NS/rk

U. S. NAVAL TECHNICAL MISSION TO JAPAN
CARE OF FLEET POST OFFICE
SAN FRANCISCO, CALIFORNIA

27 December 1945

RESTRICTED

From: Chief, Naval Technical Mission to Japan.
To : Chief of Naval Operations.

Subject: Target Report - Japanese Radio Frequency Measuring Technique.

Reference: (a)"Intelligence Targets Japan" (DNI) of 4 Sept., 1945.

1. Subject report, covering Target E-22 of Fascicle E-1 of reference (a), is submitted herewith.

2. The investigation of the target and the target report were accomplished by Lieut. W.G. Lamb, USNR, with the assistance of Lieut. E.E. Schwalm, USNR, and Lt.(jg) S.H. Kadish, USNR, as interpreter and translator.

C. G. GRIMES
Captain, USN

JAPANESE RADIO FREQUENCY MEASURING TECHNIQUE

"INTELLIGENCE TARGETS JAPAN" (DNI) OF 4 SEPT. 1945

FASCICLE E-1, TARGET E-22

DECEMBER 1945

U.S. NAVAL TECHNICAL MISSION TO JAPAN

SUMMARY

ELECTRONICS TARGETS

RADIO FREQUENCY MEASURING TECHNIQUE

The lack of adequate test equipment and advanced measuring techniques was probably the most serious factor hampering the development of modern Japanese radar and radio frequency components.

Inspection of equipment and interrogation of technical personnel revealed only elementary methods and equipment.

Enclosure (A) is a tabular summary of the more important items of test equipment in use at the end of the war.

TABLE OF CONTENTS

REFERENCES

Location of Target:

Navy Yard, SASEBO
Navy Yard, YOKOSUKA
Second Naval Technical Institute, KANEGAWA
Naval Fighter Director School, CHIGASAKI
Second Naval Technical Institute, Meguro Branch, TOKYO

Japanese Personnel Interrogated and Their Capabilities:

See Enclosure (C)

LIST OF ENCLOSURES

(A) Summary of Test Equipment (12 pages)

(B) List of Documents forwarded to Washington Document Center through ATIS.

(C) Japanese Personnel Interrogated and Their Capabilities

LIST OF ILLUSTRATIONS

INTRODUCTION

This report covers radio frequency measuring technique used with Japanese radio and radar.

The information and conclusions are based upon interrogation of Japanese naval and technical personnel and inspection of equipment, installations and experimental facilities.

THE REPORT

The absence of modern, high-grade test equipment was a major factor hampering the development of micro-wave radar and high frequency components. Although theoretical background was adequate, it appears that creative imagination was lacking. This is illustrated by the method used for spectrum analysis:

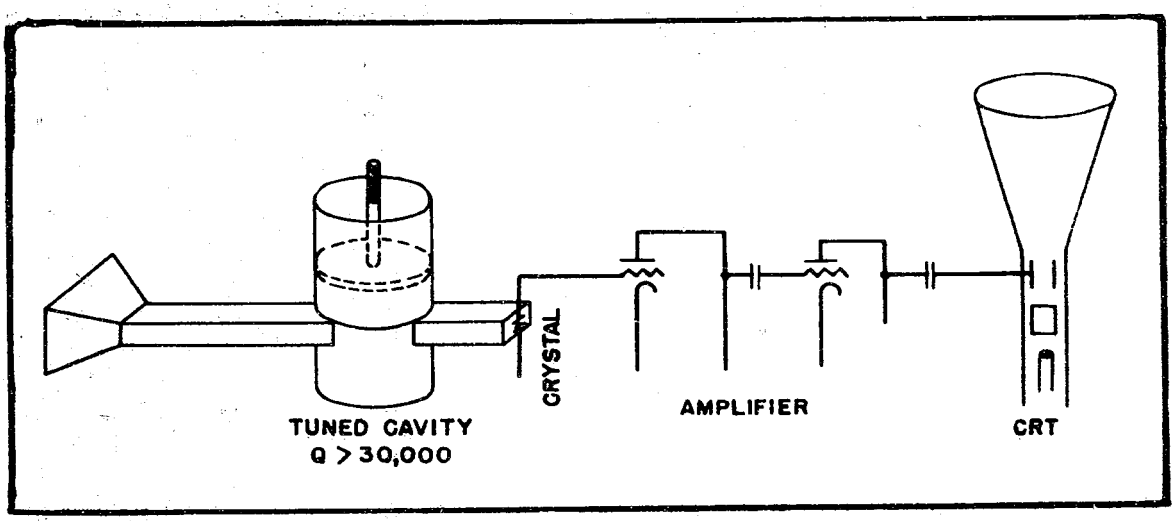

FIGURE 1

Figure 1 shows the equipment used. As the tuning of the cavity is varied, the response, as indicated by the CRT, is plotted. As far as could be determined, the idea of a direct-reading spectrum analyser was never developed.

Signal generators were available with frequencies up to 10,000 Mc; magnetrons and velocity-modulated tubes were the oscillators in the micro-wave ranges. Wavemeters of the "high Q" cavity type were standard for wave lengths of 10cm and less. Although high Q cavities were used extensively as tuning elements, no applications of the echo box principle were found. Meter wave wavemeters were of the parallel-wire type.

Standing wave measurements were made by using slotted coaxial lines as slotted wave guides. No micro-wave direct power measuring equipment was available. Field strength meters provided relative power indications, and where actual power output was desired, it was calculated from the field strength.

Measurement of dielectric constants and characteristics of coaxial cables were made with a Lecher Wire Test Set (Type 702 is an example) or test sets based on the Q-meter principle, such as Type 701.

A dummy load consisting of a tapered coaxial line of low conductivity material similar to that used on the German Wuertzburg was in general use. Very little original work had been done on dummy loads, but plans were being made at the end of the war for further investigation.

Enclosure (A) is a list of the more important items of test equipment with a short description of each.

ENCLOSURE (A)

SUMMARY OF TEST EQUIPMENT

I N D E X

METERS

OSCILLATORS

SPECIAL MEASURING DEVICES

ENCLOSURE (A)

CAPACITY COMPARATOR

TYPE	TYPE NO.	MANUFACTURER	SPECIFICATIONS	FEATURES	USE	COMMENTS
Precision differential type	603	Ando Electric	Capacity to be compared 30 to 100 micromicrofarads Measurable ranges of percentage difference (2 steps): Range I: 0 to 2% Range II: 0 to 20% Accuracy: 0.1 %	Operation simple. Comparison fast & precise	Test & adjustment of ganged variable condensers. Can also be used for resistance or inductance comparisons	a.c. source (100 volts)

CAPACITY METER

TYPE	TYPE NO.	MANUFACTURER	SPECIFICATIONS	FEATURES	USE	COMMENTS
Precision Low capacitances	601	Fuji Sokuteiki	Ranges: 0 to 120 & 1200 micromicrofarads Accuracy: 1% 0.5 micromicrofarad (for 0 to 120 micromicrofarads) 1% 5 micromicrofarads (for 0 to 1200 micromicrofarads)	Direct reading Easy to operate	Test of various low-capacity condensers	Resonance indicator employs 100kc quartz crystal: a.c. source (100 volts) measurement freq. 100kc

INDUCTANCE METER

TYPE	TYPE NO.	MANUFACTURER	SPECIFICATIONS	FEATURES	USE	COMMENTS
Precision low inductances	604		Ranges: 0 to 10, 100, 1000, & 10,000 microhenries	Direct reading. Simple to operate	Test of various coils for use in radio equipment	Resonance indicator employs 100kc quartz crystal: a.c. source (100 volts) measurement freq. changes with range (4 steps, app. 20, 60, 200, & 600kc)

LCR METER

TYPE	TYPE NO.	MANUFACTURER	SPECIFICATIONS	FEATURES	USE	COMMENTS
Simple tester ("R" tester)	651		See circuit testers			

RESISTANCE MEASURING DEVICES

TYPE	TYPE NO.	MANUFACTURER	SPECIFICATIONS	FEATURES	USE	COMMENTS
Precision	602	Yokogawa Denki	Range: 0.001 to 10^7 ohms		Measurement of various d.c. resistances	Moveable d.c. wheatstone bridge
Megger ("M" tester)	652			See circuit testers		
Contact resistance meter ("D" tester)	653			See circuit testers		

ENCLOSURE (A), continued

U.S.W. CALLIBRATION SET FOR AMMETERS

TYPE	TYPE NO.	MANUFACTURER	SPECIFICATIONS	FEATURES	USE	COMMENTS
u.s.w. large currents	511	Shimazu Seisakusho	Standard consists of resistance lamp & photo-cell. 10 to 100mc 0.1 to 10 amps		Test of u.s.w. current meters of fairly high amperage. Also useful in research	a.c. source (100 volts)

VOLTMETERS

TYPE	TYPE NO.	MANUFACTURER	SPECIFICATIONS	FEATURES	USE	COMMENTS
u.s.w. vacuum-tube voltmeter	401	Nihon Sokuteiki	5kc to 100mc Voltage ranges: 0 to 1.5, 5, 15, 50 & 150 volts Accuracy same as ordinary class meters	Portable. Has extra large scales. Probe type h.f. head (diode rectification)	Suited to general voltage measurements from 5kc to 100mc. Test & research work	Combination of diode peak-voltage rectifier & d.c. amplifier. a.c. source (100 volts). Voltage stabilization provided
Low-freq. vacuum-tube voltmeter ("V" tester)	402			See circuit testers		

WAVEMETERS

TYPE	TYPE NO.	MANUFACTURER	SPECIFICATIONS	FEATURES	USE	COMMENTS
Precision u.s.w. (Heterodyne type)	201	Nihon Musen	30 to 1500mc Accuracy: $1x10^{-3}$ Readability: $5x10^{-4}$	Crystal oscillator included for calibrations	Test & research on u.s.w. & microwave oscillators.	Battery source (6 volts & 200 volts)
Precision microwave (Heterodyne type)	202 (In use)	Nihon Musen	200 to 3500mc Accuracy: $1x10^{-3}$ Readability: $5x10^{-4}$	Same as above	Test & research on microwave oscillators	Same as above
Precision Long, med., & short waves (Heterodyne type)	203	Tsukamoto Denki	100kc to 30mc Accuracy: $1x10^{-3}$ Readability: $5x10^{-4}$	1mc crystal oscillator included for calibrations (circuit developed by Electro-technical Lab.) 6 plug-in type oscillator coils to change range	Test & research on long med., & short wave oscillators	Same as above
Absorption type	251	Yokogawa Denki	17kc to 75mc (7 plug-in type coils to change range) Accuracy: 1.5% Readability: 1%	Direct reading Easily handled	Test of long med., & short wave oscillators	Crystal detector contained in set
Absorption type u.s.w.	252	Denki Gijutsu Jitsuyoka Kyokai	75 to 350mc Accuracy: 2% Readability: 1.5%	Direct reading. L & C simultaneously varied. No change of coils required. Easily handled.	Test & research on u.s.w. oscillators	Crystal detector contained in set
Absorption type microwave	253	Same as above	Ko (A): 1000 to 2000mc Otsu (B): 500 to 1000mc Hei (C): 250 to 500mc Accuracy: 1% Readability: 0.5%	Closed type, capacity variable.	Test & research on microwave oscillators	Crystal detector contained in set
Cavity resonator microwave	254	Same as above	Alpha type: 6.5 to 15cm Pi type: 3.8 to 6.5cm Beta type: 2 to 4cm Accuracy: 0.2% Precision: 0.1%	Cavity resonator adjusted by micrometer drive	Test & research on centimetric wave oscillators	Crystal detector contained in set

ENCLOSURE (A), continued

LOW-FREQUENCY OSCILLATORS

TYPE	TYPE NO.	MANUFACTURER	SPECIFICATIONS	FEATURES	USE	COMMENTS
L.C.step freq. (Acorn tubes)	1151 (In use)	Kubota Musen	Step change of frequency by switching over L & C values (11 steps) 0.2 to 10kc Output: over 50milliwatts at 600 ohms Distortion less than 10%	Small, simple. Oscillations & frequency stable. Output constant regardless of frequency	Test & study of receivers & other low-frequency circuits	a.c. source (100 volts)
C.R. continuous variation	1152	Tokyo Shibaura Electric	Stop-change of C & L continuous variation of R. 50 cyc. to 20kc Output: over 50 milliwatts at 600 ohms or 2000 ohms Distortion less than 5%	Oscillator frequency stable. Good frequency v s output characteristic (Output deviation about ± 5%)	Same as above Suited to acoustical tests & experiments	a.c. source (100 volts)

SWEEP-FREQUENCY OSCILLATORS

TYPE	TYPE NO.	MANUFACTURER	SPECIFICATIONS	FEATURES	USE	COMMENTS
For direct observation of receiver freq. characteristics	1101 Ko (A) Otsu (B) Hei (C) (In use)	Nitchiku Kogyo	A: 4 to 30mc B: 600 to 6000kc C: 75 to 800kc Sweep frequency: 50 or 80 cycles	Electrical method used for sweeping frequency. Small, simple. Band width of frequency sweep arbitrarily adjustable. Essential for mass production of radio equipment.	Adjustment of i.f. stages of u.s.w. receivers (or long and short wave receivers) by direct observation of the frequency characteristics on a cathode-ray oscillograph	a.c. source (100 volts) used in combination with 901 oscillograph and 151 signal generator

TEST OSCILLATORS

TYPE	TYPE NO.	MANUFACTURER	SPECIFICATIONS	FEATURES	USE	COMMENTS
Ordinary class microwave	154	Oki Electric	Pi wave-length Velocity modulation tube. 1000 cyc. impulse wave mod.	Signal field produced. Doublet with reflector plate. Inductance attenuator. Balanced output	Test & study of microwave receivers.	Sources: separate eliminator using 100 volts a.c.
Impulse modulated oscillator	181		Impulse generator tube. Impulse freq. 1000 cyc./sec. 1 to 20 microseconds, 180° phase adjustment Carrier freq. 75 to 150mc 150 to 300mc Output: 10 microvolts to 1 millivolt	Short impulses producible. Waveform of impulse approximately rectangular	Test & study of overall performance of u.s.w. receivers for impulse modulated waves	Battery source
Microwave test oscillator	182	Denki Gijutsu Jitsuyoka Kyokai (Ass'n for Applications of Electrotechnology)	10, 5, & 3cm wavelengths. Double split-anode magnetron used. Cavity resonator. 1000 cyc. sinusoidal mod.	Large output, wave length variable over comparatively wide range. Oscillator tube easily manufactured	Experiments & research in microwave region, auxiliary aid to test of receivers	Source: separate eliminator using 100 volts a.c.

ENCLOSURE (A), continued

SIGNAL GENERATORS

TYPE	TYPE NO.	MANUFACTURER	SPECIFICATIONS	FEATURES	USE	COMMENTS
Precision Long, med., & short waves	101	Nihon (or Nippon) Musen	50kc to 25mc Output: 1 volt 0.1 volt to 1 microvolt. Accuracy: 1db	Simple operation Direct-reading output voltage & freq. Internal & external mod.	General studies & test of receivers for long or short waves	Output can be adjusted to less than 1 microvolt a.c. or d.c. source usable.
Same as above	102	Oki Electric	25kc to 30mc Output: 0.8 volt to 1 microvolt (Max. voltage above 20mc 0.3 volt) Accuracy: 2db	Plug-in coils. Separate output meter. Tuned buffer amplifier. Internal & external mod.	Same as above	Same as above
Precision u.s.w.	103	Nihon Musen	15 to 150mc Output: 0.1 volt to 1 microvolt Accuracy: 2db	Plug-in coils. Tuned buffer amplifier. Internal & external mod.	Study & test of u.s.w. receivers	Output can be adjusted to less than 1 microvolt Battery source (6 volts & 200 volts)
Semi-precision. Long to short waves 3 bands	111 Ko (A) Otsu(B) Hei (C) Tei (D)	Nihon Musen	A: 3.5 to 30mc B: 275kc to 4mc C: 18 to 300kc D: 3.5 to 22mc 275 to 750kc Output: 1 volt; 0.1 volt to 10 microvolt. Accuracy: 2db	Small. Easy to produce. Types A to D each contain 3 bands. Type D generates both r.f. and i.f.	Production tests (& study) of s.w. (or long & med. wave) receivers. Test of i.f. s stages of u.s.w. sets. Expected to replace 101 & 102	Output can be adjusted to less than 1 microvolt a.c. source (100 volts)
Semi-precision. 2 bands 3 w. & u.s.w.	112 Ko (A) Otsu(B) Hei (C) Tei (D) Bo (E) (In use on ships)	Ando Electric	A: 140 to 220mc B: 22mc 15% B: 90 to 160mc 22mc 15% C: 55 to 100mc 7mc 15% D: 35 to 60mc 7mc 15% E: 20 to 40mc 47mc 13% Output: 10 millivolts to 1 microvolt. Accuracy: 2db	Small. Easy to produce. Generates r.f. & i.f. Possible to modulate with rectangular waveform. Easily portable.	Production test (or study) of u.s.w. receivers of certain freq. range. Can replace 103	Output can be adjusted to 1 microvolt. Battery source (6 volts & 200 volts)
Semi-precision single band	113 Special Ko(Special A) Ko (A) Otsu(B) Hei (C) Tei (D) Bo (E)	Nitchiku Kogyo (In use)	Special A: 220 to 350mc A: 140 to 220mc B: 90 to 160mc C: 55 to 100mc D: 35 to 60mc E: 20 to 40mc Output: 10 millivolts to 10 microvolts. Accuracy: 3db	Small. Easy to produce. Possible to generate up to 700mc by suitable circuit. Balanced output possible. Also modulation by rectangular waveform	Same as above. Also suitable for use on receivers having balanced input circuits.	Output adjustable down to about 1 microvolt. Battery source (6 volts & 100 volts)
Semi-precision single band	114	Nihon Musen	75 to 350mc Output: 10 millivolts 3 microvolts Accuracy: 3db	Easier to make them 103 Generates 75 to 350 mc in one sweep Modulation by rectangular waveform possible.	Study & test of u.s.w. receivers Expected to replace 103	Output adjustable down to about 1 volt Battery source (6 volts & 200 volts)
Semi-precision	115	Fuji Tsushinki (In use)	200 to 700mc Output: 10 millivolts to 10 microvolts.	First in Japan	Study & test of u.s.w. receivers	a.c. source (100 volts)
Semi-precision single band	116	Fuji Tsushinki (In use)	Magnetron osc. with Atenuetor. Antenna with plate reflector. Rectangular wave modulator.	First in Japan. A known field is produced in which test receiver is placed and tested with antenna	Same as above	d.c. source (12 volts to 300 volts)
Ordinary class. Long, med., & short wave	151	Fuji Sokuteiki	60kc to 25mc Output: 0.1 volt to 100 microvolts 400 cyc. (mod.) Output: 3 volts to 0.3 millivolts.	Simple signal generator that can be also used as test oscillator. Small, simple operation low-frequency signal also generated.	Maintenance tests of receivers for long & short waves. Also auxilliary equipment for research & experimentation.	Output can be adjusted down to about 10 microvolts a.c. source (100 volts)
Ordinary class microwave	152	Denki Gijutsu Jitsuyoka Kyokai (Ass'n for Applications of Electrotechnology) Also Fuji Tsushinki	Alpha wave-length Type LD220 tube 1000 cyc. rectangular wave mod.	Signal field produced. Half-wave doublet with reflector (plate) Inductance attenuator. Balanced output.	Test & study of microwave receivers. Expected to replace 116	Battery source 250 volts 100 volts 4 volts
Ordinary class microwave	153	Fuji Tsushinki	Beta wave-length Type LD30A tube 1000 cyc. rectangular wave mod.	Signal field produced. Doublet with reflector plate. Inductance attenuator. Balanced output.	Test & study of microwave receivers. Gives wave band intermediate between 115 & 116	Battery source (200 volts ± 2 volts)

ENCLOSURE (A), continued

CIRCUIT TESTERS

TYPE	TYPE NO.	MANUFACTURER	SPECIFICATIONS	FEATURES	USE	COMMENTS
"A" tester Field use (Dry cell operated)	1501	Tsukamoto Denki	Voltage (d.c. & low freq. 0 to 10, 50, 250 & 1000 volts Current (d.c.) 0 to 1, 10, 100, & 500 milliamps Output voltage measurements (audio-freq.) 0 to 10 volts at 10 kilohms Resistance (d.c.) 0 to 10 & 100 kilohms	Universal tester including use as output meter. Other testers also encased in same sized box	Suited to field experiments. Sample tests of voltages, currents & resistances in radio equipment Also usable as output meter for radio receivers	Comes with carrying box. Contains square type 2 dry cell (1.5 volts)
"B" tester Indoor use	1502		Voltages (d.c. & low freq.) 0 to 10, 50, 250, & 1000 volts Output voltages (audio freq.) 0 to 10 volts at 10 kilohms Capacitances: 0 to 0.1 & 10 microfarad Resistances (d.c.) 0 to 10, 100, & 1000 kilohms	Includes output meter. Universal type using a.c. source	Chiefly for indoor experiments. Simple checking of voltages capacitances, & resistances of radio equipment. Also usable as output meter for radio receivers.	a.c. source (100 volts). Capacitance measured at 50 or 60 cycles
"E" tester (Universal voltmeter)	1503	Tsukamoto Denki	d.c. & low freq. Voltages 0 to 10, 50, 250 500, & 1000 volts Also to 3000 volts Output voltages: 0 to 10 volts at 600; 0 to 10 & 100 volts at 10 kilohm Accuracy same as ordinary less voltmeter	General voltage measurements. 3000 volts can be measured by employing external multiplier	Used in general test & research work when accuracy required is not as high as precision instruments	External multiplier & special connector cords provided
"I" meter (Universal milliammeter)	1504	Tsukamoto Denki	d.c. & low freq. Currents 0 to 1, 5, 25, 100 & 500 millamps Accuracy some what less than ordinary class meter	General current measurements Protection provided for over-current in indicating meter	Same as above	
"R" meter (L C R meter)	651	Shimazu Seisakusho	Resistances (d.c.) 0 to 1, 10, 100 & 1000 kilohms Capacities: 0 to 0.01, 0.1, & 10 microfarads Inductances: 0 to 10 & 100 henries	Suited to general checking of resistance, capacitance, and inductance. Operates by a.c. source	Checking parts used in radio equipment	a.c. source (100 volts). Capacities & inductances measured at 50 or 60 cycles
"M" meter (Megger)	652	Shimazu Seisakusho	0 to 100 megohms at 500 volts	Rectifier contained. Operates on a.c.	Indoor use. Can replace megger for checking insulation of parts & radio equipment	a.c. source (100 volts)
"V" meter (Low-freq. vacuum-tube voltmeter)	402	Nihon Sokuteiki	Low & high freq. Voltages (up to 20mc) 0 to 5, 15, 50 & 150 volts. Accuracy a little less than ordinary class meter	Rectifier set provided. Operates on a.c. Simple. High input resistance. d.c. voltages can also be measured	For general measurements in radio. To replace usual "A" type & "D" type vacumm-tube voltmeters	a.c. source (100 volts)
"D" meter (Contact resistance meter)	653	Denki Gijutsu Jitsuyoka Kyokai	Middle-point indication 100 milliamps Max. indication 1 amp	Simple to use. Reliable	Simple checking of various contact resistances & low resistors in radio equipment & parts	Battery source

ENCLOSURE (A), continued

CURRENT DISTRIBUTION METER

TYPE	TYPE NO.	MANUFACTURER	SPECIFICATIONS	FEATURES	USE	COMMENTS
u.s.w. (Matching feeder lines)	821 Ko (A) Otsu (B) Hei (C) (In use)	Oki Electric	A: 140 to 300mc B: 70 to 150mc C: 40 to 80mc Suited to measurement of u.s.w. impulse currents	Gives accurate distribution of current along lines at u.s.w. No effect of voltage. Easy to use light, source self-contained	Adjustments & matching of lines such as antenna feeders	Peak rectifier. Battery contained

FIELD-STRENGTH MEASURING APPARATUS

TYPE	TYPE NO.	MANUFACTURER	SPECIFICATIONS	FEATURES	USE	COMMENTS
Med. to short waves	301	Oki Electric	500kc to 20mc Med. wave-length intensities: 1 volt per meter to 5 microvolt per meter Short-wave intensities: 1 volt per meter to 10 microvolt per meter	Stationary type. Wheels attached	Study of med. & short-wave propagation	Sensitivity can be increased by using vertical antenna. Battery source (6 volts to 200 volts)
u.s.w.	302	Nihon Musen	20 to 200mc Intensities: 0.1 volt per meter to 10 microvolt per meter Reception possible up to 300mc	Stationary type. Wheels attached for moving short distances. Standard field-strength generator provided. Suitable for automatic recording of measurements over range of 30db	Study of u.s.w. propagation problems	Rough measurements possible down to 1 microvolt per meter. Battery source (6 volts, 200 volts, also dry cells for other voltages)
u.s.w. Field-strength indicator	351	Nihon Musen	Special: 3 bands 330mc 20% 180mc 20% 85mc 20% Ko (A): single band 330mc 20% Otsu (B): Single 180mc 20% Hei (C): Single 85mc 20% Intensity: 10 to 0.1 volts per meter	Antenna: short doublet with reflector (except type C). Suitable for simple mobile measurement of intense fields. Vertical or horizontal component of field strength measurable. Little error due to surrounding bodies	Test & measurements of field radiated near u.s.w. transmitting equipment	Source: dry cells

AUDIO-FREQUENCY AMPLIFIER

TYPE	TYPE NO.	MANUFACTURER	SPECIFICATIONS	FEATURES	USE	COMMENTS
	1301	Kubota Musen	Band: 50 to 20,000 cycles negative feedback Gain: 50db Gain deviation 1.5db or less at 1000 cyc. Input & output impedances: 600 ohms & 10 kilohms Distortion: 1% or less	Simple to handle. Small. Low noise	Study & test of audio-frequency circuits of receivers	d.c. source (6 volts & 200 volts) a.c. source (100 volts)

ENCLOSURE (A), continued

IMPEDANCE MEASURING SETS

TYPE	TYPE NO.	MANUFACTURER	SPECIFICATIONS	FEATURES	USE	COMMENTS
"P" meter (Parallel resonance impedance) Long, med. & short waves	751	Kawanishi Kikai	Freq: 50kc to 20mc Ranges: 5 kilohms to 100 kilohms in 50kc to 10mc band 5 kilohms to 30 kilohms in 10 to 20mc band	Direct reading, simple to operate, simple construction. Utilizes negative-resistance oscillator tube (transitron)	Test of LC resonance circuits. Inspection of h.f. tuned circuits & i.f. band filters	a.c. source (100 volts)
Bridge for calibrating "P" meter	752	Kawanishi Kikai	Calibration at 100 cyc. 500 to 300 kilohms. Multiplier in 3 steps	Direct reading negative-resistance dial	Calibration of 751 "P" meter scale. Any number of "P" meters can be calibrated by providing one of these bridges	Source obtained from 751 "P" meter
Radio-freq. bridge	753	Ando Electric	Freq: 1 to 30mc Ranges: 20 to 200 kilohms & 0 to 300 microcmicrofarads for symmetrical circuits 10 to 100 kilohms & 0 to 600 micromicrofarads for unsymmetrical circuits	Bridge employing differential transformers. Symmetrical & unsymmetrical impedances measurable	Measurement of antenna feeders (impedance) & test & adjustment of various radio circuits	Modulated oscillator & detecter-amplifier combined in set

LOSS MEASURING SETS

TYPE	TYPE NO.	MANUFACTURER	SPECIFICATIONS	FEATURES	USE	COMMENTS
Q meter long, med., & short wave	701	Yokogawa Denki	50kc to 25mc Q: Scale reading 0 to 2500, multiplication factor 1 to 2.5 Capacity reading: 30 to 450 micromicrofarads	Direct reading. Easy to operate. Measurements simple	Measurements of Q of coils & condensers, high resistances. Various tests (or high-frequency impedances)	a.c. source (100 volts)
Lecher-waves type. u.s.w. (Dielectric constant measurement)	702	Yokogawa Denki	Measurement wave: lengths 1.5, 2.0 & 2.5m tan: $1x10^{-4}$ to $100x10^{-4}$ Accuracy: 10%	Suited to measuring impedances symmetrical to ground	Chiefly for measuring loss angle of high freq. insulations. Also used in study of u.s.w. impedances of high resistors small condensers, etc.	Measurement by line-length variation a.c. source (100 volts)
Short-wave dielectirc loss measuring set	703	Kawanishi Kikai	Freq: 3 to 100mc tan: $1x10^{-4}$ to $200x10^{-4}$ Accuracy: 10%	Suited to measuring insulations at high temperatures (max. 200°C) Heterodyne detection & amplifying circuit used for measuring voltages (of resonance course)	Test & research on high-freq. insulating materials	Reactance (capacities) variation method Battery source (6 volts & 200 volts)

ENCLOSURE (A), continued

OSCILLOGRAPH

TYPE	TYPE NO.	MANUFACTURER	SPECIFICATIONS	FEATURES	USE	COMMENTS
Low-freq. cathode-ray oscillograph	901	Matsushita Musen	Cathode ray screen dia. 75mm. Self-contained amplifier. Freq: 50 to 10,000 cyc/sec.	Small light	Direct observation of frequency characteristics of r.f. & i.f. amplifiers. Observation of impulse signals. Also test & research	a.c. source (100 volts)

RECEIVER

TABLE	TYPE NO.	MANUFACTURER	SPECIFICATIONS	FEATURES	USE	COMMENTS
Long, med., & short waves	1201	Oki Electric	50kc to 20mc Auxiliary equipment for 50 to 100 decibel calibrations with standard signal generator	Suited to measurement of very small signals voltages. Stationary type. Contains i.f. attenuator	Test & research work requiring a long, med., or short wave receiver, such as the calibration of signal generators	Corresponds to receiver portion of 301 field-strength measuring set. Battery source (6 volts & 200 volts)
Med. to short waves ("All-wave" set)	1202	Mita Musen	550kc to 22mc Heterodyne reception possible. Output about 1 watt	Table set. Changeable coils. Easy to operate	Simple measurements of signal strength, amplification, & detection	a.c. or d.c. source
u.s.w.	1203	Oki Electric	20 to 300mc	Suited to measurement of very small signal voltages. Stationary type. Contains i.f. attenuator	Test & study with u.s.w. measuring receivers; such as calibration of signal generators	d.c. source (6 volts & 200 volts)

TUBE CHECKERS

TYPE	TYPE NO.	MANUFACTURER	SPECIFICATIONS	FEATURES	USE	COMMENTS
Simple type	1001 (In use)	Fuji Sokuteiki	Simple tests of ordinary receiver tubes, acorn tubes, metal tubes, RF2, RF3, & RF4	Small, simple Rapid checking of small tubes	Maintenance & tests of various receiver tubes	a.c. source (100 or 200 volts)
Simple type (Single purpose)	1002 (In use)	Fuji Sokuteiki	Check of acorn tubes and 8-pronged receiver tubes	Same as above	Chiefly for maintenance of special equipment	d.c. source
Operating tester for acorn tubes	1051		Simple operation test of acorn-type UN-954 tubes	Gives simple indication of performance of the UN-954 at u.s.w.	Same as above	d.c. source

ENCLOSURE (A), continued

AUXILIARY

TYPE	TYPE NO.	MANUFACTURER	SPECIFICATIONS	FEATURES	USE	COMMENTS
Dielectric loss measur-	1571	Yokogawa Denki	Tan: 2×10^{-3} to 50×10^{-3}	For use on 701 Q meter meter; tan can be easily measured with this	Measurements of loss angle of insulator by Q meters	
Box for testers	1601			Common to all testers listed	For use to carry various types of testers	

ENCLOSURE (B)

LIST OF DOCUMENTS FORWARDED TO WASHINGTON DOCUMENT CENTER THROUGH ATIS

NavTechJap No.	Title	Atis No.
ND21-6009	Centimeter wave absorption type wave meter.	3515
ND21-6040	Test Results: Improved version of the temporarily designated Type 97 Precision Wave Meter.	3516
ND21-6050	Research report on improving the Type 92 Short-Wave Meter.	3517
ND21-6051	Test Results: Temporarily designated Zero Type Ultra, High Frequency Wave Meter.	3518
ND21-6123	Centimeter wave absorption type wave meter.	3520
ND21-6240	Absolute measurement of underwater sound.	3435

ENCLOSURE (C)

JAPANESE PERSONNEL INTERROGATED AND THEIR CAPABILITIES

Rank	Name	School and Year of Graduation	Specialities
V. Adm. (Tech)	T. NAWA	Tokyo I.U. (E.E.S.), 1917; Studied Chemistry in Tokyo I.U. (S.S.), 1919-1922.	Chief of the Radar and Communication Department
Capt.	B. TAKAHARA	Naval Academy, 1919; Tohoku I.U. (E.E.S.), 1932.	Head of 4th Section (radar intercepter, radio beacons and direction finders)
Capt, & Dr. (Tech)	Y. ITO	Tokyo I.U. (E.E.S.), 1924; Technische Hoch Schule, Dresden, Germany, 1927	Head of 1st and 2nd Sections (fundamental researches)
Capt. (Tech)	Y. YAJIMA	Tohoku I.U. (E.E.S.), 1924	Secretary to T. NAWA, Head of Production Section
Capt.	I. ARISAKA	Naval Academy, 1923; Tohoku I.U. (E.E.S.), 1934	Head of 3rd Section of Communication Dept (radio equipment)
Capt.	K. NAGAI	Naval Academy, 1924	Member of Administration Dept
Lt. Comdr. (Tech)	T. HYODO	Tokyo I.U. (C.E.S.), 1936	Researcher of materials and components for high-frequency use
Lt. Comdr. (Tech)	S. KATSURAI	Tokyo I.U. (E.E.S.), 1936	Researcher of land and airborne radars (Type 51, 61, 63)
Lt. Comdr. (Tech)	S. MORI	Tokyo I.U. (E.E.S.), 1937	Research on shipborne radar (cm wave i.e. 22)
Lt. Comdr. (Tech)	H. TSUJITA	Kyoto I.U. (S.S. Physics), 1936	Research on airborne radar (meter wave, i.e. FY-3, FH-1 FK-4, H-6)
Lt. Comdr. (Tech)	K. KAMIYA	Tohoku I.U. (E.E.S.), 1936	Research on components and tubes for high frequency
Lt. Comdr. (Tech)	O. OKAMURA	Tokyo I.U. (E.E.S.), 1940	Research on tubes for cm wave
Lt. Comdr.	S. MATSUI	Naval Academy, 1934; Osaka I.U. (S.S. Physics), 1942	Head of research in Yokosuka Branch (research on installation of shipborne and landbased radio and radar)

ENCLOSURE (C), continued

Lt. Comdr. (Tech)	W. SUGIYAMA	Waseda University (E.E.S.), 1940	Research on high cable in Yokosuka Pr.
Lt. (Tech)	K. OGATA	Tohoku I.U. (E.E.S.), 1941	Research on landbased radar (cm wave) (i.e. 61)
Lt. (Tech)	S. KAWAZU	Tokyo I.U. (E.E.S.), 1941	Research on landbased radar (meter wave i.e. 14, 62)
Lt. (Tech)	S. YAMANE	Kyoto I.U. (E.E.S.), 1942	Research on airborne radar, counter measures
Lt.	K. MORI	Naval Academy, 1940	Teacher in Radar Training School
Dr.	K. TAKAYANAGI	Kuramae Tech. College, 1921	Consultant to T. NAWA Head of 3rd Section (Radar)
Eng.	H. SHINKAWA	Waseda University, 1933 (E.E.S.)	Research on radars (meter wave i.e. 1-2 L-3, S-3, S-24, N-6, M-13)
Eng.	N. HACHIYAMA	Tokyo I.U. (S.S. Physics), 1933	Research on high freq. circuits for cm wave
Eng.	S. SUZUKI	Tokyo Physical School, 1929	Research on airborne (meter wave N-6) radar
Eng.	K. UEMINAMI	Washington,University, U.S.A. 1934	Research on airborne radar intercepter and shipborne direction finder
Mr.	R. KIMURA	Waseda University, 1930	Consultant to H. TAKAHARA (research on radio freq. instruments in Electro-Technical Laboratory of Japanese Government)
Mr.	S. NISHIYAMA	Uta University, 1932	Interpreter (no relation to second Naval Technical Institute at the end of the war; belonged to Electro-Technical Laboratory of Japanese Government)

Note:

I.U.----Imperial University
E.E.S.--Electric Engineering Section
C.E.S.--Chemical Engineering Section
S.S.----Science Section