



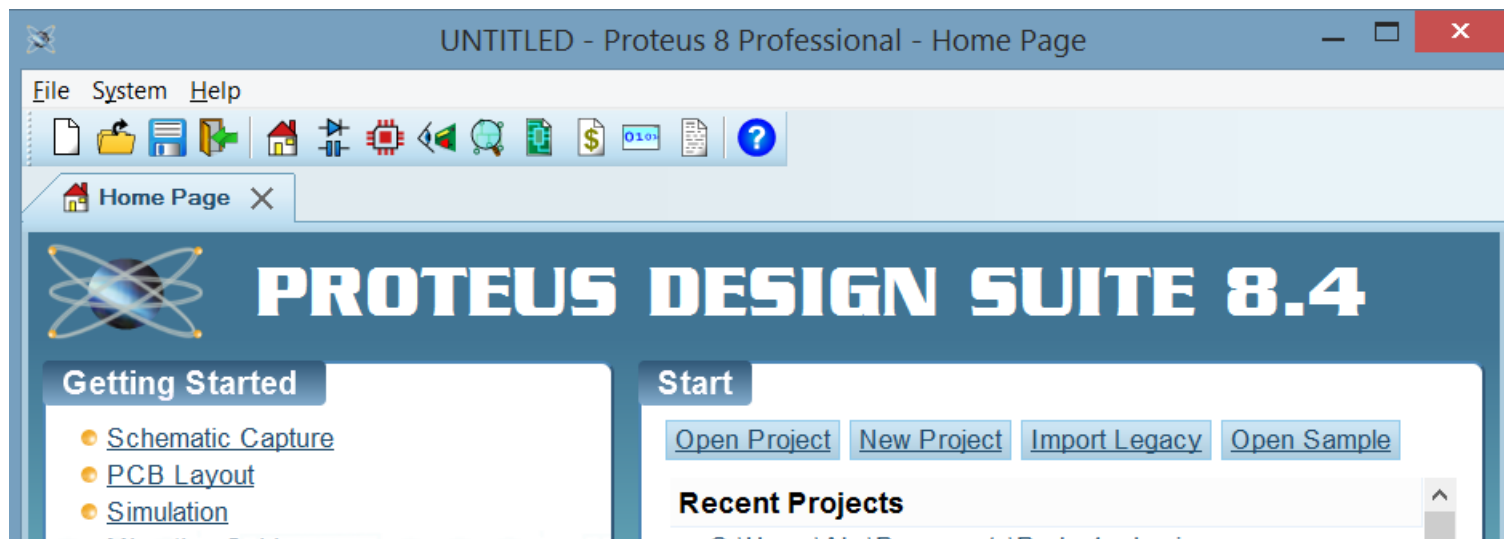
Mikroračunarski sistemi

20ER6004



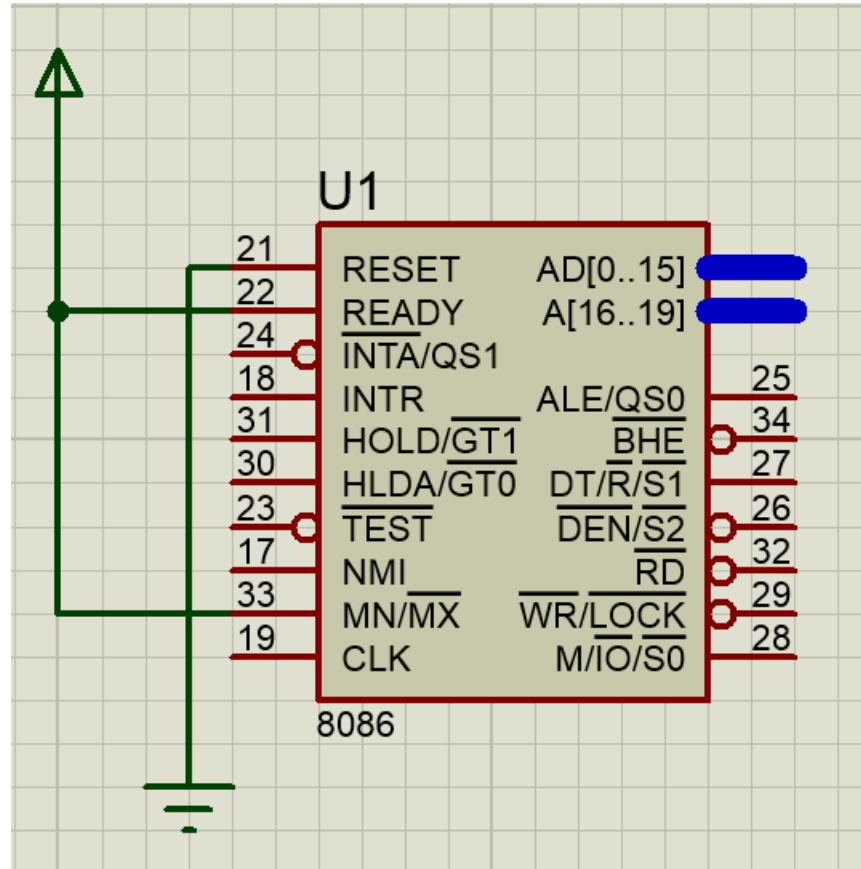
PROTEUS DESIGN SUITE

Kreiranje novog projekta

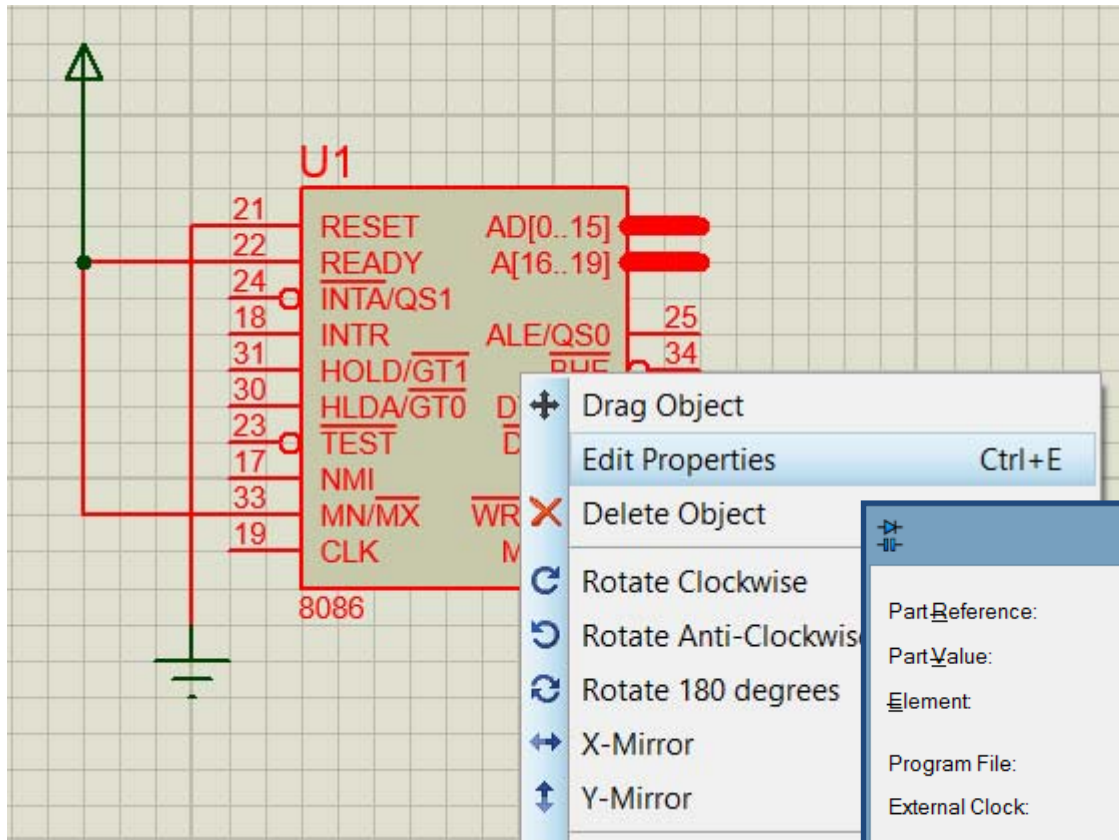


- File/New Project
- Schematic Design možete ostaviti DEFAULT templatej
- Do not create a PCB layout
- Create Firmware Project:
 - Family 8086
 - Controller 8086
 - Compiler MASM32

i8086



i8086 podešavanja



Edit Component

Part Reference: U1

Part Value: 8086

Element: New

Program File:

External Clock: No

Clock Frequency: 5MHz

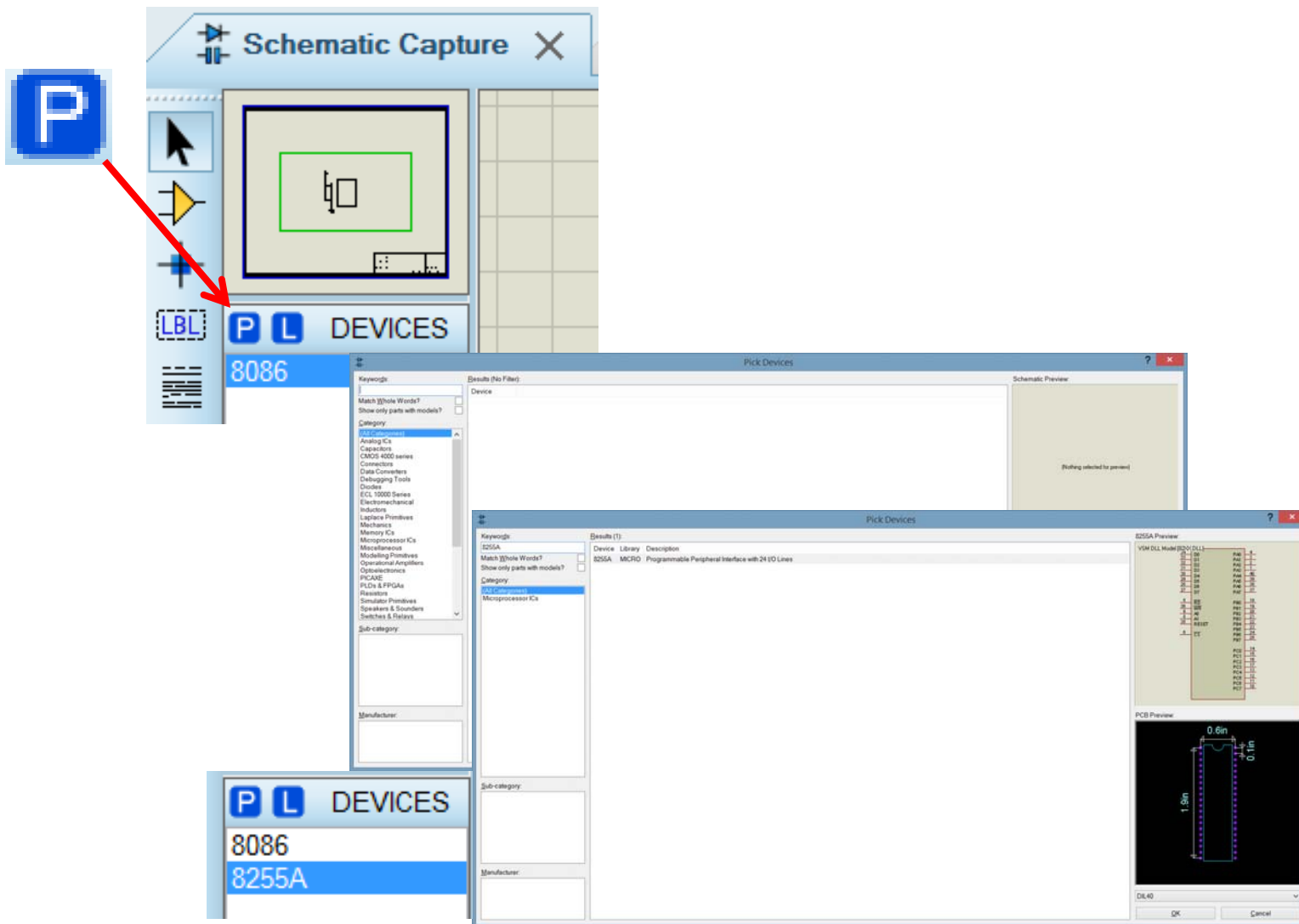
PCB Package: DIL40

Advanced Properties:

- Internal Memory Start Address: 0x00000
- Internal Memory Size
- Program Loading Segment
- BIN Entry Point
- Stop on Int3

- Clock Frequency
- **Internal Memory Size**

Dodavanje drugih komponenti



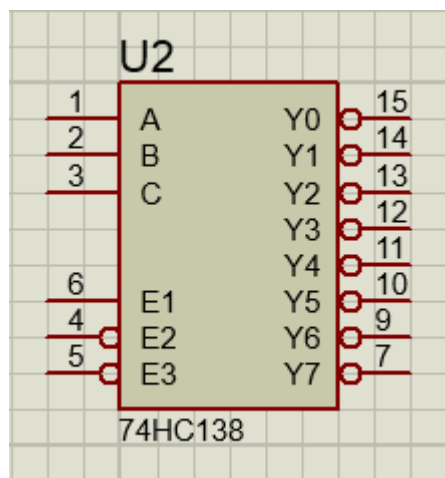
Dodatne komponente koje će biti korišćene u šemama

- **Dekoder**
 - 74HC**138** (3-Line to 8-Line Decoders/Demultiplexer)
- **Leč**
 - 74HC**373** (Octal D-Type Transparent Latches with 3-state Output)
- **Bafer (izlazni bafer)**
 - 74HC**244** (Octal Buffers/Line Drivers with Tristate Outputs) – bafer
- **Transiver (bidirekcionni bafer)**
 - 74HC**245** (Octal Bus Transceivers With Tristate Outputs)

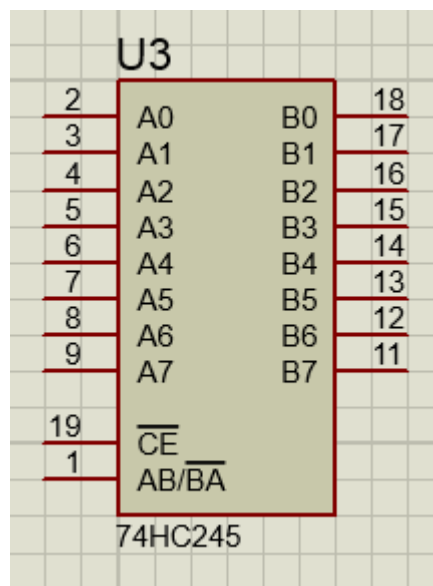
HC – koriste napajanje od 2V do 6V (TTL je 5V) i u skladu sa tim su i naponski nivoi; sve prednosti CMOS tehnologije (mala ulazna struje 1uA) sa podrškom za TTL nivoe.

Dodatne komponente koje će biti korišćene u šemama

Dekoder

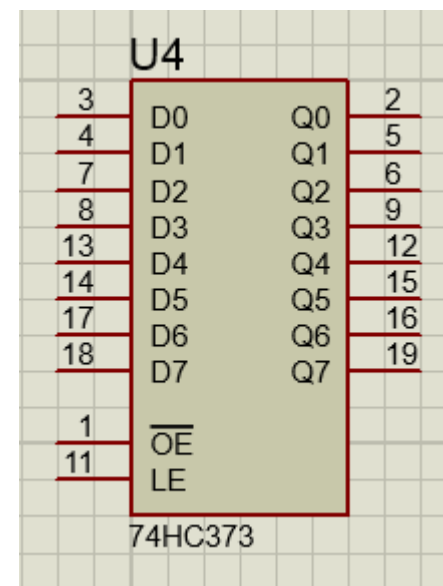


Transiver (bidirekcionni bafer)



$\overline{CE} = 1$ (U/I pinovi na HiZ)
 $\overline{AB/BA}$ - Smer prenosa

Leč



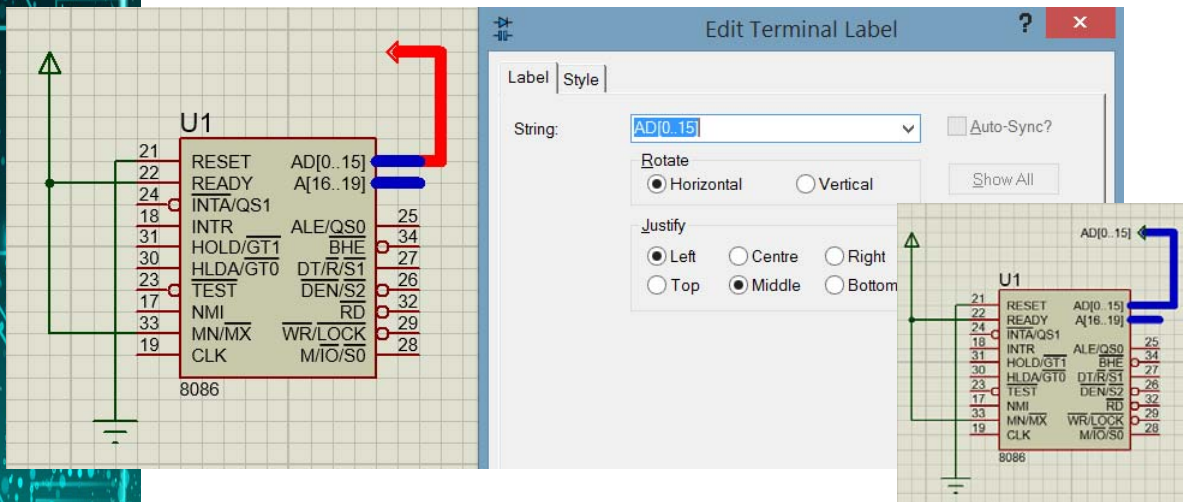
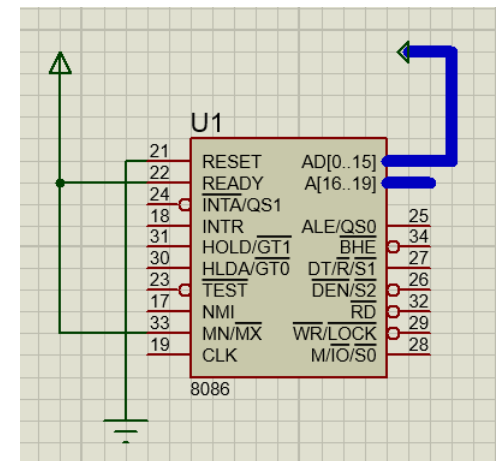
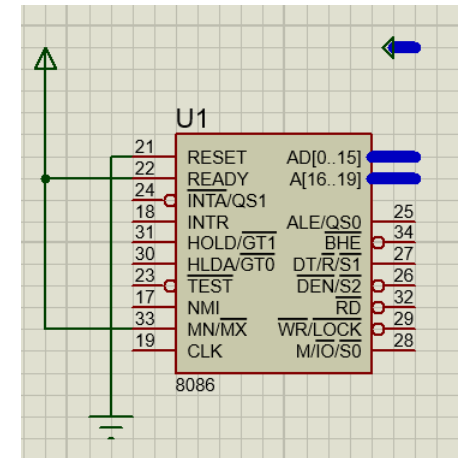
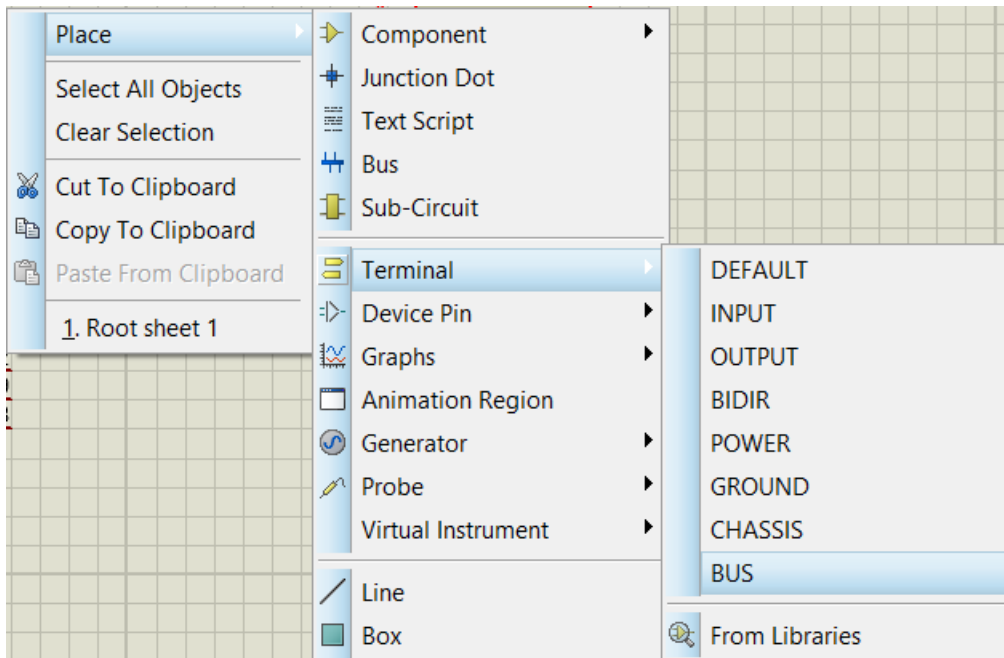
\overline{OE} - Output Enable
LE - Latch Enable



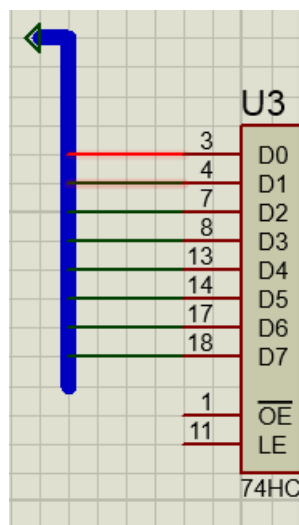
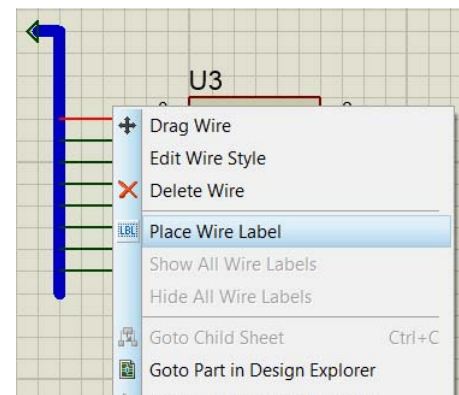
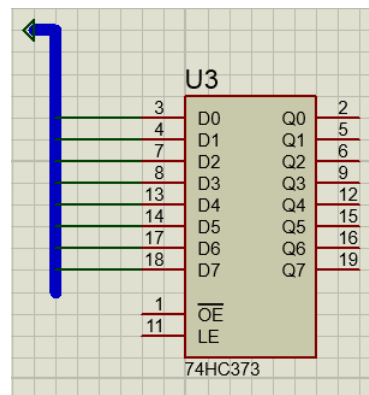
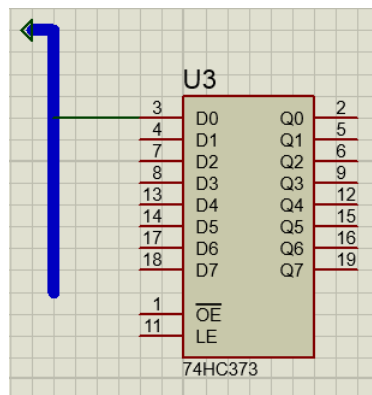
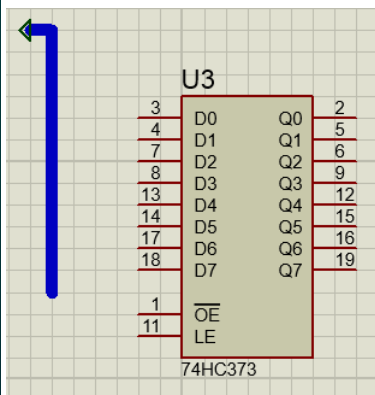
Dodatne komponente koje će biti korišćene u šemama

- **LED-RED** (Animated LED model (Red)) – animirana LED dioda koja svetli crveno,
- **SWITCH** (Interactive SPST Switch (Latched Action)) – obični prekidač,
- **RESISTOR** (Analog resistor primitive) – običan otpornik, kome se može menjati otpornost,
- **7SEG-MPX1-CA** (Red 1 Digit Common Anode 7-Segment Display),
- **LOGICSTATE** (Logic State Source (Latched Action)) – logičko stanje koje se može dovesti na neki od pinova i koristiti kao konstantna pobuda (klikom na ovu komponentu menja se stanje sa 0 na 1 i obrnuto)

Povezivanje magistrale



Povezivanje magistrale



Edit Wire Label

Label | Style | Net Class

String: ☐ Auto-Sync?

Rotate

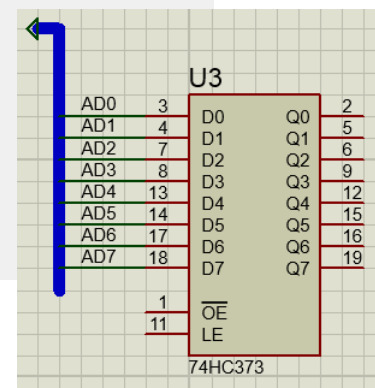
☒ Horizontal ☐ Vertical

Show All

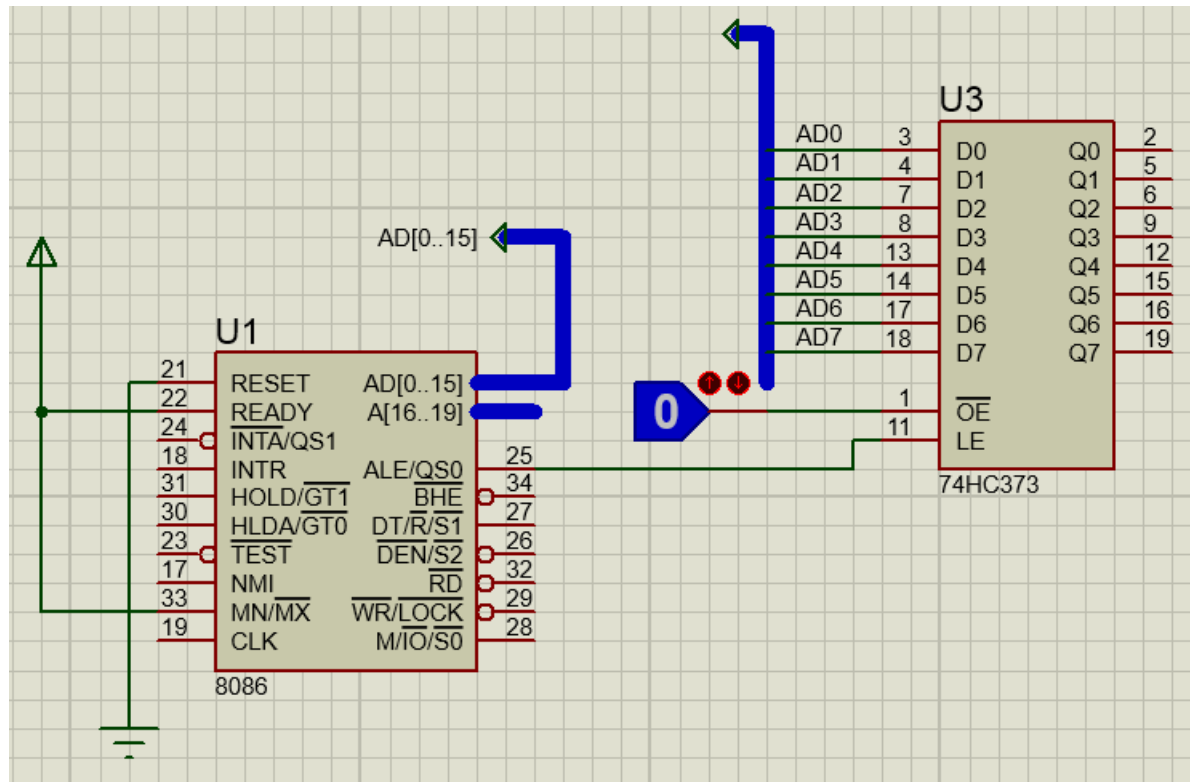
Justify

☒ Left ☐ Centre ☐ Right

☐ Top ☐ Middle ☒ Bottom



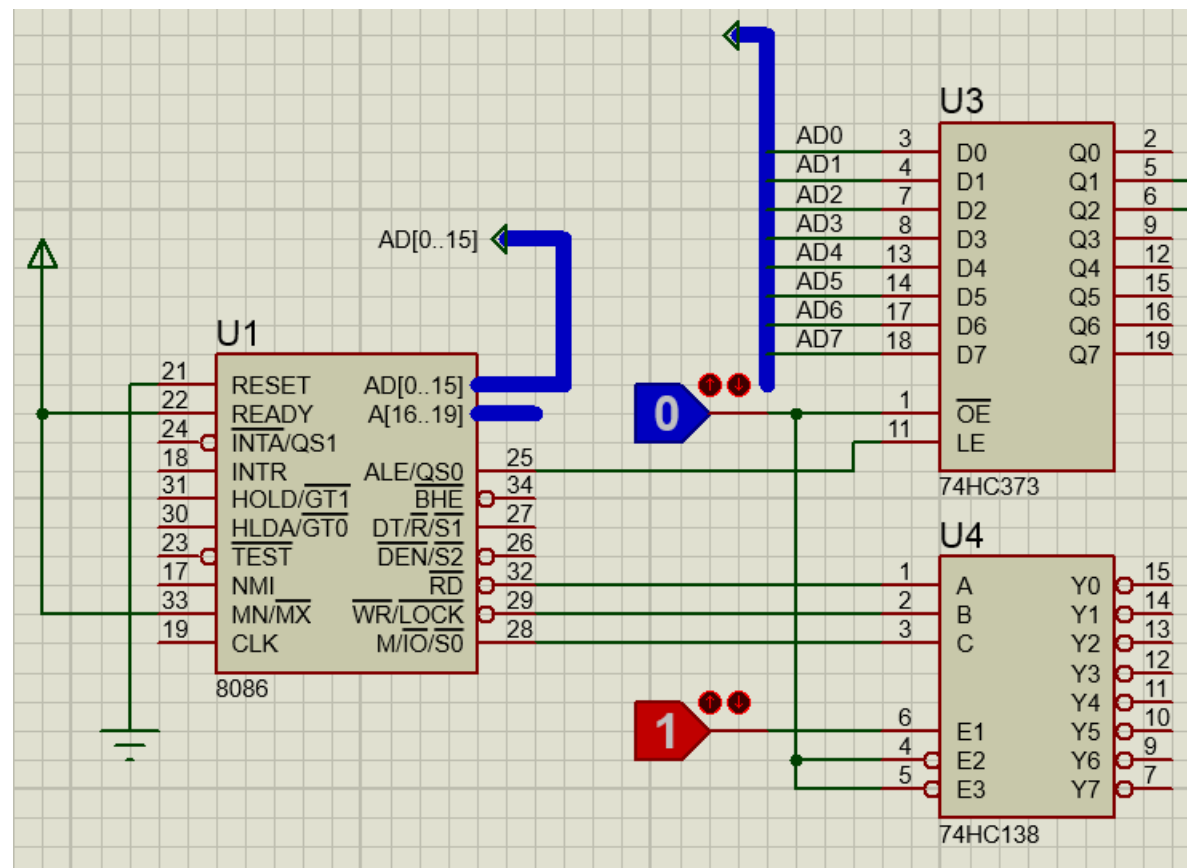
Lečovanje adresa



Za postavljanje konstantne vrednosti koristimo komponentu LOGICSTATE.

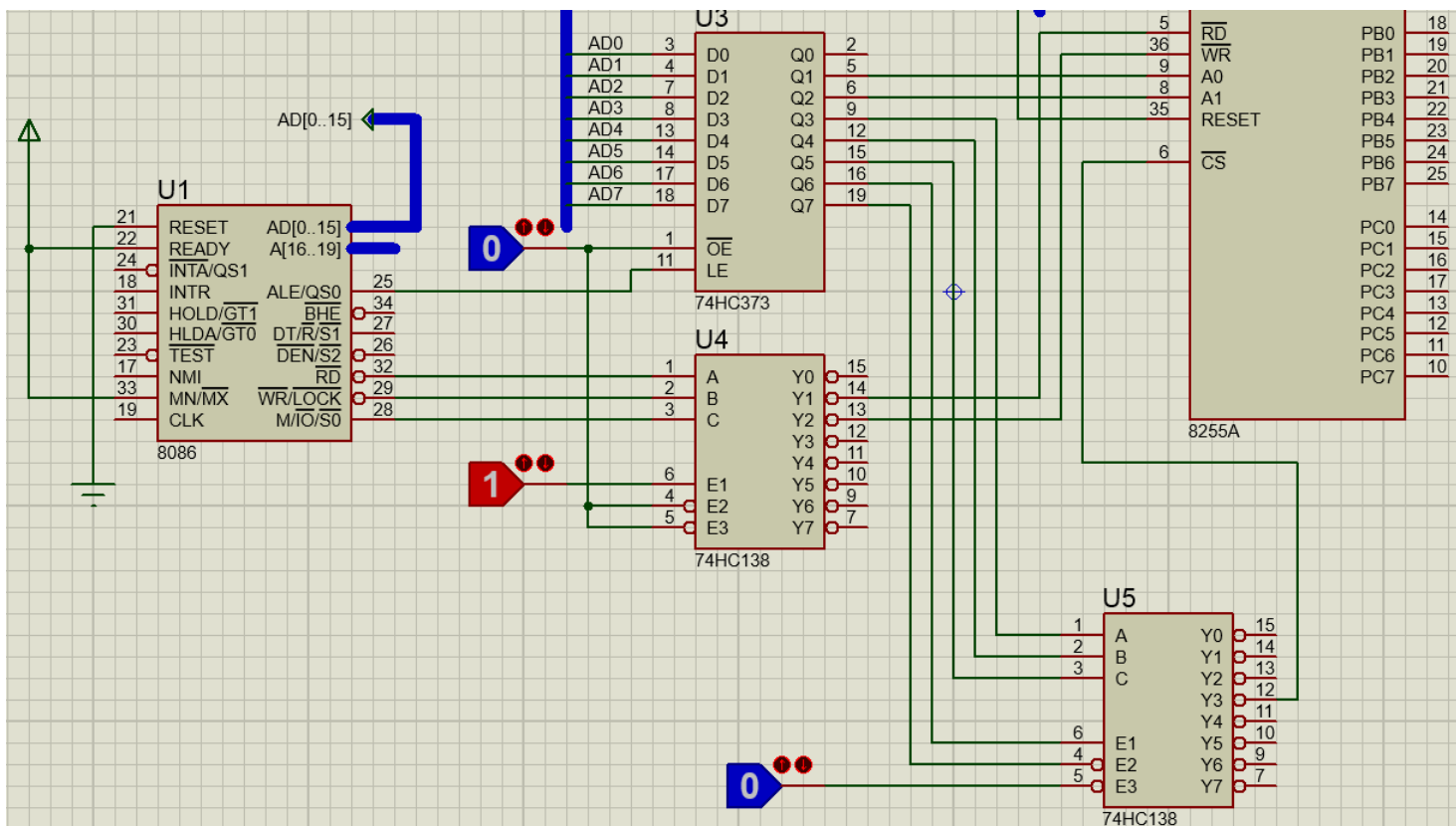
Dekodiranje upravljačkih signala

Korišćenjem dekodera, odnosno demultipleksera, na osnovu signala M/IO (pin 28), WR (pin 29) i RD (pin 32). treba generisati signale MEMR, MEMW, IOR i IOW.



Dekodiranje adrese uređaja

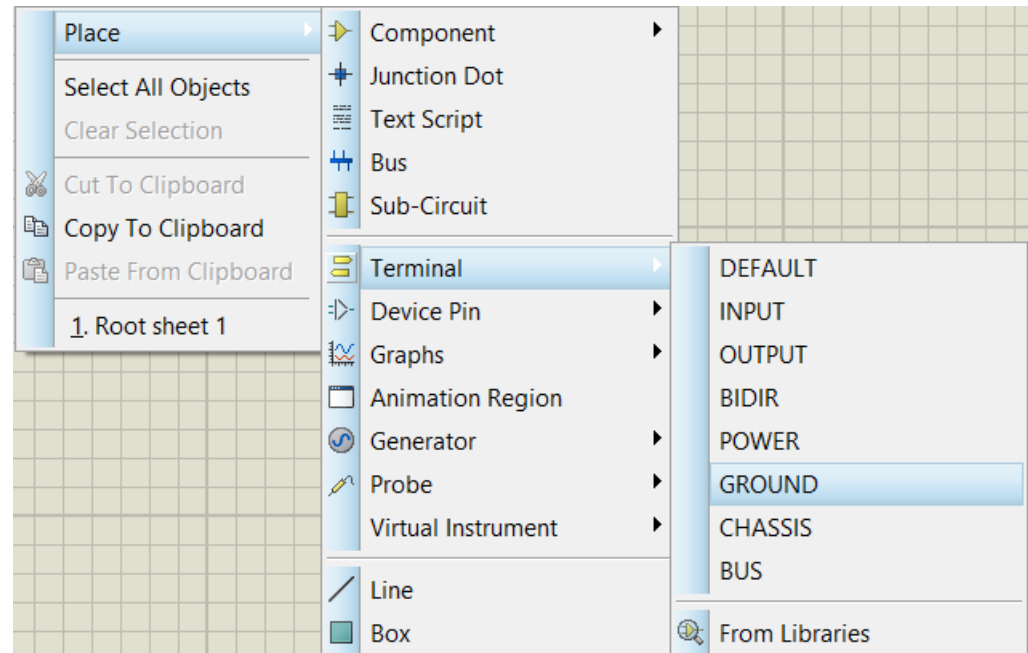
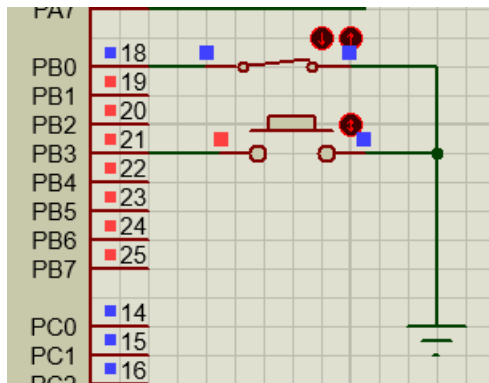
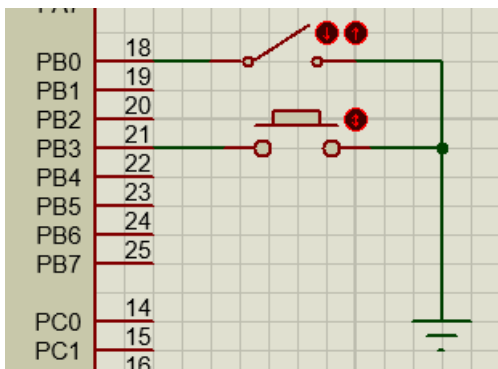
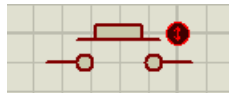
- Zavisi od uslova zadatka
- Potrebno generisati CS na osnovu adresnih linija i dekodera (74HC138).



Napomena: Ako komponenta ima RESET ulaz, obavezno ga postaviti na neaktivnu vrednost.

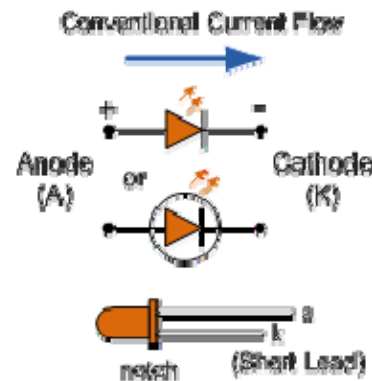
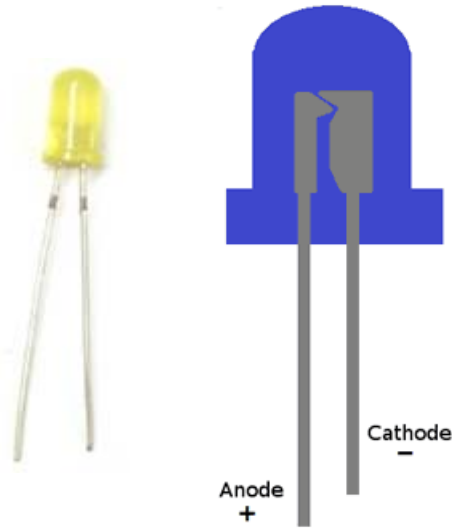
Prekidači i tasteri

- SWITCH
- BUTTON

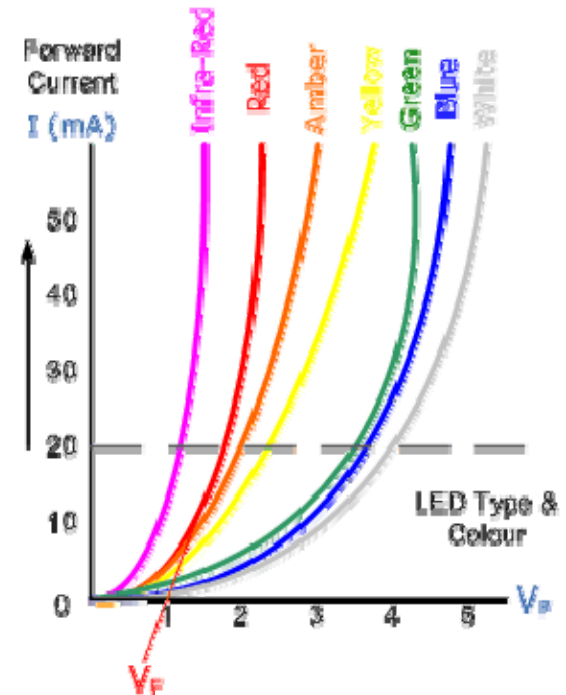


LED diode

- Animated LED (da bi se video efekat)



LED and its
I-V Characteristics



LED Color	Forward Voltage
Red	1.63 ~ 2.03V
Yellow	2.10 ~ 2.18V
Orange	2.03 ~ 2.10V
Blue	2.48 ~ 3.7V
Green	1.9 ~ 4.0V
Violet	2.76 ~ 4.0V
UV	3.1 ~ 4.4V
White	3.2 ~ 3.6V

LED diode

proračun redne otpornosti

Edit Label
Delete Label

+ Drag Object
Edit Properties Ctrl+E
X Delete Object

Diagram showing a circuit with a power supply (PB2-PB7) connected to a resistor R1 (100 ohms) and an LED D1 (LED-BLUE). The LED is connected to ground (PC0-PC7).

Edit Component

Part Reference: Hidden: ☐

Part Value: Hidden: ☐

Element: New

Model Type: Hide All

Forward Voltage: Hide All

Full drive current: Hide All

PCB Package: Hide All

Advanced Properties:

Breakdown Voltage Hide All

Other Properties:

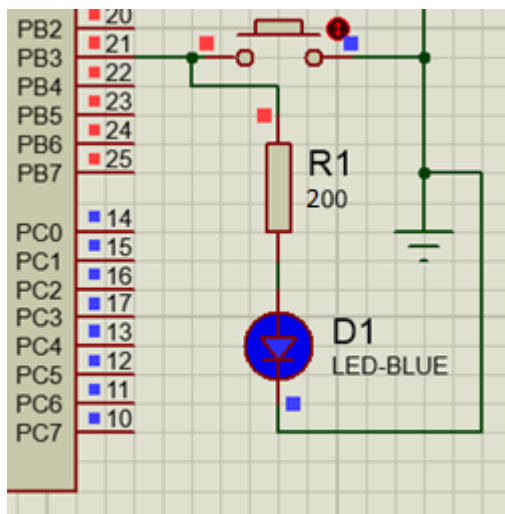
$$R = (V_S - V_{LED}) / I_{LED}$$

☐ Exclude from Simulation ☐ Attach hierarchy module
☐ Exclude from PCB Layout ☐ Hide common pins
☐ Exclude from Bill of Materials ☐ Edit all properties as text

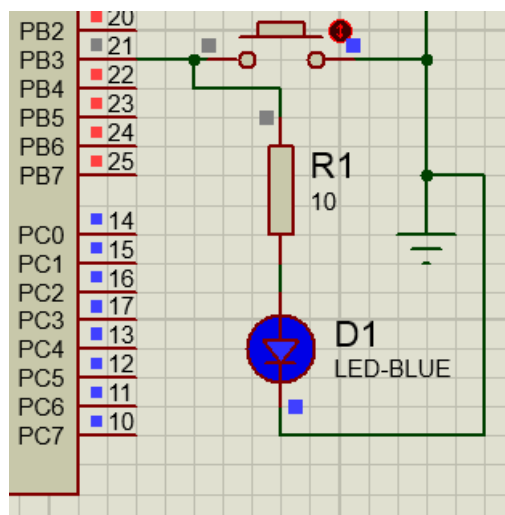
OK Cancel

LED diode

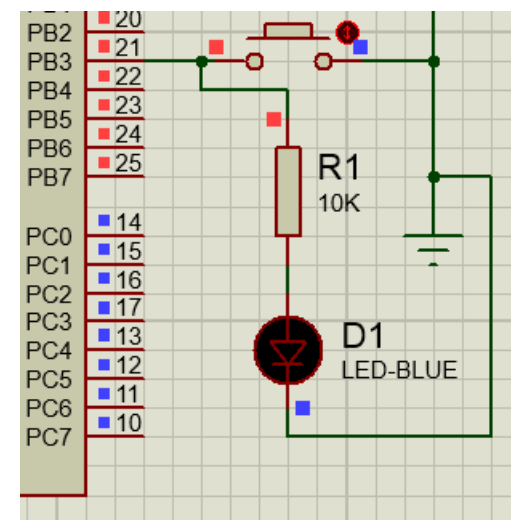
proračun redne otpornosti



Dobro dim. otpornik

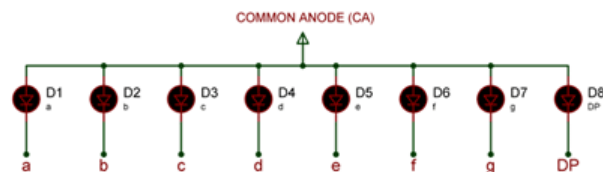
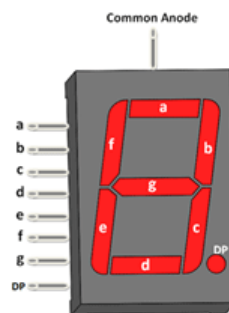
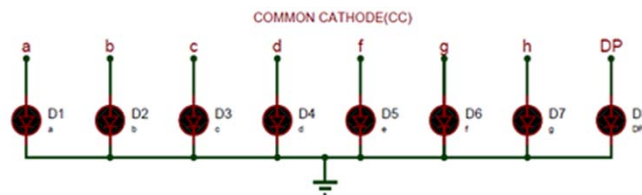
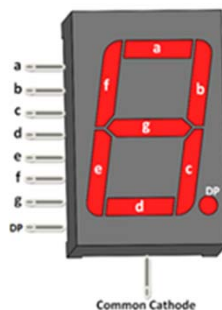
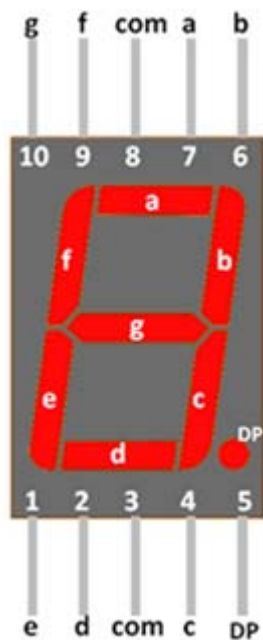


Neregularno stanje



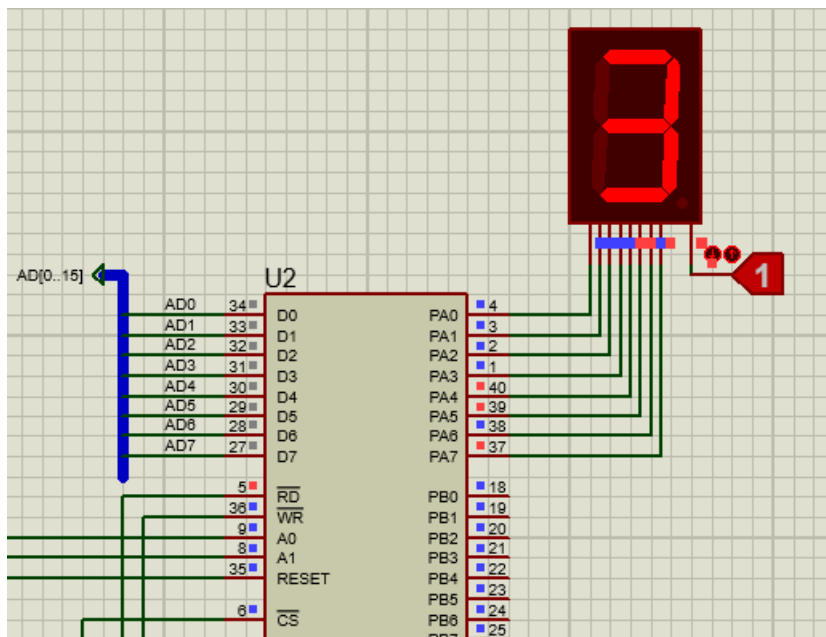
Nedovoljna struja pobude

7-segmentni displej



7-segmentni displej

Povezivanje 7SEG-MPX1-CA

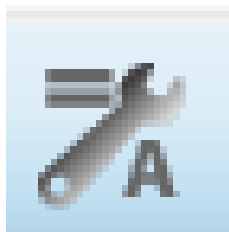


Cifra	h g f e d c b a	Hexa kod
0	1 1 0 0 0 0 0 0	C0
1	1 1 1 1 1 0 0 1	F9
2	1 0 1 0 0 1 0 0	A4
3	1 0 1 1 0 0 0 0	B0
4	1 0 0 1 1 0 0 1	99
5	1 0 0 1 0 0 1 0	92
6	1 0 0 0 0 0 1 0	82
7	1 1 1 1 1 0 0 0	F8
8	1 0 0 0 0 0 0 0	80
9	1 0 0 1 0 0 0 0	90

CA kodovi

Automatsko dodavanje labela

- Property Assignment Tool



Property Assignment Tool

String:

Count:

Increment:

Action:

- ☒ Assign
- ☐ Remove
- ☐ Rename
- ☐ Show
- ☐ Hide
- ☐ Resize

Apply To:

- ☒ On Click
- ☐ Local Tagged
- ☐ Global Tagged
- ☐ All Objects

Help:

Object	Standard Properties
Component	REF, VALUE, DEVICE, PINSWAP
Subcircuit	REF, CIRCUIT
Terminal	NET, TYPE, SYMBOL
Port	NET, TYPE, SYMBOL
Pin	NAME, NUM, TYPE, SYMBOL

The current count value is designated by a '#' in String

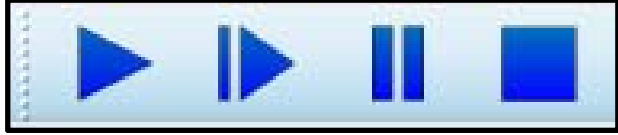

NET=AD#

OK Cancel

Olakšano dodavanje - Wire Label Mode



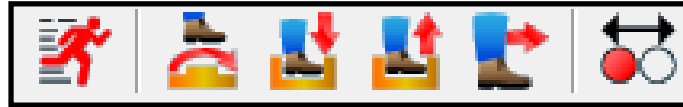
Simulacija

- Kontrole su 
 - za Schematic Capture tab – gornji deo prozora (toolbar)
 - za Source Code tab – donji levi deo
- Pokreće program i staje iza prve izvršne naredbe 

-----	ORG 0000H
-----	OUT 00H,AL
▶ 0002	IN AL,00H

-----	START:
0004	MOV DX, PORT_CON

Debugiranje



- Run simulation – izvršenje do naredne prekidne tačke
- Step over – korak po korak
- Step into – ulazak u tekuću liniju
- Step out – izlazak iz tekuće linije
- Run to – izvršenje do kursora
- Toggle breakpoint – menja stanje prekidne tačke u tekućoj liniji (dodaje, deaktivira i briše sa svakim sledećim klikom)

Prekidne tačke na klik

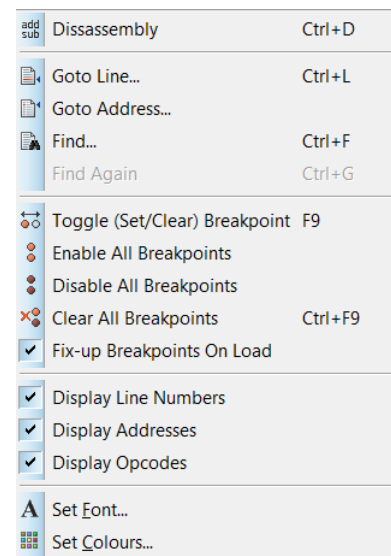
- Dvostruki klik na liniju koda – dodavanje

```
14  ----- PETLJA:  
15  ● 0011    IN AL,0A8h  
16  0013     OUT 0A8h,AL
```

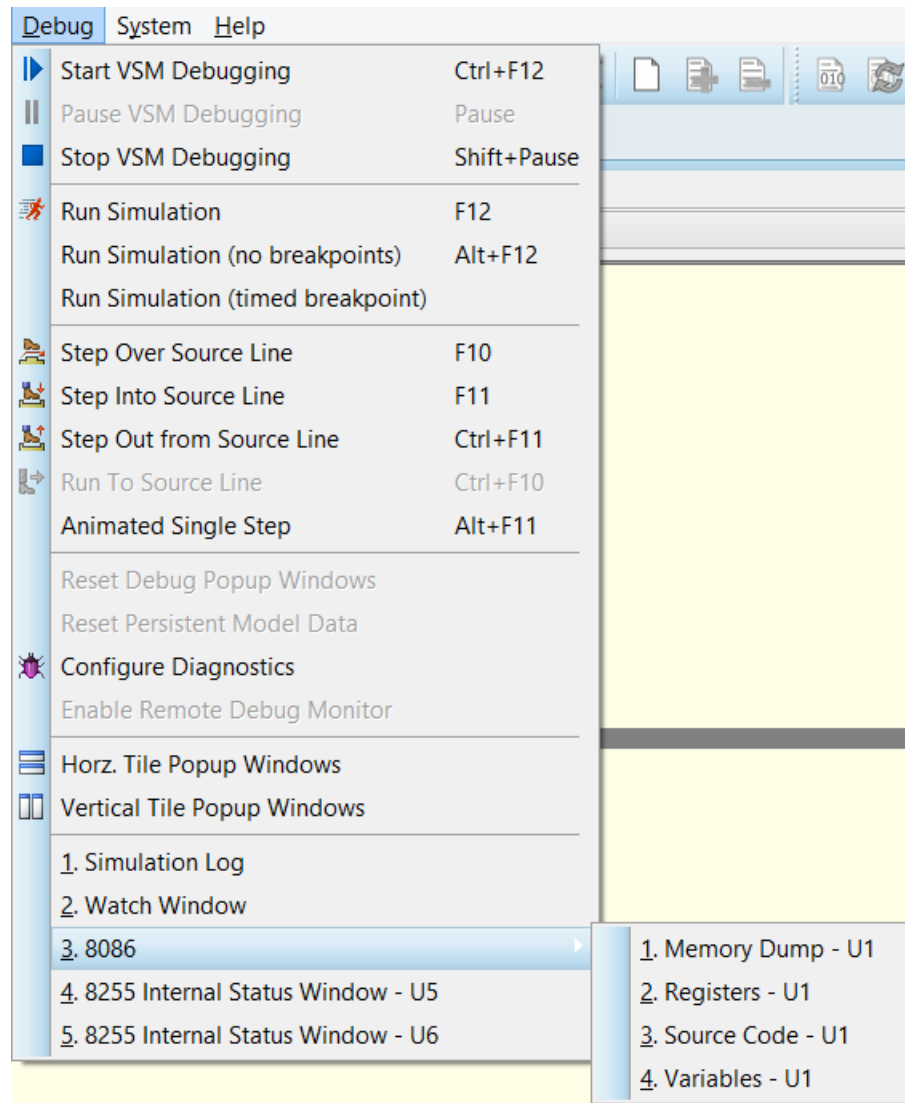
- Sledeći dvostruki klik – deaktiviranje

```
14  ----- PETLJA:  
15  ○ 0011    IN AL,0A8h  
16  0013     OUT 0A8h,AL  
17  0015     JMP PETLJA
```

- Sledeći dvostruki klik – brisanje
- Desni klik otvara sledeći popup



Stanje registara i memorije



001E INC SI
 001F CMP SI, 16
 0022 JL L0

Simulation Log 8086 Registers - U1

8086 Registers - U1

Pc: inc si
 Op: 46
 Pr: 83 FE 10 7C EC

CS: 0000 IP: 001E LA: 0001E
 AX: 00F9 BX: 0000
 CX: 0000 DX: 0070
 DS: 0000 SI: 0001 LA: 00001
 ES: 0000 DI: 0000 LA: 00000
 SS: 0000 SP: 0000 LA: 00000
 BP: 0000 LA: 00000
 FL: CF SF

8255 Internal Status Window - U4

CONTROL WORD : 80

MODE GROUP A : 0
PA : OUTPUT PCH : OUTPUT

MODE GROUP B : 0
PB : OUTPUT PCL : OUTPUT

BSR MODE : NO

STATUS WORD MODE 1-INPUT

IOPC7	IOPC6	IBFA	INTEA	INTRA	INTEB	IBFB	INTRB
0	0	0	0	0	0	0	0

STATUS WORD MODE 1-OUTPUT

OBFA	INTEA	IOPC5	IOPC4	INTRA	INTEB	OBFB	INTRB
0	0	0	0	0	0	0	0


STATUS WORD MODE 2-I/O

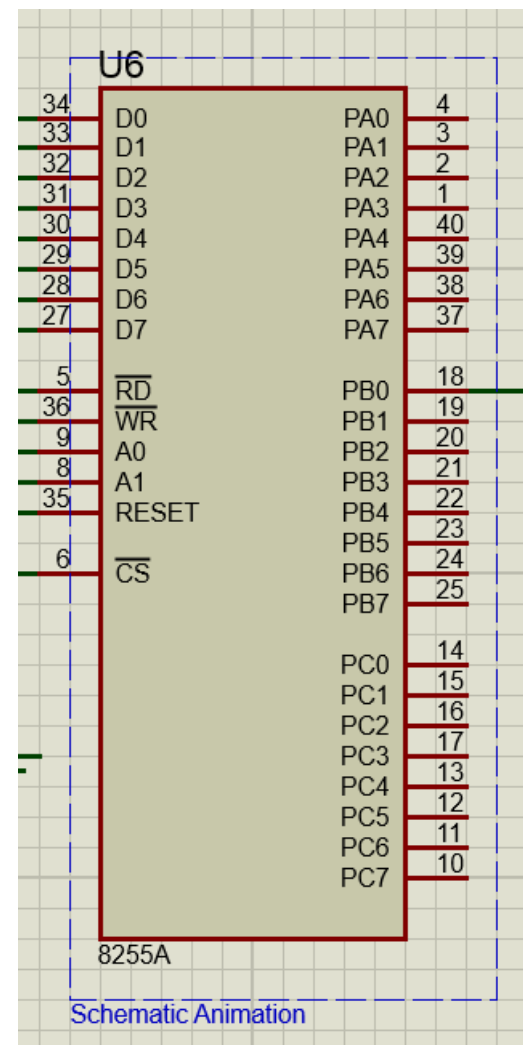
OBFA	INTE1	IBFA	INTE2	INTRA
0	0	0	0	0

8086 Memory Dump - U1

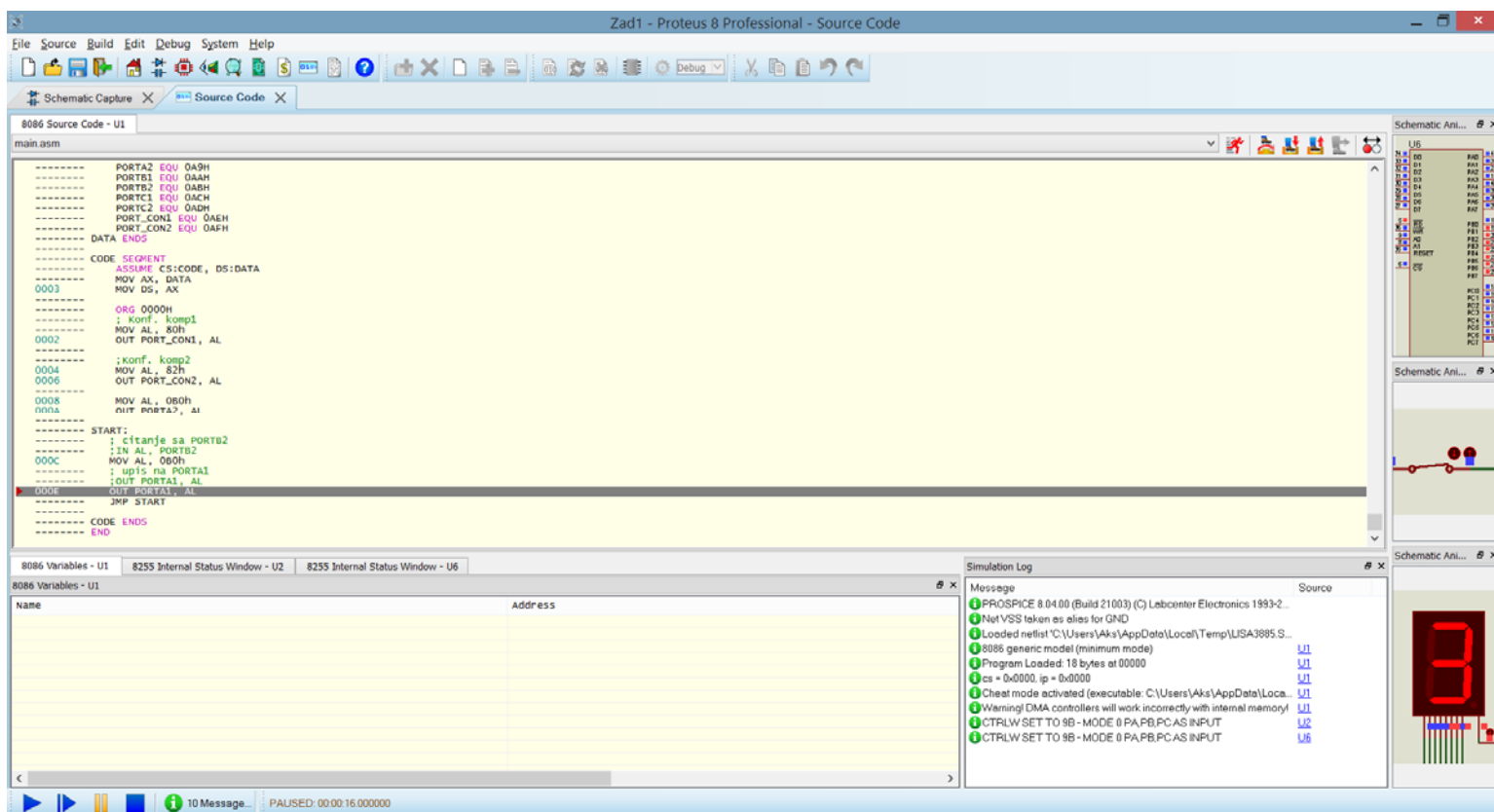
00000000	E6 00 E4 00	BA 76 00 B0	80 EE BE 00	00 BF 00 00	.....v.....
00000010	B9 FF 1F 2E	8A 84 00 10	BA 70 00 EE	E2 F5 46 83	.....p....F.
00000020	FE 10 7C EC	EB DE 00 00	00 00 00 00	00 00 00 00	..|.....
00000030	00 00 00 00	00 00 00 00	00 00 00 00	00 00 00 00	.....
00000040	00 00 00 00	00 00 00 00	00 00 00 00	00 00 00 00	.....
00000050	00 00 00 00	00 00 00 00	00 00 00 00	00 00 00 00	.....
00000060	00 00 00 00	00 00 00 00	00 00 00 00	00 00 00 00	.....
00000070	00 00 00 00	00 00 00 00	00 00 00 00	00 00 00 00	.....
00000080	00 00 00 00	00 00 00 00	00 00 00 00	00 00 00 00	.....
00000090	00 00 00 00	00 00 00 00	00 00 00 00	00 00 00 00	.....
000000A0	00 00 00 00	00 00 00 00	00 00 00 00	00 00 00 00	.....
000000B0	00 00 00 00	00 00 00 00	00 00 00 00	00 00 00 00	.....
000000C0	00 00 00 00	00 00 00 00	00 00 00 00	00 00 00 00	.....
000000D0	00 00 00 00	00 00 00 00	00 00 00 00	00 00 00 00	.....
000000E0	00 00 00 00	00 00 00 00	00 00 00 00	00 00 00 00	.....
000000F0	00 00 00 00	00 00 00 00	00 00 00 00	00 00 00 00	.....
00000100	00 00 00 00	00 00 00 00	00 00 00 00	00 00 00 00	.....
00000110	00 00 00 00	00 00 00 00	00 00 00 00	00 00 00 00	.....
00000120	00 00 00 00	00 00 00 00	00 00 00 00	00 00 00 00	.....
00000130	00 00 00 00	00 00 00 00	00 00 00 00	00 00 00 00	.....
00000140	00 00 00 00	00 00 00 00	00 00 00 00	00 00 00 00	.....

Aktivni popup-ovi

- izabrati Active Popup Mode iz toolbara sa leve strane 
- selektovati komponentu, tako što će se uokviriti (klik gore levo i drag naniže)



Aktivni popup-ovi



Izabrane komponente ne samo da se prikazuju, već se može i interagovati sa njima.



8086 set instrukcija

- Registri
- Adresiranje
- Definisanje podataka
- MOV, IN i OUT instrukcije

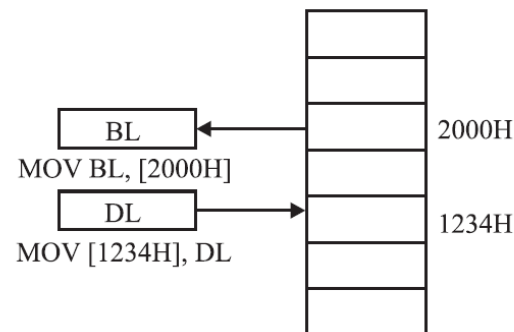
AX	AH	AL	Accumulator Register
BX	BH	BL	Base Register
CX	CH	CL	Counter Register
DX	DH	DL	Data Register
SI			Source Index Register
DI			Destination Index Register
BP			Base Pointer Register
SP			Stack Pointer Register
IP			Instruction Pointer Register

CS		Code Segment Register
DS		Data Segment Register
ES		Extra Segment Register
SS		Stack Segment Register

				O	D	I	T	S	Z		A		P		C
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Adresiranje

- **Neposredno** adresiranje (operand je u instrukciji)
 - MOV AX, 2500H
- **Registarsko** adresiranje (operand je u registru, izvor je uvek drugi param., registri moraju biti iste dužine)
 - MOV AX, BX
- **Direktno** adresiranje (adresa se specificira u instrukciji, podrazumeva se DS segment, potreban prefiks ako to treba da se promeni (CS:, ES:))
 - MOV BL, [2000H]
 - MOV [1234H], DL
 - MOV AX, ES: [4321H]

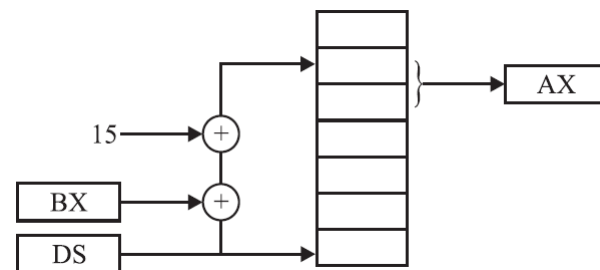


Adresiranje

- **Registarsko indirektno** adresiranje (offset adrese je u pointer, indeks ili baznom registru, za sve se podrazumeva DS segment, sem za [BP], gde se podrazumeva SS; ako to treba promeniti, koristi se prefiks (CS:, DS:, ES: ili SS:))
 - MOV DX, [BX]
 - MOV DX, [BP]
 - MOV DX, [SI]
 - MOV DX, [DI]
 - MOV DX, ES:[DI]

Adresiranje

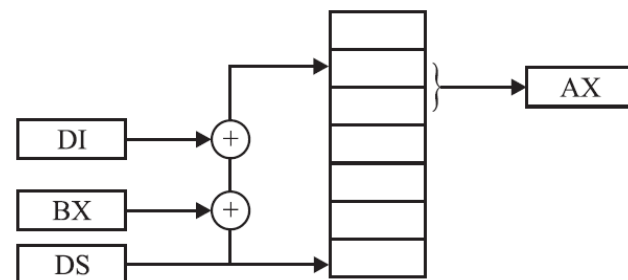
- **Bazno** adresiranje (8-bitni ili 16-bitni pomerač se dodaje na sadržaj baznog registra BX ili BP ([BX] podrazumeva DS, a [BP] SS))
 - MOV AX, [BX + 15]
 - MOV AL, DISP [BX]
 - MOV AL, SS: DISP [BX]
- **Indeksno** adresiranje (slično kao bazno, ali koristi SI i DI registre (podrazumeva se DS))
 - MOV AL, CS: DISP [SI]
 - MOV AL, SS: DISP [DI]



Adresiranje

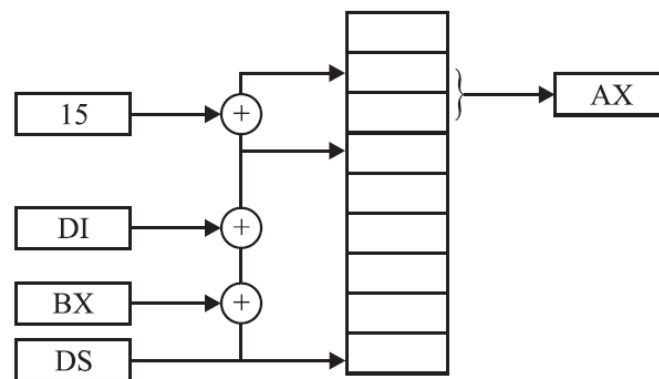
- **Bazno-indeksno** adresiranje (sabiraju se bazni (BX, BP) i indeksni registri (SI, DI), a rezultat je pointer na lokaciju sa podatkom; za BX podrazumeva se DS, a za BI SS)

- MOV AX, [BX][SI]
- MOV AX, [BX][DI]
- MOV AX, [BX + SI]



- **Bazno-indeksno** adresiranje **sa pomerajem**

- MOV AX, [BX + SI + 15]
- MOV AX, DISP[BX][SI]
- MOV AX, DISP[BX + DI]
- MOV AX, [BP + SI + DISP]
- MOV AX, [BP][DI][DISP]



MOV instrukcija

- MOV <odredište> <izvor>
- Uvek kopira drugi u prvi operand
- Izvor može biti vrednost, registar ili memorijska lokacija
- Odredište može biti registar ili mem. Lokacija
- CS i IP ne mogu se koristiti kao odredište
- Segmenti registri mogu da razmene vrednosti samo sa memorijom ili registrom opšte namene (ne može se upisati vrednost u seg. reg., niti se kopirati iz jednog u drugi seg. reg.)
- Ne može se kopirati iz memorije u memoriju, niti iz mem. na UI, ni UI u mem., ni Ui na UI.

IN instrukcija

- IN *<odredište>* *<izvor>*
- Učitava bajt ili reč sa porta u akumulator
- Odredište može biti samo AL ili AX
- Izvor može biti 8-bitna adresa porta (neposredni operand) ili DX (ako je 16-bitna adresa porta)
- Primeri:
 - IN AX, 04H
 - IN AL, DX

OUT instrukcija

- OUT <odredište> <izvor>
- Šalje bajt ili reč iz akumulatora na port
- Izvor može biti samo AL ili AX
- Odredište može biti 8-bitna adresa porta (neposredni operand) ili DX (ako je 16-bitna adresa porta)
- Primeri:
 - OUT 04H, AX
 - OUT DX, AL

Podaci

- Promenljive se zadaju u formatu
 - *<ime>* **DB** <vrednost> ili *<ime>* **DW** <vrednost>
- Polja se definišu sukcesivnim navođenjem vrednosti
 - polje **DB** 48H, 65H, 'Hello', 0
 - MOV SI 2
 - MOV AL, polje[SI]
- Veća polja (i stringovi) definišu se preko operatora DUP
 - *<ime>* **DB** <broj> **DUP** (<vrednost>)
 - prv DB 5 DUB (9) ; isto što i prv DB 9, 9, 9, 9, 9
 - drg DB 3 DUP (1, 2) ; isto što i drg DB 1, 2, 1, 2, 1, 2
- Konstante (ne zauzimaju prostor, kompajler umeće vrednosti u kod)
 - *<ime>* **EQU** <vrednost> npr. PORTA EQU 3Fh
- Brojevi u heksadecimalnom formatu imaju sufiks **H**, binarni **B** a dekadni nemaju sufiks.