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Calculation and development of the measuring amplifier with self-scaling

Abidova G.Sh., Zaripov O.O.

Senior researcher, Department of Intellectual engineering systems, Tashkent State Technical University, Tashkent, Uzbekistan

Professor, Department of Intellectual engineering systems, Tashkent State Technical University, Tashkent, Uzbekistan

ABSTRACT: In given article are considered questions of the making the amplifier with self-scaling. Due to entering of self-scaling, appears the possibility of the determination of the composition analysed mixture with small relative inaccuracy, both main material, and microimpurity. At present goes the tempestuous development nanotechnology, which use present from itself executive device, which sizes are found in nanometre range. And accordingly, controlling elements must be else less. Thence follows that material, used at fabrication these executive element must be specifically cleaned. Since, presence practically small admixtures, will provide in its queue to significant change parameter executive element. Get specifically cleaned material with percent contents of the admixtures less 10^{-8}, possible only by means of adsorption installation with big amount used kolinsky. The Amount kolinsky in this installation forms from 500 before 10000 pieces.

KEYWORDS: specifically- cleaned material, nanotechnologies, measuring amplifier with self-scaling, analog-to-digital converter.

I. INTRODUCTION

Chemical production management and execution varied research work on chemistries or chemical technology is founded on rationally built system chemist-analytical checking both separates stage, and the whole process as a whole. Exhausting information on condition of the observed system, its composition (element and phase), about characteristic of the got products, their construction, presence in them admixtures, etc. possible only when use registering, signalizing, blocking, computing and controlling machines and instrument, often being complex electronic system.

In public facilities at determination often or division with different component gas or liquids are used adsorption installation. Practically in all branch food and chemical industry for determination quality produced product is used adsorption installation.

II. PROBLEM DEFINITION

For entering and data processing on output adsorption installation on personal computer is without fall used analog-to-digital converter. When data processing by digital method of different importance's of the input signal, importance of relative inaccuracy can form from 20-60%, under small input signal. So we offer to use the amplifier with self-scaling.

In spectrometer of the nucleus radiations to intensifying cascade are presented hard requirements on stabilities, linearity's, speed and noise.

Traditionally, such amplifiers developed on transistor, getting typical importance's of instability gain factor $5 \cdot 10^{-5}\ ^0$C, integral not linear 5.10-4, time of the groth 50 nanoseconds and noise, ed about entry, 5 mV under generally accepted in spectrometry shaping passband amplifiers. Measurement of the spectrum amplifiers with like parameter are released beside foreign companies.

The first designed batch fabricated opa-amp could not provide such features. The main their defect was shown big time of the groth, exceeding 1 microseconds [1]. With appearance of the quick opa-amps, having velocity of the groth > 10 V/microseconds [2], appeared the hope to create on their base measurement of the spectrum to amplifiers comparable on quality with transistor. Our purpose was shown study parameter intensifying cascade on quick opa-amps.

There were explored not inverting intensifying cascades on opa-amps K140UD11, 154UD3, 154UD4, K544UD2, K574UD1 at gain factor 10 in dynamic range 10V. In opa-amps were used standard frequency correction and balancing [3]. As output amplifier to powers of such cascade when functioning on cable was used emitter repeater on transistor KT315V with initial current 4 mA, enclosed in chain to feedback. In chain to parallel feedback were an applying

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resistors S2-29V with nominal value 500 Om and 5 kOm. For comparison result were organized such measurements transistor intensifying cascade, similar described in work [2].
Change of time of the groth, definied as front of the output pulse of the voltage of the cascade on level (0,1-0,9) Umax by means of standard generator and oscilloscope does not present the difficulties. The measured average time groths is given in table.
In recommendation [4] is specified range of the change the value to capacities to frequency correction.

Table 1.

	Transistors	
Type of the opa-amp	*T, nS*	*C, pF*
K140UD11	250	5,1
154UD3	150	5,1
154UD4	220	10
K544UD2	350	51
K574UD1	300	5,1
transistor cascade	50	2

In table 1 is brought selected importance of the capacity, under which was absent the surge on connecting feature. For K140UD11 and K544UD2 are used maximum importance's of the capacity, however surge on connecting feature ed. It Was measured on 5-7 copies of each type. The Scatter of time of the groth ≤ 20%.
The measurement level noise was conducted on methods, offered in work [5]. At measurement of the noise was used shaping passband integrating and differentiating integer since equal constant time. The Scatter of the features for miscellaneous copy one type 10%. Possible see that beside different types of the opa-amps noise greatly differs and exceeds the noise of the transistor cascade.
Instability and not linearity gain factor was measured specially designed by method with miscellaneous variant. Final importance result has formed 50 mV. Not linearity all active element with the exclusion of K140UD11 and 154UD2 does not exceed $10^{-4.}$ For opa-amp 154UD11 and K544UD2 its value gets to $3 \cdot 10^{-4}$ that is conditioned presence of the surge on connecting feature.
The Input voltage of the analog-to-digital converter must vary from 1 V before 10 V, at importance of the input signal less 1 V, relative inaccuracy increases so this article is dedicated to development of the amplifier, which will provide change the input signal within from 1 V before 10 V. Usually in practice [6] attitude greatly and minimum correlations of the contents material in mixture c miscellaneous component is:

$$\frac{m_{max}}{m_{min}} = 1000 \cdot$$

Considering that attitude $U_{вх\ max}/U_{вх\ min} = 10$.

Coming from above brought circumstance attitude gain factor maximum ($K_y$max) to minimum gain factor will:

$$\frac{K_{ymax}}{K_{ymin}} = 100 \cdot$$

So at development of the amplifier with programmed gain factor we choose

$$K_{y\ max}/K_{y\ min} = 128$$

since in under development amplifier measurement gain factor will be produced in binary code. Us are designed differential measuring amplifier, providing at arrival of the digital command determination for time 15 microseconds any one of eight importances gain factor, changing on binary law within from 0,5 before 64. The amplifier works

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within the range of frequencies before 200 kG with input (output) by signal 10 V under not linearities of the feature of the amplitude 0,02 %.

III. SOLUTION OF THE TASK

In technology relationship, at radio location, seismic study and technology of the nucleus experiment necessary transacter with broad range of the input signal. Usually, this requirement is satisfied with cut-in in composition device amplifier with nonlinear of the amplitude by feature [7]. Suitable for such using is an amplifier with digital programming gain factor [8]. However conservation of the high speed when increase gain factor is provided by essential complication of the scheme of the amplifier, for instance building specialized input cascade if this measuring amplifier with differential input. Scheme of the differential measuring amplifier is presented on fig. 1 with digital programming gain factor.

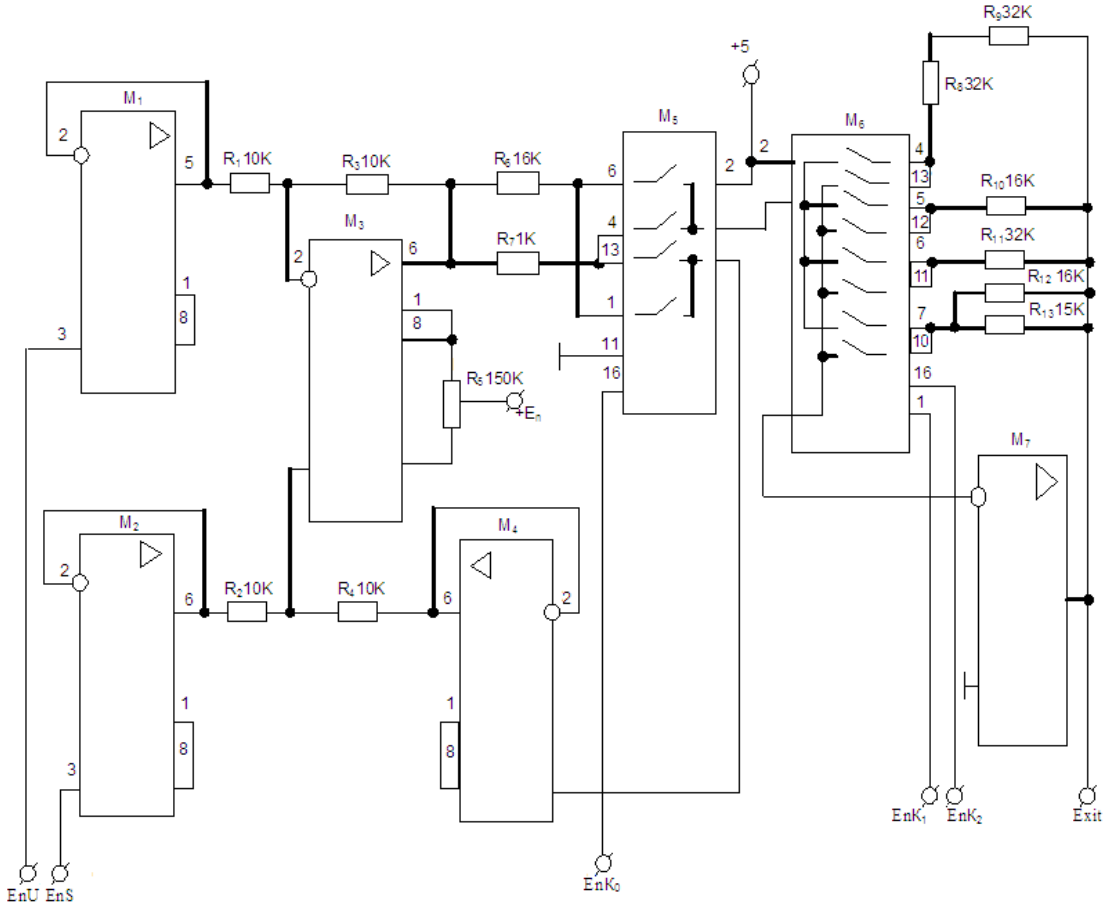

Fig.1. Principle scheme programmed differential amplifier

Dependency gain factor is excluded In scheme from resistance of the key that allows to avoid the individual tailoring of each importance of the reinforcement.

The Amplifier consists of consecutively united converters: converter of the voltage in current and converter of the current in voltage, run for opa-amps and resistor divisor. The discrete transistors are absent In scheme. The Input converter of the voltage in current is built on modified scheme Haulenda [3], on opa-amp M3 output which united with inverting entry through resistor divisor of the voltage R1, R3, forming circuit to negative feedback. Current leaving the converter united with not inverting entering the opa-amp through resistor R6 or R7. The Choice and connection of the

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resistor are realized with the help of analog commutator M5. This choice is fixed one of two things possible importances of the factor of the transmission of the converter of the voltage in current. Under equal importances of the resistances resistor divisor R1 R4 factor of the transmission is defined by expression

$$K_{c.v.c} = \frac{I_{exit\ c.v.c}}{U_{entry} - U_{entryU}} = 1/R_i\ , \qquad (1)$$

where I_{ex} - an output current of the converter; U_{en}, U_{en} - a voltages on its not inverting and inverting entry; R_i - a resistance resistor R6 or R7.

For exception of the influence of the key of the commutator M5on gain factor for connection of each resistor are used two keys. Through one key - potential - is provided join for the reason positive feedback, through other - current - is connected the load to leaving the converter. Potential is connected directly to leaving the resistor R6 or R7 before current key.

Thereby, current key is part of loads, resistance which under it is enough high exit resistance converter of the voltage in current practically does not render the influences upon value of the output current. For improvement of the features of the converter in chain to positive feedback is incorporated repeater of the voltage on opa-amp M4, separating potential keys and rezistor divisor. Herewith on the one hand due to small value of the input current and high input resistance of the opa-amp is excluded passage of the current through potential key of the commutator M5. With provision for absences of the remaining voltage beside key on field transistor such cut-in practically completely avoids the influence of the key on accuracy of the converter. On the other hand, enabling the repeater of the voltage prevents the passing of the current resistor divisor R2, R4 on leaving the converter that not only perfects its determined feature, but also provides high importance of the factor of the weakening of the input inphase voltages. For increase the input resistance device in it are incorporated else two repeaters of the voltage on opa-amps M1, M2, separating not inverting and inverting divisor positive and negative feedback. The Converter of the current in voltage is built on opa-amps M7, between inverting entry and output which is included resistor, prescribing gain factor. Not inverting entering the opa-amp is connected to the unibus that provides the zero voltage on inverting entry, to which enters the output current of the converter of the voltage in current. In this case factor of the issue of the converter of the current in voltage

$$K_{c.c.v} = \frac{U_{exit}}{I_{entry}} = R_j, \qquad (2)$$

where Uex - a voltage on leaving the amplifier, Ri- resistance of the resistor, included between output and inverting entering the opa-amp M7. As such resistor are used resistors R8÷R13.

Table 2

Gain factor		*Logical condition*		
		EnK_o	EnK_1	EnK_2
K_1	0,5	1	1	1
K_2	1	1	1	0
K_3	2	1	0	1
K_4	4	1	0	0
K_5	8	0	1	1
K_6	16	0	1	0
K_7	32	0	0	1
K_8	64	0	0	0

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In scheme of the converter of the current in voltage are provided four importance's of the factor of the issue, installed by analog commutator M6, the connecting resistors R8÷R13 with leaving the opa-amp M7 through potential keys and with leaving the converter of the current in voltage - through current. Herewith output voltage of the opa-amp M7 is defined by fall of the voltage on resistor R8÷R13 only and is excluded influence of the resistance keys.
In scheme are used resistors only two multiple nominal values 16 and 32 lumps. Four importance's of the resistance are received to account of the use consequent (R8, R9) and parallel cut-in (R12, R13) resistor.
Gain factor of the described amplifier

$$K_u = K_{c.c.v} K_{c.v.c.} = R_j/R_i \quad (3)$$

In the same way product corresponding to importance's gain factor is defined total number of the importance's gain factor. For scheme, submitted for fig.2, such importance's will be eight.

In table 2. are brought dependency of importance gain factor from logical conditions on entry of governing the amplifier. The Diagram of the change the input voltage of the analog-to-digital converter is shown on fig. 2.

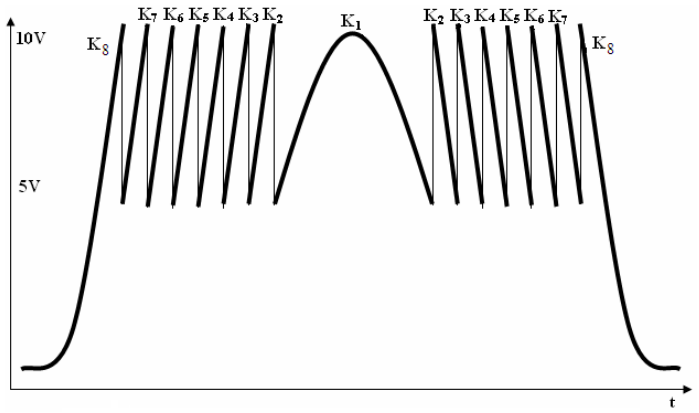

Fig. 2. Diagram of the change the output signal of the amplifier with self-scaling

Due to positive feedback output resistance converter of the voltage in current is saved high in specified issue factor range and is defined by expression

$$R_{exit} \approx 0{,}5K_{oa.}R_i \,, \quad (4)$$

where K_{oa} - a gain factor open opa-amp M3. If $K_{oa} >> K_u$ that is usually kept, that is executed condition

$$R_{exit} >> R_j \,. \quad (5)$$

Due to this opa-amp M7, on which is built output converter of the current in voltage, works practically with 100% by negative feedback in broad range of importance's gain factor. The passband M7 is herewith saved on greatly possible level and little depends on gain factor that explains the good frequency characteristic of the amplifier in contrast with the other scheme. Practically reduction of the value gain factor opa-amp with growing of the frequency brings about breach of the conditions (5), and frequency characteristic of the amplifier grow worse.
The analysis of the scheme of the amplifier shows that its transmission feature close to feature oscillatory section [4] with parameter of the fading, close to unit within the range of importance's gain factor 1÷100. At reduction passband with increase gain factor pro rata root square this increase, but surge in amplitude-frequency feature in the field of upper border passband minimum that provides small time of the determination of the connecting feature in broad range of importance's gain factor.

The parameters of the amplifier range in phase input voltages ±10V; the range of the differential input voltages 10V; the input voltage on frequency f = 110 kHz - $7 \cdot 10^5$ Om; the border frequency at full power > 200 kHz under k=0,5÷ 64; the factor of the weakening of the inphase input voltages on f =50 Hz - 80 dB under k=0,5. The range of the output voltages; nonlinearity amplitude of the feature of the factor of the issue < 0,02 % under k=0,5÷64; time of the

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determination of the output voltage ±10V with inaccuracy δ =0,1% - 10 ms under k=0,5÷1 and 20 ms k=64; time of the determination of the output voltage with δ =0,1% when switching factor issues -15 ms voltage power source ±15 V.

IV. CONCLUSION

The realization designed measuring amplifier increases the application of the computing machinery in different area public facilities. Besides increases the application a managerial system in working conditions of the reception specifically-cleaner material at presence not stochastic uncertainties, having ill-defined, overbroad nature and raises the quality of the processes of management. When use the amplifier with self-scaling vastly increases the range of management technological object. Besides, considering that relative inaccuracy is fixed at lectern- digital transformation to equal half of importance of the younger category. Using designed amplifier possible vastly to reduce absolute inaccuracy.

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AUTHOR'S BIOGRAPHY

Abidova Gulmira Shuxratovna - Senior researcher in Department of "Intellectual engineering systems", Tashkent State Technical University, named after Abu Raikhan Beruni. More than 16 scientific articles in scientific and technical journals and publications.

Zaripov Oripjon Olimovich – Doctor of technical sciences, Professor of Department of "Intellectual engineering systems", Tashkent State Technical University named after Abu Raikhan Beruni. Author of 2 monograph, more than 5 textbooks, 8 patents and more than 180 articles in scientific and technical journals and publications.