FCC Form 312 **Exhibit 1**

LEGAL NARRATIVE AND
RESPONSE TO QUESTIONS 35:
WAIVER OF THE RULES

O3b Limited ("O3b") operates a U.K.-authorized, non-geostationary orbit ("NGSO") Fixed-Satellite Service ("FSS") system in the Ka-band.[1] In this application, O3b seeks a license permitting it to operate two (2) AvL .85m earth station terminals at the O3b facility in Manassas, Virginia. Each earth station terminal will consist of two (2) .85m AvL antennas. Throughout this application, these terminals will be referred to as the collectively, the "Randolph Ridge .85m Earth Station."

Public Interest Showing

The Randolph Ridge .85m Earth Station will communicate with O3b's system and will be used to integrate and test new .85m earth station terminals before they are deployed to customers or demonstration sites. The Randolph Ridge .85m Earth Station will also permit O3b to conduct customer demonstrations at the Randolph Ridge facility should the need arise. The Randolph Ridge .85m Earth Station will enable O3b to prepare its earth station terminals for commercial use before deployment and ensure that its customers around the globe continue to receive high quality service from O3b.

U.S. Market Access

Last year, the International Bureau granted O3b's request for U.S. market access for four additional NGSO satellites, thereby increasing the number of O3b satellites that are authorized to serve the United States from eight to twelve and consolidating under a single authorization all of O3b's authority to use its space stations to serve the U.S. market.[2] O3b hereby incorporates by reference the Market Access Application and Market Access Grant, which demonstrate compliance with the requirements of Section 25.137 of the Commission's rules[3] for earth stations applicants proposing to operate with non-U.S. licensed space stations.

Frequency Plan

The Randolph Ridge .85m Earth Station will communicate with O3b's NGSO system.

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[1] In September 2012, the Commission granted O3b a license to operate one of the gateways for this system in Haleiwa, Hawaii. *See* FCC File No. SES-LIC-20100723-00952 (granted Sept. 25, 2012) (the "Hawaii Gateway License"). In June 2013, the Commission granted O3b a license to operate a second gateway in the United States, located in Vernon, Texas (the "Texas License"). *See* FCC File No. SES-LIC-20130124-00089 (granted June 20, 2013).
[2] *See* O3b's Petition for Declaratory Ruling, File Nos. SAT-LOI-20141029-00118 and SAT-AMD-20150115-00004 (the "Market Access Application"), as granted by grant stamp on Jan. 22, 2015 (the "Market Access Grant"). O3b's first four satellites were launched on June 25, 2013, and an additional four satellites were launched on July 10, 2014. O3b subsequently launched another four satellites on December 18, 2014.
[3] 47 C.F.R. s 25.137.

The frequencies to be used by the Randolph Ridge .85m Earth Station are:

- 27.6-28.4 GHz, 28.6-29.1 GHz (uplink)
- 17.8-18.6 GHz, 18.8-19.3 GHz (downlink)

The Randolph Ridge .85m Earth Station antennas will be mounted on fixed platforms. Although the pointing angle of the antennas will change as O3b's in-orbit satellites are tracked, each platform will remain stationary. O3b's proposed Randolph Ridge .85m Earth Station operations in shared bands are consistent with the Commission's rules and policies. O3b addresses each of these bands below.

O3b notes the ongoing Spectrum Frontiers proceeding,[4] which contemplates revising the status of FSS and terrestrial mobile services in the 27.5-28.35 GHz band. The earth station that is the subject of this application will be located at O3b's Network Operations Center ("NOC") also known as its "Randolph Ridge" facility in Manassas, Virginia. O3b has invested millions of dollars to construct the Randolph Ridge facility, including the construction of a private fiber line, in order to enable the NOC to effectively manage the global O3b ground station network.

O3b intends to site the Randolph Ridge .85m Earth Station at the Randolph Ridge facility, co-locating it with a number of other O3b earth stations. O3b is co-locating all its testing and integration earth stations at the Randolph Ridge site in order to streamline the testing and integration of its customer earth stations. By co-locating all its earth station testing and integration in at the Randolph Ridge facility, O3b is furthering Commission policy by limiting the geographic impact of its earth station deployments in the 27.6-28.35 GHz band and avoiding constraints on terrestrial deployment.

UPLINK

27.6-28.35 GHz – Secondary uplink band shared with primary LMDS.

The 27.6-28.35 GHz uplink band is allocated to the local multipoint distribution service ("LMDS") on a primary basis. FSS operations are allocated on a secondary basis in the same band. Accordingly, O3b's proposed operations in this band must not cause harmful interference to primary LMDS stations.

The attached Comsearch coordination report demonstrates that O3b can operate its Randolph Ridge .85m Earth Station on a secondary basis in this band without causing harmful interference to LMDS licensees. Comsearch sent a coordination notice to all existing and proposed terrestrial licensees within the Comsearch coordination contours of the Randolph Ridge .85m Earth Station site. No objections were received from any of the incumbent licensees.

28.35-28.4 GHz – Secondary uplink band shared with primary GSO FSS stations.

In the 28.35-28.4 GHz band, there is a primary allocation for GSO FSS systems and a secondary allocation for NGSO FSS systems. O3b's Randolph Ridge .85m Earth Station transmissions in this band

[4] *Use of Spectrum Bands Above 24 GHz For Mobile Radio Services*, GN Docket No. 14-177, *et al.*, Notice of Proposed Rulemaking, FCC 15-138 (rel. Oct. 23, 2015).

will be consistent with their secondary status vis-à-vis GSO FSS transmissions. The Commission has allowed similar secondary use of frequencies in the Ka-band uplink allocated to GSO FSS on a primary basis where applicants are prepared to accept interference from primary operations and can demonstrate that their proposed operations are not likely to cause harmful interference to primary operations.[5] O3b satisfies both of these standards.

As a secondary user of the 28.35-28.4 GHz band in the United States, O3b makes no claim of protection from interference from U.S.-licensed GSO FSS networks in this band segment. As for O3b's uplink operations in the 28.35-28.4 GHz band, the ITU has developed uplink equivalent power flux density limits ("$EPFD_{up}$") limits to protect co-frequency GSO FSS operations from unacceptable interference from NGSO FSS systems operating in the same frequencies. Specifically, in accordance with Article 22 of the ITU Radio Regulations, if the applicable $EPFD_{up}$ limits are met, the NGSO FSS satellite system is considered to have met its obligations to protect GSO FSS networks from unacceptable interference.

O3b previously demonstrated that its gateway located at Hawaii operating at the authorized power levels will meet the applicable ITU $EPFD_{up}$ limits in all frequency ranges where these limits apply, due to the inherent angular separation between the O3b and geostationary orbits when viewed from the Earth at latitudes away from the equator.[6] The Randolph Ridge .85m Earth Station is located further north in latitude than the Hawaii Gateway Earth Station,[7] which results in an even greater angular separation between the O3b and geostationary orbits as viewed from the Earth and an even greater assurance that the applicable ITU $EPFD_{up}$ limits will be met by O3b's proposed operations. The proposed Randolph Ridge .85m Earth Station operations, therefore, also will meet the applicable ITU $EPFD_{up}$ limits. In any event, O3b confirms that its operations will be on a secondary basis relative to U.S.-licensed GSO FSS networks in the same band.

<u>DOWNLINK</u>

<u>17.8-18.3 GHz – Primary downlink band for licensed FS Systems.</u>

This frequency band is allocated on a primary basis to FS, and there is no secondary allocation for NGSO FSS in the band. O3b's space stations transmit in this band. These transmissions have been authorized, and waivers of the Ka-Band Plan and Section 2.106 of the Commission's rules have been granted, in O3b's Market Access grant.

O3b does not believe any additional waivers should be needed for its Randolph Ridge .85m Earth Station to receive transmissions in the 17.8-18.3 GHz band. To the extent necessary, however, O3b requests a waiver of the Ka-Band Plan and Section 2.106 of the Commission's rules to permit the

[5] *Northrop Grumman Space & Missions Systems Corporation*, 24 FCC Rcd 2330, at ¶¶ 72-73 (Int'l Bur. 2009); *contactMEO Communications*, LLC, 21 FCC Rcd 4035, at ¶¶ 23-24, (Int'l Bur., 2006).
[6] O3b Hawaii Gateway License Application, FCC File No. SES-LIC-20100723-00952, Technical Attachment at A.10.1.
[7] The O3b Hawaii gateway latitude is 21° 40' 17.8" N; the Randolph Ridge .85m Earth Station latitude is 38° 47' 46.6" N.

Randolph Ridge .85m Earth Station to receive transmissions from its NGSO FSS system in the 17.8-18.3 GHz band on a non-conforming, non-interference basis.

As noted above, in analyzing requests for non-conforming spectrum uses, the Commission has indicated it will generally grant such waivers where there is not potential for interference into any service authorized under the Table of Frequency Allocations and when the non-conforming operator accepts any interference from allocated services. In this case, non-conforming use of the 17.8-18.3 GHz frequency band for downlink operations will not cause harmful interference to FS operations in the same band. This is because O3b meets the PFD limits at the earth's surface prescribed by the ITU for the protection of terrestrial services in this band. In addition, as a non-conforming user, O3b has to accept interference from FS operations in the band. Moreover, an Interference Analysis Report from Comsearch indicates that there will be no restrictions of O3b's operations due to interference considerations.

In light of the foregoing, a waiver of Section 2.106 of the Commission's rules and the Ka-Band Plan, to the extent required, is warranted because no harmful interference will result to incumbent FS operations, O3b can operate satisfactorily within the 18 GHz microwave environment, and the public interest is otherwise served by permitting O3b to support its commercial operations.

<u>18.3-18.6 GHz – Non-conforming downlink band shared with primary GSO FSS stations.</u>

The 18.3-18.6 GHz band is allocated in the United States on a primary basis to GSO FSS. In the 18.3-18.6 GHz downlink band, the ITU has developed downlink equivalent power flux density ("$EPFD_{down}$") limits to protect GSO FSS networks from unacceptable interference from NGSO FSS systems operating in the same frequencies. Specifically, in accordance with Article 22 of the ITU Radio Regulations, if the applicable $EPFD_{down}$ limits are met, the NGSO FSS satellite system is considered to have met its obligations to protect GSO FSS networks from unacceptable interference.

O3b's system meets the applicable ITU $EPFD_{down}$ limits in all frequency ranges where these limits apply.[8] As an example of how these limits are satisfied, O3b provided $EPFD_{down}$ calculations for transmissions to its Hawaii Gateway Earth Station.[9] O3b also showed how the $EPFD_{down}$ limits can be satisfied at all latitudes.[10] O3b is able to satisfy the limits by taking advantage of the inherent angular separation of the O3b and the GSO orbits when viewed from the surface of the Earth at latitudes away from the equator.[11] Based on these prior showings, it can be seen that transmissions to Randolph Ridge .85m Earth Station will be within the $EPFD_{down}$ limits.

The 27.5-28.35 Band and "Gateway-Type Services"

[8] *See* ITU Radio Regulations, Article 22. *See also* O3b Hawaii Gateway License Application, FCC File No. SES-LIC-20100723-00952, Technical Attachment at A.10.1 for a discussion of O3b's compliance with the operational limits in Article 22 of the ITU Radio Regulations. *See also* Letter from Brian D. Weimer, to Marlene H. Dortch, in re O3b Application for Hawaii Gateway Earth Station, File No. SES-LIC-20100723-00952 (Apr. 22, 2011), Annex A.
[9] O3b Hawaii Gateway License Application, FCC File No. SES-LIC-20100723-00952, Technical Attachment at A.10.1.
[10] *See* id.
[11] *See* id.

The Commission's references to "gateway-type service" in the 27.5-28.35 GHz band are not intended as a requirement that earth stations in the band serve as gateway earth stations. Rather, the references to "gateway-type service" in the 27.5-28.35 GHz band reflect the Commission's expectation as to the type of services that FSS operators would be able to provide on a secondary basis, *i.e.,* services the FSS operators can provide without causing interference to LMDS stations that are primary in the 27.5-28.35 GHz band.

No requirement that earth stations in the band serve as gateways.

The Commission's rules support the above interpretation. Although the rules limit operations in some bands to gateway earth stations, the 27.5-28.35 GHz band is not among them.

Commission's expectation as to the type of services that FSS operators would be able to provide.

The Commission's findings in the Ka-band rulemaking proceeding shed light upon what qualifies as a gateway-type earth station that an FSS licensee may operate in the 27.5-28.35 GHz band. These findings show that the Commission's concern is with ubiquitous user terminals that could interfere with LMDS operations. The Commission stated, for example, that: "Gateways are earth stations generally larger than user terminals that support multiple carriers. By their nature, they are not deployed in the same ubiquitous way as the user transceivers."[12] Similarly, the Commission stated in the Third Report and Order that: "As a practical matter, it is unlikely that FSS can operate ubiquitous terminals on an unprotected non-interference basis to LMDS."[13]

O3b's proposed operations satisfy these standards. O3b seeks authority to operate two earth stations consisting of two .85m antennas. Comsearch, on O3b's behalf, notified 28 GHz LMDS licensees and lessees of O3b's Randolph Ridge Application, and none of them objected to it.[14] O3b's Randolph Ridge .85m Earth Station, therefore, is compatible with LMDS operations and is consistent with the views expressed by the Commission as to what qualifies as gateway-like.

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[12] *In the Matter of Rulemaking to Amend Parts 1, 2, 21, and 25 of the Commission's Rules to Redesignate the 27.5 – 29.5 GHz Frequency Band, to Reallocate the 29.5 - 30.0 GHz Frequency Band, to Establish Rules and Policies for Local Multipoint Distribution Service and for Fixed Satellite Services and Suite 12 Group Petition for Pioneer's Preference, Third Notice of Proposed Rulemaking and Supplemental Tentative Decision,* 11 FCC Rcd 53, 60, n. 8 (1995).

[13] *In the Matter of Rulemaking to Amend Parts 1, 2, 21, and 25 of the Commission's Rules to Redesignate the 27.5-29.5 GHz Frequency Band, to Reallocate the 29.5-30.0 GHz Frequency Band, to Establish Rules and Policies for Local Multipoint Distribution Service and for Fixed Satellite Services, Third Report and Order*, 12 FCC Rcd 22310, 22327, ¶42 (1997). Notwithstanding its concern with ubiquitous user terminals, moreover, the Commission authorized Teledesic to provide services in the 27.5-28.35 GHz band that had ubiquitous elements. In 1997, the Commission authorized Teledesic to operate 27.5-28.35 GHz band NGSO FSS "Gigalink" terminals on a secondary basis that were to be used, among other things, "in privately owned networks and as high-rate terminals." *In the Matter of Teledesic Corporation Application for Authority to Construct, Launch, and Operate a Low Earth Orbit Satellite System in the Domestic and International Fixed Satellite Service*, 12 FCC Rcd. 3154 at ¶2156, n.6 (Chief IB 1997).

[14] *See* Randolph Ridge .85m Earth Station Application, Annex 4.

Earth Station Technical Parameters

The following documents containing technical details of the operations proposed under the requested license are attached:

- Annex 1: Link Budgets. Representative links for the Randolph Ridge .85m Earth Station are provided.
- Annex 2: Antenna Characteristics. Characteristics of the .85m AvL Antenna are provided for the Commission's convenience.
- Annex 3: Radiation Hazard Study. The radiation hazard analysis for the .85m AvL antenna is attached. As described in Annex 3, O3b will follow procedures to mitigate potential radiation hazards to personnel in controlled and uncontrolled environments.
- Annex 4: Comsearch Reports. Comsearch Reports are provided for bands in which terrestrial frequencies have primary allocations. Comsearch notified operators within a coordination zone calculated using the ITU RR Appendix 7 guidelines.
    - 27.6-28.35 GHz band. As stated in the attached Frequency Coordination Report, Comsearch has notified all existing and proposed LMDS licensees that are within the coordination contours of the Randolph Ridge .85m Earth Station and that potentially could be affected by O3b's transmissions in the 27.6-28.35 GHz portion of the Ka-band. No objections were received from any of these parties.
    - 18.3-18.6 GHz band. As stated in the attached Interference Analysis Report, for operations in the 18.3-18.6 GHz band, the Randolph Ridge .85m Earth Station will operate satisfactorily within the 18 GHz microwave environment, and there will be no restrictions of its operation due to interference considerations.
- Annex 5: Compliance with No. 22.5D of the ITU Radio Regulations. O3b demonstrates that the Randolph Ridge .85m Earth Station will comply with the EPFD(up) limits in No. 22.5D of the ITU Radio Regulations.
- Annex 6: Antenna Patterns. O3b submits measured 30 GHz band antenna performance data for the .85m AvL antenna.
- Annex 7: FAA Notification. O3b provides an explanation why, in compliance with 47 CFR Part 17 and 47 CFR part 25.113(c), FAA notification is not required for this earth station license application.

Further, O3b incorporates by reference the following technical parameters previously provided by O3b:

- Schedule S. In its Petition, O3b submitted a Schedule S describing its satellite system's technical characteristics.[15] The Schedule S correctly described the O3b satellite system for that application, and numerically enveloped all of the necessary parameters for future earth station applications. O3b will operate its Randolph Ridge .85m Earth Station within the parameters described in this Schedule S.

[15] *See* O3b PDR.

- U.S. Government Coordination. O3b has completed all necessary coordination with U.S. government satellite networks operating in Ka-band, including GSO and NGSO networks, as well as their associated specific earth stations filed under 9.7A and 9.7B of the ITU Radio Regulations through other administrations. O3b has also completed coordination, according to US footnote 334 of the FCC table of frequency allocations, with the U.S. government, and this US334 coordination agreement specifically provides for additional earth stations in U.S. territory operating with O3b's satellites, such as the Randolph Ridge .85m Earth Station. As a result, O3b's existing US334 coordination agreement covers the use of the Randolph Ridge .85m Earth Station as requested in this application.
- Space Station Nadir-Pointing Antenna Pattern Contours. O3b provided a mathematical description for the user and gateway antenna beams necessary to derive the antenna pattern contour diagram for any O3b satellite location and earth station location in its Blanket Maritime Application. O3b's prior response is hereby incorporated by reference.[16]
- CALEA. O3b has filed documents with the Commission regarding its CALEA obligations under 47 C.F.R. 1.20005.

[16] *See* FCC File No. SES-LIC-20130528-00455 (the "Blanket Maritime License"), Response to 09-25-2013 IB Letter, Oct. 25, 2013.

Conclusion

O3b has demonstrated that its Randolph Ridge .85m Earth Station will enhance the service provided by earth stations communicating with the O3b System. Grant of O3b's application, therefore, is in the public interest.

Respectfully submitted,

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ANNEX 1 – Link Budgets

Representative link budgets for the .85m AvL antenna at the Randolph Ridge .85m Earth Station are provided on the following pages.

Minimum Elevation

O3b Networks Link Analysis - Tier 2 Service for			
ECM Link Budget Rpt - 06/27/2016		**Tier 2**	**Tier 2**
Parameters	Unit	**Clear Sky**	
Ground parameters		**Teleport**	**Telco**
Location		Manassas/U.S.A.	Lima/Peru
Latitude	(deg)	38.80	-12.29
Longitude (East)	(deg)	-77.58	283.15
E/S Range to SV	(km)	11323.80	9951.63
E/S Elevation to SV	(deg)	16.06	32.94
E/S Altitude	(m)	0.00	13.00
SV Beam Identifier	(#)	TBD	
Telco Offset to Beam Center	(km)	34.45	
Modulation Parameters		**Forward**	
Enter Receiver	Type	MEOLink	
Percentage of Bandwidth	(%)	100%	
Allocated Bandwidth	(MHz)	216.0000	
Channel Symbol Rate	(Msps)	180.0000	
Channel Modulation Type		8PSK	
Channel FEC Rate		0.66420	
Channel Throughput	(Mbps)	355.1168	
Uplink		**Forward**	
E/S Carrier Frequencies	(MHz)	28,020.0000	
E/S Tx HPA Power Level	(W)	500.0	
E/S Tx OBO	(dB)	-11.3	
E/S Tx Antenna Gain (7.3m)	(dB)	65.3	
E/S Tx EIRP	(dBW)	73.2	
E/S Tx RF Link Availability	(%)	Clear	
E/S Tx Spreading Loss	(dB)	-150.9	
Satellite		**Forward**	
SV Rx G/T	(dB/K)	5.7	
SV Tx OBO	(dB)	-3.8	
SV Tx EIRP Per Channel/Carrier	dBW	44.5	
Downlink		**Forward**	
E/S Rx Carrier Frequency	(MHz)	18,220.0000	
E/S Rx Rf Link Availability	(%)	Clear	
E/S Rx Antenna Gain (0.85m)	(dBi)	42.1	
E/S Rx Effective G/T	(dB/K)	18.6	
Total Link		**Forward**	
Carrier/Noise Bandwidth	(dB)	22.6	
Carrier/Noise Uplink	(dB)	22.4	
Carrier/Noise Downlink	(dB)	8.9	
Carrier/Intermodulation Im (C/Im)	(dB)	112.2	
(C/N)- Total Actual (Es/No)	(dB)	8.2	
(C/N)-Total Required	(dB)	7.6	
(Eb/No)-Total Actual	(dB)	5.2	
(Eb/No)-Total Required	(dB)	4.6	
Excess Margin	(dB)	**0.6**	
Fade Margin	(dB)	**10.4**	

O3b Networks Link Analysis - Tier 2 Service for

ECM Link Budget Rpt - 06/27/2016		Tier 2	Tier 2
Parameters	Unit	**Rain Up**	
Ground parameters		**Teleport**	**Telco**
Location		Manassas/U.S.A.	Lima/Peru
Latitude	(deg)	38.80	-12.29
Longitude (East)	(deg)	-77.58	283.15
E/S Range to SV	(km)	11323.80	9951.63
E/S Elevation to SV	(deg)	16.06	32.94
E/S Altitude	(m)	0.00	13.00
SV Beam Identifier	(#)	TBD	
Telco Offset to Beam Center	(km)	34.45	
Modulation Parameters		**Forward**	
Enter Reciever	Type	MEOLink	
Percentage of Bandwidth	(%)	100%	
Allocated Bandwidth	(MHz)	216.0000	
Channel Symbol Rate	(Msps)	180.0000	
Channel Modulation Type		QPSK	
Channel FEC Rate		0.59704	
Channel Throughput	(Mbps)	212.8063	
Uplink		**Forward**	
E/S Carrier Frequencies	(MHz)	28,020.0000	
E/S Tx HPA Power Level	(W)	500.0	
E/S Tx OBO	(dB)	-4.0	
E/S Tx Antenna Gain (7.3m)	(dB)	65.3	
E/S Tx EIRP	(dBW)	80.5	
E/S Tx RF Link Availability	(%)	99.980%	
E/S Tx Spreading Loss	(dB)	-150.9	
Satellite		**Forward**	
SV Rx G/T	(dB/K)	5.7	
SV Tx OBO	(dB)	-3.8	
SV Tx EIRP Per Channel/Carrier	dBW	44.5	
Downlink		**Forward**	
E/S Rx Carrier Frequency	(MHz)	18,220.0000	
E/S Rx Rf Link Availability	(%)	Clear	
E/S Rx Antenna Gain (0.85m)	(dBi)	42.1	
E/S Rx Effective G/T	(dB/K)	18.6	
Total Link		**Forward**	
Carrier/Noise Bandwidth	(dB)	22.6	
Carrier/Noise Uplink	(dB)	8.0	
Carrier/Noise Downlink	(dB)	8.9	
Carrier/Intermodulation Im (C/Im)	(dB)	21.0	
(C/N)- Total Actual (Es/No)	(dB)	4.1	
(C/N)-Total Required	(dB)	3.6	
(Eb/No)-Total Actual	(dB)	3.4	
(Eb/No)-Total Required	(dB)	2.8	
Excess Margin	(dB)	**0.6**	
Fade Margin	(dB)	**6.4**	

O3b Networks Link Analysis - Tier 2 Service for

ECM Link Budget Rpt - 06/27/2016		Tier 2	Tier 2
Parameters	Unit	**Rain Dn**	
Ground parameters		**Teleport**	**Telco**
Location		Manassas/U.S.A.	Lima/Peru
Latitude	(deg)	38.80	-12.29
Longitude (East)	(deg)	-77.58	283.15
E/S Range to SV	(km)	11323.80	9951.63
E/S Elevation to SV	(deg)	16.06	32.94
E/S Altitude	(m)	0.00	13.00
SV Beam Identifier	(#)	TBD	
Telco Offset to Beam Center	(km)	34.45	
Modulation Parameters		**Forward**	
Enter Reciever	Type	MEOLink	
Percentage of Bandwidth	(%)	100%	
Allocated Bandwidth	(MHz)	216.0000	
Channel Symbol Rate	(Msps)	180.0000	
Channel Modulation Type		QPSK	
Channel FEC Rate		0.59704	
Channel Throughput	(Mbps)	212.8063	
Uplink		**Forward**	
E/S Carrier Frequencies	(MHz)	28,020.0000	
E/S Tx HPA Power Level	(W)	500.0	
E/S Tx OBO	(dB)	-11.3	
E/S Tx Antenna Gain (7.3m)	(dB)	65.3	
E/S Tx EIRP	(dBW)	73.2	
E/S Tx RF Link Availability	(%)	Clear	
E/S Tx Spreading Loss	(dB)	-150.9	
Satellite		**Forward**	
SV Rx G/T	(dB/K)	5.7	
SV Tx OBO	(dB)	-3.8	
SV Tx EIRP Per Channel/Carrier	dBW	44.5	
Downlink		**Forward**	
E/S Rx Carrier Frequency	(MHz)	18,220.0000	
E/S Rx Rf Link Availability	(%)	95.724%	
E/S Rx Antenna Gain (0.85m)	(dBi)	42.1	
E/S Rx Effective G/T	(dB/K)	16.7	
Total Link		**Forward**	
Carrier/Noise Bandwidth	(dB)	22.6	
Carrier/Noise Uplink	(dB)	22.4	
Carrier/Noise Downlink	(dB)	4.3	
Carrier/Intermodulation Im (C/Im)	(dB)	21.0	
(C/N)- Total Actual (Es/No)	(dB)	4.1	
(C/N)-Total Required	(dB)	3.6	
(Eb/No)-Total Actual	(dB)	3.3	
(Eb/No)-Total Required	(dB)	2.8	
Excess Margin	(dB)	**0.5**	
Fade Margin	(dB)	**6.3**	

Minimum Elevation

O3b Networks Link Analysis - Tier 2 Service for			
ECM Link Budget Rpt - 06/27/2016		**Tier 2**	**Tier 2**
Parameters	Unit	**Clear Sky**	
Ground parameters		**Teleport**	**Telco**
Location		Lima/Peru	Manassas/U.S.A.
Latitude	(deg)	-12.29	38.80
Longitude (East)	(deg)	283.15	-77.58
E/S Range to SV	(km)	9951.63	11323.80
E/S Elevation to SV	(deg)	32.94	16.06
E/S Altitude	(m)	13.00	0.00
SV Beam Identifier	(#)	TBD	
Telco Offset to Beam Center	(km)	0.48	
Modulation Parameters		**Return**	
Enter Receiver	Type	MEOLink	
Percentage of Bandwidth	(%)	14%	
Allocated Bandwidth	(MHz)	30.0000	
Channel Symbol Rate	(Msps)	25.0000	
Channel Modulation Type		QPSK	
Channel FEC Rate		0.33037	
Channel Throughput	(Mbps)	16.3550	
Uplink		**Return**	
E/S Carrier Frequencies	(MHz)	28,020.0000	
E/S Tx HPA Power Level	(W)	20.0	
E/S Tx OBO	(dB)	-4.9	
E/S Tx Antenna Gain (0.85m)	(dB)	45.7	
E/S Tx EIRP	(dBW)	53.0	
E/S Tx RF Link Availability	(%)	Clear	
E/S Tx Spreading Loss	(dB)	-152.1	
Satellite		**Return**	
SV Rx G/T	(dB/K)	5.9	
SV Tx OBO	(dB)	-21.4	
SV Tx EIRP Per Channel/Carrier	dBW	27.1	
Downlink		**Return**	
E/S Rx Carrier Frequency	(MHz)	18,220.0000	
E/S Rx Rf Link Availability	(%)	Clear	
E/S Rx Antenna Gain (7.3m)	(dBi)	61.9	
E/S Rx Effective G/T	(dB/K)	40.2	
Total Link		**Return**	
Carrier/Noise Bandwidth	(dB)	14.0	
Carrier/Noise Uplink	(dB)	8.2	
Carrier/Noise Downlink	(dB)	23.3	
Carrier/Intermodulation Im (C/Im)	(dB)	106.8	
(C/N)- Total Actual (Es/No)	(dB)	7.8	
(C/N)-Total Required	(dB)	-0.3	
(Eb/No)-Total Actual	(dB)	9.6	
(Eb/No)-Total Required	(dB)	1.5	
Excess Margin	(dB)	**8.1**	
Fade Margin	(dB)	**10.0**	

O3b Networks Link Analysis - Tier 2 Service for

ECM Link Budget Rpt - 06/27/2016		Tier 2	Tier 2
Parameters	Unit	**Rain Up**	
Ground parameters		**Teleport**	**Telco**
Location		Lima/Peru	Manassas/U.S.A.
Latitude	(deg)	-12.29	38.80
Longitude (East)	(deg)	283.15	-77.58
E/S Range to SV	(km)	9951.63	11323.80
E/S Elevation to SV	(deg)	32.94	16.06
E/S Altitude	(m)	13.00	0.00
SV Beam Identifier	(#)	TBD	
Telco Offset to Beam Center	(km)	0.48	
Modulation Parameters		**Return**	
Enter Reciever	Type	MEOLink	
Percentage of Bandwidth	(%)	14%	
Allocated Bandwidth	(MHz)	30.0000	
Channel Symbol Rate	(Msps)	25.0000	
Channel Modulation Type		QPSK	
Channel FEC Rate		0.24704	
Channel Throughput	(Mbps)	12.2297	
Uplink		**Return**	
E/S Carrier Frequencies	(MHz)	28,020.0000	
E/S Tx HPA Power Level	(W)	20.0	
E/S Tx OBO	(dB)	-2.0	
E/S Tx Antenna Gain (0.85m)	(dB)	45.7	
E/S Tx EIRP	(dBW)	55.9	
E/S Tx RF Link Availability	(%)	99.335%	
E/S Tx Spreading Loss	(dB)	-152.1	
Satellite		**Return**	
SV Rx G/T	(dB/K)	5.9	
SV Tx OBO	(dB)	-31.0	
SV Tx EIRP Per Channel/Carrier	dBW	17.6	
Downlink		**Return**	
E/S Rx Carrier Frequency	(MHz)	18,220.0000	
E/S Rx Rf Link Availability	(%)	Clear	
E/S Rx Antenna Gain (7.3m)	(dBi)	61.9	
E/S Rx Effective G/T	(dB/K)	40.2	
Total Link		**Return**	
Carrier/Noise Bandwidth	(dB)	14.0	
Carrier/Noise Uplink	(dB)	-1.3	
Carrier/Noise Downlink	(dB)	13.8	
Carrier/Intermodulation Im (C/Im)	(dB)	15.4	
(C/N)- Total Actual (Es/No)	(dB)	-1.8	
(C/N)-Total Required	(dB)	-2.3	
(Eb/No)-Total Actual	(dB)	1.3	
(Eb/No)-Total Required	(dB)	0.8	
Excess Margin	(dB)	**0.5**	
Fade Margin	(dB)	**0.5**	

O3b Networks Link Analysis - Tier 2 Service for

ECM Link Budget Rpt - 06/27/2016		Tier 2	Tier 2
Parameters	Unit	**Rain Dn**	
Ground parameters		**Teleport**	**Telco**
Location		Lima/Peru	Manassas/U.S.A.
Latitude	(deg)	-12.29	38.80
Longitude (East)	(deg)	283.15	-77.58
E/S Range to SV	(km)	9951.63	11323.80
E/S Elevation to SV	(deg)	32.94	16.06
E/S Altitude	(m)	13.00	0.00
SV Beam Identifier	(#)	TBD	
Telco Offset to Beam Center	(km)	0.48	
Modulation Parameters		**Return**	
Enter Reciever	Type	MEOLink	
Percentage of Bandwidth	(%)	14%	
Allocated Bandwidth	(MHz)	30.0000	
Channel Symbol Rate	(Msps)	25.0000	
Channel Modulation Type		QPSK	
Channel FEC Rate		0.24704	
Channel Throughput	(Mbps)	12.2297	
Uplink		**Return**	
E/S Carrier Frequencies	(MHz)	28,020.0000	
E/S Tx HPA Power Level	(W)	20.0	
E/S Tx OBO	(dB)	-4.9	
E/S Tx Antenna Gain (0.85m)	(dB)	45.7	
E/S Tx EIRP	(dBW)	53.0	
E/S Tx RF Link Availability	(%)	Clear	
E/S Tx Spreading Loss	(dB)	-152.1	
Satellite		**Return**	
SV Rx G/T	(dB/K)	5.9	
SV Tx OBO	(dB)	-21.4	
SV Tx EIRP Per Channel/Carrier	dBW	27.1	
Downlink		**Return**	
E/S Rx Carrier Frequency	(MHz)	18,220.0000	
E/S Rx Rf Link Availability	(%)	99.998%	
E/S Rx Antenna Gain (7.3m)	(dBi)	61.9	
E/S Rx Effective G/T	(dB/K)	35.7	
Total Link		**Return**	
Carrier/Noise Bandwidth	(dB)	14.0	
Carrier/Noise Uplink	(dB)	8.2	
Carrier/Noise Downlink	(dB)	-1.2	
Carrier/Intermodulation Im (C/Im)	(dB)	25.0	
(C/N)- Total Actual (Es/No)	(dB)	-1.7	
(C/N)-Total Required	(dB)	-2.3	
(Eb/No)-Total Actual	(dB)	1.3	
(Eb/No)-Total Required	(dB)	0.8	
Excess Margin	(dB)	**0.5**	
Fade Margin	(dB)	**0.5**	

ANNEX 2 –Terminal Characteristics

Model 870
85 cm Motorized FlyAway Antenna

The AvL 85 cm MEO Tracking Ka-Band Antenna offers the power of O3b's high throughput, low latency connectivity in a compact and transportable design.

Overview

AvL's 85 cm MEO tracking Ka-Band antenna is a transportable, rapid-deploy, tactical terminal with a geared drive for continuous operation. The antennas operate in tandem pairs with make-before-break communications, and are designed to be transported in durable transit cases and to be set-up and on-the-air within 90 minutes.

Features

- Designed for high duty cycle MEO satellite tracking
- Make-before-break handover on two antenna systems
- <90 minutes set-up
- Standard RX/TX feed
  - 2-Port Ka-Band Commercial (CP or LP)
- Optional RX/TX feeds
  - 2-Port Ka-Band MIL (CP or LP) (WGS)
  - 2-Port Ka-Band Wideband (CP) (WGS and Commercial)
  - 2-Port X-Band MIL (CP) (WGS) - Opt. RX/TX Reject Filter Kit
  - 2-Port Ku-Band Precision (LP)
  - 2-Port Ku-Band Mode-Match (LP) (enhanced Cross-Pol comp.)
- Other options
  - Single or Dual antenna systems available
  - Vehicle or Trailer or Pole Mount options available
  - BUC/LNB integration
- Standard colorization (optional colors available):
  - White
  - OD Green
  - Desert Tan
- Antenna size options:
  - 1 meter class: 0.85 m, 1.0 m, 1.2 m
- Operates with O3b Networks, virtually all GEO SatCom systems

AvL TECHNOLOGIES

Specifications

Mechanical

Az/El Drive	Motorized Dual Slew Drive Positioner
Polarization Drive System	Motorized rotation of feed
Reflector Construction	Segmented carbon fiber
Axis Travel	
Azimuth	360 degree continuous
Elevation (reflector bore sight)	0-90 degrees
Polarization	+/- 90 degrees
Az/El Speed	
Slewing/Deploying/ Tracking	4 degrees/second
Motors	24VDC variable speed, constant torque
Standard Integration Interfaces	
TX Input	Waveguide flange (cover) @ Feed; 50 ohm connector @ Lower I/O panel
RX Input	Waveguide flange (cover) @ Feed; 50 ohm connector @ Lower I/O panel
BUC (& other CFE) Mounting	Directly to feed or on the feed boom
Manual/Emergency Drive	Manual adjustment for each axis available
Size & Weight	Packed in 2 cases (each < 174 lbs / <79 kg)

Environmental

Wind – Survival	Deployed: 60 mph (97 kph) (ballasted); Stowed: 90 mph (145 kph)	
Wind – Operational	45 mph (72 kph) gusting to 60 mph (97 kph)	
Pointing Loss in Wind (RX):		
Ku 45 mph gusting to 60 mph	Typical 0.1 dB	Max 0.3 dB
Ka 30 mph gusting to 45 mph	Typical 0.2 dB	Max 0.5 dB
Temperature:		
Operational	-22 °F to 125 °F (-30 °C to 52 °C)	
Survival	-40 °F to 140 °F (-40 °C to 60 °C)	

RF/Electrical

Feed Type ⇨	**Opt. 2-Port Ka-Band Commercial****		**Opt. 2-Port Ka-Band Military**		**Opt. 2-Port X-Band (Military/WGS)**		**Opt. 2-Port Precision Ku-Band**	
RF Parameter ⇩	**Receive**	**Transmit**	**Receive**	**Transmit**	**Receive**	**Transmit**	**Receive**	**Transmit**
Frequency Range (GHz)	17.85 – 19.27**	27.65 – 29.07**	20.2 - 21.2	30.0 - 31.0	7.25 - 7.75	7.90 - 8.40	10.95 - 12.75	13.75-14.50
Polarization Configuration	RHCP or LHCP Co-Pol		Circular (opt. linear feed available)		RHCP or LHCP Co-Pol		Linear orthogonal standard, optional co-pol	
Gain (mid-band)	42.3 dBi	45.8 dBi	43.2 dBi	46.5 dBi	34.5 dBi***	35.2 dBi***	38.5 dBi	40.0 dBi
-3 dB Beam width (mid-band)	1.3°	0.9°	1.2°	0.8°	3.3°	3.0°	2.1°	1.7°
Radiation Pattern Compliance	FCC 25.209, ITU-R S.580-6		FCC 25.209, MIL-STD-188-164A		MIL-STD-188-164A		FCC 25.209*, ITU-R S.580-6	
EIRP, 29 GHz, with 5 w BUC	-	53.0	-	-	-	-	-	-
with 10 w BUC	-	56.0	-	-	-	-	-	-
with 20 w BUC	-	-	-	-	-	-	-	-
G/T with LNB, mid-band, clear horizon	19.3 dB/° K (100° LNB)	-	20.0 dB/° K (100° LNB)	-	14.1 dB/° K (55° LNB)	-	18.1 dB/° K (50° LNB)	-
Antenna Noise Temp. (mid-band, 20° El)	109° K	-	109° K	-	49° K	-	55° K	-
Maximum Feed Transmit (TX) Power	-	250 watts	-	250 watts	-	1000 watts	-	500 watts
VSWR	1.30:1	1.30:1	1.30:1	1.30:1	1.30:1	1.30:1	1.30:1	1.30:1
Axial Ratio (Ka and X only, within pointing cone)	1.8 dB	1.8 dB	1.5 dB	1.0 dB	1.21 dB	2 dB	-	-
Cross-Polarization Isolation (Ku only)								
On Axis (minimum)	-	-	-	-	-	-	35 dB	35 dB
Within pointing cone std. Precision feed	-	-	-	-	-	-	26 dB	27 dB
Within pointing cone opt. MM feed	-	-	-	-	-	-	25 dB	35 dB
Feed Port Isolation (TX to RX)	35 dB	85 dB	35 dB	80 dB (incl. filter)	100 (incl. opt. filter)	100 (incl. opt. filter)	35 dB	80 dB (incl. filter)

Controller

Controller ⇨	**AvL AAQ**
Features	AvL one button auto-acquisition of selected satellites, including peaking and optimization of cross pol. Internal movement detector and automatic stow. Optional hand-held control and separate power supply. Certified for auto-commissioning on most satellite services.
Size	Embedded ACU with separate 1 Rack Unit Controller Interface Panel (CIP) power supply with LCD and keypad. 250 W and 500 W (1.6 m and larger antennas) versions available.
CIP Input Power	120/240 VAC 60/50 Hz, 6/3 A Max. Power consumption is antenna size dependent: during acquisition 150 W or 300 W is typical, ~ 50 W Idle

Available options, upgrades and services

- Vehicle/Trailer Mount, Pole Mount, & Fly & Drive options available
- Upgrade from 2-Port Ka-Band Commercial (CP or LP):
  a) 2-Port Ka-Band MIL (CP or LP) (WGS)
  b) 2-Port Ka-Band Wideband (CP) (WGS and Commercial)
  c) 2-Port X-Band MIL (CP) (WGS) – Opt. RX/TX Reject Filter Kit
  d) 2-Port Ku-Band Mode-Match (LP) (enhanced Cross-Pol comp.)
  e) 2-Port Ku-Band Precision (LP)
- Add co-polarization Kit (for 2-Port Ku feeds only) - configures RX and TX to same polarization sense
- Add BUC/HPA mounting (**NOTE:** minimum elevation may be restricted by these options) (may require additional case)
- Upgrade to custom RF/IF I/O cabling configurations available
- Custom colorization (contact factory for available colors)
- Add custom logo on reflector face (1- or 2-Color; per AvL Logo Policy)
- Spare parts kit
- Tie down kits: simple stakes or earth anchors, refillable sandbags

AvL TECHNOLOGIES

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Anley Street
JE2 3QE Jersey
Tel: +44 1534 828 590
o3bnetworks.com

* Outside main beam / ** Contact Sales for commercial Ka-Band frequency range options and circular or linear polarization options. / *** Excluding optional filters

ANNEX 3 – Radiation Hazard Study

Two Radiation Hazard studies for the AvL .85 meter antenna are provided on the following pages. O3b has conducted a radiation hazard study for transmissions in each of its contiguous transmission bands, 27.6-28.4 GHz and 28.6-29.1 GHz. The results of those studies are included in this annex. As noted in each study, O3b will take steps to mitigate the potential for harmful exposure to radiation frequency radiation in accordance with the Federal Communications Commission's Office of Engineering and Technology (OET) Bulletin, No. 65.

Radiation Hazard Analysis

0.85 Meter - AVL GSO 20
Manassas, Virginia 20109

Introduction

A radiation hazard anaylsis is presented for a 0.85 meter Ka band aperture antenna to be installed in Manassas Virginia at the O3b Networks Global Operations Center. This Radiation Analysis calculates the non-ionizing radiation levels expected to be emitted from the earth station on a worse cases basis and is performed in accordance with the Federal Communications Commissions Office of Engineering and Technology (OET) Bulletin, No. 65.

Requirements

OET 65 outlines the maximum permissible exposure limits in two cases for operation in this frequency range.

1. The first case is the maximum level that a person may be exposed to in the general population. The exposure limit is defined as a non-ionizing power level equal to 1 milliwatt per centimeter squared averaged over a thirty minute period.
2. The second case is a controlled environment where the maximum permissible exposure limit must not exceed 5 milliwatts per centimeter squared averaged over any six minute period.

Summary

The results indicate that no significant hazard will be presented to the general population and will be fully mitigated in the controlled area by the use of procedures that require the removal of transmit power before accessing the area around the main reflector.

Analysis

This analysis was performed on seven zones. The results of this is shown in Radiation Hazard Zones. The Table labeled Input Values provides the input data used to perform the analysis. The table labeled OET 65 Calculated Values provides the intermediate calculation used to perform the assessment in accordance with OET 65. The Analysis is performed for each of the seven radiation zones as shown in figure 1 – Analysis Zones. These zones are:

1. Point between the feed and the sub-reflector
2. The power at the surface of the antenna
3. The power level between the main reflector and ground
4. The near-field or Fresnel region in which the maxima can be reached before the field starts to diminish with distance
5. The Transition region where power begins to decrease inversely with distance from the antenna
6. The Far Field or Fraunhofer region where power decreases inversely with the square of the distance. This is the point at which the antenna beam is fully collimated
7. The off axis level in the near field. This is defined as the area outside of the main beam removed and at least one antenna diameter removed from the main beam

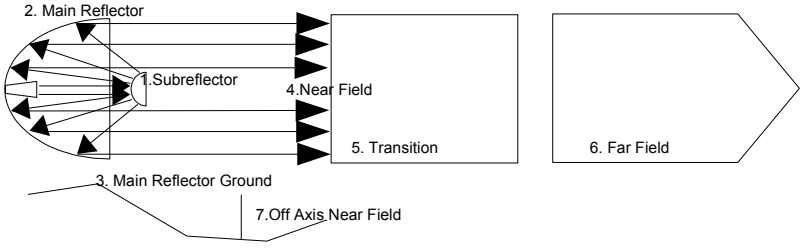


Figure 1 – Analysis Zones

Radiation Hazard Analysis

Operator:	***O3b Networks***	*FCC ID:*	
Location Designation:	***Global Operations Center***	*O3b ID:*	*AVL GSO 20*
County:	***Prince William***	*STA:*	
Town:	***Manassas***		
State/Zip:	***Virginia 20109***		

Input Values	*Value*	*Unit*
D = Aperture Diameter	*0.85*	*Meters*
d = Subreflector Diameter	*0.1*	*Meters*
η = Apperture Efficeny	*67%*	*percentage*
FCC Designation	*Ka*	*Band*
F = Frequency	*28020*	*MHz*
P = Transmitter Power Watts:	*20*	*Watts*
p = Number Transmitters:	*1*	
R_{ua} *= closest point to uncontrolled area*	*20*	*meters*
Elevation angle at closest point R_{ua}	*7*	*Degrees*

Band	*Frequency GHz*
L	*1000-2000*
S	*2000-4000*
C	*4000-8000*
X	*8000-12500*
Ku	*12500-18000*
K	*18000-25500*
Ka	*26500-40000*
O	*40000-50000*
V	*50000-75000*

OET 65 Calculated Values	*Formula*	*Value*	*Unit*
λ= Wavelength	c/F	*0.0107*	*meters*
P_1 *= Total Antenna Input Power*	$P*p$	*20*	*watts*
G = Antenna Gain	$G=\frac{4\pi\eta A}{\lambda^2}$	*41635.68*	*linear*
Antenna Gain dB	$10\log_{10}(G)$	*46.19*	*dBi*
A = Area of reflector	$\pi(\frac{D}{2})^2$	*0.57*	*meters²*
a = area of subreflector or feed	$\pi(\frac{d}{2})^2$	*0.01*	*meters²*
R_{nf} *= Near-Field Region*	$R_{nf}=\frac{D^2}{4\lambda}$	*16.87*	*meters*
		2	*Meters AGL*
Transition Region	$>R_{nf}<R_{ff}$	*16.87* *40.49*	*>meters* *<meters*
R_{ff} *= Far Field Region*	$R_{ff}=\frac{0.6D^2}{\lambda}$	*40.49*	*meters*
		5	*Meters AGL*

	Radiation Analysis Zone	*Formula*	*Level*	*Value*	*Exposure Limits* *General Public* $<1mW/cm^2$	*Occupational* $<5mW/cm^2$
1	*Power Subreflector*	$\frac{4P_t}{a}$	*1019.108*	mW/cm^2	*>FCC MPE See Note 1*	*>FCC MPE See Note 2*
2	*Antenna Surface*	$\frac{4P_t}{A}$	*14.105*	mW/cm^2	*>FCC MPE See Note 1*	*>FCC MPE See Note 2*
3	*Main Reflector Ground*	$\frac{P_t}{A}$	*3.526*	mW/cm^2	*>FCC MPE See Note 1*	*<FCC MPE*
4	*Snf =Near-Field Power Density*	$S_{nf}=\frac{16\eta P_t}{pi\,D^2}=4\eta(\frac{P_t}{A})$	*18.901*	mW/cm^2	*>FCC MPE See Note 1*	*>FCC MPE See Note 2*
5	*Max Transition Power Density*	$S_t=\frac{S_{nf}R_{nf}}{R_{nf}}$	*18.901*	mW/cm^2	*>FCC MPE See Note 1*	*>FCC MPE See Note 2*
6	*Max Far field Power Density*	$S_{ff}=\frac{P_tG}{4\pi R^2}$	*4.044*	mW/cm^2	*>FCC MPE See Note 3*	*<FCC MPE*
7	*Off Access Level Near Field*	$S_{ua}=S_{nf}-20dB$	*0.18901*	mW/cm^2	*<FCC MPE*	*<FCC MPE*

Notes

1. *The antenna is installed in a controlled location access is restricted to authorized personnel only. The area is marked with RF Radiation Hazard signage. Area not accessible to the general public.*
2. *Inside the controlled area, MPE levels exceed the MPE exposure for occupational levels. The levels will be reduced to safe MPE by removing power to the transmitters when work is performed on or around the antenna. This area can only be accessed by qualified personnel.*
3. *The far field develops 5 meters above ground level at the minimum elevation angle which is not accessable to the general public.*

Radiation Hazard Analysis

0.85 Meter - AVL NGSO 20
Manassas, Virginia 20109

Introduction

A radiation hazard anaylsis is presented for a 0.85 meter Ka band aperture antenna to be installed in Manassas Virginia at the O3b Networks Global Operations Center. This Radiation Analysis calculates the non-ionizing radiation levels expected to be emitted from the earth station on a worse cases basis and is performed in accordance with the Federal Communications Commissions Office of Engineering and Technology (OET) Bulletin, No. 65.

Requirements

OET 65 outlines the maximum permissible exposure limits in two cases for operation in this frequency range.

1. The first case is the maximum level that a person may be exposed to in the general population. The exposure limit is defined as a non-ionizing power level equal to 1 milliwatt per centimeter squared averaged over a thirty minute period.
2. The second case is a controlled environment where the maximum permissible exposure limit must not exceed 5 milliwatts per centimeter squared averaged over any six minute period.

Summary

The results indicate that no significant hazard will be presented to the general population and will be fully mitigated in the controlled area by the use of procedures that require the removal of transmit power before accessing the area around the main reflector.

Analysis

This analysis was performed on seven zones. The results of this is shown in Radiation Hazard Zones. The Table labeled Input Values provides the input data used to perform the analysis. The table labeled OET 65 Calculated Values provides the intermediate calculation used to perform the assessment in accordance with OET 65. The Analysis is performed for each of the seven radiation zones as shown in figure 1 – Analysis Zones. These zones are:

1. Point between the feed and the sub-reflector
2. The power at the surface of the antenna
3. The power level between the main reflector and ground
4. The near-field or Fresnel region in which the maxima can be reached before the field starts to diminish with distance
5. The Transition region where power begins to decrease inversely with distance from the antenna
6. The Far Field or Fraunhofer region where power decreases inversely with the square of the distance. This is the point at which the antenna beam is fully collimated
7. The off axis level in the near field. This is defined as the area outside of the main beam removed and at least one antenna diameter removed from the main beam

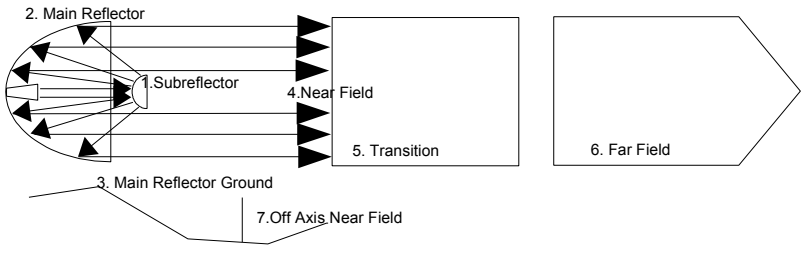


Figure 1 – Analysis Zones

Radiation Hazard Analysis

Operator:	***O3b Networks***	*FCC ID:*	
Location Designation:	***Global Operations Center***	*O3b ID:*	*AVL NGSO 20*
County:	***Prince William***	*STA:*	
Town:	***Manassas***		
State/Zip:	***Virginia 20109***		

Input Values	*Value*	*Unit*
D = Aperture Diameter	*0.85*	*Meters*
d = Subreflector Diameter	*0.1*	*Meters*
η = Apperture Efficeny	*67%*	*percentage*
FCC Designation	*Ka*	*Band*
F = Frequency	*28850*	*MHz*
P = Transmitter Power Watts:	*20*	*Watts*
p = Number Transmitters:	*1*	
R_{ua} = closest point to uncontrolled area	*20*	*meters*
Elevation angle at closest point R_{ua}	*7*	*Degrees*

Band	*Frequency GHz*
L	*1000-2000*
S	*2000-4000*
C	*4000-8000*
X	*8000-12500*
Ku	*12500-18000*
K	*18000-25500*
Ka	*26500-40000*
O	*40000-50000*
V	*50000-75000*

OET 65 Calculated Values	*Formula*	*Value*	*Unit*
λ = Wavelength	c/F	*0.0104*	*meters*
P_t = Total Antenna Input Power	$P*p$	*20*	*watts*
G = Antenna Gain	$G=\frac{4\pi\eta A}{\lambda^2}$	*44138.86*	*linear*
Antenna Gain dB	$10\log_{10}(G)$	*46.45*	*dBi*
A = Area of reflector	$\pi(\frac{D}{2})^2$	*0.57*	*meters²*
a = area of subreflector or feed	$\pi(\frac{d}{2})^2$	*0.01*	*meters²*
R_{nf} = Near-Field Region	$R_{nf}=\frac{D^2}{4\lambda}$	*17.37* *2*	*meters* *Meters AGL*
Transition Region	$>R_{nf}<R_{ff}$	*17.37* *41.69*	*>meters* *<meters*
R_{ff} = Far Field Region	$R_{ff}=\frac{0.6\,D^2}{\lambda}$	*41.69* *5*	*meters* *Meters AGL*

	Radiation Analysis Zone	*Formula*	*Level*	*Value*	*Exposure Limits* *General Public <1mW/cm²*	*Occupational <5mW/cm²*
1	*Power Subreflector*	$\frac{4P_t}{a}$	*1019.108*	*mW/cm²*	*>FCC MPE See Note 1*	*>FCC MPE See Note 2*
2	*Antenna Surface*	$\frac{4P_t}{A}$	*14.105*	*mW/cm²*	*>FCC MPE See Note 1*	*>FCC MPE See Note 2*
3	*Main Reflector Ground*	$\frac{P_t}{A}$	*3.526*	*mW/cm²*	*>FCC MPE See Note 1*	*<FCC MPE*
4	*Snf =Near-Field Power Density*	$S_{nf}=\frac{16\eta P_t}{pi\,D^2}=4\eta(\frac{P_t}{A})$	*18.901*	*mW/cm²*	*>FCC MPE See Note 1*	*>FCC MPE See Note 2*
5	*Max Transition Power Density*	$S_t=\frac{S_{nf}R_{nf}}{R_{nf}}$	*18.901*	*mW/cm²*	*>FCC MPE See Note 1*	*>FCC MPE See Note 2*
6	*Max Far field Power Density*	$S_{ff}=\frac{P_tG}{4\pi R^2}$	*4.044*	*mW/cm²*	*>FCC MPE See Note 3*	*<FCC MPE*
7	*Off Access Level Near Field*	$S_{ua}=S_{nf}-20dB$	*0.18901*	*mW/cm²*	*<FCC MPE*	*<FCC MPE*

Notes

1. *The antenna is installed in a controlled location access is restricted to authorized personnel only. The area is marked with RF Radiation Hazard signage. Area not accessible to the general public.*
2. *Inside the controlled area, MPE levels exceed the MPE exposure for occupational levels. The levels will be reduced to safe MPE by removing power to the transmitters when work is performed on or around the antenna. This area can only be accessed by qualified personnel.*
3. *The far field develops 5 meters above ground level at the minimum elevation angle which is not accessable to the general public.*

ANNEX 4 – Frequency Coordination

The Comsearch reports for the 18 GHz band and the 28 GHz band are provided on the following pages.

Ka-Band Earth Station – Manassas, VA

Frequency Coordination Report

28 GHz

Prepared on Behalf of
O3b Networks USA, LLC

July 11, 2016

COMSEARCH®
A CommScope Company

Table of Contents

1. Summary of Results

On behalf of O3b Networks, Comsearch performed a coordination notice for all existing and proposed terrestrial licenses within the coordination contours of their proposed Ka-Band earth station in Manassas, Virginia, which will transmit at 28 GHz[1]. Prior-notification letters were sent to the licensees and a copy of the notification data is provided in section four of this report. The earth station coordination was finalized on July 8, 2016.

No objections were received from any of the incumbent 28 GHz licensees. Our notification to the LMDS incumbents was performed under the assumption that the earth station would be operating on a non-interference basis in relation to primary LMDS Block A operations. A contact at O3b Networks has been provided in case any concerns may arise in the future.

2. 28 GHz Common Carrier and LTTS Coordination

In accordance with FCC Rules and Regulations, the Ka-Band earth station in Manassas, Virginia was prior-coordinated by Comsearch. A notification letter and datasheets for this earth station were sent to the following 28 GHz common carrier fixed microwave licensees on June 27, 2016. These licensees are authorized to operate temporary fixed operations from 27.5 to 29.5 GHz over a designated geographic area.

Licensee	Authorized Geographic Area
Frontier	Continental US
Verizon	Statewide: Maryland; Washington DC and Vicinity

A notification letter and datasheets for the Ka-Band earth station in Manassas, Virginia were also sent to the following 28 GHz local television transmission licensee on June 27, 2016. This licensee is authorized to operate temporary fixed operations from 27.5 to 29.5 GHz on a nationwide basis.

Licensee	Authorized Geographic Area
Information Super Station, LLC	Continental US

No objections were received from the common carrier or local television transmission service incumbents.

[1] The proposed earth station will operate in the 27.6 – 28.35 GHz portion of the Ka-Band.

3. 28 GHz LMDS Coordination

A Notification letter was sent to the following 28 GHz LMDS licensees on June 27, 2016. The proposed earth station will operate on frequencies that overlap Block A of the LMDS service. The total frequency allocation for Block A of the LMDS spectrum appears below.

Block A: 27.500-28.350 GHz
29.100-29.250 GHz
31.075-31.225 GHz

Licensee	Market	Market Name
Nextlink/XO	BTA029	Baltimore, MD
Sprint[2]	BTA029	Baltimore, MD
Nextlink/XO	BTA374	Richmond-Petersburg, VA
Nextlink/XO	BTA461[3]	Washington, DC

No objections were received from the LMDS incumbents.

[2] Sprint is leasing spectrum from XO Communications in the Baltimore Basic Trading Area (BTA).

[3] The proposed earth station will be located inside BTA461.

4. Earth Station Coordination Data

This section presents the data pertinent to the proposed Ka-Band earth station in Manassas, Virginia. This data was circulated to all incumbent licensees in the shared 28 GHz frequency ranges.

Date:	06/27/2016
Job Number:	160211COMSGE02

Administrative Information	
Status	ENGINEER PROPOSAL
Call Sign	
Licensee Code	O3BNET
Licensee Name	O3b Networks USA, LLC.

Site Information	**MANASSAS, VA**
Venue Name	
Latitude (NAD 83)	38° 47' 46.6" N
Longitude (NAD 83)	77° 34' 37.4" W
Climate Zone	A
Rain Zone	2
Ground Elevation (AMSL)	103.05 m / 338.1 ft

Link Information	
Satellite Type	Medium Earth Orbit
Mode	TR - Transmit-Receive
Modulation	Digital
Minimum Elevation Angle	7.0°
Azimuth Range	0.0° to 360°
Antenna Centerline (AGL)	8.74 m / 28.7 ft

Antenna Information		**Receive - FCC32**	**Transmit - FCC32**
Manufacturer		AVL	AVL
Model		85CM-O3B	85CM-O3B
Gain / Diameter		42.6 dBi / 0.8 m	46.0 dBi / 0.8 m
3-dB / 15-dB Beamwidth		1.30° / 3.20°	0.90° / 2.10°
Max Available RF Power	(dBW/4 kHz)		-34.6
	(dBW/MHz)		-10.6
Maximum EIRP	(dBW/4 kHz)		11.4
	(dBW/MHz)		35.4

Interference Objectives:					
	Long Term	-156.0 dBW/MHz	20%	-151.0 dBW/4 kHz	20%
	Short Term	-146.0 dBW/MHz	0.01%	-128.0 dBW/4 kHz	0.0025%

Frequency Information	**Receive 18.0 GHz**	**Transmit 28.0 GHz**
Emission / Frequency Range (MHz)	216MG7D / 17800.0 - 18600.0	216MG7D / 27600.0 - 28350.0
Max Great Circle Coordination Distance	215.8 km / 134.1 mi	112.5 km / 69.9 mi
Precipitation Scatter Contour Radius	100.0 km / 62.1 mi	100.0 km / 62.1 mi

Coordination Values	**MANASSAS, VA**			
Licensee Name	O3b Networks USA, LLC.			
Latitude (NAD 83)	38° 47' 46.6" N			
Longitude (NAD 83)	77° 34' 37.4" W			
Ground Elevation (AMSL)	103.05 m / 338.1 ft			
Antenna Centerline (AGL)	8.74 m / 28.7 ft			
Antenna Model	AVI 0.85 meters			
Antenna Mode		Receive 18.0 GHz		Transmit 28.0 GHz
Interference Objectives: Long Term		-156.0 dBW/MHz	20%	-151.0 dBW/4 kHz 20%
Short Term		-146.0 dBW/MHz	0.01%	-128.0 dBW/4 kHz 0.0025%
Max Available RF Power			-34.6 (dBW/4 kHz)	

			Receive 18.0 GHz		Transmit 28.0 GHz	
Azimuth (°)	Horizon Elevation (°)	Antenna Discrimination (°)	Horizon Gain (dBi)	Coordination Distance (km)	Horizon Gain (dBi)	Coordination Distance (km)
0	0.00	97.86	-10.00	136.20	-10.00	100.00
5	0.00	92.86	-10.00	136.20	-10.00	100.00
10	0.00	87.86	-10.00	136.20	-10.00	100.00
15	0.00	82.86	-10.00	136.20	-10.00	100.00
20	0.00	77.86	-10.00	136.20	-10.00	100.00
25	0.00	72.86	-10.00	136.20	-10.00	100.00
30	0.00	67.86	-10.00	136.20	-10.00	100.00
35	0.00	62.86	-10.00	136.20	-10.00	100.00
40	0.00	57.87	-10.00	136.20	-10.00	100.00
45	0.00	52.87	-10.00	136.20	-10.00	100.00
50	0.00	47.87	-10.00	136.20	-10.00	100.00
55	0.00	42.87	-10.00	136.20	-10.00	100.00
60	0.00	37.87	-8.99	139.00	-8.99	100.00
65	0.00	32.87	-7.69	142.70	-7.69	100.00
70	0.00	27.88	-6.23	147.10	-6.23	100.00
75	0.00	22.88	-4.54	152.30	-4.54	100.00
80	0.00	17.89	-2.58	159.20	-2.58	100.00
85	0.00	12.90	-0.22	167.10	-0.22	100.00
90	0.00	7.92	2.65	177.10	2.65	100.00
95	0.00	3.02	6.15	189.60	6.15	102.60
100	0.00	2.34	9.69	202.70	9.69	111.10
105	0.00	7.20	10.29	215.80	10.29	112.50
110	0.00	12.18	7.44	173.90	7.44	100.00
115	0.00	17.17	3.66	180.60	3.66	100.00
120	0.00	22.16	1.07	171.60	1.07	100.00
125	0.00	27.15	-0.97	164.60	-0.97	100.00
130	0.00	32.15	-2.64	159.00	-2.64	100.00
135	0.00	37.15	-4.04	153.90	-4.04	100.00
140	0.00	42.15	-5.22	150.20	-5.22	100.00
145	0.00	47.15	-6.11	129.50	-6.11	100.00
150	0.00	52.15	-6.98	132.80	-6.98	100.00
155	0.00	57.14	-7.69	133.10	-7.69	100.00
160	0.00	62.14	-8.33	140.90	-8.33	100.00
165	0.00	67.14	-8.78	139.60	-8.78	100.00
170	0.00	72.14	-9.09	138.70	-9.09	100.00
175	0.00	77.14	-9.28	138.20	-9.28	100.00
180	0.00	82.14	-9.35	138.00	-9.35	100.00
185	0.00	87.14	-9.28	138.20	-9.28	100.00

Coordination Values	**MANASSAS, VA**			
Licensee Name	O3b Networks USA, LLC.			
Latitude (NAD 83)	38° 47' 46.6" N			
Longitude (NAD 83)	77° 34' 37.4" W			
Ground Elevation (AMSL)	103.05 m / 338.1 ft			
Antenna Centerline (AGL)	8.74 m / 28.7 ft			
Antenna Model	AVl 0.85 meters			
Antenna Mode	Receive 18.0 GHz		Transmit 28.0 GHz	
Interference Objectives: Long Term	-156.0 dBW/MHz	20%	-151.0 dBW/4 kHz	20%
Short Term	-146.0 dBW/MHz	0.01%	-128.0 dBW/4 kHz	0.0025%
Max Available RF Power		-34.6 (dBW/4 kHz)		

			Receive 18.0 GHz		Transmit 28.0 GHz	
Azimuth (°)	Horizon Elevation (°)	Antenna Discrimination (°)	Horizon Gain (dBi)	Coordination Distance (km)	Horizon Gain (dBi)	Coordination Distance (km)
190	0.00	92.14	-9.09	138.70	-9.09	100.00
195	0.00	97.14	-8.78	139.60	-8.78	100.00
200	0.00	102.14	-8.33	140.90	-8.33	100.00
205	0.00	107.14	-7.76	142.50	-7.76	100.00
210	0.00	112.14	-7.06	144.60	-7.06	100.00
215	0.00	117.14	-6.22	147.10	-6.22	100.00
220	0.00	122.13	-5.22	150.20	-5.22	100.00
225	0.00	127.13	-4.04	153.90	-4.04	100.00
230	0.00	132.13	-2.64	159.00	-2.64	100.00
235	0.00	137.13	-0.97	164.60	-0.97	100.00
240	0.00	142.13	1.07	171.60	1.07	100.00
245	0.00	147.13	3.66	180.60	3.66	100.00
250	0.00	152.12	7.09	192.90	7.09	104.90
255	0.00	157.12	10.15	214.50	10.15	112.20
260	0.00	162.11	9.48	201.90	9.48	110.60
265	0.00	167.10	6.13	188.50	6.13	101.70
270	0.00	172.08	2.64	170.60	2.64	100.00
275	0.00	176.98	-0.25	161.70	-0.25	100.00
280	0.00	177.66	-2.61	157.30	-2.61	100.00
285	0.00	172.80	-4.57	149.20	-4.57	100.00
290	0.00	167.82	-6.25	137.00	-6.25	100.00
295	0.00	162.83	-7.71	134.10	-7.71	100.00
300	0.00	157.84	-9.01	124.40	-9.01	100.00
305	0.00	152.85	-10.00	121.40	-10.00	100.00
310	0.00	147.85	-10.00	124.40	-10.00	100.00
315	0.00	142.85	-10.00	133.70	-10.00	100.00
320	0.00	137.85	-10.00	136.20	-10.00	100.00
325	0.00	132.85	-10.00	136.20	-10.00	100.00
330	0.00	127.85	-10.00	136.20	-10.00	100.00
335	0.00	122.86	-10.00	136.20	-10.00	100.00
340	0.00	117.86	-10.00	136.20	-10.00	100.00
345	0.00	112.86	-10.00	136.20	-10.00	100.00
350	0.00	107.86	-10.00	136.20	-10.00	100.00
355	0.00	102.86	-10.00	136.20	-10.00	100.00

5. Contact Information

For questions or information regarding the 28 GHz Frequency Coordination Report, please contact:

Contact person:	Joanna Lynch
Title:	Manager, Spectrum & Data Solutions
Company:	Comsearch
Address:	19700 Janelia Farm Blvd., Ashburn, VA 20147
Telephone:	703-726-5711
Fax:	703-726-5599
Email:	jlynch@comsearch.com
Web site:	www.comsearch.com

FREQUENCY COORDINATION AND INTERFERENCE ANALYSIS REPORT

Prepared for
O3b Networks USA, LLC.
MANASSAS, VA
(AVL 0.85 meter)
Satellite Earth Station

Prepared By:
COMSEARCH
19700 Janelia Farm Boulevard
Ashburn, VA 20147
March 16, 2016

TABLE OF CONTENTS

1. CONCLUSIONS

An interference study considering all existing, proposed and prior coordinated microwave facilities within the coordination contours of the proposed earth station demonstrates that this site will operate satisfactorily with the common carrier microwave environment. Further, there will be no restrictions of its operation due to interference considerations.

2. SUMMARY OF RESULTS

A number of great circle interference cases were identified during the interference study of the proposed earth station. Each of the cases, which exceeded the interference objective on a line-of-sight basis, was profiled and the propagation losses estimated using NBS TN101 (Revised) techniques. The losses were found to be sufficient to reduce the signal levels to acceptable magnitudes in every case.

3. SUPPLEMENTAL SHOWING

Pursuant to Part 25.203(c) of the FCC Rules and Regulations, the satellite earth station proposed in this application was coordinated by Comsearch using computer techniques and in accordance with Part 25 of the FCC Rules and Regulations.

Coordination data for this earth station was sent to the below listed carriers with a letter dated 02/11/2016.

Company
APC Realty and Equipment CO LLC
Adams County Department of Emergency Svc
Arlington County Emergency Comm Ctr
B.F. SAUL COMPANY
Believe Wireless, LLC
Blaze Broadband
CBS Broadcasting Inc
CBS Communication Services Inc
Calvert County Government
Calvert, County of
Chesapeake Television Licensee, LLC
Clearwire Spectrum Holdings III, LLC
Clearwire Spectrum Holdings LLC
Commissioners of Caroline County
ECW Wireless, LLC
Enoch Pratt Free Library
Franklin County Dept. of Emergency Servi
George Washington University
Global Telecom & Technology Americas
Home Sales Company, Inc
Loudoun, County of
Maryland Port Administration
Maryland, State of - MDOT-MTA
NBC Telemundo License LLC
New Cingular Wireless PCS LLC - VA
Prince William, County of
Radio One Inc
RapidDSL & Wireless, Inc.
Red Zebra Broadcasting Licensee, LLC
Salisbury University Foundation, Inc.
Shenandoah Personal Communications, LLC
Sprint Spectrum L.P.
Sprintcom, Inc
Telecom Transport Management, Inc
Telegia Communications Inc.
Virginia Cellular LLC
Virginia Everywhere, LLC
Virginia PCS Alliance, L.C.
WASHINGTON CABLE SYSTEMS INC
WICOMICO BOARD OF EDUCATION

WKYSFM, INC
WRLH Licensee, LLC
Washington Metro Area Transit Police Dep
Wicomico County
Wor-Wic Community College
World Class Wireless, LLC

4. EARTH STATION COORDINATION DATA

This section presents the data pertinent to frequency coordination of the proposed earth station that was circulated to all carriers within its coordination contours.

COMSEARCH

Earth Station Data Sheet

19700 Janelia Farm Boulevard, Ashburn, VA 20147
(703)726-5500 http://www.comsearch.com

Date:	03/16/2016
Job Number:	160211COMSGE02

Administrative Information

Status	ENGINEER PROPOSAL
Call Sign	
Licensee Code	O3BNET
Licensee Name	O3b Networks USA, LLC.

Site Information — MANASSAS, VA

Venue Name	
Latitude (NAD 83)	38° 47' 46.6" N
Longitude (NAD 83)	77° 34' 37.4" W
Climate Zone	A
Rain Zone	2
Ground Elevation (AMSL)	103.05 m / 338.1 ft

Link Information

Satellite Type	Medium Earth Orbit
Mode	TR - Transmit-Receive
Modulation	Digital
Minimum Elevation Angle	7.0°
Azimuth Range	0.0° to 360°
Antenna Centerline (AGL)	2.74 m / 9.0 ft

Antenna Information		Receive - FCC32		Transmit - FCC32	
Manufacturer		AVL		AVL	
Model		85CM-O3B		85CM-O3B	
Gain / Diameter		42.6 dBi / 0.8 m		46.0 dBi / 0.8 m	
3-dB / 15-dB Beamwidth		1.30° / 3.20°		0.90° / 2.10°	
Max Available RF Power	(dBW/4 kHz)			-34.6	
	(dBW/MHz)			-10.6	
Maximum EIRP	(dBW/4 kHz)			11.4	
	(dBW/MHz)			35.4	
Interference Objectives:	Long Term	-156.0 dBW/MHz	20%	-151.0 dBW/4 kHz	20%
	Short Term	-146.0 dBW/MHz	0.01%	-128.0 dBW/4 kHz	0.0025%

Frequency Information	Receive 18.0 GHz	Transmit 28.0 GHz
Emission / Frequency Range (MHz)	216MG7D / 17800.0 - 18600.0	216MG7D / 27600.0 - 28350.0
Max Great Circle Coordination Distance	215.8 km / 134.1 mi	112.5 km / 69.9 mi
Precipitation Scatter Contour Radius	100.0 km / 62.1 mi	100.0 km / 62.1 mi

COMSEARCH

Earth Station Data Sheet

19700 Janelia Farm Boulevard, Ashburn, VA 20147
(703)726-5500 http://www.comsearch.com

Coordination Values	**MANASSAS, VA**			
Licensee Name	O3b Networks USA, LLC.			
Latitude (NAD 83)	38° 47' 46.6" N			
Longitude (NAD 83)	77° 34' 37.4" W			
Ground Elevation (AMSL)	103.05 m / 338.1 ft			
Antenna Centerline (AGL)	2.74 m / 9.0 ft			
Antenna Model	AVI 0.85 meters			
Antenna Mode	Receive 18.0 GHz		Transmit 28.0 GHz	
Interference Objectives: Long Term	-156.0 dBW/MHz	20%	-151.0 dBW/4 kHz	20%
Short Term	-146.0 dBW/MHz	0.01%	-128.0 dBW/4 kHz	0.0025%
Max Available RF Power			-34.6 (dBW/4 kHz)	

			Receive 18.0 GHz		Transmit 28.0 GHz	
Azimuth (°)	Horizon Elevation (°)	Antenna Discrimination (°)	Horizon Gain (dBi)	Coordination Distance (km)	Horizon Gain (dBi)	Coordination Distance (km)
0	0.00	97.86	-10.00	136.20	-10.00	100.00
5	0.00	92.86	-10.00	136.20	-10.00	100.00
10	0.00	87.86	-10.00	136.20	-10.00	100.00
15	0.00	82.86	-10.00	136.20	-10.00	100.00
20	0.00	77.86	-10.00	136.20	-10.00	100.00
25	0.00	72.86	-10.00	136.20	-10.00	100.00
30	0.00	67.86	-10.00	136.20	-10.00	100.00
35	0.00	62.86	-10.00	136.20	-10.00	100.00
40	0.00	57.87	-10.00	136.20	-10.00	100.00
45	0.00	52.87	-10.00	136.20	-10.00	100.00
50	0.00	47.87	-10.00	136.20	-10.00	100.00
55	0.00	42.87	-10.00	136.20	-10.00	100.00
60	0.00	37.87	-8.99	139.00	-8.99	100.00
65	0.00	32.87	-7.69	142.70	-7.69	100.00
70	0.00	27.88	-6.23	147.10	-6.23	100.00
75	0.00	22.88	-4.54	152.30	-4.54	100.00
80	0.00	17.89	-2.58	159.20	-2.58	100.00
85	0.00	12.90	-0.22	167.10	-0.22	100.00
90	0.00	7.92	2.65	177.10	2.65	100.00
95	0.00	3.02	6.15	189.60	6.15	102.60
100	0.00	2.34	9.69	202.70	9.69	111.10
105	0.00	7.20	10.29	215.80	10.29	112.50
110	0.00	12.18	7.44	173.90	7.44	100.00
115	0.00	17.17	3.66	180.60	3.66	100.00
120	0.00	22.16	1.07	171.60	1.07	100.00
125	0.00	27.15	-0.97	164.60	-0.97	100.00
130	0.00	32.15	-2.64	159.00	-2.64	100.00
135	0.00	37.15	-4.04	153.90	-4.04	100.00
140	0.00	42.15	-5.22	150.20	-5.22	100.00
145	0.00	47.15	-6.11	129.50	-6.11	100.00
150	0.00	52.15	-6.98	132.80	-6.98	100.00
155	0.00	57.14	-7.69	133.10	-7.69	100.00
160	0.00	62.14	-8.33	140.90	-8.33	100.00
165	0.00	67.14	-8.78	139.60	-8.78	100.00
170	0.00	72.14	-9.09	138.70	-9.09	100.00
175	0.00	77.14	-9.28	138.20	-9.28	100.00
180	0.00	82.14	-9.35	138.00	-9.35	100.00
185	0.00	87.14	-9.28	138.20	-9.28	100.00

COMSEARCH

Earth Station Data Sheet

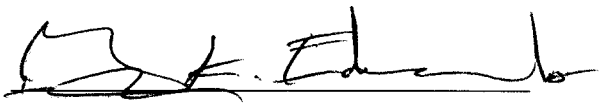
19700 Janelia Farm Boulevard, Ashburn, VA 20147
(703)726-5500 http://www.comsearch.com

Coordination Values	**MANASSAS, VA**			
Licensee Name	O3b Networks USA, LLC.			
Latitude (NAD 83)	38° 47' 46.6" N			
Longitude (NAD 83)	77° 34' 37.4" W			
Ground Elevation (AMSL)	103.05 m / 338.1 ft			
Antenna Centerline (AGL)	2.74 m / 9.0 ft			
Antenna Model	AVl 0.85 meters			
Antenna Mode	Receive 18.0 GHz		Transmit 28.0 GHz	
Interference Objectives: Long Term	-156.0 dBW/MHz	20%	-151.0 dBW/4 kHz	20%
Short Term	-146.0 dBW/MHz	0.01%	-128.0 dBW/4 kHz	0.0025%
Max Available RF Power			-34.6 (dBW/4 kHz)	

			Receive 18.0 GHz		Transmit 28.0 GHz	
Azimuth (°)	Horizon Elevation (°)	Antenna Discrimination (°)	Horizon Gain (dBi)	Coordination Distance (km)	Horizon Gain (dBi)	Coordination Distance (km)
190	0.00	92.14	-9.09	138.70	-9.09	100.00
195	0.00	97.14	-8.78	139.60	-8.78	100.00
200	0.00	102.14	-8.33	140.90	-8.33	100.00
205	0.00	107.14	-7.76	142.50	-7.76	100.00
210	0.00	112.14	-7.06	144.60	-7.06	100.00
215	0.00	117.14	-6.22	147.10	-6.22	100.00
220	0.00	122.13	-5.22	150.20	-5.22	100.00
225	0.00	127.13	-4.04	153.90	-4.04	100.00
230	0.00	132.13	-2.64	159.00	-2.64	100.00
235	0.00	137.13	-0.97	164.60	-0.97	100.00
240	0.00	142.13	1.07	171.60	1.07	100.00
245	0.00	147.13	3.66	180.60	3.66	100.00
250	0.00	152.12	7.09	192.90	7.09	104.90
255	0.00	157.12	10.15	214.50	10.15	112.20
260	0.00	162.11	9.48	201.90	9.48	110.60
265	0.00	167.10	6.13	188.50	6.13	101.70
270	0.00	172.08	2.64	170.60	2.64	100.00
275	0.00	176.98	-0.25	161.70	-0.25	100.00
280	0.00	177.66	-2.61	157.30	-2.61	100.00
285	0.00	172.80	-4.57	149.20	-4.57	100.00
290	0.00	167.82	-6.25	137.00	-6.25	100.00
295	0.00	162.83	-7.71	134.10	-7.71	100.00
300	0.00	157.84	-9.01	124.40	-9.01	100.00
305	0.00	152.85	-10.00	121.40	-10.00	100.00
310	0.00	147.85	-10.00	124.40	-10.00	100.00
315	0.00	142.85	-10.00	133.70	-10.00	100.00
320	0.00	137.85	-10.00	136.20	-10.00	100.00
325	0.00	132.85	-10.00	136.20	-10.00	100.00
330	0.00	127.85	-10.00	136.20	-10.00	100.00
335	0.00	122.86	-10.00	136.20	-10.00	100.00
340	0.00	117.86	-10.00	136.20	-10.00	100.00
345	0.00	112.86	-10.00	136.20	-10.00	100.00
350	0.00	107.86	-10.00	136.20	-10.00	100.00
355	0.00	102.86	-10.00	136.20	-10.00	100.00

5. CERTIFICATION

I HEREBY CERTIFY THAT I AM THE TECHNICALLY QUALIFIED PERSON RESPONSIBLE FOR THE PREPARATION OF THE FREQUENCY COORDINATION DATA CONTAINED IN THIS APPLICATION, THAT I AM FAMILIAR WITH PARTS 101 AND 25 OF THE FCC RULES AND REGULATIONS, THAT I HAVE EITHER PREPARED OR REVIEWED THE FREQUENCY COORDINATION DATA SUBMITTED WITH THIS APPLICATION, AND THAT IT IS COMPLETE AND CORRECT TO THE BEST OF MY KNOWLEDGE AND BELIEF.

BY: _ 

Gary K. Edwards
Senior Manager
COMSEARCH
19700 Janelia Farm Boulevard
Ashburn, VA 20147

DATED: March 16, 2016

ANNEX 5 – Compliance with No. 22.5D of the ITU Radio Regulations

The EPFD(up) limits in No. 22.5D of the ITU Radio Regulations take the form of a single EPFD(up) value that must never be exceeded (-162 dBW/m^2/40 kHz in the 27.5-28.6 GHz band). O3b complies with this limit, in the O3b frequency ranges where such EPFD limits apply, by controlling the maximum power spectral density into transmitting earth stations as a function of their latitude, their antenna size and off-axis gain towards the GSO.

The maximum EIRP density transmitted by the Randolph Ridge 0.85m Earth Station is 30.2 dBW/4kHz, which is equivalent to 40.2 dBW/40kHz (*i.e.,* the reference bandwidth used for the EPFD(up) limit). The peak earth station transmit antenna gain is 46 dBi, giving a maximum input power spectral density of −5.8 dBW/40kHz. From the Randolph Ridge 0.85m Earth Station, which is at a latitude of 38° 47′ 46.6″ N, the minimum separation angle between the GSO and O3b orbits varies from 13.1° to 16.7° depending on the difference in longitude between Randolph Ridge and the GSO/O3b satellites. The lower value applies to the case in which the GSO and O3b satellites are at very low elevation angles (~5° for the GSO and ~5° for the O3b orbit) as viewed from Randolph Ridge. For the minimum separation angle of 13.1°, the off-axis gain of the transmitting earth station is 4.1 dBi, assuming a 32-25log(θ) gain mask. That results in a worst-case off-axis EIRP density towards the GSO of −1.7 dBW/40kHz (i.e., −5.8+4.1). Taking the range to the GSO orbit from Randolph Ridge corresponding to a five-degree elevation angle (42,174 km), the spreading loss to the GSO would be 163.3 dB, resulting in a worst case EPFD(up) level at the GSO of −165 dBW/m^2/40kHz. This is below the EPFD(up) limit value of -162 dBW/m^2/40kHz specified in No. 22.5D of the ITU's Radio Regulations, so compliance exists with margin for this low-elevation case. At higher elevation angles the increase in the separation angle between the GSO and the O3b orbit more than offsets the reduced path length to the GSO, resulting in even more margin relative to the EPFD(up) limit.

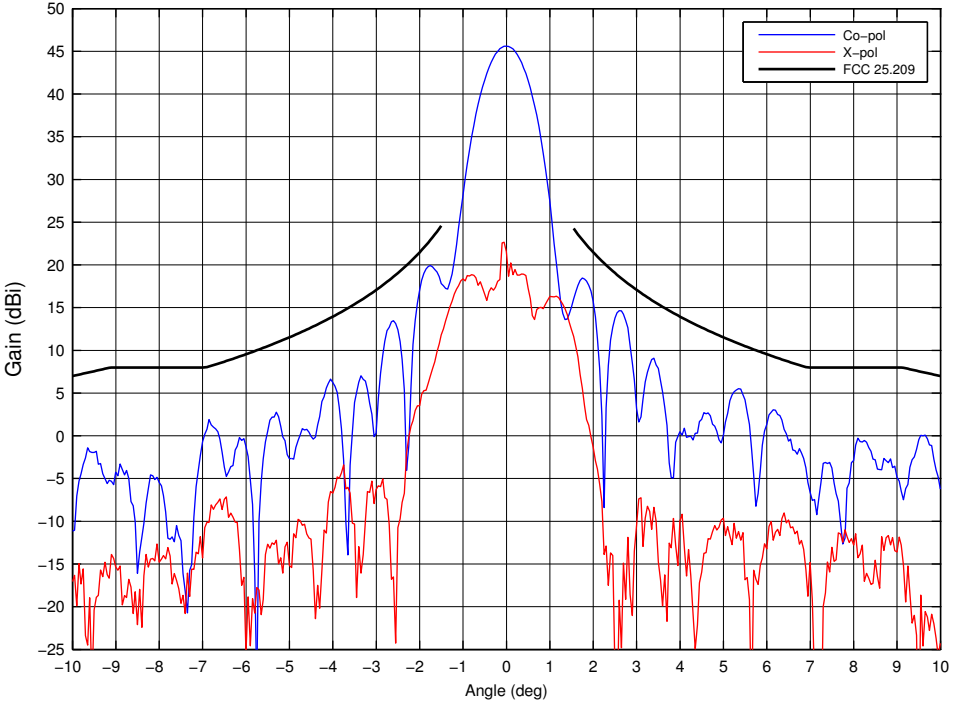
ANNEX 6 – AvL .85m Measured Antenna Patterns

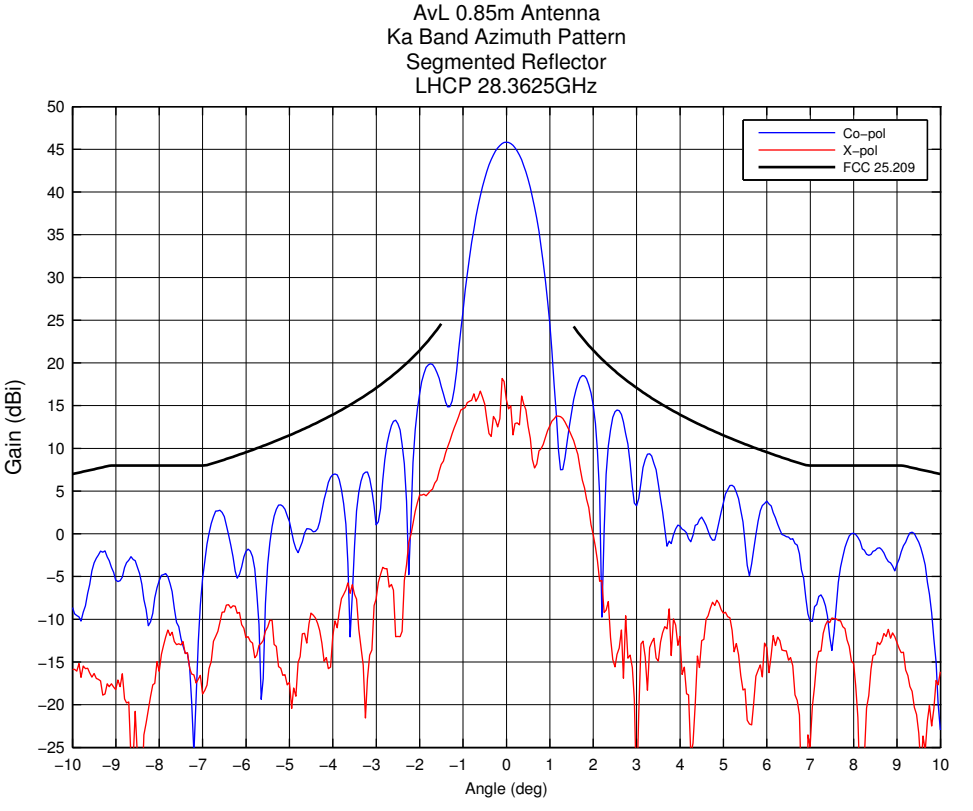
AvL Technologies

0.85m Ka Band O3b Antenna

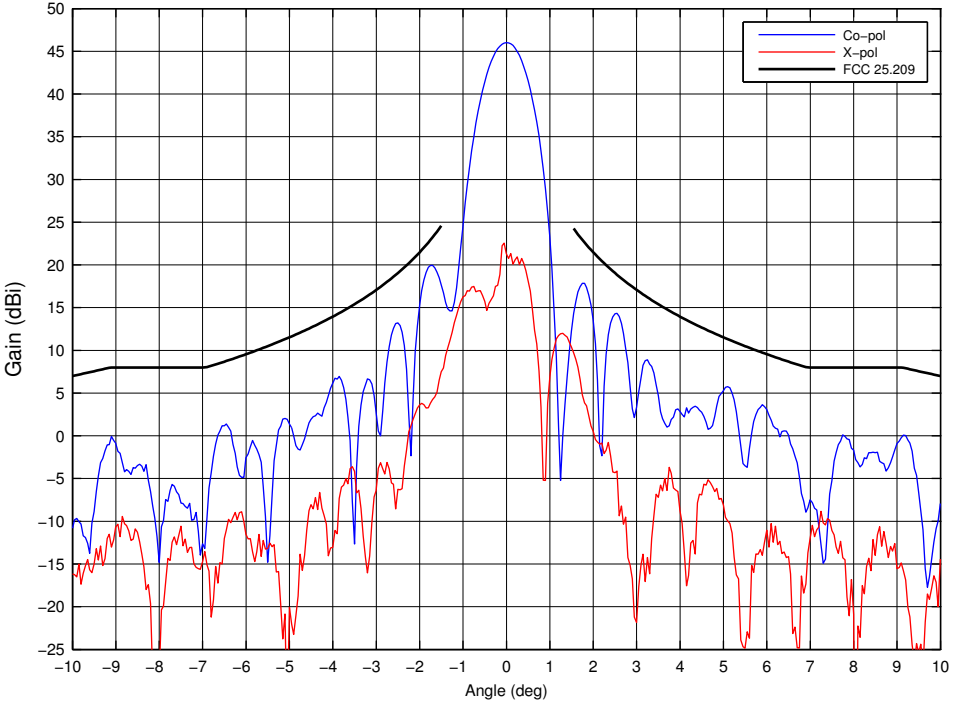
Transmit Band Azimuth Patterns

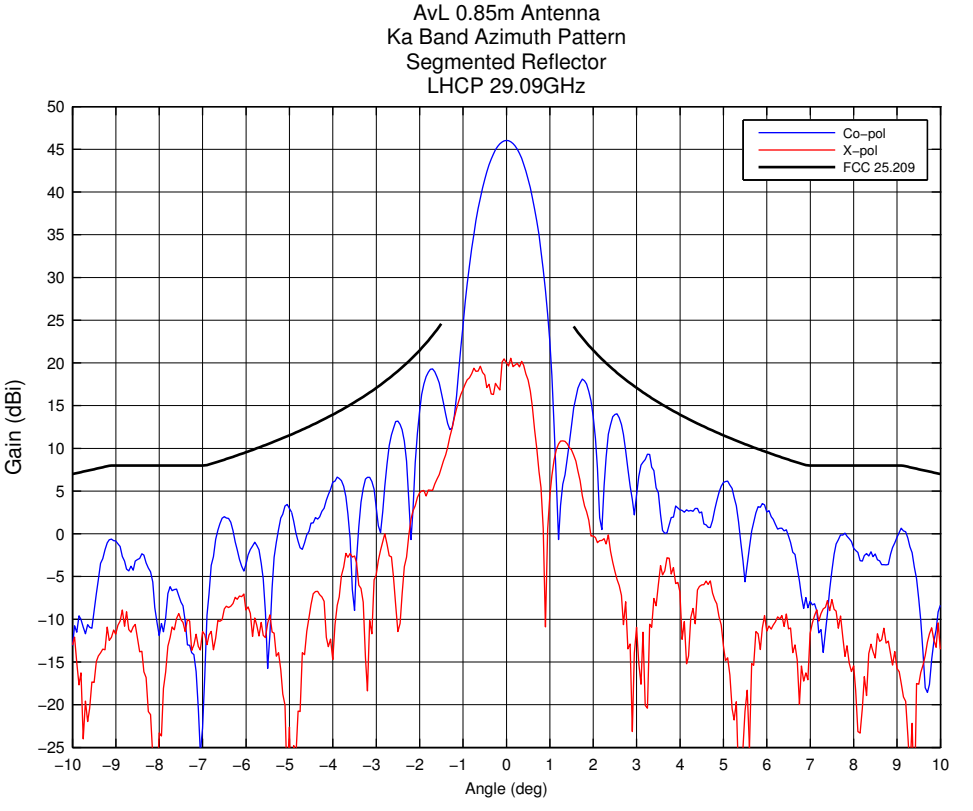
AvL 0.85m Antenna
Ka Band Azimuth Pattern
Segmented Reflector
LHCP 27.635GHz

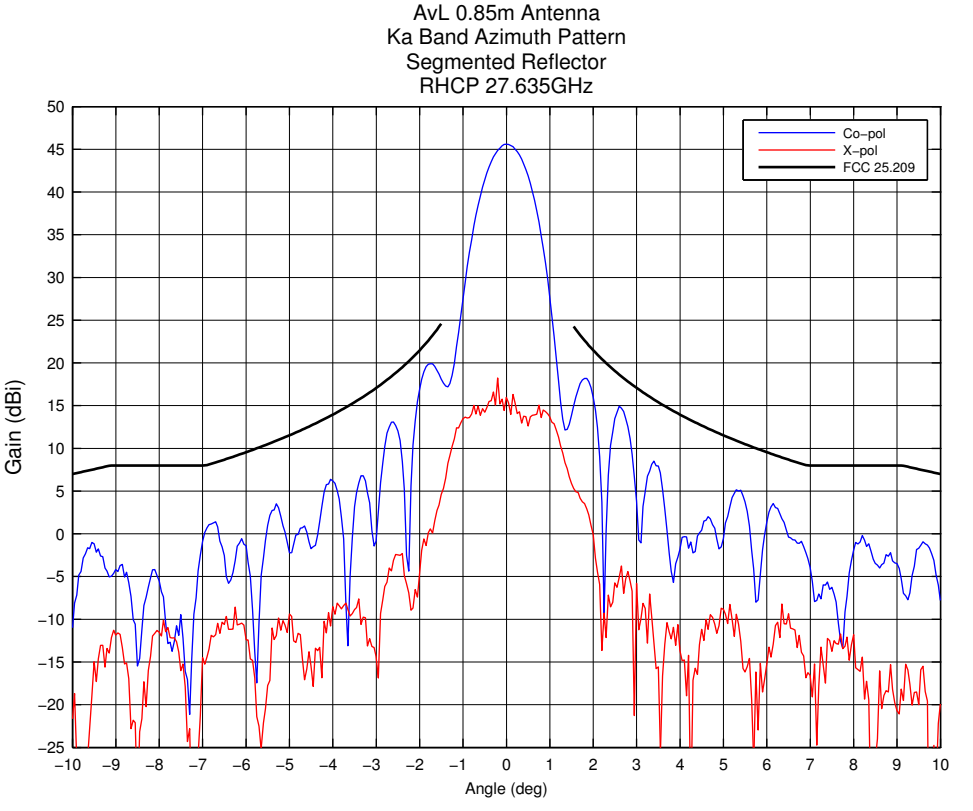



AvL 0.85m Antenna
Ka Band Azimuth Pattern
Segmented Reflector
LHCP 28.3625GHz
Co−pol
X−pol
FCC 25.209
Gain (dBi)
Angle (deg)
50
45
40
35
30
25
20
15
10
5
0
−5
−10
−15
−20
−25
−10
−9
−8
−7
−6
−5
−4
−3
−2
−1
0
1
2
3
4
5
6
7
8
9
10

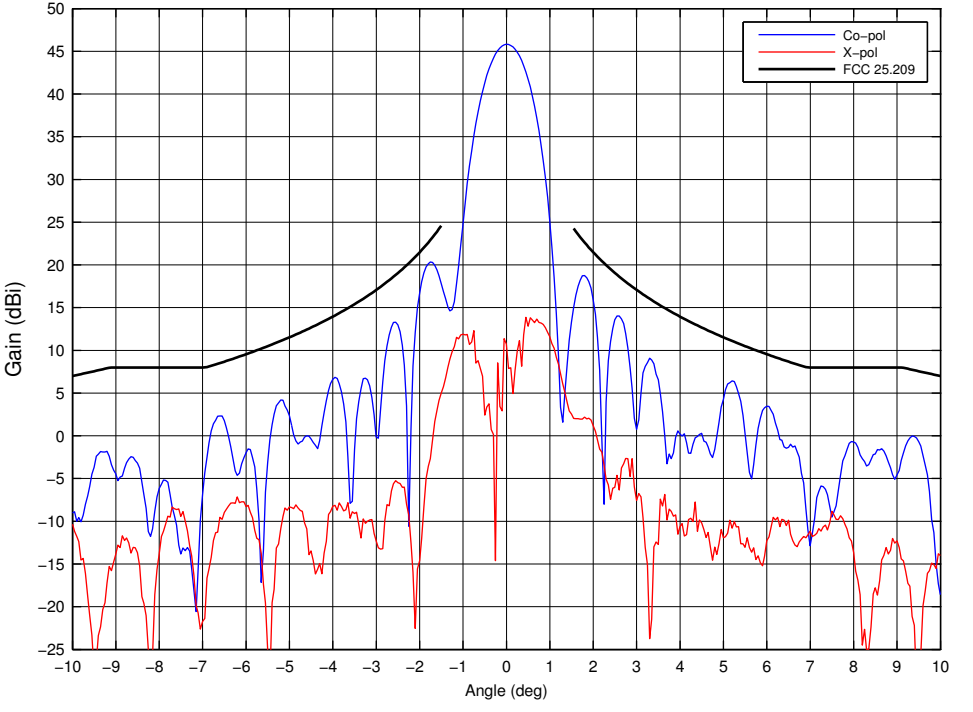
AvL 0.85m Antenna
Ka Band Azimuth Pattern
Segmented Reflector
LHCP 29GHz



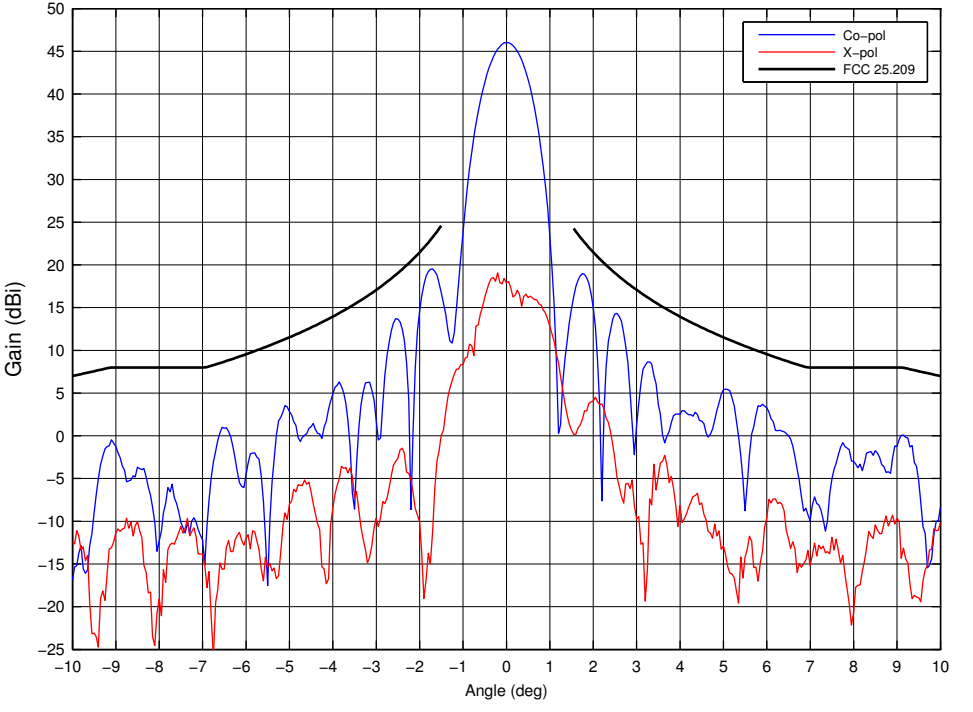

AvL 0.85m Antenna
Ka Band Azimuth Pattern
Segmented Reflector
LHCP 29.09GHz
Co−pol
X−pol
FCC 25.209
Gain (dBi)
Angle (deg)
50
45
40
35
30
25
20
15
10
5
0
−5
−10
−15
−20
−25
−10 −9 −8 −7 −6 −5 −4 −3 −2 −1 0 1 2 3 4 5 6 7 8 9 10

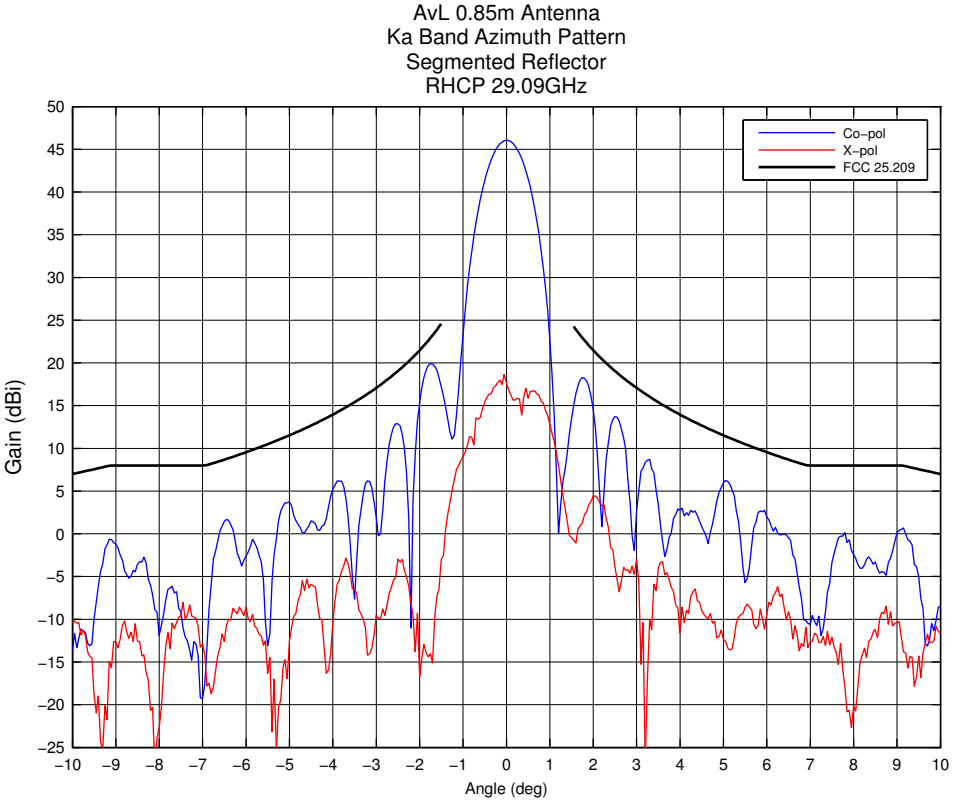

AvL 0.85m Antenna
Ka Band Azimuth Pattern
Segmented Reflector
RHCP 27.635GHz
Co−pol
X−pol
FCC 25.209
Gain (dBi)
Angle (deg)
50
45
40
35
30
25
20
15
10
5
0
−5
−10
−15
−20
−25
−10 −9 −8 −7 −6 −5 −4 −3 −2 −1 0 1 2 3 4 5 6 7 8 9 10

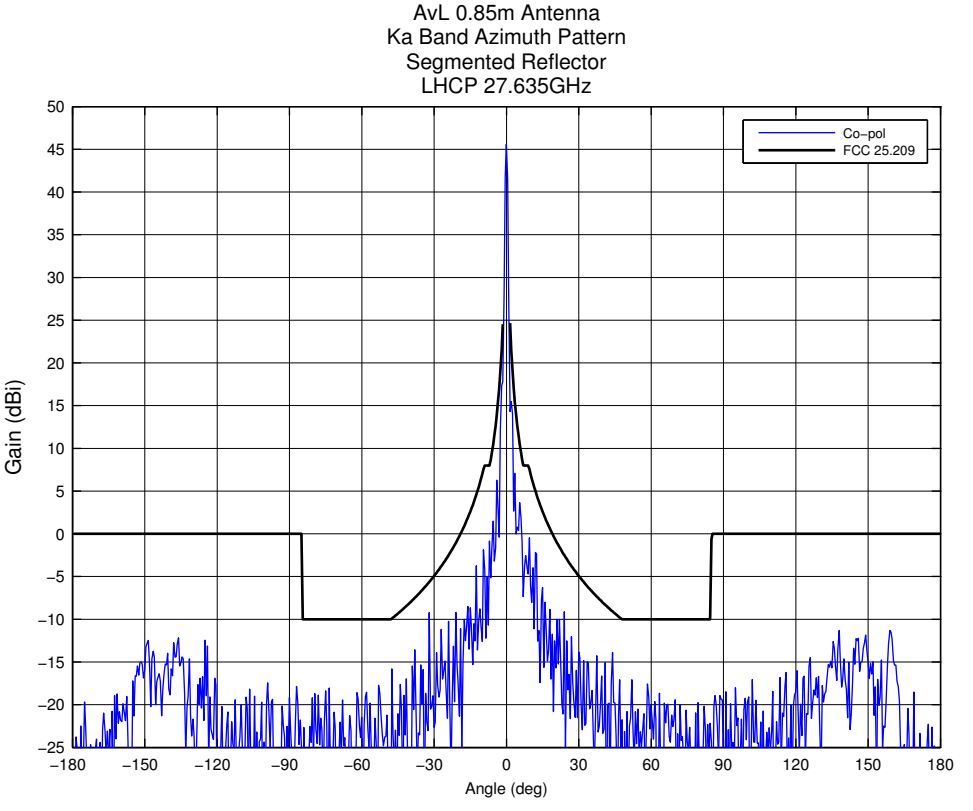
AvL 0.85m Antenna
Ka Band Azimuth Pattern
Segmented Reflector
RHCP 28.3625GHz

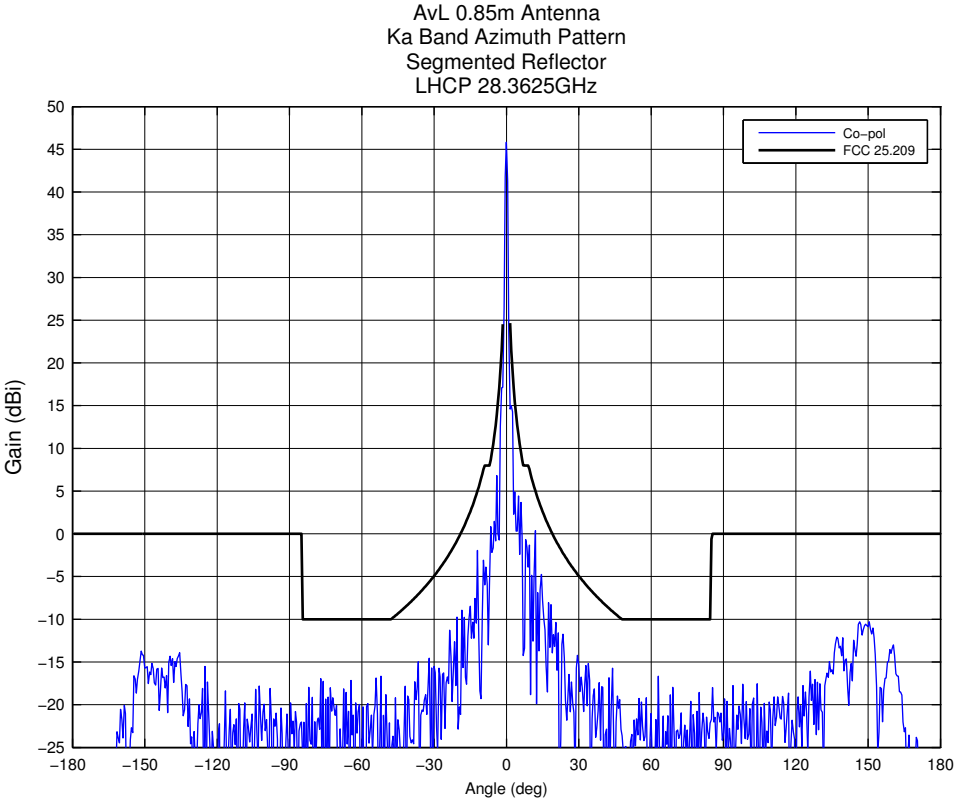


AvL 0.85m Antenna
Ka Band Azimuth Pattern
Segmented Reflector
RHCP 29GHz

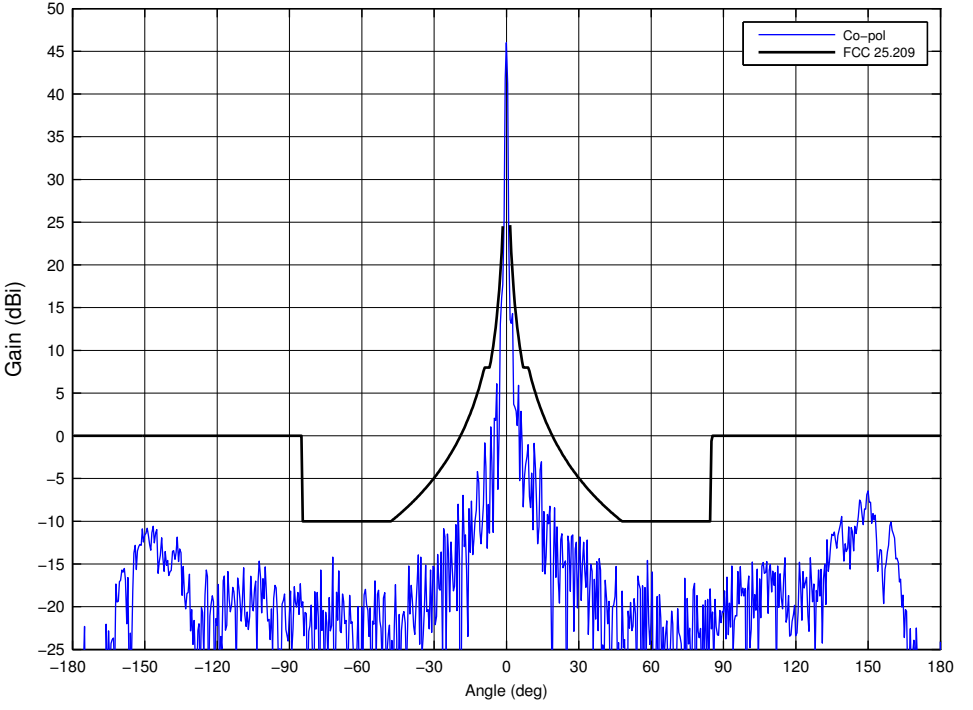


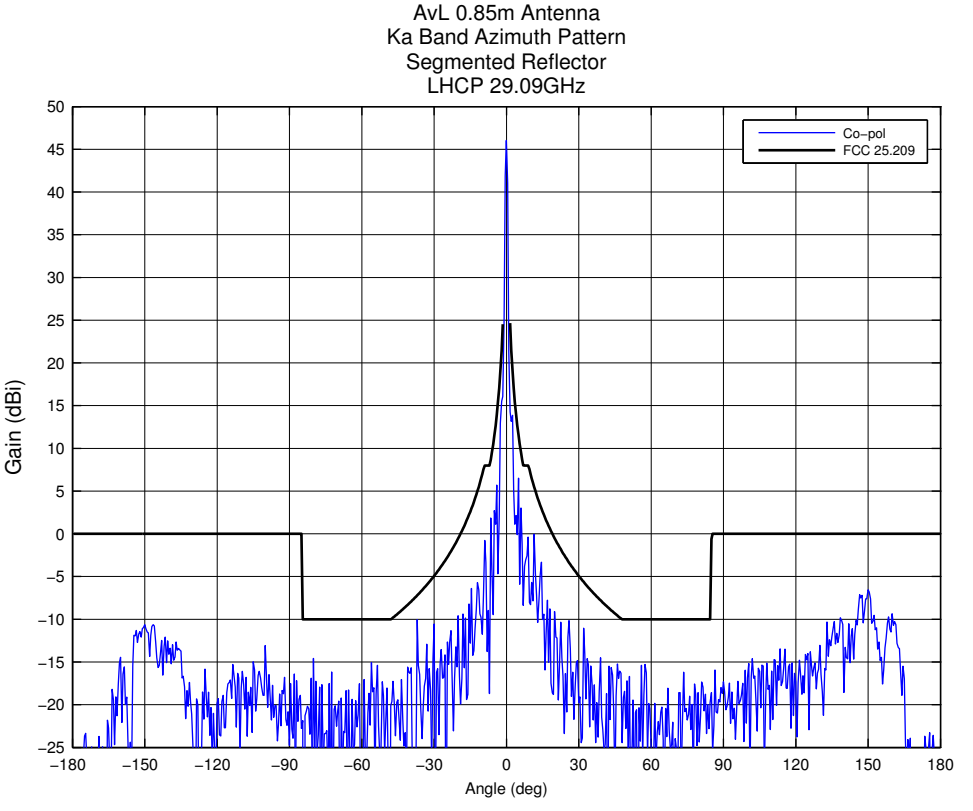

AvL 0.85m Antenna
Ka Band Azimuth Pattern
Segmented Reflector
RHCP 29.09GHz
Co−pol
X−pol
FCC 25.209
Gain (dBi)
Angle (deg)
50
45
40
35
30
25
20
15
10
5
0
−5
−10
−15
−20
−25
−10
−9
−8
−7
−6
−5
−4
−3
−2
−1
0
1
2
3
4
5
6
7
8
9
10

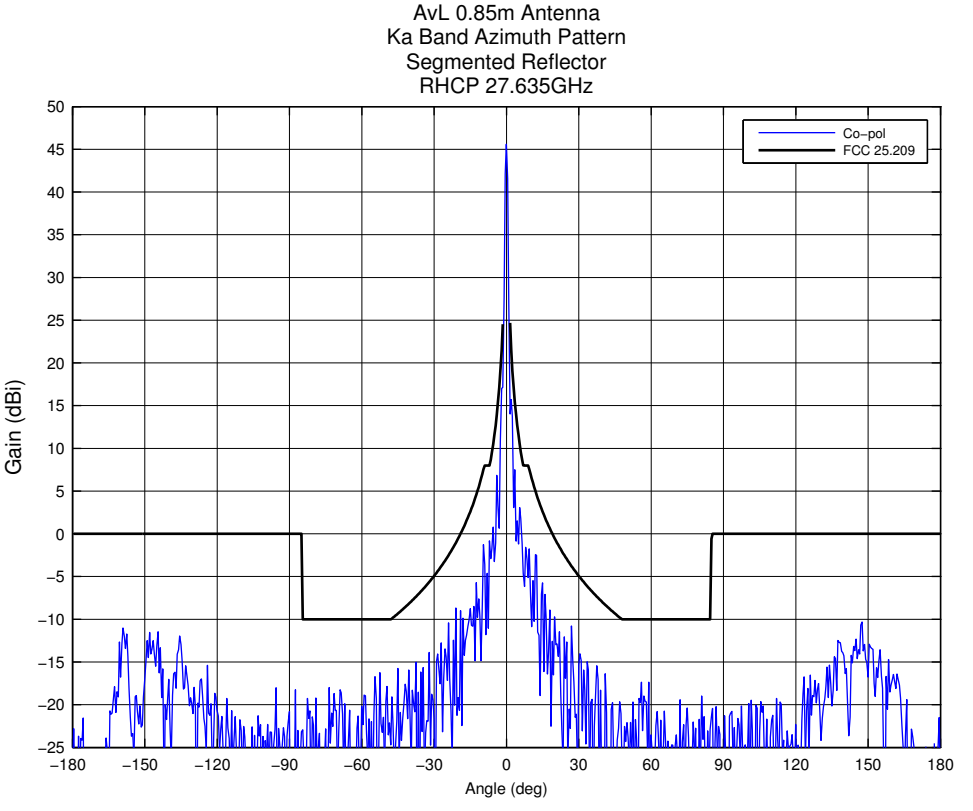

AvL 0.85m Antenna
Ka Band Azimuth Pattern
Segmented Reflector
LHCP 27.635GHz
Co−pol
FCC 25.209
Gain (dBi)
Angle (deg)
50
45
40
35
30
25
20
15
10
5
0
−5
−10
−15
−20
−25
−180
−150
−120
−90
−60
−30
0
30
60
90
120
150
180

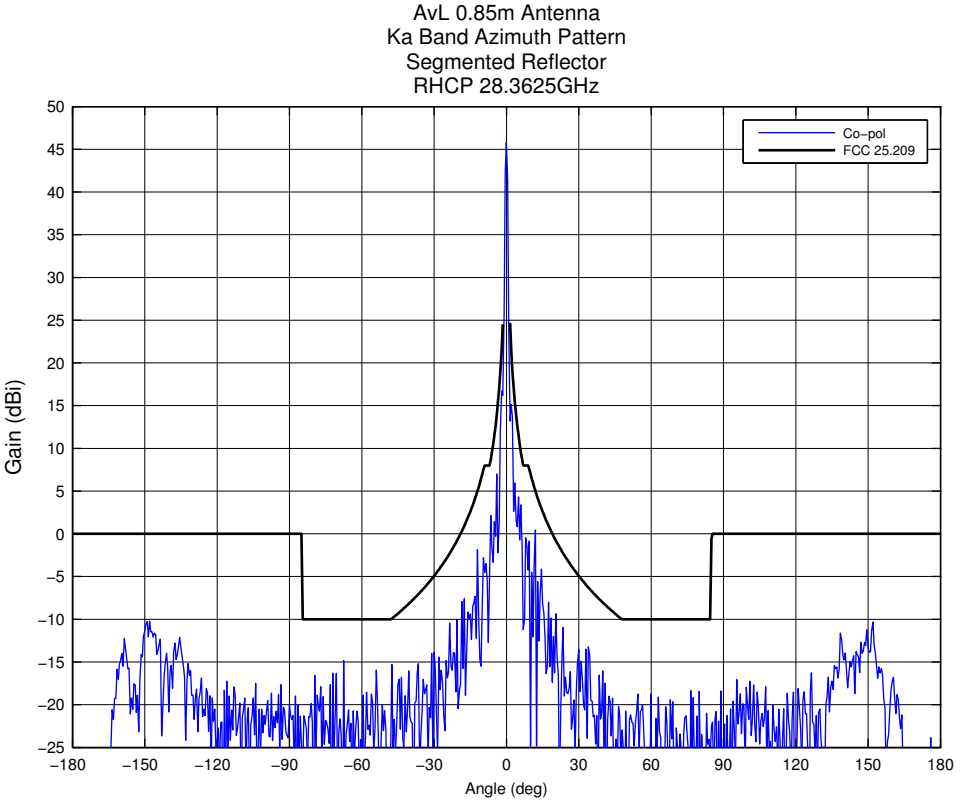

AvL 0.85m Antenna
Ka Band Azimuth Pattern
Segmented Reflector
LHCP 28.3625GHz
Co−pol
FCC 25.209
Gain (dBi)
Angle (deg)
50
45
40
35
30
25
20
15
10
5
0
−5
−10
−15
−20
−25
−180
−150
−120
−90
−60
−30
0
30
60
90
120
150
180

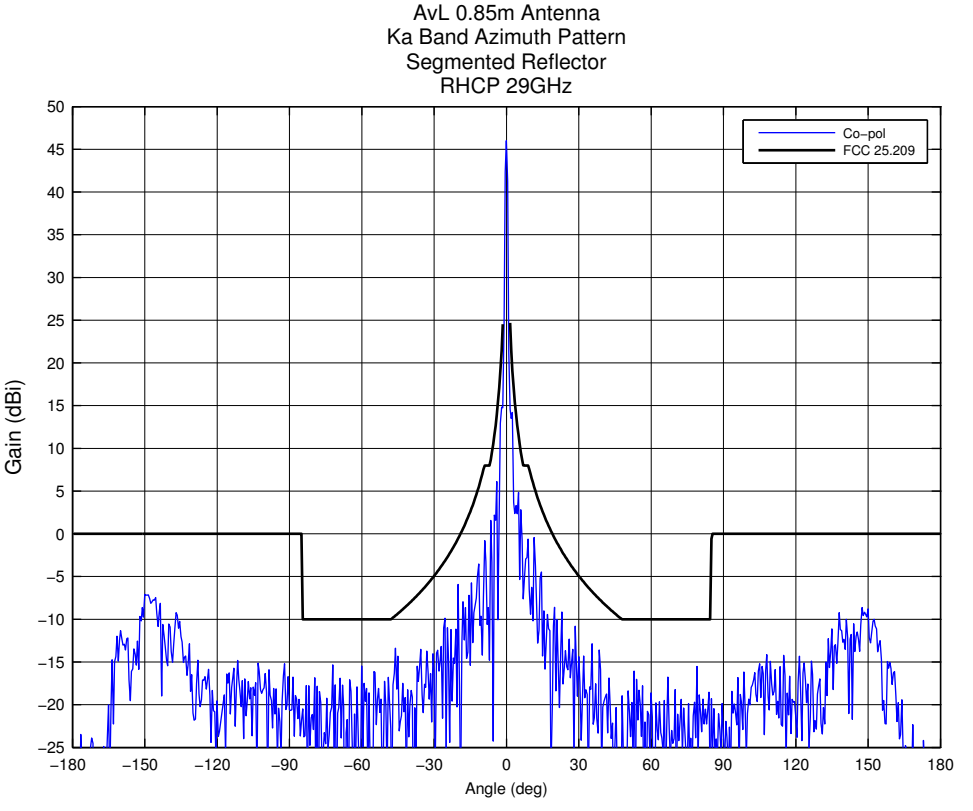
AvL 0.85m Antenna
Ka Band Azimuth Pattern
Segmented Reflector
LHCP 29GHz

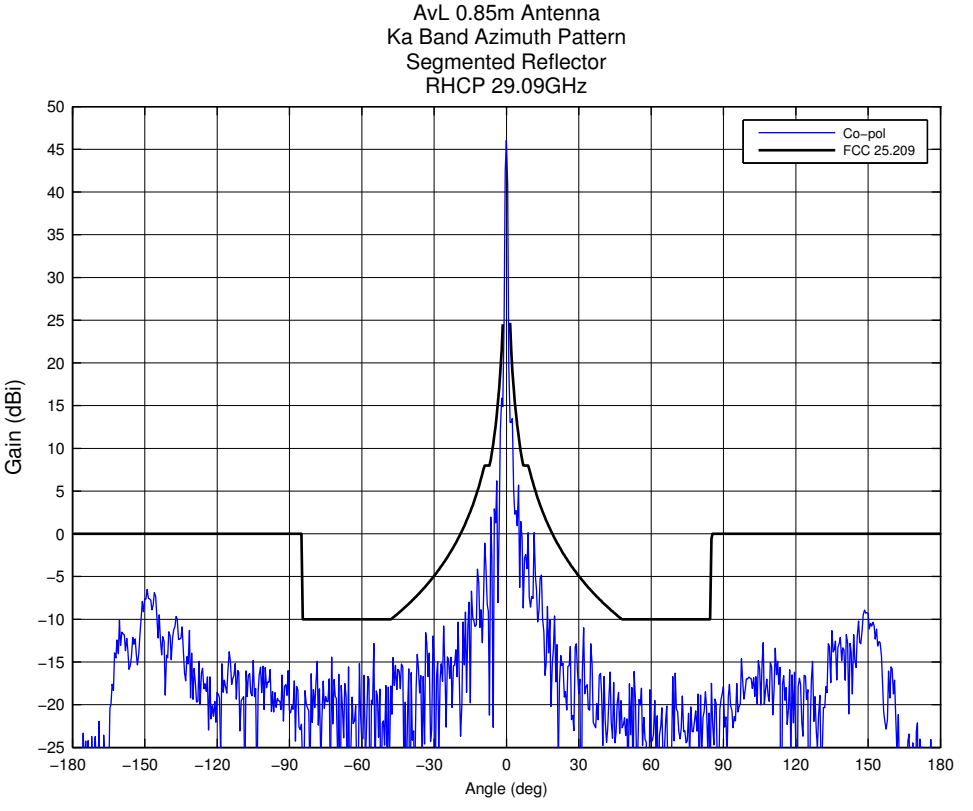



AvL 0.85m Antenna
Ka Band Azimuth Pattern
Segmented Reflector
LHCP 29.09GHz
Co−pol
FCC 25.209
Gain (dBi)
Angle (deg)
50
45
40
35
30
25
20
15
10
5
0
−5
−10
−15
−20
−25
−180
−150
−120
−90
−60
−30
0
30
60
90
120
150
180


AvL 0.85m Antenna
Ka Band Azimuth Pattern
Segmented Reflector
RHCP 27.635GHz
Co–pol
FCC 25.209
Gain (dBi)
50
45
40
35
30
25
20
15
10
5
0
−5
−10
−15
−20
−25
−180
−150
−120
−90
−60
−30
0
30
60
90
120
150
180
Angle (deg)


AvL 0.85m Antenna
Ka Band Azimuth Pattern
Segmented Reflector
RHCP 28.3625GHz
Co–pol
FCC 25.209
Gain (dBi)
Angle (deg)
50
45
40
35
30
25
20
15
10
5
0
–5
–10
–15
–20
–25
–180
–150
–120
–90
–60
–30
0
30
60
90
120
150
180

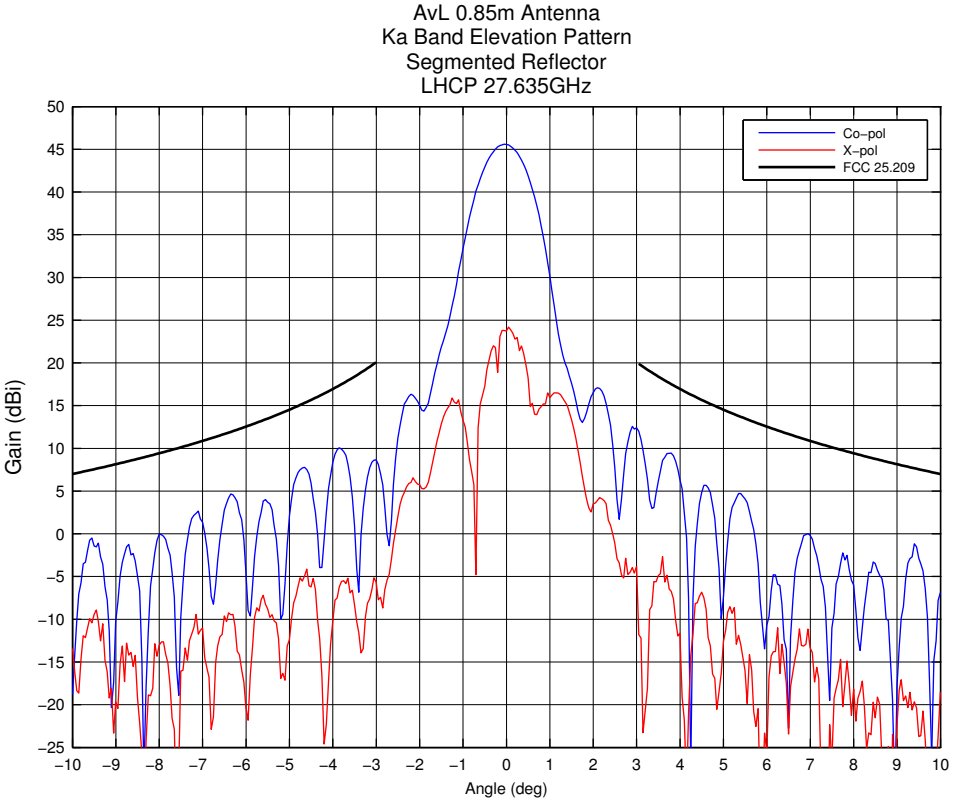

AvL 0.85m Antenna
Ka Band Azimuth Pattern
Segmented Reflector
RHCP 29GHz
Co−pol
FCC 25.209
Gain (dBi)
Angle (deg)
50
45
40
35
30
25
20
15
10
5
0
−5
−10
−15
−20
−25
−180
−150
−120
−90
−60
−30
0
30
60
90
120
150
180


AvL 0.85m Antenna
Ka Band Azimuth Pattern
Segmented Reflector
RHCP 29.09GHz
Co–pol
FCC 25.209
Gain (dBi)
Angle (deg)
50
45
40
35
30
25
20
15
10
5
0
−5
−10
−15
−20
−25
−180
−150
−120
−90
−60
−30
0
30
60
90
120
150
180

AvL Technologies

0.85m Ka Band O3b Antenna

Transmit Band Elevation Patterns


AvL 0.85m Antenna
Ka Band Elevation Pattern
Segmented Reflector
LHCP 27.635GHz
Co−pol
X−pol
FCC 25.209
Gain (dBi)
Angle (deg)
50
45
40
35
30
25
20
15
10
5
0
−5
−10
−15
−20
−25
−10
−9
−8
−7
−6
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−3
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−1
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3
4
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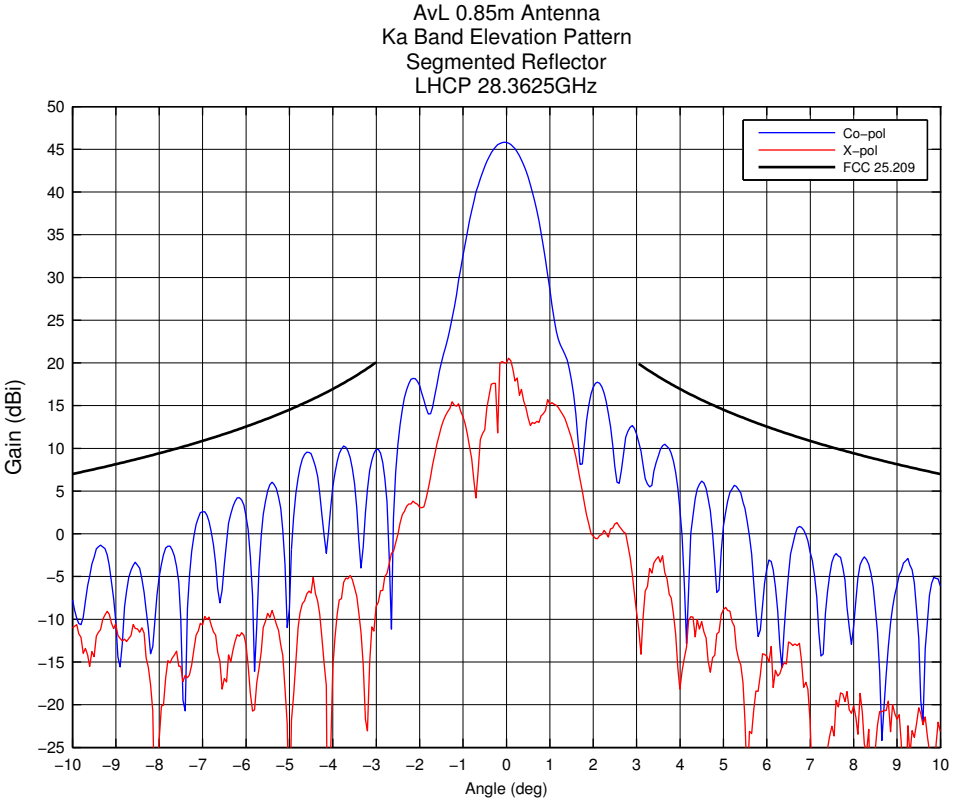
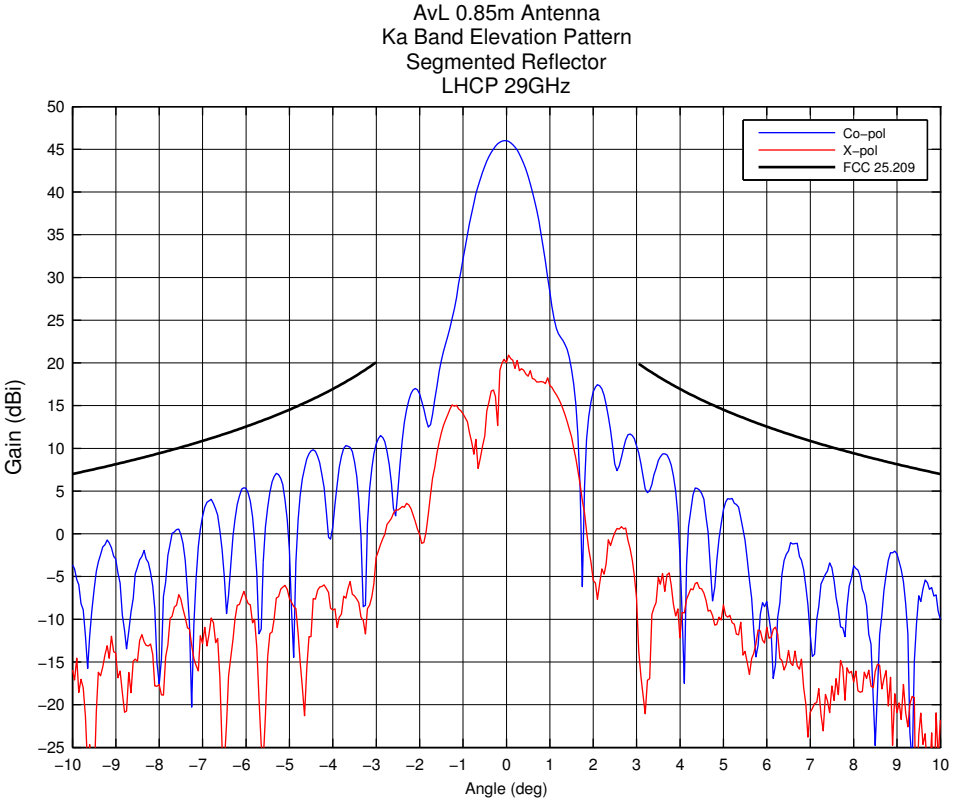
6
7
8
9
10


AvL 0.85m Antenna
Ka Band Elevation Pattern
Segmented Reflector
LHCP 28.3625GHz
Co−pol
X−pol
FCC 25.209
Gain (dBi)
Angle (deg)
50
45
40
35
30
25
20
15
10
5
0
−5
−10
−15
−20
−25
−10 −9 −8 −7 −6 −5 −4 −3 −2 −1 0 1 2 3 4 5 6 7 8 9 10


AvL 0.85m Antenna
Ka Band Elevation Pattern
Segmented Reflector
LHCP 29GHz
Co−pol
X−pol
FCC 25.209
Gain (dBi)
Angle (deg)
50
45
40
35
30
25
20
15
10
5
0
−5
−10
−15
−20
−25
−10
−9
−8
−7
−6
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−4
−3
−2
−1
0
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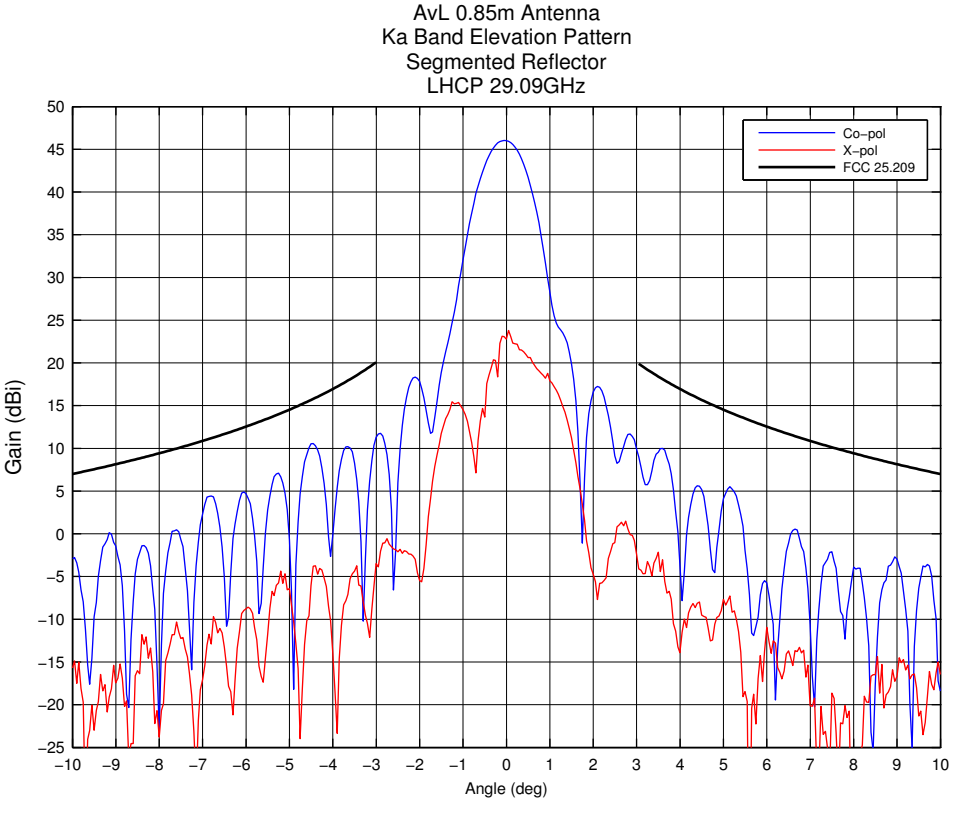
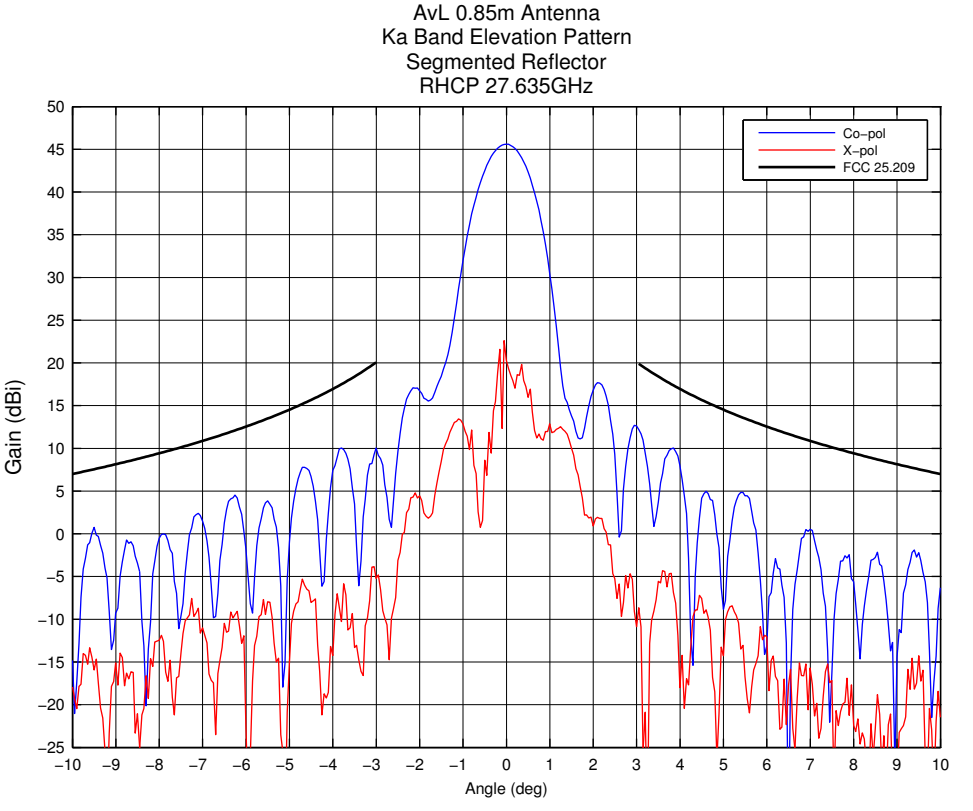
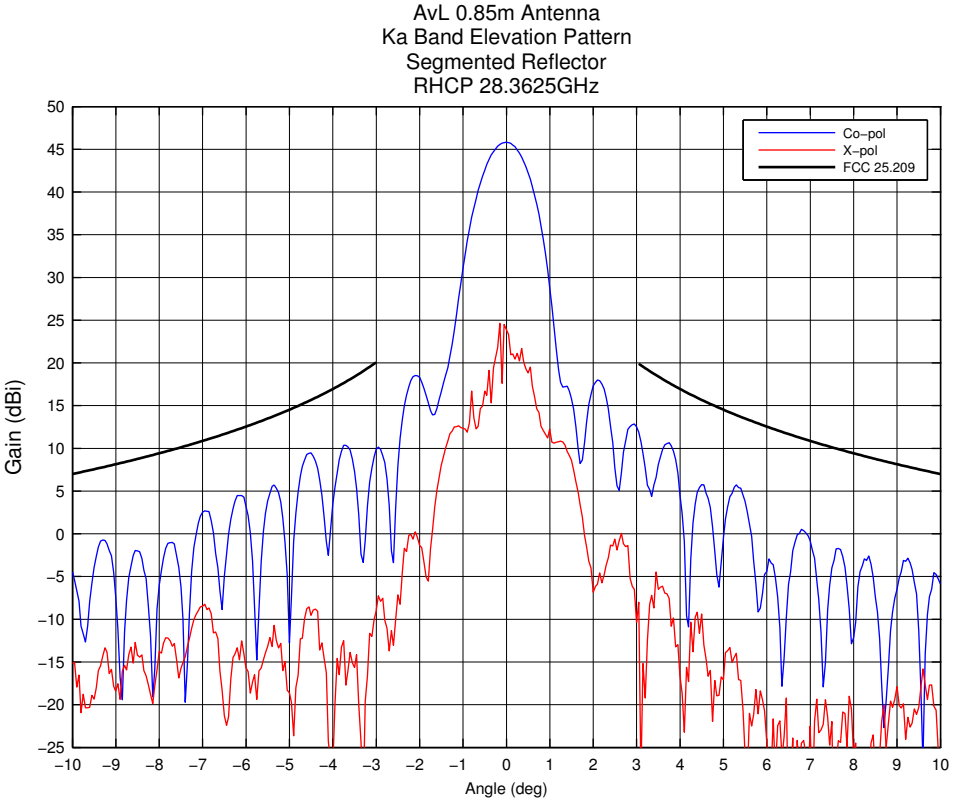
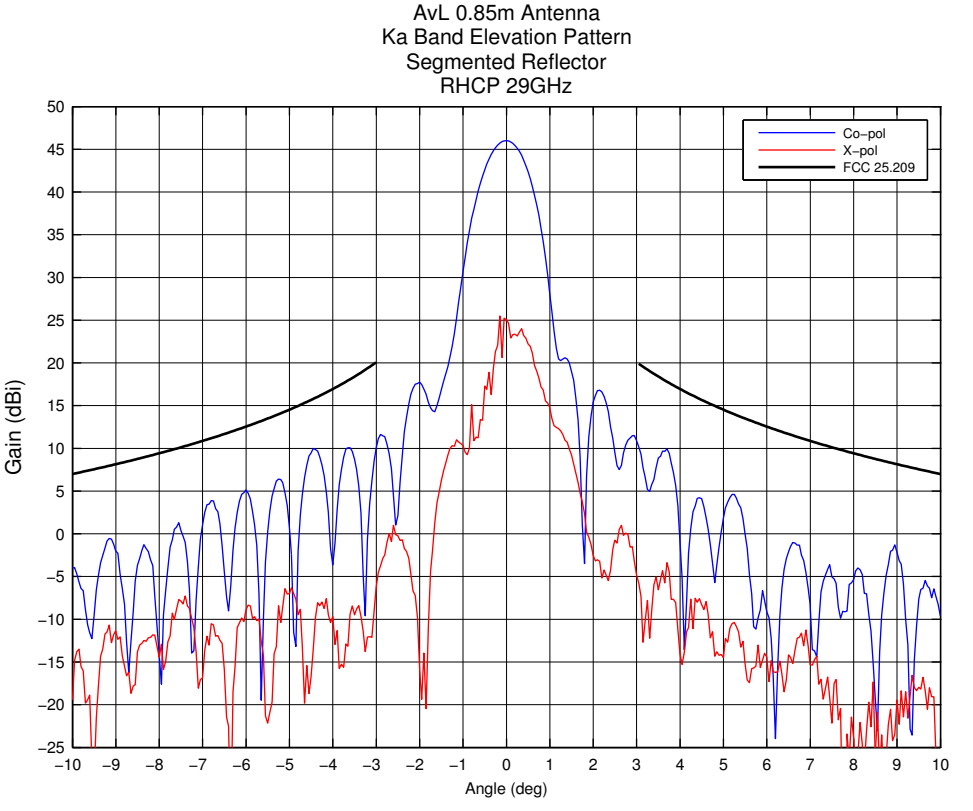
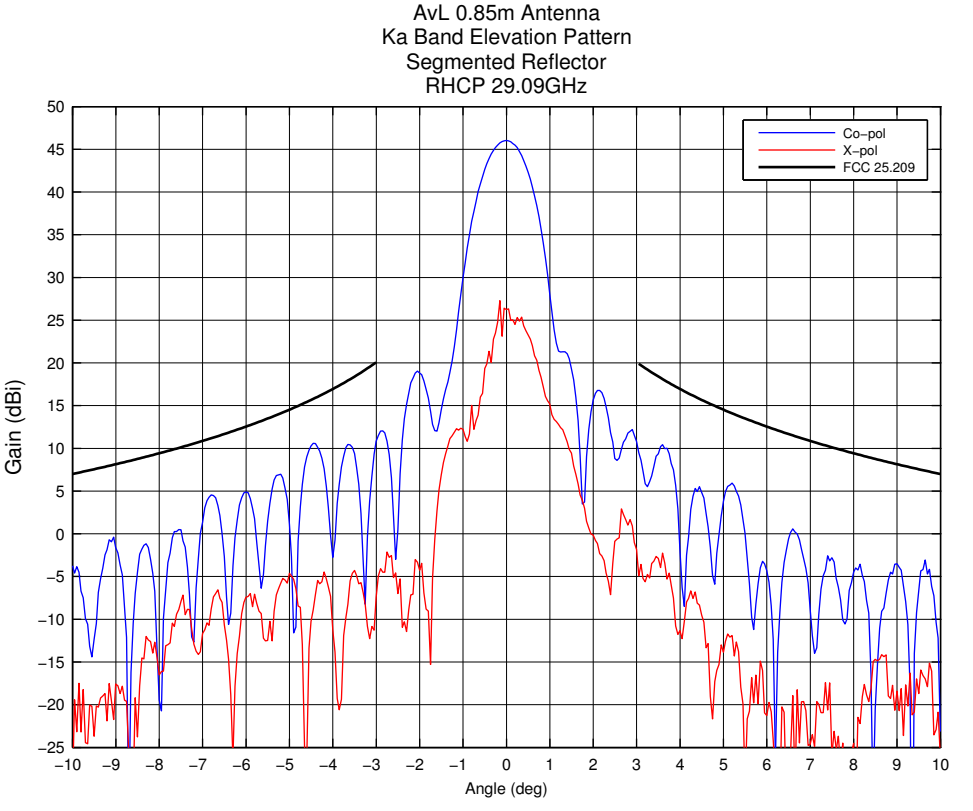
10

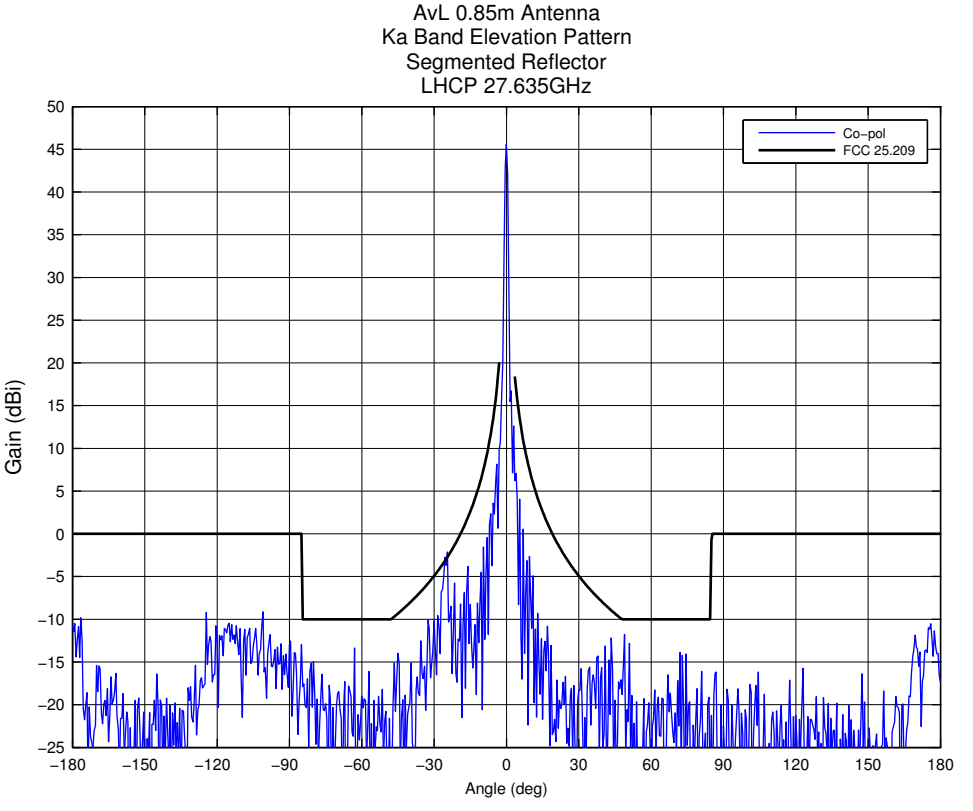

AvL 0.85m Antenna
Ka Band Elevation Pattern
Segmented Reflector
LHCP 29.09GHz
Co−pol
X−pol
FCC 25.209
Gain (dBi)
Angle (deg)
50
45
40
35
30
25
20
15
10
5
0
−5
−10
−15
−20
−25
−10 −9 −8 −7 −6 −5 −4 −3 −2 −1 0 1 2 3 4 5 6 7 8 9 10


AvL 0.85m Antenna
Ka Band Elevation Pattern
Segmented Reflector
RHCP 27.635GHz
Co−pol
X−pol
FCC 25.209
Gain (dBi)
Angle (deg)
50
45
40
35
30
25
20
15
10
5
0
−5
−10
−15
−20
−25
−10 −9 −8 −7 −6 −5 −4 −3 −2 −1 0 1 2 3 4 5 6 7 8 9 10


AvL 0.85m Antenna
Ka Band Elevation Pattern
Segmented Reflector
RHCP 28.3625GHz
Co−pol
X−pol
FCC 25.209
Gain (dBi)
Angle (deg)
50
45
40
35
30
25
20
15
10
5
0
−5
−10
−15
−20
−25
−10
−9
−8
−7
−6
−5
−4
−3
−2
−1
0
1
2
3
4
5
6
7
8
9
10


AvL 0.85m Antenna
Ka Band Elevation Pattern
Segmented Reflector
RHCP 29GHz
Co−pol
X−pol
FCC 25.209
Gain (dBi)
Angle (deg)
50
45
40
35
30
25
20
15
10
5
0
−5
−10
−15
−20
−25
−10 −9 −8 −7 −6 −5 −4 −3 −2 −1 0 1 2 3 4 5 6 7 8 9 10


AvL 0.85m Antenna
Ka Band Elevation Pattern
Segmented Reflector
RHCP 29.09GHz
Co−pol
X−pol
FCC 25.209
Gain (dBi)
Angle (deg)
50
45
40
35
30
25
20
15
10
5
0
−5
−10
−15
−20
−25
−10 −9 −8 −7 −6 −5 −4 −3 −2 −1 0 1 2 3 4 5 6 7 8 9 10


AvL 0.85m Antenna
Ka Band Elevation Pattern
Segmented Reflector
LHCP 27.635GHz
Co−pol
FCC 25.209
Gain (dBi)
Angle (deg)
50
45
40
35
30
25
20
15
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5
0
−5
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−180
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−120
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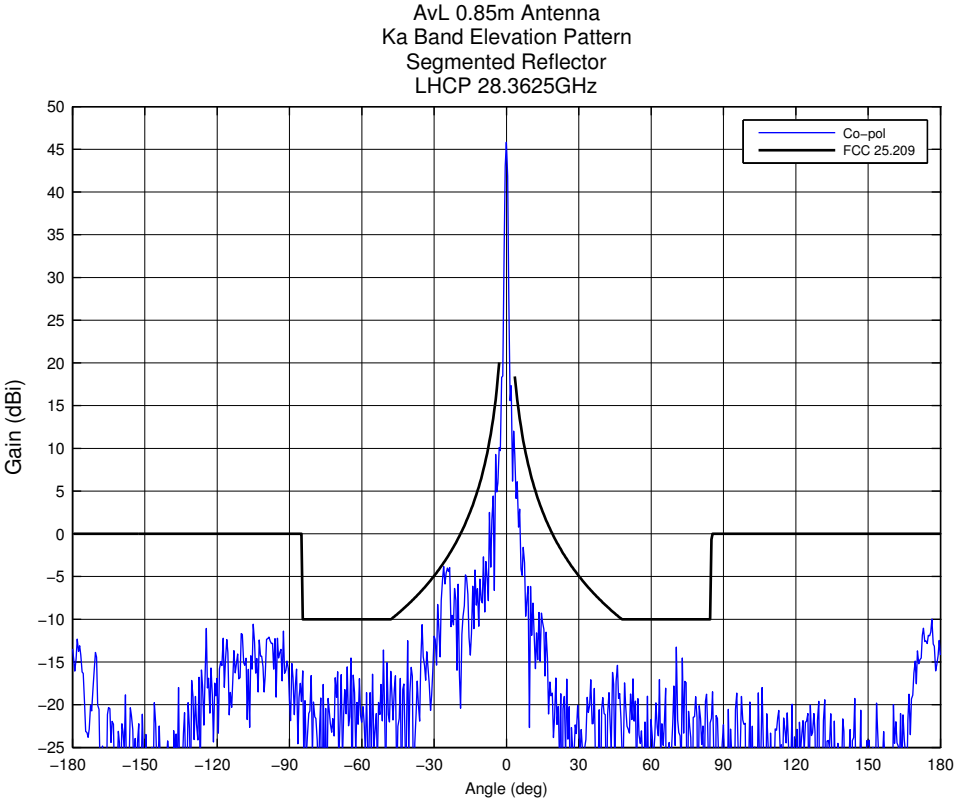
AvL 0.85m Antenna
Ka Band Elevation Pattern
Segmented Reflector
LHCP 28.3625GHz
Co–pol
FCC 25.209
Gain (dBi)
Angle (deg)
50
45
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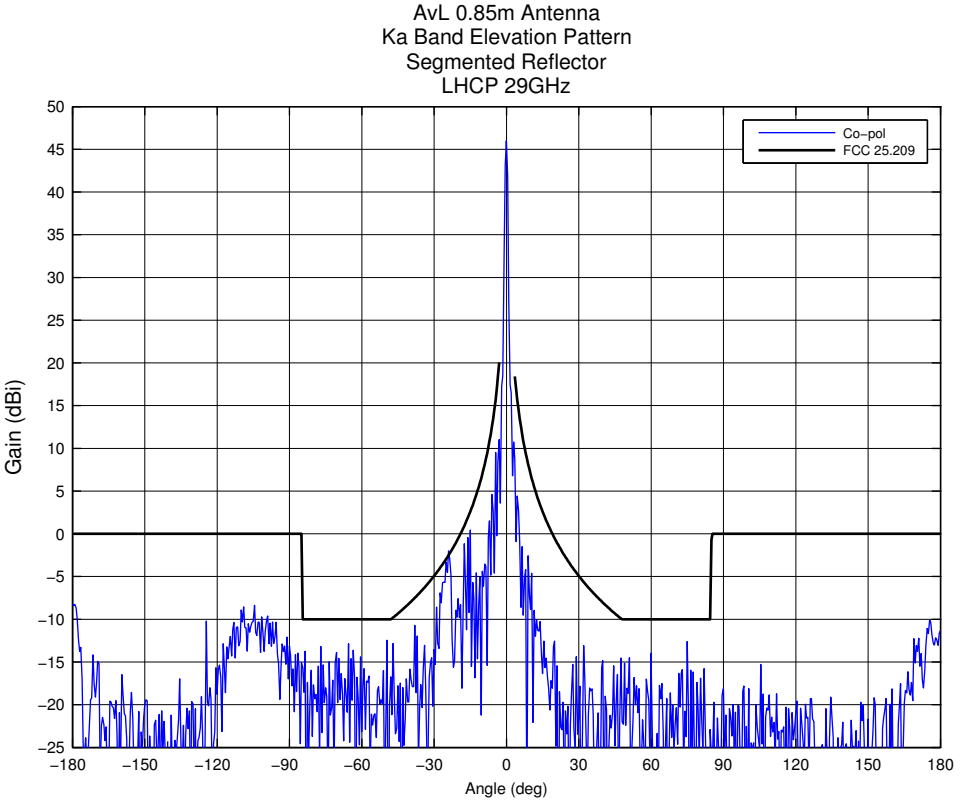
AvL 0.85m Antenna
Ka Band Elevation Pattern
Segmented Reflector
LHCP 29GHz
Co–pol
FCC 25.209
Gain (dBi)
Angle (deg)
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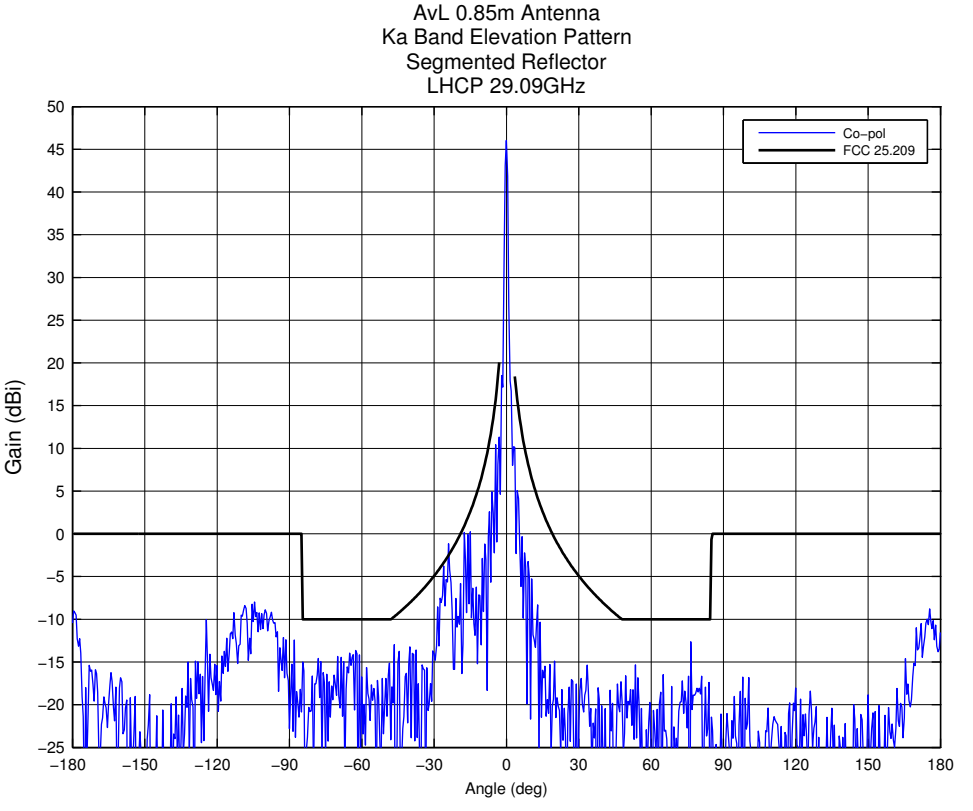
AvL 0.85m Antenna
Ka Band Elevation Pattern
Segmented Reflector
LHCP 29.09GHz
Co−pol
FCC 25.209
Gain (dBi)
Angle (deg)
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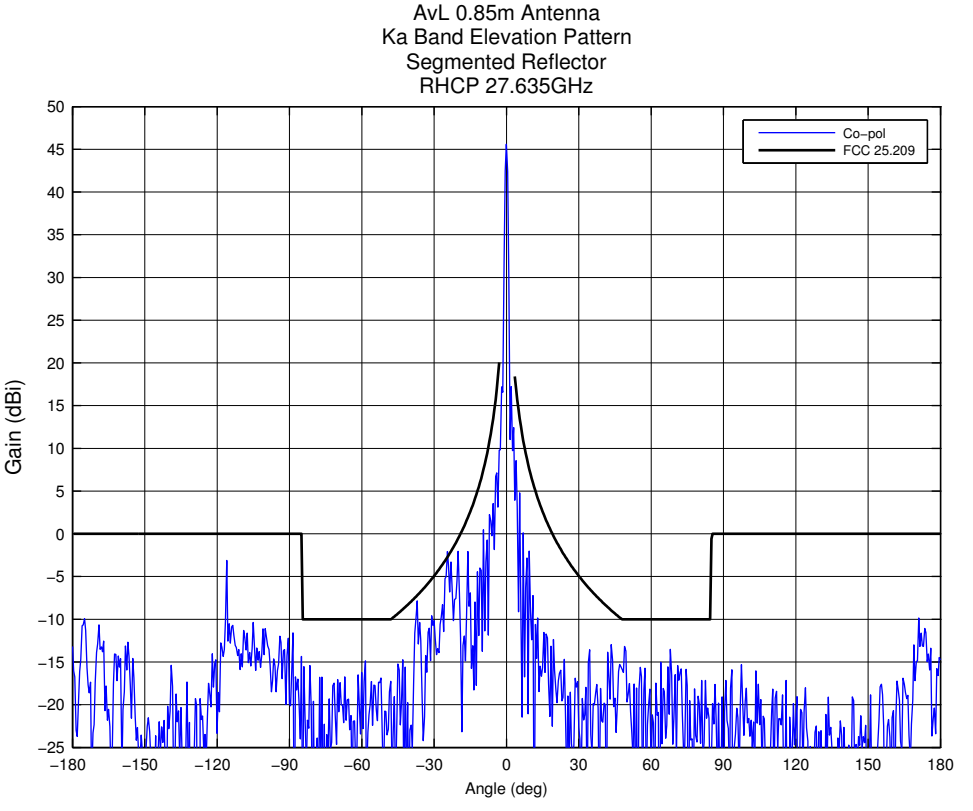
AvL 0.85m Antenna
Ka Band Elevation Pattern
Segmented Reflector
RHCP 27.635GHz
Co–pol
FCC 25.209
Gain (dBi)
Angle (deg)
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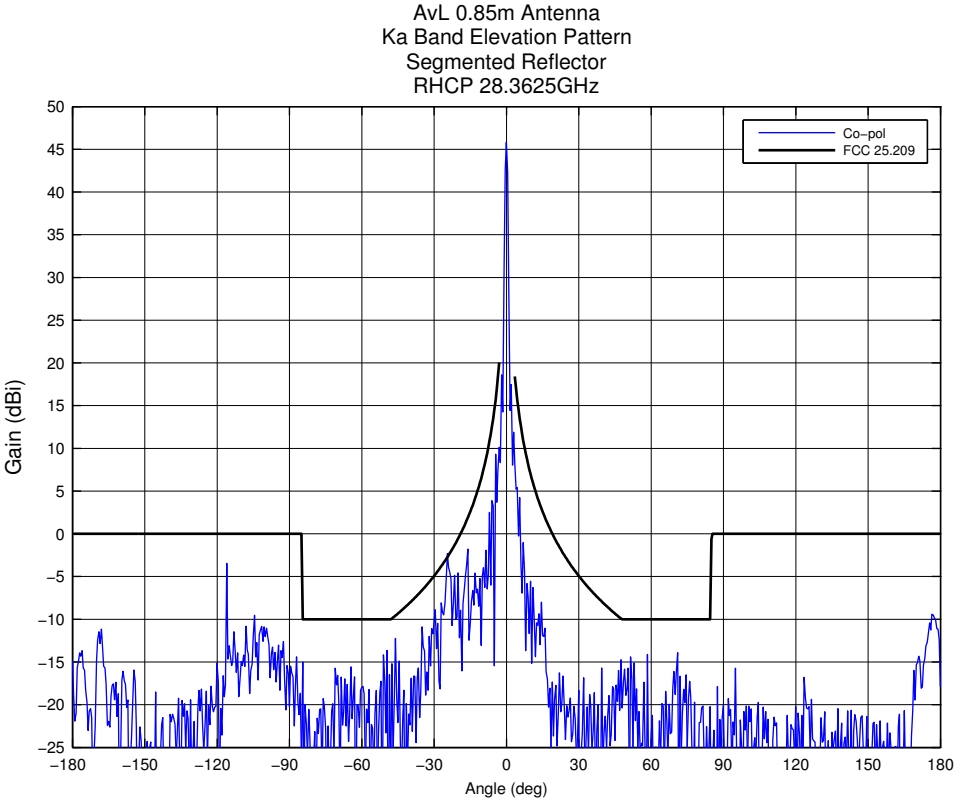
AvL 0.85m Antenna
Ka Band Elevation Pattern
Segmented Reflector
RHCP 28.3625GHz
Co–pol
FCC 25.209
Gain (dBi)
Angle (deg)
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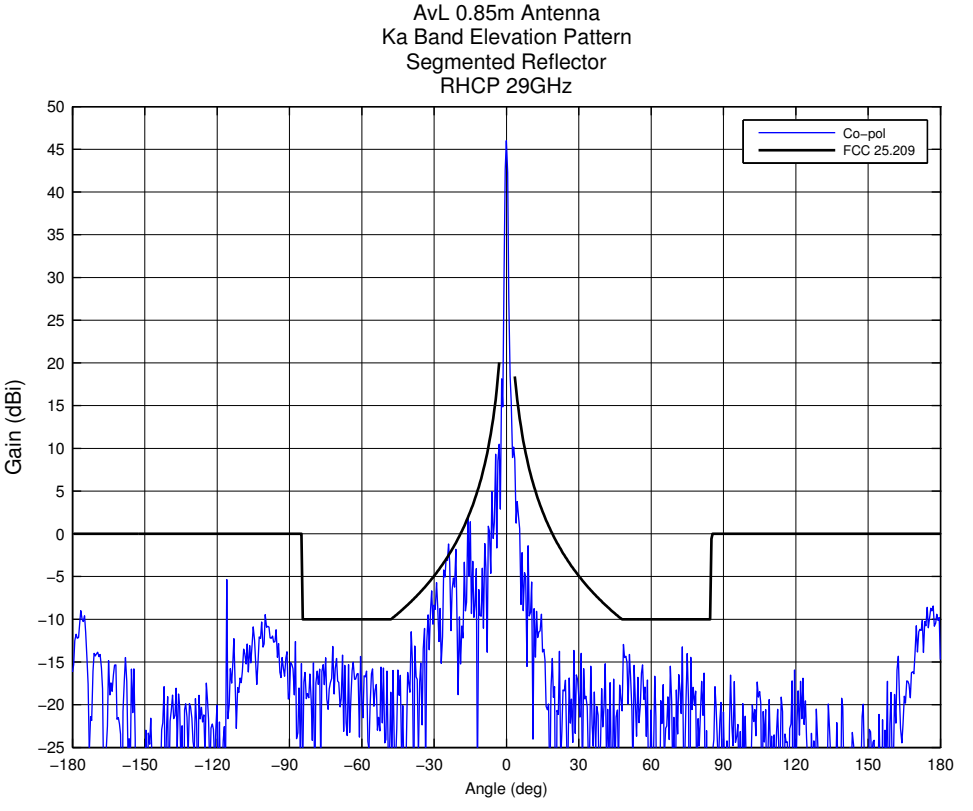
AvL 0.85m Antenna
Ka Band Elevation Pattern
Segmented Reflector
RHCP 29GHz
Co–pol
FCC 25.209
Gain (dBi)
50
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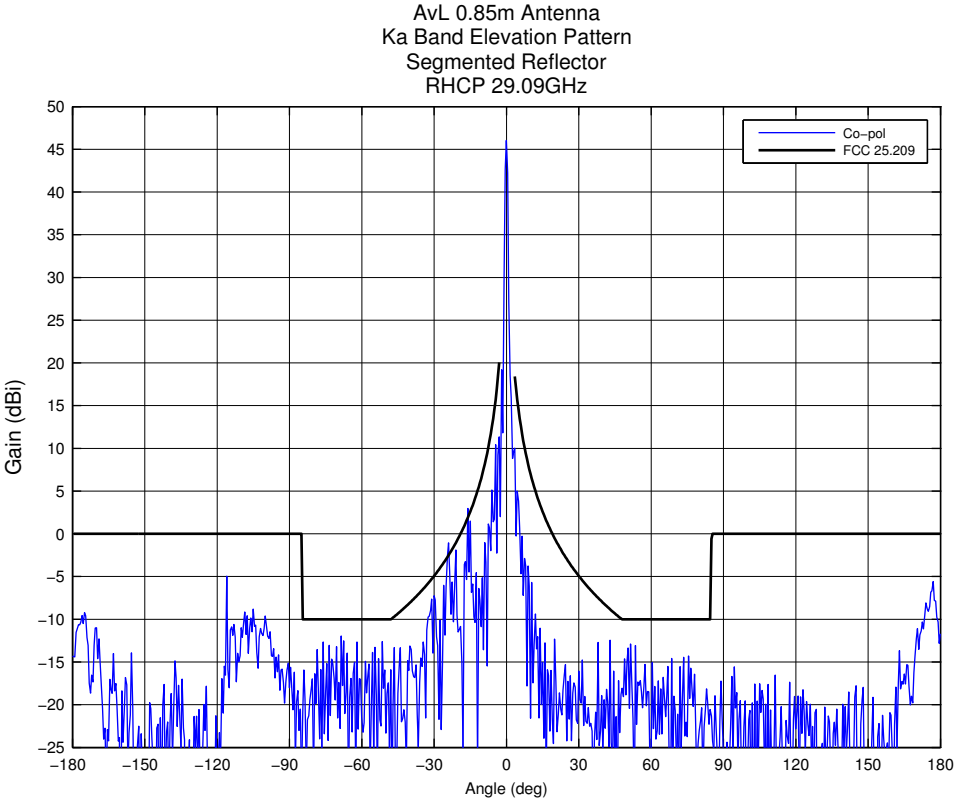
Angle (deg)


AvL 0.85m Antenna
Ka Band Elevation Pattern
Segmented Reflector
RHCP 29.09GHz
Co−pol
FCC 25.209
Gain (dBi)
Angle (deg)
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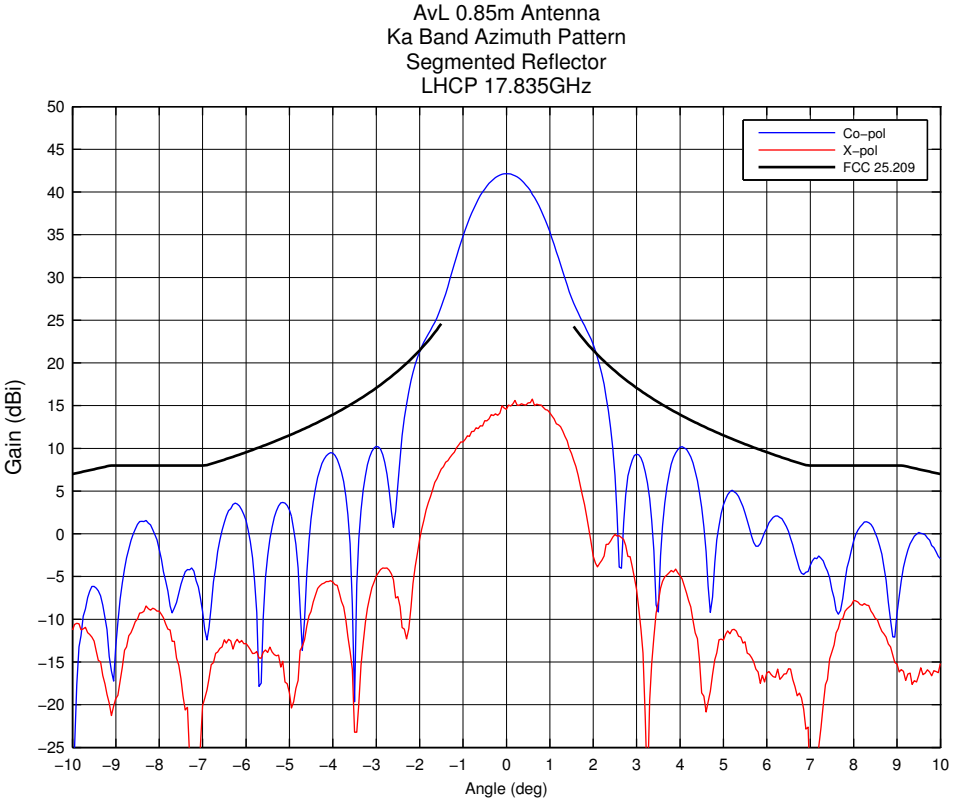
AvL Technologies

0.85m Ka Band O3b Antenna

Receive Band Azimuth Patterns


AvL 0.85m Antenna
Ka Band Azimuth Pattern
Segmented Reflector
LHCP 17.835GHz
Co−pol
X−pol
FCC 25.209
Gain (dBi)
Angle (deg)
50
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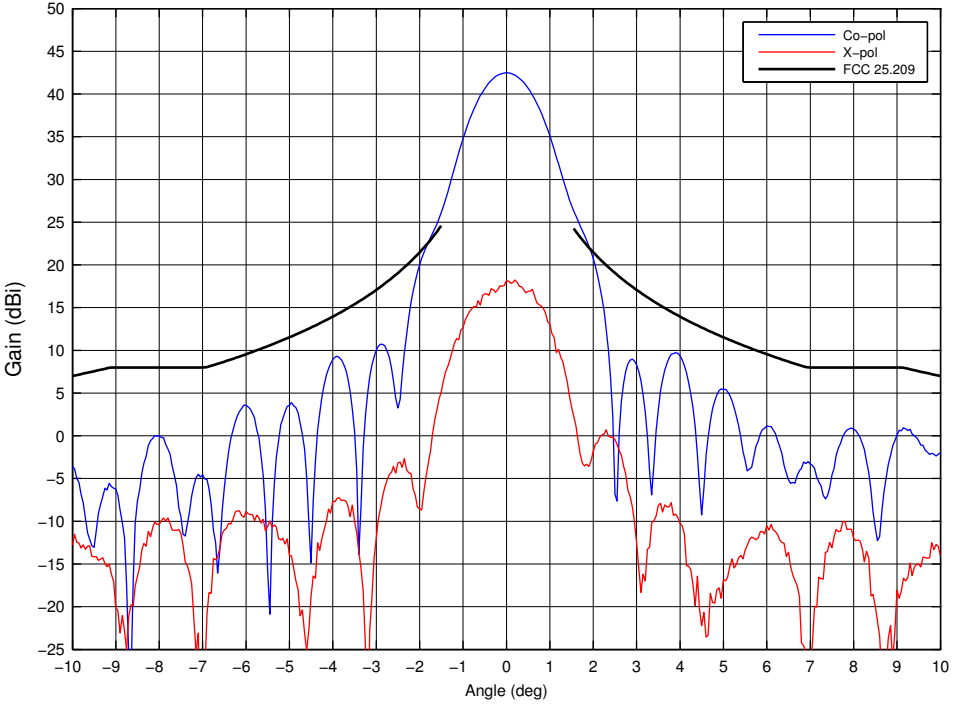
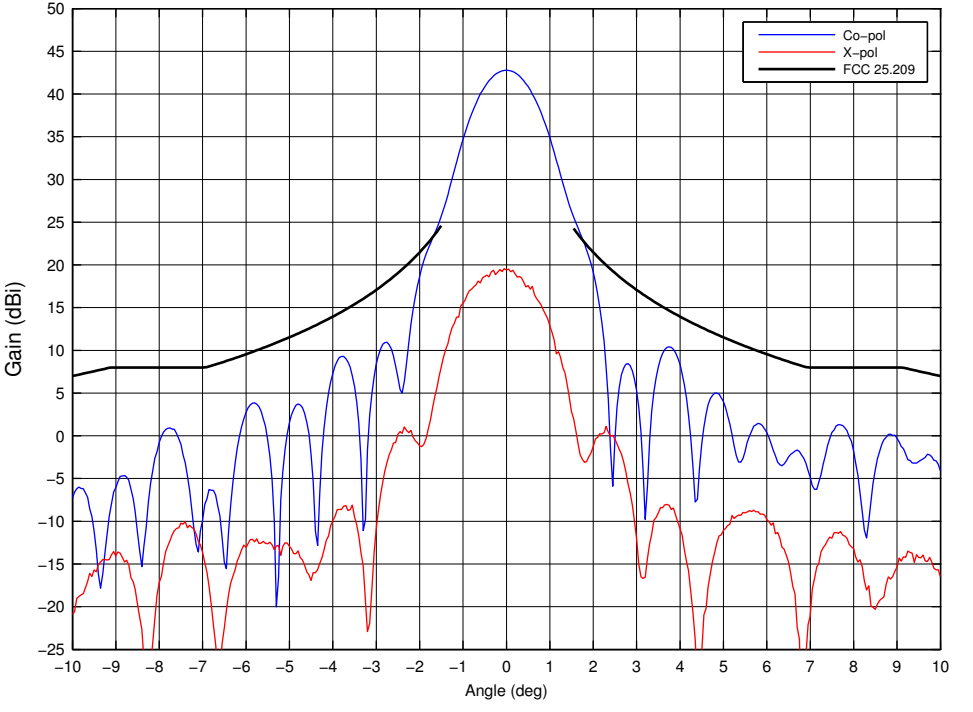
−10 −9 −8 −7 −6 −5 −4 −3 −2 −1 0 1 2 3 4 5 6 7 8 9 10

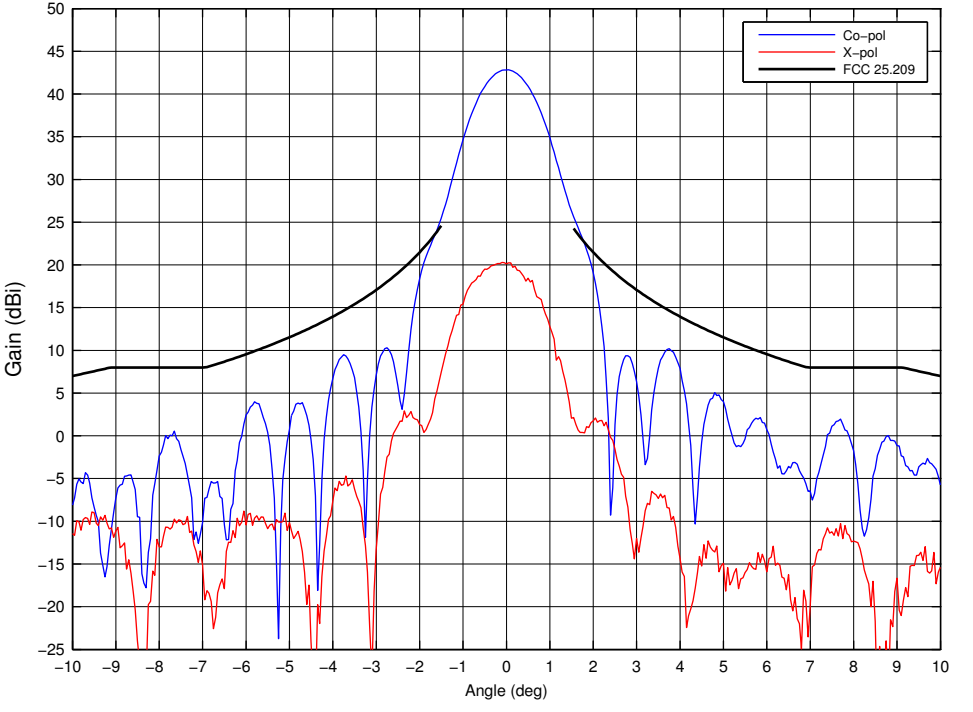
AvL 0.85m Antenna
Ka Band Azimuth Pattern
Segmented Reflector
LHCP 18.5675GHz

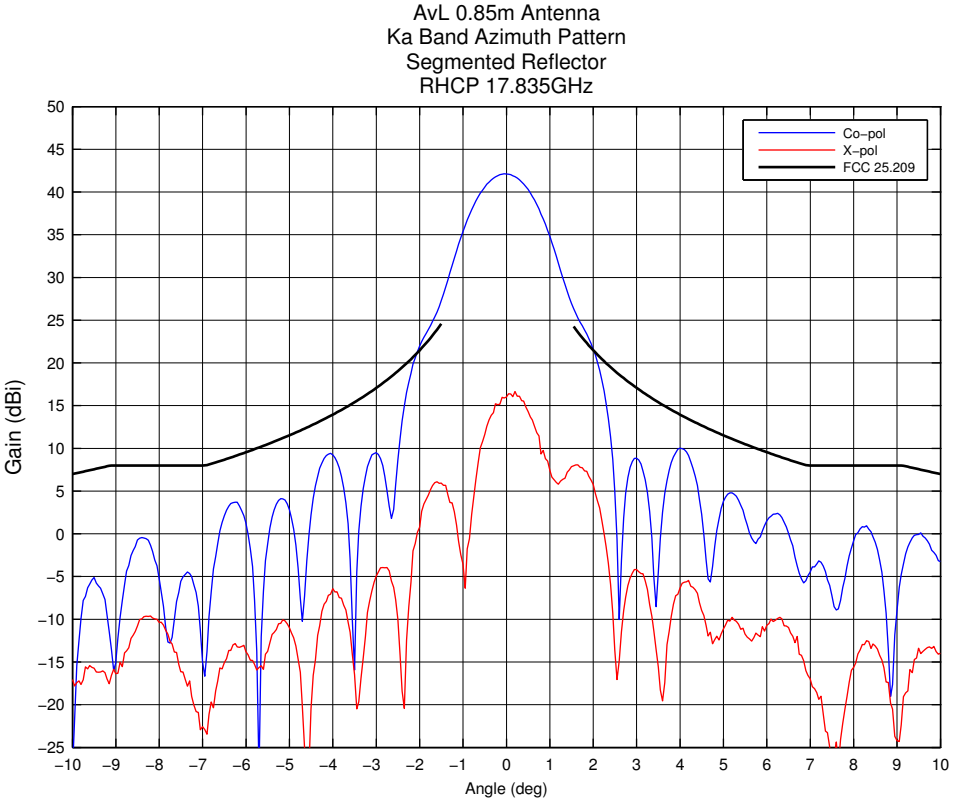


AvL 0.85m Antenna
Ka Band Azimuth Pattern
Segmented Reflector
LHCP 19.2GHz



AvL 0.85m Antenna
Ka Band Azimuth Pattern
Segmented Reflector
LHCP 19.3GHz




AvL 0.85m Antenna
Ka Band Azimuth Pattern
Segmented Reflector
RHCP 17.835GHz
Co−pol
X−pol
FCC 25.209
Gain (dBi)
Angle (deg)
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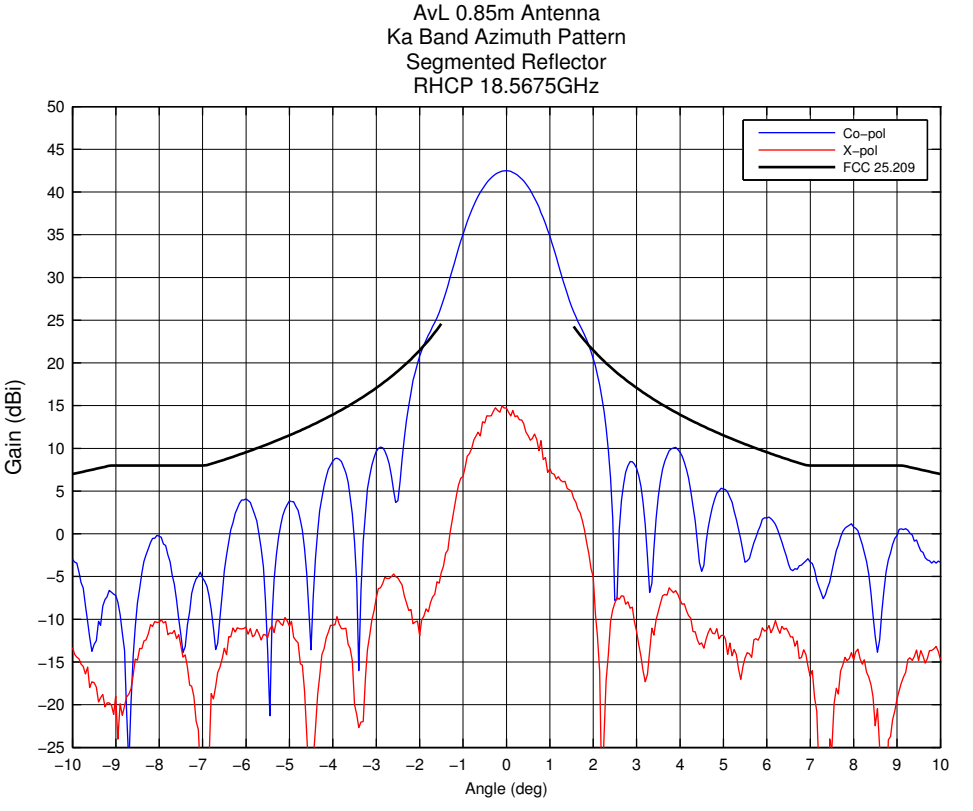
−10 −9 −8 −7 −6 −5 −4 −3 −2 −1 0 1 2 3 4 5 6 7 8 9 10


AvL 0.85m Antenna
Ka Band Azimuth Pattern
Segmented Reflector
RHCP 18.5675GHz
Co−pol
X−pol
FCC 25.209
Gain (dBi)
Angle (deg)
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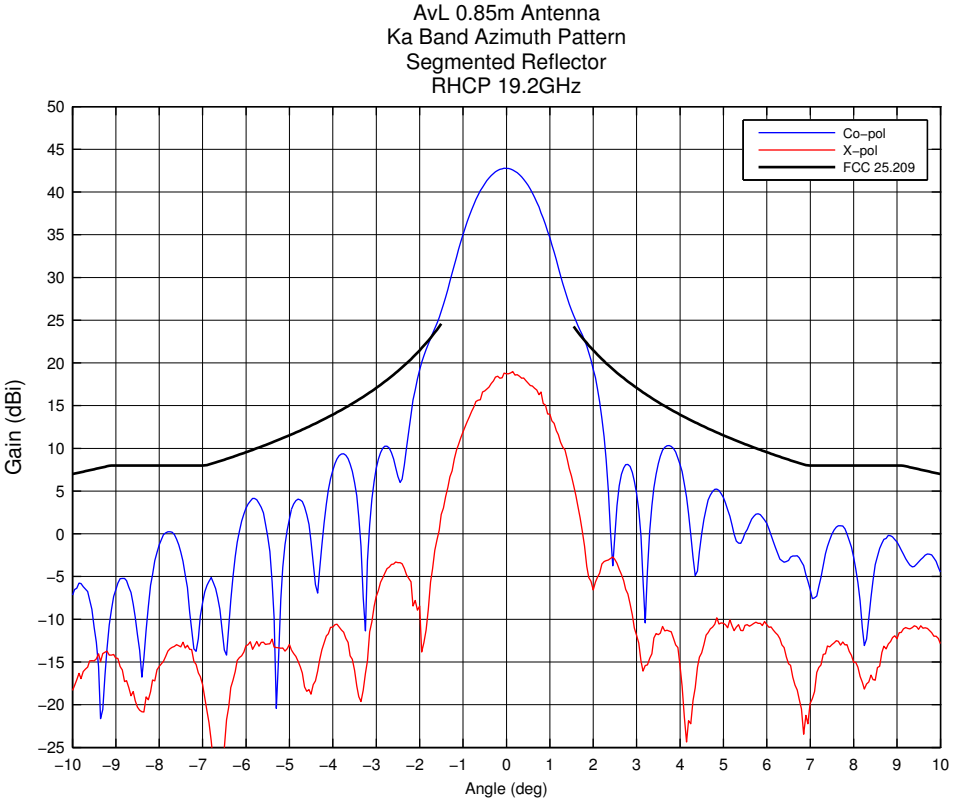
AvL 0.85m Antenna
Ka Band Azimuth Pattern
Segmented Reflector
RHCP 19.2GHz
Co−pol
X−pol
FCC 25.209
Gain (dBi)
Angle (deg)
50
45
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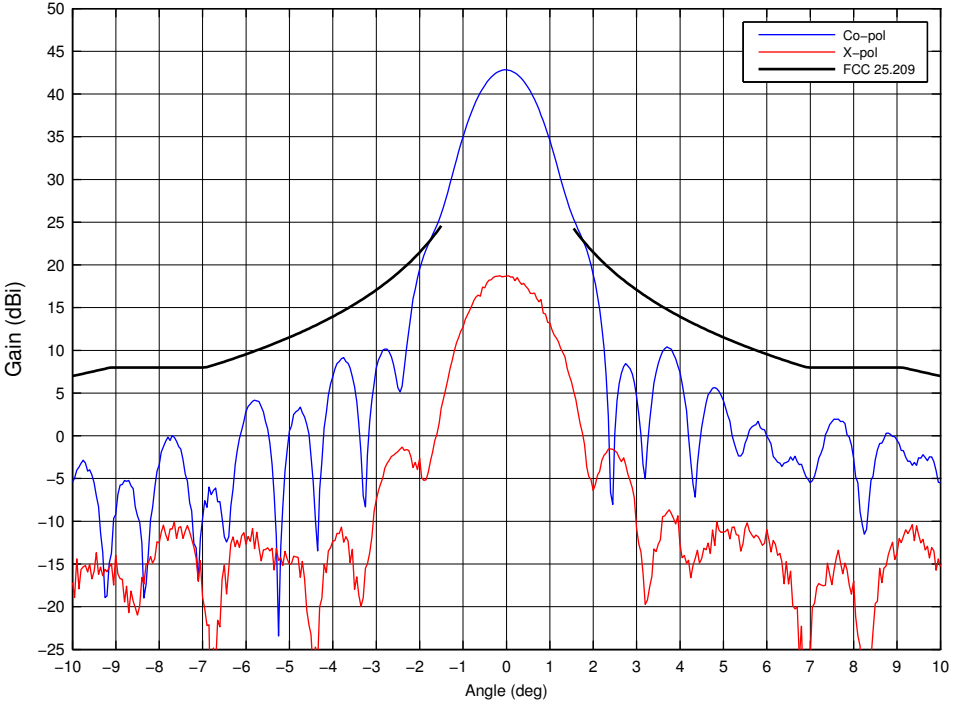
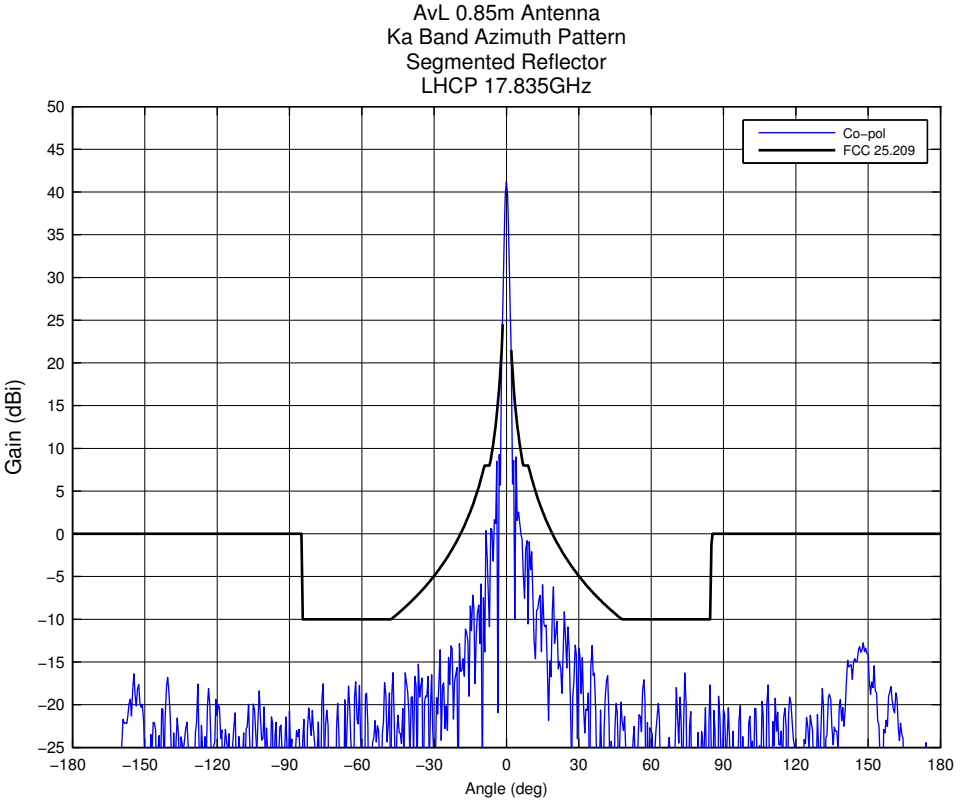
−10 −9 −8 −7 −6 −5 −4 −3 −2 −1 0 1 2 3 4 5 6 7 8 9 10

AvL 0.85m Antenna
Ka Band Azimuth Pattern
Segmented Reflector
RHCP 19.3GHz




AvL 0.85m Antenna
Ka Band Azimuth Pattern
Segmented Reflector
LHCP 17.835GHz
Co–pol
FCC 25.209
Gain (dBi)
Angle (deg)
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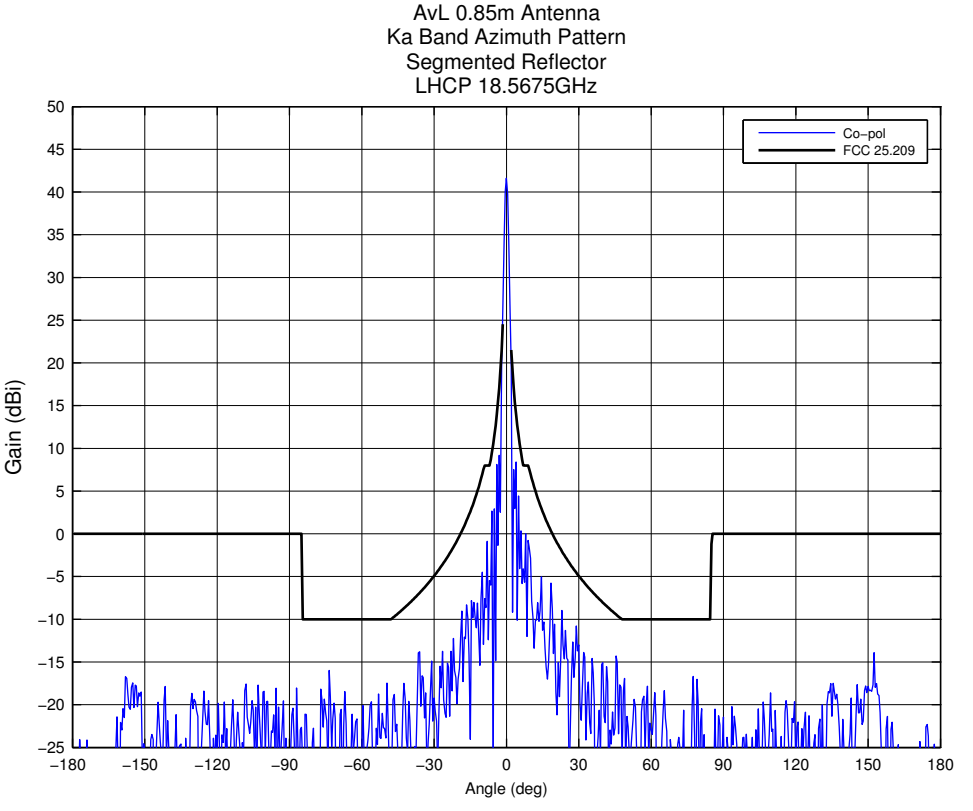
AvL 0.85m Antenna
Ka Band Azimuth Pattern
Segmented Reflector
LHCP 18.5675GHz
Co–pol
FCC 25.209
Gain (dBi)
Angle (deg)
50
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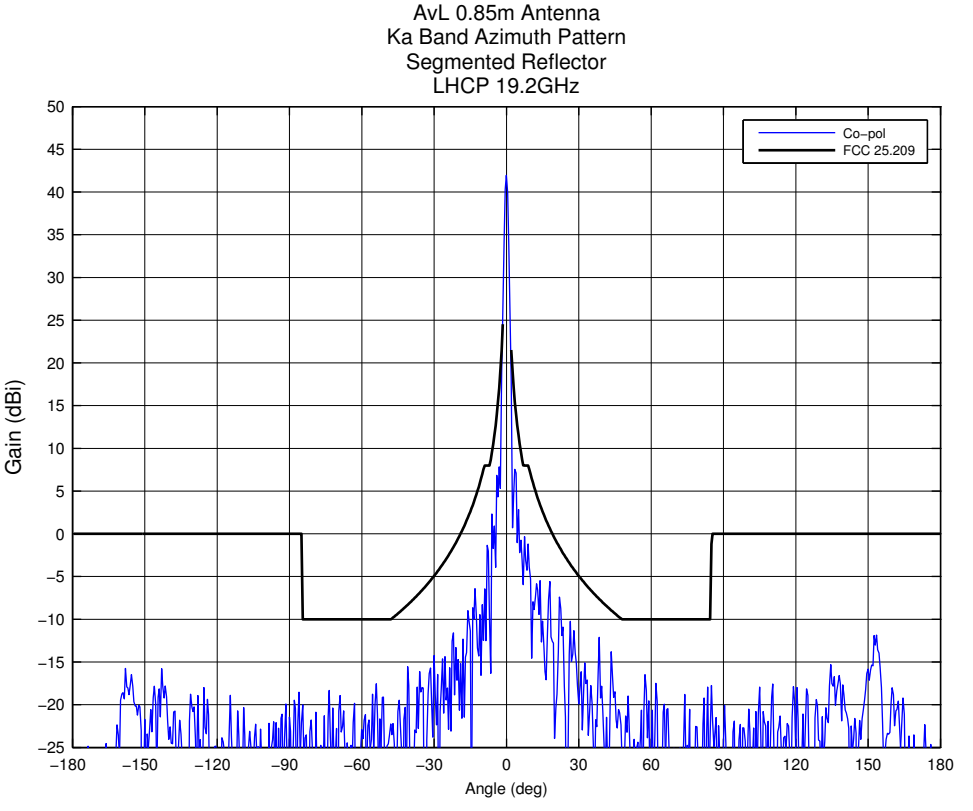
AvL 0.85m Antenna
Ka Band Azimuth Pattern
Segmented Reflector
LHCP 19.2GHz
Co−pol
FCC 25.209
Gain (dBi)
Angle (deg)
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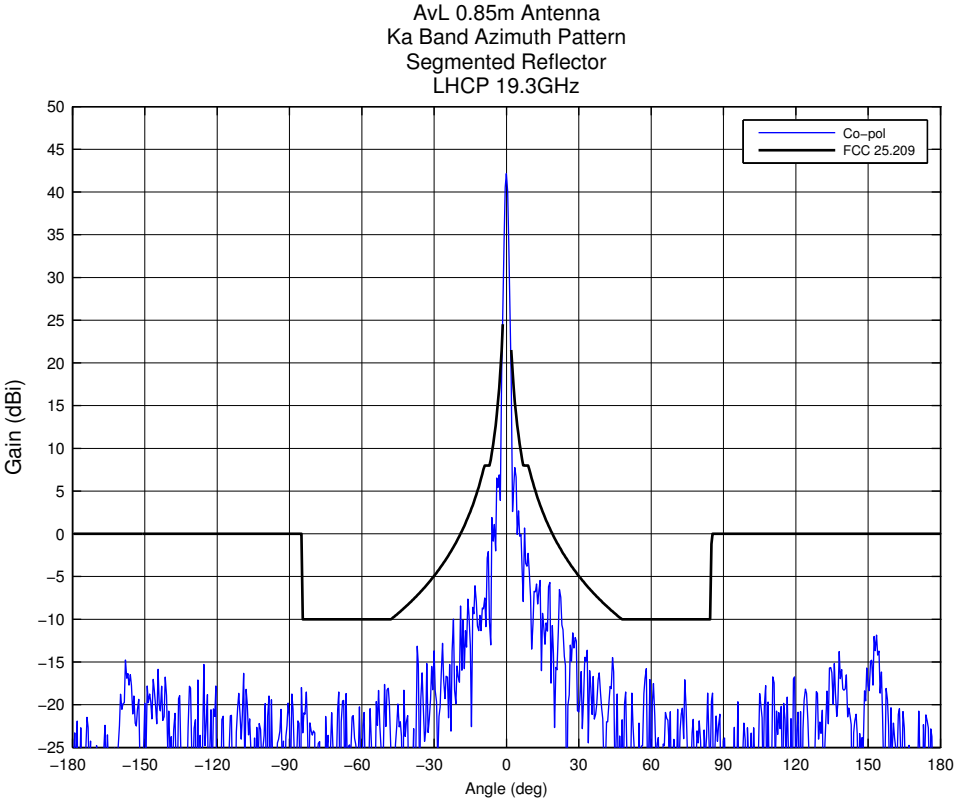
AvL 0.85m Antenna
Ka Band Azimuth Pattern
Segmented Reflector
LHCP 19.3GHz
Co−pol
FCC 25.209
Gain (dBi)
Angle (deg)
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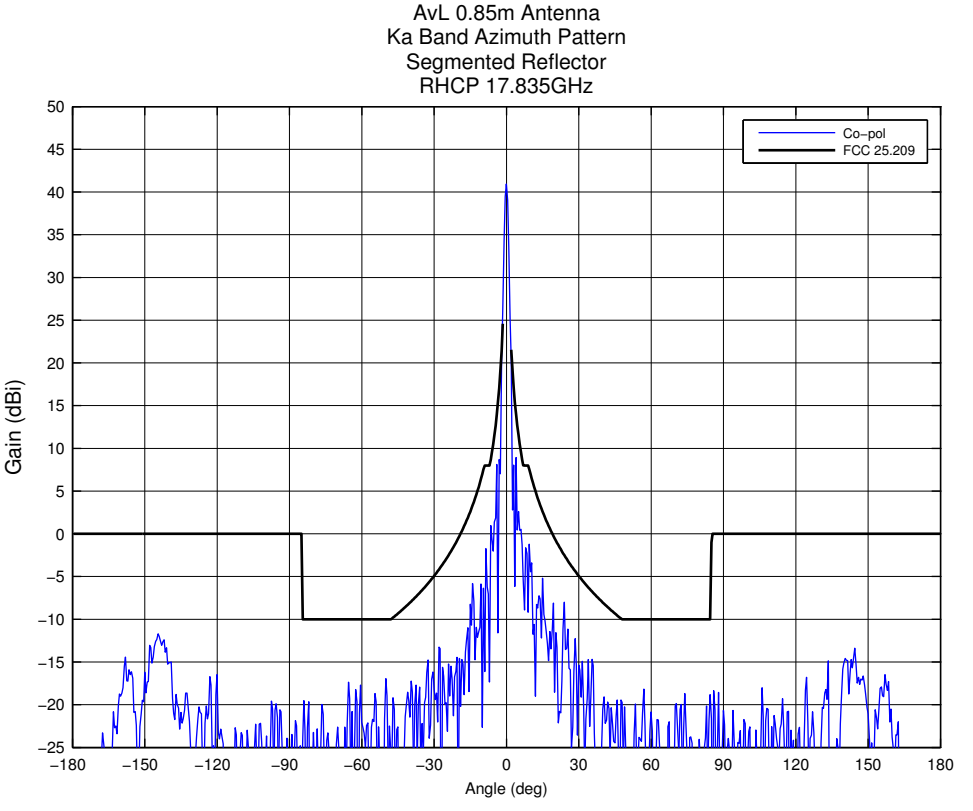
AvL 0.85m Antenna
Ka Band Azimuth Pattern
Segmented Reflector
RHCP 17.835GHz
Co–pol
FCC 25.209
Gain (dBi)
Angle (deg)
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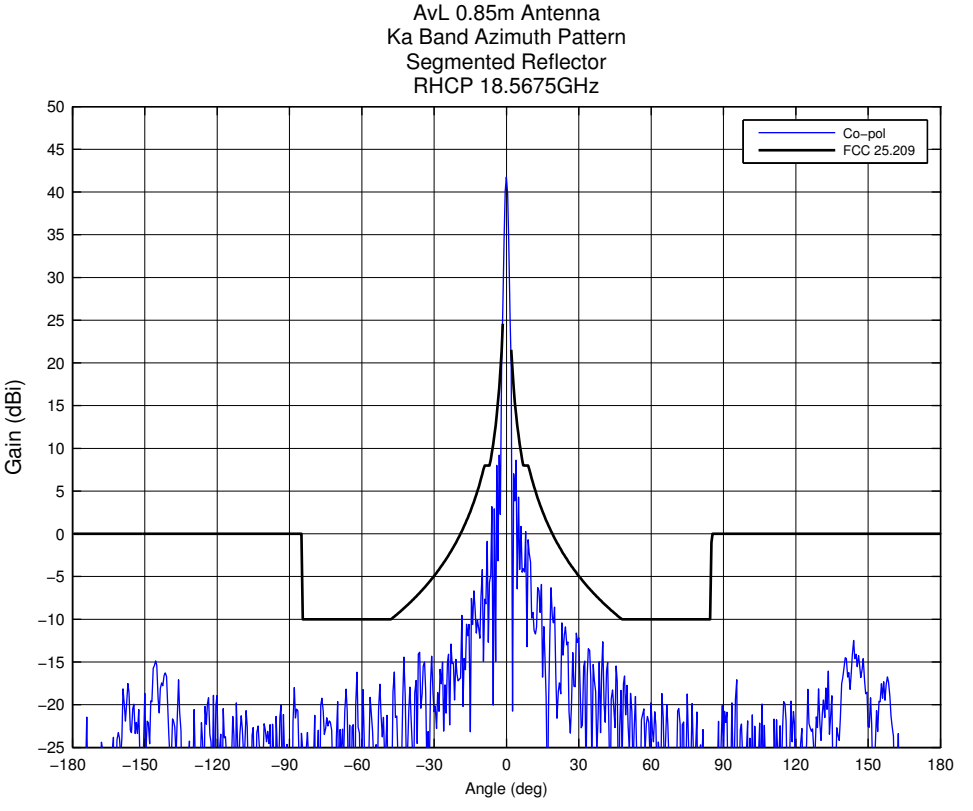
AvL 0.85m Antenna
Ka Band Azimuth Pattern
Segmented Reflector
RHCP 18.5675GHz
Co–pol
FCC 25.209
Gain (dBi)
Angle (deg)
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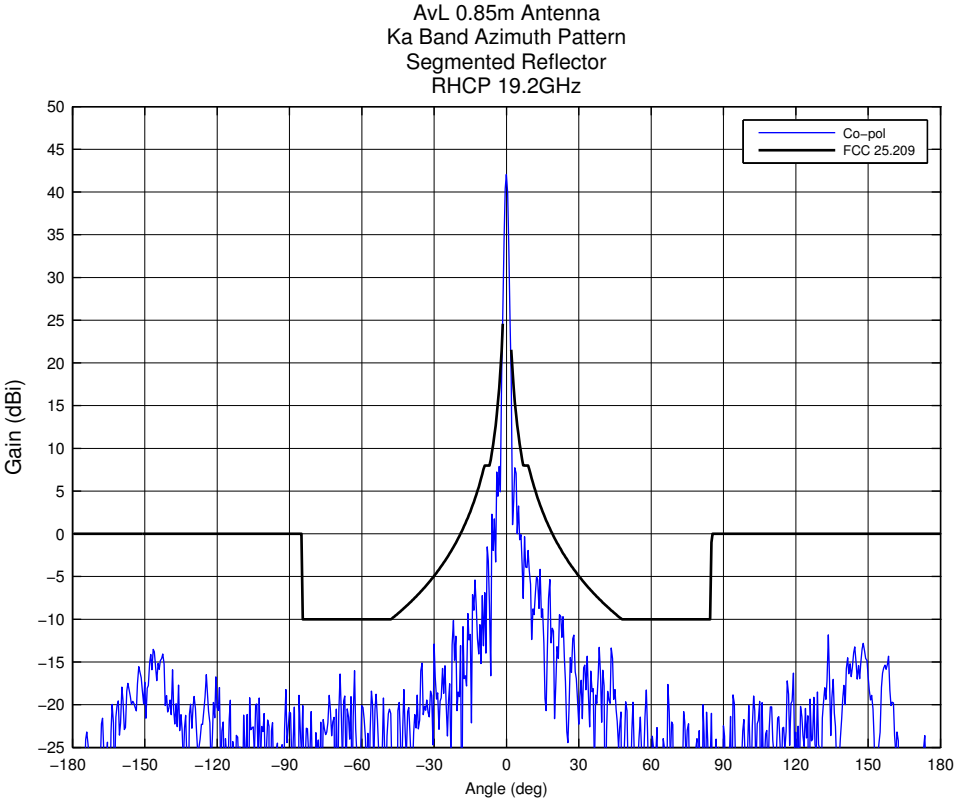
180


AvL 0.85m Antenna
Ka Band Azimuth Pattern
Segmented Reflector
RHCP 19.2GHz
Co−pol
FCC 25.209
Gain (dBi)
Angle (deg)
50
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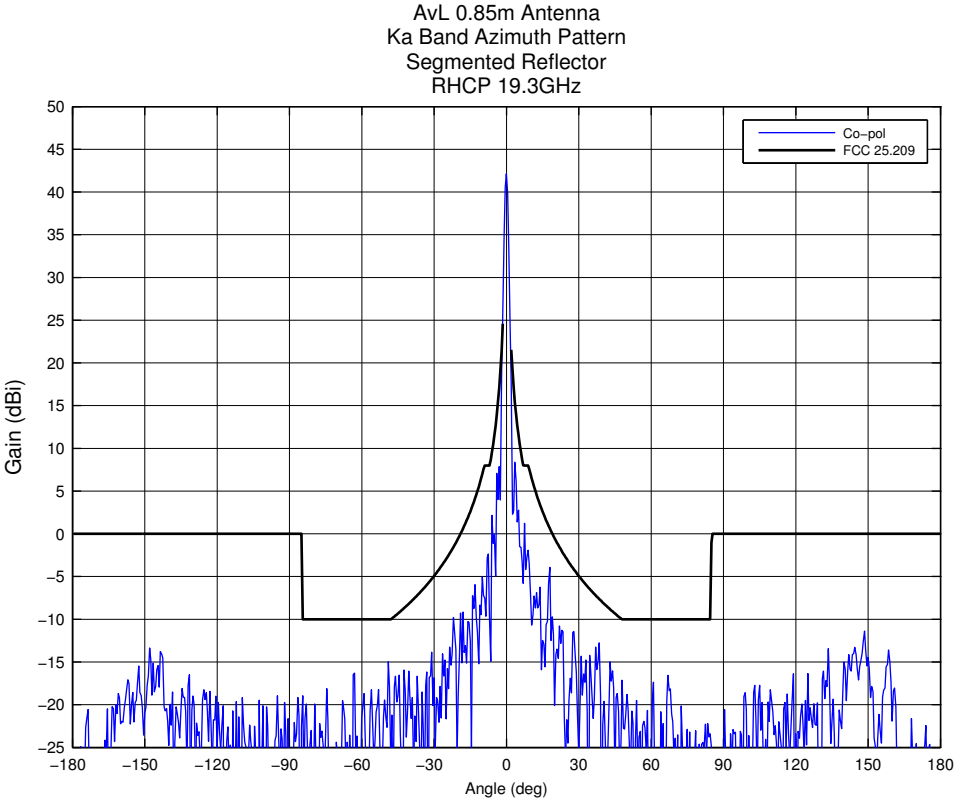
AvL 0.85m Antenna
Ka Band Azimuth Pattern
Segmented Reflector
RHCP 19.3GHz
Co–pol
FCC 25.209
Gain (dBi)
Angle (deg)
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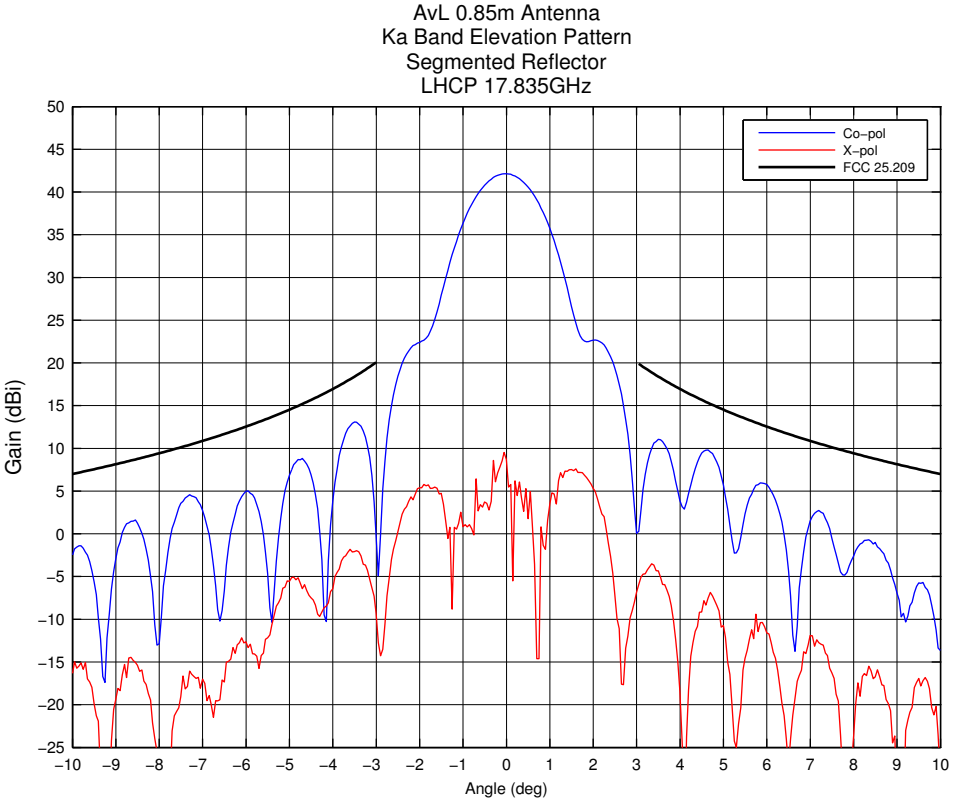
AvL Technologies

0.85m Ka Band O3b Antenna

Receive Band Elevation Patterns


AvL 0.85m Antenna
Ka Band Elevation Pattern
Segmented Reflector
LHCP 17.835GHz
Co−pol
X−pol
FCC 25.209
Gain (dBi)
Angle (deg)
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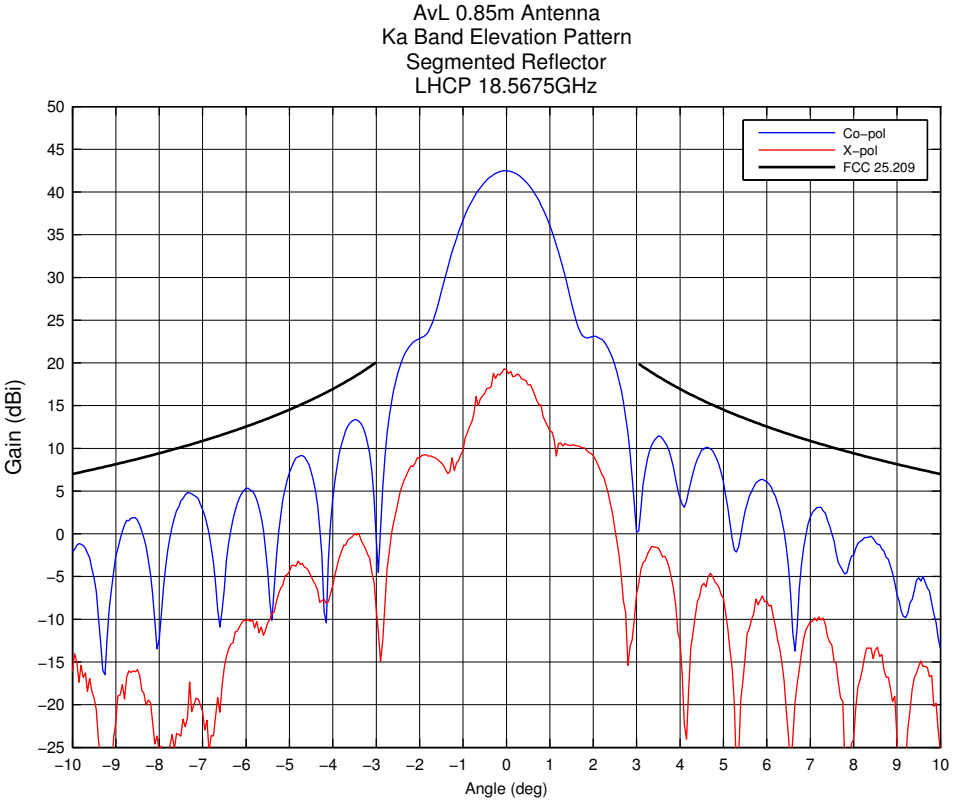
−10 −9 −8 −7 −6 −5 −4 −3 −2 −1 0 1 2 3 4 5 6 7 8 9 10


AvL 0.85m Antenna
Ka Band Elevation Pattern
Segmented Reflector
LHCP 18.5675GHz
Co−pol
X−pol
FCC 25.209
Gain (dBi)
Angle (deg)
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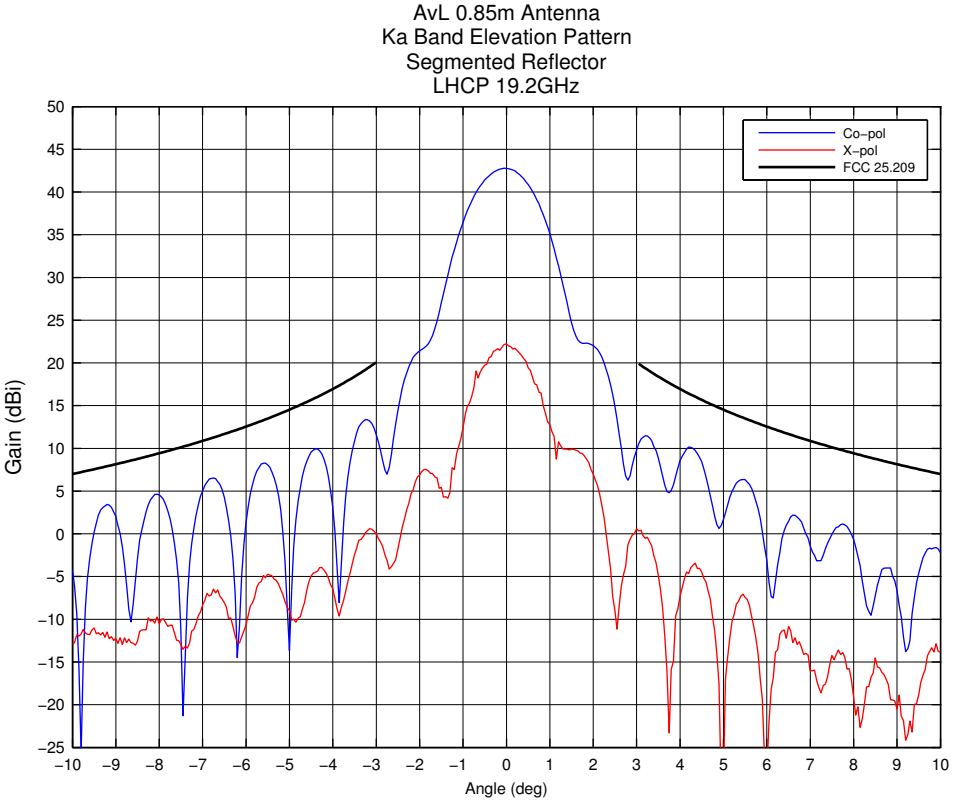
−10 −9 −8 −7 −6 −5 −4 −3 −2 −1 0 1 2 3 4 5 6 7 8 9 10


AvL 0.85m Antenna
Ka Band Elevation Pattern
Segmented Reflector
LHCP 19.2GHz
Co−pol
X−pol
FCC 25.209
Gain (dBi)
Angle (deg)
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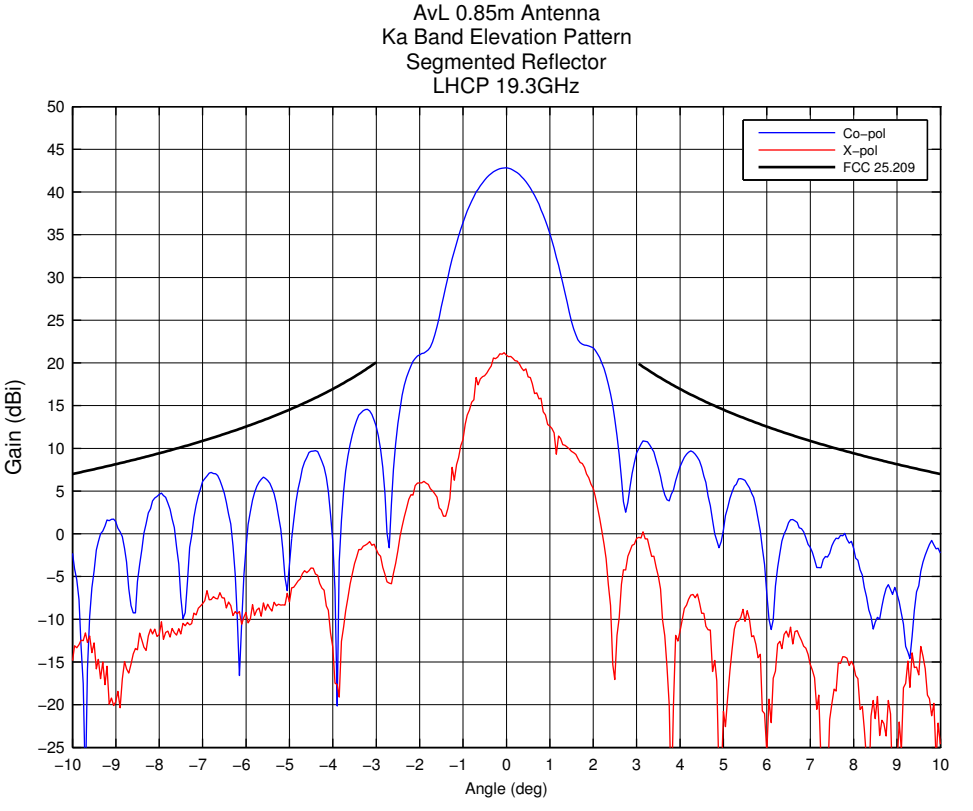
AvL 0.85m Antenna
Ka Band Elevation Pattern
Segmented Reflector
LHCP 19.3GHz
Co−pol
X−pol
FCC 25.209
Gain (dBi)
Angle (deg)
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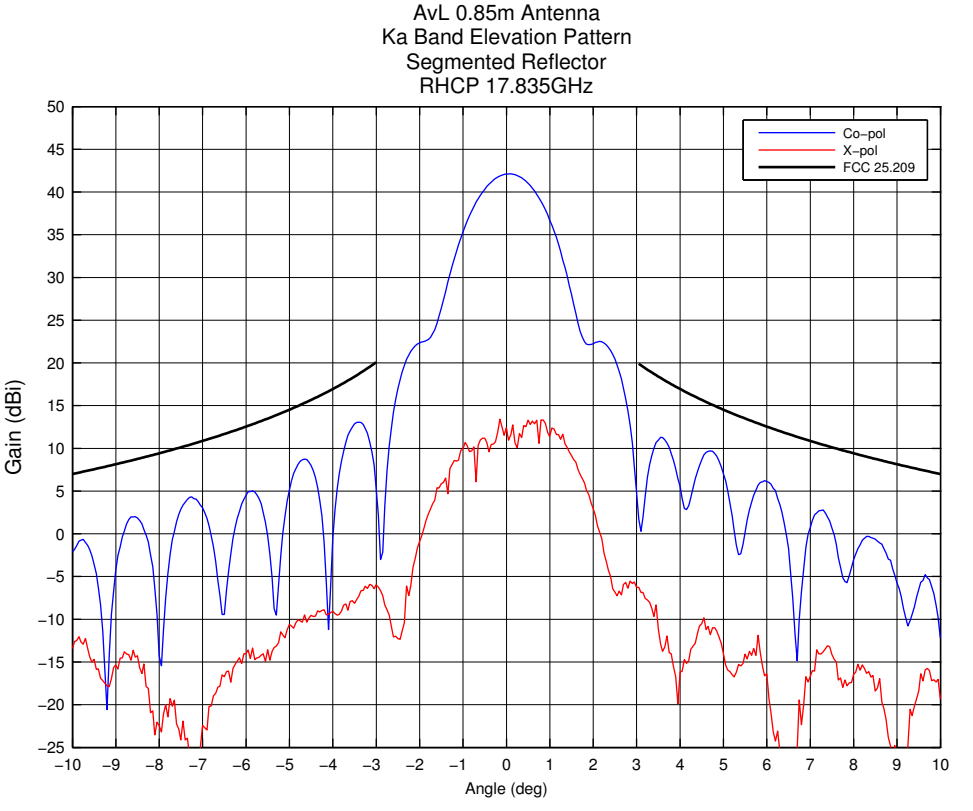
AvL 0.85m Antenna
Ka Band Elevation Pattern
Segmented Reflector
RHCP 17.835GHz
Co−pol
X−pol
FCC 25.209
Gain (dBi)
Angle (deg)
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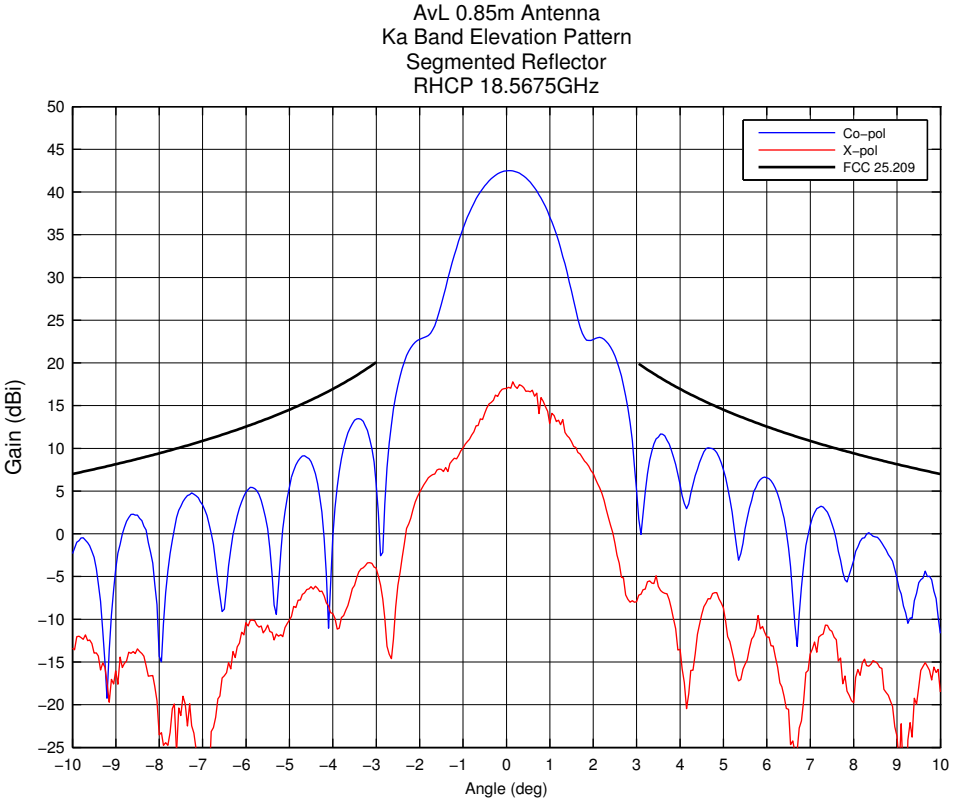
AvL 0.85m Antenna
Ka Band Elevation Pattern
Segmented Reflector
RHCP 18.5675GHz
Co−pol
X−pol
FCC 25.209
Gain (dBi)
Angle (deg)
50
45
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0
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−9
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−7
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−4
−3
−2
−1
0
1
2
3
4
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6
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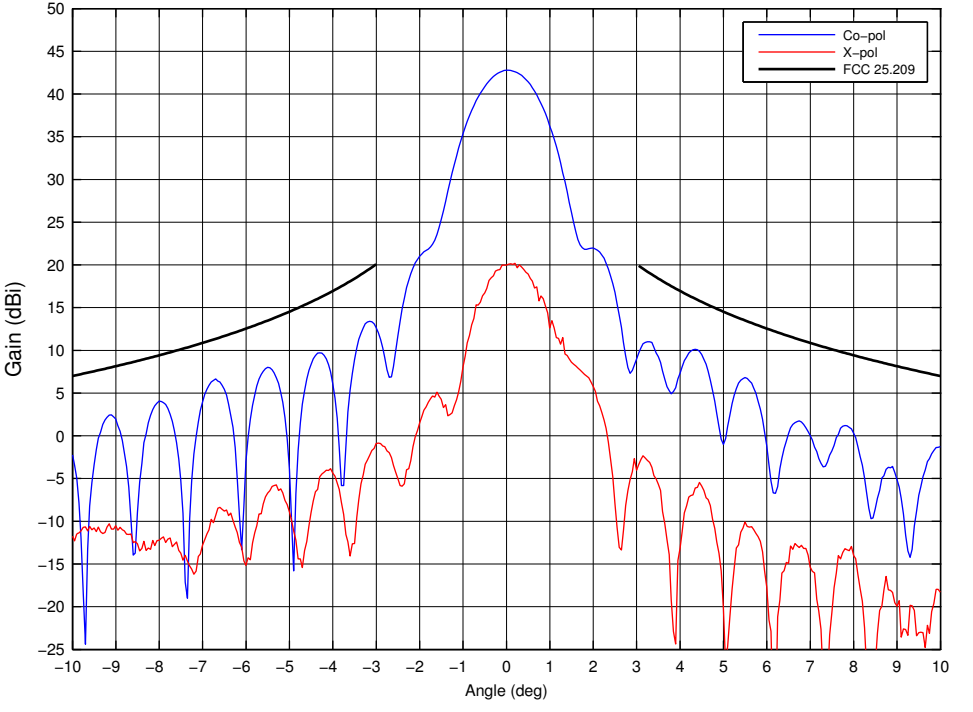
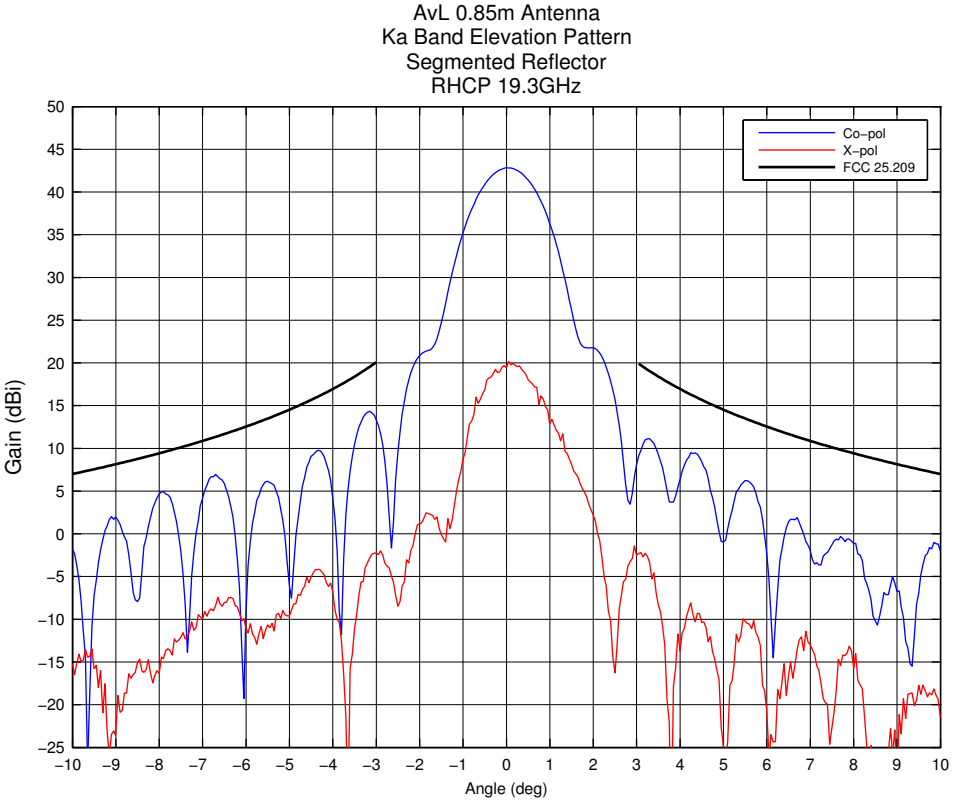
10

AvL 0.85m Antenna
Ka Band Elevation Pattern
Segmented Reflector
RHCP 19.2GHz




AvL 0.85m Antenna
Ka Band Elevation Pattern
Segmented Reflector
RHCP 19.3GHz
Co−pol
X−pol
FCC 25.209
Gain (dBi)
Angle (deg)
50
45
40
35
30
25
20
15
10
5
0
−5
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−15
−20
−25
−10
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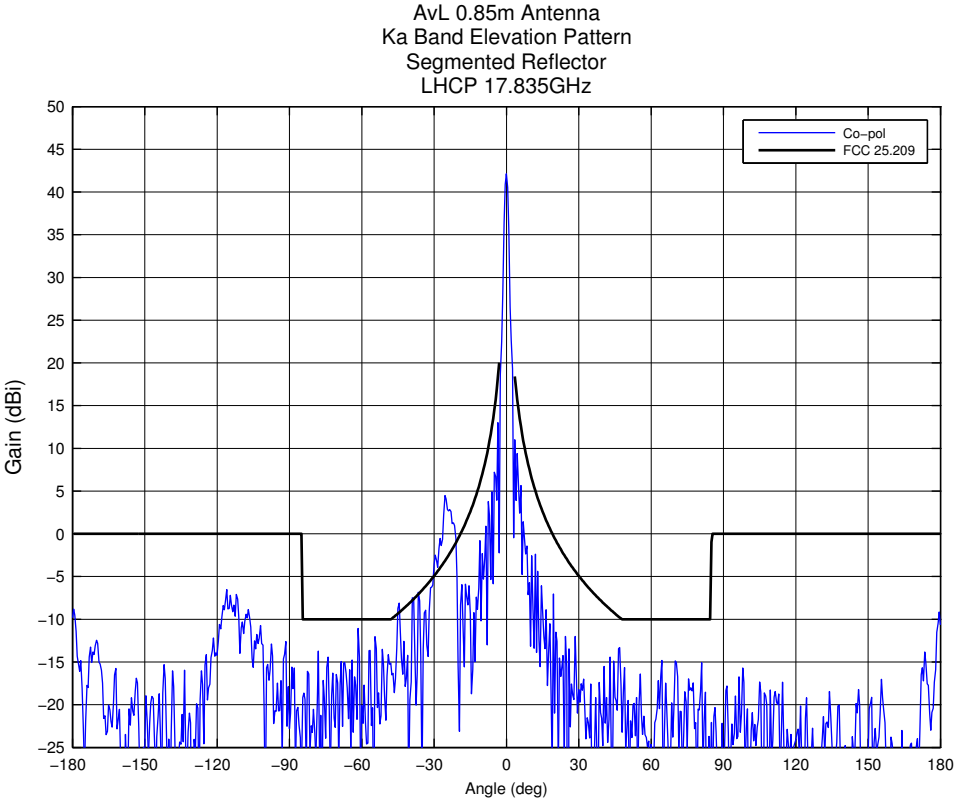
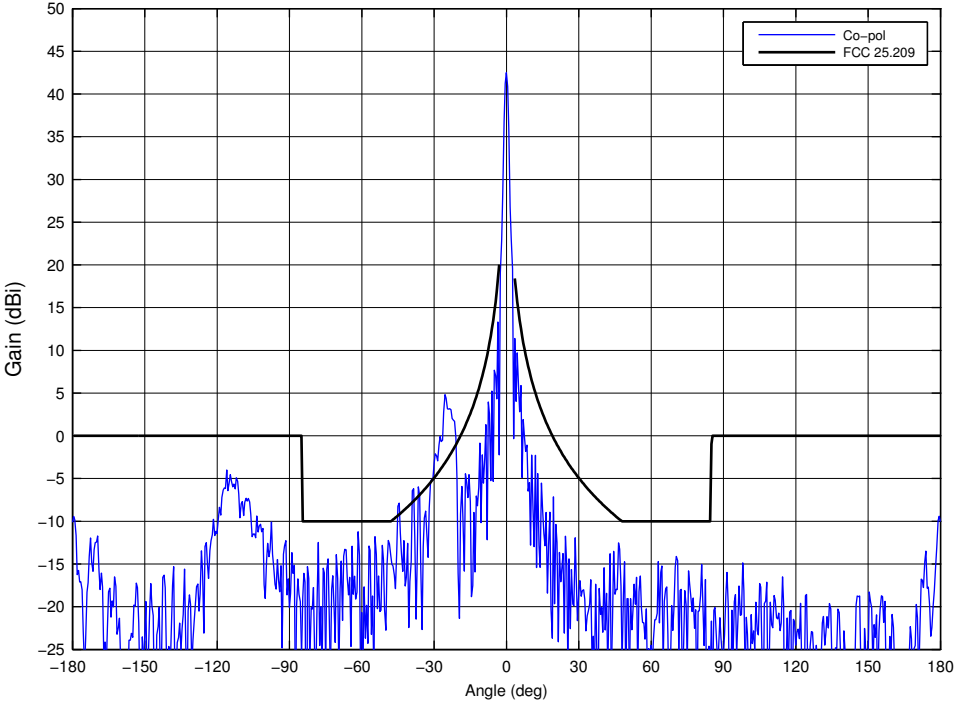
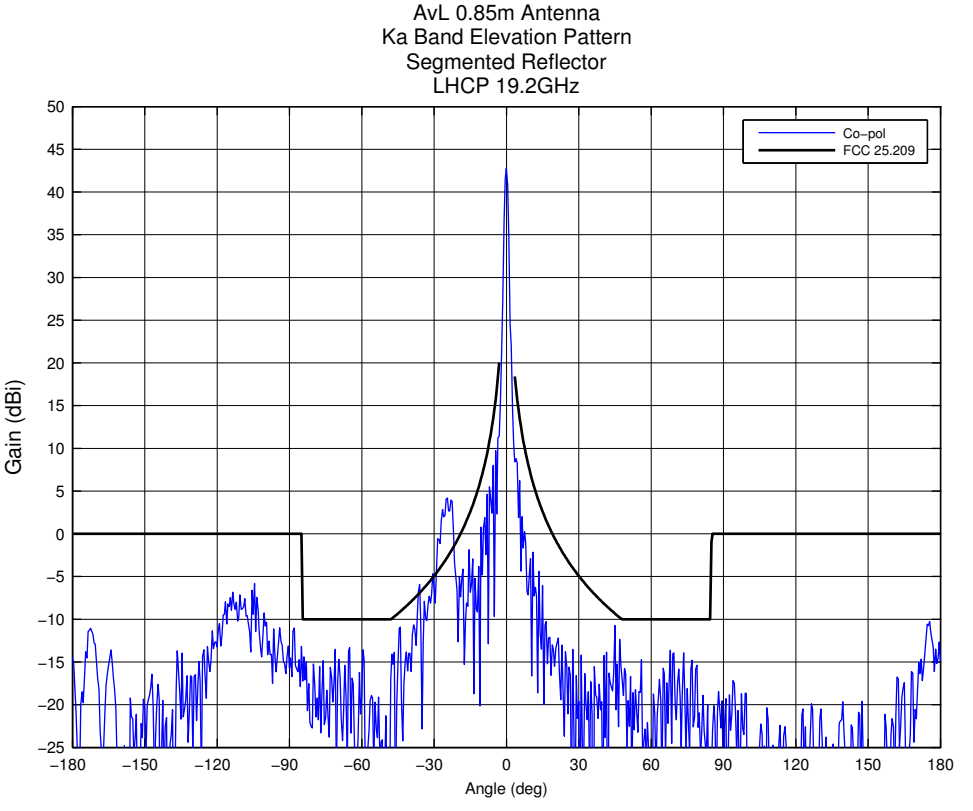

AvL 0.85m Antenna
Ka Band Elevation Pattern
Segmented Reflector
LHCP 17.835GHz
Co–pol
FCC 25.209
Gain (dBi)
Angle (deg)
50
45
40
35
30
25
20
15
10
5
0
−5
−10
−15
−20
−25
−180
−150
−120
−90
−60
−30
0
30
60
90
120
150
180

AvL 0.85m Antenna
Ka Band Elevation Pattern
Segmented Reflector
LHCP 18.5675GHz




AvL 0.85m Antenna
Ka Band Elevation Pattern
Segmented Reflector
LHCP 19.2GHz
Co−pol
FCC 25.209
Gain (dBi)
Angle (deg)
50
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35
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25
20
15
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−10
−15
−20
−25
−180
−150
−120
−90
−60
−30
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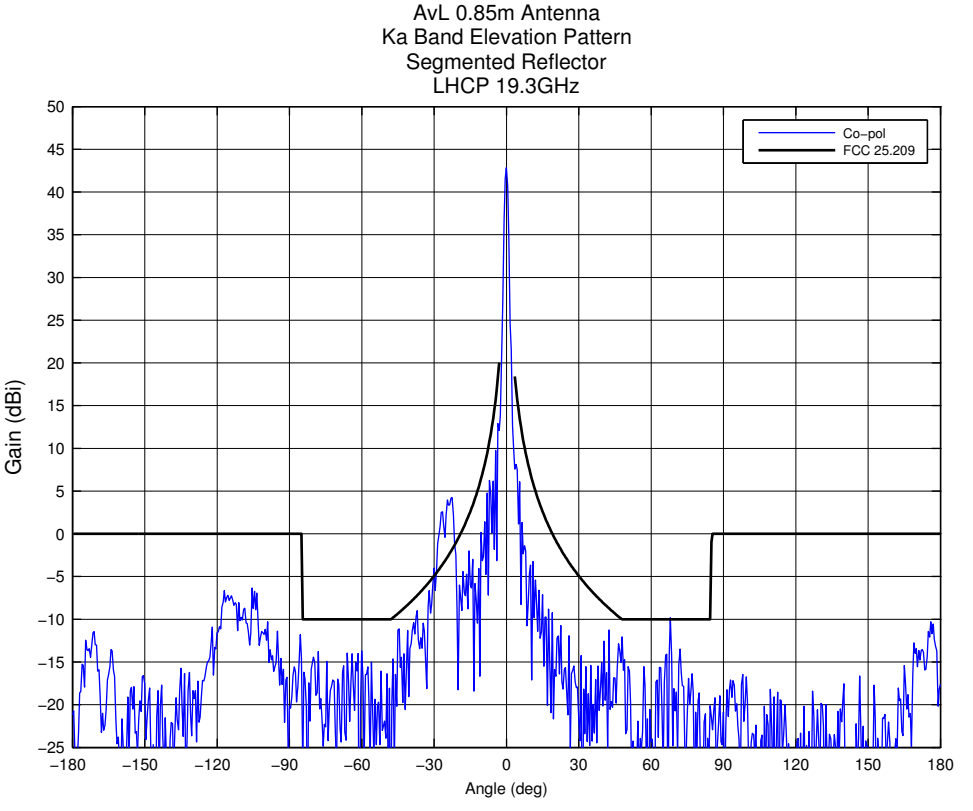
120
150
180


AvL 0.85m Antenna
Ka Band Elevation Pattern
Segmented Reflector
LHCP 19.3GHz
Co–pol
FCC 25.209
Gain (dBi)
Angle (deg)
50
45
40
35
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25
20
15
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−5
−10
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−25
−180
−150
−120
−90
−60
−30
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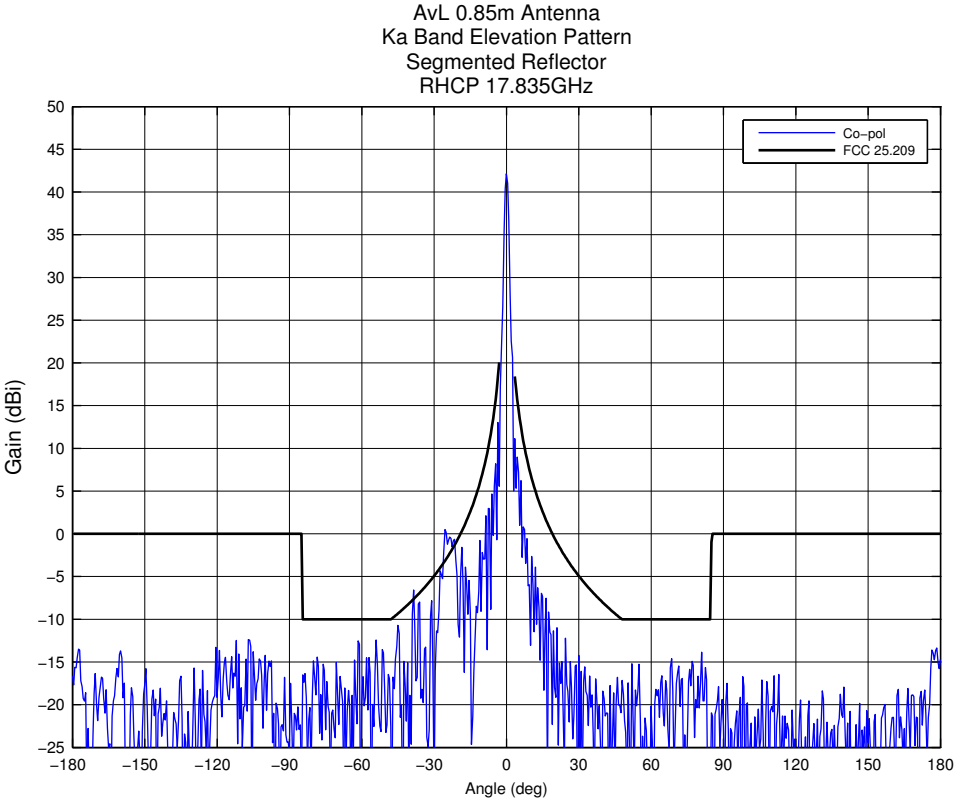
120
150
180


AvL 0.85m Antenna
Ka Band Elevation Pattern
Segmented Reflector
RHCP 17.835GHz
Co–pol
FCC 25.209
Gain (dBi)
Angle (deg)
50
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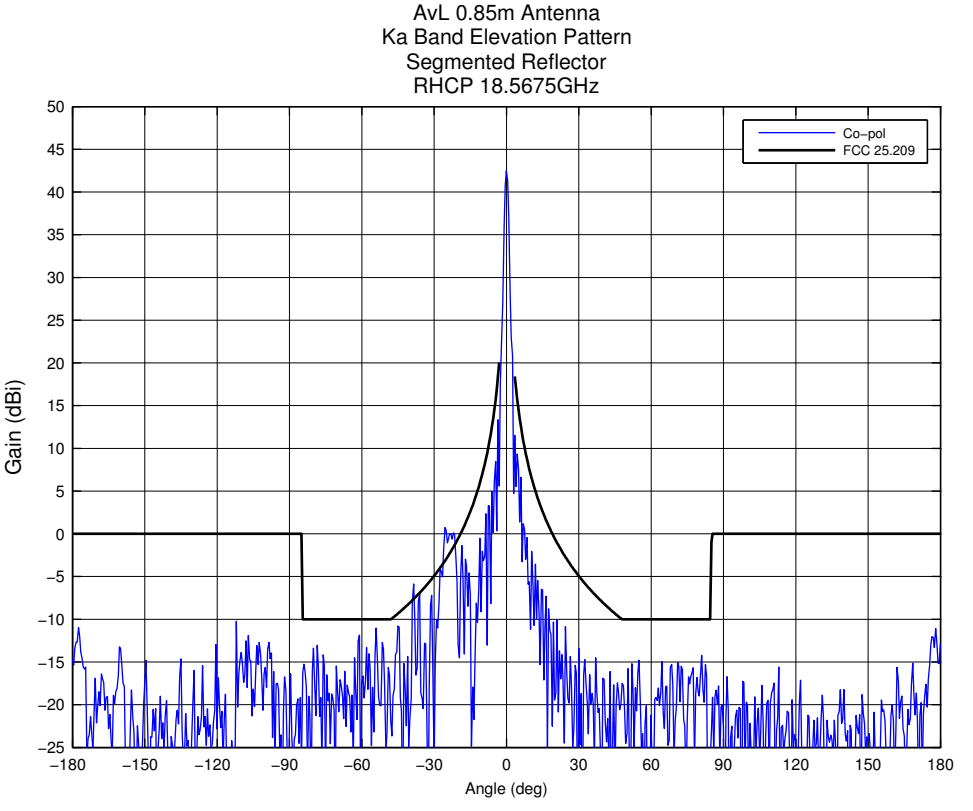
AvL 0.85m Antenna
Ka Band Elevation Pattern
Segmented Reflector
RHCP 18.5675GHz
Co−pol
FCC 25.209
Gain (dBi)
Angle (deg)
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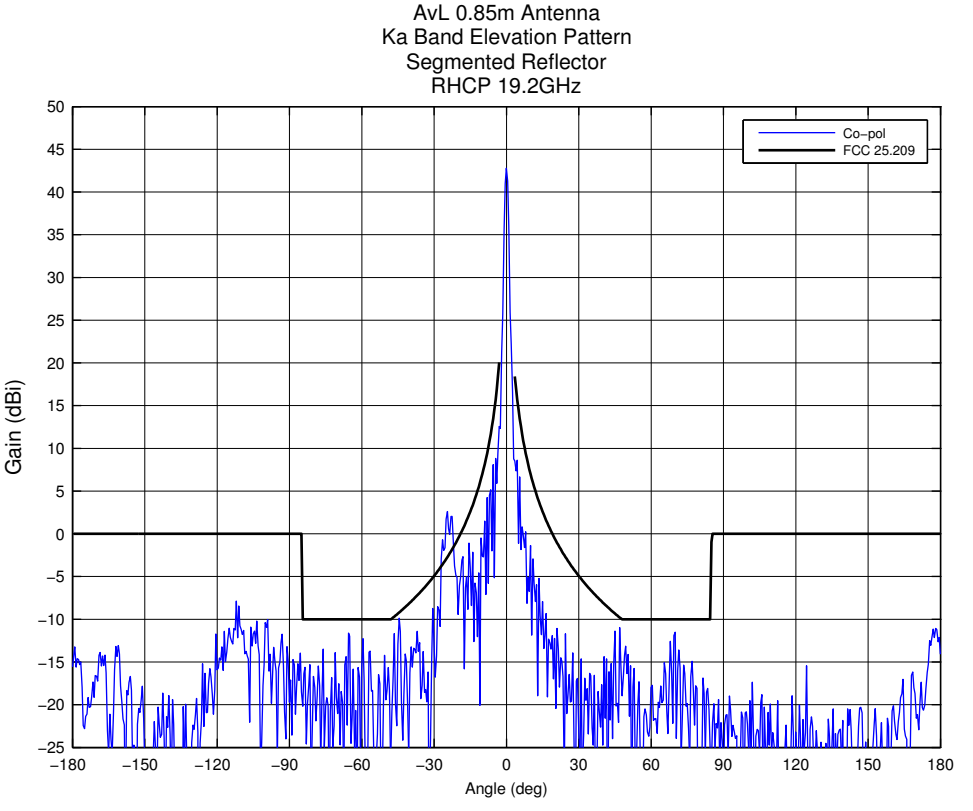
AvL 0.85m Antenna
Ka Band Elevation Pattern
Segmented Reflector
RHCP 19.2GHz
Co−pol
FCC 25.209
Gain (dBi)
Angle (deg)
50
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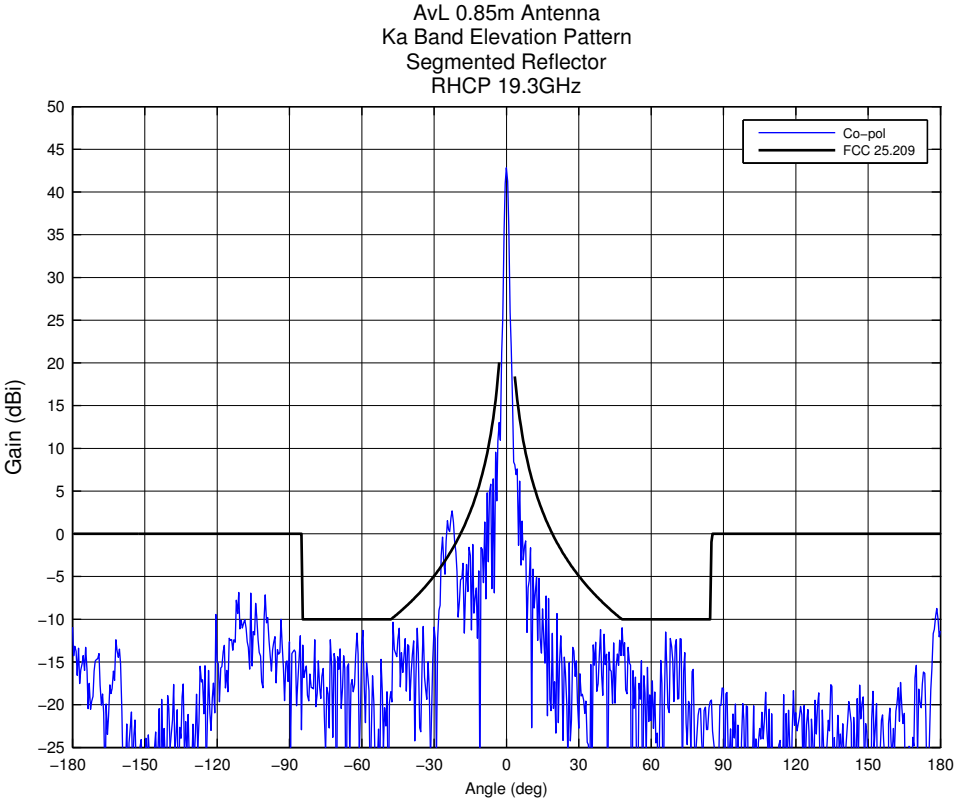
AvL 0.85m Antenna
Ka Band Elevation Pattern
Segmented Reflector
RHCP 19.3GHz
Co–pol
FCC 25.209
Gain (dBi)
Angle (deg)
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ANNEX 7 – FAA Notification is not Required

47 C.F.R. 25.115[17] requires applicants for a modification of an earth station license that involves an earth station structure over 6.1 meters above ground level to explain why FAA notification is not required.

The Randolph Ridge .85m Earth Station will be over 6.1 meters off the ground. However, 47 C.F.R. 17.7 provides an exception to the FAA notification requirement if the earth station is shielded by "natural terrain or topographic features of equal or greater height… where the shielded structure will not adversely affect safety in air navigation.[18]"

The Randolph Ridge .85m Earth Station qualifies for this exception. It is being sited on a raised platform because the site is close to a wooded area. The tree line is sufficiently high that the Randolph Ridge .85m Earth Station could not maintain its connection with the O3b satellite system if it were sited on the ground. The Randolph Ridge .85m Earth Station is being sited high enough so that it can communicate with the O3b satellite system uninterrupted but the height of the Earth Station will not exceed the height of the nearby trees. The new site, therefore, is shielded by natural terrain of equal or greater height and will not adversely affect safety in air navigation. In accordance with 47 C.F.R. 17.7, O3b does not need to submit a FAA notification.

[17] 47 C.F.R. 25.115(j).
[18] 47 C.F.R. 17.7(e)(1).