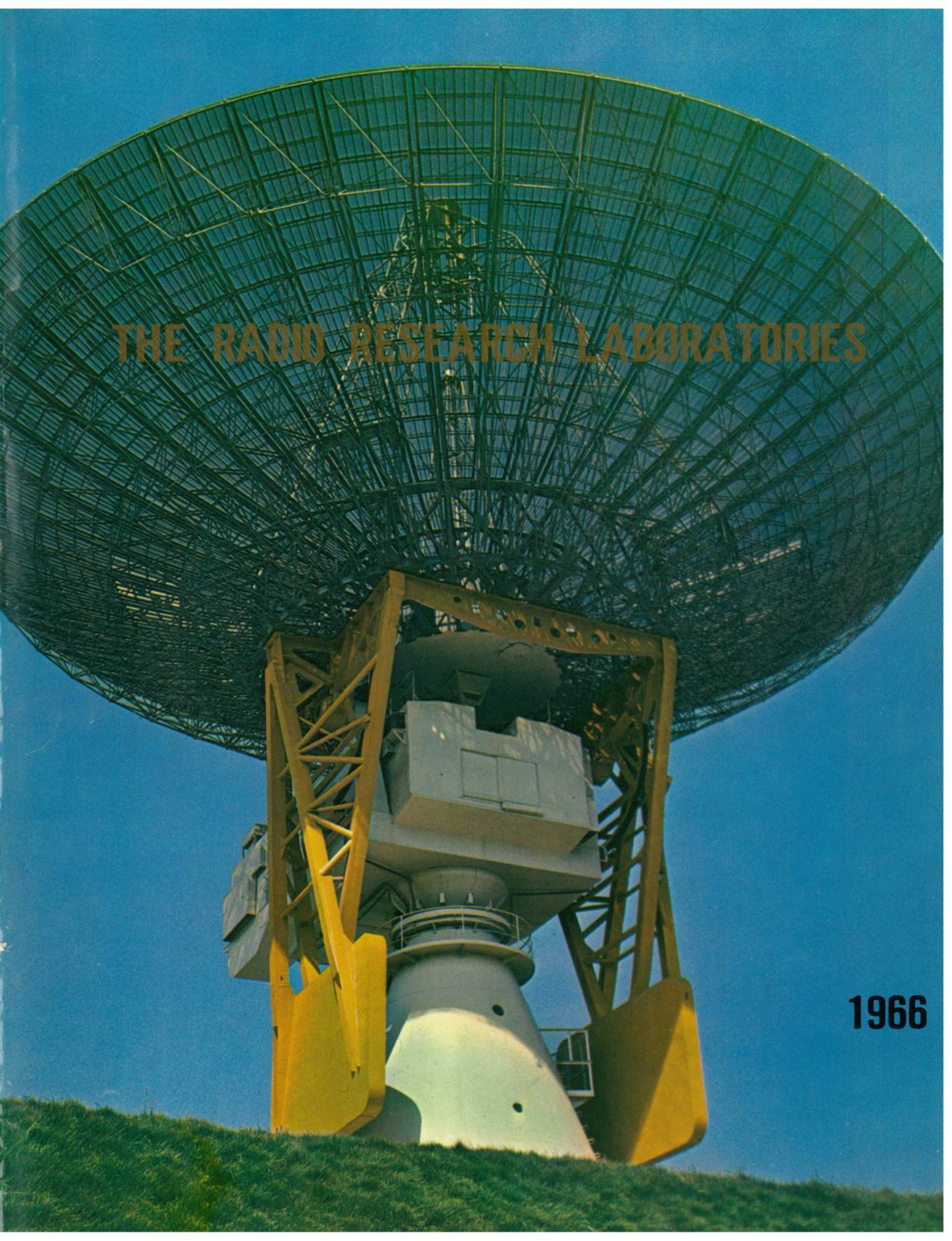

THE RADIO RESEARCH LABORATORIES
1966

CONTENTS

Picture on front cover: 30 m paraboloidal antenna for space Communications at Kashima Station, The Radio Research Laboratories

For further information, write to Planning Section, The Radio Research Laboratories, Ministry of Posts and Telecommunications, Kokubunji P. O. Koganei-shi, Tokyo, Japan (Tel. (0423) 21-1211)

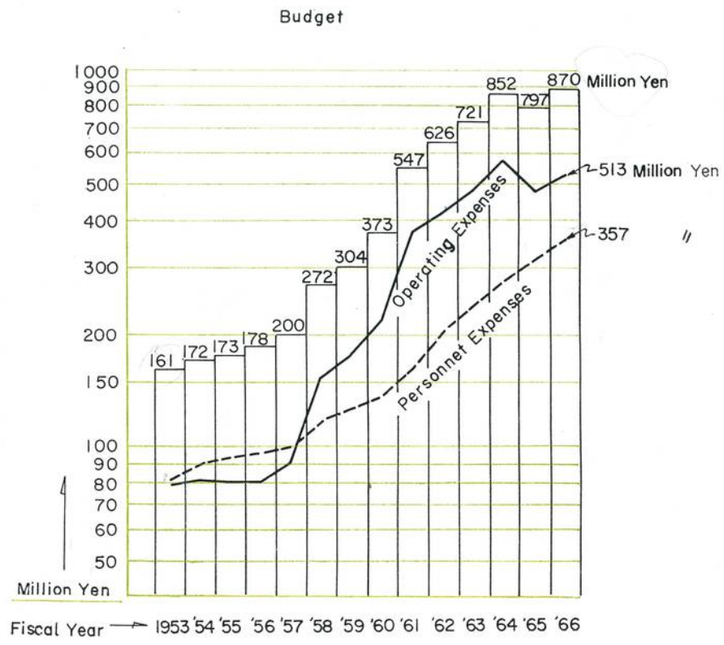
Organization and Mission of The Radio Research Laboratories

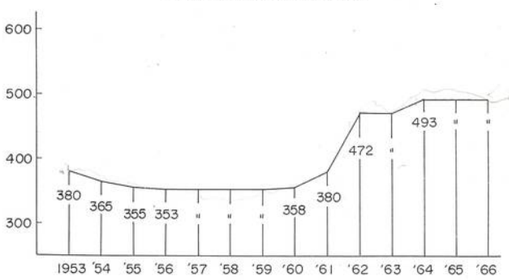
The Radio Research Laboratories came into existence on August 1, 1952, as a government research agency in the Ministry of Posts and Telecommunications. However, its history goes back even further. The Laboratories had its origin in the Research Committee for Radio Wave Propagation organized in 1922 within the National Scientific Research Council. Later it was known as the Physical Institute for Radio Waves, Ministry of Education. The present Laboratories developed into an agency having the object of overall research in radio matters.

It has its headquarters at Kokubunji and three detached offices at Koganei, Kashima and Hiraiso. Throughout the country, there are four branch radio wave observatories at Wakkanai, Akita, Inubo and Yamagawa. The organization of the Laboratories is as shown in the attached table.

The Radio Research Laboratories takes up various problems dealing with more effective and wider utilization of radio waves. In addition to research work, the Laboratories carry on the following services related to not only radio-communication but also general matters of scientific research or public utility.

Budget and Fixed Number of Personnel

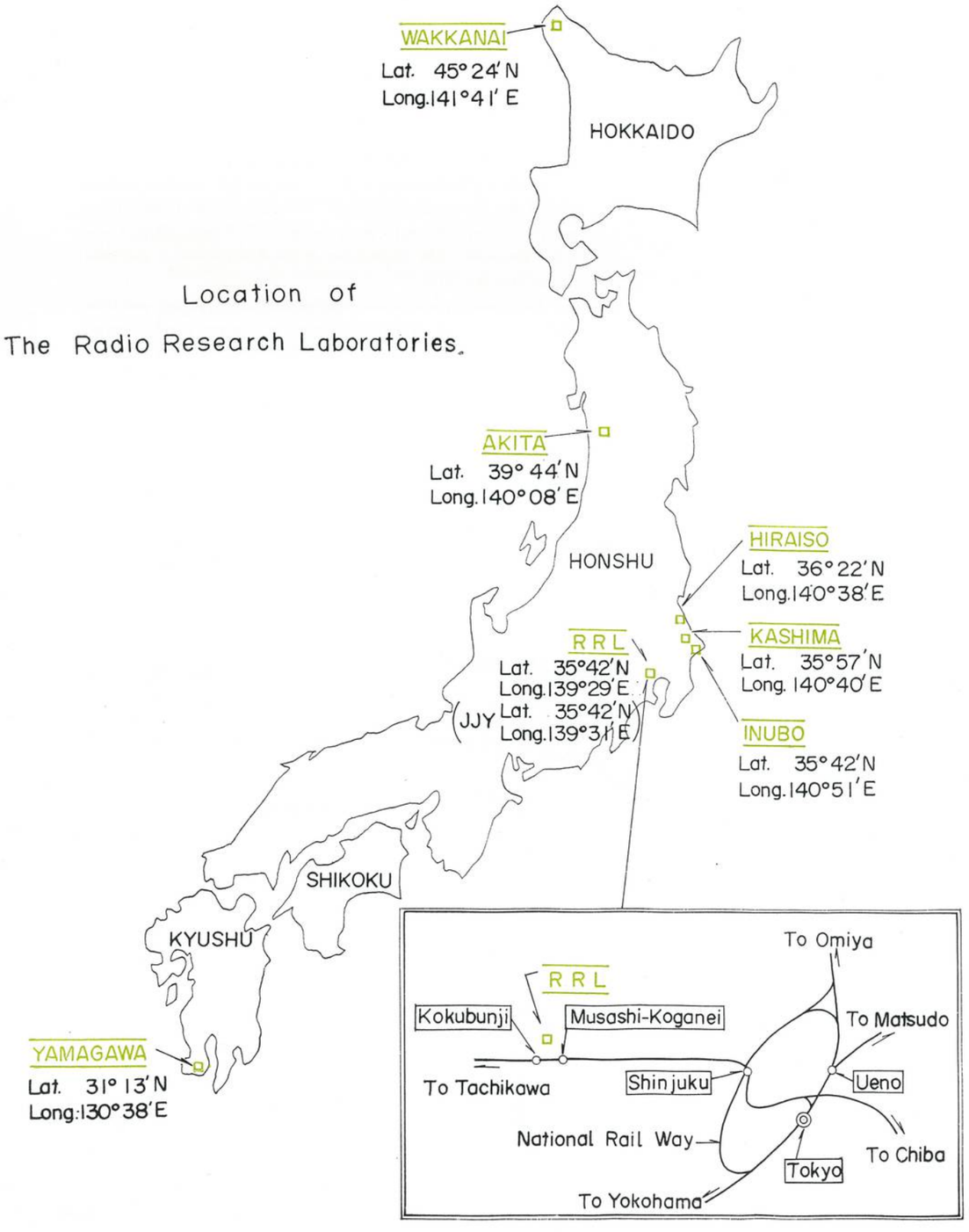


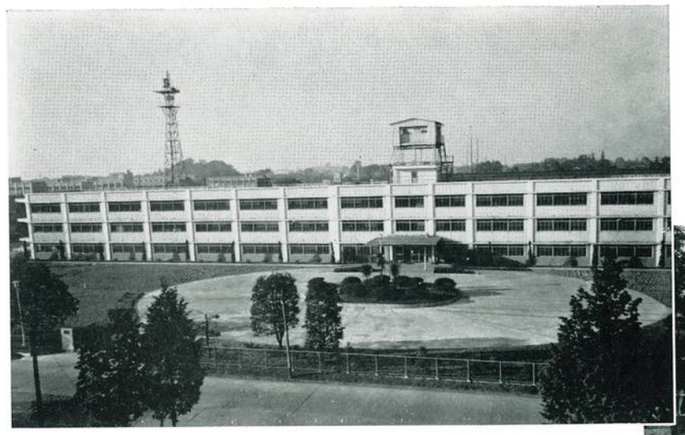


Members

	No.
Researchers	257
Director	1
Deputy directors	3
Section chiefs	22
Principal research officers	1
Senior research officers	23
Research officers	121
Assistant researchers	86
Technical workers	82
Administrative officers	108
Division chief	1
Section chiefs	2
Officers	105
Other employees	46
Total	493

Location of
The Radio Research Laboratories.





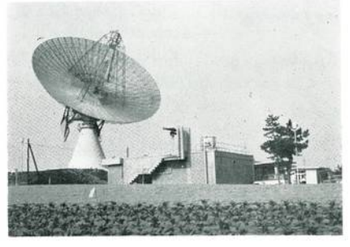
Main building of
The Radio Research Laboratories at
Koganei-shi, Tokyo.
Tel. 0423-21-1211

Standard Frequency Section
(JJY Station)
Midori-cho, Koganei-shi,
Tokyo

Wakkanai Radio Wave Observatory
Wakkanai-shi, Hokkaido

Hiraiso Branch
Nakaminato-shi,
Ibaragi Prefecture

Akita Radio Wave Observatory
Akita-shi, Akita Prefecture



Kashima Branch
(Ground Station for Satellite
Communications)
Kashima-machi,
Ibaragi Prefecture

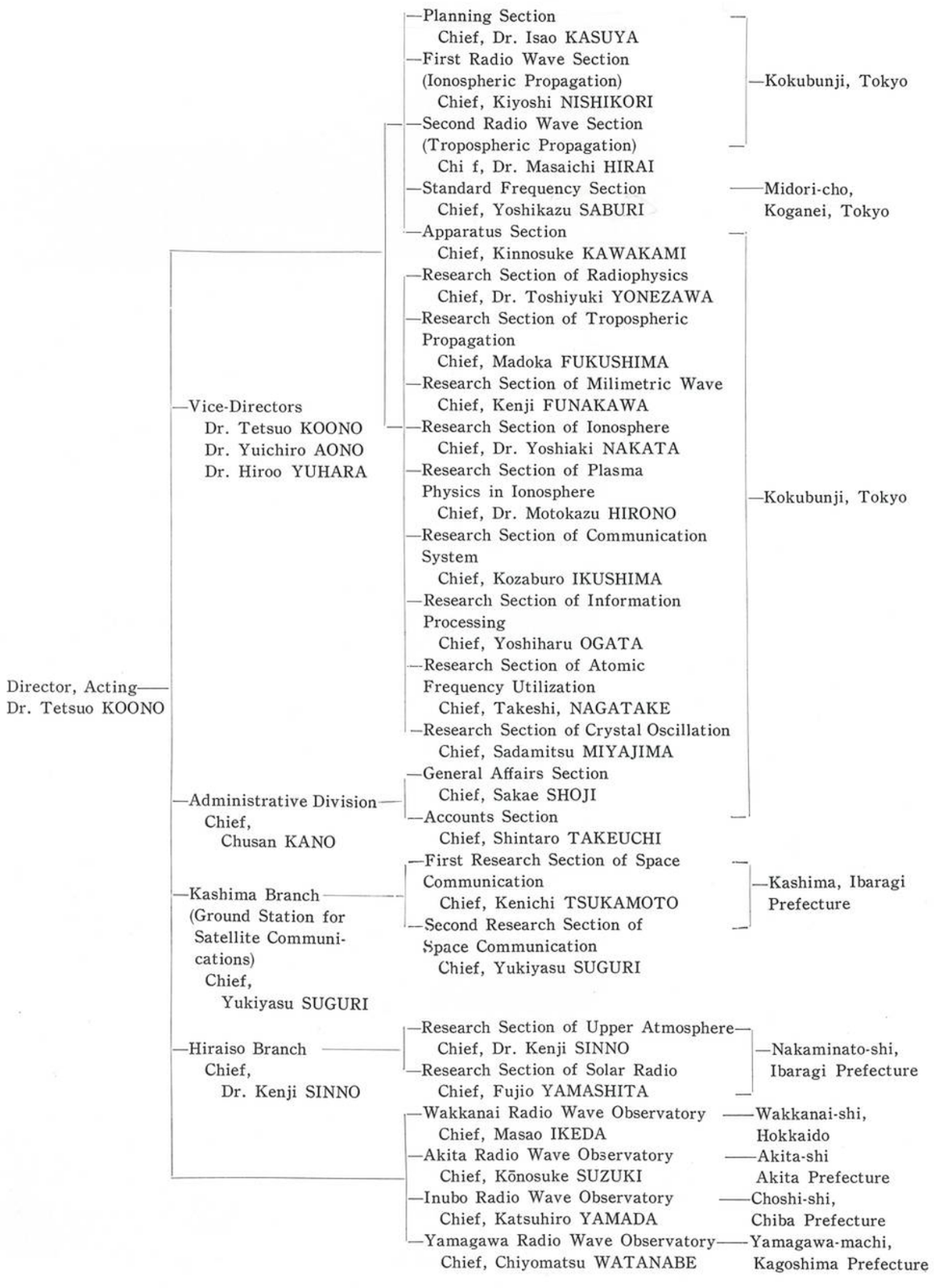
Yamagawa Radio Wave Observatory
Yamagawa-machi,
Kagoshima Prefecture

Inubo Radio Wave Observatory
Choshi-shi,
Chiba Prefecture

Organization and

Organization of The Radio Research Laboratories

(As of April 1966)



General Activities

Item	Research	Service
Research of the ionosphere and upper atmosphere Research in propagation of radio waves	(1) Space research using radio waves (2) Ionospheric and radio wave propagation theory (3) Ionospheric research using satellite radio waves (4) Upper atmosphere research using laser beams (5) Fundamental studies of ionospheric gas (6) Observation and research of the ionospheric atmosphere by rocket (7) Investigation of solar radio waves and atmospheric noises (8) Studies of radio propagation forewarning (9) Investigation of radio propagation in the troposphere and the distribution of refractive indices in the atmosphere (10) Atmospheric propagation of millimetric waves	(1) Routine observation of the ionosphere (2) Radio forecasts and radio disturbance warnings (3) World Data Center for the Ionosphere (Collection and distribution of the ionospheric data) (4) The Western Pacific Regional Warning Center (the international ursigram broadcast and the world day communication)
Research in radio communications	(1) Development of space communications (2) Improvement in communication systems (3) Research of information processing (4) Improvement in precision highly-stabilized crystal oscillators (5) Fundamental studies of atomic oscillation (6) Application of laser beams	(1) Operation of the electronic computer
Maintenance and improvement in accuracy of standard frequency	(1) Determination and improvement in accuracy of frequency standards (2) Research of atomic frequency standards (3) Research concerning the international comparison in accuracy of frequencies and time signals (4) Research concerning the precise measurement of frequencies (5) Research concerning practical use of standard long radio waves	(1) Emission of the standard frequencies (2) J.S.T. and time signaling by radio at exact intervals (3) Emission of radio warning
Governmental type approval and performance test of radio apparatus and devices, and development of standards of practical radio frequencies	(1) Synthetic testing apparatus for radio-communication circuits (2) Improvment in radio apparatus on the practical standard of frequencies (3) Higher accuracy and efficiency of various testing devices for type approval and correction	(1) Governmental type approval and performance test of radio apparatus and devices (2) Correction of measuring instruments for radio regulatory purposes (3) Calibration of radio frequency measuring instruments at request of manufacturers or others
Collection, preparation, publication and investigation of radio technical data		(1) Compilation, publication and investigation of radio technical data

Ionosphere

Brief History of Ionospheric Observations in Japan

The first step in the study of ionospheric soundings in Japan was made in 1931 by the Navy Technical Institute at Meguro, Tokyo. The Institute was successful in measurement of the height of the ionosphere in 1932, adopting the frequency modulation method of Appleton and Bernett. Furthermore, the Institute made continuous observation of the virtual height of the ionosphere, the so-called h'-t observation, by use of the pulse method on 2 Mc and 4 Mc from 1932 to 1934. This marked the beginning of the routine ionospheric soundings in Japan. Finally, the first observation of the ionosphere in virtual height versus frequency, the so-called h'-f observation, was started in Japan in June, 1934.

On the other hand, the Hiraiso Branch of the Electro-technical Laboratory, Ministry of Communications, constructed the h'-t type ionosonde in 1932, and started h'-f observation in 1936.

In 1940, the Japanese Army began routine ionospheric soundings of h'-f and other related observations at Tsitsihar, Manchuria. Thus, ionospheric soundings and study of the ionosphere were continued by Army, Navy and the Electro-technical Laboratory. However, when the Physical Society for Radio Waves was established within the Ministry of Education in March, 1941, all responsibilities for research work on the ionosphere was transferred to this Society, which was reorganized as the Physical Institute for Radio Waves in April, 1942. This Society started h'-f observation using an automatic recorder of the Berkner type at Hankow in China on the 21 st of September 1941, at the time of a solar eclipse. The reorganized Physical Institute for Radio Waves established 21 stations for routine ionospheric soundings in the Far Eastern region. One station is at Kokubunji where ionospheric soundings on a routine basis are still being continued. Though this station was temporarily moved to Kaminoge, Tokyo, during the war, observations were resumed at Kokubunji after the war, keeping up the long history of ionospheric observation in the Tokyo area since 1932. Later, Wakkanai, Akita and Yamagawa were established five degrees latitude apart to take routine ionospheric soundings. These locations are in addition to the Kokubunji installation which is considered the key station in Japan.

Automatic Recording Ionosonde (Type 6).

Monitor.

Observation of Ionosphere at Vertical Incidence

Observations of the ionosphere at vertical incidence are made at four observatories, Wakkanai, Akita, Kokubunji and Yamagawa in order to utilize the observational results for forecasting radio propagational conditions and for investigating the physical characteristics of the ionosphere itself. The routine observation following the IGY is made every 15 minutes daily, and every 5 minutes during special observation periods. At each observatory, the panoramic recorder with the transmitter and non-tuning type receiver is used for routine measurements. The values scaled from the films are published monthly in the "Ionospheric Data in Japan".

At Kokubunji, additionally, the minimum heights and critical frequencies of the E and F layers are continuously recorded by means of the remodelled panoramic recorder on special observation days. These records reveal precise variations in the ionosphere related to the solar effect, e.g. in cases of Dellinger effect, magnetic storms, etc. This process succeeded in the observation of aurora in the Tokyo area during the IGY.

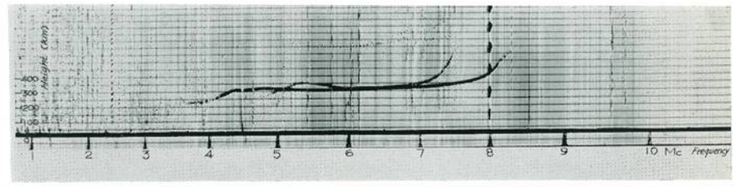
Characteristics

Frequency range: 0.55-22 Mc
Peak power output: About 10 kW
One sounding period: 24 seconds
Recording for display:
Photographic 35 mm film recording
Observation-control clock:
Crystal controlled clock

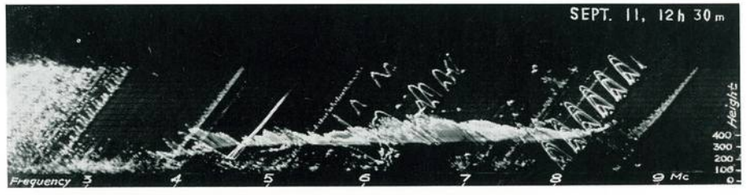
Serial Ionogram Sample

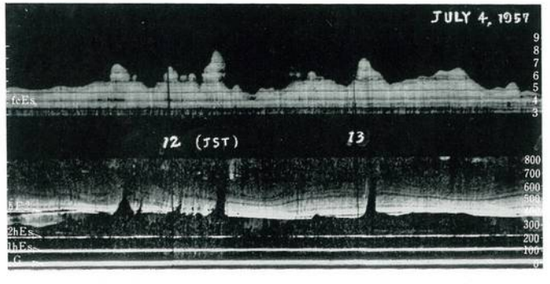
Characteristic Records.

h'-f →



$h'F$-f →





Frequency (Mc)

Virtual height (km)

(Upper) E_s Layer Critical Frequency.
(Lower) Apparent Height of E_s and F Layer.

Observation of Radio Waves from Artificial Satellites

Its object is to obtain the orbital elements of the satellites by means of their radio waves and to delve into the physical conditions of the upper atmosphere by reception of telemetering signals from the satellites. The ionosphere and radio propagation are also researched utilizing the Faraday effect, Doppler effect, and the curvature of radio propagational path. In addition, improvements in observational devices are currently in progress.

Observation of Radio Waves from Artificial Satellites

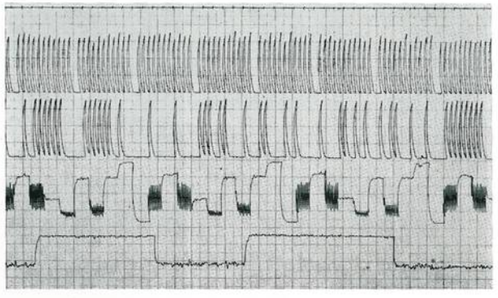
Analysis of telemetering signals from Explorer 7

560 c/s: clock pulse

730 c/s: temperature at each place

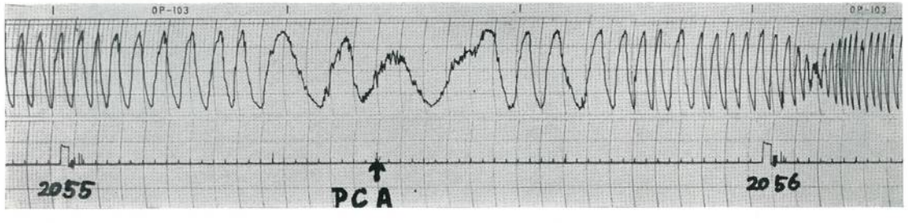
960 c/s: X-rays, Lα-rays, etc.

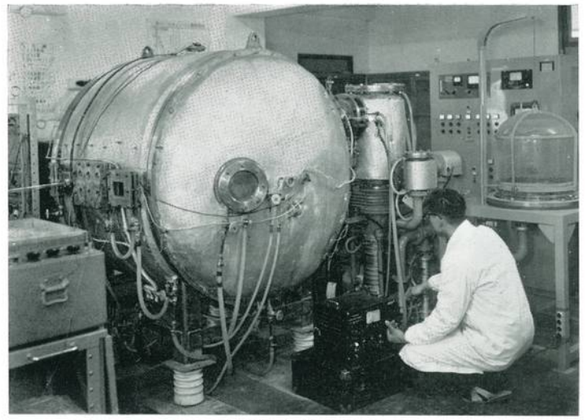
1,300 c/s: cosmic rays



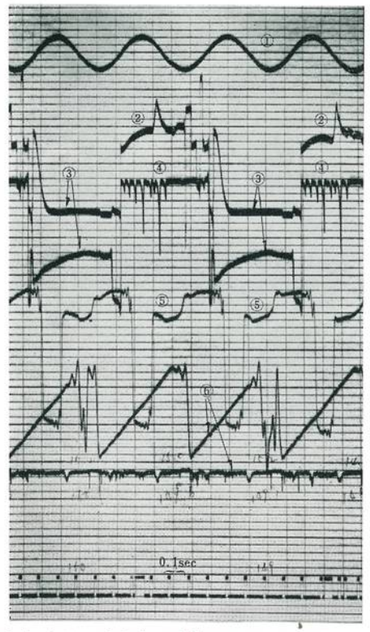
Analysis of the ionosphere by radio waves from an ionospheric beacon satellite

Differential Doppler of radio waves in 20 Mc and 40 Mc on S-66, from which may be obtained the total number of electrons contained in the propagational path.





Space Chamber



Partial data obtained from measurements by the ionosperic souder on a type L-3-3 rocket

① Attitude of the rocket (spin)
② Electron density
③ Ion density, ion temperature
④ Frequency marks
⑤ Electron temperature
⑥ Space electric potential referring to the rocket body, electron energy distribution

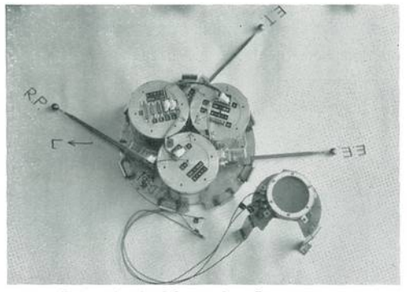
Low Density Plasma and Its Application to Direct Ionospheric Sounding

The space chamber, diameter-1200 mm, length-1000 mm, is of sufficient size to enable study of the plasma characteristics equivalent to that of the *D* and *E* layers.

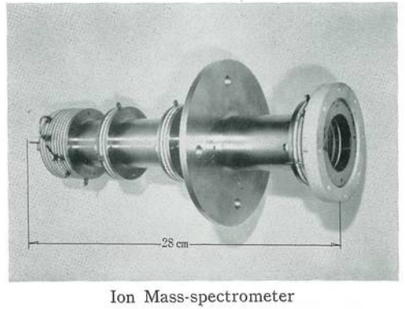
The Laboratories developed the resonance probe which is not only the best instrument but the most reliable and convenient to measure electron density and temperature of the ionosphere by a sounding rocket. The present study is by means of the probe to the measurement of the electron energy distribution, number densities and temperatures of both ion and electron of the ionosphere, electric field in plasma, and ion mass-spectrometers.

These results have brought about decided improvements in ionospheric direct sounding instruments for the past several years. Up to Feb., 1966, thirty-one instruments were flown on the Kappa and Lambda rockets with successful results in cooperation with the Institute of Space and Aeronautical Science, University of Tokyo, by firing the sounding rockets in the Kagoshima Space Center.

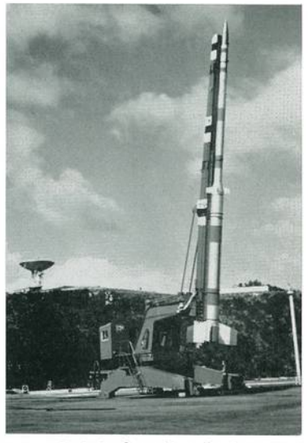
Furthermore, joint experiments with the National Aeronautics and Space Administration using these instruments developed by the Laboratories were conducted by Nike-Cajun three times with fruitful results.



Ionospheric Measuring Instrument



Ion Mass-spectrometer



L-3-3 Sounding Rocket

Three stage rocket, 735 mm in diameter, 19 m in total length, payload weight 100 kg, altitude 1100 km.

Radio Forecasts and Warnings

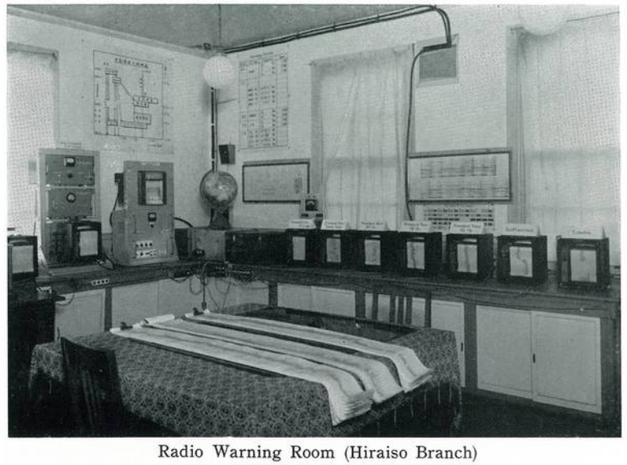
Radio Forecasts

On the basis of the ionospheric data collected at home and abroad, forecasts of radio propagation conditions are being issued three months in advance on behalf of the radio-communication services having national or international radio circuits. They are published in monthly pamphlets for distribution to those agencies concerned. In addition, special predictions of propagational conditions are furnished when requested, for example, predictions for the 1964 Olympics, the Asian Olympics, communications with the Antarctic Research Expedition Party, etc.

Radio Warnings

Radio warnings caution operators of radio circuits against the occurrence of Dellinger effects, geomagnetic storms, or ionospheric disturbances anticipated within 12 hours. This service is carried on at the Hiraiso Branch, where all necessary data are scrutinized several times daily to find the possibility and degree of disturbances likely to occur, and results are broadcast on the standard frequencies JJY. Advices of ionospheric storms are given by ursigram to the regions concerned, particularly to the Western Pacific Region. Besides, the warnings mentioned above, the disturbance forecasts for weekly and monthly periods are prepared and distributed to all agencies concerned.

In addition to these services, continuous studies are carried on for improvement of the accuracy rate of radio forecasts and forewarnings. As a result of these studies, remarkable progress has been made.



Radio Warning Room (Hiraiso Branch)

URSIGRAM Broadcasting

This service was resumed at the Radio Research Laboratories on December 25, 1951, at the request of the IXth Plenary Assembly of the International Scientific Radio Union. Its object is prompt reporting of radio disturbances and to interchange rapidly the data concerning various phenomena of the sun, terrestrial magnetism, cosmic rays, the ionosphere, etc. between the radio organizations concerned. The Radio Research Laboratories has taken the role of the Western Pacific Regional Center since 1957.

All information concerned is exchanged by radio to and from the three other Regional Centers (Nederhorst den Berg, Netherlands; Ft. Belvoir, U. S. A.; and Moscow, U. S. S. R.) and is broadcast further as scheduled in the tables below.

URSIGRAM Broadcasting Transmitter

Beamed South

Call sign	Location	Time (U.T.)	Frequency (kc/s)	Nature of message
JJD	35°42′ N 139°29′ E	04:00	A1 12,000	The same information on Adalert, current data summaries and satellite messages.
		04:45	A1 23,665	
		05:30	A1 18,785	
		08:00	A1 18,180	
		08:45	A1 15,950	
		09:30	A1 12,295	
		10:15	A1 10,415	
		23:00	A1 10,415	The same information on Geoalert, Adalert, Current data summaries, and satellite messages.

Beamed Northwest

Call sign	Location	Time (U.T.)	Frequency (kc/s)	Nature of message
JJD	35°42′ N	11:00	A1 10,415	The same information on Geoalert, Adalert, Current data summaries, and satellite messages.
	139°29′ E	22:00	A1 10,415	

Beamed Non-directional

Call sign	Location	Time (U.T.)	Frequency (kc/s)	Nature of message
JJD	35°42′ N 139°29′ E	12:00	A1 8,000	The same information on Geoalert, Adalert, Current data summaries, and satellite messages.
		15:00	A1 8,000	
		17:00	A1 8,000	
		19:00	A1 8,000	

Kashima Ground Station

The Radio Research Laboratories have a ground station for space communication experiments at Hirai, Kashima-machi, Ibaragi Prefecture. The station is located 90 km to the east-north-east of Tokyo with the following geographical coordinates and height above sea level (for the 30 m dish).

Latitude	35°57′10.0″ N
Longitude	140°39′57.8″ E
Height	42.2 m (24.7 m above sea level plus 17.5 m to the centre of the elevation axis)

A schematic diagram of the facilities is shown in Fig. 1.

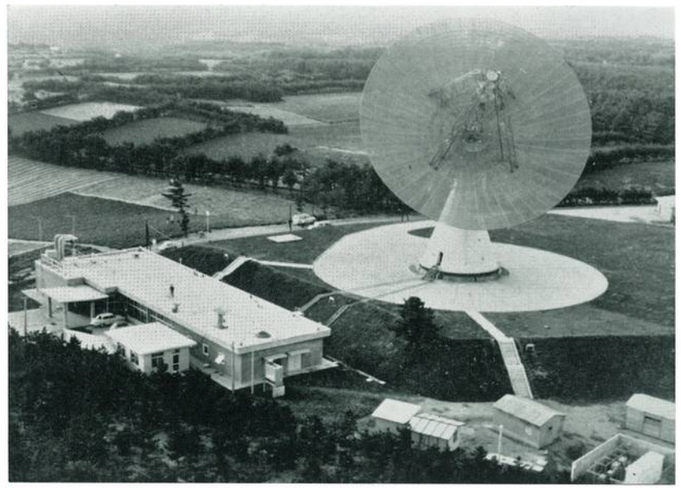
The following is a brief list of the equipment used:

(1) Antenna and feeding system, (2) Servo control system,
(3) Tracking equipment, (4) Transmitting equipment,
(5) Receiving equipment, (6) Control line.

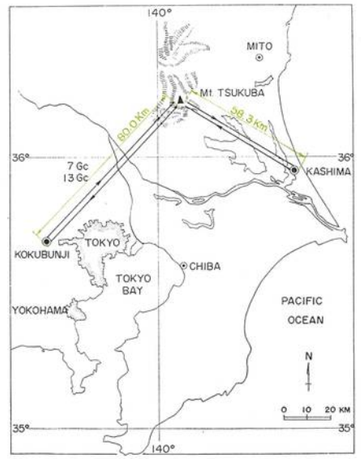
Antenna and Feeding System

An azimuth-elevation type parabolic antenna 30 m in diameter is used for space communication experiments. The antenna is employed in common for four frequencies 1725 Mc for transmission and 136 Mc, 4080 Mc and 4170 Mc for reception. For the frequency bands of 1725 Mc, 4080 Mc and 4170 Mc, the antenna is a Cassegrain type with a common feeding horn. For the frequency band of 136 Mc, the simultaneous lobing antenna utilizing the main dish is used.

A duplexer is employed to separate the transmitting and receiving signals and also to transfer the linear polarization to the circular one of the transmitting signal. The vernier tracking system (operating at 4080 Mc) is the mono-pulse receiving system making use of the radiation pattern of the TM_{01} and TE_{11} modes in the cylindrical wave guide. A high-power transmitter and a low noise receiver are housed in separate rooms on the turn-table, and are connected to the antenna system through the arm-type rotary joint assembly of the wave guide. At the rear of the sub-dish of a 1.2 m-diameter, a paraboloidal antenna is attached for gain measurement of the main antenna system.



Kashima Ground Station



Map of the Kashima Site

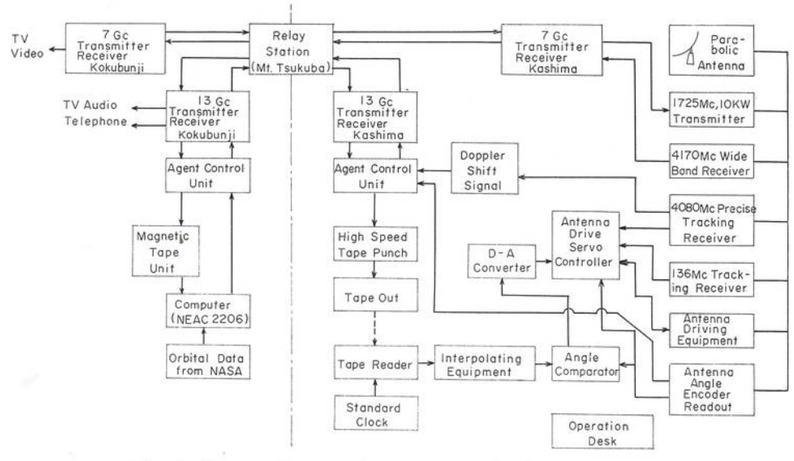


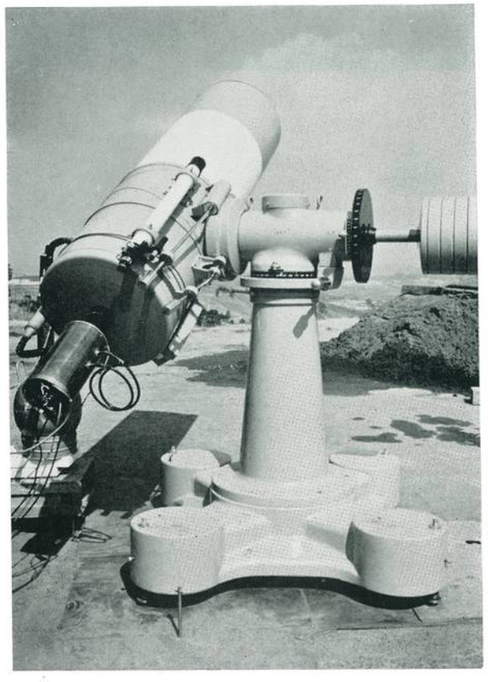
Fig. 1. System diagram of space communication equipment of the Radio Research Laboratories

Upper Atmospheric Observation by Laser Beam

Observation of the upper atmosphere is in progress using a laser transmitter and laser receiver.

It has been made clear that the laser is capable of detecting the meteoric dust and the aerosol layer so far undetected by radio. Therefore, efforts are being made to develop a new field of observation of neutral drift in the lower ionospheric region by tracking the movement of neutral dust around this region and for research in the relation to night air glow and meteorology.

Laser Transmitter



Laser Receiver

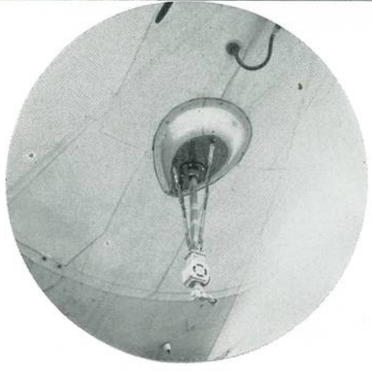
Tropospheric Propagation of Very Short Waves

In order to amass the data for designing direct long-distance communication circuits over several hundred kilometers in the VHF and UHF bands, many fundamental experiments have been carried out for many years.

The purpose was accomplished for communications between ground stations. At present, studies are being made of VHF long-distance communications between aircraft and ground station.

Experimental Ground Station on Mt. Futago, Hakone

↑
Refractometer being attached to an aircraft.



←
Sampling cavity of a refractometer on the fuselage.

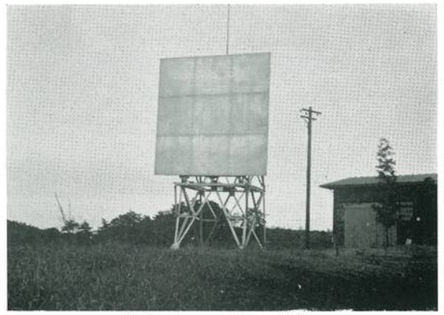
Radio Meteorology

The distribution and variations of atmospheric refractive indices affecting the tropospheric propagational characteristics on VHF and UHF are measured for further study by using aircraft.

Propagation of Millimetric Waves

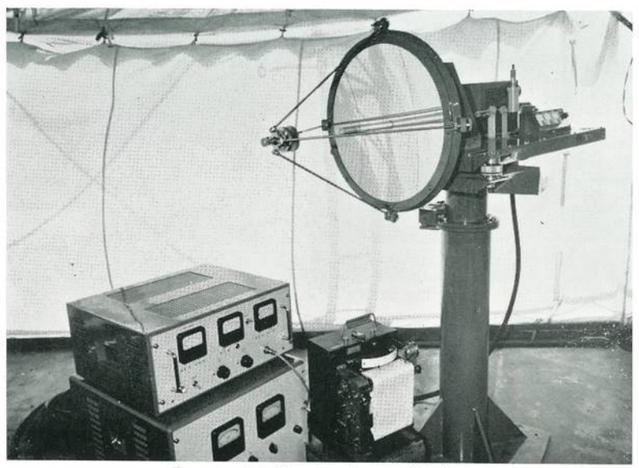
Studies are in progress on the atmospheric propagation and uses of millimetric waves.

35 Gc Transmitter



Reflector on Tama-Hill

Off-set Paraboloidal Antenna for Transmitting 35 Gc Waves from Kokubunji over 8.5 km Distance to Tama-Hill.

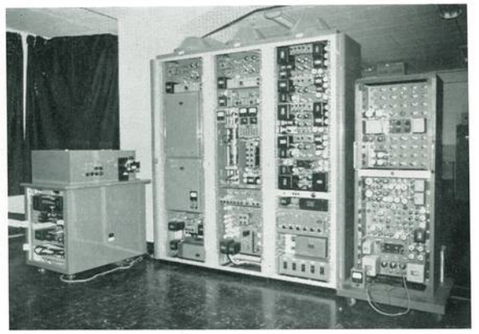


Propagation Testing Set on 140 Gc

Communication System Improvement

The development of communication systems immune from fading and noise, the study of coding and the study of bandwidth compression for television are in progress.

Research Section of Communication System



TV Picture Simulating Equipment

Simulation of TV images

This shows the input and output equipment for the simulation of TV pictures by computer. The output signal of this equipment can be converted to an original picture in the standard TV set using the storage cathode ray tube.

The computer used for this purpose is installed in the computing center and connected directly by cable.

Assessment Room where qualities of television or radio signals are evaluated. It is sound proofed and air-conditioned.

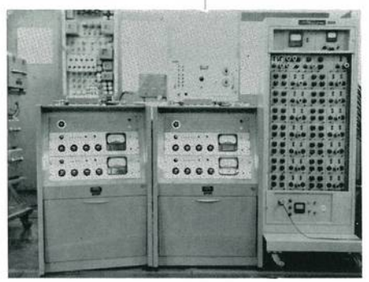
Information Processing

It is considered that speech and characters contain much redundant information. If this redundant part can be eliminated for coding, information transmission will become highly efficient. Therefore, a more detailed study is carried out on information concerning speech or characters written as patterns, and on the method of automatic recognition of these patterns.

Electronic Computer
(Type NEAC-2206)

Analog Input/output
Processing Equipment

Character Sampling Device



Speech Spectrum Analyzer

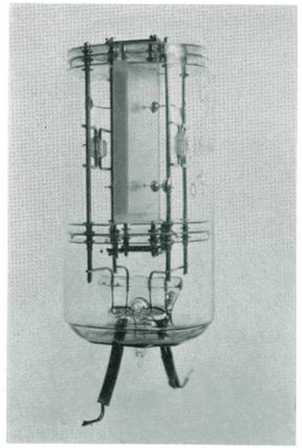
Hand-writing Analyzer

Quartz Units and Quartz Oscillators

Towards improvement in the stability of quartz oscillators, studies have been made of quartz units, oscillator circuits and precision thermostats.

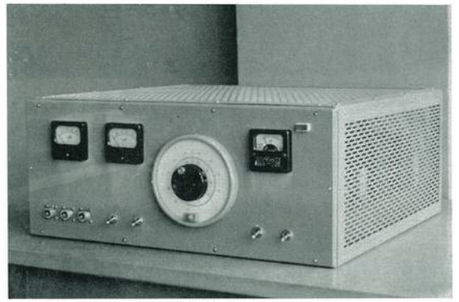
The improved GT-cut quartz units (Type 900) have a Q-factor of more than 3×10^6 and a frequency drift rate of less than 1×10^{-10} / day after one year's operation.

The frequency stability of the 100 kc bridge oscillator is better than $\pm5\times10^{-11}$.

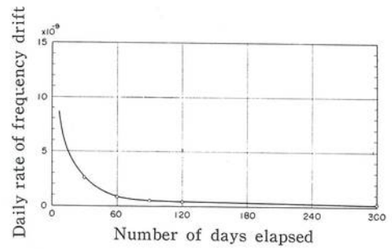


Crystal Resonators (900 Type)

Resonant Frequency:
100 kc/s GT cut
Q-value: 3.5×10^6
Series Resonant Resistance:
11.0 Ω
Frequency-temperature Coefficient:
less than 1×10^{-7}
Dimension: 39 mm×85 mm



Bridge Stabilized Quartz Oscillator



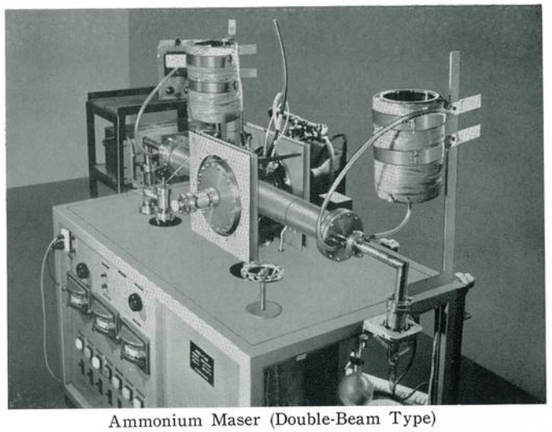
Frequency drift rate of the GT-cut Quartz Resonator Type 900

Experimental Equipment of Solid state Maser

Basic research on Solid state Maser

Towards realization of a receiver with wider bandwidth and lower noise, basic research is being made theoretically and experimentally on solid state maser.

Standard



Ammonium Maser (Double-Beam Type)

Atomic and Molecular Frequency Standards

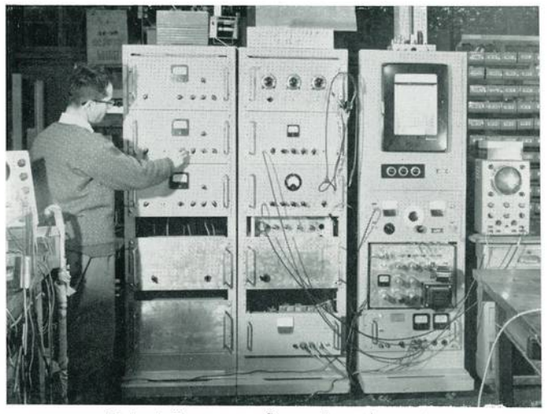
Studies have been made of atomic and molecular frequency standards since 1951. The characteristics of a double-beam maser of N^1H_3 3-2 line were investigated and the resetability is $\pm 3\times10^{-11}$.

Experiments are now in progress to put the hydrogen maser to practical use.

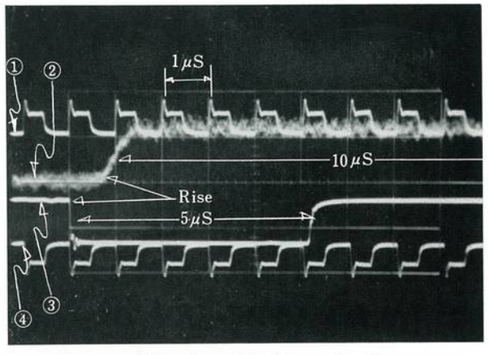
Frequency Measurements

In order to investigate the frequency characteristics of standard oscillators, mutual frequency comparison is made by various methods. The phase variation and noise in the quartz oscillator and the frequency multiplier are studied to improve the precision of frequency comparison.

For the intercontinental frequency comparison, the measurement of phase variation of VLF standard waves from other standard frequency stations is carried out against the JJY frequency standard.



Mutual Frequency Comparison Apparatus



Pulses received at Kashima Station

① ④ Time markers (1 μs)
② Mojave's pulses received
③ Kashima's reference pulses based on the JJY standard time signals

(With the cooperation of all interests concerned, the U.S.-Japanese experiments were carried out by the Radio Research Laboratories in Japan and the U.S. Naval Observatory.)

Time Synchronization Experiments

In February, 1965, experiments in precision time synchronization were conducted utilizing the Relay II satellite between Japan and the United States. Continued research is also being done in the system of time synchronization by Loran-C waves, etc.

Frequencies

Standard Frequencies and Time Signal Transmission

The standard frequencies and time signals JJY are broadcast from Koganei as shown in the table below. The frequencies are maintained within $\pm 3\times10^{-10}$ against the offset frequencies.

The time signals are synchronized within ± 1 ms with the standard time in other countries and maintained within 100 ms of the universal time UT2.

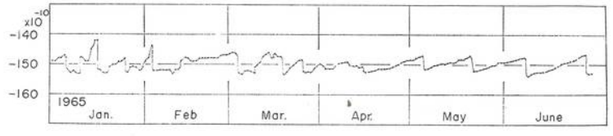
Simultaneously with the transmission of time signals, radio forewarnings are broadcast.

To maintain the accuracy, a double-beam type ammonia maser is used as the primary standard.

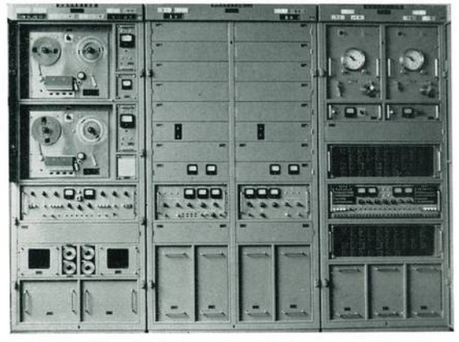
Call Sign / Location	Carrier Freq. (MHz)	Carrier Power to antenna (kW)	Hours of Emission
Standard Frequency station			
JJY 35°42′N 139°31′E	2.5	2	24
	5.0	2	24
	10.0	2	24
	15.0	2	24
Experimental station			
JG2AE (Koganei)	8.0 MHz	0.5	14 (21:00～11:00 UT)
JG2AR (Koganei)	20.0 KHz	3	2 (05:30～07:30 UT)
JG2AQ (Koganei)	16.2 KHz	3	—
JG2AS (Koganei)	40.0 KHz	10	6 (00:00～06:00 UT)

The deviations are made public in the "Standard Frequency and Time Signal Broadcast Service Bulletin."

Deviation of JJY standard frequencies



JJY Transmitter Room

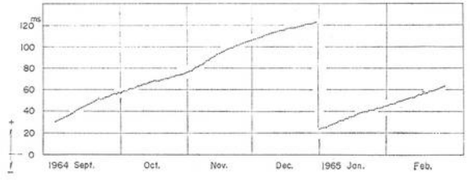


Standard Time Signal Generator

This equipment is composed of two sets of the same type. Both are operated by the same oscillator and generate modulating signals necessary for second signals, standard low-frequency signals, announcement, etc.

The second signals from this equipment are 0.1 μs in unit and can be regulated in phase step by step.

Deviation of JJY time signals with reference to UT2-Tokyo



Governmental Type Approval and Performance Test of Radio Apparatus and Devices

Research in Radio Equipment and Devices

In progress is research essential to establishment of technical standards for licensing of radio stations, frequency assignments, and monitoring for quality of emitted radio waves.

Principal items of research are as follows:

(1) Development of synthetic testing equipment for obtaining quantitatively the traffic quality of radio communication circuits and the performance required of the equipment used in the circuits;

(2) Development of automatic recording equipment of spurious emissions;

(3) Improvement of apparatus on various high-frequency standards;

(4) Problems concerning efficient utilization of transmission circuits;

(5) Relation of the actual traffic of occupied bandwidth to the quality degradation of adjacent channels;

(6) Re'ation of the modulation-demodulation system to the minimum field intensity for reception;

(7) Testing method for reliability evaluation of communication equipment under various environmental conditions;

(8) Method of calibration of measuring equipment in use for radio regulatory purposes;

(9) Development and improvement of various testing equipment in use for type approval and calibration purposes.

Synthetic Testing Equipment for Radio Communication Circuits

Type Aproval of Radio Apparatus and Devices

The Radio Research Laboratories, as one of the departments for radio administration in the Ministry of Posts and Telecommunications, takes charge of type approval of the radio apparatus and devices mentioned below. Those given official approval are announced in the Official Gazette and the Official Report of the Ministry of Posts and Telecommunications.

(1) Those to be compulsorily installed for safety:

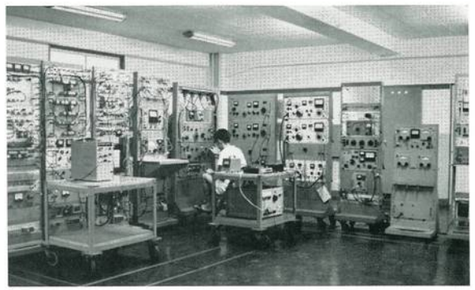
① Automatic Alarm Signal Receivers; ② Apparatus for Survival Craft Radio; ③ Radio Direction-Finder; ④ Aircraft Transmitters and Receivers

(2) Equipment with which radio stations must have for the sake of radio regulation:

① Frequency Measuring Equipment.

(3) For the maintenance of the technical standard provided for by law:

① FM Transmitters and Receivers;
② SSB Transmitters and Receivers;
③ Radio Equipment for Simple Radio Service;
④ Automatic Distress-informing Equipment;
⑤ Radio Buoys;
⑥ Radio Transmitters in the Meteorological Aids Service;
⑦ Medical Equipment Utilizing High Frequencies.



Official Testing Equipment

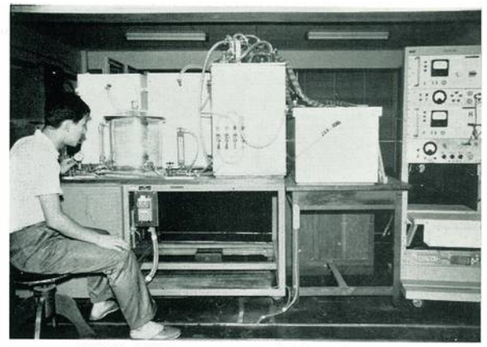
Calibration of Radio Regulation Measuring Equipment

For radio regulatory purposes, the working standards of various radio frequencies are under development, and calibration service is carried on according to these standards.

The working standards are as follows:

① Radio frequency power standard;
② Radio frequency field intensity standard;
③ Radio frequency voltage and current standard;
④ Radio frequency standard;
⑤ Occupied frequency bandwidth standard.

The calibration service deals chiefly with measuring equipment for use in radio regulation, but any manufacturers, users, etc. may make use of this service.

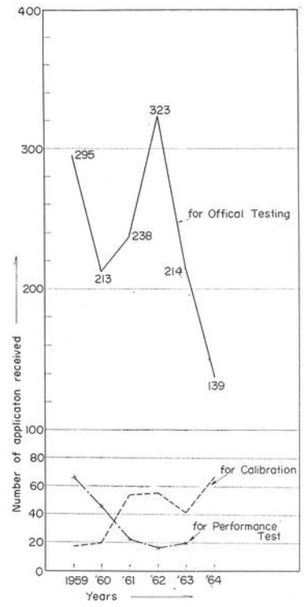


VHF, UHF power standard equipment

Performance Test

Upon the request of manufacturers, users, etc., equipment submitted for official testing, high-frequency measuring equipment, and apparatus with which radio stations requiring no licence will be equipped are tested, and results issued.

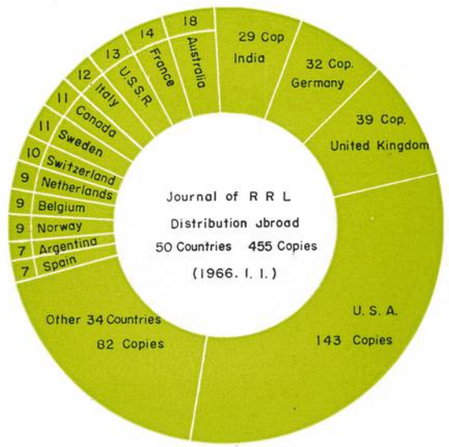
Number of applications received for Official Testing, Performance Test and Calibration

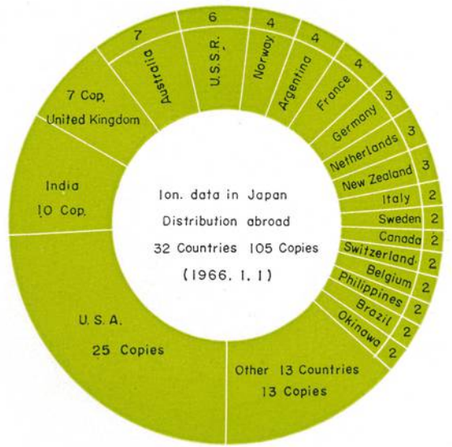


Publications and Periodicals

The publications and periodicals issued by the Radio Research Laboratories are as follows:

Ionospheric Data in Japan	In English	Monthly
Propagation Forecasts	In Japanese	Monthly
Monthly Forecast and Actual Disturbance in Radio-communication	In English	Monthly
Journal of the Radio Research Laboratories	In English	Bi-monthly
Review of the Radio Research Laboratories	In Japanese	Bi-monthly
Catalogue of Data in WDC C2 Center for Ionosphere	In English	June, December
World Maps of *F*2 Critical Frequencies and Maximum Usable Frequencies for 4,000 km	In English	Aug., 1958





World Data Center C 2 for Ionosphere

World Date Center C2 for Ionosphere

Since the IGY, Japan was selected to be one of the World Data Centers in the fields of geomagnetism, ionosphere, cosmic rays and air glow. This Laboratory has been designated as Center C2 for ionosphere and it has played an active part in the interchange and completion of data in cooperation with the other Centers "A" (Institute for Telecommunication Sciences and Aeronomy, U.S.A.), "B" (Izmiran, U.S.S.R.), and "C1" (Radio and Space Research Station, U.K.)