

## **MICROWAVE PATH SURVEY REPORT**

## RADIO FREQUENCY INTERFERENCE (RFI) MEASUREMENT REPORT

**Prepared For** 

ViaSat

Plymouth, Pennsylvania

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

### NOVEMBER 22, 25 2017

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Addendum 1 Spectral scans of known microwave paths that were not cleared during detailed interference analysis.

**ONE** 

#### **INTRODUCTION AND BACKGROUND**

#### 1.1 Introduction

On-site Radio Frequency Interference (RFI) measurements were performed on behalf of ViaSat, Inc. on OCTOBER 24, 25 2017 at their proposed site in Plymouth, Pennsylvania. 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 an existing location of  $41^{0}$  14' 45.9" N and 75<sup>0</sup> 55' 30.7" 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.

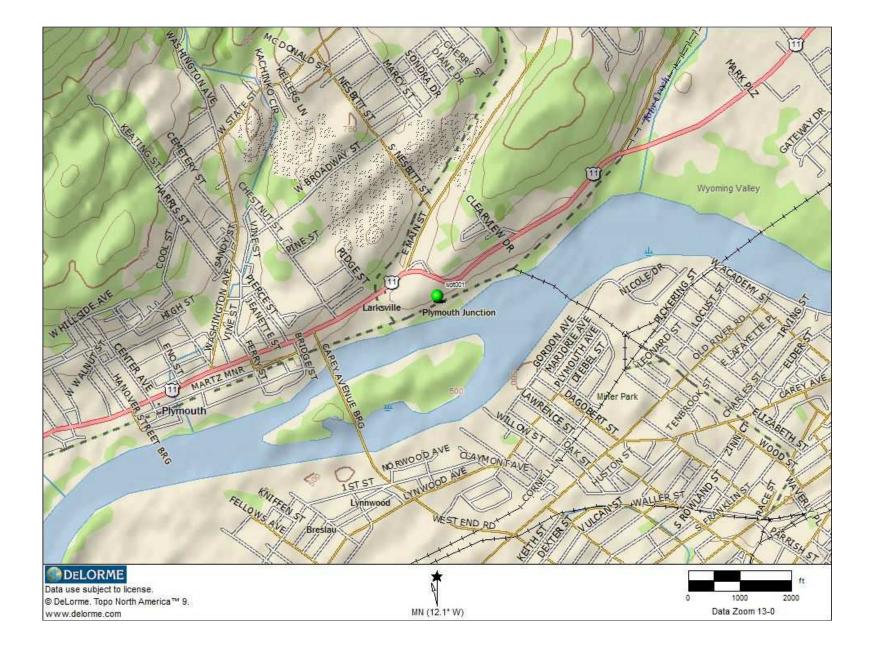


Figure 1.2-1 – Topographic Map



### 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 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:

 $dBW_I = LI - GA - 30$ 

Where:  $dBW_I = Isotropic level in dBW$ 

LI = Level (dBm) of injected signal

GA = Test antenna gain

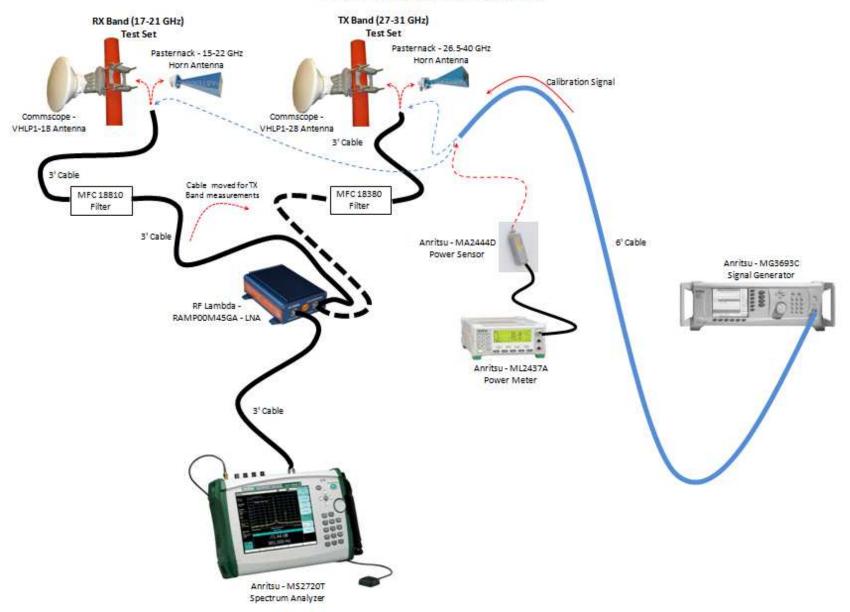
-30 =Conversion factor from dBm to dBW

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** 

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<b>Traces</b> A: Max Hold	-170.0					y z +
	-180.0					
	-190.0					Back Space
<b>Sweep</b> (Fast) Continuous	-200.0			18 E		Change Save Location
Freq Ref	-210.0 dBm					Change Type
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Freq		Amplitude	Span		BW	Marker

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

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	M1 -120.55 dBm @18.500 GHz	Spectrum Analyzer	abc
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<b>Input Atten</b> D.0 dB	-130.0	8 <u> </u>	g hi j k l
Detection <sup>J</sup> eak	-140.0		j Ki m n o
<b>#RBW</b> 1 MHz	-150.0		pqr
<b>VBW</b> 300 kHz	un manuna manung mana manun burner and and	mudruhamanananana	stu
<b>Sweep Time</b> B3 ms			vwx
<b>Traces</b> A: Max Hold	-170.0		y z +
	-180.0		
25	-190.0		Back Space
<b>Sweep</b> (Fast) Continuous	-200.0		Change Save Location
F <b>req Ref</b> nt Std Accy	-210.0 d&m		Change Type
3	18.000 GHz Center 18.500 GHz Span 1.000 GHz	19.000 GHz	Setup/JPEG/.
Freq	Amplitude Span	BW	Marker

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

Freq	Amp	litude	Span		BW	Marker
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req Ref nt Std Accy	-210.0 aBm					Change Type
ontinuous	-200.0 -210.0 dBm					Save Location
weep (Fast)						Change
	-190.0			~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		Back Space
Max Hold	-180.0					<b></b>
races	-170.0					y z +
w <b>eep Time</b> 3 ms	170.0					vwx
<b>BW</b> 00 kHz	-160.0	- 4 M 4- 11				
MHz	-150.0	nothinghand	have and the second	myshipphanon	Mun manufacture	Access(0)
eak RBW						– pqr
etection	-140.0				c	mno
.0 dB	-130.0					jkl
0.0 dB Ext Gain nput Atten						ghi
<b>8ef L∨I</b> ∙120.0 dBm	-120.0 dBm		ĥ	<u> </u>		def
	M1 -119.54 dBm @1	9.500 GHz			Spectrum Analyze	abc
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Figure 2.1-2 (C) Calibration Spectrum Photo 19.5 GHz

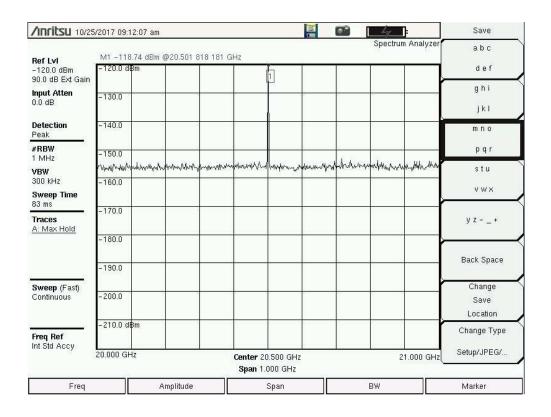


Figure 2.1-2 (D) Calibration Spectrum Photo 20.5 GHz

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Continuous	-200.0 -210.0 dBm					2			Save Location
Sweep (Fast)									Change
	-190.0	3				~			Back Space
A: Max Hold	-180.0	<u> </u>				č			-
races	-170.0								y z +
<b>Sweep Time</b> 13 ms								-	vwx
<b>/BW</b> 100 kHz	ничичничичнични -160.0	where where we wanted	with when the work	Muranw	enterland the second	ent_apph/1014	WYHHENY WHEN	math when we are	stu
RBW MHz	-150.0	<u>.</u>	. 3						pqr
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).0 dB	-130.0								j k l
10.0 dB Ext Gain Input Atten				1				^	ghi
<b>RefL∨l</b> -120.0 dBm	-120.0 dBm			4					def
	M1 -122.34 dBm	@27 500 GH:					Spectrur	n Analyzer	abc
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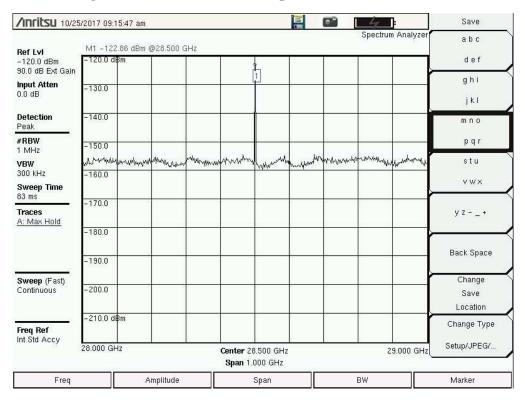


Figure 2.1-2 (F) Calibration Spectrum Photo 28.5 GHz

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			25	1		510	Spectrum A	nalyzer	abc
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nput Atten ).0 dB	-130.0			-	*				ghi
J.U UD									j k l
Detection Peak	-140.0				ü				mno
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	-190.0			-	-				Back Space
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Continuous	-200.0								Save Location
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nt Std Accy	29.000 GHz			29.500 GHz 1.000 GHz			30.0	D0 GHz	Setup/JPEG/
Freq		Amplitude		Span		В	w		Marker

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

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	M1 1217	5 dBm @30.50	1 CU-					Spectrur	n Analyzer	abc
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Detection Peak	-140.0					ă.	¢		<b>`</b>	mno
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	-180.0								ł	
	-190.0		-		-		2			Back Space
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Freq		Amplitude			Span		1	BW		Marker

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 Plymouth, Pennsylvania

- 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:	Plymouth, Penns	ylvania
3.	SITE IDENTIFICATION:	Plymouth	
4.	COORDINATES: (NAD 1983)	LATITUDE: LONGITUDE:	41° 14' 45.9" N 75° 55' 30.7" W
5.	GROUND ELEVATION:	596.11 feet AMS	L
6.	MEASUREMENT DATE AND TIMES:	OCTOBER 24, 2	25 2017
7.	GEOSTATIONARY ARC RANGE: SATELLITE POSITIONS: AZIMUTH: ELEVATION:	55W – 115W 149.9° – 230.9° 37.7° / 28.0°	
8.	GEOSTATIONARY ARC VISIBILITY:	Satellite arc has r	no blockage at this time.



North



East

Figure 3.1-1 Earth Station Site Photographs



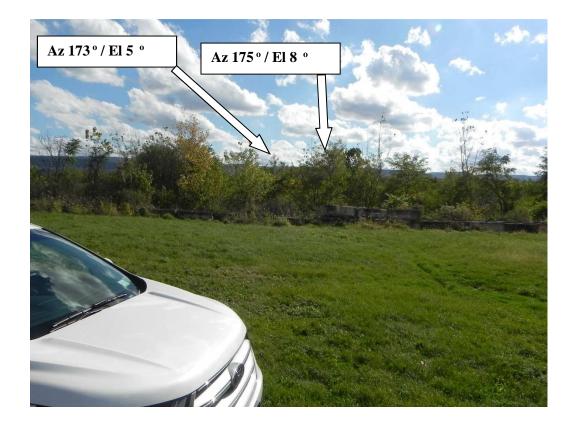
South



West



Figure 3.1-2 Horizon Photographs of Earth Station Site



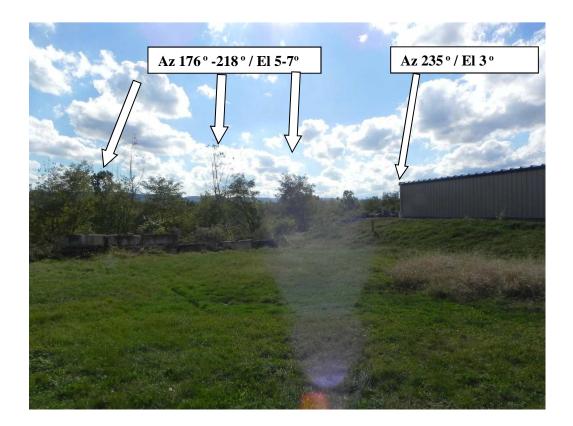


Figure 3.1-2 (cont.) Horizon Photographs of Earth Station Site



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

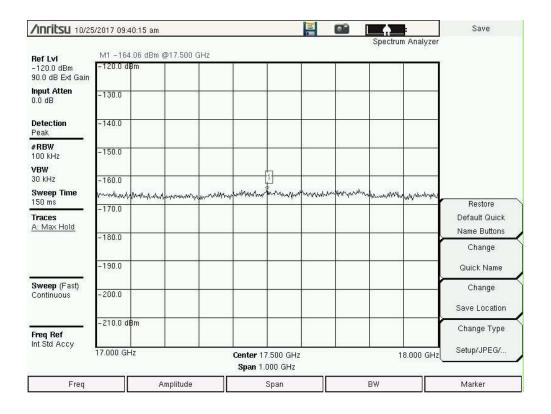


Figure 3.1-3 (B) Spectrum Photos 17-18 GHz 100 kHz Res BW Horizontal Pol 360<sup>0</sup>

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	M1 -156.0	)5 dBm @	17.500 GH	z				Spectrum	Analyzer	
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Freq		Am	plitude		Span			BW		Marker

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

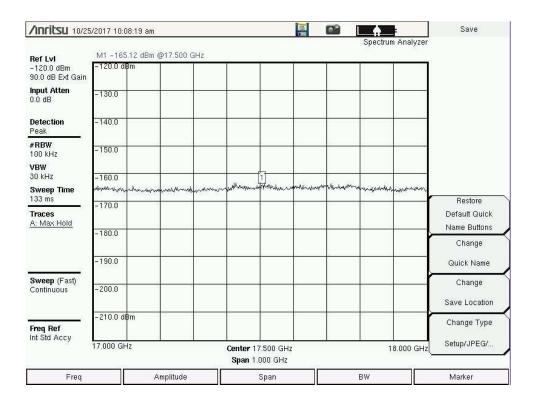


Figure 3.1-3 (D) Spectrum Photos 17-18 GHz 100 kHz Res BW Horizontal Pol Worst Case

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S1 3	17.000 GHz			Center 17 Span 1.1				1	8.000 GHz	Setup/JPEG/
Freq		Amplitude			Span		1	BW		Marker

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

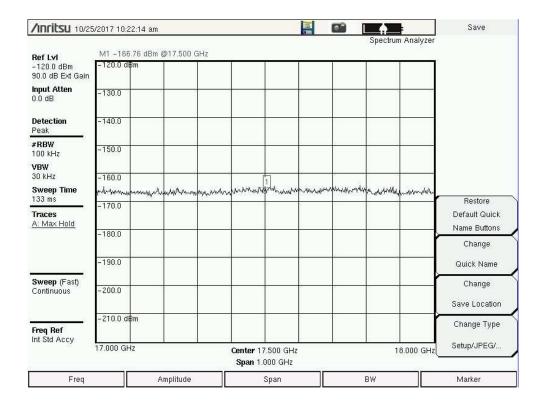


Figure 3.1-3 (F) Spectrum Photos 17-18 GHz 100 kHz Res BW Vertical Pol 360<sup>0</sup>

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Ref Lvl	M1 -155.3		17.500 GH	z		1. W/2-2-1		Spectr	um Analyzer	
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Detection Peak	-140.0									
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Freq		Am	plitude		Sp	an		BW		Marker

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

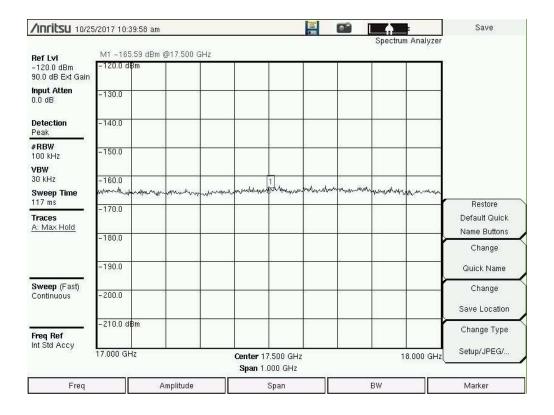


Figure 3.1-3 (H) Spectrum Photos 17-18 GHz 100 kHz Res BW Vertical Pol Worst Case

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Ref Lvl	M1 *-156		@30.500 (	GHz					Spectrur	n Analyzer	
-120.0 dBm 90.0 dB Ext Gain	-120.0 dB	m									
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Detection Peak	-140.0					-		6	· · · · · ·		
#RBW 1 MHz	-150.0				1	77			10		
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	-180.0										Change
	-190.0		0					12			Quick Name
<b>Sweep</b> (Fast) Continuous	-200.0					¢	*	. 6			Change Save Location
Freq Ref Int Std Accy	-210.0 dB	m									Change Type
ini olu ACCy	18.000 GH2	:			Center 18 Span 1.0			1	1	9.000 GHz	Setup/JPEG/
Freq		An	nplitude			Span			BW		Marker

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

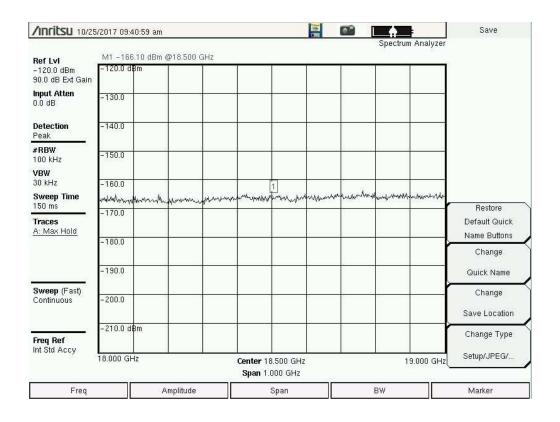


Figure 3.1-4 (B) Spectrum Photos 18-19 GHz 100 kHz Res BW Horizontal Pol 360<sup>0</sup>

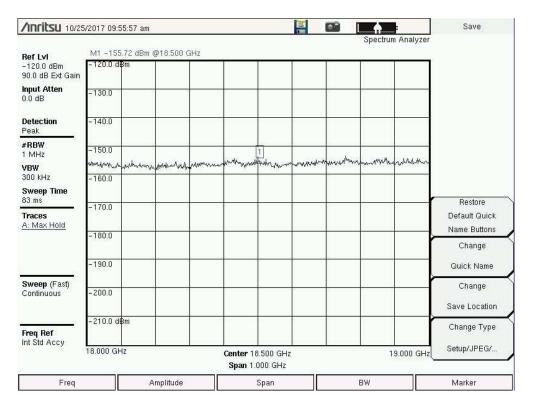


Figure 3.1-4 (C) Spectrum Photos 18-19 GHz 1 MHz Res BW Horizontal Pol Worst Case

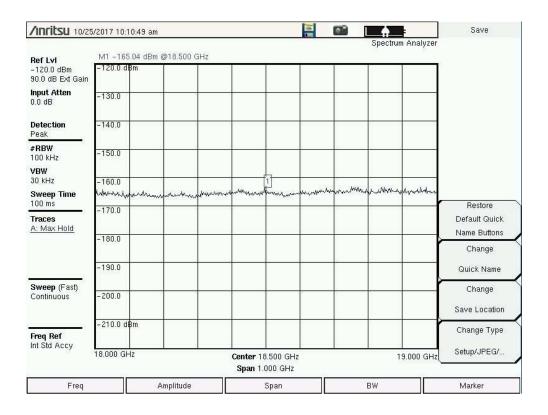
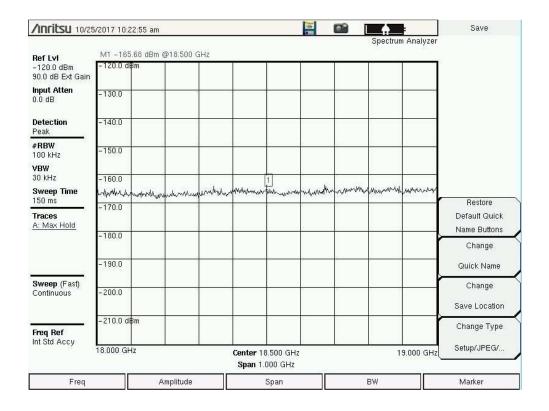


Figure 3.1-4 (D) Spectrum Photos 18-19 GHz 100 kHz Res BW Horizontal Pol Worst Case

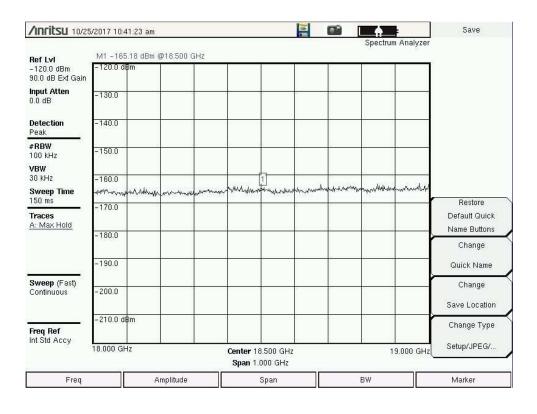
<b>/INFITSU</b> 10/2	25/2017 10:19:	55 am							Save
ef Lvl	M1 -156.0	3 dBm @18.50	) GHz		- 975 Me		Spectrum	Analyzer	
120.0 dBm 0.0 dB Ext Gair	-120.0 dBm	L.							
<b>put Atten</b> 0 dB	-130.0			•					
etection eak	-140.0								
<b>RBW</b> MHz	-150.0		-	1				3. 8. 19.	
<b>BW</b> 00 kHz	тантицин цин -160.0	hand	nyunuhma	www.how.hom	Nonderstalan	Nely Inwall	www.wywy.www.wyw	al-andrew Viceby	
<b>weep Time</b> 3 ms	-170.0		_			_	_	ł	Restore
races Max Hold									Default Quick Name Buttons
	-180.0							ľ	Change
41	-190.0								Quick Name
<b>weep</b> (Fast) ontinuous	-200.0							ſ	Change Save Location
req Ref t Std Accy	-210.0 dBm							Ì	Change Type
. ora nooy	18.000 GHz		5	Center 18.50 Span 1.000			19	9.000 GHz	Setup/JPEG/
Freq		Amplitud	•	Sp	an		BW		Marker

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



<b>/INFILSU</b> 10/2	5/2017 10:31:1	6 am							Save
							Spectrum	Analyzer	
<b>lef Lvi</b> 120.0 dBm 10.0 dB Ext Gain	-120.0 dBm	dBm @18.500 G	Hz			1			
<b>put Atten</b> .0 dB	-130.0				×	8			
etection eak	-140.0				÷	8			
RBW MHz	-150.0	munum		1			. Ke ulima	A AA ROUND	
<b>/BW</b> 100 kHz	-160.0	munich	- And	www.rehy	n waynar v		www.nowiniii iniir	Walling	
<b>weep Time</b> 3 ms	-170.0							r	Restore
races Max Hold									Default Quick Name Buttons
	-180.0							r	Change
	-190.0				-	ř.			Quick Name
weep (Fast) Continuous	-200.0				2	5	6 5	-ſ	Change Save Location
req Ref It Std Accy	-210.0 dBm								Change Type
n olu nocy	18.000 GHz			18.500 GHz 1.000 GHz			19	.000 GHz	Setup/JPEG/
Freq		Amplitude		Span			BW		Marker

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





/INFILSU 10/2	5/2017 09:38:	04 am					0		F.	Save
								Spectru	m Analyzer	
Ref Lvl		4 dBm @19.50	D GHz							
-120.0 dBm 10.0 dB Ext Gain	-120.0 dBm									
n <b>put Atten</b> 1.0 dB	-130.0						6	-		
Detection Peak	-140.0					ž	8	-		
<b>RBW</b> MHz	-150.0				1					
<b>/BW</b> 300 kHz	-160.0	whennedwarth	manderador	vahanahati	idpuncture	haantahaa	undrivally.	woman	Mr. www.www.w	
<b>Sweep Time</b> 57 ms	-170.0								r	Restore
Fraces A: Max Hold										Default Quick Name Buttons
	-180.0								ľ	Change
25	-190.0						ľ			Quick Name
<b>Sweep</b> (Fast) Continuous	-200.0						8	-	<u>⊢</u> -ľ	Change
	010.0 10									Save Location
<b>req Ref</b> nt Std Accy	-210.0 dBm									Change Type
	19.000 GHz		3	Center 19 Span 1.0			•	i	20.000 GHz	Setup/JPEG/
	5787					5767			57AV.	

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

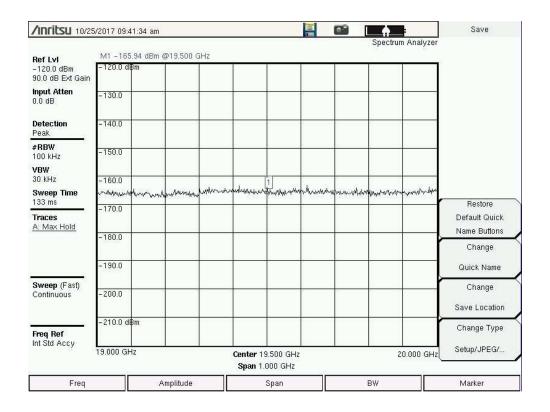


Figure 3.1-5 (B) Spectrum Photos 19-20 GHz 100 kHz Res BW Horizontal Pol 360<sup>0</sup>

/INCIESU 10/2	5/2017 09:59:	27 am						F	Save
					100 - 100 - 100 - 100 - 100 - 100 - 100 - 100 - 100 - 100 - 100 - 100 - 100 - 100 - 100 - 100 - 100 - 100 - 100		Spectrun	n Analyzer	
<b>Ref Lvi</b> •120.0 dBm 10.0 dB Ext Gain	-120.0 dBm	2 dBm @19.500 (	GHz			ſ			
n <b>put Atten</b> .0 dB	-130.0				-	6	-	5	
Detection Yeak	-140.0			0	- sù	-			
RBW MHz	-150.0	manyaman	warden warman	und 1	whenever.	munha	have and the state of the state	Mangahan	
<b>/BW</b> 300 kHz	-160.0	unch Maine and	•			-			
<b>Sweep Time</b> 13 ms	-170.0				_			r	Restore
<b>races</b> A: Max Hold									Default Quick Name Buttons
	-180.0							ľ	Change
	-190.0						-		Quick Name
Sweep (Fast) Continuous	-200.0							ſ	Change Save Location
req Ref	-210.0 dBm				- Sú				Change Type
nt Std Accy	19.000 GHz			ter 19.500 GH an 1.000 GHz		N.	2	0.000 GHz	Setup/JPEG/
Freq		Amplitude		Span		2	BW		Marker

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

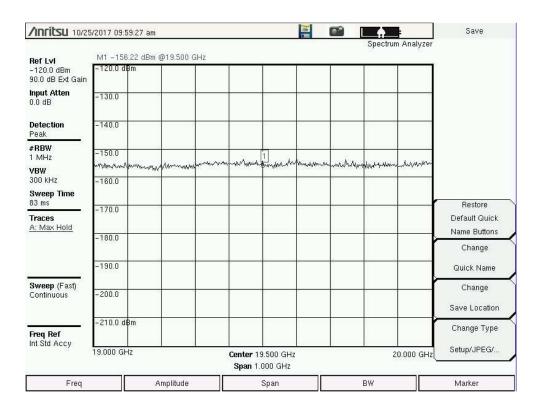


Figure 3.1-5 (D) Spectrum Photos 19-20 GHz 100 kHz Res BW Horizontal Pol Worst Case

/INFILSU 10/25	5/2017 09:59:	27 am					•		ŧ.	Save
Ref Lvl	M1 -156.22		.500 GHz			9/7 <90 10		Spectrur	n Analyzer	
-120.0 dBm 90.0 dB Ext Gain	-120.0 dBm									
Input Atten 0.0 dB	-130.0	- 3				192	6	2		
Detection Peak	-140.0					14			2	
#RBW 1 MHz	-150.0	v	and we had been add	www.www.www.	1 1 month	Maryan	-	ante at a star	where	
<b>VBW</b> 300 kHz	-160.0	under Martine.				-				
Sweep Time 83 ms	-170.0							ļ	r	Restore
Traces A: Max Hold										Default Quick Name Buttons
	-180.0								ľ	Change
	-190.0			1		1				Quick Name
<b>Sweep</b> (Fast) Continuous	-200.0					. P	6	· · · ·	ſ	Change Save Location
Freq Ref Int Std Accy	-210.0 dBm								Ì	Change Type
25 I	19.000 GHz				19.500 GH 1.000 GHz	z		2	0.000 GHz	Setup/JPEG/
Freq		Ampl	itude		Span			BW		Marker

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

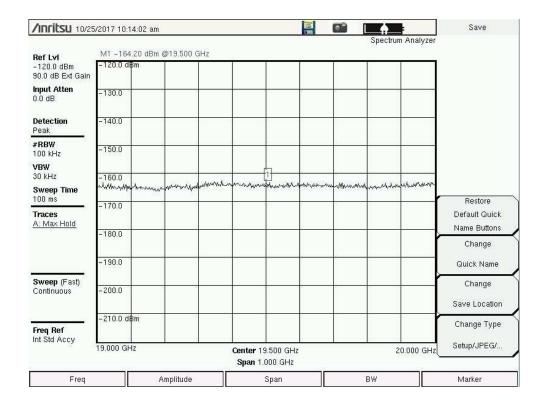


Figure 3.1-5 (F) Spectrum Photos 19-20 GHz 100 kHz Res BW Vertical Pol 360<sup>0</sup>

/INFITSU 10/25	5/2017 10:20:3	5 am								Save
Ref Lvl	M1 -155.02	n Analyzer								
-120.0 dBm 90.0 dB Ext Gain	-120.0 dBm									
<b>Input Atten</b> 0.0 dB	-130.0					*	8	4. A		
Detection Peak	-140.0					š		0		
#RBW 1 MHz	-150.0				1		1 2		. 1	
<b>VBW</b> 300 kHz	Личинчифии -160.0	have a second second	Warman	on Ada Cadre	hhudhadatan an h	waler war da	Alph Mary	Mummunian	Nurrayanya	
Sweep Time 83 ms	-170.0							-	r	Restore
Traces A: Max Hold	- 180.0				·;			-		Default Quick Name Buttons
	100.0				<u>.</u>		<i>x</i>			Change
Sweep (Fast)	-190.0									Quick Name Change
Continuous	-200.0		*			*	. 22			Save Location
Freq Ref	-210.0 dBm								ŕ	Change Type
Int Std Accy	19.000 GHz	1		Center 19 Span 1.0				2	0.000 GHz	Setup/JPEG/
Freq		Amplitude			Span			BW		Marker

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

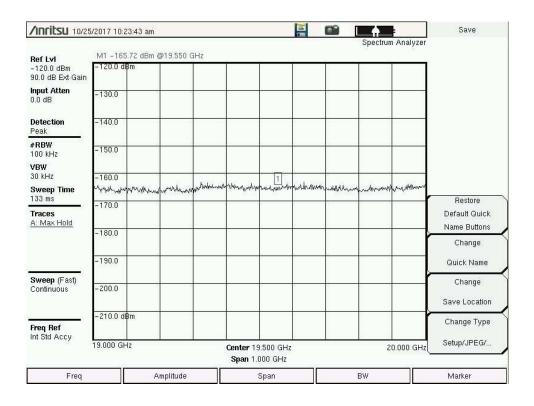
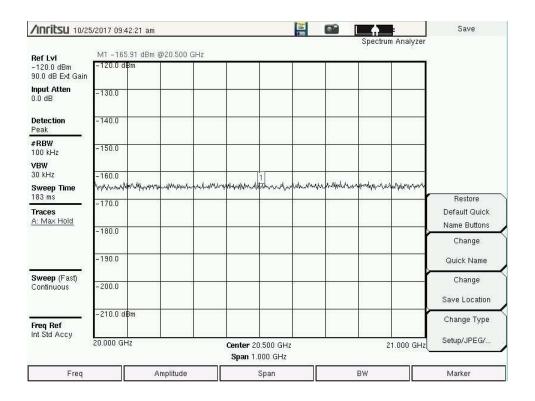


Figure 3.1-5 (H) Spectrum Photos 19-20 GHz 100 kHz Res BW Vertical Pol Worst Case

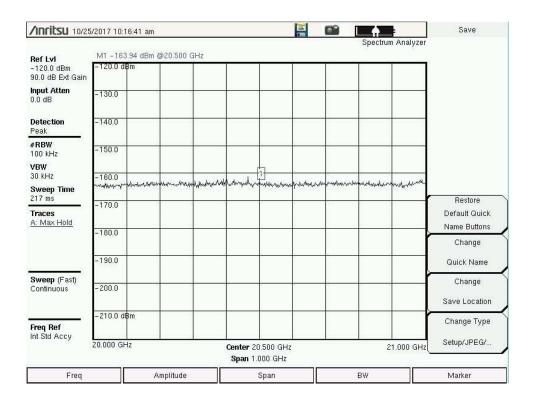
/Inritsu 10/25	5/2017 09:39	.02 am									Save
Ref Lvl	M1 -156.0	)5 dBm @	20.500 G	Hz					Spectru	ım Analyzer	
-120.0 dBm 90.0 dB Ext Gain	-120.0 dBi	n									
<b>Input Atten</b> 0.0 dB	-130.0							- 6			
Detection Peak	-140.0	0						-			
# <b>RBW</b> 1 MHz	-150.0 AntiMaturin	muture	an a	puntation of the state	monorthing	1 1 Marina an	with	manan	Mannan	nununum	
<b>VBW</b> 300 KHz	-160.0				1			-			
<b>Sweep Time</b> 83 ms	-170.0									⊢ r	Restore
Traces A: Max Hold											Default Quick Name Buttons
	-180.0									l r	Change
	-190.0					<u>.</u>	-				Quick Name
<b>Sweep</b> (Fast) Continuous	-200.0						. >	8		+ ľ	Change Save Location
Freq Ref Int Std Accy	-210.0 dBi	n									Change Type
nii olu Accy	20.000 GHz				Center 20 Span 1.	).500 GH; 000 GHz		-	12	21.000 GHz	Setup/JPEG/
Freq		Ar	nplitude			Span			BW		Marker

Figure 3.1-6 (A) Spectrum Photos 20-21 GHz 1MHz Res BW Horizontal Pol  $360^{0}$ 



/Inritsu 10/2	5/2017 10:04>	49 a.m							E I	Save
Ref Lvl	M1 -154.7	7 dBm @21	0.500 GHz					Spectru	m Analyzer	
-120.0 dBm 90.0 dB Ext Gain	-120.0 dBm	2								
<b>Input Atten</b> 0.0 dB	-130.0			2.2			S.	-	<del>.</del>	
Detection Peak	-140.0					-	-	0		
#RBW 1 MHz	-150.0 Muuluutuutuutuu	providences	manuda	mhapun	1 maria	when	www.when	maline	hand with the second	
<b>VBW</b> 300 kHz	-160.0								4	
Sweep Time 83 ms	-170.0					-	_		r	Restore
Traces A: Max Hold			2							Default Quick Name Buttons
	-180.0								ľ	Change
/5	-190.0					-	ľ			Quick Name
<b>Sweep</b> (Fast) Continuous	-200.0						8	2	ſ	Change Save Location
Freq Ref Int Std Accy	-210.0 dBm									Change Type
	20.000 GHz				er 20.500 Gl an 1.000 GH				21.000 GHz	Setup/JPEG/
Freq		Amp	litude		Span			BW		Marker

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



/INFILSU 10/25	5/2017 10:21:2	2 am						<b>∟ </b> ♠	•	Save
Ref Lvl	M1 -155.98	dBm @20.500	) GHz					Spectrur	n Analyzer	
-120.0 dBm 90.0 dB Ext Gain	-120.0 dBm									
Input Atten 0.0 dB	-130.0		~				5			
Detection Peak	-140.0						-			
#RBW 1 MHz	-150.0	mangelerm		ndram da an	1	بارد دراهه	allow which all	nhumin	a a surba	
<b>VBW</b> 300 kHz	-160.0	Onder the second	mid/4Main. D	an na ngangangangangangangangangangangangangan	en uched via	an culture ned and a	1	ne - neuvra		
Sweep Time 83 ms	-170.0		_						r	Restore
Traces <u>A: Max Hold</u>						5				Default Quick Name Buttons
	-180.0								ľ	Change
	-190.0		1				2			Quick Name
Sweep (Fast) Continuous	-200.0	8	×				0		ſ	Change Save Location
Freq Ref Int Std Accy	-210.0 dBm									Change Type
	20.000 GHz			Center 20 Span 1.	).500 GHz 300 GHz		•	2	1.000 GHz	Setup/JPEG/
Freq		Amplitude	9		Span			BW		Marker

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

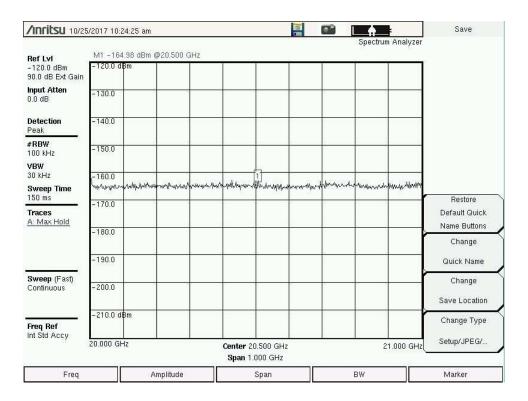


Figure 3.1-6 (F) Spectrum Photos 20-21 GHz 100 kHz Res BW Vertical Pol 360<sup>0</sup>

/INFITSU 10/25	5/2017 10:36:1	) am					•	<b>h</b>	ŧ.	Save
Ref Lvl	M1 -155.32	dBm @20.500	GHz					Spectrur	n Analyzer	
-120.0 dBm 90.0 dB Ext Gain	–120.0 dBm									
<b>Input Atten</b> 0.0 dB	-130.0						Ş	2		
Detection Peak	-140.0		3			1	2		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	
#RBW 1 MHz VBW	-150.0 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		madenationalis	union colorisation	1] mahamahan	northerabl	wybarrang	mana	human h	
300 kHz	-160.0		*							
Sweep Time 133 ms	-170.0		_						r	Restore
Traces A: Max Hold										Default Quick Name Buttons
	-180.0								ľ	Change
27	-190.0						-			Quick Name
<b>Sweep</b> (Fast) Continuous	-200.0							-	ſ	Change Save Location
Freq Ref Int Std Accy	-210.0 dBm									Change Type
	20.000 GHz			Center 20 Span 1.0				2	1.000 GHz	Setup/JPEG/
Freq		Amplitude		ŝ	Span		1	BW		Marker

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

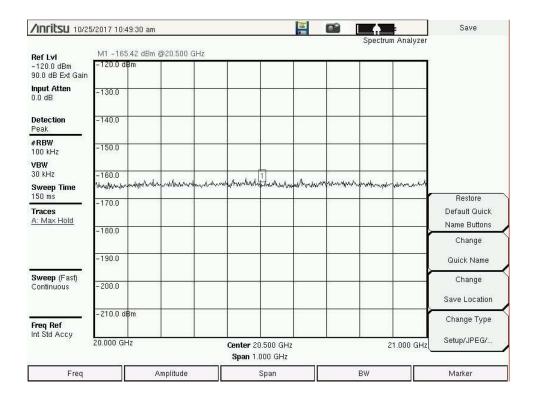


Figure 3.1-6 (H) Spectrum Photos 20-21 GHz 100 kHz Res BW Vertical Pol Worst Case

<b>/INFILSU</b> 10/25	/2017 11:09:4	3 am					Save
				1.97%		Spectrum Anal	yzer
<b>Ref Lvi</b> -120.0 dBm 90.0 dB Ext Gain	M1 -157.99 -120.0 dBm	dBm @27.500 G	Hz				
nput Atten ).0 dB	-130.0						_
Detection <sup>D</sup> eak	-140.0						
<b>#RBW</b> 1 MHz	-150.0		2	1		7 7 7	
<b>VBW</b> 300 kHz	~160.0	manyman	ale and the second second	Not you with the work	www.	videndermonthingerter	denati
Sweep Time 67 ms	-170.0						Restore
Traces A: Max Hold							Default Quick Name Buttons
	-180.0						Change
75	-190.0				- K		Quick Name
<b>Sweep</b> (Fast) Continuous	-200.0						Change Save Location
F <b>req Ref</b> nt Std Accy	-210.0 dBm				Č.		Change Type
nicolu Accy	27.000 GHz			27.500 GHz 1.000 GHz	Ľ	28.000	GHz Setup/JPEG/
Freq		Amplitude		Span		BW	Marker

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

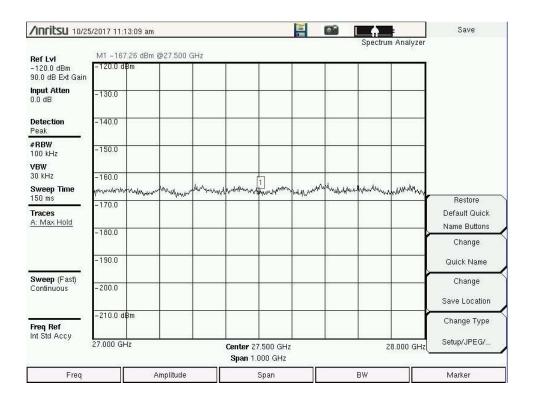
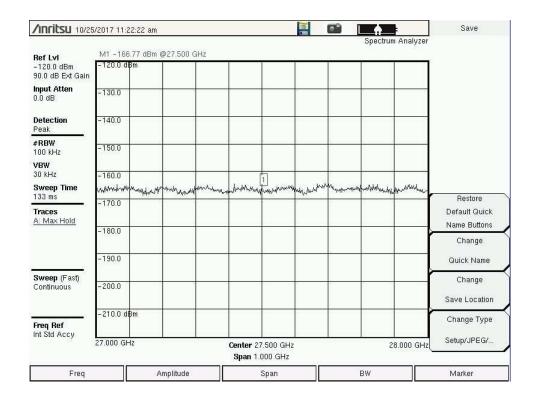


Figure 3.1-7 (B) Spectrum Photos 27-28 GHz 100 kHz Res BW Horizontal Pol 360<sup>0</sup>

/Inritsu 10/28	5/2017 11:19:	07 am					0		ŧ	Save
tef Lvl	M1 -158.8	2 dBm @27.50	0 GHz					Spectru	m Analyzer	
120.0 dBm 10.0 dB Ext Gain	-120.0 dBm									
n <b>put Atten</b> 1.0 dB	-130.0				C		<u>.</u>			
<b>Detection</b> Peak	-140.0				·		6	0		
<b>#RBW</b> 1 MHz	-150.0				า	- 11				
<b>VBW</b> 300 kHz	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	here the state was	white many	March 1000000	an war	www.www.iNte	Mananalta	MANAN	Warderwally	
<b>Sweep Time</b> 33 ms	-170.0								L r	Restore
Traces A: Max Hold										Default Quick Name Buttons
	-180.0									Change
	-190.0						14			Quick Name
<b>Sweep</b> (Fast) Continuous	-200.0		*	2			6	-	f	Change Save Location
F <b>req Ref</b> nt Std Accy	-210.0 dBm								r	Change Type
ni olu Accy	27.000 GHz	1		Center 27 Span 1.0			1	12	28.000 GHz	Setup/JPEG/
Freq		Amplitud	e	5	Span			BW		Marker

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





/Inritsu 10/25	5/2017 11:10	):26 am						0		F	Save
Ref Lvi	M1 -158.	40 dBm (	@28.500 (	àHz					Spectru	m Analyzer	
-120.0 dBm 90.0 dB Ext Gain	-120.0 dB	m									
<b>Input Atten</b> 0.0 dB	-130.0						×		-	<u> </u>	
Detection Peak	-140.0						2	-	- C		
<b>#RBW</b> 1 MHz	-150.0		i.			1	1				
<b>VBW</b> 300 kHz	-160.0	Virallagerr	www.www.rv	an an an Arthon by	nhann varað	Waltering	my and when	r <b>r</b> annan yafar		ul www.www.dang	
Sweep Time 67 ms Traces A: Max Hold	-170.0									r	Restore Default Quick
	-180.0										Name Buttons Change
	-190.0					-		-K			Quick Name
<b>Sweep</b> (Fast) Continuous	-200.0						19 <sup>2</sup>	6		ſ	Change Save Location
Freq Ref nt Std Accy	-210.0 dB	m									Change Type
ni du Accy	28.000 GH:	:				3.500 GHz 000 GHz		1	1	29.000 GHz	Setup/JPEG/
Freq		A	mplitude			Span			BW		Marker

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

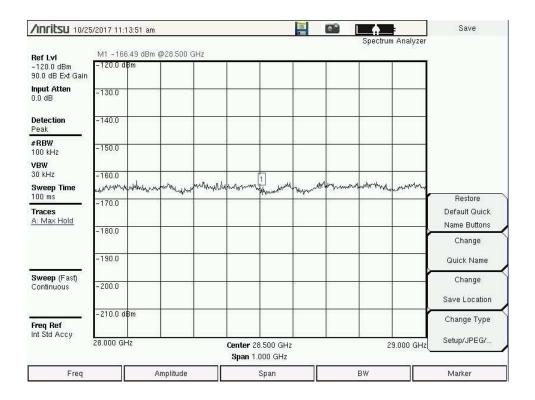


Figure 3.1-8 (B) Spectrum Photos 28-29 GHz 100 kHz Res BW Horizontal Pol 360<sup>0</sup>

/Inritsu 10/28	5/2017 11:19	3:59 am							<b>A</b>	ŧ.	Save
Ref Lvl	M1 -157.	90 dBm (	@28.500 C	GHz					Spectrun	n Analyzer	
-120.0 dBm 90.0 dB Ext Gain	-120.0 dB	m									
Input Atten 0.0 dB	-130.0	;					*	- (fr)	-		
Detection Peak	-140.0							- (	·		
#RBW 1 MHz	-150.0					1	2			A . 1	
<b>VBW</b> 300 kHz	-160.0	¥WAYAAA	ann glader	Control Control of the	and Maria M	Warmport	44hayyahara	www.	ahawa.ook	And you work the	
<b>Sweep Time</b> 67 ms	-170.0									r	Restore
Traces <u>A: Max Hold</u>							6				Default Quick Name Buttons
	-180.0									ľ	Change
<u> </u>	-190.0							1¢			Quick Name
<b>Sweep</b> (Fast) Continuous	-200.0						*			ſ	Change Save Location
Freq Ref	-210.0 dB	m					94. 	2	°	ŕ	Change Type
Int Std Accy	28.000 GH	z			Center 28 Span 1.	1 3.500 GHz 000 GHz		N	2	9.000 GHz	Setup/JPEG/
Freq		A	mplitude		province concerne	Span		l í	BW		Marker

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

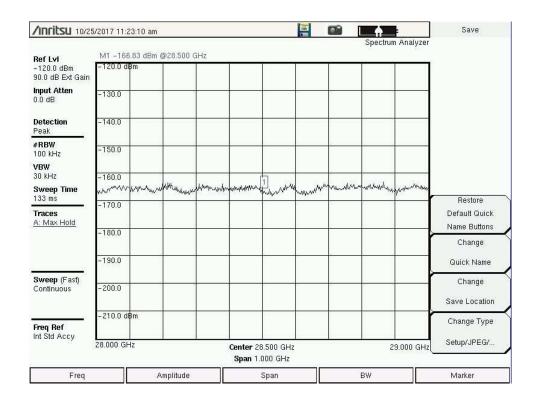


Figure 3.1-8 (D) Spectrum Photos 28-29 GHz 100 kHz Res BW Vertical Pol 360<sup>0</sup>

/INFITSU 10/25	/2017 11:11:00	am							•	Save
Ref Lvl	M1 -158.47 (	dBm @29.500 (	GHz		1 V.			Spectrur	n Analyzer	
-120.0 dBm 90.0 dB Ext Gain	-120.0 dBm									
Input Atten 0.0 dB	-130.0						÷.			
Detection Peak	-140.0				ē)		0			
#RBW 1 MHz	-150.0	Yunna Marina Marina	head on a	4	1		molen	l. Abusha s	antalin	
<b>VBW</b> 300 kHz	-160.0	Thomas an manifula	Provide K A Providence	witerAu in D	Stry hy man	Jull Younger	999 1997	Marin a shore	ko <sup>or - r</sup>	
<b>Sweep Time</b> 67 ms	-170.0						2	c	r	Restore
Traces <u>A: Max Hold</u>										Default Quick Name Buttons
	-180.0								ľ	Change
	-190.0						<i>.</i>			Quick Name
<b>Sweep</b> (Fast) Continuous	-200.0						é,	a	ſ	Change Save Location
Freq Ref Int Std Accy	-210.0 dBm								ŕ	Change Type
	29.000 GHz		}	Center 29 Span 1.0	1.500 GHz 300 GHz			3	0.000 GHz	Setup/JPEG/
Freq		Amplitude			Span		1	BW		Marker

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

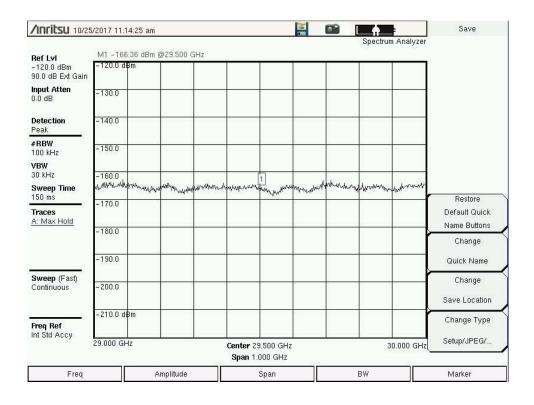
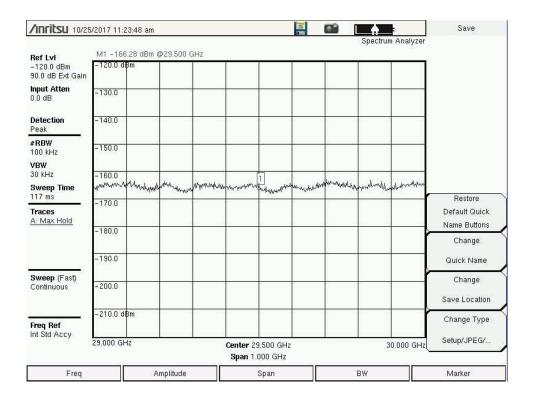


Figure 3.1-9 (B) Spectrum Photos 29-30 GHz 100 kHz Res BW Horizontal Pol 360<sup>0</sup>

/INCIESU 10/25	/2017 11:2	):46 am								F I	Save
									Spectrur	n Analyzer	
Ref Lvl			929.500 GI	Hz							
-120.0 dBm 30.0 dB Ext Gain	-120.0 dB	m									
<b>nput Atten</b> ).0 dB	-130.0						/	6			
Detection Peak	-140.0						3 ic				
<b>#RBW</b> 1 MHz	-150.0					1					
<b>VBW</b> 300 kHz	-160.0	myww		withing	Kanana ana ang ang ang ang ang ang ang an	Wyrnepolen M	Manaphrode	n stan and star	hanning	www.www.www.	
<b>Sweep Time</b> 83 ms	-170.0									r	Restore
Traces A: Max Hold											Default Quick Name Buttons
	-180.0									ľ	Change
25	-190.0	>						~			Quick Name
Sweep (Fast) Continuous	-200.0	8						÷		l r	Change
Continuous	-200.0										Save Location
Freq Ref	-210.0 dB	m								r	Change Type
Int Std Accy	29.000 GH	z				).500 GHz 300 GHz			3	0.000 GHz	Setup/JPEG/
Freq		A	nplitude		-	Span			BW		Marker

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



<b>/INFITSU</b> 10/25	5/2017 11:	11:42 am							<b>A</b>	ŧ.	Save
Ref Lvi	M1 -156	6.34 dBm (	@30.500 C	àHz					Spectru	n Analyzer	
-120.0 dBm 90.0 dB Ext Gain	-120.0 d	Bm									
Input Atten 0.0 dB	-130.0						*	6			
Detection Peak	-140.0						i.	6	· · · · · ·		
#RBW 1 MHz	-150.0 N.M.N.M.A	Maria	and.	udmiddau	a Marana Ma	1	Sudich & dire	Manutur	th i surrhas	www.mantinted	
<b>VBW</b> 300 kHz	-160.0	Y 'NYOU,A	- Www	Avera - 14	en Nol	College In .			hower, is an	Martha Anna an	
Sweep Time 67 ms	-170.0	-			6	6			6	l r	Restore
Traces A: Max Hold	-180.0						5				Default Quick Name Buttons
	-100.0									r	Change
	-190.0										Quick Name
Sweep (Fast) Continuous	-200.0					¢		-	8		Change Save Location
Freq Ref Int Std Accy	-210.0 d	Bm									Change Type
	30.000 GI	Ηz		5	Center 30 Span 1.	).500 GHz 000 GHz			3	1.000 GHz	Setup/JPEG/
Freq		A	mplitude			Span		P	BW		Marker

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

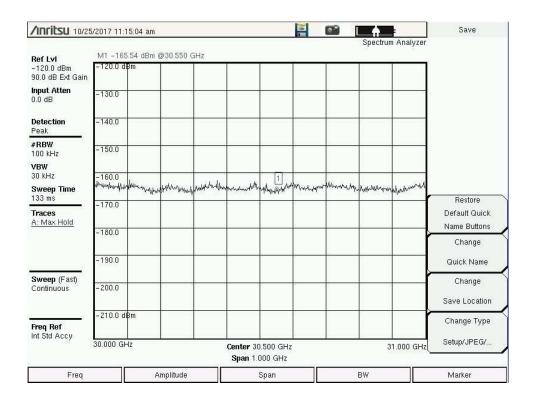


Figure 3.1-10 (B) Spectrum Photos 30-31 GHz 100 kHz Res BW Horizontal Pol 360<sup>0</sup>

/Inritsu 10/28	5/2017 11:21:2	25 am							ŧ	Save
Ref Lvl	M1 -156.43	) dBm @30.50	0 GHz					Spectrur	n Analyzer	
-120.0 dBm 90.0 dB Ext Gain	-120.0 dBm									
Input Atten 0.0 dB	-130.0					>	6			
Detection Peak	-140.0					ú.	6		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	
<b>#RBW</b> 1 MHz	–150.0				1	in. iska	and the		h da 6	
<b>VBW</b> 300 kHz	-160.0	Mynowing	half and and	a destandes des	terry when we are	a nadala an	1979 M	Maked States and the states of	Montheast	
Sweep Time 83 ms	-170.0		_				2		r	Restore
Traces A: Max Hold										Default Quick Name Buttons
	-180.0								ľ	Change
	-190.0					-	ľ			Quick Name
<b>Sweep</b> (Fast) Continuous	-200.0			3		×	5	-	ſ	Change Save Location
Freq Ref Int Std Accy	-210.0 dBm					6 C				Change Type
	30.000 GHz				).500 GHz 000 GHz			. 3	1.000 GHz	Setup/JPEG/
Freq		Amplitud	e		Span			BW		Marker

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

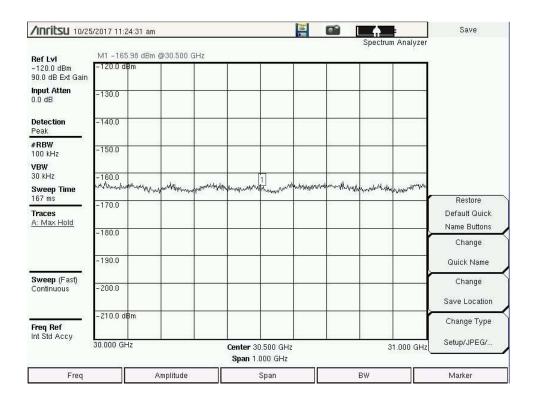


Figure 3.1-10 (D) Spectrum Photos 30-31 GHz 100 kHz Res BW Vertical Pol 360<sup>0</sup>

FOUR

### **SUMMARY OF RESULTS**

The results of the measurements conducted at the proposed ViaSat, Inc site in Plymouth, Pennsylvania 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. The detailed interference study was able to clear all but two cases. Those cases were closely observed while on site and no interference was noted. Spectral scans are shown in Addendum 1 in this report.

**FIVE** 

#### **CONCLUSIONS AND RECOMMENDATIONS**

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

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

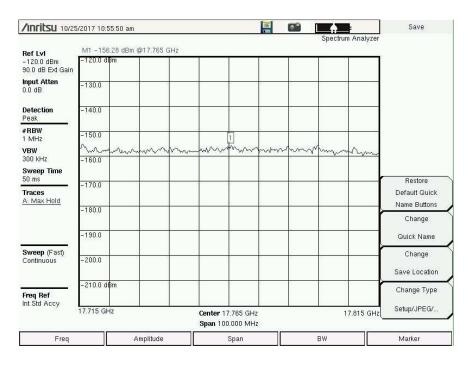
The satellite arc has no potential blockage from 55W through 115W.

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

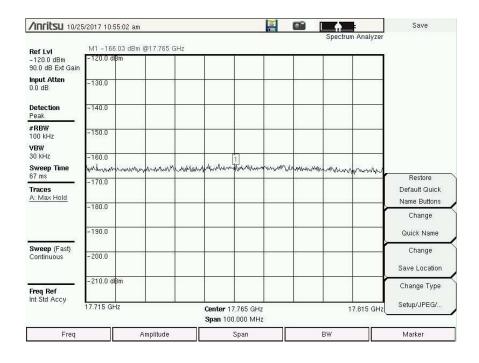
•

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

# Addendum 1

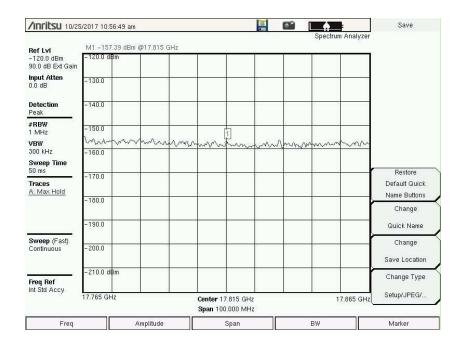


Spectrum Photos 17.765 GHz 1 MHz Res BW Vertical Pol AZ 81.9<sup>0</sup>

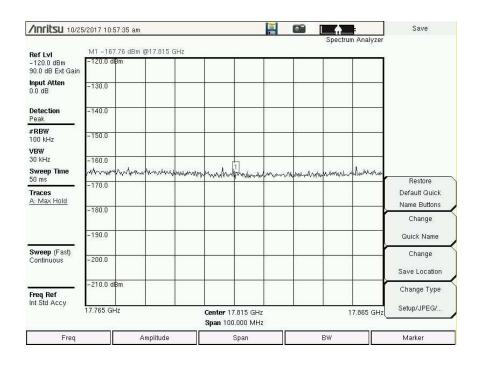


Spectrum Photos 17.765 GHz 100 kHz Res BW Vertical Pol AZ 81.90

# Addendum 1(cont.)



Spectrum Photos 17.815 GHz 1 MHz Res BW Vertical Pol AZ 81.9<sup>0</sup>

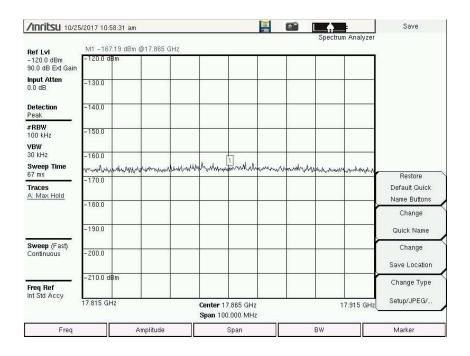


Spectrum Photos 17.815 GHz 100 kHz Res BW Vertical Pol AZ 81.90

# Addendum 1(cont.)

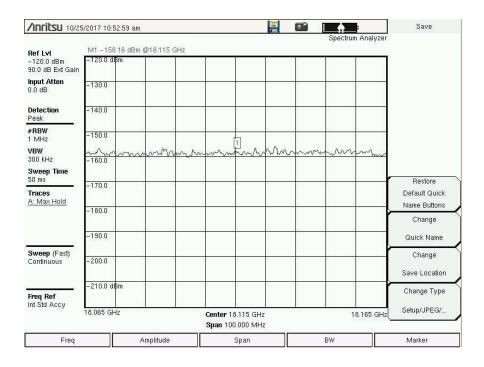
/INFITSU 10/25	/2017 10:59:3	5 am				•			Save
Ref Lvl	M1 -158.02	dBm @17.865 G	iHz				Spectrum	Analyzer	
-120.0 dBm 90.0 dB Ext Gain	-120.0 dBm				Ť				
<b>nput Atten</b> ).0 dB	-130.0	3			-	-			
Detection <sup>D</sup> eak	-140.0				- ic	1			
# <b>RBW</b> 1 MHz	-150.0			1					
<b>VBW</b> 300 KHz	-160.0	mpm	march	mohn	mar	mm	m	mm	
<b>Sweep Time</b> 67 ms	-170.0				_			-	Restore
Traces A: Max Hold									Default Quick Name Buttons
	-180.0								Change
	-190.0				2	Ť.			Quick Name
Sweep (Fast) Continuous	-200.0					8	8	-	Change Save Location
Freq Ref Int Std Accy	-210.0 dBm								Change Type
	17.815 GHz			Center 17.865 GHz Span 100.000 MHz			17.915 GHz		Setup/JPEG/
Freq		Amplitude		Span			BW		Marker

Spectrum Photos 17.865 GHz 1 MHz Res BW Vertical Pol AZ 81.9<sup>0</sup>

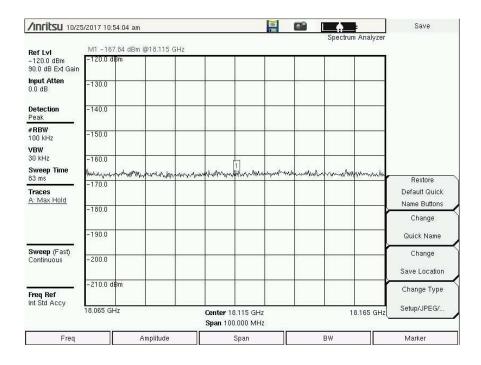


Spectrum Photos 17.865 GHz 100 kHz Res BW Vertical Pol AZ 81.90

# Addendum 1(cont.)



### Spectrum Photos 18.115 GHz 1 MHz Res BW Vertical Pol AZ 81.9<sup>0</sup>



Spectrum Photos 18.115 GHz 100 kHz Res BW Vertical Pol AZ 81.9<sup>0</sup>