

e.i.r.p. (ai) = equivalent isotropic radiated spectral power density of the i-th hub (in W/MHz) at elevation angle a where a is the angle in degrees of elevation above horizon. e.i.r.p.(0°) is the hub e.i.r.p. area density at the horizon used in Section 101.113c(2). The nominal antenna pattern will be used for elevation angles between 0° and 8°, and average levels will be used for angles beyond 8°, where average levels will be calculated by sampling the antenna patterns in each 1° interval between 8° and 9015, dividing by 83.

TABLE 2

Elevation angle (a)	Relative e.i.r.p. density (dBW/MHz-km ²)
0° ≤ a ≤ 4.0°	e.i.r.p.(a) = e.i.r.p.(0°) + 20 log (sinΠ x)/(1/Π x) where x = (a + 1)/7.5°.
4.0° < a ≤ 7.7°	e.i.r.p.(a) = e.i.r.p.(0°) - 3.85a + 7.7.
a > 7.7°	e.i.r.p.(a) = e.i.r.p.(0°) - 22.

(ii) LMDS system licensees in two or more BTAs may individually or collectively deviate from the spectral area density computed above by averaging the power over any 200 km by 400 km area, provided that the aggregate interference to the satellite receiver is no greater than if the spectral area density were as specified in Table 1. A showing to the Commission comparing both methods of computation is required and copies shall be served on any affected non-GSO MSS providers.

(4) *Power reduction techniques.* LMDS hub transmitters shall employ methods to reduce average power levels received by non-geostationary mobile satellite receivers, to the extent necessary to comply with paragraphs (c)(1) and (c)(2) of this section, by employing the methods set forth below:

(i) *Alternate polarizations.* LMDS hub transmitters in the LMDS service area may employ both vertical and horizontal linear polarizations such that 50 percent (plus or minus 10 percent) of the hub transmitters shall employ vertical polarization and 50 percent (plus or minus 10 percent) shall employ horizontal polarization.

(ii) *Frequency interleaving.* LMDS hub transmitters in the LMDS service area may employ frequency interleaving such that 50 percent (plus or minus 10 percent) of the hub transmitters shall employ channel center frequencies which are different by one-half the

channel bandwidth of the other 50 percent (plus or minus 10 percent) of the hub transmitters.

(iii) *Alternative methods.* As alternatives to paragraphs (c)(4)(i) and (c)(4)(ii) of this section, LMDS operators may employ such other methods as may be shown to achieve equivalent reductions in average power density received by non-GSO MSS satellite receivers.

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§ 101.115 Directional antennas.

(a) Unless otherwise authorized upon specific request by the applicant, each station authorized under the rules of this part must employ a directional antenna adjusted with the center of the major lobe of radiation in the horizontal plane directed toward the receiving station with which it communicates: *provided, however*, where a station communicates with more than one point, a multi- or omni-directional antenna may be authorized if necessary. New Periscope antenna systems will not, under ordinary circumstances, be authorized.

(b) Fixed stations (other than temporary fixed stations and DEMS nodal stations) operating at 932.5 MHz or higher must employ transmitting and receiving antennas (excluding second receiving antennas for operations such as space diversity) meeting the appropriate performance Standard A indicated below, except that in areas not subject to frequency congestion, antennas meeting performance Standard B may be used, subject to the requirements set forth in paragraph (d) of this section. Licensees shall comply with the antenna standards table shown in this paragraph in the following manner:

(1) With either the maximum beamwidth to 3 dB points requirement or with the minimum antenna gain requirement; and

(2) With the minimum radiation suppression to angle requirement.

ANTENNA STANDARDS

Frequency (MHz)	Category	Maximum beamwidth to 3 dB points ¹ (included angle in degrees)	Minimum antenna gain (dbi)	Minimum radiation suppression to angle in degrees from centerline of main beam in decibels						
				5° to 10°	10° to 15°	15° to 20°	20° to 30°	30° to 100°	100° to 140°	140° to 180°
932.5 to 935	A	14.0	n/a	n/a	6	11	14	17	20	24
	B	20.0	n/a	n/a	6	11	14	17	20	24
941.5 to 944	A	14.0	n/a	n/a	6	11	14	17	20	24
	B	20.0	n/a	n/a	6	10	13	15	20	24
952 to 960 ^{2,3}	A	14.0	n/a	n/a	6	11	14	17	20	24
	B	20.0	n/a	n/a	6	10	13	15	20	24
1,850 to 2,500 ⁴	A	5.0	n/a	12	18	22	25	29	33	39
	B	8.0	n/a	5	18	20	20	25	28	36
3,700 to 4,200	A	2.7	36	23	29	33	36	42	55	55
	B	2.7	36	20	24	28	32	32	32	32
5,925 to 6,425 ⁵	A	2.2	38	25	29	33	36	42	55	55
	B	2.2	38	21	25	29	32	35	39	45
5,925 to 6,425 ⁶	A	2.2	38	25	29	33	36	42	55	55
	B	2.2	38	20	24	28	32	35	36	36
6,525 to 6,875 ⁵	A	2.2	38	25	29	33	36	42	55	55
	B	2.2	38	21	25	29	32	35	39	45
6,525 to 6,875 ⁶	A	1.5	n/a	26	29	32	34	38	41	49
	B	2.0	n/a	21	25	29	32	35	39	45
10,550 to 10,680 ^{5,7}	A	2.2	38	25	29	33	36	42	55	55
	B	2.2	38	20	24	28	32	35	35	39
10,550 to 10,680 ⁷	A	3.5	33.5	18	24	28	32	35	55	55
	B	3.5	33.5	17	24	28	32	35	40	45
10,565 to 10,615	n/a	360	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
10,630 to 10,680 ⁸	n/a	3.5	34	20	24	28	32	35	36	36
10,700 to 11,700 ⁵	A	2.2	38	25	29	33	36	42	55	55
	B	2.2	38	20	24	28	32	35	36	36
12,200 to 13,250 ⁹	A	1.0	n/a	23	28	35	39	41	42	50
	B	2.0	n/a	20	25	28	30	32	37	47
17,700 to 18,820	A	2.2	38	25	29	33	36	42	55	55
	B	2.2	38	20	24	28	32	35	36	36
18,920 to 19,700 ¹⁰	A	2.2	38	25	29	33	36	42	55	55
	B	2.2	38	20	24	28	32	35	36	36
21,200 to 23,600 ^{7,11}	A	3.3	33.5	18	26	26	33	33	55	55
	B	3.3	33.5	17	24	24	29	29	40	50
24,250 to 25,250 ¹⁰	A	2.8	38	25	29	33	36	42	55	60
	B	2.8	38	20	24	28	32	35	36	45
31,000 to 31,300 ^{12,13}	n/a	4.0	38	n/a	n/a	n/a	n/a	n/a	n/a	n/a
38,600 to 40,000 ¹⁴	A	n/a	38	25	29	33	36	42	55	55
	B	n/a	38	20	24	28	32	35	36	36
71,000 to 76,000 (co-polar) ¹⁵	N/A	1.2	43	35	40	45	50	50	55	55
71,000 to 76,000 (cross-polar) ¹⁵	N/A	1.2	43	45	50	50	55	55	55	55
81,000 to 86,000 (co-polar) ¹⁵	N/A	1.2	43	35	40	45	50	50	55	55
81,000 to 86,000 (cross-polar) ¹⁵	N/A	1.2	43	45	50	50	55	55	55	55
92,000 to 95,000	N/A	0.6	50.0	36	40	45	50	55	55	55

¹ If a licensee chooses to show compliance using maximum beamwidth to 3 dB points, the beamwidth limit shall apply in both the azimuth and the elevation planes.

² Except for Multiple Address System frequencies listed in §§ 101.147(b)(1) through (b)(4), where omnidirectional antennas may be used.

³ Antennas used at outlying stations as part of a central protection alarm system need conform to only the following 2 standards:

- (i) The minimum on-beam forward gain must be at least 10 dBi, and
- (ii) The minimum front-to-back ratio must be at least 20 dB.

⁴ Omnidirectional antennas may be authorized in the band 2150–2160 MHz.

⁵ These antenna standards apply to all point-to-point stations authorized after June 1, 1997. Existing licensees and pending applicants on that date are grandfathered and need not comply with these standards.

⁶ These antenna standards apply to all point-to-point stations authorized on or before June 1, 1997.

⁷ Except for antennas between 140° and 180° authorized or pending on January 1, 1989, in the band 10,550 to 10,565 MHz for which minimum radiation suppression to angle (in degrees) from centerline of main beam is 36 decibels.

⁸ These antenna standards apply only to DEMS User Stations licensed, in operation, or applied for prior to July 15, 1993.

⁹ Except for Temporary-fixed operations in the band 13200–13250 MHz with output powers less than 250 mW and as provided in § 101.147(q), and except for antennas in the MVDDS service in the band 12.2–12.7 GHz.

¹⁰DEMS User Station antennas in this band must meet performance Standard B and have a minimum antenna gain of 34 dBi. The maximum beamwidth requirement does not apply to DEMS User Stations. DEMS Nodal Stations need not comply with these standards. Stations authorized to operate in the 24,250–25,250 MHz band do not have to meet these standards, however, the Commission may require the use of higher performance antennas where interference problems can be resolved by the use of such antennas.

¹¹Except as provided in § 101.147(s).

¹²The minimum front-to-back ratio shall be 38 dBi.

¹³Mobile, except aeronautical mobile, stations need not comply with these standards.

¹⁴Stations authorized to operate in the 38,600–40,000 MHz band may use antennas other than those meeting the Category A standard. However, the Commission may require the use of higher performance antennas where interference problems can be resolved by the use of such antennas.

¹⁵Antenna gain less than 50 dBi (but greater than or equal to 43 dBi) is permitted only with a proportional reduction in maximum authorized EIRP in a ratio of 2 dB of power per 1 dB of gain, so that the maximum allowable EIRP (in dBW) for antennas of less than 50 dBi gain becomes $+55 - 2(50 - G)$, where G is the antenna gain in dBi. In addition, antennas in these bands must meet two additional standards for minimum radiation suppression: At angles between 1.2 and 5 degrees from the centerline of the main beam, co-polar discrimination must be $G - 28$, where G is the antenna gain in dBi; and at angles of less than 5 degrees from the centerline of main beam, cross-polar discrimination must be at least 25 dB.

(c) The Commission shall require the replacement of any antenna or periscope antenna system of a permanent fixed station operating at 932.5 MHz or higher that does not meet performance Standard A specified in paragraph (c) of this section, at the expense of the licensee operating such antenna, upon a showing that said antenna causes or is likely to cause interference to (or receive interference from) any other authorized or applied for station whereas a higher performance antenna is not likely to involve such interference. Antenna performance is expected to meet the standards of paragraph (c) of this section for parallel polarization. For cases of potential interference, an antenna will not be considered to meet Standard A unless the parallel polarization performance for the discrimination angle involved meets the requirements, even if the cross-polarization performance controls the interference.

(d) In cases where passive reflectors are employed in conjunction with transmitting antenna systems, the foregoing paragraphs of this section also will be applicable. However, in such instances, the center of the major lobe of radiation from the antenna normally must be directed at the passive reflector, and the center of the major lobe of radiation from the passive reflector directed toward the receiving station with which it communicates.

(e) Periscope antennas used at an electric power facility plant area will be excluded from the requirements of paragraph (c) of this section on a case-by-case basis where technical considerations or safety preclude the use of other types of antenna systems.

(f) In the event harmful interference is caused to the operation of other stations, the Commission may, after no-

tice and opportunity for hearing, order changes to be made in the height, orientation, gain and radiation pattern of the antenna system.

[61 FR 26677, May 28, 1996, as amended at 62 FR 4924, Feb. 3, 1997; 62 FR 24582, May 6, 1997; 63 FR 6105, Feb. 6, 1998; 65 FR 38329, June 20, 2000; 65 FR 59358, Oct. 5, 2000; 67 FR 43038, June 26, 2002; 68 FR 4957, Jan. 31, 2003; 69 FR 3267, Jan. 23, 2004; 70 FR 29997, May 25, 2005]

§ 101.117 Antenna polarization.

Except as set forth herein, stations operating in the radio services included in this part are not limited as to the type of polarization of the radiated signal that may be employed. However, in the event interference in excess of permissible levels is caused to the operation of other stations as a result of employing other than linear polarization, the Commission may order a licensee to change its system polarization to mitigate the interference. No change in polarization may be made without prior authorization from the Commission. Unless otherwise allowed, only linear polarization (horizontal and vertical) shall be used. For LMDS systems, unless otherwise authorized, system operators are permitted to use any polarization within its service area, but only vertical and/or horizontal polarization for antennas located within 20 kilometers of the outermost edge of their service area.

[68 FR 4957, Jan. 31, 2003]

§ 101.119 Simultaneous use of common antenna structures.

The simultaneous use of common antenna structures by more than one radio station, or by one of more domestic public radio stations and one or more stations of any other class or