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# INSTRUCTIONS FOR 8051 MICROCONTROLLER

Materiały dydaktyczne dzięki dofinansowaniu ze środków
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# 8051 MICROCONTROLLER

## Seven-Segment Display

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# 1. Introduction

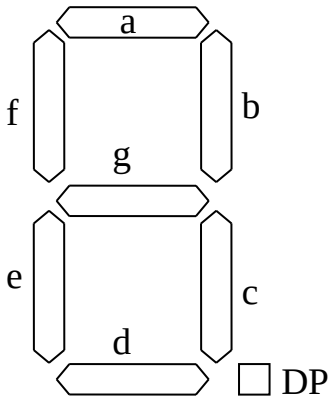
The 7-segment display connected to the DSM-51 evaluation board is controlled by two buffers:

**Cursor select buffer** – the value written to this buffer indicates which 7-segment displays are active. Each display is selected by the so-called 1 from 8 code. Each bit of the value written to the buffer individually decides about the status of a corresponding display. Setting a bit to 1 turns on the chosen display. The table below holds the mapping of each bit to a certain 7-segment display of DSM-51.

Table 1.1

| Cursor select bit | Cursor |
|---|---|
| 0 | W1 |
| 1 | W2 |
| 2 | W3 |
| 3 | W4 |
| 4 | W5 |
| 5 | W6 |
| 6 | LED |

**Cursor data buffer** – the value written to this buffer determines which segments of the currently selected displays are turned on. The value of 1 on a given bit indicates that the corresponding segment is turned on.




| Cursor data bit | Display segment | LED |
|---|---|---|
| 0 | a | F1 |
| 1 | b | F2 |
| 2 | c | F3 |
| 3 | d | F4 |
| 4 | e | ok |
| 5 | f | er |
| 6 | g | |
| 7 | DP | |

Figure 1.1

The Example 1 (available on the computers in laboratory) demonstrates the procedure of writing data to ports connected to the microcontrollers' bus. After running the program, one can observe that the segments selected by the COD value are turned on on the displays selected by the DISPLAY value. By changing the values of DISPLAY and COD, one can decide which displays and which segments are turned on.

**NOTE!**

*The 7-segment displays of the DSM-51 evaluation board are designed for sequential displaying, thus for a static usage of the displays, at least two displays should be selected, so the maximum allowed current is not exceeded.*

After writing the data to the control buffers of the display, one should also clear pin 6 of the P1 port. This pin, if set, blocks displaying on the 7-segment displays of DSM-51. The purpose of this pin is to avoid displaying random value which is stored in the buffers after turning on of the DSM-51 evaluation board. It can also be used for disabling the displays for the time needed for the change of a selected cursor (display) in the sequential displaying mode.

In the presented example, the values are displayed statically. In this method, all displays contain the same value. To display different values on different displays, a sequential displaying method should be used. In this method, at a given time instance, only one display is turned on. After some period of time, the current display is turned off and the next display is selected and turned on. On each display, different configurations of segments can be selected. If the frequency of changing the displays is high enough, the human eye inertia would cause the impression of a continuous display.

## 2. Exercise

1. Run the example presented above.
2. Modify the example so that the 7-segment display of the DSM-51 system contains 6 different symbols displayed sequentially. Set the time of the "on" state of each display to:
   a) 1 ms,
   b) 1 s.
3. Modify the program from exercise 2 so that the buffers of the 7-segment displays are addressed by using R0 and R1 registers.

   In the presented example, the buffers of the 7-segment display are addressed indirectly by the 16-bit DPTR register. Since there is only one 16-bit register in the 8051 microcontroller, it is a good practice to use the DPTR register only if it is required.

   The 8051 microcontroller has an additional way to address an external data area. It can be achieved by using R0 and R1 8-bit registers. In the MOVX @R0 instruction, the content of the register is treated as the lower byte of the address (A0…A7). The higher byte of the address bus is controlled by the microcontroller by the pins of port P2. If the instruction does not specify the higher byte of the address, the address bus takes the value stored in port P2.

   The DSM-51 system is designed in such a way that the access to all input/output peripherals in the system can be achieved with a constant value of the higher byte of the address which is $1111\ XXXX_B$. Since after the RESET signal, the value stored in port P2 is

set to 1111 $1111_B$, one can address the input/output peripherals with R0 or R1 registers (under the assumption that the state of the P2 port was not modified after RESET).