

epfd limits at the Earth's surface for downlink transmissions

Table 4 of the Petition: Minimum discrimination angle calculation for the Polar Orbits in the band 17.8-18.6 GHz

Applicable Table from Article 22 of the ITU Radio Regulations	TABLE 22-1B			TABLE 22-4A1		TABLE 22-4B
Reference GSO earth station antenna diameter [m]	1	2	5	3	10	1.8
epfd limit for the constellation [dB(w/m ² /40 kHz)]	-175.4	-178.4	-185.4	-182	-185	-164
epfd limit for the constellation [dB(w/m ² /MHz)]	-161.4	-164.4	-171.4	-168.0	-171.0	-150.0
epfd limit for each satellite (since $N_a = 2$) [dB(w/m ² /40 kHz)]	-178.4	-181.4	-188.4	-185	-188	-167
epfd limit for each satellite (since $N_a = 2$) [dB(w/m ² /MHz)]	-164.4	-167.4	-174.4	-171.0	-174.0	-153.0
Peak EIRP density [dB(W/Hz)]	-50	-50	-50	-50	-50	-50
Peak EIRP density [dB(W/MHz)]	10	10	10	10	10	10
Minimum satellite to Earth distance [km]	1000	1000	1000	1000	1000	1000
D/λ for f=17.8 GHz	59.3	118.7	296.7	178.0	593.3	107.2
D/λ for f=18.6 GHz	62	124	310	186	620	112.0
G _{r,max} [dBi] using ITU-R Rec. S.1428 for f=17.8 GHz	43.2	49.9	57.8	53.4	63.9	49.0
G _{r,max} [dBi] using ITU-R Rec. S.1428 for f=18.6 GHz	43.5	50.3	58.2	53.8	64.2	49.4
G _t (φ) for f=17.8 GHz[dBi]	-0.3	3.5	4.4	3.4	10.8	17.0
G _t (φ) for f=18.6 GHz[dBi]	0.1	3.8	4.8	3.8	11.2	17.4
φ [deg] for f=17.8 GHz	14.8	10.4	9.6	10.5	5.3	3.0
φ [deg] for f=18.6 GHz	14.3	10.1	9.3	10.2	5.1	2.9
Minimum downlink discrimination angle (φ) that should be met [deg]	14.8					

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Table 5 of the Petition: Minimum discrimination angle calculation for the Inclined Orbits in the band 17.8-18.6GHz:

Applicable Table from Article 22 of the ITU Radio Regulations	TABLE 22-1B			TABLE 22-4A1		TABLE 22-4B
Reference GSO earth station antenna diameter [m]	1	2	5	3	10	1.8
epfd limit for the constellation [dB(w/m ² /40 kHz)]	-175.4	-178.4	-185.4	-182	-185	-164
epfd limit for the constellation [dB(w/m ² /MHz)]	-161.4	-164.4	-171.4	-168.0	-171.0	-150.0
epfd limit for each satellite (since $N_a = 2$) [dB(w/m ² /40 kHz)]	-178.4	-181.4	-188.4	-185	-188	-167
epfd limit for each satellite (since $N_a = 2$) [dB(w/m ² /MHz)]	-164.4	-167.4	-174.4	-171.0	-174.0	-153.0
Peak EIRP density [dB(W/Hz)]	-50	-50	-50	-50	-50	-50
Peak EIRP density [dB(W/MHz)]	10	10	10	10	10	10
Minimum satellite to Earth distance [km]	1248	1248	1248	1248	1248	1248
D/λ for f=17.8 GHz	59.3	118.7	296.7	178.0	593.3	107.2
D/λ for f=18.6 GHz	62	124	310	186	620	112.0
G _{r,max} [dBi] using ITU-R Rec. S.1428 for f=17.8 GHz	43.2	49.9	57.8	53.4	63.9	49.0
G _{r,max} [dBi] using ITU-R Rec. S.1428 for f=18.6 GHz	43.5	50.3	58.2	53.8	64.2	49.4
G _t (φ) for f=17.8 GHz[dBi]	1.7	5.4	6.3	5.3	12.8	18.9
G _t (φ) for f=18.6 GHz[dBi]	2.0	5.8	6.7	5.7	13.1	19.3
φ [deg] for f=17.8 GHz	12.4	8.8	8.1	8.9	4.5	2.5
φ [deg] for f=18.6 GHz	12.0	8.5	7.8	8.6	4.3	2.4
Minimum downlink discrimination angle (φ) that should be met [deg]	12.4					

epfd limits at the Earth's surface for downlink transmissions

Table 6 of the Petition: Minimum discrimination angle calculation for the Polar Orbits in the band 19.7-20.2 GHz

Applicable Table from Article 22 of the ITU Radio Regulations	TABLE 22-1C				TABLE 22-4A1		TABLE 22-4B
Reference GSO earth station antenna diameter [m]	0.7	0.9	2.5	5	3	10	1.6
epfd limit for the constellation [dB(w/m ² /40 kHz)]	-187.4	-190.4	-196.4	-200.4	-182	-185	-157
epfd limit for the constellation [dB(w/m ² /MHz)]	-173.4	-176.4	-182.4	-186.4	-168.0	-171.0	-143.0
epfd limit for each satellite (since $N_{st} = 2$) [dB(w/m ² /40 kHz)]	-190.4	-193.4	-199.4	-203.4	-185	-188	-160
epfd limit for each satellite (since $N_{st} = 2$) [dB(w/m ² /MHz)]	-176.4	-179.4	-185.4	-189.4	-171.0	-174.0	-146.0
Peak EIRP density [dB(W/Hz)]	-56.4	-56.4	-56.4	-56.4	-56.4	-56.4	-56.4
Peak EIRP density [dB(W/MHz)]	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Minimum satellite to Earth distance [km]	1000	1000	1000	1000	1000	1000	1000
D/λ for f=19.7 GHz	46.0	59.1	164.2	328.3	197.0	656.7	107.2
D/λ for f=20.2 GHz	47.1	60.6	168.3	336.7	202.0	673.3	109.9
G _{r,max} [dBi] using ITU-R Rec. S.1428 for f=19.7 GHz	40.9	43.1	52.7	58.7	54.3	64.7	49.0
G _{r,max} [dBi] using ITU-R Rec. S.1428 for f=20.2 GHz	41.2	43.3	52.9	58.9	54.5	65.0	49.2
G _r (φ) for f=19.7 GHz[dBi]	-8.1	-8.9	-5.3	-3.3	10.7	18.1	30.4
G _r (φ) for f=20.2 GHz[dBi]	-7.9	-8.7	-5.1	-3.1	10.9	18.3	30.6
φ [deg] for f=19.7 GHz	30.4	32.8	20.5	17.5	5.4	2.7	0.9
φ [deg] for f=20.2 GHz	29.8	32.1	20.1	17.2	5.3	2.7	0.9
Minimum downlink discrimination angle (φ) that should be met [deg]	32.8						

epfd limits at the Earth's surface for downlink transmissions

Table 7 of the Petition: Minimum discrimination angle calculation for the Inclined Orbits in the band 19.7-20.2GHz

Applicable Table from Article 22 of the ITU Radio Regulations	TABLE 22-1C				TABLE 22-4A1		TABLE 22-4B
Reference GSO earth station antenna diameter [m]	0.7	0.9	2.5	5	3	10	1.6
epfd limit for the constellation [dB(w/m ² /40 kHz)]	-187.4	-190.4	-196.4	-200.4	-182	-185	-157
epfd limit for the constellation [dB(w/m ² /MHz)]	-173.4	-176.4	-182.4	-186.4	-168.0	-171.0	-143.0
epfd limit for each satellite (since $N_a = 2$) [dB(w/m ² /40 kHz)]	-190.4	-193.4	-199.4	-203.4	-185	-188	-160
epfd limit for each satellite (since $N_a = 2$) [dB(w/m ² /MHz)]	-176.4	-179.4	-185.4	-189.4	-171.0	-174.0	-146.0
Peak EIRP density [dB(W/Hz)]	-56.4	-56.4	-56.4	-56.4	-56.4	-56.4	-56.4
Peak EIRP density [dB(W/MHz)]	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Minimum satellite to Earth distance [km]	1248	1248	1248	1248	1248	1248	1248
D/λ for f=19.7 GHz	46.0	59.1	164.2	328.3	197.0	656.7	107.2
D/λ for f=20.2 GHz	47.1	60.6	168.3	336.7	202.0	673.3	109.9
G _{r,max} [dBi] using ITU-R Rec. S.1428 for f=19.7 GHz	40.9	43.1	52.7	58.7	54.3	64.7	49.0
G _{r,max} [dBi] using ITU-R Rec. S.1428 for f=20.2 GHz	41.2	43.3	52.9	58.9	54.5	65.0	49.2
G _r (φ) for f=19.7 GHz[dBi]	-6.2	-7.0	-3.4	-1.4	12.6	20.0	32.3
G _r (φ) for f=20.2 GHz[dBi]	-5.9	-6.8	-3.2	-1.2	12.8	20.3	32.5
φ [deg] for f=19.7 GHz	25.5	27.5	17.6	15.1	4.5	2.3	0.7
φ [deg] for f=20.2 GHz	25.0	26.9	17.4	14.9	4.4	2.2	0.7
Minimum downlink discrimination angle (φ) that should be met [deg]	27.5						

epfd limit at the geostationary orbit for uplink transmissions

Table 8 of the Petition: Calculation of the uplink discrimination angle needed to meet the uplink epfd limit

NGSO earth station antenna diameter [m]	1	3.5
NGSO earth station antenna pattern	ITU-R Rec. S.1428	ITU-R Rec. S.1428
epfd limit for the constellation [dB(w/m ² /40 kHz)]	-162	-162
Maximum number of co-frequency operating NGSO earth stations visible by a GSO satellite	78	78
epfd limit for each satellite [dB(w/m ² /40 kHz)]	-180.9	-180.9
Minimum distance between the NGSO transmitting earth station and the GSO satellite [km]	35786	35786
Peak uplink power spectral density fed into the NGSO transmitting earth station [dB(W/Hz)]	-67	-67
Peak uplink power spectral density fed into the NGSO transmitting earth station [dB(W/40 kHz)]	-21.0	-21.0
D/λ for f=27.5 GHz	91.7	320.8
D/λ for f=30 GHz	100	350
G _t (θ) for f=27.5 GHz[dBi]	2.12	2.12
G _t (θ) for f=30 GHz[dBi]	2.12	2.12
θ [deg] for f=27.5 GHz	11.9	11.5
θ [deg] for f=30 GHz	11.9	11.5
Minimum uplink discrimination angle (θ) that should be met [deg]	11.9	

epfd limit at the geostationary orbit for downlink transmissions

Table 9 of the Petition: Demonstration of compliance with the ITU epfd limit at the geostationary orbit for downlink transmissions

	Polar Orbits	Inclined Orbits
Satellite peak downlink EIRP density [dB(W/Hz)]	-50	-50
Satellite transmit antenna gain discrimination toward the GSO arc compared to the beam peak [dB]	15	25
Maximum satellite downlink EIRP density toward the GSO arc [dB(W/Hz)]	-65	-75
Geostationary orbit to Earth distance [km]	35786	35786
NGSO to Earth distance [km]	1000	1248
Minimum distance between NGSO satellite and the geostationary orbit [km]	34786	34538
Peak power flux density generated by each satellite at the geostationary orbit under worst-case assumption [dB(W/m ² /40 kHz)]	-180.8	-190.7
Maximum number of satellites in Polar Orbits or Inclined Orbits visible by a GSO satellite at any given time	50	30
Peak power flux density generated by all satellites of the Polar Orbits or Inclined Orbits at the geostationary orbit under the worst-case assumption [dB(W/m ² /40 kHz)]	-163.81	-175.97
Peak power flux density generated by all 117 satellites at the geostationary orbit under worst-case assumption [dB(W/m ² /40 kHz)]	-163.55	