Technical Brief
AVL Location

July 29, 2019

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Prepared by
Intellicom Technologies, Inc.

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1 TABLE OF CONTENTS

1 TABLE OF CONTENTS 2
2 INTRODUCTION 4
3 SYSTEM DESCRIPTION 5
3.1 Satellites (Points of Communication) 5
3.2 Earth Stations 6
3.3 Link Budget Estimates 7
3.4 Points of Contact 8
4 Antenna Patterns - AVL Model 1315 9
4.1 Summary 9
4.2 Tx LHCP Azimuth 10
4.3 Tx RHCP Azimuth 13
4.4 Tx LHCP Elevation 16
4.5 Tx RHCP Elevation 19
5 Antenna Patterns - AVL/Viasat BAT-600 22
5.1 Summary 22
5.2 Tx LHCP Azimuth 23
5.3 Tx RHCP Azimuth 24
5.4 Tx LHCP Elevation 25
5.5 Tx RHCP Elevation 26

Revision History

Revision History:	Date	Document Revision Description
V01.0	2019 04 26	Initial Release
V01.1	2019 07 10	Updated with satellite parameters
V01.2	2019 07 29	Tx frequency changed to 30-31 GHz Link budgets added

2 INTRODUCTION

We are seeking an FCC experimental license for testing, evaluation, and certification of fixed earth stations.

As a commercial entity we are seeking a license to transmit within 30.0 to 31 GHz. Transmissions will be coordinated and approved in advance with the commercial and government satellite operators.

Since the 30-31 GHz band is assigned for federal use, we anticipate that FCC will need to coordinate with the NTIA via the IRAC Interdepartmental Radio Advisory Committee. The earth stations will be owned and tested and certified by a commercial entity. Future ARSTRAT certified earth stations will be manufactured and sold to the US Government for their use. We are including a statement of US government interest and a government point of contact supporting this activity.

The earth stations are compliant with **47CFR §25.209.**

Intellicom Technologies, Inc. is representing AVL in this matter. Please contact the following for additional information, comments, or clarifications:

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Intellicom Technologies, Inc.
480-993-2220
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3 SYSTEM DESCRIPTION

This section provides a description of the SATCOM system.

3.1 Satellites (Points of Communication)

We are requesting a license for U.S. licensed space stations.

Satellites include:

- Only with authorization from ARSTRAT
  - WGS3 at 12W, 1000 MHz
  - WGS5 at 52.5W, 1000 MHz
  - WGS6 at 135W, 1000 MHz
- Only with authorization from Inmarsat
  - Inmarsat I-5 F2 (55W), 1000 MHz

Link Budget Estimates	ka Band		
20190329m12v01.2_Terminal_Specs.xlsx			
		60 cm	**134 cm**
HPA Power Output (dBW)		12.8	4.3
Coupling + Mispointing Losses (dB)		0.87	0.87
Earth Station Gain (dBi) (30.5 GHz)		44.4	50.9
Uplink EIRPu (dBW)		**56.4**	**54.3**
Path Loss Uplink (dB)		215	215
Satellite Input (dBW)		-159	-161
Satellite Parameters (Estimated)			
Rx Antenna Beamwidth (Degrees) Narrow Coverage Beam (~400 mi diameter)	*1*		
Sat Grx (dBi) (30.5 GHz) (60% efficient)	*45*		
LNA Gain (dB)	*50*		
Receiver Transfer Gain (dB)	*15*		
HPA Gain (dB)	*52*		
Tx Antenna Beamwidth (Degrees) Narrow Coverage Beam (~400 mi diameter)	*1*		
Sat Gtx (dBi) (20.7 GHz) (60% efficient)	*45*		
Satellite Transfer Gain (dB)		***207***	***207***

3.2 Earth Stations

Location	AvL Technologies 15 North Merrimon Ave Asheville, NC 288804
Coordinates	35°38'24.5"N 82°34'30.9"W
Elevation Range	7 to 40 degrees
Azimuth Range	101 to 246 degrees
Transmit Frequency	30.0 to 31.0 GHz
Receive Frequency	20.2 to 21.2 GHz

Earth Station Attributes

20190329m12v01.2_Terminal_Specs.xlsx

ID	Band	Terminal	Model	Antenna	HPA psat (dBm)	HPA sat (watts)	WG Loss (dB)	Power Into Feed (dBm)	Power Into Feed (watts)	Gtx (dBi)	EIRP (dBW)	ERP (dBW) =EIRP-2.15 dB	ERP kW	Grx (dBi)	G/T (dB/K)	Description
1	ka	AVL/Viasat	BAT-600 MMT	60cm	42.9	19.4	0.67	42.2	16.6	44.4	56.6	54.5	279	40.2	17	First Article
2	ka	AVL	Model 1315	130cm	41.3	13.5	0	41.3	13.5	50.9	62.2	60.1	1012	46.2	22	First Article

Earth Station Pointing Angles ka Band

20190329m12v01.2_Terminal_Specs.xlsx

AVL, Asheville

35.640139N 35°38'24.5"N

82.575251W 82°34'30.9"W

		Earth Station Pointing			Satellite	Satellite	Satellite	Satellite	Satellite
Satellites	**Location (degrees)**	**Elevation (degrees)**	**True Azimuth (degrees)**	**Downlink Frequency (GHz)**	**Output Power per carrier (dBW)**	**EIRP (dBW)**	**ERP (dBW) =EIRP-2.15**	**ERP (kW)**	**Emission Designator**
WGS3 at 12W	12W	7.2	101.6	20.2-21.2	3.8	48.8	46.6	46.0	10M0G7D
WGS5 at 52.5W	52.5W	37.8	135.2	20.2-21.2	3.8	48.8	46.6	46.0	10M0G7D
Inmarsat I-5 F2 (55W)	55W	39.4	138.1	20.2-21.2	3.8	48.8	46.6	46.0	10M0G7D
WGS6 at 135W	135W	21.7	245.9	20.2-21.2	3.8	48.8	46.6	46.0	10M0G7D
	Min	**7**	**101**						
	Max	**40**	**246**						

3.3 Link Budget Estimates

Downlink carrier PSD meets requirements.

Link Budget Estimates	ka Band		
20190329m12v01.2_Terminal_Specs.xlsx			
		60 cm	**134 cm**
HPA Power Output (dBW)		12.8	4.3
Coupling + Mispointing Losses (dB)		0.87	0.87
Earth Station Gain (dBi) (30.5 GHz)		44.4	50.9
Uplink EIRPu (dBW)		**56.4**	**54.3**
Path Loss Uplink (dB)		215	215
Satellite Input (dBW)		-159	-161
Satellite Parameters (Estimated)			
Rx Antenna Beamwidth (Degrees) Narrow Coverage Beam (~400 mi diameter)	*1*		
Sat Grx (dBi) (30.5 GHz) (60% efficient)	*45*		
LNA Gain (dB)	*50*		
Receiver Transfer Gain (dB)	*15*		
HPA Gain (dB)	*52*		
Tx Antenna Beamwidth (Degrees) Narrow Coverage Beam (~400 mi diameter)	*1*		
Sat Gtx (dBi) (20.7 GHz) (60% efficient)	*45*		
Satellite Transfer Gain (dB)		***207***	***207***

Power into downlink antenna (dBW)		3.8	1.7
Downlink EIRPd (dBW)		**48.8**	**46.7**
Downlink ERPd (dBW) = EIRP-2.15		***46.6***	***44.6***
Path Loss downlink (dB)		211.8	211.8
Earth Station Input (dBW)		-163.1	-165
Grx (dBi)		40.2	41.3
Carrier power into LNB		-122.9	-124
LNB gain		50	50
Es Receiver input (dBm)		-43	-44
Es G/T (dB/K)		17	22
Link C/No			
Uplink C/No (dB/Hz)		98.94	102.46
Downlink C/No (dB/Hz)		97.34	103.84
Total C/No (dB/Hz)		**95.1**	**100.1**
Total Es/No (dB)		**10**	**10**
Downlink Density			
EIRPd (dBW)		48.78	46.71
Path Loss d (dB)		211.8	211.8
G(1m, 20.7) dBi		47.78	47.78
DL Density (dBW/m^2)		-115	-117
Occupied Bandwidth (MHz) (10 Msymbols/S QPSK)		10	10
DL Density (dBW/m^2/MHz)		-125	-127
Mil-Std-188-164C, 4.3.2 Max PFD (dBW/m^2/MHz)		-112	-112
FCC 25.208c3, 17.7-19.7, 22.55-23.55 GHz, 25-90 degrees above horizontal plane		-105	-105
FCC 25.208c3, 17.7-19.7, 22.55-23.55 GHz, 0-5 degrees above horizontal plane		-115	-115
Minimum Es Elevation Angle (degrees)		7	7
Worst case Satellite to earth beam grazing angle (above horizontal) (degrees) ~ Es -satellite beamwidth		6	6
downlink density meets requirements			

3.4 Points of Contact

Primary Contact:
Ryan Gutierrez
rgutierrez@avltech.com
1 828-250-9950 ext. 3807
Cell: 443-813-3022
AvL Technologies
15 North Merrimon Ave
Asheville, NC 288804

Secondary Contact:
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PMoller@ITCcom.net
Office: 480.993.2220
Cell: 480.226.1493
Intellicom Technologies, Inc

4 Antenna Patterns - AVL Model 1315

4.1 Summary

The antenna is compliant with:

- **CFR-2010-title47-vol2-sec25-209**
- **Mil-Std-188-164c**

Transmit Gain and Axial Ratio

	30.000 GHz	30.500 GHz	31.000 GHz
Gain, dBi LHCP	50.6	50.7	50.9
Gain, dBi RHCP	50.6	50.7	50.9
Axial Ratio, (dB) LHCP	0.8	0.9	0.7
Axial Ratio, (dB) RHCP	0.8	0.9	0.7

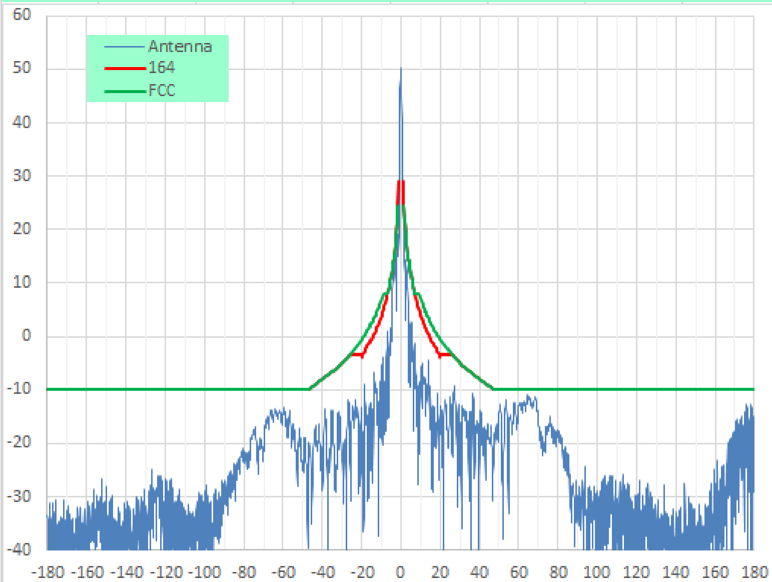
3 dB beamwidth in Azimuth is +/-0.3 or 0.6 degrees

4.2 Tx LHCP Azimuth

Antenna Gain Pattern: Uplink Azimuth LHCP Low

Gain (dBi) vs Azimuth Angle (degrees)

20190426m01v01.0_135_AntennaPlots.xlsx XlowLHCPulaz

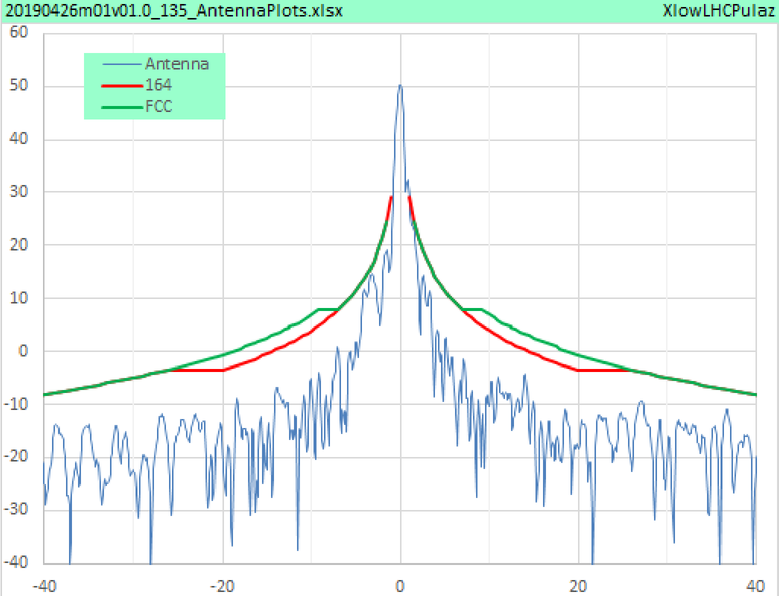


Max Gain	50.3	dBi	

Antenna Gain Pattern: Uplink Azimuth LHCP Low

Gain (dBi) vs Azimuth Angle (degrees)

20190426m01v01.0_135_AntennaPlots.xlsx XlowLHCPulaz

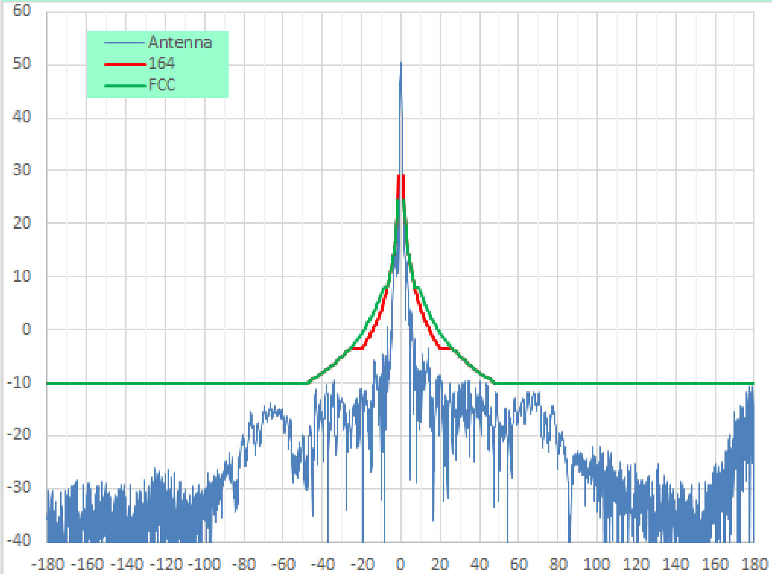


Max Gain	50.3	dBi	

Antenna Gain Pattern: Uplink Azimuth LHCP Mid

Gain (dBi) vs Azimuth Angle (degrees)

20190426m01v01.0_135_AntennaPlots.xlsx XmidLHCPulaz

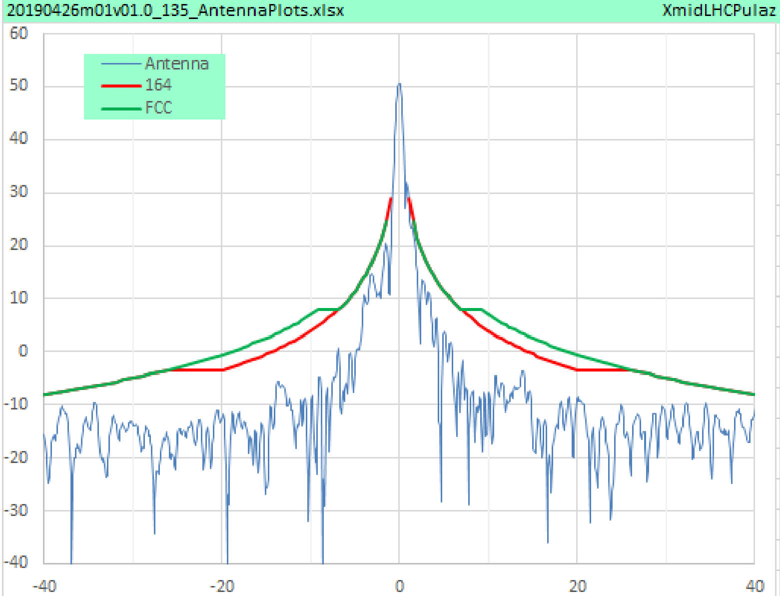


Max Gain 50.5 dBi

Antenna Gain Pattern: Uplink Azimuth LHCP Mid

Gain (dBi) vs Azimuth Angle (degrees)

20190426m01v01.0_135_AntennaPlots.xlsx XmidLHCPulaz

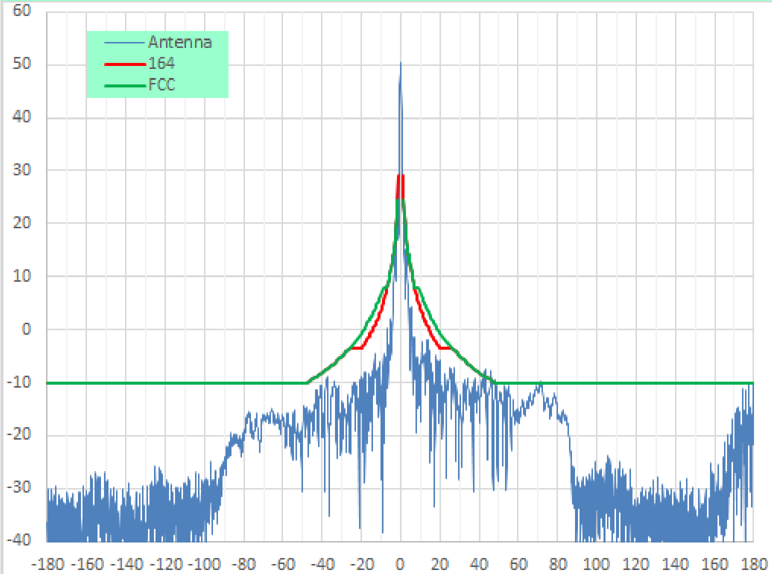


Max Gain 50.5 dBi

Antenna Gain Pattern: Uplink Azimuth LHCP High

Gain (dBi) vs Azimuth Angle (degrees)

20190426m01v01.0_135_AntennaPlots.xlsx XhighLHCPulaz

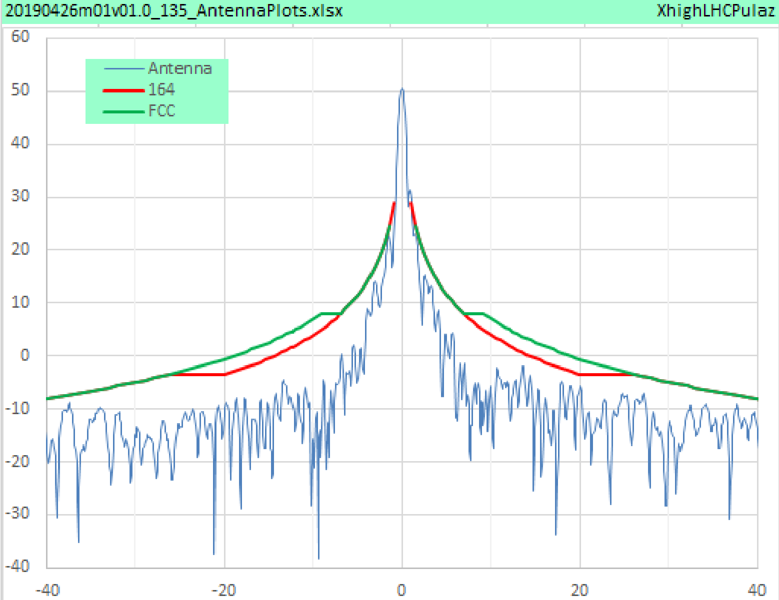


Max Gain		50.6	dBi

Antenna Gain Pattern: Uplink Azimuth LHCP High

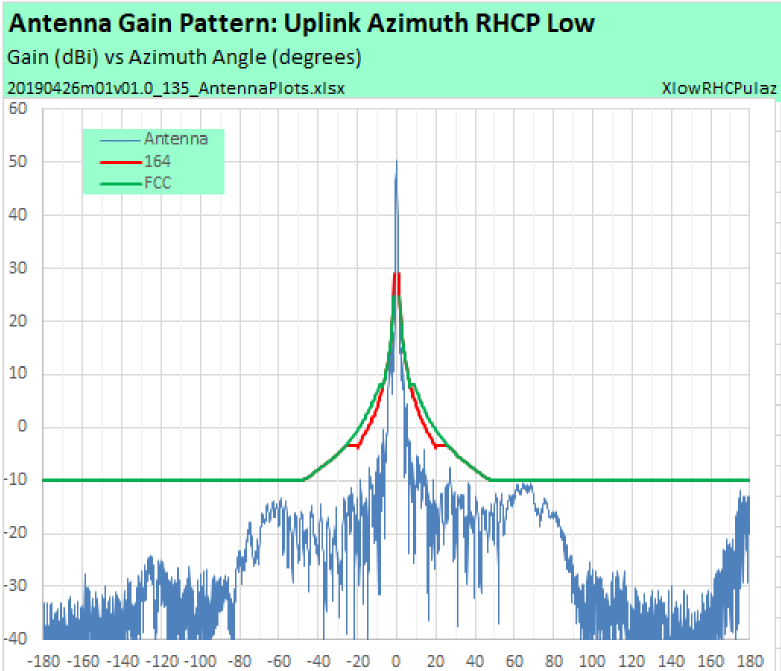
Gain (dBi) vs Azimuth Angle (degrees)

20190426m01v01.0_135_AntennaPlots.xlsx XhighLHCPulaz

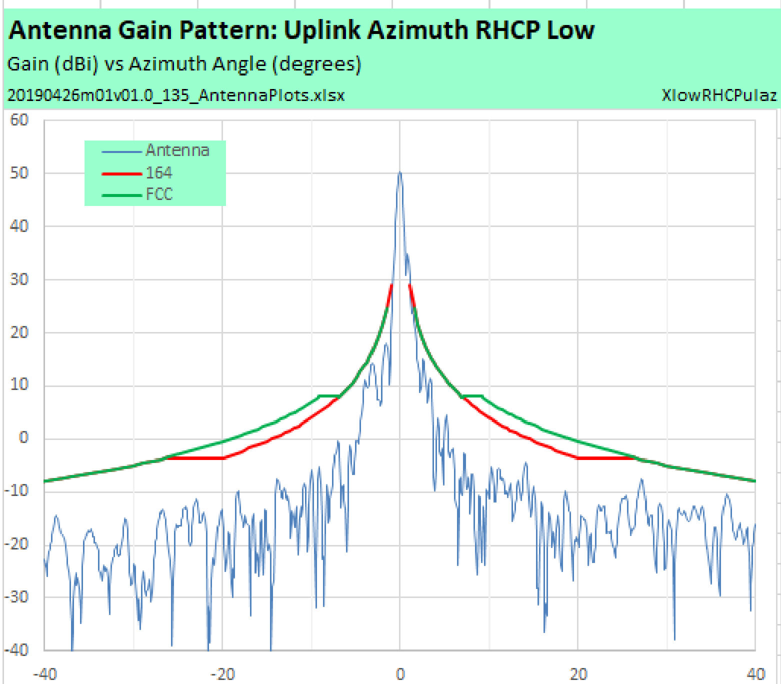


Max Gain		50.6	dBi

4.3 Tx RHCP Azimuth



Max Gain	50.3	dBi	

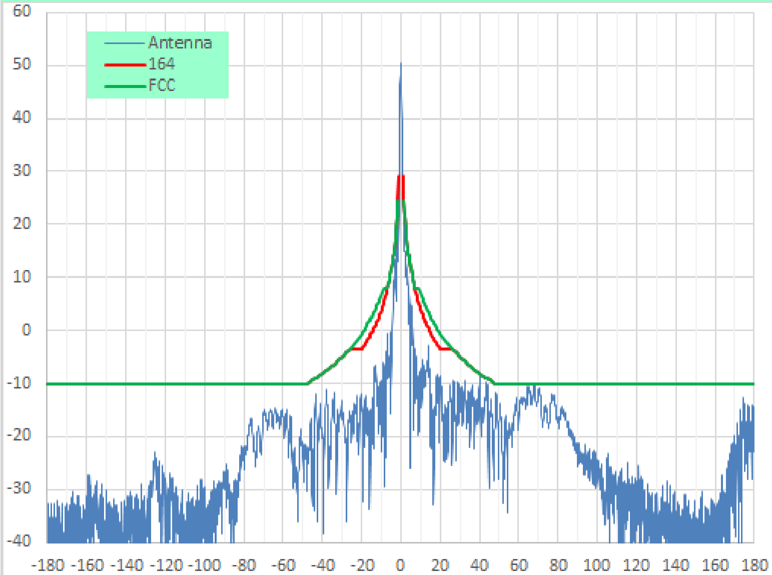


Max Gain	50.3	dBi	

Antenna Gain Pattern: Uplink Azimuth RHCP Mid

Gain (dBi) vs Azimuth Angle (degrees)

20190426m01v01.0_135_AntennaPlots.xlsx XmidRHCPulaz

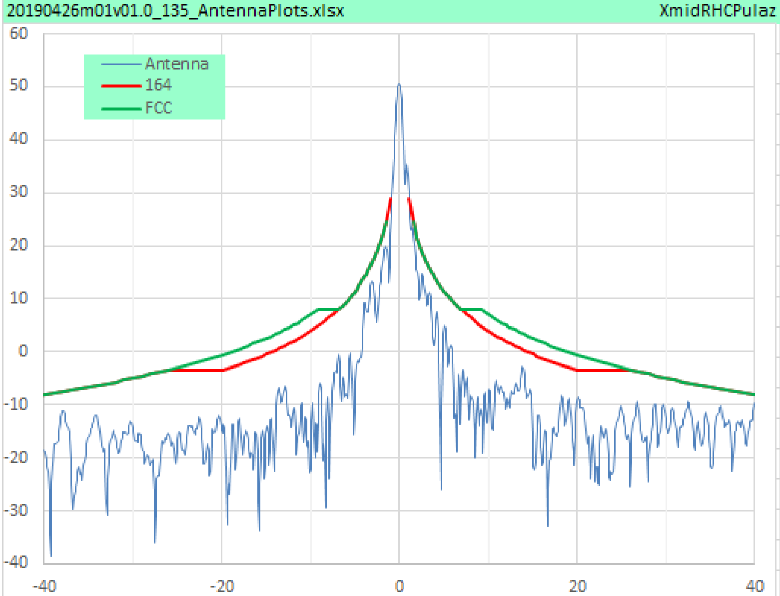


Max Gain	50.5	dBi

Antenna Gain Pattern: Uplink Azimuth RHCP Mid

Gain (dBi) vs Azimuth Angle (degrees)

20190426m01v01.0_135_AntennaPlots.xlsx XmidRHCPulaz

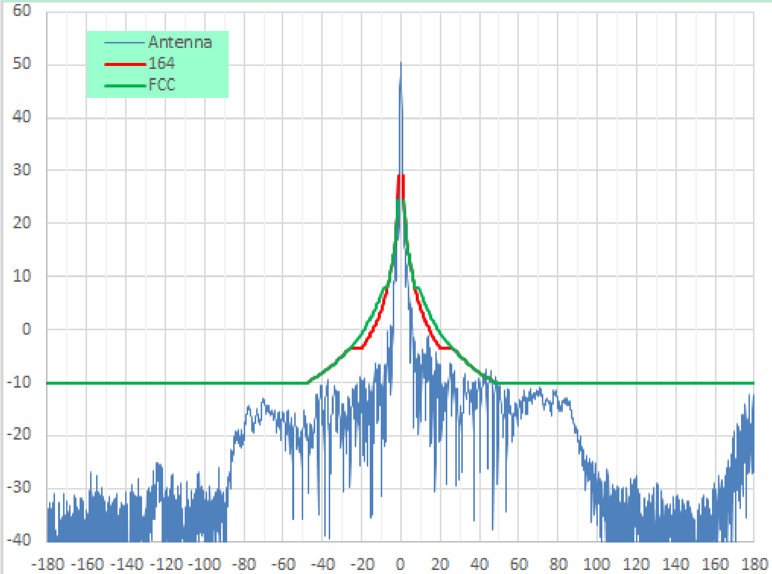


Max Gain	50.5	dBi

Antenna Gain Pattern: Uplink Azimuth RHCP High

Gain (dBi) vs Azimuth Angle (degrees)

20190426m01v01.0_135_AntennaPlots.xlsx XhighRHCPulaz

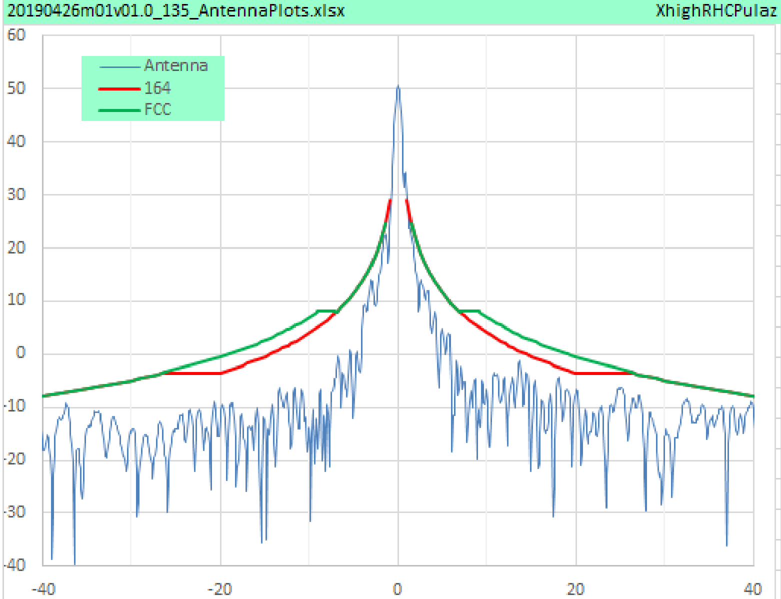


	Max Gain		50.6	dBi			

Antenna Gain Pattern: Uplink Azimuth RHCP High

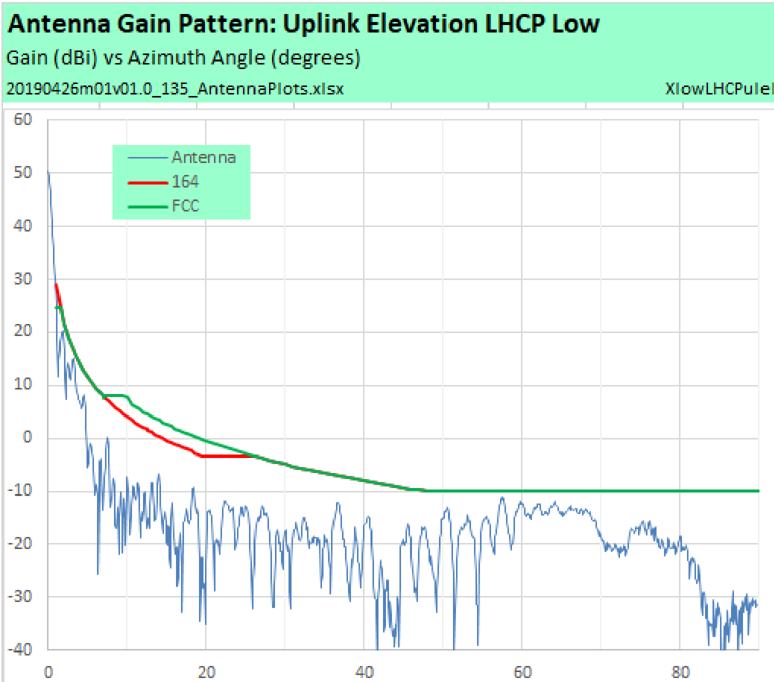
Gain (dBi) vs Azimuth Angle (degrees)

20190426m01v01.0_135_AntennaPlots.xlsx XhighRHCPulaz

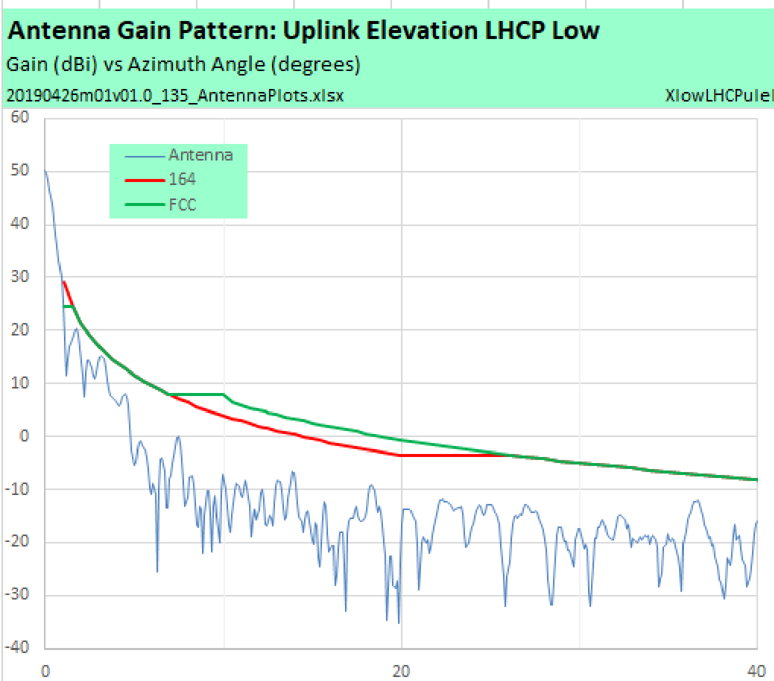


	Max Gain		50.6	dBi			

4.4 Tx LHCP Elevation



Max Gain 50.3 dBi

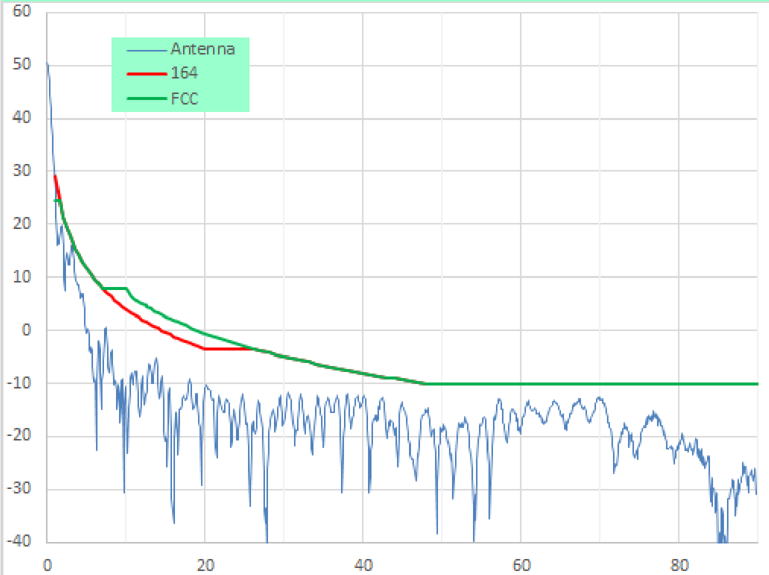


Max Gain 50.3 dBi

Antenna Gain Pattern: Uplink Elevation LHCP Mid

Gain (dBi) vs Azimuth Angle (degrees)

20190426m01v01.0_135_AntennaPlots.xlsx XmidLHCPulel



	Max Gain			50.5	dBi		

Antenna Gain Pattern: Uplink Elevation LHCP Mid

Gain (dBi) vs Azimuth Angle (degrees)

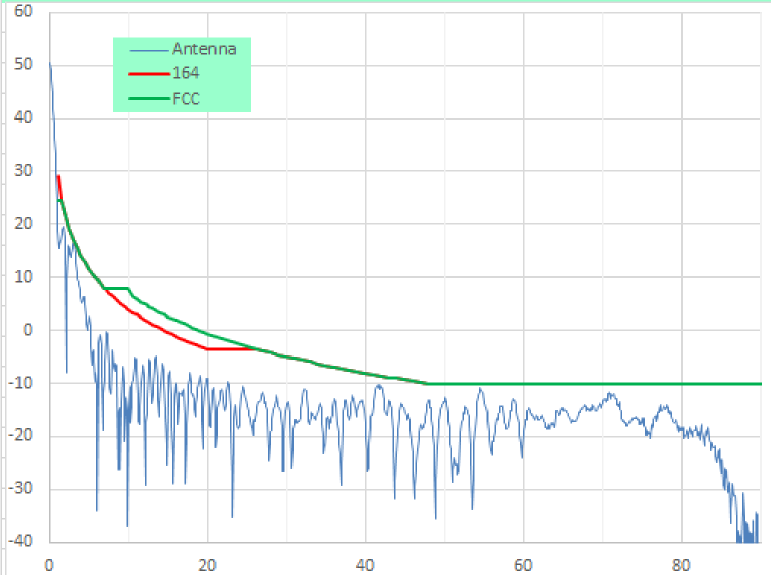
20190426m01v01.0_135_AntennaPlots.xlsx XmidLHCPulel

	Max Gain			50.5	dBi		

Antenna Gain Pattern: Uplink Elevation LHCP High

Gain (dBi) vs Azimuth Angle (degrees)

20190426m01v01.0_135_AntennaPlots.xlsx XhighLHCPulel

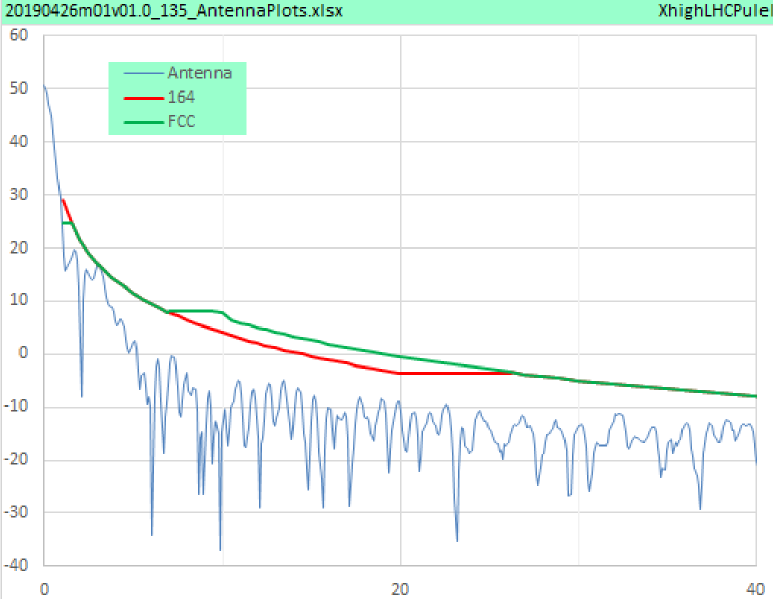


Max Gain		50.6	dBi

Antenna Gain Pattern: Uplink Elevation LHCP High

Gain (dBi) vs Azimuth Angle (degrees)

20190426m01v01.0_135_AntennaPlots.xlsx XhighLHCPulel



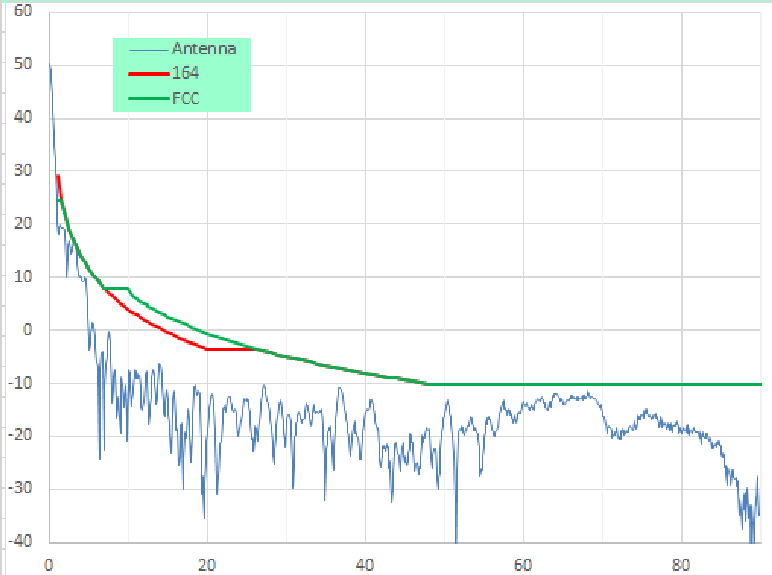
Max Gain		50.6	dBi

4.5 Tx RHCP Elevation

Antenna Gain Pattern: Uplink Elevation RHCP Low

Gain (dBi) vs Azimuth Angle (degrees)

20190426m01v01.0_135_AntennaPlots.xlsx XlowRHCPulel

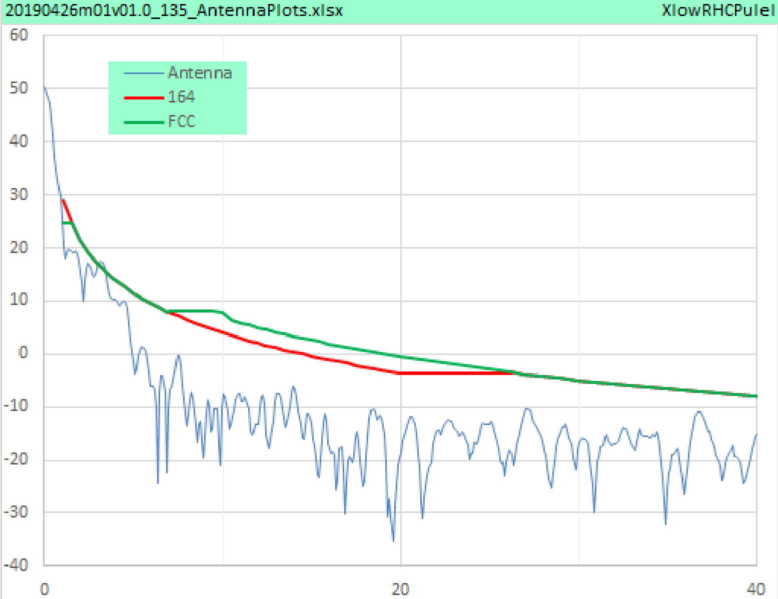


Max Gain 50.3 dBi

Antenna Gain Pattern: Uplink Elevation RHCP Low

Gain (dBi) vs Azimuth Angle (degrees)

20190426m01v01.0_135_AntennaPlots.xlsx XlowRHCPulel



Max Gain 50.3 dBi

Antenna Gain Pattern: Uplink Elevation RHCP Mid

Gain (dBi) vs Azimuth Angle (degrees)

20190426m01v01.0_135_AntennaPlots.xlsx XmidRHCPulel

Max Gain		50.5	dBi	

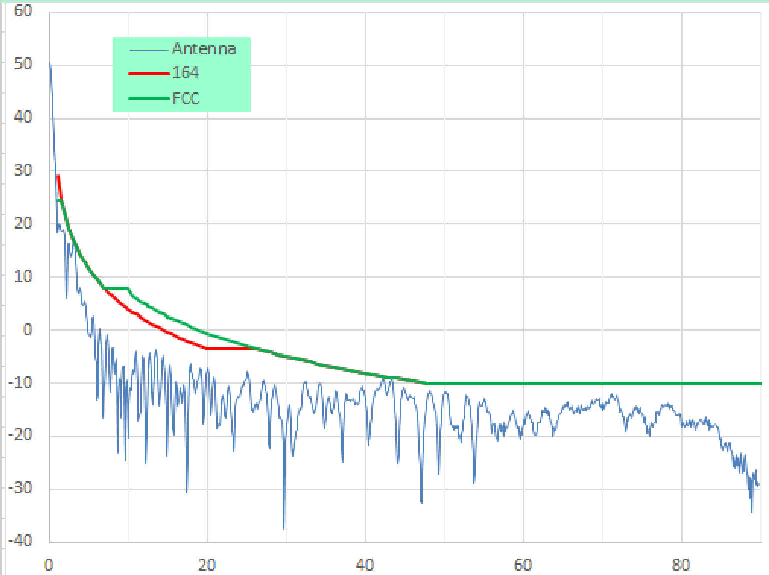
Antenna Gain Pattern: Uplink Elevation RHCP Mid

Gain (dBi) vs Azimuth Angle (degrees)

20190426m01v01.0_135_AntennaPlots.xlsx XmidRHCPulel

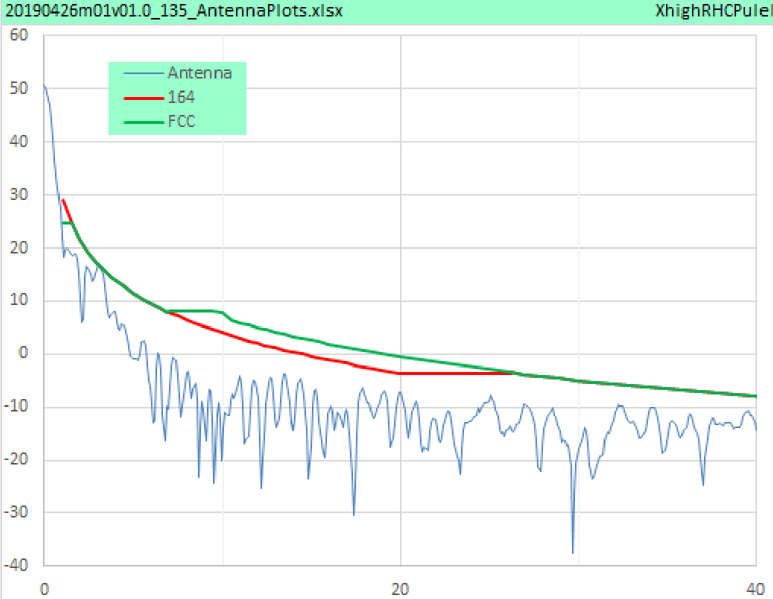
Max Gain		50.5	dBi	

Antenna Gain Pattern: Uplink Elevation RHCP High
Gain (dBi) vs Azimuth Angle (degrees)
20190426m01v01.0_135_AntennaPlots.xlsx XhighRHCPuleI



	Max Gain		50.6	dBi			

Antenna Gain Pattern: Uplink Elevation RHCP High
Gain (dBi) vs Azimuth Angle (degrees)
20190426m01v01.0_135_AntennaPlots.xlsx XhighRHCPuleI



	Max Gain		50.6	dBi			

5 Antenna Patterns - AVL/Viasat BAT-600

5.1 Summary

The antenna is compliant with:

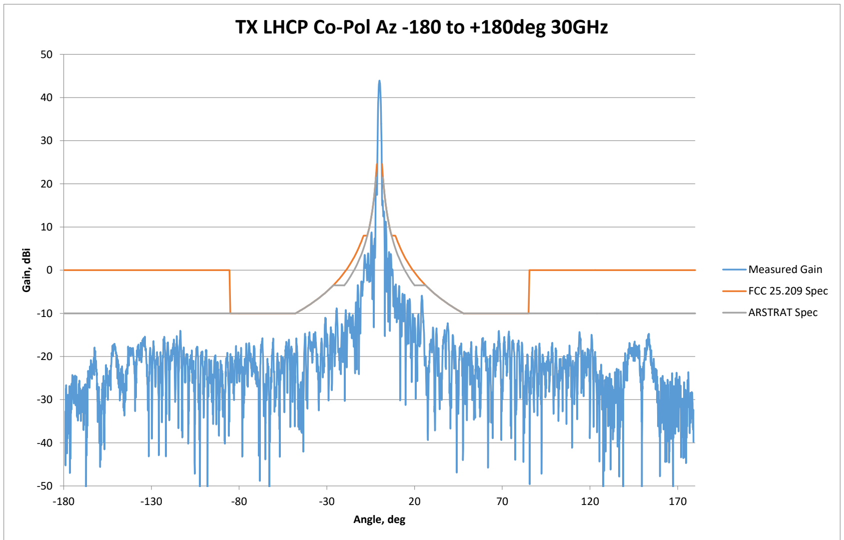
- **CFR-2010-title47-vol2-sec25-209**
- **Mil-Std-188-164c**

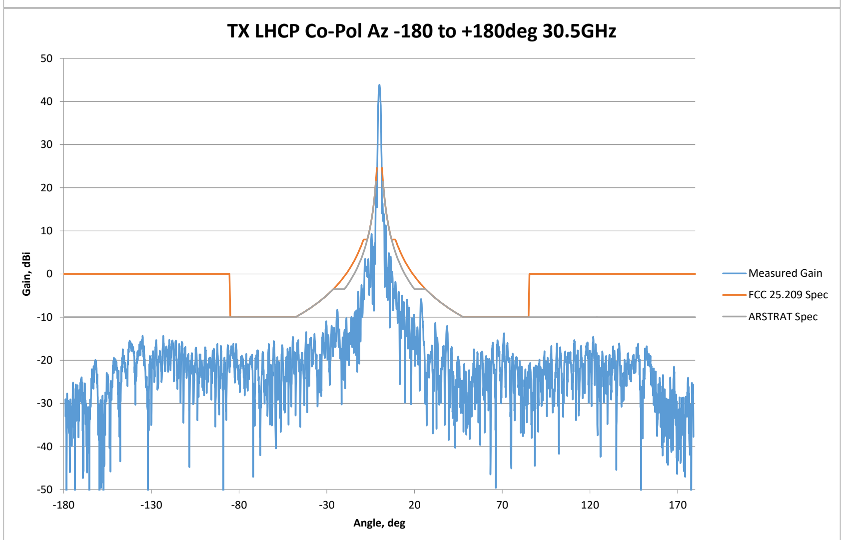
Transmit Gain and Axial Ratio

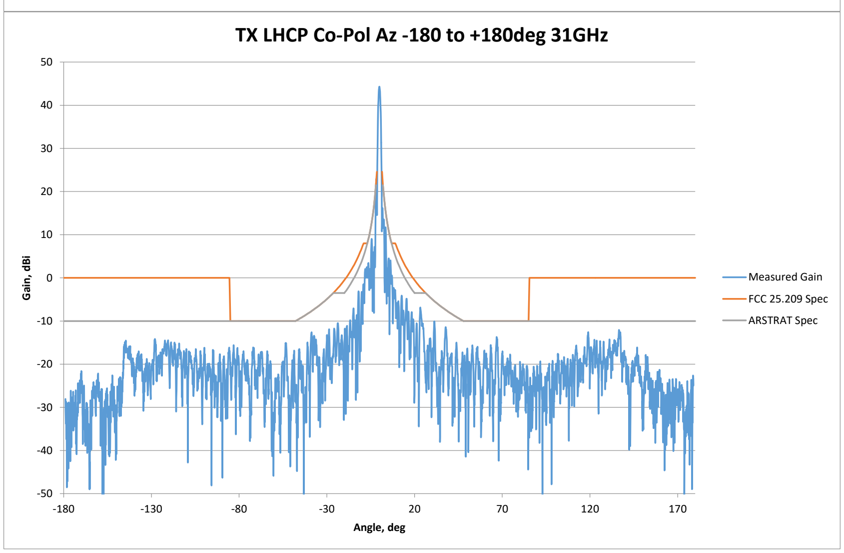
	30.0GHz	30.5GHz	31.0GHz
Gain,dBi LHCP	43.9	43.9	44.4
Gain,dBi RHCP	44.1	43.9	44.2
Axial Ratio,dB LHCP	0.51	0.45	0.69
Axial Ratio, dB RHCP	0.42	0.49	0.77

3 dB beamwidth in Azimuth is 0.9 degrees

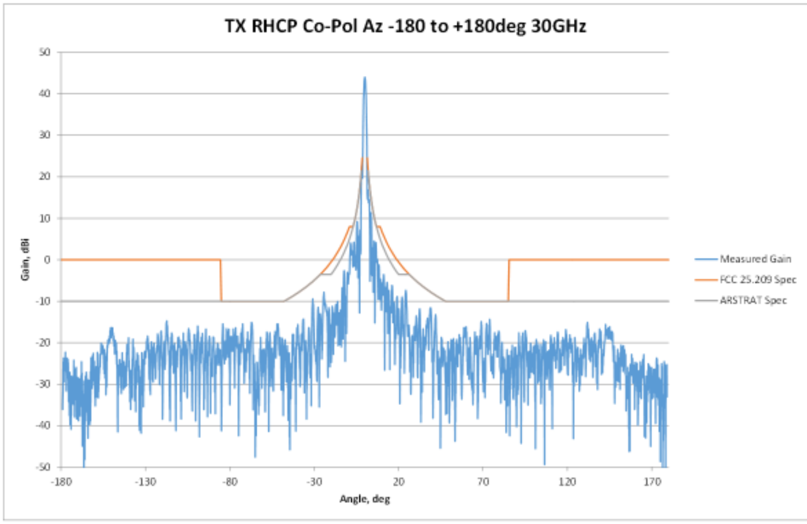
5.2 Tx LHCP Azimuth

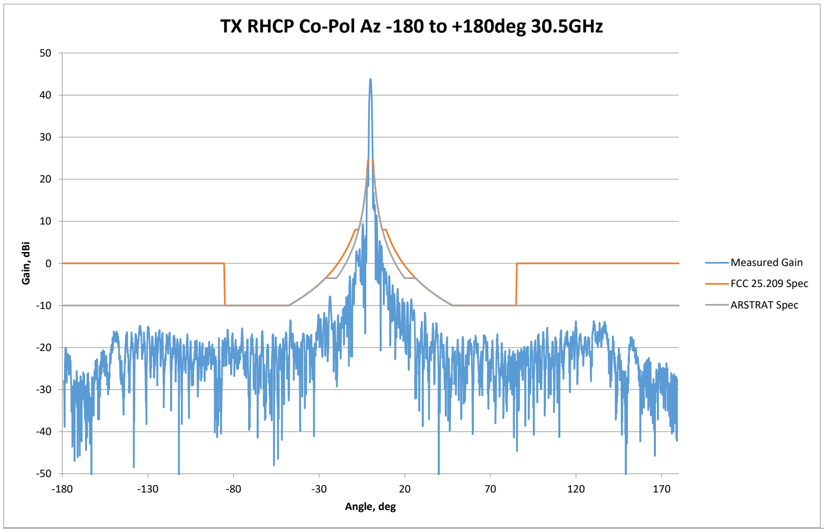


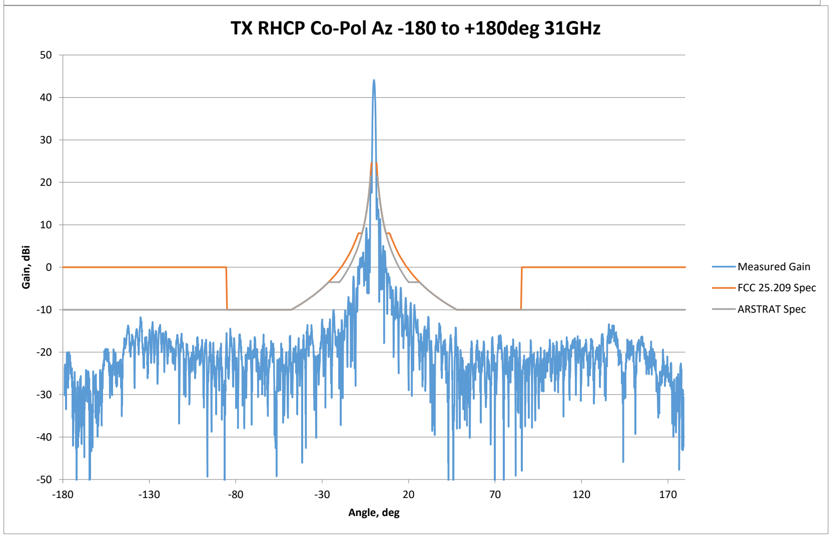




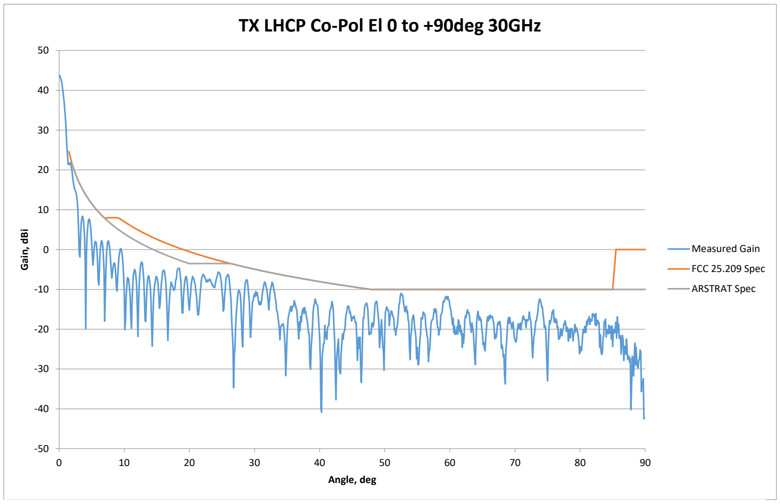
5.3 Tx RHCP Azimuth

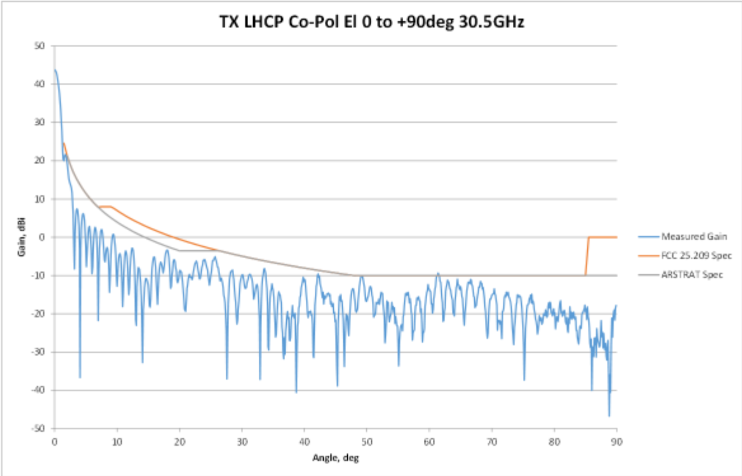


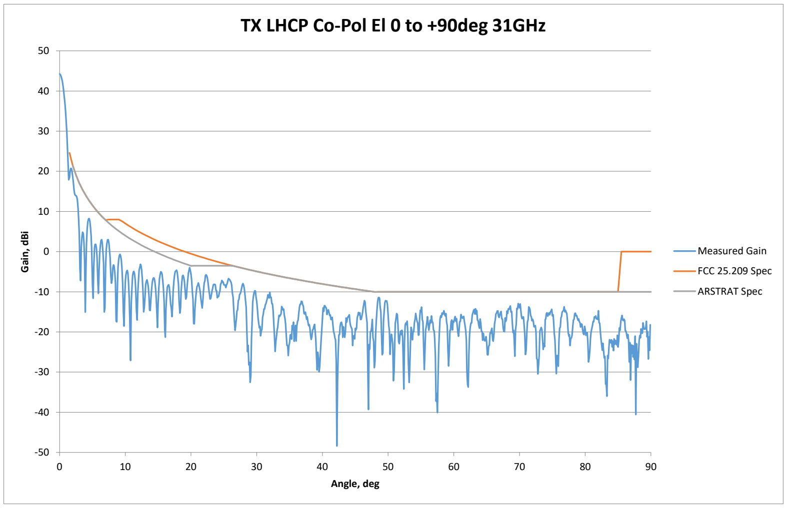




5.4 Tx LHCP Elevation







5.5 Tx RHCP Elevation