

EE323: Microprocessor Systems Design  
Lab. N° 4

Z80 Input/Output Interfacing

### 1 Objective

The objective of this lab is to learn how to interface the Z80 processor with Input/Output (I/O) devices.

### 2 Before the Lab

1. Read section 1 “MDA-WinZ80 System Configuration” of MDA-WinZ80 Manual. Give the I/O address map of the MDA-WinZ80 Training kit.
2. Read “appendix 4: MDA-WinZ80 External Circuit” of MDA-WinZ80 Manual. Which I/O addresses are already decoded? Explain how we can use the already decoded addresses.
3. Assuming 4MHz clock frequency, give the number of loops and the total time delay of the code given in Figure 2.
4. Give the complete design of the I/O interfacing circuits of the tasks 1 and 2.
5. Write the programs to test the I/O interfacing circuit of the task 1 and 2.
6. Design an interfacing circuit to connect 4 LEDs to the Z80 of the MDA-WinZ80 Training Kit using one of the already decoded I/O addresses.

### 3 Lab grading

This lab is scheduled for **1 week (3 hours)** and will be graded based on:

- 1) Preparation.
- 2) Completion of the experiment, obtained results and their interpretation. During the lab, you must show the obtained results to your teacher. Before moving to a new lab experiment (task), you have to demonstrate that your implementation is working correctly, and you must show your understanding of the experiment. To evaluate your comprehension; you may have to answer oral questions.
- 3) Answers to the questions.
- 4) Attendance to the lab.
- 5) Report sheet.

For this lab, a report sheet will be used as lab report. You must put all your experiment results and the answers to the questions on this sheet and **return it back at the end of the lab**. When you finish a task and before moving to the next task, you should get your teacher’s signature for the results of the finished task. To evaluate your comprehension, during the demonstration, you may have to answer other questions not included in the lab assignment.

## 4 Tasks

### 4.1 Task 1: Interfacing LEDs

The objective of this task is to use partial address decoding to interface LEDs to the Z80 of the MDA-WinZ80 Training kit.

For the MDA-WINZ80 kit, the Z80 signals are available on the 50 pin external connector of the kit (see Figure 1).

- 1) Based on the I/O address map of the MDA-WinZ80 Training kit (see User Manual), which port addresses can be used to interface LEDs to the Z80 of the MDA-WinZ80 kit?
- 2) Is-it possible to use port addresses a) 03H and b) 33H? why?
- 3) **Switch OFF the power** of the MDA-WINZ80 kit. Design and build a circuit to interface 4 common anode LEDs to the Z80 with port address 20H using partial I/O address decoding (leave A7, A1 and A0 unconnected). You should use 3-to-8 decoder and combine  $\overline{IORQ}$  with address lines to generate  $\overline{IOAD}$  signal and combine  $\overline{IOAD}$  with  $\overline{WR}$  signal to generate  $\overline{IOSEL}$  signal. To latch the Z80 output value, you can use 74LS573 Octal D Latch.
- 4) **Get your circuit checked by your teacher** before switching ON the power. Test your interfacing circuit by displaying the low-order bits of the accumulator on the LEDs.
- 5) Write a program to display a 4-bit counter value on the LEDs with a certain delay between consecutive counts (use the code given in Figure 2 for the delay).
- 6) Test your program with your interfacing circuit.
- 7) **Get your work checked by your teacher**. Put your design and your program on the report sheet.
- 8) Give the different addresses that can be used with the interfacing circuit.

VCC	-	1	50	-	VCC
IEO	-	2	49	-	VCC
U4/13	-	3	48	-	U4/12
A10	-	4	47	-	A11
A9	-	5	46	-	A12
A8	-	6	45	-	A13
A7	-	7	44	-	A14
A6	-	8	43	-	A15
A5	-	9	42	-	CLK
A4	-	10	41	-	D7
A3	-	11	40	-	D6
A2	-	12	39	-	D5
A1	-	13	38	-	D4
A0	-	14	37	-	D3
RFSH	-	15	36	-	D2
MI	-	16	35	-	D1
RESET	-	17	34	-	D0
BUSRQ	-	18	33	-	INT
WAIT	-	19	32	-	NMI
BUSAK	-	20	31	-	HALT
WR	-	21	30	-	MREQ
RD	-	22	29	-	IORQ
U4/11	-	23	28	-	U4/10
U4/9	-	24	27	-	U4/7
GND	-	25	26	-	GND

Figure 1: 50 Pin external connector of MDA-WinZ80 kit.

```
LD D,00H
DLY1: LD E,00H
DLY2: DEC E
JR NZ,DLY2
DEC D
JR NZ,DLY1
```

Figure 2: Assembly code for a delay function.

### 4.2 Task 2: Interfacing switches

The objective of this task is to use partial address decoding to interface switches to the Z80 of the MDA-WinZ80 Training kit.

- 1) **Switch OFF the power** of the MDA-WINZ80 kit. Modify the design of task 1 to add 4 DIP switches to the interfacing circuit. You should interface the switches to

the Z80 with port address 24H using partial I/O address decoding (leave A7, A1 and A0 unconnected). To interface the switches to the data bus, you should use 74LS244 Tristate Buffer.

- 2) **Get your circuit checked by your teacher** before switching ON the power. Test your interfacing circuit by saving the state of the switches in memory location 3000H.
- 3) Write a program to display the status of the switches on the LEDs.
- 4) Test your program with your interfacing circuit.
- 5) **Get your work checked by your teacher.** Put your design and your program on the report sheet.
- 6) Propose a new design to interface the LEDs and the Switches to the Z80 using partial decoding and using only one 3-to-8 decoder (without using any other gate).
- 7) Give the port address for the LEDs and for the switches.

