# REPORT ON THE SURVEY

# FOR

# MALAYSIA MICROWAVE NETWORK PROJECT

MARCH 1966

OVERSEAS TECHNICAL COOPERATION AGENCY

GOVERNMENT OF JAPAN

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## FOREWORD

The Government of Japan, at the request of the Government of Malaysia, has decided to execute the basic survey for the site selection and the propagation test as to the construction project of the microwave networks across the Malay Peninsular from Capital Kuala Lumpur to Kuantan and along the east coast from Kuantan to Kota Bharu, and has entrusted their practical work with the Overseas Technical Cooperation Agency.

In the light of great importance of the expansion of telecommunication and the development of the east coast in Malaysia, the Agency, for the purpose of its effective execution, organized and despatched to Malaysia the Survey Team consisting of five experts under the leadership of Mr. Yoshizo Toriyama, Councillor of the Ministry of Post and Telecommunication, during the period from September, 29, 1965 to January 6, 1966.

Fortunately, the survey works have been completed smoothly and upon returning home of all the members of the Team this survey report has been made ready for presentation.

This Agency, since it has been organized in June 1962 as an execution organization for the overseas technical cooperation planned by the Government of Japan, has been making steadily good results.

It would be the greatest pleasure to me if this survey report becomes of any help to promote the expansion of telecommunication which is considered to be one of the important policies of Malaysia, and to serve the betterment of the mutual friendship and economic intercourse between Malaysia and Japan.

In conclusion, on behalf of the Agency, I should like to express our sincere gratitude for facility and assistance extended to the mission by authorities of the Malaysia Government, particularlly by the Telecommunications Department.

March, 1966

Shinichi Shibusawa

S. Shibusawa

Director General
Overseas Technical Cooperation
Agency of Japan

CONTENTS

# I. PREFACE

# I PREFACE

## 1. Object

This survey report consists of the results of the site selection and the propagation test which, at the request of the Government of Malaysia, were carried out by Japanese Survey Team to promote the construction project of the microwave networks extending over about 500 Km from Kuala Lumpur to Kuantan and from Kuantan to Kota Bharu.

## 2. Member of Survey Team

The members included in the Survey Team are as follows.

| | | |
|---|---|---|
| Chief | Yoshizo Toriyama; | the Ministry of Post and telecommunication of Japan |
| Member | Yoshio Suzuki; | Nippon Telegragh and Telephone Public Corporation |
| Member | Toru Oyatsu; | Nippon Telegragh and Telephone Public Corporation |
| Member | Taizo Osako; | Nippon Telegraph and Telephone Public Corporation |
| Member | Keizo Tanaka; | Overseas Technical Cooperation Agency of Japan |

The Servey Team left for Kuala lumpur on September 29, 1965. Two persons of the Team, Mr. Yoshizo Toriyama and Mr. Keizo Tanaka, stayed in Malaysia untill Nobember 2, 1965 and other persons, Mr. Yoshio Suzuki, Mr. Toru Oyatsu, and Mr. Taizo Osako, stayed there untill January 6, 1966.

Throughout our stay, we have executed the survey under assistance and cooperation of the officers concerned of Telecommunications Department of Malaysia.

# II. RESULTS OF SURVEY

## II RESULTS OF SURVEY

### 1 Selection of Station Sites

We have executed the field study of the proposed microwave routes, from Kuala Lumpur to Kuantan and from Kuantan to Kota Bharu, jointly with the officers concerned of Telecommunications Department during the period from October 3 to 10.

After the field study, at the Head Quarters of Telecommunications Department, we have examined the detailed theoretical study about the location of the repeater stations.

#### 1-1 General Condition of Location of Station Sites

(1) Kuala Lumpur - Kuantan

As shown in Fig. 1, this route is made up of five sections with a total distance of about 200 km. Both terminal stations, Kula Lumpur (Bukit Nanas) and Kuantan, and one repeater station, Bukit Maran, are scheduled to make use of the exsisting stations at respective location.

On the other hand, three repeater stations, Gunong Sempah, Bukit Mentakab and Bukit Surai, become stations to be installed.

In addition to the reason of geographical features, from the fact that it has been intended to utilize the exsisting stations as much as possible for new microwave route, the porposed sections differ very much in distance one another, more over, in the sections between Bukit Nanas and Gunong Sempah, and between Bukit Surai and Kuantan, there are no ridges shielding the reflected wave, and the section between Gunong Sempah and Bukit Mentakab has a long propagation path exceeding the standard of 50 km.

(2) Kuantan - Kota Bharu

As shown in Fig. 2, this route is composed of five sections with an distance of about 308 km. Four proposed sites, Bukit Pelindong, Bukit

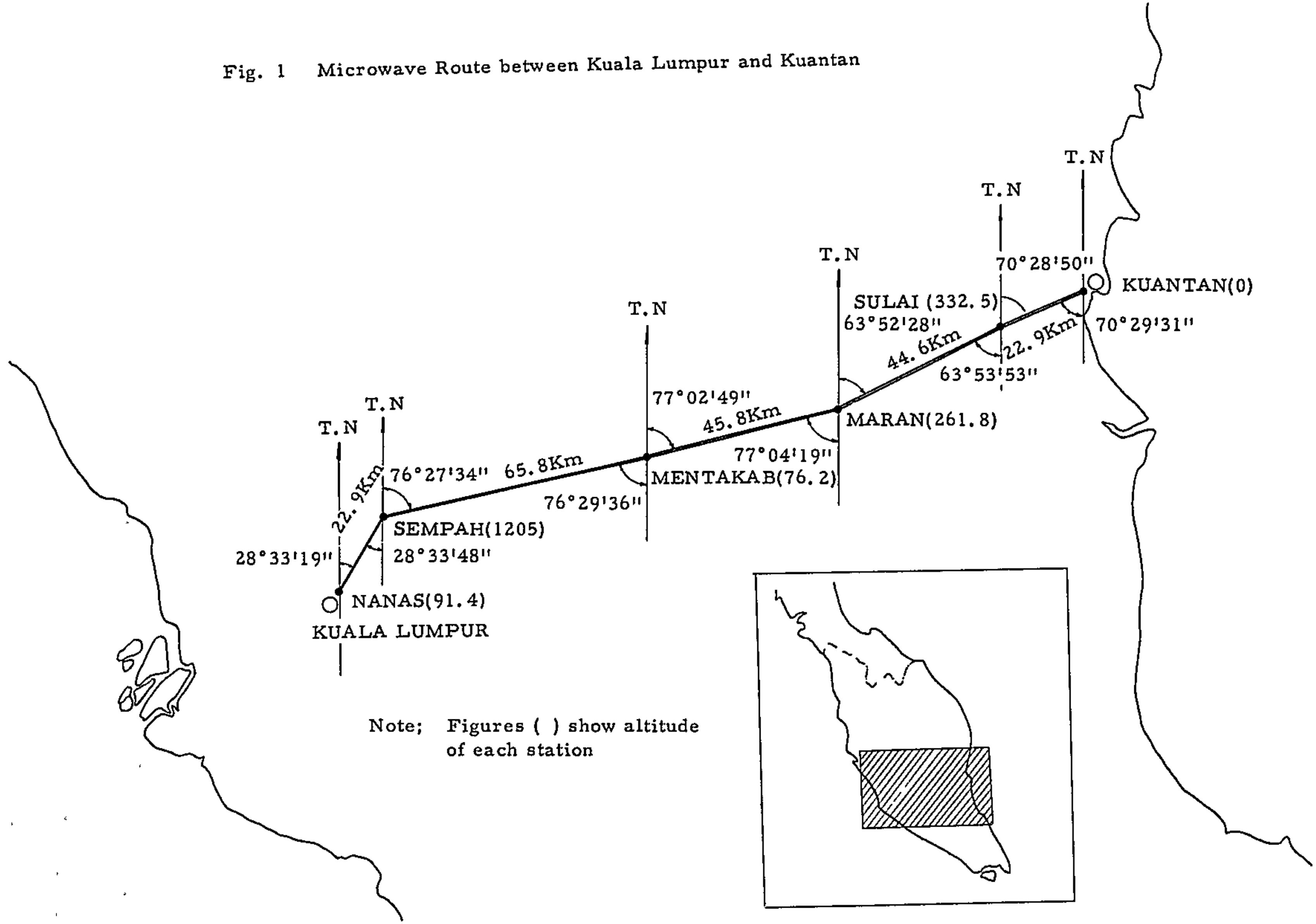
Kemuning, Bukit Besar and Kota Bharu, are scheduled to use the existing stations at every location and other two sites, Bukit Bauk and Bukit Bintang, should be newly installed.

As Fig. 2 shows, each propagation path in this route lies along or across the sea. These propagation paths are generally known to give unfavourable propagation performance. These features of propagation paths depend on the fact that it has been intended to locate the sites at places beside main road if possible, the majority of which runs along the coastal country.

Some of sections in this route have much longer distance exceeding the standard one. The sections, Pelindong-Kemuning, Kemuning-Bauk and Bintang-Kota Bharu, have no ridges shielding the reflected wave on the paths, and it is anticipated that the sea surface, paddy field etc. may get in to the reflection points.

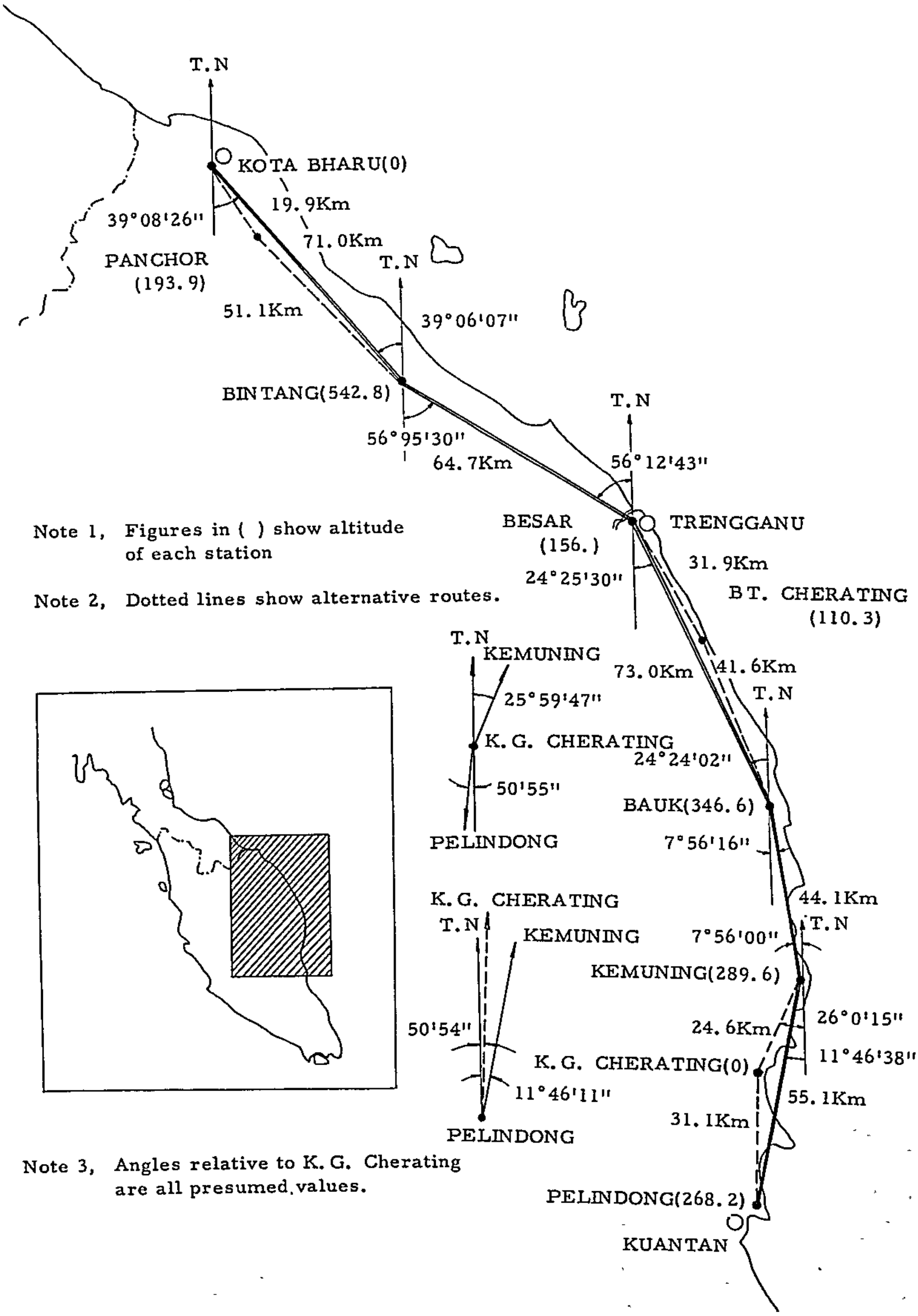
Accordingly propagation performance of such sections appears to present serious condition caused by K-type fading and duct-type fading.

Fig. 1 Microwave Route between Kuala Lumpur and Kuantan




Note; Figures ( ) show altitude of each station

Fig. 2 Microwave Route between Kuantan and Kota Bharu




Note 1, Figures in ( ) show altitude of each station

Note 2, Dotted lines show alternative routes.

Note 3, Angles relative to K.G. Cherating are all presumed values.

1.2 Proposed Sites

The location and altitude of proposed sites are shown in Table 1.

Table 1 Location and Altitude of Proposed Sites

(a) Kuala Lumpur - Kuantan

| Name of Proposed Site | Location | | Altitude (m) | Remarks |
|---|---|---|---|---|
| | North Latitude | East Longitude | | |
| Bukit Nanas | 3°09'10" | 101°40'10" | 91.4 | Existing Station (Microwave Station) |
| Gunong Sempah | 3°20'03" | 101°48'06" | 1,205 | New Station |
| Bukit Mentakab | 3°28'15" | 102°22'15" | 76.2 | - do - |
| Bukit Maran | 3°33'53" | 102°46'49" | 261.8 | Existing Station (V H F Relay Station) |
| Bukit Sulai | 3°44'27" | 103°08'25" | 232.5 | New Station |
| Kuantan | 3°48'25" | 103°19'38" | 0 | Existing Station (Telephone Exchange) |

(b) Kuantan - Kota Bharu

| Name of Proposed Site | Location | | Altitude (m) | Remarks |
|---|---|---|---|---|
| | North Latitude | East Longitude | | |
| Bukit Pelindong | 3°50'00" | 103°21'57" | 268.2 | Existing Station (VHF Station) |
| K.G. Cherating | 4°06'50" | 103°22'12" | 0 | New Station |
| Bukit Kemuning | 4°19'02" | 103°28'01" | 289.6 | Existing Station (VHF Station for Police) |
| Bukit Bauk | 4°41'48" | 103°24'50" | 346.6 | New Station |
| Bukit Besar | 5°18'25" | 103°08'09' | 156.4 | Existing Station (VHF Station for Police) |
| Bukit Bintang | 5°37'51" | 102°38'57" | 542.8 | New Station |
| Kota Bharu | 6°09'22" | 102°14'49" | 0 | Existing Station (Telephone Exchange) |

(1) Kuala Lumpur - Kuantan

i) Bukit Nanas

This proposed site is scheduled to make use an existing radio relay station which is the terminal station at Kuala Lumpur side of the micro-wave networks from Kuala Lumpur to Penang and to Singapore and of the other several VHF circuits. It is located on the hill at about center of the city,

Existing facilities such as tower can be used for new microwave system and there is no problem for the installation.

ii) Gunong Sempah

This is a new site to be located on the peak with the altituede of about 1,200m in the central mountains traversing the Malay Peninsular.

As regards this location, there may be much difficulty with the installation and maintenance, and it is necessary to construct an access road with a distance of 5-7km. However, in order to cross over the mountains chain likened to a roof of the Malay Peninsular and to connect the west part to the east part, this location may be considered to be unavoidable.

iii) Bukit Mentakab

This is a new site to be located on the small hill beside the main road, about 5Km from Mentakab town.

It is scheduled to branch the television signal to Mentakab town through this station from the microwave route in the future. An access road of several hundreds meters should be constructed from the main road.

Since this site is surrounded by rubber trees, the antenna tower of 30 meter or higher should be installed to have enough clearance above obstacle due to rubber trees.

iv) Bukit Maran

This proposed site is scheduled to utilize the existing radio relay station now operationg VHF circuits connecting Kuala Lumpur to Kuantan. There is no problem to be considered.

v) Bukit Sulai

This is a new site to be located on a hilltop with the altitude of about 330m.

There is a forestry road as far as half the way in the mountains and it can be used as part of access road, but it lies in the state ruined considerably. Therefore, the repair of existing road and the construction of a new access road of 1-2 Km in distance are necessary.

vi) Kuantan

Telephone exchange of Kuantan is scheduled to be used as a terminal station for this microwave route.

The height of antenna tower should be decided taking into account the future high buildings in the city.

(2) Kuantan - Kota Bharu

i) Bukit Pelindong (Kuantan)

The existing station for VHF circuits between Kuala Lumpur and Kuantan is scheduled to be used for terminal station of this route. This station is located on the hilltop about 270m in altitude and about 3Km from Kuantan.

Pelindong and telephone exchange of Kuantan will be connected by the cable system each other.

ii) K.G. Cherating

This is a new site to be located on the flat ground beside main road. In case the propagation performance of the section between Pelindong and Kemuning may be intolerable, this station intended to be inserted in the middle of this section.

The height of antenna tower at this site should be sufficient to go over the obstacles such as coconut trees growing nearby. On the other hand, too high tower may make the reflection point visible from the site and upon the change of K (effective radius coefficient of earth), some fear that paddy field or swamp may get into reflection point will be initiated. Therefore, the height of antenna tower has to be limited lest the reflection point should be visible from the site, taking advantage that both the adjacent stations, Pelindong and Kemuning, are situated rather high.

iii) Bukit Kemuning

The existing VHF relay station for police is scheduled to be used as this site. This station is located on the hill about 290m in height. There are no problem to be considered especially.

iv) Bukit Bauk

This is a new site to be located on the mountain with an altitude of about 350m. An access road of 5 Km in distance should be installed.

As the proposed site is surrounded by thick jungle, it is necessary to clear the shielding caused by forest in the directions of adjacent stations, especially towards Kemuning, by properly determining the antenna height.

v) Bukit Besar

The existing VHF relay station for police located on the hill nearby Trengganu town is intended to be used for this microwave station.

The antenna tower of 30m or higher is necessary because of insufficient clearance between Bauk and Besar.

vi) Bukit Bintang

This is a new site to be located on the mountain with an altitude of about 540m. An access road of 4-5Km in distance should be constructed.

Since the area proposed for the site at mountain top is extremely restricted, to obtain sufficient area for the installation, it is necessary to level the land or piling the soil at considerable extent. Otherwise, to avoid the narrow mountain top, it may be permissible to lay the site at the comparatively flat land a few decades meters below the mountain top.

In latter case, it should be confirmed that the clearance in the direction of the adjacent stations will not be disturbed by neighbouring obstacles such as trees and protuberant land.

vii) Kota Bharu

Telephone exchange in Kota Bharu is scheduled to be used for the microwave terminal station, and the existing 50m tower for VHF aerials is available for mounting microwave dishes.

As regards the determination of antanna height, it is necessary to take the lower and upper limit of antenna height into account.

The lower limit means the lowest height which is sufficient to make clear the obstacles such as the future high buildings in the city and coconut trees in the neighbouring areas ranging several hundreds meters from the site.

The upper limit means the highest height lest the reflection point should be visible from the antenna position.

Antennas should be placed at proper position within lower and upper limit.

1.3 Calculated Figures of Various Foundamental Factors on Each Section

The calculated figures of various foundamental factors and profile maps of each section are shown in Table 2 - 18 and Fig. 3-24 respectively.

Those figures in the tables have been calculated under the following condition and assumption.

(1) Those figures are theoretical values based on the data given by the

profile maps, but the results of propagation test are not included.

(2) It is assumed that the dishes with a diameter of 4m will be used at any stations.

(This assumption is intended only for the purpose of making the calculation easy, but not actual)

(3) The antenna height at each station is assumed to take the value considered nearly suitable as obtained from the profile maps and the results of field study.

(4) As regards the reflection coefficient of various kinds of the reflection point, in accordance with our experimental data in Japan, the following values are adopted here.

| | | | |
|---|---|---|---|
| Water surface | : | 1 | ( 0dB) |
| Paddy field, Swamp | : | 0.8 | ( 2dB) |
| Dry field | : | 0.5 | ( 6dB) |
| Mountain, Forest | : | 0.2 | (14dB) |

(Note: All figures above are corresponding with 6GC.)

(5) Frequency to be used is 6GC.

(6) The calculation of the necessary D/U (the ratio of desirable signal to undesirable one) for the required S/D ( the ratio of signal to distortion noise) is based on the theoretical formula by R. G. Medhurest.

(7) The allowable noise power due to the propagation distortion is assumed to take the value in the noise distribution on SF-U1 system (6GC, 1,200ch) of NTT (Nippon Telegraph and Telephone Public Corporation) which is 3.1 pW (85dB) per section.

(8) All figures are calculated assuming the both atmospheric conditions to be with K as 4/3 and 2/3.

(9) As to the antenna height,

i) considering that the space diversity reception may be adopted on a section between Sempah and Mentakab, the calculation of antenna height at Mentakab has been done on both the main antenna and the one for the space diversity reception to be located 15m apart.

ii) Taking the consideration that the antenna height is closely related to the position of reflection point, the calculations for the antenna heights of 30m and 40m at K. G. Cherating for the both sections and those of 30m, 40m, 50m and 60m at Kota Bharu have been performed respectively.

iii) Considering the fact that the clearance between Bauk and Besar is not sufficient and the height and location of ridge are not made clear, the calculations for the antenna heights of 30m and 40m at the both stations have been carried out respectively.

It is desirable that the results of item ii) and iii) will be of help to the further field study about the reflection points and the height and location of ridge.

In addition, the results of calculation and profile maps concerned with the case that Bukit Cherating and Bukit Panchor will be used as the intermediate repeater stations are shown in Table 19 - 30 and Fig. 25 - 34 respectively for reference purpose.

Table 2 Contents of Each Table of Calculated Figures

| Name of Section | Figure No. K=4/3 | Figure No. K=2/3 | Condition of Calculation Figueres in () show antenna height above ground | Table K=4/3 | Table K=2/3 |
|---|---|---|---|---|---|
| BT.NANAS ~G.SEMPAH | 4-3 | 4-14 | NANAS(30) ·SEMPAH(5) | 4-3 | 4-11 |
| G.SEMPAH ~BT.MENTAKAB | 4-4 | 4-15 | SEMPAH(5) ·MENTAKAB(50) | 4-3 | 4-11 |
| | | | 〃 (5) · 〃 (65) | 4-5 | 4-13 |
| BT.MENTAKAB ~BT.MARAN | 4-5 | 4-16 | MENTAKAB(50) ·MARAN(20) | 4-3 | 4-11 |
| BT.MARAN ~BT.SULAI | 4-6 | 4-17 | MARAN(20) ·SULAI(20) | 4-4 | 4-12 |
| BT.SULAI ~KUANTAN | 4-7 | 4-18 | SULAI(20) ·KUANTAN(35) | 4-4 | 4-12 |
| BT.PELINDONG~KG.CHERATING | 4-8 | 4-19 | PELINDONG(20)·CHERATING(30) | 4-6 | 4-14 |
| | | | 〃 (20)· 〃 (40) | 4-8 | 4-16 |
| KG.CHERATING~BT.KEMUNING | 4-9 | 4-20 | CHERATING(30)·KEMUNING(10) | 4-6 | 4-14 |
| | | | 〃 (40)· 〃 (10) | 4-8 | 4-16 |
| BT.KEMUNING ~BT.BAUK | 4-10 | 4-21 | KEMUNING(10) ·BAUK(20) | 4-6 | 4-14 |
| BT.BAUK ~BT.BESAR | 4-11 | 4-22 | BAUK(30) ·BESAR(30) | 4-7 | 4-15 |
| | | | 〃 (40) · 〃 (40) | 4-9 | 4-17 |
| BT.BESAR ~BT.BINTANG | 4-12 | 4-23 | BESAR(10) ·BINTANG(10) | 4-7 | 4-15 |
| BT.BINTANG ~KOTA BHARU | 4-13 | 4-24 | BINTANG(10) ·KOTA BHARU(40) | 4-7 | 4-15 |
| | | | 〃 (〃) · 〃 (30) | 4-9 | 4-17 |
| | | | 〃 (〃) · 〃 (50) | 4-10 | 4-18 |
| | | | 〃 (〃) · 〃 (60) | 4-10 | 4-18 |
| BT.PELINDONG~BT.KEMUNING | 4-25 | 4-30 | PELINDONG(20)·KEMUNING(10) | 4-19 | 4-25 |
| BT.BAUK ~BT.CHERATING | 4-26 | 4-31 | BAUK(20) ·CHERATING(20) | 4-20 | 4-26 |
| BT.CHERATING~BT.BESAR | 4-27 | 4-32 | CHERATING(20)·BESAR(50) | 4-20 | 4-26 |
| | | | 〃 (20)· 〃 (70) | 4-21 | 4-27 |
| BT.BINTANG ~BT.PANCHOR | 4-28 | 4-33 | BINTANG(10) ·PANCHOR(10) | 4-22 | 4-28 |
| BT.PANCHOR ~KOTA BHARU | 4-29 | 4-34 | PANCHOR(10) ·KOTA BHARU(40) | 4-22 | 4-28 |
| | | | 〃 (10) · 〃 (30) | 4-23 | 4-29 |
| | | | 〃 (10) · 〃 (50) | 4-23 | 4-29 |
| | | | 〃 (10) · 〃 (60) | 4-24 | 4-30 |

Table 3 Calculated Figures of Various Foundamental Factors on Each Section ( K = 4/3 )

| Item \ Name of Station | | BT.NANAS | | G.SEMPAH | | BT.MENTAKAB | | BT.MARAN | |
|---|---|---|---|---|---|---|---|---|---|
| Altitude | | m | 91.4 | | 1205 | | 76.2 | | 261.8 |
| Antenna Height above Ground | | m | 30 | | 5 | | 50 | | 20 |
| Effective Antenna Height | | m | | 91.2 | 914.5 | 944.1 | 74.6 | 70.4 | 174.7 |
| Half Pitch of Height Pattern | | m | | 0.31 | 3.16 | 11.0 | 0.87 | 3.28 | 8.14 |
| Effective Reflection Coefficient | Included Angle between Direct and Reflected Wave | ° ' " | | 5°47'08" | 27'17" | 8'09" | 1°34'33" | 26'06" | 10'40" |
| Effective Reflection Coefficient | Attenuation of Reflected Wave due to Antenna Directivity | dB | | 35 | 3.0 | 0.3 | 30 | 2.7 | 0.4 |
| Effective Reflection Coefficient | Shielding Ridge Loss of Reflected Wave | dB | | 0 | | 18 | | 12 | |
| Effective Reflection Coefficient — Reflection Point | Distance from Station | Km | | 1.7 | 21.2 | 60.6 | 5.2 | 13.3 | 32.5 |
| Effective Reflection Coefficient — Reflection Point | Classification of Condition | | | City | | Mountain | | Mountain | |
| Effective Reflection Coefficient — Reflection Point | Reflection Loss | dB | | 14 | | 14 | | 14 | |
| Effective Reflection Coefficient — Reflection Point | Altitude | m | | 30 | | 50 | | 45 | |
| Effective Reflection Coefficient — Total | Total Loss of Reflect Wave | dB | | 52 | | 62.3 | | 29.1 | |
| Effective Reflection Coefficient — Total | Effective Reflection Coefficient | | | 0.0025 | | 0.00077 | | 0.35 | |
| Path Difference | Path Difference between Direct and Reflected Wave | m | | 7.28 | | 2.14 | | 0.54 | |
| Path Difference | Required D/U for S/D of 85 dB | dB | | 42.0 | | 20.8 | | Less than 10 | |
| Propagation Path Length | | Km | | 22.9 | | 65.8 | | 45.8 | |
| Propagation Loss at Free Space | | dB | | 135.2 | | 144.4 | | 141.2 | |
| Profile Map | | | | Fig. 3 | | Fig. 4 | | Fig. 5 | |
| Clearance | | | | Enough | | Enough | | Enough | |
| Remarks | | | | | | Antenna height at Mentakab must clear local obstruction ( rubber trees with the height of more than 30m ) | | the same as the left | |

Table 4 Calculated Figures of Various Foundamental Factors on Each Section ( K = 4/3 )

| Item \ Name of Station | Unit | BT. MARAN | | BT. SULAI | | KUANTAN | | |
|---|---|---|---|---|---|---|---|---|
| *Altitude* | m | 261.8 | | 332.5 | | 0 | | |
| Antenna Height above Ground | m | 20 | | 20 | | ·35 | | |
| Effective Antenna Height | m | 200.6 | 254.0 | 328.7 | 34.7 | | | |
| Half Pitch of Height Pattern | m | 2.19 | 2.78 | 8.00 | 0.84 | | | |
| Effective Reflection Coefficient: Included Angle between Direct and Reflected Wave | ° ' " | 47'39" | 29'59" | 10'43" | 1°42'23" | | | |
| Effective Reflection Coefficient: Attenuation of Reflected Wave due to Antenna Directivity | dB | 9.7 | 3.7 | 0.4 | 30 | | | |
| Effective Reflection Coefficient: Shielding Ridge Loss of Reflected Wave | dB | 29.4 | | 0 | | | | |
| Effective Reflection Coefficient: Reflection Point: Distance from Station | Km | 19.0 | 25.6 | 20.1 | 2.1 | | | |
| Effective Reflection Coefficient: Reflection Point: Classification of *Condition* | | Mountain | | Swamp | | | | |
| Effective Reflection Coefficient: Reflection Point: Reflection Loss | dB | 14 | | 2 | | | | |
| Effective Reflection Coefficient: Reflection Point: Altitude | m | 60 | | 0 | | | | |
| Effective Reflection Coefficient: Total: Total Loss of Reflect Wave | dB | 56.8 | | 32.4 | | | | |
| Effective Reflection Coefficient: Total: Effective Reflection Coefficient | | 0.0015 | | 0.024 | | | | |
| Path Difference: Path Difference between Direct and Reflected Wave | m | 2.28 | | 1.03 | | | | |
| Path Difference: Required D/U for S/D of 85 dB | dB | 22.0 | | Less than 10 | | | | |
| *Propagation Path Length* | Km | 44.6 | | 22.2 | | | | |
| Propagation Loss at Free Space | dB | 141.0 | | 134.9 | | | | |
| Profile Map | | Fig. 6 | | Fig. 7 | | | | |
| Clearance | | Enough | | Enough | | | | |
| Remarks | | | | | | | | |

Table 5 Calculated Figures of Various Foundamental Factors on Each Section ( K = 4/3 )

| Item \ Name of Station | | | Unit | G.SEMPAH | BT.MENTAKAB | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Altitude | | | m | 1205 | 76.2 | | | | |
| Antenna Height above Ground | | | m | 5 | 65 | | | | |
| Effective Antenna Height | | | m | 948.3 | 89.2 | | | | |
| Half Pitch of Height Pattern | | | m | 9.21 | 0.87 | | | | |
| Effective Reflection Coefficient | Included Angle between Direct and Reflected Wave | | ° ' " | 9'28" | 1°37'45" | | | | |
| | Attenuation of Reflected Wave due to Antenna Directivity | | dB | 0.3 | 30 | | | | |
| | Shielding Ridge Loss of Reflected Wave | | dB | 18 | | | | | |
| | Reflection Point | Distance from Station | Km | 60.0 | 5.8 | | | | |
| | | Classification of Condition | | Mountain | | | | | |
| | | Reflection Loss | dB | 14 | | | | | |
| | | Altitude | m | 50 | | | | | |
| | Total | Total Loss of Reflect Wave | dB | 62.3 | | | | | |
| | | Effective Reflection Coefficient | | 0.00077 | | | | | |
| Path Difference | Path Difference between Direct and Reflected Wave | | m | 2.57 | | | | | |
| | Required D/U for S/D of 85 dB | | dB | 24.2 | | | | | |
| Propagation Path Length | | | Km | 65.8 | | | | | |
| Propagation Loss at Free Space | | | dB | 144.4 | | | | | |
| Profile Map | | | | Fig. 4 | | | | | |
| Clearance | | | | Enough | | | | | |
| Remarks | | | | | | | | | |

Table 6 Calculated Figures of Various Foundamental Factors on Each Section ( K = 4/3 )

| Item \ Name of Station | | | Unit | BT. PELINDONG | K.G. CHERATING | | BT. KEMUNING | | BT. BAUK | |
|---|---|---|---|---|---|---|---|---|---|---|
| Altitude | | | m | 268.2 | 0 | | 289.6 | | 346.6 | |
| Antenna Height above Ground | | | m | 20 | 30 | | 10 | | 20 | |
| Effective Antenna Height | | | m | 243.1 | 29.3 | 29.6 | 270.7 | 266.3 | 322.3 | |
| Half Pitch of Height Pattern | | | m | 13.3 | 1.60 | 1.14 | 10.4 | 1.71 | 2.07 | |
| Effective Reflection Coefficient | Included Angle between Direct and Reflected Wave | | ° ' " | 6'30" | 53'46" | 1°15'26" | 8'18" | 50'18" | 41'29" | |
| | Attenuation of Reflected Wave due to Antenna Directivity | | dB | 0.1 | 12.2 | 26 | 0.3 | 11.0 | 7.3 | |
| | Shielding Ridge Loss of Reflected Wave | | dB | 0 | | 0 | | 0 | | |
| | Reflection Point | Distance from Station | Km | 27.7 | 3.4 | 2.4 | 22.2 | 19.9 | 24.2 | |
| | | Classification of Condition | | Field | | Swamp | | Swamp | | |
| | | Reflection Loss | dB | 6 | | 2 | | 2 | | |
| | | Altitude | m | 0 | | 0 | | 10 | | |
| | Total | Total Loss of Reflect Wave | dB | 18.3 | | 28.3 | | 20.3 | | |
| | | Effective Reflection Coefficient | | 0.122 | | 0.037 | | 0.097 | | |
| Path Difference | Path Difference between Direct and Reflected Wave | | m | 0.46 | | 0.65 | | 3.89 | | |
| | Required D/U for S/D of 85 dB | | dB | Less than 10 | | Less than 10 | | 31.2 | | |
| Propagation Path Length | | | Km | 31.1 | | 24.6 | | 44.1 | | |
| Propagation Loss at Free Space | | | dB | 137.8 | | 135.8 | | 140.9 | | |
| Profile Map | | | | Fig. 8 | | Fig. 9 | | Fig. 10 | | |
| Clearance | | | | Enough | | Enough | | Enough | | |
| Remarks | | | | | | | | | | |

Table 7 Calculated Figures of Various Foundamental Factors on Each Section ( K = 4/3 )

| Item | | | Unit | BT. BAUK | BT. BESAR | | BT. BINTANG | | KOTA BHARU | |
|---|---|---|---|---|---|---|---|---|---|---|
| Altitude | | | m | 346.6 | 156.4 | | 542.8 | | 0 | |
| Antenna Height above Ground | | | m | 30 | 30 | 10 | 10 | | 40 | |
| Effective Antenna Height | | | m | 250.4 | 144.5 | 130.9 | 394.5 | 296.4 | 38.4 | |
| Half Pitch of Height Pattern | | | m | 6.32 | 3.64 | 2.05 | 6.18 | 23.0 | 3.00 | |
| Effective Reflection Coefficient | | Included Angle between Direct and Reflected Wave | ° ' " | 13'36" | 23'36" | 41'52" | 13'57" | 2'57" | 39'09" | |
| | | Attenuation of Reflected Wave due to Antenna Directivity | dB | 0.6 | 2.1 | 7.5 | 0.7 | 0 | 6.5 | |
| | | Shielding Ridge Loss of Reflected Wave | dB | *More than 31* | | *More than 28* | | *0* | | |
| | Reflection Point | Distance from Station | Km | 46.3 | 26.7 | 16.2 | 48.5 | 66.0 | 5.0 | |
| | | *Classification of* Condition | | Swamp | | Mountain | | Field | | |
| | | Reflection Loss | dB | 2 | | 14 | | 6 | | |
| | | Altitude | m | 0 | | 20 | | 0 | | |
| | Total | Total Loss of Reflect Wave | dB | More than 35.7 | | More than 50.2 | | 12.5 | | |
| | | Effective Reflection Coefficient | | Less than 0.016 | | Less than 0.0031 | | 0.237 | | |
| Path Difference | | Path Difference between Direct and Reflected Wave | m | 1.00 | | 1.60 | | 0.33 | | |
| | | Required D/U for S/D of 85 dB | dB | Less than 10 | | 15.7 | | Less than 10 | | |
| Propagation Path Length | | | Km | 73.0 | | 64.7 | | 71.0 | | |
| Propagation Loss at Free Space | | | dB | 145.3 | | 144.2 | | 145.0 | | |
| Profile Map | | | | Fig. 11 | | Fig. 12 | | Fig. 13 | | |
| Clearance | | | | Insufficient | | Enough | | Enough | | |
| Remarks | | | | | | | | Antenna height at Kota Bharu must clear local obstruction ( coconut trees with the height of more than 30 m ) | | |

Table 8 Calculated Figures of Various Foundamental Factors on Each Section ( K = 4/3 )

| Item | | | Unit | BT. PELINDONG | | K.G. CHERATING | | BT. KEMUNING | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Altitude | | | m | 268.2 | | 0 | | 289.6 | | | |
| Antenna Height above Ground | | | m | 20 | | 40 | | 10 | | | |
| Effective Antenna Height | | | m | | 246.1 | 38.9 | 39.4 | 272.4 | | | |
| Half Pitch of Height Pattern | | | m | | 10.0 | 1.08 | 1.13 | 7.80 | | | |
| Effective Reflection Coefficient | | Included Angle between Direct and Reflected Wave | ° ' " | | 8'53" | 54'12" | 1°16'24" | 10'58" | | | |
| Effective Reflection Coefficient | | Attenuation of Reflected Wave due to Antenna Directivity | dB | | 0.3 | 12.6 | 26.5 | 0.4 | | | |
| Effective Reflection Coefficient | | Shielding Ridge Loss of Reflected Wave | dB | | 0 | | 0 | | | | |
| Effective Reflection Coefficient | Reflection Point | Distance from Station | Km | | 26.8 | 4.3 | 3.1 | 21.5 | | | |
| Effective Reflection Coefficient | Reflection Point | Classification of Condition | | | Swamp | | Swamp | | | | |
| Effective Reflection Coefficient | Reflection Point | Reflection Loss | dB | | 2 | | 2 | | | | |
| Effective Reflection Coefficient | Reflection Point | Altitude | m | | 2 | | 0 | | | | |
| Effective Reflection Coefficient | Total | Total Loss of Reflect Wave | dB | | 14.9 | | 28.9 | | | | |
| Effective Reflection Coefficient | Total | Effective Reflection Coefficient | | | 0.180 | | 0.036 | | | | |
| Path Difference | | Path Difference between Direct and Reflected Wave | m | | 0.62 | | 0.87 | | | | |
| Path Difference | | Required D/U for S/D of 85 dB | dB | | Less than 10 | | Less than 10 | | | | |
| Propagation Path Length | | | Km | | 31.1 | | 24.6 | | | | |
| Propagation Loss at Free Space | | | dB | | 137.8 | | 135.8 | | | | |
| Profile Map | | | | | Fig. 8 | | Fig. 9 | | | | |
| Clearance | | | | | Enough | | Enough | | | | |
| Remarks | | | | | | | | | | | |

Table 9 Calculated Figures of Various Foundamental Factors on Each Section ( K = 4/3 )

| Item | | | Unit | BT. BAUK | | BT. BESAR | | BT. BINTANG | | KOTA BHARU | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Altitude | | | m | 346.6 | | 156.4 | | 542.8 | | 0 | |
| Antenna Height above Ground | | | m | 40 | | 40 | | 10 | | 30 | |
| Effective Antenna Height | | | m | | 262.0 | 153.6 | | | 287.3 | 29.2 | |
| Half Pitch of Height Pattern | | | m | | 5.95 | 3.49 | | | 30.4 | 3.09 | |
| Effective Reflection Coefficient | Included Angle between Direct and Reflected Wave | | ° ' " | | 14'28" | 24'40" | | | 2'12" | 38'52" | |
| | Attenuation of Reflected Wave due to Antenna Directivity | | dB | | 0.6 | 2.3 | | | 0 | 6.3 | |
| | Shielding Ridge Loss of Reflected Wave | | dB | | More than 31 | | | | 0 | | |
| | Reflection Point | Distance from Station | Km | | 46.0 | 27.0 | | | 67.2 | 3.8 | |
| | | Classification of Condition | | | Swamp | | | | Field | | |
| | | Reflection Loss | dB | | 2 | | | | 6 | | |
| | | Altitude | m | | 0 | | | | 0 | | |
| | Total | Total Loss of Reflect Wave | dB | | More than 35.9 | | | | 12.3 | | |
| | | Effective Reflection Coefficient | | | Less than 0.016 | | | | 0.242 | | |
| Path Difference | Path Difference between Direct and Reflected Wave | | m | | 1.10 | | | | 0.24 | | |
| | Required D/U for S/D of 85 dB | | dB | | Less than 10 | | | | Less than 10 | | |
| Propagation Path Length | | | Km | | 73.0 | | | | 71.0 | | |
| Propagation Loss at Free Space | | | dB | | 145.3 | | | | 145.0 | | |
| Profile Map | | | | | Fig. 11 | | | | Fig. 13 | | |
| Clearance | | | | | Insufficient | | | | Enough | | |
| Remarks | | | | | | | | | | | |

Table 10 Calculated Figures of Various Foundamental Factors on Each Section ( K = 4/3 )

| Item | | | Unit | BT. BINTANG | KOTA BHARU | BT. BINTANG | KOTA BHARU |
|---|---|---|---|---|---|---|---|
| Altitude | | | m | 542.8 | 0 | 542.8 | 0 |
| Antenna Height above Ground | | | m | 10 | 50 | 10 | 60 |
| Effective Antenna Height | | | m | 305.2 | 47.8 | 313.2 | 7.0 |
| Half Pitch of Height Pattern | | | m | 18.5 | 2.90 | 15.6 | 2.83 |
| Effective Reflection Coefficient | Included Angle between Direct and Reflected Wave | | ° ' " | 3'42" | 39'21" | 4'28" | 39'43" |
| Effective Reflection Coefficient | Attenuation of Reflected Wave due to Antenna Directivity | | dB | 0 | 6.5 | 0 | 6.5 |
| Effective Reflection Coefficient | Shielding Ridge Loss of Reflected Wave | | dB | 0 | | 0 | |
| Effective Reflection Coefficient | Reflection Point | Distance from Station | Km | 64.9 | 6.1 | 63.8 | 7.2 |
| Effective Reflection Coefficient | Reflection Point | Classification of Condition | | Field | | Field | |
| Effective Reflection Coefficient | Reflection Point | Reflection Loss | dB | 6 | | 6 | |
| Effective Reflection Coefficient | Reflection Point | Altitude | m | 0 | | 0 | |
| Effective Reflection Coefficient | Total | Total Loss of Reflect Wave | dB | 12.5 | | 12.5 | |
| Effective Reflection Coefficient | Total | Effective Reflection Coefficient | | 0.237 | | 0.237 | |
| Path Difference | Path Difference between Direct and Reflected Wave | | m | 0.42 | | 0.51 | |
| Path Difference | Required D/U for S/D of 85 dB | | dB | Less than 10 | | Less than 10 | |
| Propagation Path Length | | | Km | 71.0 | | 71.0 | |
| Propagation Loss at Free Space | | | dB | 145.0 | | 145.0 | |
| Profile Map | | | | Fig. 13 | | Fig. 13 | |
| Clearance | | | | Enough | | Enough | |
| Remarks | | | | | | | |

Table 11 Calculated Figures of Various Foundamental Factors on Each Section ( K = 2/3 )

| Item \ Name of Station | Unit | BT. NANAS | | BT. SEMPAH | | BT. MENTAKAB | | BT. MARAN |
|---|---|---|---|---|---|---|---|---|
| Altitude | m | 91.4 | | 1205 | | 76.2 | | 261.8 |
| Antenna Height above Ground | m | 30 | | 5 | | 50 | | 20 |
| Effective Antenna Height | m | 91.1 | 651.5 | 728.9 | 72.4 | 55.8 | 123.1 | |
| Half Pitch of Height Pattern | m | 0.44 | 3.16 | 11.4 | 1.13 | 4.64 | 10.0 | |
| Effective Reflection Coefficient – Included Angle between Direct and Reflected Wave | ° ' " | 5°37'23" | 27'22" | 7'26" | 1°18'07" | 18'06" | 8'33" | |
| Effective Reflection Coefficient – Attenuation of Reflected Wave due to Antenna Directivity | dB | 35 | 3.0 | 0.2 | 27.5 | 1.2 | 0.3 | |
| Effective Reflection Coefficient – Shielding Ridge Loss of Reflected Wave | dB | 0 | | 25 | | 15.6 | | |
| Effective Reflection Coefficient – Reflection Point – Distance from Station | Km | 1.7 | 21.2 | 60.1 | 5.7 | 14.7 | 31.1 | |
| Effective Reflection Coefficient – Reflection Point – Classification of Condition | | City | | Mountain | | Mountain | | |
| Effective Reflection Coefficient – Reflection Point – Reflection Loss | dB | 14 | | 14 | | 14 | | |
| Effective Reflection Coefficient – Reflection Point – Altitude | m | 30 | | 50 | | 45 | | |
| Effective Reflection Coefficient – Total – Total Loss of Reflect Wave | dB | 52 | | 66.7 | | 31.1 | | |
| Effective Reflection Coefficient – Total – Effective Reflection Coefficient | | 0.0025 | | 0.00046 | | 0.028 | | |
| Path Difference – Path Difference between Direct and Reflected Wave | m | 5.19 | | 1.60 | | 0.30 | | |
| Path Difference – Required D/U for S/D of 85 dB | dB | 36.5 | | 15.7 | | Less than 10 | | |
| Propagation Path Length | Km | 22.9 | | 65.8 | | 45.8 | | |
| Propagation Loss at Free Space | dB | 135.2 | | 144.4 | | 141.2 | | |
| Profile Map | | Fig. 14 | | Fig. 15 | | Fig. 16 | | |
| Clearance | | Enough | | Enough | | Enough | | |
| Remarks | | | | Antenna height at Mentakab must clear local obstruction ( rubber trees with height of more than 30m ) | | The same as the left | | |

Table 12 Calculated Figures of Various Foundamental Factors on Each Section ( K = 2/3 )

| Item \ Name of Station | Unit | BT. MARAN | BT. SULAI | | KUANTAN | | | |
|---|---|---|---|---|---|---|---|---|
| Altitude | m | 261.8 | 332.5 | | 0 | | | |
| Antenna Height above Ground | m | 20 | 20 | | 35 | | | |
| Effective Antenna Height | m | 178.0 | 217.2 | 305.5 | 34.4 | | | |
| Half Pitch of Height Pattern | m | 2.57 | 3.13 | 8.08 | 0.91 | | | |
| Effective Reflection Coefficient: Included Angle between Direct and Reflected Wave | ° ' " | 41'52" | 26'29" | 10'33" | 1°35'45" | | | |
| Effective Reflection Coefficient: Attenuation of Reflected Wave due to Antenna Directivity | dB | 7.5 | 3.0 | 0.4 | 30.5 | | | |
| Effective Reflection Coefficient: Shielding Ridge Loss of Reflected Wave | dB | 29.4 | | 0 | | | | |
| Effective Reflection Coefficient: Reflection Point: Distance from Station | Km | 19.3 | 25.3 | 20.0 | 2.2 | | | |
| Effective Reflection Coefficient: Reflection Point: Classification of Condition | | Mountain | | Swamp | | | | |
| Effective Reflection Coefficient: Reflection Point: Reflection Loss | dB | 14 | | 2 | | | | |
| Effective Reflection Coefficient: Reflection Point: Altitude | m | 60 | | 0 | | | | |
| Effective Reflection Coefficient: Total: Total Loss of Reflect Wave | dB | 53.9 | | 32.9 | | | | |
| Effective Reflection Coefficient: Total: Effective Reflection Coefficient | | 0.002 | | 0.023 | | | | |
| Path Difference: Path Difference between Direct and Reflected Wave | m | 1.74 | | 0.95 | | | | |
| Path Difference: Required D/U for S/D of 85 dB | dB | 17.5 | | Less than 10 | | | | |
| Propagation Path Length | Km | 44.6 | | 22.2 | | | | |
| Propagation Loss at Free Space | dB | 141.0 | | 134.9 | | | | |
| Profile Map | | Fig. 17 | | Fig. 18 | | | | |
| Clearance | | Enough | | Enough | | | | |
| Remarks | | | | | | | | |

Table 13 Calculated Figures of Various Foundamental Factors on Each Section ( K = 2/3 )

| Item \ Name of Station | | | Unit | BT. SEMPAH | BT. MENTAKAB | | |
|---|---|---|---|---|---|---|---|
| Altitude | | | m | 1205 | 76.2 | | |
| Antenna Height above Ground | | | m | 5 | 65 | | |
| Effective Antenna Height | | | m | 733.7 | 76.5 | | |
| Half Pitch of Height Pattern | | | m | 10.8 | 1.12 | | |
| Effective Reflection Coefficient | | Included Angle between Direct and Reflected Wave | ° ' " | 8'04" | 1°16'05" | | |
| | | Attenuation of Reflected Wave due to Antenna Directivity | dB | 0.3 | 26 | | |
| | | Shielding Ridge Loss of Reflected Wave | dB | 25 | | | |
| | Reflection Point | Distance from Station | Km | 59.5 | 6.3 | | |
| | | Classification of Condition | | Mountain | | | |
| | | Reflection Loss | dB | 14 | | | |
| | | Altitude | m | 60 | | | |
| | Total | Total Loss of Reflect Wave | dB | 65.3 | | | |
| | | Effective Reflection Coefficient | | 0.00054 | | | |
| Path Difference | | Path Difference between Direct and Reflected Wave | m | 1.70 | | | |
| | | Required D/U for S/D of 85 dB | dB | 17.0 | | | |
| Propagation Path Length | | | Km | 65.8 | | | |
| Propagation Loss at Free Space | | | dB | 144.4 | | | |
| Profile Map | | | | Fig. 15 | | | |
| Clearance | | | | Enough | | | |
| Remarks | | | | | | | |

Table 14 Calculated Figures of Various Foundamental Factors on Each Section ( K = 2/3 )

| Item \ Name of Station | | | Unit | BT. PELINDONG | | K.G. CHERATING | | BT. KEMUNING | | BT. BAUK | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Altitude | | | m | 268.2 | | 0 | | 289.6 | | 346.6 | |
| Antenna Height above Ground | | | m | 20 | | 30 | | 10 | | 20 | |
| Effective Antenna Height | | | m | | 201.2 | 28.2 | 29.2 | 242.7 | 242.2 | 288.8 | |
| Half Pitch of Height Pattern | | | m | | 13.8 | 1.93 | 1.27 | 10.5 | 1.90 | 2.28 | |
| Effective Reflection Coefficient | Included Angle between Direct and Reflected Wave | | ° ' " | | 6'17" | 44'22" | 1°7'58" | 8'08" | 45'06" | 37'43" | |
| | Attenuation of Reflected Wave due to Antenna Directivity | | dB | | 0.1 | 8.5 | 20 | 0.3 | 9.0 | 5.8 | |
| | Shielding Ridge Loss of Reflected Wave | | dB | | 0 | | 0 | | 0 | | |
| | Reflection Point | Distance from Station | Km | | 27.2 | 3.9 | 2.6 | 22.0 | 20.1 | 24.0 | |
| | | Classification of Condition | | | Field | | Swamp | | Swamp | | |
| | | Reflection Loss | dB | | 6 | | 2 | | 2 | | |
| | | Altitude | m | | 0 | | 0 | | 10 | | |
| | Total | Total Loss of Reflect Wave | dB | | 14.6 | | 22.3 | | 16.8 | | |
| | | Effective Reflection Coefficient | | | 0.196 | | 0.077 | | 0.145 | | |
| Path Difference | Path Difference between Direct and Reflected Wave | | m | | 0.37 | | 0.58 | | 3.32 | | |
| | Required D/U for S/D of 85 dB | | dB | | Less than 10 | | Less than 10 | | 27.5 | | |
| Propagation Path Length | | | Km | | 31.1 | | 24.6 | | 44.1 | | |
| Propagation Loss at Free Space | | | dB | | 137.8 | | 135.8 | | 140.9 | | |
| Profile Map | | | | | Fig. 19 | | Fig. 20 | | Fig. 21 | | |
| Clearance | | | | | Enough | | Enough | | Enough | | |
| Remarks | | | | | | | | | | | |

Table 15 Calculated Figures of Various Foundamental Factors on Each Section ( K = 2/3 )

| Item | | | Unit | Name of Station: BT. BAUK | | BT. BESAR | | BT. BINTANG | | KOTABHARU |
|---|---|---|---|---|---|---|---|---|---|---|
| Altitude | | | m | 346.6 | | 156.4 | | 542.8 | | 0 |
| Antenna Height above Ground | | | m | 30 | 30 | 10 | 10 | | 40 | |
| Effective Antenna Height | | | m | 142.9 | 91.3 | 125.1 | 304.9 | 42.5 | 36.9 | |
| Half Pitch of Height Pattern | | | m | 10.0 | 6.39 | 2.65 | 6.46 | 24.0 | 20.9 | |
| Effective Reflection Coefficient | | Included Angle between Direct and Reflected Wave | ° ' " | 8'35" | 13'28" | 32'29" | 13'16" | 1'57" | 24'54" | |
| Effective Reflection Coefficient | | Attenuation of Reflected Wave due to Antenna Directivity | dB | 0.3 | 0.6 | 4.4 | 0.7 | 0 | 2.3 | |
| Effective Reflection Coefficient | | Shielding Ridge Loss of Reflected Wave | dB | More than 34 | | More than 31 | | 7.2 | | |
| Effective Reflection Coefficient | Reflection Point | Distance from Station | Km | 44.6 | 28.4 | 18.8 | 45.9 | 65.9 | 5.1 | |
| Effective Reflection Coefficient | Reflection Point | Classification of Condition | | Swamp | | Mountain | | Field | | |
| Effective Reflection Coefficient | Reflection Point | Reflection Loss | dB | 2 | | 14 | | 6 | | |
| Effective Reflection Coefficient | Reflection Point | Altitude | m | 0 | | 0 | | 0 | | |
| Effective Reflection Coefficient | Total | Total Loss of Reflect Wave | dB | More than 36.9 | | More than 50.1 | | 15.5 | | |
| Effective Reflection Coefficient | Total | Effective Reflection Coefficient | | Less than 0.015 | | Less than 0.0032 | | 0.168 | | |
| Path Difference | | Path Difference between Direct and Reflected Wave | m | 0.36 | | 1.18 | | 0.05 | | |
| Path Difference | | Required D/U for S/D of 85 dB | dB | Less than 10 | | 11 | | Less than 10 | | |
| Propagation Path Length | | | Km | 73.0 | | 64.7 | | 71.0 | | |
| Propagation Loss at Free Space | | | dB | 145.3 | | 144.2 | | 145.0 | | |
| Profile Map | | | | Fig. 22 | | Fig. 23 | | Fig. 24 | | |
| Clearance | | | | Unsufficient | | Enough | | Enough | | |
| Remarks | | | | | | | | Antenna height at Kota Bharu must clear local obstruction ( coconut trees with height of more than 30m ) | | |

Table 16 Calculated Figures of Various Foundamental Factors on Each Section ( K = 2/3 )

| Item \ Name of Station | | BT. PELINDONG | K.G. CHERATING | | BT. KEMUNING | | | |
|---|---|---|---|---|---|---|---|---|
| Altitude | m | 268.2 | 0 | | 289.6 | | | |
| Antenna Height above Ground | m | 20 | 40 | | 10 | | | |
| Effective Antenna Height | m | 206.8 | 37.7 | 38.7 | 246.4 | | | |
| Half Pitch of Height Pattern | m | 10.3 | 1.87 | 1.25 | 7.95 | | | |
| Effective Reflection Coefficient — Included Angle between Direct and Reflected Wave | ° ' " | 6'17" | 44'22" | 1°08'49" | 10'48" | | | |
| Effective Reflection Coefficient — Attenuation of Reflected Wave due to Antenna Directivity | dB | 0.1 | 8.5 | 20 | 0.4 | | | |
| Effective Reflection Coefficient — Shielding Ridge Loss of Reflected Wave | dB | 0 | | 0 | | | | |
| Effective Reflection Coefficient — Reflection Point — Distance from Station | Km | 26.3 | 4.8 | 3.3 | 21.3 | | | |
| Effective Reflection Coefficient — Reflection Point — Classification of Condition | | Swamp | | Swamp | | | | |
| Effective Reflection Coefficient — Reflection Point — Reflection Loss | dB | 2 | | 2 | | | | |
| Effective Reflection Coefficient — Reflection Point — Altitude | m | 2 | | 0 | | | | |
| Effective Reflection Coefficient — Total — Total Loss of Reflect Wave | dB | 10.6 | | 22.4 | | | | |
| Effective Reflection Coefficient — Total — Effective Reflection Coefficient | | 0.295 | | 0.076 | | | | |
| Path Difference — Path Difference between Direct and Reflected Wave | m | 0.50 | | 0.78 | | | | |
| Path Difference — Required D/U for S/D of 85 dB | dB | Less than 10 | | Less than 10 | | | | |
| Propagation Path Length | Km | 31.1 | | 24.6 | | | | |
| Propagation Loss at Free Space | dB | 137.8 | | 135.8 | | | | |
| Profile Map | | Fig. 19 | | Fig. 20 | | | | |
| Clearance | | Enough | | Enough | | | | |
| Remarks | | | | | | | | |

Table 17 Calculated Figures of Various Foundamental Factors on Each Section (K = 2/3)

| Item \ Name of Station | | Unit | BT. BAUK | BT. BESAR | | BT. BINTANG | KOTA BHARU | |
|---|---|---|---|---|---|---|---|---|
| Altitude | | m | 346.6 | 156.4 | | 542.8 | 0 | |
| Antenna Height above Ground | | m | 40 | 40 | | 10 | 30 | |
| Effective Antenna Height | | m | 154.8 | 100.0 | | 23.9 | 28.2 | |
| Half Pitch of Height Pattern | | m | 9.14 | 5.93 | | 21.4 | 37.0 | |
| Effective Reflection Coefficient | Included Angle between Direct and Reflected Wave | ° ' " | 9'25" | 14'36" | | 1'26" | 24'22" | |
| Effective Reflection Coefficient | Attenuation of Reflected Wave due to Antenna Directivity | dB | 0.3 | 0.6 | | 0 | 2.3 | |
| Effective Reflection Coefficient | Shielding Ridge Loss of Reflected Wave | dB | More than 33 | | | 7.2 | | |
| Effective Reflection Coefficient – Reflection Point | Distance from Station | Km | 44.4 | 28.6 | | 67.1 | 3.9 | |
| Effective Reflection Coefficient – Reflection Point | Classification of Condition | | Mountain | | | Field | | |
| Effective Reflection Coefficient – Reflection Point | Reflection Loss | dB | 14 | | | 6 | | |
| Effective Reflection Coefficient – Reflection Point | Altitude | m | 0 | | | 0 | | |
| Effective Reflection Coefficient – Total | Total Loss of Reflect Wave | dB | More than 47.9 | | | 15.5 | | |
| Effective Reflection Coefficient – Total | Effective Reflection Coefficient | | Less than 0.004 | | | 0.168 | | |
| Path Difference | Path Difference between Direct and Reflected Wave | m | 0.43 | | | 0.02 | | |
| Path Difference | Required D/U for S/D of 85 dB | dB | Less than 10 | | | Less than 10 | | |
| Propagation Path Length | | Km | 73.0 | | | 71.0 | | |
| Propagation Loss at Free Space | | dB | 145.3 | | | 145.0 | | |
| Profile Map | | | Fig. 22 | | | Fig. 24 | | |
| Clearance | | | Insufficient | | | Enough | | |
| Remarks | | | | | | | | |

Table 18 Calculated Figures of Various Foundamental Factors on Each Section (K = 2/3)

| Item | | | Unit | BT. BINTANG | KOTA BHARU | BT. BINTANG | KOTA BHARU |
|---|---|---|---|---|---|---|---|
| Altitude | | | m | 542.8 | 0 | 542.8 | 0 |
| Antenna Height above Ground | | | m | 10 | 50 | ·10 | 60 |
| Effective Antenna Height | | | m | 61.3 | 45.2 | 77.9 | 53.5 |
| Half Pitch of Height Pattern | | | m | 19.6 | 14.5 | 16.2 | 11.4 |
| Effective Reflection Coefficient | | Included Angle between Direct and Reflected Wave | ° ' " | 2'29" | 25'14" | 3'02" | 25'49" |
| Effective Reflection Coefficient | | Attenuation of Reflected Wave due to Antenna Directivity | dB | 0 | 2.5 | 0 | 2.5 |
| Effective Reflection Coefficient | | Shielding Ridge Loss of Reflected Wave | dB | 7.7 | | 8.2 | |
| Effective Reflection Coefficient | Reflection Point | Distance from Station | Km | 64.6 | 6.4 | 63.5 | 7.5 |
| Effective Reflection Coefficient | Reflection Point | Classification of Condition | | Field | | Field | |
| Effective Reflection Coefficient | Reflection Point | Reflection Loss | dB | 6 | | 6 | |
| Effective Reflection Coefficient | Reflection Point | Altitude | m | 0 | | 0 | |
| Effective Reflection Coefficient | Total | Total Loss of Reflect Wave | dB | 16.2 | | 16.7 | |
| Effective Reflection Coefficient | Total | Effective Reflection Coefficient | | 0.155 | | 0.146 | |
| Path Difference | | Path Difference between Direct and Reflected Wave | m | 0.08 | | 0.12 | |
| Path Difference | | Required D/U for S/D of 85 dB | dB | Less than 10 | | Less than 10 | |
| Propagation Path Length | | | Km | 71.0 | | 71.0 | |
| Propagation Loss at Free Space | | | dB | 145.0 | | 145.0 | |
| Profile Map | | | | Fig. 24 | | Fig. 24 | |
| Clearance | | | | Enough | | Enough | |
| Remarks | | | | | | | |

Fig. 3 PROFILE MAP

(K = 4/3)

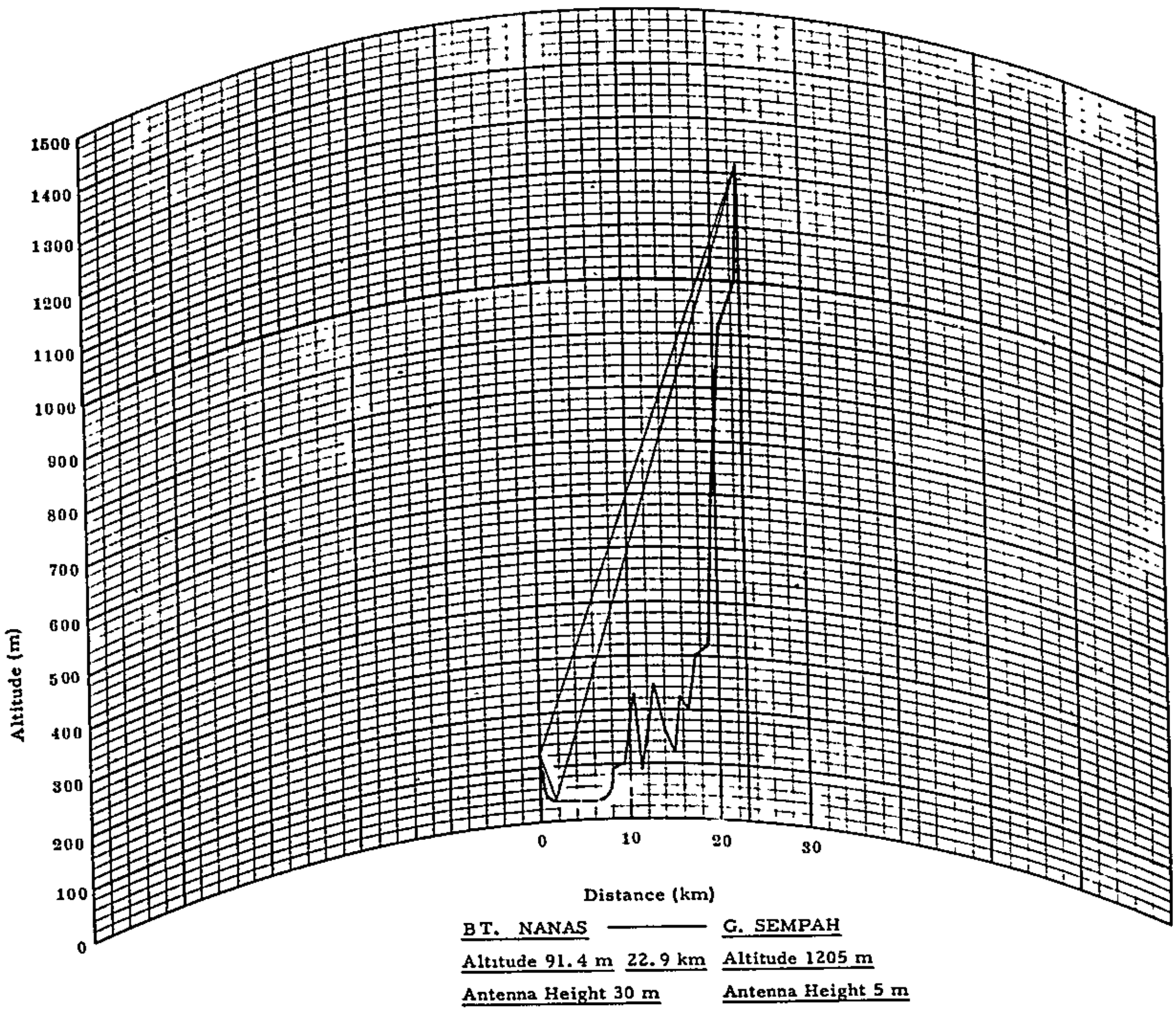


Fig. 4 PROFILE MAP

(K = 4/3)

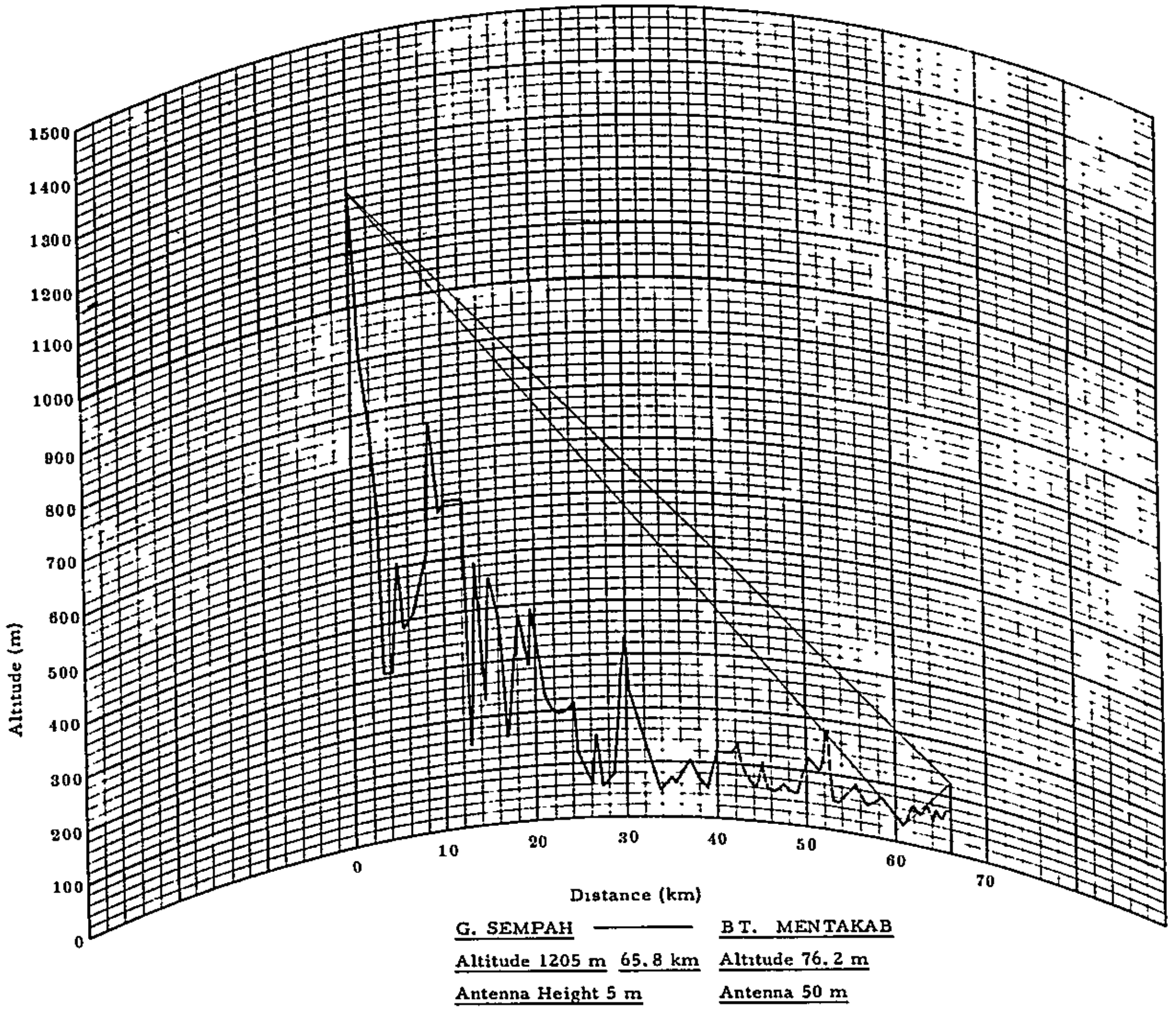


Fig. 5 PROFILE MAP
(K = 4/3)

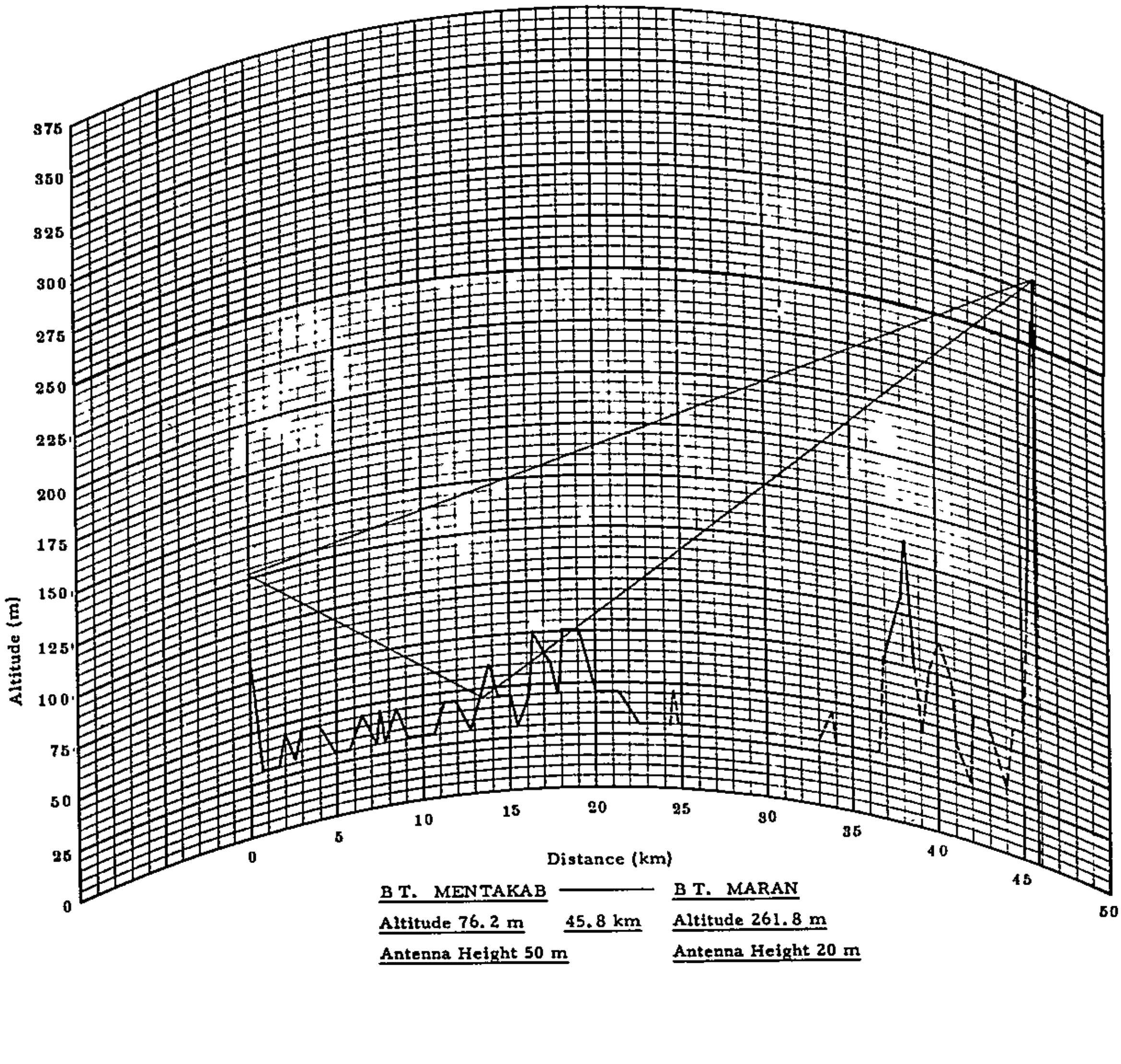


Fig. 6 PROFILE MAP

(K = 4/3)

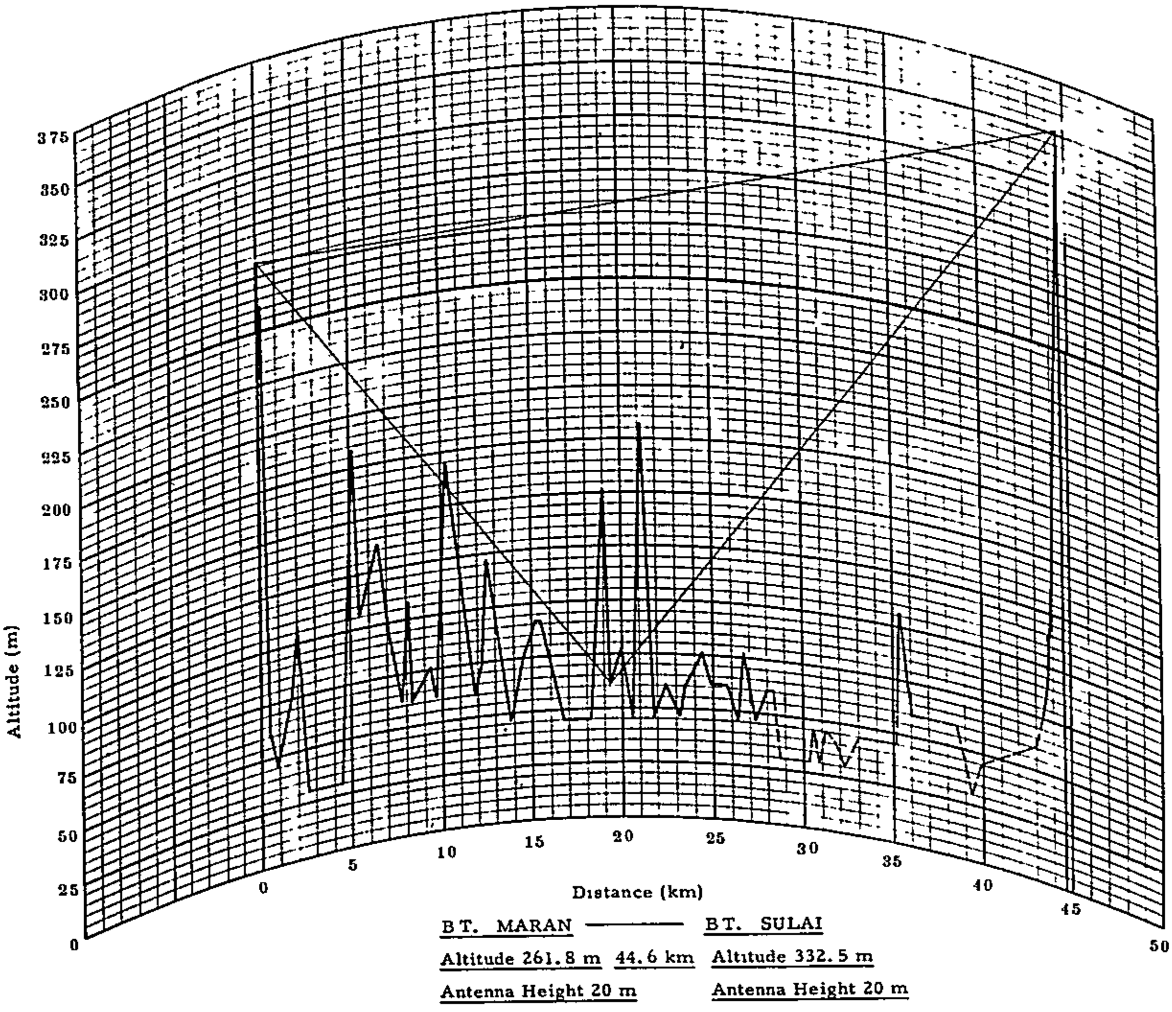


Fig. 7 PROFILE MAP

(K = 4/3)

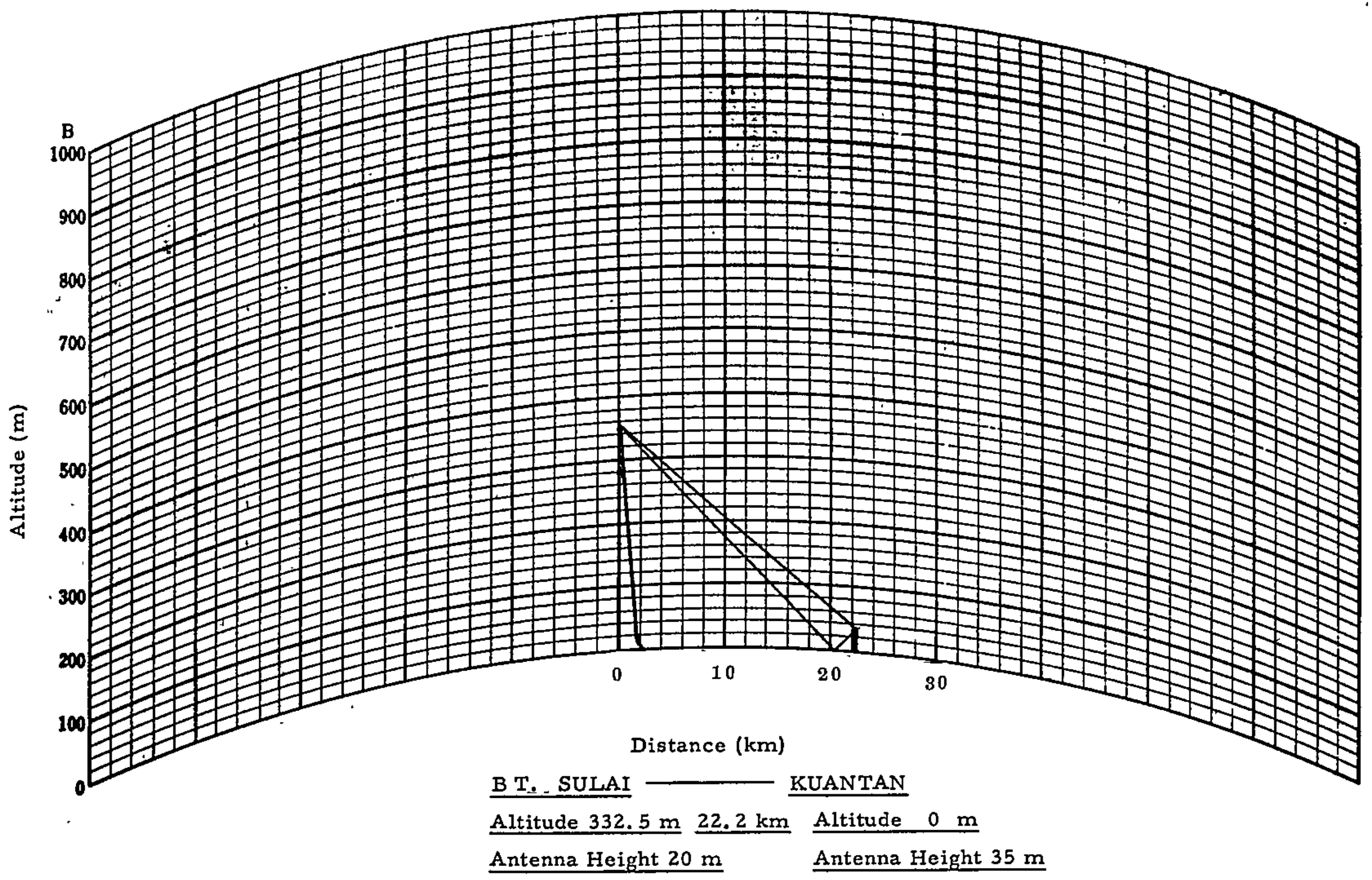


Fig. 8 PROFILE MAP

(K = 4/3)

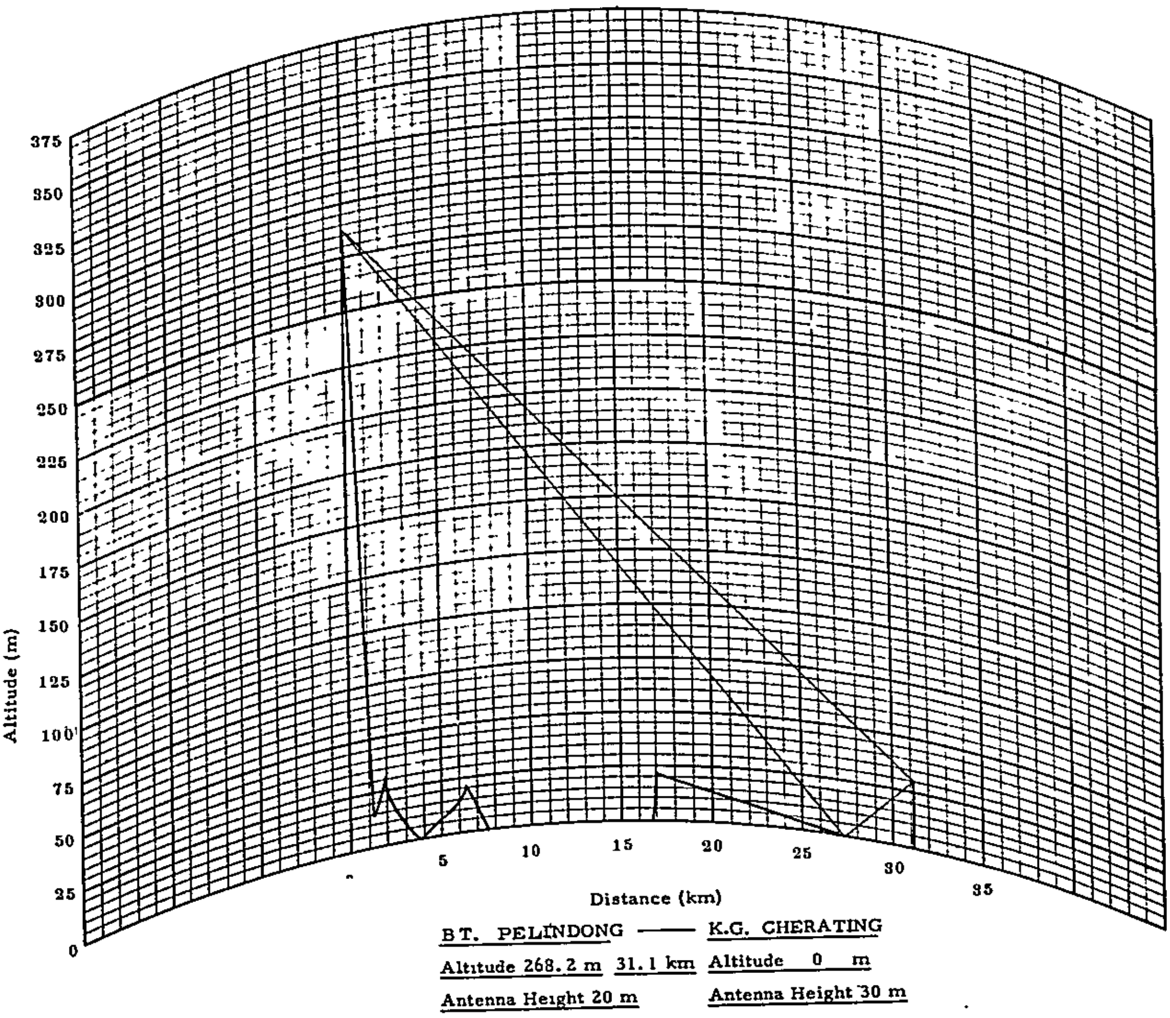


Fig. 9 PROFILE MAP

(K = 4/3)

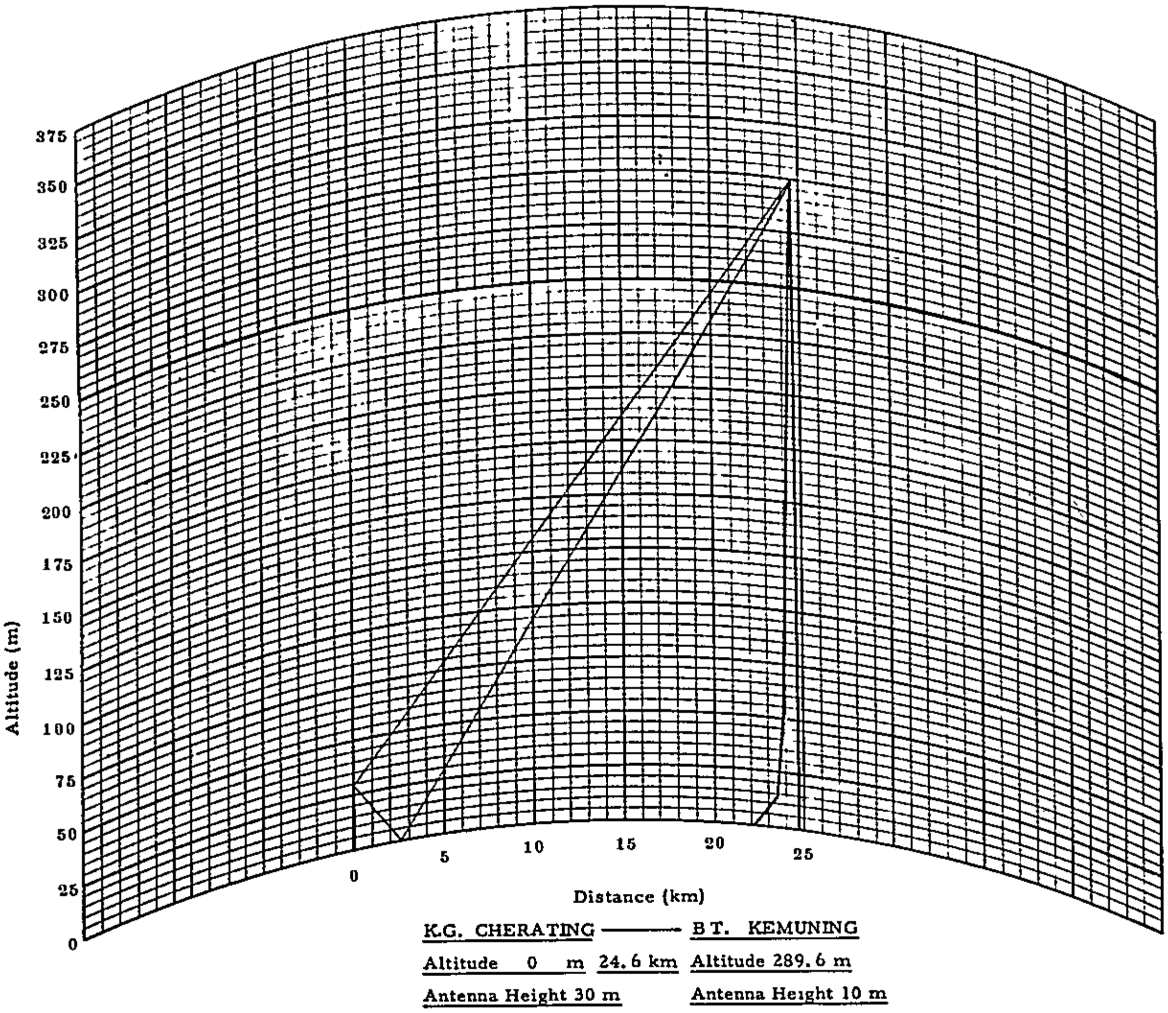


Fig. 10 PROFILE MAP

(K = 4/3)

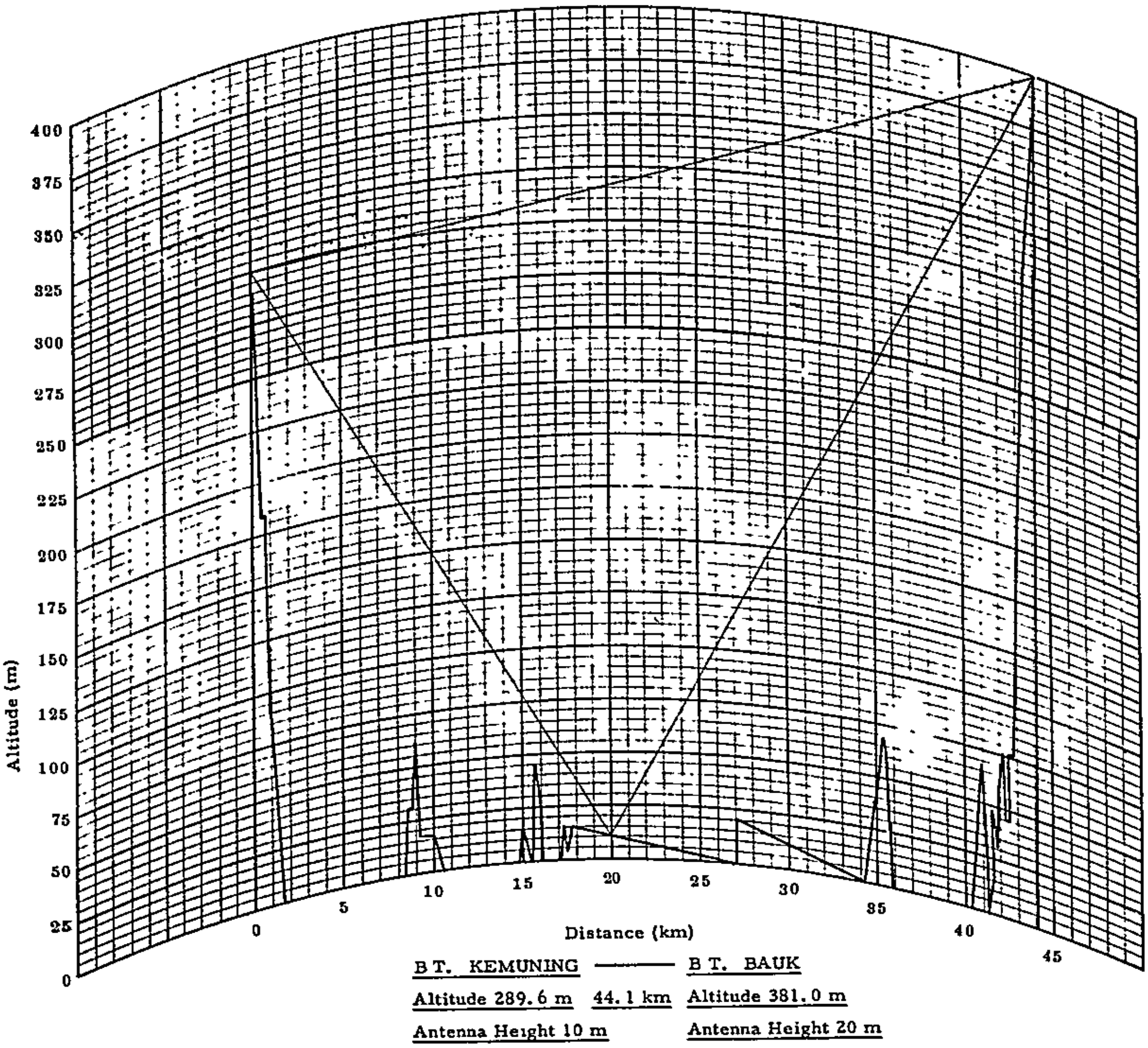


Fig. 11 PROFILE MAP

(K = 4/3)

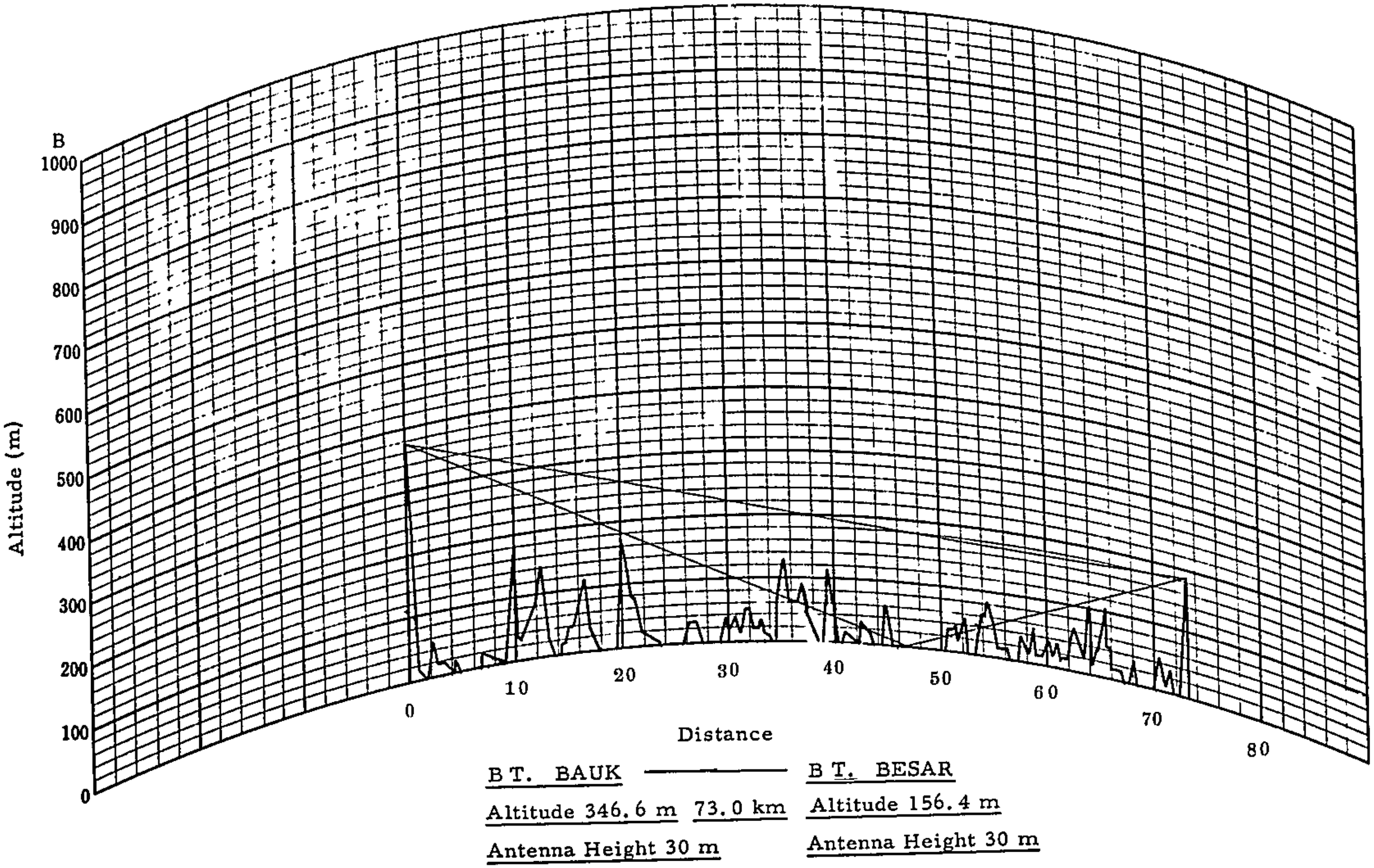
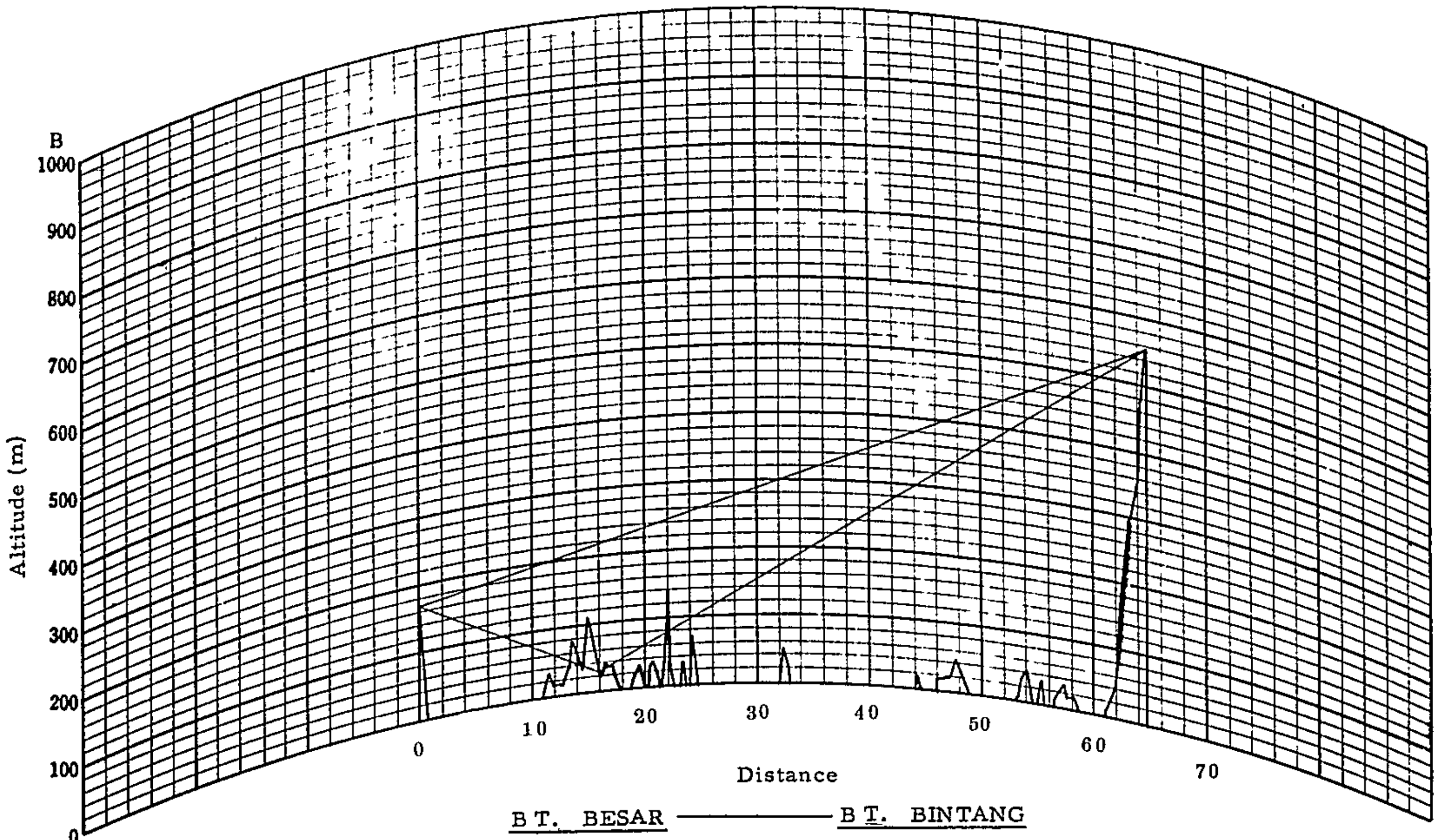


Fig. 12 PROFILE MAP

(K = 4/3)



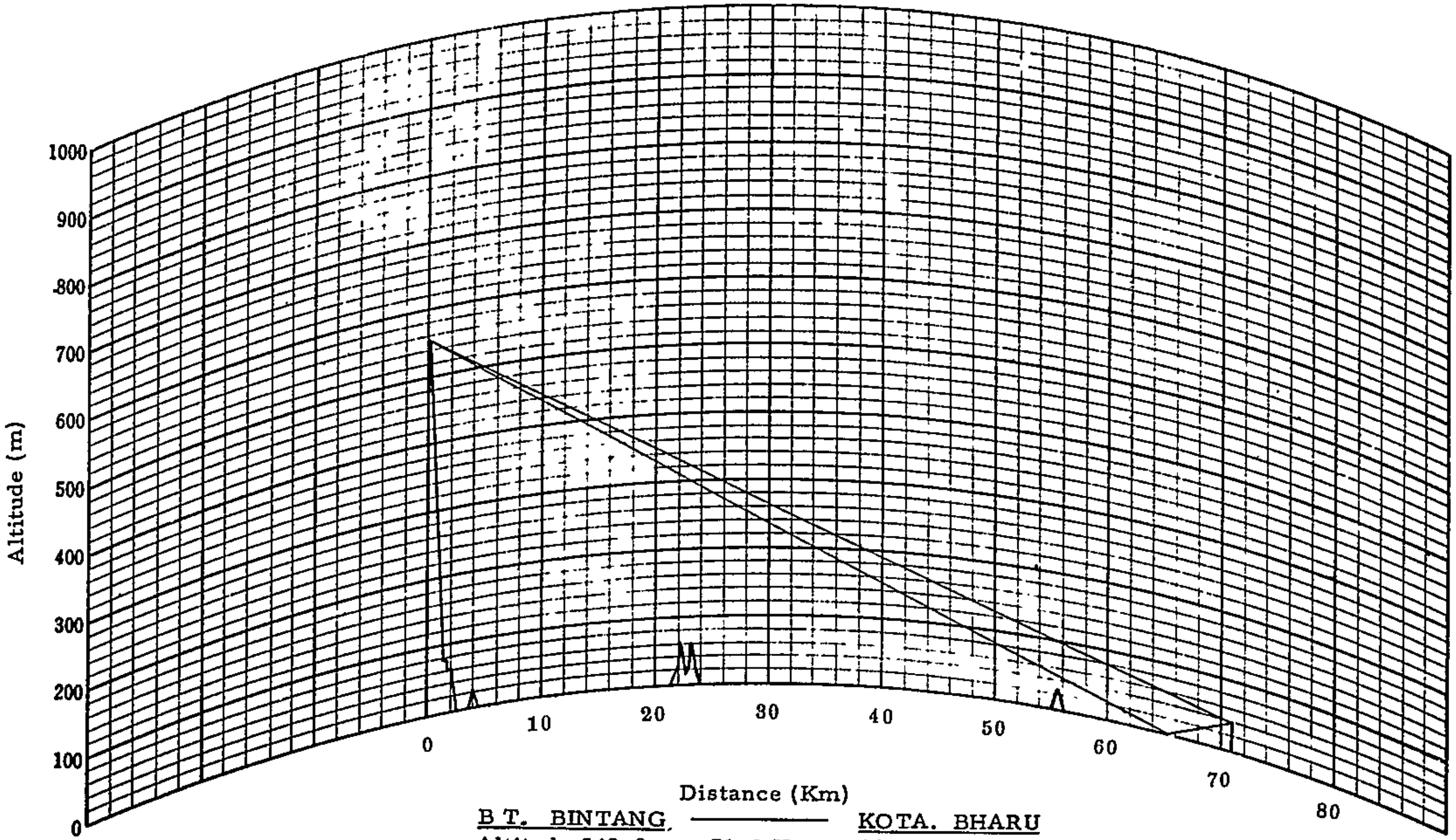

B T. BESAR ———— B T. BINTANG

Altitude 156.4 m 64.7 km Altitude 542.8 m

Antenna Height 10 m Antenna Height 10 m

Fig. 13 PROFILE MAP

(K = 4/3)




B T. BINTANG
Altitude 542.8m
Antenna Height 10m

71.0 Km

KOTA. BHARU
Altitude 0 m
Antenna 40 m

Fig. 14 PROFILE MAP

(K = 2/3)

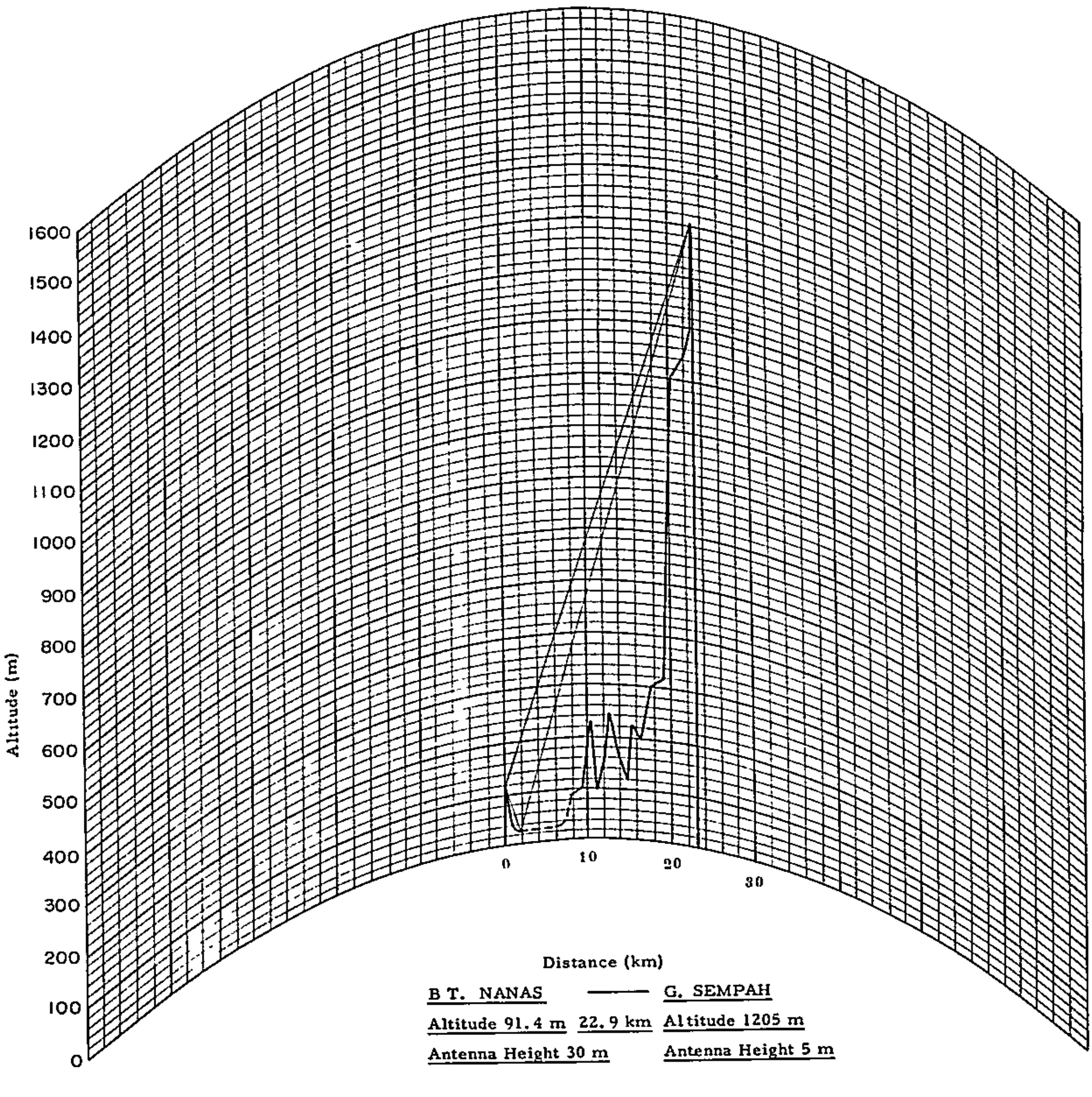


Fig. 15 PROFILE MAP

(K = 2/3)

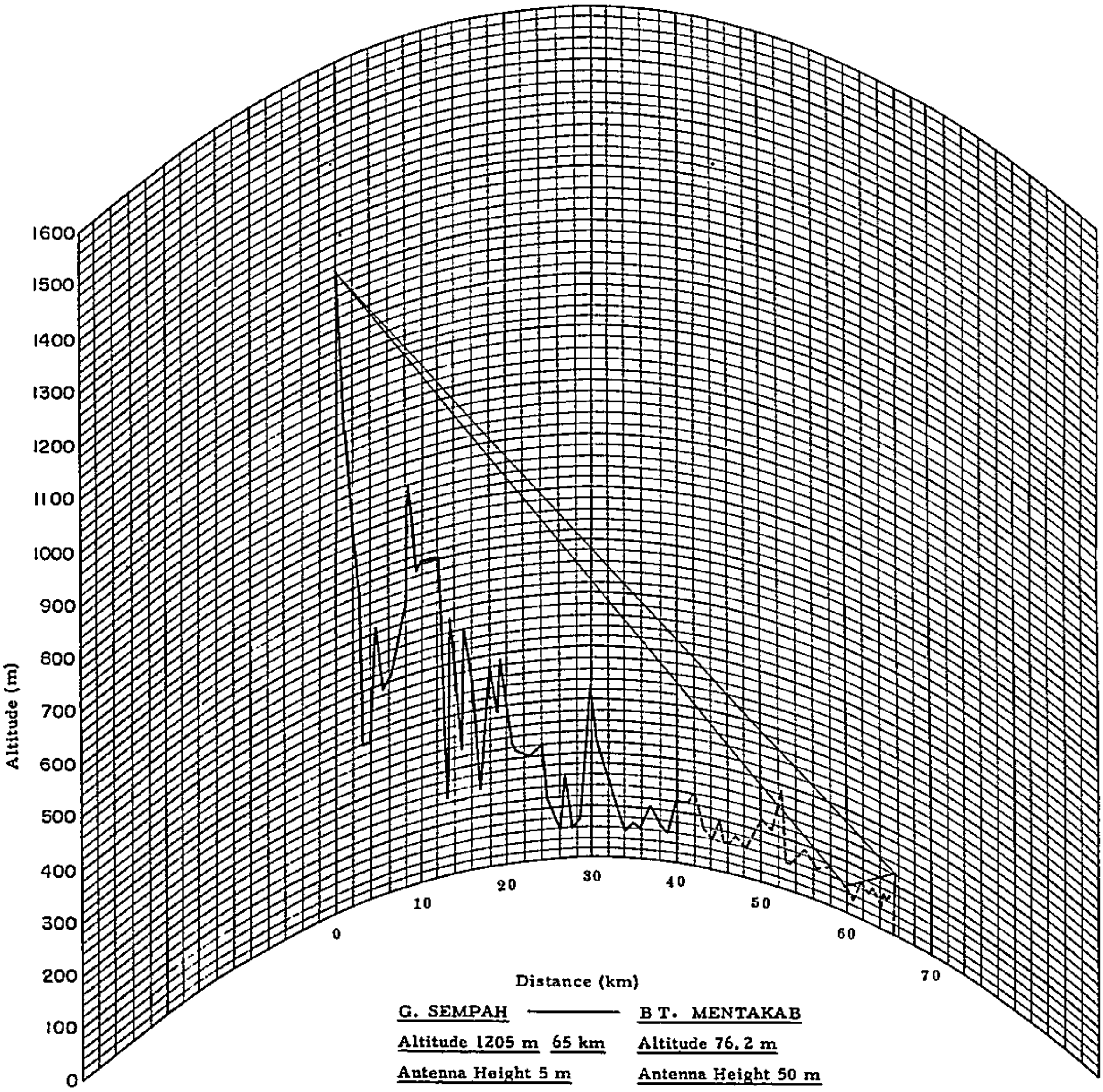


Fig. 16 PROFILE MAP
(K = 2/3)

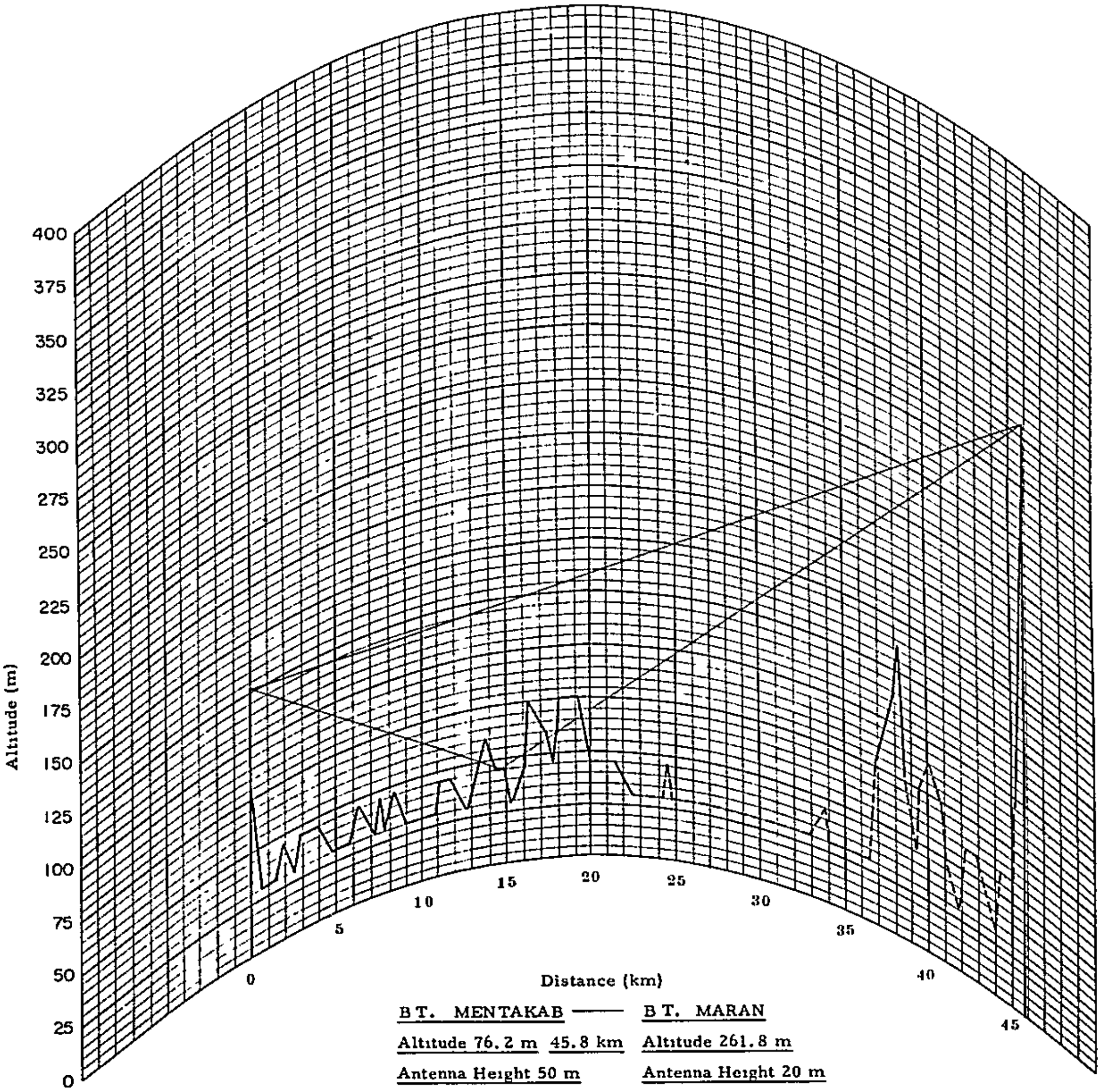


Fig. 17 PROFILE MAP
(K = 2/3)

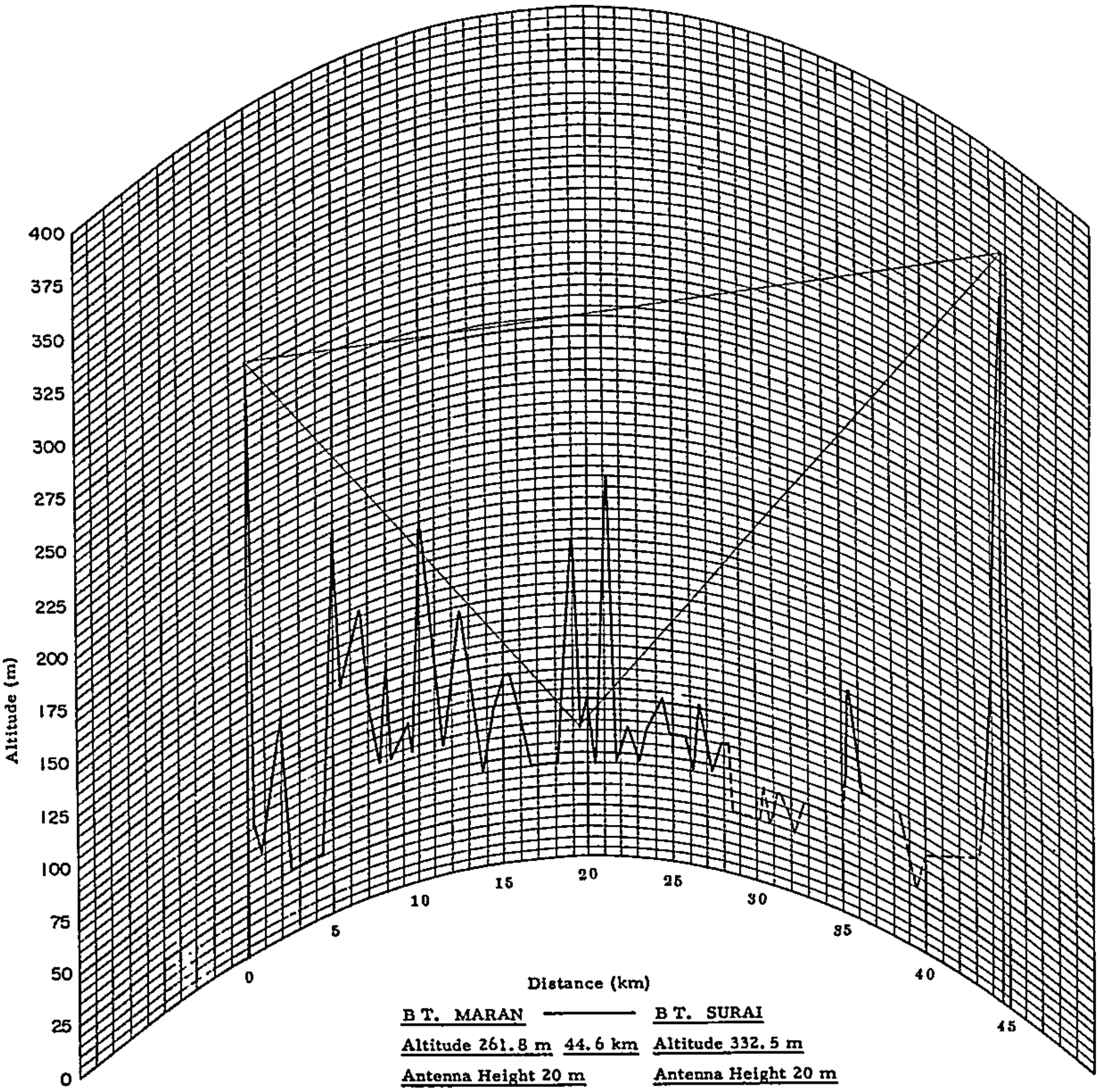


Fig. 18 PROFILE MAP

(K = 2/3)

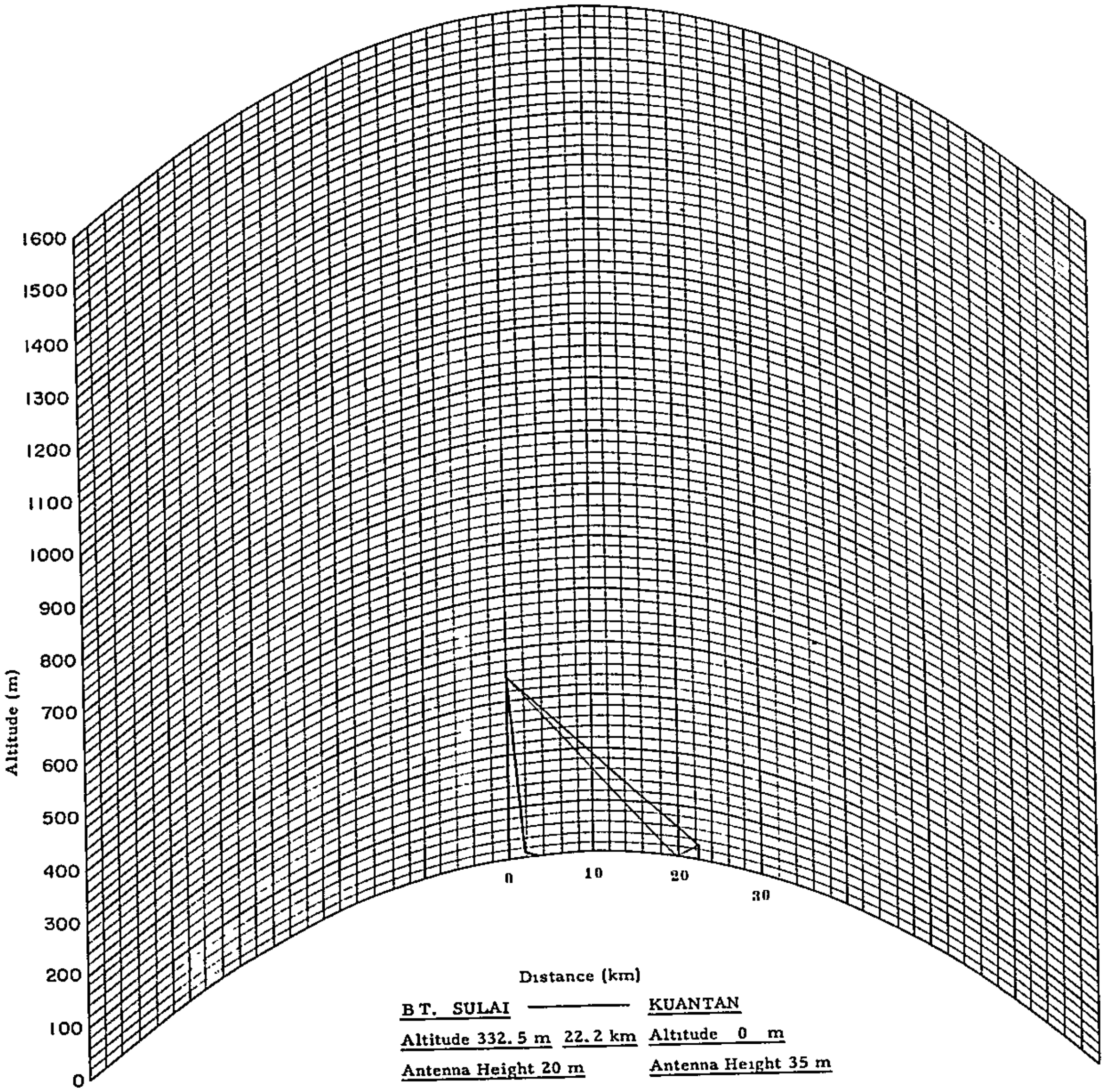


Fig. 19 PROFILE MAP
(K = 2/3)

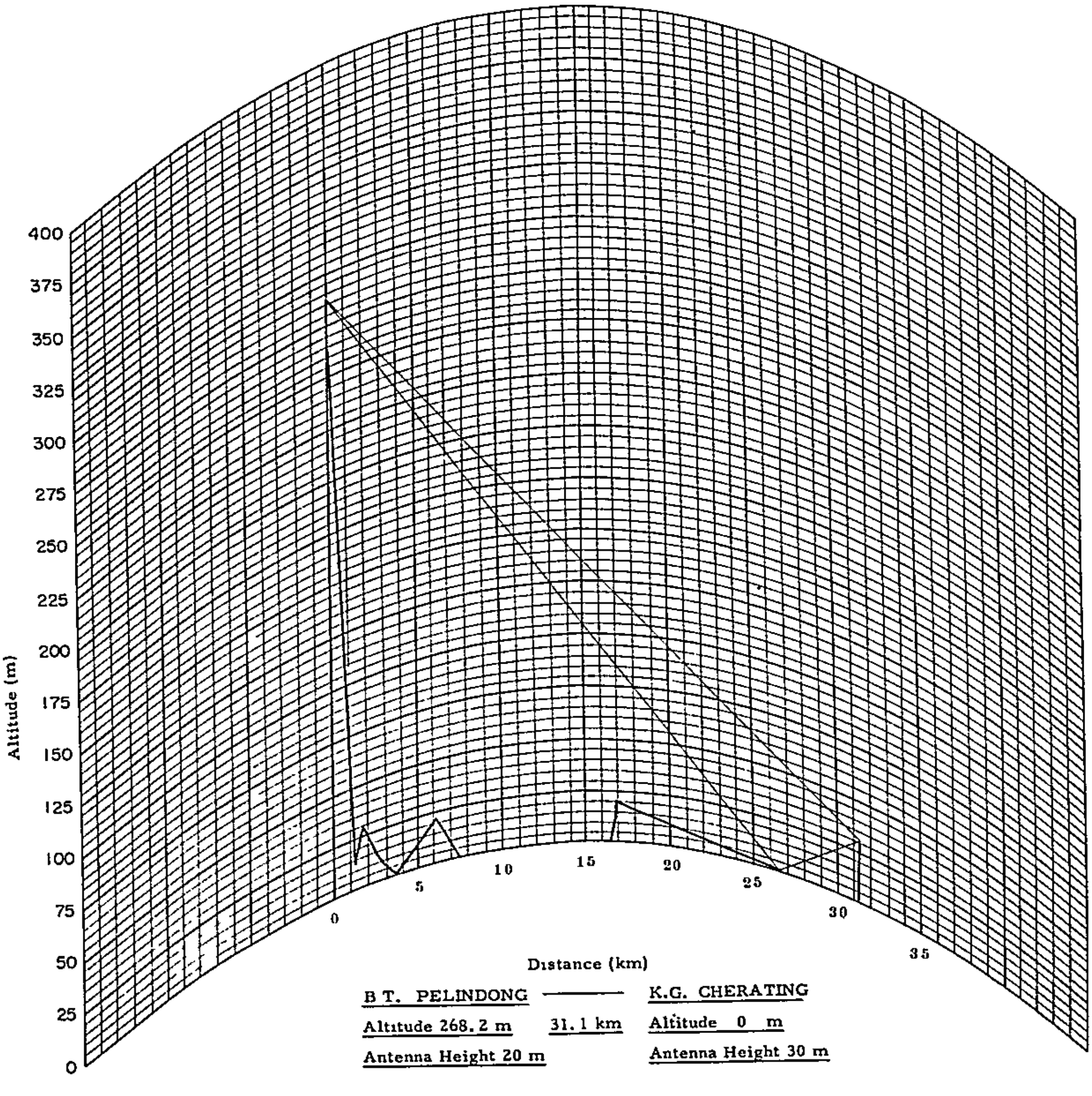


Fig. 20 PROFILE MAP
(K = 2/3)

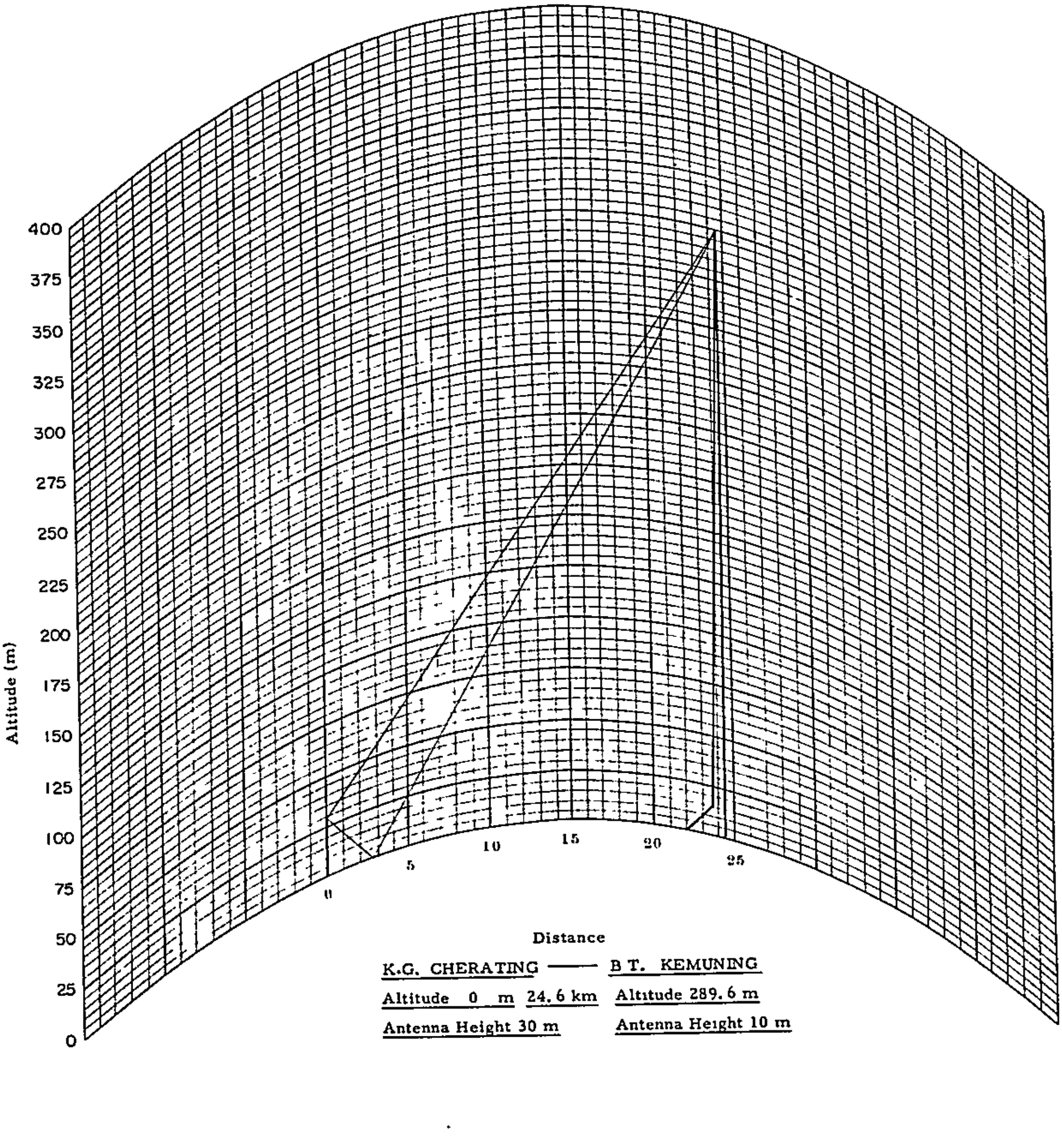


Fig. 21 PROFILE MAP

(K = 2/3)

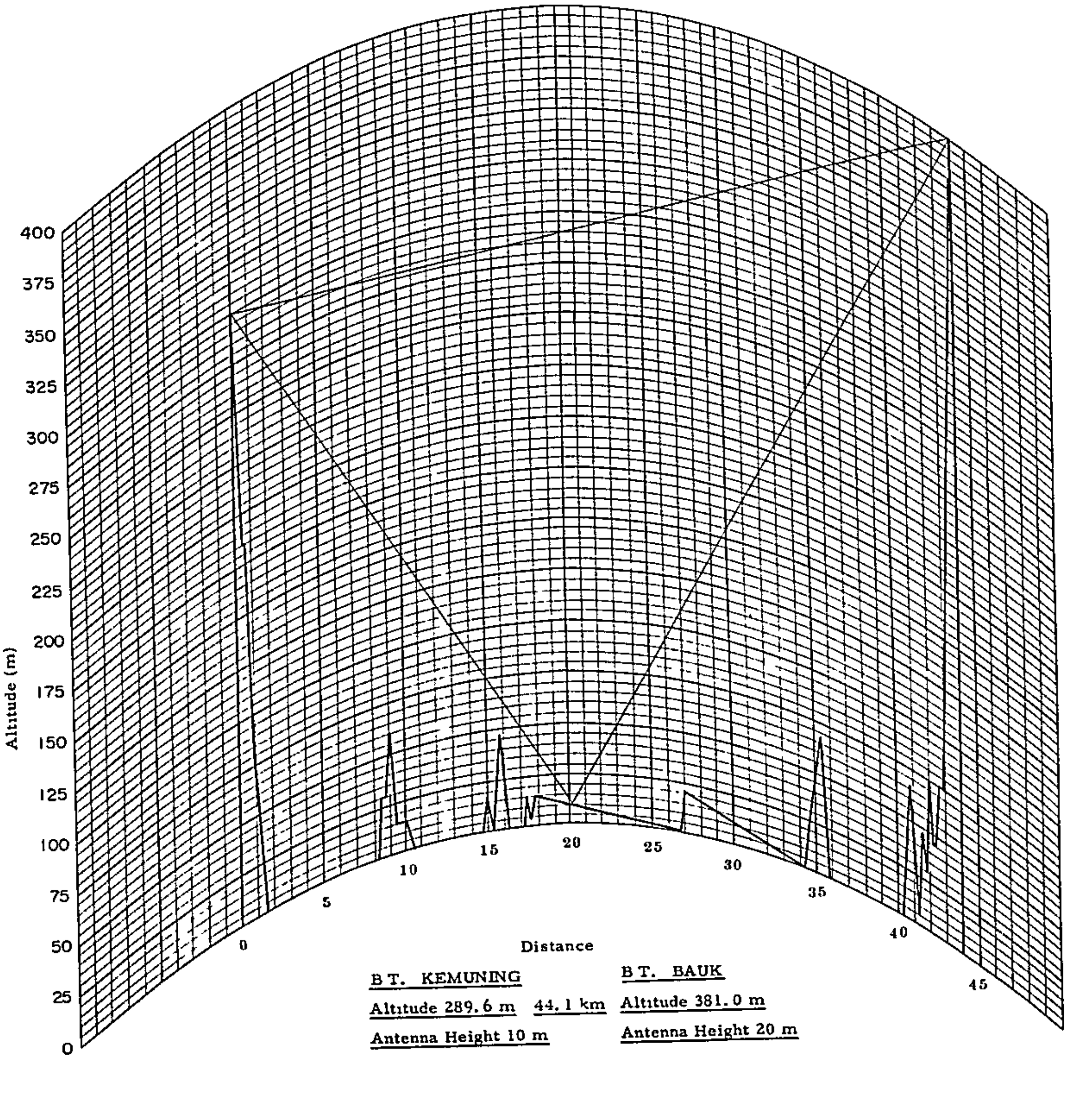


Fig. 22 PROFILE MAP

(K = 2/3)

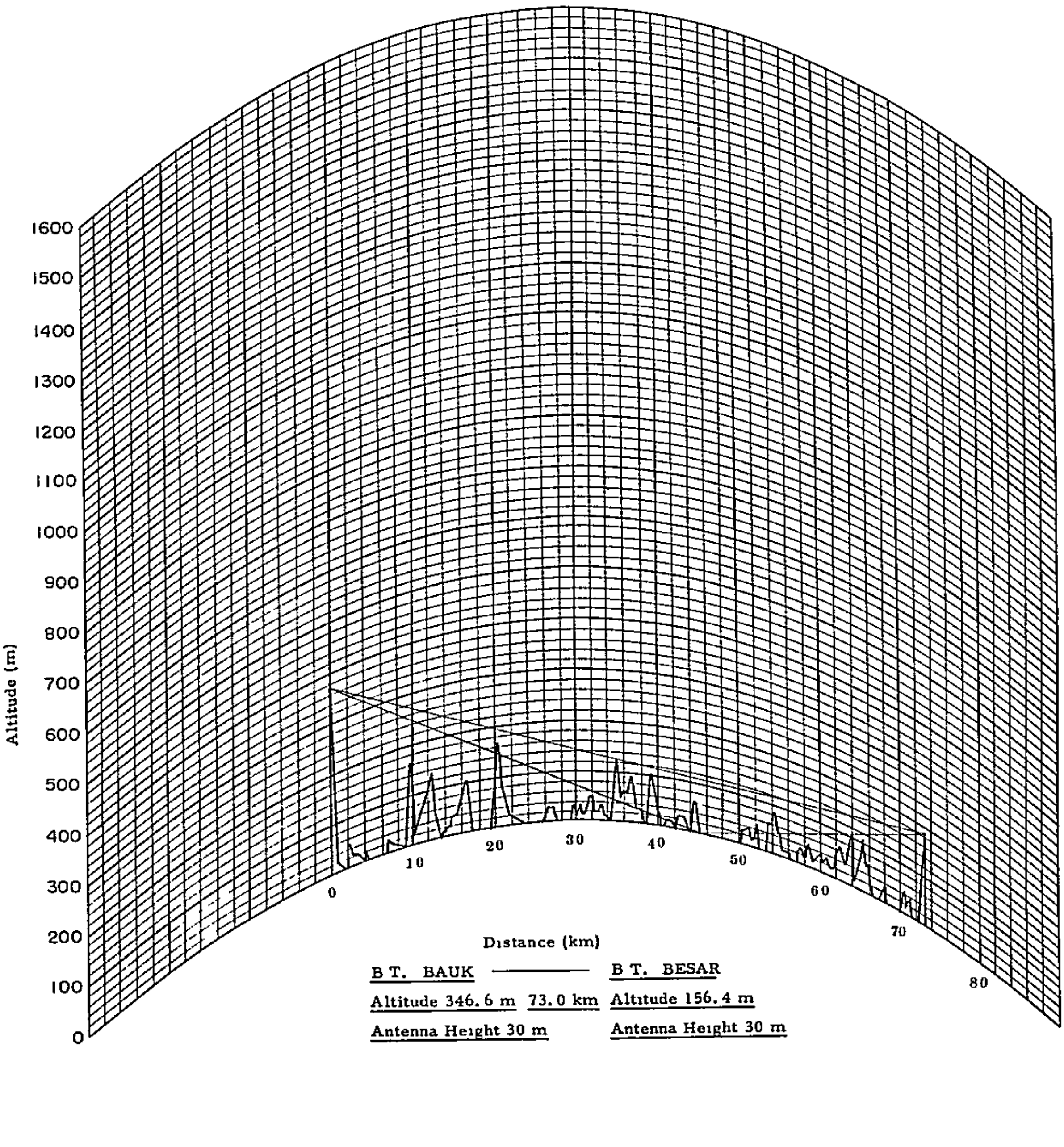


Fig. 23 PROFILE MAP
( K = 2/3)

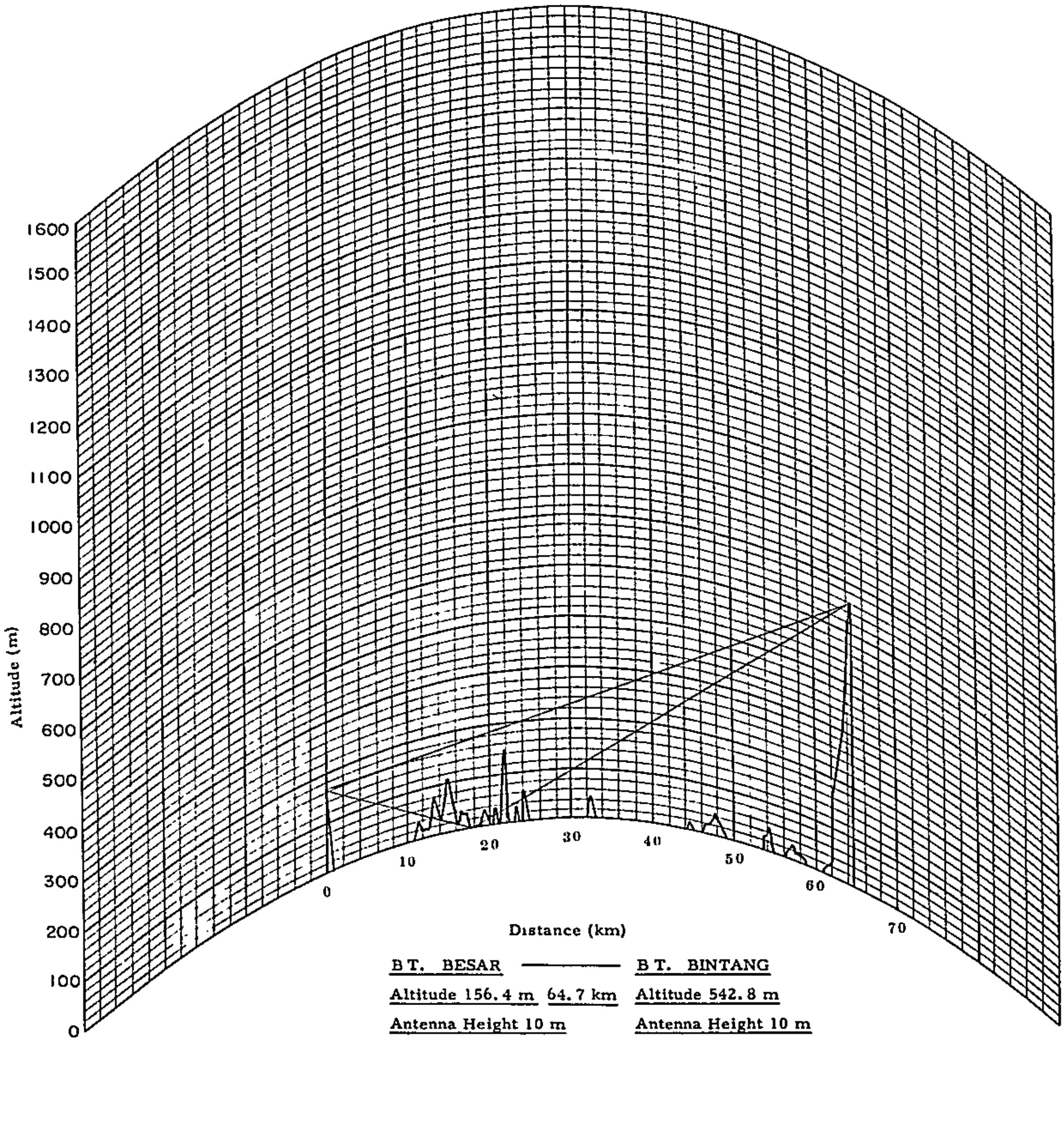


Fig. 24 PROFILE MAP

(K = 2/3)

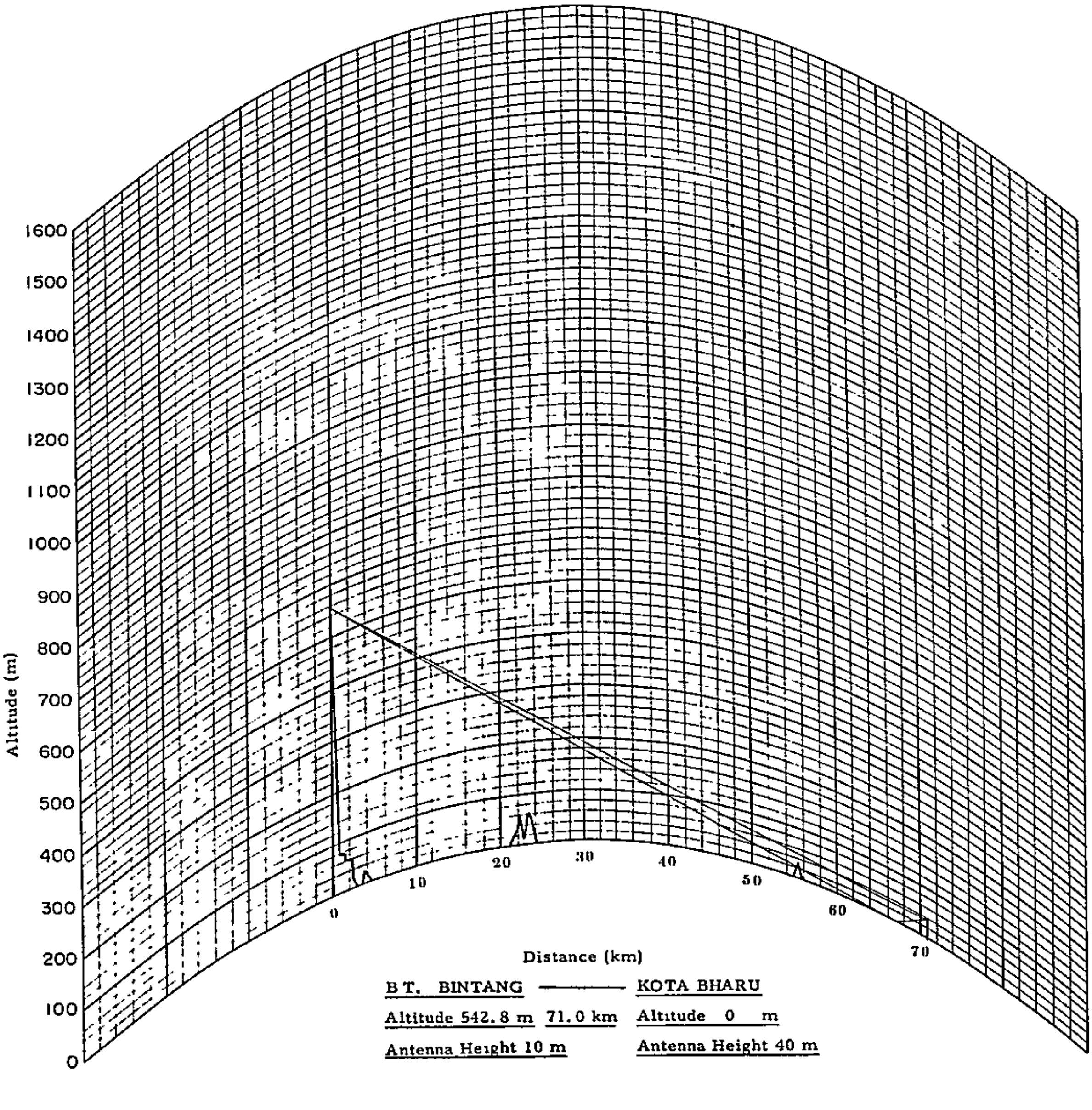


Table 19 Calculated Figures of Various Foundamental Factors on Each Section ( K = 4/3 )

| Item | | | Unit | BT. PELINDONG | BT. KEMUNING | | |
|---|---|---|---|---|---|---|---|
| Altitude | | | m | 268.2 | 289.6 | | |
| Antenna Height above Ground | | | m | 20 | 10 | | |
| Effective Antenna Height | | | m | 245.0 | 253.5 | | |
| Half Pitch of Height Pattern | | | m | 2.72 | 2.81 | | |
| Effective Reflection Coefficient | | Included Angle between Direct and Reflected Wave | ° ' " | 31'35" | 30'36" | | |
| Effective Reflection Coefficient | | Attenuation of Reflected Wave due to Antenna Directivity | dB | 4.0 | 3.8 | | |
| Effective Reflection Coefficient | | Shielding Ridge Loss of Reflected Wave | dB | 7.9 | | | |
| Effective Reflection Coefficient | Reflection Point | Distance from Station | Km | 27.1 | 28.0 | | |
| Effective Reflection Coefficient | Reflection Point | Classification of Condition | | Sea surface | | | |
| Effective Reflection Coefficient | Reflection Point | Reflection Loss | dB | 0 | | | |
| Effective Reflection Coefficient | Reflection Point | Altitude | m | 0 | | | |
| Effective Reflection Coefficient | Total | Total Loss of Reflect Wave | dB | 15.7 | | | |
| Effective Reflection Coefficient | Total | Effective Reflection Coefficient | | 0.16 | | | |
| Path Difference | | Path Difference between Direct and Reflected Wave | m | 2.25 | | | |
| Path Difference | | Required D/U for S/D of 85 dB | dB | 21.7 | | | |
| Propagation Path Length | | | Km | 55.1 | | | |
| Propagation Loss at Free Space | | | dB | 142.8 | | | |
| Profile Map | | | | Fig. 25 | | | |
| Clearance | | | | Enough | | | |
| Remarks | | | | | | | |

Table 20 Calculated Figures of Various Foundamental Factors on Each Section ( K = 4/3 )

| Item | | Name of Station | Unit | BT. BAUK | BT. CHERATING | | BT. BESAR | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Altitude | | | m | 346.6 | 110.3 | | 156.4 | | | |
| Antenna Height above Ground | | | m | 20 | 20 | | .50 | | | |
| Effective Antenna Height | | | m | 295.8 | 108.4 | 116.1 | 179.4 | | | |
| Half Pitch of Height Pattern | | | m | 4.79 | 1.76 | 2.51 | 3.75 | | | |
| Effective Reflection Coefficient | | Included Angle between Direct and Reflected Wave | ° ' " | 17'32" | 50'00" | 38'42" | 25'02" | | | |
| Effective Reflection Coefficient | | Attenuation of Reflected Wave due to Antenna Directivity | dB | 1.1 | 10.8 | 6.3 | 2.6 | | | |
| Effective Reflection Coefficient | | Shielding Ridge Loss of Reflected Wave | dB | More than 14 | | More than 35 | | | | |
| Effective Reflection Coefficient | Reflection Point | Distance from Station | Km | 30.8 | 10.8 | 12.5 | 19.4 | | | |
| Effective Reflection Coefficient | Reflection Point | Classification of Condition | | Mountain | | Mountain | | | | |
| Effective Reflection Coefficient | Reflection Point | Reflection Loss | dB | 14 | | 14 | | | | |
| Effective Reflection Coefficient | Reflection Point | Altitude | m | 15 | | 5 | | | | |
| Effective Reflection Coefficient | Total | Total Loss of Reflect Wave | dB | More than 39.9 | | More than 57.9 | | | | |
| Effective Reflection Coefficient | Total | Effective Reflection Coefficient | | Less than 0.010 | | Less than 0.0013 | | | | |
| Path Difference | | Path Difference between Direct and Reflected Wave | m | 1.54 | | 1.31 | | | | |
| Path Difference | | Required D/U for S/D of 85 dB | dB | 15.5 | | 12.0 | | | | |
| Propagation Path Length | | | Km | 41.6 | | 31.9 | | | | |
| Propagation Loss at Free Space | | | dB | 140.4 | | 138.1 | | | | |
| Profile Map | | | | Fig. 26 | | Fig. 27 | | | | |
| Clearance | | | | Enough | | Over horizon | | | | |
| Remarks | | | | | | | | | | |

Table 21 Calculated Figures of Various Foundamental Factors on Each Section ( K = 4/3 )

| Item | | | Unit | BT. CHERATING | BT. BESAR | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Altitude | | | m | 110.3 | 156.4 | | | | |
| Antenna Height above Ground | | | m | 20 | 70 | | | | |
| Effective Antenna Height | | | m | 107.3 | 187.3 | | | | |
| Half Pitch of Height Pattern | | | m | 2.12 | 3.71 | | | | |
| Effective Reflection Coefficient | | Included Angle between Direct and Reflected Wave | ° ' " | 40'23" | 23'10" | | | | |
| Effective Reflection Coefficient | | Attenuation of Reflected Wave due to Antenna Directivity | dB | 7.2 | 2.1 | | | | |
| Effective Reflection Coefficient | | Shielding Ridge Loss of Reflected Wave | dB | More than 25 | | | | | |
| Effective Reflection Coefficient | Reflection Point | Distance from Station | Km | 11.6 | 20.3 | | | | |
| Effective Reflection Coefficient | Reflection Point | Classification of Condition | | Mountain | | | | | |
| Effective Reflection Coefficient | Reflection Point | Reflection Loss | dB | 14 | | | | | |
| Effective Reflection Coefficient | Reflection Point | Altitude | m | 15 | | | | | |
| Effective Reflection Coefficient | Total | Total Loss of Reflect Wave | dB | More than 48.3 | | | | | |
| Effective Reflection Coefficient | Total | Effective Reflection Coefficient | | Less than 0.0039 | | | | | |
| Path Difference | | Path Difference between Direct and Reflected Wave | m | 1.27 | | | | | |
| Path Difference | | Required D/U for S/D of 85 dB | dB | 11.5 | | | | | |
| Propagation Path Length | | | Km | 31.9 | | | | | |
| Propagation Loss at Free Space | | | dB | 138.1 | | | | | |
| Profile Map | | | | Fig. 27 | | | | | |
| Clearance | | | | Over horizon | | | | | |
| Remarks | | | | | | | | | |

Table 22 Calculated Figures of Various Foundamental Factors on Each Section ( K = 4/3 )

| Item \ Name of Station | | | Unit | BT. BINTANG | BT. PANCHOR | | KOTA BHARU | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Altitude | | | m | 542.8 | 193.9 | | 6 | | | |
| Antenna Height above Ground | | | m | 10 | 10 | | .40 | | | |
| Effective Antenna Height | | | m | 474.9 | 191.2 | 187.9 | 39.3 | | | |
| Half Pitch of Height Pattern | | | m | 3.34 | 1.35 | 6.31 | 1.32 | | | |
| Effective Reflection Coefficient | | Included Angle between Direct and Reflected Wave | ° ' " | 25'45" | 1°03'50" | 13'33" | 1°04'56" | | | |
| | | Attenuation of Reflected Wave due to Antenna Directivity | dB | 2.6 | 18 | 0.6 | 18 | | | |
| | | Shielding Ridge Loss of Reflected Wave | dB | 0 | | 0 | | | | |
| | Reflection Point | Distance from Station | Km | 36.4 | 14.7 | 16.5 | 3.4 | | | |
| | | Classification of Condition | | Field | | Field | | | | |
| | | Reflection Loss | dB | 6 | | 6 | | | | |
| | | Altitude | m | 0 | | 0 | | | | |
| | Total | Total Loss of Reflect Wave | dB | 26.6 | | 24.6 | | | | |
| | | Effective Reflection Coefficient | | 0.047 | | 0.059 | | | | |
| Path Difference | | Path Difference between Direct and Reflected Wave | m | 3.54 | | 0.74 | | | | |
| | | Required D/U for S/D of 85 dB | dB | 30 | | Less than 10 | | | | |
| Propagation Path Length | | | Km | 51.1 | | 19.9 | | | | |
| Propagation Loss at Free Space | | | dB | 142.2 | | 134.0 | | | | |
| Profile Map | | | | Fig. 28 | | Fig. 29 | | | | |
| Clearance | | | | Enough | | Enough | | | | |
| Remarks | | | | | | | | | | |

Table 23 Calculated Figures of Various Foundamental Factors on Each Section ( K = 4/3 )

| Item / Name of Station | BT. PANCHOR | | KOTA BHARU | | BT. PANCHOR | | KOTA BHARU | |
|---|---|---|---|---|---|---|---|---|
| Altitude m | 103.9 | | 0 | | 193.9 | | 0 | |
| Antenna Height above Ground m | 10 | | 30 | | 10 | | 50 | |
| Effective Antenna Height m | | 186.5 | 29.6 | | | 189.2 | 49.0 | |
| Half Pitch of Height Pattern m | | 8.40 | 1.33 | | | 5.08 | 1.31 | |
| Effective Reflection Coefficient: Included Angle between Direct and Reflected Wave | ° ' " | 10'12" | 1°04'27" | | | 16'54" | 1°05'23" | |
| Effective Reflection Coefficient: Attenuation of Reflected Wave due to Antenna Directivity | dB | 0.4 | 18 | | | 1.0 | 18.5 | |
| Effective Reflection Coefficient: Shielding Ridge Loss of Reflected Wave | dB | 0 | | | | 0 | | |
| Effective Reflection Coefficient: Reflection Point: Distance from Station | Km | 17.2 | 2.7 | | | 15.8 | 4.1 | |
| Effective Reflection Coefficient: Reflection Point: Classification of Condition | | Field | | | | Field | | |
| Effective Reflection Coefficient: Reflection Point: Reflection Loss | dB | 6 | | | | 6 | | |
| Effective Reflection Coefficient: Reflection Point: Altitude | m | 0 | | | | 0 | | |
| Effective Reflection Coefficient: Total: Total Loss of Reflect Wave | dB | 24.4 | | | | 25.5 | | |
| Effective Reflection Coefficient: Total: Effective Reflection Coefficient | | 0.059 | | | | 0.053 | | |
| Path Difference: Path Difference between Direct and Reflected Wave | m | 0.56 | | | | 0.93 | | |
| Path Difference: Required D/U for S/D of 85 dB | dB | Less than 10 | | | | Less than 10 | | |
| Propagation Path Length | Km | 19.9 | | | | 19.9 | | |
| Propagation Loss at Free Space | dB | 134.0 | | | | 134.0 | | |
| Profile Map | | Fig. 29 | | | | Fig. 29 | | |
| Clearance | | Enough | | | | Enough | | |
| Remarks | | | | | | | | |

Table 24 Calculated Figures of Various Foundamental Factors on Each Section ( K = 4/3 )

| Item \ Name of Station | | | Unit | BT. PANCHOR | KOTA BHARU | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Altitude | | | m | 193.9 | 0 | | | | |
| Antenna Height above Ground | | | m | 10 | 60 | | | | |
| Effective Antenna Height | | | m | 190.3 | 58.7 | | | | |
| Half Pitch of Height Pattern | | | m | 4.24 | 1.31 | | | | |
| Effective Reflection Coefficient | | Included Angle between Direct and Reflected Wave | ° ' " | 20'15" | 1°05'44" | | | | |
| | | Attenuation of Reflected Wave due to Antenna Directivity | dB | 1.5 | 18.5 | | | | |
| | | Shielding Ridge Loss of Reflected Wave | dB | 0 | | | | | |
| | Reflection Point | Distance from Station | Km | 15.2 | 4.7 | | | | |
| | | Classification of Condition | | Field | | | | | |
| | | Reflection Loss | dB | 6 | | | | | |
| | | Altitude | m | 0 | | | | | |
| | Total | Total Loss of Reflect Wave | dB | 26.0 | | | | | |
| | | Effective Reflection Coefficient | | 0.050 | | | | | |
| Path Difference | | Path Difference between Direct and Reflected Wave | m | 1.12 | | | | | |
| | | Required D/U for S/D of 85 dB | dB | 29.5 | | | | | |
| Propagation Path Length | | | Km | 19.9 | | | | | |
| Propagation Loss at Free Space | | | dB | 134.0 | | | | | |
| Profile Map | | | | Fig. 29 | | | | | |
| Clearance | | | | Enough | | | | | |
| Remarks | | | | | | | | | |

Table 25 Calculated Figures of Various Foundamental Factors on Each Section ( K = 2/3 )

| Item | | | Unit | BT. PELINDONG | BT. KEMUNING | | |
|---|---|---|---|---|---|---|---|
| Altitude | | | m | 268.2 | 289.6 | | |
| Antenna Height above Ground | | | m | 20 | 10 | | |
| Effective Antenna Height | | | m | 201.6 | 208.0 | | |
| Half Pitch of Height Pattern | | | m | 3.31 | 3.42 | | |
| Effective Reflection Coefficient | | Included Angle between Direct and Reflected Wave | ° ' " | 25'52" | 25'10" | | |
| Effective Reflection Coefficient | | Attenuation of Reflected Wave due to Antenna Directivity | dB | 2.6 | 2.6 | | |
| Effective Reflection Coefficient | | Shielding Ridge Loss of Reflected Wave | dB | 10.4 | | | |
| Effective Reflection Coefficient | Reflection Point | Distance from Station | Km | 27.2 | 27.9 | | |
| Effective Reflection Coefficient | Reflection Point | Classification of Condition | | Sea surface | | | |
| Effective Reflection Coefficient | Reflection Point | Reflection Loss | dB | 0 | | | |
| Effective Reflection Coefficient | Reflection Point | Altitude | m | 0 | | | |
| Effective Reflection Coefficient | Total | Total Loss of Reflect Wave | dB | 15.6 | | | |
| Effective Reflection Coefficient | Total | Effective Reflection Coefficient | | 0.166 | | | |
| Path Difference | | Path Difference between Direct and Reflected Wave | m | 1.52 | | | |
| Path Difference | | Required D/U for S/D of 85 dB | dB | 15 | | | |
| Propagation Path Length | | | Km | 55.1 | | | |
| Propagation Loss at Free Space | | | dB | 142.8 | | | |
| Profile Map | | | | Fig. 30 | | | |
| Clearance | | | | Enough | | | |
| Remarks | | | | | | | |

Table 26 Calculated Figures of Various Foundamental Factors on Each Section ( K = 2/3 )

| Item \ Name of Station | Unit | BT. BAUK | | BT. CHERATING | | BT. BESAR | | |
|---|---|---|---|---|---|---|---|---|
| Altitude | m | 346.6 | | 110.3 | | 156.4 | | |
| Antenna Height above Ground | m | 20 | | 20 | | 50 | | |
| Effective Antenna Height | m | | 247.9 | 98.6 | 106.2 | 158.4 | | |
| Half Pitch of Height Pattern | m | | 5.37 | 2.10 | 2.51 | 3.75 | | |
| Effective Reflection Coefficient: Included Angle between Direct and Reflected Wave | ° ' '' | | 16'22'' | 40'50'' | 34'13'' | 22'52'' | | |
| Effective Reflection Coefficient: Attenuation of Reflected Wave due to Antenna Directivity | dB | | 1.0 | 7.4 | 5.0 | 1.9 | | |
| Effective Reflection Coefficient: Shielding Ridge Loss of Reflected Wave | dB | | More than 14 | | More than 41 | | | |
| Effective Reflection Coefficient: Reflection Point: Distance from Station | Km | | 29.7 | 11.9 | 12.8 | 19.1 | | |
| Effective Reflection Coefficient: Reflection Point: Classification of Condition | | | Mountain | | Mountain | | | |
| Effective Reflection Coefficient: Reflection Point: Reflection Loss | dB | | 14 | | 14 | | | |
| Effective Reflection Coefficient: Reflection Point: Altitude | m | | 15 | | 5 | | | |
| Effective Reflection Coefficient: Total: Total Loss of Reflect Wave | dB | | More than 36.4 | | More than 61.9 | | | |
| Effective Reflection Coefficient: Total: Effective Reflection Coefficient | | | Less than 0.015 | | Less than 0.0008 | | | |
| Path Difference: Path Difference between Direct and Reflected Wave | m | | 1.17 | | 1.05 | | | |
| Path Difference: Required D/U for S/D of 85 dB | dB | | 10 | | Less than 10 | | | |
| Propagation Path Length | Km | | 41.6 | | 31.9 | | | |
| Propagation Loss at Free Space | dB | | 140.4 | | 138.1 | | | |
| Profile Map | | | Fig. 31 | | Fig. 32 | | | |
| Clearance | | | Enough | | Over horizon | | | |
| Remarks | | | | | | | | |

Table 27 Calculated Figures of Various Foundamental Factors on Each Section ( K = 2/3 )

| Item \ Name of Station | | | Unit | BT. CHERATING | BT. BESAR | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Altitude | | | m | 110.3 | 156.4 | | | | |
| Antenna Height above Ground | | | m | 20 | 70 | | | | |
| Effective Antenna Height | | | m | 98.5 | 164.6 | | | | |
| Half Pitch of Height Pattern | | | m | 2.42 | 4.05 | | | | |
| Effective Reflection Coefficient | | Included Angle between Direct and Reflected Wave | ° ' " | 35'30" | 21'15" | | | | |
| | | Attenuation of Reflected Wave due to Antenna Directivity | dB | 5.2 | 1.8 | | | | |
| | | Shielding Ridge Loss of Reflected Wave | dB | More than 29 | | | | | |
| | Reflection Point | Distance from Station | Km | 11.9 | 20.0 | | | | |
| | | Classification of Condition | | Mountain | | | | | |
| | | Reflection Loss | dB | 14 | | | | | |
| | | Altitude | m | 15 | | | | | |
| | Total | Total Loss of Reflect Wave | dB | More than 50 | | | | | |
| | | Effective Reflection Coefficient | | Less than 0.0032 | | | | | |
| Path Difference | | Path Difference between Direct and Reflected Wave | m | 1.02 | | | | | |
| | | Required D/U for S/D of 85 dB | dB | Less than 10 | | | | | |
| Propagation Path Length | | | Km | 31.9 | | | | | |
| Propagation Loss at Free Space | | | dB | 138.1 | | | | | |
| Profile Map | | | | Fig. 32 | | | | | |
| Clearance | | | | Over horizon | | | | | |
| Remarks | | | | | | | | | |

Table 28 Calculated Figures of Various Foundamental Factors on Each Section (K = 2/3)

| Item \ Name of Station | | | BT. BINTANG | | BT. PANCHOR | | KOTA BHARU | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Altitude | | | m | 542.8 | 193.9 | | 0 | | | |
| Antenna Height above Ground | | | m | 10 | 10 | | 40 | | | |
| Effective Antenna Height | | | m | 403.9 | 175.5 | 172.7 | 38.5 | | | |
| Half Pitch of Height Pattern | | | m | 3.64 | 1.58 | 6.59 | 1.44 | | | |
| Effective Reflection Coefficient | | Included Angle between Direct and Reflected Wave | ° ' " | 23'39" | 54'17" | 13'15" | 59'41" | | | |
| Effective Reflection Coefficient | | Attenuation of Reflected Wave due to Antenna Directivity | dB | 2.2 | 13 | 0.6 | 15.2 | | | |
| Effective Reflection Coefficient | | Shielding Ridge Loss of Reflected Wave | dB | 0 | | 0 | | | | |
| Effective Reflection Coefficient | Reflection Point | Distance from Station | Km | 35.6 | 15.1 | 16.3 | 3.6 | | | |
| Effective Reflection Coefficient | Reflection Point | Classification of Condition | | Field | | Field | | | | |
| Effective Reflection Coefficient | Reflection Point | Reflection Loss | dB | 6 | | 6 | | | | |
| Effective Reflection Coefficient | Reflection Point | Altitude | m | 0 | | 0 | | | | |
| Effective Reflection Coefficient | Total | Total Loss of Reflect Wave | dB | 21.2 | | 21.8 | | | | |
| Effective Reflection Coefficient | Total | Effective Reflection Coefficient | | 0.087 | | 0.081 | | | | |
| Path Difference | | Path Difference between Direct and Reflected Wave | m | 2.77 | | 0.67 | | | | |
| Path Difference | | Required D/U for S/D of 85 dB | dB | 25.5 | | Less than 10 | | | | |
| Propagation Path Length | | | Km | 51.1 | | 19.9 | | | | |
| Propagation Loss at Free Space | | | dB | 142.2 | | 134.0 | | | | |
| Profile Map | | | | Fig. 33 | | Fig. 34 | | | | |
| Clearance | | | | Enough | | Enough | | | | |
| Remarks | | | | | | | | | | |

Table 29 Calculated Figures of Various Foundamental Factors on Each Section ( K = 2/3 )

| Item \ Name of Station | | BT. PANCHOR | | KOTA BHARU | | BT. PANCHOR | | KOTA BHARU |
|---|---|---|---|---|---|---|---|---|
| Altitude (m) | | 193.9 | | 0 | | 193.9 | | 0 |
| Antenna Height above Ground (m) | | 10 | | 30 | | 10 | | 50 |
| Effective Antenna Height (m) | | | 170.0 | 29.0 | | | 175.1 | 47.9 |
| Half Pitch of Height Pattern (m) | | . | 8.58 | 1.46 | | | 5.19 | 1.42 |
| Effective Reflection Coefficient: Included Angle between Direct and Reflected Wave | ° ' " | 10'05" | 58'14" | | | 16'30" | 10'29" | |
| Effective Reflection Coefficient: Attenuation of Reflected Wave due to Antenna Directivity | dB | 0.4 | 15 | | | 1.0 | 15.7 | |
| Effective Reflection Coefficient: Shielding Ridge Loss of Reflected Wave | dB | 0 | | | | 0 | | |
| Effective Reflection Coefficient: Reflection Point: Distance from Station | Km | 17.0 | 2.9 | | | 15.6 | 4.3 | |
| Effective Reflection Coefficient: Reflection Point: Classification of Condition | | Field | | | | Field | | |
| Effective Reflection Coefficient: Reflection Point: Reflection Loss | dB | 6 | | | | 6 | | |
| Effective Reflection Coefficient: Reflection Point: Altitude | m | 0 | | | | 0 | | |
| Effective Reflection Coefficient: Total: Total Loss of Reflect Wave | dB | 21.4 | | | | 22.7 | | |
| Effective Reflection Coefficient: Total: Effective Reflection Coefficient | | 0.085 | | | | 0.074 | | |
| Path Difference: Path Difference between Direct and Reflected Wave | m | 0.50 | | | | 0.85 | | |
| Path Difference: Required D/U for S/D of 85 dB | dB | Less than 10 | | | | Less than 10 | | |
| Propagation Path Length | Km | 19.9 | | | | 19.9 | | |
| Propagation Loss at Free Space | dB | 134.0 | | | | 134.0 | | |
| Profile Map | | Fig. 34 | | | | Fig. 34 | | |
| Clearance | | Enough | | | | Enough | | |
| Remarks | | | | | | | | |

Table 30 Calculated Figures of Various Foundamental Factors on Each Section ( K = 2/3 )

| Group | Sub-group | Item | Unit | BT. PANCHOR | KOTA BHARU |
|---|---|---|---|---|---|
| | | Altitude | m | 193.9 | 0 |
| | | Antenna Height above Ground | m | 10 | 60 |
| | | Effective Antenna Height | m | 176.2 | 57.2 |
| | | Half Pitch of Height Pattern | m | 4.35 | 1.41 |
| Effective Reflection Coefficient | | Included Angle between Direct and Reflected Wave | ° ' " | 19'45" | 1°01'11" |
| Effective Reflection Coefficient | | Attenuation of Reflected Wave due to Antenna Directivity | dB | 1.4 | 15.7 |
| Effective Reflection Coefficient | | Shielding Ridge Loss of Reflected Wave | dB | 0 | |
| Effective Reflection Coefficient | Reflection Point | Distance from Station | Km | 15.0 | 4.9 |
| Effective Reflection Coefficient | Reflection Point | Classification of Condition | | Field | |
| Effective Reflection Coefficient | Reflection Point | Reflection Loss | dB | 6 | |
| Effective Reflection Coefficient | Reflection Point | Altitude | m | 0 | |
| Effective Reflection Coefficient | Total | Total Loss of Reflect Wave | dB | 23.1 | |
| Effective Reflection Coefficient | Total | Effective Reflection Coefficient | | 0.022 | |
| Path Difference | | Path Difference between Direct and Reflected Wave | m | 1.03 | |
| Path Difference | | Required D/U for S/D of 85 dB | dB | Less than 10 | |
| | | Propagation Path Length | Km | 19.9 | |
| | | Propagation Loss at Free Space | dB | 134.0 | |
| | | Profile Map | | Fig. 34 | |
| | | Clearance | | Enough | |
| | | Remarks | | | |

Fig. 25 PROFILE MAP
(K = 4/3)

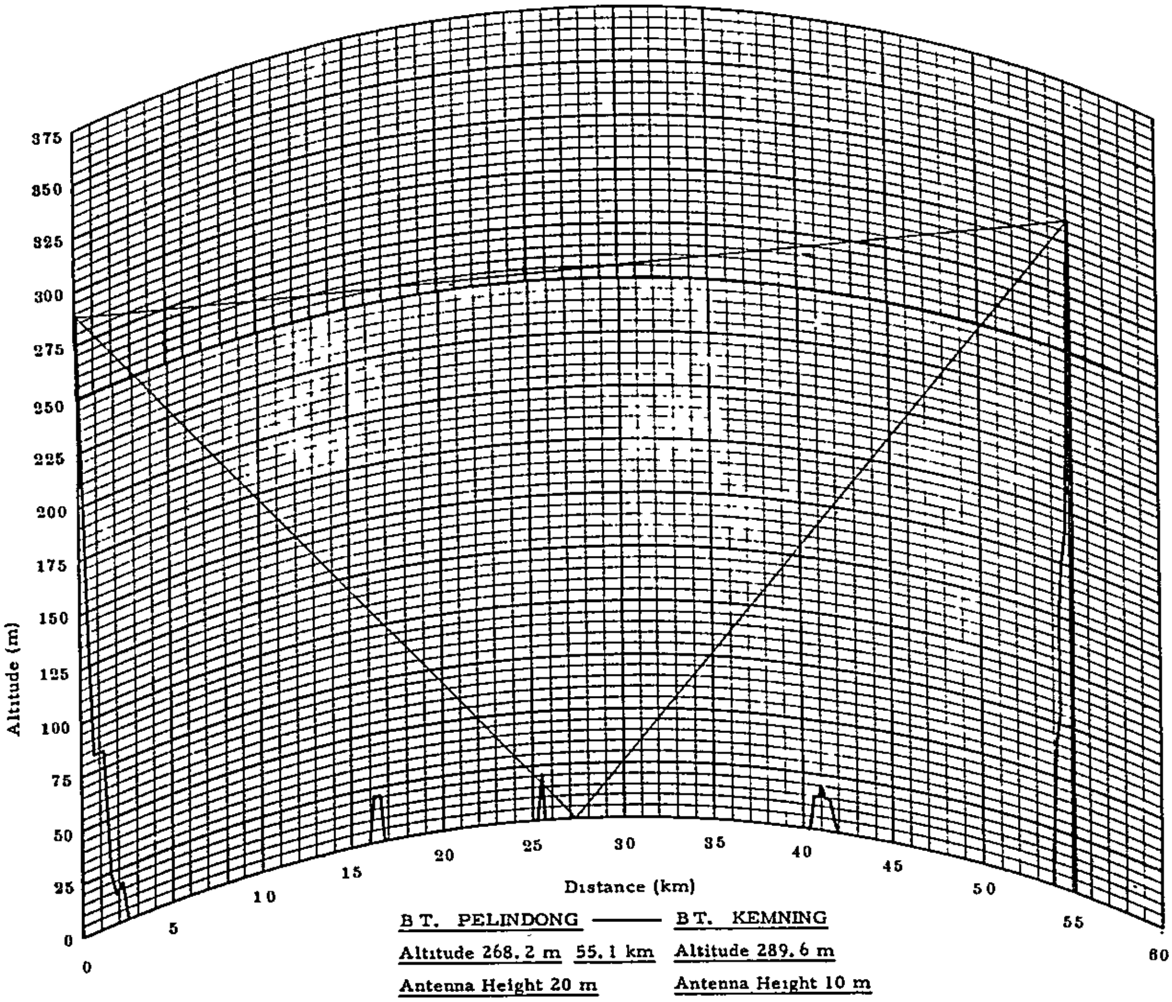


Fig. 26 PROFILE MAP

(K = 4/3)

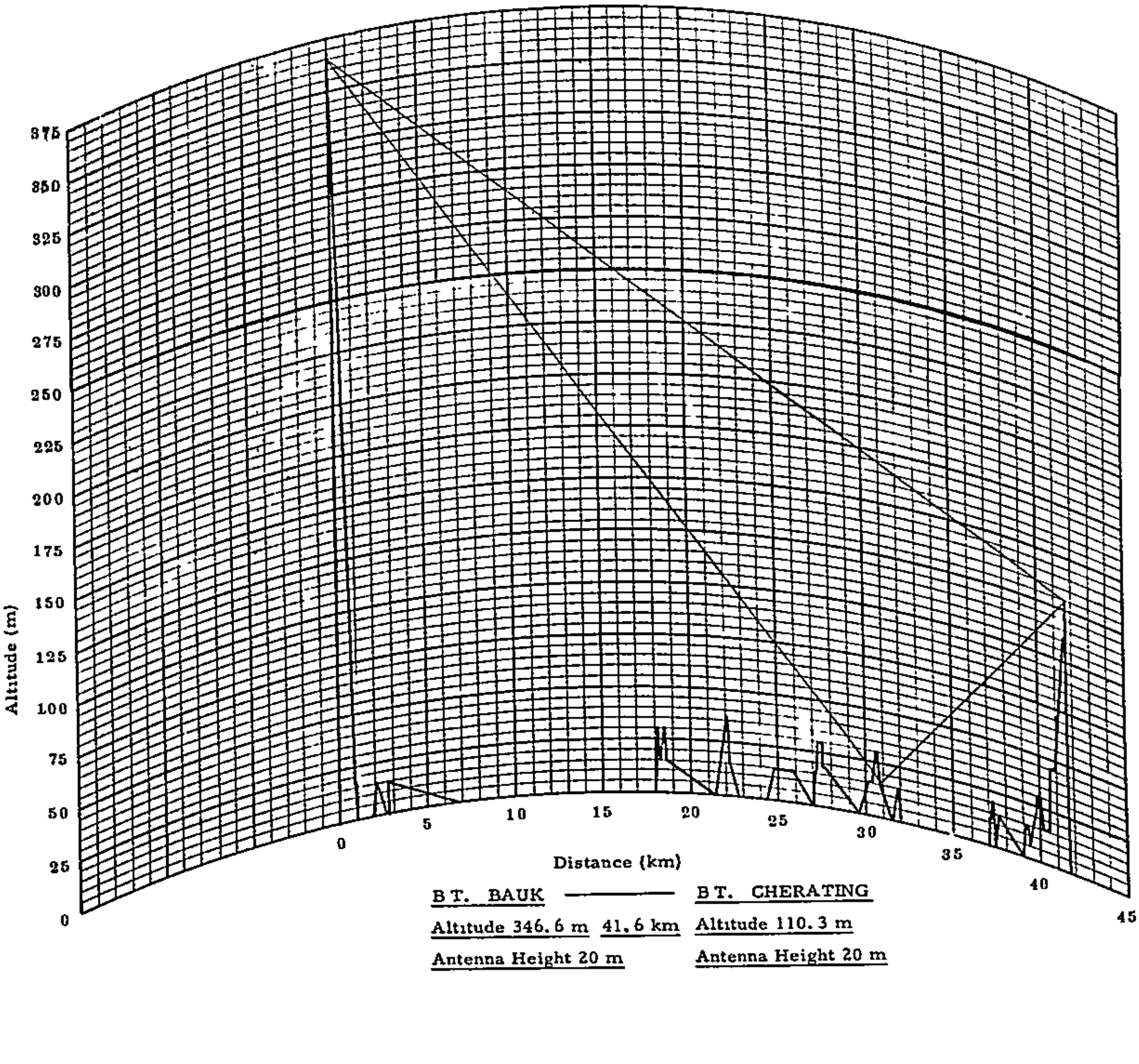
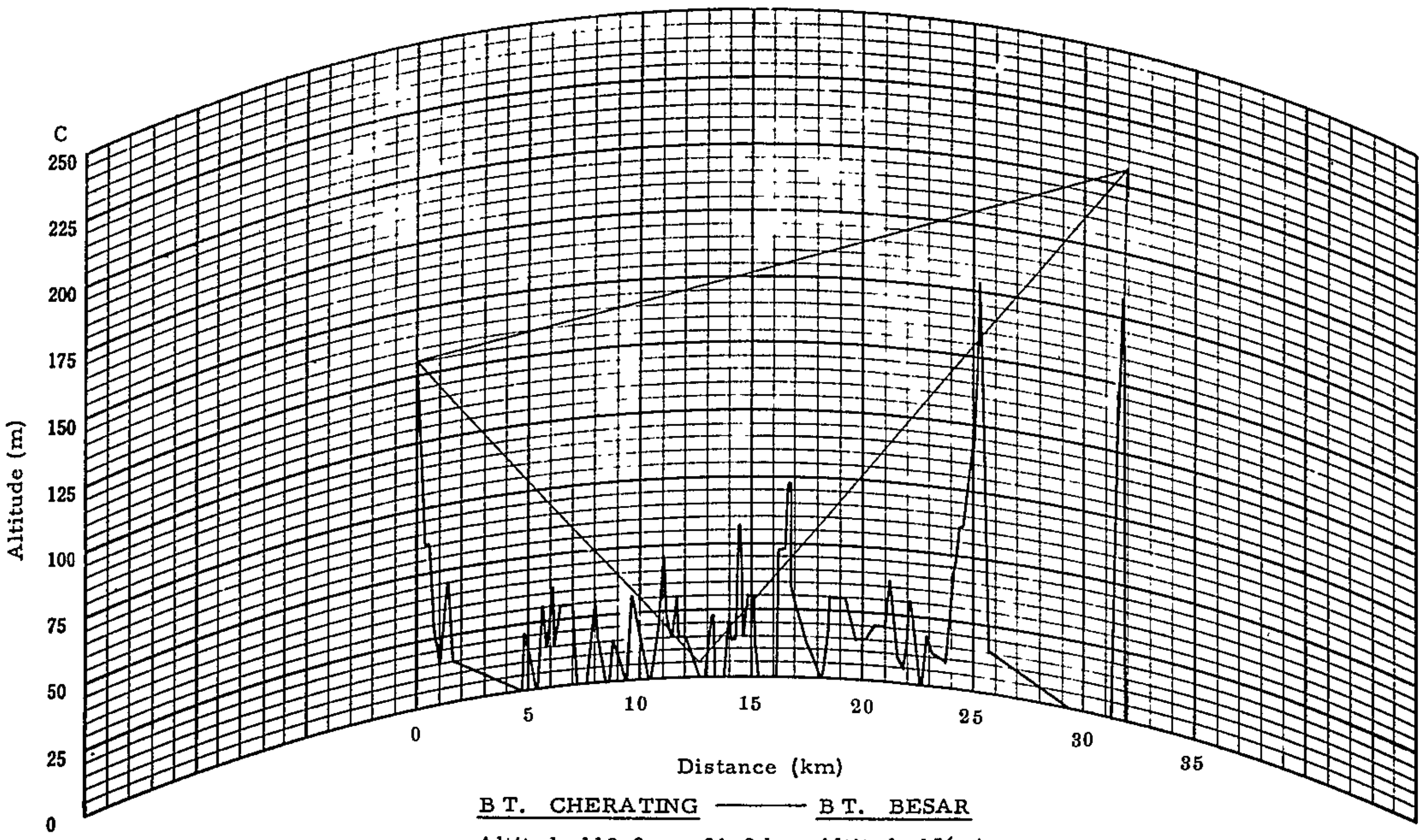


Fig. 27 PROFILE MAP

(K = 4/3)



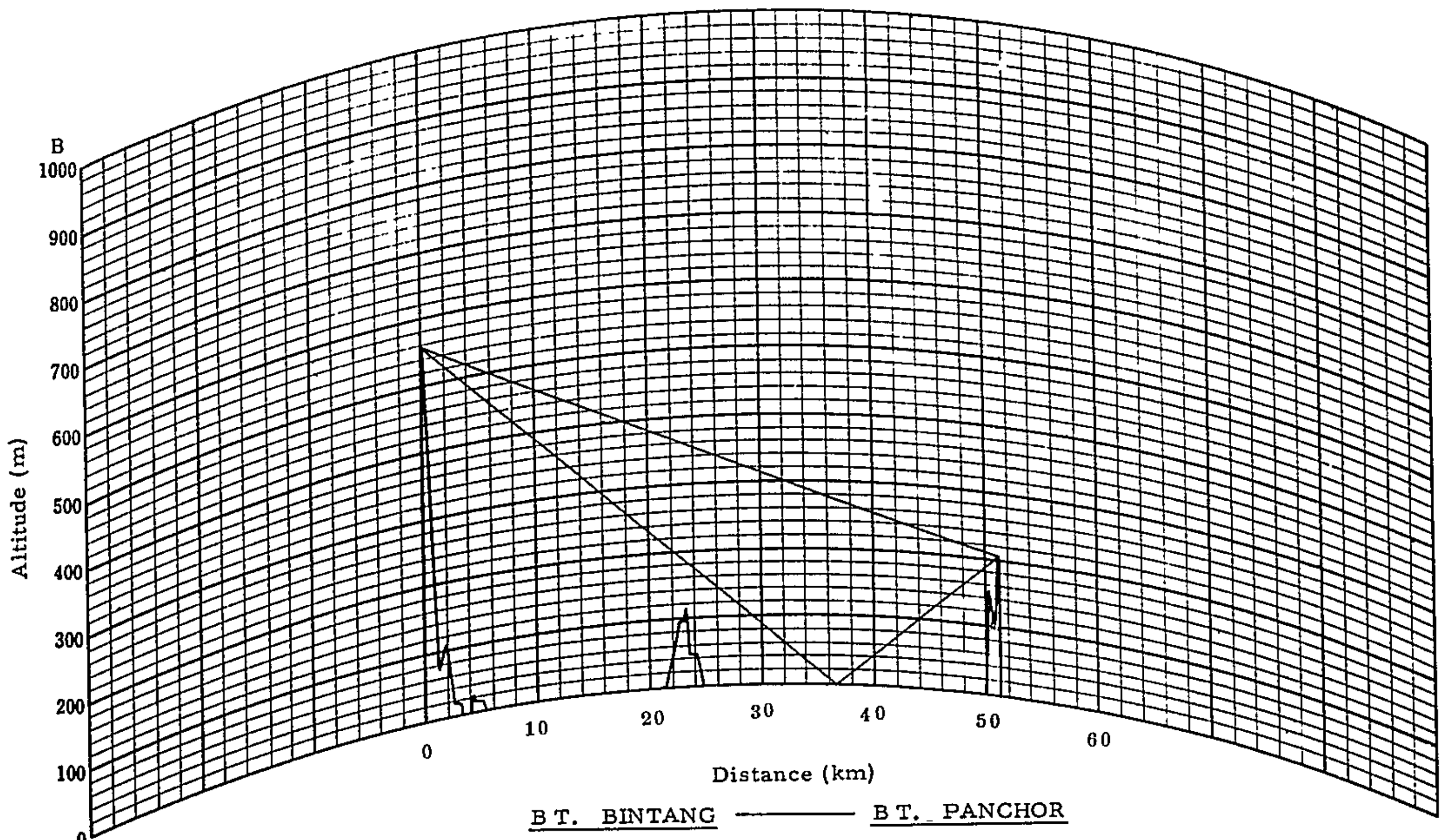

B T. CHERATING ——— B T. BESAR

Altitude 110.3 m 31.9 km Altitude 156.4 m

Antenna Height 20 m Antenna Height 50 m

Fig. 28 PROFILE MAP

(K = 4/3)




B T. BINTANG —— B T. PANCHOR

Altitude 542.8 m 51.1 km Altitude 193.9 m

Antenna Height 10 m Antenna Height 10 m

Fig. 29 PROFILE MAP

(K = 4/3)

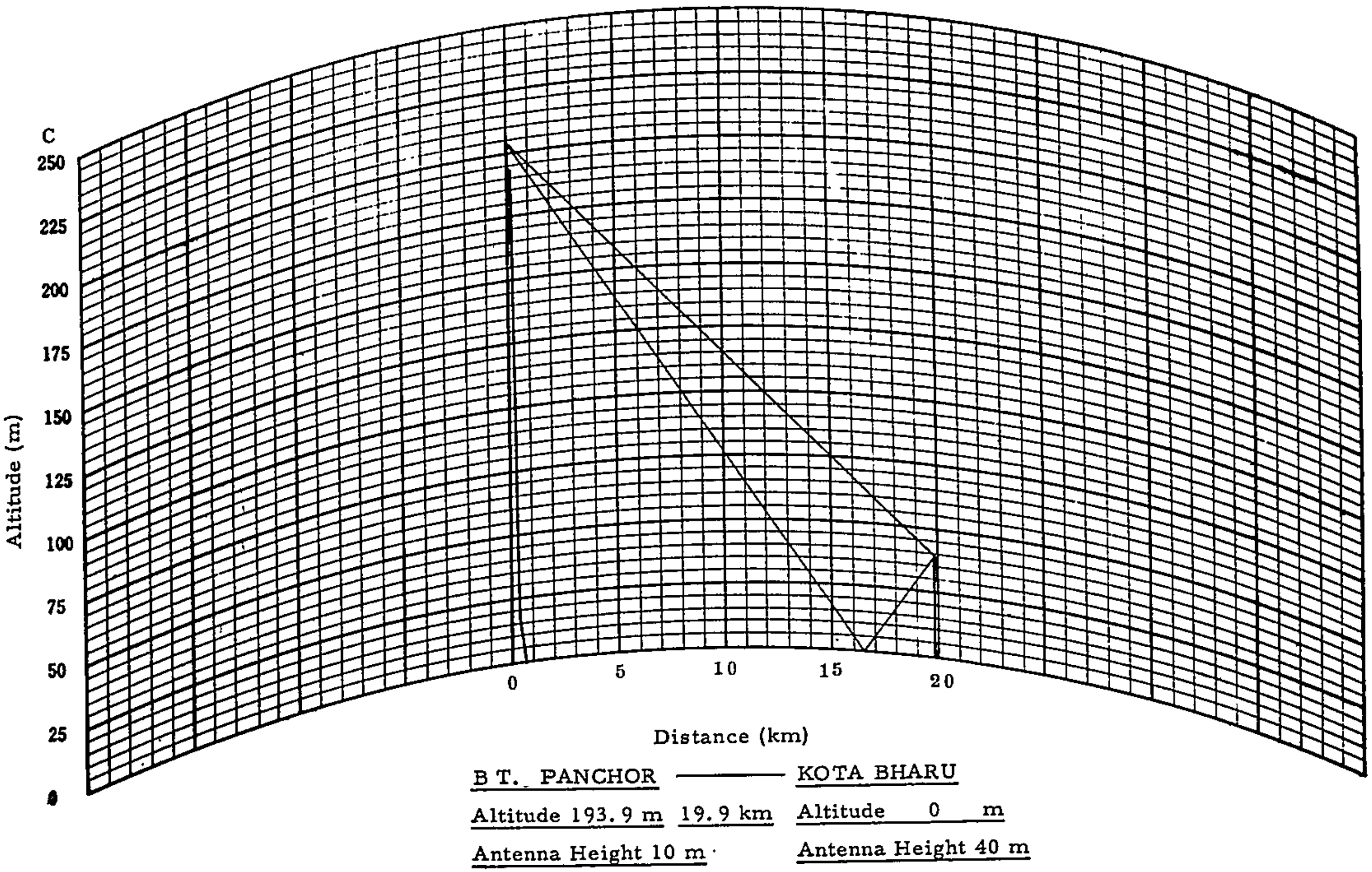


Fig. 30 PROFILE MAP

(K = 2/3)

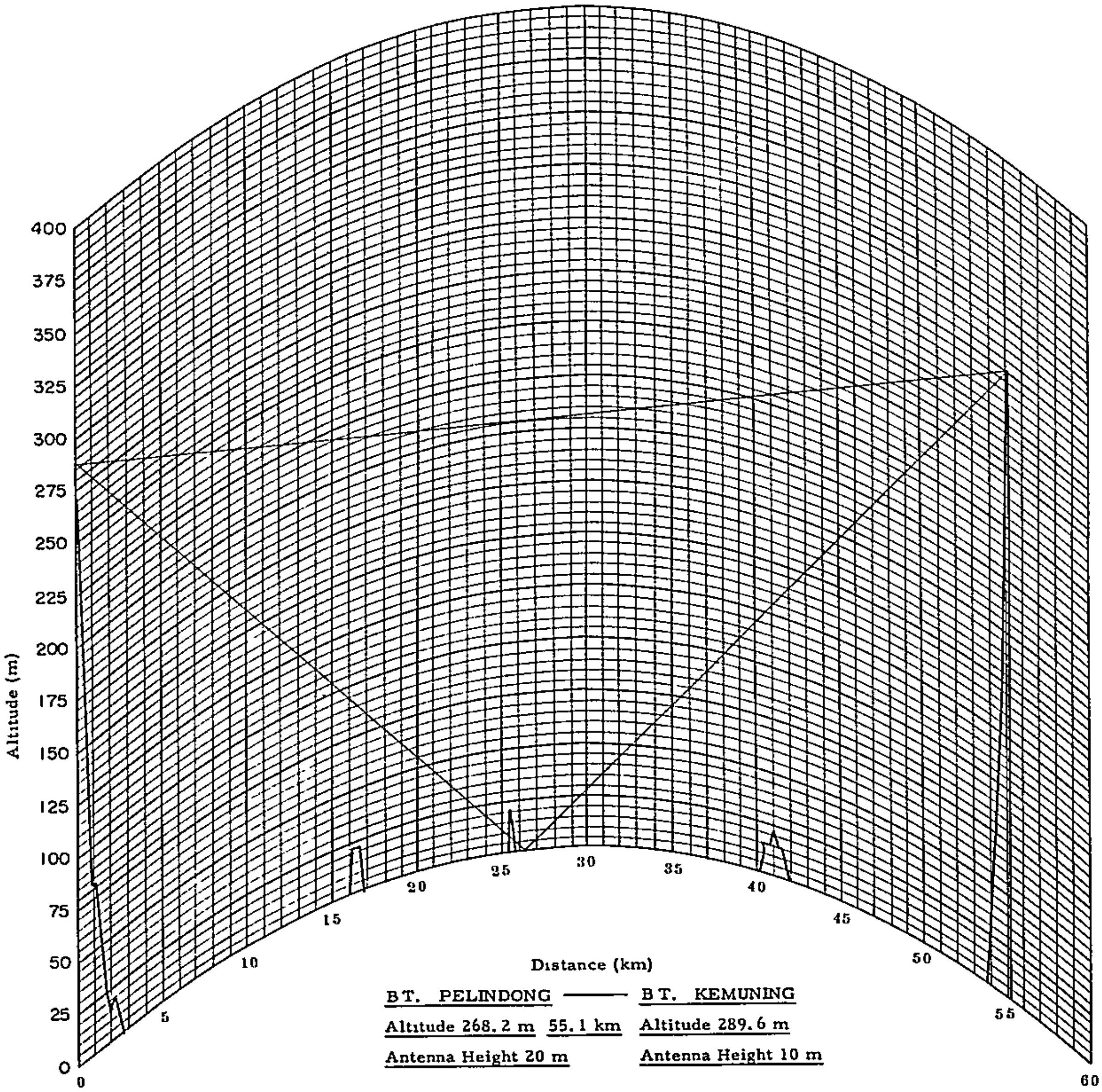


Fig. 31 PROFILE MAP

(K = 2/3)

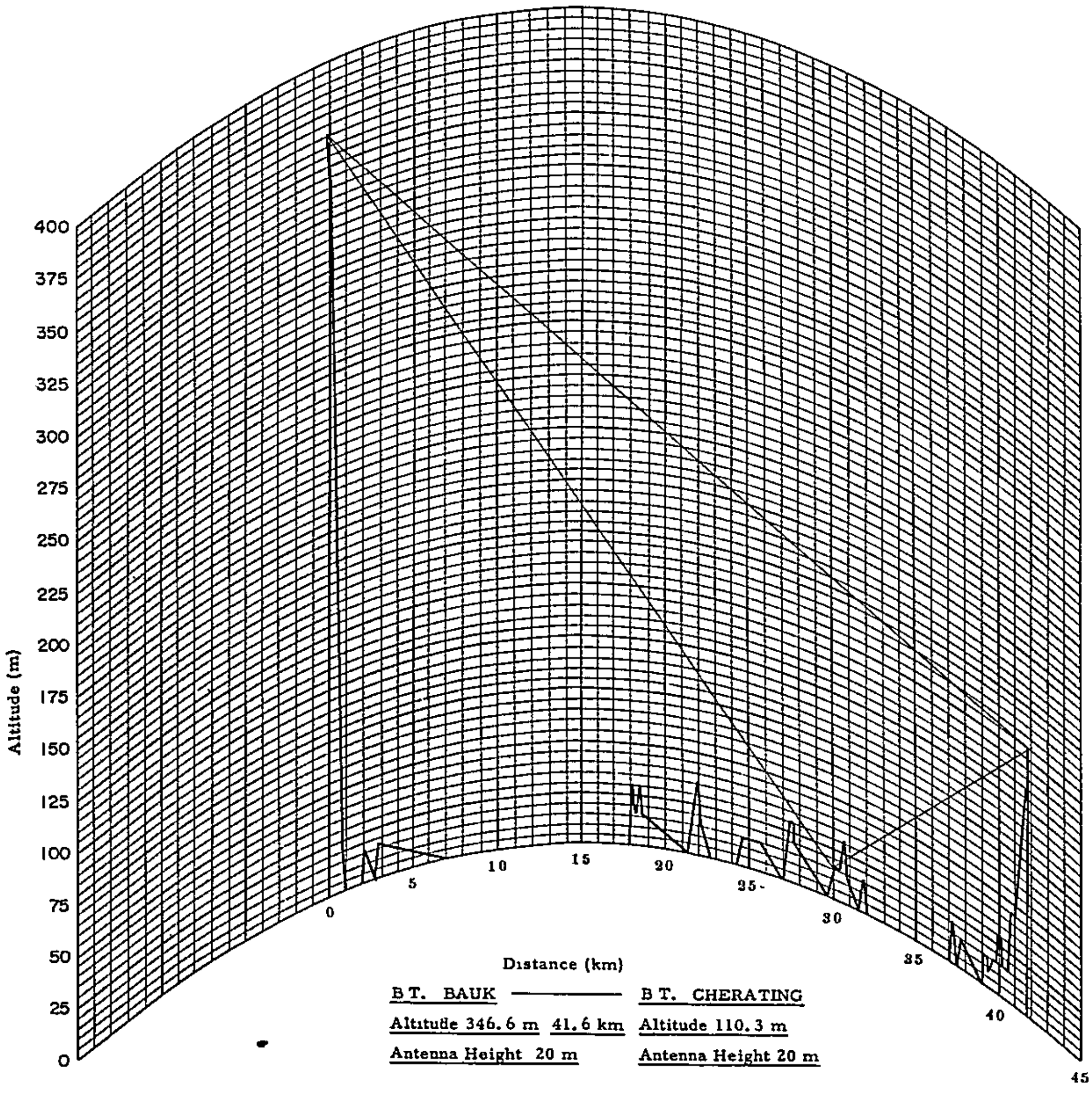


Fig. 32 PROFILE MAP

(K = 2/3)

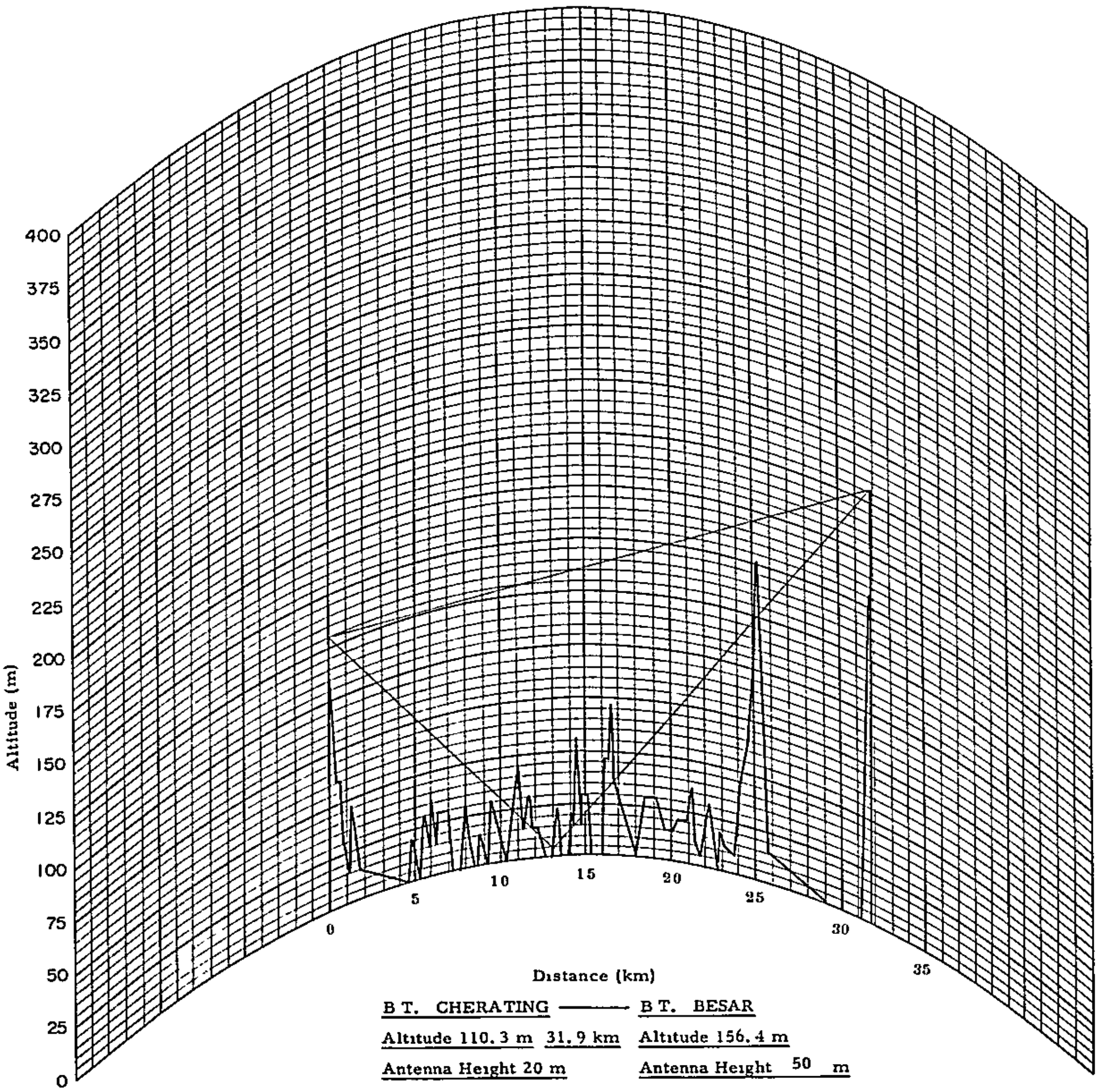


Fig. 33 PROFILE MAP

(K = 2/3)

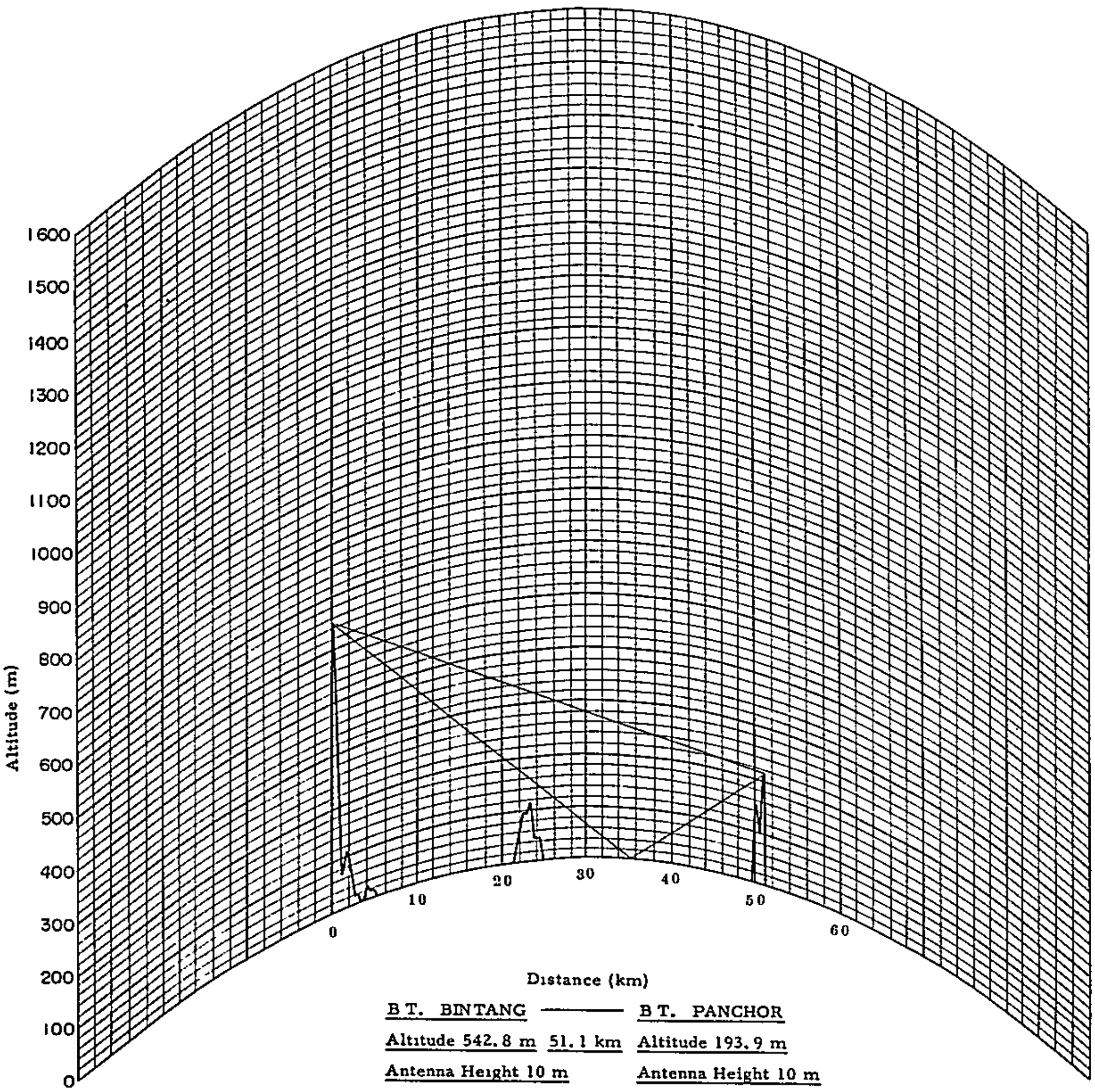
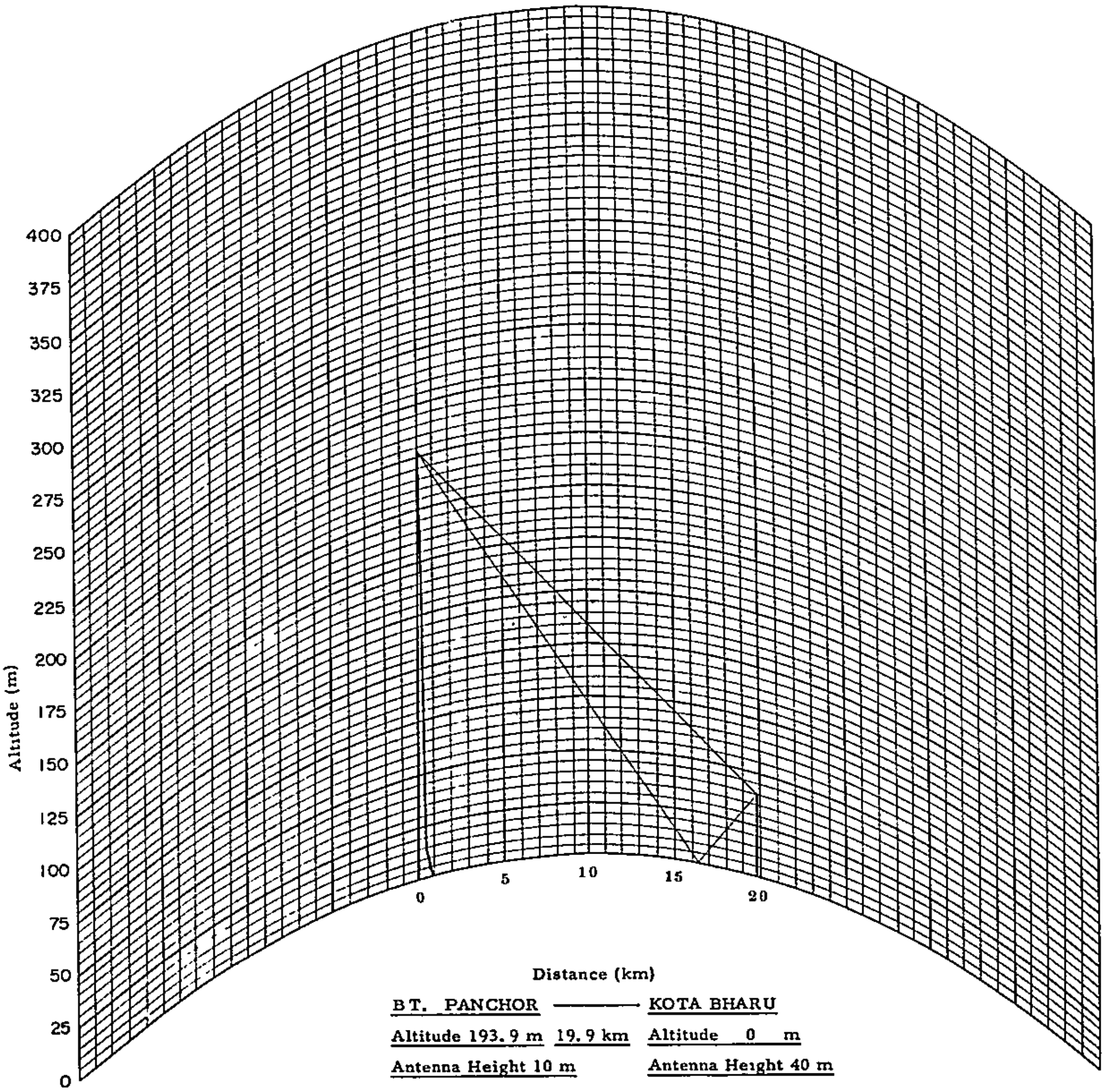


Fig. 34 PROFILE MAP
(K = 2/3)



## 1.4 Feature of Each Section

The result of the examination of the each section, based on the field study, the profile maps and the calculated figures, are shown herein.

(1) Kuala Lumpur - Kuantan

i) Bukit Nanas - Gunong Sempah (Distance: 22.9Km)

This is a shorter path and has an enough clearance. The ridge shielding the reflected wave can not be found in this section, but it can be expected that the city of which reflection coefficient is very small goes into the reflection point, and that the attenuation of reflected wave due to the characteristic of antenna directivity becomes large. Therefore, the strength of reflected wave will come to be ignored.

Moreover, as the difference between the path length of direct wave and that of reflected wave may be within an allowable range, it can be judged that any difficulties due to the interference K-type fading and the propagation distortion may not be generated in this hop.

ii) Gunong Sempah - Bukit Mentakab (Distance: 65.8Km)

This is the longest path in the route, where the probability of causing duct-type fading seems to be fairly large. The shielding ridges may be effective against the reflected wave.

The antenna height at Mentakab should make clear the obstacles such as the rubber trees growing near the site.

iii) Bukit Mentakab - Bukit Maran (Distance: 45.8Km)

This section has no problem regarding the clearance of path and the reflected wave. It can be judged that this hop gives a good propagation performance.

iv) Bukit Maran - Bukit Sulai (Distance: 44.6Km)

As to the path length, clearance and reflected wave, there are no difficulty to be feared, and it can be judged to give a good propagation performance.

v) Bukit Sulai - Kuantan (Distance: 22.2Km)

This is a shorter hop, but no ridges shielding the reflected wave are found on the way and the swamp will get into the reflection point. As far as concerning those features of the path, it is anticipated that the interference K-type fading and the propagation distortion will be originated.

However, according to the results of examination, these difficulties can be judged to be ignored because of the much attenuation of reflected wave due to the charachteristic of antenna directivity and the small path difference between direct and reflected wave.

(2) Kuantan - Kota Bharu

i) Bukit Pelindong - Bukit Kemuning (Distance: 55.1Km)

The most part of the path on this section passes over the sea and the sufficient shielding effect by ridge can not be expected for the strong reflected wave from the sea surface.

It is, therefore, judged that the worst propagation performance including the interference K-type fading and the duct-type fading occurring at the same time may appear in this hop.

ii) Bukit Pelindong - K.G. Cherating (Distance: 31.1Km)

This is one of alternative sections prepared to the section from Pelindong to Kemuning and scheduled to be taken up in case its propagation performance comes out to be the worst.

This is a shorter path and there are no ridges screening the reflected wave on the way.

It is judged that the reflection point will lie in the field or swamp near K.G. Cherating and the attenuation of reflected wave due to the characteristic of antenna directivity can not be expected so much.

But, if the proper antenna height at K.G. Cherating can be secured, the attenuation of reflected wave due to the screen effect of trees near reflection point can be expected at respectable amount.

iii) K.G. Cherating - Bukit Kemuning (Distance: 24.6Km)

This is another substitute section for the section from Pelindong to Kemuning as same as the section from Pelindong to K.G. Cherating.

This is a shorter path too and there is no obstacle for the reflected wave. But it can be expected that the strength of the reflected wave will be made slight by the characteristic of the antenna directivity and the shielding effect due to the trees near the reflection point.

Therefore, there may be no problem about the interference K-type fading and the propagation distortion.

iv) Bukit Kemuning - Bukit Bauk (Distance: 44.1Km)

There are no ridges shielding the reflected wave in this hop. Judging from the profile map, the reflection point lies in the forest near the sea shore, therefore, the propagation performance of this hop can be expected to be very favorable.

The antenna height at Bauk should make clear the local obstacle.

v) Bukit Bauk - Bukit Besar (Distance: 73Km)

This is the longest path in this route and the propagation path runs along the coastal country.

The clearance of this hop appears not to be sufficient by the heliograph test, namely, the flashing light has been found out at just above the edge of mountain located almost halfway of this section. So, in order to determine the proper height of antenna tower at both stations, the accurate height and the location of ridge should be examined in the further field study.

The shielding effect for the reflected wave is of course satisfactory.

vi) Bukit Besar - Bukit Bintang (Distance: 64.7Km)

This section is little longer than the standard propagation length of 50Km, but the clearance and the shielding effect for the reflected wave are sufficient.

vii) Bukit Bintang - Kota Bharu (Distance: 71Km)

This is a rather long path with no shielding ridge for the reflected wave, therefore, the worse propagation performance is expected in this hop.

2. Microwave Propagation Test

In consequence of careful studies based on the examination as mentioned above, which have been carried out by Japanese Team and the officers of Telecommunications Department jointly, it has been determined that the propagation test should be executed on the following sections, one section between Sempah and Mentakab in the route from Kuala Lumpur to Kuantan and all sections in the route from Kuantan to Kota Bharu, and it has been scheduled that, if necessary, the intermediate repeater stations which have been selected previously will be inserted in the sections having unfavorable propagation performance.

2.1 Condition of Propagation Test

The contents of the propagation measurement are as follows.

(1) Continuous recording of received signal strength

(2) Measurement of height pattern

(3) Heliograph test (as required)

The instruments used for this propagation test and other various factors thereof are shown in Fig. 35.

i) Transmitting Side

WG-61-type Microwave Signal Generator having high output power has been used, and the calibration of the output power and the confirmation of the performance of A. F. C have been carried out every hour throughout the testing.

At the sites where the commercial or existing power supply are not available, the portable gasoline engine generators have been used. Antenna with a diameter of 1.8 m has been utilized.

ii) Receiving Side

WI-2-Type Field Intensity Meter has been used, and the continuous recording and supervision of the received signal strength have been made by using YEW-10mA Record Meter.

The means of power supply has been the same as that of the transmitting side. The parabolic dish of 1.2m in diameter has been used as a receiving antenna and two kinds of portable towers, one is 12m high and another is 200 feets high, have been used. The latter one has been provided by Telecommunications Department.

In addition to those devices, several couples of VHF communication sets have been used for the order line between the transmitting and receiving sites. The main equipment brought from Japan are shown in Table 31.

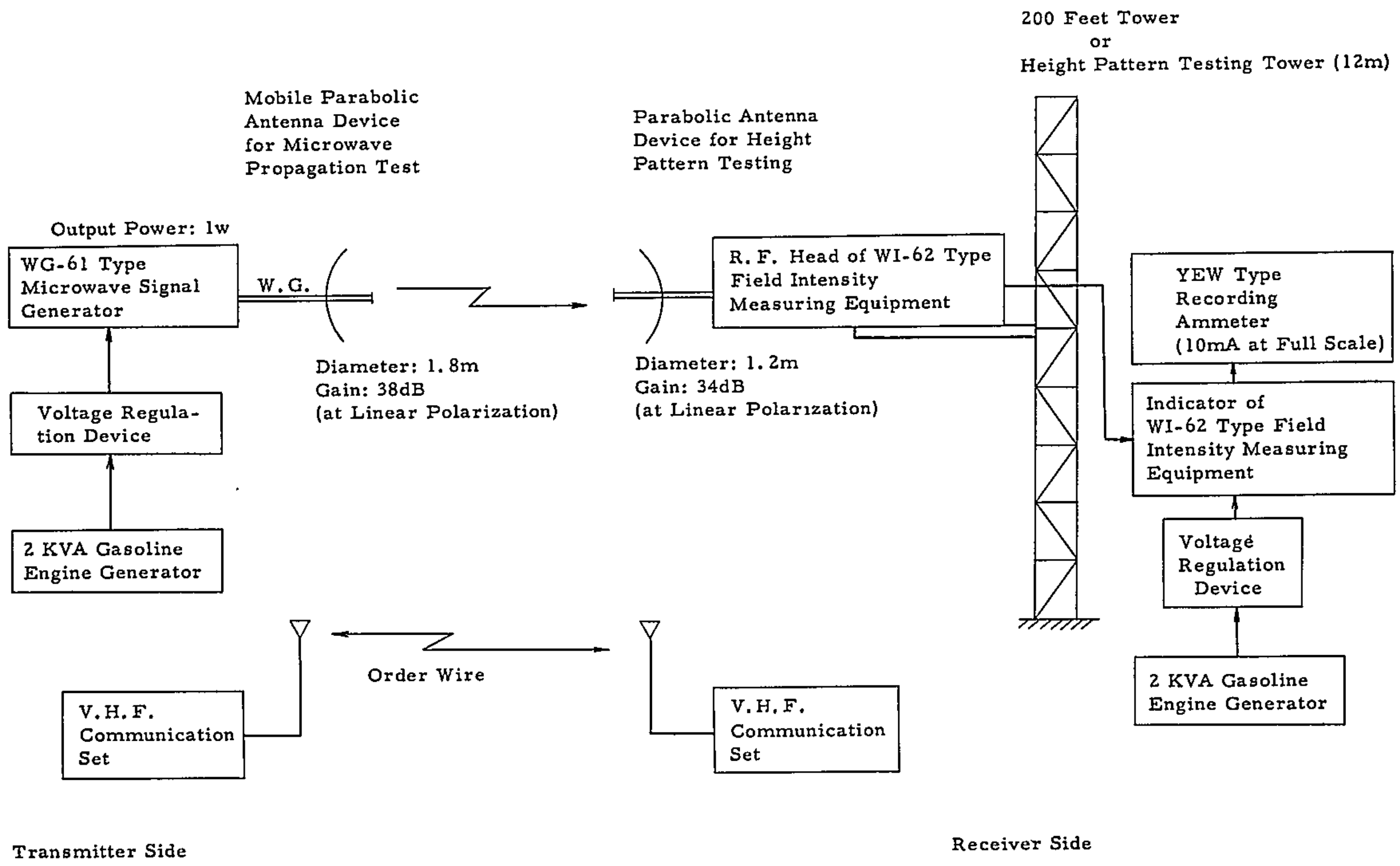



Fig. 35 Block Diagram of Propagation Measurement and Various Figures of Device

Table 31

Measuring Equipments for Microwave Propagation Test

| Name | Number |
|---|---|
| Type"W1-2" Field-Intensity Meter | |
| Field Intensity Indicator | 1 set |
| Radio Frequency Head (Type "WI-61") | 1 set |
| Power Supply for Indicator | 1 set |
| Power Supply for R. F. Head | 1 set |
| Connection Cable | 1 set |
| Cable Drum | 1 set |
| Type "WG-61" Microwave Signal Generator | |
| Microwave Oscillator | 1 set |
| A F C Adaptor | 1 set |
| Power Supply | 1 set |
| Attachement Box No. 1 | 1 set |
| Attachement Box No. 2 | 1 set |
| Mobile Antenna for Microwave Propagation Ttest | |
| Parabolic Mirror (1. 8m$\phi$) | 1 set |
| Feed Horn (for 6Gc/s) | 1 set |
| Universal rotary stand | 1 set |
| Tripod | 1 set |
| Stay Instrument | 1 set |
| 2K. V. A. Gasoline Engine Generator | |
| Engine Generator & Switch Board | 2 sets |
| Tool Box | 2 sets |

| Name | Number |
|---|---|
| Attachement Box- | 2 sets |
| Spare Fuel Tank | 2 pieces |
| Type"WG-3602" Microwave Signal Generator | |
| Signal Generator | 1 set |
| Attachement | 1 set |
| Type"WG-303" Microwave Signal Generator | 1 set |
| Type "WP-301" Microwave Power Meter | |
| Power Meter | 1 piece |
| Barretter Mount (for 6Gc/s) | 1 piece |
| Attachement | 1 set |
| Recording Ammeter (10 mA at full Scale) | 1 |
| Type "NTE-124" V H F Handy Talkie | 2 sets |
| Height-Pattern Testing Tower and Equipment | 4 sets |

2.2 Results of Propagation Test

(1) Gunong Sempah - Bukit Mentakab

i) Testing Period: November 2 - 7, 1965

ii) Propagation Path (Distance: 65.8Km)

This is an inclined path in the mountains. The results of height pattern measurement has indicated that the reflected wave was fairly weakened by the shielding ridges.

iii) Results of Test

The statistical distribution of received signal strength is as follows.

| Percentage of Time | Variance from Free Space Value | |
|---|---|---|
| | Long Term | the Worst Duration |
| (%) | (dB) | (dB) |
| 100 | + 0.4 | + 1.9 |
| 50 | - 5.1 | - 5.1 |
| 1 | -11.8 | -19.6 |
| 0.1 | -17.6 | -32.6 |

The severe fading occurred once and lasted from 8.30 p.m. to 11.00 p.m at night. At that time the weather condition on the both stations was as follows. At Mentakab, mist was hanging down covering the land and it was a dead calm and very cold. On the other hand, at Sempah, it was clear, windy and very cold.

According to these states of weather, the severe fading observed can be judged to be a sort of duct-type fading due to the atmospheric inversion layer of temperature.

iv) Outline of Propagation Performance

The strength of received signal always changed slowly within the range of about 5 dB, sometimes 2-3 dB.

At one night, particularly deep fading occurred. The periodical time of occurrence was 3-6 minutes and the depth of the fading was more than 30 dB at most and 10-15dB at least. It took about one minute from beginning to recovery. For two hours, the deep fading with the depth more than 30dB occurred three times, and the other ones with the depth of about 20dB occurred frequently.

It is very difficult to estimate the probability that such a deep fading occurs, because the severe fading recorded throughout the test occurred under the particular weather condition.

It is therefore advisable that the antenna towers having the sufficient capacity and height for the space diversity reception which is effective to improve the propagation performance should be installed at both the stations and from the results of commercial test, it should be determined whether the space diversity reception must be introduced in this hop or not.

(2) Bukit Pelindong-Bukit Kemuming

i) Testing Period: November 9 - 13, 1965

ii) Propagation Path (Distance: 55 Km)

This propagation path is crossing over the sea. The depth more than 20dB was observed in the measured height pattern. (refer Fig. 36)

According to the profile map, it was expected that the reflected wave from the sea surface would be shielded to some extent by the peninsular lying middleway of the path, but contrary to our expectation, the results propagation test indicated that there were the strong interference waves reflected from the sea surface without any attenuation due to the ridge.

iii) Result of Test

The statistical distribution of the received signal strength is shown in the table below.

| Percentage of Time (%) | Variance from Free Space Value Long Term (dB) | the Worst Duration |
|---|---|---|
| 100 | + 2 | all the same as the left |
| 50 | -14 | |
| 1 | -33.5 | |
| 0.1 | -38.0 | |

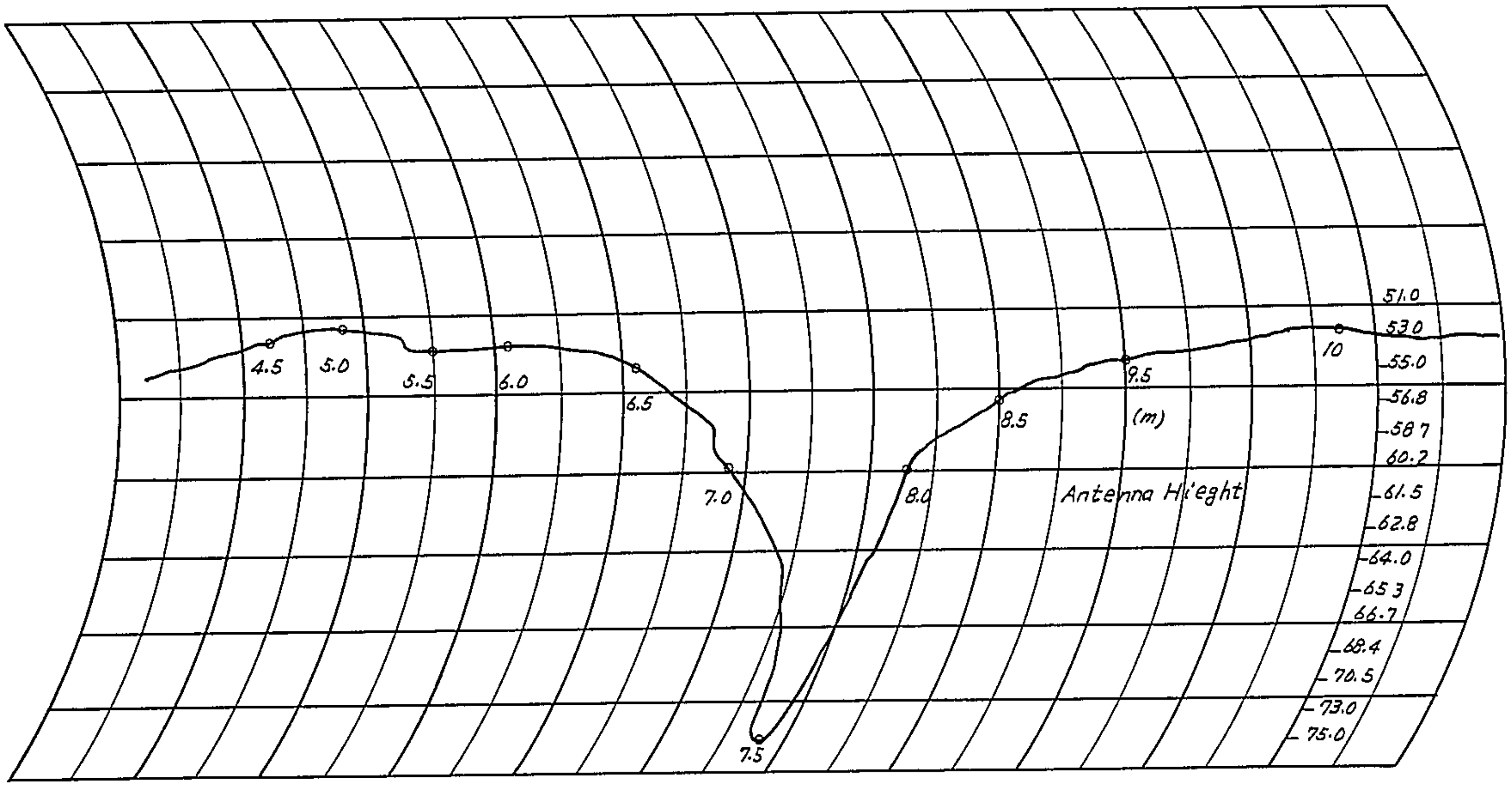
iv) Outline of Propagation Performance

Since the propagation path was crossing over the sea and the reflected wave from the sea surface was not weakened by the ridge, the serious K-type fading was initiated continuously and also the duct-type fading accompanied with it.

Consequently, this section should be divided into two sections by inserting an intermediate repeater station,K. G. Cherating.

In order to reduce the influence of K-type fading and improve the propagation performance, it has been discussed to make use the peninsular as the shiedling ridge for the reflected wave, but we could not help giving up the actual study about this idea because of the less possibility of its success.

Fig. 36 PELINDONG-KEMUNING Height Patern



(3) Bukit Kemuning-Bukit Bauk

i) Testing Period: November 14-18,1965

ii) Propagation Path (Distance: 44. 1Km)

This is a comparatively short path along the coast, and an enough clearance available.

The ridge shielding the reflected wave could not be found on the profile map, but, in fact, the reflected wave was so reduced probably by the trees nearby the reflection point that any severe fading was not recorded.

iii) Result of Test

The statistical distribution of the received signal strength during the test is shown in the table below.

| | Variance from Free Space Value | |
|---|---|---|
| Percentage of Time (%) | Long Term (dB) | the Worst Duration (dB) |
| 100 | +0. 9 | all the same as the left |
| 50 | -4. 1 | |
| 1 | -7. 6 | |
| 0. 1 | -8. 1 | |

iv) Outline of Propagation Performance

The strength of received signal always varied slowly within the range of 2-3dB. Generally, the signal strength was rather steady in the daytime, on the other hand, the fluctuation of signal sterngth tended to become somewhat bigger in the night time, especially in the eary morning, and the mean power of received signal was liable to go down slightly throughout raining.

(4) Bukit Bauk-Bukit Besar

i) Testing Period: November 19-24, 1965

ii) Propagation Path (Distance: 73Km)

This is a mountain propagation path with the longest distance. As a result of the heliograph test, flashing light could be found very close to an edge of mountain, clearance was judged then to be insufficient.

If it can be assumed that the height of trees growing on this ridge is about 30m and the profile map has been drawn with the error of some amount, it naturally must be found out even from the profile map that the clearance is very critical.

iii) Result of Test

The statistical distribution of the received signal strength is as follows.

| Percentage of Time (%) | Variance from Free Space Value | |
|---|---|---|
| | Long Term (dB) | the Worst Duration (dB) |
| 100 | + 1.3 | - 2.7 |
| 50 | - 7.7 | - 7.7 |
| 1 | -16.2 | -19.2 |
| 0.1 | -20.0 | -21.7 |

iv) Outline of Propagation Performance

Beacuse of the mountain propagation path, even if it was so long, particularly deep fading was not recorded. The received signal strength always fluctuated about 3dB and the periodical time of 3-10 minutes.

The variation range of signal strength tended to become a little bigger in the night time, and it was thought to be due to the fact that the atmospheric inversion layer of temperature causing the fading was liable to be formed frequently at night.

The signal strength was steady in the fine daytime. The comparatively deep fading occurred in the early morning from 3.00 a.m. to 7.00a.m., its depth and periodical time are 10-15dB and 10-15 minutes respectively.

When the fading was occurring, the maximum value of signal strength was higher than that of free space or almost the same, but generally its mean value was about 5dB than that of free space.

As the reflected wave was shielded completely by the ridge, neither the variation of signal strength in the height pattern nor the interference K-type fading was observed, but some fading might be judged to be the K-type fading caused by the diffraction effect due to the insufficient clearance.

Generally, the deep fading tended to occur in the morning when the atmospheric current was steady and the temperature was low. This kind of fading can be judged to be the duct-type fading.

(5) Bukit Besar-Bukit Bintang

i) Testing Period: December 11-15, 1965

ii) Propagation Path (Distance: 64.5Km)

This is a mountain propagation path. The clearance and the shielding effect for the reflected wave were found satisfactory.

iii) Result of Test

The statistical distribution of the received signal strength is as follows.

| Percentage of Time (%) | Variance from Free Space Value | |
|---|---|---|
| | Long Term (dB) | the Worst Duration (dB) |
| 100 | + 3.2 | - 0.8 |

| Percentage of Time (%) | Variance from Free Space Value | |
|---|---|---|
| | Long Term (dB) | the Worst Duration (dB) |
| 50 | - 3.8 | - 5.8 |
| 1 | -11.3 | -11.8 |
| 0.1 | -15.8 | -15.8 |

iv) Outline of Propagation Performance

The variation of signal strength with the range of 3-5dB was always recorded. The deep fading with a depth of 18dB at most was observed several times during the midnight to the early morning, and it was judged to be the duct-type fading. The variation range of signal strength and the periodical time were about 10dB at mean value and 5-10 minutes respectively.

Such a deep fading usually accompanied the shallow fading with the variation range of 1-3dB and the periodical time of 20-30 seconds.

The particularly deep fading was not recorded.

(6) Bukit Bintang - Kota Bharu

i) Testing Period: December 19-24, 1965

ii) Propagation Path (Distance: 70. 3kM)

This is a long span and the most portion of the way passes over the paddy field and the open field. There is no ridge on the way, but the reflected wave may be expected to be almost completly shielded by the coconut trees growing about 1Km far from Kota Bharu site.

Bintang site can be visible from the position raised more than 30m in height above the ground. The variation of signal strength presented in the height pattern was within 1dB at any height up to 50m above the ground, namely, the strength of reflected wave was negligible.

Accordingly, taking the consideration of growth of coconut trees, the antenna height of 50m may be judged to be suitable at Kota Bharu as far as the results of test concerned.

iii) Result of Test

The statistical distribution of the received signal strength is as follows.

| Percentage of Time (%) | Variance from Free Space Value | |
|---|---|---|
| | Long Term (dB) | the Worst Duration (dB) |
| 100 | - 1.0 | - 3.5 |
| 50 | - 7.0 | -10.0 |
| 1 | -14.0 | -16.0 |
| 0.1 | -18.0 | -18.5 |

iv) Outline of Propagation Performance

In the daytime, the signal strength was rather steady and the fading with the variation range of about 3-5dB always was recorded.

The comparatively deep fading having the depth of about 16dB at most tended to occur at midnight or the early morning.

In such a deep fading, the signal strength always varied slowly with the periodical time of 3-10 minutes and it was accompained by the shallow fading having the variation range of 2-3dB. This kind of fading was judged to be the duct-type fading.

The propagation performance of this section was ahead of previous expectation for its long distance and feature of path.

(7) Recorded Data

The curves of the statistical distribution of the received signal strength for each section are shown in Fig. 37-42, and the examples of actually traced curves of the signal strength in the typical steady state and the typical fading state for each section are shown in Fig. 43-52.

Table 32 shows the comparison between the theoretical value and the results of measurement on the receiving signal strength.

For an information, the diary kept during the propagation test is attached.

Table 32. Comparison between Theoretical Value and the Result of Measurement on Received Signal Strength

| Name of Section | Path Length (Km) | Calculated Receiving Signal Power (Free Space value)(dBm) | Percentage of Time (%) | Distribution of Received Signal Power measured | |
|---|---|---|---|---|---|
| | | | | Long Term | the Worst one Hour |
| | | | 100 | 45.0 | 43.5 |
| Sempah - Mentakab | 65.8 | -45.4 | 50 | 50.5 | 50.5 |
| | | | 1 | 57.2 | 65.0 |
| | | | 0.1 | 63.0 | 78.0 |
| | | | 100 | 42.0 | the Same as the Left |
| Pelindong - Kemuning | 55.1 | -43.8 | 50 | 58.0 | |
| | | | 1 | 77.5 | |
| | | | 0.1 | 82.5 | |
| | | | 100 | 41.0 | the Same as the Left |
| Kemuning - Bauk | 44.1 | -41.9 | 50 | 46.0 | |
| | | | 1 | 49.5 | |
| | | | 0.1 | 50.0 | |
| | | | 100 | 45.0 | 49.0 |
| Bauk - Besar | 73.0 | -46.3 | 50 | 54.0 | 54.0 |
| | | | 1 | 62.5 | 65.5 |
| | | | 0.1 | 66.3 | 68.0 |
| | | | 100 | 42.0 | 46.0 |
| Besar - Bintang | 64.7 | -45.2 | 50 | 49.0 | 51.0 |
| | | | 1 | 56.5 | 57.0 |
| | | | 0.1 | 61.0 | 61.0 |
| | | | 100 | 47.0 | 49.5 |
| Bintang - Kota Bharu | 71.0 | -46.2 | 50 | 53.0 | 56.0 |
| | | | 1 | 60.0 | 62.0 |
| | | | 0.1 | 64.0 | 64.5 |

Fig. 37 Distribution of Received Signal Power
Section; Sempah-Mentakab
Date of Measurement; Nov. 2 - Nov. 7, 1965
Total Recording Time; 58 Hours and 8 Minutes

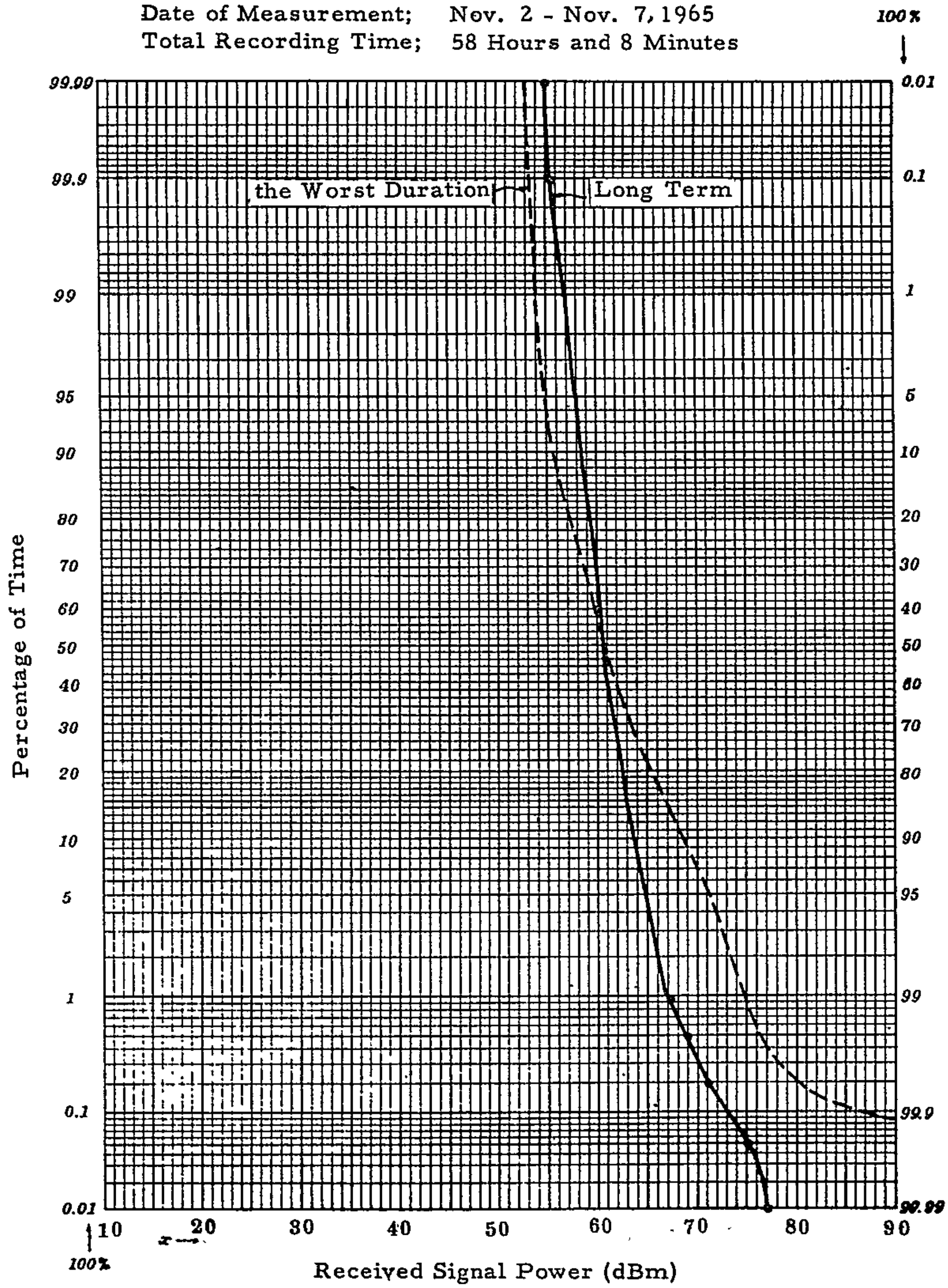


Fig. 38 Distribution of Received Signal Power
Section; Pelindong-Kemuning
Date of Measurement; Nov. 9 - Nov. 13, 1965
Total Recording Time; 59 Hours and 5 Minutes

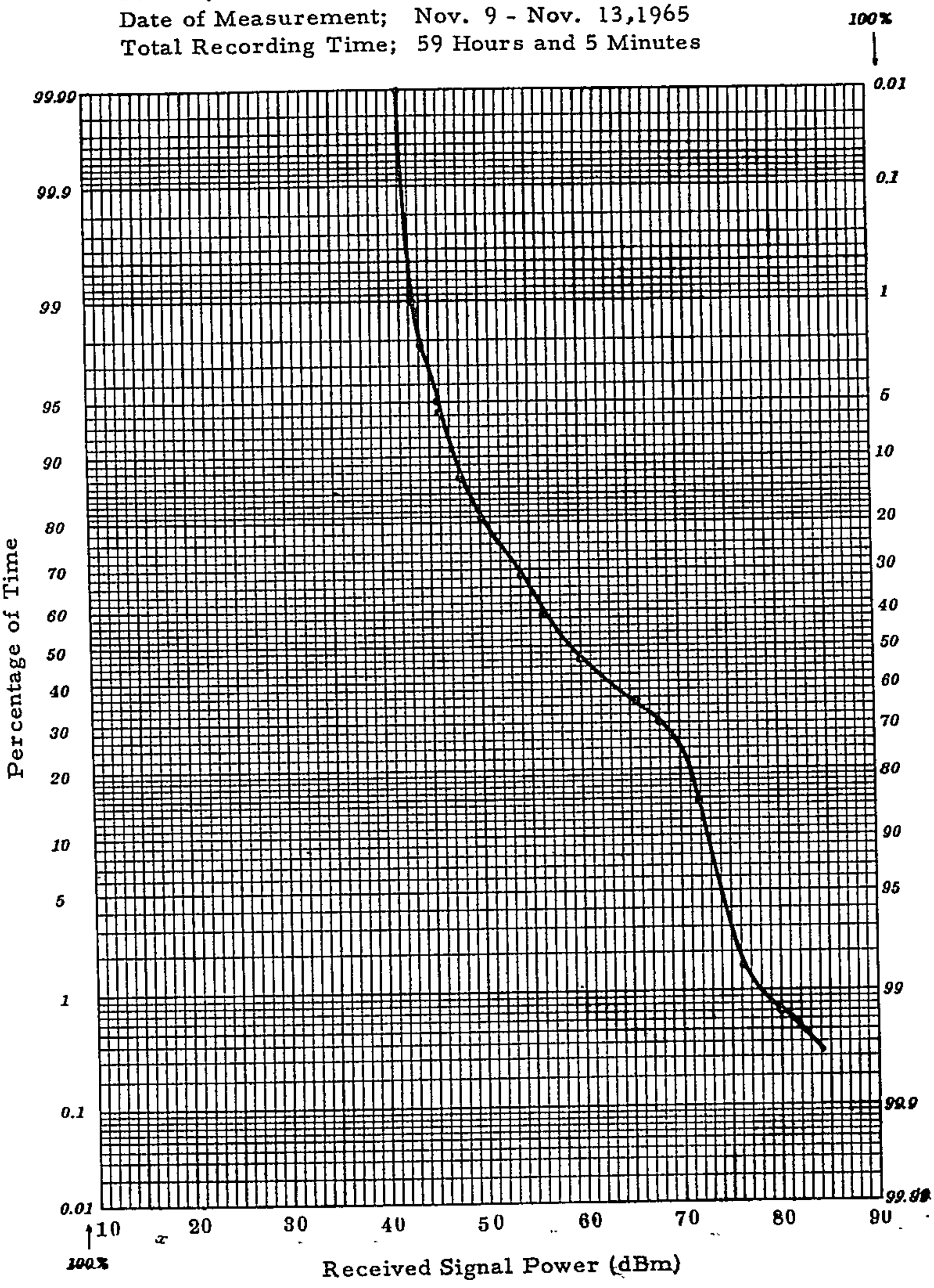


Fig. 39 Distribution of Received Signal Power

Section; Kemuning-Bauk

Date of Measurement; Nov. 14- Nov. 18,1965

Total Recording Time; 43 Hours and 30 Minutes

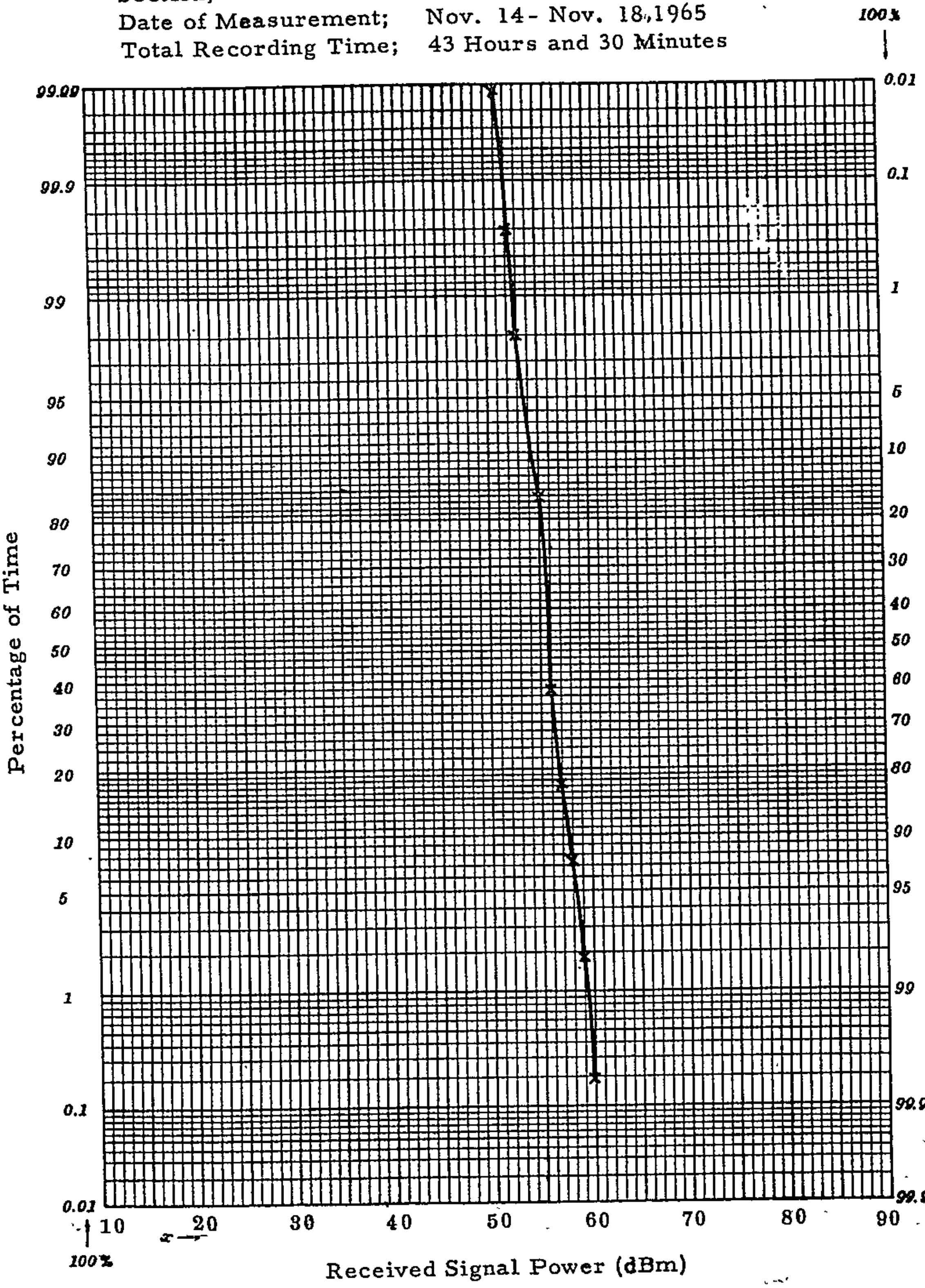


Fig. 40 Distribution of Received Signal Power

Section Bauk-Besar

Date of Measurement; Nov. 19- Nov. 25,1965

Total Recording Time; 112 Hours and 5 Minutes.

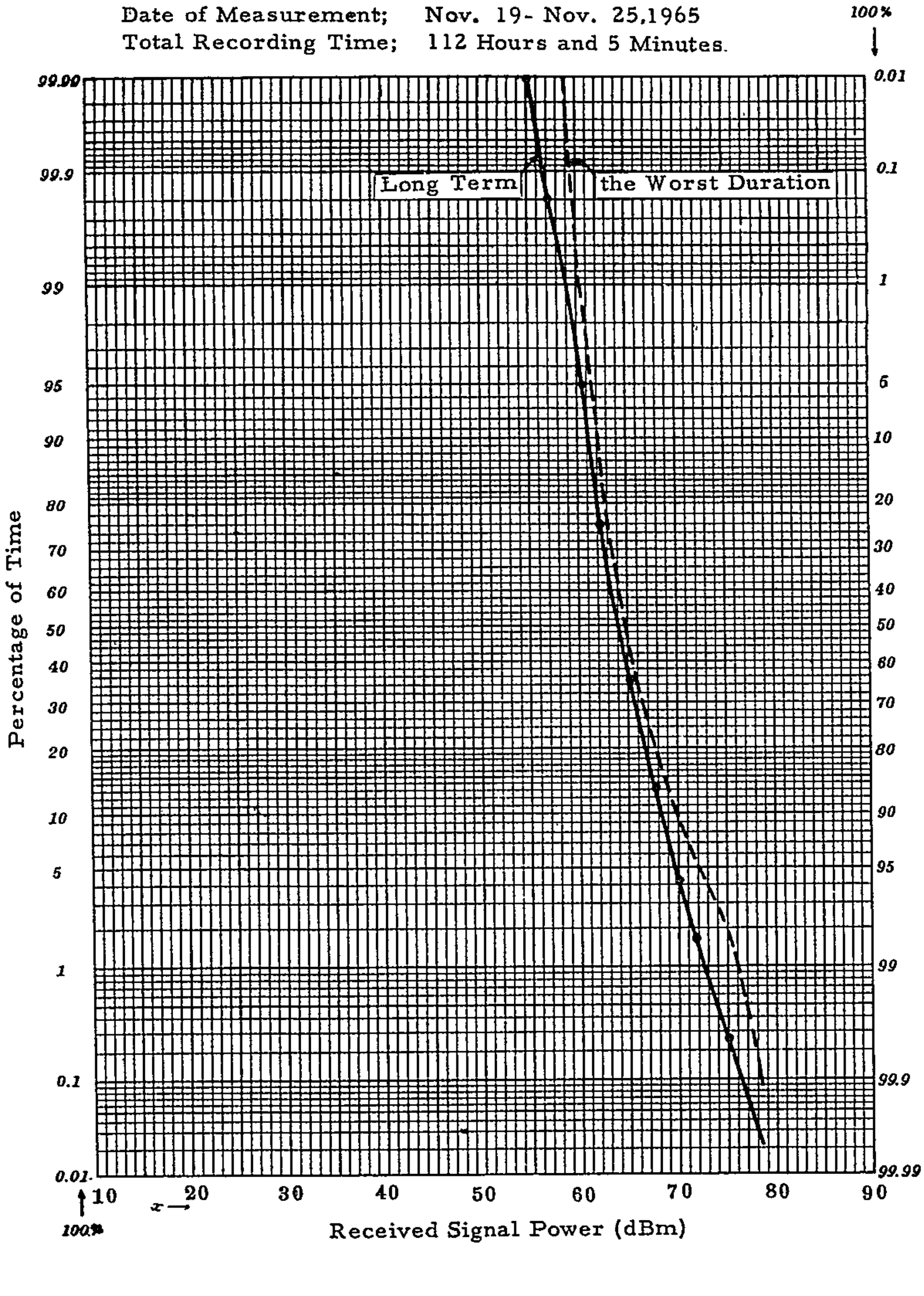


Fig: 41 Distribution of Received Signal Power

Section; Besar-Bintang

Date of Measurement; Dec. 11- Dec. 15,1965

Total Recording Time; 72 Hours

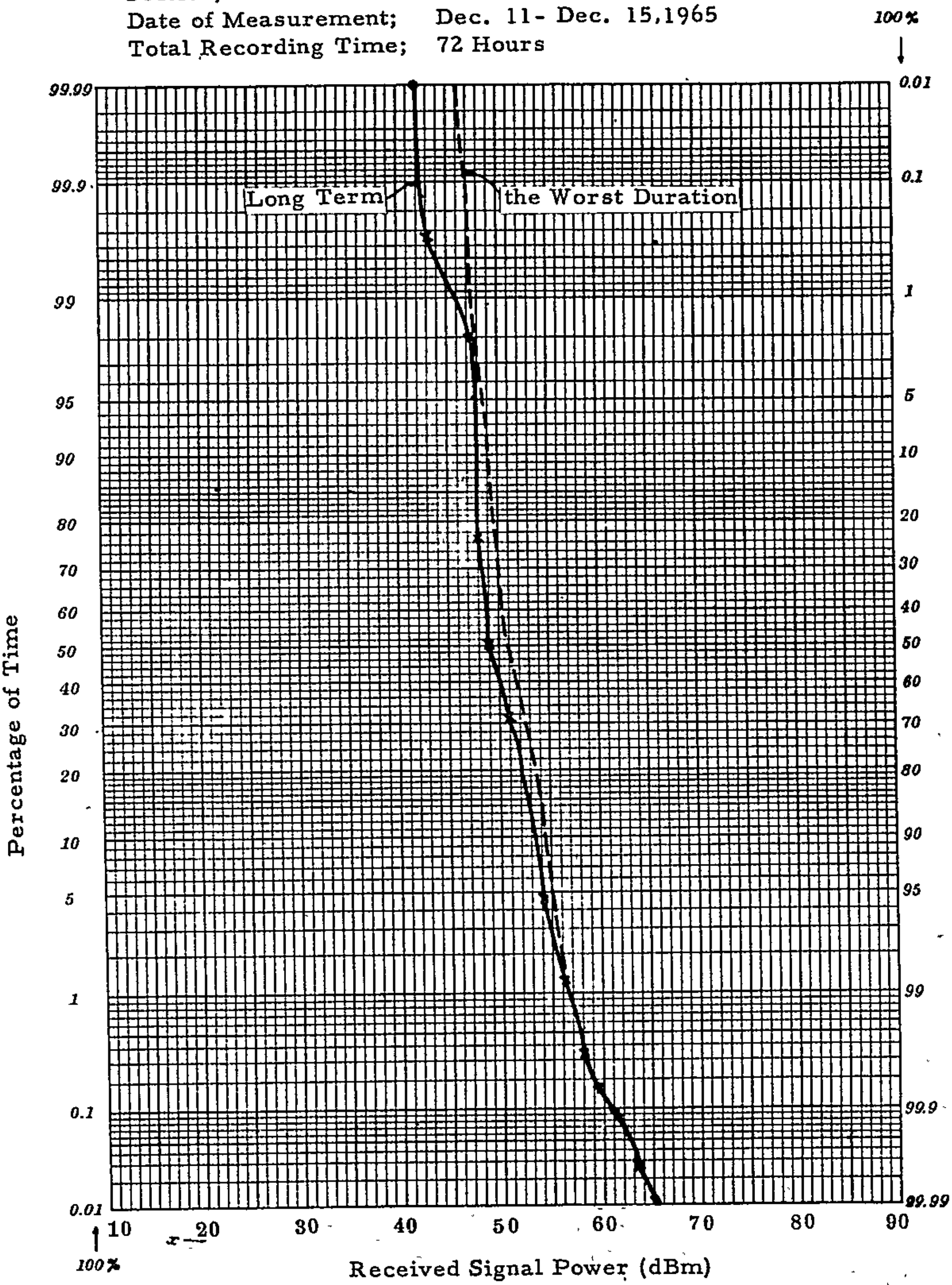


Fig. 42 Distribution of Received Signal Power

Section; Bintang-Kota Bharu

Date of Measurement; Dec. 19- Dec. 24,1965

Total Recording Time; 105 Hours and 35 Minutes

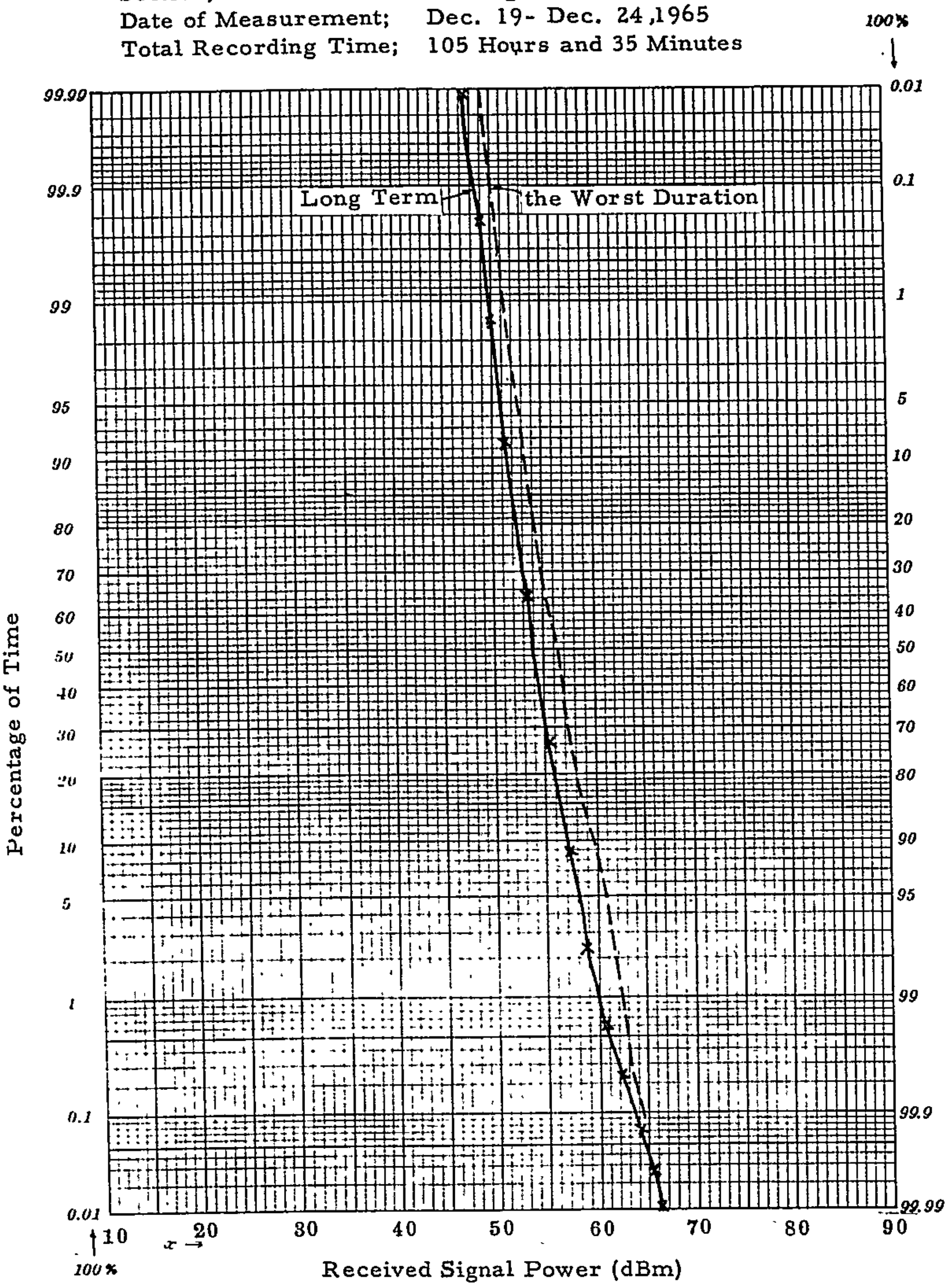


Fig. 43 Sempah-Mentakab (Period with Steady Signal)

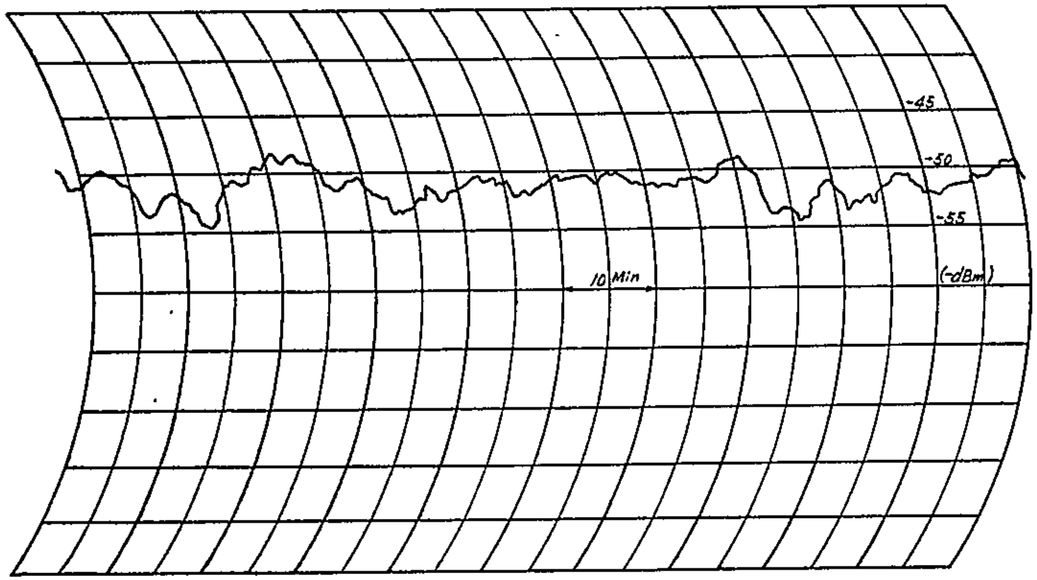



Fig. 44 Sempah-Mentakab (Period with Severe Fading)

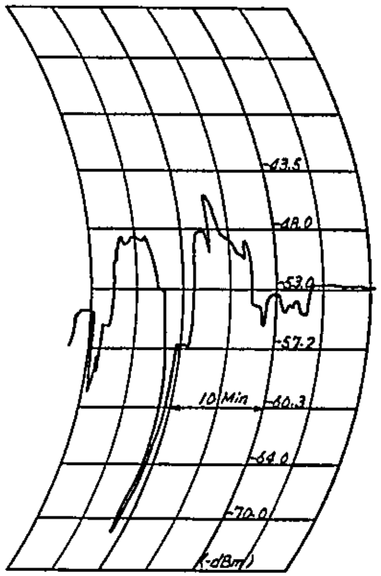


Fig. 45 Pelindong-Kemuning (Every Time)

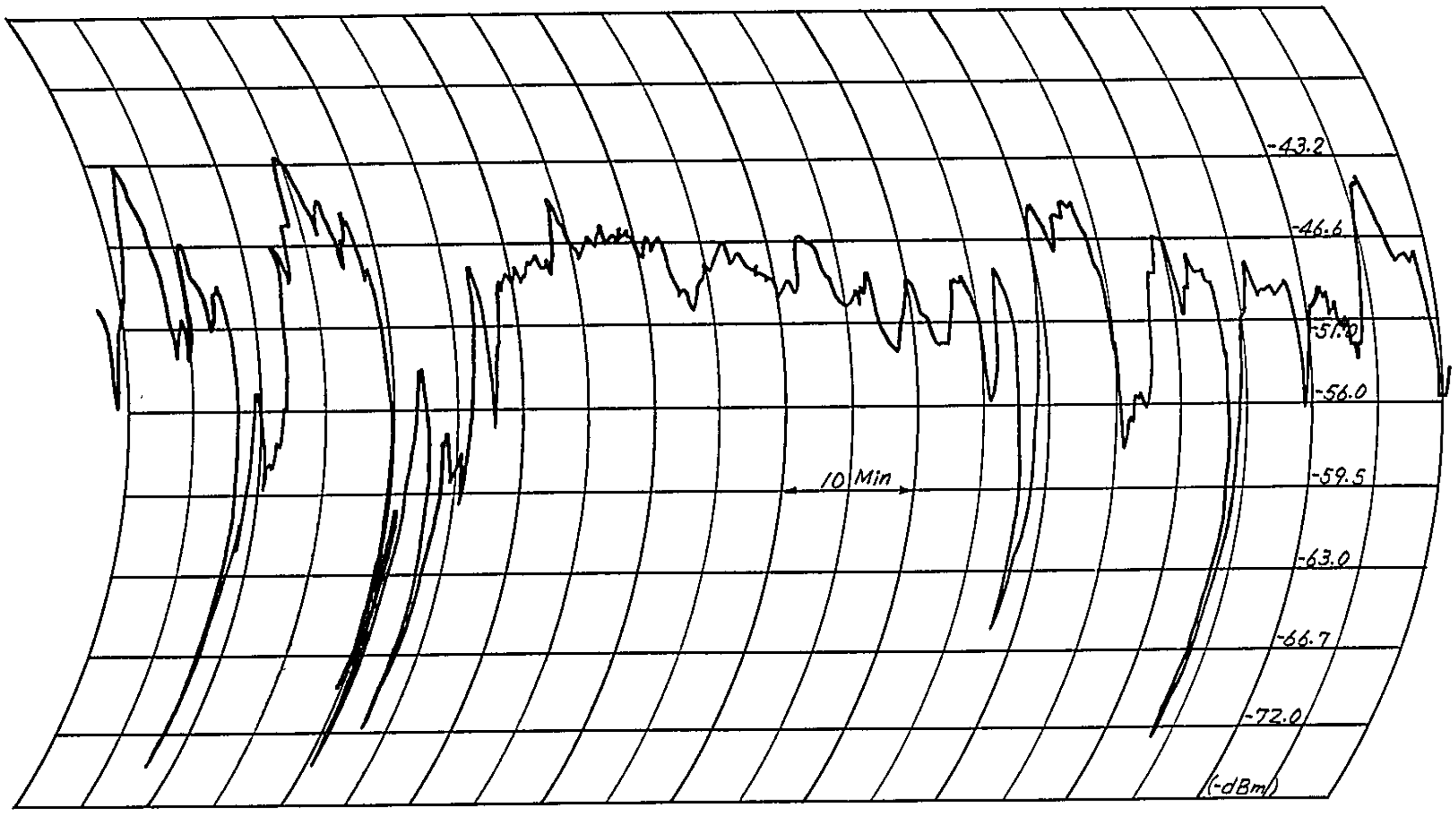


Fig. 46 Kemuning-Bauk (Every Time)

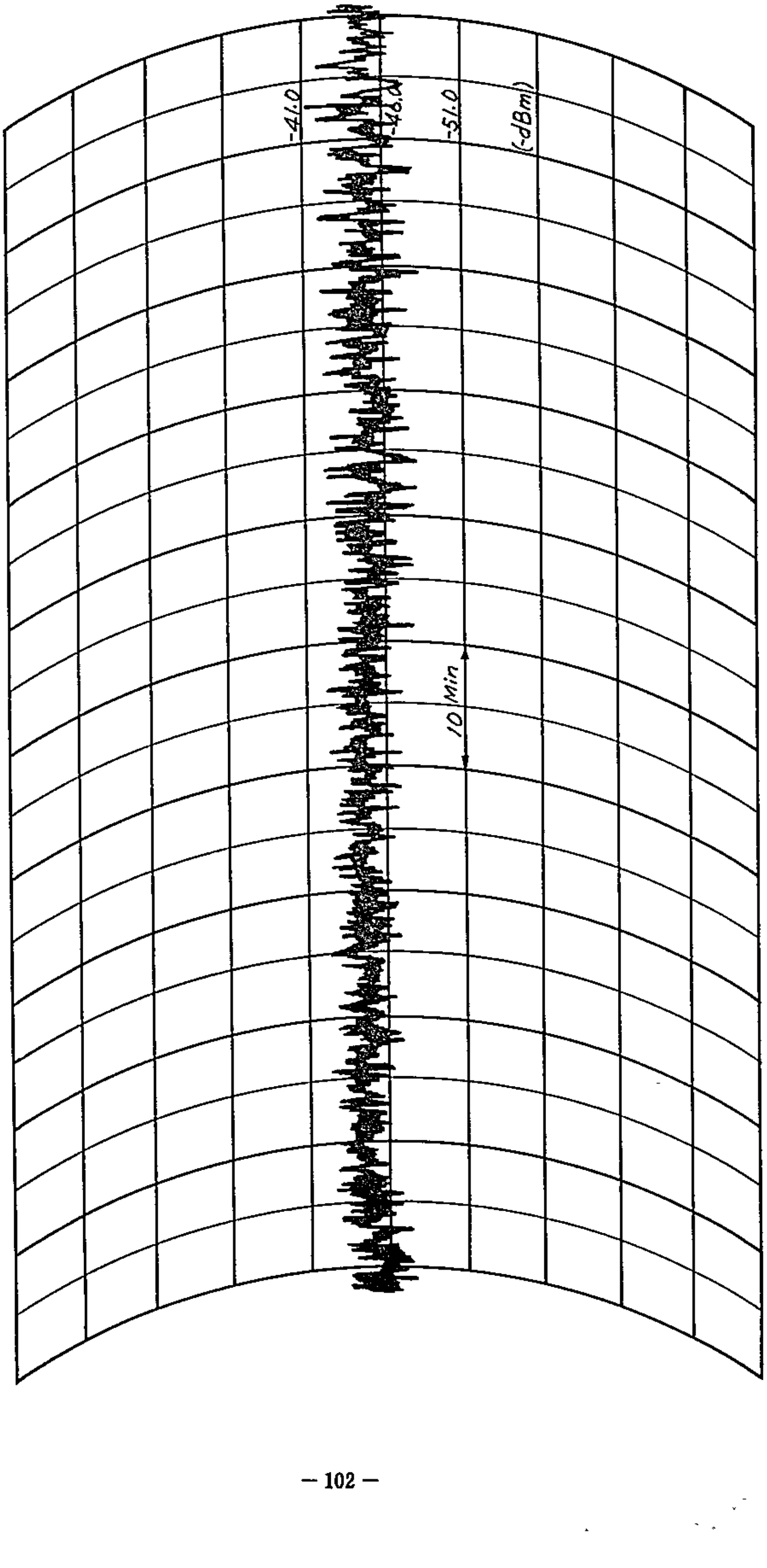


Fig. 47 Bauk-Besar (Period with Steady Signal)

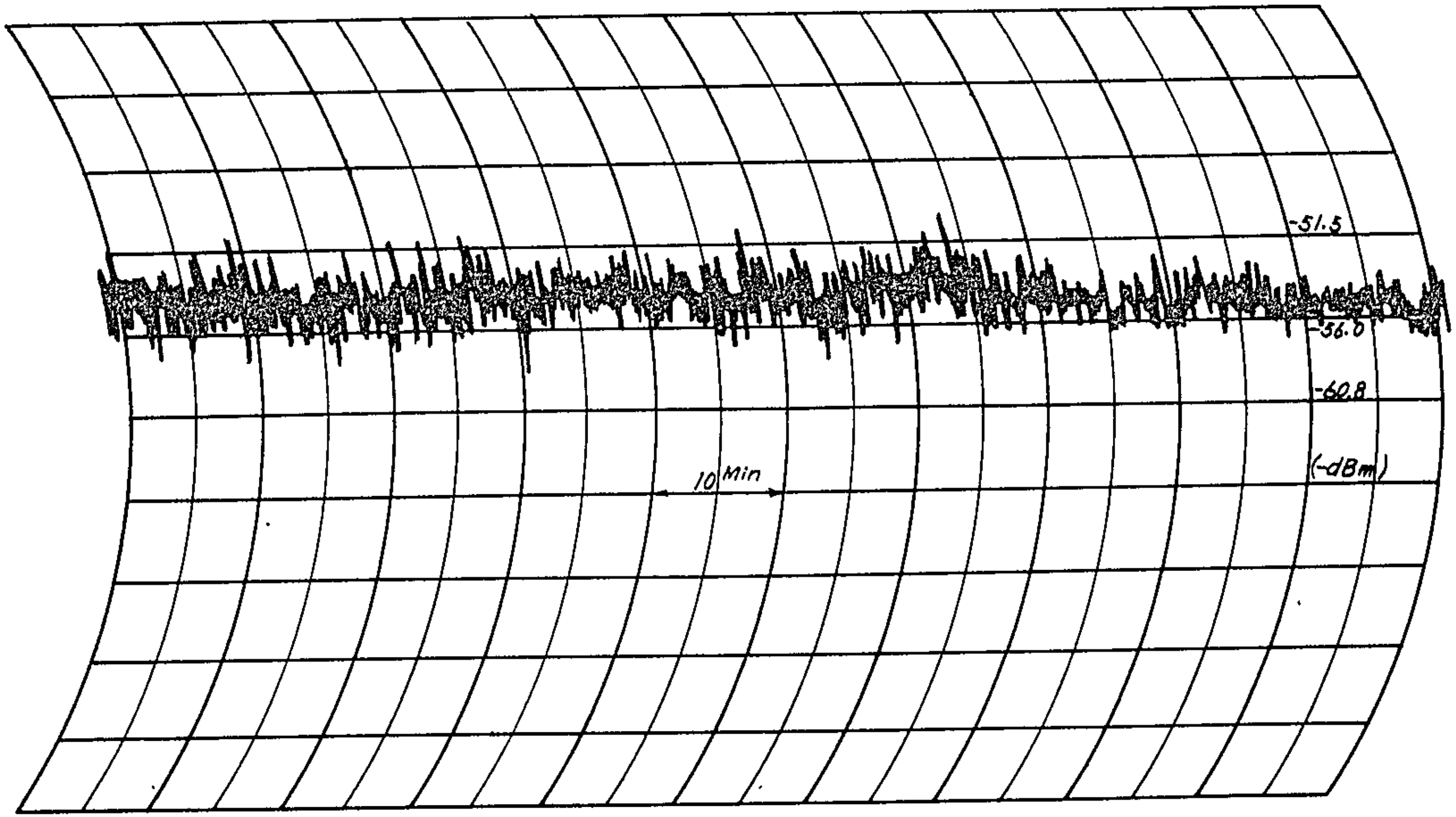


Fig. 48 Bauk-Besar (Period with Severe Fading)

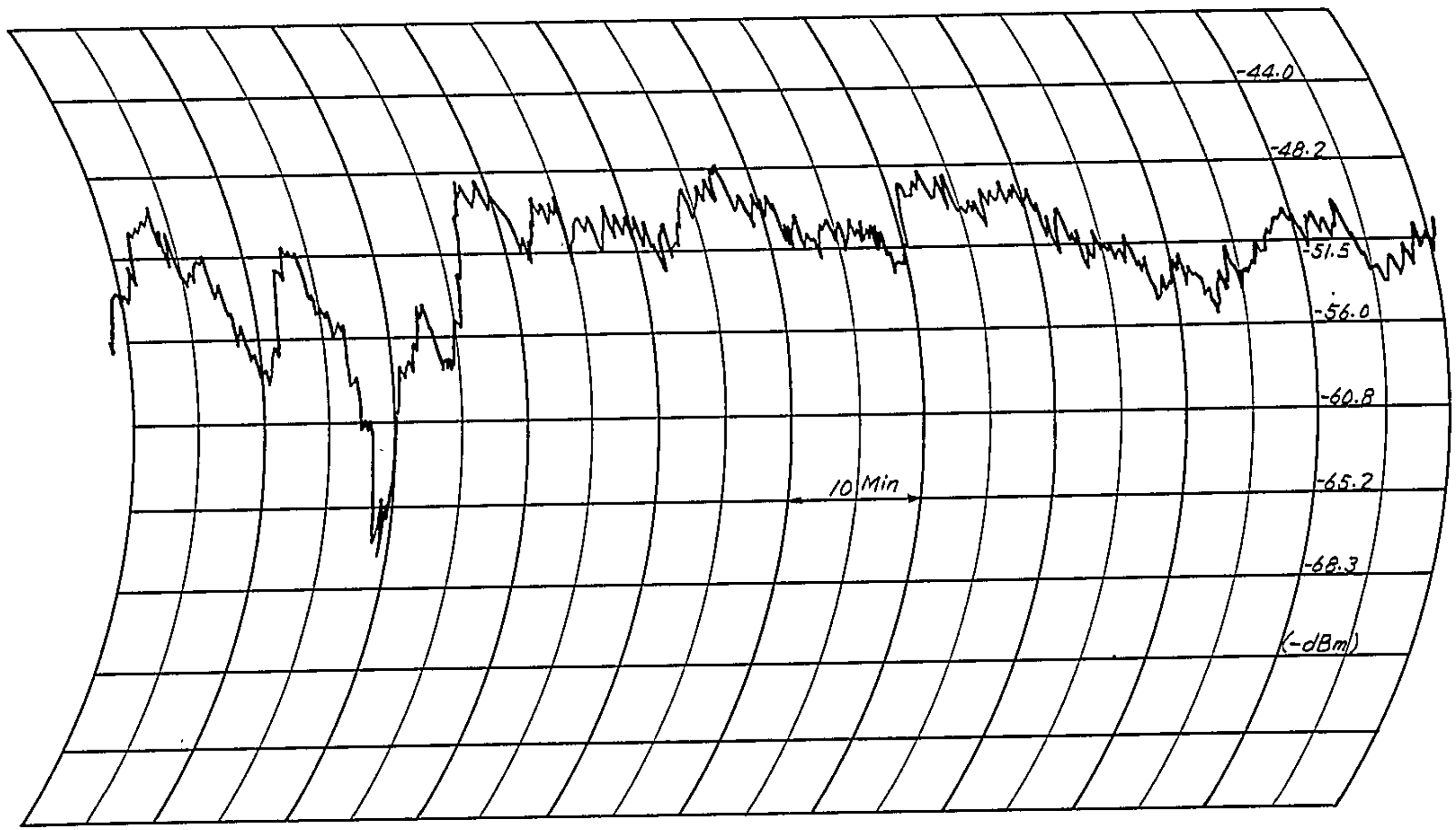


Fig. 49 Besar-Bintang (Period with Steady Signal)

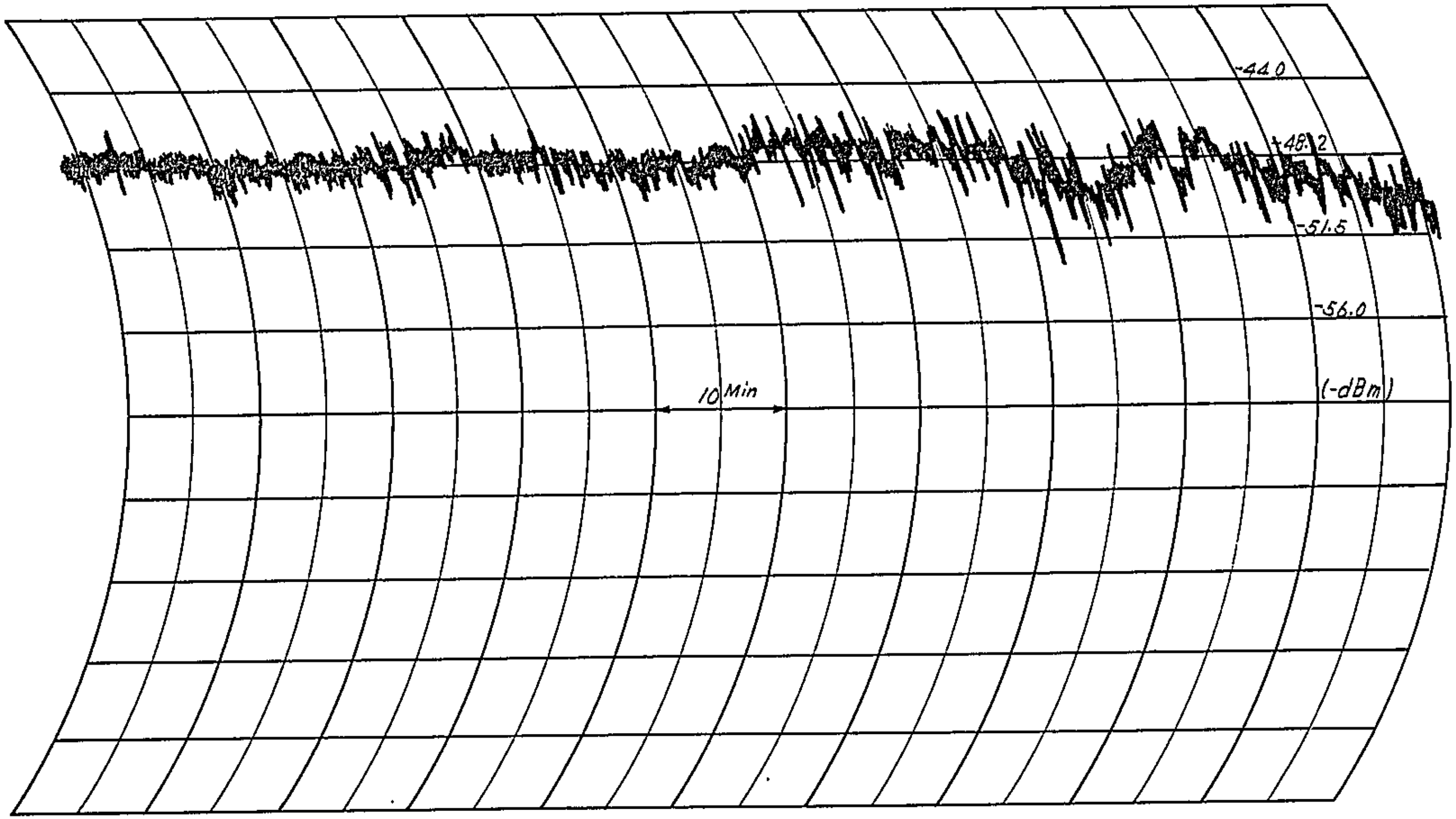


Fig. 50 Besar-Bintang (Period with Severe Fading)

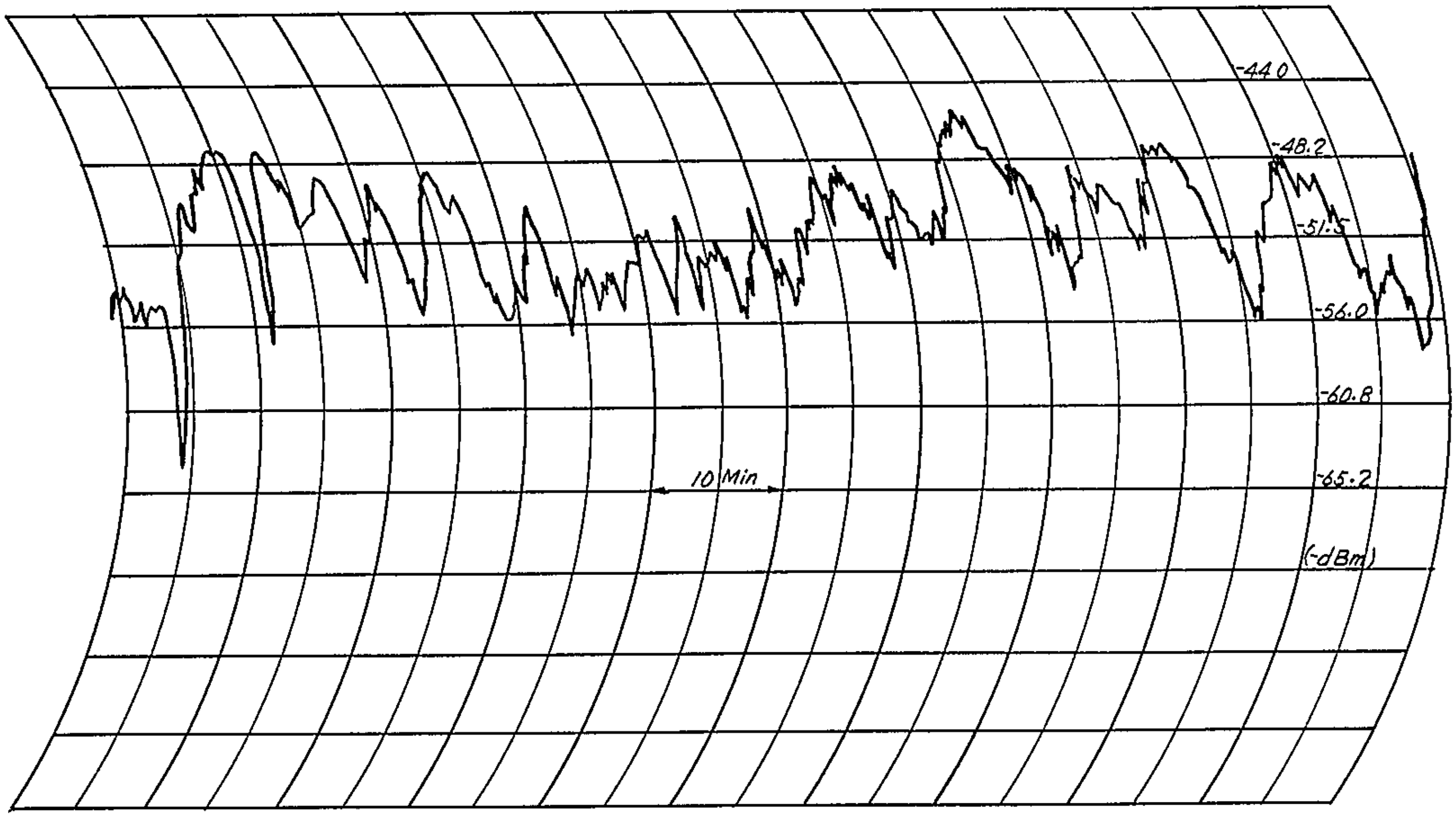


Fig. 51 Bintang-Kota-Bharu (Period with Steady Signal)

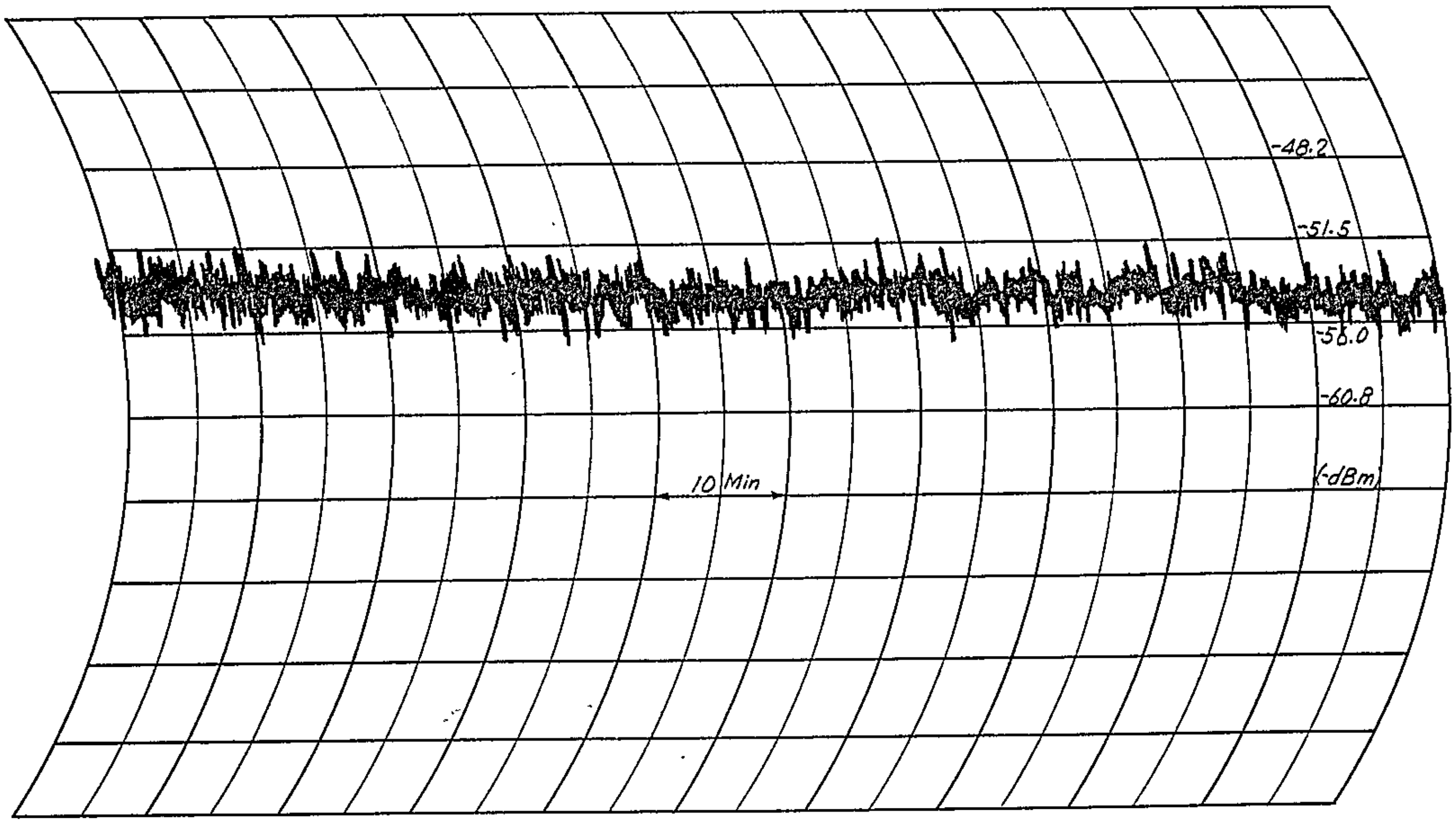
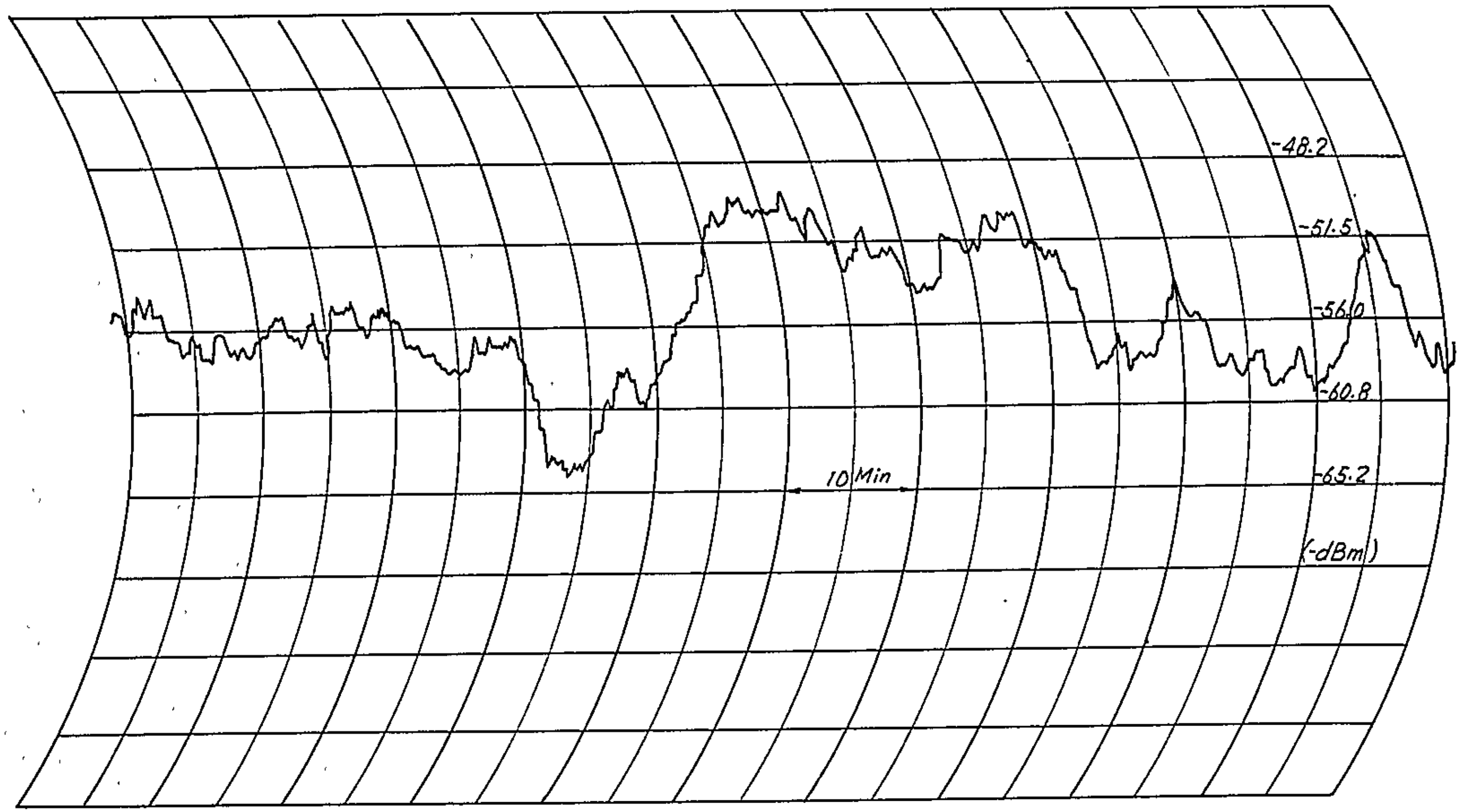


Fig. 52 Bintang-Kota Bharu (Period with Severe Fading)



## 3. Design of Radio Relay System

In view of the fact that the propagation performance between Pelindong and Kemuning has been judged to be particularly inferior, the system design has been based on the assumption that the section between Pelindong and Kemuning should be divided into two sections by inserting the repeater station (K.G. Cherating), and the other sections are as same as those of original plan proposed by Telecommunications Department.

### 3.1 Condition of System Design

(1) Standard of Allowable Noise Power in Radio Relay System

The allowable noise power in telephone channel on a 2,500Km hypothetical reference circuit for frequency-division multiplex radio relay system has been recommended at CCIR IXth plenary assembly (Los Angeles, 1959) after the studies in the IIXth plenary assembly (Warsaw, 1956). It reads as follows.

"The noise power at a point of zero relative level in any telephone channel on a 2,500Km hypothetical reference circuit for frequency-division multiplex radio relay systems should not exceed the provisional value given below, which have been chosen to take account of fading.

i) 7,500pW psophometrically weighted mean power in any hour;

ii) 7,500pW psophometrically weighted one-minute mean power for more than 20% of any month;

iii) 47,500pW psophometrically weighted one-minute mean power for more than 0.1% of any month;

iv) 1,000,000pW unweighted (with an integrating time of 5ms) for more than 0.01% of any month;"

It has been venified by the various studies so far that, when the noise power of radio relay system meets the provision in the items i) and iv) above, it may also satisfy in the items ii) and iii).

Consequently, it is sufficient to take into account only the items i) and iv) but the others for the designing of radio relay system.

However, only the item i) has been considered here but not the item iv), because the interruption of radio link corresponding with it has not observed during the propagation test.

(2) Examination of Noise Power

In order to examine the actual noise power relating to the provision given in the paragraph (1), i), following procedures are taken in turn for study.

i) Calculation of the mean noise power at the worst duration.

ii) Estimation of the occurrence probability of the worst performance.

iii) Calculation of the probability that severe fading occurs on more than two sections in one baseband section simultaneously.

iv) Checking whether the sum of noise power at a point of zero relativelevel, which may be calculated from the results of above procedures of i) to iii), meets the standard or not. Hence the standard corresponds to the noise power distributed proportionally to a distance from that given by the paragraph (1), i).

Among these procedures, the items i) and ii) can be given by the data of propagation test and the item iii) by the following relation.

It can be assumed that the occurrence of severe fading is not correlated from one section to another. Accordingly, the probability (Pk) that severe fading occurs in K sections among Z sections simultaneously and not occurs in all remaining (Z-K) sections is obtained from the following equation which corresponds to the binominal distribution formula.

$$Pk = \frac{Z/}{K/(Z-K)/} P^{K}(1-P)^{Z-K}$$

Where P: occurrence probability of severe fading in a section

Z: number of all sections

K: number of sections where severe fading occurs simultaneously

If Pk and P are known, K for various number of Z can be calculated from the above equation.

When Pk and P are assumed to be as follows respectively,

Pk = 0.0001 (this value corresponds to the worst one hour in the worst one month)

P = 0.01 or 0.02,

Calculated values of K for various Z of 5, 6 and 7 are as shown in the table below.

| Z | K(P=0.01) | K(P=0.02) |
|---|---|---|
| 5 | 1.7 | 2.1 |
| 6 | 1.9 | 2.3 |
| 7 | 2.0 | 2.5 |

(3) Simultaneous Occurrence Probability of Severe Fading

i) Kuala Lumpur - Kuantan

The route between Kuala Lumpur and Kuantan is composed of five sections. In case that an occurrence probability of severe fading in each section may be assumed to be 0.01, the number of sections where severe fading may occur simultaneously with probability of 0.0001 are to be 1.7. In fact, the distance of four sections in this route are all shorter than the standard one, 50Km and especially two sections have such a very short distance as about 20Km.

Accordingly, the occurrence probability of severe fading becomes negligibly small in each section except that between Sempah and Mentakab. Then, it is not necessary to worry about the simultaneous occurrence probability of severe fading for all sections. Namely, at the time when a severe fading is attacking in one of the five sections, no fading exists in other four sections.

Therefore, in this case, it must be permissible to calculate the sum of mean noise power of all sections in any one hour taking the noise power at the worst fading condition in one section and those at free space in other four sections.

ii) Kuantan - Kota Bharu

The occurrence probability of severe fading in each section has been estimated to be about 0. 02 or more. Accordingly, the number of sections where severe fading occurs simultaneously comes to be 2 or 3 from the equation mentioned above, therefore the sum of mean noise power of all sections in any one hour can be calculated assuming that three sections, Kemuning-Bauk, Bauk-Besar and Besar-Bintang, are under the worst state as shown in the Table 33.

Table 33

| Name of Section | Deterioration Value Due to Fading from Free Space State | Remarks |
|---|---|---|
| Pelindong — Cherating | 0 | |
| Cherating — Kemuning | 0 | |
| Kemuning — Bauk | -4. 1 | as time rate of 50% in the worst duration |
| Bauk — Besar | -7. 7 | |
| Besar — Bintang | -5. 8 | |
| Bintang — Kota Bharu | -7. 0 | as time rate of 50% in the ordinary duration |

(5) Calculation of Noise Power

Thermal noise power at a point of zero relative level can be calculated by following equations.

$$\left[S/N\right] = 10 \log \frac{Pr}{K.T.F.\Delta f} \left(\frac{So}{f}\right)^2$$

Where K: Boltzmon's constant, $1.37 \times 10^{-23}$ joule per deg. K

T: temperature in Kelvins (normal 293°K)

F: noise figure

$\Delta f$: band width of a message channel

(3,100cps specified by the CCITT)

f: top channel frequency

(4,028Kc for 960ch system)

So: r.m.s. frequency deviation of test tone

(200Kc r.m.s. per channel)

Pr: received power (given by following equation)

$$Pr = \frac{P_T . G_A{}^2}{Ls . L_F . L_B}$$

Where

$P_T$: transmitting power

$G_A$: transmitting and receiving antenna gain

$L_S$: propagation loss

$L_F$: feeder loss

$L_B$: branching filter loss

Calculated and assumed value of each element are as follows. Here the symbol[ ] means the function 10 log.

$[KT] = -174$ dB

$[F] = 13$ dB

$[f] = 34.9$ dB

$2\,[\Delta f] = 132$ dB

$2\,[So] = 106$ dB

$[G_A] = 43$ dB (for 3.3mØ), 44.5 dB (for 4mØ)

$\{P_T\}$ = 37dBm

$\{L_F\}$ = 0.053dB/m

$\{L_B\}$ = 1.3dB

Received signal power and thermal noise power a point of zero relative level of all sections obtained from the equations and the figures mentioned above are shown in Table 34. But the improvement value due to the emphasis system of 8dB per octave specified by the CCIR has not been taken into account because it is considered that this improvement value should remain as the allowance of system design and the installation.

Note 1. Feeder length on each section has been assumed to be obtained by adding 30m to the transmitting and receiving antenna height.

Note 2. It has been assumed that the antenna with a diameter of 4m should be used on the five sections, i.e., Sempah-Mentakab, Kemuning-Bauk, Bauk-Besar, Besar-Bintang and Bintang-Kota Bharu, and the antenna of 3.3m in diameter should be used on the other sections as transmitting and receiving antennas.

Note 3. The output power of microwave transmitter and noise figure of receiver have been assumed to be 5W (37dBm) and 13dB respectively.

Note 4. Considering that the span equalization may be adapted on some sections, if required, figures corresponding with this condition are shown in the above Table.

In this case, it has been assumed that the span equalization of 6dB would be applied to the sections, Nanas-Sempah, Sulai-Kuantan and Pelindong-K. G. Cherating and that of 4dB would be applied to the section K. G. Cherating-Kemuning. As a result of above span equalization, each section must be approximately equalized to the standard propagation length of 50Km.

Table 34. Calculated Receiving Signal Power and Thermal Noise

(a) Kuala Lumpur - Kuantan

| Name of Section | Path Length (Km) | Propagation Loss at Free Space (dB) | Antenna Height (m) | Feeder Length (Feeder Loss) (m), (dB) | Branching Filter Loss (dB) | Fading Depth (dB) | Received Signal Power (dBm) | Signal to Noise Ratio of Top Channel (dB) | Noise Power of Top Channel (pw) | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| Nanas-Sempah | 22.9 | 135.2 | 30 - 20 | 80 (4.2) | 1.3 x 2 | 0 | -19.0<br>(-25.0) | 81.1<br>(75.1) | 7.7<br>(30.9) | Figures for span equalization are shown in parenthesis |
| Sempah-Mentakab | 65.8 | 144.4 | 20 - 50 | 100 (5.3) | 1.3 x 2 | -5.1 | -31.4 | 68.7 | 135 | |
| Mentakab-Maran | 45.8 | 141.2 | 50 - 30 | 110 (5.8) | 1.3 x 2 | 0 | -26.6 | 73.5 | 44.7 | |
| Maran-Sulai | 44.6 | 141.0 | 30 - 20 | 80 (4.2) | 1.3 x 2 | 0 | -24.8 | 75.3 | 29.6 | |
| Sulai-Kuantan | 22.2 | 134.9 | 20 - 50 | 100 (5.3) | 1.3 x 2 | 0 | -19.8<br>(-25.8) | 80.3<br>(74.3) | 9.4<br>(37.2) | Figures for span equalization are shown in parenthesis |
| Overall Nanas-Kuantan | - | - | - | - | - | - | - | 66.5<br>(65.8) | 226.4<br>(262.4) | Figures for span equalization are shown in parenthesis |

(b) Kuantan - Kota Bharu

| Name of Section | Path Length (km) | Propagation Loss at Free Space (dB) | Antenna Height (m) | Feeder Length (Feeder Loss) (m), (dB) | Branching Filter Loss (dB) | Fading Depth (dB) | Received Signal Power (dBm) | Signal to Noise Ratio of Top Channel (dB) | Noise Power of Top Channel (pw) | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| Pelindong-Cherating | 31.1 | 137.8 | 20 - 40 | 90 (4.8) | 1.3 x 2 | 0 | -22.2 (-25.2) | 77.9 (74.9) | 16.2 (32.4) | Figures for span equalization are shown in parenthesis |
| Cherating-Kemuning | 24.6 | 135.8 | 40 - 10 | 80 (4.2) | 1.3 x 2 | 0 | -19.6 (-25.6) | 80.5 (74.5) | 8.9 (35.5) | Figures for span equalization are shown in parenthesis |
| Kemuning-Bauk | 44.1 | 140.9 | 10 - 20 | 60 (3.2) | 1.3 x 2 | -4.1 | -24.8 | 75.3 | 29.5 | |
| Bauk-Besar | 73.0 | 145.3 | 30 - 30 | 90 (4.8) | 1.3 x 2 | -7.7 | -34.4 | 65.7 | 269 | |
| Besar-Bintang | 64.7 | 144.2 | 10 - 20 | 60 (3.2) | 1.3 x 2 | -5.8 | -29.8 | 70.3 | 93.5 | |
| Bintang-Kota Bharu | 71.0 | 145.0 | 20 - 50 | 100 (5.3) | 1.3 x 2 | -7.0 | -33.9 | 66.2 | 240 | |
| Overall Pelindong-Kota Bharu | - | - | - | - | - | - | - | 61.8 (61.6) | 657.1 (699.9) | Figures for span equalization are shown in parenthesis |

Reference

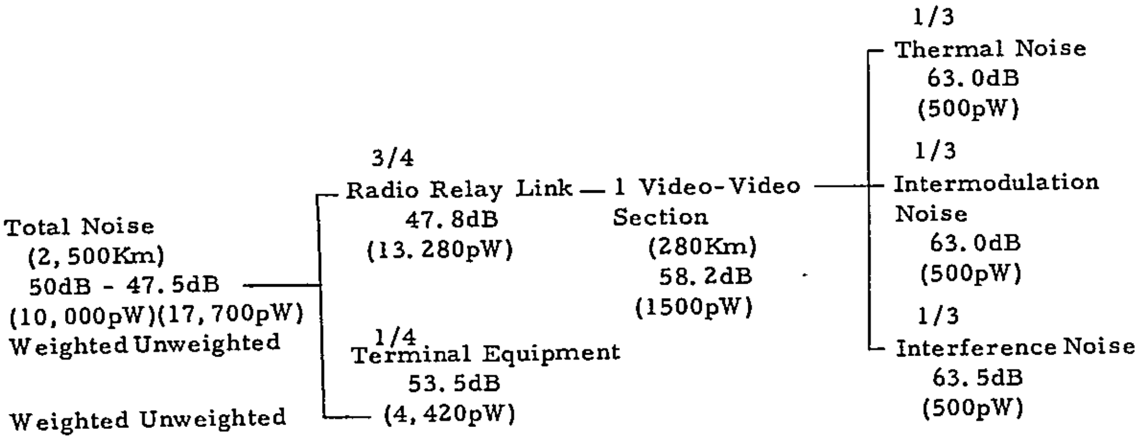
If there is a great difference in distance between the adjacent sections in the microwave route, interference due to the Front to Back ratio of antenna directivity and the differencial fading may be originated.

Therefore the span equalization system should be applied to the shorter section.

3.2 Standard of Transmission Quality

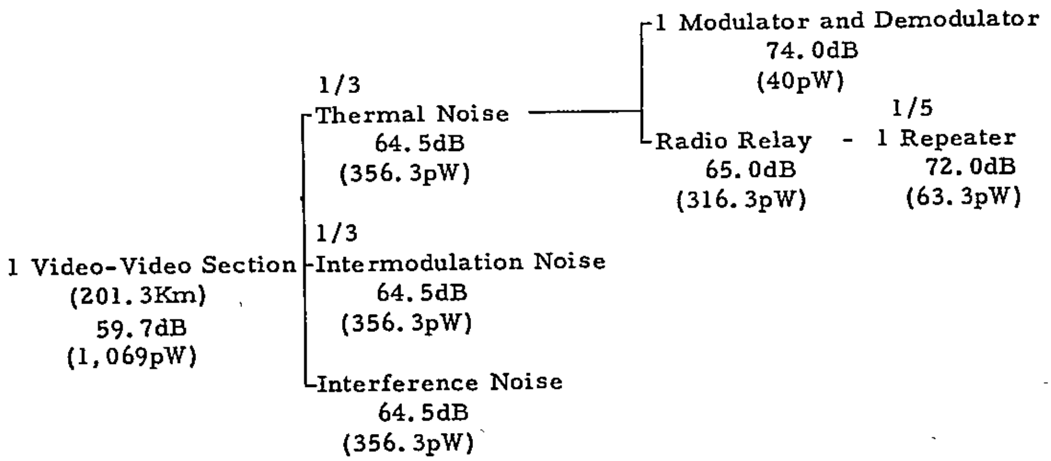
(1) Noise Distribution

i) Noise Distribution for CCIR's Hypothetical Reference Circuit




ii) Noise Distribution for Actual Circuit

(a) Kuala Lumpur Kuautan (1 Video-Video Section with Distance of 201.3Km)



(b) Kuantan – Kota Bharu (1 Video-Video Section with Distance of 308.5Km)

- 1 Video-Video Section (308.5Km) 57.9dB (1,638pW)
  - Thermal Noise 62.7dB (546pW)
    - 1 Modulator and Demodulator 74.0dB (40pW)
    - Radio Relay 63.0dB (506pW)
      - 1/6 1 Repeater 70.7dB (84.3pW)
  - Intermodulation Noise 62.7dB (546pW)
  - Interference Noise 62.7dB (546pW)

(2) Examination of Transmission Performance

The results of comparison between the actual transmission performance which is estimated from the results of propagation test, and the distributed standard value mentioned above are discribed herein.

Overall distance of the route between Kuala Lumpur and Kuantan is 201.3Km and the total thermal noise power at a point of zero relative level is estimated as to be 66.5dBm(226.4pW). It therefore has an allowance of 1.5dB(89.9pW) for the standard of 65.0dBm(316.3pW).

In case of span equalization, the total thermal noise power and an allowance for the standard come to be 65.8dBm(262.4pW) and 0.8dB(53.9pW) respectively.

On the other hand, overall distance of the route between Kuantan and Kota Bharu is 308.5Km and the total thermal noise power at a point of zero relative level is estimated to be 61.8dBm(657.1pW). Therefore, it is 1.2dB (151.1pW) worse than the standard of 62.7dBm (506pW).

In case of span equalization, the total thermal noise power and an allowance for the standard come to be 61.6dBm(699.9pW) and, –1.4dB(193.9pW) respectively.

But, in latter case, as it is not necessary to take into account an interference from other microwave route, it can be expected that the interference noise performance of this route has an adequate allowance for the standard. Therefore it will be able to supply shortage of the allowable thermal noise power by the some amount of allowable interference noise power,

Thus, overall transmission performance of this route will come to meet the standard recommended by the CCIR

As mentioned above, regarding the both thermal and interference noise, it has been made clear that the transmission performance of both routes meet the CCIR's standard.

Of course, the intermodulation noise performance should be taken into account at the time of designing of equipment so that the allowable intermodulation noise power can be satisfied. Moreover, in designing systems actually it should be considered so carefully that the length of transmitting and receiving feeder come to be shortened as much as possible.

In addition, the examination of the number of channels in microwave bearer between Kuala Lumpur and Kuantan, noise performance of which may meet the SEACOM's standard (1pW/Km) is discribed herein.

According to the results of investigation relating to operating 26 microwave bearers of Nippon Telegraph and Telephone Public Corporation, the number and maximum baseband frequency of channels, which have the noise power of 1/3 (-48dB) as compared with that of top channel, are as shown in the table below

| Probability (%) | Based Frequency (KC) | Number of Channels (Ch) |
|---|---|---|
| 100 | 300 | 80 |
| 90 | 700 | 180 |
| 50 | 1,500 | 370 |

Consequently, if the probability of 100% or 90% is secured, the channels of 80 or 180 will meet the SEACOM's standard respectively.

# Ⅲ. RECOMMENDATION

## III RECOMMENDATION

In conclusion, we should like to recommend the following, in order to make the performance of proposed microwave routes meet the standard (3pW/Km) recommended by CCIR.

1 Kuala Lumpur - Kuantan

(1) The antenna with a diameter of 4 m should be applied to the section between Sempah-Mentakab, but it is permissble touse antennas of 3. 3 m in diameter for the other sections.

(2) Since the severe fading was observed on the section from Sempah to Mentakab although it was very difficult to estimate its occurrence probability because of the limited period of propagation test, the application of space diversity reception should be decided by the results of the commercial test after the completion of this microwave route. Accordingly, it is necessary to install the antenna towers at both stations which have adequate capacity and height to mount an antenna for the space diversity reception.

2 Kuantan - Kota Bharu

(1) The section between Pelindong and Kemuning should be divided into two sections by means of inserting the intermediate station, K. G. Cherating, and it is allowable to use the antennas of 3.3 m in diameter in these sections.

(2) On the other four sections from Kemuning to Kota Bharu, the antennas with a diameter of 4 m should be used.

Since it is expected that no interference from other microwave routes will occur in this route, it is possible to improve any deficiency of allowable thermal noise power by a surplus amount of allowable interference noise power. Therefore, the noise performance of this route will meet CCIR's recommendation synthetically.

CONCLUSION

It was very short period for the survey work of the microwave networks including propagation test, but the work has completed successfully under the enthusiastic facility and assistance extended to us by authorities of the Mala ysia Government, especially by the Telecommunications Department, and the survey report now has been made ready for presentation.

We should like to express afresh our sincere gratitude for them. We think that thr industrial and economical prosperity in the east coast country are the major policies of Malaysia, and the expansion of microwave communication network in this area has a much significance. We hope with all our heart that these microwave routes will completed at the earliest opportunity and Malaysia will prosper all the more.

Diary of Propagation Test

PRACTICAL DIARY

Rute: Kuala Lumpur - Kuantan

GUNONG SEMPAH - MENTAKAB (SAKURA)

| | |
|---|---|
| 27th Oct. 1965 | Survey team left Kuala Lumpur to their respective sites. |
| 28th Oct. | Transmitting equipments taken up to sempah. |
| 29th Oct. | Receiving site: - Construction of platform at 20' height.<br>(Mentakab) Construction of hut for engines<br>Rx equipments carried up to site.<br>Transmitting site: Tx equipments carried up to site.<br>(G. Sempah) |
| 30th Oct. | Both Transmitting & Receiving equipments set up for Propagation Test.<br>Communication between Tx & Rx station commenced at 6.30 p.m.<br>Heavy rain at Mentakab so unable to pan the dish to get a good signal level.<br>Rx station close down at 8.30 p.m. |
| 31st Oct. | Sempah transmitted normally.<br>At receiving site dish direction adjusted and propagation test recording commenced at 1.30 p.m.<br>Received level - 52 dbm. |
| 1st Nov. | Tx site anchor stay adjusted and dish position controlled.<br>Rx site recording continued.<br>Tx power failed at 11.05a.m. but restored to normal 12.40.<br>Tx failed again at 6.35p.m. and restored to normal at 0.20 a.m.<br>Recording at Mentakab continued but with a input level of - 62 dbm. |
| 2nd Nov. | Dish direction at Mentakab adjusted to give a improved signal of - 52 dbm. Max.<br>Deep fading occured three times between 8.30p.m. and 10.00 p.m.<br>Recording continued except between 5p.m. and 7.00 p.m. due to heavy lightning and thunder.<br>Max. recorded level - 46 dbm.<br>Max. signal variation about 10 dbs. |
| 3rd Nov. | Sempah Transmitted normally.<br>Mentakab received signal steady. Max. signal variation 5dbs.<br>Level check - 52 dbm. Max recorded level - 48 dbm.<br>Height pattern carried out.<br>No change in signal level. |

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| 4th Nov. | Recording continued with a steady input signal.<br>Recording interrupted between 6.30p.m. and 8.30 p.m. due to heavy thunder and lightning.<br>Max. signal variation only about 5 dbs. |
| 5th Nov. | Recording continued normally with a steady input signal.<br>Max. signal variation only about 5 dbs. |
| 6th Nov. | Recording continued normally with a steady input signal.<br>Max. signal variation only about 5 dbs. |
| 7th Nov. | Recording continued till 8.10 a.m.<br>Communication between Sempah and Mentakab closed down at 9.30 a.m.<br>Tx equipments carried down the hill.<br>Rx equipments packed and stored in hut at Mentakab. |
| 8th Nov. | Removal of Tx equipments to Kuantan.<br>Removal of Rx equipments to Kuantan. |

ROUTE: KUANTAN - KOTA BHARU

PELINDONG - BUKIT KEMUNING

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| 9th Nov. 1965 | Transmitting equipments set up at Bukit Pelindong.<br>Receiving equipments set up at Bukit Kemuning.<br>Tx direction adjusted and Rx direction adjusted and recording commenced at 6.30 p.m.<br>Max. received level - 44 dbm. Reference level - 55 dbm.<br>Deep fading throughout the night. Fading of over 30 dbs. |
| 10th Nov. | Recording continued. Signal quite steady between 9.00 a.m. and 11.00 a.m. Variations about 10db. After 11.00 a.m. fading started. Height pattern test carried out at 12.00 noon but no good result obtained due to fading in signal strength. |
| 11th Nov. | Height pattern measurement carried out at about 9.00 to 10.00 a.m. An almost good height pattern recorded with a little fading. |
| 12th Nov. | Recording continued. No improvement in fading. |
| 13th Nov. | Recording continued untill 10.00 a.m.<br>Rx station receiver switched off.<br>Japanese tower adjusted in the direction of Bauk.<br>Tx. station transmitter switched off.<br>Transmitting equipment packed and carried to Dungun. |

BUKIT KEMUNING - BUKIT BAUK

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| 14th Nov. 1965 | Transmitting equipments carried to site and set up.<br>Bauk began transmitting at 8. 15 p.m.<br>Tx & Rx dish adjusted to correct position to give a level of - 45 dbm.<br>Recording continued with a steady signal. Variation in signal level less than 5 dbs.<br>Minimum recorded level 48 dbm. |
| 15th Nov. | Recording continued normally except for Engine failures at Tx and about 4 times.<br>About 5. 25 a.m. fading. Level measured - 57 dbm.<br>Fading continued until 6. 55 a.m.<br>At 5. 35 a.m. fading only about 5 dbs. |
| 16th Nov. | Recording continued with a steady input signal.<br>Transmitter at Bauk had a steady output.<br>There was very little variation in received signal, less than 6 dbs.<br>About 10 dbs fading only. |
| 17th Nov. | Recording continued with steady received leval, very little variation in signal strength, about 6 dbs.<br>A little fading about 5. 00 a.m. of about 4 dbs. |
| 18th Nov. | Recording closed down at 8. 20 a.m.<br>Removal of RX equipment to Besar. |

Bukit Bauk - Bukit Besar

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| 19th Nov. | Receiving tower and equipment set up by 3. 25 p.m.<br>T.X. and R.X. dishes adjusted. Receiving signal level-54 dbm.<br>Recording continued, maximum receiving signal level-45 dbm.<br>Reference level -60dbm.<br>Variation range of signal level 5 to 10 db. |
| 20th Nov. | Recording continued, deep fading occured at around 4. 00 a.m, measured signal level-70dbm. Steady signal recorded during day time, variation range of signal level about 5 to 10 db.<br>Fading occured at 5. 00 p.m. depth about 15db. |
| 21st Nov. | Recording continued with a steady input signal, variation range of signal level about 5 - 10 db.<br>Receiving condition mentioned above continued during whole day. |
| 22nd Nov. | Recording continued normally.<br>Height pattern measurment carried out during 10. 00 - 11. 00 a.m.<br>There was some variation of signal level due to dish height, but accurate height pattern could'nt be measured, because of tower twist.<br>Fading occured at 9. 43 p.m. 10. 07 p.m. and midnight measured level about 61 - 63 db. |

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| 23rd Nov. | Recording continued with steady signal. Variation range of signal strength about 7 db. From 3.30 p.m. height pattern measurement carried out again to correct the error due to shift of dish direction caused by Tower twist. This measurement performed by means of adjusting dish direction to get maximum signal level at each stage. Finally, any variation of signal level could'nt be fond except the small variation less than 1 db. |
| 24th Nov. | Recording continued, variation range of signal level about 5 - 7 db. Interim meeting held at Trengganu Maintenance Depot (2.30 - 5.00 p.m.) |
| 25th Nov. | Recording closed down at 9.00 a.m. Meliograph test carried out successfully to confirm the accurate direction and clearance, but unfortunately, it found that the clearance is not enough. TX. equipments packed up and carried down to Trengganu. |

<u>BUKIT BESAR - BUKIT BINTANG</u>

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| 26th Nov. | R.X. site; Analysis of recorded data carried on at maintenance depot and R.X. equipments checked up at Besar. T.X. site; Installation of accommodation and engines carried on at Bintang. |
| 27th Nov. | R.X. site; Data analysis carried on at maintenance depot and R.X. equipments checked up at Besar T.X. site; It continued to carry up the installation material, fuel, oil, etc to Bintang. |

<u>BUKIT BESAR - BUKIT BINTANG</u>

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| 28th Nov. | R.X. site; Data analysis carried on and R.X. equipments calibrated. T.X. equipments checked up at maintenance depot. T.X. site; Transportaion to Bintang stoped on the half way because of rain fall. |
| 29th Nov. | R.X. site: Data analysis continued and T.X. equipments drived on continuously to heat up at maintenance depot. T.X. site: Transportation of installation material to Bintang continued. |
| 30th Nov. | R.X. site: Data analysis and heating up T.X. equipment continued at maintenance depot. T.X. site: Transportation to Bintang continued in heavy rainfall. |
| 1st Dec. | R.X. site: Heavy rainfall but, as finding the no rain time, tower direction of Besar changed to Bintang. Data analysis and heating up T.X. equipments continued. T.X. site: The road to Bintang closed because of water flood. |
| 2nd Dec. | R.X. site: Data analysis and heating up T.X. equipments continued. T.X. site: Road closed by the flood. |

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| 3rd Dec. | R. X. site: Data analysis and heating up T. X. equipments continued.<br>T. X. site: Road closed by the flood. |
| 4th Dec. | Do, but road condition getting better. |
| 5th Dec. | Do. |
| 6th Dec. | R. X. site: Do<br>T. X. site: We started for Bintang in the morning, to make an inspection of road condition. Road traffic not available beyond 7 miles on the way from Trengganu to Bintang. |
| 7th Dec. | R. X. site: Do<br>T. X. site: Road condition geting better, but road traffic not available beyond 13 miles than, we could'nt approach to Bintang Mountain foot. |
| 8th Dec. | R. X. site: Data analysis continued.<br>T. X. site: Road condition inspected and it made sure that road condition available to approach to Bintang already. But no time enough to carry up the equipments to Bintang site. |
| 9th Dec. | R. X. site: R. X. equipments set up and made arrangement.<br>T. X. site: T. X. equipments carried up to Bintang, engines and triped set up. Several equipments left at mountain foot. |
| 10th Dec. | R. X. site: Standing by.<br>T. X. site: Remaining equipments carried up and dish and equipments made arrangement.<br>But two engines fault. |
| 11th Dec. | Alternative engine carried up to Bintang T. X. and R. X. dishes adjusted. Recording commenced at 5. 25 p. m.<br>Maximum received level -46. 5 dbm. |
| 12nd Dec. | Recording continued. Variation range 5 db.<br>Maximum signal level -46dbm.<br>Repaired engine carried up to Bintang. |
| 13rd Dec. | Recording continued keeping variation of about 5 db.<br>Heliograph test carried out successfully and the position of Bintang made sure at Besar. |
| 14th Dec. | Recording continued, variation range about 5db. In the early morning, fading with variation of about 20db occured twice.<br>Height pattern measurement carried out in the afternoon but no variation of signal level due to dish height recorded. |
| 15th Dec. | Recording closed down at 8. 00 p. m.<br>R. X. equipments packed up and transported to K. Bharu.<br>Direction of T. X. dish changed to Kota Bharu. |

## BUKIT BINTANG - KOTA BHARU

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| 16th Dec. | Installation of receiving tower at Kota Bharu exchange interrupted by rainfall.<br>Platform almost made up on the V H F tower. |
| 17th Dec. | Hut set up on the platform and installation of tower almost finished except several pieces of tower element. |
| 18th Dec. | R. X. equipments made an arrangement after tower construction completed.<br>T. X. dish adjusted to the direction of Kota Bharu, but R. X. dish adjustment could not be performed completely because of heavy rain. |
| 19th Dec. | Panning of receiving dish carried on from 8. 00 p. m. after that, height pattern measurement carried out, and dish placed in the position of about 37 meters in height to get the maximum signal level.<br>Recording started at 11. 19 a. m.<br>Receiving signal level about -52dbm. |
| 20th Dec. | Recording continued. Signal level went down several times from -49dbm to -60dbm at midnight.<br>But after that, it got well, and receiving signal level almost steady. |
| 21st Dec. | Fading with variation from -49db to -66dbm occured 4 times in the early morning.<br>Receiving dish position changed to top of tower.<br>Recording continued keeping almost steady signal level, variation about 3db. |
| 22nd Dec. | Recording continued taking slight variation.<br>Heliograph test carried out successfully and the position of Bintang made sure at Kota Bharu. |
| 23rd Dec. | Recording continued keeping slight variation of about 3 db.<br>Fading recorded twice at 4. 00 and 5. 00 a. m. measured signal level about -68dbm.<br>Theodolite test carried out at night, but not successfjl other than the light of Bintang confirmed at Kota Bharu. |
| 24th Dec. | Recording closed down at 9. 15 a. m.<br>All propogation test scheduled completed.<br>Removal of equipment and material started. |
| 25th Dec. to 29th Dec. | Removal and transportation carried out. |
| 30th Dec. to 31st Dec. | Japanese equipment packed up for shipping. |