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NATIONAL RESEARCH COUNCIL OF CANADA
RADIO AND ELECTRICAL ENGINEERING DIVISION

CLASSIFIED PROGRESS REPORT NO. 4
(JANUARY - MARCH 1956)

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Date: NOV 26 1992

OTTAWA

APRIL 1956 NRC # 35396

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, 1956

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 continued at NRC. This is reported below.

Goniometers

Two goniometers were completed by NRC and put into operation in the production prototype. These have made it possible to operate the Electronic Control and Display portions of the system.

Electronic Control and Display

Some minor problems remain in these units, but on the whole the production type units are performing satisfactorily. Co-operation between NRC and the contractor continues.

Computer

An assembly drawing of the azimuth unit was completed at NRC to CAL requirements. The centering device used in the NRC model was modified so that instead of returning the azimuth marker to center, the antenna is simply turned through a pre-set angle when this facility is required. This simplifies the operating procedure.

An assembly drawing of an NRC-proposed system for registering Difference Easting and Northing is now being made. This device simplifies the correction of counter-battery fire, as it eliminates mental computation.

An investigation of the quadrature voltages generated in helically-wound multi-turn potentiometers was made and it was shown that the potentiometer values proposed by CAL for the coordinate conversion system would not be satisfactory. These have been revised.

Video Amplifier

The latest amplifier design, which has lower rise time and higher gain, performs satisfactorily. It uses high-performance tubes which have recently become available, and thus requires fewer tubes than the NRC design. All electrolytic capacitors have been replaced by vacuum-tube regulated power supplies.

Noise Factor Measurements

Several modifications were made to a receiver preamplifier in order to reduce the IF noise factor. These modifications include re-arrangement of the filament decoupling circuit, and replacement of the cascode stage neutralizing coil, which was self-resonant near the IF frequency. With a 6.0 Mc/s bandwidth, an IF noise factor of 2.0 db was measured when a type-6AK5 input tube was used. When the type-6AK5 was replaced by a type-6688 tube, the noise factor was reduced to 1.8 db.

The average overall noise factor of a 6-Mc/s bandwidth receiver, using type-1N78A crystals and the improved IF preamplifier is 11.3 db.

Antenna

Various problems in connection with manual operation of the electric actuators,

and with raising and lowering the reflector were discussed at considerable length and satisfactory solutions were found.

The necessity for having a brake in the turntable itself was impressed on the designers and this has now been incorporated into the drawings.

ACQUISITION RADAR MODIFICATIONS (AN/MPS-501B)

Reference: Army. DND Project.....

Period under review: January-March, 1956

ANTENNA

A request was received from the Canadian Army to redesign the slotted-waveguide feed for the antenna of the AN/MPS-501B radar, in a manner similar to the redesign carried out on the antenna for the AN/MPS-502 radar (cf. Classified Progress Report, April-June 1955, ERA-289 — SECRET).

Since the antenna on the 501 radar is of the same type as that on the 502, it will, likewise, radiate second-order beams. These beams have given little or no trouble in the field so far, but it is felt that they should be removed in view of the radar's susceptance to jamming.

The modification of the feed horn for the AN/MPS-501B radar has been delayed to permit the use of a longer parallel-plate region. It has been found that the longer region is necessary to produce a high degree of suppression of the second-order beam over the complete frequency band. Pattern tests will continue in the near future.

AREA MOVING TARGET IDENTIFICATION

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

Period under review: January-March, 1956

The purpose of this investigation is to determine the performance to be expected from an Area MTI system when added to a radar set such as the AN/MPS-501B.

The RCA prototype Area MTI kit has been delivered to Canadian Arsenals Limited for test, and arrangements have been made for further tests to be made at NRC when the requirements of CAL have been satisfied.

REMOTE RADAR DISPLAY

Reference: Army, RCAF. No project number.

Period under review: January-March, 1956

This system is being developed to provide a compact equipment capable of relaying a PPI picture from a radar site to any convenient location by means of a coaxial cable or a wide-bandwidth radio-frequency communication link. The radar display must be reproduced without appreciable loss of accuracy or quality.

The modified modulator and demodulator units have been completed. Tests of azimuth accuracy were performed using the PPI display. Errors of $\pm 1^\circ$ were obtained with measurements taken every 5° . Further investigation showed that non-linearity in the sweep amplifiers was the main source of error. An attempt will be made to improve amplifier performance.

Considerable time was devoted to modifying a display chassis so that either type-B or PPI presentation may be selected.

LOW-ANGLE DETECTION

Reference: Army, RCAF. No project number.

Period under review: January-March, 1956

A military requirement exists for an acquisition radar designed specifically for good low cover on aircraft targets, and capable of sufficient resolution to permit weapon control radars to acquire the target very rapidly. An experimental radar (LAD) was assembled from available components of the AN/MPQ-501B radars with the aim of gathering sufficient experimental data on the low-cover possibilities of high-resolution radar to enable a complete proposal to be formulated.

Further operating experience is being gained with the radar. Until the present only one-microsecond pulses have been used but preparations are being made for the use of 0.2 and 0.5 microsecond pulses. A new preamplifier will be used with the shorter pulse lengths.

On one occasion, a plane (reported to be a Lancaster) was tracked continuously while practicing instrument landings. The plane made two complete circuits from takeoff at 15 miles range out to 25 miles and back.

Complete flight tests will be conducted soon.

SOUND-RANGING COMPUTER

Reference: Army. No project number.

Period under review: January-March, 1956

From the trial data recently obtained from the Army, it appears that wind and temperature effects cannot be assumed to be constant across the microphone base. That is, the effect of wind and temperature on the velocity of sound between the sound source and the microphone varies with range, and hence the meteorological corrections should be applied over the path from the sound source to each microphone. A suitable method of applying the meteorological correction is being sought.

Mechanical assemblies were constructed for the analog computer. These are motor-driven potentiometers which will be used to evaluate the probable accuracy of such a system.

INSTANTANEOUS MICROWAVE DIRECTION FINDER (AN/UPD-501)

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

Period under review: January-March, 1956

PURPOSE

The purpose of this equipment is to detect a pulsed radar transmission instantaneously and indicate the bearing in an unambiguous manner. It consists of a four-channel crystal video receiver, with signals displayed on a cathode-ray tube as a radial line from which bearings may be read.

ANTENNA DEVELOPMENT

Development of antennas for AN/UPD-501 was continued during the period under review.

A vertically polarized S-band antenna was developed with a maximum error no greater than 15° from 2.3 Kmc to 5.5 Kmc. A satisfactory horizontally polarized L-band antenna was developed covering a frequency band of 1.0 Kmc to 2.3 Kmc. A vertically polarized L-band antenna consisting of a folded dipole on a cylinder is being investigated. This antenna does not project as far from the cylinder as the present dipole with balun.

The technique of fabrication of microwave components in stripline is being improved. Low pass filters for use with the L-band horizontally polarized antenna were built and tested. Some difficulty has been encountered in getting four channels, each consisting of a horn, a filter, a coaxial switch, and a crystal mount, to track throughout the band.

CRYSTAL MOUNT

A coaxial crystal mount was developed with a lower VSWR and 2-db better average sensitivity than the best commercially available unit. This crystal mount operates from 1 Kmc to 5.5 Kmc.

TEST SOURCE

A buzzer signal source was built into a portable unit which can be placed directly against each horn of the antenna, and is undergoing evaluation.

Test buzzers were built into an antenna at 45° to each horn and bearings are being compared with those of a distant signal source.

An S-band klystron test oscillator with coaxial output was built and tested. This unit can also be made a source of X-band energy by utilizing a crystal harmonic generator. By means of suitable attenuators it is hoped that the unit can be used for selecting matched crystals at two or more frequencies.

SHORE-BASED HIGH-FREQUENCY DIRECTION FINDER (AN/GRD-501)

Reference: Navy. DND Project A14-38-10-10

Period under review: January-March, 1956.

This equipment is a narrow bandwidth direction finder which is intended to provide all the facilities required for direction finding on conventional types of communication signals in the HF band. In addition it is intended that it shall provide bearing information on messages of duration as short as 0.1 second.

Most of the effort was directed toward the writing of a performance specification for the complete equipment. A draft has been prepared which includes specifications for all units, with the exception of some parts of the recorder. The performance of the production prototype, which will soon be delivered (less recorder) by the contractor, will be measured according to this specification.

The recorder mechanism, as received from the shops in January, was found to have excessive wow inherent in the gear drive system. A new puck drive system is being fitted.

The first redesigned antenna was received from the contractor and partially assembled on a new concrete base. Performance testing awaits erection of a special hut designed by DND and under construction in the model shops.

Fourteen models of the frequency-meter adapter were received for performance tests. This equipment will be used to provide accurate frequency setting for receivers operating in conjunction with AN/GRD-501.

SHIPBORNE HIGH-FREQUENCY DIRECTION FINDER

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

Period under review: January-March, 1956.

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 experimental, broadband, twin-channel receiver was completed after a considerable period spent in eliminating instability. The receiver tunes across the band 6.5 to 11.5 Mc/s and the I.F. bandwidth is 750 kc/s. Balancing of the channels for phase and gain proved relatively simple, but no measurements were made to assess its capabilities as part of a direction-finding equipment.

In this project instantaneous sense determination is essential and the effects of unwanted signals must be assessed in terms of degradation of sense performance. A third receiver channel is being built for use as a sense channel. A series of experiments with the three-channel receiver is contemplated, which will determine the field strength required for good sense indication under varying interference conditions.

A report discussing the requirements of the Shipborne HF/DF in some detail is available as NRC/REE Document no. 29197.

MAGNETIC SIGNATURES OF ALUMINUM MINESWEEPERS

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

Period under review: January-March, 1956

This project was undertaken to determine the eddy-current magnetic field of ships rolling in the earth's magnetic field and to study methods of compensating for this field. Analysis of field measurements made on the fully fitted, aluminum-framed ship, HMCS "Comox" has been the principal objective of this period.

In order to determine the pure eddy-current field, a method of analysis was developed which separates the measured field into its two components, the field of eddy currents and the field of tilt. The magnitude and phase relationship (with respect to the ship's velocity of roll) of the uncompensated eddy-current field of the ship were determined by this process and have now been plotted and tabulated.

During compensation trials two forms of degaussing systems were tested and several degaussing coil configurations were investigated. The large number of records made during these tests have now been examined and recommendations have been made to the Royal Canadian Navy for a system which appears most suitable. This system reduced the ship's dynamic field to 25% of its uncompensated value by the technique employed during the trials. Recommendations have been made for relatively minor changes which will improve this performance appreciably.

At the conclusion of trials on HMCS "Comox", the angle and velocity recorder was retained on the minesweeper during several patrols at sea. Records of roll angle and velocity, and pitch angle and velocity were made. These records have been examined to determine typical ship motions under operational conditions. Although these have yielded valuable information, more tests of this type made under a wider range of sea and wind conditions, would be valuable. Simultaneous measurements of roll and pitch should be made.

The magnetic field measuring range, constructed for the "Comox" trials, is being modified slightly for use in measurement of the stray field of a diesel-driven, pulsing generator. Assistance will be given the RCN in carrying out the measurements on this machine.

CRASH POSITION INDICATOR

Reference: RCAF. No PCC number.

Period under review: January-March, 1956

For many years researchers have been seeking for a completely satisfactory means of quickly locating crashed aircraft. A partial solution has been found in the recent development of small, light-weight radio transceivers which can be carried in a pocket or sewn inside a tunic. Thus it is possible for any surviving personnel to provide a signal which will guide search aircraft to them and eventually lead to their rescue. However, in the case of a crash where there are no survivors, there is, at present, no means of locating the crashed aircraft other than by visual air search. Such searches are extremely difficult, costly, and often dangerous.

At the request of the Royal Canadian Air Force the National Aeronautical Establishment has undertaken, with the assistance of the Division of Radio and Electrical Engineering and the Defence Research Chemical Laboratory, a study of the problem of fitting modern high-speed aircraft with a device which would survive a crash and provide a signal that could be detected by searching aircraft several miles distant. Such a device must be ejected automatically from the aircraft so as to survive the crash. It must be light in weight, occupy little space, and be capable of withstanding severe shock. Also, it must operate automatically and continuously for periods of several days under all environmental conditions, both on land and water.

As one solution to the problem, a small self-contained radio transmitter in an enclosure of special aerodynamic design is under development. Preliminary designs, based on the aerodynamic considerations involved, have been worked out by the National Aeronautical Establishment. The shape and layout of the transmitter is, to a considerable degree, determined by these designs. Although no definite restrictions have been imposed regarding the transmission frequency, the RCAF have stated a preference for 243 Mc/s, inasmuch as all aircraft will eventually be fitted with communications and d-f equipments operating on this frequency. Furthermore, it has been possible to design an effective antenna for use at this frequency, whose size and physical arrangement is compatible with the proposed mechanical and aeronautical design.

The RCAF requirement states that the device should operate for several days without appreciable loss of output. Maximum density limitations imposed by the aeronautical design limit the total weight of batteries which can be used. This, together with present battery design techniques, determines the number of watt-hours available for operation of the transmitter. Several experimental, self-pulsing transmitters have been built using both heater-cathode and filamentary type tubes. Tests are being carried out using pulsed filaments in an effort to achieve

a saving in heater power requirements. Although these experimental transmitters do not meet the environmental requirements such as shock, they have been valuable in conducting preliminary propagation trials. Before the snow disappeared in March, tests were carried out with an experimental transmitter buried in snow at various depths. These tests were repeated with the receiver at elevation angles between approximately 2 degrees and 20 degrees. Although only limited snow conditions were available at the time of these tests it was shown that the transmitter could be buried under a few feet of dry snow without seriously affecting the radiated signal level.

C-119 AIRCRAFT ANTENNAS

Reference: RCAF. DND Project C37-55-40-09

Period under review: January-March, 1956

Radiation patterns of all the HF, VHF, and UHF antennas on the C-119 aircraft are being investigated to determine whether or not improved antenna performance may be achieved by minor modification of the antenna configuration or location.

Pattern studies have been completed on the following antennas: AW-104B, AT-256/ARC, AT-172, MN-92A, and AT-225/APN. In addition, a supplementary program has been carried out to determine the performance of a proposed ECM antenna installation.

In the period under review, the data obtained have been reduced for inclusion in a final report, and a pattern study was begun on the last remaining antenna — the HF antenna for use with the AN/ARC-21 equipment.

VHF ANTENNA FOR THE CF-100, MARK IV

Reference: RCAF. Avro Aircraft Order No. RL-7793

Period under review: January-March, 1956

An order was accepted from Avro Aircraft to study means of improving air-to-ground communication on the CF-100, Mark IV aircraft. Pattern studies show that excellent coverage can be expected from an external antenna mounted on the underside of the fuselage near the trailing edge of the wings. A prototype antenna for this location has been designed, tested, and successfully test-flown.

In the period under review a final report (ERB-384) on the development was written, and the project is now completed.

ANTENNA PATTERN AND GAIN MEASUREMENTS FOR AN/FPS-503

Reference: DRB, RCAF. No project number.

Period under review: January-March, 1956

A request was received from the Special Contracts Department, Trans-Canada Telephone System, to design and develop an antenna for the RCAF. The antenna is to be used in conjunction with the McGill Fence AN/FPS-503 antenna for the purpose of providing adequate overhead coverage.

The specifications call for a coverage diagram which is approximately semicircular in the azimuthal plane and rectangular in the elevation plane. The antenna is to have a maximum forward gain relative to an isotropic radiator of not less than 8 decibels. It is believed possible to achieve this type of coverage with a modified electromagnetic horn. Metallic posts placed in the mouth are being used in an attempt to control the phase distribution across the aperture of the horn. Pattern measurements are currently underway on the experimental antenna.

MODEL ANTENNA STUDIES FOR HMCS "BONAVENTURE"

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

Period under review: January-March, 1956

During the period under review, work on the project was confined mainly to the construction of the 1/48-scale model of the "Bonaventure".

Two technical reports were prepared describing the VHF/UHF antenna pattern measurements for HMCS "Bonaventure" and HMCS "St. Laurent" (DE-205). They will be issued as Reports ERB-385 and ERB-386, respectively.

MODEL ANTENNA STUDIES FOR HMCS "CRESCENT"

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

Period under review: January-March, 1956

It was mentioned in a previous issue of this report that VHF/UHF model antenna studies were carried out for the destroyer escort HMCS "St. Laurent" (DE-205). Naval Technical Services, NDHQ, Ottawa, has recommended that a different antenna arrangement be investigated to determine whether or not more effective all-round coverage can be obtained, especially with the AT-150/SRC antennas. It was intimated that there was a possibility that the foremast and antenna arrangement used on HMCS "Crescent" might be a suitable replacement.

For this investigation, a 1/6-scale model of the foremast used on HMCS "Crescent" was constructed and pattern measurements are being carried out on the various VHF/UHF antennas.

WAVEGUIDE SWITCHES FOR THE ROYAL CANADIAN NAVY

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

Period under review: January-March, 1956

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

A switch consisting of two short-slot hybrids and a moving vane was constructed. Tests have shown that the switch can meet all the required specifications. The voltage standing-wave ratio is excellent throughout the switching time, and for both the "on" and "off" positions. It is comparatively easy to hold the switching time down to about 5 milliseconds. The isolation was hardly satisfactory at the beginning (30 to 40 decibels), but by adding chokes and absorbing strips it appears that isolations of 80 decibels, or better, are feasible.

All the above work was done on RG-52/U waveguide. Hybrid junctions for RG-51/U waveguide were ordered early in January, but delivery was held up so that no further work could be done on the project.

CARCINOTRON STUDIES

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

Period under review: January-March, 1956

The aim of the project is to study the use of carcinotrons and other devices for jamming, and to develop experimental jamming equipments. Carcinotrons are microwave backward-wave oscillators having a very wide electronic tuning range, and output powers up to hundreds of watts. Because the tuning is accomplished electronically, the frequency can be varied at a very rapid rate. The device can be modulated in both frequency and amplitude by frequencies up to at least a few megacycles per second. Efficiencies up to 30% are obtained in current tubes. The presence in a single tube of all these desirable properties permits the development of more effective microwave jammers than have been available previously.

Development and testing of self-contained power supplies for the backward-wave oscillators to be used in the low-power test bench was completed. A second model with improved layout has been constructed and is undergoing tests. Included in the unit are a 200-2000 volt delay line supply, 100-500 volt first anode supply, 0-88 volt grid supply, and 6.3-volt 3-ampere d-c heater supply. A shunt modulator has been constructed which, when used with a type-CO127 carcinotron having its power supplies and filament leads isolated by r-f chokes, will produce a frequency deviation of ± 95 Mc/s, with a modulating bandwidth of 5 Mc/s. Some jamming tests were made with noise as a modulating signal. In particular, the effect of turning off the local oscillator of a jammed radar receiver was investigated briefly, and some assistance was given in connection with Project B22-38-20-23 (See page 24). Since a large part of the development and construction program of the low-power test bench is now completed, it is anticipated that during the coming period investigations into phenomena encountered in the jamming of radars can be undertaken.

Collection of data concerning the operation of the type-CM710 carcinotron was discontinued temporarily so that two type-CM73 X-band tubes which have been received from France can be tested. The necessary tube mount and modification of the test bench circuitry were made to permit operation of the tubes, and measurement of operating characteristics has commenced.

A progress report covering the first year of this study has been drafted, and should be issued during the coming period.

ANTENNA FOR X-7769 CARCINOTRON JAMMER

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

Period under review: January-March, 1956

The requirement is for an antenna which will radiate a vertically polarized signal, omnidirectional in the horizontal plane. The pattern is to be 28° wide at the half-power points, which are at 2° and 30° measured downward from the horizontal plane. A gain of at least 3 with respect to an isotropic radiator is desired. Power to be handled is 1 kilowatt; bandwidth is from 2500 to 3500 Mc/s at a standing-wave ratio of not more than 2. Flush-mounting on the under surface of the aircraft is desirable.

There seem to be two types of antenna which offer good possibilities of achieving the above pattern:

- a) a biconical horn,
- b) a linear array of vertical dipoles.

Of the two, the latter seems preferable, due to its smaller size. Two linear arrays have been constructed and are at present undergoing tests. The first consists of a single half-wave dipole; thus with the image dipole, the array consists of two dipoles in phase. The second consists of one and a half half-wave dipoles, so that in this case the effective array consists of three half-wave dipoles in phase. To achieve flush-mounting it is proposed to insert a slight conical depression into the base of the aircraft, and to mount the array at the cone apex.

ANTI-JAMMING MEASURES AGAINST CARCINOTRONS

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

Period under review: January-March, 1956

The purpose of the investigation is to determine a set of optimum receiver parameters for a radar system subjected to noise-modulated swept jamming.

The variables to be considered are:

- 1) receiver bandwidth to radar pulse length ratio
- 2) minimum acceptable dynamic range of receiver
- 3) optimum type of gain compression system and law
- 4) optimum shape of receiver pass-band.

These parameters are to be considered particularly with respect to their interaction with any video processing, such as integration, which may follow the receiver.

Although this is a restricted program, and does not at present entail any investigation of alternative forms of detection, such as the zero crossing phase-detector, it forms the basis for a fairly long-term study which may branch out in several directions.

An artificial target generator is being assembled as a starting point in the investigation, and several IF amplifiers are being constructed for preliminary tests. A PPI display unit has been adapted for use with the target generator. An improved model of the video-enhancer unit which gave promising results when used with the AN/MPS-501B radar during "Operation Bracket" is nearly ready for test.

VULNERABILITY OF DOPPLER DETECTION SYSTEM TO COUNTERMEASURES

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

Period under review: January-March, 1956

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.

A report on "Vulnerability of Doppler Detection System to Countermeasures" (ERA-301, see p. 28) has been distributed and a report on "Jamming Applications of a Periodically Quenched Oscillator" (ERA-302) has been prepared and will be issued shortly.

Because of the effectiveness of superregenerative oscillators in jamming the Doppler Detection System, it was decided to investigate the properties of superregenerative oscillators operating at other frequencies with a view to jamming c-w systems. A preliminary investigation of jamming of communications systems with a superregenerative oscillator indicates that it may be effective against amplitude modulation. Further work is delayed until suitable equipment is secured.

Klystrons were operated successfully as locked superregenerative oscillators at X- and K_u-bands with sensitivities of about -65 dbm. A travelling wave tube operating on J-band and a carcinotron on S-band were somewhat more sensitive. For the sake of completeness a magnetron was tried on S-band and found to be insensitive to a locking signal.

GROUND-TO-AIR COMMUNICATIONS USING IFF

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

Period under review: January-March, 1956

Short range trials were conducted with this system, which is proposed to provide an auxiliary ground-to-air communications link for Mark X IFF-equipped aircraft. The modified interrogator was used in conjunction with a trailer-mounted TPS-1D radar located about eight miles from the transponder and voice demodulator unit. These short-range ground trials indicated that for simultaneous transmission of interrogation pulses and voice-carrier pulses, it would be desirable to prevent interrogation pulses from occurring within certain limits of a voice pulse-pair. A gate circuit was constructed to do this, and a considerable improvement in performance was obtained. Preparations for a flight trial are now under way.

FLUTTAR WAVEFORMS

Reference: DRB, RCAF. DND Project D48-38-01-09

Period under review: January-March, 1956

As indicated in previous reports the line of investigation has broadened somewhat into a study of fundamental properties of waveforms generally. A detailed report on the probability distributions of the product of two diode detector waveforms is in final stages of preparation. Being of an unclassified nature it has been submitted to, and accepted by the Canadian Journal of Physics. Some of the results obtained however have fairly direct bearing on the performance of certain types of both radar and fluttar detection systems.

Murray, D.M.

Response of Mine R Type 1A to Sine-Wave Fields and
Other Magnetic Signals (ERB-350) (SECRET)

A coiled rod and tail assembly were first received for investigation. Tests were made on this mine circuit but the absence of the steel case made magnetic response tests useful only for comparative checks. Subsequently a complete assembly was received. Results from both tests are presented.

The response to sine-wave field signals was studied particularly because of recent importance attached to magnetic signals from rolling ships. Other magnetic signals were for the most part standard. The minimum amplitude of sine-wave field required to close the sensitive relay was found to be 2.5 mG when the relay was set to close with 2.1 μ a. However, it would seem possible to set the relay for 0.5 μ a and therefore the mine would be proportionally more sensitive.

It was found possible to increase the sensitivity of the mine by modifying the mine circuit to obtain a resonance in the vicinity of roll periods. This mine was particularly adaptable to this application.

Lavrench, W.

Final Report on Second-Order Beams of the AN/FPS-502
Antenna (ERB-373) (RESTRICTED)

Radiation patterns of a production model of the AN/FPS-502 antenna were taken in order to locate and measure the second-order beams. No second-order beams were found at 2700 Mc/s, while at 2800 and 2900 Mc/s the second-order beams were 14.5 percent and 12.7 percent, respectively. Percentages are in terms of field strength and are relative to the peak of the main beam.

Several modified feeds were used in an attempt to reduce the size of the second-order beams. It was found that when a suitably designed parallel-plate region was inserted in front of the slots in the array, the second-order beams were suppressed completely. The presence of the parallel-plate region increased the close-in side-lobe level but a re-design of the slotted waveguide has corrected this.

Cumming, W.A. A Study of the Telemetering Antenna Problem on the
"Velvet Glove" Missile (ERB-374) (CONFIDENTIAL)

At the request of the Canadian Armament Research and Development Establishment, the electrical characteristics of four alternatively proposed telemetering antennas for the "Velvet Glove" missile were assessed. Three of these are notch-type antennas, cut in the missile fin or in the rear portion of the body, and give adequate performance. The fourth antenna, a slot cut in the forward part of the body, was found to be too frequency-sensitive for satisfactory operation.

Hunt, F.R. Preliminary Evaluation of the X-5 Radalarm (ERB-382)
(CONFIDENTIAL)

A brief description of the X-5 Radalarm is given. Test equipment and experimental methods are described. Results obtained with the AN/FPS-3 operating as a GCI and as an EW radar are discussed. The results indicate that the X-5 installed at an early warning site has a maximum range that is about 6% less than that of an alerted operator. Suggested modifications to improve the operation of the X-5 Radalarm are included.

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