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# USSR Report

## ELECTRONICS AND ELECTRICAL ENGINEERING



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# USSR REPORT

# ELECTRONICS AND ELECTRICAL ENGINEERING

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UDC 621.391.26:621.372.54

## SEQUENTIAL CONVOLVER SEARCH FOR PSEUDORANDOM SIGNALS OF LONG DURATION

Moscow RADIOTEKHNIKA in Russian No 10, Oct 83 (manuscript received, after completion, 2 Feb 83) pp 3-7

KUZICHKIN, A. V.

[Abstract] Search for and processing of pseudorandom signals by a receiver, consisting of an accustoelectronic convolver based on surface acoustic waves, and a recirculation delay line, is very effect. Coherent storage of convolver output signals in recirculation circuit is helpful when the signal prccessing time is longer than the signal delay time in the convolver interaction space. The reference signal is formed by breakup of the anticipated pseudorandom etalon signal into segments of equal durations and subsequent inversion of each segment with respect to time. Solving the problem of synchronism detection on the basis of maximum a posteriori probability involves two procedures in each search cycle covering the entire zone of delay-time indeterminacy, first stepwise analysis of this zone with search for the maximum correlation peak in the processor output signal and then inspection of this correlation peak for correspondence with the true state of synchronism. Calculations reveal that, in terms of speed, sequential convolver search ranks as intermediate between correlational search and search with matched filters. Figures 1; references 8: 4 Russian, 4 Western.
[75-2415]

UDC 537.228.1

## RESONANCE-TYPE PIEZOELECTRIC TRANSDUCERS WITH ACOUSTIC SENSORS

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 26, No 10, Oct 83 (manuscript received 8 Jan 82) pp 11-15

TROFIMOV, A. I. and SHAMIN, G. A., Tomsk Polytechnic Institute imeni S. M. Kirov

[Abstract] The performance of a resonance-type piezoelectric transducer with an acoustic sensor is evaluated, such a device being treated as a vibrating multilayer structure (three layers with a shield between the acoustic sensor and the piezoelectric cell, or five layers with a shield between the sensor

and one cell on each side). The equivalent electric circuit and the "acoustic path length" concept are introduced for analysis of the frequency characteristics. Absorption of sound and dependence of the acoustic velocity on mechanical stresses are taken into account, assuming that the materials obey Hooke's law. The fundamental resonance frequency and the voltage transfer ratio are calculated on this basis. The vibratory force in a configuration with incident and reflected as well as standing waves is calculated by the method of complex amplitudes. The expressions obtained as a result are put in a form convenient for computer-aided design optimization. The paper was recommended by the Department Faculty (Kafedra) of Electrical Engineering, Tomsk Polytechnic Institute. Figures 3; references: 4 Russian.
[72-2415

UDC 621.396.22.019.4

## SYNTHESIS OF RECEIVER FOR SIGNALS IN LONG-DISTANCE RADIO NAVIGATION SYSTEMS OPERATING IN QUASI-RANGING MODE

Moscow RADIOTEKHNIKA in Russian No 9, Sep 83 (manuscript received 11 Feb 83) pp 21-24

RYABTSOV, A. L.

[Abstract] The optimum receiver for long-distance radio navigation systems operating in the quasi-ranging mode is synthesized, this mode of operation allowing a more accurate locating of objects than operation in the difference-ranging mode. The synthesis of such a receiver and estimation of its interference immunity are based on the Markov theory of optimal nonlinear filtration. Calculations are shown for m= 3 reference stations at known locations in some system of XY coordinates. Useful signals from these stations are assumed to appear at the object together with additive white noise. The optimum receiver of such radio signal operates quasi-coherently, its information channel estimating the space coordinates of the object with mutual spacing of stations and object taken into account. The errors in formation of the state vector are estimated from the matrix for second central moments, upon averaging of its elements over one pulse repetition period with the deviation of signal arrival time necessarily taken into account. Figures 3; references: 4 Russian.
[57-2415]

UDC 629.7.05

## OPTIMIZATION OF INERTIAL RADIO NAVIGATION COMPLEX

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 26, No 10, Oct 83 (manuscript received 23 Sep 82) pp 57-61

MEL'NIKOV, B. G., RUDNITSKIY, B. Ye. and IVANOV, V. L., Leningrad

[Abstract] Although optimization of inertial radio navigation systems is usually based on the Kalman filtration theory, indeterminacy of a priori data on the mathematical models of processes and on the regular components of navigation parameters makes it preferable to use as a criterion of optimum synthesis, the

maximum liklihood of the error vector not extending beyond a given tolerance region. Accordingly, the mathematical model of such a system is described by the corresponding stochastic differential equation with variable coefficients (functions of time) in matrix form for its q-dimensional state vector, k-dimensional vector of regular action, and 5-dimensional noise vector. The regular component of the navigation parameter sought is assumed to be known imprecisely, but a certain q-dimensional region of its possible errors to be given. Equations of optimal filtration in the state space are used for statistical synthesis of the navigation system, with the mean-value theorem applied for simplification of the corresponding transcendental functional equation and with this equation reducing to a cubic one for the one-dimensional case. Identification of the variable coefficients proceeds according to an algorithm based on the minimum-work criterion. The entire procedure is demonstrated on a numerical example $\dot{x}(t)=A(t)x(t)+B(t)(320-0.06t+2.10^{-5}t^2)+10\xi(t)$ where the white noise $\xi(t)$ has a zero mean value and a unity dispersion, the difference between distance readings and true distance being attributable solely to the error accumulated in the inertial navigation system. Figures 3; references: 5 Russian.
[72-2415]

UDC 621.396.11

SOUNDING SIGNAL OPTIMIZATION DURING MEASUREMENT OF DISTANCE TO SURFACE

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian
Vol 26, No 11, Nov 83 (manuscript received after revision 13 Dec 82) pp 8-12

CHIZHOV, V. I.

[Abstract] On the basis of an investigation of the mutual ambiguity [Woodward] function (MAF) of the reflected and sounding signals, the paper reveals the optimum ambiguity function of a sounding signal (AFSS) which minimizes the error of distance measurement. A choice of the parameters of the sounding signals is made by considering the limitations of the two methods of estimating distance--according to the position of the maximum and the leading edge of the MAF. The investigation conducted show that the optimum form of the AFSS is determined by the beam pattern of the antennas (BPA), their angular orientation, the diagram of backscattering of the surface, and the vector of the speed of movement of the aircraft. In a number of cases, with a known velocity vector, signals are optimum which have a nonsymmetrical AFSS, characteristic for linear frequency modulation. With a suitable choice of the frequency deviation and pulse width, the effect of the secondary contraction of the MAF becomes apparent. For signals with a symmetrical AFSS, optimization results in correlation of the resolution intervals with respect to distance and speed with the illuminated or resolved sections of the surface. Figures 2; references: 5 Russian.
[70-6415]

UDC 621.391.26

ELIMINATION OF INTERFERING TYPES OF RESPONSES DURING TREATMENT OF SIGNALS IN ECHO PROCESSORS

Kiev IZVESTIYA VYSSKHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian
Vol 26, No 11, Nov 83 (manuscript received 8 Jun 82) pp 12-17

BARUZDIN, S. A. and USTINOV, V. B.

[Abstract] The paper analyzes the performance of an echo-processor (EP), operating in a three-pulse regime, allowing for the internal noise originating during normal operation of the EF. A method of suppressing this noise is considered, one based on the use of an additional video pulse magnetic field $H_s$, which reduces to a change of the precision frequency of the magnetic vectors of the isochromatic curves $\vec{M}$ at a magnitude W distributed in the region of the working medium under the f(W) law. As an example, an analysis is made of the work of the EP in a regime of coordinated filtration. In the experimental part of the work, the characteristics of the suppression of interfering types of responses are cited. Figures 2; tables 1; references 7: 5 Russian, 2 Western.
[70-6415]

UDC 621.396.962.4

OPTIMUM MEASUREMENT OF COORDINATES OF SEVERAL SOURCES OF RADIO-FREQUENCY RADIATION DURING STEP-TYPE RETUNING OF SIGNAL PARAMETERS

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian
Vol 26, No 11, Nov 83 (manuscript received 4 Jun 82) pp 60-62

GREBENNIKOV, V. B.

[Abstract] In a number of cases the necessity arises for passive measurement of the coordinates of surface sources of radio-frequency radiation in relation to groups of aircraft. The present short communication is devoted to the problem of measuring the coordinates of several single-type simultaneously functioning isotropic radiators of phase-keying radio pulses, the carriers of frequencies the duration and repetition periods of which are changed irregularly from pulse-to-pulse according to the pseudo-random law. A hypothetical situation was investigated of measuring the coordinates of five transmitters removed from four isotropic receiving points by 200 km on the average. The distance between the receivers amounted approximately to 10 km, and between transmitters, 30 km. The signal-to-noise ratio with respect to energy was taken as equal to ten, and the width of the spectrum of pulses, 20 MHz. The aircraft speed amounts to 200 m/sec and the observation time to one second. In view of their insignificance, the differences of the Doppler shifts were not taken into account, and the amplitude of the pulses in the interval of observation was considered to be constant. The values obtained during simulation of the root-mean-square error of measurement of the coordinates is shown in a table. The

results of the modeling conducted point to the fact that the algorithm obtained for processing signals in a passive multiposition measuring system assures high precision in determining the coordinates of objects. Figures 2; tables 1; references: 5 Russian.
[70-6415]

UDC 621.391.8

ESTIMATION OF INPUT POWER MOMENTS BASED ON FINITE SAMPLE SELECTION OF SIGNALS AT RADAR RECEIVER OUTPUT

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian
Vol 26, No 11, Nov 83 (manuscript received 21 Jun 82) pp 65-68

LEONT'YEV, V. V.

[Abstract] During an investigation of the dispersive properties of piloted objects, it is necessary to estimate the average power of the echo signal. It is known from the literature that gamma-distribution and logarithmic normal distribution are sufficiently general statistical models of the echo powers. In addition, other works have considered the potential characteristics of an estimate of the average power for the distributions mentioned. These works show that the problem of technical realization of a device which brings about an optimum estimate turns out to be complicated. Consequently, the present brief communication conducts an investigation of the quasi-optimum evaluation of the average power. This problem is solved by the method of averaging a finite number of signals at the output of a measuring device, which in the general case has a nonlinear transfer function, i.e., at first the average value of the signal amplitude at the output of the measuring instrument receiver is evaluated and then the quasi-optimum evaluation of the average power of the reflected signal is calculated. Figures 2; references 5: 4 Russian, 1 Western.
[70-6415]

UDC 621.396.964.34

ACCOUNT OF A PRIORI AMBIGUITY IN PROBLEM OF STATISTICAL OPTIMIZATION OF PHASE DIRECTION FINDING

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian
Vol 26, No 11, Nov 83 (manuscript received after revision 30 Sep 82) pp 86-88

DENISOV, V. P. and DOROSHENKO, V. G.

[Abstract] Under real conditions, in the case of a multibase phase direction finder operating with respect to fluctuating signals on the routes of tropospheric propagation, Matrix $B_{\phi}$ (the reciprocal correlation matrix of phase errors) is a priori unknown because it depends on the distance to the radiation source,

the type of route, the weather conditions, and the like. The present brief communication is devoted to overcoming this ambiguity during statistical optimization of direction finders. The results of the study make it possible to conclude: 1) Within the limits of the signal model taken, the self-adjusting approach to construction of the multiple base direction finders is not rational because it does not give a significant advantage in comparison with a "stringent" algorithm of treatment, designed with respect to some means characteristic of the signals; and 2) The principle of minimax make it possible to determine the parameters of a "stringent" system of processing phase difference of the signal according to the given limits of change of the signal, depending on the conditions of use of the direction finder. Figures 1; references: 4 Russian. [70-6415]

UDC 525.2.047:621.391.244.029.4

# SPECTRAL CHARACTERISTICS OF EARTH'S NATURAL RANDOM FIELD IN FREQUENCY RANGE FROM A FEW HERTZ UP TO 50 KHZ (REVIEW)

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 28, No 9, Sep 83
(manuscript received 22 Mar 82) pp 1681-1697

REMIZOV, L. T. and OLEYNIKOVA, I. V.

[Abstract] Because data on the natural random radio noise field of the earth published up to now have a member of drawbacks which limit their practical application, this paper systematizes the existing material on such noise in a frequency range from fractions of a Hertz up to 50 KHz by representing the noise in spectral density units and by classifying these data with respect to latitude and seasonal criteria. The electrical and magnetic field are treated separately, because the directivity of magnetic field detection and the omnidirectional nature of electrical field reception at such frequencies preclude any determination of their strengths with sufficient precision. Only the vertical electrical and horizontal magnetic fields are treated, because data on the field strength of the other components are extremely limited. Primary attention is devoted to experimental material and the available calculated data are mentioned only by way of comparison. Because the data on extremely low frequencies for the vertical electrical fields are limited by the technical difficulties of such measurements, this component is considered down to a lower limit of a few Hertz, while for the magnetic field, the limit reaches hundredths of a Hertz. Extensive tables summarize the available information on these fields, citing authors and bibliographic sources, year of publication, frequency range, measurement site, times, and supporting organization or country. The spectral density of the vertical electrical field (in $V/[m \cdot Hz^{1/2}]$) and horizontal magnetic field (in $A/[m \cdot Hz^{1/2}]$) are plotted as a function of frequenncy in recapitulating the tabulated data. The necessity of additional systematic field measurements at various latitudes for frequencies below 10 KHz is noted. Frequencies below 10 Hz require separate treatment and the range of frequencies below a few Hertz requires additional experimental study. The contribution of such physical mechanisms as thunderstorm and magnetospheric sources is not clear. Figures 14; tables 2; references 47: 12 Russian, 35 Western.
[51-8225]

UDC 537.874.6:621.318.134

ELECTROMAGNETIC WAVE DIFFRACTION AT PARTIALLY METALLIZED SLENDER GYROTROPIC CYLINDER

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 28, No 9, Sep 83
(manuscript received 18 Jan 82) pp 1698-1703

POPOV, V. P.

[Abstract] A plane wave is diffracted at a ferrite cylinder which is uniformly magnetized along its axis and partially covered with a thin metal coating. The static magnetic field is parallel to the longitudinal axis and the electrical field of the incident wave is polarized along this same axis. In this case, half of the ribs existing at the cylinder surface become singular in a particular range of ferrite magnetization. The magnetic field at a singular rib edge has a nonintegrable singularity if the losses in the ferrites are not considered. This singularity is caused by the power flux of the sector unidirectional magnetostatic wave (UMW) directed towards the rib, where this wave is excited by the extrinsic field in the vicinity of each of the ribs formed by the coating on the cylinder surface. The occurrence of such "hot" lines at the cylinder surface is responsible for considerable absorption of the incident wave energy, even with little dissipation in the ferrite. This paper analytically solves the case of a slender cylinder, where a quasi-static approximation can be used. When there is a small slot between the ferrite and the metal, the sector wave powder at each rib edge is entirely expended on the excitation of a slot UMW which carries the energy along the slot from the edge. Because of the narrowness of the slot, even with low losses in the ferrite, the slot wave is rapidly attenuated and does not reach the nearest rib edge. Otherwise, this wave would excite a sector UMW which in turn would carry power away from the adjacent edge. This would ultimately lead to no power absorption from the incident wave. The existence of finite losses though in actual media makes it possible not only to select uniquely the class of solutions, but also to avoid changing the qualitative form of the solution with the incorporation of a new small parameter in the problem (the slot width in this case). The essence of the resonance phenomenon which occurs under certain conditions is also explained. Figures 2; references 8: 7 Russian, 1 Western in Russian translation.
[51-8225]

UDC 621.396.67.01

ON THE INFLUENCE OF THE SHIELD ON ANNULAR TRAVELING WAVE ANTENNA OPERATION

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 28, No 9, Sep 83
(manuscript received 13 May 82) pp 1708-1713

KONTOROVICH, M. I. and NOVIKOV, Yu. N.

[Abstract] The efficient application of annular traveling wave antennas requires knowledge of the radiation characteristics as a function of the dimensions of the circular shielding screen, which is an integral part of the

structure; its dimensions determine the overall size of the antenna. The directional pattern, polarization, back radiation and overall radiated power can be found if the current induced in the shield is calculated for a specific excitation current. The induced surface current is found for the case where an extrinsic annular traveling wave current flows at some height above the shield, which takes the form of a conducting disk. The radius of the disk is directly proportional to the wavelength. Integral equations are derived and solved in order to find the projections of the desired current. The radial and azimuthal projections of the surface current are then shown graphically as a function of the disk size in relative units, along with the directional gain of the antenna in directions along the axis of rotation of the disk. Using the FORTRAN-IV algorithm derived here, the number of iteration cycles was 50 to 70 when the error in the determination of the free terms and kernels of the equations was about $10^{-8}$. Calculating one variant for a specified disk diameter and ring height took about 1 minute on a YeS-1033 computer. The projections of the surface current, directional patterns and ellipticity as well as the overall radiated power are computed; the memory requirement is 80 Kb. The data on the induced currents allow for their use in calculating the radiation characteristics, without being limited to the far field, as well as determining shield dimensions. Figures 3; references 5: 4 Russian, 1 Western in Russian translation.
[51-8225]

UDC 621.391

COMPENSATING FOR PHASE DISTORTIONS IN SPACE-TIME APERTURES

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 28, No 9, Sep 83
(manuscript received 31 Aug 81) pp 1730-1739

ZHULINA, Yu. V.

[Abstract] The motion of an object whose image is constructed with a spatial aperture in which the distortions are considered to be time independent places limitations on the coherent accumulation time. When synthesizing an aperture in time in the case of long observation times, the phase distortions cannot be considered "frozen" in time and it is necessary to solve the problem of compensating for the time dependent distortions. The signal received at a particular point in space when it is transmitted from some other point and returned from a target is represented as a function of the transmission frequency, the time dependent distribution of the complex amplitudes at the target surface, the phase distortions in the transmitting positions, the phase distortions in the receiving position, the point coordinate vector at the target surface, the transmitted waveform which is assumed to be a sufficiently narrow band for the waveform to be independent of the point coordinate at the target, the point in time of the transmission by the transmitting position, the coordinate of the center of target mass and the additive noise at the reception point. An optimal algorithm for the composite construction of images and cancellation of phase distortions in such apertures is synthesized based on the concept of a likelihood

maximum. Target image estimation is conducted for the case of fixed phase distortions, when the phase distortions are estimated and when the fluctuation errors in the measurements of these distortions are estimated. Analytical expressions are also derived in order to estimate the impace of phase distortion measurement errors on image quality. References: 2 Russian. [51-8225]

UDC 621.391

SEQUENTIAL SIGNAL DETECTION IN MULTICHANNEL SYSTEMS USING COMBINED STATISTIC

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 28, No 9, Sep 83
(manuscript received 3 Nov 81) pp 1740-1743

VLASOV, I. B., KUZ'MINA, Ye. K. and SOLOV'YEV, G. N.

[Abstract] The problem of signal detection in multichannel systems, which is essentially that of deciding in favor of either the hypothesis $H_0$ that no signal is present or the hypothesis $H_1$ that a signal is present in one or more channels, can be solved by a variety of procedures (Neumann-Pearson, Marcus-Swirling, etc.). This paper considers the case where the procedures for testing $H_0$ and $H_1$ employ different sample value statistics; such techniques are called combined statistic procedures (CSP). The following decision making rule is analyzed: The alternative $H_{1j}$ in each channel is checked by comparison with the Wald threshold $A_1$ of the partial detection statistic. If this detection statistic is equal to or greater than $A_1$ in the k-th step in the L-th channel, a decision is made in favor of the alternative $H_{1L}$, and the detection statistic is excluded from the $H_0$ test operation. A generalized non-detection statistic is generated from the values of the earlier detection statistic which are less than $A_1$, based on which is decision is made in favor of $H_0$, which is simultaneously the decision to terminate the trial as a whole. The accumulation of the statistic in those channels where the detection statistic is greater than or equal to $A_1$ can be terminated immediately after intersecting the upper threshold or continued until completing the trial. From the standpoint of proving the hypothesis $H_0$, this procedure using a combined statistic differs not at all from the technique where the resolution is ignored, and consequently, with a lower Wald threshold of $B_1$ and a minimum average duration of $\bar{n}_M(H_0)$, provides for a particular calculated probability. When signals are present though, each of them is detected independently, and the information on its parameters which is contained in the detection statistic is completely preserved. Because of the difficulties involved in an analytical solution, the proposed procedure was mathematical simulated for the case of the detection of a signal having specified independent Rayleigh amplitude fluctuations. The mathematical expection $\bar{n}_M(H_{0\ \&\ 1})$ and the mean square deviation of the duration $[Dn_M(H_{0\ \&\ 1})]^{1/2}$ for the sequential procedures treated in this paper were then plotted as a function of the number of channels based on data from experiments not recounted here. The volume of the experimental series was 100 trials. It is shown that the combined statistic multichannel sequential detection procedure preserves the resolution during detection and at the same time has a minimum

average duration of the decision making in the absence of signals. The computed values of the error probabilities are assured with constant resolving thresholds, whose values do not depend on the noise and signal parameters. The appropriate circuit designs do not encounter any serious engineering difficulties. The authors are grateful to B. A. Rozanov for his useful discussion of this paper. Figures 1; references 11: 8 Russian, 3 Western in Russian translation. [51-8225]

UDC 621.391

SPECIFIC FEATURES OF ADAPTIVE SPATIAL CANCELLATION OF PASSIVE INTERFERENCE

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 28, No 9, Sep 83 (manuscript received 10 Mar 82) pp 1752-1759

ABRAMOVICH, Yu. I. and KACHUR, V. G.

[Abstract] Spatial filtering can be used to suppress high-power interfering returns falling outside the main lobe of the directional pattern of a radar receiving antenna. Because the matrix for the spatial correlation coefficients of passive interference is determined solely by the angular distribution of the interference, optimal spatial processing in the antenna aperture in this case is the same as for jamming incoming from the same directions. A significant difference is the fact that in suppressing passive interference, the tuning speed which governs the duration of the uncompensated portion of the noise (the "edge") is one of the major characteristics of the adaptation process. This makes it appropriate to study the efficiency of adaptive interference cancellation for tuning techniques which assure the ultimate speed. The requisite conditions are established for adaptive spatial suppression of passive interference, taking into account the statistical dependence of the time sequence of teaching vectors, which determines the spatial configuration of the interference and the type of transmitted signal. With a high degree of timewise correlation of the returns, they can be suppressed by a spatial filter which does not involve the creation of "troughs" in the directional pattern of the interference directions. This suppression is also effective in the case of a considerable angular coverage of the interference, when high suppression of the pattern sidelobes is not feasible, if only the radial extent of the interference is substantially smaller than a transmitted signal resolution element. Figures 6; tables 1; references: 4 Russian. [51-8225]

UDC 621.496.96:519.213

## NORMALIZED SIGNAL POWER DISTRIBUTION

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 28, No 9, Sep 83
(manuscript received 21 Jul 82) pp 1864-1868

ATAYANTS, B. A., YEZERSKIY, V. V. and KARPOV, A. F.

[Abstract] The received signal in certain engineering problems is the realization of a nonsteady-state random process and is determined by the readouts of the instantaneous power. It can be represented by the products of the information components and the multiplicative noise in the form of a constant random factor. This representation, which reflects the random energy changes in the signal, holds true if the multiplicative interference is a slower process than the transmitted message. The interfering parameter is eliminated through functional transforms of the signals which make it invariant with respect to the interference. This paper finds the distribution for the values of the instantaneous power of a signal normalized in accordance with one such noise eliminating functional signal transform, which normalizes the readouts with respect to the overall signal power and studies the properties of this distribution. Although the detailed mathematical treatment is not illustrated with any sample calculations or circuitry, it demonstrates that the discovered distribution of the normalized instantaneous power readouts of a random signal is a generalization of the well-known multi-dimensional Dirichlet distribution, and in particular, its one-dimensional analog, the beta-distribution. This generalization arises when the limitations existing in a Wilkes problem on the values of the scale parameters of the initial gamma distributions are eliminated, and consists in the appearance of additional parameters which expand the multiplicity of probability distribution forms. Figures 1; references 4: 2 Russian, 2 Western, 1 Russian in translation.
[51-8225]

UDC 621.396.96

## DETERMINATION OF MAIN DIRECTION OF SEA WAVE PROPAGATION USING HF AIRCRAFT RADAR

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 28, No 9, Sep 83
(manuscript received 14 Jun 82) pp 1871-1873

GARNAKER'YAN, A. A.

[Abstract] During 1981 and 1982 a pulsed shortwave radar operating at 10 meters from an aircraft was used to study the possibility of determining the main direction of sea wave propagation in the Black Sea. The aircraft made 14 test flights, flying in a circular pattern with a radius of 7 to 8 km at altitudes of 0.5 to 2 km. The length of the sea waves in the direction of flight was measured every 10° around the circle using an indicator on board the aircraft. Polar plots of the anisotropy of the sea wave agitation were drawn from the

data and the major direction of wave travel was detemrined. This was checked against similar plots derived from aerial photographs taken at the same time. The disparity between the two sets of data never exceeded 15°. The results confirm the conclusions of the brief theoretical discussion in the first part of this paper that it is possible to determine sea wave direction, the degree of anisotropy and the angular distribution function of the wave energy from aircraft observations in the shortwave band. No further data are provided for the equipment specifications or performance. Figures 1; references: 6 Russian. [51-8225]

UDC 621.391:519.2

OPTIMIZATION OF ALGORITHM FOR SEQUENTIAL SCANNING OF SPACE OF REFERENCE STANDARDS IN DETERMINISTIC RADAR SIGNAL CLASSIFIER

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 28, No 9, Sep 83 (manuscript received 30 Mar 82) pp 1873-1875

VAGAPOV, A. M. and LOPAT'KO, N. P.

[Abstract] One of the important tasks of modern electronic systems for observing a radar return field is the real time identification of the registered signal. This problem is solved in special signal classifiers after measuring a certain multidimensional information criterion of the class, which includes the carrier frequency, the pulse repetition rate, pulse width, intrapulse modulation parameters, etc. Within the space X of an informational criterion, each class n occupies some subset $X_n$. This paper analyzes digital deterministic classifiers for which the subsets $X_n$ do not intersect and are called reference standards. When the unknown signal is fed into the analyzer, the reference standard space is sequentially scanned (in steps) and in some step, $u_n$ = 1, 2, ..., N, a decision is made as to whether the incoming signal belongs to the class n. The algorithm for scanning the reference standard space is defined by a particular vector and the complete set of all possible algorithms is a set of permutations of the numbers 1, 2, ..., N containing N! algorithms. The number of the step in which the decision is made in a sequential analyzer depends on the number of the class n to which the incoming signal belongs and the scanning algorithm. The questions arises concerning the choice of the algorithm which is optimal in a certain sense under conditions of apriori ambiguity in the evolution of the parameter n with time. It is assumed here that this ambiguity is described by a particular probability distribution of the signal classes being identified which is either known or predictable in a finite time range. An optimality function is adduced, the relevant optimization problem is solved and a general representation is given for the minimum average number of steps prior to making a decision in the analyzer of the reference standards, depending on the probability distribution. The strictly theoretical treatment which utilizes the property of a uniform distribution of the algorithms on a specified hypercircle is not illustrated with any particular circuitry or applications. The optimality criterion selected here provides for practically the maximum average carrying capacity of a classifier when a random signal flow is observed. References: 2 Russian.
[51-8225

UDC 621.396.962:629.7

## RESOLVING POWER OF RADAR WITH SYNTHESIZED ANTENNA APERTURE AT ANY OBSERVATION ANGLE

Moscow RADIOTEKHNIKA in Russian No 9, Sep 83 (manuscript received, after completion, 5 May 83) pp 18-20

TOLSTOV, Ye. F. and SHAPOVALOV, A. V.

[Abstract] The resolving power of a radar with synthesized antenna aperture is defined, for estimating purposes, as the width of the signal function characterizing the response to a single point target. The azimuthal resolution is, accordingly, calculated from the azimuthal signal function (synthesized radiation pattern) at the 3 dB level. The product of amplitude modulation G(t) of the reflected signal and a weight function E(t), both functions of time, is assumed to be normalizable to G(t)E(t) =1 so that only the exponential factor under the integral over one signal period describing the radiation pattern needs to be evaluated. The width of the radiation pattern (signal function) corresponds to the resolution, only over the range of angles within which symmetric components do not intersect. At lower angles, as the azimuth of a target approaches zero, it is more expedient to define the resolution as the angle equal to the width of the radiation pattern plus the angular distance between its principal maxima. Figures 4; references: 1 Russian. [57-2415]

UDC 621.371:621.396.663

## METHOD OF REDUCING MULTIBEAM EFFECT ON ACCURACY OF DETERMINATION OF RADIO WAVE ARRIVAL ANGLE

Moscow RADIOTEKHNIKA in Russian No 9, Sep 83 (manuscript received, after completion, 13 Jan 83) pp 69-72

AVRAMIDI, I. G., BARABASHOV, B. G. and VERTOGRADOV, G. G.

[Abstract] Direction finding by the phase-difference method with a multibeam short-wave receiver is made difficult by interference of waves, which distorts the phase surfaces and thus introduces errors in the determination of wave arrival angles. One method of reducing this effect is statistical averaging of phase readings. The principle is demonstrated on the simplest case of a two-antenna array with a given aperture and azimuth. In the close-spacing approximation thecomplex voltage at each receiver antenna is represented as the sum of plane waves $u_{1,2} = \sum_{m=1}^{N} u_m e^{-j\varphi_m}$ and the phase difference between them is expressed accordingly, there being $L = N(N-1)/2$ independent random phases in the case of N beams. Calculations are continued for decametric waves with one dominant beam $u_1$ ($u_m/u_1 = \rho < 1$), in which case the distribution of random phases is approximately uniform with a probability density of $1/2\pi$ over

the $(-\pi, \pi)$ interval. The results indicate that generally statistical averaging reduces the error in reading the phase angle of the dominant beam from a quantity proportional to o to a quantity proportional to $\rho^4$. This is revealed more precisely in the specific case of N=2 beams where one is dominant, where statistical averaging reduces the effect of the second beam on the readings most appreciably when specular components dominate. Figures 1; references 7: 4 Russian, 3 (?) Western (2 in Russian translation).
[57-2415]

UDC 621.314:621.385.6

ANALYTICAL DESIGN OF HIGH-EFFICIENCY MICROWAVE RECTIFIER WITH SCHOTTKY-BARRIER DIODE

Moscow RADIOTEKHNIKA in Russian No 10, Oct 83 (manuscript received, after completion, 30 Mar 83) pp 41-44

BOYAKHCHYAN, G. P., VANKE, V. A., LESOTA, S. K., MASLOVSKIY, F. N. and NOVITSKIY, V. A.

[Abstract] Low-loss Schottky-varrier diodes on Au-GaAs structures are considered for conversion of microwave power to d.c. power in such systems as receiver antennas. Design and performance calculations are shown, assuming an ideal filter passing only the fundamental-frequency component from the source on the input side and an ideal filter passing only the d.c. component to the load on the output side. The calculations are based on an equivalent circuit of a diode which includes capacitance of the barrier as well as resistances of the semiconductor bulk, the substrate, contact tabs and lead wires, and also inductance of the leads and capacitance of the holder. Expressions are derived for the input resistance and the efficiency of the device, the former an important factor in matching the rectifier to the microwave source and the latter peaking at 94% over the 0.5-5 W range of input power. The results of these analytical calculations agree within 5% with earlier calculations by numerical methods. Figures 1; tables 1; references 8: 5 Russian, 3 Western.
[75-2415]

UDC 621.396.67

ALGORITHM OF DIGITAL PROCEEDINGS OF SIGNALS IN AIRCRAFT RECEIVER ANTENNA ARRAYS

Moscow RADIOTEKHNIKA in Russian No 10, Oct 83 (manuscript received, after condensation, 12 Apr 83) pp 47-50

BOGACHEV, A. S.

[Abstract] An algorithm was proposed earlier (RADIOTEKHNIKA No 6, 1978) for plotting the radiation pattern of phased receiver antenna arrays mounted on nonmaneuverable objects by digital processing of signals. Here this algorithm is

extended to the radiation pattern of phased receiver antenna arrays on board of aircraft subject to yawing, pitching, and rolling. The complex "digital" pattern at any k-th discrete instant of time is defined in terms of binary codes appearing at the outputs of a quadrature pair of analog-to-digital converters in the n-th channel and corresponding signals at the outputs of a quadrature pair of phase detectors. Focusing the peak of the radiation pattern in a given direction under conditions of yaw, pitch, and roll requires appropriate conversion of the analytical expressions for the weighting factors, which is done on the basis of known vector-matrix relations between corresponding coordinates of any one point in two Cartesian systems with common origin. The effect of errors of yaw, pitch, and roll measurement on the characteristics of the radiation pattern is evaluated for the special case of an equidistant linear array with a large number of signal quantization levels and a high signal-to-noise ratio at the outputs of the phase detectors. The errors of these three angles are included in calculating the mathematical expectation of the pattern modulus squared, with only the first three terms of the Taylor series expansion retained, and are found to make the major lobe appear wider with a smaller maximum and flatter dips. Figures 4; references: 2 Russian. [75-2415]

UDC 621.396.677.75

CONICAL DIELECTRIC ANTENNA

Moscow RADIOTEKHNIKA in Russian No 11, Nov 83 (manuscript received after completion,9 Mar 83) pp 65-68

VASIL'YEV, Ye. N., SEDEL'NIKOVA, Z. V. and SEREGINA, A. R.

[Abstract] Based to a very large extent on the previous work of Ye. N. Vasil'yev, the paper rigorously solves the problem of exciting a conical dielectric antenna with the use of a system of integral equations. The results of a calculation of the distribution of equivalent currents are presented. Directional diagrams for dielectric antennas with a small conical angle corresponding to real antennas are studied. It is shown that the physical processes for forming radiation characteristics is close to the same processes in cylindrical antennas. Figures 4; references: 6 Russian. [83-6415]

UDC 621.371.334 + 535.42/44

DEFRACTION OF ELEKTROMAGNETIC WAVES AT REFLECTOR-TYPE CONDUCTIVE ARRAY

Moscow RADIOTEKHNIKA in Russian No 11, Nov 83 (manuscript received after reduction, 2 Feb 83) pp 68-71

KORSUNOV, V. V.

[Abstract] The necessity exists for the creation of a simple and satisfactory universal numerical algorithm for analysis of the properties of conductive arrays. The present paper considers this problem in a rigorous formulation

based on the method of functional equations. A virtue of the numerical method developed is the satisfactory simplicity in conjunction with the rigorous strictness of the problem statement, which makes it possible to perform an analysis for both conductive and transparent arrays of the reflector type of arbitrary profile within wide limits of change of the material parameters. Figures 3; references: 5 Russian.
[83-6415]

UDC 621.396.677.49

INVESTIGATION OF CERTAIN CHARACTERISTICS OF THINNED OUT ANTENNA ARRAYS WITH DIGITAL PROCESSING OF SIGNALS

Moscow RADIOTEKHNIKA in Russian No 11, Nov 83 (manuscript received after completion, 5 Apr 83) pp 71-74

DANILEVSKIY, L. N., DOMANOV, Yu. A., KOROBKO, O. V., and TAUROGINSKIY, B. I.

[Abstract] Three methods for thinning out the number of elements in antenna arrays are considered. In two instances, thinning out algorithms are included in the arrangement of the elements of the antenna array, according to the random or determinate law. In this case, the algorithm for processing signals from the outputs of the elements remains traditional. It is shown that a gain in the number of useable elements is accomplished by losses in the signal-to-noise ratio and a higher level of the lateral field. It is possible, however, to change the circuit for processing the signals of a thinned out antenna array so that after fulfillment of several conditions, the characteristics of a complete antenna array and a thinned out antenna array will be identical. Precisely such thinned out antenna arrays are the object of investigation in the present paper. The results of this investigation show that for large values of the discrete phase $\Delta \phi$, the level of the lateral lobes of the thinned out antenna array is considerably higher than in a complete antenna array and only when $\Delta \phi \to 0$ does the levels of the lateral lobes of the complete and thinned out antenna arrays become approximately identical. Here, the direction of phasing of the antenna array also has a significant value. It is possible to show that for a given discrete phased $\Delta\phi$, a direction of phasing $\alpha_0$ also exists during which a complete and thinned out antenna array are equivalent. In particular, in a limited case (with $\alpha_0 = 0$), it is always possible to replace a complete antenna array by a thinned out one without deterioration of the output characteristics. Figures 3; references 6: 4 Russian, 2 Western.
[83-6415]

UDC 621.397.61.006 + 621.396.712.3

# USE OF QUASI-RANDOM SCANNING DURING DESIGN OF SOUND SCATTERING SURFACES

Moscow TEKHNIKA KINO I TELEVIDENIYA in Russian No 3, Mar 83 pp 3-6

LANE, M. Yu., PAVLOV, S. A., and TOLSTYKH, G. D., All-Union Scientific-Research Institute of Television and Radio Broadcasting; Moscow Aviation Institute imeni S. Ordzhonikidze

[Abstract] The paper considers a design of sound scattering surfaces which have good sound scattering properties, not in one but in two mutually perpendicular surfaces. This design is obtained by replacing grooves in a plane by cells of a square cross-section, the depth of which varies according to the principle of any two-dimensional sequence with good correlation properties. A similar "caisson" design was mentioned in a 1979 paper by M. Schroeder but the results of tests were not cited. A series of experiments was made in order to determine the sound scattering properties of the design by the use of the scale modelling method. The design model was an array made of smooth, carefully sanded veneer (1.26 x 0.63 m), containing 512 (16 x 32) identical square in plan cells. The various relationships were selected in accordance with the recommendations in M. Schroeder's 1979 paper. The models were tested in an anechoic chamber. Harmonic oscillations with frequencies lying in the 1.25--20 kHz range served as the test signal. The reflection diagrams were determined in the limits of $\pm$ 80° for the case of normal incidence of sound waves. The following figures are shown in the paper: 1) Reflection diagrams of an array at frequencies of 1.25 kHz and 5 kHz; 2) Reflection diagrams of smooth surface at the same frequencies; and 3) Reflection diagrams of model in vertical plane at frequencies of 1.25 kHz, 2.5 kHz and 5 kHz. The authors believe that the results of the experiments, "an insignificant part of which are presented in the paper," make it possible to recommend the designs considered for processing of parts of the interior of rooms where assurance of uniform dispersion of sound energy is required. In the future it is proposed to use similar "caisson" designs for processing of the ceilings of some musical radio broadcasting studios. Figures 4; references 5: 1 Russian, 4 Western.
[63-6415]

UDC 778.5:621.397.13

## VIDEO TAPE ELECTRONIC EDITING SYSTEM

Moscow TEKHNIKA KINO I TELEVIDENIYA in Russian No 3, Mar 83 pp 6-11

POTASHNIKOV, A. I. and STUDENIKIN, V. A., All-Union Scientific-Research Institute of Motion Pictures and Photography (NIKFI)

[Abstract] The paper considers the importance of editing systems in the production of feature films, and the problems involved. The PMV-3 experimental video tape electronic editing system developed by NIKFI is described. The unit, which is for use during shooting of feature films on location, enters into the composition of the KNK-M specialized automobile motion picture-television complex. The PMV-3 was developed on the basis of the VO-2860 Sony video tape recorder. The following items are shown and discussed: 1) Block diagrams of the overall PMV-3 system, and tape editing desk; 2) The organs of manual control and the display units of the PMV-3; 3) A diagram of the code pulses; and 4) Diagrams of the search, video recording, and editing algorithms realizable by the PMV-3. At present, work is under way at the NIKFI on the creation of a system of electronic editing for simultaneous operation with 3 to 4 video tape recorders--sources of information, and with the possibility of including in this system equipment for recording and reproduction of phonograms. Conclusions are made with respect to the affect of the electronic editing system. Figures 6; references 6: 4 Russian, 1 German, 1 English.
[63-6415]

UDC 621.391.837.1:621.397.13

## VISION ANISOTROPY AND TV SYSTEM RESOLUTION

Moscow TEKHNIKA KINO I TELEVIDENIYA in Russian No 3, Mar 83 pp 30-33

DMITRIYEV, A. Ya., YEFIMOV, V. P., ZAYTSEV, A. G., and KRAVCHENKO, V. S.

[Abstract] During draft planning of TV systems intended for reproduction of small-sized objects it is necessary to evaluate precisely the real resolutions and the expected distortion, taking into account the phycho-physiological features of the observer. With this in mind, the paper considers the relatively recently clarified dependence of the change of resolution of vision on the orientation of the graduations of test charts. In addition, the following data are examined in connection with vision anistropy and the characteristic form of the energy distribution in the spatial-frequency spectra of lenses: 1) Resolution of vision with respect to different directions; 2) Space-frequency characteristics of vision; 3) Average space-frequency characteristics of objects; 4) Space frequencies for various directions; 5) Fields of useful and perceptible information for horizontal scanning; and fields of useful and perceptible information for scanning at a 45° angle. It is possible to use the phenomena examined to increase the efficiency of TV systems, printing, and other items. Figures 5; references 6: 3 Russian, 3 Western.
[63-6415]

UDC 621.397.611

CODING DEVICE IN SYSTEMS FOR RECORDING TV SIGNALS ON DISK CARRIER

Moscow TEKHNIKA KINO I TELEVIDENIYA in Russian No 3, Mar 83 pp 33-35

DROBIT, M. I., KORNIYENKO, G. P., LOBANOV, V. V. and EKTOV, A. I.

[Abstract] The principal features of coding devices to be used in optical recording of TV signals on a disk carrier are considered. An experimental model of a coding device developed by the authors is described. The device is intended for conversion of the brightness and color components of a composite TV signal, in combination with the signal of the sound accompaniment, into a FM signal for recording on a disk carrier by the optical method. A functional diagram of the experimental coding device and its technical parameters are presented. Figures 2; references 4: 2 Russian, 2 Western.
[63-6415]

UDC 621.385.832.56

INTEGRATED COORDINATE PHOTORECEIVING AREA MATRICES IN SYSTEMS FOR DETECTING THE CONTOURS OF OPTICAL OBJECTS

Moscow TEKHNIKA KINO I TELEVIDENIYA in Russian No 3, Mar 83 pp 44-48

STINOV, M. N., Khabarovsk Branch, Novosibirsk Electrotechnical Institute of Communications

[Abstract] The paper is concerned with integrated coordinate photoreceiving area matrices used in spatial filtering of the contours of objects. A series of models of systems with simultaneous-sequence filtration of contours with output of information on a video control device are described. These models use native integrated coordinate photoreceiving area matrices (IKFPM), the types of which are shown. A block diagram of the mating of an IKFPM with a video control device, a circuit for matching a contour detector with a TV standard, and a circuit for mating a system of analog treatment with a video control device are presented. Figures 5; references 7: 4 Russian, 1 Russian based on 1967-1977 foreign patents, 1 Japanese and 1 Western.
[63-6415]

UDC 621.397.6-182.3

SOUND ACCOMPANIMENT EQUIPMENT FOR MOBILE TELEVISION STATIONS

Moscow TEKHNIKA KINO I TELEVIDENIYA in Russian No 3, Mar 83 pp 53-54

VINOGRADOV, A. V. and KRIVOROTOVA, S. P., Kirovograd Radio Products Plants

[Abstract] Small-dimension mobile television stations are distinguished by high effectiveness and mobility. At present, development and improvement of

mobile television stations are given the most serious attention. In particular, it is intended to use such stations at TV correspondence points. A completed television program includes the signals of sound accompaniment, musical records, commentary, interviews, and so on. The principal component in the formation of the sound accompaniment signals is the sound director's desk. The paper describes such a desk developed by the Special Design Office of the Kirovograd Radio Products Plant. A block diagram of the formation of a sound program and supervision at the sound director's desk is presented. References: 1 Russian. [63-6415]

UDC 681.335.2

ANALOG-TO-DIGITAL CONVERTERS FOR SIGNALS WITH WIDE FREQUENCY SPECTRUM

Moscow RADIOTEKHNIKA in Russian No 9, Sep 83 (manuscript received, after completion, 20 Feb 83) pp 62-65

VAVILOV, V. A., MAMRO, V. M. and TSYSOV, V. A.

[Abstract] In order to be able to widen the spectrum of a signal processed by a high-speed analog-to-digital converter containing a parallel array of level comparators, it is necessary to reduce the errors of these comparators caused by their zone of ambiguity and variance of response time. This is achieved by prediscretization of the signal with the aid of an analog memory. The signal in such a memory is sampled either by means of a commutating circuit, the latter determining the time constant of signal integration so that the memory capacitor cannot be optimized but must be traded off, or by the method of stroboscopic oscillography. This method is preferable and, accordingly, the analog memory should be designed for operation in this mode. The number and the configuration of threshold elements will match the parameters of the quantization process, the time constant of signal integration being commutated with a threshold device which consists of a differential amplifier and a trigger-stopper. In this way, integration ceases to limit the acceptable width of the signal spectrum. Such a threshold device and this method of signal sampling through integration was implemented and tested in the microassembly of a 1970-73 model 04PV13 4-digit analog-to-digital converter. A signal with a spectrum wider than 100 MHz and amplitude varying over a range of 150 mV could be discretized at frequencies up to 25 MHz with intervals down to 4 ns, shorter intervals being feasible upon relaxation of the stability requirements. Figures 3; references: 5 Russian.
[57-2415]

UDC 621.391.832.2:621.397.13.088

CORRECTION OF SIGNAL NON-UNIFORMITY IN CHARGE COUPLED DEVICE-BASED UNITS FOR FILTERING CONTOURS OF OPTICAL OBJECTS

Moscow TEKHNIKA KINO I TELEVIDENIYA in Russian No 10, Oct 83 pp 52-56

MUSLIMOV, Sh. R. and STINOV, M. N.

[Abstract] The paper considers the problem of decreasing the effect of inefficiency of transfer on the characteristics of a device for filtration of the contours of optical objects. The device, which is based on charge-coupled units, is to be used in adaptive television broadcasting systems. A simplified block diagram of the device is explained. Alternatives for correction of the inefficiency of transfer are considered, and a block diagram for implementation of a correcting signal channel is presented. Figures 4; references 10: 5 Russian, 5 Western (1 in Russian translation).
[88-6415]

UDC 621.397.13

SPACE FILTRATION OF RECTILINEAR FRAGMENTS ALONG IMAGE CONTOUR

Moscow RADIOTEKHNIKA in Russian No 10, Oct 83 (manuscript received, after completion, 7 Feb 83) pp 17-20

KRIVCHENKO, A. N.

[Abstract] An effective method of image transmission in some television systems is coding the images of regular objects such as polyhedra by extraction of rectilinear fragments and rejection of incidental data. This requires a highly interference-immune detection and filtration algorithm. The principle is demonstrated on a brightness jump in space at a rectilinear contrast boundary (straight edge). The necessary performance characteristics of such a detector-filter for a vertical straight edge are calculated, assuming a Gaussian approximation of its pulse response characteristic and a normal quasi-isotropic exponentially correlated background noise. The practical feasibility of constructing such a filter depends on matching the delay time, equal to the duration of a line signal, with the time interval of the given finite difference. The frequency deviation of video signals in discrete delay lines can be designed to facilitate detection of variously sloping straight edges by means of a single filter or an array of identical ones. Figures 5; references 5: 3 Russian, 2 Western (1 in Russian translation).
[75-2415]

TELEVISION INTERFERENCE

Moscow RADIO In Russian No 10, Oct 83 pp 17-20

KURINYY, Yu., UA9ACZ, USSR sports master of International Class, Chelyabinsk

[Abstract] Causes of television interference are traced to various sources of electromagnetic radiation other than the antenna, namely the transceiver and power amplifier as well as coaxial connecting cables and signal cables. An analysis of statistical data indicates that the three main factors which enhance interference are overloading the receiver, pickup from adjacent channels, and poor shielding of the transmitter field. Accordingly, electromagnetic shielding of the transmitter field and filtration of the transmitter output signal require careful attention. Important rules for shielding are that the shield be grounded at more then one point, equalization currents be barred from the shield, reflection of waves and standing waves by avoided by proper matching of capacitances and inductances, and all transmitter output cables be isolated from each other. Most suitable as inductances for this application are choke coils would on ferrite ring cores. Combination-frequency (sum, difference) signal components are eliminated by correct selection of conversion frequencies in the exciter. The basic three methods of suppressing signal-frequency harmonics are using a special output amplifier, the harmonic being automatically eliminated in a push-pull configuration, use of sharp tank circuits, and inclusion of special-purpose "television" filters. The design of all three countermeasures is based on application of filter theory to television frequency ranges and specific transmitter geometry. Figures 11; tables 4; references 3: 2 Russian, 1 Western (in Russian translation).
[67-2415]

CONVERSION OF R-250 RECEIVER INTO TRANSCEIVER

Moscow RADIO in Russian No 10, Oct 83 p 21

BUNIN, S., UB5UN, USSR sports master

[Abstract] In 1982 (RADIO, No 3 QUA) radio amateur UB5JD in Simferopol proposed a way to convert an R-250 radio receiver into a transceiver. The idea has stimulated inquires from many other radio amateurs. For their benefit is shown here the complete circuit diagram of the modified receiver components and the single-sideband signal generator. Particularly interesting are the UHF part and the i-f amplifier. Care must be taken to install the relay near the indicator light panel and to supply the latter through a shielded two-wire cable, to remove the calibrator antenna wire from the compartment of the second mixer stage, to generate a 0.7 V - 215 kHz single-sideband signal, to connect capacitor C2 directly to the plate of tube L5, to connect capacitor 222 into the plate circuit of tube L2 and use the coupling coil 220 as output inductance, with a 75-100 ohm resistance load R2 across for suppression of resonance at 7 MHz, to tune all tank circuits connected to the relay connector groups for operation in the transmitter mode, and not to exceed an output voltage of 2 V

and thus avoid damage at weak points during operation of the receiver mode. If the transceiver is intended for telegraph operation only, it suffices to use the receiver quartz oscillator for the generator of manipulated signals. Figures 1.
[67-2415]

SHORT-RANGE RADIO PROVING FACILITY

Moscow RADIO in Russian No 10, Oct 83 pp 23-24

VOLKOV, A., Penza

[Abstract] A military short-range proving facility has been built by the All-Union Voluntary Society for Assistance to USSR Army, Air Force and Navy at its Joint Technical School in Penza. It consists of two compartments, each containing 17 test cells with glass doors and windows. On the table in each cell stand a radio transmitter, a radio receiver, a field telephone set, and a lamp. Necessary documents are filed in cabinets. There are available ten radio routes from R104M transmitters and eleven monitoring points (five R311 receivers, five R326 receiver, one R108M transmitter) so that 33 cadets can work simultaneously. For psychological training of cadets who have already completed their training in handling communication equipment, battle conditions are simulated by means of light and sound equipment. The latter includes a "Mayak-203" sound recorder, a 2-channel 2x50 W low-frequency amplifier, and a color-music generating system which feeds 8 ceiling lamps and 10 floor lamps installed in passages between the test cells, also automobile headlights mounted on shafts of RD-0.9 reversible motors with switching from low to high beam and vice versa every 180° of rotation. All simulation equipment, including interference generators, is controlled from a central panel and through a telephone exchange. Figures 4.
[67-2415]

UDC 721.316.726.078

STABILITY ANALYSIS OF PULSE SYSTEMS OF PHASE AUTOMATIC FREQUENCY CONTROL WITH VARIABLE REGULATION PERIOD

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 26, No 11, Nov 83 (manuscript received 2 Mar 82) pp 45-48

KARYAKIN, V. L. and MOROZOVA, L. A.

[Abstract] Using the method of point mapping, the paper investigates the stability of a pulse system of phase automatic frequency control, which in the general case has connected in a ring, a pulse-phase detector, a filter of lower frequencies, a control element, a tunable generator, a divider with a fixed coefficient of division, and a divider with a variable coefficient of division. Analytical expressions are found for the boundaries of the stability domains, with regard paid to the effect of the nonlinearity of the phase detector and the variable period of discretization. Figures 2; references: 5 Russian.
[70-6415]

UDC 621.391.8

# POTENTIAL CHARACTERISTICS OF RADIO SYSTEMS AND RADIO EQUIPMENT AND THEIR APPLICATION

Moscow RADIOTEKHNIKA in Russian No 11, Nov 83 (manuscript received after completion, 3 Feb 83) pp 27-33

GUTKIN, L. S.

[Abstract] The potential characteristics of radio systems (and radio equipment) are understood to be the best theoretically attainable values of their quality indices, confirming to some totality D of the initial data mathematically formulated beforehand. A combination of two methods--optimization and idealization--is used during determination of the potential characteristics. Optimization consists in the fact that the best possible values of the quality indices in all systems are sought, satisfying the initial data D and consequently called strictly acceptable. Idealization consists of a simplification of the initial data D such that it can only lead to an improvement of the quality indices under consideration. It is shown that in finding the potential value of a given quality index, it is necessary for a series of other quality indices to move to the category of a limited type of equality (or nonequality), i.e., it is essentially necessary to take them into account. Evidently, if all the quality indices except the one under consideration are neglected, then the problem of search for its potential (minimum) value loses meaning because this value in such conditions can be good as much as is desired (or bad as much as desired). The diagram of exchange between the indicators of precision, noise immunity and carrying capacity is considered and three examples are explored. Application of potential characteristics are presented. Determination of the potential characteristics of systems is particularly useful during scientific investigations (i.e., previous to the beginning of designing concrete systems) because during this a priori information proves to be a minimum and the application somehow of an arbitrary criterion of preference instead of the unconditional is the most troublesome and least justified. Figures 1; references: 3 Russian. [83-6415]

UDC 681.3.06:621.382.3

# ALGORITHM AND PROGRAM FOR CALCULATING LARGE INTEGRATED CIRCUITS

Kiev TEKHNICHESKAYA ELEKTRODINAMIKA in Russian No 4, Jul-Aug 83
(manuscript received 20 Apr 82) pp 103-105

BONDARENKO, VLADIMIR MIKHAYLOVICH, doctor of technical sciences, head of department, Institute of Electrodynamics, UkSSR Academy of Sciences, Kiev; AKHMETOV, BAKHYTZHAN STRAZHATDINOVICH, graduate student, Kiev State University and MARANOV, ALEKSANDR VIKTOROVICH, leading engineer, Institute of Electrodynamics, UkSSR Academy of Sciences, Kiev

[Abstract] This paper is a contrinuation of work primarily done by Bondarenko and Akhmetov in 1981 (2 papers) and 1982. The logical nature of functioning of systems for control of the devices of converting techniques planned for large integrated circuits provides the possibility of wide use of logical--electrical modeling for their analysis. The necessary condition for functioning of such programs is the presence of developed libraries of logical--electrical macromodel elements and their parameters. The indicated method of modeling was realized in a program of hybrid modeling of the digital large integrated system KomPAS-YeS, a block diagram of which is shown. In order to determine the parameters enumerated in the paper, a program of analysis of the electronic system is used, by virtue of which a program of hybrid designation was prepared. After the introduction of source information and its processing, a mathematical model of the circuit is formed. Subsequently, control is transferred to a procedure for forming the operating body of the parameters. After determination of the macromodels, a procedure for modeling begins, which as a method of analysis uses the method of summation of finite increments, adjusted for solution of the problem of logical--electrical modeling of large integrated circuits. The program is written in the PL/1, FORTRAN and ASSEMBLER systems. Its concrete implementation is the YeS-1033 and YeS-1040 electronic computers. Figures 2; references: 3 Russian.
[76-6415]

UDC 621.372.54

## AMPLITUDE-FREQUENCY CHARACTERISTIC OF TRACKING AMPLITUDE-MODULATION FILTER

Moscow RADIOTEKHNIKA in Russian No 9, Sep 83 (manuscript received 18 Feb 83) pp 33-36

SIMONTOV, I. M. and LEGA, Yu. G.

[Abstract] The amplitude-frequency characteristic of a tracking AM filter is calculated, considering that in such a filter the input signal is not only linearly amplified but also subject to nonlinear secondary modulation by a frequency-dependent low-frequency voltage. The calculations are based on a Taylor series expansion of the transfer ratio with a slowly varying complex gain and on an equivalent quadripole network representing a narrow-band i-f amplifier with a low-pass filter as modulator. The resulting expression, with both amplitude and frequency normalized, is convenient for analysis and synthesis of such filters, inasmuch as it contains only the secondary-modulation gain and derivatives of the amplifier gain as performance and design parameters. This is demonstrated on a tracking filter with a KP350B field-effect transistor in the tuned-amplifier stage. Figures 4; references: 4 Russian. [57-2415]

UDC 621.391

## DIRECT FREQUENCY SYNTHESIS BASED ON DIGITAL STRUCTURES

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 28, No 9, Sep 83 (manuscript received 29 Feb 80, after revision 2 Mar 83) pp 1765-1771

IVANOV, V. A.

[Abstract] The advantages of direct digital-frequency synthesizers are the speed of nominal frequency change, the extraordinarily small tuning step and the capability of generating arbitrary sets of even fractional frequencies. Nonetheless, parasitic-phase modulation of the output signals of such direct synthesizers limits their applications. This paper studies the possibilities of generating sequences which differ to a minimal extent from periodic sequences in terms of a minimax criterion introduced here. An algorithm is derived digital-frequency synthesis which is optimal with respect to a minimum of the maximum current integral error in the time position of the pulses. The ability to compensate for the digitization error is demonstrated with the use of a block diagram of the proposed device and the time traces of the pulses. The frequency synthesis technique allows for the timely determination of the initial data for generating each sequential pulse in the sequence being synthesized. In conjunction with the compensation for the predicted error, it also provides for the design of an ideal direct synthesizer in which the procedural error caused by the discrete nature of the time scale is theoretically eliminated or at least does not exceed errors of other kinds. This theoretical treatment presents no specific designs or examples of hardware. Figures 3; references 11: 9 Russian, 2 Western.
[51-8225]

UDC 621.396.662.072.6.078

## DYNAMICS OF AUTOMATIC FREQUENCY CONTROL SYSTEM WITH FREQUENCY-PHASE DETECTOR

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 28, No 9, Sep 83
(manuscript received 8 Jun 81) pp 1772-1777

BELYKH, V. N., MEL'NIKOVA, V. A. and PASHEV, G. P.

[Abstract] A digital frequency-phase detector behaves like a phase detector when the input frequencies are the same, but otherwise a DC error voltage is produced at the detector output with the polarity determined by the frequency difference sign. Such detectors are widely used in phase synchronization systems in order to expand the capture band. This paper analyzes an AFC system having a proportional integrating filter and a frequency-phase detector, whose piecewise-linear characteristic is a function of the phase difference and the difference frequency. A continuous model is developed for such second order phase synchronization systems and it is used to derive an analytical expression for the transient response time. The capture bandwidth in such systems with a frequency-phase detector coincides with the lock-on bandwidth. System behavior is illustrated graphically with a phase portrait of a "glued" conservative system and the phase trajectory which governs the transient time. Figures 5; references: 5 Russian.
[51-8225]

UDC 621.396.62:681.325.3

## STROBING TIME DURING ANALOG-TO-DIGITAL CONVERSION IN DIGITAL RADIO RECEIVERS

Moscow RADIOTEKHNIKA in Russian No 10, Oct 83 (manuscript received, after condensation, 26 Apr 83) pp 29-31

POBEREZHSKIY, Ye. S.

[Abstract] Design of digital radio receiver equipment includes deterination of the strobing time in the analog-to-digital converter, the latter usually preceded by an integrating sampler and storage. The strobing (integration) time must, accordingly, be sufficiently short to yield the instantaneous value of the varying voltage at the midpoint. The voltage is usually assumed to vary linearly over the integration interval, which imposes an upper bound on the strobing time such that the average error power resulting from this approximation will not exceed the quantization noise power. An analysis reveals that this upper bound can be raised by assuming a sinusoidal variation of the voltage over the integration interval in intermediate-frequency converters with almost constant center frequency and in high-frequency converters with the integration interval changing to follow changes of the center frequency. Figures 2; references 6: 4 Russian, 2 Western.
[75-2415]

UDC 621.372.54

SPECTRAL DENSITY OF NOISE VOLTAGE AT OUTPUT OF ACTIVE FILTERS

Moscow RADIOTEKHNIKA in Russian No 10, Oct 83 (manuscript received, after completion, 3 Mar 83) pp 52-55

CHERNYSHOV, Yu. I.

[Abstract] The spectral density of noise voltage in second-order active filters consisting of several operational amplifiers is calculated by extending the method used for such filters with a single operational amplifier as active element. The transfer function of second-order stages is generally $T_{21}(p)=K(p^2+ pQ_z^{-1}\omega_z + \omega_z^2)/(p^2 + pQ_0^{-1}\omega_0 + \omega_0^2)$ ($\omega_z$ and $Q_z$ - frequencies and Q-factors at zeros, $\omega_0$ and $Q_0$ - frequencies and Q-factors at poles). The equivalent circuit of a second-order stage consists of an operational amplifier behind a passive multipole network, with two noise current sources and one noise voltage source representing the noise characteristics of both. The noise sources associated with the operational amplifier are assumed to be noncorrelated and frequency-dependent. In addition there are two equivalent current sources representing thermal noise in the passive network. The latter has in most cases a zero internal admittance between its two terminals leading to the input of the operational amplifier, which simplifies the calculation. The results reveal that reducing the spectral density of noise voltage at the filter output requires using a filter with unity transfer ratio. By variously cascading second-order stages, one can construct low-pass, high-pass, band-pass, or band-elimination filters. In the interesting case of an active filter with three operational amplifiers, the spectral density of noise voltage depends not only on their amplitude-frequency and noise characteristics but also on the external resistances so that, with the amplifiers already selected, it can be reduced by decreasing those resistances. The method of analysis and calculation extends to higher-order active filters consisting of lower-order stages. Figures 2; tables 1; references 4: 3 Russian, 1 Western. [75-2415]

UDC 621.391

ADAPTIVE FILTERING OF POLARIZED SIGNALS

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 26, No 11, Nov 83 (manuscript received 19 Jul 82) pp 69-71

LIKHAREV, V. A. and MALASHKEVICH, V. V.

[Abstract] A 1974 report from the literature demonstrated that one of the characteristics of a polarized signal is the modulus of a polarized coefficient $r = E_2/E_1$ where $E_1$ and $E_2$ are the amplitudes of the enveloping orthogonal polarized components of the signal. The magnitude r, as shown in a 1976 report,

is substantially different for various classes of signals and noise. Consequently, the natural use is presented of polarized characteristics for selection of signals observed on a background of correlated noise with a different polarized structure. The present brief communication considers the operation of the filter of a polarized signal with a known value of the modulus of a polarized coefficient r of the receiving channels. The circuit of an adaptive polarized filter and a vector diagram of the polarized signals are shown. Figures 3; references 2: 1 Russian, 1 Western.
[70-6415]

UDC 621.372.54 + 621.372.58

## GYRATOR BAND-PASS FILTERS BASED ON PARALLEL CONNECTION OF RESONATORS

Moscow ELEKTROSVYAZ' in Russian No 11, Nov 83 (manuscript received 16 Apr 80) pp 46-50

SIDYAK, V. A., VERKHOVSKIY, Ya. M. and SHTERN, I. I.

[Abstract] The paper is concerned with an analysis of the circuits of band-pass filters (BPF) with gyrator equivalent inductances, the amplitude-frequency characteristics of gyrator BPF, and practical realization of BPF based on gyrators. It is shown that with the construction of BPF based on parallel-antiphase connection of resonators with gyrator equivalent inductances the number of matching amplifiers is decreased. Experimental investigations show that the BPF developed have satisfactory temperature stability and can find use as selective devices in multi-channel systems of information transmission. Figures 6; references 4: 3 Russian, 1 French (in Russian translation).
[86-6415]

UDC 621.372.852.13

## EQUIVALENT CIRCUITS OF SECTIONS OF COUPLED GRADED LINES WITH TEM WAVE

Moscow ELEKTROSVYAZ' in Russian No 11, Nov 83 (manuscript received 19 May 81) pp 50-54

BELOV, A. S. and KUZNETSOV, S. V.

[Abstract] Lately, interest has substantially increased in devices realized using graded coupled transmission lines (GCTL) with a TEM wave. They have new useful properties in comparison with devices based on uniform connected transmission lines. However, effective aids for their analysis and synthesis are almost completely absent in the literature, which undoubtedly restrains their practical application. This paper studies: 1) Parameters of the equivalent circuit of a GCTL; 2) Definition of GSTL parameters by an equivalent circuit; 3) Example of synthesis of one of the possible variations of band-pass filters (BPF) for GCTL; and 4) Example of design of BPF for a GCTL, based on canonical

sections with diagonal-open terminals. The results of an experiment are reported in which a BPF for the decimeter band was designed and produced with three resonators (4 sections of couple graded lines). A calculation was made of the Chebyshev characteristics with pulsations of 0.1 db and a relative transmission band of 5%. The experimental filter produced on the basis of fluoroplastic foil had a standing wave ratio $\leqslant 1.3$, an insertion loss $\leqslant 1.8$ db, a center frequency less than the "calculated" of 4%, and a width of the transmission band--at 15%. The overall dimensions of the experimental filter are 1.5 times smaller than an analogous filter based on uniform parallel-connected resonators in the first parasitic pass-band situated 2.1 times further, which coincided with calculations. Figures 6; references 6: 3 Russian, 3 Western (2 in Russian translation).
[86-6415]

UDC 621.315.22.3.013.001.24

## CALCULATION OF ELECTROMAGNETIC FIELD IN MULTILAYER CABLE SHIELDS

Moscow ELEKTROTEKHNIKA in Russian No 9, Sep 83 (manuscript received 9 Mar 83) pp 48-51

ABRAMOV, K. K. and PAS'KO, V. A., candidates of technical sciences

[Abstract] The paper is concerned with an algorithm for calculation of the dependences of the electromagnetic field strength components on the time, for multilayer cable shields, some containing layers of ferromagnetic materials. The algorithm was developed as applied to exterior (relative to the cable) influencing fields. The field is defined by a lonitudinal current $I_E(t)$ present with respect to the shield, or a longitudinal component of the electrical field $E_Z(t)$ with respect to the exterior circuit of the shield. In the work a system of differential equations in partial derivatives, describing the electromagnetic processes in the shield, is replaced by a system of nonlinear differential equations of the first order. The cross-section of the multilayer shield of a communication cable is shown. Figures 4; tables 2; references 9: 8 Russian, 1 Western.
[74-6415]

UDC 621.391

## RELATIVE CODING WITHOUT EXPANSION OF SPECTRUM

Moscow RADIOTEKHNIKA in Russian No 9, Sep 83 (manuscript received, after completion, 1 Mar 83) pp 12-17

DOLGOV, V. I.

[Abstract] A modem is synthesized for data coding and transmission by means of 16 biorthogonal signals which occupy a frequency channel of the same width as that of relative-phase modulation signals. The simplest method of generating a biorthogonal or quadrature basis is using four phases of the carrier $(0, \pi/2, -, 3\pi/2)$, with provisions made in the transmitter for either removing any phase ambiguity in the receiver or rendering the extraction of useful information in the receiver immune to such ambiguities. Any possible algorithm of

data processing by such a modem must, therefore, include removal of all ambiguities due to errors in phase determination. This is achieved by multibase relative coding of binary signals. An analysis of this method and its algorithm, or decision rule, reveals that its interference immunity is somewhat but not much lower than that of plain multibase coding. In different-coherent reception of binary signals, moreover, it is more energy efficient and does not require additional widening of the frequency band of the communication channel. Figures 1; tables 1; references 10: 8 Russian, 2 Western (1 in Russian translation).
[57-2415]

UDC 621.391.278

OPTIMUM ALGORITHMS OF SIGNAL FILTRATION IN RADIO ENGINEERING SYSTEMS FOR TRAJECTORY MEASUREMENTS

Moscow RADIOTEKHNIKA in Russian No 9, Sep 83 (manuscript received 2 Feb 83) pp 42-44

STRYUKOV, B. A.

[Abstract] For primary processing of trajectory measurements with radio engineering systems are considered algorithms of estimating the parameters of a useful signal $S(t,p)$ in an additive mixture with "white" noise $n(t)$ according to the criterion of maximum a posteriori probability $P(p/y)$. The form of signal $S(t,p)$ is assumed to be known and the input mixture $y(t)= S(t,p)+ n(t)$ to be a normal Markov process. Optimum algorithms are constructed on this basis in three stages. First the corresponding equation for the one-step likelihood function $P(y/p)$ is derived by standard procedures from the Fokker-Planck-Kolmogorov equation, then the rigorous relation between input process $y(t)$ and signal parameter p is utilized for converting this equation to one of the a posteriori probability function $P(p/y)$, and finally the latter equation is analyzed for explicit estimates of parameter p. The expression for the a posteriori probability density $\hat{P}(t,p)$ yields an equation of the receiver which can be modeled on a computer for the purpose of optimization with respect to accuracy. The optimum receiver is attainable under certain limitations on its noise noise band and signal tracking (equation solving) time, on the phase difference between $y(t)$ and $S(t)$, and with normalization of the input process $y(t)$. References: 4 Russian.
[57-2415]

UDC 621.376.5

OPTIMUM RECEPTION OF ANALOG PULSE SIGNALS IN PRESENCE OF NONGAUSSIAN INTERFERENCE

Moscow RADIOTEKHNIKA in Russian No 10, Oct 83 (manuscript received 2 Mar 83)
pp 7-13

FOMIN, A. F.

[Abstract] The effect of non-Gaussian interference on the reception of analog signals, specifically wideband pulse signals, is analyzed, assuming that an additive mixture $y(t) = s_c(\ ,t) + n(t)$ appears at the receiver input. By the process of sampling $y(t) = y(t_h)$ $(h = 1,\ldots,H)$, the receiver calculates the probability density function $w_p(n)$ for all possible values of $\lambda$. Assuming statistically independent samples, with the information carrying parameter $\lambda_0$ transmitting no power and remaining constant during the signal period, the conditions for optimum reception are established in the cases of PAM (pulse amplitude modulation) - FM (frequency modulation), PPM (pulse phase modulation) - AM (amplitude modulation), and PAM (pulse amplitude modulation) - PM (phase modulation) signals. The asymptotically optimum receiver must consist of a noninductive nonlinear quadripole network with an amplitude characteristic $Z(\ _0) = Z(y) - \frac{d}{dy} \ln w_p(y)$, a detector-filter which calculates the cross-correlation function, and a resolver which estimates the transmitted signal. The performance characteristics of such a receiver, namely its reliability and accuracy, are evaluated on the basis of two indicators: probability of anomalous errors and dispersion of normal error, respectively. References 7: 5 Russian, 2 Western.
[75-2415]

UDC 621.396.2

DATA TRANSMISSION WITH COLLECTIVE CONTROL OF RADIATED POWER

Moscow RADIOTEKHNIKA in Russian No 10, Oct 83 (manuscript received 17 Apr 83)
pp 23-26

GUT, R. E.

[Abstract] Multidirectional transmission over several radio lines which have varying characteristics and share a common energy source at the center is considered, such a collective use of a single energy source requiring adaptive control of the radiated power and its distribution between the lines. The algorithm of this power control is constructed from the standpoint of optimum signal transmission in terms of signal-to-noise radio. The algorithm yields the decision rule for the components of the optimum power-destination vector. The efficiency of any one radio line in the multidirectional array is evaluated in terms of probability of a break in the radio link, such a break being defined as a drop of the signal-to-noise ratio before a given floor level. The general results of calculations are particularized on the example of discrete messages

consisting of binary orthogonal signals transmitted to two optimum noncoherent receivers in different directions over statistically similar channels with Rayleigh fadeout characteristics. The author thanks V. M. Kirillova for performing calculations for the numerical example. Figures 2; references 6: 4 Russian, 2 Western.
[75-2415]

UDC 621.391.812.3

METHOD OF RECEPTION WITH TIME DIVERSITY

Moscow RADIOTEKHNIKA in Russian No 10, Oct 83 (manuscript received 3 Mar 83) pp 50-52

PANTIKYAN, R. T.

[Abstract] A method of reception with time diversity is proposed, applicable to short discrete messages, without using a separate prefix for removal of delay indeterminacy through synchronization. As a separation interval one is selected during which no error appears, with a window as wide as the length of a code word seeming to "slide" along the received sequence of code signals without synchronization. This method of decoding requires that the code be invariant with respect to cyclic shift and thus always retains the minimum separation. Contiguous classes of cyclic codes are suitable for this purpose, typically a q-ary cyclic code $C_0$ with a generating polynomial g(x) of length n and minimum separation d. For an original code $C_0$ of length $n= q^m - 1$ and dimensionality (number of informative symbols) k and contiguous code C of dimensionality $k'= k- m$, the additional redundancy needed for ensuring invariance is $m= \log_q(n+ 1)$, and thus sufficiently small. The decoder for this method consists of two analog generators with a register each, one register having k cells and the other having Nk cells, a NOR circuit with n- k outputs, a register having N(n- k) cells, a circuit which divides by the primitive polynomial g (x) (minimum polynomial of root $\beta$ of order n for a subcode of code $C_0$ with generating polynomial $g'(x)= g(x)g_\beta (x)$ to form the contiguous code), and a decoder of the synchronization syndrome. Such a decoder searches for the error-free time diversity interval continuously, which is preferable to "piecewise" search in decoding a code with a prefix necessarily longer than k. Figures 1; references 3: 2 Russian, 1 Western (in Russian translation).
[75-2415]

UDC 621.936.67.001.24

ERROR IN CALCULATION OF SPECTRA OF FINITE SIGNALS WITH AID OF INTERPOLATION SPLINES

Moscow RADIOTEKHNIKA in Russian No 10, Oct 83 pp 57-58

[Annotation of article deposited at the Central Scientific and Technical Institute 'Informsvyaz', No 231]

MISANS, P. A. and BEKERIS, E. P.

[Abstract] One method of calculating the spectra of finite real signals involves using a finite series of complex exponential basis functions and approximating such signals either with cubic interpolation splines or with rectangular orthogonal pulses. A comparative evaluation of both approximations, based on computer experiments, reveals that there are frequency ranges within which, respectively, one or the other approximation is more accurate. [75-2415]

UDC 621.315.2/3.001.1

MAIN TRENDS IN DEVELOPMENT OF CABLE INDUSTRY AND IN IMPROVEMENT OF CABLE AND WIRE TECHNOLOGY

Moscow ELEKTROTEKHNIKA in Russian No 10, Oct 83 pp 2-4

GREBLOV, I. M., chief, VPO (All-Union Planning Department) of "Soyuzelektrokabel'"

[Abstract] The main trends in development and improvement of cable and wire production involve introduction of new insulation systems and new manufacturing processes as well as mechanization and microcomputer-based automation. Power cables with polymer insulation will have thinner armor and the applicability of unarmored cables will expand. Communication cables will be designed with smaller wire sizes and more extensively with corrugated steel sheaths, a major role will also be played by optical fibers. New insulation systems are porous polyethylene for single coaxial communication cables in pulse-code modulation systems with multiplexing at frequencies up to 40 MHz, single-layer and double-layer high-temperature enamel, fiberglass, and enamel-glass for windings of electrical machines, enamel coating being hazardous because of toxic fumes and requiring protective measures in the production plant, polyimide-fluorocarbon film insulation for high-voltage d.c. machines, and heat-resistant synthetic rubbers such as ethylene-propylene caoutchouc and chlorosulfonated or chlorinated polyethylene. Developments in manufacturing processes include more extensive use of high-frequency and argon-arc welding and introduction of radiation technology, using electron accelerators and requiring safety measures. Production will improve as result of increased mechanization and automation. The economic impact on both producer and user should be tremendous, in terms of labor and material savings as well as better product quality and more efficient equipment performance. Automation alone should raise the fraction of high-quality cable

and wire products to 55.2% of the total volume, reduce the labor force by 15,000 on a relative basis and eliminate 4,600 manual jobs absolutely, with an overall industry-wide 92.5 million rubles saving of production costs over the eleventh Five-Year-Plan period.
[77-2415]

UDC 621.315.2/3.004.18

MAIN TRENDS IN REDUCTION OF MATERIAL CONTENT IN CABLE PRODUCTS DURING ELEVENTH FIVE-YEAR-PLAN PERIOD

Moscow ELEKTROTEKHNIKA in Russian No 10, Oct 83 (manuscript received 4 Mar 83) pp 4-6

GOLUBKOV, V. V., engineer and MOROVA, A. G., engineer, All-Union Scientific-Research Institute of Cable Industry

[Abstract] Reduction of the material content in cable products targeted for the eleventh Five-Year Plan period mainly affects five materials: copper and aluminum by 2.6% each, tin by 7.2%, lead by 34%, and polyethylene by 3.4%, such a weight reduction being equivalent to a total saving of over 500 million rubles. This will be made possible by replacement of lead with less scarce substitute materials, by introduction of new high-temperature insulation materials such as impregnated paper for 1-35 kV cables, and by redesign of 110-220 kV cables, also by more economical and efficient equipment of 1500 kV transmission lines (Ekibastuz-Center) and nuclear power plants. Additional factors contributing to more economical use of materials will be more extensive introduction of optical fibers in telephone and other communications networks, use of 180-200°C polyimide-fluorocarbon film and 155-180°C enamel (PEVL, PEMF, PEF) insulation for windings of electrical machines, and radiation-modified immersible insulation (BPDO) in marine equipment. All planning and projections are based on functional-cost analysis and supply-delivery estimates with the 1978-81 period serving as reference. In terms of material cost, the saving in nonferrous metals per 1000 rubles worth of cable products will be by 4.6% in copper, 2.5% in aluminum, and 35.4% in lead by the end of the eleventh Five-Year-Plan period.
[77-2415]

UDC 621.315.346:621.38.011

THERMOMECHANICAL STRESSES IN RADIO-FREQUENCY CABLES

Moscow ELEKTROTEKHNIKA in Russian No 10, Oct 83 (manuscript received 4 Mar 83) pp 11-14

LOBANOV, A. V., engineer, PAVLOV, A. A., candidate of technical sciences and KHRENKOV, N. N., candidate of technical sciences, Experimental Design Office of Cable Industry

[Abstract] Use of semirigid miniature r-f cables with Teflon insulation in microwave equipment operating over wide frequency and temperature ranges is

meant to ensure good matching and high interference immunity. However, appreciable temperature changes during heating or cooling cause mechanical stresses between conductors and insulation which may result in irreversible dimensional changes followed by changes in electrical characteristics. These changes are evaluated here on the basis of conventional stress analysis, with a cable treated as a structure consisting of three coaxial cylinders: solid inner conductor-insulation-hollow outer conductor. The critical load on the conductors, in terms of elastic limit or yield point, is found to be determined by the maximum allowable shearing stress. The general results are applicable to cables RK 50-1.5-22 and RK 50-3-38, characterized by a thick outer conductor and by a temperature rating of 160°C under a mechanical shearing force of 40 newton or 30 newton, respectively, and normal operating conditions otherwise. Figures 4; tables 1; references 4: 3 Russian, 1 Western.
[77-2415]

UDC 621.315.2:621.78.012.5

HEAT TREATMENT OF CABLES IN ELECTROMAGNETIC MICROWAVE FIELD

Moscow ELEKTROTEKHNIKA in Russian No 10, Oct 83 (manuscript received 4 Mar 83) pp 16-18

PRODON, G. P., candidate of technical sciences, VNIIP (expansion unknown)

[Abstract] Heat treatment of cables by a microwave field ensures fast and uniform heating for thermochemical interlinkage of polymer insulation, protection, or filler. An experimental method has been developed for studying the behavior of cable-grade polymers in microwave fields and establishing the optimum process conditions. The equipment consists of a test chamber which consists of a rectangular waveguide 90x45 $mm^2$ in cross section and 450 mm long, with a 45 mm high Teflon insert holding the specimen, energized by a 2375±50 MHz - 2.5 kW oscillator through an attenuator for power regulation over the 5-100% nominal range. A directional coupler with 30 dB attenuation records the reflected power and automatically switches the oscillator off in case of excessive heating. The temperature is measured continuously by an infrared pyrometer through a window in the waveguide cutoff region and is checked with a thermocouple immediately after the heat has been turned off. Comparative tests performed on a dozen insulating materials indicate that, in terms of the nominal heating rate, the items most suitable for microwave heat treatment are rubber based on weakly polar polychloroprene caoutchouc (13.3°C/min), rubber based on weakly polar caoutchouc with high content of carbon black as filler (1.81-5.00 °C/min), and chlorosulfonated polyethylene with Cl and $SO_3$ in the macromolecule (6.70°C/min with 30% carbon black). Vulcanization and interlinkage of these polymers by microwave heating are efficient and economical, especially in the case of unfilled polyethylene composites, copolymerization of ethylene and vinyl acetate (0.50°C/min with 28% vinyl acetate) being of particular interest for cable filling and sealing. Figures 4; tables 1; references: 2 Russian.
[77-2415]

UDC 621.315.212:629.7.048.7.001.4

## EXPERIMENTAL EVALUATION OF PROMISING HEAT-RESISTANT RADIO-FREQUENCY CABLES OF SEMIRIGID CONSTRUCTION

Moscow ELEKTROTEKHNIKA in Russian No 10, Oct 83 (manuscript received 24 Mar 83) pp 20-22

DOREZYUK, I. I., candidate of technical sciences, KORSHUNOVA, N. N., engineer, POPOV, N. F., candidate of technical sciences and RUBTSOV, B. N., engineer, Experimental Design Office of Cable Industry

[Abstract] Frequency and temperature characteristics of semirigid coaxial r-f cables (RK 50-1.5-22, RK 50-2-25, RK 50-4-27S) have been evaluated in an experimental study, taking into consideration that the operating temperature of these cables must be much lower (85-125°C) than the maximum allowable temperature for Teflon insulation (200-250°C) so as to avoid rupture of conductors caused by excessive microwave heating. Cables for this study were insulated by three different methods: ram extrusion, screw extrusion, and film coating. The frequency dependence of the attenuation coefficient, the dielectric loss tangent, the voltage standing-wave ratio, and the power capacity was measured over the 1-18 GHz range, the temperature dependence of the phase shift was measured over the -40-(+100)°C range. An evaluation of the data with reference to theoretical relations and by statistical analysis indicates that optimizing the insulation requires a tradeoff between low VSWR and high fatigue strength, taking into consideration that Teflon has an anomalously high coefficient of linear thermal expansion. It is nevertheless feasible to optimize the cable design with respect to any one or several cable performance parameters. Figures 5; tables 2; references: 4 Russian.
[77-2415]

UDC 621.391.266

## OPTIMUM RECEPTION OF DETERMINISTIC SIGNALS WITH MINIMUM FREQUENCY KEYING

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 26, No 11, Nov 83 (manuscript received after revision 21 Oct 82) pp 30-35

KONSTANTINOV, P. A., PARAMONOV, A. A. and YAMANOV, D. N.

[Abstract] A block diagram of a device for optimum reception of deterministic signals with minimum frequency keying is synthesized with the use of an assumption concerning a delay in the admission of a solution for one timing interval. The circuit contains two channels in each of which is realized coherent processing of a signal to a sum or difference frequency $\omega_0 \pm \omega_p$. A formula is obtained for the probability of erroneous reception of the deterministic signals. The proposed method of synthesis can also be applied to other signals with an intersymbol information connection, e.g., to FM signals with a continuous phase in the case of arbitrary keying indices. Figures 2; references 3: 1 Russian, 2 Western.
[70-6415]

UDC 621.391.019

DISCRETE CONTROL OF ENSEMBLE OF SIGNALS IN ADAPTIVE RADIO SYSTEMS WITH LUMPED NOISE

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 26, No 11, Nov 83 (manuscript received, after revision, 20 Jul 82) pp 82-84

ORLOVSKIY, Yu. Ye. and KRIVOSHYEIN, I. V.

[Abstract] The ba sic difficulties in problems of optimum synthesis of adaptive radio systems with nonlinear control of signals are connected with the necessity for constructing an analytical model of signals, making it possible to formulate a sufficiently general variation of the problem. A determined advantage in this direction is presented by one unit of the theory of controlled random processes, validated in a 1977 Russian paper, which makes it possible in a clear manner to express the distribution of random processes in a system by means of an algorithm of the work of its objectives, and, furthermore, to describe a wide class of permissible algorithms, including those linear and nonlinear. In terms of this method, the present brief communication formulates the problem of synthesizing an algorithm for optimum control of a signal ensemble used for transmission of information. A block diagram is presented of a radio system with control, the units of which are the transmitter-receivers of distant stations transmitting useful information, and distant stations receiving it; and straight line and reverse radio channels. The overall system is explained. Figures 2; references: 2 Russian.
[70-6415]

UDC 621.391.1.019.4

GROWTH IN USSR OF THEORY OF OPTIMUM FILTRATION OF COMMUNICATIONS

Moscow RADIOTEKHNIKA in Russian No 11, Nov 83 (manuscript received 10 Mar 83) pp 11-27

TIKHONOV, V. I.

[Abstract] The problem of filtration of communications is systematically expressed at the engineering level. In a survey of the history during the past 20 years of the development of optimum filtration of communications by native scientists, the concrete uses of this theory in radio engineering are considered. A general statement of the problem of filtration is presented, with definitions concerned with the reception of radio signals on a background of noise. Methods for solution of filtration problems are explained. Radio use of the Markov theory of filtration, first used by R. L. Stratonovich in 1960, is described. References 89: 80 Russian, 9 Western (5 in Russian translation).
[83-6415]

UDC 621.391.2

ALGORITHM FOR EVALUATION OF RADIO INTERFERENCE LEVELS WITH LOW SENSITIVITY TO CHANGE OF THEIR CORRELATION

Moscow RADIOTEKHNIKA in Russian No 11, Nov 83 (manuscript received, after completion, 14 Mar 83) pp 62-64

SHAROV, A. N.

[Abstract] The paper solves the problem of synthesizing an analyzer of the levels of random radio interference with low sensitivity to change of their correlation properties. A distinctive feature of this analyzer is the use at each step of the measurements of flowing information concerning the real errors of evaluation. The results are presented in tabular form of statistical modelling of the algorithm with the use of an electronic computer. These results bear witness to the high precision of evaluation and the low sensitivity of the synthesized algorithm to the correlation properties of radio interference. Figures 1; tables 1; references 6: 4 Russian, 2 Western (1 in Russian translation).
[83-6415]

UDC 621.391.82:621.317.2

COMPENSATOR OF POWER CONCENTRATION OF INTERFERENCE PROVIDING FOR DUPLEX OPERATION OF SHIPBORNE COMMUNICATION SYSTEMS

Moscow RADIOTEKHNIKA in Russian No 11, Nov 83 (manuscript received, after reduction, 13 Apr 83) pp 93-94

SHCHEPETKIN, F. V. and GROSHEV, G. A.

[Abstract] In maritime practice the necessity often appears for simultaneous operation of the ship's radio transmitters and receivers in the decimeter band with a difference of frequency of 15...30 kHz. In order to solve the problem of assuring electromagnetic compatibility with such small frequency differences, a compensator of interference is used which makes it possible to suppress at the receiver input not only the component corresponding to the fundamental radiation of the transmitter, but also the components of the radiation spectrum of the transmitter, feeding directly into the transmission band. The means for realization of the compensator are considered and the results of experimental investigation in the frequency band 4-26 MHz described. Ships tests of the compensator were conducted on the mother ship "Lenin's Way" in a region of the east central Atlantic. Figures 3; references 2: 1 Russian, 1 Western.
[83-6415]

UDC 681.325:621.39

MICROELECTRONICS AND MICROPROCESSORS IN COMMUNICATION TECHNOLOGY

Moscow ELEKTROSVYAZ' in Russian No 11, Nov 83 (manuscript received 27 Jun 83) pp 1-7

GOROKHOV, V. A. and YEFIMOV, I. Ye.

[Abstract] The paper notes that the introduction of microelectronics with a high level of integration is not a simple replacement of an old elemental base by a new one, but as a rule it requires fundamental changes in the principles of the structure and method of designing of devices and communication systems, in particular a general penetration into communication technology of digital principles of processing and transmission of information. The following items are considered in detail: 1) Increase in level of integration of microelectronic products and its effect on the technical and economic characteristics of communication equipment; 2) Effect of microprocessor means and specialized large integrated circuits on the principles of construction of communication technology and systems; and 3) Prospects for growth of tele-information service based on microelec-ronic means. It is concluded that the creation of communication equipment with high technical and economic indices and provision for production of digital telephone means consistent with the needs for development of the networks is possible only on a basis of large and super large integrated circuits, including microprocessors and microelectronic computers. The necessity for thorough unification of equipment is connected with the development of specialized large integrated circuits, with an active participation in it of enterprises, creating and operating communication equipment. The achievements of microelectronics makes it possible to predict integration in the near future of communication networks and electronic computers into a single tele-information network with free access, and an electronic library. Figures 4; tables 2; references 15: 14 Russian, 1 Western.
[86-6415]

UDC 621.396.946

GROUND STATION OF 'INTERSPUTNIK' IN IRAQ

Moscow ELEKTROSVYAZ' in Russian No 11, Nov 83 (manuscript received 18 Apr 83) pp 8-10

BOROVKOV, V. A. and KURILOV, S. P.

[Abstract] During the second half of 1982, with the participation of Soviet and Japanese specialists, a new ground station of the "Intersputnik" system was installed and placed into operation. The station is located on the territory of a cosmic complex found not far from Dudzheyl, approximately 60 kilometers from Baghdad, the capital of Iraq. With respect to construction and system parameters, the new station is close to that of the ground station

of "Intersputnik" in Algeria. The station is equipped with a parabolic antenna which has a mirror diameter of 11 meters, has a figure of merit not less than 32 db/K, and was made with equipment of Soviet and Japanese production. The paper lists the equipment of the station and a block diagram is presented of the overall layout. Figures 2; references: 4 Russian.
[86-6415]

UDC 621.395.51:621.315(001.2)

PROBLEMS OF INCREASING RELIABILITY OF CABLE MAIN LINES IN AREAS WITH OCCURRENCE OF PERMAFROST ROCKS

Moscow ELEKTROSVYAZ' in Russian No 11, Nov 83 (manuscript received 29 Oct 81) pp 11-13

KALYAGIN, A. M.

[Abstract] The zone which has negative average multiyear temperature of rocks occupies more than 10 million square kilometers or 47% of the territory of the USSR. Almost 100% of the cable long lines of Siberia and the extreme north are found in areas with occurrence of permafrost rocks, where many processes take place which attack cables, giving rise to their deformation, breaking their cores and rupturing sheathing and casings. The object of this paper is to attract a wide circle of specialists to the development of general recommendations with respect to an increase of the reliability of cable long lines in areas with permafrost rocks. The problem of protection of cable long lines from thunderstorm overvoltages is discussed, and a number of general long-term problems are outlined. In order to reveal sections of frozen ground dangers it is necessary to accomplish a large amount of engineering--geological and hydrogeological investigations. These investigations are significantly facilitated by the use of aerometers. These devices can find successful use in solving the following basic problems: establishment of the boundaries of frozen strata; determination of the depth of seasonal freezing and thawing; exposure of regularity of structure of frozen strata; study of temperature field in frozen rocks strata; establishment of nature of freezing processes; investigation of connections between parameters of frozen strata and environment. References: 6 Russian.
[86-6415]

UDC 621.315.212

EXPERIMENTAL INVESTIGATIONS OF SUPERCONDUCTING COMMUNICATION LINES (SURVEY)

Moscow ELEKTROSVYAZ' in Russian No 11, Nov 83 (manuscript received 19 May 80) pp 17-21

GAL'PEROVICH, D. Ya.

[Abstract] In the last 10 years [note date of manuscript] new directions for communication lines--superconducting--appeared and were developed. Investigation of superconducting communication lines began in 1970. The first simulated

and experimental specimens of superconducting cables for communication lines were prepared and investigated in Japan and the USSR. These cables mainly differed from one another. In Japan a specialized superconducting cable was developed, and in the USSR a composite superconducting power and information service cable. The present paper presents a survey of the principal published results of the development and tests of specimens of both composite and specialized superconducting cables, and the promising directions of work in superconducting communication lines are considered. The paper concludes that it is possible to establish that early in the 80's, the creation will be successfully accomplished of experimental specimens of both specialized superconducting communications and composite superconducting power and information service cables as well as concrete methods for further growth of this new type of control systems. Figures 3; tables 3; references 21: 15 Russian, 6 Western.
[86-6415]

UDC 621.395.3.004.12

BASIC CONCEPTS IN FIELD OF QUALITY SERVICING OF TELEPHONE NETWORK SUBSCRIBERS

Moscow ELEKTROSVYAZ' in Russian No 11, Nov 83 (manuscript received 2 Nov 81) pp 22-26

BAKLANOV, Yu. A., DEDOBORSHCH, V. G., IVANOVA, O. N., MISULOVIN, L. Ya., PARILOV, V. P. and ROGINSKIY, V. N. (deceased)

[Abstract] The paper studies the term "Quality servicing of telephone network subscribers", taking into account factors appearing in the system "man-means of communication-environment," which unites the subscriber and the operational personnel with the telephone network through a process of their interaction in the environment. The following factors which determine the quality of the processes of servicing are described and examples are furnished of the basic values of the qualitative indices: 1) Quality of assignment of means of communication to subscribers; 2) Quality of use by subscribers of means of communication; 3) Quality of servicing of telephone signals and quality of information transmission; 4) Quality of servicing subscribers; 5) Quality of installation of telephone networks; 6) Quality of means of communication; and 7) Quality of operation of telephone networks. The paper concludes that it is necessary to consider the quality of servicing subscribers as a totality of the qualities of the separate processes of servicing, flowing in the system "man-means of communication-environment." The principal processes of servicing are: assigning means of communication to the use of subscribers, use by subscribers of the means of communication, and servicing telephone signals and transmission of information. The quality of the processes of servicing subscribers is determined by the totality of the characteristics of processes which influence the consumer's evaluation of their results. The degree of usefulness of the properties of the processes for servicing in order to satisfy the needs of subscribers in telephone communication in evaluated by the quality indices of the processes of servicing subscribers. The standard value of these

indices must be given, taking account of the capital outlay of the operational expenditures and rates. The quality of servicing subscribers depends on a number of factors which it is possible to divide into three groups: human factors, quality of communication means and installations and factors of means. Quality control should be directed to an increase of the quality of servicing subscribers of the telephone network with a given technical and economic level of development of the network. Figures 2; tables 1; references 10: 7 Russian, 3 Western.
[86-6415]

UDC 621.395.31:519.2

## MATHEMATICAL MODEL OF SIGNALIZATION SYSTEM NO 7 USING BASIC METHOD OF ERROR CORRECTION

Moscow ELEKTROSVYAZ' in Russian No 11, Nov 83 (manuscript received 6 Jul 82) pp 27-30

BASHARIN, G. P., ZHARKOV, M. A., NAUMOV, V. A. and SAMUYLOV, K. Ye.

[Abstract] This paper is concerned with Signalization System No 7, the specifications for which were issued by the International Telegraph and Telephone Committee (ITTC) in 1981. The following items are considered: 1) Brief description of characteristic features of Signalization System No 7; 2) Characteristics of basic method of error correction; 3) Method of calculating probability of delivery of significant signal units to one signaling section, using basic method of error correction; and 4) Example of calculating delays of signal units in System No 7 on long-distance networks using basic method of error correction. It is concluded that the proposed mathematical model of Signalization System No 7 makes it possible to evaluate the field of application of the basic method of error correction on General Channel of Signalization networks. In this case, if the transmission rate is 64 kbit/sec, then their propagation time in the coupling loop must not exceed 30 magacycles, and the permissible load--0.7 erlang. In the future it will be necessary to investigate the method of error correction in System No 7 by forced cyclical repetition, the use of which on the telephone networks of the USSR is also possible but standard working formulas for it are practically absent in the recommendations of the ITTC. Figures 4; references 12: 10 Russian, 2 Western.
[86-6415]

UDC 621.395.344

DEGENTRALIZED CONTROL IN ELECTRONIC SWITCHING SYSTEMS (SURVEY)

Moscow ELEKTROSVYAZ' in Russian No 11, Nov 83 (manuscript received 2 Jun 82) pp 31-33

SHUL'TS, Kh. P., German Democratic Republic

[Abstract] The paper considers the following aspects of control in electronic switching systems: 1) Principles of function distribution; 2) Modularity of systems; 3) Regional processors; 4) AXE-10 System [the control system AP@-210 of the AXE-10 system includes regional processing, a control processor and a bus for interprocessor communications]; 5) ESS-4 Bell system; 6) EWSD System; and 7) ITT-12 System. Figures 3; references: 7 nonSoviet.
[86-6415]

UDC 621.396.62-52

TELECONTROL OF GROUP OF SHORT-WAVE AUTOMATED RECEIVERS

Moscow ELEKTROSVYAZ' in Russian No 11, Nov 83 (manuscript received 11 Apr 83) pp 34-36

FRANTSEV, E. P. and SUPERFIN, Ya. Z.

[Abstract] In accordance with the 11th Five-Year Plan, work is under way on automation of the means for short-wave radio communication. This will make it possible to release operational personnel of radio centers. Existing automatic equipment for the receivers of short-wave radio centers--the receivers "Prizma", R-155P, and the antenna switches UKPR, "Trezubets-1", "Trezubets-2"--make it possible to establish remote control from Radio Bureau technical groups of receiving equipment. It is possible for receivers of one and of different types to be in the composition of a technical group. The quantitative composition of a group (up to 10 individuals) is determined by the optimum load for the on duty operators of the radio bureau and the specific staffing of the work space in the control rooms of the radio centers. Not less than 150 commands and 200 signals are necessary for control by such technical groups. These are divided into the following categories: 1) Address commands and signals for confirmation of choice of address; 2) Commands for control of a receiving device and signals for confirmation of command fulfillment; 3) Commands for control of an antenna switch and signals for confirmation of command fulfillment; 4) Operational-emergency signals concerning condition of receiving device; 5) Inquiry signals (with respect to operator inquiry); and 6) Service commands and signals of telecommunication system. A block diagram of the equipment complex of a tele-control group of receivers is presented and explained. Figures 3; references: 1 Russian.
[86-6415]

UDC 621.396.43:621.396.67.012.12

# INFLUENCE OF DIRECTIONAL PATTERN WIDTH ON STABILITY OF PERFORMANCE OF INTERVALS OF LINE-OF-SIGHT RADIO RELAY LINES

Moscow ELEKTROSVYAZ' in Russian No 11, Nov 83 (manuscript received 8 Apr 83) pp 36-40

NADENENKO, L. V., SVYATOGOR, V. V. and BRIKMAN, G. A.

[Abstract] In recent years, pencil-beam antennas with an amplification efficiency of more than 43 db began to be used on line-of-sight radio relay lines. The width of the radiation pattern of such antennas becomes communsurable with random variations of the angles of rmergence and arrival of radio waves in the surface layer of the troposphere, and in addition thermal and wind deformation of the antenna supports becomes possible, which leads to impairment of the normal orientation of the antenna. As a result a significant reduction of the stability of the signal at intervals of the radio relay line is observed. At the end of 1979, this problem of the effect of the radiation pattern width on the statistical characteristics of the signal was considered at the Section of Antennas and Radio Wave Propagation of the Scientific-Technical Council of the USSR Ministry of Communications. The Section noted the necessity for conducting extensive investigations of this pressing problem, with the objective of determining the effect of the above factors and making more precise the dimensions of radio relay line antennas. The present paper reports the results of investigations conducted by various countries, and discusses the effect of deformation of the supports. In order to decrease the effect of this deformation on the stability of orientation of the antennas, it is necessary to increase the level of geodetic and technical inspection of the supports by the operational services. Figures 5; references 11: 5 Russian, 6 Western. [86-6415]

UDC 681.325.5-181.4

## ORGANIZATION OF REGISTER MEMORY IN MICROPROCESSOR SECTIONS

Moscow RADIOTEKHNIKA in Russian No 9, Sep 83 (manuscript received 29 Feb 83) pp 66-68

LEBEDEVA, S. I. and PYATRAUSKAS, A. -V. V.

[Abstract] Microprocessor sections K1800 for medium-capacity computers have been produced with optimum utilization of emitter-coupled-logic technology. Particularly interesting is the organization of registers in the microcircuits driving the main memory. There are registers for storage of data, for storage of addresses, and for storage of commands. They are all based on M-S triggers responding to the front of synchronizing pulses. Any register array consists of four unconnected registers and each register consists of four triggers. One such array is used as a stack for storage of addresses during access to subroutrines and for memorizing the state of internal registers during processing of interruptions, information being read out from this stack in an order the reverse to that in which it has been entered. Figures 5; tables 2; references 5: 2 Russian, 3 Western (1 in Russian translation).
[57-2415]

UDC 681.3/181.48

## HARDWARE OF 'ELEKTRONIKA-60' MICROCOMPUTERS

Moscow RADIOTEKHNIKA in Russian No 10, Oct 83 (manuscript received, after completion, 14 Apr 83) pp 58-60

PLOTNIKOV, V. V., TALOV, I. L., LOPATIN, V. S. and KASYUK, B. N.

[ABstract] The basic hardware of an "Elektronika-60" microcomputer is a central processor on a single 280x240 $mm^2$ printed-circuit board consisting of a microprocessor, a memory with capacity of 4K 16-bit words, and a data transfer module. The microprocessor, completely large-scale integrated, contains a control module, an arithmetic-logic register, and three read-only memories. Three configurations of this microcomputer are ready for commercial production, each tailored to specific applications: the 15VM-16-007 configuration is minimal, designed

for building into technological equipment as a high-speed computing device; the 15VM-16-012 configuration is minimal plus a power supply module and a control module for peripheral equipment, designed for control of technological processes; the 15VM-16-013 configuration includes peripheral equipment, namely a "Consul 260.1" typewriter, an FS-1501 or SPZ optical readout device, and a PL150 tape punch, designed for program writing and debugging. The latter two configurations include a timer with a 20 μs period for time marking. Three types of memories for expanding the microcomputer capabilities are ready for production: one with capacity of 16 K words, a read-only one with capacity of 2 K words for storage of programs and numerical constants, and a programmable read-only one with capacity of 4 K words. Improvements considered for peripheral equipment are use of flexible magnetic-disk storages, addition of an analog data input, and introduction of the new MT70 high-speed peripheral microprocessor. Two new models, the 15VUMS-28-025 automatic universal and the 15VUMS-28-032 automatic universal one with telephone service, will be introduced where the existing 15VM-16-013 model is not adequate. All versions of the "Elektronika-60" operate with software written in BASIC or FORTRAN.
[75-2415]

UDC 621.315.61:536.423

# DIELECTRIC STRENGTH OF HEXAFLUORIDE OF SULPHUR DURING ITS CONDENSATION

Moscow ENERGETIKA I TRANSPORT in Russian No 6, Nov-Dec 83 (manuscript received 3 May 83) pp 93-98

ANTONOV, A. V., LYAPIN, A. G. and POPKOV, V. I., Moscow

[Abstract] The paper investigates the temperature dependence of the discharge voltages of several interelectrode gaps for gaseous hexafluoride of sulphur, as well as during its condensation. It is shown that the dielectric strength of gaseous hexafluoride of sulphur in a hermetically sealed volume at a temperature above the temperature of its condensation into a liquid is constant, as a minimum up to 333 K. During condensation of hexafluoride of sulphur, the pressure of the saturated steam and its breakdown voltages are smoothly decreased during reduction of the temperature to the point of crystallization. The dependence of the dielectric strength of the saturated steam on the temperature has a linear nature in all the area of existence of the two-phase state of the hexafluoride of sulphur. As the result of retracting the molecules of the saturated steam between the electrodes, a jumper is formed out of the liquid phase. For a jumper, nonremoved during the discharges of an interelectrode, a supplementary uneven reduction is observed of the dielectric strength of the gap, which leads to a total decrease of it of approximately two times.
Figures 3; references 8: 5 Russian, 3 nonRussian.
[73-6415]

UDC 538.56

# SOLUTION OF DIFFRACTION PROBLEM FOR ELECTROMAGNETIC WAVE AND DIELECTRIC CYLINDER WITH INTRICATE CROSS SECTION

Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA in Russian No 10, Oct 83 (manuscript received 8 Sep 81, after completion 24 Jun 82) pp 11-17

STADNIK, IVAN PETROVICH, candidate of technical sciences, docent, KOZIK, GENNADIY PETROVICH, senior instructor and GORSKAYA, IRINA YUR'YEVNA, junior scientific associate, all of Simferopol State University

[Abstract] Because solving the integral equation in the problem of diffraction for electromagnetic waves is difficult, the problem has been reduced to a system of linear algebraic equations with complex coefficients. The system is solved in this paper by an iteration method which converges even in the most general case and can be programmed on a digital computer. An infinite cylinder is considered with an arbitrary intricate cross section and with a dielectric permittivity which varies over the cross section but not in the axial direction, the magnetic permeability being everywhere in the entire space equal to that of a vacuum. The incident electromagnetic wave $\bar{E}_0$, $\bar{H}_0$ is linearly polarized, with the electric field vector parallel to the cylinder axis. The resulting electromagnetic field E,H outside and inside the cylinder is calculated, considering that no electric charge exists inside and no surface current flows. The only additional source of an electromagnetic field are polarization currents inside. The corresponding Maxwell equations with continuity conditions at the cylinder boundary are reduced to a system of algebraic equations, after the cylinder cross section has been subdivided into finite elementary regions. Results obtained by this method for cylinders with circular and square cross section, respectively, are compared for accuracy with the exact analytical solution. Figures 4; tables 1; references: 6 Russian.
[66-2415]

UDC 621.391.82.016.35

# MODIFIED METHOD OF SEARCH WITH RETURN IN PROBLEM OF FREQUENCY ASSIGNMENT TO RADIOENGINEERING COMPLEX FOR ASSURANCE OF ELECTROMAGNETIC COMPATIBILITY

Moscow RADIOTEKHNIKA in Russian No 10, Oct 83 (manuscript received, after completion, 18 Mar 83) pp 26-28

KREMENETSKIY, S. D., LOS', V. F. PIKOVSKIY, V. N. and SOLOVEYCHIK, L. F.

[Abstract] Selecting S frequencies from N allowable ones for assignment to a radioengineering complex so as to ensure its electromagnetic compatibility within a radio engineering system is a problem solvable by various methods of discrete combinatorial programming such as dynamic programming, search with return, or method of branches and edges. In the general case of a system consisting of J receivers, K transmitters, and L simplex transceivers, assignment of S among N frequencies is restricted by consideration of harmonic and intermodulation components. Formulation of the problem as one of finding frequencies which satisfy a system of inequalities is simple, but the large number of these inequalities and the multidimensionality of this system make the solution unwieldy. Here a modification of the method of search with return is proposed which involves minimization of the frequency functional, according to the theory of operational research, by applying first the diagonalization principle and then the sieve principle. The number of variants to be scanned for determining one S= J+ K+ L sector can be reduced typically by a factor of $10^4$. The algorithm is easily programmed on a YeS-1033 Unified System computer. References 3: 1 Russian, 2 Western (both in Russian translation). [75-2415]

UDC 535.317.1

## POLARIZATION OF LIGHT DIFFRACTED BY THREE-DIMENSIONAL PHASE GRATING

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian
Vol 26, No 10, Oct 83 (manuscript received 27 Mar 83) pp 86-89

ROMANOV, Yu. F., Leningrad Institute of Precision Mechanics and Optics

[Abstract] Polarization of light diffracted by a three-dimensional phase grating is examined by the method of Jones and Mueller matrices, assuming a grating with the vector in the plane of light incidence so that both TM and TE polarizations occur. The electric field of the incident wave and that of the diffracted wave are represented in the form of complex Jones vectors $\hat{E}_k$ and $\hat{E}_s$, respectively, with TM and TE polarizations selected as basis states. The amplitudes of waves can be calculated on the basis of the electrodynamic perturbation theory. There follows a transition from elements of the Jones matrix to elements of the more precise Mueller matrix, which describes not only the polarized light but also partially polarized and completely nonpolarized light. This transition is made through the corresponding Stokes vectors $\tilde{E}_k$ and $\tilde{E}_s$, which reveal that the diffracted light is elliptically polarized when the incident light is. The two ellipses are different, however. In the case of nonpolarized incident light the diffracted wave can be represented as a superposition of two linearly polarized ones corresponding to phase differences $\delta = 0$ and $\delta = \pi$, respectively. This paper was recommended by the Department Faculty (Kafedra) of Computer Engineering. References 4: 2 Russian, 2 Western (both in Russian translation). [72-2415]

UDC 621.328.323

## EVALUATION OF THERMOGENERATION NOISE IN CHARGED-COUPLE DEVICES

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian
Vol 26, No 11, Nov 83 (manuscript received after revision 4 Oct 82) pp 75-77

ZHURIKHIN, A. V.

[Abstract] On the basis of new information obtained in an experiment, this brief communication evaluates the noise of charge thermogeneration in charged-couple devices (CCD), taking into account both the known components of

internal noise. The experimental investigations made of the static characteristics of CCD verify the advisability of using the ratios obtained in this communication during its theoretical analysis of the noise immunity of devices based on CCD. Figures 2; references 3: 1 Russian, 2 Western in Russian translation.
[70-6415]

UDC 621.314.26:621.314.632

## DIAGNOSIS OF DIRECT SINGLE MODULATION FREQUENCY CONVERTERS

Kiev TEKHNICHESKAYA ELEKTRODINAMIKA in Russian No 4, Jul-Aug 83
(manuscript received 31 Aug 82) pp 8-11

MORDACH, VASILIY PAVLOVICH, senior engineer, Institute of Electrodynamics, Academy of Sciences, UkSSR, Kiev; P'YANYKH, BORIS YEGOROVICH, candidate of technical sciences, senior scientific associate, Institute of Electrodynamics, Academy of Sciences, UkSSR, Kiev; and CHEKHET, EDUARD MIKHAYLOVICH, candidate of technical sciences, senior scientific associate, Institute of Electrodynamics, Academy of Sciences, UkSSR, Kiev

[Abstract] The paper considers the concrete technical means of diagnosis of direct single modulation frequency converters using the voltage of a three-phase supply network for testing. The diagnostic tree is presented of an algorithm of search and localization of a defect, which is constructed on the basis of the modeling of inaccuracies presented in a table, with minimization of the expenditure of time on the search taken into account. Synthesis of the block structure of a combination-sequence diagnostic device is accomplished on the basis of an operational-circuit interpretation of algorithms of search for defects. Figures 1; tables 2; references 3: 2 Russian, 1 Western (in Russian translation).
[76-6415]

## BIPHONIC SOUND IN PORTABLE COMBINATION RADIO-TAPE RECORDER

Moscow RADIO in Russian No 10, Oct 83 pp 39-41

IVANOV, R., Riga

[Abstract] A portable combination radio-taperecorder has been developed for industrial purposes by the Japanese firm JVC on the basis of the long-ignored principle of biphonic sound transmission. The telephone sets, inadequate because of "localization effects inside the head" and crosstalk distortion, are replaced by a processor which provides perfect binaural hearing through loudspeakers. This "biphonic" processor consists of a left-ear channel and a right-ear channel, with a signal amplifier, a delay line, a phase shifter,

and a summator in each. The output signals are discriminated in the two loudspeakers so that each ear hears only the signals coming from its channel. Another advantage is the possibility of widening the stereobase (acoustic field) of stereophonic programs. Figures 4; tables 1.
[67-2415]

UDC 007.52

KINEMATIC CONTROL ALGORITHM FOR THREE-DIMENSIONAL MOTION OF TONGS IN INDUSTRIAL ROBOTS

Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA in Russian No 10, Oct 83 (manuscript received 6 Apr 82) pp 56-61

ZOTEYEV, AL'BERT IVANOVICH, candidate of technical sciences, docent, Vladimir Polytechnic Institute

[Abstract] A servomechanism for an industrial robot is considered which will kinematically control the motion of tongs along all three coordinates of a rectangular, cylindrical, or spherical system. The motion of a point representing the tongs along an analytically stipulated smooth spatial curve L (intersection of two surfaces $S_1$ and $S_2$) is described by the system of differential equations in orthogonal coordinates ($\alpha_1, \alpha_2, \alpha_3$): $\dot{\alpha}_1 = u_{\alpha 1}; \dot{\alpha}_2; u_{\alpha 2}; \dot{\alpha}_3 = u_{\alpha 3}$; $w = A_1\alpha_1 + A_2\alpha_2 + A_3\alpha_3$ excursion with $A_1 = (1,0,0)$, $A = (0,1,0)$, $A_3 = (0,0,1)$, $u_{0\,i}$ - control actions or components of control $u_\alpha = (u_{\alpha 1}, u_{\alpha 2}, u_{\alpha 3})$. The problem is formulated as one of finding among piecewise-continuous kinematic controls the one which will make the tongs move along curve L at some instant of time after departure from point $w_0$ in a region D free of singularities. The problem is solved by introduction of three nonintersecting surfaces in that region and successive testing of the trajectory for location and direction with respect to them. The algorithm is particularized for the case of ideal sliding motion on some surface, such a motion being defined here as oscillatory about this surface with infinitesimally small amplitude at infinitely high frequency and thus as a limit process. The algorithm yields three control equations, one for each coordinate, with two parameters which must be determined from the grad $s_{1,2} \cdot \dot{w}_k = 0$ condition. The equations of motion (ideal sliding) are then transformed accordingly. Figures 2; references: 3 Russian.
[66-2415]

UDC 007.52:681.136

DETERMINATION OF SPACE COORDINATES OF OBJECT POINTS IN TECHNICAL VISION SYSTEM OF INDUSTRIAL ROBOT

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 26, No 12, Dec 83 (manuscript received 26 Jan 83) pp 66-71

MINCHENKOV, P. V., Leningrad Polytechnical Institute imeni M. I. Kalinin

[Abstract] The paper analyzes the errors of determination of the corrdinates of object points, originating because of quantization of an image, by a method

based on the separation of the points of objects and their projection on the supporting plane. The optimum values are determined of the slopes of the light plane and the central axis of the video channel for different variations of the construction of technical vision systems, during which a minimum error exists in the determination of the coordinates of object points. The results of theoretical and experimental investigations can be used during the development of sensitized robots in a position to work under conditions of an unorganized exterior medium. The paper was recommended by the Departmental Faculty (Kafedra) of Technical Cybernetics. Figures 3; references 8: 5 Russian, 3 Western (in Russian translation).
[78-6415]

UDC 62-506.2

PHOTODIODE MATRICES IN VISUAL SYSTEM OF ROBOTS

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 26, No 12, Dec 83 (manuscript received 11 May 83) pp 71-75

DVOROVKIN, V. Ye., KARASEV, A. A. and PANKOV, V. A., Moscow Higher Technical School imeni N. E. Bauman

[Abstract] Two versions of a visual system for robots based on photomatrices--an image pickup and a coordinator--have been developed at the Problem-Solving Laboratory of the Moscow Higher Technical School imeni N. E. Bauman. The image pickup is intended for operation in the composition of a robotized coloring model with a color camera. It is proposed to use the coordinator for sensitization of a robot-welder. With the aid of the two items, identification is conducted of objects or their fragments, and guidance of manipulators on the object. Block diagrams are presented of the image pickup and the coordinator. The image pickup is shown mating with an "Electronika-60" electronic computer. Experiments conducted with the image pickup and coordinator showed resolution in the visual field, respectively, of 40 angular minutes and 20 angular minutes (objective lens RO-51 with a viewing angle of 30° and a 7.5 x 10.4 mm frame dimension). Such resolution assures a sufficiently precise realization of such robot engineering operations as, for example, guidance of a gripping device to an object. The paper was recommended by the Department Faculty (Kafedra) of Automatic Systems. Figures 2; references 4: 3 Russian, 1 Western (in Russian translation).
[78-6415]

UDC 78.53.022.5

## CIRCUIT DIAGRAMS OF EXPOSURE METERING DEVICES OF PROFESSIONAL FILMING EQUIPMENT

Moscow TEKHNIKA KINO I TELEVIDENIYA in Russian No 3, Mar 83 pp 15-19

ZELENER, M. F. and PANTELEYEV, V. S., All-Union Scientific-Research Institute of Motion Pictures and Photography (NIKFI); Moscow Motion Picture Equipment Design Bureau (MKBK)

[Abstract] For a number of years, development of built-in exposure metering devices was conducted at the motion picture studios "Kiev Scientific Film" imeni A. P. Dovzhenko, the Central Scientific Film, as well as NIKFI and MKBK. This paper considers the principal parameters of exposure metering devices for professional filming equipment and the advantage of setting up an exposure condition with the aid of these devices. The principal circuit diagrams of exposure metering devices developed in 1976-1980 by the NIKFI and MKBK are presented. Figures 2; references: 7 Russian.
[63-6415]

UDC 621.586.772

## CALCULATION OF ERROR INDUCED BY CURRENT ELECTRODE AND SHIELD ELECTRODE MISALIGNMENT IN 'YEMKOSIN' VARIABLE CAPACITANCE ANGULAR TRANSDUCER

Kiev TEKHNICHESKAYA ELEKTRODINAMIKA in Russian No 4, Jul-Aug 83 (manuscript received 22 Feb 82) pp 88-95

GRINEVICH, FEODOSIY BORISOVICH, academician, UkSSR Academy of Sciences, head of department, Institute of Electrodynamics, UkSSR Academy of Sciences, Kiev; ZATSERKIVNYY, ZINOVIY ALEKSEYEVICH, director of Special Design and Technological Office, Institute of Electrodynamics, UkSSR Academy of Sciences, Kiev; SURDU, MIKHAIL NIKOLAYEVICH, candidate of teechnical sciences, head of laboratory, Institute of Electrodynamics, UkSSR Academy of Sciences, Kiev; VOYCHENKO, GENNADIY IVANOVICH, junior scientific associate, Institute of Electrodynamics, UkSSR Academy of Sciences, Kiev; and LEVITSKIY, ANATOLIY STANISLAVOVICH, head of sector of Special Design and Technological Office, Institute of Electrodyanmics, UkSSR Academy of Sciences, Kiev.

[Abstract] The Institute of Electrodynamics of the UkSSR Academy of Sciences, together with a Special Design and Technological Office (SKTB) has developed

a high-precision angle-measuring system designated "Emkosin" which realized the principles put forward in four Russian patents (1978, 1981, and two in 1982). The system is intended for measurement of angles in the 0-360° range with a resolution of less than one second of arc. A block diagram of the device is presented and explained. The effect of deviation of the geometrical center of a drawing of the current electrode from the axis of rotation of the electrode-shield is investigated. During this, it is considered that the geometrical center of a drawing of the electrode-shield coincides with its axis of rotation. It is concluded that: 1) With small eccentricities of the current electrode, not disturbing the uniformity of the field in the effective volume of the pick-ups and the even number of openings in the electrode-shield, the error from eccentricity is zero; 2) A pickup with an odd number of openings in the electrode-shield can be used as an exact channel of primary converters with the number of openings $n \geqslant 5\text{-}7$ because the error from eccentricity of the current electrode will practically equal zero; and 3) A pickup with an opening in the electrode-shield can be used as a rough channel of a primary converter because its error even with the large eccentricities $\delta_e = 0.004$ will be small. Figures 6; references: 8 Russian.
[76-6415]

UDC 621.391.8.08:621.317.373

ANALYZERS OF FINITE PHASE DIFFERENCES WITH DISCRETE REFERENCE-SIGNAL CHANNELS

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian
Vol 26, No 10, Oct 83 (manuscript received 30 Mar 83) pp 3-7

VESHKURTSEV, Yu. M., Omsk Polytechnic Institute

[Abstract] An analyzer of finite phase differences in a fluctuating signal is described which includes a discrete reference channel. Its theory is based on the mathematical concept of finite difference and its design is based on application of digital microelectronic technology. It includes a mixer and a frequency doubler at the input, followed by a meander generator and then a shift register. A push-pull discrete delay line delivers two-stroke control pulses to the shift register. This delay line, the frequency doubler with a narrow-band filter and the meander generator, form a discrete reference channel. Pulses from the outputs of the shift register are fed back, through two synchronously operating switches, to the input of the frequency doubler and to the free input of the mixer, respectively. The voltage at the sum frequency is fed to the transducer channel and, through a comparator, to the reference channel. Refinements include automatic phase-locked frequency control with frequency divider in the delay line, and a generator of random numbers with a phase shifter and etalon generator for simulating a given phase distribution in the input signal. Such analyzers with discrete reference channels are structurally and technologically simpler than those with analog reference channels. They can also operate as parametric devices. The paper was recommended by the Department Faculty (Kafedra) of Instrumentation-Measuring Techniques, Omsk Polytechnic Institute. Figures 3; references: 9 Russian.
[72-2415]

UDC 536.532

STRUCTURAL METHODS OF IMPROVING ACCURACY OF TEMPERATURE-DIGITAL CODE CONVERSION

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian
Vol 26, No 10, Oct 83 (manuscript received 24 Aug 82) pp 7-11

POZDNYAKOV, Yu. V., Institute of Physics and Mechanics imeni G. V. Karpenko

[Abstract] A performance analysis of digital thermoelectric transducers reveals that the inaccuracy of temperature measurements with these devices is principally caused by the intrinsic transducer imprecision, nonlinearity and time instability of the conversion characteristics, and the temperature changes at the free ends of the thermocouple. Preliminary analog conversion of the temperature with subsequent analog-to-digital conversion, rather than direct temperature-to-code conversion, has been proposed as an effective way to improve the accuracy of digital temperature measurements. This concept is particularly applicable to temperature measurements by the contact method. The basic structure of such an instrument includes a summing circuit between the analog temperature transducer and analog-to-digital converter, with feedback through an automatic potentiometer and a corrector. The inherent dynamic error caused by time lag in the feedback loop can be eliminated by adding two resistance thermometers with resistance-to-(d.c.)emf transducers. One of them feeds signals to the same summing circuit to which the thermocouple feeds, the other feeds signals to another summing circuit to which the first summing circuit feeds signals through a scaler. This second summing circuit feeds signals to the analog-to-digital converter. An advantage of such digital thermometers is the use of a piecewise-nonlinear approximating function, which appreciably widens the range of measurements. The paper was recommended by the Institute. Figures 2; references 10: 8 Russian, 2 Western (both in Russian translation). [72-2415]

UDC 621.391.2

RAPID SEARCH SEQUENCES FOR COMBINED SYSTEMS

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian
Vol 26, No 11, Nov 83 (manuscript received 28 Jun 82) pp 17-21

LOSEV, V. V. and YAKUTIK, K. V.

[Abstract] This paper is concerned with the same subject as that discussed in two previous papers (1978 and 1980) by V. V. Losev, i.e., rapid search sequences. Regular methods are presented for construction of pairs of orthogonal and quasi-orthogonal rapid search sequences (RSS) for combined information-measuring systems. The construction presented makes it possible to build a large family of orthogonal and quasi-orthogonal pairs of RSS for combined systems with rigid limitations on the time of signal search and an entrance into synchronization. References: 2 Russian.
[70-6415]

UDC 621.372.852.21

METHOD OF MEASUREMENT OF THE COEFFICIENTS OF AMPLITUDE AND PHASE MODULATION OF SUPERHIGH FREQUENCY RADIATION IN GUIDE SYSTEMS

Moscow RADIOTEKHNIKA in Russian No 11, Nov 83 (manuscript received after reduction, 5 Jan 83) pp 84-86

ZAPOROZHETS, V. V., KOBERIDZE, A. V., and OLEYNIK, V. V.

[Abstract] The paper considers a simple method of investigating AM and FM superhigh frequency radiation in guide systems with any coefficients of modulation, without the solution of complex transcendental equations. This method is suitable for those guide systems with the assistance of which construction is possible of the phase measuring circuit shown in a block diagram, i.e., in practically all of the superhigh frequency band. The basis of the method, the method of measurements and the results of experimental testing are described. Figures 2; references: 3 Russian.
[83-6415]

UDC 621.317.742

CALIBRATION OF CONTACT DEVICES DURING MEASUREMENT OF ELEMENTS OF SUPERHIGH FREQUENCY INTEGRATED CIRCUITS

Moscow RADIOTEKHNIKA in Russian No 11, Nov 83 (manuscript received after completion, 16 Mar 83) pp 88-90

NIKULIN, S. M., PETROV, V. V. and SALOV, A. N.

[Abstract] A new method of calibration is proposed which does not require attested microstrip measures, and the statistical characteristics of the measurements are investigated. The method considered is useful during the solution of problems connected with the measurement of the active and passive elements of superhigh frequency integrated circuits in microstrip guide systems of various types in which TEM and quasi-TEM waves exist, as well as during investigation of the dispersion characteristics of various transmission lines and waveguides. Figures 2; references 8: 6 Russian, 2 Western.
[83-6415]

UDC 621.374.32 (088.8)

OSCILLOGRAPHIC TIME-INTERVAL INDICATOR

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 26, No 12, Dec 83 (manuscript received 12 Apr 83) pp 8-11

ODINOKOV, V. F., Ryazan Radio Engineering Institute

[Abstract] The oscillographic time-interval indicator described by Odinokov in a 1974 paper has substantial deficiencies, included in the duration of the measuring operations of large $\tau$ intervals. This deficiency is explained by the absence of automatic displacement of images on the screen of the oscillograph. A block diagram is shown of such a device with increased efficiency, an Author's Certificate for which was obtained by Odinokov in 1982. The increased efficiency is caused by the use of a circuit for automatic shift of the scanning of the oscillographic indicator. The control circuit for phase scanning is shown. The paper was recommended by the Department Faculty (Kafedra) of Automated Control Systems. Figures 2; references: 2 Russian.
[78-6415]

UDC 621.39:531.77

DIGITAL MEASURER OF MOTOR SHAFT ROTATION SPEED

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 26, No 12, Dec 83 (manuscript received 5 May 83) pp 12-15

IGNATCHENKO, A. I., Leningrad Institute of Precision Machinery and Optics

[Abstract] On the basis of the relationships described in this paper, the performance algorithm and the block diagram presented, it is possible to construct a digital measurer of the rotation speed of a motor shaft, as applied to various code angle-data transmitters with a given control range of the speed. The possibilities are shown for an enlargement of the range of speed measurement. The paper was recommended by the Department Faculty (Kafedra) of Electrical Engineering. Figures 3; references: 3 Russian.
[78-6415]

UDC 621.3.016.1

MEASUREMENT OF ANGULAR SPEED WITH HIGH DYNAMIC PRECISION

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 26, No 12, Dec 83 (manuscript received 15 Apr 83) pp 15-19

POTAPOV, L. A. and ZOTIN, V. F., Bryansk Institute of Transport Machine Building

[Abstract] During an experimental investigation of nonstationary types of operation of electric motors, automatic systems, and other devices, problems

often arise with respect to measurement of instantaneous angular velocity, the magnitude of which changes within wide limits with high acceleration. In such cases it is necessary to utilize a tachometer with high dynamic properties. The present paper describes the design of a photoelectric technosensor with a rotating light wave. Such a wave is obtained with the aid of static radiators by a method analogous to that used for obtaining a rotating magnetic field. One of the possible versions of the design fulfillment of frequency tachosensors with a static source of a rotating light wave is presented and explained. On the basis of data obtained by the authors from tests of a number of samples of the type of tachosensor considered, recommendations are made with respect to a choice of the basic construction parameters. The paper was recommended by the Department Faculty (Kafedra) of Power Engineering. Figures 2; references 3: 2 Russian, 1 Western (in English).
[78-6415]

UDC 536.52

INVESTIGATION OF DYNAMIC CHARACTERISTICS OF THERMAL CONVERTER UNITS OF TOTAL RADIATION PYROMETER

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 26, No 12, Dec 83 (manuscript received 24 Apr 83) pp 76-81

LUSHCHAYEV, G. A., BARANENKO, A. P., GREKOVA, A. G. and FANDEYEV, Ye. I., Novocherkassk Polytechnical Institute

[Abstract] A 1982 work by the four authors of this paper describes a method for design of the thermal converter units of a pyrometer which contains a radiation detector and a compensation element arranged on a heat-conducting cylindrical framework. The results are presented here of an analytical investigation of the dynamic properties of the telescope of the above mentioned pyrometer. A formula is obtained for calculation of the two-dimensional nonstationary temperature field of the thermal converter units. With the object of planning the junction "Radiation detector--framework--compensating element" and determination of the dynamic characteristics of the pyrometer, a program of calculations on the YeS-1022* electronic computer was composed. In this instance use of the proposed method of calculation lead to an increase of the speed of response of the pyrometer of almost eight times. Investigations showed that the divergence between calculated and experimental data did not exceed 10-12%. The paper was recommended by the Department Faculty (Kafedra) of Physico-Technical Discipline. Figures 1; references: 6 Russian.
[78-6415]

UDC 537.633.9:621.014.4

# CYLINDRICAL ELECTROMAGNETIC SHIELD IN NONSTATIONARY MAGNETIC FIELD

Moscow ENERGETIKA I TRANSPORT in Russian No 6, Nov-Dec 83 (manuscript received 9 Jul 82) pp 86-92

SHCHUKIN, A. V., Leningrad

[Abstract] When a multilayer cylindrical electromagnetic shield is exposed to the nonstationary three-dimensional field of an arbitrary system of quasi-stationary currents, affects appear which essentially cannot be investigated on a two-dimensional model. In particular, this pertains to an irregularity of the distribution of vortex currents lengthwise of the shield, and the variability of this distribution in time. The present paper is devoted to obtaining an analytical solution to the three-dimensional problem. Figures 3; references 8: 7 Russian, 1 Western.
[73-6415]

UDC 621.385.6:621.372.413

## SOME RESULTS FROM OPTIMIZING COAXIAL OROTRON

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 28, No 9, Sep 83
(manuscript received 20 Oct 81) pp 1791-1798

GULYAYEV, Yu. V., KURAYEV, A. A., NEFËDOV, Ye. I., OLENIN, V. D., (deceased), SLEPYAN, A. Ya. and SLEPYAN, G. Ya.

[Abstract] The need for stable tunable millimeter and submillimeter band oscillators with a high-power output can be met by orotrons (diffracted radiation oscillators) using an open coaxial cavity which has a cylindrical outer reflector and an internal focusing reflector. The problem of optimizing such an oscillator with respect to the electron efficiency is solved, given the following assumptions: 1) The cavity Q is so high that the structure of the RF field can be considered fixed and as coinciding with the structure of the working $E_{0mn}$ eigenmode; 2) The model of the electron beam is one-dimensional, without any separation into layers; and 3) The influence of the space charge can be disregarded. The controlling factors are: The distribution function of the RF field acting on the electrons over the length of the interaction space; the length of the interaction region; the difference between the electron velocity and the phase velocity of the synchronous spatial harmonic. Design equations are derived for the shape of the focusing reflector and the results of numerical studies on a BESM-6 computer are given. Efficiencies of 59.5% and 54.2% were obtained for the two variants which were analyzed. Some ways of further enhancing this efficiency are noted. Figures 4; references: 17 Russian.
[51-8225]

UDC 621.3.012.6

## ELECTRODYNAMICAL ANALYSIS OF SHIELDED REGULAR MICROSTRIP LINES

Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA in Russian No 10, Oct 83 pp 18-25

MUSHENKO, SERGEY VASIL'YEVICH, candidate of technical sciences, docent, Taganrog Institute of Radio Engineering

[Abstract] The dispersion characteristics of microwave microstrip lines are calculated by a method suitable for automated design of such devices. The

corresponding vector problem is split into two scalar ones, which facilitates calculations for each of the linearly independent excitation modes in a multi-conductor transmission line. For illustration, the algorithm is constructed for a strip conductor on a ferrite-dielectric substrate inside a "rectangular" shield. The material of both strip and shield is assumed to be ideal, with an infinitely high electrical conductivity. The conductor surface charge and current densities are stipulated as harmonic functions of time and of the longitudinal coordinate, their amplitudes as functions of the transverse coordinate being sought in the class of functions which satisfy a boundary condition at the strip edge in the form of a Chebyshev polynomial of the first kind with respect to time t and of order q. The corresponding homogeneous Maxwell field equations are solved by finding the electrodynamic scalar potentials from the Laplace equation and the given surface charge density, subsequently finding first the normal component and then the transverse component of the electro-dynamic vector potential, and finally, with the aid of the Lorentz calibrating relation, finding its longitudinal component. After this is done, by applying the method of separation of variables to the appropriate differential equations, integral equations are obtained for charge and current. These equations will be solved by a numerical method in the next article by this author and Kh. O. Kazandzhyan. Figures 1; references 6: 3 Russian, 2 Western (1 in Russian translation).
[66-2415]

UDC 621.316.5.029.6-213.3

SUPERWIDEBAND SWITCHING MODULE BASED ON GERKON IN MICROWAVE RANGE

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 26, No 12, Dec 83 (manuscript received 28 Jun 83) pp 52-55

ZAKHAR'YASHCHEV, L. I., ALYMOV, V. N. and VASIL'YEV, Ye. P., Ryazansk Radio Engineering Institute

[Abstract] Gerkons (hermetically-sealed magnetocontrolled contacts), serially produced by Soviet industry, find wide application in radio-electronic devices up to frequencies of 10-20 MHz. However, during transition to the microwave range, certain difficulties appeared in the use of the gerkon as a switching device which arose from the difference of its impedance in a closed state of the contacts from the wave resistance of transmission lines. Consequently, the present paper proposes the design of a superwideband switching module with a gerkon, which eliminates the above disadvantages. The results are presented of experimental investigations for a Type Mk10-701A gerkon in the microwave range. The paper was recommended by the Department Faculty (Kafedra) for Design and Production of Radio Equipment. Figures 4; references: 4 Russian.
[78-6415]

UDC 621.317.799

# MEASUREMENT OF DURATION OF MICROCIRCUIT FRONTS

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian
Vol 26, No 12, Dec 83 (manuscript received 23 May 83) pp 55-60

SMAGIN, Yu. A., SMIRNOVA, N. P., TRIFONOV, Ye. F. and SHADRIN, M. P.,
Penza Plant-Higher Technical School

[Abstract] The paper considers two methods for measuring the duration of the fronts of microcircuit output signals, where conversion of the value of any part of the front into a digital code is a method based on the use of a ring oscillator. The distinctive features of the two methods are discussed, and the principal electrical circuit of the measuring part of the converter, which reveals special features of its construction, is illustrated. Laboratory tests of one of the circuits considered in the paper produced the following results: in the range of measurement of 0-100 nanoseconds with a 2% error of measurement, the measurement time amounted to 300 microseconds (with K = 1000). The paper was recommended by the Department Faculty (Kafedra) of Computational Electronic Machines. Figures 4; references: 4 Russian.
[78-6415]

UDC 621.314

# QUALITY ESTIMATION OF PARAMETRIC EQUALIZATION OF TRANSDUCER OUTPUT POWERS IN MULTICELL POWER SUPPLY SOURCES

Kiev TEKHNICHESKAYA ELEKTRODINAMIKA in Russian No 4, Jul-Aug 83
(manuscript received 17 Feb 82) pp 30-35

GLEBOV, BORIS ALEKSANDROVICH, candidate of technical sciences, assistant professor, Moscow Power Engineering Institute; NOVIKOV, ALEKSANDR AL'BERTOVICH, candidate of technical sciences, assistant, Smolensk Affiliate of Moscow Power Engineering Institute, NOVIKOVA, TAT'YANA NIKOLAYEVNA, candidate of technical sciences, assistant, Smolensk Affiliate of Moscow Power Engineering Institute; SIBICHENKOV, VIKTOR FEDEROVICH, leading engineer, Moscow; and SHILADZHYAN, AKOP MKRTYCHEVICH, senior scientific associate, Yerevan Scientific-Research Institute of Mathematical Machines.

[Abstract] This paper is concerned with clarifying the figure of merit of control methods, from the point of view of equalization of the output powers (currents and voltages) of individual transducers in the composition of multicell sources of secondary electrical supply (MSSES). It is shown that during an investigation of methods for control of the output power of transducers which guarantee parametric equalization of the output power in the composition of MSSES, an analysis is necessary of the stability and quality of parametric equalization. This leads to the method described in the present paper. It is especially necessary to emphasize that the analysis in question does not determine the conduct of the closed system of automatic control (SAC) which ordinarily is represented by the MSSES included with the feedback for stabilization of the output voltage or current. The exception of the instability of the process of equalization of the output powers only makes it possible to exclude the structural instability unit of the SAC indicated, which, as a rule leads to instability of the system as a whole. Figures 2; tables 1; references: 6 Russian.
[76-6415]

UDC 621.316.72

BLOCK DIAGRAM FOR SYNTHESIS OF ALTERNATING VOLTAGE STABILIZATION SYSTEMS WITH BOOSTER CHANNEL

Kiev TEKHNICHESKAYA ELEKTRODINAMIKA in Russian No 4, Jul-Aug 83 (manuscript received 30 Apr 82) pp 35-40

AKULOV, NIKOLAY DMITRIYEVICH, senior scientific associate, Komsomolsk-na-Amure Polytechnical Institute, YELSHIN, ANATOLIY IVANOVICH, candidate of technical sciences, head of department, Komsomolsk-na-Amure Polytechnical Institute; KUDEL'KO, ANATOLIY ROMANOVICH, candidate of technical sciences, assistant professor, Komsomolsk-na-Amure Polytechnical Institute; and SOCHELEV, ANATOLIY FEDOROVICH, candidate of technical sciences, senior teacher, Komsomolsk-na-Amure Polytechnical Institute

[Abstract] This paper obtains the equivalent circuits for one of the versions of transformer-thyristor stabilizers (regulators) of alternating voltage with a booster channel and conditions for stable operation of the regulators, block diagrams of regulators and stabilizers are developed, and the parameters are determined of transfer functions entering into their units. The results obtained make it possible to effect a synthesis of systems for stabilization of alternating voltage which satisfy the precision and dynamic indices desired. Figures 3; references: 2 Russian.
[76-6415]

UDC [621.319.53:621.382.233.026.012].3.38.027.3

SWITCHING PROCESSES IN THYRISTOR CONTROL SYSTEMS FOR LARGE-POWER HIGH-VOLTAGE ELECTRON DEVICES

Moscow ELEKTROTEKHNIKA in Russian No 9, Sep 83 (manuscript received 10 Jan 83) pp21-25

LIPATOV, V. S., candidate of technical sciences, Istrinsk Department of All-Union Electrotechnical Institute imeni V. I. Lenin.

[Abstract] In high-voltage electrovacuum and gas-discharge chambers a series of electrophysical units require shaping of square voltage pulses with steep fronts (the 10th part of a microsecond). The present paper investigates the switching processes in an applicable shaper of square pulses with series capacitor switching of a thyristor shunt circuit intended for control of high-voltage electron commutation switches. Basic formulas are obtained for calculation of the switching intervals during operation of the shaper with a resistive-capacitive load. Figures 3; references: 6 Russian.
[74-6415]

UDC 621.313.1.3.062.4.024.027.8

## HIGH-VOLTAGE CASCADE-CONNECTED DIRECT-CURRENT GENERATORS

Moscow ELEKTROTEKHNIKA in Russian No 9, Sep 83 (manuscript received 22 Nov 82) pp 25-27

GUSEV, S. I. engineer, LISIN, V. I., candidate of technical sciences, All-Union Electrotechnical Institute imeni V. I. Lenin

[Abstract] The paper discusses the characteristics of 10 high-voltage direct-current generators (1-140 kW, 100-1200 kV), applicable to the power supply of high-voltage charged particle accelerators. Because of the increase of power of the technological units, generators are required, constructed according to the principles of series-connected transformer-rectifier stages (cascades). Such units have better indices as compared with electrostatic generators or generators with a capacitance-rectifier voltage multiplier. A comparison is made of the specific powers (per unit of mass or volume) reduced to the basic power and the internal resistance of the generators. The construction is described of a three-phase transformer-rectifier which contains three columns of toroidal magnetic circuits. The columns carry loops of the secondary winding which feed three-phase rectifiers connected serially on the side of the direct current. Tables 1; references 12: 11 Russian, 1 Western.
[74-6415]

UDC 621.35.21.68-533.65

## INCREASE OF PERMISSIBLE REHEAT TEMPERATURE OF POWER CABLES

Moscow ELEKTROTEKHNIKA in Russian No 9, Sep 83 (manuscript receiver 9 Mar 83) pp 42-45

KAMENSKIY, M. K. and NIKITINA, N. A., engineers

[Abstract] To a considerable extent the carrying capacity of power cables is determined by the permissible temperature during prolonged operation. The present paper describes experimental and theoretical investigations made with the object of increasing the permissible temperatures and is concerned with an improvement of the impregnated paper insulation of cables at voltages up to 35 kV. The experimental data obtained are presented by a chart in the form of the dependence of the probability of breakdown voltages of paper cable insulation on various temperatures and pressures. The minimum values of the life of cable insulation at increased reheat temperatures are determined. Figures 6; tables 3; references 5: 4 Russian, 1 Western.
[74-6415]

UDC 621.315.21.3.013.072:621.315.616.9.3.012

## CHARACTERISTICS OF POLYMER MATERIALS FOR CONTROL OF ELECTRICAL FIELD IN INSULATION OF CABLE FITTINGS

Moscow ELEKTROTEKHNIKA in Russian No 9, Sep 83 (manuscript received 9 Mar 83) pp 45-48

BAZANOVA, N. N., engineer, MAKAROV, L. Ye., candidate of technical sciences, PANKRATOVA, L. A., candidate of chemical sciences and SEMENENKO, M. I., candidate of physico-mathematical sciences, NKIIKP (expansion unknown)

[Abstract] The paper determines the nonlinearity indices of compositions which can be used for control of the electrical field intensity in cable fittings. Investigations were made of compositions based on diene epoxy resin (K-116), and consolidated polyethylene-poliamiron (PEPA), in the composition of which silicon carbide, acetylene black, and zinc oxide were introduced. The amount of the acetylene black varied from 0.5 to 5 percent of the total mass. In one composition a metal-ceramic material employed for oxide-zinc RNS-60 resistors with grain dimensions of 70 mkm was used as an ingredient. The dimensions of the silicon carbide grain was 14 to 20 mkm. The investigations established that polymer materials with nonlinear volt-ampere characteristics (nonlinearity index of 1.3) can be used for control of the electrical field in cable fittings. Figures 5; tables 1; abstracts 2: 1 Russian, 1 Western. [74-6415]

UDC 621.311.69:621.313.001.57

## MATHEMATICAL MODEL OF PROBLEM OF OPTIMIZING ELECTRICAL MACHINES IN AUTONOMOUS ELECTRICAL SUPPLY SYSTEMS

Moscow ELEKTROTEKHNIKA in Russian No 9, Sep 83 (manuscript received 28 Apr 83) pp 54-56

RADIN, V. I., doctor of technical sciences, professor, ZAGORSKIY, A. Ye., candidate of technical sciences and LANGEN, S. A., engineer, Plant imeni Vladimir Il'ich

[Abstract] Contemporary autonomous electrical supply systems (AESS) represent a complex aggregate of technical means which carry out generation and multi-stage conversion of electrical energy. An AESS can contain a large amount of electromechanical and static converters with various functional connections. The common problem of synthesis of such systems includes in itself optimization of the individual elements of the AESS. The present paper contains a mathematical model placed at the base of search algorithms for optimization of electrical machines in an AESS, during choice of the most effective variation of a system at the initial stages of planning. References: 2 Russian. [74-6415]

STABILIZER OF ROTATIONAL SPEED OF ELECTRIC MOTORSHAFT

Moscow RADIO in Russian No 10, Oct 83 pp 26-27

SAMELYUK, V. and SUSHKO, L., Kiev

[Abstract] A speed stabilizer has been designed for d.c. motors as well as for various automation and remote-control devices. It ensures high stability of the average speed (within±0.4%) over a wide temperature range (-40 to +60°C) and a wide torque range (0-100 g·cm), the instantaneous speed being maintained within ±3%. Its operation is based on comparing the repetition period of voltage pulses at the output of the tachometer transducer with a reference time interval and switching the motor off or on depending on whether the former does or does not exceed the latter. The stabilizer consists of a quarta oscillator, a pulse counter, a trigger, a generator of adjusting pulses (with transformer), and a power amplifier, with the tachometer generator generating a sinusoidal voltage mounted on the shaft of the servomotor. The sequences of operations and the performance of the stabilizer are demonstrated on a typical case, naemly maintaining and limiting the shaft speed at 3444 rpm. The stabilizer can be built with series K133 microcircuits, particularly the amplifier-limiter using an operational amplifier. The transformer is either the matching transformer from a VEF-201 radio receiver or a TOT-25(34) commercially-produced one. The stabilizer was tested with a DPR-52-N1-02 motor. Figures 1.
[67-2415]

UDC 621.313.333.001.3

OPTIMIZATION OF GEOMETRY, PARAMETERS AND CHARACTERISTICS OF ELECTROMAGNETIC CLUTCHES AND BRAKES WITH MASSIVE MAGNET STRUCTURE

Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA in Russian No 10, Oct 83 (manuscript received 7 Jun 82) pp 75-78

GUSEYNOV, FRIDUN GAMZA OGLY, corresponding member, AzSSR Academy of Sciences, doctor of technical sciences, professor at Scientific Research Institute of Power Engineering and ALIYEV, NADIR ABDURAKHMAN OGLY, assistant, Azerbaijan Institute of Petroleum and Chemistry

[Abstract] Design and performance optimization of electromagnetic clutches and brakes is considered on the basis of a regression equation for the electromagnetic torque as function of all independent influencing factors. Only five factors are considered, namely: length of armature and pole pieces, electrical conductivity of steel, magnetic induction in the air gap at no load, armature-reaction factor and saliency factor. Slip is not included explicity, its value being stipulated in discrete intervals from 0.05 to 1.0 and the regression equation determined for each of its values. A preliminary analysis has revealed that only pairwise interaction of these factors are significant so that all terms with products of three or more factors can be dropped from the regression

equation. All necessary $2^{n-1}$= 16 factorial experiments were performed for all 16 elements of the planning matrix, with calculations made according to the complete design algorithm. The resulting five numerical regression equations, one for each value of the slip s= 0.05, 0.1, 0.2, 0.5, 1.0 have been checked for significance and adequacy. The results have also been checked against physical test data. This system of five regression equations, which are nonlinear algebraic ones, can be programmed for solution on a digital computer by the method of steepest descent and subsequent minimization of the composite rms difference between left-hand sides and right-hand sides. From the results can also be established the range of possible variation of mechanical characteristics and within it the optimum mechanical performance curve. Figures 2; tables 1; references 5: 4 Russian, 1 Western (in Russian translation).
[66-2415]

UDC 621.315.62:658

OPTIMIZATION OF INSULATOR CHAINS FOR SUPERHIGH-VOLTAGE OVERHEAD ELECTRICAL TRANSMISSION LINES

Minsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ENERGETIKA in Russian No 11, Nov 83 (manuscript received 7 Dec 82) pp 8-12

LISOCHKINA, T. V., candidate of economic sciences, docent, Order of Lenin Leningrad, Polytechnic Institute imeni M. I. Kalinin

[Abstract] Optimization of insulator chains for superhigh-voltage overhead electrical transmission lines is treated from the engineering economics standpoint, taking into account probabilistic factors (number of flashovers, probability of unsuccessful automatic reclosure) and probabilistic-indeterminate ones (number of dangerous moist spots, per-unit economic loss caused by one disconnection). As principal optimizable variables are regarded the interdependent length of chain and ratio of leakage path length to structural insulator height. As an optimality criterion is selected the minimum unit normalized cost of transmission line equipment and operation. Parameters in the problem are the prototype power rating of a transmission line, the cost of electric power transmission, the normative investment cost effectiveness, the equipment depreciation, and the mathematical expectation of damage caused by transmission failure to the national economy. All factors are evaluated on the basis of semiempirical relations and known performance characteristics of PS and PSG 750 kV suspension-type glass insulators. Analysis and solution of the problem yield the equieconomical ranges for the two design variables and the dependence of their optimum values on the voltage class. The results indicate that the equieconomical range of both variables extends from -10% to +10% of their absolute optimum values. In a dusty atmosphere the optimum ratio of leakage path length to structural insulator height ranges from 2 to 3, tending toward the lower limit as the nominal voltage increases. Figures 3; references: 6 Russian.
[71-2415]

UDC 621.315.2.015.38

WAVE PARAMETERS AND WAVE PROCESSING IN THREE-PHASE GAS-INSULATED CABLES

Minsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ENERGETIKA in Russian No 11, Nov 83 (manuscript received 24 Dec 82) pp 31-35

KADOMSKAYA, K. P., doctor of technical sciences, professor, and LAVROV, Yu. A., engineer, Novosibirsk Institute of Electrical Engineering

[Abstract] Gas-insulated cables (GIC) offer several advantages over oil-insulated ones, with higher power rating and lower power losses in addition to noninflammability. However, operation of cables with compressed gas gives rise to various problems such as reliability under atmospheric or switching surges. Such a typical cable is a GIC 3-Ø rated for 500 kV, with symmetric or asymmetric configuration of the three-phase conductors (aluminum) inside the shell (steel). The performance of either type in response to pulse action is analyzed by the method of conformal mapping, assuming a ratio $K_{n-1}(y)/K_n(y) \approx 1$ of MacDonald functions for values of argument y which characterize conducting media. The electrical impedance and its components are calculated on this basis, assuming an infinitely long cable, and, consequently, the voltage transient at various points along the cable as well as the voltage wave propagating along one phase and through adjacent channels. The results reveal appreciable differences between the performance of gas-insulated cables and that of oil- or air-insulated ones. The voltage transfer function (frequency characteristic) below 1 MHz and the high wave impedance of gas-insulated ones indicate that they are not "self-protected" components of electric power transmission systems. Figures 3; references 5: 3 Russian, 2 Western.
[71-2415]

UDC 621.311.076.12.026.5

OVERVOLTAGES DURING SWITCHING OF CAPACITOR BANKS TO STATIC COMPENSATORS WITH THYRISTOR CONTROL IN ULTRAHIGH-VOLTAGE ELECTRICAL TRANSMISSION LINES

Minsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ENERGETIKA in Russian No 11, Nov 83 (manuscript received 20 Jul 82) pp 41-44

LAZIMOV, T. M., engineer, ISMAYLOVA, E. A., engineer, and MIRONOV, G. A., candidate of technical sciences, Azerbaijan Scientific Research Institute of Power Engineering imeni I. G. Yes'man

[Abstract] Overvoltages present a problem when a large capacitor bank is switched to the medium-voltage busbars in an ultrahigh-voltage substation with thyristor-type static compensators also connected to these busbars. This problem was studied by numerical methods, with a 3-Ø system as the mathematical model and with simulation of the switching process on a BESM-6 high-speed digital computer. A 3-Ø 200 Mvar capacitor bank was switched to three $500/\sqrt{3}$ kV busbars also carrying two static compensators in parallel with the load, both compensators including thyristors and 3rd-harmonic filters. The busbars were

energized from a 3-Ø-Y 1150 kV alternator through three single-phase autotransformers. All calculations were made in accordance with the rules of circuit theory and transient analysis, particularly taking into consideration the compensator performance characteristics. The results of these calculations, in the form of overvoltage oscillograms, reveal that switching overvoltages are influenced by a static compensator, namely depend on its reactive power at nominal frequency (50 Hz). The recurrence of such overvoltages can be minimized by proper setting of the thyristor conduction angle and corresponding adjustment of the compensator design. Inductive compensators do not contribute to a higher overvoltage recurrence rate, because without capacitive elements they do not pump back reactive power. Figures 4; references: 3 Russian.
[71-2415]

UDC 621.3.051.025

CALCULATION OF NATURAL POWER OF CONTROLLED ELECTRIC POWER TRANSMISSION LINE

Moscow ENERGETIKA I TRANSPORT in Russian No 6, Nov-Dec 83
(manuscript received 20 Oct 82) pp 11-16

TSYGANKOV, L. M., Novosibirsk

[Abstract] The basic characteristics of electric power transmission lines (LEP) are the propagation constant, the wave impedance and the natural power. Expressions are known for calculation of the characteristics of controlled LEP which contain two identical circuits for one class of voltage. The present paper obtains algorithms for calculation of natural power, as well as matrices of wave impedance and the propagation constant for any number of circuits entering into a controlled LEP of increased capability. The algorithms developed for calculation of natural power, based on the application of modal transformation, are applicable for both two-circuit controlled lines and for multicircuits containing any number of circuits with mutual effects. In general, the natural power of the circuits of a controlled LEP has active and reactive components. The reactive component is determined by the electromagnetic effect of the circuits; its total value for all LEP is close to zero. Figures 1; references: 6 Russian.
[73-6415]

UDC 621.311.016.001.24

AUTOMATIC FORMATION OF MATHEMATICAL MODELS OF ELECTRIC POWER SYSTEMS FROM TELEMETERING DATA

Moscow ENERGETIKA I TRANSPORT in Russian No 6, Nov-Dec 83 (manuscript received 13 Oct 82; after revision 24 Mar 83) pp 27-33

LISEYEV, M. S. and POCHECHUYEV, S. V., Moscow

[Abstract] The paper describes an algorithm, the special features of which are the simulaneous processing of telemetering and remote indication, mutual

verification of these two forms of information, automatic determination of the sufficiency of telemetering for calculation (observability) and automatic formation of a mathematical model of the operation of electric power systems. In comparison with the processing of the verification measurements and 24-hour data lists, processing of the telemetry in question has a number of special features: the high requirements on the speed of information processing with switchings of possible losses of observability, and of possible errors both in remote indication and in determination of the topology of networks. It is advisable to determine the observability of electric power systems by a comparison of a graph of the measurements with the tree graph. During a change of the topology of the network, it is advisable simultaneously to monitor the observability and the automatic formation of the model of electric power systems. The presence of two interconnected forms of information (telemetering and remote information) determines their mutual verification which increases the reliability of the model of a network and its present regime. Figures 3; tables 2; references 9: 7 Russian, 2 Western.
[73-6415]

UDC 621.315.1.027.3.001.4

## JOINT SOVIET-AMERICAN STUDY OF SINGLE-PHASE AUTOMATIC RECLOSURE IN 750-765 kV ELECTRIC TRANSMISSION LINES WITH TETRAPADIATE REACTORS

Moscow ELEKTRICHESTVO in Russian No 12, Dec 83 (manuscript received 19 May 83) pp 9-14

BELYAKOV, N. N., RASHKES, V. S. and KHOYETSIAN, K. V., All-Union Scientific-Research Institute of Electric Power Engineering, Ussr; SHERER, H. N., SHPERLING, B. R., Automatic Electric Power Transmission (?), USA; and CHADWICK, J. W., Tennessee Valley Authority, USA

[Abstract] A joint Soviet-American study was made of single-phase automatic reclosure in 750-765 kV electric transmission lines with tetraradiate reactors, the Soviet 417 km long 750 kV - 50 Hz Dnepr-Vinnitsa line being a transposed one and the American 243 km long 750/765 kV - 60 Hz Kammer-Merrysville line being an untransposed one. Tetraradiate reactors were installed in both lines, their nonstandard components including compensators with protective overvoltage limiters and stabilizing spark gaps. The tests were concerned with their circuit breaking and arc quenching characteristics, the purpose of the study being to find ways to shorten the shutdown time after faults. Accordingly, voltages and currents during switching transients were recorded on magnetic tape and the rate of voltage recovery was measured. The results have revealed a dependence of the quench time on the magnetizing current and on the voltage in the disconnected phase. The results also confirm the effectiveness of four-prong reactors, preferably with hypernonlinear overvoltage limiters, such reactors in untransposed 60 Hz lines requiring a commutator. Figures 5; tables 1; references 11: 5 Russian, 6 Western.
[79-2415]

UDC 621.316.176.015.2

ELECTROMAGNETIC INTERFERENCE IN ELECTRIC POWER SUPPLY SYSTEMS IN INDUSTRIAL PLANTS

Moscow ELEKTRICHESTVO in Russian No 12, Dec 83 (manuscript received 16 Dec 81) pp 14-18

ZHEZHELENKO, I. V., doctor of technical sciences, Zhdanov; and SHIMANSKIY, O. B., engineer, Daugavpils

[Abstract] In connection with the increased use of electronic and microelectronic control systems in industrial plants, there arises the problem of electromagnetic interference with a resulting degradation of equipment reliability. From the standpoint of protective countermeasures, an analysis of electromagnetic interference begins with a classification of electromagnetic transient processes according to their source, namely into internal and external ones, the latter causing over 80% of all interference-related failures in a plant. This is illustrated by data pertaining to a typical chemical fiber-manufacturing plant located within the zone of influence of high-voltage (110-330 kV) transmission lines, data which cover the 1977-80 period. The degree of susceptibility of electronic equipment such as receivers to electromagnetic interference and thus the resulting failure rate are determined by the amplitude-frequency characteristics of both. They are best evaluated relative to the ratio of interference duration to amplitude, a unique functional relation, while the conventional interference "dose" (product of interference duration and amplitude) as a criterion yields an almost noncorrelated characteristic. Calculations are shown for a pulse-phase-controlled thyristor inverter with T-logic commutation, namely the dependence of the critical control angle on the ratio of relative increase of "lagging" phase voltage to relative residual voltage in the distribution network. The 3-Ø voltage on the a.c. side of the inverter is assumed to be symmetric, without ripple and without fluctuations. The results indicate that systematic minimization of electromagnetic interference effects requires limiting the voltage dips and optimizing the short-circuit currents in the distribution network. An effective alternative is use of autonomous electric power supplies with high-speed automatic voltage regulators. Figures 6; tables 2; references 5: 2 Russian, 3 Western.
[79-2415]

UDC 621.311:338

ELECTRICAL TECHNOLOGY IN NATIONAL ECONOMY OF USSR

Moscow ELEKTRICHESTVO in Russian No 12, Dec 83 (manuscript received 7 Feb 83) pp 18-21

DONSKOY, A. V., doctor of technical sciences, Leningrad

[Abstract] The most economical use of energy resources is defined as the major problem continuously facing the power industry in the USSR. The role of electrical technology in contributing and ensuring this economy is analyzed

first in relation to the role played by electric appliances, electric motors being the dominant representative of the latter. Electrical manufacturing equipment is then classified into three categories, with a considerable degree of overlap, namely: electrometallurgical, electrochemical, electrothermal. Statistical data covering the 1965-80 period and projections for the 1980-2000 period reveal trends in each category, growth and decline of various processes in various industries such as ferrous and nonferrous metallurgy, chemicals, electrical products, machine tools, instruments, agricultural machinery, and automobiles. Typically, steelmarking in an acid Bessemer converter and with the use of electric melting is on the rise since 1970, while steelmaking by the plain Bessemer process and the Martens process is on the decline since 1970. Objective indicators are established for quantitative evaluation of the increasing role of electrical technology, namely its relative total energy consumption and the relative change of its energy consumption. The technological efficiency of electrical manufacturing equipment is defined in terms of heat transfer and temperature rise. This parameter is then evaluated for each category of equipment, to serve as rational basis for further planning and development of such equipment but also, more importantly, of electric power generation and distribution plants which will supply the necessary energy with maximum fuel efficiency. Tables 3; references: 4 Russian.
[79-2415]

UDC 621.396.22.029.7

# FIBER-OPTIC LINE FOR TRANSMISSION OF ANALOG DATA

Moscow RADIOTEKHNIKA in Russian No 9, Sep 83 (manuscript received, after completion, 23 Feb 83) pp 3-7

ABRAMOV, V. V., KARPENKO, V. A., POTAPOV, V. T. and SOSNIN, V. P.

[Abstract] An fiber-optic communication line up to 1 km long has been designed for transmission of analog data in the 0.1-25 MHz frequency range as well as of positive and negative pulses of up to 3 dB amplitude and 0.1-25 ns duration. The basic requirements it must meet are an output signal with a minimum dynamic range of 50 dB, voltage transfer ratios $K_1 = 1 \pm 0.005$ and $K_2 = 3 \pm 0.15$, and nonlinear distortion not exceeding 5%. These requirements are met by "Gradan" gradiental multimode fiber (average power loss 10 dB/km, dispersion of nanosecond/km order, diameter of light conductor 50 μm, numerical aperture 0.2). The most suitable light source for this line is an ILPN-301-1 radiator, containing a superluminescent light-emitting diode (wavelength $\lambda = 0.85$ μm) with a GaAlAs twin heterostructure. The optical transmitter is built with three transistors (KT399A, KT363B, KT610A), three diode-resistor series circuits for nonlinearity compensation, and a GaAs diode for temperature stabilization of the LED starting current. For calibration of the prototype transmitter were used sequences of 64 pulses of 1 μs duration and 1 μs separation, with a repetition period of 1024 μs and with an amplitude increasing linearly from -3 to +3 V. The high-sensitivity linear optical receiver contains a photodiode with feedback resistor, a high-speed inverting amplifier, a pair of identical noninverting amplifiers, a controllable attenuator, and an emitter follower at the output. The line consists of two channels, a main one for data transmission and an auxiliary one for transmitter control. The electric input signal, of either positive or negative polarity, has an amplitude not larger than 3 dB. The line operates stably over a wide range of ambient temperature, the transmitter at -40 to +50°C and the receiver at +10 to +30°C. Figures 5; references 7: 5 Russian, 2 Western.
[57-2415]

UDC 681.7.068

DEPENDENCE OF PARAMETERS OF FIBER-OPTIC GYROMETER WITH PHASE COMPENSATION ON ANGULAR ACCELERATION AND ON DISPERSION

Moscow RADIOTEKHNIKA in Russian No 9, Sep 83 (manuscript received 14 Jan 83) pp 73-75

FATEYEV, V. F.

[Abstract] Progress in development and application of fiber-optic gyrometers depends on ensuring high sensitivity and accuracy of measurements, another desirable feature being the possibility of direct digital readout. Two ways to achieve this are modulation and heterodyning. The advantages of both methods, high sensitivity and direct digital readout, respectively, have been combined in a gyrometer with phase compensation. The frequency difference between opposing waves in the heterodyne circuit, proportional to the angular velocity of the gyrometer and to the radius of the ring structure, but inversely proportional to the laser wavelength and to the refractive index of the fiber material, causes a phase shift in the difference-frequency oscillation. This phase shift is made to compensate the phase shift caused by gyrometer rotation. Now the measured quantity is not the Sagnac-effect phase shift, but the frequency difference produced by the local oscillator. In the plane of the photoreceiver the frequencies of opposing waves become the same. This makes possible modulation with a stationary interference pattern. An analysis of processes in such a gyrometer rotating at angular velocity $\Omega_0$ and angular acceleration $\dot{\Omega}$ in a readout system rigidly coupled to it, with gravitational and centrifugal forces disregarded, reveals a strong dependence of the gyrometer performance parameters on the angular acceleration of the gyrometer and on the frequency dispersion of the refractive index. This dependence must be minimized in the gyrometer design for minimum error of phase shift measurements. References 7: 3 Russian, 4 Western.
[57-2415]

UDC 621.791.72:621.373.826

PROJECTION LASER EQUIPMENT FOR PROCESSING FILM MATERIALS

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 26, No 10, Oct 83 (manuscript received 18 Oct 82) pp 93-96

VEYKO, V. P., KOTOV, G. A., RUMYANTSEV, D. M., SIDOROVA, T. A. and YURKEVICH, B. M., Leningrad Institute of Precision Mechanics and Optics

[Abstract] The feasibility of drawing figures on a film by means 1f laser radiation has led to the development of projection lasers for film processing. Some problems in the direct use of projection lasers for this purpose arise from the discrepancy between the field of an image and the resolution. Other problems are minimizing the energy loss in the mask and ensuring a uniform

illumination of the latter. Although neodymium-glass lasers are suitable for projection processing of large figures on films, modifications of this concept are universally much more expedient. Contour-projection processing involves microprojection onto a simple geometrical element such as a square of minimum dimensions, and the subsequent scanning over the entire film surface. This method has been implemented in the construction of "Kod" and "Kvarts-2" equipment with an LGI-21 $N_2$-laser. The "Kod" equipment is designed for producing scales, grids, and phototemplates. The "Kvarts-2" equipment is designed for dimensional and parametric trimming of thin-film electrical and optical devices such as resistors, capacitors, etc. Energy losses in the mask have been further reduced and the stability of the mask increased, with a still more uniform illumination, by resorting to screen-projection processing. The "Kvarts-5" equipment with an LGI-502 $N_2$-laser and a lenticular screen is designed for processing thick-film devices (up to 50 um thick) as well, without limitation on the laser output power. Use of these devices saves annually 50,000-200,000 rubles depending on the operation. The authors thank A. I. Korkin and P. N. Sobolev for participation in the work. The paper was recommended by the Department Faculty (Kafedra) of Labor Protection. References: 4 Russian. [72-2415]

UDC 621.378.33

# REFLECTION-TYPE WAVEGUIDE SWITCH FOR INTEGRATED-OPTICS SIGNAL DECODER

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 26, No 10, Oct 83 (manuscript received 11 Feb 83) pp 90-92

GLADKIY, V. P., IVANOV, V. N., LOPATKINA, Ye. I. and YAKOVENKO, N. A., Kuban State University

[Abstract] Space-time switches of optical radiation are the basic structural components of optoelectronic data processing logic. A reflection-type light switch has been developed on the basis of an X-cut $LiNbO_3$ single crystal forming a planar waveguide, with titanium deposited on the substrate by vacuum evaporation serving as diffusant. The two control electrodes (capacitance 3.6 pF) were built in photolithographically. For an experimental determination of its performance characteristics, coherent light of 632.8 nm wavelength was brought in the brought out through GaP prisms. Measurements were made for the $TE_0$-mode with a radiation recording FD-24K photodiode and a voltmeter. From the data have been evaluated the signal modulation factor and the reflection coefficient at a fixed incidence angle, both as functions of the electric field intensity over the 0-10 V/μm range. The time constant of the switch under a load of 50 ohm was estimated at $1.8\ 10^{-8}$ s. The results indicate the suitability of such a switch for use in integrated-optics signal decoders. Such a decoder consists of m optical stages with $N= 2^{m-1}$ (m= 1,2,... consecutive number of a stage) in each. The paper was recommended by the Department Faculty (Kafedra) of Electronics, Kuban State University. Figures 3; references 4: 3 Russian, 1 Western (in Russian translation).
[72-2415]

UDC 621.37/39:534

# DISPERSION CHARACTERISTICS OF ACOUSTIC-OPTICAL LIGHT-SIGNAL CONVERTER

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian
Vol 26, No 11, Nov 83 (manuscript received 7 Jun 82) pp 3-7

BALAKSHIY, V. I., IVANOV, V. V. and UPASENA, Kh. A.

[Abstract] The paper investigates the dispersion characteristics of acousto-optical light-signal converters concerned with recording the amplitude of a light field. To a considerable degree the dispersion characteristics of an acousto-optical scanning device (AOSD) determine the field of application of such devices, and the possibility of their use in television systems. The diffraction of light at the travelling acoustic train, the monochromatic lighting, and the specific dispersion characteristics are considered. The calculations made of the space-frequency characteristics of AOSD show the outlook for development of such devices for the purpose of transforming optical images into electrical signals. It is shown that under optimum operation conditions the dispersion characteristics of AOSD are weakly expressed, which makes it possible to use such devices for scanning images obtained not only in coherent but also in white light. Figures 3; references: 5 Russian.
[70-6415]

UDC 621.335:538.312:62-52

# MATHEMATICAL MODEL OF ELECTROMAGNET IN ELECTROMAGNETIC SUSPENSION SYSTEM

Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA in Russian No 10, Oct 83 (manuscript received 28 May 82, after completion 19 Oct 82) pp 116-117

POPOVICH, NIKOLAY GAVRILOVICH, doctor of technical sciences, professor, GAVRILYUK, VIKTOR AVKSENT'YEVICH, senior instructor, TERYAYEV, VITALIY IVANOVICH, candidate of technical sciences, assistant, RED'KO, ALEKSANDR PAVLOVICH, junior scientific assistant and AVRINSKIY, VIKTOR DMITRIYEVICH, student, all of Kiev Polytechnic Institute

[Abstract] A mathematical model has been constructed on an analog computer which describes the dynamics of an electromagnetic suspension system where both the thrust force and the magnetic pull force are nonlinearly dependent on the magnetic flux and on the gap width. This model takes into account leakage and fringing of the magnetic flux, as well as saturation of the magnetization curves for the electromagnet components and the effect of eddy currents on the time lag of magnetic flux buildup. The model is specifically designed for II-core electromagnets and contains necessary experimentally obtained data. These data correspond to an electromagnet for an HSGT vehicle weighing 40 t (magnetic leakage and fringing fluxes almost independent of gap width over the 10-30 mm range). Figures 2; references 2: 1 Russian, 1 Western.
[66-2415]

INSERT: In JPRS-UEE-84-001 of 17 January 1984 in translation of RADAR SIGNAL RECEPTION AGAINST BACKGROUND OF RANDOM INTERFERENCE, pages 24 and 25 of the original text were unavailable at the time of printing. Translation of these two pages are supplied herewith. Please insert between pages 20 and 21 of the report.

RADAR SIGNAL RECEPTION AGAINST BACKGROUND OF RANDOM INTERFERENCE

Moscow PRIYEM RADIOLOKATSIONNYKH SIGNALOV NA FONE FLUKTUATSIONNYKH POMEKH in Russian 1961 pp 24-25

[Pages 24-25 from book "Radar Signal Reception Against Background of Random Interference" by S. Ye. Fal'kovich, Izdatel'stvo "Sovetskoye Radio", 10,000 copies, 336 pages]

[Text] and interference $n_1(t)$, which according to (1.49) can be represented as

$$n_1(t) = N_{c1}(t)\cos[2\pi f_0(t-\tau_0)+\varphi] + \\ + N_{s1}(t)\sin[2\pi f_0(t-\tau_0)+\varphi], \tag{1.88}$$

where

$$N_{c1}(t) = \int_{-\infty}^{\infty} N_c(z)\,h_0(t-z)\,dz, \\ N_{s1}(t) = \int_{-\infty}^{\infty} N_s(z)\,h_0(t-z)\,dz, \tag{1.89}$$

and $N_c(t)$ and $N_s(6)$ - low frequency random mutually independent processes approximated by white noise with spectral intensity $N_0$.

For a matched (optimal) frequency response [26]

$$a(f) = \overline{g(f)} \leftrightarrow s(-t) \tag{1.90}$$

the signal at the output of a linear system is similar in form to the correlation function

$$s_1(t-\tau_0) = Q^2\psi(t-\tau_0) \tag{1.91}$$

and according to (1.20) is always amplitude-modulated oscillations. Therefore, our study of the combined transmission of signal and interference refers to amplitude-modulated (AM) radar signals, as well as radar signals of arbitrary form, as long as the frequency response of the linear system is matched.

The voltage at the output of an inertialess detector $X_2(t)$ represents some function $\Phi$ of the envelope of the input voltage

$$X_2(t)=\Phi\left\{\sqrt{[S_1(t-\tau_0)+N_{c1}(t)]^2+N_{s1}^2(t)}\right\}. \quad (1.92)$$

The precise form of the function $\Phi$ is determined by the detector response, which can be divided into two sections for the circuits ordinarily used: an initial one, which is quadratic in nature, and a main section which is linear. Accordingly, it is acceptable in practice to distinguish a total of two types of detectors: linear (i.e., a detector with linear detector response)

$$X_2(t)=\sqrt{[S_1(t-\tau_0)+N_{c1}(t)]^2+N_{s1}^2(t)} \quad (1.93)$$

and quadratic

$$X_2(t)=S_1^2(t-\tau_0)+2S_1(t-\tau_0)N_{c1}(t)+ \\ +N_{c1}^2(t)+N_{s1}^2(t). \quad (1.94)$$

In addition, it is advisable to distinguish the cases of strong and weak signals, depending upon the relationship between the signal intensity and the interference intensity. A strong signal is one for which the square of the envelope at the detector input significantly exceeds the interference dispersion

$$S_1^2(t)\gg\langle n_1^2(t)\rangle. \quad (1.95)$$

Conversely, a weak signal is one for which the inverse relationship holds:

$$S_1^2(t)\ll\langle n_1^2(t)\rangle. \quad (1.96)$$

Expression (1.93) is simpler for the limiting cases of weak and strong signals. For a weak signal (1.93) is transformed to the relationship

$$X_2(t)\approx\frac{1}{\sqrt{N_{c1}^2(t)+N_{s1}^2(t)}}\left[\frac{1}{2}S_1^2(t-\tau_0)+N_{c1}^2(t)+N_{s1}^2(t)+\right. \\ \left.+S_1(t-\tau_0)N_{c1}(t)\right], \quad (1.97)$$

which is fairly complicated but basically duplicates the case of quadratic detection. Therefore, it is acceptable for the case of linear detection of weak signals to employ (1.94) instead of (1.97) (which is usually done), which provides sufficient accuracy for practical application.

Accordingly, the transmission of signal and interference through the detector can accordingly be reduced to examining the following special cases in theoretical analysis and practical calculations.

1. Linear detection of a strong signal

$$X_2(t) \approx S_1(t-\tau_0)+N_{01}(t). \qquad (1.98)$$

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CSO: 8344/1711-A

UDC 621.391.268:621.396

# ON POSSIBILITY OF USING ACOUSTICAL-OPTICAL MODULATORS WITH OVERLAPPING ULTRASONIC BEAMS IN OPTICAL INFORMATION PROCESSING SYSTEMS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 28, No 9, Sep 83
(manuscript received 10 Jun 81) pp 1846-1853

AKSENOV, Ye. T., VODOVATOV, I. A., YESEPKINA, N. A. and ROGOV, S. A.

[Abstract] Although multichannel acoustical-optical modulators which can parallel process large volumes of information are quite promising, the use of suchodulators with a high-channel density can be precluded because of the divergence of the ultrasonic waves, which leads to overlapping of adjacent channels. This paper is a theoretical and experimental study of the performance of multichannel modulators with overlapping beams in holographic correlators. The experimental study used a four-channel acoustical-optical modulator based on TF-10 glass with the following parameters: 1) The width of the electrodes of the piezoelectric transducers was 0.8 mm and the spacing between them was 1 mm; and 2) The depth of the individual channels was 50 mm, where the channels diverged and subsequently overlapped over a portion of this depth. A frequency of about 30 MHz was used and the possibility of using the system for correlation processing in two coordinates (in a Van der Lugt correlator) as well as the possibility of compensating for the divergence of the ultrasonic waves by means of holographic filters in such correlators and in a spectrum analyzer was tested. Photographs show the distribution of the light intensity at the output of the acoustical-optical correlator for the case of processing in one coordinate for input signal frequencies of 29, 31, 32.5, 34 and 36 MHz, as well as the output signals from an acoustical-optical spectrum analyzer which compensates for the divergence, where signals at different frequencies near 30 MHz are fed to different pairs of channels in the acoustical-optical modulator. Such modulators can clearly be used in multichannel processors. The number of channels can be increased by employing a diaphragm stop in the frequency plane of the optical system or through holographic compensation for the divergence. Figures 5; references 7: 4 Russian, 3 Western, 1 in Russian translation.
[51-8225]

UDC 534.232:621.372.542

MULTIFREQUENCY REJECTION FILTER BASED ON SURFACE ACOUSTIC WAVE RESONATOR

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 28, No 9, Sep 83
(manuscript received 13 Jul 81) pp 1854-1857

GUREVICH, G. L., PASHKIN, V. M. and SANDLER, M. S.

[Abstract] The high Q of SAW resonators permits the use of such devices as effective rejection filters. A set of SAW rejection filters turned to the appropriate frequencies can be used in order to suppress interference having the same modulation period and carriers close to the signal frequencies. The discrimination of the useful signal and the suppression of such close frequency interference can be accomplished with a conventional SAW resonator in which the input and output intermeshing stub SAW transducers are connected via a two-port network have a particular impendance. This paper is a theoretical and experimental study of such a multiple frequency rejection filter in the case of various levels of coupling of the signal source and load to the filter. The theoretical conclusions concerning filter performance were confirmed by the following experiment: A SAW filter resonator was made from two intermeshing pin transducers forming a pi-network with the coupling element at the top being a resistor of about 700 ohms. The SAW device was fabricated on a lithium-niobate YZ-cut crystal. The spatial period of the transducers was 100 micrometers and they had six pairs of intermeshing pins each, spaced 47 mm from each other. Matching was achieved with tapped input and output inductances. With sufficiently loose coupling to the resonator, the Q's of its modes close to the center frequency were about 4,300 and the rejection was 48 to 50 dB at frequencies between 34.5 and 35.5 MHz, where the individual channels were 75 KHz wide. Figures 2; references: 2 Western.
[51-8225]

UDC 621.315.320.45:538.945

TRANSPOSED SUPERCONDUCTOR COILS FOR LARGE MAGNET SYSTEMS

Moscow ELEKTROTEKHNIKA in Russian No 10, Oct 83 (manuscript received 24 Mar 83)
pp 6-8

KLIMENKO, Ye. Yu., doctor of physico-mathematical sciences, KAZANCHYAN, G. P., candidate of technical sciences, ARZUMANYAN, G. G., engineer, and KAZAROV, B. A., engineer, All-Union Scientific-Research Institute of Cable Industry, Yerevan branch

[Abstract] Superconducting magnet systems designed for future "Tokamak"-type thermonuclear reactors, inductive energy storing devices, plasma traps, Magnetohydrodynamic machines and other equipment must be capable of operating with currents up to 50 kA and of holding up to $10^{13}$ J energy. In accordance with the already established dependence of the "optimum" operating current and

the allowable current density in niobium-titanium conductors with stabilizing copper or aluminum matrix on the scale (energy capacity) of the magnet system, three schemes of transposing conductors in field coils are proposed which will result in maximum economy and stability of the normal metal. Each coil consists of two adjacent stacks of eight rectangular conductors, all having the same height and width. The two stacks are separated by a vertical strip of stainless steel and both stacks plus another such conductor on top at the center are wrapped in a common insulation sleeve. In the first scheme solid NT-50 superconductors and tubular copper conductors alternate in a checker-board pattern. In the second scheme there are all NT-50 superconductors. In the third scheme solid NT-50 superconductors and solid copper conductors alternate in a checker-board pattern. The advantages of such transposition schemes, besides that possibility of internal reinforcement with a steel strip, are the feasibility of producing all conductors of the necessary length with available tools and pretesting them prior to assembly so as to minimize the failure rate in service, retention of the winding flexibility despite the large total cross section, the possibility of twisting the conductors about their longitudinal axis, of insulating each individually, and of their short-pitch transportation for higher mechanical stability during fast changes in the magnetic field intensity. Figures 3; tables 1.
[77-2415]

UDC 62-506.42

EXPERIMENTAL STUDY OF ALGORITHMIC ERROR COMPENSATION IN SET OF ACCELEROMETERS

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 26, No 10, Oct 83 (manuscript received 11 Mar 83) pp 45-51

PLOTNIKOV, P. K., ALESHKIN, V. V. and FILIPPOV, V. A., Saratov Polytechnic Institute

[Abstract] Error compensation in a set of three pendulum-type accelerometers by the algorithmic method was tested experimentally for accuracy, with the aid of a "Saratov-2" digital control computer. The appropriate compensation algorithm was implemented for each of the following principal errors: those caused by cross connections, those caused by nonlinearity of scale factors, and dynamic errors. The scale factor of each accelerometer and the gain of each angle transducer were measured first, using resistors in series with the coils of corresponding torque transducers and phase-sensitive rectifiers, respectively. Then with rotation of the platform through fixed angles about the mutually orthogonal axes, the effectiveness of compensation with regard to the first two types of errors was determined. Finally, compensation of dynamic errors caused by transients was checked by measurement of instantaneous values of a stepwise varied apparent acceleration. The data on the components of the apparent-acceleration vector were processed statistically, in terms of mathematical expectation, mean-square deviation, and dispersion. The results indicate that compensation according to the given algorithms reduces the overall error by a factor of 6-10, the dynamic errors veing reduced appreciably by shortening of the transient period to about one third. The paper was recommended by the Department Faculty (Kafedra) of Gyroscopic Instruments and Devices, Saratov Polytechnica Institute. Figures 4; tables 2; references: 5 Russian.
[72-2415]

UDC 629.07.054.07.5

SYNTHESIS OF REGULATOR FOR ASTRONOMICAL DIRECTION FINDER

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 26, No 10, Oct 82 (manuscript received 28 Feb 83) pp 51-57

KHASANOV, I. N., Leningrad Institute of Precision Mechanics and Optics

[Abstract] A special-purpose regulator for astronomical direction finders is considered, a regulator capable of either evading or processing certain external perturbations. Only the algebraic part of such a regulator is synthesized here for a uniaxial direction finder, synthesis of the estimator being a separate problem, with the state vectors of dynamic objects assumed to be accessible to measurement. The analysis is based on the differential equation of motion in operator form for the direction finder. Introducing the angle of equivalent flutter and with it the torque time constant into this equation reduces the subsequent synthesis of a space stabilization system to synthesis of an angle tracking system. The equation of motion, rewritten in terms of the state space variables in matrix form, is solved for transient response to a step perturbation. A typical regulator is then designed to specifications of zero steady-state error, maximum 15% overshoot, and a certain length of the transient period. Calculations are based on the method of modal control, with a fourth-degree Butterworth polynomial approximating the response. The complete structure of an astronomical direction finder is shown, with a digital control computer executing the algebraic regulation and the estimation. The paper was recommended by the Department Faculty (Kafedra) of Airborne Control Instruments. Figures 3; references 5: 4 Russian, 1 Western (in Russian translation).
[72-2415]

UDC 537.312.8

MATHEMATICAL MODELLING OF THERMAL PROCESSES IN SUPERCONDUCTING WINDING

Moscow ENERGETIKA I TRANSPORT in Russian No 6, Nov-Dec 83 (manuscript received 6 Sep 82) pp 108-115

MARTYNYUK, S. S., Lvov

[Abstract] The paper derives a mathematical model of the temperature processes in the superconducting windings of electromagnetic systems, taking into account the thermal interaction of neighboring wraps. This makes it possible to describe more precisely the actual constructional use of superconducting windings. The model of a "single conductor" is included as a particular case. An analysis of a quasi-stationary process of extension of a normal zone with the aid of the new model showed that as a result of taking the thermal conduct of neighboring wraps into account, the normal zone in the winding is extended more rapidly than in a "single conductor," which was also observed in an experiment. An interwrap interlayer with a large heat capacity and a low

thermal conductivity decreases the speed of transition of a magnetic system in a normal state. In a first approximation for large rates (of currents), in the case of the winding, a simple connnection is established between the value of the current and the speed of extension of the front. An approximate formula is obtained for the rate of extension of the front in the case of inadequate cooling (strong thermal interaction of neighboring wraps). Figures 3; references 8: 7 Russian, 1 Western.
[73-6415]

UDC 772.99 + 538.56:519.25

STATISTICAL CHARACTERISTICS OF IMAGES OF SCATTERED OBJECTS AND LIGHT SCATTERED BY THEM WITH COHERENT ILLUMINATION

Moscow RADIOTEKHNIKA in Russian No 11, Nov 83 (manuscript received 9 Oct 82) pp 77-81

STROMILOV, I. S.

[Abstract] It is necessary to use statistical methods in order to study the properties of the images of scattered objects obtained with coherent illumination. In order to solve a number of problems (for example, with the presence of nonlinear elements in the optical channel) it is also necessary to know not only the one-dimensional but also the two-dimensional distribution of the intensity probabilities. The statistical properties of electromagnetic waves scattered by rough surfaces are most completely investigation with the use of radar. Five works in the literature consider several models of rough surfaces, which makes it possible with one or another degree of precision to imitate the real properties of scattered objects. On the basis of the above and other considerations, the present work obtains a two-dimensional distribution of the intensity probabilities, demonstrates the convulation theory for the intensity of the image, and finds the physical meaning of the correlation function of complex component fields and the intensities in the pattern of light scattering. Figures 3; references 13: 9 Russian, 4 Western (2 in Russian translation).
[83-6415]

UDC 621.374.5

DISTORTION OF NANOSECOND VIDEO PULSES IN SUPERCONDUCTING RECIRCULATOR

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 26, No 11, Nov 83 (manuscript received after revision 20 Sep 82) pp 94-95

NOVIKOV, S. A. and SHIYAN, V. P.

[Abstract] This brief communication is mainly concerned with an open type recirculator which consists of a section of superconducting cable (SC) opened at one end, and a valve based on a p-n juntion connected to the second end

of the SC. The principal circuit of the recirculator is shown and a description of its operation presented. The experimental results demonstrate that the efficiency of the superconducting recirculator is basically determined by the parameters of the semiconductor switch and the distortions of the pulses because of the repeated reflections from the nonuniformities of the SC. In the case of the careful processing of the input-output device and the use of the SC with high regularity, providing that distortion of pulses is acceptable in practice, the superconducting recirculator makes it possible to realize a variety of intersecting devices: 1) A variable delay line at hundreds of microseconds; 2) An oscillograph for registration of single nanosecond video pulses; and 3) An analyzer of the spectrum of single nanosecond and microwave pulses. Fiugres 1; references: 8 Russian.
[70=6415]

UDC 621.3.045:537.312.62.001.24

## DESIGN AND PERFORMANCE PARAMETERS OF SUPERCONDUCTOR WINDINGS WITH COIL SECTIONS IN PARALLEL

Moscow ELEKTRICHESTVO in Russian No 12, Dec 83 (manuscript received 12 Feb 83) pp 43-46

ANDRIANOV, V. V., doctor of technical sciences, and KOPYLOV, S. I., engineer, Moscow Power Engineering Institute

[Abstract] Superconductor windings have coil sections connected in parallel for high-current electrical machines or inductive energy storage devices, the latter used widely in power generating systems for covering peak loads and raising the stability limit. With coil sections connected in parallel, the total current is determined by the number of sections, and the current in each is determined by its inductance. A procedure for design and performance calculations has been developed on the basis of fundamental circuit laws and geometrical relations, with $Bj_c$=const (B- magnetic induction, $j_c$-circuit current density) as theoretical criterion and $B_{max}j_{des} \approx A$= const($j_{des}=\lambda k j_c$, $\lambda$-coil space factor, k- safety factor) as design criterion. The principal performance parameter is the increment of energy capacity defined as ratio of energy capacity with sectionalized winding to energy capacity with equivalent integral winding. The principal design variables are gap width, inside diameter, and length, all three referred to the outside diameter, in addition to the number of coil sections and with the coil cross section accommodating the allowable current density. The procedure facilitates design and performance analysis on a dimensionless and thus universal basis. It yields the optimum gap width for maximum increment of energy capacity attainable through sectionalization of the winding and the dependence of this increment on the sectionalization scheme, namely number and configuration of sections. A comparative evaluation of radial (concentric) and axial sectionalization reveals that the former is much more efficient in terms of magnetic induction. Data are shown in the form of graphs based on formulas, specifically applicable to superconducting magnet systems operating at magnetic induction of 5 T or higher. Figures 5; references 8: 5 Russian, 3 Western.
[79-2415]

UDC 621.313.322-81:537.312.62.001.2

# DIMENSIONAL DESIGN OF SADDLE-FORM SUPERCONDUCTOR FIELD WINDING FOR TURBO-GENERATOR

Moscow ELEKTRICHESTVO in Russian No 12, Dec 83 (manuscript received 22 Feb 82) pp 46-48

KHUTORETSKIY, G. M., VARSHAVSKIY, V. D. and PRAZDNIKOV, V. I., Leningrad

[Abstract] The design of saddle-form superconductor field windings for cryogenic turbogenerators involves calculating a three-dimensional magnetic field and optimizing the coil dimensions. This is done analytically, with subsequent refinement by numerical methods. The superconducting material is assumed to be a composite one and to retain its functional properties within some ranges of magnetic induction B, current density j, and absolute temperature T. At a given temperature $T= T_0= \text{const}$ the sufficient condition for normal operation is defined as $j_c = jk= f(B_{max})$ ($j_c$ - critical current density, $k > 1$ current safety factor, $B_{max}$ - maximum magnetic induction. The magnetic field in both the slotted zone and the end zone is calculated on the basis of corresponding Laplace and Poisson equations for the magnetic vector potential, with appropriate boundary conditions. Design analysis includes determining the dependence of the safety factor on the ratio of wound surface area to total surface area of the rotor for given coil heights, then comparing various coil configurations for some nominal amplitude of the fundamental Fourier component of magnetic induction at the stator bore, assuming a uniform current density distribution over the winding zone which will ensure that amplitude of $B_1$, and calculating the safety factor for each configuration. The magnetic field is evaluated by the methods of finite differences and sequential upper relaxation, assuming a magnetic vector potential with only an axial component. Design optimization by variation of independent dimensional parameters is done by linear programming. The algorithm yields first the optimum ratio of wound surface area to total surface area, one which will result in the maximum safety factor and which should serve as a basis for further design. The solution of both parts of the problem, magnetic field calculation and winding calculation, have been programmed in FORTRAN-4 for a computer. Figures 4; references 5: 4 Russian, 1 Western.
[79-2415]

CSO: 1860

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