Laboratory No 1

Investigation of the training 8-bit microprocessor kit

1. The aim of the work

To acquaint with the structure, control and indication facilities of the training microprocessor kit (TMK); to clear up functions of a system monitor.

2. Short description of TMK

2.1. Purpose

TMK is a computer of minimal architecture with the 8-bit microprocessor КР580ИК80А (Intel® 8080) intended:

- for the acquaintance with the structure of the microprocessor system in practice;
- for the investigation of the microprocessor instruction set;
- for providing basic knowledge about possibilities of practical application of microprocessor systems.

2.2. Specifications

Microprocessor type	– КР580ИК80А (Intel® 8080);
Random access memory	– 1 KB;
Non-volatile memory	– 2 KB;
Out of it intended for user	– 1 KB;
Outer interrupts	– 1 vector;
Software	– system program ”Monitor”.

2.3. Control elements

TMK is controlled by a keyboard formed of informational, directional and control as well as mode switching key groups. A hexadecimal 4×4 matrix intended for the input of addresses and data forms an informational group. The names of microprocessor registers are also indicated as group keys.

The following 8 keys form a directional group:

”П” (Memory) – reading / modification of the memory cell contents;

“РГ”(Register) – reading / modification of the microprocessor registers;

“СТ” (Start) – control transmission to the user program;

“КС” (Control Sum) – calculation of the memory array control sum;

“ЗК” (Constant Recording) – filling of the memory field by a constant;

“ПМ” (Array Transfer) – the data array transfer in the memory address field;

“␣” – the space key used for the address increment formation or as a separator introducing two or more addresses;

“ВП” (End) – a key ending the directive.

A general form of the directive line is the following:

“Directive key“ <address or addresses, separated by spaces “␣“> “ВП”.

The following 5 keys form the control and a mode variation group:

“СБ” (Reset) – a reset key. By pressing it control is transmitted to the system monitor;

”ПР” (Interrupt) – a interrupt key. By pressing it the instruction **RST 7** calls the interrupt subprogram, which stores all contents of processor registers and control is transmitted to the system monitor;

“РБ / ШГ” (Operation / Step) – a operating mode switch key. If the switch key is not pressed, the user program will be executed from

the beginning to the end by the automatic mode. If the key is pressed, the program will be executed by a step mode;

"КМ / ЦК" (Instruction / Cycle) – a step length switch key. If the switch key is not pressed, pressing button "**ШГ"** one instruction will be executed. If the switch key is pressed, pressing the button **"ШГ"** one computer cycle will be performed;

"ШГ" (Step) – the button used to perform one step when TMK is switched to the step operating mode.

2.4. Indication facilities

The information input / output operation is performed in the hexadecimal form. A 6-bit 7-segment indicator is applied for its description. If a sign "-", is indicated, the monitor is in a waiting state. Trying to abort the program of a system monitor, the sign **"?"** appears on display.

By working in a step mode, 16-bit address buses, 8-bit data buses and 8-bit state register light binary indication (light emitting diode lines) operate.

From the state register light indication it can be judged what operation TMK operational unit performs at each step. The following states of the operational unit are possible:

1 0 1 0 0 0 1 0 – selection of the instruction;
1 0 0 0 0 0 1 0 – memory reading;
0 0 0 0 0 0 0 0 – recording to memory;
1 0 0 0 0 1 1 0 – reading of the stack;
0 0 0 0 0 1 0 0 – recording to the stack;
0 1 0 0 0 0 1 0 – input;
0 0 0 1 0 0 0 0 – output;
0 0 1 0 0 0 1 1 – interrupt;
1 0 0 0 1 0 1 0 – break;
0 0 1 0 1 0 1 1 – interrupt at the break state.

On the upper wall of TMK there is also the light indication of power supply voltages +5 V, -5 V and +12 V.

Attention! *TMK can be switched on once again only after 10 seconds following the switch off at the earliest.*

2.5. Addressable memory

TMS can directly address 3 KB of memory. Beginning with a zero address, memory is distributed in the following succession:

- non-volatile memory of a system monitor – 1 KB;
- non-volatile memory intended for the user – 1 KB;
- random access memory – 1 KB;
- the last 54 cells of random access memory are intended for the system monitor stack.

3. Task

1. To switch on TMK and initiate the system monitor (press the **“СБ“** button).

2. To draw and fill in the table:

Table 1. Results of tests with registers

Register	Contents of registers		
	Initial	After modification	After pressing “**СБ**”

Names of registers (identifiers):
A – 8-bit register **A**, or accumulator;
B – 8-bit register **B**;
C – 8-bit register **C**;
D – 8-bit register **D**;
E – 8-bit register **E**;
H – 8-bit register **H**;
L – 8-bit register **L**;
F – 8-bit flag register **F**;
SL – lower byte of the stack pointer;
SH – higher byte of the stack pointer;
PL – lower byte of the program counter;
PH – higher byte of the program counter.

3. Referring to the memory distribution data, to find out and write down hexadecimal limit addresses of different memory fields.

4. To draw a table:

Table 2. Results of memory review and modification

Address	Contents of memory cells		
	Initial	After modification	After pressing **“СБ”**

5. To revise and modify small memory fields (of 3 – 5 bytes) where certain limit addresses of memory fields get. To press “**СБ”** button and once again revise the same memory fields. Write the results in Table 2.

6. To calculate the control sum of the selected memory field.

7. To write a constant into the selected memory field.

8. To relocate the selected array at another memory place.

4. Contents of the report

1. The aim of the work.

2. Results of the registers review and modification.

3. Results of the memory review and modification.

4. Examples of processing all possible directives of the system monitor.

5. Conclusions.

References

1. Uffenbeck J. Microcomputers and Microprocessors: The 8080, 8085, and Z-80 Programming, Interfacing and Troubleshooting. USA, New Jersey: Pearson Prentice Hall; 3rd Edition. June 18, 1999. 729 p.

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3. Gražulevičius A. Mikroprocesoriai. Laboratorinių darbų užduotys ir metodikos nurodymai. Vilnius: Technika, 2000. 60 p.