FCC 75-636

BEFORE THE

FEDERAL COMMUNICATIONS COMMISSION

WASHINGTON, D.C. 20554

In the Matter of	
AMENDMENT OF SECTIONS 73.333 AND 73.699, FIELD STRENGTH CURVES FOR FM AND TV BROADCAST STATIONS	Docket No. 16004
AMENDMENT OF PART 73 OF THE RULES REGARDING FIELD STRENGTH MEASUREMENTS FOR FM AND TV BROADCAST STATIONS	Docket No. 18052

REPORT AND ORDER

(Proceeding Terminated)

(Adopted May 29, 1975; Released June 27, 1975)

BY THE COMMISSION: COMMISSIONERS HOOKS AND WASHBURN ABSENT.

1. In the above entitled proceeding the Commission proposed to amend Part 73 of its Rules and Regulations to effect the following changes:

(1) Adoption of revised F(50.50) field strength curves for the television broadcast service (Section 73.699) and the FM broadcast service (Section 73.333), the adoption of new F(50.10) field strength curves for both services (however, with the exclusion of a "roughness factor" originally proposed in Docket 16004 for modification of the values predicted by the curves where the terrain traversed by the signal is of other than average roughness).[1]

(2) Revision of the procedure specified in Section 73.686 for making field strength measurements in the television broadcast service, and a broader definition of the situations in which the results of such measurements will be considered as of probative value. Also contemplated is the incorporation of similar provisions for field strength measurements in the rules governing the FM broadcast service.

(3) Modification of the F(50.50) field strength values specified in § 73.683 for Grade B service.

(4) Possible changes in the rules to provide for the depiction of areas within the television station's Grade B contour subject to interstation interference.

2. Prior to the consolidation of Dockets 16004 and 18052 by a Further Notice of Proposed Rule Making, adopted April 14, 1971 (FCC 71-422), 36 Fed. Reg. 8699 (1971), comments were received in the separate proceedings concerning the adoption of field strength curves

[1] The revised field strength curves are those contained in Report No. R-6602 of the Research Division of the Office of Chief Engineer of the FCC, issued on September 11, 1966. This Report, which fully describes the development of the curves, and the development and use of the "roughness factor" is a part of the record of this proceeding.

(Docket 16004) and the revision of the rules governing the performance of field strength measurements and their usage (Docket 18052). The Further Notice invited comments on the proposed adoption of amended field strength values defining Grade B service, as a part of a "package" which would include rule amendments to implement the proposals advanced in the aforementioned Dockets, excluding, however, the "roughness factor" offered for adoption in Docket 16004. While disclaiming any requirement of the FCC for such information, the Further Notice sought comments on the usefulness of interference predictions for other purposes, and the technical standards which should be employed if depictions of interference areas within Grade B contours were required.

3. As extended, the deadline for filing comments was set as July 28, 1971, and for filing reply comments as December 29, 1971. In arriving at a decision in this proceeding, we have had before us and have given full consideration to the comments filed in each of the separate Dockets, and those filed in response to the Further Notice, as listed in Appendix A hereto.

4. As many of the parties have emphasized, there are two major and interrelated questions to be considered in this proceeding:

(1) The validity of these proposals purely from an engineering viewpoint.

(2) The effect of the adoption of the proposals, separately or in combination, on competitive relationships between television broadcast stations and on their relationship to other media (CATV) and other services (e.g., land mobile).

5. An additional consideration is the allegation that an undue burden, economic and otherwise, would be imposed on television stations required to comply with the new standards, regardless of other effects which may be involved.

6. Thus, largely in behalf of broadcast interests, it is argued that the revised F(50,50) field strength curves for VHF are no more accurate, and may be less accurate than the curves presently contained in the rules. A. Earl Cullum and AMST have provided detailed analyses of what they consider to be the faulty or incomplete use of available measurements in the preparation of the revised curves. Opposition to the adoption of the revised F(50,50) curves for UHF is less pronounced. That these curves will permit a better approximation of UHF field strengths than the low band VHF curves presently employed for this purpose is recognized, but it is strongly urged that if the UHF curves are adopted, they should be employed in individual cases with corrections for terrain roughness. However, the method for making these corrections which we had proposed to adopt in Docket 16004 (but later rejected in the Further Notice) is held to be defective in several respects. Cullum suggests that the extreme variability of the UHF signal defies any attempt to depict service provided with such signals by an area concept, and we should give consideration to devising some other means for predicting UHF service.

7. In the above connection, the Department of Commerce urges that, in lieu of revising its field strength curves or amending its rules regarding field strength measurements, the Commission give consideration to computer methods developed by the Department by which

realistic estimates of the quality and extent of service provided by each station to various areas can be developed with suitable inputs to the computer of station frequency, effective radiated power, antenna height, and data on pertinent terrain irregularities and meteorological conditions. A technical report of ESSA, fully describing the method, is appended to the Department's comment.

8. As to the engineering merits of the proposed revision of Grade B values, it is held that the Commission has provided insufficient technical support to justify the modification of certain of the parameters used in the Grade B computations: that certain computations (i.e., the method of combining the effects of external and receiver noise) are faulty, and that such information as is available to the parties from other sources indicates the Commission has assumed unrealistically low receiver noise figures and unrealistically high values of antenna gain. The inclusion of the effects of external noise in the computation of the Grade B contour value for low band VHF stations creates a situation where such stations produce Grade B signals at lesser distances than do high band VHF stations of comparable power and antenna height. It is contended that this result is contrary to the findings of TASO, and to common experience.

9. Out to distances which include the normal service range of television broadcast stations, the revised F(50,50) curves for VHF frequencies generally show higher fields from shorter antennas, and lower fields from higher antennas than do the present curves, the crossover point occurring at antenna heights between 500 and 1,000 feet. The differences are not major, however, except for extremely low or extremely high antennas. It is, of course, with the practical effect of adopting these curves on stations using taller than average antennas that most of the concern is expressed. However, it is not argued that the adoption of the VHF curves would seriously affect the viability of television stations operating in this band. Rather, it is offered that the differences between the present and the proposed VHF curves are not sufficiently great as to justify adoption of the new curves, absent convincing engineering evidence that the new curves represent a substantial improvement over the old, but the fact that differences do exist is sufficient to result in substantial expense and hardship to VHF station licensees should the new curves be adopted. Although the Commission has stated that if the proposed rules were adopted, it would require the filing of revised Grade A and B contours only in instances where individual stations are engaged in proceedings in which the location of these contours is a pertinent consideration, the many Commission procedures whose resolution requires such consideration (particularly in CATV matters) will, in a relatively brief period, involve many, if not all stations.

10. The situation with respect to UHF stations is considerably different. Grade A and B contours for these stations, as predicted with the proposed curves, in all cases will fall at distances from their transmitters which are very substantially less than those determined by the present curves. While most of the parties who have commented on this question recognize that the new curves produce a result which is closer to reality than do the present low band VHF curves (some UHF licensees do not concede this to be the case), the adverse effects of em-

ploying these curves is held by UHF stations and their organizations to be little short of disastrous. The saleability of UHF stations to advertisers will be hampered—it is claimed that advertisers look first at the size of the areas included within its Grade A and B contours of a station in assessing its suitability for reaching the audience desired by the advertiser. More importantly, the UHF station's position vis-a-vis CATV systems in its area with respect to carriage and nonduplication, which may have been established only after prolonged and expensive litigation, will be disrupted seriously. These effects will ensue, regardless of whether or not revised Grade B values are adopted in connection with the revised curves, since the new Grade B contour for each station will still fall short of its old location. Moreover, the Commission has offered nothing which would compensate, even partially, for the foreshortening of the Grade A contour which would occur. It is urged that those UHF licensees who, heeding the prompting of the Commission, have invested large sums in the improvement of their transmitting plants, deserve something better than an untoward result dictated solely by a blind adherence to engineering considerations.[2] Several UHF licensees and ACTS suggest that if the adoption of the new curves is decided upon, we "grandfather" existing CATV carriage and non-duplication rights on the basis of the present predicted Grade A and B contours. While some licensees would be satisfied with such "grandfathering" with respect to existing CATV systems, others hold it is necessary to provide such protection also against systems established in the future.

11. In addition to the deficiencies which Cullum finds in the new curves, even when employed for average terrain and meteorological conditions, he maintains we are remiss in not making provision, at this time, for the special propagation conditions existing in southern California coastal areas and in Puerto Rico, which, he urges, are even more abnormal than those in the Gulf area, whose existence the Commission has recognized in its rules by the specification of larger co-channel station separations in this area than are required in other sections of the country.

12. In contrast to the rather general opposition to the adoption of the new curves expressed by broadcasting interests are the positions of Motorola, Inc., GE, and EIA, which parties, in the interest of "improved spectrum management," which in the context presented appears a euphemism for increased opportunities for land mobile sharing of TV channels, favor adoption of the curves. Motorola would employ these curves with roughness factor corrections when it will "improve spectrum usage." GE and EIA take exception to certain of the parameters which were utilized in the derivation of the new Grade B values. The figures for receiver noise, antenna gain, and transmission line loss are claimed to be too optimistic and the external noise factor included in the low VHF band computation is subject

[2] Certain of the entities which, in general, favor adoption of the UHF curves believe they should be utilized only with appropriate corrections for terrain roughness. If such corrections were employed UHF stations located in rugged terrain (e.g., the Scranton/Wilkes Barre area or the Pacific Northwest) would sustain a shrinkage of their Grade A and B contours even more drastic than that resulting from the use of the new curves without such corrections. On the other hand, an engineering showing submitted in behalf of UHF station WTOE, Pensacola, Florida, demonstrates that, in smooth terrain, the application of these corrections will appreciably increase the radius of the Grade B contour.

to adverse criticism, EIA, in particular, suggesting it should be substantially increased. However, NCTA and Jerrold Corp., which adopts NCTA's comments, fully support all of the proposals made by the Commission in this proceeding.

13. A number of the comments suggest that we adopt the proposed measurement procedure, but defer adoption of the new curves for a period of a year or more with the thought that such action will result in the making of measurements whose results can be used to settle the controversy as to the accuracy of the new curves.[3]

14. In general, those comments which critically examine the measurement proposal recognize it as offering a marked improvement over the procedure specified in the rules, and would accept it as a substitute for that procedure for the purposes which the rules now permit measurements to be made. However, considerable opposition is offered to our proposal to permit determinations of the extent of service to be made by measurements, with the results of such measurements taking precedence over determinations based on the propagation curves. Several parties hold that, for this purpose, measurements will yield results no more accurate than predictions made with the use of the curves. Pertinent to the suggestion, previously mentioned, that the adoption of rules permitting the expanded use of measurements will result in the accumulation of data by which the accuracy of the new curves may be verified, or their accuracy improved, Cullum holds that any rule which permits, but does not require the use of measurements in lieu of curves will not result in the accumulation of reliable and unbiased data for this purpose, since any measurements made in individual cases will be submitted to the Commission only when the results support the position being advanced by the party undertaking the measurements.

15. While the proposal that we provide in our rules the tools for predicting the extent of interstation interference was originally advanced to the Commission in promotion of UHF television (apparently with the thought that VHF stations, in general, can be shown to be subject to more such interference than UHF stations, and, in consequence of this fact, on a basis of effective service, the disparity between UHF and VHF coverage would be less pronounced), no UHF station or organization supports the adoption of such rules in the instant proceeding. Rather, the only supporters of the proposal are Motorola and EIA, who view it as one more instrument which could be used to further the sharing of TV channels by the land mobile services, and NCTA, which, as previously noted, espouses all of the proposals advanced in this proceeding.

16. Neil Smith, who, in behalf of Kear and Kennedy, participated in the FCC/industry committee whose efforts resulted in the production of the curves, urges their adoption, as well as the measurement proposal, which was originally instituted as a result of a petition filed by Kear and Kennedy. However, Mr. Smith submits a report of a test which he conducted in an attempt to correlate TV picture quality with

[3] These comments, in most instances, submitted in behalf of VHF stations operating in the high band, also urge that the revised Grade B contour values be adopted at this time.

the strength of received signals, which, he asserts, offers no support for a reduction in field strength values necessary for Grade B service. If, however, the Commission considers that the adoption of such lower values is a necessary part of a package which includes the revised curves and measurement rules, he believes that the virtues of these latter proposals far outweigh the deficiencies of the former.

DECISION

17. Despite the considerable controversy which has swept around the technical merits of the proposals put forward in this proceeding, the task of arriving at a decision in this matter would be immeasurably simplified if such a decision could be made to hinge entirely on an evaluation of the engineering virtues of these proposals. However, in a regulatory system engineering rules are administrative tools, and a decision, at any time, to substitute new tools for old, even though they may be demonstrated to be keener and more precise than the ones presently available, inevitably must take into consideration the practical consequences of such action, both with respect to the efficiency, expeditiousness and finality of regulatory processes, and the impact of the rule changes on those whose activities are under the jurisdiction of the regulatory body.

18. That this is true is recognized either explicitly or implicitly by most of the parties who have commented in this proceeding. Generally, those who favor adoption of the field strength curves and the Grade B contour proposals, separately or together, or the proposal to permit more extensive use of measurements, either ignore or minimize the engineering deficiencies which others profess to see in these proposals, and urge their adoption because such action would facilitate the achievement of ends which the individual parties consider desirable.

19. Parties who concern themselves primarily with the engineering aspects of these matters are not insensitive to the practical problems which might eventuate should the Commission adopt the particular "engineering" proposal which a party recommends, but urge that "non-engineering" solutions be found, as necessary, for such problems.

20. The "package" approach which we advanced in the consolidated docket has gained little support—the majority of the parties have reduced the proposal to its separate elements and picked and chosen among them. Consequently, we have abandoned this approach, and will consider each of the major proposals—propagation curves, Grade B redefinition, and measurements—on its individual merits.

21. We shall first discuss the technical virtues and deficiencies of our proposals in these dockets. If we decide that the engineering merits of these proposals have been sufficiently established to justify their adoption solely on this basis, we will then examine the effects of such action on the Commission's regulatory functions, and on the relationships among stations and between television and other services, to ascertain whether dislocations or disruptions of existing procedures and relationships will be of such magnitude that a more advanced engineering approach should be rejected in the name of administrative

efficiency, or because the adverse effects on the regulated industry are determined to be unduly great.

The proposed propagation curves

22. The new propagation curves were developed by the Working Group appointed by an engineering conference called by the Commission. All the methods and procedures employed in the preparation of the curves were approved by the Working Group, which was comprised of engineering representatives from industry, other government agencies, and of Commission engineers.

23. As a data base, the Group had available the results of many recordings of the signals of FM and TV stations made at fixed sites, principally by the FCC, Central Radio Propagation Laboratories,[4] and the National Bureau of Standards, gathered during a period between 1943 and 1954, and of mobile surveys made between 1955 and 1962, the great majority of which were conducted by A. D. Ring and Associates, A. Earl Cullum, Jr. and Associates, and by the FCC.

24. The two last mentioned firms, of course, are the parties who have mounted the principal attack on the adequacy of the proposed curves, with the claim that, insofar as the VHF curves are concerned, the measurement data is more accurately reflected in the curves now contained in our rules than in the proposed curves.[5] Generally, others who oppose the adoption of the curves primarily because of the practical effects of their employment, rely on the showings of these two parties to support a claim that the curves are, in any case, technically deficient.

25. Much of the controversy, it appears, revolves around the weight to be given certain measurement data, and the nature and magnitude of corrections to be applied to this data. Ring believes that a major source of error lies in the application of a linear height-gain factor by the Commission in lieu of a spherical earth factor in the development of the new curves; Cullum agrees that this may be the case.

26. The Commission has thoroughly reviewed the procedures and data employed by the Committee in the preparation of the curves. It has also studied the extensive technical filings made by Cullum and Ring in the current and earlier phases of this proceeding, in an attempt to ascertain the reasons their conclusions in this matter are at variance with the Commission's.

27. Insofar as the Commission can determine, neither party in his analysis, made adequate use of long term measurement data at fixed locations. There are a number of such data points at pertinent distances, which the Commission feels must be considered in any critique of the proposed curves. Cullum apparently ignored this data; Ring used it, but failed to reduce the measured fields in accordance with the "preferred location bias" which the Ad Hoc Committee agreed was reasonably applicable.

28. Cullum places particular weight on mobile measurements on WFAA, which were made in June, at which time propagated fields may be expected to be considerably higher than average, while reject-

[4] Now the Institute for Telecommunications Sciences, Office of Telecommunications, U.S. Department of Commerce.

[5] The Ring engineering presentations were submitted in support of AMST pleadings.

ing measurements made on Channels 2 and 7 in New York City in the FCC UHF experiment. We consider the New York City data as among the most reliable and accurate of the available mobile measurements.

29. Ring recognized that atypically high fields exist in mid-California at ultra high frequencies because of unusual terrain conditions, but apparently failed to take into account that the conditions responsible for the abnormal signal levels at UHF are operative in the high VHF band. Thus, measured unweighted data obtained in this area cannot be accepted for verification of propagation curves prepared for typical terrain.

30. In any derivation of propagation curves, it is necessary to provide smooth trends with distance, transmitting antenna height, time fading and frequency. If a technique is employed which fails to take into account all of these parameters there will be no satisfactory trends for the parameters not taken into consideration. For instance, 10% measurement data would have led to propagation curves with lower values of field strength than the 50% best fit curves of Cullum—a result which is manifestly insupportable.

31. In any undertaking such as this, which inevitably involves, in many areas, the exercise of a considerable degree of expert judgment, it is possible for experts to disagree with particular aspects of the procedure employed. It was to develop a consensus on the important points at issue that the Ad Hoc Committee was formed. It performed its task in a careful and competent manner. That the results, considered purely from a technical viewpoint, have not received universal acceptance, is unfortunate, but not fatal. As indicated above, we believe that the criticisms leveled at the curves are subject to logical rebuttal, and that the determinations of the Ad Hoc Committee must prevail over the opinions of individual engineers, even highly competent engineers such as Ring and Cullum, to whom the Committee is greatly in debt for much of the raw mobile measurement data which were used in the preparation of the curves.

32. The Commission is firmly of the opinion that the proposed curves represent a substantial improvement in prediction accuracy, and their adoption, as an improved allocations tool, is fully justified.

33. We have given full attention to the comments of those parties who maintain that regardless of the technical merits or deficiencies of the proposed curves, they should not be adopted because their employment will result in a redetermination of the locations of principal city, Grade A and Grade B contours, and may lead to a review of determinations and decisions arrived at in reliance on previously established locations of these contours. We stated in the Further Notice, and we now reiterate that we have no intention of allowing this to happen, and such actions will be "grandfathered".

34. Contours of UHF stations, when predicted with the use of the new propagation curves of course will be reduced substantially in average radii. However, it appears that this circumstance would have an adverse impact on a UHF station's ability to operate viably only insofar as contour locations remain a major factor in determining its rights for carriage and network program nonduplication on CATV systems. The Commission is presently in the process of eliminating the

use of contours for this purpose. Thus, in a *First Report and Order* in Docket 19995, adopted April 3, 1975 (FCC 75–413) the cable rules were amended to prescribe zones of fixed radii, in lieu of contours, for determining the areas over which television stations are entitled to protection from network program duplication. In a *Notice of Proposed Rule Making* in Docket 20496, adopted May 29, 1975 (FCC 75–635), we look toward the substitution of a zone of fixed radius for the Grade B contour in the cable rules governing signal carriage. Pending the conclusion of this proceeding, carriage requirements will continue to be determined by the procedures heretofore applying, including the determination of contours by use of the old curves. In the light of the above, we believe that the adverse effects on UHF stations in their cable relationships foreseen, should the new curves be adopted, would not occur.

35. In other situations where the locations of the service contours of TV stations are a pertinent consideration we do not believe that the setting of UHF stations' contours on a more realistic basis will result in substantially adverse effects on their economic health or general status. Time buyers of the present day possess sufficient sophistication that, in decisions regarding their television advertising efforts, only secondary importance is placed on data showing the extent of each station's contours; they rely primarily on audience survey data made available by ARB and other similar services. Determinations of contour locations by means of the new curves obviously, in many cases, will make easier the task of the station licensee in meeting the requirements of the rules in multiple ownership cases, whether TV/TV or TV/CATV cross ownership is contemplated. In summary, we are of the view that the adoption of the new curves will not result in significant economic harm to existing television broadcast stations. Accordingly, we will amend our rules to incorporate the new curves therein.

36. We have decided also to adopt the terrain roughness factor, originally proposed in Docket 16004 for use in the adjustment of results obtained by application of the propagation curves. While, as pointed out in the comments, the proposed factor does not take into account all terrain characteristics which may affect signal propagation over a particular path, such as terrain tilt or sequence, or the attenuation caused by foliage, it does offer a practical means for making, in particular cases, gross first order corrections of predictions based on the use of propagation curves which assume terrain of average roughness, thus improving the accuracy of predicted values—especially at the higher television frequencies. In the immediate absence of a more sophisticated, and not unduly burdensome method of assessing the effects of a variety of terrain anomalies, we believe that the procedure proposed is a worthwhile addition to our allocation tools.

37. Some parties appeared to believe that an undue burden and expense would be imposed on television station licensees by a requirement that they prepare revised contour maps based on the new curves. We fail to see why this should be the case. While the effort required is more than nominal, it is certainly not one of major proportions. Nevertheless, to mitigate the impact, such as it is, of this requirement, we had previously suggested that the submission of revised contour maps

would be expected only of licensees involved in cases in which the location of their station's contours is a matter of probative importance. We have given further thought to this matter, however, and now are of the opinion that the indefinite existence of a situation where the contours of some stations are based on the old curves, and of others on the new, is undesirable. We believe that the present usefulness of contour information can best be preserved, and confusion minimized, only if all television broadcast stations are required to file updated contour maps with the Commission within a reasonable period of time. We have decided, therefore, to require each station to submit to the Commission revised maps at the time it applies for its first renewal of license subsequent to the effective date of these rule amendments.

38. We will not impose a similar requirement on the licensees of FM broadcast stations. There appears to be no pressing need that revised contours for all of these stations be made available in the immediate future. However, in any Commission proceeding in which a pertinent consideration is the location of the contours of specific FM stations, the parties concerned are expected, of course, to submit showings involving the contours and coverage of these stations, as determined in accordance with the amended rules.

39. In his original comments in Docket 16004, and as reiterated in his filings in this consolidated proceeding Cullum maintains that the Commission should be faulted in not making some provision for the now demonstrated fact that meterological conditions in Southern California and Puerto Rico favor long distance propagation of interfering signals to an extent even greater than has long been known to exist along the Gulf Coast. This condition in the latter area was recognized in the present television allocation by the specification of greater than standard co-channel separations between stations. He suggests that a similar procedure be adopted for Southern California and for Puerto Rico.

40. Had the abnormal propagation conditions existing in Puerto Rico and Southern California been evident prior to the promulgation of the Sixth Report and Order of April, 1952, which adopted the existing allocation rules, consideration might more feasibly have been given to the adoption of special separation standards for these areas. Now, however, except for stations in the UHF spectrum, the matter seems largely academic. VHF assignments are fully occupied, service areas in the face of the greater-than-normal interference have been established, and it cannot be considered within the realm of practicability that existing stations could be uprooted and moved to locations affording more favorable separations.

41. Moreover, even if this practical impediment to the implementation of greater separations did not exist, we are not at all sure that, taking all pertinent factors into account, we would opt for greater geographical separations in Southern California and Puerto Rico. We note that our present rules provide for two departures from the separation requirements applicable to the major portion of the country (Zone II): the greater separations prescribed for the Gulf Coast area (Zone III) for the reasons which have been discussed, and the lesser separations set for the northeastern portion of the United States (Zone I) to accommodate the greater number of stations deemed necessary to serve this populous area.

42. When the Commission last had occasion to determine the kind of co-channel separations which should obtain in various areas of the United States based on considerations of population distribution (the FM allocation of 1962) it decided to treat Southern California and Puerto Rico in the same manner as the northeastern states—it provided for lesser-separated Class B assignments in these areas while the remainder of the country enjoyed more widely separated Class C assignments.

43. Thus, in any new look at TV separations in Southern California and Puerto Rico, two conflicting influences would be at work—one looking toward greater separations because of abnormal propagation conditions, and another, toward lesser separations to accommodate the number of stations deemed necessary to serve these densely populated areas. In such a situation, a compromise solution might well have been arrived at—which could have produced a result not greatly different than the separation formula which now obtains.

44. Any method of service analysis which takes into detailed consideration as many as possible of the factors which affect signal propagation, and assigns to these factors values unique to the area or each segment of the area over which television or FM service is to be estimated has the potential for producing more accurate results in the individual case than can be achieved with the use of propagation curves based on average propagation conditions over long paths. Thus, the computer method proposed by the Department of Commerce may prove useful in any undertaking where the degree of precision which may be attainable justifies the inevitable complications of the method. However, for the day-to-day regulatory purposes in which propagation curves are presently employed, we believe that they yield results of an acceptable degree of accuracy, and that the adoption of Commerce's method for estimating coverage for such purposes would impose unnecessary burdens on both licensees and the Commission.[6]

Redefinition of the Grade B contours

45. Our proposal to define Grade B contours at field strength values somewhat lower than are presently specified in our rules was made primarily in an attempt to mitigate such practical impact as might be experienced by television station licensees, who, in utilizing the new propagation curves for the prediction of station coverage, find that coverage within the Grade B contour had been reduced.

46. The lower field strength values proposed resulted largely from a revision in the magnitude of certain parameters included in the computation of Grade B signal strength, a reduction in estimated receiver noise figures, an upward revision in values for receiving antenna gain, and a reduction in the assessed effect of transmission line losses. The assignment of new values to these parameters was held to be justified as a result of equipment refinements occurring since the original Grade B determinations were made. The reduction in the proposed Grade B contour value for low band VHF was quite moderate, for, in the computation of this value, we included, for the

[6] While we are rejecting this proposal primarily for practical reasons, we have taken note of an engineering study submitted as an attachment to the reply comments of AMST. The results of this study suggest that the Commerce method, in its present form, may be less than satisfactory in yielding realistic estimates of UHF fields occurring at distances of less than 50 to 60 miles from the transmitter.

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first time, a factor intended to account for the effects of external noise, which we found to be of significant strength only in this band of television frequencies.

47. Except in those cases where individual stations find that the employment of the new curves in combination with redefined Grade B contours confer practical benefits on them, either on an absolute or competitive basis, there is general unwillingness to accept the proposed Grade B values for coverage determinations. Rather, the technical soundness for Grade B contour redefinition is attacked, with the allegation there is insufficient evidence that the values which the Commission assigned to the receiver noise figure or to antenna gain are realized at present in any but exceptional cases, or are likely to be realized more generally in the foreseeable future. The external noise figure included in the low band VHF Grade B determination is held not to be justified by available data, and it is urged its inclusion produces a result contrary to common experience.

48. Admittedly, the receiver noise figures and antenna gain values utilized by the Commission are optimistic, representing the performance of a receiving installation much better than average. The best justification for employing these values is a comparative one—the corresponding parameters in the original Grade B determinations also were optimistic at the time they were adopted and there is no doubt that receivers and antennas have improved in these respects over the intervening years. On the other hand, it is argued that a similarly optimistic approach—assuming performance levels of receiving installations hoped to be reached generally in the future with improved equipment—is not justified at this time. For instance, current trends in receiver design, it is alleged, portend higher, rather than lower, receiver noise figures.

49. It would appear that the practical benefits accruing from a redefinition of the Grade B contours are deemed by many parties to be minimal. Since questions have been raised as to the reasonableness of certain of the assumptions made by the Commission in its computation of the proposed new Grade B values, we have decided not to press this proposal further. While we might attempt to support further the figures we have employed, we consider such an effort unnecessary. There is no urgent need, from an engineering standpoint, to redefine the Grade B contour, and since other considerations do not make such a course of action expedient, we will not pursue it. Accordingly, the rules will not be amended in this respect.

Measurements

50. In its Notice of Proposed Rule Making in Docket 18052 it is stated "The Commission is seeking a method [of field strength measurement] that will yield substantially the same results when measurements are made under similar conditions, by independent observers and at different times. Otherwise, measurements can have no probative value."

51. All parties agree that this ideal cannot be achieved fully as between two sets of measurements made at different times, since the time fading factor, predominantly seasonal in character, would forbid such a result.

52. There is an equal degree of agreement, however, that the measurement procedure set forth in Section 73.686 is obsolete, and where television field strength measurements are now made for any purpose, is more honored in the breach than in its observance. Therefore, this section should be amended to specify a more acceptable procedure, which the majority of those commenting believe should be generally patterned on the technique developed and employed by the Television Allocations Study Organization (TASO). While this procedure does not meet the criteria which the Commission cited as desirable—it admittedly does not take into account temporal variations in field strength, and even carefully made measurements by different observers over the same path may yield results sufficiently different to be controversial—this procedure is now generally employed by engineers making television field strength measurements, and clearly represents an improvement of the one set forth in our rules. Accordingly, we are amending our rules to adopt this procedure with certain modifications proposed in this proceeding, and with other changes which we believe will serve to clarify its application. In taking this step, however, we are not abandoning our quest for a method of measurement which more fully meets the criteria we have established. The Commission intends to study this matter further, and would welcome assistance from the industry in pursuit of this end. At such time as developments warrant such a course of action, we will propose such further amendment of Section 73.686 and the rule for FM measurements which we are adopting, as may be appropriate.

53. There are strong differences of opinion on the question of whether field intensity measurements should be accepted by the Commission only in "rule making proceedings to amend . . . technical standards" and when submitted in response to a request by the Commission (the present rule limitation), or whether individuals should be permitted also "to submit measurement data for the purpose of showing more precisely the propagation over a particular path, or the field intensity received at a particular location" (the petitioner's proposal).

54. The preponderance of engineering opinion submitted in this proceeding is to the effect that while field strength measurements, if properly executed, are a valid means for determining the general level of a VHF or UHF signal prevailing over a particular area, e.g., a city, they cannot or should not be employed in an attempt to establish the location of a particular contour, by a procedure wherein measurements are made along a particular radial, and a best fit curve is drawn through the measured points. Thus, A. Earl Cullum states "The frequently used procedure of drawing connecting lines or curves between plotted measured clusters does not give a median value. No point may be at the median for the area or all may be. To say that a line drawn between measured points defines, by crossing a particular field intensity ordinate, the distance to a contour representing the median (with respect to locations) field intensity is to 'pin the tail on the donkey' while blindfolded."

55. Another objection raised to the procedure is that it fails to take into account that the strength of a VHF or UHF signal varies with time, and, even assuming that the location of a contour could be pin-

pointed by a particular measurement procedure, its location would be determined only for the time at which the measurements were made. It could well be somewhere else at some other time.

56. The contrary argument in Docket 18052 is that, in the standard broadcast service, contours determined by field strength measurements take precedence over predicted contours, even though such measured contours are subject to temporal variations and to limitations similar to those found at higher frequencies. Thus, the argument goes, there is no reason why the same approach should not be used at UHF and VHF frequencies.

57. However, groundwave fields at standard broadcast frequencies are not usually subject to as sharp and substantial variations in amplitude between closely adjacent locations as are typical of the effects found at higher frequencies. Consequently, measurements made at medium frequencies over the same path by different observers are likely to produce results which are in closer correspondence than similar measurements at VHF and UHF frequencies. There is, of course, a temporal variation in measured field strength, generally seasonal in nature, whose magnitude probably was not fully realized until after the custom of utilizing field strength measurements in individual cases had been firmly embedded in standard broadcast regulatory structure. It should be noted, furthermore, that for standard broadcast propagation conditions where the variation in signal strength with time is very great, i.e., skywave transmission, the rules permit only empirical curves to be used for determining service contours and the levels of undesired signals.[7]

58. We are not basing our decision on whether or not to permit the expanded employment of field strength measurements of television signals primarily on technical considerations. It should be pointed out that permissive employment of measurements for groundwave service and interference showings in the standard broadcast service has greatly complicated and lengthened many Commission proceedings. It can plausibly be argued that had the performance of measurements in this service long ago been permitted only for certain specific purposes (e.g., to gain conductivity data in general allocations matters and in adjusting directional antenna radiation patterns), the extent and quality of standard broadcast service would not have suffered appreciably, but the causes of administrative speed, efficiency, simplicity, and finality would have been very substantially advanced.

59. The framers of the TV rules took due note of the tortuous standard broadcast experience, and designed an allocations structure and assignment procedure intended to be as free from tampering as possible. To this end, engineering tools which might be used for the individual tailoring of assignments were largely omitted from the rules. While Grade A and Grade B "service" contours were provided for, they were intended to have only nominal significance. However,

[7] It is fairly obvious that measurements, carefully made at some particular time over some particular area yield results, which for that time and over that area, can have a higher degree of accuracy than those obtained by the use of propagation curves based on average conditions. However, the great virtue of the curves, from a regulatory standpoint, is that they produce a unique result, reproducible at different times by different individuals, which is of sufficient accuracy, in the great majority of cases, to permit the attainment of basic regulatory objectives.

the need for some convenient measure of TV station service for a variety of purposes appeared over the years, and, in the absence of any more realistic or usable standard, the Grade A and Grade B contours came generally into use. Inevitably, then, when a determination requiring the use of these contours produced a result adverse to the interests of a particular party, he sought ways acceptable to the Commission of changing this result, e.g., changing the position of a Grade B contour, predicted by use of the curves, with measurements. In a number of instances, the Commission has accorded probative value to such measurements. However, we do not believe the fact we have done so, on occasion, requires that we formalize this case-to-case approach by rule amendment.

60. Obviously, the right to utilize measurements in an attempt to alter an otherwise ordained result may offer a substantial advantage to one individual, but the result, as altered by measurements, may impose a substantial detriment on another. It seems clear that the decision as to whether to change the rules to permit the results of measurements to be accepted in a wider range of cases should not hinge on such considerations, but should be made on a basis which will best conduce to the furtherance of Commission objectives in the most equitable and efficient manner, and redound to the public interest.

61. If the Grade B contour were a wall within which all service provided by a television station were confined, the determination of its location by the most precise means available could well be worth whatever complication might be involved. However, since this and other contours are primarily administrative tools, it seems clear they should be located by means which promote the most efficient administration—by a relatively simple procedure which produces a speedy and unequivocal result.

62. Whether a duopoly question involving the extent of Grade B service is presented, or a CATV problem of carriage or non-duplication, it seems evident that its resolution can be reached much more simply, expeditiously and finally if the pertinent contours are determined only by prediction. The nature of the determination involved does not, in the consistent and successful application of the pertinent rules, require such greater degree of exactitude which field strength measurements may provide.

63. Therefore, we are not amending Section 73.686(a) in any way which would allow, as a matter of right, the determination of contour locations by means of field strength measurements. As we have discussed, the procedure, in the minds of many parties is of questionable validity, and, even if it were not, we do not believe that proceedings involving the television broadcasting service should be burdened with the mass of often conflicting showings which, in many cases, have so complicated standard broadcast proceedings. Occasionally, there may be instances when the location of TV contours, as determined by prediction, are obviously in gross error, and measurements will produce a result which, by any standard, is more realistic. We believe that when such cases are brought to our attention, measurements may be accepted when made on an individual basis "upon the request of the Commission" in accordance with the present wording of Section 73.686(a).

64. Nearly all parties agree that the TASO measurement procedure can be applied to determine with an acceptable degree of accuracy the median level of a television signal prevailing over a particular area, such as that included within the boundaries of a community. Where the results of such measurements are properly made, and are pertinent to the resolution of the issues in a particular proceeding, they will be accepted and considered by the Commission. However, all contour determinations shall be made using the propagation curves included in the rules, as modified by application of corrections for terrain roughness. Section 73.686 is being amended in accordance with this determination. A new Section 73.314 is being added to the FM broadcast rules, establishing similar policies and procedures for field strength measurements in this service.

65. With the adoption of Section 73.314(c), a procedure is established for determining, by field strength measurements, the level of an FM broadcast signal prevailing over a particular community. In appropriate cases, we contemplate the acceptance of the results of measurements made for this purpose. In particular, an applicant for a standard broadcast station, desiring to show, pursuant to Section 73.37(e)(1)(ii) or Section 73.37(e)(2)(iii), that the community proposed to be served receives fewer than two aural services, may seek to demonstrate that an existing FM broadcast station does not, in fact, provide a signal with 70 dbu (3.16 mV/m) or greater strength to as much as 80 percent of the population or area of the community. In such an instance, properly made measurements showing that at 20 percent or more of the measuring locations within the boundaries of the community, as established pursuant to Section 73.314(c)(1), the measured field is of lower strength than 70 dbu (3.16 mV/m), will be accepted in support of a contention that less than 80 percent of the area of the community receives an aural service from the FM station.

66. The TASO procedures and methods are being adopted with the following modifications, in accordance with the suggestions made by the parties in an attempt to lend greater specificity to certain of these procedures and methods.

(a) The two mile measurement interval is being specified as a maximum, to permit measurements at shorter distances at high frequencies and in rough terrain. A cluster of five measurements is permitted in lieu of one hundred foot mobile run, and general limitations are placed on the areas including the clusters.

(b) Measurements are to be made only of the visual carrier.[8]

(c) In making measurements to determine the signal level in a community, the number of locations for such measurements is set as approximately 3 times the square root of the population in thousands (reduced, for convenience, in the rules, to the expression $0.1\ (P)^{1/2}$), with a minimum number of 15. All of these locations are required to be within the boundaries of the community.

67. We are adopting this measurement procedure, after fully considering Jansky & Bailey's proposal that our rules permit measurements

[8] This restriction is contained only in Section 73.686—the field strength measurement rules for television. It, of course, has no pertinence to measurements made of the signals of FM broadcast stations.

with the receiving antenna at a 10 foot height, the 30/10 height/gain factor being determined for various parts of a radial at intervals which might be widely spaced in smooth terrain and at short intervals where the terrain is rough. If this procedure were followed, Jansky & Bailey state that information would become available for both 10 and 30 foot receiving antenna heights giving representative results for both rooftop and indoor antennas, and results which may be logically referenced to the many earlier measurements made with 8 and 10 foot antennas. While this procedure might have some virtues, we found no support for the proposal by others, and we think its adoption would needlessly complicate a methodology which appears to have general industry support.

Depiction of interference areas within Grade B contours

68. The Commission offered this proposal for comment without supporting it, stating that even if information as the effects of interstation interference were made available, it would not affect our present regulatory procedures. We requested views on the desirability of requiring interference showings by individual stations for other useful purposes, and listed a number of technical problems which would require solution before a uniform procedure for making such showings could be adopted. As we have indicated hereinbefore, the broadcasting industry evidently wants no part of this proposal. Others who favor it see it as providing one more factor which could be considered in determining the basis for TV/land mobile and TV/CATV relationships—obviously an extension of the regulatory function which the Commission has disclaimed its intention of undertaking. In any event, as stated in paragraph 19 of the Further Notice in this proceeding, the technical criteria for TV/land mobile sharing were established pursuant to Docket 18261, and any amendment of these criteria is beyond the purview of the instant proceeding. Certain physical and technical factors involved in TV/CATV relationships are being reviewed in the current proceeding in Docket 19995 and will be further examined in Docket 20496, which is being initiated contemporaneously with the adoption of the instant Report and Order. There is little to be gained in pursuing this proposal further, and, accordingly, we will take no further steps toward the incorporation in our rules of a requirement for the submission by individual stations of showings of the effect of interstation interference on the extent of service rendered.

SUMMARY

69. As hereinbefore discussed, and for the reasons we have outlined, we are amending Part 73 of our rules in the following general respects:

(a) To adopt new F(50,50) and F(50,10) propagation curves for the prediction of field strengths in the television and FM broadcast services.

(b) To adopt a terrain roughness correction procedure to be applied, when appropriate, to determinations made with these curves.

(c) To amend the television broadcast rules to specify a modified procedure for making field strength measurements in the

VHF and UHF bands, and to amend the FM broadcast rules to adopt such a measurement procedure.

(d) To relax the present restrictions in the television rules on the use and acceptance of measurements in individual cases, to the extent that so-called TASO grid measurements to determine the median level of a signal in a community will be accepted in appropriate cases.

the specific text of the amendments is set forth in Appendix B hereto.

70. Accordingly, IT IS ORDERED, effective August 1, 1975, that Part 73 of the Rules and Regulations IS AMENDED in accordance with Appendix B.

71. Authority for adoption of these rule amendments is found in Sections 4(i) and 303(r) of the Communications Act of 1934, as amended.

72. IT IS FURTHER ORDERED, That this proceeding IS TERMINATED.

FEDERAL COMMUNICATIONS COMMISSION,
VINCENT J. MULLINS, *Secretary.*

APPENDIX A

PARTIES FILING COMMENTS IN RESPONSE TO NOTICE OF PROPOSED RULE MAKING IN DOCKET NO. 16004

American Broadcasting—Paramount Theatres, Inc. (ABC)
Kear and Kennedy
Selma Television Incorporated (WSLA–TV)
WCOV–TV
Birmingham Television Corporation (WBMG–TV)
A. Earl Cullum Jr. & Associates (Cullum)
Association of Federal Communications Consulting Engineers (AFCCE)
National Association of Broadcasters (NAB)
King Broadcasting Company
Trigg-Vaugh Stations, Inc.
Meredith Broadcasting Company
KUTV, Inc.
Southern Nevada Radio and Television Company
Association of Maximum Service Telecasters, Inc. (AMST)
WBEN, Inc.
Storer Broadcasting Company
WLAC–TV, Inc.
Arkansas Television Company
The Hearst Corporation
KING–TV, et al.
Coldwater Cablevision, Incorporated
South Bend Tribune
WKBN Broadcasting Corporation
Royal Street Corporation
Evening News Association, et al.
Time-Life Broadcast, Inc.
KOGO–TV and KOGO–FM
A. H. Belo Corporation
WHDH, Inc.
Channel 13 of Rochester, Inc.

PARTIES FILING COMMENTS IN RESPONSE TO NOTICE OF PROPOSED RULE MAKING IN DOCKET NO. 18052

North Dakota Broadcasting Company, Inc.
Doubleday Broadcasting Company
A. Earl Cullum, Jr. & Associates

Association of Federal Communications Consulting Engineers
Association of Maximum Service Telecasters, Inc.
National Association of Broadcasters
WBRE–TV, Inc.
National Cable Television Association, Inc. (NCTA)
Jansky & Bailey
Kear & Kennedy

PARTIES FILING COMMENTS IN RESPONSE TO THE FURTHER NOTICE OF PROPOSED RULE MAKING IN DOCKETS 16004 AND 18052

Fisher's Blend Stations, Inc.
Electronics Industries Association (EIA)
National Cable Television Associations, Inc.
All-Channel Television Society (ACTS)
WBRE–TV, Inc.
Home Entertainment Business Division; Communications Systems Business Division; Government Agency Liaison of the General Electric Company (GE)
Motorola, Inc.
A. Earl Cullum, Jr. and Associates
Midwest Radio-Television, Inc.
The Jerrold Corporation
The Association of Federal Communications Consulting Engineers (AFCCE)
FM Station Atlas
National Broadcasting Company (NBC)
National Association of Broadcasters
Neil M. Smith
KSL, Incorporated
Leake TV, Inc.
Gill Industries
WTOG
WKRG–TV
WGAL Television, Inc.
Jefferson Standard Broadcasting Company
Eastern Oklahoma Television Company, Inc.
Scranton Broadcasters, Inc.
Griffin Television, Inc.
Rock River Television Corporation
Connecticut TV, Inc. et al.
Taft Broadcasting Company
Cowles Broadcasting Service, Inc.
Department of Commerce
WHNB, Inc.
WRAU–TV, et al.

APPENDIX B

1. Section 73.313 is amended by the addition of subparagraphs (f), (g), (h), (i) and (j) to read as follows:

§ 73.313 PREDICTION OF COVERAGE.

* * * * * * *

(f) The effect of terrain roughness on the predicted field strength of a signal at points distant from an FM 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 value equal 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 §73.333, FIG. 4).

(g) 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.

(h) 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 with contour intervals of 50 feet, or less, if available.

(i) The field strength charts (§73.333, Figs. 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 Δh, 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:

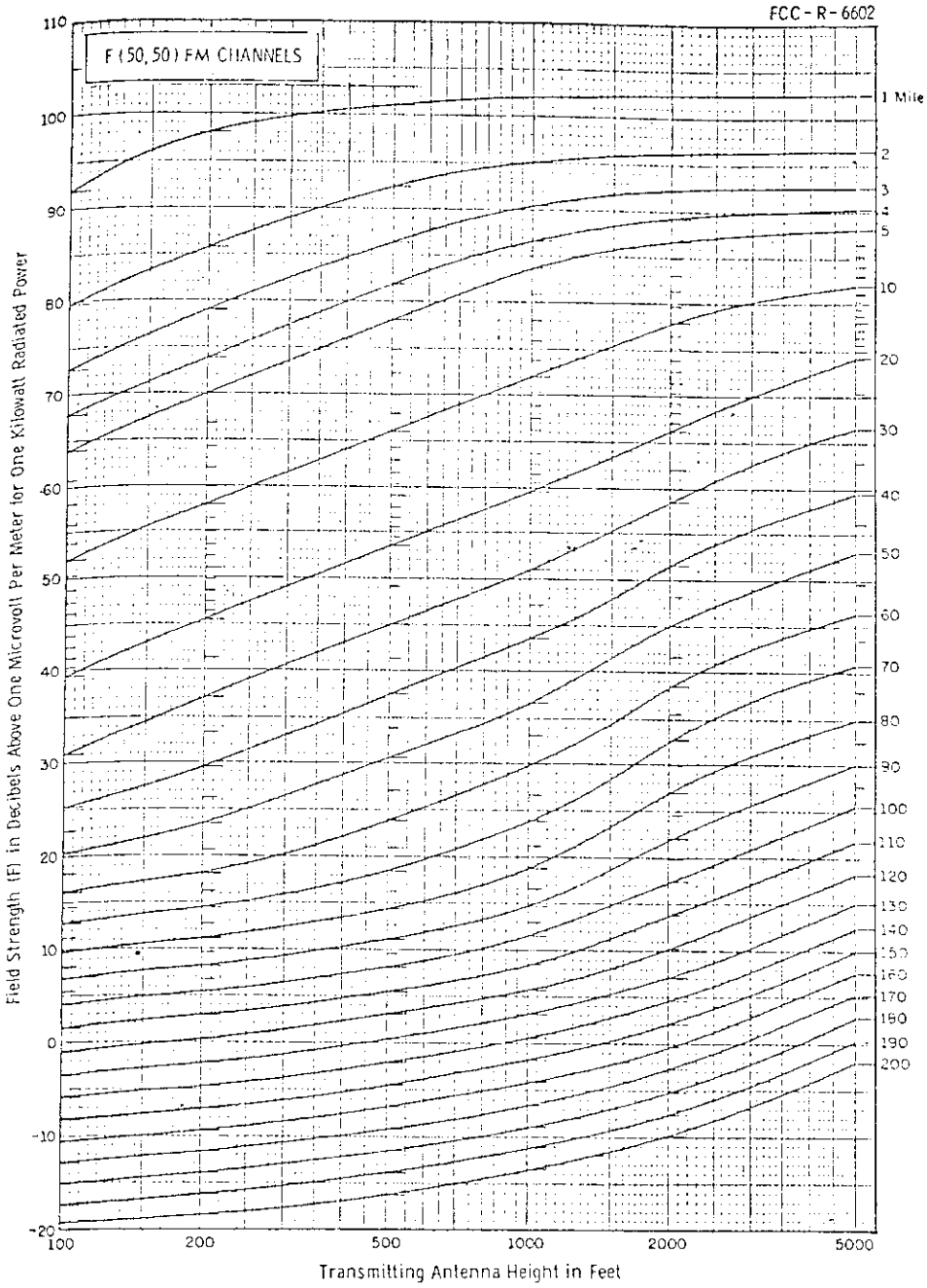
$$\Delta F = 1.9 - 0.03(\Delta h)(1 + f/300)$$

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

2. Section 73.333 is amended by replacing existing Figure 1 with amended Figure 1 and the addition of new Figures 1a, 4 and 5. Section 73.333 reads as follows:

§ 73.333 ENGINEERING CHARTS.

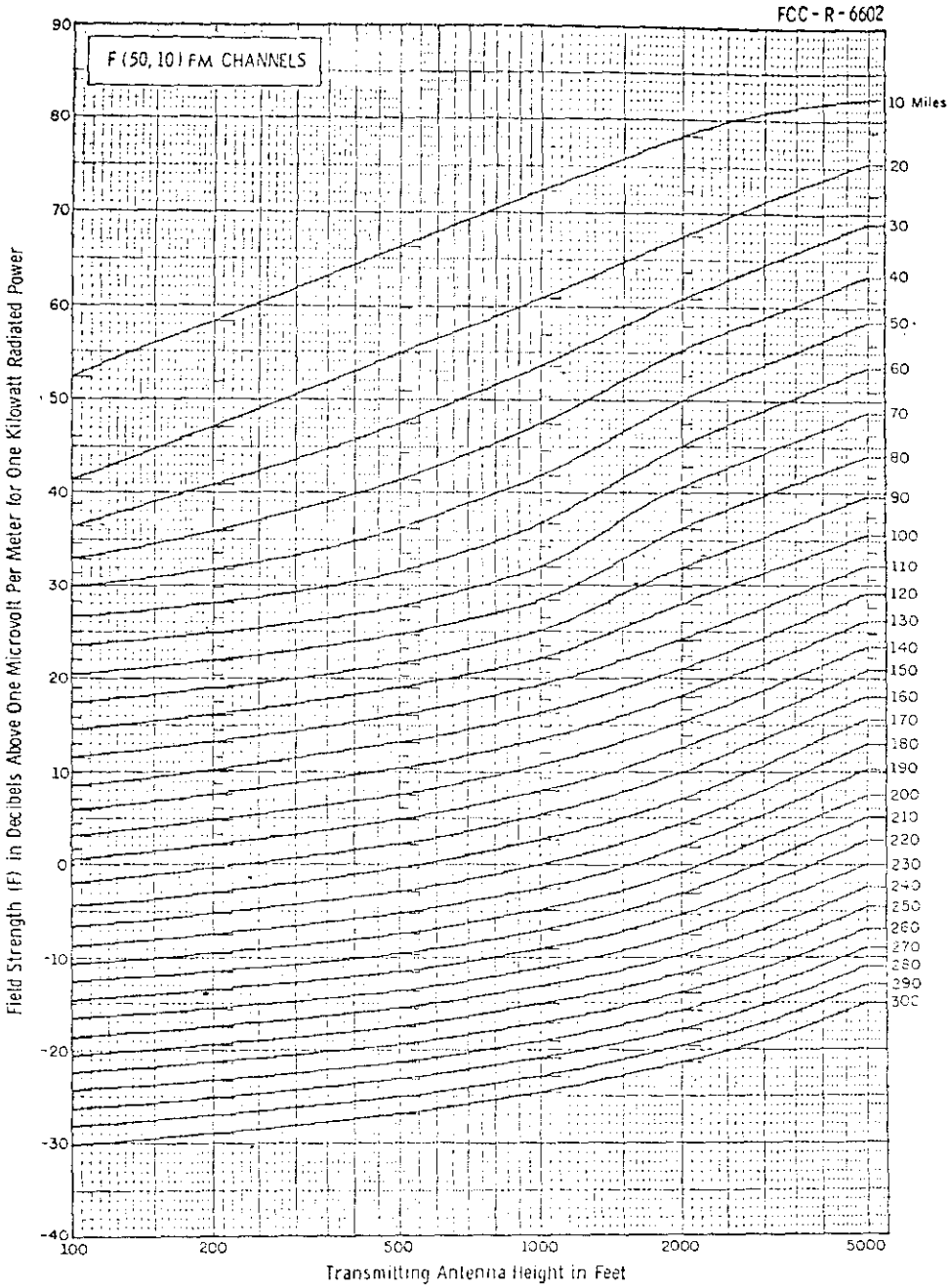
This section consists of the following Figures 1, 1a, 2, 3, 4 and 5.



FM CHANNELS

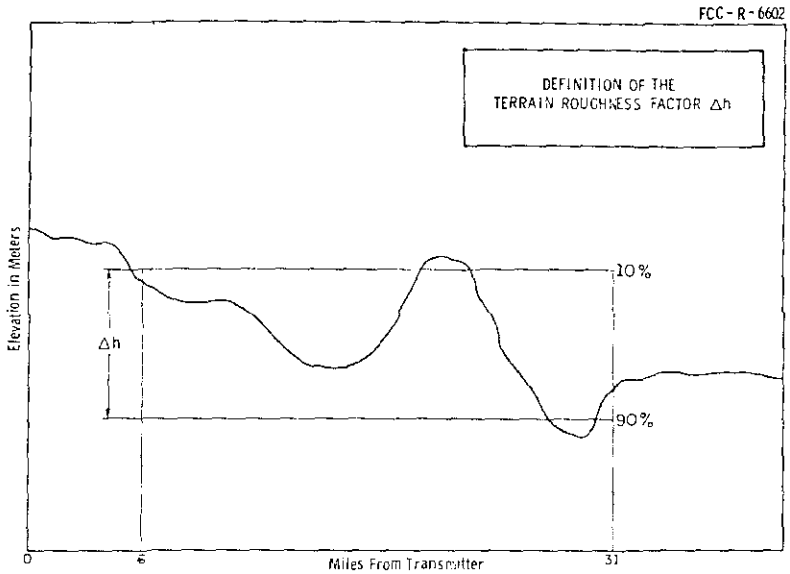
ESTIMATED FIELD STRENGTH EXCEEDED AT 50 PERCENT
OF THE POTENTIAL RECEIVER LOCATIONS FOR AT LEAST 50 PERCENT
OF THE TIME AT A RECEIVING ANTENNA HEIGHT OF 30 FEET

FCC §73.333 FIGURE 1
(replacement)

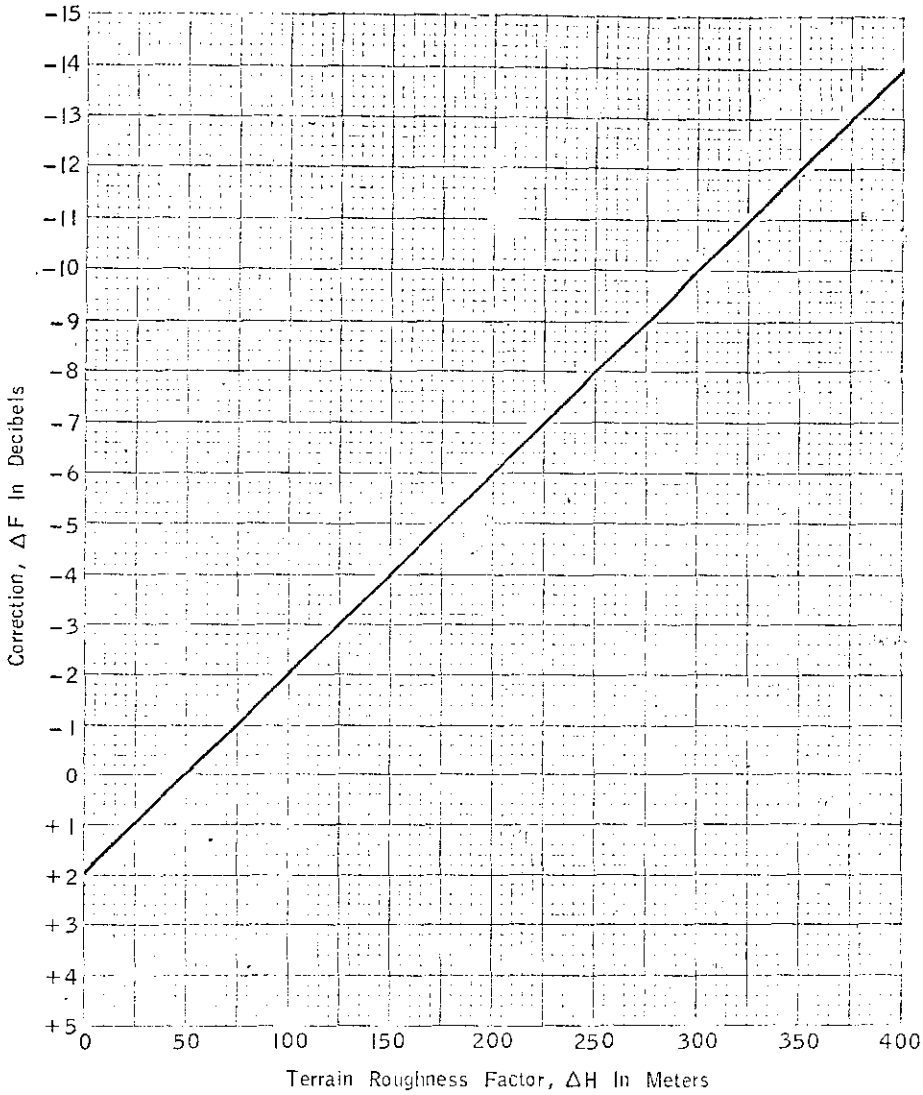


FM CHANNELS
ESTIMATED FIELD STRENGTH EXCEEDED AT 50 PERCENT
OF THE POTENTIAL RECEIVER LOCATIONS FOR AT LEAST 10 PERCENT
OF THE TIME AT A RECEIVING ANTENNA HEIGHT OF 30 FEET

FCC §73.333 FIGURE 1a
(new)



FCC §73.333 FIGURE 4
(new)



TERRAIN ROUGHNESS CORRECTION

for use with estimated FM F(50,50) and F(50,10) field strength curves

FCC §73.333 FIGURE 5
(new)

3. Part 73 is amended by the addition of new Section 73.414, which reads as follows:

§ 73.414 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 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 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) At a point exactly 10 miles from the transmitter, each radial is marked, and at greater distances at successive two mile intervals. Where measurements are to be conducted 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 two mile 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 two mile marker as nearly as possible.

(2) Measurement procedure.

All measurements shall be made utilizing a receiving antenna designed for reception of the horizontally polarized signal component, elevated 30 feet above the roadbed. At each measuring location, the following procedure shall be employed:

(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 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 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.

(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 (iii), above, the strongest signal is found to come from a direction other than from the transmitter, after the mobile run prescribed in (v) 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 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 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 0 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 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.

All measurements shall be made utilizing a receiving antenna designed for reception of the horizontally polarized signal component, elevated 30 feet 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.

(iii) At 20 percent or more of the measuring locations, mobile runs, as described in (b)(2) 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 suitably 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 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 received 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 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 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.

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

4. Section 73.684 is amended by the addition of subparagraphs (h), (i), (j), (k) and (l) which read as follows:

§ 73.684 PREDICTION OF COVERAGE.

* * * * * * *

(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 value equal 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, Fig. 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

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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 Section 73.699 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 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

Δh=terrain roughness factor in meters

f=frequency of signal in megahertz (MHz)

5. In Section 73.686 the headnote and text are amended to read as follows:

§ 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 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 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 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) At a point exactly 10 miles from the transmitter, each radial is marked, and at greater distances at successive two 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 two mile 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 two mile marker as nearly as possible.

(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 above the roadbed. At each measuring location, the following procedure shall be employed.

(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 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 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.

(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 (iii), above, the strongest signal is found to come from a direction other than from the transmitter, after the mobile run prescribed in (v) 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 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 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 0 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 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 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.

(iii) At 20 percent or more of the measuring locations, mobile runs, as described in (b)(2) 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 suitably 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 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 received 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 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.

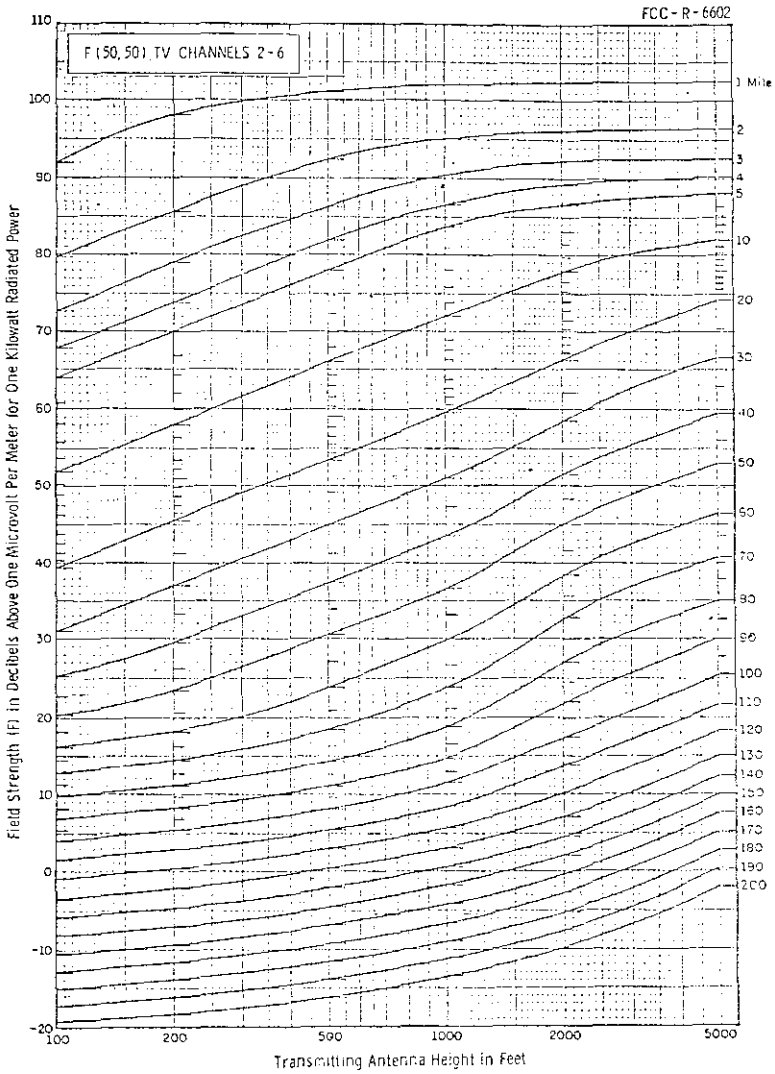
(vi) A list of calibrated equipment used for the measurements, which for each instrument, specifies its manufacturer, type, serial number and rated accuracy, and the date of its most recent calibration by the manufacturer, or by a laboratory. Complete details of any instrument not of standard manufacture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

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

6. Section 73.699 is amended by the substitution of new Figure 9 for present Figure 9, the addition of new Figure 9a, the substitution of new Figure 10 for present Figure 10, and the addition of new Figures 10a, 10b, 10c, 10d and 10e. Section 73.699, as amended, reads as follows:

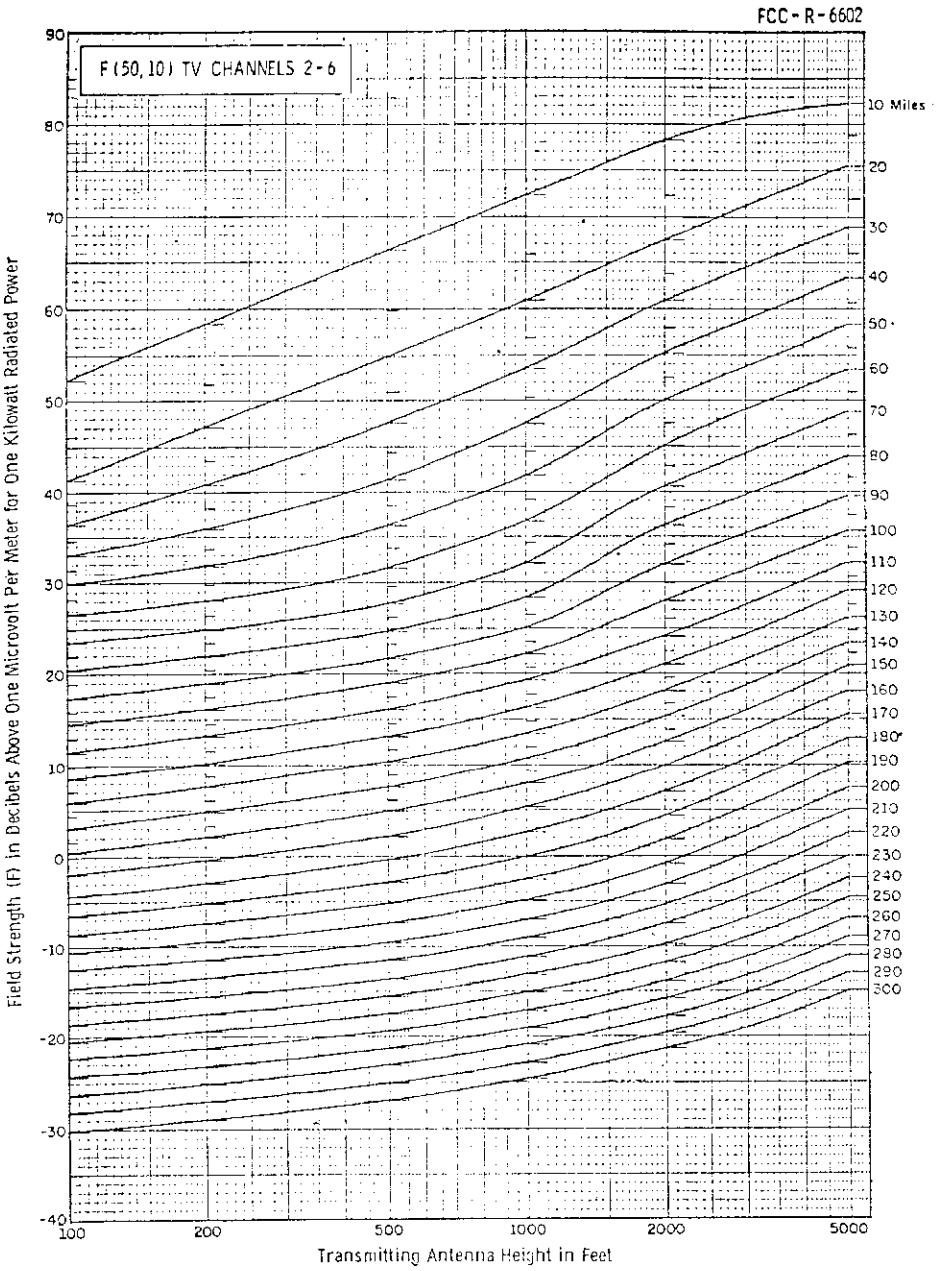
§ 73.699 ENGINEERING CHARTS.

This section consists of the following Figures 1–5, 5a, 6–10, 10a–10e, 11–12, 13–15.



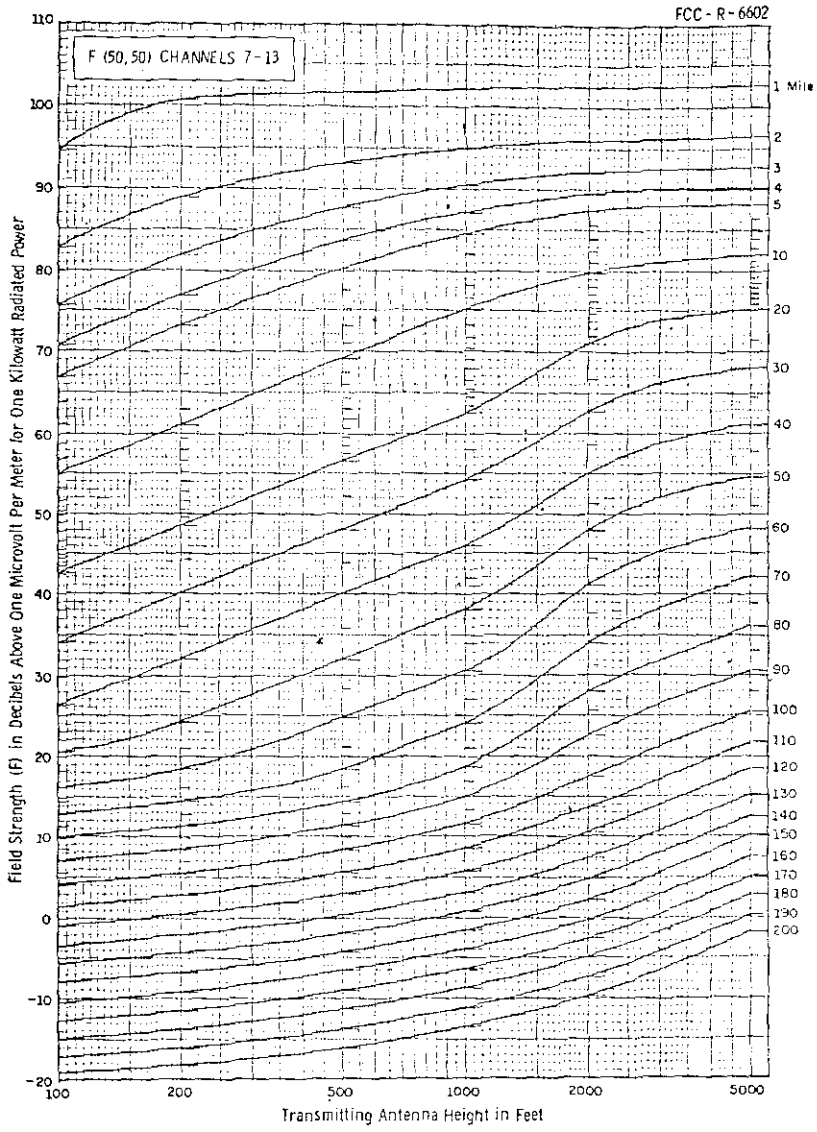
TELEVISION CHANNELS 2-6
ESTIMATED FIELD STRENGTH EXCEEDED AT 50 PERCENT
OF THE POTENTIAL RECEIVER LOCATIONS FOR AT LEAST 50 PERCENT
OF THE TIME AT A RECEIVING ANTENNA HEIGHT OF 30 FEET

FCC §73.699 FIGURE 9
(replacement)



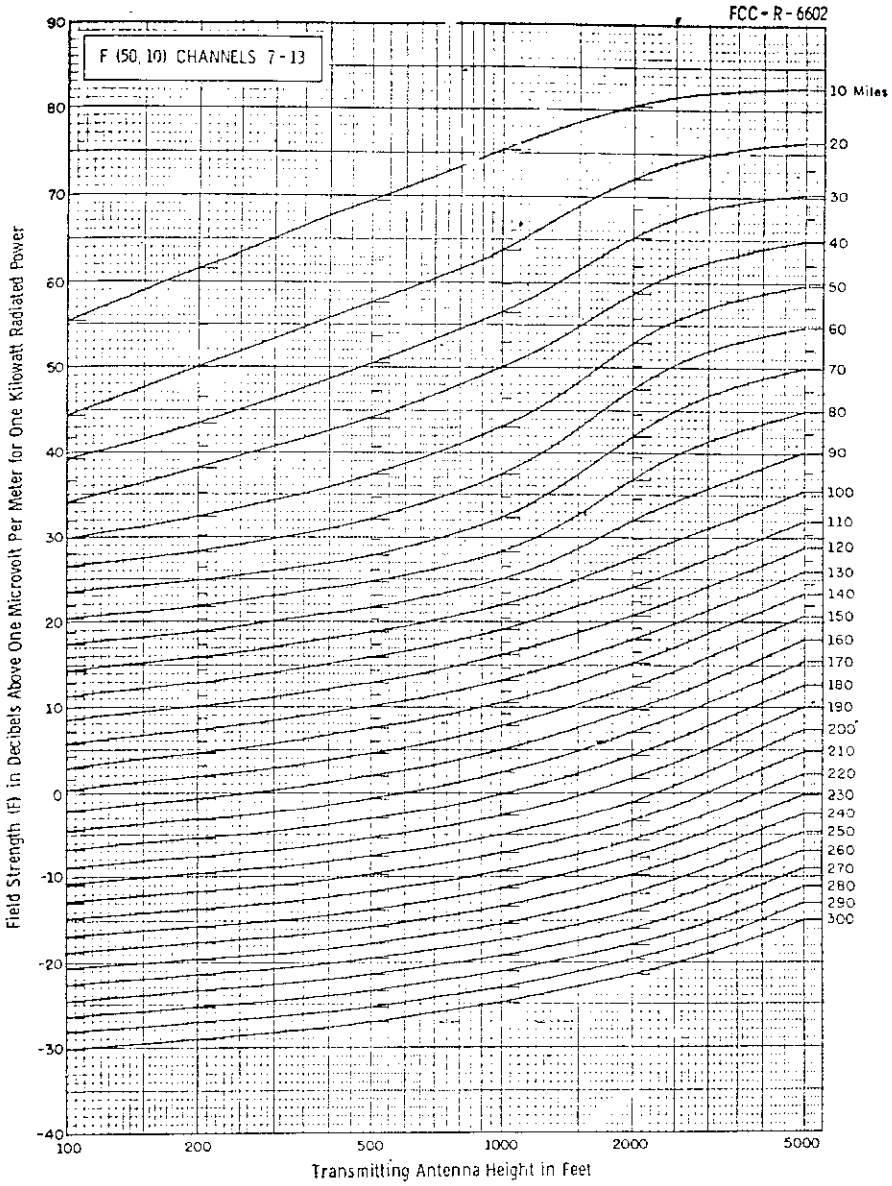
TELEVISION CHANNELS 2-6
ESTIMATED FIELD STRENGTH EXCEEDED AT 50 PERCENT
OF THE POTENTIAL RECEIVER LOCATIONS FOR AT LEAST 10 PERCENT
OF THE TIME AT A RECEIVING ANTENNA HEIGHT OF 30 FEET

FCC §73.699 FIGURE 9a
(new)



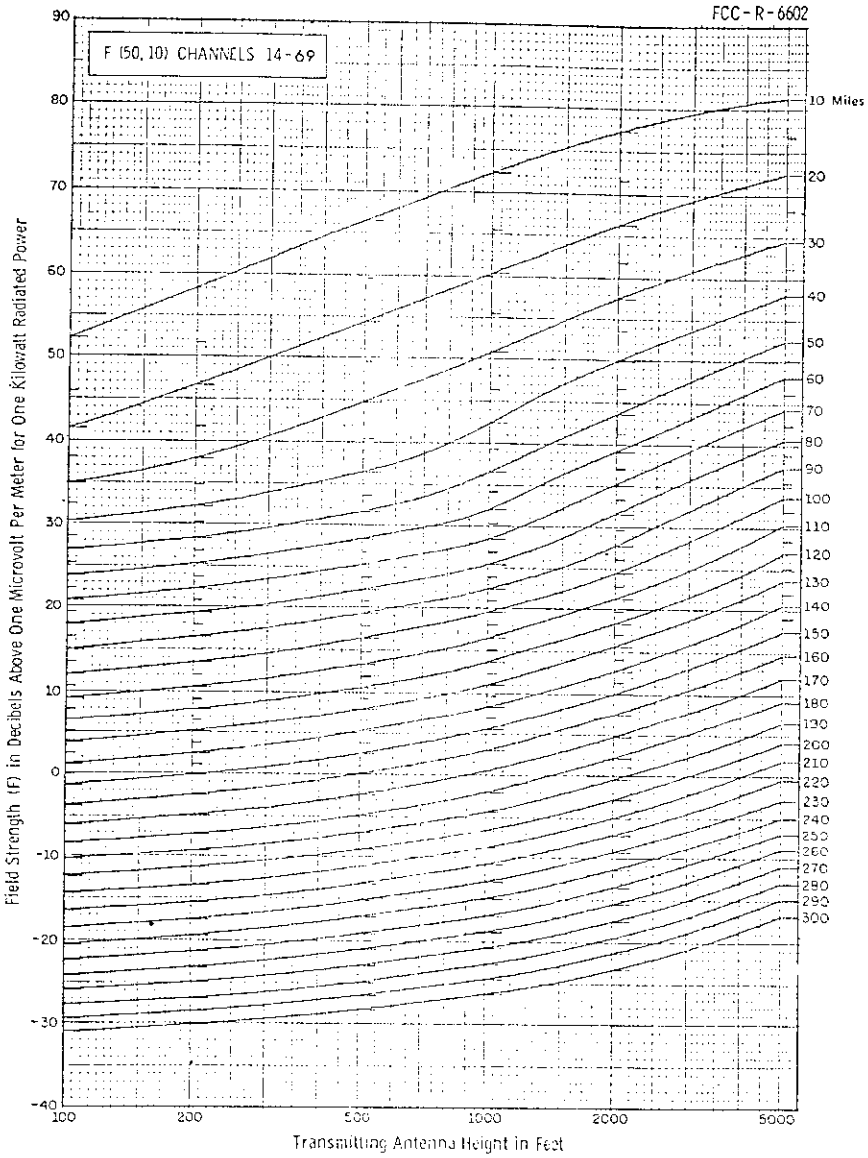
TELEVISION CHANNELS 7 - 13
ESTIMATED FIELD STRENGTH EXCEEDED AT 50 PERCENT
OF THE POTENTIAL RECEIVER LOCATIONS FOR AT LEAST 50 PERCENT
OF THE TIME AT A RECEIVING ANTENNA HEIGHT OF 30 FEET

FCC §73.699 FIGURE 10
(replacement)



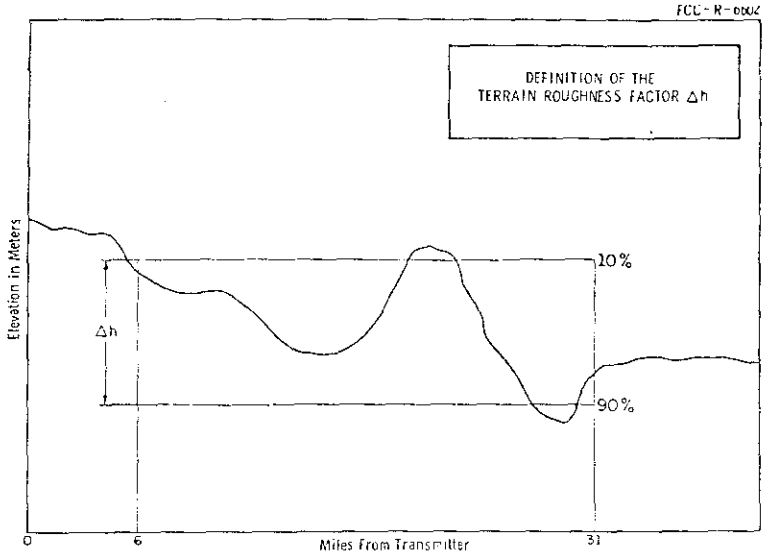
TELEVISION CHANNELS 7 - 13
ESTIMATED FIELD STRENGTH EXCEEDED AT 50 PERCENT
OF THE POTENTIAL RECEIVER LOCATIONS FOR AT LEAST 10 PERCENT
OF THE TIME AT A RECEIVING ANTENNA HEIGHT OF 30 FEET

FCC §73.699 FIGURE 10a
(new)

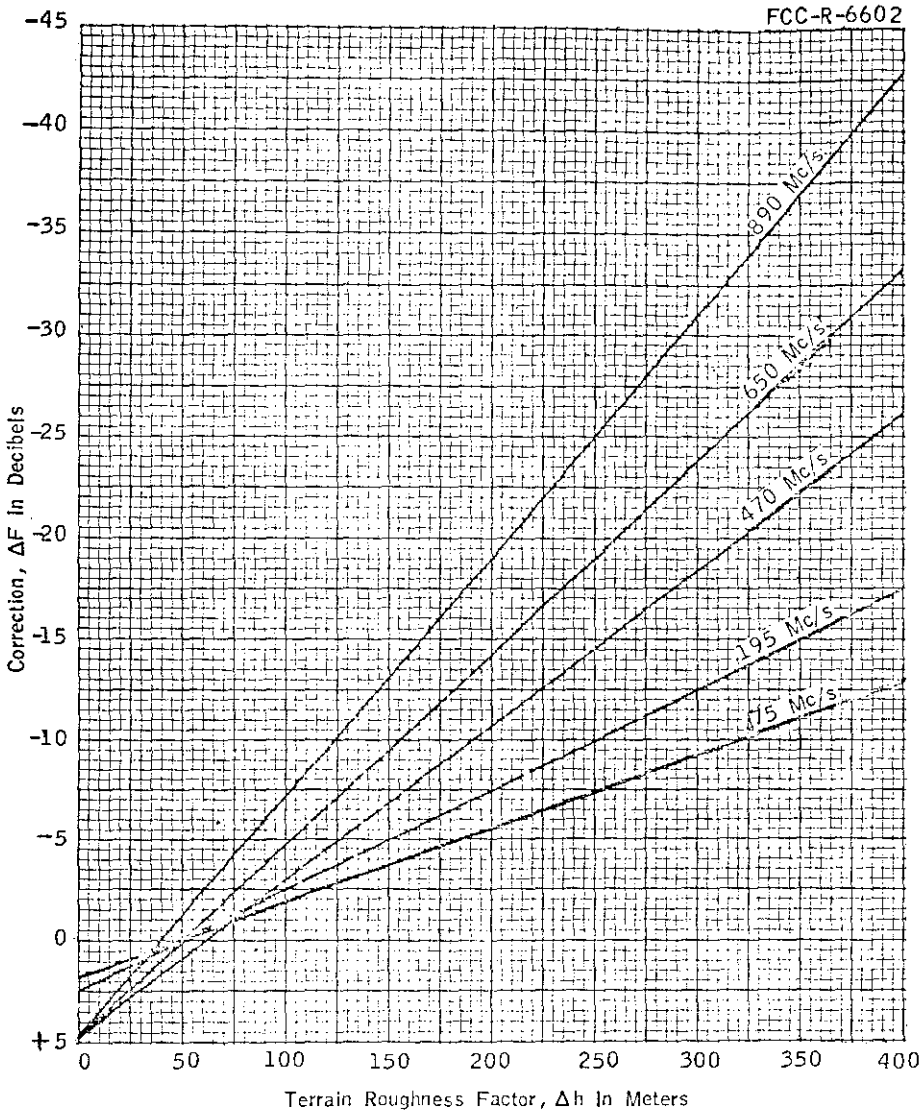


TELEVISION CHANNELS 14 - 69
ESTIMATED FIELD STRENGTH EXCEEDED AT 50 PERCENT
OF THE POTENTIAL RECEIVER LOCATIONS FOR AT LEAST 10 PERCENT
OF THE TIME AT A RECEIVING ANTENNA HEIGHT OF 30 FEET

FCC §73.699 FIGURE 10c
(new)



FCC §73.699 FIGURE 10d
(new)



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

FCC §73.699 FIGURE 10e
(new)