Frequency band (MHz)	Maximum allowable EIRP[1][2]	
	Fixed[1][2] (dBW)	Mobile (dBW)
17,700–18,600	+ 55	
18,600–18,800[6]	+ 35	
18,800–19,700	[5] + 55	
21,200–23,600[10]	+ 55	
24,250–25,250	[5] + 55	
29,100–29,250	([7])	
31,000 to 31,075[8][9]	30 dBW/MHz	30 dBW/MHz
31,075 to 31,225[8][9]	30 dBW/MHz	30 dBW/MHz
31,225 to 31,300[8][9]	30 dBW/MHz	30 dBW/MHz
71,000–76,000[13]	+ 55	+ 55
81,000–86,000[13]	+ 55	+ 55
92,000–95,000	+ 55	+ 55

[1] Per polarization.
[2] For multiple address operations, see § 101.147. Remote alarm units that are part of a multiple address central station projection system are authorized a maximum of 2 watts.
[3] When an omnidirectional antenna is authorized in the 2150–2160 MHz band, the maximum power shall be 60 dBm.
[4] Also see § 101.145.
[5] The output power of a DEMS System nodal transmitter shall not exceed 0.5 watt per 250 kHz. The output power of a DEMS System user transmitter shall not exceed 0.04 watt per 250 kHz. The transmitter power in terms of the watts specified is the peak envelope power of the emission measured at the associated antenna input port. The operating power shall not exceed the authorized power by more than 10 percent of the authorized power in watts at any time. Frequencies from 10,600–10,680 MHz are subject to footnote US265 in the Table of Frequency Allocations in § 2.106 of the Commission's Rules. Stations authorized prior to April 1, 2003 to exceed the 40 dBW limit may continue to operate at their authorized output power level indefinitely, provided that neither end point of the relevant link is relocated.
[6] Maximum power delivered to the antenna shall not exceed −3 dBw.
[7] See § 101.113(c).
[8] For stations authorized prior to March 11, 1997, and for non-Local Multipoint Distribution Service stations authorized pursuant to applications refiled no later than June 26, 1998, the transmitter output power shall not exceed 0.050 watt.
[9] For subscriber transceivers authorized in these bands, the EIRP shall not exceed 55 dBw or 42 dBw/MHz.
[10] See § 101.147(s).
[11] The EIRP for MVDDS stations is limited to 14.0 dBm per 24 MHz (−16.0 dBW per 24 MHz). Incumbent point-to-point stations may use up to + 50 dBW except for low power systems which were licensed under § 101.147(q).
[12] Beginning March 1, 2005, no new LTTS operators will be licensed and no existing LTTS licensees will be renewed in the 14.2–14.4 GHz band.
[13] The maximum transmitter power is limited to 3 watts (5 dBW) unless a proportional reduction in maximum authorized EIRP is required under § 101.115. The maximum transmitter power spectral density is limited to 150 mW per 100 MHz.

(b) The power of transmitters that use Automatic Transmitter Power Control shall not exceed the power input or output specified in the instrument of station authorization. The power of non-ATPC transmitters shall be maintained as near as practicable to the power input or output specified in the instrument of station authorization.

(c)(1) *Transmitter power limitations.* Point-to-point stations in the 29.1–29.25 GHz band for the LMDS backbone between LMDS hubs shall be limited to a maximum allowable e.i.r.p. density per carrier of 23 dBW/MHz in any one megahertz in clear air, and may exceed this limit by employment of adaptive power control in cases where link propagation attenuation exceeds the clear air value due to precipitation and only to the extent that the link is impaired.

(2) *Hub transmitter EIRP spectral area, density limit.* LMDS applicants shall demonstrate that, under clear air operating conditions, the maximum aggregate of LMDS transmitting hub stations in a Basic Trading Area in the 29.1–29.25 GHz band will not transmit a co-frequency hub-to-subscriber e.i.r.p. spectral area density in any azimuthal direction in excess of X dBW/(MHz-km^2) when averaged over any 4.375 MHz band, where X is defined in Table 1. Individual hub stations may exceed their clear air e.i.r.p.s by employment of adaptive power control in cases where link propagation attenuation exceeds the clear air value and only to the extent that the link is impaired.

(i) The e.i.r.p. aggregate spectral area density is calculated as follows:

$$10\log_{10}\ 1/A\sum_{i=1}^{N} pigi\ \text{dBW/MHz-km}^2$$

where:

N = number of co-frequency hubs in BTA.
A = Area of BTA in km^2.
pi = spectral power density into antenna of i-th hub (in W/MHz).
gi = gain of i-th hub antenna at zero degree elevation angle.
Each pi and gi are in the same 1 MHz within the designated frequency band.

(ii) The climate zones in Table 1 are defined for different geographic locations within the US as shown in Appendix 28 of the ITU Radio Regulations.

TABLE 1[1]

Climate zone	e.i.r.p. Spectral Density (Clear Air) (dBW/MHz-km^2)[2]
1	−23
2	−25
3,4,5	−26

[1] 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 20/30 GHz MSS providers.
[2] See § 21.1007(c)(i) for the population density of the BTA.

(3) *Hub transmitter e.i.r.p. spectral area density limit at elevation angles above the*

horizon. LMDS applicants shall demonstrate that, under clear air operating conditions, the maximum aggregate of LMDS transmitting hub stations in a Basic Trading Area in the 29.1–29.25 GHz band will not transmit a co-frequency hub-to-subscriber e.i.r.p. spectral area density in any azimuthal direction in excess of X dBW/(MHz-km^2) when averaged over any 4.375 MHz band where X is defined in Table 2. Individual hub stations may exceed their clear air e.i.r.p.s by employment of adaptive power control in cases where link propagation attenuation exceeds the clear air value and only to the extent that the link is impaired.

(i) The e.i.r.p. aggregate spectral area density is calculated as follows:

$$10\log_{10}\ 1/A\sum_{i=1}^{N}\text{e.i.r.p.(ai) dBW/MHz-km}^2$$

where:

N = number of co-frequency hubs in BTA.

A = Area of BTA in km^2.

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.

[61 FR 26677, May 28, 1996]

EDITORIAL NOTE: For FEDERAL REGISTER citations affecting §101.113, see the List of CFR Sections Affected, which appears in the Finding Aids section of the printed volume and at *www.govinfo.gov*.

§ 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. For frequencies with a Standard B1 and a Standard B2, in order to comply with Standard B an antenna must fully meet either Standard B1 or Standard B2. 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° to10°	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	n/a	6	10	13	15	20
941.5 to 944	A	14.0	n/a	n/a	6	11	14	17	20	24
	B	20.0	n/a	n/a	n/a	6	10	13	15	20
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	n/a	6	10	13	15	20
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
	B	2.2	38	21	25	29	32	35	39	45
5,925 to 6,425 [5]	A	2.2	38	25	29	33	36	42	55	55
	B1	2.2	38	21	25	29	32	35	39	45
	B2	4.1	32	15	20	23	28	29	60	60
6,525 to 6,875 [5]	A	2.2	38	25	29	33	36	42	55	55
	B1	2.2	38	21	25	29	32	35	39	45
	B2	4.1	32	15	20	23	28	29	60	60
6,875 to 7,125	A	2.2	38	25	29	33	36	42	55	55
	B1	2.2	38	21	25	29	32	35	39	45
	B2	4.1	32	15	20	23	28	29	60	60
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
10,700–11,700 [5]	A	2.2	38	25	29	33	36	42	55	55
	B	3.5	33.5	17	24	28	32	35	40	45
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
	B1	2.2	38	20	24	28	32	35	36	36
	B2	3.3	33.5	18	22	29	31	35	55	55
18,920 to 19,700 [10]	A	2.2	38	25	29	33	36	42	55	55
	B1	2.2	38	20	24	28	32	35	36	36
	B2	3.3	33.5	18	22	29	31	35	55	55
21,200 to 23,600 [7 11]	A	3.3	33.5	18	26	26	33	33	55	55
	B1	3.3	33.5	17	24	24	29	29	40	50
	B2	4.5	30.5	14	19	22	24	29	52	52
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
	B	n/a	38	20	24	28	32	35	36	36
71,000 to 76,000 (co-polar) [14].	N/A	1.2	43	35	40	45	50	50	55	55

ANTENNA STANDARDS—Continued

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° to10°	10° to 15°	15° to 20°	20° to 30°	30° to 100°	100° to 140°	140° to 180°
71,000 to 76,000 (cross-polar) [14].	N/A	1.2	43	45	50	50	55	55	55	55
81,000 to 86,000 (co-polar) [14].	N/A	1.2	43	35	40	45	50	50	55	55
81,000 to 86,000 (cross-polar) [14].	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] For stations authorized or pending on April 1, 2003, the minimum radiation suppression for Category B is 35dB in the 10,550–10,680 MHz band and 36 dB in the 21,200–23,600 MHz band for discrimination angles from 100° to 180°.

[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.

[10] DEMS 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.

[11] Except as provided in § 101.147(s).

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

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

[14] Antenna 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-