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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/m<sup>2</sup>) in any 4 kHz band for angles of arrival between 0 and 5 degrees above the horizontal plane;
- 152+( $\delta$ –5)/2 dB(W/m<sup>2</sup>) in any 4 kHz band for angles of arrival  $\delta$  (in degrees) between 5 and 25 degrees above the horizontal plane; and
- 142 dB(W/m<sup>2</sup>) 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/m<sup>2</sup>) in any 4 kHz band for angles of arrival between 0 and 5 degrees above the horizontal plane; –150 + ( $\delta$ –5)/2 dB(W/m<sup>2</sup>) in any 4 kHz band for angles of arrival ( $\delta$ ) (in degrees) between 5 and 25 degrees above the horizontal plane; and –140 dB(W/m<sup>2</sup>) in any

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4 kHz band for angles of arrival between 25 and 90 degrees above the horizontal plane; or

- (2) –126 dB(W/m<sup>2</sup>) in any 1 MHz band for angles of arrival between 0 and 5 degrees above the horizontal plane; –126 + ( $\delta$ –5)/2 dB(W/m<sup>2</sup>) in any 1 MHz band for angles of arrival ( $\delta$ ) (in degrees) between 5 and 25 degrees above the horizontal plane; and –116 dB(W/m<sup>2</sup>) 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 and for all methods of modulation shall not exceed the following values:

- (1) –115 dB (W/m<sup>2</sup>) in any 1 MHz band for angles of arrival between 0 and 5 degrees above the horizontal plane.
- (2) –115 + 0.5 ( $\delta$ –5) dB (W/m<sup>2</sup>) in any 1 MHz band for angles of arrival  $\delta$  (in degrees) between 5 and 25 degrees above the horizontal plane.
- (3) –105 dB (W/m<sup>2</sup>) 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/m<sup>2</sup>) 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/m<sup>2</sup>+MHz) ..... for  $0^\circ \leq \delta < 5^\circ$
- 115 – X + ((10+X)/20)( $\delta$ –5)dB(W/m<sup>2</sup>+MHz) ..... for  $5^\circ \leq \delta < 25^\circ$
- 105 dB(W/m<sup>2</sup>+MHz) ..... for  $25^\circ \leq \delta < 90^\circ$

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Where:

$\delta$ : 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<sub>down</sub>), 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<sub>down</sub> LIMITS FOR PROTECTION OF 0.6, 1.2, 3 AND 10 METER GSO FSS EARTH STATION ANTENNAS<sup>1,2</sup>

Frequency band (GHz) for International Allocations	Single-entry EPFD <sub>down</sub> dB(W/m <sup>2</sup> )	Percentage of time during which EPFD <sub>down</sub> level may not be exceeded	Reference bandwidth (kHz)	Reference antenna diameter and reference radiation pattern <sup>3</sup>
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.

<sup>1</sup> 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.

<sup>2</sup> 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.

<sup>3</sup> 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<sub>down</sub> LIMITS RADIATED BY NON-GSO FSS SYSTEMS AT CERTAIN LATITUDES

100% of the time EPFD <sub>down</sub> dB(W/(m <sup>2</sup> /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<sub>down</sub>), 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<sub>down</sub> LIMITS FOR PROTECTION OF 0.6, 1.2, 3 AND 10 METER GSO FSS EARTH STATION ANTENNAS<sup>1</sup>

Frequency band (GHz) for International Allocations	Aggregate EPFD <sub>down</sub> dB(W/m <sup>2</sup> )	Percentage of time during which EPFD <sub>down</sub> may not be exceeded	Reference bandwidth (kHz)	Reference antenna diameter and reference radiation pattern <sup>2</sup>
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.

<sup>1</sup> In addition to the limits shown in Table 1H, the aggregate EPFD<sub>down</sub> limits shown in Table 2H shall apply to all antenna sizes greater than 60 cm in the frequency bands listed in Table 1H.

<sup>2</sup> 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<sub>down</sub> LIMITS RADIATED BY NON-GSO FSS SYSTEMS AT CERTAIN LATITUDES

100% of the time EPFD <sub>down</sub> dB(W/(m <sup>2</sup> /40 kHz))	Latitude (North or South in degrees)
–160 .....	0 <   Latitude   ≤ 57.5

TABLE 2H—SINGLE-ENTRY EPFD<sub>down</sub> LIMITS RADIATED BY NON-GSO FSS SYSTEMS AT CERTAIN LATITUDES—Continued

100% of the time EPFD <sub>down</sub> dB(W/(m <sup>2</sup> /40 kHz))	Latitude (North or South in degrees)
−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<sub>down</sub>) 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<sub>down</sub> RADIATED BY NON-GSO FSS SYSTEMS INTO 3 M AND 10 M GSO FSS EARTH STATION ANTENNAS

EPFD <sub>down</sub> dB(W/(m <sup>2</sup> /40 kHz))	Percentage of time during which EPFD <sub>down</sub> may not be exceeded	Receive GSO earth station antenna diameter (m)
−182 .....	99.9.	3.
−179 .....	99.94.	
−176 .....	99.97.	
−171 .....	99.98.	
−168 .....	99.984 .....	
−165 .....	99.993.	
−163 .....	99.999.	
−161.25 .....	99.99975.	
−161.25 .....	100.	
−185 .....	99.97.	10.
−183 .....	99.98.	
−179 .....	99.99.	
−175 .....	99.996.	
−171 .....	99.998 .....	
−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<sub>down</sub>) 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<sub>down</sub> RADIATED BY NON-GSO FSS SYSTEMS IN CERTAIN FREQUENCY BANDS<sup>1</sup>

Frequency band (GHz) for International allocations	EPFD <sub>down</sub> dB(W/m <sup>2</sup> )	Percentage of time dur- ing which EPFD <sub>down</sub> may not be exceeded	Reference bandwidth (kHz)	Receive GSO earth station an- tenna di- ameter <sup>2</sup> (m)	Orbital inclination of GSO satellite (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 – 166 – 167.5 – 169.5 100 40	3 6 9 ≥18 ≤2.5			
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 – 163 – 164.5 – 166.5 100 40	3 6 9 ≥18 >2.5 and ≤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 – 164 – 165.5 – 167.5 100 40	3 6 9 ≥18 ≤2.5			
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 .....	– 158.25 – 161 – 162.5 – 164.5 100 40	3 6 9 ≥18 >2.5 and ≤4.5			

<sup>1</sup> The operational limits on the EPFD<sub>down</sub> radiated by non-GSO FSS systems shall be the values given in Table 2G or this table, whichever are the more stringent.

<sup>2</sup> For antenna diameters between the values given in this table, the limits are given by linear interpolation using a linear scale for EPFD<sub>down</sub> 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<sub>up</sub>) 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<sub>up</sub> RADIATED BY NGSO FSS SYSTEMS IN CERTAIN FREQUENCY BANDS

Frequency band (GHz) for International Allocations	EPFD <sub>up</sub> dB(W/m <sup>2</sup> )	Percentage of time dur- ing which EPFD <sub>up</sub> may not be exceeded	Reference bandwidth (kHz)	Reference antenna beam- width and reference radi- ation pattern <sup>1</sup>
12.5–12.75; 12.75–13.25; 13.75–14.5 .....	– 160	100	40	4° ITU-R S.672–4, Ls= – 20

<sup>1</sup> For the case of L<sub>s</sub> = – 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<sub>s</sub>, 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<sub>down</sub>), 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 <sup>1,2,3,5</sup>

Frequency band (GHz) for inter- national allocations	EPDF <sub>down</sub> dB(W/m <sup>2</sup> )	Percentage of time during which EPFD <sub>down</sub> level may not be exceeded	Reference bandwidth (kHz)	Reference antenna diameter and reference radiation pattern <sup>4</sup>
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		
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		
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		
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.	– 160	99.997	40	90 cm Recommendation ITU-R BO.1443 Annex 1
	– 160	100		
	– 178.94	0		
	– 178.44	33		
	– 176.44	98		
	– 171	99.429		
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.	– 165.5	99.714	40	90 cm Recommendation ITU-R BO.1443 Annex 1
	– 163	99.857		
	– 161	99.943		
	– 160	99.991		
	– 160	100		
	– 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 <sup>1,2,3,5</sup>—Continued

Frequency band (GHz) for international allocations	EPFD <sub>down</sub> dB(W/m <sup>2</sup> )	Percentage of time during which EPFD <sub>down</sub> level may not be exceeded	Reference bandwidth (kHz)	Reference antenna diameter and reference radiation pattern <sup>4</sup>
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 <sup>3</sup> 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 <sup>2</sup> 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

<sup>1</sup> 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.

<sup>2</sup> 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<sup>2</sup>/40 kHz)) single-entry 100% of the time operational EPFD<sub>down</sub> limit also applies to receive antennas.

<sup>3</sup> 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<sup>2</sup>/40 kHz)) single-entry 100% of the time operational EPFD<sub>down</sub> limit also applies.

<sup>4</sup> 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.

<sup>5</sup> 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<sub>down</sub> LIMITS RADIATED BY NON-GSO FSS SYSTEMS AT CERTAIN LATITUDES

100% of the time EPFD <sub>down</sub> dB(W/(m <sup>2</sup> /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

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NOTE TO PARAGRAPH (1): 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<sub>down</sub>) 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<sub>down</sub> LIMITS FOR PROTECTION OF 30, 45, 60, 90, 120, 180, 240 AND 300 CM GSO BSS EARTH STATION ANTENNAS<sup>1,2,3,5</sup>

Frequency band (GHz) for international allocations	EPFD <sub>down</sub> dB (W/m <sup>2</sup> )	Percentage of time during which EPFD <sub>down</sub> level may not be exceeded	Reference bandwidth (kHz)	Reference antenna diameter, and reference radiation pattern <sup>4</sup>
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<sub>down</sub> LIMITS FOR PROTECTION OF 30, 45, 60, 90, 120, 180, 240 AND 300 CM GSO BSS EARTH STATION ANTENNAS<sup>1,2,3,5</sup>—Continued

Frequency band (GHz) for international allocations	EPFD <sub>down</sub> dB (W/m <sup>2</sup> )	Percentage of time dur- ing which EPFD <sub>down</sub> level may not be ex- ceeded	Reference bandwidth (kHz)	Reference antenna diame- ter, and reference radiation pattern <sup>4</sup>
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.

<sup>1</sup>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.

<sup>2</sup>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<sup>2</sup>/40 kHz)) aggregate 100% of the time operational EPFD<sub>down</sub> limit also applies to receive antennas.

<sup>3</sup>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<sup>2</sup>/40 kHz)) aggregate 100% of the time operational EPFD<sub>down</sub> limit also applies.

<sup>4</sup>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.

<sup>5</sup>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<sub>down</sub> LIMITS RADIATED BY NON-GSO FSS SYSTEMS AT CERTAIN LATITUDES

00% of the time EPFD <sub>down</sub> dB(W/(m <sup>2</sup> /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-sat-

ellite 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/m <sup>2</sup> ) for angle of arrival ( $\delta$ ) above the horizontal plane			Reference band-width
	0°–5°	5°–25°	25°–90°	
6700–6825 MHz .....	–137 .....	–137 + 0.5( $\delta$ – 5)	–127 .....	1 MHz.
6825–7075 MHz .....	–154 .....	–154 + 0.5( $\delta$ – 5)	–144 .....	4 kHz.
	and	and	and	
	–134 .....	–134 + 0.5( $\delta$ – 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/m<sup>2</sup>) in any 4 kHz band for angles of arrival between 0 and 2 degrees above the horizontal plane; and

(2)  $-158 + 3.33(\delta - 2)$  dB(W/m<sup>2</sup>) in any 4 kHz band for angles of arrival ( $\delta$ ) (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/m<sup>2</sup>) 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<sup>2</sup>) in any 1 MHz band for angles of arrival between 5 and 25 degrees above the horizontal plane;

–105 dB(W/m<sup>2</sup>) 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 propagation impairments such as rain-fade):

–139 dB(W/m<sup>2</sup>) in any 1 MHz band for angles of arrival between 0 and 5 degrees above the horizontal plane;

–139 + 4/3 ( $\delta$  – 5) dB(W/m<sup>2</sup>) in any 1 MHz band for angles of arrival  $\delta$  (in degrees) between 5 and 20 degrees above the horizontal plane; and

–119 + 0.4 ( $\delta$  – 20) dB(W/m<sup>2</sup>) in any 1 MHz band for angles of arrival  $\delta$  (in degrees) between 20 and 25 degrees above the horizontal plane;

–117 dB(W/m<sup>2</sup>) 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/m<sup>2</sup>) in any 1 MHz band for angles of arrival between 0 and 5 degrees above the horizontal plane;

–127 + 4/3 ( $\delta$  – 5) dB(W/m<sup>2</sup>) in any 1 MHz band for angles of arrival  $\delta$  (in degrees) between 5 and 20 degrees above the horizontal plane; and

–107 + 0.4 ( $\delta$  – 20) dB(W/m<sup>2</sup>) in any 1 MHz band for angles of arrival  $\delta$  (in degrees) between 20 and 25 degrees above the horizontal plane;

–105 dB(W/m<sup>2</sup>) 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 propagation impairments such as rain-fade):

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

–132 + 0.75 (δ–5) dB(W/m<sup>2</sup>) 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<sup>2</sup>) 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<sup>2</sup>) in any 1 MHz band for angles of arrival between 0 and 5 degrees above the horizontal plane;

–120 + 0.75 (δ–5) dB(W/m<sup>2</sup>) 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<sup>2</sup>) 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 40.04–40.5 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<sup>2</sup>) in any 1 MHz band for angles of arrival between 0 and 5 degrees above the horizontal plane;

–115 + 0.5 (δ–5) dB(W/m<sup>2</sup>) 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<sup>2</sup>) 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<sup>2</sup>) in any 1 MHz band for angles of arrival between 0 and 5 degrees above the horizontal plane;

–115 + 0.5 (δ–5) dB(W/m<sup>2</sup>) 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<sup>2</sup>) 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<sup>2</sup>) in any 1 MHz band for angles of arrival between 0 and 5 degrees above the horizontal plane;

–120 + (δ–5) dB(W/m<sup>2</sup>) in any 1 MHz band for angles of arrival δ (in degrees) between 5 and 15 degrees above the horizontal plane;

–110 + 0.5 (δ–15) dB(W/m<sup>2</sup>) 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<sup>2</sup>) 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)  $-144 \text{ dB (W/m}^2\text{)}$  in 4 kHz for all angles of arrival between 0 and 5 degrees above the horizontal plane;  $-144 \text{ dB (W/m}^2\text{)} + 0.65(\delta - 5)$  in 4 kHz for all angles of arrival between 5 and 25 degrees above the horizontal plane; and

$-131 \text{ dB (W/m}^2\text{)}$  in 4 kHz and for all angles of arrival between 25 and 90 degrees above the horizontal plane.

(2)  $-126 \text{ dB (W/m}^2\text{)}$  in 1 MHz for all angles of arrival between 0 and 5 degrees above the horizontal plane;  $-126 \text{ dB (W/m}^2\text{)} + 0.65(\delta - 5)$  in 1 MHz for all angles of arrival between 5 and 25 degrees above the horizontal plane; and

$-113 \text{ dB (W/m}^2\text{)}$  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:  $-115 \text{ dBW/m}^2\text{/MHz}$ .

(2) In the region of the contiguous United States, located north of 38° North Latitude and east of 100° West Longitude:  $-118 \text{ dBW/m}^2\text{/MHz}$ .

(3) In the region of the contiguous United States, located west of 100 West Longitude:  $-121 \text{ dBW/m}^2\text{/MHz}$ .

(4) For all regions outside of the contiguous United States including Alaska and Hawaii:  $-115 \text{ dBW/m}^2\text{/MHz}$ .

[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; 73 FR 25496, May 6, 2008]

#### § 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:

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

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

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

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

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:

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

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

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