Approved by OMB
3060−0678

Date & Time Filed: Mar 21 2019 12:33:52:803PM
File Number: SES−MOD−INTR2019−00820

FCC APPLICATION FOR SPACE AND EARTH STATION:MOD OR AMD − MAIN FORM FCC 312 MAIN FORM FOR OFFICIAL USE ONLY	FCC Use Only

APPLICANT INFORMATION
Enter a description of this application to identify it on the main menu:
Modification of E140029 to Add GetSat Terminals

1−8. Legal Name of Applicant

Name:	ISAT US Inc.	**Phone Number:**	202−572−0686
DBA Name:		**Fax Number:**	202−248−5177
Street:	1101 Connecticut Avenue NW Suite 1200	**E−Mail:**	Ethan.Lucarelli@inmarsat.com
City:	Washington	**State:**	DC
Country:	USA	**Zipcode:**	20036 −
Attention:	M. Ethan Lucarelli		

9−16. Name of Contact Representative

Name:	M. Ethan Lucarelli	**Phone Number:**	202−572−0686
Company:	ISAT US Inc.	**Fax Number:**	202−248−5177
Street:	1101 Connecticut Avenue NW Suite 1200	**E−Mail:**	Ethan.Lucarelli@inmarsat.com
City:	Washington	**State:**	DC
Country:	USA	**Zipcode:**	20036−
Attention:		**Relationship:**	Same

CLASSIFICATION OF FILING

17. Choose the button next to the classification that applies to this filing for both questions a. and b. Choose only one for 17a and only one for 17b. ◉ a1. Earth Station ○ a2. Space Station	(N/A) b1. Application for License of New Station (N/A) b2. Application for Registration of New Domestic Receive−Only Station ○ b3. Amendment to a Pending Application ◉ b4. Modification of License or Registration b5. Assignment of License or Registration b6. Transfer of Control of License or Registration ○ b7. Notification of Minor Modification (N/A) b8. Application for License of New Receive−Only Station Using Non−U.S. Licensed Satellite (N/A) b9. Letter of Intent to Use Non−U.S. Licensed Satellite to Provide Service in the United States (N/A) b10. Other (Please specify) (N/A) b11. Application for Earth Station to Access a Non−U.S.satellite Not Currently Authorized to Provide the Proposed Service in the Proposed Frequencies in the United States (N/A) b12. Application for Database Entry ○ b13. Amendment to a Pending Database Entry Application ○ b14. Modification of Database Entry

17c. Is a fee submitted with this application?

(●) If Yes, complete and attach FCC Form 159. If No, indicate reason for fee exemption (see 47 C.F.R.Section 1.1114).

( ) Governmental Entity ( ) Noncommercial educational licensee

( ) Other(please explain):

17d.

Fee Classification CGB − Mobile Satellite Earth Stations

18. If this filing is in reference to an existing station, enter:	19. If this filing is an amendment to a pending application enter both fields, if this filing is a modification please enter only the file number:	
(a) Call sign of station: E140029	(a) Date pending application was filed:	(b) File number: SESMOD2017081700928

TYPE OF SERVICE

20. NATURE OF SERVICE: This filing is for an authorization to provide or use the following type(s) of service(s): Select all that apply:

- ☐ a. Fixed Satellite
- ☒ b. Mobile Satellite
- ☐ c. Radiodetermination Satellite
- ☐ d. Earth Exploration Satellite
- ☐ e. Direct to Home Fixed Satellite
- ☐ f. Digital Audio Radio Service
- ☐ g. Other (please specify)

21. STATUS: Choose the button next to the applicable status. Choose only one.

○ Common Carrier ◉ Non−Common Carrier

22. If earth station applicant, check all that apply.

- ☐ Using U.S. licensed satellites
- ☒ Using Non−U.S. licensed satellites

23. If applicant is providng INTERNATIONAL COMMON CARRIER service, see instructions regarding Sec. 214 filings. Choose one. Are these facilities:

○ Connected to a Public Switched Network ○ Not connected to a Public Switched Network ◉ N/A

24. FREQUENCY BAND(S): Place an 'X' in the box(es) next to all applicable frequency band(s).

☐ a. C−Band (4/6 GHz) ☐ b. Ku−Band (12/14 GHz)

☒ c.Other (Please specify upper and lower frequencies in MHz.)

Frequency Lower: 19700 Frequency Upper: 30000 (Please specify additional frequencies in an attachment)

TYPE OF STATION

25. CLASS OF STATION: Choose the button next to the class of station that applies. Choose only one.

- ○ a. Fixed Earth Station
- ○ b. Temporary−Fixed Earth Station
- ○ c. 12/14 GHz VSAT Network
- ○ d. Mobile Earth Station
- ○ e. Geostationary Space Station
- ○ f. Non−Geostationary Space Station
- ◉ g. Other (please specify) Earth station on fixed/moving platforms

26. TYPE OF EARTH STATION FACILITY:

◉ Transmit/Receive ○ Transmit−Only ○ Receive−Only ○ N/A

"For Space Station applications, select N/A."

PURPOSE OF MODIFICATION

27. The purpose of this proposed modification is to: (Place an 'X' in the box(es) next to all that apply.)

- [ ] a −− authorization to add new emission designator and related service
- [ ] b −− authorization to change emission designator and related service
- [ ] c −− authorization to increase EIRP and EIRP density
- [ ] d −− authorization to replace antenna
- [x] e −− authorization to add antenna
- [ ] f −− authorization to relocate fixed station
- [ ] g −− authorization to change frequency(ies)
- [ ] h −− authorization to add frequency
- [ ] i −− authorization to add Points of Communication (satellites & countries)
- [ ] j −− authorization to change Points of Communication (satellites & countries)
- [ ] k −− authorization for facilities for which environmental assessment and radiation hazard reporting is required
- [ ] l −− authorization to change orbit location
- [ ] m −− authorization to perform fleet management
- [ ] n −− authorization to extend milestones
- [ ] o −− Other (Please specify)

ENVIRONMENTAL POLICY

28. Would a Commission grant of any proposal in this application or amendment have a significant environmental impact as defined by 47 CFR 1.1307? If YES, submit the statement as required by Sections 1.1308 and 1.1311 of the Commission's rules, 47 C.F.R. 1.1308 and 1.1311, as an exhibit to this application.A Radiation Hazard Study must accompany all applications for new transmitting facilities, major modifications, or major amendments.	○ Yes ◉ No Exhibit C

ALIEN OWNERSHIP Earth station applicants not proposing to provide broadcast, common carrier, aeronautical en route or aeronautical fixed radio station services are not required to respond to Items 30−34.

29. Is the applicant a foreign government or the representative of any foreign government?	○ Yes ◉ No
30. Is the applicant an alien or the representative of an alien?	○ Yes ○ No ◉ N/A
31. Is the applicant a corporation organized under the laws of any foreign government?	○ Yes ○ No ◉ N/A
32. Is the applicant a corporation of which more than one−fifth of the capital stock is owned of record or voted by aliens or their representatives or by a foreign government or representative thereof or by any corporation organized under the laws of a foreign country?	○ Yes ○ No ◉ N/A

33. Is the applicant a corporation directly or indirectly controlled by any other corporation of which more than one−fourth of the capital stock is owned of record or voted by aliens, their representatives, or by a foreign government or representative thereof or by any corporation organized under the laws of a foreign country?	○ Yes ○ No ◉ N/A
34. If any answer to questions 29, 30, 31, 32 and/or 33 is Yes, attach as an exhibit an identification of the aliens or foreign entities, their nationality, their relationship to the applicant, and the percentage of stock they own or vote.	

BASIC QUALIFICATIONS

35. Does the Applicant request any waivers or exemptions from any of the Commission's Rules? If Yes, attach as an exhibit, copies of the requests for waivers or exceptions with supporting documents.	◉ Yes ○ No
36. Has the applicant or any party to this application or amendment had any FCC station authorization or license revoked or had any application for an initial, modification or renewal of FCC station authorization, license, or construction permit denied by the Commission? If Yes, attach as an exhibit, an explination of circumstances.	◉ Yes ○ No

37. Has the applicant, or any party to this application or amendment, or any party directly or indirectly controlling the applicant ever been convicted of a felony by any state or federal court? If Yes, attach as an exhibit, an explination of circumstances.	○ Yes ◉ No
38. Has any court finally adjudged the applicant, or any person directly or indirectly controlling the applicant, guilty of unlawfully monopolizing or attemptiing unlawfully to monopolize radio communication, directly or indirectly, through control of manufacture or sale of radio apparatus, exclusive traffic arrangement or any other means or unfair methods of competition?If Yes, attach as an exhibit, an explanation of circumstances	○ Yes ◉ No
39. Is the applicant, or any person directly or indirectly controlling the applicant, currently a party in any pending matter referred to in the preceding two items? If yes, attach as an exhinit, an explanation of the circumstances.	○ Yes ◉ No
40. If the applicant is a corporation and is applying for a space station license, attach as an exhibit the names, address, and citizenship of those stockholders owning a record and/or voting 10 percent or more of the Filer's voting stock and the percentages so held. In the case of fiduciary control, indicate the beneficiary(ies) or class of beneficiaries. Also list the names and addresses of the officers and directors of the Filer.	

41. By checking Yes, the undersigned certifies, that neither applicant nor any other party to the application is subject to a denial of Federal benefits that includes FCC benefits pursuant to Section 5301 of the Anti−Drug Act of 1988, 21 U.S.C. Section 862, because of a conviction for possession or distribution of a controlled substance. See 47 CFR 1.2002(b) for the meaning of "party to the application" for these purposes.	(●) Yes ( ) No
42a. Does the applicant intend to use a non−U.S. licensed satellite to provide service in the United States? If Yes, answer 42b and attach an exhibit providing the information specified in 47 C.F.R. 25.137, as appropriate. If No, proceed to question 43.	(●) Yes ( ) No
42b. What administration has licensed or is in the process of licensing the space station? If no license will be issued, what administration has coordinated or is in the process of coordinating the space station?United Kingdom	

43. Description. (Summarize the nature of the application and the services to be provided). (If the complete description does not appear in this box, please go to the end of the form to view it in its entirety.)

ISAT US seeks to modify its blanket earth station license, Call Sign E140029 to add Get Sat Earth station terminal types that will communicate with the Inmarsat−5 F2 and Inmarsat−5 F3 satellites.

Exhibit A

43a. Geographic Service Rule Certification

By selecting A, the undersigned certifies that the applicant is not subject to the geographic service or geographic coverage requirements specified in 47 C.F.R. Part 25.

(●) A

By selecting B, the undersigned certifies that the applicant is subject to the geographic service or geographic coverage requirements specified in 47 C.F.R. Part 25 and will comply with such requirements.

( ) B

By selecting C, the undersigned certifies that the applicant is subject to the geographic service or geographic coverage requirements specified in 47 C.F.R. Part 25 and will not comply with such requirements because it is not feasible as a technical matter to do so, or that, while technically feasible, such services would require so many compromises in satellite design and operation as to make it economically unreasonable. A narrative description and technical analysis demonstrating this claim are attached.

( ) C

CERTIFICATION

The Applicant waives any claim to the use of any particular frequency or of the electromagnetic spectrum as against the regulatory power of the United States because of the previous use of the same, whether by license or otherwise, and requests an authorization in accordance with this application. The applicant certifies that grant of this application would not cause the applicant to be in violation of the spectrum aggregation limit in 47 CFR Part 20. All statements made in exhibits are a material part hereof and are incorporated herein as if set out in full in this application. The undersigned, individually and for the applicant, hereby certifies that all statements made in this application and in all attached exhibits are true, complete and correct to the best of his or her knowledge and belief, and are made in good faith.

44. Applicant is a (an): (Choose the button next to applicable response.)

- ○ Individual
- ○ Unincorporated Association
- ○ Partnership
- ◉ Corporation
- ○ Governmental Entity
- ○ Other (please specify)

45. Name of Person Signing	46. Title of Person Signing
M. Ethan Lucarelli	Director, Regulatory and Public Policy

−−>

WILLFUL FALSE STATEMENTS MADE ON THIS FORM ARE PUNISHABLE BY FINE AND / OR IMPRISONMENT
(U.S. Code, Title 18, Section 1001), AND/OR REVOCATION OF ANY STATION AUTHORIZATION
(U.S. Code, Title 47, Section 312(a)(1)), AND/OR FORFEITURE (U.S. Code, Title 47, Section 503).

SATELLITE EARTH STATION AUTHORIZATIONS
FCC Form 312 − Schedule B:(Technical and Operational Description)
FOR OFFICIAL USE ONLY

Location of Earth Station Site

E1: Site Identifier:	Remote 9	E5. Call Sign:	E140029
E2: Contact Name	Kevin Baker	E6. Phone Number:	808−469−7104
E3. Street:	6211 Glen Circle	E7. City:	Lino Lakes
		E8. County:	Anoka
E4. State	MN	E9. Zip Code	55014
E10. Area of Operation:		South Atlantic Ocean Region	
E11. Latitude:	0 °0 ’0.0 "		
E12. Longitude:	0 °0 ’0.0 "		
E13. Lat/Lon Coordinates are:	○ NAD−27	○ NAD−83	◉ N/A
E14. Site Elevation (AMSL):	0.0 meters		

E15. If the proposed antenna(s) operate in the Fixed Satellite Service (FSS) with geostationary satellites, do(es) the proposed antenna(s) comply with the antenna gain patterns specified in Section 25.209(a) and (b) as demonstrated by the manufacturer’s qualification measurement? If NO, provide as a technical analysis showing compliance with two−degree spacing policy.	○ Yes ○ No ◉ N/A

E16. If the proposed antenna(s) do not operate in the Fixed Satellite Service (FSS), or if they operate in the Fixed Satellite Service (FSS) with non−geostationary satellites, do(es) the proposed antenna(s) comply with the antenna gain patterns specified in Section 25.209(a2) and (b) as demonstrated by the manufacturer's qualification measurements?	○ Yes ○ No ◉ N/A
E17. Is the facility operated by remote control? If YES, provide the location and telephone number of the control point.	◉ Yes ○ No

E18. Is frequency coordination required? If YES, attach a frequency coordination report as	○ Yes ◉ No
E19. Is coordination with another country required? If YES, attach the name of the country(ies) and plot of coordination contours as	○ Yes ◉ No
E20. FAA Notification − (See 47 CFR Part 17 and 47 CFR part 25.113(c)) Where FAA notification is required, have you attached a copy of a completed FCC Form 854 and/or the FAA's study regarding the potential hazard of the structure to aviation? FAILURE TO COMPLY WITH 47 CFR PARTS 17 AND 25 WILL RESULT IN THE RETURN OF THIS APPLICATION.	○ Yes ◉ No

POINTS OF COMMUNICATION

Satellite Name: INMARSAT 5F3 | INMARSAT 5F3 | 179.6 E.L. If you selected OTHER, please enter the following:	
E21. Common Name:	E22. ITU Name:
E23. Orbit Location:	E24. Country:

Satellite Name: INMARSAT 5F2 | INMARSAT 5F2 | 55.0 W.L. If you selected OTHER, please enter the following:

E21. Common Name:	E22. ITU Name:
E23. Orbit Location:	E24. Country:

POINTS OF COMMUNICATION (Destination Points)

E25. Site Identifier:	
E26. Common Name:	E27. Country:

ANTENNA

Site ID	**E28. Antenna Id**	**E29. Quantity**	**E30. Manufacturer**	**E31. Model**	**E32. Antenna Size<meters>**	**E41/42. Antenna Gain Transmint and/or Recieve (____dBi at _____GHz)**	
Remote 9	MilliSat−W	50	GetSat	MilliSat−W	0.5	35.4 dBi at 30	
Remote 9	MilliSat−W	50	GetSat	MilliSat−W	0.5	35.2 dBi at 29.5	
Remote 9	MilliSat−W	50	GetSat	MilliSat−W	0.5	38.3 dBi at 19.7	
Remote 9	MilliSat−W	50	GetSat	MilliSat−W	0.5	38.6 dBi at 20.2	

E28. Antenna Id	**E33/34. Diameter Minor/Major (meters)**	**E35. Above Ground Level (meters)**	**E36. Above Sea Level(meters)**	**E37. Building Height Above Ground Level (meters)**	**E38. Total Input Power at antenna flange (Watts)**	**E39. Maximum Antenna Height Above Rooftop (meters)**	**E40. Total EIRP for al carriers(dBW)**
MilliSat−W	0.135/0.5	0.0	0.0	0.0	16.0	0.0	48.8

FREQUENCY

E28. Antenna Id	E43/44. Frequency Bands (MHz)	E45. T/R Mode	E46. Antenna Polarization(H,V, L,R)	E47. Emission Designator	E48. Maximum EIRP per Carrier (dBW)	E49. Maximum ERIP Density per Carrier (dBW/4kHz)
MilliSat−W	19700 20200	R	Left Hand Circular	32M0G7W	0.0	0.0
E50. Modulation and Services (If the complete description does not appear in this box, please go to the end of the form to view it in its entirety.) Various modulations up to 32 APSK Digital Data Link						
MilliSat−W	29500 30000	T	Right Hand Circular	460KG7W	48.8	28.2
E50. Modulation and Services (If the complete description does not appear in this box, please go to the end of the form to view it in its entirety.) Various modulations up to 32 APSK Digital Data Link						
MilliSat−W	29500 30000	T	Right Hand Circular	5M00G1W	48.8	17.8

E50. Modulation and Services (If the complete description does not appear in this box, please go to the end of the form to view it in its entirety.)

Various modulations up to 32 APSK Digital Data Link

FREQUENCY COORDINATION

E28. Antenna Id	**E51. Satellite Orbit Type**	**E52/53. Frequency Limits(MHz)**	**E54/55. Range of Satellite Arc Eastern/Western Limit**	**E56. Earth Station Azimuth Angle Eastern Limit**	**E57. Antenna Elevation Angle Eastern Limit**	**E58. Earth Station Azimuth Angle Western Limit**	**E59. Antenna Elevation Angle Western Limit**	**E60. Maximum EIRP Density toward the Horizon (dBW/4kHz)**
MilliSat−W	Geostationary	19700 20200	0.0/360.0	0.0	5.0	0.0	5.0	0.0
	Geostationary	29500 30000	0.0/360.0	0.0	5.0	0.0	5.0	−9.0

REMOTE CONTROL POINT LOCATION

E61. Call Sign
E120072
NOTE: Please enter the callsign of the controlling station, not the callsign for which this application is being filed.

E66. Phone Number
808−469−7104

E62. Street Address
6211 Glen Circle
(MilliSat−W)

E63. City	E68. County	E67/68. State/Country	E64. Zip Code
Lino Lakes	Anoka	MN/ USA	55014

SATELLITE EARTH STATION AUTHORIZATIONS
FCC Form 312 − Schedule B:(Technical and Operational Description)
FOR OFFICIAL USE ONLY

Location of Earth Station Site

E1: Site Identifier:	Remote 10	E5. Call Sign:	E140029
E2: Contact Name	Kevin Baker	E6. Phone Number:	808−469−7104
E3. Street:	6211 Glen Circle	E7. City:	Lino Lakes
		E8. County:	Anoka
E4. State	MN	E9. Zip Code	55014
E10. Area of Operation:		South Atlantic Ocean Region	
E11. Latitude:	0 °0 ’0.0 "		
E12. Longitude:	0 °0 ’0.0 "		
E13. Lat/Lon Coordinates are:	○ NAD−27	○ NAD−83	◉ N/A
E14. Site Elevation (AMSL):	0.0 meters		

E15. If the proposed antenna(s) operate in the Fixed Satellite Service (FSS) with geostationary satellites, do(es) the proposed antenna(s) comply with the antenna gain patterns specified in Section 25.209(a) and (b) as demonstrated by the manufacturer’s qualification measurement? If NO, provide as a technical analysis showing compliance with two−degree spacing policy.	○ Yes ○ No ◉ N/A

E16. If the proposed antenna(s) do not operate in the Fixed Satellite Service (FSS), or if they operate in the Fixed Satellite Service (FSS) with non−geostationary satellites, do(es) the proposed antenna(s) comply with the antenna gain patterns specified in Section 25.209(a2) and (b) as demonstrated by the manufacturer's qualification measurements?	○ Yes ○ No ◉ N/A
E17. Is the facility operated by remote control? If YES, provide the location and telephone number of the control point.	◉ Yes ○ No

E18. Is frequency coordination required? If YES, attach a frequency coordination report as	○ Yes ◉ No
E19. Is coordination with another country required? If YES, attach the name of the country(ies) and plot of coordination contours as	○ Yes ◉ No
E20. FAA Notification − (See 47 CFR Part 17 and 47 CFR part 25.113(c)) Where FAA notification is required, have you attached a copy of a completed FCC Form 854 and/or the FAA's study regarding the potential hazard of the structure to aviation? FAILURE TO COMPLY WITH 47 CFR PARTS 17 AND 25 WILL RESULT IN THE RETURN OF THIS APPLICATION.	○ Yes ◉ No

POINTS OF COMMUNICATION

Satellite Name: INMARSAT 5F3 | INMARSAT 5F3 | 179.6 E.L. If you selected OTHER, please enter the following:	
E21. Common Name:	E22. ITU Name:
E23. Orbit Location:	E24. Country:

Satellite Name: INMARSAT 5F2 | INMARSAT 5F2 | 55.0 W.L. If you selected OTHER, please enter the following:

E21. Common Name:	E22. ITU Name:
E23. Orbit Location:	E24. Country:

POINTS OF COMMUNICATION (Destination Points)

E25. Site Identifier:	
E26. Common Name:	E27. Country:

ANTENNA

Site ID	**E28. Antenna Id**	**E29. Quantity**	**E30. Manufacturer**	**E31. Model**	**E32. Antenna Size<meters>**	**E41/42. Antenna Gain Transmint and/or Recieve (____dBi at _____GHz)**	
Remote 10	MilliSat−H	50	GetSat	MilliSat−H	0.27	32.9 dBi at 29.5	
Remote 10	MilliSat−H	50	GetSat	MilliSat−H	0.27	33.8 dBi at 20.2	
Remote 10	MilliSat−H	50	GetSat	MilliSat−H	0.27	33.9 dBi at 19.7	
Remote 10	MilliSat−H	50	GetSat	MilliSat−H	0.27	34.3 dBi at 30.0	

E28. Antenna Id	**E33/34. Diameter Minor/Major (meters)**	**E35. Above Ground Level (meters)**	**E36. Above Sea Level(meters)**	**E37. Building Height Above Ground Level (meters)**	**E38. Total Input Power at antenna flange (Watts)**	**E39. Maximum Antenna Height Above Rooftop (meters)**	**E40. Total EIRP for al carriers(dBW)**
MilliSat−H	0.248/0.27	0.0	0.0	0.0	16.0	0.0	48.8

FREQUENCY

E28. Antenna Id	E43/44. Frequency Bands (MHz)	E45. T/R Mode	E46. Antenna Polarization(H,V, L,R)	E47. Emission Designator	E48. Maximum EIRP per Carrier (dBW)	E49. Maximum ERIP Density per Carrier (dBW/4kHz)
MilliSat−H	19700 20200	R	Left Hand Circular	32M0G7W	0.0	0.0
E50. Modulation and Services (If the complete description does not appear in this box, please go to the end of the form to view it in its entirety.) Various modulations up to 32 APSK Digital Data Link						
MilliSat−H	29500 30000	T	Right Hand Circular	460KG7W	48.8	28.2
E50. Modulation and Services (If the complete description does not appear in this box, please go to the end of the form to view it in its entirety.) Various modulations up to 32 APSK Digital Data Link						
MilliSat−H	29500 30000	T	Right Hand Circular	5M00G1W	48.8	17.8

E50. Modulation and Services (If the complete description does not appear in this box, please go to the end of the form to view it in its entirety.)

Various modulations up to 32 APSK Digital Data Link

FREQUENCY COORDINATION

E28. Antenna Id	**E51. Satellite Orbit Type**	**E52/53. Frequency Limits(MHz)**	**E54/55. Range of Satellite Arc Eastern/Western Limit**	**E56. Earth Station Azimuth Angle Eastern Limit**	**E57. Antenna Elevation Angle Eastern Limit**	**E58. Earth Station Azimuth Angle Western Limit**	**E59. Antenna Elevation Angle Western Limit**	**E60. Maximum EIRP Density toward the Horizon (dBW/4kHz)**
MilliSat−H	Geostationary	19700 20200	0.0/360.0	0.0	5.0	0.0	5.0	0.0
	Geostationary	29500 30000	0.0/360.0	0.0	5.0	0.0	5.0	−9.0

REMOTE CONTROL POINT LOCATION

E61. Call Sign E120072 NOTE: Please enter the callsign of the controlling station, not the callsign for which this application is being filed.			E66. Phone Number 808−469−7104
E62. Street Address 6211 Glen Circle (MilliSat−H)			
E63. City Lino Lakes	E68. County Anoka	E67/68. State/Country MN/ USA	E64. Zip Code 55014

SATELLITE EARTH STATION AUTHORIZATIONS
FCC Form 312 − Schedule B:(Technical and Operational Description)
FOR OFFICIAL USE ONLY

Location of Earth Station Site

E1: Site Identifier:	Remote 11	E5. Call Sign:	E140029
E2: Contact Name	Kevin Baker	E6. Phone Number:	808−469−7104
E3. Street:	6211 Glen Circle	E7. City:	Lino Lakes
		E8. County:	Anoka
E4. State	MN	E9. Zip Code	55014
E10. Area of Operation:		South Atlantic Ocean Region	
E11. Latitude:	0 °0 ’0.0 "		
E12. Longitude:	0 °0 ’0.0 "		
E13. Lat/Lon Coordinates are:	○ NAD−27	○ NAD−83	◉ N/A
E14. Site Elevation (AMSL):	0.0 meters		

E15. If the proposed antenna(s) operate in the Fixed Satellite Service (FSS) with geostationary satellites, do(es) the proposed antenna(s) comply with the antenna gain patterns specified in Section 25.209(a) and (b) as demonstrated by the manufacturer’s qualification measurement? If NO, provide as a technical analysis showing compliance with two−degree spacing policy.	○ Yes ○ No ◉ N/A

E16. If the proposed antenna(s) do not operate in the Fixed Satellite Service (FSS), or if they operate in the Fixed Satellite Service (FSS) with non−geostationary satellites, do(es) the proposed antenna(s) comply with the antenna gain patterns specified in Section 25.209(a2) and (b) as demonstrated by the manufacturer's qualification measurements?	○ Yes ○ No ◉ N/A
E17. Is the facility operated by remote control? If YES, provide the location and telephone number of the control point.	◉ Yes ○ No

E18. Is frequency coordination required? If YES, attach a frequency coordination report as	○ Yes ◉ No
E19. Is coordination with another country required? If YES, attach the name of the country(ies) and plot of coordination contours as	○ Yes ◉ No
E20. FAA Notification − (See 47 CFR Part 17 and 47 CFR part 25.113(c)) Where FAA notification is required, have you attached a copy of a completed FCC Form 854 and/or the FAA's study regarding the potential hazard of the structure to aviation? FAILURE TO COMPLY WITH 47 CFR PARTS 17 AND 25 WILL RESULT IN THE RETURN OF THIS APPLICATION.	○ Yes ◉ No

POINTS OF COMMUNICATION

Satellite Name: INMARSAT 5F3 | INMARSAT 5F3 | 179.6 E.L. If you selected OTHER, please enter the following:	
E21. Common Name:	E22. ITU Name:
E23. Orbit Location:	E24. Country:

Satellite Name: INMARSAT 5F2 | INMARSAT 5F2 | 55.0 W.L. If you selected OTHER, please enter the following:

E21. Common Name:	E22. ITU Name:
E23. Orbit Location:	E24. Country:

POINTS OF COMMUNICATION (Destination Points)

E25. Site Identifier:	
E26. Common Name:	E27. Country:

ANTENNA

Site ID	**E28. Antenna Id**	**E29. Quantity**	**E30. Manufacturer**	**E31. Model**	**E32. Antenna Size<meters>**	**E41/42. Antenna Gain Transmint and/or Recieve (____dBi at _____GHz)**	
Remote 11	MicroSat	50	GetSat	MicroSat	0.248	31.5 dBi at 20.2	
Remote 11	MicroSat	50	GetSat	MicroSat	0.248	31.75 dBi at 30.0	
Remote 11	MicroSat	50	GetSat	MicroSat	0.248	32.2 dBi at 29.5	
Remote 11	MicroSat	50	GetSat	MicroSat	0.248	33.7 dBi at 19.7	

E28. Antenna Id	**E33/34. Diameter Minor/Major (meters)**	**E35. Above Ground Level (meters)**	**E36. Above Sea Level(meters)**	**E37. Building Height Above Ground Level (meters)**	**E38. Total Input Power at antenna flange (Watts)**	**E39. Maximum Antenna Height Above Rooftop (meters)**	**E40. Total EIRP for al carriers(dBW)**
MicroSat	0.135/0.248	0.0	0.0	0.0	16.0	0.0	46.0

FREQUENCY

E28. Antenna Id	E43/44. Frequency Bands (MHz)	E45. T/R Mode	E46. Antenna Polarization(H,V, L,R)	E47. Emission Designator	E48. Maximum EIRP per Carrier (dBW)	E49. Maximum ERIP Density per Carrier (dBW/4kHz)
MicroSat	19700 20200	R	Left Hand Circular	32M0G7W	0.0	0.0
E50. Modulation and Services (If the complete description does not appear in this box, please go to the end of the form to view it in its entirety.) Various modulations up to 32 APSK Digital Data Link						
MicroSat	29500 30000	T	Right Hand Circular	460KG7W	46.0	25.4
E50. Modulation and Services (If the complete description does not appear in this box, please go to the end of the form to view it in its entirety.) Various modulations up to 32 APSK Digital Data Link						
MicroSat	29500 30000	T	Right Hand Circular	5M00G1W	46.0	15.0

E50. Modulation and Services (If the complete description does not appear in this box, please go to the end of the form to view it in its entirety.)

Various modulations up to 32 APSK Digital Data Link

FREQUENCY COORDINATION

E28. Antenna Id	**E51. Satellite Orbit Type**	**E52/53. Frequency Limits(MHz)**	**E54/55. Range of Satellite Arc Eastern/Western Limit**	**E56. Earth Station Azimuth Angle Eastern Limit**	**E57. Antenna Elevation Angle Eastern Limit**	**E58. Earth Station Azimuth Angle Western Limit**	**E59. Antenna Elevation Angle Western Limit**	**E60. Maximum EIRP Density toward the Horizon (dBW/4kHz)**
MicroSat	Geostationary	19700 20200	0.0/360.0	0.0	5.0	0.0	5.0	0.0
	Geostationary	29500 30000	0.0/360.0	0.0	5.0	0.0	5.0	−9.0

REMOTE CONTROL POINT LOCATION

E61. Call Sign E120072 NOTE: Please enter the callsign of the controlling station, not the callsign for which this application is being filed.	E66. Phone Number 808−469−7104
E62. Street Address 6211 Glen Circle (MicroSat)	

E63. City Lino Lakes	E68. County Anoka	E67/68. State/Country MN/ USA	E64. Zip Code 55014

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ISAT US Inc.
FCC Form 312 Exhibit A

Application to Modify License E140029

I. DESCRIPTION OF MODIFICATION

ISAT US Inc. ("ISAT US") hereby seeks to modify its Global Xpress blanket license for Ka-band maritime Earth Stations in Motion ("ESIM"), Call Sign E140029 ("License"), File No. SES-LIC-20140224-00098 ("GX Maritime Application") (as modified by File Nos. SES-MOD-20151106-00818, SES-MOD20161130-00917, and SES-MOD-20170817-00928) to add a three new GX Earth station terminal types ("MicroSat", "MilliSat-W", "MilliSat-H") that will communicate with the Inmarsat-5 F2 ("I5F2") and Inmarsat- 5 F3 ("I5F3") satellites. Section II addresses the proposed new Earth station terminals. No other changes are requested by this modification application. ISAT US incorporates by reference Exhibits E (response to Question E17 regarding the remote control point) and (24-hour point of contact) of the GX Maritime Application, as well as certain other portions of the GX Maritime Application referenced below.

II. NEW EARTH STATION IN MOTION TERMINALS

This modification application seeks to add three terminal models that are manufactured by GetSat. The terminals will provide mobile communications services over Inmarsat's Ka-band Global Xpress satellite system in the 29.5-30.0 GHz (Earth-to-space) and 19.7-20.2 GHz (space-to-Earth) frequency bands. ISAT US already holds a blanket license for ESIMs that provide broadband communications in maritime applications[1] with the Inmarsat 5F2 and Inmarsat 5F3 satellite networks. This license covers operations in the 29.5-30.0 GHz (Earth-to-space) and 19.7-20.2 GHz (space-to-Earth) frequency bands. This application seeks authority to operate in these same frequencies for maritime applications. As pictured below, the GetSat terminals

[1] *See* Call Sign E140029.

utilize small flat panel antennas to achieve a compact terminal size that is especially useful in mobile applications. These terminals will add to the option of terminals available to meet the needs of maritime users. In the future, Inmarsat plans to file an additional application seeking authorization for these same terminals in land-mobile deployments.

A. Maritime ESIM Terminal Description

This application seeks to license the MicroSat, MilliSat-W, and MilliSat-H terminals manufactured by GetSat ("GetSat Terminals"). The terminals will operate on the same frequencies as the GX Terminals in the current license: 19.7-20.2 GHz (space-to-Earth) and 29.5-30.0 GHz (Earth-to-space). As illustrated in the off-axis EIRP spectral density plots in Exhibit B, the MicroSat, MilliSat-W, and MilliSat-H terminals meet the performance requirements in Section 25.138 (a) under clear sky conditions. Additionally, each of these ESIM terminal types will be operated within the -118 dBW/m^2/MHz power flux-density at the earth's surface of the I5F2 and I5F3 satellite. Thus, the proposed terminals are able to operate without causing unacceptable interference, consistent with the requirements of Section 25.209(f).[2]

The Commission has deleted the requirement to provide receive earth station patterns in the 19.7-20.2 GHz frequency band (see Sections 25.132 and 25.115). To the extent that the proposed terminal may have minor exceedance at certain off-axis angles Inmarsat understands and agrees to accept interference from adjacent FSS satellite networks to the extent the relevant receiving antenna performance requirements of Section 25.209 are exceeded.

Radiation hazard analyses for the MicroSat, MilliSat-W, and MilliSat-H terminals and a discussion of the results are provided in Exhibit C.

[2] *See* Section 25.209(f).

The proposed GetSat Terminals will be subject to the same national security requirements described in Section 4 of Exhibit A of the GX Maritime Application. That discussion is incorporated by reference herein. Inmarsat has completed US334 coordination with the applicable Federal users.

The following sections provide a description of each of the terminal types.

B. MICROSAT Terminal

The required technical data for the proposed MicroSat earth station is provided in the Form 312. This terminal type employs a 0.248 x 0.135 meter flat panel antenna and the half-power beamwidth required in Section 25.130(f) is 2.4 degrees. In addition, for blanket licensing of transmitting Earth stations in the 29.5-30.0 GHz band, the Commission adopted off-axis EIRP spectral density levels contained in Section 25.138(a). As illustrated in the off-axis EIRP spectral density plots in Exhibit B, the proposed terminal type meets the performance requirements in Section 25.138 (a) under clear sky conditions.

Below are images of the MicroSat terminal both inside and outside of its radome:

C. MILLISAT-W Terminal

The required technical data for the proposed MILLISAT-W earth station is provided in the Form 312. This terminal type utilizes a variation on the MicroSat design, that employs a 0.5 x 0.135 meter flat panel antenna; and the half-power beamwidth required in Section 25.130(f) is 1.2 degrees. In addition, for blanket licensing of transmitting Earth stations in the 29.5-30.0 GHz band, the Commission adopted off-axis EIRP spectral density levels contained in Section 25.138(a). As illustrated in the off-axis EIRP spectral density plots in Exhibit B, the proposed terminal type meets the performance requirements in Section 25.138 (a) under clear sky conditions.

Below are images of the MilliSat-W terminal, both inside and outside of its radome:

D. <u>MILLISAT-H Terminal</u>

The required technical data for the proposed MILLISAT-H earth station is provided in the Form 312. This terminal type utilizes a variation on the MicroSat design, that employs a 0.248 x 0.27 meter flat panel antenna; and the half-power beamwidth required in Section 25.130(f) is 2.2 degrees. In addition, for blanket licensing of transmitting Earth stations in the 29.5-30.0 GHz band, the Commission adopted off-axis EIRP spectral density levels contained in Section 25.138(a). As illustrated in the off-axis EIRP spectral density plots in Exhibit B, the proposed terminal type meets the performance requirements in Section 25.138 (a) under clear sky conditions.

Below is an image of the MilliSat-H terminal both inside and outside of its radome:

III. REQUEST FOR WAIVER

ISAT US hereby respectfully requests a partial waiver of Sections 25.115(g) and 25.132(b)(1) of the FCC's rules to the extent the antenna plots in Exhibit B of this application do not cover the entire range of off-axis angles called for in those rule sections. The relevant portions of Sections 25.115 and 25.132 call for plots of maximum co-polarized EIRP density in the plane tangent to the GSO arc at off-axis angles from minus 180° to plus 180°. Exhibit

B of this application includes plots covering off-axis angles from minus 90° to plus 90°. These are the plots that were provided by the terminal manufacturer, and ISAT US was unable to receive plots covering the rest of the range called for in Sections 25.115 and 25.132 of the FCC's rules.[3] The plots provided for each antenna show a sharp drop off in EIRP density at angles moving away from the GSO arc, and in each case show that by minus 50° or plus 50°, the EIRP densities are well below the envelope specified in Section 25.209 of the FCC's rules. This strong performance against the Section 25.209 envelope is in part a result of the small rectangular panel and tight beam-forming of the GetSat terminal antennas. As a result of the terminal design, there is no reason to expect that that the EIRP density levels would dramatically increase beyond minus 90° or plus 90°. Grant of this partial waiver will help accelerate the approval process of these terminals by not requiring unnecessary and duplicative measurements to be taken by the manufacturer, and thus would serve the public interest.

IV. RESPONSE TO QUESTION 36

ISAT US submits this response to Question 36 of the FCC Form 312 out of an abundance of caution. In 2005, the Commission dismissed a Petition for Declaratory Ruling (the "Petition") filed by Inmarsat Mobile Networks, Inc.'s affiliate, Inmarsat Global Limited ("Inmarsat Global"), seeking United States market access to provide MSS in the 2 GHz band. Subsequent to Inmarsat Global's filing, the Commission assigned all 2 GHz spectrum currently allocated for

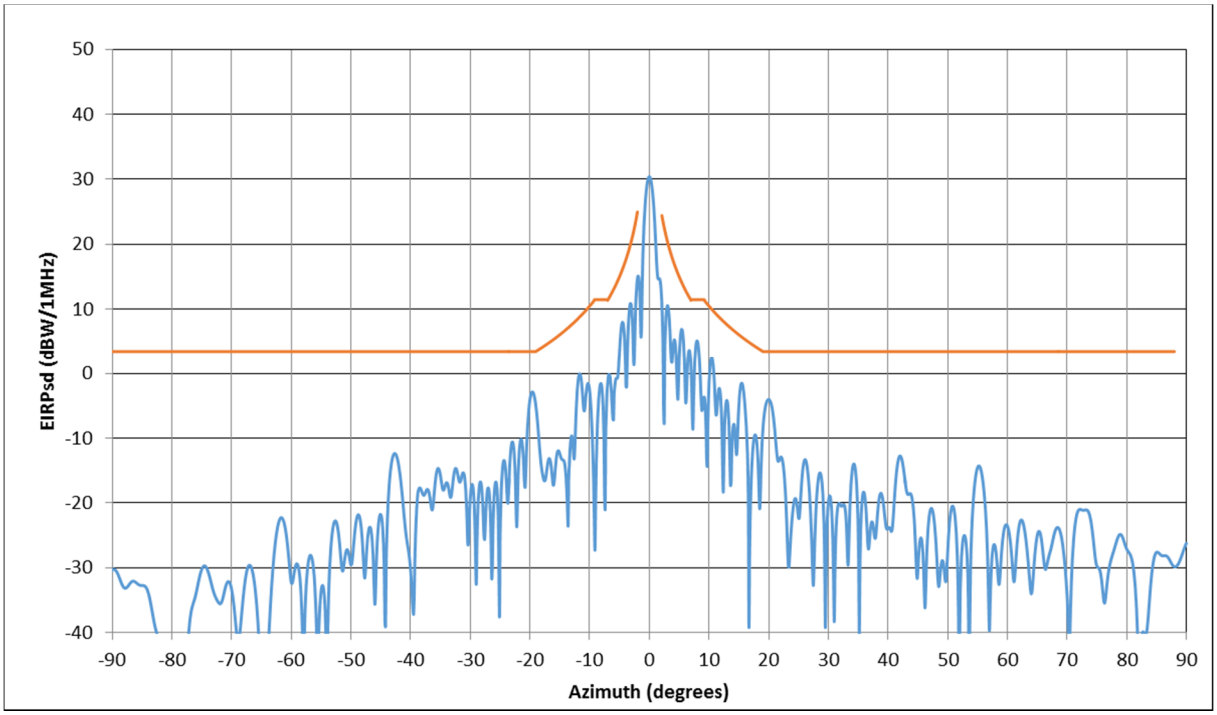
[3] In other instances, the plots provided by the manufacturer show greater ranges than those required under the FCC rules. Those greater ranges are included in this application for completeness and only reinforce the favorable performance of the GetSat terminals.

MSS in the United States to two other satellite operators, and thus dismissed Inmarsat Global's Petition.

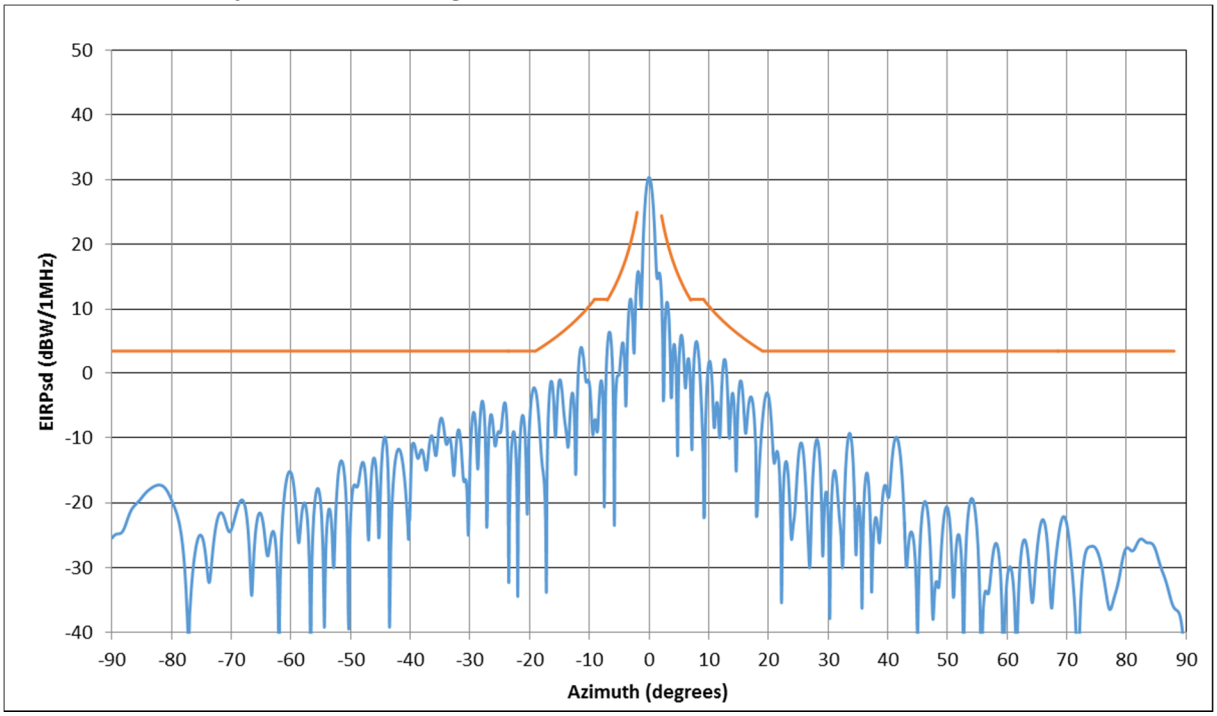
EXHIBIT B

1.0 MilliSat-W Off-Axis EIRP Masks

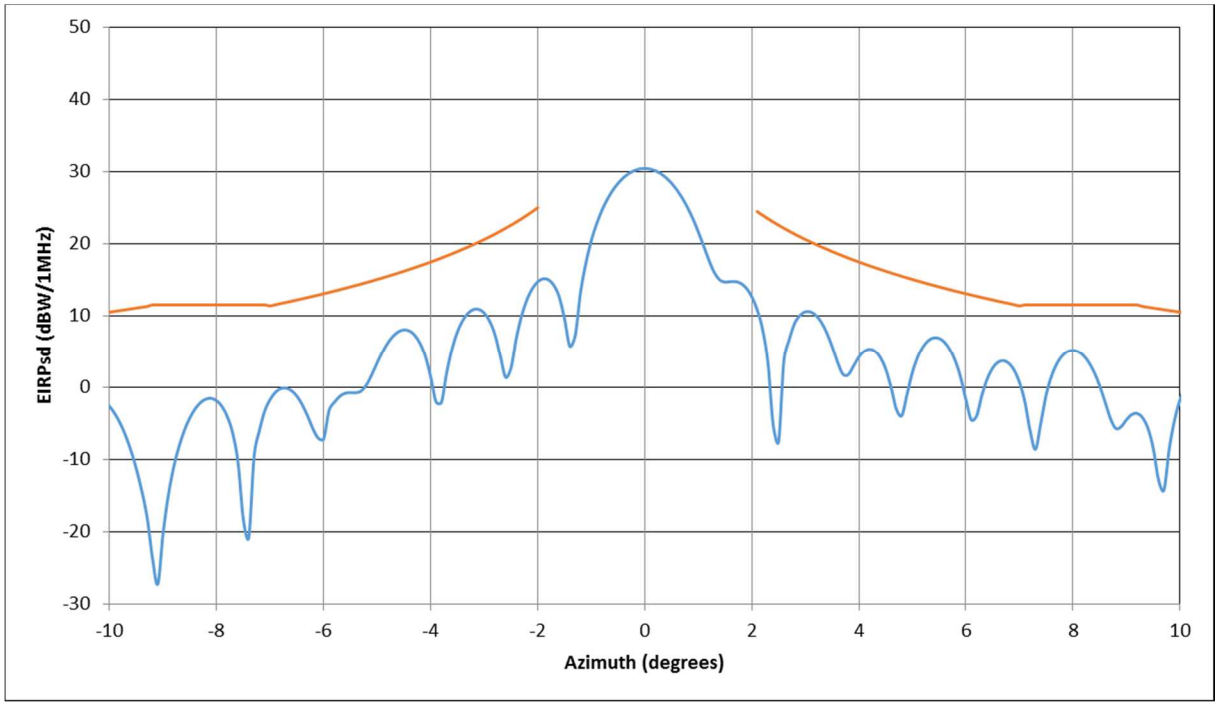
Co-Pol EIRP density in the Plane Tangent to the GSO Arc 29.5 GHz



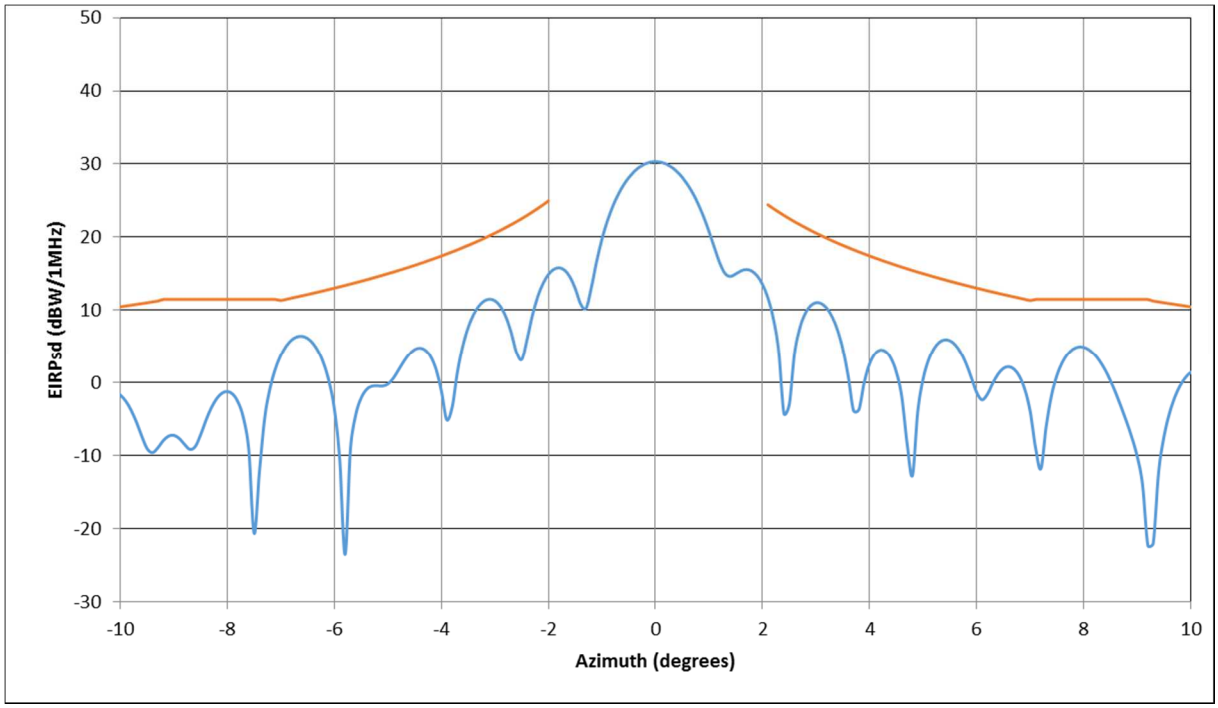
Co-Pol EIRP density in the Plane Tangent to the GSO Arc 30.0 GHz



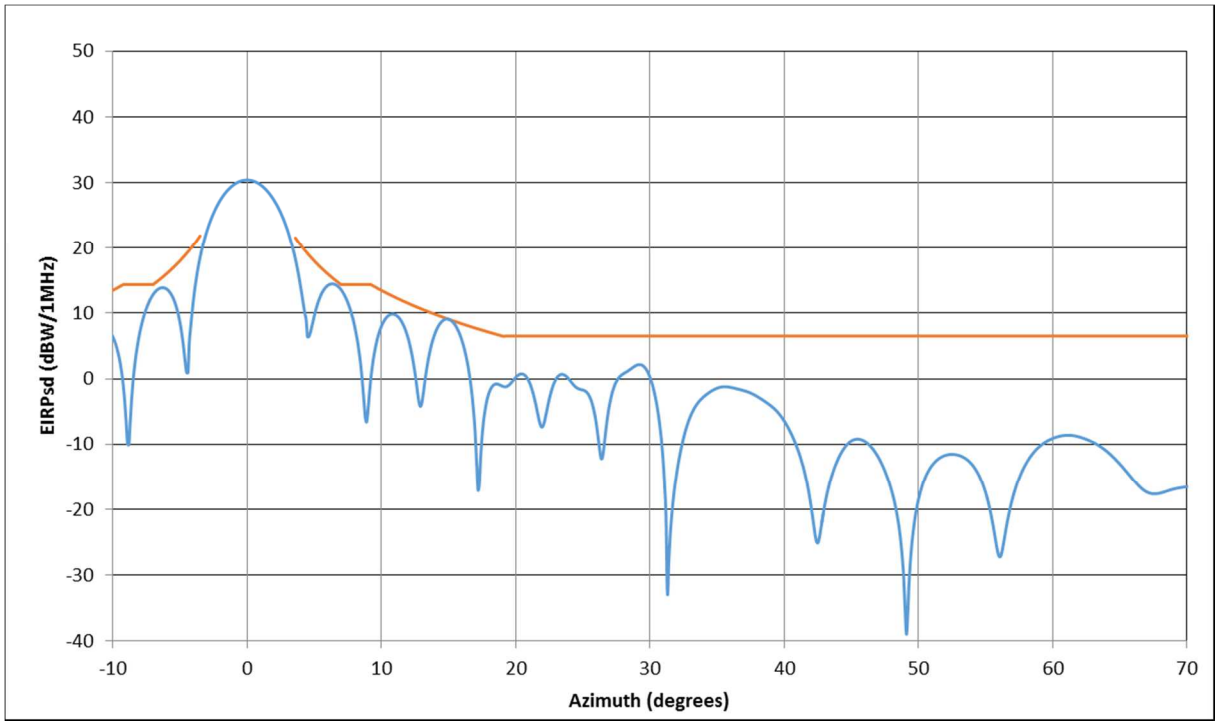
Co-Pol EIRP density in the Plane Tangent to the GSO Arc 29.5 GHz (-10 to +10 degrees)



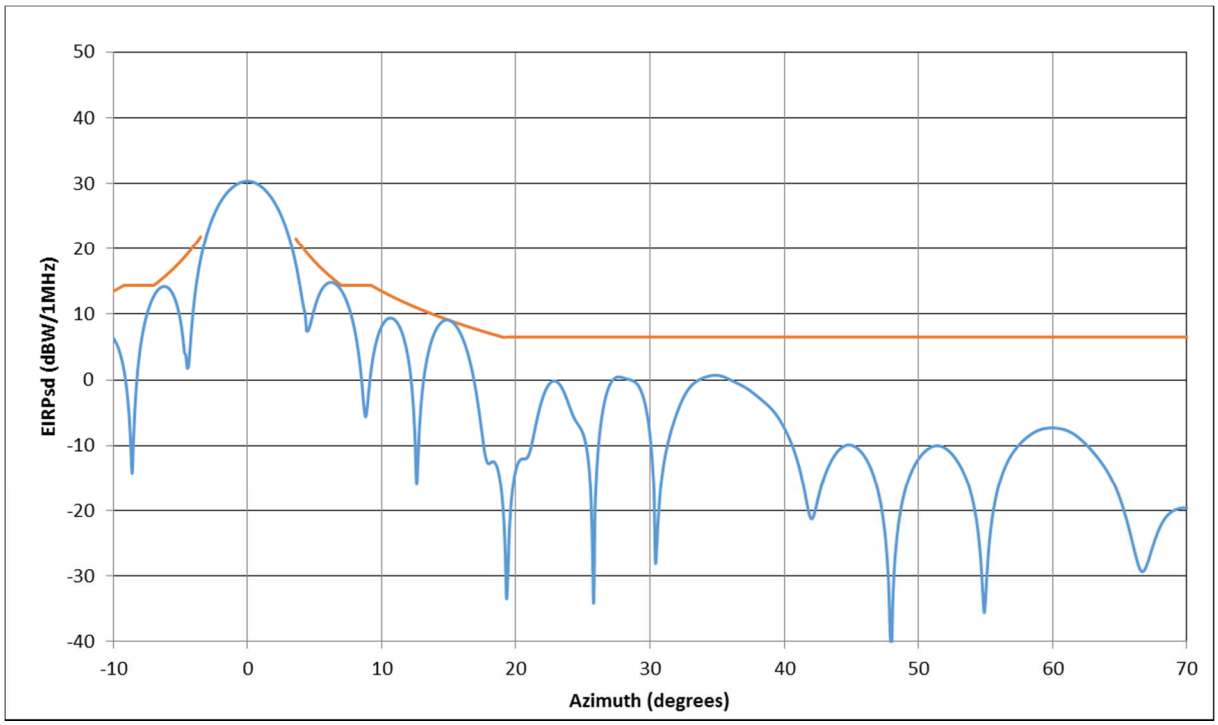
Co-Pol EIRP density in the Plane Tangent to the GSO Arc 30.0 GHZ (-10 to +10 degrees)



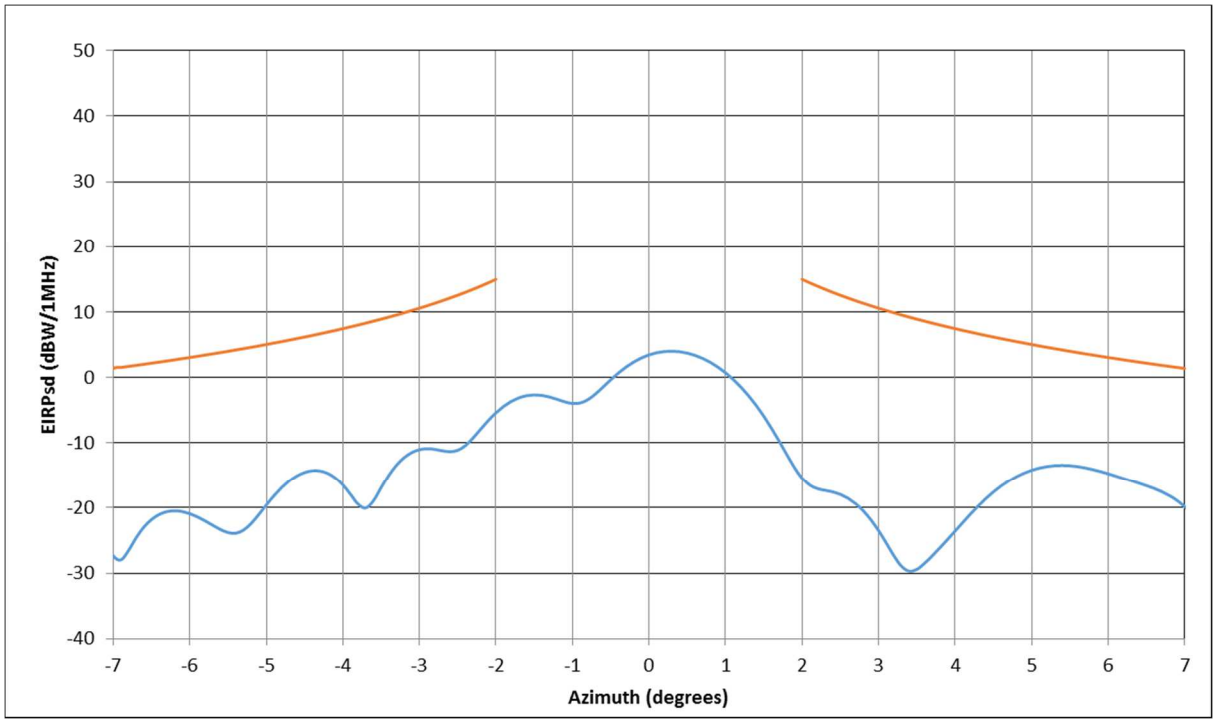
Co-Pol EIRP density in the Perpendicular to the GSO Arc 29.5 GHz (0 to +30 degrees)



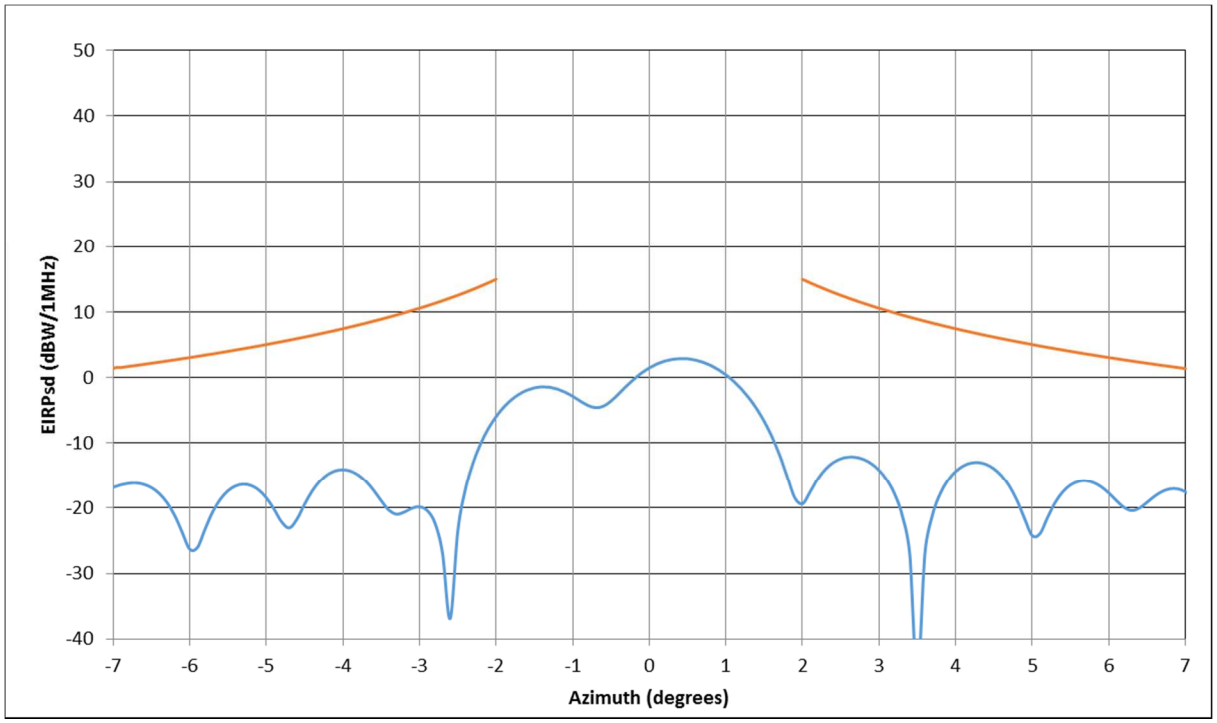
Co-Pol EIRP density in the Perpendicular to the GSO Arc 30.0 GHz (0 to +30 degrees)



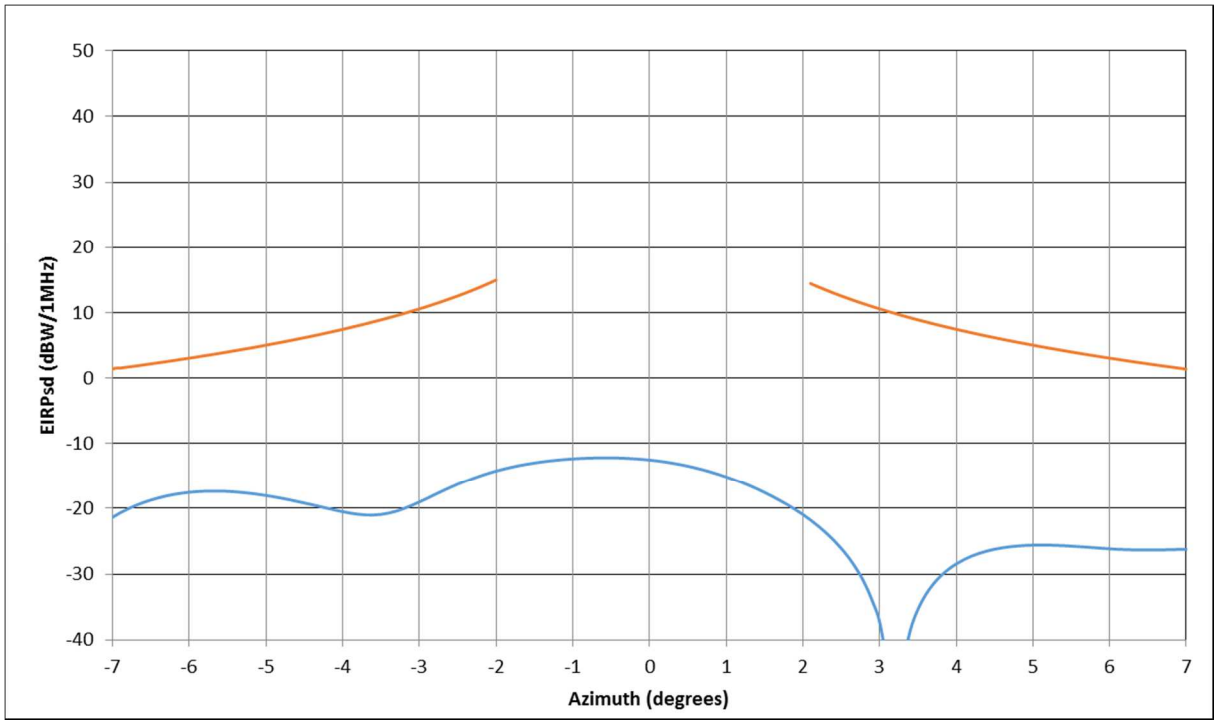
X-Pol EIRP density in the plane tangent to the GSO Arc 29.5 GHZ (-7 to +7 degrees)



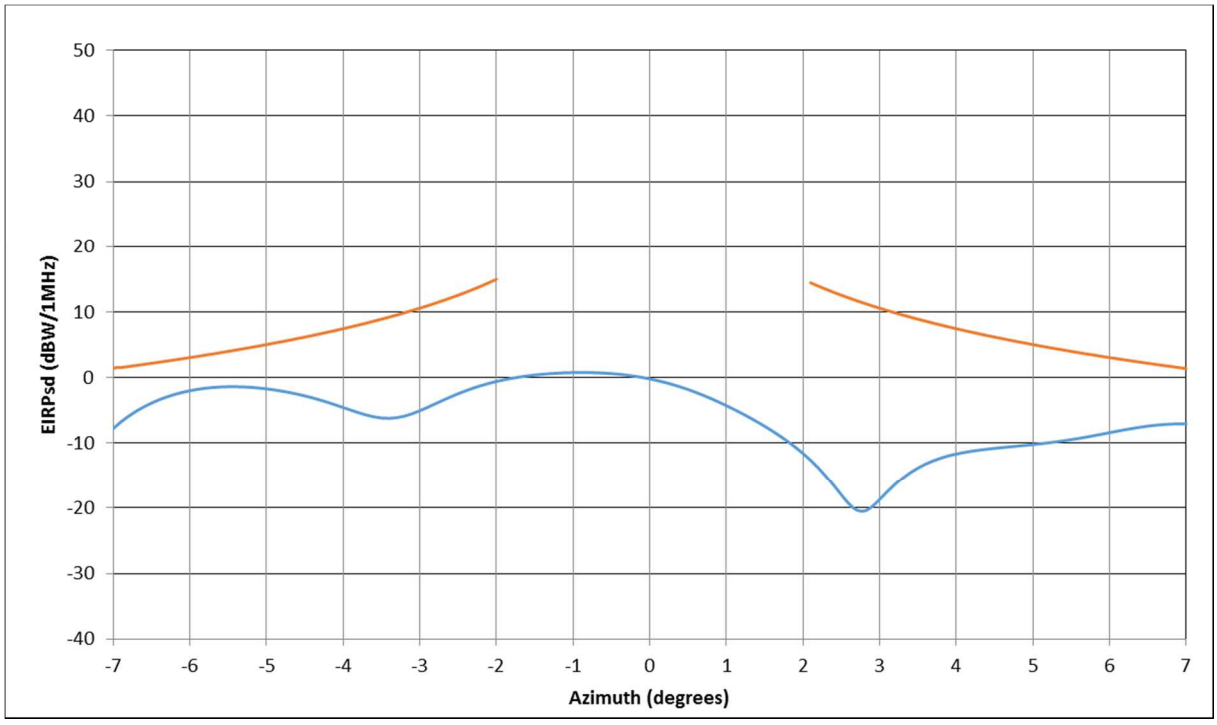
X-Pol EIRP density in the plane tangent to the GSO Arc 30 GHZ (-7 to +7 degrees)



X-Pol EIRP density in the plane perpendicular to the GSO Arc 29.5 GHZ (-7 to +7 degrees)

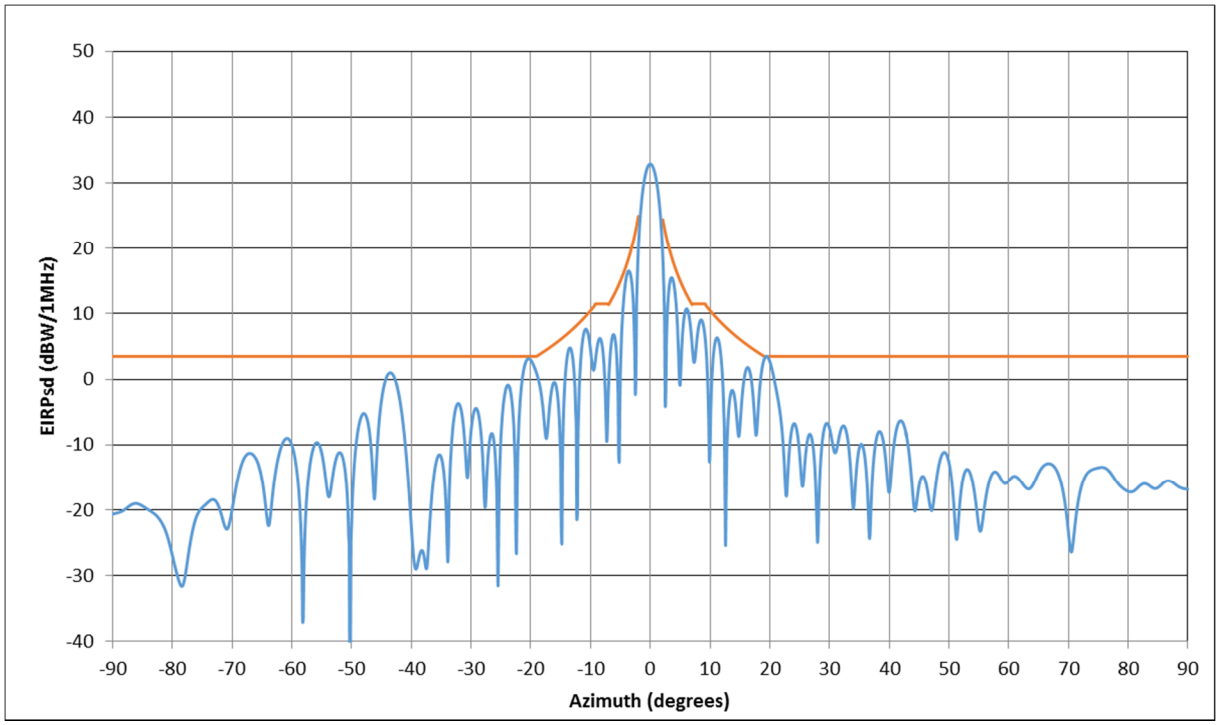


X-Pol EIRP density in the plane perpendicular to the GSO Arc 30 GHZ (-7 to +7 degrees)

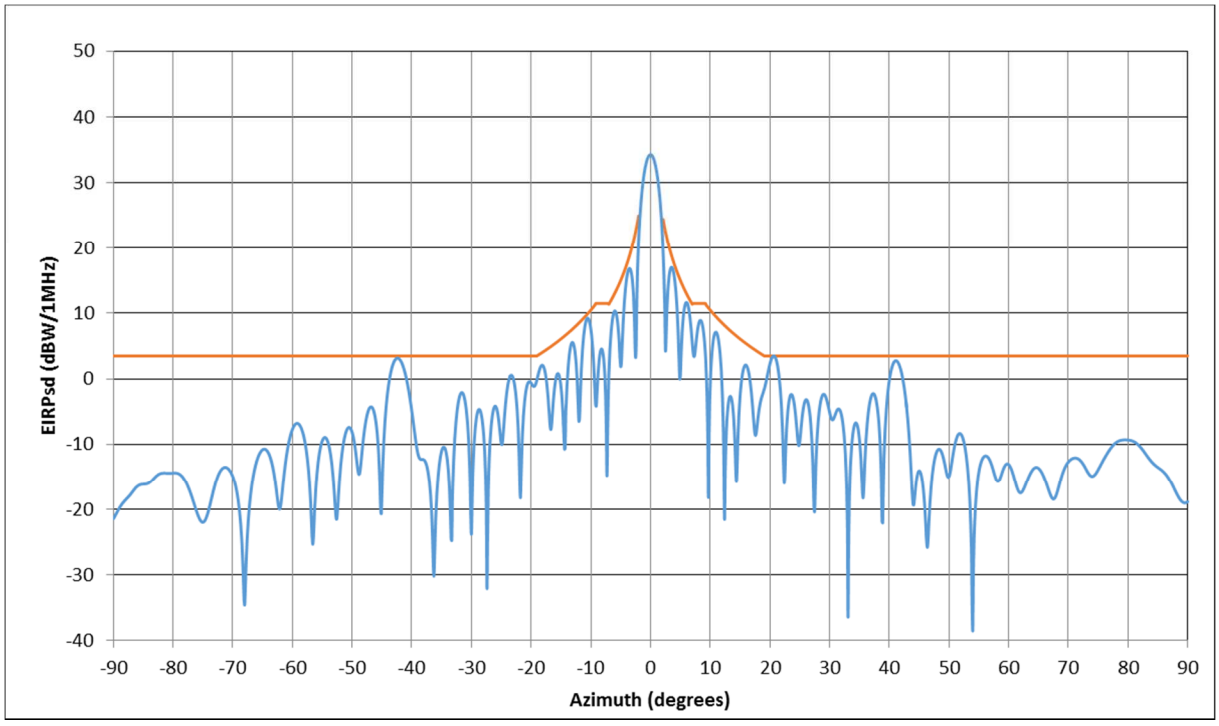


2.0 MilliSat-H Off-Axis EIRP Masks

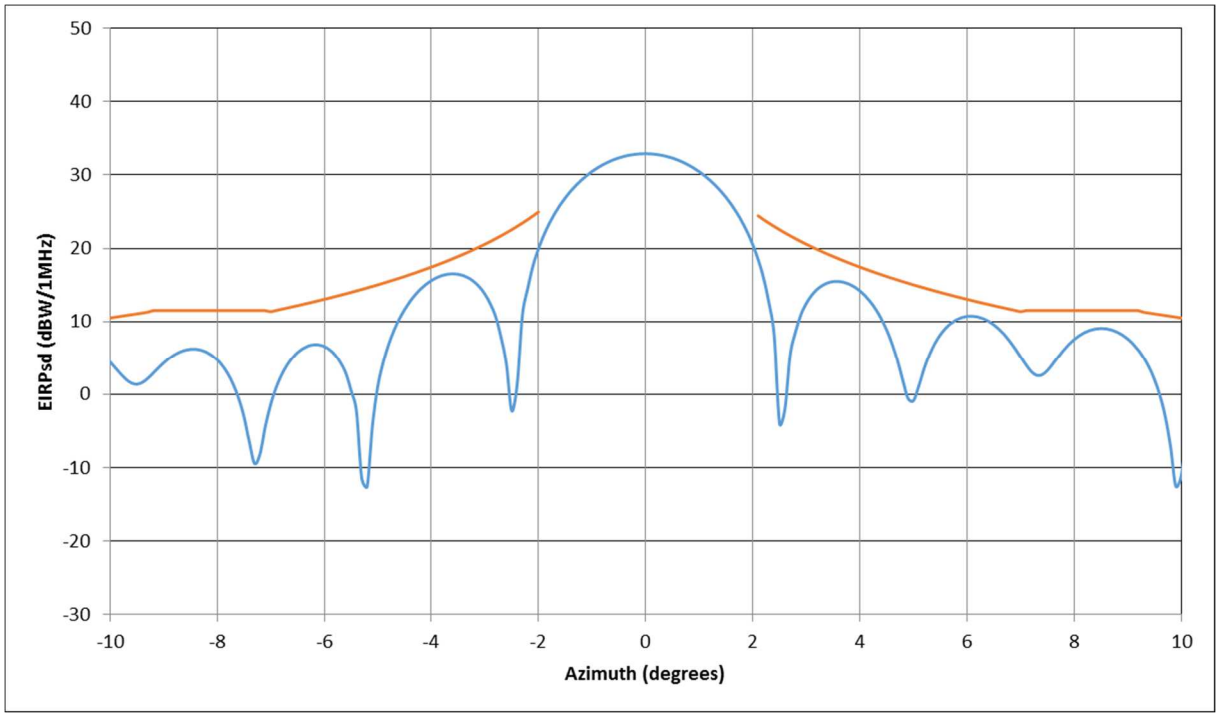
Co-Pol EIRP density in the Plane Tangent to the GSO Arc 29.5 GHz



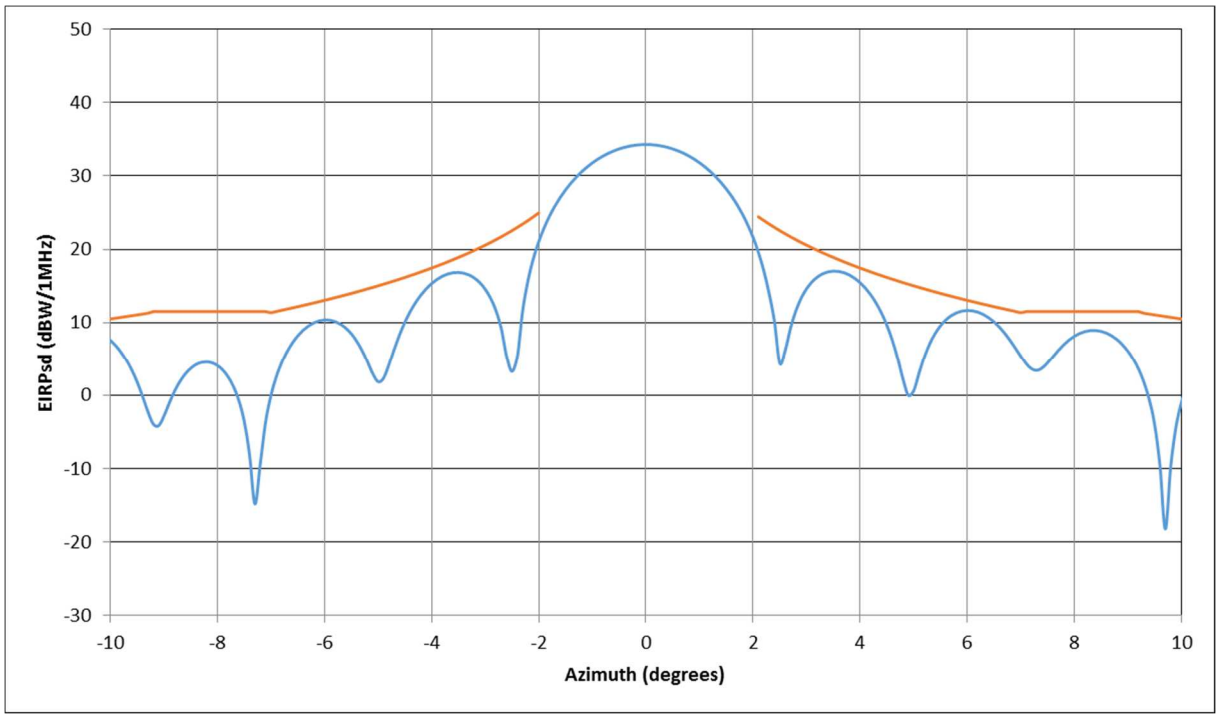
Co-Pol EIRP density in the Plane Tangent to the GSO Arc 30 GHZ



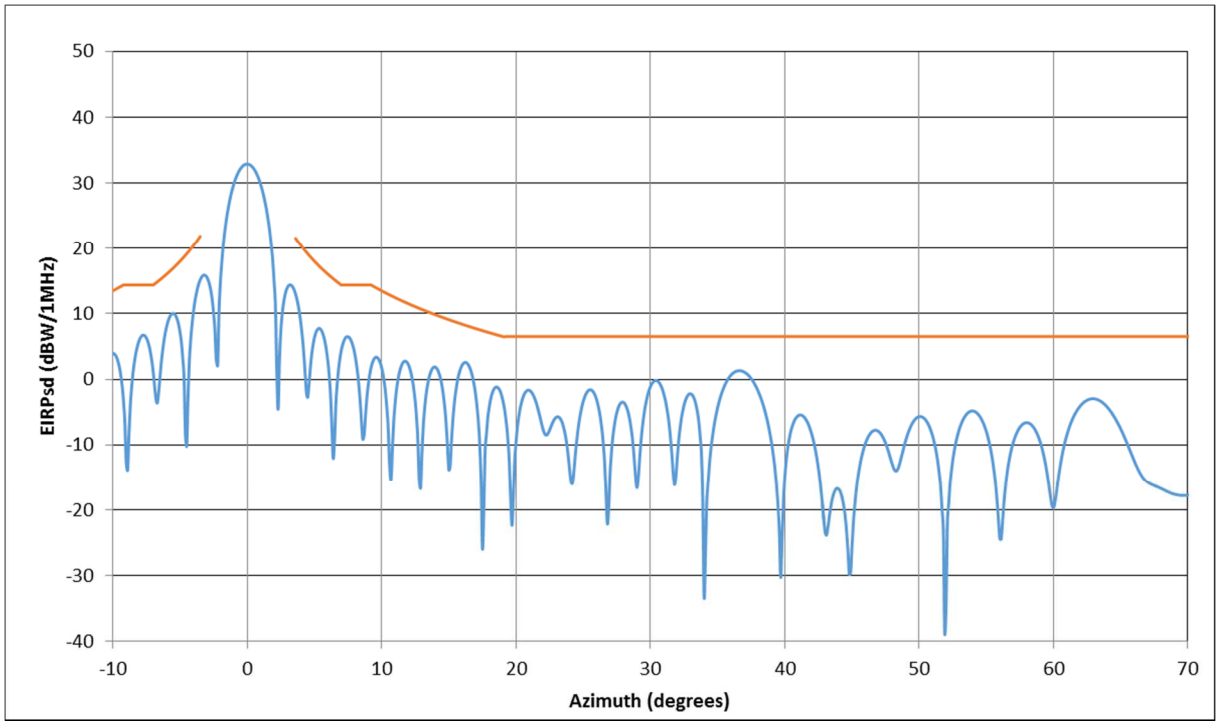
Co-Pol EIRP density in the Plane Tangent to the GSO Arc 29.5 GHz (-10 to +10 degrees)



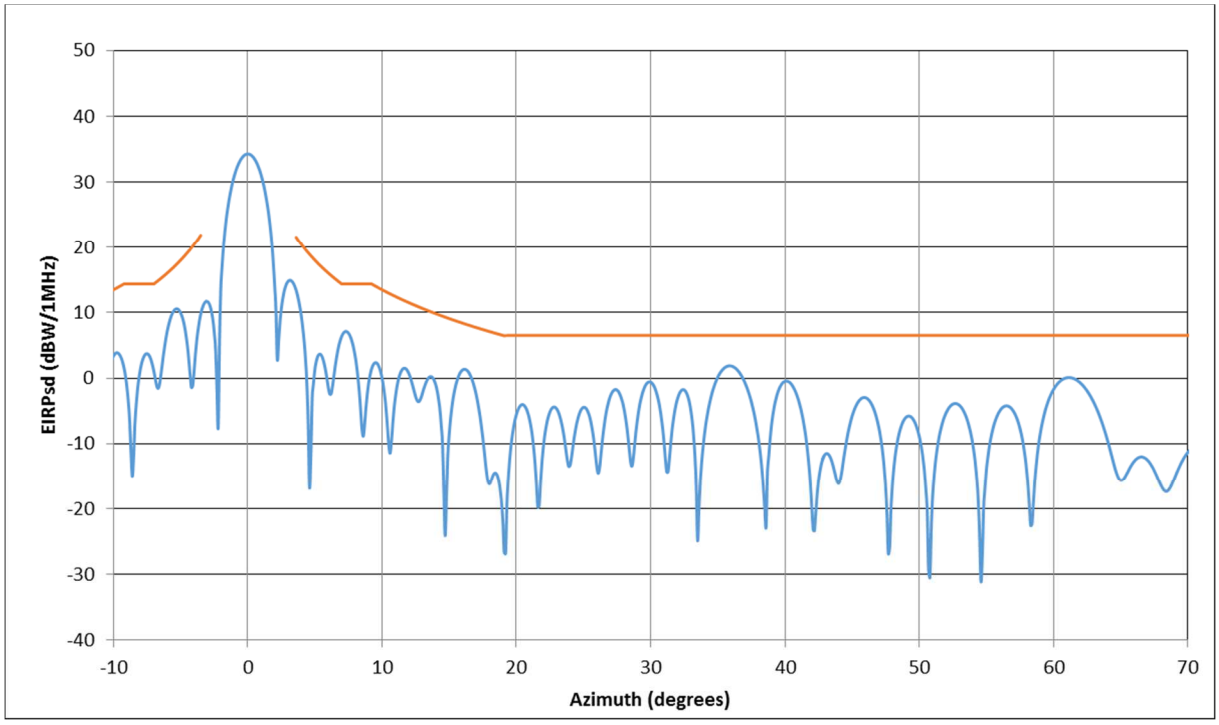
Co-Pol EIRP density in the Plane Tangent to the GSO Arc 30 GHz (-10 to +10 degrees)



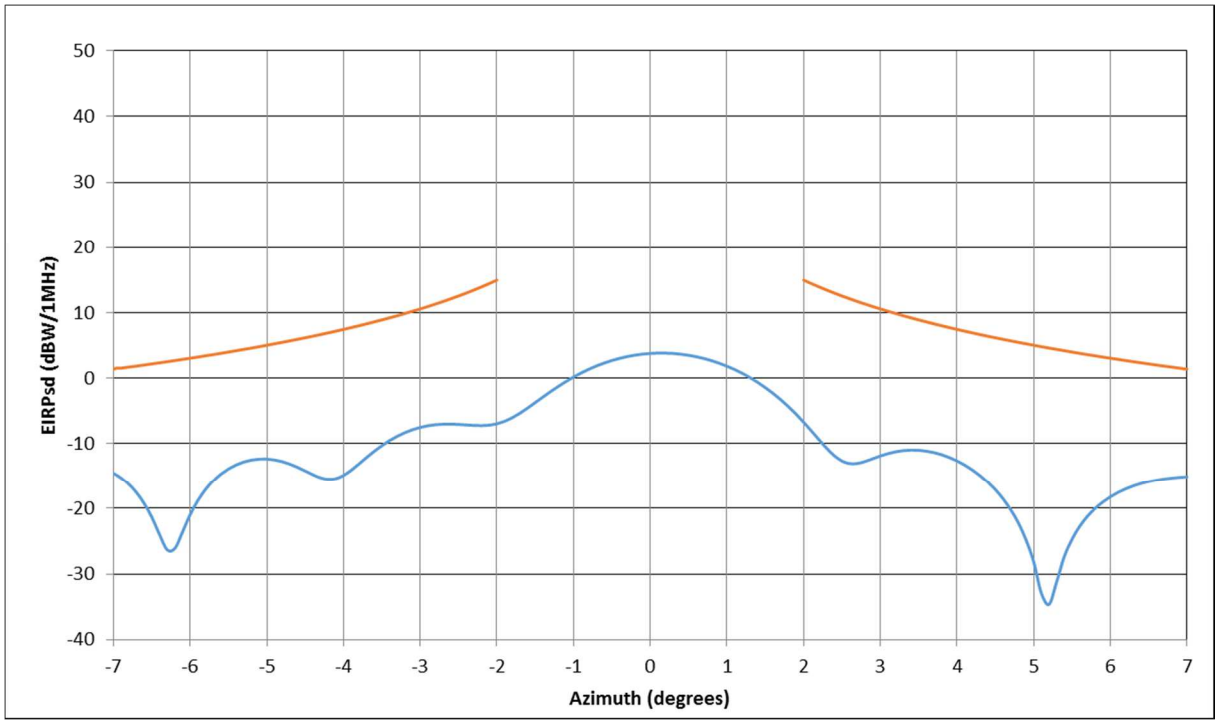
Co-Pol EIRP density in the Perpendicular to the GSO Arc 29.5 GHz (0 to +30 degrees)



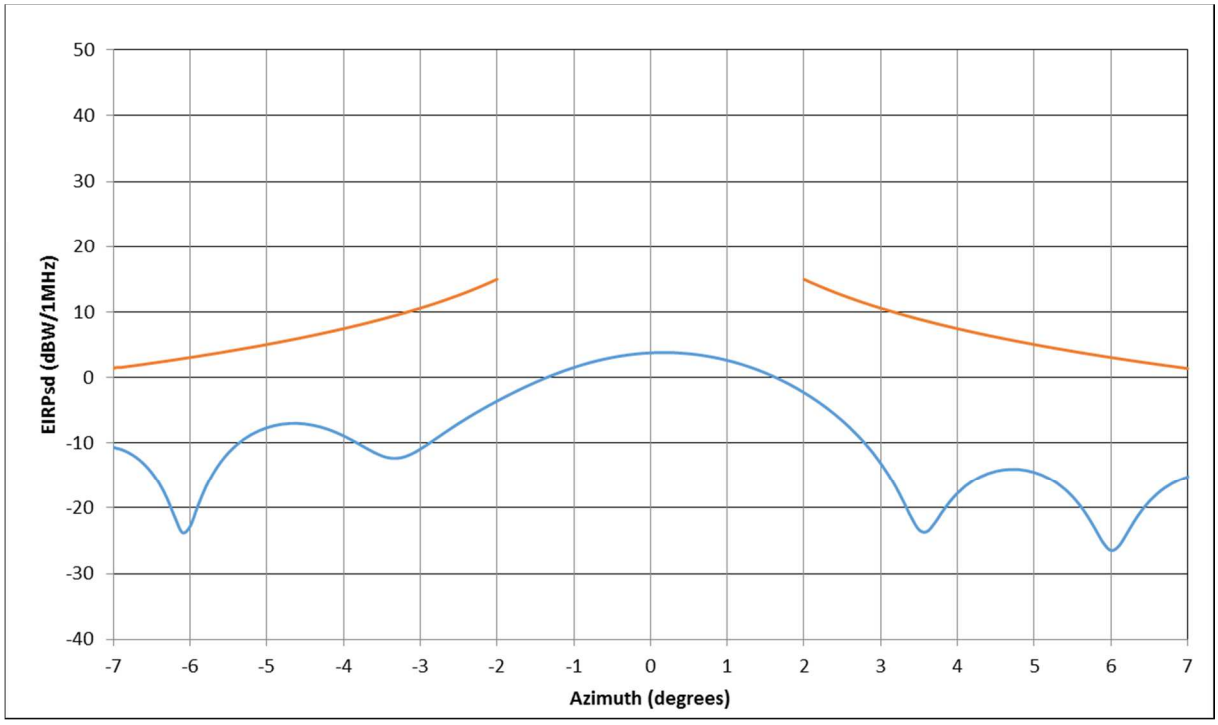
Co-Pol EIRP density in the Perpendicular to the GSO Arc 30.0 GHz (0 to +30 degrees)



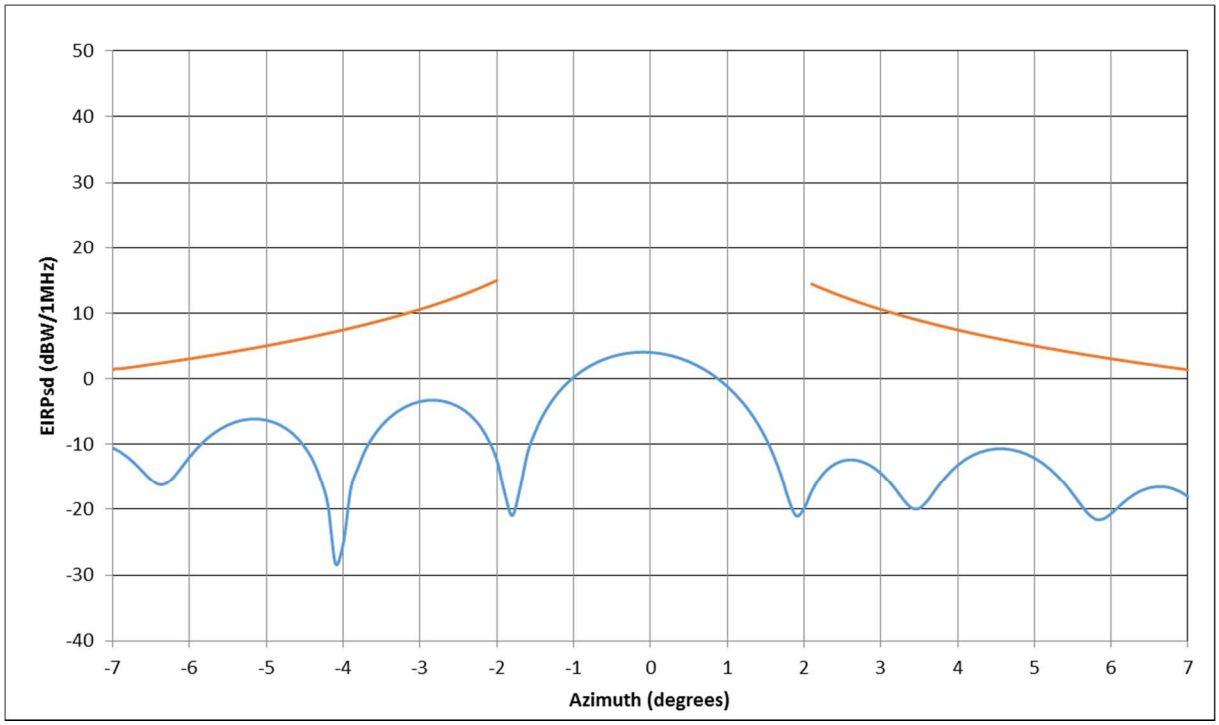
X-Pol EIRP density in the plane tangent to the GSO Arc 29.5 GHZ (-7 to +7 degrees)



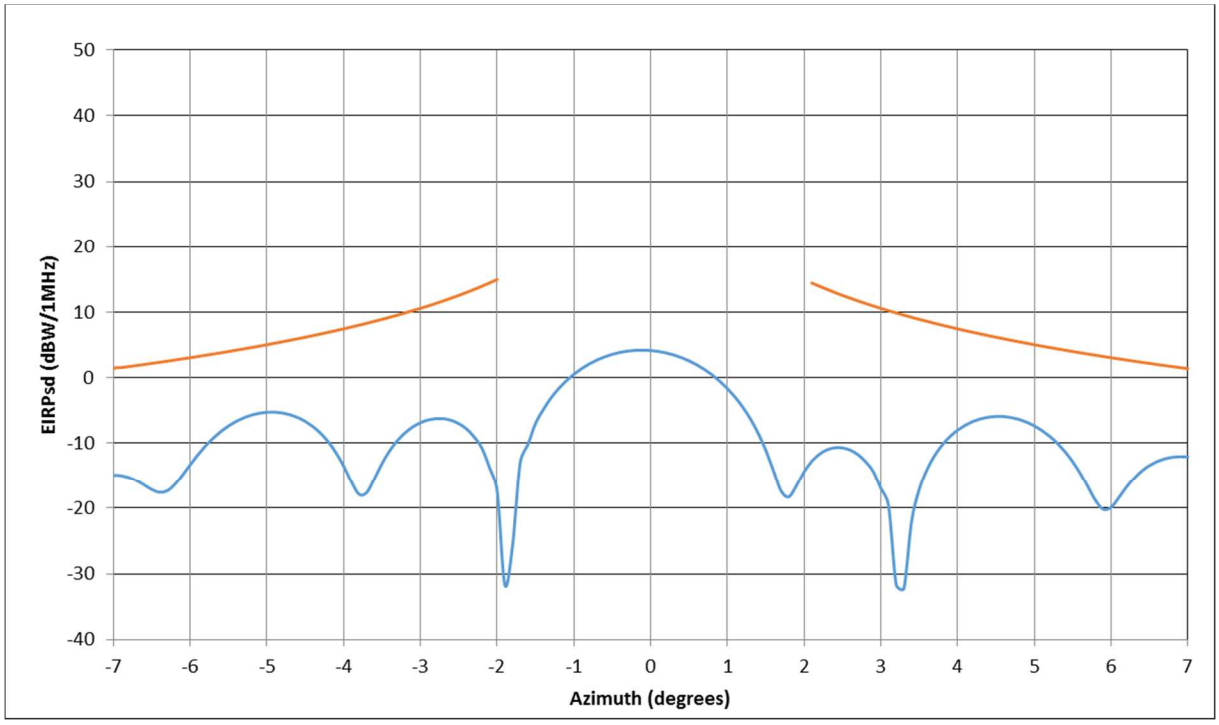
X-Pol EIRP density in the plane tangent to the GSO Arc 30.0 GHz (-7 to +7 degrees)



X-Pol EIRP density in the plane perpendicular to the GSO Arc 29.5 GHZ (-7 to +7 degrees)

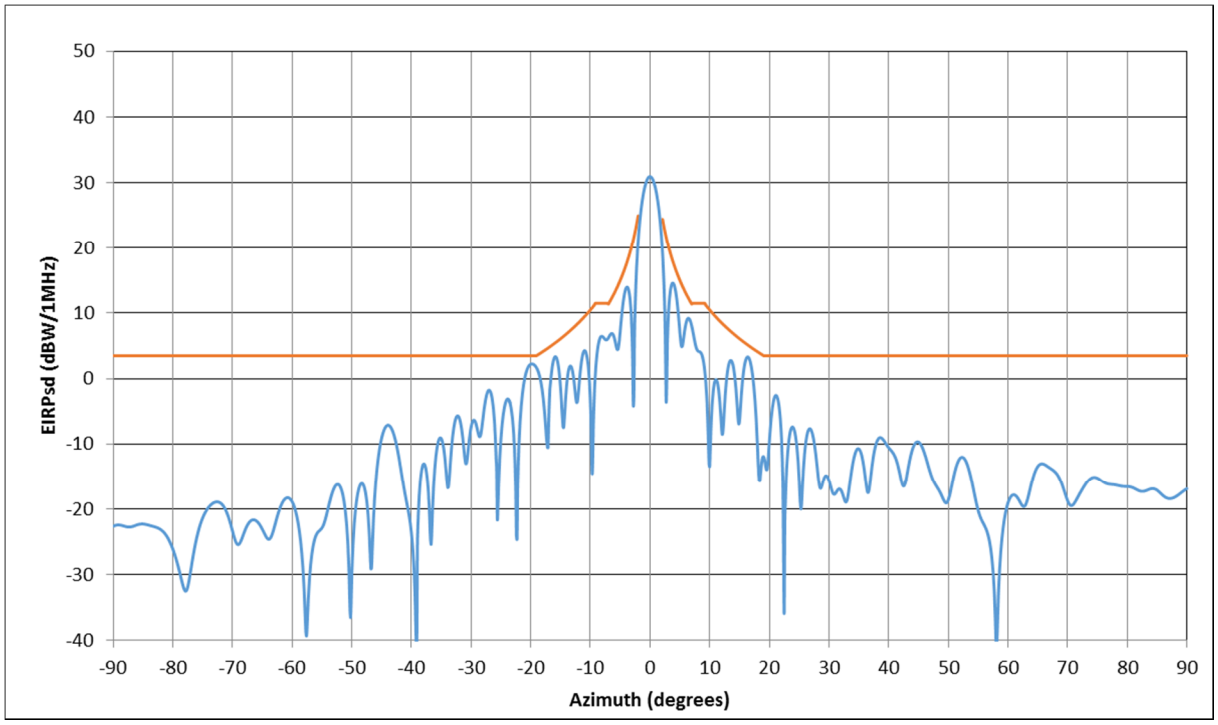


X-Pol EIRP density in the plane perpendicular to the GSO Arc 30.0 GHZ (-7 to +7 degrees)

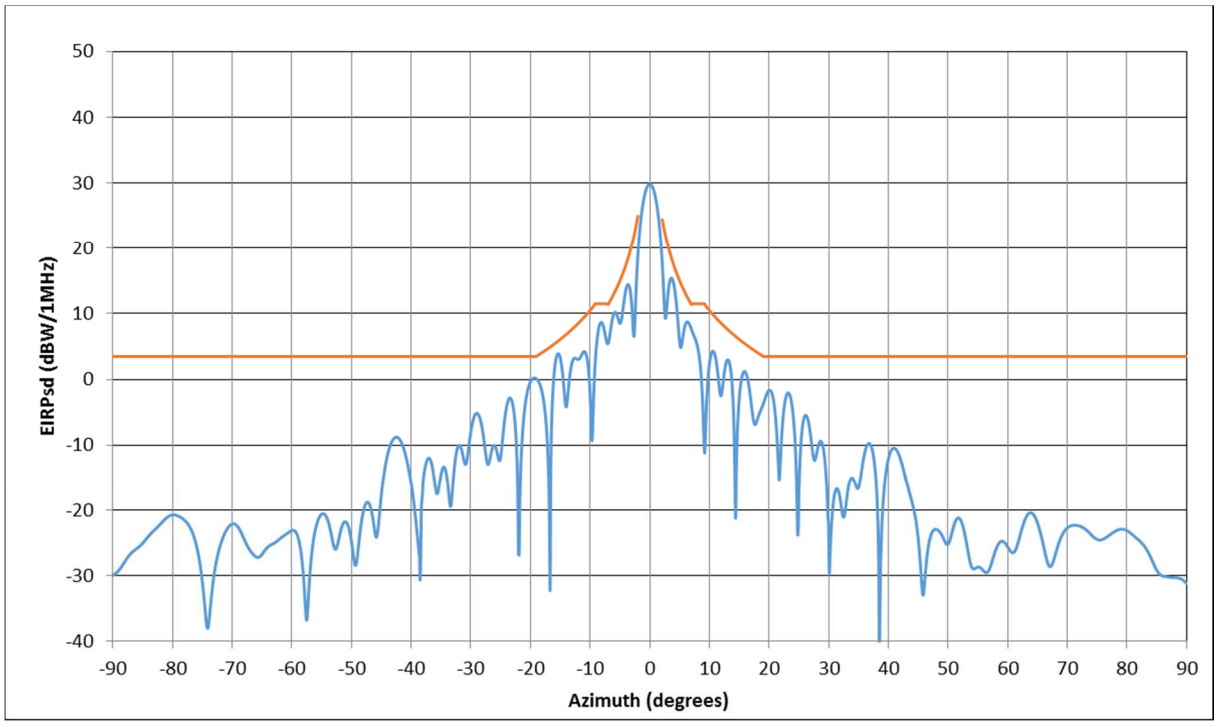


3.0 MicroSat Off-Axis EIRP Masks

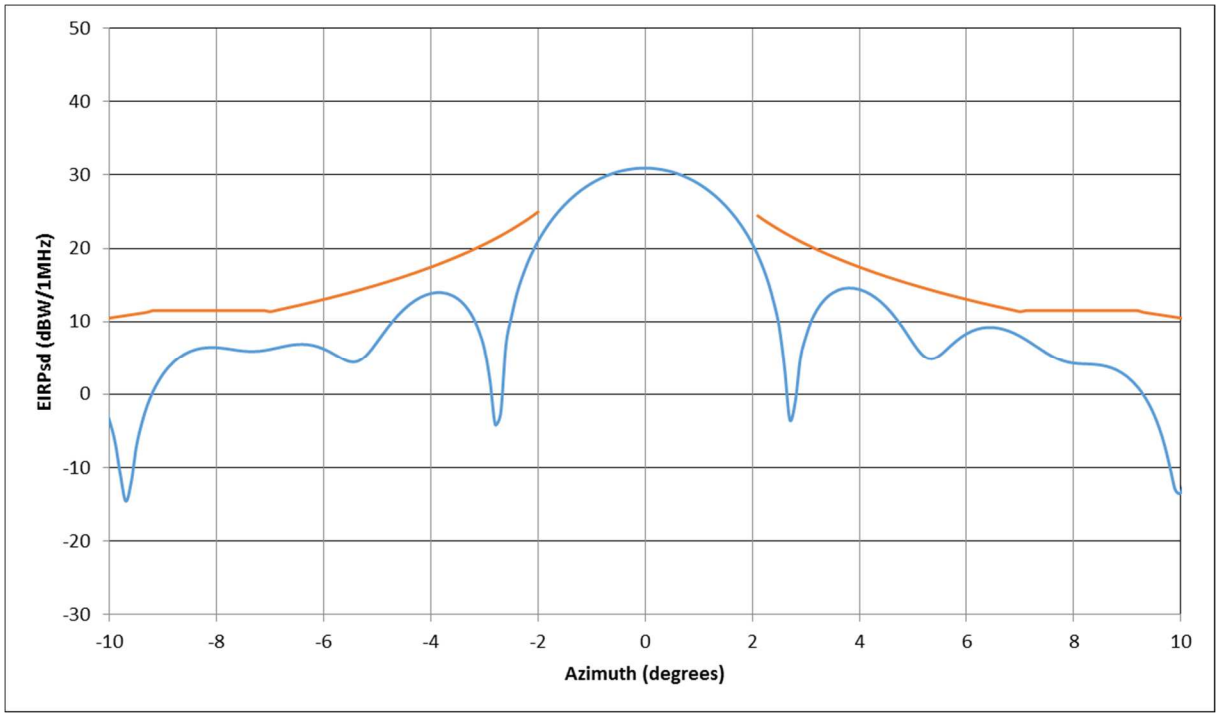
Co-Pol EIRP density in the Plane Tangent to the GSO Arc 29.5 GHz



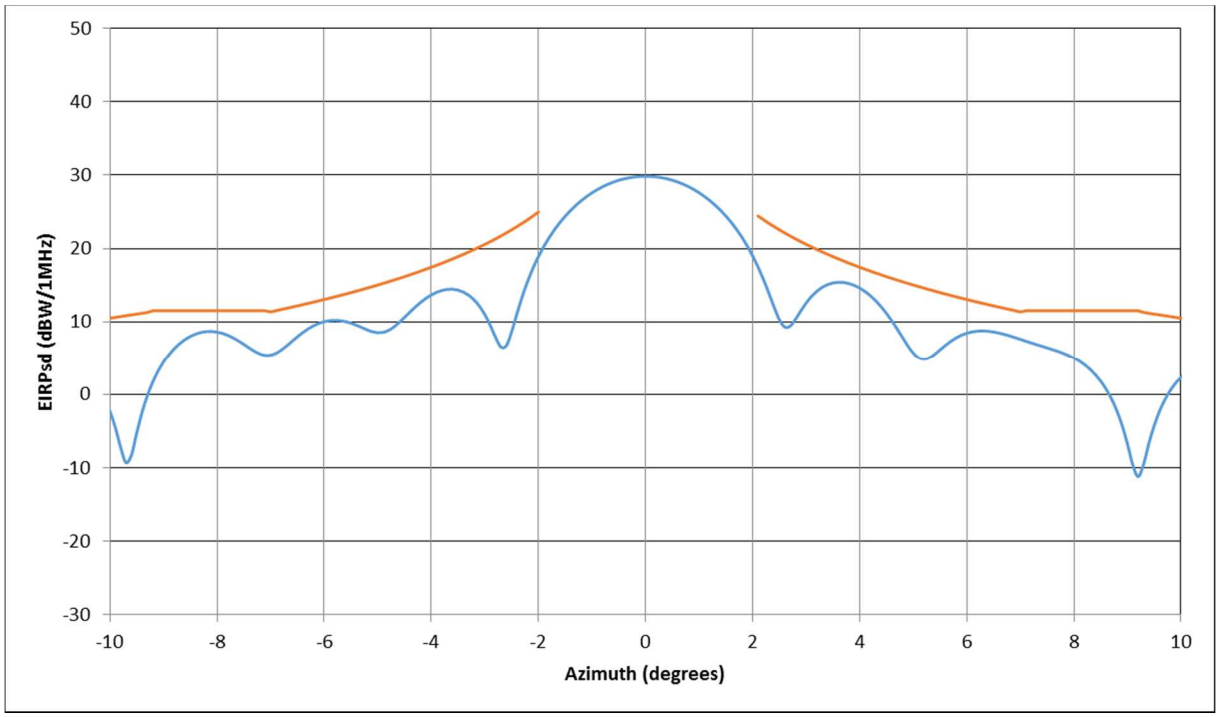
Co-Pol EIRP density in the Plane Tangent to the GSO Arc 30.0 GHz



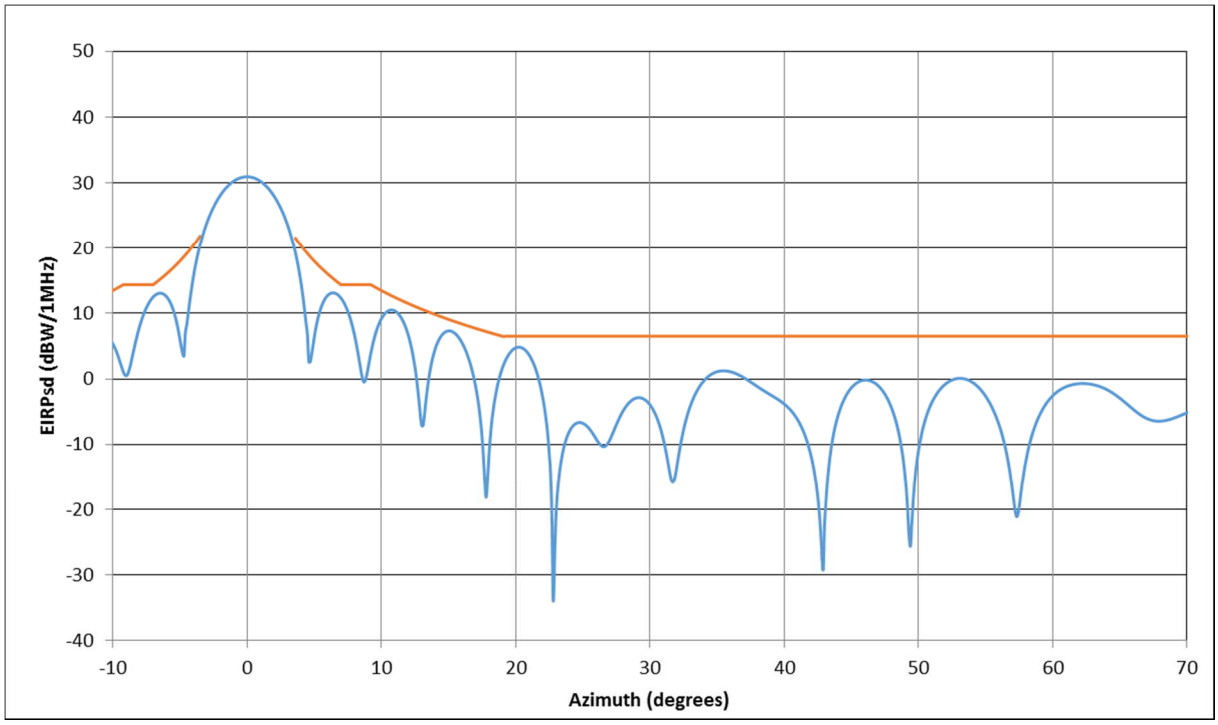
Co-Pol EIRP density in the Plane Tangent to the GSO Arc 29.5 GHz (-10 to +10 degrees)



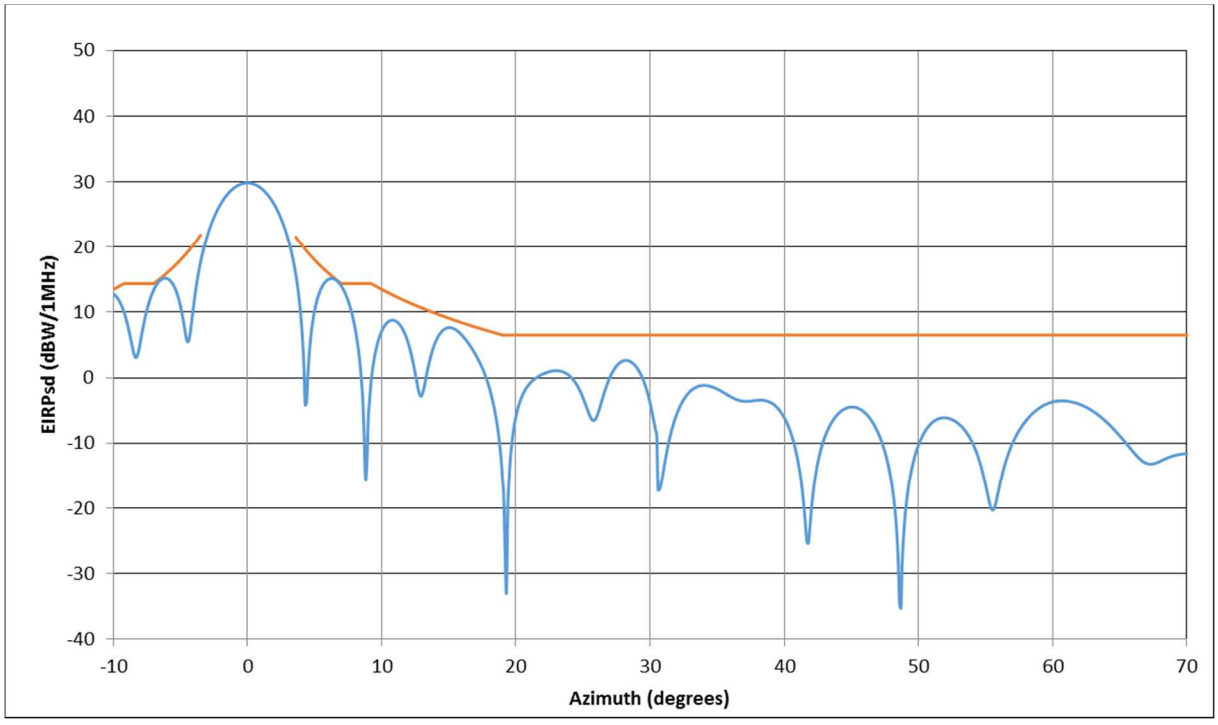
Co-Pol EIRP density in the Plane Tangent to the GSO Arc 30.0 GHz (-10 to +10 degrees)



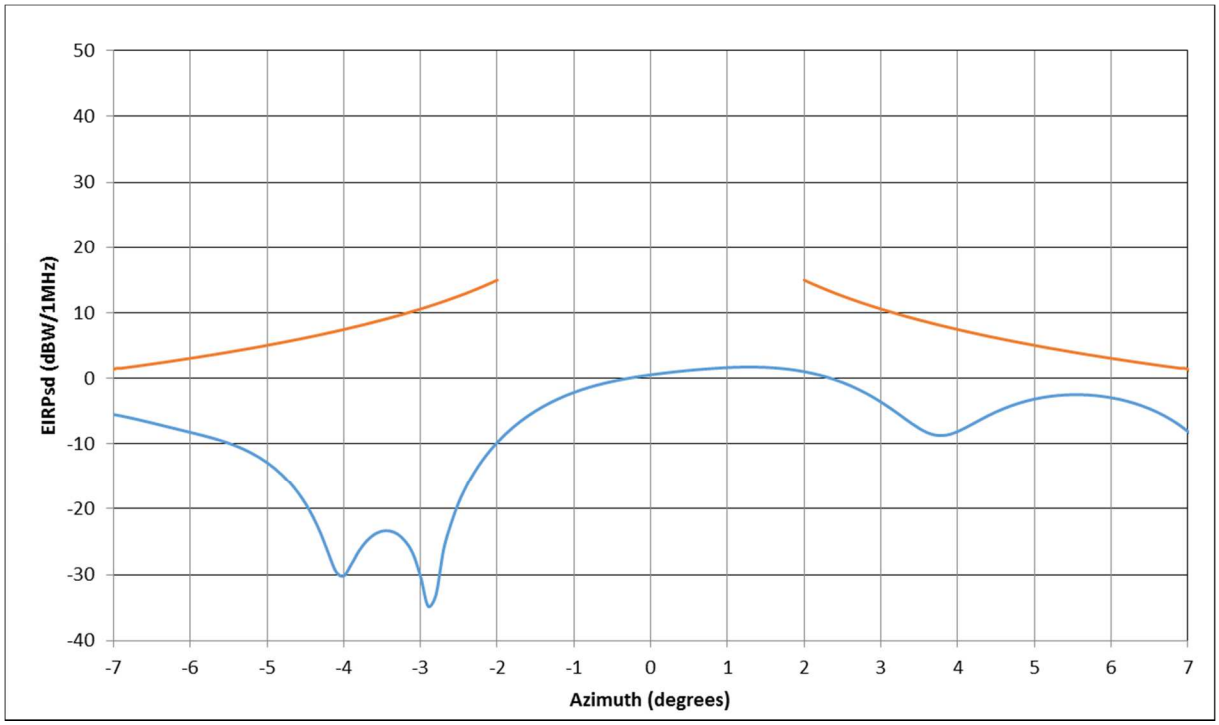
Co-Pol EIRP density in the Perpendicular to the GSO Arc 29.5 GHz (0 to +30 degrees)



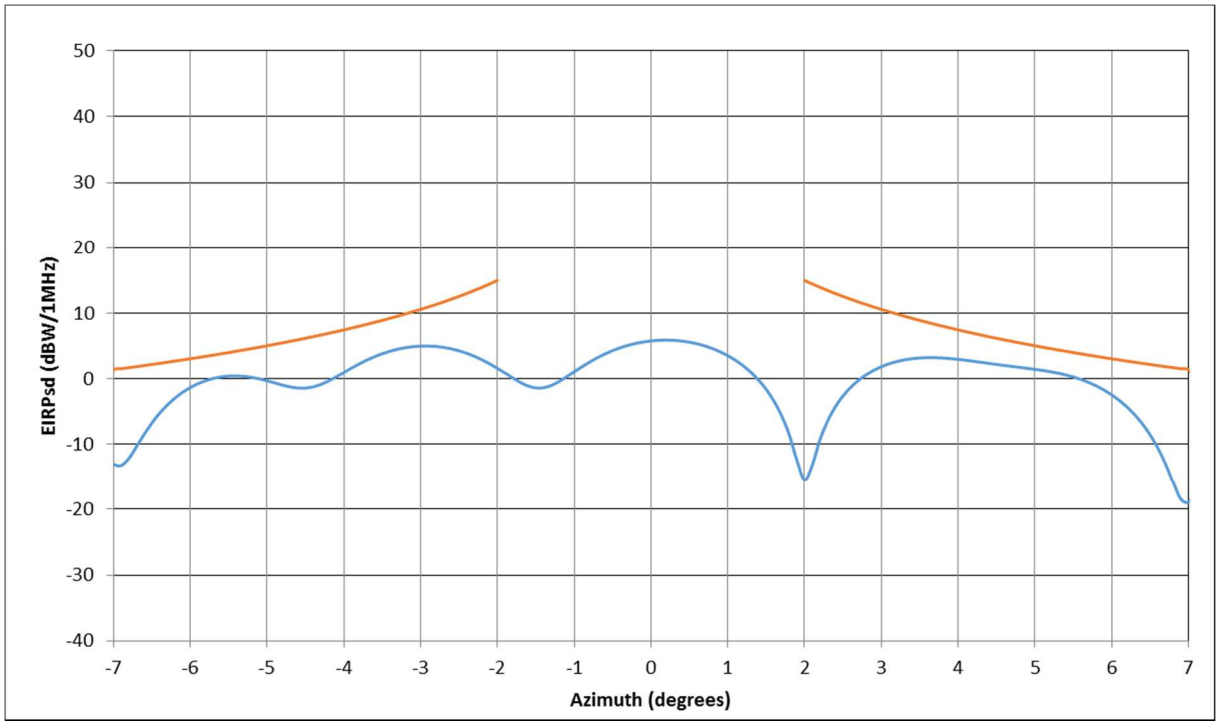
Co-Pol EIRP density in the Perpendicular to the GSO Arc 30.0 GHz (0 to +30 degrees)



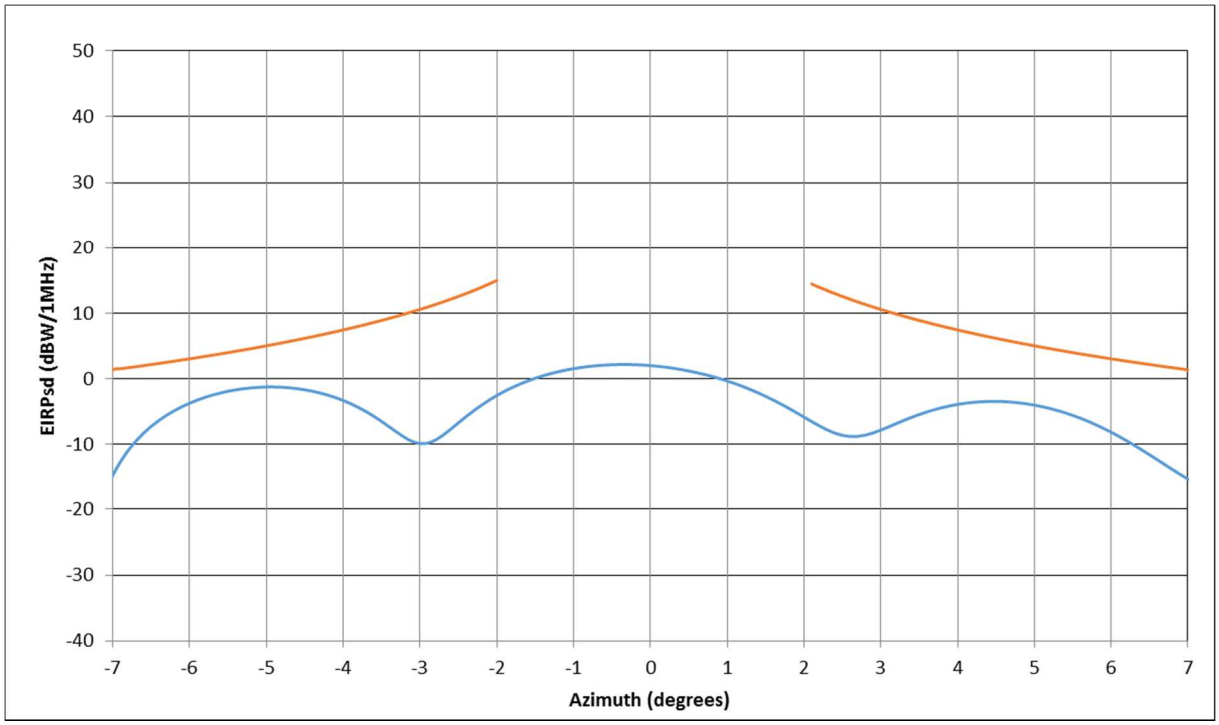
X-Pol EIRP density in the plane tangent to the GSO Arc 29.5 GHZ (-7 to +7 degrees)



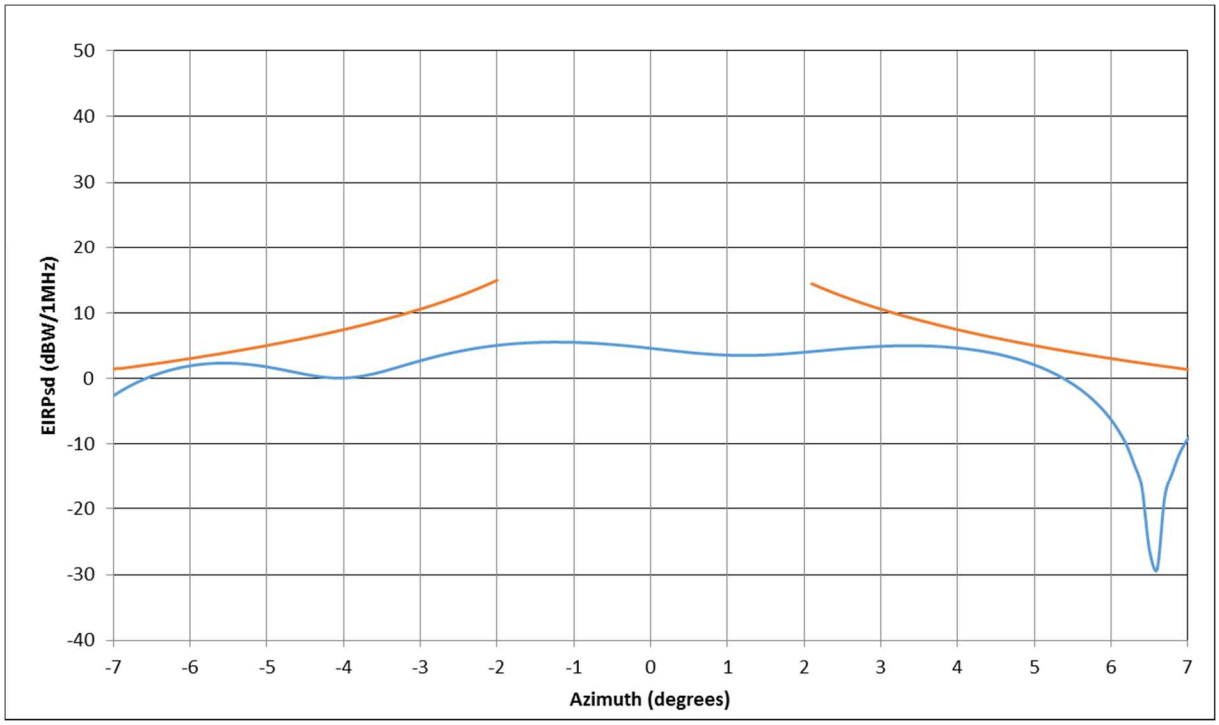
X-Pol EIRP density in the plane tangent to the GSO Arc 30.0 GHz (-7 to +7 degrees)



X-Pol EIRP density in the plane perpendicular to the GSO Arc 29.5 GHZ (-7 to +7 degrees)



X-Pol EIRP density in the plane tangent to the GSO Arc 30.0 GHZ (-7 to +7 degrees)



ISAT US Inc.

FCC Form 312 Exhibit C

Radiation Hazard Analysis

I. Introduction

This Exhibit analyzes the non-ionizing radiation levels for the three GetSat Terminal earth stations included in this application. The analysis and calculations performed in this Exhibit comply with the methods described in the FCC Office of Engineering and Technology Bulletin, No. 65 first published in 1985 and revised in 1997 in Edition 97-01.

Bulletin No. 65 and the FCC R&O 96-326 specify two Maximum Permissible Exposure (MPE) limits that are dependent on the situation in which the exposure takes place and/or the status of the individuals who are subject to the exposure. These are described below:

- General Population/Uncontrolled environment MPE limit is 1 mW/cm2. The General Population /Uncontrolled MPE is a function of transmit frequency and is for an exposure period of thirty minutes or less.
- Occupational/Controlled environment MPE limit is 5 mW/cm2. The Occupational MPE is a function of transmit frequency and is for an exposure period of six minutes or less.

The analysis determined the power flux density levels of the earth station in the 1) far-field, 2) near-field, 3) transition region, 4) region between the feed and main reflector surface, 5) at the main reflector surface, and 6) between the antenna edge and the ground. The analysis also examined the safe distance required to meet both the controlled and uncontrolled exposure limits. The summary of results and discussion is provided in Section 2 and the detailed analyses are provided in Section 3.

II. Summary of Results

The Tables below summarize the results for the proposed GetSat terminals. The analysis of the non-ionizing radiation levels, provided in Section 3, assumed the maximum allowed input power to antenna of 16W and a 100% duty cycle resulting in worst case radiation levels. In a significant number of deployments the terminal duty cycle would be below 100% and the actual power required would be lower than the 16W maximum resulting in lower radiation levels than those calculated. As with any directional antenna the maximum level of non-ionizing radiation is in the main beam of the antenna that is pointed to the satellite. As one moves around the antenna to the side lobes and back lobes the radiation levels decrease significantly. Thus, the maximum radiation level from an antenna occurs in a limited area in the direction the antenna is pointed to. This is especially true in the case of the GetSat terminals, as they utilize small, flat panel antennas that result in tighter beam-forming that concentrates the transmitted power in a smaller area around the main beam, resulting in higher calculated power density in the main beam but a sharp drop off in energy as one moves toward the side lobes.

The GetSat terminals are for commercial and government use and are not intended to be operated by the general public. The terminal is cost prohibitive for purchase by the general public, therefore it will only be operated by trained professional personnel. The antenna installers will be aware of the antenna's radiation environment and use measures best suited to maximize protection to anyone who may come into the proximity of the terminal.

As summarized in the tables below, the MilliSat-W and MilliSat-H antennas meet the FCC's MPE levels for controlled or uncontrolled environments beyond separation distances of about 21 m and 9.5 m, respectively. The MicroSat antenna meets the FCC's MPE levels for contolled or uncontrolled environments beyond separation distances of about 15.2 m and 6.8 m, respectively. Based on these calculations, the MilliSat-W antenna meets the FCC's MPE levels for controlled environments in the far field of the antenna and exceeds the levels in the near field and the transition region, as well as on the main reflector. The Millisat-H and MicroSat antennas exceed the FCC's MPE levels for controlled environments in the near field, far field, and transition region, as well as on the main reflector. Since the antenna of each terminal will be enclosed within a radome, the main reflector and feed flange areas will not be accessible while the antenna is in operation. Training of personnel with access to the terminal would include consideration of the operational modes of the antenna and information on how to prevent radiation exposure, including disabling the communications system. The terminal is not designed to be serviceable in the field. If maintenance of the antenna requiring removal of the radome is necessary, this typically will be done at the manufacturer's facility, by trained technicians who will turn off the transmit power before performing work in these areas.

Additionally, there are various safety features associated with the operation and installation of the terminals that will prevent radiation exposure. The antenna will be installed on vessels, and only at locations not accessible by the general population on the vessels. Given that the antenna will not operate below elevation angles of five degrees, and that the terminal will be pointed upward toward the satellite - persons on the vessel are unlikely to be exposed to the main beam of the antenna. Any areas where the limits for uncontrolled environments could be exceeded will be restricted to trained personnel. Furthermore, the manuals for these terminals will provide warnings regarding potential for radiation hazard, including a label attached to the surface of the terminal warning about the potential for radiation hazard.

The terminals also are designed to cease transmitting if the receive signal from the satellite is blocked, which could be caused by a person standing in front of the terminal or from other blockage. If the receive signal is blocked, the transmitter is shut down nearly instantaneously and will not resume operating until the signal from the satellite is reacquired. In fact there is a double shut down protection in the event that someone or something obstructs the RF path to the satellite. Not only does the terminal automatically turn off its Transmit capability if it loses the satellite Receive signal, i.e. the transmission path is compromised, but the radio frequency amplifier is additionally muted via its monitor and control so that no radio frequency can be transmitted. Especially given the small size of these flat panel antennas and their operational elevation angle, there is a high probability that any person passing close enough to the antenna to be exposed to its main beam would also block the RF path between the terminal and the satellite triggering the automatic shutdown mechanism. As a result of this automatic shutdown mechanism, the maximum continuous time that a person could be exposed to the main beam transmissions at any power level would be significantly less than one second before the antenna would cease transmitting.

Finally, the software interface for the terminals also includes the ability to set up three-dimensional blocking zones that will prevent the terminal from transmitting in certain set directions relative to the terminal's place of installation. This would allow the trained personnel installing and operating the terminal to ensure that the terminal will never transmit when it is pointed at areas where people are likely to be present.

In conclusion, the results of the analysis combined with the design and operational characteristics of the terminals show that the GetSat terminals, in a controlled environment, and under the proper mitigation procedures, meet the guidelines specified in § 1.1310 of the Regulations.

MilliSat-W Terminal

Region	Distance (m)	Calculated Power Density (mW/cm2)	Limit Controlled Environment ≤ 5 mW/cm2	Limit Uncontrolled Environment ≤ 1 mW/cm2
Safe Range for Uncontrolled	≥21.02	1.0	Meets Limit	Meets Limit
Safe Range for Controlled	≥9.40	5.0	Meets Limit	Exceeds Limit
Near Field	6.3	18.91	Exceeds Limit	Exceeds Limit
Far Field	15.0	1.96	Meets Limit	Exceeds Limit
Transition Region	6.3	18.91	Exceeds Limit	Exceeds Limit
Main Reflector	NA	94.81	Exceeds Limit	Exceeds Limit

MilliSat-H Terminal

Region	Distance (m)	Calculated Power Density (mW/cm2)	Limit Controlled Environment ≤ 5 mW/cm2	Limit Uncontrolled Environment ≤ 1 mW/cm2
Safe Range for Uncontrolled	≥21.26	1.0	Meets Limit	Meets Limit
Safe Range for Controlled	≥9.51	5.0	Meets Limit	Exceeds Limit
Near Field	1.8	64.83	Exceeds Limit	Exceeds Limit
Far Field	4.4	23.61	Exceeds Limit	Exceeds Limit
Transition Region	1.8	64.83	Exceeds Limit	Exceeds Limit
Main Reflector	NA	95.58	Exceeds Limit	Exceeds Limit

MicroSat Terminal

Region	Distance (m)	Calculated Power Density (mW/cm2)	Limit Controlled Environment ≤ 5 mW/cm2	Limit Uncontrolled Environment ≤ 1 mW/cm2
Safe Range for Uncontrolled	≥15.23	1.0	Meets Limit	Meets Limit
Safe Range for Controlled	≥6.81	5.0	Meets Limit	Exceeds Limit
Near Field	1.8	64.83	Exceeds Limit	Exceeds Limit

Far Field	4.4	12.11	Exceeds Limit	Exceeds Limit
Transition Region	1.8	64.83	Exceeds Limit	Exceeds Limit
Main Reflector	NA	191.16	Exceeds Limit	Exceeds Limit

III. Detailed Calculations

Millisat-W Terminal

Input Parameter	Value	Units	Symbol	
Antenna Major Axis Dimension	0.5	m	D	
Antenna Transmit Gain @30 GHz	35.4	dBi	G	
Transmit Frequency	30000	MHz	F	
Power Input to the Antenna	16	Watts	P	
Antenna Surface Area	675	cm^2	A	
Antenna Efficiency	0.58	Real	η	
Calculated Parameter	Value	Units	Symbol	Formula
Gain Factor	3467.37	Real	g	10^(G/10)
Wavelength	0.01	m	Λ	300/f
Antenna Field Distances				
Calculated Parameter	Value	Units	Symbol	Formula
Near-Field Distance	6.25	m	Rnf	$D^2/(4\lambda)$
Distance to Far-Field	15.00	m	Rff	$0.6D^2/\lambda$
Distance of Transition Range	6.25	m	Rt	Rt=Rnf
Power Density				
Calculated Parameter	Value	Units	Symbol	Formula
Power Density in the Near Field	18.91	mW/cm^2	Snf	$16\eta P/(\pi D^2)$
Power Density in the Far Field	1.96	mW/cm^2	Sff	$gP/(4\pi Rff^2)$
Power Density in the Transition Region	18.91	mW/cm^2	St	Snf*Rnf/Rt
Power Density at Aperture Surface	94.81	mW/cm^2	Ssurface	4P/A
Distance to 1 mW/cm^2	21.02	m		
Distance to 5 mW/cm^2	9.40	m		

Millisat-H Terminal

Input Parameter	Value	Units	Symbol	
Antenna Major Axis Dimension	0.27	m	D	
Antenna Transmit Gain @30 GHz	35.5	dBi	G	

Input Parameter	Value	Units	Symbol	
Transmit Frequency	30000	MHz	F	
Power Input to the Antenna	16	Watts	P	
Antenna Surface Area	669.6	cm^2	A	
Antenna Efficiency	0.58	Real	η	
Calculated Parameter	Value	Units	Symbol	Formula
Gain Factor	3548.13	Real	g	10^(G/10)
Wavelength	0.01	m	Λ	300/f
Antenna Field Distances				
Calculated Parameter	Value	Units	Symbol	Formula
Near-Field Distance	1.82	m	Rnf	$D^2/(4\lambda)$
Distance to Far-Field	4.37	m	Rff	$0.6D^2/\lambda$
Distance of Transition Range	1.82	m	Rt	Rt=Rnf
Power Density				
Calculated Parameter	Value	Units	Symbol	Formula
Power Density in the Near Field	64.83	mW/cm^2	Snf	$16\eta P/(\pi D^2)$
Power Density in the Far Field	23.61	mW/cm^2	Sff	$gP/(4\pi Rff^2)$
Power Density in the Transition Region	64.83	mW/cm^2	St	Snf*Rnf/Rt
Power Density at Aperture Surface	95.58	mW/cm^2	Ssurface	4P/A
Distance to 1 mW/cm2	21.26	m		
Distance to 5 mW/cm2	9.51	m		

MicroSat

Input Parameter	Value	Units	Symbol	
Antenna Major Axis Dimension	0.27	m	D	
Antenna Transmit Gain @30 GHz	32.6	dBi	G	
Transmit Frequency	30000	MHz	F	
Power Input to the Antenna	16	Watts	P	334.8
Antenna Surface Area	334.8	cm^2	A	0.03348
Antenna Efficiency	0.58	Real	η	
Calculated Parameter	Value	Units	Symbol	Formula
Gain Factor	1819.70	Real	g	10^(G/10)
Wavelength	0.01	m	Λ	300/f
Antenna Field Distances				

Calculated Parameter	Value	Units	Symbol	Formula
Near-Field Distance	1.82	m	Rnf	$D^2/(4\lambda)$
Distance to Far-Field	4.37	m	Rff	$0.6D^2/\lambda$
Distance of Transition Range	1.82	m	Rt	Rt=Rnf
Power Density				
Calculated Parameter	Value	Units	Symbol	Formula
Power Density in the Near Field	64.83	mW/cm^2	Snf	$16\eta P/(\pi D^2)$
Power Density in the Far Field	12.11	mW/cm^2	Sff	$gP/(4\pi Rff^2)$
Power Density in the Transition Region	64.83	mW/cm^2	St	Snf*Rnf/Rt
Power Density at Aperture Surface	191.16	mW/cm^2	Ssurface	4P/A
Distance to 1 mW/cm^2	15.23	m		
Distance to 5 mW/cm^2	6.81	m		