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USSR REPORT

ELECTRONICS AND ELECTRICAL ENGINEERING

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ADAPTIVE SIGNAL PROCESSING IN PRESENCE OF STEADY-STATE INTERFERENCE

Moscow RADIOTEKHNIKA in Russian No 10, Oct 86 pp 65-66

[Article by V.M. Koshevoy]

[Abstract] This brief summary of a manuscript of 15 pages, 2 figures and 16 references (deposited under No. 852-sv in the Informsvyaz Center for Scientific and Technical Information and Propaganda) describes the construction of efficient algorithms for recurrence relations that define a filter optimal in terms of a maximum signal to interference ratio. In contrast to known algorithms, these are applicable to estimates of matrices that take a steady-state interference structure into account; such estimates of the correlation matrices reduce the teaching sample volume (increase the speed) of adaptive processing algorithms. The recurrence algorithms are used to generate a composite filter for optimal processing of a signal that is a function of the doppler phase shift of the anticipated signal or phase change related to the direction of arrival of the expected signal in the case of spatial filtration. The filter can process signals of different levels, since changing over to new signals does not require restructuring the filter as a whole, butonly the addition or subtraction of a certain number of filter sections. Another important property of the filter is that the processing at the output of one bus is optimal in terms of a minimum mean square error, and at another bus, is optimal in terms of the maximum signal/interference ratio. The paper also analyzes a suboptimal variant of a composite filter using only an estimate of the correlation factor at the output of each filter section and examines its efficiency. Figures 1.

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EPSILON ENTROPY OF FLIGHT TRAJECTORY DATA

Moscow RADIOTEKHNIKA in Russian No 10, Oct 86 (manuscript received after revision 14 Apr 86) pp 51-54

[Article by A.I. Velichkin and S.N. Gerashchenko]

[Abstract] When aircraft spatial position data are transmitted via a digital communications channel, there is an unavoidable error manifest in the difference between the true and recovered trajectories, because of the time digitization and coordinate quantization of the true trajectory in the transmission process. The mean square error of trajectory data transmission is a function of the transmission rate and the volume of the region within which the flight path is monitored. This paper determines the minimum possible data transmission speed as a function of the mean square error in the reproduction of the flight path and the size of the observed space. Kolmogorov's epsilon entropy theory is applied by substituting an equivalent RLC filter through which white noise is passed for the trajectory message. The resulting analytical expressions are solved numerically to generate a graph of the mean square error in the data transmission as a function of the transmission rate in a system using pulse code modulation. If the mean square error is specified as $(0.2 \text{ km})^2$ and the observed area is $(10 \text{ km})^2$, the transmission rate for a light aircraft if greater than 3.8 bits/s. An ideal communications system would generate a much lower error than the PCM system, given the same data transmission speed, which is evidence of the benefit of further work on improving flight path data transmission systems. Figures 3; references: 4 Russian.

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TRANSFER OF GAS ION ENERGY AND IMPULSE TO ELECTRICALLY CONDUCTING SURFACE PARTIALLY COATED WITH THIN DIELECTRIC LAYER

Novosibirsk ZHURNAL PRIKLADNOY MEKHANIKI I TEKHNICHESKOY FIZIKI in Russian
No 4, Jul-Aug 86 (manuscript received 5 Mar 85) pp 8-16

[Article by V.A. Shuvalov, Dnepropetrovsk]

[Abstract] The force exerted on a surface by a partially ionized, low density gas flow, in the case when the surface acquires a "floating" potential (the negative equilibrium potential due to the plasma flow), is comprised of the bombardment force of the electrons, ions, slow and fast neutral particles arising from the charging of the ions in the residual gas, metastable particles, etc. This paper is an experimental study of the influence of these factors that characterize the interaction of such a gas with the exposed surface on the energy and impulse accomodation factors of gas ions with atomic weights of from 4 to 131. Helium, Ne, N, O, Ar, Kr and Xe gases of the highest purity were used to produce an accelerated ion flow at 10^{16} to 10^{17} $cm^{-2} \cdot s^{-1}$, fed into a test chamber where the residual gas pressure was $4 \cdot 10^{-5}$ Pa. The target exposed to the flow was circular disk 36 mm in diameter, about 0.35 mm thick; the working face of the target was an aluminized polymer film having a conducting surface coated with a dielectric mesh (glass fabric) having a transparency ratio of about 0.12 and a thickness of 0.09 mm. The target was mounted on a compensation type microbalance; the range of measurable forces on the arm about 450 mm long was $5 \cdot 10^{-3}$ to 250 dynes. The accomodation factors of the normal and tangential impulses of the particles are determined as a function of the ion energies, attack angle of the disk in the flow and the molecular weight of the particles. The overall error in the worst case determination of any of these parameters does not exceed ±6%. Figures 5; references 24: 23 Russian, 1 Western (in Russian translation).

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DIGITAL ROW AND COLUMN PHASING OF ANTENNA ARRAYS

Moscow RADIOTEKHNIKA in Russian No 10, Oct 86 (manuscript received after revision 20 May 86) pp 70-72

[Article by A.G. Antipin, I.M. Antoshkova and A.F. Puzankov]

[Abstract] The control algorithms for the digital phase shifters in phased antenna arrays are usually row and column control algorithms. This paper analyzes two such algorithms: 1) A simple configuration in which two phase shifter are sequentially inserted in the circuit of each array element, with one of them connected to the row control and the other to the column control; 2) A modified control algorithm, in which the exact values of the row and column phases are quantized prior to being written into the control elements. Expressions are derived for the directional gain in these two cases; with the latter modified algorithm, reducing the quantization level brings the directional gain as close as desired to the directional gain with digital element by element phasing. Directional gain losses are curtailed by increasing the number of phase write cycles, which increases in proportion to the product of the quantization step times the number of discrete positions of the phase shifter. The calculated directional gain decrease and the empirical average gain reduction are plotted as a function of the digital phasing steps and the quantization levels. The analytical estimate agrees with the results of a numerical experiment (for a square array of 50 x 50 elements with a half-wavelength spacing between them). The discrepancy between experiment and calculation for more than two quantization steps is less than 1%. Figures 1; references: 5 Russian.

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SPATIAL ISOLATION BETWEEN ANTENNAS ON LARGE BODIES

Moscow RADIOTEKHNIKA in Russian No 10, Oct 86 (manuscript received after revision 29 Apr 86) pp 77-79

[Article by K.K. Belostotskaya, M.A. Vasilyev, and V.M. Legkov]

[Abstract] The installation of antennas for different systems on large (greater than the wavelength) objects such as satellites and aircraft requires an electromagnetic compatibility analysis, in turn requiring the calculation of the spatial isolation between the antennas. This paper analyzes the isolation between slot antennas on the surface of a model body consisting of a circular cylinder and plate attached to it (representing the wing and fuselage of an aircraft), with one antenna on the cylinder and the other on the plate. The antennas are slightly directional and located in the far field relative to the edges of the body and each other. Singal power attenuation is found through the application of geometric diffraction theory and the resulting analytical expression is checked with an experiment in an anechoic chamber using collinear half-wave slots in a physical model. The measurements were made at a wavelength of 2.5 cm with an error of ±1.5 dB on a cylinder (radius = 31 cm) with an attached 31 x 31 cm attached plate. The proposed procedure is accurate enough for engineering practice (15 to 20% error). The most effective means of obtaining the requisite spatial isolation is the proper selection of the mutual positioning and orientation of the antennas. Figures 2; references 3: 2 Russian, 1 Western.

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MEASUREMENTS OF ATMOSPHERIC EMISSION DISTRIBUTION AT WAVELENGTHS OF 2.2 AND 3.3 MILLIMETERS DURING SNOWFALLS

Moscow RADIOTEKHNIKA in Russian No 10, Oct 86 (manuscript received 22 Apr 86) pp 79-81

[Article by I.V. Kuznetsov]

[Abstract] In order to obtain experimental data on the natural atmospheric radiation during snowfalls to improve the theory of millimeter radiation transport in hydrometeors, such emissions were measured with a dual band radiometer with a sensitivity of 0.2 to 0.3 K at 3.3 mm and 0.4 to 0.5 K at 2.2 mm. The radiometers were calibrated against the no-snowfall emissions. At elevation angles of more than about 3°, snow distorts the natural emission, increasing the antenna temperature as a function of the elevation angle and reduces this temperature at elevation angles of less than 3°. The

qualitative nature of the curves of the change in the antenna temperature plotted as a function of the elevation angle do not change from snowfall to snowfall and the antenna temperature differences are practically always greater at 2.2 mm than at 3.3 mm. The quantitative difference in the values of the antenna temperature change as a function of the elevation angle shows a dependence of the atmospheric emission distribution on the physical parameters of a snowfall. This dependence can be employed in studies of hydrometeors by remote sensing when solving a radiation transport problem for a snowy atmosphere. Figures 2; references 6: 3 Russian, 3 Western.

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CSO: 1860/51

UDC 550.35

MULTIPLE REFLECTION OF WAVES FROM UNEVEN SURFACE

Moscow RADIOTEKHNIKA in Russian No 10, Oct 86 pp 81-82

[Article by A.I. Kozlov and Yu.K. Shestopalov]

[Abstract] The intensity of different multiple reflection components in the scattering of both acoustic and electromagnetic waves by a surface with large inhomogeneities is calculated using an aggregate of uneven places described by a deterministic function with distributed parameters described by the probability density that is known for some unknown parameter vector to be determined and the geometry of the irregularities. These uneven places are modeled by circles tangent to each other in a two-dimensional formulation. A cumbersome general integral expression is derived for the intensity of a signal reflected n-times from such a surface, taking into account the probabilistic parameters of the surface and the probability of the shading of surface points. The analysis assumes a locally smooth surface where mirror reflection occurs and the procedure is extrapolated to the case where the scattering pattern of each elementary area is known, though this substantially increases the requisite computer time. No numerical examples or applications are noted. This paper is a brief summary of a manuscript of 11 pages, 1 figure and 2 references, deposited as No. 835-sv at the Informsvyaz Center for Scientific and Technical Information and Propaganda.

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SIGNAL CORRELATION IN ANTENNAS WITH DIFFERENT APERTURES

Moscow RADIOTEKHNIKA in Russian No 10, Oct 86 (manuscript received after revision 5 May 86) pp 82-84

[Article by V.B. Fortes]

[Abstract] In certain communciations and radar applications (e.g. background radiation and sidelobe compensation systems) signals are compared that are taken from the output of antennas whose phase centers and electrical axes are the same, but which have considerable different aperture sizes. The degree of signal decorrelation in such systems is estimated using the example of linear antennas; the random current distribution in the aperture of such antennas is due either to the imprecision in the fabrication of the antennas or random distortions in the incident wave field. This paper derives expressions for the correlation function of the signal fluctuations in these antennas, assuming uniform gaussian fluctuations. The decorrelation of the signals due to the difference in the effective apertures can be quite significant. In the case of two-dimensional antennas, given a small constant signal component in the incident wave field, the correlation factor of the signal envelopes at the antenna outputs varies as the fourth power of the antenna radii. In background interference compensation systems, it is expedient to use such "dimensional" separation of the antennas, while spatial diversity is best for communications systems. This analysis makes it possible to estimate the effectiveness of "dimensional" diversity antennas taking into account the actual degree of statistical signal correlation in the channels. Figures 2; references: 5 Russian.

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CSO: 1860/51

UDC 535+534.222+539.196

INFLUENCE OF MOLECULAR RADIATION ABSORPTION KINETICS ON PROPAGATION OF PULSE AT WAVELENGTH OF 10.6 MICROMETERS IN ATMOSPHERE

Novosibirsk ZHURNAL PRIKLADNOY MEKHANIKI I TEKHNICHESKOY FIZIKI in Russian No 4, Jul-Aug 86 (manuscript received 30 May 85) pp 3-8

[Article by V.V. Netesov, Saransk]

[Abstract] A CO_2 laser beam at 10.6 micrometers propagates in a standard atmosphere free of aerosols and dust along a vertical path up to 20 km above sea level. The collimated gaussian beam experiences resonant absorption by the atmospheric CO_2. Beam attenuation due to absorption is significant, since the spectral transmittance of atmospheric CO_2 at the initial point in time is 0.6624 and that of the water vapor at 100% relative humidity is

0.828. The square wave pulse width is governed by the onset of beam defocusing in the output cross-section and ranges from 0.1 to 2 ms for practical beam parameters. The impact of kinetic cooling and optical transillumination of the propagation medium on the changes in the beam shape is analyzed numerically using a kinetic model for the molecular absorption and thermalization in the $CO_2-N_2-O_2-H_2O$ mixture for various values of beam intensity and atmospheric humidity. The primary mechanism governing the effect of the beam on itself is nonlinear rerefraction, with the beam initially being focused, followed by rapid defocusing. Increasing the beam power produces fast resonant transillumination of the propagating medium followed by a gently sloping power decline curve corresponding to beam propagation in a medium with a slightly perturbed density. Even with a comparatively low beam intensity, the predominating self-affecting mechanism of the beam in the atmosphere is the nonlinear refraction due to kinetic cooling. Nonlinear saturation of the CO_2 absorptance plays a greater part with increasing beam intensity. Water vapor increases the focusing and delays the onset of defocusing at low beam intensities. The author is grateful to V.A. Levin and A.M. Starik for their useful discussions and interest in the work. Figures 2; references 12: 8 Russian, 2 Western (in Russian translation).

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METAL OXIDE SEMICONDUCTOR FIELD EFFECT TRANSISTORS

Moscow RADIO in Russian No 10, Oct 86 p 17

[Article by R. Malinin, Moscow]

[Abstract] This brief discussion of metal oxide semiconductor field effect transistors available to Soviet radio amateurs focuses on depletion-mode and enhancement-mode FET's. The elementary text is supplemented with diagrams of the semiconductor structure, circuit symbols for n- and p-channel MOSFETs and cutaway drawings of a small signal and high power FET showing the packaging and heat sink. The following Soviet transistors are mentioned: KP305, KP313 n-channel depletion mode FET's; KP306, KP350 dual gate, enhancement mode MOSFET's as well as the p-channel KP901 and KP904 depletion-mode plus the n-channel KP301 and KP304 enhancement mode devices. Simple static discharge protection measures when working with such FET's are also noted. Figures 1.

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DIGITAL FREQUENCY METER FOR MODERN SHORTWAVE TRANCEIVER

Moscow RADIO in Russian No 10, Oct 86 pp 25-30

[Article by V. Drozdov, Amateur Callsign RA3AO, Moscow]

[Abstract] Complete construction details (including printed circuit board patterns) are given for a frequency meter to be incorporated in an amateur radio transceiver covering the 160 m through 10 m amateur bands. The meter uses a 1 MHz master oscillator, seven-segment neon numeric display tubes and a variety of IC's from the K555, K561 and K514 families. The complete circuit schematic is shown and supplemented with diagrams showing the waveforms of the timing pulses at the important IC pins. In order for the brightness of all of the display digits to be the same, the filaments are powered from a separate transformer winding and a small positive DC voltage of 2 to 4 V is applied to this winding to prevent stray illumination of inactive segments. The five last decades of the main counter use an

unconventional counting configuration designed around K561IYe11 binary counters using feedback, due to the scarcity of K561IYe14 IC's. Modifications are discussed for using a 1,024 MHz master oscillator instead of the 1 MHz crystal if it is desired that frequencies that are multiples of 1 MHz be kept clear. No actual performance specifications for the meter in a transceiver are given, though adequate alignment information appears to be given. Figures 4; references: 7 Russian.

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NOISE SUPPRESSION COMPANDER DESIGNED AROUND DYNAMIC FILTER

Moscow RADIO in Russian No 10, Oct 86 pp 36-38

[Article by N. Sukhov, Kiev]

[Abstract] This paper concludes the description of a homebrew noise reducing compander (Part 1: RADIO, No 9, 1986) used to improve the dynamic recording and playback range as well as the noise reduction of tape recorders. An operational amplifier is used as a controlled second order low pass filter with a minimum cutoff frequency of about 1.6 kHz, which is employed when making tape recordings on machines equipped with the Mayak noise reduction filter. The frequency response curves of the compander are plotted between 20 Hz and 20 kHz. In one application using a cassette recorder, the actual noise reduction was 8 to 9.5 dB at 9.53 cm/s (tape transport speed) and 4.5 to 5 dB at 19.05 cm/s. Recommendations are given for circuit alignment to Dolby standards as well as when using particular Soviet standard test tapes. The compander provides as much as a 22 dB gain or rolloff at 20 kHz relative to 1 kHz. The article also provides a template for making the printed circuit board and shows the component mounting plus additional jumpers. Figures 5; references: 2 Russian.

8225/9835
CSO: 1860/52

TREMOLO ACCESSORY FOR ELECTRONIC MUSICAL INSTRUMENT SPECIAL EFFECTS CIRCUIT

Moscow RADIO in Russian No 10, Oct 86 p 39

[Article by V. Shtuchkin, Shyaulyay, Lithuanian SSR]

[Abstract] A simple circuit using a single OEP-13 resistive opto-isolator and a DA1 operational amplifier can produce 0 to 100% amplitude modulation of a 20 to 500 mV musical input signal from an instrument. The entire circuit fits on a single circuit board and this brief article also provides the template for the printed circuit. The input impedance is about 56 kohm. The device again is adjustable from about -10 dB (attenuator) and +12 dB. Figures 2.

8225/9835
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TEST INSTRUMENTS FOR RADIO AMATEURS

Moscow RADIO in Russian No 10, Oct 86 pp 40-41

[Article by R. Lentochnikov, Moscow]

[Abstract] Soviet radio amateurs have the following test instruments available through the retail trade network of the USSR Ministry of Instrument Making, Automation and Control Systems: 14 volt-ohmmeters with input impedances of from 0.7 to 83 kohm/v, dimensions of 135x85x45 mm to 290x200x135 mm and weighing from 0.35 kg to 3.5 kg; student oscilloscopes (N3013 and N3017), with a frequency response of DC to 10^4 or 10^5 Hz at 3 dB and 4.6 dB down, respectively; amateur oscilloscopes (N313, N3015, N3018) with a frequency response of from DC to 10^6 and to 10^7 Hz at 1.6 and 3 dB down, with an input sensitivity of 5 mV and an input impedance of 500 kohm with screen sizes from 24x40 to 30x40 mm. Specifications are also listed for two signal generators (L30 and L31) with triangular, sine and square wave outputs with both amplitude and frequency modulation. This essential tabular summary of instrument specifications also notes the class of precision, size, weight and power consumption of this equipment along with its general environmental requirements. Tables 2.

8225/9835
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3USTsT TELEVISION RECEIVERS

Moscow RADIO in Russian No 10, Oct 86 pp 42-44

[Article by G. Borkov, Moscow]

[Abstract] The new standardized 3USTsT Console color TV sets are being manufactured with screen (diagonal) dimensions of 51 and 61 cm. The new Ts-280 and Ts380 sets use 61LK5Ts and 51LK2Ts picture tubes, though the former are in short supply and the plants are continuing to make the 3USTsT sets with the old Ts-275 designation using the 61LK4Ts tubes. This paper provides a block diagram of the new color sets and summarizes their specifications (for the 61 cm and 51 cm versions, respectively): picture size of 404 x 303 mm and 482 x 362 mm; sensitivity of 55 microvolts; maximum brightness of no less than 200 cd/m^2 and 160 cd/m^2; horizontal line resolution at the center of the screen of no less than 450 and 500 lines; audio response of 100 to 10,000 Hz and 80 to 12,500 Hz; power consumption of 75 and 80 W; and weights of no more than 27 and 39 kg. The IC's are from the K174 family. Various design innovations are also noted. Tables 1; figures 1.

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CSO: 1860/52

INFRARED REMOTE CONTROL SYSTEM TRANSMITTER

Moscow RADIO in Russian No 10, Oct 86 pp 46-48

[Article by N. Medvedev, Vitebsk]

[Abstract] This article is the first of two describing a remote control transmitter for TV sets that generates an IR beam and can be used with the UPIMTsT-61/51, 4UPITsT-61/51, 3 USTsT-61/51, PITsT-61/51 and other sets. It provides for switching 6 channels, adjusting the brightness, contrast and color as well as the audio volume and can mute the audio and shut the set off. The circuit schematic is supplemented with oscilloscope traces of the waveforms at key points in the circuit. The device is powered by a 9 V battery and has a range of up to 6 m with the 3 IR LED's (maximum pulsed current of 3 A) with a control angle of no less than 60°. Drawings show the construction of the hand-held transmitter; a printed circuit board pattern is also provided. The transmitter contains 4 IC's and 9 transistors. Figures 6.

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SCHEMATIZATION OF EQUIVALENT MULTIDIMENSIONAL GENERATORS ACCORDING TO GAUSS AND KRAUT PROCEDURES IN CIRCUIT DIAKOPTICS

Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA
in Russian No 7, Jul 86 (manuscript received, after revision 21 Feb 86)
pp 28-34

[Article by Mansur Akmelovich Shakirov, doctor of technical sciences, professor, and Valeriy Petrovich Bulavochkin, graduate student, Leningrad Polytechnic Institute]

[Abstract] Methods of diakoptics are used for schematization of y-parameter circuits representing equivalent multidimensional current generators. This is done by partitioning a circuit into subcircuits and boundary branches, formulating branch equations for isolated subcircuits, forming equivalent multidimensional current generators by transformation of transfers of controlling connections, these transformations being adequate for application of Gauss exclusion procedures, then calculating the parameters of the unified circuit, and calculating the voltages across branches of the current generators as well as those across internal branches. The algorithm has been constructed for programming on a computer. A typical example is shown to demonstrate the validity of extending the general principle, namely the theorem about an equivalent multidimensional electric generator, according to the classical approach proposed by G. Kron. Figures 4; tables 1; references 9: 6 Russian, 3 Western (1 in Russian translation).

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CSO: 1860/29

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PROCEDURE FOR CALCULATING NUMBER OF CHANNELS IN ASYNCHRONOUS PULSED RADIOTELEMETRY SYSTEMS FOR MOVING OBJECTS

Tashkent IZVESTIYA AKADEMII NAUK UZBEKSKOY SSR: TEKHNICHESKIYE NAUKI in Russian No 3, May-Jun 86 (manuscript received 5 Dec 85) pp 9-12

[Article by R.L. Pulatov, Uzbek Scientific Production Association Kibernetika, UzSSR Academy of Sciences]

[Abstract] Telemetry signals from moving objects have a large dynamic range and the signal equalization difficulties make the use of frequency division multiplexing or waveform separation of multichannel data for the individual parameters vulnerable to crosstalk in addition to the poor power utilization efficiency for the transmitter in the object. Time division multiplexing is best, where the information block from an individual object consists of a synchronization group followed by a number of data channels for the particular parameters. This paper mathematically analyzes such pulsed radiotelemetry systems for the case for a large number of simultaneously monitored moving objects. Pseudorandom signals (which have good aperiodic autocorrelation functions) are used for the synchronization and the sync system employs a cross correlating receiver that estimates the mutual position of the signals based on a maximum likelihood criterion. The optimal value of the sync signal transmission time becomes more commensurate with the duration of the total communications session as the length of the session decreases. Synchronization system design must be based on the equations given here that relate signal transmission time to such system parameters as pulse width, spectral noise density, sync signal spectrum width, etc. The number of channels must also be calculated for the optimal sync system parameters. No design examples are cited. Figures 2; references 5: 4 Russian, 1 Western (in Russian translation).

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BRANCHING OF VLT-24P AND K-24P TRANSMISSION SYSTEM DISTRIBUTING LINES FROM UNATTENDED AMPLIFIER POINTS

Moscow VESTNIK SVYAZI in Russian No 10, Oct 86 pp 25-27

[Article by A.M. Gerasimov and O.G. Gedovius, senior engineers, Central Scientific Research Institute of Communications, and V.N. Parkhomenko, deputy laboratory chief]

[Abstract] The VLT-24P and K-24P transmission systems allow a line to be branched from any unattended amplifier point. The maximum length of branches from such a point can reach 90-95 km for the VLT-24P, 120-125 km for the K-24P or, if the branching occurs at the center amplifier point, 186-246 km. The K-60P-4 or VK-60-2 transmission systems, manufactured in Hungary, are used to produee the branches. Two 4-quad cables are used to wire the branches. Suggested circuits for this purpose are illustrated. Figures 3.

6508/9835
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INTRODUCTION OF ELECTRONIC AUTOMATION EQUIPMENT

Moscow VESTNIK SVYAZI in Russian No 10, Oct 86 pp 31-32

[Article by A.Ya. Volskiy, senior engineer, Moscow City Radio Relay Network, and V.I. Verba, shop chief]

[Abstract] Electronic automation was first introduced on a broad scale in the Moscow City Radio Relay Network in 1977-1978. Since that time, racks of equipment have been developed for control and monitoring of radio program transmission, as well as a large controllers panel, automatically controlled amplifiers and other devices. Major features of the design of transmitting and receiving devices used in the network are briefly outlined. Thought positive effects have been achieved by introduction of electronic automation equipment, they are said to be "difficult to express in absolute numbers." Work is now underway on introduction of a new automated system made practically entirely of integrated circuits and intended to provide new capabilities, eliminating many connecting lines, reducing labor consumption and decreasing the number of required intermediate amplifiers. Figures 2.

6508/9835
CSO: 1860/50

INTERFACE FOR ISKRA-226 PROGRAMMABLE ELECTRONIC CALCULATOR AND ARM-20 AUTOMATIC TESTING AND MEASUREMENT EQUIPMENT

Moscow VESTNIK SVYAZI in Russian No 10, Oct 86 pp 33-35

[Article by V.V. Andrianov, sneior engineer, Production-Technical Laboratory, Tashkent Long Distance Telephone Exchange]

[Abstract] The ARM-20 automatic long-distance telephone exchange is equipped with automatic testing and measurement equipment (ATME) which checks originating channels and trunk lines according to a stored program in several modes. The output information, however, must be manually sorted and analyzed. The Tashkent long distance telephone exchange has developed a system for automatic testing of the status of channels and trunk lines using a program for the Iskra-226, working through an interface with the ARM-20 ATME. Information from the ATME is automatically input to the Iskra-226 and output on punch tape. The interface can transmit 20 numbers from the Iskra-226 to the ATME, sufficient to transmit all necessary information to test a single channel or trunk line, and receive a block of 80 numbers, sufficient to receive the results of the test.

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EFFECTIVENESS OF SHORTWAVE BROADCAST TRANSMITTERS IMPROVED

Moscow VESTNIK SVYAZI in Russian No 10, Oct 86 pp 35-37

[Article by T.M. Timofeyev, chief technologist, State Union Planning Institute]

[Abstract] Modernization of common-grid radio broadcast transmitter amplifiers is underway in the Soviet Union on a broad scale. The use of output shortwave amplifiers with common grid allows easy parallel connection of the most powerful triodes, including the GU-23 (100 kW), GU-66 (100 kW), GK-5A (250 kW), GU-68 (250 kW) and GU-65 (500 kW). This method has been used to construct very powerful amplifiers with common grid operating at 120, 250, 500 and 1000 kW or more into the 13-15 m band. A table lists the types of tubes used in such devices. Another table notes the economic effect achieved by redesign of shortwave radio transmitters while simultaneously increasing their power by connecting 4 powerful triodes instead of 2 in the output stage. When the power of a transmitter is doubled, the cost per kW decreases by 22-47%, when it is quadrupled-by up to 70% per transmitter. The total savings achieved by such conversion of 10 transmitters is about 112.1 million rubles. The results which have been achieved by this method were previously simply impossible.

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ECONOMIC EFFECTIVENESS OF DEVELOPMENT OF LONG DISTANCE TELEPHONE COMMUNICATIONS

Moscow VESTNIK SVYAZI in Russian No 10, Oct 86 pp 38-39

[Article by M.A. Gorelik, doctor of economic sciences, Professor,
A.A. Shchurikov, candidate of economic sciences, senior scientific fellow,
Moscow Electrical Engineering Institute of Communications, and
B.S. Ivanova, lecturer, Department of Economics of Communications,
Kuybyshev Institute of Communications Electrical Engineering]

[Abstract] The Moscow Communications Institute has studied the economic effectiveness of the usage and development of long distance telephone communications in the area of production, in nonproduction areas and for the population in general. Methods have been developed for determining the economic effectiveness of this type of communications and establishment of standards for its use in the 12th Five-Year plan. Long distance telephone communications are reported to be a convenient method by which people can communicate with each other over long distances. The capital investments required to develop long distance telephone communications are compared to the economic effect achieved by saving of costs, increased industrial output and gross national product. Calculations show that the total time savings of all users during the twelfth five year plan will be at least 400 million hours, with 12.5% of this savings going to the public, 76.2% going to material production and 11.3% expended in the nonproductive sphere. Development of long distance telephone communications can increase the productivity of labor by 0.1%, decrease costs by 0.3% and achieve a total economic effect of 2.5 billion rubles during the 12 Five-Year plan. Each ruble invested will result in an increase in the gross national product of 1.7 rubles.

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ERGONOMIC SUPPORT OF THE WORK OF COMMUNICATIONS OPERATORS

Moscow VESTNIK SVYAZI in Russian No 10, Oct 86 pp 40-41

[Article by S.A. Ovchinnikov, candidate of technical sciences, lecturer,
Department of Industrial Safety, Leningrad Electronics Institute of
Communications, and N.D. Ptitsyna, engineer, Leningrad Electronics
Institute of Communications]

[Abstract] Operators utilize needle-type indicators, light and sound indicators, communications equipment, power supply equipment, measurement instruments and an operator's panel to service sectors of main trunk lines at attended amplification points. Operators eliminate emergencies, perform preventive maintenance, fill out documentation, conduct service telephone conversations, and monitor equipment. A structure of the activity of an operator is presented in the form of a connected graph and matrix of

transitions. Photographic studies of the working day of an operator were used to construct a diagram of the distribution of time among operations in percent. The data from these studies can be used to modernize working locations to make their work easier and facilitate an increase in the productivity of labor and the quality of work performed. The annual economic savings to be achieved from the use of these data is about 2000 rubles.

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ANALYSIS OF CYCLE SYNCHRONIZATION RECEIVER THAT CORRECTS DISTORTED SYNCHRONIZATION CHARACTERS

Moscow RADIOTEKHNIKA in Russian No 10, Oct 86 (manuscript received after revision 12 Apr 86) pp 15-17

[Article by L.N. Oganyan]

[Abstract] While error probabilities of no more than 10^{-4} to 10^{-5} in the line circuit of digital transmission systems present few difficulties for system synchronization, such communications links as satellite and microwave systems in which probabilities briefly greater than 10^{-3} are possible can be subject to degraded noise immunity and speed of the cycle synchronization. This paper quantitatively analyzes the significant parameters of an error correcting cycle synchronization signal receiver. A block diagram of the receiver is drawn and the sync character distortion probability is plotted as a function of the average error probability in the digital signal for various values of the number of distortion-corrected characters in a sync group having from 3 to 10 characters. The conditions producing false synchronization are ascertained for systems with and without error correcting receivers. A cycle synchronization receiver that takes into account the information on the correctness of the reception of the transmit rate matching control instructions protects against false dropouts in asynchronous digital transmission systems and reduces the storage parameter of the loss-of-sync detector, without changing the hold time of the system in synchronization. Analyzing the digital signal for the presence of false sync groups and instructions in a search mode also increases the cycle synchronization speed. Figures 3; references 5: 4 Russian, 1 Western.

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CSO: 1860/51

UDC 621.39

ADAPTIVE TRACKING METER

Moscow RADIOTEKHNIKA in Russian No 10, Oct 86 (manuscript received after revision 21 Apr 86) pp 17-20

[Article by A.I. Perov]

[Abstract] A tracking meter consisting of a discriminator and filter must adapt to unknown static parameters of the information process by adjusting its own parameters in the presence of white noise. The adaptation goal is written as a function describing the generation of parameters that minimize a quality indicator at each point in time. It is assumed that the signal to noise ratio is high enough for the tracking error to be small and fall within the linear portion of the discrimination characteristic. The case when the filter gain is the variable is analyzed and a block diagram is drawn of the resulting circuit. The method used produces adaptation algorithms that are governed only by the type of filter in the tracking meter loop and the set of variable parameters, and are independent of the type of meter (phase or frequency meter, etc.). The algorithms apply to an extensive class of electronic metering circuits. No sample calculations or equipment designs are cited. Figures 4; references 3: 2 Russian, 1 Western (in Russian translation).

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USE OF ADAPTIVE PRE-EMPHASIS TO ENHANCE LINEARITY OF MULTICHANNEL WIDEBAND AMPLIFIERS

Moscow RADIOTEKHNIKA in Russian No 10, Oct 86 (manuscript received after revision 14 Apr 86) pp 20-22

[Article by P.L. Asovich, V.A. Ivanov and A.A. Solovyev]

[Abstract] Since traditional nonlinearrdistortion reduction techniques (feedback) are difficult to use in wideband, high power amplifiers because of stability considerations, the best approach for multichannel transistorized power amps is the use of adaptive pre-emphasis. This paper describes the circuit design of a multichannel amplifier containing input isolation and output combining bridge multiport networks. The KOMPLAN applied program packages is used to determine the frequency response equalization effectiveness and nonlinear distortion as a function of the pre-emphasis. The optimal value of the pre-emphasis is found for each of the channels from the viewpoint of minimizing the overall nonlinear distortion power in the load. An experimental check of the method using a two-channel 100 watt amplifier for

0.1 MHz to 3 MHz shows good improvement in the third and fifth harmonic distortion reduction as well as the combination product when the appropriate pre-emphasis is employed. The technique substantially boosts the output signal linearity without reducing the output power of multichannel amplifiers. Graphs shows the distortion as a function of frequency before and after pre-emphasis. Figures 4; references: 3 Russian.

8225/9835
CSO: 1860/51

UDC 621.375.026

DISTORTION IN PUSH-PULL, LOW FREQUENCY, PULSE DURATION MODULATION AMPLIFIERS

Moscow RADIOTEKHNIKA in Russian No 10, Oct 86 (manuscript received after revision 26 Mar 86) pp 34-37

[Article by A.A. Aleksanyan, V.A. Aleksandrov and V.A. Galakhov]

[Abstract] Class BD push-pull pulse width modulation switching amplifiers can have rather low output signal distortion, when the existing distortion is due to the nonideal nature of the amplifier itself and the pulse width modulation. The considerably greater distortion observed in practice is due to the complex input impedance of their low pass filters. This paper analyzes the conditions governing the occurrence of distortion for the case of a single frequency input signal and an RL low pass filter at the output of the push-pull bridge-type switching power amplifier. It is shown that the distortion cannot be reduced by increasing the switching frequency, but rather by broadening the passband of the low pass filter or by choosing a type of low pass filter with a minimal phase-frequency response slope within the amplifier bandwidth. Expressions and graphs given here make it possible to determine the low pass filter parameters of such amplifiers from the specified nonlinear distortion and working bandwidth. Figures 4; references: 4 Russian.

8225/9835
CSO: 1860/51

UDC 621.396.61

ANALYSIS OF ANTENNA TUNERS FOR SHORTWAVE MARINE RADIO TRANSMITTERS

Moscow RADIOTEKHNIKA in Russian No 10, Oct 86 (manuscript received after revision 1 Apr 86) pp 38-40

[Article by K.A. Semenov and V.N. Ryabyshkin]

[Abstract] While existing shortwave marine transmitters rated at 1.5 kW having vacuum tube power amplifiers can tolerate standing wave ratios of down to 0.3, which can occur with the use of broadband antennas, transistorized amplifiers with hybrid power combining circuits require load matching so as to obtain a SWR within 0.8 to 0.9. This paper analytically determines the optimal parameters of an antenna tuner for such transmitters when driving telescoping whip antennas at frequencies of 1.6 to 26 MHz, using a 75-ohm feedline. The correct design can attain usable SWR's with a variable inductance of 0 to 82 microhenries. The antenna tuner configuration of this paper is to be used on antennas with comparatively low resistances, while the reactance must have the same sign throughout the frequency band employed. Figures 2; references: 3 Russian.

8225/9835
CSO: 1860/51

UDC 621.396.625:681.325.5-181.4

USE OF MICROPROCESSOR FOR PHASE-KEYED SIGNAL PROCESSING

Moscow RADIOTEKHNIKA in Russian No 10, Oct 86 (manuscript received after revision 25 Feb 86) pp 66-69

[Article by Ye.N. Mokhov]

[Abstract] While a fast specialized processor is used to execute the limited set of operations in the digital filtering of phase-keyed signals, the subsequent processing can be done with general purpose microprocessors when the requirements placed on processor speed are minimized. This paper describes a simple, optimal coherent demodulator in which a phase to code converter and general purpose microprocessor are employed. It is assumed that the circuit noise is gaussian and the simple signals are N-tuple phase-keyed. A block diagram shows the demodulator that uses a Fortran program written for the SM-4 computer; the simple program with 31 statements is also written out. The optimal keying code providing the best noise immunity is a Gray code and it is shown that the approximation errors with this technique are less than 10% in the worst case. The applications of the demodulator are somewhat limited by the switching frequency of the IC used in the phase to code converter. At a switching frequency of 10 MHz and with a word length of 6 bits, a 150 kHz phase to code converter can be

built when N = 1 or 2. When N is more than 2, the word length must increase, thus reducing the filter output frequency that can be processed. The algorithm was checked both by computer simulation and on a mock-up with a K589 microprocessor. The signal phase quantization is the only source of a small loss of noise immunity. Figures 2; references: 3 Russian.

8225/9835
CSO: 1860/51

UDC 621.391

DATA TRANSMISSION USING WALSH SIGNALS WITH RELATIVE MODULATION

Moscow RADIOTEKHNIKA in Russian No 10, Oct 86 pp 94-95

[Article by N.P. Petrovich and N.D. Voronov]

[Abstract] Multichannel modems using Walsh signals present one signal from the Walsh system of the modem to each channel; such data transmission is used in communications systems having a considerable bandwidth, since the system bandwidth must be increased as the number of channels increases. This paper analyzes general modulation and demodulation algorithms for Walsh signals with relative modulation as well as questions of the reception noise immunity for a Walsh pulse train with relative modulation. The modem algorithm consists in the partitioning of the n channels into n/3, n/4 or n/5 groups, offering the system of Walsh signals consisting 4-. 8- and 16-element signals to each group and then executing the corresonding inversions of the signals. The proposed method enables the use of Walsh signals for message transmission in narrow band communications systems, since the breakdown of the channels into groups permits the transmission of Walsh signals with a fixed number of elements as the number of channels increases. The error probability is computed for the case of Walsh signal recovery from the received Walsh pulse train with relative modulation by means of a method of simple Markov chains. The paper also describes the operation of an eight-channel modem and provides graphs of the error probability as a function of the signal to noise ratio. This paper is a summary of a manuscript containing 12 pages, 4 figures and 4 references, deposited as No. 932-sv in the Inforsvyaz Center for Scientific and Technical Information and Propaganda.

8225/9835
CSO: 1860/51

QUANTITATIVE EVALUATION OF IRREGULARITIES OF UIP-KS DEVICE

Moscow VESTNIK SVYAZI in Russian No 9, Sep 85 pp 23-24

[Article by A.S. Vorontsov, chief of laboratory, Central Scientific-Research Institute of Communications]

[Abstract] Recommendations are presented to technological engineering workers concerned with measurements of the irregularities of the characteristic impedance of coaxial pairs on the amplifying section of UIP-KS pulse devices. Their use makes it possible to avoid errors during an evaluation of the irregularities of coaxial cables and to provide a reduction of the amount of electrical measurement of cables developed for the BK-960 transmission system. Examples of the following are shown in figure form: 1) Evaluation of pulse characteristic of a type 2.6/9.4 mm coaxial pair by a UIP-KS device with connection of corrector at 2 and 3 kilometers; 2) Evaluation of pulse characteristics of a 1.2/4.6 mm coaxial pair by a UIP-KS device with a 4 kilometer long section; and 3) Pulse characteristics of 2.6/9.4 mm coaxial pair without use of correction. Figures 3.

6415/9835
CSO: 1860/38

SIMPLIFIED CALCULATION OF EFFICIENCY OF SUBDIVISION OF RURAL WIRE BROADCASTING

Moscow VESTNIK SVYAZI in Russian No 9, Sep 86 pp 25-26

[Article by I.A. Sikorskiy, chief of service, Sumskiy Industrial and Technical Communications Administration]

[Abstract] An experimental rayon system of wire broadcasting (RSPV) was constructed in the Shostkinskiy rayon of Symskaya oblast in 1984-1985. Before reorganization, all the broadcasting radio relay network of the rayon fed one radio relay installation (RTU) located in the Shostka rayon center. At present the central system of wire broadcasting (TsSPV) of Shostka and eight 3-program rural radio relay installations enter into the rayon system of wire broadcasting. As the result of the reorganization, the length of the main feeder lines was reduced to 95.5 kilometers, 3-program broadcasting entered into all populated points of the rayon, and a network of Kolkhoz-Sovkhoz broadcasting was created. The operation of the Shutinsk Regional Communication Center (RUS) with respect to subbranches of wire broadcasting is described. Figures 1.

6415/9835
CSO: 1860/38

CONTROL DESK OF A SORTING UNIT

Moscow VESTNIK SVYAZI in Russian No 9, Sep 86 pp 28-29

[Article by V.A. Novikov, senior engineer of Republic Center for Transportation of the Post (RCTP), Ministry of Communications, UkSSR]

[Abstract] In 1983 the engineering-technical staff of RCTP set up a control desk produced in accordance with the efficiency suggestions of the senior engineer of the unit, V.A. Novikov, in the SSP-K system for sorting parcels located at RCTP. The desk is described with the aid of two circuits and other sketches. The desk is convenient for operators, thanks to which their fatigue is reduced. The electricians and operators remark upon its compactness, the convenience of presentation and signalling, the high maintainability and reliability. The desk can be used in USP-K and KPSM installations. It does not contain scarce materials and components or those from special stocks. Figures 4.

6415/9835
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UDC 621.92:681.327

DETERMINATION OF GRINDING SPEED WHEN MACHINING COMPUTER MEMORY DISK BASE

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: MASHINOSTROYENIYE in Russian
No 8, Aug 86 (manuscript received 19 Feb 86) pp 116-120

[Article by A.I. Ovchinnikov, post-graduate student]

[Abstract] The process of grinding bases of magnetic disks (MD) was analyzed, in an attempt to find a single operation factor, that could be used for optimization of the process. Operation factors of the grinding process were conditionally divided into technological (thrust of the grinding wheel on the machined surface; characteristics of the grinding wheel, such as grain mesh of the abradant, bonding, hardness etc.) and kinematic (rotational speed of the grinding wheel; the outer and inner radii of the grinding wheel; the distance between centers of the grinding wheel and the work-piece; counter or relative direction of rotation of the grinding wheel and the work-piece). Unlike the majority of existing grinding processes, the speed of the memory disk was taken into consideration, because it is comparable to the rotational speed of the grinding wheel. Because grinding speed considerably changes over the contact area between the wheel and the work and is different at different contact points, it was desirable to choose a grinding speed that would most adequately represent the entire process of grinding a disk. For this purpose, an integral grinding speed parameter was introduced. It was defined as the quotient of the volume of the grinding speed profile over the contact area and the area of contact between the wheel and the work. Integral formulae for grinding speed profile were derived, both for counter and relative grinding; integration was performed on an Elektronika 100-25 computer using Simpson's method. The contact area was also calculated by integration based on the intersection diagram of two rings of specified dimensions. The epxression for the integral grinding speed includes all kinematic factors of the process. Therefore, it was sought to prove, that using this parameter, one could unambiguously describe the process of grinding MD. To test experimentally this assumption, various combinations of kinematic factors, that resulted in the same integral grinding speed, were calculated on a computer; and two combinations with extreme absolute values of contributing factors were chosen for integral speeds of 6 and 10 m/s. For these combinations, experiments in grinding MD were conducted with other technological operation factors remaining constant. F-test and Student's

t-test of experimental results proved the hypothesis that for the same integral grinding speed with different combinations of operation factors the results belonged to the same statistical sampling. However, the same tests of the average and maximum grinding speed did not confirm a similar assumption. Because the integral grinding speed parameter cannot be used in manufacturing environment, a reverse procedure was recommended: determine the values of kinematic factors that realize an optimum integral grinding speed. The proposed concept of integral grinding speed could be used in other cases of abrasive processing when the work-piece speed is comparable to the tool speed. Figures 3; references: 3 Russian.

12770/9835
CSO: 1860/19

UDC 631.3:621.39

SELECTING LSI MICROPROCESSOR SETS BASED ON MINIMAX CRITERION

Moscow RADIOTEKHNIKA in Russian No 10, Oct 86 (manuscript received after revision 3 Apr 86) pp 62-65

[Article by Yu.P. Kotov, P.P. Maltsev and V.V. Kharko]

[Abstract] The rapid development of bit-sliced LSI microprocessors has complicated the design of digital electronic systems, since there is a multitude of microprocessor components, the word lengths in such systems can be increased and the efficiency of any microprogramming is a function of several factors. This paper proposes a procedure for selecting the best LSI microprocessor sets for specific applications based on a minimax evaluation of the microprocessor parameters and allows the use of quality indicators differing both in number and size, while not requiring apriori knowledge of the nature of the change in the values of some indicators as a function of the others. The technique is applied to an evaluation of four Soviet LSI microprocessor families: K583, K584, K589 and K1804. The criteria used for the minimax analysis are the area required by the microprocessor on a circuit board, the maximum clock frequency, the microprocessor cycle time, the control memory size, the microinstruction word length and power consumption. Specifications for the I^2L and Schottky TTL microprocessor sets are summarized in a table. Agreement between qualitative and quantitative evaluations (the latter obtained with the proposed method) confirm the applicability of the formulas derived here to the selection of the best hardware. Figures 1; tables 1; references: 7 Russian.

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UDC 621.317

ELEKTRONIKA-60 MICROCOMPUTER SIGNAL SIMULATOR

Moscow RADIOTEKHNIKA in Russian No 10, Oct 86 (manuscript received after revision 31 Mar 86) pp 72-74

[Article by Yu.T. Krivoruchko, A.V. Perekhodov and B.V. Ponomarenko]

[Abstract] Microcomputer simulators are useful for debugging the peripheral interfaces developed for microprocessor systems based on the Elektronika-60 microcomputer, though existing simulators can debug only simple interfaces. This paper describes a simulator that emulates the parallel interface bus of the Elektronika-60 in order to debug complex controllers operating in all microcomputer modes (program exchange, interrupt and direct memory access modes). It simulates the signals for program accessing of the processor to the memory locations and the operation of the processor and memory elements when a peripheral directly accesses the memory; it also processes vector and nonvector interrupt requests. It provides for digital data input and has extensive capabilities for displaying input and output data in an octal code on a digital readout, LED display of the operating modes as well as the hardware for the connection of peripheral interfaces, oscilloscopes, etc. A block diagram of the simulator supplements the text detailing its operation. The simulator contains three circuit boards (without the regulated +5 V supply board) and is 500 x 250 x 160 mm. The microcomputer simulator has been used to develop sophisticated preprocessors for electronic equipment, has reduced their debugging time and made it possible to use less highly trained technicians. Figures 1; references: 2 Russian.

8225/9835
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SOME QUESTIONS OF PRODUCING A NEW GENERATION OF SUPER-SPEED AND VERY LARGE SCALE INTEGRATED CIRCUITS

Tbilisi SOOBSHCHENIYA AKADEMII NAUK GRUZINSKOY SSR in Russian Vol 123, No 2, Aug 86 (manuscript received 20 Sep 85) pp 361-364

[Article by M.Sh. Surguladze, Ye.P. Derbakova, I.P. Makarov, V.I. Nikishin, Yu.N. Subbotin, and G.I. Fursin, Institute of Cybernetic Problems, Institute of Cybernetic Problems, Academy of Sciences, USSR]

[Abstract] An increase of the speed of response of logic and memory elements of highly productive computing systems leads to the necessity for choosing appropriate semiconductor materials. In addition to such traditional materials as silicon, Type A_3B_5 components (gallium arsenide, indium phosphide, indium antimonide, and some others) are of considerable interest. At present maximum attention is given to gallium arsenide, on the basis of which it is

possible to produce superfast integrated circuits (SFIC) which possess better dynamic characteristics than silicon. However, in spite of the marked success in technology of gallium arsenide, silicon technology remains at present practically outside competition because of the very low cost and high adaptibility to manufacture. Silicon continues to have the best prospects for producing SFIC and very large-scale integrated circuits VLSIC. Devices with plasms coupling and their electric analogs are a prospective elementary base for producing VLSIC with a high information capacity. References 5: 1 Russian, 4 Western.

6415/9835
CSO: 1860/33

UDC 621.315.624:632.15

RESULTS OF TRIAL OPERATION OF POLYMER LINE INSULATORS WITH SILICONE RUBBER COATING

Moscow ELEKTRICHESKIYE STANTSII in Russian No 8, Aug 86 pp 49-52

[Article by I.Yu. Gutman, engineer, Ye.A. Solomonik, candidate of technical sciences, A.A. Semenov, Yu.N. Yashin, engineers, Scientific Research Institute for Direct Current, Novgorod Power Grids, Special Design Office of the Electric Network Insulation All-Union Production Association]

[Abstract] Type LK-70/110 polymer insulators (overall length of 1,399 mm outside diameter of 90 mm) were placed in trial service on the Novgorod power grids of the Leningrad Power Administration starting in June of 1982. About 2,000 LK type insulators are in service now in 12 power systems at voltages of 35 to 750 kV. This paper details the laboratory test data and field results from 110 kV line operation. The field data on silicone rubber coated polymer insulator strings in regions with category I, II or III atmospheric pollution (essentially low level pollution) indicates that such insulators can be recommended for regular service on such 110 kV lines. For power lines at 220 kV and higher, and regions of worse pollution than category III, the operational experience is insufficient for any recommendations. Details of a variety of laboratory tests are also given. Figures 2; references: 4 Russian.

8225/9835
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UDC 621.315.6.001.5

EVALUATION OF ELECTRIC STRENGTH OF GLASS-REINFORCED PLASTIC INSULATION OF HIGH-VOLTAGE PULSE UNITS

Minsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ENERGETIKA in Russian No 8, Aug 86 pp 37-40

[Article by S.N. Goryachkin, G.A. Filippov, candidates of technical sciences, assistant professors; S.V. Shilov, engineer, Ivanov Institute of Power Engineering imeni V.I. Lenin]

[Abstract] The problem is considered of the development of dependence on the number of influencing voltage pulses and the pulse amplitudes of the electric strength along the surface of specimens of materials subjected to test. Because composite polymeric materials, in particular glass-reinforced plastic, are the most promising from the point of view of their use as insulating and structural elements of high-voltage pulse units, the investigations were conducted on samples of sheet glass-reinforced plastic based on PN-1 unsaturated polyester resin, armored by chopped glass fiber. An investigation of the effect of the number of influencing pulses and the average voltage of the pulse electrical field on the discharge characteristics of the specimens of glass-reinforced plastic was conducted for weakly-nonuniform and widely-nonuniform fields. It was found that the repeated effect of the pulse voltage exerts a considerable influence on the discharge characteristics of glass-reinforced plastics in a weakly-nonuniform field. In a widely-nonuniform field, reduction of the discharge characteristics is not found. The discharge characteristics of glass-reinforced plastics are reduced, both by an increase of the voltage of the influencing pulse field and by an increase of the number of influencing pulses. In the case of a choice of the effective strength along the surface of the glass-reinforced plastic construction intended for operation and conditions of repeated effect of a pulse electric field, it is necessary to take into account the form of a field of real construction and the dynamics of a change of the discharge characteristics in the course of operations. Figures 3; references: 5 Russian.

6415/9835
CSO: 1860/25

UDC 621.382.71(088.8)

ALUMINUM COOLER FOR SEMICONDUCTOR POWER DEVICES

Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA in Russian No 7, Jul 86 (manuscript received, after completion, 23 Oct 84) pp 84-87

[Article by Anatoliy Ivanovich Isakeyev, candidate of technical sciences, assistant professor, and Aleksandr Vladimirovich Noskov, candidate of technical sciences, senior scientific associate, Leningrad Technological Institute of Refrigeration Industry, Igor Georgiyevich Kiselev, doctor of technical sciences, professor, Aleksandr Borisovich Buyanov, candidate of technical sciences, senior scientific associate, and Vladimir Vladimirovich Frolov, junior scientific associate, Leningrad Institute of Railroad Transportation Engineers]

[Abstract] A wickless or gravity heat pump acting as a closed-cylce thermosiphon for a two-phase stream has been found to be suitable for colling semiconductor power devices with ratings up to 1 kW and even higher. A universal cooler of this type, using a tube made of an aluminum alloy, has been developed for this application by the Leningrad Technological Institute of the Refrigeration Industry jointly with the Leningrad Institute of Railroad Transportation Engineers and the All-Union Scientific Research Institute of Electric Locomotives. It consists of an evaporator and a condenser whose cavities are connected thorugh a collector. The evaporator segment has holes drilled in the wall for tight pinning to the housing of the semiconductor device and has a cross-arm carrying insulators. The surface of the condenser segment is finned. After vacuumization, 39% of the entire inside volume is filled with an intermediate coolant fluid, which will boil in the evaporator and liquefy in the condenser for continuous closed-cycle heat transfer from the semiconductor device to the ambient cooling air stream. The cooler can be placed in a horizontal or vertical air stream. Its advantage in performance over that of a solid-metal heat sink depends on its shape and size as well as on the material of the solid heat sink. With distilled water as intermediate coolant, an advantage over solid-aluminum heat sinks OA-033 and OA-036 has been established experimentally. A major drawback of this heat pump is its in intricacy, causing technological problems and raising its costs. Figures 4; references: 1 Russian.

2415/9835
CSO: 1860/29

INDUSTRIAL ELECTRONICS AND CONTROL INSTRUMENTATION

UDC 658.512

IMPROVING QUALITY OF STANDARDIZATION IN SINGLE-ITEM AND SMALL-SCALE PRODUCTION

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: MASHINOSTROYENIYE in Russian
No 8, Aug 86 (manuscript received 10 Feb 86) pp 157-160

[Article by Yu.A. Abramov, candidate of economic sciences, assistant professor, R.V. Skomorokhov, candidate of technical sciences, lecturer and V.N. Klyuchko, engineer]

[Abstract] A new approach to setting time standards in unit and small-scale production was offered, in order to overcome difficulties caused by the wide product mix and non-repeatability of parts processing operations. A part was viewed as a topological product of elementary surfaces, directly related to primary structural elements of a manufacturing process. In the process of forming a surface, the operator implements concrete specification as to the precision, surface roughness, alignment, etc. Bounds of variation of geometric characteristics and specifications are finite, therefore shop industrial engineers can determine, within these bounds, the time required for processing elementary surfaces using such accurate time-setting methods as time-motion study and microelement analysis that are now only used in mass and large-scale production. For practical implementation of the proposed approach, software should be developed that would make it possible to derive operational time as a combination of time expenditures for machining elementary surfaces. It was proposed to solve the problem within the framework of image recognition theory. It has previously been determined that it was feasible to use a method involving groups of piecewise-linear models and a method based on reconstructing relationships from results of indirect experiments. Selection of a specific method for solving the problem was under study at the time of writing. The proposed method could become a basis for developing an automated system for setting time standards in individual and small-scale production. References: 5 Russian.

12770/9835
CSO: 1860/19

UDC 621.316.543.1

THYRISTOR CONTROLLERS FOR ACTUATING MOTOR

Tashkent IZVESTIYA AKADEMII NAUK UZBEKSKOY SSR: TEKHNICHESKIYE NAUKI in Russian No 3, May-Jun 86 (manuscript received 22 Jul 85) pp 74-79

[Article by A.F. Mumindzhanov and S.K. Ismatkhodzhayev, Institute of Power Engineering and Automation, UzSSR Academy of Sciences]

[Abstract] The constant velocity actuating mechanisms driven by a two-phase motor in modern automatic control systems must meet the pulse response requirements of State Standard GOST 7192-80. Present designs do not do this, because the actuating force is a function of the actuating element travel, thus influencing the drive motor negatively. This paper describes a simple thyristor controller for the run-up of such asynchronous motors. The controller regulates the r.p.m. of the actuating motor and control the starting torque. The application of the adduced formula for motor starting parameters is illustrated with experimental data on an MEO-630/25-0.25 constant velocity actuating mechanism. Oscilloscope traces of the control signal waveforms are shown along with the related circuit schematics. Figures 4; references: 5 Russian.

8225/9835
CSO: 1860/21

UDC 621.372:621.382.233.026

ANALYSIS OF SELF-EXCITED OSCILLATIONS IN THYRISTOR CIRCUIT

Moscow ELEKTRICHESTVO in Russian No 8, Aug 86 (manuscript received 10 Dec 85) pp 49-50

[Article by V.F. Samoseyko, candidate of technical sciences]

[Abstract] While thyristor power controllers are traditionally triggered by pulsed control circuits, it is possible to use self-excited oscillation of the thyristor power circuit itself as a means of power control. This paper analyzes the parameters governing the stability of such self-excited circuits as well as the conditions under which the thyristor does not turn on or off. The simple circuit used here shows the thyristor shunted across a series LC network with the thyristor gate tied to its anode through a variable resistor. A resistor is also inserted in series between the source voltage and the anode and feedback resistor connection point. The theoretical expressions for circuit behavior were checked experimentally with a KU202N thyristor using a load inductance of 0.22 Hy, load capacitances of 0.25 to 10.0 microfarads as well as a series resistance of 500 ohms with a supply voltage of 30 volts. Good agreement is noted between theory and experiment. Figures 5; references: 4 Russian.

8225/9835
CSO: 1860/18

UDC 62-83-52

DESIGNING DIGITAL-ANALOG SPEED CONTROL SYSTEMS FOR ELECTRIC DRIVES WITH FLEXIBLE COUPLINGS

Moscow ELEKTRICHESTVO in Russian No 8, Aug 86 (manuscript received 2 Jan 86) pp 58-59

[Article by V.M. Shestakov, candidate of technical sciences, Leningrad]

[Abstract] Automatic digital-analog speed control systems are widespread in the multiple motor electric drives used on continuous flow lines in paper making and other industries. This paper analyzes the control parameters for such systems with one, two and three control loops for flexibly coupled multimotor configurations having either a common (thyristor) control converter or individual converters. The speed of the sections in a system with a common converter is controlled by inputs to the string of motors, while in the case of individual converters, the armature voltage is controlled. When designing digital-analog speed control systems of this type, for which the analog and digital component parameters satisfy the relations spelled out here, it is expedient to employ continuous methods when the computational errors are limited to set values. The dynamic performance parameters of one-, two- and three-loop control systems are compared and it is shown that multiple control loop structures should be used for the flexibly coupled electric drives of continuous flow lines. The requirements formulated here can be met using a standard 16 bit microprocessor that services a specified set of sectional speed control systems for the flow line. Nomograms are given for the computation of the control precision. Figures 2; references: 5 Russian.

8225/9835
CSO: 1860/18

UDC 53.089.68:538.521

SPECIAL GOVERNMENT STANDARD FOR UNIT OF MAGNETIC INDUCTION IN 1-10 T RANGE

Moscow IZMERITELNAYA TEKHNIKA in Russian No 8, Aug 86 pp 3-4

[Article by Yu.I. Kazantsev and G.K. Yagoda]

[Abstract] A new Government Standard for unit magnetic induction within the range of strong magnetic fields officially replaces, since November 1985, the existing GOST 8.188-76. The Standard, built and kept at the All-Union Scientific Research Institute of Physicotechnical and Radiotechnical Measurements, is based on precise measurements in a stable uniform magnetic field of a superconducting solenoid, utilizing the principle of nuclear-magnetic resonance of protons in distilled water. The equipment of this Standard includes a teslameter, two superconducting solenoids SS-10 and SS-5, four control panels (one for control of the magnetic field, two for control of the cryostat containing the solenoids, one with the teslameter for control of the Standard operation), an Elektronika D3-28 microcomputer with display and printer, and auxiliary instruments such as temperature and vacuum monitors. The teslameter measured the magnetic induction by the nutation method of nuclear-magnetic resonance in running water, like the teslameter in the previous Standard, with two probes for measurement at room temperature and at cryogenic temperature respectively. Both solenoids are immersed in liquid helium. Solenoid SS-10 with the corrective winding on the inside generates a magnetic field of 9 T at 4.2 K or 9.9 T at 2.5 K (He vapor removed). Solenoid SS-5 with the corrective winding on the outside reproduces magnetic induction up to 5.5 T at 4.2 K. The solenoid constants are 0.0939 T/A (SS-10) and 0.0443 T/A (SS-5). The magnetic fields in these solenoids are uniform respectively within $1 \cdot 10^{-4}$ and $5 \cdot 10^{-6}$ over a volume 10 mm in diameter and 10 mm high. The panel for control of the magnetic field has a potentiometer with an oil-cooled resistance coil for precise current measurement and a stabilized power supply for both solenoids. The two solenoids were calibrated and tested for accuracy at temperatures 4.2 K, 77 K, and 293 K, each found to have a nonremovable residual systematic error not larger than $7 \cdot 10^{-6}\%$ at any of these temperatures. References: 7 Russian.

2415/9835
CSO: 1860/31

UDC 53.072.33:529.7:521.12

BEHAVIOR OF TIME SCALE IN VICINITY OF EARTH

Moscow IZMERITELNAYA TEKHNIKA in Russian No 8, Aug 86 pp 13-16

[Article by R.F. Polishchuk]

[Abstract] Considering that the trend in International Time and Frequency Service is toward use of fiber-optic cables for connecting the Standard Keeper to the transmitter antenna in the master station which sends time and frequency signals to user stations, the behavior of a time scale in the vicinity of the Earth is analyzed for accuracy. The error of a global astronomical time scale with a supplementary more precise local atomic scale or pulsar scale is calculated according to Einsteins's general theory of relativity and gravitational equation, taking into account propagation of signals above the Earth and with correction for nonuniform rotation of the Earth. On the basis of this analysis is envisioned replacement of the Earth, as reference frame, with driftless three or preferably six clusters of 3-4 satellites spinning in high 24-hour orbits so as to provide CW and CCW rotation in three orthogonal planes. References 8: 6 Russian, 2 Western.

2415/9835
CSO: 1860/31

UDC 621.382.2.085.34.089.6:389.14

REFERENCE SOURCE FOR CERTIFICATION OF LOW-LEVEL RADIATION RECEIVERS

Moscow IZMERITELNAYA TEKHNIKA in Russian No 8, Aug 86 pp 26-27

[Article by V.Ye. Belonogov, A.Kh. Zabrodskiy, L.S. Lovinskiy, and V.A. Frolov]

[Abstract] A reference radiation source has been developed for calibration and inspection of 10^{-7}-10^{-10} W devices operating with an either internal or external photoelectric effect. Such devices include photomultipliers, also photronic cells and photodiodes. The source comprises a set of 3L107 light-emitting diodes supplemented with special GaP green and GaAsP red light-emitting diodes. A narrow light beam of low-power radiation is shaped by a conical diaphragm with a 0.5 mm diameter at the exit in front of a light-emitting diode, while an FD-8K silicon photodiode characterized by high stability in time serves as receiver of all remaining radiation and thus also as feedback device. Emitter and receiver are located at conjugate points inside a spherical mirror, a pinhole in the latter passing only light for the beam-shaping optics. The electronic circuitry includes a power amplifier with two inputs for the reference signal and the error signal respectively. The feedback channel contains, in addition to the photoreceiver, an amplifier with gain control, a converter-averager, an error extractor, and

an error storage. Other components are a current-to-voltage converter, an analog-to-digital converter with counter, comparator, and controllable reference-voltage generator. The current-to-voltage converter is built on series 140 microcircuit chips with an MDM structure, the amplifier with gain control is built on a series 153 microcircuit chip. The source is furnished with periodic correction of null drift and with temperature control, the latter including a thermoelectric heater-cooler and a thermostat which maintains 20°C within ±0.03-0.05°C. Figures 3; references: 8 Russian.

2415/9835
CSO: 1860/31

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MEASURING OPTICAL CHARACTERISTICS OF FIBER OPTICS AND REQUIRED INSTRUMENTATION

Moscow IZMERITELNAYA TEKHNIKA in Russian No 8, Aug 86 pp 29-32

[Article by S.N. Khotyaintsev]

[Abstract] A Luch apparatus for nondestructive testing of fiber optics has been developed which satisfies accuracy and reliability requirements in industrial use. It combines simplicity with economy and it is adaptable to single-mode and multimode fiber optics used for optical cables or optical communication lines. It consists of three separate instruments. The Luch-A instrument measured the aperture characteristics of an optical fiber and the light intensity distribution in its far field under various conditions of excitation, using light sources with various radiation patterns, also its geometrical characteristics and refractivity profile. The Luch-P instrument measures the optical losses, a particularly intricate task, by the comparison method with a reference standard and two-point scattering. The Luch-D measures the dispersion by analysis of pulse widening in time. Components of the Luch-A include two light sources, namely an incandescent lamp with a short-focus objective and an LG-72-1 He-Ne laser (wavelength $\lambda = 0.63$ μm, power 2 mW), and a stationary photodetector scanning the far field moved across its aperture by a rotating mirror. Components of the Luch-P include an LG-72-1 He-Ne laser and a 32 DL 102 semiconductor injection laser (wavelength $\lambda = 0.86$ μm) with separate optics, and an FEU-28 photomultiplier-detector with a wide sensitivity spectrum ($\lambda_{max} = 1.1$ μm). Components of the Luch-D include a 32 DL 102 semiconductor injection laser and an LFD2 photodiode-detector, also a delay line and an S1-70 stroboscopic oscillograph. All three instruments have been certified by the Metrological Service. Some of the design concepts implemented here are applicable to other optical instruments as well. Figures 1; references 15: 7 Russian, 8 Western (1 in Russian translation).

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METROLOGICAL CHARACTERISTICS OF TWO-MODE CO_2-LASER

Moscow IZMERITELNAYA TEKHNIKA in Russian No 8, Aug 86 pp 28-29

[Article by V.N. Petrovskiy, A.N. Rurukin, and R.A. Shananin]

[Abstract] Two-mode lasers with controllable phase anisotropy generating two orthogonally polarized linear modes can operate with an almost 100% frequency modulation index and with adjustable frequency separation of modes. Such lasers are particularly suitable for measuring the amplitude-frequency characteristics of photodetectors, also for plasma diagnosis and for quantum frequency standards. Only two-mode He-Ne lasers being well known so far, it was deemed worthwhile to also consider a two-mode CO_2-laser. An experimental study of such a laser generating two orthogonally polarized longitudinal modes with smoothly variable frequency separation was therefore made, the hardware consisting of a d.c. discharge tube and a Fabry-Perot resonator. The discharge tube, made of BeO ceramic 550 mm long with an inside diameter of 5 mm, contained a $CO_2:N_2:He:Xe = 1:0.5:2:0.25$ gas mixture as active medium and was water cooled. The resonator cavity, 130 cm long, was formed by dielectric mirrors with a 2 m radius of curvature and a 0.99 reflection coefficient each. The nominal discharge current was 4 mA, but the gas pressure and composition could be varied by means of a vacuum suction pump. Two-mode lasing was attainable within the pressure range of 2-4 kPa. The frequency separation of modes was varied by means of two CdS wedges with phase anisotropy, while each mode was tuned by means of a piezoceramic stub holding one of the resonator mirrors. The Fabry-Perot interferometer, a thin GaAs plate, was used for extracting any one of four lasing vibrational-rotational transitions P(18), P(20), R(18), R(20) with an emission power of 5 mW each. Experiments with this laser have revealed that the frequency range of two-mode emission increases with increasing pressure of the active medium and with increasing net gain over losses, that the beat frequency depends quaquaversally on the deviation of the modes from symmetry with respect to the amplification line, if losses in both modes are equal, and that this dependence weakens with increasing pressure but an inversion never occurs. The laser was experimentally used for testing infrared photodetectors, among them CdHgTe devices of various sizes and with various magnitudes of the dark resistance. During measurements the beat frequency of laser modes remained stable within 10^{-4} and the error, produced essentially by fluctuation of the discharge current, did not exceed 5%. The results indicate that the response speed of photodetectors with a large sensitive surface ($5x5\ mm^2$) is limited by theiry time constant $\tau = RC$ (R- equivalent load resistance, C- photodiode capacitance) and that their amplitude-frequency characteristics have the form $V = [1 + (\nu_{12}/\nu_o')^2]^{-1/2}$ (V- normalized photodetector output voltage, ν_{12}- frequency separation of modes, $\nu_o' = 1/2\pi\tau$ - photodetector "frequency"). Figures 3; references 4: 3 Russian, 1 Western.

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AUTOMATIC INSTRUMENT FOR MEASURING AMPLITUDES AND PHASES OF HARMONIC INFRALOW-FREQUENCY SIGNALS

Moscow IZMERITELNAYA TEKHNIKA in Russian No 8, Aug 86 pp 46-48

[Article by Yu.I. Polikarpov, V.G. Burtsev, A.L. Fomin, and N.A. Udovichenko]

[Abstract] Testing of materials with harmonic signals at infralow frequencies for application in acoustics of biophysics is considered, sufficiently accurate measurement of signal amplitude and phase being particularly difficult while the average signal level varies in time. The most common practical case is a monotonically varying difference between average signal level and reference level in measurement by the comparison method. Analysis of this situation indicates that the phase error will decrease with increasing number of time intervals on which the determination is made and the amplitude error will decrease with increasing number of successive approximations. Such an amplitude determination is demonstrated on the common case of an average signal level varying linearly in time during measurement. An instrument which implements these concepts of error minimization, with automation of the procedure, has been designed with two channels: a test signal channel and a reference signal channel. Each channel includes a level compensator at the input followed by a photoamplifier, an electronic amplifier-limiter, a fourth-order active filter, and a comparator. The test signal amplifier-limiter has a second output to another amplifier followed by an LKS4-003 potentiometer and a Vy-21 digital voltmeter. Other instrument components behind the comparators include three Ch3-54 frequency meters and an S1-55 two-beam oscillograph. Readings are processed by a mini-computer for printout. This instrument was tested on signals covering the 10^{-3}-1 Hz frequency range and the 10^{-6}-1 V amplitude range. The phase error did not exceed 0.2° and the ampltidue error did not exceed 0.5% at frequencies below 0.5 Hz, the amplitude error increased to 2% at 1 Hz. Variation of the average signal level increased only the phase error. The accuracy can be improved by use of a higher-speed voltmeter. Figures 2; tables 1; references 8: 6 Russian, 2 Western.

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PHASE METER FOR INFRALOW-FREQUENCY RANGE

Moscow IZMERITELNAYA TEKHNIKA in Russian No 8, Aug 86 pp 49-50

[Article by V.I. Kosyuk and I.A. Pashanin]

[Abstract] A phase meter for the infralow-frequency range is described which operates by the method of phase angle transfer to the frequency of a reference generator, its distinctive advantage being that the measured phase angle remains independent of the frequency of the input signal while that frequency varies during measurement. The phase angle ϕ_x is transferred by means of two constant orthogonal components $u_x \sin\phi_x$ and $u_x \cos\phi_x$ proportional to the orthogonal components of the input signal $u_{in}=u_x \sin(\omega t-\phi_x)$, whereupon the thus generated time interval is filled with pulses at a repetition rate f_F. The instrument consists of two resolvers in the input stage and two analog signal multipliers, in the test channel one and in the reference channel one, a 90° phase shifter between the multipliers, a summator followed by a pulse shaper and a frequency divider, a filler-pulses quartz generator with a switch and with a frequency divider followed by a band filter, another pulse shaper, and a D-trigger for the generator switch and for a multivibrator driving another one with a pulse counter and an indicator in the output stage. The multipliers are built with series 525 microcircuit chips. The summator, using operational amplifiers with 89-90 dB attenuation of the cophasal component, is built on series 544 microcircuit chips. The systematic error of the phase shifter is 0.06°, assuming that its capacitances and resistances can be measured with an instrument of Class 0.1 accuracy, the error of the pulse counter is ±1. The theoretical error of the phase meter, using a 278 Hz reference signal, is therefore within ±0.1° at a pulse count rate of 3600 per cycle of the reference signal. The phase meter was tested on signals covering the 10^{-4}-10^{3} Hz frequency range, its error not exceeding ±1° with 525PS1A multipliers and not exceeding ±0.5° with 525PS2A multipliers. Figures 2; references 13: 11 Russian, 2 Western (in Russian translation).

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PHASE METER FOR MEASURING PHASE DIFFERENCE BETWEEN SIGNALS OF DIFFERENT FREQUENCIES

Moscow IZMERITELNAYA TEKHNIKA in Russian No 8, Aug 86 pp 52-54

[Article by S.V. Oskin and Yu.N. Shulgin]

[Abstract] Measurement of the phase difference between signals of different frequencies is analyzed theoretically, with phase converted to time and with introduction of the "initial time phase" concept. A phase meter measuring such phase differences by the weighting method is then described and its principle is demonstrated on the simplest case of two signals only. It consists of two (n) pulse shapers in the input stage and two (n) code registers, all feeding a control module, the latter followed by a storing summator and then either a digital-to-analog converter and an analog filter or a digital filter directly without converter, a totaling module with a second input directly from the control module, and a recording device in the output stage. The instrument is designed with maximum possible quantization of readings and for phase differences larger than the period of the lower-frequency signal. A modification of this instrument includes compensation of the carrier signal by means of artificially formed sawtooth ramp signals and their addition to the summator output signal. Both versions of such a phase meter are built with series K155 microcircuit chips. Figures 2; references: 6 Russian.

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UDC 53.089.68:621.223:621.372.8

REFERENCE GAGE OF SPECTRAL NOISE POWER DENSITY FOR 37.5-78.3 GHz FREQUENCY RANGE

Moscow IZMERITELNAYA TEKHNIKA in Russian No 8, Aug 86 pp 58-59

[Article by O.G. Petrosyan, V.I. Aderikhin, O.S. Abramova, V.A. Golba, T.Ya. Zhdanova, and E.F. Yurchuk]

[Abstract] A thermal noise generator of the waveguide type serving as reference gage of spectral noise power density has been designed and built for the microwave range of noise measurements. The source of electromagnetic oscillations at a given noise temperature is a matched load at one end of the waveguide segment, this load being either heated above or cooled below room temperature, with a coupling flange at the other end. In the reference gage the temperature of the flange is maintained at near room level by a radiator coil carrying water, the water temperature being maintained at the proper level within ±0.5 K by a thermostat, while the temperature of the load is

maintained at 77.4 K in a cryostat. The waveguide segment separating them is a thin nickel tube reinforced with epoxy compound for thermal insulation, the cryostat for the matched load being insulated with foam plastic. The reference gage is to be used for determining the error of matched loads as thermal noise generators and accordingly the necessary correction to their physical temperature, the main error being caused essentially by the nonuniform temperature distribution along the waveguide with resulting dissipation of energy radiated by the load-generator and also by intrinsic radiation of energy from the waveguide walls. The reference gage was thoroughly tested for accuracy and reliability with a Chromel-Copel thermocouple which had been calibrated against a TSPN-3 standard resistance thermometer. A comprehensive evaluation of its systematic and random errors due to inaccuracy of temperature andaattenuation measurements, due to frequency and temperature instability, and also due to nonreproducibility and indeterminacy of mechanical connections has yielded a total veriation of the noise temperature T_n within 0.5% at the center of the 37.5-78.3 GHz frequency range and within 1% at both ends of that range. This variation determines the error of measurement of spectral noise power density

$$G = k(T_n + \frac{hf}{2k})$$ (k= Boltzmann constant, h- Planck constant,

f- frequency). Figures 1; tables 1; references: 6 Russian.

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MEASUREMENT OF FLUCTUATION CHARACTERISTICS OF MICROWAVE OSCILLATORS BY AUTODYNE METHOD

Moscow IZMERITELNAYA TEKHNIKA in Russian No 8, Aug 86 pp 60-61

[Article by V.S. Dubinin and A.F. Tereshchenko]

[Abstract] An instrument for measuring the spectral noise power density and the noise factor in microwave oscillators by the autodyne method is described, this method not requiring a reference-voltage generator and a microwave amplitude detector. The instrument includes a controllable attenuator of the incoming oscillator signal followed by a circulator with a short-circuiting plunger and then a modulator driven by an audio-frequency oscillator. The modulator is a p-i-n diode conducting during the positive half-period of a modulation cycle and blocked during the negative half-period so that high-frequency power is respectively transmitted to and absorbed by a load behind the modulator or reflected back through the circulator and the attenuator to the microwave oscillator. The reflected signal, simulating a harmonic signal of a reference-voltage generator used in other methods, produces a voltage across a resistive low-frequency oscillator load in series with the power supply. With the circulator and the plunger one can set the phase of the reflected signal for maximum voltage

across the oscillator load. The self-detection property of a microwave oscillator, with a linear characteristic for reflected signals over a wide range of amplitude, is utilized in lieu of a separate amplitude detector. Measurements are made in two stages. First the attenuator is set to maximum attenuation, for determination of the output noise power with a millivoltmeter and an amplifier tuned to the given noise frequency band. Next, with an audio-frequency voltage applied to the modulator, the attenuator is set as to make the output power at the modulation frequency much larger than that noise power measured before. The spectral noise power density and the noise factor are then calculated from the two equations relating them to the two power readings, with the difference between noise at ambient temperature and at standard temperature (290 K) included. The instrument was tested on millimetric-wave oscillators. Calculations for 1-100 kHz noise based on the experimental data yield a noise factor of 27.8-42.3 dB for oscillators built with Gunn-effect diodes and 41-43 dB for oscillators built with IMPATT diodes. The accuracy of this method is the same as that of direct noise measurements. Figures 2; tables 1; references: 6 Russian.

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ELECTROMAGNETIC FIELD IN LONG FERROMAGNETIC TUBE

Moscow ELEKTRICHESTVO in Russian No 8, Aug 86 (manuscript received 16 Dec 85) pp 40-44

[Article by A.B. Kuvaldin, candidate of technical sciences and P.N. Tokranov, engineer, Moscow Power Engineering Institute]

[Abstract] The greatest difficulty in designing induction heating equipment for ferromagnetic steel is the consideration of the nonlinear dependence of the permeability of the heated production on the magnetic field intensity. Previous analytical solutions of the electromagnetic field equation for heating a semi-infinite ferromagnetic solid with strong fields do not work well when the size of the product is commensurate with the field penetration depth. Engineering methods for calculating the induction heating of a solid cylinder, pipe or plate are based on the use of correction functions that take the form of the ratios of the specific surface power and reactive power to the specific surface power and reactive power levels in a semi-infinite solid. This paper provides a mathematical model for calculating the correction functions for axially symmetric ferromagnetic solids and tubes, and is also applicable to a semi-infinite solid and plate. Recommendations are given for choosing the convergence conditions and step of the iteration. The algorithm is written in FORTRAN IV for the YeS computers and sample calculations are used to illustrate the graphing of the correction factors for ferromagnetic materials at $t = 20°C$, $f = 50$ Hz when the resistivity is $2 \cdot 10^{-7}$ ohm·m using an averaged value for the relative permeability as a function of the field intensity. Experimental data for St.45 steel rods 32 and 13.8 mm in diameter at 50 Hz exposed to magnetic field intensities of from 36.4 to 196.8 kA/m yield induction heating parameters within 5% of those obtained from the correction factors determined by the traditional engineering procedure. The program can also compute the electromagnetic field parameters in nonmagnetic materials taking into account the change in the resistivity of the heated solid through its cross-section in step with the heating. Figures 4; references: 8 Russian.

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INHOMOGENEOUS SUPERCONDUCTOR IN A MAGNETIC FIELD

Moscow ELEKTRICHESTVO in Russian No 8, Aug 86 (manuscript received 24 Dec 85) pp 62-66

[Article by Sh.I. Lutidze, doctor of technical sciences, Moscow]

[Abstract] An inhomogeneous superconductor (a conducting diamagnetic medium with nonlocal properties) is placed in a steady-state alternating magnetic field. The current distribution intthe conductor is analyzed for two cases:
1) The superconductor has a cylindrical shape with a specified radius;
2) The superconductor has a flat surface and is in a steady-state homogeneous magnetic field with no demagnetizing effect. Analytical expressions describing critical state of the superconductor are written for different values of the nonlocality parameter (this parameter, p_{nl}, is determined from the magnetization curve of the superconductor and its geometry and has the following values here; -1/3, -0.5, -0.6, -2/3, -5.7, -0.75 and -7/9). The superconducting electron density, the magnetic induction and the current density are all plotted as a function of the distance from the center of the conductor for various p_{nl}:p_{nl} = -1/2, -1/3, 1 and 0. This detailed analysis shows that the physical processes occurring in superconductors of the first and second kinds are described by the same common equations of a nonlocal nature. The introduction of functional nonlinear parameters makes it possible to obtain a generalized model of the superconductor that is a more accurate reflection of the picture of the penetration of the magnetic field into these types of superconductors as compared to existing models exhibiting a local nature. The nonlocal relations of this paper are confirmed by experimental data and the results obtained can be used to solve a number of acute problems related to the practical application of superconductivity (increasing the current capacity, reducing losses, developing superconducting shields, etc.). Figures 6; references 7: 3 Russian, 3 Western (1 in Russian translation).

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CHARACTERISTICS OF UNIAXIAL ELECTROMAGNETIC SUPPORT WITH BIAS MAGNETIZATION

Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA in Russian No 7, Jul 86 (manuscript received after revision 19 Dec 85) pp 75-81

[Article by Nikolay Zosimovich Mastyayev, candidate of technical sciences, assistant professor, Volmar Grigoryevich Morozov, senior instructor, Vladimir Aleksandrovich Tregubov, candidate of technical sciences, senior scientific associate, and Vladimir Sergeyevich Shirinskiy, senior instructor, Moscow Institute of Power Engineering]

[Abstract] Bias magnetization of adjustable uniaxial electromagnetic suspensions by a permanent magnet is considered, which will decrease both the power loss in the control winding and its time constant. Electromagnet and permanent magnet are preferably coupled in parallel with addition of magnetic fluxes than in series with addition of mmf's so as to ensure a lower resultant magnetic reluctance and a wider range of control. Performance analysis is based on the equivalent electric circuit of a typical possible configuration providing radial as well as axial support. Design analysis is based on relations between performance characteristics and magnet dimensions, with minimum power loss in the control winding under static conditions as optimization criterion. Figures 6; references: 3 Russian.

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EXPERIMENTAL CONFIRMATION OF COUNTERMOTION EFFECT

Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA in Russian No 7, Jul 86 (manuscript received 4 Jul 84) pp 82-84

[Article by Marat Zakiyevich Girfanov, engineer, Vladimir Nikolayevich Ostreyko, candidate of technical sciences, assistant professor, North-Western Polytechnic Correspondence Institute, and Yuriy Ivanovich Povazhuk, candidate of technical sciences]

[Abstract] The countermotion effect, linear or rotational, has been demonstrated earlier theoretically on electrical conductors moving in a magnetic field. If a plate moving in some direction is replaced by two plates of the same material with the same overall thickness moving one in the same direction and the other in the opposite direction at the same velocity, then the total losses in the two plates can exceed the loss in the original one plate even though the volume of material has decreased by presence of an air gap between the two plates. This effect can be utilized

in devices such as brakes or measuring instruments: tachometers and accelerometers. It has been confirmed experimentally on two rotating disks. The equipment for demonstrating it included a d.c. micromotor driving, through a speed-reducing gear set, two shafts in a telescopic arrangement with a longer solid shaft inside a shorter hollow one and a disk mounted on each. Both disks were positioned precisely at the center of the air gap in a rotating magnet set. The braking torque, proportional to the losses, was measured by the balancer method with the DPR-32-N6-02 permanent-magnet d.c. micromotor having a linear torque-current characteristic. Copper disks and aluminum disks, 0.5 mm thick in each case, were tested in the experiment. Copper disks, evidently because of the higher electrical conductivity and therefore a stronger magnetic field of eddy currents induced in them, produced a stronger counter-rotation effect and thus a larger braking torque. Figures 3; references: 7 Russian.

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RADIATION FROM EDGES OF METAL-DIELECTRIC STRUCTURES

Moscow RADIOTEKHNIKA in Russian No 10, Oct 86 (manuscript received after revision 27 May 86) pp 85-86

[Article by B.A. Panchenko, S.A. Baranov and V.D. Oshivalov]

[Abstract] Many microwave radiators using printed circuit technology take the form of breaks in current conducting metal film structures adjacent to dielectrics. Such gaps produce electromagnetic wave scattering and can result in undesirable interaction between stripline components, though diffraction phenomena at the edges of film conductors are useful for stripline antennas. The radiation from the edges is characterized by the specific conductance G and the scattering pattern F(θ). This paper derives engineering formulas for G and F(θ) for widespared types of metal-dielectric structures: 1) An E-mode plane-parallel waveguide formed by a base shield and a shorter conductor above it, with energy radiated into the space beyond the edge of the shorter conductor, assuming no filler between the conductors; 2) The same configuration as (1), but with the space between the conductors filled with a dielectric layer; 3) The same configuration, but with the space above the shorter conductor covered with a dielectric layer and no filler between the shorter conductor and the shield; 4) The space between the shield and the shorter conductor is half-filled with a dielectric layer and half without any filler. The behavior of G and F(θ) is discussed for these four geometries. Figures 3; references: 2 Russian.

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CALCULATING ELECTROMAGNETIC WAVE ATTENUATION IN SHIELDED HELICAL COIL

Moscow RADIOTEKHNIKA in Russian No 10, Oct 86 (manuscript received 30 Jan 86) pp 87-88

[Article by L.N. Loshakov and Yu.N. Pchelnikov]

[Abstract] Helical lines are widely used in traveling wave tubes and delay lines, where there is a small spacing between the coil and the shield; the resulting losses in the shield can be significant. This paper approximates the attenuation of an axially symmetric, slow wave in a helical line. Large slow-wave values are assumed with a turn perimeter much less than the excitation wavelength. A thin-walled cylinder conductive only in the direction of the winding is used to model the coil. Shchukin-Leontovich boundary conditions apply at the inside and outside surfaces of the cylinder; the angular components of the electric field and the magnetic field component parallel to the direction of conductivity are assumed to be continuous. Solutions of Maxwell's equations for this system show that the attenuation increases greatly with decreasing spacing between the shield and the helix. In a sample calculation for a Cu helix in air excited at a wavelength of 10 cm, the attenuation is 1.62 dB/m without a shield and 20.8 dB/m with a shield close to the coil. When the shield spacing from the coil is reduced to one-third of its former value (other parameters remaining constant), the attenuation increases to 55 dB/m. Figures 1; references: 3 Russian.

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PLANNING REPAIRS IN POWER SYSTEM WITH ASYNCHRONOUS GENERATORS

Tashkent IZVESTIYA AKADEMII NAUK UZBEKSKOY SSR: TEKHNICHESKIYE NAUKI in Russian No 3, May-Jun 86 (manuscript received 12 Dec 85) pp 22-25

[Article by K.R. Allayev and S.S. Usachev, Scientific Research Institute of the Central Asian Division of Energosetproyekt, Main Scientific Research Institute for Planning of the USSR Ministry of Power Engineering and Electrification]

[Abstract] The economic impact of incorporating asynchronous generators in a power grid on the total planned repair expenditures is determined by representing these overall costs in the form of a function of the vector for the points in time of generator shutdown. This function takes into account the excess fuel consumption and cost of this consumption when a unit is taken off line, the points of power unit shutdown, the specific cost of conventional fuel, the anticipated losses when the reliability of the power system goes below the permissible value and the costs of idle repair personnel. Expressions are adduced for these factors and the repair plan for the primary equipment of electrical power plants was calculated with the assumption of the sequential inclusion of 10, 30 and 50% asynchronous generators in the power system, where the generators had capacities of 200 to 300 MW. The savings in the overall costs of equipment repair increase with an increase in the number of asynchronous generators and their unit power capacity. The reduction in the total expenditures when planning equipment repairs holds true up to the point when 50% of the power system is asynchronous generators. The inclusion of such generators in power plants as well as an improvement in their operating and cost-effectiveness indicators will enhance the efficiency of power system repair strategies. References 5: 4 Russian, 1 Western.

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UDC 621.314

CALCULATION OF FORCES OF ELECTROMECHANICAL TRANSDUCERS AT HIGH TEMPERATURES

Tashkent IZVESTIYA AKADEMII NAUK UZBEKSKOY SSR: TEKHNICHESKIY NAUKI in Russian No 3, May-Jun 86 (manuscript received 4 Dec 85) pp 79-83

[Article by M.E. Mamedshakhov and S.M. Ismailov, Tashkent Institute of Irrigation and Mechanization of Agriculture]

[Abstract] Current and magnetic conductors in such equipment as low speed, linear asynchronous motors for open pit mine transport vehicles can reach temperatures on the order of 400°C and higher. Heat and temperature conductivities as well as the resistivity change at such working temperatures, necessitating a departure from the conventional linear analysis for the determination of the stress developed in thermally loaded electrical machines. The permissible maximum error of ±1% in the maximum temperature calculations is exceeded at high temperatures with linear approximations. This paper finds a solution for the nonlinear boundary problem of thermal stress calculations by means of numerical integration using an implicit, locally one-dimensional scheme. The machine integration techniques enables the use of more complex expressions for the parameters as a function of temperature and coordinates. The error in this approach is found to be a function of the density of the heat sources, the rate of change of the parameters and the heat developed along the coordinates in the region being analyzed. A sample calculation for the tractive force of a two-way linear asynchronous motor with a short stator shows that when the steel rotor mass temperature is 70, 200 and 400°C above the nominal, the tractive force is reduced by 13, 27 and 41%, respectively. Figures 4; references 10: 9 Russian, 1 Western.

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PROBABILISTIC STATISTICAL ESTIMATE OF EFFECTIVENESS OF GROUNDING OF SUPPORTS FOR ALTERNATING CURRENT CONTACT POWER NETWORK

Moscow ELEKTRICHESTVO in Russian No 8, Aug 86 (manuscript received 10 Feb 86) pp 12-16

[Article by B.I. Kosarev, doctor of technical sciences, G.N. Kosolapov and A.I. Kushnir, candidates of technical sciences]

[Abstract] All metal structures within 5 m of the contact power lines for electrified rail transport must be grounded to the rails according to current regulations. Such measures do not always improve electrical safety, since hazards arise not only with the damaging or bridging of support insulators,

but with any shorts to the rails, i.e. breaks in the conductors, insulation breakdown in the rolling stock or mistakes by operators. Such factors can produce high rail potentials (3 kV and more) on heavily loaded sections and grounding supports to the rails is effective only when such grounding is also done at the power source. Drawbacks to grounding contact line supports include possible disruption of the operation of automatic rail blocking circuits and increased repair difficulty when using track machinery. This paper details the possibilities for disconnecting the supports of the contact propulsion power AC grid from the rails from the viewpoint of electrical safety. Expressions are derived for the probability of hazardous voltages occurring in various maintenance and repair situations. Factors such as the response time of the shutoff circuits, soil conductivity as well as distances from a ground connection point and power sources are taken into account. The mathematical expectation of the number of electrical injuries on a section with supports disconnected from the rails is always significantly lower than on a section with supports grounded to the rails. Figures 3; references: 6 Russian.

8225/9835
CSO: 1860/18

UDC 621.316.176.015.016.2.001.24

CALCULATION OF STEADY-STATE OPERATING MODE OF ELECTRIC POWER SUPPLY SYSTEM FOR INDUSTRIAL ENTERPRISE BY SEQUENTIAL EQUIVALENT CIRCUIT METHOD

Moscow ELEKTRICHESTVO in Russian No 8, Aug 86 (manuscript received 5 Mar 86) pp 7-12

[Article by V.A. Igumenshchev, I.A. Salamatov and Yu.P. Kovalenko, Magnitgorsk]

[Abstract] Ierative nodal voltage techniques are widely used for calculating the steady-state operating parameters of complex power grids and are the basis for such programs as Mustang and B-2/77, etc. These methods are difficult to apply to the branched, open networks of industrial enterprises, because the latter open supply configurations make the matrix notation used for the parameters of state both cumbersome and inefficient. This paper applies a sequential equivalent circuit method to such analyses for industrial plants. The initial data are the parameters of the elements comprising an equivalent circuit: 1) A voltage source driving an impedance; 2) A load element (sink) comprised of the resistive and reactive loads, with the source phase specified. These open power networks are represented then by a hierarchical structure with a string of equivalent circuits forming the computational iterations. The RESTA program, formatted as an individual module, implements this procedure and can be incorporated in programs for solving more complex operating mode problems. The program has seen regular service in computing existing operational and optimal steady-state parameters at 18 mining and metallurgical enterprises, including the power

systems supplying the Magnitogorsk, Nizhne-Tagilsk, Chelyabinsk Metallurgical and Lebedinsk Mining and Ore Concentrating Combines. Sample calculations are given for a supply circuit having two balancing nodes and 29 circuit elements. The impedance, power in MVA and voltage in kV are listed for each circuit element in tabular form. Figures 5; references: 6 Russian.

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CSO: 1860/18

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ELECTROMAGNETIC PROCESSES IN CONTROLLED THREE-PHASE RECTIFIERS

Moscow ELEKTRICHESTVO in Russian No 8, Aug 86 (manuscript received 21 Nov 85) pp 28-33

[Article by P.F. Merabishvili, doctor of technical sciences and G.K. Kokhreidze, candidate of technical sciences, Georgian Polytechnical Institute]

[Abstract] The steady-state and transient electromagnetic processes in controlled three-phase bridge rectifiers tied to transformers can be analyzed by curve-fitting methods, though this is cumbersome. This paper proposes a clear analytical technique for ascertaining the electromagnetic parameters in such circuits, taking the main specifications of the transformer into account. The analysis uses complex transformed phase values known from general electrical machine theory when controlled semiconductor switches are used as well as the spectral operator technique developed in rectifier circuit theory. The three major components of the analyzed system are the three-phase power transformer, the three-phase thyristor rectifier (six thyristors) and a load represented by a resistance, inductance and e.m.f. in series. A mathematical model is found that is adequate and convenient for the determination of the transient voltages and currents in the circuit components. Curves of the transient voltages and currents when power is applied to such rectifiers (plotted as a function of time between 0.02 and 0.40 sec) show good agreement between experiment and theory. Figures 3; references: 9 Russian.

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TRANSIENT PROCESSES IN MIXED TYPE ELECTROMAGNETIC SYSTEMS

Moscow ELEKTRICHESTVO in Russian No 8, Aug 86 (manuscript received 10 Sep 85) pp 33-36

[Article by K.M. Vasilyev and E.A. Meyerovich, Moscow]

[Abstract] Mixed type electromagnetic systems are electrical networks having branch parameters determined by the distribution of the electromagnetic field vectors. A typical class of such systems that has its parameters determined by the spatial distribution of two-dimensional magnetic and electric fields includes high voltage power and instrument transformers, and a class of such mixed systems having electromagnetic parameters characterized by the distribution of a plane-parallel magnetic field is typified by phase shielded current conductors used for high power generators and automated electric drive systems for electrical machines with controlled frequency converters. This paper analyzes the transient processes in these electromagnetic systems, taking displacement currents, the skin effect, the proximity effect as well as nonlinearity of the conducting medium into account. A mathematical model based on the simultaneous solutions of the quasisteady-state electromagnetic field equations in terms of the vector magnetic field potential and a system of algebraic differential equations for the related electrical circuits is employed to describe the transient processes in a particular class of these electromagnetic systems: one described by a unidirectional electrical field and a two-dimensional magnetic field. The displacement currents between individual conductors is found by means of an equivalent circuit with partial capacitances. The transient response computer program takes the form of a combination of independent program segments that 1) Numerically calculate the transient process in an RLC network with lumped parameters of the branches using implicit integration formulas and the Newton-Raphson method; 2) Numerically solve the two-dimensional quasisteady state electromagnetic field or steady-state magnetic field problem in terms of the vector potential for specified values of the winding currents and voltages at the terminal of the massive conductors; 3) Determine the values of the lumped capacitive parameters of the equivalent circuit branches based on the solution of the electrostatic problem for the scalar potential, given specified boundary conditions at the surfaces of the conductors. The purely theoretical analysis adduces neither sample calculations nor design examples. References 15: 13 Russian, 2 Western.

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RELIABILITY MODELS FOR ELECTRICAL POWER SYSTEM FACILITIES IN CASE OF DISCRETE MULTIPLE FACTOR INPUTS

Moscow ELEKTRICHESTVO in Russian No 8, Aug 86 (manuscript received 11 Feb 86) pp 51-53

[Article by B.M. Kinash, candidate of technical sciences, Lvov Polytechnical Institute]

[Abstract] Power system components such as transmission lines, generating equipment and substations are exposed to intermittent, multiple factor perturbing inputs that produce component failures under certain conditions. since the reliability of such facilities is defined in terms of the failure rate and the probability of failure with a single input, developing appropriate models for system failure mode analysis requires a study of methods for calculating the failure probability of a facility with multiple factor inputs as well as an analysis of the probabilistic parameters of the event input and the derivation of expressions for the reliability indicators with different input flows. Perturbing factors are combined into an n-dimensional vector while the output parameters of the exposed system are combined in an m-dimensional vector; analytical expressions are derived for the definition of the region in m-dimensional space for which safety requirements are met. The following types of input event flows are considered: 1) A steady-state Poisson input; 2) A non-steady-state Poisson input flow and 3) Erlang flows. Reliability functions are found for the affected facilities for each of these three input types and the resulting expressions can be used to calculate the failure probability for a single multifactor input; this is evidence of the ability to construct reliability models for such systems with discrete multifactor inputs in all cases of practical interest. The purely theoretical analysis adduces neither sample calculations nor design applications. References: 7 Russian.

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RELIABILITY PARAMETERS OF POWER DIODES IN DIRECT CURRENT ICE-MELTING SYSTEMS FOR POWER LINES

Moscow ELEKTRICHESKIYE STANTSII in Russian No 8, Aug 86 pp 52-54

[Article by M.Ye. Izotov, engineer, V.S. Molodtsov, and M.M. Seredin, candidates of technical sciences, Southern Division of the All-Union Planning, Surveying and Scientific Research Institute for Power Systems and Electric Power Networks]

[Abstract] Type VUKN rectifier installations are widely used in power networks for melting ice build-up on power lines by means of direct current. Long term operational experience has shown that the V2-320 diodes are the components most subject to failure in the VUKN system. Some 576 of these diodes were tested for their recovery time, leakage current and volt-ampere characteristic both at the time of their installation (1980) and after four years of service (1984). The test data reveal: 1) Any new ice-melting system design must be capable of being installed in a closed room; 2) Regular measurements must be made of the voltage rating and inverse leakage current in order to ascertain and replace defective diodes and improve system reliability; 3) Appropriate selection and matching of the diodes with respect to recovery time enhances the effectiveness of measures for equalizing the inverse voltages and thus improve long term reliability. Figures 2; references: 3 Russian.

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UDC 621.315.626.027.3.001.4

TESTING HIGH VOLTAGE ENTRANCE INSULATOR ASSEMBLIES

Moscow ELEKTRICHESKIYE STANTSII in Russian No 8, Aug 86 pp 65-66

[Article by A.A. Shkolnik, engineer, Moldavian Power System Repair Administration]

[Abstract] The Moldavian Power System Repair Administration has designed and placed in service a test stand for measuring the loss angle tangent of high voltage entrances at voltages up to 110 kV inclusively for the major overhaul of such facilities. A R-5026 alternating current bridge is used to measure the loss angle tangent of the primary insulation and associated insulating layers. This test stand reduces the testing time and improves the accuracy of the measurements. A drawing of the test rack and the circuit schematic of the test instrument are also shown. Figures 2; references: 2 Russian.

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UDC 62-52 (075.8)

INVESTIGATION OF METHODS OF ADJUSTMENT OF CONTROL SYSTEMS BY MEANS OF A MORE RAPID HIGH-SPEED SIGNAL

Minsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ENERGETIKA in Russian No 8, Aug 86 pp 73-76

[Article by G.T. Kulakov, A.A. Moskalenko, candidates of technical sciences, A.T. Kulakov and V.V. Timoshenko, engineers, Belorussian Polytechnical Institute]

[Abstract] A new method is proposed for the design of automatic systems of control (ASC) for thermal power engineering by means of a more rapid high-speed signal. General formulas are derived for calculation of the parameters of a dynamic adjustment of an ASC, with minimization of the principal disturbances, which permits proximate methods to produce an evaluation of direct quality indices. References: 7 Russian.

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UDC 621.31

METHODOLOGICAL PROBLEMS OF EVALUATION OF ECONOMIC CONSEQUENCES OF CONSTRUCTING HIGH-VOLTAGE ELECTRICAL TRANSMISSION LINES IN AGRICULTURAL DISTRICTS

Minsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ENERGETIKA in Russian No 8, Aug 86 pp 34-37

[Article by Ye.A. Bubis, candidate of economical sciences, S.N. Uspenskaya and G.R. Tsirulnikova, engineers, Tashkent Polytechnical Institute imeni A.R. Beruni]

[Abstract] The important economic losses of agricultural production from the construction of overhead lines is considered. These losses can be divided into two components: 1) Permanent damage in the case of removal of soil under the supports of an operating electrical transmission line; and 2) Damage from temporary removal of soil during construction of an overhead line. It is concluded that in designing an overhead line, calculations of the damage from temporary removal of agricultural land used for its construction must also take into account the loss of productivity of the soil. The damage from temporary removal has a probability nature. Consequently, it is important to estimate its magnitude by mathematical expectation. The article was presented by the Department of Economics and Energy Organization of the Tashkent Polytechnical Institute. References: 3 Russian.

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UDC 621.311

WORK OF HIGHER EDUCATIONAL INSTITUTIONS WITH RESPECT TO INTENSIFICATION OF INDUSTRIAL PRODUCTION IN THE FIELD OF ENERGY ECONOMY

Minsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ENERGETIKA in Russian No 8, Aug 86 pp 3-7

[Article by V.A. Venikov, doctor of technical sciences, professor, and Yu.F. Arkhiptsev, engineer, Moscow Energy Institute]

[Abstract] Problems of the intensification of industrial production in the USSR are urgent and affect the work of higher educational institutions. In June 1985, at a meeting of the Central Committee of the Communist Part of the Soviet Union with respect to problems of accelerating scientific-technical progress, the necessity was emphasized for an abrupt change in intensification of the economy. The scientific facilities of higher education institutions were considered an important reserve whose possibilities have not been fully utilized. The present article presents a detailed description of the work conducted by higher educational institutes in the field of energy economy. The quality of the specialists and engineers produced is evaluated. This article is recommended by the electrical technology and electrical engineering sections of the Scientific and Technical Council of the USSR Ministry of Higher Educational Institutions. It was presented by the Department Faculty for Electrical Systems of the Moscow Energy Institute. References: 3 Russian.

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REDUCTION OF ENERGY LOSSES IN CONTROLLABLE ELECTRIC MOTOR DRIVE

Minsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ENERGETIKA in Russian No 8, Aug 86 pp 8-13

[Article by V.I. Panasyuk, doctor of technical sciences, professor, Belorussian Polytechnical Institute]

[Abstract] A means is proposed for solution of the probelm of minimizing energy losses in controllable electric motor drives by the use of two formulas which are derived, with stepwise variable values of the Lagrange multiplier λ_2 or λ_3 and an approximation of the loading moment according to the stepwise dependence on time or angle of rotation. The article was presented by the Department of Computing Methods and Control Systems. References: 7 Russian.

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WAYS TO OBJECTIVELY ESTIMATE QUALITY OF INSULATION IN ELECTRIC TRACTION MOTORS

Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA
in Russian No 7, Jul 86 (manuscript received after revision 23 Jul 85)
pp 40-44

[Article by Aleksandr Sergeyevich Serebryakov, candidate of technical sciences, docent, Sergey Aleksandrovich Smigirinov, director of laboratory, and Leonid Pavlovich Bekh, candidate of technical sciences, assistant professor, All-Union Correspondence Institute of Railroad Transportation Engineers, Gorkiy branch]

[Abstract] An original instrument has been developed for objective estimation of the quality of insulation in NB-412K electric traction motors for VL60K electric locomotives. The ground insulation in these motors consists of a six-layer stack of glass-mica tape (capacitance C_1, leakage resistance R_1) and a single layer of glass tape (capacitance C_2, leakage resistance R_2). The instrument for determining the state of this insulation consists of an ammeter and a voltmeter with a stabilized high-voltage power supply and two high-voltage relays. Unlike measurements with a Megger, readings obtained with this instrument do not include and depend on the parameters of the measuring circuit. Three parameters, namely the insulation resistance, the self-discharge voltage, and the recovery voltage are measured four times: every 15 s over a 1 min period. Measurements made on 124 motors yielded accordingly 12 readings for each. A factorial analysis of the (124x12) matrix has revealed that only one reading of each of these three parameters is needed for qualitative diagnosis of the motor insulation. Subsequent forward and reverse regression analyses of the data indicates the possibility of predicting the still available margin of insulation life and converting it into kilometers of traction. It also indicates the causes of lowering of the life estimates, namely moisture or dirt, and thus also the method of restoring the insulation by drying or by washing respectively. Figures 3; references: 3 Russian.

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QUANTUM ELECTRONICS, ELECTRO-OPTICS

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IMAGE TRANSMISSION VIA KILOMETER-LONG FIBER OPTIC LIGHTGUIDE USING SPECTRAL-TIME CODING

Moscow RADIOTEKHNIKA in Russian No 10, Oct 86 (manuscript received 17 Apr 86) pp 91093

[Article by G.G. Voyevodkin, Ye.M. Dianov, A.A. Kuznetsov and S.M. Nefedov]

[Abstract] The spatial information contained in an image can be recoded as spectral information by having emissions at particular wavelengths correspond to particular resolved image elements, where the intensity of the emission at each wavelength is proportional to the brightness of the corresponding element. Such a spectrally encoded signal can propagate without information losses through any channel that does not distort the spatial relationships. This paper describes the experimental transmission of a black-and-white image (slide) through a 1 km fiber optic lightguide using this technique. A white light source (objective lenses and a diffraction grating) projected a beam onto the transparent slide; the resulting spectrum was modulated by the spatial distribution of the slide transparency along an image scan line. The modulated output was focused by the lenses and grating on the lightguide. A pair of lenses with a grating between them recovered the spectrum of the light from the guide, reconstructing the image line as a multicolor strip, having the same brightness distribution as the transmitted black-and-white line. All of the lenses were Yupiter-9's with focal lengths of 85 mm and gratings has 1,200 lines/mm. The 1 km lightguide was step-index quartz with a core diameter of 55 micrometers. The image lines were scanned mechanically and the slide was 20 x 20 mm. Photos of the test pattern before and after transmission show the reproduction of 80-micrometer wide lines. The spatial resolution measured from the test pattern is 10 line pairs per mm, while approximately 400 image elements were transmitted simultaneously through the lightguide. The calculated real-time transmission distance can run up to 2 km, though this can be extended to 20 km using the far infrared spectrum. By employing a faster electro-optical converter (scan rate of 10^{-9} s) and a graded-index, 1 km fiber, it is anticipated that up to 10^9 frames/s (10^{12} bits/s) can be transmitted. Figures 2; references 10: 6 Russian, 3 Western, 1 Western (in Russian translation).

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DEPENDENCE OF OPTICAL TRANSMITTANCE OF THIN METAL MESH ON LIGHT INCIDENCE ANGLE

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST in Russian No 7, Jul 86 (manuscript received 24 Sep 85) pp 4-6

[Article by A.P. Shliteris and T.B. Chenskaya]

[Abstract] An experimental study was made for establishing the relation between the optical transmission coefficient of thin metal meshes and the incidence angle of polarized light, geometrical parameters influencing this relation being the mesh periods and the strip dimensions. The object were copper meshes and measurements were made, for the first time ever, covering the 400-1100 cm^{-1} range of the spectrum. The meshes with a two-dimensional equiperiodic uniform square structure had been produced by the electroforming process. The half-width w of all strips was varied from 1.31 μm to 2.1 μm and their thickness in each case made equal to twice the width, with the period p in both directions 10 ± 0.005 μm or 20 ± 0.005 μm. A mesh for testing was tightly spread over a circular frame and the latter mounted on the indicator dial with 1° divisions in the test chamber of a Specord-75 IR spectrophotometer. A reflection polarizer consisting of GaAs plates was inserted in the measuring channel so as to ensure complete polarization of incident light with a divergence angle not larger than 1.7° in the plane of incidence and 0.06° in the plane perpendicular to it. The incidence angle θ was varied from 0 to 85° in 1°-5° steps. The results of measurements revealed a transmission band with a peak corresponding to a transmission coefficient T_0 at normal incidence $\theta=0$ of light at the wavelength $\lambda_0=(1.16\pm0.01)p$ and T at an incidence angle $\theta>0$ of light at a wavelength $\lambda<\lambda_0$. An evalution of the data has yielded the dependence of T_0-T and $(\lambda_0-\lambda)/p$ on angle θ. These relations reveal new characteristics of such meshes, namely that the transmission coefficient of meshes with a ratio of mesh period to strip width $p/2w>3.7$ remains constant over the $\theta=0-7°$ range, that both T and the corresponding λ are minimum at incidence angles $\theta=32.5°$ and $\theta=25°$ for meshes with any p/2w ratio, and that λ_{min}/p depends linearly on w/p. Measurements made on meshes of other metals yielded essentially the same qualitative and quantitative results. Figures 2; references 10: 2 Russian, 8 Western (1 in Russian translation).

2415/9835
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DETERMINING PROPER THICKNESSES OF PLATES FOR STACK USED AS SEMIOPAQUE RESONATOR MIRROR

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST in Russian No 7, Jul 86 (manuscript received 12 Apr 85) pp 6-9

[Article by I.M. Minkov]

[Abstract] Stacks of plane-parallel glass plates are considered for semiopaque mirrors of laser resonators, in which case the reflection coefficient as a function of the radiation wavelength must have at least one nearly absolute maximum within the luminescence band of the active medium. This maximum reflection coefficient, which in the case of normal incidences is $R^{max} = [(n^{2m} - 1)/(n^{2m} + 1)]^2$ (n- refractive index of glass, m- number of plates), corresponds to the wavelength at which the optical thicknesses of the plates and the air interlayers are all odd multiples of a quarter-wavelength and the phase shift is an odd multiple of $1/2\pi$. As design problem is considered determination of the proper thicknesses of all layers, for a given number of plates, such that maximum reflection coefficient within the luminescence band of the active medium will remain the highest during any mutually independent variations of glass temperature and air temperature. An exact analytical solution of this problem is not possible, only a numerical solution by the scanning method and even such a solution computer-aided is feasible only when the relative width of the luminescence band is very small. While changes in the physical thickness of glass and air layers are measured in millimeters, the reflection coefficient is sensitive to changes in the optical thickness measured in fractions of the wavelength. Calculations for a stack of two glass plates indicate that the negative effect of temperature fluctuations can be minimized by making the optical thicknesses of the two glass plates high multiples of that of the air interlayer and one of the other. Using only multiple optical thicknesses also greatly simplifies the scan and thus the calculations. Results obtained also by an approximate algebraic method for stacks of two glass plates with a refractive index $n = 1.79$ and with the thinnest plate 2 mm thick indicate that such a method yields an overestimate of the minimum acceptable maximum reflection coefficient and that the error increases with decreasing thickness of air interlayers. Figures 1; tables 1; references 9: 3 Russian, 6 Western (1 in Russian translation).

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ERROR ANALYSIS OF MEASUREMENTS MADE ON THIN DIELECTRIC FILMS BY WAVEGUIDE METHOD

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST in Russian No 7, Jul 86 (manuscript received 26 Sep 85) pp 9-10

[Article by S.P. Chashchin, A.Z. Murzakhanova, and I.P. Guzhova]

[Abstract] Utilization of the waveguide behavior of thin dielectric films for determination of their thickness h and refractive index n is analyzed for accuracy, refractometry by this method involving measurement of the effective refractive index of two waveguide modes with light fed into such a waveguide through a prism or a grating of the appropriate material at a resonance angle of incidence. After the effective refractive index of two waveguide modes has been measured, thickness h and refractive index n of the film are calculated according to the dispersion equation with known refractive index of the substrate material and of the ambient medium as well as known wavelength of light in vacuum. Usually the zeroth-order waveguide mode is selected as one of the pair and a waveguide mode of m-th order as the second. The accuracy of this method of h and n determination hinges on the error of mode measurement, namely measurement of angles determining the effective refractive index. The dispersion equation is solved approximately by the iteration method or more conveniently by the graphical method, which yields curves of the function h = f(n) for various values of $N_m \pm \sigma N_m$ (N_m - effective refractive index of m-th mode, σ-r.m.s. relative error of N_m measurement) and their intersections establish h_{max}, n_{max}, h_{min}, n_{min}. An error analysis for a typical dielectric film constituting a multimode waveguide reveals that the relative errors $\Delta h/h$ and $\Delta n/n$ decrease with increasing order m of the selected waveguide mode, also with increasing h and with increasing n. Figures 4; references 4: 2 Russian, 2 Western (1 in Russian translation).

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BRAGG REFLECTION OF INFRARED SURFACE ELECTROMAGNETIC WAVES AND METHODS OF ITS OPTIMIZATION

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST in Russian No 7, Jul 86 (manuscript received 6 Aug 85) pp 11-13

[Article by A.S. Svakhin, S.P. Surov, and V.A. Sychugov]

[Abstract] Infrared spectroscopy of thin metal films by means of surface electromagnetic waves requires planar devices for conversion of volume waves into surface waves and also planar dispersion element, a major problem being to reduce the losses during propagation of such waves along smooth or

corrugated surfaces and thus lengthening their path. An experimental study with copper film on glass substrate and infrared radiation of the 10.6 μm wavelength has revealed new ways to achieve this by increasing the reflection coefficient of such a Bragg mirror. Considering that the attenuation of surface electromagnetic waves depends on both quality of the substrate and mode of film deposition, standard vacuum evaporation with an ion source was employed so that ion-beam etching of the glass surface and deposition of the copper film could be effected in one cycle. Etching of the glass was done first "roughly" with CF_4-Freon ions and then "softly" with Ar ions for removal of residual carbon. Copper deposition was followed by etching of the copper film, for minimizing the diffuse reflection by that metal mirror. An initially 260 Å thick copper film was reduced to 0.1-0.5 μm thickness by "soft" etching with Ar ions, which reduced the attenuation of 10.6 μm waves to 0.25 cm^{-1}. The main purpose of the experiment was to establish the "aging" characteristics of such a mirror, namely the decrease of the wave propagation path in time and its dependence on the ambient temperature. For this purpose, copper films were oxidized in a furnace at various temperatures covering the 20-230°C range and the thickness of oxide buildup was varied by regulation of the oxidation time. Measurements of the radiation intensity and calculation of the propagation path on the basis of intensity attenuation over a given distance indicate that a 2.4 cm long path of infrared (10.6 um) surface electromagnetic waves on smooth copper can be maintained for at least 4 months at room temperature, "aging" at room temperature being evidently associated with buildup of a Cu_2O film. Sharp degradation at higher temperatures, after a time which depends on the temperature, is evidently associated with buildup of an opaque CuO film. Another known method of reducing the attenuation is sinusoidal corrugation of the metal surface with the appropriate period, as has been demonstrated on gratings with various profiles. Figures 4; references 8: 6 Russian, 2 Western.

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MODELING OF OPTICAL SYSTEMS WITH REAL SURFACE FABRICATION ERRORS

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST in Russian No 7, Jul 86 (manuscript received 26 Sep 85) pp 18-20

[Article by M.A. Gan and S.I. Ustinov]

[Abstract] Modeling of optical systems for surface inspection and quality control is described, fabrication errors including generally not only zonal axisymmetric but also asymmetric ones. An approximate model is based on laws of geometrical optics, which allow additive summation of wavefront perturbations caused by components of the optical system along the trajectory of "unperturbed" rays. This model is demonstrated on two vectors representing respectively an incident ray and a refracted ray at a surface separating two

media with different refractive indexes of an "unperturbed" optical system. The accuracy of this model is estimated for a Ricci-Crêtien mirror system with three different field-of-vision angles, and found to be adequate for surface with large fabrication errors. An exact model is based on calculation of paths of rays through the system, also according to laws of geometrical optics and the equation of a generally aspherical surface. This model can, in the case of symmetric errors, be approximated with appropriate correction of coefficients. These two models have been used for inspection of both small and large mirrors of a Ricci-Crêtien system as well as for predicting the wavefront deformation at the exit pupil of a telescope. Figures 1; tables 2; references 4: 2 Russian, 2 Western.

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DEPENDENCE OF THERMOOPTICAL ABERRATIONS IN FOCUSING MIRRORS ON DIRECTION AND INTENSITY OF HEAT TRANSFER

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST in Russian No 7, Jul 86 (manuscript received 15 Apr 85) pp 21-24

[Article by S.I. Khankov]

[Abstract] The dependence of thermooptical aberrations in parabolic and spherical focusing mirrors on the axial temperature gradient is calculated according to a model of heat transfer and thermal deformation for a long-focus mirror which approaches a disk with a uniform thermal flux density over both the heat absorbing surface and heat emitting surface. The problem is solved for mirrors with the heat emitting surface converted by backing thermal insulation into a heat reflecting one. Expressions are derived accordingly for shifts of the paraxial focus as well as for the two coefficients representing respectively the effects of axial and radial displacements of a point on the mirror surface. A comparison with the effect of radial heat transfer reveals that an axial temperature gradient enlarges the focus much more (up to two orders of magnitude more) than does a radial temperature gradient of the same magnitude, but does not produce spherical aberration. Changes affecting the focus cease to depend on the direction of heat transfer, however, when the Biot number is sufficiently small and the cooling rate correspondingly low so that the mean-volume overheating determines focal shifts. Figures 2; tables 2; references: 4 Russian.

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APPARATUS FOR QUALITY CONTROL OF INFRARED OBJECTIVES

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST in Russian No 7, Jul 86 (manuscript received 30 Jul 85) pp 31-32

[Article by N.I. Gusarova, N.F. Koshchavtsev, and S.S. Kolbe]

[Abstract] An apparatus for quality control of infrared objectives by an optical method has been developed which uses a CO_2-laser (wavelength $\lambda_{ir} = 10.6$ µm) as radiation source and a nonlinear crystal for frequency conversion into the visible range. Radiation emitted by the LGN-74 CO_2-laser passes through a telescopic system of three lenses (biconcave - biconvex - biconvex) with a zonal diaphragm to the tested objective. Upon passage through the objective, the laser beam proceeds through a Ge-plate inclined at a 45° angle to the optical axis, the proustite crystal, an interference filter, and a polarizing plate to a microscope for analysis. The crystal also receives and transmits another radiation beam, reflected into it by the Ge-plate, coming from an LG-52-2 He-Ne pump laser (wavelength $\lambda_v = 0.63$ µm) after reflection by a 45° mirror and passage through another polarizing plate. The proustite crystal shifts the diffraction pattern spectrally from the infrared region into the visible region and geometrically from the focal plane of the objective into a parallel plane some distance behind, this distance depending on the two radiation frequencies as well as on the length of the crystal and its refractive indexes for the two radiation wavelengths. The diffraction pattern obtained upon insertion of the zonal diaphragm with two pairs of pinholes for generation of an interference effect, indicates the quality of the objective and yields quantitative data on longitudinal geometrical aberrations in the objective with a λ_{ir}/λ_v times smaller error than conventional infrared measurement. Figures 4; references: 4 Russian.

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DEVELOPMENT STATUS OF HIGH-REFLECTIVITY DIFFUSERS FOR MIDDLE-INFRARED RADIATION

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST in Russian No 7, Jul 86 (manuscript received 14 Nov 85) pp 54-60

[Article by V.A. Parfinskiy]

[Abstract] The development status of diffusers for radiation within the middle-infrared region of the spectrum, specifically within the 2-20 µm range of wavelengths is reviewed from the standpoint of their application in spectrophotometry as commercially producible reference spheres or hemispheres.

The main object of theoretical and experimental research in this area is to produce scatterers with properties approaching those of the ideal Lambert scatterer. First are considered scattering surfaces, which require intentionally generated and specially controlled roughness. Attemptssare made to produce such surfaces by grinding with loose abrasive grains, by sand blasting, by plasma-beam sputtering, by coating with abrasive powder in a layer of adhesive binder, by grating with formation of regular inhomogeneities, and by various novel less conventional methods. Next is considered scattering below the surface, as radiation passes through the transmitting volume of a diffuser. Materials are sought which combine surface and volume scattering, shattered glass and crystals of various salts such as NaCl and BaF_2 having been found to be promising. Figures 8; tables 2; references 38: 26 Russian, 12 Western (2 in Russian translation).

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USE OF GRAPHITIZED PHOTOGRAPHIC FILMS FOR INSPECTION OF INFRARED OBJECTIVES BY HOLOGRAPHIC METHOD

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST in Russian No 7, Jul 86 pp 61-62

[Article by A.K. Afonskiy, V.N. Kurzenkov, P.A. Sergeyev, and V.N. Sokolov]

[Abstract] The possibility of inspecting infrared objectives by the holographic method is considered, recording of the wavefront at the 10.6 μm wavelength with the aid of coherent optics requiring a medium with a resolving power of at least 30 mm^{-1}, a diffraction efficiency of at least 0.5%, and a dynamic range sufficiently wide for linear recording of an object wave whose intensity drops by a factor of 10. Graphitized photographic film has been found to be suitable for this application, its recording mechanism being based on thermal sensitizing of the emulsion and thermal glow which produces an actinic flux. An experimental study of such an inspection system was made with an apparatus which included a transverse-excitation atmospheric-pressure CO_2-laser emitting single-mode pulses of 0.1 J energy and 1 μs duration. An iris was inserted in the resonator cavity, one sphenoidal Ge-plate positioned at the Brewster angle polarized the laser beam in the vertical plane while reflecting it, and another sphenoidal Ge-plate split it. Energy and intensity ratio were monitored by an IMO-2 radiation power meter, a BaF_2-lens with a focal of 300 mm and a relative aperture of 1:48 formed a point source in the focal plane of the tested objective, and another lens served as Fourier objective. After chemical processing of the hologram, the wavefront was reconstructed at the 0.63 μm wavelength by means of coherent optics and the intensity distribution was measured. The two-dimensional modulation transfer functions and the defocusing point scattering functions were then calculated with the aid of fast Fourier transformation. The error did not exceed 7%. Figures 2; references: 4 Russian.

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UDC 535.854

PHASE CORRECTION AND CONDITONS FOR ITS ACHIEVEMENT IN FOURIER SPECTROMETER

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST in Russian No 6, Jun 86
(manuscript received 12 Nov 85) pp 1-3

[Article by Ye.M. Sharov, O.A. Snetkova, B.V. Vylegzhanin, and
V.I. Kartushin]

[Abstract] An algorithm of phase correction, necessary for satisfactory performance of Fourier spectrometers, is constructed on a rigorous mathematical basis and the conditions for its implementation in the Soviet-made LAFS-50 instrument are established. The algorithm is designed to minimize displacements on the adjustable interferometer mirror as well as the data processing on an M-4030 minicomputer. Its gist is calculating the phase distortion $\phi(k) = \phi_0(k) + \phi_1(k) + \phi_2(k)$ (k- wave number) on the interferogram I(x) (x- path difference), where $\phi_0(k)$ is the nonlinear component of phase distortion caused by interferometer asymmetry resulting from different thicknesses of light-beam splitter and compensator as well as by frequency and phase distortions in the signal receiver-amplifier channel, $\phi_1(k)$ is the linear component of phase distortion caused by quantization of the interferogram with the absolute maximum I_0 reading as the initial one, and $\phi_2(k)$ is the linear component of phase distortion caused by quantization of the interferogram with an arbitrary I_n reading as the initial one. The correct phase is then calculated with the aid of discrete Fourier transformation. The algorithm and its programming have been checked for accuracy against the analytical model of a spectrogram as well as against typical real spectrograms obtainable with Fourier spectrometers. Figures 3; references 11: 5 Russian, 6 Western (3 in Russian translation).

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CSO: 1860/30

UDC 621.373.536

THERMOOPTICAL ABERRATIONS IN MIRRORS WITH CENTRAL HOLE

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST in Russian No 6, Jun 86
(manuscript received 22 Jul 85) pp 8-11

[Article by Ye.V. Truneva and S.I. Khankov]

[Abstract] Thermooptical aberrations in parabolic and spherical mirrors with a circular center hole, principal components of reflection telescopes, are analyzed for focus displacement in accordance with laws of geometrical optics. General relations are established for a long-focus parabolic or spherical mirror with a paraxial radius of curvature such that the mirror can be replaced, with only a small error, by a disk with center hole.

Mounted in a circular frame, it absorbs radiant heat on the inside surface. The mathematically most difficult case of radial heat transfer into the hole and through the periphery into the frame is considered, assuming steady-state conditions with the incident thermal flux uniformly distributed over the inner mirror surface from hole to periphery and isotropic thermophysical properties of the mirror material. The solution to the corresponding boundary-value problem is used for calculating the deformation of the inner mirror surface, in the case of free thermal expansion, and the attendant focus displacement. Figures 2; tables 1; references: 4 Russian.

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UDC 535.512:527.8

TWO-MIRROR SCANNING SYSTEM

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST in Russian No 6, Jun 86 (manuscript received 20 Nov 85) pp 11-13

[Article by N.A. Agapov]

[Abstract] A scanning system which consists of two plane mirrors is considered, each mirror oscillating about its axis of symmetry according to a different specified law of motion and the two axes remaining in fixed positions mutually perpendicular. Vector analysis of the motion of mirrors in corresponding two systems of Cartesian coordinates and analysis of the path of light rays yield the relation between configuration of mirrors and resulting raster. An example are two square mirrors 200 mm apart center-to-center, each oscillating sinusoidally, scanning a target surface 10 km away along the azimuth and the elevation respectively. Figures 3; references 8: 6 Russian, 2 Western (in Russian translation).

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UDC 681.786.3

OPTICAL SYSTEM WITH THREE-DIMENSIONAL HINGE

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST in Russian No 6, Jun 86
(manuscript received 23 Sep 85) pp 13-16

[Article by M.P. Kolosov]

[Abstract] A high-precision optical goniometer is described which features a three-dimensional optic hinge carrying two special reflector prisms and two photoelectric rotation angle transducers. This arrangement eliminates the conventional collimator and allows combining several autocollimators into one without increasing the 1" error. The five goniometer components which determine its configuration are two mounts, a stationary horizontal one and a movable vertical one, two sets of a coded dial disk, a BR-180° prism between two 90° prisms, and a pentaprism, one set on each mount, and the autocollimator. The hinge consists of these two mounts with wedges under the dial disks. The autocollimator includes a light source, a condenser consisting of two lenses (planoconvex - convexoplane) with a rack carrying four interchangeable selective light filters between them, a diaphragm with a pinhole, a light-beam splitting cubic prism, a long main prism, an objective, and a coordinator behind the light-beam splitter. The geometrical design and the optical performance of this goniometer are analyzed on the basis of expressions for 11 relevant direction cosines in the conventional approximation. The autocollimator and the transducers feed data to a computer for processing and solution of 8 equations of the goniometer problem. Figures 4; tables 1; references 6: 5 Russian, 1 Western.

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CSO: 1860/30

UDC 621.383.932.049.47:681.7.013.84:771.3

INSPECTION OF INTEGRATED CIRCUITS FOR AUTOMATIC FOCUSING ATTACHMENTS TO CAMERAS

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST in Russian No 6, Jun 86
(manuscript received 18 Jul 85) pp 21-23

[Article by K.N. Kasparov, V.I. Sergeyev, and S.Yu. Rakhley]

[Abstract] The problem of quality control of the KA1808VV3 automatic focusing attachment to cameras is analyzed, this device operating by the comparison method and its photoelectric channel being built on an integrated-circuit chip. Five pairs of photodiodes, in two linear arrays of five, sense the illumination distribution over elements of the photographed object and transmit signals through two pairs of logarithmic amplifiers to five differential amplifiers. The output signals of the latter are added

in a summator and the resultant signal passes through a peak detector to the output stage of the focusing device. The focusing signal depends nonlinearly on the illumination and thus also on the wavelength of light, inasmuch as the photodiodes are silicon devices. An important factor is that their sensitivity peaks within the near-infrared region of the spectrum (λ_{max} = 850 nm), the fraction of infrared radiation being quite large in daylight as well as in the light of incandescent lamps. It therefore is important to monitor the parameters of those integrated-circuit chips. Measurements to this effect were made experimentally under an MBS-200 microscope, with a KGM-100 halide lamp and a revolver mechanism driving an array of interference filters, a cassette containing interchangeable neutral filters, and two opaline glass plates. Figures 3; references 5: 3 Russian, 2 Western.

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UDC 621.383.4:771.376.3

PHOTORESISTORS FOR EXPOSURE METERS USED WITH CAMERAS

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST in Russian No 6, Jun 86
(manuscript received 24 May 85) pp 23-26

[Article by V.L. Poltorak, O.P. Polyakov, V.A. Potsar, and L.L. Khrenov]

[Abstract] Two photoresistors, the first ones of their kinds commercially produced in the USSR for exposure meters, are the double-decker FR-119 in a metal-glass case and the miniature bare FR-121. Their performance characteristics, namely resistance-illumination characteristic over the 10^{-2}-$1.6 \cdot 10^{3}$ lx range and its degree of linearity, photocurrent rise time, photoresistance stability, spectral sensitivity characteristic, and thermal expansion as well as basic design parameters including overall geometrical dimensions are compared with those of Japanese photoresistors for cameras Olympus XA, Minox 35 GL, and Canondeit. The outstanding feature of both photoresistors is an almost linear resistance-illumination characteristic with an almost 1 kohm/lx slope, necessary for cameras with automatic exposure time control. Figures 4; tables 1; references 6: 4 Russian, 2 Western.

2415/9835
CSO: 1860/30

UDC 681.7.028

INSPECTION AND ADJUSTMENT OF VIEWFINDERS FOR REFLEX CAMERAS BY MEASUREMENT OF OFF-AXIS DEFOCUSING

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST in Russian No 6, Jun 86 (manuscript received 29 Jul 85) pp 28-32

[Article by P.A. Sannikov and V.T. Gordeychik]

[Abstract] A new method is proposed for inspecting and adjusting the viewfinder with a reflex camera, this method not requiring a breakdown of these operations for each viewfinder component separately. Since viewfinders for modern reflex cameras contain a focusing screen, the method is based on measurement of its defocusing at four points symmetric with respect to, but not on, the viewfinder axis and then calculating the angle the viewfinder axis makes with a normal to the focusing screen as well as the misalignment between the focusing plane and the focal plane of the camera objective. Five versions of PKN-4 instrument have been developed and built with standard components for implementation of this method with cameras Kiev-88 (PKN-4-00M), Kiev-65 (PKN-4-01M), Kiev-20 (PKN-4-02), Almaz (PKN-4-03), Zenit (PKN-4-04) respectively. Each consists of a measuring microscope, a reading microscope, a mirror-switch from one to the other, three luminaires, and an intricate optico-kinematic system. The instruments are designed for eventual automation of their operation with the aid of a minicomputer. Figures 4; tables 1; references: 10 Russian.

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UDC 535.8.666.189.2

METHOD OF MACHINING ENDS OF OPTICAL FIBERS

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST in Russian No 6, Jun 86 (manuscript received 4 Apr 84) pp 39-41

[Article by G.G. Zubyuk, A.I. Ivachevskiy, Yu.G. Vulchin, and A.S. Smereka]

[Abstract] The electric-spark process of machining the ends of optical fibers is known to have distinct advantages over conventional mechanical machining methods, individual treatment of fibers yielding and surfaces of high optical quality. Internal stresses spread over a relatively long but finite fiber segment and microcracks form within the region adjacent to the end surface after cleavage, however, which can lower the strength and the reliability of a fiber. The feasibility of minimizing the deficiency by machining with electric-arc pulses was studied in an experiment using a special apparatus on fibers 140 μm and 160 μm in diameter for optical

communication lines. The equipment included a shaper of high-voltage pulses (amplitude 2.5 kV, duration 35 ns) and a G5-54 pulse generator controlling their repetition rate, also a timer, a two-stage frequency divider, a power supply, and an S1-79 oscillograph. The two electrodes were separated to form a gap 180 μm wide for 140 μm fibers and 200 μm wide for 160 μm fibers. The pulse repetition rate was varied over the 1-3.2 kHz range. After treatment the fibers were examined under an MII-12 microinterferometer. Their surfaces roughness was found not to exceed 0.03 μm, with both planarity and perpendicularity of the end surfaces within 0.4-0.7°. The optimum number of pulses was found to be within the $(2.5\text{-}3.3)\cdot 10^4$ range, fewer pulses producing excessive waviness and more pulses producing excessive shear stresses. The optimum repetition rate is accordingly 3.2 kHz, more heat escaping at a lower one. Thinner fibers are machined more evenly, because of a more uniform heating. Figures 2; references 3: 2 Russian, 1 Western.

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CSO: 1860/30

UDC 65.011.56:681.787

MEASUREMENT AND COMPUTATION COMPLEX FOR PROCESSING INTERFEROGRAMS

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST in Russian No 6, Jun 86 (manuscript received 26 Sep 85) pp 43-45

[Article by M.A. Gan, S.I. Ustinov, S.G. Dolgikh, and V.V. Kotov]

[Abstract] A measurement and computation complex for semiautomatic processing of interferograms is described, its basic components being a DIP-1 instrument with an Elektronika D3-28 microcomputer and an SM-4 minicomputer. The instrument stores data in the microcomputer memory while reading an interferogram and, after the readout has been completed, all data are transferred to the minicomputer for processing according to the INTERF program written in FORTRAN. Aiming at the centers of interference fringes is done visually, with the aid of an UIM-29 microscope included in the DIP-1 instrument complex. Peripheral equipment includes an instrument bench, a microcomputer terminal and Konsul interface to a BESM-6 high-speed computer, a minicomputer terminal, magnetic disks, and an alphanumeric printer. The software includes coordinates measuring programs written in BASIC, proximate analysis programs, and data transfer to the INTERF minicomputer software. The latter consists of programs for data acquisition and conversion, wavefront calculation and analysis on polynomial basis, and diffraction analysis. These programs are executed in the dialog mode, with first-level instructions HELP, SET, FRING, FORM, SPOLY, DIFRA, STOP. The complex can process 15-20 interferograms daily. Figures 2; references: 3 Russian.

2415/9835
CSO: 1860/30

UDC 681.128.087

STATE OF ART AND OUTLOOK FOR DEVELOPMENT OF FIBER-OPTIC LEVEL TRANSDUCERS

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST in Russian No 6, Jun 86
(manuscript received 31 Oct 85) pp 51-56

[Article by A.T. Akhmadiyev, E.N. Belotserkovskiy, and A.L. Patlakh]

[Abstract] Liquid-level measuring devices for control of processes must be highly sensitive and linear, simple in construction for easy installation, setting, and maintenance, small in size and weight, very reliable and resistant to external factors. These requirements are generally satisfied by fiber-optic devices operating either as data transmitters or as sensing elements. The first group includes visual and interspatial ones, also those with an optic element such as a prism or a waveguide as sensor. The second group includes contactive, bent, and longitudinally irregular ones. The operating principle as well as the distinctive design and performance characteristics of each are reviewed, considering specific applications, technological advantages and constraints, and development trends. Figures 11; references 55: 24 Russian, 31 Western (4 in Russian translation).

2415/9835
CSO: 1860/30

SOLID STATE CIRCUITS

UDC 681.142.16.019

SIMULATION OF MULTILEVEL INPUT MAJORITY GATES USING INJECTION LOGIC STRUCTURES

Tashkent IZVESTIYA AKADEMII NAUK UZBEKSKOY SSR: TEKHNICHESKIYE NAUKI
in Russian No 3, May-Jun 86 (manuscript received 13 Dec 84) pp 3-6

[Article by A. Akhmadzhanov, S.A. Davimuka, V.S. Lyamin and Yu.V. Spekh,
Uzbek Scientific Production Association Kibernetika, UzSSR Academy of Sciences]

[Abstract] A mathematical model of an I^2L multilevel input majority gate takes the form of a system of differential equations requiring the use of nonlinear models for the circuit structures. The multiple collector I^2L elements are represented by a set of bipolar transistors and the injection coupling between the structures is considered by using DC sources. The nonlinear model for the bipolar transistors was the transfer function model of Ebers and Moll, since it is the most convenient for CAD applications in I^2L circuit analysis. The proposed model for such majority gates is applied to the sample case of a three-input gate, each input having levels of 0, 0.25, 0.5, 0.75 and 1.0 mA. The input and output waveforms are shown to illustrate the operation of the test circuit with the particular combination of input signals. The transient response simulation time on a YeS-1022 computer for the first millisecond is 40 to 50 minutes; the number of integration steps is 250 - 300 and the number of Jacobi matrix computations is 480 to 620. The proposed procedure can readily determine such majority gate performance as, primarily, the precision and speed. The simulation results are in good agreement with experimental data in Soviet literature. Tables 1; figures 2; references 8: 7 Russian, 1 Western (in Russian translation).

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UDC 621.382.011.222

REDUCING SPECIFIC POWER CONSUMPTION OF LSI ELECTRICALLY PROGRAMMABLE READ ONLY MEMORIES BY MEANS OF THYRISTOR STRUCTURES

Moscow RADIOTEKHNIKA in Russian No 10, Oct 86 (manuscript received after revision 8 Apr 86) pp 23-26

[Article by P.S. Prikhodko and Yu.I. Shchetinin]

[Abstract] The most widespread types of Soviet EPROM's are the 1 and 4 Kbit Schottky TTL KR556RT4A and KR556RT5A, respectively. Programming is accomplished by the selective destruction of thin film nichrome jumpers with current pulses of up to 60 mA. This paper shows that the requisite programming current cannot be developed while retaining a fixed power level as the level of integration of the IC's increases. The most expedient solution is the use of four-layer controlled thyristors (p-n-p-n structures) in the required decoders. They enable an increase in the ratio between the control and load currents during the programming without increasing the circuit complexity or changing the size of the components. This approach has made it possible to create a number of new fast EPROM LSI circuits that extend the KR556 series while reducing the specific power consumption and keeping the chips small. The new IC's, KR556RT12/13, KR556RT14/15 and KR556RT18, have memory capacities of 1K x 4, 2K x 4 and 2K x 8 bits, respectively, with an addressing time of 60 ns and specific power consumption levels ranging from 0.152 to 0.55 mW/bit and specific areas of $2.41 \cdot 10^{-3}$ to $1.06 \cdot 10^{-3}$ mm^2/bit. The semiconductor structure of the thyristor switches and the volt-ampere characteristics are shown. Figures 4; references: 4 Russian.

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