engineer:</b> Ning Ma	<i>nm</i>
<b>Report Number:</b> R1205182-27	
<b>Report Date:</b> 2012-06-12	
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\* This report may contain data that are not covered by the A2LA accreditation and are marked with an asterisk "\*" ...

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**DOCUMENT REVISION HISTORY**

<b>Revision Number</b>	<b>Report Number</b>	<b>Description of Revision</b>	<b>Date of Revision</b>
0	R1205182-27	Original Report	2012-06-12

# 1 General Description

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## 1.1 Product Description for Equipment under Test (EUT)

The ADC Telecommunications Inc. product, model: Inter Reach Fusion, FCC ID: NOO-F0693-012, model: FSN-W2-7021-1, or the "EUT" as referred to in this report, is a RAU for Indoor Booster; which is an Indoor Wireless Repeater System that consists three modular components, the Main Hub (model number: FSN-w2-MH-3), Expansion Hub (model: FSN-W1-EH-2) and RAU (model: FSN-W2-7021-1). The downlink frequency bands are 728-746 MHz, 746-757 MHz, and 2110-2155 MHz.

## 1.2 Mechanical Description

The EUT dimension is approximately 28.1cm (L) x 28.6cm (W) x 5.4cm (H) and weighs approximately 14.06 kg.

*The test data gathered are from production sample. Serial number: MR222PF3, assigned by ADC Telecommunications Inc.*

## 1.3 Objective

This type approval report is prepared on behalf of ADC Telecommunications Inc. in accordance with Part 2, Part 27 of the Federal Communication Commissions rules.

The objective is to determine compliance with FCC rules for RF output power, modulation characteristic, occupied bandwidth, spurious emissions at antenna terminal, field strength of spurious radiation, frequency stability, band edge, and conducted and radiated margin.

## 1.4 Related Submittal(s)/Grant(s)

N/A

## 1.5 Test Methodology

All tests and measurements indicated in this document were performed in accordance with the Code of Federal Regulations Title 47 Part 2, Sub-part J as well as the following parts:

Part 27 - Miscellaneous Wireless Communications Services

Applicable Standards: TIA/EIA 603-C

All radiated and conducted emissions measurement was performed at Bay Area Compliance Laboratory, Corp. The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

## 1.6 Measurement Uncertainty

All measurements involve certain levels of uncertainties, especially in the field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, antenna factor frequency interpolation, measurement distance variation, site imperfections, mismatch (average), and system repeatability.

Based on CISPR16-4-2:2003, The Treatment of Uncertainty in EMC Measurements, the values ranging from  $\pm 2.0$  dB for Conducted Emissions tests and  $\pm 4.0$  dB for Radiated Emissions tests are the most accurate estimates pertaining to uncertainty of EMC measurements at BACL Corp.

## 1.7 Test Facility

The test site used by BACL Corp. to collect radiated and conducted emissions measurement data is located at its facility in Sunnyvale, California, USA.

The test site at BACL Corp. has been fully described in reports submitted to the Federal Communication Commission (FCC) and Voluntary Control Council for Interference (VCCI). The details of these reports have been found to be in compliance with the requirements of Section 2.948 of the FCC Rules on February 11 and December 10, 1997, and Article 8 of the VCCI regulations on December 25, 1997. The test site also complies with the test methods and procedures set forth in CISPR 22:2008 §10.4 for measurements below 1 GHz and §10.6 for measurements above 1 GHz as well as ANSI C63.4-2003, ANSI C63.4-2009, TIA/EIA-603 & CISPR 24:2010.

The Federal Communications Commission and Voluntary Control Council for Interference have the reports on file and they are listed under FCC registration number: 90464 and VCCI Registration No.: A-0027. The test site has been approved by the FCC and VCCI for public use and is listed in the FCC Public Access Link (PAL) database.

Additionally, BACL Corp. is an American Association for laboratory Accreditation (A2LA) accredited laboratory (Lab Code 3297-02). The current scope of accreditations can be found at <http://www.a2la.org/scopepdf/3297-02.pdf?CFID=1132286&CFTOKEN=e42a3240dac3f6ba-6DE17DCB-1851-9E57-477422F667031258&jsessionid=8430d44f1f47cf2996124343c704b367816b>

## 2 EUT Test Configuration

### 2.1 Justification

The EUT was configured for testing according to TIA/EIA-603-C.

The final qualification test was performed with the EUT operating at normal mode.

### 2.2 EUT Exercise Software

N/A.

### 2.3 Equipment Modifications

No modifications were made to the EUT.

### 2.4 Special Equipment

No special equipment used during testing.

### 2.5 Local Support Equipment

Manufacturer	Description	Model	Serial Number
ADC Telecommunications Inc.	Main Hub	FSN-W2-MH-3	-
ADC Telecommunications Inc.	Expansion Hub	FSN-W1-EH-2	-

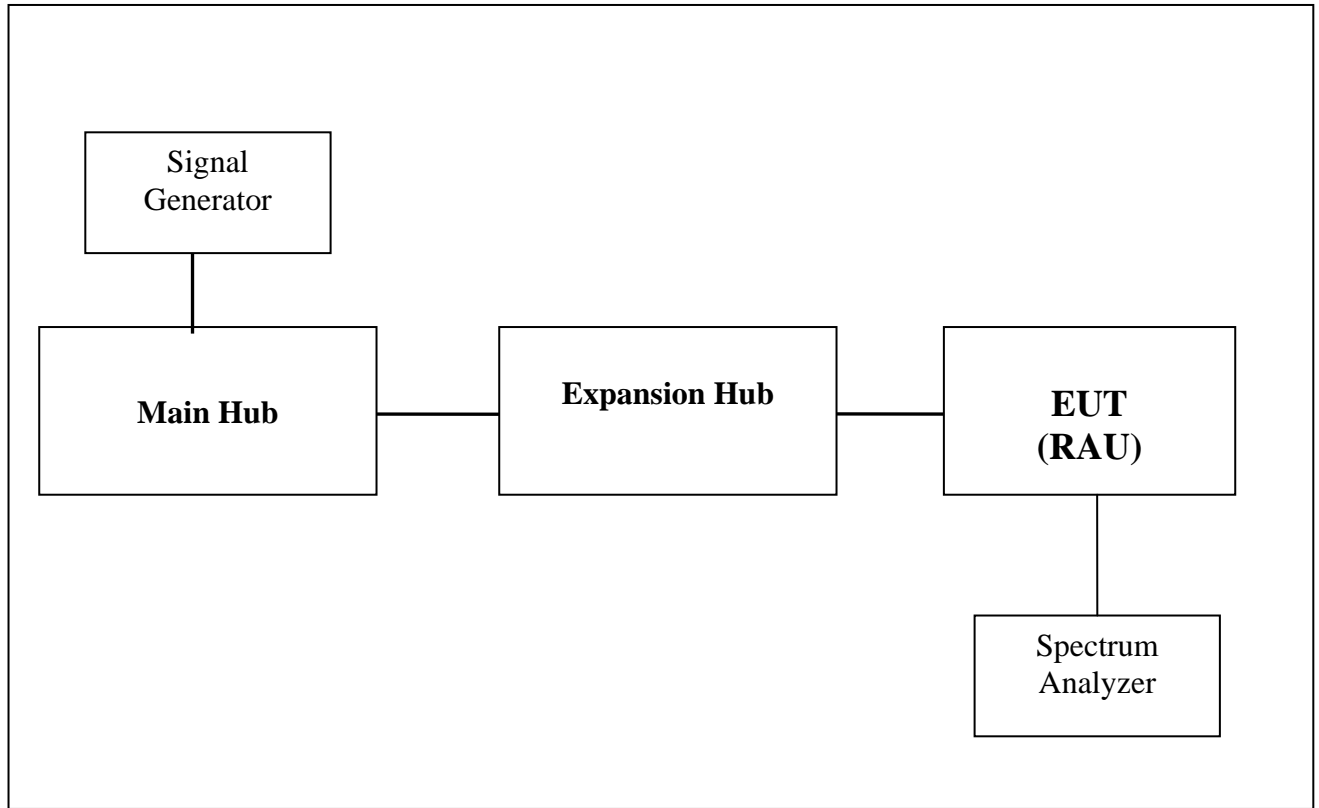
### 2.6 EUT Internal Configuration Details

Manufacturer	Description	Model	Serial Number
ADC Telecommunications Inc.	PCB Board	740693-0	-

### 2.7 External I/O Cabling List and Details

Cable Description	Length (m)	From	To
Shielded Detachable K/B Cable	15	Expansion Hub	RAU (EUT)
Fiber Cable	2.0	Main Hub	Expansion Hub

## 2.8 Test Setup Block Diagram





### 3 Summary of Test Results

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<b>FCC Rules</b>	<b>Description of Tests</b>	<b>Results</b>
§2.1046 §27.50	RF Output Power	Compliant
§2.1047	Modulation Characteristics	N/A
§2.1049 §27.53	Occupied Bandwidth / Out of Band Emissions	Compliant
§2.1053 §27.53	Spurious Radiated Emissions	Compliant
§2.1051 §27.53	Spurious Emissions at Antenna Terminals	Compliant
§27.53	Band Edge	Compliant
§2.1055 §27.54	Frequency Stability	Compliant
§2.1091	RF Exposure Information	Compliant

## 4 FCC §2.1046 & §27.50 – RF Output Power

### 4.1 Applicable Standard

According to FCC §27.50, the maximum effective radiated power (ERP) of fixed and base station must not exceed 1000 Watts.

### 4.2 Test Procedure

*Conducted:*

The RF output of the transmitter was connected to the signal generator and the spectrum analyzer through sufficient attenuation.

### 4.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date
Agilent	Spectrum Analyzer	E4440A	US45303156	2010-08-09 <sup>1</sup>
Agilent	Signal Generator	E4438C	MY45091309	2012-05-03

*Note 1: Based on a two year calibration cycle.*

**Statement of Traceability:** **BACL Corp.** attests that all calibrations have been performed according to A2LA requirements, traceable to the NIST.

### 4.4 Test Environmental Conditions

<b>Temperature:</b>	21 °C
<b>Relative Humidity:</b>	57 %
<b>ATM Pressure:</b>	101.4kPa

*The testing was performed by Ning Ma from 2012-06-01 at RF Site.*

## 4.5 Test Results

Maximum Output Power – Modulated Signal

**700 MHz Lower ABC: 728-746 MHz band:**

### WCDMA/HSPA

Mode		Channel	Frequency (MHz)	Input Power (dBm)	Output Power (dBm)
WCDMA/HSPA	737 MHz Downlink	Low	730.4	2	15.86
		Middle	737	2	15.97
		High	743.6	2	15.76

**AWS: 2110 – 2155 MHz Band:**

### WCDMA/HSPA

Mode		Channel	Frequency (MHz)	Input Power (dBm)	Output Power (dBm)
WCDMA/HSPA	2110-2155 MHz Downlink	Low	2112.4	7	18.99
		Middle	2132.4	7	18.76
		High	2152.6	7	18.64

**700 MHz Lower ABC Band, LTE – Downlink**

Mode	Modulation	Frequency (MHz)	Input Power (dBm)	Output Power (dBm)
Downlink 728-746 MHz (LTE)	QPSK (1.4 MHz)	729	2	14.89
	QPSK (1.4 MHz)	737	2	15.23
	QPSK (1.4 MHz)	745	2	14.89
	16QAM (1.4 MHz)	729	2	14.89
	16QAM (1.4 MHz)	737	2	15.22
	16QAM (1.4 MHz)	745	2	14.90
	64QAM (1.4 MHz)	729	2	14.87
	64QAM (1.4 MHz)	737	2	15.20
	64QAM (1.4 MHz)	745	2	14.88
	QPSK (3 MHz)	730	2	15.12
	QPSK (3 MHz)	737	2	15.28
	QPSK (3 MHz)	744	2	15.04
	16QAM (3 MHz)	730	2	15.15
	16QAM (3 MHz)	737	2	15.31
	16QAM (3 MHz)	744	2	15.08
	64QAM (3 MHz)	730	2	15.13
	64QAM (3 MHz)	737	2	15.29
	64QAM (3 MHz)	744	2	15.06
	QPSK (5 MHz)	731	2	15.25
	QPSK (5 MHz)	737	2	15.30
	QPSK (5 MHz)	743	2	15.06
	16QAM (5 MHz)	731	2	15.25
	16QAM (5 MHz)	737	2	15.31
	16QAM (5 MHz)	743	2	15.08
	64QAM (5 MHz)	731	2	15.24
	64QAM (5 MHz)	737	2	15.30
	64QAM (5 MHz)	743	2	15.07
	QPSK (10 MHz)	733	2	15.37
	QPSK (10 MHz)	741	2	15.20
	16QAM (10 MHz)	733	2	15.37
	16QAM (10 MHz)	741	2	15.28
	64QAM (10 MHz)	733	2	15.39
64QAM (10 MHz)	741	2	15.21	

**700 MHz Upper Band, LTE – Downlink**

Mode	Modulation	Frequency (MHz)	Input Power (dBm)	Output Power (dBm)
Downlink 746-757 MHz (LTE)	QPSK (1.4 MHz)	747	2	15.88
	QPSK (1.4 MHz)	752	2	16.56
	QPSK (1.4 MHz)	756	2	16.68
	16QAM (1.4 MHz)	747	2	15.77
	16QAM (1.4 MHz)	752	2	16.70
	16QAM (1.4 MHz)	756	2	16.74
	64QAM (1.4 MHz)	747	2	15.77
	64QAM (1.4 MHz)	752	2	16.69
	64QAM (1.4 MHz)	756	2	16.75
	QPSK (3 MHz)	748	2	16.05
	QPSK (3 MHz)	752	2	16.74
	QPSK (3 MHz)	755	2	16.90
	16QAM (3 MHz)	748	2	16.07
	16QAM (3 MHz)	752	2	16.75
	16QAM (3 MHz)	755	2	16.92
	64QAM (3 MHz)	748	2	16.05
	64QAM (3 MHz)	752	2	16.73
	64QAM (3 MHz)	755	2	16.89
	QPSK (5 MHz)	749	2	16.27
	QPSK (5 MHz)	754	2	16.88
	16QAM (5 MHz)	749	2	16.25
	16QAM (5 MHz)	754	2	16.87
	64QAM (5 MHz)	749	2	16.25
	64QAM (5 MHz)	754	2	16.88
	QPSK (10 MHz)	752	2	16.71
	16QAM (10 MHz)	752	2	16.70
64QAM (10 MHz)	752	2	16.69	

## AWS Band, LTE – Downlink

Mode	Modulation	Frequency (MHz)	Input Power (dBm)	Output Power (dBm)
Downlink 2110-2155 MHz (LTE)	QPSK (1.4 MHz)	2111	8	19.78
	QPSK (1.4 MHz)	2132	8	19.61
	QPSK (1.4 MHz)	2154	8	19.64
	16QAM (1.4 MHz)	2111	8	19.92
	16QAM (1.4 MHz)	2132	8	19.75
	16QAM (1.4 MHz)	2154	8	19.74
	64QAM (1.4 MHz)	2111	8	19.82
	64QAM (1.4 MHz)	2132	8	19.79
	64QAM (1.4 MHz)	2154	8	19.80
	QPSK (3 MHz)	2112	8	20.14
	QPSK (3 MHz)	2132	8	19.83
	QPSK (3 MHz)	2153	8	19.76
	16QAM (3 MHz)	2112	8	20.09
	16QAM (3 MHz)	2132	8	19.51
	16QAM (3 MHz)	2153	8	19.82
	64QAM (3 MHz)	2112	8	20.08
	64QAM (3 MHz)	2132	8	19.78
	64QAM (3 MHz)	2153	8	19.71
	QPSK (5 MHz)	2113	8	20.09
	QPSK (5 MHz)	2132	8	19.75
	QPSK (5 MHz)	2152	8	19.62
	16QAM (5 MHz)	2113	8	20.07
	16QAM (5 MHz)	2132	8	19.75
	16QAM (5 MHz)	2152	8	19.63
	64QAM (5 MHz)	2113	8	20.11
	64QAM (5 MHz)	2132	8	19.76
	64QAM (5 MHz)	2152	8	19.65
	QPSK (10 MHz)	2115	8	20.08
	QPSK (10 MHz)	2132	8	19.76
	QPSK (10 MHz)	2150	8	19.62
	16QAM (10 MHz)	2115	8	20.10
	16QAM (10 MHz)	2132	8	19.78
	16QAM (10 MHz)	2150	8	19.66
64QAM (10 MHz)	2115	8	20.11	
64QAM (10 MHz)	2132	8	19.76	
64QAM (10 MHz)	2150	8	19.64	

## 5 FCC §2.1049 & §27.53 – Occupied Bandwidth

### 5.1 Applicable Standard

Requirements: FCC §2.1049 and §27.53.

### 5.2 Test Procedure

The RF output of the transmitter was connected to the simulator and the spectrum analyzer through sufficient attenuation.

The resolution bandwidth of the spectrum analyzer was set at 1% of the authorized bandwidth and the 26 dB & 99% bandwidth was recorded.

### 5.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date
Agilent	Spectrum Analyzer	E4440A	US45303156	2010-08-09 <sup>1</sup>
Agilent	Signal Generator	E4438C	MY45091309	2012-05-03

*Note 1: Based on a two year calibration cycle.*

**Statement of Traceability:** **BACL Corp.** attests that all calibrations have been performed according to A2LA requirements, traceable to the NIST.

### 5.4 Test Environmental Conditions

<b>Temperature:</b>	21 °C
<b>Relative Humidity:</b>	57 %
<b>ATM Pressure:</b>	101.4kPa

*The testing was performed by Ning Ma from 2012-06-02 at RF Site.*

## 5.5 Test Results

### 700 MHz Lower ABC Band - Downlink

Mode		Channel	Frequency (MHz)	Emission Bandwidth Input (MHz)	Emission Bandwidth Output (MHz)
WCDMA/HSPA	737 MHz Downlink	Middle	737	4.1533	4.1828

### AWS Band

Mode		Channel	Frequency (MHz)	Emission Bandwidth Input (MHz)	Emission Bandwidth Output (MHz)
WCDMA/HSPA	2100 MHz Downlink	Middle	2132.4	4.1716	4.1726

### 700 MHz Lower ABC Band – Downlink

Mode	Modulation	Frequency (MHz)	Emission Bandwidth Input (MHz)	Emission Bandwidth Output (MHz)
Downlink 728-746 MHz (LTE)	QPSK (1.4 MHz)	737	1.0995	1.0931
	16QAM (1.4 MHz)	737	1.0950	1.1023
	64QAM (1.4 MHz)	737	1.0975	1.0975
	QPSK (3 MHz)	737	2.6937	2.6968
	16QAM (3 MHz)	737	2.7027	2.7140
	64QAM (3 MHz)	737	2.6981	2.6943
	QPSK (5 MHz)	737	4.4831	4.4883
	16QAM (5 MHz)	737	4.4862	4.4905
	64QAM (5 MHz)	737	4.4815	4.4841
	QPSK (10 MHz)	737	8.9455	8.9546
	16QAM (10 MHz)	737	8.9435	8.9587
	64QAM (10 MHz)	737	8.9492	8.9441



**700 MHz Upper Band – Downlink**

Mode	Modulation	Frequency (MHz)	Emission Bandwidth Input (MHz)	Emission Bandwidth Output (MHz)
Downlink 746-757 MHz (LTE)	QPSK (1.4 MHz)	752	1.0914	1.0979
	16QAM (1.4 MHz)	752	1.1015	1.0979
	64QAM (1.4 MHz)	752	1.0976	1.0980
	QPSK (3 MHz)	752	2.6905	2.6958
	16QAM (3 MHz)	752	2.6992	2.6917
	64QAM (3 MHz)	752	2.6955	2.6966
	QPSK (5 MHz)	752	4.4779	4.4805
	16QAM (5 MHz)	752	4.4864	4.4849
	64QAM (5 MHz)	752	4.4840	4.4905
	QPSK (10 MHz)	752	8.9528	8.9350
	16QAM (10 MHz)	752	8.9305	8.9453
	64QAM (10 MHz)	752	8.9356	8.9407

**AWS Band – Downlink**

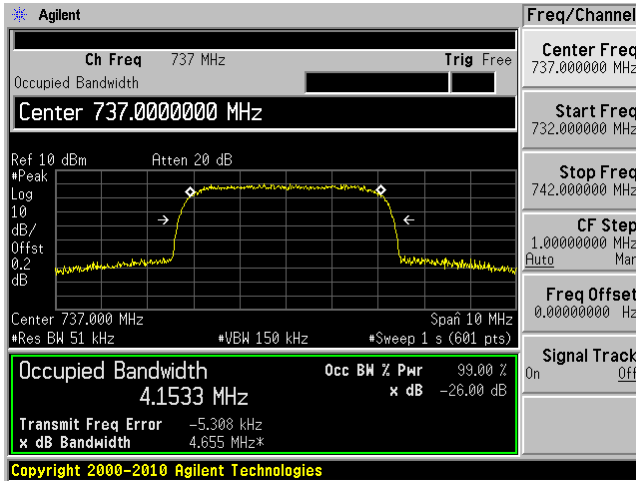
Mode	Modulation	Frequency (MHz)	Emission Bandwidth Input (MHz)	Emission Bandwidth Output (MHz)
Downlink 2110-2155 MHz (LTE)	QPSK (1.4 MHz)	2132	1.0943	1.0971
	16QAM (1.4 MHz)	2132	1.0960	1.0986
	64QAM (1.4 MHz)	2132	1.0933	1.0984
	QPSK (3 MHz)	2132	2.6942	2.6952
	16QAM (3 MHz)	2132	2.6947	2.6948
	64QAM (3 MHz)	2132	2.6981	2.7003
	QPSK (5 MHz)	2132	4.4755	4.4847
	16QAM (5 MHz)	2132	4.4866	4.4847
	64QAM (5 MHz)	2132	4.4819	4.5093
	QPSK (10 MHz)	2132	8.9480	8.9506
	16QAM (10 MHz)	2132	8.9424	8.9403
	64QAM (10 MHz)	2132	8.9381	8.9495

Please refer to the following plots.

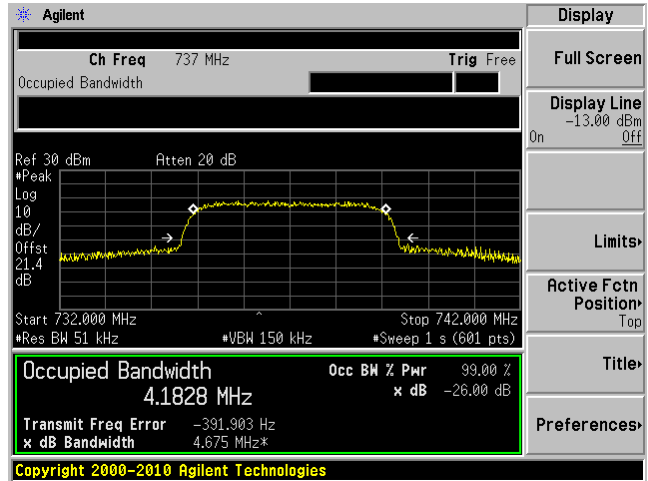
### 700 MHz Lower Band, Downlink

#### WCDMA/HSPA (Middle Channel)

Input



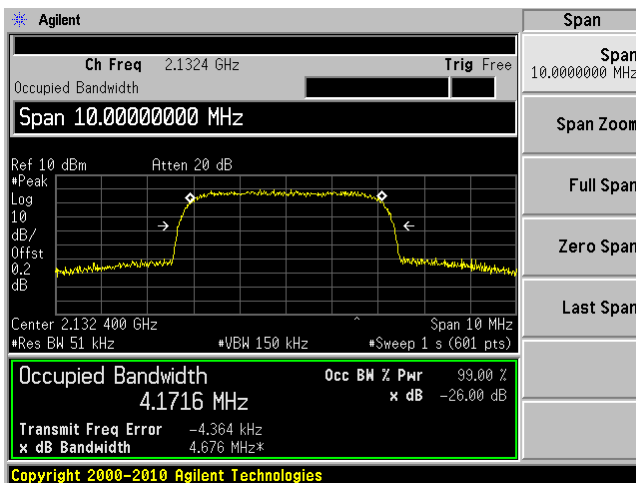
Output



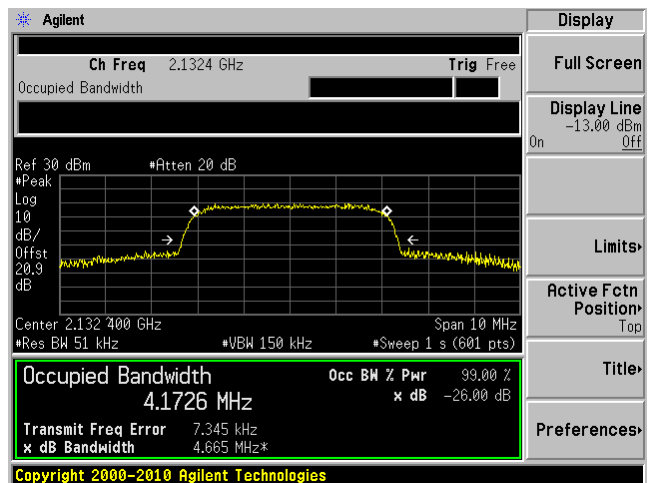
### AWS Band, Downlink

#### WCDMA/HSPA (Middle Channel)

Input



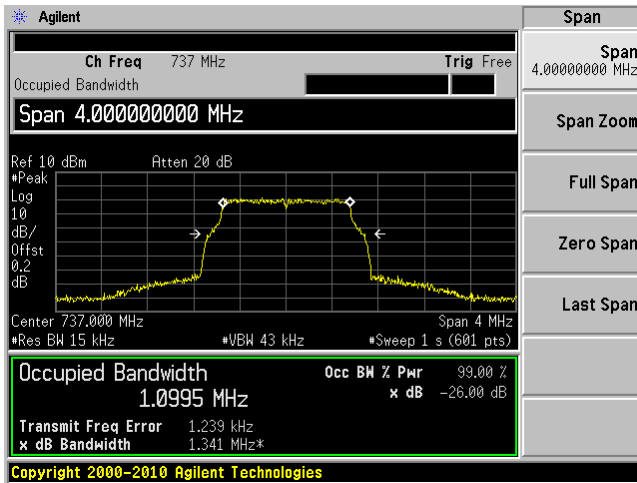
Output



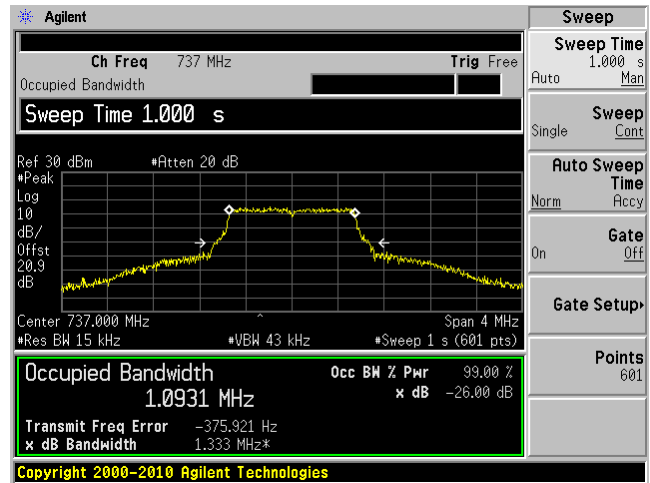
700 MHz Lower Band; DL: 728-746 MHz

QPSK (1.4 MHz), (Middle Channel)

Input

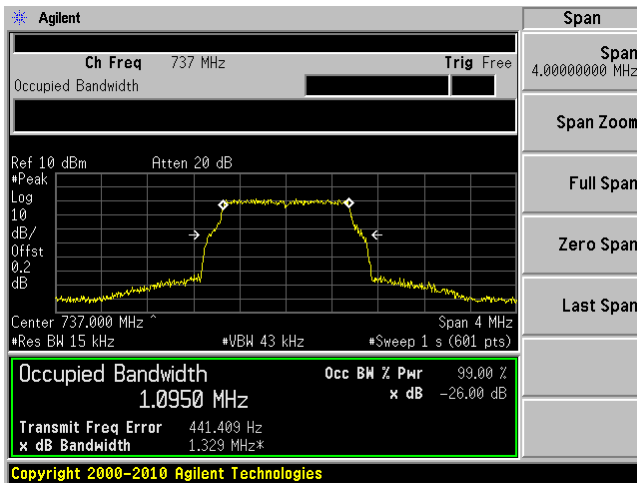


Output

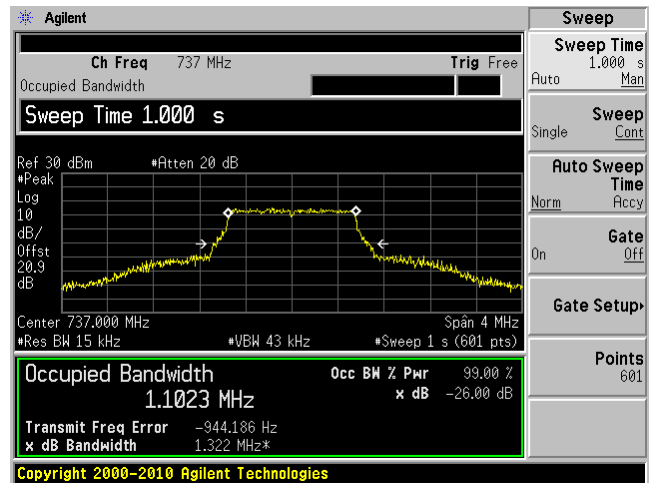


16QAM (1.4 MHz), (Middle Channel)

Input

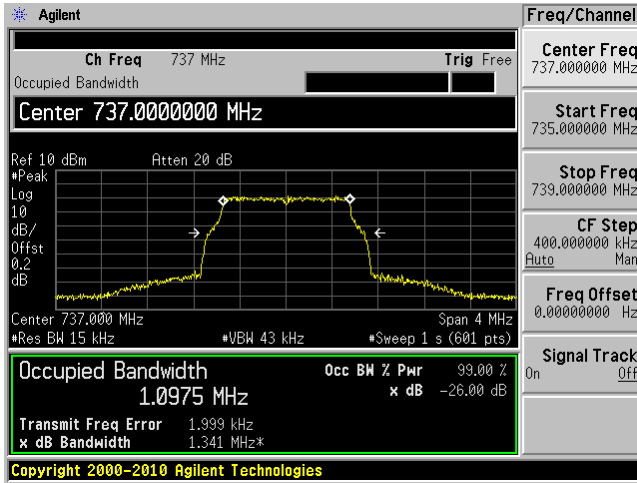


Output

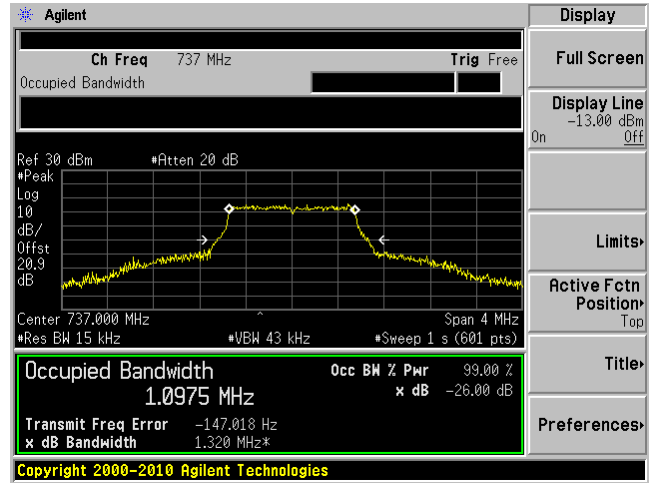


64QAM (1.4 MHz), (Middle Channel)

Input

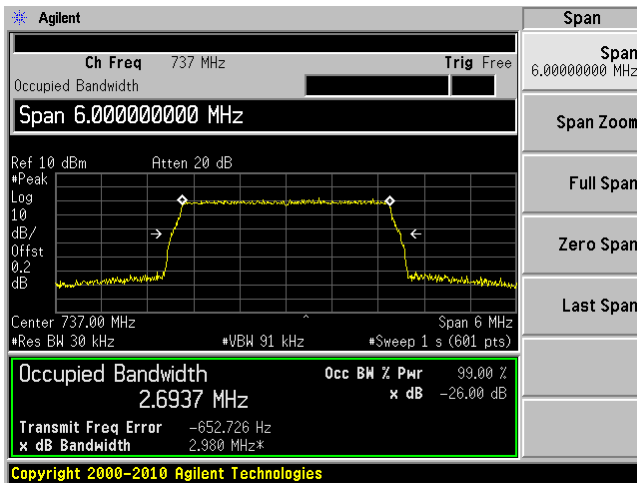


Output

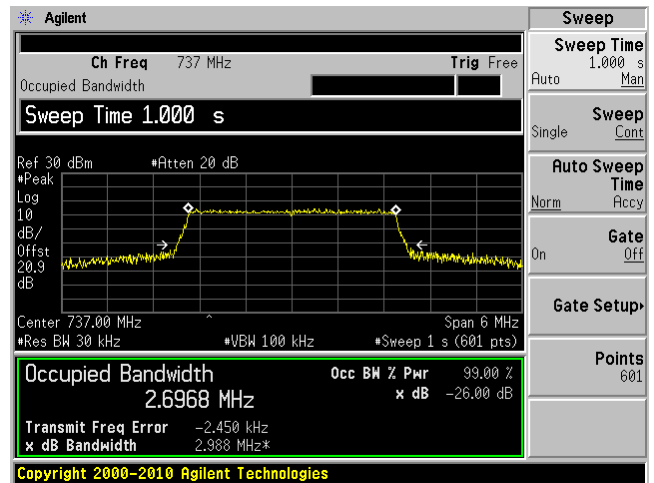


QPSK (3 MHz), (Middle Channel)

Input

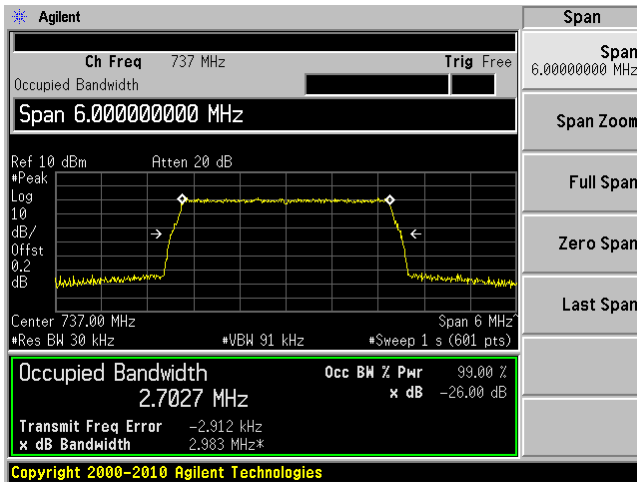


Output

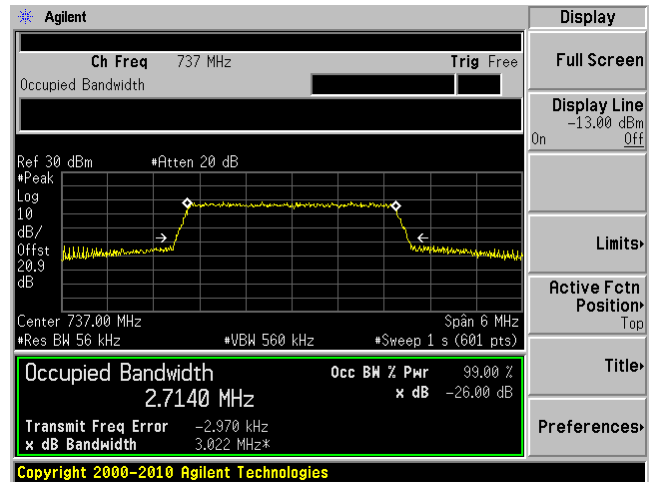


16QAM (3 MHz), (Middle Channel)

Input

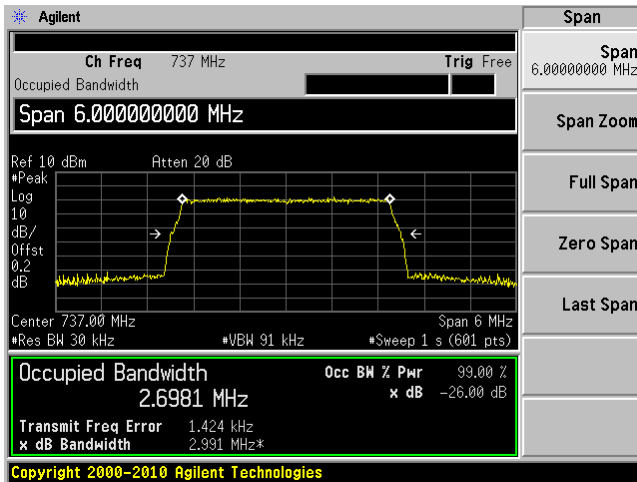


Output

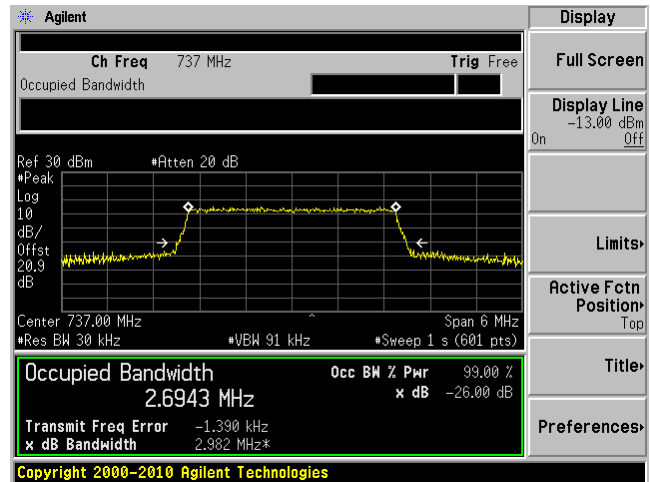


64QAM (3 MHz), (Middle Channel)

Input

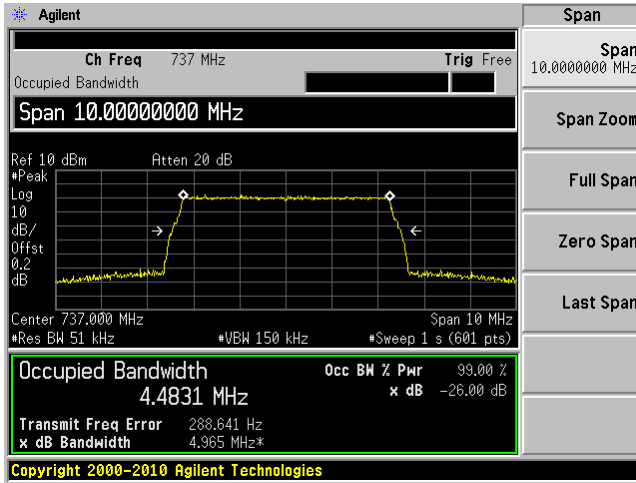


Output

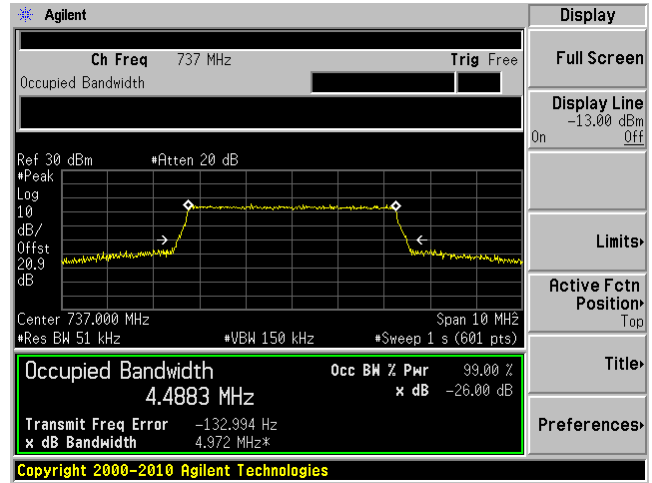


QPSK (5 MHz), (Middle Channel)

Input

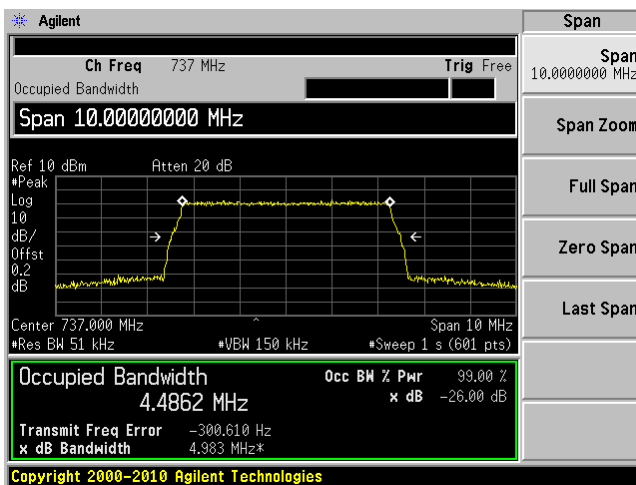


Output

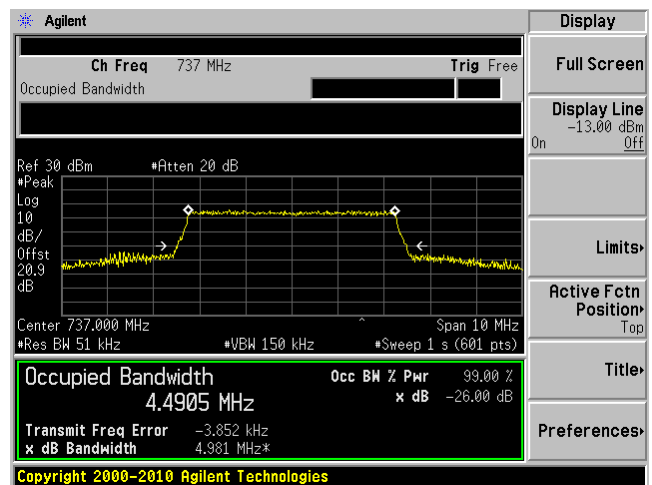


16QAM (5 MHz), (Middle Channel)

Input

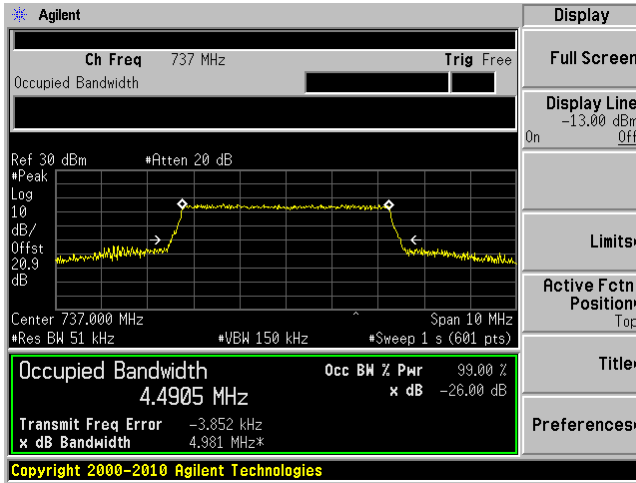


Output

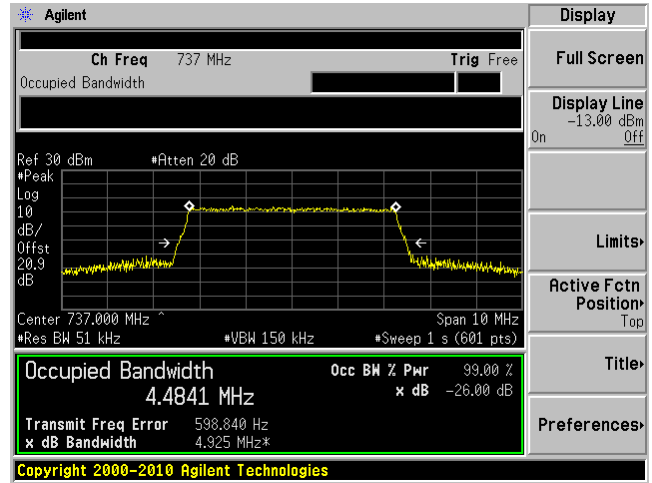


64QAM (5 MHz), (Middle Channel)

Input

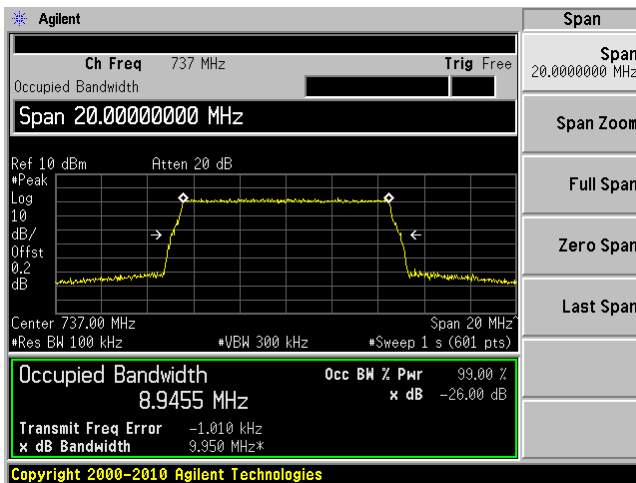


Output

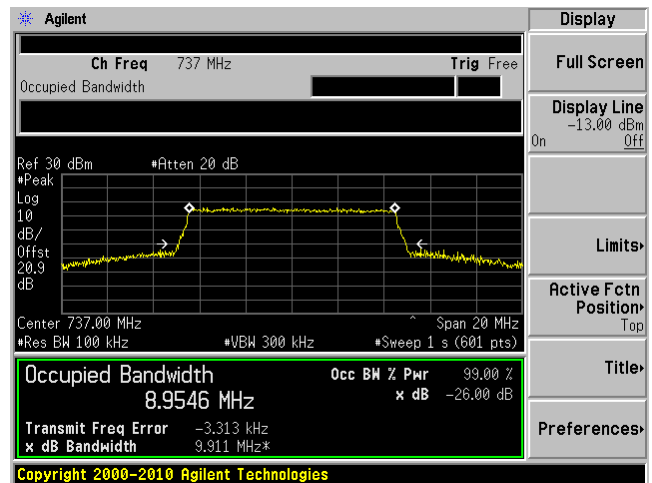


QPSK (10 MHz), (Low Channel)

Input

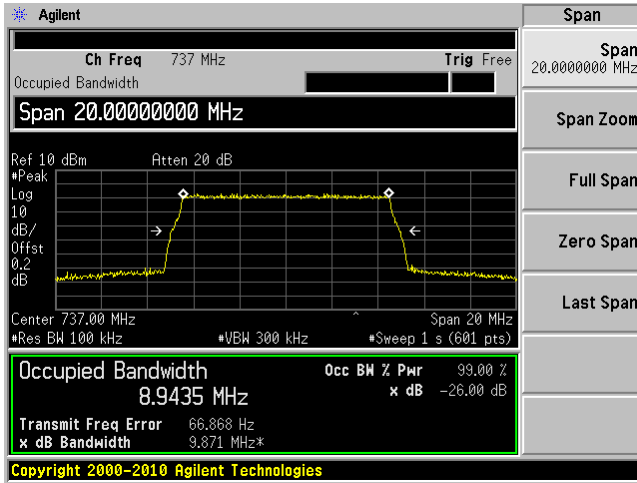


Output

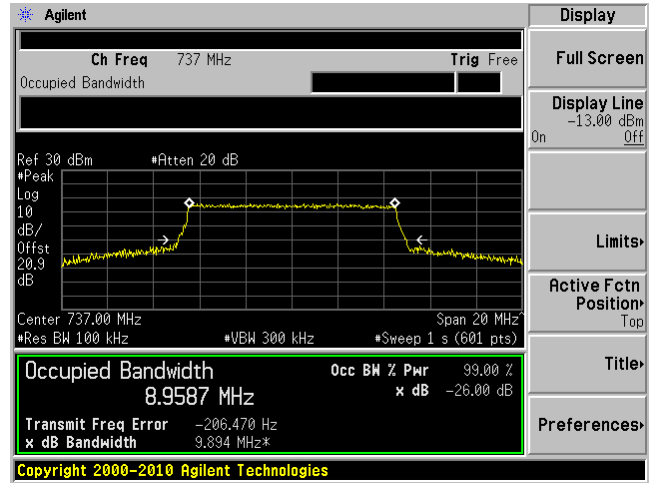


16QAM (10 MHz), (Low Channel)

Input

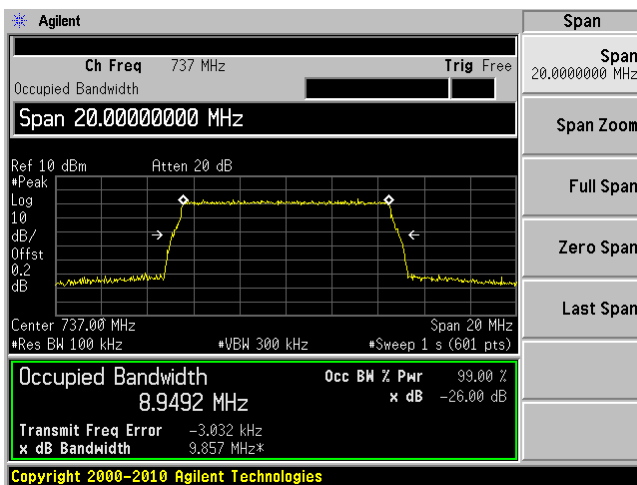


Output

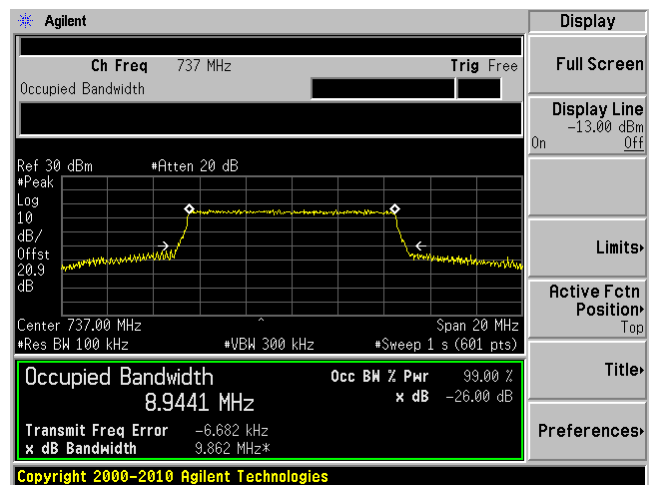


64QAM (10 MHz), (Low Channel)

Input



Output



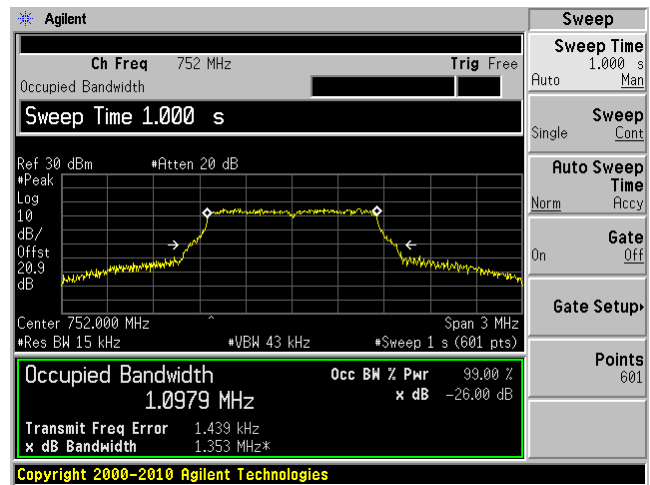
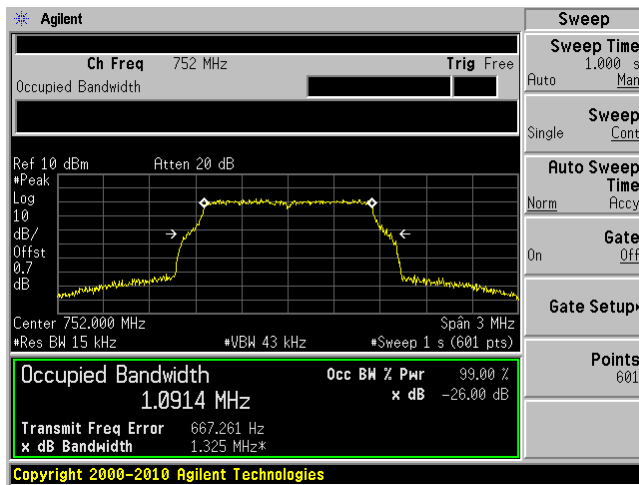


### 700 MHz Upper Band; DL: 746-757 MHz

#### QPSK (1.4 MHz), (Middle Channel)

Input

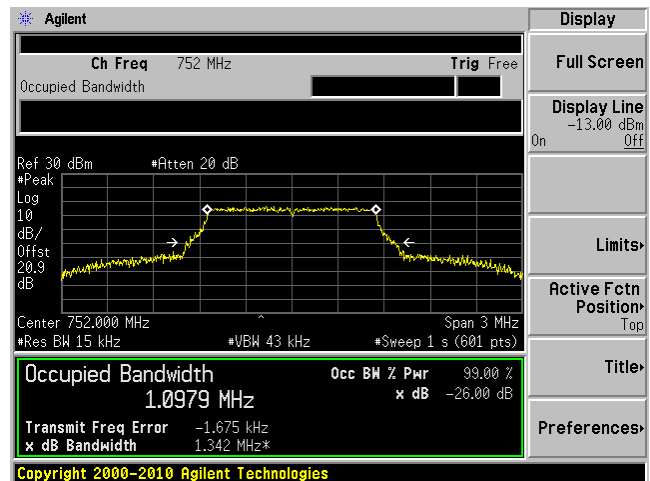
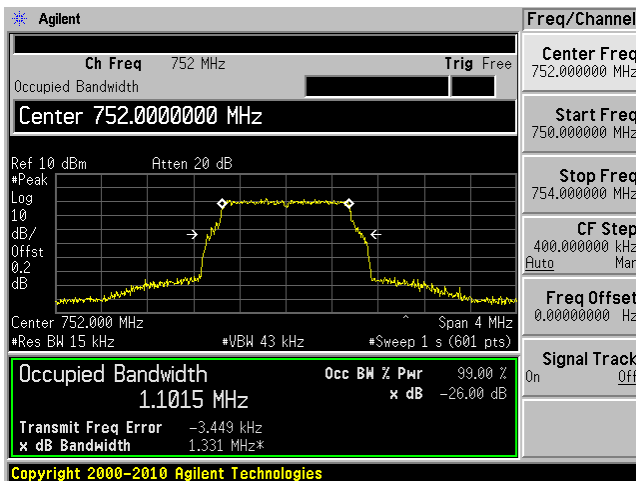
Output



#### 16QAM (1.4 MHz), (Middle Channel)

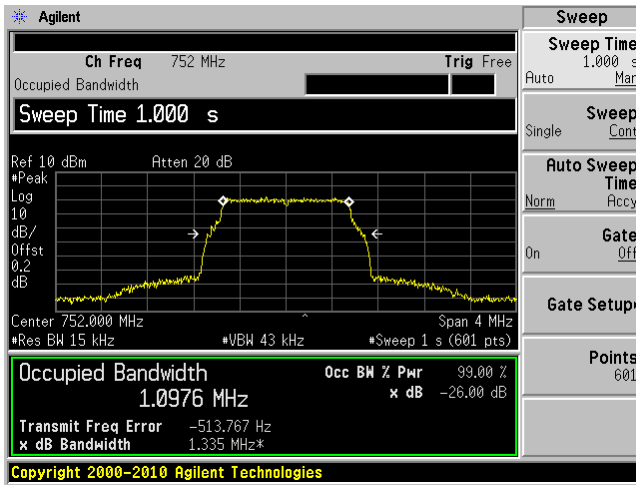
Input

Output

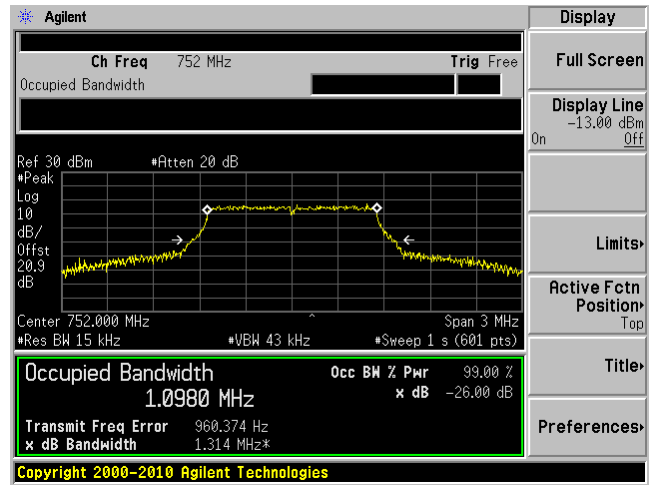


64QAM (1.4 MHz), (Middle Channel)

Input

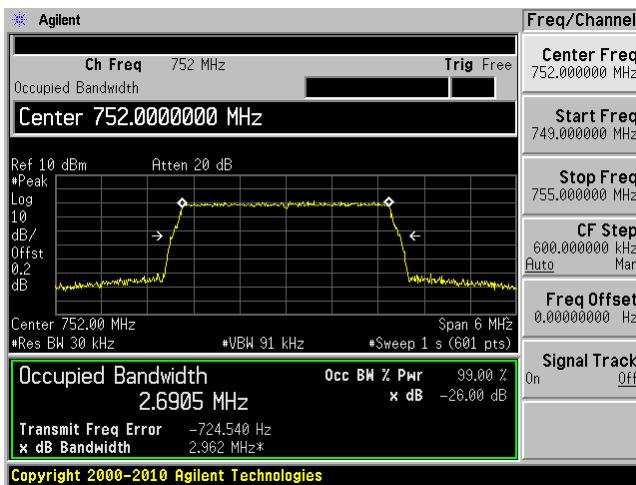


Output

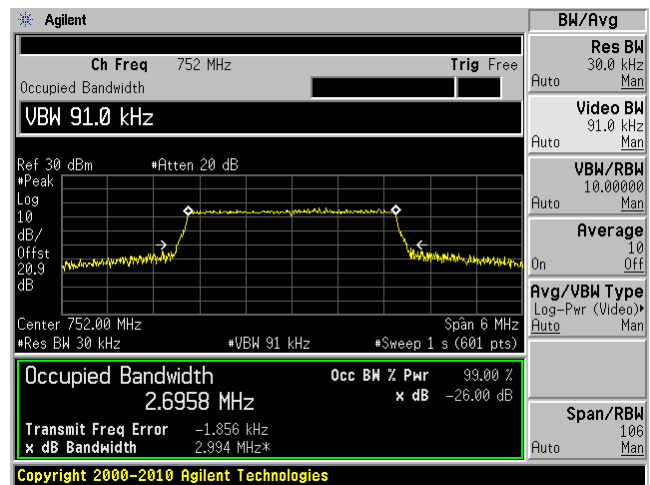


QPSK (3 MHz), (Middle Channel)

Input

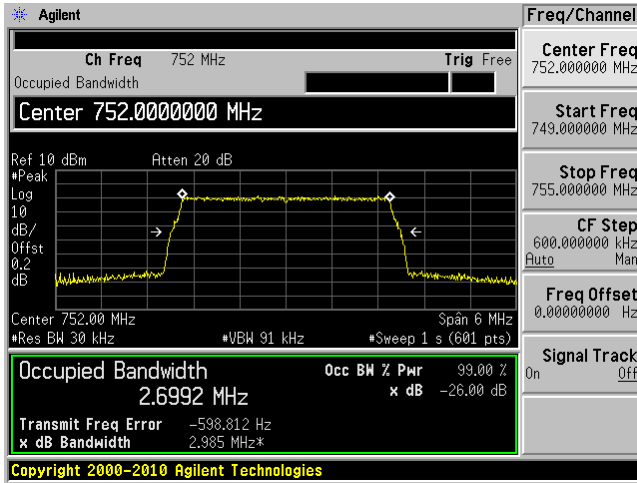


Output

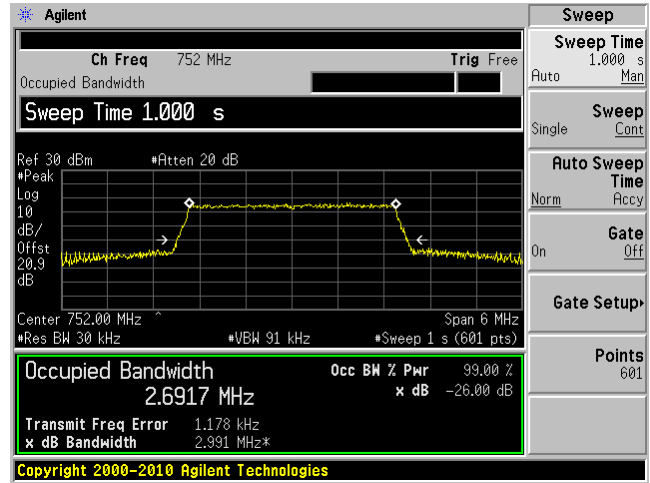


16QAM (3 MHz), (Middle Channel)

Input

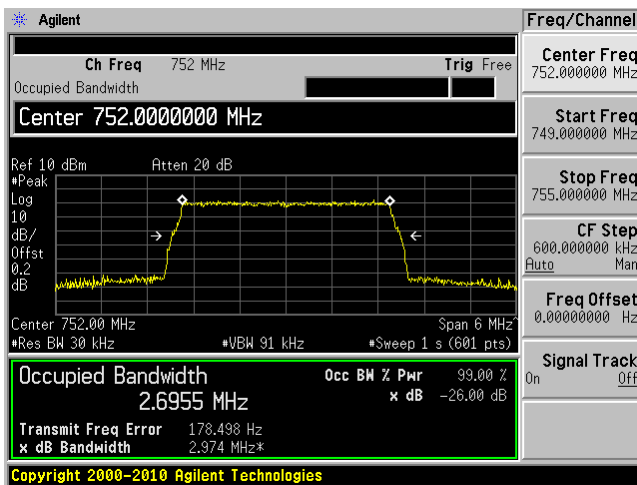


Output

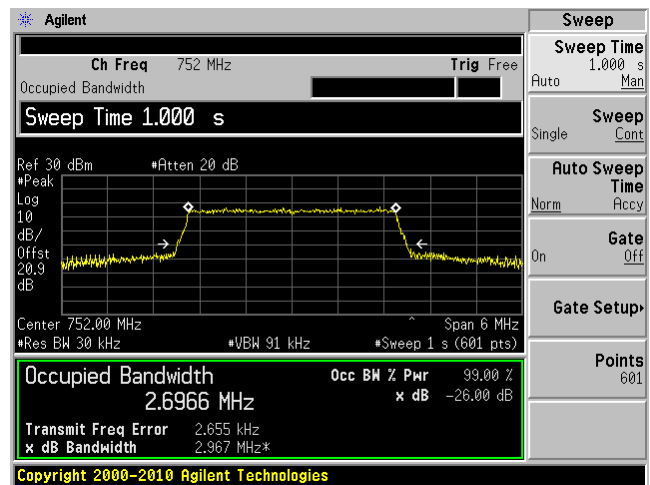


64QAM (3 MHz), (Middle Channel)

Input

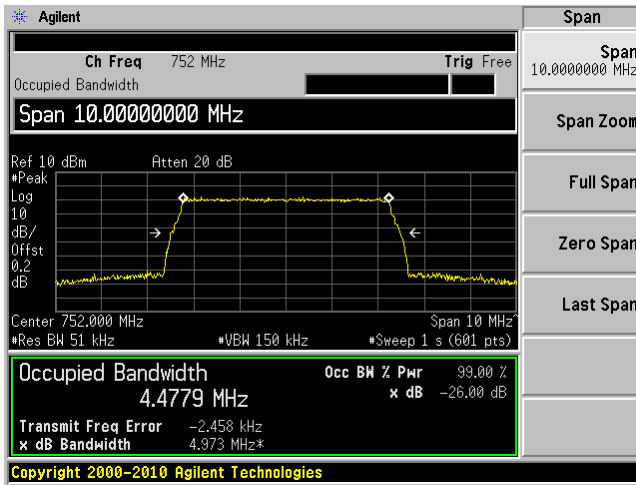


Output

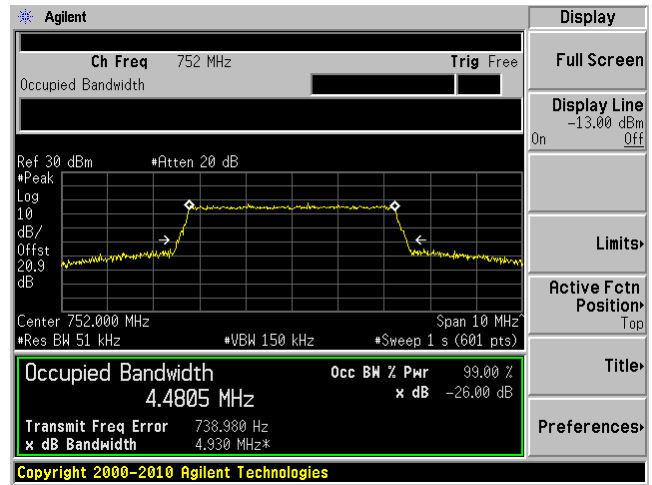


QPSK (5 MHz), (Middle Channel)

Input

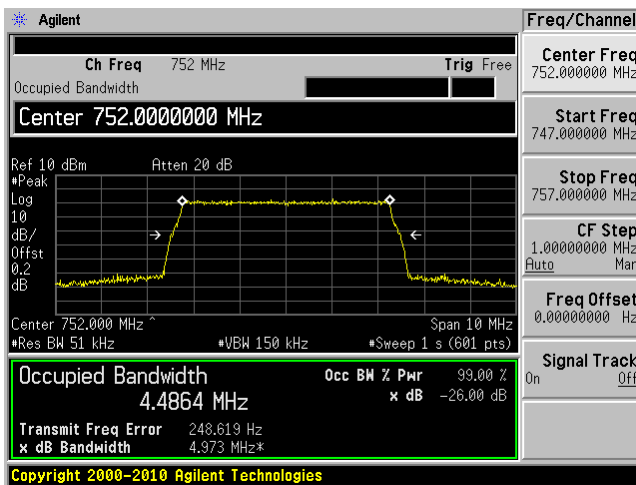


Output

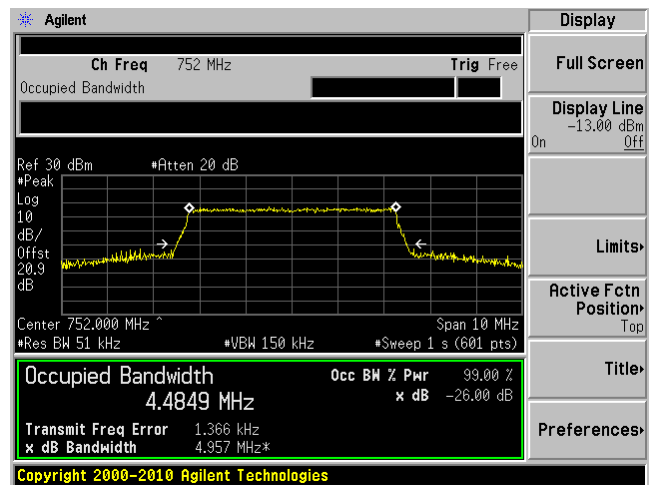


16QAM (5 MHz), (Middle Channel)

Input

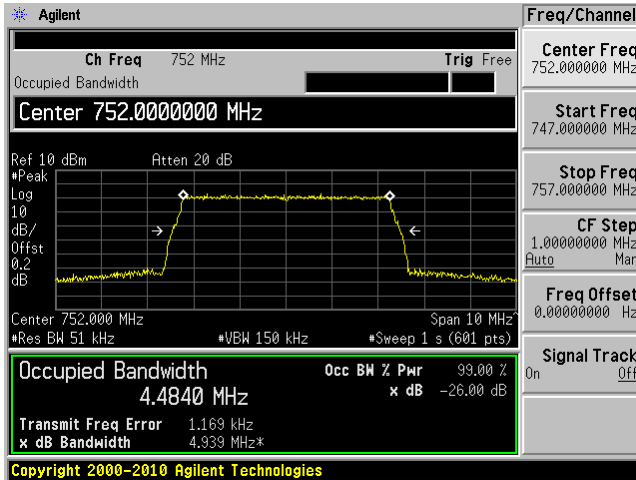


Output

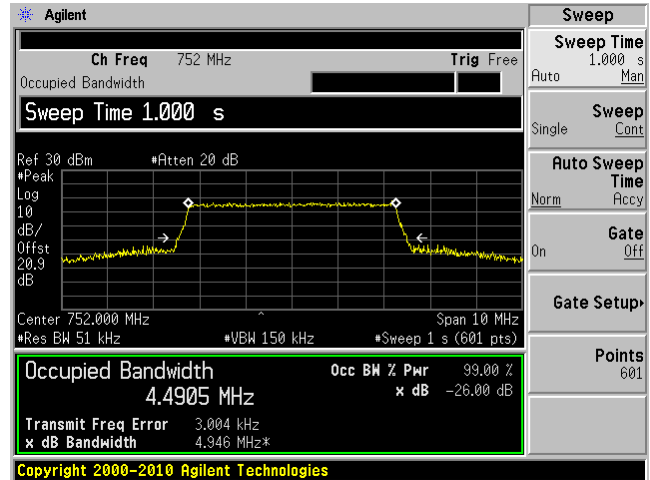


64QAM (5 MHz), (Middle Channel)

Input

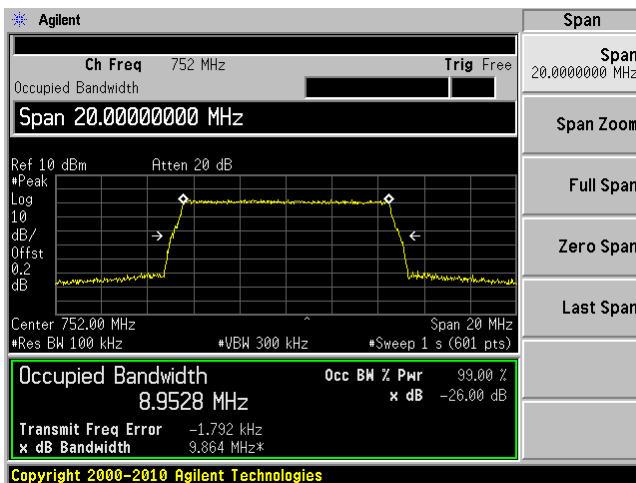


Output

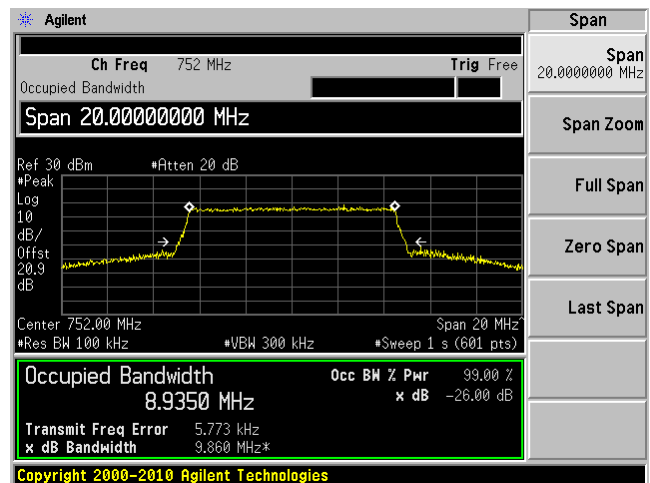


QPSK (10 MHz), (Low Channel)

Input

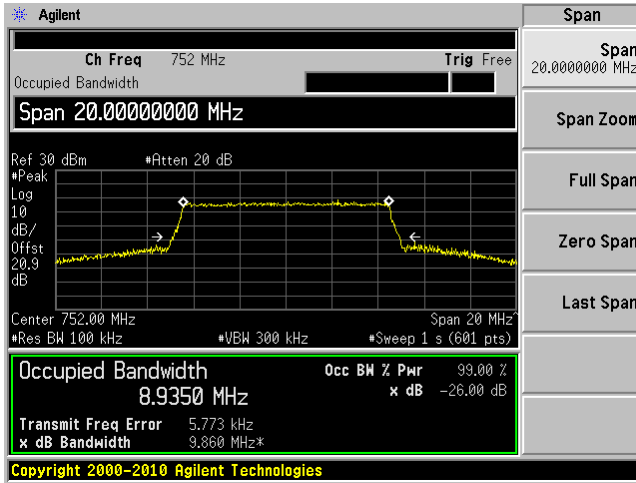


Output

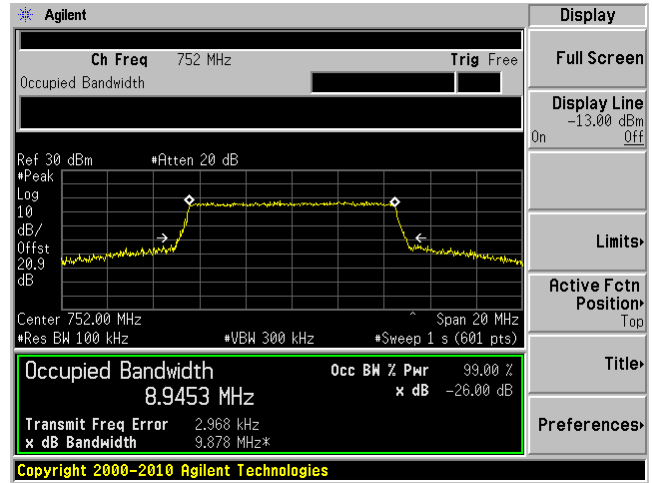


16QAM (10 MHz), (Low Channel)

Input

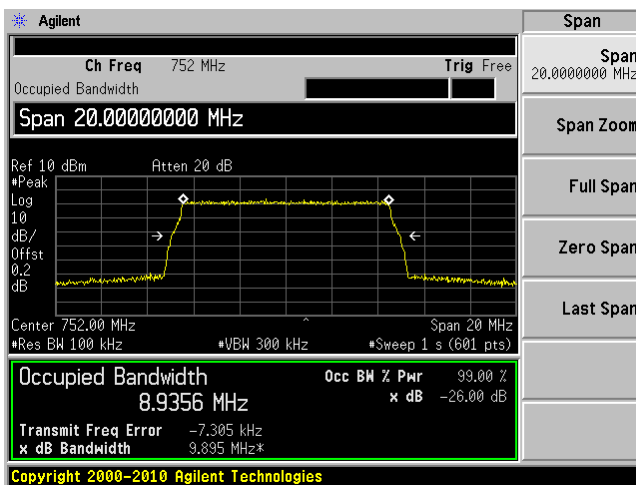


Output

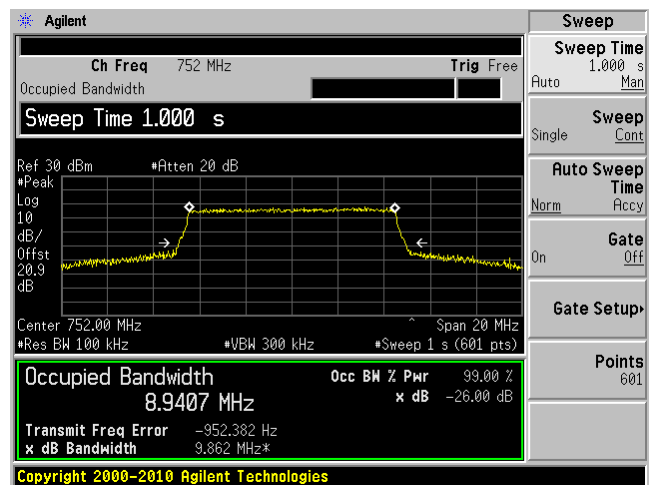


64QAM (10 MHz), (Low Channel)

Input



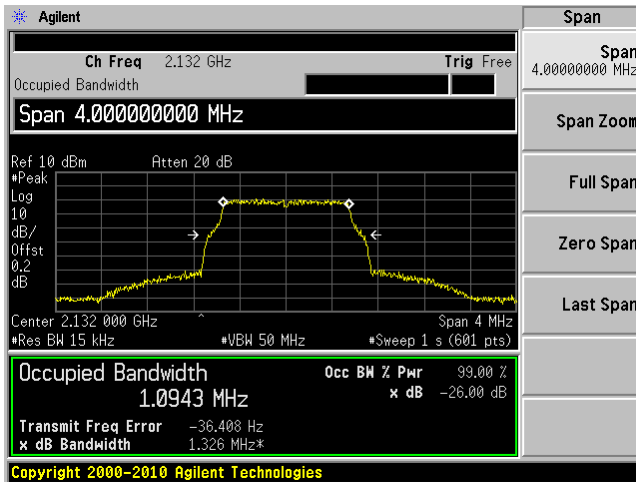
Output



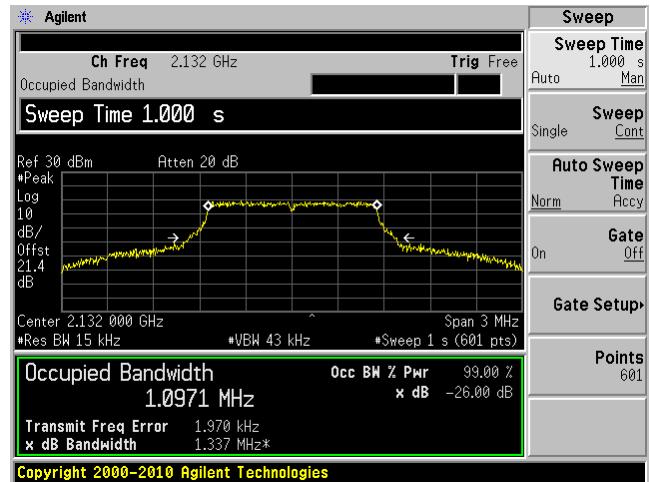
**AWS Band; DL: 2110-2155 MHz**

**QPSK (1.4 MHz), (Middle Channel)**

Input

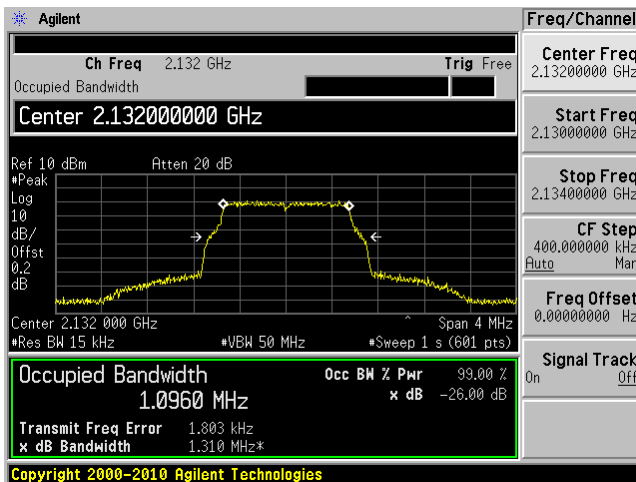


Output

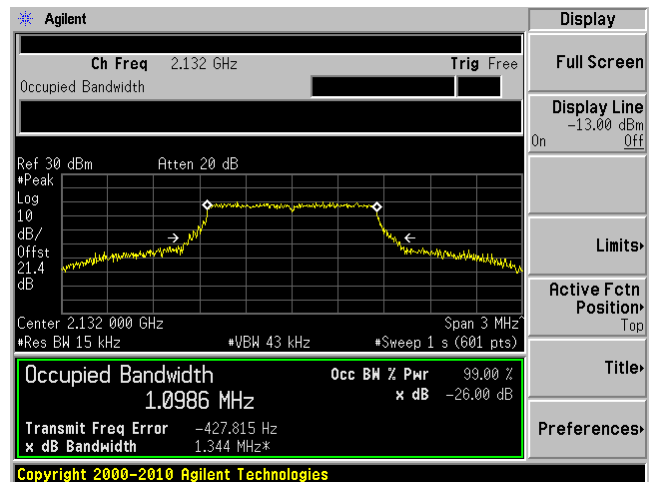


**16QAM (1.4 MHz), (Middle Channel)**

Input

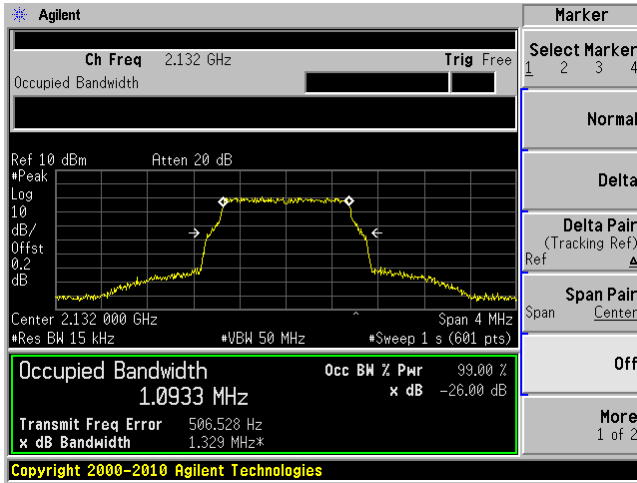


Output

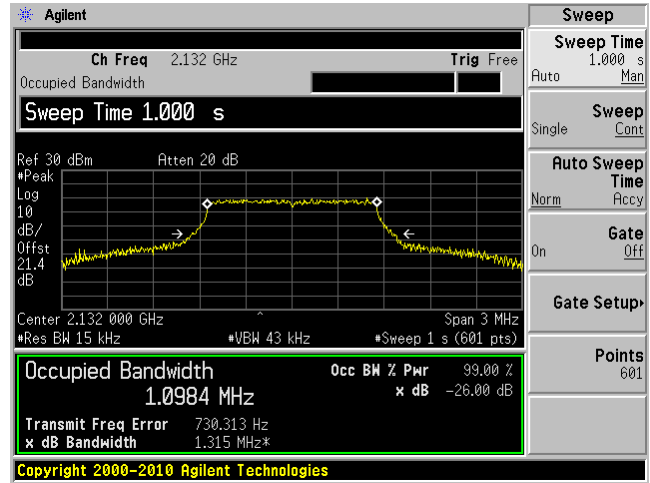


64QAM (1.4 MHz), (Middle Channel)

Input

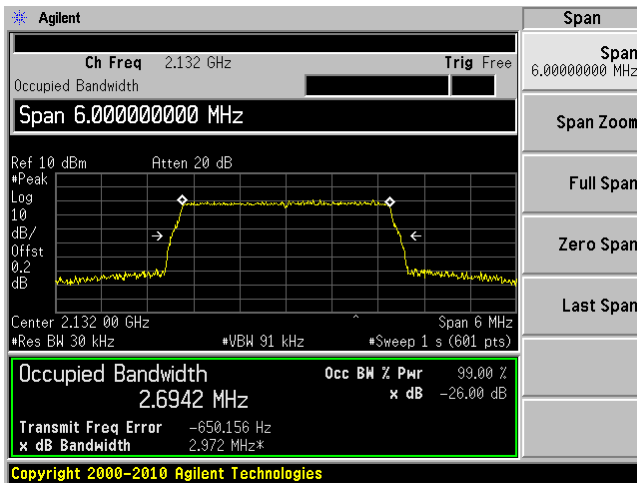


Output

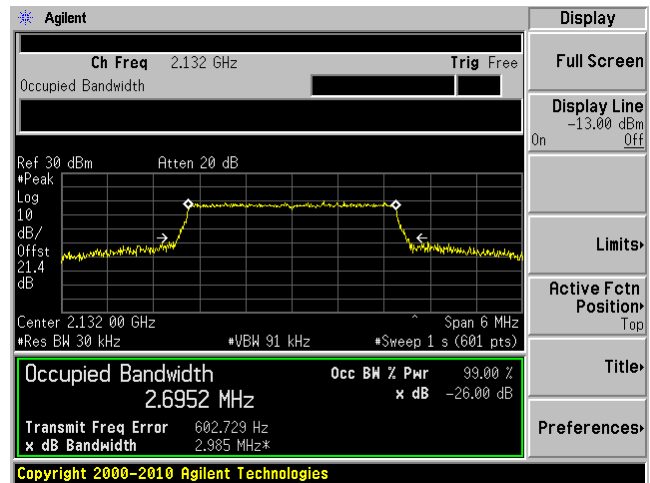


QPSK (3 MHz), (Middle Channel)

Input



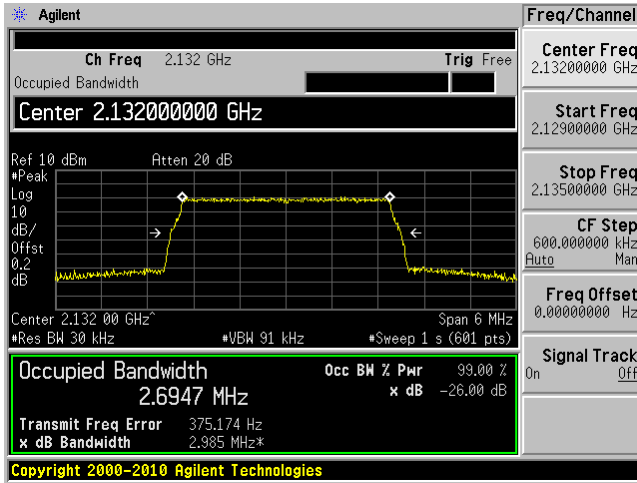
Output



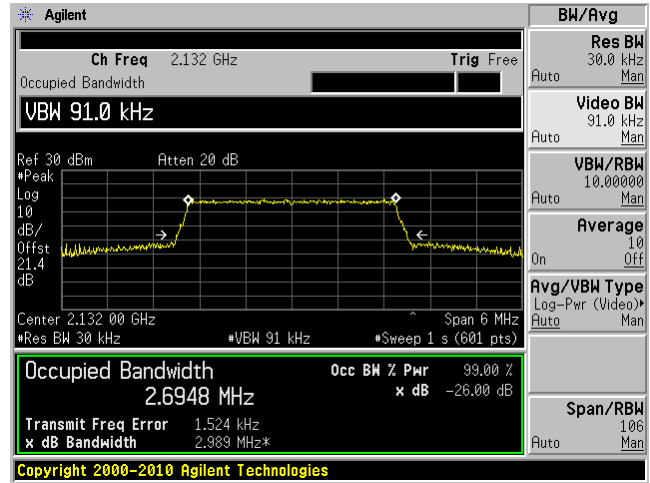


16QAM (3 MHz), (Middle Channel)

Input

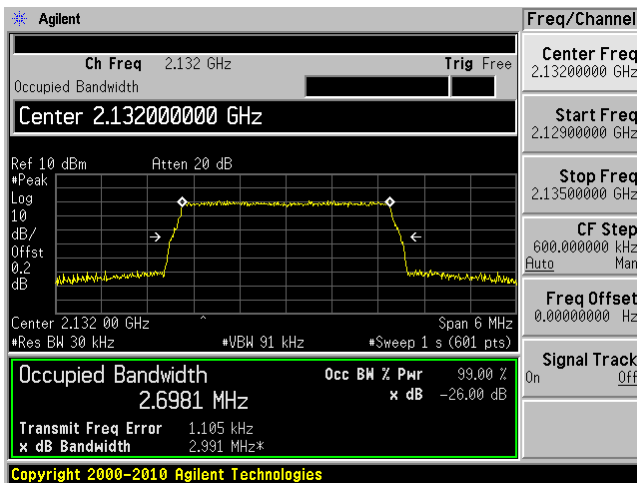


Output

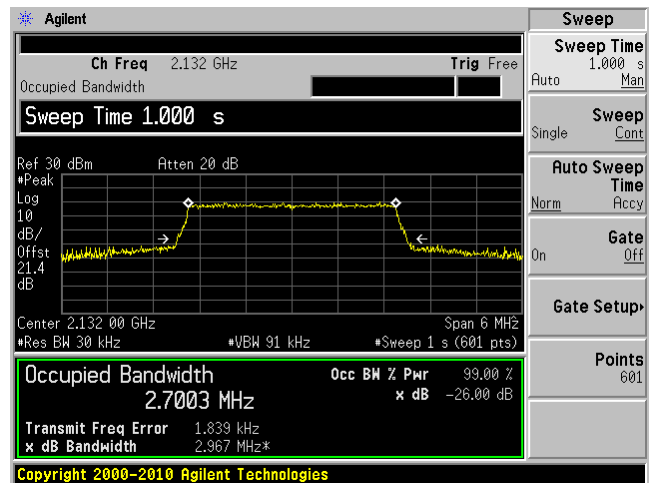


64QAM (3 MHz), (Middle Channel)

Input

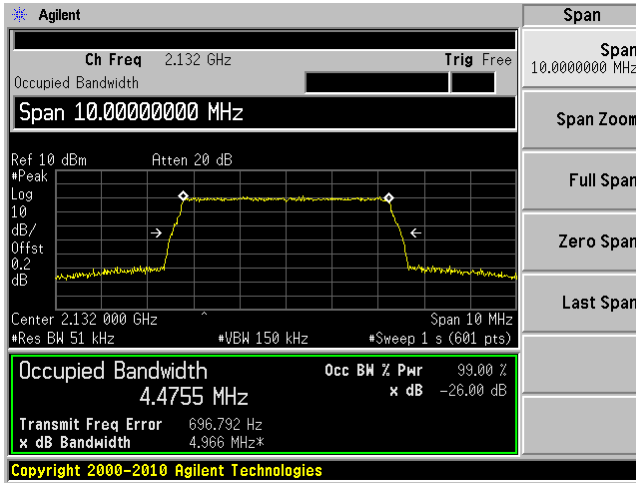


Output

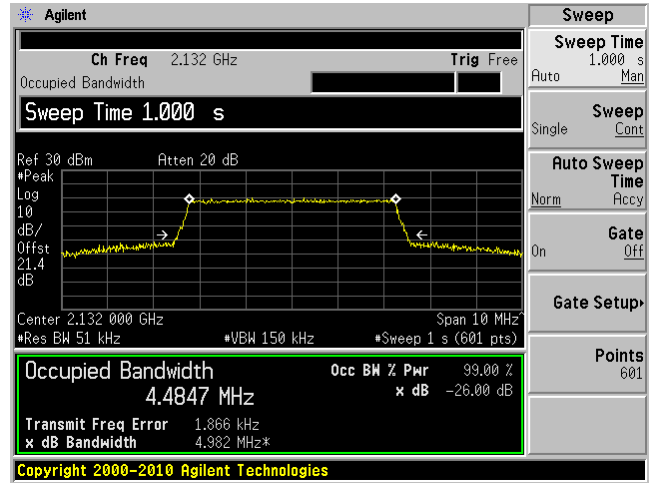


QPSK (5 MHz), (Middle Channel)

Input

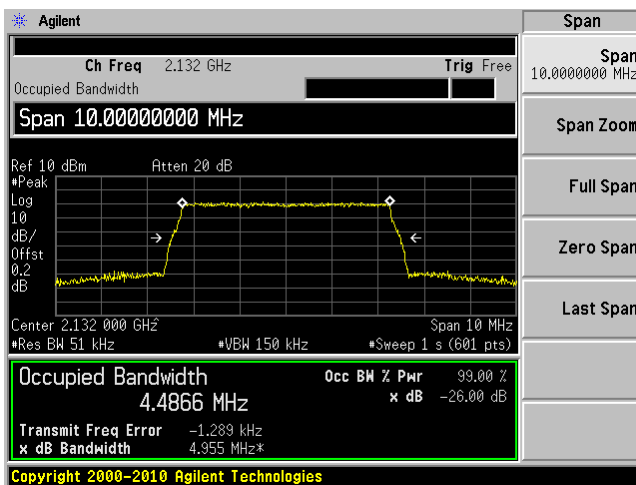


Output

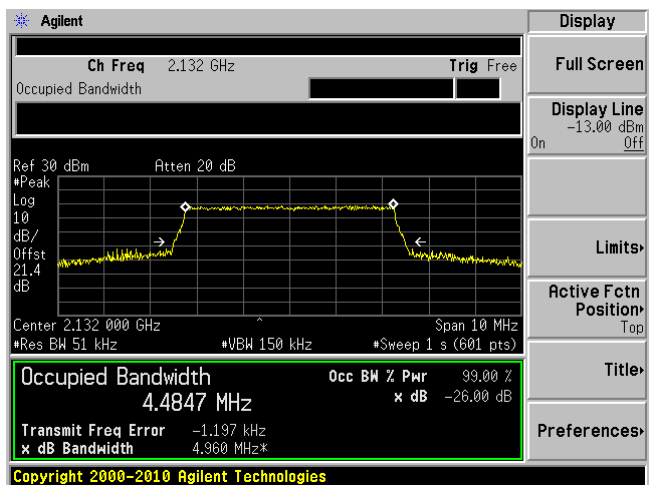


16QAM (5 MHz), (Middle Channel)

Input

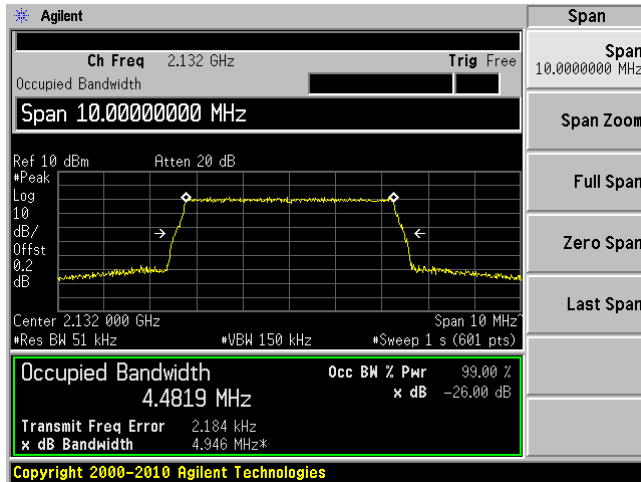


Output

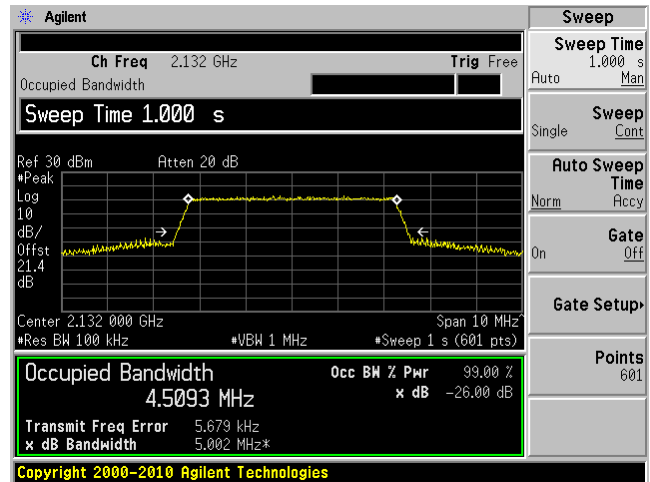


64QAM (5 MHz), (Middle Channel)

Input

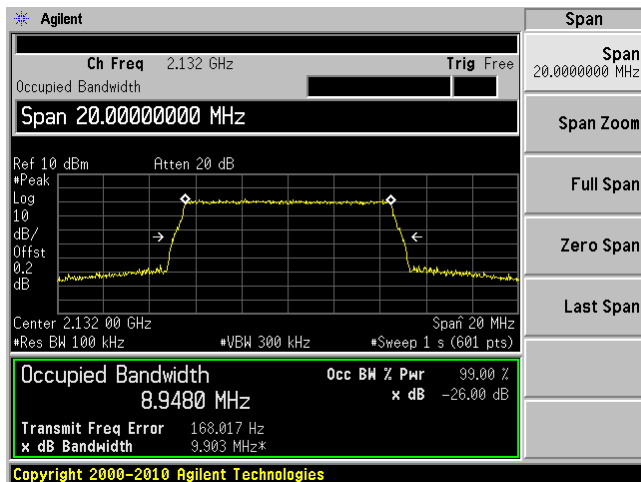


Output

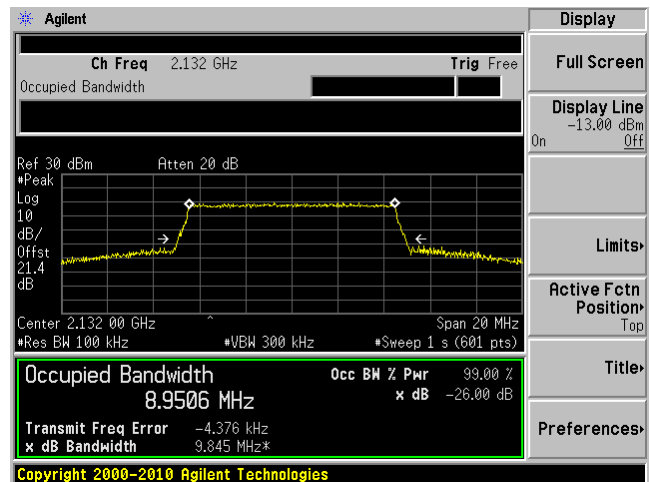


QPSK (10 MHz), (Low Channel)

Input

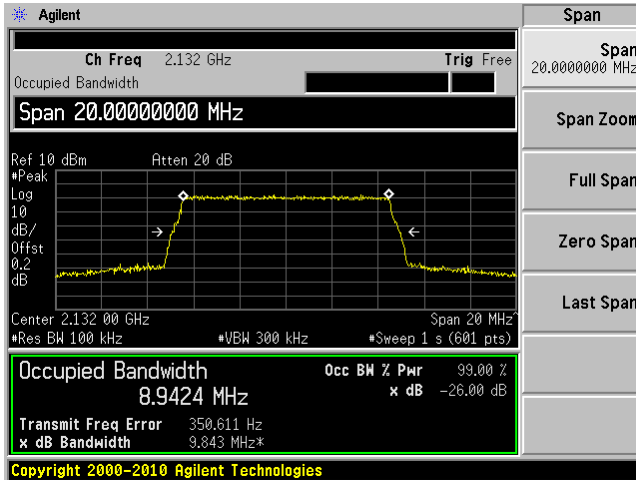


Output

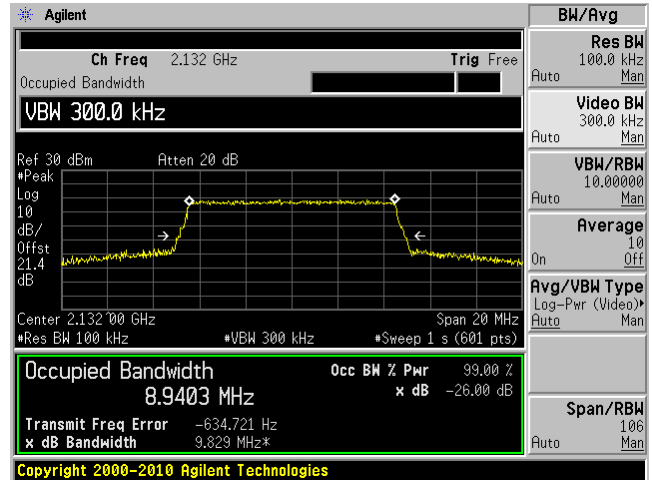


16QAM (10 MHz), (Low Channel)

Input

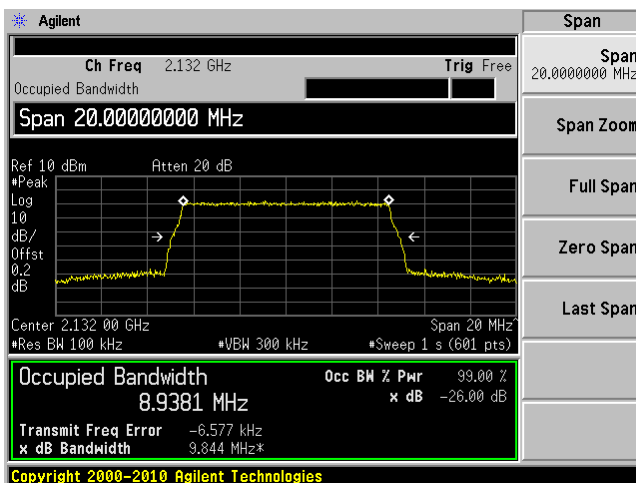


Output

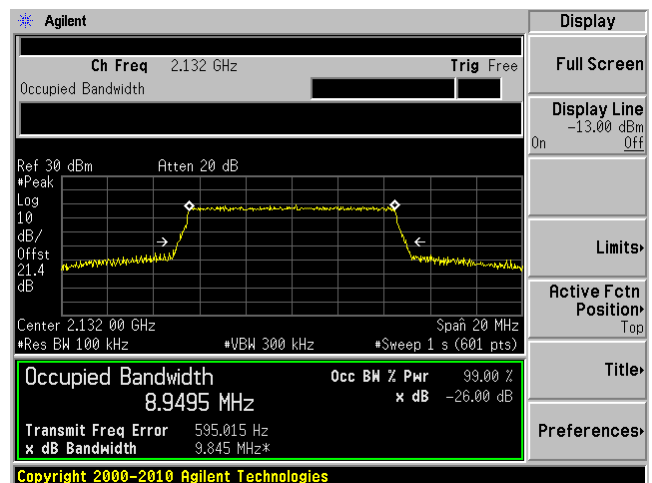


64QAM (10 MHz), (Low Channel)

Input



Output



## 6 FCC §2.1053 & §27.53 - Spurious Radiated Emissions

### 6.1 Applicable Standard

Requirements: FCC §2.1053 and §27.53.

### 6.2 Test Procedure

The transmitter was placed on a wooden turntable, and it was transmitting into a non-radiating load which was also placed on the turntable.

The measurement antenna was placed at a distance of 3 meters from the EUT. During the tests, the antenna height and polarization as well as EUT azimuth were varied in order to identify the maximum level of emissions from the EUT. The test was performed by placing the EUT on 3-orthogonal axis.

The frequency range up to tenth harmonic of the fundamental frequency was investigated.

Remove the EUT and replace it with substitution antenna. A signal generator was connected to the substitution antenna by a non-radiating cable. The absolute levels of the spurious emissions were measured by the substitution.

Spurious emissions in dB = 10 log (TX Power in Watts/0.001) – the absolute level

Spurious attenuation limit in dB = 43 + 10 Log10 (power out in Watts)

### 6.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date
Agilent	Spectrum Analyzer	E4440A	US45303156	2010-08-09 <sup>1</sup>
Sunol Science Corp	System Controller	SC99V	122303-1	N/R
Sunol Science Corp	Combination Antenna	JB3	A020106-2	2011-08-10
Hewlett Packard	Pre-amplifier	8447D	2944A06639	2011-06-09
Eaton	Horn antenna	96001	Mar-07	2011-10-03
A.H. Systems	Horn antenna	SAS-200/571	261	2012-01-18
Mini-Circuits	Pre-amplifier	ZVA-183-S	667400960	2012-05-08
HP	Signal Generator	8648C	3426A00417	2011-08-18

Note 1: Based on a two year calibration cycle.

**Statement of Traceability:** **BACL Corp.** attests that all calibrations have been performed according to A2LA requirements, traceable to the NIST.

## 6.4 Test Environmental Conditions

<b>Temperature:</b>	23 °C
<b>Relative Humidity:</b>	42 %
<b>ATM Pressure:</b>	101.79kPa

The testing was performed by Wei Sun from 2012-06-02 at Chamber 3.

## 6.5 Test Results

726-746 MHz Downlink (Input frequency = 737 MHz)

Indicated		Azimuth (degree)	Test Antenna		Substituted					Limit (dBm)	Margin (dB)
Frequency (MHz)	S.A. Amp. (dBuV)		Height (cm)	Polarity (H/V)	Frequency (MHz)	Level (dBm)	Ant. Gain Correction (dB)	Cable Loss (dB)	Absolute Level (dBm)		
488	34.62	163	155	V	488	-64.01	0	0.72	-64.73	-13	-51.73
488	34.85	297	155	H	488	-66.69	0	0.72	-67.41	-13	-54.41
101	33.39	194	202	V	101	-68.63	0	0.39	-69.02	-13	-56.02
101	38.41	102	229	H	102	-69.26	0	0.39	-69.65	-13	-56.65

746-757 MHz Downlink (Input frequency = 752 MHz)

Indicated		Azimuth (degree)	Test Antenna		Substituted					Limit (dBm)	Margin (dB)
Frequency (MHz)	S.A. Amp. (dBuV)		Height (cm)	Polarity (H/V)	Frequency (MHz)	Level (dBm)	Ant. Gain Correction (dB)	Cable Loss (dB)	Absolute Level (dBm)		
473	39.83	164	187	V	473	-58.58	0	0.72	-59.3	-13	-46.3
473	38.65	94	162	H	473	-62.41	0	0.72	-63.13	-13	-50.13
101	34.8	144	258	V	101	-67.22	0	0.39	-67.61	-13	-54.61
101	39.91	76	155	H	102	-67.76	0	0.39	-68.15	-13	-55.15

2110-2155 MHz Downlink (Input frequency = 2152 MHz)

Indicated		Azimuth (degree)	Test Antenna		Substituted					Limit (dBm)	Margin (dB)
Frequency (MHz)	S.A. Amp. (dBuV)		Height (cm)	Polarity (H/V)	Frequency (MHz)	Level (dBm)	Ant. Gain Correction (dB)	Cable Loss (dB)	Absolute Level (dBm)		
650	33.32	149	155	V	650	-62.37	0	0.92	-63.29	-13	-50.29
650	34.85	233	155	H	650	-63.69	0	0.92	-64.61	-13	-51.61
101	35.34	311	258	V	101	-66.68	0	0.39	-67.07	-13	-54.07
102	39.69	272	155	H	102	-67.98	0	0.39	-68.37	-13	-55.37

## 7 FCC §2.1051 & §27.53 - Spurious Emissions at Antenna Terminals

### 7.1 Applicable Standard

Requirements: FCC §2.1051 and §27.53.

The spectrum shall be investigated to the tenth harmonics of the highest fundamental frequency as specified in § 2.1057.

### 7.2 Test Procedure

The RF output of the transceiver was connected to a spectrum analyzer and simulator through appropriate attenuation. The resolution bandwidth of the spectrum analyzer was set at 100 kHz. Sufficient scans were taken to show any out of band emissions up to 10<sup>th</sup> harmonic.

### 7.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date
Agilent	Spectrum Analyzer	E4440A	US45303156	2010-08-09 <sup>1</sup>
HP	Signal Generator	E4438C	MY45091309	2012-05-03

*Note 1: Based on a two year calibration cycle.*

**Statement of Traceability:** **BACL Corp.** attests that all calibrations have been performed according to A2LA requirements, traceable to the NIST.

### 7.4 Test Environmental Conditions

<b>Temperature:</b>	21 °C
<b>Relative Humidity:</b>	57 %
<b>ATM Pressure:</b>	101.4kPa

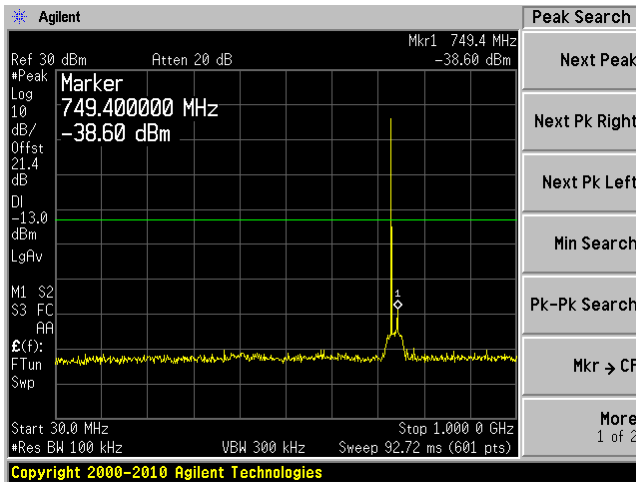
*The testing was performed by Ning Ma from 2012-05-27 at RF Site.*

### 7.5 Test Results

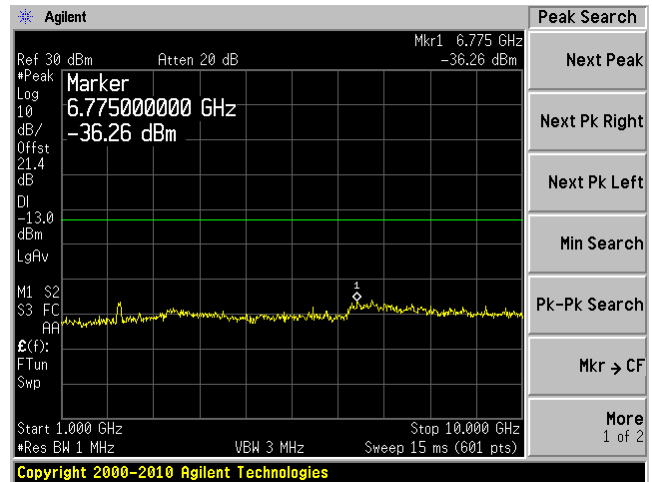
Please refer to the following plots.

### 700 MHz Lower ABC Band Downlink, Middle Channel: 737 MHz

Plot 1: 30 MHz to 1 GHz

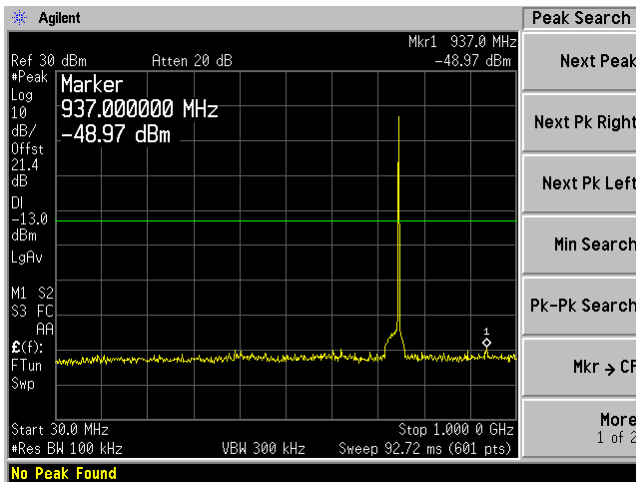


Plot 2: Above 1 GHz

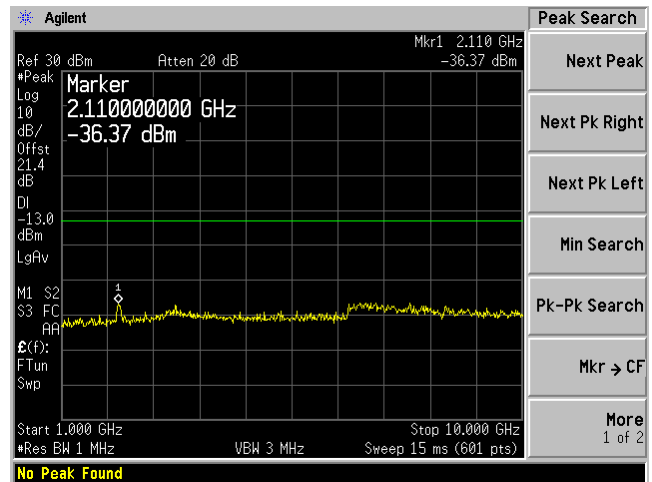


### 700 MHz Upper Band Downlink, Middle Channel: 752 MHz

Plot 1: 30 MHz to 1 GHz



Plot 2: Above 1 GHz

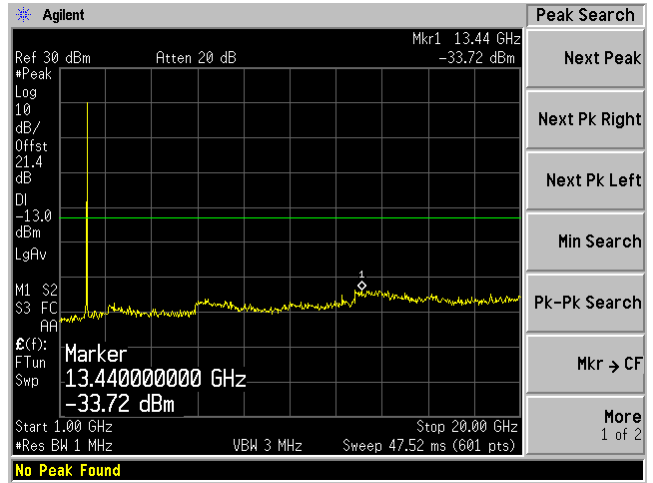
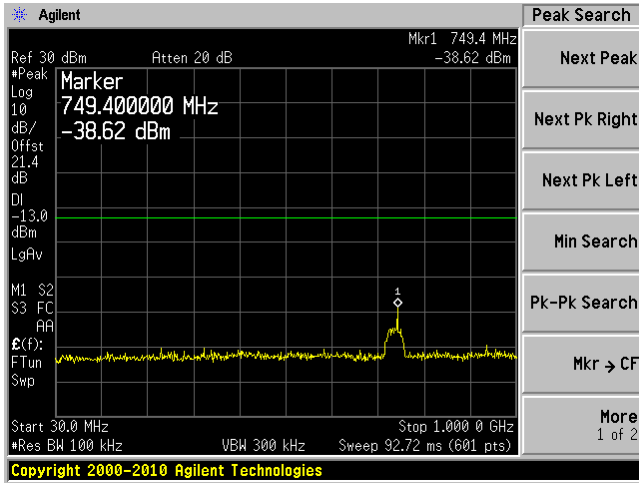




### AWS Band Downlink, Middle Channel: 2132 MHz

Plot 1: 30 MHz to 1 GHz

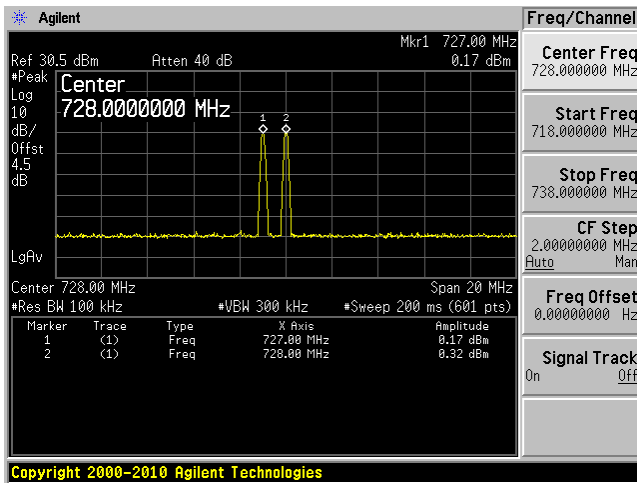
Plot 2: Above 1 GHz



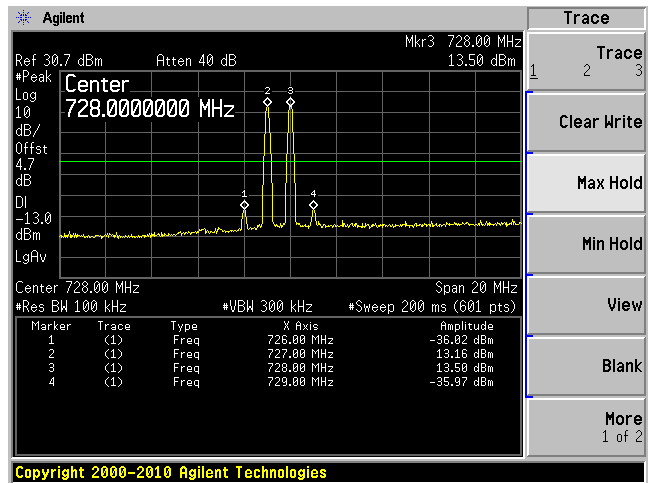
### Inter-modulation

### 700 MHz Lower ABC Band Downlink

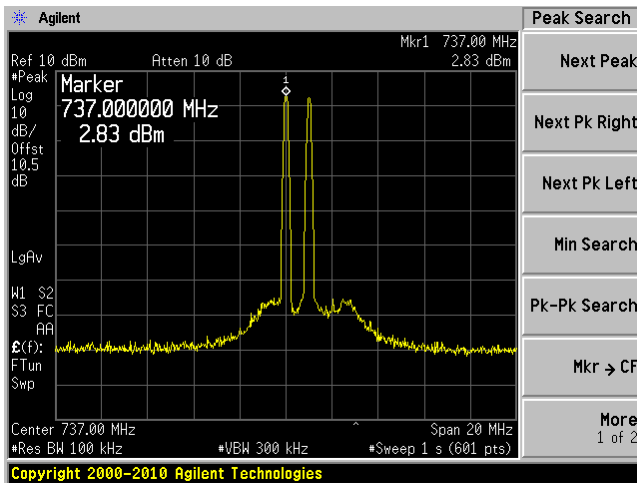
Low Channel, Input



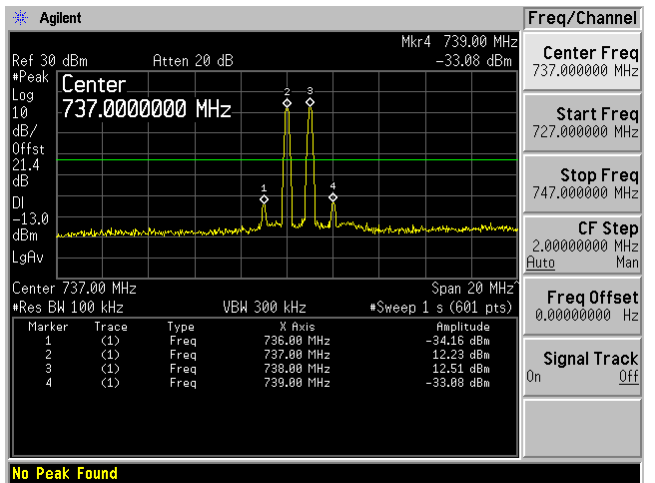
Low Channel, Output



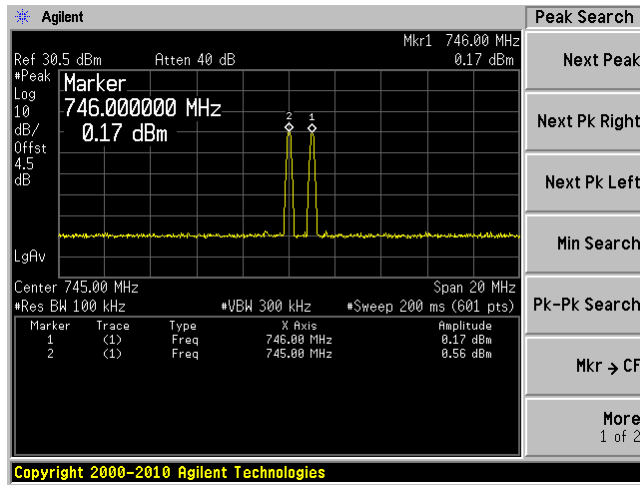
Middle Channel, Input



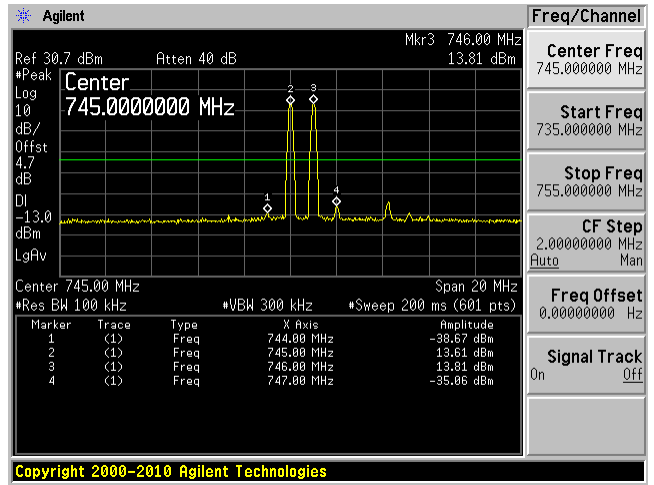
Middle Channel, Output



### High Channel, Input

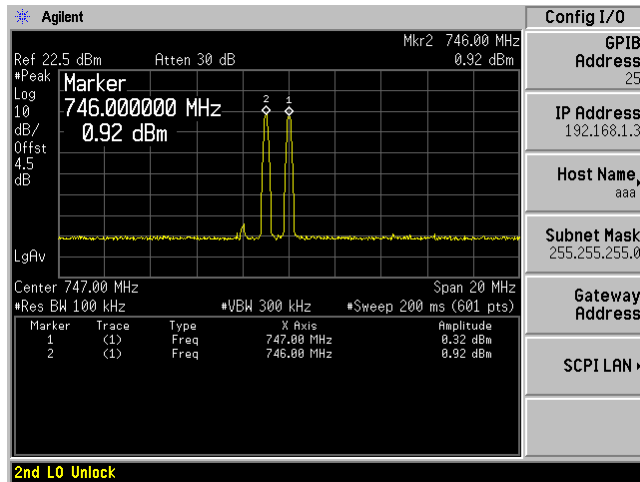


### High Channel, Output

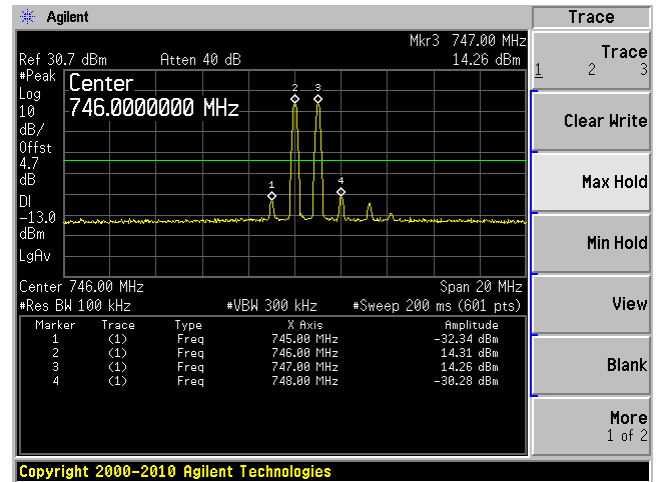


## 700 MHz Upper Band Downlink

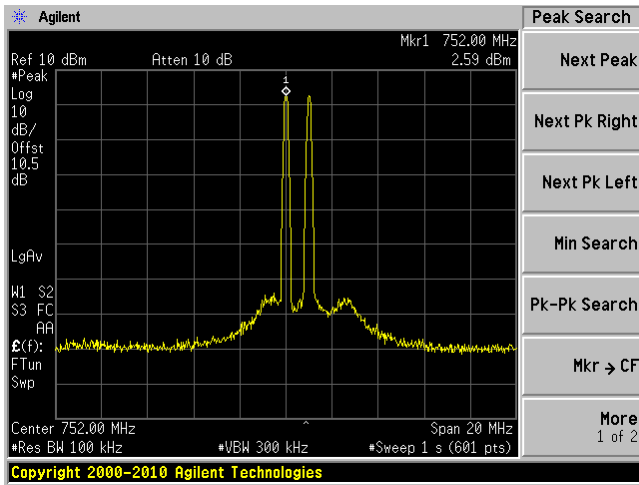
### Low Channel, Input



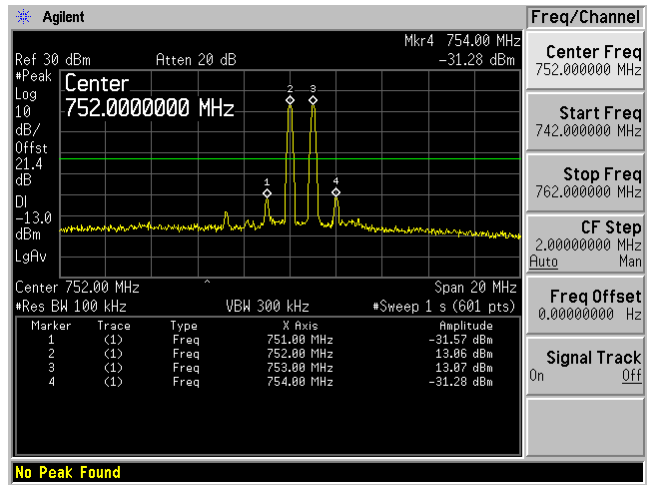
### Low Channel, Output



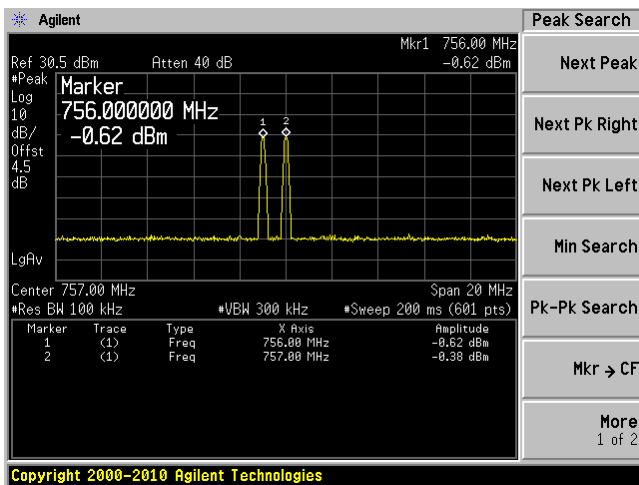
Middle Channel, Input



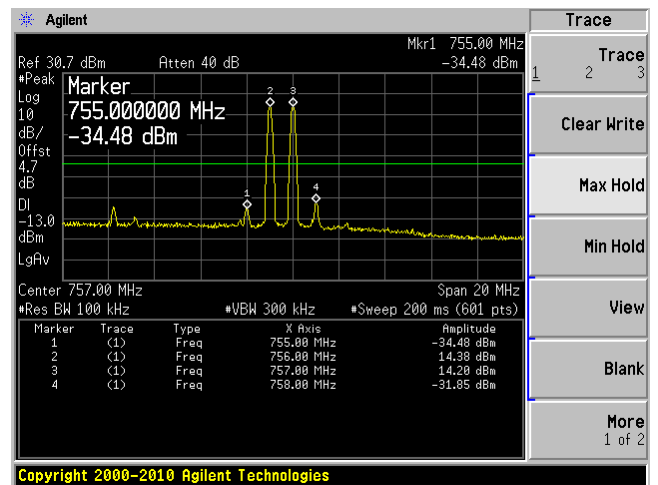
Middle Channel, Output



High Channel, Input

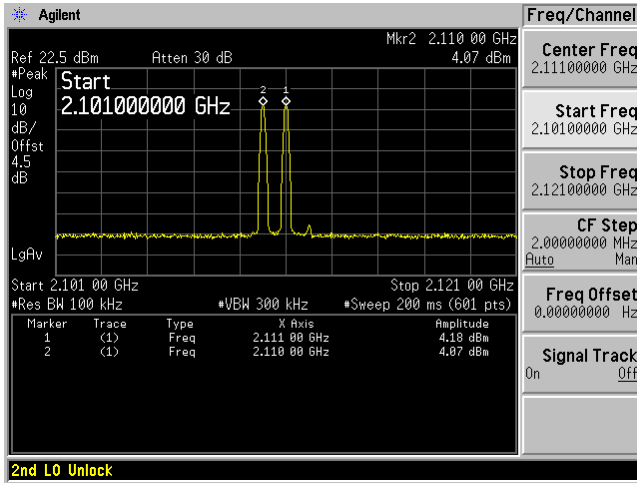


High Channel, Output

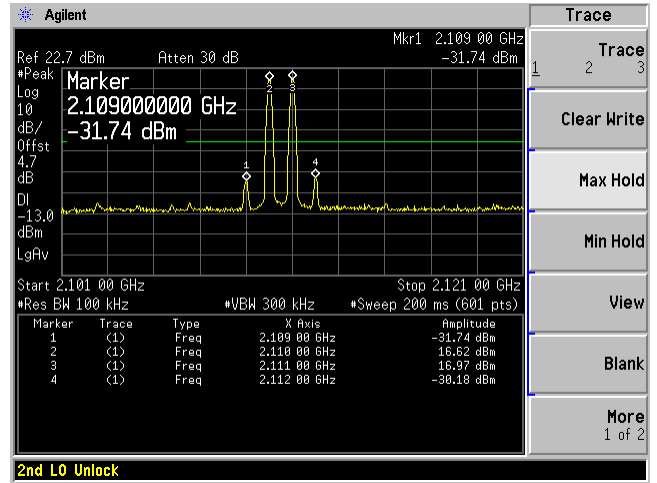


### AWS Band Downlink

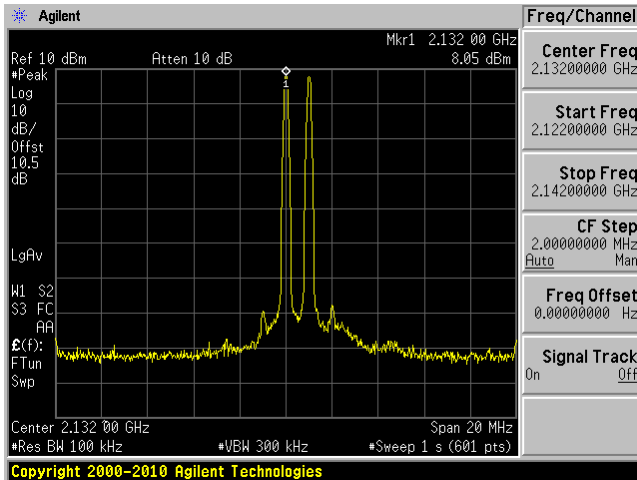
Low Channel, Input



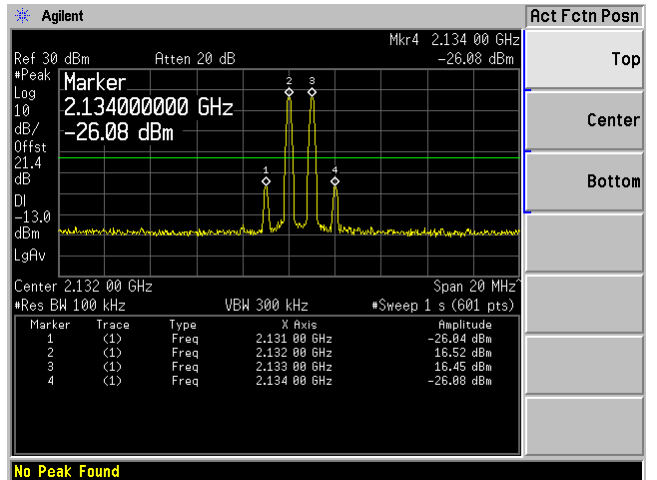
Low Channel, Output



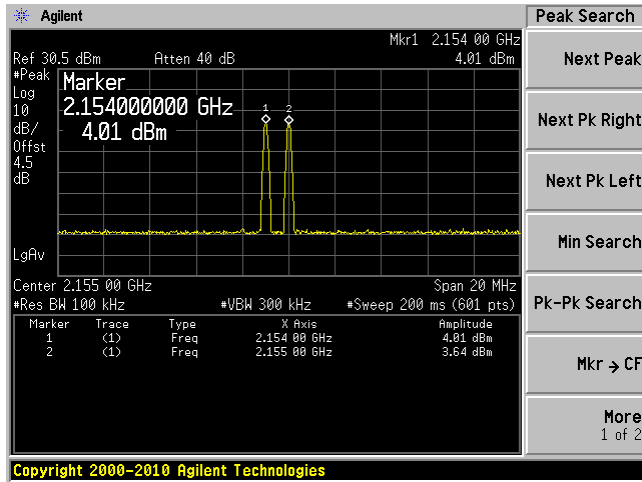
Middle Channel, Input



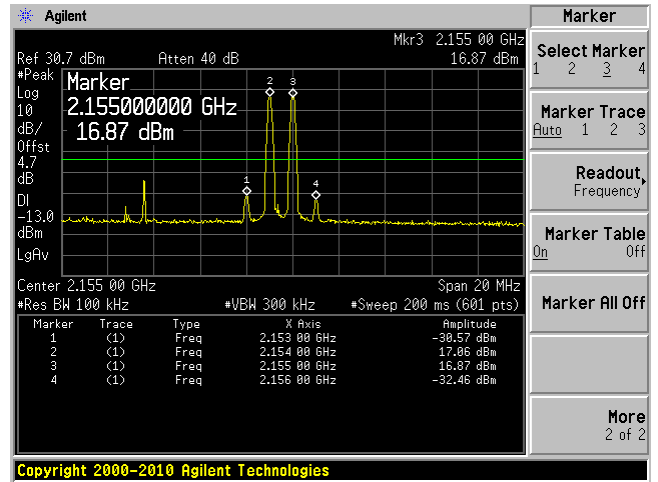
Middle Channel, Output



### High Channel, Input



### High Channel, Output



## 8 FCC §27.53 – Band Edge

### 8.1 Applicable Standard

According to FCC §27.53, 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.

### 8.2 Test Procedure

The RF output of the transmitter was connected to the input of the spectrum analyzer through sufficient attenuation.

The center of the spectrum analyzer was set to block edge frequency.

### 8.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date
Agilent	Spectrum Analyzer	E4440A	US45303156	2010-08-09 <sup>1</sup>
HP	Signal Generator	E4438C	MY45091309	2012-05-03

*Note 1: Based on a two year calibration cycle.*

**Statement of Traceability:** **BACL Corp.** attests that all calibrations have been performed according to A2LA requirements, traceable to the NIST.

### 8.4 Test Environmental Conditions

<b>Temperature:</b>	21 °C
<b>Relative Humidity:</b>	57 %
<b>ATM Pressure:</b>	101.4kPa

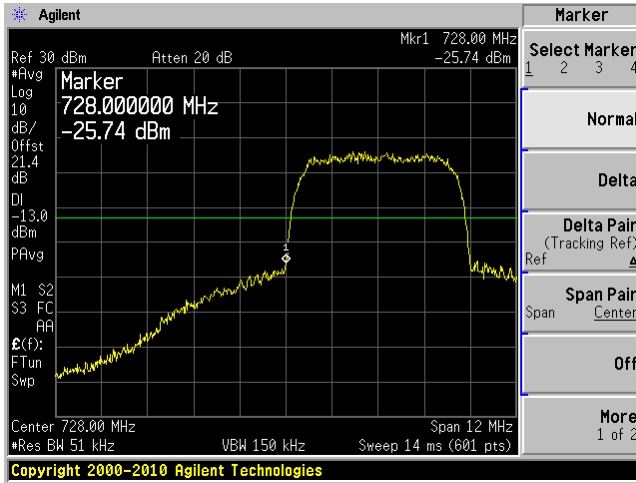
*The testing was performed by Ning Ma from 2012-05-27 at RF Site.*

### 8.5 Test Results

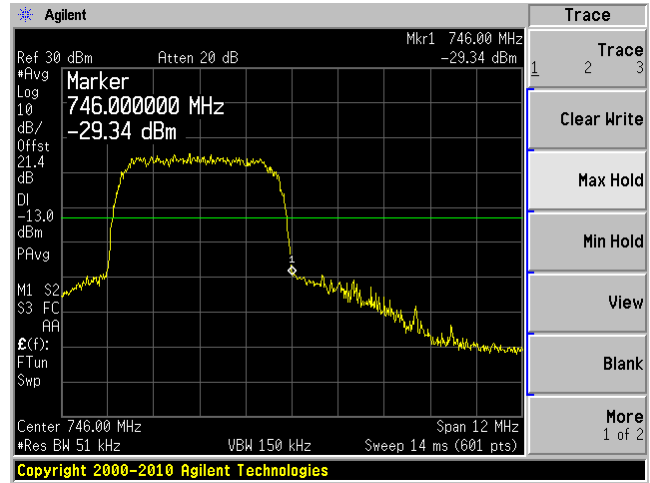
Please refer to the following plots.

### 700 MHz Lower ABC Band Downlink

WCDMA - Low Channel

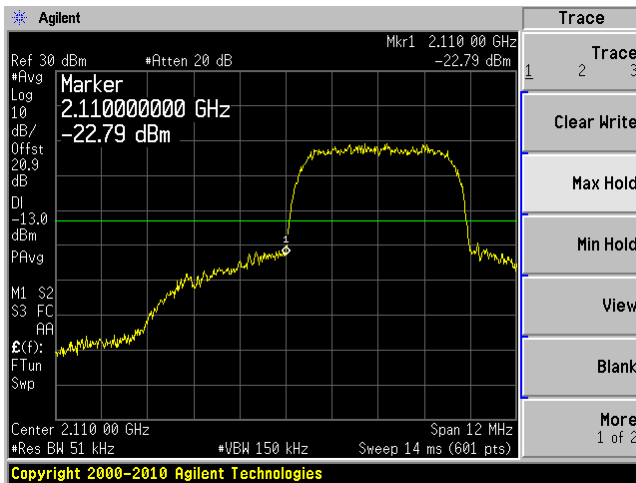


WCDMA - High Channel

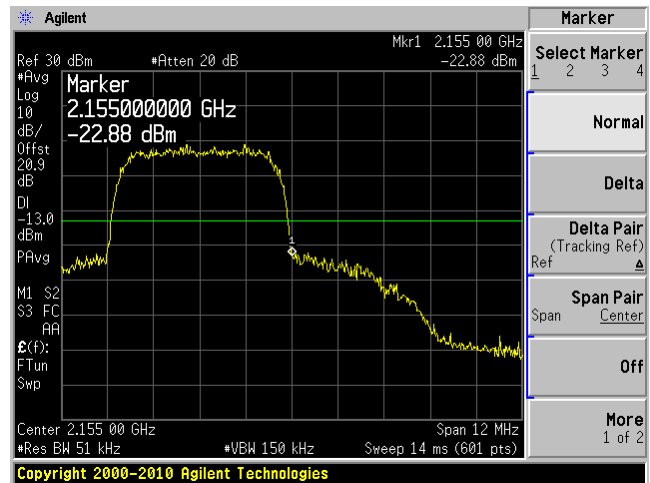


### AWS Band Downlink

WCDMA - Low Channel



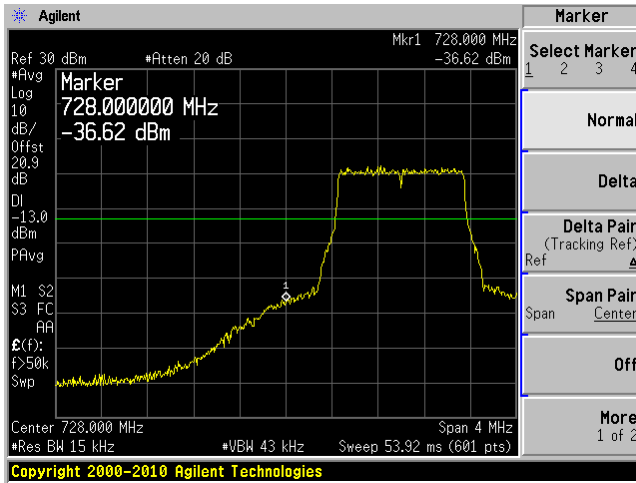
WCDMA - High Channel



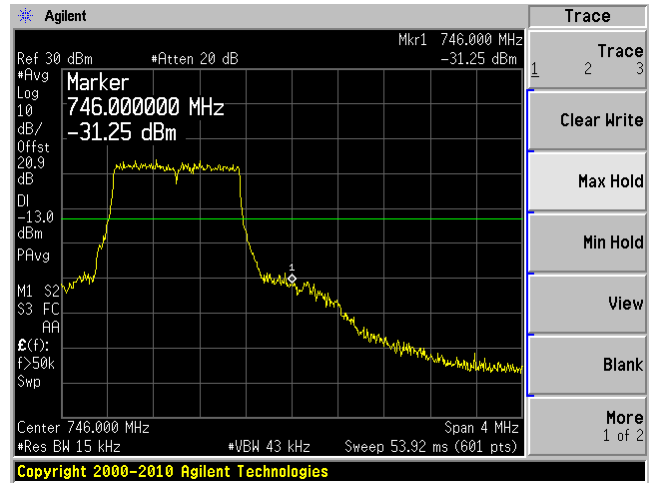


### 700 MHz Lower ABC Band Downlink

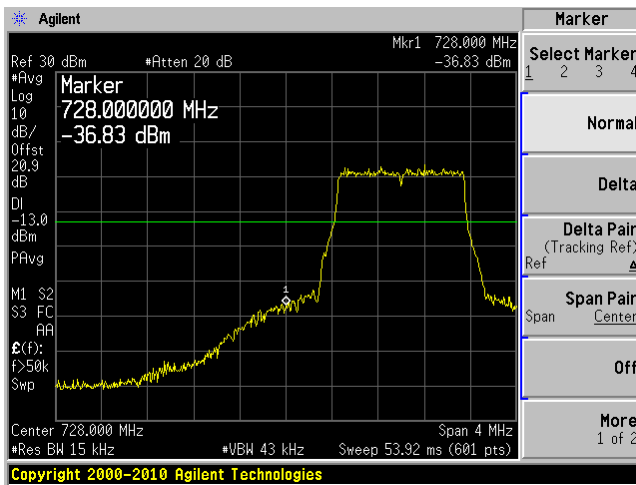
QPSK (1.4 MHz) - Low Channel



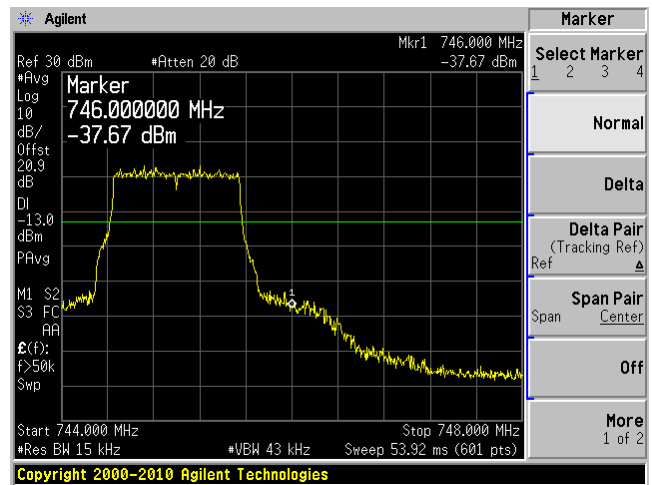
QPSK (1.4 MHz) - High Channel



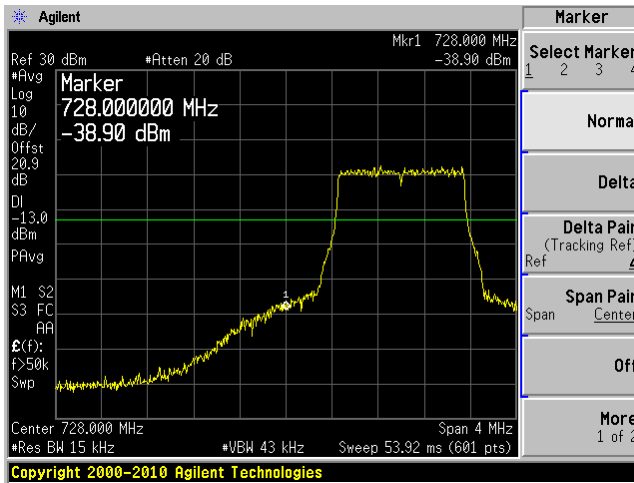
16QAM (1.4 MHz) - Low Channel



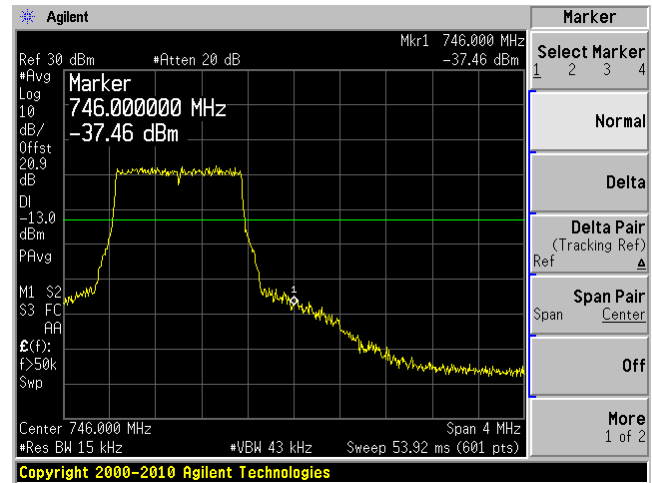
16QAM (1.4 MHz) - High Channel



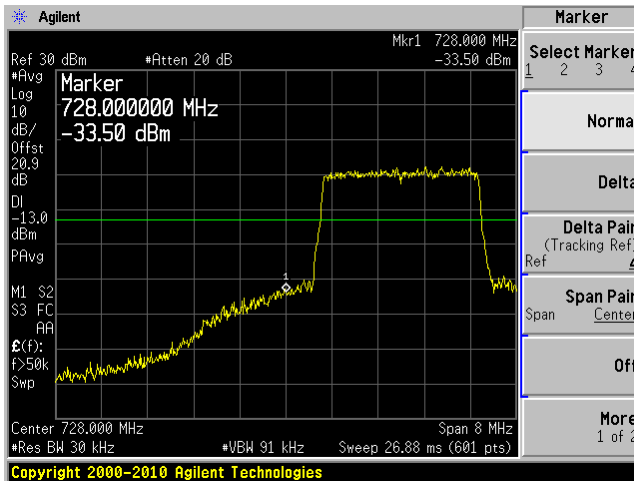
64QAM (1.4 MHz) - Low Channel



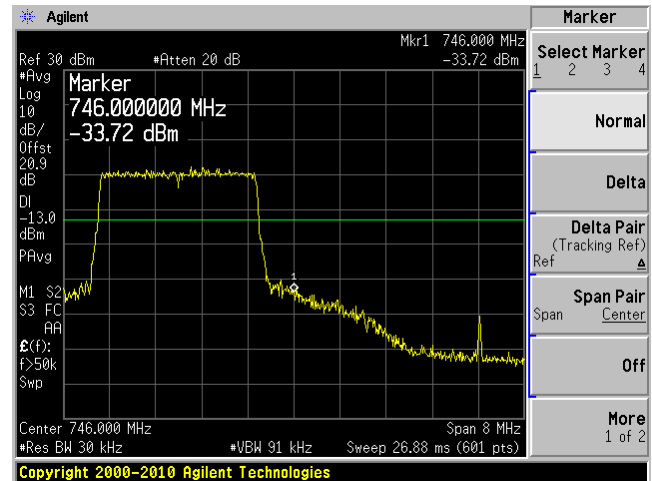
64QAM (1.4 MHz) - High Channel



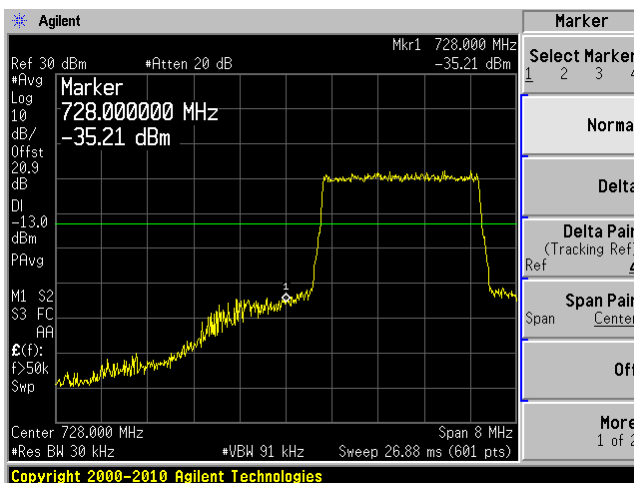
QPSK (3 MHz) - Low Channel



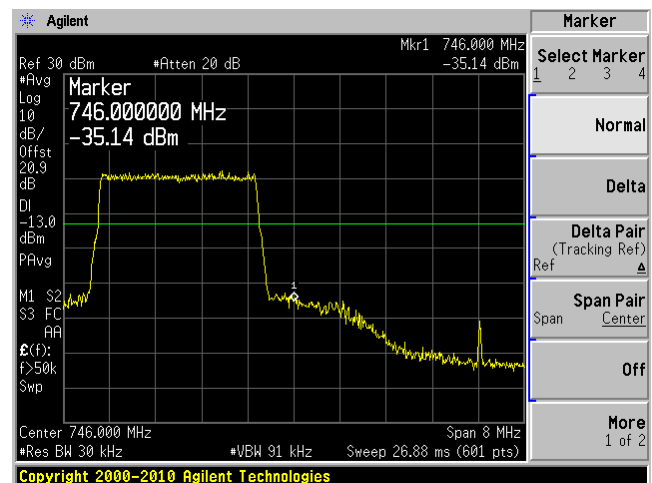
QPSK (3 MHz) - High Channel



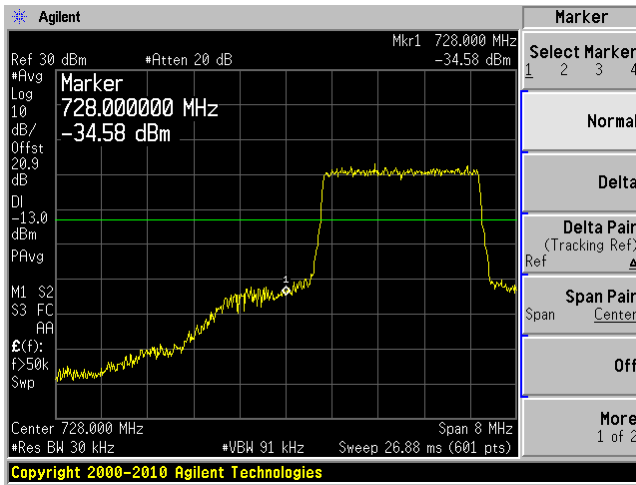
16QAM (3 MHz) - Low Channel



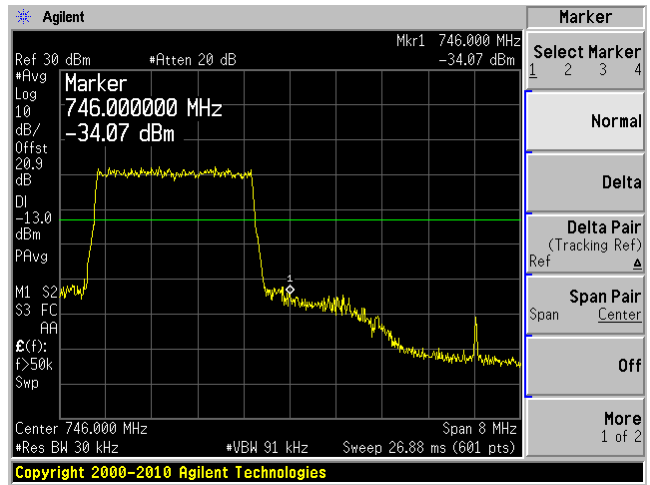
16QAM (3 MHz) - High Channel



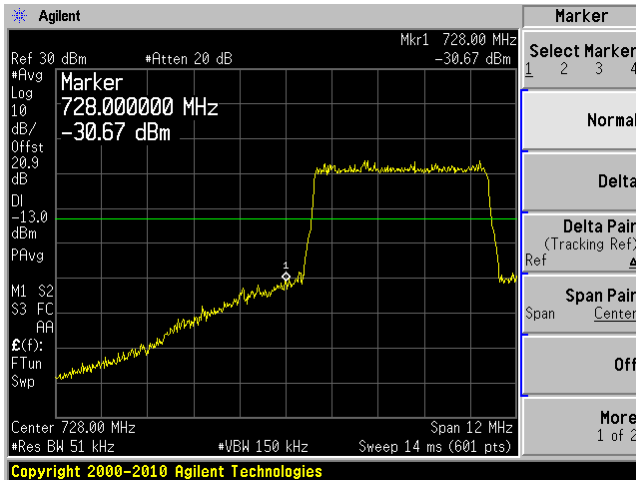
64QAM (3 MHz) - Low Channel



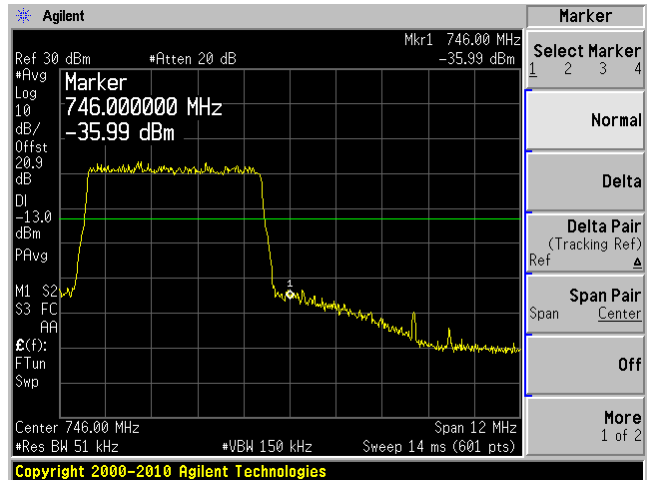
64QAM (3 MHz) - High Channel



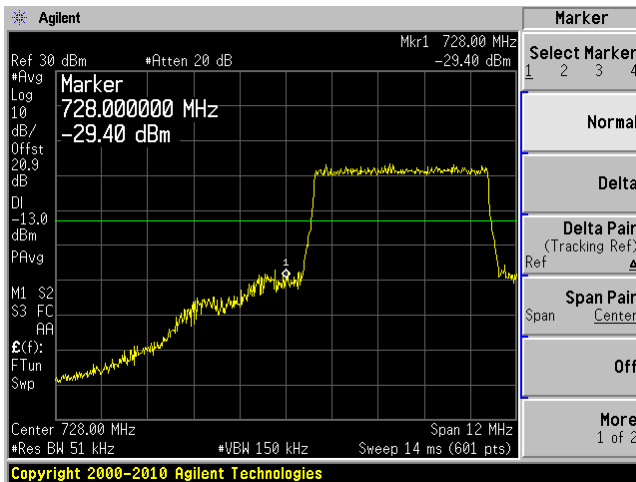
QPSK (5 MHz) - Low Channel



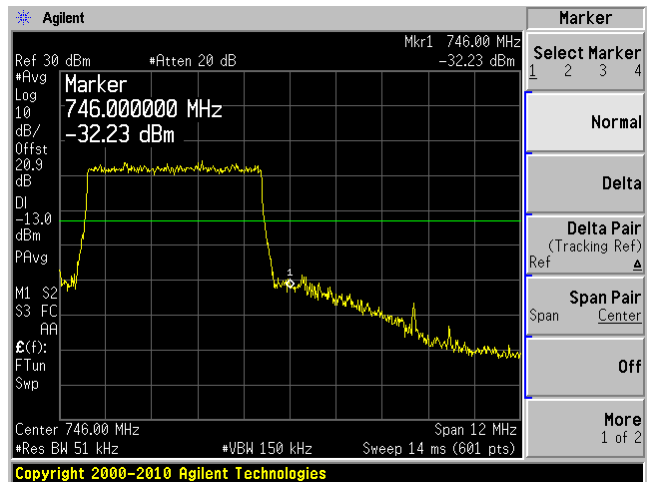
QPSK (5 MHz) - High Channel



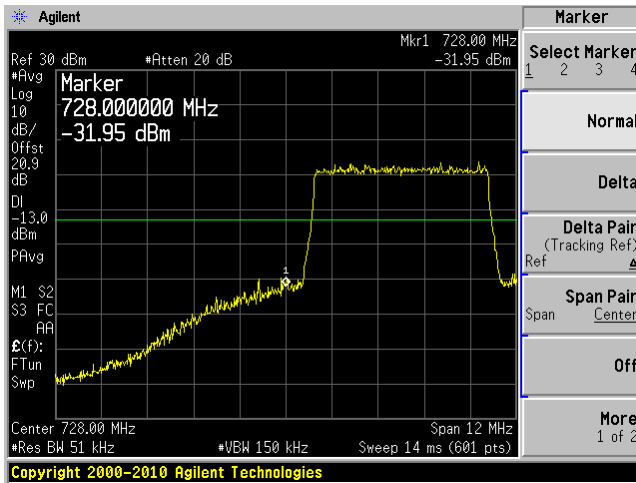
16QAM (5 MHz) - Low Channel



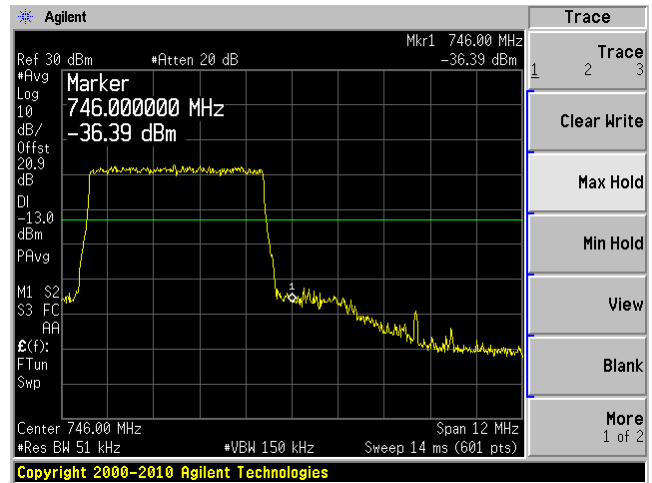
16QAM (5 MHz) - High Channel



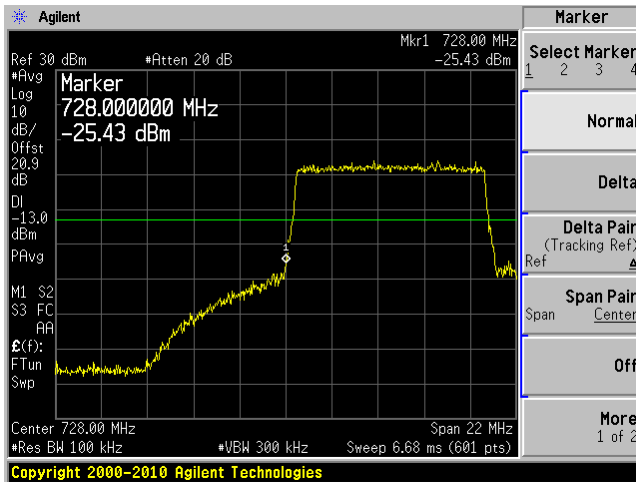
64QAM (5 MHz) - Low Channel



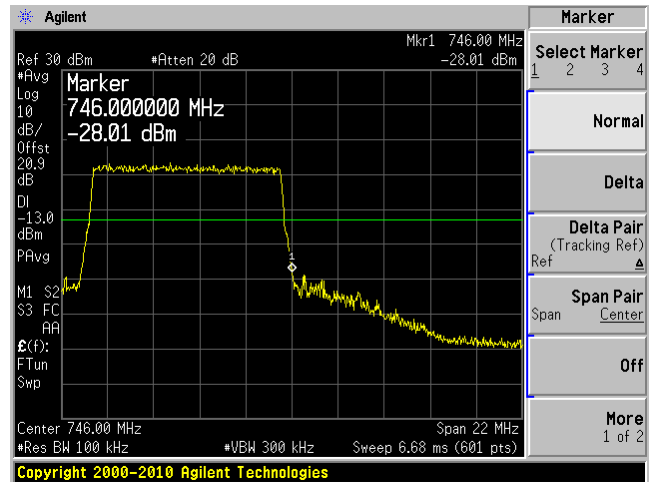
64QAM (5 MHz) - High Channel



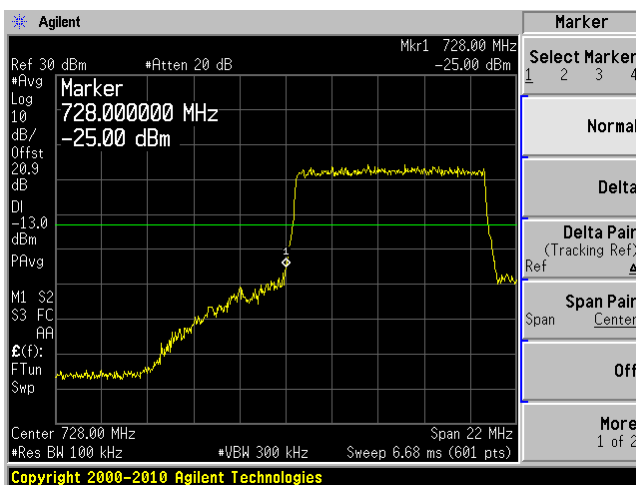
QPSK (10 MHz) - Low Channel



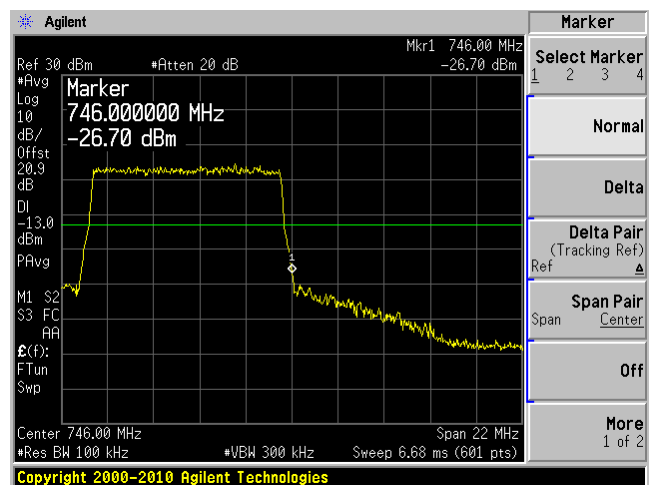
QPSK (10 MHz) - High Channel



16QAM (10 MHz) - Low Channel

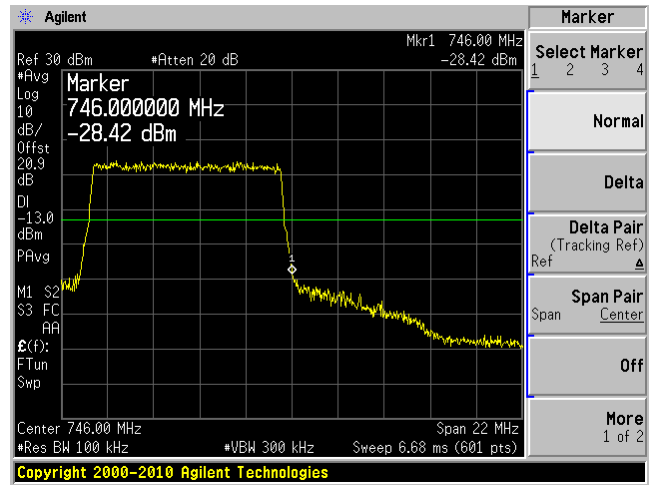
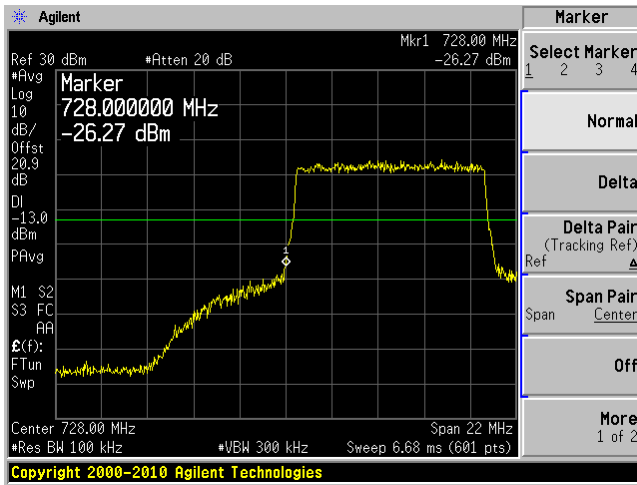


16QAM (10 MHz) - High Channel



64QAM (10 MHz) - Low Channel

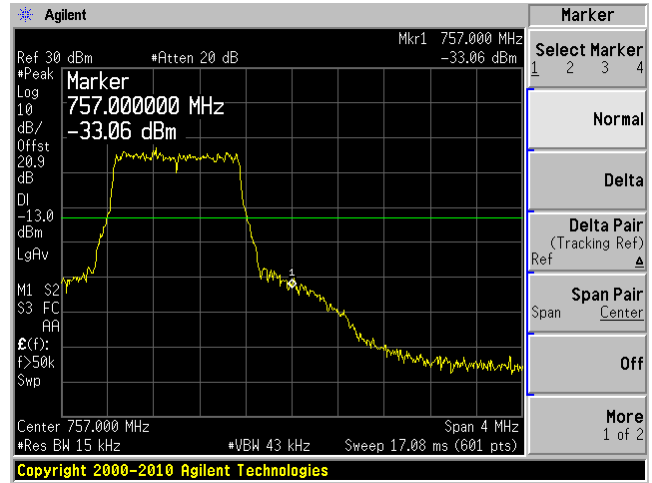
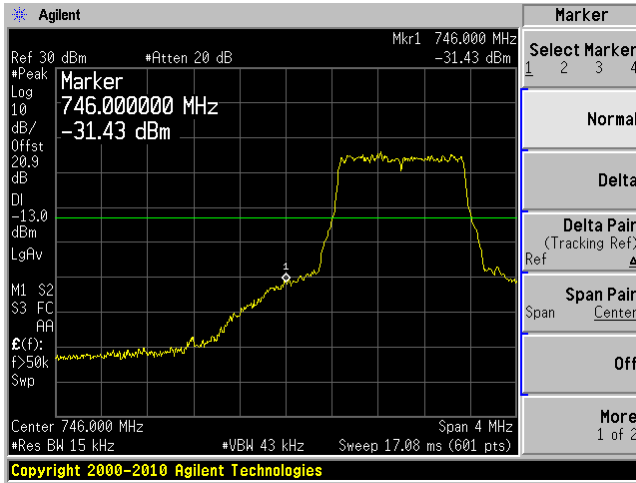
64QAM (10 MHz) - High Channel



### 700 MHz Upper Band Downlink

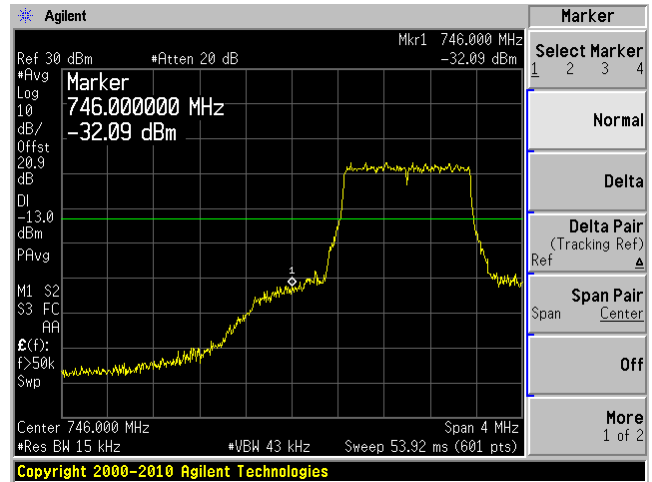
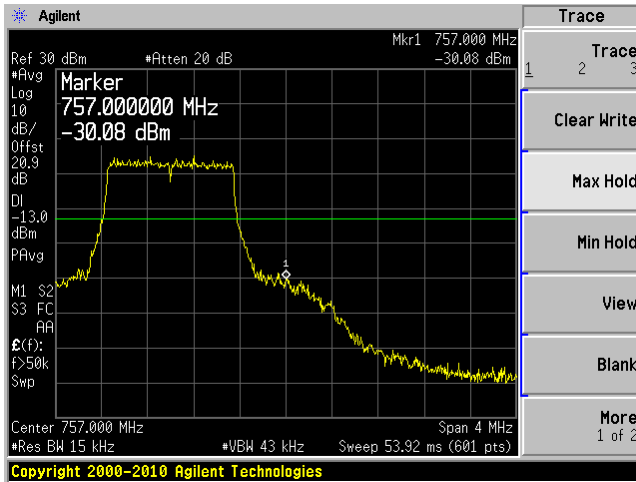
QPSK (1.4 MHz) - Low Channel

QPSK (1.4 MHz) - High Channel

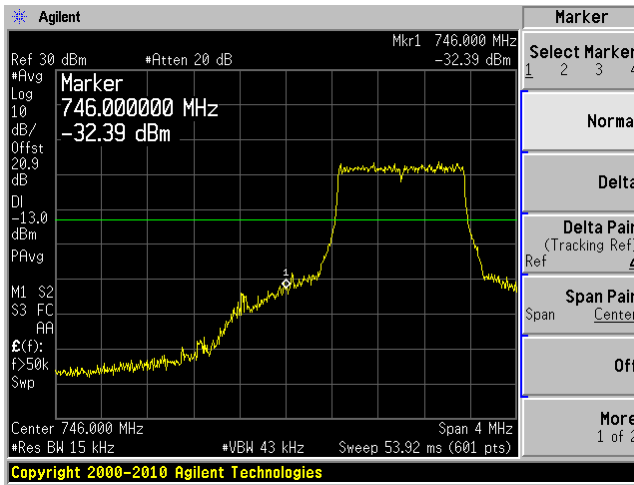


16QAM (1.4 MHz) - Low Channel

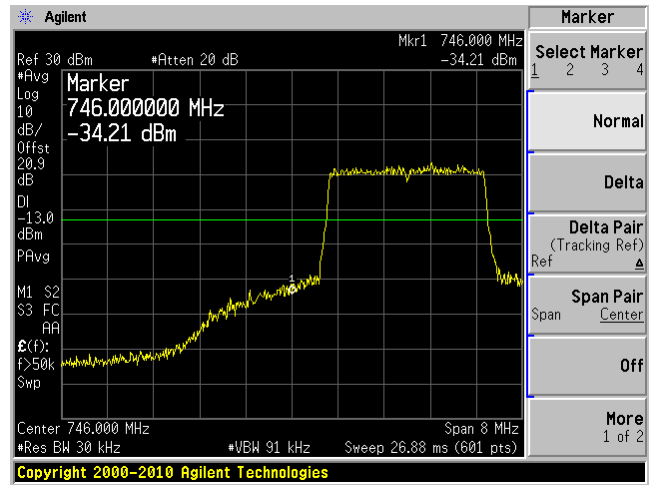
16QAM (1.4 MHz) - High Channel



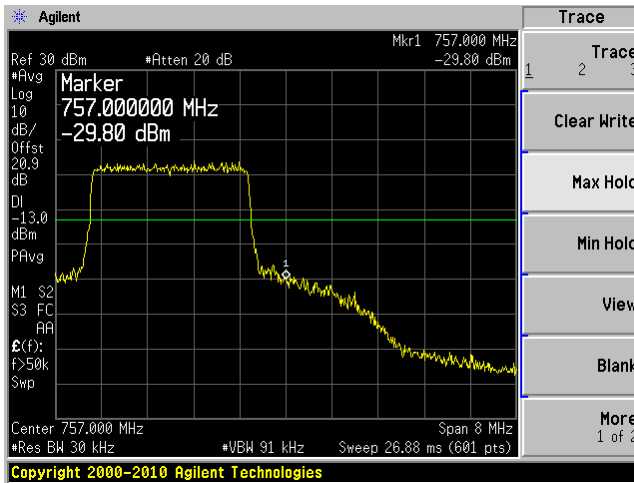
64QAM (1.4 MHz) - Low Channel



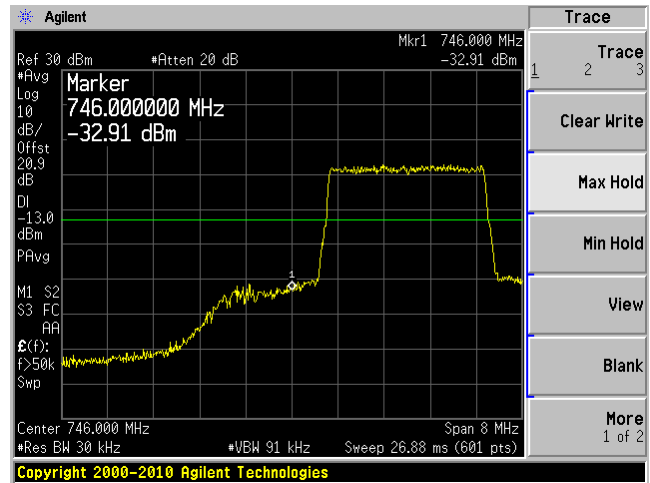
64QAM (1.4 MHz) - High Channel



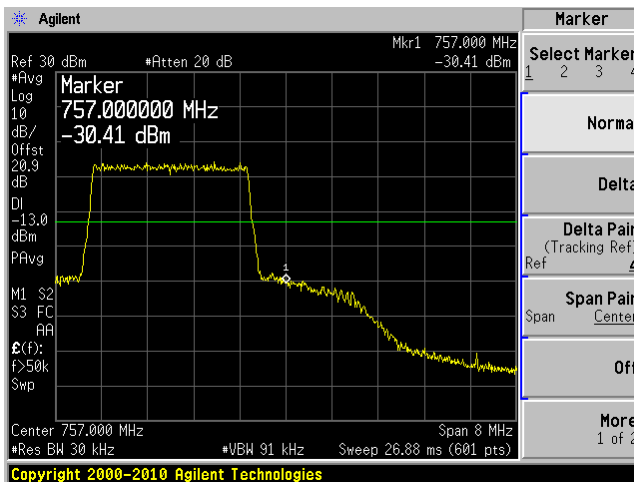
QPSK (3 MHz) - Low Channel



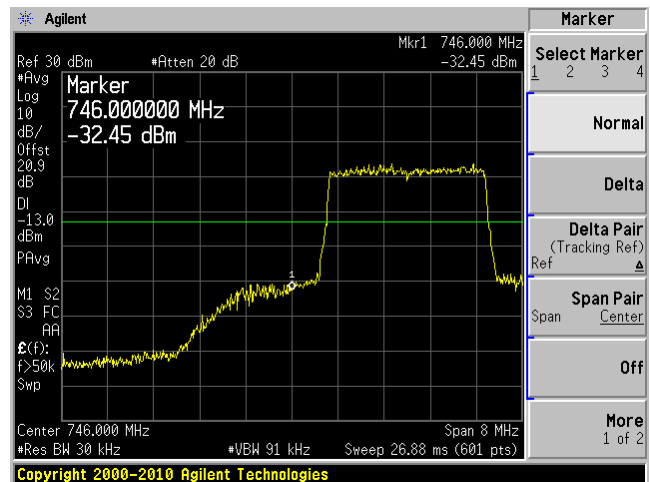
QPSK (3 MHz) - High Channel



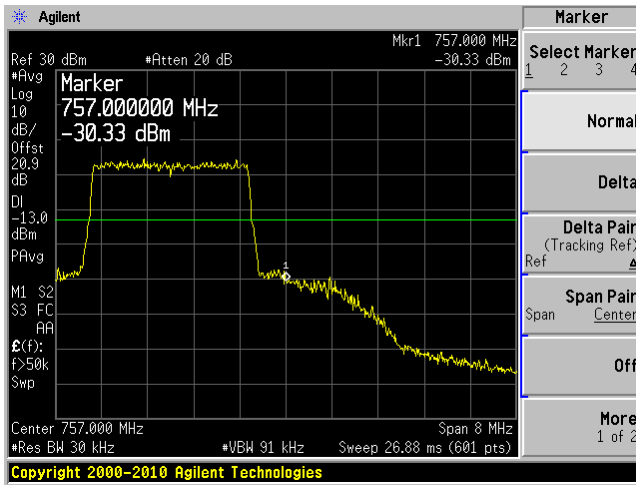
16QAM (3 MHz) - Low Channel



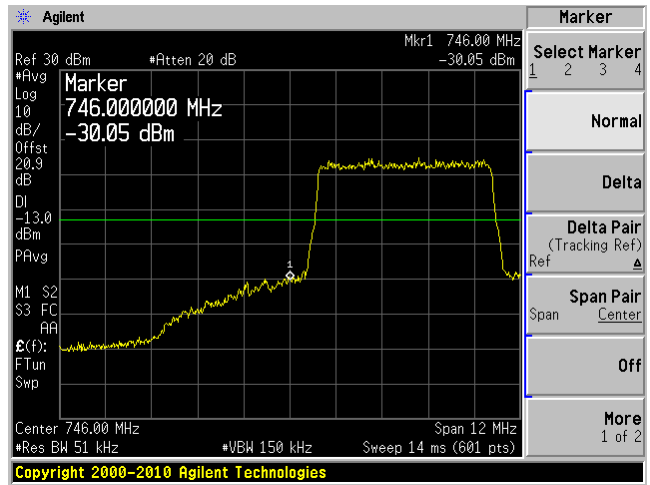
16QAM (3 MHz) - High Channel



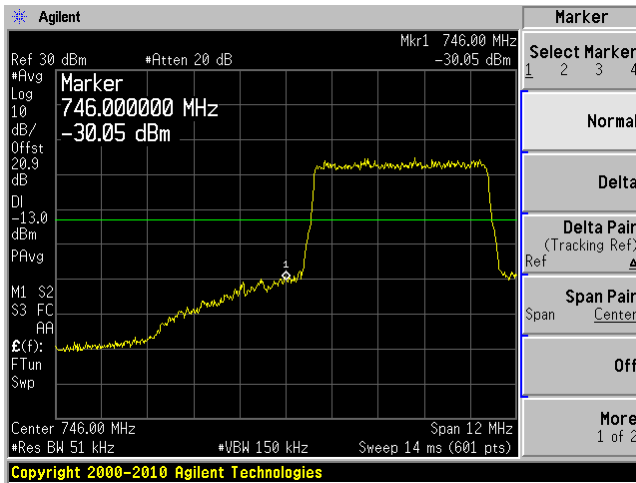
64QAM (3 MHz) - Low Channel



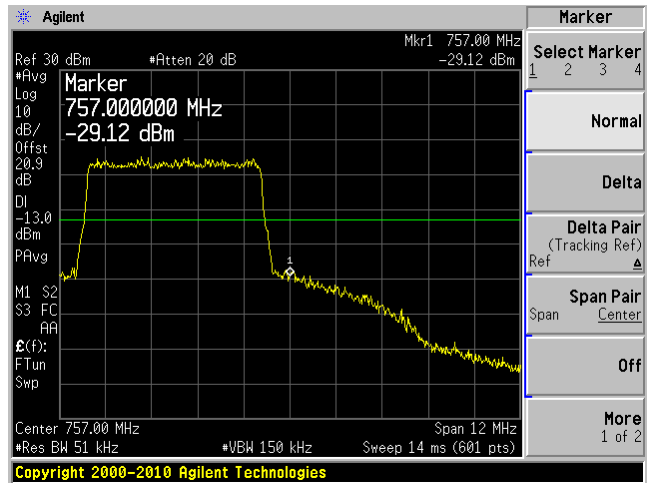
64QAM (3 MHz) - High Channel



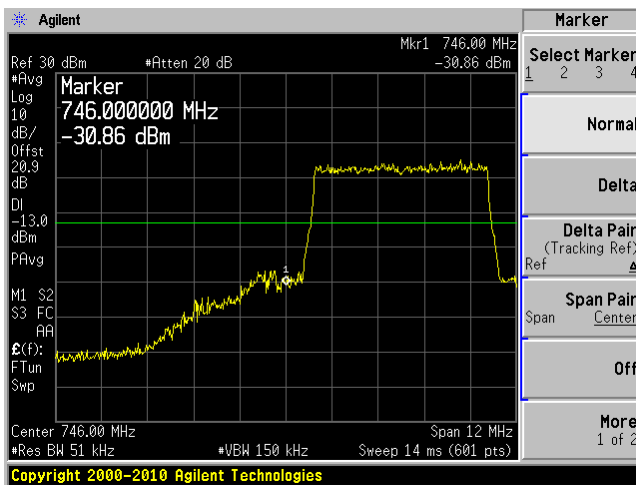
QPSK (5 MHz) - Low Channel



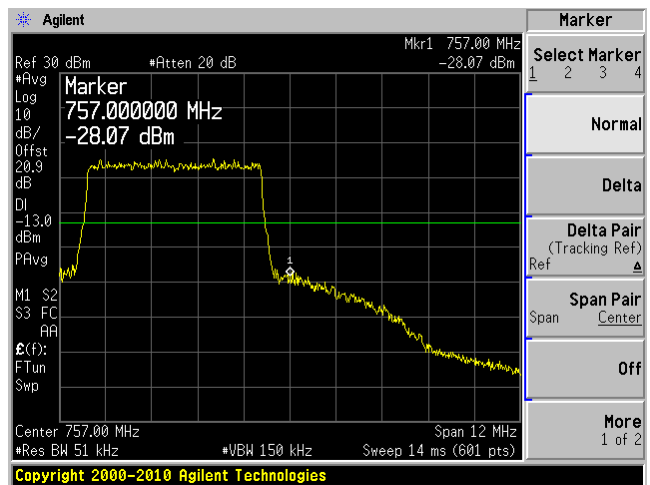
QPSK (5 MHz) - High Channel



16QAM (5 MHz) - Low Channel

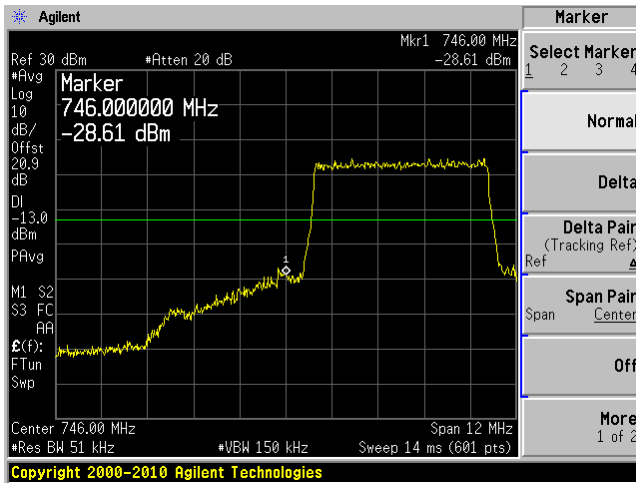


16QAM (5 MHz) - High Channel

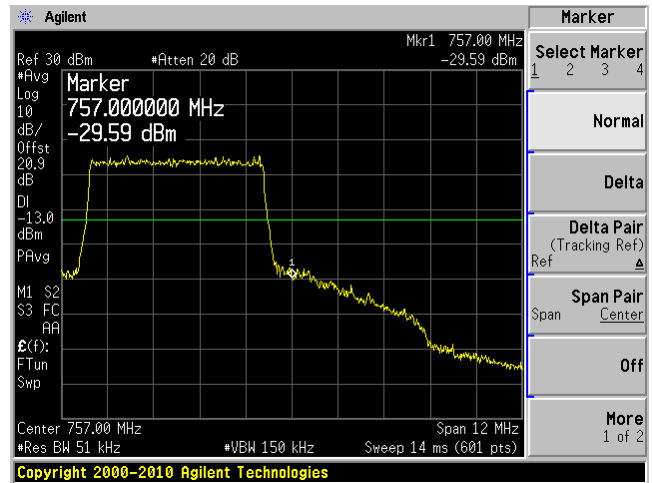




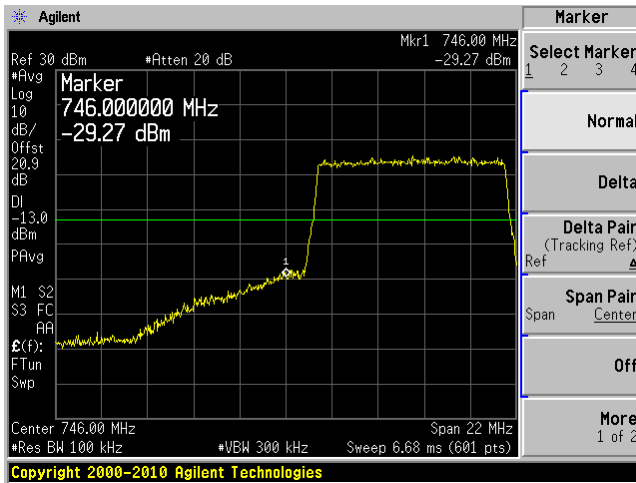
64QAM (5 MHz) - Low Channel



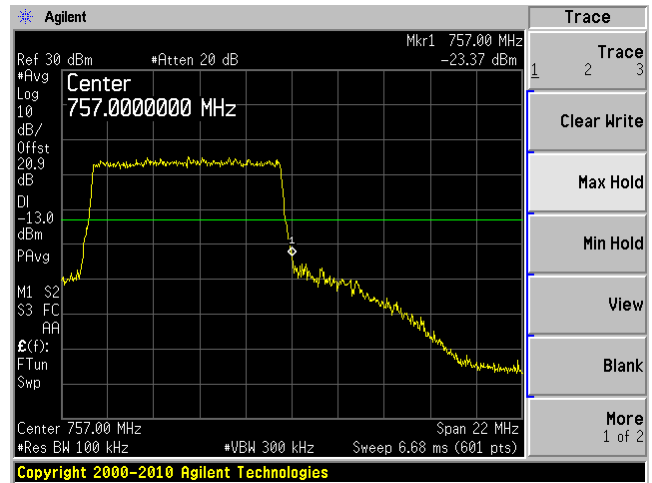
64QAM (5 MHz) - High Channel



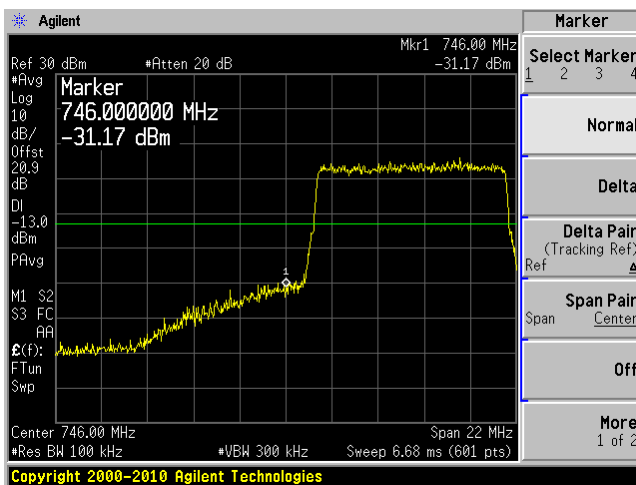
QPSK (10 MHz) - Low Channel



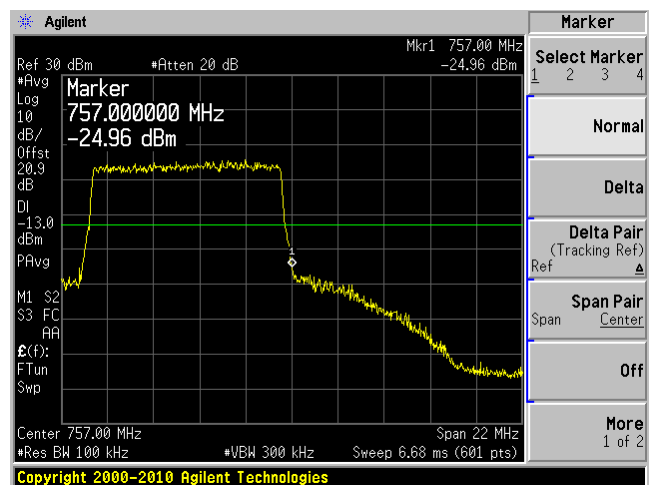
QPSK (10 MHz) - High Channel



16QAM (10 MHz) - Low Channel

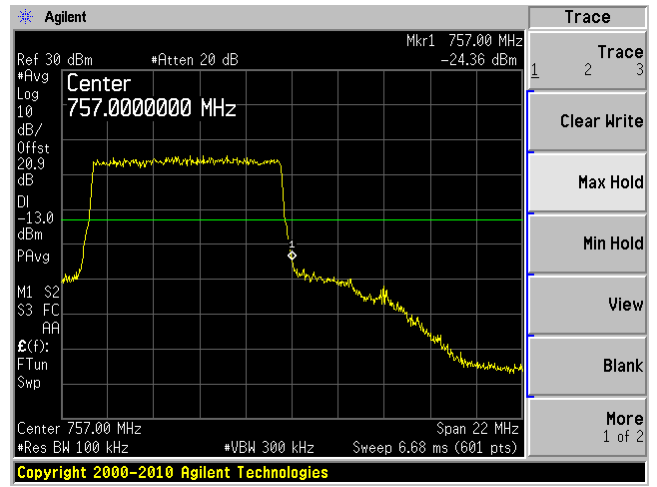
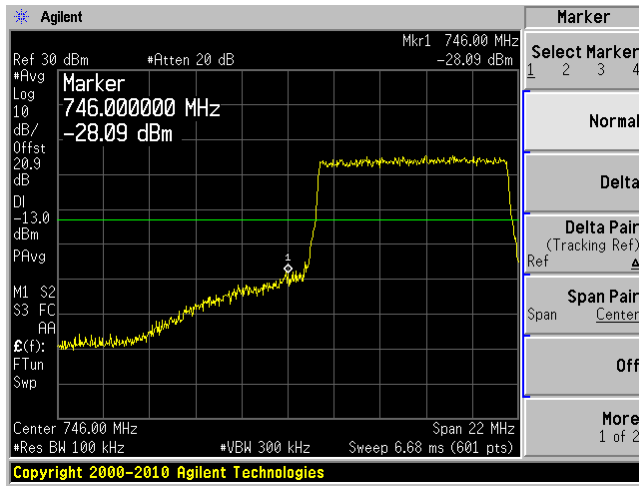


16QAM (10 MHz) - High Channel



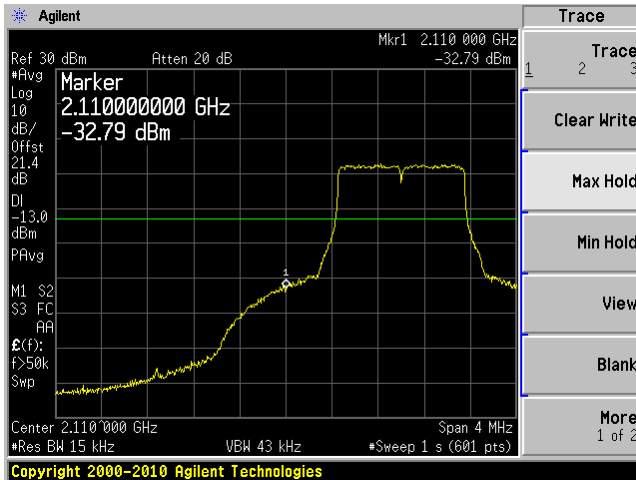
64QAM (10 MHz) - Low Channel

64QAM (10 MHz) - High Channel

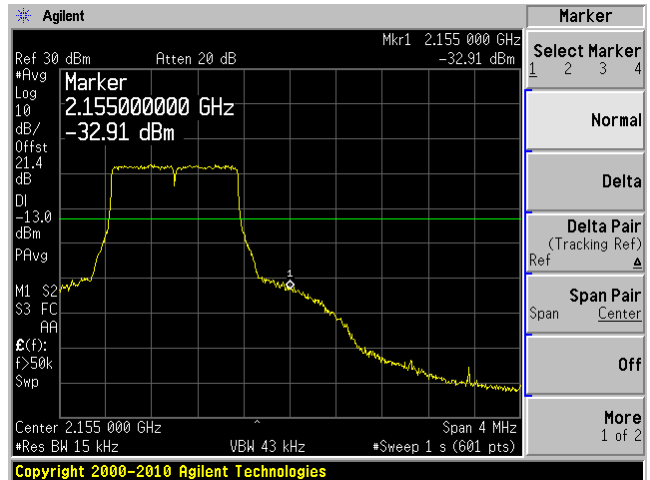


### AWS Band Downlink

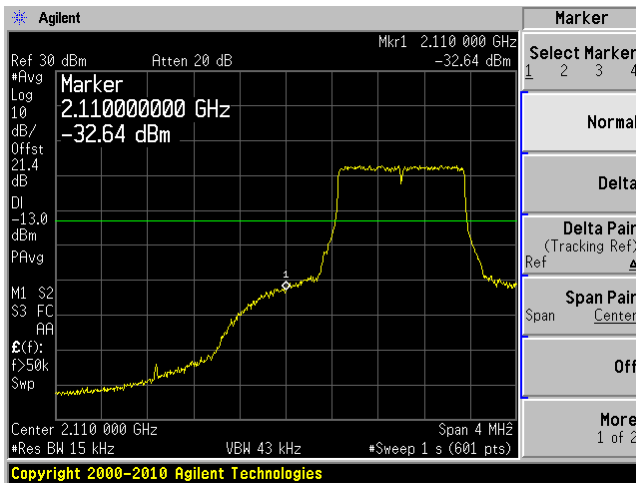
QPSK (1.4 MHz) - Low Channel



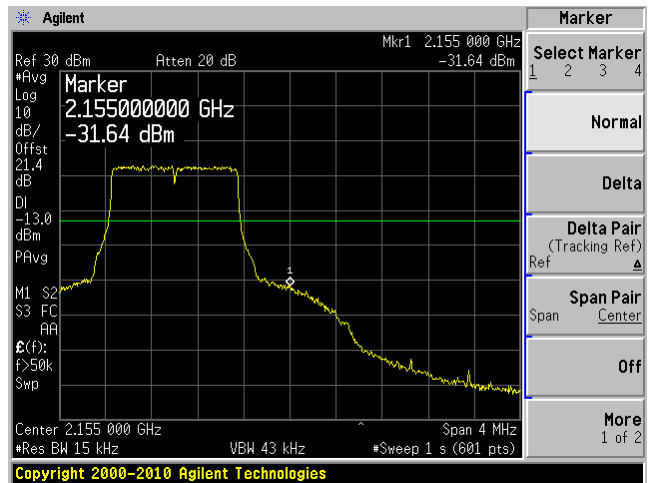
QPSK (1.4 MHz) - High Channel



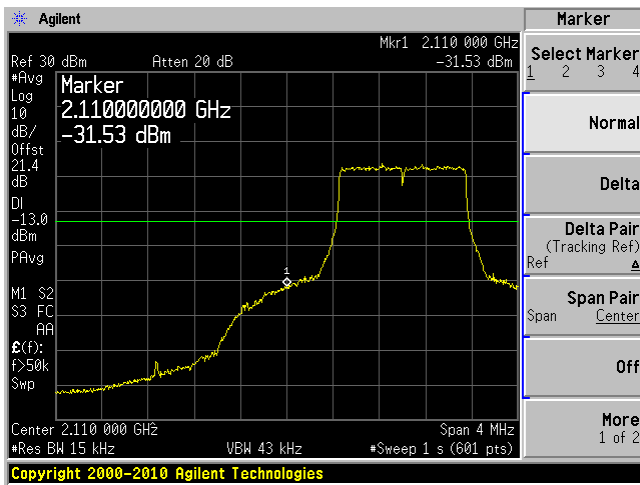
16QAM (1.4 MHz) - Low Channel



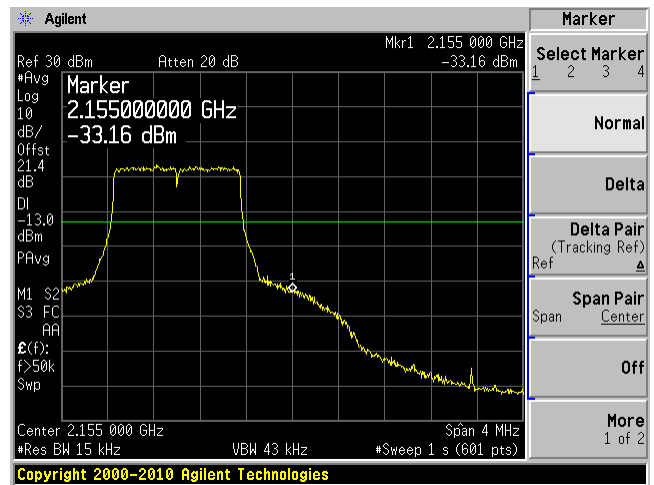
16QAM (1.4 MHz) - High Channel



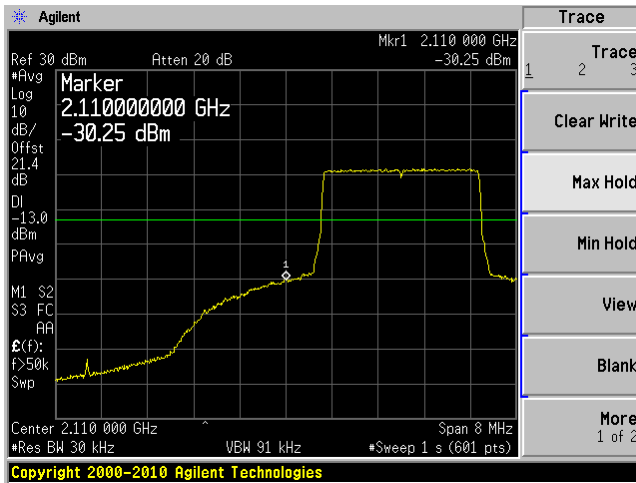
64QAM (1.4 MHz) - Low Channel



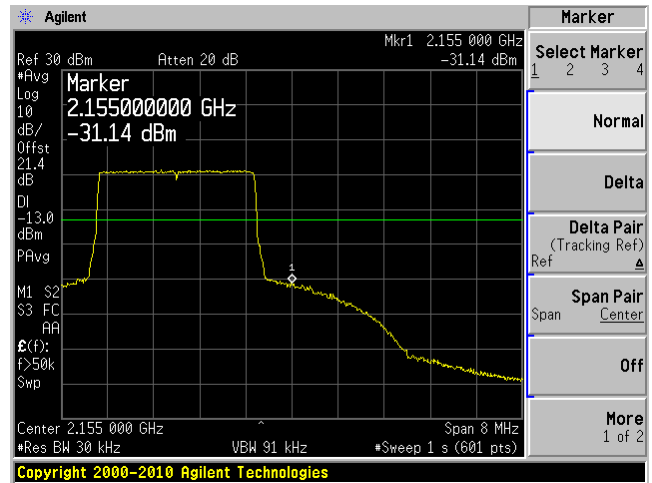
64QAM (1.4 MHz) - High Channel



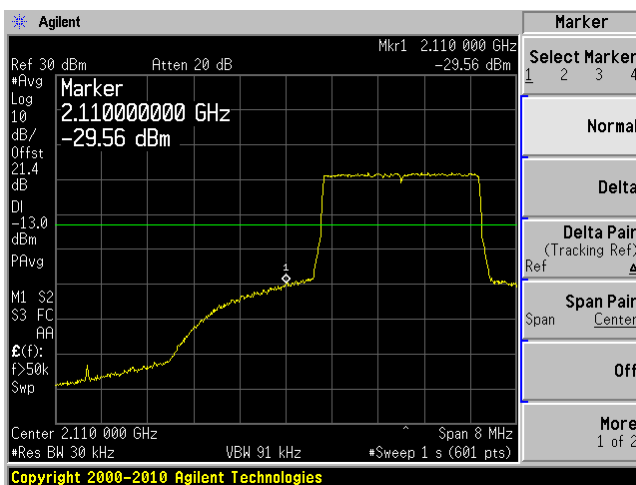
QPSK (3 MHz) - Low Channel



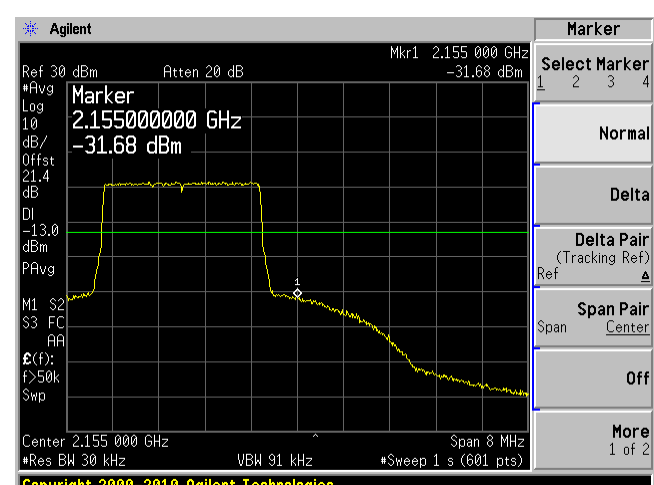
QPSK (3 MHz) - High Channel



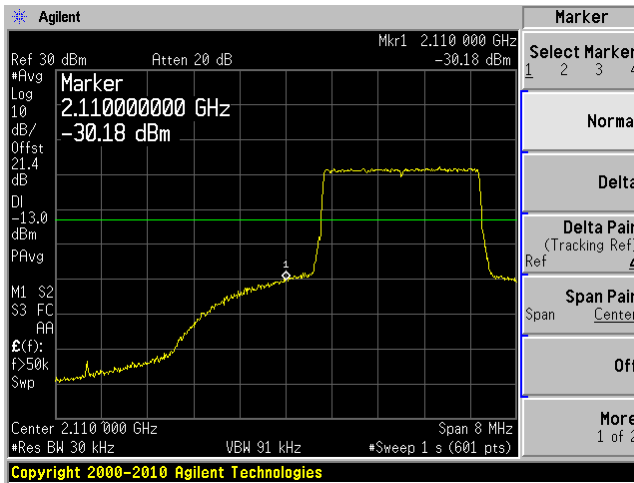
16QAM (3 MHz) - Low Channel



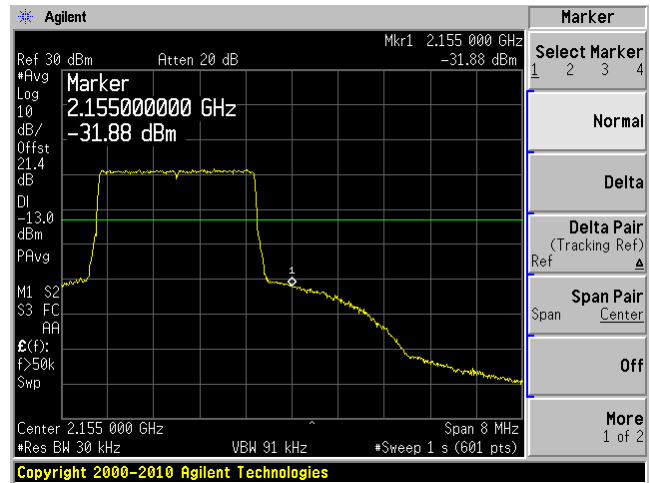
16QAM (3 MHz) - High Channel



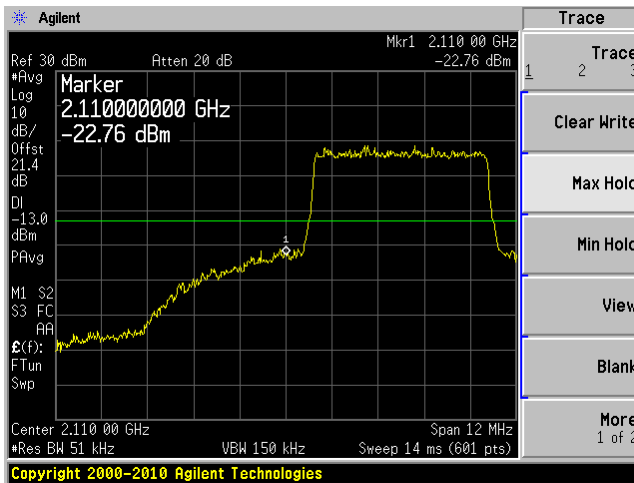
64QAM (3 MHz) - Low Channel



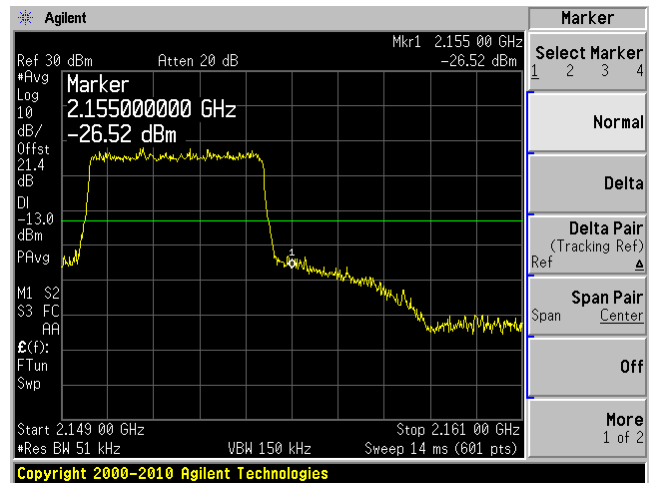
64QAM (3 MHz) - High Channel



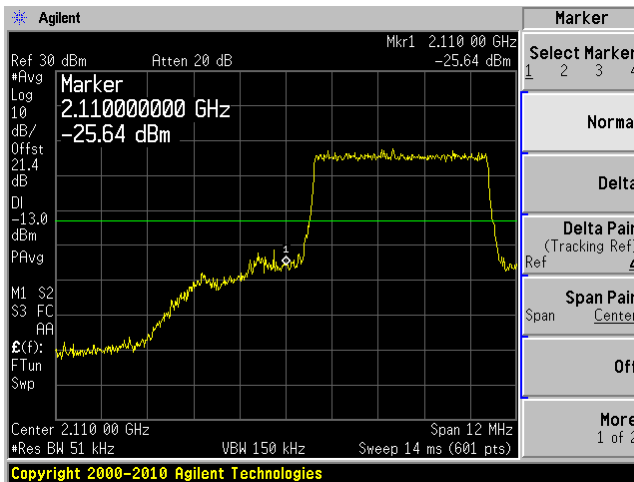
QPSK (5 MHz) - Low Channel



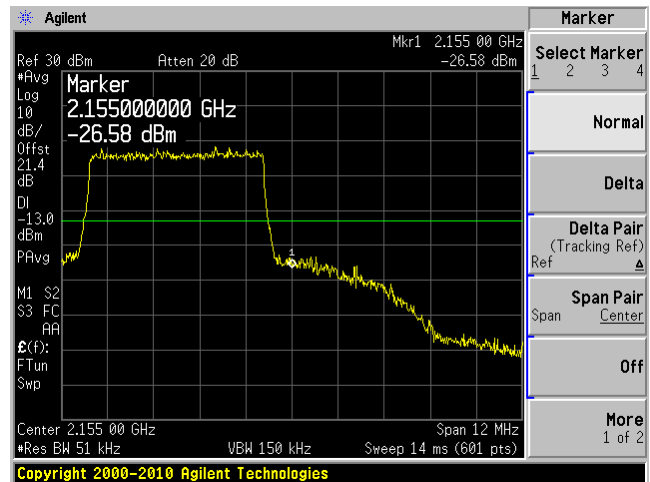
QPSK (5 MHz) - High Channel



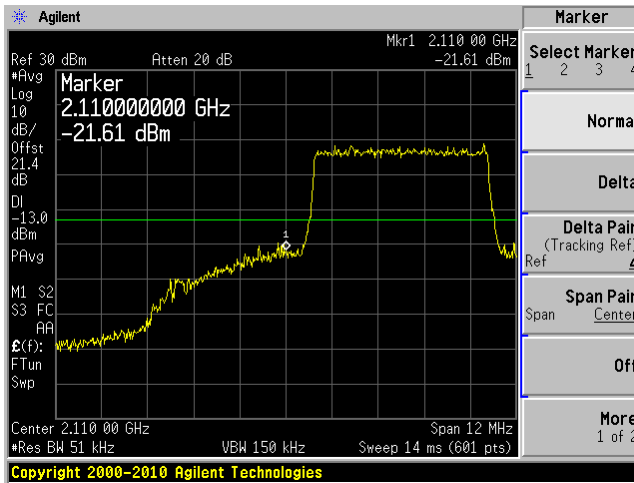
16QAM (5 MHz) - Low Channel



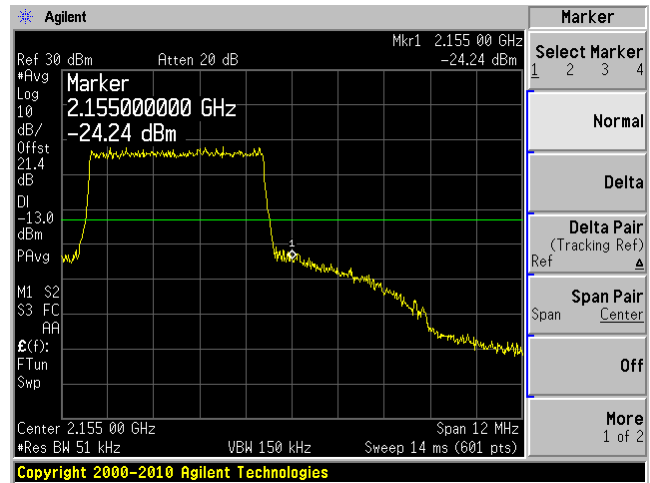
16QAM (5 MHz) - High Channel



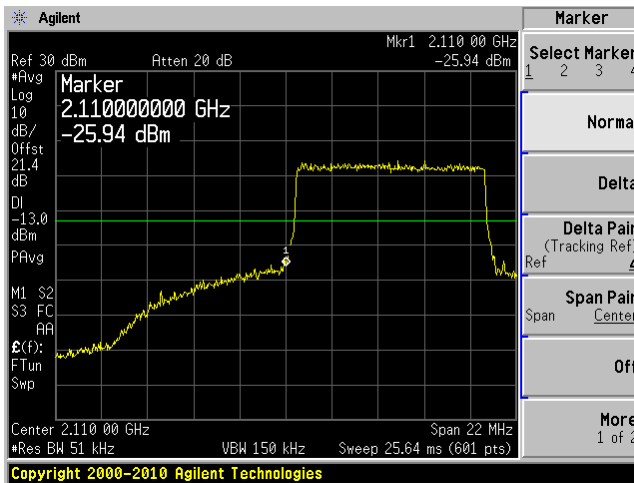
64QAM (5 MHz) - Low Channel



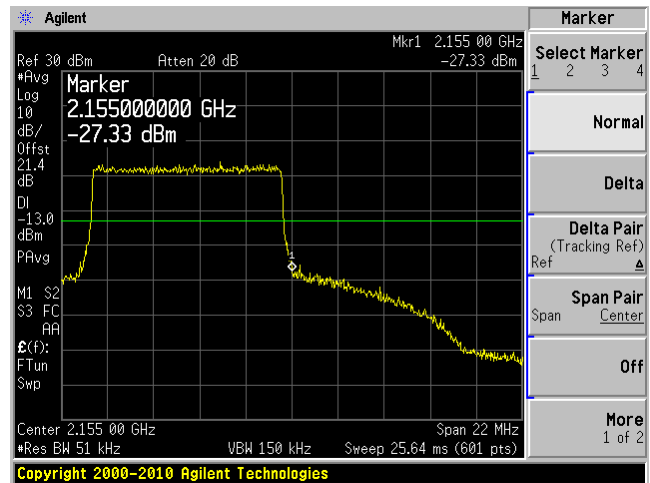
64QAM (5 MHz) - High Channel



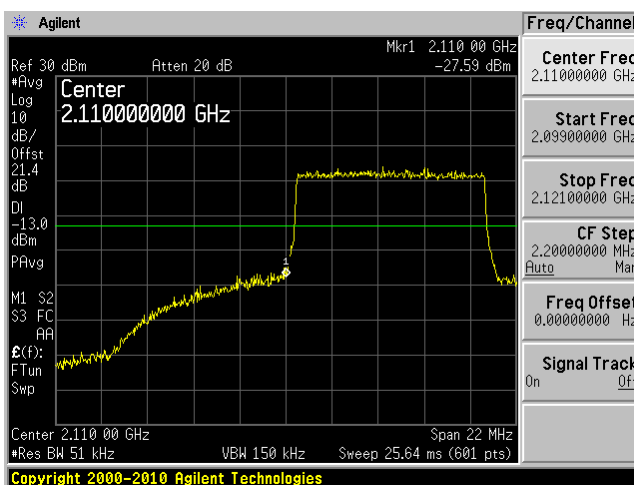
QPSK (10 MHz) - Low Channel



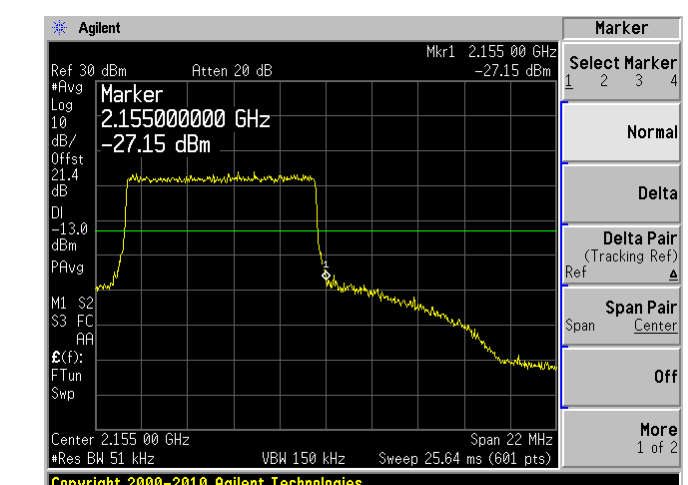
QPSK (10 MHz) - High Channel



16QAM (10 MHz) - Low Channel

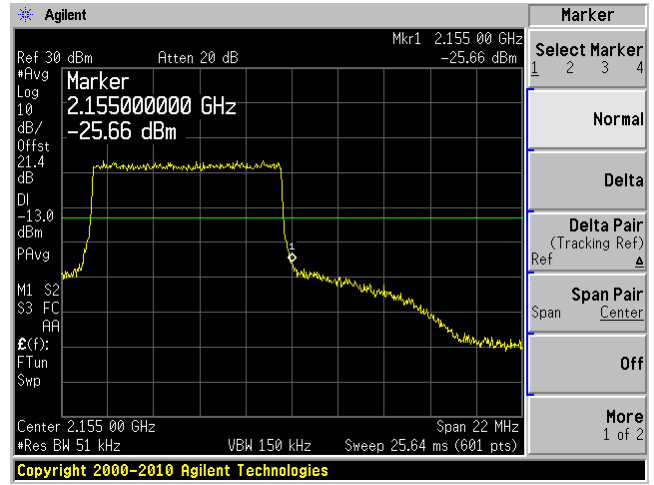
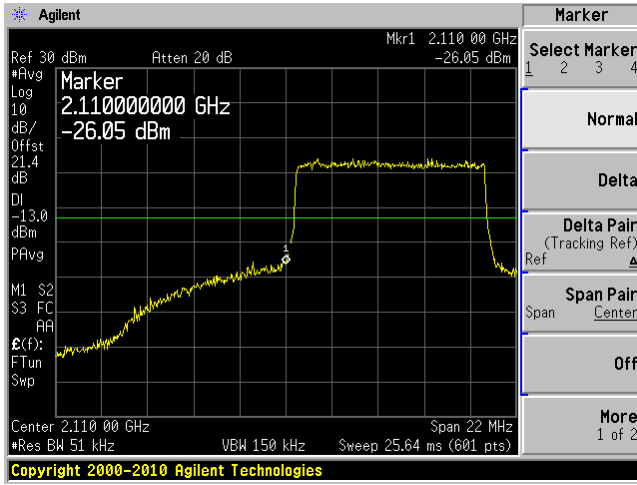


16QAM (10 MHz) - High Channel



64QAM (10 MHz) - Low Channel

64QAM (10 MHz) - High Channel



## 9 FCC §2.1055 & §27.54 – Frequency Stability

### 9.1 Applicable Standard

According to FCC §2.1055 the frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.

### 9.2 Test Procedure

The frequency stability of the transmitter is measured by:

- a.) **Temperature:** The temperature is varied from - 30 °C to + 50 °C using an environmental chamber.
- b.) **Primary Supply Voltage:** The primary supply voltage is varied from battery end point to 115 % of the voltage normally at the input to the device or at the power supply terminals if cables are not normally supplied.

Specification — the frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block. The frequency stability of the transmitter shall be maintained within  $\pm 0.00025$  % ( $\pm 2.5$  ppm) of the center frequency.

CW was tested as worst case.

### 9.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date
Agilent	Spectrum Analyzer	E4440A	US45303156	2010-08-09 <sup>1</sup>
HP	Signal Generator	E4438C	MY45091309	2012-05-03

*Note 1: Based on a two year calibration cycle.*

**Statement of Traceability:** **BACL Corp.** attests that all calibrations have been performed according to A2LA requirements, traceable to the NIST.

### 9.4 Test Environmental Conditions

<b>Temperature:</b>	21 °C
<b>Relative Humidity:</b>	57 %
<b>ATM Pressure:</b>	101.4kPa

*The testing was performed by Ning Ma from 2012-06-03 at RF Site.*



## 9.5 Test Results

### 728-746 MHz

Test Condition		Reference Frequency (MHz)	Measured Frequency (MHz)	Frequency Error (PPM)	Result
Voltage (Vdc)	Temperature (°C)				
Frequency vs. Temperature					
120	45	737	737.000000	0	Compliant
120	35	737	737.000000	0	Compliant
120	25	737	736.999967	-0.045	Compliant
120	15	737	736.999967	-0.045	Compliant
120	5	737	737.000000	0	Compliant
120	-5	737	737.000000	0	Compliant
120	-15	737	736.999967	-0.045	Compliant
120	-25	737	737.000000	0	Compliant
Frequency vs. Voltage					
108	25	737	736.999967	-0.045	Compliant
132	25	737	736.999967	-0.045	Compliant

### 746-757 MHz

Test Condition		Reference Frequency (MHz)	Measured Frequency (MHz)	Frequency Error (PPM)	Result
Voltage (Vdc)	Temperature (°C)				
Frequency vs. Temperature					
120	45	752	752.000000	0	Compliant
120	35	752	751.999967	-0.044	Compliant
120	25	752	752.000000	0	Compliant
120	15	752	752.000000	0	Compliant
120	5	752	752.000000	0	Compliant
120	-5	752	752.000000	0	Compliant
120	-15	752	752.000000	0	Compliant
120	-25	752	751.999967	-0.044	Compliant
Frequency vs. Voltage					
108	25	752	752.000000	0	Compliant
132	25	752	752.000000	0	Compliant

**2110-2155 MHz**

Test Condition		Reference Frequency (MHz)	Measured Frequency (MHz)	Frequency Error (PPM)	Result
Voltage (Vdc)	Temperature (°C)				
Frequency vs. Temperature					
120	45	2132	2131.999830	-0.08	Compliant
120	35	2132	2131.999830	-0.08	Compliant
120	25	2132	2131.999830	-0.08	Compliant
120	15	2132	2131.999830	-0.08	Compliant
120	5	2132	2131.999830	-0.08	Compliant
120	-5	2132	2131.999830	-0.08	Compliant
120	-15	2132	2131.999830	-0.08	Compliant
120	-25	2132	2131.999830	-0.08	Compliant
Frequency vs. Voltage					
108	25	2132	2131.999830	-0.08	Compliant
132	25	2132	2131.999830	-0.08	Compliant

## 10 FCC §1.1307(b)(1) & §2.1091 – RF Exposure Information

### 10.1 Applicable Standard

According to FCC §1.1310 and §2.1091 (Mobile Devices) RF exposure is calculated.

Limits for General Population/Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm <sup>2</sup> )	Averaging Time (minute)
<b>Limits for General Population/Uncontrolled Exposure</b>				
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*(180/f <sup>2</sup> )	30
30-300	27.5	0.073	0.2	30
300-1500	/	/	f/1500	30
1500-100,000	/	/	1.0	30

Note: f = frequency in MHz

\* = Plane-wave equivalent power density

### 10.2 MPE Prediction

Predication of MPE limit at a given distance, Equation from OET Bulletin 65, Edition 97-01

$$S = PG/4\pi R^2$$

Where: S = power density

P = power input to antenna

G = power gain of the antenna in the direction of interest relative to an isotropic radiator

R = distance to the center of radiation of the antenna

#### AWS Band

Maximum peak output power at antenna input terminal (dBm): 20.14

Maximum peak output power at antenna input terminal (mW): 103.27

Prediction distance (cm): 20

Prediction frequency (MHz): 2112

Antenna Gain, typical (dBi): 15

Maximum Antenna Gain (numeric): 31.62

Power density at predication frequency and distance (mW/cm<sup>2</sup>): 0.650

MPE limit for uncontrolled exposure at predication frequency (mW/cm<sup>2</sup>): 1.0

**700 MHz Lower ABC Band**

<u>Maximum peak output power at antenna input terminal (dBm):</u>	<u>15.97</u>
<u>Maximum peak output power at antenna input terminal (mW):</u>	<u>39.54</u>
<u>Prediction distance (cm):</u>	<u>20</u>
<u>Prediction frequency (MHz):</u>	<u>737</u>
<u>Antenna Gain, typical (dBi):</u>	<u>15</u>
<u>Maximum Antenna Gain (numeric):</u>	<u>31.62</u>
<u>Power density at predication frequency and distance (mW/cm<sup>2</sup>):</u>	<u>0.249</u>
<u>MPE limit for uncontrolled exposure at predication frequency (mW/cm<sup>2</sup>):</u>	<u>0.4913</u>

**700 MHz Upper Band**

<u>Maximum peak output power at antenna input terminal (dBm):</u>	<u>16.92</u>
<u>Maximum peak output power at antenna input terminal (mW):</u>	<u>49.20</u>
<u>Prediction distance (cm):</u>	<u>20</u>
<u>Prediction frequency (MHz):</u>	<u>755</u>
<u>Antenna Gain, typical (dBi):</u>	<u>15</u>
<u>Maximum Antenna Gain (numeric):</u>	<u>31.62</u>
<u>Power density at predication frequency and distance (mW/cm<sup>2</sup>):</u>	<u>0.310</u>
<u>MPE limit for uncontrolled exposure at predication frequency (mW/cm<sup>2</sup>):</u>	<u>0.5033</u>

**Results**

The highest power density level at 20 cm is below the MPE uncontrolled exposure limit.