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conditions must not exceed 1.5 dB or 15 percent of the actual amount of monitored excess attenuation in dB, whichever is larger, with a confidence level of 90 percent except over transient periods accounting for no more than 0.5 percent of the time during which the excess is no more than 4.0 dB.

(f) An earth station in the Fixed-Satellite Service transmitting in the 13.75–14 GHz band must have a minimum antenna diameter of 4.5 m, and the EIRP of any emission in that band should be at least 68 dBW and should not exceed 85 dBW.

(g) [Reserved]

(h) ESV transmissions in the 5925–6425 MHz (Earth-to-space) band shall not exceed an e.i.r.p. spectral density towards the radio-horizon of 17 dBW/MHz, and shall not exceed an e.i.r.p. towards the radio-horizon of 20.8 dBW. The ESV network shall shut-off the ESV transmitter if the e.i.r.p. spectral density towards the radio-horizon or e.i.r.p. towards the radio-horizon are exceeded.

(i) Within 125 km of the TDRSS sites identified in §25.222(d), ESV transmissions in the 14.0–14.2 GHz (Earth-to-space) band shall not exceed an e.i.r.p. spectral density towards the horizon of 12.5 dBW/MHz, and shall not exceed an e.i.r.p. towards the horizon of 16.3 dBW.

(j) Within 125 km of the Tracking and Data Relay System Satellite (TDRSS) sites identified in §25.226(c), VMES transmissions in the 14.0–14.2 GHz (Earth-to-space) band shall not exceed an EIRP spectral density towards the horizon of 12.5 dBW/MHz, and shall not exceed an EIRP towards the horizon of 16.3 dBW.

(k) Within radio line-of-sight of the Tracking and Data Relay System Satellite (TDRSS) sites identified in §25.227(c), ESAA transmissions in the 14.0–14.2 GHz (Earth-to-space) band shall not exceed an EIRP spectral density towards or below the horizon of 12.5 dBW/MHz, and shall not exceed an

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EIRP towards or below the horizon of 16.3 dBW.

[48 FR 40255, Sept. 6, 1983, as amended at 58 FR 13420, Mar. 11, 1993; 61 FR 52307, Oct. 7, 1996; 62 FR 61457, Nov. 18, 1997; 66 FR 10623, Feb. 16, 2001; 70 FR 4784, Jan. 31, 2005; 70 FR 32255, June 2, 2005; 72 FR 50029, Aug. 29, 2007; 74 FR 57098, Nov. 4, 2009; 78 FR 8427, Feb. 6, 2013; 78 FR 14927, Mar. 8, 2013; 79 FR 8322, Feb. 12, 2004; 81 FR 55336, Aug. 18, 2016]

§ 25.205 Minimum antenna elevation angle.

(a) Earth station antennas must not transmit at elevation angles less than five degrees, measured from the horizontal plane to the direction of maximum radiation, in a frequency band shared with terrestrial radio services or in a frequency band with an allocation to space services operating in both the Earth-to-space and space-to-Earth directions. In other bands, earth station antennas must not transmit at elevation angles less than three degrees. In some instances, it may be necessary to specify greater minimum elevation angles because of interference considerations.

(b) ESAAs in aircraft on the ground must not transmit at elevation angles less than three degrees. There is no minimum angle of antenna elevation for ESAAs while airborne.

[81 FR 55336, Aug. 18, 2016]

§ 25.206 Station identification.

The requirement to transmit station identification is waived for all radio stations licensed under this part with the exception of earth stations subject to the requirements of §25.281.

[79 FR 8322, Feb. 12, 2014]

§ 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 be-

tween 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/m ² + MHz) | for 0° ≤ δ < 5° |
| -115 - X + ((10 + X)/20)(δ - 5)dB(W/m ² + MHz) | for 5° ≤ δ < 25° |
| -105 dB(W/m ² ÷ MHz) | for 25° ≤ δ < 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 ≤ 50 X = 0 (dB)
- for 50 < n ≤ 288 X = (5/119) (n - 50) (dB)
- for n > 288 X = (1/69) (n + 402) (dB)

(f) [Reserved]

(g) In the 10.7–11.7 GHz and 11.7–12.2 GHz bands, 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

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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/m ²) | 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/(m ² /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 propaga-

tion conditions, for all conditions and for all methods of modulation.

(h) In the 10.7–11.7 GHz and 11.7–12.2 GHz bands, 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/m ²) | 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/(m ² /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 10.7–11.7 GHz and 11.7–12.2 GHz bands, 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

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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/(m ² /40 kHz)) | Percentage of time during which EPFD _{down} 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. | | 10. |
| -185 | 99.97. | | |
| -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 10.7–11.7 GHz and 11.7–12.2 GHz bands, 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/m ²) | 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 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 | 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 | | | |

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

| Frequency band (GHz) for International allocations | EPFD _{down} dB(W/m ²) | 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 satellite (degrees) |
|--|--|--|---------------------------|---|--|
| 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 | | | |

¹The 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.

²For 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 12.75–13.15 GHz, 13.2125–13.25 GHz and 13.75–14.5 GHz bands, the equivalent power flux-density, in the Earth-to-space direction, (EPFD_{up}) pro-

duced 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, L _s = – 20 |

¹For 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 11.7–12.2 GHz and 12.5–12.75 GHz bands in Region 3, 11.7–12.5 GHz bands in Region 1, and 12.2–12.7 GHz band 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

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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 | | |
| | | 100 | | |
| | | 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 | 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 | | | |
| 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 | 0 | 40 | 120 cm Recommendation ITU-R BO.1443 Annex 1 |
| | -180.69 | 90 | | |
| | -179.19 | 98.9 | | |
| | -178.44 | 98.9 | | |
| | -174.94 | 99.5 | | |
| | -173.75 | 99.68 | | |
| | -173 | 99.68 | | |
| | -169.5 | 99.85 | | |
| | -167.8 | 99.915 | | |
| | -164 | 99.94 | | |
| | -161.9 | 99.97 | | |
| | -161 | 99.99 | | |
| | -160.4 | 99.998 | | |
| | -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. | -184.941 | 0 | 40 | 180 cm ³ Recommendation ITU-R BO.1443 Annex 1 |
| | -184.101 | 33 | | |
| | -181.691 | 98.5 | | |
| | -176.25 | 99.571 | | |
| | -163.25 | 99.946 | | |
| | -161.5 | 99.974 | | |
| | -160.35 | 99.993 | | |
| | -160 | 99.999 | | |
| | -160 | 99.999 | | |
| | -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 | 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; 1.7–12.2 and 12.5–12.75 in Region 3; 12.2–12.7 in Region 2. | –187.441 | 0 | 40 | 240 cm ² Recommendation ITU-R BO.1443 Annex 1 |
| | –186.341 | 33 | | |
| | –183.441 | 99.25 | | |
| | –178 | 99.786 | | |
| | –161.4 | 99.957 | | |
| | –161.9 | 99.983 | | |
| | –160.5 | 99.994 | | |
| | –160 | 99.999 | | |
| 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 | 0 | 40 | 300 cm Recommendation ITU-R BO.1443 Annex 1 |
| | –189.441 | 33 | | |
| | –185.941 | 99.5 | | |
| | –180.5 | 99.857 | | |
| | –173 | 99.914 | | |
| | –167 | 99.951 | | |
| | –162 | 99.983 | | |
| | –160 | 99.991 | | |
| –160 | 100 | | | |

¹For 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.
²For 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)) single-entry 100% of the time operational EPFD_{down} limit also applies to receive antennas.
³For 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)) single-entry 100% of the time operational EPFD_{down} limit also applies.
⁴Under 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.
⁵For 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 (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 11.7–12.2 GHz and 12.5–12.75 GHz bands in Region 3, 11.7–12.5 GHz bands in Region 1, and 12.2–12.7 GHz band 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:

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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. |
| 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. |

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. | –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/(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 (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 ²) 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 and –134 | –154 + 0.5(δ – 5) and –134 + 0.5(δ – 5) | –144 and –124 | 4 kHz. 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.

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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 propagation 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 propagation impairments such as rain-fade):

– 132 dB(W/m²) 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/m²) 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/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:

– 120 dB(W/m²) 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/m²) 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/m²) 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 rule-making by the Commission on the satellite service rules.

(s) In the 40.0–40.5 GHz 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 dB(W/m²) 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/m²) 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/m²) 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/m²) 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/m²) 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/m²) 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/m²) in any 1 MHz band for angles of arrival between 0 and 5 degrees above the horizontal plane;

–120 + ($\delta - 5$) dB(W/m²) 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/m²) 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/m²) 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/m²) in 4 kHz for all angles of arrival between 0 and 5 degrees above the horizontal plane; –144 dB (W/m²) + 0.65($\delta - 5$) in 4 kHz for all angles of arrival between 5 and 25 degrees above the horizontal plane; and

–131 dB (W/m²) in 4 kHz and for all angles of arrival between 25 and 90 degrees above the horizontal plane.

(2) –126 dB (W/m²) in 1 MHz for all angles of arrival between 0 and 5 degrees above the horizontal plane; –126 dB (W/m²) + 0.65($\delta - 5$) in 1 MHz for all angles of arrival between 5 and 25 degrees above the horizontal plane; and

–113 dB (W/m²) 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 and all methods of modulation must not exceed the regional power flux density levels prescribed in

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paragraphs (w)(1) through (4) of this section.

(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.

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

[48 FR 40255, Sept. 6, 1983]

EDITORIAL NOTE: For FEDERAL REGISTER citations affecting § 25.208, see the List of CFR Sections Affected, which appears in the Finding Aids section of the printed volume and at www.fdsys.gov.

§ 25.209 Earth station antenna performance standards.

(a) Except as provided in paragraph (f) of this section, the co-polarization gain of any earth station antenna operating in the FSS and transmitting to a GSO satellite, including earth stations providing feeder links for satellite services other than FSS, may not exceed the following limits:

(1) In the plane tangent to the GSO arc, as defined in § 25.103, for earth stations not operating in the conventional Ku-band, the 24.75–25.25 GHz band, or the 28.35–30 GHz band:

| | | |
|--------------------------------|-----|---------------------|
| 29–25log ₁₀ θ | dBi | for 1.5° ≤ θ ≤ 7°. |
| 8 | dBi | for 7° < θ ≤ 9.2°. |
| 32–25log ₁₀ θ | dBi | for 9.2° < θ ≤ 48°. |
| – 10 | dBi | for 48° < θ ≤ 180°. |

Where θ is the angle in degrees from a line from the earth station antenna to the assigned orbital location of the target satellite, and dBi refers to dB relative to an isotropic radiator. This envelope may be exceeded by up to 3 dB

in 10% of the range of θ angles from ±7–180°, and by up to 6 dB in the region of main reflector spillover energy.

(2) In the plane tangent to the GSO arc, for earth stations operating in the conventional Ku-band:

| | | |
|--------------------------------|-----|-----------------------|
| 29–25log ₁₀ θ | dBi | for 1.5° ≤ θ ≤ 7°. |
| 8 | dBi | for 7° < θ ≤ 9.2°. |
| 32–25log ₁₀ θ | dBi | for 9.2° < θ ≤ 19.1°. |
| 0 | dBi | for 19.1° < θ ≤ 180°. |

Where θ and dBi are as defined in paragraph (a)(1) of this section. This envelope may be exceeded by up to 3 dB in

180°, and by up to 6 dB in the region of main reflector spillover energy.

(3) In the plane tangent to the GSO arc, for earth stations operating in the 24.75–25.25 GHz or 28.35–30 GHz bands:

| | | |
|--------------------------------|-----|-----------------------|
| 29–25log ₁₀ θ | dBi | for 2° ≤ θ ≤ 7°. |
| 8 | dBi | for 7° < θ ≤ 9.2°. |
| 32–25log ₁₀ θ | dBi | for 9.2° < θ ≤ 19.1°. |
| 0 | dBi | for 19.1° < θ ≤ 180°. |

Where θ and dBi are as defined in paragraph (a)(1) of this section. This envelope may be exceeded by up to 3 dB in

10% of the range of θ angles from ±7–180°, and by up to 6 dB in the region of main reflector spillover energy.