AM STANDARDS

FILING INSTRUCTIONS

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RULES #553

PARTS	PAGES	CHANGES
73 AMS	13	73.184(a) and (b) revised
	14	No change
	15	73.184(d) revised
	16	73.184(f) "
	16a add	General information re: new Metric Groundwave Field Strength Curves
	16b add	Sample Field Strength Measurement Form. If used, may be reproduced.
	Graphs	Remove old graphs 1 through 19 and replace with new graphs 1 through 19a

Note - The enclosed groundwave curves become effective on February 1, 1987 and all studies filed with FCC must use the new curves.

Remove blue page filed opposite page 7 of Part 73 TVS, also
" " " " " 12aI of Part 73H

Please place this instruction sheet in front of Rules book preceding all other material. If for some reason the last preceding numbered sheet is found to be missing, inform us, and it, with amendments will be mailed immediately.

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1/20/87

FILING INSTRUCTIONS

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RULES # 552

PARTS	PAGES	CHANGES
0	72	0.465(a) 2nd and 4th sentence deleted; note revised; (b) revised; old (c)(1) now (e) and now on new page 72aa; (c)(2) now (c)(1) and revised; (c)(3) now (c)(2)
	72a	0.465note added to (c)(2); (c)(4) now (c)(3); (d)(1) and (d)(3) revised
	72aa	0.465(d)(4) added; (e) revised
1	8	1.52 revised
	a24	no change was old page 24
	24	1.115(e)(3) revised
2	75	2.933(a) last sentence added
	76	2.936(b) and (c) paragraph numbers changed
	76a	2.939(a)(1) paragraph numbers changed
	78	2.967(c) revised
	79aa	2.977(d) added. Remove blue page opposite
	a87a	2.1001(1) " " " " "
	88	2.1035(a) and (c) revised
73AM	27a	Should this page be missing, please file. No change
	a30a	73.38(b) note added
	40-45	73.127(f) 2nd line, number (6) deleted
73H	9	73.1225(c) revised
	9a	73.1225(d) revised, remove blue page opposite
	12aI	73.1660(b) and (d) last sentence added
	12a1V	73.1690(b)(1) and (2) deleted, (b)(3),(4) and (5) now (b)(1), (2) and (3)
	12V	73.1690(e) revised, remove blue page opposite, docket #86-264 dated 7/14/86
74	79d	74.913(b)(3)(ii) deleted; (d) note 3 added.

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11/28/86

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AM BROADCAST TECHNICAL STANDARDS

STANDARD BROADCAST TECHNICAL STANDARDS

73.182 Engineering standards of allocation. (a) Sections 73.21 to 73.37 inclusive, govern allocation of facilities in the AM broadcast band of 535 to 1605 kc/s. Section 73.21 establishes three classes of channels in this band, namely, clear channels, regional channels for the use of medium powered stations, and local channels for the use of low-powered stations. The classes and power of AM broadcast stations which will be assigned to the various channels are set forth in 73.21. the classification of the AM broadcast stations are as follows:

(1) Class I stations are dominant stations operating on clear channels with powers of not less than 10 or more than 50 kw. These stations are designed to render primary and secondary service over an extended area and at relatively long distances, hence have their primary service areas free from objectionalbe interference from other stations on the same and adjacent channels and secondary service areas free from objectionable interference from stations on the same channels. (The secondary service area of a Class I station is not protected from adjacent channel interference. However, it it is desired to make a determination of the area in which adjacent channel groundwave interference (10 kHz removed) to skywave service exists, it may be considered as the area where the ratio of the desired 50% skywave of the Class I station to the undesired groundwave of a station 10 kc removed is 1 to 4). From an engineering point of view, Class I stations may be divided into 3 groups and, hereafter, for the purpose of convenience, the 3 groups of Class I stations will be termed Class I-A, I-B or I-N in accordance with the assignment to channels allocated by §73.25(a) or (b).

(i) The Class I station in Group I-A are those assigned to the channels allocated by Section 73.25(a). The power of these stations shall be 50kW. The Class I stations in this group are afforded protection as follows:

(A) DAYTIME: To the 0.1 mV/m groundwave contour from stations on the same channel, and to the 0.5 mV/m groundwave contour from stations on adjacent channels.

(B) NIGHTTIME, To the 0.5 mV/m 50% skywave contour from stations on the same channel, and to the 0.5 mV/m groundwave contour from stations on adjacent channels.

(ii) The Class I stations in group I-B are those assigned to the channels allocated by 73.25(b), on which duplicate operation is permitted, that is, other Class I or Class II stations operating unlimited time may be assigned to such channels. During nightime hours in operation a Class I-N station is protected to the 100uV/m 50 percent skywave contour and a Class I-B station of this group is protected to the 500uV/m 50 percent skywave contour. During daytime hours of operation Class I-B and Class I-N stations are protected to the 100uV/m groundwave contour from stations on the same channel. Protection in given to the 500uV/m groundwave contour from stations on adjacent channels for both day and nightime operation. The operating powers of Class I stations on these frequencies shall be not less than 10kW nor more than 50 kW.

(iii) In Alaska there is a third group of ClassI stations, designated as ClassI-N. These station operate on channels allocated by 73.25(a) or Section 73.25(b) with a minimum power of 10 kW and antenna efficiency of 175 mV/m for 1 kW. Stations operating on these channels in Alaska which have not been designated as Class I-N stations in response to licensee request will continue to be condidered as Class II stations. During daytime hours a Class I-N station receives protection to the 100 uV/m groundwave contour from co-channel stations. During nithttime hours a Class I-N station receives protection to the 100uV/m 50 percent skywave contour from cochannel stations. Protection is given to the 500 uV/m groundwave contour from stations on adjacent channels for both day and nighttime operation.

Note: In the Report and Order in MM Docket No. 83-807, the Commission designated 15 stations operating on U.S. clear channels as Class I-N stations. Eleven of these stations already have Class I-N facilities and are to be protected accordingly. Permanent designation of the other four stations as Class I-N is conditioned on their constructing minimum Class I-N facilities no later than December 31, 1989. During this period, until such facilities are obtained, temporary designation as Class I-N stations shall be applied and calculations involving these stations should be based on existing facilities but with an assumed power of 10 kW. Therefore, these stations are to be protected based on their actual Class I-N facilities. If any of these stations does not obtain Class I-N facilities in the period specified, it is to be protected as a Class II station based on its actual facilities. These four stations may increase power to 10kW without regard to the impact on Class II co-channel stations. However, increases by these stations beyond 10kW (or by existing Class I-N stations beyond their current power level) are subject to applicable protection requirements for co-channel Class II stations. Other stations not on the original list but which meet applicable requirements may obtain Class I-N status by seeking such designation from the Commission. If a power increase or other change in facilities by a station not on the original list is required to obtain minimum Class I-N facilities, any such application shall meet the interference protection requirements applicable to a Class I-N proposal on the channel.

(2) Class II stations are secondary to stations which operate on clear channels with powers not less than 250 watts nor more than 50 kW, except that Class II-A stations shall not operate nighttime with less than 10 kW, and Class II-B stations coming within Section 73.21(a)(2)(ii)(C) shall not operate with nighttime power exceeding 1 kW. Class II stations are required to use directional antennas or other means to avoid causing interference within the normally protected service areas of Class I stations or other Class II stations. (For special rules concerning Class II-A stations, see Section 73.22.) These stations normally render primary service only, the area of which depends on the geographical location, power, and frequency. This may be relatively large but is limited by an subject to such interference as may be received from Class I stations. However, it is recommended that Class II stations be so located that the interference received from other stations will not limit the service area to greater than 2.5 mV/m groundwave contour nighttime and 0.5 mV/m groundwave contour daytime, which are the values for the mutual protection of this class of stations with other stations of the same class. There are three exceptions:

(i) Class II-A stations are normally protected at night to the limit imposed by the co-channel Class I-A station;

(ii) Class II-B stations coming within Section 73.21(a)(2)(ii)(D) are normally protected at night to the limit imposed by the co-channel Class I-A or Class I-N station or the higher limit, if any, imposed by previously authorized facilities of other stations: and

(iii) Class II-B stations coming within Section 73.21(a)(2)(ii)(C) are normally protected at nighttime to their 10mV/m groundwave contour, or the higher limit, if any, imposed by previously authorized facilities of other stations.

(3) Class III stations operate on regional channels and normally render primar service to the larger cities and the rural area contiguous thereto. They operate with powers not less than 0.5kW and not more than 5kW and are normally protected to the 2500uV/m groundwave contour nighttime and the 500uV/m groundwaver contour daytime; provided, that Class IV stations in the 48 conterminous United States may, during nighttime hours, treat all stations assigned in Alaska, Hawaii, Puerto Roco and the U.S. Virgin Islands on 1230, 1240, 1340, 1400, 1450 and 1490kHz as if they were Class IV stations.

Note 1 - Class III stations in Alaska, Hawaii, Puerto Roco and The U.S. Virgin Islands are permitted a maximum power of 50kW day or night. Use of such higher power is subject to amendment of the U.S./Mexican Agreement and final disposition of NARBA. Pending such amendment, the maximum power permitted stations in these localities may not exceed 5kW. Stations in the above-names places that are reclassified from Class IV to Class III stations under 73.26(b) shall not be authorized to increase power to levels that, under the RSS procedure and the 50% exclusion rule in 73.182(o), would increase the nighttime interference-free limit of cochannel Class IV stations in the conterminous U. S.

Note 2 - Stations that were classified as Class III-B, before the distinctions between Class III-A and Class III-B stations were removed, shall-insofar as AM applications filed before March 10, 1986 are concerned--remain normally protected during nighttime hours to their 4000 uV/m contour.

(4) Class IV stations operate on local channels, normally rendering primary service or rural areas, contiguous thereto, with powers not less than 0.25 kW, nor more than 1 kW, except as provided in 73.21(c)(1) (for restrictions on daytime power of stations near the Mexican border see Note 2 in 73.21. Such stations are normally protected to the 0.5 mVm contour daytime. On local channels the separation required for the daytime protection shall also determine the nightime seperation. Where directional antennas are employed daytime by Class IV stations operating with more than 0.25 kW power, the seperation required shall in no case be less than those necessary to afford protection, assuming nondirectional operation with 0.25 kW. In no case will 0.25 kW or greater nightime power be authorized to a station unable to operate nondirectionally at 0.25 kW in the daytime. The actual nightime limitation will be calculated.

NOTE: The following approximate method may be used. It is based on the assumption of 0.25 wavelength antenna height and 88 mv/m at one mile effective field for 250 watts power, using the 10% skywave field intensity curve of Figure 2 of §73.190. Zones defined by circles of various radii specified below are drawn about the desired station and the interfering 10% skywave signal from each station in a given zone is considered to be the value tabulated below. The effective interfering 10% skywave signal is taken to be the RSS value of all signals originating within these zones. (Stations beyond 500 miles are not considered.)

ZONE	Inner Radius	Outer Radius	10 percent skywave signal (mv/m)
A	--	60	0.10
B	60	80	.12
C	80	100	.14
D	100	250	.16
E	250	350	.14
F	350	450	.12
G	450	500	.10

Where the power of the interfering station is not 250 watts, the 10% skywave signal should be adjusted by the square root of the ratio of the power to 250 watts.

(b) The class of any station is determined by the channel assignment,-the power, and the field intensity contour to which it renders service free of interference from other stations as determined by these standards. No station will be permitted to change to a class normally protected to a contour of less intensity than the contour to which the station actually renders interference-free service. Any station of a class normally protected to a contour of less intensity than that to which the station actually render interference-free service, will be automaticlly reclassified according to the class normally protected, the minimum consistent with the power and channel assignment. Likewise, any station to which the interference is reduced so that service is rendered to a contour normally protected for a higher class will be automatically changed to that class if consistent with its power and channel assignment.

(c) Reserved.

(d) When a station is already limited by interference from other stations to a contour of higher value than that normally protected for its class, this contour shall be the established standard for such station with respect to interference from all other stations.

(e) The several classes of broadcast stations have in general three service areas; namely, primary, secondary, and intermittent service area. (See §73.11 for the definitions of primary, secondary, and intermittent service areas.) Class I stations render service to all three service areas. Class II stations render service to a primary area but the secondary and intermittent service areas may be materially limited or destroyed due to interference from other stations depending on the station assignments involved. Class III and IV stations usually have only primary service areas as interference from other stations generally prevents any secondary service and may limit the intermittent service area. However, complete intermittent service may be obtained in many cases depending on the station assignments involved.

(f) The groundwave signal strength required to render primary service is 2 mV/m for communities with populations of 2,500 or more; and 0.5 mV/m for communities with populations of less then 2,500. See 73.184 for curves showing distance to various groundwav field strength contours for different frequencies and ground conductivities and also see 73.183, "Groundwave Signals."

(g) The FCC will authorize the directional antenna for a Class IV station for daytime operation only with power in excess of 0.25 kW. In computing the degrees of protection which such antenna will aford, the radiation produced by this antenna will be assumed to be no less, in any direction, than that which would result from non-directional operation using a single element of the directional array with 0.25 kW.

(h) All classes of broadcast stations have primary service areas subject to limitation by fading and noise, and interference from other stations to the contours set out for each class of station.

(i) Secondary service is delivered in the areas where the skywave for 50% or more of the time has a field strength of 0.5 mV/m or greater (0.1 mVm in Alaska).

It is not considered that satisfactory secondary service can be rendered to cities unless the skywave approaches in value the groundwave required for primary service. The secondary service is necessarily subject to some interference and extensive fading whereas the primary service area of a station is subject to no objectionable interference or fading. Class I stations only are assigned on the basis of rendering secondary service.

NOTE: Standards have not been established for objectionable fading as such standards would necessarily depend on the receiver characteristics which have been changed considerably in this regard during the last several years. Selective fading causing audio distortion and the signal fading below the noise level are the objectionable characteristics of fading on modern design receivers. The AVC circuits in the better designed modern receivers in general maintain the audio output sufficiently constant to be satisfactory during most fading.

(j) The intermittent service is rendered by the groundwave and begins at the outer boundary of the primary service area and extends to the value of signal where it may be considered as having no further service value. This may be down to only a few microvolts in certain areas and up to several millivolts in other areas of high noise level, interference from other stations, or objectionable fading at night. The intermittent service area may vary widely from day to night and generally varies from time to time as the name implies. Only Class I stations are assigned for protection from interference from other stations into the intermittent service area.

(k) Section 73.23 provides that the several classes of broadcast stations may be licensed to operate unlimited time, limited time, daytime, sharing time, and specified hours, with full explanation given in the section (see §3.38 for restriction on limited time authorizations.

(l) Section 73.24 sets out the general requirements for obtaining an increase in facilities of a licensed station and for a new station. Sections 73.24(b) and 73.37 concern the matter of interference that may be caused by a new assignment or increase in facilities of an existing assignment.

(m) (Reserved.)

(n) (Reserved.)

(o) Objectionable interference from a station on an adjacent channel shall be considered to exist to a station when, at the normally protected contour of a desired station, the field strength of the ground wave of an undesired station operating on an adjacent channel (or the root-sum-square value of the field strengths of two or more such undesired stations operating on the same adjacent channel) exceeds a value specified in paragraph (u) of this section.

(1) With respect to the root-sum-square values of interfering field intensities referred to herein, except in the case of Class IV stations on local channels, calculation is accomplished by considering the signals in order of decreasing magnitude, adding the squares of the values and extracting the square root of the sum, excluding those signals which are less than 50% of the RSS value of the higher signals already included.

(2) The RSS value will not be considered to be increased when a new interfering signal is added which is less than 50% of the RSS value of the interference from existing stations, and which at the same time is not greater than the smallest signal included in the RSS value of interference from existing stations.

(3) It is recognized that application of the above "50% exclusion" method of calculating the RSS interference may result in some cases in anomalies wherein the addition of a new interfering signal or the increase in value of an existing interfering signal will cause the exclusion of a previously included signal and may cause a decrease in the calculated RSS value of interference. In order to provide the Commission with more realistic information regarding gains and losses in service (as a basis for determination of the relative merits of a proposed operation) the following alternate method for calculating the proposed RSS values of interference will be employed wherever applicable.

(4) In the cases where it is proposed to add a new interfering signal which is not less than 50% of the RSS value of interference from existing stations or which is greater than the smallest signal already included to obtain this RSS value, the RSS limitation after addition of the new signal shall be calculated without excluding any signal previously included. Similarly, in cases where it is proposed to increase the value of one of the existing interfering signals which has been included in the RSS value, the RSS limitation after the increase shall be calculated without excluding the interference from any source previously included.

(5) If the new or increased signal proposed in such cases is ultimately authorized, the RSS values of interference to other stations affected will thereafter be calculated by the "50% exclusion" method without regard to this alternate method of calculation.

(6) Examples of RSS interference calculations:

(i) Existing interferences:

Station No. 1 -- 1.0 mv/m
Station No. 2 -- 0.60 mv/m
Station No. 3 -- 0.59 mv/m
Station No. 4 -- 0.58 mv/m

The RSS value from Nos. 1, 2 and 3 is 1.31 mv/m: therefore interference from No. 4 is excluded for it is less than 50% of 1.31 mv/m.

(ii) Station A receives interference from:

Station No. 1 -- 1.0 mv/m
Station No. 2 -- 0.60 mv/m
Station No. 3 -- 0.59 mv/m

It is proposed to add a new limitation--0.68 mv/m. This is more than 50% of 1.31 mv/m, the RSS value of Nos. 1, 2 and 3. The RSS value of Station No. 1 and the proposed station would be 1.21 mv/m which is more than twice as large as the limitation from Station No. 2 or No. 3. However, under the above provision the new signal and the three existing interferences are nevertheless calculated for purposes of comparative studies, resulting in an RSS value of 1.47 mv/m. However, if the proposed station is ultimately authorized, only No. 1 and the new signal are included in all subsequent calculations for the reason that Nos. 2 and 3 are less than 50% of 1.21 mv/m, the RSS value of the new signal and No. 1.

(iii) Station A receives interference from:

Station No. 1 -- 1.0 mv/m
Station No. 2 -- 0.60 mv/m
Station No. 3 -- 0.59 mv/m

No. 1 proposes to increase the limitation it imposes on Station A to 1.21 mv/m. Although the limitations from stations Nos. 2 and 3 are less than 50% of the 1.21 mv/m limitation, under the above provision they are nevertheless included for comparative studies, and the RSS limitation is calculated to be 1.47 mv/m. However, if the increase proposed by Station No. 1 is authorized, the RSS value then calculated is 1.21 mv/m because Stations Nos. 2 and 3 are excluded in view of the fact that the limitations they impose are less than 50% of 1.21 mv/m.

(p) Objectionable interference from a station on the same channel shall be considered to exist to a station when, at the field intensity contour specified in paragraph (v) of this section with respect to the class to which the station belongs, the field intensity of an interfering station (or the root-sum-square value of the field intensities of two or more interfering stations) operating on the same channel, exceeds for ten (10) percent or more of the time the value of the permissible interfering signal set forth opposite such class in paragraph (v) of this section.

(q) Objectionable interference from a station on an adjacent channel shall be considered to exist to a station when, at the normally protected contour of a desired station, the field intensity of the ground wave of an undesired station operating on an adjacent channel (or the root-sum-square value of the field intensities of two or more such undesired stations operating on the same adjacent

(r) For the purpose of estimating the coverage and the interfering effects of stations in the absence of field strength measurements, use shall be made of Figure 8 of 73.190, which describes the estimated effective field for one kilowatt power input of simple vertical omni-directional antennas of various heights with ground systems of at least 120 one-quarter wave-length radials. Certain approximations, based on the curve or other appropriate theory, may be made when other than such antennas and ground systems are employed, but in any event the effective field to be employed shall not be less than given in the following:

Class of Station	Effective field (at 1 km)
I-A and I-B	362 mV/m.
I-N, II and III	282 mV/m.
IV	241 mV/m.

In case a directional antenna is employed, the interfering signal of a broadcasting station will vary in different directions, being greater than the above values in certain directions and less in others depending upon the design and adjustment of the directional antenna system. To determine the interference in any direction the measured or calculated radiated field (unabsorbed field intensity at 1 kilometer from the array) must be used in conjunction with the appropriate propagation curves. (See 73.185 for further discussion and solution of a typical directional antenna case.)

Note - For Class III stations in Alaska, Hawaii, Puerto Rico and the U.S.Virgin Islands, 241uV/M shall be used.

(s) The existence or absence of objectionable groundwave interference from stations on the same or adjacent channels shall be determined by actual measurements made in accordance with the method described in 73.186, or, in the absence of such measurements, by reference to the propagation curves of 73.184. The existence or absence of objectionable interference due to skywave propagation shall be determined by reference to the appropriate formulas set forth in 73.190 and the appropriate propagation curves in Figure 1a, 1b or Figure 2 of 73.190.

(t) Computation of Skywave Field Strength Values: (1) Fifty Percent Skywave Field Strength Values (Clear Channel). In computing the fifty percent skywave field strength values of a Class I-A or I-B clear channel station, use shall be made of Figure la of 73.190 entitled "Skywave Field Strength" for 50 percent of the time. In computing the fifty percent Skywave field strength values of a Class I-N station (in Alaska), use shall be made of the formula in 73.190(c)(1) for deriving such values.

(2) Ten Percent Skywave Field Strength Values (Clear Channel). In computing the 10% skywave field strength for stations on clear channels on a single signal basis, the curve in Figure la and the formula in 73.190 (b)(2) shall be used unless one or both of the stations being considered are in Alaska: in such a case, the formula included in 73.190(c)(2) should be used to calculate the 10% values for both stations. In computing the 10% skywave field strength for stations on clear channels on an RSS basis, the formula in 73.190(c)(2) shall be used in computing the RSS of a station in Alaska. In computing the RSS of a station not in Alaska, the formula in 73.190(c)(2) shall be used in computing the contribution from stations in Alaska, and the formula in 73.190(b)(2) shall be used in computing contributions from stations not in Alaska.

(3) Regional and Local Channels. In computing the 10% skywave field strength values for stations on a regional channel, on an RSS basis, the formula in 73.190(c)(2) shall be used in computing the RSS of a station in Alaska. In computing the RSS of a station not in Alaska, the formula in 73.190(c)(2) shall be used in computing the contribution from stations in Alaska, and the appropriate curve in Figure 2 shall be used in computing contributions from stations not in Alaska. (In the case of Class IV stations on local channels, simplifying assumptions may be made. See Note in paragraph (a)(4) of this section.)

(4) Determination of Angles of Departure. In calculating skywave field strength for stations on all channels, the pertinent vertical angle shall be determined by use of the formulas in 73.190(d).

(u) The distance to any specified groundwave field intensity contour for any frequency may be determined from the appropriate curves in 73.184 entitled "Ground Wave Field Intensity vs. Distance."

(v) Protected service contours and permissible interference signals for broadcast stations are as follows (for Class I and Class II-A stations, see paragraph (a) of this section:

Class of station	Class of channel used	Permissible power	Signal strength contour of area protected from objectionable interference [1]		Permissible interfering signal on same channel [2]	
			Day [3]	Night	Day	Night [4]
I-A	Clear	50 kW	SC 100 μV/m. AC 500 μV/m.	SC 500 μV/m(50% skywave).[7] AC 500 μ[3].	5 μV/m	25 μV/m.[7]
I-B	......do	10 kW to 50 kW	SC 100 μV/m. AC 500 μV/m.	SC 500 μV/m 50% skywave. AC 500 μV/m[3].	5 μV/m	25 μV/m.
I-N	......do	50 kW	SC 100 μV/m. AC 500 μV/m.	SC 100 μV/m 50% skywave. AC 500 μV/m.	5 μV/m	5 μV/m.
II-A	......do	0.25 kW to 50 kW (daytime). 10 kW to 50 kW (nighttime).	500 μV/m	500 μV/m[3]	25 μV/m	25 μV/m.
II-B	......do	0.25 kW to 50 kW	500 μV/m	2,500 μV/m[3],[5]	......do	125 μV/m.
II-C	......do	0.25 kW to 1 kW	500 μV/m	10,000 μV/m[8]	......do	500 μV/m.
II-D	......do	0.25 kW to 50 kW (daytime)	500 μV/m	Not prescribed	......do	Not prescribed.
II-S	......do	0.25 kW to 50 kW (daytime) less than 0.25 (nighttime).	500 μV/m	......do	......do	Do.
III	Regional	0.5 kW to 5 kW	500 μV/m	2,500 μV/m[3],[9]	......do	125 μV/m.
IV	Local	0.25 to 1 kW	500 μV/m	Not prescribed[6]	......do	Not prescribed.

[1] When a station is already limited by interference from other stations to a contour of higher values than that normally protected for its class, this contour shall be the established standard for such station with respect to interference from all other stations.
[2] For adjacent channel, see paragraph (w) of this section.
[3] Groundwave.
[4] Skywave field strength for 10 percent of more of the time.
[5] These values are with respect to interference from all stations except Class I-B, which stations may cause interference to a field strength contour of higher value. However, it is recommended that Class II stations be so located that the interference received from Class I-B stations will not exceed these values. If the Class II stations are limited by Class I-B stations to higher values, then such values shall be the established standard with respect to protection from all other stations.
[6] See paragraph (a)(4) of this section and Note 1 to paragraph (a)(3).
[7] Class I-A stations on channels reserved for the exclusive use of one station during nighttime hours are protected from co-channel interference on that basis.
[8] Applies only to nighttime operations of Class II-C stations coming within §73.21(a)(iii), and to the operation of limited-time Class II-D stations during nighttime hours other than those during which they were authorized to operate as of June 1, 1980.
[9] During nighttime hours, Class IV stations in the conterminous 48 states may treat all Class III stations assigned to 1230, 1240, 1340, 1400, 1450 and 1490 kHz in Alaska, Hawaii, Puerto Rico and the U.S. Virgin Islands as if they were Class IV stations.

Note.—SC=Same channel. AC=Adjacent channel.

(w) The following table is to be used for determining the minimum ratio of the field intensity of a desired to an undesired signal for interference free service. In the case of a desired groundwave signal interfered with by two or more skywave signals on the same frequency, the RSS value of the latter is used. From the table, it is apparent that in many cases stations operating on channels 10 and 20 kilocycles apart may be operated with antenna systems side by side or otherwise in proximity without any indications of interference if the interference is defined only in terms of permissable ratios listed in this paragraph. As a practical matter, serious interference problems may arise when two or more stations with the same general area are operated on channels 10, 20 and 30 kilohertz apart.

Frequency separation of desired to undesires signals	Desired groundwave to--		Desired 50 percent skywave to undesired 10 percent skywave
	Undesired groundwave	Undesired 10 percent skywave	
0 kHz --------	20:1	20:1	20:1
10 kHz --------	1:1	1:5	(1)

(1) The secondary service area of a Class I station is not protected from adjacent channel interference. However, if it is desired to make a determination of the area in which adjacent channel groundwave interference (10 kHz removed) to skywave service exists, it may be considered as the area where the ratio of the desired 50 percent skywave of the Class I station to the undesired groundwave of a station 10 kc removed is 1 to 4.

(x) Two stations, one with a frequency twice that of the other, should not be assigned in the same groundwave service area unless special precautions are taken to avoid interference from the second harmonic of the lower frequency. In selecting a frequency, consideration should be given to the fact that occasionally the frequency assignment of two stations in the same area may bear such a relation to the intermediate frequency of some broadcast receivers as to cause so-called "image" interference. However, since this can usually be rectified by readjustment of the intermediate frequency of such receivers, the Commission in general will not take this kind of interference into consideration in allocation problems.

(y) Two stations operating with synchronized carriers and carrying the identical program will have their goundwave service subject to some distortion in areas where the signals from the two stations are of comparable intensity. For the purpose of estimating coverage of such stations areas in which the signal ratio is between 1 to 2 to 1 will not be considered ashaving satisfactory service.

NOTE: Two stations are considered to be operated synchronously when the carriers are maintained within one-fifth of a cycle per second of each other and they transmit identical programs.

§73.183 Groundwave signals.-(a) Interference that may be caused by a proposed assignment or an existing assignment during day time hours should be determined when possible, by measurements on the frequency involved or on another frequency over the same terrain and by means of the curves in §73.184 entitled "Ground Wave Field strength versus Distance".

(b) In determining interference based upon field intensity measurements, it is necessary to do the following: First, establish the outer boundary of the protected service area of the desired station in the direction of the station that may cause interference to it. Second, at this boundary, measure the interfering signal from the undesired station. The ratio of the desired to the undesired signal given in §73.182(w) should be applied to the measured signals and if the required ratio is observed, no objectionable interference is foreseen. When measurements of both the desired and undesired stations are made in one area to determine the point where objectionable interference from groundwave signals occur or to establish other pertinent contours, several measurements of each station shall be made within a few miles of this point or contour. The effective field of the antennas in the pertinent directions of the stations must be established and all measurements must be made in accordance with §73.186.

NOTE: International agreement in the matter of standards for good engineering practice concerning determination of ground conductivity by field intensity measurements has not been arrived at as contemplated by NARBA, and the United States has no established procedures for reciprocal consideration of such measurements with any country except Canada. Therefore, groundwave field intensity measurements will not be accepted or considered for the purpose of establishing that interference to a station in a foreign country other than Canada, or that signal intensity at the border thereof, would be less than indicated by the application of the ground conductivity maps and engineering standards contained in this part and applicable international agreements. Satisfactory groundwave measurements offered for the purpose of demonstrating values of conductivity other than those shown by Figure M-3 of §73.190 in problems involving protection of Canadian stations or the Canadian border will be considered only if, after review thereof, the appropriate agency of the Canadian government notifies the Commission that they are acceptable for such purpose.

(c) In all cases where measurements taken in accordance with the requirements are not available, the groundwave strength must be determined bu means of the pertinent map of ground conductivity and the groundwave curves of field strength, versus distance. The conductivity of a given terrain may be determined by measurements of any broadcast signal traversing the terrain involved. Figure M3 (see Note 1) shows the conductivity throughout the United States by general areas of reasonably uniform conductivity. When it is clear that only one conductivity value is involved, Figure R3 of 73.190, which is a replica of Figure M3 and contained in these standards, may be used; in all other situations Figure M3 must be employed. It is recognized that in areas of limited size or over a particular path, the conductivity may vary widely from the values given; therefore, these maps are to be used only when accurate and acceptable measurements have not been made. (For determinations of interference and service requiring a knowledge of ground conductivities in Mexico, Annex XIV-C to the Agreement Between the United States of America and the United Mexican States Concerning Radio Broadcasting in the Standard Broadcasting Band (535-1605 kHz), Mexico, D.F., 1968, may be used. Similarly, for values of ground conductivity in Canada, a map issued by the Department of Communications, Government of Canada entitled "Ground Conductivity Map," dated January, 1980, may be used. Where different conductivities appear in the maps of two countries on opposite sides of the border, such differences are to be considered as real, even if they are not explained by geophysical cleavages. A uniform ground conductivity of 10 millimhos per meter may be assumed for Cuba.).

NOTE 1. Figure R3 in 73.190 is a replica of Figure M3. Figure M3, which is incorporated in these Standards by reference, was derived by indicating ground conductivity values in the United States on the United States Albers equal area projection map (based on standard parallels 29-1/2° and 45-1/2°; North American datum; scale 1/2,5000,000).

NOTE 2. Copies of "Ground Conductivity Map" May be obtained by contacting the Chief, Broadcast Applications Engineering Division, Department of Communications, 300 Slater Street, Ottawa, Ontario K1A 0C8, Canada. Cost is $100.00, Canadian. Remittance should be made by check or money order payable to Receiver General for Canada.

(d) Example of determining interference by the graphs in 73.184: It is desired to find whether objectionable interference exists between a 5 kW Class III station on 990 kHz and a 1 kW Class III station on the adjacent channel of 1000 kHz. The spacing between the two stations is 165 kilometers and both stations operate nondirectionally with antenna systems which produce an effective field of 282 mV/kW at one kilometer. (See 73.185 in case of use of directional antennas.) The conductivity at each station and of the intervening terrain is determined to be 6 mS/m. The protection to Class III stations during daytime is to the 500 uV/m (0.5 mV/m) contour. The distance to the 0.5 mV/m contour of the 1 kW station is determined by the use of the appropriate curve in 73.184, Graph 12. Since the curve is plotted for 100 mV/m at 1 kilometer, to find the distance to the 0.5 mV/m contour of the 1 kW station, it is necessary to determine the distance to the 0.1773 mV/m contour.

(100 x 0.5/282 = 0.1773)

Using the 6 mSm curve, the estimated radius of the 0.5 mV/m contour is seen to be 64.5 kilometers. Subtracting this distance from the distance between the two stations leaves 100.5 kilometers. Using the same propagation curve, the signal from the 5 kW station at this distance is seen to be 0.251 mV/m. Since a protection ratio of one to one, desired to undesired signal applies to stations separated by 10 kHz, the undesired signal could have a value up to 0.5 mV/m without causing objectionable interference. Consequently, there would be no mutually objectionable interference between the two stations. Had the undesired signal been found to be greater than 0.5 mV/m, objectionable interference would then have existed. For co-channel operation, a desired to undesired signal ratio of no less than 20 to 1 is required to avoid causing objectionable interference.

(e) Where a signal traverses a path over which different conductivities exist, the distance to a particular groundwave field intensity contour shall be determined by the use of the equivalent distance method. Reasonably accurate results may be expected in determining field intensities at a distance from the antenna by application of the equivalent distance method when the unattenuated field of the antenna, the various ground conductivities and the location of discontinuities are known. This method considers a wave to be propagated across a given conductivity according to the curve for a homogeneous earth of that conductivity. When the wave crosses from a region of one conductivity into a region of a second conductivity, the equivalent distance of the receiving point from the transmitter changes abruptly but the field intensity does not. From a point just inside the second region the transmitter appears to be at that distance where, on the curve for a homogeneous earth of the second conductivity, the field intensity equals the value that occurred just across the boundary in the first region. Thus the equivalent distance from the receiving point to the transmitter may be either greater or less than the actual distance. An imaginary transmitter is considered to exist at that equivalent distance. This technique is not intended to be used as a means of evaluating unattenuated field or ground conductivity by the analysis of measured data. The method to be employed for such determinations is set out in §73.186.

(f) An example of the equivalent distance method follows:

It is desired to determine the distance to the 0.5 mV/m and 0.025 mV/m contours of a station on a frequency of 1000 kHz with an inverse distance field of 100 mV/m of one kilometer being radiated over a path having a conductivity of 10 mS/m for a distance of 20 kilometers. 5 mS/m for the next 30 kilometers and 15 mS/m thereafter. Using the appropriate curve in 73.184, Graph 12 at a distance of 26 kilometers on the 10 mS/m curve, it is seen that the field strength is 2.86 mV/m. On the 5 mS/m curve, the equivalent distance to this field strength is seen to be 14.9 kilometers, which is 5.1 (20-14.9) kilometers nearer to the transmetter. Continuing on this propagation curve, the distance to a field strength of 0.5 mV/m is seen to be 36.4 kilometers. The actual length of the path travelled, however, is 41.5 (36.4 + 5.1) kilometers. Continuing on this propagation curve to the conductivity change at 44.9 (50-5.1) kilometers, it is seen that the field strength is 0.257 mV/m. On the 15 mS/m propagation curve, the equivalent distance to this field strength is seen to be 94 kilometers, which changes the effective path length by 49.1 (94-44.9) kilometers. Continuing on this propagation curve, the distance to a field strength of 0.025 mV/m is seen to be 231 kilometers. The actual length of the path travelled, however is 187 (231 + 5.1 - 49.1) kilometers.

73.184 Groundwave field strength graphs. (a) Graphs 1 to 19 show, for each of 20 frequencies, the computed values of groundwave field strength as a function of groundwave conductivity and distance from the source of radiation. The groundwave field strength is here considered to be that part of the vertical component of the electric field which has not been reflected from the ionosphere nor from the troposphere. These 20 families of curves are plotted on log-log graph paper and each is to be used for the range of frequencies shown thereon. The curves themselves were generated by straight-line connection of the plotted computed values of groundwave field strength as a function of distance. The computed and plotted points are sufficiently numerous and closely spaced that the error introduced by straight-line interpolation is negligible. Computations are based on a dielectric constant of the ground (referred to air as unity) equal of 15 for land and 80 for sea water and for the ground conductivities (expressed in mS/m) given on the curves. The curves show the variation of the groundwave field strength with distance to be expected for transmission from a vertical antenna at the surface of a uniformly conducting spherical earch with the groundwave constants shown on the curves. The curves are for an antenna power of such efficience and current distribution that the inverse distance (unattenuated) field is 100 mV/m at 1 kilometer. The curves are valid at distances large compared to the dimensions of the antenna for other than short vertical antennas.

(b) The inverse distance field (100 mV/m divided by the distance in kilometers) corresponds to the groundwave field intensity to be expected from an antenna with the same radiation efficiency when it is located over a perfectly conducting earth. To determine the value of the groundwave field intensity corresponding to a value of inverse distance field other than 100 mV/m at 1 Kilometer, multiply the field strength as given on these graphs by the desired value of inverse distance field at 1 kilometer divided by 100; for example, to determine the groundwave field strength for a station with an inverse distance field of 2700 mV/m at 1 kilometer, simply multiply the values given on the charts by 27. The value of the inverse distance field to be used for a particular antenna depends upon the power input to the antenna, the nature of the ground in the neighborhood of the antenna, and the geometry of the antenna. For methods of calculating the interrelations between these variables and the inverse distance field, see "The Propagation of Radio Waves Over the Surface of the Earth and in the Upper Atmosphere." Part II, by Mr. K. A. Norton, Proc. I.R.E., Vol. 25, September 1937, pp. 1203-1237.

NOTE -- The computed values of field strength versus distance used to plot Graphs 1 to 19 are available in tabular form. Copies of these tabulations may be ordered from the FCC official copy center whose name and address may be obtained by calling or writing the Consumer Affairs Office, Federal Communications Commission, Washington, D.C. 20554. (202)632-7000.

(c) At sufficiently short distances (say less than 35 miles), such that the curvature of the earth does not introduce an additional attenuation of the waves, the graphs were computed by means of the plane earth formulas given in the paper, "The propagation of Radio Waves Over the Serface of the Earth and in the Upper Atmonphere", Part I, by Mr. K. A. Norton, Proc. I.R.E., Vol. 24, October 1936, pp.1367-1387. At larger distances the additional attenuation of the waves which is introduced by the effect of the curvature of the earth was introduced by the methods outlined in the papers, "The Diffraction of Electromagnetic Waves from an Electrical Point Source round a Finitely Conducting Sphere, with Applications to Radiotelegraphy and the Theory of the Rainbow," by Balth van der Pol and H. Bremmer, Part I, Phil. Mag., Vol. 24, p. 141, July 1937, Part II, Phil. Mag., Vol. 24, p. 825, Suppl., November 1937, "Ergebnisse einer Theorie ueber die Fortpflanzung elektron magnetischer Wellen ueber eine Kugel endlicher Leitfahigkeit," by Balth van der Pol and H. Bremmer, Hochfrequenztechnik and Elektroakustick, Band 51, Heft 6, June 1938, "Further Note on the Propagation of Radio Waves over a Finitely Conducting Spherical Earth," by Balth van der Pol and H. Bremmer, Phil Mag., Vol. 27, p. 261, March 1939. In order to allow for the refraction of the radio waves in the lower atmosphere due to the variation of the dielectric constant of the air with height above the earth, a radius of the earth equal to 4/3 the actual radius was used in the computations for the effect of the earth's curvature in the manner suggested by C. R. Burrows, "Radio Propagation over Spherical Earth", by Proc. I.R.E., May 1935; i.e., the distance corresponding to a given value of attenuation due to the curvature of the earth in the absence of air refraction was multiplied by the factor (4/3) 2/3 = 1.21 The amount of this refraction varies from day to day and from season to season, depending on the air mass conditions in the lower atmosphere. If k denotes the ratio between the equivalent radius of the earth and the true radius, the following table gives the values of k for several typical air masses encountered in the United States.

Air mass type	k	
	Summer	Winter
Tropical Gulf-T_c	1.53	1.43
Polar Continental-P_c	1.31	1.25
Superior-S	1.25	1.25
Average	1.33	

It is clear from this table that the use of the average value of k = 4/3 is justified in obtaining a single correction for the systematic effects of atmospheric refraction. (21FR2947)

(d) Provided the value of the dielectric constant is near 15, the curves of Graphs 1 to 19 may be compared with experimental data to determine the appropriate values of the ground conductivity and the inverse distance field intensity at 1 kilometer. This is accomplished by simply plotting the measured fields on transparent log-log graph paper similar to that used for Graphs 1 to 19 and superimposing this chart over the graph corresponding to the frequency involved. The log-log graph sheet is then shifted vertically until the best fit is obtained with one of the curves on the graph; the intersection of the inverse distance line on the graph with the 1 kilometer abscissa on the chart determines the inverse distance field strength at 1 kilometer. For other values of dielectric constant, the following procedure may be used for a determination of the dielectric constant of the ground, conductivity of the ground and the inverse distance field strength at 1 mile. Before the results of such determinations are submitted to the F.C.C., they must be converted to equivalent metric units. Graph 20 gives the relative values of groundwave field strength over a plane earth as a function of the numerical distance p and phase angle b. On graph paper with coordinates similar to those of Graph 20, plot the measured values of field strength as ordinates versus the corresponding distances from the antenna expressed in miles as abscissae. The data should be plotted only for distances greater than one wavelength (or, when this is greater, fives times the vertical height of the antenna in the case of a single element, i.e., nondirectional antenna or 10 times the spacing between the elements of a directional antenna) and for distances less than $50/(f\ \text{Mhz})^{1/3}$ miles (i.e., 50 miles at 1 Mhz). Then, using a light box, place the sheet with the data plotted on it over the sheet with the curves of Graph 20 and shift the data sheet vertically and horizontally (making sure that the vertical lines on both sheets are parallel) until the best fit with the data is obtained with one of the curves on Graph 20. When the two sheets are properly lined up, the value of the field strength corresponding to the intersection of the inverse distance line of Graph 20 with the 1 mile abscissa on the data sheet is the inverse distance field strength at 1 mile, and the values of the numerial distance at 1 mile, p1, and of b are also determined. Knowing the values of b and p1 (the numerical distance at 1 mile), we may substitute in the following approximate formulas to determine the appropriate values of the ground conductivity and dielectric constant.

$\chi = (\pi/p_1) \cdot (R/\lambda)_1 \cos b$

(1)

$(R/\lambda)_1$ = Number of wavelengths in 1 mile.

$\sigma_{e.m.u.} = (\chi f\text{MHz}/17.9731) \cdot 10^{-14}$

(2)

$\sigma_{e.m.u.}$ = Conductivity of the ground expressed in electromagnetic units.

fMHz = frequency expressed in megacycles.

$e = x \tan b - 1$

ϵ = dielectric constant of the ground referred to air as unity.

First solve for x by substituting the known values of p_1, $(R/\lambda)_1$ and cos b in equation (1). Equation (2) may then be solved for and equation (3) for ϵ. At distances greater than 50/f MHz miles the curves of Graph 20 do not give the correct relative values of field strength since the curvature of the earth weakens the field more rapidly than these plane earth curves would indicate. Thus,nno attempt should be made to fit experimental data to these curves at the larger distances.

NOTE -- For other values of dielectric constant, use can be made of the computer program which was employed by the FCC in calculating the points used for plotting the curves in Graphs 1 to 19. A printout of this program can be ordered from the FCC official copy center whose name and address may be obtained by calling or writing the Consumer Affairs Office, Federal Communications Commission, Washington, D.C. 20554, (202) 632-7000.

(e) At sufficiently short distances (say less than 35 miles at broadcast frequencies), such that the curvature of the earth does not introduce an additional attenuation of the waves, the curves of Graph 20 may be used for determining the ground wave field intensity for transmitting and receiving antennas at the surface of the earth for any radiated power, frequency, or set of ground constants in the following manner: First, lay off the straight inverse distance line corresponding to the power radiated on transparent log-log graph paper similar to that of Graph 20, labelling the ordinates of the chart in terms of field intensity, and the abscissae in terms of distance. Next, by means of the formulas given on Graph 20, calculate the value of the numerical distance, p, at 1 mile, and the value of b . Then superimpose the log-log chart over Graph 20, shifting it vertically until the inverse distance lines on both charts coincide and shifting it horizontally until the numerical distance at 1 mile on Graph 20 coincides with 1 mile on the log-log graph paper. The curve of Graph 20 corresponding to the calculated value of b is then traced on the log-log graph paper giving the field intensity versus distance in miles.

(f) This paragraph consists of the following Graphs 1 to 19a and 20.

NOTE -- Graphs will not be published in the CFR. Copies are available by calling or writing the Consumer Affairs Office, Federal Communications Commission, Washington, D.C. 20554, Telephone: (202) 632-7000.

GROUNDWAVE FIELD STRENGTH VERSUS DISTANCE

National Association of Broadcasters

This package contains a complete set of all graphs published by the FCC in 73.184. These graphs have been printed using original materials generated by FCC computers. Great care has been taken to assure accuracy of reproduction.

These graphs and graph paper should not be copied. Office copiers introduce geometric distortions which will affect accuracy. Copies for submission to the FCC and station files should only be made after all data have been plotted.

The Field Strength Measurement Form on the next page may be reproduced for use in taking measurements.

Additional sets of graph paper may be purchased from NAB Services. Call 800-368-5644.

GENERAL REQUIREMENTS FOR MEASUREMENTS*

All measurements should be made during the daylight hours in the absence of interference, and special temporary authority may be required prior to the commencement of measurements for a new authorization. For established stations, the FCC Rules permit considerable flexibility in operation during periods of making antenna system field strength measurements.

It is FCC policy that the measurement observations to be recorded and utilized as a basis of analysis of the inverse distance radiation values are those observed with the field strength meter oriented towards the station. The maximum indication can occur when the meter is oriented away from the transmitting source. This phenomenon can be caused by many factors including null depth on the measured radial. These factors vary from local effects surrounding or adjacent to the measuring point, non-uniform conditions inherent in the propagation path and can be affected by the position of the observation point on a rapidly changing portion of the directional pattern.

A record must be kept of the measurement data, including each point number, the field strength observations, dates and times of the measurements, the pattern under investigation, a description of each point location, the name of the individual taking the measurements, the general weather conditions, the field strength instrument utilized and the date of its last calibration. A sample form is provided for tabulating the field measurement data.

Graphical Analysis

The inverse distance field or unattenuated field strength at a reference distance kilometer (1 km) is the field strength predicted at that distance from the transmitting antenna if the earth were to behave as a perfect conductor. As the wave energy travels away from the antenna, the unattenuated field strength reduces by the inverse proportion to the distance from the antenna. For example, if the value of the unattenuated field at 1 km is 100 mV/m, its value at 2 km will be one-half that value or 50 mV/m, and at 10 km, its value will be one-tenth of the 1 km value or 10 mV/m. The effects of attenuation on field strength are shown by families of curves for field strength vs distance for various values of ground conductivity. These graphs are included in Section 73.184 of the FCC Rules. The actual field will be diminished by this inverse distance factor as well as the losses attributable to ground conductivity.

The FCC, in its conversion to the metric system, redetermined the frequency curves. In addition, the FCC used its computer program and determined additional conductivity values for each frequency chart. The dielectric constant for all curves except for sea water, is 15. For sea water the calculations are based upon a dielectric constant of 80.

There are 19 sets of frequency dependent propagation graphs that encompass the frequencies from 540 to 1610 kHz. Curves for each frequency group are drawn on two graphs. One graph shows the uppermost portion with conductivity curves normalized for 100 mV/m/km from one-tenth to 50 km and the bottom portion reflects the conductivity curves for 10 to 5000 km. The second graph is an expanded version of the uppermost portion of the first graph to allow for easier determination of the inverse distance field and conductivity values for measurements less than 50 km from the transmitting antenna.

After the distances from the transmitting antenna to each of the measuring points have been determined and tabulated opposite the observed field strength values, the measured field strength values can be plotted on log-log graph paper. The ordinate (vertical scale) is field strength, expressed in mV/m, and the abscissa (horizontal scale) is distance in kilometers. Data can be plotted on groundwave field intensity graph paper available through NAB. This paper has the same logarithmic scale as the expanded version of the FCC curves.

Plotting Data

For the logarithmic coordinate system, (log-log graph paper) the inverse distance field strength plots as a straight line. The conductivity curves are drawn for the case of an inverse distance field of 100 mV/m at 1 km, but their use is not limited to that value. If an inverse distance field strength is 200 mV/m (twice the reference value) or 50 mV/m (one-half the reference number) or some other value at 1 km, and if all points on the curve are multiplied by the ratio of the actual inverse distance field strength to 100 mV/m, the effect would be the equivalent of moving the curves by that amount on the logarithmic coordinate paper. This is the basis on which field strength measurements are analyzed. The appropriate conductivity values for the frequency involved are made by matching the abscissa of the data with that of the FCC graph and sliding the ordinate information data vertically to obtain the "best fit" of measured field strength values to the conductivity curves. By this method, both the unattenuated field at 1 km and the conductivity values along the radial path can be determined. The use of a light table will assist in aligning and moving the two sheets of paper.

An individual attempting to analyze measurement data for the first time and without the benefit of experienced supervision can find this a frustrating experience. One approach is to take log-log graph paper for the appropriate frequency (either the regular or expanded scale) and plot the measurement point values normalized to 100 mV/km. For example, if the non-directional 0.25 kW operation is expected to possess an RMS field at 1 kW of 91 mV/m (70 degrees [0.194 of a wavelength] electrical height tower with a normal ground system—see Figure 8, Section 73.190 of the FCC Rules), it has a field 91/100 less than the FCC log-log conductivity graph. Therefore, multiply all values (divide all values if the expected field is greater than 100 mV/m) of the measurement data by the ratio of 100/91 to normalize it to 100 mV/m. Plot the normalized data. The plotted values can be viewed in relation to the conductivity values if the assumption of the inverse distance field is correct. If the normalized data appear to be over the inverse distance line, then the radiation value is higher than assumed and conversely if the normalized data appear normally low, the assumed radiation value selected is too high.

This approach can be useful when the non-directional measurements out to 3 km in the various directions have been taken and a quick evaluation of the conductivity values/radiation efficiency around the site is desired. It also will help to assess whether or not the non-directional radiation pattern is being influenced by other adjacent towers in the directional antenna system.

*From "AM Field Strength Measurements and Proof of Performance" by Donald G. Everist, in the *NAB Engineering Handbook*, 7th Edition, 1985.

National Association of Broadcasters

FIELD STRENGTH MEASUREMENTS

FOR ______________________

____

____

N ____ ° E

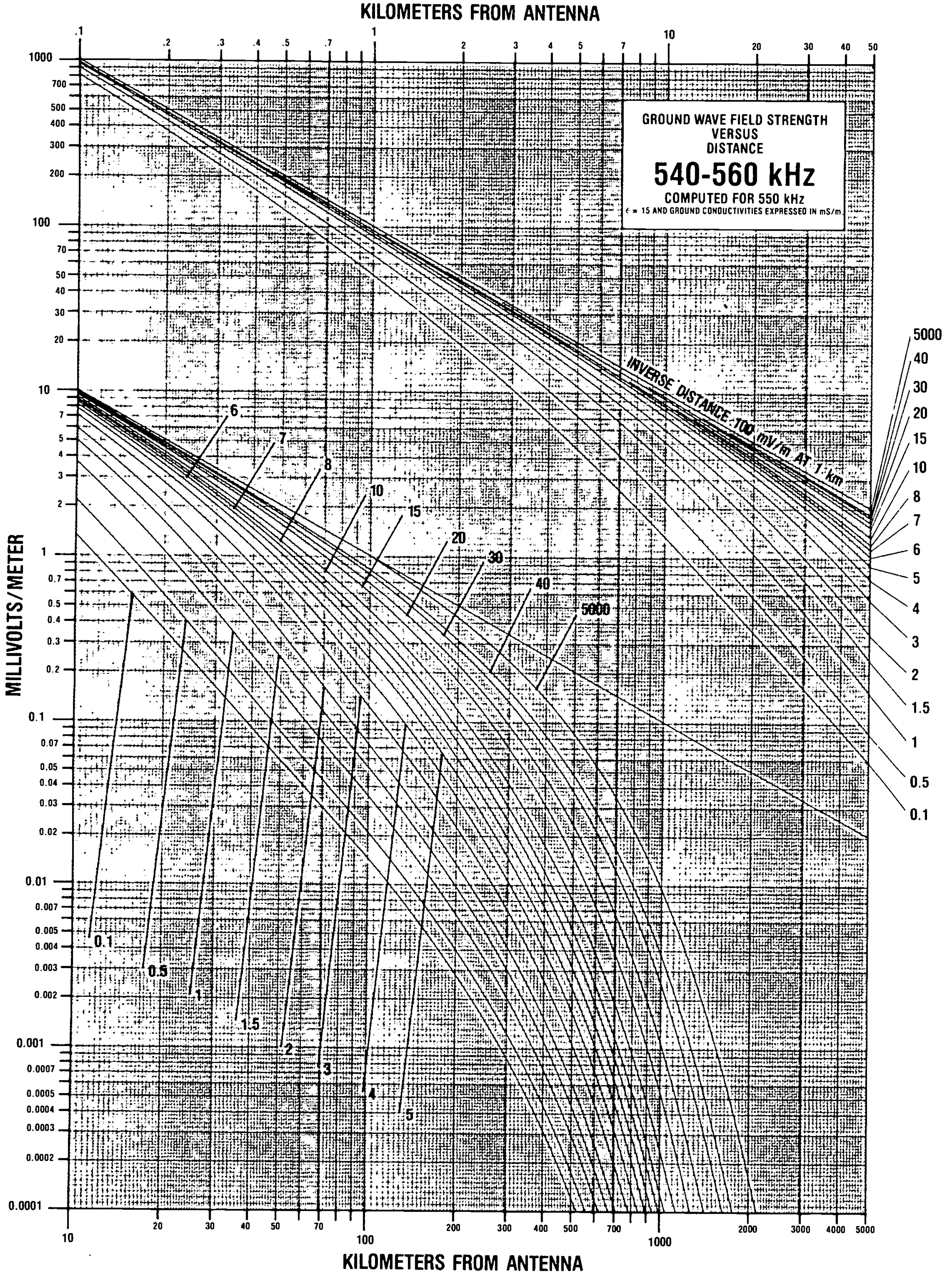
DATE: __/__/__

PAGE NO: ______________

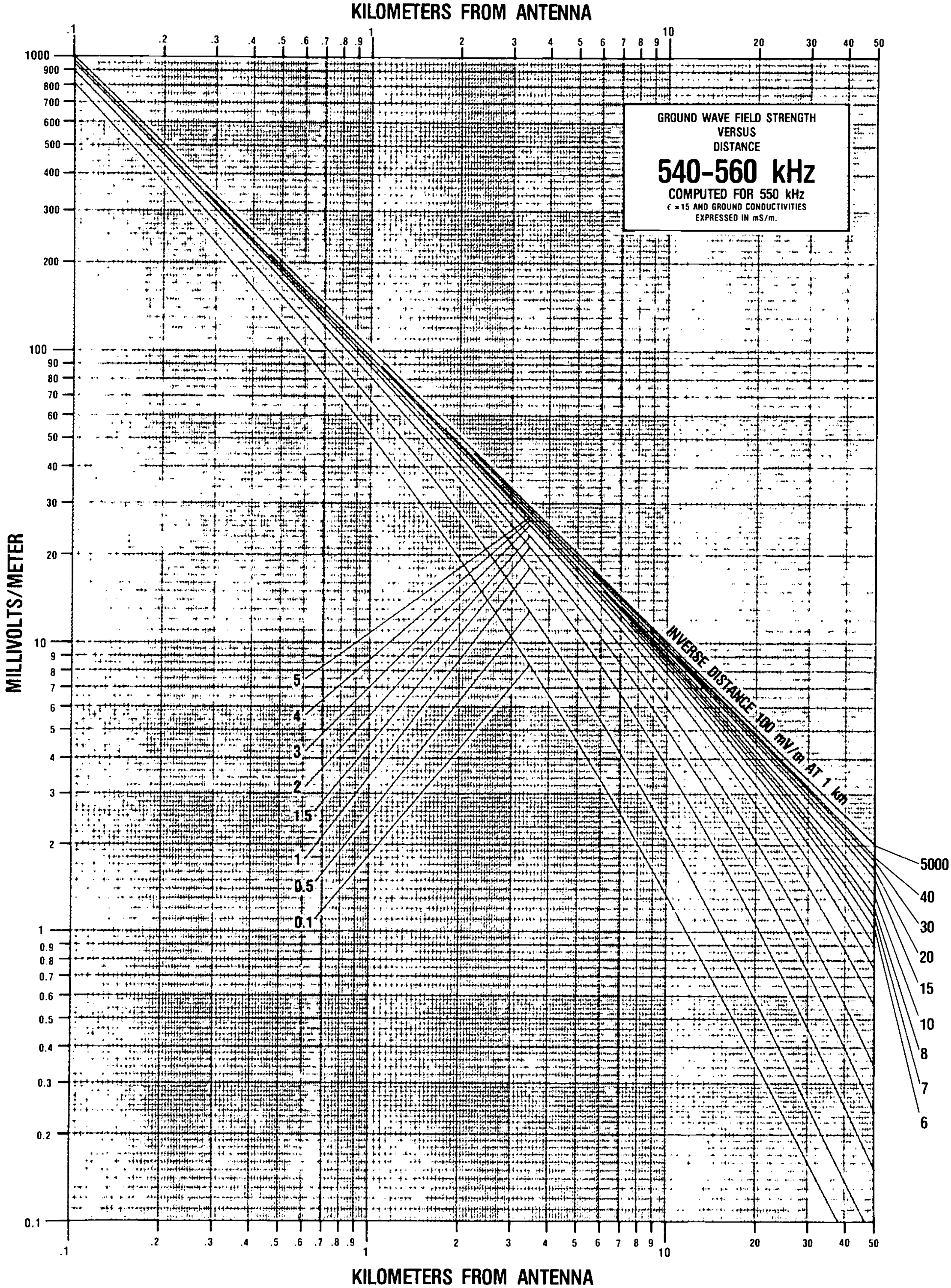
ENGINEER: ______________

METER: ______________

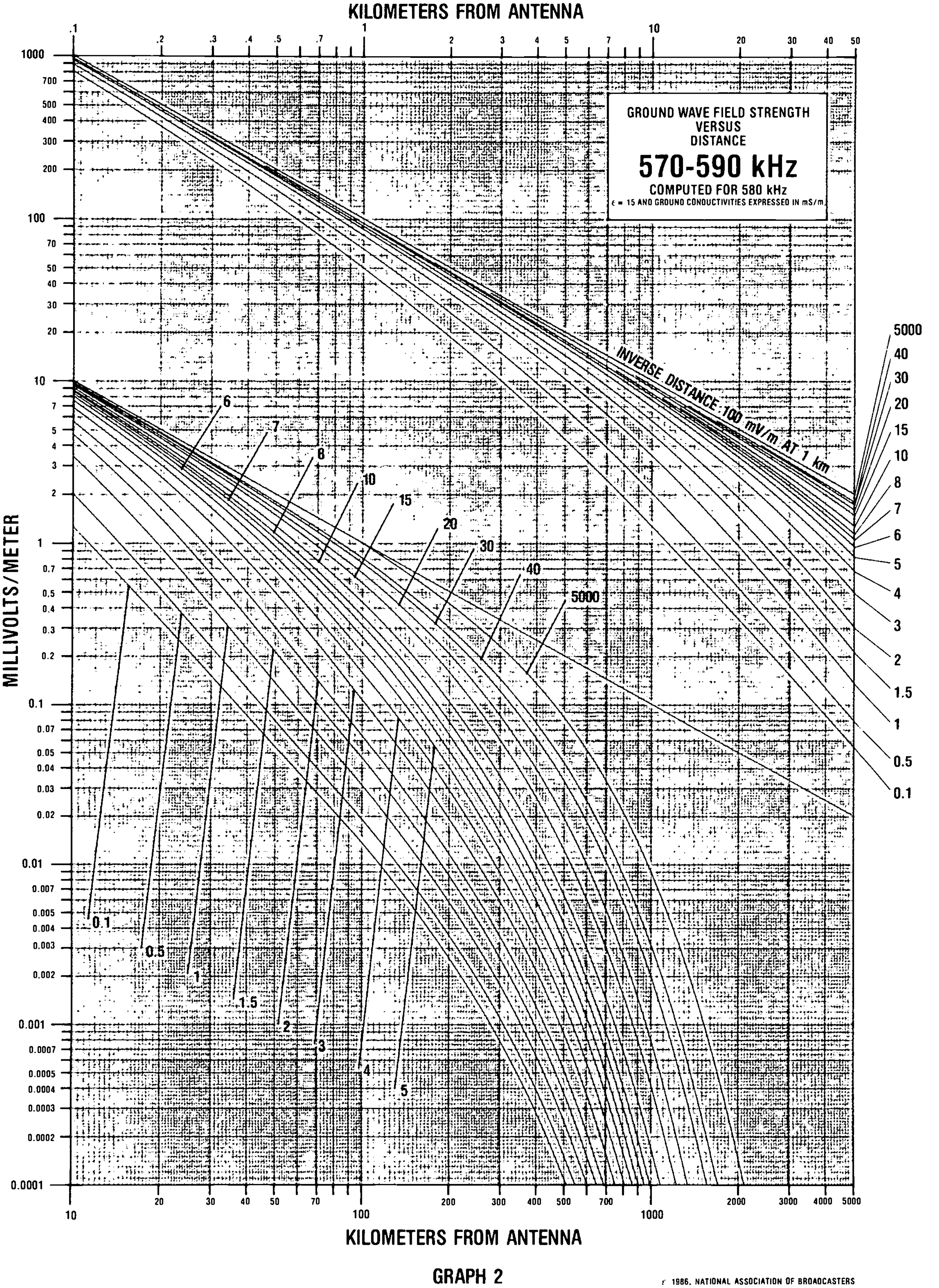
POINT NO.	POINT DIST.	DATE	TIME	___kW ND MV/M	DATE	TIME	___kW DA-___ MV/M	RATIO DA___/ND	POINT DESCRIPTION
				73 AMS			-16b-		


KILOMETERS FROM ANTENNA
GROUND WAVE FIELD STRENGTH
VERSUS
DISTANCE
540-560 kHz
COMPUTED FOR 550 kHz
ε = 15 AND GROUND CONDUCTIVITIES EXPRESSED IN mS/m
INVERSE DISTANCE 100 mV/m AT 1 km
MILLIVOLTS/METER
5000
40
30
20
15
10
8
7
6
5
4
3
2
1.5
1
0.5
0.1
KILOMETERS FROM ANTENNA

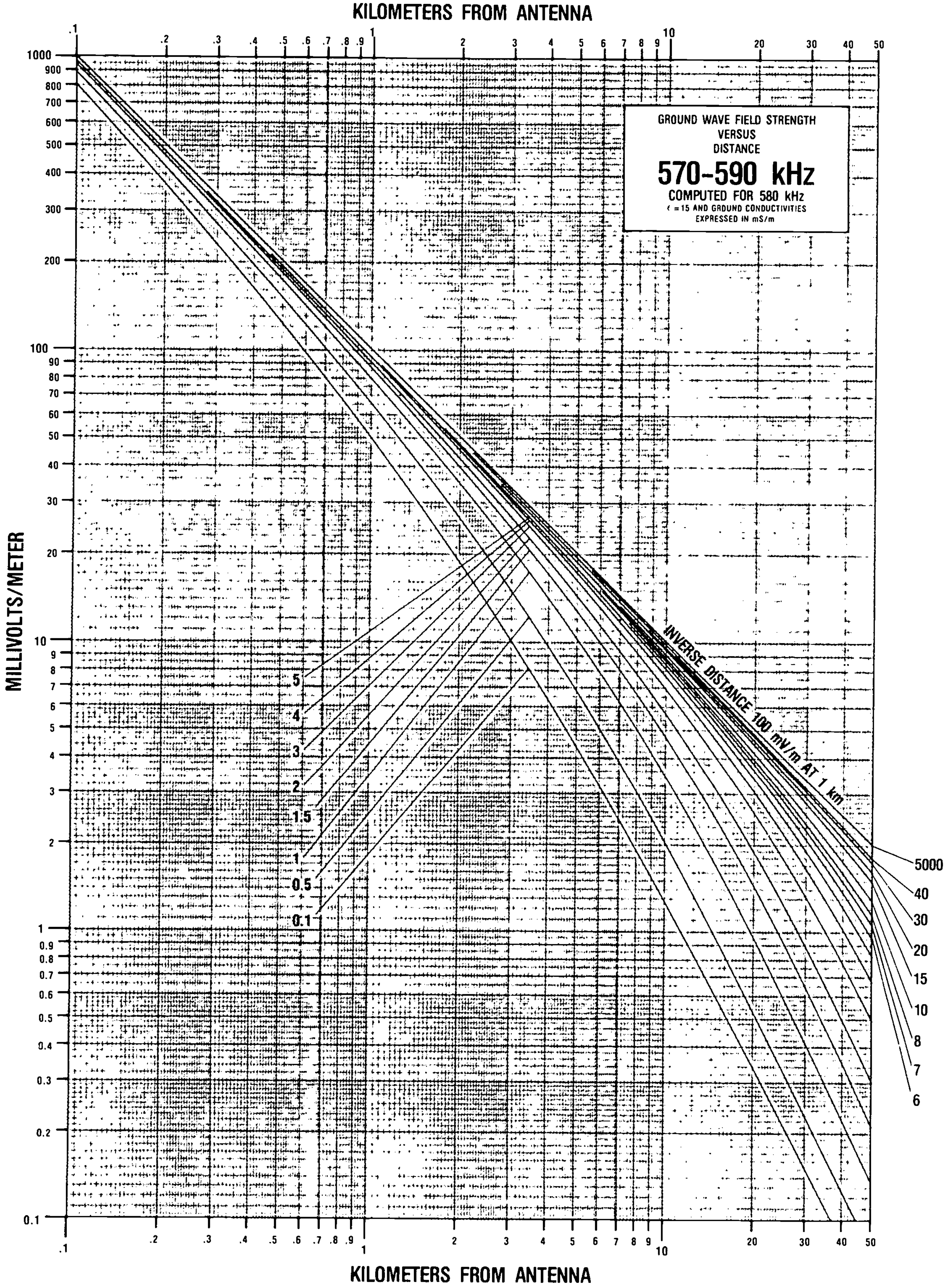
GRAPH 1


KILOMETERS FROM ANTENNA
GROUND WAVE FIELD STRENGTH
VERSUS
DISTANCE
540-560 kHz
COMPUTED FOR 550 kHz
ε = 15 AND GROUND CONDUCTIVITIES
EXPRESSED IN mS/m.
MILLIVOLTS/METER
INVERSE DISTANCE 100 mV/m AT 1 km
5
4
3
2
1.5
1
0.5
0.1
5000
40
30
20
15
10
8
7
6
KILOMETERS FROM ANTENNA

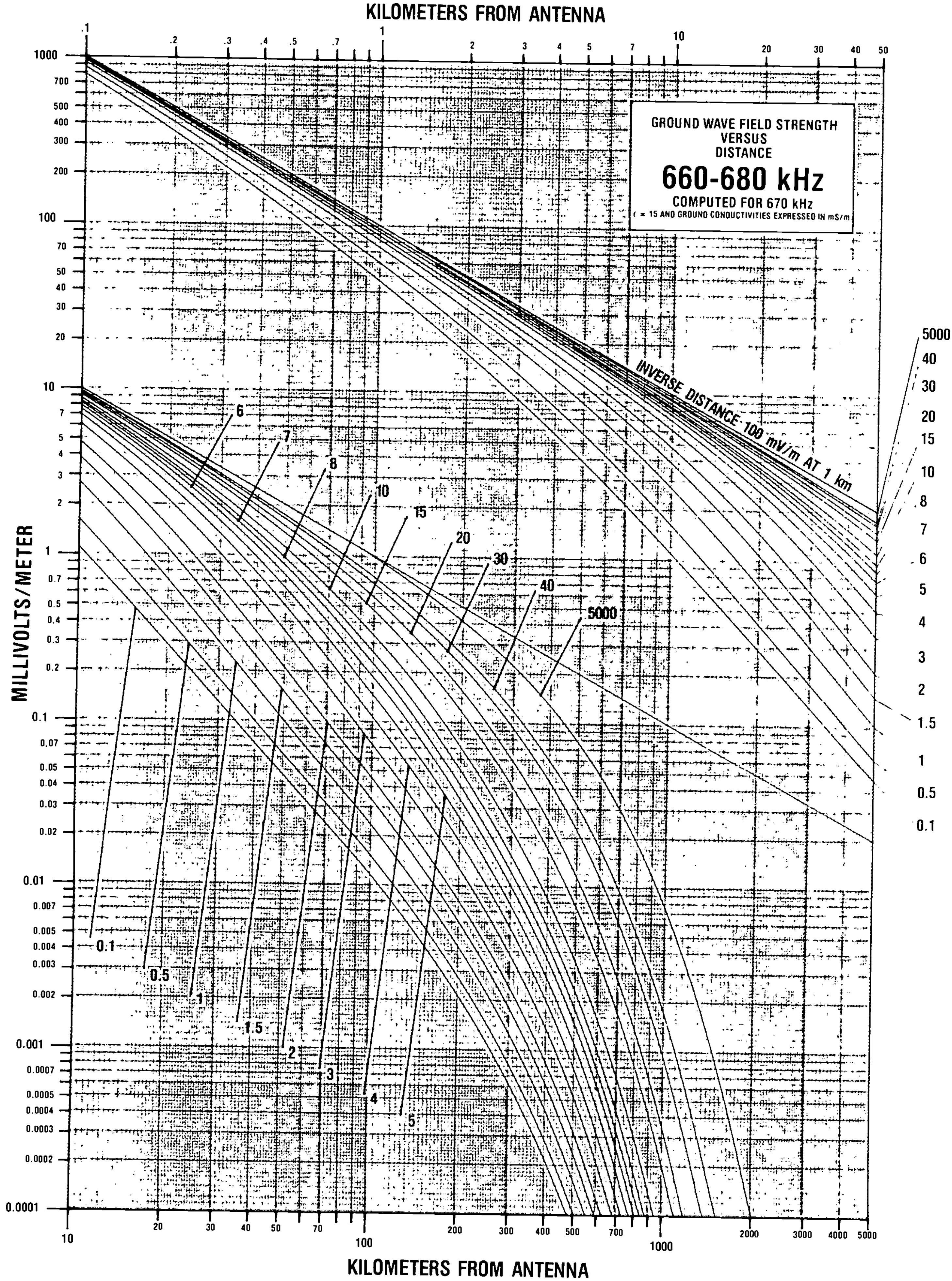
GRAPH 1-A


KILOMETERS FROM ANTENNA
GROUND WAVE FIELD STRENGTH
VERSUS
DISTANCE
570-590 kHz
COMPUTED FOR 580 kHz
ε = 15 AND GROUND CONDUCTIVITIES EXPRESSED IN mS/m
INVERSE DISTANCE 100 mV/m AT 1 km
MILLIVOLTS/METER
KILOMETERS FROM ANTENNA

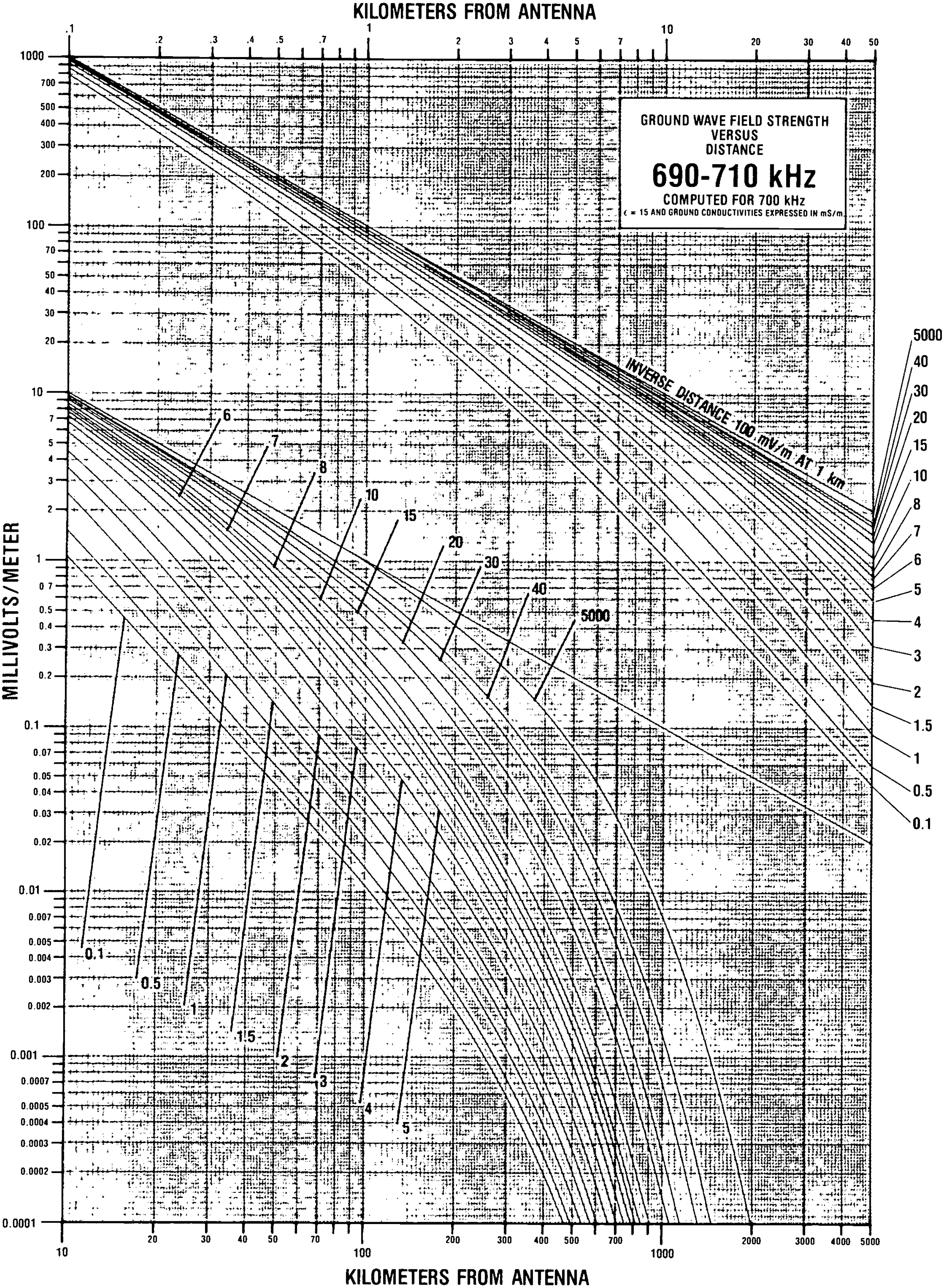
GRAPH 2


KILOMETERS FROM ANTENNA
GROUND WAVE FIELD STRENGTH
VERSUS
DISTANCE
570-590 kHz
COMPUTED FOR 580 kHz
ε =15 AND GROUND CONDUCTIVITIES
EXPRESSED IN mS/m
MILLIVOLTS/METER
INVERSE DISTANCE 100 mV/m AT 1 km
5000
40
30
20
15
10
8
7
6
5
4
3
2
1.5
1
0.5
0.1
KILOMETERS FROM ANTENNA

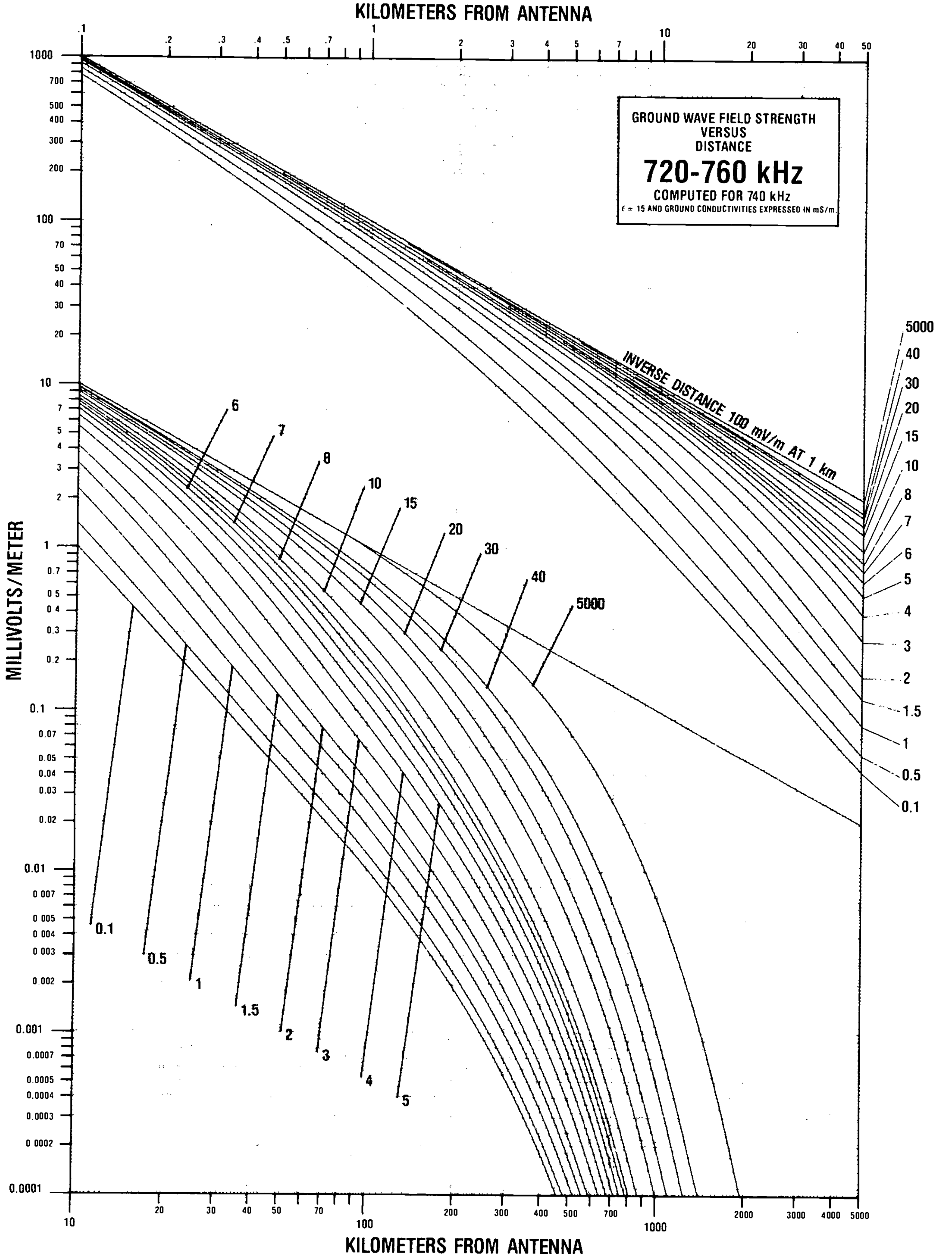
GRAPH 2-A


KILOMETERS FROM ANTENNA
GROUND WAVE FIELD STRENGTH
VERSUS
DISTANCE
660-680 kHz
COMPUTED FOR 670 kHz
ε = 15 AND GROUND CONDUCTIVITIES EXPRESSED IN mS/m
INVERSE DISTANCE 100 mV/m AT 1 km
MILLIVOLTS/METER
KILOMETERS FROM ANTENNA

GRAPH 5

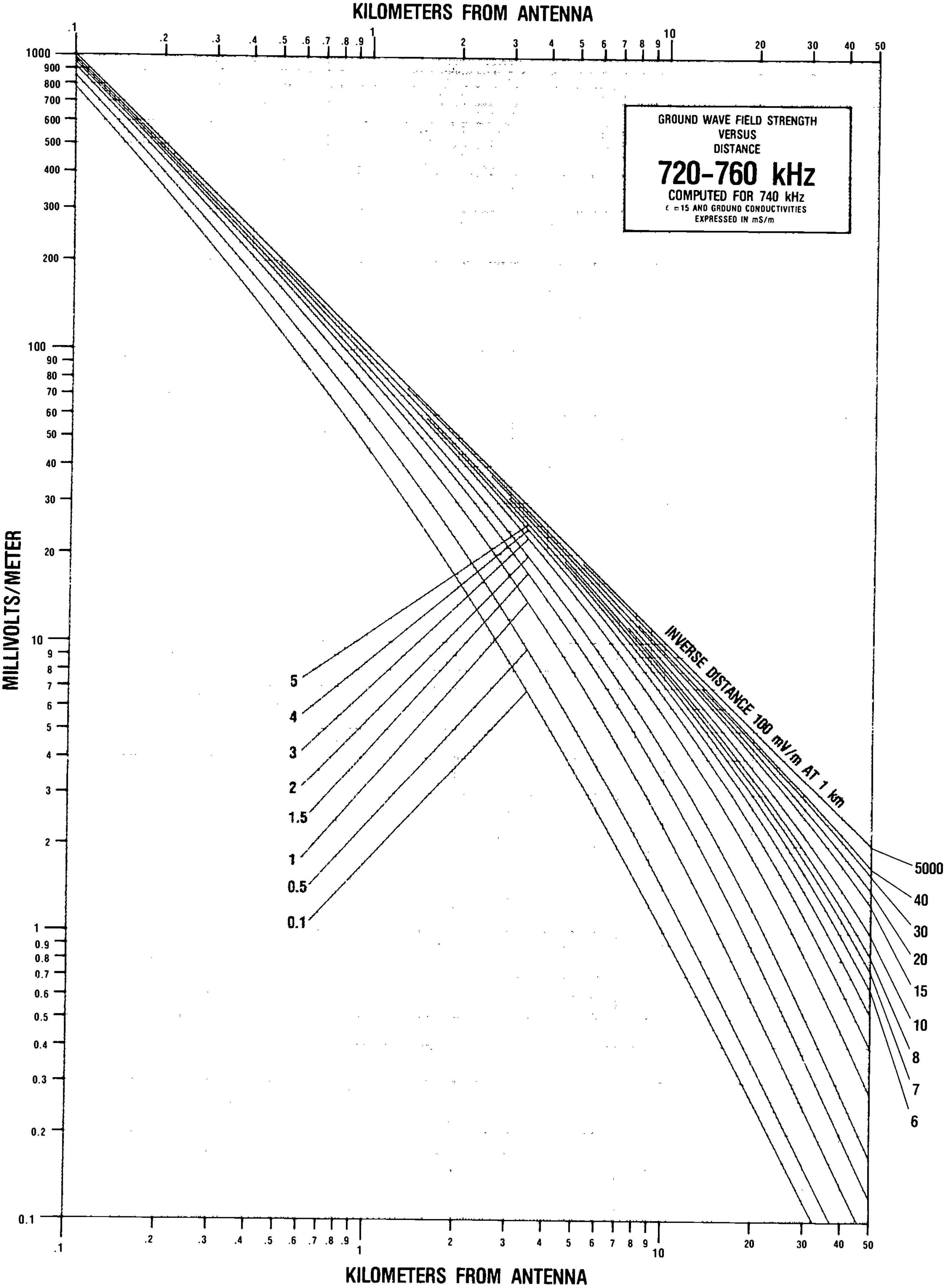

KILOMETERS FROM ANTENNA
GROUND WAVE FIELD STRENGTH
VERSUS
DISTANCE
690-710 kHz
COMPUTED FOR 700 kHz
ε = 15 AND GROUND CONDUCTIVITIES EXPRESSED IN mS/m.
INVERSE DISTANCE 100 mV/m AT 1 km
MILLIVOLTS/METER
KILOMETERS FROM ANTENNA

GRAPH 6

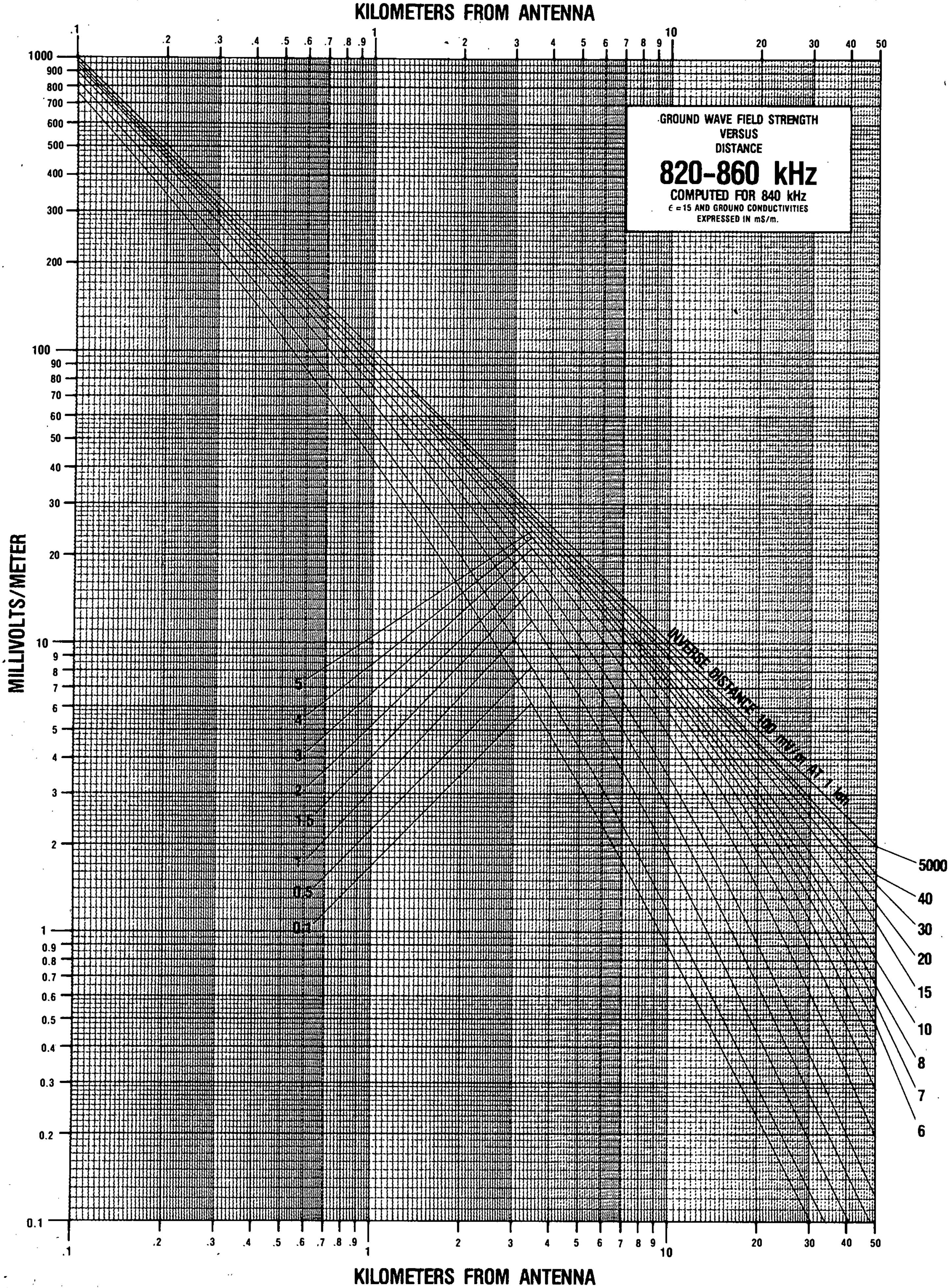


KILOMETERS FROM ANTENNA
GROUND WAVE FIELD STRENGTH
VERSUS
DISTANCE
720-760 kHz
COMPUTED FOR 740 kHz
ε = 15 AND GROUND CONDUCTIVITIES EXPRESSED IN mS/m.
INVERSE DISTANCE 100 mV/m AT 1 km
MILLIVOLTS/METER
KILOMETERS FROM ANTENNA

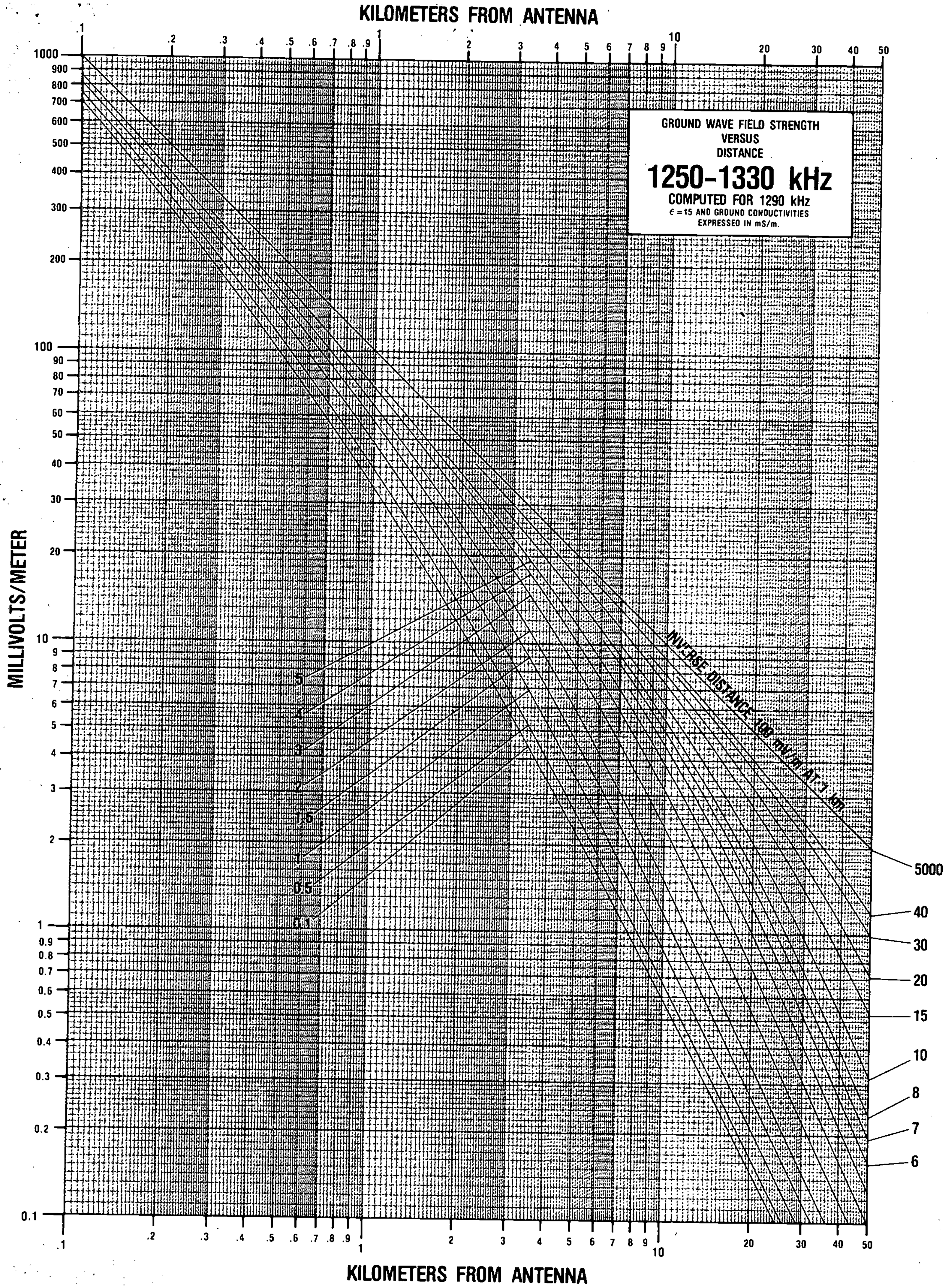
GRAPH 7


KILOMETERS FROM ANTENNA
GROUND WAVE FIELD STRENGTH
VERSUS
DISTANCE
720-760 kHz
COMPUTED FOR 740 kHz
ε =15 AND GROUND CONDUCTIVITIES
EXPRESSED IN mS/m
MILLIVOLTS/METER
INVERSE DISTANCE 100 mV/m AT 1 km
5
4
3
2
1.5
1
0.5
0.1
5000
40
30
20
15
10
8
7
6
KILOMETERS FROM ANTENNA

GRAPH 7-A

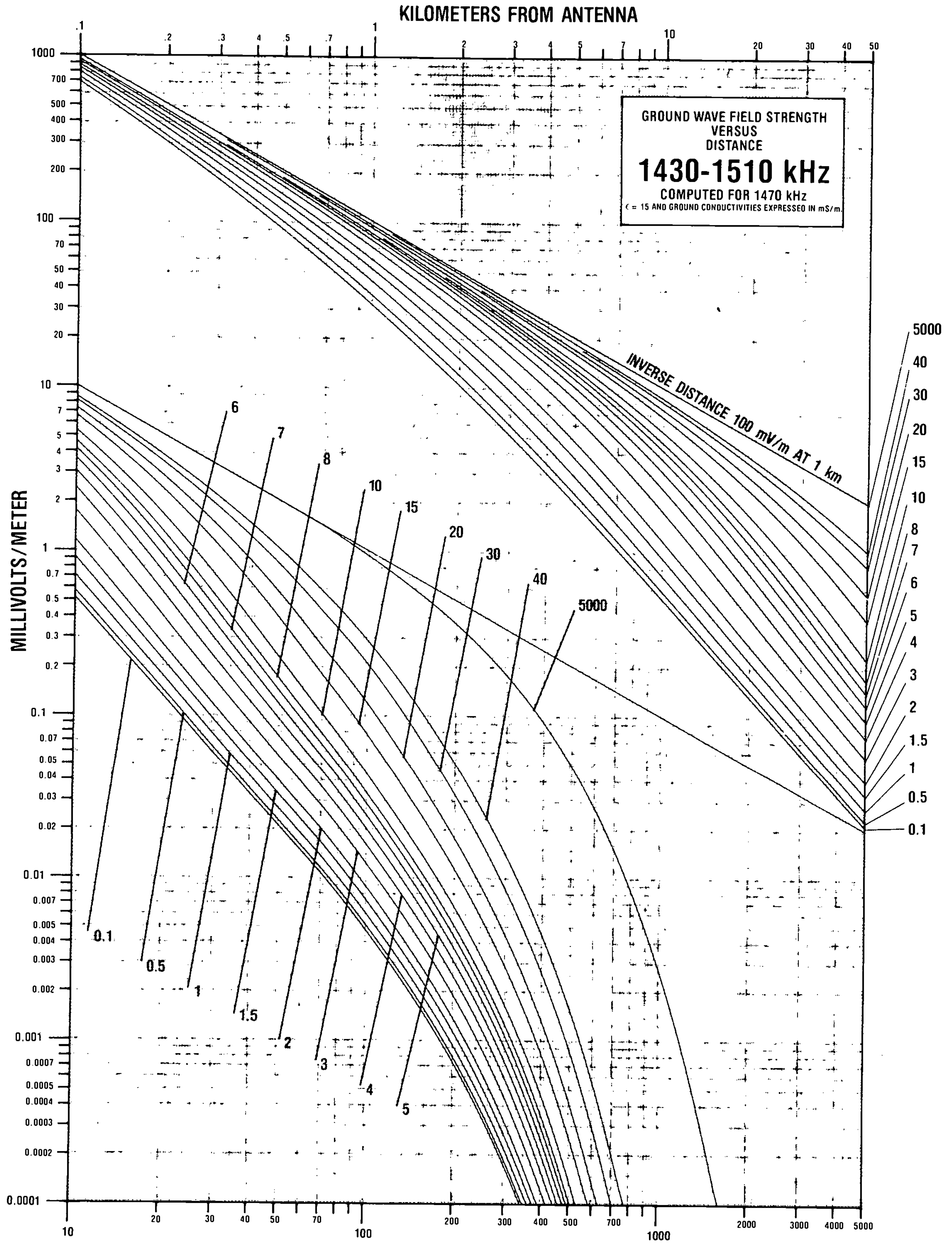

KILOMETERS FROM ANTENNA
GROUND WAVE FIELD STRENGTH
VERSUS
DISTANCE
820-860 kHz
COMPUTED FOR 840 kHz
ε =15 AND GROUND CONDUCTIVITIES
EXPRESSED IN mS/m.
MILLIVOLTS/METER
INVERSE DISTANCE 100 mV/m AT 1 km
5000
40
30
20
15
10
8
7
6
5
4
3
2
1.5
1
0.5
0.1
KILOMETERS FROM ANTENNA

GRAPH 9-A



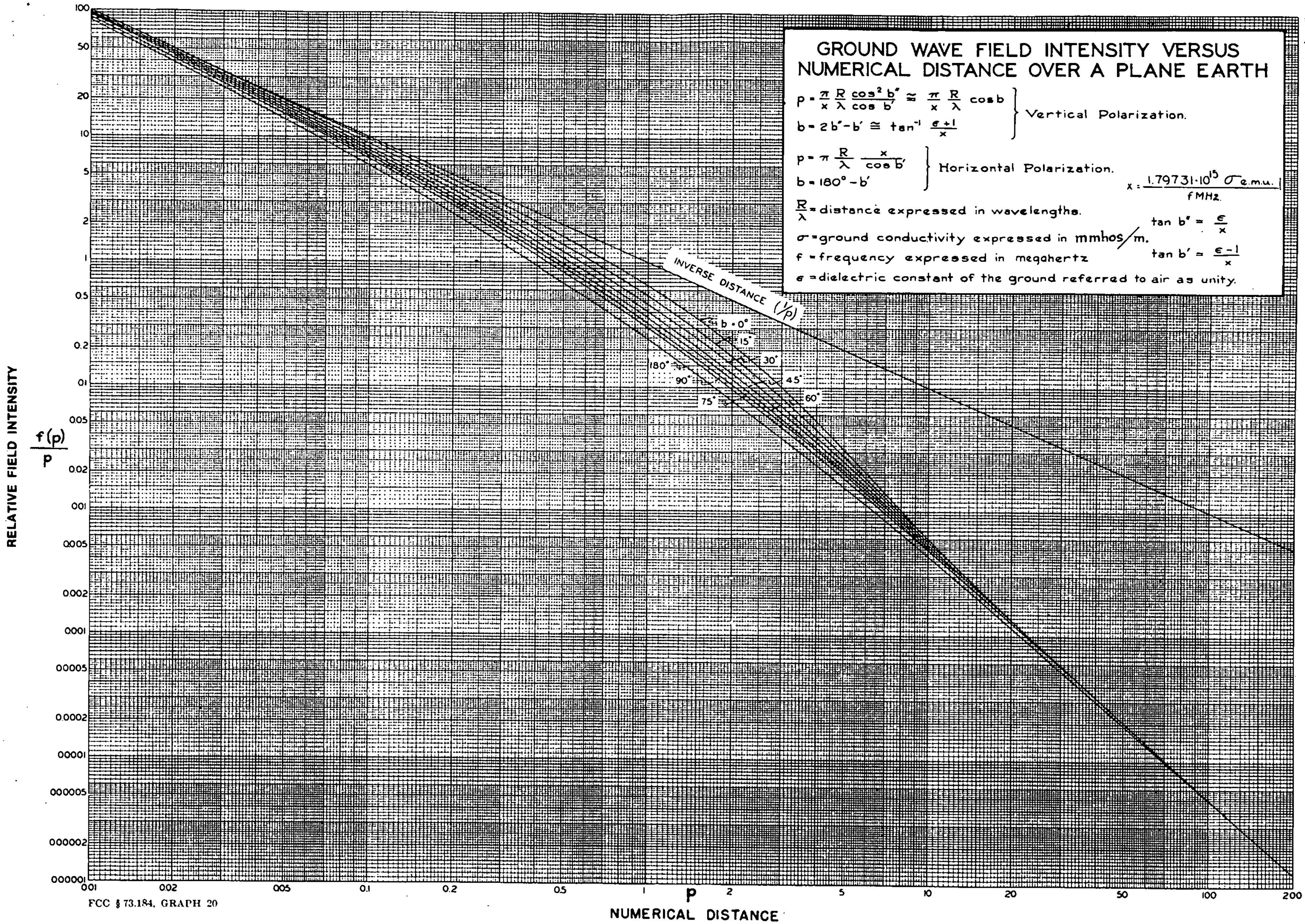
KILOMETERS FROM ANTENNA
GROUND WAVE FIELD STRENGTH
VERSUS
DISTANCE
1250-1330 kHz
COMPUTED FOR 1290 kHz
ϵ = 15 AND GROUND CONDUCTIVITIES
EXPRESSED IN mS/m.
MILLIVOLTS/METER
INVERSE DISTANCE 100 mV/m AT 1 km
5000
40
30
20
15
10
8
7
6
5
4
3
2
1.5
1
0.5
0.1
KILOMETERS FROM ANTENNA

GRAPH 16-A



KILOMETERS FROM ANTENNA
GROUND WAVE FIELD STRENGTH VERSUS DISTANCE
1430-1510 kHz
COMPUTED FOR 1470 kHz
ε = 15 AND GROUND CONDUCTIVITIES EXPRESSED IN mS/m.
INVERSE DISTANCE 100 mV/m AT 1 km
MILLIVOLTS/METER
KILOMETERS FROM ANTENNA

GRAPH 18



FCC § 73.184, GRAPH 20

73.185 Computation of interference and overlap. (a) Measured values of radiation are not to be used in calculating overlap, interference, and coverage.

(1) In the case of an antenna which is intended to be non-directional in the horizontal plane, and ideal non-directional radiation pattern shall be used in determining interference, overlap, and coverage, even if the antenna is not actually non-directional.

(2) In the case of an antenna which is directional in the horizontal plane, the radiation which shall be used in determining interference, overlap, and coverage is that calculated pursuant to 73.150 or 73.152, depending on whether the station has a standard or modified standard pattern.

(3) In the case of calculation of interference or overlap to (not from) a foreign station, the notified radiation shall be used, even if the notified radiation differs from that in paragraphs (a)(1) or (2) of this section.

(b) For signals from stations operating on clear channels, skywave interference shall be determined from the appropriate formulas and Figures 1a (or 1b) and 6a contained in 73.190.

(c) For signals from stations operating on regional and local channels, skywave interference is determined from the formulas and Figures 2 and 6a of 73.190. (Certain simplifying assumptions may be made in the case of Class IV stations on local channels. See note to 73.182(a)(4).

(d) The formulas in 73.190(d) depicted in Figure 6a of 73.190, entitled "Angles of Departure versus Transmission Range" are to be used in determining the angles in the vertical pattern of the antenna of an interfering station to be considered as pertinent to transmission by one reflection. To provide for variation in the pertinent vertical angle due to variations of ionosphere height and ionosphere scattering, the curves 4 and 5 indicate the upper and lower angles within which the radiated field is to be considered. The maximum value of field strength occurring between these angles shall be used to determine the multiplying factor to apply to the 10% skywave field intensity value determined from the formulas in 73.190(b)(2), 73.190(c)(2), of Figure 2 of 73.190 as appropriate. The multiplying factor is found by dividing the maximum radiation between the pertinent angles by 100 mV/m. (Curves 4 and 5 include factors which represent the variation due to variation of the effective height of the E-layer and scattering.)

(e) Example of the use of skywave curves for stations operating on clear channels: Assume a Class II station with which interference may be expected is located at a distance of 724 kilometers from a proposed Class II station. The critical angles of radiation as determined from Figure 6a of 73.190 are 9.6° and 16.3°. If the vertical pattern of the antenna of the proposed station, in the direction of the other station, is such that between the angles of 9.6° and 16.3° above the horizon the maximum radiation is 260 mV/m at one kilometer, the value of the 50% field, as read from Figure 1a of 73.190, is multiplied by 2.6 to determine the interfering field intensity of the location in question. In order to obtain the value of the 10% field, this value is then increased by 9 dB. For calculations involving Class I-N stations, Figure 1b and 13dB are employed instead of Figure 1a and 8 dB.

(f) For stations operating on regional and local channels, interfering skywave field intensities shall be determined in accordance with the procedure specified in (d) of this section and illustrated in (e) of this section, except that Figure 2 of 73.190 is used in place of Figure 1a and 1b and the formulas of 73.190. In using Figure 2 of 73.190, one additional parameter must be considered, i.e., the variation of received field with the latitude of the path.

(g) Figure 2 of §73.190, "10 percent Skywave Signal Range Chart," shows the signal as a function of the latitude of the transmission path, which is defined as the geographic latitude of the mid-point between the transmitter and receiver. When using Figure 2 of §73.190, latitude 35° should be used in case the mid-point of the path lies below 35° North and latitude 50° should be used incase the mid-point of the path lies above 50° North.

(h) In the case of an antenna which is intended to be non-directional in the horizontal plane, the vertical distribution of the relative fields should be computed pursuant to section 73.160. In the case of an antenna which is directional in the horizontal plane, the vertical pattern in the great circle direction towards the point of reception in question must first be calculated. In cases where the radiation in the vertical plane, in the pertinent azimuth, contains a large lobe at a higher angle than the pertinent angle for one reflection, the method of calculating interference will not be restricted to that just described, but each such case will be considered on the basis of the best knowledge available.

(i) Example of the use of skywave curves for stations operating on regional and local channels: It is desire to determine the amount of interference to a Class III station at Portland, Oregon, caused by another Class III station of Los Angeles, California. The Los Angeles station is radiating a signal of 901 mV/m at 1 kilometer, in the horizontal plane, in the great circle direction of Portland, using a 0.5 wavelength antenna. The distance is 1328 kilometers. From Figure 6a of 73.190, the upper and lower pertinent angles are 7° and 3.5° and, from Figure 5 of 73.190, the maximum radiation within these angles is 99% of the horizontal radiation or 892 mV/m at one kilometer. The mid-point latitude of the transmission path is 39.8° N and, from Figure 2 of 73.190, the 10% skywave field at 1328 kilometers is 0.050 mV/m for 100 mV/m radiated. Multiplying by 892/100 to adjust this value to the actual radiation gives 0.277 mV/m as to the interfering signal strength. At 20 to 1 ratio, the limitation to the Portland station is to the 5.5 mV/m contour.

(j) When the distance is large, more than one reflection may be involved and due consideration must be given each appropriate vector in the vertical pattern, as well as the constants of the earth where reflection takes place between the transmitting station and the service area to which interference may be caused.

(k) In performing calculations to determine permissible radiation from stations operating pre-sunrise or post-sunset in accordance with §73.99, calculated diurnal factors will be multiplied with the values of skywave signals for such stations obtained from Figure 1a or Figure 2 of §73.190.

(1) The diurnal factor is determined using the time of day at the mid-point of path between the site of the interfering station and the point at which interference is being calculated. Diurnal factors are computed using the formula $D_f=a+bF+cF^2+dF^3$ where: D_f represents the diurnal factor, F is the frequency in MHZ, a,b,c, and d are constants obtained from the tables in paragraph (k)(2). A diurnal factor greater than one will not be used in calculations and interpolation is to be used between calculated values where necessary. For reference purposes, curves for pre-sunrise and post-sunset diurnal factors are contained in Figures 12 and 13 of §73.190.

(2) Constants used in calculating diurnal factors for the pre-sunrise and post-sunset periods are contained in paragraph (k)(2)(i) and (ii) rspectively. The columns labeled T_{mp} represents the number of hours before and after sunrise and senset at the path midpoint.

(i) Presunrise Constants

T_{mp}	a	b	c	d
−2	1.3084	.0083	−.0155	.0144
−1.75	1.3165	−.4919	.6011	−.1884
−1.5	1.0079	.0296	.1488	−.0452
−1.25	.7773	.3751	−.1911	.0736
−1	.6230	.1547	.2654	−.1006
−.75	.3718	.1178	.3632	−.1172
−.5	.2151	.0737	.4167	−.1413
−.25	.2027	−.2560	.7269	−.2577
SR	.1504	−.2325	.5374	−.1729
+.25	.1057	−.2092	.4148	−.1239
+5	.0642	−.1295	.2583	−.0699
+.75	.0446	−.1002	.1754	−.0405
+1	.0148	.0135	.0462	.0010

(ii) Post Sunset Constants

T_{mp}	a	b	c	d
1.75	.9495	−.0187	.0720	−.0290
1.5	.7196	.3583	−.2280	.0611
1.25	.6756	.1518	.0279	−.0163
1.0	.5486	.1401	.0952	−.0288
.75	.3003	.4050	−.0961	.0256
.5	.1186	.4281	−.0799	.0197
.25	.0382	.3706	−.0673	.0171
SS	.0002	.3024	−.0540	.0086
−.25	.0278	.0458	.1473	−.0486
−.5	.0203	.0132	.1166	−.0340
−.75	.0152	−.0002	.0786	−.0185
−1.0	−.0043	.0452	−.0040	.0103
−1.25	.0010	.0135	.0103	.0047
−1.5	.0018	.0052	.0069	.0042
−1.75	−.0012	.0122	−.0076	.0076
−2.0	−.0024	.0141	−.0141	.0091

73.186 Establishment of effective field at one mile. (a) Section 73.45 provides that certain minimum field strengths are acceptable in lieu of the required minimum physical heights of the antennas proper. Also, in other situations, it may be necessary to determine the effective field. The following requirements shall govern the taking and submission of data on the field strength produced:

(1) Beginning as near to the antenna as possible without including the induction field and to provide for the fact that a broadcast antenna is not a point source of radiation (not less than one wave length or 5 times the vertical height in the case of a single element, i.e., nondirectional antenna or 10 times the spacing between the elements of a directional antenna), measurements shall be made on eight or more radials, at intervals of approximately 0.2 kilometers up to 3 kilometers (1.87 miles) from the antenna, at intervals of approximately 1 kilometer from 3 kilometers (1.87 miles) to 10 kilometers (6.2 miles) from the antenna, at intervals of approximately 3 kilometers from 10 kilometers (6.2 miles) to 25 or 34 kilometers (15.5 miles or 20 miles) from the antenna, and a few additional measurements if needed at greater distances from the antenna. Where the antenna is rurally located and unobstructed measurements can be made, there shall be as many as 18 measurements on each radial. However, where the antenna is located in a city where unobstructed measurements are difficult to make, measurements shall be made on each radial at as many unobstructed locations as possible, even thought the intervals are considerably less than stated above, particularly within 3 kilometers of the antenna. In cases where it is not possible to obtain accurate measurements at the closer distances (even out to 8 or 10 kilometers due to the character of the intervening terrain), the measurements at greater distances should be made at closer intervals. (It is suggested that "wave titlt" measurements may be made to determine and compare locations for taking field strength measurements, particularly to determine that there are no abrupt changes in ground conductivity or that reflected waves are not causing abnormal strengths.

(2) The date required by subparagraph (1) of this paragraph should be plotted for each radial in accordance with either of the two methods set forth below:

(i) Using log-log coordinate paper, plot field intensities as ordinate and distance as abscissa.

(ii) Using semi-log coordinate paper, plat field intensity times distance as ordinate on the log scale and distance as abscissa on the linear scale.

(3) However, regardless of which of the methods in paragraph (a)(2) of this section is employed, the proper curve to be drawn throught the points plotted shall be determined by comparison with the curves in 73.184 as follows: Place the sheet on which the actual points have been plotted over the appropriate Graph in 73.184, hold to the light if necessary and adjust until the curve most closely matching the points is found. This curve should then be drawn on the sheet on which the points were plotted, together with the inverse distance curve corresponding to that curve. The field at 1 kilometer for the radial concerned shall be the ordinate on the inverse distance curve at 1 kilometer.

(4) When all radials have been analyzed in accordance with paragraph (a)(3) of this section, a curve shall be plotted on polar coordinate paper from the fields obtained, which gives the inverse distance field pattern at 1 kilometer. The radius of a circle, the area of which is equal to the area bounded by this pattern, is the effective field. (See 73.14).

(5) In analyzing the results of a partial proof of performance as defined in §73.154 when the data are insufficient for independent graphical analysis, either of two analysis methods may be used. In such cases, either the arithmetic average or logarithmic average of the ratios of field strength at each measurement point along each radial to the corresponding field strength in the latest complete proof of performance may be utilized to establish the inverse distance fields. (The logarithmic average for each radial is the antilogarithm of the mean of the logarithms of the ratios of field strength (new to old) for each measurement location along a given radial.)

(6) The antenna power of the station shall be maintained at the authorized level during all field measurments. The power determination will be made using the direct method as described in 73.51(a) with instruments of acceptable accuracy specified in 73.1215.

(b) Complete data taken in conjunction with the field intensity measurements shall be submitted to the Commission in affidavit form including the following:

(1) Tabulation by number of each point of measurement to agree with the map required in (2) below; the date and time for each measurement, the field strength (E) the distance from the antenna (D) and the product of the field strength and distance (ED) (if data for each radial are plotted or semi-logarithmic paper, see above) for each point of measurement.

(2) Map showing each point of measurement numbered to agree with tabulation required above.

(3) Description of method used to take field strength measurements.

(4) The family of theoretical curves used in determining the curve for each radial properly identified by conductivity and dielectric constants.

(5) The curves drawn for each radial and the field strength pattern.

(6) The antenna resistance at the operating frequency.

(7) Antenna current or currents maintained during field strength measurements.

73.187 Linitation on daytime radistion. (a)(1) Except as otherwise orovided in paragraphs (a)(2) and (3) of this section, no authorization will be granted for Class II facilities if the proposed facilities would radiate during the period of critical houea (the two hours after local sunrise and the two hours before local sunset) toward any point on the 0.1mV/m contour of a co-channel U.S. Class I-A or I-B station, at or below the pertinent verticalangle determined from Curve 4 of Figure 6a of 73.190, values in excess of those obtained as provided in paragraph (b) of this section.

(2) The limitation set forth in paragraph (a)(1) of this section shall not aooly in the following cases:

(i) Any Class II facilities authorized before November 30, 1959; or

(ii) For Class II stations authorized before November 30, 1959, subsequent changes in facilities which do not involve a change in frequency, an increase in radiation toward any point on the 0.1mV/m contour of a co-channel U.S. Class I-A or I-B station, or the move of transmitter site materially closer to the 0.1mVm contour of such Class I-A or I-B station.

(3) If a Class II station authorized before November 30, 1959, is authorized to increase its daytime radiation in any direction toward the 0.1mV/m contour of a co-channel Class I-A or I-B station (without a change in frequency or a move of transmitter site materially closer to such contour), it may not during the two hours after local sunrise or the two hours before local sunset, radiate in such directions a value exceeding the higher of;

(i) The value radiated in such directions with facilities last authorized before November 30, 1959, or

(ii) The limitation specified in paragraph (a)(i) of this section.

(b) To obtain the maximum permissible radiation for a Class II station on a given frequency (f_{kc}) from 640 kc/s through 990 **kHz** multiply the radiation value obtained for the given distance and azimuth from the 500 kc chart (Figure 9 of §73.190) by the appropriate interpolation factor shown in the K500 column of paragraph (c) of this section; and multiply the radiation value obtained for the given distance and azimuth from the 1000 **kHz** chart (Figure 10 of §73.190) by the appropriate interpolation factor shown in the K1000 column of paragraph (c) of this section. Add the two products thus obtained; the result is the maximum radiation value applicable to the Class I station in the pertinent directions. For frequencies from 1010 **kHz** to 1580 **kHz** obtain in a similar manner the proper radiation values from the 1000 kc and 1600 kc charts (Figures 10 and 11 of §73.190), multiply each of these values by the appropriate interpolation factor in the K'1000 and K'1600 columns in paragraph (c) of this section, and add the products.

(c) Interpolation factors.

(1) Frequencies below 1000 kHz

f kHz	K500	K 1000	f kHz	K 500	K 1000
640	0.720	0.280	780	0.440	0.560
650	0.700	0.300	800	0.400	0.600
660	0.680	0.320	810	0.380	0.620
670	0.660	0.340	820	0.360	[illegible]
680	0.640	0.360	830	0.340	[illegible]
690	0.620	0.380	840	0.320	0.680
700	0.600	0.400	850	0.300	0.700
710	0.580	0.420	860	0.280	0.720
720	0.560	0.440	870	0.260	0.740
730	0.540	0.460	880	0.240	0.760
740	0.520	0.480	890	0.220	0.780
750	0.500	0.500	900	0.200	0.800
760	0.480	0.520	940	0.120	0.880
770	0.460	0.540	990	0.020	0.980

(2) Frequencies above 1000

f'	K'1000	K'1600	f'	K'1000	K'1600
1010..........	0.983	0.017	1170..........	0.717	0.283
1020..........	0.967	0.033	1180..........	0.700	0.300
1030..........	0.950	0.050	1190..........	0.683	0.317
1040..........	0.933	0.067	1200..........	0.667	0.333
1050..........	0.917	0.083	1210..........	0.650	0.350
1060..........	0.900	0.100	1220..........	0.633	0.367
1070..........	0.883	0.117	1500..........	0.167	0.833
1080..........	0.867	0.133	1510..........	0.150	0.850
1090..........	0.850	0.150	1520..........	0.133	0.867
1100..........	0.833	0.167	1530..........	0.117	0.883
1110..........	0.817	0.183	1540..........	0.100	0.900
1120..........	0.800	0.200	1550..........	0.083	0.917
1130..........	0.783	0.217	1560..........	0.067	0.933
1140..........	0.767	0.233	1570..........	0.050	0.950
1160..........	0.733	0.267	1580..........	0.033	0.967

§73.189 <u>Minimum antenna heights or field strength requirements.</u>-(a) Section §73.45 requires that all applicants for new, additional, or different broadcast facilities and all licensees requesting authority to move the transmitter of an existing station, shall specify a radiating system, the efficiency of which complies with the requirements of good engineering practice for the class and power of the station.

(b) The specifications deemed necessary to meet the requirements of good engineering practice at the present state of the art are set out in detail below.

(1) The licensee of a standard broadcast station requesting a change in power, time of operation, frequency, or transmitter location must also request authority to install a new antenna system or to make changes in the existing antenna system which will meet the minimum height requirements, or submit evidence that the present antenna system meets the minimum requirements with respect to field intensity, before favorable consideration will be given thereto. (See §73.186). In the event it is proposed to make substantial changes in an existing antenna system, the changes shall be such as to meet the minimum height requirements or will be permitted subject to the submission of field intensity measurements showing that it meets the minimum requirements with respect to effective field intensity.

(2) These minimum actual physical vertical heights of antennas permitted to be installed are shown by curves A, B, and C of Figure 7 of §73.190 as follows:

(i) Class IV stations and stations in Alaska, Hawaii, Puerto Roco and the U.S.Virgin Islands on 1230, 1240, 1340, 1400, 1450 and 1490 kHz that were formerly Class IV and were redesignated as Class III pursuant to Section 73.26(b), 45 meters or a minimum effective field strength of 241mV/m for 1kW (121mV/m for 0.25kW). (This height applies to a Class IV station on a local channel only. Curve A shall apply to any Class IV stations in the 48 conterminous states that are assigned to Regional channels).

(ii) Class I-N and Class II stations, and Class III stations other than those covered in Section 73.189(b)(2)(i), a minimum effective field strength of 282mV/m for 1kW.

(iii) Class I-A, and I-B stations, a minimum effective field strength of 362 mV/m for 1 kW.

(3) The heights given on the graph for the antenna apply regardless of whether the antenna is located on the ground or on a building. Except for the reduction of shadows, locating the antenna on a building does not necessarily increase the efficiency and where the height of the building is in the order of a quarter wave the efficiency may be materially reduced.

(4) At the present development of the art, it is considered that where a vertical radiator is employed with its base on the ground, the ground system should consist of buried radial wires at least one-fourth wave length long. There should be as many of these radials evenly spaced as practicable and in no event less than 90. (120 radials of 0.35 to 0.4 of a wave length in length and spaced 3^{o} is considered an excellent ground system and in case of high base voltage, a base screen of suitable dimensions should be employed.)

(5) In case it is contended that the required antenna efficiency can be obtained with an antenna of height or ground system less than the minimum specified, a complete field intensity survey must be supplied to the Commission showing that the field intensity at a mile without absorption fulfills the minimum requirements. (See §73.186). This field survey must be made by a qualified engineer using equipment of acceptable accuracy.

(6) The main element or elements of a directional antenna system shall meet the above minimum requirements with respect to height or effective field intensity. No directional antenna system will be approved which is so designed that the effective field of the array is less than the minimum prescribed for the class of station concerned, or in case of a Class I station less than 90 percent of the ground wave field which would be obtained from a perfect antenna of the height specified by Figure 7 of §73.190 for operation on frequencies below 1000 kilocycles, and in the case of a Class II or III station less than 90 percent of the ground wave field which would be obtained from a perfect antenna of the height specified by Figure 7 of §73.190 for operation on frequencies below 750 kilocycles.

73.190 <u>Engineering charts and related formulas</u>. (a) This section consists of the following Figures: 1a, 1b, 2, r3, 5, 6a, 7, 8, 9, 10, 11, and 13. Additionally, formulas that are directly related to graphs are included.

(b) Figure 1a depicts 50% field strength values (F(50)).

(1) For distances greater than 4250 kilometers, the following formula may be used to compute 50% field strength values:

$$F_c = \text{antilog}\left[\frac{\frac{231}{3 + d/1000} - 35.5}{20}\right] \quad \mu V/m$$

where: F=50% skywave field strength values [F(50)]
d^c=path distance in kilometers

(2) 10% field strength values [F(10)] are derived from Figure 1a by the following formula:

F(10)=F(50) + 8 dB. dB(1mV/m)

(3) The field strength value in Figure 1a at 100 km also is to be used for distance less than 100 km. However, the actual great-circle distance is to be used in determining angle of departure.

(c) Figure 1b depicts 50% field strength values F(50) for calculations involving Alaskan stations.

(1) The following formula also may be used for computing field strength values for such applications:

$F_c = 95 - 20 \log_d - 20 ((d+300)/1000)$ ½ dB(1 uV/m)

where:
F=50% skywave filed strength values F(50) in dB (1 uV/m)
d^c=path distance in kilometers

(2) 10% field strength values F(10) are derived from Figure 1b from the following formula:

F(10)=F(50)+13 dB microvolts per meter

(d) Figure 6a depicts angles of departure versus transmission range. These angles may also be computed using the following formulas:

$$\Theta = \tan^{-1}\left(K_n \cot + \frac{d)}{444.54}\right) \quad \frac{d}{444.54} \quad \text{degrees}$$

(e) In the event of disagreement between computed values using the formulas shown above and values obtained directly from the figures, the computed values will control.

Where:
d is distance in kilometers
n=1 for 50% field strength values
n=2 or 3 for 10% field strength values

and Where:
K_1=0.00752
K_2=0.00938
K_3=0.00565

Note.—Computations using these formulas should not be carried beyond 0.1 degree.

Note - It might not hurt to check with FCC first to see if the charts as reproduced here in, due to their small scale, may be used in connection with material submitted to them.

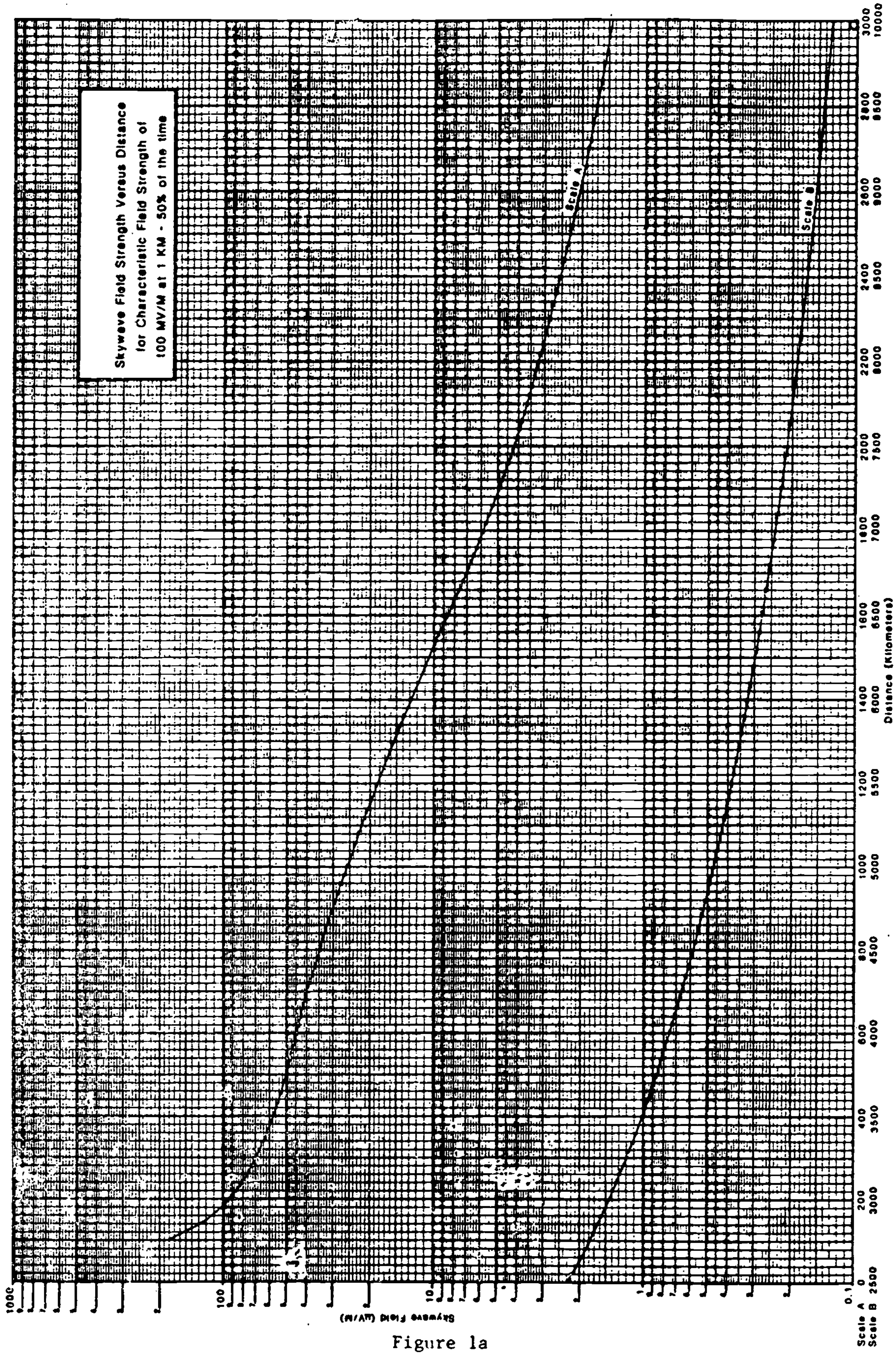
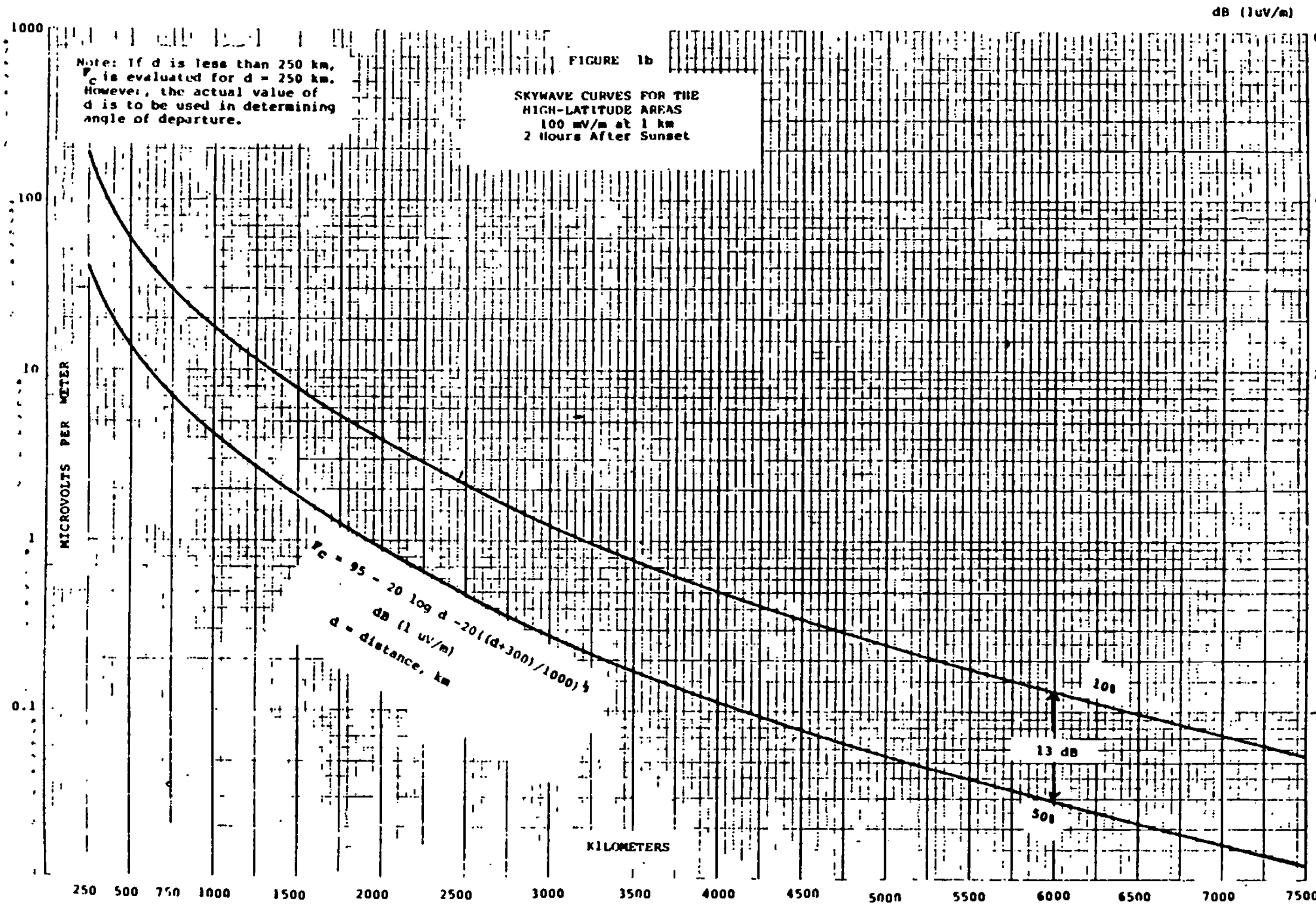
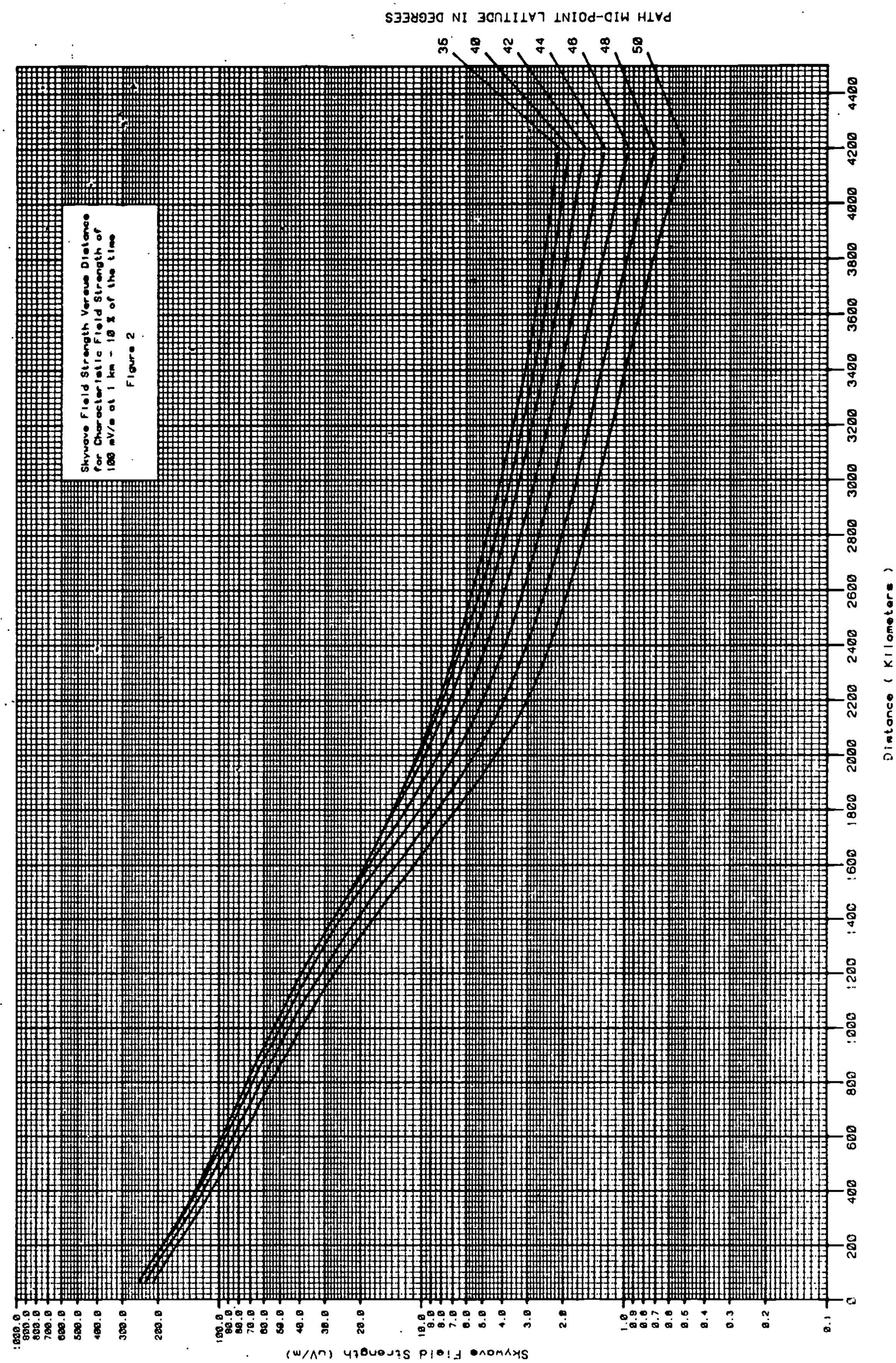

Skywave Field Strength Versus Distance
for Characteristic Field Strength of
100 MV/M at 1 KM - 50% of the time
Scale A
Scale B
Distance (Kilometers)
Skywave Field (µV/M)
1000
100
10
0.1
Scale A 0 200 400 600 800 1000 1200 1400 1600 1800 2000 2200 2400 2600 2800 3000
Scale B 2500 3000 3500 4000 4500 5000 5500 6000 6500 7000 7500 8000 8500 9000 9500 10000

Figure 1a



Note: If d is less than 250 km, F_c is evaluated for d = 250 km. However, the actual value of d is to be used in determining angle of departure.
FIGURE 1b
SKYWAVE CURVES FOR THE HIGH-LATITUDE AREAS
100 mV/m at 1 km
2 Hours After Sunset
dB (1uV/m)
MICROVOLTS PER METER
F_c = 95 - 20 log d -20((d+300)/1000)^{½}
dB (1 uV/m)
d = distance, km
10%
50%
13 dB
KILOMETERS
1000
100
10
1
0.1
60
40
20
0
-20
250
500
750
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
6500
7000
7500


Skywave Field Strength Versus Distance
for Characteristic Field Strength of
100 mV/m at 1 km - 10 % of the time
Figure 2
PATH MID-POINT LATITUDE IN DEGREES
36
40
42
44
46
48
50
Distance (Kilometers)
Skywave Field Strength (uV/m)

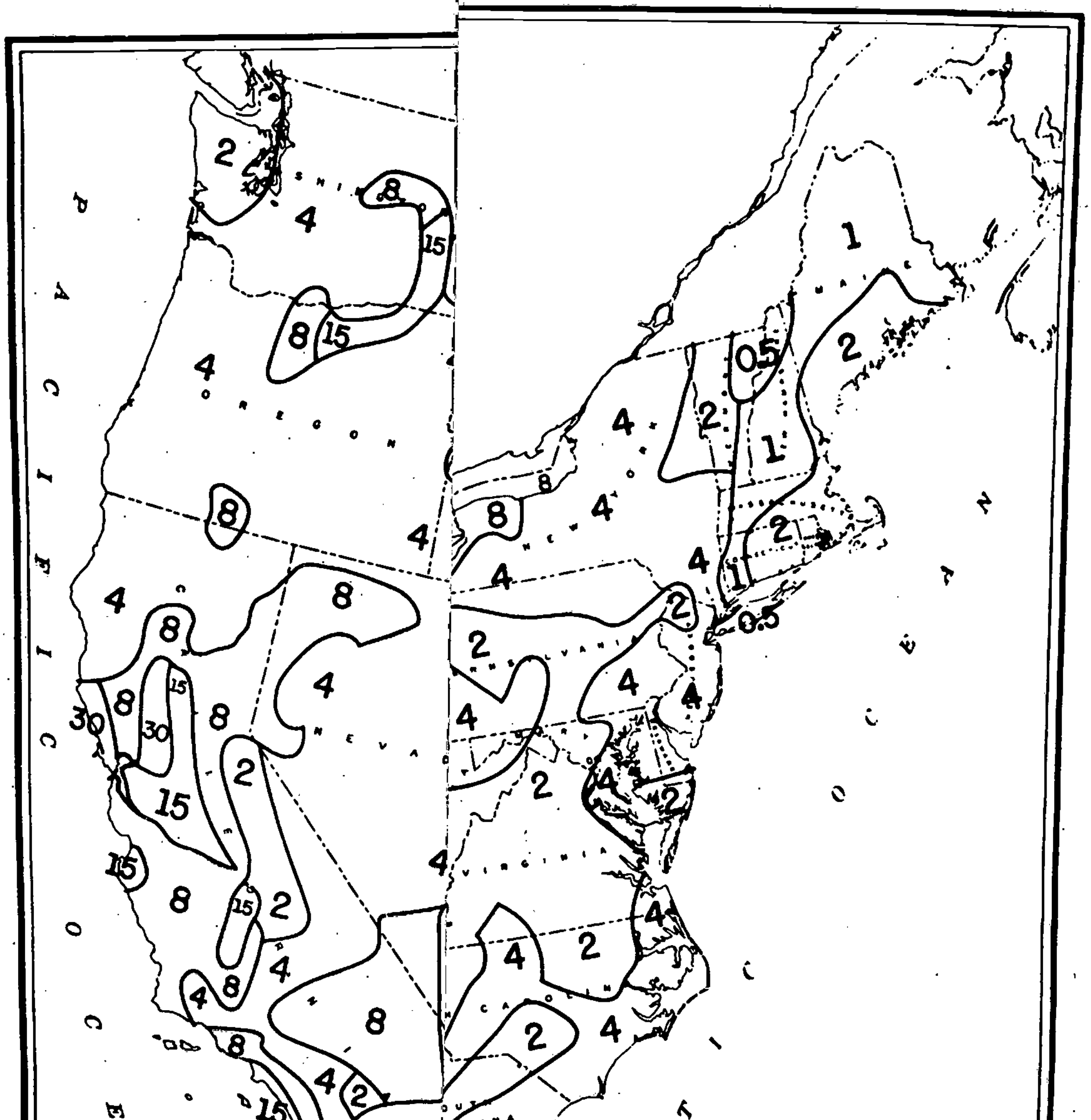


FIGURE R3

FCC § 3.190, FIGURE R3

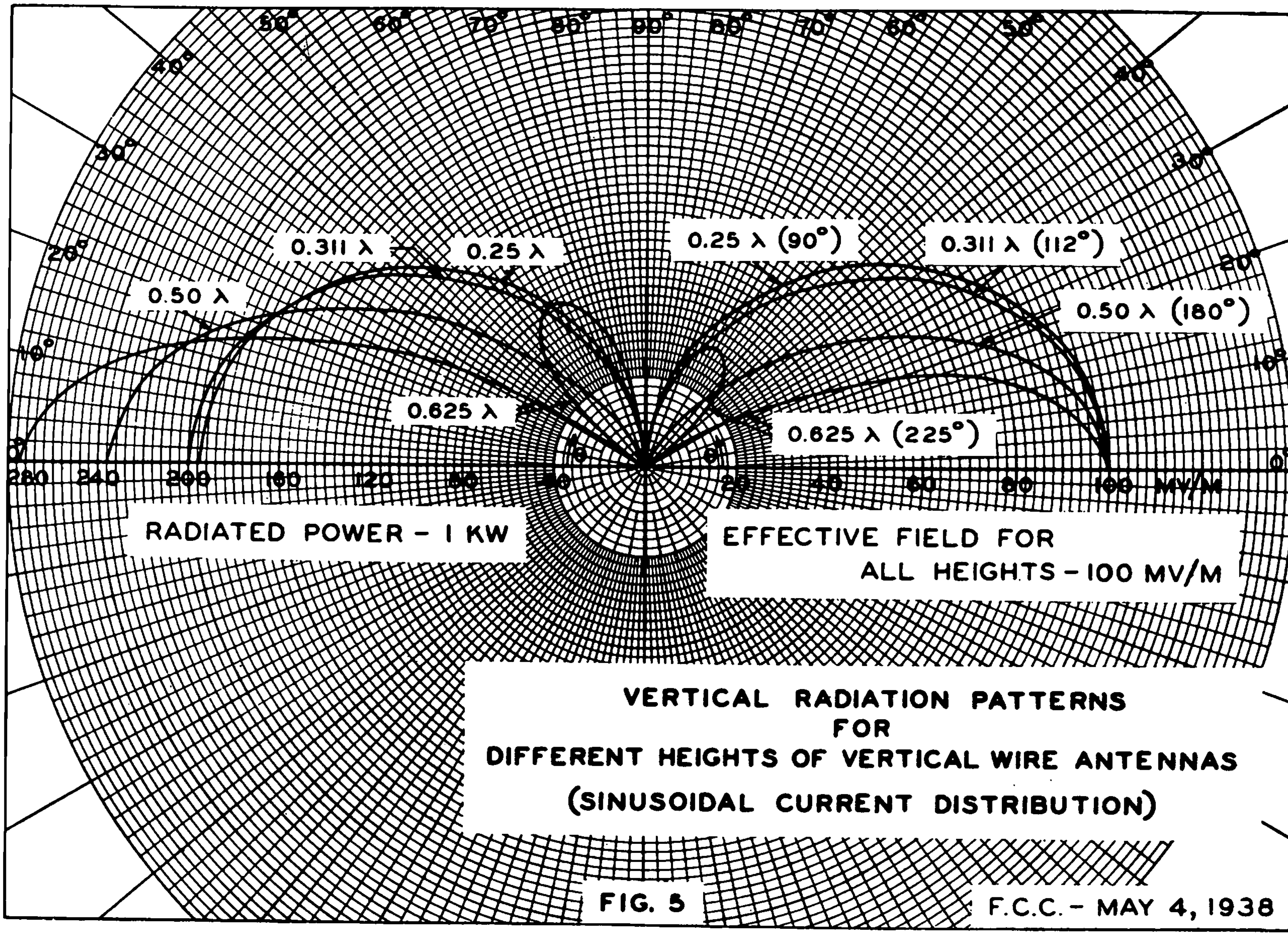
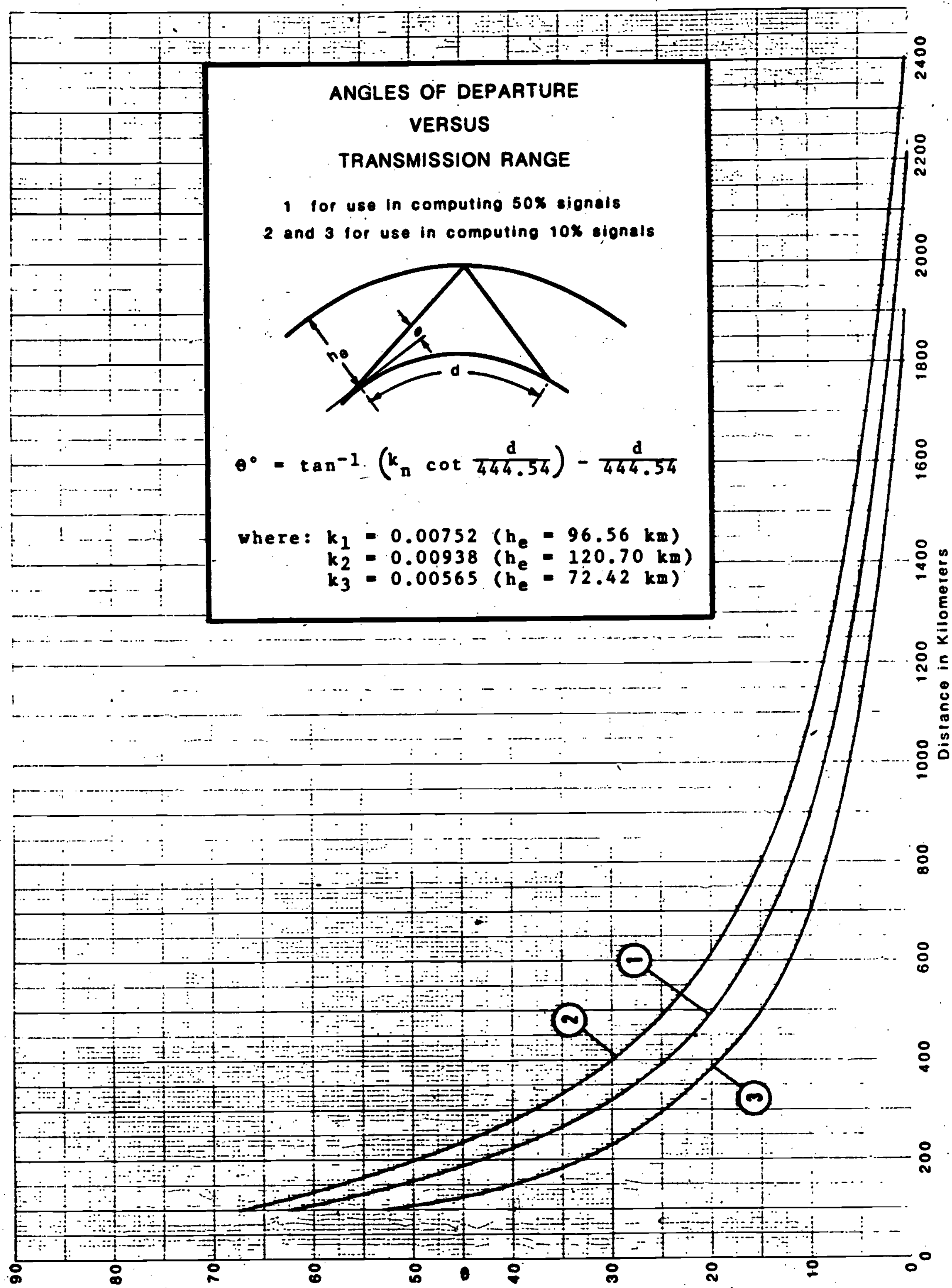
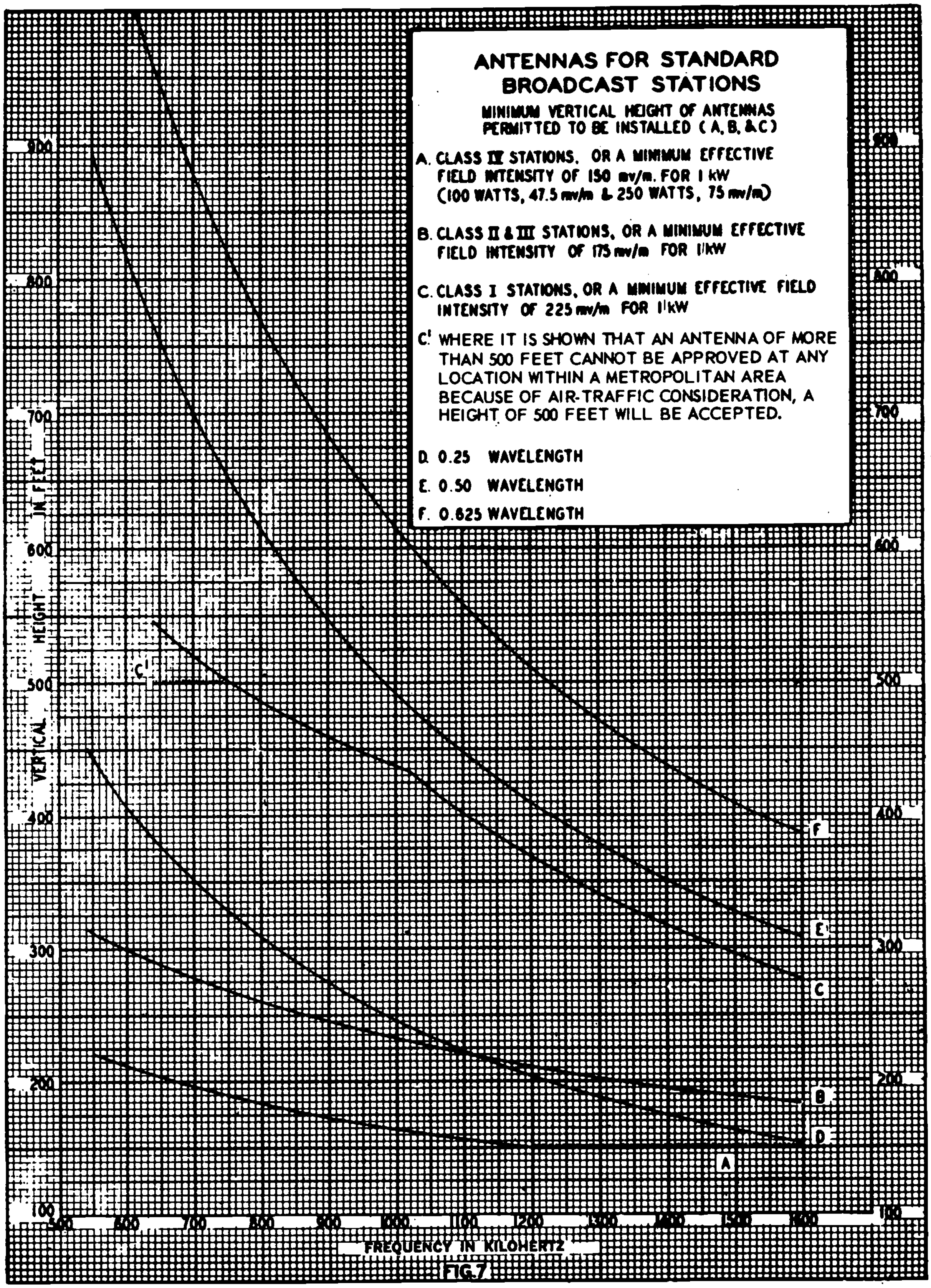
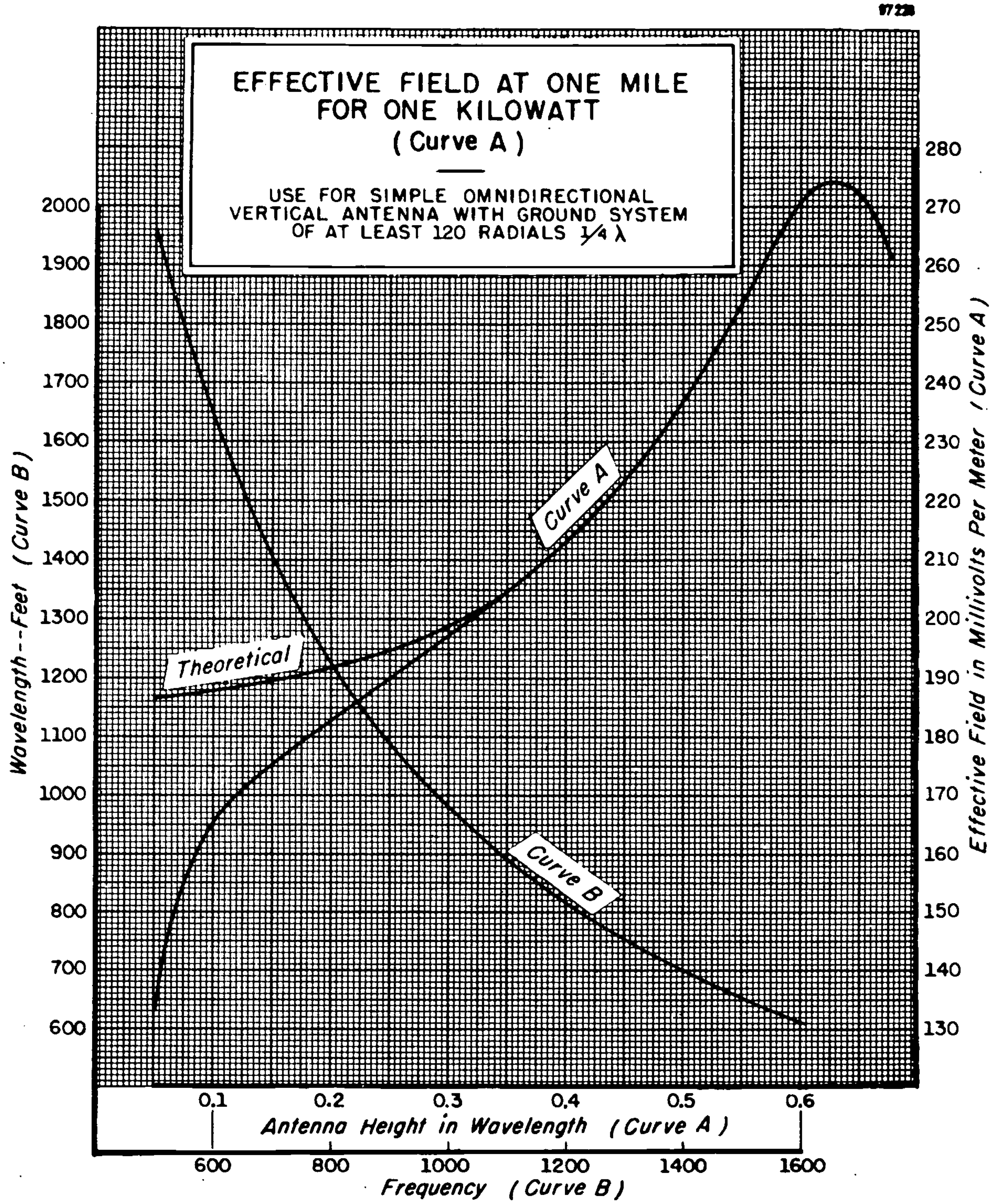

0.311 λ
0.25 λ
0.50 λ
0.625 λ
0.25 λ (90°)
0.311 λ (112°)
0.50 λ (180°)
0.625 λ (225°)
280 240 200 160 120 80 40 20 40 60 80 100 MV/M
RADIATED POWER - 1 KW
EFFECTIVE FIELD FOR
ALL HEIGHTS - 100 MV/M
VERTICAL RADIATION PATTERNS
FOR
DIFFERENT HEIGHTS OF VERTICAL WIRE ANTENNAS
(SINUSOIDAL CURRENT DISTRIBUTION)
F.C.C. - MAY 4, 1938

FIG. 5



FCC §73.190 FIGURE 6a


ANTENNAS FOR STANDARD BROADCAST STATIONS
MINIMUM VERTICAL HEIGHT OF ANTENNAS PERMITTED TO BE INSTALLED (A, B, & C)
A. CLASS IV STATIONS, OR A MINIMUM EFFECTIVE FIELD INTENSITY OF 150 mv/m. FOR 1 kW (100 WATTS, 47.5 mv/m & 250 WATTS, 75 mv/m)
B. CLASS II & III STATIONS, OR A MINIMUM EFFECTIVE FIELD INTENSITY OF 175 mv/m FOR 1 kW
C. CLASS I STATIONS, OR A MINIMUM EFFECTIVE FIELD INTENSITY OF 225 mv/m FOR 1 kW
C' WHERE IT IS SHOWN THAT AN ANTENNA OF MORE THAN 500 FEET CANNOT BE APPROVED AT ANY LOCATION WITHIN A METROPOLITAN AREA BECAUSE OF AIR-TRAFFIC CONSIDERATION, A HEIGHT OF 500 FEET WILL BE ACCEPTED.
D. 0.25 WAVELENGTH
E. 0.50 WAVELENGTH
F. 0.625 WAVELENGTH
VERTICAL HEIGHT IN FEET
100
200
300
400
500
600
700
800
900
FREQUENCY IN KILOHERTZ
500
600
700
800
900
1000
1100
1200
1300
1400
1500
1600
A
B
C
C'
D
E
F
FIG.7



§ 73.190 FIGURE 8

PERMISSIBLE DAYTIME RADIATION
FOR CLASS II STATIONS

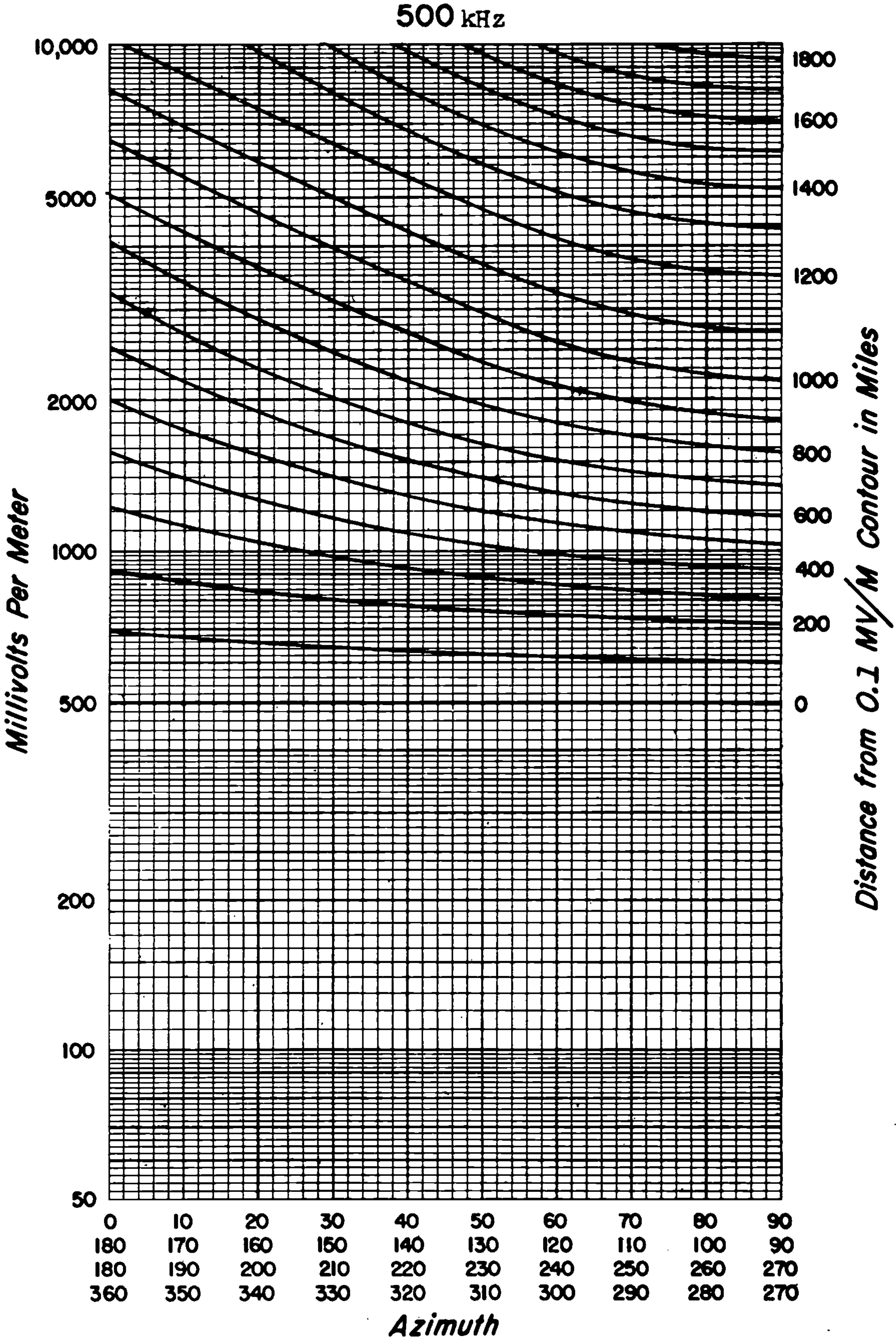
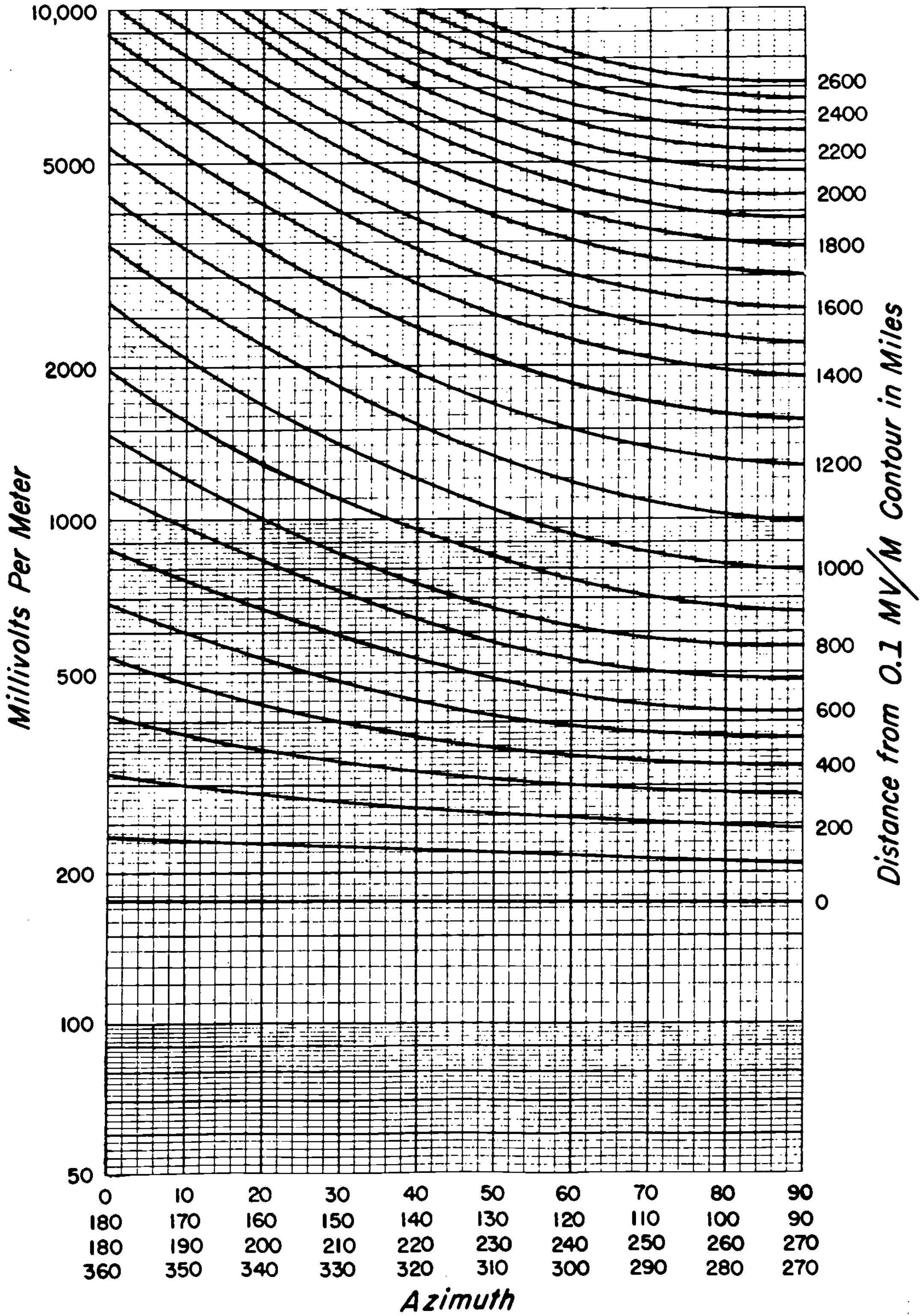


FIGURE 9

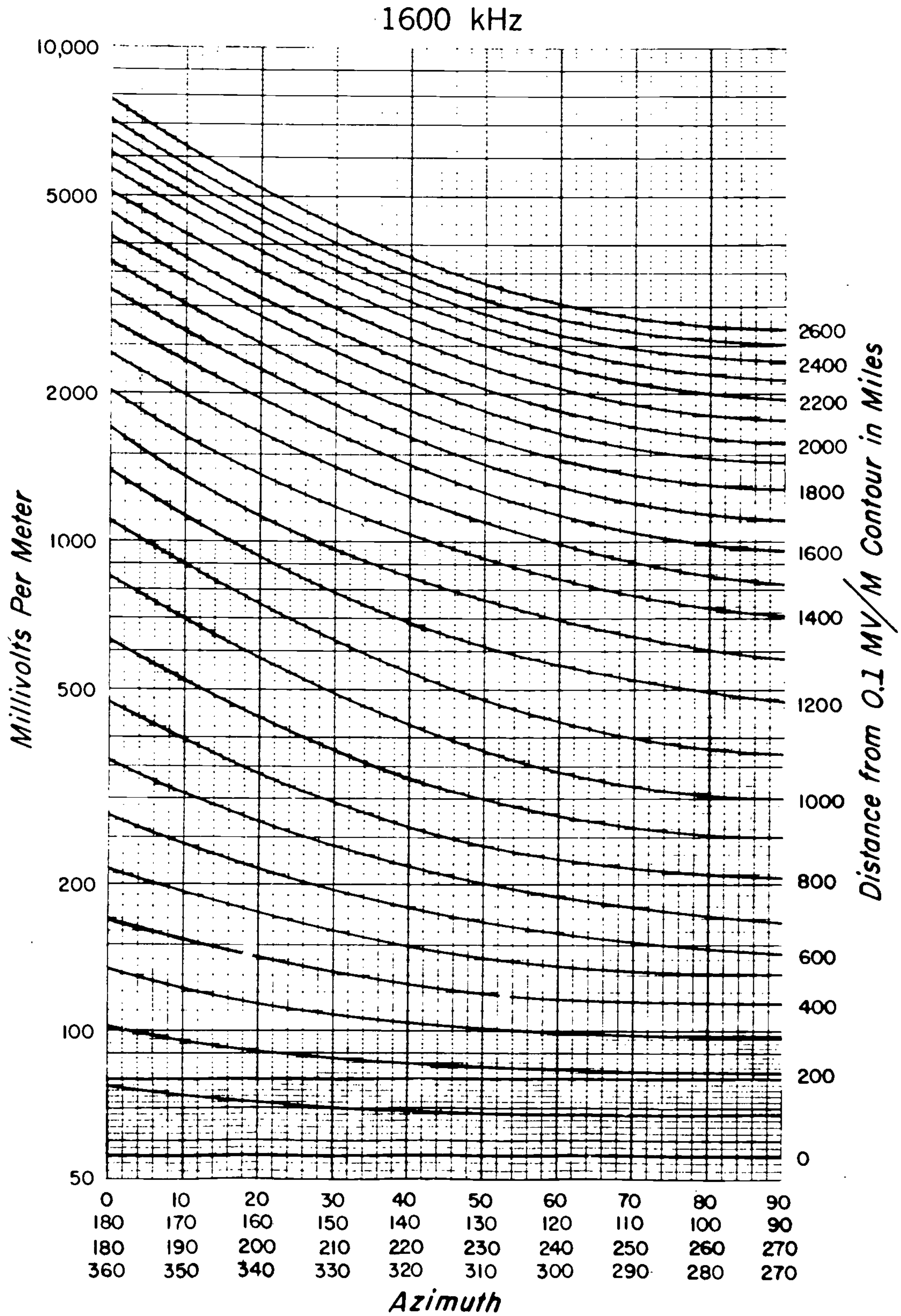
PERMISSIBLE DAYTIME RADIATION
FOR CLASS II STATIONS

1000 kHz



§ 73.190 FIGURE 10

PERMISSIBLE DAYTIME RADIATION
FOR CLASS II STATIONS



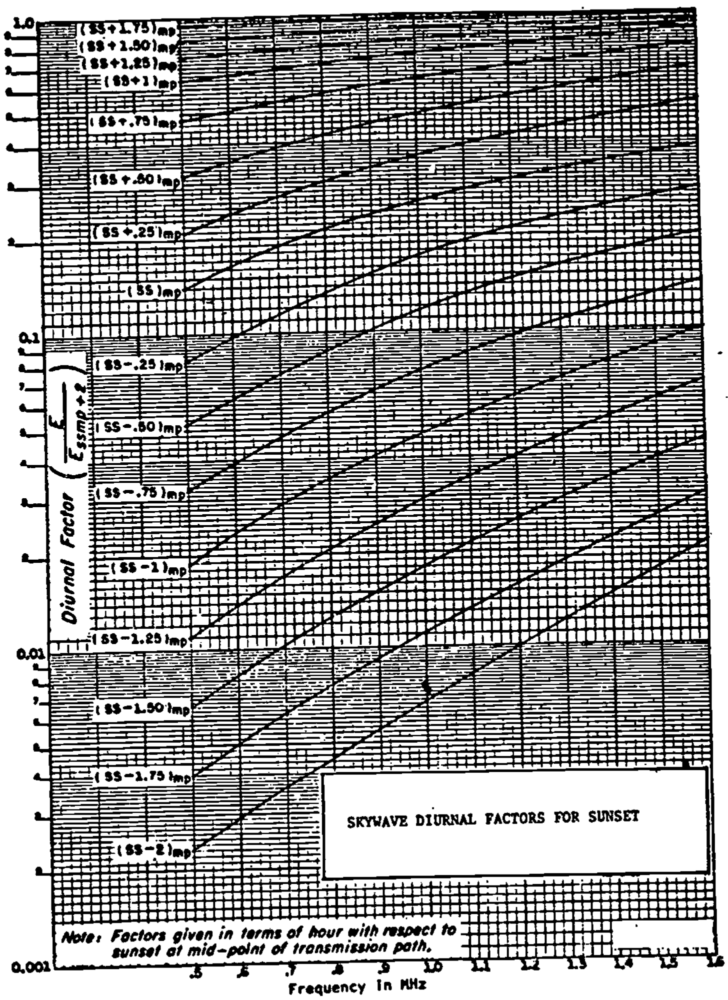

(SS+1.75)mp
(SS+1.50)mp
(SS+1.25)mp
(SS+1)mp
(SS+.75)mp
(SS+.50)mp
(SS+.25)mp
(SS)mp
(SS-.25)mp
(SS-.50)mp
(SS-.75)mp
(SS-1)mp
(SS-1.25)mp
(SS-1.50)mp
(SS-1.75)mp
(SS-2)mp
1.0
0.1
0.01
0.001
Diurnal Factor (E / E ssmp+2)
SKYWAVE DIURNAL FACTORS FOR SUNSET
Note: Factors given in terms of hour with respect to sunset at mid-point of transmission path.
.5 .6 .7 .8 .9 1.0 1.1 1.2 1.3 1.4 1.5 1.6
Frequency in MHz

Figure 13

FM STANDARDS

TABLE OF CONTENTS

FM TECHNICAL STANDARDS

§73.301 DELETED

§73.310 FM broadcast technical definitions.

(a) Antenna height above average terrain (HAAT). HAAT is calculated by: determining the average of the antenna heights above the terrain from 3 to 16 kilometers (2 to 10 miles) from the antenna for each 45 degrees of azimuth starting with True North (a different antenna height will be determined in each direction from the antenna): and computing the average of these separate heights. In some cases less than eight directiond may be used. (See 73.313(d).) Where circular or elliptical polarization is used, the antenna height above average terrain must be based upon the height of the radiation of the antenna that transmits the horizontal component of radiation.

Antenna power gain. The square of the ration of the root-mean-square (RMS) free space field strength produced at 1 kilometer in the horizontal plane in millivolts per meter for 1 kW antenna input power to 221.4 mV/m. This ratio is expressed in decibels (dB). If specified for a particular direction, antenna power gain is based on that field strength in the direction only.

Center frequency. The term "center frequency" means:

(1) The average frequency of the emitted wave when modulated by a sinusoidal signal.

(2) The frequency of the emitted wave without modulation.

Composite baseband signal. A signal which is composed of all program and other communications signals that frequency modulated the FM carrier.

Effective radiated power. The term "effective radiated power" means the product of the antenna power (transmitter output power less transmission line loss) times (1) the antenna power gain, or (2) the antenna field gain squared. Where circular or elliptical polarization is employed, the term effective radiated power is applied separately to the horizontal and vertical components of radiation. For allocation purposes, the effective radiated power authorized is the horizontally polarized component of radiation only.

Equivalent Isotropically radiated power (EIRP). The term "equivalent isotropically radiated power (also known as "effective radiated power above isotropic) means the product of the antenna input power and the antenna gain in a given direction relative to an isotropic antenna.

FM Blanketing. Blanketing is that form of interference to the reception of other broadcast stations which is caused by the presence of an FM broadcast signal of 115 dBu (562 mV/m or greater signal strength in the area adjacent to the antenna of the transmitting station. The 115 dBu contour is referred to as the blanketing contour and the area within this contour is referred to as the blanketing area.

FM broadcast band. The band of frequencies extending from 88 to 108 megahertz, which includes those assigned to noncommercial educational broadcasting.

FM broadcast channel. A band of frequencies 200 kHz wide and designated by its center frequency. Channels for FM broadcast stations begin at 88.1 MHz and continue in successive steps of 200 kHz to and including 107.9 MHz.

FM broadcast station. A station employing frequency modulation in the FM broadcast band and licensed primarily for the transmission of radiotelephone emissions intended to be received by the general public.

Field strength. The electric field strength in the horizontal plane.

Free space field strength. The field strength that would exist at a point in the absence of waves reflected from the earth or other reflecting objects..

Frequency departure. The amount of variation of a carrier frequency or center frequency from its assigned value.

Frequency deviation. The peak difference between the instantaneous frequency of the modulated wave and the carrier frequency.

Frequency Modulation. A system of modulation where the instantaneous radio frequency varies in proportion to the instantaneous amplitude of the modulating signal (amplitude of modulating signal to be measured after pre-emphasis, if used) and the instantaneous radio frequency is independent of the frequency of the modulating signal.

Frequency swing. The peak difference between the maximum and the minimum values of the instantaneous frequency of the carrier wave during modulation.

Multiplex transmission. The term "multiplex transmission" means the simultaneous transmission of two or more signals within a single channel. Multiplex transmission as applied to FM broadcast stations means the transmission of facsimile or other signals in addition to the regular broadcast signals.

Percentage modulation. The ratio of the actual frequency deviation to the frequency deviation defined as 100% modulation, expressed in percentage. For FM broadcast stations, a frequency deviation of ± 75 kHz is defined as 100% modulation.

(b) Stereoohonic sound. The radio information carried by plurality of channels arranged to afford the listner a sense of the apatial distribution of so8nd sources. Sterophonic sound broadcasting includes, but is not limited to, biohonic (two channel), triohonic (three channel) and quadrophonic (four channel) program service.

Stereophonic sound broadcasting. Cross talk. An undesired signal occurring in one channel caused by an electrical signal in another channel.

FM stereophonic broadcasting. The transmission of stereophonic program by a single FM broadcast station utilizing the main channel and a stereophonic subchannel.

Left (or right signal. The electrical output of a microphone or combination of microphones placed so as to convey the intensity, time, and location of sounds originating predominately to the listener's left (or right) of the center of the performing area.

Left (or right) stereophonic channel. The left (or right) signal as electrically reproduced in reception of FM stereophonic broadcasts.

Main channel. The band of frequencies from 50 to 15,000 Hz. which frequency modulate the main carrier.

Pilot subcarrier. A subcarrier that serves as a control signal for use in the reception of FM stereophonic sound broadcasting.

Stereophonic seperation. The ratio of the electrical signal caused in sound channel A to the signal caused in sound channel B by the transmission of only a channel B signel. Channels A and B may be any two channels of a stereophonic sound broadcast transmission system.

Stereophonic sound subcarrier. A subcarrier within the FM broadcast baseband used for transmitting signels for stereophonic sound reception of the main broadcast program service.

Stereophonic sound subchannel. The band of frequencies from 23KHz to 99kHz containing sound subcarriers and their associated sidebands.

Facsimile. Available line. The portion of the total length of scanning line that can be used specifically for picture signals.

Index of cooperation. The product of the number of lines per inch, the available line length in inches, and the reciprocal of the line-use ration (e.g., 105x8.2x8/7-984).

Line-use ratio. The ration of the available line to the total length of scanning line.

Optical density. The logarithm (to the base 10) of the radio of indicent to transmitted or reflected light.

Rectilinear scanning. The process of scanning an area in a predetermined sequence of narrow straight parallel strips.

(c) Visual transmissions. Communications or message transmitted on a subcarrier intended for reception and visual presentation on a viewing screen, teleprinter, facsimile printer, or other form of graphic display or record.

(d) Control and telemetry transmissions. Signels transmitted on a multiplex subcarrier intended for any form of control and switching functions or for equipment status data and aural or visual alarms.

73.311 Field strength contours. (a) Applications for FM broadcast authorization must show two field strength contours. These are the 70 dbu (3.16mv/m), 60 dbu (1 mv/m). These contours indicate only the approximate extent of coverage over average terrain and in the absence of interference. Under actual conditions, the true coverage may vary greatly from these desimates because the terrain over any specific path is expected to be different from the average terrain on which the field strength chart was based. Because of these factors the estimated contours give no assistance of service to any specific percentage of receiver locations within the distances indicated.

(b) The field strength contours provided for in this section shall be considered for the following purposes only:

(1) In the estimation of coverage resulting from the selection of a particular transmitter site by an applicant for an FM broadcast station.

(2) In connection with problems of coverage arising out of application of §73.240.

(3) In determining compliance with §73.315(a) concerning the minimum field strength to be provided over the principal community to be served.

§73.312 Topographic data. (a) In the preparation of the profile graphs previously described, and in determining the location and height above mean sea level of the antenna site, the elevation or contour intervals shall be taken from United States Geological Survey Topographic Quadrangle Maps, United States Army Corps of Engineers Maps or Tennessee Valley Authority maps, whichever is the latest, for all areas for which such maps are available. If such maps are not published for the area in question, the next best topographic information should be used. Topographic data may sometimes be obtained from state and municipal agencies. The data from the Sectional Aeronautical Charts (including bench marks) or railroad depot elevations and highway elevations from road maps may be used where no better information is available. In cases where limited topographic data can be obtained, use may be made of an altimeter in a car driven along roads extending generally radially from the transmitter site.

(b) The Commission will not ordinarily require the submission of topographical maps for areas beyond 15 miles from the antenna site, but the maps must include the principal city or cities to be served. If it appears necessary, additional data may be requested.

(c) The U.S. Geological Survey Topography Quadrangle Sheets may be obtained from the U.S. Geological Survey Department of the Interior, Washington, D. C. 20240. The Sectional Aeronautical Charts are available from the U.S. Coast and Geodetic Survey, Department of Commerce, Washington, D. C. 20235. These maps may also be secured from branch offices and from authorized agents or dealers in most principal cities.

(d) In lieu of maps, the average terrain elevation may be computer generated except in cases of dispute, using elevations from a 30 second point or better topographic data file. The file must be identified and the data processed for intermediate points along each radial using linear interpolation techniques. The height above mean sea level of the antenna site must be obtained manually using appropriate topographic maps.

§73.313 Prediction of coverage. (a) All predictions of coverage made pursuant to this section shall be made without regard to interference and shall be made only on the basis of estimated field strengths.

(b) Predictions of coverage shall be made only for the same purposes as relate to the use of field strength contours as specified in §73.311.

(c) In predicting the distance to the field strength contours, the F(50,50) field strength chart, Figure 1 of §73.333 must be used. The 50% field strength is defined as that value exceeded for 50% of the time.

(1) The F(50,50) chart gives the estimated 50% field strengths exceeded at 40% of the locations in dB above 1 uV/m. The chart is based on an effective power radiated from a half-wave dipole antenna in free space, that produces an unattenuated field strength at 1 kilometer of about 107 dB above 1 uV/m (221.4 mV/m).

FMS

(2) To use the chart for other powers, the sliding scale associated with the chart should be trimmed and used as the ordinate scale. This sliding scale is placed on the chart with the appropriate gradation for power in line with the horizontal 40 db line on the chart. The right edge of the scale is placed in line with the appropriate antenna height gradations, and the chart then becomes direct reading (in uv/m and in db above 1 uv/m) for this power and antenna height. Where the antenna height is not one of those for which a scale is provided, the signal strength or distance is determined by interpolation between the curves connecting the equidistant scale. Dividers may be used in lieu of the sliding scale. In predicting the distance to the field strength contours, the effective radiated power to be used is that in the horizontal plane in the pertinent direction. In predicting other field strengths over areas not in horizontal plane, the effective radiated power to be used is the power in the direction of such areas; the appropriate vertical plane radiation pattern must, of course, be considered in determining this power.

(d) The antenna height to be used with this chart is the height of the radiation center of the antenna above the average terrain along the radial in question. In determining the average elevation of the terrain, the elevations between 3 and 16 kilometers from the antenna site are used.

(1) Profile graphs must be drawn for eight radials beginning at the antenna site and extending 16 kilometers therefrom. The radials should be drawn for each 45° of azimuth starting with True North. At least on radial must include the principal community to be served even though it may be more than 16 kilometers from the antenna site. However in the event none of the evenly spaced radials include the principal community to be served, and one or more such radials are drawn in addition, these radials must not be used in computing the antenna height above average terrain.

(2) Where the 3 to 16 kilometers portion of a radial extends in whole or in part over a large body of water or extends over foreign territory but the 50 uV/m contour encompasses land area within the United States beyond the 16 kilometers portion of the radial, the entire 3 to 16 kilometers portion of the radial must be included in the computation of antenna height above average terrain. However, where the 5u uV/m contour does not so encompass United States land area and (i) the entire 3 to 16 kilometers portion of the radial extends over large bodies of water or foreign territory, such radial must be completely omitted from the computation of antenna height above average terrain, and (ii) where a part of the 3 to 16 kilometers portion of a radial extends over large bodies of water or foreign territory, only that part of the radial extending from the 3 kilometers sector to the outermost portion of land area within the United States covered by the radial must be used in the computation of antenna height above average terrain.

(3) The prfile graphs for each radial should be plotted by contour intervals of from 12 to 30 meters and, where the data permits, at least 50 points of elevation (generally uniformly spaced) should be used for each radial. In instances of very rugged terrain where the use of contour intervals of 30 meters would result in several points in a short distance, 60 or 120 meter contour intervals may be used for such distances. On the other hand, where the terrain is uniform or gently sloping the smallest contour interval indicated on the topographic map should be used, although only relatively few points may be available. The profile graph should indicate the topography accurately for each radial, and the graphs should be plotted with the distance in kilometers as the abscissa and the elevation in meters above mean sea level as the ordinate. The profile graphs should indicate the source of the topographical data used. The graph shoull also show the elevation of the center of the radiating system. The graph may be plotted either on rectangular coordinate paper or on special paper that shows the curvature of the earth. It is not necessary to take the curvature of the earth into consideration in this procedure as this factor is taken care of in the chargs showing signal strengths. The average elevation of the 13 kilometer distance between 3 and 16 kilometers from the antenna site should then be determined from the profile graph for each radial. This may be obtained by averaging a large number of equally spaced points, by using a planimeter, or by obtaining the median elevation (that exceeded for 50% of the distance) in sectors and averaging those values.

(4) Examples of HAAT calculations:

(i) The heights above average terrain on the eight radials are as follows:

	Meters
0°	120
45°	255
90°	185
135°	90
180°	-10
225°	-85
270°	40
315°	85

The antenna heigh above terrain (defined in §73.310(a)) is computed as follows:
(120+125+185+90-10-85+40+85)/8=85 meters.

(ii) Same as (i), except the 0^{0} radial is entirely over sea water. The antenna height above average terrain is computed as follows (note that the divisor is 7 not 8):
(255+185+90-10-85+40+85)/7=80 meters.

(iii) Same as (i), except that only the first 10 kilometers of the 90° radial are in the United States; beyond 10 kilometers the 90° radial is in a foreign country. The height above average terrain of the 3 to 10 kilometer portion of the 90°radial is 105 meters. The antenna height above average terrain is computed as follows (note that the divisor is 8 not 7.5):
(120+255+105+90-10-85+40+85)/8=75 meters.

(e) In cases where the terrain in one or more directions from the antenna site departs widely from the average elevation of the 3 to 16 kilometer sector, the prediction method may indicate contour distances that are different from what may be expected in practice. For example, a mountain ridge may indicate the practical limit of service although the prediction method may indicate otherwise. In such cases, the prediction method should be followed, but a supplemental showing may be made concerning the contour distances as determined by other means. Such supplemental showings should describe the procedure used and should include sample calculations. Maps of predicted coverage should include both the coverage as predicted by the regular method and as predicted by a supplemental method. When measurements of area are required, these should include the area obtained by the regular prediction method and the area obtained by the supplemental method. In directions where the terrain is such that antenna heights less than 30 meters for the 3 to 16 kilometer sector are obtained, an assumed height of 30 meters must be used for the prediction of coverage. However, where the actual contour distances are critical factors, a supplemental showing of expected coverage must be included together with a description of the method used in predicting such coverage. In special cases, the FCC may require additional information as to terrain and coverage.

(f) The effect of terrain roughness on the predicted field strength of a signal at points distant from an FM transmitting antenna is assumed to depend on the magnitude of a terrain roughness factor (h) which, for a specific propagation path, is determined by the characteristics of a segment of the terrain profile for that path 40 kilometers in length located between 10 and 50 kilometers from the antenna. The terrain roughness factor has a value equal to the distance, in meters, between elevations exceeded by all points on the profile for 10% and 90% respectively, of the length of the prfile segment. (See §73.333, Figure 4.)

(g) If the lowest field strength value of interest is initially predicted to occur over a particular propagation path at a distance that is less than 50 kilometers from the antenna, the terrain profile segment used in the determination of terrain roughness factor over that path must be that included between points 10 kilometers from the transmitter and such lesser distances. No terrain roughness correction need be applied when all field strength values of interest are predicted to occur 10 kilometers or less from the transmitting antenna.

(h) Profile segments prepared for terrain roughness factor determinations are to be plotted in rectangular coordinates, with no less than 50 points evenly spaced within the segment using data obtained from topographic maps with contour intervals of approximately 15 meters (50 feet) or less if available.

(i) The field strength charts (73.333, Figures 1-1a) were developed assuming a terrain roughness factor of 50 meters, which is considered to be representative of average terrain in the United States. Where the roughness factor for a particular propagation path is found to depart appreciably from this value, a terrain roughness correction (ΔF) should be applied to field strength values along this path, as predicted with the use of these charts. The magnitude and sign of this correction, for any value of Δ h, may be determined from a chart included in Section 73.333 as Figure 5.

(j) Alternatively, the terrain roughness correction may be computed using the following formula:

$$\Delta F = 1.9-0.03\ (\Delta h)(1 + f/300)$$

Where: ΔF = terrain roughness correction in dB
Δk = terrain roughness factor in meters
f = frequency of signal in megahertz (MHz)

73.314 Field strength measurements. (a) Except as provided for in 73.209, FM broadcast stations shall not be protected from any type of interference or propagation effect. Persons desiring to submit testimony, evidence or data to the Commission for the purpose of showing that the technical standards contained in this subpart do not properly reflect the levels of any given type of interference or propagation effect may doso only in appropriate rule making proceedings concerning the amendment of such technical standards. Persons making field strength measurements for formal submission to the Commission in rule making proceedings, or making such measurements upon the request of the Commission, shall follow the procedure for making and reporting such measurements outlined in paragraph (b) of this section. In instances where a showing of the measured level of a signal prevailing over a specific community is appropriate, the procedure for making and reporting field strength measurements for this purpose is set forth in paragraph (c) of this section.

(b) Collection of field strength data for propagation analysis.

(1) Preparation for measurements.

(i) On large scale topographic maps, eight or more radials are drawn from the transmitter location to the maximum distance at which measurements are to be made, with the angles included between adjacent radials of approximately equal size. Radials should be oriented so as to traverse representative types of terrain. The specific number of radials and their orientation should be such as to accomplish this objective.

(ii) Each radial is marked, at a point exactly 16 kilometers from the transmitter and, at greater distances, at successive 3 kilometer intervals. Where measurements are to be conducted over extremely rugged terrain, shorter intervals may be used, but all such intervals must be of equal length. Accessible roads intersecting each radial as nearly as possible at each 3 kilometer marker are selected. These intersections are the points on the radial at which measurements are to be made, and are referred to subsequently as measuring locations. The elevation of each measuring location should approach the elevation at the corresponding 3 kilometer marker as nearly as possible.

(2) Measurement procedure. All measurements must be made utilizing a receiving antenna designed for reception of the horizontally polarized signal component, elevated 9 meters above the roadbed. At each measuring location, the following procedure must be used:

(i) The instrument calibration is checked.

(ii) The antenna is elevated to a height of 9 meters.

(iii) The receiving antenna is rotated to determine if the strongest signal is arriving from the direction of the transmitter.

(iv) The antenna is oriented so that the sector of its response pattern over which maximum gain is realized is in the direction of the transmitter.

(v) A mobile run of at least 30 meters is made, that is centered on the intersection of the radial and the road, and the measured field strength is continuously recorded on a chart recorder over the length of the run.

(vi) The actual measuring location is marked exactly on the topographic map, and a written record, keyed to the specific location, is made of all factors which may affect the recorded field, such as topography, height and types of vegetation, buildings, obstacles, weather, and other local features.

(vii) If, during the test conducted as described in paragraph (b)(2)(iii) of this section, the strongest signal is found to come from a direction other than from the transmitter, after the mobile run prescribed in subparagraph (b)(2)(v) of this section is concluded, additional measurements must be made in a "cluster" of at least five fixed points. At each such point, the field strengths with the antenna oriented toward the transmitter, and with the antenna oriented so as to receive the strongest field, are measured and recorded. Generally, all points should be within 60 meters of the center point of the mobile run.

(viii) If overhead obstacles preclude a mobile run of at least 30 meters, a "cluster" of five spot measurements may be made in lieu of this run. The first measurement in the cluster is identified. Generally, the locations for other measurements must be within 60 meters of the location of the first.

(3) Method of reporting measurements. A report of measurements to the Commission shall be submitted in affidavit form, in triplicate, and should contain the following information:

(i) Tables of field strength measurements, which, for each measuring location, set forth the following data:

(a) Distance from the transmitting antenna.

(b) Ground elevation at measuring location.

(c) Date, time of day, and weather.

(d) Median field in dBu for dBk, for mobile run or for cluster, as well as maximum and minimum measured field strengths.

(e) Notes describing each measuring location.

(ii) U.S. Geological Survey topographic maps, on which is shown the exact location at which each measurement was made. The original plots shall be made on maps of the largest available scale. Copies may be reduced in size for convenient submission to the Commission, but not to the extent that important detail is lost. The original maps shall be made available, if requested. If a large number of maps is involved, an index map should be submitted.

(iii) All information necessary to determine the pertinent characteristics of the transmitting installation, including frequency, geographical coordinates of antenna site, rated and actual power output of transmitter, measured transmission line loss, antenna power gain, height of antenna above ground, above mean sea level, and above average terrain. The effective radiated power should be computed, and horizontal and vertical plane patterns of the transmitting antenna should be submitted.

(iv) A list of calibrated equipment used in the field strength survey, which, for each instrument, specifies its manufacturer, type, serial number and rated accuracy, and the date of its most recent calibration by the manufacturer, or by a laboratory. Complete details of any instrument not of standard manufacture shall be submitted.

(v) A detailed description of the calibration of the measuring equipment, including field strength meters, measuring antenna, and connecting cable.

(vi) Terrain profiles in each direction in which measurements were made, drawn on curved earth paper for equivalent 4/3 earth radius, of the largest available scale.

(c) Collection of field strength data to determine FM broadcast service in specific communities.

(1) Preparation for measurement. (i) The population (P), of the community, and its suburbs, if any, is determined by reference to an appropriate sourge, e.g., the 1970 U.S. Census tables of populations of cities and urbanized areas.

(ii) The number of locations at which measurements are to be made shall be at least 15, and shall be approximately equal to $0.1(P)^{\frac{1}{2}}$, if this product is a number greater than 15.

(iii) A rectangular grid, of such size and shape as to encompass the boundaries of the community is drawn on an accurate map of the community. The number of line intersections on the grid included within the boundaries of the community shall be at least equal to the required number of measuring locations. The position of each intersection on the community map determines the location at which a measurement shall be made.

(2) Measurement procedure. All measurements must be made using a receiving antenna designed for reception of the horizontally polarized signal component, elevated 9 meters above ground level.

(i) Each measuring location shall be chosen as close as feasible to a point indicated on the map, as previously prepared, and at as nearly the same elevation as that point as possible.

(ii) At each measuring location, after equipment calibration and elevation of the antenna, a check is made to determine whether the strongest signal arrives from a direction other than from the transmitter.

(iii) At 20 percent or more of the measuring locations, mobile runs, as described in paragraph (b) (2) of this section shall be made with no less than three such mobile runs in any case. The points at which mobile measurements are made shall be well separated. Spot measurements may be made at other locations.

(iv) Each actual measuring location is marked exactly on the map of the community, and suitably keyed. A written record shall be maintained, describing for each location, factors which may affect recorded field, such as the appropriate time of measurement, weather topography, overhead wiring, heights and types of vegetation, buildings and other structures. The orientation with respect to the measuring location shall be indicated of objects of such shape and size as to be capable of causing shadows or reflections. If the strongest signal recorded was found to arrive from a direction other than that of the transmitter, this fact shall be recorded.

(3) Method of reporting measurements. A report of measurements to the Commission shall be submitted in affidavit form, in triplicate, and should contain the following information:

(i) A map of the community showing each actual measuring location, specifically identifying the points which mobile runs were made.

(ii) A table keyed to the above map, showing the field strength at each measuring point, reduced to dBu for the actual effective radiated power of the station. Weather, date, and time of each measurement shall be indicated.

(iii) Notes describing each measuring location.

(iv) A topographic map of the largest available scale on which are marked the community and the transmitter site of the station whose signals have been measured, which includes all areas on or near the direct path of signal propagation.

(v) Computations of the mean and standard deviation of all measured field strengths, or a graph on which the distribution of measured field strength values is plotted.

(vi) A list of calibrated equipment used for the measurements, which for each instrument, specifies its manufacturer, type, serial number, and rated accuracy and the date of its most recent valibration by the manufacturer, or by a laboratory. Complete details of any instrument not of standard manufacture shall be submitted.

(vii) A detailed description of the procedure employed in the calibration of the measuring equipment, including field strength meters, measuring antenna, and connecting cable.

73.315 Transmitter location. (a) The transmitter location shall be chosen so that, on the basis of the effective radiated power and antenna height above average terrain emoloyes, a minimum field strength of 70 dB above one uV/m, or 3.16 mV/m, will be provided over the entire orincipal community to be served.

Note - The requirements of paragraph (a) of this section do not apply to noncommercial educational FM broadcast stations.

(b) The transmitter location should be chosen to maximize coverage to the city of license while minimizing interference. This is normally accomplished by locating in the least populated area available while maintaining the provisions of parapraph (a) of this section. In general, the transmitting antenna of a station should be located in the most sparsely populated area available at the highest elevation available. The location of the antenna should be so chosen that line-of-sight can be obtained from the antenna over the principle city or cities to be served; in no event should there be a major obstruction in this path.

(c) The transmitting location should be selected so that the 1 mv/m contour encompasses the urban population with in the area to be served. It is recognized that topography, shape of the desired service area, and population distribution may make the choice of a transmitter location difficult. In such cases consider-graphical location of the transmitter is permitted; however, the necessity for a high elevation for the antenna may render this problem difficult. In general, the transmitting antenna of a station should be located at the most central point at the highest elevation available. In providing the best degree of service to an area, it is usually preferable to use a high antenna rather than a lower antenna with increased transmitter power. The location should be so chosen that line-of-sight can be obtained from the antenna over the principal city or cities to be served; in no event should there be a major obstruction in this path.

(c) The transmitting location should be selected so that the 1 mv/m contour encompasses the urban population within the area to be served. It is recognized that topography, shape of the desired service area, and population distribution may make the choice of a transmitter location difficult. In such cases consideration may be given to the use of a directional antenna system, although it is generally prefereable to choose a site where a nondirectional antenna may be employed.

(d) In cases of questionable antenna locations it is desirable to conduct propagation tests to indicate the field intensity expected in the principal city or cities to be served and in other areas, particularly where severe shadow problems may be expected. In considering applications proposing the use of such locations, the Commission may require site tests to be made. Such tests should include measurements made in accordance with the measurement procedures described in73.314 and full data thereon shall be supplied to the Commission. The test transmitter should employ an antenna having a height as close as possible to the proposed antenna height, using a ballon or other support if necessary and feasible. Information concerning the authorization of site tests may be obtained from the Commission upon request.

(e) Cognizance must of course be taken regarding the possible hazard of the proposed antenna structure to aviation and the proximity of the proposed site to airports and airways. Procedures and standards with respect to the Commission's consideration of proposed antenna structures which will serve as a guide to persons intending to apply for radio station licenses are contained in Part 17 of this chapter (Construction, Marking, and Lighting of Antenna Structures).

§73.316 Antenna systems. (a) It shall be standard to employ horizontal polarization; however, circular or elliptical polarization may be employed if desired. Clockwise or counterclockwise rotation may be used. The supplemental vertically polarized effective radiated power required for circular or elliptical polarization shall in no event exceed the effective radiated power authorized.

(b) Deleted.

(c) Directional antennas. A directional antenna is considered to be an antenna that is designated or altered for the purpose of obtaining a noncircular radiation pattern. Directional antennas may not be used for the purpose of reducing minimum mileage separation requirements but may be employed for the purpose of improving service or for the purpose of using a particular site; directional antennas with a ratio of maximum to minimum radiation in the horizontal plane of more than 15 decibels will not be permitted.

(d) Applications for directional antennas. Applicatinns proposing the use of directional antenna systems must be accompanied by the following:

(1) Complete description of the proposed antenna system, including:

(i) A description of the means whereby the directivity is proposed to be obtained, and

(ii) The means (such as a rotatable reference antenna) whereby the operational antenna pattern will be determined prior to licensed operation and maintained within proper tolerances thereafter.

(2) Horizontal and vertical plane radiation patterns showing the free space field strength in mv/m at 1 mile and effective radiated power in dbk for each direction. If directivity was computed, the method by which the radiation patterns were computed, including formulae used, sample calculations and tabulations of data. If the directivity was measured, the method employed should be fully described, including the equipment used and the resultant measured data shall be tabulated. Sufficient vertical patterns shall be included to indicate clearly the radiation characteristics of the antenna above and below the horizontal plane. Complete information and patterns shall be provided for angles of $\pm 10^\circ$ from the horizontal plane and sufficient additional information included on that portion of the pattern lying between $+10^\circ$ and the zenith and -10° and the nadir, to conclusively demonstrate the absence of undesirable lobes in these areas. The horizontal plane pattern shall be plotted on polar coordinate paper with reference to True North. The vertical plane pattern shall be plotted on rectangular coordinate paper with reference to the horizontal plane.

(3) Name, address, and qualifications of the engineer making the calculations.

(e) Applications proposing the use of FM transmitting antennas in the immediate vicinity (i.e. 60 meters or less) of other FM or TV broadcast antennas must include a showing as to the expected effect, if any, of such approximate operation.

(f) In cases where it is proposed to use a tower of a standard broadcast station as a supporting structure for an FM broadcast antenna, an application for construction permit (or modification of construction permit) for such standard broadcast station must be filed for consideration with the FM application, only in the event the overall height of the standard broadcast station tower changes. Applications may be required for other classes of stations when their towers are to be used in connection with FM stations.

(g) When an FM broadcast antenna is mounted on a nondirectional standard broadcast antenna, new resistance measurements must be made of the standard broadcast antenna after installation and testing of the FM broadcast antenna. During the installation and until the new resistance determination is approved, the standard broadcast station licensee should operate by the indirect method of power determination. The FM broadcast license application will not be considered until the application form concerning resistance measurements is filed for the standard broadcast station.

(h) When an FM broadcast antenna is mounted on an element of a standard broadcast directional antenna, a full engineering study concerning the effect of the FM broadcast antenna on the directional pattern must be filed with the application concerning the standard broadcast station. Depending upon the individual case, the Commission mav require readjustment and certain field intensity measurments of the standard broadcast station following the completion of the FM broadcast antenna system.

(i) **When the proposed FM antenna is to be mounted on a tower in the vicinity of an AM station directional antenna system and it appears that the operation of the directional antenna system may be affected, an engineering study must be filed with the FM application concerning the effect of the FM antenna on the AM directional radiation pattern. Field measurements of the AM station may be required prior to and following construction of the FM station antenna, and readjustments made as necessary.**

(j) Information regarding data required in connecting with standard broadcast directional antenna systems may be found in §73.150 of this chapter. (See also Standard Broadcast Technical Standars.)

73.317 FM transmission system requirements. (a) FM broadcast stations employing transmitters authorized after January 1, 1960 must maintain the bandwidth occupied by their emissions in accordance with the specification detailed below. FM broadcast stations employing transmitters installed or type accepted before January 1, 1960, must achieve the highest degree of compliance with these specifications practicable with their existing equipment. In either case, should harmful interference to other authorized stations occur, the licensee shall correct the problem promptly or cease operation.

(b) Any emission appearing on a frequency removed from the carrier by between 120 kHz and 240 kHz inclusive must be attenuated at least 25 dB below the level of the unmodulated carrier. Compliance with this requirement will be deemed to show the occupied bandwidth to be 240 kHz or less.

(c) Any emission appearing on a frequency removed from the carrier by more than 240 kHz and up to and including 600 kHz must be attenuated at least 35 dB beldw the level of the unmodulated carrier.

(d) Any emission appearing on a frequency removed from the carrier by more than 600 kHz must be attenuated at least 43 plus $10 \log_{10}$ (Power, in watts) dB below the level of the unmodulated carrier, or 80 dB, whichever is the lesser attenuation.

(e) Preemphasis shall not be greater than the impedance-frequency characteristics of a series inductance resistance network having a time constant of 75 microseconds. (See upper curve of Figure 2 of 73.333.)

73.318 FM blanketing interference. Areas adjacent to the transmitting antenna that receive a signal with a strength of 115 dBu (562 mV/m) or greater will be assumed to be blanketed. In determining the blanketed area, the 115 dBu contour is determined by calculating the inverse distance field using the effective radiated power of the maximum radiated lobe of the antenna without condidering its vertical radiation pattern or height. For directional antennas, the effective radiated power in the pertinent bearing shall be used.

(a) The distance to the 115 dBu contour is determined using the following equation:

$$D \text{ (in kilometers)} = 0.394\sqrt{P}$$
$$D \text{ (in miles)} =).245\sqrt{P}$$

Where P is the maximum effective radiated power (ERP), measured in kilowatts, of the maximum radiated lobe.

(b) Permittees or licensees who commence program tests, replace their antennas or request facilities modifications and who are issued a new Construction Permit on or after January 1, 1985, must satisfy all complaints of blanketing interference which are received by the station during a one year period. The period begins with the commencement of program tests, or commencement of programming utilizing the new antenna. Resolution of complaints shall be at no cost to the complainant. These requirements specifically do not include interference complaints resulting from malfunctioning or mistuned receivers, imporperly installed antenna systems, or the use of high gain antennas or antenna booster amplifiers. Mobile receivers and non-RF devices such as tape recorders or hi-fi amplifiers (phonographs) are also excluded.

(c) A permittee colleocating with one or more existing stations and beginning program tests on or after January 1, 1985, must assume full financial responsibility for remedying new complaints of blankering interference for a period of on year. Two or more permittees that concurrently collocate on or after January 1, 1985, shall assume shared responsibility for remedying blanketing complaints within the blanketing area unless an offending station can be readily determined and then that station shall assume full financial responsibility.

(d) Following the one year period of full financial obligation to satisfy blanketing complaints, licensees shall provide technical information or assistance to complainants or remedies for blanketing interference.

73.319 FM multiplex subcarrier technical standards. (a) The technical specifications in this Section apply to all transmissions of FM multiplex subcarriers except those used for sterophonic sound broadcasts under the

(b) Modulation. Any form of modulation may be used for subcarrier operation.

(c) Subcarrier baseband. (1) During monophonic program transmissions, multiplex subcarriers and their significant sidebands must be within the range of 20kHz to 99 kHz.

(2) During sterophonic sound program transmissions (see 73.322), multiplex subcarriers and their significant sidebands must be within the range of 53 kHz to 99kHz.

(3) During periods when broadcast programs are not being transmitted, multiplex sigebands must be within the range of 20kHz to 99kHz.

(d) Subcarrier injection. (1) during monophonic program transmissions. modulation of the carrier by arithmetic sum of all subcarriers may not exceed 30% referenced to 75 kHz modulation deviation. However, the modulation of the carrier by the arithmetic sum of all subcarriers above 75 kHz may not modulate the carrier by more than 10%.

(2) During stereophonic program transmissions, modulation of the carrier by the arithmetic sum of all subcarriers may not exceed 20% referenced to 75kHz modulation deviation. However, the modulation of the carrier by the arithmetic sum of all subcarriers above 75kHz may not modulate the carrier by more than 10%.

(3) During periods when no broadcast program service is transmitted, modulation of the carrier by the arithmetic sum of all carriers may not exceed 30% referenced to 75kHz modulation deviation. However, the modulation of the carrier by the arithmetic sum of all subcarriers above 75kHz may not modulate the carrier by more than 10%.

(4) During periods when no broadcast program service is transmitted, modulation of the carrier by the arithmetic sum of all subcarriers above 75kHz may not exceed 10% and modulation of the carrier by the arithmetic sum of all subcarriers may not exceed 30%, referenced to 75kHz deviation.

(e) Subcarrier generators may be installed and used with a type accepted FM broadcast transmitter without specific authorization from the FCC provided the generator can be connected to the transmitter without requiring any mechanical or electrical monifications in the transmitter FM exciter circuits.

(f) Stations installing multiplex subcarrier reansmitting equipment must ensure the proper suppression of spurious or harmonic radiations. See 73.317, 73.1590 and 73.1690. If the subcarrier operation causes the station's transmissions not to comply with the technical provisions for FM Briadcast stations or causes harmful interference to other communication services, the licenses or permittee must correct the problem promptly or cease operation. The licensee may be required to verify the corrective measures with supporting data. Such data lust be retained at the station and be made available to the FCC upon request.

73.320 Indicating insturments-Specifications. See 73.1215 (Subpart H).

73.321 Deleted.

73.322 FM Steronophonic sound transmission standards. (a) An FM Broadcast station shall not use 19kHz plus or minus 20 Hz, except as the sterophonic system meeting the following parameters:

(1) The modulating signal for the main channel consists of the sum of the right and left signals.

(2) The pilot subcarrier at 19 kHz plus or minus 2 Hz, must frequency modulate the main carrier between the limits of 8 and 10 percent.

(3) One sterophonic subscrrier must be the second harmonic of the pilot subcarrier (i.e. 38 kHz) and must cross the time axis with a positive slope simultaneously with each crossing of the time axis by the subcarrier. Additional sterophonic subcarriers are not precluded.

(4) Double sideband, suppressed-carrier, amplitude modulation of the sterophonic subcarrier at 38 kHz must be used.

(5) The sterophonic subcarrier at 38 kHz must be suppressed to a level less than 1% modulation of the main carrier.

(6) The modulating signal for the required sterophonic subcarrier must be equal to the difference of the left and right signals.

(7) The following modulation levels apply: (i) When a signal exists in only one channel of a two channel (biphonic) sound transmission, modulation of the carrier by audio components within the baseband range of 50 kHz shall not exceed 45% and modulation of the carrier by the sum of the amplidude modulation subcarrier in the baseband range of 23 kHz to 53 kHz shall not exceed 45%.

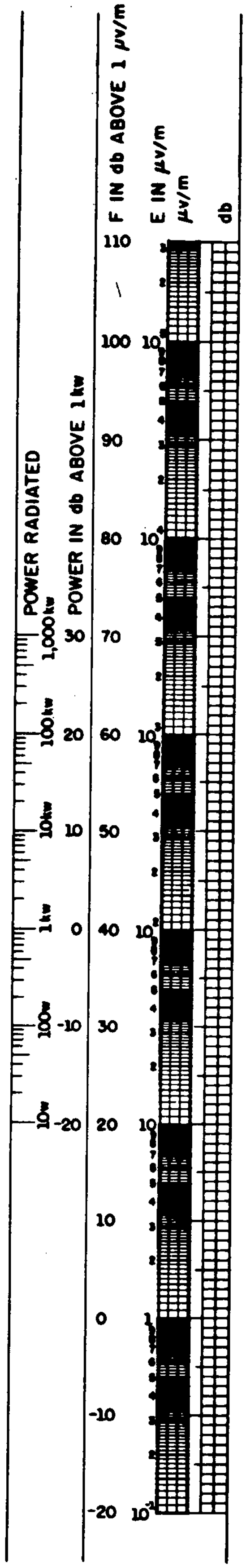
(ii) When a signal exists in only one channel of a sterophonic sound transmission having more than one sterophonic subcarrier in the baseband, the modulation of the carrier by audio components within the audio baseband range of 23 kHz to 99 kHz shall not exceed 53% with total modulation not to exceed 90%.

(b) Stations not transmitting stereo with the method described in (a), must limit the main carrier deivation caused by any modulating signals occupying the band 19 kHz plus or minus 20 Hz to 125 Hz.

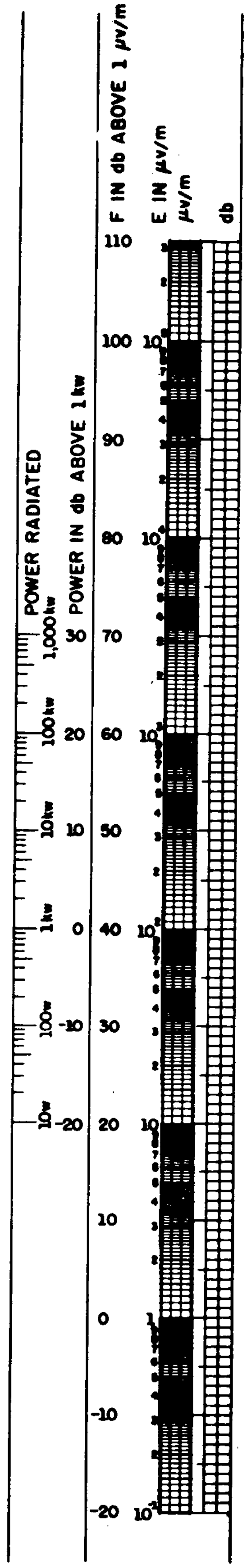
(c) All stations, regardless of the sterophonic transmission system used, must not exceed the maximum modulation limits specified in 73.1570 (b)(2). Stations not using the method described in (a), must limit the modulation of the carrier by audio components within the audio baseband range of 23 kHz to 99 kHz to not exceed 53%.

73.333 Engineering charts.

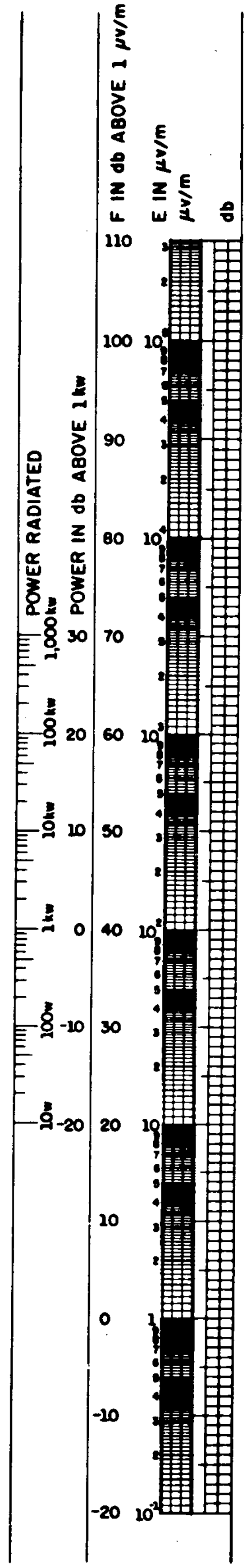
Sliding Scale for use with Figures 1 and 1a



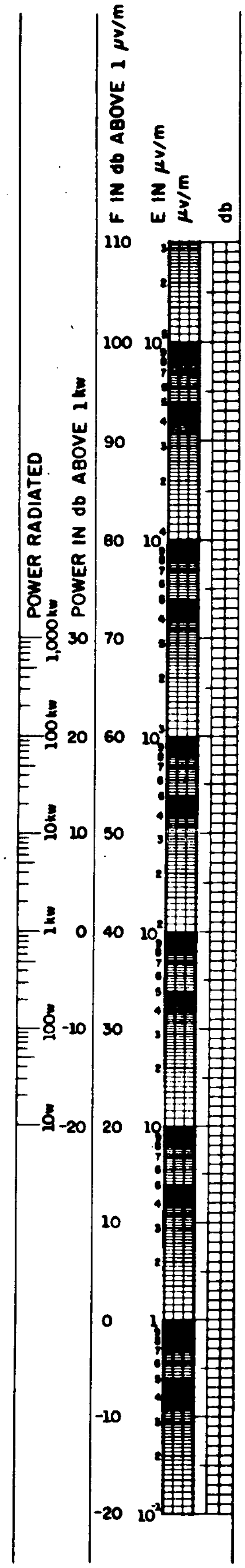
Sliding scale for use with Figure 1 & 1a.



Sliding scale for use with Figure 1 & 1a.



Sliding scale for use with Figure 1 & 1a.



Sliding scale for use ith Figure 1 & 1a.

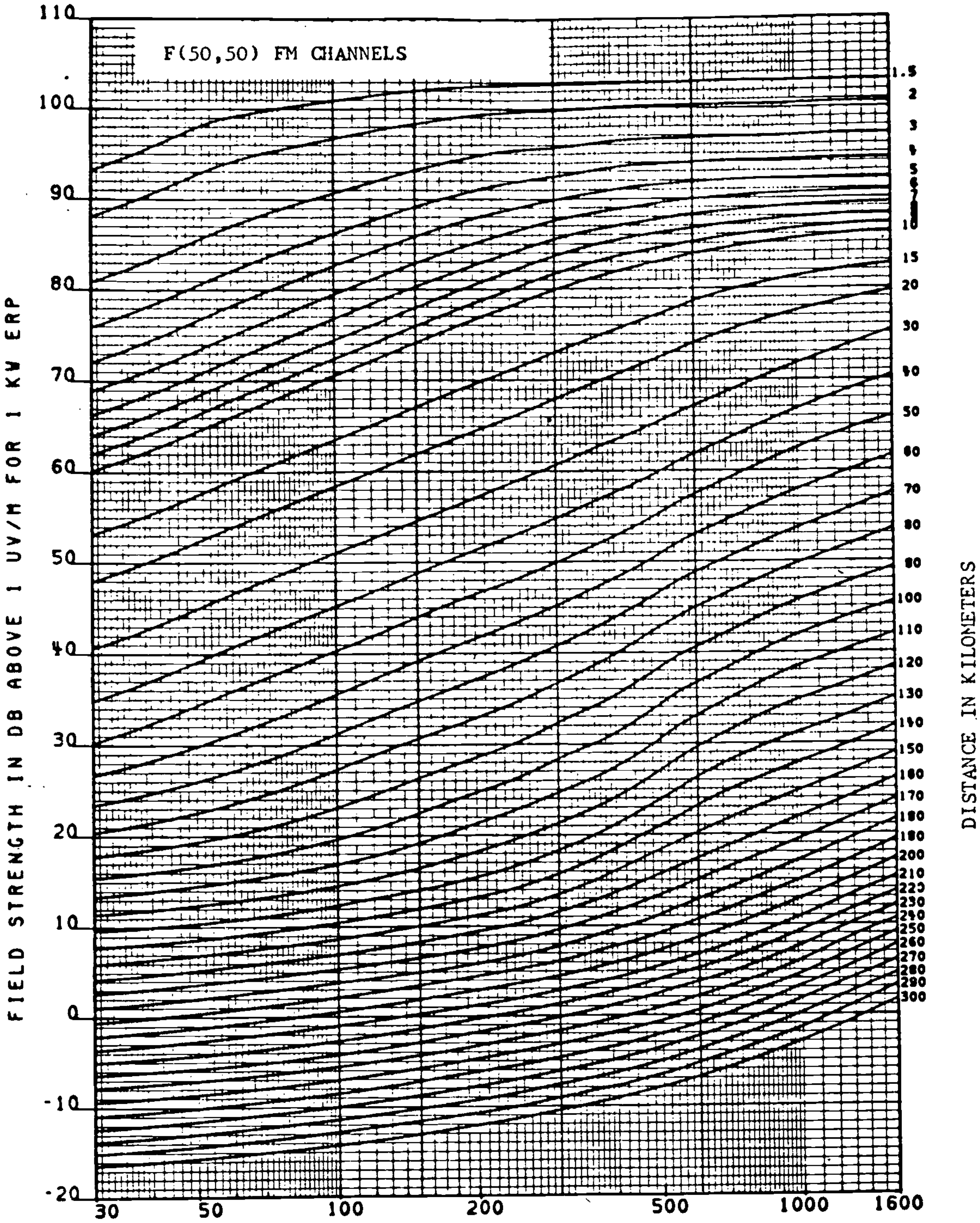


fig. 1

FM CHANNELS

ESTIMATED FIELD STRENGTH EXCEEDED AT 50 PERCENT OF THE POTENTIAL RECEIVER LOCATIONS FOR AT LEAST 50 PERCENT OF THE TIME AT A RECEIVING ANTENNA HEIGHT OF 9 METERS

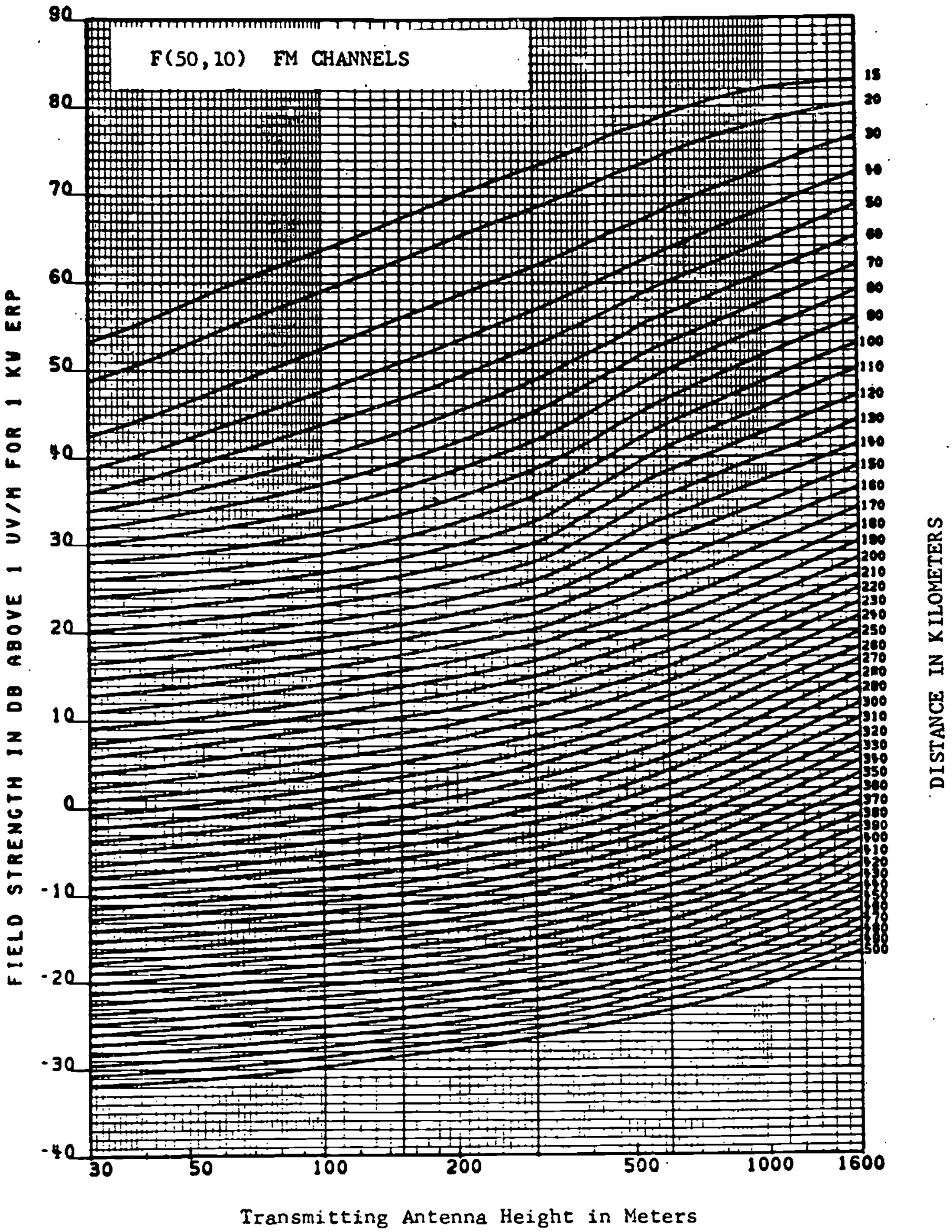


fig. 1a

FM CHANNELS
ESTIMATED FIELD STRENGTH EXCEEDED AT 50 PERCENT
OF THE POTENTIAL RECEIVER LOCATIONS FOR AT LEAST 10 PERCENT
OF THE TIME AT A RECEIVING ANTENNA HEIGHT OF 9 METERS

figure 3 removed

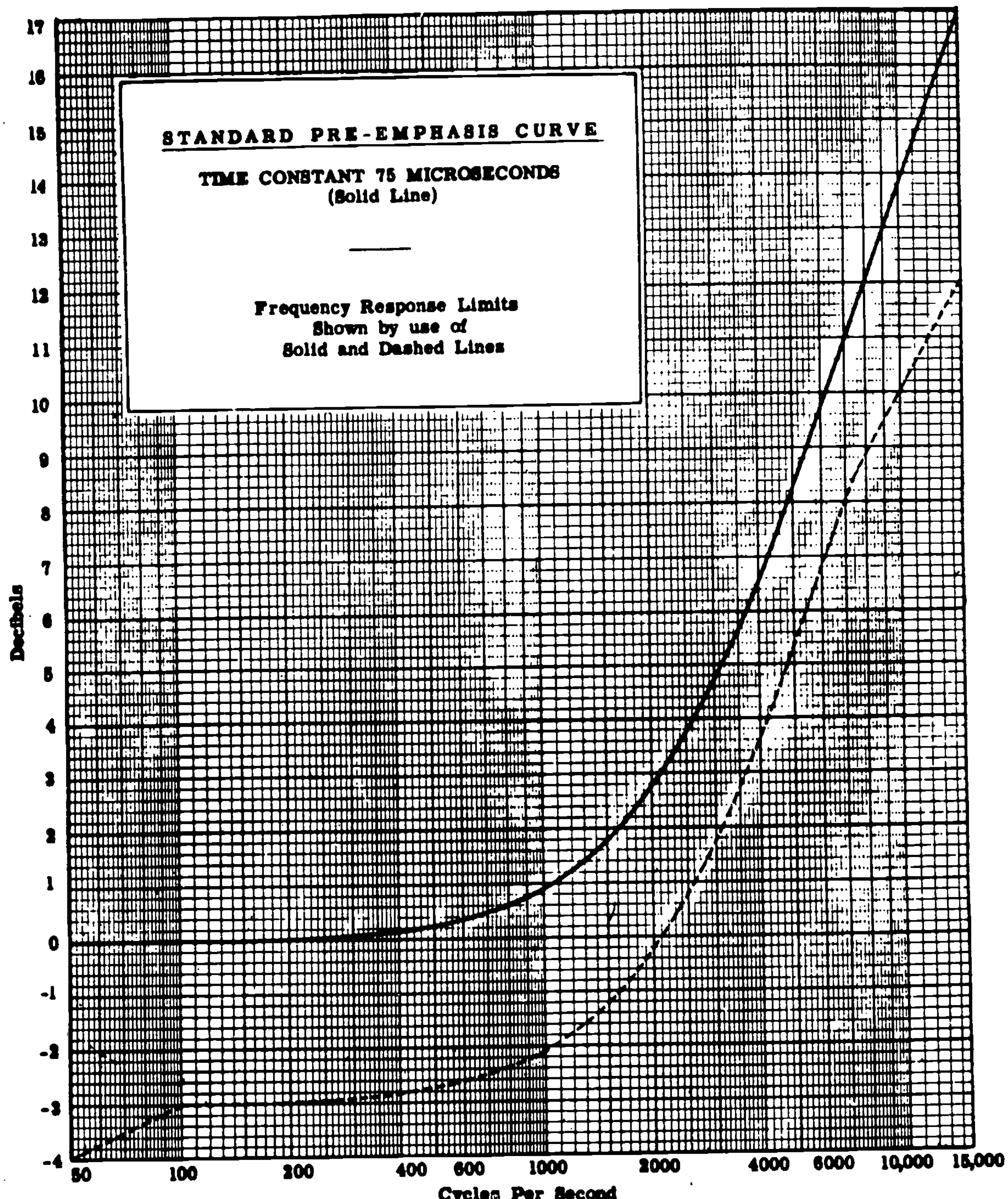


Figure 2

FM STANDARD

TV STANDARDS

TV TECHNICAL STANDAEDS

MONITORING EQUIPMENT

TV TECHNICAL STANDARDS

73.681 Definitions. Amplitude modulation (AM). - A system of modulation in which the envelope of the transmitted wave contains a component similar to the wave form of the signal to be transmitted.

Antenna electrical beam tilt. The shaping of the radiation pattern in the vertical plane of a transmitting antenna by electrical means so that maximum radiation occurs at an angle below the horizontal plane.

Antenna height above average terrain. The average of the antenna heights above the terrain from two to ten miles from the antenna for the eight directions spaced evenly for each 45 degrees of aximuth starting with True North. (In general, a different antenna height will be determined in each direction from the antenna. The average of these various heights is considered the antenna height above the average terrain. In some cases less than 8 directions may be used. See 73.684(d). Where circular or elliptical polarization is employed the antenna height above average terrain shall be based upon the height of the radiation center of the antenna which transmits the horizontal component of radiation.

Antenna mechanical beam tilt. The intentional installation of a transmitting antenna so that its axis is not vertical, in order to change the normal angle of maximum radiation in the vertical plane.

Antenna power gain. The squre of the ratio of the root-mean-square free space field intensity produced at one mile in the horizontal plane, in millivolts per meter for one kilowatt antenna input power to 137.6 mv/m. This ratio should be expressed in decibels (db). (If specified for a particular direction, antenna power gain is based on the field strength in that direction only.)

Aspect ratio. The ratio of picture width to picture hhight as transmitted.

Aural transmitter. The radio equipment for the transmission of the aural signal only.

Aural center frequency. (a) The average frequency of the emitted wave when modulated by a sinusoidal signal; (2) the frequency of the emitted wave without modulation.

BTSC. Broadcast Television systems committe recommendation for multichannel television sound transmission and audio processing as defined in FCC Bulletin OST 60.

Baseband. Aural transmitter input signals between 0 and 120 kHz.

Blanking level. The level of the signal during the blanking interval, except the interval during the scanning synchronizing pulse and the chrominance subcarrier synchronizing burst.

Chrominance. - The colorimetric difference between any color and a reference color of equal luminance, the reference color having a specific chromaticity.

Chrominance subcarrier. - The carrier which is modulated by the chrominance information.

Color transmission. - The transmission of color television signals which can be reproduced with different values of hue, saturation, and luminance.

Effective radiated power. The product of the antenna input power and the antenna power gain. This product should be expressed in kW and in dB above 1KW. (If specified for a particular direction, effective radiated power is based on the antenna power gain in that direction only. The licensed effective radiated power is based on the maximum antenna power gain. When a station is authorized to use a directional antenna beam tilt, the direction of the maximum effective radiated power will be specified.) Where circular or elliptical polarization is employed, the term effective radiated power is applied separately to the horizontally and vertically polarized components of radiation. For assignment purposes, only the effective radiated power authorized for the horisontally polarized component will be considered. TVS

Equivalent isotrophically radiated power (EIRP). The term "equivalent isotropically radiated power" (also known as "effective radiated power above isotropic") means the product of the antenna input power and the antenna gain in a given direction relative to an isotropic antenna.

Field. Scanning through picture area once in chosen scanning pattern. In the line interlaced scanning pattern of 2 to 1, the scanning of alternate lines of the picture area once.

Frame - Scanning all of the picture area once. In the line interlaced scanning pattern of two to one, a frame consists of two fields.

Free space field strength - The field strength that would exist at a point in the absence of waves reflected from the earth or other reflecting objects.

Frequency departure. The amount of variation of a carrier frequency or center frequency from its assigned value.

Frequency deviation. The peak difference between the instantaneous frequency of the modulated wave and the carrier frequency.

Frequency modulation (FM) - A system of modulation where the instantaneous radio frequency varies in proportion to the instantaneous amplitude of the modulating signal (amplitude or modulating signal to be measured after pre-emphasis, if used) and the instantaneous radio frequency of the modulating signal.

Frequency swing. The peak difference between the maximum and the minimum values of the instantaneous frequency of the carrier wave during modulation.

Interlaced scanning - A scanning process in which successively scanned lines are spaced an integral number of line widths, and in which the adjacent lines are scanned during successive cycles of the field frequency.

IRE Standard Scale - A linear scale for measuring, in IRE units, the relative amplitudes of the components of a television signal from a zero reference at blanking level, with picture information falling in the positive, and synchronizing information in the negative domain.

NOTE: When a carrier is amplitude modulated by a television signal in accordance with §73.682, the relationship of the IRE standard scale to the conventional measure of modulation is as follows:

Level	IRE Standard Scale (units)	Modulation Percentage
Zero carrier	120	0
Reference white	100	12.5
Blanking	0	75
Synchronizing peaks (maximum carrier level)	-40	100

Luminance - Luminance flux emitted, reflected, or transmitted per unit solid angle per unit projected area of the source.

Main channel. The band of frequencies from 50 to 15,000 Hertz which frequency modulate the main aural carrier.

Monochrome transmission - The transmission of television signals which can be reproduced in gradations of a single color only.

Multichannel Television Sound (MTS). Any system of aural transmission that utilizes aural baseband operation between 15 kHz and 120 kHz to convey information or that encodes digital information in the viedo portion of the television signal that is intended to be decoded as audio information.

Multiplex transmission (aural) - A subchannel added to the regular aural carrier of a television broadcast station by means of frequency modulated subcarriers.

Negative transmission - Where a decrease in initial light intensity causes an increase in the transmitted power.

Peak power - The power over a radio frequency cycle corresponding in amplitude to synchronizing peaks.

Percentage modulation. As applied to frequency modulation, the ratio of the actual frequency deviation to the frequency deviation defined as 100% modulation expressed in percentage. For the aural transmitter of TV broadcast stations, a frequency deviation of ±25 kHz is defined as 100% modulation.

Pilot subcarrier. A subcarrier used in the reception of TV stereophonic aural or other subchannel broadcasts.

Polarization - The direction of the electric field as radiated from the transmitting antenna.

Program related data signal - A signal, consisting of a series of pulses representing data, which is transmitted simultaneously with and directly related to the accompanying television program.

Reference black level - The level corresponding to the specified maximum excursion of the luminance signal in the black direction.

Reference white level of the luminance signal. The level corresponding to the specified maximum excursion of the luminance signal in the white direction.

Scanning - Process of analyzing successively, according to a predetermined method, light values of picture elements constituting total picture area.

Scanning line - A single continuous narrow strip of picture area containing highlights, shadows, and halftones, determined by the process of scanning.

Standard television signal. - A signal which conforms to the television transmission standards.

Synchronization. - The maintenance of one operation in step with another.

Television broadcast band. - The frequencies in the band extending from 54 to 806 megahertz which are assignable to television broadcast stations. These frequencies are 54 to 72 megahertz (channels 2 through 4), 76 to 88 megahertz (channels 5 and 6), 174 to 216 megahertz (channels 7 through 13), and 470 to 806 megahertz (channels 14 through 69).

Television broadcast station. - A station in the television broadcast band transmitting simultaneous visual and aural signals intended to be received by the general public.

Television channel. - A band of frequencies 6 megahertz wide in the television broadcast band and designated either by number or by the extreme lower and upper frequencies.

Television transmission standards. - The standards which determine the characteristics of a television signal as radiated by a television broadcast station.

Television transmitter. - The radio transmitter or transmitters for the transmission of both visual and aural signals.

Vestigial sideband transmission. - A system of transmission wherein one of the generated sidebands is partially attenuated at the transmitter and radiated only in part.

Visual carrier frequency. - The frequency of the carrier which is modulated by the picture information.

Visual transmitter. - The radio equipment for the transmission of the visual signal only.

Visual transmitter power. - The peak power output when transmitting a standard television signal.

§73.682 Transmission standards. (a) Transmission standards.

(1) The wideth of the television broadcast channel shall be 6MHz.

(2) The visual carrier frequency shall be nominally 1.25 MHz above the lower boundary of the channel.

(3) The aural center frequency shall be 4.5 MHz higher than the visual carrier frequency.

(4) The visual transmission amplitude characteristic shall be in accordance with the chart designated as Figure 5 of §73.699: Provided, however, That for stations operation on Channel 15- 69and employing a transmitter with maximum peak visual power output of 1 kilowatt or less the visual transmission amplitude characteristic may be in accordance with the chart designated as Figure 5(a) of §73.699.

(5) The chrominance subcarrier frequency is 63/88 times precisly 5 MHz (3.57954545...MHz). The tolerance is ± 10Hz and the rate of frequency drift not excedd 0.1 Hz per second (cycles per second squared).

(6) For monochrome and color transmissions the number of scanning lines perframe shall be 525, interlaced two to one in successive fields. The horizontal scanning frequency shall be 2/455 times the chrominance subcarrier frequency; this corresponds nominally to 15,750 herts (with an actual value of 15,734.264 ± 0.044 hertz). The vertical scanning frequency is 2/525 times the horizontal scanning frequency; this corresponds nominally to 60 hertz (the actual value is 59.94 hertz). For monochrome transmissions only, the nominal values line and field frequencies may be used.

(7) The aspect ratio of the transmitted television picture shall be 4 units horizontally to 3 units vertically.

(8) During active scanning intervals, the scene shall be scanned from left to right horizontally and from top to bottom vertically, at uniform velocities.

(9) A carrier shall be modulated within a single television channel for both picture and synchronizing signals. The two signals comprise different modulation ranges in amplitude in accordance with the following:

(i) Monochrome transmissions shall comply with synchronizing waveform specifications in Figure 7 of 73.699.

(ii) Color transmissions shall comply with the synchronizing waveform specifications in Figure 6 of 73.699.

(iii) All stations operating on Channels 2 through 14 and those stations operating on Channels 15 through 69 licensed for a peak visual transmitter output power greater than one kilowatt shall comply with the picture transmission amplitude characteristics shown in Figure 5 of 73.699.

(iv) Stations operating on Channels 15 through 69 licensed for a peak visual transmitter output power of one kilowatt or less shall comply with the picture transmission amplitude characteristic shown in Figure 5 or 5a of 73.699.

(10) A decrease in initial light intensity shall cause an increase in radiated power (negative transmission).

(11) The reference black level shall be represented by a definite carrier level, independent of light and shade in the picture.

(12) The blanking level shall be transmitted at 75 ± 2.5 percent of the peak carrier level.

(13) The reference white level of the luminance signal shall be 12.5 ± 2.5 percent of the peak carrier level.

(14) It shall be standard to employ horizontal polarization. However, circular or elliptical polarization may be employed if desired, in which case clockwise (right hand) rotation, as defined in the IEEE Standard Definition 42A65-3E2, and transmission of the horizontal and vertical components in time and space quadrature shall be used. For either omnidirectional or directional antennas the licensed effective radiated power of the vertically polarized component may not exceed the licensed effective radiated power of the hotizontally polarized component. For directional antennas, the maximum effective radiated power of the vertically polarized component shall not exceed the maximum effective radiated power of the hotizontally polarized component in any specified horizontal or vertical direction.

(15) The effective radiated power of the aural transmitter must not exceed 22% of the peak radiated power of the visual transmitter.

(16) The peak-to-peak variation of transmitter output within one frame of video signal due to all causes, including hum, noise, and low-frequency response, measured at both scanning synchronizing peak and blanking level, shall not exceed 5 percent of the average scanning synchronizing peak signal amplitude. This provision is subject to change but is considered the best practice under the present state of the art. It will not be enforced pending a further determination thereof.

(17) The reference black level shall be separated from the blanking level by the setup interval, which shall be 7.5 ± 2.5 percent of the video range from blanking level to the reference white level.

(18) For monochrome transmission, the transmitter output shall vary in substantially inverse logarithmic relation to the brightness of the subject. No tolerances are set at this time. This provision is subject to change but is considered the best practice under the present state of the art. It will not be enforced pending a further determination thereof.

(19) The color picture signal shall correspond to a luminance component transmitted as amplitude moculation of the picture carrier and a simultaneous pair of chrominance components transmitted as the amplitude modulation sidebands of a pair of suppressed subcarriers in quadrature.

(20) Equation of complete color signal.

(i) The color picture signal has the following composition:

$$E_M = E_{Y'} + \{E_{Q'} \sin(\omega t + 33^\circ) + E_{I'} \cos(\omega t + 33^\circ)\}$$

Where:

$$E_{Q'} = 0.41 (E_{B'} - E_{Y'}) + 0.48 (E_{R'} - E_{Y'}).$$

$$E_{I'} = -0.27 (E_{B'} - E_{Y'}) + 0.74 (E_{R'} - E_{Y'}).$$

$$E_{Y'} = 0.30 E_{R'} + 0.59 E_{G'} + 0.11 E_{B'}.$$

For color-difference frequencies below 500 kHz (see (iii) below), the signal can be represented by:

$$E_M = E_{Y'} + \left\{\frac{1}{1.14}\left[\frac{1}{1.78} (E_{B'} - E_{Y'}) \sin \omega t + (E_{R'} - E_{Y'}) \cos \omega t\right]\right\}$$

(ii) The symbols in subdivision (i) of this subparagraph have the following significance:

E_M is the total video voltage, corresponding to the scanning of a particular picture element, applied to the modulator of the picture

$E_{Y'}$ is the gamma-corrected voltage of the monochrome (black and white) portion of the color picture signal, corresponding to the given picture element.

NOTE: Forming of the high frequency portion of the monochrome signal in a different manner is permissible and may in fact be desirable in order to improve the sharpness on saturated colors.

$E_{Q'}$ and $E_{I'}$ are the amplitudes of two orthogonal components of the chrominance signal corresponding respectively to narrow-band and wide-band axes.

$E_{R'}$, $E_{G'}$, and $E_{B'}$ are the gamma-corrected voltages corresponding to red, green, and blue signals during the scanning of the given picture element.

ω is the angular frequency and is 2π times the frequency of the chrominance subcarrier.

The portion of each expression between brackets in (i) represents the chrominance subcarrier signal which carries the chrominance information.

The phase reference in the E_M equation in (i) is the phase of the burst + 180° as shown in Figure 8 of § 73.699. The burst corresponds to amplitude modulation of a continuous sine wave.

(iii) The equivalent bandwidth assigned prior to modulation to the color difference signals E_Q' and E_I' are as follows:

Q- channel bandwidth:
At 400 kHz less than 2 db down.
At 500 kHz less than 6 db down.
At 600 kHz at least 6 db down.

O- channel bandwidth:
At 1.3 mHz less than 2 db down.
At 3.6 mHz at least 20 db down.

(iv) The gamma corrected voltages E_R', E_G' and E_B' are suitable for a color picture tube having primary colors with the following chromaticicities in the CIE system of specification:

	x	y
Red (R) -	0.67	0.33
Green (G) -	0.21	0.71
Blue (B) -	0.14	0.08

and having a transfer gradient (gamma exponent) of 2.2 associated with each primary color. The voltages E_R', E_G' and E_B' may be respectively of the form $E_R 1/\gamma$, $E_B 1/\gamma$ and E_B $1/\gamma$, although other forms may be used with advances in the state of the art.

NOTE: At the present state of the art it is considered inadvisable to set a tolerance on the value of gamma and correspondingly this portion of the specification will not be enforced.

(v) The radiated chrominance subcarrier shall vanish on the reference white of the scene.

NOTE: The numberical values of the signal specification assume that this condition will be reproduced as CIE Illuminant C (x = 0.310, y = 0.316).

(vi) E_Y', E_Q', E_I', and the components of these signals shall match each other in time to 0.05 μ secs.

(vii) The angles of the subcarrier measured with respect to the burst phase, when reproducing saturated primaries and their complements at 75 percent of full amplitude, shall be within ± 10° and their amplitudes shall be within ± 20 percent of the values specified above. The ratios of the measured amplitudes of the subcarrier to the luminance signal for the same saturated primaries nd their complements shall fall between the limits of 0.8 and 1.2 of the values specified for their ratios. Closer tolerance may prove to be practicable and desirable with advance in the art.

(21) The interval beginning with line 17 and continuing through line 20 of the vertical blanking interval of each field may be used for the transmission of test signals, cue and control signals and identification signals, subject to the conditions and restrictions set forth below. Test signals may include signals designed to check the performance of the overall trandmission system or its individual components. Cue and control signals shall be related to the operation of the TV broadcast station. Identification signals may be transmitted to identify the broadcast material or its source and the date and time of its origination. Figures 6 and 7 of Section 73.699 identify the numbered lines referred to in its subparagraph.

(i) Modulation of the TV transmitter by such signals shall be confined to the area between the reference white level and the blanking level, except where test signals include chrominance subcarrier frequencies, in which case positive excursions of chrominance components may exceed reference white, and negative excursions may extent into the synchronizing area. In no case may the modulation excursions produced by test signals extend beyond peak-of-sync, or to zero carrier level.

(ii) The use of test, cue and control signals shall not result in significant degradation of the program transmissions of the TV broadcast station, nor produce emissions outside of the frequency band occupied for normal program transmissions.

(iii) Test signals or cue and control signals may not be transmitted during hat portion of each line devoted to horizontal blanking.

(iv) Regardless of other provisions of this subparagraph, line 19, in each field, may be used only for the transmission of the reference signal described in Figure 16 of 73.699.

(22)(i) All of Line 21, Field 1 and the first half of Line 21, Field 2 may be used for the transmission of a program related data signal which, when decoded, provides a visual depiction of information simultaneously being presented on the aural channel. Such data signal shall conform to the format described in Figure 17a of Section 73.699 and may be transmitted during all periods of regular operation.

(A) A reference pulse for a decoder associated adaptive multipath equalizer filter may replace the data signal every eighth frame. The reference pulse shall conform to the format described in Figure 17b of Section 73.699.

(B) A decoder test signal consisting of data representing a repeated series of alphanumeric characters may be transmitted at times when no program related data is being transmitted.

(C) A framing code to be used by the data decoder may be transmitted during the first half of Line 21, Field 2 when data, reference pulse and test signals are present. See Figure 17c of Section 73.699 for a description of the format for the framing code.

(D) The data signal shall be coded using a non-return-to-zero (NRZ) format and shall employ standard ASCII 7 bit plus parity character codes.

(ii) At times when Line 21 is not being used to transmit a program related data signal, data signals which are not program related may be transmitted, PROVIDED: the same data format is used and the information to be displayed is of a broadcast nature.

(iii) The use of Line 21 for transmission of other data signals conforming to other formats may be used subject to prior authorization by the Commission.

(iv) The data signal shall cause no significant degradation to any portion of the visual signal nor produce emissions outside the authorized television channel.

(v) Transmission of visual emergency messages pursuant to Section 73.675 shall take precedence and shall be cause for interrupting transmission of data signals permitted under this subparagraph.

(23) Specific scanning lines in the vertical blanking interval may be used for the purpose of transmitting telecommunications signals in accordance with 73.646, subject to certain conditions:

(i) Telecommunications may be transmitted on Lines 10-18 and 20, all of Field 2 and Field 1. Modulation level shall not exceed 70 IRE on lined 10. 11 and 12: and. 80 IRE on lines 13-18 and 20.

(ii) No observable degratation may be cauded to any portion of the visual or aural signals.

(iii) Telecommunications signals must not produce emissions outside the authorized television channel bandwidth. Digital data pulses must be shaped to limit spectral energy to the nominal video baseband.

(iv) Transmission of emergency visual messages oursuant to 73.150 must take precedence over and shall be cause for interrupting a service such as teltext that provides a visual depiction of information simultaneously transmitted on the aural channel.

(v) A reference pulse for a decoder associated adaptive equalizer filter designed to improve the decoding of telecommunications signals may be inserted on any portion of the vertical blanking interval authorized for data service, in accordance with the signal levels set forth in paragraph (a)(23)(i) of this section.

(vi) All limes authorized for telecommunications transmission may be used for other purposes upon prior approval by the Commission.

(b) Subscription TV technical systems. The FCC may specify, as part of the advance approval of the technical system for transmitting encoded subscription programming, deviations from the power determination procedures, operating power levels, aural or video baseband signals, modulation levels or other characteristics of the transmitted signal as otherwise specified in this Subpart. Any decision to approve such operating deviations shall be solely at the discretion of the FCC.

(c) TV multiplex subcarrier/sterophonic aural transmission standards.

(1) The modulating signal for the main channel shall consist of the sum of the sterophonic (biphonic, quasraphonic, etc.) input signals.

(2) The instantaneous frequency of the baseband sterophonic subcarrier must at all times be within the range 15 kHz to 120 kHz. Either amplitude or frequency modulation of the sterophonic subcarrier may be used.

(3) One or more pilot subcarriers between 16 kHz and 120 kHz may be used to switch a TV receiver between the sterophonic and monophonic reception modes or to activate a sterophonic audio indicater light and one or more subcarriers between 15 kHz and 120 kHz may be used for any other authorized purpose except that stations employing the BTSC system of sterophonic sound transmission and audio processing may transmit a pilot subcarrier at 15,734 Hz ± 2 Hz. Other methods of multiplex subcarrier or sterophonic aural transmission systems must limit energy at 15,734 Hz ± 20 Hz, to no more than ± 0.125 kHz aural carrier deviation.

(4) Aural baseband information above 120 kHz must be attenuated 40 dB referenced to 25 kHz main channel deviation of the aural carrier.

(5) For required transmitter performance, all of the requirements of 73.687(b) shall apply to the main channel, with the transmitter in the multiplex subcarrier or sterophonic aural mode.

(6) For electrical performance standards of the transmitter, the requirements of 73.687(b) apply to the main channel.

(7) Multiplex subcarrier or sterophonic aural transmission systems must not exceed ± 25 kHz main channel deviation of the aural carrier.

(8) The arithmetic sum of non-multiphonic baseband signals between 15 kHz and 120 kHz must not exceed ± 50 kHz deviation of the aural carrier.

(9) Total modulation of the aural carrier must not exceed ± 75 kHz.

§73.683 Field strength contours. (a) In the authorization of TV stations, two field strength contours are considered. These are specified as Grad A and Grade B and indicate the approximate extent of coverage over average terrain in the absence of interference from other television stations. Under actual conditions, the true coverage may vary greatly from these estimates because the terrain over any specific path is expected to be different from the average terrain on which the field strength charts were based. The required field strength, F (50-50), in decibels above one micro-volt per meter (dBu) for the Grade A and Grade B contours are as follows:

	Grade A (dBu)	Grade B (dBu)
Channels 2 - 6	68	47
Channels 7 - 13	71	56
Channels 14 -69	74	64

(b) It should be realized that the F (50-50) curves when used for Channels 14-69 are not based on measured data at distances beyond about 30 miles. Theory would indicate that the field strengths for Channels 14-69 should decrease more rapidly with distance beyond the horizon than for Channels 2-6, and modification of the curves for Channels 14-69 may be expected as a result of measurements to be made at a later date. For these reasons, the curves should be used with appreciation of their limitations in estimating levels of field strength. Further, the actual extent of service will usually be less than indicated by these estimates due to interference from other stations. Because of these factors, the predicted field strength contours give no assurance of service to any specific percentage of receiver locations within the distances indicated. In licensing proceedings these variations will not be considered.

(c) The field strength contours will be considered for the following purposes only:

(1) In the estimation of coverage resulting from the selection of a particular transmitter site by an applicant for a TV station.

(2) In connection with problems of coverage arising out of application of §73.3555.

(3) In determining compliance with §73.685(a) concerning the minimum field strength to be provided over the principal community to be served.

§73.684 Prediction of coverage - (a) All predictions of coverage made pursuant to this section shall be made without regard to interference and shall be made only on the basis of estimated field intensities. The peak power of the visual signal is used in making predictions of coverage.

(b) Predictions of coverage shall be made only for the same purposes as relate to the use of field strength contours as specified in §73.683(c).

(c) In predicting the distance to the field strength contours, the F (50-50) field strength charts (Figures 9 and 10 of §73.699) shall be used. If the 50% field strength is defined as that value exceeded for 50% of the time, the F (50-50) charts give the estimated 50% field strengths exceeded at 50% of the locations in dB above 1 mV/m. The charts are based on an effective power of 1 kW radiated from a half-wave dipole in free space, which produces an unattenuated field strength at 1 mile of about 103 dB above 1 mV/m (137.6 millivolts per meter). To use the charts for other powers, the sliding scale associated with the charts should be trimmed and used as the ordinate scale. This sliding scale is placed on the charts with the appropriate gradation for power in line with the horizontal 40 dB line on the charts. The right edge of the scale is placed in line with the appropriate antenna height gradations, and the charts then become direct reading (in uV/m and in dB above 1 uV/M) for this power and antenna height. Where the antenna height is not one of those for which a scale is provided, the signal strength or distance is determined by interpolation between the curves connecting the equidistant points. Dividers may be used in lieu of the sliding scale.

(1) In predicting the distance to the Grade A and Grade B field strength contours, the effective radiated power to be used is that radiated at the vertical angle corresponding to the depression angle between the transmitting antenna center of radiation and the radio horizon as determined individually for each azimuthal direction concerned. The depression angle is based on the difference in elevation of the antenna center of radiation above the average terrain and the radio horizon, assuming a smooth spherical earth with a radius of 5,280 miles, and shall be determined by the following equation:

$$A\eta = 0.0153\sqrt{H}$$

Where:

$A\eta$ is the depression angle in degrees.

H is the height in feet of the transmitting antenna radiation center above average terrain of the 2-10 mile sector of the pertinent radial. This formula is empirically derived for the limited purpose specified herein. Its use for any other purpose may be inappropriate.

(2) In cases where the relative field strength at the depression angle determined by the above formula is 90% or more of the maximum field strength developed in the vertical plane containing the pertaining radial, the maximum radiation shall be used.

(3) In predicting field strengths for other than the Grade A and Grade B contours, the effective radiated power to be used is to be based on the appropriate antenna vertical plane radiation pattern for the aximuthal direction concerned.

(4) Applicants for new TV stations or changes in the facilities of existing TV stations must submit to the FCC a showing as to the location of their stations' or proposed stations' predicted Grade A and Grade B contours, determined in accordance with §73.684. This showing is to include maps showing these contours, except where applicants have previously submitted material to the FCC containing such information and it is found upon careful examination that the contour locations indicated therein would not change, on any radial, when the locations are determined under this Section. In the latter cases, a statement by a qualified engineer to this effect will satisfy this requirement and no contour maps need be submitted.

(d) The antenna height to be used with these charts is the height of the radiation center of the antenna above the average terrain along the radial in question. In determining the average elevation of the terrain, the elevations between 2 and 10 miles from the antenna site are employed. Profile graphs shall be drawn for 8 radials beginning at the antenna site and extending 10 miles therefrom. The radials should be drawn for each 45 degrees of azimuth starting with True North. At least one radial must include the principal community to be served even though such community may be more than 10 miles from the antenna site. However, in the event none of the evenly spaced radials include the principal community to be served and one or more such radials are drawn in addition to the 8 evenly spaced radials, such additional radials shall not be employed in computing the antenna height above average terrain. Where the 2 to 10 mile portion of a radial extends in whole or in part over large bodies of water as specified in paragraph (e) of this section or extends over foreign territory but the Grade B intensity contour encompasses land area within the United States beyond the 10 mile portion of the radial, the entire 2 to 10 mile portion of the radial shall be included in the computation of antenna height above average terrain. However, where the Grade B contour does not so encompass United States land area and (1) the entire 2 to 10 mile portion of the radial extends over large bodies of water or foreign territory, such radial shall be completely omitted from the computation of antenna height above average terrain, and (2) where a part of the 2 to 10 mile portion of a radial extends over large bodies of water or over foreign territory, only that part of the radial extending from the 2 mile sector to the outermost portion of land area within the United States covered by the radial shall be employed in the computation of antenna height above average terrain. The profile graph for each radial should be plotted by contour intervals of from 40 to 100 feet and, where the data permits, at least 50 points of elevation (generally uniformly spaced) should be used for each radial. In instances of very rugged terrain where the use of contour intervals of 100 feet would result in several points in a short distance, 200 - 400 foot contour intervals may be used for such distances. On the other hand, where the terrain is uniform or gently sloping the smallest contour interval indicated on the topographic map (see paragraph (g) of this section) should be used, although only relatively few points may be available. The profile graphs should indicate the topography accurately for each radial, and the graphs should be plotted with the distance in miles as the abscissa and the elevation in feet above mean sea level as the ordinate. The profile graphs should indicate the source of the topographical data employed. The graph should also show the elevation of the center of the radiating system. The graph may be plotted either on rectangular coordinate paper or on special paper which shows the curvature of the earth. It is not necessary to take the curvature of the earth into consideration in this procedure, as this factor is taken care of in the charts showing signal intensities. The average elevation of the 8-mile distance between 2 and 10 miles from the antenna site should then be determined from the profile graph for each radial. This may be obtained by averaging a large number of equally spaced points, by using a planimeter, or by obtaining the median elevation (that exceeded for 50 percent of the distance) in sectors and averaging those values.

NOTE The Commission will, upon a proper showing by an existing station that the application of this rule will result in an unreasonable power reduction in relation to other stations in close proximity, consider requests for adjustment in power on the basis of a common average terrain figure for the stations in question as determined by the Commission.

(e) In instances where it is desired to determine the area in square miles within the Grade A and Grade B field intensity contours, the area may be determined from the coverage map by planimeter or other approximate means; in computing such areas, exclude (1) areas beyond the borders of the United States, and (2) large bodies of water, such as ocean areas, gulfs, sounds, bays, large lakes, etc., but not rivers.

(f) In cases where the terrain in one or more directions from the antenna site departs widely from the average elevation of the 2 to 10 mile sector, the prediction method may indicate contour distances that are different from what may be expected in practice. For example, a mountain ridge may indicate the practical limit of service although the prediction method may indicate otherwise. In such cases the prediction method should be followed, but a supplemental showing may be made concerning the contour distances as determined by other means. Such supplemental showing should describe the procedure employed and should include sample calculations. Maps of predicted coverage should include both the coverage as predicted by the regular method and as predicted by a supplemental method. When measurements of area are required, these should include the area obtained by the regular prediction method and the area obtained by the supplemental method. In directions where the terrain is such that negative antenna heights or heights below 100 feet for the 2 to 100 mile sector are obtained, an assumed height of 10 feet shall be used for the prediction of coverage. However where the actual contour distance are critical factors, a supplemental showing of expected coverage must be included togather with a description of the method employed in predicting such coverage. In special cases, the Commission may require additional information as to terrain and coverage.

(g) In the preparation of the profile graphs previously described, and in determining the location and height above sea level of the antenna site, the elevation or contour intervals shall be taken from the United States Geological Survey Topographic Quadrangle Maps, United States Army Corps of Engineers maps or Tennessee Valley Authority maps, whichever is the latest, for all areas for which such maps are available. If such maps are not published for the area in question, the next best topographic information should be used. Topographic data may sometimes be obtained from State and municipal agencies. Data from Sectional Aeronautical Charts (including bench marks) or railroad depot elevations and highway elevations from road maps may be used where no better information is available. In cases where limited topographic data is available, use may be made of an altimeter in a car driven along roads extending generally radially from the transmitter site. Ordinarilly the Commission will not require the submission of topographical maps for areas beyond 15 miles from the antenna site, but the maps must include the principal community to be served.

If it appears necessary, additional data may be requested. United States Geological Survey Topographic Quadrangle Maps may be obtained from the Department of the Interior, Geological Survey, Washington, D.C. Sectional Aeronautical Charts are available from the Department of Commerce, Coast and Geodetic Survey, Washington, D.C.
In lieu of maps, the average terrain elevation may be computer generated, except in cases of dispute, using elevations from a 30 second, point or better topographic data file. The file must be identified and the data processed for intermediate points along each radial using linear interpolation techniques. The height above mean sea level of the antenna site must be obtained manually using appropriate topographic maps.

(h) The effect of terrain roughness on the predicted field strength of a signal at points distant from a television broadcast station is assumed to depend on the magnitude of a terrain roughness factor (Δh) which, for a specific propagation path, is determined by the characteristics of a segment of the terrain profile for that path 25 miles in length, located between 6 and 31 miles from the transmitter. The terrain roughness factor has a valueequal to the difference, in meters, between elevations exceeded by all points on the profile for 10 percent and 90 percent, respectively, of the length of the profile segment (see 73.699 Figure 10d).

(i) If the lowest field strength value of interest is initially predicted to occur over a particular propagation path at a distance which is less than 31 miles from the transmitter, the terrain profile segment used in the determination of the terrain roughness factor over that path shall be that included between points 6 miles from the transmitter and such lesser distance. No terrain roughness correction need be applied when all field strength values of interest are predicted to occur 6 miles or less from the transmitter.

(j) Profile segments prepared for terrain roughness factor determinations should be plotted in rectangular coordinates with no less than 50 points evenly spaced within the segment, using data obtained from topographic maps, if available, with contour intervals of 50 feet, or less.

(k) The field strength charts (73.699 Figs. 9-10c) were developed assuming a terrain roughness factor of 50 meters, which is considered to be representative of average terrain in the United States. Where the roughness factor for a particular propagation path is found to depart appreciably from this value, a terrain roughness correction (ΔF) should be applied to field strength values along this path as predicted with the use of these charts. The magnitude and sign of this correction, for any value of Δh, may be determined from a chart included in 79.699 as Figure 10e, with linear interpolation as necessary, for the frequency of the UHF signal under consideration.

(l) Alternatively, the terrain roughness correction may be computed using the following formula:

$$\Delta F = C - 0.03 (\Delta h)(1 + f/300).$$

Where:

ΔF = terrain roughness correction in dB
C = a constant having a specific value for the use with each set of field strength charts:

1.9 for TV channels 2-6
2.5 for TV Channels 7-13
4.8 for TV channels 14-69

h = terrain roughness factor in meters
f = frequency of signal in megahertz (mHz).

§ 73.685 Transmitter location and antenna system.-- (a) The transmitter location shall be chosen so that, on the basis of the effective radiated power and antenna height above average terrain employed, the following minimum field strength in decibels above one uVm (dBu) will be provided over the entire principal community to be served:

Channels 2 - 6	Channels 7 - 13	Channels 14 - 69
74 dBu	77 dBu	80 dBu

(b) Location of the antenna at a point of high elevation is necessary to reduce to a minimum the shadow effect on propagation due to hills and buildings which may reduce materially the intensity of the station's signals. In general, the transmitting antenna of a station should be located at the most central point at the highest elevation available. To provide the best degree of service to an area, it is usually preferable to use a high antenna rather than a low antenna with increased transmitter power. The location should be so chosen that line-of-sight can be obtained from the antenna over the principal community to be served; in no event should there be a major obstruction in this path. The antenna must be constructed so that it is as clear as possible of surrounding buildings or objects that would cause shadow problems. It is recognized that topography, shape of the desired service area, and population distribution may make the choice of a transmitter location difficult. In such cases, consideration may be given to the use of a directional antenna system, although it is generally preferable to choose a site where a non-directional antenna may be employed.

(c) In cases of questionable antenna locations it is desirable to conduct propagation tests to indicate the field intensity expected in the principal community to be served and in other areas, particularly where severe shadow problems may be expected. In considering applications proposing the use of such locations, the Commission may require site tests to be made. Such tests should be made in accordance with the measurement procedure in §73.686 and full data thereon must be supplied to the Commission. Test transmitters should employ an antenna having a height as close as possible to the proposed antenna height, using a balloon or other support if necessary and feasible. Information concerning the authorization of site tests may be obtained from the Commission upon request.

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(d) Present information is not sufficiently complete to establish "blanket areas" of television broadcast stations. A "blanket area" is that area adjacent to a transmitter in which the reception of other stations is subject to interference due to the strong signal from this station. The authorization of station construction in areas where blanketing is found to be excessive will be on the basis that the applicant will assume full responsibility for the adjustment of reasonable complaints arising from excessively strong signals of the applicant's station or take other corrective action.

(e) An antenna designed or altered to produce a noncircular radiation pattern in the horizontal plane is considered to be a directional antenna. Antennas purposely installed in such a manner as to result in the mechanical beam titlting of the major vertical radiation lobe are included in this category. Directional antennas may be employed for the purpose of improving service upon an appropriate showing of need. Stations operating on Channels 2-13 will not be permitted to employ a directional antenna having a ratio of maximum to minimum radiation in the horizontal plane in excess of 10 decibels. Stations operating on Channels 14-69 with transmitters delivering a peak visual power output of more than 1 kilowatt may employ directive transmitting antennas with a maximum to minimum radiation in the horizontal plane of not more than 15 decibels. Stations operating on Channels 14-69 and employing transmitters delivering a peak visual power output of 1 kilowatt or less are not limited as to the ratio of maximum to minimum radiation.

(f) Applications proposing the use of directional antenna systems must be accompanied by the following:

(1) Complete description of the proposed antenna system, including the manufacturer and model number of the proposed directional antenna.

(2) Relative field horizontal plane pattern (horizontal polarization only) of the proposed directional antenna. A value of 1.0 should be used for the maximum radiation. The plot of the pattern should be oriented so that 0^{o} corresponds to true North. Where mechanical beam tilt is intended, the amount of tilt in degrees of the antenna vertical axis and the orientation of the downward tilt with respect to true North must be specified, and the horizontal plane pattern must reflect the use of mechanical beam tilt.

(3) A tabulation of the relative field pattern required in (2), above. The tabulation should use the same zero degree reference as the plotted pattern, and be tabulated at least every 10^{o}. In addition, tabulated values of all maxima and minima, with their corresponding azimuths, should be submitted.

(4) Horizontal and vertical plane radiation patterns showing the effective radiated power, in dBk, for each direction. Sufficient vertical plane patterns must be included to indicate clearly the radiation characteristics of the antenna above and below the horizontal plane. In cases where the angles at which the maximum vertical radiation varies with aximuth, a separate vertical radiation pattern must be provided for each pertinent radial direction.

(5) All horizontal plane patterns must be plotted to the largest scale possible on unglazed letter-size polar coordinate paper (main engraving approximately 7" x 10") using only scale divisions and subdivisions of 1, 2, 2.5, or 5 times 10-nth. All vertical plane patterns must be plotted on unglazed letter-size rectangular coordinate paper. Values of field strength on any pattern less than 10% of the maximum field strength plotted on that pattern must be shown on an enlarged scale.

(6) The horizontal and vertical plane patterns that are required are the patterns for the complete directional antenna system. In the case of a composite antenna composed of two or more individual antennas, this means that the patterns for the composite antenna, but not patterns for each of the individual antennas, must be submitted.

(g) Applications proposing the use of television broadcast antennas within 61.0 meters (200) feet of other television broadcast antennas operating on a channel within 20 percent in frequency of the proposed channel or proposing the use of television broadcast antennas on Channels 5 or 6 within 61,0 meters (200) feet of FM broadcast antennas, must include a showing as to the expected effect, if any, of such proximate operation.

(h) Where a simultaneous use of antennas or antenna structures is proposed, the following provisions shall apply:

(1) In cases where it is proposed to use a tower of a standard broadcast station as a supporting structure for a television broadcast antenna, an appropriate

application for changes in the radiating system of the standard broadcast station must be filed by the licensee thereof. A formal application (FCC Form 301) will be required if the proposal involves substantial change in the physical height or radiation characteristics of the standard broadcast antennas; otherwise an informal application will be acceptable. (In case of doubt, an informal application (letter) together with complete engineering data should be submitted.) An application may be required for other classes of stations when the tower is to be used in connection with a television station.

(2) When the proposed TV antenna is to be mounted on a tower in the vicinity of an AM station directional antenna system and it appears that the operation of the directional antenna system may be affected, an engineering study must be filed with the TV application concerning the effect of the TV antenna on the AM directional radiation pattern. Field measurements of the AM stations may be required prior to and following construction of the TV station antenna, and readjustments made as necessary.

(i) Deleted.

73.686 Field strength measurements. (a) Except as provided for in 73.612, television broadcast stations shall not be protected from any type of interference or propagation affect. Persons desiring to submit testimony, evidence or data to the Commission for the purpose of showing that the technical standards contained in this subpart do not properly reflect the levels of any given type of interference or propagation effect may do so only in appropriate rule making proceedings concerning the amendment of such technical standards. Persons making field strength measurements for formal submission to the Commission in rulemaking proceedings, or making such measurements upon the request of the Commission shall follow the procedures for making and reporting such measurements outlined in paragraph (b) of this section. In instances where a showing of the measured level of a signal prevailing over a specific community is apprioriate , the procedure for making and reporting field strength measurements for this purpose is set forth in paragraph (c) of this section.

(b) Collection of field strength data for propagation analysis.

(1) Preparation for measurements.

(i) On large scale topographic maps, eight or more radials are drawn from the transmitter location to the maximum distance at which measurements are to be made, with the angles included between adjacent radials of approximately equal size. Radials should be oriented so as to traverse representative types of terrain. The specific number of radials and their orientation should be such as to accomplish this objective.

(ii) At a point exactly 16.1 kilometers (10miles) from the transmitter, each radial is marked, and at greater distances at successive 3.2 kilometers (2 mile) intervals. Where measurements are to be conducted at UHF, or over extremely rugged terrain, shorter intervals may be employed, but all such intervals shall be of equal length Accessible roads intersecting each radial as nearly as possible at each 3.2 kilometer (2 mile) marker are selected.

These intersections are the points at which measurements are to be made, and are referred to subsequently as measuring locations. The elevation of each measuring location should approach the elevation at the corresponding 3.2 kilometer (2 mile) marker as nearly as possible.

(2) Measurement procedure. The field strength of the visual carrier shall be measured with voltmeter capable of indicating accurately the peak amplitude of the synchronizing signal. All measurements shall be made utilizing a receiving antenna designed for reception of the horizontally polarized signal compoennt, elevated 9.1 meters (30feet) above the roadbed. At each measuring location the following shall be employd.

(i) The instrument calibration is checked.

(ii) The antenna is elevated to a height of 30 feet.

(iii) The receiving antenna is rotated to determine if the strongest signal is arriving from the direction of the transmitter.

(iv) The antenna is oriented so that the section of its response pattern over which maximum gain is realized is in the direction of the transmitter.

(v) At mobile run of at least 30.5 meters (100 feet) is made, which is centered on the intersection of the radial and the road, and the measured field strength is continuously recorded on a chart recorder over the length of the run.

(iv) The actual measuring location is marked exactly on the topographic map, and awritten record, keyed to the specific location, is made of all factors which may affect the recorded field, such as topography, height and type of vegetation, buildings, obstacles, weather, and other local features.

(vii) If, during the test conducted as described in paragraph (b)(2)(iii) of this section, the strongest signal is found to come from a direction other than from the transmitter, after the mobile run prescribed in paragraph (b)(1)(v) of this section is concluded, additional measurements shall be made in a "cluster" of at least five fixed points. At each such point, the field strengths with the antenna oriented toward the transmitter, and with the antenna oriented so as to receive the strongest field, are measured and recorded. Generally, all points should be within 61.0 meters (200 feet) of the center point of the mobile run.

(viii) If overhead obstacles preclude a mobile run of at least 100 feet, a "cluster" of five spot measurements may be made in lieu of this run. The first measurement in the cluster is identified. Generally, the locations for other measurements shall be within 61 meters (200 feet) of the location of the first.

(3) Method of reporting measurements. A report of measurements to the Commission shall be submitted in affidavit form, in triplicate, and should contain the following information.

(i) Tables of field strength measurements, which, for each measuring location, set forth the following data:

(a) Distance from the transmitting antenna.

(b) Ground elevation at measuring location.

(c) Date, time of day, and weather.

(d) Median field in dBu for 9 dBk, for mobile run or for cluster, as well as maximum and minimum measured field strengths.

(e) Notes describing measuring location.

(ii) U.S. Geological Survey topographic maps, on which is shown the exact location at which each measurement was made. The original plots shall be made on maps of the largest available scale. Copies may be reduced in size for convenient submission to the Commission, but not to the extent that important detail is lost. The original maps shall be made available, if requested. If a large number of maps is involved, an index map should be submitted.

(iii) All information necessary to determine the pertinent characteristics of the transmitting installation, including frequency, geographical coordinates of antenna site, rated and actual power output of transmitter, measured transmission line loss, antenna power gain, height of antenna above ground, above mean sea level, and above agerage terrain. The effective radiated power should be computed, and horizontal and vertical plane patterns of the transmitting antenna should be submitted

(iv) A list of calibrated equipment used in the field strength survey, which, for each instrument, specifies its manufacturer, type, and serial number and rated accuracy, and the date of its most recent calibration by the manufacturer, or by a laboratory. Complete details of any instrument not of standard manufacture shall be submitted.

(v) Detailed descriptions of the calibration of the measuring equipment, including field strength meters, measuring atenna, and connecting cable.

(vi) Terrain profiles in each direction in which measurements were made, drawn on curved earth paper for equivalent 4/3 earth radius, of the largest available scale.

(c) Collection of field strength data to determine television service in specific communities.

(1) Preparation for measurement. (i) The population (P) of the community, and its suburbs, if any, is determined by reference to an appropriate source, e.g., the 1970 U.S. Census tables of population of cities and urbanized areas.

(ii) The number of locations at which measurements are to be made shall be at least 15, and shall be approximately equal to $0.1(P)^{1/2}$, if this product is a number greater than 15.

(iii) A rectangular grid, of such size and shape as to encompass the boundaries of the community is drawn on an accurate map of the community. The number of line intersections on the grid included within the boundaries of the community shall be at least equal to the required number of measuring locations. The position of each intersection on the community map determines the location at which a measurement shall be made.

(2) Measurement procedure. The field strength of the visual carrier shall be measured, with a voltmeter capable of indicating accurately the peak amplitude of the synchronizing signal. All measurements shall be made utilizing a receiving antenna designed for reception of the horizontally polarized signal component elevated 30 feet 9.1 meters above street level.

(i) Each measuring location shall be chosen as close as feasible to a point indicated on the map, as previously prepared, and at as nearly the same elevation as that point as possible.

(ii) At each measuring location, after equipment calibration and elevation of the antenna, a check is made to determine whether the strongest signal arrives from a direction other than from the transmitter.

(ii) At 20 percent or more of the measuring locations, mobile runs, as described in paragraph (b)(2) of this section shall be made, with no less than three such mobile runs in any case. The points at which mobile measurements are made shall be well separated. Spot measurements may be made at other measuring points.

(iv) Each actual measuring location is marked exactly on the map of the community, and suitable keyed. A written record shall be maintained, describing, for each location, factors which may affect the recorded field, such as the approximate time of measurement, weather topography, overhead wiring, heights and types of buildings, vegetation, and other structures. Theorientation with respect to the measuring locations shall be indicated of objects of such shape and size as to be capable of causing shadows or reflections. If the strongest signal received was found to arrive from a direction other than that of the transmitter, this fact shall be recorded.

(3) Method for reporting measurements. A report of measurements to the Commission shall be submitted in affidavit form, in triplicate, and should contain the following information.

(i) A map of the community showing each actual measuring location, specifically identifying the points at which mobile runs were made.

(ii) A table keyed to the above map, showing the field strength at each measuring point, reduced to dBu for the actual effective radiated power of the station. Weather, date, and time of each measurement shall be indicated.

(iii) Notes describing each measuring location.

(iv) A topographic map of the largest available scale on which are marked the community and the transmitter site of the station whose signals have been measured, which includes all areas on or near the direct path of signal propagation.

(v) Computations of the mean and standard deviation of all measured field strengths, or a graph on which the distribution of measured field strength values is plotted.

(vi) A list of calibrated equipment used for the measurements, which for each instrument, specifies its manufacture, type, serial number and rated accuracy, and the date of its most recent calibration by the manufacturer, or by a laboratory. Complete details of any instrument not of standard manufacture shall be submitted.

(vii) A detailed description of the procedure employed in the calibration of the measuring equipment including field strength meters measuring antenna, and connecting cable.

73.687 Transmission System requirements. (a) Visual transmitter.

(1) The field strength or voltage of the lower sideband, as radiated or dissipated and measured as described in paragraph (a)(2) of this section, shall not be greater than -20dB for modulating frequency of 1.25 MHz or greater and in addition, for color, shall not be greater than -42 dB for a modulating frequency of 3.579545 MHz (the color subcarrier frequency). For both monochrome and color, the field strength or voltage of the upper sideband as radiated or dissipated and measured as described in parapraph (a)(2) of this section shall not be greater than -20 dB for a modulating frequency of 4.75 MHz or greater. For stations operating on channels 15-69 and employing a transmitter delivering maximum peak visual power output of 1 kW or less, the field strength or voltage of the upper and lower sidebands, as radiated or dissipated and measured as described in paragraph (a)(2) of this section, shall depart from the visual amplitude characteristic (Figure 5a of 73.699) by no more than the following amounts:

-2 dB at 0.5 MHz below visual carrier frequency;
-2 dB at 0.5 MHz above fisual carrier frequency;
-2 dB at 1.25 MHz above visual carrier frequency;
-3 dB at 2.0 MHz above visual carrier frequency;
-6 dB at 3.0 MHz above visual carrier frequency;
-12 dB at 3.5 MHz above visual carrier frequency;
-8 dB at 3.58 MHz above visual carrier frequency (for color transmission only).

The field strength or voltage of the upper and lower sidebands, as radiated or dissipated and measured as described in paragraph (a)(2) of this section, shall not exceed a level of -20 dB for a modulating frequency of 4.75 MHz or greater. If interference to the reception of other stations is caused by out-of-channel lower sideband emission, the technical requirements applicable to stations operating on Channels 2-13 shall be met.

(2) The attenuation characteristics of a visual transmitter shall be measured by application of a modulating signal to the transmitter input terminals in place of the normal composite television video signal. The signal applied shall be a composite signal composed of a synchronizing signal to establish peak output voltage plus a variable frequency sine wave voltage occupying the interval between synchronizing pulses. (The "synchronizing signal" referred to in this section means either a standard synchronizing wave form or any pulse that will properly set the peak.) The axis of the sine wave in the composite signal observed in the output monitor shall be maintained at an amplitude 0.5 of the voltage at synchronizing peaks. The amplitude of the sine wave input shall be held at a constant value. This constant value should be such that at no modulating frequency does the maximum excursion of the sine wave, observed in the composite output signal monitor, exceed the value of 0.75 of peak output voltage. The amplitude of the 200 kilohertz sideband shall be measured and designated zero db as a basis for comparison. The modulation signal frequency shall then be varied over the desired range and the field strength or signal voltage of the corresponding sidebands measured. As an alternate method of measuring, in those cases in which the automatic d-c insertion can be replaced by manual control, the above characteristic may be taken by the use of a video sweep generator and without the use of pedestal synchronizing pulses. The d-c level shall be set for midcharacteristic operation.

(3) A sine wave, introduced at those terminals of the transmitter which are normally fed the composite color picture signal, shall produce a radiated signal having an envelope delay, relative to the average envelope delay between 0.05 and 0.20 MHz of zero microseconds up to a frequency of 3.0 MHz & then linearly decreasing to 4.18 MHz so as to be equal to -0.17µ secs at 3.58 MHz. The tolerance on the envelope delay shall be ±0.05µ secs at 3.58 MHz. The tolerance shall increase linearly to ±0.1µ sec down to 2.1 MHz and remain at ±0.1µ sec down to 0.2 MHz (Tolerances for the interval of 0.0 to 0.2 are not specified at the present time.) The tolerance shall also increase linearly to ±0.1µ sec at 4.18 MHz.

(4) The radio frequency signal, as radiated, shall have an envelope as would be produced by a modulating signal in conformity with §73.682 and Figure 6 or 7 of §73.699, as modified by vestigial sideband operation specified in Figure 5 of §3.699. For stations operating on Channels 15-69 the radio frequency signal as radiated, shall have an envelope as would be produced by a modulating signal in conformity with §73.682 and Figures 6 or 7 of §73.699.

(5) The time interval between the leading edges of successive horizontal pulses shall vary less than one half of one percent of the average interval. However, for color transmissions, §73.682(a)(5) and §73.682(a)(6) shall be controlling.

(6) The rate of change of the frequency of recurrence of the leading edges of the horizontal synchronizing signals shall be not greater than 0.15 percent per second, the frequency to be determined by an averaging process carried out over a period of not less than 20, nor more than 100 lines, such lines not to include any portion of the blanking interval. However, for color transmissions, §73.682(a)(5) and §73.682(a)(6) shall be controlling.

(b) Aural transmitter. (1) Pre-emphasis shall be employed as closely as practicable in accordance with the inpedance-frequency characteristic of a series inductance-resistance network having a time constant of 75 microseconds. (See upper curve of Fig. 12, 73.699.)

(2) If a limiting or compression amplifier is employed, precaution should be maintained in its connection in the circuit due to the use of pre-emphasis in the transmitting system.

(3) Aural modulation levels are specified in 73.1570.
consistent

(c) Requirements applicable to both visual and aural transmitters. (1) Automatic means shall be provided in the visual transmitter to maintain the carrier frequency within ± one kilohertz of the authorized frequency; automatic means shall be provided in the aural transmitter to maintain the carrier frequency 4.5 megacycles above the actual visual carrier frequency within ± one kilohertz

(2) The transmitters shall be equipped with suitable indicating instruments for the determination of operating power and with other instruments necessary for proper adjustment, operation, and maintenance of the equipment.

(3) Adequate provision shall be made for varying the output power of the transmitters to compensate for excessive variations in line voltage or for other factors affecting the output power.

(4) Adequate provisions shall be provided in all component parts to avoid overheating at the rated maximum output powers.

(d) Construction. In general, the transmitters shall be mounted either on racks and panels or in totally enclosed frames protected as required by the provisions of the National Electrical Code concerning transmitting equipment at radio and television stations, and as set forth below:

(1) Means shall be provided for making all tuning adjustments, requiring voltages in excess of 350 volts to be applied to the circuit, from the front of the panels with all access doors closed.

(2) Proper bleeder resistors or other automatic means shall be installed across all the capacitor banks to lower any voltage which may remain accessible with access door open to less than 350 volts within two seconds after the access door is opened.

(3) All plate supply and other high voltage equipment, including transformers, filters, rectifiers and motor generators, shall be protected so as to prevent injury to operating personnel.

(i) Commutator guards shall be provided on all high voltage rotating machinery. Coupling guards should be provided on motor generators.

(ii) Power equipment and control panels of the transmitters shall meet the above requirements (exposed 220-volt A.C. switching equipment on the front of the power control panels is not recommended but is not prohibited).

(iii) Power equipment located at a television broadcast station not directly associated with the transmitters (not purchased as part of same), such as power distribution panels, are not subject to the provisions of this subpart.

(4) The following provisions shall be applicable to metering equipment:

(i) All instruments having more than 1,000 volts potential to ground on the movement shall be protected by a cage or cover in addition to the regular case. (Some instruments are designed by the manufacturers to operate safely with voltages in excess of 1,000 volts on the movement. If it can be shown by the manufacturer's rating that the instrument will operate safely at the applied potential, additional protection is not necessary.)

(ii) In case the plate voltmeters are located on the low potential side of the multiplier resistors with the high potential terminal of the instruments at or less than 1,000 volts above ground, no protective case is required, However, it is good practice to protect voltmeters subject to more than 5,000 volts with suitable over-voltage protective devices across the instrument terminals in case the winding opens.

(iii) Transmission line meters and any other radio frequency instrument which may be necessary for the operator to read shall be so installed as to read easily and accurately without the operator having to risk contact with circuits carrying high potential radio frequency energy.

(e) Wiring and shielding. (1) The transmitter panels or units shall be wired in accordance with standard practice, such as insulated leads properly cabled and supported, coaxial cables, or rigid bus bar properly insulated and protected.

(2) Wiring between units of the transmitters, with the exception of circuits carrying radio frequency energy or video energy, shall be installed in conduits or approved fiber or metal raceways to protect it from mechanical injury.

(3) Circuits carrying radio frequency or video energy between units shall be coaxial cables, two wire balanced lines, or properly shielded lines.

(4) All stages or units shall be adequately shielded and filtered to prevent interaction and radiation.

(f) Deleated and reserved.

(g) Installation. (1) The installation of transmitting equipment shall be made in suitable quarters.

(2) Suitable facilities shall be provided for the welfare and comfort of the operator.

(h) Reserved.

(i) Operation.--(1) Spurious emissions, including radio frequency harmonics, shall be maintained at as low a level as the state of the art permits. As measured at the output terminals of the transmitter (including harmonic filters, if required) all emissions removed in frequency in excess of 3 Mc above or below the respective channel edge shall be attenuated no less than 60 db. below the visual transmitted power. (The 60 db. value for television transmitters specified in this rule should be considered as a temporary requirement which may be increased at a later date, especially when more higher-powered equipment is utilized. Stations should, therefore, give consideration to the installation of equipment with greater attenuation than 60 db.) In the event of interference caused to any service greater attenuation will be required.

(2) If a limiting or compression amplifier is used in conjunction with the aural transmitter, due operating precautions should be maintained because of pre-emphasis in the transmitting system.

(j) Studio equipment.--Studio equipment shall be subject to all the above requirements where applicable, except as follows:

(1) If properly covered by an underwriter's certificate, it will be considered as satisfying safety requirements.

(2) The pertinent provisions of the National Electrical Code concerning transmitting equipment at radio and television stations shall apply for voltages only when in excess of 500 volts.

(3) No specific requirements are made relative to the design and acoustical treatment of studios. However, the design of studios, particularly the main studio, shall be compatible with the required performance characteristics of television

§73.688 Indicating instruments. (a) Each TV broadcast station shall be equipped with indicating instrements which conform with the specifications described in §73.1215 for measuring the operating parameters of the last radio stage of the visual transmitter and with such other instruments as are necessary for the proper adjustment, operation and maintenance of the visual transmitting system.

(b) **The function of each instrument shall be clearly and permanently shown on the instrument itself or on the panel immediately adjacent thereto.**

(c) **In the event that any one of these indicating instruments becomes defective, when no substitute which conforms with the required specifications is available, the station may be operating without the defective instrument pending its repair/replacement for a period not in excess of 60 days without further authorization of the Commission, Provided,**

(1) If the defective instrument is the transmission line meter used for determining the output power by the direct method, the operating power shall be determined or maintained by the indirect method whenever possible or by using the operating parameters of the last radio stage of the transmitter during the time the station is operated without the transmission line meter.

(2) If conditions beyond the control of the licensee prevent the restoration of the meter to service within the above allowed period, informal request in accordance with 73.3549 may be filed with the Engineer in Charge of the radio district in which the station is located for such additional time as may be required to complete repairs of the defective instrument.

§73.689 Operating power.

(a) Determination. See 73.663.

(b) Maintenance. See 73.1560.

(c) Reduced power. See 73.1560.

73.690 Frequency measurements.
See 73.1540

73.691 Visual modulation monitors.

Each TV station must have measuring equipment for determining that the transmitted visual signal conforms to the provisions of this Subpart. The licensee shall decide the monitoring and measurement methods or procedures for indicating and controlling the visual signal.

73.692 Reserved.

73.694 Deleted.

73.695-73.698 Reserved.

73.698 Tables. See next page.

TABLE I

TABLE I.—MINUTES TO DECIMAL PARTS OF A DEGREE

Minutes	*Degrees*	*Minutes*	*Degrees*
1	0.01667	31	0.51667
2	.03333	32	.53333
3	.05	33	.55
4	.06667	34	.56667
5	.08333	35	.58333
6	.10	36	.60
7	.11667	37	.61667
8	.13333	38	.63333
9	.15	39	.65
10	.16667	40	.66667
11	.18333	41	.68333
12	.20	42	.70
13	.21667	43	.71667
14	.23333	44	.73333
15	.25	45	.75
16	.26667	46	.76667
17	.28333	47	.78333
18	.30	48	.80
19	.31667	49	.81667
20	.33333	50	.83333
21	.35	51	.85
22	.36667	52	.86667
23	.38333	53	.88333
24	.40	54	.90
25	.41667	55	.91667
26	.43333	56	.93333
27	.45	57	.95
28	.46667	58	.96667
29	.48333	59	.98333
30	.50	60	1.00

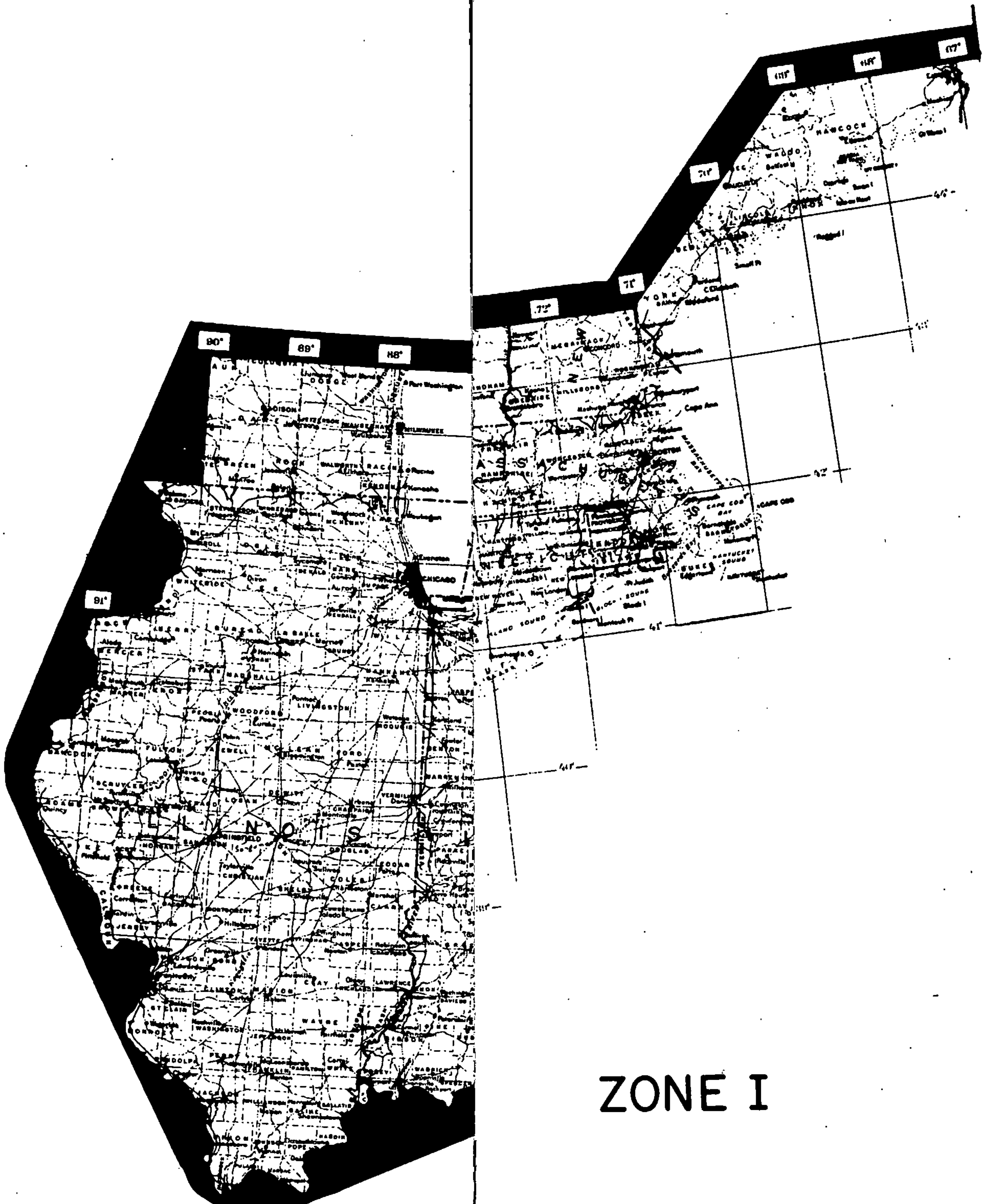
TABLE I—Continued

SECONDS TO DECIMAL PARTS OF A DEGREE

Seconds	*Degrees*	*Seconds*	*Degrees*
1	0.00028	31	0.00861
2	.00056	32	.00889
3	.00083	33	.00917
4	.00111	34	.00944
5	.00139	35	.00972
6	.00167	36	.01
7	.00194	37	.01028
8	.00222	38	.01056
9	.0025	39	.01083
10	.00278	40	.01111
11	.00306	41	.01139
12	.00333	42	.01167
13	.00361	43	.01194
14	.00389	44	.01222
15	.00417	45	.0125
16	.00444	46	.01278
17	.00472	47	.01306
18	.005	48	.01333
19	.00528	49	.01361
20	.00556	50	.01389
21	.00583	51	.01417
22	.00611	52	.01444
23	.00639	53	.01472
24	.00667	54	.015
25	.00694	55	.01528
26	.00722	56	.01556
27	.0075	57	.01583
28	.00778	58	.01611
29	.00806	59	.01639
30	.00833	60	.01667

Channel	31.4 kilometers (19.5 miles) if beat	31.4 kilometers (19.5 miles) intermodulation	87.7 kilometers 54.5 miles adjacent channel	95.7 kilometers (59.5 miles) oscillator	95.7 kilometers (59.5 miles) sound image	119.9 kilom. (74.5 miles) picture image
14	22	16-19	15	21	28	29
15	23	17-20	14, 16	22	29	30
16	24	14, 18-21	15, 17	23	30	31
17	25	14-15, 19-22	16, 18	24	31	32
18	26	14-16, 20-23	17, 19	25	32	33
19	27	14-17, 21-24	18, 20	26	33	34
20	28	15-18, 22-25	19, 21	27	34	35
21	29	16-19, 23-26	20, 22	28, 14	35	36
22	30, 14	17-20, 24-27	21, 23	29, 15	36	37
23	31, 15	18-21, 25-28	22, 24	30, 16	37	38
24	32, 16	19-22, 26-29	23, 25	31, 17	38	39
25	33, 17	20-23, 27-30	24, 26	32, 18	39	40
26	34, 18	21-24, 28-31	25, 27	33, 19	40	41
27	35, 19	22-25, 29-32	26, 28	34, 20	41	42
28	36, 20	23-26, 30-33	27, 29	35, 21	42, 14	43
29	37, 21	24-27, 31-34	28, 30	36, 22	43, 15	44, 14
30	38, 22	25-28, 32-35	29, 31	37, 23	44, 16	45, 15
31	39, 23	26-29, 33-36	30, 32	38, 24	45, 17	46, 16
32	40, 24	27-30, 31-37	31, 33	39, 25	46, 18	47, 17
33	41, 25	28-31, 35-38	32, 34	40, 26	47, 19	48, 18
34	42, 26	29-32, 36-39	33, 35	41, 27	48, 20	49, 19
35	43, 27	30-33, 37-40	34, 36	42, 28	49, 21	50, 20
36	44, 28	31-34, 38-41	35, 37	43, 29	50, 22	51, 21
37	45, 29	32-35, 39-42	36, 38	44, 30	51, 23	52, 22
38	46, 30	33-36, 40-43	37, 39	45, 31	52, 24	53, 23
30	47, 31	34-37, 41-44	38, 40	46, 32	53, 25	54, 24
40	48, 32	35-38, 42-45	39, 41	47, 33	54, 26	55, 25
41	49, 33	36-39, 43-46	40, 42	48, 34	55, 27	56, 26
42	50, 34	37-40, 44-47	41, 43	49, 35	56, 28	57, 27
43	51, 35	38-41, 45-48	42, 44	50, 36	57, 29	58, 28
44	52, 36	39-42, 46-49	43, 45	51, 37	58, 30	59, 29
45	53, 37	40-43, 47-50	44, 46	52, 38	59, 31	60, 30
46	54, 38	41-44, 48-51	45, 47	53, 39	60, 32	61, 31
47	55, 39	42-45, 49-52	46, 48	54, 40	61, 33	62, 32
48	56, 40	43-46, 50-53	47, 49	55, 41	62, 34	63, 33
49	57, 41	44-47, 51-54	48, 50	56, 42	63, 35	64, 34
50	58, 42	45-48, 52-55	49, 51	57, 43	64, 36	65, 35
51	59, 43	46-49, 53-56	50, 52	58, 44	65, 37	66, 36
52	60, 44	47-50, 54-57	51, 53	59, 45	66, 38	67, 37
53	61, 45	48-51, 55-58	52, 54	60, 46	67, 39	68, 38
54	62, 46	49-52, 56-59	53, 55	61, 47	68, 40	69, 39
55	63, 47	50-53, 57-60	54, 56	62, 48	69, 41	
56	64, 48	51-54, 58-61	55, 57	63, 49	70, 42	
57	65, 49	52-55, 59-62	56, 58	64, 50	71, 43	
58	66, 50	53-56, 60-63	57, 59	65, 51	72, 44	
59	67, 51	54-57, 61-64	58, 60	66, 52	73, 45	
60	68, 52	55-58, 62-65	59, 61	67, 53	74, 46	
61	69, 53	56-59, 63-66	60, 62	68, 54	75, 47	
62	70, 54	57-60, 64-67	61, 63	69, 55	76, 48	
63	71, 55	58-61, 65-68	62, 64	70, 56	77, 49	
64	72, 56	59-62, 66-69	63, 65	71, 57	78, 50	
65	73, 57	60-63, 67-70	64, 66	72, 58	79, 51	
66	74, 58	61-64, 68-71	65, 67	73, 59	80, 52	
67	75, 59	62-65, 69-72	66, 68	74, 60	81, 53	
68	76, 60	63-66, 70-73	67, 69	75, 61	82, 54	
69	77, 61	64-67, 71-74	68, 70	76, 62	83, 55	
70	78, 62	65-68, 72-75	69, 71	77, 63	56	
71	79, 63	66-69, 73-76	70, 72	78, 64	57	
72	80, 64	67-70, 74-77	71, 73	79, 65	58	
73	81, 65	68-71, 75-78	72, 74	80, 66	59	
74	82, 66	69-72, 76-79	73, 75	81, 67	60	
75	83, 67	70-73, 77-80	74, 76	82, 68	61	
76	68	71-74, 78-81	75, 77	83, 69	62	
77	69	72-75, 79-82	76, 78	70	63	
78	70	73-76, 80-83	77, 79	71	64	
79	71	74-77, 81-83	78, 80	72	65	
80	72	75-78, 82-83	79, 81	73	66	
81	73	76-79, 83	80, 82	74	67	
82	74	77-80	81, 83	75	68	
83	75	78-81	82	76	69	

§73.699 <u>Figures.</u> Consists of figures 1, 2, 5 through 17 inclusive.

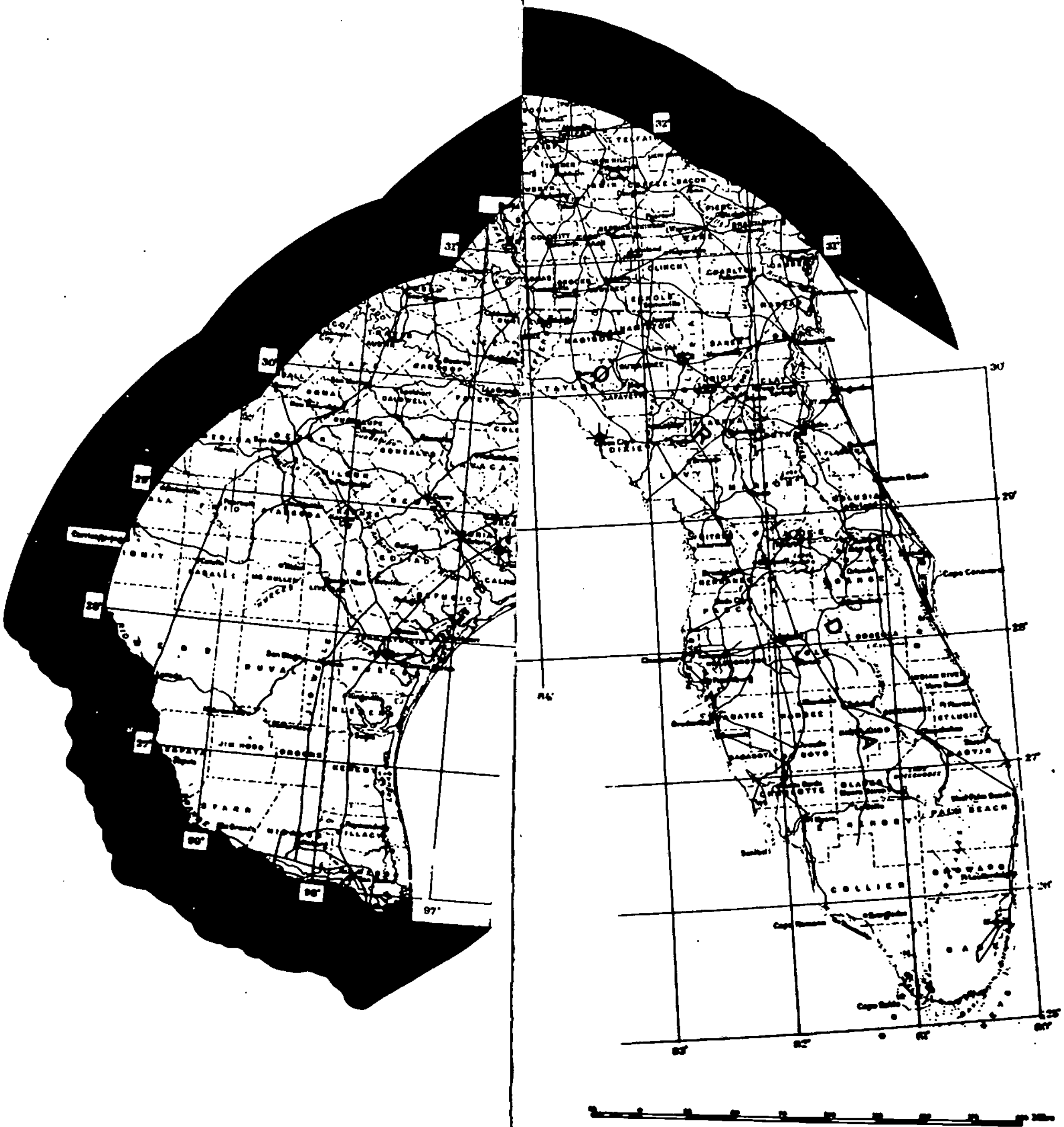


ZONE I

Feb. 1954

FCC § 73.699, FIGURE 1

.3-382 O - 76 (Face Blank p. 292) No. 3



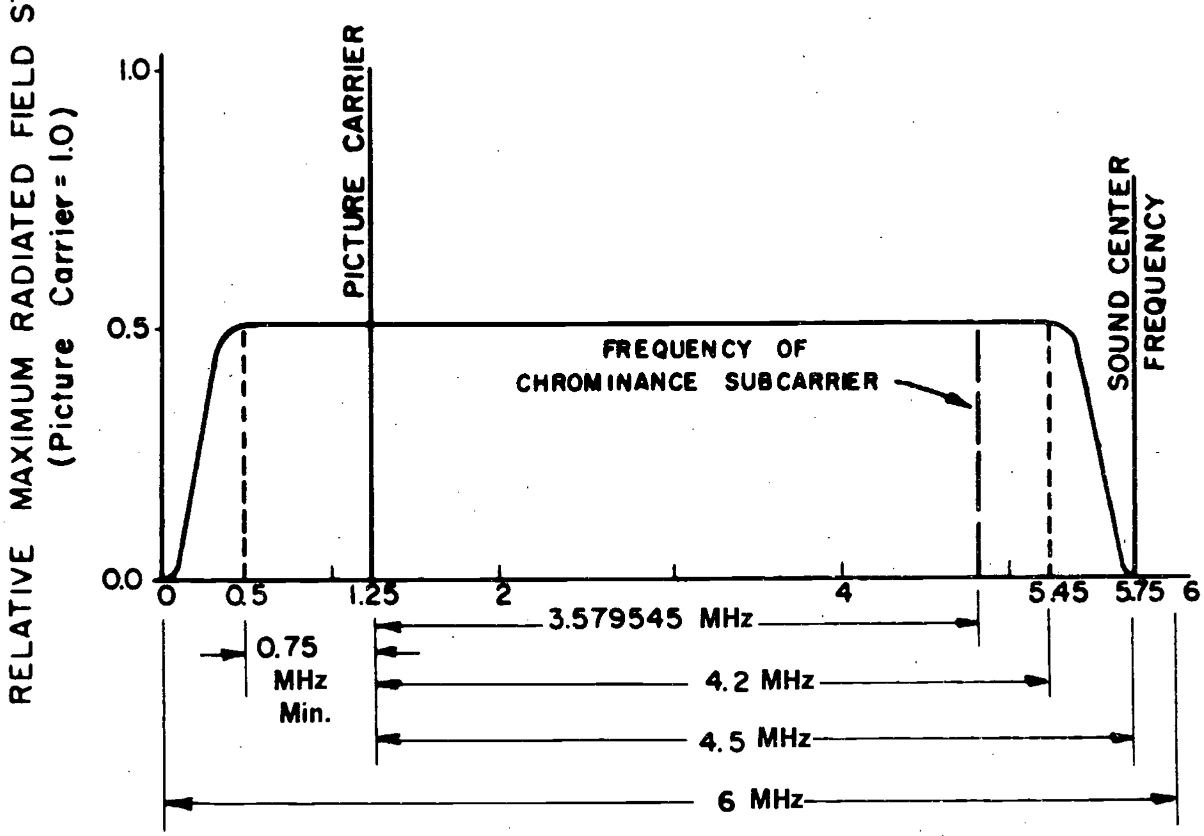
ZONE III

MARCH 1957

FCC § 73.609, FIGURE 2

TV Standard

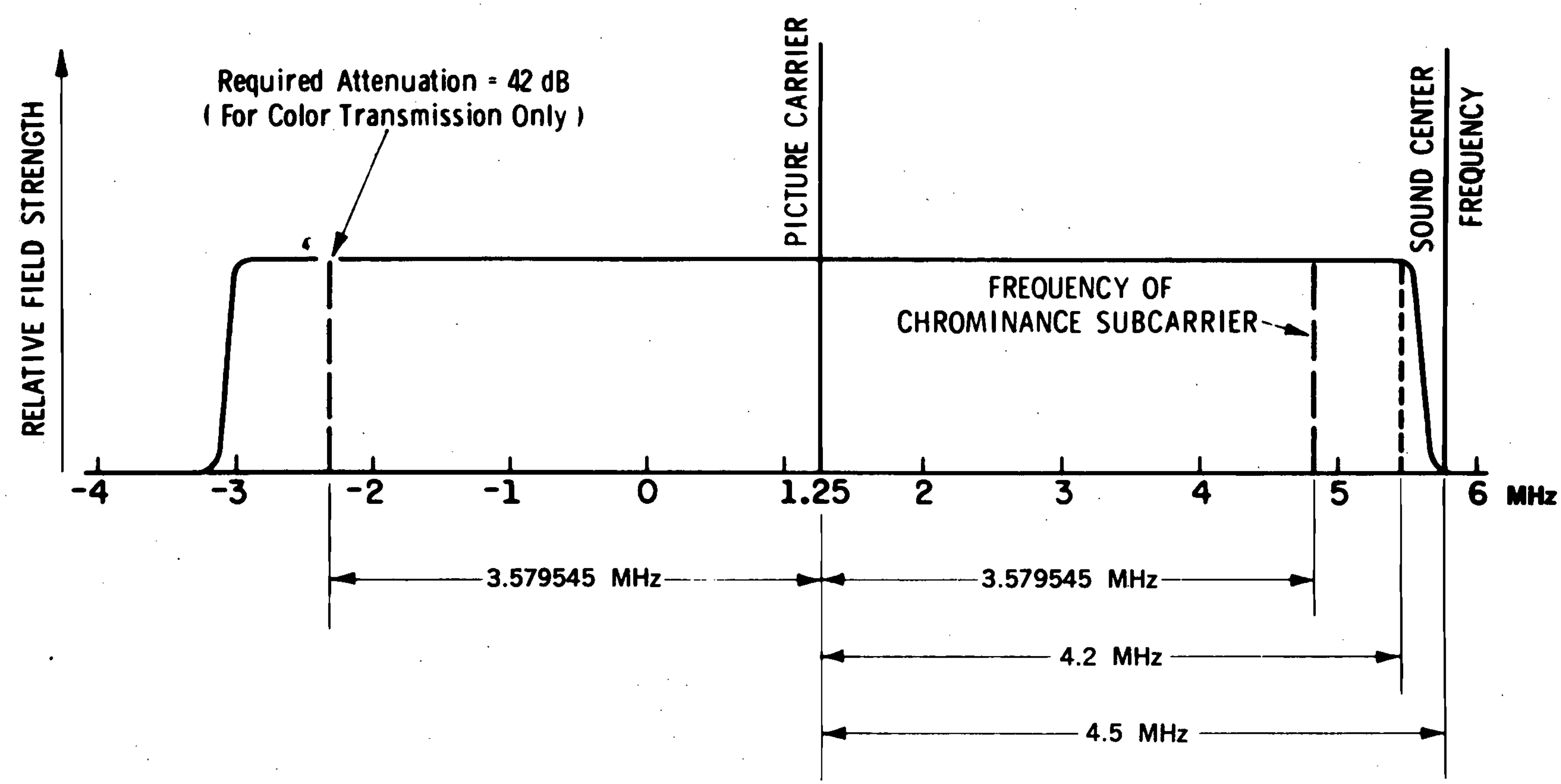
IDEALIZED PICTURE TRANSMISSION AMPLITUDE CHARACTERISTIC



Note: Not drawn to scale

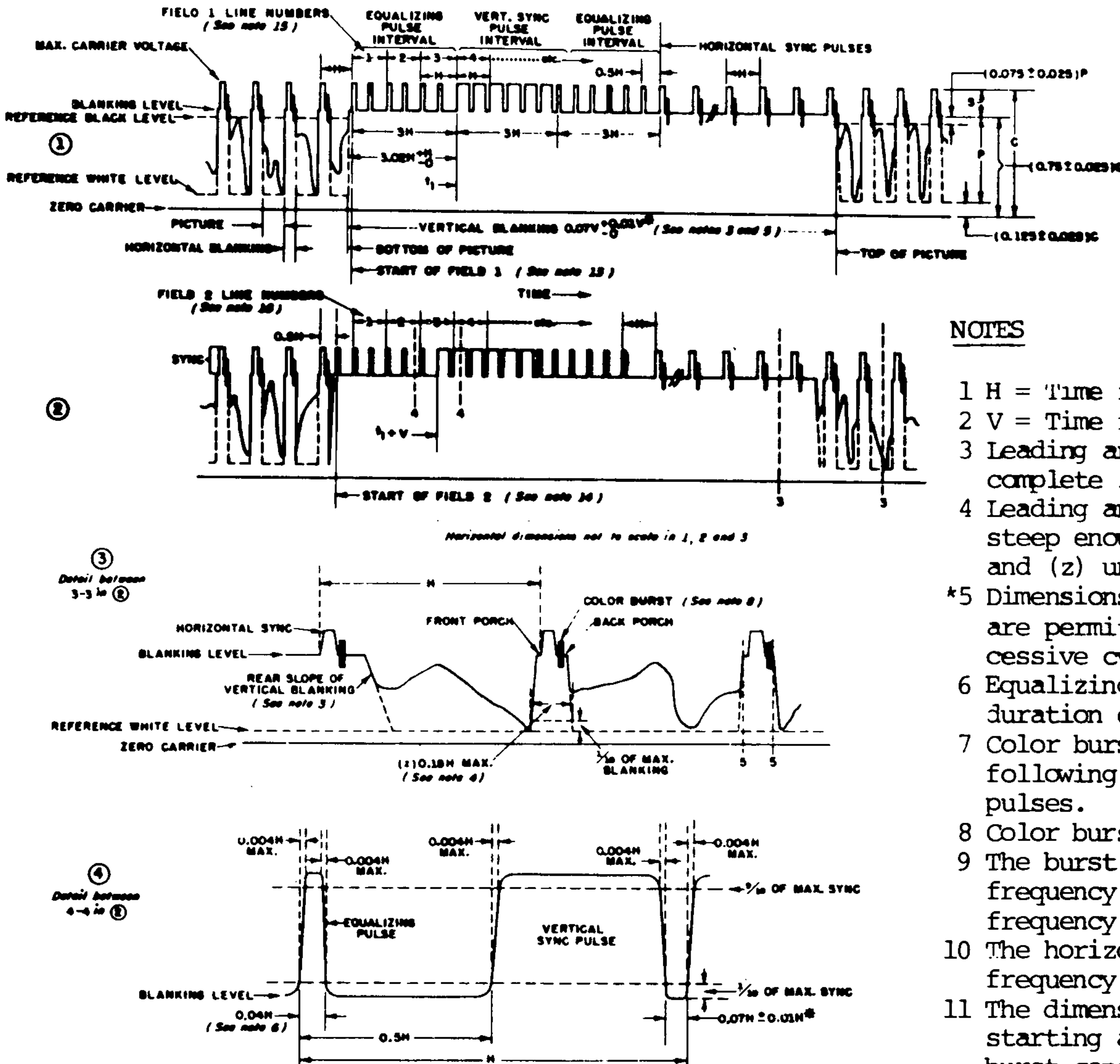
FCC § 73.699, FIGURE 5

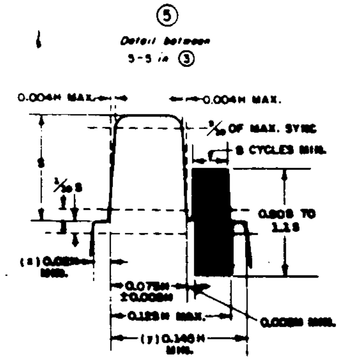
IDEALIZED PICTURE TRANSMISSION AMPLITUDE CHARACTERISTIC



FCC § 73.699, FIGURE 5a

TV ENGINEERING CHARTS
FOR COLOR TRANSMISSION





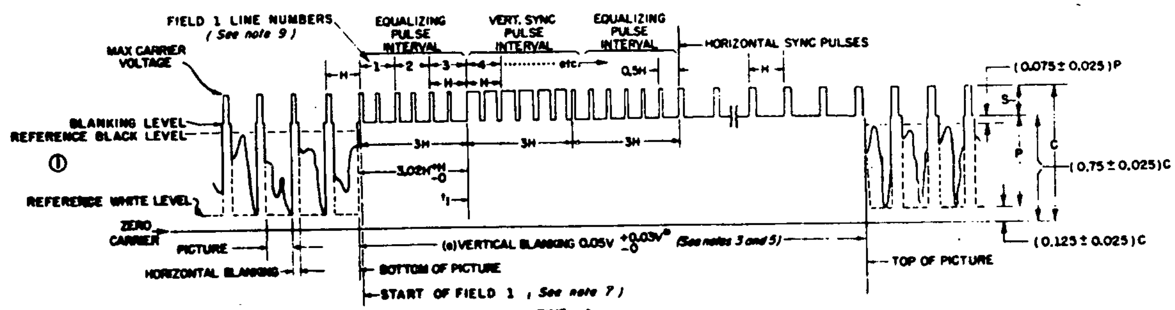
NOTES

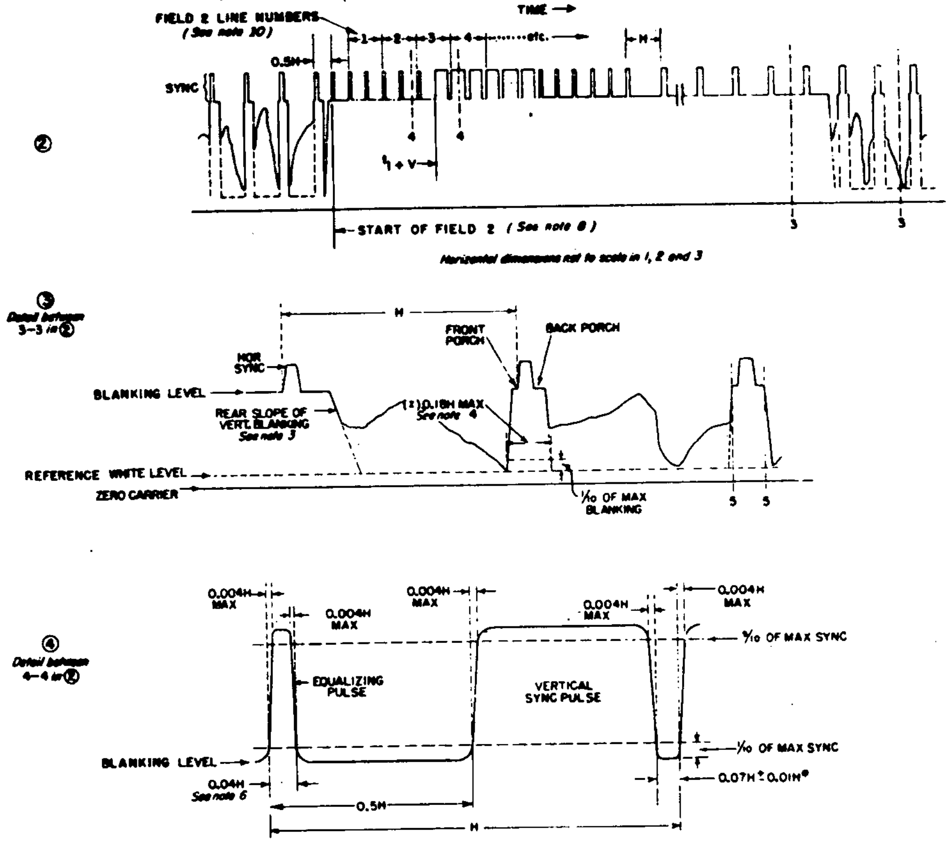
1 H = Time from start of one line to start of next line.
2 V = Time from start of one field to start of next field.
3 Leading and traling edges of vertical blanking should be complete in less than 0.1H.
4 Leading and trailing slopes of horizontal blanking must be steep enough to preserve minimum and maximum values of (x + y) and (z) under all conditions of picture content.
*5 Dimensions marked with asterisk indicate that tolerances given are permitted only for long time variations and not for successive cycles.
6 Equalizing pulse duration must be between 0.45 and 0.55 of the duration of the horizontal synchronizing the pulse duration.
7 Color burst follows each horizontal pulse, but is omitted following the equalizing pulses and during the broad vertical pulses.
8 Color bursts to be omitted during monochrome transmission.
9 The burst frequency shall be 3.579545 MHz. The tolerance on the frequency shall be ±10 hertz with a maximum rate of change of frequency not to exceed 1/10 hertz per second.
10 The horizontal scanning frequency shall be $\frac{2}{455}$ times the burst frequency.
11 The dimensions specified for the burst determine the times of starting and stopping the burst, but not its phase. The color burst consists of amplitude modulation of a continuous sine wave.
12 Dimension "P" represents the peck excursion of the luminance signal from blanking level, but does not include the chrominance signal. Dimension "S" is the sync amplitude above blanking level. Dimension "C" is the peak carrier amplitude.
13 Start of Field 1 is defined by a whole line between first equalizing pulse and preceding H sync pulses.
14 Start of Field 2 is defined by a whole line between first equalizing pulse and preceding H sync pulses.
15 Field 1 line numbers start with first equalizing pulse in Field 1.
16 Field 2 line numbers start with second equalizing pulse in Field 2.
17 Refer to text for further explanations and tolerances.
18 During color transmissions, the chrominance component of the picture signal may penetrate the synchronizing region and the color burst penetrates the picture region.

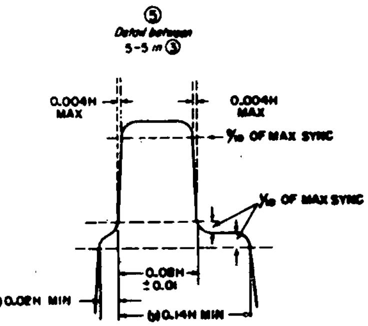
19 Maximum horizontal and vertical blanking intervals are recommended values only.

TV ENGINEERING CHARTS

FOR MONOCHROME TRANSMISSION ONLY







NOTES

1 H = Time from start of one line to start of next line.

2 V = Time from start of one field to start of next field.

3 Leading and trailing edges of vertical blanking should be completed in less than 0.1H.

4 Leading and trailing slopes of horizontal blanking must be steep enough to preserve minimum and maximum values of (x + y) and (z) under all conditions of picture content.

*5 Dimensions marked with asterisk indicate that tolerances given are permitted only for long time variations and not for successive cycles.

6 Equalizing pulse duration must be between 0.45 and 0.55 of the duration of the horizontal synchronizing pulse duration.

7 Start of Field 1 is defined by a whole line between first equalizing pulse and preceding H sync pulses.

8 Start of Field 2 is defined by a half line between first equalizing pulse and preceding H sync pulses.

9 Field 1 line numbers start with first equalizing pulse in Field 1.

10 Field 2 line numbers start with second equalizing pulse in Field 2.

11. Refer to text for further explanations and tolerances.

12 Manimum horozpnta; and vertocal blanking intervals are recommended values only.

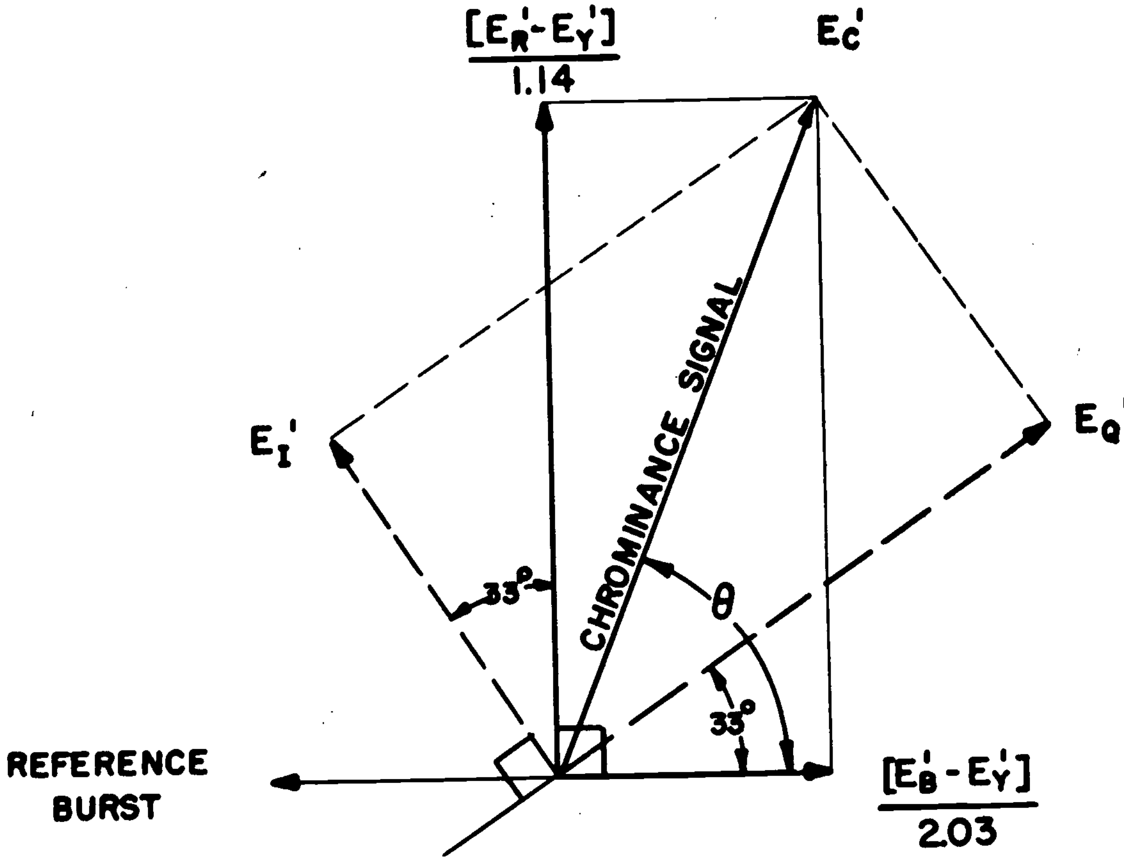
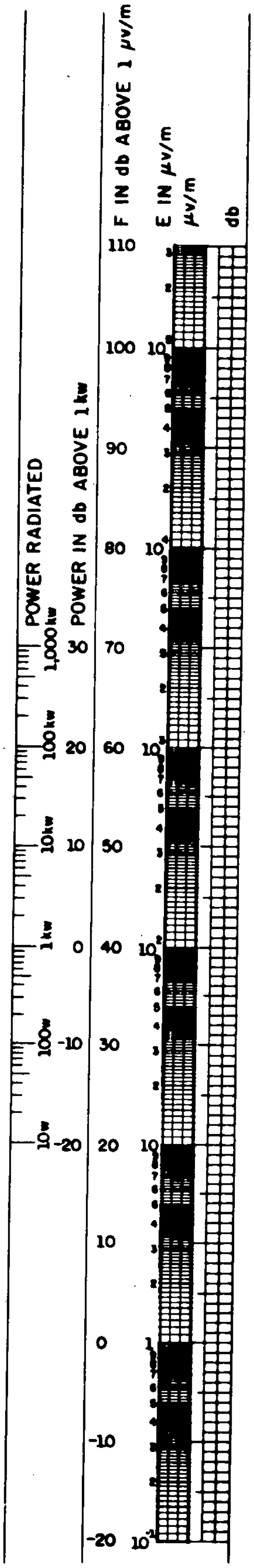
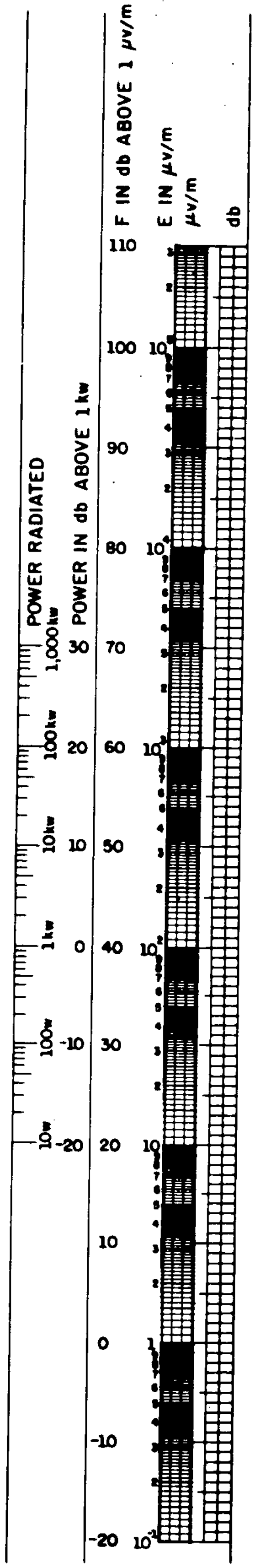

[E'R - E'Y] / 1.14
E'C
CHROMINANCE SIGNAL
E'I
E'Q
33°
θ
33°
REFERENCE BURST
[E'B - E'Y] / 2.03

 Figure 8

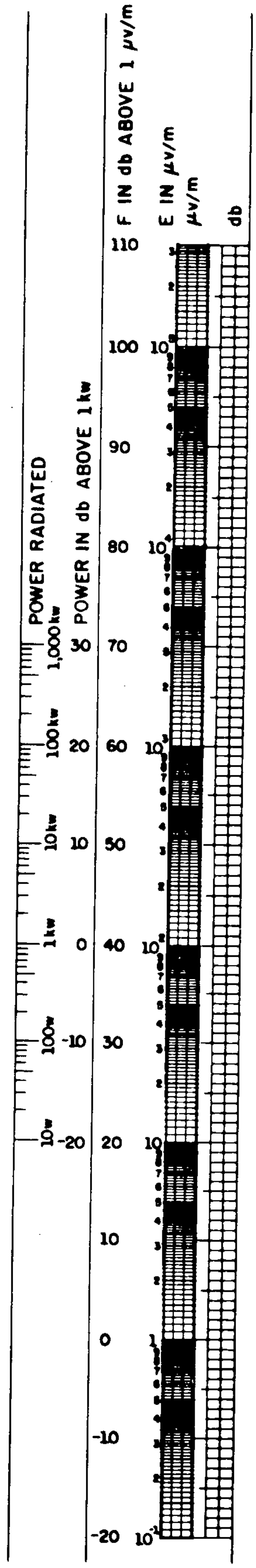
Sliding Scale for use with Figures 9 and 10



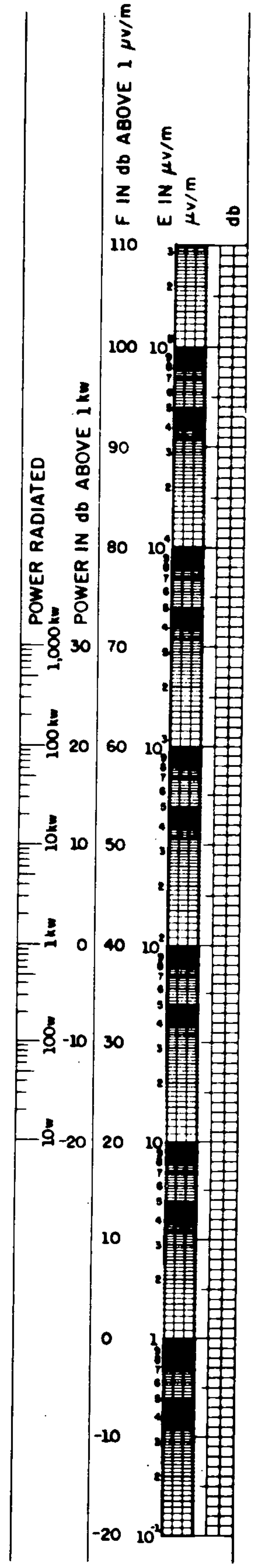
Sliding scale for use with Figures 9 & 10.



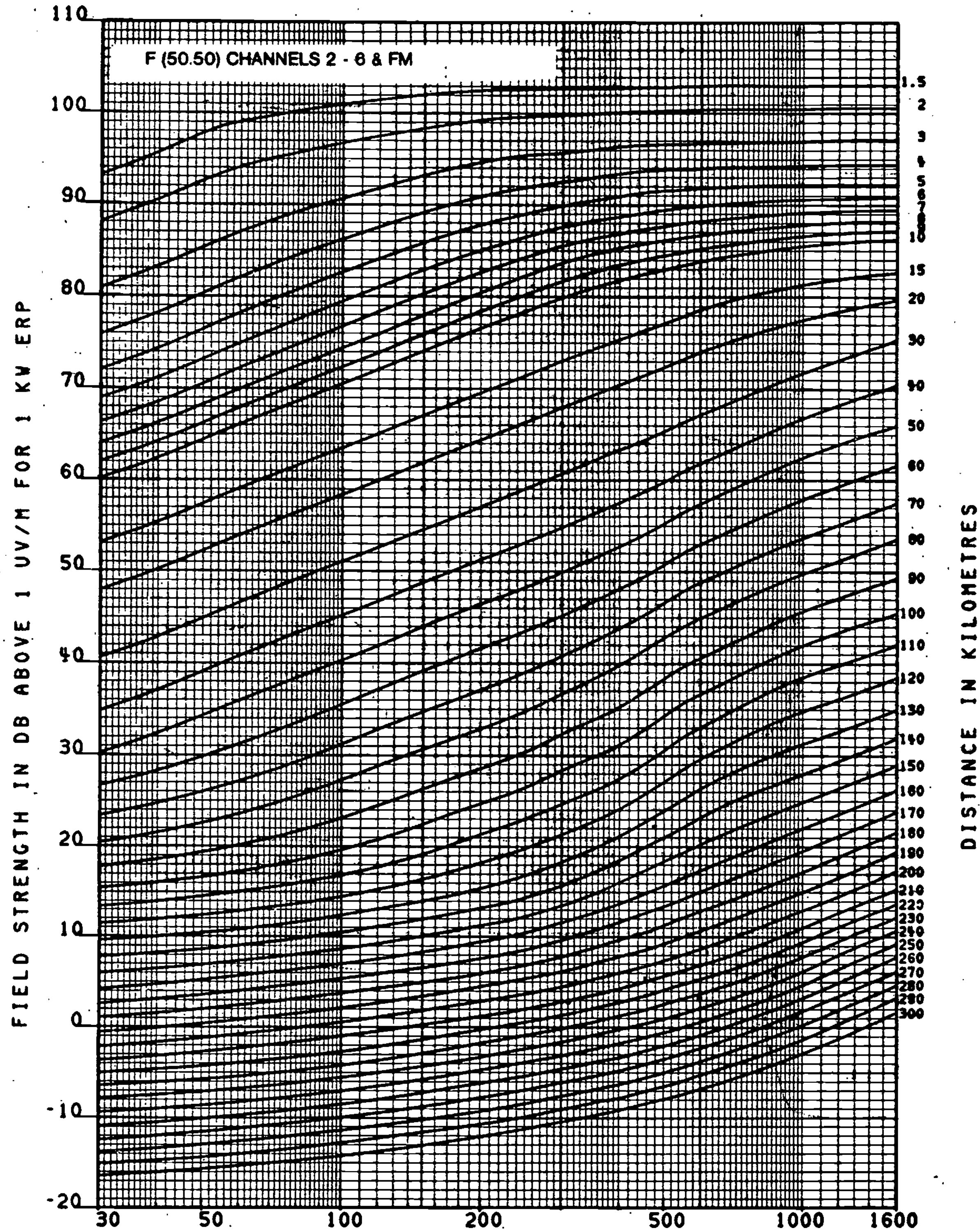
Sliding scale for use with Figures 9 & 10.



Sliding scale for use with Figures 9 & 10.

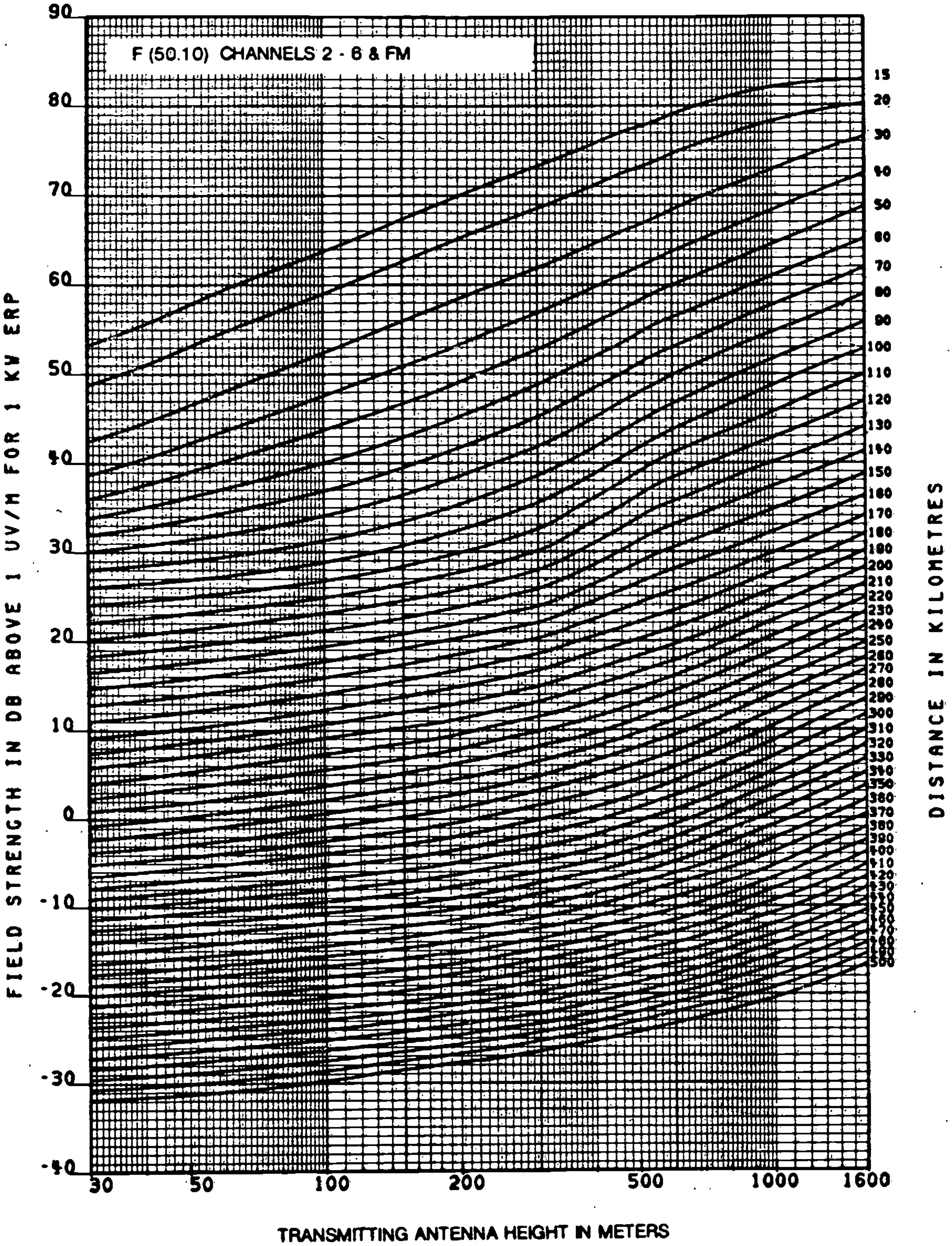


Sliding scale for use with Figures 9 & 10.



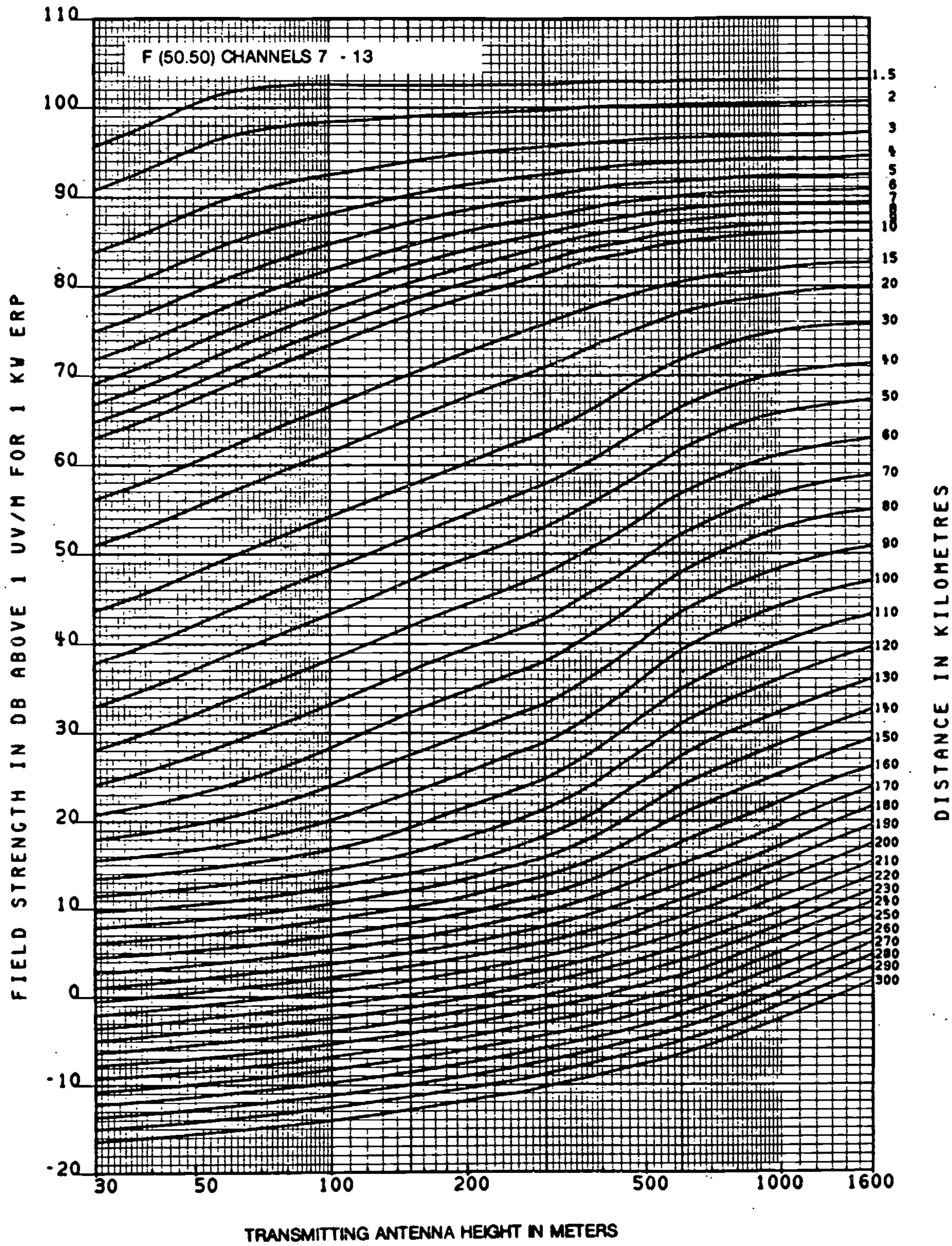
FCC 73.699 Figure 9

ESTIMATED FIELD STRENGTH EXCEEDED AT 50 PERCENT
OF THE POTENTIAL RECEIVER LOCATIONS FOR AT LEAST 50 PERCENT
OF THE TIME AT A RECEIVING ANTENNA HEIGHT OF 9 METERS



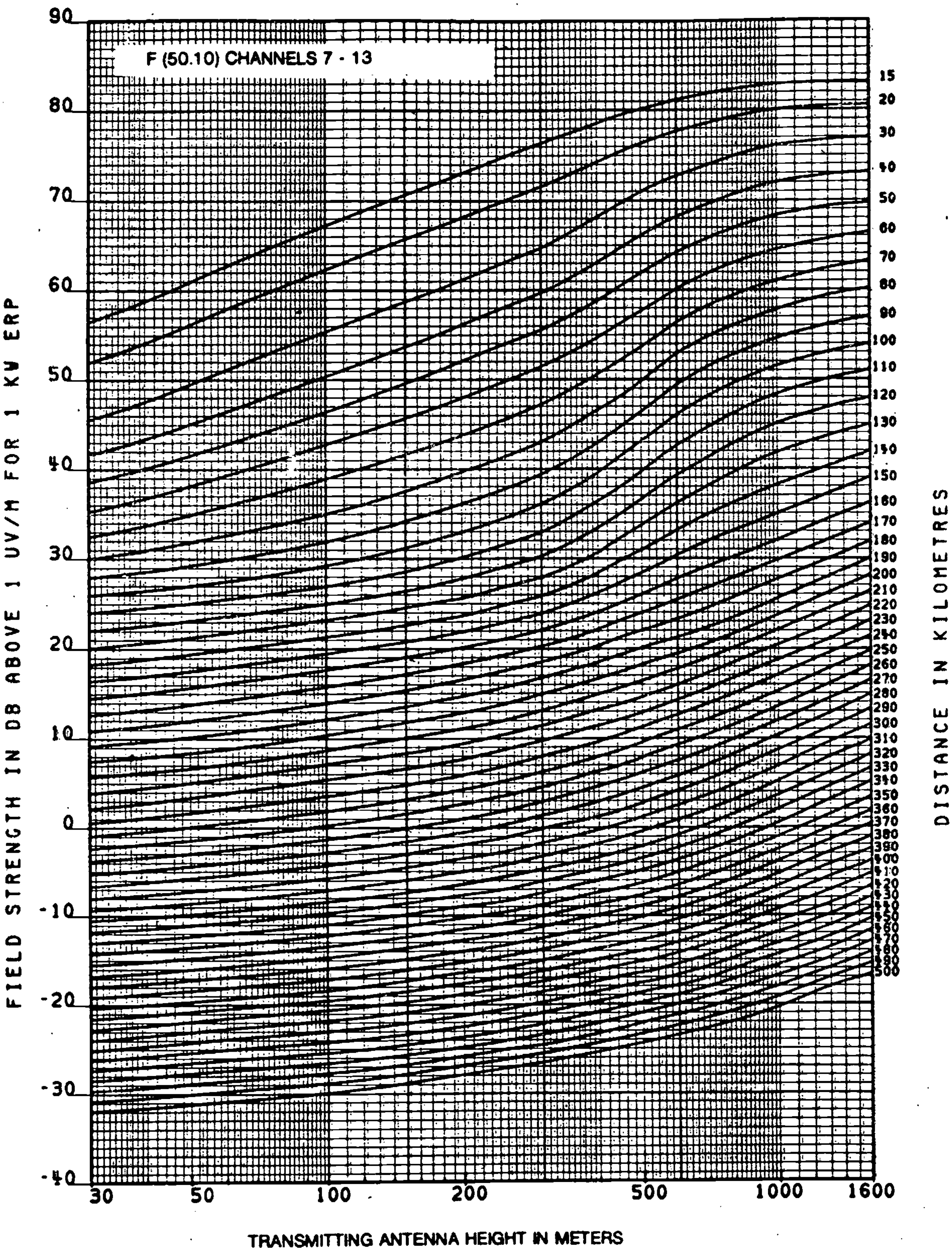
FCC 73.699 Figure 9a

ESTIMATED FIELD STRENGTH EXCEEDED AT 50 PERCENT OF THE POTENTIAL RECEIVER LOCATIONS FOR AT LEAST ~~50 PERCENT~~ 10 % OF THE TIME AT A RECEIVING ANTENNA HEIGHT OF 9 METERS



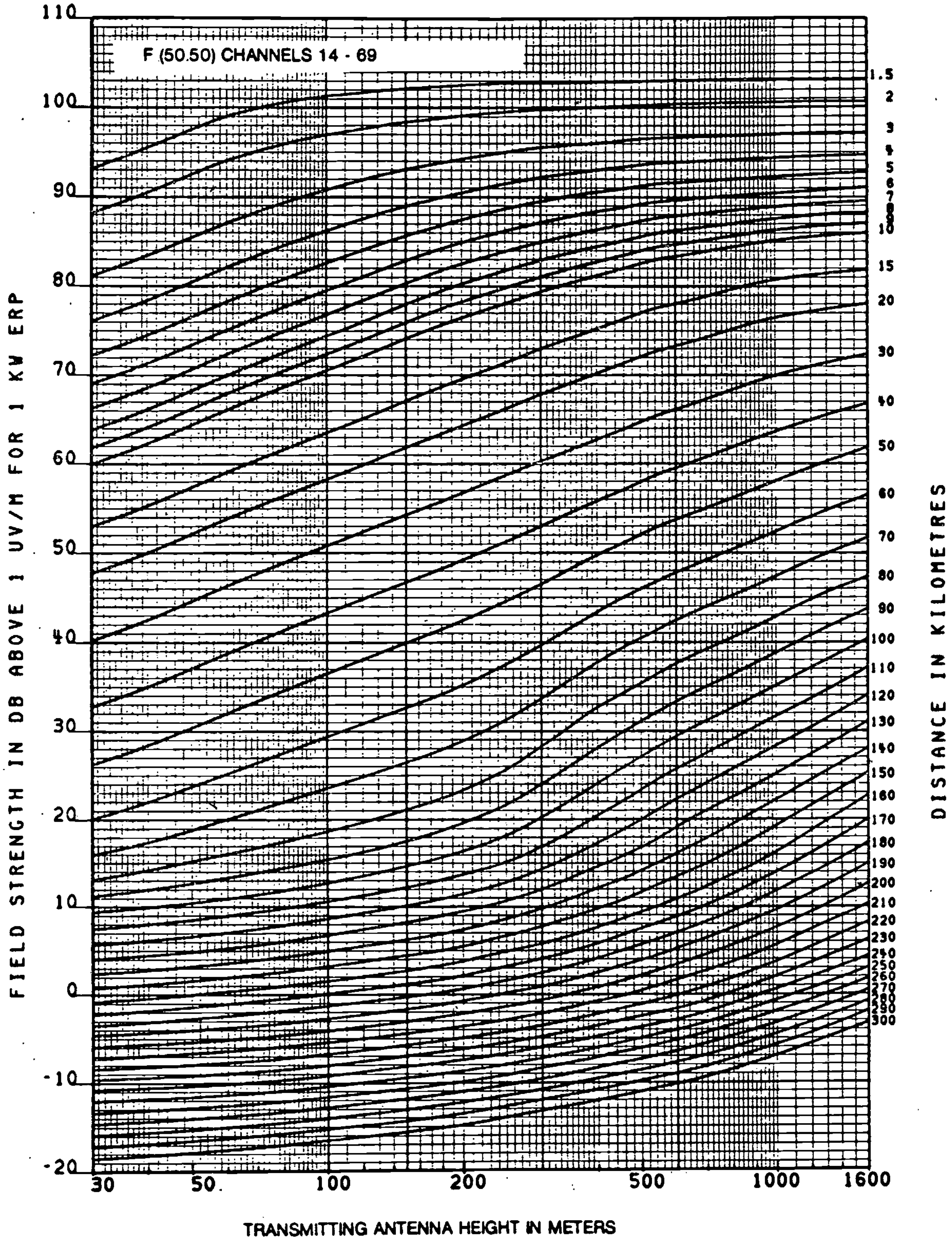
CC 73.699 Figure 10

ESTIMATED FIELD STRENGTH EXCEEDED AT 50 PERCENT
OF THE POTENTIAL RECEIVER LOCATIONS FOR AT LEAST 50 PERCENT
OF THE TIME AT A RECEIVING ANTENNA HEIGHT OF 9 METERS



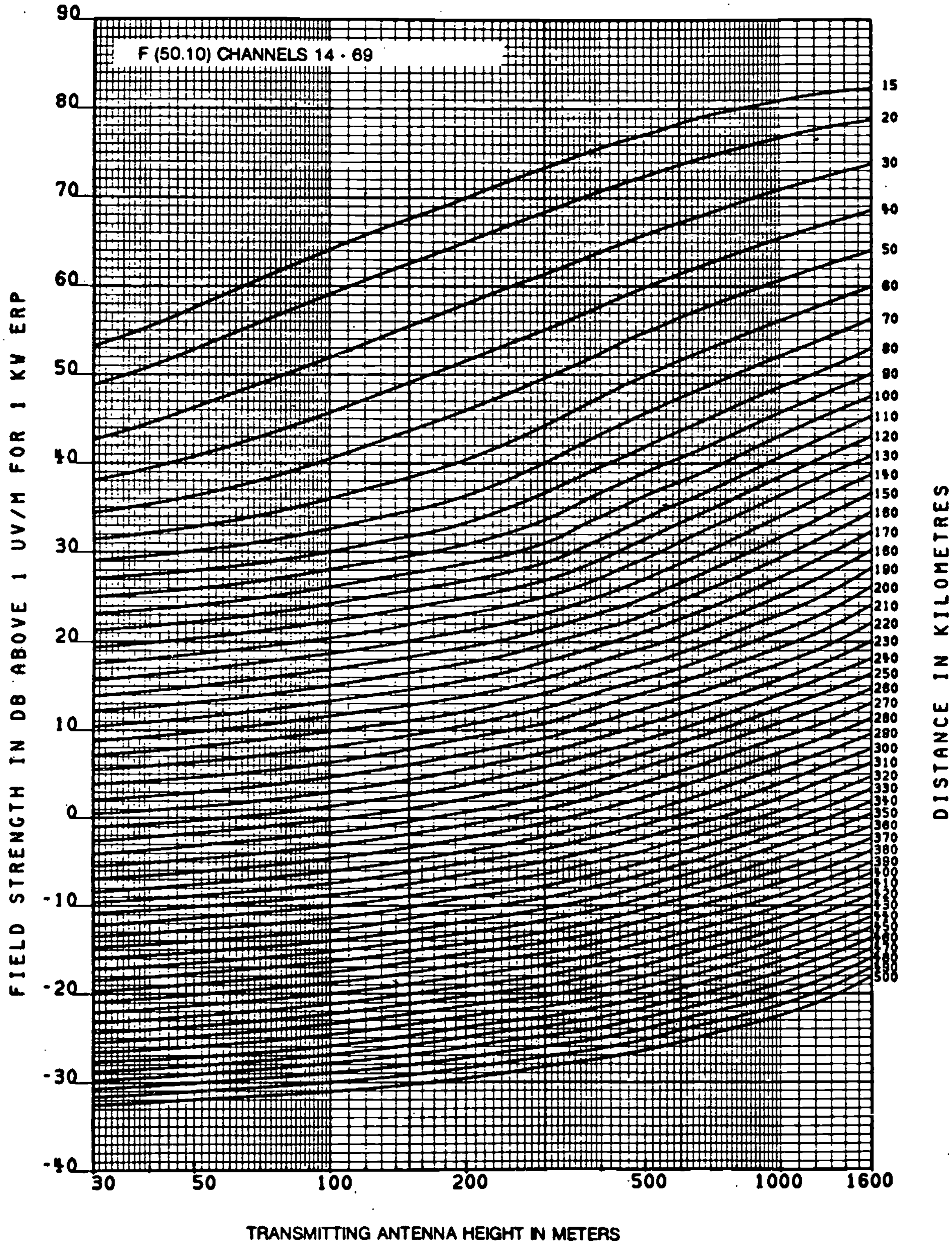
FCC 73.699 Figure 10a

ESTIMATED FIELD STRENGTH EXCEEDED AT 50 PERCENT OF THE POTENTIAL RECEIVER LOCATIONS FOR AT LEAST ~~50 PERCENT~~ 10% OF THE TIME AT A RECEIVING ANTENNA HEIGHT OF 9 METERS



FCC 73.699 Figure 10b

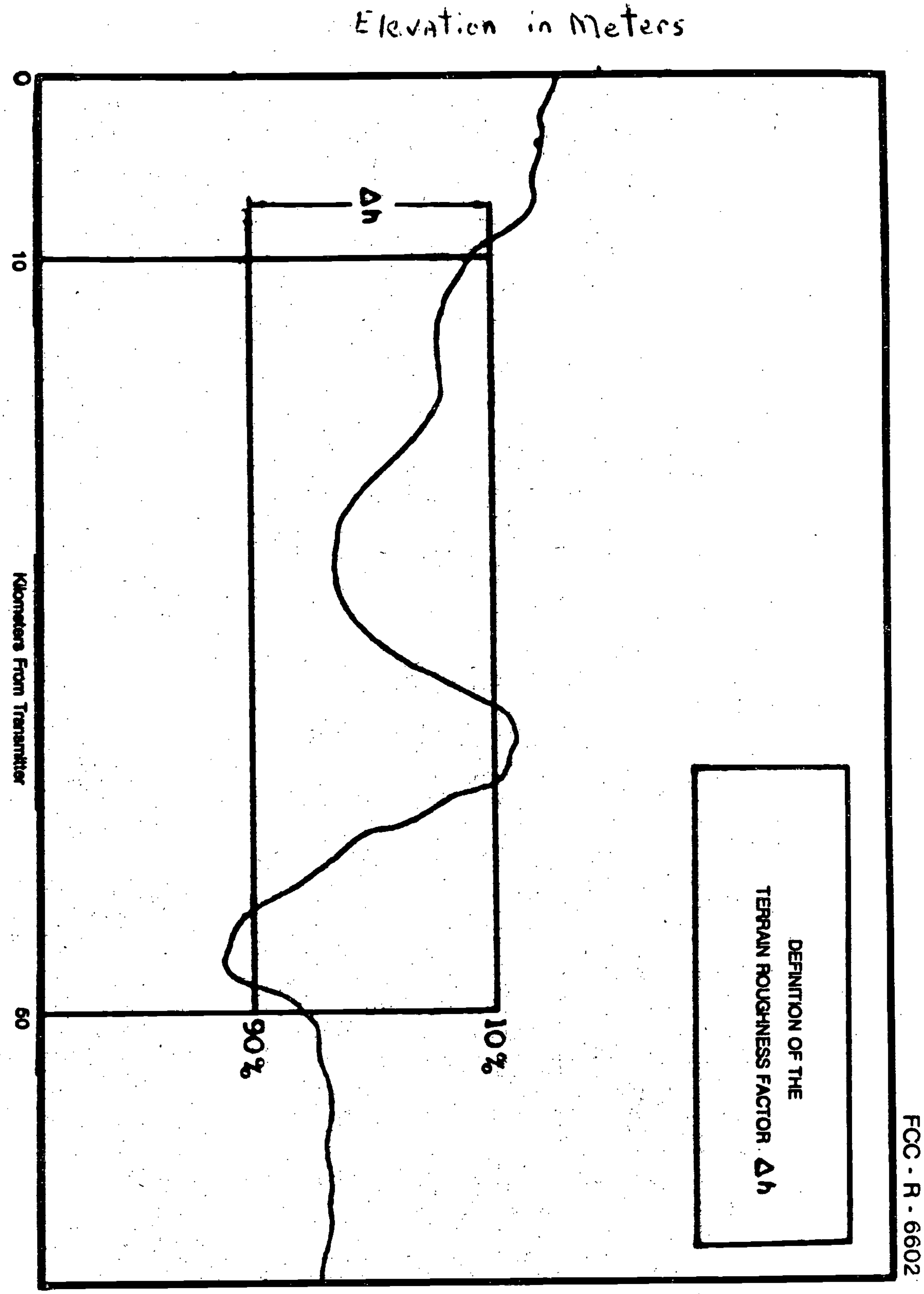
ESTIMATED FIELD STRENGTH EXCEEDED AT 50 PERCENT
OF THE POTENTIAL RECEIVER LOCATIONS FOR AT LEAST 50 PERCENT
OF THE TIME AT A RECEIVING ANTENNA HEIGHT OF 9 METERS

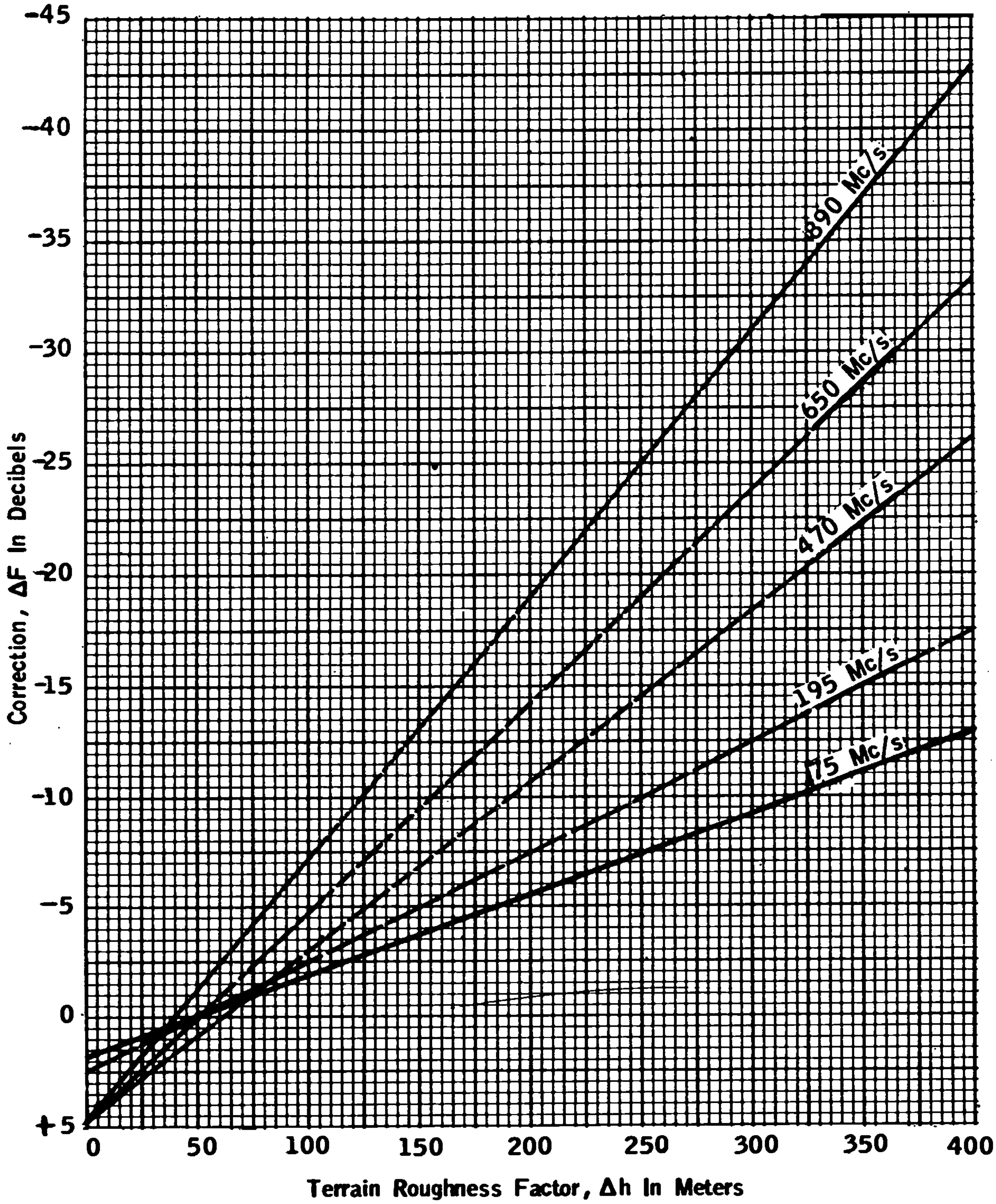


FCC 73.699 Figure 10c

ESTIMATED FIELD STRENGTH EXCEEDED AT 50 PERCENT
OF THE POTENTIAL RECEIVER LOCATIONS FOR AT LEAST ~~50 PERCENT~~ 10 %
OF THE TIME AT A RECEIVING ANTENNA HEIGHT OF 9 METERS

FCC §73.699 FIGURE 10d

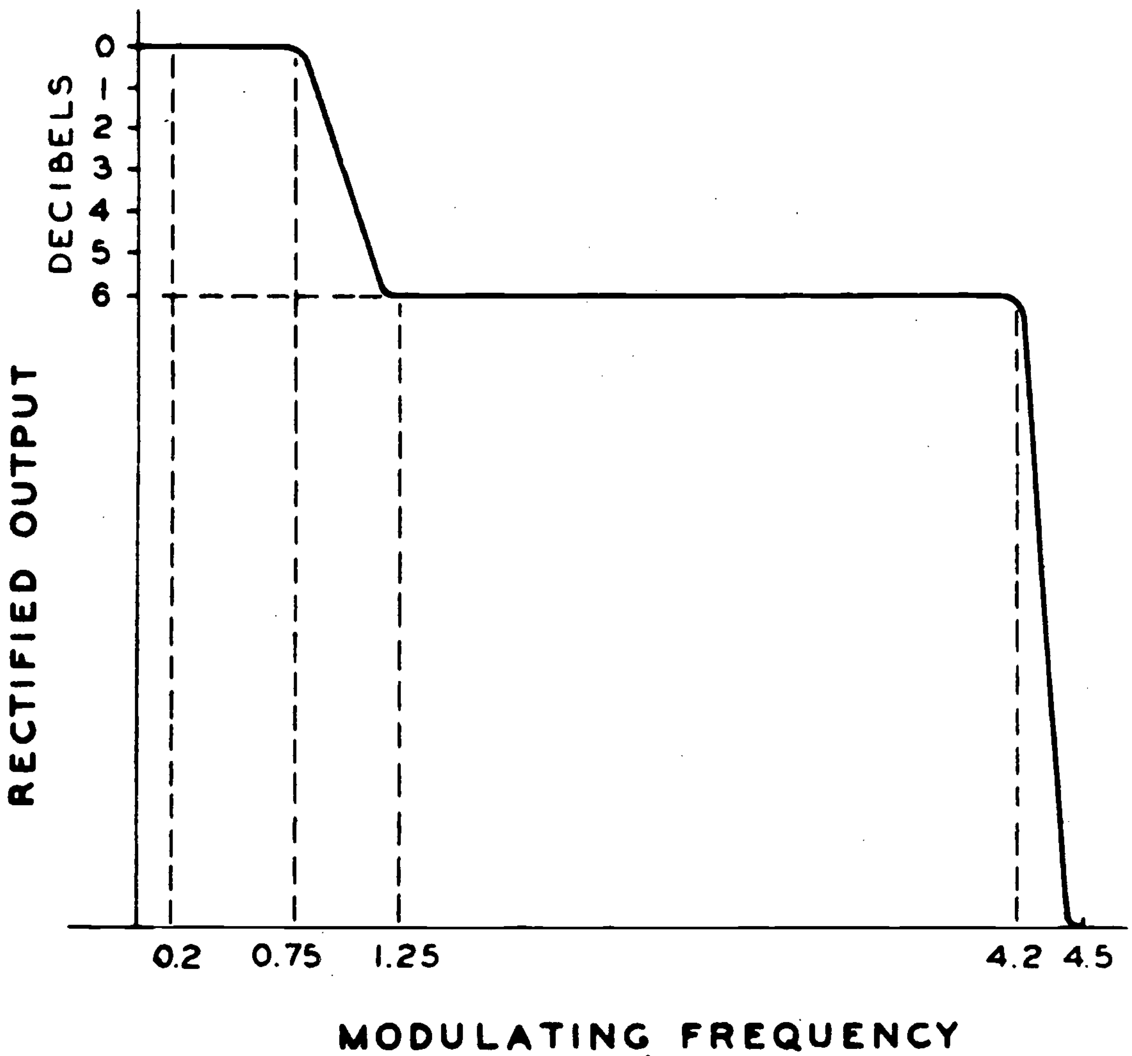




TERRAIN ROUGHNESS CORRECTION
for use with estimated F(50,50) and F(50,10) field strength curves

FCC §73.699 FIGURE 10e (Ed. 8/76)

ASSUMED IDEAL DETECTOR OUTPUT



MEGAHERTZ

FIGURE 11

Figures 13, 14 and 15 deleted and reserved

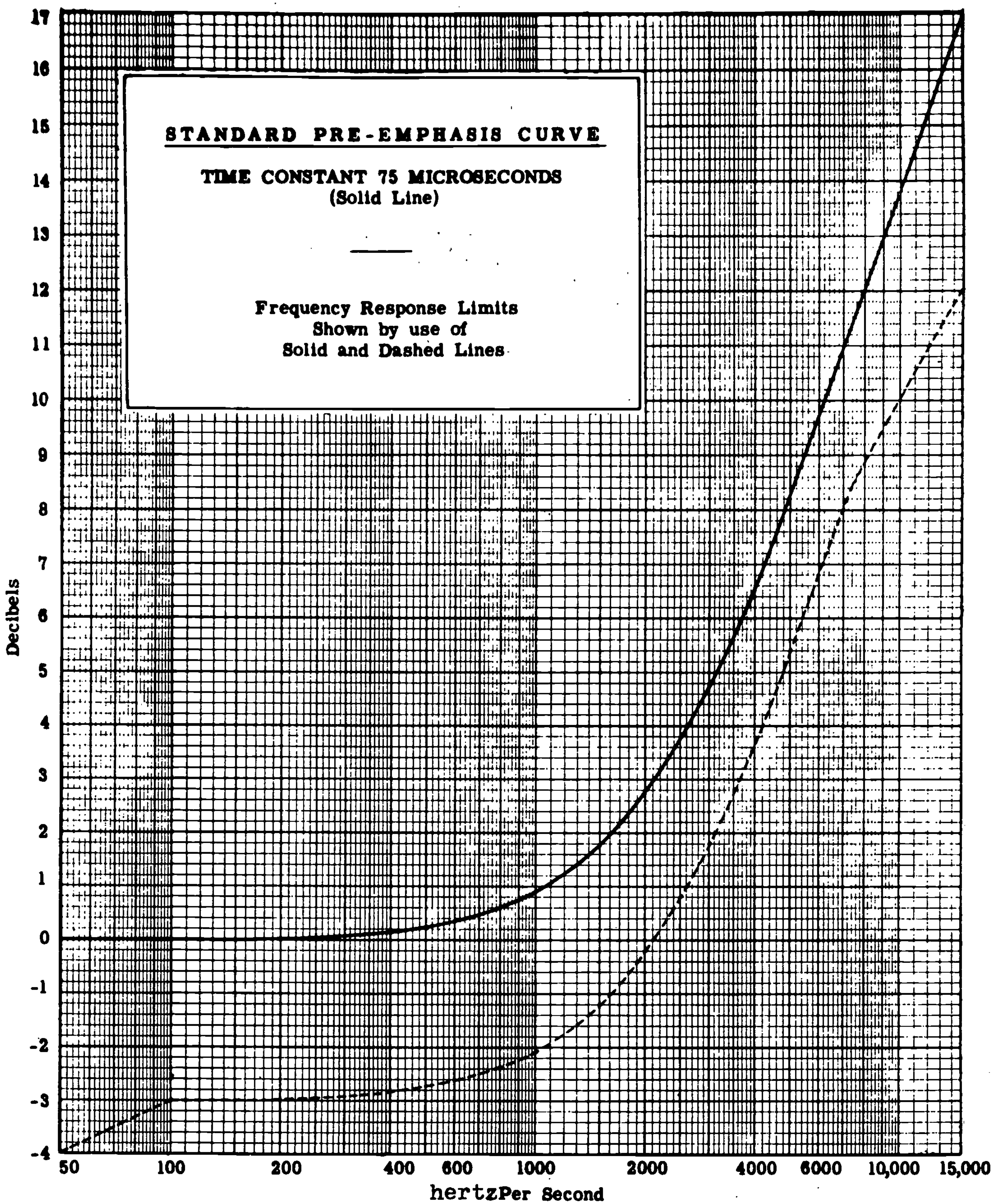
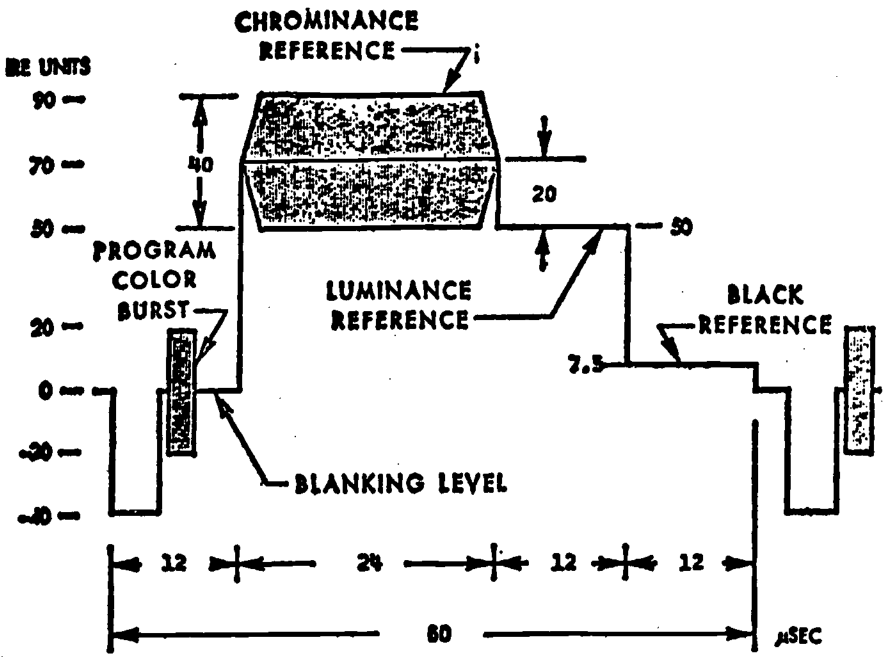


FIGURE 12

VERTICAL INTERVAL REFERENCE (VIR) SIGNAL



NOTE: The Chrominance Reference and the Program Color Burst have the same phase.

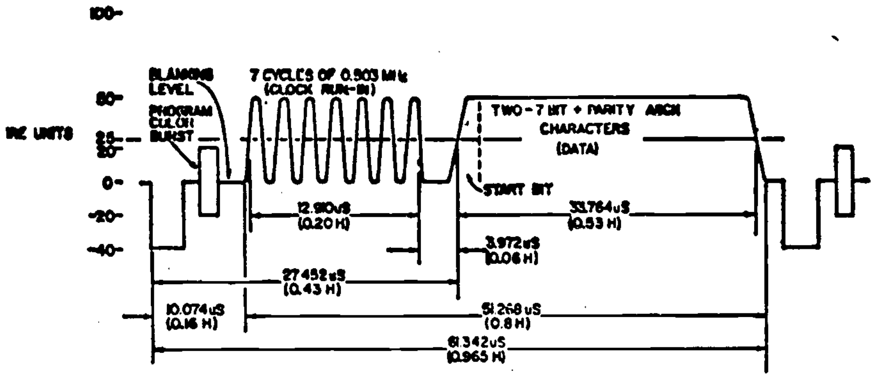


FIGURE 17 A LINE 21 FIELD 1 DATA SIGNAL FORMAT

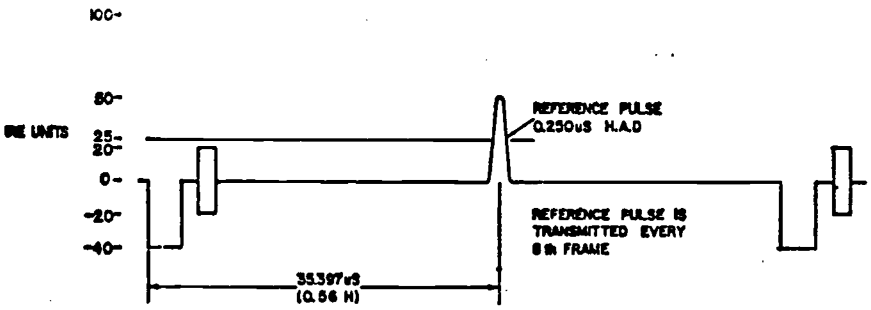


FIGURE 17 B ADAPTIVE EQUALIZER REFERENCE PULSE

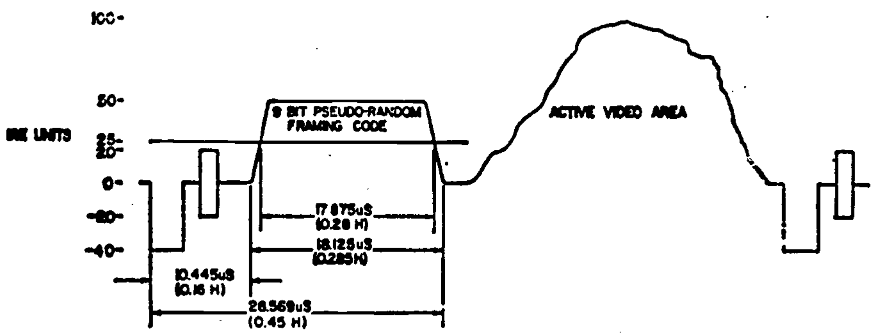


FIGURE 17 C LINE 21 FIELD TWO FRAMING CODE

HORIZONTAL DIMENSIONS NOT TO SCALE

1 Data "1" = 50ire units, data "0" = 0
2 Data pulse rise time = 2T bat rise time
3 Data time base = $32f_H$ (050349650 MHz)
4 Data bit interval = H/32 (1.986uS
5 Nagative going zero crossings of clock are coherent with data transitions
6 Data and clock run-in coherent with H

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INDEX TO

BROADCAST SERVICE BUREAU (INCORPORATED)

RULES AND REGULATIONS OF FEDERAL COMMUNICATIONS COMMISSION PARTS: 0, 1, 2, 5, 13, 17, 73, 74, 76 and 78

This index is designed to give Broadcasters a "descriptive word" quick-search index direction to the rules, regulations and standards of the Federal Communications Commission pertinent to the establishment and operation of their stations.

The entire FCC Rules are divided into 40 specifically numbered Parts. All of these Parts are broken down into numbered section references containing a decimal point, with the numbers to the left of the decimal point corresponding to the Part number of the Rules. The numbers to the right of the decimal bear the number of the section in the Part. For example §73.9 of the FCC Rules is section 9 of part 73; §73.182 is section 182 of Part 73; §17.33 is section 33 of part 17, and so on. Thus each section of the entire FCC Rules is designated by one specific number containing the Part in which it is found, and the Part section to the right of the decimal point.

Broadcast Service Bureau deals only with those ten Parts of interest to the Broadcasting Industry and is an exact duplication of these Parts by section reference. Hence, the coverage of this index, with the FCC Part designation in parentheses, is as follows:

PART	0 -	RULES RELATING TO ORGANIZATION AND PRACTICE AND PROCEDURE (Part 0)
	1 -	PRACTICE AND PROCEDURE (Part 1)
	2 -	FREQUENCY ALLOCATIONS AND RADIO TREATY MATTERS (Part 2)
	5 -	EXPERIMENTAL RADIO SERVICES (OTHER THAN BROADCAST) (Part 5)
	13 -	COMMERCIAL RADIO OPERATORS (Part 13)
	17 -	CONSTRUCTION, MARKING, AND LIGHTING OF ANTENNA STRUCTURES (Part 17)
	73AM -	STANDARD BROADCAST STATIONS (Part 73 Subpart A)
	73AMS -	STANDARD BROADCAST TECHNICAL STANDARDS (Part 73 Subpart A) (§73.181-73.190)
	73FM -	FM BROADCAST STATIONS (Part 73 Subpart B)
	73FMS -	FM TECHNICAL STANDARDS (Part 73 Subpart B) (§73.310-73.333)
	73ED -	NON-COMMERCIAL EDUCATIONAL FM BROADCAST STATIONS (Part 73 Subpart C)
	73TV -	TV BROADCAST STATIONS (Part 73 Subpart E)
	73TVS -	TV TECHNICAL STANDARDS (Part 73 Subpart E) (§73.681-73.699)
	73INT -	INTERNATIONAL BROADCAST STATIONS (Part 73 Subpart F)
	73EBS -	EMERGENCY BROADCASTING SYSTEM FOR STANDARD, FM, TV, NON-COMMERCIAL EDUCATIONAL FM, AND INTERNATIONAL BROADCAST STATIONS (Part 73 Subpart G)
	74 -	EXPERIMENTAL AUXILIARY AND SPECIAL BROADCAST SERVICES (Part 74)
	76 -	CABLE TELEVISION SERVICE (Part 76)
	78 -	CABLE TELEVISION RELAY SERVICE (Part 78)

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