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National Research Council of Canada. Radio and Electrical Engineering Division

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NATIONAL RESEARCH COUNCIL OF CANADA  
RADIO AND ELECTRICAL ENGINEERING DIVISION

CLASSIFIED PROGRESS REPORT NO. 8  
(JANUARY - MARCH 1957)

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ORIGINAL SOURCE BY  
ORIGINAL SOURCE PER  
Authority: S. A. MAYMAN  
Date: NOV 26 1992

OTTAWA  
APRIL 1957 NRC # 35406

## FOREWORD

This Classified Progress Report is intended to present a convenient quarterly summary of some of the classified aspects of the research and development program of this Division, for the information of the Services in Canada, the United Kingdom, and the United States, and of laboratories and other organizations in these countries which are engaged in work similar to ours and which have been supplying us with reciprocal information. Unclassified material, whether or not it is of Service interest, appears in our open publications and will not be covered here. The format of this report is such that the account of each project may be separated from the whole without loss of security grading. It is thought that this feature may be appreciated by some agencies, such as the Project Coordinating Centre of the Department of National Defence, where they may prefer to file the individual sheets according to their own systems. It also permits us to issue the separate sheets to persons who may have an interest in certain selected projects but who do not require the remainder of the report.

A list of classified reports issued by the Division each quarter is included. There is no automatic distribution for these reports — the circulation list for each is determined by the nature and interest of the work described. Requests for copies of these reports, to be directed to the Document Control Office of this Division, will be given every consideration, subject to security regulations. Recipients of these documents should note that Canadian approval is required for release to other persons, organizations, or governments of any classified information (including this Classified Progress Report) which may be issued by this Division.

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CONFIDENTIAL

COUNTER MORTAR RADAR (AN/MPQ-501)

Reference: Army. DND Project B22-38-50-01

Period under review: January-March 1957

PURPOSE OF EQUIPMENT

The primary role of this radar is the detection and location of mortars to ranges of at least 7000 meters. A parabolic extrapolation through two points located on the bomb trajectory is made by means of a computer. The mortar location is given as a map grid reference and contour. Range and bearing to the mortar are indicated also. Secondary roles include location of airburst, fall of shot, vehicles, and personnel.

GENERAL DESCRIPTION

The radar is designed for mounting on an AFV 603 armored personnel carrier in order to achieve a high degree of mobility, reliability, and protection for operators and equipment. The antenna, transmitter, and generator assemblies are mounted outside, while the display and control equipment are inside the body of the vehicle. No cabling or external stabilization of the vehicle is necessary on site; consequently the equipment may go into, or out of action with minimum delay and manpower.

While the equipment is designed specifically for the AFV 603 vehicle, the construction would make other mountings feasible, as was demonstrated during engineering trials when a modified 2½-ton truck chassis was used.

STATUS

During 1953 and 1954 field trials were held, following which a contract for a prototype was let. NRC personnel have been actively associated with the engineers engaged in the production design. In addition, development on several items has been continued at NRC. During the period under review liaison was continued with the manufacturer and design authority. The scanner was completed and checking commenced. The reflector, air-conditioner and rack were completed. The electronic units were under systems test by the end of the period. The computer units were brought near to completion. The vehicle was insulated and mounting arrangements for the units were partially installed.

GENERAL

An American report dealing with the AN/MPQ-4 from a human engineering

standpoint was studied in detail. The recommendations made have in almost all instances been anticipated in the design of the AN/MPQ-501. A paper analyzing the report, as it applies to the AN/MPQ-501, is being prepared.

### Transmitter

This unit is now undergoing performance trials. Difficulties were encountered at maximum ambient temperatures and it has been necessary to re-locate the pulse line on the outer periphery rather than among the tubes. Some baffles are being added to improve cooling air circulation within the case.

### Receiver

The logarithmic i-f amplifier was completed at NRC. Several modifications of the original design, which utilized germanium diodes as successive detectors, were necessary. The germanium diodes were replaced with thermionic diodes, to eliminate severe changes in resonant frequency and damping of the tuned circuits which occurred as the ambient temperature was raised. It was found necessary to include video amplifiers between each of the diode detectors and the summing delay line, to prevent back-biasing of the lower level detectors by the signal already on the delay line. The effect of the back-biasing was to reduce the dynamic range of the amplifier greatly. The video amplifier and diode detector were combined in one envelope with type-6AM8 diode-pentode tubes.

Large bypass capacitors normally not used in i-f amplifiers, were added to the cathode and screen circuits of the type-6688 tubes in order to reduce distortion of long-duration high-level pulses.

The characteristics of the completed amplifier are: bandwidth, 8.0 mc/s; gain approximately 70 db; dynamic range 68 db above the input level which produces 1 volt output; and logarithmic range approximately 65 db.

### Computer

Tests on the Angle of Sight Servo which were required as a result of the modification from a two-channel to a single-channel synchro system have borne out the desirability of the original NRC design. Bench tests have succeeded in attaining the required accuracy of  $\pm 0.5$  mil, but very little margin of safety is now available. The CAL design will be carefully reconsidered before production of the equipment is begun.

Some additional assistance in design of the Q-bridge (the correction for parabolic extrapolation) has been provided to CAL.

#### Range Oscillator and Goniometers

Two goniometers were received from Canadian Arsenals Limited, Toronto. It was found that the residual error would be too large if the circuit and transformers supplied by CAL were used.

A new air core transformer was designed and built, and using a modification of the CAL circuit, a satisfactory error curve was obtained. The errors for the two goniometers were  $\pm 0.35^\circ$  and  $\pm 0.30^\circ$  with an input of 1.25 volts rms. These errors are equivalent to approximately two meters.

#### Antenna Tests

In preparation for the forthcoming antenna pattern tests, a 100' tower was purchased some months ago. An adjustable mount for a 4' disk and an anti-twist frame have been designed for attachment at the top of the tower.

#### Polarizer

Electrical tests on a "plane" polystyrene model have shown that reasonable circular polarization can be obtained by this method. Whether satisfactory performance results during precipitation, remains to be shown in field trials. Work is progressing on the design of a "helical" model suitable for attachment to the horn of the Foster scanner. The problem is not simple and some time may elapse before a satisfactory unit is produced.



ACQUISITION RADAR MODIFICATIONS (AN/MPS-501B)

Reference: Army. No DND project number.

Period under review: January-March 1957

R.F. SWITCH FOR AZIMUTH SECTOR GATED OPERATION

A broad-band high-power switch is being designed for use with S-band radars to permit greater flexibility in the use of the radar under jamming conditions.

The switch will have a low VSWR during the switching cycle and will handle peak powers in excess of 500 kw. In design it is similar to the X-band switch which is covered separately in this report. Electrical tests of the experimental switch were satisfactory but several mechanical problems must be overcome before a practical design will be realized.

## FIELD MODIFICATIONS OF RCAF GROUND RADARS

Reference: RCAF. DND Project D48-38-03-27

Period under review: January-March 1957

### AN/CPS-6B EW Receiver

A logarithmic receiver has been designed and constructed for use with the EW kit as a means of combating spot and slow-sweep jammers. The receiver has a small-signal bandwidth of 1.8 mc/s and a gain of 90 db. The response is logarithmic for 60 db above noise level, and the receiver does not saturate for at least 80 db above noise level.

One laboratory test indicated that its use can be advantageous in the presence of c-w jamming where the ratio of input c-w power to input pulse power required to maintain a constant output pulse amplitude was greater than unity for a range exceeding 60 db above noise level. The receiver was tried in an operating radar, the AN/TPS-1D, with c-w jamming. Results were as anticipated, black strobes were produced in the jammed sectors. Echoes equal to, or slightly less than the jamming level appeared on the PPI in these sectors. Recovery time was sufficiently fast that no loss of radar coverage was noted in regions outside the black strobes.

The receiver has been loaned to the RCAF for full scale operational trials against jamming aircraft.

### AN/FPS-3(C)

Two units have been loaned to the RCAF for use with this radar in operational trials with jamming aircraft.

The first is an azimuth-gated-gain unit which allows the gain reduction of either, or both the lower and upper beam normal receivers in any one sector. The width of the sector can be varied from 0° to 120°. Reduction of receiver gain will prevent saturation of receivers by jamming signals, and hence may allow detection of strong targets lying along the jamming strobe.

The second is a PRF jitter unit. This unit allows the PRF of the radar to be varied from 200 to 800 pulses per second. The jitter at any given PRF is approximately 6% of the average inter-pulse period. Its use is against repeater jammers which attempt to simulate a target whose range is less than that of the true target.

FLIGHT PLAN CORRELATION EQUIPMENT

Reference: RCAF. DND Project C98-39-30-02

Period under review: January-March 1957

The purpose of this equipment is to provide a means of displaying flight plan information along with radar information on the Charactron tube, thus enabling the radar operator to identify aircraft for which flight plans are available. During the period under review construction of the individual chassis and racks for the experimental model was completed.

AREA MOVING TARGET IDENTIFICATION

Reference: Army, RCAF. DND Project B22-38-20-23

Period under review: January-March 1957

This unit is a simple addition to a radar system to enable some discrimination to be made against moving targets. The unit consists of a Radechon (single electron gun) storage tube which is scanned in range and azimuth, exactly as in a normal type-B display, the beam intensity being modulated with video radar signals. When equilibrium is established — i.e., when the storage plate has received a charge pattern which represents the impressed video display — the system will, in principle, give no output. Should a new target appear, however, or if any pulse should change position, the charge pattern will change and an output will appear, corresponding to the alteration in the original picture.

Some work was done on this project with a view to fitting such a unit to the AN/MPS-501B Radar; since an independent project was started by Canadian Arsenals Limited and Radio Corporation of America with the same ultimate object, it was decided to conserve limited engineering time and suspend work on the system. Accordingly, no further work has been done. Added weight was attached to the validity of this decision by the abandonment of the whole project by U.S. authorities.

REMOTE RADAR DISPLAY

Reference: Army, RCAF. No DND project number.

Period under review: January-March 1957

A demonstration of the system for transmission of full-bandwidth radar information was given to personnel of the three services and DRB. Motorola portable microwave television relay equipment was obtained to serve as the r-f link between the Metcalfe Road Field Station and Building M-50, a distance of 6 miles.

In order that existing display consoles could be readily operated from the system, a servo amplifier was built to drive a 60-cycle synchro. A USAF type UPA-35 display was successfully operated with this additional equipment.

LOW ANGLE DETECTION

Reference: Army, RCAF. No DND project number

Period under review: January-March 1957

The detector circuit mentioned in the previous report is functioning and appears to be an improvement. Arrangements are being made for a quantitative comparison with a standard detector circuit.

SOUND-RANGING COMPUTER

Reference: Army. No DND project number

Period under review: January-March 1957

There was nothing to report on this project during the period under review.

RADAR INTERFERENCE EFFECTS IN MICROWAVE RADIO RELAY

Reference: RGAF. No DND project number.

Period under review: January-March 1957

There was nothing to report on this project during the period under review.



INSTANTANEOUS MICROWAVE DIRECTION FINDER (AN/UPD-501)

Reference: Navy, RCAF. DND Project A12-44-10-03

Period under review: January-March 1957

The purpose of this equipment is to detect a pulsed radar transmission instantaneously and to indicate the bearing in an unambiguous manner. It consists of a four-channel crystal video receiver with the signal displayed on a cathode-ray tube as a radial line. The angle of the line with respect to a reference represents the bearing of the signal.

Most of the work done during the period under review was on development of antennas for the UPD-501.

The antenna operating in the band 480-620 mc/s consists of eight folded dipoles arranged symmetrically around a 10-inch-diameter cylinder. To receive either vertical or horizontal polarization each dipole is mounted at 45° to the vertical. For signals of horizontal polarization the back radiation of the dipoles is too great, causing bearing errors of more than 15°. Further development is required on this antenna to obtain satisfactory performance.

A newly designed split-cylinder antenna incorporating the quick-disconnect type of mounting was fabricated by Cossor Ltd., and has been successfully test flown. The latest design is lighter and more compact than earlier models, and so is more satisfactory for mounting on aircraft wing tips.

An analog device was built to study UPD-501 bearing errors caused by various antenna patterns of four and eight elements. It consists of a pulsed light source received by eight photomultiplier tubes which are in turn connected to the four inputs of the UPD-501 receiver, through a resolving network. The amount of light received by the phototubes is made proportional to the antenna pattern, thus producing a bearing indication. It has been found that the error in the simulator is less than 2° and therefore the results are useful in assessing antenna patterns and other properties of the system. This approach avoids the labor of detailed mathematical analysis and the considerable cost of experimental work on multi-antenna systems. A report is being prepared.

A study was made of the various antenna configurations to determine the most suitable size and shape of cylinders for ships and for aircraft. The more

important considerations were: the use of four or eight elements, the number of frequency bands, dual or single polarization, and gain, balanced against size and weight.

A method of measuring the sensitivity of the antennas has been developed and tested in the laboratory. It consists of feeding the r-f energy into each horn in turn, from a small horn. This transmitting horn is made as reflectionless as possible by surrounding it with absorbing material. Using the test box, the channel gains can be adjusted to balance the system at any desired frequency in the band of the antenna being checked.

An anechoic room was fabricated and equipped with an automatic bearing error plotter and pattern recorder. This produces a continuous indication of bearing errors as the receiving antenna is rotated in azimuth. The system has obvious advantages over the point-by-point plotting method. The room appears to be satisfactory for bearing errors and antenna pattern measurements in the S, X, and  $K_u$  bands.

A stripline low-pass filter was designed and built which rejects signals from X-band down to 700 mc/s.

The eight-element antenna system has been investigated further.

Several configurations of resistive resolving networks for converting from eight to four channels were built and tested.

SHIPBORNE HIGH-FREQUENCY DIRECTION FINDER

Reference: Navy. DND Project A12-38-20-19

Period under review: January-March 1957

This equipment when made, will be required to intercept and provide unambiguous bearings of ground-wave short signals occurring on frequencies anywhere within a wide bandwidth at random time intervals.

The external test signal source was calibrated in terms of field strength at the aerial outfit S25B and the results used to calibrate the three-channel receiver.

A short-duration test signal source was built which gives a signal whose duration is variable between 25 and 150 milliseconds. A switching unit switches this signal on three times a minute at irregular intervals. The test signal is injected into the three-channel receiver through a goniometer search coil rotating at 4 rpm. This arrangement has been calibrated in terms of the field strength required at the aerial to give the same input to the receiver. A counter is operated each time a test signal is injected.

Intercept trials were started using the short-signal equipment described to determine the visibility of signals in the presence of interfering signals. A large number of tests, including nighttime measurements of maximum interference levels, are necessary before the results can be regarded as informative.

A "Memotron" direct-display storage tube was purchased to assess its value as a short-signal storage device. A power supply and mounting chassis have been built for this tube.

MAGNETIC SIGNATURES OF ALUMINUM MINESWEEPERS

Reference: Navy. DND Projects A20-05-60-02 and A12-05-60-04

Period under review: January-March 1957

Investigation of the first type of aluminum minesweeper made in Canada showed that these ships had an excessive magnetic field due to eddy currents. The currents were generated in electrically conducting loops in the aluminum framework structure as the ship rolled and pitched in the earth's magnetic field. In order to decrease this magnetic field a new design of ship was made in which most eddy current paths were eliminated.

It was decided to test the new design at two stages of construction. First tests were to be made on the hull structure only, but with most large aluminum fittings, such as fuel tanks, superstructure, etc., in place. Later tests were to be conducted when the ship was completely fitted. In this case, the ferromagnetic materials in the ship could be expected to contribute to the dynamic field.

Rolling trials on the hull structure of HMCS "Cowichan" (MCB 162), which is representative of the new design, were carried out at Esquimalt, B.C., on March 2 and 3, 1957. These showed that the eddy-current field due to rolling has been reduced to about  $2\frac{1}{2}\%$  of that of the older design of ship. The remaining field was due chiefly to the aluminum fuel tanks. If necessary, it could be still further reduced by altering the construction of these tanks.

Because of the low levels of magnetic field in the new design it is necessary to increase the sensitivity of the magnetic field instrumentation. This work is now being done in preparation for tests on the fully fitted ship.

During the period under review, some assistance was given the RCN in specifying a suitable type of commercially-made magnetometer for use in permanent magnetic field ranges.

FIELD CONTOURS OF MAGNETIC SWEEP

Reference: Navy. DND Project A17-05-60-05

Period under review: January-March 1957

The objective of this project was to produce maps of each of three components of the magnetic field of two RCN minesweeping loops.

The field of the ML Mk. 4 Mod.2 Sweep was measured and plotted for depths of  $6\frac{1}{4}$ , 10, 20, and 30 fathoms and a pulsing current of 2500 amperes. The field of the ML Diverted Sweep was also measured and plotted for the single depth of 10 fathoms under the same conditions.

A report on this project is now being prepared.

INVESTIGATION OF STRAY VOLTAGES IN THE CF-100 AIRCRAFT

Reference: RCAF. No DND project number

Period under review: January-March 1957

Present equipment used to test the wing-rocket firing circuits of the CF-100 aircraft, to determine whether it is safe to make an electrical connection to the rocket ignitors, has indicated that stray or induced voltages are sometimes present in one or more of the circuits. The Radio and Electrical Engineering Division was asked to determine whether these voltages were capable of firing a 2.75-inch rocket, and if any voltages generated by atmospheric conditions when the aircraft was airborne could be dangerous.

The first part of this problem was resolved into one of instrumentation. It was found that the resistance of the meter indicator in the test instrument (Aircraft Rocket Circuit and Stray Voltage Tester, RCAF Stores ref. 11C75) was so high that the meter indicated voltages above the safe limit which were not capable of supplying sufficient current to fire a rocket. Also, the meter scale gave a poor indication of the actual safe limit voltage. It was therefore recommended that a more suitable meter, i.e., one whose resistance was comparable with that of the igniting squib, be incorporated in the test equipment for the stray voltage test.

Consideration of the remainder of the problem indicated that it would involve a flight test program of considerable magnitude, and a decision to proceed with it has not yet been made.

CRASH POSITION INDICATOR

Reference: RCAF. No DND project number.

Period under review: January-March 1957

In the period under review further experimental work as well as field tests were continued.

Experimental work included a number of modifications in the physical design of the components for greatest possible reduction in weight, as well as minor changes in the circuitry in order that operation of the CPI unit will be little influenced by variations in the characteristics of circuit elements.

A number of range tests revealed reception varying from 4 to 70 miles, depending on propagation conditions, type of terrain, and altitude of the searching aircraft.

A paper entitled "Filament Pulsing as a Means of Reducing Power Supply Consumption of a Vacuum Tube", has been prepared for publication.

EXPERIMENTAL ANTENNA FOR S-BAND SURVEILLANCE RADAR

Reference: RCAF. No DND project number.

Period under review: January-March 1957

This antenna is a semi-parabolic cylinder, having an aperture of  $36' \times 6'$ , and is fed by a single slotted-waveguide radiator. The reflector surface can be deformed to provide either a cosecant-squared pattern or a pencil beam. The horizontal beam width is approximately 0.7 degrees.

Tests of this antenna are now essentially complete, but the antenna and the associated AN/MPS-501B Radar are being kept in a state of readiness for trials with airborne jamming equipment. Observations of solar noise from the sun's disc at sunset have been used to confirm the position of the pencil beam in the vertical plane.



MODEL ANTENNA STUDIES FOR HMCS "BONAVENTURE"

Reference: Navy. DND Project A12-55-40-16

Period under review: January-March 1957

Because the HF antenna pattern range was employed for another program, no measurements were carried out on antennas for HMCS "Bonaventure" during the period under review.

MODEL ANTENNA STUDIES FOR HMCS "LABRADOR"

Reference: Navy. DND Project A12-55-40-16

Period under review: January-March 1957

VHF/UHF antenna model studies on HMCS "Labrador" have been essentially completed. A preliminary report and a complete set of measured radiation patterns have been forwarded to Naval Technical Services, NDHQ, Ottawa.

The following conclusions and recommendations were submitted:

i) AT-150/SRC Antenna A great improvement in the circularity of the AT-150/SRC antenna patterns can be achieved by relocating the T-spar on the pole mast. It is recommended that the three antennas be located above the AN/SPS-10 Radar in order to minimize shadowing effects due to the reflector. Further improvement can be effected by replacing the metal pole mast with one of dielectric.

ii) 3BA/15 and AP-56130 Antennas A solution to the problem of determining the best location for these two VHF antennas is not straightforward. One possible location for each antenna was suggested. It is felt that since two requirements (electrical and structural) must be met, further investigations should not be made until the present results have been analysed and evaluated by Naval Technical Services.

X-BAND WAVEGUIDE SWITCH FOR THE ROYAL CANADIAN NAVY

Reference: Navy. DND Project A12-55-10-02

Period under review: January-March 1957

The purpose of this project is to develop fast-acting waveguide switches to allow switching of the full magnetron power of X-band radars from the antenna to a dissipative load.

During the period under review construction of an experimental model of the switch using RG-51/U waveguide was completed. This switch was fitted with a vane moving in the H-plane of the waveguides, rather than in the E-plane, as in a former model of the switch. VSWR was measured at the transmitter terminal of the switch. Although no rapid changes in VSWR occur, there is a steady variation as the vane is moved through the waveguides, a maximum value of approximately 1.22 occurring with the vane completely closed. Much of the observed reflection appears to be due to the pairs of 90-degree twists in this model. The switch layout is being studied with a view to eliminating these twists while retaining the vane motion in the H-plane of the waveguide.

### CARCINOTRON STUDIES

Reference: DRB. DND Project D48-44-20-01

Period under review: January-March 1957

The aim of the project is to study the use of carcinotrons and other devices for jamming, and to develop experimental jamming equipments.

Investigation of the effects of frequency-modulation-by-noise jamming of radar receivers was continued. The work on conventional radar receivers was concluded, and a report [1] will be issued shortly. The study of the requirements for jamming radars equipped with wideband-input plus limiter ("Dicke fix") type receivers is nearing completion, and preparation of a report will be undertaken. Topics to be discussed will include receiver design considerations, effect of single and multiple jammers, effect of varying the video noise bandwidth and the position of the receiver frequency in the jamming spectrum, and the possibility of reducing the usefulness of the receiver by using spot jamming in addition to FM-by-noise barrage jamming.

A report was written which outlines the method of using combined frequency modulation by sine wave and random amplitude modulation by superregeneration. By this means, barrage jamming similar in effectiveness to FM-by-noise jamming may be obtained, but at a considerable saving in modulator power requirements.

Anti-jamming measures were tested, and the use of r-f preselection ahead of a Dicke fix type receiver was investigated. A short series of jamming tests was made on the prototype Dicke fix receiver for the AN/FPS-6 constructed by Canadian Arsenals Limited. Very creditable performance was obtained.

Tests of the possibility of detecting a target carrying a jammer by switching off the local oscillator of the radar can be continued now that the low-noise travelling-wave amplifier tube has been received and the associated power supplies have been constructed. Negotiations have been initiated with the RCN for loan of an AN/SPG-48 fire control radar, for the purpose of becoming more familiar with the vulnerability of such systems to jamming.

1. Pulfer, J.K. and Shepertycki, T.H.,  
"Discernibility of Radar Signals in the Presence of FM Barrage Jamming".  
NRC Report ERB-420

ANTI-JAMMING MEASURES AGAINST CARCINOTRONS

Reference: Army. DND Project B22-38-20-23

Period under review: January-March 1957

DICKE-FIX RECEIVERS

Relative performance of two competing receivers under wide-band noise-modulated-FM conditions was measured. It was established that a 12-stage all-synchronous amplifier is almost indistinguishable in anti-jamming characteristics from a 12-stage amplifier made up of four flat-staggered triples, utilizing the same tubes, with the same overall gain. This would indicate that the half-power bandwidth is of secondary importance, and leads to the tentative rough statement that performance depends primarily on maximizing the product (Number of stages  $\times$  Gain Bandwidth product per stage).

The clipper stage was further improved and is now very satisfactory: a high performance pentode (Phillips type-E180F) is used with plate and screen fed from a well regulated 30-volt supply (a d-c coupled cathode follower with output impedance of about 100 ohms).

Experiments with a surface barrier transistor (Philco type-2N128) have shown some promise of good clipping at 0.5 volt to 1 volt peak, and this subject is being pursued, but has not yet been tested operationally.

The first production receiver for the AN/MPS-501B Radar was received from Canadian Arsenals Limited, and is ready for operational trials.

ANTENNA FOR X-7769 CARCINOTRON JAMMER

Reference: DRB. DND Project D-48-44-20-01

Period under review: January-March 1957

The optimum dimensions of the circular dielectric-slab antenna were determined and an S-band model was constructed. Impedance measurements on the antenna indicate that a final standing-wave ratio of the order of 1.4 will be attained across the band 2500-3500 mc/s. Construction of a matching unit is in progress.

Consideration is being given to the possibility of using the "scimitar" antenna on the jammer. The main advantage of the scimitar appears to be its extremely wide impedance and pattern bandwidth (up to 10 : 1). Its disadvantage is comparatively low gain and a large cross-polarized component.

VULNERABILITY OF DOPPLER DETECTION SYSTEM TO COUNTERMEASURES

Reference: DRB. DND Project D48-44-01-01

Period under review: January-March 1957

The purpose of this project is to study the Doppler Detection System with a view to determining what countermeasures might be used against it, how effective they might be, and what might be done to counter them.

No work directly connected with the Doppler Detection System was done in the period under review but investigation of superregenerative devices was continued.

Experimental work on superregenerative jamming with backward-wave oscillators was completed and a report prepared.

Some experimental work on the application of backward-wave oscillators to countermeasures receiving problems at X-band was done.

Preparations for experimental work with a Varian backward-wave amplifier and Huggins cascade backward-wave amplifier are almost complete. Both tubes are expected soon.

GROUND-TO-AIR COMMUNICATIONS USING IFF

Reference: RCAF. DND Project C37-28-01-05

Period under review: January-March 1957

Work was confined to the ground equipment for the forthcoming operational trials of the system. An IFF antenna was mounted on the pedestal from an ISG-98 radar, and a rotating coupler was designed and built. The servo control was wired roughly, and, since operation appears to be satisfactory, the system is now being wired properly.



PRESENTED PAPER

The following paper was presented:

Brown, W.C.                      Radar Anti-jamming Developments at the National Research Council. Paper presented at Air Defence Command, St. Hubert, Que., October 24, 1956

CLASSIFIED REPORTS ISSUED

The following classified reports were issued by the Radio and Electrical Engineering Division during the period under review:

Cairns, F.V.                      An 8-Antenna 4-Channel Microwave Direction Finder (ERB-419, Secret)

An experimental investigation of the performance of an eight-antenna system for the four-channel instantaneous microwave direction-finder (AN/UPD-501) was undertaken. Results for a number of frequency bands are given.

Hudson, A.C.                      Visit to Radar Research Establishment (August 24, 1956) Concerning Circular Polarization on Radar Type-80 (ERB-409, Secret)

The Radar Research Establishment at Malvern is currently modifying a Type-80 Radar to permit the use of circular polarization in order to reject rain clutter. Details of this project were obtained on a visit to RRE on August 24, 1956, and are described in this report.

Kusters, N.L.,  
Morris, R.M.,  
and  
Pedersen, B.O.                      Investigation of the Stray Field of a Minesweeping Impulse Generator (ERA-310, Secret)

The stray fields of two impulse generators of the same design with impulse ratings of 540 kilowatts,

Possible methods of reducing the stray fields are discussed.

McCormick, G.C. Georgia Tech - SCEL Symposium on Scanning Antennas  
(ERB-415, Confidential)