

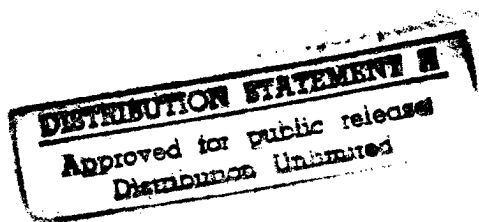
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# USSR Report

ELECTRONICS AND ELECTRICAL ENGINEERING



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12 FEBRUARY 1987

USSR REPORT  
ELECTRONICS AND ELECTRICAL ENGINEERING

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UDC: 621.391

DETERMINING MEAN TIME OF COMPLEX SIGNAL DELAY SEARCH IN 2-LEVEL SEARCH SYSTEM

Moscow RADIOTEKHNIKA in Russian No 8, Aug 86 (manuscript received 18 Nov 85)  
pp 58-59

[Article by V. V. Gorshkov, S.Z. Karamov, S.A. Rubtsov, and A.V. Sukhov]

[Abstract] A study is made of the variation of  $T_{av}$  as a function of the signal/noise ratio for 2-level search systems with arbitrary number of active correlators. The method presented allows selection of the optimal relationship between the number of matching filter channels and the number of active correlators, as well as estimation of the mean search time in the 2-level system. Figures 2; references 6: 4 Russian, 2 Western.

6508/9716

CSO: 1860/13

UDC: 621.396.96

CHARACTERISTICS OF DETECTION OF NONCOHERENT SIGNALS WITH GAMMA DISTRIBUTION OF ENERGY PROBABILITY

Moscow RADIOTEKHNIKA in Russian No 8, Aug 86 (manuscript received 13 Jan 86)  
pp 59-61

[Article by L.S. Levchenko and Yu.V. Sopelnik]

[Abstract] The detection characteristics of a noncoherent signal with group fluctuations of coherent components are given for arbitrary, not necessarily integer, values of the form parameter. Figure 1; references: 7 Russian.

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CSO: 1860/13

## COHERENT OPTICAL PROCESSING OF SIGNALS PRESENTED IN BINARY CODE

Gorkiy IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOFIZIKA in Russian  
Vol 29, No 7, July 86 (manuscript received 18 Jan 85) pp 793-797

[Article by D.A. Dementyev and V.D. Svet, Acoustic Institute]

[Abstract] A method is proposed for multi-channel recording and coherent optical processing of signals presented in binary code. Such use of binary presentation is most attractive because recording of signals requires only two levels of transmissivity. This clearly reduces the requirements on the characteristics of space-time light modulators. The proposed method of recording makes it possible to achieve a specified dynamic range, difficult to attain with ordinary recording using modulation of the transmission coefficient, as well as to accomplish parallel multi-channel processing. It was found, however, that the diffraction efficiency of this method of recording is less than with optical density modulation recording. Figures 3; references 2: 1 Russian, 1 Western.

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CSO: 1860/15

UDC 621.316.019.4

## SIGN AND RANK DETECTION OF A SIGNAL AGAINST A BACKGROUND OF MARKOV INTERFERENCE

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 31, No 6, Jun 86 (manuscript received 20 Jun 84) pp 1121-1132

[Article by P.S. Akimov and V.I. Nedoluzhko]

[Abstract] The sign and rank binary rules for detection of a signal operating under conditions of a single- and double-connected Markov interference are investigated. An approach based on use of series theory is explored. The article concludes that the relations obtained for distribution of statistics makes it possible to obtain sign and rank adaptive algorithms for detection of a signal against a background of Markov interference and to calculate their quality. The following items are considered in detail: 1) Statement of problem; 2) Probabilities of vector components; 3) Distribution of statistics; 4) Algorithms of adaptive detection; and 5) Characteristics of detectors. Figures 2; references 8: 7 Russian, 1 Western (in Russian translation).

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CSO: 1860/311

UDC 621.396.96

CONSIDERATION OF NONLINEARITY IN STATISTICAL ANALYSIS OF SIGNALS IN A MONO-PULSE DIRECTION FINDER

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian  
Vol 29, No 7, Jul 86 (manuscript received 14 May 85) pp 20-25

[Article by A.A. Monakov, R.V. Ostrovityanov, G.N. Khramchenko] 7

[Abstract] Previous studies have analyzed the influence of nonlinearity in the signal processing channels on statistical characteristics of signals in sum-difference monopulse direction finders. However, the practical interest in certain types of nonlinearity require that this problem be discussed further. This article establishes the analogy between the effect of internal noise on the error signal in the device and the angular noise of elongated targets, which allows determination of the physical essence of the calculated parameters in a number of relationships obtained earlier, as well as the solution of new nonlinear problems involving determination of spectral noise characteristics in the error signal processing section of the device. Figures 4; references: 3 Russian.

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UDC 621.394.1:591.216

ESTIMATE OF COORDINATES AND THEIR DERIVATIVES OF A TARGET IN MULTIPosition MEASUREMENT SYSTEMS USING WIDEBAND SIGNALS

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian  
Vol 29, No 7, Jul 86 (manuscript received after revision 4 Oct 85) pp 63-66

[Article by G.S. Nakhmanson]

[Abstract] The increase in accuracy in determining the location of moving targets in radar systems resulting from simultaneous painting of the target by probe signals from several separate points is analyzed. The results obtained are illustrated by analyzing the accuracy of combined estimates of

range and radial velocity of a target moving in the Fresnel zone of a multi-position radar system in which the receiving portion is an equidistant array. Results of the analysis indicate that signals with random changes in numerical sequence are most effective, allowing an increase in the accuracy of determination of the location of targets moving in the distant zone of the measurement system by an order of magnitude with virtually no loss in accuracy in the Fresnel zone of the system. Figure 1; references: 4 Russian.

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UDC 621.396.9

#### MULTIPLE-ELEMENT DIGITAL FILTRATION OF RANGE READINGS

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian  
Vol 29, No 7, Jul 86 (manuscript received after revision 31 Jul 85) pp 69-72

[Article by G.P. Kablov]

[Abstract] Secondary processing of radar data requires digital filtration of range readings based on individual observations using target movement assumptions. Range data are fixed by a random time series of readings. Problems of filtration of range readings by a sliding sample method are analyzed. Two-element digital filtration is studied using a sliding sample. The first element averages three range readings and this information is used as input for the second element, which also averages three range readings. The analysis indicates that quasi-optimal filtration by multiple-element digital devices with even sample numbers can simplify the technical implementation of digital filters while very slightly increasing dispersion in the estimation of coordinates. Figures 2; references: 2 Russian.

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CSO: 1860/10

UDC 621.396.969.1

#### ALGORITHMS FOR ELIMINATION OF DISTANCE MEASUREMENT UNCERTAINTY BY PULSE-PHASE METHOD

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian  
Vol 29, No 7, Jul 86 (manuscript received 29 May 85) pp 46-50

[Article by A. G. Rindik]

[Abstract] A study is made of possible algorithms for eliminating uncertainty by means of a pulse-phase measurement method based on the use of a probing signal consisting of the sum of 2 pulse trains with carrier frequencies shifted by  $\Omega/2\pi$ . The reliability of measurements are estimated for an algorithm which is optimal from the standpoint of maximum likelihood ratio, and a quasi-optimal algorithm. The possibility of implementing both algorithms in practice is demonstrated. Figures 3; references: 3 Russian.

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## PHASE MEASUREMENTS OF DISTANCES WHICH CHANGE WITH TIME

Moscow RADIOTEKHNIKA in Russian No 8, Aug 86 (manuscript received after revision 4 Jan 86) pp 3-9

[Article by K. Kholeiko and Ye. Syuzdan]

[Abstract] This article presents an analysis of the accuracy of precise measurements between objects which move with respect to each other in cases when noise is present, and determines the requirements for phase measurement device design. The behavior of the mathematical expectation of the number of pulses counted by a phase measurement device for various speeds and signal/noise ratios, as well as the behavior of the mean square error, are determined and illustrated graphically. The theoretical results produced are checked experimentally. Results of the measurements agree well with the theoretically calculated results, particularly in terms of mathematical expectation of phase shift. The slight variation between experimental and theoretical results is explained by the fact that the dispersion of the phase is influenced by such factors as phase shifter instability. Figures 9; references 10: 3 Russian, 7 Western.

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## DESIGN OF PRELIMINARY FILTER FOR DIGITAL SIGNAL PROCESSING IN SYNTHESIZED APERTURE RADARS

Moscow RADIOTEKHNIKA in Russian No 8, Aug 86 (manuscript received 12 Dec 85) pp 49-51

[Article by A.F. Churzin]

[Abstract] Synthesized aperture radars with digital signal processing utilize signal selection after analog-digital conversion. This can overload on-board computer RAM capacity. To prevent this, a preliminary filter must eliminate most of the data before processing. A preliminary filter for this purpose is suggested. Methods of reducing phase distortion when the filter is used are discussed. The sequence of operations involved in designing the preliminary filter is noted. The filter is suitable for use in all cases in which spectral analysis of signals must be performed with a reduction in the volume of the input signal sample. Figures 2; references 2: 1 Russian, 1 Western.

6508/9716

CSO: 1860/13

## OPTIMIZATION OF ALGORITHMS FOR REMOVAL OF INDETERMINACY FROM READINGS OF PULSE-PHASE DIFFERENTIAL-RANGE MEASURING SYSTEMS

Moscow RADIOTEKHNIKA in Russian No 6, Jun 86 (manuscript received after revision 30 Dec 85) pp 3-9

[Article by M.S. Yarlykov, M.A. Mironov, and P.P. Filatov]

[Abstract] Complex primary processing of output signals from a pulse-phase differential-range measuring system under possible anomalous operating conditions in a turbulent atmosphere is considered, and quasi-optimum algorithms of such processing without indeterminacy are constructed in accordance with the Markov theory of optimum nonlinear filtration in the poly-Gaussian approximation. The input signal measured by the receiver on board of an aircraft is assumed to be an additive mixture of a useful signal and a white Gaussian noise with known characteristics. Upon establishment of the optimum discriminator characteristics, there are also included transformation of coordinates and time quantization by analog-to-digital conversion of output signals from the Doppler speed-and-drift meter. Quasi-optimum algorithms with extrapolation of the state vector are constructed, taking into account polymodality of a posteriori estimated processes. For specificity is considered a pulse packet beginning within the observation and estimation period, with the solution to the Stratonovich equation obtained in analytical form. Complexing and optimization of differential-range measurement by accounting for polymodality of the a posteriori distribution yields a performance payoff in terms of a 30-40 dB lower threshold signal-to-noise ratio than with the conventional assumption of monomodality. Figures 5; references: 8 Russian.

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## MULTISCALE MODELS OF RADAR CARRIERS

Moscow RADIOTEKHNIKA in Russian No 6, Jun 86 (manuscript received after revision 25 Oct 85) pp 15-18

[Article by A.A. Pogodin]

[Abstract] The dependence of radar performance parameters and particularly of the radiation pattern on the structure of the radar carrier, ship or aircraft, and its layout is evaluated by the method of optical modeling. Accordingly, similitude criteria are established and applied to original radio-frequency and model optical-frequency electromagnetic fields. The diversity of structural components in the field requires different scales for each and appropriate transformations of coordinates, for determination of changes in the major lobe of the radiation pattern depending on the relative position of antennas and relevant components of the vessel structure.

These changes in the major lobe are essentially an angular shift of its axis and usually a decrement of radiation power within it. Systematic errors of their determination by such multiscale optical modeling are introduced by surface roughness of interfering objects, by a difference between the reflection coefficients of object and model, and by finite dimensions of the photodetector probe. Figures 3; tables 1; references: 2 Russian.

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# COMPARATIVE EVALUATION OF TWO DETECTORS OF RANDOM SIGNALS SUBMERGED IN NON-GAUSSIAN NOISE

Moscow RADIOTEKHNIKA in Russian No 6, Jun 86 (manuscript received after revision 25 Nov 85) pp 18-20

[Article by P.V. Gorev]

[Abstract] Contrastive detection of a Gaussian signal in a mixture with Gaussian noise and random interference pulses is considered with a large sample of equally distributed independent random readings to be tested for presence or absence of a signal. Two detectors of such a signal by this method are compared with respect to optimum detection rule and corresponding sample statistics. Lack of nontrivial adequate statistics on the interference-to-noise ratio and the pulse duty factor makes it difficult to construct a detection rule with the false-alarm probability independent of both parameters, but the probability of exceeding some threshold in either detector depends monotonically on the interference-to-noise ratio when the pulse duty factor is fixed and the signal-to-noise ratio is zero. A detector based on sample quantiles is therefore more efficient than a square-law detector with integrator based on the energy criterion when the pulse duty factor is smaller than  $1-p$  ( $p$ - sample quantile) while the maximum interference-to-noise ratio is above a level which depends on both the sample quantile and the pulse duty factor. Figures 2; references 7: 3 Russian, 4 Western (3 in Russian translation).

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CSO: 1860/306

## SPECTRAL CHARACTERISTICS OF PULSE SIGNALS MULTIPLY REFLECTED BY MULTILAYER OCEAN BED AND BY OCEAN SURFACE

Moscow AKUSTICHESKIY ZHURNAL in Russian Vol 32, No 4, Jul-Aug 86 (manuscript received 25 Jun 85) pp 462-467

[Article by V.N. Golubev, Ye.F. Orlov, and Yu.V. Petukhov, Institute of Applied Physics, USSR Academy of Sciences]

[Abstract] Multiple reflection of pulse signals by the layerwise non-homogeneous ocean bed and by the ocean surface is analyzed theoretically, disregarding the variation of acoustic velocity across the gradiental water layer, and the results are compared with experimental data on the frequency spectra of such a signal after each reflection. Although each reflection attenuates the signal, the amplitude of modulation by interference of echo signals is slightly increased when both transmitter and receiver are located near the surface and the amplitude of modulation by multilayer bed structure is always increased according to a power law. Consequently, and because the reverberation interference level decreases, signal spectra after many reflections should yield reliable data on the structure of the ocean bed. This has been confirmed by seismography of the ocean bed with apparatus including an electric-spark generator as source of 25 kJ pulses and transmitter of acoustic signals at an up to 500 Hz repetition rate and a large receiver with recording instrumentation, those acoustic pulse signals covering the 0-1000 Hz frequency spectrum. The analysis is refined by consideration of pressure pulse waves striking the ocean bed obliquely, the effect of a multilayer bed structure on their multiple reflection being established by the method of a steady phase in the approximation of geometrical acoustics. Figures 4; references 13: 8 Russian, 5 Western (1 in Russian translation).

2415/9716

CSO: 1860/318

UDC 534.26:551.4.63.21:551.596.1

## DISCRETE SPECTRUM OF ACOUSTIC FIELD OF POINT SOURCE IN STRATIFIED MOVING MEDIUM

Moscow AKUSTICHESKIY ZHURNAL in Russian Vol 32, No 4, Jul-Aug 86 (manuscript received 20 May 85) pp 486-491

[Article by V.Ye. Ostashev, Institute of Atmospheric Physics, USSR Academy of Sciences]

[Abstract] A point source of sound standing in a wind above ground or in any other moving fluid medium above a solid surface such as a water current above the ocean bed is considered, assuming linearly nonuniform vertical temperature and velocity profiles. The acoustic field in the waveguide region and in the shadow region is analyzed for the effects of stratification of the medium on

discrete frequency spectrum of that field and on the radiation pattern of its source. Calculations are made for a point source in windy air above a perfectly solid earth surface, with the spectral density of sound pressure expressed in terms of Airy functions. The author thanks V.I. Tatarskiy for interest. Figures 2; references 8: 6 Russian, 2 Western.

2415/9716

CSO: 1860/318

UDC 551.463

#### ATTENUATION OF LOW-FREQUENCY SOUND IN OCEAN DUE TO SCATTERING BY INTERNAL WAVES

Moscow AKUSTICHESKIY ZHURNAL in Russian Vol 32, No 4, Jul-Aug 86 (manuscript received 6 Jun 85) pp 492-498

[Article by A. G. Sazontov and V.A. Farfel, Institute of Applied Physics, USSR Academy of Sciences]

[Abstract] The problem concerning attenuation of sound in the ocean and its not yet definitively established frequency dependence, or independence, is tackled by model representation of the wave field in the oceanic waveguide. The evolution of normal acoustic modes and losses of acoustic energy through leakage from the waveguide upon scattering by internal waves are calculated on the basis of the Helmholtz equation for acoustic pressure and the equation of radiation transfer in the diffusion approximation. The medium is assumed to be statistically homogeneous and isotropic in a horizontal plane, with a corresponding correlation function for fluctuations of the refractive index. Calculations are made for a plane sound wave propagating horizontally along the acoustic channel, back-scattering being negligible in the case of large-scale nonhomogeneity of the oceanic medium. For estimating the magnitude of the attenuation coefficient, use is made of the C.J.R.Garrett-W.H.Munk weight function and analytical expressions as well as numerical data describing the random field of internal ocean waves. Figures 1; references 11: 4 Russian, 7 Western (3 in Russian translation).

2415/9716

CSO: 1860/318

UDC 551.463.26

#### METHOD OF PROBING ACOUSTIC FIELDS IN OCEAN

Moscow AKUSTICHESKIY ZHURNAL in Russian Vol 32, No 4, Jul-Aug 86 (manuscript received 12 Jul 85) pp 550-552

[Article by V.V. Krasnoborodko and V.M. Tarasenko, Institute of Oceanology, USSR Academy of Sciences]

[Abstract] Experimental studies have established that fast probing of acoustic fields in large water masses is possible with a freely sinking

sonoprobe. Such a probe, based on the concept of an XBT nonretrievable thermoprobe, measures not only the amplitude but also the phase of sound waves as functions of the wave frequency and the immersion depth. For measurement of acoustic signals carrying information about sound propagation and refraction, sound focusing and defocusing, or other acoustic phenomena in water, the probe must contain a hydrophone with built-in preamplifier as acoustoelectric transducer in lieu of a standard thermocouple. Such a device was tested in a 12 m deep water basin, with a nondirectional sound radiator operating at a frequency of 1 kHz mounted on one of the walls. Flow noise during sinking of the probe was found to be an  $f^{-3}$ -noise, almost negligible within the given range of measurements. The authors thank L.M. Brekhovskikh for guidance and interest. Figures 2; references 3: 2 Russian, 1 Western (in Russian translation).

2415/9716  
CSO: 1860/318

UDC 534+534.231.2

#### HORIZONTAL ANTENNA ON SHALLOW SEA

Moscow ~~AKUSTICHESKIY~~ ZHURNAL in Russian Vol 32, No 4, Jul-Aug 86 (manuscript received 7 Aug 84) pp 554-558

[Article by A.V. Mikryukov and O.Ye. Popov, Institute of Acoustics imeni N.N. Andreyev, USSR Academy of Sciences]

[Abstract] Use of a linear horizontal antenna array for estimating the parameters of single normal acoustic wave modes in a flat water waveguide, theoretically feasible, was examined in a laboratory experiment including space-spectral analysis of acoustic signals. Tests were performed with a homogeneous water layer (speed of sound 1475 m/s) 300 m long, mean depth 5.5 m, on a bed in the upper layer of which the speed of sound was the same as in air. The frequency range of test signals was 400-1000 Hz. Subsequent evaluation of the data on the basis of a waveguide model with perfectly soft walls and with a harmonic longitudinal depth (thickness of water layer) variation indicates that analysis of the acoustic space spectrum by this method is not reliable, at least for probing shallow water, and therefore use of a horizontal antenna for this purpose is not advisable. Figures 3; tables 1; references 3: 2 Russian, 1 Western (in Russian translation).

2415/9716  
CSO: 1860/318

## RADIOMETRIC METHOD OF MEASURING THE INTENSITY OF SEA DISTURBANCE

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian  
Vol 29, No 5, May 86 (manuscript received 7 May 85) pp 511-518

[Article by A.P. Barabanov, A.N. Reznik, and K.S. Stankevich, Scientific  
Research Radiophysics Institute]

[Abstract] The possibility was investigated of measuring the intensity of sea disturbance using aircraft and satellites to search for the maximum frequency in the spectrum of the fluctuations of brightness of the surface temperature. In the process the fact was used that the spectrum of fluctuations of the brightness of the choppy surface is concentrated in a narrow band of the low-frequency range and the frequency of the maximum spectrum is determined by the intensity of the disturbance. This range of frequencies was used to determine the intensity and effect of other factors. The proposed method does not require measurement of the absolute magnitude of the average brightness of the sea surface, and consequently items such as foam, small-scale ripples, petroleum film, natural radiation, and the like which affect the absolute magnitude of the signal, are not of importance in the present method. A radiometric device developed for measuring the intensity of sea disturbance is described. An experimental check of its operation was conducted under laboratory conditions. Figures 5; references 10: 8 Russian, 2 Western.

6415/9716

CSO: 1860/312

UDC: 621.396.96

POLARIZATION TARGET SCATTERING MATRICES FOR ANTENNAE CHARACTERISTIC CONTROL

Moscow RADIOTEKHNIKA in Russian No 8, Aug 86 (manuscript received after revision 13 Nov 85) pp 75-77

[Article by Ye.L. Kazakov]

[Abstract] The elements of the polarization scattering matrix of a target can be measured by successive radiation of a pair of orthogonally polarized signals and simultaneous reception of signals reflected from the target with the corresponding polarization. This article calculates the polarization scattering matrix of a target for radiation of a signal in an orthogonal base and reception of signals reflected from the target in a different orthogonal base. The equations derived can be used to compute polarization scattering matrix elements of the target from elements of the target matrix measured while controlling the polarization characteristics of the transmitting and receiving antennas. Expressions are derived for determination of the error matrix of the polarization scattering matrix elements of the target. It is found that the errors in determination of the modulus of polarization scattering matrix elements increase with increasing error of determination of the position of the base vectors of the transmitting and receiving antennas. Figures 3; references: 2 Russian.

6408/9716  
CSO: 1860/13

UDC: 621.371.31

EXPERIMENTAL STUDY OF 2-MODE IONOSPHERIC SIGNAL FIELD

Moscow RADIOTEKHNIKA in Russian No 8, Aug 86 (manuscript received 7 Mar 86) pp 77-79

[Article by A.G. Bologdin and V.A. Smorodinov]

[Abstract] An ionospheric signal has a multimode structure, generally with not over 7 modes. In studying the structure and properties of radio signals of this type one must consider their multimode nature and randomness of components. The properties of the field of stochastic interference signals

and its individual modes are studied in this article, using experimental 2-mode signals for vertical ionospheric soundings. The studies indicate that the stochastic interference model used for the experimental 2-mode signals under these conditions is realistic. Methods of determining stochastic interference field parameters of the 2-mode signals based on observation of quadrature components are also experimentally confirmed. Figures 3; references: 7 Russian.

6508/9716  
CSO: 1860/13

UDC: 621.396.67

#### MEASUREMENT OF PHASED ANTENNA ARRAY GAIN BY DYNAMIC METHOD

Moscow RADIOTEKHNICA in Russian No 8, Aug 86 (manuscript received 19 Mar 86)  
pp 80-82

[Article by D.B. Zimin, I.V. Kaplun and M.Yu. Kholshchevnikov]

[Abstract] Equations are presented for determination of the gain of a phased antenna array. A method is suggested for greatly simplifying the measurement of the surface utilization factor of the array for dynamic-method determination of its gain. The dynamic method is based on measurement of quantities proportional to the radiation flux density of the array in the phased and unphased states. Experimental studies were performed on a 150-element array to determine the variation in error of determination of the gain as a function of the number of actualizations of the random phase distribution. Experimental and calculated results agree well. Figure 1; references: 3 Russian.

6508/9716  
CSO: 1860/13

UDC: 621.396.677

#### INCREASING DIRECTIONALITY IN TRAVELLING WAVE ANTENNAS

Moscow RADIOTEKHNICA in Russian No 8, Aug 86 (manuscript received 26 Feb 86)  
pp 82-85

[Article by G.A. Erokhin and N.L. Lazarov]

[Abstract] A study is made of a model of a plane antenna which can achieve the amplitude-phase distribution required for a travelling wave antenna. The antenna consists of a horn exciter, a flat shield and a modulated impedance surface, the profile of which is determined. The studies show that it is possible to achieve improved directionality of travelling wave antennas, particularly by the use of plane impedance structure. The method suggested for representation of the near field as a system of virtual sources allows analysis of all types of distributions in the antennas, with optimization of

its parameters and more complete utilization of the entire length of the radiating structure for the formation of the required radiation pattern than previous methods of representation of the near field as a superposition of surface or waveguide waves. Figures 3; references 6: 5 Russian, 1 Western.

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CSO: 1860/13

UDC: 621.396.677.75(088.8)

#### DIELECTRIC RESONATOR ANTENNA DEVICES

Moscow RADIOTEKHNIKA in Russian No 8, Aug 86 (manuscript received after revision 25 Feb 86) pp 85-88

[Article by Yu.M. Bezborodov and S.F. Massalitin]

[Abstract] A study is made of the designs and results of investigation of antenna devices based on new high-Q thermally stable microelectronic components, dielectric resonators. Dielectric resonators can be successfully used as simple radiators in antenna arrays, in which they are preferable to other radiators such as wave guides and spiral radiators if the band of frequencies is limited, due to their broad radiation pattern, negligible reactive field at the resonant frequency and reradiation effectiveness. The author suggests that future efforts be concentrated on the creation of a number of effective radiators for the decimeter, centimeter and millimeter wave bands, with synthesis of antenna devices with complex radiation patterns. Figures 7; references: 4 Russian.

6508/9716  
CSO: 1860/13

UDC: 621.396.962:629.7

#### SPECIFICS OF SYNTHESIS OF ANTENNA APERTURE WITH ARBITRARY AIRCRAFT TRAJECTORY

Moscow RADIOTEKHNIKA in Russian No 8, Aug 86 (manuscript received 26 Nov 85) pp 89-92

[Article by N.A. Sazonov]

[Abstract] Synthesis of an antenna aperture for arbitrary aircraft trajectories requires knowledge of the change of the instantaneous distance over each synthesis interval. This article presents a simple adaptive expression for the rule governing this change allowing good approximation of the distance. The maximum synthesis time and radar image frame size are determined. The maximum synthesis time depends on wave length, permissible level of distortion, rate of change of radial acceleration due to aircraft maneuvering and statistical characteristics of the trajectory instabilities. The results show that with any aircraft platform flight trajectory, the reference function must be calculated for each synthesis interval. The radar information frame obtained by processing of radar signals by harmonic analysis is

limited in its angular dimensions. The limitation is determined primarily by the nature of movement of the platform relative to the area being viewed. A parabolic approximation of the distance also places limitations on the maximum antenna aperture synthesis time, determined primarily by aircraft maneuvering rates. Figures 2; references: 8 Russian.

6508/9716  
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UDC: 621.396.677.494.71.001.1

#### INFLUENCE OF DIELECTRIC LAYER IN CHARACTERISTICS OF WAVE GUIDE-SLOT ANTENNAS

Moscow RADIOTEKHNIKA in Russian No 8, Aug 86 p 93

[Article by V.V. Bodrov and V.I. Gridnev]

[Abstract] A study is made of the problem of calculating electrodynamic characteristics of plane wave guide-slot antenna arrays covered with a dielectric layer. The solution of the problem of excitation of the array is based on solution of a system of integral equations obtained from the boundary condition of continuity of tangential components of the magnetic field on the surface of slots. All basic characteristics of an individual slot radiator covered with a dielectric layer are analyzed, and the results of the analysis are used to calculate the characteristics of linear antennas, which are then compared with the properties of antennas radiating in air. Characteristics of arrays consisting of a number of parallel linear antennas are studied as a function of the distance between the antennas excited in phase with equal amplitudes. The full text of the article is 15 pages long and has 13 figures and 10 bibliographic references. It can be obtained from "Informsvyaz" Institute as No. 840-sv.

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UDC 550.388

#### WHISTLER PROPAGATION IN MAGNETIC TUBES

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 29, No 7, July 86 (manuscript received 17 Dec 84) pp 756-762

[Article by R.N. Kaufman, Institute of Terrestrial Magnetism, Ionosphere and Propagation of Radio Waves, USSR Academy of Sciences]

[Abstract] The possibility is shown of guided whistler propagation in axial-symmetrical magnetic tubes in which the plasma density is constant and the magnetic field is a function of the distance to the axis of the tube. The following items in the article are considered in relative detail: 1) Condition for waveguide propagation; 2) Magnetic tubes with reduced field; and 3) Magnetic tubes with enhanced field. Expressions are obtained for the mode number of thresholds of the frequency of whistlers trapped in the tubes. The author thanks V.I. Karpman for discussions. Figures 4; references 6: 4 Russian, 2 Western.

6415/9716  
CSO: 1860/15

## QUASI-LINEAR THEORY OF IRREGULARITIES OF AN AURORAL ELECTROJET

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian  
Vol 29, No 7, Jul 86 (manuscript received 28 Apr 85) pp 763-766

[Article by A.V. Volosevich, Mogilevskiy State Pedagogical Institute]

[Abstract] An experimental study of auroral scattering of radio waves has revealed a number of distinctive features not corresponding to linear theory, and set up the problem of investigating the nonlinear stage of instability development. The study of mechanisms leading to the formation of a quasi-stationary state, during which the linear growth of the instability of the waves is balanced by some nonlinear mechanism, is of the most interest. The present article considers the possibilities of establishing such a quasi-stationary state. It is shown that as a consequence of the growth of instability in plasma the effective frequency of electron collisions increases, which leads to stabilization of the instabilities and to formation of a quasi-stationary state. The distinctive features of this quasi-stationary state can be detected in experiments concerned with auroral radar measurements. References 7: 4 Russian, 3 Western.

6415/9716  
CSO: 1860/15

UDC 533.951

## PROPAGATION OF RADIO WAVES IN PLASMA WITH STRONGLY ANISOTROPIC MOVING IRREGULARITIES

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian  
Vol 29, No 7, Jul 86 (manuscript received 21 Feb 85) pp 788-792

[Article by L.M. Yerukhimov, I.A. Ruvinskaya, and P.I. Shpiro, Scientific-Research Institute of Radiophysics]

[Abstract] This article is concerned with an effect similar to one found in a 1981 paper by two of the above authors, Yerukhimov and Shpiro. Transfer equations are derived and analyzed for an average field  $[E]$  and the spatial coherence function  $\Gamma_E(r)$  of the field of a wave passing a medium with moving strongly-extended irregularities. It is shown that the ray output from the irregularity because of its transverse displacement and the finite group velocity of a wave leads to a substantially slower damping of  $[E]$  and the occurrence of function  $\Gamma_E$  symmetry. Figures 2; references: 4 Russian.

6415/9716  
CSO: 1860/15

## RADIATION EFFECT OF ELECTRIC AND MAGNETIC DIPOLES INSIDE AND OUTSIDE A SPHERE

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 29, No 7, Jul 86 (manuscript received after abridgment 2 Apr 85) pp 816-824

[Article by N.P. Romanov, Institute of Experimental Meteorology]

[Abstract] Expressions are presented for the electromagnetic field of elementary electric and magnetic radiators (dipoles) in the presence of a sphere. Expressions for the field in the form of an expansion of the vector wave spherical functions make it possible (with the aid of expressions obtained earlier for the energy flux of partial waves) to calculate the energy flux of these dipoles in an arbitrary spherical region with a center coincident with the center of the sphere. From the analysis conducted for particular cases it follows that for nonabsorbing media the ratio of the energy fluxes of the inner and outer dipoles with identical magnitudes located near the surface of the sphere does not depend on the radius of the sphere and is determined only by the magnitudes of the relative refractive index and relative magnetic permeability. A model of elementary radiators used for describing combined scattering and luminescence is explained. The following items in the article are considered in relative detail: 1) Assumption formulas; 2) Representation of electric field of dipole radiators in the presence of a sphere with the aid of vector wave spherical functions; 3) Energy flux of dipoles in the presence of a sphere located in a non-absorbing medium; 4) Results of numerical calculations; and 5) Distinctive features of use of elementary radiators for a description of combined scattering and luminescence. Figures 3; references 16: 12 Russian, 4 Western.

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UDC 621.346.677

## USE OF VERTICAL CONDUCTION PINS AND DIELECTRIC INSERTS FOR MATCHING WAVEGUIDE PHASED ARRAYS

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 29, No 7, Jul 86 (manuscript received 18 Mar 85) pp 825-832

[Article by V.V. Bodrov and S.A. Voynov, Moscow Power Engineering Institute]

[Abstract] Using the integral equation method, the radiation is analyzed of phased arrays with a combined radiator consisting of the radiating aperture of a waveguide with a rectangular cross section and a vertical conducting nonsymmetrical vibrator, loaded by a concentrated complex resistance. The results are presented of numerical calculations of the effect of the vertical pins with concentrated loadings on the scanning angle dependence of the reflection coefficient modulus in the feeder of the phased array radiating unit. It is shown that the use of dielectric inserts and pins with inductive

loading makes possible achievement of a definite level matching of a phased array in a broad sector of scanning angles. The applied value of the above investigation consists of the simple and efficient process presented for matching a waveguide array and the method making it possible to determine the parameters of the matching device. Figures 6; references 8: 7 Russian, 1 Western (in Russian translation).

6415/9716  
CSO: 1860/15

UDC 551.524

#### EFFECT OF CONDITION OF PEAT BOG AREAS ON THEIR RADIOEMISSION IN THE MICRO-WAVE BAND

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 29, No 7, Jul 86 (manuscript received after revision 14 Oct 85) pp 856-859

[Article by E.A. Arzumanyants, A.A. Kazarov, Ye.S. Kamenetskiy, and A.V. Shpakov, North Ossetian State University]

[Abstract] Peat bog areas are one of the important objects subject to distant sounding. The necessity for a mobile noncontact method of determining such parameters of peat as humidity and temperature is caused in the first place by long stretches of peat bog areas, and in the second by the presence of interior sources of spontaneous combustion not leading to a change of the surface temperature. The present article determines the connection of microwave radiation parameters with certain characteristics of peat bog covers, conducted by the numerical simulation method. Figures 2; references: 7 Russian.

6415/9716  
CSO: 1860/15

UDC 621.396.96

#### CORRELATION COEFFICIENT OF SIGNAL PHASE ENVELOPE DURING PERIODICALLY NONSTATIONARY GAUSSIAN NOISE

Moscow RADIOTEKHNIKA in Russian No 2, Feb 86 (manuscript received after revision 11 June 85) pp 3-7

[Article by B.S. Rybakov]

[Abstract] The normalized correlation coefficients of the envelopes and phases of determinate signals mixed additively with noise are analyzed within a generalized Gaussian distribution framework by the Monte Carlo method. The behavior of the envelope fluctuation spectrum and the relationship between its width and the width of the fluctuation spectrum of the quadrature components of the noise is analyzed by the equivalent rectangle method. The use of the findings for solving physical problems pertaining to long-range troposcatter UHF channels is described. Figures 5, references 15: 13 Russian, 2 Western.

6900/9716  
CSO: 1860/222

## ON NONLINEAR WAVE STRUCTURES IN IONOSPHERE

Gorkiy IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 29, No 6, Jun 86 (manuscript received 18 Dec 84) pp 645-653

[Article by A.S. Bakay and G.K. Solodovnikov]

[Abstract] The degree of correlation between ionospheric inhomogeneities is unaffected by low-level perturbations in the ionosphere, however, with sufficiently intense sources, interaction of the inhomogeneities breaks up the space-time correlation, producing a turbulent state. The characteristic correlation breakdown time,  $t_c$ , is usually assumed to be the same as the time for energy exchange between inhomogeneities,  $t_{NL}$ . When the amplitudes of the inhomogeneities rise so fast that  $t_{NL}$  becomes less than  $t_c$ , the initial correlations are strengthened rather than attenuated and ordered turbulent structures can form. The main property of this state is the presence of nonlinear coherent wave packets, containing the bulk of the energy of the inhomogeneities. This paper experimentally shows that ordered wave structures are established in the high latitude ionospheric plasma because of plasma current instabilities. The phenomenon occurs for inhomogeneities with characteristic spatial scales on the order of  $10^3$  to  $10^4$  meters. The experimental data were obtained in September 1979 at  $68^\circ$  N latitude during different phases of a magnetic storm by receiving 150 MHz signals from Tranzit satellites and from the comparison of these signals with cosmic radio noise at 32 MHz. The analysis of the relative ionospheric opacity meter data reveals a singular feature of the behavior of wave inhomogeneities in the various magnetic storm stages: hysteresis is present that is a function of  $t_c$  and the magnetic activity index, indicating the formation of stable, coherent dissipative structures in a turbulent ionosphere that are maintained by external sources. The authors are grateful to A.S. Abyzov for assisting with the experiments. Figures 7; references 22: 12 Russian, 10 Western.

8225/9716

CSO: 1860/325

UDC 537.86.029.42

## ON INFLUENCE OF DAY-NIGHT INHOMOGENEITY OF EXTREMELY LOW FREQUENCY FIELD

Gorkiy IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 29, No 6, Jun 86 (manuscript received 27 Dec 84) pp 635-644

[Article by L.M. Rabinovich, UkSSR Academy of Sciences Institute of Radiophysics and Electronics]

[Abstract] The surface of the earth and the ionosphere form a spherical resonant cavity with an inhomogeneous upper boundary. This cavity is excited by a vertical, electrical point dipole at frequencies close to 8 Hz. The surface of the earth is an ideal conductor and the ionospheric wall has a

definable impedance at a given radius, where the impedance changes in accordance with a simple trigonometric function. The resulting ELF fields in the spherical cavity are calculated for the case when the day-night ionospheric inhomogeneity is present. The presence of this discontinuity produces substantial changes in the field in the vicinity of the nodal line of the first ELF oscillation mode as well as distortion of the constant field level lines and the transformation of the first mode nodal line to a single node point. The absolute value of the field at frequencies of 7.5, 8.0 and 8.5 Hz is calculated for paths parallel and symmetric with the terminator for various angles between the observer and the dipole source. The algorithm used here substantially reduces the order of the system of equations employed for calculating ELF fields in such cases and allows the estimation of the computational precision. The author is grateful to A.P. Nikolayenko for formulating the problem and discussing the results obtained. Figures 4; references 5: 3 Russian, 2 Western.

8225/9716  
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UDC 621.371.332.1

#### REFLECTION AND SCATTERING OF RADIO WAVES BY SPORADIC IONOSPHERIC $E_s$ -LAYER

Moscow RADIOTEKHNIKA in Russian No 6, Jun 86 (manuscript received 9 Jan 86)  
pp 71-73

[Article by V.D. Gusev, I.Yu. Zhidovlenko, and L.I. Prikhodko]

[Abstract] Propagation of radio waves through the sporadic ionospheric  $E_s$ -layer ranging from 90 km to 120 km altitude is analyzed, with emphasis on reflection and scattering of waves within this layer. The analysis is based on the model of a thin sporadic layer with small-scale inhomogeneities of varying anisotropy and the model of a triangular layer characterized by a local intrinsic concentration gradient. An analytical solution to the corresponding boundary-value problem for the angular distribution of the back-scattered field, in the Born approximation and assuming random inhomogeneities with a Gaussian correlation function, yields the mean intensity squared of radio waves leaving the layer. A numerical solution has been obtained assuming that the dispersion of electron concentration depends on the altitude and the dispersion of dielectric permittivity depends on the carrier frequency only. Figures 3; references 6: 4 Russian, 2 Western.

2415/9716  
CSO: 1860/306

## FLUCTUATION CHARACTERISTICS OF ACTIVE PHASED ANTENNA ARRAYS

Moscow RADIOTEKHNIKA in Russian No 6, Jun 86 (manuscript received 14 Sep 85)  
pp 74-77

[Article by V.L. Gostyukhin]

[Abstract] An active phased transmitter antenna array is considered consisting of a passive distribution network and radiators with an active module as well as a matching device in the channel of each. Variance of complex signal amplitudes at the outputs from phase shifters, thus at the inputs to active modules, and of the complex transmission coefficients of nonlinear active modules causes amplitude and phase errors in currents or voltages of radiators. The resulting dispersion of the radiation power pattern of such an antenna array is calculated by solution of the corresponding electrodynamic problem, taking into account edge effects in the antenna and interaction of radiators. For simplification, the general solution is reduced to the approximation of single-mode currents in radiators. Figures 2; references: 4 Russian.

2415/9716  
CSO: 1860/306

UDC 537.874.34:58

## SCATTERING AND ABSORPTION OF MICROWAVE RADIATION BY PLANT ELEMENTS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 31, No 6, Jun 86 (manuscript received 2 Apr 85) pp 1095-1104

[Article by A.A. Chukhlantsev]

[Abstract] This article deals with models of plant elements, small in comparison with the length of electromagnetic waves ( $\lambda \sim 1-30$  cm), plane particles with the dimensions of much longer wavelengths, plane thin particles, and long dielectric cylinders. The techniques and results are cited of radio-metric experimental measurements of the cross-sections of scattering and absorption of the elements of plant covers in the microwave range. The experimental data are compared with the results of model calculations. The following items are considered in detail: 1) Models of plant elements; 2) Method of experimental investigations (illustrated by diagram); and 3) Results of measurements and their comparison with model calculations. Figures 6; references 17: 12 Russian, 5 Western (1 in Russian translation).

6415/9716  
CSO: 1860/311

UDC 537.874.7:551.510.62

TOWARDS A PROCEDURE FOR MEASURING THE ATTENUATION OF MILLIMETER WAVES IN RAIN  
USING ITS SELF-RADIATION

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 31, No 6, Jun 86 (manuscript received 10 Aug 84) pp 1105-1109

[Article by Yu.S. Babkin, A.G. Kislyakov, and Ye.V. Sukhonin]

[Abstract] An analysis is made of possible causes of errors in measuring attenuation of millimeter waves in rain using its self-radiation, and an evaluation of these errors is conducted. A block diagram of the measuring device is explained. The following items are considered in detail: 1) Errors connected with calibration of measurements; 2) Errors caused in sampling of the effective temperature of the atmosphere; 3) Absorption and radiation of water film forming on the reflecting panel; and 4) Consideration of effect of scattering on radiometric measurement of attenuation in rain. Figures 1; references 10: 4 Russian, 6 Western.

6415/9716

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STATISTICAL PROPERTIES OF THE SPECTRAL DENSITY OF ATMOSPHERIC INTERFERENCE

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 31, No 6, Jun 86 (manuscript received 8 Apr 84) pp 1115-1120

[Article by D.S. Dobryak and L.G. Petrova]

[Abstract] An area-time statistical model of the spectral density of the component fields of atmospheric interference in the 20 Hz - 30 KhZ frequency range is considered, as well as a method for calculating its characteristics with known reliability indices and time resolution of one hour at an arbitrary point on the earth's surface at a prescribed time of day, at one or another time of year. A description of the spectral density of atmospheric radio interference is given in the form of its characteristic functional, with the assistance of which formulas are obtained for calculation of its statistical characteristics, also including its covariance functions. The examples cited of calculations of the distributed parameters of the spectral density of atmospheric interference and the comparison of time with experimental estimates, make it possible to draw a sufficiently satisfactory conclusion concerning their convergence. In contrast to a known empirical model of the world distribution of the power of natural radio interference cited in a 1964 reference, the model presented in this article combines the spectral density of atmospheric radio interference with lightning activity, includes the frequency range below 10 kHz, and has an algorithmic form. Figures 4; references 9: 4 Russian, 5 Western.

6415/9716

CSO: 1860/311

## ANALYSIS OF EFFECTIVENESS OF PARTIAL ADAPTATION IN ANTENNA ARRAYS WITH ADAPTIVE PATTERN-GENERATING CIRCUITS

Gorkiy IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOFIZIKA in Russian  
Vol 29, No 5, May 86 (manuscript received 12 Nov 84) pp 551-556

[Article by V.T. Yermolayev, B.A. Krasnov, V.Ya. Solomatin, and A.G. Flaksman]

[Abstract] The effectiveness is investigated of partial adaptation in adaptive antenna arrays (AAA) which use a limited number of channels of an adaptive pattern-forming circuit (APFC) formed on the base of the vectors of a power sequence. It is shown that an increase of the ratio of signal-to-noise power (RSNP) is assured, basically at the expense of the first channels, and a reduction of double the number of outputs of the APFC leads to deterioration of the RSNP, not more than 3 db on the average, even in fairly complex interference situations. A comparison is made of the effectiveness of AAA with an APFC which has a reduced number of outputs, and a sectionalized AAA with an equal number of adaptation channels. It is shown that the AAA with an APFC has the greater effectiveness, particularly with a small number of adaptation channels. Figures 1, references 13: 9 Russian, 3 Western (1 in Russian translation).

6415/9716  
CSO: 1860/312

## ELECTROMAGNETIC WAVE DIFFRACTION AT PERIODIC BOUNDARY BETWEEN TWO MEDIA

Gorkiy IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOFIZIKA in Russian  
Vol 29, No 5, May 86 (manuscript received 17 Oct 84) pp 586-596

[Article by I.V. Borovskiy and N.A. Khizhnyak, Institute of Radio Physics and Electronics, USSR Academy of Sciences]

[Abstract] The numerical-analytical method is one of the most efficient means for calculating diffraction fields in periodic dielectric structures. This makes it possible to obtain analytical expressions for scattered fields but only in a long-wave approximation. The present article obtains precise expressions for scattered fields in such structures with an arbitrary ratio of the length of the wave and the period of the structure. The key problems involved is concerned with the diffraction of a plane electromagnetic H-polarized wave at the periodic border of two isotropic nonmagnetic media. It is solved by the method of integral equations of macroscopic electrodynamics. Precise analytical expressions are found for the components of the scattered field. Problems concerned with the diffraction of a plane wave by a dielectric comb and by a rectangular-bar grating are solved, and the components of the previous and reflected fields of this grating are found. The analytical and numerical results obtained are compared with those published elsewhere. Figures 3; references: 6 Russian.

6415/9716  
CSO: 1860/312

## BROADCASTING, CONSUMER ELECTRONICS

### NEW EAST GERMAN CONSUMER ELECTRONICS PRODUCTS

Moscow RADIO in Russian No 7, Jul 86 p 16

[Article by V. Frolov]

[Abstract] Some East German consumer electronics devices exhibited at the 1986 Leipzig Fair are described. Photographs are presented of a tabletop color t.v. set, LP turntable, tuner, loudspeaker system, portable radio and home stereo.

6508/9716

CSO: 1860/6

### INTEGRATED MICROCIRCUITS FOR REMOTE CONTROL SYSTEMS

Moscow RADIO in Russian No 7, Jul 86 pp 23-25

[Article by V. Plotnikov, Moscow]

[Abstract] The KR1506XL2 microcircuit is described. The device can be used as an automatic controller for such consumer devices as television sets and VCR's. Control signals can be input to various page zero addresses depending on the power connections of the IC, or a direct control input mode for use with control panels is provided. A possible control circuit employing the device is diagrammed. The speed of the device varies directly with the frequency of the crystal oscillator used with it, which may range from 0.4-4.4 MHz. Figures 2.

6508/9716

CSO: 1860/6

## THE RADIO-86RK PERSONAL HAM COMPUTER

Moscow RADIO in Russian No 7, Jul 86 pp 26-28

[Article by D. Gorshkov, G. Zelenko, Yu. Ozerov and S. Popov, Moscow]

[Abstract] This article is a continuation of a series presenting instructions for assembly of a ham radio enthusiast's personal computer, the Radio-86RK. The article describes a method for diagnosis of the system in the event of errors or problems in operation of the computer after assembly has been completed. A hexadecimal listing of a diagnostic program is presented, plus illustrations of oscilloscope displays and step by step trouble shooting instructions. The series will be continued in future issues of the journal. Figures 2.

6508/9716  
CSO: 1860/6

## USE OF K155 SERIES MICROCIRCUITS

Moscow RADIO in Russian No 7, Jul 86 pp 32-34

[Article by S. Alekseyev, Moscow]

[Abstract] The K155 series includes microcircuits for conversion of binary decimal code to binary code signals and the reverse conversion. The conversions are performed in ROM with routines provided by the manufacturer of the microcircuit. You can convert signals corresponding to the decimal numbers 0-39, binary numbers 0-63. The BCD to binary converter chip is the K155pr6, the binary to BCD is the K155pr7. Connections used with the chips are diagrammed.

6508/9716  
CSO: 1860/6

UDC: 621.372.542

## BASICS OF DIGITAL NOISE SUPPRESSIONS IN TV CHANNELS

Moscow RADIOTEKHNIKA in Russian No 8, Aug 86 (manuscript received after revision 12 Mar 86) pp 9-14

[Article by L.S. Vilenchik, M.I. Krivosheyev and Yu.D. Shavdiya]

[Abstract] Digital noise suppression in TV signals allows the signal/noise ratio in nonmoving portions of images to be improved by more than 10 dB. This article presents the principles of the theory of digital noise suppression based on analysis of the energy spectrum of noise in TV transmission channels. Digital noise suppressors are considered to be a new and promising type of

device for TV signal processing, theoretically allowing significant noise suppression in nonmoving image sections. The actual amount of noise suppression is limited by the internal noise of the noise suppressor itself, particularly in the ADC and DAC circuits, meaning that noise suppressors are less effective for signals which contain little noise at their inputs. Equations presented in this article allow estimation of the amount of noise suppression which can be achieved in digital noise suppressors based on recursive filtration. A table lists values of signal/noise ratio achieved experimentally using these devices. Figures 3; references 20: 18 Russian, 2 Western.

6508/9716  
CSO: 1860/13

UDC: 621.372.8.09

#### FIBER OPTIC CONNECTING LINES FOR TRANSMISSION OF HIGH QUALITY COLOR TV IMAGES

Moscow RADIOTEKHNIKA in Russian No 8, Aug 86 (manuscript received 8 Mar 86)  
pp 25-27

[Article by M.I. Belovolov, Yu.L. Bessonov, A.N. Guryanov, G.G. Devyatykh, Ye.M. Dianov, V.I. Karpov, Yu.M. Kirik, M.I. Krivosheyev, A.V. Kuznetsov, Yu.I. Marymont, V.P. Minashin, A.M. Prokhorov, Yu.A. Kharitonova, V.F. Khopin, A.I. Shlein and Ye.A. Shcherbakov]

[Abstract] A model has been developed of a fiber optic line for transmission of high quality color TV images, using standard transmission system radio relay station hardware as the terminal devices. The characteristics of the fiber optic lines are analyzed. The line was 9 km long and utilized FM to transmit the TV image on a 70 MHz subcarrier. The signal/noise ratio was found to be 57 dB. Calculated and experimental results are compared. The studies show that it is now possible to create fiber optic communication links without relays of up to 10 km length using the available base of soviet components for the 0.85  $\mu$ m wavelength. Figures 4; references 4: 3 Russian, 1 Western.

6508/9716  
CSO: 1860/13

## RESULTS OF THE RECONSTRUCTION OF THE ANCHOR TELEVISION TRANSMITTING STATION

Moscow VESTNIK SVYAZI in Russian No 8, Aug 86 pp 34-36

[Article by A.A. Koltsev, chief engineer, Scientific Research Institute of Radio Engineering; A.M. Lokshin, chief of laboratory; A.A. Ivashchenko, senior engineer, Riga Radio Direction Finding Station; A.A. Lakernik, chief of Ultra-Short Wave Section; and O.A. Shafranov, senior engineer]

[Abstract] An increase of the operating reliability of equipment, its modernization with the object of saving materials, energy, and labor resources, as well as improvement of labor quality, are pressing problems during the development of new and the reconstruction of functioning equipment. One of the ways to solve this problem in the case of functioning transmitting television stations of average power is the creation of generator-modulator sections constructed on a new element base which replace old tube sections. The present article describes the reconstruction of the Anchor transmitting television station by the Riga Radio Direction Finding Station and gives the details of the results obtained. It is proposed to adopt this method at other stations. The expected economic effect from the introduction amounts to approximately 600 thousand rubles. Figures 6.

6415/9716

CSO: 1860/12

UDC: 621.396.62:621.372.632

COMPARATIVE CHARACTERISTICS OF DIFFERENCE TYPES OF FREQUENCY CONVERSION

Moscow RADIOTEKHNIKA in Russian No 8, Aug 86 (manuscript received 22 May 86)  
pp 66-70

[Article by Yu.I. Sharapov]

[Abstract] In designing radio reception devices, it is important to achieve a frequency converter band width such that there are no harmonic or combined components due to nonlinearity of the mixing element which fall within the pass band of the frequency converter. Tables are presented which allow comparison of various difference frequency converters with various types of mixers in terms of pass band and permissible input frequency range. An example of calculation of conversion parameters using tables is presented. References: 2 Russian.

6508/9716  
CSO: 1860/13

UDC 621.318.43

DESIGN OF INDUCTANCE COILS FOR RADIO ENGINEERING POWER EQUIPMENT

Moscow RADIOTEKHNIKA in Russian No 6, Jun 86 pp 48-49

[Article by Yu.S. Cherkashin]

[Abstract] A method of designing optimum coils for radio engineering power equipment is outlined, an optimum coil being one which will have a given time constant with either the minimum overall volume or the minimum copper volume. An optimum coil is, moreover, to fit into many different devices. For specificity are considered coils with rectangular cross-section. Design calculations are aided by graphs representing quantitative relations between geometrical dimensions and performance parameters, the time constant being not only a generalized performance parameter but also determining the coil size as well as the number of turns. Depending on the application, the time constant can be determined from other electrical parameters for a given Q-factor, for a given current waveform and maximum permissible copper losses, or for a matched pulse shaping circuit with identical coils in all sections. Figures 1.

2415/9716  
CSO: 1860/306

SYNTHESIS OF OPTIMUM RECEIVER OF RADIO PULSE SIGNALS UTILIZING ONLY PART OF  
RADIO PULSE

Moscow RADIOTEKHNIKA in Russian No 6, Jun 86 (manuscript received 4 Nov 85)  
pp 49-52

[Article by A.L. Ryabtsov]

[Abstract] An optimum receiver of radio pulses utilizing only a part of the radio pulse is synthesized according to the Markov theory of optimum nonlinear filtration. Assuming an additive mixture of a useful signal and a stationary normal white noise at the receiver input, the algorithm of receiver operation is formulated for a bell-shape pulse and for a pulse with exponential-power-law envelope. The corresponding system of two differential equations in time delay as information carrying parameter is solved for the leading edge of the pulse only and, for comparison, for the entire pulse. The filtration error is found to be larger in the first case and, although most information is contained in the leading edge, it is necessary to change the transfer ratio of the receiver during strobing so as to ensure the required accuracy. Figures 3; references: 4 Russian.

2415/9716

CSO: 1860/306

## COMMUNICATIONS

UDC: 621.391.28

### CONSTRUCTION OF DIGITAL COMMUNICATIONS NETWORKS

Moscow ELEKTROSVYAZ in Russian No 7, Jul 86 (manuscript received 7 Feb 85)  
pp 6-8

[Article by V.M. Dmitrachenko and V.G. Osipov]

[Abstract] This article is written in response to a previous article in Number 10, 1984, in which it was suggested that all digital communications networks in the USSR be made a part of a nationwide packet-switching universal communications network. The authors indicate that departmental networks, even those using techniques other than packet switching, should still have a place in the overall communications mix of the nation. The authors speak in favor of synchronous channel-switching networks for some applications, stating that the problem of synchronization in such networks is not as serious as the previous article suggested. The authors called for a limited number of secondary networks, a few of which might be integrated. Further studies are needed to demonstrate the superiority of packet switching. References: 4 Russian.

6508/9716

CSO: 1860/4

UDC: 621.315.2

### DOUBLE-QUAD RURAL COMMUNICATIONS CABLES

Moscow ELEKTROSVYAZ in Russian No 7, Jul 86 (manuscript received 12 Mar 84)  
pp 15-17

[Article by Yu.V. Dobin, L.I. Kaizer, Yu.A. Parfenov, N.L. Sherman and L.S. Chervyakov]

[Abstract] The KSPVPB 2X4X1.2(0.9) double-quad cable has been developed to reduce capital investment and operating costs of rural communications networks, allowing single-cable operation of PCM systems with separation of transmission and reception into different shielded cable groups. A cross-sectional diagram of the new cable and its major technical characteristics are presented. The cable consists of two single-quad cores with copper conductors 1.2 or 0.9 mm in diameter, polyethylene core insulation, hydrophobic

filler, aluminum foil shields and thin steel strips around each quad, both quads in a common polyethylene outer shell. The cable is suggested for IKM-15, Zona-15 and IKM-30S systems with 30 to 60 channels. The use of this cable can increase the length of sectors between regenerators, decrease the number of regenerators per line and reduce operating costs and the consumption of polyethylene. Figures 2; references: 4 Russian.

6508/9716  
CSO: 1860/4

UDC: 621.315.2:621.395

#### DIELECTRIC STRENGTH OF INSULATION OF MKT-4 BALANCED CABLE CONDUCTORS

Moscow ELEKTROSVYAZ in Russian No 7, Jul 86 (manuscript received 16 May 84)  
pp 17-19

[Article by N.D. Kalinin]

[Abstract] Studies of a ten meter specimen of MKT-4 cable were conducted at voltages significantly exceeding the maximum permissible voltage for balanced cable pairs. The method consisted of preliminary exposure to AC voltages with subsequent measurement of the voltage at which partial discharges appeared and the breakdown voltage. Specimens were then aged while exposed to the standard test voltage, then partial discharge and breakdown voltages were remeasured. The breakdown voltage of aged and nonaged specimens was found to be quite high, 18-22 KV. Tensile strength was also quite high, and did not decrease with aging under the applied voltage. It is suggested that the rated voltage for this product be increased to 500 V, which still provides a significant safety margin. Figures 2; references: 2 Russian.

6508/9716  
CSO: 1860/4

UDC: 621.391.883

#### ACCURACY OF EXPRESS MEASUREMENTS OF PROBABILITY OF ERROR IN DIGITAL COMMUNICATIONS LINES

Moscow ELEKTROSVYAZ in Russian No 7, Jul 86 (manuscript received 23 Jul 85)  
pp 20-22

[Article by S.V. Dulov and Yu.K. Smirnov]

[Abstract] Methods of rapid analysis of the probability of error in digital communications lines by introduction of pseudoerrors utilizing two digital signals is discussed. The results of modelling allow selection of parameters for testing considering the required accuracy of measurement of the reliability of transmission. The quality and stability of devices utilizing the method described can be monitored by comparing relative mean square deviations in linear regression coefficients with their theoretical values, which are presented in a table. Figure 1; references 8: 7 Russian, 1 Western.

6508/9716  
CSO: 1860/4

## RESULTS OF EXPERIMENTAL STUDIES OF UPS-9600 DIGITAL SIGNAL CONVERSION APPARATUS

Moscow ELEKTROSVYAZ in Russian No 7, Jul 86 (manuscript received after revision 1 Nov 85) pp 29-32

[Article by K.F. Astapkovich, V.F. Buyanov, V.A. Yegorov, V.A. Zharenov, I.I. Zakharov, S.A. Kuritsyn, S.I. Lopatin, E.P. Perfilyev and V.I. Ponomarev]

[Abstract] The characteristics of digital signal conversion apparatus operating at 9600 hps in a standard voice-grade channel are presented. An experimental model of the device, developed at the Leningrad Electric Engineering Institute of Communications, was exhibited at the International Exhibition "SVYAZ-81," and fully satisfies CCITT recommendation V.29. The algorithms developed for the apparatus are used in devices exhibited at "SVYAZ-86." The design of the apparatus is briefly discussed and equations describing its operation are presented. Results of testing of the apparatus are presented. The UPS-9600 is found to support noise-tolerant transmission in a complex noise environment. Figures 2; references: 7 Russian.

6508/9716  
CSO: 1860/4

## STUDY OF EFFECTIVENESS OF NOISE COMPENSATION SYSTEMS IN COMMUNICATIONS CHANNELS FOR FM SIGNALS

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 29, No 7, Jul 86 (manuscript received after revision 19 Jul 85) pp 25-31

[Article by I.V. Terentyev]

[Abstract] An analysis is presented of noise compensation systems and their effectiveness. Two different systems are analyzed in comparison for use in channels carrying FM signals. Conditions under which the two types of noise compensation systems can be used are noted. The system can both suppress noise from interfering signals effectively and can be used to improve the quality of channels exposed to interfering signals, thus improving the electromagnetic compatibility of radio communications systems. Figures 2; references: 6 Russian.

6508/9716  
CSO: 1860/10

UDC: 621.396.61:621.396.7

CENTRALIZED CONTROL OF THE AVAILABLE POWER FOR A GROUP OF RADIO LINKS

Moscow RADIOTEKHNIKA in Russian No 8, Aug 86 (manuscript received 1 Apr 86)  
pp 18-19

[Article by F.M. Dorokhov and V.P. Postyushkov]

[Abstract] The problem of optimal control of the available energy of a radio center, consisting of a certain number of identical discrete power quanta, is formulated mathematically. An algorithm is synthesized for optimal control of the available energy so as to minimize the mean total power consumption and maximize the number of radio links serviced. Use of the algorithm is reported to increase significantly the reliability of communications on the links serviced by the radio center. Figures 2; references: 4 Russian.

6508/9716  
CSO: 1860/13

UDC: 621.396:519.24

2-STAGE ESTIMATION OF HETEROGENEITY OF AN IMAGE FORMED BY A SEQUENCE OF RECEIVERS

Moscow RADIOTEKHNIKA in Russian No 8, Aug 86 (manuscript received after revision 10 Mar 86) pp 20-22

[Article by A.A. Spektor]

[Abstract] Differences in the parameters of receiving and switching elements may cause distortion of images received by a sequence of receivers. Image distortion can be reduced by digital processing of the signal. The essence of the method suggested is formation of estimates of the parameters characterizing the heterogeneity and subsequent compensation by means of the estimates produced. This article studies the case in which the heterogeneity is manifested as variation in mean signal levels from the different receivers. A 2-stage estimation method is suggested and an algorithm generated for its use. The variation in relative error of estimation of the heterogeneity parameter as a function of the number of rows is produced for two values of signal/noise ratio. Figure 1; references: 5 Russian.

6508/9716  
CSO: 1860/13

## AUTOMATION OF PROCESSING OF PRIMARY INFORMATION AT STATIONS BY MEANS OF MICROCOMPUTERS

Moscow AVTOMATIKA TELEMEXHANIKA I SVYAZ in Russian No 6, Jun 86 pp 10-12

[Article by A.S. Kuzmin, chief project engineer, Automated Control System for Railway Transport Technical Design Bureau]

[Abstract] The introduction of SM-1800 microcomputer technology at railway stations for the input of railway routing data and real-time interactive linkage to railway data processing centers is described. Until recently, the lower levels of the railway network have not had direct computerized access to the computer centers leading to errors and lack of feedback. A block diagram is shown of the microcomputer system which can be realized in different ways for stations with various requirements (one or two computer layouts). Several versions of the SM-1800 exist which are suitable for various levels of requirements with the most developed having a single disk for operating system start-up and working storage. Various programming arrangements are used because of constraints due to the limited amount of available storage and the slow speeds of the floppy disc operations. Routing information is assembled and checked in interactive mode and transmitted and there is a connection to the railway control system giving access to telegraph and punched tape transmission and communication lines and stations may have various types of data transmission links depending upon how the station is connected to the control system. Routing data which has been entered into the railway computers can be corrected via the microprocessor system. The equipment is now in use at about forty railway stations and has improved routing data quality and reliability and reduced the time necessary for processing. Figures 2.

12497/9716

CSO: 1860/284

UDC 656.25:621.315

## FAILURE-FREE OPERATION OF CABLE LINES

Moscow AVTOMATIKA TELEMEXHANIKA I SVYAZ in Russian No 6, Jun 86 pp 30-34

[Article by R. Sh. Yagudin, head of reliability department, Center for Signals and Communications, Ministry of Railways]

[Abstract] An analysis is given of factors leading to the failure of railway cable lines and means for improving service. For 100 km, there is an average failure rate of .93 per year and for some lines the rate can be as much as three times greater. Of the failures, 48 percent are due to cable damage, 24.7 percent to insulation deterioration, 16.8 percent to strand damage and 8 percent to strand grounding with cable damage often occurring because of construction work, lightning, mechanical loading, climatic effects, biological and electrical activity, aging and defective fabrication. The damage from various sources can affect electrical characteristics. The cables are subjected to bending during fabrication and assembly and to tensions due to soil

temperature variations or cable laying operations and are also affected by compression, attrition and wear. Cables under roads with heavy traffic can suffer damage to sheathing and sleeves while vibration can damage installed cable sheathing. Temperature variations can deteriorate insulation and introduce humidity. Damage can also result from rodents, funguses and insects and from electrical interference of various kinds. Standards and procedures for cable maintenance, protection and laying as well as logging procedures for the collection of cable failure data are described. Statistics show that the maximum number of failures in railway cables occur in June and September and are due to agricultural work. Forms used for documenting repair procedures and collecting statistics are shown. Preventive maintenance is recommended as necessary for cable effectiveness. Figures 5.

12497/9716  
CSO: 1860/284

UDC 656.25:621.315.23

#### EXPERIENCE IN CONSTRUCTION AND ASSEMBLY OF SYMMETRICAL-COAXIAL COMMUNICATION LINES

Moscow AVTOMATIKA TELEMEXHANIKA I SVYAZ in Russian No 6, Jun 86 pp 36-38

[Article by N.M. Burtsev and K.A. Lyubimov, senior scientific staff members of the All-Union Scientific Research Institute for Railway Transport, candidates of technical sciences]

[Abstract] The MKKPAB cable and irregularities arising in its coaxial part are described. This cable is replacing the symmetrical seven-quad cables which are now used in pairs for railway communication lines while only a single combined MKKPAB line is necessary. The aluminum-sheathed cable is an improved version of the seven-quad cable in that two low-frequency quads are replaced by two 1.2/4.6 mm coaxial pairs on opposite sides of the cable. The cable began to be used on the Moscow line in 1983 and repeaters are located 4.1-4.6 km apart. Impedance irregularities in the coaxial lines are considered which are due to irregular dimensions of inner and outer lines, excentricities, insulation defects and deformations or to defects in cable connections at repeater points to other cable lengths or at terminal junctions. The cable lengths used are 500-1000 m long so that most impedance irregularities are due to internal defects in the cable sections but performance can be improved by correctly matching impedances at joints. Procedures for measuring and evaluating the parameters of impedance irregularities by means of the pulse method using the UIP-KS reflectometer with 10 ns pulses for cable sections and 50 ns pulses for repeater sections are discussed. The cable is designed for a standard average impedance of 75 ohms for frequencies of 1 or 2.5 MHz with a deviation of less than  $\pm 1.5$  ohms and the cable as factory produced and provided it is adequately connected satisfies Soviet and CCITT standards. Experience with the MKKPAB cable showed that it is suitable for railway communications over distances of 400-500 km. Figures 2.

12497/9716  
CSO: 1860/284

TEMPORARY CONNECTION OF OVERHEAD COMMUNICATION LINE CIRCUITS TO CABLE TRUNK LINE

Moscow AVTOMATIKA TELEMEXHANIKA I SVYAZ in Russian No 6, Jun 86 pp 44-45

[Article by V.I. Fedenev, senior engineer of Automation, Telemechanics and Communications Laboratory of West-Siberian railway line]

[Abstract] The method is described for a transition from an overhead communication line to a cable trunk line which is still under construction as was used on the West-Siberian line during electrification of traction equipment. V-12-2 and V-12-3 12-channel multiplexing systems were temporarily connected to a MKPAB cable equipped with non-attended K-60p repeaters. Block diagrams are given of the connections and the procedures for realizing the operation in stages are described. Adequate amplification sufficiently corrected attenuation on the cable line and the set-up operated well for more than a year. Figures 2.

12497/9716  
CSO: 1860/284

NOTES FROM THE INTERNATIONAL EXHIBITION "COMMUNICATIONS-86"

Moscow VESTNIK SVYAZI in Russian No 8, Aug 86 pp 2-9

[Article by A.I. Kuzhtuyev, candidate of technical sciences, Chief of Department, Scientific Research Institute of Radio Engineering, exhibition consultant]

[Abstract] Equipment is described which was presented at the international specialized exhibition "Svyaz 86" (Systems and Means of Communication, Transmission and Processing of Information--Communications 86") which took place in Moscow from 27 May to 5 June 1986. As was the case with the preceding exhibitions "Communications-75" and "Communications-81," the exhibition gave rise to much interest on the part of specialists from the USSR and foreign firms. More than 300 firms from 25 countries participated in the exhibition. Six photographs are shown of communication equipment from various countries.

6415/9716  
CSO: 1860/12

## CONTROL BY MICROCOMPUTER

Moscow VESTNIK SVYAZI in Russian No 8, Aug 86 pp 21-22

[Article by M.G. Oysgelt, deputy chief, Laboratory for Construction of Stationary Structures of the All-Union State Trust for the Construction of Long-Distance Wire Communication Structures]

[Abstract] The graphical fact information-search system program, Kontrol has been introduced into the installation management of the above mentioned trust. The Kontrol system can be used with the YeS 8534 (TAP-34) microcomputer or any analogous system - Iskra-226, Robotron-1715 and others and makes it possible simultaneously to handle up to nine thousand documents. Use of the system over a year makes it possible to save more than ten thousand man hours. A detailed explanation of Kontrol's method of operation is given. Figures: 2.

6415/9716

CSO: 1860/12

## ORGANIZATION OF ULTRASHORT WAVE RADIO NETWORK FOR COMMUNICATION SERVICE

Moscow VESTNIK SVYAZI in Russian No 8, Aug 86 pp 23-24

[Article by B.Yu. Livshits, senior engineer, Territorial Center for Long-Distance Communication and Television No 23 (TTsUMS-23)]

[Abstract] An ultrashort wave radio network for communication service organized in the zone of TTsUMS-23 and the equipment involved are described. The Series FM 300 radio equipment produced by the Hungarian People's Republic used in organizing the network included stationary radio stations, relay stations, and mobile and portable radio stations. The radio stations have nine channels and operate in a range up to 160 MHz. The power output of the transmitters is 10 W (the portables 0.4 W) and the sensitivity is not worse than 0.4 microvolt. The radio net provides: operator control of brigades accomplishing line repairs and emergency-restoration work; communication between them during work on sections of a considerable size as well as during work on masts of radio relay stations; notification of personnel located at various points of a line should the need arise for urgent work; and operational exchange of information with personnel along a communication line. Figures 2; photographs 3.

6415/9716

CSO: 1860/12

# EQUIPMENT FOR CHECKING REGENERATORS OF RURAL DIGITAL TRANSMISSION SYSTEMS

Moscow VESTNIK SVYAZI in Russian No 8, Aug 86 pp 31-32

[Article by I.F. Zabelin, chief engineer, Odessa Branch, Central Scientific-Research Institute of Communications (TsNIIS) and Yu.V. Pokotilov, engineer]

[Abstract] Digital communication networks in rural areas developed during the 10th and 11th Five-Year Plan, basically because of the introduction into operation of digital transmission systems (DTS) -- the IKM-12M, IKM-12 x 3 (Zona), IKM-15, and Zona-15. At present several thousand DTS, the principal functional units of which are regenerators, are in operation on rural primary networks. During operation of digital systems, it becomes necessary for a number of reasons to check and maintain regenerators. Test stand equipment developed for this purpose by TsNIIS and operating with a clock frequency of 1024 and 2048 kHz is described in detail with the aid of block diagrams. Figures 3.

6415/9716

CSO: 1860/12

UDC 681.32:656.25-52

# THE SM-1300 MICROCOMPUTER IN REMOTE DATA PROCESSING SYSTEMS

Moscow AVTOMATIKA TELEMEXHANIKA I SVYAZ in Russian No 9, Sep 86 pp 4-6

[Article by M.V. Spevak, junior scientific staff member, All-Union Scientific Research Institute of Railroad Transport, and A. L. Gozman, engineer]

[Abstract] The characteristics and prospective areas of application of the Soviet SM-1300 microcomputer in remote data processing systems are discussed. The SM-1300 is a common bus microcomputer in the SM-4 family, a microprocessor analog of the SM-3 minicomputer utilizing the same command set, architecture and system interface. It is a 16-bit indirect addressing microcomputer with 64K RAM, presently being modified to allow up to 256K RAM. The machines can be used as a network terminal or preprocessor for controlled objects. Figures 2.

6508/9716

CSO: 1860/2

## METHODS OF CALCULATING THE STRUCTURE OF AN AUTOMATICALLY SWITCHED RAILROAD SECTION TELEPHONE NETWORK

Moscow AVTOMATIKA, TELEMEXHANIKA I SVYAZ in Russian No 9, Sep 86 pp 6-9

[Article by A. V. Demchuk, senior scientific staff member, All-Union Scientific Research Institute of Railroad Transport, candidate of technical sciences; V. A. Prokofyayeva, assistant professor, Moscow Institute of Railroad Engineering, candidate of technical sciences; and V. V. Baranova, senior instructor]

[Abstract] A methodology is presented for determining the number and locations of intradivisional nodes for a railroad divisional automatically switched telephone network based on the criterion of minimum cost of line and cable equipment. The basis of the method proposed is successive run-through of different versions distinguished by network node placement. The sequence of computations presented in the article allows selection of the optimal network version, minimizing total channel-km cost of cable. A specific example is analyzed. In the example, optimization of the network structure reduces capital investment for line equipment by 20-30%.

6508/9716  
CSO: 1860/2

## OPERATION OF THE KVANT QUASIELECTRONIC AUTOMATIC TELEPHONE EXCHANGE ON THE PENZA LINE

Moscow AVTOMATIKA, TELEMEXHANIKA I SVYAZ in Russian No 9, Sep 86 pp 26-29

[Article by V. A. Konyashin, deputy chief, Signals and Communications Service, Kuybyshev Railroad, and M. A. Fedorov, engineer, Penza Line]

[Abstract] The Kvant quasielectronic automatic telephone exchange equipment has been in use at the Penza rail junction since 1984. Introduction of this equipment has significantly improved communications quality, providing additional services, improving speed of operation of the line and increasing communications flexibility. Introduction of the equipment also represented some difficulty, since the mix of analog and integrated microcircuit equipment requires that trained specialists be available for installation and maintenance. The equipment provides for automatic diagnostic testing, on command or at fixed time intervals. The Penza line has designed and installed a control panel for testing of connecting lines used with the equipment. A structural diagram of the control panel is presented, and its operation is described in detail. This control panel has been successfully used at Penza III Station with Kvant exchange equipment. Figures 3.

6508/9716  
CSO: 1860/2

## COMMUNICATIONS EQUIPMENT IN THE SERVICE OF MAN AND SOCIETY

Moscow AVTOMATIKA, TELEMEXHANIKA I SVYAZ in Russian No 9, Sep 86 pp 43-45

[Article by M. Serezhina]

[Abstract] The fourth international communications exhibition "Svyaz-86" (Communications-86) was held 27 May through 5 June in Moscow. Some 350 enterprises, organizations and firms from 25 foreign nations took part in the exhibition. The major thematic areas included: automation of communications and data transmission systems including digital communications networks; application software for planning of communications systems; automated communications control systems; satellite and space communications systems and hardware; television and radio broadcast equipment; information transmission and processing systems; switching equipment and terminals; electronic computers for communications control; radio measurement equipment; and consumer electronics hardware. The domestic and foreign exhibits at the exhibition reflected a new stage in the development of technology, the merging of the previously independent area of communications equipment and computer technology. The Soviet section included more than 800 exhibits in all of the theme areas. Photographs are presented of some of the devices, including a 32-number quasielectronic automatic telephone exchange rack, a virtual measurement instrument, an East German personal computer and a French microprocessor-controlled teletype.

6508/9716

CSO: 1860/2

UDC 621.391

## ENTROPIC SECRETIVENESS OF SIGNALS OF VARIOUS FORMS

Moscow RADIOTEKHNIKA in Russian No 6, Jun 86 (manuscript received, after completion, 25 Dec 85) pp 60-61

[Article by Z.M. Kanevskiy and V.P. Litvinenko]

[Abstract] Secretiveness of a signal being defined as the average minimum number of binary readings necessary for extraction of certain data from it, entropic secretiveness is not always exactly equal to but only approaches this number and especially so in the presence of masking signals or interference. Assuming that signals are sampled independently and equiprobably from a set of signals, entropic secretiveness is equal to the product of signal duration and transmitter bandwidth. With a unit of this quantity defined in terms of its base-2 logarithm, formulas are derived for calculating the entropic secretiveness of narrow-band signals (signal base  $B=1$ ) and wideband signals (signal base  $B \gg 1$ ) with M-sequences, linear-frequency-modulation, random sequences, and "jumping" discrete-frequency signals included in the latter category. Figures 1; references: 5 Russian.

2415/9716

CSO: 1860/306

UDC 681.142

THE ELECTRONIKA MK-52 PROGRAMMABLE CALCULATOR

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian  
Vol 29, No 7, Jul 86 (manuscript received 13 Jan 86) pp 95-96

[Article by V. P. Zakharov, Yu. M. Polskiy, N. P. Romashko and N. T. Golets]

[Abstract] The Electronika MK-52 programmable calculator provides the programmer with a 4-register stack and an intermediate results register, 15 addressable data registers, 105 steps of program memory, input and editing operations, 4 arithmetic functions, algebraic operations including square root, natural and base 10 logarithms and exponentiation, trigonometric functions, data representation conversions, logic operations, service operations including  $\pi$ , sin, max and stack rotation, program control operations, direct and indirect memory addressing and expression of angles in radians or degrees. A description and drawing of the device are presented, as well as a block diagram showing the interconnection of the microcircuits (K745 family). The device allows development of application programs which can be stored in peripheral storage devices. Figures 2; references: 2 Russian.

6508/9716

CSO: 1860/10

UDC 621.391.63:621.396.624

FIBER-OPTIC COMMUNICATION LINES BETWEEN TERMINALS OF COMPUTERS

Moscow RADIOTEKHNIKA in Russian No 6, Jun 86 (manuscript received after revision 31 Oct 85) pp 79-81

[Article by V.V. Korovkin, S.V. Perminov, and V.G. Tatsenko]

[Abstract] Multiplexers and demultiplexers for data transmission over fiber-optic cables between terminals of special-purpose computers with quantum-electronic modules are described, data transmission over such cables requiring conversion from parallel to sequential code. The multiplexer operating with binary pulse-position-modulation consists of a sync generator, an alternating-pause generator, a control-signal generator, a direct-access memory register which converts the incoming parallel code into a non-return-to-zero sequential one, and a phase keyer which converts the latter code into the Manchester code.

The corresponding demultiplexer is almost like a standard one for this code. A multiplexer operating with binary pulse-code-modulation of signals, for higher reliability and interference immunity of transmission over long fiber-optic lines, consists of a clock-pulse generator, a pulse shaper, a frequency divider, a phase shifter, a direct-access memory register for code conversion, a flag-pause generator, a summator, and a modulator. The corresponding duplexer is designed for a fixed word length. The second set was tested and found to be operational in real time, though with a lower maximum pulse repetition rate, without distortions caused by data asymmetry and with less stringent constraints on the dynamic range of the optical receiver input. Figures 4; references: 5 Russian.

2415/9716  
CSO: 1860/306

UDC 681.322.012

#### GENERATION OF IMAGES AT A RASTER GRAPHICS TERMINAL

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 29, No 7, Jul 86 (manuscript received 5 Dec 85) pp 33-38

[Article by T. T. Paltashev, Leningrad Institute of Precision Mechanics and Optics]

[Abstract] This article studies the principle of generation of bit-map images on raster terminals using multimicroprocessor systems consisting of graphic processors based on programmed microprocessor systems. Several approaches are discussed for allowing parallel processing during generation of bit-mapped images, including separate processing of images for each color and separation of the bit-mapped image into rectangular segments. Conditions which must be met during development of bit-mapped image generation control systems include development of potential parallelism by decomposition, communications between bit-mapped image generation processes and graphics processors, minimization of system control delays, utilization of standard interface buses, and assurance of uniform loading of graphics processors and input video memory interface. The analysis performed and preliminary estimates produced show that organization of the bit-mapped image generation system of a raster graphics terminal as a multimicroprocessor system with graphics processors based on programmable microprocessor systems is promising, allowing implementation of the principle of modularity and expandability of structures, utilizing well developed means for automation of programming and debugging and significantly reducing the cost of terminal systems. References: 3 Russian.

6508/9716  
CSO: 1860/324

## DIGITAL SYNCHRONOUS ACCUMULATION OF PHYSIOLOGICAL SIGNALS

Novosibirsk AVTOMETRIYA in Russian No 3, May-Jun 86 (manuscript received 14 Nov 85) pp 23-29

[Article by A.A. Zubkov, Ye.I. Shulman, and G.Ya. Yanovskiy; Novosibirsk]

[Abstract] A programmed system is described which achieves digital synchronous accumulation of physiological signals, and which permits a number of additional possibilities for increasing the effectiveness of the method, as well as flexibility during adaptation to the conditions of a concrete investigation. The following items are considered in detail: 1) Achieved properties of software; 2) Use of program of synchronous accumulation; and 3) Conditions for accomplishment of an experimental program. The authors thank S. V. Astafyeva, B.N. Deriya, I.V. Yegorushkina, and V.P. Tretyakeva for assistance in the work. Figures 1; references 12: 8 Russian, 1 Western, 3 Western (1 in Russian translation).

6415/9716  
CSO: 1860/316

UDC 612.822:616.071

## HARDWARE AND SOFTWARE FOR INVESTIGATIONS OF CHANGES CAUSED BY BIOELECTRICAL PROCESSES OF A HUMAN BRAIN

Novosibirsk AVTOMETRIYA in Russian No 3, May-Jun 86 (manuscript received 19 Nov 85) pp 29-37

[Article by Yu. L. Gogolitsyn, S.G. Danko, Yu.L. Kaminskiy, Yu. D. Kropotov, S.V. Medvedev, K.V. Melnichuk, S.V. Parkhomov, and V.A. Ponomarev; Leningrad]

[Abstract] The hardware-software complex described is used for investigation of changes in bioelectrical activity, achieved on the IN-110 (roman letters) laboratory computer. Principal attention is paid to the organization and structure of the packet of applied programs of statistical analysis of the experimental data. The method presented can be modified in two directions, which are described. The following items are considered in detail: 1) Equipment for recording biological processes and control of the course of investigations; 2) Organization of program for introduction of data and control of investigation; 3) Program for preliminary processing of data; 4) Program of statistical analysis of induced changes of bioelectrical processes; and 5) Component presentation of changes caused by bioelectrical processes. Figures 3; references 7: 6 Russian, 1 Western.

6415/9716  
CSO: 1860/316

SOFTWARE FOR ELECTROPHYSIOLOGICAL EQUIPMENT WITH BUILT IN MICROCOMPUTER

Novosibirsk AVTOMETRIYA in Russian No 3, May-Jun 86 (manuscript received 10 Oct 85) pp 37-41

[Article by G.A. Zaytman and B.Ya. Pyetigorskiy. Kiev]

[Abstract] The principles of organization and the structure of software which performs the function of controlling the problem-oriented real-time system of a computer built into electrophysiological equipment are described and examples of its employment are cited. The technology described for preparing software is oriented to the multiple procedures of single-type experiments which are sufficiently representative of medical-biological investigations. The following items are considered in detail: 1) Principles of conducting electrophysiological experiments with the assistance of automated devices; and 2) Structure of problem-oriented real-time system. The authors believe that the approach described can be utilized for built in computers of various architectures. Figures 2; references 6: 4 Russian, 1 Western, 1 Western in Russian translation.

6415/9716

CSO: 1860/316

## COMPONENTS, HYBRIDS & MANUFACTURING TECHNOLOGY

UDC: 666.651.6

### NEW RAW MATERIALS IN ELECTROCERAMIC PRODUCTION

Moscow STEKLO I KERAMIKA in Russian No 8, Aug 86 pp 20-21

[Article by F.Ya. Kharitonov, doctor of technical sciences, M.V. Glazacheva, candidate of technical sciences, Ye.Ya. Medvedovskiy, and G.F. Dobrynin, engineers, All-Union Scientific Research Institute of Electroceramics, Institute of Computer Technology, USSR Academy of Sciences, Perm High Voltage Electric Insulator Plant]

[Abstract] The purpose of this work was to develop an electroceramic corundum-mullite type material using a boron-containing additive in which boric anhydride is bonded to other oxides in a chemical compound, such as natural boron-containing minerals with slight quantities of alkali metal ions. Only datolite among all boron-containing minerals available commercially in the USSR meets the requirements of  $B_2O_3$  content, low content of impurities, low calcination losses, stable chemical composition and easy availability. A series of experimental batches were manufactured to work out the technology of preparation of electroceramic corundum-mullite type materials with added datolite concentrate and study their properties. Maximum density was achieved at a roasting temperature of  $1430^\circ C$ . The materials had good mechanical properties and a broad sintered state interval, and can be used for the manufacture of various insulators and structural products. Figures 2; references: 4 Russian.

6508/9716

CSO: 1860/3

UDC: 621.318.4

### EXPERIMENTAL STUDIES OF THIN-FILM ALUMINUM INDUCTANCE COILS

Moscow RADIOTEKHNIKA in Russian No 8, Aug 86 (manuscript received 4 Mar 86) pp 48-49

[Article by E.I. Tochitskiy, V.F. Surganov, and G.G. Gorokh]

[Abstract] Results are presented from experimental studies of thin film inductance coils made of layers of aluminum by planar technology. Test

thin film coils were made as flat square spirals with conductor width 200  $\mu$ m, spacing between turns 50  $\mu$ m. The number of turns varied from 1 to 6, first turn square side 1 to 4 mm. The experimentally determined values of L and Q as functions of number of turns and side length are illustrated for operation at 90 MHz. Q was found to decrease with increasing N. The results of the studies showed the possibility of manufacturing inductance coils with acceptable parameters in this size range by the method of evaporation of aluminum in a vacuum, photolithography and electrochemical anodizing. Figure 1; references 9: 8 Russian, 1 Western.

6508/9716

CSO: 1860/13

## ELECTROMAGNETIC COMPATIBILITY

UDC 621.3.014.332:551.594.221

### DEPENDENCE OF DISTRIBUTION OF AMPLITUDES OF LIGHTNING CURRENTS ON ALTITUDE OF LOCALITY ABOVE SEA LEVEL

Minsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ENERGETIKA in Russian No 4,  
Apr 86 pp 24-28

[Article by V.A. Rakov, candidate of technical sciences, and A.A. Dulzon,  
candidate of technical sciences, assistant professor]

[Abstract] At the present time it is supposed that lightning stroke current amplitudes in mountains decrease by a factor of 2 when they occur at altitudes above 1000 m but this has been shown to be approximate. There is conflicting evidence while various measurement methods are used. A statistical study was made on the basis of the literature and measurements in the Tomsk oblast in order to establish a more exact evaluation method. It was found that the latitude has a greater effect and the altitude a lesser effect than had been thought on stroke amplitudes. The amplitude is reduced at greater heights because clouds are closer but for latitudes 40-48° this may not happen because the altitude of the center of the storm cloud discharge zone is further away. It is supposed that the observed reduced lightning amplitudes at higher altitudes are probably due to the fact that rising strokes are more frequent at higher altitudes (10% at altitudes under 100 m and more than 95% for above 400 m). However this can only partly be explained by the altitude and the mountain relief and character of the discharge may explain the reduction. Figure 1; references 18: 12 Russian, 6 Western.

12497/9716  
CSO: 1860/257

ELECTROMAGNETIC COMPATIBILITY OF ELECTRICAL ENGINEERING INSTALLATIONS AND FEEDER LINES

Kiev TEKHNIЧЕСКАЯ ЭЛЕКТРОДИНАМИКА in Russian No 2, Feb 86 (manuscript received 25 Jun 85) pp 35-39

[Article by Gennadiy Yakovlevich Vagin, candidate of technical sciences, head of department, Gorkiy Polytechnical Institute]

[Abstract] The electromagnetic noise produced at industrial enterprises by various types of electrical engineering installations (EEI) is analyzed. This noise can have an adverse effect on the EEI themselves, on other electrical devices, on control systems, computers, and measuring and signalization units. Recommendations are made with respect to the construction of electrical power systems at enterprises, with an allowance made for the electromagnetic compatibility of EEI. The following items are considered in detail: 1) Basic definitions; 2) Electromagnetic noise; 3) Susceptability of electrical receivers and their control systems to electromagnetic noise; and 4) Construction of electric power supplies for industrial enterprises, taking into account electromagnetic compatibility. References: 6 Russian.

6415/9716

CSO: 1860/256

ELECTRICAL MODELS OF ELECTRON-BEAM DEVICES

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian  
Vol 29, No 6, Jun 86 (manuscript received 13 Sep 85) pp 80-85

[Article by S.V. Denbnovetskiy, A.V. Leshchishin, and A.V. Terletskiy]

[Abstract] A method of modeling electron-beam devices for computer-aided design is described which involves quantization and approximation of electrical data conversion processes. The mathematical model of such a device is a system of nonlinear partial differential equations describing the space distribution of the data conversion processes and numerically integrable through algebraization, which yields a discrete model whose system of nonlinear algebraic equations is solvable after successive linearization on each integration step. Inasmuch as operation of an electron-beam device involves space-time conversion of data, spectral analysis of both writing and reading electron beams as well as of the space-distributed data conversion processes in a system of coordinates rigidly tied to the target-screen surface is the most expedient way to determine the sought approximating functions. The algorithm includes a two-dimensional Fourier transformation. It is demonstrated on electron beams with Gaussian radial distribution of current density in a cathode-ray tube. Circuitual representation of this model allows the use of universal applied program packages for analysis of electronic circuits in computer-aided design of electron-beam devices. Figures 2; references: 5 Russian.

2415/9716

CSO: 1860/305

## DESORPTION SLIT CATHODE FOR ELECTRON GUN OF LINEAR INDUCTION ACCELERATOR

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 31, No 6, Jun 86 (manuscript received 10 Dec 84) pp 1209-1212

[Article by V.I. Pershin]

[Abstract] The article is concerned with achievement of the principle of a desorption slit cathode at the source of electrons of the LIU-5/5000 linear induction accelerator with pulse repetition rates of 0.25 Hz and 1 kHz. An investigation of the operation of the accelerator of the thermoemission of an oxide-nickel cathode incorporated in the design showed the complexity of its operation and the fact that with the required current density of  $\sim 18 \text{ A/cm}^2$ , the thermionic cathode, for which the density of the thermoemission saturation current amounts to  $5-7 \text{ A/cm}^2$ , emits with a nonzero field on the cathode, according to the Schottky effect. Such an emission regime sharply amplifies the nonuniformity of the current density in the beam as a consequence of the nonuniformity of the current density in the beam as a consequence of the nonuniformity of the cathode surface temperature in comparison with an emission region with a zero field at the cathode and the presence of an electron cloud over its surface. The author thanks B.I. Mashin for assistance in production of the cathode. Figures 4; references: 4 Russian.

6415/9716

CSO: 1860/311

UDC 621.335.2/3.65.011.56

AUTOMATION OF ELECTRIC LOCOMOTIVE CONTROL BASED ON MICROPROCESSOR TECHNOLOGY

Moscow ELEKTROTEKHNIKA in Russian No 4, Apr 86 (manuscript received 18 Nov 85)  
pp 20-22

[Article by V.P. Yanov and A.G. Volvich, candidates of technical sciences,  
All-Union Scientific-Research Institute for Electric Locomotive Building]

[Abstract] The advisability of a transition to a microprocessor means of electric locomotive control is considered, as well as the potentialities and merits of such control as compared with those traditionally used. Problems are listed which arise during the development of technical means for an electric locomotive control system. Block diagrams are shown of microprocessor control systems for electric locomotives with a semicontrolled bridge circuit and a rectifier-inverter converter. Also shown is a block diagram of control with a multiplex communication channel. The favorable results of the work conducted demonstrated the necessity and effectiveness of a rapid transition to a microprocessor means of control. Figures 3.

6415/9716  
CSO: 1860/259

UDC [061.5:629.423]:658.512.624

EXPERIENCE IN TEAM ORGANIZATION FOR PRODUCTION OF ELECTRIC LOCOMOTIVES AT THE NOVOCHERKASSK ELECTRIC LOCOMOTIVE CONSTRUCTION PLANT (NELCP) WITH USE OF AUTOMATED CONTROL SYSTEM

Moscow ELEKTROTEKHNIKA in Russian No 4, Apr 86 pp 29-31

[Article by V.A. Semenchenko, Deputy Director, NELCP]

[Abstract] The NELCP is known not only by its output--main line electric locomotives--but also by its experience in the organization of production. A detailed account of this production organization is given. Years ago the plant developed and introduced a system of continuous day-to-day production planning (CDPP) which subsequently received wide use at machine building enterprises and a number of other sectors of industry. In 1965 NELCP began to use a computer for control and introduced an automatic control system (ACS).

Recent requirements brought about the introduction of a number of adjustments to the control system, focusing it on fulfillment of production plans in all its units--from the work bench up to the shop--for specific products and at specified dates. Its principal components are the CDPP, the ACS, the team form of organization of labor, and stimulation of all categories of employees, with respect to fulfillment of planned tasks. In 1985 the plant turned out production 15% greater than in 1984. The collectives of the plant continued to investigate new more effective means for production control. This will make it possible to surmount the still higher limits planned by the 27th Congress of the Communist Party of the Soviet Union.

6415/9716  
CSO: 1860/259

UDC 629.423.32:621.38

#### DEVELOPMENT PRINCIPLES OF HIGHLY-RELIABLE ELECTRONIC CONTROL SYSTEMS FOR ELECTRIC LOCOMOTIVES

Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA in Russian No 5, May 86 pp 28-36

[Articles by Aleksandr Leonidovich Lozanovskiy, candidate of technical sciences, senior scientific research worker, All-Union Scientific-Research Institute for Electric Locomotive Building]

[Abstract] The basic method for obtaining maximum operational reliability of the automatic control system of the multimotorized drive of electrical locomotives is to minimize the number of its components. This can be realized by a choice of the structure of the specialized control and by minimizing the number of its functions. A system of scheduled repairs is an auxiliary method of increasing the operational reliability up to a specified level. This system is closely connected with the reliability of the automatic control with respect to failures of the third type (any malfunction not requiring immediate elimination) and with the operating life of its component parts. Figures 1; references: 4 Russian.

6415/9716  
CSO: 1860/278

MICROPROCESSOR-BASED TRACTION DRIVE CONTROLLER OF MAIN LINE ELECTRIC LOCOMOTIVE

Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA in Russian No 5, May 86 (manuscript received 31 Oct 85) pp 36-38

[Article by Stanislav Petrovich Mikulyak, senior scientific research worker; Mikhail Viktorovich Naprasnik, chief of laboratory; and Viktor Ivanovich Plis, senior scientific coworker; all from All-Union Scientific-Research Institute of Electric Locomotive Building]

[Abstract] Up to the present microprocessor means have not been used on domestic main line electric locomotives, basically because of the absence of series-produced microcomputers, capable of operating in severe climatic conditions (range of operating temperatures:  $-60^{\circ}$  to  $+60^{\circ}$  C) and a high degree of vibration. Now a microprocessor controller developed at the All-Union Scientific-Research Institute of Electric Locomotive Building is specifically intended for creation of the control systems of main line electric locomotives. Nine of the principal models of the controller are briefly described. The hardware and software of the controller were tested on the VL80R-1729 electric locomotive. It was concluded that introduction of microprocessor control systems for main line electric locomotives makes it possible almost completely to unify the hardware of the control systems of various types of electric locomotives, to reduce the period for their development and introduction, and to reduce the labor intensity and expense during their production and operation. References: 3 Russian.

6415/9716

CSO: 1860/278

UDC 621.391

ESTIMATING LENGTH OF A RANDOM GAUSSIAN SIGNAL WITH UNKNOWN POWER

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 29, No 7, Jul 86 (manuscript received 9 Jul 85) pp 7-10

[Article by A.P. Trifonov, V.I. Parfenov, Voronezh State University imeni Lenin's Komsomol]

[Abstract] A study is made of the possibility of determining the length of a random signal with a priori unknown power using the method of maximum likelihood. Equations derived in this article allow a well founded selection to be made between measurements as a function of the accuracy with which the power of the random signal is known a priori and also as a function of the requirements placed on accuracy of the length estimate and simplicity and hardware implementation of the measurement device. The scatter and bias of the estimates are determined. Figures 2; references: 3 Russian.

6508/9716

CSO: 1860/324

UDC 621.398.088

CODING OF READINGS DURING CYCLICAL QUANTIZATION IN INFORMATION-MEASUREMENT SYSTEMS

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 29, No 7, Jul 86 (manuscript received 17 Sep 85) pp 10-15

[Article by S.N. Litsyn, A.A. Yuzhakov, Perm Polytechnical Institute]

[Abstract] Transformation of signals in an information-measurement system includes cyclical quantization, coding, transmission and restoration of signals. This article discusses problems of the noise tolerance of such systems considering the correlation of sequences of readings. Codes with  $M=2^n$ ,  $d_V=2/3(n-1)$  and  $M=2^{n/3}$ ,  $d_V=2/3n$  are constructed. The method used to construct the redundant and nonredundant codes for systems with cyclical quantization allow correction of 30% more errors than previous  $M=2^n$ ,  $d_V=n/2$  codes with the same number of code words. References: 2 Russian.

6508/9716

CSO: 1860/324

# DETERMINATION OF FORCES AND MOMENTS IN ELECTROMAGNETIC SUSPENSIONS FOR PRECISION INSTRUMENTS FROM ENERGY EXPRESSIONS

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 29, No 7, Jul 86 (manuscript received 7 Jun 85) pp 44-48

[Article by S.A. Shakhov, Moscow Higher Technical School imeni N. E. Bauman]

[Abstract] The interrelationship between the methods of calculation of forces and moments of forces acting in electromagnetic devices containing ferromagnetic masses is far from obvious. This article shows that calculation of conservative components of forces and moments in electromagnetic suspensions by an energy method can be reduced to determination of the electromagnetic field on the surface of the area of the suspended body studied and determination of relationships for forces and moments obtained by a method based on integration of elastic electromagnetic field intensity. Determination of conservative components of the perturbing moments of forces acting on a suspended ferromagnetic motor is studied. Equations are derived on the basis of the volumetric density of electromagnetic field energy which show that knowledge of the full distribution of the electromagnetic field of the electromechanical system and the volume of the working gap need not be complete. It is sufficient to know the values of the distribution of the electromagnetic field on the surface of the area of the suspended body which is studied. This allows significant simplification and acceleration of calculation of forces and moments in electromagnetic devices by the energy method, since the need for precise determination of the energy state of the entire electromechanical system and the stage of analytical expression magnetic resistances and conductances in the gaps of the electromechanical devices disappear. Figure 1; references: 5 Russian.

6508/9716

CSO: 1860/324

UDC 681.327

# DEVICE FOR TIMELY PROCESSING AND DISPLAY OF POLAR-COORDINATE IMAGES ON PLASMA DISPLAY PANELS

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 29, No 7, Jul 86 (manuscript received 4 Feb 85) pp 62-66

[Article by T.M. Aliev, F.S. Mamedov, A.R. Radzhabov, Azerbaijan Institute of Petroleum and Chemistry imeni M. Azizbekov]

[Abstract] A description is presented of a plasma display panel designed for display of images in polar coordinates as continuous closed curves. The display device is used to monitor the profile of the cross-section of a bore hole during drilling. Photographs are presented of images taken from the screen of the device, which shows a circle as the ideal bore hole shape and

the actual bore hole profile with exaggerated deviations from circular shape. The image of the profile is represented by 256 points and is produced by analysis of the signals from a 16-radius profilometer. Figures 3; references: 4 Russian.

6508/9716  
CSO: 1860/324

UDC 535.3

#### KINEMATICS OF A MIRROR DEFLECTOR

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 29, No 7, Jul 86 (manuscript received 8 Feb 85) pp 67-69

[Article by Yu. A. Korotaev, Moscow]

[Abstract] The law of reflection does not exhaust the kinematic dependencies between the orientation vectors of an incident ray, reflecting plane and reflected ray. In studies of stabilization and guidance systems, which contain mirror deflectors, a more complete mathematical description of the kinematics of the deflectors is required. This article derives kinematic equations for the angular velocities of a mirror deflector and a kinematic equation for mirror deflector errors. References: 4 Russian.

6508/9716  
CSO: 1860/324

UDC 535.317.2

#### SYNTHESIS OF OPTICAL SYSTEMS FOR DEVICES FOR MONITORING THE EXTERNAL FORM OF PRODUCTS

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 29, No 7, Jul 86 (manuscript received 18 Jun 85) pp 75-81

[Article by A. K. Shirokov, Leningrad Institute of Precision Mechanics and Optics]

[Abstract] Devices for reading optical information contain devices for creating an optical image of the object being observed, converting and optically processing the image, as well as scanning devices and devices for photoelectronic conversion of the images produced. A block diagram of an optical information reader based on charge-coupled devices is presented and discussed. The design of lenses for dissector and CCD-based monitoring devices is illustrated. The optical systems thus developed were tested in a CCD-matrix device for monitoring the external appearance of a number of electronics products. Figures 5; references: 5 Russian.

6508/9716  
CSO: 1860/324

## METROLOGY IN THE STATE STANDARDIZATION PLAN FOR THE FIRST YEAR OF THE TWELFTH FIVE-YEAR PLAN

Moscow STANDARTY I KACHESTVO in Russian No 7, Jul 86, pp 12-15

[Article by I.V. Shmayev and V.A. Omelchenko]

[Abstract] Methods are considered for the solution during the 12th Five-Year Plan (1986-1990) of the manifold problems concerned with metrological support of production, as well as improvement of the activities of the metrological services of the USSR. The details of many of these methods are discussed. Within the framework of the complex program of metrological support of the branches of the national economy, the agricultural industry complex, the large-scale scientific-technical and national economy problems, and others, there is a close connection between program planning with respect to metrological support and the major problems of the economic and socialist growth of the country. In the 11th Five-Year Plan the results obtained from the realization of the tasks of such programs amounted to 350 million rubles in a year (with respect to those tasks, the effectiveness of which was evaluated). The article includes photographs with brief captions of the following items: 1) UPED02 for testing ultrasonic echo-pulse flaw detectors; 2) UGM-1 small-size holographic unit; 3) ILD-2M unit for measurement of the energy and time parameters of laser radiation at a given point; 4) PKZh-902 complex of means for metrological support of instruments for checking the purity of liquids; 5) State special standard of units of energy intensity of solar radiation; 6) Agat-SF5 electron-optical chamber for registration and measurement of the parameters of once through rapidly-passing processes; and 7) Type PPL-TM mobile laboratory for checking fuel and oil dispenser pumps. Figures 7.

6415/9716

CSO: 1860/315

UDC 612.014.423

## MEASUREMENT AND ANALYSIS OF MAGNETIC FIELDS OF HEART AND BRAIN

Novosibirsk AVTOMETRIYA in Russian No 3, May-Jun 86 (manuscript received 10 Oct 85) pp 101-106

[Article by K. Vitsenik, P. Vrabchek, V. Zrubets, P. Kneppo, and P. Tekel; Bratislava, Czechoslovak Socialist Republic]

[Abstract] In previous years at the Center of Electrophysical Investigations, Slovak Academy of Sciences, interesting results were obtained in the field of development of methods and technical means of measurement and evaluation of some forms of the biomagnetic activity of the human heart and brain. Further intensive development of these problems continues at present in collaboration with public health services. This development is oriented towards further technical improvement and verification of the diagnostic significance of these

investigations in clinical practice. (The equipment and software used are described.) The following items are considered in detail: 1) Methods of measurement; 2) Magnetocardiological measurements; and 3) Magnetoencephalogramical measurements. Figures 4; references 10: 1 Russian, 1 Czech, 8 Western.

6415/9716

CSO: 1860/316

## MAGNETICS

UDC 537.533

### VORTEX-FREE STATES OF RELATIVISTIC ELECTRON FLOWS OF ANNULAR AND RING CONFIGURATIONS IN A MAGNETIC FIELD

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 29, No 7, Jul 86 (manuscript received 25 Jan 85) pp 833-837

[Article by M.A. Gorshkova and V.Ye. Nechayev, Institute of Applied Sciences, USSR Academy of Sciences]

[Abstract] A solution to an interior problem concerned with the so-called bidronic states of annular and ring electron flows which have zero velocities on the inner surface is analyzed. It is shown that taking relativism and diamagnetism into account changes the flow conditions from those known from nonrelativistic theory. Figures 10: 7 Russian, 3 Western.

6415/9716

CSO: 1860/15

UDC 533.313

### PECULIARITIES OF FORCE-FREE CURRENT CONFIGURATIONS IN SCREW EXTERNAL MAGNETIC FIELDS

Kiev TEKHNIЧЕСКАЯ ЭЛЕКТРОДИНАМИКА in Russian No 2, Feb 86 (manuscript received 28 Feb 85) pp 16-21

[Article by Yuriy Makarovich Vasetskiy, candidate of technical sciences, senior scientific research worker, Institute of Electrodynamics, UkSSR Academy of Sciences, Kiev]

[Abstract] The article analyzes shaping of a force-free magnetic field in systems having screw symmetry. In such systems an external magnetic field can be given by a screw current winding. A connection is established between the total current and the uniform components of the external field which is expressed by an identical dependence for the cylindrical systems with the plane, axial, and screw symmetries. The geometry of the magnetic surfaces in the force-free regions is analyzed. However, the structure of the magnetic surfaces considered does not completely determine the magnetic field. In addition to the surfaces on which the field lines are arranged, for the

characteristics of its geometry it is necessary to analyze the degree of twist of the lines of force with reference to the magnetic axes. This question will be the subject of further investigations. Figures 2; references 9: 4 Russian, 3 Western (2 in Russian translation).

6415/9716  
CSO: 1860/256

UDC 621.365

# JOULE HEAT RELEASE IN THE PROCESS OF INDUCTION HEATING OF FLAT FERROMAGNETIC BODIES IN A TRAVELLING MAGNETIC FIELD

Kiev TEKHNIЧЕСКАЯ ELEKTRODINAMIKA in Russian No 2, Feb 86 (manuscript received 21 May 85) pp 21-28

[Article by Petr Aleksandrovich Vishtak, engineer, Institute of Electrodynamics, UkSSR Academy of Sciences; Igor Petrovich Kondratenko, senior engineer, Institute of Electrodynamics, UkSSR Academy of Sciences; Anatoliy Pavlovich Rashchepkin, candidate of technical sciences, senior scientific research worker, Institute of Electrodynamics, UkSSR Academy of Sciences; and Vladimir Aleksandrovich Krutilin, chief engineer, Institute of Electrodynamics, UkSSR Academy of Sciences]

[Abstract] Induction heating of ferromagnetic materials has a number of features connected with the nonlinear nature of the change of magnetic permeability in a magnetic field. In the general case during heating of steel items, the magnetic permeability is a function of the intensity of the magnetic field and the temperature  $\mu = f(MF, T)$ . The specific electrical conduction of the material,  $\sigma = f(T)$ , also depends on the temperature. In a calculation of electromagnetic fields, a complete computation of the real characteristics  $\mu$  and  $\sigma$  is only possible with the assistance of numerical methods which are not characterized by generalization and clarity of representation of the solutions obtained. The present article constructs an analytical method for solution of problems involving a nonlinear magnetic permeability which is based on a 1949 report by L.R. Neyman. A process of induction heating of a flat ferromagnetic body in a travelling magnetic field is considered. Electromagnetic processes and the distribution of the specific power of Joule heat release in the depth of a ferromagnetic body subjected to induction heating are involved. An analysis of the processes is conducted for the case where it is possible to describe the body as consisting of two layers--nonferromagnetic heated to a temperature above the point of magnetic transformation and ferromagnetic with nonlinear magnetic permeability. A method for calculation of the basic energy parameters of an inductor in a regime of constancy of induction on the inductor surface is explained. Figures 6; references 5: 4 Russian, 1 Western.

6415/9716  
CSO: 1860/256

## CALCULATION OF CONDUCTION ACCELERATOR OF MACROBODIES WHEN USING CAPACITIVE ENERGY ACCUMULATOR

Kiev TEKHNIЧЕСКАЯ ЭЛЕКТРОДИНАМИКА in Russian No 2, Feb 86 (manuscript received 27 May 85) pp 28-31

[Article by Irina Nikolayevna Abashina, engineer, Institute of Electrodynamics, UkSSR Academy of Sciences, Kiev, Aleksandr Dmitriyevich Podoltsev, candidate of technical sciences, senior scientific research worker, Institute of Electrodynamics, UkSSR Academy of Sciences, Kiev, and Vladimir Terentyevich Chemeris, candidate of technical sciences, head of laboratory, Institute of Electrodynamics, UkSSR Academy of Sciences, Kiev]

[Abstract] One of the important problems during planning of a conductive type electrodynamic accelerator (EDA) for acceleration of solids is an evaluation of the thermal state of the current-carrying sections of the contact rails and the body being accelerated (armature), and the subsequent selection of the material of the active parts of the EDA. In the present article a method is developed for numerical calculation of the electro-mechanical and thermal transients in the EDA with a capacitor storage device as a pulse power supply. The method developed makes it possible to evaluate the energy characteristics of the EDA and the level of thermal loads in the armature and conductor rails at various stages of the acceleration process. During use of the data concerned with the magnitude of the voltage drop at the sliding contact, the numerical method of calculation stated in the article can form the basis for an algorithm optimizing the characteristics of the accelerator. Figures 2; references 6: 2 Russian, 4 Western.

6415/9716  
CSO: 1860/256

UDC 621.822.72

## STUDY OF COOLED ELECTROMAGNETIC SUPPORTS

Kiev TEKHNIЧЕСКАЯ ЭЛЕКТРОДИНАМИКА in Russian No 2, Feb 86 (manuscript received 30 Jan 85) pp 31-34

[Article by Vladimir Yevdokimovich Miloshenko, candidate of physico-mathematical sciences, assistant professor, Voronezh Polytechnical Institute, and V.M. Karmazin]

[Abstract] The results are presented of an experimental investigation of superconductive supports immersed in liquid helium. These investigations show that a negligible increase of the temperature in some local areas of a superconducting platform which have good thermal contact with liquid helium exert a substantial effect on the distribution of a magnetic field and cause worsening of the power characteristics of the support. Figures 5; references 9: 6 Russian, 3 Western.

6415/9716  
CSO: 1860/256

PRINCIPLES FOR CONSTRUCTION OF AUTOMATIC SYSTEMS FOR PERMANENT MAGNET  
CALIBRATION

Kiev TEKHNIЧЕСКАЯ ЭЛЕКТРОДИНАМИКА in Russian No 2, Feb 86 (manuscript  
received 6 Mar 85) pp 96-102

[Article by Yevgeniy Aleksandrovich Andriyevskiy, candidate of technical sciences, head of laboratory, Institute of Electrodynamics, UkSSR Academy of Sciences, Kiev; Larisa Nikolayevna Lesnik, candidate of technical sciences, junior research worker, Institute of Electrodynamics, UkSSR Academy of Sciences, and Gennadiy Petrovich Sheverdin, engineer, Institute of Electrodynamics, UkSSR Academy of Sciences]

[Abstract] The basic principles for construction of digital automatic systems used for calibration of permanent magnets are considered, as well as measurement of their residual magnetization. Magnetic measuring devices with an incompletely closed magnetic circuit and galvanomagnetic transducers are at the base of such systems. According to the method used to create the demagnetizing field, the systems considered can be divided into devices with a low-frequency periodically changing demagnetizing fields, and devices with a change of single-pole demagnetizing pulses with a controlled amplitude. Block diagrams and algorithms of the operation of such systems are presented. Figures 4; references: 4 Russian.

6415/9716

CSO: 1860/256

UDC 548.537.611.46

DETERMINATION OF PARAMETERS OF EPITAXIAL IRON-YTTRIUM-GARNET FILMS

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian  
Vol 29, No 7, Jul 86 (manuscript received after revision 17 Oct 85) pp 37-42

[Article by A. S. Beregov, Ye. V. Kudinov, and V. G. Oblamskiy]

[Abstract] A nondestructive method for local determination of the saturation magnetization and anisotropic constant of ferrite-garnet large diameter films is suggested and tested. The method consists of measurement of standing wave ratios in a strip converter exciting magneto-static waves in a film with various orientations of the crystalline axes of the film relative to fixed positions of the converter and external constant magnetic field. The components of the magnetic permeability tensor and dispersion variation of frequency as a function of wave number are computed for magnetic field directed in the plane of the layer along the  $\langle 110 \rangle$  and  $\langle 112 \rangle$  axes. Results are presented for measurements of saturation magnetization and cubic anisotropy field for iron-yttrium-garnet films. The nondestructive methods can be successfully used for measurement of the parameters of films which must be known to calculate the major characteristics of magnetostatic wave devices. Figures 3; references 11: 5 Russian, 6 Western.

6508/9716

CSO: 1860/10

UDC 621.396.677

ENERGY BALANCE IN MICROWAVE DEVICES WITHOUT LOSSES CONSIDERING NONPROPAGATING WAVES

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian  
Vol 29, No 7, Jul 86 (manuscript received 1 Jul 85) pp 50-54

[Article by V. M. Maksimov and O.V. Abritalina]

[Abstract] One of the most common ways used in practice to estimate correctness and accuracy of computer calculations of the scattering matrix of microwave devices or individual elements is to monitor the balance of energy of the

propagating waves. This article analyzes equations which determine the energy balance in microwave devices without losses considering such nonpropagating waves. Application of the equations to determination of the correctness of computation of the elements of a general scattering matrix of simple microwave devices is demonstrated. The equations represent a convenient tool for testing the correctness and accuracy of computation of the external characteristics of microwave devices without losses. Figures 3; references: 2 Russian.

6508/9716  
CSO: 1860/10

UDC: 621.372.413

#### EXPERIMENTAL STUDY OF HIGH-Q SHIELDED DIELECTRIC RESONATOR

Moscow RADIOTEKHNIKA in Russian No 8, Aug 86 (manuscript received 7 Mar 86)  
pp 22-24

[Article by V.Ya. Dvadrninko, V.A. Korobkin and Yu. P. Yurchenko]

[Abstract] To achieve the potential capabilities of leukosapphire wave guide-dielectric resonators, losses in the metal surrounding the dielectric must be reduced. This can be achieved by separating the metal shield from the dielectric, requiring that no wave guide resonances be excited in the shield cavity in the working bandwidth. A design to achieve this is suggested. Experimental studies were performed, producing a value of system Q of  $26 \cdot 10^3$  in the 3 cm wave band without using expensive or complex resonator manufacturing technology. Figures 3; references: 4 Russian.

6508/9716  
CSO: 1860/13

UDC: 621.372.8

#### OPTIMIZATION OF CHARACTERISTICS OF COCOON-SHAPED WAVEGUIDES

Moscow RADIOTEKHNIKA in Russian No 8, Aug 86 (manuscript received 19 Aug 85)  
pp 73-74

[Article by Yu.Ya. Kharlanov]

[Abstract] Losses in microwave feeders can be minimized by the use of cocoon-shaped waveguides. There are relationships of the parameters of the cross-sections of such waveguides which minimize the losses. These relationships are computed as a function of the width of the working band of frequencies of the waveguide. The results obtained can be used to design optimal flexible corrugated cocoon-shaped waveguides. Figures 5; references 4: 3 Russian, 1 Western.

6508/9716  
CSO: 1860/13

## ELECTRODYNAMIC ANALYSIS OF WAVEGUIDE-DIELECTRIC FILTERS

Gorkiy IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOFIZIKA in Russian  
Vol 29, No 7, Jul 86 (manuscript received 30 Jan 85) pp 809-815

[Article by V.P. Lyapin, M.V. Manuilov, G.P. Sinyavskiy, and T. Yu. Chernikova, Rostov State University]

[Abstract] The problem of diffraction of the  $H_{op}$  waves at a waveguide-dielectric structure with an arbitrary number of flat dielectric layers is solved by the method of partial regions with an allowance made for the distinctive features of the field at the edge. The results obtained are compared with the theoretical and experimental results of a 1980 article "Waveguide Dielectric Filters" by B.Yu. Kapilevich. The authors stress that the rigorous method for analysis of waveguide-dielectric filters presented in the present article is satisfactorily simple and at the same time efficient, making it possible in practice to investigate a wide range of structures of the type considered, with any change of the problem's parameters, including the multimode area. Figures 5; references: 5 Russian.

6415/9716

CSO: 1860/15

## ANDALUSITE AS AN ACTIVE SUBSTANCE FOR 3-mm BAND TRAVELING-WAVE MASERS

Gorkiy IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOFIZIKA in Russian  
Vol 29, No 7, Jul 86 (manuscript received 4 Feb 85) pp 838-844

[Article by K.V. Vorsul, T.A. Smirnova, and N.T. Chernak, Institute of Radiophysics and Electronics, USSR Academy of Sciences]

[Abstract] The results are given of an experimental investigation of the maser characteristics of andalusite with  $Fe^{3+}$  ions as an active substance for a traveling wave maser in the 3-mm wave range. It is shown that a 3-level pumping scheme (with an orientation  $\theta = 90^\circ$  of the external magnetic field with reference to the Z-axis of the magnetic complex) has an advantage with respect to the quantum efficiency as compared with a push-pull pumping scheme ( $\theta = 44^\circ$ ). A method is presented for an experimental investigation of an active substance in an electrodynamic structure with a traveling wave (for an example, a waveguide partly filled by a dielectric). The following items in the article are considered in detail: 1) Spectral characteristics of  $Al_2SiO_5:Fe^{3+}$  in 3-mm band; 2) Measurement methodology and technology; and 3) Experimental results and their consideration. The authors thank S.A. Peskovatskom for making an andalusite specimen available for measurement. Figures 5; references 13: 9 Russian, 4 Western.

6415/9716

CSO: 1860/15

## APPROXIMATE BOUNDARY CONDITIONS IN THE THEORY OF ELECTROMAGNETIC WAVES IN A FERRITE LAYER

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 31, No 6, Jun 86 (manuscript received 4 May 85) pp 1110-1114

[Article by M.I. Kontorovich and S.A. Tretyakov]

[Abstract] A rigorous solution of electrodynamic problems which originate during investigations of waves in an isotropic laminated structure is very complex, and consequently methods for solving such problems are of interest. In the present article a layer, thin in comparison with wavelengths, of arbitrarily magnetized ferrite lying on a metal surface is considered. Approximate boundary conditions are obtained which have the nature of an impedance operator, making it possible to simplify substantially the solution of many electrodynamic problems. As an example, a problem is solved concerned with an unbalanced stripline on a laminated anisotropic support. Simple approximate formulas are obtained which make it possible to study the constant propagation and distribution of a field in a cross-section, for basic and higher wave types. Figures 2; references 9: 6 Russian, 3 Western.

6415/9716

CSO: 1860/311

## MAXIMUM CURRENT DENSITIES OF AUTOEMISSION IN MICROWAVE FIELD

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 31, No 6, Jun 86 (manuscript received 11 Jan 85) pp 1193-1195

[Article by Yu.V. Andriyanov, V.N. Bazdyrev, D.A. Borisov, and V.M. Zhukov]

[Abstract] The results are described of experimental investigations directed toward attainment of a maximum autoemission current from a tungsten auto-cathode, as well as toward studies of the effect of an autoemission current on processes in a square-wave resonator. The experiments made it possible, among the discharge processes in a resonator, to provide a significant autoemission current (up to 0.5 A), acceptable for practical use in accelerating procedures. Figures 2; references: 4 Russian.

6415/9716

CSO: 1860/311

UDC 551.46.01

SECOND ALL-UNION CONFERENCE ON OCEANIC POWER ENGINEERING

Minsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ENERGETIKA in Russian No 6,  
Jun 86 pp 120-122

[Article by A.K. Ilin, candidate of technical sciences, Pacific Institute  
of Oceanology]

[Abstract] Various aspects of oceanic power engineering were discussed at the Second All-Union Conference held in Vladivostok on 3-6 December 1985 and organized by the Pacific Institute of Oceanology. Representatives of academies of sciences and scientific research institutes all over the USSR participated, altogether 65 lectures were delivered. These dealt with the international scope of utilization of renewable oceanic energy sources, major achievements made since the first conference in 1983, nonconventional renewable energy sources, economics of oceanic power generation, wave power, new energy converters including special heat pumps and gasdynamic converters as well as converters of oceanic thermoelectric ones, construction and performance of oceanic heat and electric power plants and feasibility of increasing their inherently low efficiency, unique features of an Arctic oceanic heat and electric power plant, surface water near an oceanic heat and electric power plant, corrosion, experimental electrodialytic and osmotic power equipment based on salinity gradients, problems of tide harnessing, effect of a tidal electric power plant on tides, consideration of freezing and thawing in construction of the dam for a tidal power plant, hybrid pumped-storage hydroelectric and tidal electric power plants, relation energy extraction and the environment, and finally the importance of oceanic power engineering to the national economy as well as socio-economic and international legal problems related to utilization of oceanic energy sources. Tables 2; references: 1 Russian.

2415/9716

CSO: 1860/303

## ESTIMATING COST OF HIGHER-CAPACITY OVERHEAD 2-CIRCUIT ELECTRIC POWER TRANSMISSION LINES

Minsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ENERGETIKA in Russian No 6,  
Jun 86 pp 11-16

[Article by G.Ye. Pospelov, doctor of technical sciences, professor, V.T. Fedin, candidate of technical sciences, assistant professor, M.S. Chernetskiy, candidate of technical sciences, Belorussian Polytechnic Institute]

[Abstract] Necessary data are developed for estimating the cost of a higher-capacity new overhead 2-circuit electric power transmission line on the basis of the general cost equation in per-unit-length terms. All cost components, manufacturing and installation as well as preparatory, auxiliary, and startup operations, are accounted for. The ultimate purpose is to compare the economics of a new design for higher capacity with the economics of existing ones. The data are organized in simple formulas, calculations are aided by tables and graphs. The costing procedure is demonstrated on a 1 MW power line, the cost per 1 km length of a more compact multicircuit line being found to decrease with increase of the nominal voltage level and with the number of conductors per phase. Some novel compact multicircuit configurations appear to be 1.5-3.0 times more cost effective, with respect to specific economic indicators, than conventional configurations. Figures 1; tables 4; references: 5 Russian.

2415/9716  
CSO: 1860/303

## CALCULATION OF CURRENT HARMONICS GENERATED DURING DEICING OF OVERHEAD ELECTRIC POWER TRANSMISSION LINES AND OF THEIR INTERFERENCE IN COMMUNICATION LINES

Minsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ENERGETIKA in Russian No 6,  
Jun 86 pp 16-21

[Article by I.V. Zhezhelenko, doctor of technical sciences, professor, and I.I. Marchenko, engineer, Zhdanov Institute of Metallurgy]

[Abstract] Deicing of overhead electric power transmission lines, by heating with either alternating current or rectified direct current, generates higher harmonics in these lines and consequently interference in nearby communication lines. For a determination of their magnitude and of the electromagnetic interference, a simple conductor - ground deicer circuit is considered and the rectifier is assumed to be a source of even harmonics only. On this basis are calculated the amplitudes of even harmonics in the rectified voltage and the impedance of the deicing circuit at any harmonic frequency, this impedance being the sum of three components: internal impedance of the deicer

generator, input impedance of the power line with a short at the output end (worst case), and resistance of the grounding grid. The amplitude of any current harmonic is then equal to the corresponding voltage divided by the corresponding impedance. Voltages and currents induced in telegraph, telephone, and wire radio broadcasting circuits by these harmonics are calculated according to standard rules and formulas for interference suppression. Calculations reveal that deicing interferes most in tone-frequency telephone lines, a.c. deicing being dangerous for 1-conductor communication lines and d.c. deicing being dangerous for 2-conductor communication lines. Figures 1; tables 2; references: 5 Russian.

2415/9716

CSO: 1860/303

UDC [665.5:62-68].003.1

#### PROBLEMS OF LOW-GRADE HEAT RECOVERY IN OIL REFINERIES

Moscow PROMYSHLENNAYA ENERGETIKA in Russian No 7, Jul 86 pp 2-4

[Article by R.A. Bishev, engineer, Groznyy State Institute for the Planning of the Petrochemical Industry]

[Abstract] Several years of operational experience at the Grozgiptoneftekhim [Groznyy State Institute for the Planning of the Petrochemical Industry] are the basis for the treatment of three facets of low-grade heat recovery in oil refining operations: 1) Qualitative and quantitative aspects of low-grade heat sources; 2) Problems of equipment design and configurations for recovering this heat; 3) Trends in low-grade heat utilization. The Grozgiptoneftekhim Institute developed the KT-1/1 heat recovery system, in which optimization of the regenerative heat exchange resulted in an annual increase in the steam output (at 6 to 9 kgf/cm<sup>2</sup>) to 400,000 t (as opposed to 100,000 t with the KT-1) through the heat recovered from petroleum product flows. This institute has employed an intermediate heat exchange medium for more than 10 years in the recovery of low-grade heat. While the double heat exchange configuration requires metal, it has been quite reliable, though there are a number of unresolved questions such as providing a back-up for the recovery heat exchanger. A comparison of heat exchanger designs shows a substantial advantage of the plate-type developed by the Ukrainian Scientific Research Institute for Chemical Machinery; their design uses only half the usual amount of metal. A modern oil refinery uses 40 to 60 Gcal/h for heating and ventilation and approximately the same amount for all kinds of process heat. The low-grade heat output from modern combination systems reaches 50 to 150 Gcal/h, meaning that the low-grade heat consumed by the entire enterprise and this heat output per installation are of the same order of magnitude. Low-grade heat output is a full-time process, while the consumers require seasonal supplies with a maximum load of 2,000 to 3,000 hours annually. These and other considerations necessitate the development of economically justified criteria for the minimal temperature of a low grade heat source, below which this heat should not be recovered, as well as the determination of the most efficient utilization of such heat over the year. Grozgiptoneftekhim data indicate that the

lower cost effectiveness limit for the temperature is 120 to 130 °C for recovery, and not the 110 °C stipulated in present norms. A number of specific recommendations are made for the resolution of comprehensive questions of low-grade heat recovery and waste heat disposal via water.

8225/9716

CSO: 1860/321

UDC [621.311.4:621.311.43].001.8

OPERATIONAL EXPERIENCE WITH TM-301 REMOTE CONTROL SYSTEM FOR SILICON RECTIFIER CONVERTER SUBSTATION SHOP

Moscow PROMYSHLENNAYA ENERGETIKA in Russian No 7, Jul 86 pp 16-17

[Article by S.A. Denisov and V.I. Surov, engineers, Bratsk Aluminum Plant]

[Abstract] The TM-301 remote control system is used for dispatcher control of the electric power supply for the Bratsk aluminum plant. The power substations serviced by the system are up to 3 km apart; there are 19 monitored sites, tied to the control center by radial communications lines. The remote control system has 274 remote control instructions, 150 on-off remote control instructions, 599 remote signalling signals and 244 remotely measured electrical parameters. In order to maintain proper control system operation in the case of anomalies in the 10 kV and 220 kV power distribution and supply grids, the monitor points are powered with 220 V, regulated with an automatic reclosure switch, thus eliminating the need for manual reclosure by attending personnel after normal power is restored. Punched tape is the data recording medium and Konsul-254 electric typewriters are used by operators to record remote signalling data. The system first went on line in September, 1982; by 1985, it had been upgraded to the point that an increase in the period between servicing and repairs could be planned. Further improvements though a fail-safe power supply, better visual light signalling on the dispatcher control console and the use of miniature logic test probes for checking the TM-301 circuits are planned. No drawings or failure data are given. References: 2 Russian.

8225/9716

CSO: 1860/321

UDC 621.311.15:62-529.008.2

FORMALIZATION OF PROBLEM OF OPTIMUM CONTROL OF UNFORESEEN LOAD IN POWER GRID

Moscow ELEKTRICHESTVO in Russian No 6, Jun 86 (manuscript received 31 Jan 84) pp 1-5

[Article by V.P. Vasilyev, V.N. Kozlov, R.P. Stroganov, V.D. Yarmiychuk, and Kh. Segura]

[Abstract] Optimum control of unforeseen active loads in centralized electrical power grids with either single-level or hierarchical multilevel

automatic power and frequency regulation is considered, most expedient being combined power control and frequency control with simultaneous overcurrent limitation. Power control and frequency control can still be synthesized individually, while limitation of active overcurrents in transmission lines becomes a problem of quasi-static optimum control under constraints imposed by regulation of frequency and tie power, by limitation of active overcurrents in monitoring transmission lines, and by limitation of power swings in regulating stations or grid nodes. The problem of optimum control of unforeseen loads is accordingly formulated in three different ways, depending on the optimality criterion. One formulation is based on minimum deviation of either power in regulating stations or active overcurrent in transmission lines from the initial level. Another formulation is based on minimum deviation of variable quantities such as the distribution of unforeseen loads among grid nodes from given relations or from the most economical ones, or from conditions of matched pull-in of regulating stations. The third way of formulating this problem is based on combining optimality criteria of both kinds. The effectiveness of such a formalization was confirmed by numerical solution of this optimization problem for the Middle Volga electrical power grid, for which control of unforeseen loads had been synthesized by the method of mathematical programming and computer simulation with minimum deviation of power at the regulating stations from initial levels as optimality criterion. The problem was solved first for the case of a 300 MW power perturbation at one grid node and then for the case of such power perturbations at two grid nodes. Figures 1; tables 2; references 8: 7 Russian, 1 Western (in Russian translation).

2415/9716

CSO: 1860/319

UDC 621.315.1:551.594.221

#### LIGHTNING IMMUNITY OF ULTRAHIGH-VOLTAGE POWER TRANSMISSION LINES WITHOUT GROUNDING ARRESTER CABLES

Moscow ELEKTRICHESTVO in Russian No 6, Jun 86 (manuscript received 10 Dec 85)  
pp 10-18

[Article by G.N. Aleksandrov, doctor of technical sciences, B.B. Bochkovskiy, engineer, and G.V. Podporkin, candidate of technical sciences]

[Abstract] Design of ultrahigh-voltage (1150-1800 kV) overhead power transmission lines for adequate lightning immunity without grounding arrester cables is analyzed, taking into account the effect of streamer corona on the surge impedance of conductors and lightning channels as well as on the probability of transition from flashover pulse to power arc. Calculations for split conductors ( $n=8-20$ , separation radius up to 2 m) are supported by available data on amplitude distributions of lightning currents above 100 kA, 50% discharge voltages across conductor-to-ground, conductor-to-pole, and conductor-to-conductor gaps, also on the effect of streamer corona and of neighboring conductors on the coupling coefficients. While the number of failures caused by lightning strokes can be only roughly estimated on the basis of these statistical data, both the surge impedance of a corona conductor and the

lightning immunity of a transmission line are calculated quite accurately as functions of geometrical and electrical dimensions with the aid of theoretical and experimentally determined applicable capacitance-voltage characteristics. The results indicate the possibility of eliminating the arrester cables without lowering the lightning immunity to an unacceptable level. This requires adequate lengthening of the isolation gaps increasing their electrical strength, with ecological safety ensured by limiting the electric field intensity under the conductors to 20 kV/m and by utilizing the protective properties of vegetation which covers the ground. Figures 7; tables 3; references 18: 12 Russian, 6 Western.

2415/9716  
CSO: 1860/319

UDC 621.311.15.083.9

#### MEASUREMENT OF POWER LOSSES IN SUPERHIGH-VOLTAGE POWER TRANSMISSION LINES

Moscow/ELEKTRICHESTVO in Russian No 6, Jun 86 (manuscript received 15 Jul 85)  
pp 46-49

[Article by M.M. Zitser and A.I. Tamazov]

[Abstract] Measurement of power losses in superhigh-voltage (up to 750 kV) power transmission lines is analyzed, the difficulty being determination of the voltage-dependent and weather-dependent corona component of the total power loss. Since place and time of corona discharge are not a priori known, detectors with data transmission channels along the power transmission line are needed for measurement of its power. Another method of determining the corona power is from the difference between total power readings at both ends of the transmission line taken synchronously with wattmeters, such a determination being very inaccurate on account of corona discharge power being much smaller than conductor heating power. An accuracy analysis of such a power loss measurement, including errors of wattmeters and errors of instrument transformers, indicates the instrument precision requirements as the appropriate manner of determining and compensating the systematic error for sufficiently accurate measurement of the total power loss by this method with two wattmeters. Such a measuring system, with three analog-to-digital converters, four summators, and one memory for compensation of the systematic error, has yielded accurate readings of power losses in the Donbass-Dneper 750 KV overhead power transmission line. Figures 4; tables 3; references 7: 6 Russian, 1 Western.

2415/9716  
CSO: 1860/319

## ANALYSIS OF TRENDS FOR ENERGY REQUIREMENTS IN INDUSTRY OF KAZAKH SSR

Minsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ENERGETIKA in Russian  
No 4, Apr 86 pp 3-6

[Article by V.R. Okorokov, doctor of economic sciences, professor, and  
G. Ishmukhamedova, engineer, Leningrad Polytechnical Institute imeni  
M.I. Kalinin]

[Abstract] Energy supply is a crucial factor in the planning of economic growth which requires the analysis of current energy requirements and the establishment of trends for regional and sectorial needs. A formalization is presented for the relations between energy needs and industrial production and establishing indicators upon which planning could be based. Growth depends upon energy input since each product represents a certain energy consumption. Energy sources are considered to consist of electric power, heat and fuels and energy consumption is linked to production. Electricity demand is related to the gross product of the industrial apparatus considered as a single system and electricity consumption is considered the main indicator for the system. Electrification of equipment and labor productivity affect electricity consumption which can be considered as the ratio of electrification of equipment to work productivity. The volume of production is characterized by the pure output (indicating the product of the branch apart from exchanges with the system as a whole) which is a function of allocated materials, labor input and a technical progress coefficient. Heat and fuel requirements are linked to gross industrial production trends. Data from the statistics for 1960-1980 for the Kazakh SSR were used to evaluate the equations of the formalization and correlation coefficients and relative errors are given. It was found that the formalization adequately describes industrial growth and can be used for long-term planning. References: 3 Russian.

12497/9716  
CSO: 1860/257

## SELECTION OF RATIONAL HEAT CIRCUIT FOR HEAT STORAGE SECTION OF REMOTE THERMAL ENERGY SUPPLY ATOMIC STATION

Minsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ENERGETIKA in Russian No 4,  
Apr 86 pp 59-62

[Article by Ye.A. Larin, candidate of technical sciences, and A.F. Lutyantov,  
candidate of technical sciences]

[Abstract] A procedure is described for determining and optimizing the design for the heat storage section of a thermal energy atomic station which is to supply heat to users at a distance from the plant. This type of station is considered a promising source for this type of supply. High-potential heat

from the helium of high-temperature gas-cooled reactors is accumulated in a chemically bound state in a methane steam conversion process and is then delivered to users. The heat storage section can be realized in various ways whose parameters (steam/methane ratio, temperature and pressure levels, ratio of converter and steam generator thermal powers, conversion gas thermal use and methane and steam preheat capacities) determine the station's characteristics. Safety, reliability, efficiency and capital costs also affect design selection. Gas reheating of steam in a steam generator is superior to a steam-steam process but is less reliable so that a steam-reheating turbine is preferred. Steam temperature parameters and the drainage of the heating system are important factors in the design. Establishment of the profile of the turbine system involves optimization of the most important parameters, i.e., feed water temperature, heating steam pressure, intermediate reheating steam temperature and pressure. The optimization procedure for determining economically preferable solutions is described for a unit with reactor thermal power of 2500 MW, helium pressure of 5 MPa and reactor input temperature of 350° C and output at 950° C. The best design involved use of dry saturates steam produced by converter gas heat as the intermediate superheater of the turbine unit. The best drainage system uses high-potential heat for gas heating of feed water and turbine condensate while low-potential heat is used to supply users. Figures 3; references 4.

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UDC 621.314.21.045.017.2.001.5 (045)

#### DEPENDENCE OF LOSSES IN CONVERTER TRANSFORMER WINDINGS ON OPERATIONAL CONDITIONS OF THE CONVERTER

Kiev TEKHNIЧЕСКАЯ ЭЛЕКТРОДИНАМИКА in Russian No 2, Feb 86 (manuscript received 4 Mar 85) pp 45-50

[Article by Tamara Mikhaylovna Vitrenko, junior research worker, All-Union Scientific Research Drawing, Designing and Technological Institute of Transformer Construction (VIT), Zaporozhye, and Garri Ivanovich Kalayda, candidate of technical sciences, head of laboratory, VIT, Zaporozhye]

[Abstract] The results are presented of an investigation of the losses in the winding of a converter transformer, operating with a bridge rectifier, and the possibility is determined of selecting regimes the most adverse to losses. The following items are considered in detail: 1) Losses in winding of converter transformer; 2) Losses in winding with small dimensions of conductors; 3) Modelling on computer of various dependences; and 4) Results of calculations and their analysis. An example of the calculation of losses in a winding, and an appendix concerned with calculation of the harmonic components of current are presented. Figures 6, references 6: 4 Russian, 2 Western (1 in Russian translation).

6415/9716  
CSO: 1860/256

## ALLOWING FOR NONUNIFORM COOLING OF FRONTAL PARTS OF WINDINGS IN THERMAL CALCULATIONS OF ELECTRICAL MACHINES

Kiev TEKHNIЧЕСКАЯ ЭЛЕКТРОДИНАМИКА in Russian No 2, Feb 86 (manuscript received 28 Mar 85) pp 59-64

[Article by Gennadiy Grigoryevich Schastlivyy, corresponding member, UkSSR Academy of Sciences, deputy director, Institute of Electrodynamics UkSSR Academy of Sciences, for scientific work, Kiev; Vadim Vasilyevich Bandurin, candidate of technical sciences, scientific worker, Institute of Electrodynamics, UkSSR Academy of Sciences; and Svetlana Nikolayevna Ostapenko, candidate of physico-mathematical sciences, senior scientific research worker, Institute of Electrodynamics, UkSSR Academy of Sciences, Kiev]

[Abstract] Nonuniformity of cooling of the surface of the frontal parts of windings, according to their length, is characteristic in practice for all designs of electrical machines with an indirect cooling winding. Distribution of the intensity of cooling with respect to the overhang of the frontal parts depends on a number of factors, in the general case having an arbitrary form. The present article proposes an approach to a solution of the problem of thermal conductivity which removes the systematic restrictions connected with the nature of the nonuniformity of the thermal exchange at one of the sections, and expands the possibilities of design analysis of the heating of electrical machine units with a choice of various methods of cooling, depending on the design of the machine. Figures 2; references: 4 Russian.

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CSO: 1860/256

UDC: 621.186.4.001.24

## DESIGN OF SHIELD INSULATION

Minsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ENERGETIKA in Russian No 7, Jul 86 pp 66-69

[Article by Candidates of Technical Sciences, Assistant Professors S.F. Kravtsov, E.G. Bratuta and R.G. Akmen, Kharkov Polytechnical Institute imeni V.I. Lenin]

[Abstract] An approximate method is suggested for numerical solutions of the problem of the unsteady temperature field of multilayer insulation, considered as a system with concentrated parameters. The unsteady thermal mode of the system is calculated for a cylindrical shield of insulation. The method suggested allows a simple transition from the first order boundary conditions on the surface of the insulated body to second order conditions. An example is presented of design of the insulation for a pipe.

6508/9716  
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## CALCULATION OF INDUCED STRESSES IN SINGLE-CONDUCTOR AUTONOMOUS ELECTRIC POWER SYSTEM LINES

Minsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ENERGETIKA in Russian No 7, Jul 86 pp 19-23

[Article by Candidate of Technical Sciences G.N. Tsitsikyan, and Engineers V.G. Merkuryev and N.Yu. Musina, Leningrad Polytechnical Institute]

[Abstract] An estimate is presented of the induced electric field voltage in an autonomous electric power system considering the influence of the body in a transient process in which the influencing cable can be considered a single-conductor line. The maximum possible induced EMF is calculated for the time before the maximum current is reached, since it is in this time interval that the current rise rate is greatest. The method of calculating the induced electric field intensity presented here allows estimation of the maximum possible induced EMF in cable lines during transient processes in such power systems considering the electromagnetic parameters of the body. The induced EMF may reach several volts per unit of length. Induced EMF can be decreased by avoiding laying single-core power cables of large cross-sections and by the use of cable cores as grounding conductors, with grounding at a common point. Figures 3, references 9: 6 Russian, 3 Western.

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UDC: 621.3.01

## ANALYSIS AND SYNTHESIS OF ELECTROMAGNETIC FIELDS BASED ON VARIABLE APPROXIMATION OF THEIR VECTOR LINES

Minsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ENERGETIKA in Russian No 7, Jul 86 pp 24-28

[Article by Candidate of Technical Sciences, Assistant Professor V.N. Ostreyko, Northwestern Correspondence Polytechnical Institute]

[Abstract] The coordinate-structure method is a means of producing analytic solutions in specific coordinates for electromagnetic problems related to modern electrical engineering, approximating the geometric structure of the vector lines of the field studied with a certain accuracy. This article presents a further development of the coordinate-structure method, eliminating the shortcomings of previous versions (suitable only for areas of comparatively simple configuration in which the vector lines can be approximated using known coordinates or coordinates formed by means of functions of a complex variable while the approximation produced is rigidly fixed, since the structure of the specific coordinates used is determined only by the geometry of the boundaries of the field area studied). This is achieved by using a variable approximation of the field vector line structure, thus achieving its

maximum adaptation to the actual structure based on the field equations. The new method is thus called an adaptive-structural method. It is based on subdivision of the field area studied into a number of subareas so that, based on general considerations concerning the nature of transmission of lines of the major field vector, determined from the magnetic flux, electric charge or current, these lines can be approximated in each of the subareas by the lines of certain coordinates, which generally differ in the different subareas. The variable approximation of vector lines of the electromagnetic field provides the possibility of analytic solution of complex boundary problems in heterogeneous and nonlinear media allowing not only comprehensive field analysis, but also field synthesis. Figure 1, references: 7 Russian.

6508/9716

CSO: 1860/322

UDC [621.333:621.385.2/3].001.4

#### SYSTEM FOR AUTOMATIC DESIGN OF THE TRACTION MOTORS OF ELECTRIC LOCOMOTIVES

Moscow ELEKTROTEKHNIKA in Russian No 4, Apr 86 (manuscript received 18 Nov 85)  
pp 22-26

[Article by V.I. Sedov, engineer, and V.G. Shcherbakov, candidate of technical sciences, All-Union Institute for Electric Locomotive Building]

[Abstract] Because the difficulty of designing and adjustment of test models of traction motors increases from year to year, a significant decrease of the time for designing with a simultaneous increase of the quality is only possible by automation of planned work with a computer. It is advisable to perform design computation work on a computer, which it is possible conditionally to divide into two types: 1) Design of a new traction motor which does not have analogs, all units and details of which are worked out for the first time; and 2) Design of a new traction motor, the individual units and details of which are units and details of machines designed earlier. In the first case, primarily during calculation, there will be programs of search for permissible variation and optimization of programs. In the second case programs for verifying calculations in dialog regime find the greatest use. The following items are considered in detail: 1) Complex of programs for calculation of magnetic field; 2) Complex of programs for calculation of commutation; and 3) Examples of operational programs. It is concluded that the creation of a system of automated design of traction motors is a complex scientific-technical problem, on the solution of which progress in the field of designing traction motors depends to a considerable degree.

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## IMPROVEMENT OF CURRENT COLLECTORS OF ELECTRIC LOCOMOTIVES

Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA in Russian No 5, May 86 (manuscript received 26 Feb 86) pp 50-56

[Article by Viktor Petrovich Mikheyev, doctor of technical sciences, professor at Omsk Institute of Railroad Transportation Engineers]

[Abstract] The article examines the importance and means of creating a basic current collector, using a complex approach to a synthesized device and the use of priority solutions with respect to fundamental units. The following items concerned with these current collectors are considered: 1) Problem of current removal; 2) Optimization of current collector characteristics; 3) Calculation of the characteristics and parameters of current collectors; and 4) Use of computers for calculation of the characteristics and parameters of current collectors. Computer-aided calculations made at the Omsk Institute of Railroad Transportation Engineers over a number of years made it possible by means of experimental tests to reduce the number of current collector variations. Figures 1; references: 4 Russian.

6415/9716

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UDC 621.3.029.65::621.376.42

QUASI-OPTICAL CONTINUOUS POLARIZATION PLANE ROTATION DEVICE

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian  
Vol 29, No 7, Jul 86 (manuscript received after revision 29 Jul 85) pp 42-46

[Article by M. S. Yanovskiy and B. N. Knyyazvkov]

[Abstract] Continuous rotation of the polarization plane is used to rotate the polarization ellipsis of an electromagnetic wave. A 3-mirror polarization rotator contains three flat metal mirrors which leave the direction of propagation the same, but rotate the plane of polarization by twice the angle of rotation of the mirror system. However, the speed of rotation is limited due to the large diameter of the 3-mirror section. This article studies the possibility of rotating the plane of polarization by means of rectangular corner reflectors, allowing more rapid rotation. The device contains polarization gratings and 2-faced corner reflectors. Figure 1; references: 5 Russian.

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CSO: 1860/10

UDC 535.212

ACOUSTIC TOMOGRAPHY OF PULSED LASER BEAMS

Moscow AKUSTICHESKIY ZHURNAL in Russian Vol 32, No 4, Jul-Aug 86 (manuscript received 26 Aug 85) pp 457-461

[Article by V.V. Vorobyev, M.Ye. Gracheva, and A.S. Gurvich, Institute of Atmospheric Physics, USSR Academy of Sciences]

[Abstract] A problem of laser tomography is considered, namely reconstructing the energy density distribution over the cross-section of a pulsed laser beam on the basis of recorded diverging sound waves this beam has generated. The medium is assumed to be a liquid or gas which absorbs heat but hardly sound. Acoustic waves are recorded on the basis of pressure readings at observation points in accordance with the wave equation  $\partial^2 P / \partial t^2 = v^2 (\partial^2 P / \partial x^2 + \partial^2 P / \partial y^2)$  (P- pressure, v- velocity, t- time, x,y- Cartesian coordinates in z= const plane) and its solution in integral form for the gas-thermodynamic initial condition  $P(x,y,0)=P_0(x,y)=\alpha \gamma^{-1}(\gamma-1) I(x,y)$  ( $\alpha$ - thermal absorption

coefficient,  $\gamma = c_p/c_v$  ratio of specific heats,  $I$  - laser energy density). Satisfactory results are obtained with at least three and preferable more optimally selected observation points  $M(x,y)$ . Figures 3; references: 4 Russian.

2415/9716  
CSO: 1860/318

UDC 621.396.62:621.391.84

# INCREASE OF NOISE IMMUNITY OF HOMODYNE RECEPTION OF OPTICAL SIGNAL IN THE ATMOSPHERE

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 31, No 6, Jun 86  
(manuscript received 18 Feb 85) pp 1174-1177

[Article by A.S. Abramya, R.A. Kazaryan, and T.A. Mnatsakanyan]

[Abstract] It is theoretically and experimentally shown that for an increase of the signal-to-noise ratio and a decrease in fading of the signal caused by atmospheric turbulence, it is sufficient in the case of angular modulation of the optical carrier to receive even the first two harmonics of the signal. The experiments were performed with the aid of an installation for heterodyne reception of an infrared signal ( $\lambda = 10.6$  micrometer) using an atmospheric route with a length of 200 meters. A block diagram of the installation is explained in detail. Pulse code modulation of the phase of the transmitted signal was used. Measurements of the signal-to-noise ratio and the probable error were conducted for signal beam powers of 0.4 W and 30 mW. Figures 3, references 4: 3 Russian, 1 Western.

6415/9716  
CSO: 1860/311

## RELIABILITY

UDC 621.396.6

### APPROXIMATE ESTIMATION OF THE MOMENT A FIXED LEVEL IS REACHED BY A PERIODICALLY MEASURED PARAMETER OF AN ELECTRONIC DEVICE

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian  
Vol 29, No 7, Jul 86 (manuscript received after revision 11 Sep 85) pp 60-61

[Article by O. I. Illarionov]

[Abstract] The problem mentioned in the title is important in estimating the actual characteristics of durability and necessary times of preventive maintenance of electronics. If there is a series of measurements of a parameter, performed periodically with normally distributed error, the problem is to estimate the moment at which the measured parameter reaches an assigned value and determine the error of the estimate thus produced. It is assumed that the measurement as a function of time is monotonic over the period of time covered by the measurements and is described by simple polynomials. Figure 1; references: 2 Russian.

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CSO: 1860/10

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### EFFECTIVENESS AND INTEGRITY OF ELECTRONIC SYSTEMS

Moscow RADIOTEKHNIKA in Russian No 8, Aug 86 (manuscript received after revision 26 Mar 86) pp 63-65

[Article by V.A. Ivanov]

[Abstract] Considering an electronic system to be a means of achieving a goal, the author defines the goal function, which characterizes the positive effect which can be achieved by the use of the electronic system. The concept of integrity of the system is introduced, defined as the ability of the system to remain a means of achieving the goal when operating in a real-world electromagnetic environment. The requirements for electromagnetic compatibility of systems in operation must be met to an extent sufficient to maintain integrity. For example, the integrity of a runway beacon system must be

$1 \cdot 10^{-6}$  with an MTBF of 1000 hours for a decision altitude of 30 to 60 m,  
 $0.5 \cdot 10^{-9}$  with MTBF 2000-4000 hours where the landing decision must be made  
at 15 m altitude or less. This example illustrates that the integrity of an  
electronic system is determined in part by conditions of use of the system.  
References: 7 Russian.

6508/9716  
CSO: 1860/13

UDC 621.382.82.001

STATISTICAL OPTIMIZATION OF TOPOLOGICAL DIMENSIONS OF DIFFUSED RESISTORS  
ACCORDING TO CRITERION OF MAXIMUM PRODUCTION YIELD OF ACCEPTABLE INTEGRATED-  
CIRCUIT DEVICES

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian  
Vol 29, No 6, Jun 86 (manuscript received after revision 21 Oct 85) pp 98-99

[Article by A.I. Bashkis]

[Abstract] Considering that an integrated-circuit device as a mass product is a stochastic object, its design optimization requires functional and then statistical analysis rather than a deterministic model. Crossover from functional analysis based on a mathematical model of the circuit to statistical analysis based on an experimental set of test data occurs when intermediate parameters become involved, their probability characteristics being interrelated with the topological dimensions of circuit components on the one hand and with the output parameters of the device on the other. The complexity of the mathematical model describing an integrated-circuit device is determined by those intermediate parameters with either physical or only formalistic meaning. Optimization of the integrated-circuit topology for maximum production yield of acceptable devices is approached from this standpoint and treated accordingly as a maximization problem. For illustration, it is solved for an integrated-circuit voltage divider consisting of a pair of nominally 5 kohm diffused resistors. With the actual resistances as intermediate parameters and with the mean specific resistance of a chip layer given as  $250 \text{ ohm}/\square$ , a relation is established between the chip surface area and the topological dimensions of the resistors. Both parts of the optimization problem were solved on a BESM-6 high-speed computer, with various values of the two parameters of the approximating function based on experimental curves and characterizing the technological precision level. As a result was obtained the dependence of the production yield, in terms of the number of acceptable chips, on the resistor width (all other resistor dimensions being determined by the width) indicating the resistor width with which the production yield will be maximum. Figures 3; references: 2 Russian.

2415/9716  
CSO: 1860/305

## MODELING OF ELECTRONIC COMPONENTS IN COMPUTER-AIDED DESIGN SYSTEMS

Kiev IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOELEKTRONIKA in Russian  
Vol 29, No 6, Jun 86 (manuscript received 6 Feb 86) pp 3-15

[Article by V.P. Sigorskiy]

[Abstract] Modeling of electronic components in computer-aided design systems is reviewed, topically and chronologically covering the 1970-84 period, from the standpoint of design methods and computer capability. Design precision and reliability requirements have been leading to new developments in computer software and hardware such as a supercomputer and algorithms of two-dimensional or even three-dimensional modeling. Improvements in conventional modeling methods, macromodeling with both structural (space) and eventwise (time) decomposition or fragmentation especially of analog and digital integrated circuits, piecewise-linear and exponential-logarithmic continuous approximations are among them. Both physico-topological and technological modeling, including statistical analysis and optimization with testing by computer experiment in the final stage, is particularly relevant to new devices such as semiconductor microwave devices and electron-beam devices as well as to new microelectronic circuits, whether film circuits or monolithic ones, with up to large-scale integration. References 97: 90 Russian, 1 East German, 6 Western (3 in Russian translation).

2415/9716

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## SOFTWARE FOR MODELING LARGE-SCALE-INTEGRATION COMPONENTS

Kiev IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOELEKTRONIKA in Russian  
Vol 29, No 6, Jun 86 (manuscript received 26 Aug 85) pp 16-31

[Article by K.O. Petrosyants, A.I. Gurov, A.A. Mishin, N.I. Ryabov,  
A.I. Kanunnikov, A.M. Kozhusher, O.V. Mazing, O.M. Mikhaylova, and A.A.  
Pugachev]

[Abstract] Technologically feasible computer-aided design of LSI components involves modeling their physical structure and geometry, modeling their required electrical performance characteristics as well as extreme operating conditions tolerable under given constraints, then synthesizing the models for circuit analysis and optimization. There are programs available for these purposes, written in FORTRAN for either YeS computers or superminicomputers such as Elektronika-82. There are five programs for modeling the physical structure and particularly calculating the dopant concentration profiles in semiconductor layers: REGRES-IMPL one-dimensional approximation of B,P,As,Sb atom concentration profiles after ion implantation, PROFIL one-dimensional distribution of doping impurities, one-dimensional profiles after diffusion

of two electrically interacting impurities, one-dimensional approximation of impurity redistribution process in buried layers, DIFF2D two-dimensional distribution of doping impurities. There are five programs for modeling the dependence of electrical characteristics on physical and topological parameters: AELIS (Analysis of Components and Integrated Circuits) modeling and analysis of LSI components in integrated circuits, quasi-three-dimensional design of transistor structures in steady state, quasi-three-dimensional calculation of their frequency characteristics, COMPONENT quasi-three-dimensional design of plain and functionally integrated components in steady state, quasi-three-dimensional design of LSI fragments in steady state. There are four programs for modeling the dependence of electrical characteristics on influencing factors: SAMORAZOGREV (= SELF-HEATING) quasi-three-dimensional simultaneous calculation of static electrical and thermal performance characteristics, GURRADIA modification of COMPONENT quasi-three-dimensional calculation of static performance characteristics including effects of radiation, two-dimensional modeling of breakdown voltages for p-n junctions, AELIS modeling of cross interference and time delays in communication lines for calculation of transient processes in unshielded parallel planar conductors according to the telegraph equations. There is a library of electrical models describing bipolar and MOS components: Ebers-Moll model, Gummel-Poon model, superhigh-speed ECL model, Electrical/PhysicoTopological models describing transistors and I<sup>2</sup>L components of LSI and VLSI, Sah-Pao model, A.N. Karmazinskiy model, model of small-geometry effects with dependence of charge carrier mobility on longitudinal and transverse components of electric field. There are two programs of identification of model parameters, IDENT and IDENT-1 differing only in formulation of problems of linear programming and in method of their solution with constraints on optimization variables as well as on characteristics of devices and with constraints only on optimization variables respectively. Figures 4; tables 5; references 37: 24 Russian, 13 Western (2 in Russian translation).

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#### MORE COMPUTER-EFFICIENT MATHEMATICAL MODELS OF INTEGRATED-CIRCUIT COMPONENTS

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian  
Vol 29, No 6, Jun 86 (manuscript received after revision 30 Oct 85) pp 38-44

[Article by V.P. Vatagin, M.S. Miropolskiy, and S.G. Rusakov]

[Abstract] A method of more computer-efficient modeling of LSI components without lowering the precision in the process is proposed. It is based on use of the special function  $g(x) = e^{x-g(x)}$  analytically describing processes which involve two competing mechanisms, a linear one and an exponential one, so that the solution to the corresponding equation  $y = x - A \log y$  becomes  $y = Ag(\frac{x}{A} - \log A)$ . With this g-function are constructed models and are calculated the current-voltage characteristics of a diode with high base resistance, a stabilatron, and IC bipolar transistor, and an MOS-transistor. This

$g(x)$  function is defined on the entire real axis and increases monotonically as its argument increases from  $x = -\infty$  to  $x = +\infty$ , asymptotically approaching  $e^x$  in the  $x < 0$  range and  $x - \log x$  in the  $x > 0$  range. It is easily differentiable and integrable, appearing again in its derivatives and transforms. The function is very useful in macromodels and for solving equations  $y^p + A \log y = x$ , of which  $y = x - A \log y$  is a special case. Figures 6; references 6: 3 Russian, 3 Western.

2415/9716  
CSO: 1860/305

UDC 621.382.82.001

TWO-DIMENSIONAL PHYSICOTOPOLOGICAL MODELING OF COMPONENTS OF ELEMENTAL BASE FOR LARGE-SCALE INTEGRATION OF REPROGRAMMABLE READ-ONLY MEMORIES

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian  
Vol 29, No 6, Jun 86 (manuscript received after revision 25 Oct 85) pp 50-54

[Article by N.B. Grudanov, V.B. Nevzorov, and V.I. Beregovoy]

[Abstract] Time and cost of designing the elemental base for large-scale integration of reprogrammable read-only memories, both prohibitive now even with use of simplified analytical models and experimental data, can be reduced by two-dimensional physicotopological modeling of MOS-transistors based on direct numerical solution of the fundamental system of semiconductor equations. This method eliminates the need for preliminary particularization of the modeling problem and reduces the volume of optimizing calculations while, at the same time, it also covers high-voltage modes of MOS-transistor operation. The simplest two-dimensional mathematical model describing the electrophysical characteristics of an n-channel device are the Poisson equation of an electrostatic field and the continuity equation for electrons. Solution of this system of two vector equations by a 2-level iteration process, according to a variant of the Gummel method with both logarithmic correction and use of the STEPSOLVING algorithm for better global convergence, has been programmed in IRIS (Tool for Integrated-Circuit Designer). The optimum iteration algorithm equally well solving the two corresponding difference equations without requiring stipulation and thus cumbersome a priori estimation of the iteration parameters is demonstrated on a 3-layer local computation grid with regular splitting of the difference operator. Figures 2; references 15: 5 Russian, 10 Western (2 in Russian translation).

2415/9716  
CSO: 1860/305

## MACROMODELS OF ANALOG MICROCIRCUITS

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian  
Vol 29, No 6, Jun 86 (manuscript received after revision 17 Jan 86) pp 64-71

[Article by V.A. Fesechko, N.G. Ivanushkina, V.V. Kozachuk, V.P. Muzychenko,  
N.V. Ostrogradskiy, and S.N. Polishchuk]

[Abstract] Macromodels for computer-aided design of analog and hybrid integrated-circuit devices are shown which have been constructed with minimum necessary initial description of the basic circuit and by combining decomposition of the basic circuit and aggregation of partial models with structural and functional synthesis. The array of general and particular models has been organized into cells according to dynamicity, linearity, destabilization, and precision indicators in accordance with the relational-heuristic principle. The macromodels include those of operational amplifiers and comparators with either bipolar or field-effect transistors in the input stage, high-frequency voltage amplifiers, analog voltage multipliers, voltage stabilizers capable of handling polarity reversals on the input side and short circuits on the output side, and an analog-to-digital compatible with TTL, CMOS, ECL circuits and operational in unipolar or bipolar mode, with adjustable voltage or current conversion coefficient and with null shift on the output side. Figures 5; references 10: 7 Russian, 3 Western (in Russian translation).

2415/9716

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UDC 621.382:681.32

## COMPUTER-AIDED MODELING OF ELECTRONIC CIRCUIT COMPONENTS

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian  
Vol 29, No 6, Jun 86 (manuscript received 1 Jul 85) pp 45-50

[Article by V.I. Anisimov, Yu.Ya. Pavlov, V.A. Maksimovich, and G.D. Dmitrevich]

[Abstract] Computer-aided design of electronic apparatus involves computer-aided modeling of its components, macromodeling being most efficient in terms of lowering the dimensionality of the vectors of model parameters and thus also the number of required electrical measurements. This is demonstrated first on calculation of steady-state parameters and static characteristics using a priori information about the physical properties of the macromodel components. It is then demonstrated on calculation of transient-state parameters and dynamic characteristics of a macromodel, with the latter constructed as a separable one. Automation of macromodeling for technological or scientific research purposes is then entirely feasible, owing to a small finite number of tests required and owing to convergence of computer iterations during parametric identification. Testers with measuring and computing

apparatus have been developed for this purpose, with appropriate hardware and software, a special nonconventional tester being needed for determining the macromodel dynamics. For data processing are available two variants of modular software consisting of statistical modeling programs, SMAK-1 based on the disk operating system in an automatic workstation and SMAK-2 based on the RSX-11M V3.2 multistation operating system. Interprocessor communication proceeds over a local network to which are also connected an SM small computer and an Elektronika-60 microcomputer, using long-distance adapters as well as a sequential data exchangers and operating with DECNET software. Figures 4; tables 1; references 7: 4 Russian, 1 East German, 2 Western (1 in Russian translation).

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CSO: 1860/305

UDC 621.396.622:621.373.187.4

ACOUSTICAL OPTICAL PROCESSORS (SURVEY)

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian  
Vol 29, No 7, Jul 86 (manuscript received 20 Feb 86) pp 3-10

[Article by Yu. V. Yegorov]

[Abstract] This article reviews studies performed at the Leningrad Electrical Engineering Institute on acoustical optical devices. These devices are based on an acoustical optical modulator in which information which is to be processed in an optical channel is modulated. The cycle of work covered in this article studied the theory of diffraction of light by acoustical waves of complex spectral composition and great amplitude. The theoretical results obtained were used to develop an acoustical optical high resolution spectrum analyzer for radio astronomy applications. The active search is continuing for new physical phenomena which can be used as the basis for a new generation of optical signal processing equipment. One such promising effect is the interaction of light with spin waves in thin ferromagnetic films pioneering work has been performed at the Institute, achieving effective interaction of near IR band light with surface and body spin waves propagating jointly through a thin yttrium-iron-garnet film. Figures 5; references: 53 Russian.

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UDC 621.37:534.001

STRONG ACOUSTOOPTICAL INTERACTION IN A FIELD OF FOCUSED SOUND WAVE

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian  
Vol 29, No 7, Jul 86 (manuscript recieved 7 Dec 84) pp 798-808

[Article by A.S. Zadorin and S.N. Sharangovich, Tomsk Institute of Automated Control Systems and Radio Electronics]

[Abstract] The problem of acoustooptical interaction of complex light and sound fields in crystals is considered. The differential equations defining the diffracted light field in an anisotropic medium have been defined and a

general solution for the equation for the weak Bragg's interaction has been found. A problem concerned with a strong acoustooptical interaction in the field of a focused sound wave is solved. The solutions obtained describe the diffraction field as close to an acoustic lens, in the area of its focus. An asymptotic of solutions for large and small sound power is defined. The following items are considered in detail: 1) Basic relationships; and 2) Diffraction of light at focused sound wave. Figures 2; references 11: 9 Russian, 2 Western.

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UDC 621.373.826:621.376

#### CALCULATION OF OPTICAL DECOUPLING BETWEEN CHANNELS OF ACOUSTOOPTIC DEFLECTOR

Moscow RADIOTEKHNIKA in Russian No 6, Jun 86 (manuscript received after revision 12 Dec 85) pp 81-83

[Article by Yu.G. Vasilyev, A.D. Kuptsov, and V.N. Ryzhevnik]

[Abstract] A two-coordinate acoustooptic deflector is considered consisting of an optical input channel with collimator, an acoustooptic modulators with sound guide and two acoustic channels  $x, y$  which receive radio signals at frequencies  $f_x$  and  $f_y$  respectively, and a lens which focuses light beams on the entrances to four optical output channels. The decoupling between these optical channels for diffracted light beams, during switching from one channel to another and with the Bragg conditions satisfied in the focal plane of the lens, is calculated with the frequency resolution in both acoustic channels taken into account according to the Rayleigh criterion. Analytical and numerical results indicate the feasibility of a 70 dB or stronger decoupling with the use of a decimetric-wave acoustooptic modulator made of high-frequency material. Figures 1; references 7: 4 Russian, 3 Western (1 in Russian translation).

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UDC 534.213:534.22.222.1

#### INVERSE PROBLEMS OF SCATTERING IN ACOUSTICS. REVIEW

Moscow AKUSTICHESKIY ZHURNAL in Russian Vol 32, No 4, Jul-Aug 86 (manuscript received 6 Jan 86) pp 433-449

[Article by V.A. Burov, A.A. Goryunov, A.V. Saskovets, and T.A. Tikhonova, Chair of Acoustics, Department of Physics, Moscow State University imeni M.V. Lomonosov]

[Abstract] Inverse problems of scattering in acoustics, namely determining the quantitative characteristics of a local inhomogeneity in a medium from

the known acoustic field scattered by it, are solved for such practical applications as nondestructive inspection (defectoscopy) and medical diagnosis (introscopy) as well as for seismological and oceanological research. Methods of their solution must deal with several difficulties, major ones being ill-conditioned inverse problem of diffraction and of its radiation part, namely determining the characteristics of a radiation source from the known radiation field, nonlinearity of this problem with respect to the sought scatterer parameters, and nonuniqueness of the solution to the reverse problem of radiation. All inverse problems of scattering can be classified into scalar problems and vector problems, depending on whether the medium is fluid or elastic respectively. They can also be classified according to the a priori known kind of inhomogeneity or its scattering power. The two basic kinds of inhomogeneities are "smooth" ones describable by piecewise-smooth functions of space coordinates and "sharp" ones describable by boundary conditions. With regard to scattering power, inhomogeneities are "weak", "intermediate", or "strong" and the reverse problems are formulated correspondingly. As the fundamental inverse problems of scattering are considered scalar ones for an inhomogeneity perturbing both the density of a liquid or gaseous medium and the acoustic velocity in it. These problems are determining both as piecewise-smooth functions of the radius and determining the form of such a structurally uniform scatterer as well as the kind of boundary conditions, first kind or second kind, at its surface. The boundary-value problem reduces to an inverse problem of refraction involving the wave equation for acoustic pressure in a nonhomogeneous medium. Next are considered alternative forms of the equation of scattering for a scalar wave and a refractive inhomogeneity, this equation being usually split into two and the form being most expedient for a given kind of scatterer the inhomogeneity is. Weak scatterers are treated in the Born approximation. Multiple scattering is covered by an iterative solution of the equation or two equations of scattering, the procedure simplifying for intermediate scatterers because of smallness and negligibility of one set of operators. For strong scatterers it becomes necessary to extend the algorithms of iteration, which can be done upon representation of the scattered field as the sum of partial fields and is facilitated by doubling the number of incident fields or the number of frequencies so that the resulting 100% redundancy will preclude false final estimates even after false initial ones. Inverse problems of scattering for isotropic solid media are vector problems and their degree of complexity is higher than that of scalar problems for fluid media, not only owing to the larger number of unknowns, Lamé coefficients  $\lambda$ ,  $\mu$  and density  $\rho$ , but also owing to severe limitations on the method of ranging and detection. Iteration procedures for solution of scalar problems are extendable to solution of vector problems, as demonstrated on the problem for an inhomogeneity in an elastic isotropic medium. Figures 6; references 65: 27 Russian, 38 Western (2 in Russian translation).

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## EXPLICIT EXPRESSIONS FOR ACOUSTIC EDGE WAVE SCATTERED BY RIB ELEMENT

Moscow AKUSTICHESKIY ZHURNAL in Russian Vol 32, No 4, Jul-Aug 86 (manuscript received 27 Mar 85) pp 450-456

[Article by D.I. Butorin and P.Ya. Ufimtsev, Institute of Radio Engineering and Electronics, USSR Academy of Sciences]

[Abstract] Scattering of an elementary edge wave by an infinitesimally small element of a wedge edge and adjacent infinitesimally narrow strips of both wedge faces is considered, assuming that these strips run parallel to the diffraction rays so as to preclude interference from "foreign" wedge edge elements and assuming that the velocity potential of the wave field satisfies either the Dirichlet condition or the Neumann condition at the wedge faces. Explicit expressions for the components of this field are derived from the corresponding Helmholtz integral expressions with the aid of the residue theorem. These expressions are asymptotic and yield the directional pattern of elementary edge waves generated by the entire current or only by its uniform "geometrical optics" component. This pattern consists of bright cones and shadow regions. The authors thank G.D. Yakovleva for assisting with numerical calculations. Figures 3; references: 2 Russian.

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## CONVERSION OF ACOUSTIC MODES IN MULTILAYER STRUCTURES WITH MAGNETIC NONHOMOGENEITY

Moscow AKUSTICHESKIY ZHURNAL in Russian Vol 32, No 4, Jul-Aug 86 (manuscript received 13 Sep 85) pp 468-473

[Article by Yu.V. Gulyayev, I.A. Ignatyev, V.G. Plekhanov, and A.F. Popkov Moscow Institute of Engineering Physics]

[Abstract] Conversion of acoustic modes during propagation of sound in a material with space-periodic magnetic nonhomogeneity and with isotropic elasticity is analyzed, first in a plate of a uniaxial ferrite and then in a film of such a material on a nonmagnetic substrate, such a conversion being the acoustic analog of the Faraday effect in integrated magneto-optics. The analysis is based on the wave equation in displacement and energy for volume acoustic or Lamb waves propagating parallel to the surface, where energy includes elastic energy and magnetoelastic interaction energy as well as Zeeman energy in an external magnetic field also parallel to the surface. Assuming that the magnetic nonhomogeneity is established by a constant periodically nonuniform external magnetic field and considering that the time-oscillation of magnetization caused by propagation of a sound wave with attendant magnetoelastic interaction is describable by the Landau-Lifshits

equations, calculations are simplified by considering a plate and a film of thicknesses much smaller than the space period of magnetic nonhomogeneity and assuming a negligible space-oscillation of magnetization. Calculations by the method of singular perturbations, with collocation at the interlayer boundaries, yield the sought coupling and conversion coefficients. Numerical results for 100-300  $\mu\text{m}$  thick  $\text{Y}_3\text{Fe}_5\text{O}_{12}$  plates and for 5-20  $\mu\text{m}$  thick  $\text{Y}_3\text{Fe}_5\text{O}_{12}$  films on 1000  $\mu\text{m}$  thick  $\text{Gd}_3\text{Ga}_5\text{O}_{12}$  substrates indicate the feasibility of 100% conversion within a traveling distance of approximately 1 cm at frequencies still below but approaching the 1 GHz frequency of magnetoelastic resonance. Figures 3; references 11: 8 Russian, 3 Western.

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#### GENERATION OF SURFACE ACOUSTIC WAVES BY DEFORMATION AND BY THERMAL MECHANISM UPON OPTICAL TREATMENT OF SILICON

Moscow AKUSTICHESKIY ZHURNAL in Russian Vol 32, No 4, Jul-Aug 86 (manuscript received 23 Jan 86) pp 562-564

[Article by S.M. Avanesyan, V.E. Gusev, B.V. Zhdanov, V.I. Kuznetsov, and S.A. Telenkov, Moscow State University imeni M.V. Lomonosov]

[Abstract] For the first time surface acoustic waves were recorded during experimental photogeneration of an electron-hole plasma in silicon, this process being accompanied by deformation of the crystal lattice. A cylindrical silicon crystal with a radius  $R \approx 1.5$  cm and  $H \approx 1$  cm high, with (111) planes as bases, had a flat ground on one side for lateral mounting of a piezoelectric transducer. This transducer, with a resonance frequency of 18.2 MHz, recorded the vertical component of the SAW vibration velocity, after a light beam had been focused on a narrow strip of the upper base (length  $L$  and width  $W$  of strip being such that  $L^2/W \gg R$ ). Light was coming from a YAG:Nd<sup>3+</sup> laser in pulses of  $\tau \approx 20$  ns duration, of either fundamental 1.06  $\mu\text{m}$  or second-harmonic 0.53  $\mu\text{m}$  wavelength. The oscillograms reveal a strong surface acoustic wave after two weak volume acoustic waves, a longitudinal one and a transverse one. Switching the wavelength of light caused a polarity reversal of the surface acoustic wave, evidently owing to a change of the dominant excitation mechanism. A theoretical analysis of relations which describe electron-hole processes including diffusion and Auger recombination, both limiting the buildup of concentration of excess charge carriers, indicates that surface acoustic waves are generated by the thermal mechanism upon absorption of 0.53  $\mu\text{m}$  light and by mechanical deformation upon absorption of 1.06  $\mu\text{m}$  light in small energy doses. Figures 3; references 5: 4 Russian, 1 Western.

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## SMALL-APERTURE CONVERTERS OF SURFACE ACOUSTIC WAVES

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 31, No 6, Jun 86  
(manuscript received 5 Jan 85) pp 1249-1251

[Article by V.G. Shishkin, A.S. Bagdasaryan, A.M. Kmita, and Yu.M. Shchukin]

[Abstract] The construction was investigated of a converter of surface acoustic waves on a lithium niobate support. The basic sequence of sources concerned with the function  $\sin x/x$  with three side lobes are formed with an equal subsidiary sequence of sources making up 20% of the amplitude of the maximum source of the basic sequence. The width and location of the basic and subsidiary converters agreed so that the calculated frequency of the acoustic synchronism of the subsidiary sequence was twice as high as the basic. The topology of the converter obtained by this means acquired the form of a converter with split electrodes and individual weighting. The converter had a control frequency of 35 megahertz and a maximum overlap of the electrodes in the control part of the converter of  $5\lambda_0$  ( $\lambda_0$  = length of surface acoustic waves at the central frequency). It was found possible to reduce the influence of the diffraction effects, to enlarge the pass band, to improve the bandwidth ratio, and to increase the level of suppression of the minor lobes of the amplitude-frequency characteristics. It should be particularly noted that these results are obtained with a very small aperture of the opposing-pin converter, which is most important during development of filters based on surface acoustic waves. Figures 2; references 4: 3 Russian, 1 Western.

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TRANSPORTATION

UDC 62-83:621.313.17-12 + 621.318

CRITERIA OF EFFECTIVENESS OF LINEAR TRACTION DRIVE AND MAGNETIC SUSPENSION  
OF SURFACE TRANSPORT

Moscow ELEKTROTEKHNIKA in Russian No 4, Apr 86 (manuscript received  
25 Nov 85) pp 33-36

[Article by Yu. A. Bakhvalov, V.I. Bocharov, doctors of technical sciences,  
Ye. V. Kozachenko, Yu. V. Kuprianov, and V.M. Pavlyukov, candidates of  
technical sciences]

[Abstract] The necessity is shown for development of new forms of transport systems, in particular electrified surface transport with magnetic suspension of the underframe of rolling stock and a linear traction drive based on linear electric motors of various types. Because of the overall tendency to increase the speed of movement considerably and to decrease significantly the effect on the environment, as compared with traditional wheeled transport, the range of possible fields of application and technical solutions have made it urgent to develop criteria for alternative versions. Preliminary versions are considered of a system of linear traction drive and magnetic suspension of surface transport, the basic requirements placed on them, and the parameters for comparison of alternative versions. A criterion of effectiveness is proposed which makes it possible to conduct a sufficiently objective comparison of versions capable of competition with specified external and variable internal parameters and permitting optimization of the latter. Figures 1; references: 8 Russian.

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## SOME PROBLEMS OF THE ECONOMIC AND FUEL EFFICIENCY OF ELECTROMOBILES

Moscow ELEKTROTEKHNIKA in Russian No 4, Apr 86 (manuscript received 11 May 85) pp 39-41

[Article by Ye.I. Surin, candidate of technical sciences, and A.S. Midler, engineer]

[Abstract] The growth of the fleet of motor vehicles and the increase in consumption of liquid fuel, the supplies of which are limited, lead to a significant pollution of the atmospheres of cities by exhaust gases. Consequently, considerable attention is now given to the creation of electromobiles (E) which might be able to take over some forms of urban transportation - domestic services, delivery of the press, commercial transportation, servicing of the post, and official passenger transportation, where the daily distance covered is not large. Today from one charging of a lead-acid traction storage battery, an E has a distance endurance under urban conditions of approximately 50 km and can replace approximately 20% of the automobile transportation within the boundaries of a town. Recently, in order to increase their range of application, E with a multiple powered unit were proposed, which together with certain economies of liquid fuel, made it possible to increase the distance endurance to 200 km and more. In 1983 a department of the All-Union Scientific-Research Institute for Electric Locomotive Building conducted an experimental investigation and calculation of the efficiency of E, including those with a multiple power unit. It was shown that with respect to the cost and consumption of prime fuel, E at present are inferior to automobiles. However, a number of measures are indicated which will make it possible at present and in the immediate future to attain and exceed the characteristics of automobiles.

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