Subpart C - Technical Standards

§ 101.101 Frequency availability.

FREQUENCY BAND (MHz)	RADIO SERVICE				
	COMMON CARRIER (Part 101)	PRIVATE RADIO (Part 101)	BROADCAST AUXILIARY (Part 74)	OTHER (Parts 15, 21, 24, 25, 74, 78, & 100)	NOTES
928 - 929		MAS			
932.0 - 932.5	MAS	MAS			*
932.5 - 935.0	CC	OFS			*
941.0 - 941.5	MAS	MAS			*
941.5 - 944.0	CC	OFS	Aural BAS		*
952 - 960		OFS/MAS			
1850 - 1990		OFS		PCS	
2110 - 2130	CC			ET	
2130 - 2150		OFS		ET	
2150 - 2160		OFS		MDS	
2160 - 2180	CC			ET	
2180 - 2200		OFS		ET	
2450 - 2500	LTTS	OFS	TV BAS	ISM	F/M/TF
2650 - 2690		OFS		MDS/ITFS	
3700 - 4200	CC LTTS	OFS		SAT	
5925 - 6425	CC LTTS	OFS		SAT	
6425 - 6525	LTTS	OFS	TV BAS	CARS	M
6525 - 6875	CC	OFS			F/TF
10,550 - 10,680	CC DEMS	OFS, DEMS			
10,700 - 11,700	CC LTTS	OFS		SAT	
11,700 - 12,200	LTTS			SAT	

FREQUENCY BAND (MHz)	RADIO SERVICE				
	COMMON CARRIER (Part 101)	PRIVATE RADIO (Part 101)	BROADCAST AUXILIARY (Part 74)	OTHER (Parts 15, 21, 24, 25, 74, 78, & 100)	NOTES
12,200 - 12,700		OFS		DBS	
12,700 - 13,250	CC LTTS	OFS	TV BAS	CARS	F/M/TF
14,200 - 14,400	LTTS			SAT	
17,700 - 18,580	CC	OFS	TV BAS	SAT CARS	
18,580 - 18,820	CC	OFS	Aural BAS	SAT	
18,820 - 18,920	DEMS	OFS DEMS		SAT	
18,920 - 19,160	CC	OFS	Aural BAS	SAT	
19,160 - 19,260	DEMS	OFS DEMS		SAT	
19,260 - 19,700	CC	OFS	TV BAS	CARS SAT	
21,200 - 23,600	CC LTTS	OFS			TF
27,500 - 29,500	CC			SAT	
31,000 - 31,300	CC LTTS	OFS	TV BAS	CARS	F/M/TF
38,600 - 40,000	CC	OFS	TV BAS		F/M/TF

BAS: Broadcast Auxiliary Service -- (Part 74)
CARS: Cable Television Relay Service -- Part 78)
CC: Common Carrier Fixed Point-to-Point Microwave Service -- (Part 101, Subparts C & I)
DBS: Direct Broadcast Satellite -- (Part 100)
DEMS: Digital Electronic Message Service -- (Part 101, Subpart G)
ET: Emerging Technologies (per ET Dkt. No. 92-9, not yet assigned)
ISM: Industrial, Scientific & Medical -- (Part 18)
ITFS: Instructional Television Fixed Service -- (Part 74)
LTTS: Local Television Transmission Service -- (Part 101, Subpart J)
MAS: Multipoint Address System -- (Part 101)
MDS: Multipoint Distribution Service -- (Part 21)
OFS: Private Operational Fixed Point-to-Point Microwave Service -- (Part 101, Subparts C & H)
PCS: Personal Communications Service -- (Part 24)
SAT: Fixed Satellite Service -- (Part 25)

Notes:

F - Fixed
M - Mobile
TF - Temporary Fixed

*-Applications for frequencies in the 932.5-935/941.5-944 MHz bands may be filed initially during a one-week period to be announced by public notice. After these applications have been processed, the Commission will announce by public notice a filing date for remaining frequencies. From this filing date forward, applications will be processed on a daily first-come, first-served basis.

§ 101.103 Frequency coordination procedures.

(a) Assignment of frequencies will be made only in such a manner as to facilitate the rendition of communication service on an interference-free basis in each service area. Unless otherwise indicated, each frequency available for use by stations in these services will be assigned exclusively to a single applicant in any service area. All applicants for, and licensees of, stations in these services must cooperate in the selection and use of the frequencies assigned in order to minimize interference and thereby obtain the most effective use of the authorized facilities. In the event harmful interference occurs or appears likely to occur between two or more radio systems and such interference cannot be resolved between the licensees thereof, the Commission may specify a time sharing arrangement for the stations involved or may, after notice and opportunity for hearing, require the licensees to make such changes in operating techniques or equipment as it may deem necessary to avoid such interference.

(b) The provisions of this section do not apply to operations in the band 31.0 to 31.3 GHz. Operations in this band are unprotected and subject to harmful interference from other licensed operations in this band.

(c) Frequency diversity transmission will not be authorized in these services in the absence of a factual showing that the required communications cannot practically be achieved by other means. Where frequency diversity is deemed to be justified on a protection channel basis, it will be limited to one protection channel for the bands 3,700-4,200, 5925-6425, and 6525-6875 MHz, and a ratio of one protection channel for three working channels for the bands 10,550-10,680 and 10,700-11,700 MHz. In the bands 3,700-4,200, 5,925-6,425, and 6525-6875 MHz, no frequency diversity protection channel will be authorized unless there is a minimum of three working channels, except that where a substantial showing is made that a total of three working channels will be required within three years, a protection channel may be authorized simultaneously with the first working channel. A protection channel authorized under such exception will be subject to termination if applications for the third working channel are not filed within three years of the grant date of the applications for the first working channel. Where equipment employing digital modulation techniques with cross-polarized operation on the same frequency is used, the protection channel authorized under the above conditions may be considered to consist of both polarizations of the protection

frequency where such is shown to be necessary.

(d) Frequency coordination. For each frequency authorized under this part, the following frequency usage coordination procedures will apply.

(1) General requirements. Proposed frequency usage must be prior coordinated with existing licensees, permittees and applicants in the area, and other applicants with previously filed applications, whose facilities could affect or be affected by the new proposal in terms of frequency interference on active channels, applied-for channels, or channels coordinated for future growth. Coordination must be completed prior to filing an application for regular authorization, or an amendment to a pending application, or any major modification to a license. In coordinating frequency usage with stations in the fixed satellite service, applicants must also comply with the requirements of § 101.21(f). In engineering a system or modification thereto, the applicant must, by appropriate studies and analyses, select sites, transmitters, antennas and frequencies that will avoid interference in excess of permissible levels to other users. All applicants and licensees must cooperate fully and make reasonable efforts to resolve technical problems and conflicts that may inhibit the most effective and efficient use of the radio spectrum; however, the party being coordinated with is not obligated to suggest changes or re-engineer a proposal in cases involving conflicts. Applicants should make every reasonable effort to avoid blocking the growth of systems as prior coordinated. The applicant must identify in the application all entities with which the technical proposal was coordinated. In the event that technical problems are not resolved, an explanation must be submitted with the application. Where technical problems are resolved by an agreement or operating arrangement between the parties that would require special procedures be taken to reduce the likelihood of interference in excess of permissible levels (such as the use of artificial site shielding) or would result in a reduction of quality or capacity of either system, the details thereof may be contained in the application.

(2) Coordination procedure guidelines are as follows:

(i) Coordination involves two separate elements: notification and response. Both or either may be oral or in written form. To be acceptable for filing, all applications and major technical amendments must certify that coordination, including response, has been completed. The names of the licensees, permittees and applicants with coordinated proposals, applicants, permittees, and licensees with which coordination was accomplished must be specified. If such notice and/or response is oral, the party providing such notice or response must supply written documentation of the communication upon request.

(ii) Notification must include relevant technical details of the proposal. At minimum, this should include, as applicable, the following:

Applicant's name and address.
Transmitting station name.
Transmitting station coordinates.
Frequencies and polarizations to be added, changed or deleted.
Transmitting equipment type, its stability, actual output power, emission designator, and type of modulation (loading).
Transmitting antenna type(s), model, gain and, if required, a radiation pattern provided or certified by the manufacturer.
Transmitting antenna center line height(s) above ground level and ground elevation above mean sea level.
Receiving station name.
Receiving station coordinates.
Receiving antenna type(s), model, gain, and, if required, a radiation pattern provided or certified by the manufacturer.
Receiving antenna center line height(s) above ground level and ground elevation above mean sea level.
Path azimuth and distance.
Estimated transmitter transmission line loss expressed in dB.
Estimated receiver transmission line loss expressed in dB.

NOTE: The position location of antenna sites shall be determined to an accuracy of no less than ±1 second in the horizontal dimensions (latitude and longitude) and ±1 meter in the vertical dimension (ground elevation) with respect to the National Spacial Reference System.

(iii) For transmitters employing digital modulation techniques, the notification should clearly identify the type of modulation. Upon request, additional details of the operating characteristics of the equipment must also be furnished.

(iv) Response to notification should be made as quickly as possible, even if no technical problems are anticipated. Any response to notification indicating potential interference must specify the technical details and must be provided to the applicant, in writing, within the 30-day notification period. Every reasonable effort should be made by all applicants, permittees and licensees to eliminate all problems and conflicts. If no response to notification is received within 30 days, the applicant will be deemed to have made reasonable

efforts to coordinate and may file its application without a response.

(v) The 30-day notification period is calculated from the date of receipt by the applicant, permittee, or licensee being notified. If notification is by mail, this date may be ascertained by:

(A) The return receipt on certified mail,

(B) The enclosure of a card to be dated and returned by the recipient, or

(C) A conservative estimate of the time required for the mail to reach its destination.

In the last case, the estimated date when the 30-day period would expire should be stated in the notification.

(vi) An expedited prior coordination period (less than 30 days) may be requested when deemed necessary by a notifying party. The coordination notice should be identified as "expedited" and the requested response date should be clearly indicated. However, circumstances preventing a timely response from the receiving party should be accommodated accordingly. It is the responsibility of the notifying party to receive written concurrence (or verbal, with written to follow) from affected parties or their coordination representatives.

(vii) All technical problems that come to light during coordination must be resolved unless a statement is included with the application to the effect that the applicant is unable or unwilling to resolve the conflict and briefly the reason therefor.

(viii) Where a number of technical changes become necessary for a system during the course of coordination, an attempt should be made to minimize the number of separate notifications for these changes. Where the changes are incorporated into a completely revised notice, the items that were changed from the previous notice should be identified. When changes are not numerous or complex, the party receiving the changed notification should make an effort to respond in less than 30 days. When the notifying party believes a shorter response time is reasonable and appropriate, it may be helpful for that party to so indicate in the notice and perhaps suggest a response date.

(ix) If, after coordination is successfully completed, it is determined that a subsequent change could have no impact on some parties receiving the original notification,

these parties must be notified of the change and of the coordinator's opinion that no response is required.

(x) Applicants, permittees and licensees should supply to all other applicants, permittees and licensees within their areas of operations, the name, address and telephone number of their coordination representatives. Upon request from coordinating applicants, permittees and licensees, data and information concerning existing or proposed facilities and future growth plans in the area of interest should be furnished unless such request is unreasonable or would impose a significant burden in compilation.

(xi) Parties should keep other parties with whom they are coordinating advised of changes in plans for facilities previously coordinated. If applications have not been filed 6 months after coordination was initiated, parties may assume that such frequency use is no longer desired unless a second notification has been received within 10 days of the end of the 6 month period. Renewal notifications are to be sent to all originally notified parties, even if coordination has not been successfully completed with those parties.

(xii) Any frequency reserved by a licensee for future use in the bands subject to this Part must be released for use by another licensee, permittee or applicant upon a showing by the latter that it requires an additional frequency and cannot coordinate one that is not reserved for future use.

(e) Where frequency conflicts arise between co-pending applications in the Private Operational Fixed Point-to-Point Microwave, Common Carrier Fixed Point-to-Point Microwave and Local Television Transmission Services, it is the obligation of the later filing applicant to amend his application to remove the conflict, unless it can make a showing that the conflict cannot be reasonably eliminated. Where a frequency conflict is not resolved and no showing is submitted as to why the conflict cannot be resolved, the Commission may grant the first filed application and dismiss the later filed application(s) after giving the later filing applicant(s) 30 days to respond to the proposed action.

(f) When the proposed facilities are to be operated in the band 12,500-12,700 MHz, applications must also follow the procedures in § 101.21 of this Part and the technical standards and requirements of Part 25 of this Chapter as regards licensees in the Communication-Satellite Service.

§ 101.105 Interference protection criteria.

(a) The interference protection criteria for fixed stations subject to this Part are as follows:

(1) To long-haul analog systems, employing frequency modulated radio and frequency division multiplexing to provide multiple voice channels, the allowable interference level per exposure:

(i) Due to co-channel sideband-to-sideband interference must not exceed 5 pwpO (Picowatts of absolute noise power psophometrically weighted (pwpO), appearing in an equivalent voice band channel of 300-3400 Hz).

(ii) Due to co-channel carrier-beat interference must not exceed 50 pwpO.

(2) To short-haul analog systems employing frequency modulated radio and frequency division multiplexing to provide multiple voice channels, the allowable interference level per exposure:

(i) Due to co-channel sideband-to-sideband interference must not exceed 25 pwpO except in the 952-960 MHz band interference into single link fixed relay and control stations must not exceed 250 pwpO per exposure.

(ii) Due to co-channel carrier-beat interference must not exceed 50 pwpO except in the 952-960 MHz band interference into single link fixed relay and control stations must not exceed 1000 pwpO per exposure.

(3) FM-TV. In analog systems employing frequency modulated radio that is modulated by a standard, television (visual) signal, the allowable interference level per exposure may not exceed the levels which would apply to long-haul or short-haul FM-FDM systems, as outlined in paragraphs (b)(1) and (2) of this section, having a 600-1200 voice channel capacity.

(b) In addition to the requirements of paragraph (a) of this Section the adjacent channel interference protection criteria to be afforded, regardless of system length, or type of modulation, multiplexing, or frequency band, must be such that the interfering signal does not produce more than 1.0 dB degradation of the practical threshold of the protected receiver.

(i) The "practical threshold" of the protected receiver can be based upon the definition

in TSB 10, referenced in paragraph (c) of this section, or upon alternative generally acceptable good engineering standards.

(c) Applying the Criteria.

(1) Guidelines for applying the interference protection criteria for fixed stations subject to this Part are specified in the Telecommunications Industry Association's Telecommunications Systems Bulletin TSB 10, "Interference Criteria for Microwave Systems" (TSB 10). Other procedures that follow generally acceptable good engineering practices are also acceptable to the Commission.

(2) If TSB 10 guidelines cannot be used, the following interference protection criteria may be used by calculating the ratio in dB between the desired (carrier signal) and the undesired (interfering) signal (C/I ratio) appearing at the input to the receiver under investigation (victim receiver):

(i) Except as provided in § 101.147 of this Part, where the applicants proposed facilities are of a type not included in paragraphs (a) and (b) of this section or where the development of the carrier-to-interference (C/I) ratio is not covered by generally acceptable procedures, or where the applicant does not wish to develop the carrier-to-interference ratio, the applicant must, in the absence of criteria or a developed C/I ratio, employ the following C/I protection ratios:

Co-channel interference: both sideband and carrier-beat, applicable to all bands; the existing or previously authorized system must be afforded a carrier to interfering signal protection ratio of at least 90 dB except in the 952-960 MHz band where it must be 75 dB.

Adjacent channel interference: applicable to all bands; the existing or previously authorized system must be afforded a carrier to interfering signal protection ratio of at least 56 dB.

(3) Applicants for frequencies listed in § 101.147(b)(1) must make the following showings that protection criteria have been met over the entire service area of existing systems. Such showings may be made by the applicant or may be satisfied by a statement from a frequency coordinator.

(i) For multiple address stations in the 928-929/952-960 MHz bands, a

statement that the proposed system complies with the following co-channel separations from all existing stations and pending applications:

Fixed-to-fixed	145 km
Fixed-to-mobile	113 km
Mobile-to-mobile	81 km

Multiple address systems employing only remote stations will be treated as mobile for the purposes of determining the appropriate separation. For mobile operation, the mileage is measured from the reference point specified on the license application. For fixed operation on subfrequencies in accordance with § 101.147 of this Part, the mileage also is measured from the reference point specified on the license application.

(ii) For multiple address stations in the 932-932.5/941-941.5 MHz bands, a statement that the proposed system complies with the following co-channel separation from all existing stations and pending applications:

Fixed-to-fixed	113 Km

(iii) In cases where the geographic separation standard in paragraphs (c)(3)(i) and (c)(3)(ii) of this section are not followed, an engineering analysis must be submitted to show the coordination of the proposed assignment with existing systems located closer than those standards. The engineering analyses will include:

(A) Specification of the interference criteria and system parameters used in the interference study.

(B) Nominal service areas of each system included in the interference analysis.

(C) Modified service areas resulting from the proposed system. The propagation models used to establish the service boundary limits must be specified and any special terrain features considered in computing the interference impact should be described.

(D) A statement that all parties affected have agreed to the engineering analysis and will accept the calculated levels of interference.

(4) Multiple address systems operating on subfrequencies in accordance with § 101.147 of this Part that propose to operate master stations at unspecified locations must

define the operating area by a radius about a geographical coordinate and describe how interference to co-channel users will be controlled.

(5) Multiple address frequencies in the 956 MHz band may be assigned for use by mobile master stations on a primary basis. Multiple address frequencies in the 952 MHz band may be assigned for use by mobile master stations on a case-by-case basis. Mobile operation in the 952 MHz band will be on a secondary basis to fixed operations.

(6) Each application for new or modified nodal station on channels numbered 4A, 4B, 7, 9, and 19/20 in the 10.6 GHz band and all point-to-multipoint channels in the 18 GHz band must demonstrate that all existing co-channel stations are at least 56 kilometers from the proposed nodal station site. Applicants for these channels must certify that all licensees and applicants for stations on the adjacent channels within 56 kilometers of the proposed nodal station have been notified of the proposed station and do not object. Alternatively, or if one of the affected adjacent channel interests does object, the applicant may show that all affected adjacent channel parties are provided a C/I protection ratio of 0 dB. An applicant proposing to operate at an AAT greater than 91 meters must reduce its EIRP in accordance with the following table; however, in no case may EIRP exceed 70 dBm on the 10.6 GHz channels.

AAT (meters)	**EIRP dBm**
Above 300	+38
251 to 300	41
201 to 250	43
151 to 200	49
101 to 150	55
100 and below	85

(7) Each application for new or modified nodal station on channels numbered 21, 22, 23, and 24 in the 10.6 GHz band must include an analysis of the potential for harmful interference to all other licensed and previously applied for co-channel and adjacent channel station located within 80 kilometers of the location of the proposed station. The criteria contained in § 101.103(d)(2) must be used in this analysis. Applicants must certify that copies of this analysis have been served on all parties which might reasonably be expected to receive interference above the levels set out in § 101.103(d)(2) within 5 days of the date the

subject application is filed with the Commission.

(8) If the potential interference will exceed the prescribed limits, a statement shall be submitted with the application for new or modified stations to the effect that all parties have agreed to accept the higher level of interference.

(d) Effective August 1, 1985, when a fixed station that conforms to the technical standards of this subpart (or, in the case of the 12,200-12,700 MHz band, a direct broadcast satellite station) receives or will receive interference in excess of the levels specified in this section as a result of an existing licensee's use of non-conforming equipment authorized between July 20, 1961 and July 1, 1976, and the interference would not result if the interfering station's equipment complied with the current technical standards, the licensee of the non-conforming station must take whatever steps are necessary to correct the situation up to the point of installing equipment which fully conforms to the technical standards of this subpart. In such cases, if the engineering analysis demonstrates that (1) the conforming station would receive interference from a non-conforming station in excess of the levels specified in this section and (2) the interference would be eliminated if the non-conforming equipment were replaced with equipment which complies with the standards of this subpart, the licensee (or prospective licensee) of the station which would receive interference must provide written notice of the potential interference to both the non-conforming licensee and the Commission's office in Gettysburg, PA. The non-conforming licensee must make all required equipment changes within 180 days from the date of official Commission notice informing the licensee that it must upgrade its equipment, unless an alternative solution has been agreed to by all parties involved in the interference situation. If a non-conforming licensee fails to make all required changes within the specified period of time, the Commission may require the licensee to suspend operation until the changes are completed.

(e) Interference Dispute Resolution Procedures.

Should a licensee licensed under this part receive harmful interference from another licensee licensed under this chapter, the parties involved shall comply with the dispute resolution procedures set forth herein:

(i) The licensee experiencing the harmful interference shall notify the licensee believed to be causing the harmful interference and shall supply information describing its problem and supporting its claim.

(ii) Upon receipt of the harmful interference notice, the licensee alleged to be causing the harmful interference shall respond immediately and make every reasonable effort to identify and resolve the conflict.

(iii) Licensees are encouraged to resolve the harmful interference prior to contacting the Commission.

§ 101.107 Frequency tolerance.

(a) The carrier frequency of each transmitter authorized in these services must be maintained within the following percentage of the reference frequency except as otherwise provided in paragraph (b) of this section or in the applicable subpart of this part (unless otherwise specified in the instrument of station authorization the reference frequency will be deemed to be the assigned frequency):

	FREQUENCY TOLERANCE (PERCENT)		
Frequency (MHz)	**All fixed and base stations**	**Mobile stations over 3 watts**	**Mobile stations 3 watts or less**
928 to 929 (2)(5)	0.0005		
932 to 932.5 (2)	0.00015		
932.5 to 935 (2)	0.00025		
941 to 941.5	0.00015		
941.5 to 944	0.00025		
952 to 960 (7)			
944.0 to 1,000	0.0005	0.0005	0.0005
1,850 to 1,990	0.002		
2,110 to 2,200	0.001		
2,200 to 12,200 (1) (3)	0.005	0.005	0.005
2,450 to 2,500	0.001		
3,700 to 4,200	0.005		
5,925 to 6,875	0.005		
10,550 to 11,700	0.005		
12,200 to 13,250 (6)	0.005		
12,200 to 17,700	0.03	0.03	0.03
17,700 to 18,820 (4)(5)	0.003		
18,820 to 18,920 (4)(5)	0.001		
18,920 to 19,700 (4)(5)	0.003		

	FREQUENCY TOLERANCE (PERCENT)		
Frequency (MHz)	**All fixed and base stations**	**Mobile stations over 3 watts**	**Mobile stations 3 watts or less**
19,700 to 40,000 (6)	0.03	0.03	0.03

(1) Applicable only to common carrier LTTS stations. Beginning Aug. 9, 1975, this tolerance will govern the marketing of LTTS equipment and the issuance of all such authorizations for new radio equipment. Until that date new equipment may be authorized with a frequency tolerance of .03 percent in the frequency range 2,200 to 10,500 MHz and .05 percent in the range 10,500 MHz to 12,200 MHz, and equipment so authorized may continue to be used for its life provided that it does not cause interference to the operation of any other licensee.

(2) Equipment authorized to be operated on frequencies between 890 and 940 MHz as of Oct. 15, 1956, must maintain a frequency tolerance within 0.03 percent subject to the condition that no harmful interference is caused to any other radio station.

(3) See Subpart G for the stability requirements for transmitters used in the Digital Electronic Message Service.

(4) Existing type accepted equipment with a frequency tolerance of ±0.03% may be marketed until December 1, 1988. Equipment installed and operated prior to December 1, 1988 may continue to operate after that date with a minimum frequency tolerance of ±0.03%. However, the replacement of equipment requires that the ±0.003% tolerance be met.

(5) For remote stations with 12.5 KHz bandwidth, the tolerance is ±0.00015%.

(6) Applicable to private operational fixed point-to-point microwave only. For exceptions see § 101.147.

(7) For private operational fixed point-to-point microwave systems, with a channel greater than or equal to 50 KHz bandwidth, ±0.0005%; for multiple address master stations, regardless of bandwidth, ±0.00015%; for multiple address remote stations with 12.5 KHz bandwidths, ±0.00015%; for multiple address remote stations with channels greater than 12.5 KHz bandwidth, ±0.0005%.

(b) Heterodyne microwave radio systems may be authorized at a somewhat less restrictive frequency tolerance (up to .01 percent) to compensate for frequency shift caused by numerous repeaters between base band signal insertion. Where such relaxation is sought, applicant must provide all calculations and indicate the desired tolerance over each path. In such instances the radio transmitters and receivers used must individually be capable of complying with the tolerance specified in paragraph (a) of this section. Heterodyne operation is restricted to

channel bandwidth of 10 MHz or greater.

(c) As an additional requirement in any band where the Commission makes assignments according to a specified channel plan, provisions must be made to prevent the emission included within the occupied bandwidth from radiating outside the assigned channel at a level greater than that specified in § 101.111.

§ 101.109 Bandwidth.

(a) Each authorization issued pursuant to these rules will show, as the emission designator. a symbol representing the class of emission which must be prefixed by a number specifying the necessary bandwidth. This figure does not necessarily indicate the bandwidth actually occupied by the emission at any instant. In those cases where Part 2 of this chapter does not provide a formula for the computation of the necessary bandwidth, the occupied bandwidth may be used in the emission designator.

(b) Stations in this service will be authorized any type of emission, method of modulation, and transmission characteristic, consistent with efficient use of the spectrum and good engineering practice, except that Type B. damped-wave emission will not be authorized.

(c) The maximum bandwidth which will be authorized per frequency assigned is set out in the table that follows. Regardless of the maximum authorized bandwidth specified for each frequency band, the Commission reserves the right to issue a license for less than the maximum bandwidth if it appears that a lesser bandwidth would be sufficient to support an applicant's intended communications.

Frequency Band (MHz)	Maximum Authorized Bandwidth
928 to 929	25 KHz /1/ /6/
932 to 932.5, 941 to 941.5	12.5 KHz /1/
932.5 to 935, 941.5 to 944	200 KHz /1/
952 to 960	200 KHz /1/ /5/
1,850 to 1,990	10 MHz /1/
2,110 to 2,130	3.5 MHz
2,130 to 2,150	800 or 1600 KHz /1/

2,150 to 2,160	10 MHz
2,160 to 2,180	3.5 MHz
2,180 to 2,200	800 or 1600 KHz /1/
2,450 to 2,483.5	625 KHz /2/
2,483.5 to 2,500	800 KHz
3,700 to 4,200	20 MHz
5,925 to 6,425	30 MHz /1/
6,425 to 6,525	25 MHz
6,525 to 6,875	10 MHz /1/
10,550 to 10,680	5 MHz /1/
10,700 to 11,700	40 MHz /1/
12,200 to 12,700	20 MHz /1/
13,200 to 13,250	25 MHz
17,700 to 18,140	220 MHz /1/
18,140 to 18,142	2 MHz
18,142 to 18,580	6 MHz
18,580 to 18,820	20 MHz /1/
18,820 to 18,920	10 MHz
18,920 to 19,160	20 MHz /1/
19,160 to 19,260	10 MHz
19,260 to 19,700	220 MHz /1/
21,200 to 23,600	100 MHz /4/
27,500 to 29,500	220 MHz
31,000 to 31,300	25 or 50 MHz
38,600 to 40,000	50 MHz
Bands above 40,000	/3/

/1/ The maximum bandwidth that will be authorized for each particular frequency in this band is detailed in the appropriate frequency table in § 101.147.

/2/ 1250 KHz, 1875 KHz, or 2500 KHz on a case-by-case basis.

/3/ To be specified in authorization.

/4/ For exceptions, see § 101.147(t).

/5/ A 12.5 KHz bandwidth applies only to frequencies listed in § 101.147(b)(1).

/6/ For frequencies listed in § 101.147(b)(1), consideration will be given on a case-by-case basis to authorizing bandwidths up to 50 KHz.

§ 101.111 Emission limitations.

(a) The mean power of emissions must be attenuated below the mean output power of the transmitter in accordance with the following schedule:

(1) When using transmissions other than those employing digital modulation techniques:

(i) On any frequency removed from the assigned frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth: At least 25 decibels;

(ii) On any frequency removed from the assigned frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth: At least 35 decibels;

(iii) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43+10 Log_{10} (mean output power in watts) decibels, or 80 decibels, whichever is the lesser attenuation.

(2) When using transmissions employing digital modulation techniques (see § 101.141(b)) in situations not covered in this section:

(i) For operating frequencies below 15 GHz, in any 4 KHz band, the center frequency of which is removed from the assigned frequency by more than 50 percent up to and including 250 percent of the authorized bandwidth: As specified by the following equation but in no event less than 50 decibels.

$A=35+0.8(P-50)+10\ Log_{10}B$. (Attenuation greater than 80 decibels is not required.)

where:

A=Attenuation (in decibels) below the mean output power level.
P=Percent removed from the carrier frequency.
B=Authorized bandwidth in MHz.

(ii) For operating frequencies above 15 GHz, in any 1 MHz band, the center

frequency of which is removed from the assigned frequency by more than 50 percent up to and including 250 percent of the authorized bandwidth: As specified by the following equation but in no event less than 11 decibels.

$A=11+0.4(P-50)+10\ Log_{10}B$. (Attenuation greater than 56 decibels is not required.)

(iii) In any 4 KHz band, the center frequency of which is removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43+10 Log_{10} (mean output power in watts) decibels, or 80 decibels, whichever is the lesser attenuation.

(3) For Digital Termination System channels used in the Digital Electronic Message Service (DEMS) operating in the 10,550-10,680 MHz band:

(i) In any 4 KHz band, the center frequency of which is removed from the edge of the DEMS channel by up to and including 1.125 times the DEMS subchannel bandwidth: As specified by the following equation may in no event be less than 50+10 $\log_{10}$ N decibels.

$A=50+0.0333\ (F-0.5B)+10\ \log_{10} N$ decibels

Where:
A=Attenuation (in decibels) below means output power level contained within the DEMS channel for a given polarization.
B=Bandwidth of DEMS channel (in KHz).
F=Absolute value of the difference between the center frequency of the 4 KHz band measured and the center frequency of the DEMS channel (in KHz).
N=Number of active subchannels of the given polarization within the DEMS channel.

(ii) In any 4 KHz band within the authorized DEMS band the center frequency of which is removed from the center frequency of the DEMS channel by more than the sum of 50% of the DEMS channel bandwidth plus 1.125 times the subchannel bandwidth: As specified by the following equation but in no event less than 80 decibels.

$A=80+10\ \log_{10} N$ decibels

(iii) In any 4 KHz band the center frequency of which is outside the

authorized DEMS band: At least 43+10 $\log_{10}$ (mean output power in Watts) decibels.

(4) For Digital Termination System channels used in the Digital Electronic Message Service (DEMS) operating in the 17,700-19,700 MHz band:

(i) In any 4 KHz band, the center frequency of which is removed from the frequency of the center of the DEMS channel by more than 50 percent of the DEMS channel bandwidth up to and including 50 percent plus 500 KHz: As specified by the following equation but in no event be less than 50+10 $\log_{10}$ N decibels.

$A=50+0.06\ (F-0.5B)+10\ \log_{10} N$ decibels

Where:
A=Attenuation (in decibels) below means output power level contained within the DEMS channel for a given polarization.
B=Bandwidth of DEMS channel (in KHz).
F=Absolute value of the difference between the center frequency of the 4 KHz band measured and the center frequency of the DEMS channel (in KHz).
N=Number of active subchannels of the given polarization within the DEMS channel.

(ii) In any 4 KHz band within the authorized DEMS band, the center frequency of which is removed from the center frequency of the DEMS channel by more than the sum of 50 percent of the channel bandwidth plus 500 KHz: As specified by the following equation but in no event less than 80 decibels.

$A=80+10\ \log_{10} N$ decibels

(iii) In any 4 KHz band the center frequency of which is outside the authorized Digital Message Service band:

At least 43+10 $\log_{10}$ (mean output power in Watts) decibels.

(5) When using transmissions employing digital modulation techniques on the 900 MHz multiple address frequencies with a 12.5 KHz bandwidth, the power of any emission must be attenuated below the unmodulated carrier power of the transmitter (P) in accordance with the following schedule:

(i) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in KHz) of more than 2.5 KHz up to and including 6.25 KHz: At least 53 $\log_{10}$ (fd/2.5) decibels;

(ii) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in KHz) of more than 6.25 KHz up to and including 9.5 KHz: At least 103 $\log_{10}$ (fd/3.9) decibels;

(iii) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in KHz) of more than 9.5 KHz up to and including 15 KHz: At least 157 $\log_{10}$ (fd/5.3) decibels;

(iv) On any frequency removed from the center of the authorized bandwidth by a displacement frequency greater than 15 KHz: At least 50 plus 10 $\log_{10}$(P) or 70 decibels, whichever is the lesser attenuation.

(4) When using transmissions employing digital modulation techniques on the 900 MHz multiple address frequencies with a bandwidth greater than 12.5 KHz, the power of any emission must be attenuated below the unmodulated carrier power of the transmitter (P) in accordance with the following schedule;

(i) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in KHz) of more than 5 KHz up to and including 10 KHz: At least 83 $\log_{10}$ (fd/5) decibels;

(ii) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in KHz) of more than 10 KHz up to and including 250 percent of the authorized bandwidth: At least 116 $\log_{10}$ (fd/6.1) decibels or 50 plus 10 $\log_{10}$ (P) or 70 decibels, whichever is the lesser attenuation;

(iii) On any frequency removed from the center of the authorized bandwidth by more that 250 percent of the authorized bandwidth: At least 43 plus 10 $\log_{10}$ (output power in watts) decibels or 80 decibels, whichever is the lesser attenuation.

(b) When an emission outside of the authorized bandwidth causes harmful interference. the Commission may, at its discretion, require greater attenuation than specified in paragraph (a) of this section.

(c) The emission of an unmodulated carrier is prohibited except for test purposes as required for proper station and system maintenance.

§ 101.113 Transmitter power limitations.

(a) On any authorized frequency, the average power delivered to an antenna in this service must be the minimum amount of power necessary to carry out the communications desired. Application of this principle includes, but is not to be limited to, requiring a licensee who replaces one or more of its antennas with larger antennas to reduce its antenna input power by an amount appropriate to compensate for the increased primary lobe gain of the replacement antenna(s). In no event shall the average equivalent isotropically radiated power (EIRP), as referenced to an isotropic radiator, exceed the values specified below. In cases of harmful interference, the Commission may, after notice and opportunity for hearing, order a change in the effective radiated power of this station. Further, the output power of a transmitter on any authorized frequency in this service may not exceed the following:

Frequency Band (MHz)	Maximum allowable EIRP (1)*	
	Fixed (dBW)	Mobile (dBW)
928.0 to 929.0	+17	. . . .
932.0 to 932.5	+17	. . . .
932.5 to 935.0	+40	. . . .
941.0 to 941.5	+30	. . . .
941.5 to 944.0	+40	. . . .
952.0 to 960.0 (1)	+40	. . . .
1,850 to 1,990	+45	. . . .
2,110 to 2,130	+45	. . . .
2,130 to 2,150	+45	
2,150 to 2,160 (2)	+45	
2,160 to 2,180 (2)	+45	. . . .
2,180 to 2,200	+45	. . . .
2,450 to 2,500	+45	. . . .
2,500 to 2,686 (3)		
2,686 to 2,690 (3)	+45	. . . .
3,700 to 4,200	+55	. . . .
5,925 to 6,425 (3)	+55	. . . .
6,425 to 6,525 (3)	. . . .	+35

Frequency Band (MHz)	Maximum allowable EIRP (1)*	
	Fixed (dBW)	Mobile (dBW)
6,525 to 6,875 (3)	+55	. . . .
10,550 to 10,680 (4)	+55	. . . .
10,700 to 11,700	+55	. . . .
12,200 to 12,700	+50	. . . .
12,700 to 13,250 (3)	+50	
17,700 to 18,600	+55	. . . .
18,600 to 18,800 (5)	+35	. . . .
18,800 to 19,700	+55	. . . .
21,200 to 23,600 (6)	(4) +55	. . . .
27,500 to 29,500	+55	. . . .
31,000 to 31,300	. . . . (7)	. . . . (7)
38,600 to 40,000	+55	. . . .

*per polarization

(1) For multiple address operations, see § 101.147. Remote alarm units that are part of a multiple address central station protection system are authorized a maximum of 2 watts.

(2) When an omnidirectional antenna is authorized in the 2150-2160 MHz band, the maximum power shall be 60 dBm.

(3) Also, see § 101.145.

(4) The output power of a DEMS System nodal transmitter shall not exceed 0.5 watts per 250 KHz. The output power of a DEMS System user transmitter shall not exceed 0.04 watts 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.

(5) Maximum power delivered to the antenna shall not exceed -3 dBW

(6) Also, see § 101.147(t).

(7) The maximum transmit power is 0.05 watts.

(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.

§ 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) Stations operating below 932.5 MHz that are required to use directional antennas must employ antennas meeting the standards indicated below. (Maximum beamwidth is for the major lobe of radiation at the half power points. Suppression is the minimum attenuation required for any secondary lobe signal and is referenced to the maximum signal in the main lobe.)

Frequency range	Maximum beamwidth (degrees)	Suppression (dB)
512 to 932.5 MHz	20	13

(c) 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 subjected to frequency congestion antennas meeting performance Standard B may be used subject to the requirements set forth in paragraph (d) of this Section.