



## **MICROWAVE PATH SURVEY REPORT**

## RADIO FREQUENCY INTERFERENCE (RFI) MEASUREMENT REPORT

**Prepared For** 

ViaSat

Albuquerque, NM

**Transmit and Receive Earth Station** 17-21 GHz and 27-31 GHz

November 17, 2014

19700 Janelia Farm Boulevard. - Ashburn, Virginia 20147, USA - 703.726.5500 - Fax 703.726.5597

#### **TABLE OF CONTENTS**

#### **<u>SECTION 1</u>** Introduction and Background

- **1.1 Introduction**
- 1.2 Background
- **1.3 Constraints**

### **SECTION 2** Test Procedure

- 2.1 Calibration
- 2.2 Methodology

#### **SECTION 3** Data Presentation

## **SECTION 4** Summary of Results

#### **<u>SECTION 5</u>** Conclusions and Recommendations

- 5.1 Conclusions
- 5.2 Recommendations

#### Addendum 1

**ONE** 

#### INTRODUCTION AND BACKGROUND

#### 1.1 Introduction

On-site Radio Frequency Interference (RFI) measurements were performed on behalf of ViaSat, Inc. on November 17, 2014 at their proposed site in Albuquerque, NM. The purpose of these measurements was to determine the relative RFI levels in the 17-21 and 27-31 GHz common carrier frequency band and their impact on digital down-link satellite reception. Measurements were performed at one designated location. The purpose of this report is to document the results of these measurements and to present recommendations.

The analysis in this report is based upon the following:

- 4.1 Meter Antenna
- Satellite Arc: 55 to 115 Degrees West Longitude
- Frequency Range Considered: 17 to 21 GHz and 27-31 GHz
- Interference Objective: -156 dBW/1 MHz
- Type of Reception: Digital
- Measured Antenna Center Line: 6.5 Feet Above Ground Level

#### 1.2 Background

ViaSat, Inc is proposing to locate a new transmit/receive antenna at an existing location of  $35^{0} 5$ ' 37.1" N and  $106^{0} 38' 44.8$ " W ViaSat, Inc had requested that Comsearch conduct RFI measurements at the facility to assess the interference potential. This facility is currently nonoperational and measurements were done at a point near the proposed antenna locations.

The measured site is identified on a portion of a topographic map shown in Figure 1.2-1. An aerial photo of the site location is shown in Figure 1.2-2. A photo of the measurement using a GPS is shown in Figure 1.2-3.

#### 1.3 Constraints

The analysis in this report is based upon the following assumptions and constraints.

- The antenna selected will conform to the FCC reference pattern 32-25 Log $\theta$  as specified in 47CFR 25.209(a)(2).
- It is assumed that during the measurement period all of the terrestrial transmitters were active and operating at full transmit power for the licensed frequencies unless otherwise noted.
- The signal identification and frequencies analyzed are based upon information obtained from the various common carriers as to what frequencies were active at the time of the measurements and the traffic these frequencies were supposed to be carrying.
- The actual ground elevation of the site is based on the data from the topographic map.
- The interference objective of -156 dBW/1 MHz used throughout this report is based upon estimated link budget parameters and is subject to change. ViaSat, Inc should review the system parameters for this down-link in order to verify the viability of this objective.

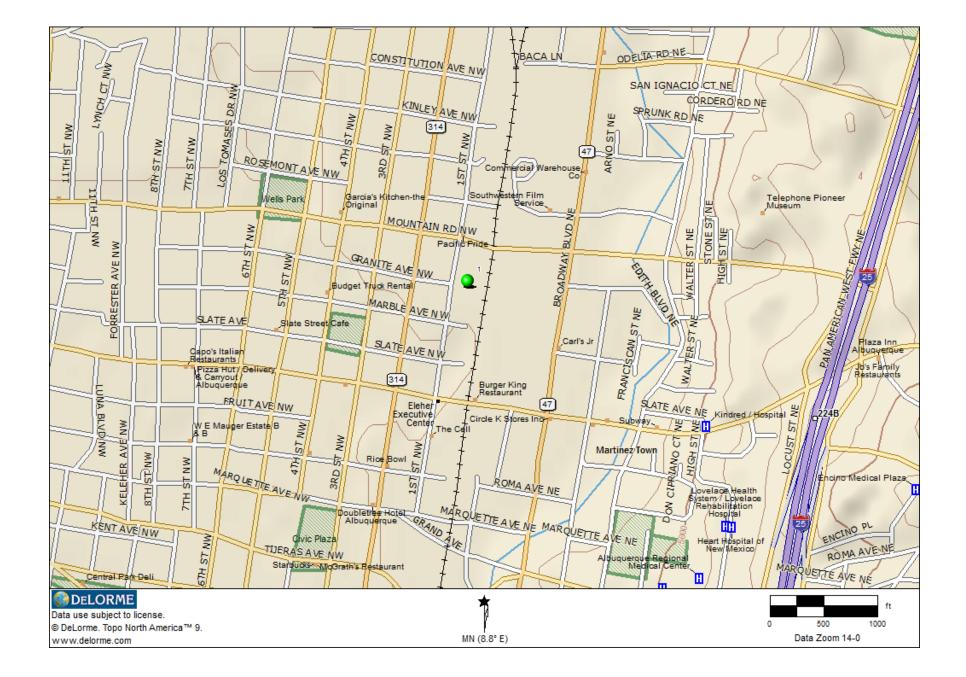




Figure 1.2-2 – Aerial Photograph

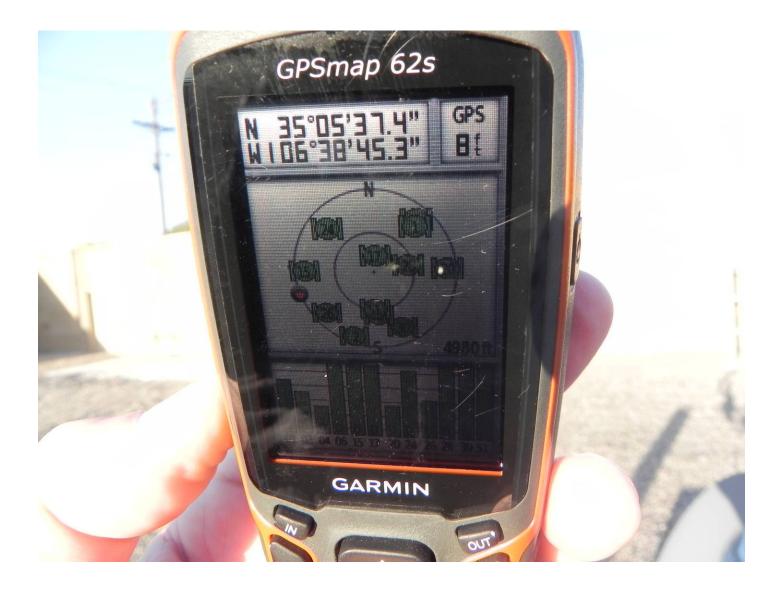


Figure 1.2-3 – GPS Photograph

TWO

#### **TEST PROCEDURE**

#### 2.1 Calibration

Figures 2.1-1 is the block diagram of the test set for all bands to be tested. All test equipment used was allowed a proper warm-up period prior to calibration. The test set was calibrated by the signal substitution method, as recommended by NSMA, utilizing a synthesized signal generator. The reference signal from the signal generator was adjusted for the center frequency of each band to be tested and measured with a thermal power meter for calibrated reference test level (-60 dBm). This calibrated reference signal from the signal generator was then injected into the end of the coaxial cable of the test set at the point, which normally connects to the test antenna. A spectrum analyzer then measured the reference test signal level after passing through the test set. At this point, the spectrum analyzer was calibrated reference signal (-60 dBm) by utilizing the reference level offset function of the Anritsu – MS2720T spectrum analyzer. Upon completion of the calibration process, a known reference level was obtained for the measurements that correspond to a given set of spectrum analyzer display readings.

The following formula is used to transform the measured signal level as read on the spectrum analyzer display (dBm) to an isotropic reference signal level (dBW<sub>I</sub>) as seen at the point of test:

 $dBW_I = LI - GA - 30$ 

Where:  $dBW_I = Isotropic level in dBW$ 

LI = Level (dBm) of injected signal

GA = Test antenna gain

-30 =Conversion factor from dBm to dBW

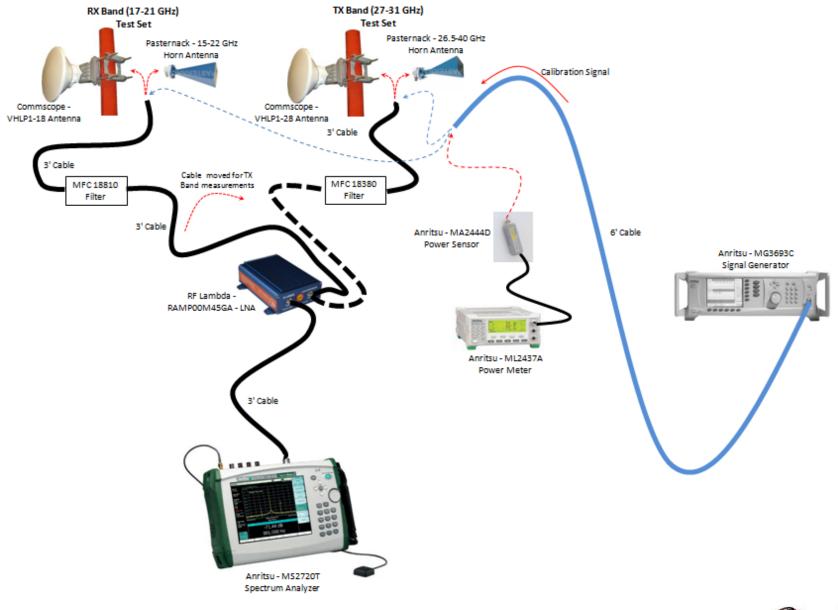
at 19.5 GHz:  $dBW_I = -60 dBm - 30 dB - 30 dB$ 

 $= -120 \text{ dBW}_{\text{I}}$ 

In this instance, the spectrum analyzer displayed measured signal level of -60 dBm equates to an isotropic signal level of -120 dBW<sub>I</sub>.

Figures 2.1-2(A-H) displays the spectrum photographs of the described calibration procedure employed during these measurement.

### **Test Set Equipment Diagram**





**Figure 2.1-1 Receive Test Equipment Block** 

<b>/Inritsu</b> 11/17	/2014 08:	24:14 am						[	4	-	Save
Ref Lvi			@17.500 G	iHz					Spectrur	n Analyzei	r
–120.0 dBm 90.0 dB Ext Gain	-120.0 c	IBm				1					
Input Atten 0.0 dB	-130.0										
<b>Detection</b> Peak	-140.0										
<b>#RBW</b> 1 MHz	-150.0										
<b>VBW</b> 300 kHz	- 460.0M	Anastana	when the start	and a star	man part and	mann	alyan an a	Anton	and for the second	whereardet	1
Sweep Time 50 ms Traces	-170.0										
<u>A: Max Hold</u>	-180.0										Change
	-190.0										Quick Name
<b>Sweep</b> (Fast) Continuous	-200.0										Change
	-210.0 c										Save Location
Freq Ref Int Std Accy											Change Type
	17.000 G	Hz				7.500 GHz 000 GHz			1	8.000 GH;	Setup/JPEG/
Freq		A	mplitude			Span			BW		Marker

Figure 2.1-2 (A) Calibration Spectrum Photo 17.5 GHz

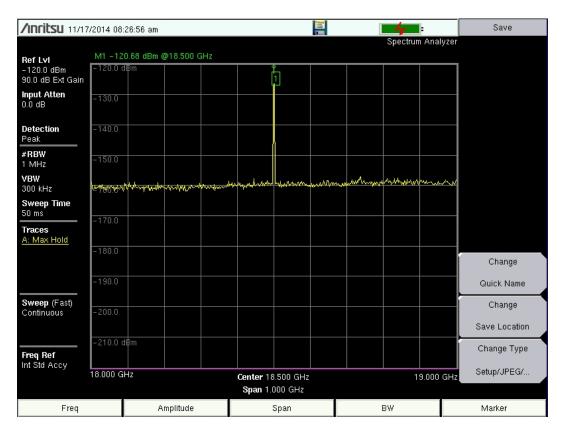


Figure 2.1-2 (B) Calibration Spectrum Photo 18.5 GHz

<b>/Inritsu</b> 11/13	7/2014 08:	:28:06 am						[	-	•	Save
<b>Ref Lvi</b> -120.0 dBm	M1 - 11 - 120.0 c		@19.500 @	iHz					Spectrum	Analyzer	
90.0 dB Ext Gain Input Atten 0.0 dB	-130.0					1					
<b>Detection</b> Peak	-140.0										
<b>#RBW</b> 1 MHz	-150.0										
<b>VBW</b> 300 kHz	- 160.0	- la tradage a de tradage	andredge	manon	wellynnwrw	www.	www.where	manna	w Westerner	mhair	
Sweep Time 67 ms Traces A: Max Hold	-170.0										
	-180.0										Change
	-190.0										Quick Name
<b>Sweep</b> (Fast) Continuous	-200.0										Change Save Location
Freq Ref Int Std Accy	-210.0 0	18m									Change Type
	19.000 G	Hz				9.500 GHz 000 GHz			2	0.000 GHz	Setup/JPEG/
Freq		A	mplitude			Span			BW		Marker

Figure 2.1-2 (C) Calibration Spectrum Photo 19.5 GHz

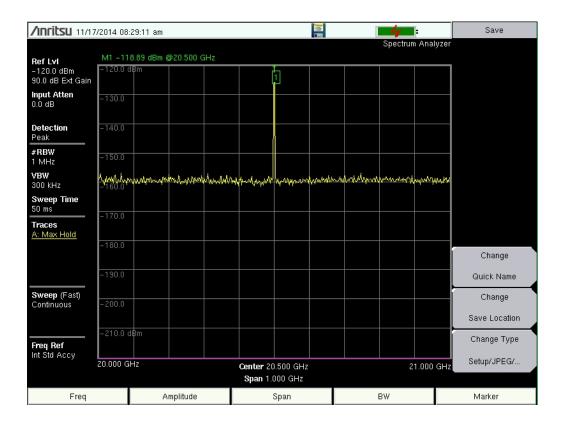


Figure 2.1-2 (D) Calibration Spectrum Photo 20.5 GHz

/Inritsu 11/17	/2014 08:	30:51 am						[	4	:	Save
Ref Lvl		0.94 dBm (	@27.500 @	iHz					Spectrum	Analyzer	
-120.0 dBm 90.0 dB Ext Gain	-120.0 d	Bm				1					
Input Atten 0.0 dB	-130.0										
<b>Detection</b> Peak	-140.0										
<b>#RBW</b> 1 MHz	-150.0										
<b>VBW</b> 300 kHz	-160.0W	www.	Anthropy	pmhotionit	hannalana	retropped	-happy	er how how how how	www.mp	whenter	
Sweep Time 50 ms	-170.0										
Traces <u>A: Max Hold</u>	-180.0										
	- 100.0									Í	Change
	-190.0										Quick Name
Sweep (Fast) Continuous	-200.0									——i	Change
											Save Location
Freq Ref Int Std Accy	-210.0 d	l₿m									Change Type
Intola Accy	27.000 G	Hz				, 7.500 GHz 000 GHz			2	3.000 GHz	Setup/JPEG/
Freq		А	mplitude			Span			BW		Marker

Figure 2.1-2 (E) Calibration Spectrum Photo 27.5 GHz

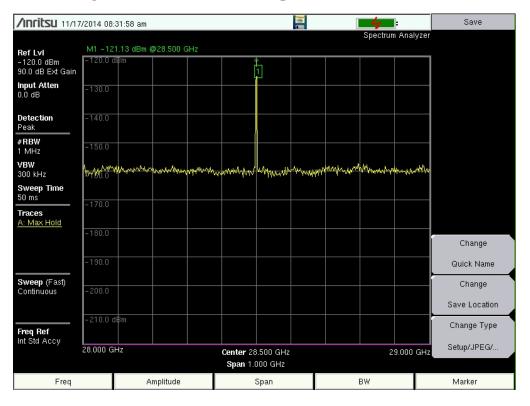


Figure 2.1-2 (F) Calibration Spectrum Photo 28.5 GHz

/Inritsu 11/17	/2014 08:	33:13 am							4	-	Save
Ref Lvl			@29.500 G	Hz					Spectrum	1 Analyzer	
-120.0 dBm 90.0 dB Ext Gain	-120.0 d	IBm				1					
Input Atten 0.0 dB	-130.0										
Detection Peak	-140.0										
#RBW 1 MHz	-150.0										
<b>VBW</b> 300 kHz	₩ <b>₩₩₩₩</b>	htter attack	wwwww	www.	www.	magderna	MW Marry	man	enter marine	supervender	
Sweep Time 67 ms	-170.0										
Traces <u>A: Max Hold</u>	-180.0										
											Change
	-190.0										Quick Name
<b>Sweep</b> (Fast) Continuous	-200.0										Change
											Save Location
Freq Ref Int Std Accy	-210.0 d	IBm									Change Type
	29.000 GI	Hz			Center 29 Span 1.	9.500 GHz 000 GHz			3	0.000 GHz	Setup/JPEG/
Freq		A	mplitude			Span			BW		Marker

Figure 2.1-2 (G) Calibration Spectrum Photo 29.5 GHz

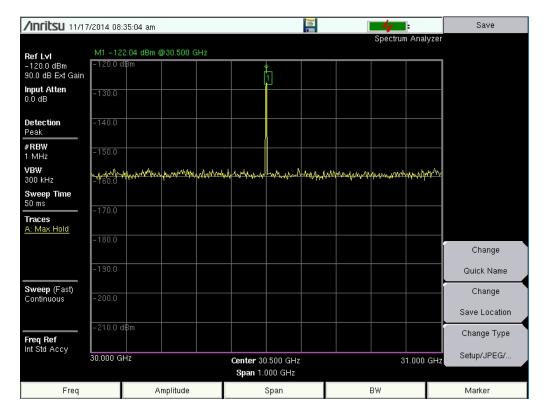


Figure 2.1-2 (H) Calibration Spectrum Photo 30.5 GHz

#### 2.2 Methodology

Upon arriving at the existing earth station site, azimuth and horizon elevation measurements were performed to evaluate if any satellite arc obstructions exist. The coordinates of the existing earth station site were verified on the DeLorme topographic map. Photographs were taken to document the satellite arc (clearance) and are included in this report.

After site coordinates and horizon elevations were verified, the test equipment was set up and calibrated to measure the RF environment. Measurements were conducted at the proposed earth station location for the 17-21 and 27-31 GHz band. After the equipment calibration was completed, the test antenna was mounted on an extendable tower and elevated to a height of 6.5 feet. This height is greater than the centerline of the earth station antenna. The antenna was rotated 360 degrees (scanning), once in each polarization, while activating the peak hold function of the spectrum analyzer. This enabled the analyzer to maintain and display the maximum signal level received for all frequencies under consideration. After the initial documentation of interference, all interference conflicts if observed were peaked on to determine the azimuth and the level of the interference source.

Upon completion of the RF testing, the measured signal levels were transposed to earth station interference levels after accounting for the addition of the corresponding earth station antenna gain.

THREE

## **DATA PRESENTATION**

The following section contains the tables and spectrum photos pertaining to the site location measured.

#### 3.1 Albuquerque, NM

- Table 3.1-1 presents a site data sheet including all pertinent site information.
- Figures 3.1-1 and 3.1-2 are the photographs depicting the existing earth station site and satellite arc.
- Figures 3.1-3 through 3.1-10 are the RF spectrum photographs depicting the interference environment at the test site.

## **TABLE 3.1-1**

## **MEASUREMENT SITE DATA SHEET**

1.	SYSTEM NAME:	ViaSat, Inc
2.	CITY AND STATE:	Albuquerque, NM
3.	SITE IDENTIFICATION:	Albuquerque
4.	COORDINATES: (NAD 1983)	LATITUDE: 35° 5' 37.1" N LONGITUDE: 106° 38' 44.8" W
5.	GROUND ELEVATION:	4961 feet AMSL
6.	MEASUREMENT DATE AND TIMES:	November 17, 2014
7.	GEOSTATIONARY ARC RANGE: SATELLITE POSITIONS: AZIMUTH: ELEVATION:	55W – 115W 114.5° – 194.3° 22.5° / 48.3
8.	GEOSTATIONARY ARC VISIBILITY:	Satellite arc has no blockage at this time



North



East



South



West

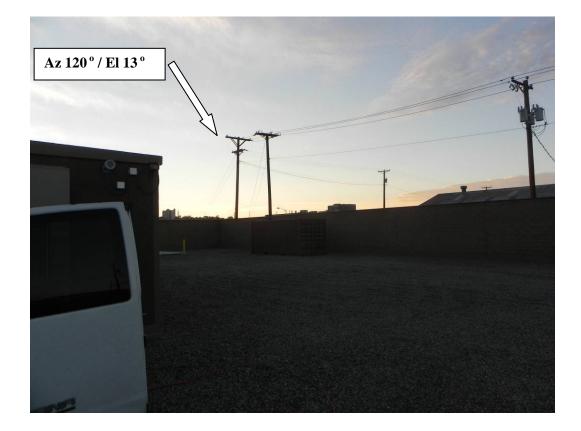




Figure 3.1-2 Horizon Photographs of Earth Station Site





Figure 3.1-2 (cont.) Horizon Photographs of Earth Station Site



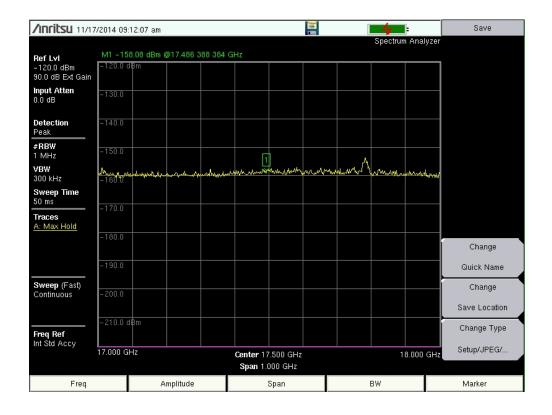


Figure 3.1-3 (A) Spectrum Photos 17-18 GHz 1MHz Res BW Horizontal Pol  $360^{\circ}$ 

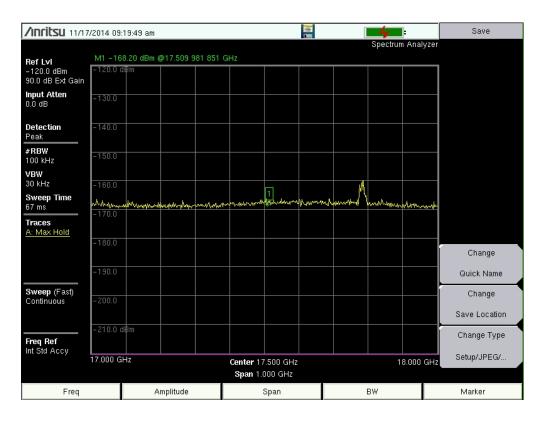


Figure 3.1-3 (B) Spectrum Photos 17-18 GHz 100 KHz Res BW Horizontal Pol 360<sup>0</sup>

/INCIESU 11/17	/2014 09:	31:05 am							4		Save
<b>Ref Lvi</b> -120.0 dBm	M1 *-11		@20.504 \$	537 205	GHz				Spectrun	n Analyzer	
90.0 dB Ext Gain											
Input Atten 0.0 dB	-130.0										
<b>Detection</b> Peak	-140.0										
<b>#RBW</b> 1 MHz	-150.0										
<b>VBW</b> 300 kHz	mid abiron	www.	handar	www.	wand hallow ward	ntheadown-	www.cheller	manan	ununun	portender and	
Sweep Time 67 ms	-170.0									>1	
Traces A: Max Hold											
	-180.0									Í	Change
	-190.0										Quick Name
<b>Sweep</b> (Fast) Continuous	-200.0										Change
Johanaoas	-200.0										Save Location
Freq Ref Int Std Accy	-210.0 c	18m									Change Type
ni olu riccy	17.000 G	Hz			Center 17 Span 1.1	, 7.500 GHz 000 GHz			1	8.000 GHz	Setup/JPEG/
Freq		ρ	mplitude		•	Span			BW		Marker

Figure 3.1-3 (C) Spectrum Photos 17-18 GHz 1 MHz Res BW Horizontal Pol Worst Case

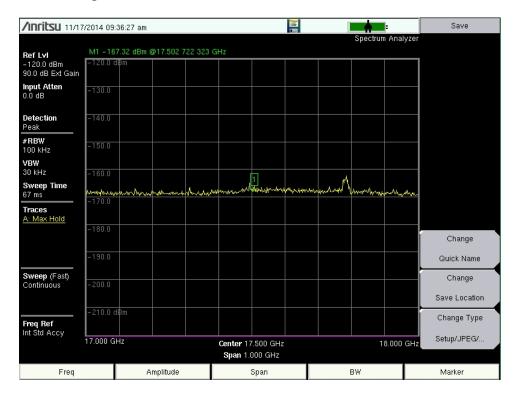


Figure 3.1-3 (D) Spectrum Photos 17-18 GHz 100 KHz Res BW Horizontal Pol Worst Case

/INCIESU 11/17	72014 09:	52:42 am						[	•	÷	Save
Ref LvI	M1 -15	9.10 dBm i	@17.508 1	66 969 (	GHz				Spectrun	1 Analyzer	
-120.0 dBm 30.0 dB Ext Gain	-120.0 d	Bm									
nput Atten 1.0 dB	-130.0										
)etection <sup>2</sup> eak	-140.0										
<b>RBW</b> MHz	-150.0					5					
<b>/BW</b> :00 kHz	-160.0	windowers	egraphic spectar	uhun Aydu	the flow of the second second	without the	nghlinhing	programition	with	addamadas	
<b>weep Time</b> 3 ms	-170.0										
races A: Max Hold											
	-180.0										Change
	-190.0										Quick Name
<b>weep</b> (Fast) ontinuous	-200.0										Change
	-210.0 d	P									Save Location
req Ref ht Std Accy											Change Type
	17.000 GI	Ηz				7.500 GHz .000 GHz			1	8.000 GHz	Setup/JPEG/
Freq		ρ	mplitude			Span			BW		Marker

Figure 3.1-3 (E) Spectrum Photos 17-18 GHz 1MHz Res BW Vertical Pol  $360^{\circ}$ 

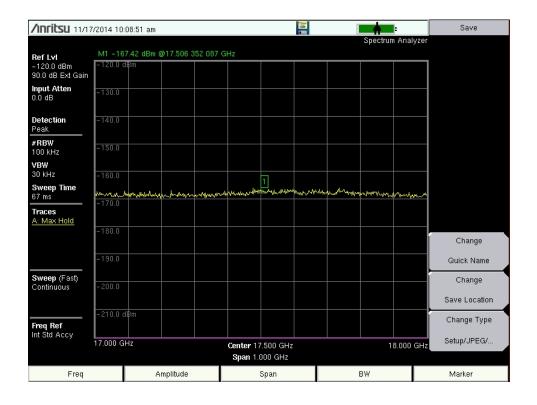
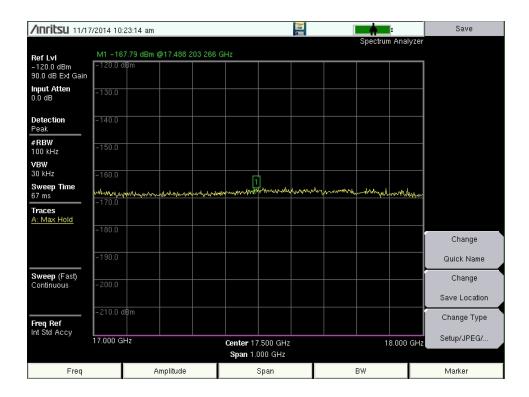


Figure 3.1-3 (F) Spectrum Photos 17-18 GHz 100 KHz Res BW Vertical Pol 360<sup>0</sup>

<b>/Inritsu</b> 11/17	//2014 10:	:17:43 am						[	•	:	Save
Ref LvI		8.70 dBm (	@17.459 1	65 154	GHz				Spectrun	ı Analyzer	
-120.0 dBm 90.0 dB Ext Gain	-120.0 (	l₿m									
Input Atten 0.0 dB	-130.0										
Detection Peak	-140.0										
#RBW 1 MHz	-150.0										
<b>VBW</b> 300 kHz	<u>√₩₩₩,</u> -160.0	manadada	sate to such that	unhaven	Mansant	Un-sephydrwllyny	hand and the second	hopen	www.	Manapar	
Sweep Time 50 ms											
Traces A: Max Hold	-170.0										
	-180.0										Change
	-190.0										Quick Name
Sweep (Fast) Continuous	-200.0									——İ	Change
											Save Location
Freq Ref Int Std Accy	-210.0 (	18m									Change Type
	17.000 G	Hz			Center 15 Span 1.1	7.500 GHz 000 GHz			1	8.000 GHz	Setup/JPEG/
Freq		A	mplitude			Span			BW		Marker

Figure 3.1-3 (G) Spectrum Photos 17-18 GHz 1 MHz Res BW Vertical Pol Worst Case



<b>/INCIESU 11/17</b>	/2014 09:	14:26 am						[	4	=	Save
Ref Lvl	M1 -15	8.78 dBm	@18.517 2	41 379 (	GHz				Spectrum	ı Analyzer	
-120.0 dBm 90.0 dB Ext Gain	–120.0 c	iBm									
Input Atten 0.0 dB	-130.0										
Detection Peak	-140.0										
#RBW 1 MHz	-150.0										
<b>VBW</b> 300 kHz	-160.0	www	Antonation	qh,xiiii <sub>i</sub> naqayi	and when	Mary Mark	underen	Anna	and her had a shape	whenter	
Sweep Time 50 ms	-170.0										
Traces <u>A: Max Hold</u>	100.0										
	-180.0										Change
	-190.0										Quick Name
Sweep (Fast) Continuous	-200.0										Change Save Location
	-210.0 c	18m									Change Type
Freq Ref Int Std Accy	18.000 G	Hz			Contor 1	3.500 GHz				3.000 GHz	Setup/JPEG/
						000 GHz				5.000 GH2	
Freq		ŀ	Amplitude			Span			BW		Marker

Figure 3.1-4 (A) Spectrum Photos 18-19 GHz 1 MHz Res BW Horizontal Pol  $360^{\circ}$ 

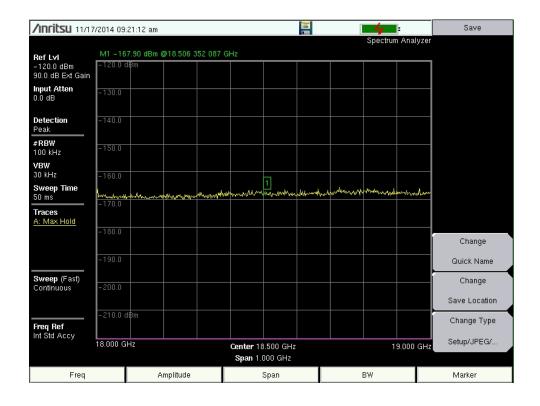


Figure 3.1-4 (B) Spectrum Photos 18-19 GHz 100 KHz Res BW Horizontal Pol 360<sup>0</sup>

/Inritsu 11/17	/2014 09:	32:11 am						[	•	:	Save
<b>Ref Lvi</b> -120.0 dBm 90.0 dB Ext Gain	M1 *-16 -120.0 d		@20.504 5	537 205 (	GHz				Spectrur	n Analyzer	
Input Atten 0.0 dB	-130.0										
Detection Peak	-140.0										
#RBW 1 MHz	-150.0										
<b>VBW</b> 300 kHz		WARRAN MAR	ahhandunrur	www.	human	ad an and the second	dq.deenh-ui	woldentersta	war hagen	marile	
Sweep Time 67 ms										>1	
Traces <u>A: Max Hold</u>	-170.0										
	-180.0										Change
	-190.0										Quick Name
Sweep (Fast) Continuous	-200.0										Change
											Save Location
Freq Ref Int Std Accy	-210.0 d	Bm									Change Type
	18.000 GI	Hz			Center 18 Span 1.1	3.500 GHz 000 GHz			1	9.000 GHz	Setup/JPEG/
Freq		A	mplitude			Span			BW		Marker

Figure 3.1-4 (C) Spectrum Photos 18-19 GHz 1 MHz Res BW Horizontal Pol Worst Case

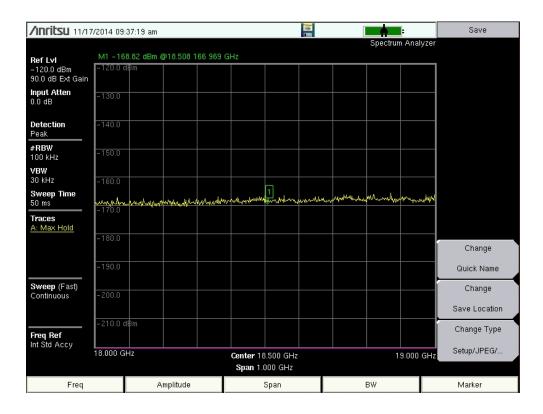


Figure 3.1-4 (D) Spectrum Photos 18-19 GHz 100 KHz Res BW Horizontal Pol Worst Case

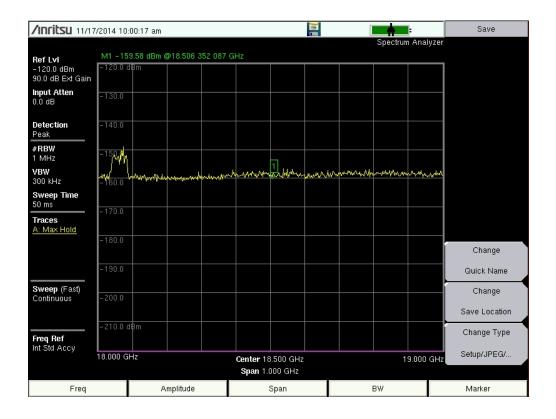


Figure 3.1-4 (E) Spectrum Photos 18-19 GHz 1 MHz Res BW Vertical Pol 360<sup>0</sup>

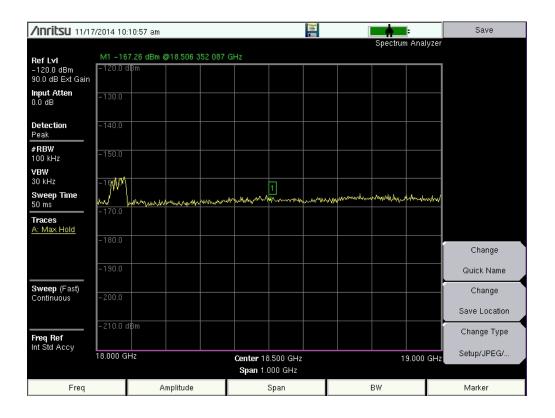


Figure 3.1-4 (F) Spectrum Photos 18-19 GHz 100 KHz Res BW Vertical Pol 360<sup>0</sup>

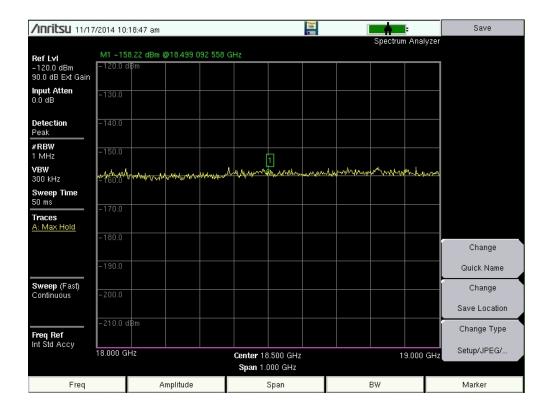


Figure 3.1-5 (G) Spectrum Photos 18-19 GHz 1 MHz Res BW Vertical Pol Worst Case

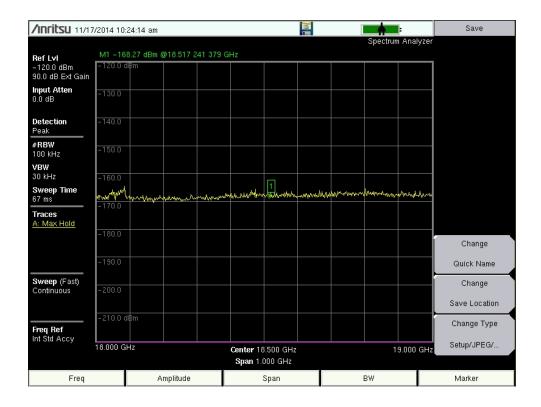
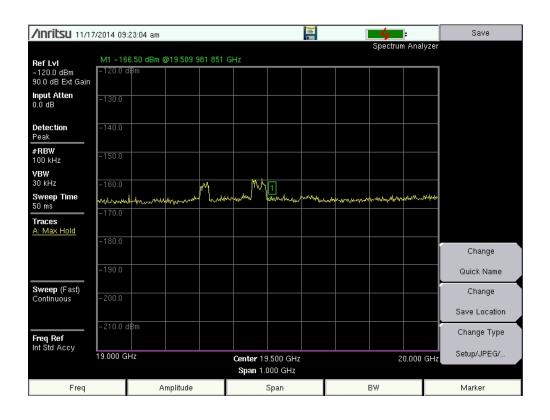


Figure 3.1-4 (H) Spectrum Photos 18-19 GHz 100 KHz Res BW Vertical Worst Case

/Inritsu 11/17	7/2014 09:	16:50 am						[	4	ŧ	Save
Ref Lvi	M1 -15	4.44 dBm (	@19.482 7	58 620 0	âHz				Spectrum	n Analyzer	
-120.0 dBm 90.0 dB Ext Gain	-120.0 d	lBm									
nput Atten ).0 dB	-130.0										
<b>Detection</b> Veak	-140.0										
<b>RBW</b> MHz	-150.0										
<b>'BW</b> 00 kHz	-160.0	kansteinert	Je Nummer	Munhar	manni	Mahandhad	Muchanther	munition	er openskom vilke over	m dansfeder	
<b>Weep Time</b> O ms	-170.0										
F <b>races</b> A: Max Hold											
	-180.0									Í	Change
	-190.0										Quick Name
weep (Fast) ontinuous	-200.0										Change
	-210.0 c	18m									Save Location
req Ref nt Std Accy											Change Type
	19.000 G	Hz			Center 19 Span 1.0				21	0.000 GHz	Setup/JPEG/
Freq		A	mplitude			Span			BW		Marker

Figure 3.1-5 (A) Spectrum Photos 19-20 GHz 100 KHz Res BW Vertical Pol 360<sup>0</sup>



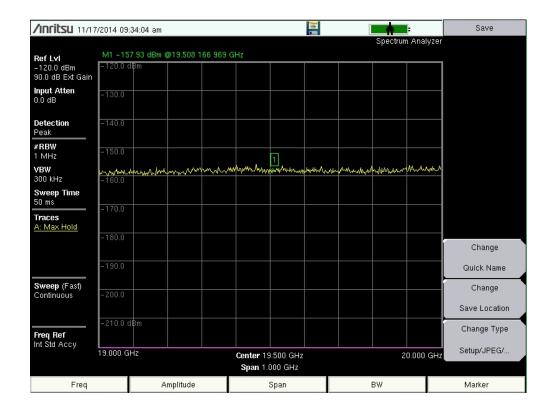


Figure 3.1-5 (C) Spectrum Photos 19-20 GHz 1 MHz Res BW Horizontal Pol Worst Case

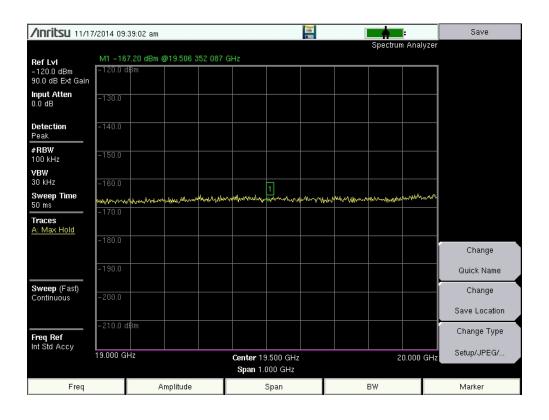


Figure 3.1-5 (D) Spectrum Photos 19-20 GHz 100 KHz Res BW Horizontal Pol Worst Case

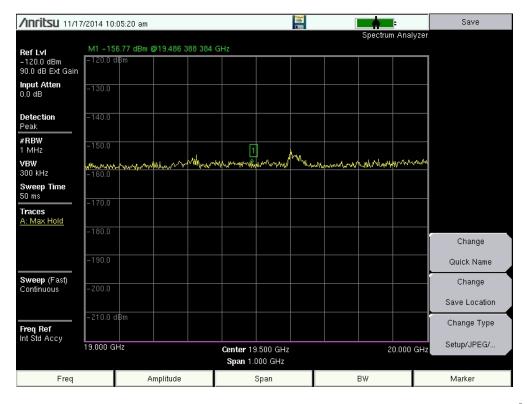


Figure 3.1-5 (E) Spectrum Photos 19-20 GHz 1MHz Res BW Vertical Pol  $360^{\circ}$ 

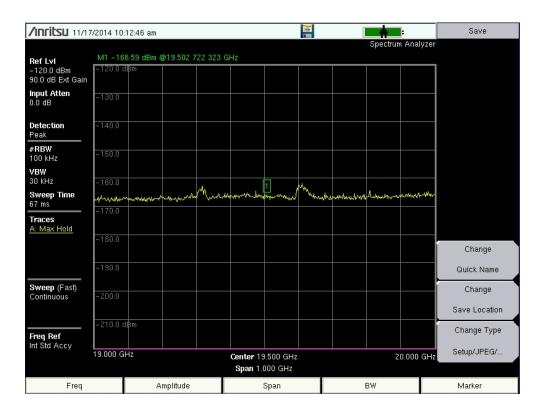


Figure 3.1-5 (F) Spectrum Photos 19-20 GHz 100 KHz Res BW Vertical Pol 360<sup>0</sup>

<b>/INFILSU</b> 11/17	/2014 10:	20:49 am						[		ŀ .	Save
Ref Lvi	M1 -15	9.13 dBm (	@19.509 9	181 851 G	iHz				Spectrur	1 Analyzer	
120.0 dBm 10.0 dB Ext Gain	-120.0 d	iBm									
n <b>put Atten</b> .0 dB	-130.0										
etection eak	-140.0										
<b>RBW</b> MHz	-150.0			<u>Nn</u>		1					
<b>BW</b> 00 kHz	<mark>ч</mark> родиција -160.0	Maryan	Madminhah	Whyne	and with the	gover Man	ha salimati Lahada	,h m Mm	and fail the states	hannann	
w <b>eep Time</b> 0 ms	-170.0										
races : Max Hold											
	-180.0										Change
	-190.0										Quick Name
<b>weep</b> (Fast) ontinuous	-200.0										Change
	-210.0 c	18m									Save Location
req Ref t Std Accy											Change Type
	19.000 G	Hz			Center 19 Span 1.0	9.500 GHz 000 GHz			2	0.000 GHz	Setup/JPEG/
Freq		Α	mplitude		:	Span			BW		Marker

Figure 3.1-5 (G) Spectrum Photos 19-20 GHz 1MHz Res BW Vertical Pol Worst Case

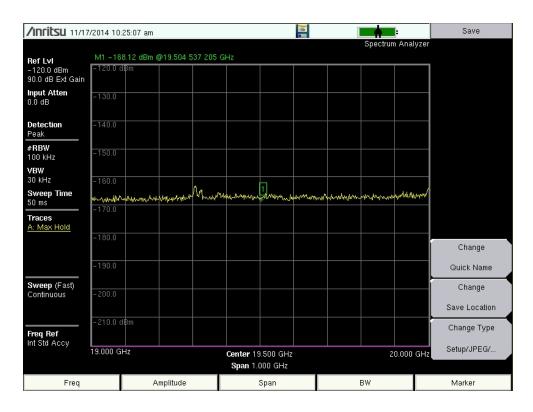


Figure 3.1-5 (H) Spectrum Photos 19-20 GHz 100 KHz Res BW Vertical Pol Worst Case

/Inritsu 11/17	/2014 09:	18:08 am						]	4	•	Save
Ref Lvl			@20.504 5	37 205 (	GHz				Spectrun	1 Analyzer	
-120.0 dBm 10.0 dB Ext Gain	-120.0 d	Bm									
nput Atten 1.0 dB	-130.0										
<b>Detection</b> Peak	-140.0										
RBW MHz	-150.0					1 .					
<b>/BW</b> 100 kHz	160.0	vorybrity.html	erninaly min	~~~~~	www.	annyuhunna	Maprovale	www.	www	mappedlaggy	
Sweep Time 10 ms	-170.0										
<b>Fraces</b> A: Max Hold											
	-180.0										Change
	-190.0										Quick Name
weep (Fast) ontinuous	-200.0										Change
											Save Location
req Ref nt Std Accy	-210.0 d	₿m									Change Type
	20.000 GI	Hz			Center 20 Span 1.0				2	1.000 GHz	Setup/JPEG/
Freq		ρ	mplitude		:	Span			BW		Marker

Figure 3.1-6 (A) Spectrum Photos 20-21 GHz 1MHz Res BW Horizontal Pol  $360^{\circ}$ 

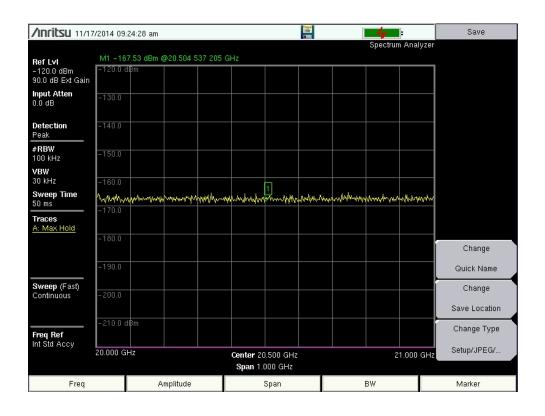
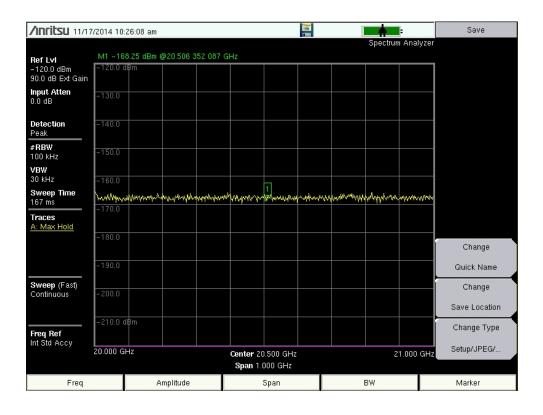


Figure 3.1-6 (B) Spectrum Photos 20-21 GHz 100 KHz Res BW Horizontal Pol 360<sup>0</sup>

/Inritsu 11/17	/2014 09:	34:04 am						[	-	ŀ.	Save
<b>Ref Lvi</b> -120.0 dBm 90.0 dB Ext Gain	M1 -15 -120.0 d	7.93 dBm ( Bm	@19.508 1	66 969	GHz				Spectrun	n Analyzer	
90.0 dB Ext Gain Input Atten 0.0 dB	-130.0										
Detection Peak	-140.0										
<b>#RBW</b> 1 MHz	-150.0					1					
<b>VBW</b> 300 kHz	-160.0	mand	mm	www	whappen Jorga	KANA MANANANA	huthaan	antronational	hallower	Minidan	
Sweep Time 50 ms Traces	-170.0										
<u>A: Max Hold</u>	-180.0										Change
	-190.0										Quick Name
<b>Sweep</b> (Fast) Continuous	-200.0										Change Save Location
Freq Ref Int Std Accy	-210.0 d										Change Type
	19.000 G	Hz				9.500 GHz 000 GHz			2	0.000 GHz	Setup/JPEG/
Freq		А	mplitude			Span			BW		Marker

Figure 3.1-6 (C) Spectrum Photos 20-21 GHz 1 MHz Res BW Horizontal Pol Worst Case



/Inritsu 11/17	/2014 10:	:06:34 am						[		:	Save
<b>Ref Lvi</b> -120.0 dBm	M1 -15 -120.0 d	8.08 dBm ( 18m	@20.515 4	26 497 0	iHz				Spectrum	Analyzer	
90.0 dB Ext Gain Input Atten 0.0 dB	-130.0										
Detection Peak	-140.0										
<b>#RBW</b> 1 MHz	-150.0					1					
<b>VBW</b> 300 kHz	-160.0	hornorth	den why why	humu	man	www.	magnili	mmun	Manpapart	NHWAN	
Sweep Time 50 ms Traces <u>A: Max Hold</u>	-170.0										
	-180.0										Change
	-190.0										Quick Name
Sweep (Fast) Continuous	-200.0										Change Save Location
Freq Ref Int Std Accy	-210.0 c										Change Type
	20.000 G	Hz			Center 20 Span 1.0				2	1.000 GHz	Setup/JPEG/
Freq		A	mplitude			Span			BW		Marker

Figure 3.1-6 (E) Spectrum Photos 20-21 GHz 1MHz Res BW Vertical Pol 360<sup>0</sup>

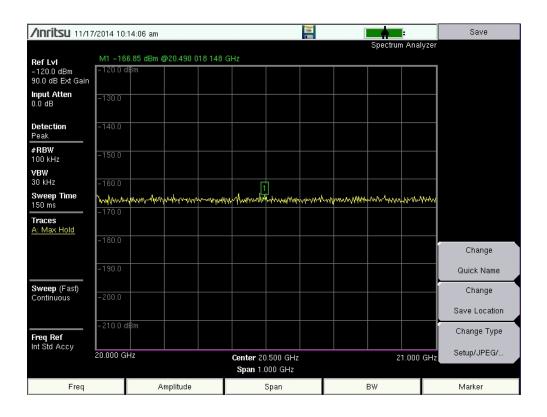
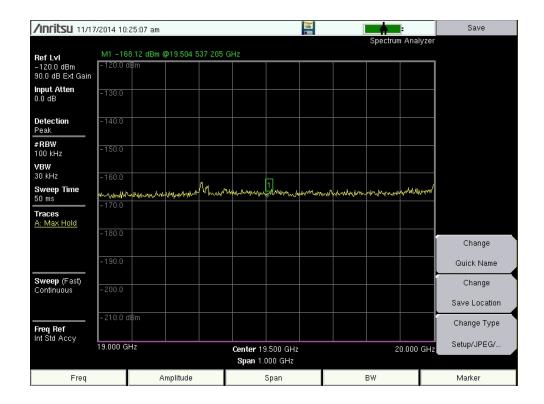
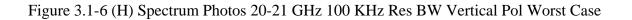


Figure 3.1-6 (F) Spectrum Photos 20-21 GHz 100 KHz Res BW Vertical Pol  $360^{0}$ 

<b>/Inritsu</b> 11/17	/2014 10:	21:56 am						[		:	Save
Ref Lvl	M1 -15	8.09 dBm (	20.509 9	81 851 G	iHz				Spectrum	Analyzer	
–120.0 dBm 90.0 dB Ext Gain	- 120.0 t	10 III									
Input Atten 0.0 dB	-130.0										
Detection Peak	-140.0										
#RBW 1 MHz	-150.0					1					
<b>VBW</b> 300 kHz	-160.0	NWWWWWWW	maylimanitad	Manath	aparter and	shr.hwly	www.ww	mpananth	NAMANAN	w Mangrow	
Sweep Time 50 ms	-170.0										
Traces <u>A: Max Hold</u>											
	-180.0										Change
	-190.0										Quick Name
Sweep (Fast) Continuous	-200.0										Change
											Save Location
Freq Ref Int Std Accy	-210.0 d	18m									Change Type
	20.000 G	Hz			Center 20 Span 1.0				2	1.000 GHz	Setup/JPEG/
Freq		A	mplitude			Span			BW		Marker

Figure 3.1-6 (G) Spectrum Photos 20-21 GHz 1MHz Res BW Vertical Pol Worst Case





	7/2014 10:	30:51 am						[	•	=	Save
Ref Lvl			@27.500 G	iHz					Spectrum	ı Analyzer	
-120.0 dBm 90.0 dB Ext Gain	-120.0 d	Bm									
<b>Input Atten</b> 0.0 dB	-130.0										
Detection Peak	-140.0										
<b>≭RBW</b> IMHz	-150.0					 1					
<b>√BW</b> 300 kHz	-160.0	manner	wander hallprover	www.	yn argydradd	or ward down	Murphip	N-Malyland	Mayan	www.www	
Sweep Time 50 ms	-170.0										
Traces A: Max Hold	-180.0										
	-100.0										Change
	-190.0										Quick Name
Sweep (Fast) Continuous	-200.0										Change
	-210.0 d	IBm									Save Location
F <b>req Ref</b> nt Std Accy											Change Type
	27.000 G	Hz			Center 27 Span 1.0	7.500 GHz 000 GHz			2	8.000 GHz	Setup/JPEG/
Freq		A	mplitude			Span			BW		Marker

Figure 3.1-7 (A) Spectrum Photos 27-28 GHz 1MHz Res BW Horizontal Pol  $360^{\circ}$ 

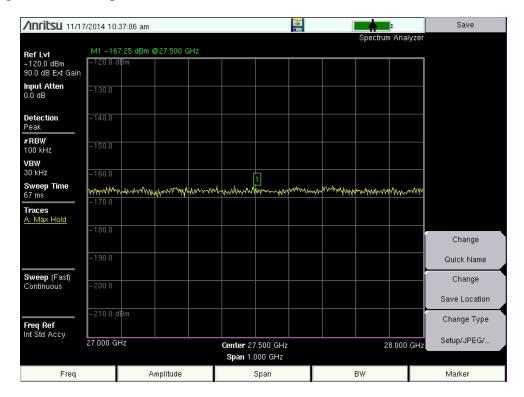


Figure 3.1-7 (B) Spectrum Photos 27-28 GHz 100 KHz Res BW Horizontal Pol 360<sup>0</sup>

/Inritsu 11/17	/2014 10:	45:06 am						[	•	ŀ	Save
Ref LvI		9.12 dBm (	@27.500 G	iHz					Spectrur	n Analyzer	
-120.0 dBm 90.0 dB Ext Gain	-120.0 c	IBM									
Input Atten 0.0 dB	-130.0										
Detection Peak	-140.0										
<b>#RBW</b> 1 MHz	-150.0										
<b>VBW</b> 300 kHz	<b>Նիչուս~~^</b> −160.0	myshinks	Murrand of	would	happortuga-	the Wanter	many	www.	handhain	Howard	
Sweep Time 67 ms	-170.0										
Traces A: Max Hold											
	-180.0										Change
	-190.0										Quick Name
Sweep (Fast) Continuous	-200.0									——İ	Change
											Save Location
Freq Ref Int Std Accy	-210.0 c	I₿m									Change Type
	27.000 G	Hz			Center 2 Span 1.	7.500 GHz 000 GHz	: 		2	8.000 GHz	Setup/JPEG/
Freq		A	mplitude			Span			BW		Marker

Figure 3.1-7 (C) Spectrum Photos 27-28 GHz 1MHz Res BW Vertical Pol 360<sup>0</sup>

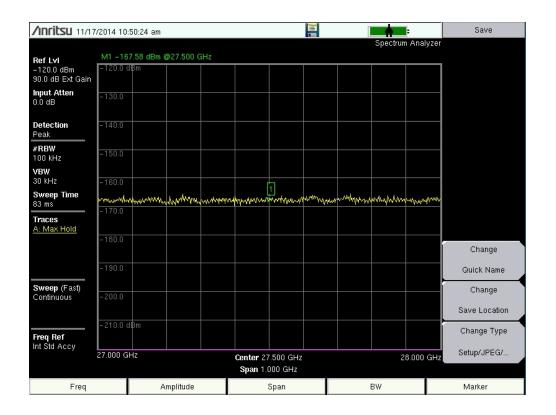


Figure 3.1-7 (D) Spectrum Photos 27-28 GHz 100 KHz Res BW Vertical Pol 360<sup>0</sup>

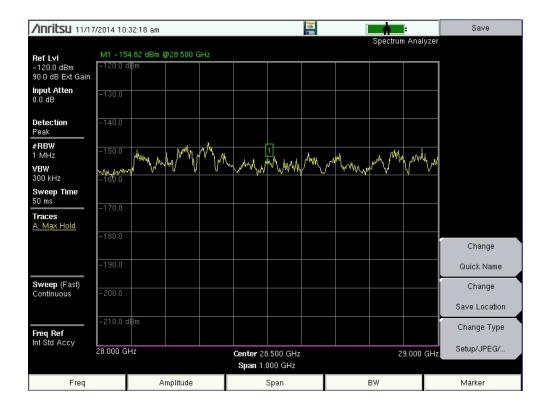


Figure 3.1-8 (A) Spectrum Photos 28-29 GHz 1MHz Res BW Horizontal Pol 360<sup>0</sup>

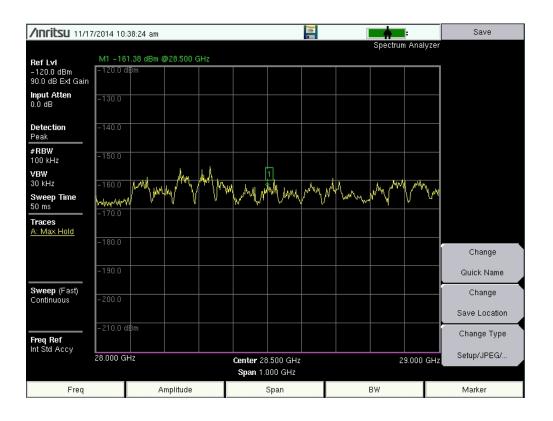


Figure 3.1-8 (B) Spectrum Photos 28-29 GHz 100 KHz Res BW Horizontal Pol 360<sup>0</sup>

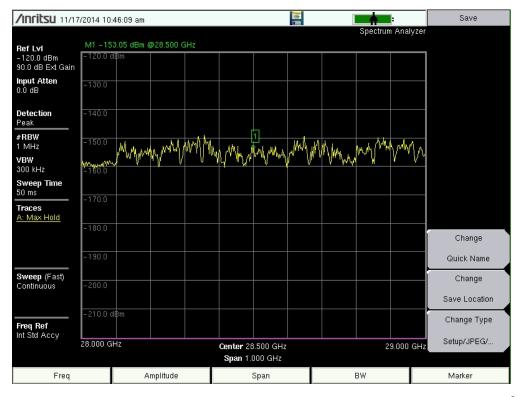


Figure 3.1-8 (C) Spectrum Photos 28-29 GHz 1MHz Res BW Vertical Pol 360<sup>0</sup>

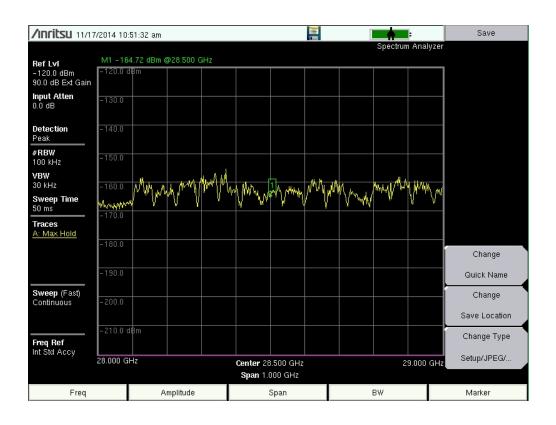


Figure 3.1-8 (D) Spectrum Photos 28-29 GHz 100 KHz Res BW Vertical Pol 360<sup>0</sup>

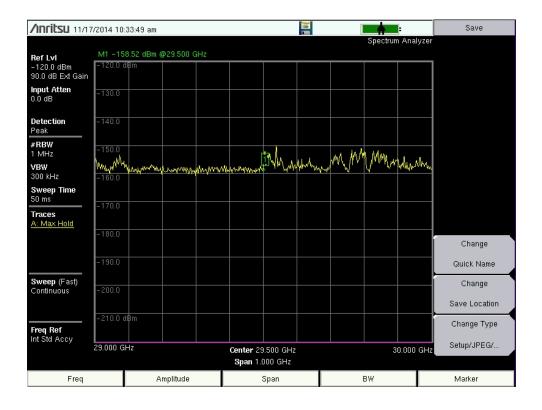


Figure 3.1-9 (A) Spectrum Photos 29-30 GHz 1MHz Res BW Horizontal Pol 360<sup>0</sup>

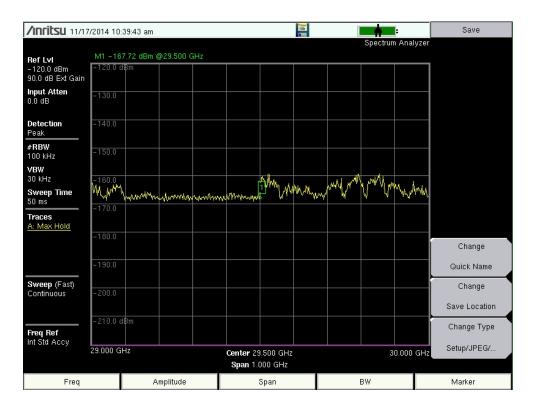


Figure 3.1-9 (B) Spectrum Photos 29-30 GHz 100 KHz Res BW Horizontal Pol 360<sup>0</sup>

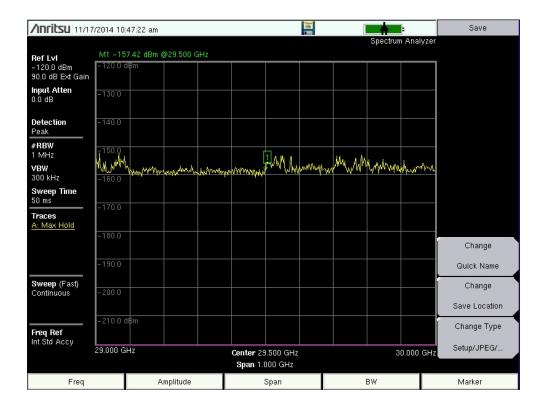


Figure 3.1-9 (C) Spectrum Photos 29-30 GHz 1MHz Res BW Vertical Pol 360<sup>0</sup>

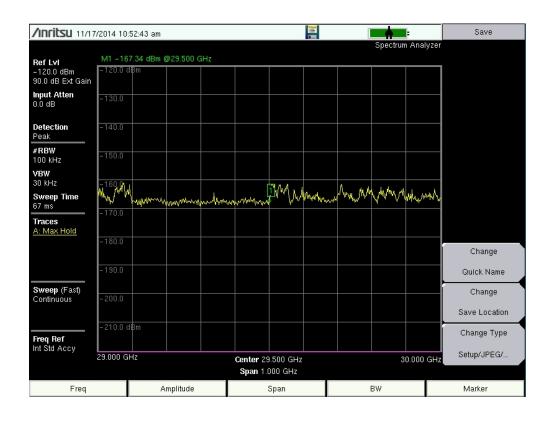


Figure 3.1-9 (D) Spectrum Photos 29-30 GHz 100 KHz Res BW Vertical Pol 360<sup>0</sup>

/Inritsu 11/17	//2014 10:	35:08 am						[	-	l.	Save
<b>Ref Lvi</b> -120.0 dBm 90.0 dB Ext Gain	M1 -15	7.86 dBm ( 18m	@30.500 G	iHz					Spectrun	n Analyzer	
Input Atten 0.0 dB	-130.0										
Detection Peak	-140.0										
#RBW 1 MHz	-150.0										
<b>VBW</b> 300 kHz	-160.0	horymportung	Nep Mary	wywyn	mmmun	mmul w	potent and a post	er-alegenza	Minterprotection	NUMAN AND	
Sweep Time 50 ms	-170.0										
Traces A: Max Hold											
	-180.0										Change
	-190.0										Quick Name
Sweep (Fast) Continuous	-200.0										Change
	-210.0 c	IBm									Save Location Change Type
Freq Ref Int Std Accy	30.000 G	H7			0					1 000 011-	Satur/IREG/
						0.500 GHz 000 GHz			3	1.000 GHz	
Freq		A	mplitude			Span			BW		Marker

Figure 3.1-10 (A) Spectrum Photos 30-31 GHz 1MHz Res BW Horizontal Pol  $360^{\circ}$ 

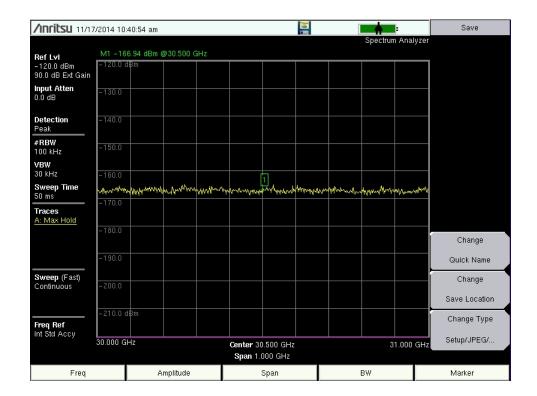


Figure 3.1-10 (B) Spectrum Photos 30-31 GHz 100 KHz Res BW Horizontal Pol 360<sup>0</sup>

/Inritsu 11/17	/2014 10>	48:46 am						[	•	ŧ.	Save
<b>Ref Lvi</b> -120.0 dBm	M1 - 150		@30.500 (	GHz					Spectrur	n Analyzer	
90.0 dB Ext Gain											
<b>Input Atten</b> 0.0 dB	-130.0										
<b>Detection</b> Peak	-140.0										
<b>#RBW</b> 1 MHz	-150.0					 1					
<b>VBW</b> 300 kHz	<b>↓~~~//↓</b> −160.0	www.ww	manyah	www.www.ww	MANA	ar when her	Mann	whenperform	konorina	Muhan	
Sweep Time 50 ms	-170.0										
<b>Traces</b> A: Max Hold											
	-180.0										Change
	-190.0										Quick Name
<b>Sweep</b> (Fast) Continuous	-200.0										Change
continuous	200.0										Save Location
Freq Ref	-210.0 d	Bm									Change Type
Int Std Accy	30.000 GI	Hz			Center 30 Span 1.	L ).500 GHz 000 GHz			3	1.000 GHz	Setup/JPEG/
Freq		ρ	mplitude			Span			BW		Marker

Figure 3.1-10 (C) Spectrum Photos 30-31 GHz 1 GHz Res BW Vertical Pol 360<sup>0</sup>

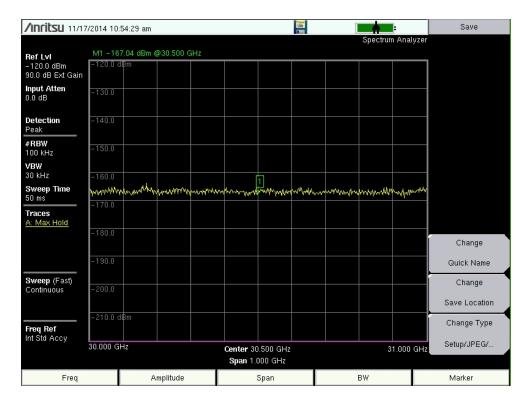


Figure 3.1-10 (D) Spectrum Photos 30-31 GHz 100 KHz Res BW Vertical Pol  $360^{\circ}$ 

FOUR

## **SUMMARY OF RESULTS**

The results of the measurements conducted at the proposed ViaSat, Inc site in Albuquerque, NM are presented in this section.

#### Arc Clearance:

There is no potential satellite arc blockage at this site. Final arc clearance will depend on antenna placement.

## **Ka-Band Measurements:**

There was six (6) radio frequency interference cases measured at this site above the noise floor of the test equipment. Fifteen (15) cases were predicted but only six (6) were observed during the measurement period (See Addendum 1).

**FIVE** 

#### **CONCLUSIONS AND RECOMMENDATIONS**

#### 5.1 <u>Conclusions</u>

There were signals measured above the -156 dBW/ 1 MHz interference objective for digital reception at this site. Please see ADDENDUM 1 for detail on the cases as seen.

The satellite arc has no potential blockage from 55W through 115W.

#### 5.2 <u>Recommendations</u>

•

ViaSat, Inc should review the system parameters for this down-link in order to verify the viability of this objective. It is recommended that frequency coordination of this site be initiated to protect this location at the more stringent digital receive interference objective.

#### **ADDENDUM 1**

## **INTRODUCTION AND BACKGROUND**

## A1.1 Introduction

Based on the Detailed Interference Analysis Report conducted by Comsearch Engineering there were cases that could not be cleared by the analysis and were specifically tested in the field during the On-Site Radio Frequency Interference (RFI) measurement. Below is the result of that On-Site measurement.

#### The results in this report is based upon the following:

- The Analysis was unable to clear 6 of 15 cases of possible interference conflicts
- Satellite Arc: 55 to 115 Degrees West Longitude
- Frequency Range Considered: 17 to 21 GHz
- Interference Objective: -156 dBW/1 MHz
- Type of Reception: Digital
- Measured Antenna Center Line: 6.5 Feet Above Ground Level

## A1.2 Background

Based on actual On-Site measurements at the Albuquerque ViaSat location of the 15 possible interference cases there were five (5) signals detected of known licensed broadcasts in the Receive bands. This Addendum contains the spectral photo of the received carrier as well as the direction and possible transmit site for each.

There was also one signal detected from an unknown source apparently transmitting from an adjacent building just outside the proposed arc, at approximately 222<sup>0</sup>. Photos are shown below in Figures A1.2.1- A1.2.6. The licensed site name is in parenthesis after the figure number.

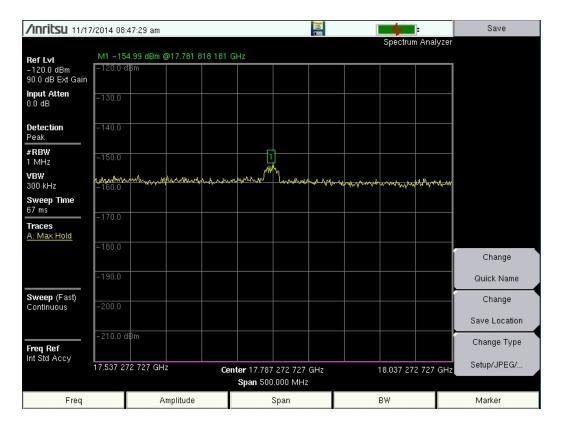


FIGURE A1.2.1-A (4 – Crest Site)



FIGURE A1.2.1-B (4 – Crest Site)

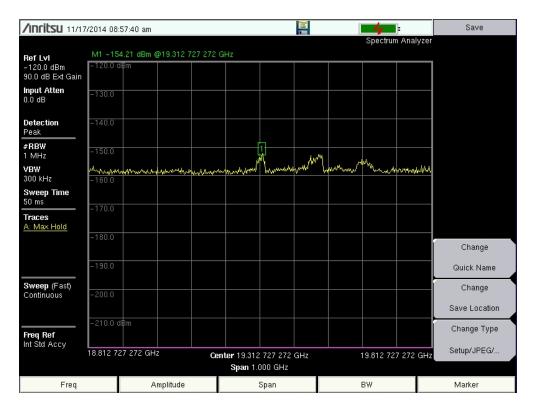


FIGURE A1.2.2-A (13 – CO)



**FIGURE A1.2.2-B** (13 – CO)

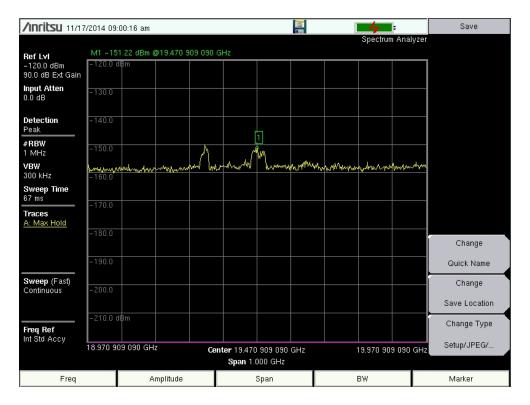


FIGURE A1.2.3-A (23 – Sandia Cres)



FIGURE A1.2.3-B (23 – Sandia Cres)

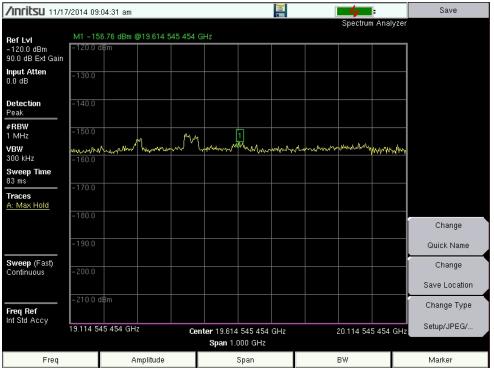


FIGURE A1.2.4-A (Unknown)



FIGURE A1.2.4-B (Unknown)

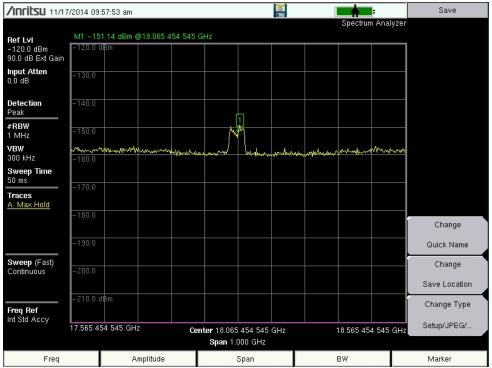


FIGURE A1.2.5-A (5-Sandia Crest)



FIGURE A1.2.5-B (5 – Sandia Crest)

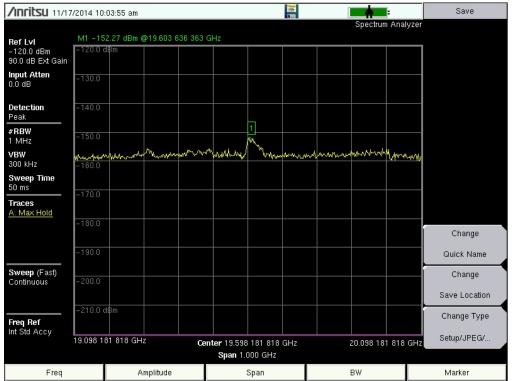


FIGURE A1.2.6-A (21-ABQCOORS)



FIGURE A1.2.6-B (21-ABQCOORS)