ANALOG INTERFACE FOR TRANSMITTING THE MEASURED INFORMATION ON THE BASIS OF SMU TECHNOLOGY

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In the present article, a new way of building an analog interface connection among industrial measuring controllers is discussed. The analog interface is realized on the basis of a compact scheme based on SMU technology. By means of program commutation depending on the needed requirements, the outgoing quantity programs as electricity or voltage. The work of the scheme and its contrariwise relations for the respective conditions are considered. A particular scheme solution is illustrated,which realizes an analog voltage or electricity interface, transmitting the measured information. In the work an analysis is made of the accuracy given for the outgoing quantity - electricity or voltage. The opportunities for expanding the technological options of the suggested solution are analyzed.

Keywords: source-measuring unit, industrial controllers, transmitting information

A basic problem with the modernization of the existing technological measuring systems is the combining of digital measuring controllers of a next generation with existing analog ones (a 4-20mA line for data transmitting) [1]

The article describes a relatively simple schematic solution to that problem.

The concept of development of the existing module is based on SMU (Source Measuring Unit) technology [2] [3]. According to that technology, one of the quantities, current, for example, is set at the output of the module and its dual quantity - voltage is measured. Changes in the types of both the stimulated and the measured quantities should be done when the internal ones of the suggested solution are changed, without interrupting its normal work.

Figure 1 shows the structure of a stimulating measuring configuration in current assignment mode – measuring of voltage - a typical representative for data transmitting along a 4-20mA current line.

If assigned:

$$R4 = R6 = Ri \qquad R5 = R7 = Rf \qquad /1/$$

$$R13 = R14 = Rii \quad R12 = R15 = Rff$$

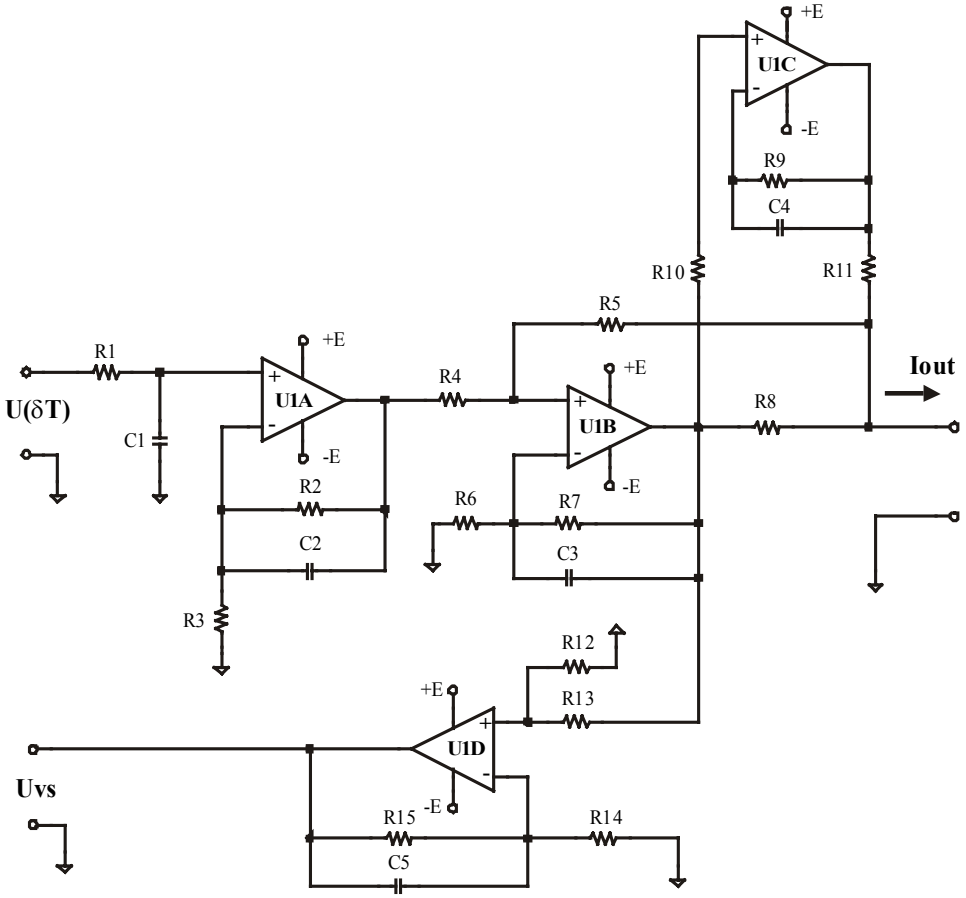

Figure 1 SMU as a current source – measuring voltage

, then the value of the generated output current is:

$$Iout = \frac{2}{R8}.\frac{Rf}{Ri}.\left(1+\frac{R2}{R3}\right).\frac{1}{T}.\int_0^{\delta T} Uinp(t)dt \qquad /2/$$

The value of the measured voltage, causing that current floating in the interface analog line as a reaction of the stimulated circuit, is:

$$Uvs = \left(Uout - R8.\frac{Iout}{2}\right).\frac{Rff}{Rii} \qquad /3/$$

The measured value of the output voltage, when the limiting values of line resistance are defined, shows the condition of that line – a lack of a short circuit or a float circuit.

Another alternative for an analog data transmission is to transmit voltage using analog interface line. Figure 2 shows the configuration in that case.

The value of the output stimulating voltage in the line is:

$$Uout = \frac{Rf}{Ri}.\left(1+\frac{R2}{R3}\right).\frac{1}{T}.\int_0^{\delta T} Uinp(t).dt \qquad /4/$$

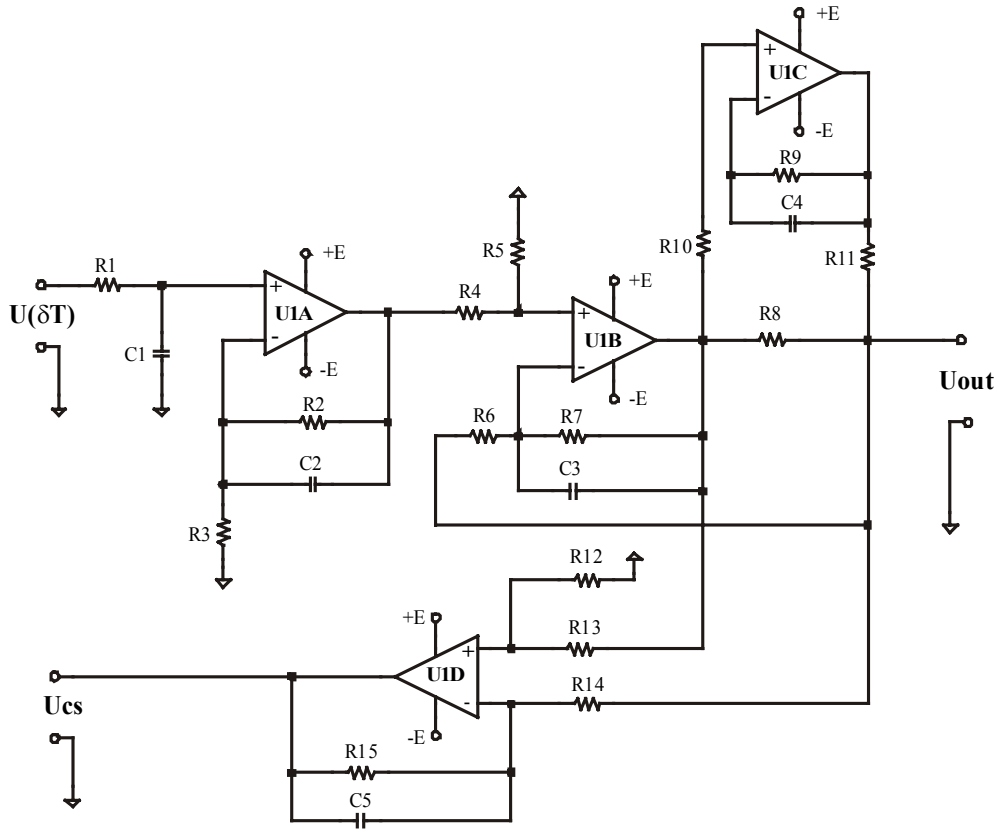

Figure 2 SMU as a voltage source – measuring current

The reaction of the object, which reaction is the floating current resulting from the stimulating voltage, is:

$$Ucs = \frac{Iout.R8}{2}.\frac{Rff}{Rii} \qquad /5/$$

By measuring the Ucs voltage, which is a function of the floating current in the line and knowing the limiting values of the line parameters, an information is obtained about the condition of line.

Another important problem, when an analog data is transmitted, is how the long accuracy of the analog module to be maintained.

That problem is solved by re-configuring the interface module and including in it an option for measuring the value of the generated output quantity without its interruption.

Figure 3 shows the current source configuration for measuring the value of the generated output current.

This configuration is especially useful for testing the option of module to assign the current in the analog interface line in limiting and in case of failure situations.

Another task of the given configuration is to test the transmission coefficient of the stimulating tract..

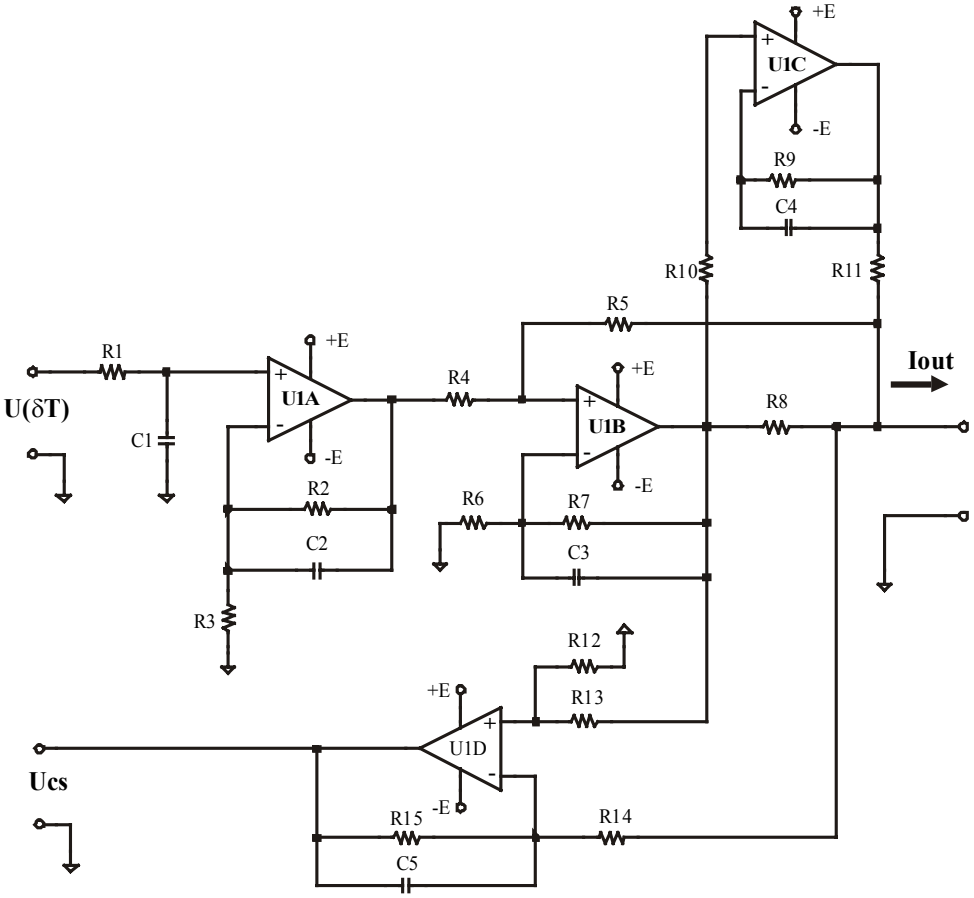

Figure 3 SMU as a current source – measuring current

The assigned value of output testing current is:

$$Iout = \frac{2}{R8}.\frac{Rf}{Ri}.\left(1+\frac{R2}{R3}\right).\frac{1}{T}.\int_0^{\delta T} Uinp(t)dt \qquad /6/$$

The measured value, necessary for the accuracy check of stimulation in a current generation mode, is:

$$Ucs = \frac{Iout.R8}{2}.\frac{Rff}{Rii} \qquad /7/$$

Figure 4 shows a dual method of stimulating tract testing in a voltage stimulating mode.

The assigned value of the output voltage is:

$$Uout = \frac{Rf}{Ri}.\left(1+\frac{R2}{R3}\right).\frac{1}{T}.\int_0^{\delta T} Uinp(t).dt \qquad /8/$$

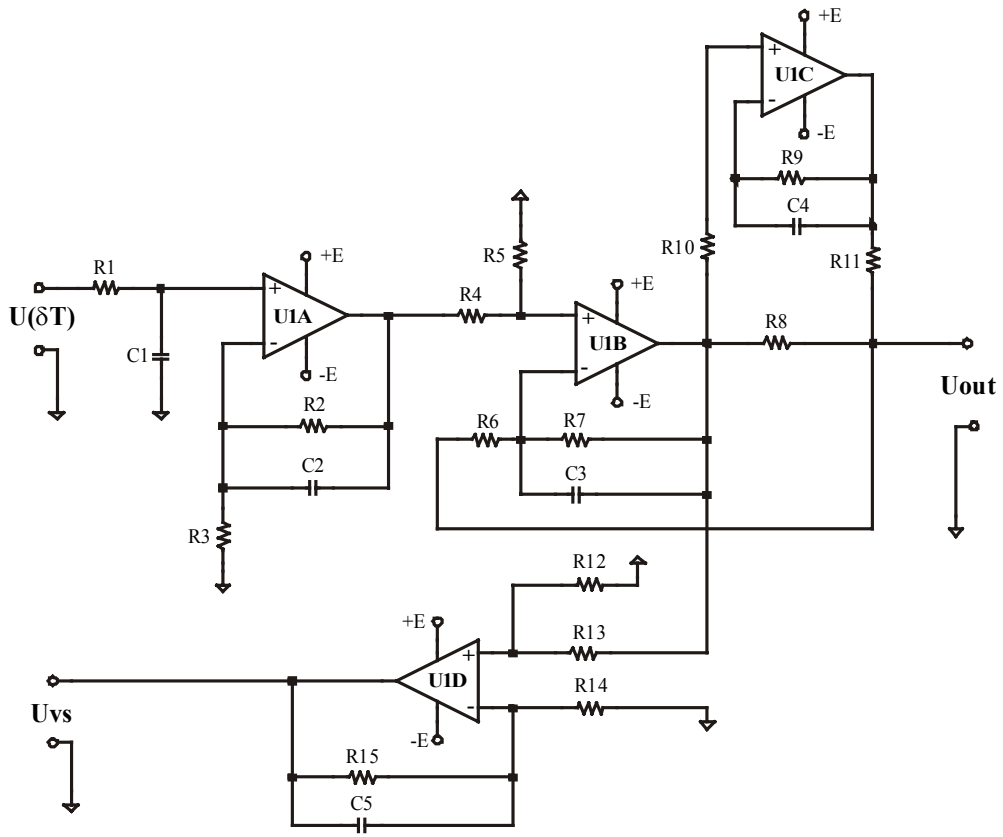

Figure 4 SMU as a voltage source – measuring voltage

The measured value, necessary for the accuracy check of stimulation in a voltage generation mode, is:

$$Uvs = \left(Uout - R8.\frac{Iout}{2} \right).\frac{Rff}{Rii} \qquad /9/$$

The real scheme is shown in figure 5, where the four basic configurations are combined, and an analog multiplexor realizes the commutations of internal analog circuits.

Another important feature of that solution is that it can not only work as a simulator of an analog line, but also as an input device. It is realized by assigning a "zero" value for stimulation and measuring the dual value.

The described SMU module, together with an intelligent sensor or a digital controller with ADC, provides a way of a fast and easy modernization of measuring modules in the fields of industry.

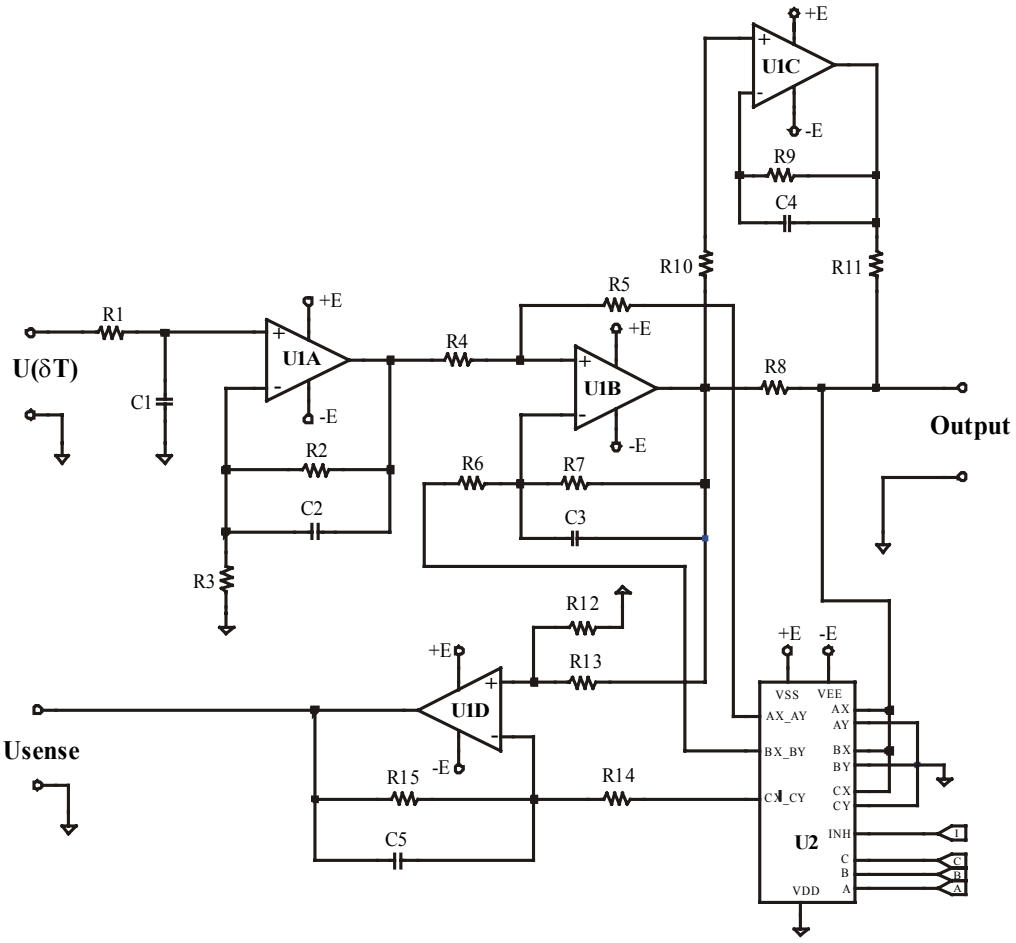

Figure 5 SMU as an analog interface

CONCLUSION:

The article considers a simple solution to combine the new generations of digital controllers and integrated sensors with the existing ones of analog type, that make possible analog data transmitting along a current or a voltage line. Mathematical functions are defined for working in a normal mode and in test only. The special features of the suggested solution for continuous control in process of stimulation of the interface line are shown.

REFERENCES:

[1] Mihov G.S., Todorov D. G. "Mains interference absorbing in industrial controllers", XXXIV International Scientific Conference "Communication, Electronic and Computer Systems'99 " 28 may 1999 , Volume 1, p.326

[2] Todorov D. G. " Low-noise and high effective power Source Measuring Unit",Proceeding of International Scientific Conference on Energy and Information System and Technologies 2001, Bitola, June 7-8 2001, Volume I, p.208

[3] HP-4140 - SMU - Referents manual