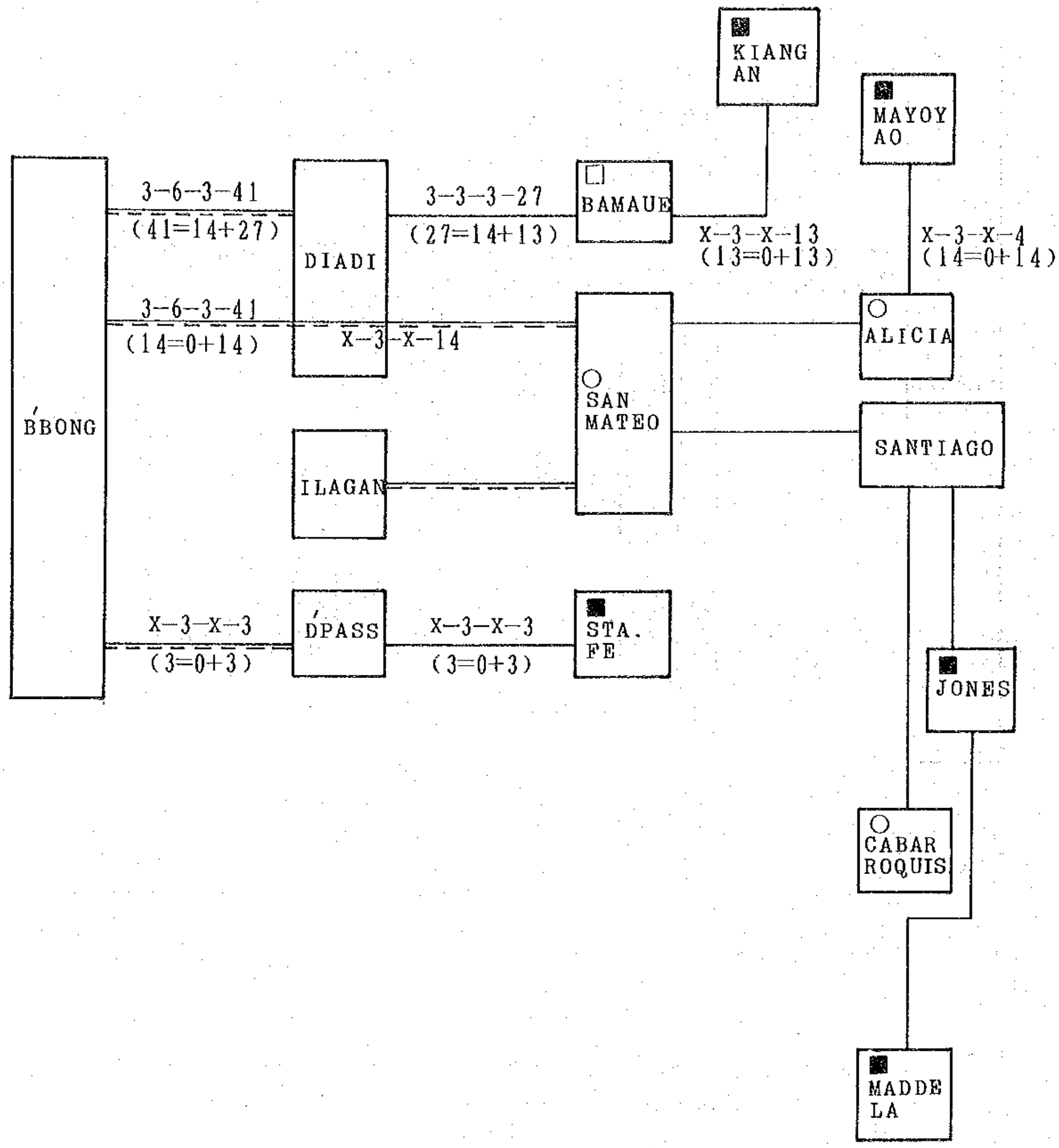


Fig.Ⅷ-2-2-120 Required telephone channel numbers for spur route radio sections in Bayombong PC area

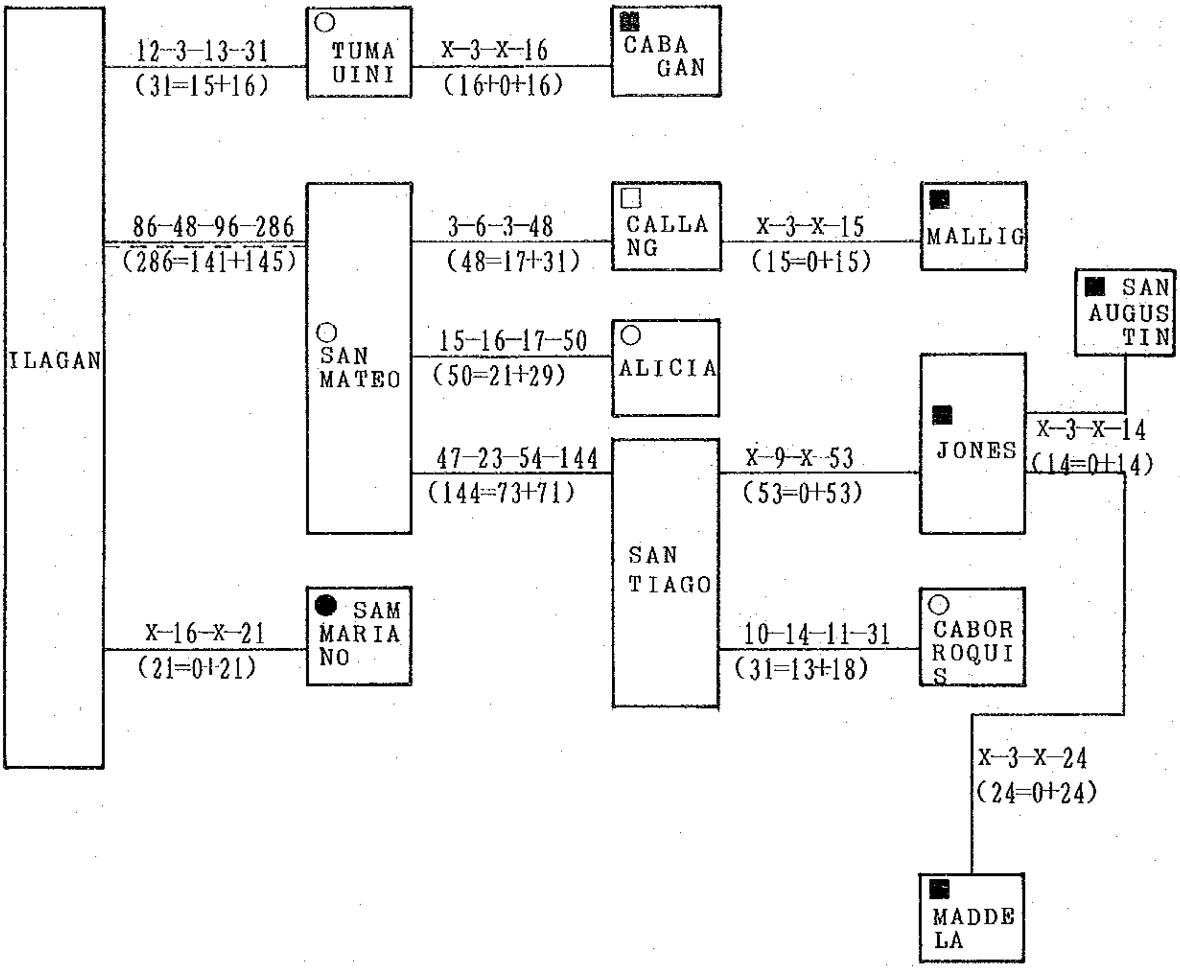


Fig.Ⅷ-2-2-121 Required telephone channel numbers for spur route radio sections in Ilagan PC area

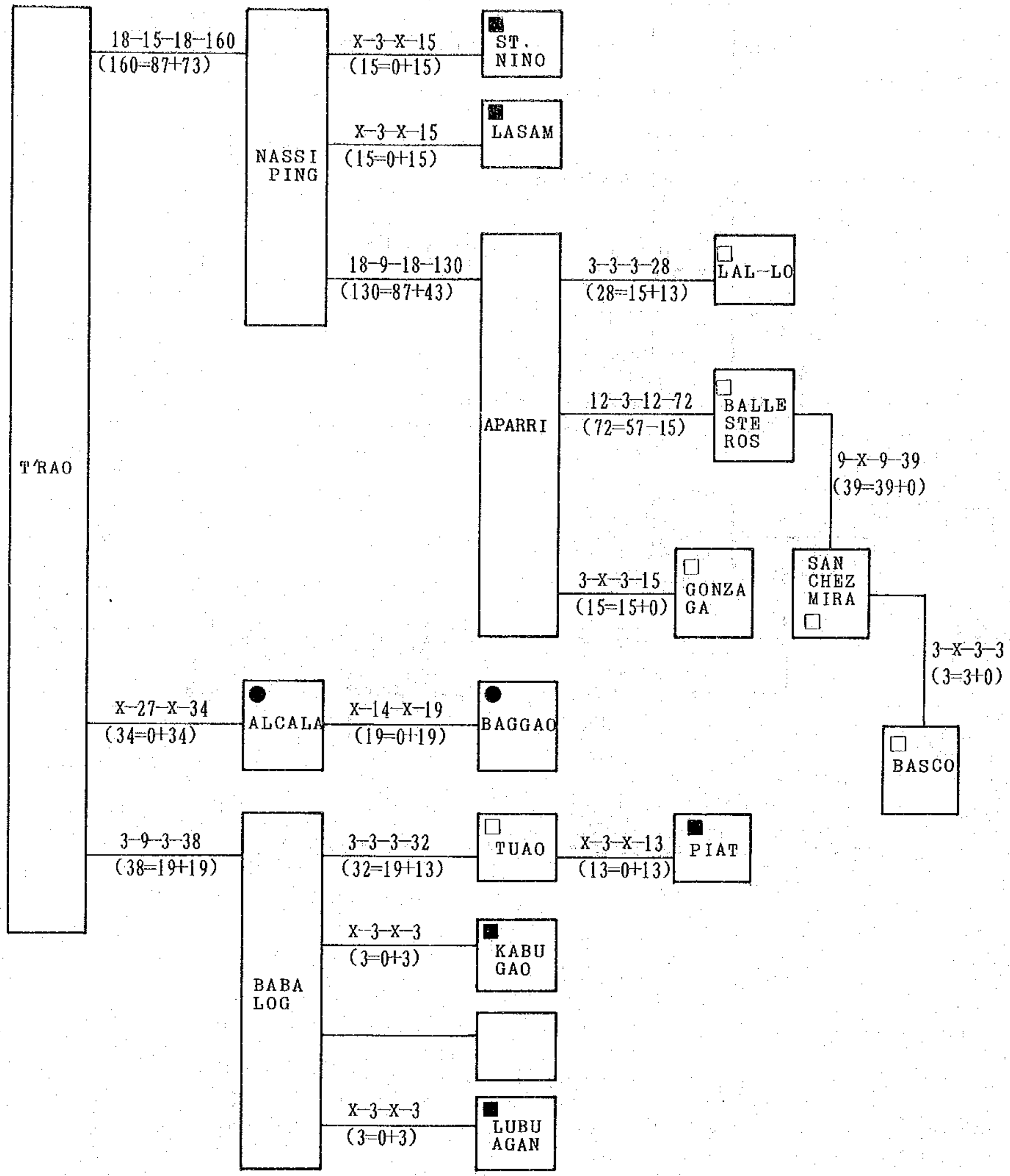


Fig.Ⅷ-2-2-122 Required telephone channel numbers for spur route radio sections in Tuguegarao PC area

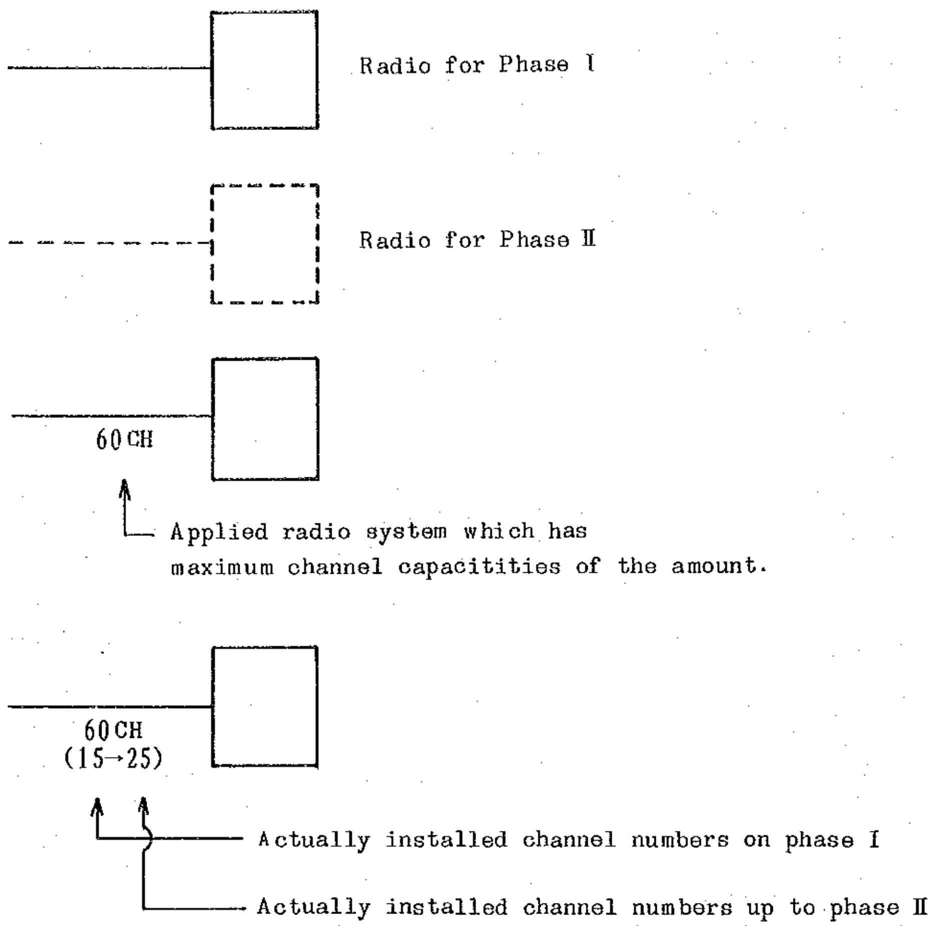
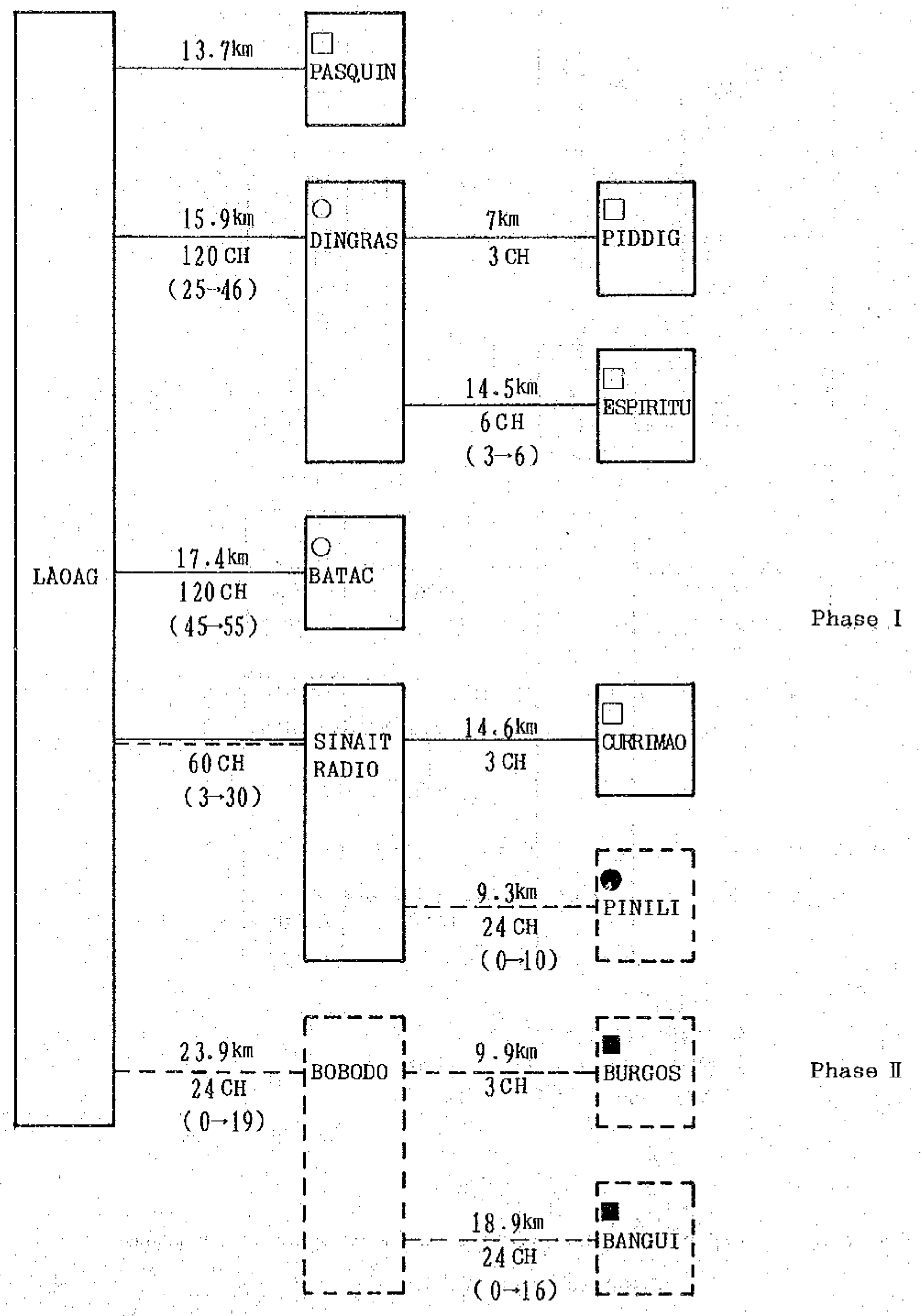


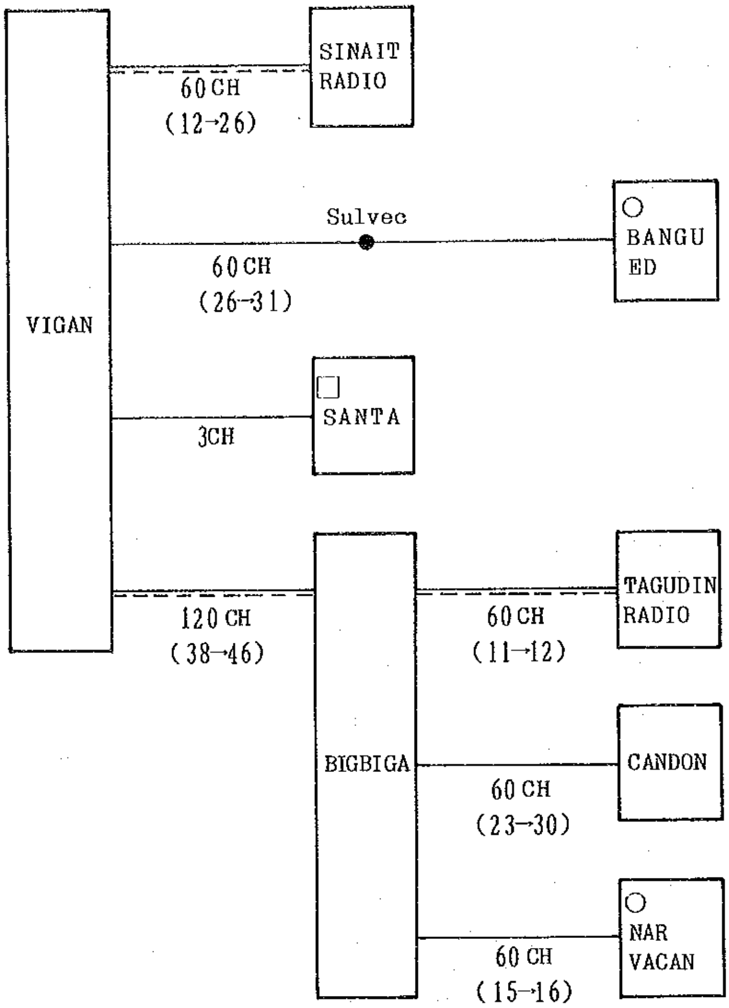
Fig.Ⅷ－2－2－123　Legend of Fig.Ⅷ－2－2－124～Fig.Ⅷ－2－2－131



1 branched microwave route.
5 UHF routes (2 routes in phase I and 3 routes in phase II)
5 VHF routes (4 〃 〃 and 1 〃 〃)

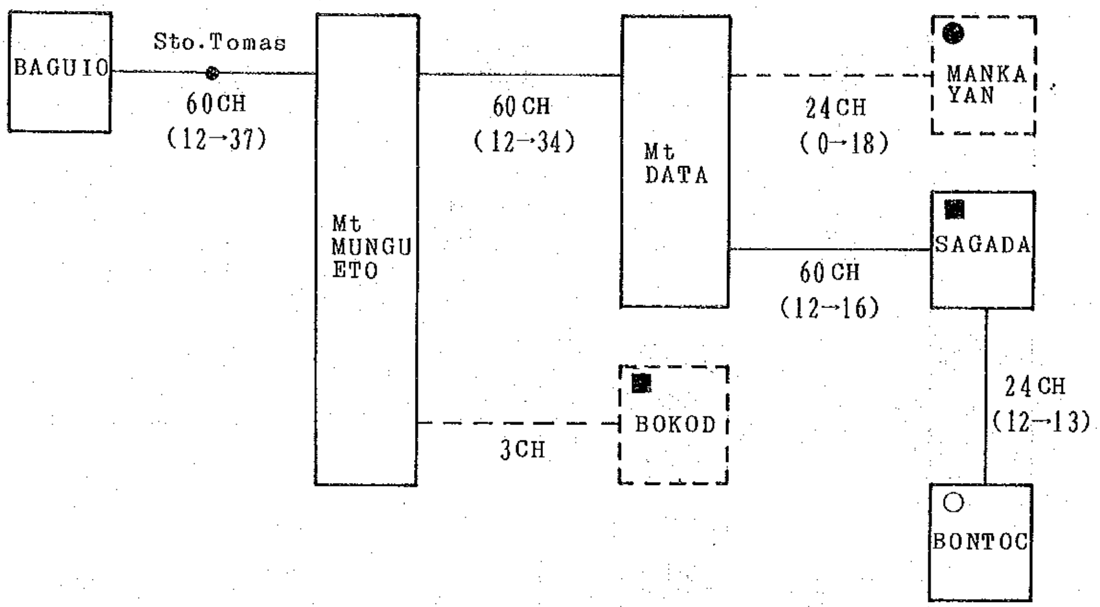
Broken Line:Phase II

Fig.Ⅷ－2－2－124 Maximum channel capacity of spur route radio sections in Laoag PC area



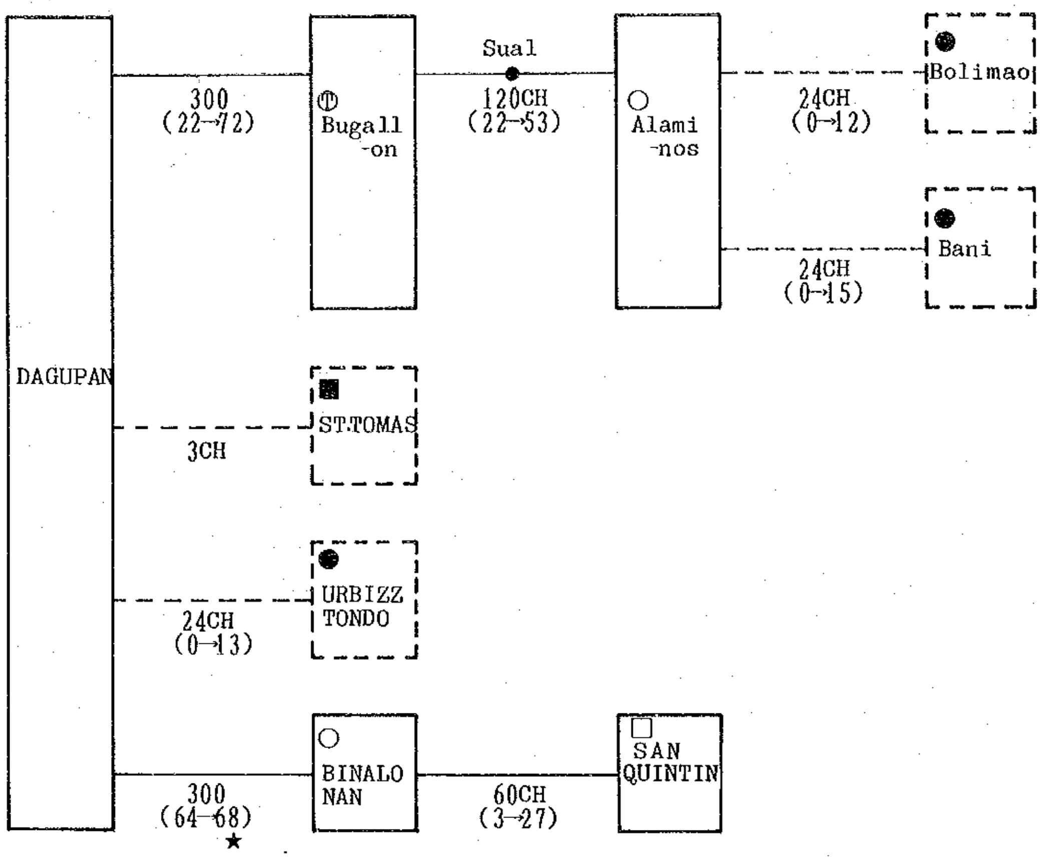
3 branched microwave routes
4 UHF routes (All in phase I)
1 VHF route (in phase I)

Fig. Ⅷ−2−2−125 Maximum channel capacity of spur route radio section in Vigan PC area



6 UHF routes(5 routes in phase I and 1 route in phasi II)
1 VHF route(in phase II)

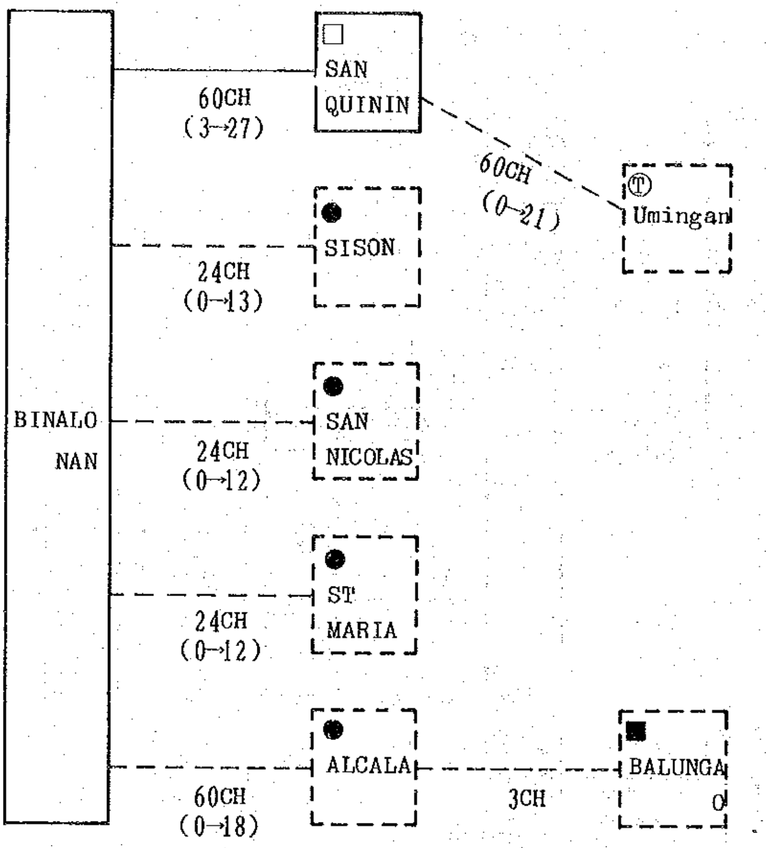
Fig. VIII−2−2−126 Maximum Channel caqacity of spur route radio sections in Baguio SC arca



★ This number is a reguired trunk line number between Dagupan P.C and Baguio S.C.

8 UHFroutes (5 routes in phase I and 3routes in phase II
1 VHFroutes in phase I

Fig. VII-2-2-127 Maximum channel capacity of spur route radio sections in Dagupan PC area



5 UHF routes in phase II
1 VHF routes in phase II

Fig. Ⅶ-2-2-128 Maximum channel capacity for spur route radio sections in Binalonan PC area

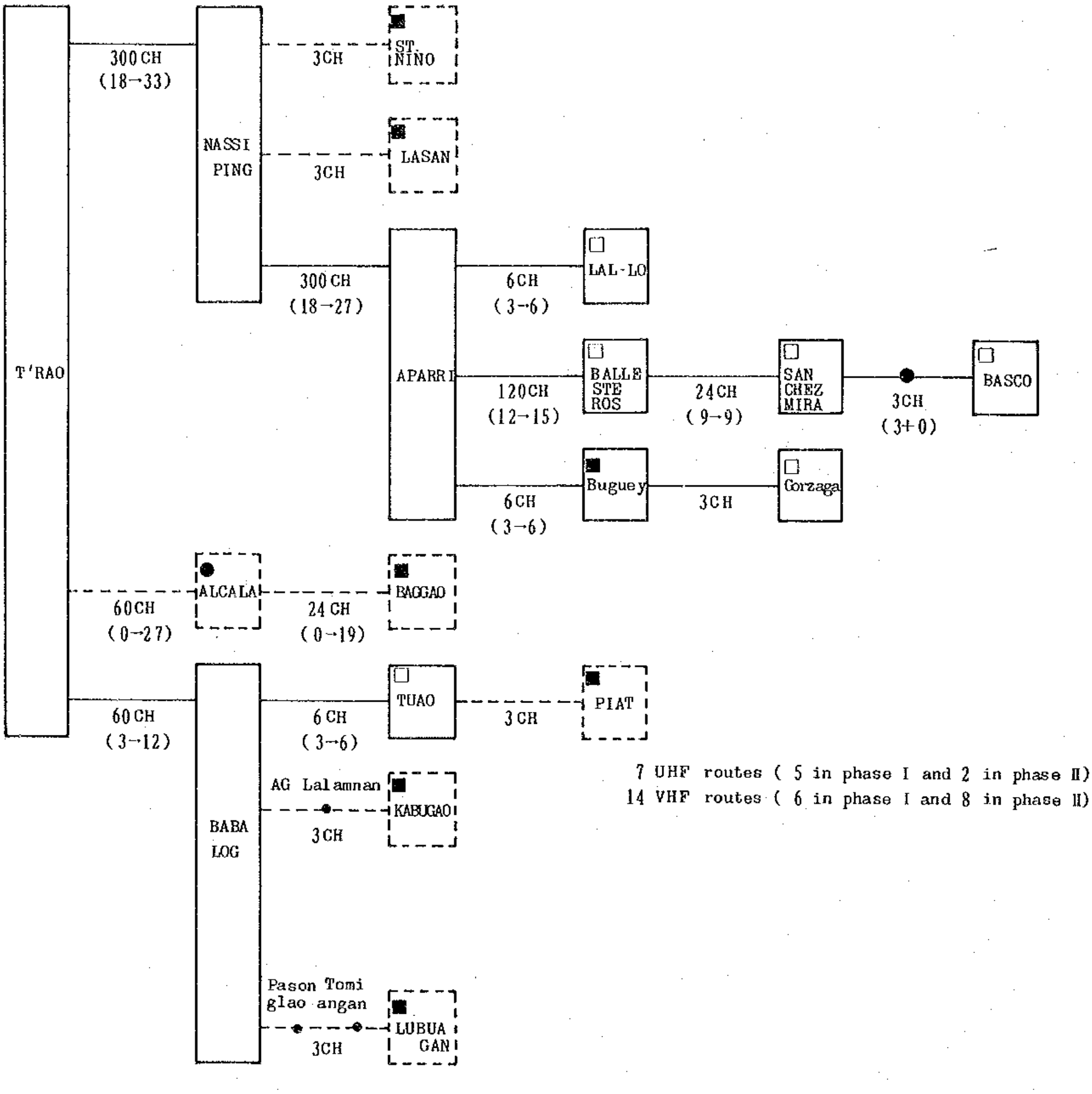
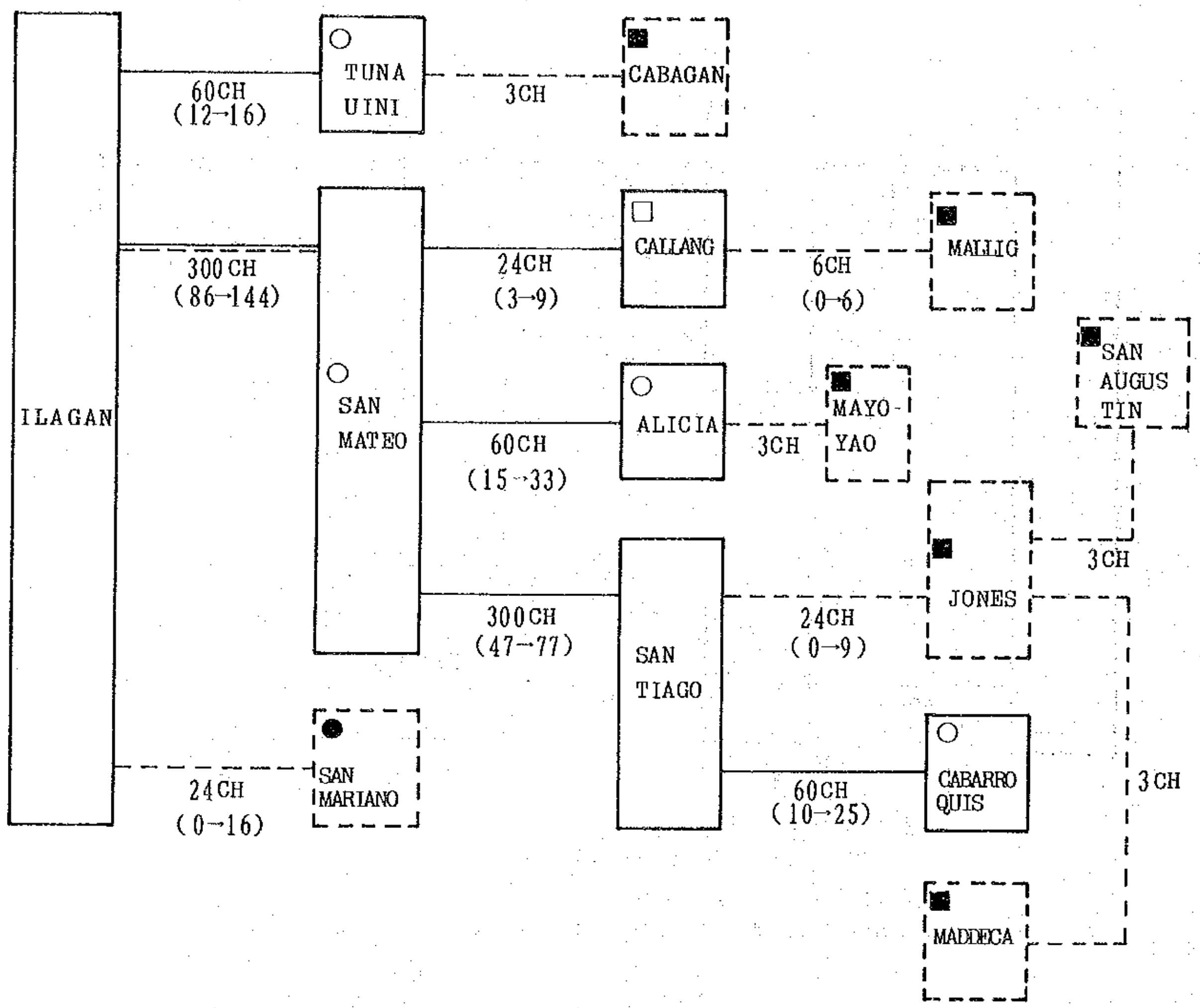
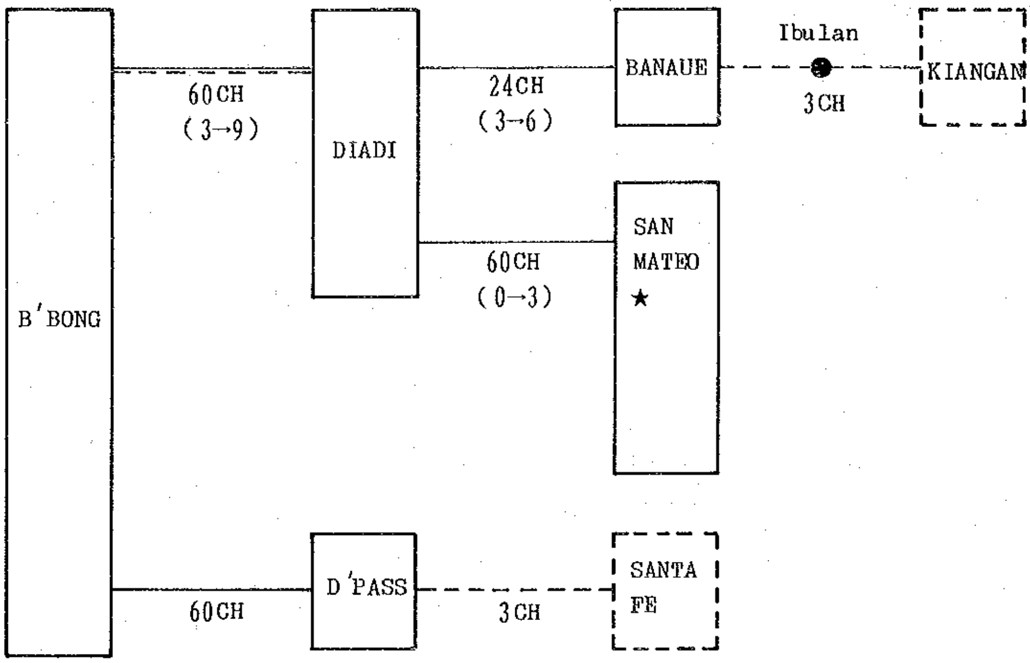


Fig. VIII-2-2-129 Maximum channel capacity for spur route radio sections in Tuguegarao PC area



1 branched microwave
7 UHF routes (5 in phbse I and 2 in phase II)
5 VHF routes (in phase II)

Fig. VIII-2-2-130 Maximum channel capacity for spur route radio sections in Ilazan PC area



2 branched microwave
1 UHF route (in phase I)
3 VHF route (in phase II)
★ not branched but goes to Ilagan

Fig. VIII-2-2-131 Maximum channel capacity for spur route radio sections in Bayombong PC area

Table VIII-2-2-14 Equipped transmission capacity of spur route stations

Remarks : planned on Phase I

: planned on Phase II

Spur route Station		Function as microwave			Maximum capacity which is equipped						Type of station		Same bldg. with exchange? ○: Yes. ×: No.
		Termi-nal	Simple re-peater	Leakage re-peater	3CH	6CH	24CH	60CH	120CH	300CH	Ter-minal	Re-peater	
Laoag	1	○			○		⊗		○ ○		○		×
Pasquin	2				○						○		○
Dingras	3				○	○			○		○		○
Batac	4								○		○		○
Sinait	5			○	○		⊗				○		
Currimao	6				○						○		×
Pinili	7						⊗				○		○
Bobodo	8				⊗		⊗ ⊗				○		
Burgos	9				⊗						○		○
Bangui	10						⊗				○		○
Piddig	11				○						○		○
Espiritu	12					○					○		×

Table VIII-2-2-15 Equipped transmission capacity of spur route stations

Name of spur route station		Function as microwave			Maximum capacity which is equipped						Type of station		Same bldg. with exchange? ○ : Yes. × : No.
		Termi-nal	Simple re-peater	Leakage re-peater	3CH	6CH	24CH	60CH	120CH	300CH	Ter-minal	Re-peater	
Vigan	13	○			○			○ ○			○		×
Sulvec	14							○ ○				○	
Bangued	15							○			○		×
Santa	16				○						○		○
Bigbiga	17			○				○ ○			○		
Candon	18							○			○		
Narracan	19							○			○		○
Baguio	20	○						○			○		○
Sto. Tomas	21		○					○ ○				○	
Mt. Mungu-eto	22				○			○ ○			○		
Mt. Data	23						⊗	○ ○			○		
Bokod	24				⊗						○		×
Mankayan	25						⊗				○		○

Table VIII-2-2-16 Equipped transmission capacity of spur route stations

Spur route station		Function as microwave			Maximum capacity which is equipped						Type of station		Same bldg. with exchange? ○ : Yes. × : No.
		Terminal	Simple repeater	Leakage repeater	3CH	6CH	24CH	60CH	120CH	300CH	Terminal	Repeater	
Sagada	26						○	○			○		×
Bontoc	27						○				○		×
Dagupan	28				⊗		⊗		○	○	○		○
Bugallon	29								○	○	○		○
Sual	30								○ ○			○	
Alaminos	31						⊗ ⊗		○		○		○
Bolinao	32						⊗				○		×
Bani	33						⊗				○		○
Sto. Tomas	34				⊗						○		○
Urbizztondo	35						⊗				○		○
Binalonan	36						⊗ ⊗ ⊗	○ ⊗			○		○
San Quintin	37				⊗			○ ⊗			○		○

Table VIII-2-2-17 Equipped transmission capacity of spur route stations

Spur route station	Function as microwave			Maximum capacity which is equipped						Type of station		Same bldg. with exchange? ○ : Yes. × : No.
	Terminal	Simple repeater	Leakage repeater	3CH	6CH	24CH	60CH	120CH	300CH	Terminal	Repeater	
Tagudin 38			○									
Umingan 39							⊗			○		○
Sison 40						⊗				○		○
San Nicolas 41						⊗				○		○
Sta. Maria 42						⊗				○		○
Alcala 43				⊗			⊗			○		○
Balungao 44				⊗						○		○
Tuguegarao 45	○						○ ⊗		○	○		○
Nassiping 46				⊗ ⊗					○ ○		○	
Aparri 47				○	○			○	○		○	
Sto. Nino 48				⊗						○		○
Lazam 49				⊗						○		○
Lal-Lo 50					○					○		○

Table VIII-2-2-18 Equipped transmission capacity of spur route stations

Spur route station		Function as microwave			Maximum capacity which is equipped						Type of station		Same bldg. with exchange? ○ : Yes. × : No.
		Terminal	Simple re-peater	Leakage re-peater	3CH	6CH	24CH	60CH	120CH	300CH	Ter-minal	Re-peater	
Ballesteros	51						○		○		○		○
Gonzaga	52				○						○		○
Sanchez-Mira	53				○		○				○		○
Basco	55				○						○		×
Alcala	56						⊗	⊗			○		○
Baggao	57						⊗				○		○
Babalog	58				⊗⊗	○		○			○		
Tuao	59				⊗	○					○		○
Piat	60				⊗						○		○
Kabugao	61				⊗						○		×
Lubuagan	62				⊗						○		×
Ag-Lalamnan	63				⊗⊗							○	
Tomiangan	64				⊗⊗							○	

Table VIII-2-2-19 Equipped transmission capacity of spur route stations

Spur route station		Function as microwave			Maximum capacity which is equipped						Type of station		Same bldg. with exchange? ○ : Yes. × : No.
		Terminal	Simple repeater	Leakage repeater	3CH	6CH	24CH	60CH	120CH	300CH	Terminal	Repeater	
Pasonglao	65				⊗ ⊗							○	
Ilagan	66	○					⊗	○			○		×
Tumauini	67				⊗			○			○		○
Cabagan	68				⊗						○		○
San Mateo	69			○			○	○		○	○		×
San Manuel	70					⊗	○				○		○
Mallig	71					⊗					○		○
Alicia	72				⊗			○			○		○
Santiago	73						⊗	○		○	○		○
Jones	74				⊗ ⊗		⊗				○		○
San Augustin	75				⊗						○		○
Maddela	76				⊗						○		○
Cubarroguis	77							○			○		○

Table VIII-2-2-20 Equipped transmission capacity of spur route stations

Spur route station		Function as microwave			Maximum capacity which is equipped						Type of station		Same bldg. with exchange? ○ : Yes. × : No.
		Termi-nal	Simple re-peater	Leakage re-peater	3CH	6CH	24CH	60CH	120CH	300CH	Ter-minal	Re-peater	
San Mariano	78						⊗				○		×
Diadi	79			○			○				○		
Banaue	80				⊗		○				○		×
Dalton Pass	81			○	⊗						○		
Sta. Fe	82				⊗						○		○
Kiangan	83				⊗						○		○
Mayoyao	84				⊗						○		○
Ibulao	85				⊗ ⊗							○	
Buguey	86					⊗					○		○
Boyambong	87	○											×
Balungao	88		○										
Guingui-nabang	89		○										
Kitakita	90		○										

Table VIII-2-2-20(b) Detail number of radio equipments on spur routes

Legend:

3 CH System	
52	
15	37

- 3 CH System — Proposed radio system
- 52 — Total number of proposed equipments
- 37 — Equipment numbers planned in Phase 2
- 15 — Equipment numbers planned in phase 1

3CH System		6CH System		24CH System		60CH System		120CH System		240CH System		Total of all spur radio	
52		8		34		34		16		6		150	
15	37	6	2	11	23	28	6	16	0	6	0	82	68

Table VIII-2-2-21 Trend of channel demand in spur route base-band sections

	Demand of				Applied channel capacity	Remarks	
	1987 in phase 1	1990 in phase 2	1990 in phase 1	1997 in phase 1 phase 2			
1. Laoag -	3CH		3CH	15CH	3CH	13.7km	E120°35'52" N 18°12'49"
Pasquin							E120°37'01" N 18°20'08"
2. Laoag -	25		27	57	120	15.9km	
Dingras		19		20			E120°41'53" N 18°06'24"
3. Dingras -	3		3	13	3	7.0km	
Piddig							E120°42'53" N 18°10'05"
4. Dingras -	3		3	3	6	14.5km	
Espiritu		3		3			E120°39'06" N 17°58'59"
5. Laoag -	45		55	69	120	17.4km	
Batac							E120°33'57" N 18°03'35"
6. Laoag -	3		3	16	60	38.0km	Leaking from microwave
Sinait. R.		27		32			E120°28'17" N 17°53'34"
7. Sinait R. -	3		3	16	3	14.6km	
Currimao							E120°28'56" N 18°01'28"
8. Sinai R. -					24	9.3km	
Pinili		10		11			E120°31'45" N 17°57'23"
9. Laoag -					24	23.9km	
Bobodo		19		22			E120°37'23" N 18°25'40"
10. Bobodo -					3	9.9km	
Burgos		3		3			E120°38'34" N 18°30'56"
11. Bobodo -					24	18.9km	
Bangui		16		19			E120°45'41" N 18°32'31"
12. Vigan -	12		13	17	60	36.6km	E120°23'18" N 17°34'25"
Sinait R.		13		14			Leaking form microwave
13. Vigan, (Sulvec)	26		31	39	60	17.8km	E120°33'16" N 17°32'22"
- Bangued						9.3km	E120°37'13" N 17°30'43"
14. Vigan -	3		3	15	3	10.4km	
Santa							E120°26'02" N 17°29'21"

Table VIII-2-2-22 Trend of channel demand in spur route base-band sections

	Demand of				Applied channel capacity	Remarks	
	1987 in phase 1	1990 in phase 2	1990 in phase 1	1997 in phase 1 phase 2			
15. Vigan -	49CH		55CH	75CH	120CH	29.6km	Through a microwave
Bigbiga		3CH		14			E120°26'59" N 17°18'51"
16. Bigbiga -	11		12	14	60	44.1	Through a microwave
Tagudin							E120°27'44" N 16°55'04"
17. Bigbiga -	23		27	32	60	13.2	
Candon		3		14			E120°26'32" N 17°11'46"
18. Bigbiga -	15		16	29	60	12.0	
Narvacan							E120°28'36" N 17°25'14"
19. Baguio -(Sto. Tomas)	12		13	14	60	10.6	E120°36'33" N 16°25'05"
Mt. Mungueto		24		37		42.8	E120°47'06" N 16°39'22"
20. Mt. Mungueto -					60	23.5	
Mt. Data		21		34			E120°51'06" N 16°51'22"
21. Sagada -	12		13	14	60	26.1	
Mt. Data		3		13			E120°53'57" N 17°05'18"
22. Bontoc -	12		13	14	24	7.4	
Sagada							E120°58'04" N 17°05'38"
23. Mankayan -					24	8.2	
Mt. Data		18		21			E120°46'51" N 16°51'58"
24. Dagupan -	22		26	33	120	15.7	
Bugallon		46		66	(300)		E120°19'09" N 16°02'44"
25. Bugallon - (Sual)	22		26	33	120	18.8	E120°13'07" N 15°57'19"
Alaminos		27		31		15.7	E119°58'52" N 16°09'43"
26. Alaminos -					24	25.9	
Bolinao		12		14			E119°53'50" N 16°22'53"
27. Alaminos -					24	13.4	
Bani		15		17			E119°51'32" N 16°11'15"
28. Dagupan -					3	26.6	
Sto. Tomas		3		14			E120°22'41" N 16°16'53"

Table VIII-2-2-23 Trend of channel demand in spur route base-band sections

	Demand of				Applied channel capacity	Remarks	
	1987 in phase 1	1990 in phase 2	1990 in phase 1	1997 in phase 1 phase 2			
29. Dagupan -					24CH	18.0km	
Urbiztondo		13CH		16CH			E120°19'39" N 15°49'31"
30. Dagupan -	64CH		36CH	54	120	27.1	
Binalonan		18		32	(300)		E120°35'13" N 16°03'17"
31. Binalonan -	3		3	14	60	25.1	
San Quintin		24		38			E120°48'43" N 15°59'08"
32. San Quintin -					60	6.8	
Umingan		21		25			E120°50'14" N 15°55'47"
33. Binalonan -					24	18.6	
San Nicolas		14		14			E120°45'37" N 16°04'22"
34. Binalonan -					24	15.6	
Sison		13		15			E120°30'35" N 16°10'28"
35. Binalonan -					24	29.4	
Sta. Maria		12		14			E120°42'03" N 15°58'50"
36. Binalonan -					60	34.1	
Alcara							E120°31'11" N 15°50'51"
37. Alcara -					3	17.1	
Balungao							E120°40'15" N 15°53'55"
38. Bayombong -	3		3	14	60	26.2	Leaking form
Diadi		6		27			Microwave
39. Diadi -	3		3	14	24	42.9	
Banaue		3		13			E121°02'51" N 16°54'32"
40. Banaue -(Ibulao)					3	15.8	E121°17'21" N 16°54'28"
Kiangan		3		13		3.8	E121°05'01" N 16°46'42"
41. Alicia -					3	55.8	
Mayoyao		3		14			E121°12'48" N 16°58'25"
42. Daltan Pass -					60	44.7	Through a
Bayombong		3		3			microwave
43. Daltonpass -					3	3.3	
Sta. Fe		3		3			E120°16'07" N 16°09'37"
44. Ilagan -	12		13	15	60	17.8	
Tumauini		3		16			E121°48'59" N 17°16'41"

Table VIII-2-2-24 Trend of channel demand in spur route base-band sections

	Demand of				Applied channel capacity	Remarks	
	1987 in phase 1	1990 in phase 2	1990 in phase 1	1997 in phase 1 Phase 2			
45. Tumauini –					3CH	17.0km	
Cabagan		3CH		16CH			E121°45'49" N 17°25'29"
46. Ilagan –	86CH		96CH	141	300	41.0	Through microwave
San Mateo		48		145			E121°35'32" N 16°52'47"
47. San Mateo –	3		3	17	24	16.9	
Callang		6		31			E121°38'05" N 17°01'35"
48. San Mateo –	15		17	21	60	15.6	
Alicia		16		29			E121°41'52" N 16°46'38"
49. Callang –					3	32.3	
Mallig		3		15			E121°36'12" N 17°18'58"
50. San Mateo –	47		54	73	240	21.3	
Santiago		23		71	(300)		E121°32'56" N 16°41'26"
51. Santiago –					24	21.8	
Jones		9		53			E121°42'02" N 16°33'34"
52. Jones –					3	6.9	
San Augustin		3		14			E121°44'44" N 16°30'52"
53. Jones –					3	24.0	
Maddela		3		24			E121°41'07" N 16°20'28"
54. Tuguegarao –	18		18	87	240	41.7	
Nassiping		15		73	(300)		E121°37'40" N 17°59'05"
55. Nassiping –					3	12.6	
Sto. Nino		3		15			E121°34'04" N 17°53'08"
56. Nassiping –					3	9.6	
Lazam		3		15			E121°35'59" N 18°04'00"
57. Nassiping –	18		18	87	240	39.9	
Aparri		9		43	(300)		E121°38'51" N 18°20'43"
58. Aparri –	3		3	15	6	15.9	
Lal-Lo		3		13			E121°39'46" N 18°12'09"
59. Aparri –	12		12	57	120	15.9	
Ballesteros		3		15			E121°30'45" N 18°24'35"

Table VIII-2-2-25 Trend of channel demand in spur route base-band sections

	Demand of 1987 in phase 1	Demand of 1990 in phase 2	Demand of 1990 in phase 1	Demand of 1997 in phase 1 / phase 2	Applied channel capacity	Remarks	
60. Sanchez Mira -	9CH		9CH	39CH	24CH	33.8km	
Ballesteros							E121°18'58" N 18°33'37"
61. Sanchez Mira -	3		3	3	3	85	
Basco						14.8	E121°59'51" N 20°27'08"
62. Aparri -	3		3	15	6	20.1	
Buguey		3		15			
63. Tuguegarao -					60	32.5	
Alcara		27		34			E121°39'25" N 17°54'32"
64. Alcara -					24	11.9	
Baggao		14		19			E121°46'01" N 17°55'40"
65. Tuguegarao -	3		3	19	60	22.4	
Babalog		9		19			E121°32'56" N 17°28'56"
66. Babalog -	3		3	19	6	30.1	
Tuao		3		13			E121°27'21" N 17°44'19"
67. Tuao -					3	6.2	
Piat		3		13			E121°28'39" N 17°44'19"
68. Babolong - (Ag Lalamnan)					3	56.2	E121°18'57" N 17°53'28"
Kabugao		3		3		15.7	E121°11'04" N 18°01'31"
69. Babalog - (Tomiangan					3	17.0	
Pasonglao) Lubuagan		3		3		18.2 10.2	E121°10'23" N 17°20'51"
70. Santiago -	10		11	13	60	19.3	
Cabarroguis		14		18			
71. Mt. Mungueto -					3	18.9	
Bokod		3		3			E120°49'16" N 16°29'34"
72. Ilagan -					24	22.0	
San Mariano		16		21			
73. Buguey - Gonzaga	3		3	15	3	17.7	E121°50'28" N 18°16'58" E121°59'38" N 18°15'39"
74. Diadi -					60	40.3	
San Mateo		3		14			

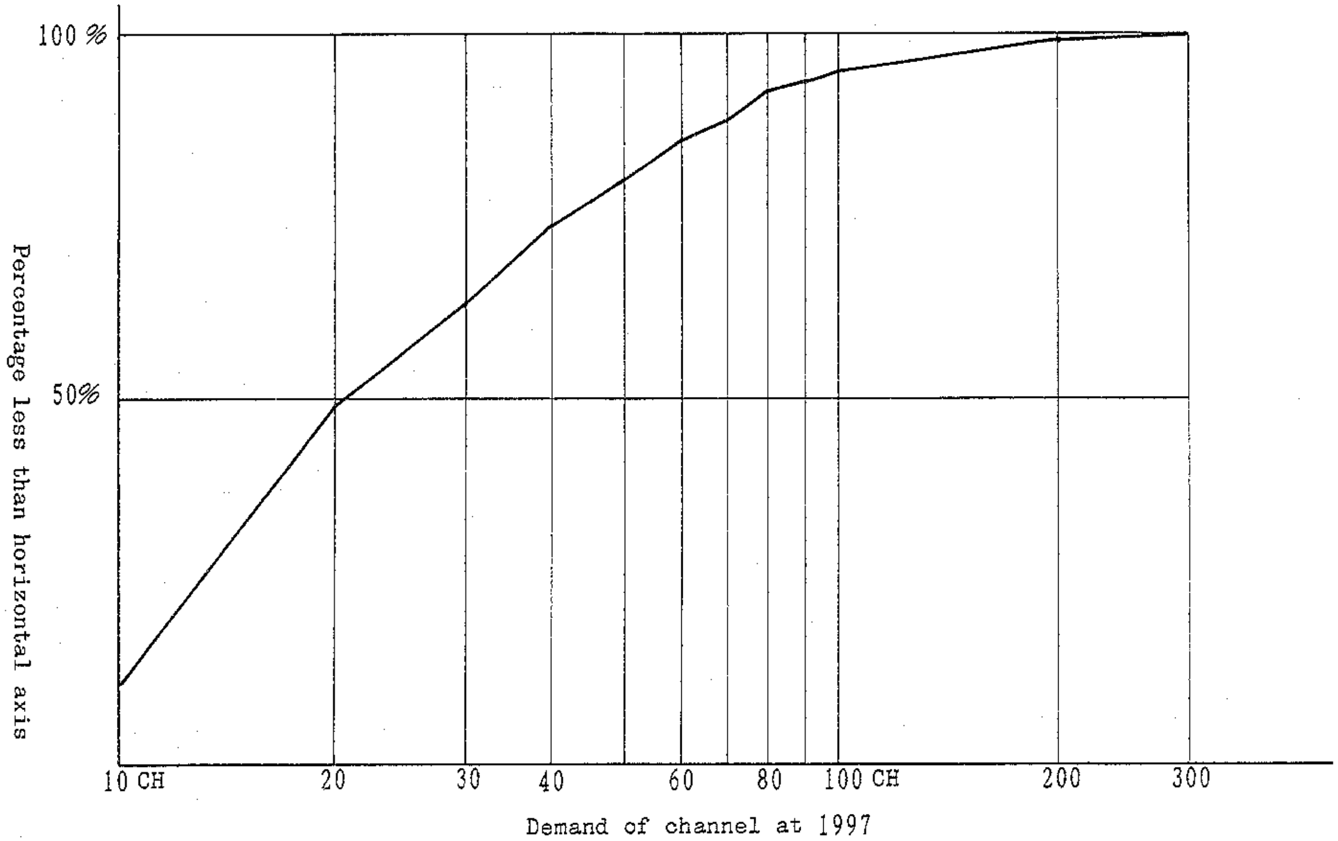


Fig.Ⅷ−2−2−132 Accumulated distribution of demand of channel capacity at 1997 in spur routes

(4) Radio system configuration

As already mentioned, radio systems of 150MHz, 400MHz, and 800MHz, and 2GHz bands will be used for spur routes. The 150MHz band will have a maximum channel capacity of 6 channels and be used for spur routes incorporating IPTS. FM or PM of a modulation index of 10kHz rms/channel will be used. Yagi antenna of 5 elements will be provided. Carrier multiplex equipment will be such that is built in the radio equipment rack and should not require a wide space. The stand-by system will be of preset standby type, so that both working and stand-by transmitter receiver equipment and carrier multiplex equipment should all be built into one equipment. Configuration of IPTS will be such as shown in Fig. VIII-2-2-133. In Type A, radio equipment and associated power supply equipment will be installed on a nearby hill or wherever convenient for radio wave transmission, and switchboard will be installed in a room of the municipal hall. These two locations separating about 0.5km ~ 1.5km from each other will be connected by a local cable. IPTS's belonging to Type A will be:

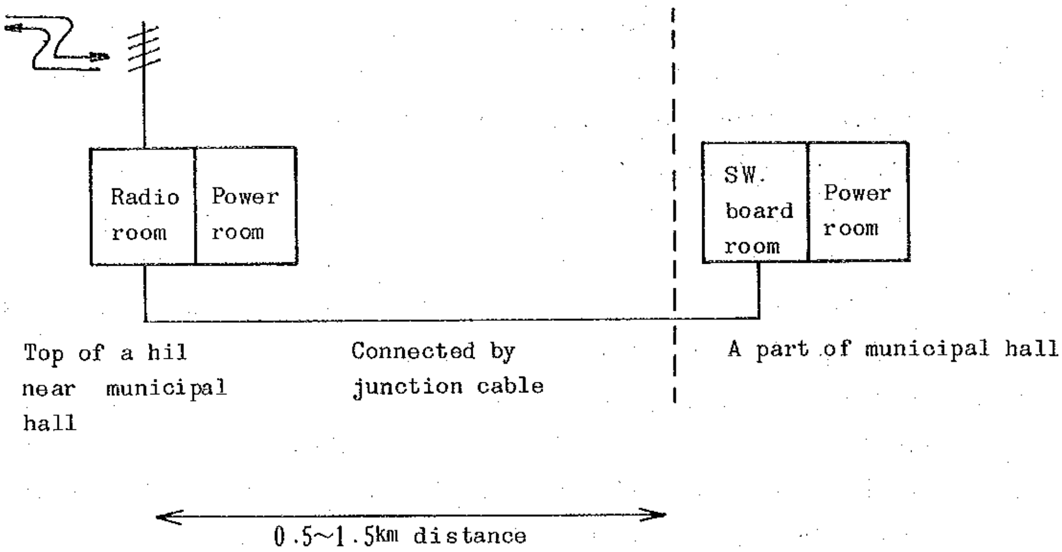
Currimao	Sta. Fe
Espiritu	Maddela
Bokod	Sn Mariano
Sagada	Mankayan
Kabugao	
Kubuagan	
Banaue	
Gonzaza	

Other IPTS's belong to Type B.

In the case of Type A, the radio equipment room requires a space of $15m^2$ and the power equipment room requires a space of $15m^2$. In the case of Type B, the radio equipment and switchboard room requires a space of $30m^2$ in the municipal buildings.

The 400MHz system will have a maximum channel capacity of 24 channels and will be used mainly for transmission between primary center and end office. In this case, also, the location of the radio equipment and that of telephone exchange will not necessarily be identical. Although details are given in Table VIII-2-2-14 ~ VIII-2-2-20, it can be said generally that 57 repeater stations out of 90 repeater stations (a part of which may also become

○ A type



○ B type

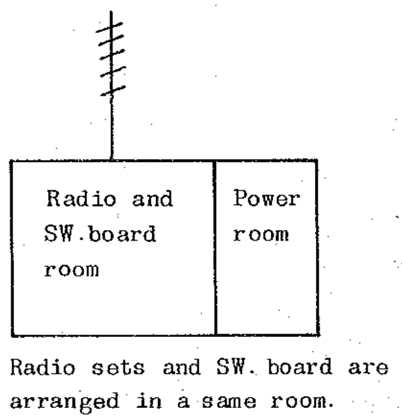


Fig. Ⅶ-2-2-133 Type of IPTS

microwave repeater stations) can be set in the buildings of offices furnished with telephone exchanges. For power supply, commercial power has not yet been available in many munucipalities in Region II. It is reported, however, that most of all end offices and IPTS's proposed at present will be electrified by 1982 or the year of expected completion of Phase 1, so that it has been assumed that commercial power will be available then except rare cases.

The 800MHz system will have a maximum channel capacity of 60 channels ~ 120 channels and will be used mainly for transmission between primary center and end office. The repeatering method of this system is, like the 400MHz system, baseband repeatering and the stand-by system is a preset stand-by method.

For demands exceeding 120 channels, the 2GHz system (300 channels in channel capacity) will be used. In this case, route protection system will be employed and the antenna will be a parabolic type. Heterodyne repeatering be employed as the repeatering method.

The same intermediate frequency (IF) as used in the main route will be used.

The basic ratings of these radio systems are given in the following table.

Maximum Capacity [channel]	Baseband Width [kHz]	Noise Figure [dB]	Transmitting Power [W]	Modulation Index [kHz rms/CH]
3	0.3 - 12	7	10	10
6	12 - 36	7	10	20
24	12 - 108	7	10	35
60	60 - 300	7	2	100
120	60 - 552	7	2	100
300	60 - 1300	7	1	200

The recommended gains of the respective antennas are given in the following tables. The antennas should be installed separately as transmitting and receiving antennas.

Operating Frequency / Type of Antenna	150MHz	400MHz	900MHz	2GHz
5-Element Yagi	6dB	-	-	-
8-Element Yagi	-	12dB	12dB	-
12-Element Yagi	-	14dB	14dB	-
1.8m-Diameter Grid parabola	-	15dB	21dB	28.8dB*
2.4m-Diameter Grid parabola	-	17dB	24dB	31.4dB
3m-Diameter Grid parabola	-	19dB	26dB	-
3.3m-Diameter Parabola	-	-	-	34dB

(* Without grid)

All items of equipment associated with the radio equipment used in the spur routes should operated from DC 24V ± 10%.

(5) Discussion on operating frequencies

As many scales of spur routed given below will be introduced in this project.

- o Stations expected to introduce radio spur routes:
  85 stations (of which 12 stations are common to microwave stations)
- o Radio transmission sections: 73 sections
- o End offices and IPTS's connected by radio: 58 offices

Accordingly, unless operating radio frequency bands are carefully selected, a serious confusion may be caused upon introduction of planned routes.

(5)-1 Operating frequency bands and channel capacities

It is then necessary to discuss what frequencies in the VHF and UHF bands should be used. This depends on the required channel capacities for the respective radio sections. The frequency distribution of channel capacities to be demanded ultimately by 1997 is shown in Fig. VIII-2-2-132. In consideration of the tendency of demands shown in the figure, the maximum channel capacities of radio sections are divided into the following 6 stages.

3 channels

6 channels

24 channels

60 channels

120 channels

300 channels

The radio frequency bands used by the 3-channel and 6-channel systems will be used for IPTS's. Some sections may involve rather unfavourable transmission conditions. Therefore, it is recommended to assign the 150MHz band. In consideration of Memorandum No.77-29, issued by BOC (July 20, 1977), 138 - 140MHz and 170 - 171.9MHz bands should be used for the 150MHz operating frequency band to be used in this project. For the 24-channel system, it is recommended to use the 335.400 - 399.900MHz band for the 400 MHz band. In consideration of required bandwidth of 24 channels, the 400MHz band may be most suitable because of the fractional bandwidth. For 60 and 120 channels, and particulary for 60 channels, a 800MHz band will be used because of wider channel separation than 24 channels as described later although the 400MHz system may be usable. For this band, it is recommended to use the 610 - 890MHz band. For 300 channels, which is considerably large in channel capacity, the adoption of a 2GHz system with a route protection system is recommended since wuch sections are very important among spur routes and from the standpoint of reliability in consideration of serious influence to be given in case these sections should fail. Of the 2GHz band, the 1770-1900MHz band has been already employed by BUTEL and PLDT. Accordingly, the 2100 - 2300MHz band set out by the CCIR Recommendation is recommended.

(5)-2 Channel separation in respective systems

What frequency bands should be used for the respective radio systems is discussed in the preceding paragraph. Now, let us determine how much separation should be kept from adjacent channels in using each frequency band and also how many minimum frequency separation should be kept between the transmitting and receiving frequencies. For this purpose, it is first necessary to understand noise allotment. As already mentioned in the paragraph of system configuration, a noise power of 677pW is to be allotted to each radio section, which is still divided as follows.

One radio section 677pW	Thermal noise	200pW
	Interferance noise	350pW
	Distortion noise and others	127pW

Interference noise 350pW	Interference from adjacent channels	100pW
	Interference between transmit and receive sides	50pW
	Interference from other circuits	200pW

Now, let us condider the interference theory.

When the power spectrum of a frequency-modulated desired RF signal is $w_D(f)$ and RF power spectrum of a frequency-modulated interference noise is $w_U(f)$, the frequency spectrum of the demodulated FM signal, $W_{FM}(f)$, is given by

$$W_{FM}(f) = \frac{2f^2}{A^2} \int_{-\infty}^{\infty} W_D(f) W_U(f+x)dx$$

where f: Baseband frequency

$\frac{A^2}{2}$: Total power of desired signal

It is now understood that all that all that is requered for obtaining $W_{FM}(f)$ is to obtain W_D ans W_U of FM signal and integrate the product of W_D and W_U. However, this integration is extremely difficult in the case of general FM. Let us consider, as a typical example, a case when the effective frequency deviation of the FM signal is large (when the phase deviation per channel exceeds 1 radian in terms of PM). It has been known that in this case the spectrum of the modulated signal forms a Gayssuab distribution. Let us obtain $W_{FM}(f)$ through integration when the effective frequency deviation is large. By definition we can put

$$W_D = \frac{A^2}{2} \frac{1}{\sqrt{2\pi}\,\sigma_A} e^{-\frac{(f-fc)^2}{2\sigma_A^2}}$$

$$W_U = \frac{B}{2} \frac{1}{\sqrt{2\pi}\,\sigma_B} e^{-\frac{(f-fc-fo)^2}{2\sigma_B^2}}$$

Then the integration of $W_{FM}(f)$ can easily be achieved as follows.

$$W_{FM}(f) = \frac{1}{2}\left(\frac{B}{A}\right)^2 \frac{f^2}{\sqrt{2\pi\sigma}} e^{-\frac{(f-fo)^2}{2\sigma^2}}$$

$$\sigma = \sqrt{\sigma A^2 + B^2}$$

The signal-to-noise ratio (S/N) per channel for test tone level So after demodulation is given by

$$S/N = -10 \log \frac{\Delta f}{So^2} \frac{1}{2}\left(\frac{B}{A}\right)^2 \frac{f^2}{\sqrt{2\pi\sigma}} e^{-\frac{(f+fo)^2}{2\sigma^2}}$$

$$= D/U + \frac{(f-fc)^2}{2\sigma^2} 10 \log e + 10 \log \frac{So^2}{\Delta f} \frac{\sqrt{2\pi\sigma}}{f^2}$$

Then,

$$S/N - D/U = \frac{(f-fc)^2}{2\pi^2} 10 \log e + 10 \log \frac{So^2}{\Delta f} \frac{\sqrt{2\pi\sigma}}{f^2}$$

By calculating this equation, we have Feg. VIII-2-2-134, which is useful for obtaining the required channel separation for obtaining the required S/N when the D/U is known. When the noise power allotment to the interference from adjacent channels is 100pW, we have from Fig. VIII-2-2-134.

Minimum 120kHz for 6-channel system,
Minimum 500kHz for 24-channel system,
Minimum 1.5MHz for 60-channel system, and
Minimum 2.2MHz for 120-channel system.

The figure shows the relationship between the frequency spacing from interfering waves and S/N - D/U. For the above-mentioned frequency separation (e.g., 1.5MHz in the case of 60-channel system), the D/U expectable for the selectivity of the receiver may be 10 ~ 20dB, so that the channel separation is made equal to such that gives 70 ~ 90dB in the value of S/N - D/U.

For the interference between the transmitting and receiving frequencies, which is described in the paragraph of frequency allocation, such frequency separation as

32MHz in 150MHz band,
18.3MHz in 400MHz band, and
29MHz in 800MHz band

can be provided between the transmitting and receiving frequencies, so that the S/N of 50pW can be met with no problem at all in Fig. VIII-2-2-134 as well.

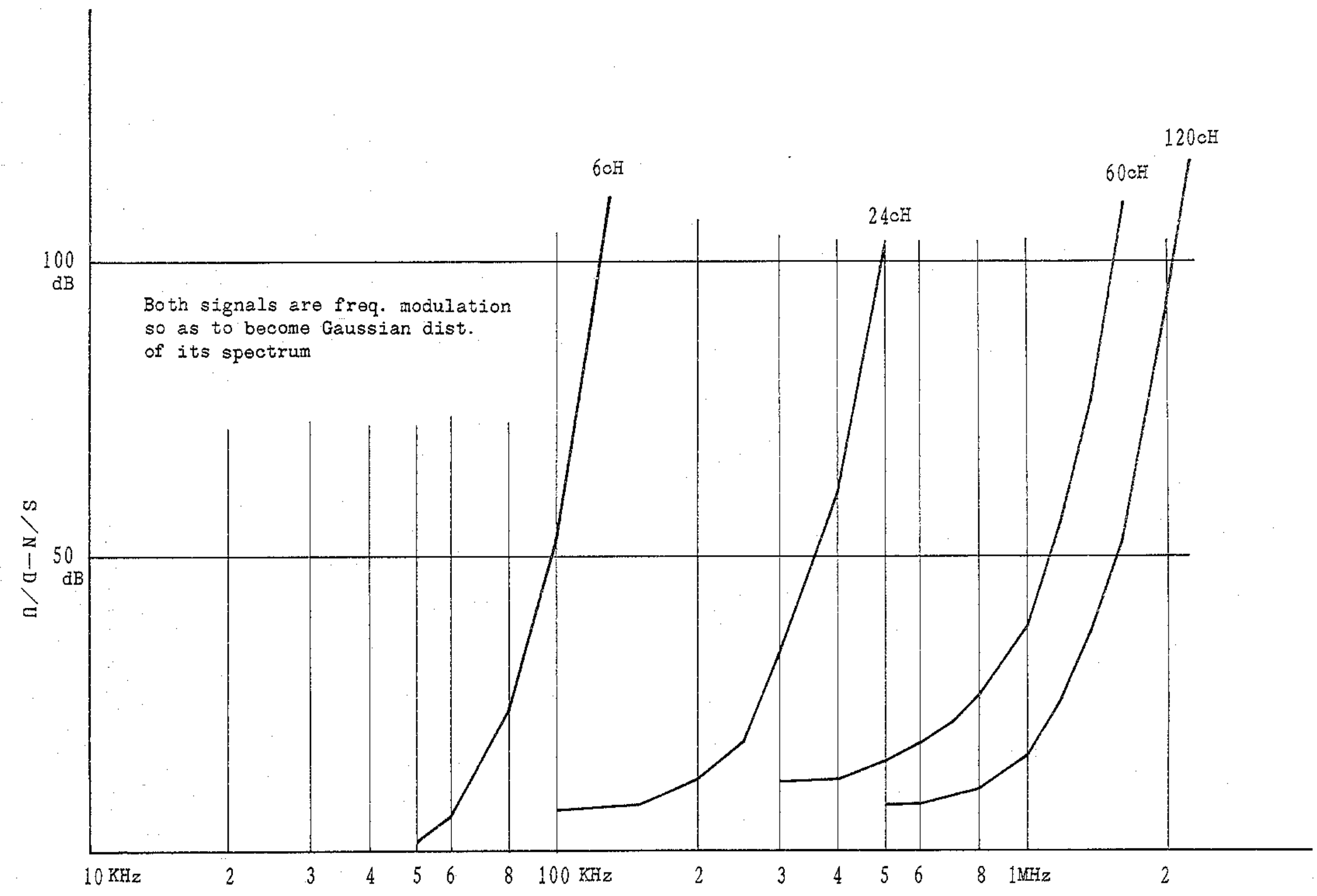


Fig. Ⅶ−2−2−134 Spectrum improvement foctor of FDM−FM case

(5)-3 Frequency allocation

The frequency allocation of the 150MHz, 400MHz, and 800MHz bands which has been obtained in consideration of all these conditions mentioned so far is shown in Figs. VIII-2-2-135 , VIII-2-2-137.

(5)-4 Frequency channel assignment

Now let us assign frequencies to respective radio sections on the basis of the above-mentioned frequency allocation.

a) 150MHz band

Not only in the 150MHz band but in general frequency bands it is extremely difficult to grasp the present condition of the utilization of frequency spectrum in the country. However, such a frequency assignment of the 150MHz band as shown in Fig. VIII-2-2-135 is recommended for the time being. In order to establish the IPTS radio transmission routes by the 3-channel ~ 6-channel systems, this frequency band is inevitable and its formal assignment from the related authority is strongly desired. For the route to which the 3-channel ~ 6-channel systems will be applied, Regions I and II will be divided into 5 areas and 4 ~ 7 channels will used repeatedly to be assigned to these areas.

For Laoag PC area:

Burgos-Bobodo	138.10/170.00
Pasquin-Laoag	138.22/170.12
Piddig-Dingras	138.34/170.24
Espiritu-Nueva Era	138.46/170.36
Currimao	138.58/170.48

For Dagupan, Binalonan, Baguio, and Bayombong PC (part) area:

Sto. Tomas-Dagupan	138.10/170.00
Balungan-Alcala	138.22/170.12
Sta. Fe-Dalton Pass	138.34/170.24
Bokod-Mt. Mungueto	138.46/170.36

For Basco route and Aparri area:

Gonzaga-Buguey	138.10/170.00
Buguey-Aparri	138.22/170.12
Lal-lo-Aparri	138.34/170.24
Lazam-Nassiping	138.46/170.36
Sto. Nino-Nassiping	138.58/170.48

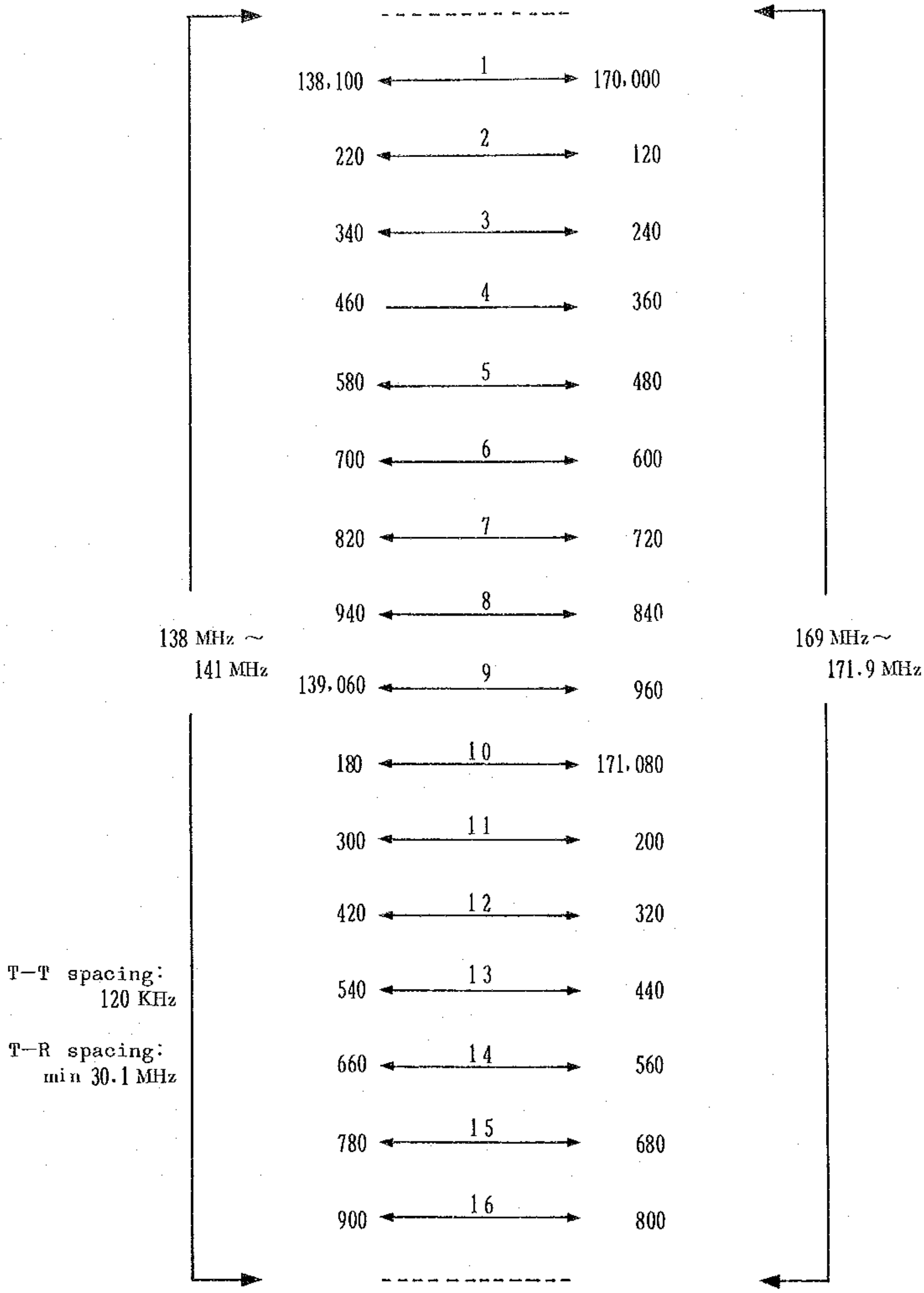


Fig. Ⅷ−2−2−135 Frequeucy allocation for 3CH~6CH system

For Kabugao Lubuagan and Tuao area:

Piat-Tuao	138.10/170.00
Tuao-Babolog	138.22/170.12
Pasonglao-Babalog	138.34/170.34
Tomiangan-Pasonglao	138.46/170.36
Pasonglao-Lubuagan	138.58/170.48
Ag Lalamnan-Babalog	138.70/170.60
Kabugao-Ag Lalamnan	138.82/170.72

For Ilagan and Bayombong PC areas:

Banaue-Ibulao	138.10/170.00
Ibulao-Kiangan	138.22/170.12
Mayoyao-Alicia	138.34/170.24
Maddela-Jones	138.46/170.36
San Augustin-Jones	138.58/170.48
Mallig-San Manuel	138.70/170.60
Cabagan-Tumauini	138.82/170.72

b) 400MHz band

When 10 frequencies are assigned to the transmitting signal group, 10 frequencies to the receiving signal group, and about 20MHz to the spacing between the transmitting and receiving signal groups, then a band of about 5MHz + 5MHz + 20MHz = 30MHz will be required with the spacing between transmitting signals being equal to 0.5MHz. The spectrum for which a 30MHz band can be obtained is, in the case of the Philippines,

273 ~ 328.6MHz

or

335,4 ~ 399.9MHz.

At present, the frequency band of 350 ~ 399.9MHz are congested considerably in the Philippines, and it seems rather difficult to use this band. As mentioned in the preceding paragraph on 150MHz band, it is almost impossible to accurately grasp the condition of the frequency spactrum utilization in the Philippines, but according to the results of the investigation by the preceding survey team (although somehow limited because of difficulties), it seems that the 335.4 ~ 352 MHz band in the 335.4 ~ 399.9MHz range contains considerable blank spec-

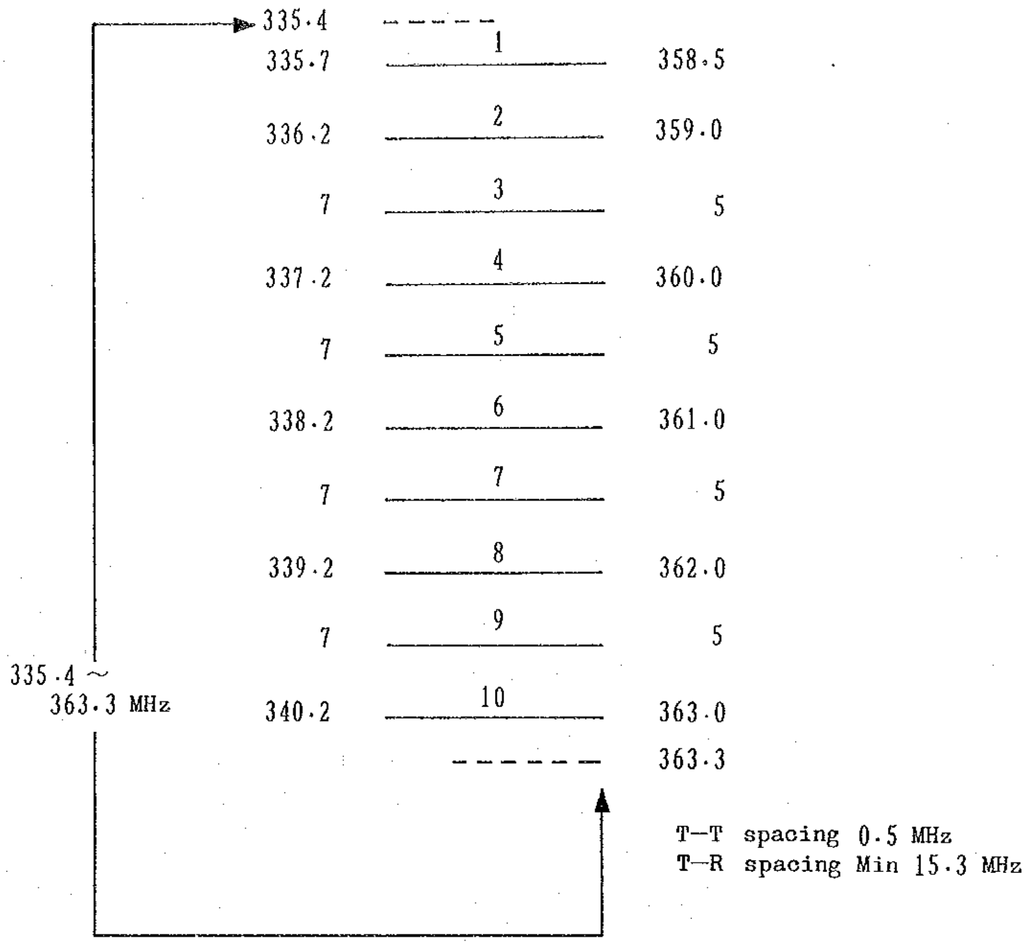


Fig. Ⅷ-2-2-136 Frequeucy allocation for 24CH system tra, so that the frequency allocation shown in Fig. VIII-2-2-136 is proposed for the time being. The 24-channel radio system is, in general, such that can be easily used and it is estimated that a number of frequency demands will appear for it. The 2 regions will still be divided into 4 areas and 6 radio channels are assigned to each of these areas while using the 6 radio channels repeatedly.

For Laoag, Vigan, and Tuguegarao PC area:

Laoag - Bobodo	336.2/359.0
Bangui-Bobodo	335.7/358.5
Babodo-Vigan	336.2/359.0
Pinili-Sinait	336.7/359.5
Santa-Vigan	337.2/360.0
Baggao-Alcala	337.7/360.5
Ballesteros-Sanchez Mira	338.2/361.0

For Ilagan, Bayombong PC, and Baguio SC (part) area:

San Mariano-Ilagan	335.7/358.5
Jones-Santiago	336.2/359.0
San Mateo-Callang	336.7/359.5
Banaue-Diadi	337.2/360.0
Bontoc-Sagada	337.7/360.5
Mankayan-Mt. Data	338.2/361.0

For Dagupan and Binalonan PC area:

Bolinao-Alaminos	335.7/358.5
Bani-Alaminos	336.2/359.0
Urbiztondo-Dagupan	336.7/359.5
Sison-Binalonan	337.2/360.0
San Nicolas-Binalonan	337.7/360.5
Sta. Maria-Binalonan	338.2/361.0

In Laoag, a radio station using 362.8MHz and 370.4MHz are existing, so that the transmitting frequency of the Laoag station to Bobodo should use 359.0MHz.

In Vigan, a radio station using 364.4MHz is existing, so that the transmitting frequency of the Vigan station to Santa should use 360.0MHz. In Dagupan, a radio station using 367.6MHz is existing, so that the transmitting frequency of the Dagupan station to Urboztonds should use 354.5MHz.

c) 800MHz band

For the 800MHz band for transmission of 60 channels - 120 channels, the frequency allocation shown in Fig. VIII-2-2-137 is recommended.

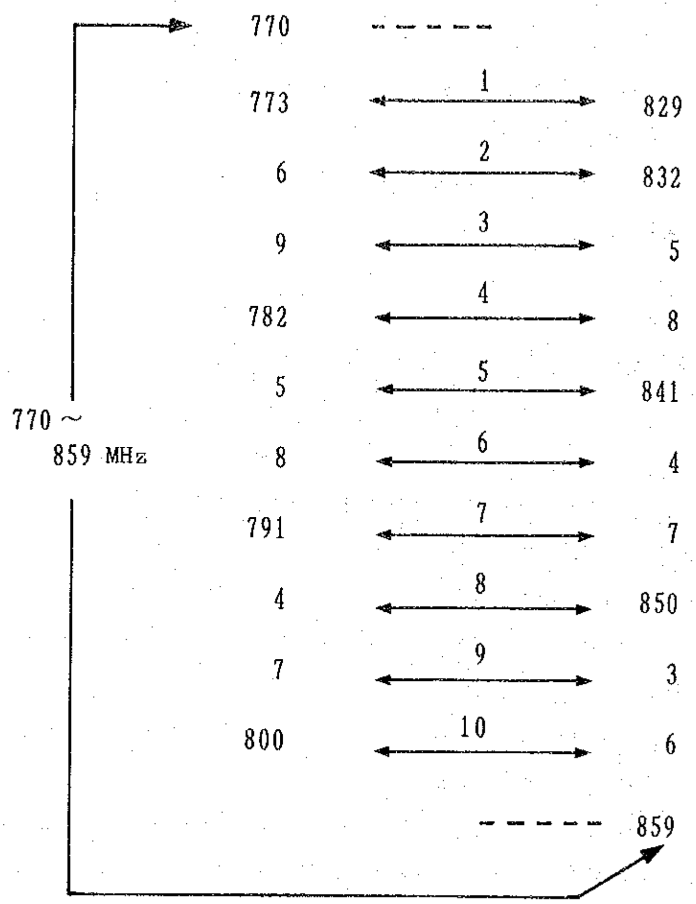
This frequency band is now used by the Defense Forces in Regions I and II, so that due care should be taken not to cause interference.

For Laoag and Vigan PC areas:

Dingras-Laoag	785 / 841
Batac-Laoag	791 / 847
Sulvec-Vigan	776 / 832
Bangued-Sulvec	773 / 829
Narvacan-Bigbiga	797 / 853
Candon-Bigbiga	800 / 856

The caution to be taken upon frequency assignment in this area is that three frequencies are used by the Defense Forces in Laoag and Vigan as mentioned. That is, in Laoag City, a radio station using a transmitting frequency of 850MHz and a receiving frequency of 806MHz is existing and in Vigan a radio station using a transmitting frequency of 844MHz and a receiving frequency of 794MHz is existing for transmission to Laoag and a radio station using a transmitting frequency of 838MHz and a receiving frequency of 788MHz for transmission to Vigan is existing. Since it is feard that Bigbiga and Vigan areas may be overreached from Bolinao, Alaminos, or Bugallon in Pangasinan Province so that along the coast of Pangasinan and Ilocos Sur Provinces due care should be taken not to cause interference by improper frequency assignment.

As already mentioned, the transmitting frequency of the Defense Station in Laoag is 856Mhz, which belongs to the 829 856MHz in the channel plan of Fig. VIII-2-2-137. Accordingly, the transmitting frequency of Laoag to Dingras and that to Batac should also belong to the 829 ~ 856MHz band. For this purpose, the transmitting frequency of Laoag to Dingras is made 841MHz and that to Batac 847MHz. In Vigan the Defense Station uses transmission frequencies of 838MHz and 844MHz and receiving frequencies of 794MHz and 788MHz, so that the transmitting frequency should be made equal to 832MHz.



T-T spacing : 3 MHz for 60 CH

60 MHz for 120 CH

T-R spacing : min 29 MHz

Fig. Ⅷ-2-2-137 Frequency allocation for 60CH/120CH system

In Baguio SC area, the Defense Station uses a transmitting frequency of 788MHz at Sto. Tomas, so that frequency assignment should be effected to avoid this.

Baguio-Sto. Tomas	794 / 850
Sto. Tomas-Mt. Mungueto	791 / 847
Mt. Mungueto-Mt. Data	776 / 832
Mt. Data-Sagada	773 / 829

The transmitting frequencies at Sto. Tomas should be made equal to 791 and 794MHz.

Now let us consider the frequency assignment to Pangasinan Province (Dagupan/Binalonan PC area).

The frequency allocation to this area is most difficult.

That is, there are many factors to be considered in this area, some of which area:

- o Overreach between the west part of Pangasinan and Irocos Sur.
- o Interference from Sto. Tomas (including that from the existing and planned facilities)
- o Interference with the Defense radio station at Kitakita

By these reasons, the frequencies which may be used actually are quite limited.

Alaminos-Sual Umingan-San Quintin	773 / 829
Binalonan-San Quintin	785 / 841
Sual-Bugallon	779 / 835
Alcala-Binalonan	800 / 850

As already mentioned, the existing transmitting frequency of sto. Tomas is 788MHz and those of Kitakita are 833MHz and 844MHz. By avoiding these frequencies and considering the overreach from Ilocos Sur and Sto. Tomas, there is no frequency available to the Binalonan-Dagupan-Bugallon section. Accordingly, it is recommended to use a 2GHz system for these sections.

For Tuguegarao PC area:

Alcala-Tuguegarao	773 / 829
Babalog-Tuguegarao	776 / 832
Ballesteros-Aparri	779 / 835

In Tuguegarao Town, a Defense radio station using a transmitting frequency of 838MHz is existing, so that the transmitting frequency of Tuguegarao to Babalog is made 832MHz and that to Alcala 829MHz.

For Ilagan and Bayombong PC area:

Cabarroguis-Santiago	782 / 838
Alicia-San Meteo	785 - 841
Tumauini-Ilagan	791 / 847

Since a Defense Station exists in Ilagan which uses a transmitting fequency of Ilagan to Tumauini should be 847MHz.

d) 2GHz system

Since a 1700 ~ 1900MHz band is used in Sto. Tomas, Dagupan, Alaminos, and San Fernando areas, it is recommended to employ a 2100 ~ 2300 band in this project. The following 5 sections are expected to use 2GHz band in this project.

Aparri-Nassiping,
Nassiping-Tuguegarao,
Santiago-San Mateo,
Bugallon-Dagupan,
and Dagupan-Binalonan

As already mentioned, heterodyne repeatering is recommended for the 2GHz system of these sections, so that Nassiping station will become IF repeater station and branching will be made to Lazam and Sto. Nino in a similar manner as in branching repeater stations in the main route. The channel plan set out by CCIR Recommendation No. 282-2 is adopted.

The actual frequency allocation is shown in Fig. VIII-2-2-138. The radio channel assignment to the respective sections in the all spur routes mentioned above is charted and shown in Figs. VIII-2-2-139 - VIII-2-2-150.

(6) Radio interference due to intermodulation product

When the frequency relationship of

$$2f_{T1} - f_{T2} = f_R$$

That is, when the frequency difference between the two transmitting frequencies is equal to the frequency difference between the receiving fequency and a transmitting frequency, interference due to intermodulation product is possible.

In general,

when

$$n(f_{T1} - f_{T2}) = f_R - f_{T1},$$

this type of interference may be caused. By rewriting the above equation, we have

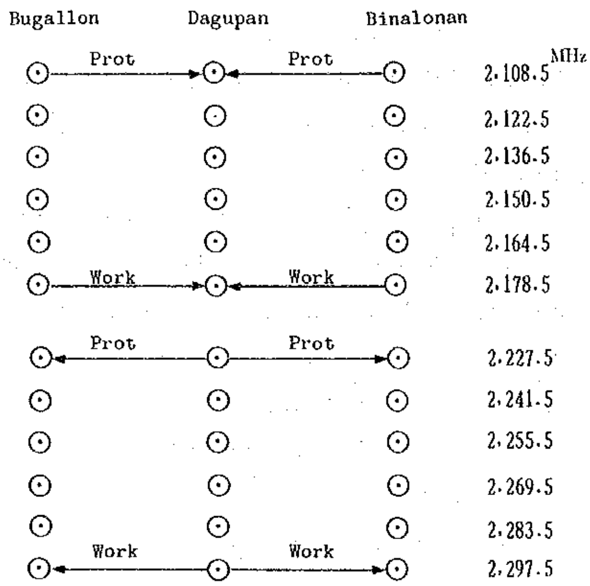


Fig. Ⅷ-2-2-138 (b) Radio channel plan and frequency assignment for 2GHZ stations

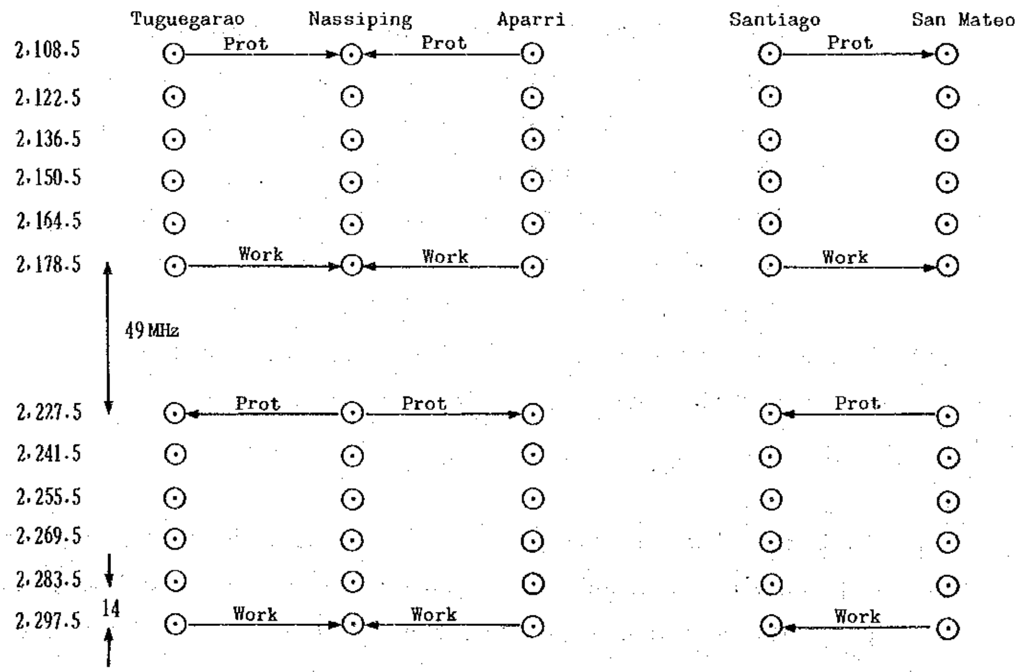


Fig. Ⅷ-2-2-138 Radis channel plan and frequency assignment for 2GHZ stations

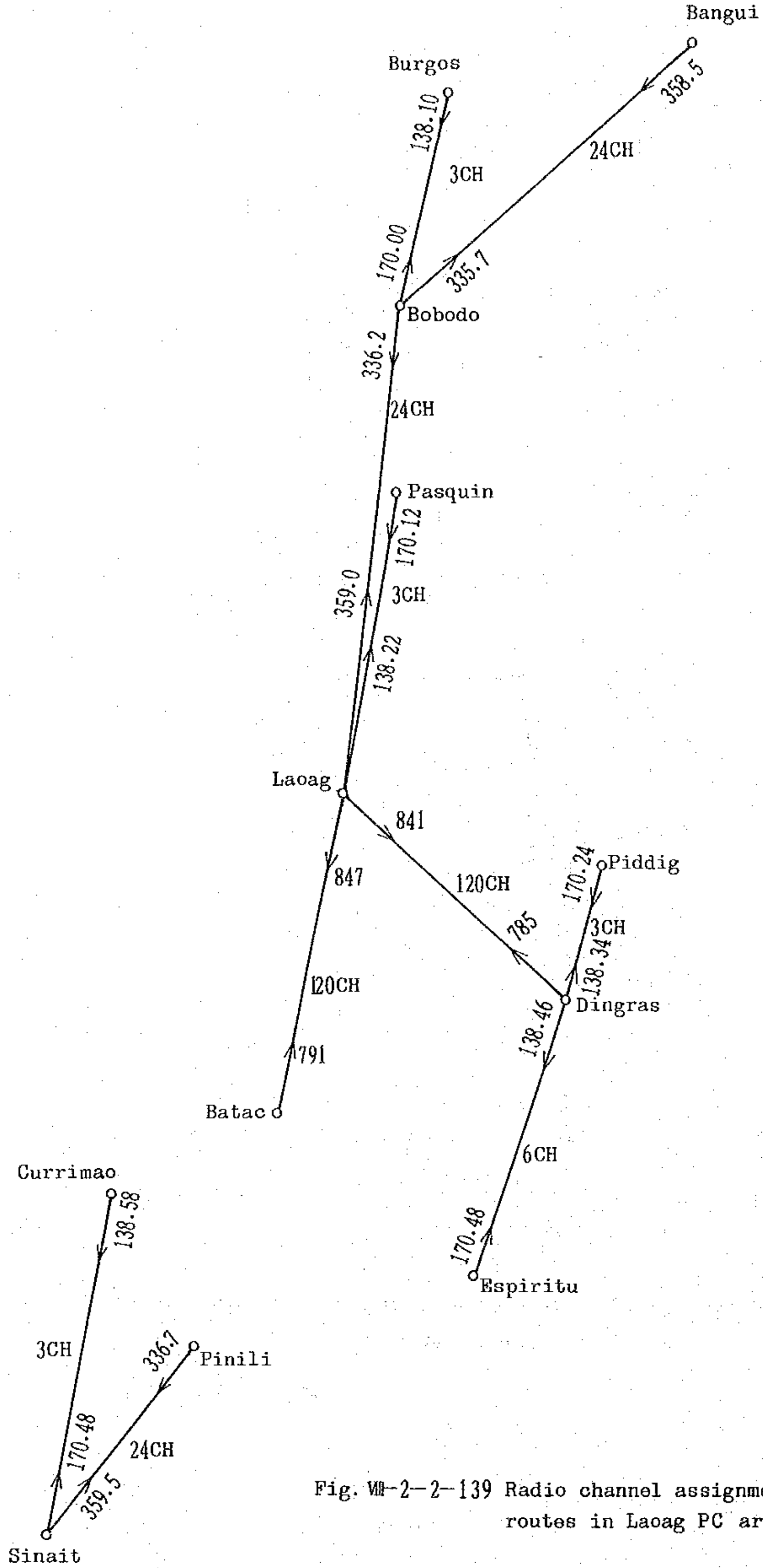


Fig. Ⅷ-2-2-139 Radio channel assignment for spur routes in Laoag PC area

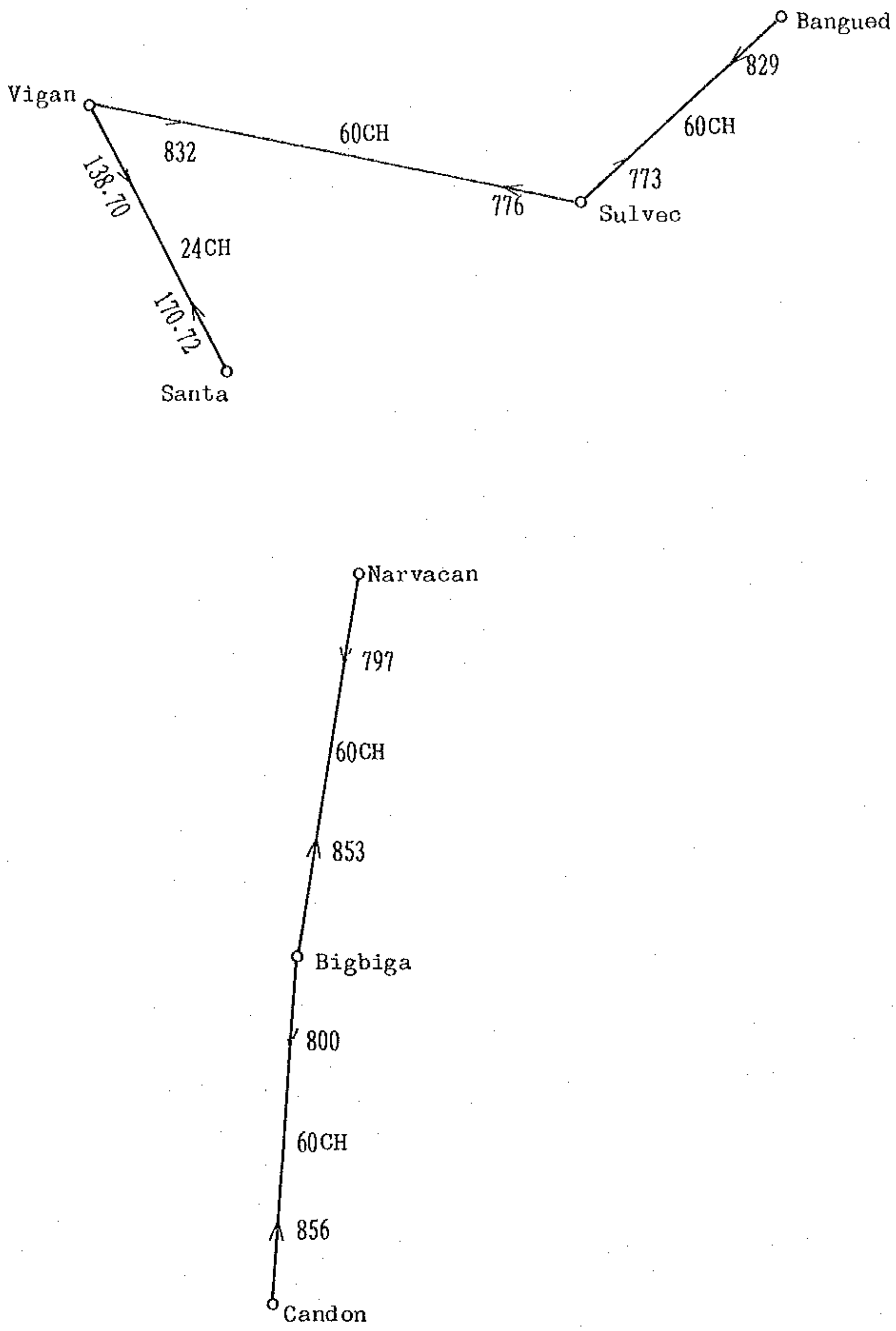


Fig. Ⅷ-2-2-140 Radio channel assignment for spur routes in Vigan PC area

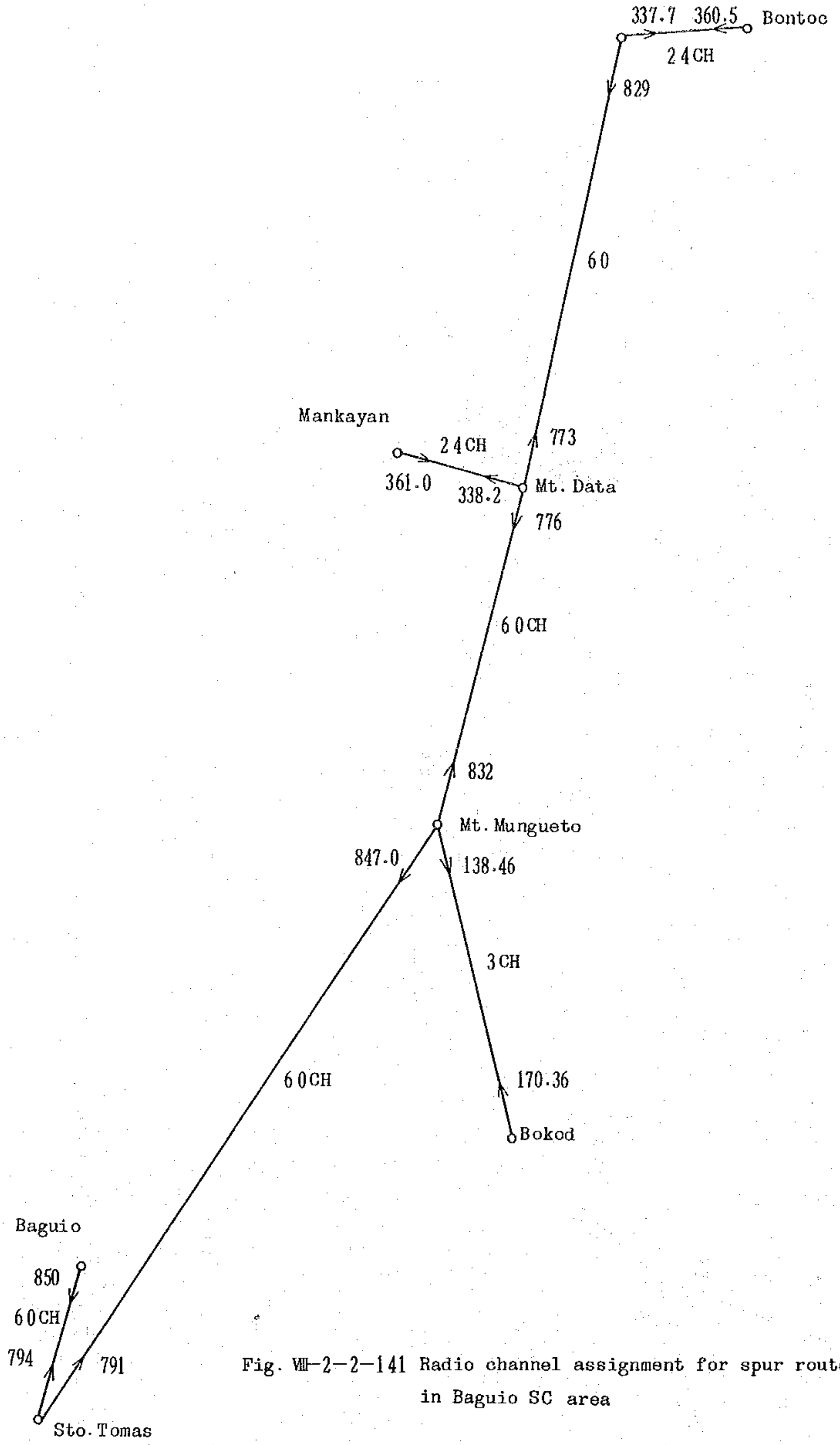


Fig. Ⅷ-2-2-141 Radio channel assignment for spur routes in Baguio SC area

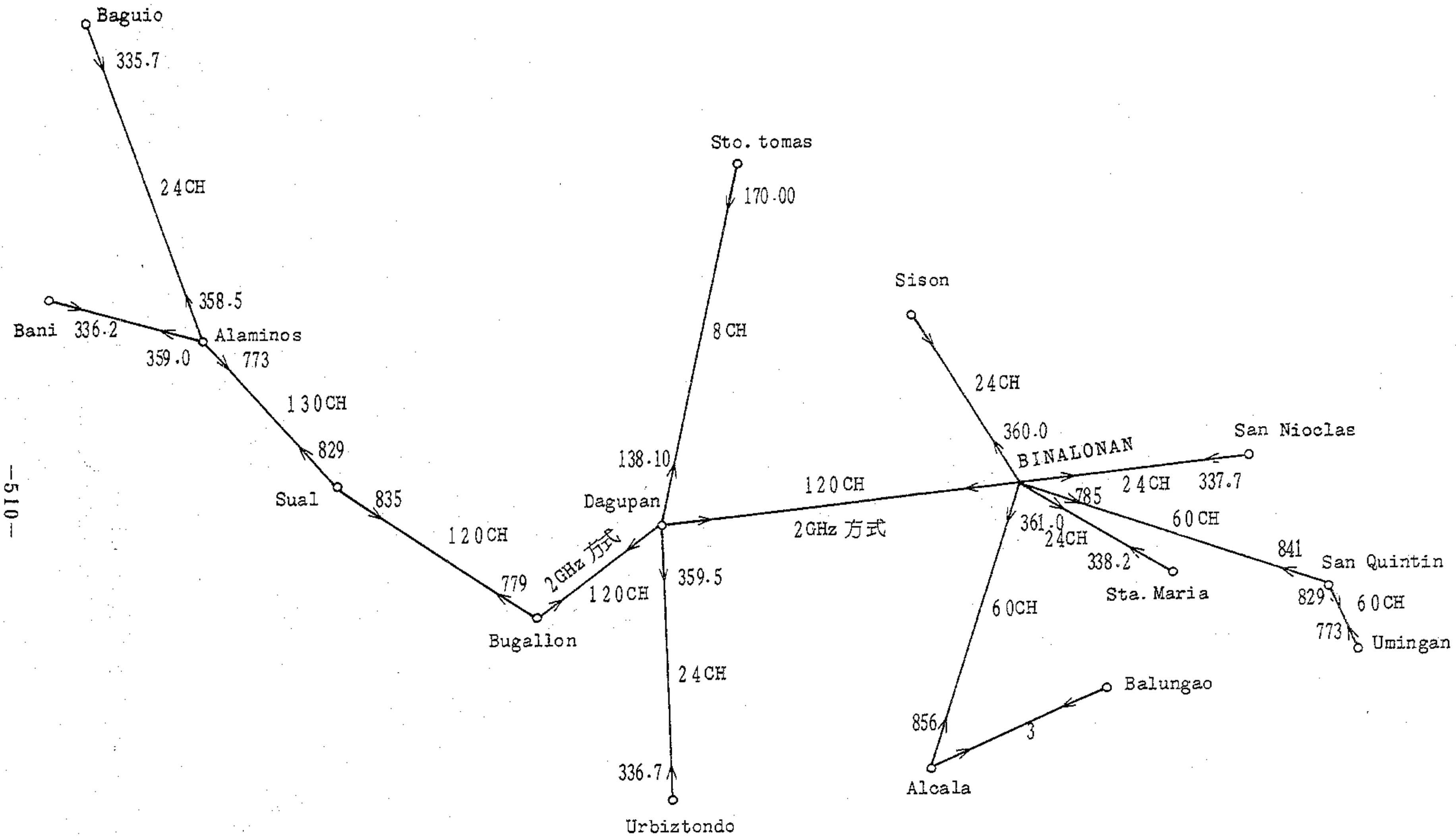


Fig. Ⅷ-2-2-142 Radio channel assignment for spur routes in Dagupan. and Binalonan PC area

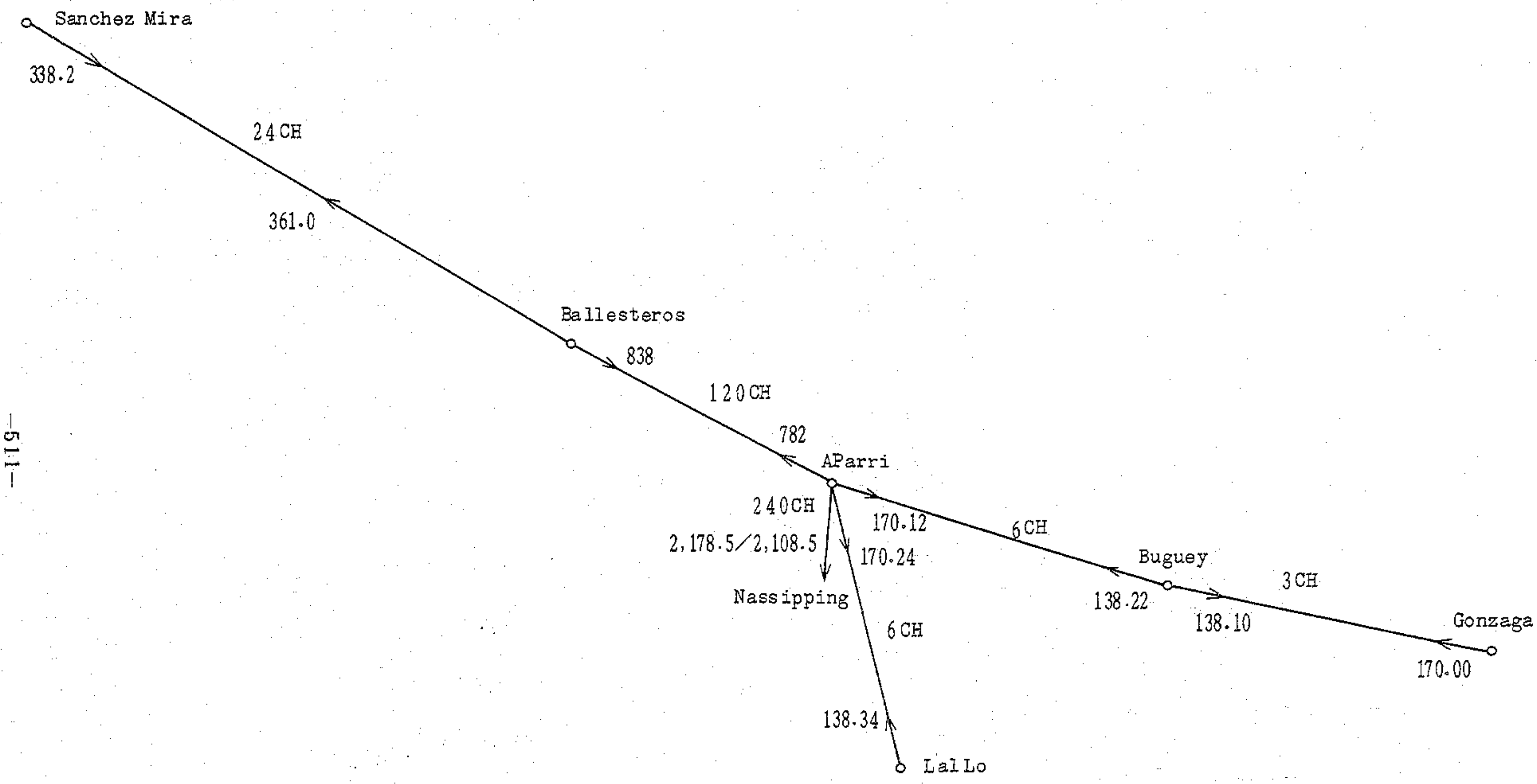


Fig. Ⅷ-2-2-143 Radio channel assignment for spur routes in the north Tuguegarao PC area

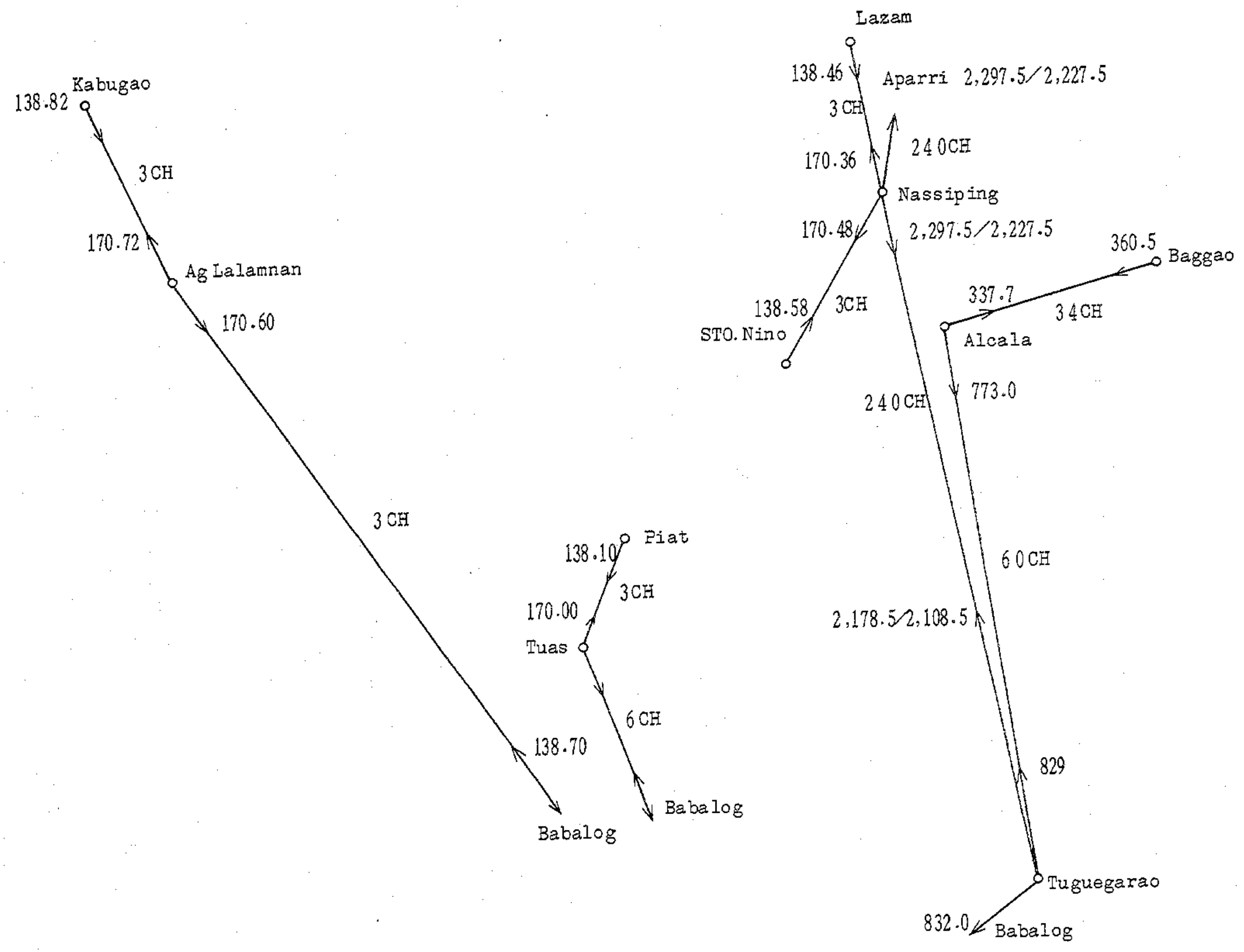


Fig. Ⅷ-2-2-144 Radio channel assignment for spur routes in the middle of tuguegarao PC area

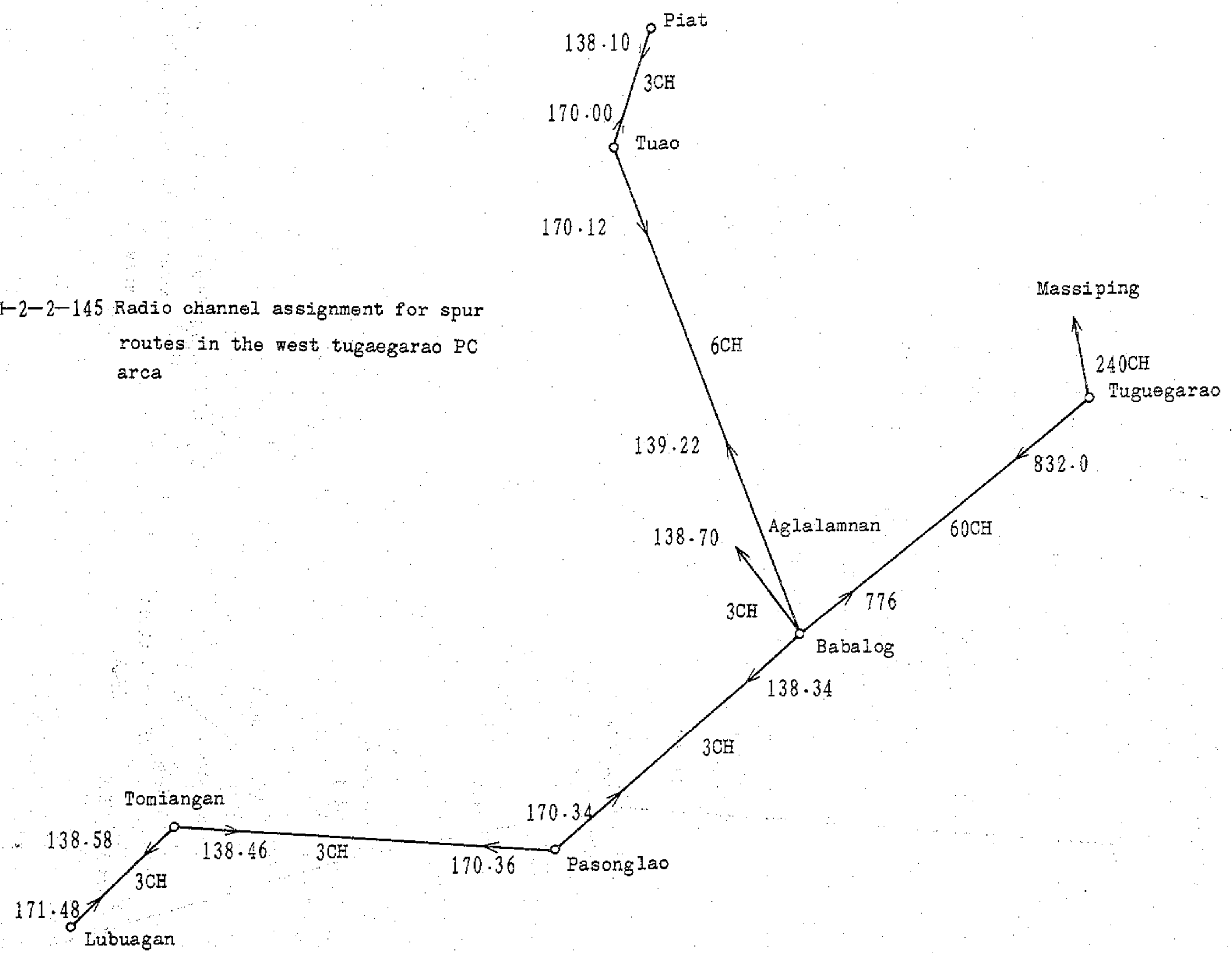
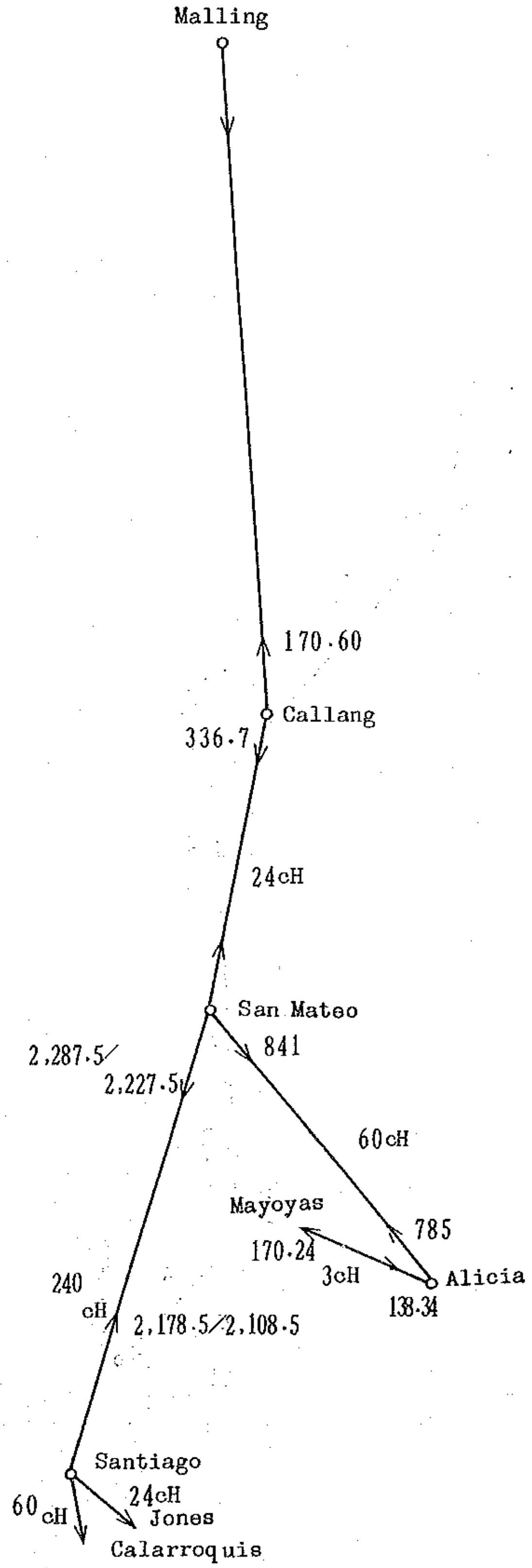


Fig. Ⅷ-2-2-145 Radio channel assignment for spur routes in the west tugaegarao PC arca



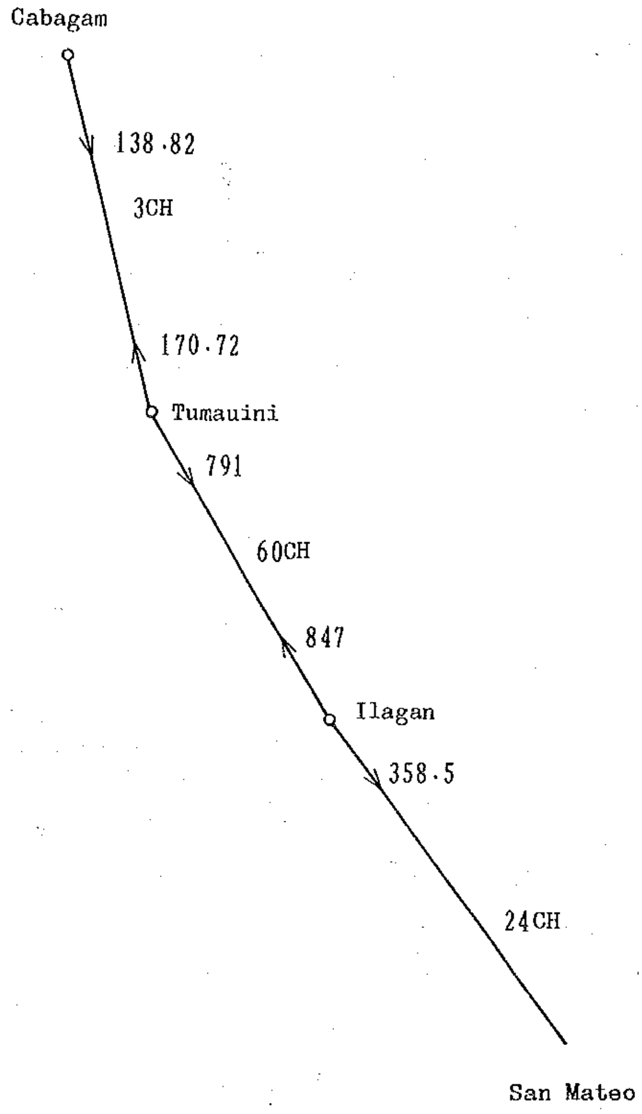


Fig. Ⅷ-2-2-146 Radio channel assignm for spur routes in Ilagan PC area

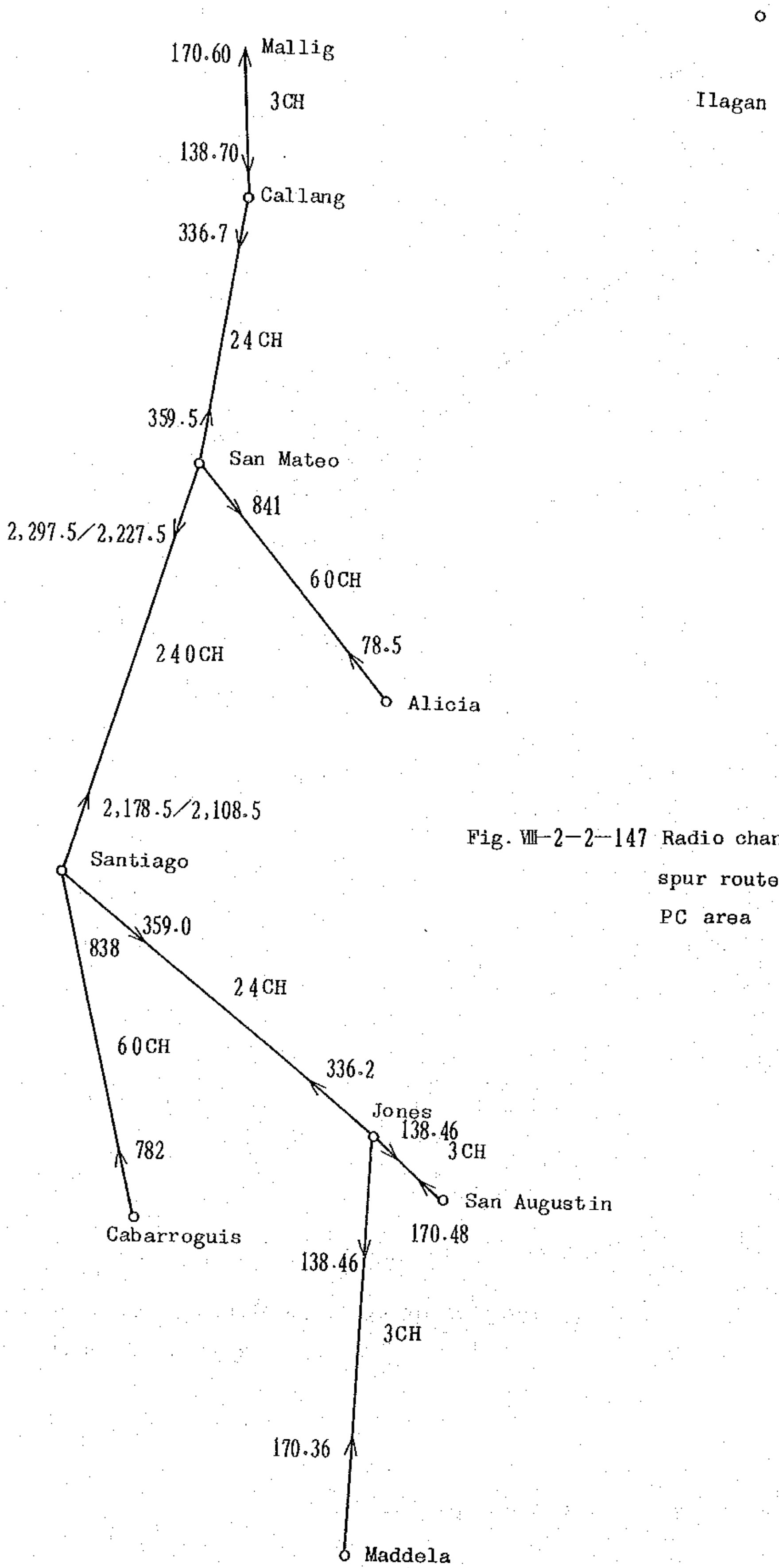
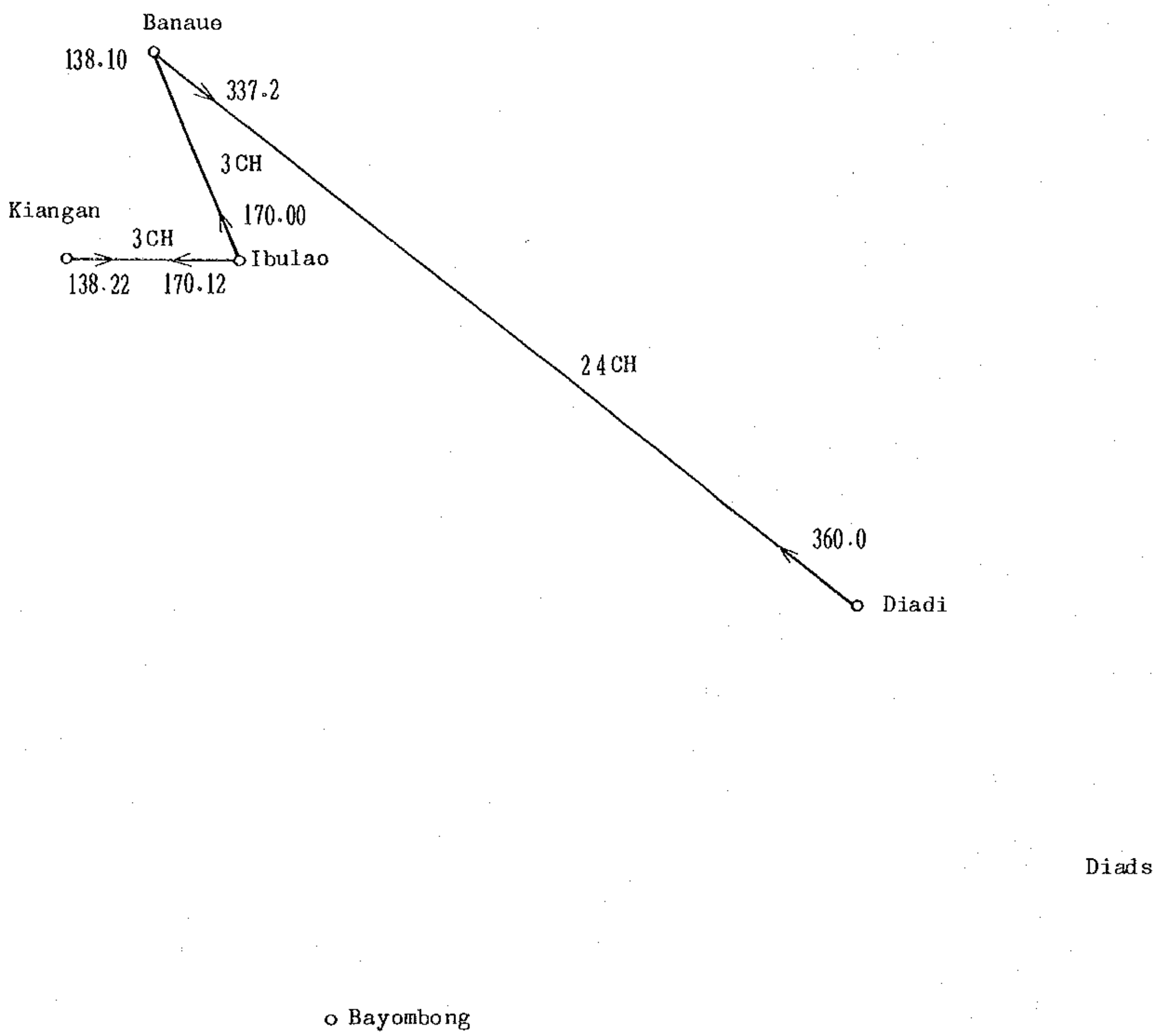


Fig. Ⅷ-2-2-147 Radio channel assignment for spur routes in the south Ilagan PC area



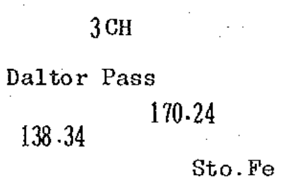


Fig. Ⅷ-2-2-148 Radio channel assignment for spur routes in Bayombong PC area

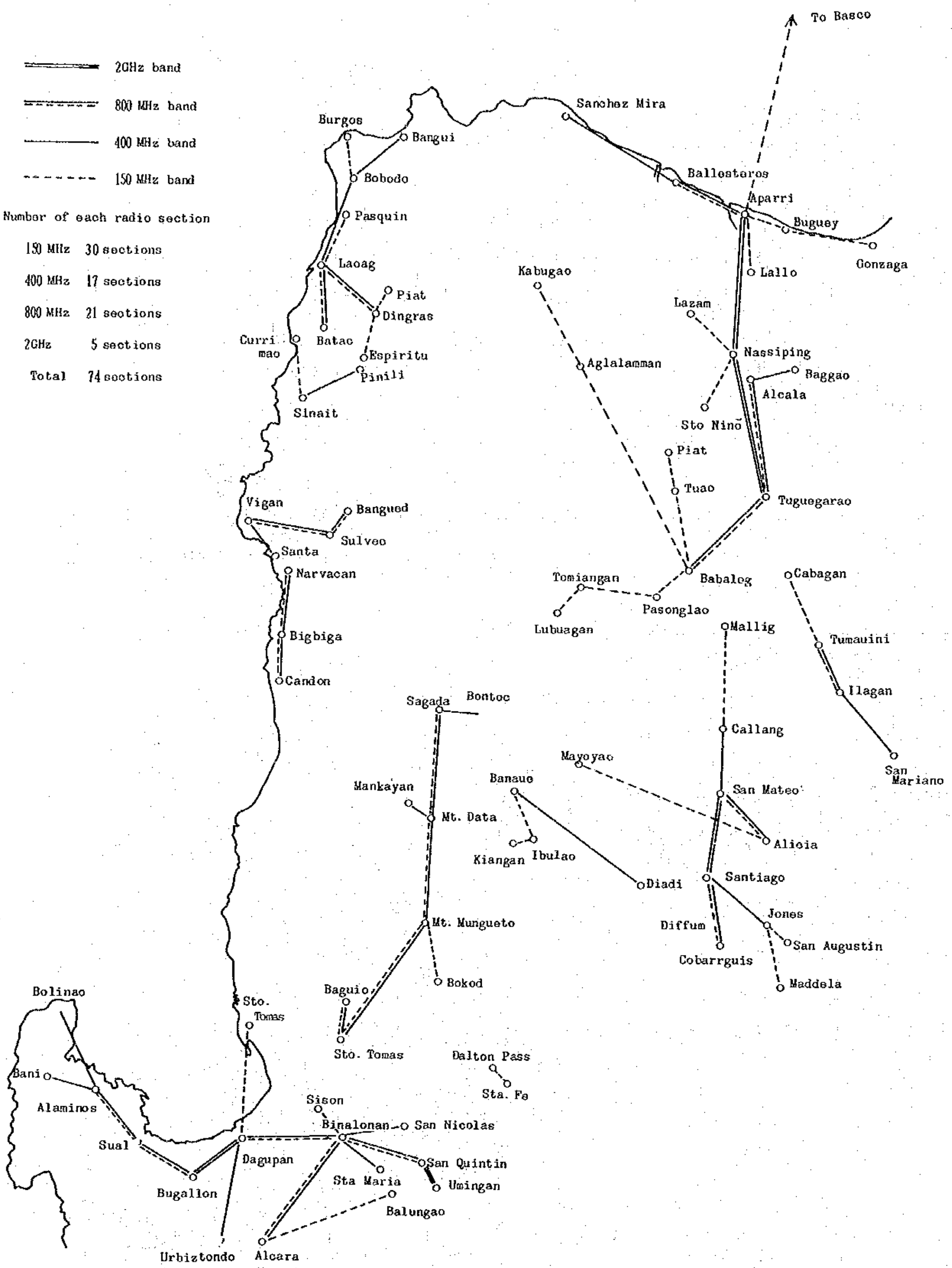


Fig. VII-2-2-149 Frequeney band assignment to Spur routes

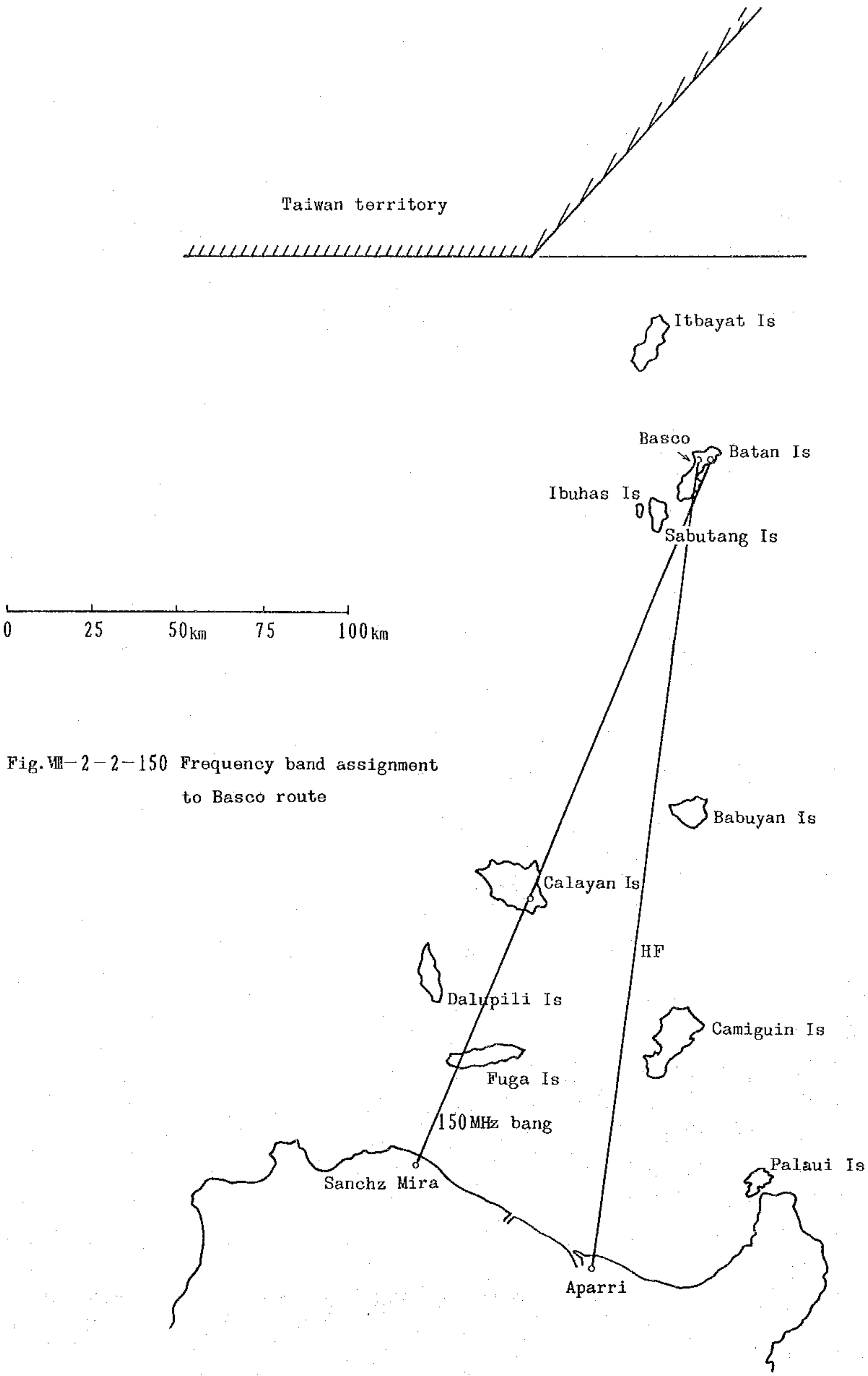


Fig.Ⅷ-2-2-150 Frequency band assignment to Basco route

$$(n + 1)f_{T1} - nf_{T2} = f_R$$

The sum of the coefficient of f_{T1}, $n + 1$ and that of f_{T2}, n, is $2n + 1$, which is called the number of degrees of the intermodulation wave. This inerference is called the interference of $(2n + 1)$th-order interference. When $n = 1$, the interference is called 3rd-order interference. It is empirically known that under normal condition the 3rd-order intermodulation is most dominant and the next possible interference is 5th-order interference (when $n = 2$) which, however, scarecely occurs.

Although we have so far discussed interference due to the intermodulation product of 2 transmitting frequencies, interference due to the intermodulation product of 3 transmitting frequencies occurs condiderably frequently.

holds where f_{T1} and f_{T2} are two different transmitting frequencies and f_R is the receiving frequency at the receiver, the receiver of f_R may be subject to interference. Let us consider the phenomenon of the radio interference in more detail.

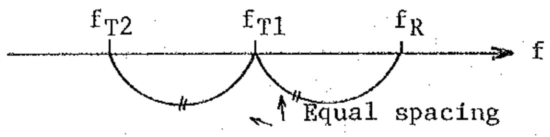
RF stages of a receiver contain many components which cause nonlinearity. This tendency of causing nonlinearity becomes remarkable for a large imput singal level. When f_{T1} and f_{T2} are received through the receiving antenna (in particular, when their input powers are large, the problem becomes serious), a frequency component of $2f_{T1} - f_{T2}$ will form. When this frequency happens to be equal to or adjacent to f_R, serious interference will be caused. This phenomenon is called interference due to intermodulation product and the frequency component of $2f_{T1} - f_{T2}$ is called intermodulation wave. Let us now consider under what frequency condition the interference due to intermodulation product is caused.

By putting

$$2f_{T1} - f_{T2} = f_R$$

we have

$$f_{T1} - f_{T2} = f_R - f_{T1}$$



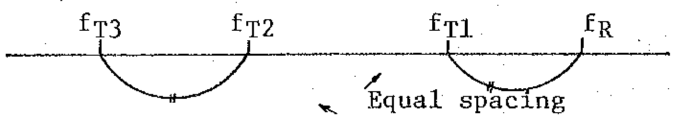
In this later case,

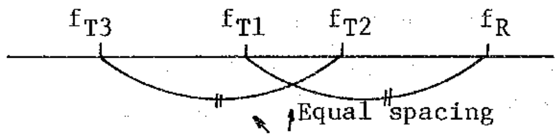
$$f_{T1} + f_{T2} - f_{T3} = f_R$$

which can be rewritten to

$$f_{T2} - f_{T3} = f_R - f_{T1}$$

Here, the relationship among frequencies is as follows.





In this case too, the interference is called 3rd-order interference. Anyhow, these type of interference may oftern occur in frequency bands below UHF and VHF where it is rather difficult to acheive proper sielding effect. In particular, when the receiver or receiving antenna is put into a large field strength circumstance, this type of interference tends to be caused. A factor representing the degree of possibility of causing this type of interference is the intermodulation generation level of the receiver. Now, let us suppose that 2 frequencies are applied to the first stage of the receiver at input level of L_{T1} and L_{T2}[dBμ]. When the coefficient (degree of orders) of L_{T1} is 2 and that of L_{T2} is 1, that is, in the case of the 3rd-order intermodulation product, the value of

$$2L_{T1} + L_{T2} \ (\text{dB}\mu)$$

is called intermodulation level. It is empirically known that when the intermodulation level reaches about 200dBμ in the case of a general receiver, intermodulation wave may be caused.
In order to prevent interference due to intermodulation wave, it is important to minimize the intermodulation level (to below 150dBμ at least).
The receiver input power is normally 20dBμ - 50dBμ, so that when 3

frequencies each being 50dBμ in input power are applied to the receiver, the total input power is 50+50+50+(dBμ) = 150(dBμ), which is of no problem. However, when each receiving input exceeds 100 dBμ, the intermodulation level may exceeds 200dBμ, which is extremely hazardous. Of course, at frequencies considerably apart from the receiving frequency of the receiver selectivity improvement by the use of a filter can be expected. At frequencies near the receiving frequency selectivity improvement by using an RF filter can not be achieved, so that when each receiving level exceeds 100dBμ, a particular care should be taken. It is possible in the case of minimum spacing between the transmitting and receiving frequencies to cause a high input interferernce level from its own system.

For example, when CH-1 and CH-16 are used simultaneously in an area for the channel plan shown in Fig. VIII-2-2-135, we have

139.90MHz: Transmitting frequency

170.00MHz: Receiving frequency

This is the worst case and the frequency difference in this case is 30.1MHz. In the case of the 400MHz and 800MHz systems to be constructed in this project, the frequency differences are respectively 20.3MHz and 31MHz. However, the selectivity improvement by using an RF filter at the head of the receiver can be made to exceed 70dB when the frequency separation is 20MHz in the case of the 400MHz band and 30MHz in the case of the 800MHz band.

When, for example, the transmitting antenna is installed at a separate location and the distance between the antennas is supposed to be 50m, the free space loss for 50m becomes

at 150MHz: $20 \log \frac{4\pi d}{\lambda} = 50\text{dB}$

at 400Mhz: 58.5dB

at 800MHz: 64.5dB

Suppose the transmitting output is 10W, the receiving input is given by

147dBμ - 50dB - 70dB = 27dBμ

↑	↑	↑
10W at 50Ω	Free space loss in 150MHz	RF selectivity

where the antenna gain, antenna directivity, and attenuation are neglected.

That is, in the case of interference from the local (own) circuit, no such high signal level as reaches the intermodulation level exists even in the worst case. Instead, other radio stations which may be installed at distances of 50 ~ 100m from the receiving antenna by using frequency adjacent to the receiving frequency may become dangerous. Accordingly, when the locations of the antenna steel towers in the spur routes are determined, it is necessary to check, by using a field strength meter, to determine whether there is no such high input level as exceeding 100dB reletive to the surroundings.

(7) Signal-to-noise ratio (S/N) due to thermal noise

As mentioned in the paragraph of the main route, the S/N due to thermal noise depends greatly on the condition of the transmission course and the condition of the site location. The same can be said for spur routes. As mentioned in paragraph (5)-2, 200pW (67dB) will be allotted to thermal noise out of the total noise allotment of 677pW per radio section. Let us find the S/N for thermal noise in consideration of the noise allotment in each radio section. The S/N can theoretically be given by

$$S/N = 10 \log \frac{Pr}{KTF} \frac{(So)^2}{\Delta f(f_{top})^2}$$

The parameters necessary for the calculation of this equation are given in the following table.

For antennas

5-element Yagi antenna

8-element Yagi antenna

1.8m grid parabola in the case of 800MHz

1.8m parabola in the case of 2GHz

	150MHz	400MHz	800MHz	2GHz	Remarks
Transmitting output [W]	10	10	2	1	
Antenna gain [dB]	6	12	21	29	
Feeder loss [dB]	6	9.5	12	6	

(Continued)

	150MHz	400MHz	800MHz	2GHz	Remarks
Noise figure [dB]	7	7	7	7	
Modulation index [kHz rms/CH]	20	35	100	200	
Baseband width [kHz]	12 ~ 36	12 ~ 108	60 ~ 552	60 ~ 1300	
Emphasis improvement [dB]			4	4	Not contained in Fig. VIII-2-2-150.

The results of calculation for these parameters are shown in Fig. VIII-2-2-150(b). From this graph, the S/N of the respectiv radio sections become as follows.

In the case of 150MHz system:

		Course Distance	S/N
1)	Burgos-Bobodo	9.9km	86dB
2)	Pasquin-Laoag	13.7km	83dB
3)	Piddig-Dingras	7.0km	89dB
4)	Espiritu-Dingras	14.5km	80dB
5)	Currimao-Sinait	14.6km	80dB
6)	Sto. Tomas-Dagupan	26.6km	77dB
7)	Balungao-Alcala	17.1km	82dB
8)	Sta. Fe-Dalton Pass	3.3km	95dB
9)	Bokod -Mt. Mungueto	18.9km	80dB
10)	Ibulao-Banaue	15.8km	82dB
11)	Kiangan-Ibulao	3.8km	103dB
12)	Mayoyao-Alicia	55.8km	71dB
13)	Maddela-Jones	24.0km	78dB
14)	San Augustin-Jones	6.9km	89dB
15)	Mallig-San Manuel	32.3km	75dB
16)	Cabagan-Tumauini	17.0km	81dB
17)	Piat-Tuao	6.2km	90dB
18)	Tuao-Babalog	30.1km	76dB
19)	Pasonglao-Babalog	17.0km	81dB
20)	Tomiangan-Pasonglao	18.2km	81dB
21)	Lubuagan-Tomiangan	10.2km	86dB
22)	Ag Lalamnan-Babalog	56.2km	71dB
23)	Kabugao-Ag Lalamnan	15.7km	82dB

	①	②	③	④	⑤
3CH	10	10	7	6	6
6CH	20	10	7	6	6
24CH	35	10	7	95	12
60CH	100	5	7	12	21
120CH	100	5	7	12	21
300CH	200	1	7	6	28

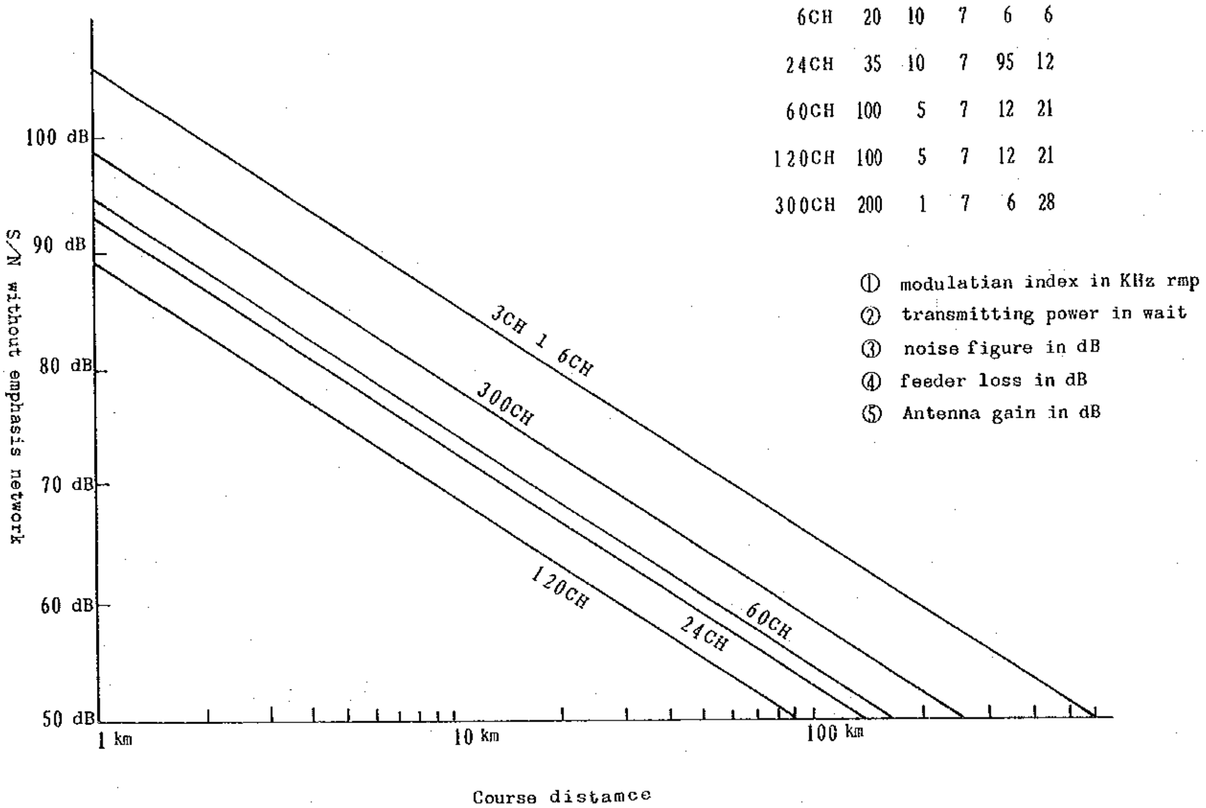


Fig. Ⅷ-2-2-150(b) S/N due to thermal noise

		Course Distance	S/N
24)	Gonzaga-Buguey	17.7km	81dB
25)	Buguey-Aparri	20.1km	80dB
26)	Lal-lo-Aparri	15.9km	82dB
27)	Lazam-Nassiping	9.6km	86dB
28)	Sto. Nino-Nassiping	12.6km	83dB

Now, let us find S/N in the case of 400MHz system.

		Course Distance	S/N
1)	Bangui-Bobodo	18.9km	72dB
2)	Bobodo-Laoag	23.9km	70dB
3)	Pinili-Sinait	9.3km	78dB
4)	Santa-Vigan	10.4km	76dB
5)	Baggao-Alcala	11.9km	75dB
6)	Sachez Mira-Ballesteros	33.8km	67dB
7)	San Mariano-Ilagan	22.0km	70dB
8)	Jones-Santiago	21.8km	70dB
9)	San Manuel-San Mateo	15.9km	73dB
10)	Banaue-Diadi	42.9km	65dB
11)	Bontoc-Sagada	7.4km	80dB
12)	Mankayan-Mt. Data	8.2km	79dB
13)	Bolinao-Alaminos	25.9km	69dB
14)	Bani-Alaminos	13.4km	75dB
15)	Urbiztondo-Dagupan	18.3km	72dB
16)	Sison-Binalonan	15.6km	73dB
17)	San Nicolas-Binalonan	18.6km	72dB
18)	Sta. Maria-Binalonan	29.4km	67dB

For the sections of 6), 10), 13), and 18), the use of a 12-element double stacked Yagi antenna allows and S/N improvement of 8dB. Then the S/N of these sections can be improved as follows.

6)	67dB	75dB
11)	65dB	73dB
13)	69dB	77dB
18)	67dB	74dB

Here an emphasis improvement of 4dB is considered for all sections. For the 800MHz system, the S/N of the respective sections are as follows.

		Channel Capacity	Course Distance	S/N
1)	Dingras-Laoag	120CH	15.9km	69dB
2)	Batac-Laoag	120CH	17.4km	69dB
3)	Sulvec-Vigan	60CH	17.8km	74dB
4)	Bangued-Sulvec	60CH	9.3km	79dB
5)	Narvacan-Bigbiga	60CH	12.0km	77dB
6)	Candon -Bigbiga	60CH	13.2km	76dB
7)	Sagada-Mt. Data	60CH	26.1km	70dB
8)	Mr. Data-Mt. Mungueto	60CH	23.5km	71dB
9)	Mt. Mungueto-Sto. Tomas	60CH	42.8km	66dB
10)	Sto. Tomas-Baguio	60CH	10.6km	78dB
11)	Alaminos-Sual	120CH	15.7km	69dB
12)	Sual-Bugallon	120CH	18.8km	68dB
13)	Alcala-Binalonan	60CH	24.1km	71dB
14)	San Quintin-Binalonan	60CH	25.1km	71dB
15)	Umingan-San Quintin	60CH	6.8km	82dB
16)	Ballesteros-Aparri	120CH	15.9km	69dB
17)	Alcala-Tuguegarao	60CH	32.5km	68dB
18)	Babalog-Tuguegarao	60CH	22.4km	73dB
19)	Tumauini-Ilagan	60CH	17.8km	74dB
20)	Alicia-San Mateo	60CH	15.6km	75dB
21)	Cabarroguis-Santiago	60CH	19.3km	73dB

In obtaining S/N, an emphasis improvement of 4dB is considered. In the case of section 9), the S/N is somehow insufficient, so that a grid parabola of 2.4m will be used at both Mt. Mungueto and Sto. Tomas so as to achieve an improvement of 6dB. Then, the S/N will be changed from 66dB to 72dB.

For the 2GHz system:

		Course Distance	S/N
1)	Aparri-Nassiping	39.9km	71dB
2)	Nassiping-Tuguegarao	41.7km	70dB
3)	Bugallon-Dagupan	15.7km	79dB
4)	Dagupan-Binalonan	27.1km	74dB
5)	Santiago-San Mateo	21.3km	76dB

For these S/N, an improvement of 4dB by the emphasis is considered. There is no problem at all in all sections.

2-2-3 Power Facilities

Since commercial power is expected to be supplied to almost all stations expected to be contructed in this project (including those of Region II) by 1982, a single standby engine will be installed at these radio repeater stations excluding IPTS's so as to supply power to communication equipment in a battery floating method.
The repeater where the commercial power supply will not be available at 1983 will take the dual engine method. This care is very rare.
The power consumption of the respective radio repeater stations are obtained by calculation and given in Table VIII-2-2-29. From this, the following engine, battery (for 8-hour discharge) and charger to be installed at each repeater station will be as follows. At IPTS no battery nor charger will be installed and only a small engine with AVR will be installed. In the event of power failure, power will be changed over manually to the engine side at IPTS. When a radio repeater station and a telephone office can share a station building, power to the communication equipment will be fed from the power for exchange use.

- o Repeater station expected to be furnished with a 3KVA engine, a battery with a capacity of 100AH, and a charger of 30A:

  Sual (one station)

- o Repeater stations expected to be furnished with a 5KVA engine, a 400AH battery and a 60A charger:

  Bangued, Candon, Mankayan, Bontoc, Bolinao, Basco, San Mariano, and Banaue (8 stations)

- o Repeater stations expected to be furnished with a 5KVA engine, a 600AH battery and a 90A charger:

  Mr. Mungueto, Sagada, Calayan, Sulvec and Babalog (5 stations)

- o Repeater stations expected to be furnished with a 5KVA engine, a 800AH battery and a 120A charger:

  Mr. Data, Nassiping, and Bobodo (3 stations)

Station	M'wave equipment	V/UHF equipment	Mult. for M'wave	Total	Remarks
Laoag	2100	2600	1200	5900	
Pasquin		700		700	
Dingras		1500		1500	
Batac		1100		1100	
Sinait	2250	1000		3250	
Currimao		700		700	
Pinili		800		800	
Bobodo		1800		1800	
Burgos		700		700	
Bangui		800		800	
Piddig		700		700	
Espiritu		700		700	
Vigan	3200	2100	1300	6600	
Tagudin	2250			2250	
Sulvec		1100		1100	
Bangued		900		900	
Santa		700		700	
Bigbiga	2250	1300		3550	
Candon		900		900	
Narvacan		900		900	
Guinguinabang	2150			2150	
Baguio	4200	900	1600	6700	
Sto. Tomas	4250	1300		5550	
Mt. Mungueto		1500		1500	
Mt. Data		1600		1600	

Table VIII-2-2-29

Power comsumption of radio stations

Station	M'wave equipment	V/UHF equipment	Mult. for M'wave	Total	Remarks
Bokod		700		700	
Mankayan		800		800	
Sagada		1200		1200	
Bontoc		800		800	
Dagupan		2200		2200	
Bugallon		600		600	
Sual		250		250	
Alaminos		1700		1700	
Bolinao		800		800	
Bani		800		800	
Sto. Tomas		900		900	
Urbiztondo		800		800	
Binalonan	2250	2800	1200	6250	
San Quintin		1500		1500	
Umingan		900		900	
Sison		800		800	
San Nicolas		800		800	
Sta. Maria		800		800	
Alcala		900		900	
Balungao		700		700	
Balungao (Radio)	2150			2150	
Kitakita	2150			2150	
Tuguegarao	2100	1900	1200	5200	
Nassiping		1750		1750	

[Watt]

Station	M'wave equipment	V/UHF equipment	Mult. for M'wave	Total	Remarks
Aparri		2100		2100	
Sto. Nino		700		700	
Lal-lo		700		700	
Ballesteros		1400		1400	
Gonzaga		700		700	
Sanchez Mira		1000		1000	
Basco		700		700	
Alcala		1200		1200	
Baggao		800		800	
Babalog		1500		1500	
Tuao		900		900	
Piat		700		700	
Kabugao		700		700	
Lubuagan		700		700	
AgLalamnan		900		900	
Tomiagan		900		900	
Passonglao		900		900	
Ilagan	3200	1200	1500	5900	
Tumauini		1100		1100	
Cabagan		700		700	
San Mateo	2250	1800		4050	
San Manuel		1000		1000	
Mallig		700		700	
Alicia		900		900	
Santiago		1800		1800	
Jones		1200		1200	
San Augustin		700		700	
Maddela		700		700	
Cabarroguis		900		900	
San Mariano		800		800	

Stations	M'wave equipment	V/UHF equipment	Mult. for M'wave	Total	Remarks
Diadi	2250	800		3050	
Banaue		1000		1000	
Dalton Pass	2250	700		2950	
Sta. Fe		700		700	
Kiangan		700		700	
Mayoyao		700		700	
Ibulao		900		900	
Buguey		700		700	
Bayombong	3200		1200	4400	

- o Repeater stations expected to be furnished with a 7.5KVA engine, a 1000AH battery and a 150A charger:

  Tagudin, Guinguirabang, Balungao, Kitakita, and Aparri (5 stations)

- o Repeater stations expected to be furnished with a 15KVA engine, a 1600AH battery and a 210A charger:

  Sinait, Bigbiga, San Mateo, Diadi, Dalton Pass, and Bayombong (6 stations)

- o Repeater stations expected to be furnished with a 25KVA engine, a 2500AH battery and a 300A charger:

  Laoag, Vigan, Sto. Tomas, and Ilagan (4 stations)

- o Repeater stations (IPTS's) expected to be furnished with only a 3KVA engine (with AVR):

  Currimao, Espiritu, Bokod, Kabugao, Lubuagan, Ag Lalamnan, Tomiangan, Passong lao and Ibulao (9 stations)

2-2-4 Station Buildings and Steel Towers

(1) Station buildings

Two types of station buildings will be employed for accommodation of communication equipments and facilities: Attended station which is continuously attended by persnnel and unattended station which is not usually attended by personnel but in the event of maintenance servicing. Proposed attended stations to be employed in this project are as follows.

Laoag, Dingras
Vigan, (Bangued)*
Alaminos, Dagupan, Binalonan,
Baguio, Bontoc
Basco,
Aparri
Tuguegarao, Tuao
Ilagan, Santiago, San Mateo,
Bayombong,

(* Bangued may or may not be attended.)

Thus a total of 16 (or 17) stations will be attended type. All other stations are of unattended type as radio equipment maintenance. Now let us consider the configuration of station building. Each attended station building comprises the following room and others.

- o Communication equipment room
- o Power room
- o Warehouse for equipment
- o Office
- o Service yard
- o Underground tank for light oil

The configuration of unattended station building is the same as that of an attended station building except that the unattended station building as radio equipment part comprises no office nor part of the service yard.

The communication room should be determined in consideration of future expansion of facilities. The space of the communication equipment room will be calculated as follows.

Intermediate repeater stations in the main route and all repeater stations in spur routes:

$$15m^2 + \text{Number of facilities to be installed including future expansion} \times 0.5m^2$$

video switching stations in the main route:

$$30m^2 + \text{Number of facilities to be installed including future expansion} \times 0.5m^2$$

The communication equipment room should be designed to have as small window as practicable and with due consideration against dust-proofing although airconditioning will be required.

In particular, when the station building is subject to sand dust, the communication equipment room should have no window and employ compulsory ventilation through filtering. The space of the power room in repeater stations with battery capacity up to 800AH should be $36m^2$, that in repeaters with battery capacity up to 800AH should be $36m^2$, that in repeaters with battery capacity up to 1400AH should be $49m^2$, and that in repeater stations with battery capacity exceeding 1400AH should be $60m^2$.

The warehouse for equipment is intended for storing tools, equipment, and materials. The warehouses for equipment of the abovementioned 15 (or 16) attended stations and Basco station will have a space of $20m^2$ whereas other repeater stations will have a space of $10m^2$. In the case of Baguio and Tuguegarao, the warehouse will be used also as the maintenance center and $50m^2$ is added respectively.

Details of building space are mentioned in paragraph VIII-6.

2-2-5 Items of Radio Equipment to Be Installed

The items of radio equipment to be installed on the main routes and spur routes are as follows.

Description on the power and station building is given in paragraphs 2-2-3 and 2-2-4 and omitted here.

(1) The following 960-channel, 6GHz microwave terminal stations will have the switching control function as microwave switching stations and the functions of supervisory and control of intermediate repeater stations and be furnished with

Transmitter .... 2 sets
Modem .... 2 sets
Switching control equipment .... 1 set
Supervisory and control equipment .... 1 set
Antenna system .... 1 system

Laoag and Tuguegarao

(2) The following stations will have the same functions as item (1) above and will be furnished with

Transmitter-receiver .... 4 sets (6 sets)
Modem .... 4 sets (6 sets)
Switching control equipment .... 2 sets (3 sets)
Supervisory and control equipment .. 1 set (1 set)
Antenna system .... 2 systems (3 systems)

Vigan, Baguio, Bayombong, Ilagan

Parenthesized numbers show Binalonan case.

(3) The following stations will be 960-channel, 6GHz microwave repeater stations having the function of being supervised and controlled from a master station and will be furnished with

Transmitter-receiver .... 4 sets (8 sets)
Supervisory and control equipment .. 1 set (1 set)
Antenna system .... 2 systems (3 systems)

Guinguinabang and Kitakita

Parenthesized numbers show Balungao case.

(4) The following stations will have the function of branching part of the 960 channel multiplex signal in addition to the function of item (3) above and will be furnished with

Transmitter-receiver .... 4 sets
Supervisory and control equipment .... 1 set
Antenna system .... 2 systems
Branching equipment .... 1 set

Sinait, Bigbiga, Tagudin, Binalonan, Dalton Pass, Diadi, and San Mateo, Tarlac, Dau, Pandi

(5) The following station will have the same function as item (3) above and will be furnished with

Transmitter-receiver .... 8 sets
Supervisory and control equipment .... 1 set
Antenna system .... 3 systems

Sto. Tomas

(6) The items of equipment to be installed at the respective repeater stations on the spur routes are given in Table VIII-2-2-30. The following items of equipment are included in the item of equipment given in the table.

PC area	Phase I							Phase II						
	VHF 3CH	VHF 6CH	UHF 24CH	UHF 60CH	UHF 120CH	UHF 300CH	Total	VHF 3CH	VHF 6CH	UHF 24CH	UHF 60CH	UHF 120CH	UHF 300CH	Total
Laoag	3	1			2		6	1		3				4
Vigan	1			4			5							
Baguio			1	4			5	1		1				2
Dagupan Binalonan				1	2	2	5	2		6	2			10
Tuguegarao	1	3	1	1	1	2	10	8		1	1			10
Ilagan			1	2		1	5	4	1	2				7
Boyombong			1				1	3						3
Total							38							36

Table VIII-2-2-30 Number of planned spur route sections on Phase 1 and Phase 2

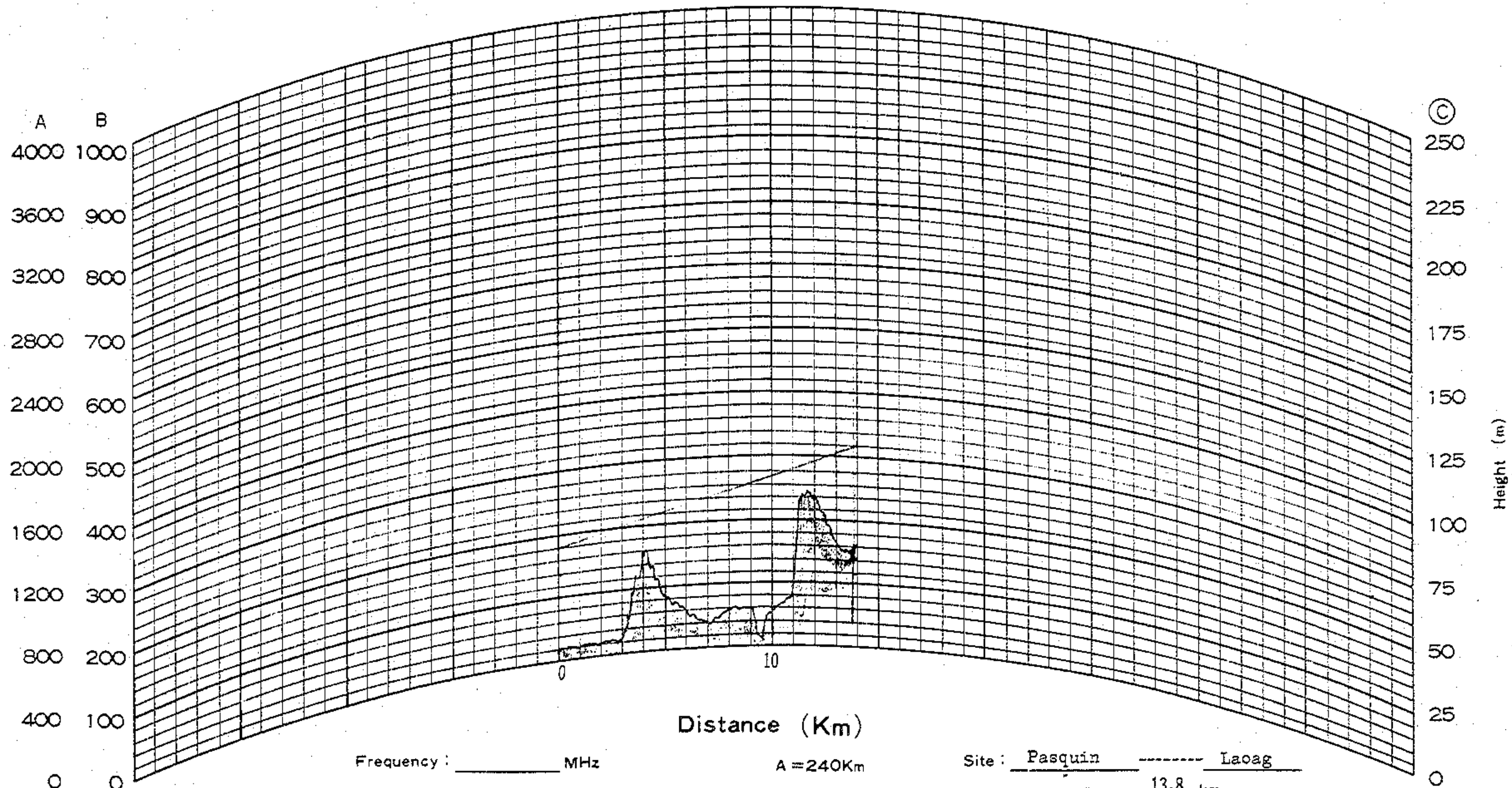
- For each radio section, 4 sets of transmitter receiver (2 sets for working use and 2 sets for stand-by use), 2 sets of supervisory and control equipment, 2 panels of antenna, 1 set of test equipment and 1 set of feeder system.
- For radio systems of less than 120 channels, per set system will be employed. For the 300-channel system, route protection system will be employed.

FORM-1

PATH PROFILE

(K=4/3)

Name of Route :
No. : Fig Ⅷ-2-2-33
Drawer :
Date : July 27. 1978



Distance (Km)

Frequency : ______ MHz

Power : ______ W

Full Scale A = 240Km, B = 120Km, Ⓒ = 60Km

Site :	Pasquin	--------	Laoag
Height :	5 m	13.8 km	40 m
Antenna height :	40 m		40 m

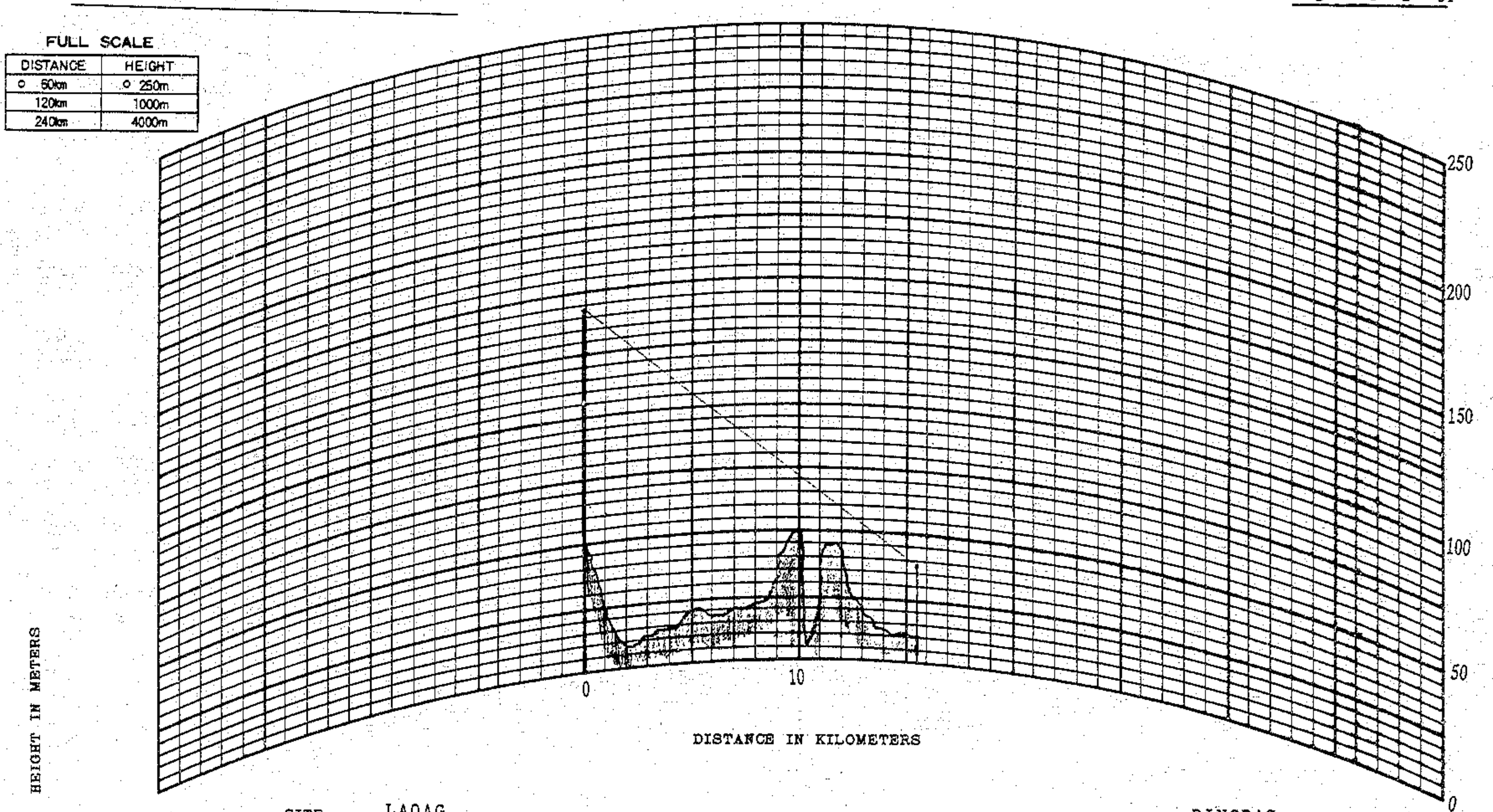
PROFILE MAP
(4 / 3 RADIUS)

ROUTE: ______

DRAWING NO.: Fig Ⅷ－2－2－34

FULL SCALE

DISTANCE	HEIGHT
○ 60km	○ 250m
120km	1000m
240km	4000m



SITE: LAOAG
LATITUDE:
LONGITUDE:
GROUND ELEVATION: 50 m
ANTENNA HEIGHT: 90 m

DISTANCE: 15.6 km

HOP NO.:

SITE: DINGRAS
LATITUDE:
LONGITUDE:
GROUND ELEVATION: 10 m
ANTENNA HEIGHT: 30 m

FORM-1

Name of Route :

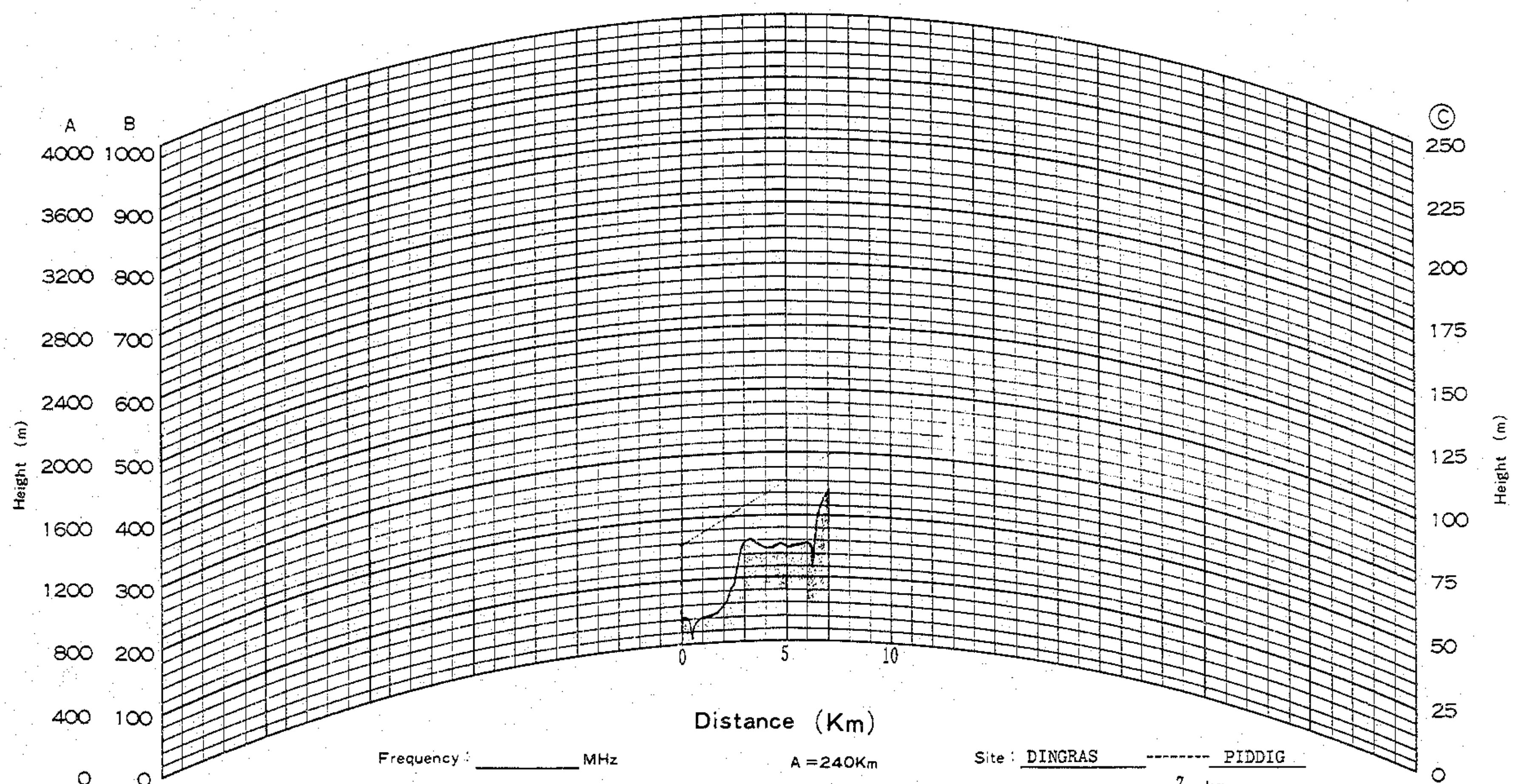
No. : Fig Ⅷ-2-2-35

PATH PROFILE

Drawer :

(K=4/3)

Date : 78. 5 4



Distance (Km)

Frequency : ______ MHz

Power : ______ W

Full Scale A = 240Km B = 120Km Ⓒ = 60Km

Site : DINGRAS -------- PIDDIG

Height : 10 m — 7 km — 60 m

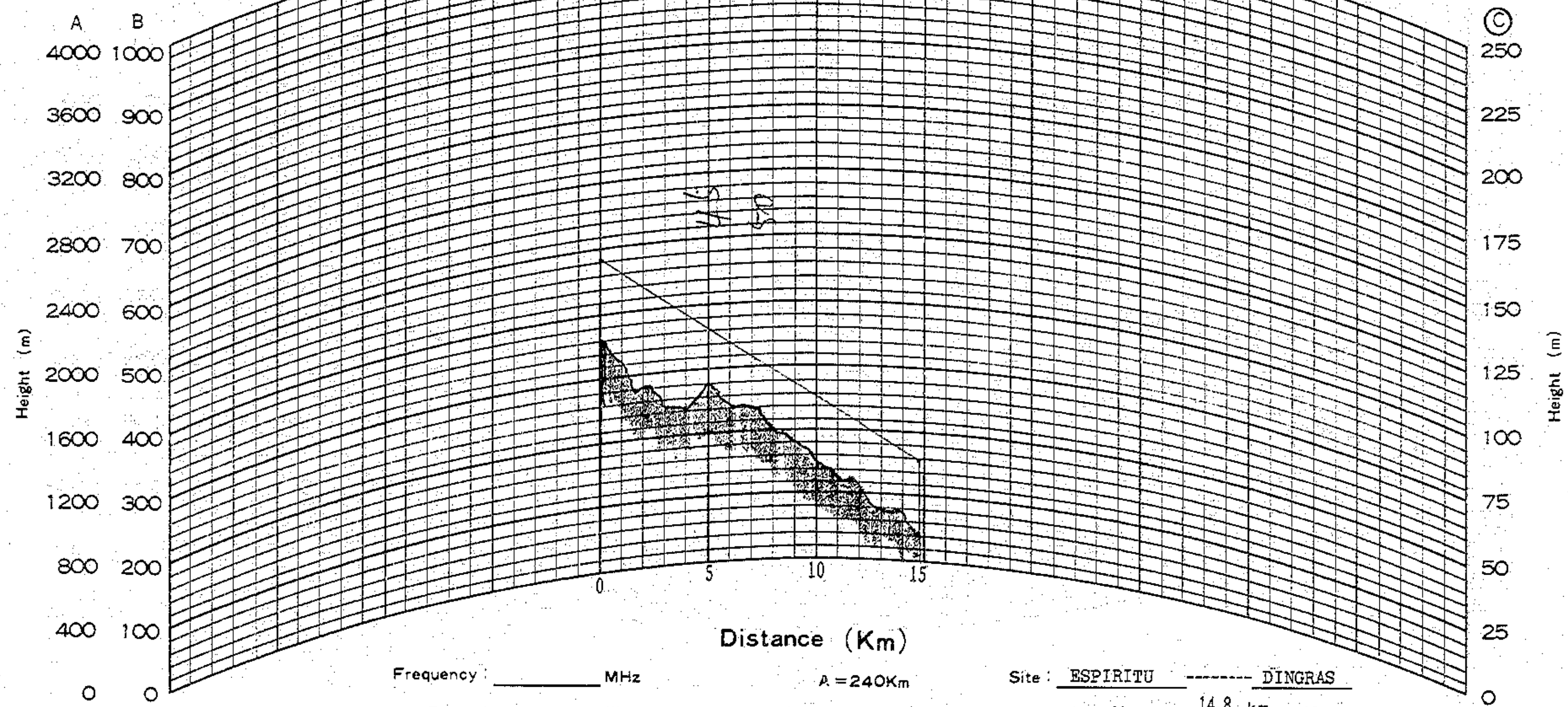
Antenna height : 30 m — 15 m

FORM-1

PATH PROFILE

(K=4/3)

Name of Route :
No. : Fig VIII-2-2-36
Drawer :
Date : 78. 5. 4



Frequency : ________ MHz

Power : ________ W

Full Scale A=240Km B=120Km Ⓒ= 60Km

Site : ESPIRITU -------- DINGRAS

Height : 90 m 14.8 km 10 m

Antenna height : 30 m 30 m

FORM-1

PATH PROFILE

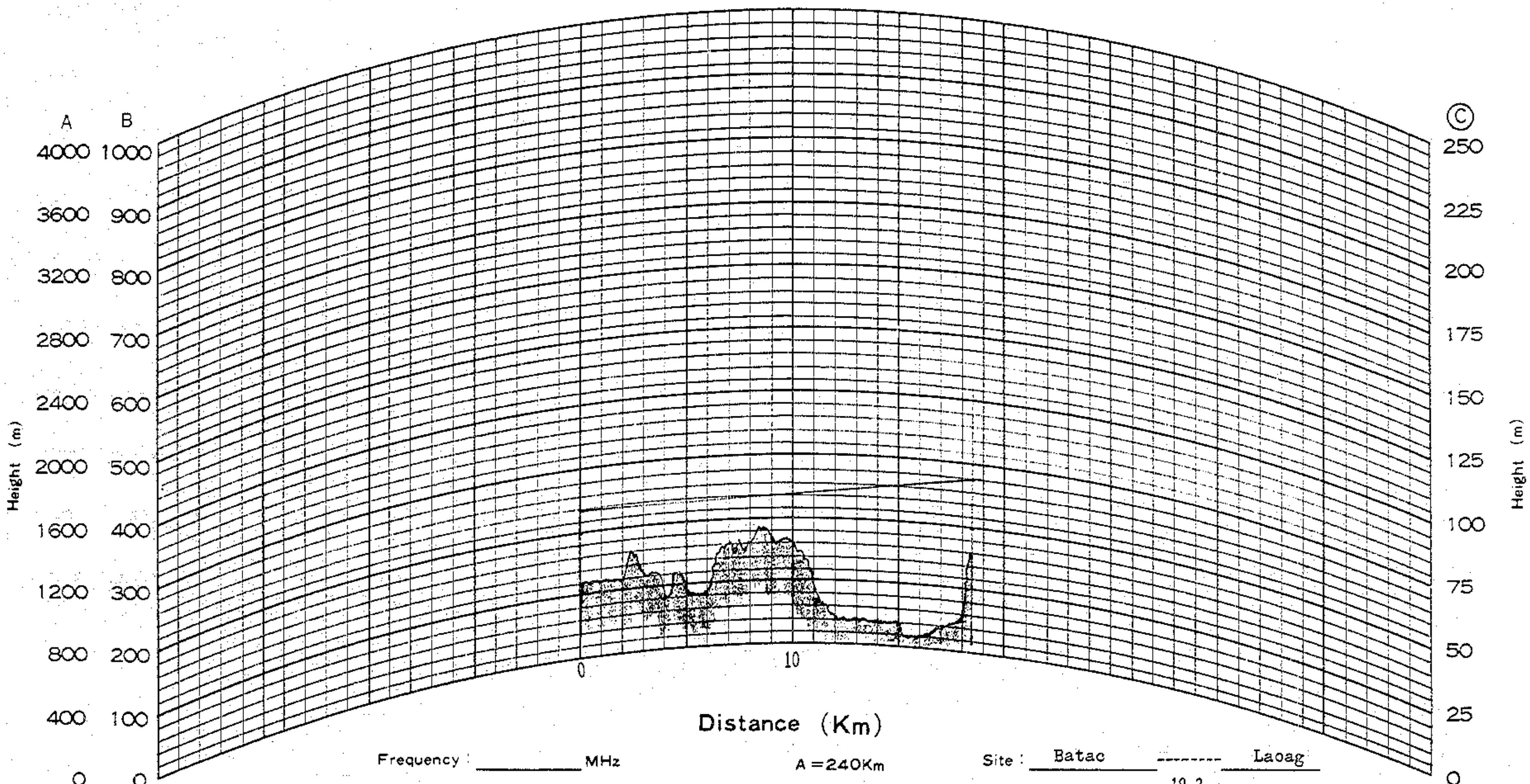
Name of Route :

No. : Fig Ⅷ-2-2-37

Drawer :

Date : July 27.78

(K=4/3)



Frequency : ________ MHz

Power : ________ W

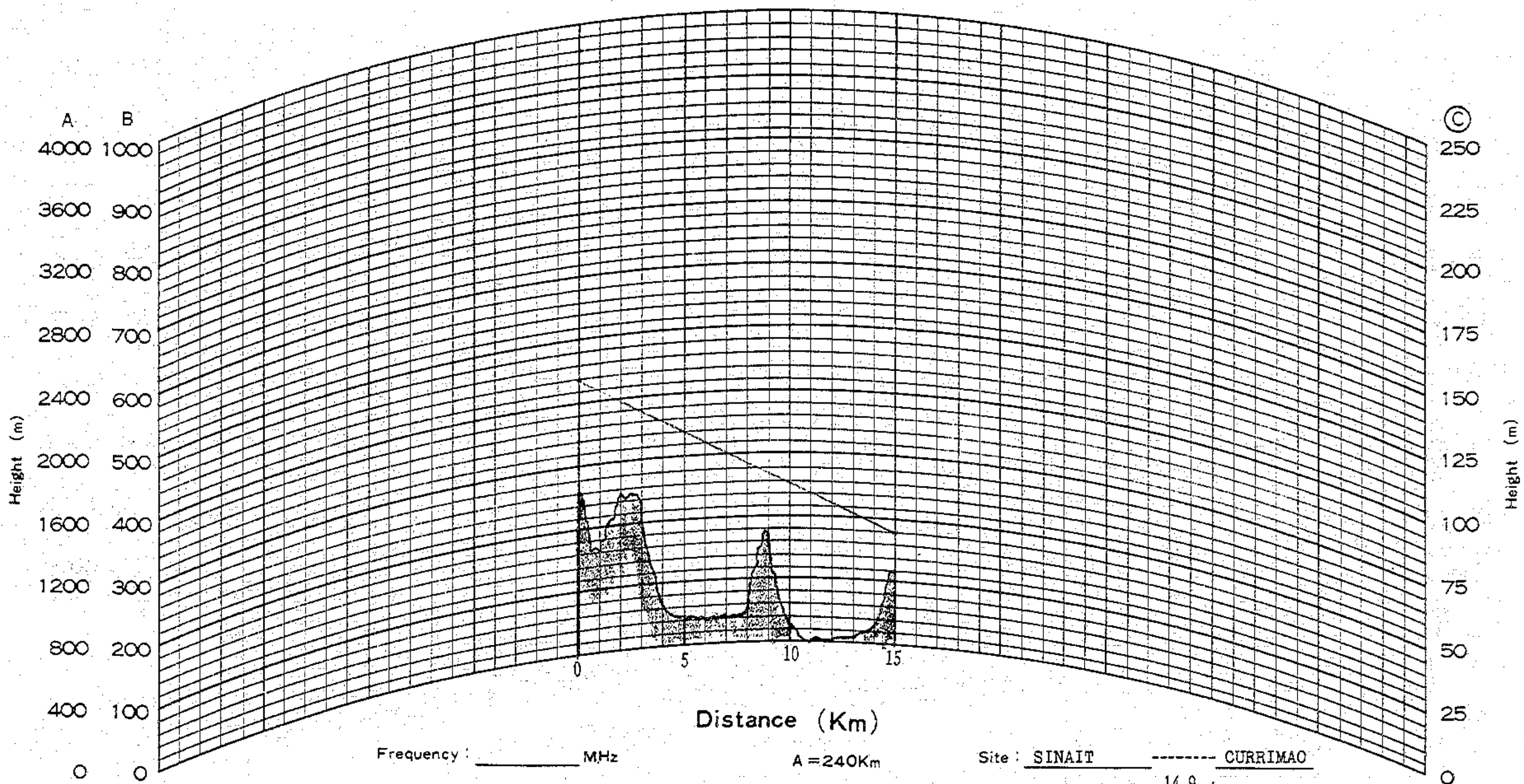
Full Scale A = 240Km B = 120Km Ⓒ = 60Km

Site :	Batac	--------	Laoag
Height :	30 m	18.3 km	40 m
Antenna height :	30 m		30 m

Name of Route :
No. : Fig Ⅷ-2-2-38
Drawer :
Date : 78. 5. 4

PATH PROFILE

(K=4/3)



Distance (Km)

Frequency : ______ MHz

Power : ______ W

Full Scale A=240Km B=120Km Ⓒ=60Km

Site : SINAIT -------- CURRIMAO

Height : 65 m 14.9 km 30 m

Antenna height : 45 m 15 m

FORM-1

PATH PROFILE

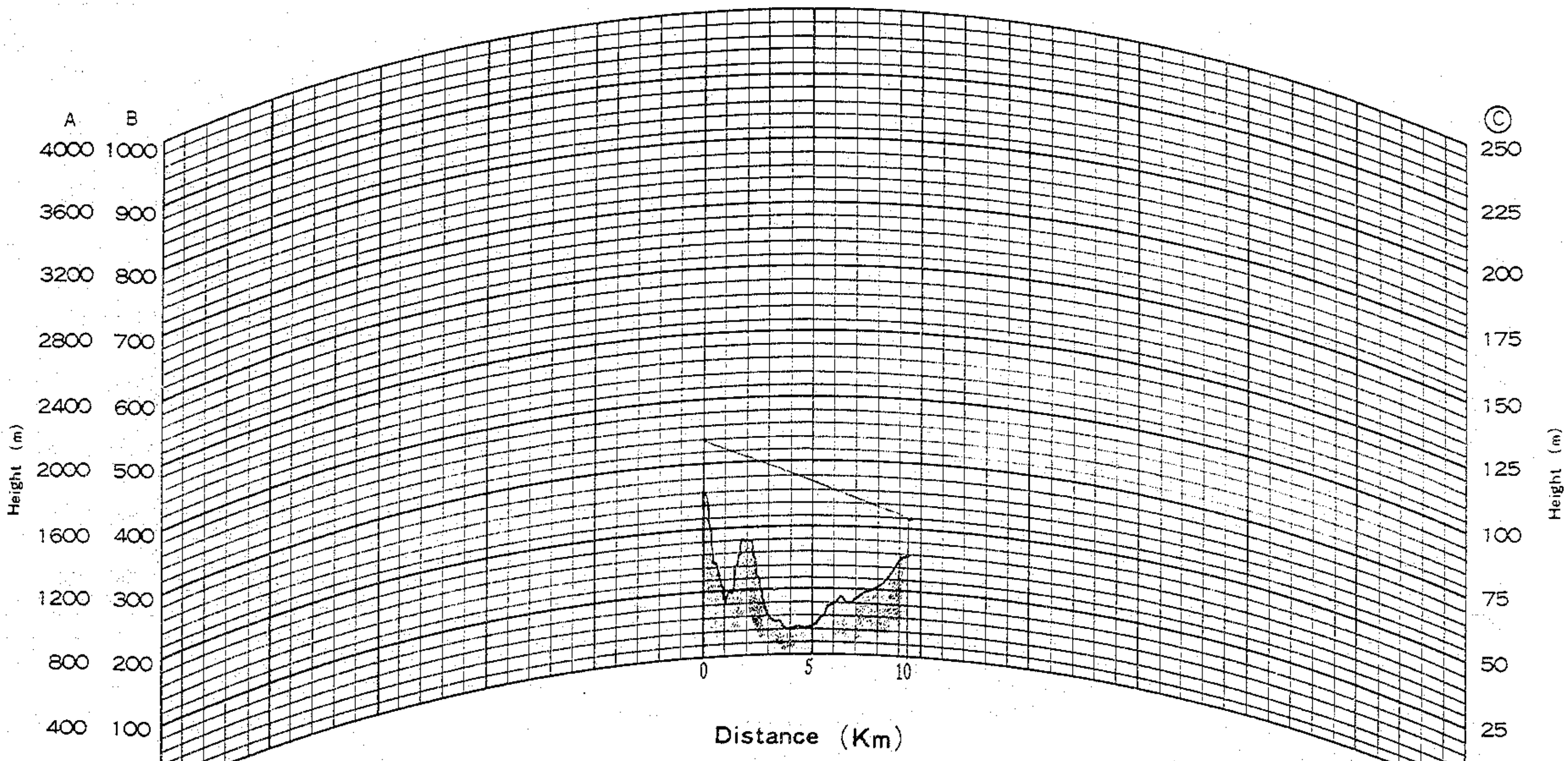
Name of Route :

No. : Fig Ⅷ－2－2－39

Drawer :

Date : 78. 5. 4

(K=4/3)



Frequency : ________ MHz

Power : ________ W

Full Scale A = 240Km B = 120Km Ⓒ= 60Km

Site : SINAIT -------- PINILI

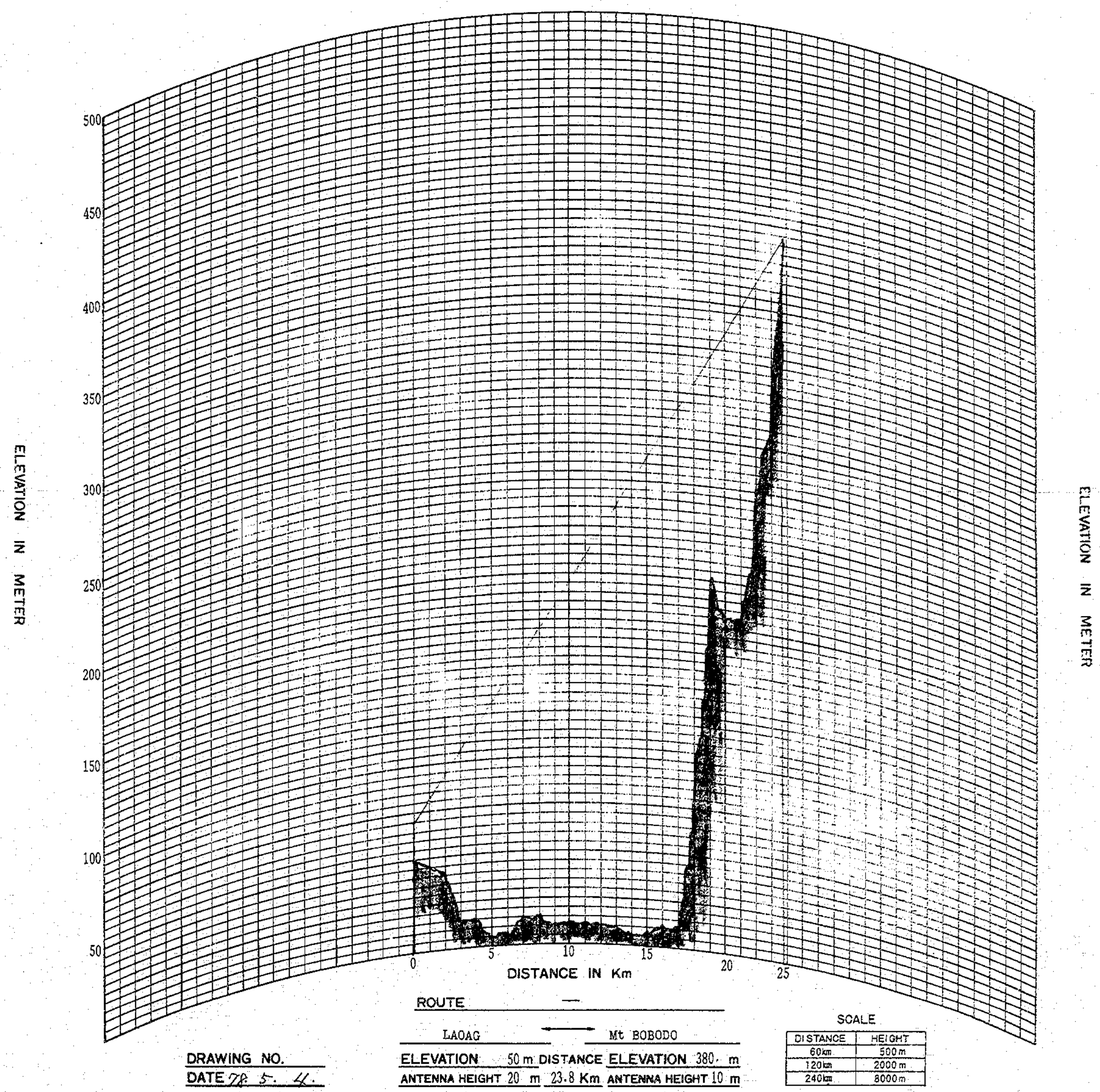
Height : 65 m 9.3 km 40 m

Antenna height : 20 m 15 m

Fig Ⅷ-2-2-40

PROFILE MAP

(4/3 RADIUS)



ROUTE

LAOAG ⟷ Mt BOBODO

DRAWING NO.
DATE 78. 5. 4.

ELEVATION 50 m	DISTANCE	ELEVATION 380 m	
ANTENNA HEIGHT 20 m	23.8 Km	ANTENNA HEIGHT 10 m	

SCALE

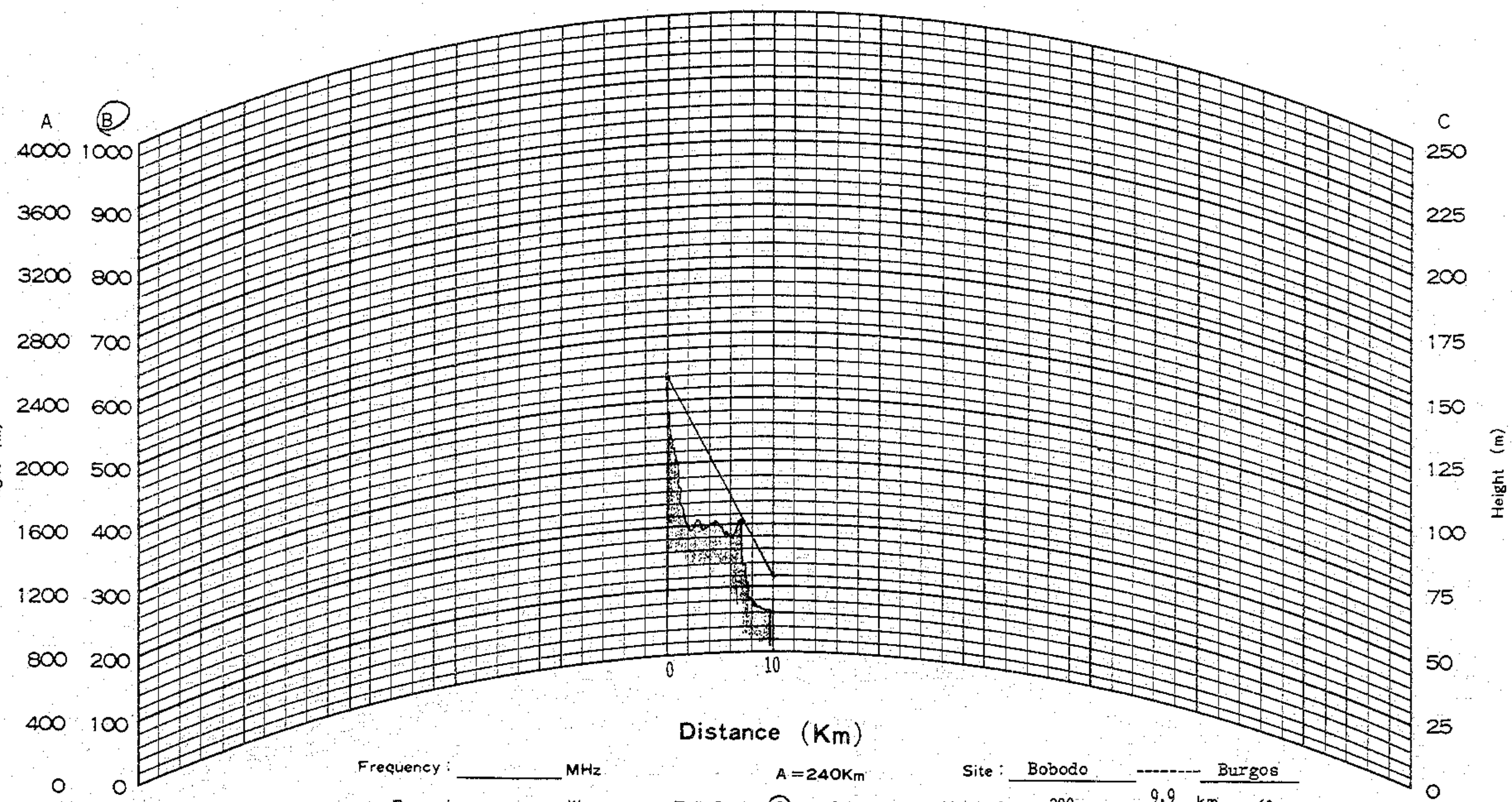
DISTANCE	HEIGHT
60km	500m
120km	2000m
240km	8000m

FORM-1

PATH PROFILE

Name of Route :
No. : Fig Ⅷ-2-2-41
Drawer :
Date : July 27.78

(K=4/3)



Frequency : ______ MHz
Power : ______ W

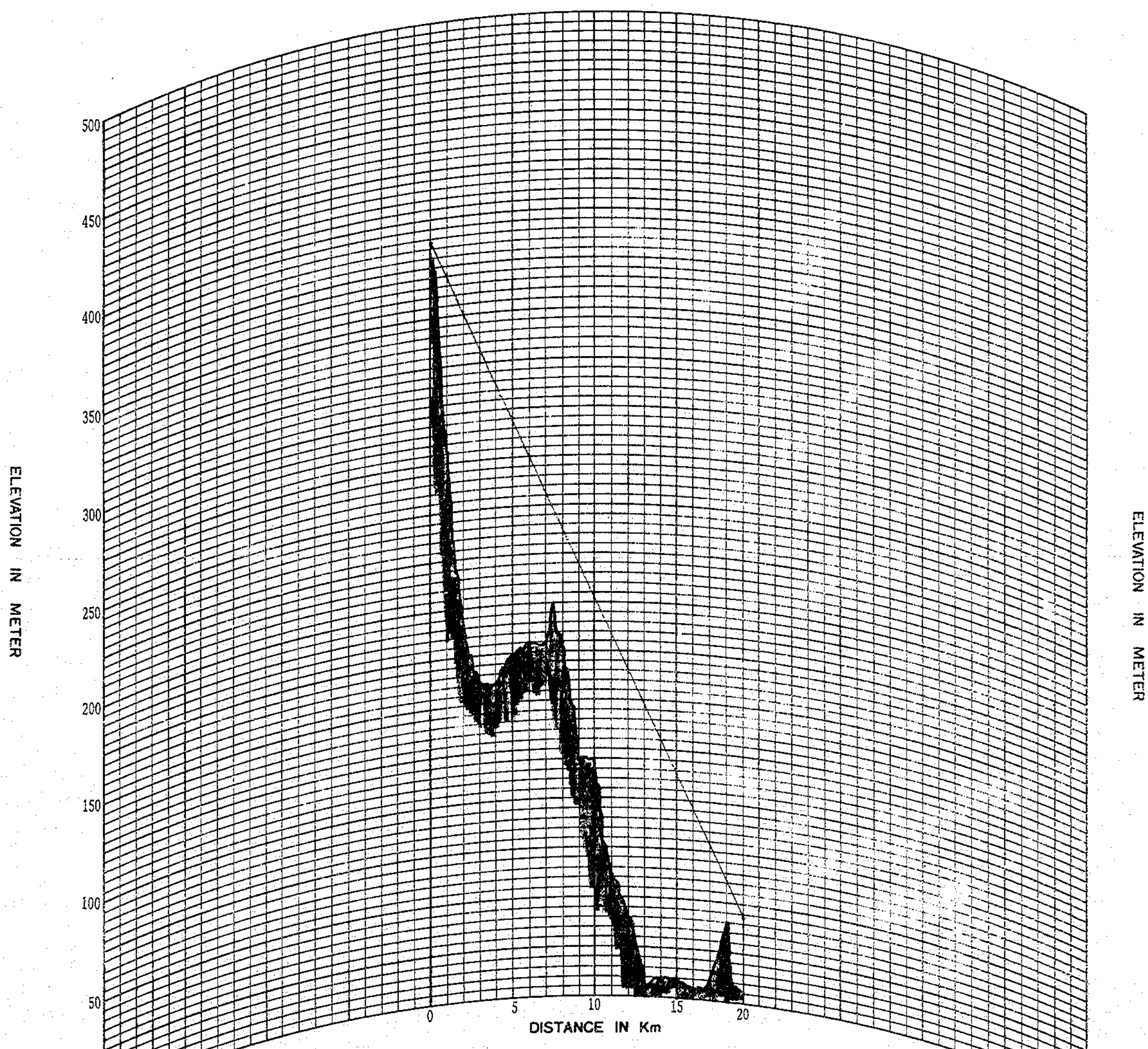
Full Scale
A = 240Km
B = 120Km
C = 60Km

Site : Bobodo -------- Burgos
Height : 380 m 9.9 km 60 m
Antenna height : 60 m 60 m

PROFILE MAP

(4/3 RADIUS)

Fig Ⅷ-2-2-42



ROUTE —

Mt BOBODO ←→ BANGUI

ELEVATION 380 m DISTANCE ELEVATION 5 m

ANTENNA HEIGHT 10 m 19 Km ANTENNA HEIGHT 40 m

DRAWING NO.

DATE 78. 5. 4.

SCALE

DISTANCE	HEIGHT
60km	500 m
120km	2000 m
240km	8000 m

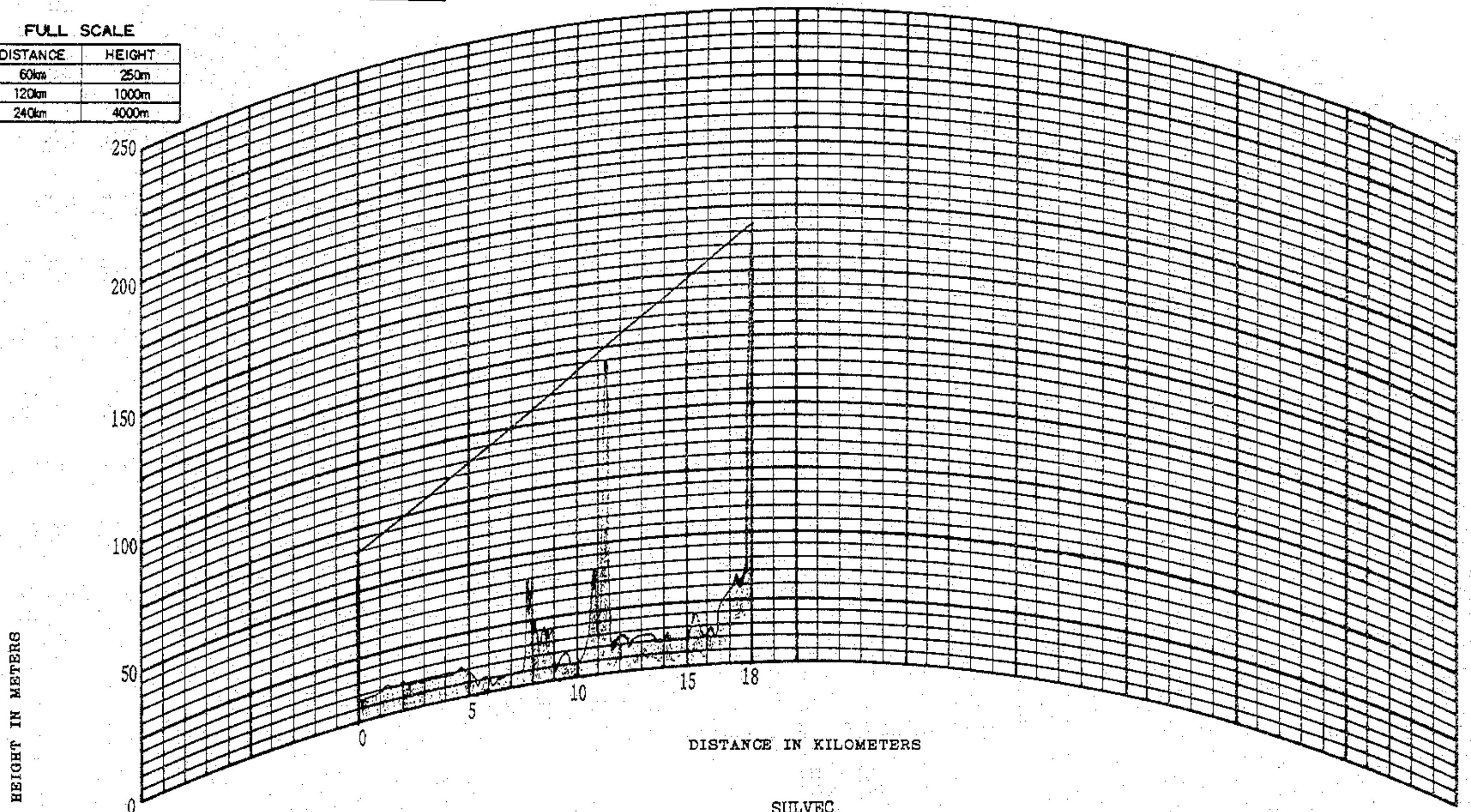
PROFILE MAP
(4 / 3 RADIUS)

ROUTE: ______

DRAWING NO.: Fig Ⅷ-2-2-43

FULL SCALE

DISTANCE	HEIGHT
60km	250m
120km	1000m
240km	4000m



SITE: VIGAN
LATITUDE: ______
LONGITUDE: ______
GROUND ELEVATION: 8 m
ANTENNA HEIGHT: 60 m

SULVEC
DISTANCE: 18.0 km
HOP NO.: ______

SITE: SULVEC
LATITUDE: ______
LONGITUDE: ______
GROUND ELEVATION: 160 m
ANTENNA HEIGHT: 10 m

PATH PROFILE

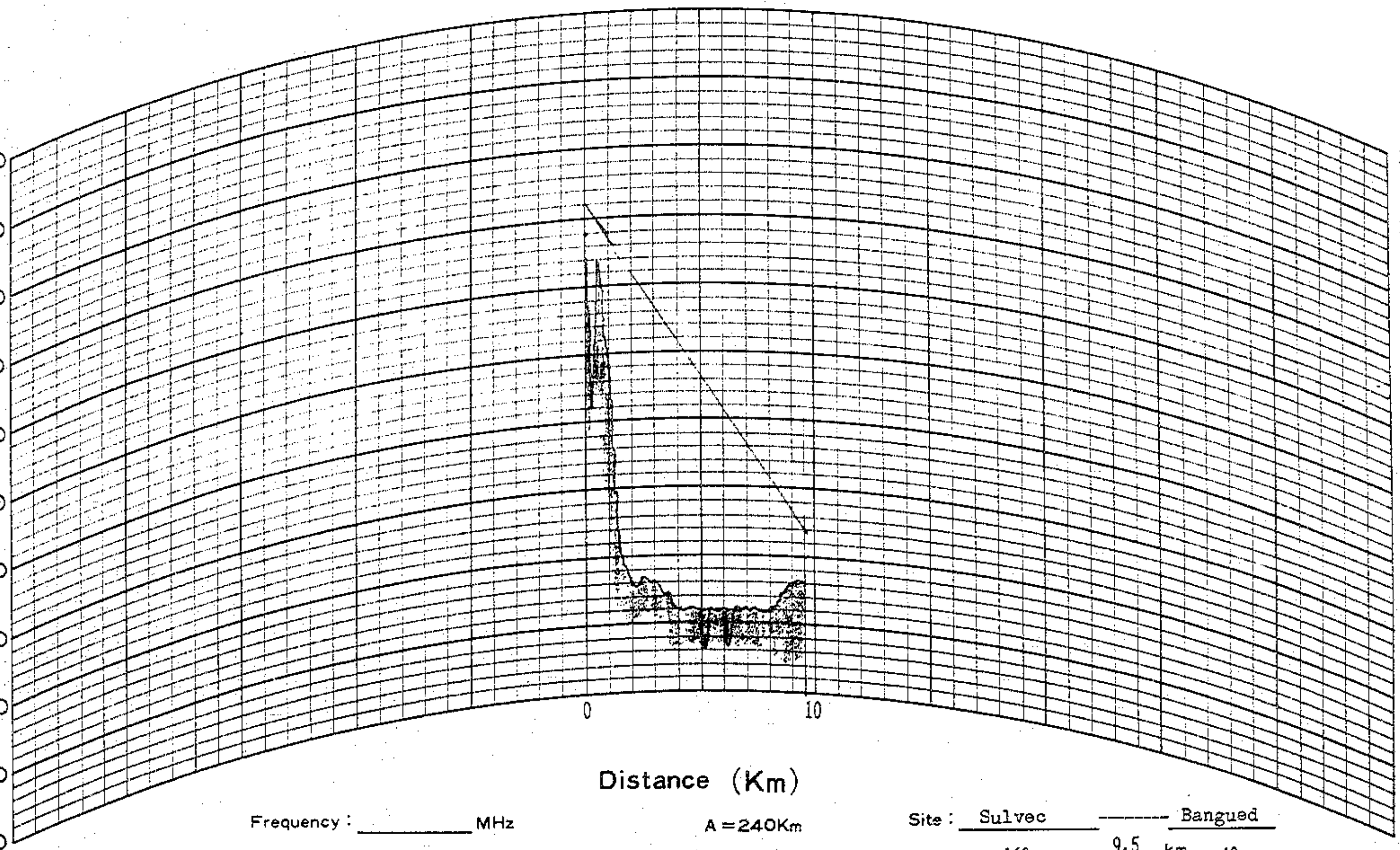
Name of Route :

No. : Fig Ⅷ－2－2－44

Drawer :

Date :

(K=4/3)



Frequency : ______ MHz

Power : ______ W

Full Scale A = 240Km B = 120Km C = 60Km

Site : Sulvec ------ Bangued

Height : 160 m 9.5 km 40 m

Antenna height : 20 m 20 m

(林寿堂) 651165 RT-1

FORM-1

PATH PROFILE

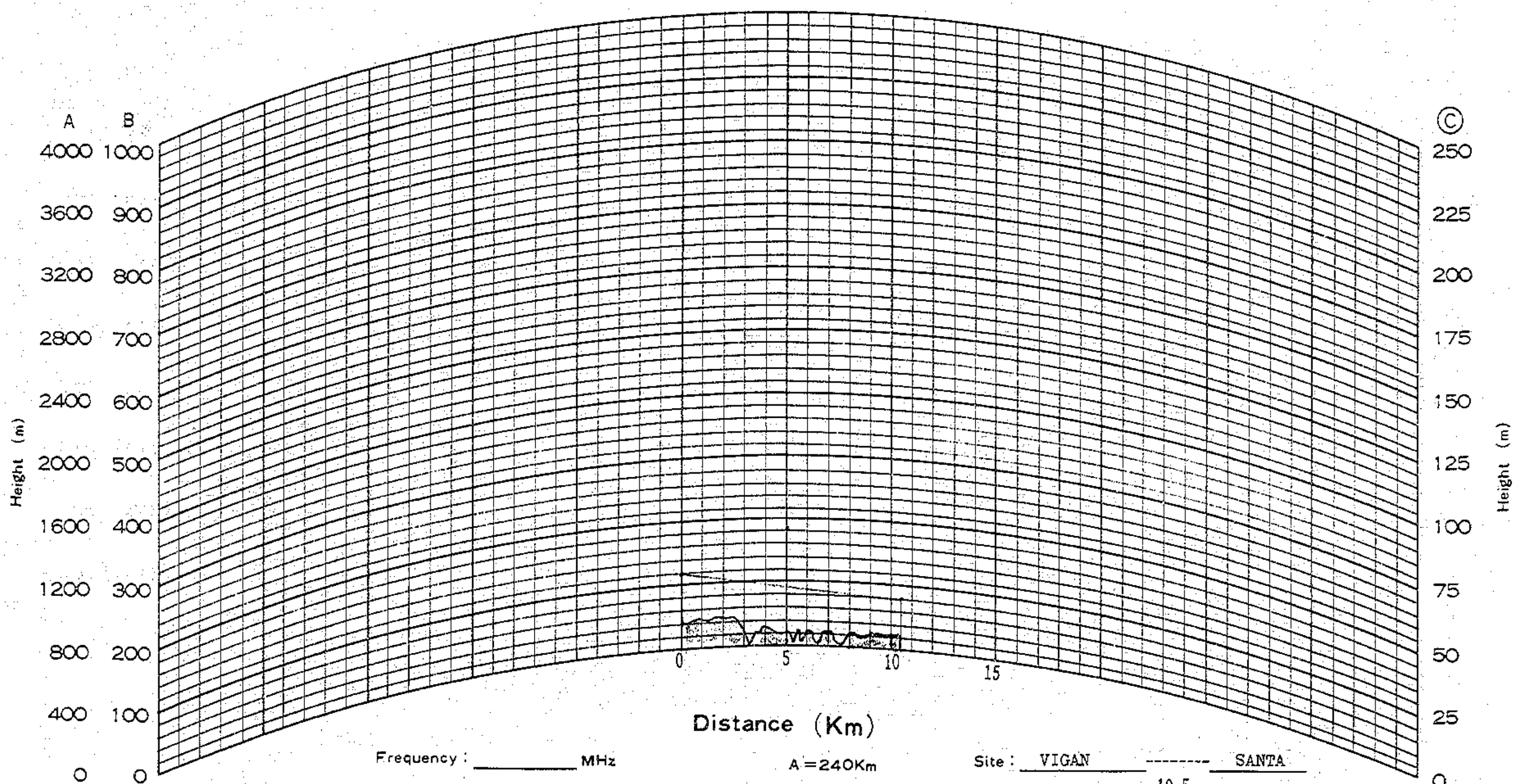
(K=4/3)

Name of Route :

No. : Fig Ⅷ-2-2-45

Drawer :

Date : 78. 5. 4



Distance (Km)

Frequency : ________ MHz

Power : ________ W

Full Scale A=240Km B=120Km Ⓒ= 60Km

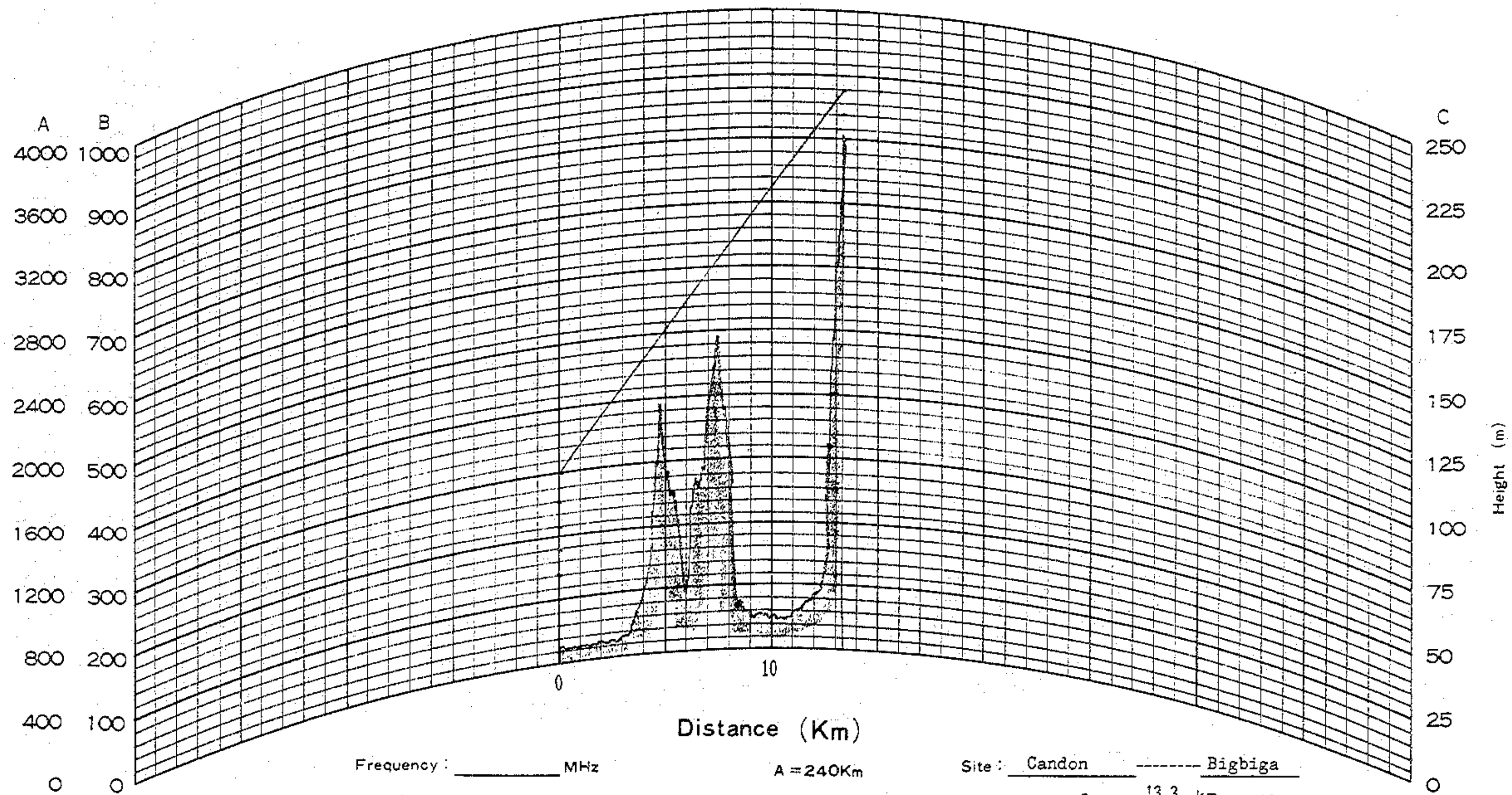
Site :	VIGAN	--------	SANTA
Height :	10 m	10.5 km	5 m
Antenna height :	20 m		15 m

FORM-1

PATH PROFILE

Name of Route :
No. : Fig Ⅷ-2-2-46
Drawer :
Date : July 27.78

(K=4/3)



Distance (Km)

Frequency : ______ MHz

Power : ______ W

Full Scale A = 240Km B = 120Km C = 60Km

Site : Candon -------- Bigbiga

Height : 5 m 13.3 km 200 m

Antenna height : 70 m 20 m

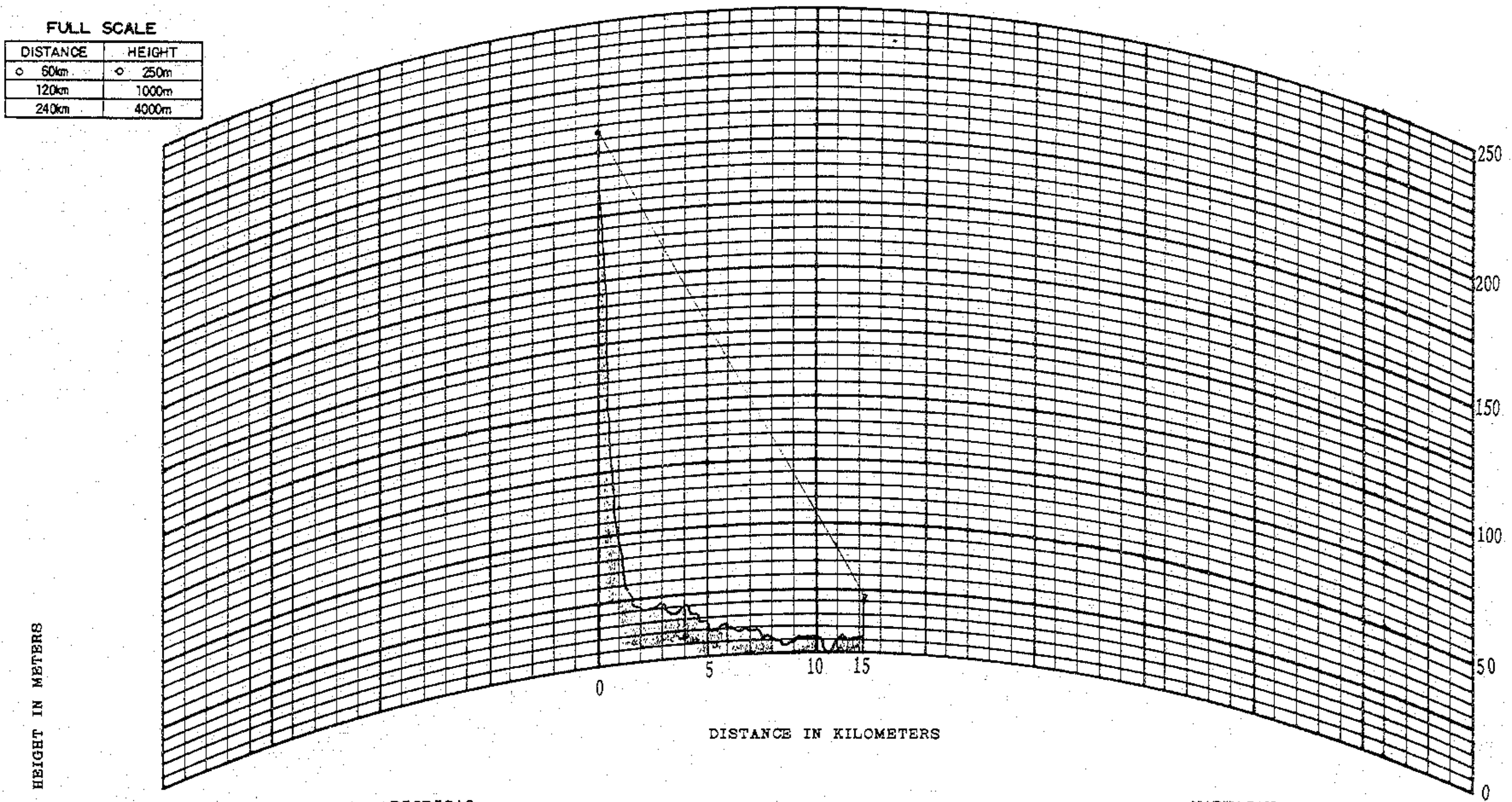
PROFILE MAP
(4 / 3 RADIUS)

ROUTE: ______

DRAWING NO.: Fig Ⅷ－2－2－47

FULL SCALE

DISTANCE	HEIGHT
○ 60km	○ 250m
120km	1000m
240km	4000m



SITE: BIGBIGAO
LATITUDE: ______
LONGITUDE: ______
GROUND ELEVATION: 200 m
ANTENNA HEIGHT: 10 m

DISTANCE: 12.2 km

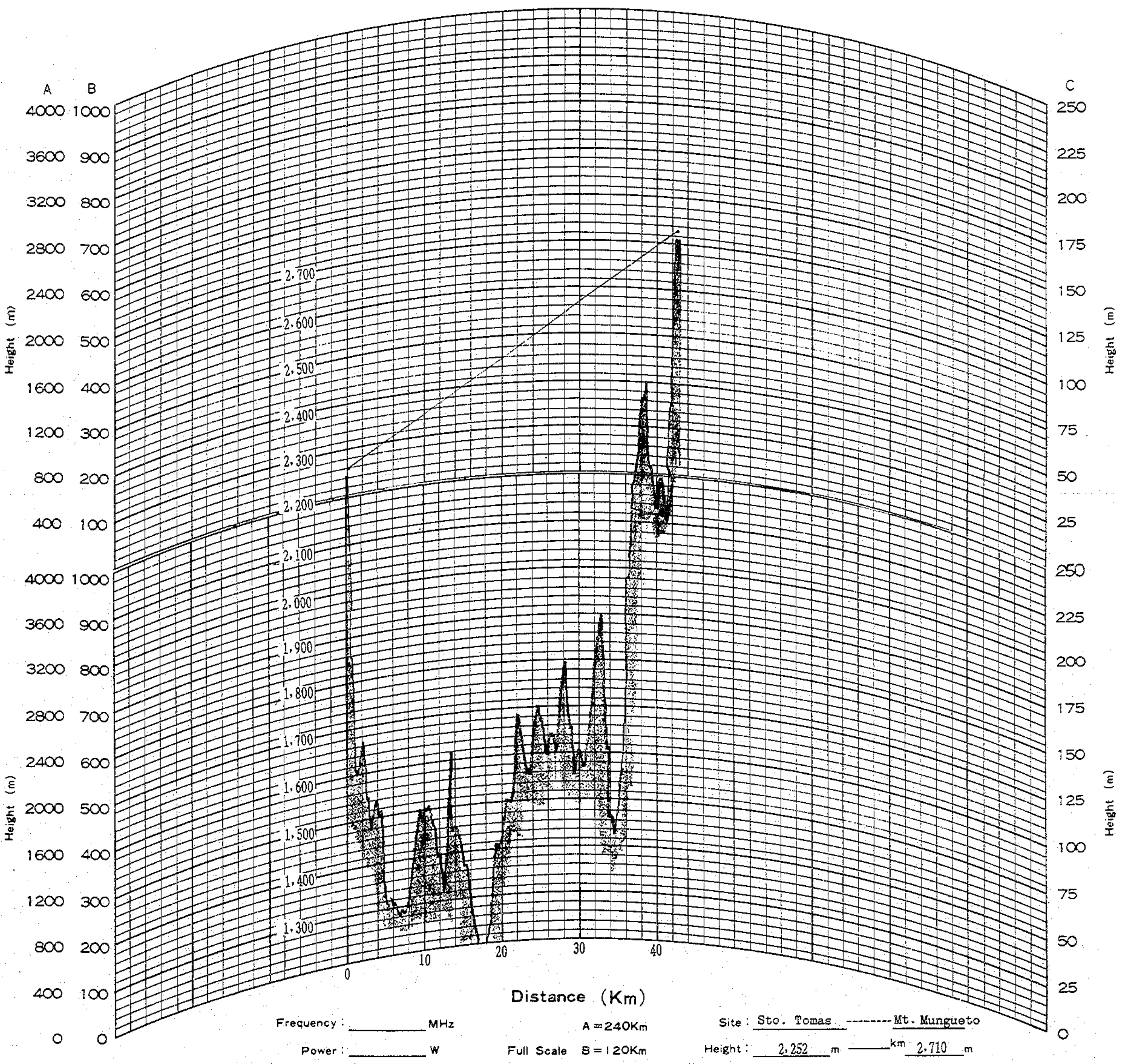
HOP NO.: ______

SITE: NARVACAN
LATITUDE: ______
LONGITUDE: ______
GROUND ELEVATION: 5 m
ANTENNA HEIGHT: 20 m

PATH PROFILE

(K=4/3)

Name of Route :
No. : Fig Ⅷ－2－2－48
Drawer :
Date : July 28.78



Frequency : ______ MHz
Power : ______ W

Full Scale A = 240Km
B = 120Km
C = 60Km

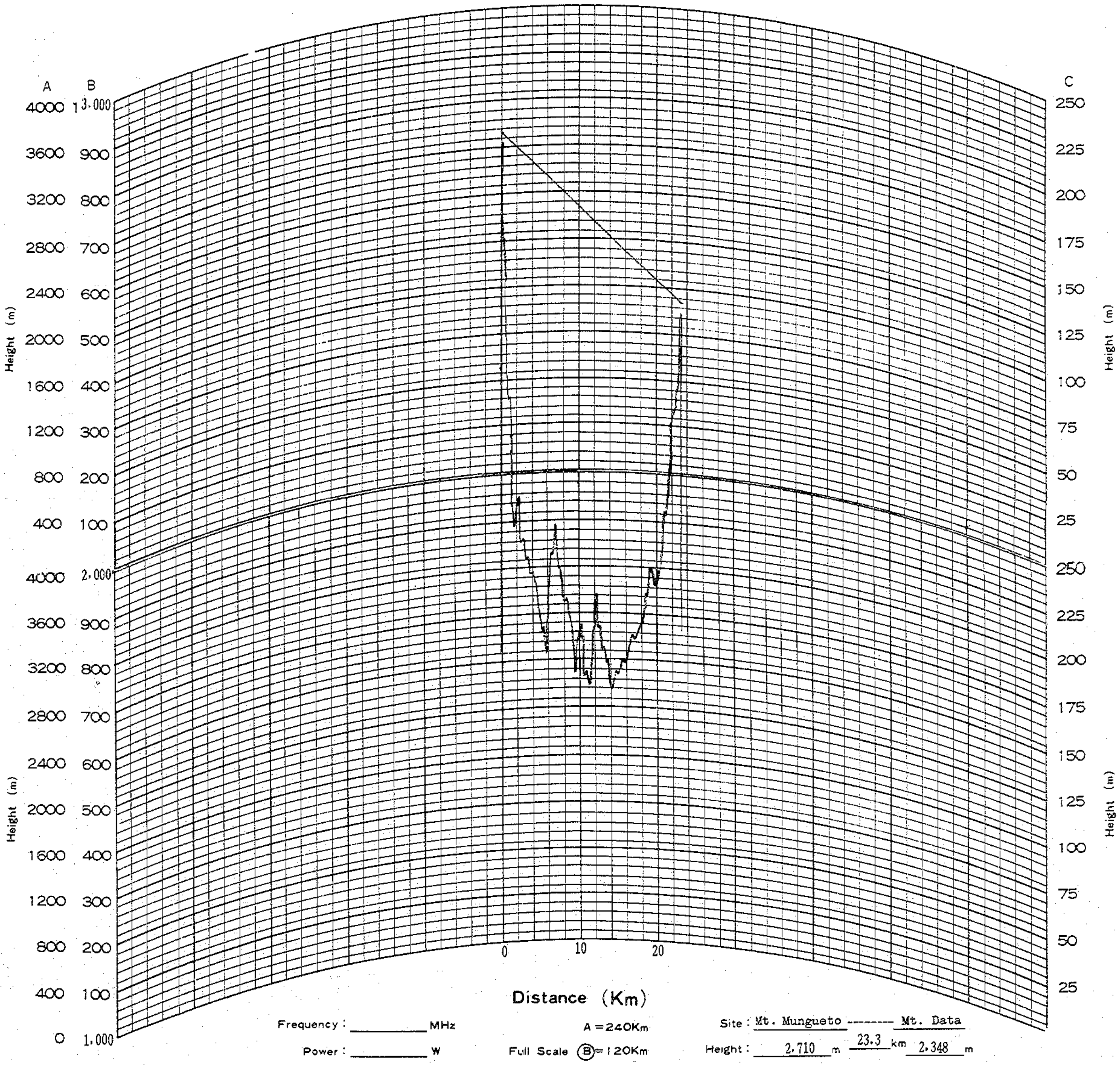
Site : Sto. Tomas ——— Mt. Mungueto
Height : 2,252 m ——— km 2,710 m
Antenna height : 20 m 20 m

FORM-1

PATH PROFILE

(K=4/3)

Name of Route :
No. : Fig VII-2-2-49
Drawer :
Date : July 27.78



Frequency : ______ MHz

Power : ______ W

Full Scale A = 240Km, B = 120Km, C = 60Km

Site : Mt. Mungueto -------- Mt. Data

Height : 2.710 m 23.3 km 2.348 m

Antenna height : 20 m 20 m

FORM-1

PATH PROFILE

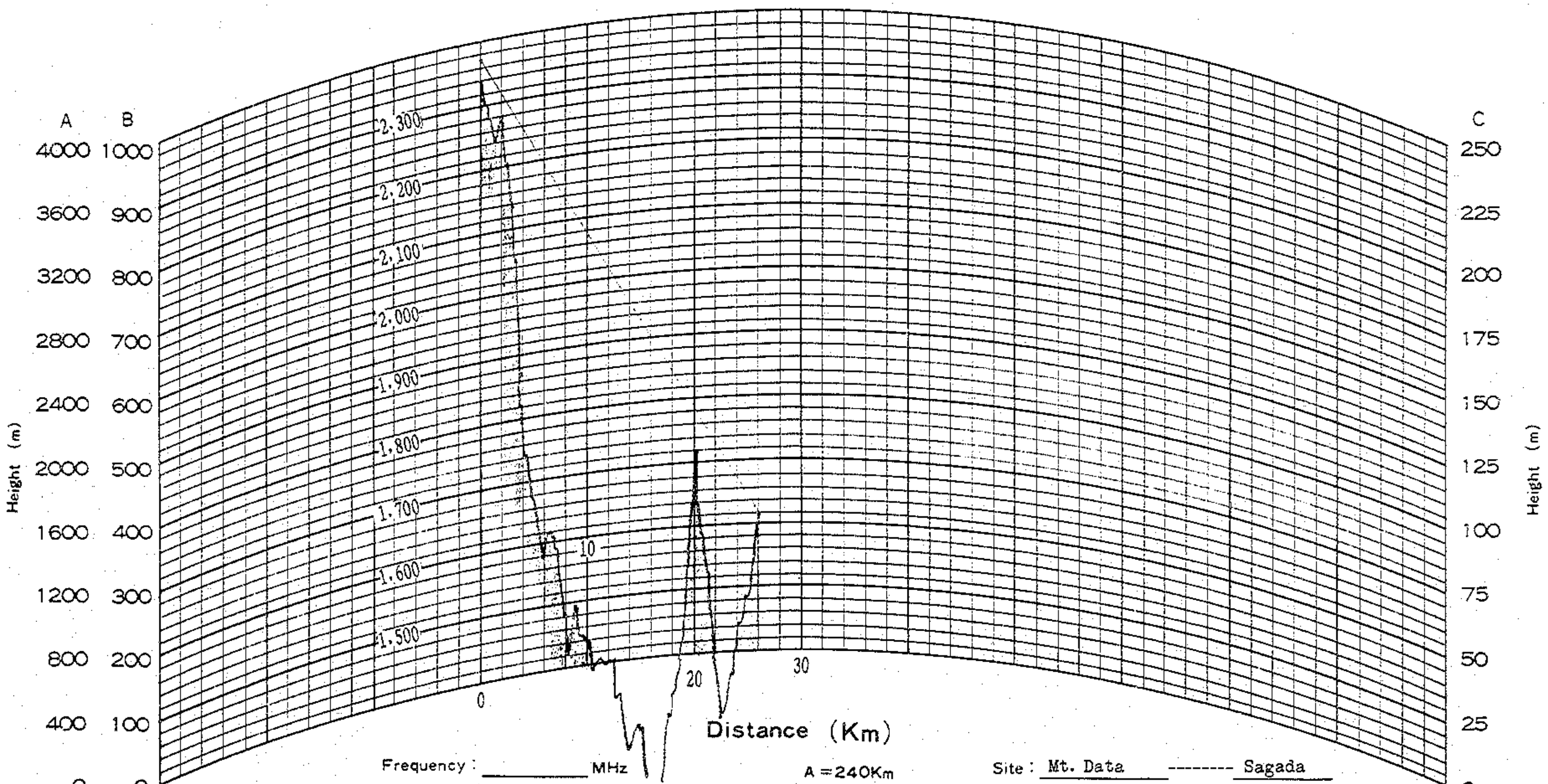
(K=4/3)

Name of Route :

No. : Fig Ⅷ- 2 - 2 - 50

Drawer :

Date : July 27.78



Frequency : ________ MHz

Power : ________ W

A = 240Km
Full Scale (B)= 120Km
C = 60Km

Site : Mt. Data -------- Sagada

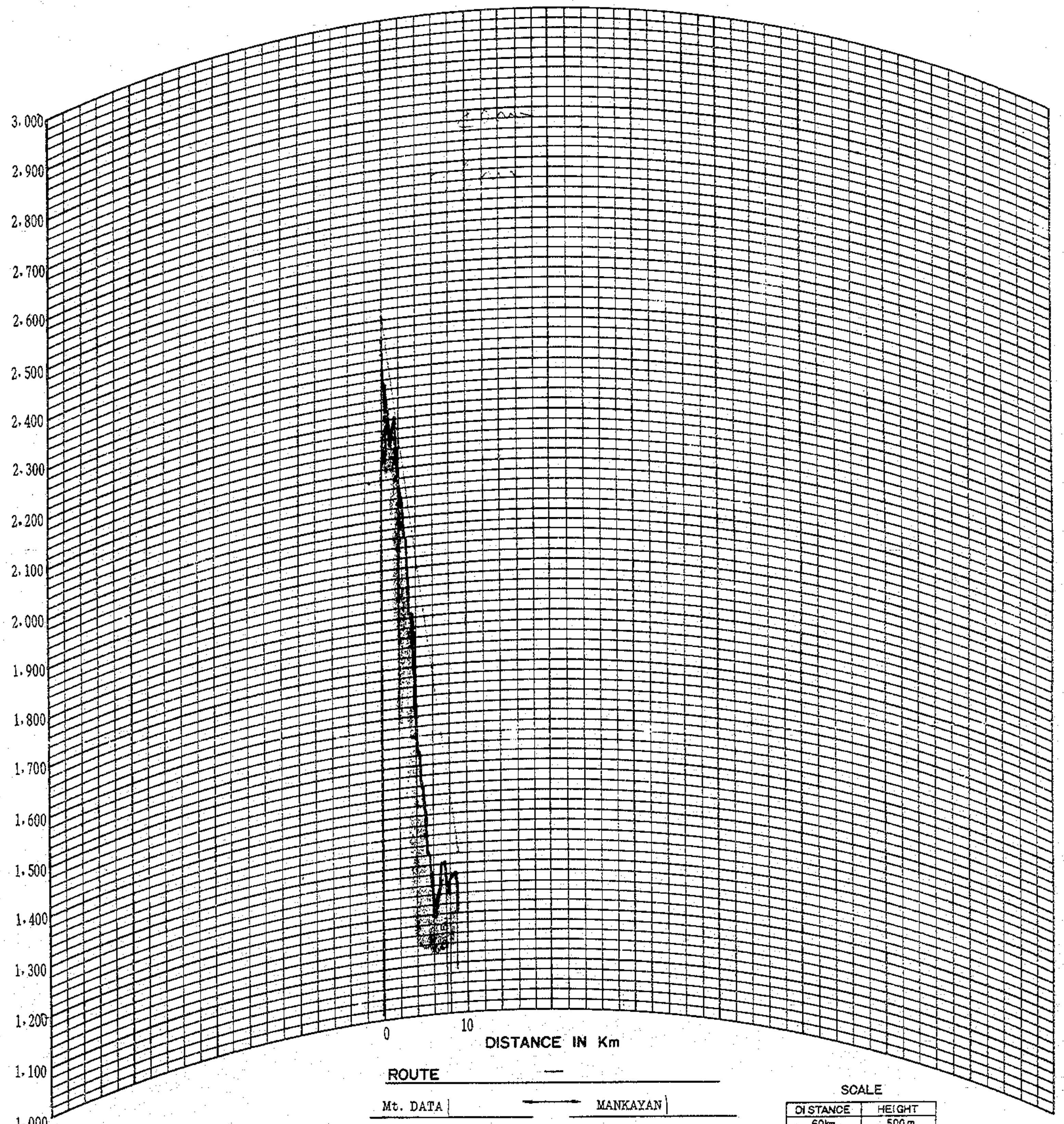
Height : 2,340 m 26.0 km 1,640 m

Antenna height : 30 m 20 m

PROFILE MAP

(4/3 RADIUS)

Fig Ⅷ-2-2-52



ROUTE

Mt. DATA ⟶ MANKAYAN

ELEVATION 2,365 m DISTANCE 8.3 Km ELEVATION 1,280 m

ANTENNA HEIGHT 40 m ANTENNA HEIGHT 40 m

N 16°51′44″
E 120°47′21″

DRAWING NO.

DATE . . .

SCALE

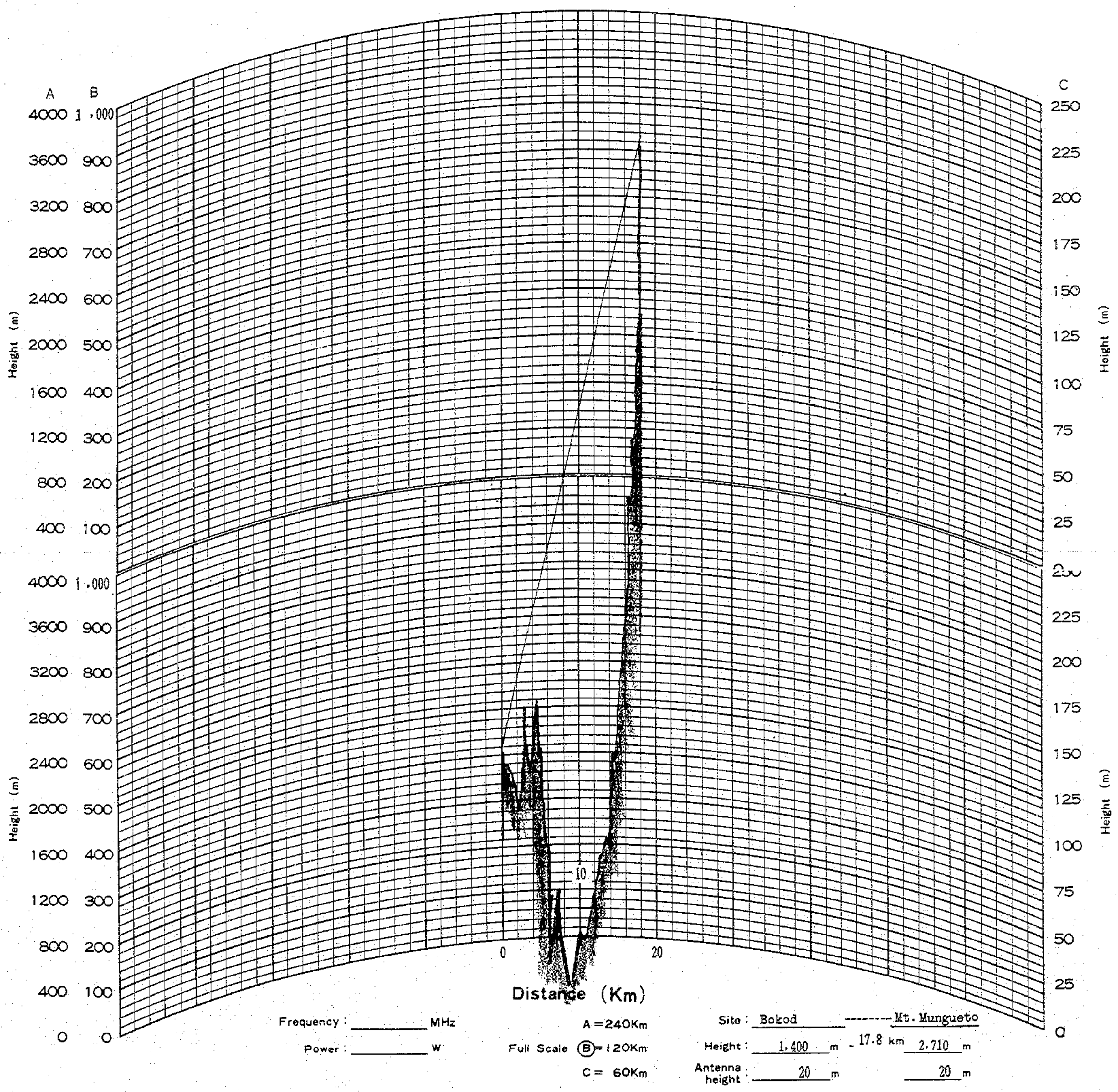
DISTANCE	HEIGHT
60km	500m
120km	2000m
240km	8000m

FORM-1

PATH PROFILE

(K=4/3)

Name of Route :
No. : Fig Ⅷ-2-2-53
Drawer :
Date :



Frequency : ______ MHz
Power : ______ W

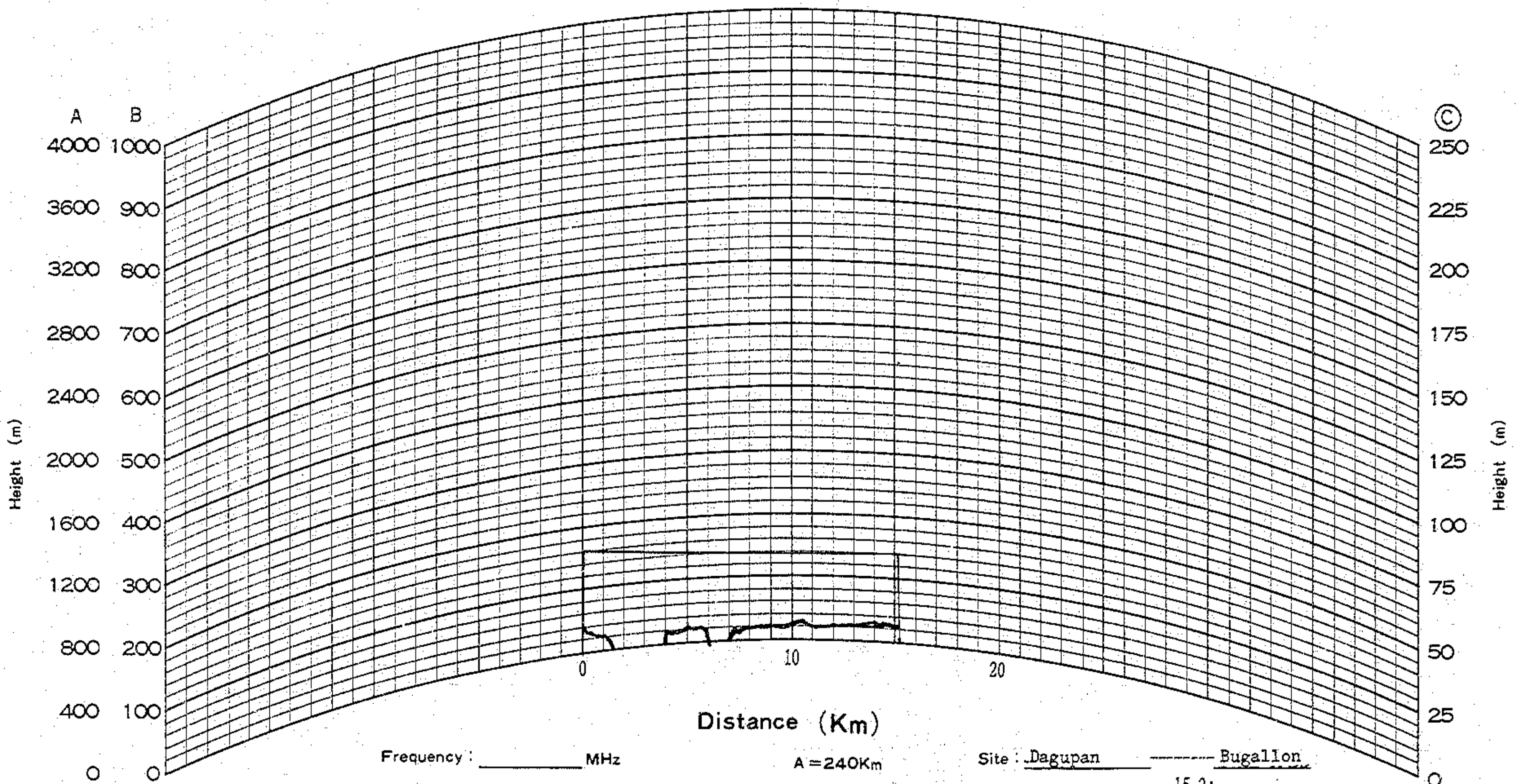
Full Scale A = 240Km, (B) = 120Km, C = 60Km

Site : Bokod ------- Mt. Mungueto
Height : 1,400 m - 17.8 km 2,710 m
Antenna height : 20 m 20 m

Name of Route :
No. : Fig Ⅷ－2－2－54
Drawer :
Date :

PATH PROFILE

(K=4/3)



Frequency : ______ MHz
Power : ______ W

Full Scale A = 240Km
B = 120Km
Ⓒ = 60Km

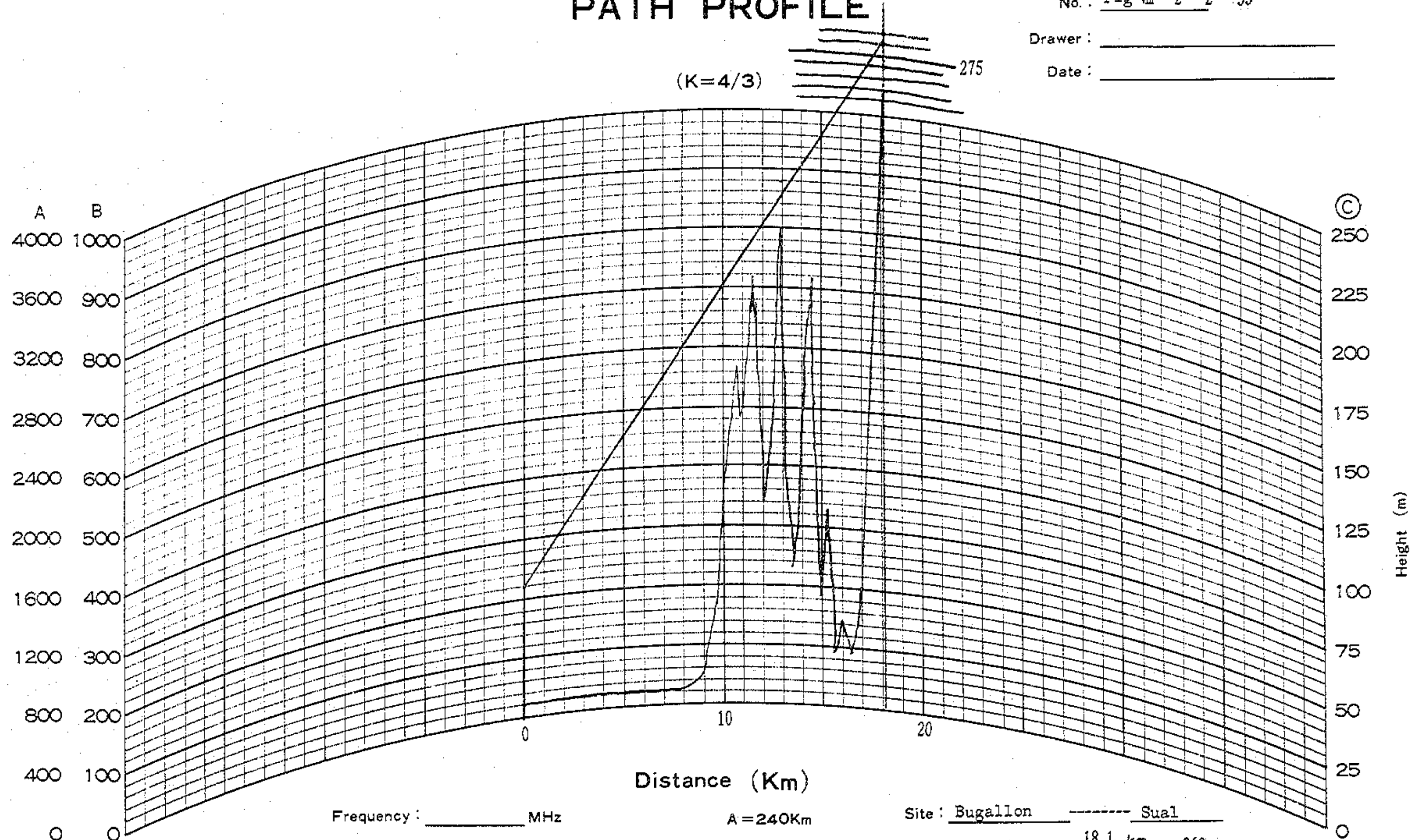
Site : Dagupan ------- Bugallon
Height : 10 m 15.2km 5 m
Antenna height : 30 m 30 m

(丼興堂) 651165 RT－1

PATH PROFILE

Name of Route :
No. : Fig Ⅷ－2－2－55
Drawer :
Date :

(K=4/3)



Distance (Km)

Frequency : ______ MHz
Power : ______ W

Full Scale A=240Km B=120Km Ⓒ=60Km

Site : Bugallon -------- Sual
Height : 5 m 18.1 km 260 m
Antenna height : 50 m 20 m

(共今堂) 651165 RT-1

FORM-1

Name of Route : ____________

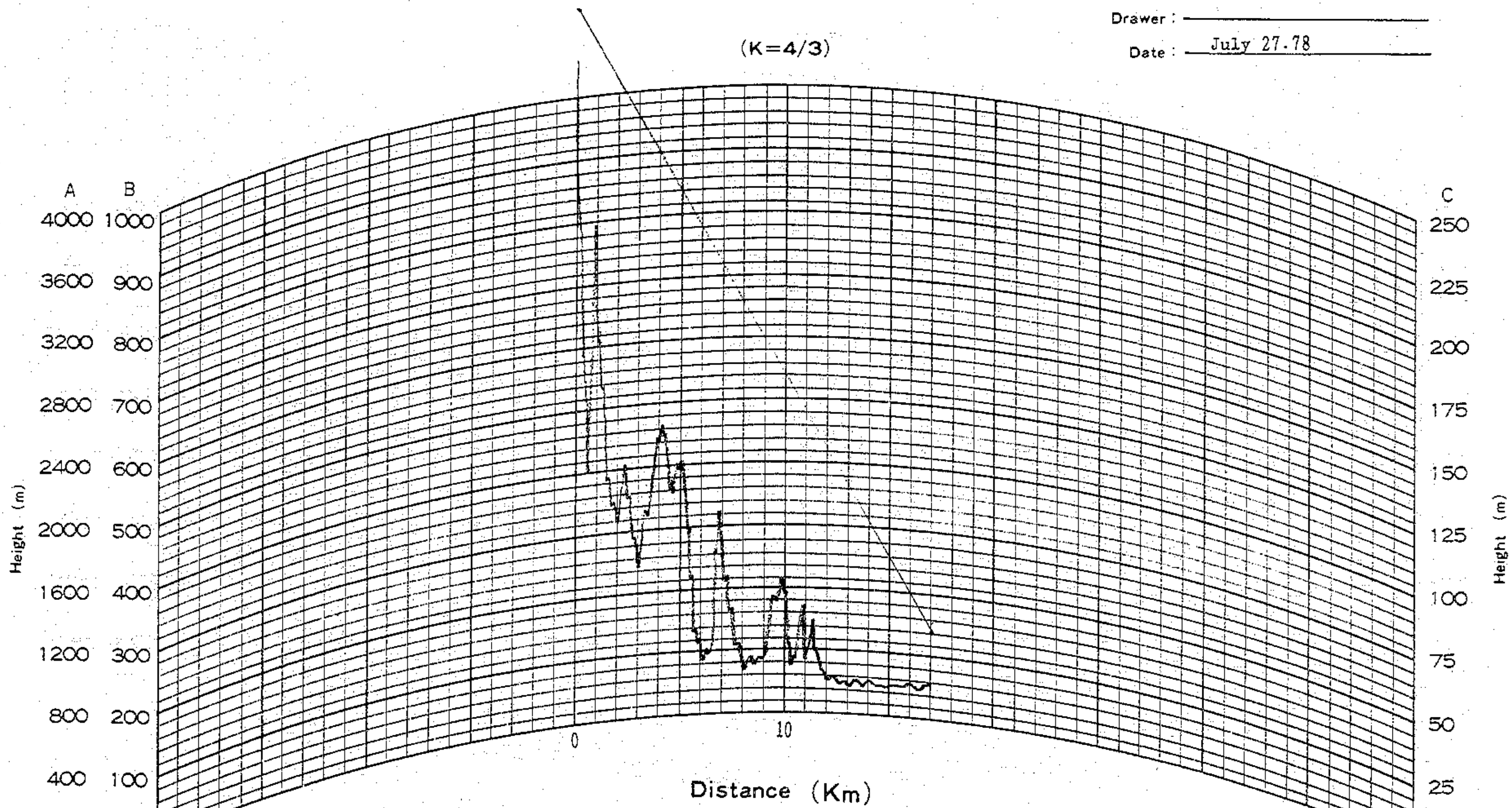
No. : Fig Ⅷ-2-2-56

Drawer : ____________

Date : July 27.78

PATH PROFILE

(K=4/3)



Frequency : ________ MHz

Power : ________ W

Full Scale A = 240Km B = 120Km Ⓒ = 60Km

Site :	Sual	--------	Alaminos
Height :	260 m	16.0 km	10 m
Antenna height :	20 m		20 m

FORM-1

PATH PROFILE

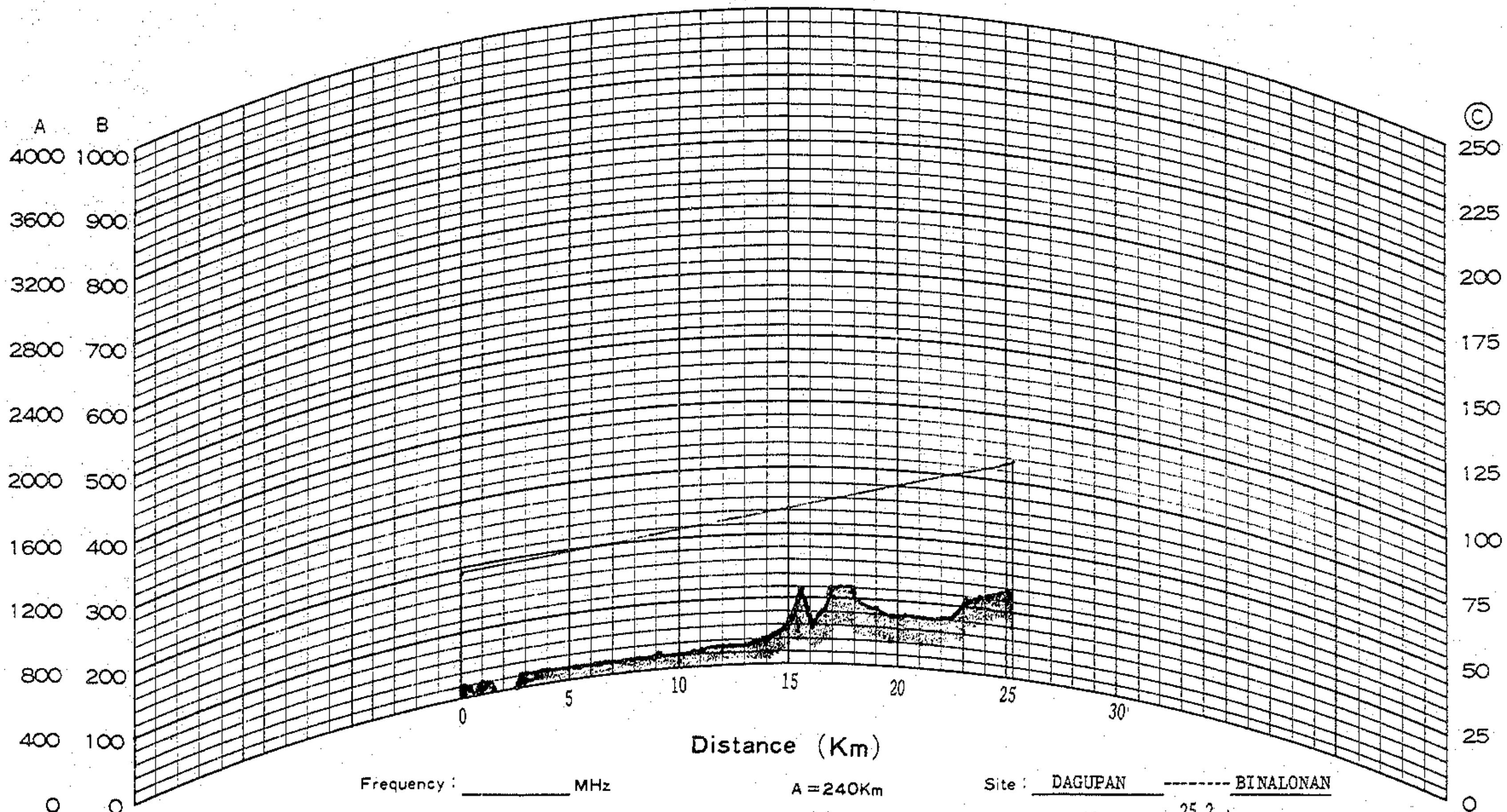
Name of Route : ____________

No. : Fig Ⅶ－2－2－57

Drawer : ____________

Date : ____________

(K=4/3)



Frequency : ________ MHz

Power : ________ W

Full Scale A = 240Km B = 120Km Ⓒ = 60Km

Site : DAGUPAN -------- BINALONAN 25.2 km

Height : 10 m 35 m

Antenna height : 43 m 48 m