

# Computer Modeling as Element of Education and Training

N.A. Korotaev, M.M. Vysocki

Belarusian State University, Nezavisimosci av. 4, 220030 Minsk, Belarus, e-mail: korotaev@bsu.by  
 Belarusian State University, Nezavisimosci av. 4, 220030 Minsk, Belarus, e-mail: vysocki@bsu.by

**Abstract:** *The questions of development and application in educational process of software of modeling are stated: dialogue educational environment of computer support of laboratory works (DEECSLW) and Electronics Workbench (EWB) at study of physical bases of the computer by the students of mathematical specialties of university.*

**Keywords:** Software, modeling, integrated circuits, laboratory works, modules, physics of the computer, blocks (units), device.

## 1. INTRODUCTION

At study of physical bases of the computer by the convenient and necessary tool (as the practice has shown) are the software of modeling, allowing widely to investigate principles of construction, functioning and application of base elements of microelectronics and modern means of computer engineering, elementary and typical digital blocks and devices of the computer. So, for example, at the Belarusian State University at faculty of applied mathematics and computer science to the students fourth (speciality - applied mathematics) and fifth (speciality - computer science, the computer safety) rates is taught discipline "Physics of computers", which is focused on acquaintance of the students with physical bases of computers, in particular - with principles of construction, modes of operations and application of element base, elementary and typical blocks (units) and devices of the computer [1]. For formation at the students of practical skills on the basic questions of investigated discipline the laboratory employment, on which students with the help of program systems of modeling will be carried out: dialogue educational environment of computer support of laboratory works (DEECSLW) and Electronics Workbench (EWB) on computers independently functioning and applications of element base, blocks (units) and devices of the computer practically get acquainted with physical bases of construction. It is necessary thus to note, that the system DEECSLW is developed in the simplified variant for the educational purposes on the basis of professional system EWB of firm "Interactive Image Technologies" (Canada).

## 2. THE SYSTEM DEECSLW

The system DEECSLW represents the interactive tool of the developed modeling of functioning of the logic circuits, blocks (units) and devices of the computer, has modular structure allowing it is easy to update program modules (laboratory works), not requiring on it of essential expenditures of labour. The program system consists of the following modules: the managing module (MM), ensuring loading and preservation of a working table; the module of initial microcircuits (MIM), storing base of initial microcircuits; the editor of elements (EE), intended for construction of the certain circuits on the basis of initial microcircuits; a working table (WT),

including menu, control panel, panel of tools, panel of inputs, panel of outputs, field of accommodation of initial microcircuits, both intended for assembly and study of the given circuits on the basis of the tables of the validity, structural formulas and temporary diagrams; the module "Oscilloscope" (OS), intended for the graphic image of the temporary diagrams of work of the researched circuits of the computer; the module of the help (MH), containing the methodical instruction to laboratory works, algorithms of performance of the tasks, help information on work with program system and list of the necessary literature, and module of check of knowledge (MCK), including control questions and tasks on each laboratory work.

## 3. THE PANEL OF INPUTS OF THE MODULE WT

The panel of inputs of the module WT allows to investigate the assembled circuits in dynamic (pulse) and/or static (potential) modes. The panel of outputs represents model of the panel of indication (luminescence displays logic "1", and - logic "0"). The algorithms of performance of the tasks of laboratory works in system DEECSLW are rather simple and are convenient in operation. So, for example, at construction in basis AND-NOT and research of a function chart of the synchronous multiplexer on 2 inputs in static and dynamic modes, using microcircuits K155LA3 and K155LA6, the following steps of algorithm are carried out: 1) on the basis of the task the table of the validity of the synchronous multiplexer on 2 inputs (Table 1) is made; 2) on the basis

**Table 1. The table of the validity of the synchronous multiplexer**

Synchroinput	Managing input	Information input		Output
		DI <sub>0</sub>	DI <sub>1</sub>	
E	A	DI <sub>0</sub>	DI <sub>1</sub>	DO
1	0	0	X	0
1	0	1	X	1
1	1	X	0	0
1	1	X	1	1
0	X	X	X	0

of the table of the validity the expression boolean of function DO enters the name, which is minimized and it is represented in basis AND-NOT:

$$\begin{aligned}
 DO &= (DI_0 \wedge \bar{A} \wedge E) \vee (DI_1 \wedge A \wedge E) = \\
 &= \text{< in basis AND-NOT >} = \\
 &= \overline{\overline{(DI_0 \wedge \bar{A} \wedge E) \vee (DI_1 \wedge A \wedge E)}} = \\
 &= \overline{(DI_0 \wedge \bar{A} \wedge E) \wedge (DI_1 \wedge A \wedge E)}
 \end{aligned}
 \tag{1}$$

3) On the basis of expression boolean of function (1) the logic circuit of the synchronous multiplexer on 2 inputs in basis AND-NOT (Fig.1):

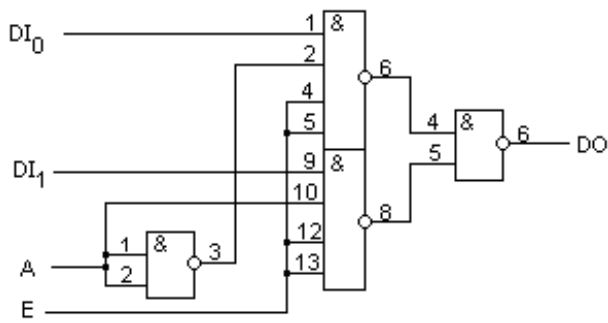


Fig.1 - Functionally - logic circuit of synchronous the multiplexer on 2 inputs in basis AND-NOT.

4) Get out of library of the integrated circuits of a microcircuit K155LA3, K155LA6 and settle down on a working table; 5) manipulations to the graphic editor and performance with its help of the appropriate connections for reception of a function chart of the synchronous multiplexer on 2 inputs according to a Fig.1. Thus synchroinput E, managing input A and the information inputs  $DI_0$ ,  $DI_1$  incorporate to the panel of inputs, and input DO - with the panel of outputs according to a Fig.2:

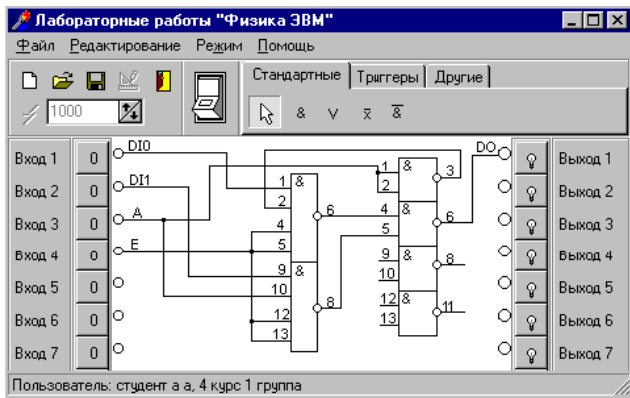


Fig.2 - Functionally - logic circuit of synchronous the multiplexer on a working table.

6) The static mode of researches is established, that "Mode" should be fixed on a working table with the help of the button, and the work of the synchronous multiplexer according to the table of the validity (Table 1) is investigated, for what the circuit in work is included by submission of a potential signal "1" on synchroinput E (Input 4) and move on a managing input A (Input 3) and information inputs  $DI_0$  (Input 1),  $DI_1$  (Input 2) the appropriate potential signals. Thus on visual supervision of indication of an output DO (Output 1) and/or under the temporary diagram is supervised correctness of work of the circuit (as the panel of outputs represents model of a payment of indication, logic "1" - potential (pulse) the signal is displayed as a luminescence, and logic "0"). The temporary diagram can be observed on the screen of model oscilloscope. By results of research enters the name and the table of condition and temporary diagram of work of the multiplexer in a potential mode is kept; 7) the dynamic mode of researches with the help of the button «Mode» is established and the work of the multiplexer on the table of the validity is investigated, for what the actions with pulse signals similar to actions, carried out on a step 6 are carried out. Thus the installation of parameters of entrance signals (duration of a pulse signal, period of its recurrence, inverting) is carried out with the

help of a dialogue window, which is caused by pressing of the right key of the mouse on any of inputs of the entrance panel of a working table. By results of researches enters the name and the temporary diagram of work of the multiplexer in a pulse mode (Fig.3) is kept.

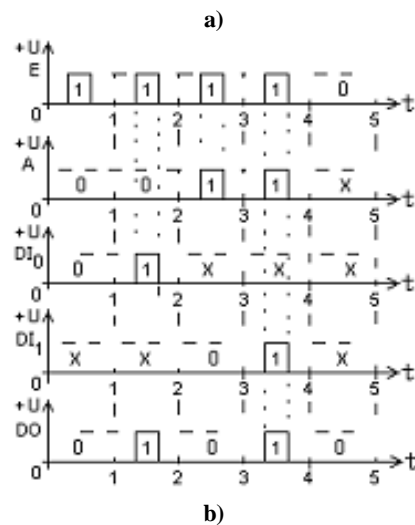
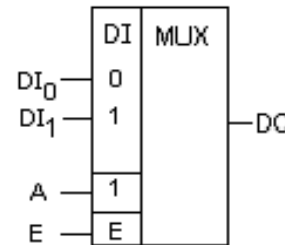


Fig.3 - The synchronous multiplexer on 2 inputs: a) conditional graphic designation, b) the temporary diagram works in a dynamic mode.

On it the research of the synchronous multiplexer on 2 inputs in basis AND-NOT comes to an end.

#### 4. SYSTEM OF MODELING ELECTRONICS WORKBENCH

For deeper (professional) study of element base, blocks and devices of the computer the opportunity of use of professional system of modeling Electronics Workbench is given to the students, which is intended for modeling the analog, digital and analog-digital circuits, and at construction of the given electronic circuit allows: 1) to choose elements and measuring devices from library; 2) to move elements and circuits to any place of the screen of the monitor; 3) to copy to insert or to delete elements, fragments of the circuits; 4) to connect some measuring devices and to observe their indications on the screen of the monitor; 5) to change parameters of elements; 6) to set mode of operations of measuring devices; 7) simultaneously to observe some diagrams; 8) to measure coordinates of points on the diagram; 9) to observe results of modeling on oscilloscope; and row of other opportunities. So, for example, at research of work of the synchronous multiplexer in basis AND-NOT with the help of system of modeling EWB it is possible except for study of work of the multiplexer under the table of the validity and temporary diagram to determine with the help

of the generator of words (GW), oscilloscope (OS) and logic analyzer (LA) frequency, amplitude of a signal (Fig.4 - 6).

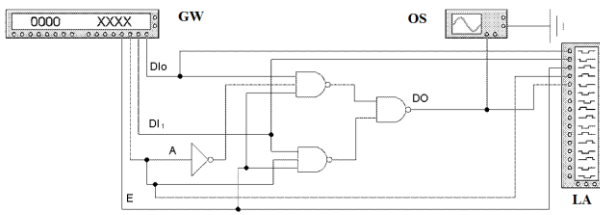


Fig.4 - Function chart the multiplexer in basis AND-NOT.

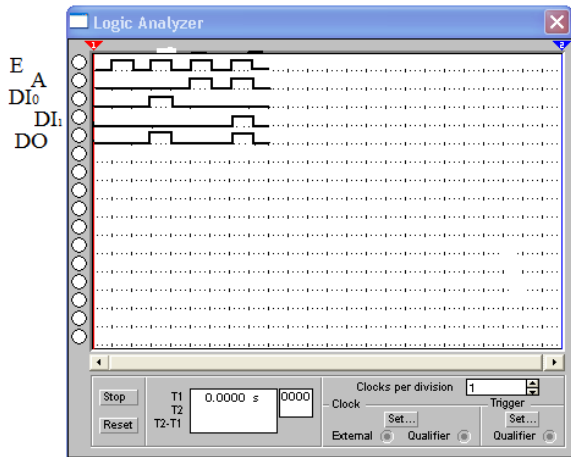


Fig.5 - The temporary diagram of work of the multiplexer on 2 inputs in system EWB.

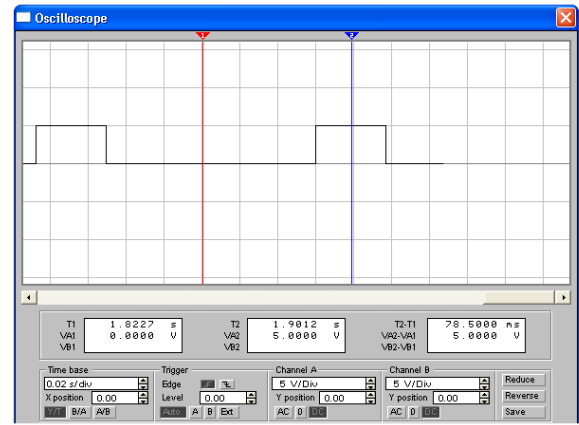


Fig.6 - Measurement of amplitude of a target signal multiplexer with the help OS in system EWB.

## 5. CONCLUSION

Thus, the software of modeling allow in complete volume to investigate physical features of functioning, designing, manufacturing and operation of the analog, digital and analog-digital circuits, representing doubtless interest both for the appropriate experts, and for the educational purposes as an element of education and training.

## 6. REFERENCES

- [1] N. Korotaev. *A technique of teaching of a rate "Physics of the COMPUTER" at faculty of applied mathematics and computer science of the BSU*, Network computer technologies: the collection of works 3 international a scientific conference, Minsk, 2007, pp.131-134.