REPORT ON A BASIC SURVEY FOR THE GENERAL ARRANGEMENTS FOR PLANNING OF THE METEOROLOGICAL DATA COMMUNICATION SYSTEM IN THE REPUBLIC OF THE PHILIPPINES

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JAPAN INTERNATIONAL COOPERATION AGENCY

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PREFACE

In response to a request of the Government of the Republic of the Philippines, the Government of Japan decided to conduct a survey on the meteorological telecommunication system in the Philippines, and entrusted the Japan International Cooperation Agnecy (JICA) with the work. The JICA dispatched two meteorological telecommunication experts, Messrs. Takeo SAITO and Tetsuro FUKUI for the survey, to the Philippines from October 20 to November 19, 1980.

The experts conducted a joint survey and had discussions with their counterparts of the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) of the Government of the Philippines. Based on the findings of the survey and further studies subsequently made in Japan, they have compiled this report.

I hope this report will contribute to the improvement of the meteorological data collection and warning dissemination in the Philippines, thus dedicating to the promotion of the friendly relations between our two countries.

I wish to express my deep appreciation to the officials concerned in the Philippines for their close cooperation extended to the experts.

April 1981

K. Nakazawa

Kazuto NAKAZAWA
Executive Director
Japan International Cooperation Agency

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Chapter 1. PREFACE

1-1 Introduction

The Philippines are affiliated to the World Meteorological Organization and are thus obliged to offer meteorological information. However, owing to problems in the domestic information collection, a prompt improvement of the meteorological information communication network is necessary. With regard to this, the dispatch of Telecommunication specialists to the Philippines for the purpose of making a close survey for the improvement of this country's meteorological communication system was decided on at the 11th conference of the ESCAP Typhoon Committee held in October 1979 in Bangkok, by mutual agreement of the meteorological representatives of the Philippines and Japan.

1-2 The Names of the Specialists Dispatched

Takeo Saito

Assistant to Head, Radio Communication Division,
Forecast Department,
Japan Meteorological Agency

Tetsuro Fukui

Assistant to Chief,
Facility Management Division,
Meteorological Satellite Center,
Japan Meteorological Agency

1-3 Schedule

The survey team arrived at Manila on October 20, 1980, and returned to Japan on November 19, 1980. Its schedule was as follows:

The Day's Schedule of Survey Work

Date			Schedule
October	20	Mon.	Arrived at Manila
	21	Tue.	Preliminary meeting on survey items with Mr. Komura, telecommunication specialist with PAGASA and Messrs. Tang and Machida with TCS. Orientation on present status of the meteorological data collection and the observation system, given by the following officers of PAGASA. Mr. J. Lirios Director, National Weather Office Mr. Ascension Service Chief, National Weather Office Mr. S. Fontano Chief, Meteorological Communication Division Mr. V. M. Tio Senior Electrical Engineer Mr. C. Ferraris Assistant Weather Services Chief
	22	Wed.	Investigation of PAGASA's facilities in Manila. Observation of PAGASA's Headquarters, New Flood Forecasting Center and Deliman Communication Station.
	23	Thu.	Collection of data and discussion
	24	Fri.	– ditto –

Date			Schedule
October	25 26	Sat. Sun.	Free
	27	Mon.	Travel from Manila to Naga. Investiation of BICOL River Basin Flood Forecasting Sub-center at Camaligan, accompanied by Messrs. Komura, Saito, Fukui, Fontano and Tio.
	28	Tue.	Investigation of Iriga Relay Station, Bato Observation Station and Legaspi Airport Forecast Station. Travel from Legaspi to Cebu.
	29	Wed.	Investigation of Cebu Radar Station in Mactan Island (including Synop, Pilot Balloon). Travel from Cebu to Davao. Investigation of Davao Forecast Station (Synop, Pilot Balloon).
	30	Thu.	Travel from Davao to Manila.
	31	Fri.	Free
November	1 2	Sat. Sun.	
	3	Mon.	Travel from Manila to Baguio. Investigation of Baguio Meteorological Observatory (Synop, Pilot Balloon) accompanied by Messrs. Komura, Saito, Fukui, Fontano and Tio.
	4	Tue.	Investigation of Baguio Radar Station on Mt. Sto. Tomas.
	5	Wed.	Travel from Baguio to Manila.
	6 7	Thu. Fri.	Collection and arrangement of data.

Date			Schedule
November	8 9	Sat. Sun.	Free
	10	Mon.	Collection and examination of data.
	11	Tue.	Discussion with counterparts.
	12	Wed.	Examination of data with Telecommunication specialists from PAGASA and TCS.
	13 14	Thu. Fri.	Examination of data and preparing of reports with counter-parts.
	15 16	Sat. Sun.	Free
	17 18	Mon. Tue.	Preparing of interim report. Final meeting with PAGASA's officers.
	19	Wed.	Returned to Japan.

1-4 Acknowledgement

We wish to express our sincere gratitude to PAGASA's officers for their kind help and also to Mr. Komura, Telecommunication specialist with PAGASA and Specialists Messers. Tang (communications) and Machida (hydrology) of the Typhoon Committee Secretariat (TCS) for their appropriate advice, offering of data and assistance in spot surveys.

Chapter 2. OUTLINE OF THE SURVEY ON EXISTING CONDITIONS

The survey team conducted spot surveys on meteorological data communications, meteorological observation, etc. according to the above itinerary. The contents of the spot surveys may be outlined as below.

2-1 Communication System

Fig. 1 and Fig. 2 show the existing Synoptic Data Communication System in PAGASA and the Flood Forecasting and Warning Telecommunication Network, respectively. As shown in Table 2, an exchange of meteorological information and warnings is transmitted, 8 times a day, between about 50 observational stations and Manila Central Weather Bureau, using 100-watt, single side band (SSB).

Our survey was conducted mainly in the daytime. Therefore, we had no experience of poor transmission conditions. But the following problems were noted:

(1) The frequency used in SSB Transmission was only one, i.e. 7,995 kHz.

(2) At some stations, the direction patterns, length of elements and heights of antennas were inadequate.

(3) Matching between antenna and equipment was imperfect.

(4) Maintenance of equipment was unsatisfactory.

In addition, the UHF multiplex circuits in use between Deliman Communication Unit and PAGASA Central Office have not been effectively used.

2-2 Weather Radar Station and Upper Wind Station (Fig. 3)

At present, there are seven weather radar stations (Basco, Apari, Mt. Sto, Tomas, Diet, Manila, Guian and Cebu) and 11 upper wind stations. In the near future, four new radars and one renewal are planned.

Fig. 1. Synoptic Data Communication System in PAGASA

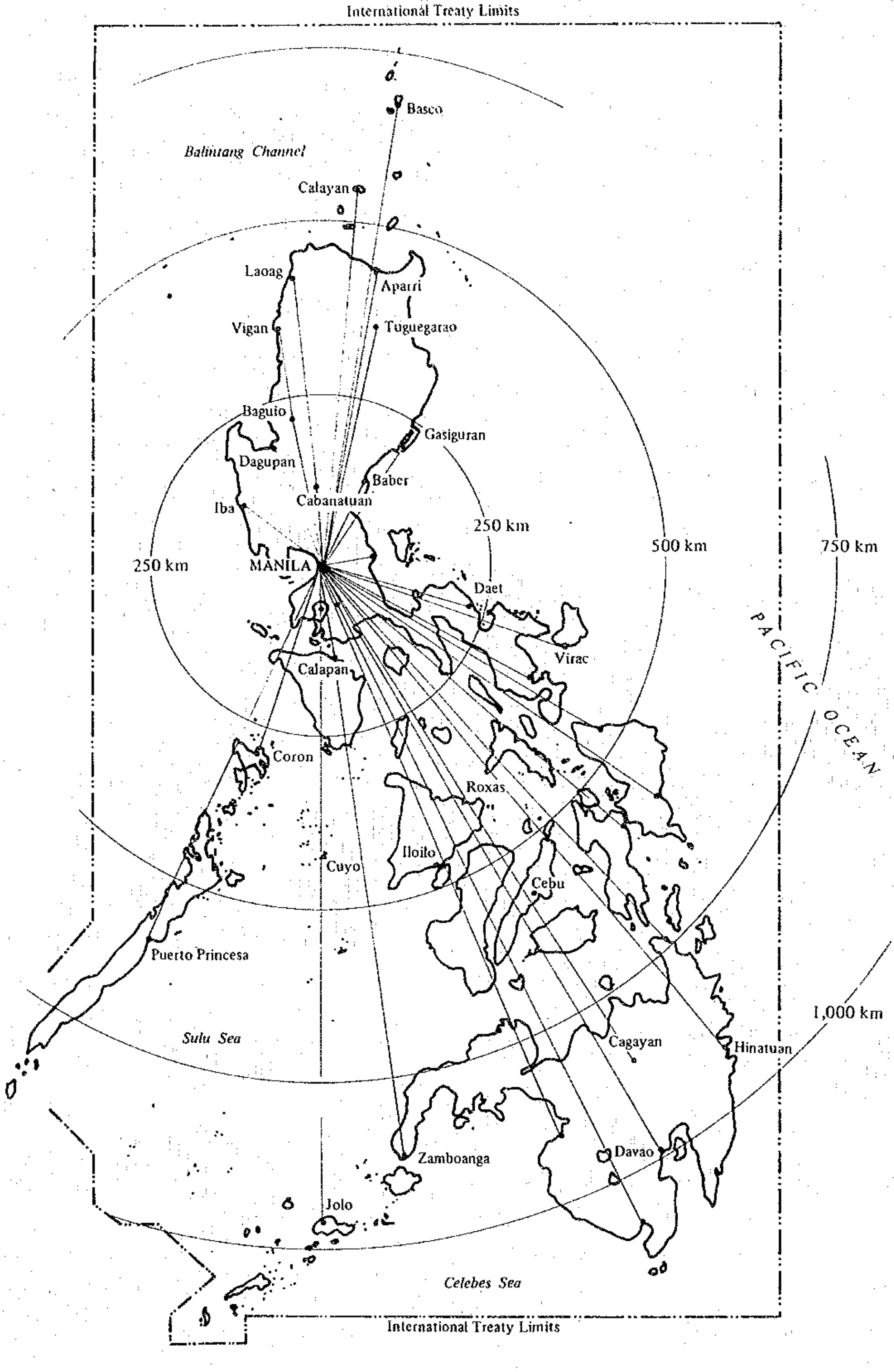


Fig. 2. Flood Forecasting and Warning Telecommunication Network

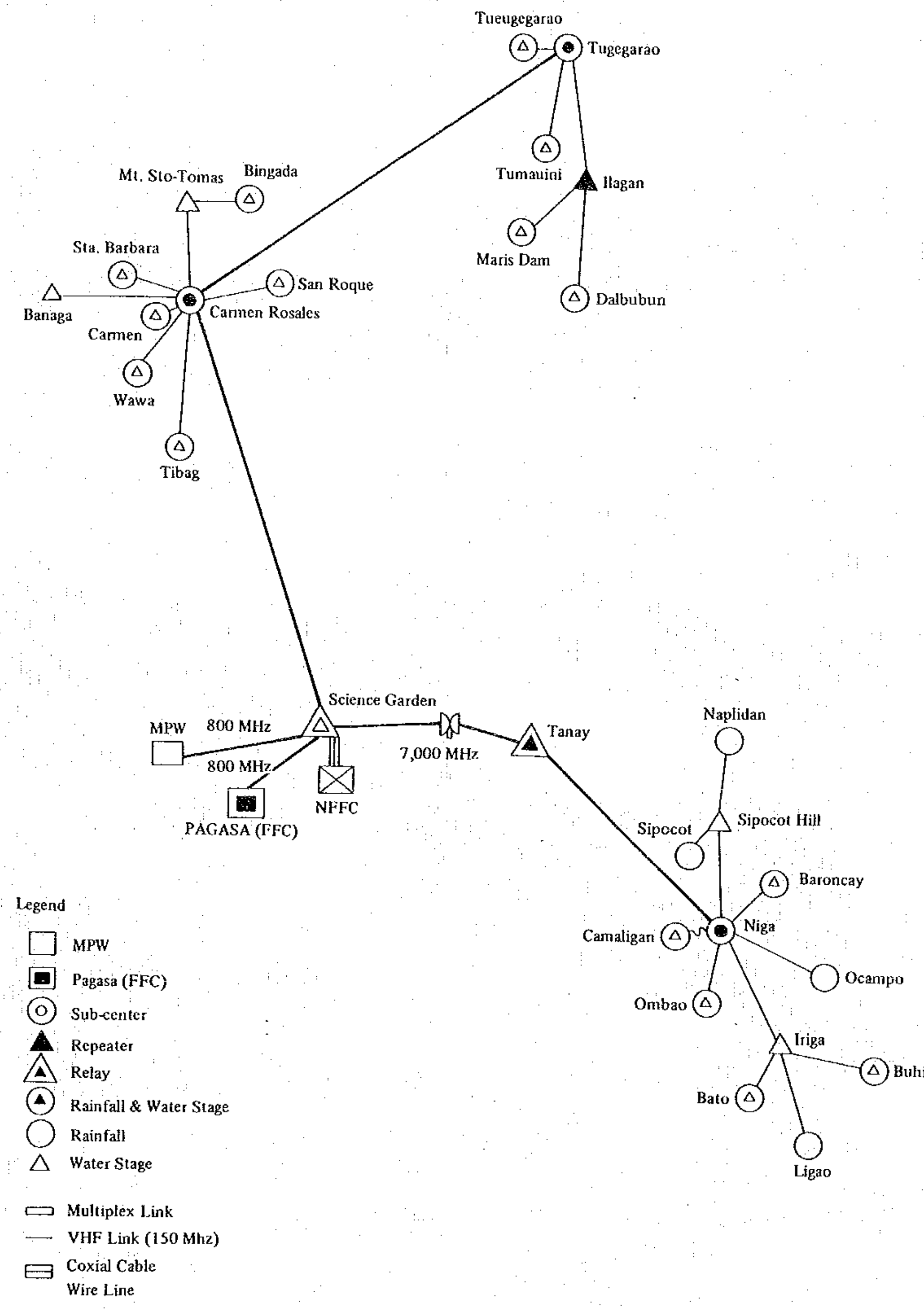


Fig. 3. Weather Radar Station and Upper Wind Station in the Philippines

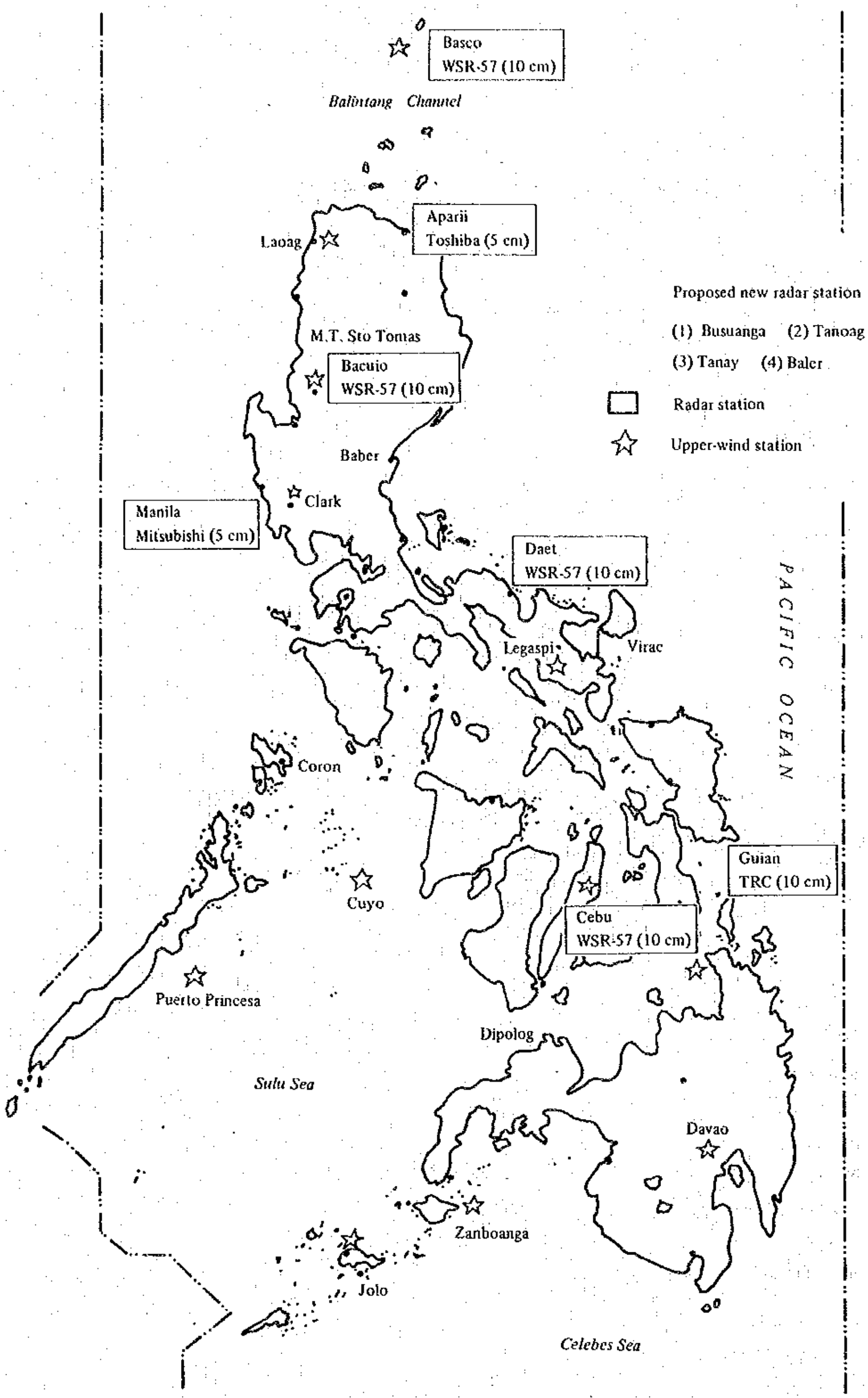


Table 1. Data for Communication and Power Generating System of Synoptic Stations

Station Index No.	Station	Distance from MLA (kms)	Station Elevation (m)	Latitutde	Longitude	SSB Transceiver Brand	Power Generator Brand	Status Commerce Power
132	o Itbayat	705	122	20°41′N	121°51′E	RCA	Honda	None
133	△ Calayan	529	12	19°10′N	121°16′E	PYE	Lister	None
135	Basco	672	10	20°27′	212°58′	RACAL	Lister	None
232	Aparii	123	2	16°22′	121°38′	RCA	Honda	Unstable
223	Laoag	411	4	18°11′	120°32′	RF, RACAL	Lister	Stable
222	Vican	336	31	17°34′	120°23′	RACAL	Lister	Stable
233	△ Tuguegarao	336	22	17°37′	121°41′	RCA	Honda	None
328	Baguio	208	1,500	16°25′	120°36′	RF	Lister	Stable
336	△ Casiguran	224	3	16°17′	122°07′	RACAL	Lister	None
325	Dagupan	176	1	16°03′	120°20′	RCA	None	Stable
333	△ Baler	131	4	15°46′	121°34′	RACAL	Lister	None
324	Iba	131	3	15°20′	119°58′	RCA	Honda	Stable
329	Cabanatuan	112	31	15°29′	120°55′	RACAL	Honda	Stable
434	Infanta	80	5	14°45′	121°39′	RCA	Lister	Unstable
	Manila					RF	Lister	Stable
432	Ambulong	64	11	16°06′	121°03′	RCA	Honda	Stable
427	Tayabas	96	157	14°02′	121°35′	RF	None	Stable
431	Calapan	136	39	13°25′	121°11′	RACAL	Lister	Unstable
439	Daet	216	10	14°07′	122°57′	PYE, RACAL	Lister	Stable
536	o Romblon	272	46	12°35′	122°16′	RACAL	Lister	None
526	△ Coron	291	14	12°00′	120°12′	RCA	Lister	None
444	Legaspi	353	17	13°08′	123°44′	RF	Lister	Stable
446	Virac	374	5	13°35′	124°14′	RCA	Lister	Stable
543	△ Nasbate	374	10	12°22′	123°37′	RCA	Lister	Unstable
538	Roxas	393	2	11°35′	122°45′	RF	None	Stable
539	△ Cuyo	424	3	10°51′	121°02′	RCA	Lister	None
637	Iloilo	465	1	10°42′	122°34′	RF	None	Stable
546	△ Catarman	465	4	12°29′	124°38′	RCA	Lister	None
548	Catbalogan	529	3	11°47′	124°53′	RCA	Honda	Stable
550	Tacloban	576	16	11°15′	125°00′	RF	Lister	Stable
546	Mactan	576	33	10°20′	123°54′	RF	None	Stable
553	△ Borongan	592	6	11°37′	125°26′	RACAL	Lister	None
318	Pto. Princesa	600	14	69°45′	118°44′	RACAL	Lister	Stable
344	Tagbilaran	632	5	09°35′	123°52′	RF	None	Stable
342	Dumaguete	640	5	09°18′	123°18′	RCA	Honda	Stable
658	△ Guiuan	656				RF	Lister	None
41	Dipolog	720	3	08°36′	123°21′	RACAL	Lister	Stable
233	Surigao	735	40	09°48′	125°30′	RF	Lister	Stable
248	Cag. de Oro	800	5	08°29′	124°38′	RF, RACAL	Lister	Stable
451	o Malaybalay	840	620	08°09′	125°05′	RCA	Honda	None
436	Zamboanga	860	5	06°54′	122°04′	RCA	Lister	Stable
455	o Hinatuan	911	2	08°22′	126°20′	RF	Lister	Unstable
330	o Jolo	952	11	06°03′	121°00′	RACAL	Lister	Unstable
754	Davao	977	19	07°04′	125°36′	RACAL	Lister	Stable
851	Gen. Santos	1,042	14	06°07′	125°14′	RCA	Lister	Unstable

Table 2. Observational Station in Philippines

PHILIPPINES							PHILIPPINES						
Index Number		Name	Lat.	Long.	Elevation (m) HP	H or HA	Index Number		Name	Lat.	Long.	Elevation (m) HP	H or HA
98440	P	Daet	14.08N	122.59E	3	2	98132		Itbayat	20.48N	121.51E	124	123
98444	P	Legaspi	13.08N	123.44E	19	17	98133		Calayan	19.16N	121.28E	13	12
98446		Virac	13.35N	124.14E	6	5	98134		Batan	20.42N	121.58E	15	
98447		Catanduanes Radar	13.59N	124.19E	233	228	98135	P	Basco	20.27N	121.58E	11	10
98501		Pagasa	11.01N	114.10E	3		98136		Basco Radar	20.26N	121.57E	13	12
98524		Talampulan Island	12.07N	119.50E	?		98222		Vigan	17.34N	120.23E	33	31
98526	P	Coron	12.00N	120.12E	14	12	98223	P	Laoag	18.11N	120.32E	5	4
98536		Romblon	12.35N	122.16E	47	46	98231		Aparri Radar	18.22N	121.37E		
98538		Roxas	11.35N	122.45E	6	5	98232	P	Aparri	18.22N	121.38E	4	2
98543		Masbate	12.22N	123.37E	11	10	98233		Tuguegarao	17.37N	121.44E	24	22
98546		Catarman	12.29N	124.38E	6	4	98321		Sto. Tomas	6.20N	120.34E	2,256	2,254
98548		Catbalogan	11.47N	124.53E	5	3	98322		Crow Valley Gunnery Range	15.19N	120.23E	161	
98550	P	Tacloban	11.15N	125.00E	21	16							
98553		Borongan	11.37N	125.26E	7	6	98323		Naula Point	15.42N	119.58E	5	
98558		Guiuan	11.02N	126.44E	60	56	98324		Iba	15.20N	119.58E	5	4
98613		Tarumpitao Point	9.02N	117.37E	2		98325		Dagupan	16.03N	120.20E	2	1
98618	P	Puerto Princesa	9.45N	118.44E	16	14	98326		Basa AB	14.59N	120.29E	46	
98630	P	Cuyo	10.51N	121.02E	4	3	98327		Clark AB	15.10N	120.34E	196	
98637	P	Iloilo	10.42N	122.34E	8	7	98328	P	Baguio	16.25N	120.36E	1,501	1,500
98642		Dumaguete	9.18N	123.18E	6	5	98329		Cabanatuan	15.29N	120.58E	32	31
98644		Tagbilaran	9.36N	123.51E	6	5	98333		Baler	15.46N	121.34E	6	4
98645		Cebu	10.20N	123.54E	35	33	98336	P	Casiguran	16.17N	122.07E	4	3
98646	P	Mactan	10.18N	123.58E	9	8	98425		Manila	14.35N	120.59E	16	6
98648		Maasin	10.08N	124.50E	19	12	98426		Cubi Point	14.48N	120.16E	18	
98653	P	Surigao	9.48N	125.30E	21	20	98427		Tayabas	14.02N	121.35E	158	157
98741		Dipolog	8.36N	123.21E	5	3	98428		Sangley Point	14.30N	120.55E	4	3
98747		Lumbia Airport	8.26N	124.17E	188	186	98429	P	Manila Internationa Airport	14.31N	121.00E	15	14
98748	P	Cagayan de Oro	8.29N	124.38E	6	5	98430		Science Garden	14.38N	121.01E	46	45
98751		Malaybalay	8.09N	125.05E	627	626	98431		Calapan	13.25N	121.11E	40	39
98753	P	Davao Airport	7.07N	125.39E	25	24	98432		Ambulong	14.05N	121.03E	11	10
98754		Davao	7.04N	124.36E	20	19	98434		Infanta	14.45N	121.39E	7	5
98755	P	Hinatuan	8.22N	126.20E	3	2	98435		Alabat	14.05N	122.01E	5	4
98815		Cagayan de Tawi-Tawi	7.00N	118.05E	34	33	98436		Fernando AB	13.57N	121.23E	372	
98830	P	Jolo	6.03N	121.00E	13	11	98437		San Francisco	13.22N	122.31E	4	2
98836	P	Zamboanga	6.54N	122.04E	6	5	98851		Gen. Santos	6.07N	125.11E	15	14

They operate once a day, but it seems that they do not function well. The reason is the shortage of spare parts, inadequate calibration and imperfect maintenance.

2-3 Comment on the Existing Conditions

2-3-1 Improvement of communication system

TCS previously mentioned that the defective weather communication system affected the collection of domestic weather data (see Appendix 1 and 2). The following counter-measures can be recommended for the present:

Present State	Countermeasure
Only one frequency, 7,995 kHz is used.	Use four allocated frequencies effectively.
Height, length of element and directivity of antennas are inadequate.	Reinvestigate the antenna design, for example, use of double doublets matched to each frequency.
Mismatching between antenna and communication equipment.	Use adequate feeder cable and use matching transformers.
Malfunction of communication equipment.	Ensure perfect maintenance, spare parts and measuring equipment for maintenance.

2-3-2 Improvement of operation

(1) Fascimile transmission for radar sketches are not used at present owing to mutual interference with SSB transmission for Synop. However, by adjusting the frequency used and transmission times, it can be operated adequately.

(2) The function of radar should be further expanded, by adding the memory of sketch data and photographs of echo pictures etc.

2-3-3 Alteration of frequency allocation

(1) SSB Transmission

3,650 kHz, 4,615 kHz, 7,995 kHz, 11,120 kHz

(2) Facsimile Transmission

2,525 kHz, 4,617 kHz, 4,615 kHz, 7,337.5 kHz

The above allocation should be changed as follows:

(1) SSB Transmission

2,525 kHz, 3,650 kHz, 4,615 kHz, 7,995 kHz

(2) Facsimile Transmission

3,617 kHz, 7,337.5 kHz

11,120 kHz is inadequate for this transmission, because it is beyond the MUF band (see Appendix 4).

Chapter 3. RECOMMENDATIONS FOR THE TRANSMISSION SYSTEM

3-1 Purpose

In this chapter, consolidation and improvements concerned with the transmission network for collecting promptly all the data observed at weather observatories all over the Philippines towards Manila Weather Center, will be recommended.

3-2 Allocation of Weather Observatories

The Philippines is an archipelago consisting of 7,200 islands, from 5° to 22° N.Lat. The territory extends about 1,850 km from north to south and about 1,120 km from east to west and has 69 observatories (registered by WMO, Annex 3, see Table 2).

3-3 Construction of a Telecommunciation Network

The purpose of meteorological observation is to collect data from each area as soon as possible, to analyze and forecast changes in the weather based on these data, and to prevent disasters in local communities by distributing the result. Therefore, the meteorological data, which changes with time, should be broadcast as promptly as possible and correctly.

In order to fulfill these requirement, various kinds of telecommunication network systems will be considered. Considering that the greater part of this country consists of islands separated by the sea and that even small islands are mountainous with complicated topography, at present, the short wave band (H.F) should be introduced in the telecommunication system for the following reasons:

(1) Telecommunication systems at each observatory can be organized indepdendently (relay stations unnecessary).

(2) Telecommunication facilities are inexpensive and their operation is simple.

Comparing the HF band (3 MHz – 30 MHz) with the VHF band (30 MHz – 300

MHz), although the HF band has the advantage of no relay stations, Propagation Condition differs from day to night and is affected by solar spots. Consequently, the selection of frequencies becomes inevitably difficult. On the other hand, frequencies in VHF are stable all the year round and have the advantage of excellent networks with good signal-to-noise ratios. However, it requires many relay stations and a complicated system. Accordingly, a future telecommunication system should be shifted to the VHF or UHF band with the increase in data used. However, considering the complication of relay stations, HF transmission will still remain in some networks.

From this point of view, the survey team will draw up the step-by-step consolidation plan mentioned below and recommend the completion of the weather data transmission system by reviewing the procedure.

3-3-1 Consolidation plan for the telecommunication network

A. Phase–1 (Fig. 4 and 5)

a. In Luzon Island, collect data using the HF or VHF band linked between multiplex sub-centers (Tuguegarao, Cabanatuan and Naga) set up by the Flood Forecasting Weather System and the weather observatories. Data collected at sub-centers be packaged and sent to Manila Central Office using one channel of the multiplex route. The method of transmission is mentioned in 3-3-2.

b. In the south of Luzon, sub-centers located at Cebu and Iloilo to collect data from weather observatories using HF. Packaged data to be sent from the sub-center to Manila Central Office using HF also. In the 2nd survey, the feasibility of the following channels will be considered:

(a) Two channel ISB transmission between Cebu and Manila.

(b) OH (Over Horizon) multiplex channel between Cebu and Manila.

(c) After constructing on OH multiplex channel between Cebu and Naga, the connection of this channel with the existing Naga-Manila channel.

Fig. 4. Phase-1 Propose Data Collecting System Net Work

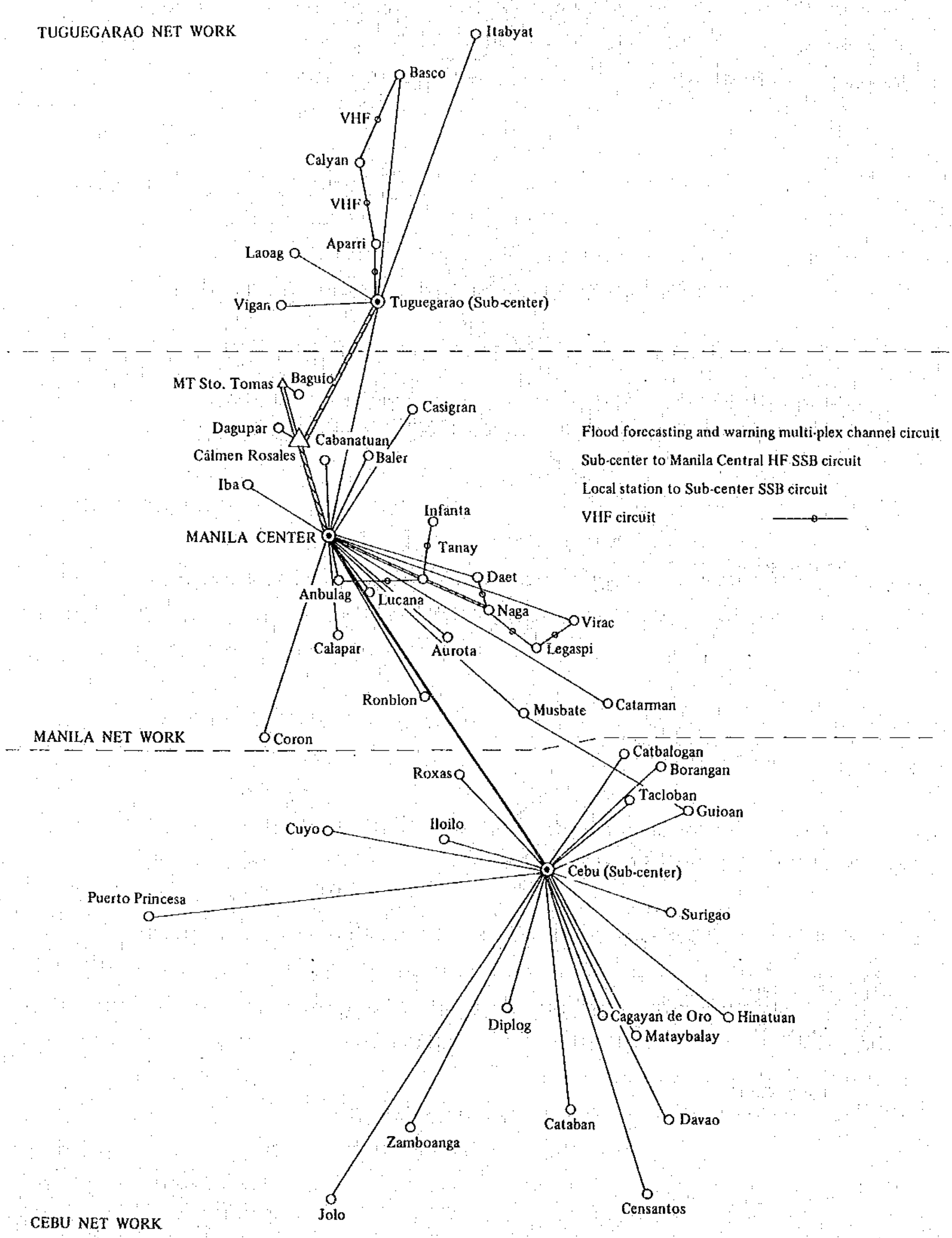
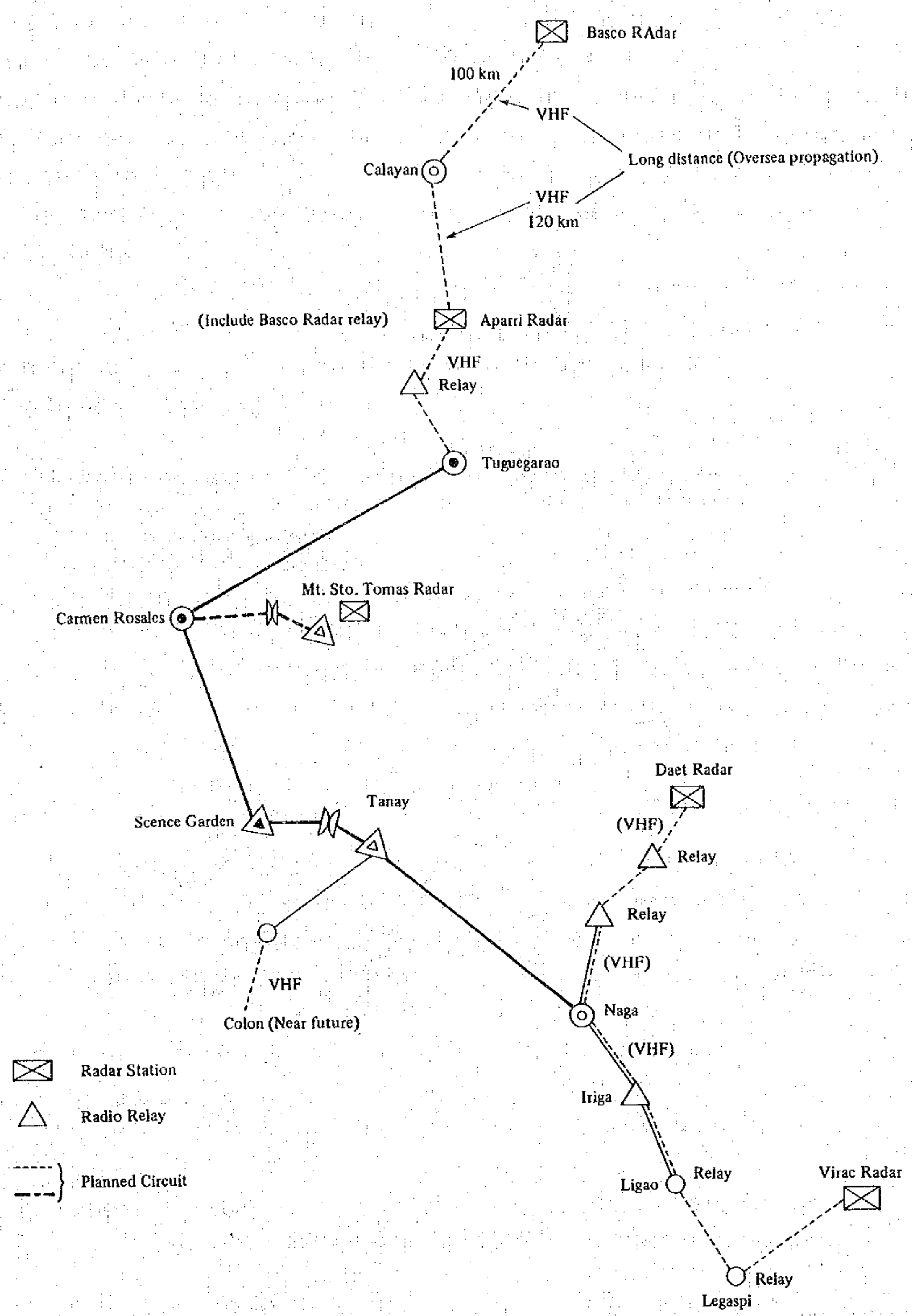


Fig. 5. Radar Faccimile Transmission



c. In the weather radar station, install equipment such as an A/D converter and a transmission speed converter (the radar video signal will be sent to a sub-center using VHF). Between sub-centers and the Central Office, this data to be transmitted using one channel (different from Synop data Channel) of the existing FFWS multiplex channels.

d. In the weather radar stations (Cebu and Guiuan), where multiplex channels cannot be used, a radar sketch to be drawn and transmitted to the Central Office using HF facsimile. In Basco, Aparri and Virac, a back-up HF transceiver equipped for radar sketch transmission against the failure of VHF or multiplex channels to be set up.

e. A simultaneous transmission network from PAGASA to the government organizations (if necessary, to information media) to be installed.

B. Phase–2

a. In the south of Luzon, a multiplex network is planned. When FFWS's Phase–2 has the same plan, data will be collected using this network. In this case, the method of A, Phase–1–a will be adopted.

b. The Phase–1–c method will be adopted instead of the radar sketch mentioned in Phase–1–a.

c. The method facsimile transmission as well as dissemination of processed data by teletype from the central office using multiplex, VHF and HF will be planned.

In addition, after the completion of the above data collecting and distribution systems, in Phases–1 and –2, new development plans and their execution, such as system automation (for example, an automatic data editing and switching system), introduction of computers for analysis and forecast, and utilization of meteorological satellites should be considered.

Surplus HF equipment, having been substituted by VHF in Phase–2, should be installed at stations remaining as a HF stations for stand-by facility.

3-3-2 Method of data collection

In telecommunications there are two methods, namely, teletype and voice transmission (SSB). Teletype is mainly to be used, and for radar transmission is VHF, a digital transmission method is adopted.

A. Synop Data Transmission

a. Time of data collection

In the case of voice transmission, time is no problem when there are few observatories. However, data collection takes a lot of time with as many as 50 stations as in this system.

In the teletype system, responses are controlled by order of the Center and the time is about 20 seconds for one station. Consequently, the collection time required for the sub-centers is as follows:

Order Station	No. of Observatories	Time
Manila Central Office	16	5 min. 20 sec.
Tugegarao Sub-center	7	2 min. 20 sec.
Cabanatuan	3	1 min.
Naga Sub-center	3	1 min.
Cebu Sub-center	19	6 min. 20 sec.

Each Sub-center receives all the data from observatories in their zones and transmit them to Manila Central Office. Therefore, the Manila office requires about 11 minutes to receive the data.

Voice operation is used for pre-warning from the Central Office and as a back-up for teletype failure.

b. Transmission, control, etc.

Data from the observatory is transformed by teletype into the form of punched-tape and is transmitted automatically in accordance with the call from sub-centers or the Central Office.

The coding mode for teletype is the CCITT International Alphabet Code method and the order of call for data collection and others will be studied and decided by the time of the next survey. Examples of teletype and voice communication of this kind used in Japan are shown in Fig. 6.

B. Radar Transmission

Weather radar information has been used only at observatories. However, transmission of these signals to Manila Central Office should be considered. A block diagram of the radar relay system is shown in Fig. 7.

When this system is connected to the multiplex channel, the transmission of Synop data and radar data will use their own channels. The switching system and other related matters should be studied by the time of the next survey.

3-3-3 Frequencies used (H.F)

Operating frequencies of short wave transmission should be decided in consideration of physical factors, such as season, time, location, number of solar spots, etc. The calculation of necessary frequencies based upon these factors is shown in Appendix-3.

The number of solar spots will be largest in this year (1980) at about 130 spots, and it will gradually decrease. Around 1991, it will number about ten spots. Examples of MUF over a distance of 175 km and reliability according to each frequency are shown in reference, pp. 15, 16, 57, 58, 59 and 60. As clearly noted, before and after 4 o'clock, local time, short wave transmission is not available, because MUF is under 2 MHz when the Solar Spot Number (SSN) is 10. Although perfect transmission becomes impossible in this band, 3, 5, 7 and 9 MHz can be used stably all the year round (refer to Appendix-3).

Fig. 6-1. System Block Diagram of the Manila Central Station

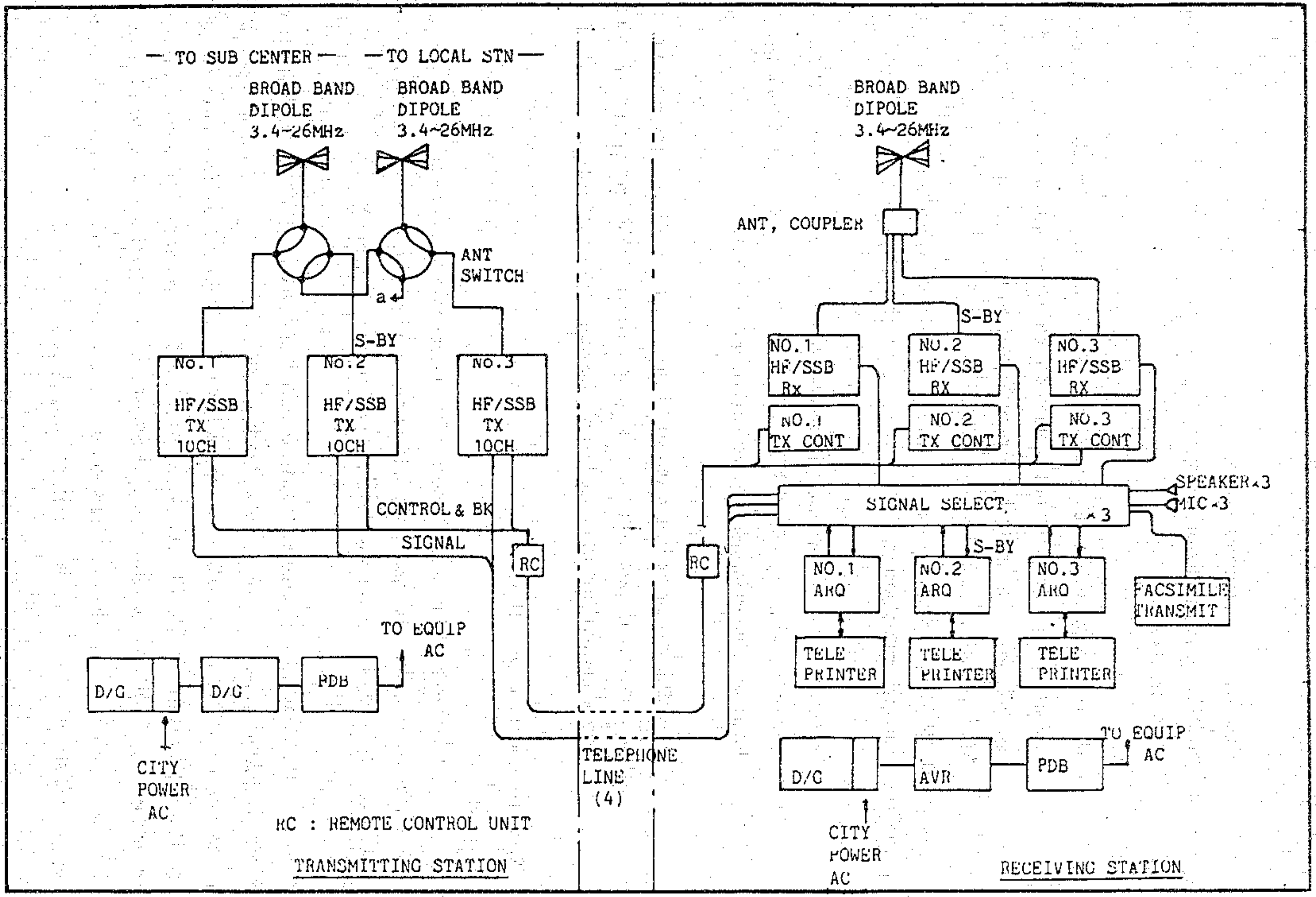
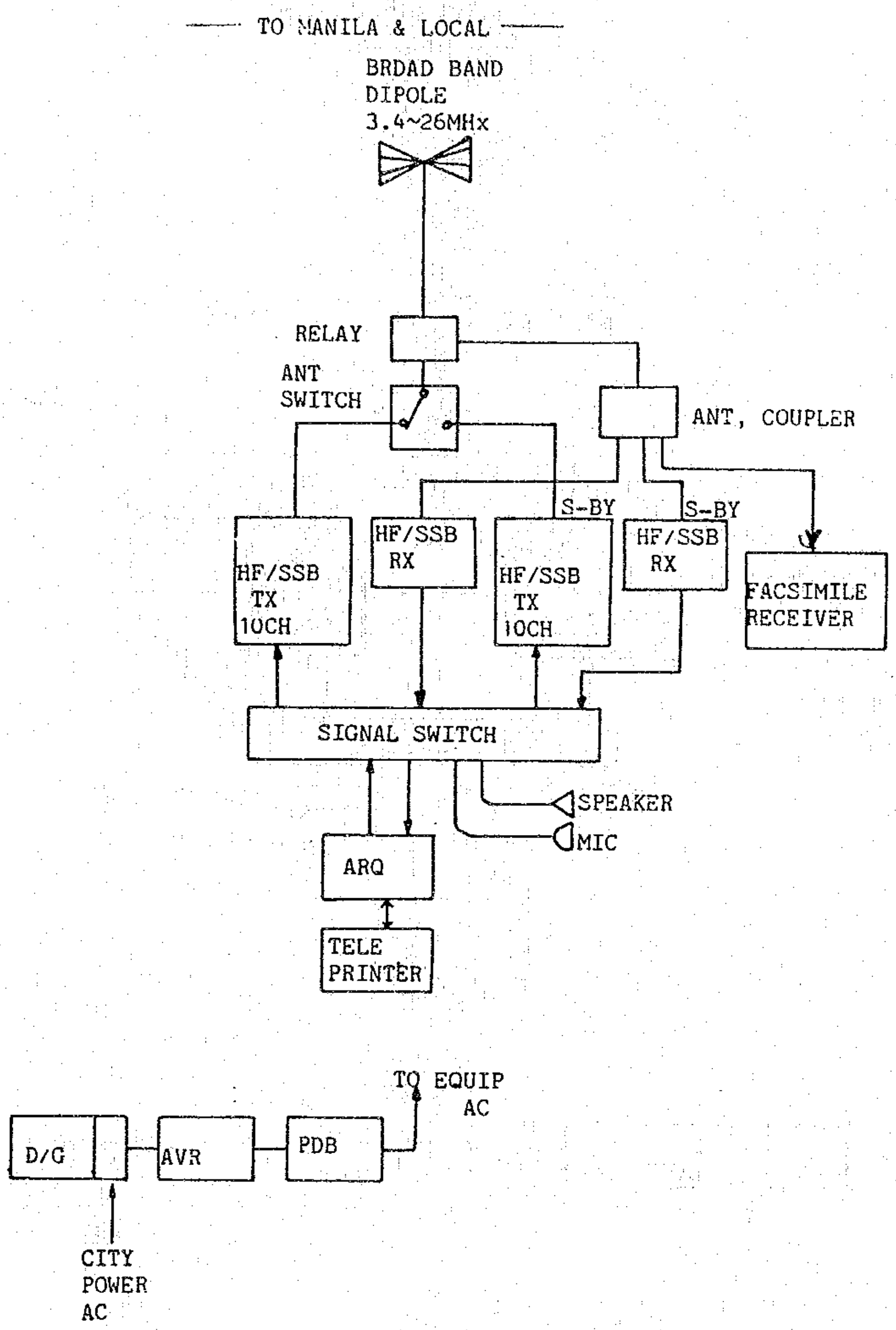
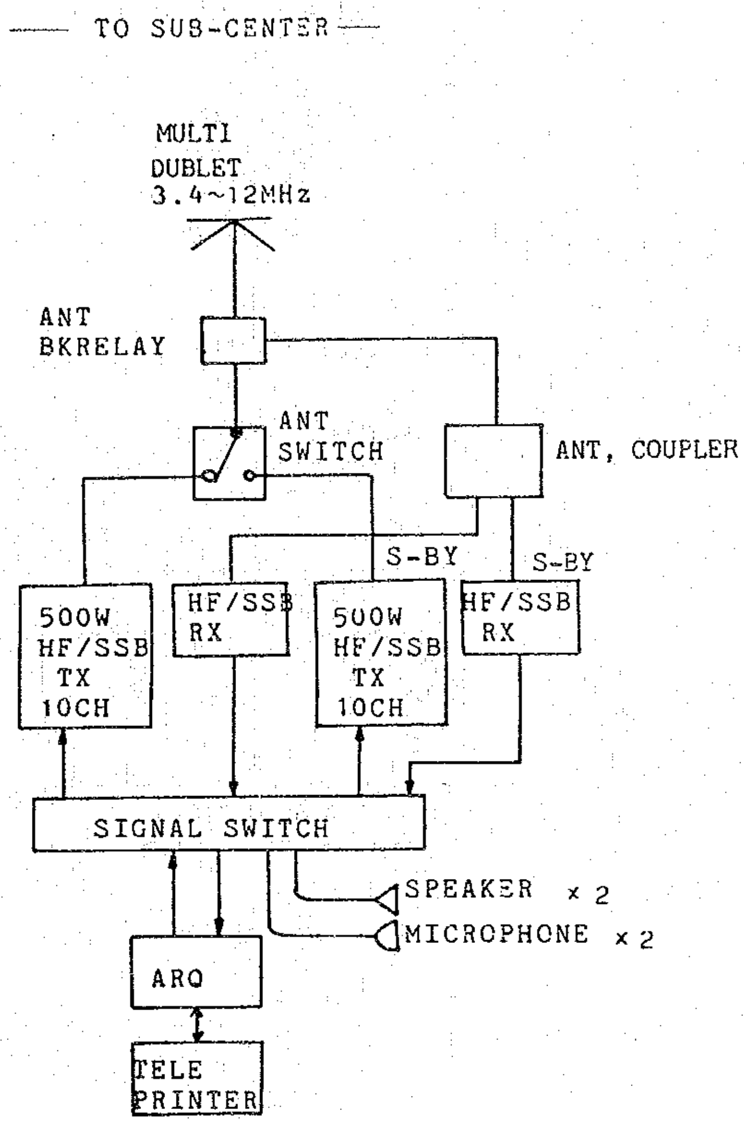


Fig. 6-2. System Block Diagram of the Sub-Center



TUGUEGARAO, CEBU,

Fig. 6-3. System Block Diagram of the Local Station



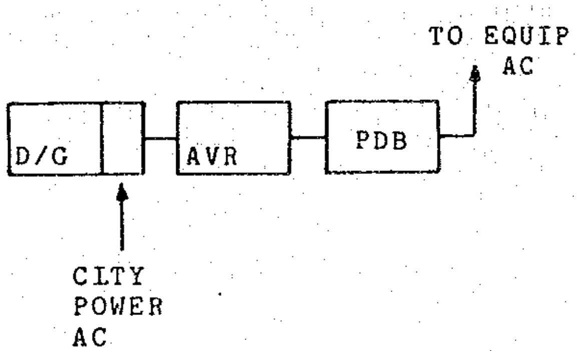
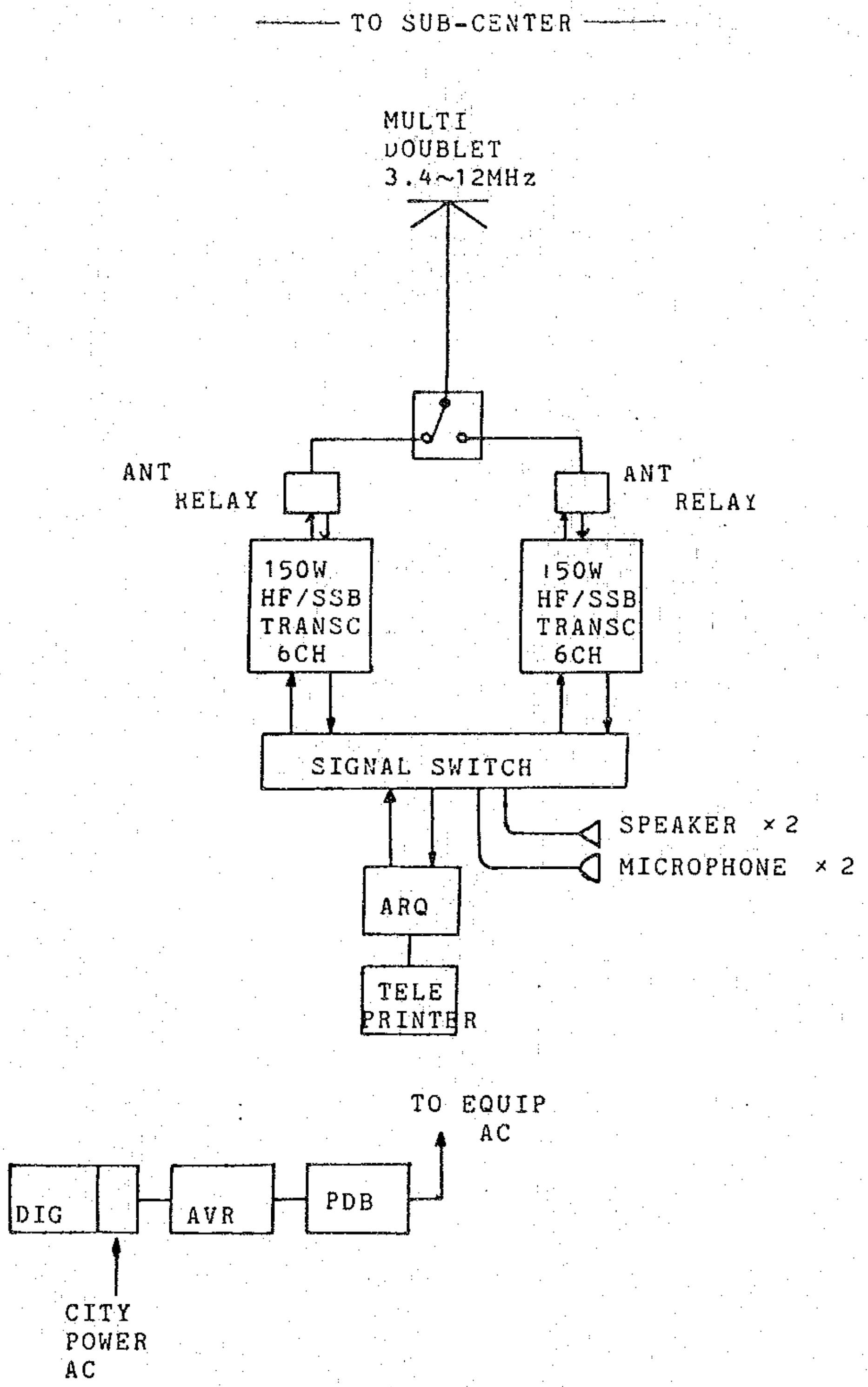
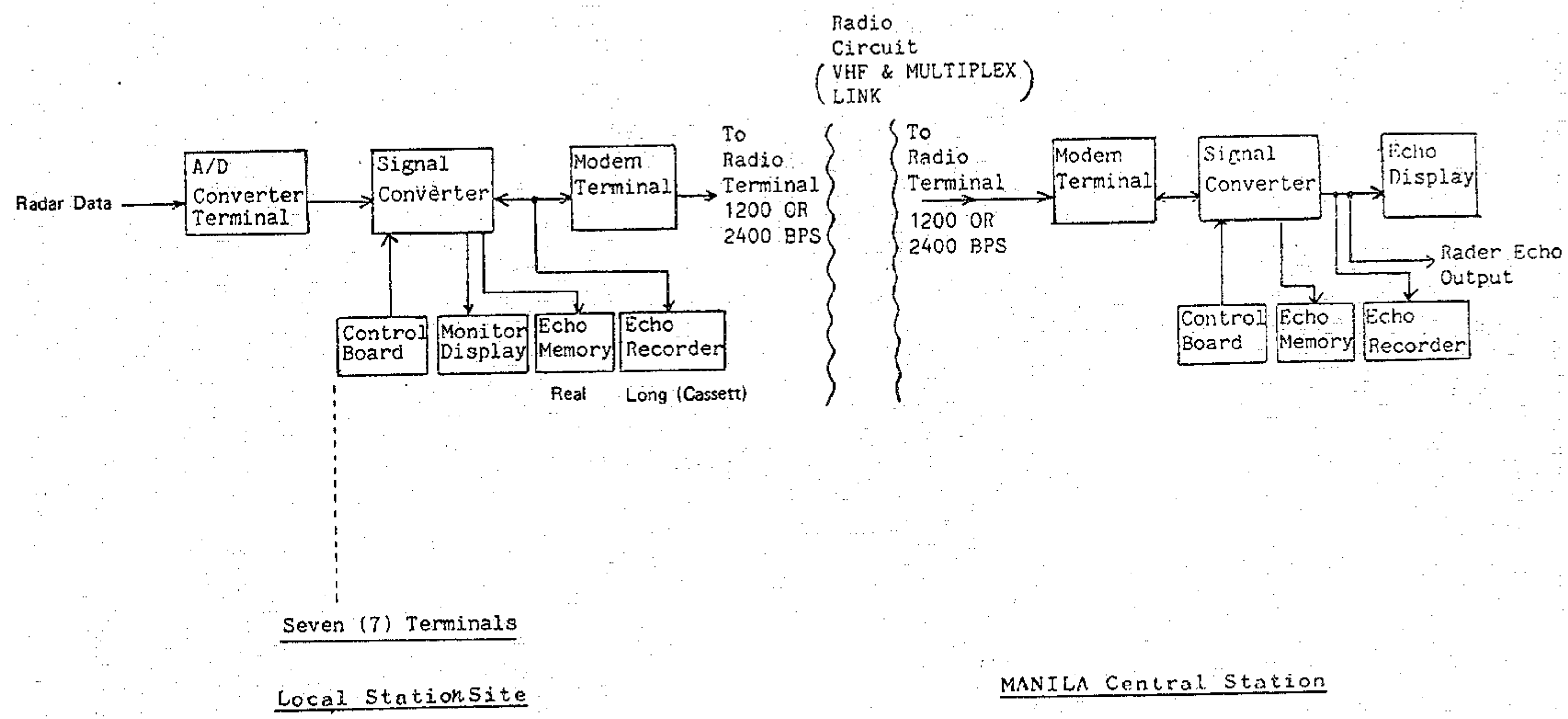


Fig. 6-4. System Block Diagram of the Local Station (Short & Medium Distance)



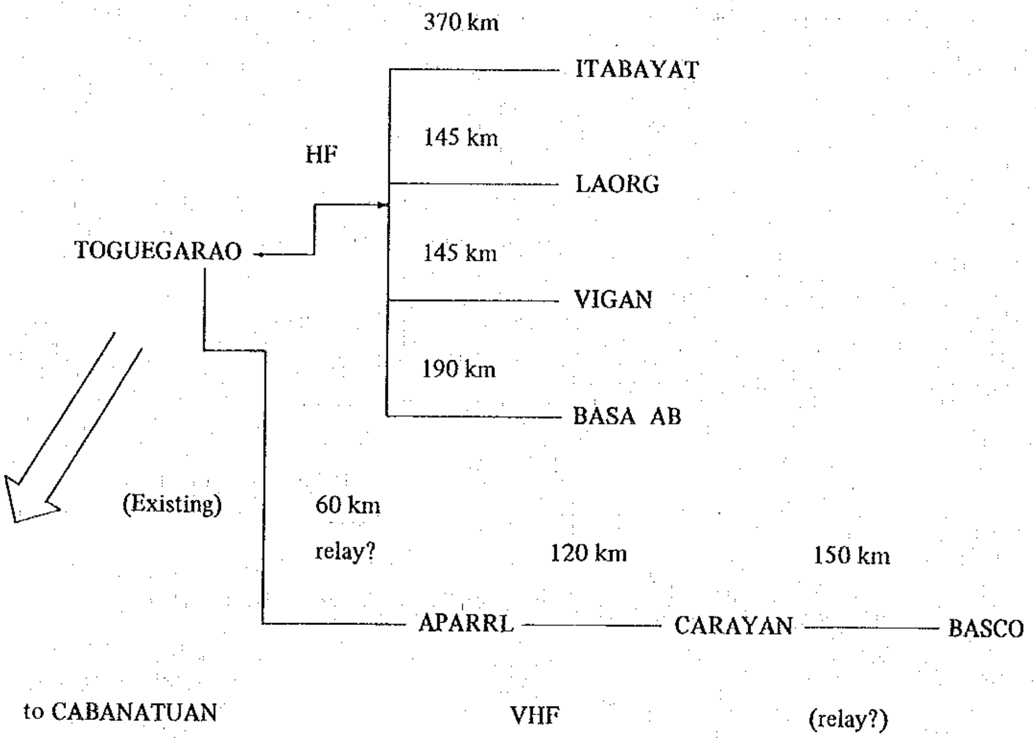
TRANSC : TRANSCEIVER

Fig. 7. Block Diagram of the Rader Relay System

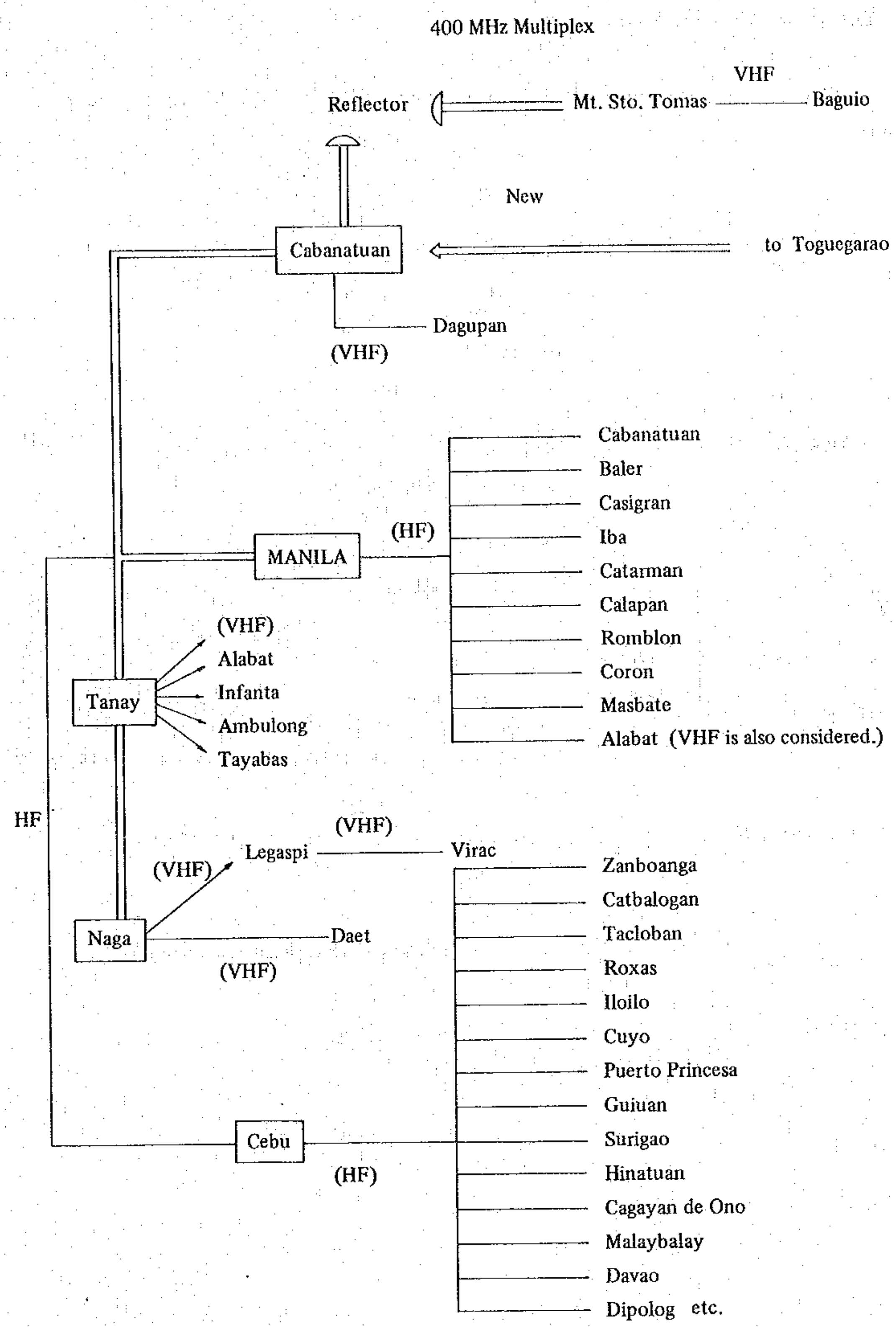


3-3-4 Transmission system network

The data collecting system network, shown in Fig. 4, is divided according to system as follows:



(except multiplex, all are new channels)


400 MHz Multiplex
VHF
Reflector
Mt. Sto. Tomas
Baguio
New
Cabanatuan
to Toguegarao
Dagupan
(VHF)
Cabanatuan
Baler
Casigran
Iba
Catarman
Calapan
Romblon
Coron
Masbate
Alabat (VHF is also considered.)
(HF)
MANILA
(VHF)
Alabat
Infanta
Ambulong
Tayabas
Tanay
HF
(VHF)
Legaspi
Virac
(VHF)
Naga
Daet
(VHF)
Zanboanga
Catbalogan
Tacloban
Roxas
Iloilo
Cuyo
Puerto Princesa
Guiuan
Surigao
Hinatuan
Cagayan de Ono
Malaybalay
Davao
Dipolog etc.
Cebu
(HF)

BASIC CONDITIONS OF PARAMETER CALCULATION FOR SHORT WAVE TRANSMISSION DESIGN

Date:

Column	No. of figures	Figures described	Unit	Significance	Description
2	1	1		Forecast curves of LUF and MUF	1
		3		Field intensity, Propagation mode, Radiation angle, Noise power, Channel reliability, etc.	3
4	1	1 – 24	Time	Time interval of calculation time	2
1–8 ~ 73–80	8 - 5	3 – 30	MHz	Frequency, Designation of under 10 waves is available, Unnecessary in the calculation of LUF and MUF	3.0, 3.8, 4.7, 5.9, 7.4, 9.3, 11.7, 14.7, 18.4, 23.0
2–3	⩽2	01 – 12	Month	Designated month (Jan.–Dec.)	03, 06, 09, 12
4–8	⩽5	Positive real no.		Solar Spot Number	10, 100
1–8	⩽8	Arbitrary		Name of Transmitting Station	CAGAYAN
10	1	N or S		Latitudinal name of transmitting site	N
11–16	⩽6	0 – 90	Degree	Latitude of transmitting site	8.29
17	1	E or W		Latitudinal name of transmitting site	E
18–23	⩽6	0 – 180	Degree	Longitude of receiving site	124.38
24–25	⩽2	Positive integer	dB	Gain of transmitting antenna	0
26–33	⩽8	Arbitrary		Name of receiving station	DAVAO

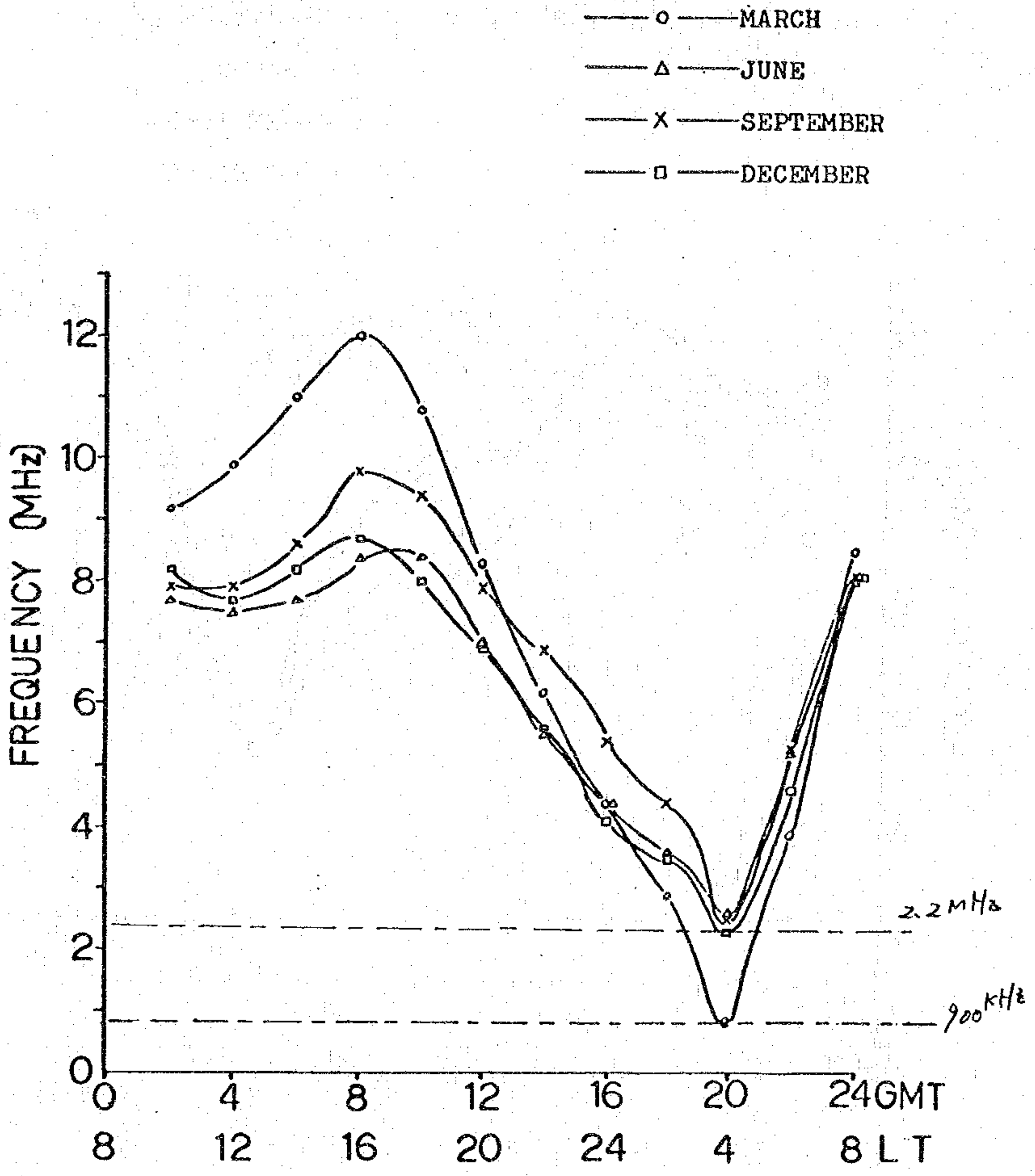
Column	No. of figures	Figures described	Unit	Significance	Description
35	1	N or S		Latitudinal name of receiving site	N
36–41	≤6	0 – 90	Degree	Latitude of receiving site	7.07
42	1	E or W		Longitudinal name of receiving site	E
43–48	≤6	0 – 180	Degree	Longitude of receiving site	125.39
49–50	≤2	Positive integer	dB	Gain of receiving antenna	0
51–54	≤4	Positive real no.	kW	Transmitting power	0.15
55–57	≤3	Integer	dB	Minimum necessary field intensity or necessary signal to noise ratio	S/N 61
58–61	≤4	1		Artificial noise (Urban area)	
		2		Artificial noise (Others)	
		3		Artificial noise (Rural area)	
		Negative integer	dB	Artificial noise (Designated by user)	
62–64	≤3	Positive integer	%	Effective time rate	
69	1	0		Front side route	0
		1		Back side route	
73	1	E or W		Longitudinal name which decides local time	E
74–78	≤5	0 – 180	Degree	Longitude which decides local time	120

MUF CURVE

SSN - 10 DISTANCE = 175KM POWER = 0.15KW

T - CAGAYAN DE ORO (748) 8.29N 124.38E

R - DAVAO AIRPORT (753) 7.07N 125.39E

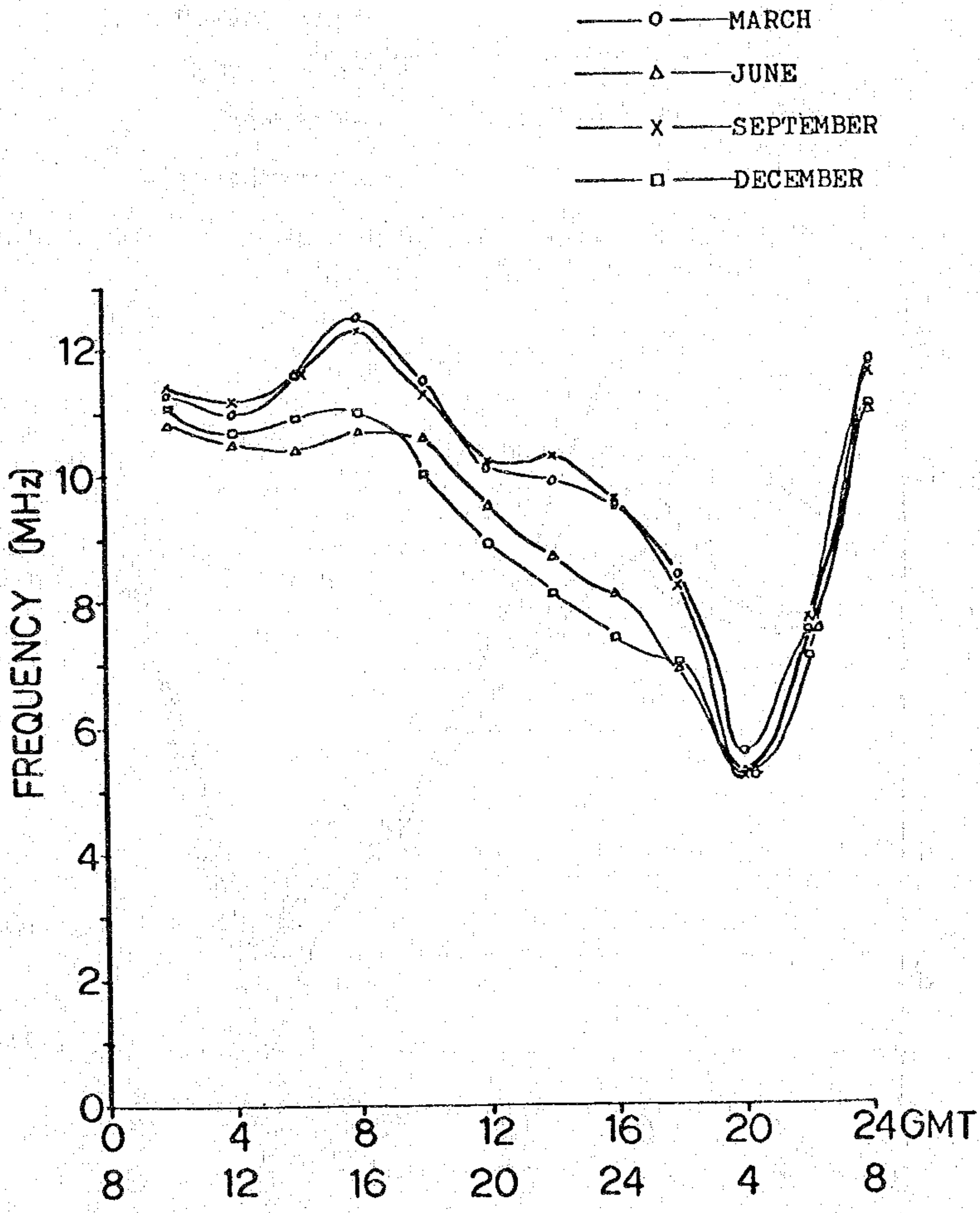


MUF CURVE

SSN - 100 DISTANCE =175KM POWER = 0.15KW

T - CAGAYAN DE ORO (748) 8.29N 124.38E

R - DAVAO AIRPORT (753) 7.07N 125.39E



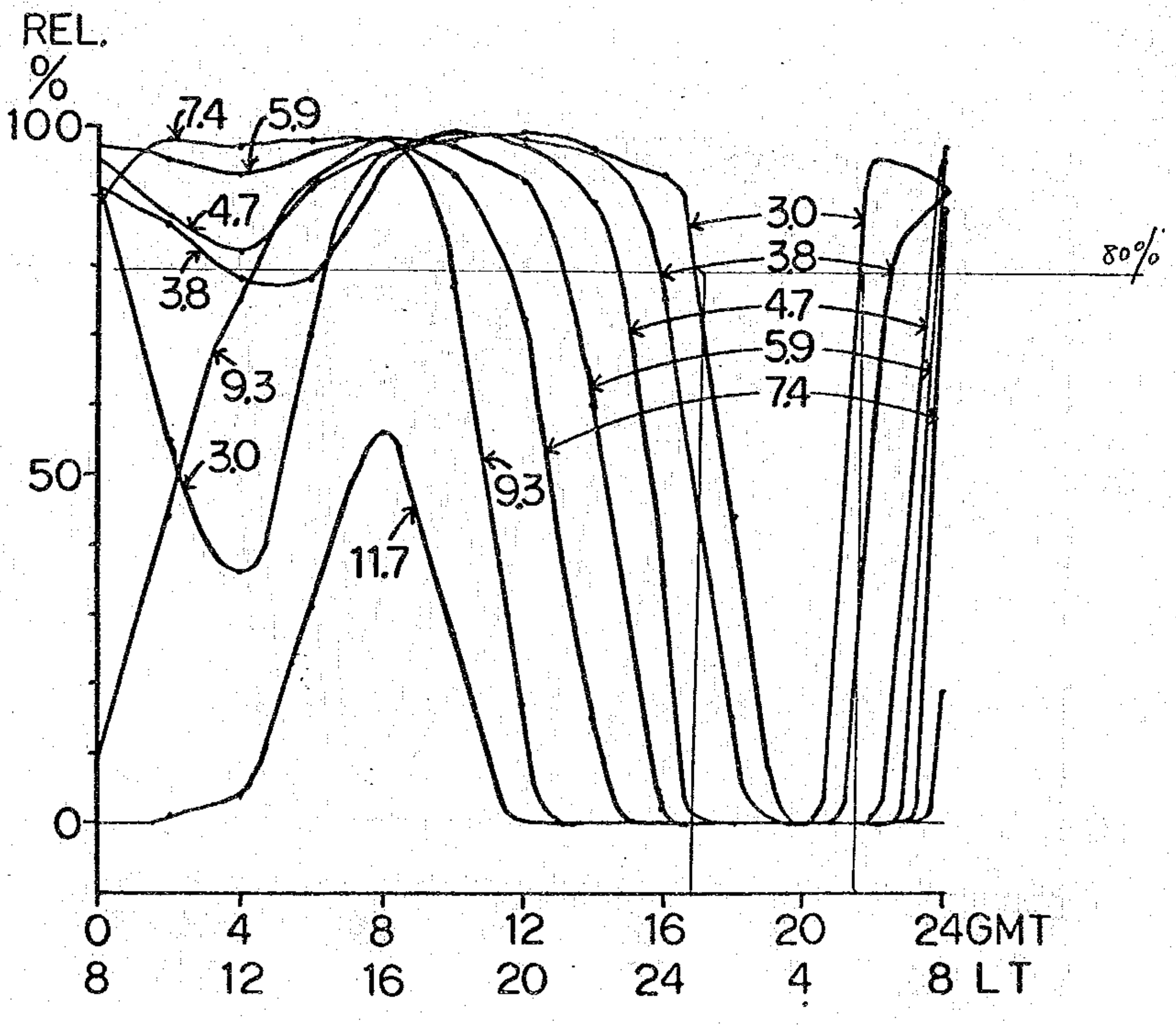
CIRCUIT RELIABILITY : REL.

MONTH - 3 SSN - 10 POWER = 0.15KW

T - CAGAYAN DE ORO (748) 8.29N 124.38E

R - DAVAO AIRPORT (753) 7.07N 125.39E

DISTANCE = 175KM AZIMUTHS TR - 140 RT - 320



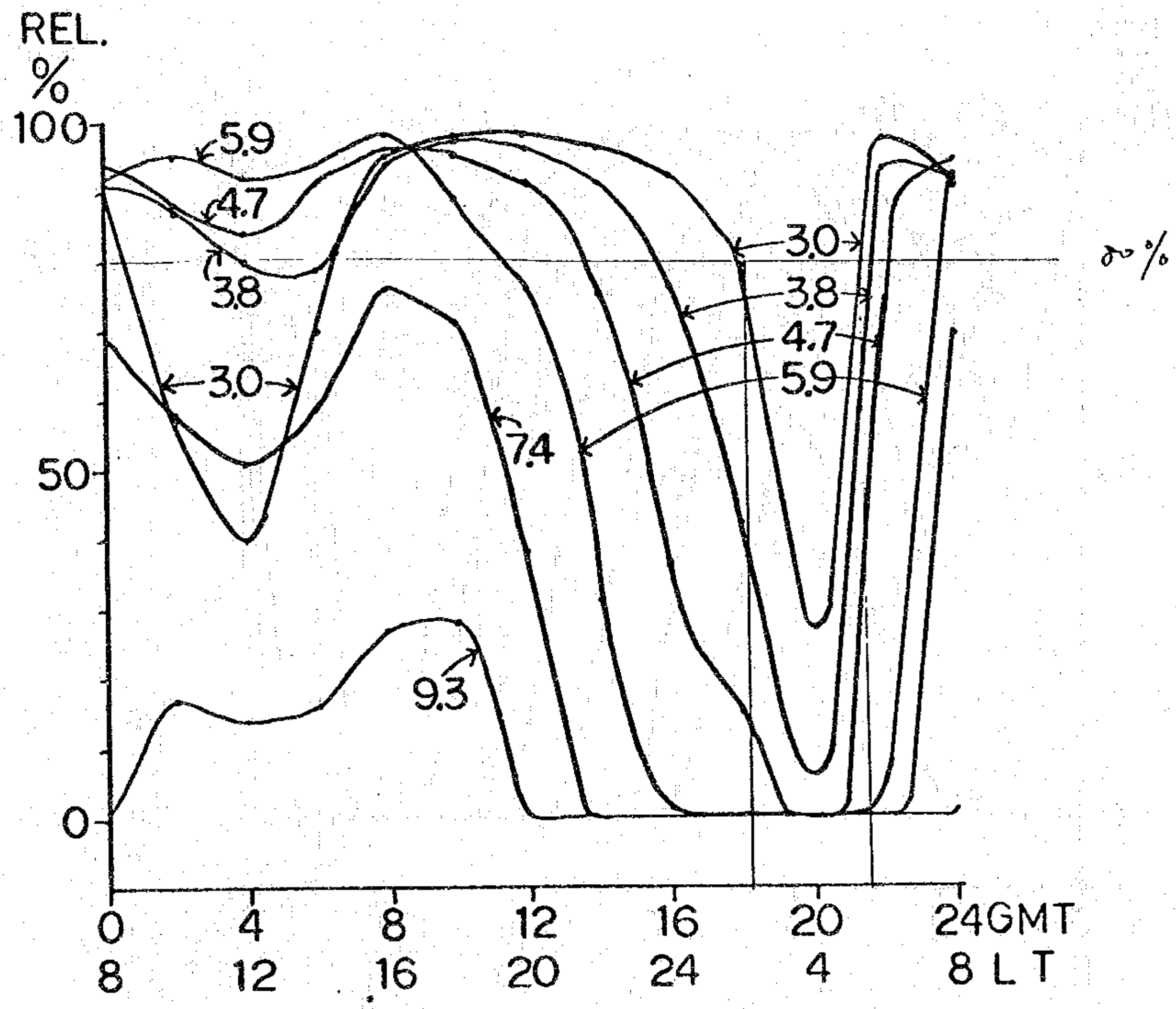
CIRCUIT RELIABILITY : REL.

MONTH - 6 SSN - 10 POWER = 0.15KW

T - CAGAYAN DE ORO (748) 8.29N 124.38E

R - DAVAO AIRPORT (753) 7.07N 125.39E

DISTANCE = 175KM AZIMUTHS TR - 140 RT - 320



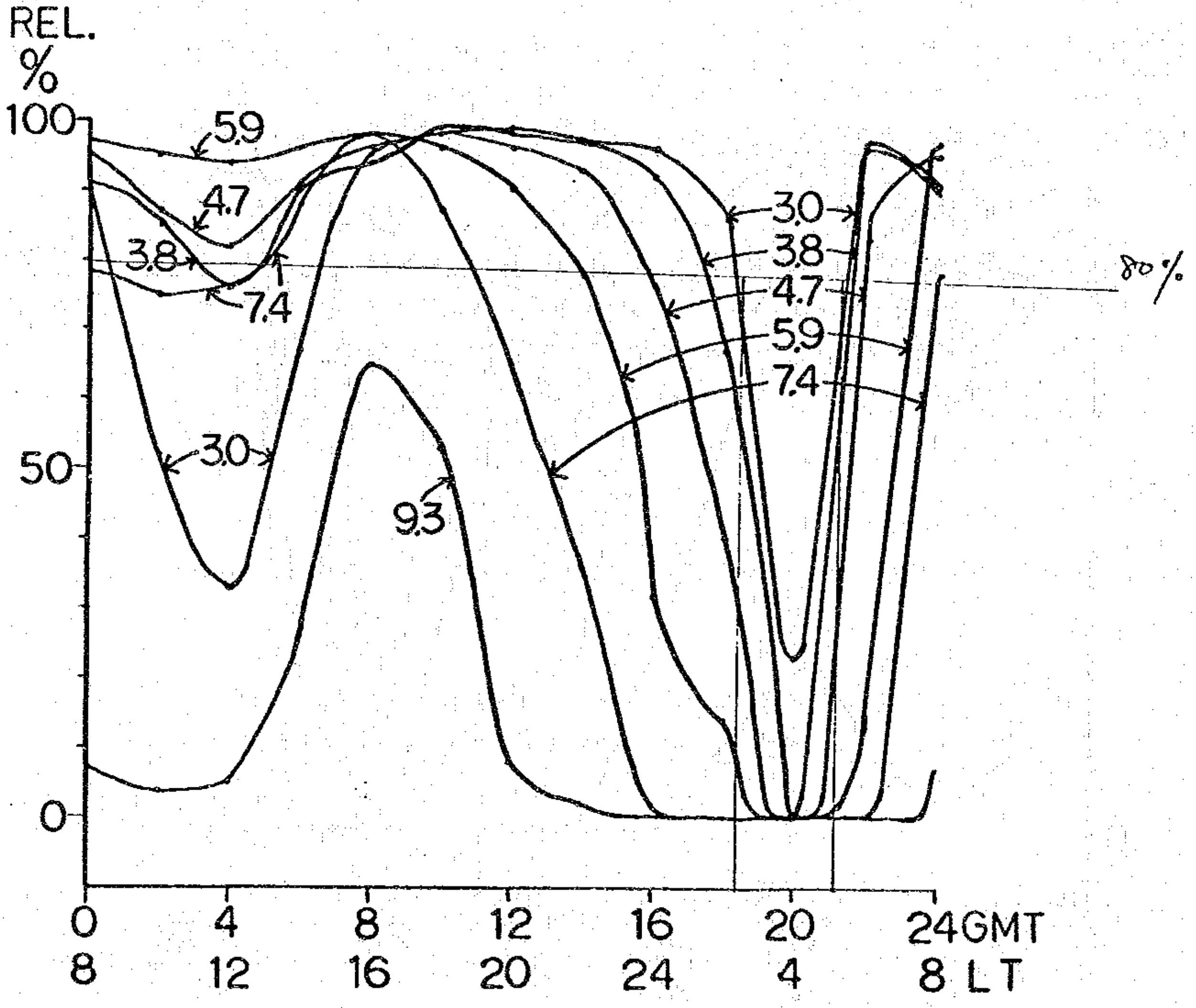
CIRCUIT RELIABILITY : REL.

MONTH - 9 SSN - 10 POWER = 0.15KW

T - CAGAYAN DE ORO (748) 8.29N 124.38E

R - DAVAO AIRPORT (753) 7.07N 125.39E

DISTANCE = 175KM AZIMUTHS TR - 140 RT - 320



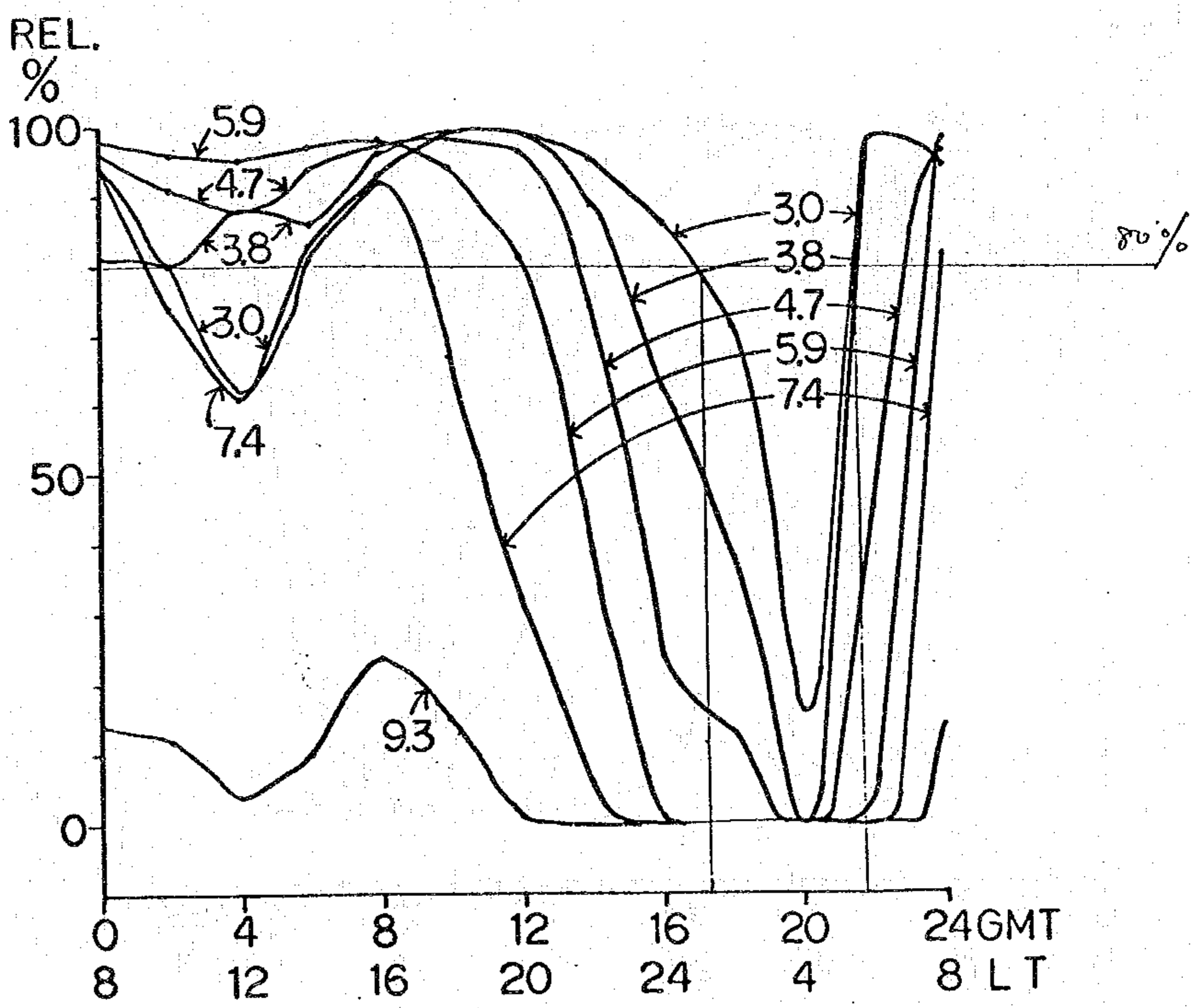
CIRCUIT RELIABILITY : REL.

MONTH - 12 SSN - 10 POWER = 0.15KW

T - CAGAYAN DE ORO (748) 8.29N 124.38E

R - DAVAO AIRPORT (753) 7.07N 125 39E

DISTANCE = 175KM AZIMUTHS TR - 140 RT - 320



3-3-5 Antenna system

The following conditions should taken into consideration for transmitting and receiving antennas installed at observatories:

(a) The transmission distance for HF is 100 km (minimum) to 550 km (maximum). Because of point-to-point transmission, radiation angles of antenna should cover from 88.8° to 47.5°.

(b) Operating frequencies cover from 2.5 to 12 MHz. Transmitting and receiving antenna at Manila Central Office and a transmit-receive common antenna at Tuguegarao and Cebu Sub-centers adopt non-directional wideband antennas for communication with local stations in their zones. Local stations will use double-doublet antennas which cover all frequencies, because they communicate only with sub-centers.

Note 1: In manila Central Office, antennas cannot be erected because of the narrow site. Therefore, transmitting antennas and transmitters are located at Deliman Station, and receiving antennas and receivers at Science Garden. Manila Central Office distributes and collects data and remotely controls the equipment.

(c) When more than two antennas are used in the same site, a specious site should be obtained so that two antennas can be separated over $\lambda/2$ to prevent mutual interference.

Note 2: The distance between the transmitting site and the receiving site of Manila Station should be more than about 3 km.

3-3-6 Electric power facilities

Engine Generators are used as a stand-by system for power supply. Power supply of unattended VHF stations will be considered at the field survey of the 2nd dispatch.

3-3-7 Examples of circuit design (Basco-Calayan, marine propagation)

A circuit design supposedly using 60 MHz, VHF band, which is used by the Japan Meteorological Agency, is shown below. About the circuit which has scarcely any margin like this, we should put into practice this field Propagation test and choose the practical circuit.

(1)	Antenna power	44 kBm (including feeder loss of -3 dB)	
(2)	Antenna gain, 5-element	10 dB x 2 dB	
(3)	Loss of free space	-109.6 dB	
(4)	Additional loss	-27.9 dB	
(5)	Rayleigh distribution loss	-20	Reliability: 99%
(6)	K-type fading loss	-15	
(7)	Receiving power	-108.5 dBm	
(8)	Threshold level	-112 dBm	
(9)	Threshold margin	-3.5 dB	
(10)	Signal to noise ratio	Approx. 21 dB	

Chapter 4. THE 2ND SURVEY PLAN

In order to execute Phase–1, a further close investigation, based upon this survey, will be necessary.

Therefore, the following plan and its execution are recommended.

4-1 Outline of Survey

a.	Time	by mutual agreement of both meteorological agencies
b.	Duration	– ditto –
c.	No. of Specialists	– ditto –
d.	Items	Circuit design, propagation tests and site investigation
e.	Place of propagation test and place investigation	BASCO – CARAYAN CARAYAN – APARRI APARRI – TOGUEGARAO TANAY – ALBAT – INFANTA – AMBULONG – TAYABAS LEGASPI – VIRAC LEGASPI – LIGAO NAGA – DIET
f.	Counterparts	6 persons from PAGASA and temporary employment at the site if needed.

4-2 Necessary Equipment

(1) Field Intensity Meter
(2) Portable VHF Tranceiver
(3) Portable Antenna
(4) Pen Recorder
(5) Standard Frequency Generator
(6) Engine Generator (300 W)
(7) Variable AC Transformer
(8) Circuit Tester, Level Meter
(9) CM Power Meter
(10) Telescopic Pole, Angles
(11) Winch
(12) Feeder Cable, 25 m
(13) AC Code (Cable), 100 m
(14) Compass
(15) Camping Goods
(16) Nylon Rope
(17) Shovel
(18) Lorge Hammer
(19) Tool Set for Wiring and Repairing
(20) Sickle (for Mowing), Tape Measure
(21) Rubber Boots, Gloves
(22) Helmets
(23) Rain Gear
(24) Altitude Meter, Pedometer
(25) Vehicles for Transportation

4-3 Training Plan

In order to set up a communication circuit between certain points, its purpose, and required quality and reliability should be clarified. After that, construction designs for housing, wiring and towers, and another design for transmission quality, transmission method, electric power supply and radio wave propagation are necessary.

When making a circuit design, a profile between transmission and reception sites is drawn, and the circuit reliability of the route is calculated on paper. Practically, some of buildings or the shapes and height of the mountains on the route are not described. Therefore, the value on desk theory differs greatly from practice.

Specifically, in the Philippines, because of the many seas, mountains and islands, perfect circuit design using a map on a scale of 1 to 50,000 is rather difficult. Therefore, considering topographical conditions, transportation to the sites, power supply and local inhabitants, the selection of transmitting and receiving sites is impossible alone by the members of the Japan Meteorological Agency. Assistance from the counterparts from PAGASA and local laborers is cordially requested. Because tests are often executed at different places at the same time, each counterpart will be expected to have enough knowledge of the system and to give helpful advice to the specialists.

For this purpose, the following preliminary training course is proposed:

(1)	Time	June – July
(2)	Duration	1 – 1.5 month
(3)	Participants	6 persons from PAGASA
(4)	Place	JMA and manufacturing companies of telecommunication equipment
(5)	Item	Circuit Design (Engineering)
(6)	Purpose	To acquire the knowledge necessary for joining the 2nd survey of domestic data collection, system design and propagation test.

APPENDIX 1

REMARKS ON DATA COLLECTION

Annex A

Collection of 3-hourly Synop

	Percentage of collection within 1 hour		Day or night time observation
	(During 1976–1978)	(1979)	
KOREA	100.0%	100.0%	Both day and night
MALAYSIA	99.5%	98.1%	Day time
	97.2%	97.7%	Night time
PHILIPPINES	69.9 to 82.4%	69.1%	Day time
	17.2 5o 34.6%	46.7%	Night time
THAILAND	99.2 to 100.0%	99.3%	Day time
	48.6 to 61.9%	87.3%	Night time

Collection of Upper-air Observations

Percentage of collection within 3-hours of observation time

	00 Z		12 Z	
	(During 1976–1978)	(1979)	(During 1976–1978)	(1979)
KOREA	64.4 to 85.0%	67.5%	53.3 to 97.5%	96.3%
MALAYSIA	96.0%	98.6%	98.9%	99.5%
PHILIPPINES	72.5 to 85.0%	92.7%	98.3 to 100.0%	88.8%
THAILAND	98.6 to 100.0%	100.0%	100.0%	100.0%

Notes:

(1) While non-receipts of SYNOP are entirely due to communication failure, non-receipt of Upper-air observations implies both communication failure and/or non-recording of observations.

(2) Remarks on data collection and transmission during 1979, significant changes since previous years and further improvements needed are summarised below:

KOREA

Synop : Collection and retransmission fully satisfactory.

Upper-air : Improvement needed in collection and transmission.

MALAYSIA

Synop
) Collection and retransmission fully satisfactory.
Upper-air

PHILIPPINES

Synop : There has been slight improvement in night-time collection. However, further improvement necessary both for day and night time collection.

Upper-air : Further improvement in collection desirable.

THAILAND

Synop : There has been improvement in night time collection. However, improvement in retransmission during day and night considered necessary.

Upper-air : Continue to be fully satisfactory.

Statistics of Collection and Transmission of SYNOP during 1976–1979

		Data Collection		Data Transmission	
		A	B	C	D
Korea (24 stations)					
00-21 Z (all observations)	1976	99.9	100.0	99.9	100.0
	1977	100.0	100.0	100.0	100.0
	1978	100.0	100.0	100.0	100.0
	1979	100.0	100.0	100.0	100.0
Malaysia (12 stations)					
00-12 Z (day time)	1978	98.9	99.5	98.9	99.5
	1979	96.4	98.1	95.8	98.1
15-21 Z (night time)	1978	95.8	97.2	95.8	97.2
	1979	97.3	97.7	97.4	97.7
Philippines (25 stations)					
00-12 Z (day time)	1976	75.0	82.4	74.5	82.5
	1977	64.8	77.6	66.2	76.2
	1978	59.7	69.9	57.9	68.5
	1979	61.5	69.1	58.4	66.6
15-21 Z (night time)	1976	17.2	17.2	16.1	16.6
	1977	25.1	30.0	25.1	29.4
	1978	33.4	34.6	33.0	33.8
	1979	46.0	46.7	40.6	44.4
Thailand (52 stations)					
00-12 Z (day time)	1976	98.7	99.5	98.7	98.8
	1977	98.6	100.0	99.4	99.5
	1978	99.2	99.2	99.2	99.2
	1979	46.4	99.3	86.5	86.5
15-21 Z (night time)	1976	51.0	52.1	51.0	51.2
	1977	48.6	48.6	48.6	48.6
	1978	61.6	61.9	61.6	61.8
	1979	74.4	87.3	74.4	74.4

Legend:

Column A : Percentage of obsn. received at NMC within 20 minutes of time of obsn.

Column B : Percentage of obsn. received at NMC within 1 hour of time of obsn.

Column C : Percentage of obsn. transmitted from NMC to RTH within 45 minutes of the time of obsn.

Column D : Percentage of observations transmitted from NMC to RTH within 1½ hours of the time of observation.

Quarterly Statistics of Collection and Transmission of Upper-air Observations (RS/RW) during 1976–1979

Name of Country	Hour of Observations	No. of RS/RW Recommended under WMO Regional Plan	No. of RS/RW Observations Implemented		Data Collection		Data Transmission
					A	B	C
KOREA	00 Z	3	3	1976	15.0	77.5	77.5
				1977	0	64.4	64.4
			2	1978	85.0	85.0	85.0
			2	1979	67.5	67.5	67.5
	12 Z	3	0	1976	–	–	–
			3	1977	0	53.3	53.3
			2	1978	97.5	97.5	97.5
			2	1979	86.3	86.3	86.3
MALAYSIA	00 Z	4	6	1978	47.2	96.0	96.1
			* 6 – 7	1979	51.9	98.6	98.6
	12 Z	4	5	1978	56.0	98.7	98.7
			* 5 – 7	1979	60.0	99.5	99.5
PHILIPPINES	00 Z	7	3	1976	0	75.0	75.0
				1977	0	85.0	85.0
				1978	72.5	72.5	72.5
			* 3 – 5	1979	67.7	92.7	91.9
	12 Z	7	1	1976	0	100.0	100.0
				1977	0	98.3	98.3
				1978	100.0	100.0	100.0
			* 1 – 5	1979	63.8	88.8	88.8
THAILAND	00 Z	6	4	1976	92.9	99.3	99.4
				1977	86.6	98.6	100.0
				1978	100.0	100.0	100.0
			* 3 – 4	1979	100.0	100.0	100.0
	12 Z	6	4	1976	100.0	100.0	100.0
				1977	98.6	100.0	100.0
				1978	100.0	100.0	100.0
				1979	100.0	100.0	100.0

Remarks:

* Additional RS/RW observations were implemented by Malaysia and the Philippines in connection with FGGE.

Legend:

Column A : Percentage of the implemented RS/RW observations received at NMC within 1½ hours of th time of observation.

Column B : Percentage of RS/RW observations received at NMC within 3 hours of the time of observation.

Column C : Percentage of RS/RW observations transmitted from NMC to RTH within 4 hours of the time of observation.

Republic of the Philippines
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METEOROLOGICAL COMMUNICATIONS DIVISION
National Weather Service
Quezon City

REPORT ON THE AVAILABILITY OF PHILIPPINE SYNOPS AT CENTRAL OFFICE, Q.C. FOR THE PERIOD JANUARY – MARCH 1976

Total number of stations: 50

Month	0000Z	0300Z	0600Z	0900Z	1200Z	1500Z	1800Z	2100Z	Remarks
Reports available at C.O. within 30 minutes after observation time									
January 1976	917 59%	842 54%	968 62%	867 56%	811 52%	242 16%	115 7%	82 5%	
February 1976	929 64%	855 59%	902 62%	892 55%	753 52%	363 25%	123 8%	74 5%	
March 1976	868 56%	880 57%	1,029 66%	944 61%	960 62%	483 33%	197 13%	95 6%	
Reports available at C.O. within 1 hour after observation time									
January 1976	1,054 68%	852 55%	1,074 69%	899 58%	854 55%	243 16%	115 7%	83 5%	
February 1976	1,031 71%	922 64%	984 69%	821 57%	815 56%	371 26%	123 8%	74 5%	
March 1976	1,129 73%	965 62%	1,095 71%	951 61%	991 64%	519 33%	202 13%	96 6%	

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METEOROLOGICAL COMMUNICATIONS DIVISION
National Weather Service
Quezon City

REPORT ON THE AVAILABILITY OF PHILIPPINE SYNOPS AT CENTRAL OFFICE, Q.C. FOR THE PERIOD APRIL – JUNE 1976

Total number of stations: 50

Month	0000Z	0300Z	0600Z	0900Z	1200Z	1500Z	1800Z	2100Z	Remarks
Reports available at C.O. within 30 minutes after observation time									
April 1976	891 59%	875 58%	1,007 67%	960 64%	955 64%	417 28%	208 14%	76 5%	
May 1976	871 56%	753 49%	897 58%	822 53%	760 49%	209 13%	113 7%	70 5%	
June 1976	869 58%	667 44%	875 58%	728 49%	728 49%	294 20%	152 10%	70 5%	
Reports available at C.O. within 1 hour after observation time									
Aprile 1976	1,108 74%	897 60%	1,106 74%	962 54%	976 65%	418 28%	208 14%	76 5%	
May 1976	935 60%	771 50%	912 59%	887 53%	764 49%	221 14%	113 7%	70 5%	
June 1976	901 60%	670 45%	879 59%	730 49%	730 49%	294 20%	152 10%	71 5%	

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REPORT ON THE AVAILABILITY OF PHILIPPINE SYNOPS AT CENTRAL OFFICE, Q.C. FOR THE PERIOD JULY – SEPTEMBER 1975

Total number of stations: 50

Month	0000Z	0300Z	0600Z	0900Z	1200Z	1500Z	1800Z	2100Z	Remarks
Reports available at C.O. within 30 minutes after observation time									
July 1975	978 63.1%	812 52.4%	929 59.9%	813 52.5%	644 41.5%	328 20.8%	140 9.0%	81 5.2%	
August 1975	895 57.7%	811 52.3%	1,009 65.1%	862 55.6%	901 58.1%	423 27.3%	147 9.5%	94 6.1%	
September 1975	844 56.3%	754 50.3%	891 59.4%	775 51.7%	862 57.5%	441 20.4%	182 12.1%	89 5.9%	
Reports available at C.O. within 1 hour after observation time									
July 1975	1,056 68.1%	857 55.3%	1,004 64.8%	839 54.1%	690 44.5%	334 21.5%	140 9.0%	82 5.3%	
August 1975	1,100 71.0%	842 54.5%	1,048 61.6%	866 55.9%	917 59.2%	447 28.8%	148 9.5%	91 5.9%	
September 1975	961 64.1%	776 51.7%	903 60.2%	779 51.9%	892 59.5%	442 29.5%	177 11.8%	105 7.0%	

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National Weather Service
Quezon City

REPORT ON THE AVAILABILITY OF PHILIPPINE SYNOPS AT CENTRAL OFFICE, Q.C. FOR THE PERIOD NOVEMBER – DECEMBER 1975

Total number of stations: 50

Month	0000Z	0300Z	0600Z	0900Z	1200Z	1500Z	1800Z	2100Z	Remarks
Reports available at C.O. within 30 minutes after observation time									
October 1975	899 58.0%	872 56.3%	1,001 64.6%	868 56.0%	915 59.0%	480 30.1%	224 14.5%	85 5.5%	
November 1975	867 57.8%	867 57.8%	933 62.6%	925 61.7%	940 62.7%	516 34.4%	178 11.9%	77 5.1%	
December 1975	903 58.3%	929 59.9%	971 62.6%	946 61.0%	892 57.5%	302 19.5%	169 10.9%	82 5.3%	
Reports available at C.O. within 1 hour after observation time									
October 1975	1,063 68.6%	917 59.2%	1,054 68.0%	886 57.2%	937 60.5%	481 31.0%	265 17.1%	88 5.7%	
November 1975	1,144 76.3%	990 65.6%	1,075 71.7%	963 64.2%	1,024 68.3%	522 34.8%	173 11.5%	80 5.3%	
December 1975	1,157 74.6%	1,021 65.9%	1,114 71.9%	1,030 66.5%	919 59.3%	321 20.7%	180 11.6%	115 7.4%	

CALCULATION BY COMPUTER OF VARIOUS OPERATION PARAMETERS FOR HF RADIO CIRCUIT DESIGNING

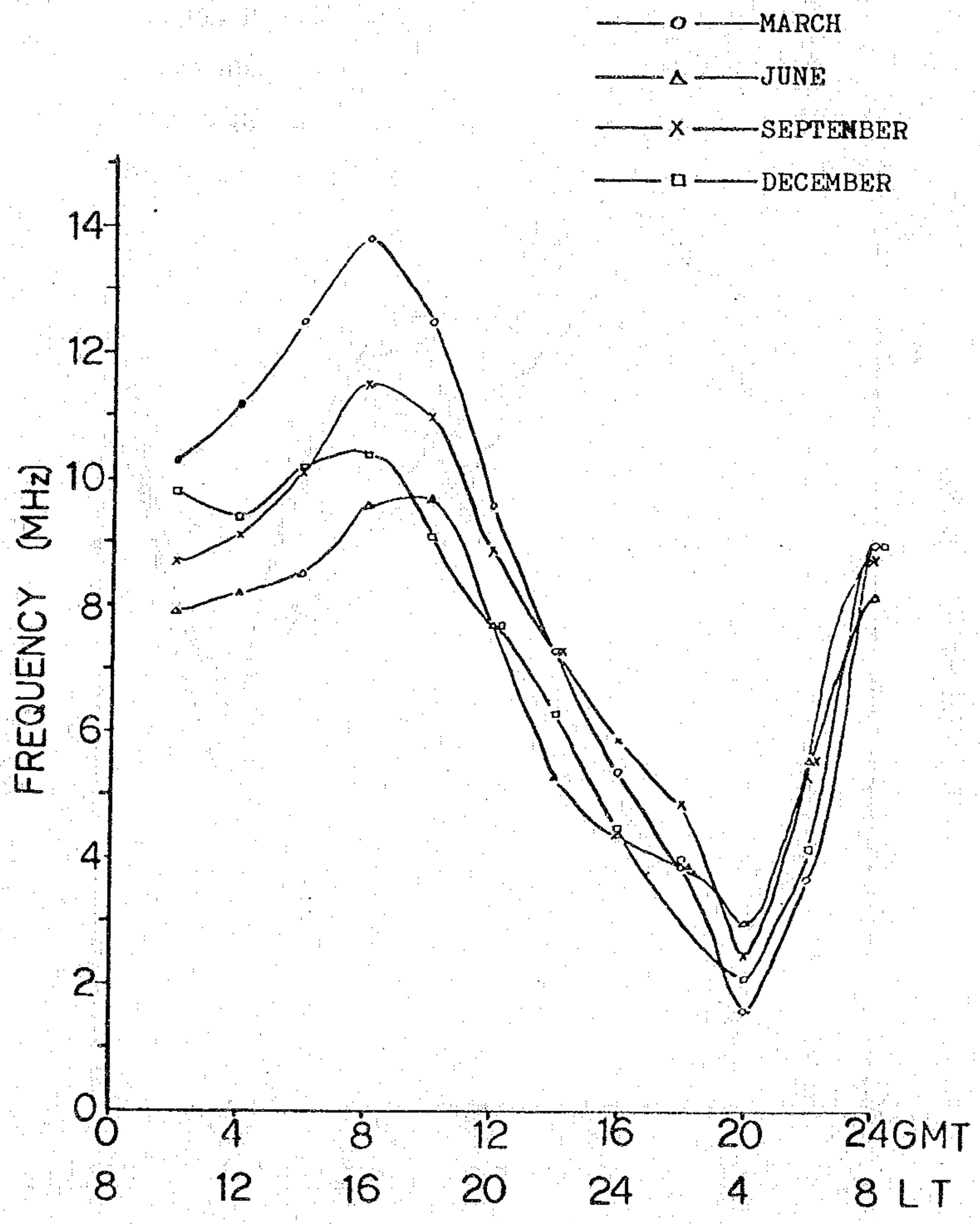
PAGE	CIRCUIT NAME	SSN
1	MANILA - TACLOBAN	10
2	MANILA - TACLOBAN	100
3	MANILA - MACTAN	10
4	MANILA - MACTAN	100
5	MANILA - CAGAYAN DE ORO	10
6	MANILA - CAGAYAN DE ORO	100
7	MANILA - DAVAO A.P.	10
8	MANILA - DAVAO A.P.	100
9	TUGUEGARAO - CALAYAN	10
10	TUGUEGARAO - CALAYAN	100
11	LEGASPI - ROXAS	10
12	LEGASPI - ROXAS	100
13	MACTAN - DIPOLOG	10
14	MACTAN - DIPOLOG	100
15	CAGAYAN DE ORO - DAVAO A.P.	10
16	CAGAYAN DE ORO - DAVAO A.P.	100
17	MANILA - BASCO	10
18	MANILA - BASCO	100
19	MANILA - TUGUEGARAO	10
20	MANILA - TUGUEGARAO	100
21	MANILA - BAGUIO	10
22	MANILA - BAGUIO	100
23	MANILA - CUYO	10
24	MANILA - CUYO	100
25	MANILA - PUERTO PRINCESA	10
26	MANILA - PUERTO PRINCESA	100
27	MANILA - JOLO	10
28	MANILA - JOLO	100
29	MANILA - LEGASPI	10
30	MANILA - LEGASPI	100

MUF CURVE

SSN - 10 DISTANCE = 595KM POWER = 0.3KW

T - MANILA (425) 14.35N 120.59E

R - TACLOBAN (550) 11.15N 125.00E

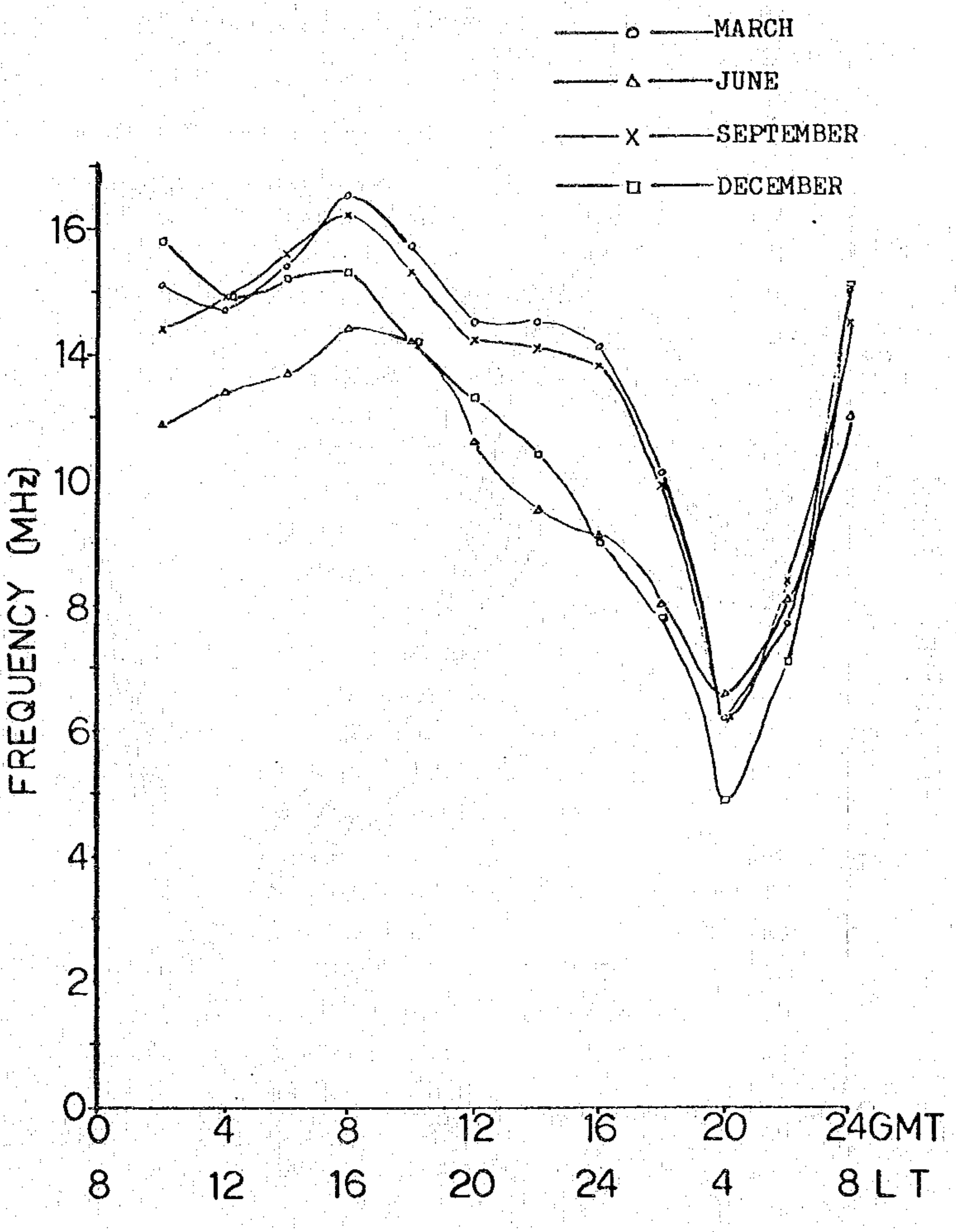


MUF CURVE

SSN - 100 DISTANCE = 595KM POWER = 0.3KW

T - MANILA (425) 14.35N 120.59E

R - TACLOBAN (550) 11.15N 125.00E

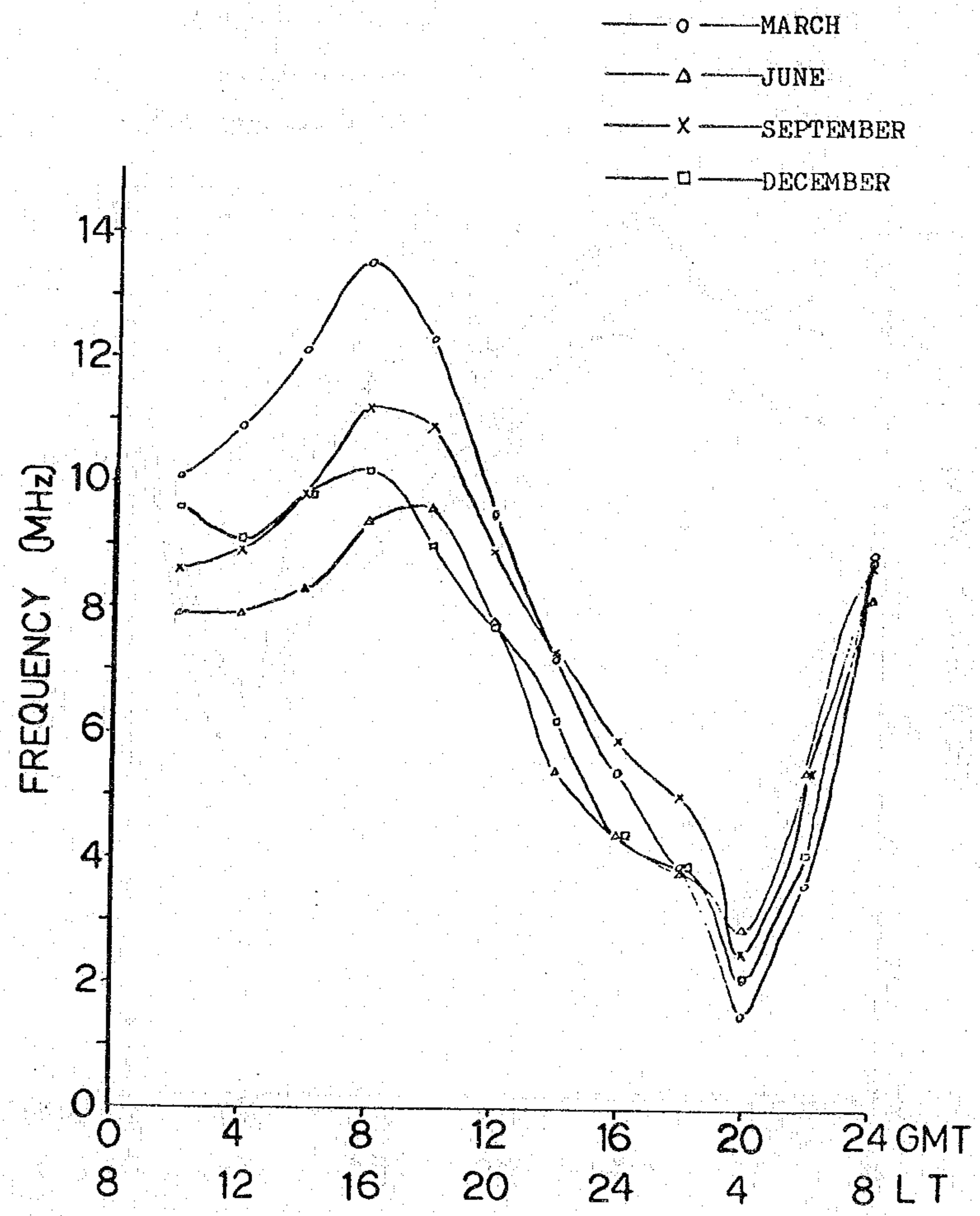


MUF CURVE

SSN - 10   DISTANCE = 565KM   POWER = 0.3KW

T - MANILA (425)   14.35N   120.59E

R - MACTAN (646)   10.18N   123.58E

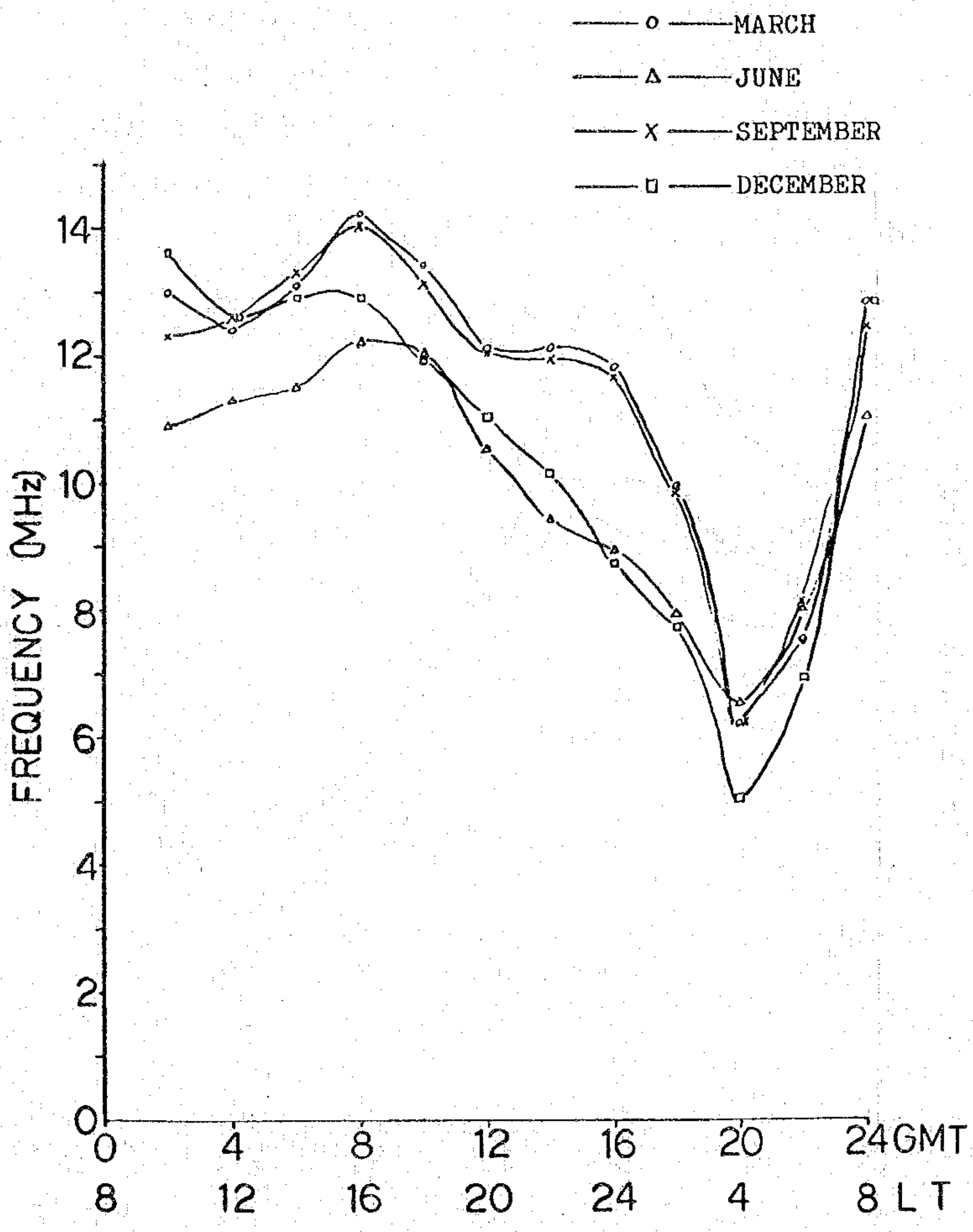


MUF CURVE

SSN - 100 DISTANCE = 565KM   POWER = 0.3KW

T - MANILA (425)   14.35N   120.59E

R - MACTAN (646)   10.18N   123.58E

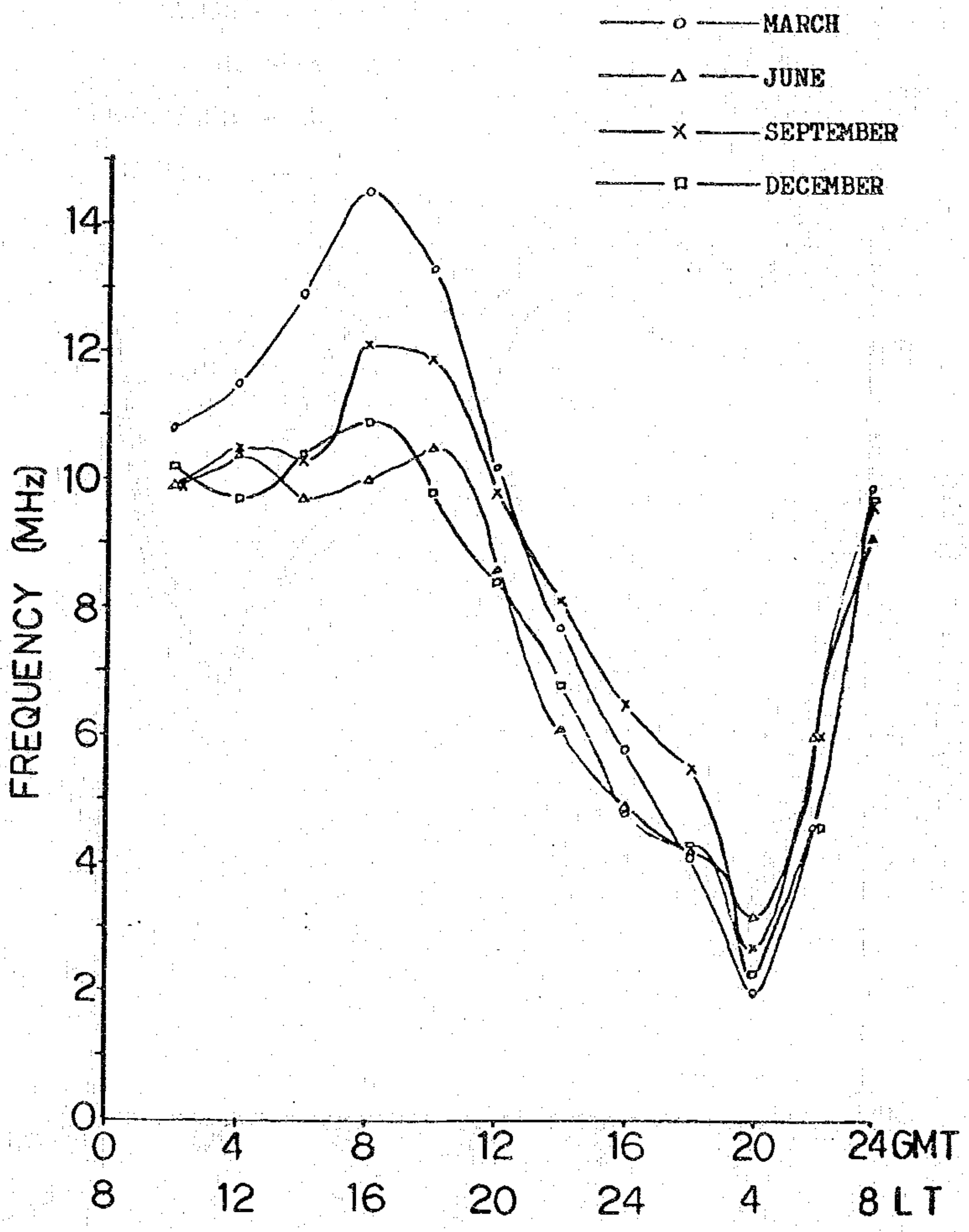


MUF CURVE

SSN - 10 DISTANCE = 789KM POWER = 0.3KW

T - MANILA (425) 14.35N 120.59E

R - CAGAYAN DE ORO (748) 8.29N 124.38E

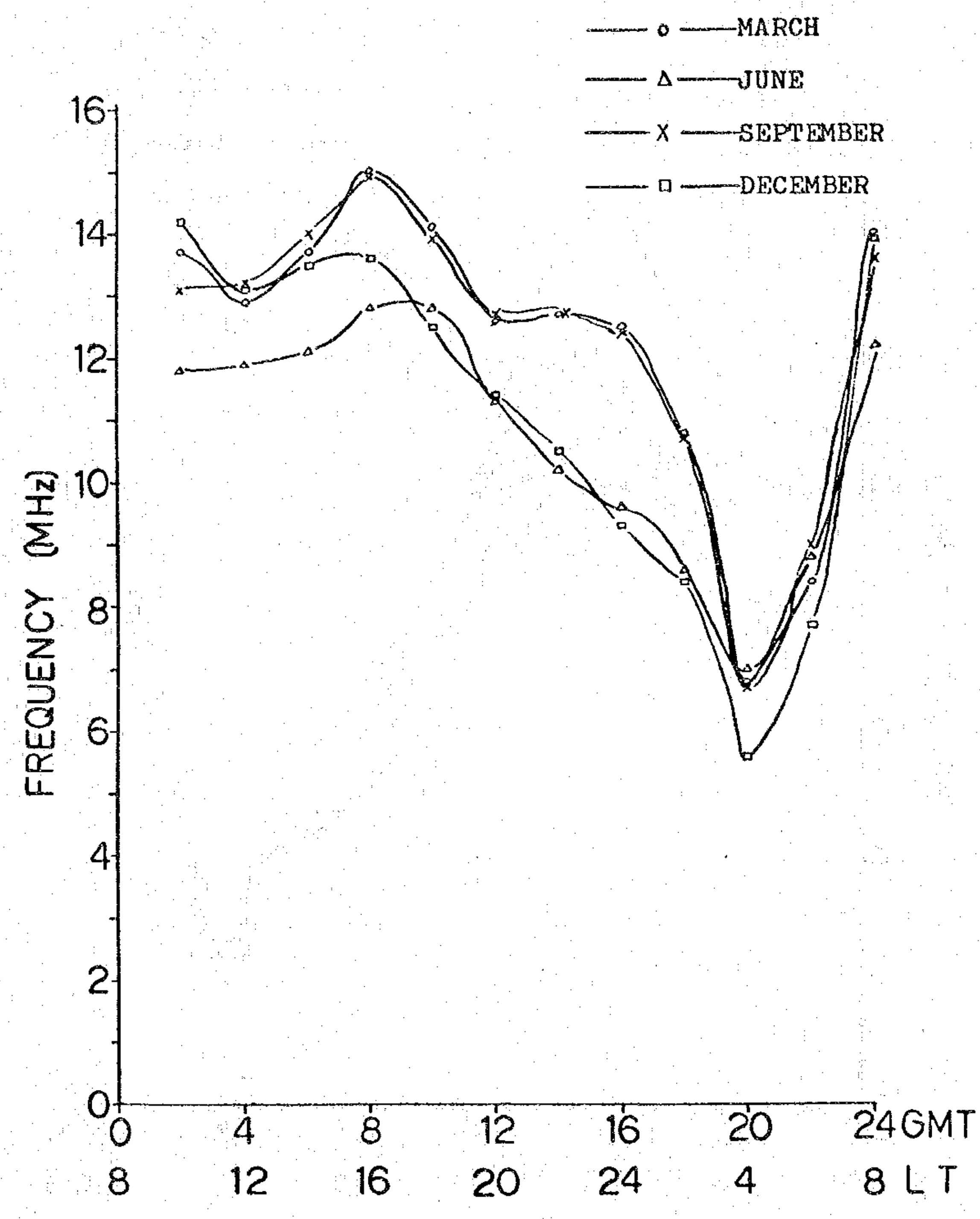


MUF CURVE

SSN - 100 DISTANCE = 789KM POWER = 0.3KW

T - MANILA (425) 14.35N 120.59E

R - CAGAYAN DE ORO (748) 8.29N 124.38E

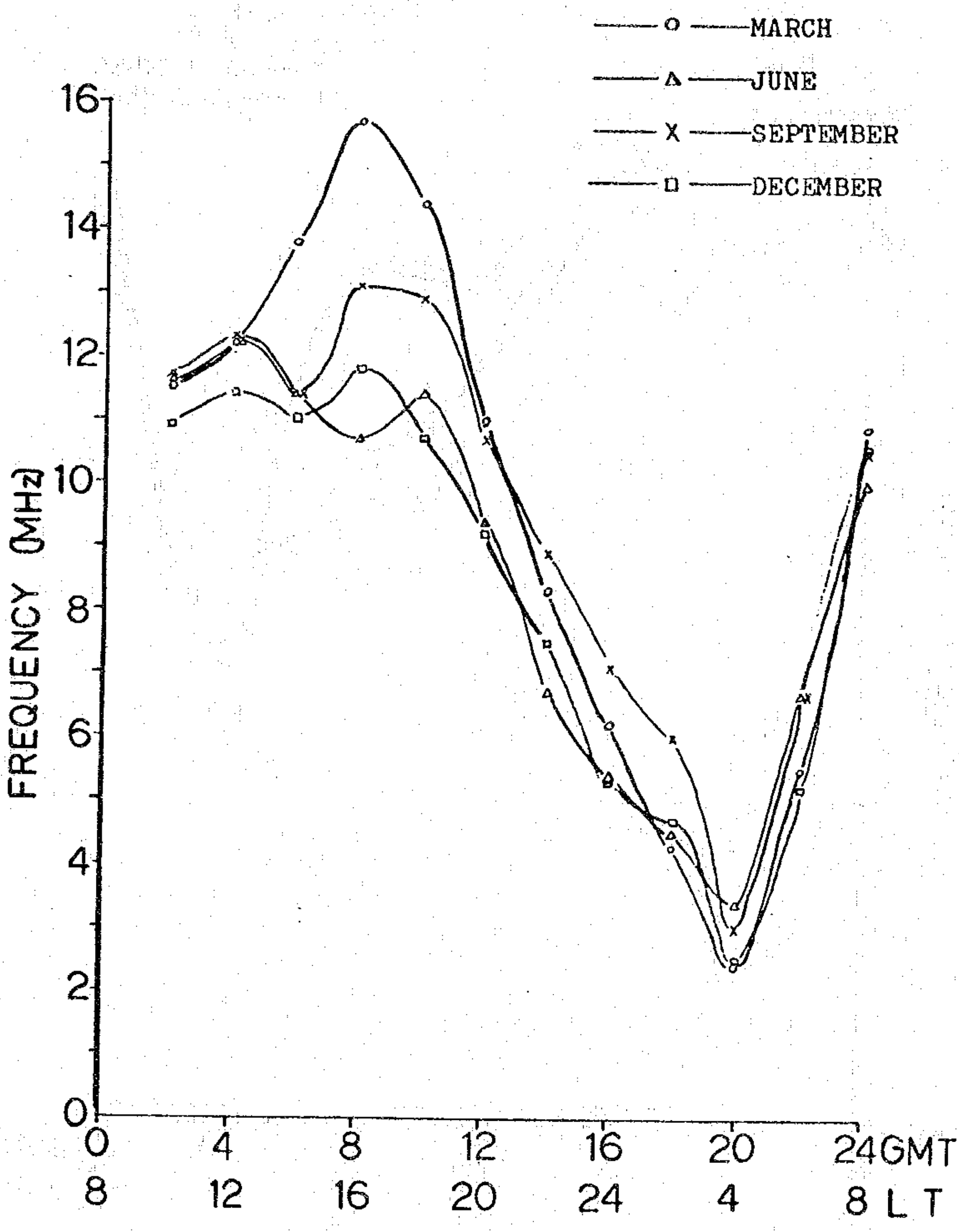


MUF CURVE

SSN - 10 DISTANCE = 963KM POWER = 0.3KW

T - MANILA (425) 14.35N 120.59E

R - DAVAO AIRPORT (753) 7.07N 125.39E

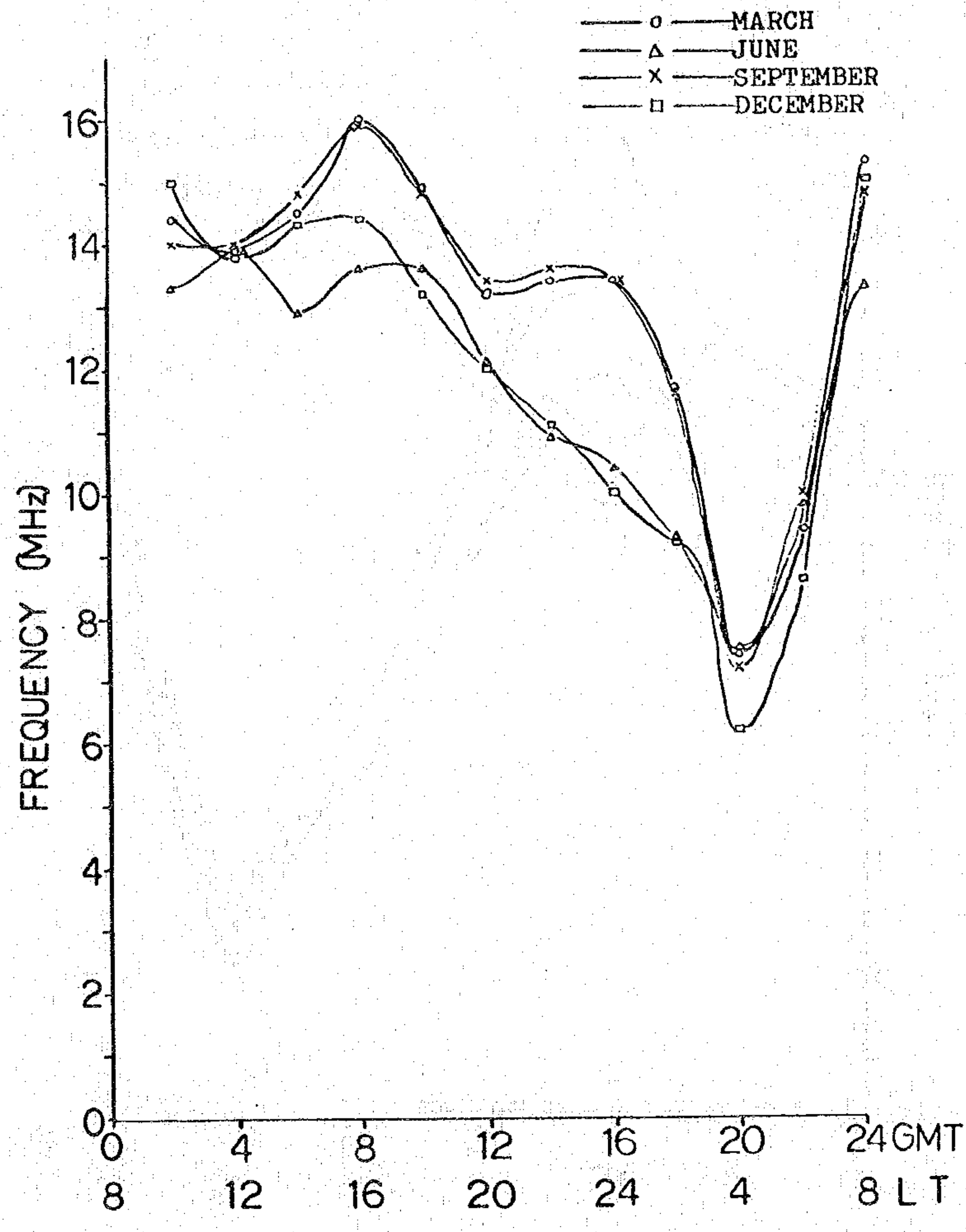


MUF CURVE

SSN - 100 DISTANCE = 963KM POWER = 0.3KW

T - MANILA (425) 14.35N 120.59E

R - DAVAO AIRPORT (753) 7.07N 125.39E



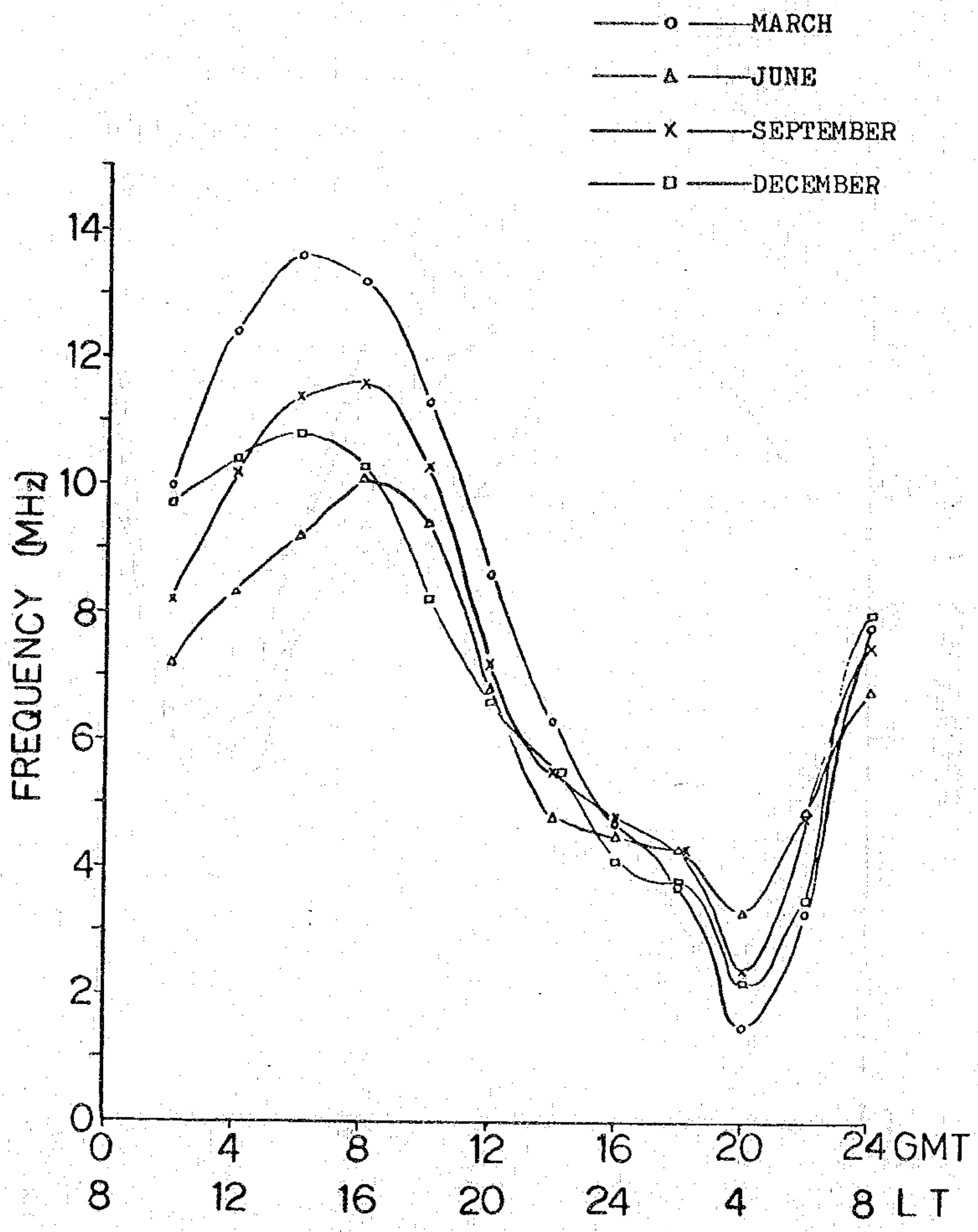
9

MUF CURVE

SSN - 10 DISTANCE = 199KM POWER = 0.15KW

T - TUGUEGARAO (233) 17.37N 121.44E

R - CALAYAN (133) 19.16N 121.28E

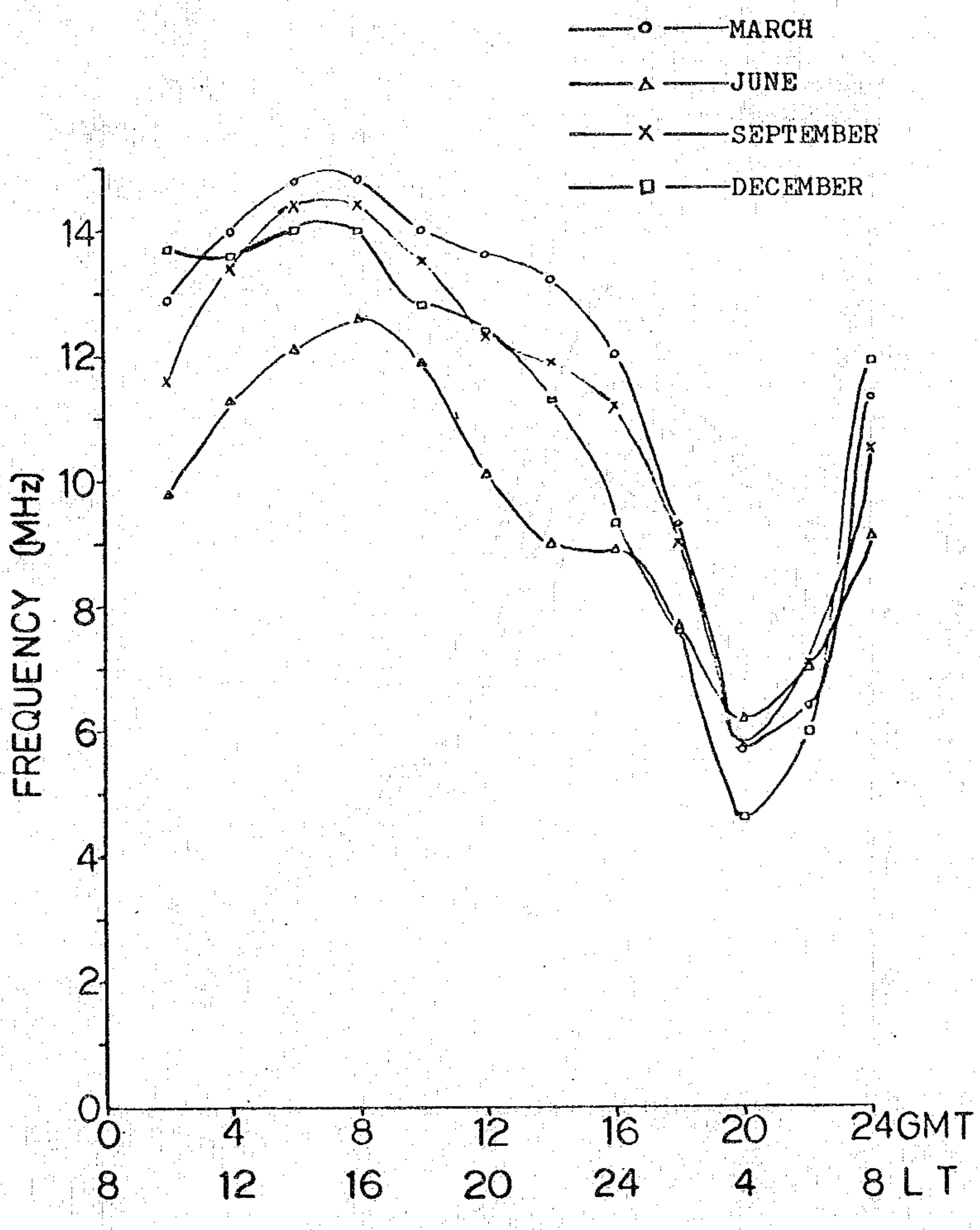


MUF CURVE

SSN - 100 DISTANCE = 199KM POWER = 0.15KW

T - TUGUEGARAO (233) 17.37N 121.44E

R - CALAYAN (133) 19.16N 121.28E



MUF CURVE

SSN - 10 DISTANCE = 220KM POWER = 0.15KW

T - LEGASPI (444) 13.08N 123.44E

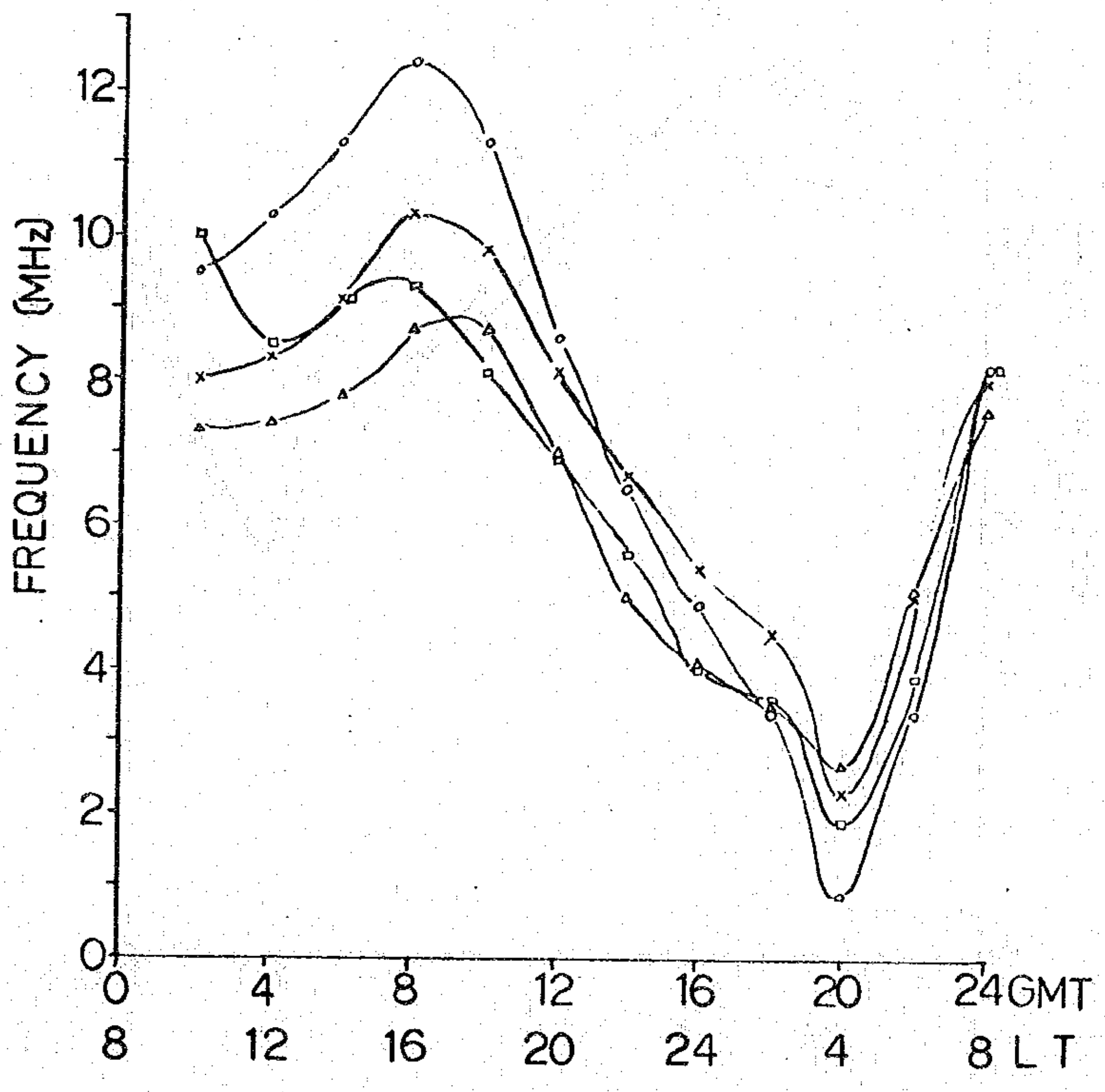
R - ROXAS (538) 11.35N 122.45E

—— o ——MARCH

—— Δ ——JUNE

—— X ——SEPTEMBER

—— □ ——DECEMBER

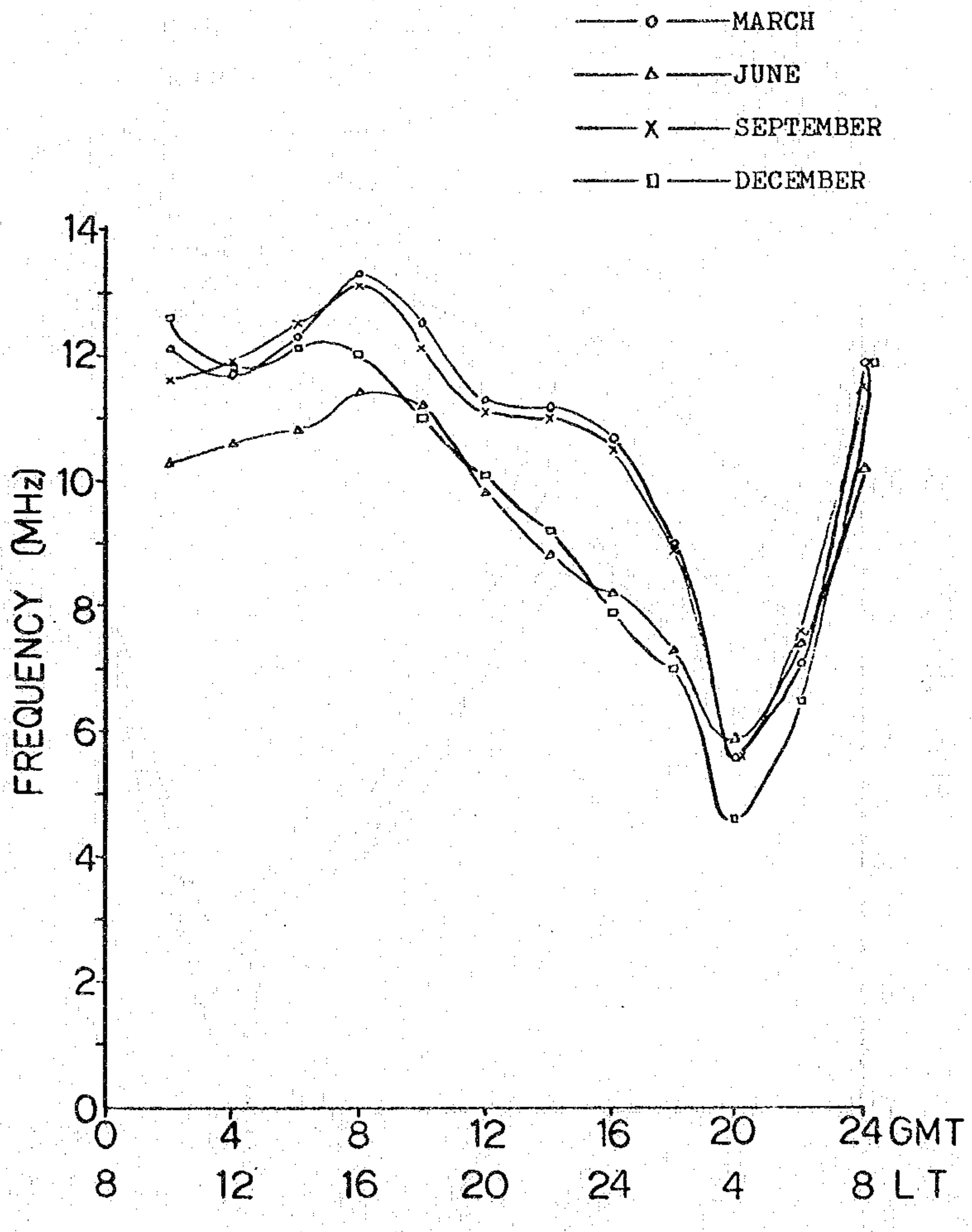


MUF CURVE

SSN -100 DISTANCE = 220KM POWER = 0.15KW

T - LEGASPI (444) 13.08N 123.44E

R - ROXAS (538) 11.35N 122.45E

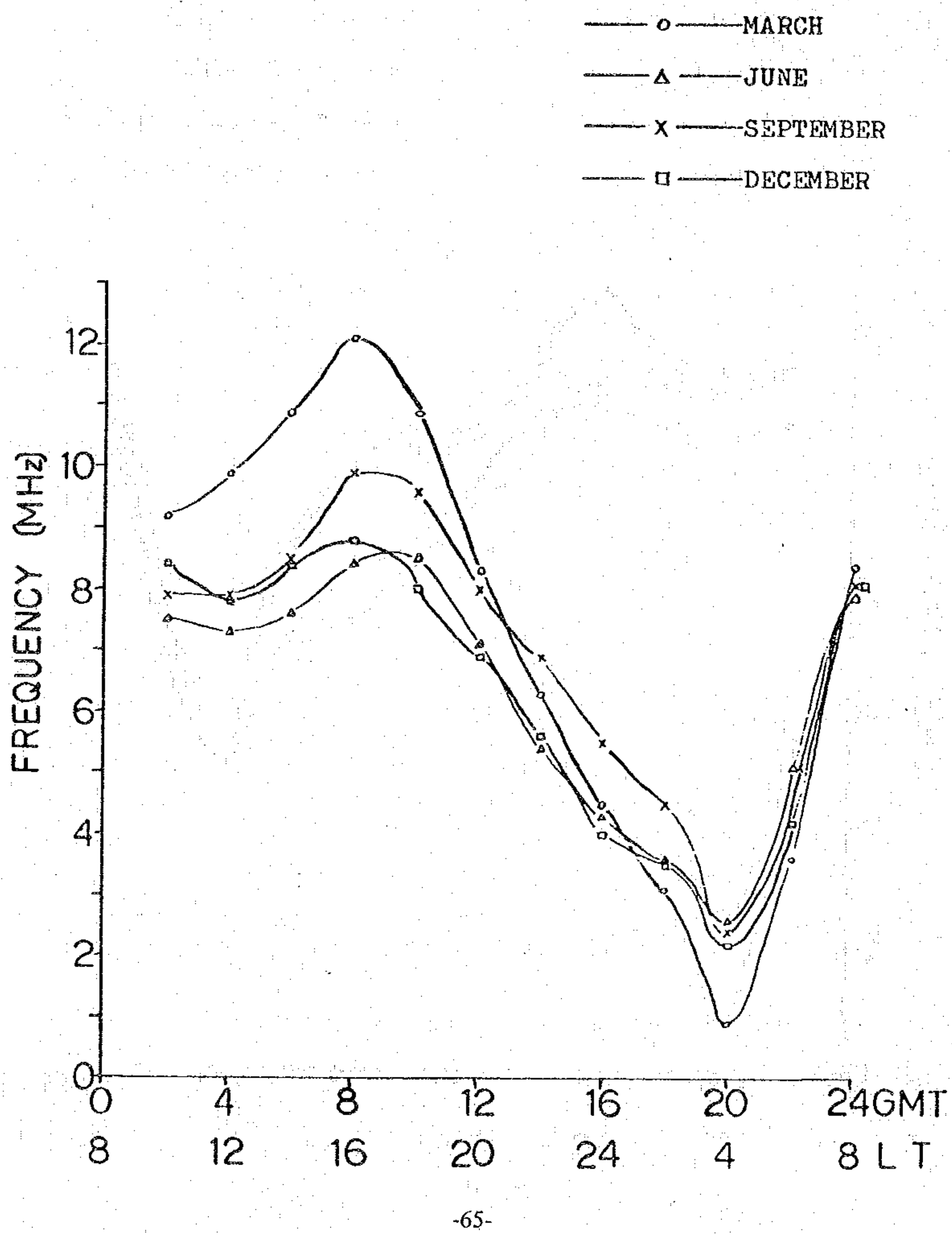


MUF CURVE

SSN - 10 DISTANCE = 206KM POWER = 0.15KW

T - MACTAN (646) 10.18N 123.58E

R - DIPOLOG (741) 8.36N 123.21E



MUF CURVE

SSN - 100 DISTANCE = 206KM POWER = 0.15KW

T - MACTAN (646) 10.18N 123.58E

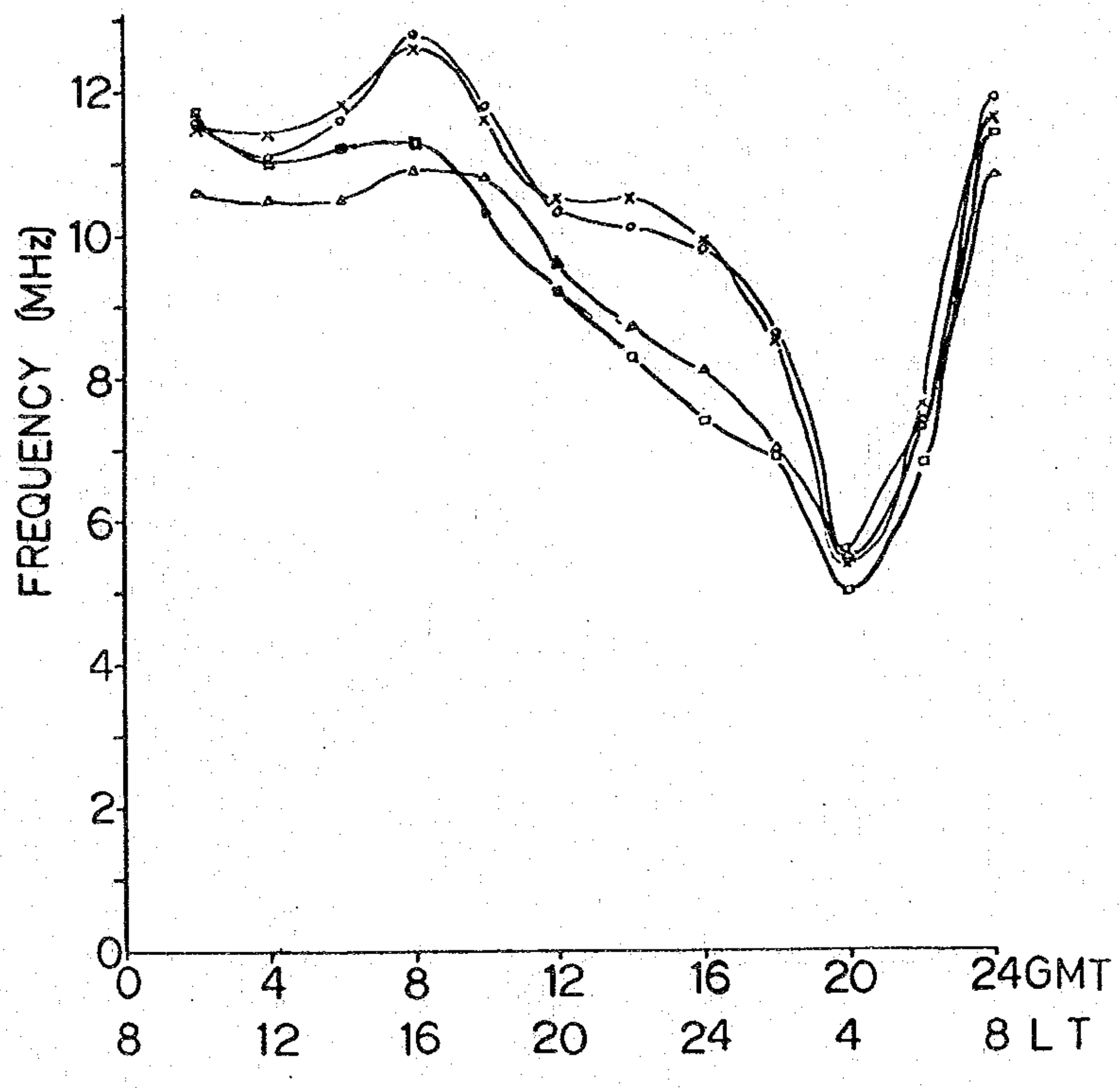
R - DIPOLOG (741) 8.36N 123.21E

——o—— MARCH

——Δ—— JUNE

——x—— SEPTEMBER

——□—— DECEMBER

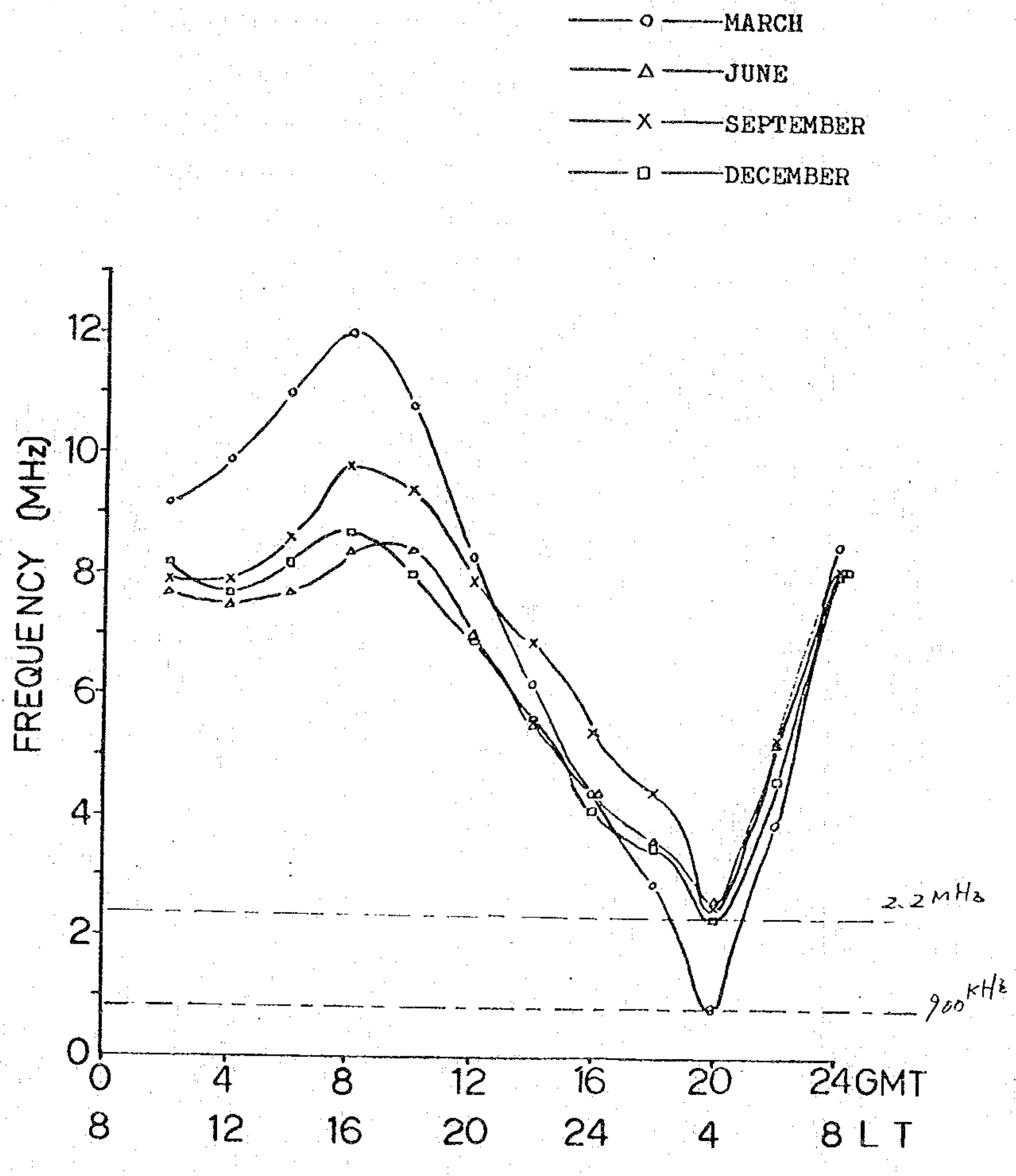


MUF CURVE

SSN - 10 DISTANCE = 175KM POWER = 0.15KW

T - CAGAYAN DE ORO (748) 8.29N 124.38E

R - DAVAO AIRPORT (753) 7.07N 125.39E

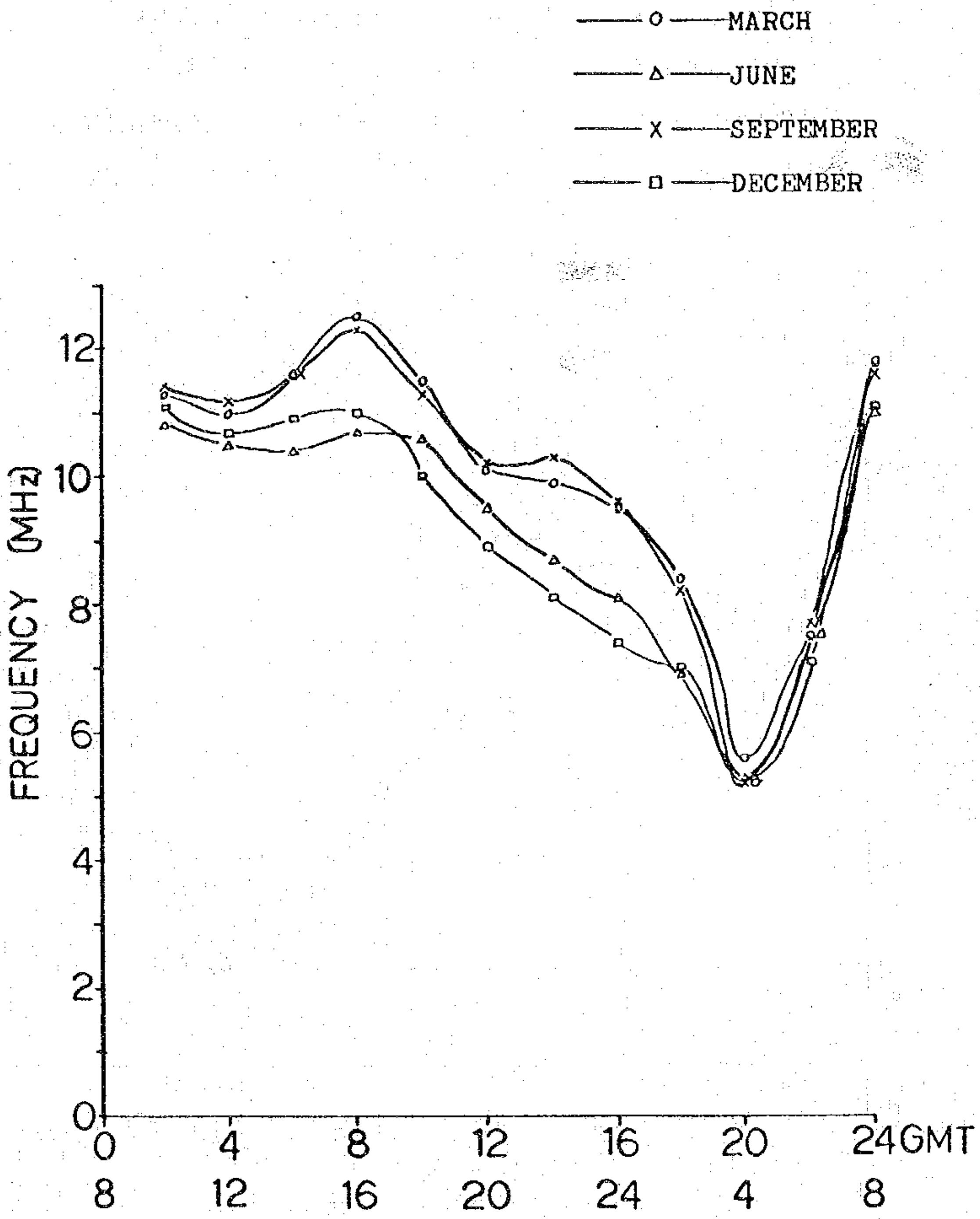


MUF CURVE

SSN - 100 DISTANCE =175KM POWER = 0.15KW

T - CAGAYAN DE ORO (748) 8.29N 124.38E

R - DAVAO AIRPORT (753) 7.07N 125.39E

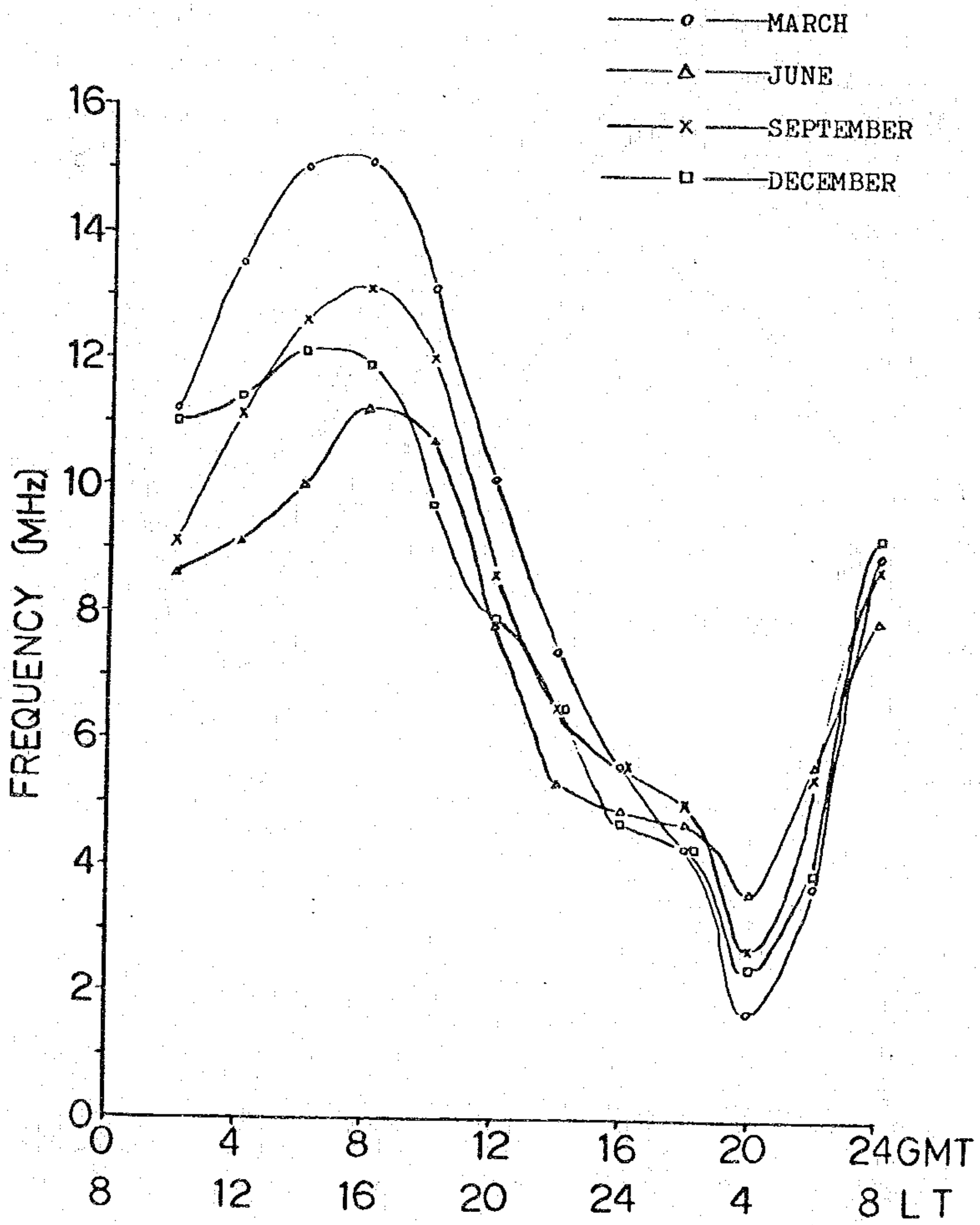


MUF CURVE

SSN - 10 DISTANCE = 666KM POWER = 0.3KW

T - MANILA (425) 14.35N 120.59E

R - BASCO (135) 20.27N 121.58E

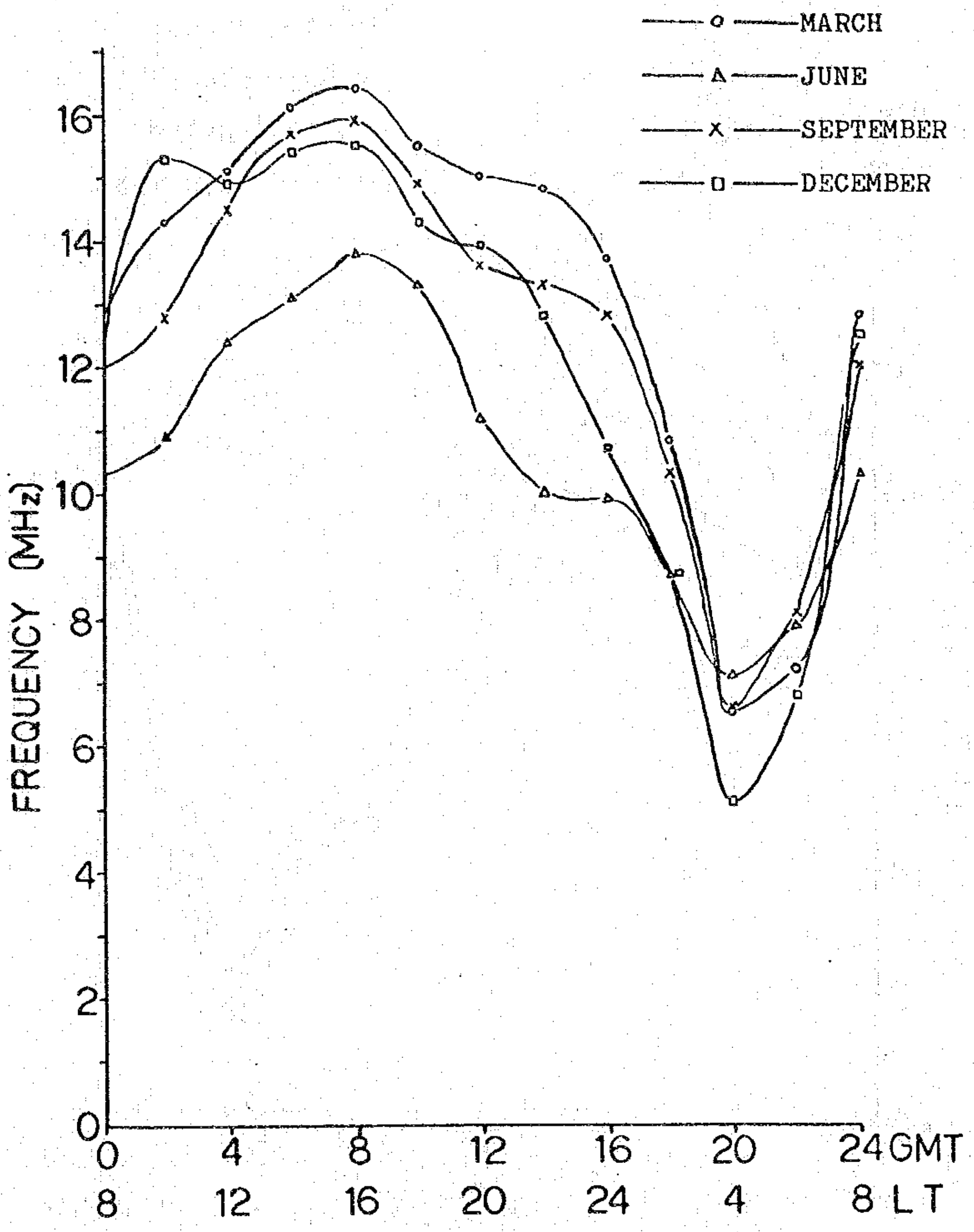


MUF CURVE

SSN - 100 DISTANCE = 666KM POWER = 0.3KW

T - MANILA (425) 14.35N 120.59E

R - BASCO (135) 20.27N 121.58E

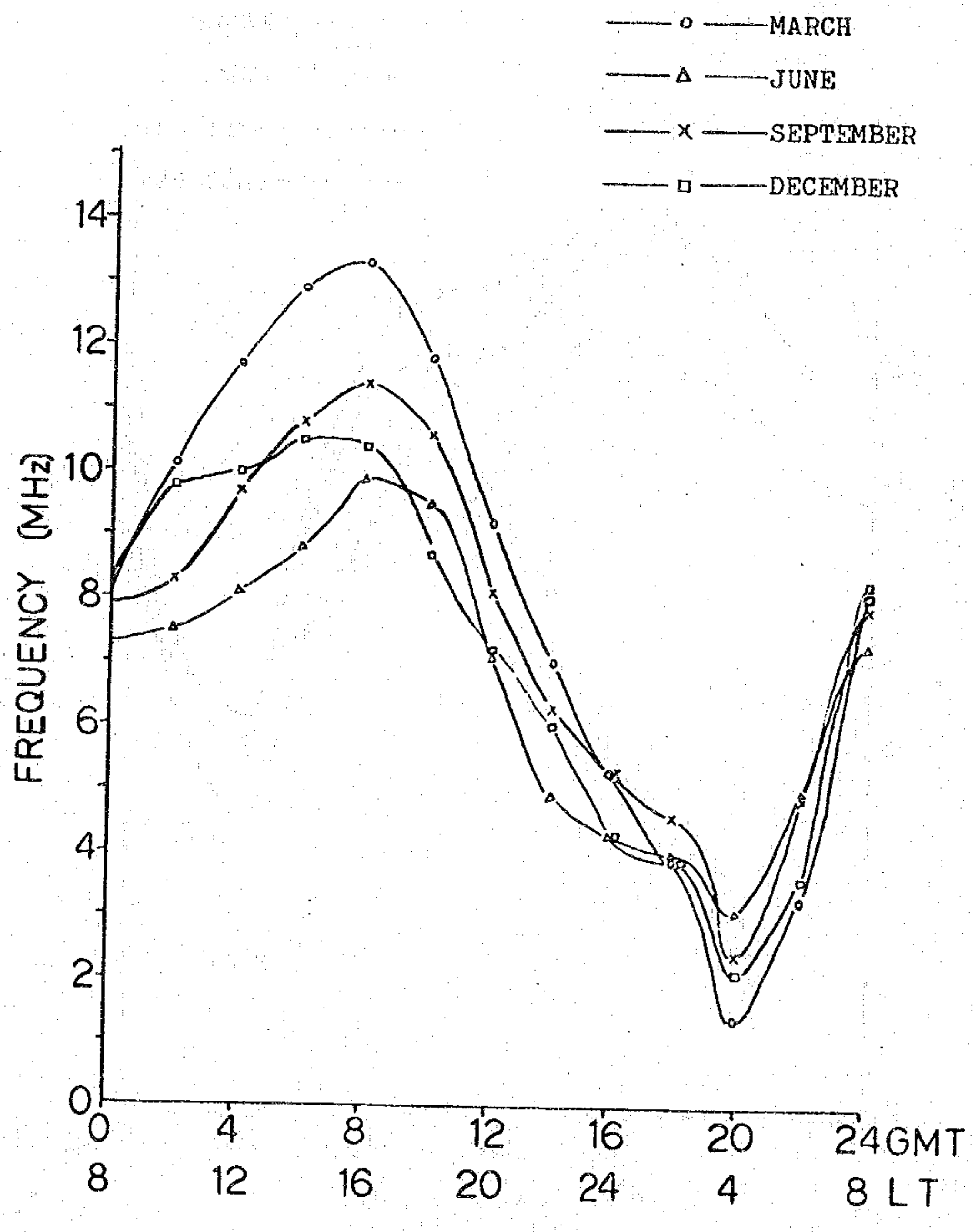


MUF CURVE

SSN - 10 DISTANCE = 347KM POWER = 0.3KW

T - MANILA (425) 14.35N 120.59E

R - TUGUEGARAO (233) 17.37N 121.44E

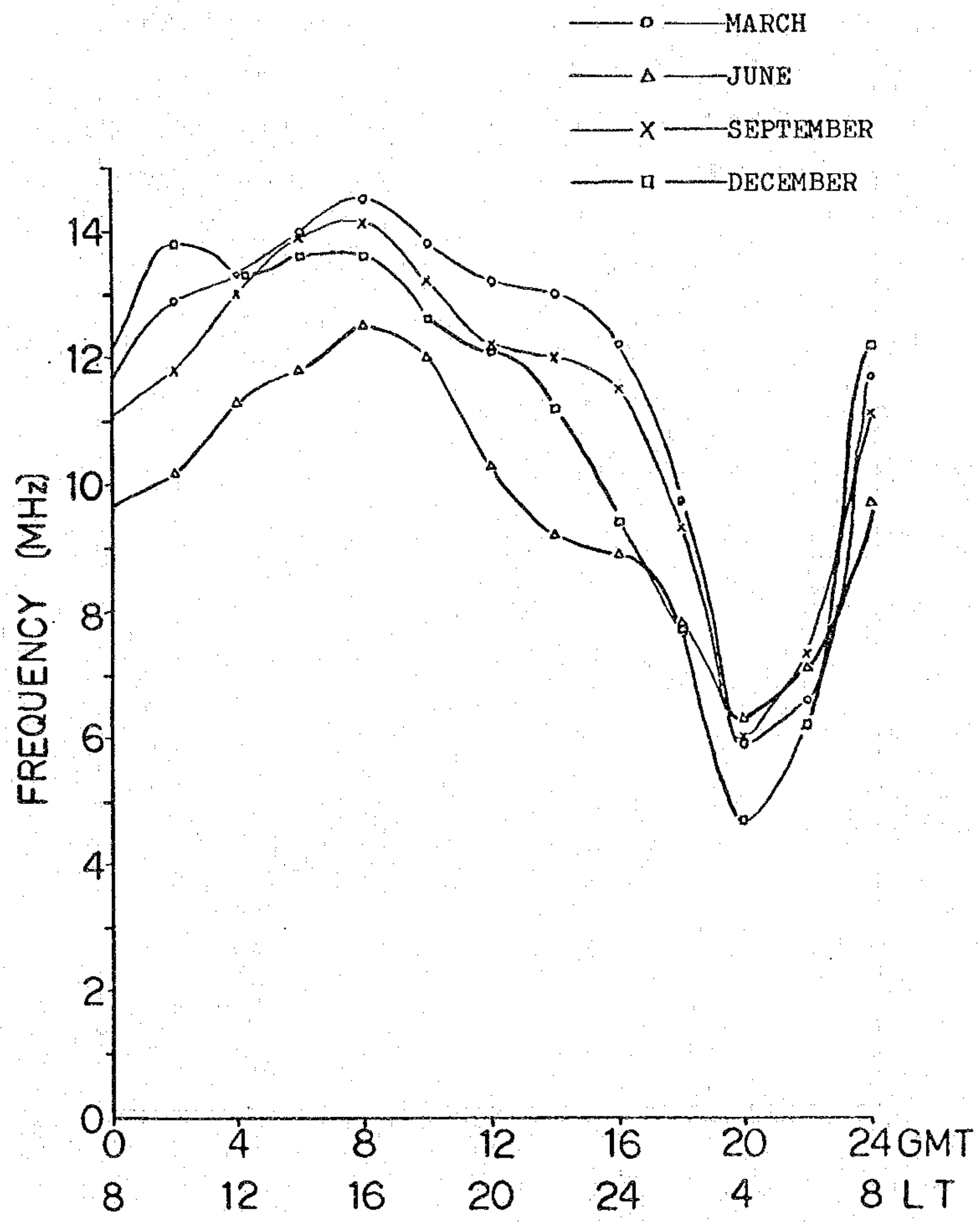


MUF CURVE

SSN - 100 DISTANCE = 347KM POWER = 0.3KW

T - MANILA (425) 14.35N 120.59E

R - TUGUEGARAO (233) 17.37N 121.44E

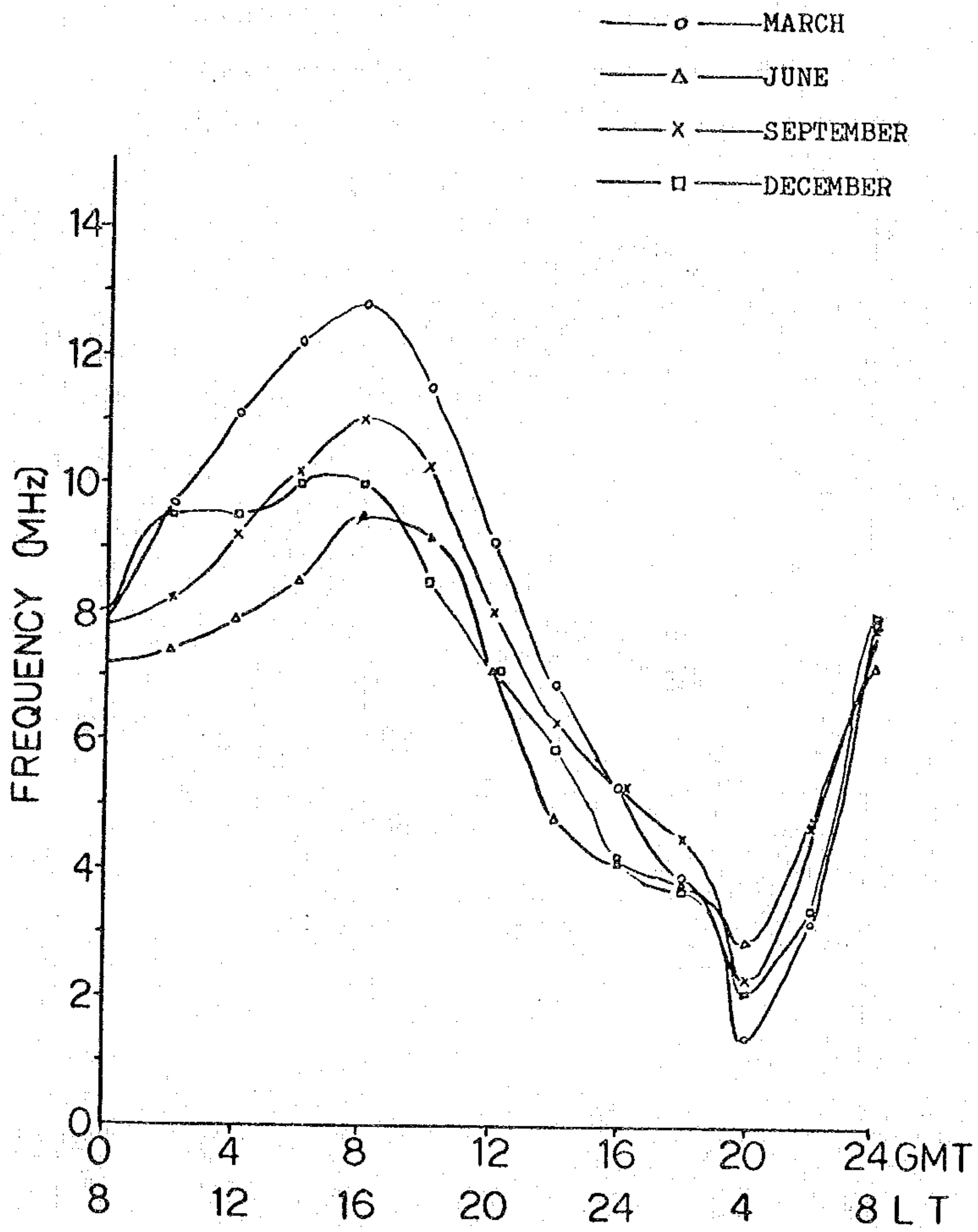


MUF CURVE

SSN - 10 DISTANCE = 212KM POWER = 0.15KW

T - MANILA (425) 14.35N 120.59E

R - BAGUIO (328) 16.25N 120.36E

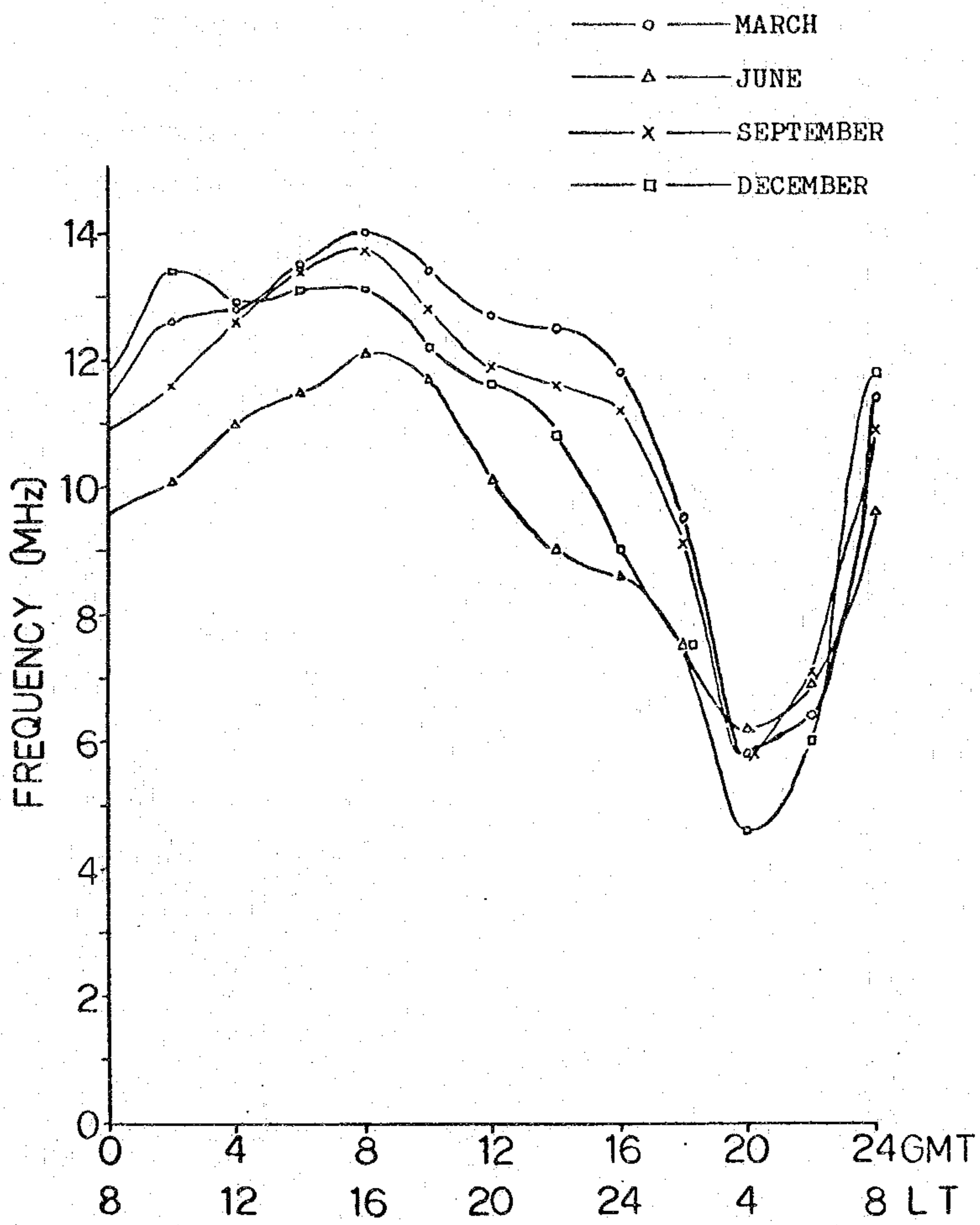


MUF CURVE

SSN - 100 DISTANCE = 212KM POWER = 0.15KW

T - MANILA (425) 14.35N 120.59E

R - BAGUIO (328) 16.25N 120.36E

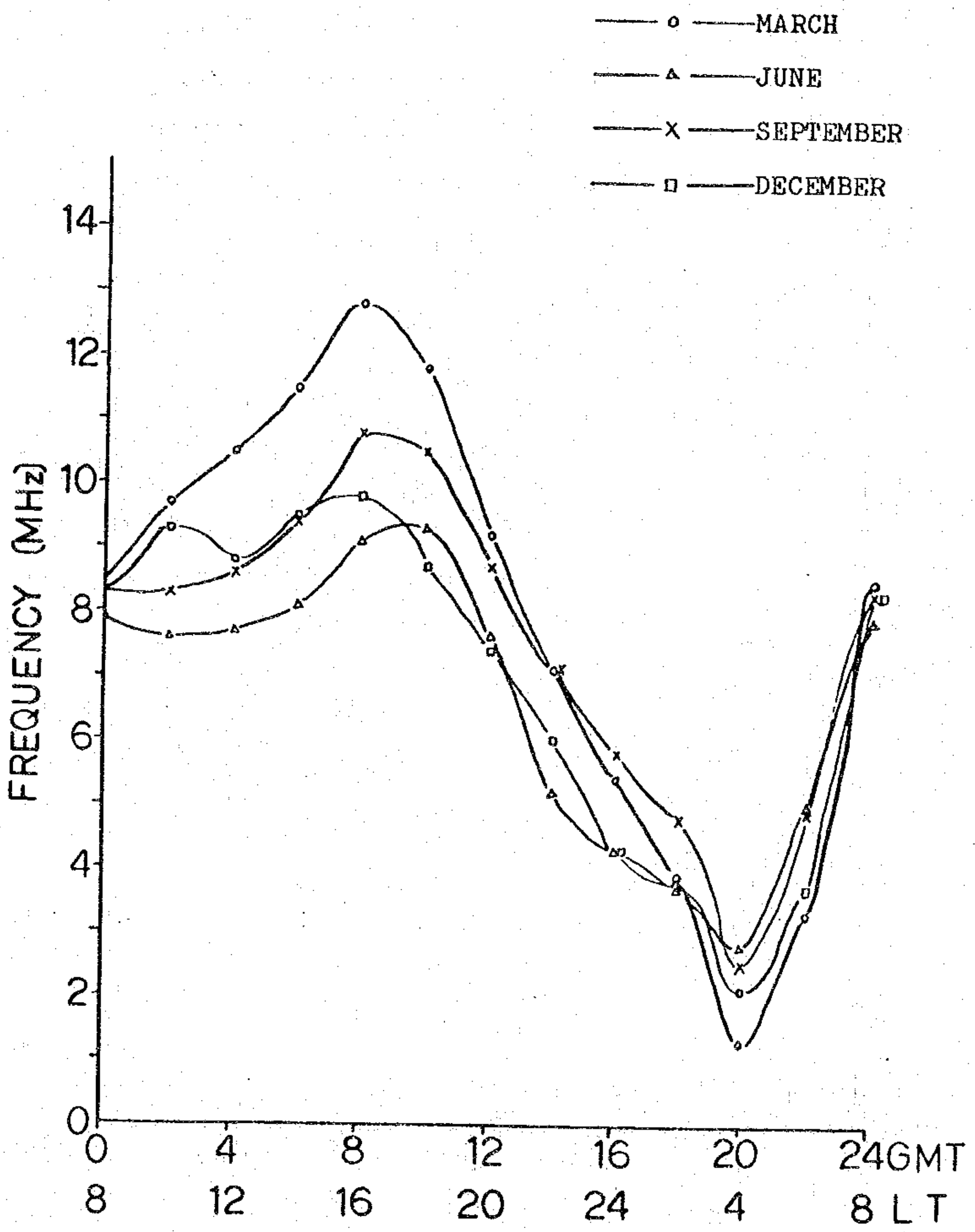


MUF CURVE

SSN - 10 DISTANCE = 429KM POWER = 0.3KW

T - MANILA (425) 14.35N 120.59E

R - CUYO (630) 10.51N 121.02E

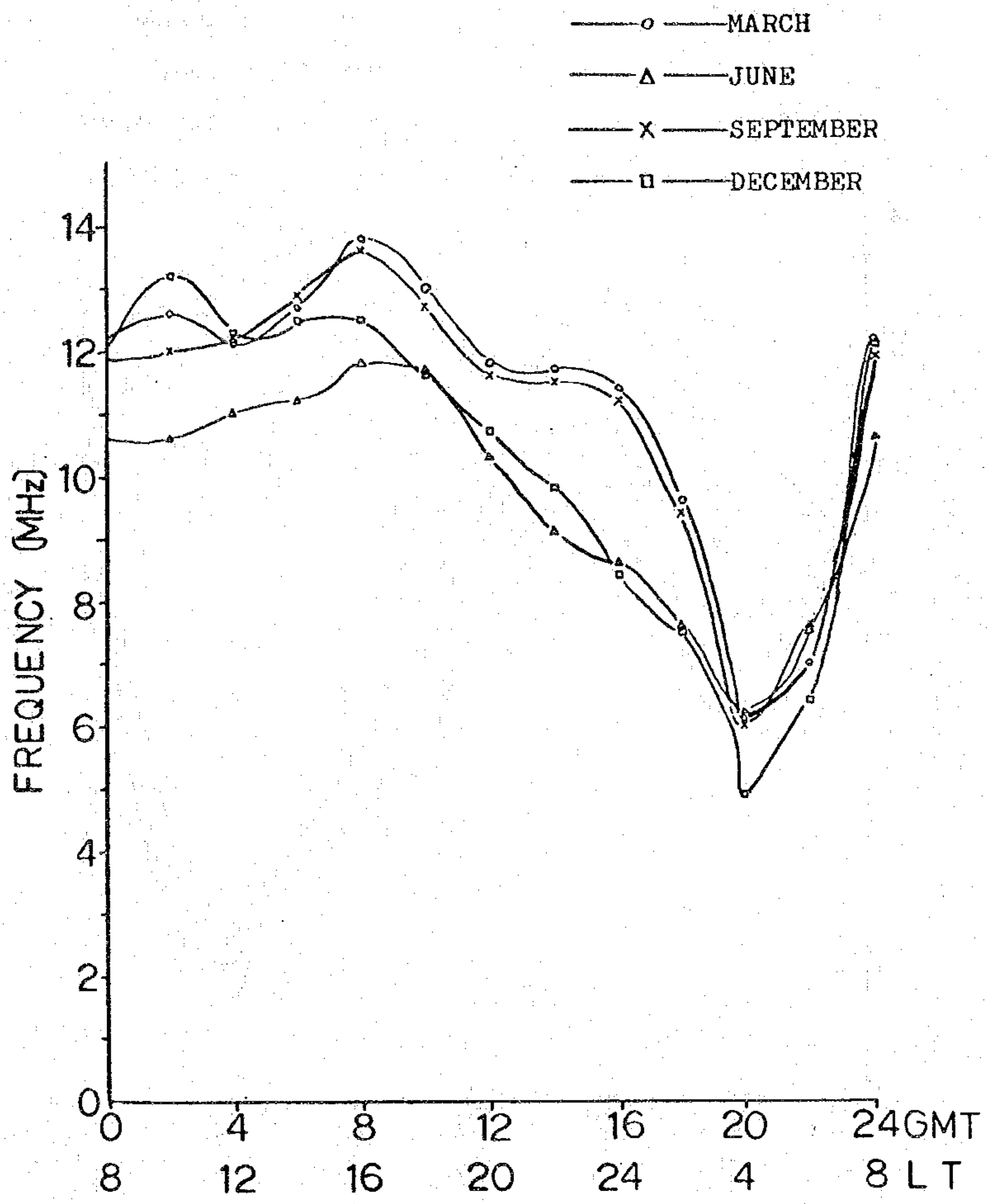


MUF CURVE

SSN - 100 DISTANCE = 429KM POWER = 0.3KW

T - MANILA (425) 14.35N 120.59E

R - CUYO (630) 10.51N 121.02E

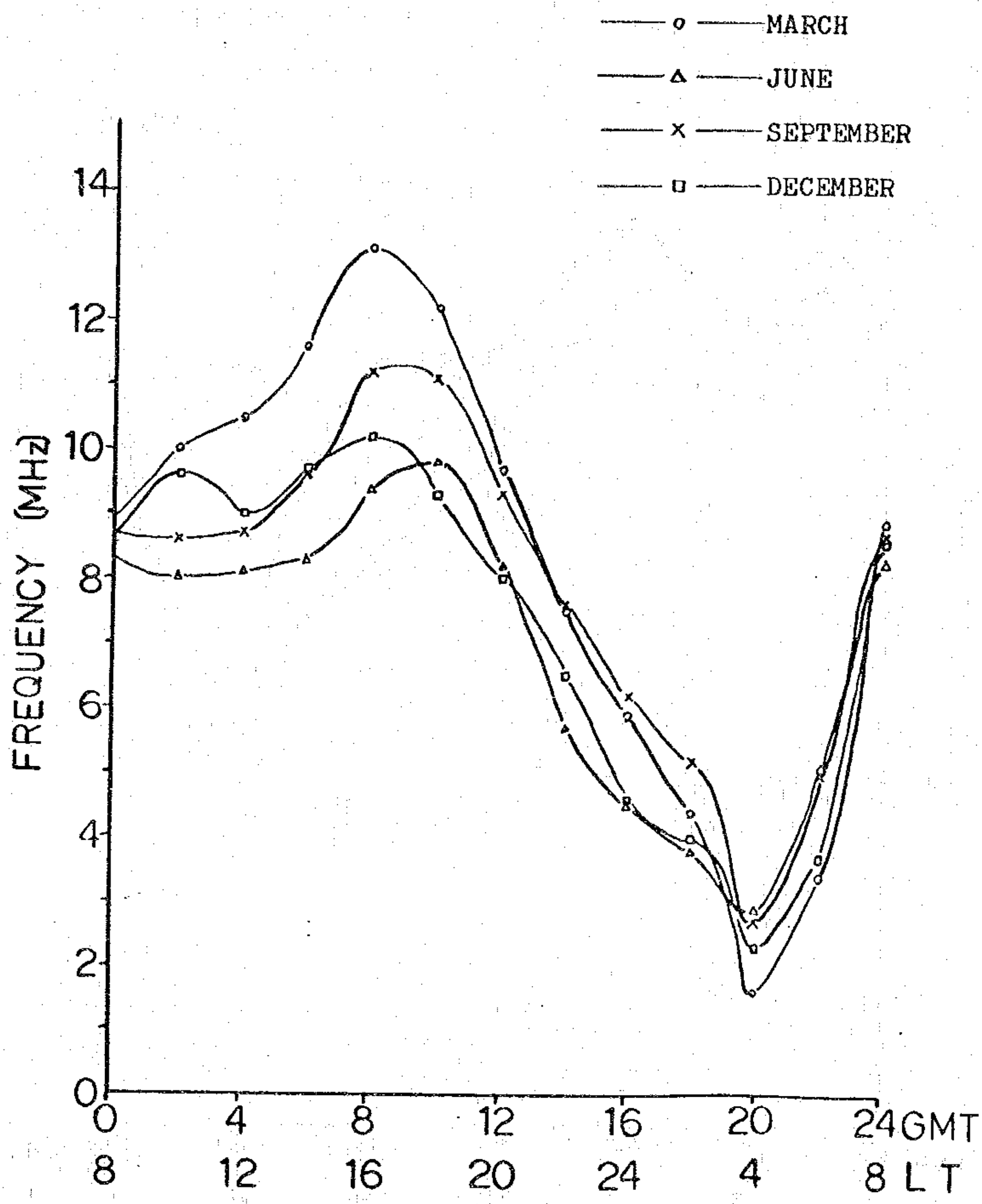


MUF CURVE

SSN - 10 DISTANCE = 592KM POWER = 0.3KW

T - MANILA (425) 14.35N 120.59E

R - PUERTO PRINCESA (618) 9.45N 118.44E

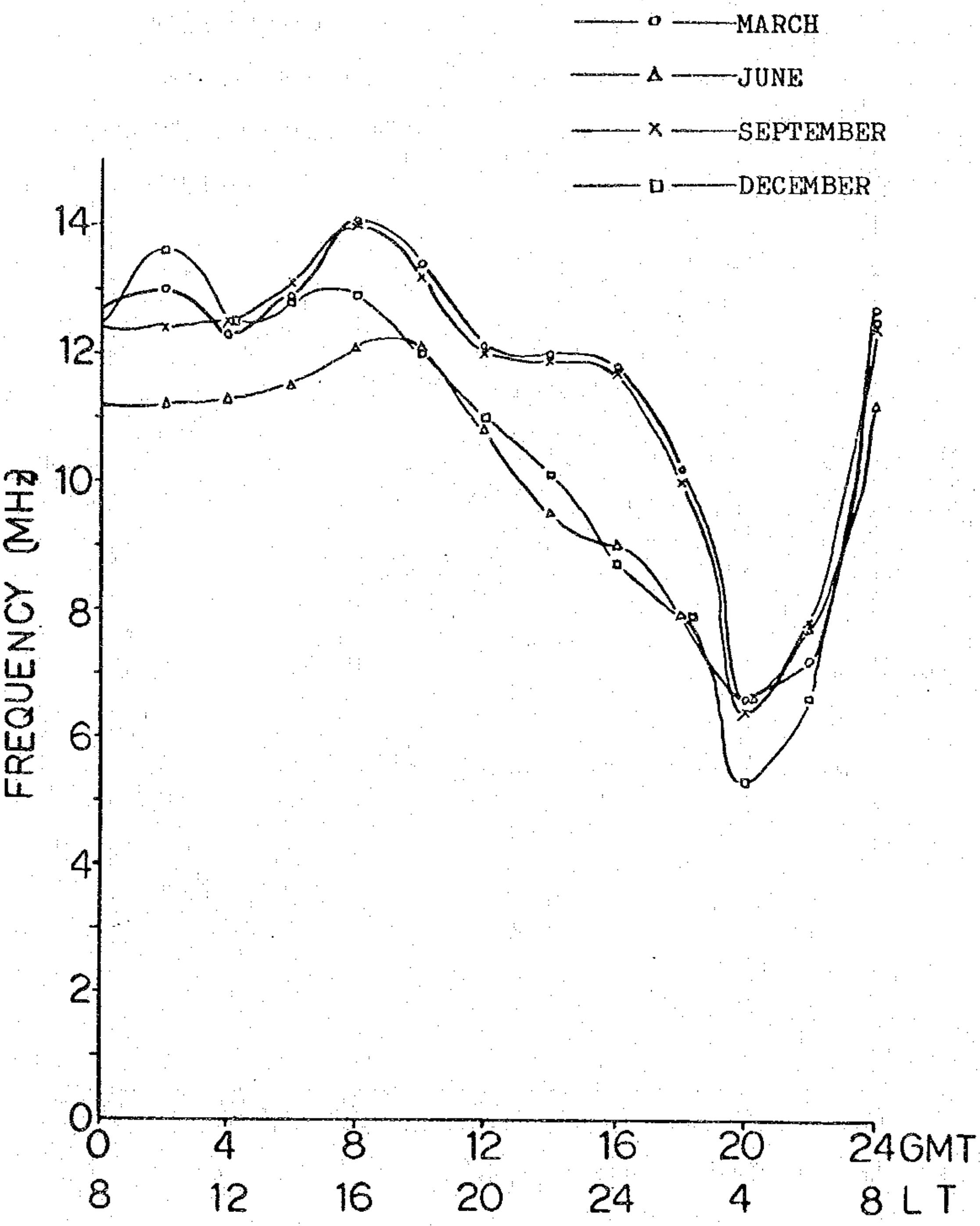


MUF CURVE

SSN - 100 DISTANCE = 592KM POWER = 0.3KW

T - MANILA (425) 14.35N 120.59E

R - PUERTO PRINCESA (618) 9.45N 118.44E

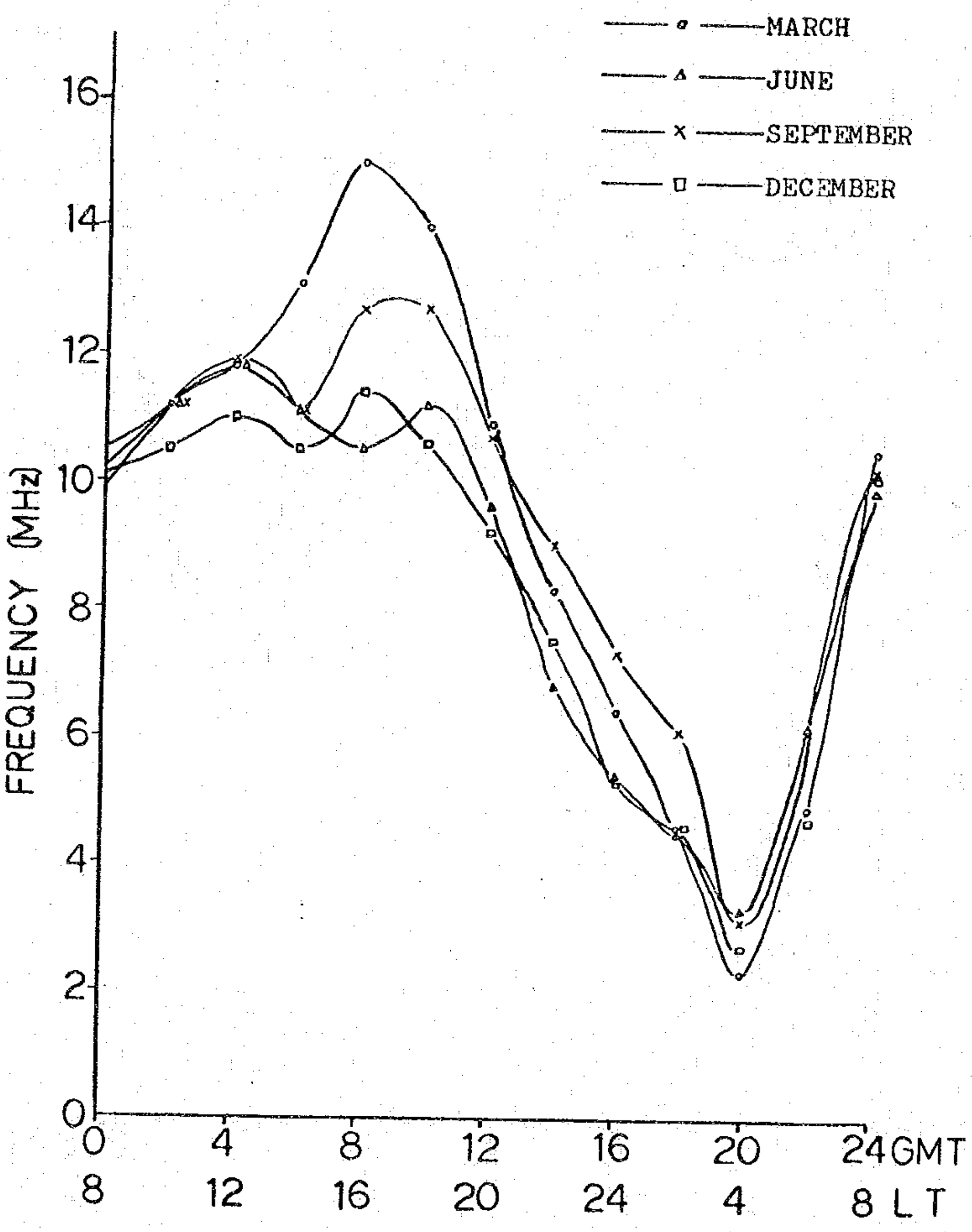


MUF CURVE

SSN - 10 DISTANCE = 925KM POWER = 0.3KW

T - MANILA (425) 14.35N 120.59E

R - JOLO (830) 6.03N 121.00E

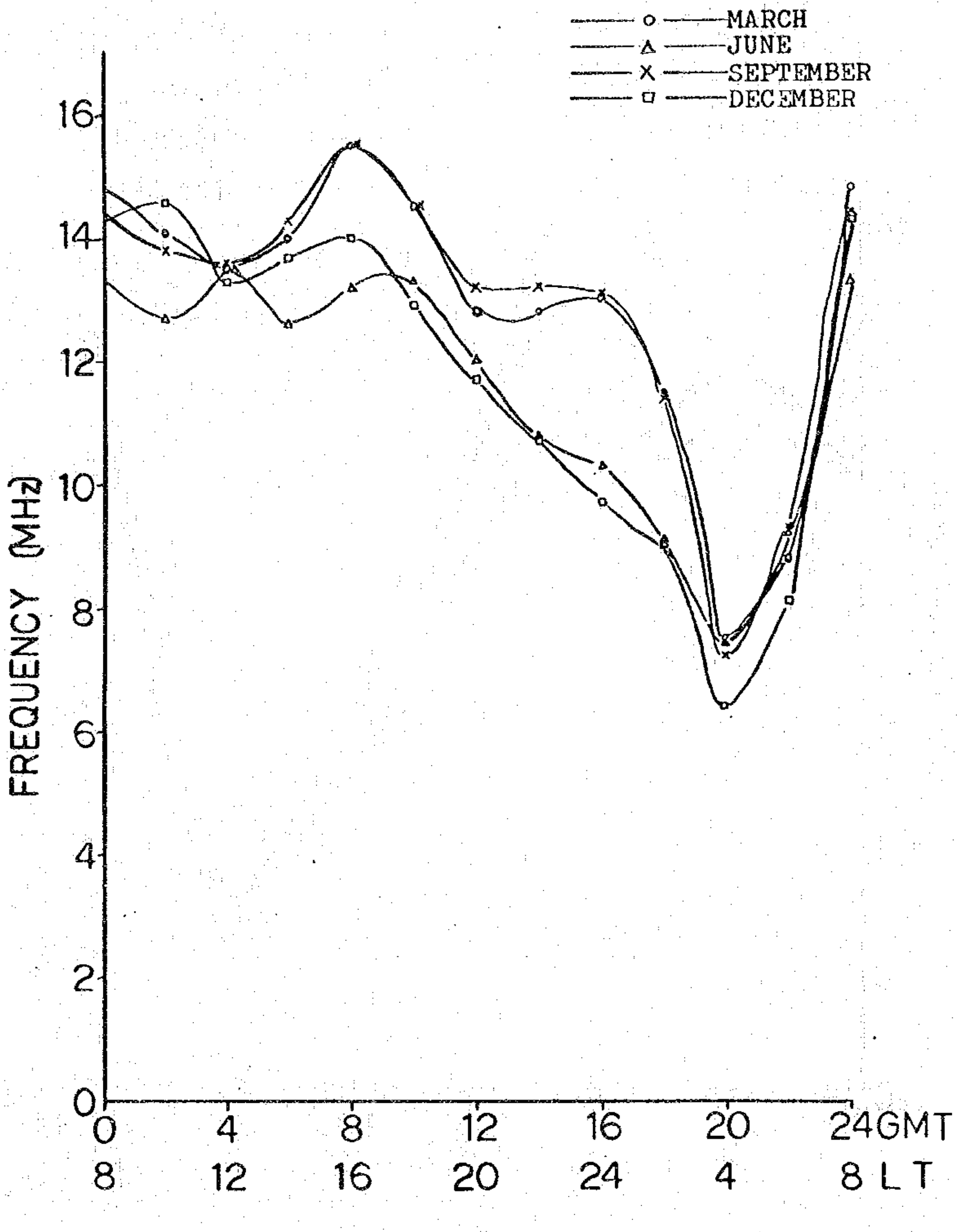


MUF CURVE

SSN -100 DISTANCE = 925KM POWER = 0.3KW

T - MANILA (425) 14.35N 120.59E

R - JOLO (830) 6.03N 121.00E

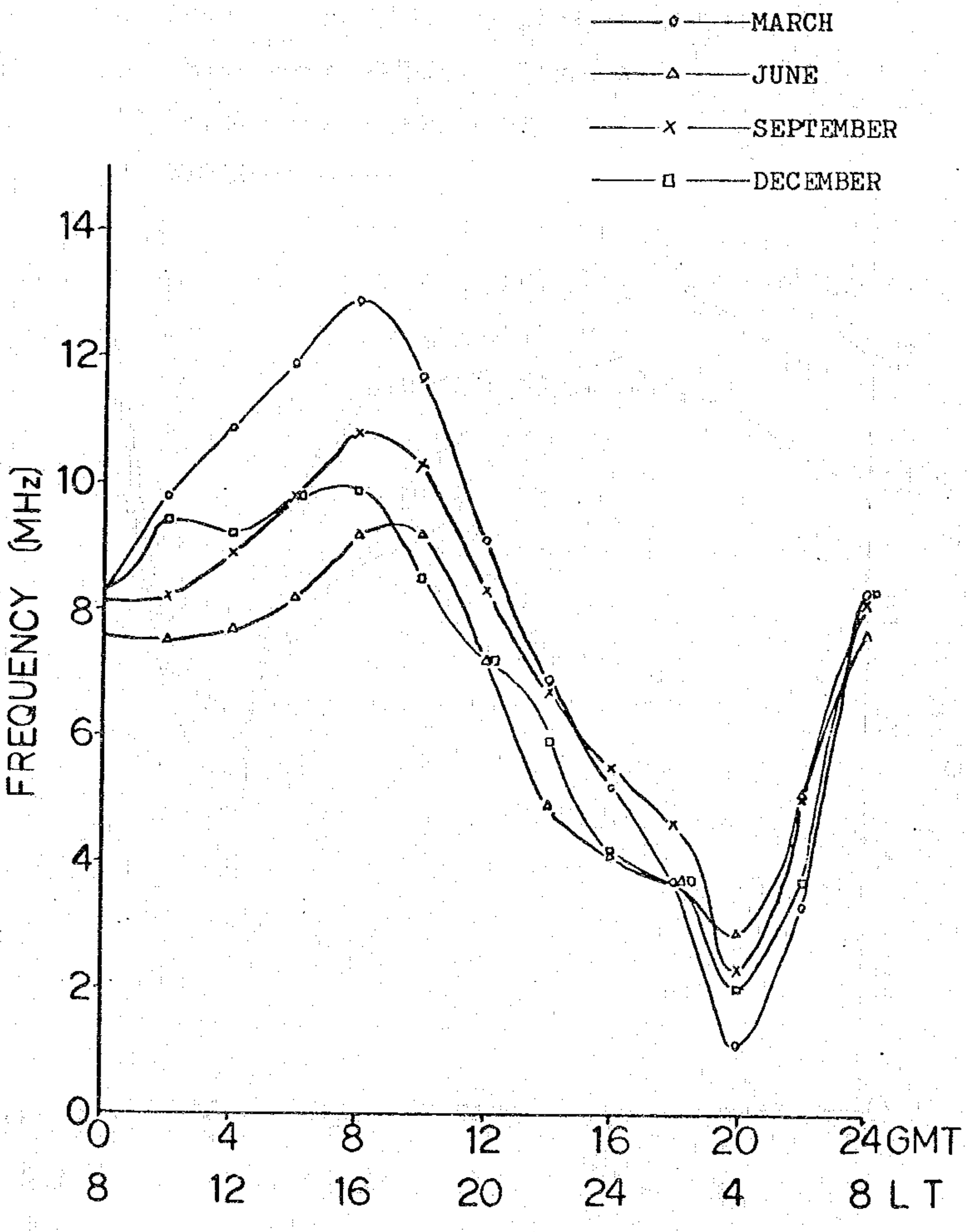


MUF CURVE

SSN - 10 DISTANCE = 338KM POWER = 0.3KW

T - MANILA (425) 14.35N 120.59E

R - LEGASPI 0444) 13.08N 123.44E

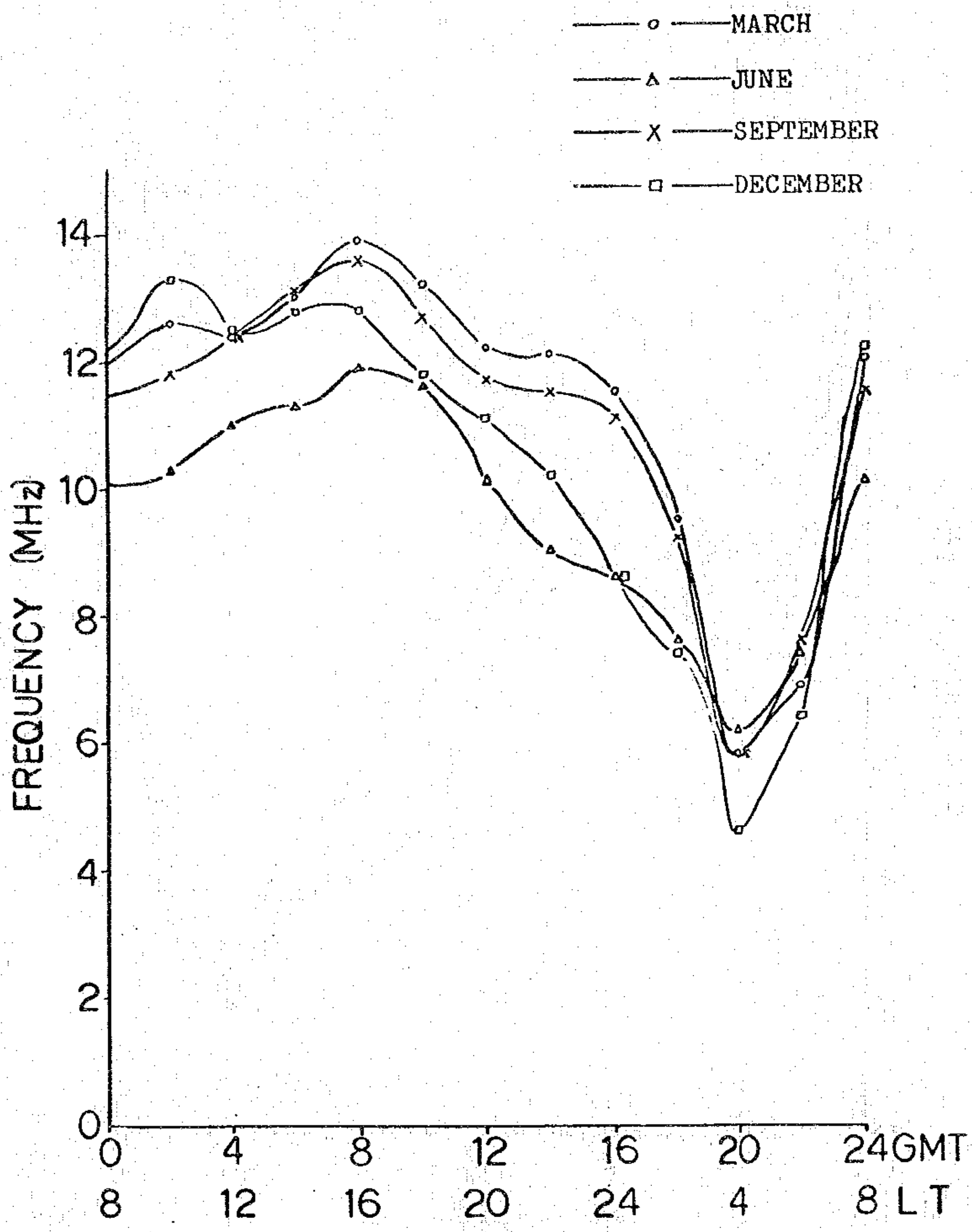


MUF CURVE

SSN - 100 DISTANCE = 338KM POWER = 0.3KW

T - MANILA (425) 14.35N 120.59E

R - LEGASPI (444) 13.08N 123.44E



CIRCUIT RELIABILITY : REL.

****

GMT 2,4,6,8,10,12,14,16,18,20,22,24

FREQUENCY (MHz) 3.0,3.8,4.7,5.9,7.4,9.3,11.7,14.7

3 MHz NOISE = -148.6DBW

TIME = 90%

REQ. S/N = 38DB

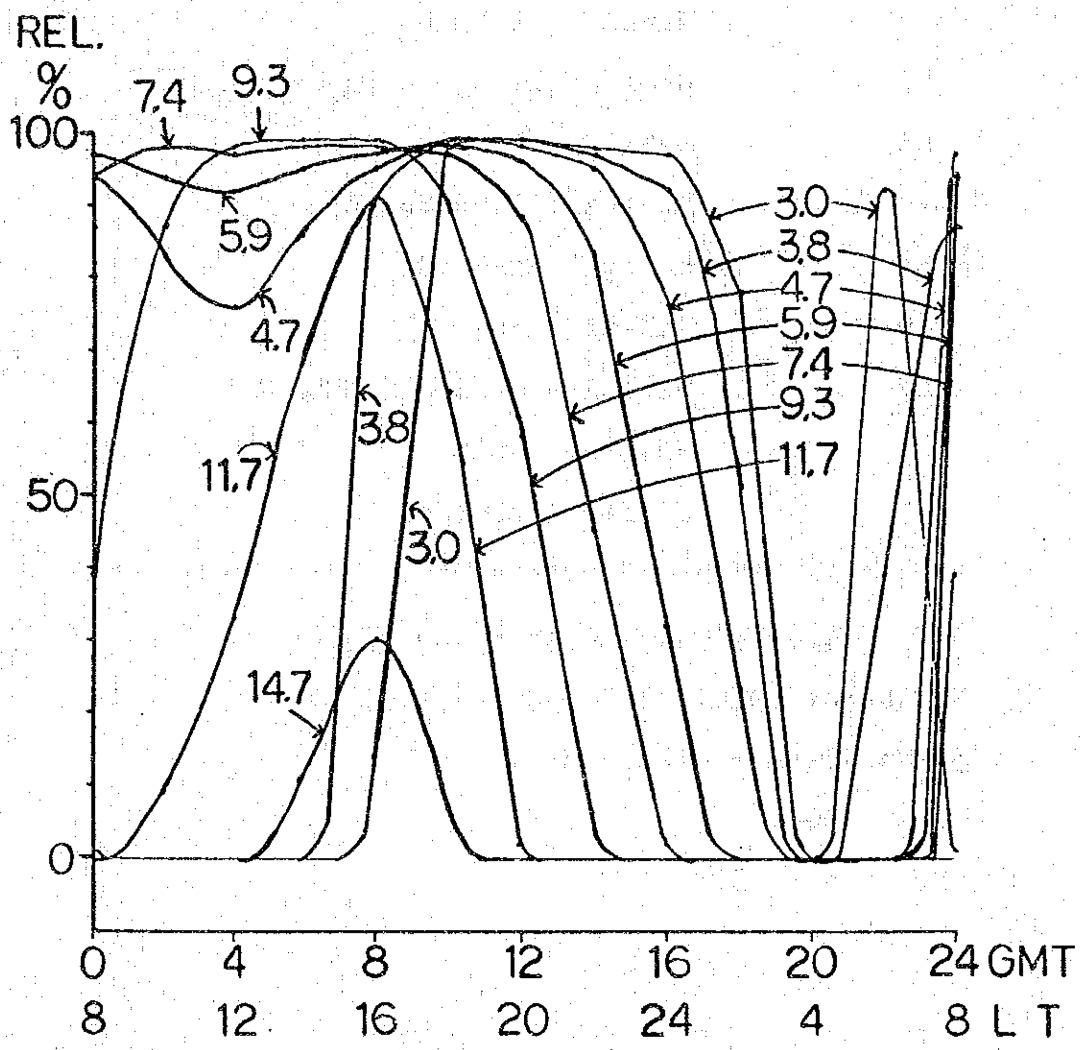
CIRCUIT RELIABILITY : REL.

MONTH - 3 SSN - 10 POWER = 0.3KW

T - MANILA (425) 14.35N 120.59E

R - TACLOBAN (550) 11.15N 125.00E

DISTANCE = 595KM AZIMUTHS TR - 126 RT - 307



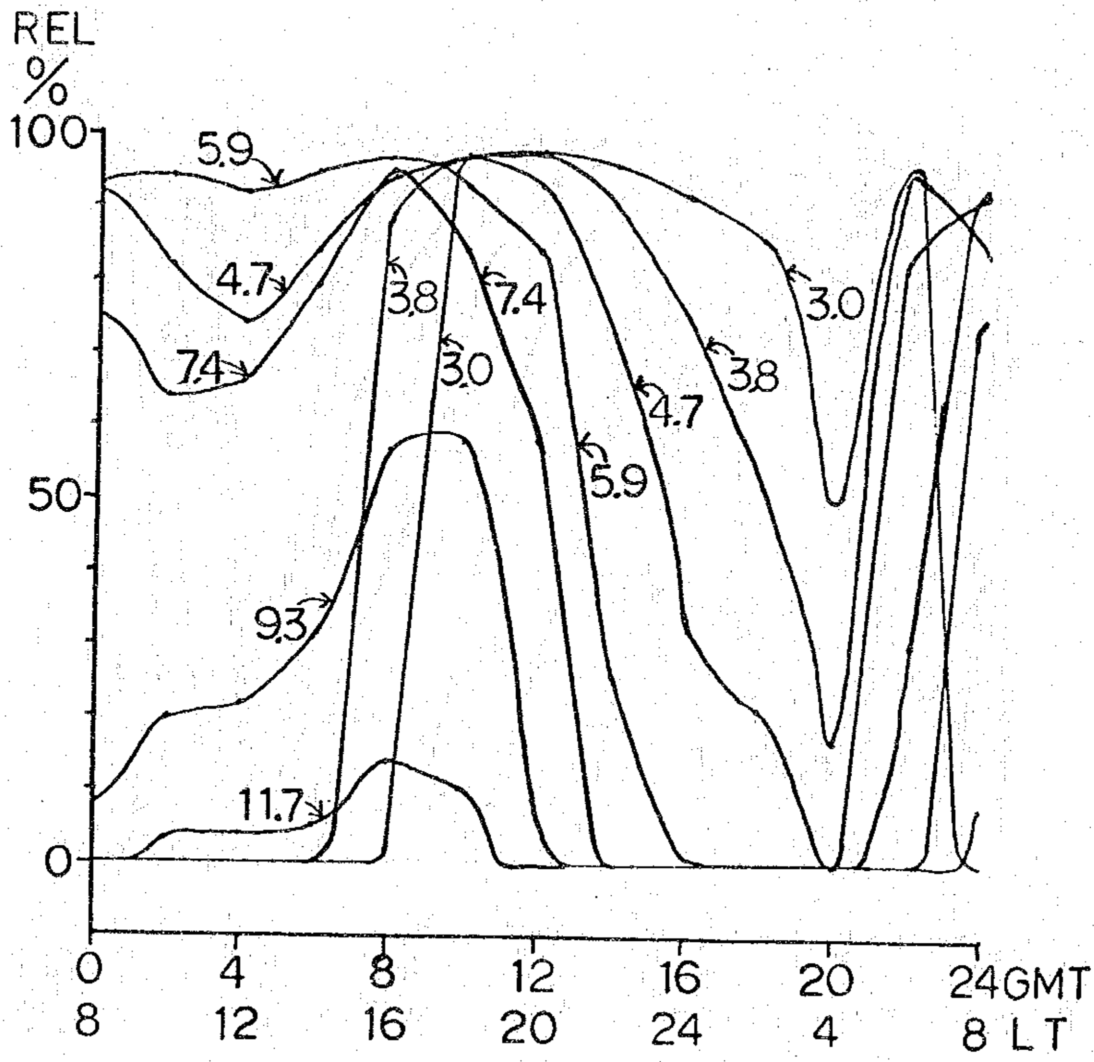
CIRCUIT RELIABILITY : REL.

MONTH - 6 SSN - 10 POWER = 0.3KW

T - MANILA (425) 14.35N 120.59E

R - TACLOBAN (550) 11.15N 125.00E

DISTANCE = 595KM AZIMUTHS TR - 126 RT - 307



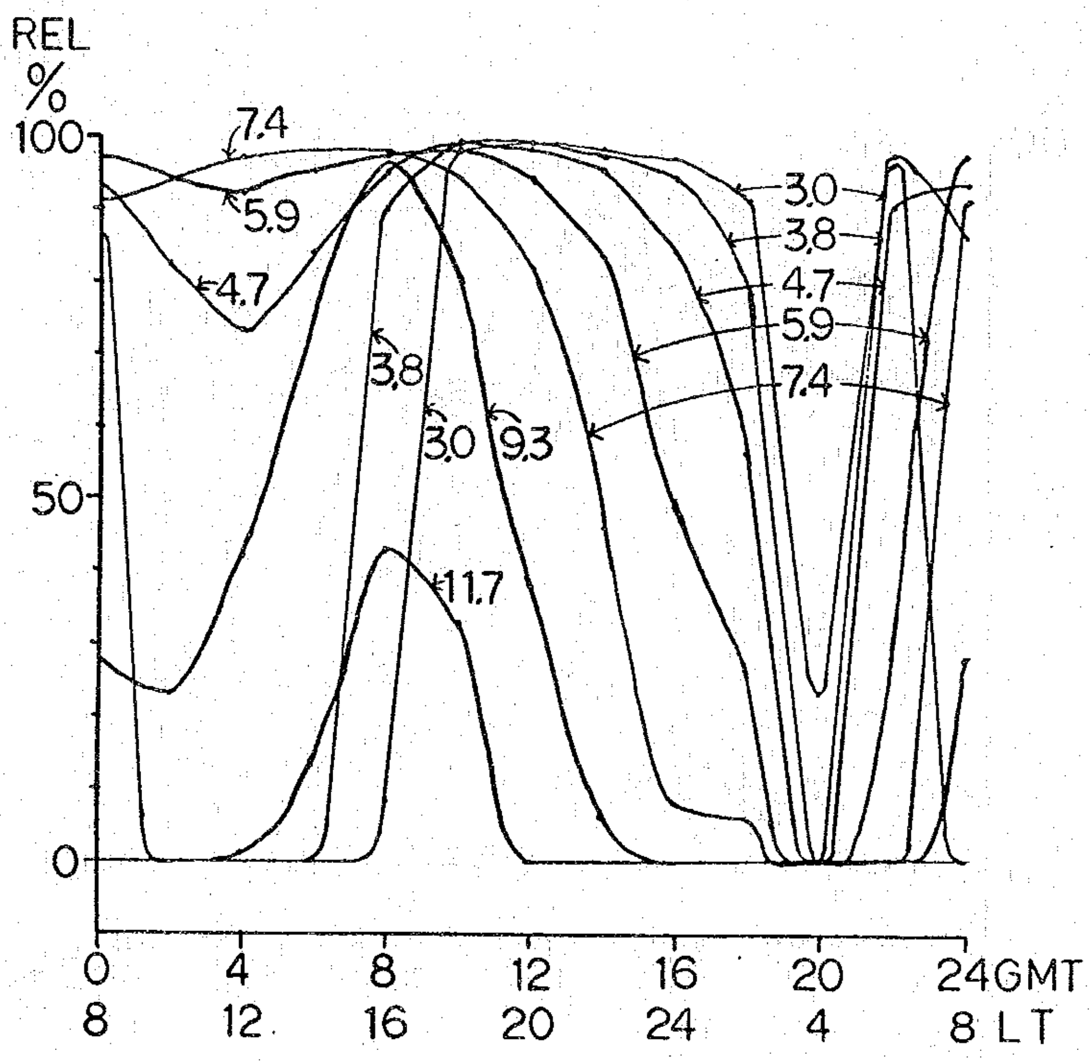
CIRCUIT RELIABILITY : REL.

MONTH - 9 SSN - 10 POWER = 0.3KW

T - MANILA (425) 14.35N 120.59E

R - TACLOBAN (550) 11.15N 125.00E

DISTANCE = 595KM AZIMUTHS TR - 126 RT - 307



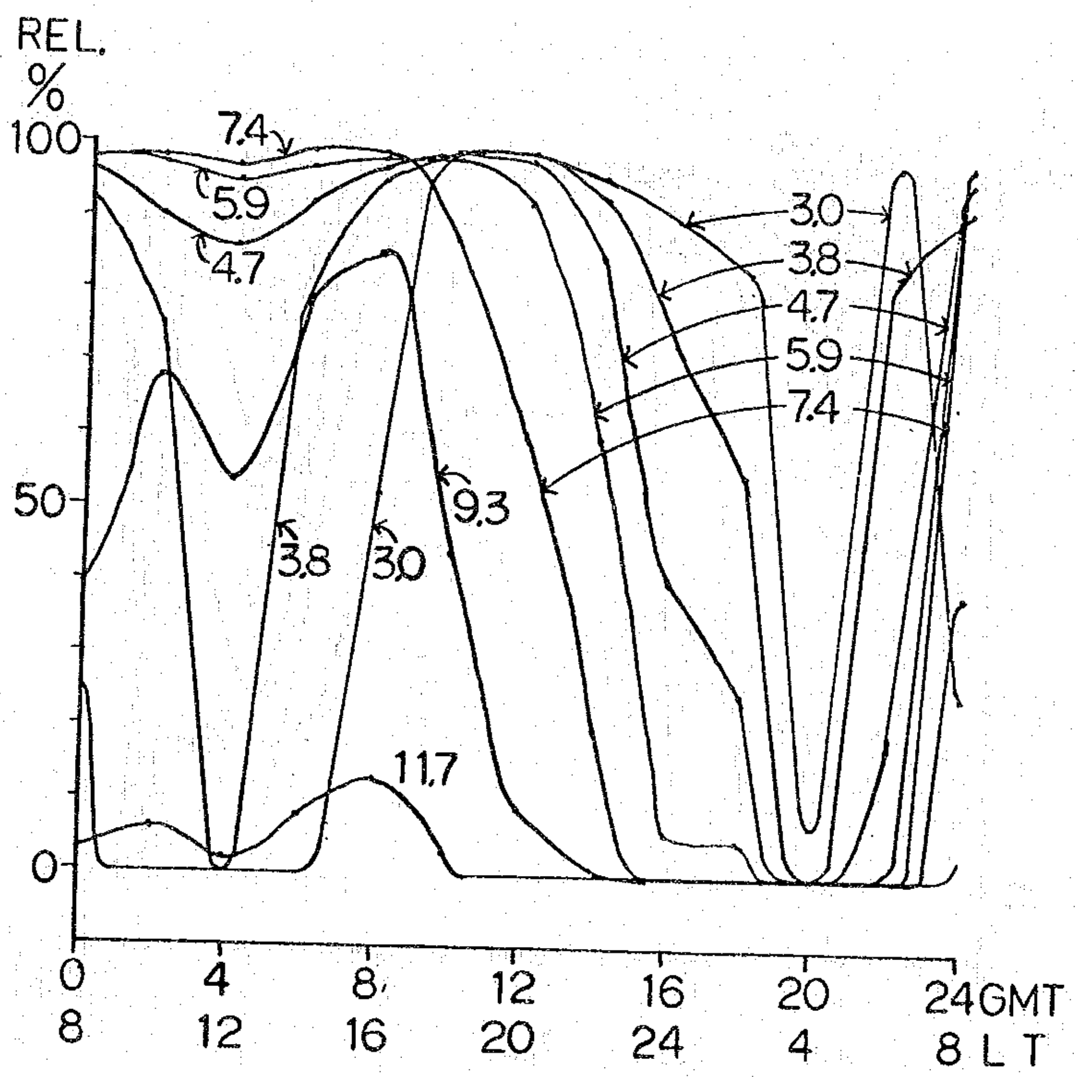
CIRCUIT RELIABILITY : REL.

MONTH - 12 SSN - 10 POWER = 0.3KW

T - MANILA (425) 14.35N 120.59E

R - TACLOBAN (550) 11.15N 125.00E

DISTANCE = 595KM AZIMUTHS TR - 126 RT - 307



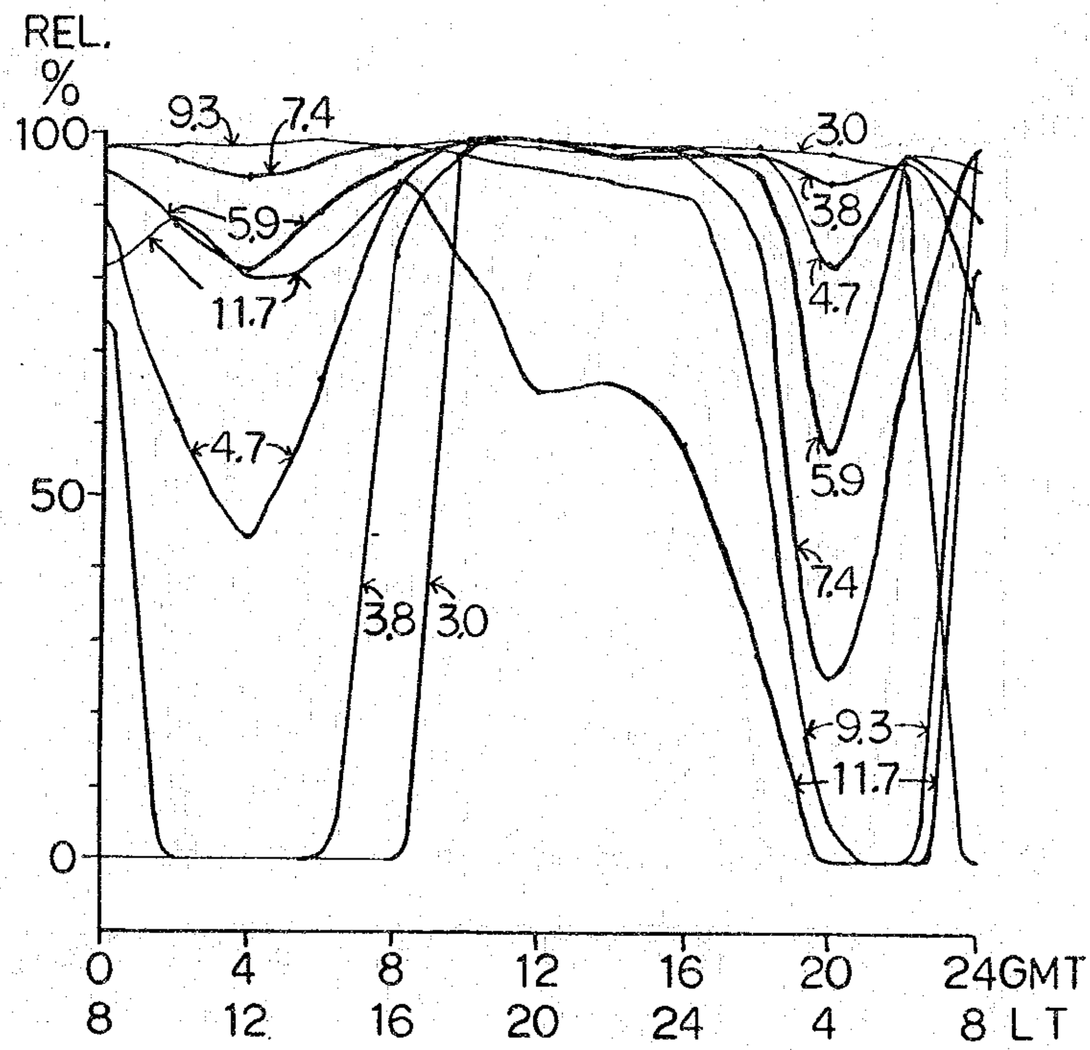
CIRCUIT RELIABILITY : REL.

MONTH - 3 SSN - 100 POWER = 0.3KW

T - MANILA (425) 14.35N 120.59E

R - TACLOBAN (550) 11.15N 125.00E

DISTANCE = 595KM AZIMUTHS TR - 126 RT - 307



6

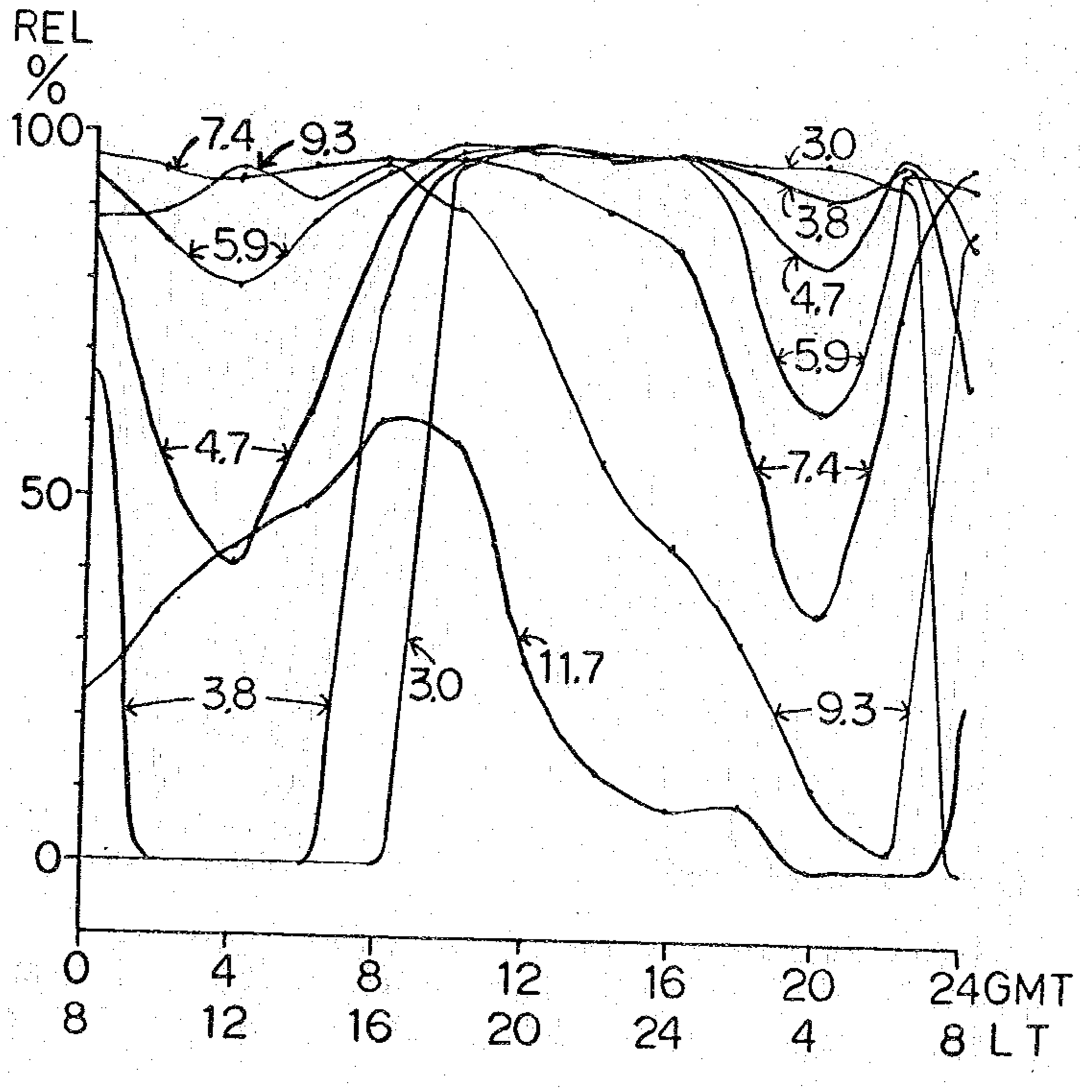
CIRCUIT RELIABILITY : REL.

MONTH - 6 SSN - 100 POWER = 0.3KW

T - MANILA (425) 14.35N 120.59E

R - TACLOBAN (550) 11.15N 125.00E

DISTANCE = 595KM AZIMUTHS TR - 126 RT - 307



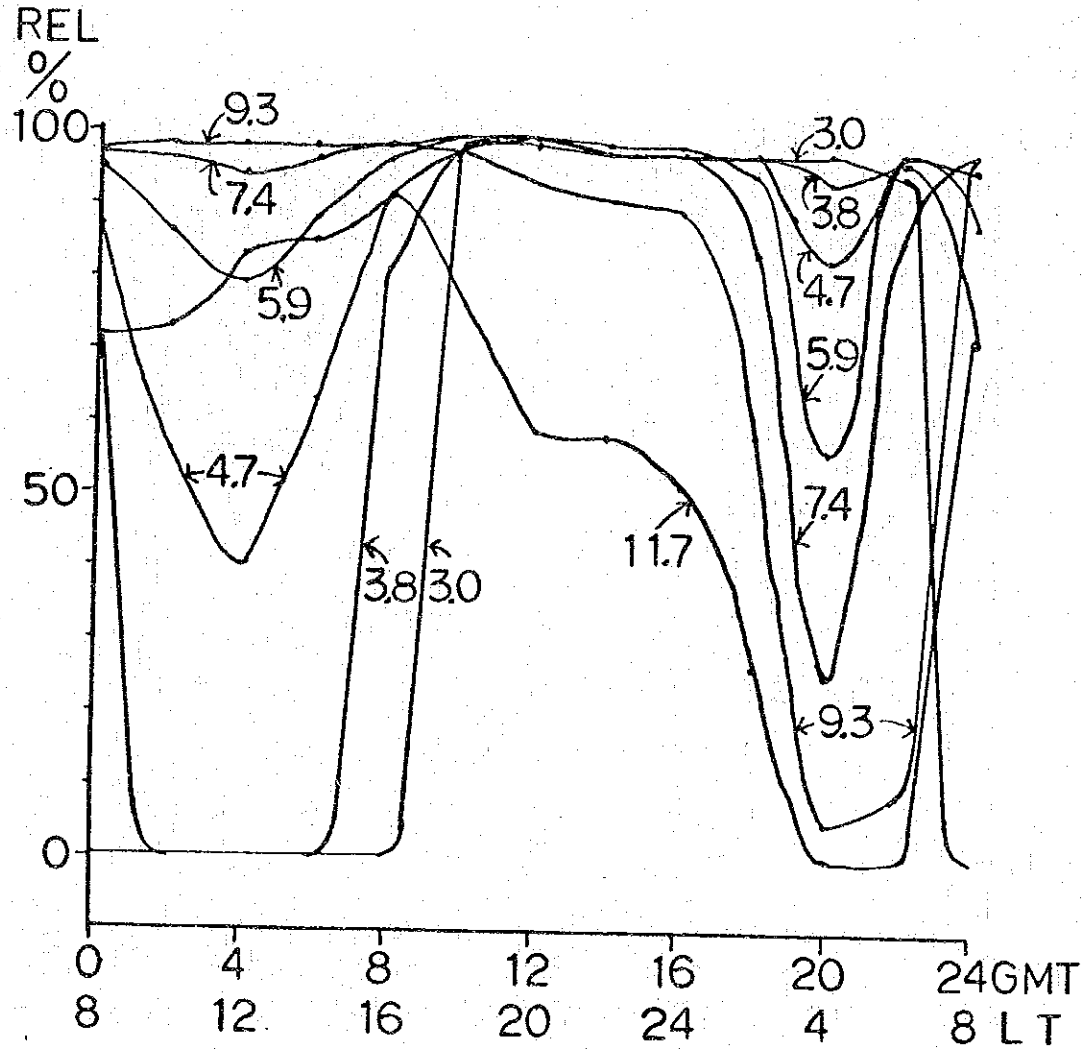
CIRCUIT RELIABILITY : REL.

MONTH - 9 SSN - 100 POWER = 0.3KW

T - MANILA (425) 14.35N 120.59E

R - TACLOBAN (550) 11.15N 125.00E

DISTANCE = 595KM AZIMUTHS TR - 126 RT - 307



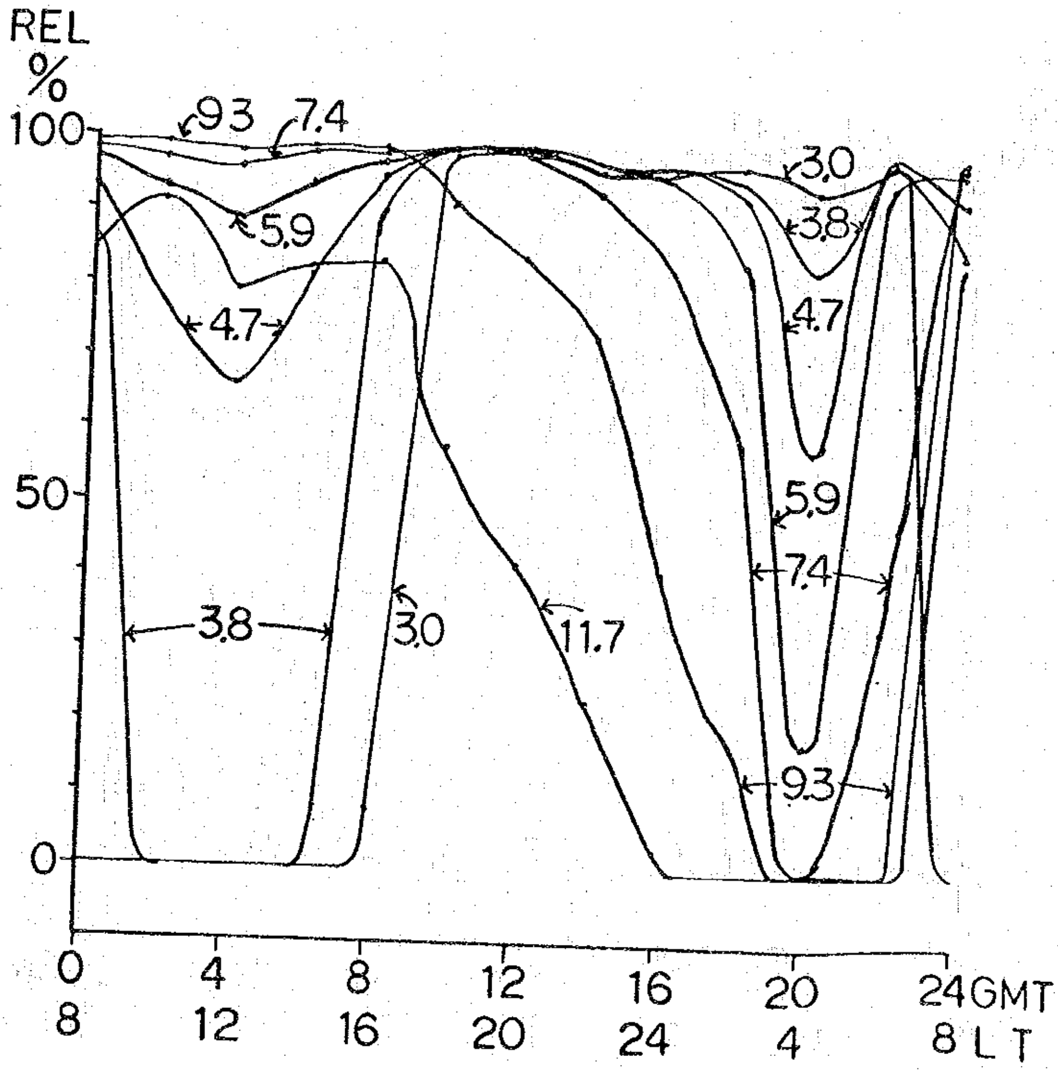
CIRCUIT RELIABILITY : REL.

MONTH - 12 SSN - 100 POWER = 0.3KW

T - MANILA (425) 14.35N 120.59E

R - TACLOBAN (550) 11.15N 125.00E

DISTANCE = 595KM AZIMUTHS TR - 126 RT - 307



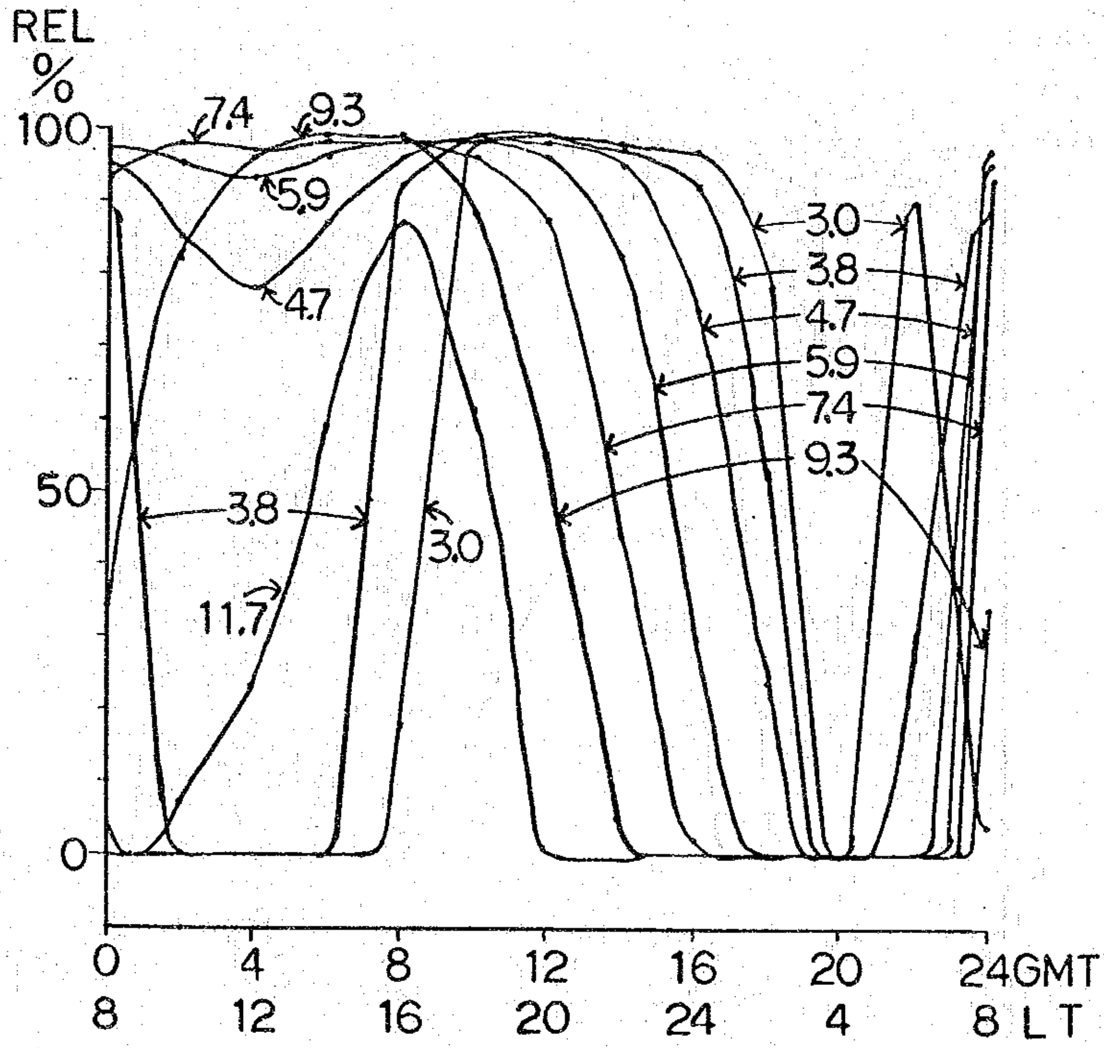
CIRCUIT RELIABILITY : REL.

MONTH - 3 SSN - 10 POWER = 0.3KW

T - MANILA (425) 14.35N 120.59E

R - MACTAN (646) 10.18N 123.58E

DISTANCE = 565KM AZIMUTHS TR - 144 RT - 325



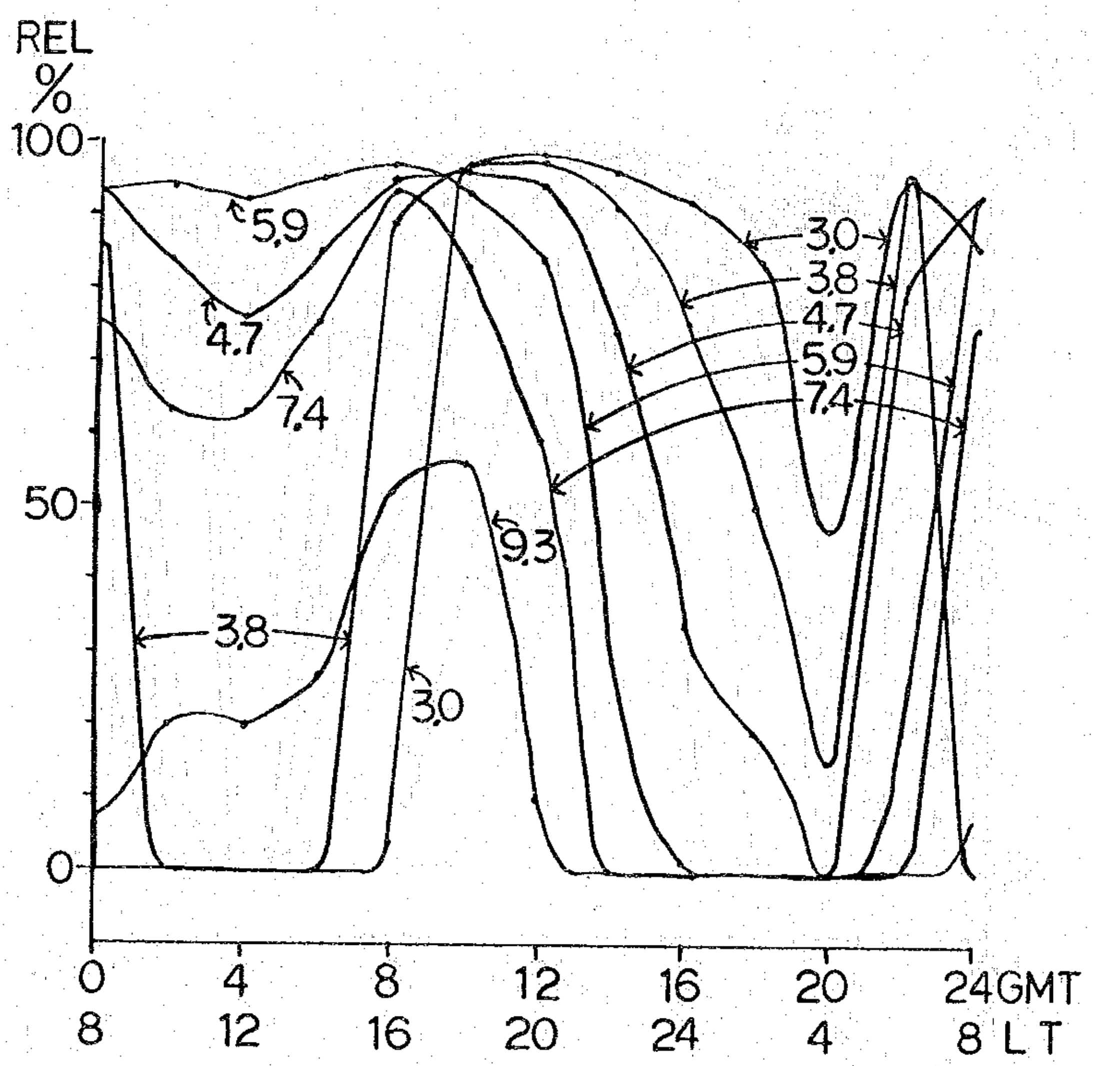
CIRCUIT RELIABILITY : REL.

MONTH - 6 SSN - 10 POWER = 0.3KW

T - MANILA (425) 14.35N 120.59E

R - MACTAN (646) 10.18N 123.58E

DISTANCE = 565KM AZIMUTHS TR - 144 RT - 325



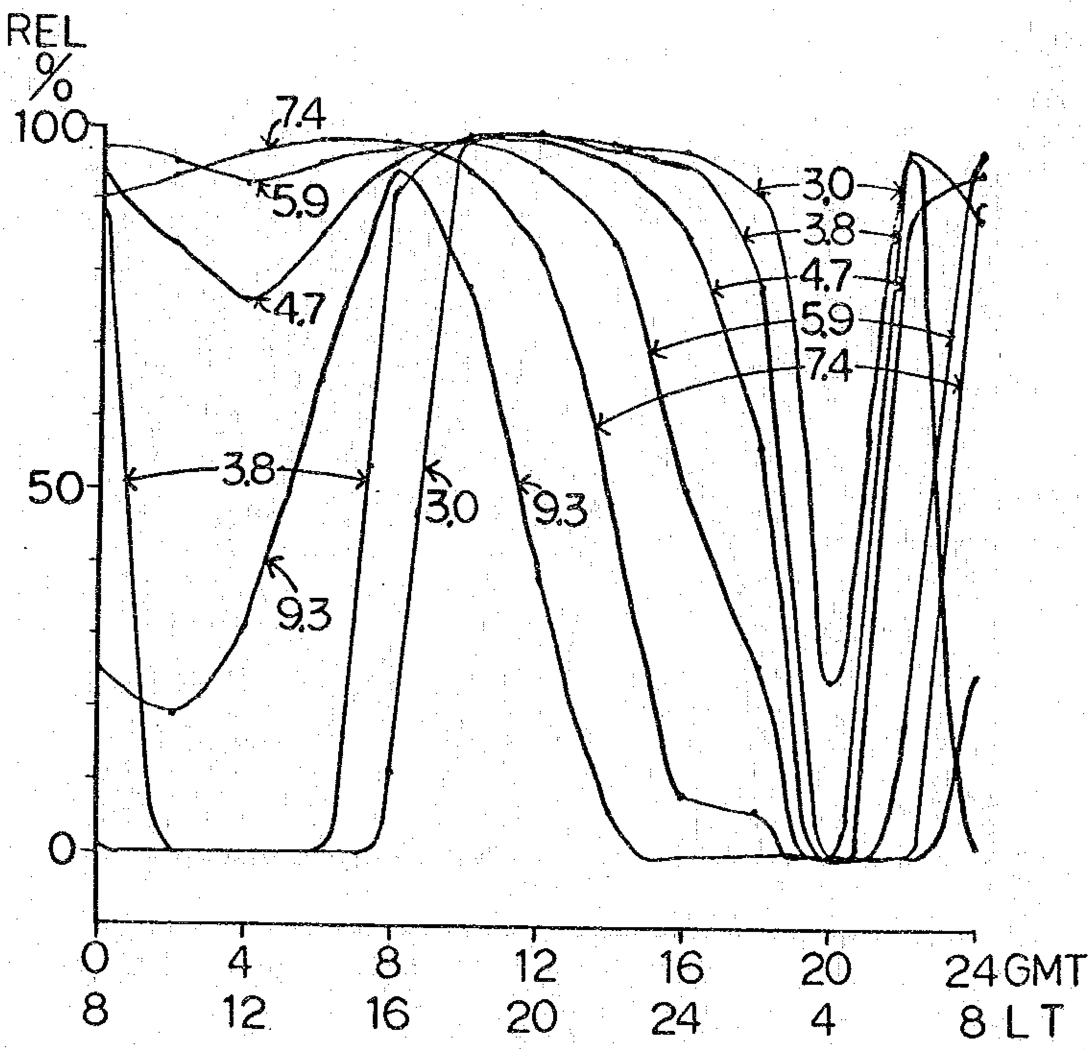
CIRCUIT RELIABILITY : REL.

MONTH - 9 SSN - 10 POWER = 0.3KW

T - MANILA (425) 14.35N 120.59E

R - MACTAN (646) 10.18N 123.58E

DISTANCE = 565KM AZIMUTHS TR - 144 RT - 325



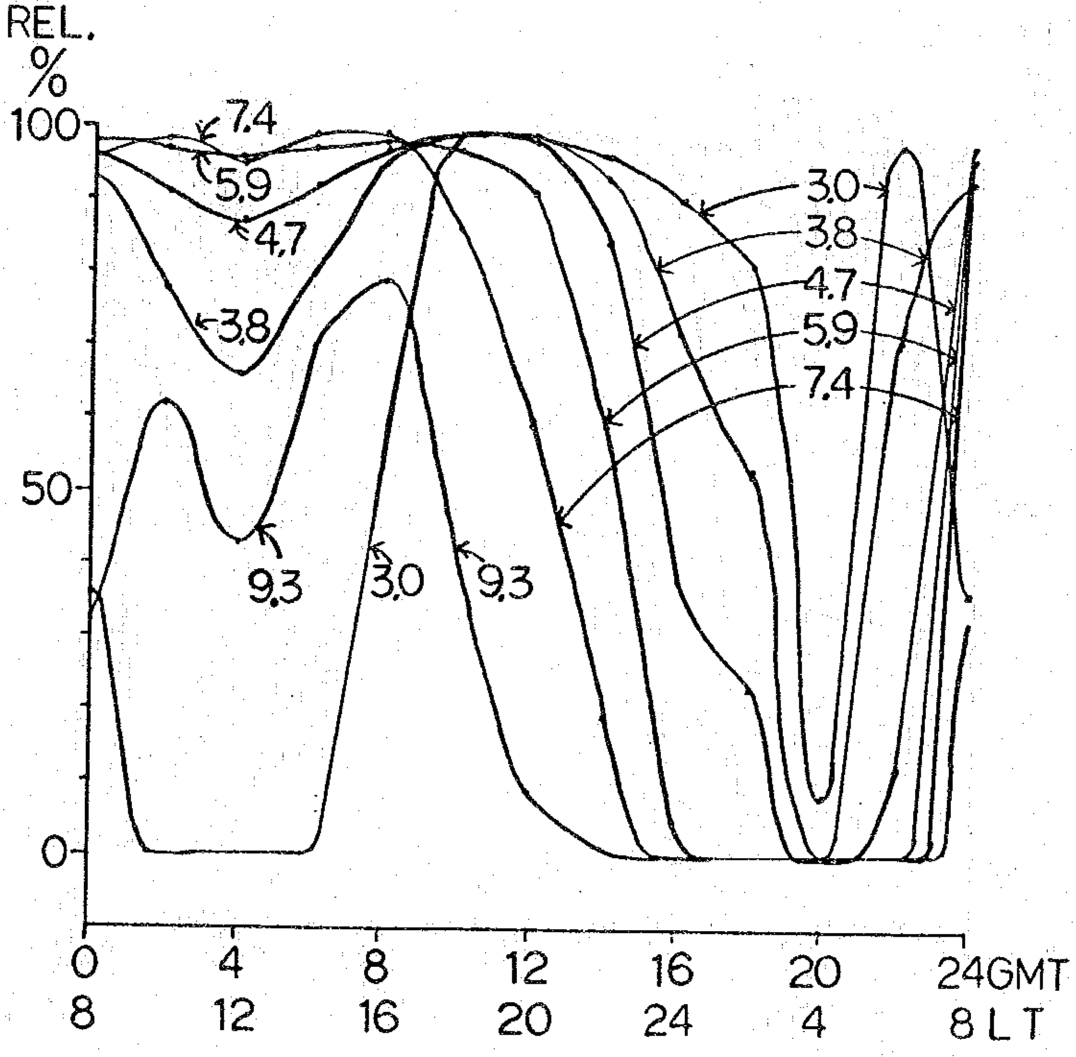
CIRCUIT RELIABILITY : REL.

MONTH - 12   SSN - 10   POWER = 0.3KW

T - MANILA (425)   14.35N   120.59E

R - MACTAN (646)   10.18N   123.58E

DISTANCE = 565KM   AZIMUTHS TR - 144 RT - 325



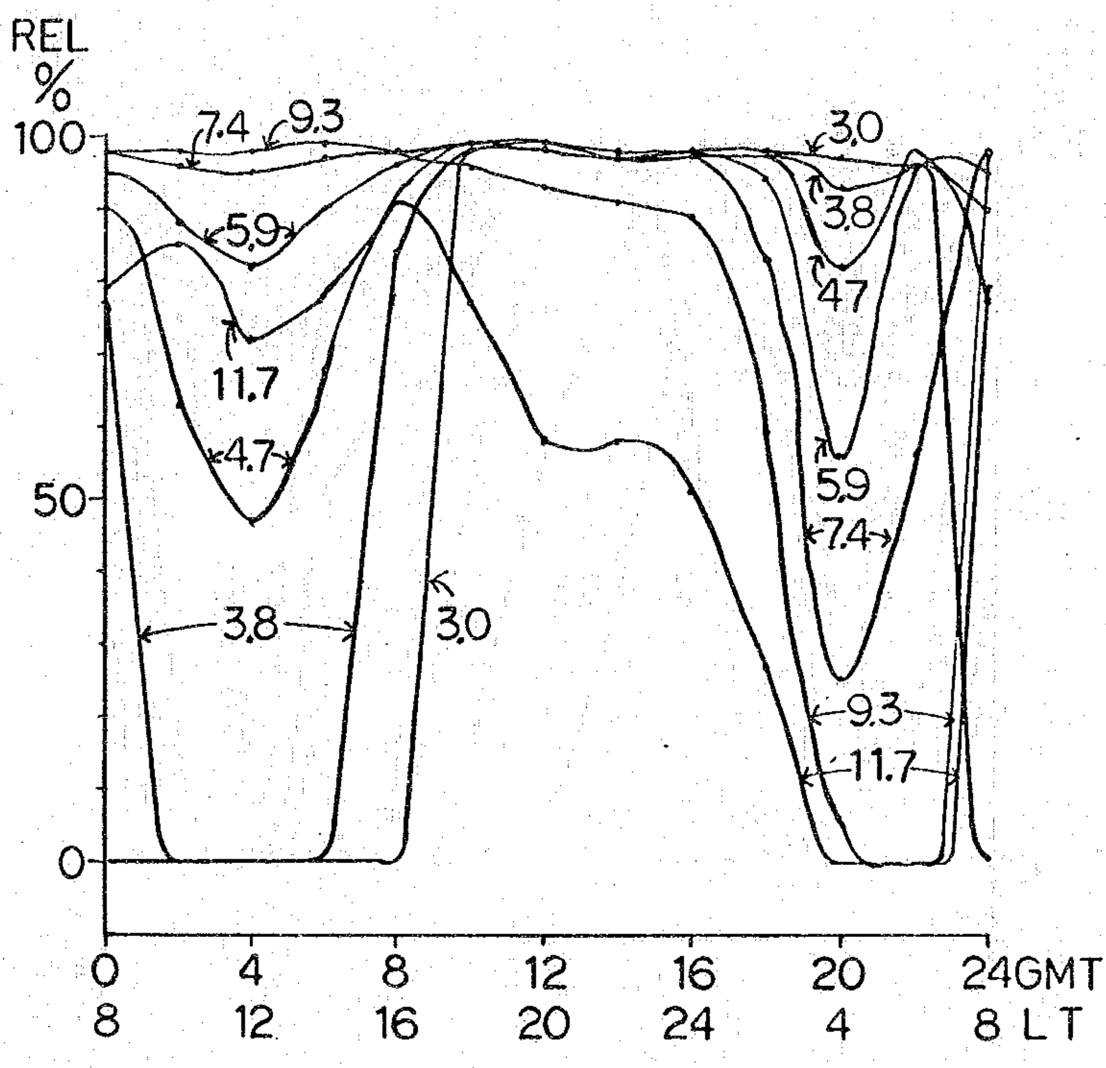
CIRCUIT RELIABILITY : REL.

MONTH - 3 SSN - 100 POWER = 0.3KW

T - MANILA (425) 14.35N 120.59E

R - MACTAN (646) 10.18N 123.58E

DISTANCE = 565KM AZIMUTHS TR - 144 RT - 325



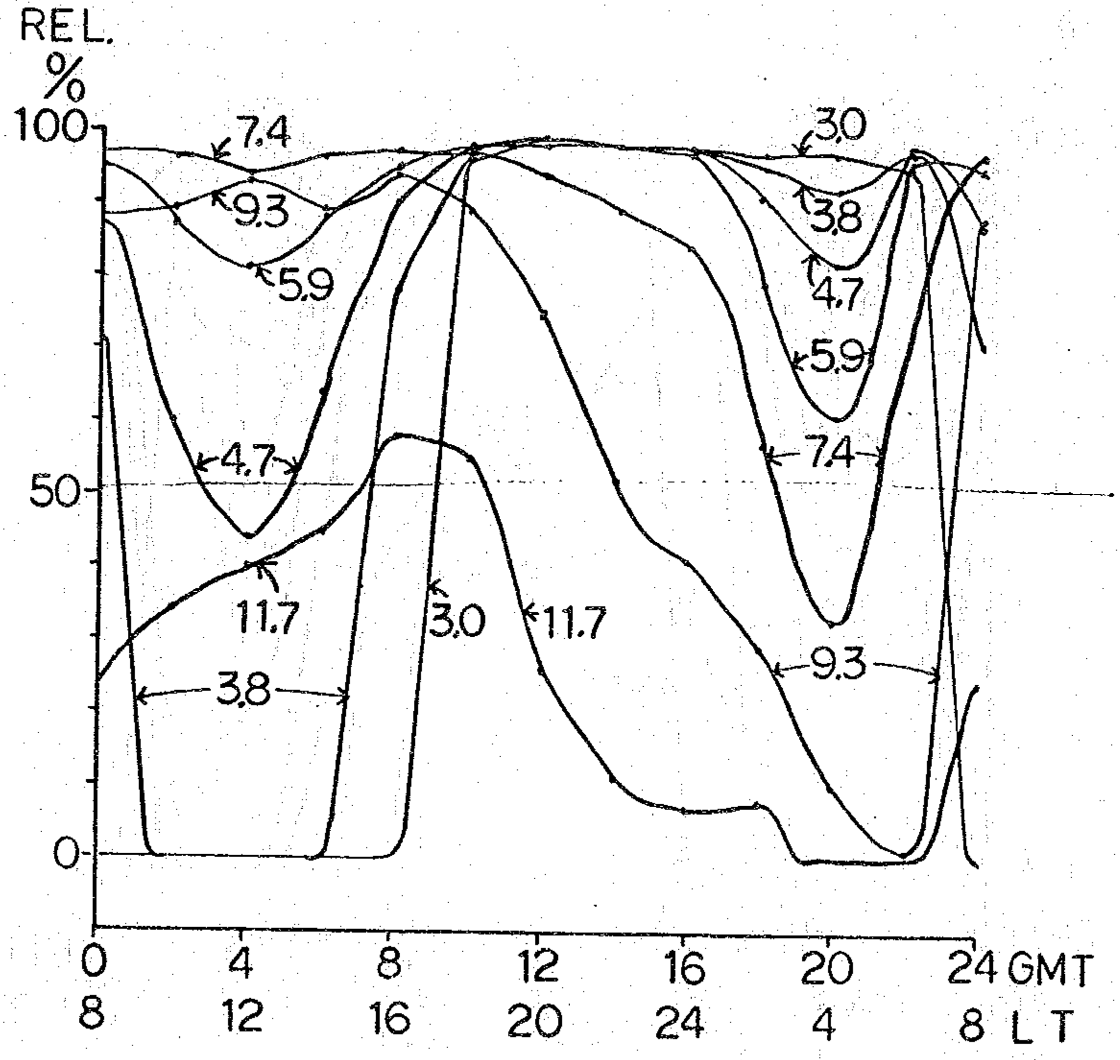
CIRCUIT RELIABILITY : REL.

MONTH - 6 SSN - 100 POWER = 0.3KW

T - MANILA (425) 14.35N 120.59E

R - MACTAN (646) 10.18N 123.58E

DISTANCE = 565KM AZIMUTHS TR - 144 RT - 325



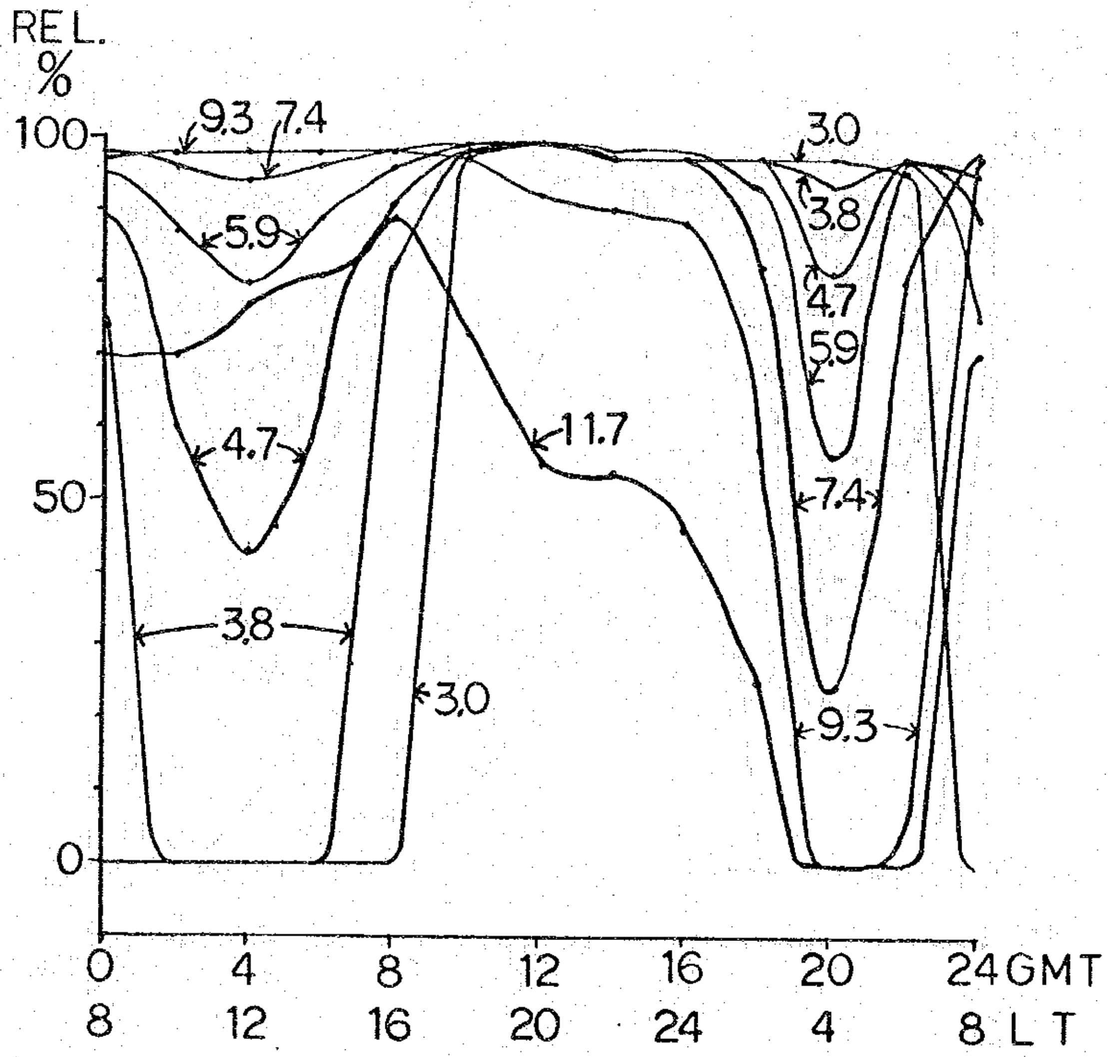
CIRCUIT RELIABILITY : REL.

MONTH - 9 SSN - 100 POWER = 0.3KW

T - MANILA (425) 14.35N 120.59E

R - MACTAN (646) 10.18N 123.58E

DISTANCE = 565KM AZIMUTHS TR - 144 RT - 325



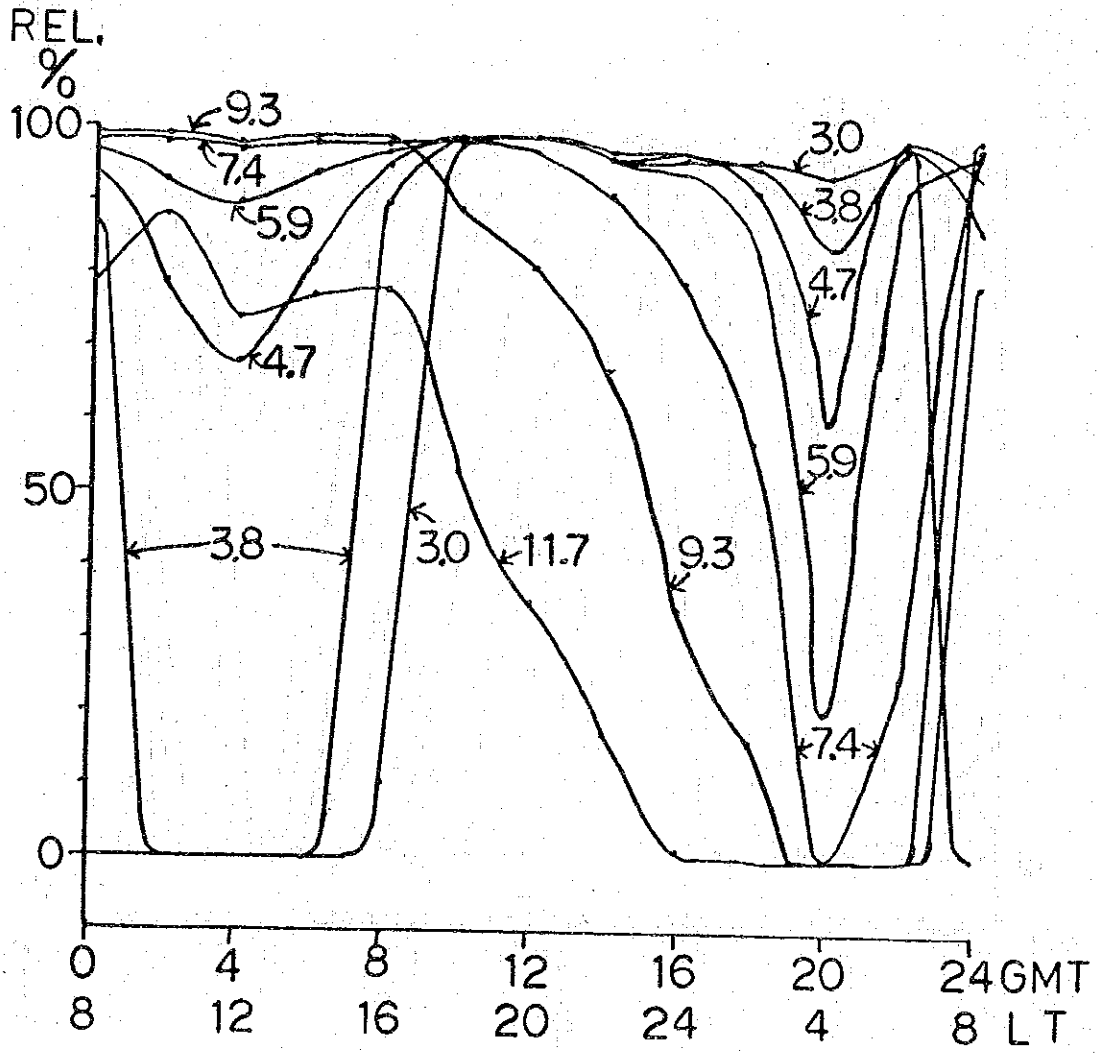
CIRCUIT RELIABILITY : REL.

MONTH - 12 SSN - 100 POWER = 0.3KW

T - MANILA (425) 14.35N 120.59E

R - MACTAN (646) 10.18N 123.58E

DISTANCE = 565KM AZIMUTHS TR - 144 RT - 325



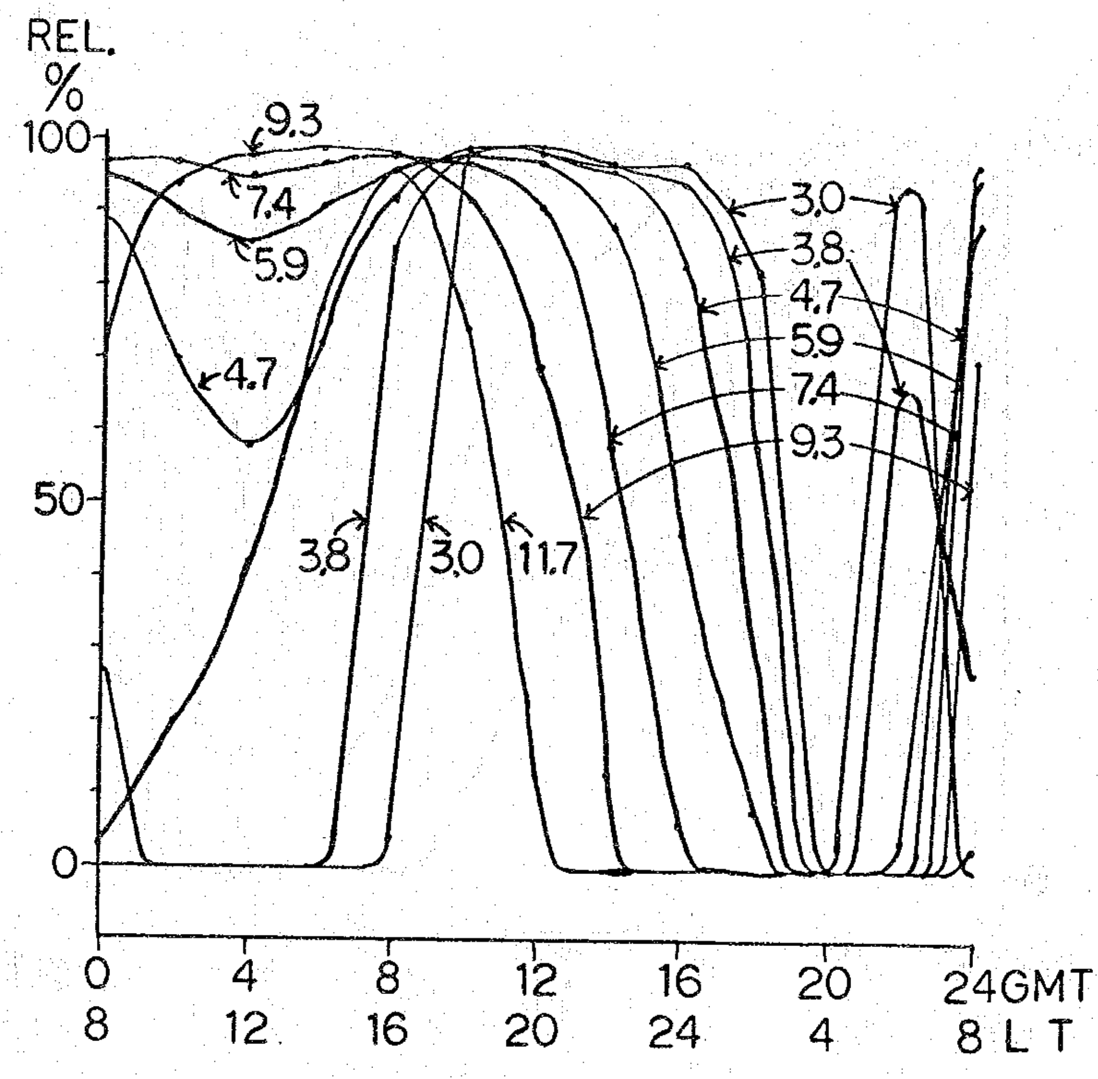
CIRCUIT RELIABILITY : REL.

MONTH - 3 SSN - 10 POWER = 0.3KW

T - MANILA (425) 14.35N 120.59E

R - CAGAYAN DE ORO (748) 8.29N 124.38E

DISTANCE = 789KM AZIMUTHS TR - 148 RT - 328



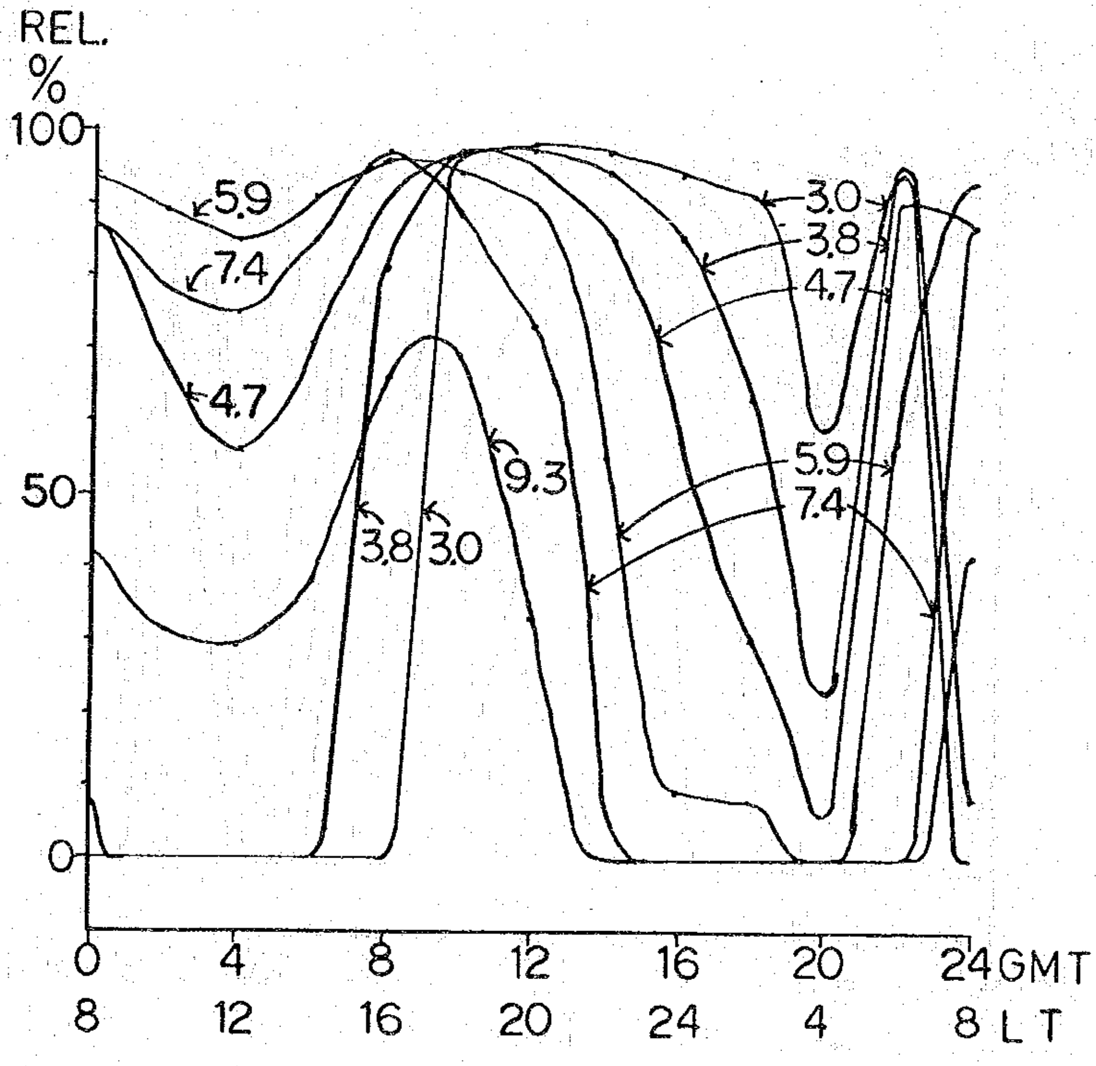
CIRCUIT RELIABILITY : REL.

MONTH - 6 SSN - 10 POWER = 0.3KW

T - MANILA (425) 14.35N 120.59E

R - CAGAYAN DE ORO (748) 8.29N 124.38E

DISTANCE = 789KM AZIMUTHS TR - 148 RT - 328



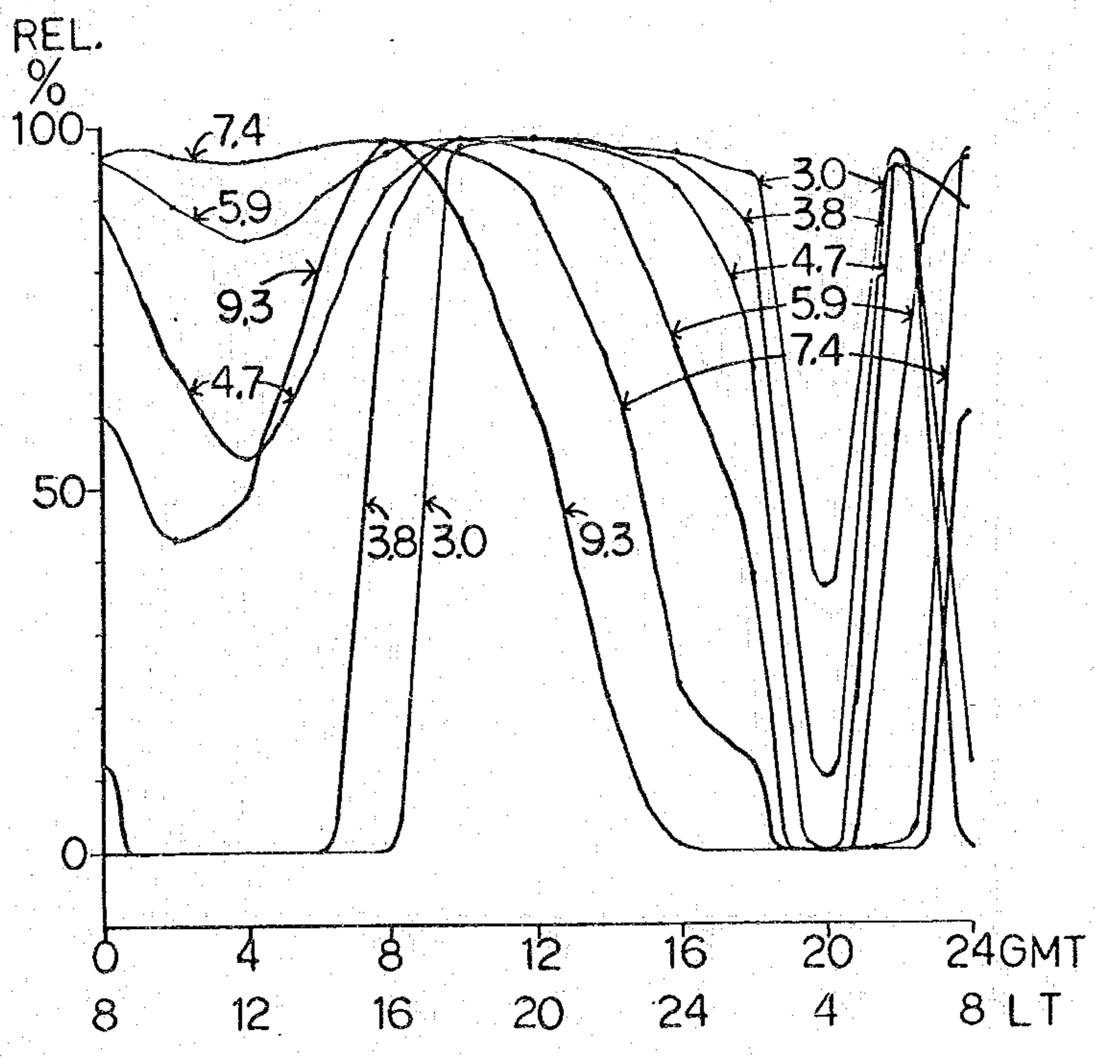
CIRCUIT RELIABILITY : REL.

MONTH - 9 SSN - 10 POWER = 0.3KW

T - MANILA (425) 14.35N 120.59E

R - CAGAYAN DE ORO (748) 8.29N 124.38E

DISTANCE = 789KM AZIMUTHS TR - 148 RT - 328



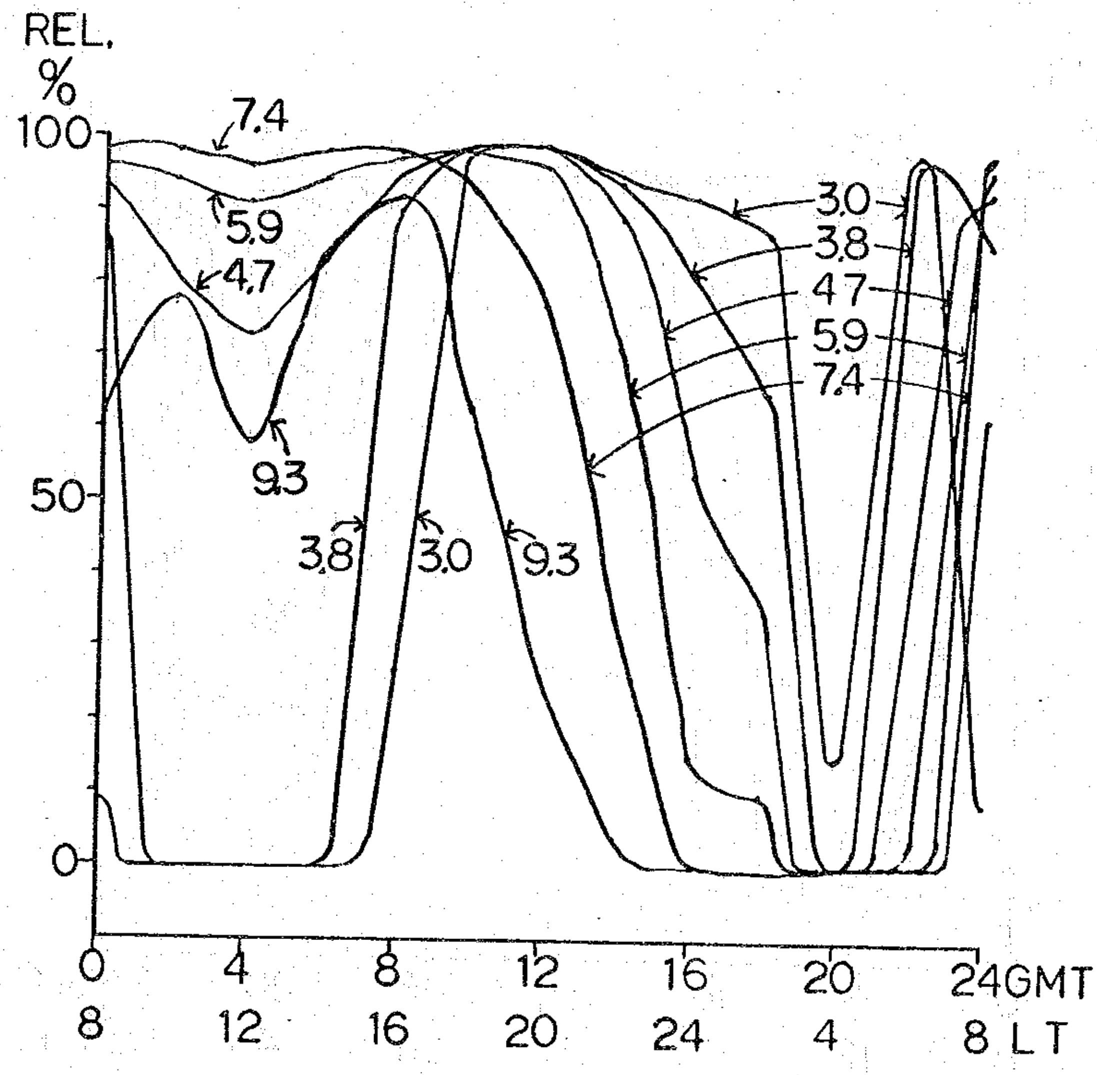
CIRCUIT RELIABILITY : REL.

MONTH - 12   SSN - 10   POWER = 0.3KW

T - MANILA (425)   14.35N   120.59E

R - CAGAYAN DE ORO (748)   8.29N   124.38E

DISTANCE = 789KM   AZIMUTHS   TR - 148   RT - 328



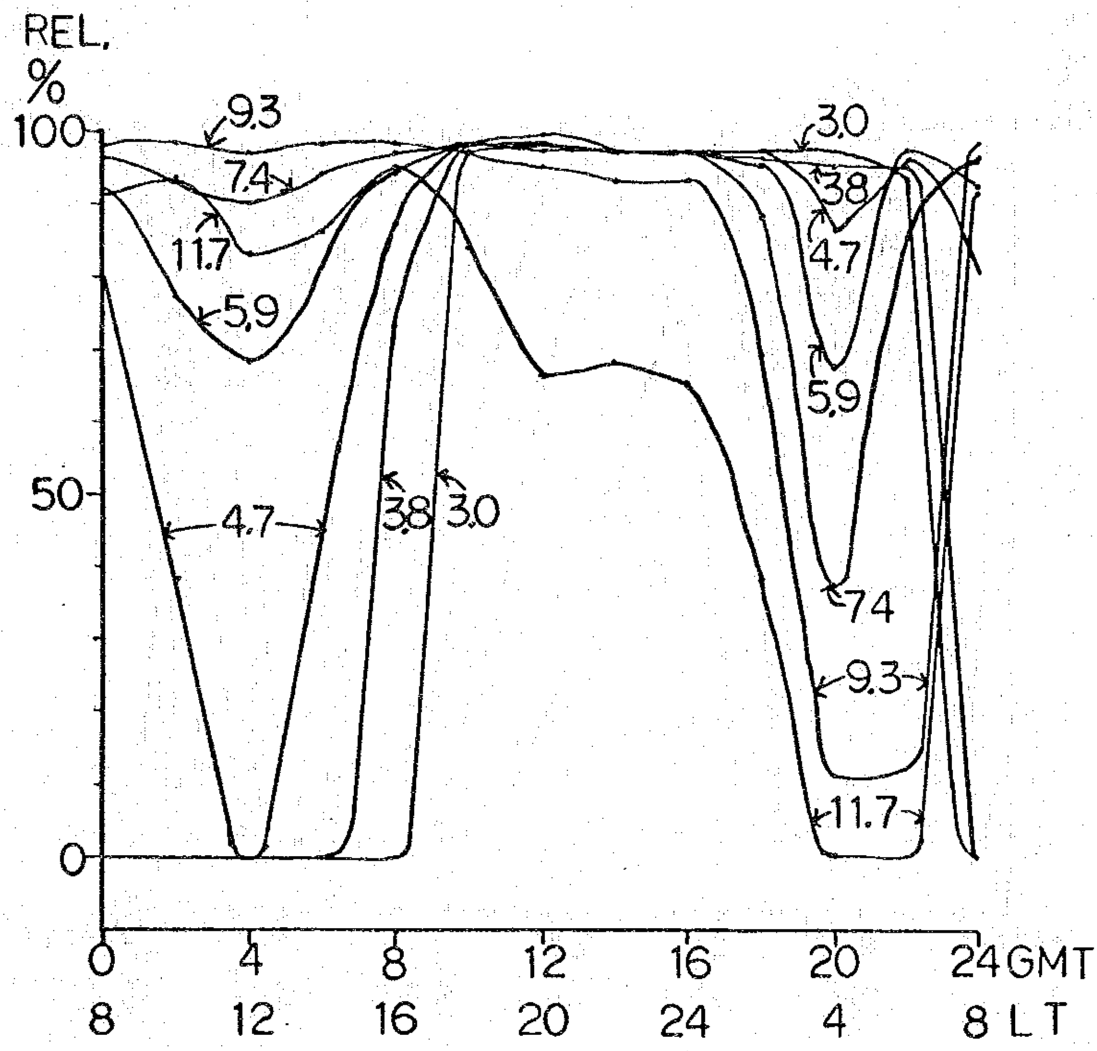
CIRCUIT RELIABILITY : REL.

MONTH - 3 SSN - 100 POWER = 0.3KW

T - MANILA (425) 14.35N 120.59E

R - CAGAYAN DE ORO (748) 8.29N 124.38E

DISTANCE = 789KM AZIMUTHS TR - 148 RT - 328



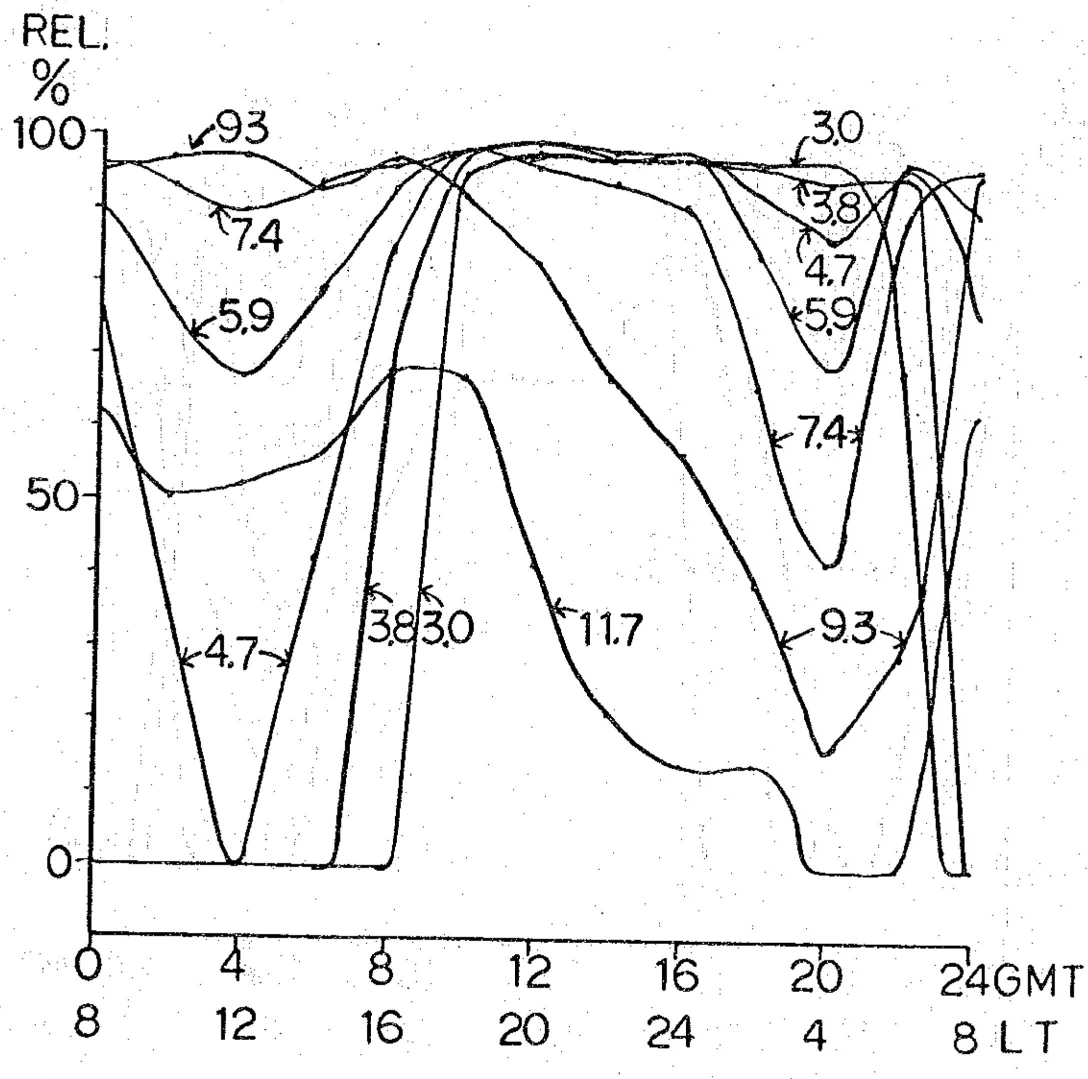
CIRCUIT RELIABILITY : REL.

MONTH - 6 SSN - 100 POWER = 0.3KW

T - MANILA (425) 14.35N 120.59E

R - CAGAYAN DE ORO (748) 8.29N 124.38E

DISTANCE = 789KM AZIMUTHS TR - 148 RT - 328



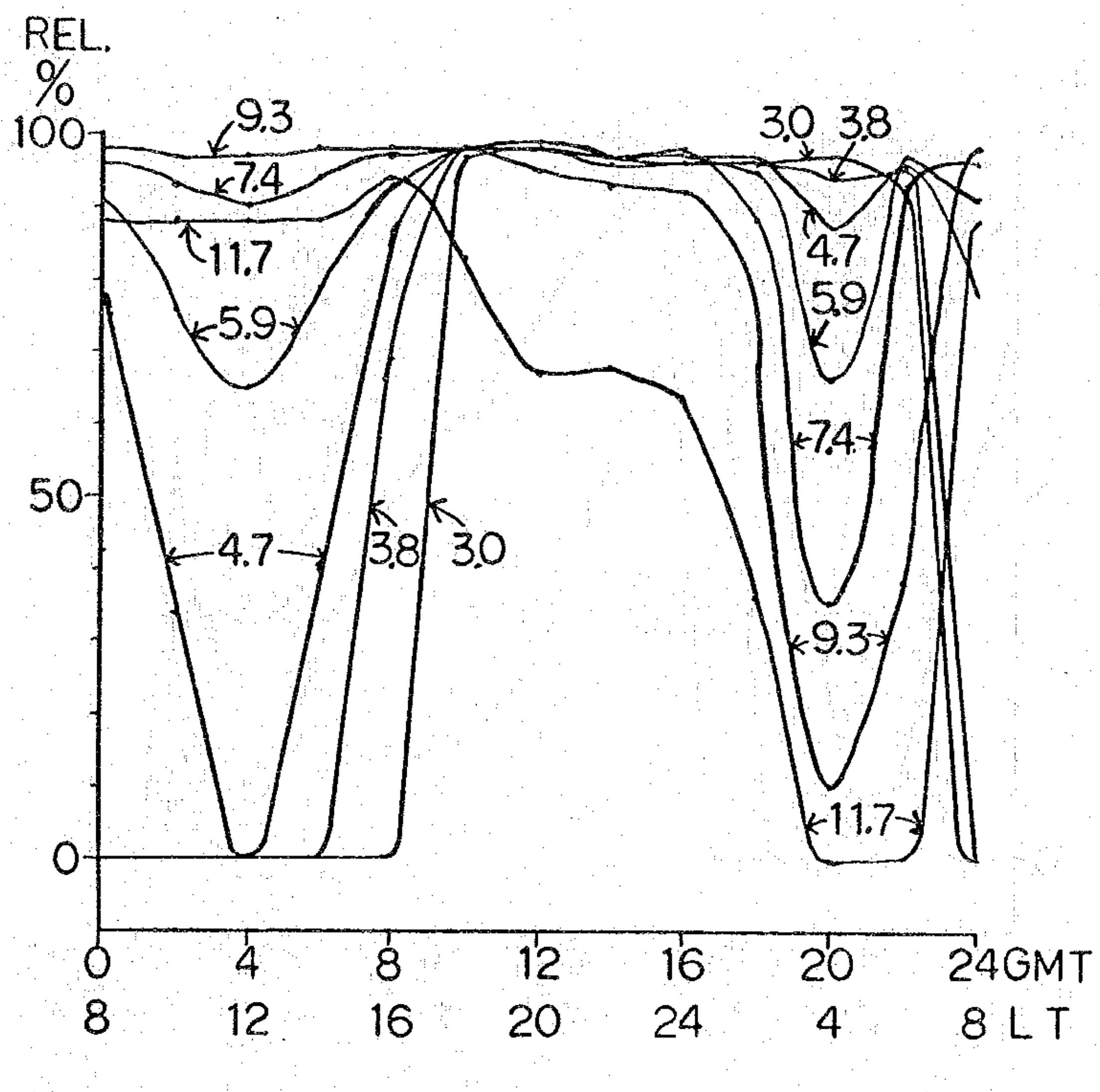
CIRCUIT RELIABILITY : REL.

MONTH - 9 SSN - 100 POWER = 0.3KW

T - MANILA (425) 14.35N 120.59E

R - CAGAYAN DE ORO (748) 8.29N 124.38E

DISTANCE = 789KM AZIMUTHS TR - 148 RT - 328



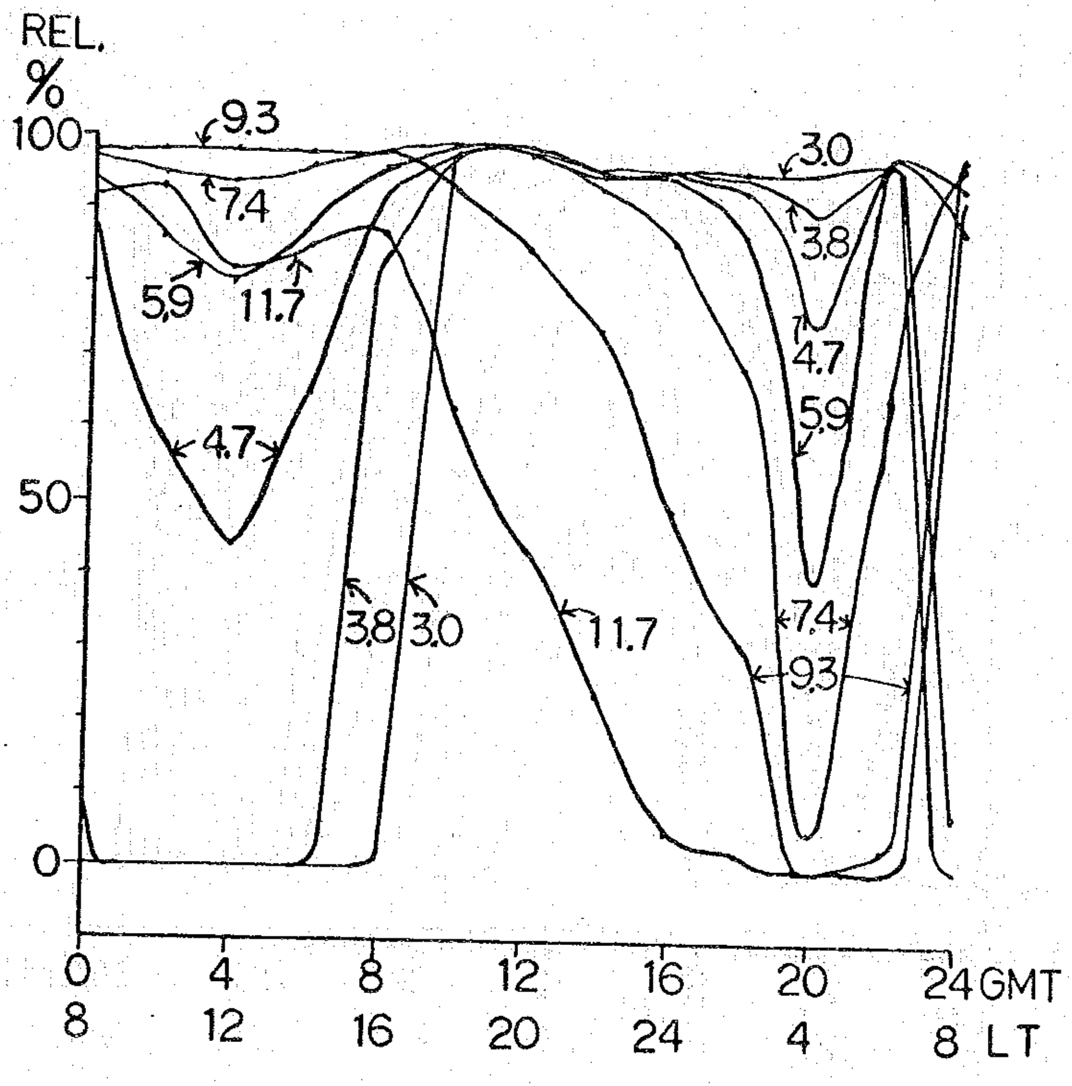
CIRCUIT RELIABILITY : REL.

MONTH - 12 SSN - 100 POWER = 0.3KW

T - MANILA (425) 14.35N 120.59E

R - CAGAYAN DE ORO (748) 8.29N 124.38E

DISTANCE = 789KM AZIMUTHS TR - 148 RT - 328



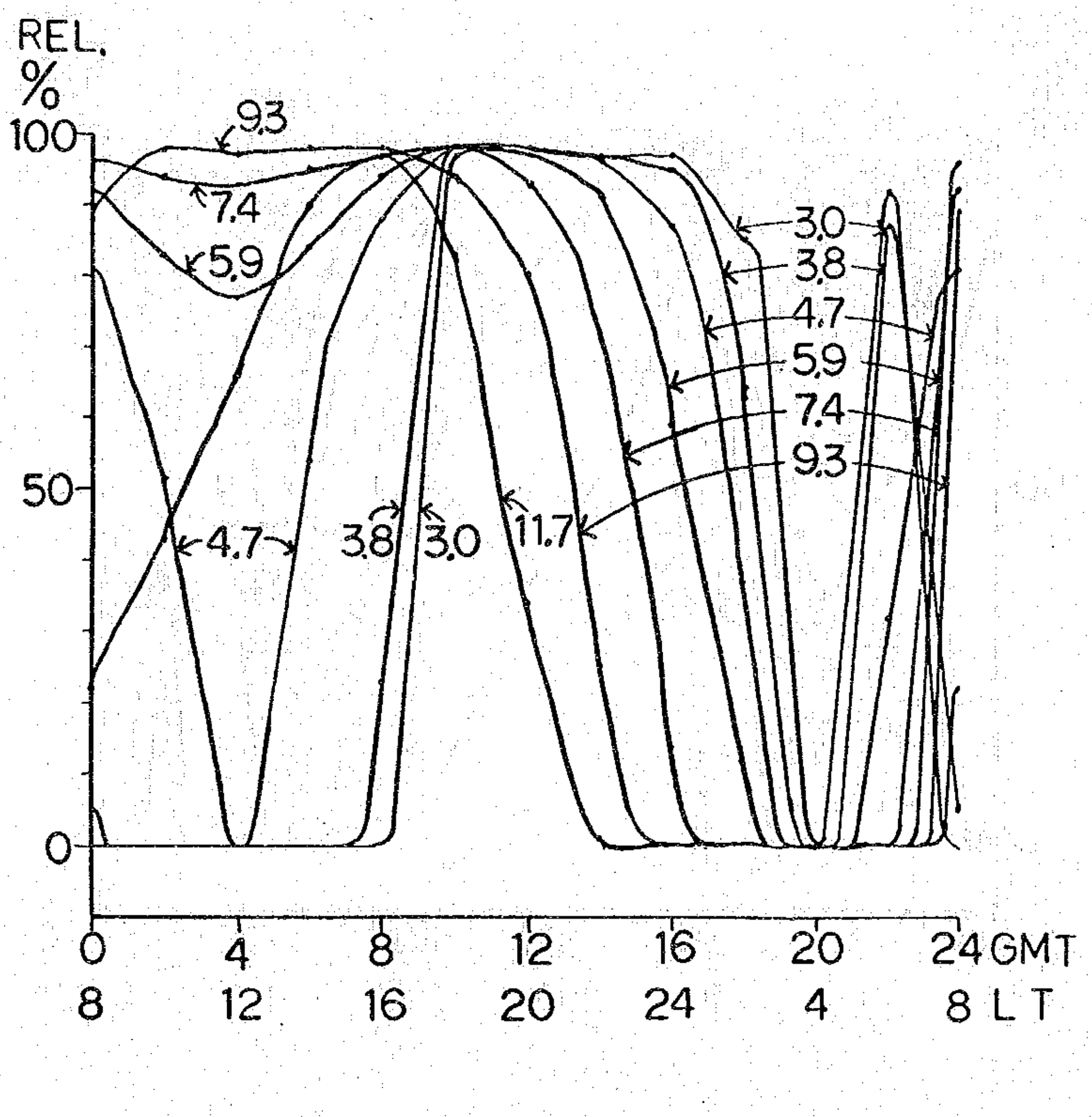
CIRCUIT RELIABILITY : REL.

MONTH - 3 SSN - 10 POWER = 0.3KW

T - MANILA (425) 14.35N 120.59E

R - DAVAO AIRPORT (753) 7.07N 125.39E

DISTANCE = 963KM AZIMUTHS TR - 146 RT - 327



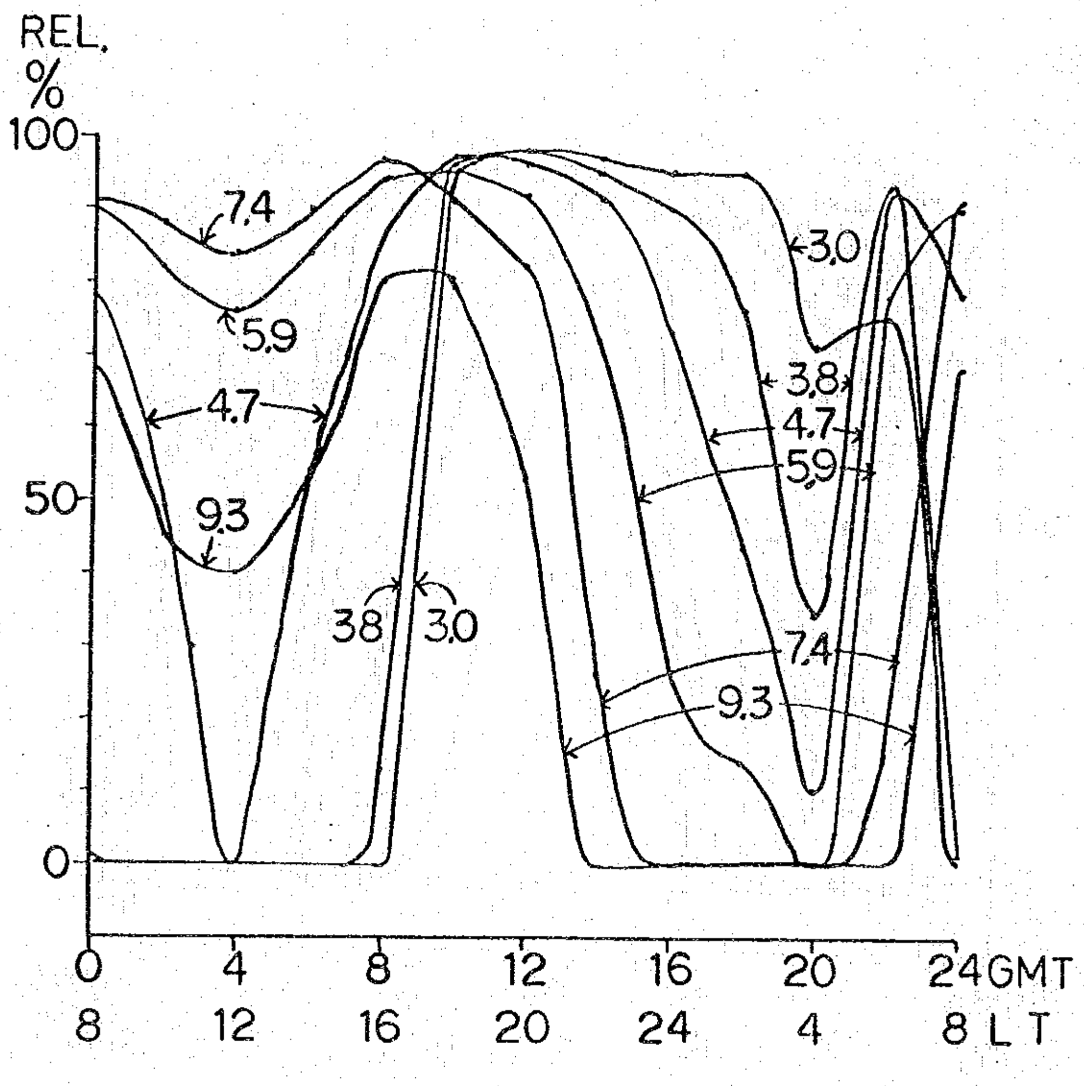
CIRCUIT RELIABILITY : REL.

MONTH - 6 SSN - 10 POWER = 0.3KW

T - MANILA (425) 14.35N 120.59E

R - DAVAO AIRPORT (753) 7.07N 125.39E

DISTANCE = 963KM AZIMUTHS TR - 146 RT - 327



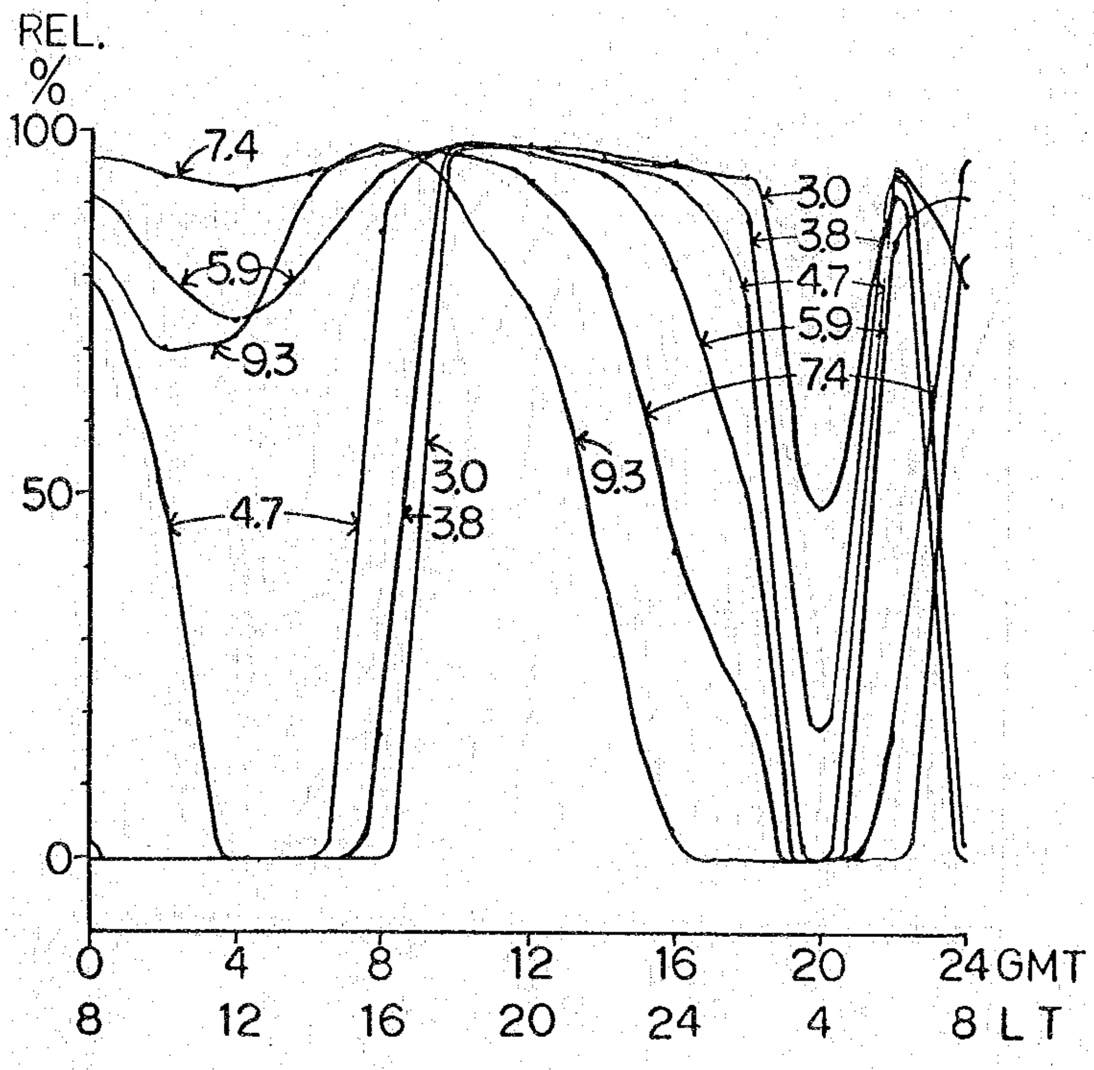
CIRCUIT RELIABILITY : REL.

MONTH - 9 SSN - 10 POWER = 0.3KW

T - MANILA (425) 14.35N 120.59E

R - DAVAO AIRPORT (753) 7.07N 125.39E

DISTANCE = 963KM AZIMUTHS TR - 146 RT - 327



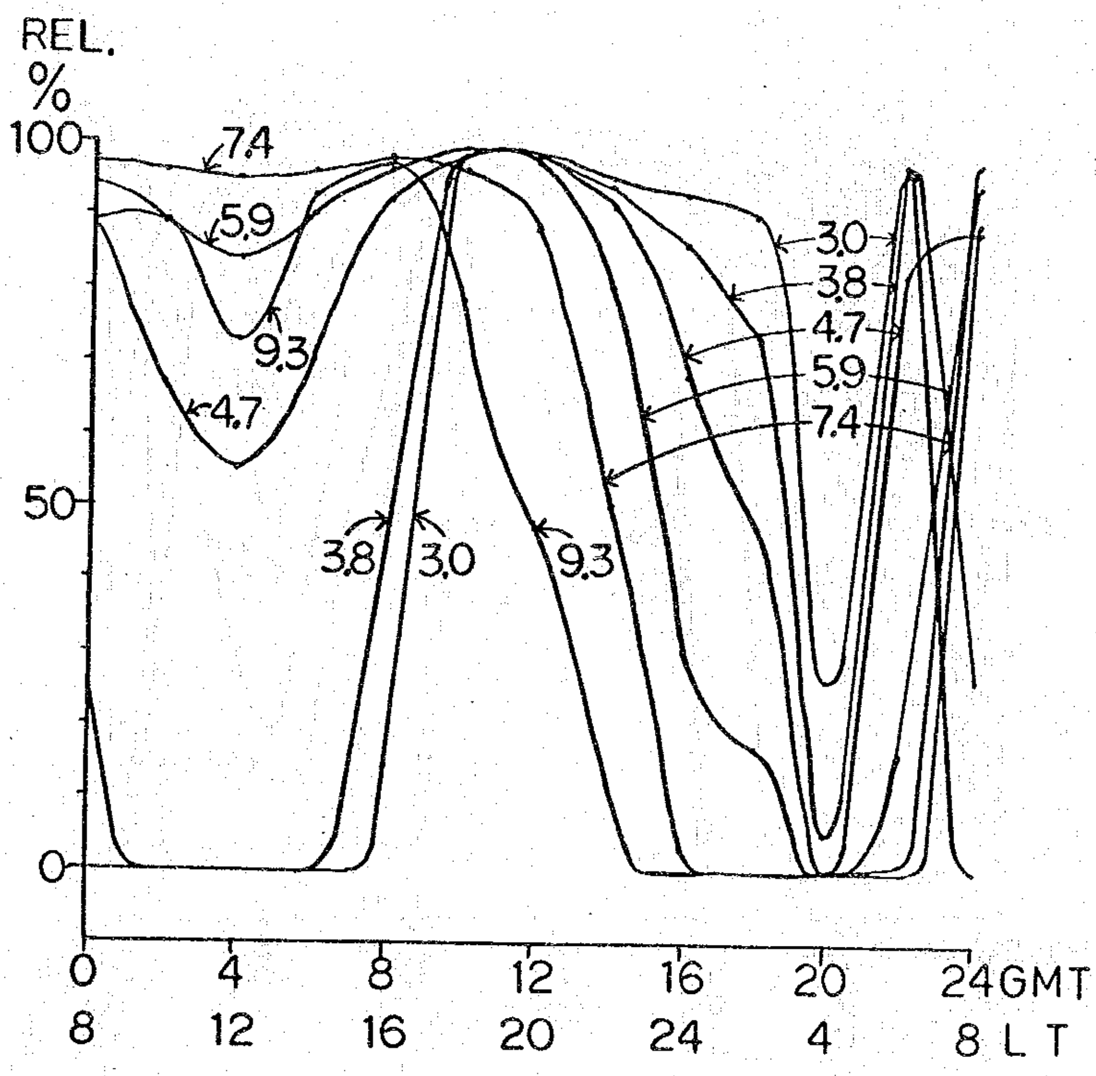
CIRCUIT RELIABILITY : REL.

MONTH - 12 SSN - 10 POWER = 0.3KW

T - MANILA (425) 14.35N 120.59E

R - DAVAO AIRPORT (753) 7.07N 125.39E

DISTANCE = 963KM AZIMUTHS TR - 146 RT - 327



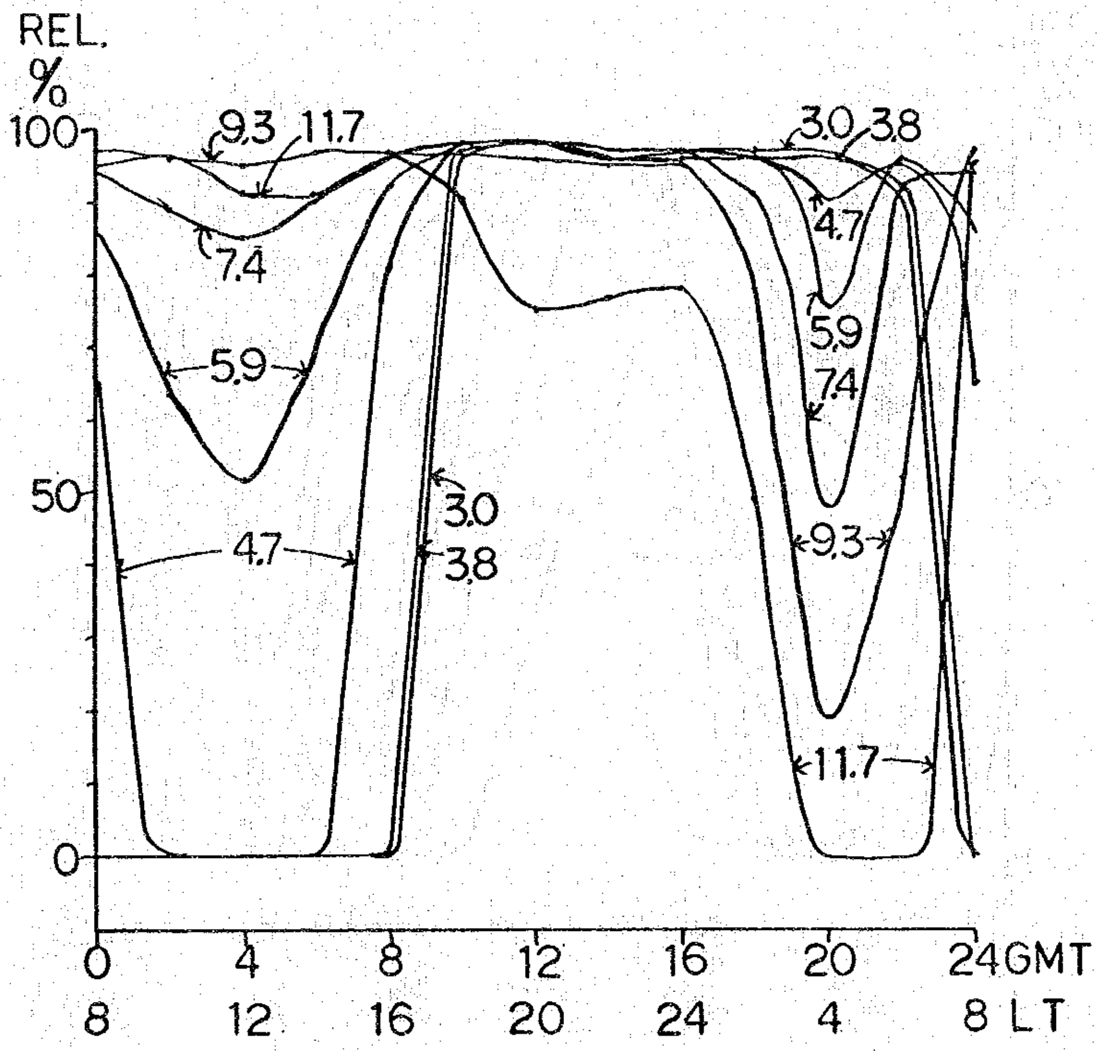
CIRCUIT RELIABILITY : REL.

MONTH - 3 SSN - 100 POWER = 0.3KW

T - MANILA (425) 14.35N 120.59E

R - DAVAO AIRPORT (753) 7.07N 125.39E

DISTANCE = 963KM AZIMUTHS TR - 146 RT - 327



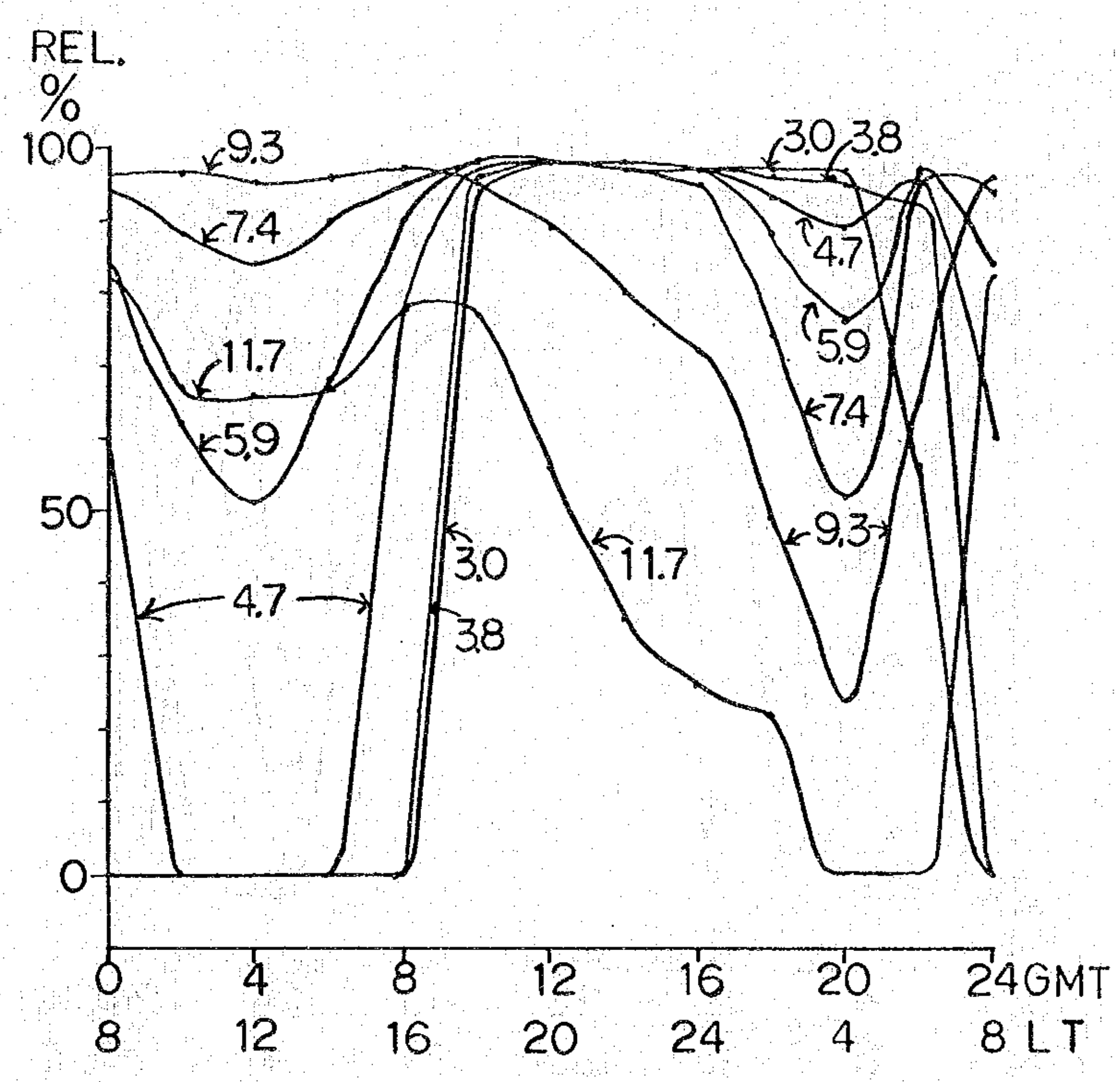
CIRCUIT RELIABILITY : REL.

MONTH - 6 SSN - 100 POWER = 0.3KW

T - MANILA (425) 14.35N 120.59E

R - DAVAO AIRPORT (753) 7.07N 125.39E

DISTANCE = 963KM AZIMUTHS TR - 146 RT - 327



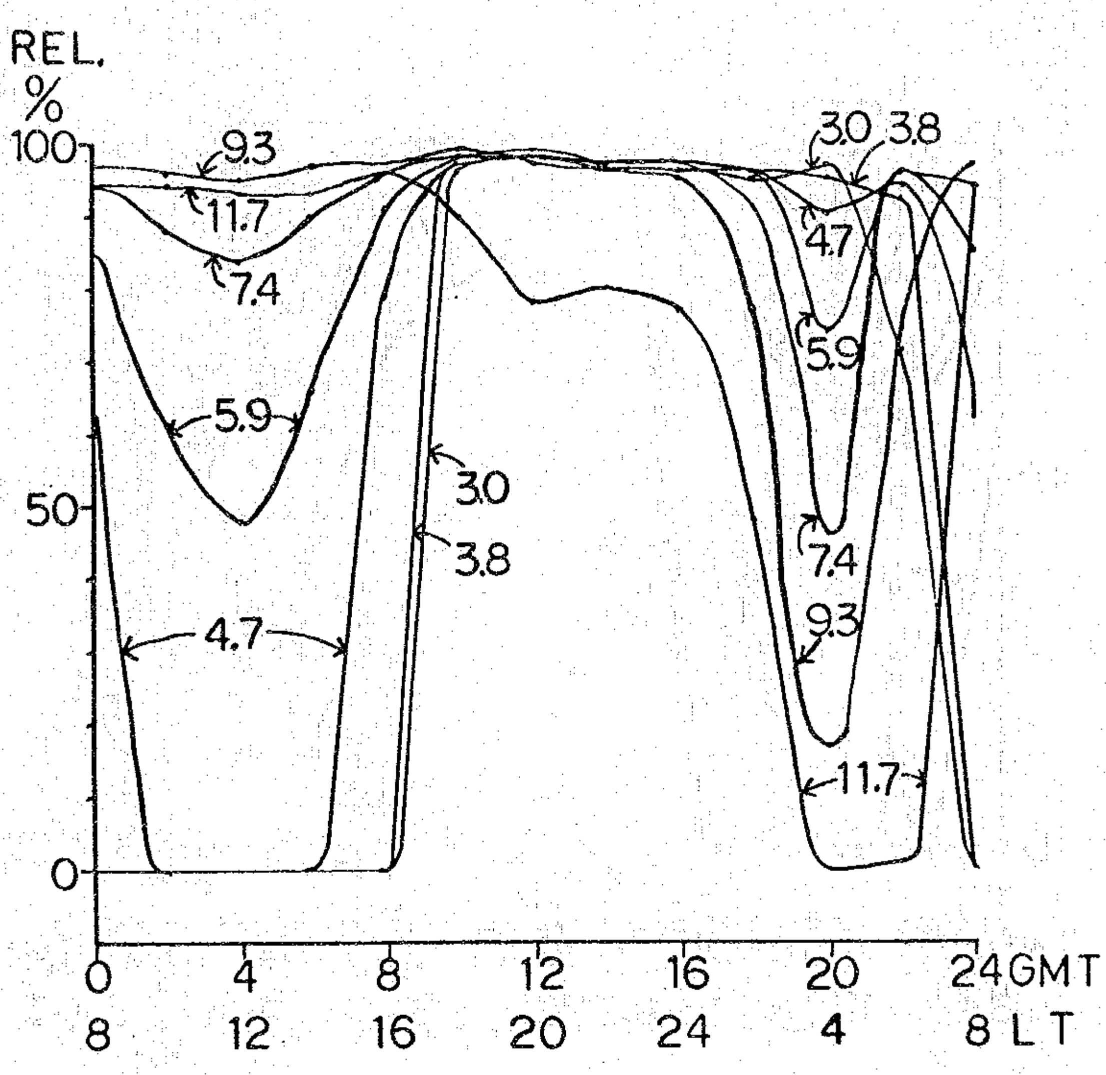
CIRCUIT RELIABILITY : REL.

MONTH - 9 SSN - 100 POWER = 0.3KW

T - MANILA (425) 14.35N 120.59E

R - DAVAO AIRPORT (753) 7.07N 125.39E

DISTANCE = 963KM AZIMUTHS TR - 146 RT - 327



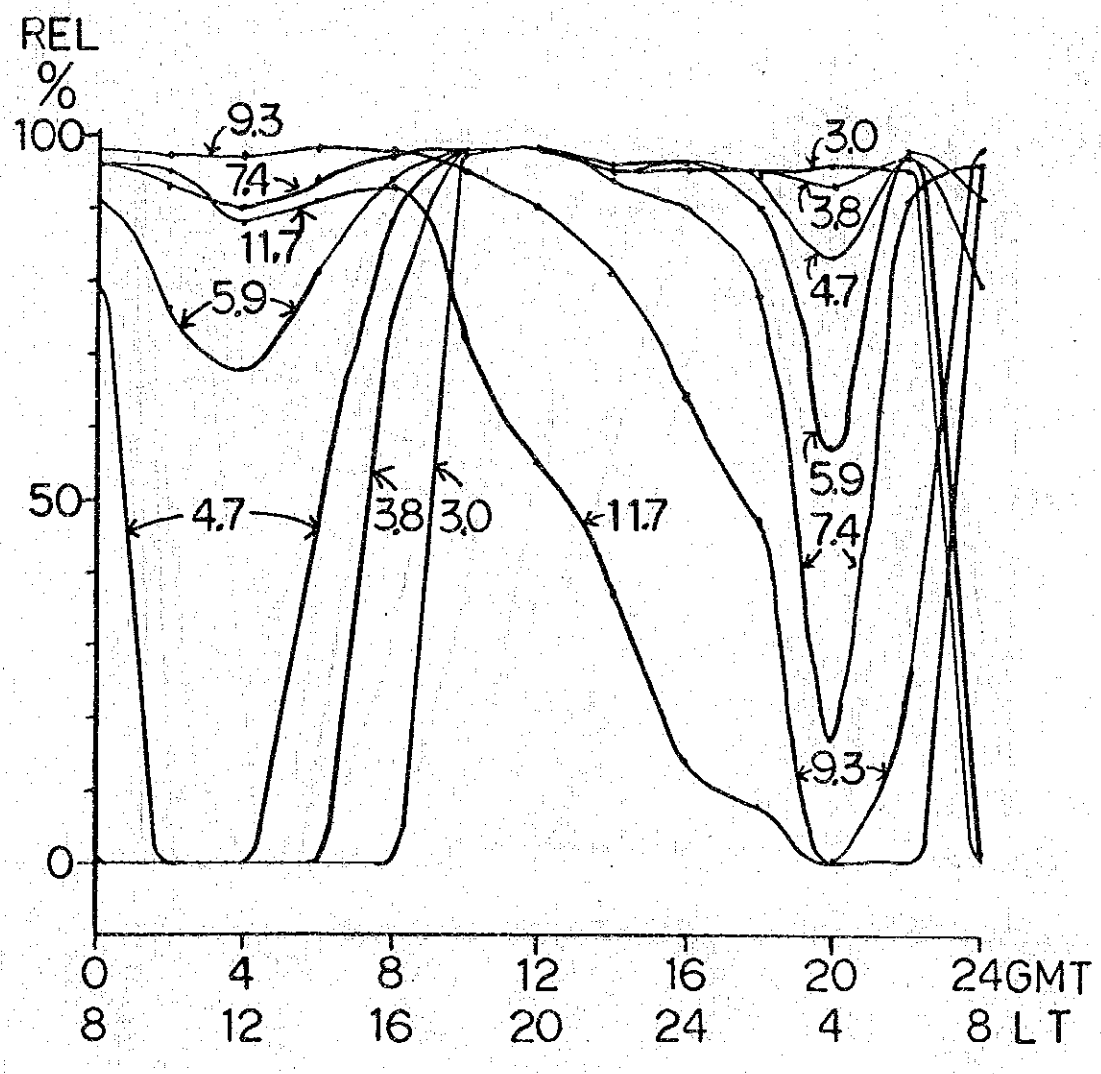
CIRCUIT RELIABILITY : REL.

MONTH - 12 SSN - 100 POWER = 0.3KW

T - MANILA (425) 14.35N 120.59E

R - DAVAO AIRPORT (753) 7.07N 125.39E

DISTANCE = 963KM AZIMUTHS TR - 146 RT - 327



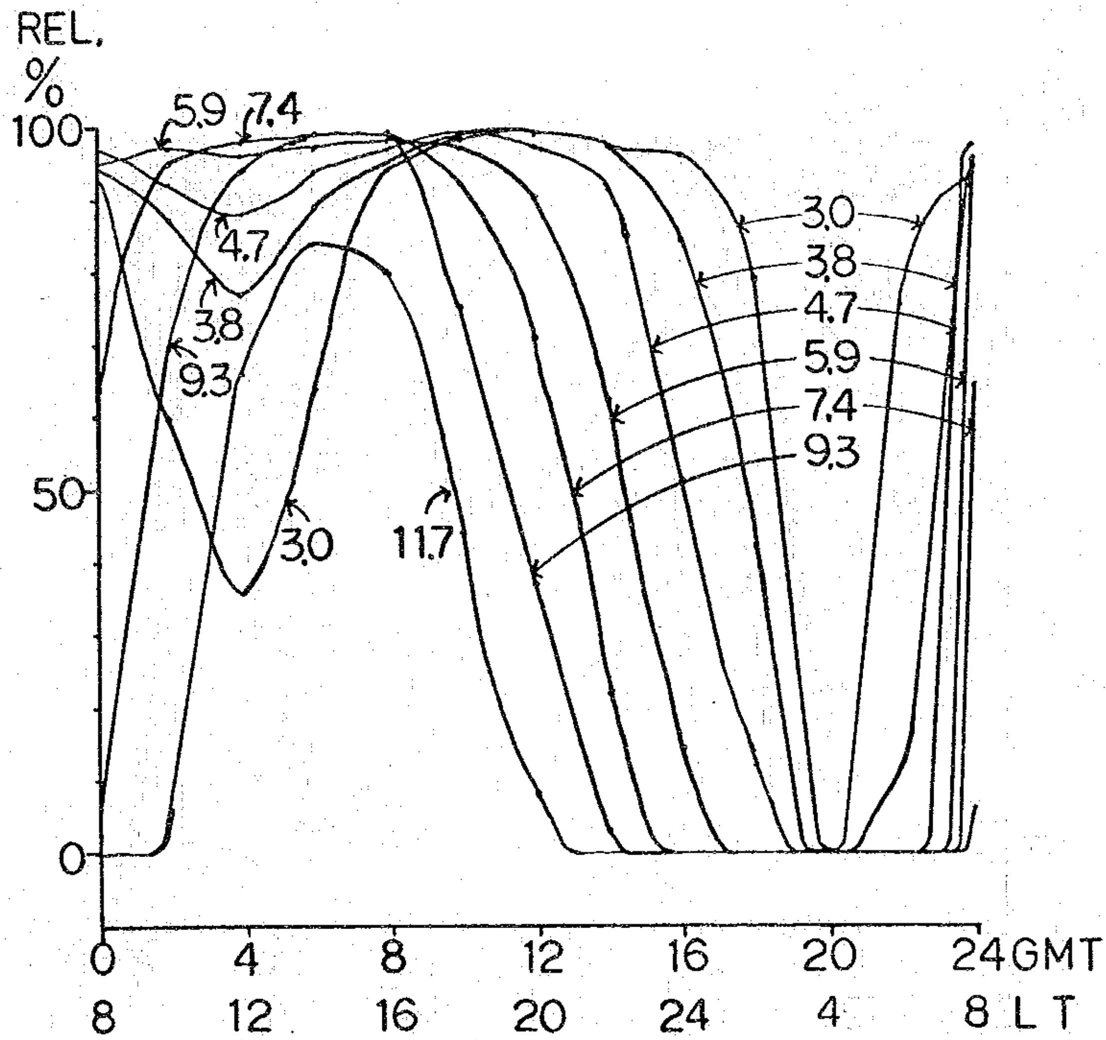
CIRCUIT RELIABILITY : REL.

MONTH - 3 SSN - 10 POWER = 0.15KW

T - TUGUEGARAO (233) 17.37N 121.44E

R - CALAYAN (133) 19.16N 121.28E

DISTANCE = 199KM AZIMUTHS TR - 355 RT - 175



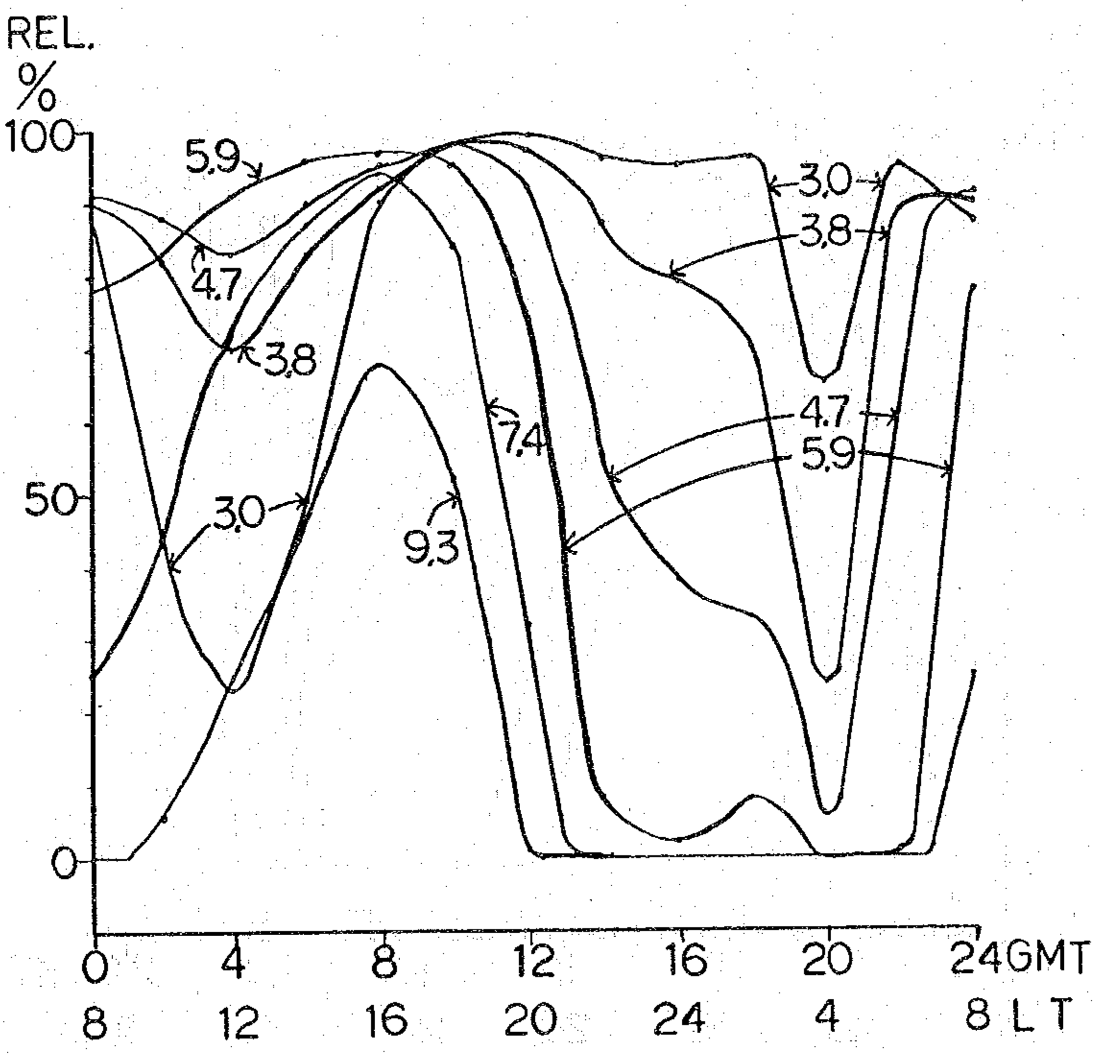
CIRCUIT RELIABILITY : REL.

MONTH - 6 SSN - 10 POWER = 0.15KW

T - TUGUEGARAO (233) 17.37N 121.44E

R - CALAYAN (133) 19.16N 121.28E

DISTANCE = 199KM AZIMUTHS TR - 355 RT - 175



CIRCUIT RELIABILITY : REL.

MONTH - 9 SSN - 10 POWER = 0.15KW

T - TUGUEGARAO (233) 17.37N 121.44E

R - CALAYAN (133) 19.16N 121.28E

DISTANCE = 199KM AZIMUTHS TR - 355 RT - 175