



# **MICROWAVE PATH SURVEY REPORT**

# RADIO FREQUENCY INTERFERENCE (RFI) MEASUREMENT REPORT

**Prepared For** 

ViaSat

Milwaukee (Dousman), WI

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

April 27, 2015

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**ONE** 

## **INTRODUCTION AND BACKGROUND**

### **1.1 Introduction**

On-site Radio Frequency interference (RFI) measurements were performed on behalf of ViaSat, Inc. on April 27, 2015, at their proposed site in Milwaukee (Dousman), WI. 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:

- Andrew 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 a new location of 43° 00' 52.3" N 088° 27' 58.7" 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. A photo of the surrounding cellular/PCS coverage is shown in Figure 1.2-4.

## **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 1.2-3 – GPS Photograph



TWO

### **TEST PROCEDURE**

### 2.1 Calibration

Where:

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 such that the top graticule of the spectrum analyzer display (-60 dBm) corresponded to the injected reference signal (-60 dBm) by utilizing the reference level offset function of the Anritsu –M52720T spectrum analyzer. Upon completion of the calibration process, a known reference level was obtained for the measured in 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:

 $dBW_I = LI - GA - 30$  $dBW_I = Isotropic level in dBW$ 

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 this measurement.



## **Test Set Equipment Diagram**

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

/Inritsu 04/27	7/2015 07:10:23	am				- 4	7	Save
Ref Lvl	M1 -120.79 d	Bm @17.500 G	Hz			Spe	ectrum Analyzer	
-120.0 dBm 90.0 dB Ext Gain	–120.0 dBm			1				
Input Atten 0.0 dB	-130.0							
Detection Peak	-140.0							
#RBW 1 MHz	-150.0	a y	2		10.00		6 70260	
<b>VBW</b> 300 kHz	-160.0	Annan Marthan Marthan	have an offered a	added and the shower of	takata ana ang pang pang pang pang pang pang	and the second	and and a second and	
Sweep Time 50 ms	-170.0							
Traces A: Max Hold	-180.0		*		· · · · ·			
	-190.0							Change
	-200.0				s			Quick Name
Sweep (Fast) Continuous								Change
	-210.0 dBm							Save Location
Freq Ref Int Std Accy	17.000 GHz		C	<b>Center 1</b> 7.500 GHz <b>Span</b> 1.000 GHz			18.000 GHz	Change Type
G:	Mkr Ref D	elta Ref	X	Ref Y	Delta	аX	Delta Y	Setup/JPEG/
Freq		Amplitude	GHZ	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

/Inritsu 04/27	7/2015 07:12	:26 am				4	Save
Ref Lvl	M1 -119.8	15 dBm @	19.500 GHz			Spectrum Analyze	r
–120.0 dBm 90.0 dB Ext Gain	–120.0 dBr	0.		1			
Input Atten 0.0 dB	=130.0						
<b>Detection</b> Peak	-140.0						
<b>#RBW</b> 1 MHz	-150.0				-13.4 A		
<b>VBW</b> 300 kHz	-160.0	Water-militer	Martin Martin Martin	halle dhallenader, wik prosisi oo wood	and many deriver a	abientine of the second second second	
Sweep Time 50 ms	-170.0						
Traces A: Max Hold	-180.0						
	-190.0					8	Change
	-200.0					8 8 S	Quick Name
<b>Sweep</b> (Fast) Continuous	-210.0 dBr	n					Change
							Save Location
Freq Ref	19.000 GHz			Center 19.500 GHz		20.000 GH:	Change Type
Int Std Accy	Mkr Ref	Delta	Ref X	Ref Y	Delta X	Delta Y	Setup/JPEG/
	1 ON	OFF	19.500 GHz	-119.85 dBm			
Freq		Am	nplitude	Span		BW	Marker





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

/Inritsu 04/27	//2015/07:14:13	7 am						4	)	Save
Ref Lvl	M1 -121.48	dBm @27.5	i00 GHz					Spectrum	1 Analyzer	
–120.0 dBm 90.0 dB Ext Gain	–120.0 dBm				1					
Input Atten 0.0 dB	-130.0									
Detection Peak	-140.0							8 8		
#RBW 1 MHz	-150.0		ona - 20							
<b>VBW</b> 300 kHz	JE 74819.944444	chlman have	hanner flagery	www.	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	ky warder of	w <sup>all</sup> an water	www.	horentente	
Sweep Time 67 ms	-170.0									
Traces A: Max Hold	-180.0							<u>e</u>	<u>~</u>	
	-190.0							<u></u>		Change
	-200.0							8 8		Quick Name
Sweep (Fast) Continuous								5		Change
	-210.0 aBM									Save Location
Freq Ref	27.000 GHz			Center 27	7.500 GHz			2	8.000 GHz	Change Type
Int Std Accy	Mkr Dof	Dolto		Span 1.	000 GHz	Dal	to V	De	to V	Setup/JPEG/
	1 ON	OFF 2	7.500 GHz	-121.4	48 dBm	Dei		Dei		
Freq		Amplitu	ıde		Span		1	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 04/23	7/2015 07:16	i:26 am					4	:	Save
Ref Lvl	M1 -122.1	10 dBm @	29.500 GHz				Spectrum	Analyzer	
–120.0 dBm 90.0 dB Ext Gain	–120.0 dBr			¢ []					
Input Atten 0.0 dB	-130.0								
Detection Peak	-140.0								
#RBW 1 MHz	-150.0				harmak			alı ıßı	
<b>VBW</b> 300 kHz	-160.0	******	*A-m/mAMm+	and and an	AV MAL ~ 4	KANA WANA ANA A	s-sala-pe-paper-	and all a second s	
Sweep Time 67 ms	-170.0								
Traces A: Max Hold	-180.0						2 2 		
	-190.0								Change
	-200.0								Quick Name
<b>Sweep</b> (Fast) Continuous	–210.0 dBr	n							Change Save Location
Freq Ref	29.000 GHz			Center 29.500 GHz			31	0.000 GHz	Change Type
Int Std Accy	Mkr Ref	Delta	Ref X	Ref Y	E	elta X	Del	ta Y	Setup/JPEG/
	1 ON	OFF	29.500 GHz	-122.10 dBm					
Freq		Am	nplitude	Span		1	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 Milwaukee (Dousman), WI

- 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:	Milwaukee (Dousman), WI	
3.	SITE IDENTIFICATION:	Milwaukee	
4.	COORDINATES: (NAD 1983)	LATITUDE: 43° 00' 52.3" N LONGITUDE: 088° 27' 58.7" W	
5.	GROUND ELEVATION:	871.6 feet AMSL	
6.	MEASUREMENT DATE AND TIMES:	April 27, 2015	
7.	GEOSTATIONARY ARC RANGE: SATELLITE POSITIONS: AZIMUTH: ELEVATION:	55W – 115W 135.9° – 216.2° 30.1° / 33.6°	
8.	GEOSTATIONARY ARC VISIBILITY:	Satellite arc has no blockage at this tin	ne



North



East

Figure 3.1-1 Earth Station Site Photographs



South



West

Figure 3.1-1 (cont.) Earth Station Site Photographs





Figure 3.1-2 Horizon Photographs of Earth Station Site





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

/INFILSU 04/27	/2015 07:44:58 am				4		Save
Ref I vi	M1 -157.84 dBm @	017.500 907 441	GHz		Spectrum Ar	nalyzer	
-120.0 dBm 90.0 dB Ext Gain	–120.0 dBm						
<b>Input Atten</b> 0.0 dB	-130.0				5		
Detection Peak	-140.0				60 C		
# <b>RBW</b> 1 MHz	-150.0		1				
<b>VBW</b> 300 kHz	-160.0	-padatapatratantar	wand for the work	when we wanted the second	m. www.www.	M-4A	
Sweep Time 50 ms	-170.0				5 di		
Traces A: Max Hold	180.0				a 5		
	- 100.0						Change
	-190.0						Quick Name
<b>Sweep</b> (Fast) Continuous	-200.0						Change Save Location
Freq Ref Int Std Accv	–210.0 dBm						Change Type
	17.000 GHz		<b>Center</b> 17.500 GF <b>Span</b> 1.000 GHz	Z	18.00	00 GHz	Setup/JPEG/
Freq	A	mplitude	Span		BW		Marker





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



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



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



Figure 3.1-3 (E) Spectrum Photos 17-18 GHz 1MHz Res BW Vertical Pol 360<sup>0</sup>

<b>/INFITSU</b> 04/27	//2015 08:21:33 am		4	Save
Ref Lvl	M1 -167.71 dBm @17.497 27	7 676 GHz	Spectrum Analyzer	
-120.0 dBm 90.0 dB Ext Gain	-120.0 dBm			
Input Atten 0.0 dB	-130.0			
Detection Peak	-140.0			
<b>#RBW</b> 100 kHz	-150.0			
<b>VBW</b> 30 kHz	-160.0			
Sweep Time 50 ms	-Widgemarkharkanangeneralisen -170.0	when have proved and the second and	the when we and the second second	
Traces <u>A: Max Hold</u>	-180.0			
				Change
<b>D</b>	-190.0			Quick Name
Sweep (Fast) Continuous	-200.0			Change Save Location
Freq Ref Int Std Accy	-210.0 dBm			Change Type
	17.000 GHz	<b>Center</b> 17.500 GHz <b>Span</b> 1.000 GHz	18.000 GHz	Setup/JPEG/
Freq	Amplitude	Span	BW	Marker

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



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



Figure 3.1-3 (H) Spectrum Photos 17-18 GHz 100 kHz Res BW Vertical Pol Worst Case



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



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



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



## Figure 3.1-5 (A) Spectrum Photos 19-20 GHz 1MHz Res BW Horizontal Pol 360<sup>0</sup>



Figure 3.1-5 (B) Spectrum Photos 19-20 GHz 100 kHz Res BW Horizontal Pol 360<sup>0</sup>



Figure 3.1-5 (C) Spectrum Photos 19-20 GHz 1MHz 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<sup>0</sup>



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



Figure 3.1-5 (G) Spectrum Photos 19-20 GHz 1 MHz 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 04/27	'/2015 07:48:48 am		4	Save
Ref I vi	M1 -157.71 dBm @20.513 611 615	5 GHz	Spectrum Analyzer	
-120.0 dBm 90.0 dB Ext Gain	-120.0 dBm			
Input Atten 0.0 dB	-130.0			
Detection Peak	-140.0			
#RBW 1 MHz	-150.0			
<b>VBW</b> 300 kHz	Jungunni linnind unight Male	where we are an and the second state of the se	Mandaland	
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 dBm			Change Type
	20.000 GHz	Center 20.500 GHz Span 1.000 GHz	21.000 GHz	Setup/JPEG/
Freq	Amplitude	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  $360^{\circ}$ 



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



Figure 3.1-6 (D) Spectrum Photos 20-21 GHz 100 kHz Res BW Horizontal Pol Worst Case

/Inritsu 04/27	/2015 08:16:21 am		-4	Save
Ref Lvl	M1 -160.15 dBm @20.497 277 67	3 GHz	Spectrum Ana	alyzer
-120.0 dBm 90.0 dB Ext Gain	–120.0 dBm			
Input Atten 0.0 dB	-130.0			
Detection Peak	-140.0			
#RBW 1 MHz	-150.0			
<b>VBW</b> 300 kHz	multipling man man man man and the second	why apple of the apply provide a provide the second	mthemanalantikanaan	Herbow
Sweep Time 67 ms	-170.0			_
Traces A: Max Hold	190.0			
	- 160.0			Change
	-190.0			Quick Name
<b>Sweep</b> (Fast) Continuous	-200.0			Change Save Location
Freq Ref Int Std Accy	-210.0 dBm			Change Type Setun(JPEG/
	20.000 GH2	<b>Center</b> 20.500 GHz <b>Span</b> 1.000 GHz	21.000	GHz
Freq	Amplitude	Span	BW	Marker

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

/Inritsu 04/27	7/2015 08:18:06 am		4	Save
Refivi	M1 -167.26 dBm @20.497 277 67	'6 GHz	Spectrum Analyzer	
-120.0 dBm 90.0 dB Ext Gain	−120.0 d₿m			
Input Atten 0.0 dB	-130.0			
Detection Peak	-140.0		C. G. C C	
<b>#RBW</b> 100 kHz	-150.0			
<b>VBW</b> 30 kHz	-160.0			
Sweep Time 167 ms	-170.0	mmultimetrometrom	manymana	
Traces <u>A: Max Hold</u>	100.0			
	-180.0			Change
	-190.0			Quick Name
<b>Sweep</b> (Fast) Continuous	-200.0			Change Save Location
Freq Ref Int Std Accy	-210.0 d8m			Change Type
	20.000 GHZ	Center 20.500 GHz Span 1.000 GHz	21.000 GHz	detup/or Edr
Freq	Amplitude	Span	BW	Marker

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

/Inritsu 04/27	7/2015 08:29:04	am			-4:	Save
Ref Lvi	M1 -159.58 dl	3m @20.517 241 379	) GHz		Spectrum An	alyzer
-120.0 dBm 90.0 dB Ext Gain	–120.0 dBm					
Input Atten 0.0 dB	-130.0					
<b>Detection</b> Peak	-140.0					
# <b>RBW</b> 1 MHz	-150.0			<u> </u>	<u> </u>	
<b>VBW</b> 300 kHz	-160.0	hele water and	manghalange	un hanna an	-paper proportion of	arana ka
Sweep Time 50 ms	2170.0					
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	-210.0 dBm					Change Type
Int Stu Acty	20.000 GHz		<b>Center</b> 20.500 GH <b>Span</b> 1.000 <u>GHz</u>	Z	21.00	0 GHz Setup/JPEG/
Freq		Amplitude	Span		BW	Marker

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



Figure 3.1-6 (H) Spectrum Photos 20-21 GHz 100 kHz Res BW Vertical Pol Worst Case



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



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



Figure 3.1-7 (C) Spectrum Photos 27-28 GHz 1MHz Res BW Vertical Pol  $\overline{360^0}$ 

/Inritsu 04/27	7/2015 08:57:49 am			Save
Ref I vl	M1 -168.34 dBm @27.500 907 441	GHz	Spectrum Analyzer	
-120.0 dBm 90.0 dB Ext Gain	-120.0 dBm			
Input Atten 0.0 dB	-130.0			
Detection Peak	-140.0			
#RBW 100 kHz	-150.0			
<b>VBW</b> 30 kHz	-160.0			
Sweep Time 50 ms	-170.0	en management and more	an annan an anna anna anna anna anna a	
Traces <u>A: Max Hold</u>	-180.0			
	100.0			Change
	-190.0			Quick Name
<b>Sweep</b> (Fast) Continuous	-200.0			Change Save Location
Freq Ref Int Std Accy	-210.0 dBm			Change Type
	27.000 GHZ	Center 27.500 GHz Span 1.000 GHz	28.000 GHz	Detapyor Edr
Freq	Amplitude	Span	BW	Marker

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>

/Inritsu 04/27/2015 08:53:03 am				-4		Save	
Ref Lvl	M1 -160.63 dBm @29	).508 166 969 GI	Ηz		Spectrum	Analyzer	
-120.0 dBm 90.0 dB Ext Gain	–120.0 dBm						
Input Atten 0.0 dB	-130.0				<u>.</u>		
Detection Peak	-140.0				<u>8</u> 8		
<b>#RBW</b> 1 MHz	-150.0				4 (v.		
<b>VBW</b> 300 kHz	чинурил Марика (шарана) - 160.0	have been been been been been been been be	man	mann	maplement	whereast	
Sweep Time 50 ms	-170.0		5				
Traces A: Max Hold	190.0				a 5		
	-100.0						Change
	-190.0						Quick Name
<b>Sweep</b> (Fast) Continuous	-200.0						Change Save Location
Freq Ref Int Std Accy	-210.0 dBm						Change Type
29.000 GHz Center 29.500 GHz 30.000 GHz 30.000 GHz Span 1.000 GHz							
Freq	Ampl	itude	Span		BW		Marker

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

/Inritsu 04/27	Save				
Refivi	M1 -167.16 dBm @29.515 426 49	7 GHz	Spectrum Analyzer		
-120.0 dBm 90.0 dB Ext Gain	–120.0 d₿m				
Input Atten 0.0 dB	-130.0				
<b>Detection</b> Peak	-140.0				
#RBW 100 kHz	-150.0				
<b>VBW</b> 30 kHz	-160.0				
Sweep Time 50 ms	-170.0	www.whatamanahandhahahahahahahahahahahahahahahahah	Annon management		
Traces <u>A: Max Hold</u>	190.0				
	-100.0			Change	
	-190.0			Quick Name	
<b>Sweep</b> (Fast) Continuous	-200.0			Change Save Location	
Freq Ref Int Std Accy	-210.0 dBm			Change Type	
29.000 GHz Center 29.500 GHz 30.000 GHz Span 1.000 GHz					
Freq	Amplitude	Span	BW	Marker	

Figure 3.1-9 (D) Spectrum Photos 29-30 GHz 100 kHz Res BW Vertical Pol  $360^{\circ}$ 

/inritsu 04/27/2015 08:42:18 am			-4:	Save
Ref I vi	M1 -158.41 dBm @30.480 943 738	3 GHz	Spectrum Analyzer	
-120.0 dBm 90.0 dB Ext Gain	-120.0 dBm			
Input Atten 0.0 dB	-130.0			
Detection Peak	-140.0			
#RBW 1 MHz	-150.0			
<b>VBW</b> 300 kHz	hpppharalistication and the second seco	mannamanna	Laboran management and and	
Sweep Time 50 ms	-170.0			
Traces A: Max Hold				
	-180.0			Change
	-190.0			Quick Name
Sweep (Fast) Continuous	-200.0			Change Save Location
Freq Ref	-210.0 dBm			Change Type
Int Std Accy	30.000 GHz	Setup/JPEG/		
Freq	Amplitude	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>



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

/Inritsu 04/27	Save					
Ref LvI	M1 -167.70 dBm @30.500 907 441	l GHz	Spectrum Analyzer			
–120.0 dBm 90.0 dB Ext Gain	–120.0 dBm					
Input Atten 0.0 dB	-130.0					
Detection Peak	-140.0		6			
<b>#RBW</b> 100 kHz	-150.0					
<b>VBW</b> 30 kHz	-160.0					
Sweep Time 50 ms	Hundrighan Manan Man - 170.0	under market and the superior of the second s	monorman			
Traces <u>A: Max Hold</u>	180.0					
	-100.0			Change		
	-190.0			Quick Name		
<b>Sweep</b> (Fast) Continuous	-200.0			Change Save Location		
Freq Ref Int Std Accy	–210.0 d฿m			Change Type		
30.000 GHz Center 30.500 GHz 31.000 GHz 31.000 GHz Setup 3PEG/ Span 1.000 GHz						
Freq	Amplitude	Span	BW	Marker		

Figure 3.1-10 (D) Spectrum Photos 30-31 GHz 100 kHz Res BW Vertical Pol 360<sup>0</sup>

# FOUR

## **SUMMARY OF RESULTS**

The results of the measurements conducted at the proposed ViaSat, Inc site in Minneapolis (Chaska), MN 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.

## **Ku-Band Measurements:**

There was no radio frequency interference cases measured at this site above the noise floor of the test equipment. No conflicts were projected.

**FIVE** 

## CONCLUSIONS AND RECOMMENDATIONS

## 5.1 <u>Conclusions</u>

There was no signal measured above the -156 dBW/ 1 MHz interference objective for digital reception at this site.

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

## 5.2 <u>Recommendations</u>

It is recommended that frequency coordination of this site be initiated to protect this location at the more stringent digital receive interference objective.