International HF Broadcasting Conference
(Mexico, 1948-1949)

A set of Field Intensity charts was prepared by the United States delegation to facilitate the work of the International HF Broadcasting Conference (Mexico, 1948-1949).

The pages in this file are a small sample of what is included in the documents. The complete set is available for consultation at the ITU Library & Archives in Geneva, Switzerland, and includes the following charts:

- June, Sunspot Number 70
- June, Sunspot Number 125
- September, Sunspot Number 5
- September, Sunspot Number 70
- December, Sunspot Number 5
- December, Sunspot Number 70
- December, Sunspot Number 125

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FIELD INTENSITY CHARTS

The enclosed charts of field intensity as a function of time of day have been prepared by the United States and Mexican Delegations to the High Frequency Broadcasting Conference, Mexico City, 1948-1949, with the assistance of the Central Radio Propagation Laboratory, National Bureau of Standards, and with the assistance of engineering students of the Escuela Superior de Ingenieria Mecanica y Electrica, Mexico, D. F. The methods used in the calculation of these charts are described in Chapter 7, paragraph 7.7 of National Bureau of Standards Circular 462 modified as regards the calculation of auroral zone absorption in accordance with the more recent work of the Provisional Frequency Board.1/

An attempt has been made to include charts for all of the high frequency broadcasting requirements as well as additional charts for critical paths which are of particular interest in considering simultaneous channel sharing possibilities. The areas and locations for which the charts have been prepared are shown on the world map. The table of locations and the small circles on the map indicate the exact locations for which the calculations have been made, except for those charts on which the locations are specifically marked otherwise.

The calculations have been made for the center of five of the high frequency broadcast bands, the frequencies used in calculation being 6.08 Mc/s, 9.64 Mc/s, 11.84 Mc/s, 15.28 Mc/s, and 21.6 Mc/s, the corresponding curves for these frequencies being labeled 6, 9, 12, 15 and 21 for simplicity. The curves are shown solid at the times the frequency is below the OWF and dashed at the times the frequency is above the OWF for the path. All paths assumed have been the short great circle paths and for near antipodal circuits, (circuits near 20,000 km), a possibility of error exists since it is recognized that on very long paths the most favorable propagation path may not be the great circle path. For some of

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1/ Provisional Frequency Board, Geneva, 1948, Committee 4, Group 8, "Instructions for the use of charts giving field intensity for distances exceeding 4000 kilometers", 22 September 1948.

the long paths the curves are given for both the short great circle path and the long great circle path and are designated as east and west transmitting directions.

As a practical expedient, the field intensity charts for the short distance paths for which sky wave service is required from zero distance out to 500, 1000, or 1500 km have vertical incidence (zero distance) F2 layer OWF data on them and the field intensities have been determined from the solid line curves on the master field intensity charts for distances less than 3000 km given in Figures 2, 3, 4, 5 and 6. The solid line curves have been derived from the short distance charts given in Chapter 7, NBS Circular 462, neglecting the screening effect of the E layer when it is sufficiently reflective to prevent transmission via the one hop F2 layer transmission mode. Consideration of this effect was suggested by Committee 6-D of this High Frequency Broadcasting Conference subsequent to the preparation of the area-to-area field intensity charts. The dashed lines on the low frequency master charts show the field intensities received from the one hop E layer and two hop F layer modes which are important during the daytime for some paths somewhat greater than 600 km having high absorption co-efficients. These dashed lines were incorporated to illustrate the magnitude of the E layer effect and to permit its consideration in the use of the area-to-area charts. The estimation of field intensities for short path lengths other than the distance for which they are given is possible with the master charts.

Whereas the field intensity data given in NBS Circular 462 are given on the basis that 1 kW radiated power is equivalent to 300 mV/m at a kilometer (radiation from a short grounded vertical antenna), the enclosed curves are presented on the basis that 1 kW radiated power is equivalent to 222 mV/m at a kilometer (radiation in the equatorial plane of a half wave dipole in free space). They are thus 2.5 db lower than would be directly calculated from NBS Circular 462. This procedure was followed in order to put the curves on the same basis as has been assumed for determining the gains of antennas used for high frequency broadcasting. Specific antenna directivity characteristics have not been taken into account in their preparation on the assumption that the user will follow the procedures given to NBS Circular 462 in the application of the data in this regard.

The area-to-area charts, as well as providing the basic information regarding the delivered field intensity over desired transmission paths, are useful in considering sharing possibilities, since they may also be used to determine the delivered field intensities over undesired transmission paths. When two charts, one for the desired signal and the other the undesired signal, are superimposed over each other, displaced vertically by the proper desired to undesired signal ratio in decibels after taking into account the differences in radiated power for the two paths, the times of sharing on a particular frequency channel may be read directly from the points of intersection of the two curves for the same frequency band.

USE OF THE CHARTS

Field Intensity Example:

What field intensity would be delivered on frequencies below the OWF for the circuit from Area 28 to Area 11 at 2200 GMT during June, sunspot number 5, using a transmitter of 100 kW power (20 db above 1 kW) and curtain antennas having power gains of 68 (19 db) in the desired direction with reference to a half wave dipole in free space.

Referring to the June, sunspot 5 chart for Area 28 to Area 11, it is seen that the delivered fields at 2200 GMT will be 1.5 db below 1 microvolt per meter on 6.08 Mc/s and 9.0 db above 1 microvolt per meter on 9.64 Mc/s for 1 kW radiated power. The curves for 12, 15 and 21 Mc/s are dashed at this time indicating these frequencies are above the OWF. A total of 39 db must be added to the delivered fields to take care of the transmitter power and antenna gains. The delivered fields will then be 37.5 db above 1 microvolt per meter on 6.08 Mc/s (74 microvolts per meter) and 48 db above 1 microvolt per meter on 9.64 Mc/s (250 microvolts per meter). The same result would be obtained under the same conditions for the reciprocal direction of transmission.

Sharing Example:

At what time during June, sunspot 5, may two stations, one in Area 28 and the other in Area 11, operate on the same channel in the 6 Mc/s band and maintain a 40 db desired to undesired median field intensity ratio, 500 km from the transmitter in Area 11. The radiated power of the transmitter in Area 11 is one kilowatt in the desired direction and the radiated power of the transmitter in Area 28 is one kilowatt in the direction of Area 11.

The two charts, Area 11 to Area 11 (500 km) and Area 28 to Area 11, are selected and superimposed one on the other placing the zero db reference level of the Area 28 to Area 11 chart above the desired to undesired signal ratio (40 db) level on the Area 11 to Area 11 chart. The times that the ratio exceeds 40 db are then read directly from the intersection of the two 6 Mc/s curves as being from 0600 GMT to 2215 GMT. This would apply during the period the frequency does not exceed the OWF for Area 11 to Area 11. It will be noted that 6 Mc/s is above the OWF from 0200 to 1430 GMT for Area 11 to Area 11 and at these times reliable reception 500 kilometers from the transmitter would not be expected.

TABLE I

Latitude and Longitude of Areas
Used for Field Intensity Calculations

Area No.	Latitude Degrees	Longitude Degrees	Area No.	Latitude Degrees	Longitude Degrees
1	65 N	150 W	40	30 N	60 E
2	60 N	125 W	41	20 N	80 E
3	60 N	100 W	42	40 N	85 E
4	60 N	80 W	43	35 N	100 E
5	70 N	40 W	44	30 N	120 E
6	40 N	120 W	45	35 N	140 E
7	40 N	100 W	46	10 N	05 W
8	40 N	80 W	47	10 N	20 E
9	50 N	60 W	48	10 N	40 E
10	20 N	100 W	49	15 N	100 E
11	10 N	80 W	50	10 N	120 E
12	10 S	70 W	51	0°	140 E
13	10 S	50 W	52	10 S	20 E
14	30 S	60 W	53	10 S	40 E
15	25 S	50 W	54	5 S	105 E
16	45 S	70 W	55	15 S	140 E
17	65 N	20 W	56	20 S	165 E
18	65 N	15 E	57	30 S	25 E
19	65 N	40 E	58	25 S	120 E
20	70 N	60 E	59	35 S	150 E
21	70 N	80 E	60	40 S	170 E
22	70 N	100 E	61	20 N	160 W
23	70 N	120 E	62	20 S	170 W
24	65 N	140 E	63	20 S	150 W
25	65 N	160 E	64	15 N	145 E
26	65 N	180 E	65	10 N	170 E
27	50 N	0°			
28	50 N	20 E			
29	50 N	40 E			
30	50 N	60 E			
31	50 N	80 E			
32	50 N	100 E			
33	50 N	120 E			
34	55 N	140 E			
35	55 N	160 E			
36	40 N	23 W			
37	30 N	0°			
38	30 N	20 E			
39	30 N	40 E			

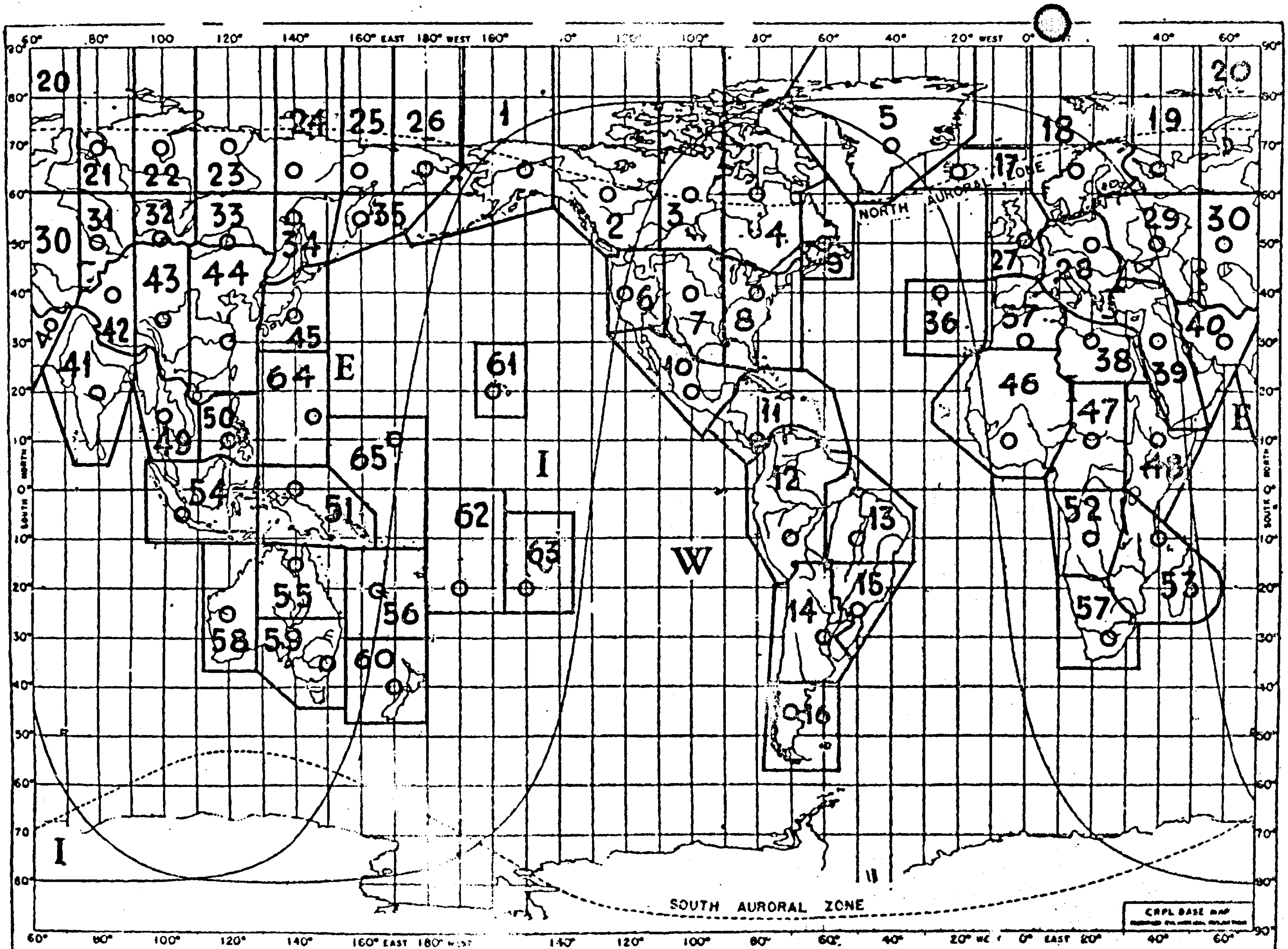


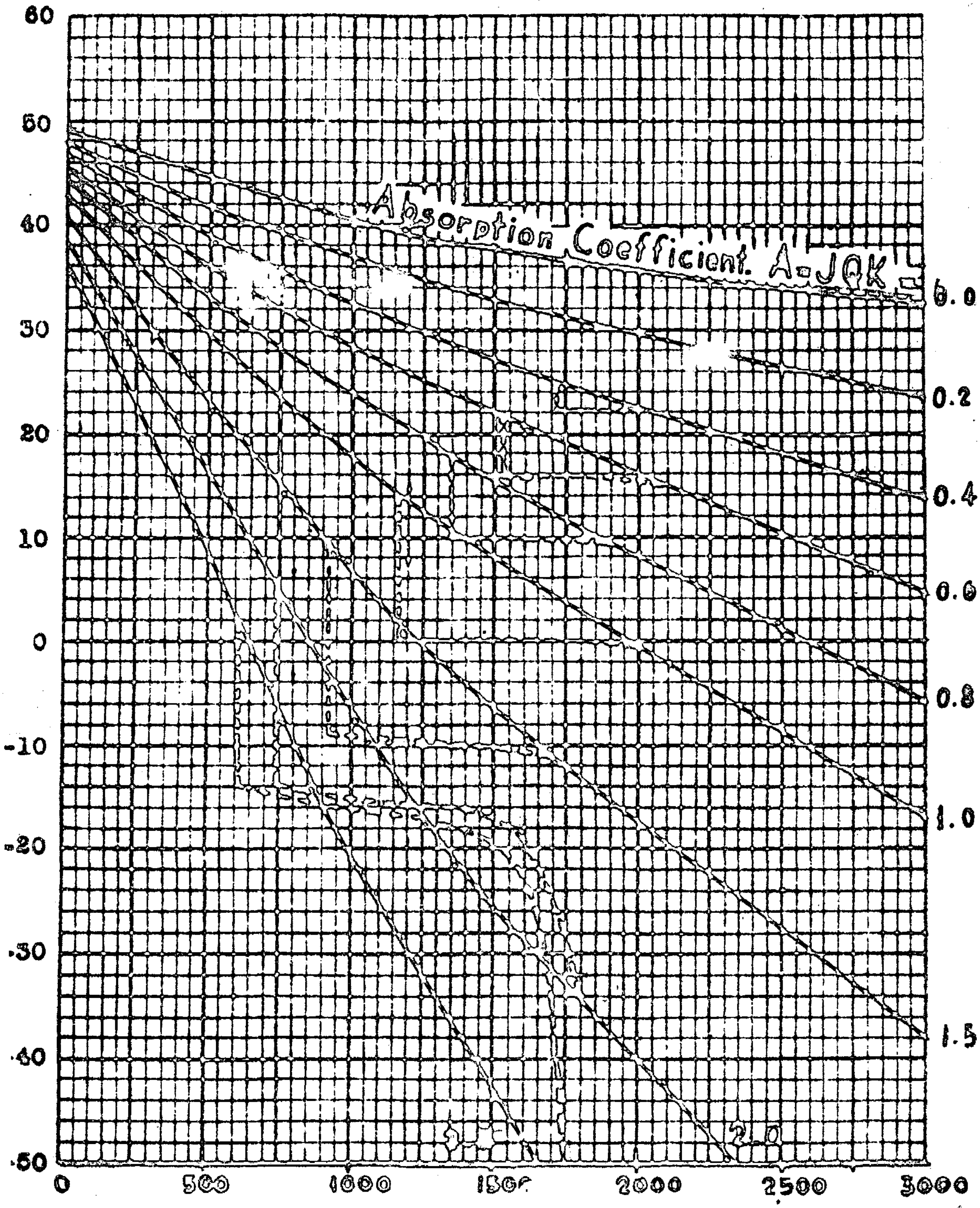
FIGURE Nº 1 *World map sh... ıg zones cove...d by predicted charts, and auroral zones*

Median Field Intensity(DB above 1 uv/m) for

Delivered Median Field Intensity
in Decibels above 1 Microvolt
per Meter for 1 Kilowatt Radiated
Power

6.08 Mc.

____ Used for Area to Area Charts. ..... E Layer Effects.



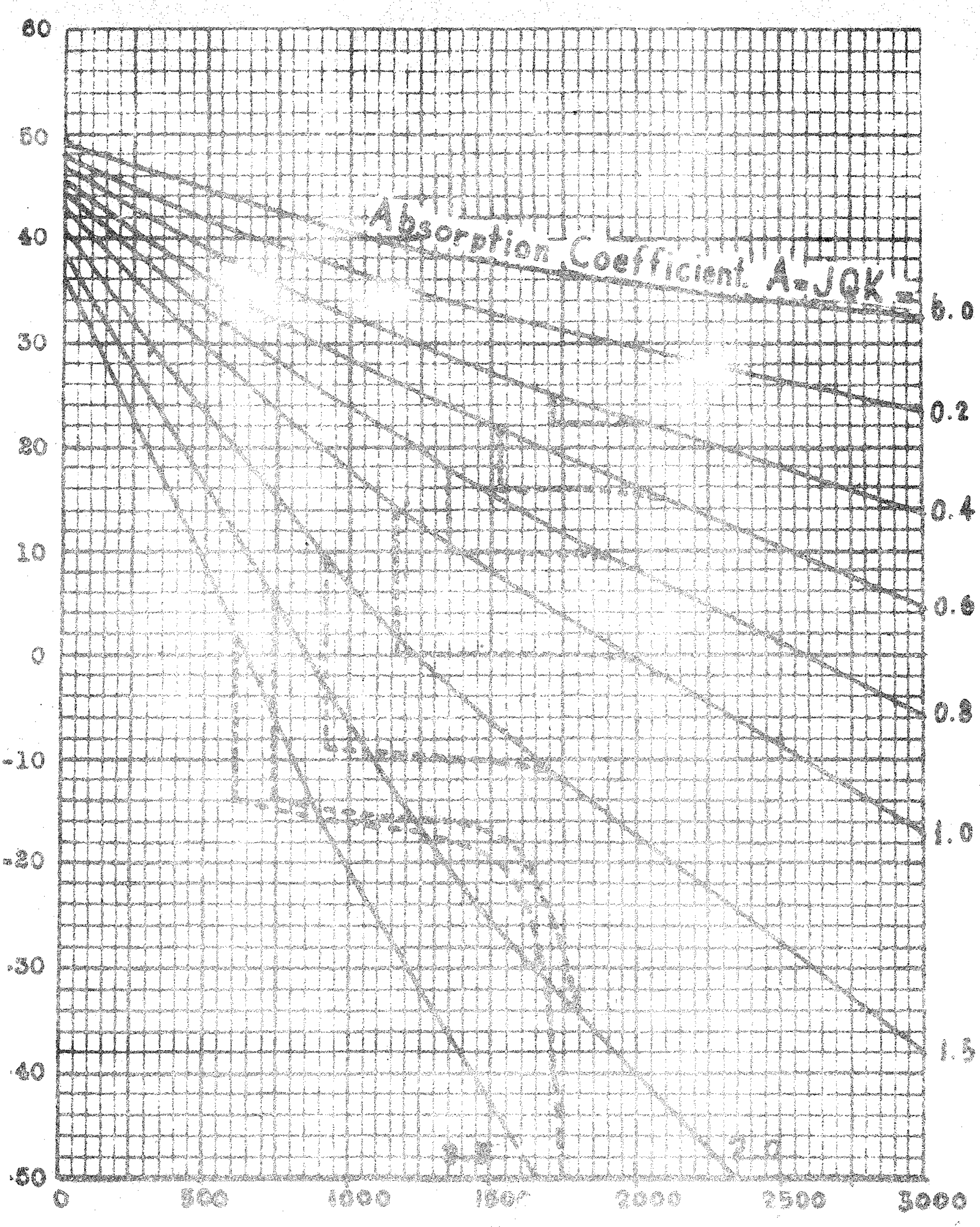
Distance in Km.

Figure 2

Delivered Median Field Intensity
in Decibels above 1 Microvolt
per Meter for 1 Kilowatt Radiated
Power

6.08 Mc.

___ Used for Area to Area Charts. ....E Layer Effects.



Distance in Km.

Figure 2

Delivered Median Field Intensity
in Decibels above 1 Microvolt
per Meter for 1 Kilowatt Radiated
Power

9.64 Mc.

— Used for Area to Area Charts ---- E Layer Effects.

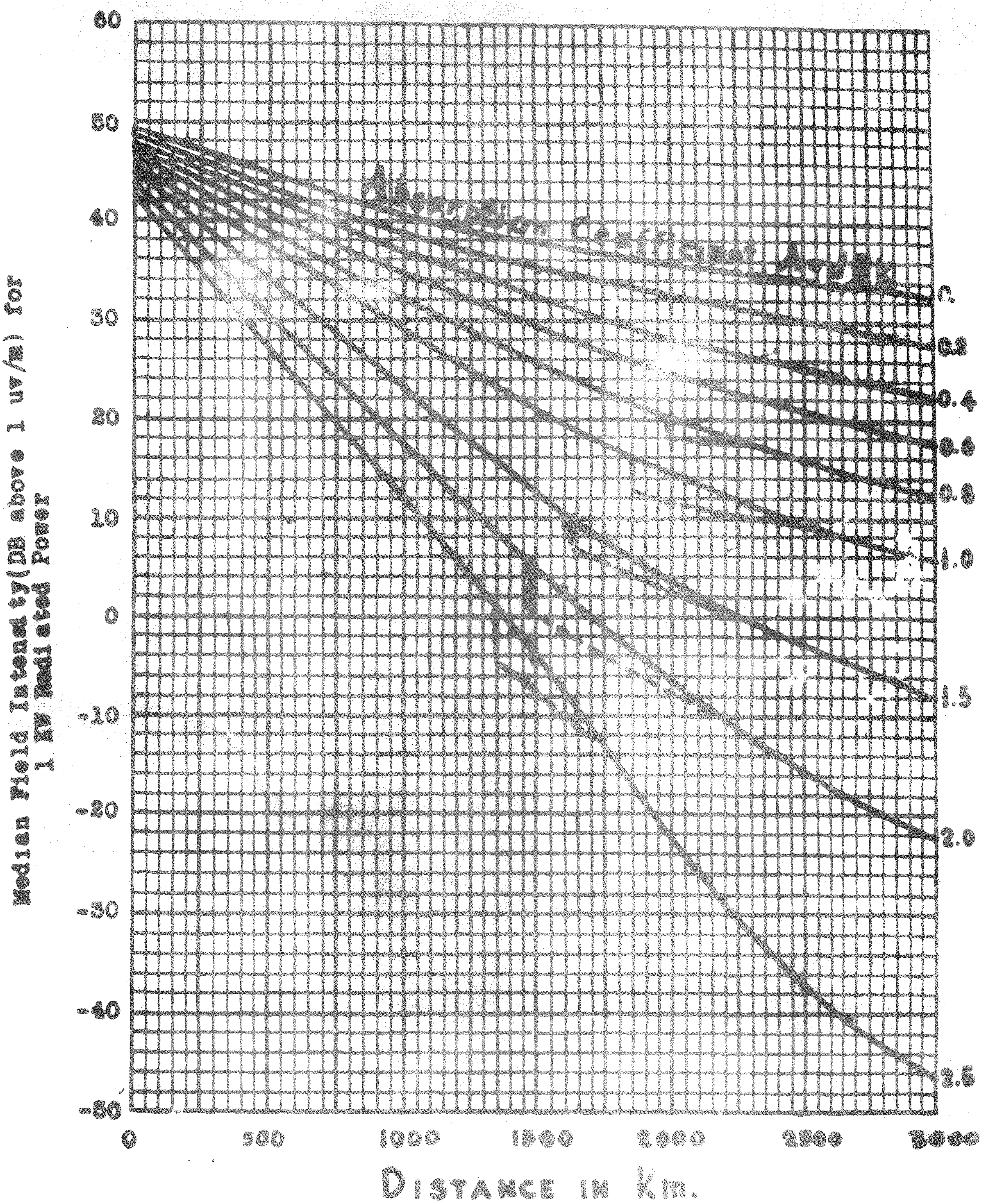


FIGURE 3

Delivered Median Field Intensity
in Decibels above 1 Microvolt
per Meter for 1 Kilowatt Radiated
Power

11.54 Mc.

___ USED FOR AREA TO AREA CHARTS.

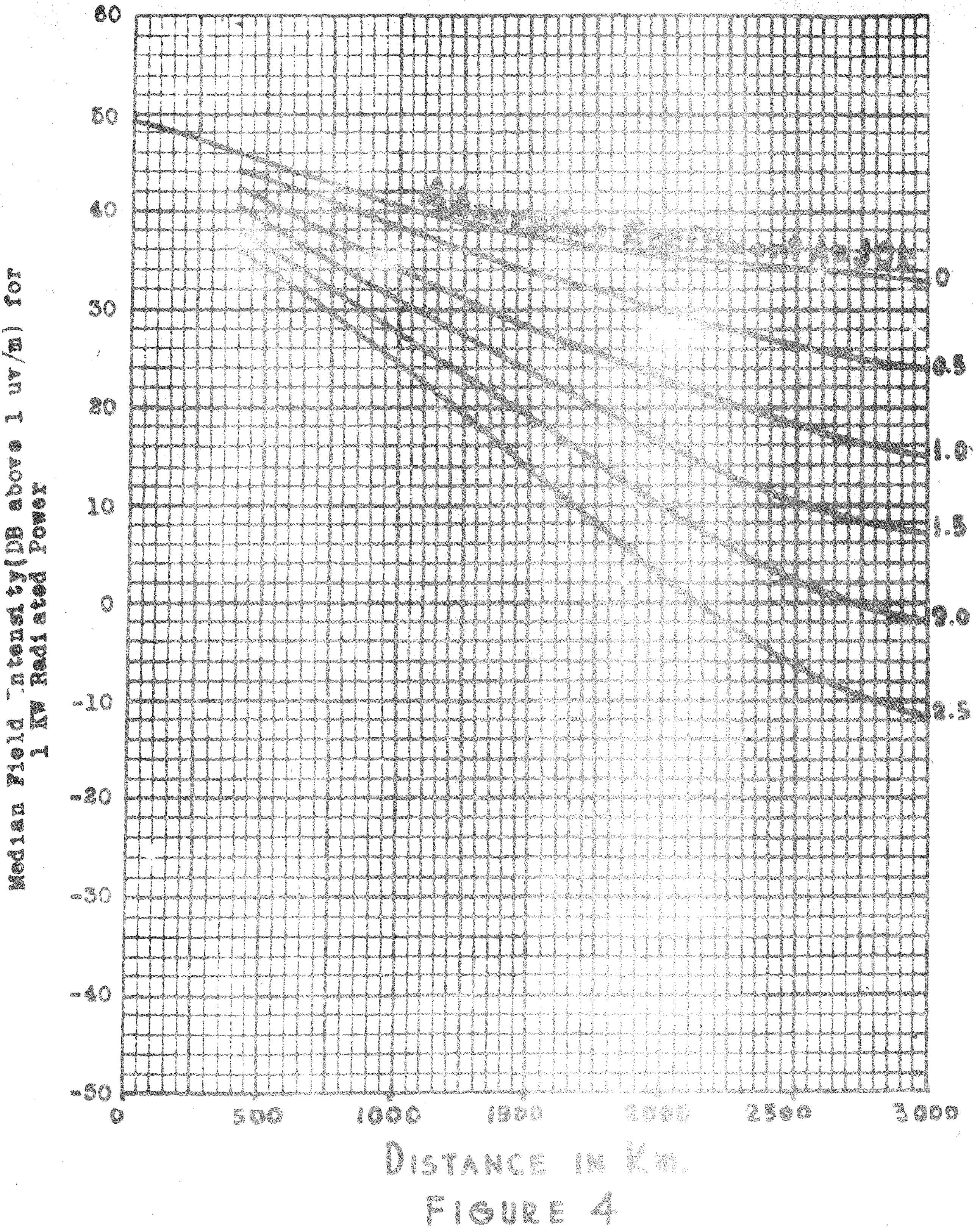
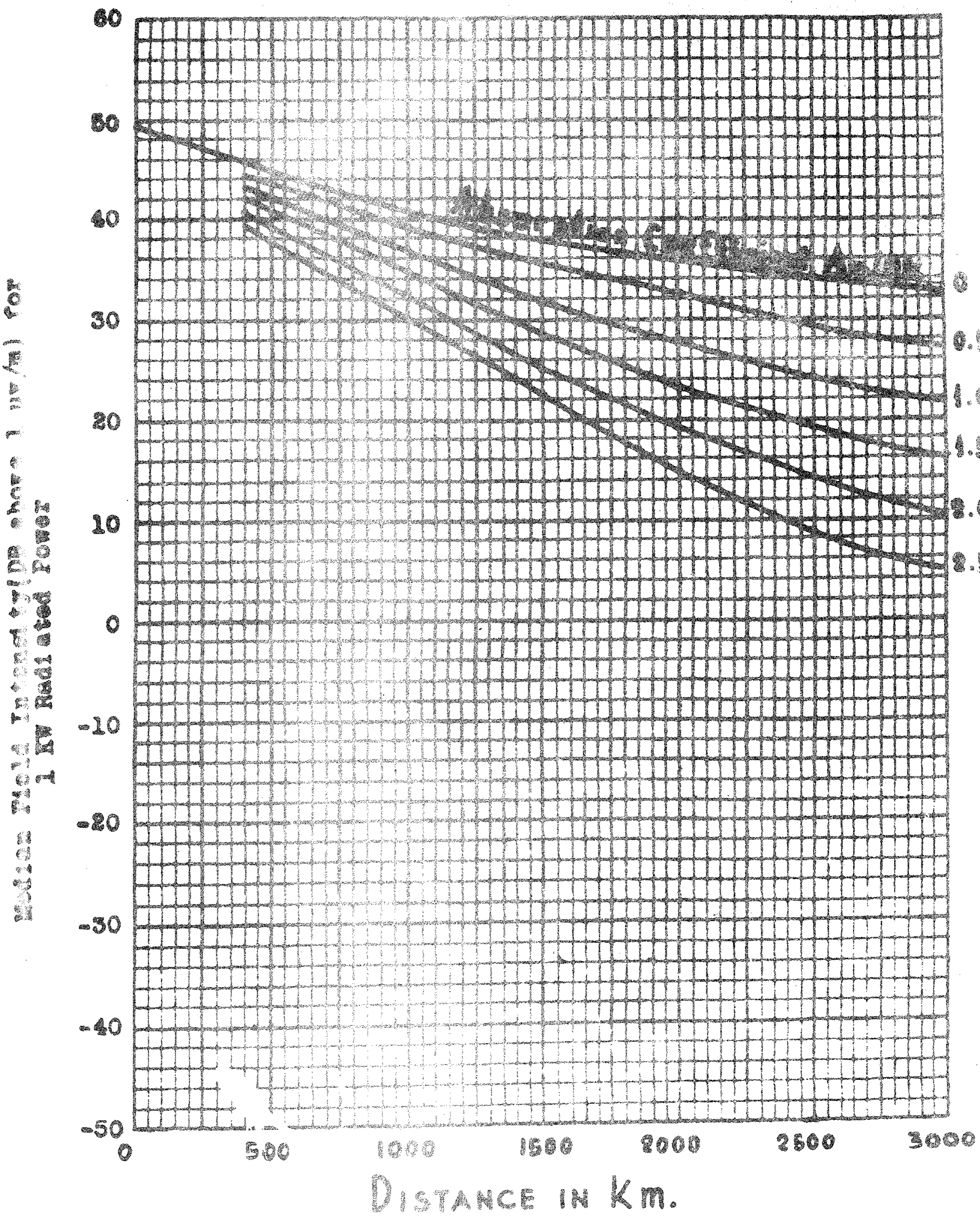


FIGURE 4

Delivered Median Field Intensity
in Decibels above 1 Microvolt
per Meter for 1 Kilowatt Radiated
Power

15.28 Mc.

—— Used for Area to Area Charts.



[illegible] Median Field Intensity
[illegible]ibels above 1 Microvolt
per Meter for 1 Kilowatt Radiated
Power

21.6 Mc.

——— USED FOR AREA TO AREA CHARTS

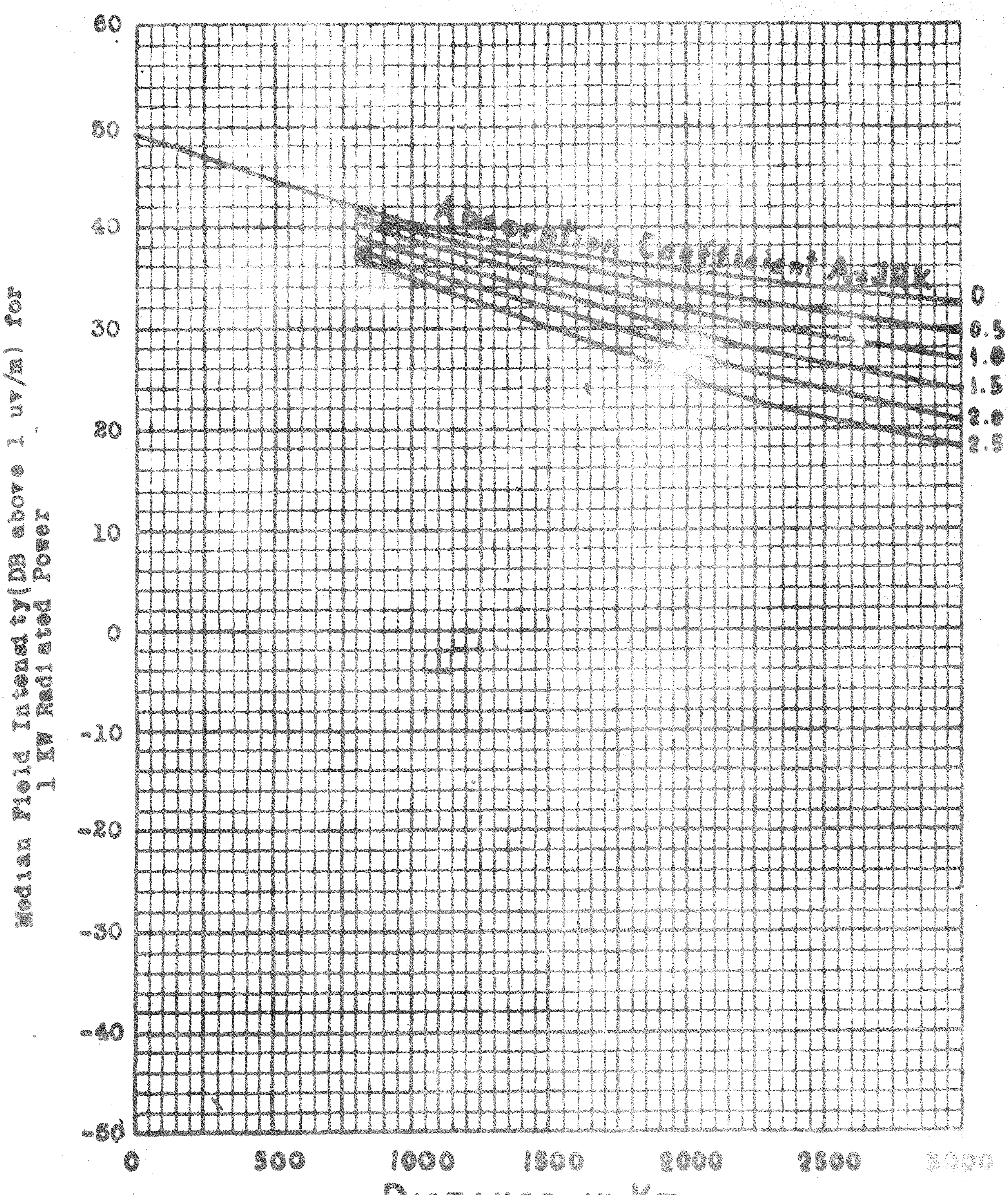
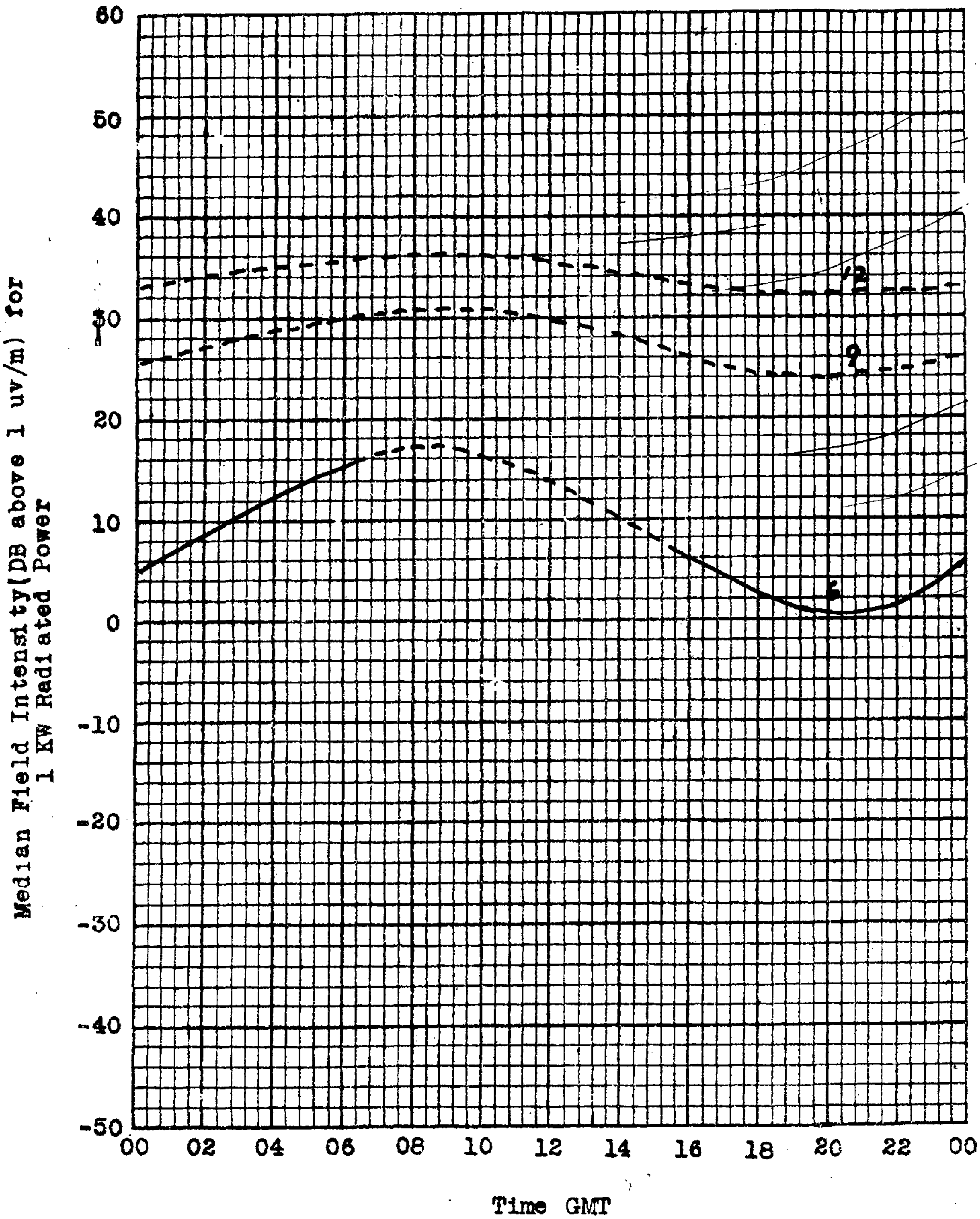


FIGURE 6

Delivered Median Field Intensity
in Decibels above 1 Microvolt
per Meter for 1 Kilowatt Radiated
Power

Transmitting Area 2 Receiving Area 2
Month JUNE Sunspot Number 125
Distance V.I. (600) Km.



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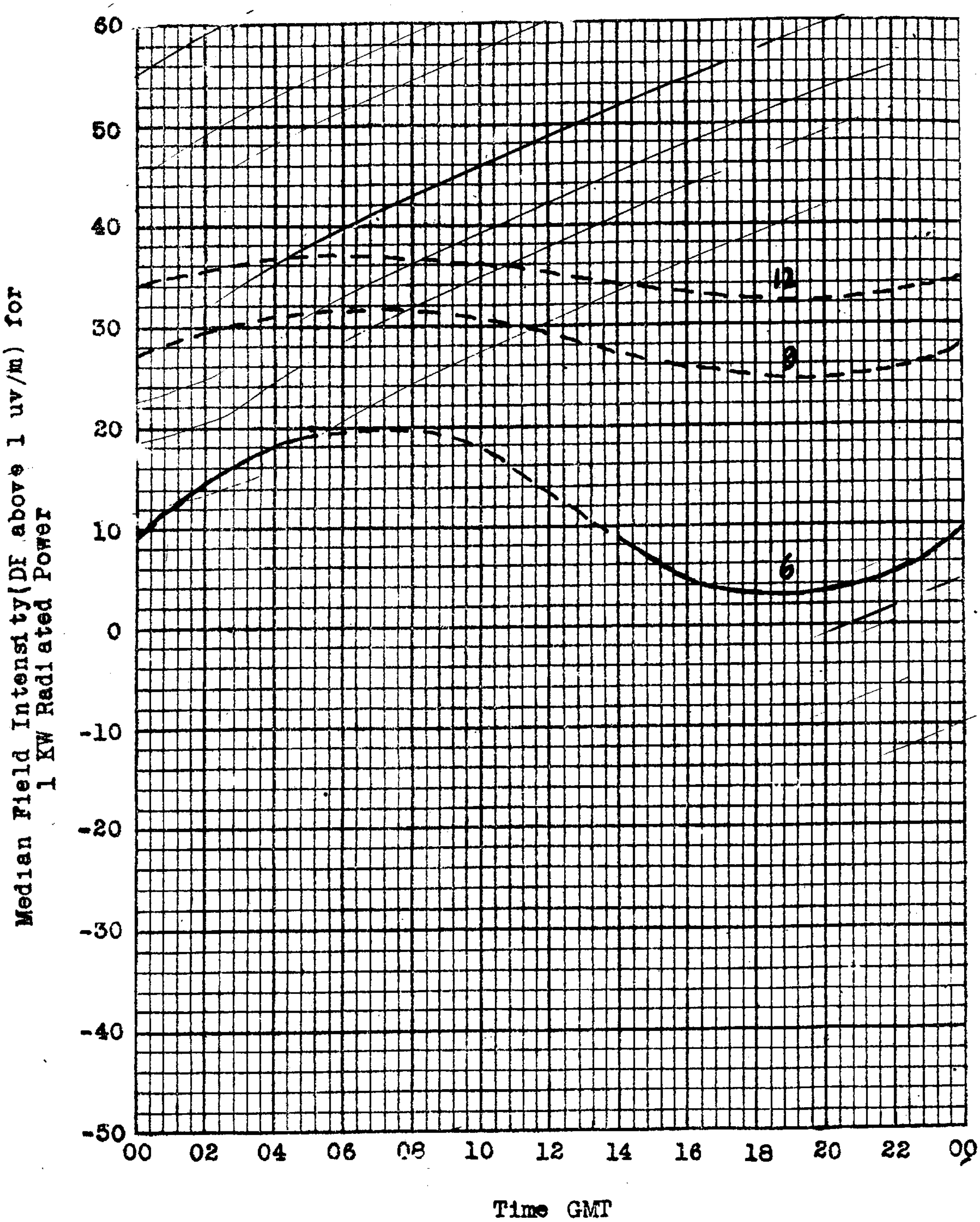
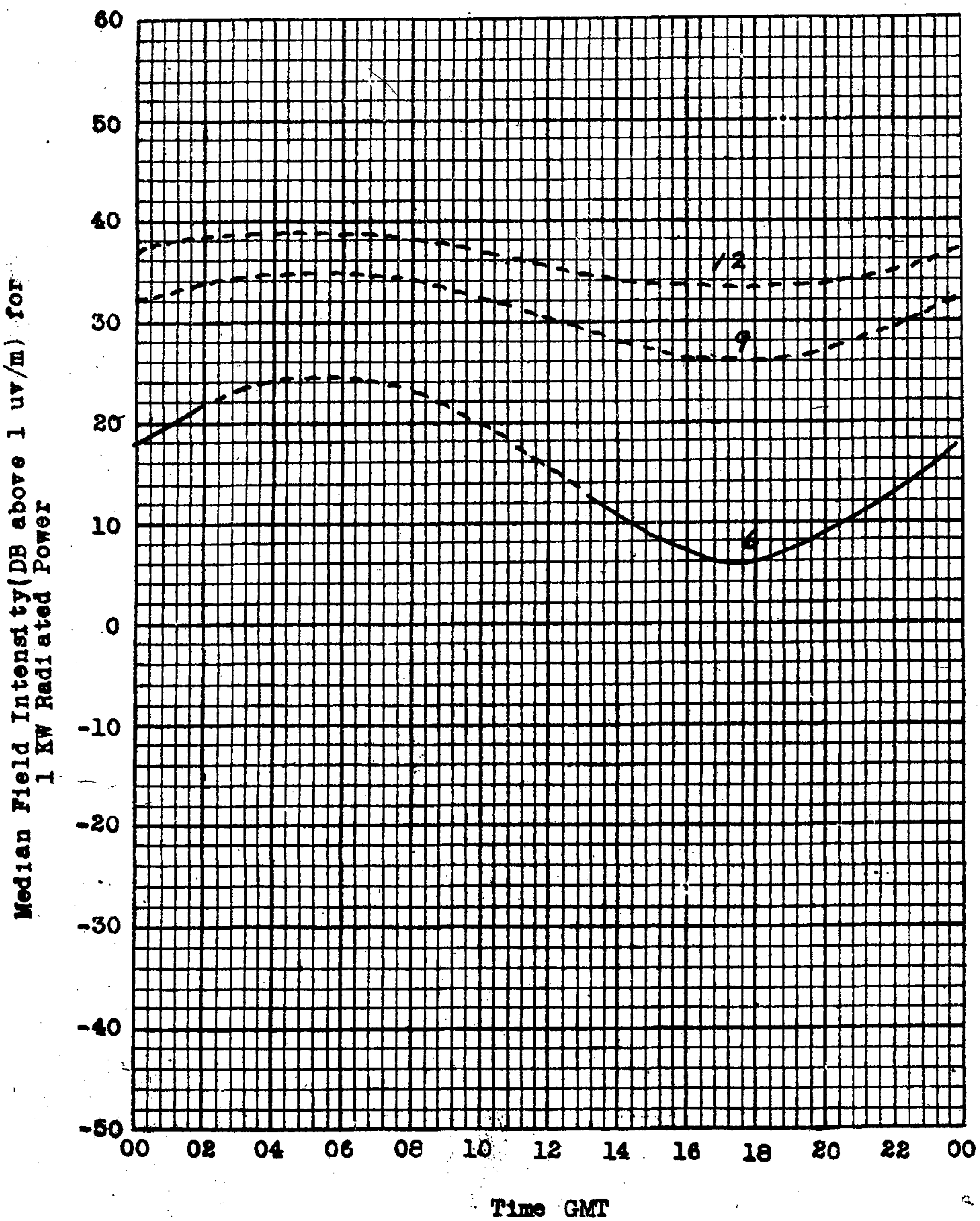
Delivered Median Field Intensity
in Decibels above 1 Microvolt
per Meter for 1 Kilowatt Radiated
Power

Transmitting Area 3 Receiving Area 3
Month JUNE Sunspot Number 125
Distance V.I.(500) Km.



Delivered Median Field Intensity
in Decibels above 1 Microvolt
per Meter for 1 Kilowatt Radiated
Power

Transmitting Area 4 Receiving Area 4
Month JUNE Sunspot Number 125
Distance 0 (500 Km.



Delivered Median Field Intensity
in Decibels above 1 Microvolt
per Meter for 1 Kilowatt Radiated
Power

Transmitting Area 5 Receiving Area 5
Month JUNE Sunspot Number 125
Distance 0(500) Km.