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ATTORNEYS AT LAW

December 8, 2008

BY ELECTRONIC FILING

Marlene H. Dortch
Office of the Secretary
Federal Communications Commission
445 12th Street, S.W.
Washington, D.C. 20554

Re: *DIRECTV Enterprises, LLC, FCC File No. SAT-AMD-20080114-00014*

Dear Ms. Dortch:

This is to inform you that Stacy Fuller, David Pattillo, and undersigned counsel representing DIRECTV Enterprises, LLC ("DIRECTV") met on December 5, 2008 with Robert Nelson, Cassandra Thomas, Fern Jarmulnek, Andrea Kelly, Kathyrn Medley, Chip Fleming, and Rockie Patterson of the Commission's International Bureau to discuss the above referenced 17/24 GHz BSS application. The content of DIRECTV's presentation is set forth in the attached materials, which were provided to the staff at the meeting.

Sincerely yours,

William M. Wiltshire
Counsel for DIRECTV Enterprises, LLC

Attachment

cc: Robert Nelson
Cassandra Thomas
Fern Jarmulnek
Andrea Kelly
Kathyrn Medley
Chip Fleming
Rockie Patterson

DIRECTV Enterprises, LLC ("DIRECTV") is currently seeking authority to launch and operate 17/24 GHz BSS satellite systems at five orbital locations, including the DIRECTV RB-2 satellite at the nominal 103° W.L. location.[1] In each of those applications, DIRECTV has demonstrated that its proposed system will comply with the limitations on power flux-density ("PFD") at the Earth's surface imposed in Section 25.208(w) of the Commission's rules, as adjusted for any offset from the "on-grid" locations established by the Commission. In a recent application for authority to serve the U.S. market from a 17/24 GHz BSS system licensed by the Netherlands at 103.15° W.L.,[2] Spectrum Five LLC ("Spectrum Five") has criticized DIRECTV's methodology for calculating PFD levels. Although Spectrum Five failed to file timely comments in connection with DIRECTV's actual license application to raise this issue, we nonetheless wish to address its arguments to ensure that the Commission is not misled by them.

Spectrum Five asserts that, because Section 25.208(w) specifies that PFD limits are to be calculated under "clear sky" conditions, such a calculation is limited to free space conditions and "without doubt, do[es] not include weather variable effects due to cloud cover and increased humidity levels in the atmosphere."[3] Because DIRECTV included not only free space path losses but also other factors in its PFD calculation, Spectrum Five argues that DIRECTV has resorted to "impermissible reliance on atmospheric losses to bring its proposed PFD within prescribed limits."[4]

While Spectrum Five may have no doubt that the term "clear sky" means the same thing as "free space," it cites no Commission rule or precedent for this proposition. In fact, neither term is specifically defined in the Commission's rules.[5] More importantly, the structure of Section 25.208 itself demonstrates that the two terms must be read to have different meanings.

Section 25.208 establishes PFD limits for satellite systems operating in a number of bands. The rule has 22 subsections, denoted as (a) through (w). Of those 22 subsections, 19 specifically state that the limits relate to the PFD that would be obtained under free space propagation conditions. In other words, subsections (a), (b), (d), (g), (h), (i), (j), (k), (l), (m), (n), (o), (p), (q), (r), (s), (t), (u), and (v) specifically call for the assumption of free space conditions – while subsection (w) is the only subsection that

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1 *See* FCC File No. SAT-AMD-20080114-00014 ("DIRECTV RB-2 Application").

2 *See* FCC File No. SAT-LOI-20081119-00217 ("S5 103W LOI").

3 *Id.* at 9.

4 *Id.* at 8.

5 Arguably, the term "free space" could be understood to be "defined" in Section 25.208(q)(1), which provides that a particular PFD limit is to be determined with reference to "assumed free space conditions (that is, when no allowance is made for propagation impairments such as rain fade)." There is no similar provision related to the term "clear sky."

refers only to "clear sky" conditions.[6] It is well established that "[w]hen Congress uses explicit language in one part of a statute to cover a particular situation and then uses different language in another part of the same statute, a strong inference arises that the two provisions do not mean the same thing."[7] This is especially true where the disparate terms "are only lines away from each other."[8] Applying the same principle of construction here, one can only conclude that the Commission intended that "clear sky" should mean something other than "free space."

Accordingly, the only question is what additional factors are appropriate for inclusion in a clear sky calculation in addition to those inherent in free space conditions. In its applications, DIRECTV used figures from its link budgets to calculate PFD levels. The "clear sky" figures in those link budgets include line items for free space loss, gaseous, cloud, and scintillation.[9] The use of these factors reflects a conservative approach to link budgets, recognizing the critical importance of assessing atmospheric losses in evaluating satellite system performance.[10] Signal absorption in atmospheric gas affects transmissions to the Earth's surface for frequencies above 10 GHz[11] – a phenomenon that occurs under all weather conditions, including "clear sky." Similarly, scintillation is a clear-air phenomenon – and one that even Spectrum Five does not appear to contest.[12] However, upon further consideration, DIRECTV has concluded that one of the three additional factors used in its link budgets – clouds – would not be appropriate for use in a calculation based on "clear sky" conditions.

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6 Two other two subsections ((c) and (e)) are silent on this issue, while a third (subsection (f)) has been reserved.

7 *Persinger v. Islamic Republic of Iran*, 729 F.2d 835, 843 (D.C. Cir. 1984). *See also KP Permanent Make-Up, Inc. v. Lasting Impression I, Inc.,* 543 U.S. 111, 118 (2004) ("'[W]here Congress includes particular language in one section of a statute but omits it in another section of the same Act, it is generally presumed that Congress acts intentionally and purposely in the disparate inclusion or exclusion.'" (citation omitted)).

8 *Board of Trustees v. BES Services, Inc.*, 469 F.3d 369, 372-73 (4th Cir. 2006).

9 DIRECTV RB-2 Application, Narrative, App. A. The link budgets also include a column showing the effects of losses due to rain.

10 The importance of these factors is reflected by the adoption of a series of International Telecommunication Union Recommendations on the subject. *See, e.g.,* Rec. ITU-R P.618-9 ("Propagation data and prediction methods required for the design of Earth-space telecommunication systems") (citing related and supporting ITU-R Recommendations). As highlighted in these ITU-R Recommendations, accounting for propagation impairments (including absorption in atmospheric gases) is particularly important for systems operating at frequencies above 10 GHz, which are more susceptible to such impairments.

11 *See, e.g, id.*, Sec. 2.1 (discussing attenuation due to atmospheric gases).

12 *See, e.g., id.*, Sec. 2.3 (discussing other "clear-air effects," including scintillation); S5 103W LOI at 8-9 (discussing DIRECTV's use of losses for gaseous effects and cloud effects, but not scintillation effects).

Yet, even adjusting the PFD calculation in this manner, DIRECTV RB-2 would still comply with the limitations established in Section 25.208(w). The maximum PFD allowed under that rule is -115 dBW/m^2/MHz. Since DIRECTV proposes to operate at a 0.175° offset from the "on grid" 103.0° W.L. location, it must decrease power by 0.49 dB to account for the decreased discrimination from the nearest adjacent "on grid" location – establishing a new maximum of -115.49 dBW/m^2/MHz. In its application, DIRECTV calculated the maximum PFD on the Earth's surface from DIRECTV RB-2 as: Max EIRP/channel minus spreading loss in direction of max gain minus atmospheric attenuation (at 17.5 GHz) minus bandwidth correction factor, or 63.0 dBW/36MHz – 162.4 (dB-m^2) – 1.1 dB (atmospheric) – 10log(36) = -116.1 dBW/m^2/MHz.[13] Adjusting the atmospheric attenuation to account only for gaseous and scintillation effects (and not clouds) reduces that input from 1.1 dB to 0.74 dB.[14] Using this slightly reduced value in the formula yields a PFD of 63.0 dBW/36MHz – 162.37 (dB-m^2) – 0.74 dB (atmospheric) – 10log(36) = -115.67 dBW/m^2/MHz. This is still 0.18 dB less than the maximum allowable PFD under Section 25.208, and therefore complies with the Commission's rules.[15]

Spectrum Five has not filed any objection or otherwise participated in any of DIRECTV's currently pending 17/24 GHz BSS application proceedings. Nonetheless, as demonstrated by the analysis set forth above, the Commission need not be concerned about the PFD calculation issue Spectrum Five has raised elsewhere, and should grant DIRECTV's applications as amended.

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[13] DIRECTV RB-2 Application, Narrative at 12.

[14] *Id.*, App. A (showing losses from gaseous effects as 0.44 dB and from scintillation as 0.3 dB). Atmospheric losses do not necessarily add linearly. In the absence of rain, such losses can be calculated as gaseous loss plus the square root of cloud loss squared plus scintillation loss squared. When clouds are not considered, however, the calculation reverts to a linear formula (*i.e.,* gaseous loss plus scintillation loss).

[15] Spectrum Five also notes that Section 25.138(a)(6) of the Commission's rules establishes PFD limits for Ka-band satellites for all conditions, including clear sky, and notes that DIRECTV's calculations in two recent Ka-band applications did not include gaseous and scintillation effects. *See* S5 103W LOI at 11-12. However, the fact that DIRECTV could demonstrate compliance with a PFD limitation in one context without reference to these factors does not mean that it should be precluded from including those factors in another context. Moreover, Section 25.138(a)(6) incorporates "the limits specified in Section 25.208(d)," which explicitly calls for "assumed free-space propagation conditions."

with the exception of satellite uplinks carrying broadband video information which are required to incorporate ATIS in accordance with the provisions set forth under § 25.308 of these rules.

[55 FR 21551, May 25, 1990]

§ 25.207 Cessation of emissions.

Space stations shall be made capable of ceasing radio emissions by the use of appropriate devices (battery life, timing devices, ground command, etc.) that will ensure definite cessation of emissions.

§ 25.208 Power flux density limits.

(a) In the band 3650–4200 MHz, the power flux density at the Earth's surface produced by emissions from a space station for all conditions and for all methods of modulation shall not exceed the following values:

−152 dB(W/m²) in any 4 kHz band for angles of arrival between 0 and 5 degrees above the horizontal plane;
−152+(δ−5)/2 dB(W/m²) in any 4 kHz band for angles of arrival δ (in degrees) between 5 and 25 degrees above the horizontal plane; and
−142 dB(W/m²) in any 4 kHz band for angles of arrival between 25 and 90 degrees above the horizontal plane

These limits relate to the power flux density which would be obtained under assumed free-space propagation conditions.

(b) In the bands 10.95–11.2 and 11.45–11.7 GHz for GSO FSS space stations and 10.7–11.7 GHz for NGSO FSS space stations, the power flux-density at the Earth's surface produced by emissions from a space station for all conditions and for all methods of modulation shall not exceed the lower of the following values:

(1) −150 dB(W/m²) in any 4 kHz band for angles of arrival between 0 and 5 degrees above the horizontal plane; −150 + (δ−5)/2 dB(W/m²) in any 4 kHz band for angles of arrival (δ) (in degrees) between 5 and 25 degrees above the horizontal plane; and −140 dB(W/m²) in any 4 kHz band for angles of arrival between 25 and 90 degrees above the horizontal plane; or

(2) −126 dB(W/m²) in any 1 MHz band for angles of arrival between 0 and 5 degrees above the horizontal plane; −126 + (δ−5)/2 dB(W/m²) in any 1 MHz band for angles of arrival (δ) (in degrees) between 5 and 25 degrees above the horizontal plane; and −116 dB(W/m²) in any 1 MHz band for angles of arrival between 25 and 90 degrees above the horizontal plane.

NOTE TO PARAGRAPH (b): These limits relate to the power flux density, which would be obtained under assumed free-space propagation conditions.

(c) In the 17.7–17.8 GHz, 18.3–18.8 GHz, 19.3–19.7 GHz, 22.55–23.00 GHz, 23.00–23.55 GHz, and 24.45–24.75 GHz frequency bands, the power flux density at the Earth's surface produced by emissions from a space station for all conditions for all methods of modulation shall not exceed the following values:

(1) −115 dB (W/m²) in any 1 MHz band for angles of arrival between 0 and 5 degrees above the horizontal plane.

(2) −115 + 0.5 (δ-5) dB (W/m²) in any 1 MHz band for angles of arrival d (in degrees) between 5 and 25 degrees above the horizontal plane.

(3) −105 dB (W/m²) in any 1 MHz band for angles of arrival between 25 and 90 degrees above the horizontal plane.

(d) In addition to the limits specified in paragraph (c) of this section, the power flux-density across the 200 MHz band 18.6–18.8 GHz produced at the Earth's surface by emissions from a space station under assumed free-space propagation conditions shall not exceed −95 dB (W/m²) for all angles of arrival. This limit may be exceeded by up to 3 dB for no more than 5% of the time.

(e) In the 18.8–19.3 GHz frequency band, the power flux-density at the Earth's surface produced by emissions from a space station for all conditions and for all methods of modulation shall not exceed the following values:

$-115-X$ dB(W/m²÷MHz)	for $0° \le \delta < 5°$
$-115-X+((10+X)/20)(\delta-5)$ dB(W/m²÷MHz)	for $5° \le \delta < 25°$
−105 dB(W/m²÷MHz)	for $25° \le \delta < 90°$

Where:

δ: is the angle of arrival above the horizontal plane; and

X is defined as a function of the number of satellites in the non-GSO FSS constellation, n, as follows:

for $n \leq 50$ ..... X = 0 (dB)
for $50 < n \leq 288$ X = (5/119) (n − 50) (dB)
for $n > 288$ ..... X = (1/69) (n + 402) (dB)

(f) [Reserved]

(g) In the frequency bands 10.7–11.7 GHz and 11.7–12.2 GHz, the single-entry equivalent power-flux density in the space-to-Earth direction ($EPFD_{down}$), at any point on the Earth's surface, produced by emissions from all co-frequency space stations of a single non-geostationary-satellite orbit (NGSO) system operating in the fixed-satellite service (FSS) shall not exceed the following limits for the given percentages of time. Tables 1G and 2G follow:

TABLE 1G—SINGLE-ENTRY $EPFD_{down}$ LIMITS FOR PROTECTION OF 0.6, 1.2, 3 AND 10 METER GSO FSS EARTH STATION ANTENNAS [1,2]

Frequency band (GHz) for International Allocations	Single-entry $EPFD_{down}$ dB(W/m²)	Percentage of time during which $EPFD_{down}$ level may not be exceeded	Reference bandwidth (kHz)	Reference antenna diameter and reference radiation pattern [3]
10.7–11.7 in all Regions; 11.7–12.2 in Region 2; 12.2–12.5 in Region 3; and 12.5–12.75 in Regions 1 and 3.	175.4 174 170.8 165.3 160.4 160 160	0 90 99 99.73 99.991 99.997 100 40	.....	60 cm, Recommendation ITU-R S.1428.
10.7–11.7 in all Regions; 11.7–12.2 in Region 2; 12.2–12.5 in Region 3; and 12.5–12.75 in Regions 1 and 3.	181.9 178.4 173.4 173 164 161.6 161.4 160.8 160.5 160 160	0 99.5 99.74 99.857 99.954 99.984 99.991 99.997 99.997 99.9993 100 40	.....	1.2 m, Recommendation ITU-R S.1428.
10.7–11.7 in all Regions; 11.7–12.2 in Region 2; 12.2–12.5 in Region 3; and 12.5–12.75 in Regions 1 and 3.	190.45 189.45 187.45 182.4 182 168 164 162 160 160	0 90 99.5 99.7 99.855 99.971 99.988 99.995 99.999 100 40	.....	3 m, Recommendation ITU-R S.1428.
10.7–11.7 in all Regions; 11.7–12.2 in Region 2; 12.2–12.5 in Region 3; and 12.5–12.75 in Regions 1 and 3.	195.45 195.45 190 190 172.5 160 160	0 99 99.65 99.71 99.99 99.998 100 40	.....	10 m, Recommendation ITU-R S.1428.

[1] In addition to the limits shown in Table 1G, the limits shown in Table 2G shall apply to all antenna sizes greater than 60 cm in the frequency bands listed in Table 1G.

[2] For each reference antenna diameter, the limit consists of the complete curve on a plot which is linear in decibels for the EPFD levels and logarithmic for the time percentages, with straight lines joining the data points.

[3] The earth station antenna reference radiation patterns are to be used only for the calculation of interference from NGSO FSS systems into GSO FSS systems.

TABLE 2G—SINGLE-ENTRY $EPFD_{down}$ LIMITS RADIATED BY NON-GSO FSS SYSTEMS AT CERTAIN LATITUDES

100% of the time $EPFD_{down}$ dB(W/(m²/40 kHz))	Latitude (North or South in degrees)
−160	0 < | Latitude | ≤ 57.5.
−160 + 3.4 (57.5 | Latitude |)/4	57.5 < | Latitude | ≤ 63.75
−165.3	63.75 ≤ | Latitude |

NOTE TO PARAGRAPH (g): These limits relate to the equivalent power flux density, which would be obtained under free-space propagation conditions, for all conditions and for all methods of modulation.

(h) In the frequency bands 10.7–11.7 GHz and 11.7–12.2 GHz, the aggregate equivalent power-flux density in the space-to-Earth direction ($EPFD_{down}$), at any point on the Earth's surface, produced by emissions from all co-frequency space stations of all non-geostationary-satellite orbit systems operating in the fixed-satellite service (FSS) shall not exceed the following limits for the given percentages of time. Tables 1H and 2H follow:

TABLE 1H—AGGREGATE $EPFD_{down}$ LIMITS FOR PROTECTION OF 0.6, 1.2, 3 AND 10 METER GSO FSS EARTH STATION ANTENNAS [1]

Frequency band (GHz) for International Allocations	Aggregate $EPFD_{down}$ dB(W/m²)	Percentage of time during which $EPFD_{down}$ may not be exceeded	Reference bandwidth (kHz)	Reference antenna diameter and reference radiation pattern [2]
10.7–11.7 in all Regions; 11.7–12.2 in Region 2; 12.2–12.5 in Region 3; and 12.5–12.75 in Regions 1 and 3.	170 168.6 165.3 160.4 160 160	0 90 99 99.97 99.99 100 40	.....	60 cm, Recommendation ITU-R S.1428.
10.7–11.7 in all Regions; 11.7–12.2 in Region 2; 12.2–12.5 in Region 3; and 12.5–12.75 in Regions 1 and 3.	176.5 173 164 161.6 164.4 160.8 160.5 160 160	0 99.5 99.84 99.945 99.97 99.99 99.99 99.9975 100 40	.....	1.2 m, Recommendation ITU-R S.1428.
10.7–11.7 in all Regions; 11.7–12.2 in Region 2; 12.2–12.5 in Region 3; and 12.5–12.75 in Regions 1 and 3.	185 184 182 168 164 162 160 160	0 90 99.5 99.9 99.96 99.982 99.997 100 40	.....	3 m, Recommendation ITU-R S.1428.
10.7–11.7 in all Regions; 11.7–12.2 in Region 2; 12.2–12.5 in Region 3; and 12.5–12.75 in Regions 1 and 3.	190 190 166 160 160	0 99 99.99 99.998 100 40	.....	10 m, Recommendation ITU-R S.1428.

[1] In addition to the limits shown in Table 1H, the aggregate $EPFD_{down}$ limits shown in Table 2H shall apply to all antenna sizes greater than 60 cm in the frequency bands listed in Table 1H.

[2] The earth station antenna reference patterns are to be used only for the calculation of interference from NGSO FSS systems into GSO FSS systems.

TABLE 2H—SINGLE-ENTRY $EPFD_{down}$ LIMITS RADIATED BY NON-GSO FSS SYSTEMS AT CERTAIN LATITUDES

100% of the time $EPFD_{down}$ dB(W/(m²/40 kHz))	Latitude (North or South in degrees)
−160	0 < | Latitude | ≤ 57.5
−160 + 3.4 (57.5 | Latitude |)/4	57.5 < | Latitude | ≤ 63.75
−165.3	63.75 ≤ | Latitude |

NOTE TO PARAGRAPH (h): These limits relate to the equivalent power flux density, which would be obtained under free-space propagation conditions, for all conditions and for all methods of modulation.

(i) In the frequency bands 10.7–11.7 GHz and 11.7–12.2 GHz, the additional operational equivalent power-flux density, in the space-to-Earth direction, (additional operational $EPFD_{down}$) at any point on the Earth's surface, produced by actual operational emissions from all co-frequency space stations of a non-geostationary-satellite orbit (NGSO) system operating in the fixed-satellite service (FSS) shall not exceed the following operational limits for the given percentages of time:

ADDITIONAL OPERATIONAL LIMITS ON THE $EPFD_{down}$ RADIATED BY NON-GSO FSS SYSTEMS INTO 3 M AND 10 M GSO FSS EARTH STATION ANTENNAS

$EPFD_{down}$ dB(W/(m²/40 kHz))	Percentage of time during which $EPFD_{down}$ may not be exceeded	Receive GSO earth station antenna diameter (m)
182	99.9.	
179	99.94.	
176	99.97.	
171	99.98.	
168	99.984	3.
165	99.993.	
163	99.999.	
161.25	99.99975.	
161.25	100.	
185	99.97.	
183	99.98.	
179	99.99.	
175	99.996.	
171	99.998	10.
168	99.999.	
166	99.9998.	
166	100.	

NOTE TO PARAGRAPH (i): These limits relate to the equivalent power flux density, which is obtained under free-space propagation conditions, for all conditions and for all methods of modulation.

(j) In the frequency bands 10.7–11.7 GHz and 11.7–12.2 GHz, the operational equivalent power-flux density, in the space-to-Earth direction, (operational $EPFD_{down}$) at any point on the Earth's surface, produced by actual operational emissions from the in-line co-frequency space station of a non-geostationary-satellite orbit (NGSO) system operating in the fixed-satellite service (FSS) shall not exceed the following operational limits for 100% of the time:

OPERATIONAL LIMITS TO THE $EPFD_{down}$ RADIATED BY NON-GSO FSS SYSTEMS IN CERTAIN FREQUENCY BANDS[1]

Frequency band (GHz) for International allocations	$EPFD_{down}$ dB(W/m²)	Percentage of time during which $EPFD_{down}$ may not be exceeded	Reference bandwidth (kHz)	Receive GSO earth station antenna diameter[2] (m)	Orbital inclination of GSO satelite (degrees)
Prior to 31 December 2005: 10.7–11.7 in all Regions; 11.7–12.2 in Regions 2; 12.2–12.5 in Region 3; and 12.5;–12.75 in Regions 1 and 3					
	163	3			
	166	6			
	167.5	9			
	169.5	≥18			
	100	≤2.5			
	40				
Prior to 31 December 2005: 10.7–11.7 in all Regions; 11.7–12.2 in Region 2; 12.2–12.5 in Region 3; and 12.5–12.75 in Regions 1 and 3					
	160	3			
	163	6			
	164.5	9			
	166.5	≥18			
	100	>2.5 and			
	40	≤4.5			
From 31 December 2005: 10.7–11.7 in all Regions; 11.7–12.2 in Region 2; 12.2–12.5 in Region 3; and 12.5–12.75 in Regions 1 and 3					
	161.25	3			
	164	6			
	165.5	9			
	167.5	≥18			
	100	≤2.5			
	40				
From 31 December 2005: 10.7–11.7 in all Regions; 11.7–12.2 in Region 2; 12.2–12.5 in Region 3; and 12.5–12.75 in Regions 1 and 3					
	158.25	3			
	161	6			
	162.5	9			
	164.5	≥18			
	100	>2.5 and			
	40	≤4.5			

[1] The operational limits on the $EPFD_{down}$ radiated by non-GSO FSS systems shall be the values given in Table 2G or this table, whichever are the more stringent.

[2] For antenna diameters between the values given in this table, the limits are given by linear interpolation using a linear scale for $EPFD_{down}$ in decibels and a logarithmic scale for antenna diameter in meters.

NOTE TO PARAGRAPH (j): These limits relate to the operational equivalent power flux-density which would be obtained under free-space propagation conditions, for all conditions, for all methods of modulation and for the specified inclined GSO FSS operations.

(k) In the frequency bands 12.75–13.15 GHz, 13.2125–13.25 GHz and 13.75–14.5 GHz, the equivalent power flux-density, in the Earth-to-space direction, ($EPFD_{up}$) produced at any point on the geostationary satellite orbit (GSO) by the emissions from all co-frequency earth stations in a non-geostationary satellite orbit fixed-satellite service (NGSO FSS) system, for all conditions and for all methods of modulation, shall not exceed the following limits for the specified percentages of time limits:

LIMITS TO THE $EPFD_{up}$ RADIATED BY NGSO FSS SYSTEMS IN CERTAIN FREQUENCY BANDS

Frequency band (GHz) for International Allocations	$EPFD_{up}$ dB(W/m^2)	Percentage of time during which $EPFD_{up}$ may not be exceeded	Reference bandwidth (kHz)	Reference antenna beamwidth and reference radiation pattern [1]
12.5–12.75; 12.75–13.25; 13.75–14.5	160	100	40	4° ITU-R S.672–4, Ls= 20

[1] For the case of L_s = 10, the values a = 1.83 and b = 6.32 should be used in the equations in the Annex of Recommendation ITU-R S.672–4 for single-feed circular beams. In all cases of L_s, the parabolic main beam equation should start at zero.

NOTE TO PARAGRAPH (k): These limits relate to the uplink equivalent power flux density, which would be obtained under free-space propagation conditions, for all conditions and for all methods of modulation.

(l) In the frequency bands 11.7–12.2 GHz and 12.5–12.75 GHz in Region 3, 11.7–12.5 GHz in Region 1 and 12.2–12.7 GHz in Region 2, the single-entry equivalent power-flux density, in the space-to-Earth direction, ($EPFD_{down}$), at any point on the Earth's surface, produced by emissions from all co-frequency space stations of a single non-geostationary-satellite orbit (NGSO) system operating in the fixed-satellite service (FSS) shall not exceed the following limits in Tables 1L and 2L for the given percentages of time:

TABLE 1L—SINGLE-ENTRY EPFD DOWN LIMITS FOR PROTECTION OF 30, 45, 60, 90, 120, 180, 240 AND 300 CM GSO BSS EARTH STATION ANTENNAS [1,2,3,5]

Frequency band (GHz) for international allocations	$EPDF_{down}$ dB(W/m^2)	Percentage of time during which $EPFD_{down}$ level may not be exceeded	Reference bandwidth (kHz)	Reference antenna diameter and reference radiation pattern [4]
11.7–12.5 in Region 1; 1.7–12.2 and 12.5–12.75 in Region 3; 12.2–12.7 in Region 2.	165.841	0	40	30 cm Recommendation ITU-R BO.1443 Annex 1
	165.541	25		
	164.041	96		
	158.6	98.857		
	158.6	99.429		
	158.33	99.429		
	158.33	99.429		
		100		
11.7–12.5 in Region 1; 1.7–12.2 and 12.5–12.75 in Region 3; 12.2–12.7 in Region 2.	175.441	0	40	45 cm Recommendation ITU-R BO.1443 Annex 1
	172.441	66		
	169.441	97.75		
	164	99.357		
	160.75	99.809		
	160	99.986		
	160	100		
11.7–12.5 in Region 1; 1.7–12.2 and 12.5–12.75 in Region 3; 12.2–12.7 in Region 2.	176.441	0	40	60 cm Recommendation ITU-R BO. 1443 Annex 1
	173.191	97.8		
	167.75	99.371		
	162	99.886		
	161	99.943		
	160.2	99.971		
	160	99.997		
	160	100		
11.7–12.5 in Region 1; 1.7–12.2 and 12.5–12.75 in Region 3; 12.2–12.7 in Region 2.	178.94	0	40	90 cm Recommendation ITU-R BO.1443 Annex 1
	178.44	33		
	176.44	98		
	171	99.429		
	165.5	99.714		
	163	99.857		
	161	99.943		
	160	99.991		
	160	100		

TABLE 1L—SINGLE-ENTRY EPFD DOWN LIMITS FOR PROTECTION OF 30, 45, 60, 90, 120, 180, 240 AND 300 CM GSO BSS EARTH STATION ANTENNAS [1,2,3,5]—Continued

Frequency band (GHz) for international allocations	EPDF $_{down}$ dB(W/m^2)	Percentage of time during which EPFD$_{down}$ level may not be exceeded	Reference bandwidth (kHz)	Reference antenna diameter and reference radiation pattern [4]
11.7–12.5 in Region 1; 1.7–12.2 and 12.5–12.75 in Region 3; 12.2–12.7 in Region 2.	182.44 180.69 179.19 178.44 174.94 173.75 173 169.5 167.8 164 161.9 161 160.4 160	0 90 98.9 98.9 99.5 99.68 99.68 99.85 99.915 99.94 99.97 99.99 99.998 100	40	120 cm Recommendation ITU-R BO.1443 Annex 1
11.7–12.5 in Region 1; 1.7–12.2 and 12.5–12.75 in Region 3; 12.2–12.7 in Region 2.	184.941 184.101 181.691 176.25 163.25 161.5 160.35 160 160	0 33 98.5 99.571 99.946 99.974 99.993 99.999 100	40	180 cm [3] Recommendation ITU-R BO.1443 Annex 1
11.7–12.5 in Region 1; 1.7–12.2 and 12.5–12.75 in Region 3; 12.2–12.7 in Region 2.	187.441 186.341 183.441 178 161.4 161.9 160.5 160 160	0 33 99.25 99.786 99.957 99.983 99.994 99.999 100	40	240 cm [2] Recommendation ITU-R BO.1443 Annex 1
11.7–12.5 in Region 1; 1.7–12.2 and 12.5–12.75 in Region 3; 12.2–12.7 in Region 2.	191.941 189.441 185.941 180.5 173 167 162 160 160	0 33 99.5 99.857 99.914 99.951 99.983 99.991 100	40	300 cm Recommendation ITU-R BO.1443 Annex 1

[1] For BSS antenna diameters 180 cm, 240 cm and 300 cm, in addition to the single-entry limits shown in Table 1L, the limits in Table 2L shall also apply in the frequency band listed in Table 1L.

[2] For 240 cm GSO BSS earth station antennas located in Alaska, communicating with GSO BSS satellites at the 91° W.L., 101° W.L., 110° W.L., 119° W.L. and 148° W.L. nominal orbital locations with elevation angles greater than 5°, 167 dB(W/(m^2/40 kHz)) single-entry 100% of the time operational EPFD$_{down}$ limit also applies to receive antennas.

[3] For 180 cm GSO BSS earth station antennas located in Hawaii communicating with GSO BSS satellites that are operational as of December 30, 1999 at the 110° W.L., 119° W.L. and 148° W.L. nominal orbital positions, 162.5 dB(W/(m^2/40 kHz)) single-entry 100% of the time operational EPFD$_{down}$ limit also applies.

[4] Under the section reference pattern of Annex 1 to Recommendation ITU-R BO.1443 shall be used only for the calculation of interference from non-GSO FSS systems into BSS systems.

[5] For each reference antenna diameter, the limit consists of the complete curve on a plot which is linear in decibels for the EPFD levels and logarithmic for the time percentages, with straight line joining the data points.

TABLE 2L—SINGLE-ENTRY EPFD$_{down}$ LIMITS RADIATED BY NON-GSO FSS SYSTEMS AT CERTAIN LATITUDES

100% of the time EPFD$_{down}$ dB(W/(m^2/40 kHz))	Latitude (North or South in degrees)
160.0	0 ≤ | Latitude | ≤ 57.5
160.0 + 3.4 (57.5 | Latitude |)/4	57.5 ≤ | Latitude | ≤ 63.75
165.3	63.75 ≤ | Latitude |

NOTE TO PARAGRAPH (l): These limits relate to the equivalent power flux density, which would be obtained under free-space propagation conditions, for all conditions and for all methods of modulation.

(m) In the frequency bands 11.7–12.2 GHz and 12.5–12.75 GHz in Region 3, 11.7–12.5 GHz in Region 1 and 12.2–12.7 GHz in Region 2, the aggregate equivalent power-flux density, in the space-to-Earth direction, ($EPFD_{down}$) at any point on the Earth's surface, produced by emissions from all co-frequency space stations of all non-geostationary-satellite orbit systems operating in the fixed-satellite service (FSS) shall not exceed the following limits in Tables 1M and 2M for the given percentages of time:

TABLE 1M—AGGREGATE $EPFD_{down}$ LIMITS FOR PROTECTION OF 30, 45, 60, 90, 120, 180, 240 AND 300 CM GSO BSS EARTH STATION ANTENNAS [1,2,3,5]

Frequency band (GHz) for international allocations	$EPFD_{down}$ dB (W/m^2)	Percentage of time during which $EPFD_{down}$ level may not be exceeded	Reference bandwidth (kHz)	Reference antenna diameter, and reference radiation pattern [4]
11.7–12.5 in Region 1; 11.7–12.2 and 12.5–12.75 in Region 3; 12.2–12.7 in Region 2.	160.4 160.1 158.6 158.6 158.33 158.33	0 25 96 98 98 100	40	30 cm Recommendation ITU-R BO.1443 Annex 1.
11.7–12.5 in Region 1; 11.7–12.2 and 12.5–12.75 in Region 3; 12.2–12.7 in Region 2.	170 167 164 160.75 160 160	0 66 97.75 99.33 99.95 100	40	45 cm Recommendation ITU-R BO.1443 Annex 1.
11.7–12.5 in Region 1; 11.7–12.2 and 12.5–12.75 in Region 3; 12.2–12.7 in Region 2.	171 168.75 167.75 162 161 160.2 160 160	0 90 97.8 99.6 99.8 99.9 99.99 100	40	60 cm Recommendation ITU-R BO.1443 Annex 1.
11.7–12.5 in Region 1; 11.7–12.2 and 12.5–12.75 in Region 3; 12.2–12.7 in Region 2.	173.75 173 171 165.5 163 161 160 160	0 33 98 99.1 99.5 99.8 99.97 100	40	90 cm Recommendation ITU-R BO.1443 Annex 1.
11.7–12.5 in Region 1; 11.7–12.2 and 12.5–12.75 in Region 3; 12.2–12.7 in Region 2.	177 175.25 173.75 173 169.5 167.8 164 161.9 161 160.4 160	0 90 98.9 98.9 99.5 99.7 99.82 99.9 99.965 99.993 100	40	120 cm Recommendation ITU-R BO.1443 Annex 1.

TABLE 1M—AGGREGATE $EPFD_{down}$ LIMITS FOR PROTECTION OF 30, 45, 60, 90, 120, 180, 240 AND 300 CM GSO BSS EARTH STATION ANTENNAS [1,2,3,5]—Continued

Frequency band (GHz) for international allocations	$EPFD_{down}$ dB (W/m^2)	Percentage of time during which $EPFD_{down}$ level may not be exceeded	Reference bandwidth (kHz)	Reference antenna diameter, and reference radiation pattern [4]
11.7–12.5 in Region 1; 11.7–12.2 and 12.5–12.75 in Region 3; 12.2–12.7 in Region 2.	179.5 178.66 176.25 163.25 161.5 160.35 160 160	0 33 98.5 99.81 99.91 99.975 99.995 100	40	180 cm Recommendation ITU-R BO.1443 Annex 1.
11.7–12.5 in Region 1; 11.7–12.2 and 12.5–12.75 in Region 3; 12.2–12.7 in Region 2.	182 180.9 178 164.4 161.9 160.5 160 160	0 33 99.25 99.85 99.94 99.98 99.995 100	40	240 cm Recommendation ITU-R BO.1443 Annex 1.
11.7–12.5 in Region 1; 11.7–12.2 and 12.5–12.75 in Region 3; 12.2–12.7 in Region 2.	186.5 184 180.5 173 167 162 160 160	0 33 99.5 99.7 99.83 99.94 99.97 100	40	300 cm Recommendation ITU-R BO.1443 Annex 1.

[1] For BSS antenna diameters 180 cm, 240 cm and 300 cm, in addition to the aggregate limit shown in Table 1M, the limits in Table 2M shall also apply.

[2] For 240 cm GSO BSS earth station antennas located in Alaska, communicating with GSO BSS satellites at the 91° W.L., 101° W.L., 110° W.L., 119° W.L. and 148° W.L. nominal orbital locations with elevation angles greater than 5°, 167 dB(W/(m²/40 kHz)) aggregate 100% of the time operational $EPFD_{down}$ limit also applies to receive antennas.

[3] For 180 cm GSO BSS earth station antennas located in Hawaii communicating with GSO BSS satellites that are operational as of December 30, 1999 at the 110° W.L., 119° W.L. and 148° W.L. nominal orbital positions, 162.5 dB(W/(m²/40 kHz)) aggregate 100% of the time operational $EPFD_{down}$ limit also applies.

[4] Under the section reference pattern of Annex 1 to Recommendation ITU-R BO.1443 shall be used only for the calculation of interference from non-GSO FSS systems into GSO BSS systems.

[5] For each reference antenna diameter, the limit consists of the complete curve on a plot which is linear in decibels for the EPFD levels and logarithmic for the time percentages, with straight line joining the data points.

TABLE 2M—AGGREGATE $EPFD_{down}$ LIMITS RADIATED BY NON-GSO FSS SYSTEMS AT CERTAIN LATITUDES

00% of the time $EPFD_{down}$ dB(W/(m²/40 kHz))	Latitude (North or South in degrees)
160.0	0 ≤ | Latitude | ≤ 57.5.
160.0 + 3.4 (57.5 | Latitude |)/4	57.5 ≤ | Latitude | ≤ 63.75.
165.3	63.75 ≤ | Latitude |.

NOTE TO PARAGRAPH (m): These limits relate to the equivalent power flux density, which would be obtained under free-space propagation conditions, for all conditions and for all methods of modulation.

(n) The power-flux density at the Earth's surface produced by emissions from a space station in the fixed-satellite service (space-to-Earth), for all conditions and for all methods of modulation, shall not exceed the limits given in Table N. These limits relate to the power flux-density which would be obtained under assumed free-space conditions.

TABLE N—LIMITS OF POWER-FLUX DENSITY FROM SPACE STATIONS IN THE BAND 6700–7075 MHz

Frequency band	Limit in dB(W/m2) for angle of arrival (δ) above the horizontal plane			Reference bandwidth
	0°–5°	5°–25°	25°–90°	
6700–6825 MHz	137	137 + 0.5(δ 5)	127	1 MHz
6825–7075 MHz	154	154 + 0.5(δ 5)	144	4 kHz
	and	and	and	
	134	134 + 0.5(δ 5)	124	1 MHz

(o) In the band 12.2–12.7 GHz, for NGSO FSS space stations, the specified low-angle power flux-density at the Earth's surface produced by emissions from a space station shall not be exceeded into an operational MVDDS receiver:

(1) −158 dB(W/m²) in any 4 kHz band for angles of arrival between 0 and 2 degrees above the horizontal plane; and

(2) −158 + 3.33(δ−2) dB(W/m²) in any 4 kHz band for angles of arrival (δ) (in degrees) between 2 and 5 degrees above the horizontal plane.

NOTE TO PARAGRAPH (o): These limits relate to the power flux density, which would be obtained under assumed free-space propagation conditions.

(p) The power flux-density at the Earth's surface produced by emissions from a space station in either the Earth exploration-satellite service in the band 25.5–27 GHz or the inter-satellite service in the band 25.25–27.5 GHz for all conditions and for all methods of modulation shall not exceed the following values:

−115 dB(W/m²) in any 1 MHz band for angles of arrival between 0 and 5 degrees above the horizontal plane;

−115 + 0.5(−5) dB(W/m²) in any 1 MHz band for angles of arrival between 5 and 25 degrees above the horizontal plane;

−105 dB(W/m²) in any 1 MHz band for angles of arrival between 25 and 90 degrees above the horizontal plane.

These limits relate to the power flux-density which would be obtained under assumed free-space propagation conditions.

(q) In the band 37.5–40.0 GHz, the power flux-density at the Earth's surface produced by emissions from a geostationary space station for all methods of modulation shall not exceed the following values.

(1) This limit relates to the power flux-density which would be obtained under assumed free space conditions (that is, when no allowance is made for propogation impairments such as rain-fade):

−139 dB(W/m²) in any 1 MHz band for angles of arrival between 0 and 5 degrees above the horizontal plane;

−139 + 4/3 (δ−5) dB(W/m²) in any 1 MHz band for angles of arrival δ (in degrees) between 5 and 20 degrees above the horizontal plane; and

−119 + 0.4 (δ−20) dB(W/m²) in any 1 MHz band for angles of arrival δ (in degrees) between 20 and 25 degrees above the horizontal plane;

−117 dB(W/m²) in any 1 MHz band for angles of arrival between 25 and 90 degrees above the horizontal plane;

(2) This limit relates to the maximum power flux-density which would be obtained anywhere on the surface of the Earth during periods when FSS system raises power to compensate for rain-fade conditions at the FSS Earth station:

−127 dB(W/m²) in any 1 MHz band for angles of arrival between 0 and 5 degrees above the horizontal plane;

−127 + 4/3 (δ−5) dB(W/m²) in any 1 MHz band for angles of arrival δ (in degrees) between 5 and 20 degrees above the horizontal plane; and

−107 + 0.4 (δ−20) dB(W/m²) in any 1 MHz band for angles of arrival δ (in degrees) between 20 and 25 degrees above the horizontal plane;

−105 dB(W/m²) in any 1 MHz band for angles of arrival between 25 and 90 degrees above the horizontal plane.

NOTE TO PARAGRAPH (q): The conditions under which satellites may exceed the power flux-density limits for normal free space propagation described in paragraph (p)(1) to compensate for the effects of rain fading are under study and have therefore not yet been defined. Such conditions and the extent to which these limits can be exceeded will be

the subject of a further rulemaking by the Commission on the satellite service rules.

(r) In the band 37.5–40.0 GHz, the power flux-density at the Earth's surface produced by emissions from a non-geostationary space station for all methods of modulation shall not exceed the following values:

(1) This limit relates to the power flux-density which would be obtained under assumed free space conditions (that is, when no allowance is made for propogation impairments such as rain-fade):

-132 dB(W/m^2) in any 1 MHz band for angles of arrival between 0 and 5 degrees above the horizontal plane;

$-132 + 0.75\ (\delta - 5)$ dB(W/m^2) in any 1 MHz band for angles of arrival δ (in degrees) between 5 and 25 degrees above the horizontal plane; and

-117 dB(W/m^2) in any 1 MHz band for angles of arrival between 25 and 90 degrees above the horizontal plane;

(2) This limit relates to the maximum power flux-density which would be obtained anywhere on the surface of the Earth during periods when FSS system raises power to compensate for rain-fade conditions at the FSS Earth station:

-120 dB(W/m^2) in any 1 MHz band for angles of arrival between 0 and 5 degrees above the horizontal plane;

$-120 + 0.75\ (\delta - 5)$ dB(W/m^2) in any 1 MHz band for angles of arrival δ (in degrees) between 5 and 25 degrees above the horizontal plane; and

-105 dB(W/m^2) in any 1 MHz band for angles of arrival between 25 and 90 degrees above the horizontal plane.

NOTE TO PARAGRAPH (r): The conditions under which satellites may exceed these power flux-density limits for normal free space propagation described in paragraph (q)(1) to compensate for the effects of rain fading are under study and have therefore not yet been defined. Such conditions and the extent to which these limits can be exceeded will be the subject of a further rulemaking by the Commission on the satellite service rules.

(s) In the band 40.04 0.5 GHz, the power flux-density at the Earth's surface produced by emissions from a space station for all conditions and for all methods of modulation shall not exceed the following values:

-115 dB(W/m^2) in any 1 MHz band for angles of arrival between 0 and 5 degrees above the horizontal plane;

$-115 + 0.5\ (\delta - 5)$ dB(W/m^2) in any 1 MHz band for angles of arrival δ (in degrees) between 5 and 25 degrees above the horizontal plane; and

-105 dB(W/m^2) in any 1 MHz band for angles of arrival between 25 and 90 degrees above the horizontal plane;

NOTE TO PARAGRAPH (s): These limits relate to the power flux-density that would be obtained under assumed free-space propagation conditions.

(t) In the band 40.5–42.0 GHz, the power flux density at the Earth's surface produced by emissions from a non-geostationary space station for all conditions and for all methods of modulation shall not exceed the following values:

-115 dB(W/m^2) in any 1 MHz band for angles of arrival between 0 and 5 degrees above the horizontal plane;

$-115 + 0.5\ (\delta - 5)$ dB(W/m^2) in any 1 MHz band for angles of arrival δ (in degrees) between 5 and 25 degrees above the horizontal plane; and

-105 dB(W/m^2) in any 1 MHz band for angles of arrival between 25 and 90 degrees above the horizontal plane;

NOTE TO PARAGRAPH (t): These limits relate to the power flux density that would be obtained under assumed free-space propagation conditions.

(u) In the band 40.5–42.0 GHz, the power flux-density at the Earth's surface produced by emissions from a geostationary space station for all conditions and for all methods of modulation shall not exceed the following values:

-120 dB(W/m^2) in any 1 MHz band for angles of arrival between 0 and 5 degrees above the horizontal plane;

$-120 + (\delta - 5)$ dB(W/m^2) in any 1 MHz band for angles of arrival δ (in degrees) between 5 and 15 degrees above the horizontal plane;

$-110 + 0.5\ (\delta - 15)$ dB(W/m^2) in any 1 MHz band for angles of arrival δ (in degrees) between 15 and 25 degrees above the horizontal plane; and

-105 dB(W/m^2) in any 1 MHz band for angles of arrival between 25 and 90 degrees above the horizontal plane;

NOTE TO PARAGRAPH (u): These limits relate to the power flux-density that would be

obtained under assumed free-space propagation conditions.

(v) In the band 2496–2500 MHz, the power flux-density at the Earth's surface produced by emissions from non-geostationary space stations for all conditions and all methods of modulation shall not exceed the following values (these values are obtained under assumed free-space propagation conditions):

(1) −144 dB (W/m^2) in 4 kHz for all angles of arrival between 0 and 5 degrees above the horizontal plane; −144 dB (W/m^2) + 0.65(δ −5) in 4 kHz for all angles of arrival between 5 and 25 degrees above the horizontal plane; and

−131 dB (W/m^2) in 4 kHz and for all angles of arrival between 25 and 90 degrees above the horizontal plane.

(2) −126 dB (W/m^2) in 1 MHz for all angles of arrival between 0 and 5 degrees above the horizontal plane; −126 dB (W/m^2) + 0.65(δ −5) in 1 MHz for all angles of arrival between 5 and 25 degrees above the horizontal plane; and

−113 dB (W/m^2) in 1 MHz and for all angles of arrival between 25 and 90 degrees above the horizontal plane.

(w) The power flux density at the Earth's surface produced by emissions from a 17/24 GHz BSS space station operating in the 17.3–17.7 GHz band for all conditions, including clear sky, and for all methods of modulation shall not exceed the regional power flux density levels defined below.

(1) In the region of the contiguous United States, located south of 38° North Latitude and east of 100 West Longitude: −115 dBW/m²/MHz.

(2) In the region of the contiguous United States, located north of 38° North Latitude and east of 100° West Longitude: −118 dBW/m²/MHz.

(3) In the region of the contiguous United States, located west of 100 West Longitude: −121 dBW/m²/MHz.

(4) For all regions outside of the contiguous United States including Alaska and Hawaii: −115 dBW/m²/MHz.

[48 FR 40255, Sept. 6, 1983, as amended at 52 FR 45636, Dec. 1, 1987; 59 FR 53329, Oct. 21, 1994; 65 FR 54171, Sept. 7, 2000; 66 FR 10623, Feb. 16, 2001; 66 FR 63515, Dec. 7, 2001; 67 FR 17299, Apr. 10, 2002; 67 FR 46911, July 17, 2002; 68 FR 16448, Apr. 4, 2003; 68 FR 43946, July 25, 2003; 69 FR 31745, June 7, 2004; 69 FR 52207, Aug. 25, 2004; 70 FR 24725, May 11, 2005; 70 FR 46675, Aug. 10, 2005; 71 FR 35188, June 19, 2006; 72 FR 50029, Aug. 29, 2007]

§ 25.209 Antenna performance standards.

(a) The gain of any antenna to be employed in transmission from an earth station in the geostationary satellite orbit fixed-satellite service (GSO FSS) shall lie below the envelope defined as follows:

(1) In the plane of the geostationary satellite orbit as it appears at the particular earth station location:

$$29\text{-}25 \log_{10} (\text{Theta}) \text{ dBi } 1° \leq \text{Theta} \leq 7°$$

$$+8 \text{ dBi } 7° < \text{Theta} \leq 9.2°$$

$$32\text{-}25 \log_{10} (\text{Theta}) \text{ dBi } 9.2° < \text{Theta} \leq 48°$$

$$-10 \text{ dBi } 48° < \text{Theta} \leq 180°$$

where Theta is the angle in degrees from the axis of the main lobe, and dBi refers to dB relative to an isotropic radiator. For the purposes of this section, the peak gain of an individual sidelobe may not exceed the envelope defined above for Theta between 1.0 and 7.0 degrees. For Theta greater than 7.0 degrees, the envelope may be exceeded by no more than 10% of the sidelobes, provided no individual sidelobe exceeds the gain envelope given above by more than 3 dB.

(2) In all other directions, or in the plane of the horizon including any out-of-plane potential terrestrial interference paths:

Outside the main beam, the gain of the antenna shall lie below the envelope defined by:

$$32\text{-}25 \log_{10} (\text{Theta}) \text{ dBi } 1° \leq \text{Theta} \leq 48°$$

$$-10 \text{ dBi } 48° < \text{Theta} \leq 180°$$

where Theta and dBi are defined above. For the purposes of this section, the envelope may be exceeded by no more than 10% of the sidelobes provided no individual sidelobe exceeds the gain envelope given above by more than 6 dB. The region of the