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FOREIGN TECHNOLOGY DIVISION



DEFENSE OF DISSERTATIONS

By

I. A. Mlodzeyevskaya

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## EDITED TRANSLATION

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DEFENSE OF DISSERTATIONS

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U. S. BOARD ON GEOGRAPHIC NAMES TRANSLITERATION SYSTEM

| Block | Italic     | Transliteration | Block | Italic     | Transliteration |
|-------|------------|-----------------|-------|------------|-----------------|
| А а   | <b>А а</b> | A, a            | Р р   | <b>Р р</b> | R, r            |
| Б б   | <b>Б б</b> | B, b            | С с   | <b>С с</b> | S, s            |
| В в   | <b>В в</b> | V, v            | Т т   | <b>Т т</b> | T, t            |
| Г г   | <b>Г г</b> | G, g            | У у   | <b>У у</b> | U, u            |
| Д д   | <b>Д д</b> | D, d            | Ф ф   | <b>Ф ф</b> | F, f            |
| Е е   | <b>Е е</b> | Ye, ye; E, e*   | Х х   | <b>Х х</b> | Kh, kh          |
| Ж ж   | <b>Ж ж</b> | Zh, zh          | Ц ц   | <b>Ц ц</b> | Ts, ts          |
| З э   | <b>З э</b> | Z, z            | Ч ч   | <b>Ч ч</b> | Ch, ch          |
| И и   | <b>И и</b> | I, i            | Ш ш   | <b>Ш ш</b> | Sh, sh          |
| Й й   | <b>Й й</b> | Y, y            | Щ щ   | <b>Щ щ</b> | Shch, shch      |
| К к   | <b>К к</b> | K, k            | Ъ ъ   | <b>Ъ ъ</b> | "               |
| Л л   | <b>Л л</b> | L, l            | Ы ы   | <b>Ы ы</b> | Y, y            |
| М м   | <b>М м</b> | M, m            | Ь ь   | <b>Ь ь</b> | '               |
| Н н   | <b>Н н</b> | N, n            | Э э   | <b>Э э</b> | E, e            |
| О о   | <b>О о</b> | O, o            | Ю ю   | <b>Ю ю</b> | Yu, yu          |
| П п   | <b>П п</b> | P, p            | Я я   | <b>Я я</b> | Ya, ya          |

\*ye initially, after vowels, and after ъ, ь; e elsewhere.  
When written as ë in Russian, transliterate as yë or ë.

RUSSIAN AND ENGLISH TRIGONOMETRIC FUNCTIONS

| Russian | English | Russian | English | Russian  | English            |
|---------|---------|---------|---------|----------|--------------------|
| sin     | sin     | sh      | sinh    | arc sh   | sinh <sup>-1</sup> |
| cos     | cos     | ch      | cosh    | arc ch   | cosh <sup>-1</sup> |
| tg      | tan     | th      | tanh    | arc th   | tanh <sup>-1</sup> |
| ctg     | cot     | cth     | coth    | arc cth  | coth <sup>-1</sup> |
| sec     | sec     | sch     | sech    | arc sch  | sech <sup>-1</sup> |
| cosec   | csc     | csch    | csch    | arc csch | csch <sup>-1</sup> |

Russian      English

rot      curl  
lg      log

DEFENSE OF DISSERTATIONS

Dissertations in Competition for the Degree of

Doctor of Technical Sciences

Moscow Electrical-engineering Institute of Communications

by K.T.N. I. A. Mlodzeyevskaya

[Note: D.T.N. - Doctor of Technical Sciences; K.T.N. - Candidate of Technical Sciences]

Samoylov, V. G., Television Sweep Oscillators. The defense took place on 12 January 1967. Official opponents: D.T.N. Prof. P. V. Shmakov, D.T.N. Prof. S. V. Novakovskiy, D.T.N. Prof. Yu. K. Khodarev.

The monograph is devoted to the theory and practice of the most important units in television devices - the horizontal and vertical sweep oscillators of the electron beam in receiving tubes. Setups for synchronization of the sweep oscillators are also considered in it.

Particular attention is given to new problems: full-angle diffraction oscillators, feedback in the output stages of the vertical sweep, stabilization of raster size, tuning of the horizontal transformer on the third harmonic, methods of creating an S-shaped beam-deflecting current, improvement of the noiseproof feature of synchronization circuits, etc.

The book is intended for scientific and engineering-technical workers who are engaged in the development and operation of television receiving equipment which contains sweep oscillators, and can also serve as an instruction manual for students.

Shakhgil'dyan, V. V., Some Problems of the Theory and Calculation of Continuous Systems of Phase Automatic Frequency Control. The defense took place on 16 February 1967. Official opponents: D.T.N. Prof. M. R. Kaplanov, D.T.N. Prof. N. T. Petrovich, D.T.N. Prof. P. I. Chinayev.

The work is devoted to the development of a general theory of operation of systems of phase automatic frequency control (FAPCh). In it a wide circle of problems connected with the analysis of the stability of complex autonomous nonlinear systems of phase synchronization is solved and the nature and duration of transient processes in these systems are determined.

An analysis of the operation of nonautonomous FAPCh systems made it possible to establish the optimal parameters for a system which would ensure its effective operation. A general method is given for determining the stability of nonautonomous inertial systems of phase synchronization. The fluctuation accuracy of operation of FAPCh systems is established. A procedure is indicated for the calculation of the characteristics of the statistical dynamics of complex FAPCh systems.

The analysis of different modifications of systems of phase synchronization made it possible to develop a method for the synthesis of systems which were optimal in respect to different criteria. A large number of examples of the practical use of the results of the developed theory is given.

Tereshin, O. N., Synthesis of Plane and Raised Impedance Antennas in Respect to Assigned Field Structure in the Near and Far Zones. The defense took place on 13 April 1967. Official opponents: D.T.N. Prof. L. D. Bakhrakh, D.T.N. Prof. Ye. G. Zelkin, D.T.N. Prof. V. V. Nikol'skiy, D.T.N. Prof. V. D. Kuznetsov.

The work is devoted to the development of a method of synthesis of impedance antennas based on assigned characteristics of directivity and structure of the near field. The use of the parameter of impedance boundary conditions during the synthesis makes it possible to construct the design of an antenna based directly on the results of calculations.

The method developed makes it possible to synthesize raised impedance antennas with axial and normal radiation with any assigned form of radiation pattern. For excitation of the impedance surface it is possible to use an incident surface wave or the simplest system of linear sources.

The synthesis of impedance surfaces based on assigned structure of the near field is done for the purpose of constructing plane and raised impedance decoupling structures for lowering the level of communication between closely located antennas and devices for the excitation of surface waves over the impedance surface with the simplest system of sources.

On the basis of the calculated and experimental results the possibility is shown for improving significantly the characteristics of antenna devices, constructed according to the method developed, in comparison with known [methods] and the possibility of extending the results obtained to other attenuating systems.

Borodich, S. V., Analysis and Methods for the Calculation of Transient Noises and Linear Distortions in Multichannel Radio Relay Systems with Frequency-division Multiplexing and Frequency Modulation. The defense took place on 27 April 1967. Official opponents: T.D.N. Prof. V. A. Smirnov, D.T.N. Prof. G. V. Dlugach, D.T.N. Prof. N. I. Chistyakov.

The basic forms and causes of transient interferences in telephone channels of radio relay communication systems are considered.

By methods of the theory of random processes, with the help of a mathematical model of multichannel communication, in the form of a normal steady-state random process with a limited spectrum, an analysis is made of the transient interferences which develop in different elements: in the group channel as a result of the non-linearity of its amplitude characteristics, in the high-frequency channel due to the nonuniformity of the frequency and the non-linearity of the phase characteristics, and also under the influence of radio interferences, in antenna feeders due to echo-signals.

Methods are developed for the calculation of transient interferences in these elements of the system and formulas are derived which make it possible to determine the expected magnitude of interferences based on known characteristics of the system or to determine the requirements for the characteristics based on the assigned permissible magnitude of transient interferences. For more complex cases graphs are given which facilitate the calculation.

Graphs are calculated for the energy spectrum of a signal, modulated on frequency by multichannel communication and a determination is made of the width of the band of the high-frequency channel, within the limits of which the behavior of the characteristics of the channel has a noticeable influence on the magnitude of transient interferences.

The summation of transient interferences on the line is reviewed and the statistical characteristics of the power of the interferences on the end of the line are determined.

On the basis of an analysis of linear distortions of communications in the high-frequency channel formulas are derived which make it possible to calculate the linear distortions based on the characteristics of the channel.

Results of experiments are given which confirm the correctness of all the basic calculation formulas.

Kharkevich, A. D., Synthesis of the Optimal Structures of Automatic Telephone Switching Systems. The defense took place on 28 June 1967. Official opponents: D.T.N. Prof. B. S. Livshits, D.T.N. Prof. A. M. Bryleyev, D.T.N. O. N. Ivanova.

An investigation is made of the structure of switching systems which are used in automatic telephony. A matrix formulation is proposed for operations on switching circuits and methods are developed for determining the qualitative indices which characterize the servicing of a flow of calls by the system. Methods are proposed and developed for the synthesizing of abstract theoretical structures, the individual parts of real switching systems on the whole, and investigations are conducted using these methods.

Further a theoretical generalization is made of the methods developed on no-telephone structures of switching systems and the optimal structure of one of the real telephone switching stations - a coordinate substation of the type PS-MKS-100.

#### Dissertations in Competition for the Degree of Candidate of Technical Sciences

Rud', V. V., Some Problems of the Theory of Multifrequency Systems with Variable Parameters. The defense took place on 19 April 1967. Official opponents: D.T.N. Prof. V. A. Graft, K.T.N. Associate Prof. G. S. Segal'. Scientific guide: D.T.N. Prof. N. I. Chistyakov.

With the use of the theory of linear circuits the main characteristics of multifrequency circuits, in which frequency conversion is carried out, were considered. The connection between circuits, tuned on different frequencies, is realized with the help of complex controlled two-terminal networks. Control of the parameters of two-terminal networks is done with several generators of strong signals. The contours of the outer circuits are considered close

to ideal. Expressions are obtained for the coefficient of transfer based on power of input conductivities, the coefficient of noise, and the instability of gain in regenerative modes.

Different modes of operation of such systems are investigated.

With the help of linear two-terminal pair networks it was possible to simplify significantly the apparatus for investigation of multifrequency systems with variable parameters. The operating modes of such two-terminal pair networks are analyzed as well as the conditions of unidirectional transfer of energy.

In conclusion a number of conclusions are obtained for partial cases of two-circuit frequency converters on semiconductor diodes.

The possibility is considered for the expansion of the pass band in a three-frequency regenerative system due to the appropriate detuning of disconnected circuits.

Rabinovich, V. A., Development and Investigation of Television Methods of Linear Measurements Based on Optical Coding. The defense took place on 23 February 1967. Official opponents: D.T.N. Prof. V. S. Vikhman, K.T.N. Associate Prof. V. G. Makoveyev.

An analysis is made of new television methods of linear measurements based on optical coding. Concepts of useful and useless information are introduced and information parameters of television measuring systems based on these concepts are proposed. On the basis of the information theory means of improving these systems are noted. It is shown that optical coding, which is a partial case of spatial coding, makes it possible to construct fundamentally new television measuring systems with parameters which approximate optimal. Five new television methods of linear measurements, based on the effective optical coding and logical sweep, are proposed and investigated. It is shown that the most effective are the coordinate-code method and the method of optimal optical coding.

Results are given of the experimental investigations of models of digital fiber optics and digital television sensors, conducted under laboratory and industrial conditions in the rolling industry. It is shown that these methods can be used practically in all cases when it is required to process a large amount of information contained in the images of controlled processes or objects, and the input of this information into a digital computer.

Mikhaylov, A. V., Improving the Reliability of Transmission on Real Communication Channels. The defense took place on 23 February 1967. Official opponents: D.T.N. Prof. N. T. Petrovich, K.T.N. G. B. Davydov. Scientific guide: D.T.N. Prof. N. I. Chistyakov.

Phenomena leading to an increase in the probability of error in systems of data transmission are considered, measures for improving reliability are proposed, and the effectiveness of the proposed measures is determined.

The influence of fadings of signals, transient processes, phase-frequency distortions, and the non-optimal nature of the reference threshold and noises on reliability is investigated.

Expressions for reliability are obtained, which take into account in the case of the joint influence of transient processes on the system for transmission of information in a discrete form, the phase-frequency distortions, echo-signals and noises for a random assumed pulse sequence.

An evaluation is made of effectiveness and recommendations are given in the case of application of the proposed measures for improving reliability: an improvement of reliability with a calculation of the correlation between sendings in a system of interrupted communication with fadings, an increase of reliability with the determination of operation with an optimal reference threshold in the event of the presence of noises and transient processes in the data transmission channels, a lessening of the probability of error with the correction of phase-frequency characteristics and compensation of transient processes.

Recommendations are given for the selection of optimal parameters and the design of the proposed devices. The resulting theoretical results are confirmed experimentally.

Makarov, A. A., Problems of the Phasing of Systems of Interrupted Radiotelegraph Communications. The defense took place on 30 March 1967. Scientific guides: D.T.N. V. S. Mel'nikov, D.T.N. Prof. N. I. Chistyakov. Official opponents: D.T.N. Prof. A. G. Zyuko, K.T.N. V. I. Kirsanov.

The work is devoted to an analysis of methods of phasing of radiotelegraph communication systems which use the meteor communication channel.

Discrete systems of synchronization of receiving distributors

are analyzed. A method is proposed for the calculation of the main characteristics of discrete systems of synchronization with constant and variable correlation effects.

Formulas are obtained for the calculation of errors of phasing, the time of phasing and the band of capture of these systems. On the basis of calculation formulas and examples of the calculation the conclusion is made that in those cases when it is required to have a minimal phasing time with an assigned error it is expedient to use synchronization systems with a constant correlation effect.

An analysis is made of methods of phasing of systems of meteor communications for the purpose of determining the moments of hooking up of the receiver after a break in communications, used for the recovery of a comparatively slow drop of signal level at the end of the meteor flashes and synchronized distributors.

The phasing of meteor communication systems is considered under the condition that the transmission of telegraph messages in the communication channel is realized with a 7-digit code detecting the errors.

Nikitin, E. P., Investigation of the Reliability of Transistors Which Are Used in Long-range Communication Equipment. The defense took place on 20 April 1967. Scientific guide V. O. Shvartsman. Official opponents: D.T.N. A. D. Vlasov, K.T.N. A. V. Sheremet'yev.

An investigation is made of the interconnection between reliability of the metallic channel of long-range communication and the transistors used in the equipment. A method is developed for the experimental investigation of transistors for reliability. The expedience of evaluation of the distribution of breakdowns of transistors by the superposition of two exponential laws is shown. The results of the testings of transistors on benches and their statistical evaluation are given. For the period of normal operation the intensity of breakdowns of transistors and its dependence on the coefficient of electrical load are calculated. The problem of the necessity for and duration of electrical aging of transistors with an account of the requirements presented for the reliability of the equipment is reviewed. A method is proposed for input control and electrical aging of transistors. The results of experimental investigations are cited. Recommendations are developed for improving the reliability of transistors in communication equipment by the methods: constantly hooked-up redundancy, stabilization of the operating point of the transistor, the use of circuits of negative feedback, the protection of transistors from overloads from the side of its input and sources of power.

Prokof'yeva, V. A., Investigation of Systems of Joint Servicing of Two Flows of Information on Communications Networks. The defense took place on 18 May 1967. Scientific guide: K.T.N. Associate Prof. A. D. Kharkevich. Official opponents: D.T.N. O. N. Ivanova, K.T.N. V. K. Leserzon.

The work is devoted to problems of the organization of systems of servicing of several flows of information by a single cluster of devices, called systems of joint servicing. Such a system makes it possible to take into account the excess carrying capacity of the cluster, on which a real flow of calls arrives which are characterized by considerable nonstability (variation of the average number of calls) and randomness (variation of the number of calls around an average value). Special attention is given to problems of servicing with the advantage or priority of one flow of calls in a joint system of servicing of two flows. Possible methods are considered for servicing with a relative advantage of one of the flows, disciplines for preferential servicing are formulated, and the calculation of such systems is substantiated. On the basis of the calculated data obtained an analysis is made of preferential systems of servicing, the most effective area of their application is determined, and a method is given for determining the optimal method of organization of a system (discipline of servicing). The power of mechanization of the process of calculation of priority systems with losses on a computer is shown; an engineering method of calculation is given. The work contains tables of priorities of losses in a preferential system with losses.

Genkina, N. F., Some Problems of Reliability of Low-speed Systems for the Transmission of Discrete Information. The defense took place on 18 May 1967. Scientific guides: D.T.N. Prof. B. P. Terent'yev, K.T.N. Prof. P. A. Naumov. Official opponents: D.T.N. Prof. E. L. Blokh, K.T.N. Associate Prof. P. A. Yemel'yanov.

Problems of reliability of low-speed communications channels organized on wire channels are considered. On the basis of experimental data a mathematical model is obtained for the reliability of TT channels with ChM taking packing into account. The correlation dependences of breakdowns in parallel channels are investigated.

The theoretical aspects of the organization of communications on parallel channels, and also problems of reliability of the individual elements making up the communication channel are reviewed. Methods for improving the reliability of terminal devices for the transmission of discrete information are investigated.

Chupin, V. P., Investigation of the Parameters of a New Design for a High-frequency Transmission Line. The defense took place on 21 September 1967. Scientific guide: D.T.N. Prof. I. Ye. Yefimov. Official opponents: D.T.N. Prof. I. I. Grodnev, K.T.N. K. V. Lebedev.

A new design for a high-frequency guiding system is investigated theoretically. It is a spiral line, representing a combination of two identical ribbon conductors, submerged in a dielectric, and curved in a transverse plane on the arcs of logarithmic spirals which are symmetrical relative to the longitudinal axis of the line. The special features of a spiral guiding system are analyzed.

A new system of generalized curvilinear orthogonal coordinates is introduced which permits the separation of variables in the Laplace equation and provides the possibility for the effective solution of a boundary problem of electrodynamics for the conditions being considered.

In the system of generalized coordinates which is introduced wave equations are constructed which describe the distribution of the components of the electromagnetic field in a transverse direction of ribbon conductors which are bent in a spiral and in a dielectric medium, filling the interconductor space.

By means of specially developed methods approximate solutions are obtained for the constructed differential equations for the field of a spiral line. The variable coefficients which enter into the indicated solutions are found and the constants of integration are determined.

It is shown that the results of the derived theoretical developments and the principles utilized in them can be applicable for the solution of a number of other boundary problems of electrodynamics on curvilinear interfaces which are unsolvable in a general form by other known methods.

On the basis of the theoretical constructions made general expressions are obtained for the primary parameters of transmission of a spiral line in a function of curvilinear coordinates.

An engineering method is developed for the calculation of the electrical and design parameters of a spiral line and the problems of the technology of their production are considered.

Kurenkova, N. A., Some Problems of Linear Correction of Wide-band Channels, Intended for the Transmission of Discrete Information. The defense took place on 5 October 1967. Scientific guides: D.T.N. Prov. I. A. Koshcheyev, D.T.N. G. B. Davydov. Official opponents: D.T.N. Prof. K. Ye. Kul'batskiy, K.T.N. D. A. Tsirel'son.

Specific engineering methods are developed for determining the optimal magnitudes, characterizing the accuracy of correction of frequency characteristics of wide-band channels, formed on the basis of group systems of hf telephony and intended for the transmission of discrete information in systems with amplitude and phase modulation. Templates are constructed which make it possible to evaluate the magnitudes of residual deviations of frequency characteristics. An expedient system of correction is considered which provides for a combination of two types of correcting devices, realizing the main and the refined correction. Correction limits are determined for each of the correcting devices which are included in the correcting system. The causes leading to error of correction when a refining harmonic corrector is used are analyzed and recommendations are given relative to the selection of the number of links which determines the complexity of the corrector.

The results of testing of a harmonic corrector, calculated on the basis of the recommendations obtained, are given. The use of the corrector in the correction of frequency characteristics of a tangibly existing line with an extent of 2500 km ensured the assigned accuracy of correction, determined on the calculation templates.

Andreyev, M. I., Some Problems in the Use of Tunnel Diodes in the Equipment of Discrete Communications Systems. The defense took place on 12 October 1967. Scientific guide: D.T.N. Prof. N. I. Chistyakov. Official opponents: D.T.N. Prof. S. I. Katayev, K.T.N. L. A. Korobkov.

The work is devoted to theoretical and practical problems of the application of tunnel diodes in equipment for discrete communication systems for the purpose of improving the operating speed of the latter. A complete analysis is made of all the possible modes of operation of the most widespread electrical circuits with tunnel diodes. Analytical expressions are obtained for the calculation of time characteristics of the main pulsed devices (multivibrator, flip-flop). The calculation relationships include the certification data for tunnel diodes. Problems dealing with the reaction of a tunnel diode to external harmonic and linearly increasing influences and problems of the combining of tunnel diodes with transistors and inverted diodes are investigated. An analysis is made of the accuracy of a decoding device with combined stages. For the evaluation of the total error of conversion a calculation is made of the dispersion of the error of quantization of a multichannel signal in the

case of intervals of quantization which exceed the interval of V. A. Kotel'nikov. The results of these investigations were used in the development of different high-speed multistage pulsed devices for communication equipment with IKM (60 TLF channels in the case of a nine-position binary code): pulse counters, frequency dividers, shift registers, keying and logical devices, decoding device, and pulse distributor. The high operating speed of these devices was achieved due to the use of tunnel diodes in them.

Livshits, V. M., Optimal Receiver of Binary Gaussian Signals. The defense took place on 30 November 1967. Scientific guide: K.T.N. Associate Prof. S. M. Gol'din. Official opponents: D.T.N. Prof. N. T. Petrovich.

The work is devoted to problems of optimal and quasioptimal discrimination of binary signals which have a Gaussian distribution. The basic considered is that when the signals have average values which are the same and equal to zero, but are characterized by correlation functions. It is considered that on the input of the receiver, in addition to the signals, white noise is acting.

Using the criterion of a minimum of total probability of error, a block diagram is obtained for a receiver. It consists of a filter with variable parameters, a multiplier and integrator, and an integral equation is found which determines the pulsed transient characteristic of this filter.

Using the properties of an integral equation, it is proven that for arbitrary signals on the input with the presence of white noise a filter with variable parameters is physically realizable. It is shown that for steady-state signals with (fractional)-rational spectra of power the pulsed transient characteristic of the filter is divisible and contains the sums of exponential and exponential-cosine functions. For steady-state wide-band signals the optimal filter is a filter with constant parameters. A transmitting function is obtained for this filter and it is proven that such a filter is realizable for any signals.

Special consideration is given to the case of a low noise/signal ratio and it is found that in this case the optimal filter is determined by the difference of the correlation functions of the transmitted signals.

The simplest filter is obtained during the reception of wide-band steady-state signals. It is proposed to use this filter as quasioptimal for arbitrary signals.

The pulsed transient characteristics of the filter for wide-band signals with an exponential correlation function and the probabilities of error were calculated. An exponential check of the calculated

receiver, conducted by the method of simulation, showed the coincidence of the numerical data and that obtained during simulation.

Veksler, N. G., The Influence of Pulsed Interferences on the Transmission of Discrete Information. The defense took place on 14 December 1967. Scientific guide: K.T.N. N. D. Pasechnik. Official opponents: D.T.N. Prof. B. R. Sergiyevskiy, K.T.N. K. A. Brusilovskiy.

A method is proposed for determining the reliability of transmission of discrete information under the influence of pulsed interferences. Principles are worked out for the construction of simple operational devices for the measurement of losses of reliability due to pulsed interferences. Methods for improving the reliability of transmission are investigated. An experimental check is made of the results obtained.

Zhurbenko, E. M., Vertical Log-periodic Antenna with a Reflector for Short-wave Radio Communication and Radio Broadcasting. The defense took place on 21 December 1967. Scientific guide: D.T.N. Prof. G. Z. Ayzenberg. Official opponents: D.T.N. Prof. G. A. Lavrov, K.T.N. A. S. Knyazev.

On the basis of an analysis of the construction and related shortcomings of existing types of slanted log-periodic antennas in operation a new type of short-wave ultrabroad-range antenna is proposed - a vertical log-periodic antenna with reflector. The new antenna ensures, with a lower antenna height, smaller angles of increase in the maximum beam of the radiation pattern in a vertical plane, which makes it possible to use it on routes of greater extent than the known types of log-periodic antennas. A precise analysis is made of the electrical characteristics of the developed type of antenna, on the basis of which its optimal design is selected. The electrical characteristics of the antenna were checked experimentally on models in the decimeter range of waves. The results of a mathematical analysis and the experimental data agree satisfactorily. At the present time the antenna which has been developed is being realized.

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