

## RESOLUTION 76 (REV.WRC-23)

**Protection of geostationary fixed-satellite service and geostationary broadcasting-satellite service networks from the maximum aggregate equivalent power flux-density produced by multiple non-geostationary fixed-satellite service systems in frequency bands where equivalent power flux-density limits have been adopted**

The World Radiocommunication Conference (Dubai, 2023),

*considering*

- a)* that WRC-97 adopted, in Article 22, provisional equivalent power flux-density (epfd) limits to be met by non-geostationary (non-GSO) fixed-satellite service (FSS) systems in order to protect geostationary-satellite (GSO) FSS and GSO broadcasting-satellite service (BSS) networks in parts of the frequency range 10.7-30 GHz;
- b)* that WRC-2000 revised Article 22 to ensure the limits contained therein provide adequate protection to GSO networks without placing undue constraints on any of the systems and services sharing these frequency bands;
- c)* that WRC-2000 decided that a combination of single-entry validation, single-entry operational and, for certain antenna sizes, single-entry additional operational epfd limits, contained in Article 22, along with the aggregate limits in Tables 1A to 1D as contained in Annex 1 to this Resolution, which apply to non-GSO FSS systems, protects GSO networks in these frequency bands;
- d)* that these single-entry validation limits have been derived from aggregate epfd masks contained in Tables 1A to 1D, assuming a maximum effective number of non-GSO FSS systems of 3.5;
- e)* that the aggregate interference caused by all co-frequency non-GSO FSS systems in these frequency bands into GSO FSS networks should not exceed the aggregate epfd limits in Tables 1A to 1D;
- f)* that to achieve the objective in *considering e)*, administrations of non-GSO FSS systems would need to establish collaboration through consultation meetings;
- g)* that WRC-97 decided, and WRC-2000 confirmed, that non-GSO FSS systems in the frequency bands in question are to mutually coordinate the use of frequencies in these frequency bands under the provisions of No. 9.12;
- h)* that the orbital characteristics of such systems are likely to be inhomogeneous;

i) that, as a result of this likely inhomogeneity, the aggregate epfd levels from multiple non-GSO FSS systems will not be directly related to the actual number of systems sharing a frequency band, and the number of such systems operating co-frequency is likely to be small;

j) that the possible misapplication of single-entry limits should be avoided,

*recognizing*

a) that non-GSO FSS systems are likely to need to implement interference mitigation techniques to mutually share frequencies;

b) that, on account of the use of such interference mitigation techniques, it is likely that the number of non-GSO systems will remain small, as will the aggregate interference caused by non-GSO FSS systems into GSO networks;

c) that, notwithstanding *considering d) and e) and recognizing b)*, there may be instances where the aggregate interference from non-GSO systems could exceed the interference levels given in Tables 1A to 1D;

d) that administrations operating GSO networks may wish to ensure that the aggregate epfd produced by all operating co-frequency non-GSO FSS systems in the frequency bands referred to in *considering a)* above into GSO FSS and/or GSO BSS networks does not exceed the aggregate interference levels given in Tables 1A to 1D,

*noting*

a) that Recommendation ITU-R S.1588 provides methodologies for calculating aggregate downlink epfd produced by multiple non-GSO FSS systems into a GSO FSS network;

b) that, given *considering j)*, some non-GSO FSS systems use multiple filings, which may be submitted by more than one administration,

*resolves*

1 that administrations operating or planning to operate non-GSO FSS systems, for which coordination or notification information, as appropriate, was received after 21 November 1997, in the frequency bands referred to in *considering a)* above, individually or in collaboration, shall take all possible steps, including, if necessary, by means of appropriate modifications to their systems, to ensure that the aggregate interference into GSO FSS and GSO BSS networks caused by such systems operating co-frequency in these frequency bands does not cause the aggregate power levels given in Tables 1A to 1D to be exceeded (see No. **22.5K**);

2 that, in the event that the aggregate interference levels in Tables 1A to 1D are exceeded, administrations operating non-GSO FSS systems in these frequency bands shall take all necessary measures expeditiously to reduce the aggregate epfd levels to the limits given in Tables 1A to 1D, or to higher levels where those levels are acceptable to the affected GSO administration (see No. **22.5K**);

3 that, in order to fulfil the requirements in *resolves* 1, administrations operating or planning to operate non-GSO FSS systems shall, on a regular basis (e.g. yearly), hold a consultation meeting to determine the level of aggregate interference caused to GSO FSS or GSO BSS networks from non-GSO FSS systems and determine the necessary measures to ensure compliance with the required level for protecting GSO FSS and GSO BSS networks;

4 that administrations engaged in consultation meetings, when developing agreements to carry out their obligations under *resolves* 1 and 2 above, shall establish mechanisms to ensure that all administrations are given full visibility of the process and its outcome and the aggregate interference allowance into GSO FSS or GSO BSS networks is shared fairly among non-GSO FSS systems;

5 that those administrations participating in the consultation meeting shall designate one administration that shall communicate to the Radiocommunication Bureau the results of any technical or operational amendment to the relevant non-GSO FSS systems following the application of *resolves* 2 above;

6 that consultation meetings to achieve the objective of *resolves* 1 and 2 shall be held after the ITU Radiocommunication Sector (ITU-R) adopts the Recommendation specified in *invites the ITU Radiocommunication Sector* 1 below, with the exception of meetings for the purpose of organizing the functioning of the consultation meetings and establishing preliminary terms of reference;

7 that administrations, when evaluating the aggregate interference into GSO FSS or GSO BSS networks under *resolves* 1, shall take into account the submission of appropriate notification information under No. **11.2** for non-GSO FSS systems and the submission of the information referred to in Resolution **35 (Rev.WRC-23)** for non-GSO FSS systems, along with the relevant information provided to the consultation meetings referred to in *considering f)*;

8 that the aggregate epfd calculations performed within the scope of the consultation meeting referred to in *resolves* 3 shall involve two assessments, one considering only the operational space stations of non-GSO FSS systems and another for information only, if needed, considering also non-GSO FSS space stations planned to be deployed before the next consultation meeting;

9 that any amendment to the relevant non-GSO FSS systems mentioned in *resolves* 7 above shall not affect the regulatory status of the affected non-GSO FSS systems, including following any modifications to their published characteristics,

*invites the ITU Radiocommunication Sector*

1 to continue its studies on the subject and develop, as a matter of urgency and preferably before 30 July 2027, and taking into account existing and relevant ITU-R Recommendations, a Recommendation on a suitable methodology for calculating the aggregate co-frequency epfd produced by non-GSO FSS systems and accurately modelling non-GSO FSS operations in the frequency bands referred to in *considering a)* above into GSO FSS and GSO BSS networks, which may be used to determine whether the systems are in compliance with the aggregate power levels given in Tables 1A to 1D, taking into account relevant elements of Recommendations ITU-R S.1588 and ITU-R S.1503, as appropriate;

2 to develop, as a matter of urgency and preferably before 30 July 2027, a Recommendation on a suitable methodology to adapt the operation of co-frequency non-GSO FSS systems in the frequency bands referred to in *considering a)* above to ensure that the aggregate power levels given in Tables 1A to 1D are met;

3 to continue to verify, as a matter of urgency, the effectiveness of the provisions defined in this Resolution and, if needed, to study and analyse possible amendments to those provisions,

*instructs the Director of the Radiocommunication Bureau*

1 to participate in the consultation meetings mentioned in *resolves* 3 to 9 and to observe carefully the results of the epfd calculation mentioned in *resolves* 3;

2 to publish in the Radiocommunication Bureau International Frequency Information Circular the information referred to in *resolves* 5 and *instructs the Director of the Radiocommunication Bureau* 1;

3 to report to WRC-27, and to subsequent world radiocommunication conferences, on the implementation of this Resolution;

4 to examine the possibility, if needed, of developing software that can be used to calculate the epfd level mentioned under *resolves* 1,

*invites the 2027 world radiocommunication conference*

to review the report on the implementation of this Resolution and to take any necessary action, as appropriate,

*invites administrations*

1 to participate in the discussions and determinations mentioned under *resolves* 5, as appropriate;

2 to provide to the Bureau, and to all participants in the consultation meetings, access to software developed, taking into consideration the methodology referred to in *invites the ITU Radiocommunication Sector* 1, to calculate the epfd level mentioned under *resolves* 2.

## ANNEX 1 TO RESOLUTION 76 (REV.WRC-23)

TABLE 1A<sup>1, 2, 3</sup>Limits on aggregate  $\text{epfd}_{\downarrow}$  radiated by non-GSO FSS systems in certain frequency bands

Frequency band (GHz)	$\text{epfd}_{\downarrow}$ (dB(W/m <sup>2</sup> ))	Percentage of time during which $\text{epfd}_{\downarrow}$ may not be exceeded	Reference bandwidth (kHz)	Reference antenna diameter, and reference radiation pattern <sup>4</sup>
10.7-11.7 in all Regions 11.7-12.2 in Region 2 12.2-12.5 in Region 3 12.5-12.75 in Regions 1 and 3	-170	0	40	60 cm Recommendation ITU-R S.1428
	-168.6	90		
	-165.3	99		
	-160.4	99.97		
	-160	99.99		
	-160	100	40	1.2 m Recommendation ITU-R S.1428
	-176.5	0		
	-173	99.5		
	-164	99.84		
	-161.6	99.945		
	-161.4	99.97		
	-160.8	99.99		
	-160.5	99.99		
	-160	99.9975		
	-160	100		
	-185	0	40	3 m <sup>5</sup> Recommendation ITU-R S.1428
	-184	90		
	-182	99.5		
	-168	99.9		
	-164	99.96		
	-162	99.982		
	-160	99.997		
	-160	100		
	-190	0	40	10 m <sup>5</sup> Recommendation ITU-R S.1428
	-190	99		
	-166	99.99		
	-160	99.998		
	-160	100		

<sup>1</sup> For certain GSO FSS receive earth stations, see also Nos. 9.7A and 9.7B.<sup>2</sup> In addition to the limits shown in Table 1A, the following aggregate  $\text{epfd}_{\downarrow}$  limits apply to all antenna sizes greater than 60 cm in the frequency bands listed in Table 1A:

100% of the time $\text{epfd}_{\downarrow}$ (dB(W/(m <sup>2</sup> · 40 kHz)))	Latitude (North or South) (degrees)
-160	0 ≤  Latitude  ≤ 57.5
$-160 + 3.4(57.5 -  Latitude )/4$	57.5 <  Latitude  ≤ 63.75
-165.3	63.75 <  Latitude

<sup>3</sup> For each reference antenna diameter, the limit consists of the complete curve on a plot which is linear in decibels for the  $\text{epfd}_{\downarrow}$  levels and logarithmic for the time percentages, with straight lines joining the data points.<sup>4</sup> For this Table, reference patterns in Recommendation ITU-R S.1428 shall be used only for the calculation of interference from non-GSO FSS systems into GSO FSS systems.<sup>5</sup> The values for the 3 m and 10 m antennas are applicable only for the methodology referred to *invites the ITU Radiocommunication Sector* 1.

TABLE 1B<sup>1, 2, 3</sup>Limits on aggregate epdf<sub>↓</sub> radiated by non-GSO FSS systems in certain frequency bands

Frequency band (GHz)	epfd <sub>↓</sub> (dB(W/m <sup>2</sup> ))	Percentage of time during which epdf <sub>↓</sub> may not be exceeded	Reference bandwidth (kHz)	Reference antenna diameter, and reference radiation pattern <sup>4</sup>
17.8-18.6	-170	0	40	1 m Recommendation ITU-R S.1428
	-170	90		
	-164	99.9		
	-164	100		
	-156	0	1 000	2 m Recommendation ITU-R S.1428
	-156	90		
	-150	99.9		
	-150	100		
	-173	0	40	5 m Recommendation ITU-R S.1428
	-173	99.4		
	-166	99.9		
	-164	99.92		
	-164	100		5 m Recommendation ITU-R S.1428
	-159	0	1 000	
	-159	99.4		
	-152	99.9		
	-150	99.92		
	-150	100		
	-180	0	40	5 m Recommendation ITU-R S.1428
	-180	99.8		
	-172	99.8		
	-164	99.992		
	-164	100		5 m Recommendation ITU-R S.1428
	-166	0	1 000	
	-166	99.8		
	-158	99.8		
	-150	99.992		
	-150	100		

<sup>1</sup> For certain GSO FSS receive earth stations, see also Nos. 9.7A and 9.7B.<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 epdf<sub>↓</sub> levels and logarithmic for the time percentages, with straight lines joining the data points.<sup>3</sup> A non-GSO system shall meet the limits of this Table in both the 40 kHz and the 1 MHz reference bandwidths.<sup>4</sup> For this Table, reference patterns in Recommendation ITU-R S.1428 shall be used only for the calculation of interference from non-GSO FSS systems into GSO FSS systems.

TABLE 1C<sup>1, 2, 3</sup>Limits on aggregate e<sub>pf</sub>↓ radiated by non-GSO FSS systems in certain frequency bands

Frequency band (GHz)	e <sub>pf</sub> ↓ (dB(W/m <sup>2</sup> ))	Percentage of time during which e <sub>pf</sub> ↓ may not be exceeded	Reference bandwidth (kHz)	Reference antenna diameter, and reference radiation pattern <sup>4</sup>
19.7-20.2	-182 -172 -154 -154	0 90 99.94 100	40	70 cm Recommendation ITU-R S.1428
	-168 -158 -140 -140	0 90 99.94 100	1 000	
	-185 -176 -165 -160 -154 -154	0 91 99.8 99.8 99.99 100	40	90 cm Recommendation ITU-R S.1428
	-171 -162 -151 -146 -140 -140	0 91 99.8 99.8 99.99 100	1 000	
	-191 -162 -154 -154	0 99.933 99.998 100	40	2.5 m Recommendation ITU-R S.1428
	-177 -148 -140 -140	0 99.933 99.998 100	1 000	
	-195 -184 -175 -161 -154 -154	0 90 99.6 99.984 99.9992 100	40	5 m Recommendation ITU-R S.1428
	-181 -170 -161 -147 -140 -140	0 90 99.6 99.984 99.9992 100	1 000	

<sup>1</sup> For certain GSO FSS receive earth stations, see also Nos. 9.7A and 9.7B.<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 e<sub>pf</sub>↓ levels and logarithmic for the time percentages, with straight lines joining the data points.<sup>3</sup> A non-GSO system shall meet the limits of this Table in both the 40 kHz and the 1 MHz reference bandwidths.<sup>4</sup> For this Table, reference patterns in Recommendation ITU-R S.1428 shall be used only for the calculation of interference from non-GSO FSS systems into GSO FSS systems.

TABLE 1D<sup>1,2</sup>

Limits on aggregate  $\text{epfd}_{\downarrow}$  radiated by non-GSO FSS systems in certain frequency bands  
into 30 cm, 45 cm, 60 cm, 90 cm, 120 cm, 180 cm, 240 cm and 300 cm BSS antennas

Frequency band (GHz)	$\text{epfd}_{\downarrow}$ (dB(W/m <sup>2</sup> ))	Percentage of time during which $\text{epfd}_{\downarrow}$ may not be exceeded	Reference bandwidth (kHz)	Reference antenna diameter, and reference radiation pattern <sup>3</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	0	40	30 cm Recommendation ITU-R BO.1443, Annex 1
	-160.1	25		
	-158.6	96		
	-158.6	98		
	-158.33	98		
	-158.33	100		
	-170	0	40	45 cm Recommendation ITU-R BO.1443, Annex 1
	-167	66		
	-164	97.75		
	-160.75	99.33		
	-160	99.95		
	-160	100		
	-171	0	40	60 cm Recommendation ITU-R BO.1443, Annex 1
	-168.75	90		
	-167.75	97.8		
	-162	99.6		
	-161	99.8		
	-160.2	99.9	40	90 cm Recommendation ITU-R BO.1443, Annex 1
	-160	99.99		
	-160	100		
	-173.75	0		
	-173	33		
	-171	98		
	-165.5	99.1		
	-163	99.5		
	-161	99.8		
	-160	99.97		
	-160	100		
	-177	0	40	120 cm Recommendation ITU-R BO.1443, Annex 1
	-175.25	90		
	-173.75	98.9		
	-173	98.9		
	-169.5	99.5		
	-167.8	99.7		
	-164	99.82		
	-161.9	99.9		
	-161	99.965		
	-160.4	99.993		
	-160	100		



TABLE 1D<sup>1, 2</sup> (end)

Frequency band (GHz)	epfd↓ (dB(W/m <sup>2</sup> ))	Percentage of time during which epfd↓ may not be exceeded	Reference bandwidth (kHz)	Reference antenna diameter, and reference radiation pattern <sup>3</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	0	40	180 cm Recommendation ITU-R BO.1443, Annex 1
	-178.66	33		
	-176.25	98.5		
	-163.25	99.81		
	-161.5	99.91		
	-160.35	99.975		
	-160	99.995		
	-160	100		
	-182	0	40	240 cm Recommendation ITU-R BO.1443, Annex 1
	-180.9	33		
	-178	99.25		
	-164.4	99.85		
	-161.9	99.94		
	-160.5	99.98		
	-160	99.995		
	-160	100		
	-186.5	0	40	300 cm Recommendation ITU-R BO.1443, Annex 1
	-184	33		
	-180.5	99.5		
	-173	99.7		
	-167	99.83		
	-162	99.94		
	-160	99.97		
	-160	100		

<sup>1</sup> For BSS antenna diameters of 180 cm, 240 cm and 300 cm, in addition to the aggregate limits shown in Table 1D, the following aggregate 100% of the time epfd↓ limits also apply:

100% of the time epfd↓ (dB(W/(m <sup>2</sup> · 40 kHz)))	Latitude (North or South) (degrees)
-160	0 ≤   Latitude   ≤ 57.5
-160 + 3.4(57.5 -   Latitude  )/4	57.5 <   Latitude   ≤ 63.75
-165.3	63.75 <   Latitude

<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. For BSS antenna of diameter 240 cm, in addition to the above aggregate 100% of the time epfd↓ limit, a -167 dB(W/(m<sup>2</sup> · 40 kHz)) aggregate 100% of the time operational epfd↓ limit also applies to receive antennas located in Region 2, west of 140° W, north of 60° N, pointing toward GSO BSS satellites at 91° W, 101° W, 110° W, 119° W and 148° W with elevation angles greater than 5°. This limit is implemented during a transition period of 15 years.

<sup>3</sup> For this Table, reference patterns in the 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.