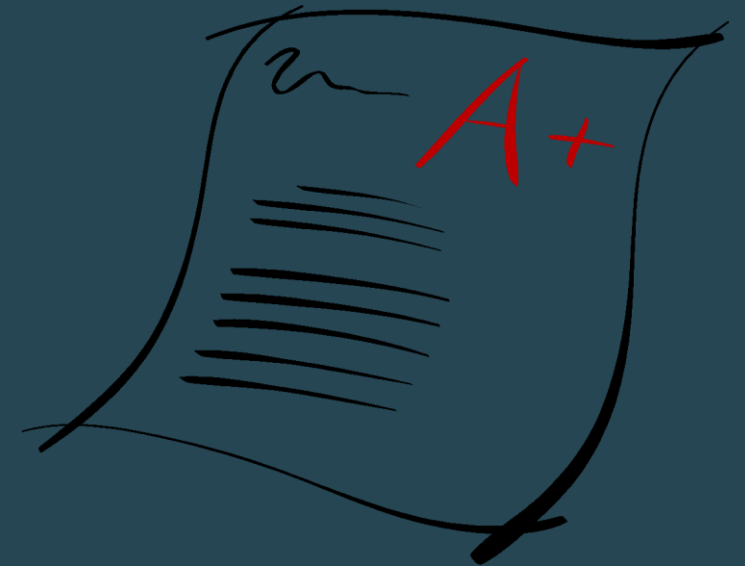


# Mikroprocesorski merno- informacioni sistemi 2

Vežbe 1

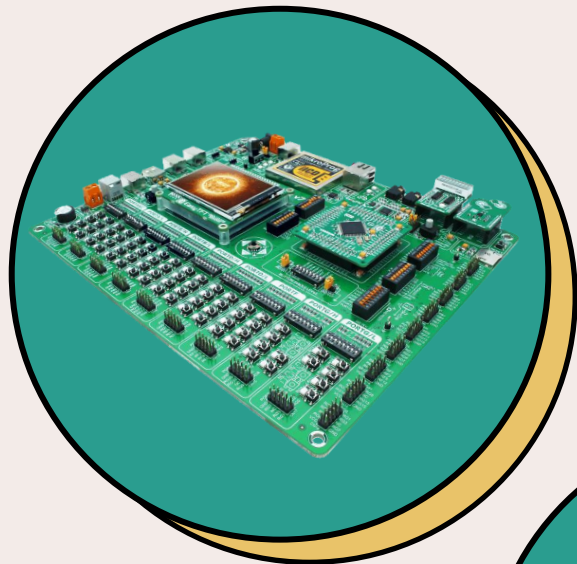
# Polaganje ispita

- ❑ **Teorijski deo** – 30 bodova
- ❑ **Laboratorijski kolokvijum** – 20 bodova
  - jedna mogućnost ispravka u ispitnom roku
- ❑ **Projekat** – 50 bodova
  - u grupama od po 2 do 3 studenta
  - predefinisani zadaci ili proširenje projekata sa MMIS1
- ❑ +odbrana laboratorijskih vežbi umesto projekta – 15 bodova

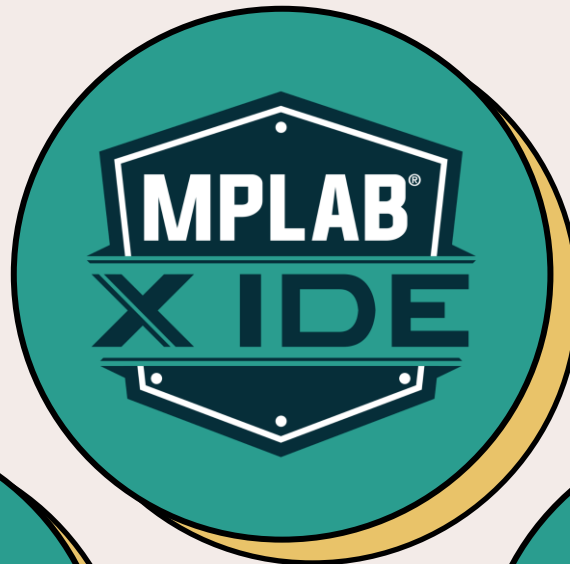


# Laboratorijske vežbe

EasyPIC Fusion v7  
razvojna ploča



MPLAB X IDE



MPLAB Harmony v3

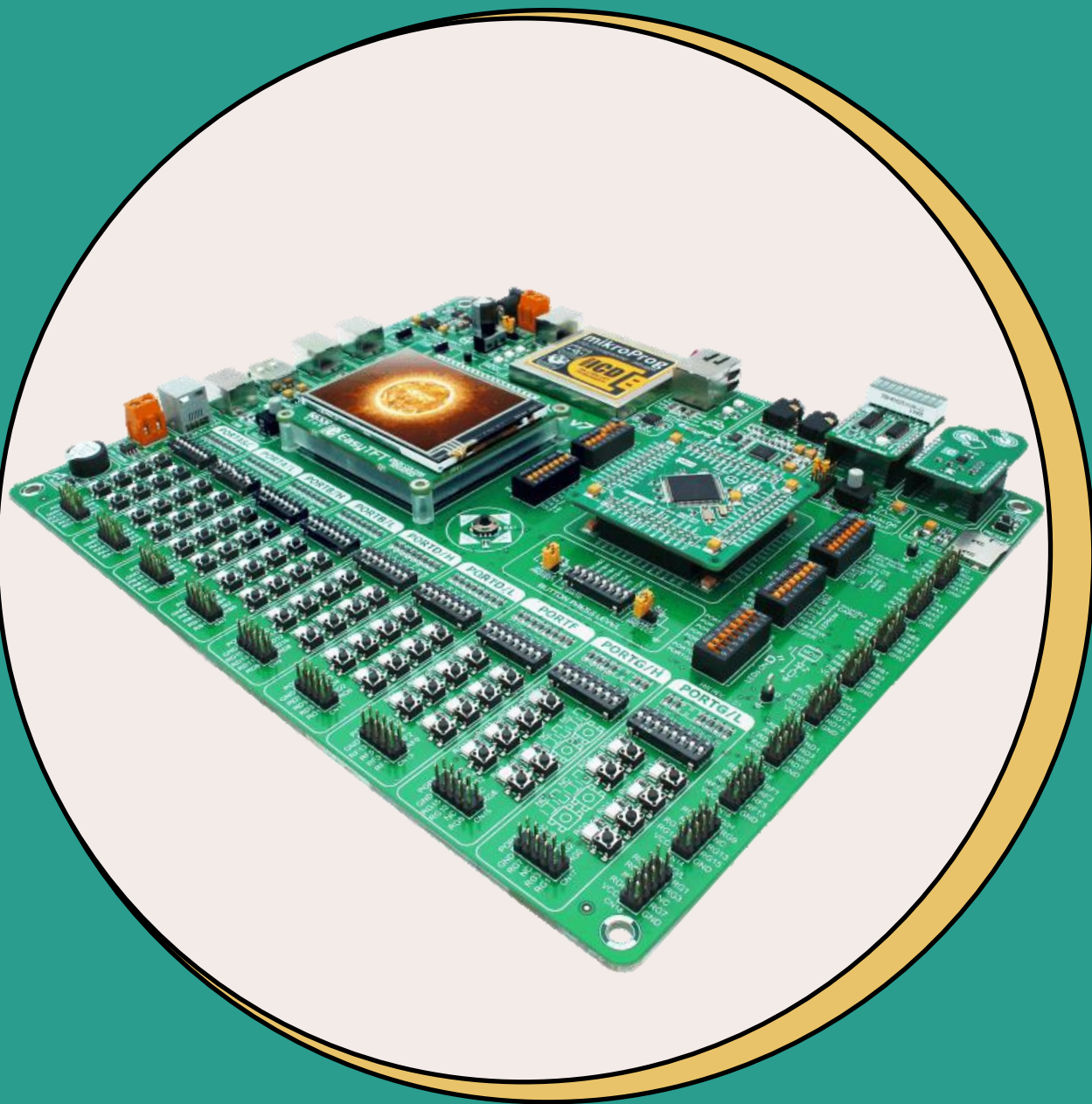


CODEGRIP FOR PIC + CODEGRIP SUITE



MPLAB XC32 kompajler

# EasyPIC Fusion v7 razvojná ploča

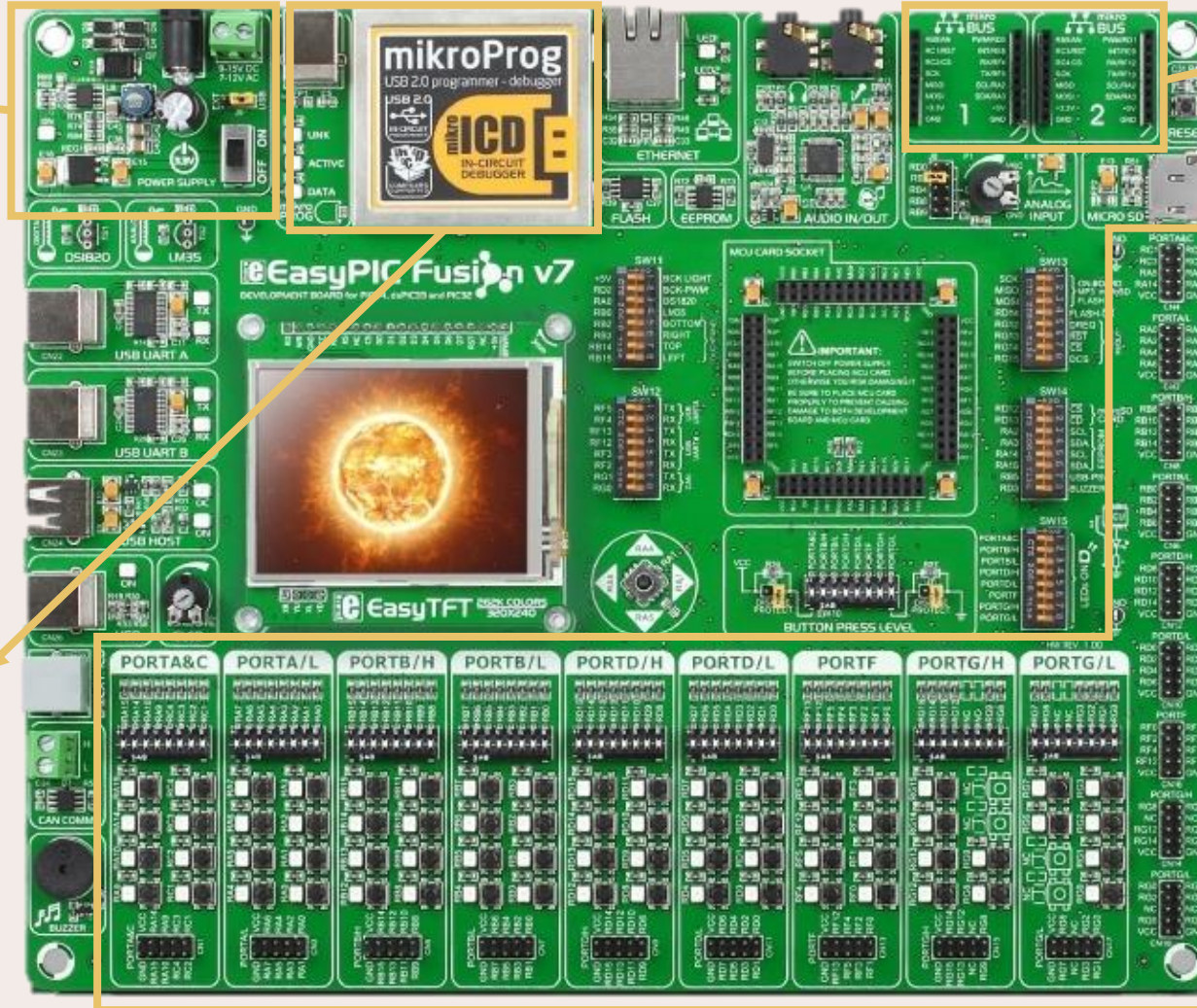




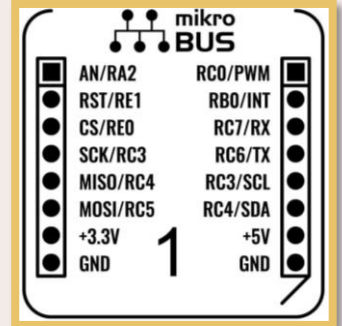
# EasyPIC Fusion v7 razvojna ploča

☐ Napajanje ploče

☐ MikroBUS socket



☐ MikroProg USB 2.0 programator i mikroICD debager



☐ I/O grupe (68 pinova)

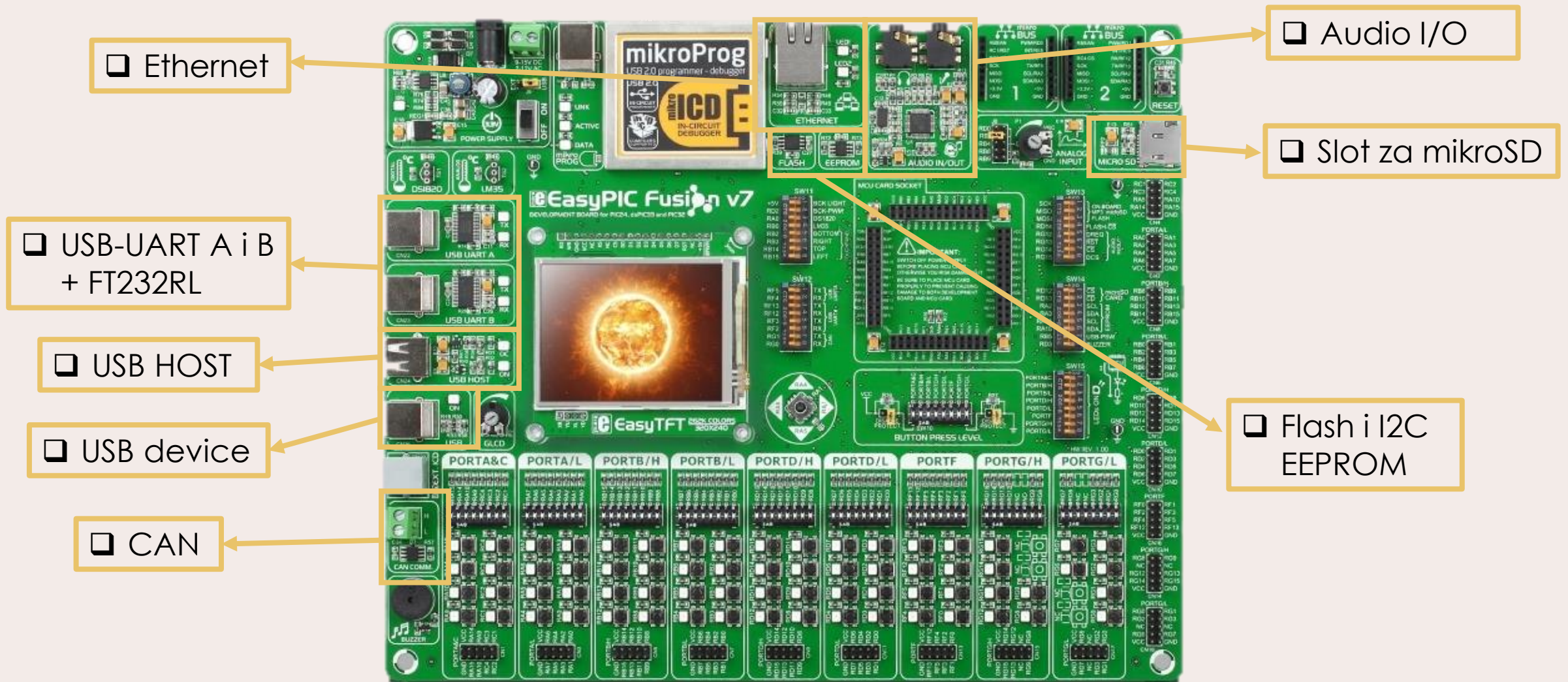
- LED
- Pinovi
- Tasteri

☐ Tri-state pull-up/down DIP switch

☐ Button press level



# EasyPIC Fusion v7 razvojna ploča





# EasyPIC Fusion v7 razvojna ploča

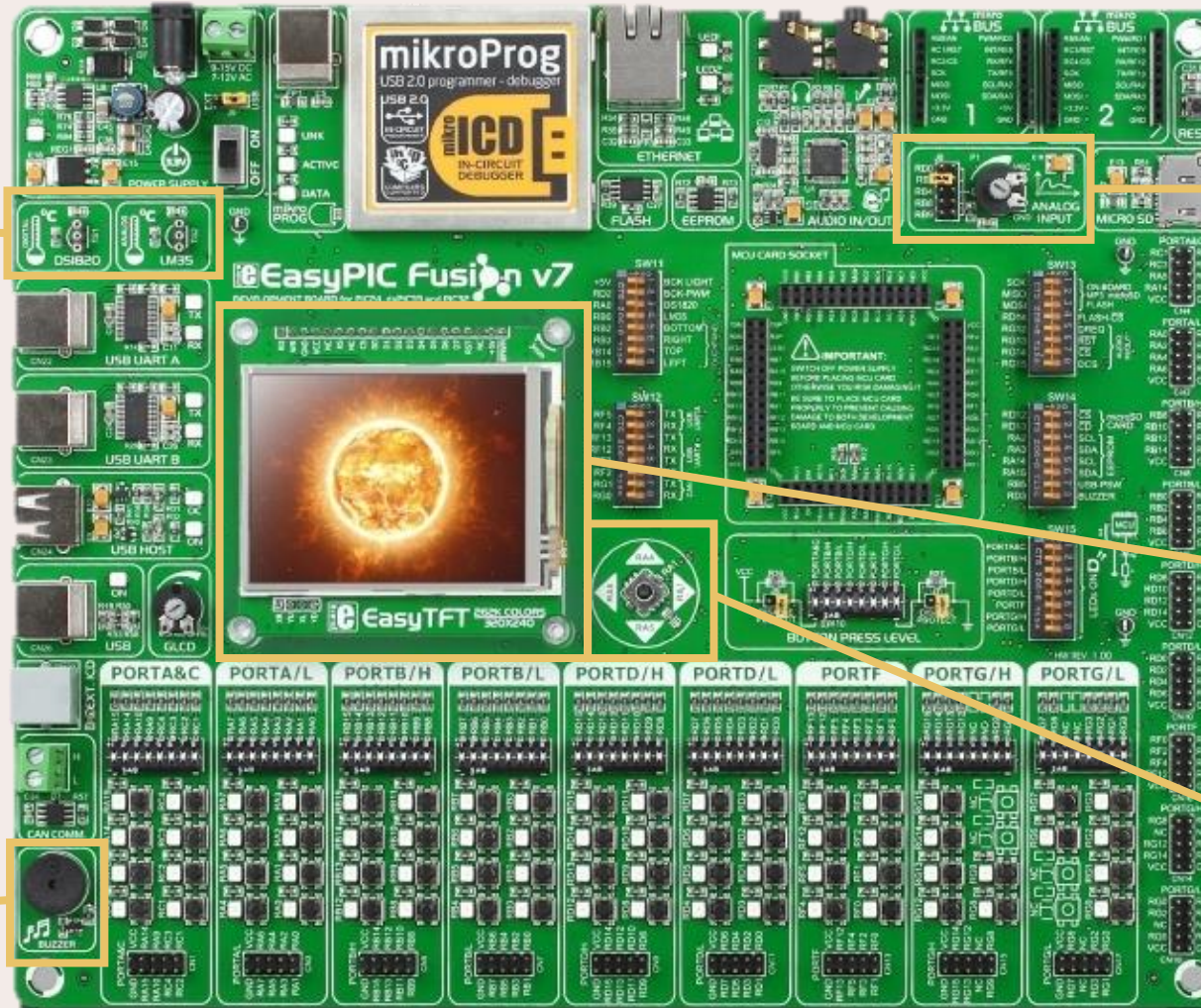
- ❑ Digitalni temperaturni senzor DS18B20
- ❑ Analogni temperaturni senzor LM35

❑ ADC input

❑ EasyTFT displej + touch panel

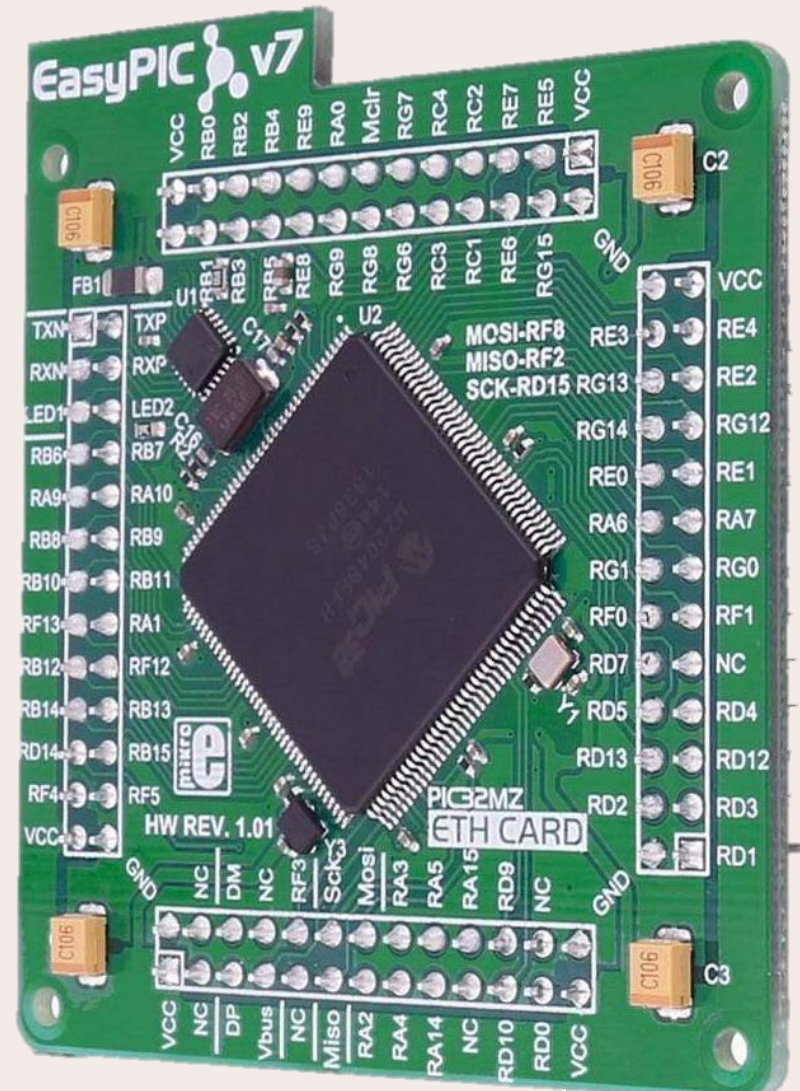
❑ Džojstik

❑ Piezo buzzer



# PIC32MZ2048EFH144 mikrokontroler

- ❑ Programabilan izvor takta (do 252 MHz)
- ❑ Devet 16-bitnih ili do četiri 32-bitna timer/counter-a
- ❑ Devet input capture i devet output compare modula
- ❑ RTCC
- ❑ DMA
- ❑ USB 2.0 Hi-Speed OTG kontroler
- ❑ 10/100 Mbps Ethernet interfejs
- ❑ Audio komunikacija – I2S
- ❑ 6xSPI,
- ❑ 5xI2C,
- ❑ 2xCAN,
- ❑ 9xUART
- ❑ 12-bitni ADC (do 48 analognih ulaza, programabilna referenca)





# CODEGRIP for PIC



# CODEGRIP for PIC

- ❑ Programer i debager
- ❑ CODEGRIP for PIC – podržava PIC, PIC24, PIC32 i dsPIC familije mikrokontrolera
- ❑ Programiranje:
  - a) Putem USB-C
  - b) Putem WiFi
- ❑ 2-wire JTAG

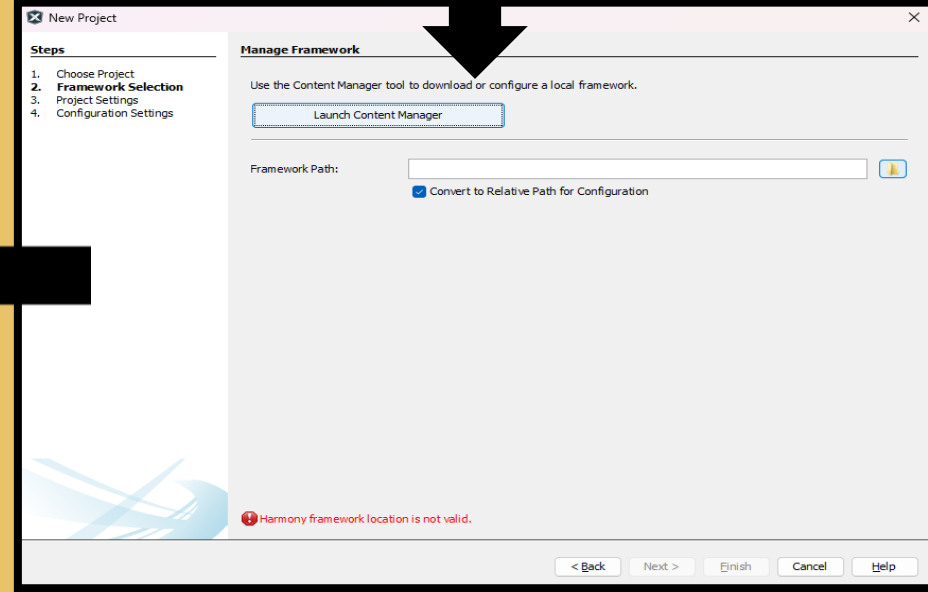
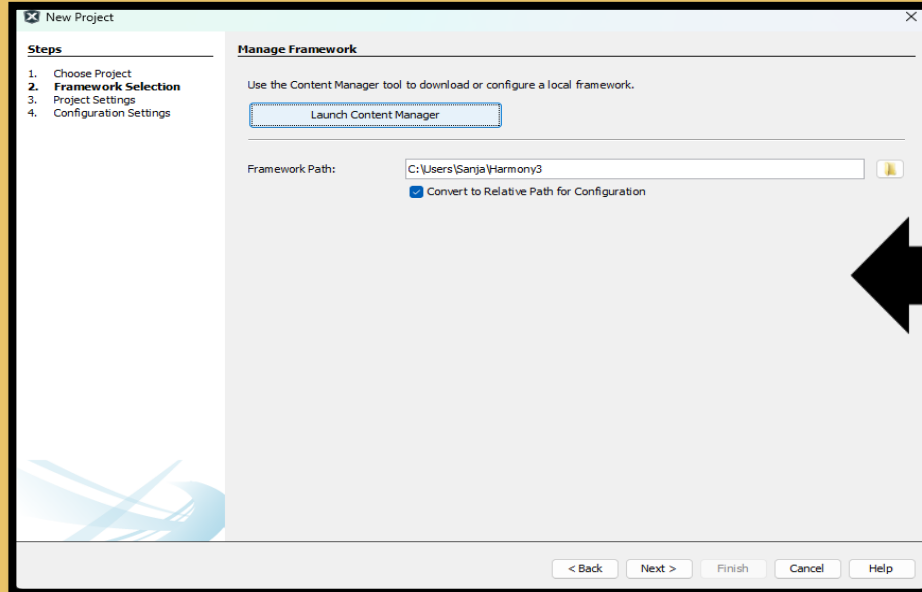
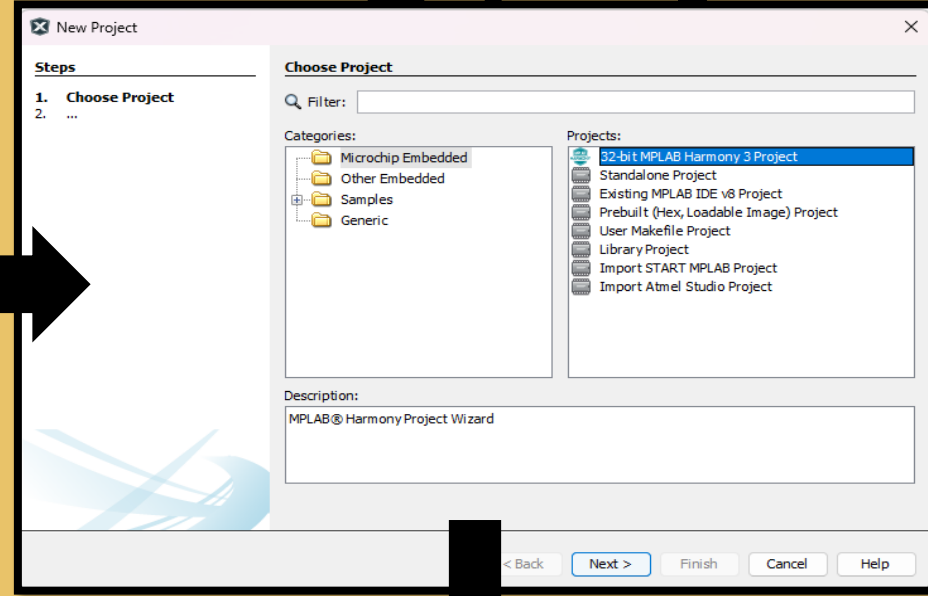
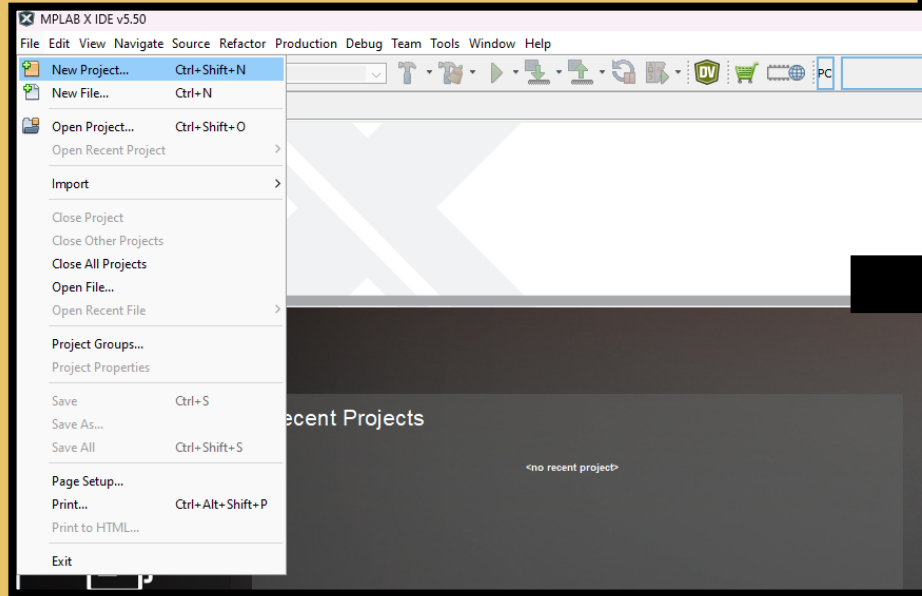
EXT ICD konektor



VCC-TGT	■ ■	EJTAG_TMS
GND	■ ■	EJTAG_CLK/PGEC
GND	■ ■	EJTAG_TDO/PGED
RESERVED	■ ■	EJTAG_TDI
PROG_MUX/GND	■ ■	MCLR
GND	■ ■	RESERVED
GND	■ ■	RESERVED
GND	■ ■	RESERVED
GND	■ ■	RESERVED
GND	■ ■	RESERVED

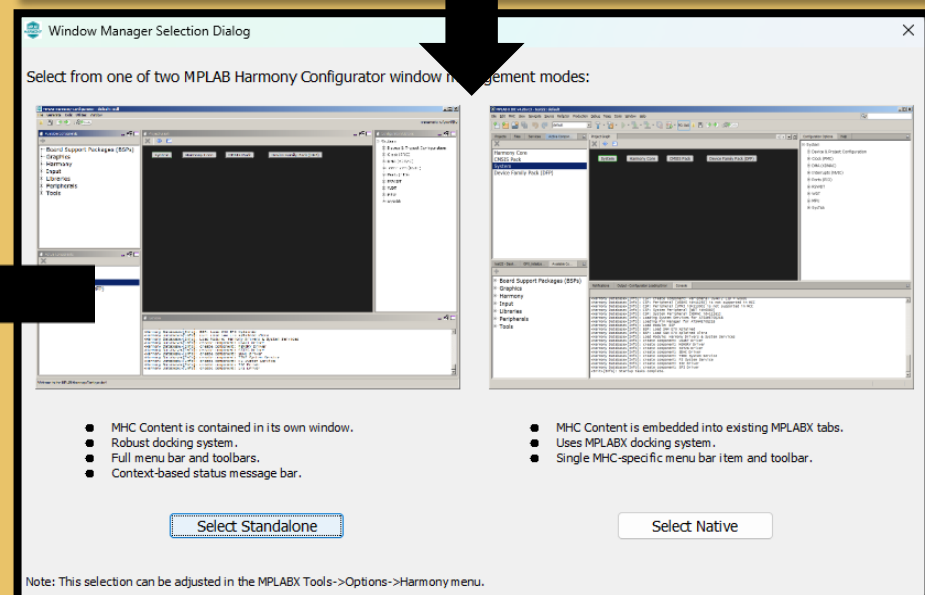
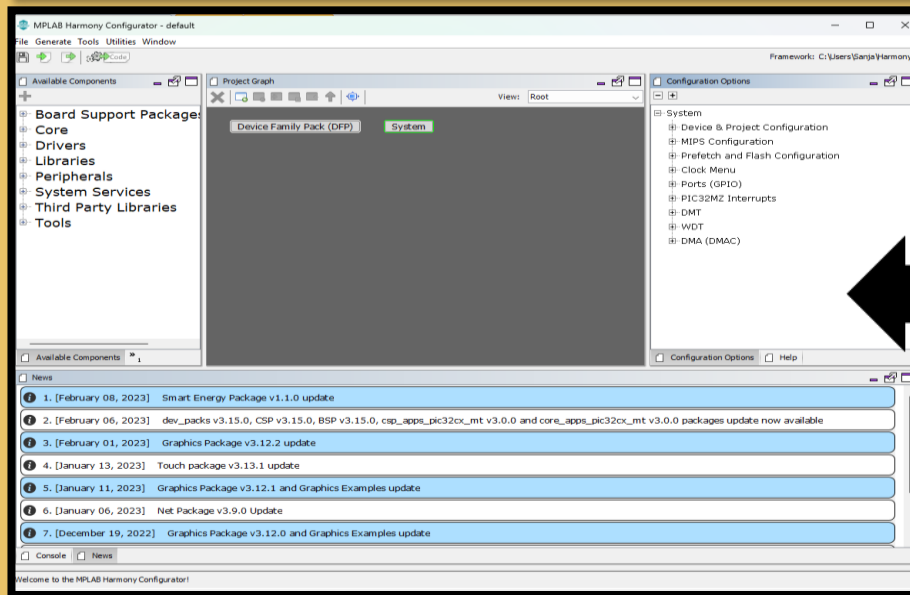
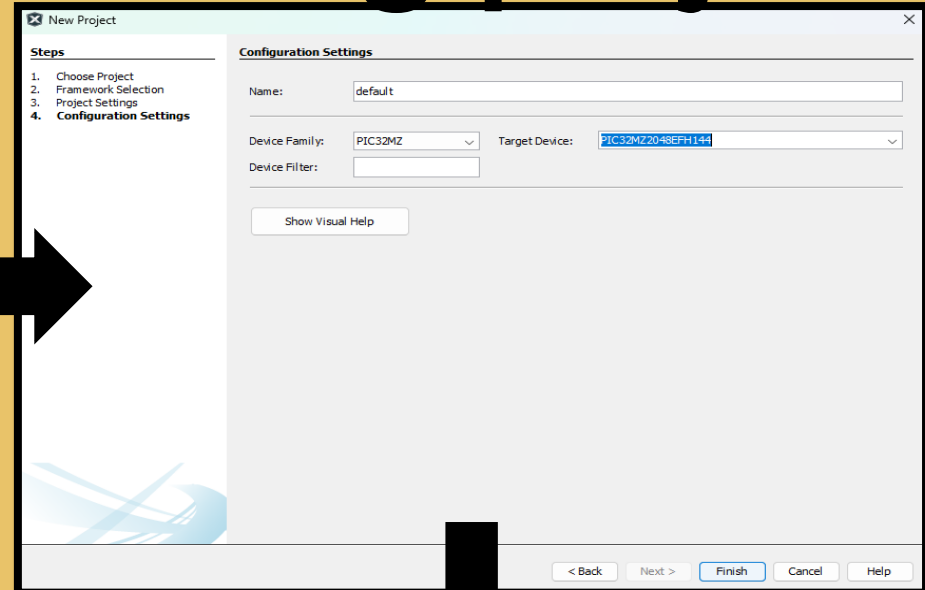
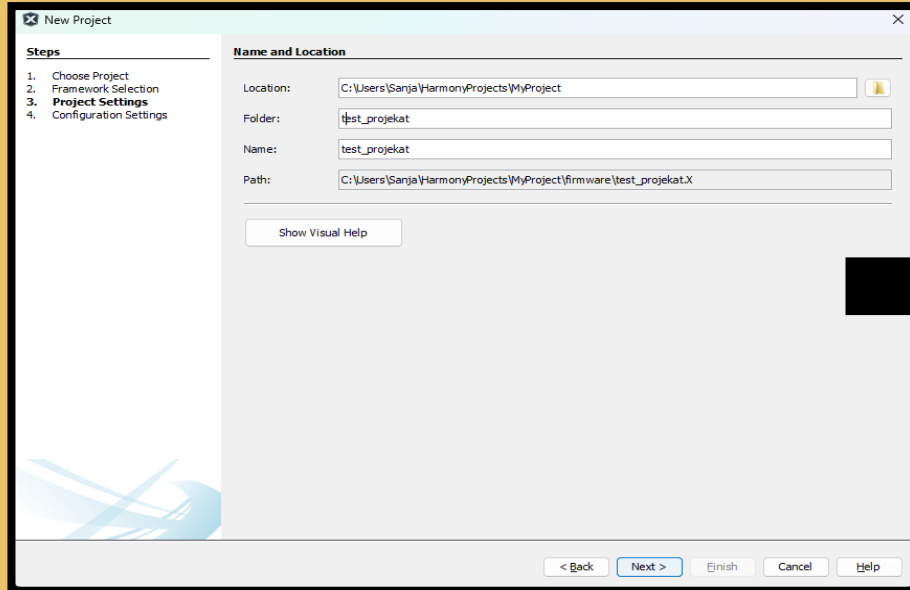


# MPLAB – kreiranje novog projekta

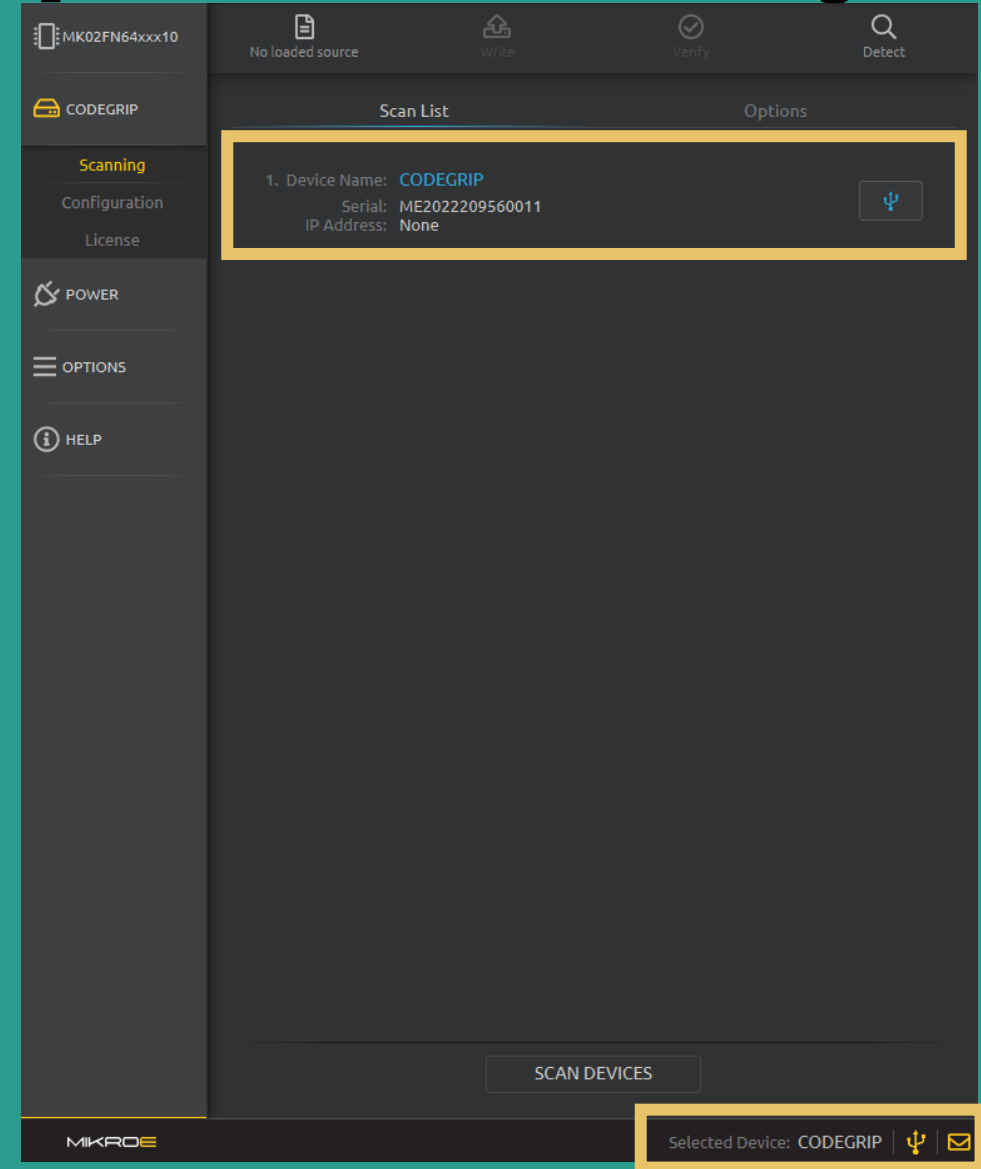
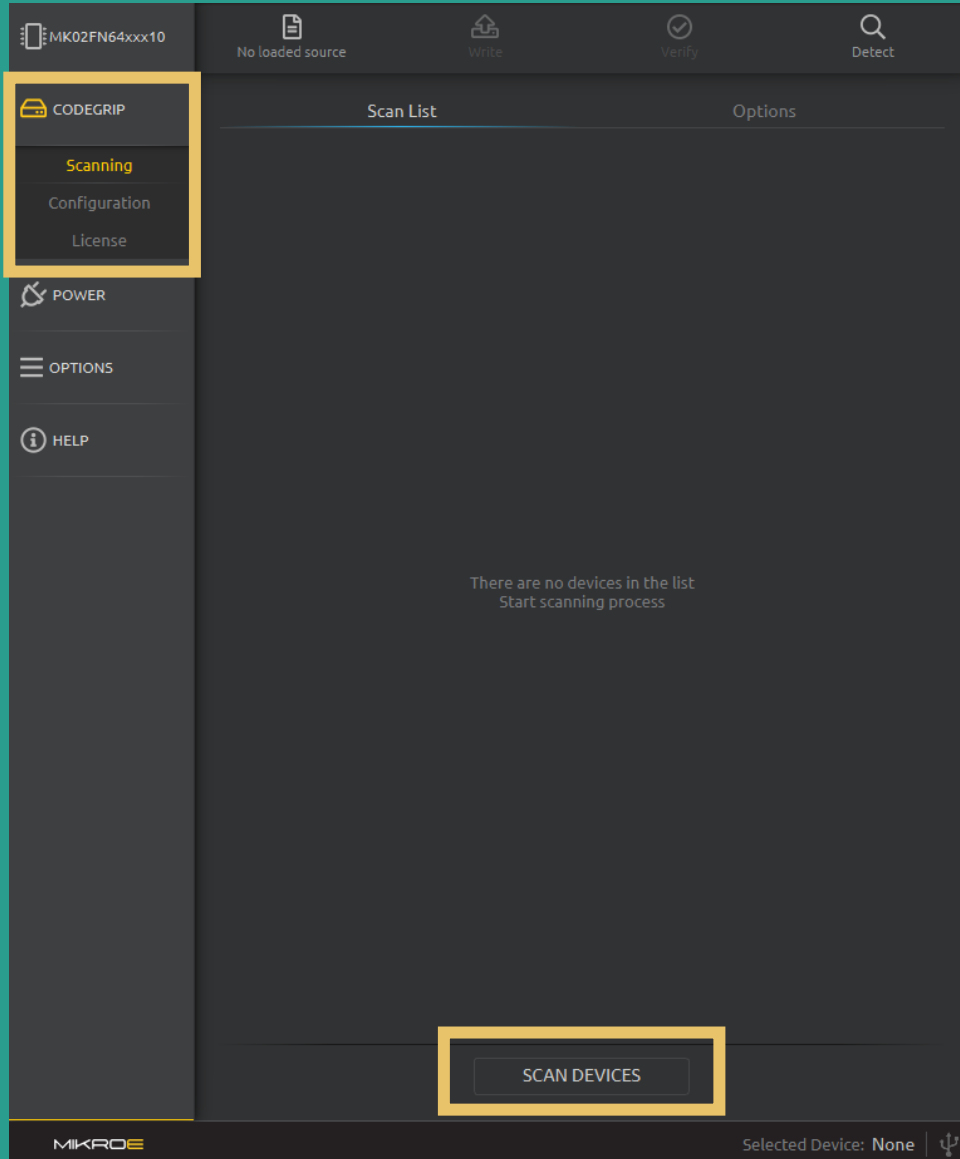




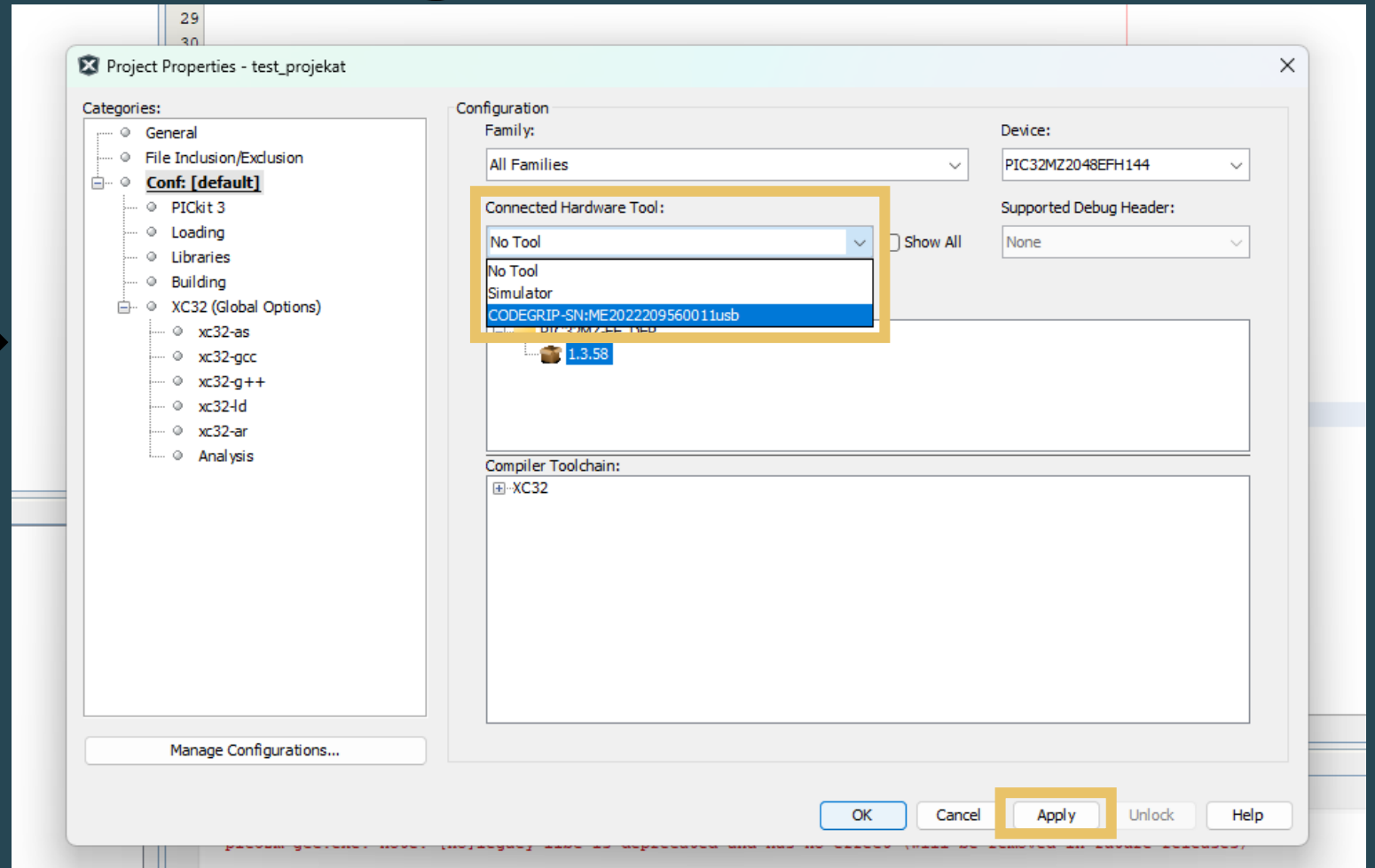
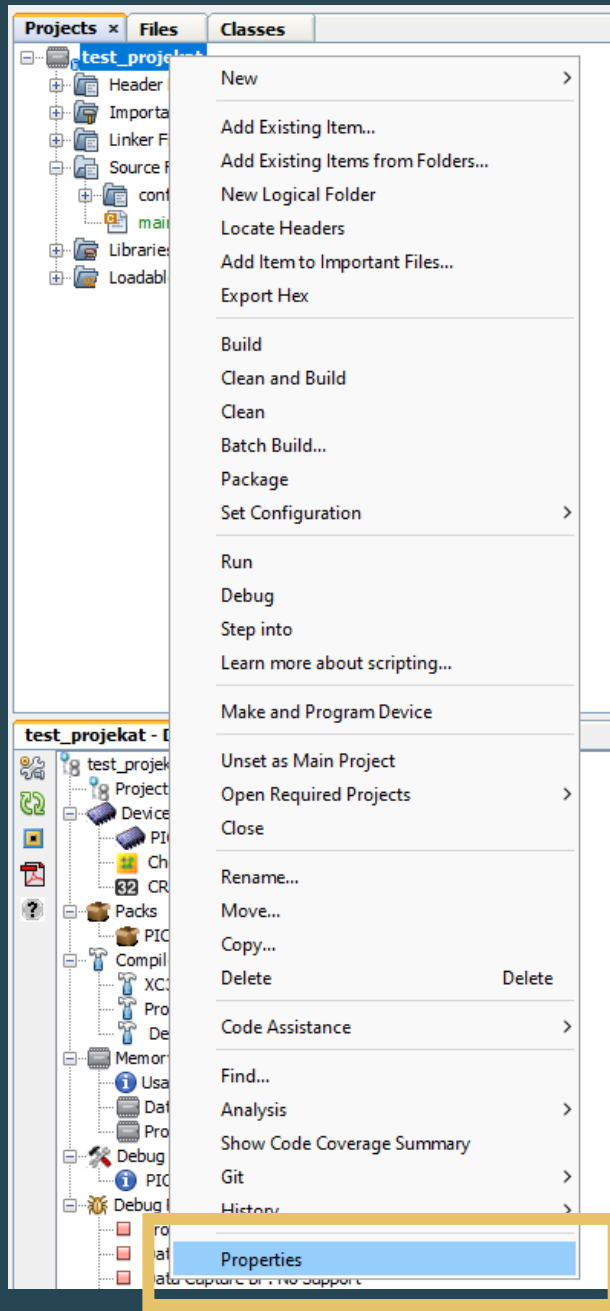
# MPLAB – kreiranje novog projekta



# CODEGRIP Suite podešavanja

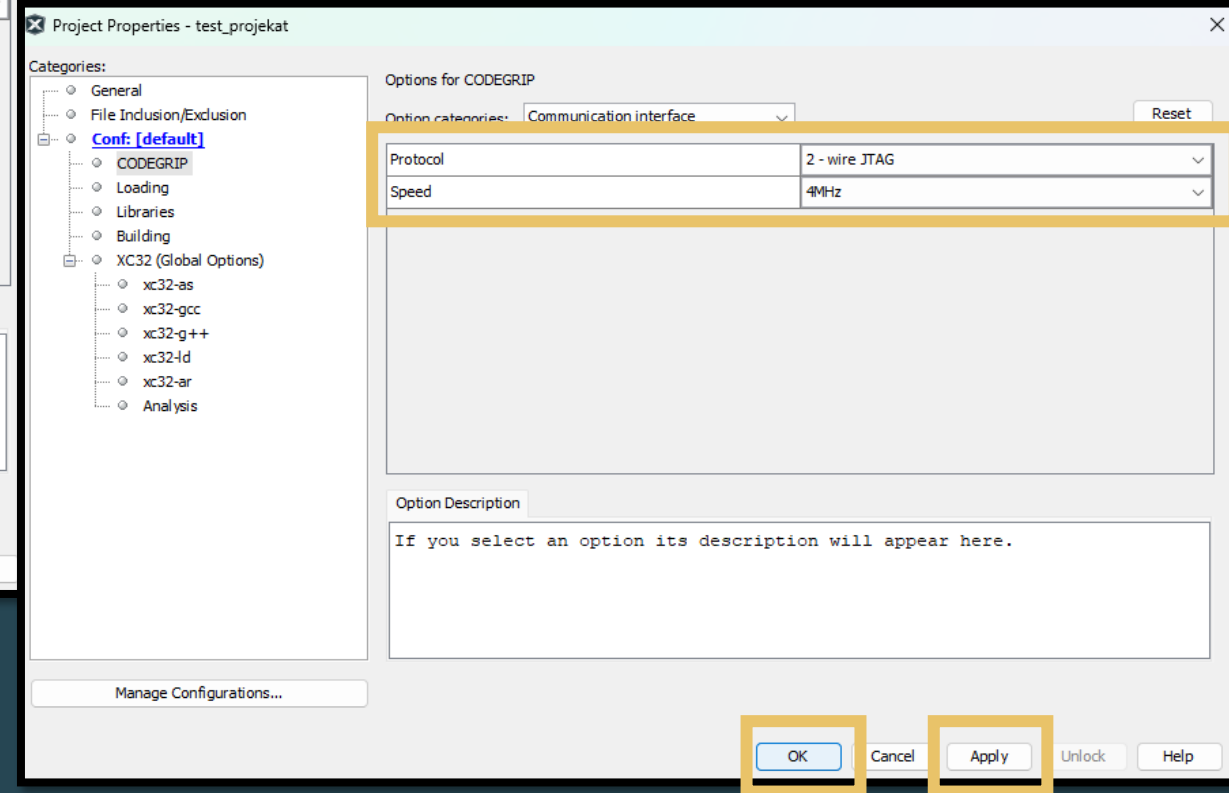
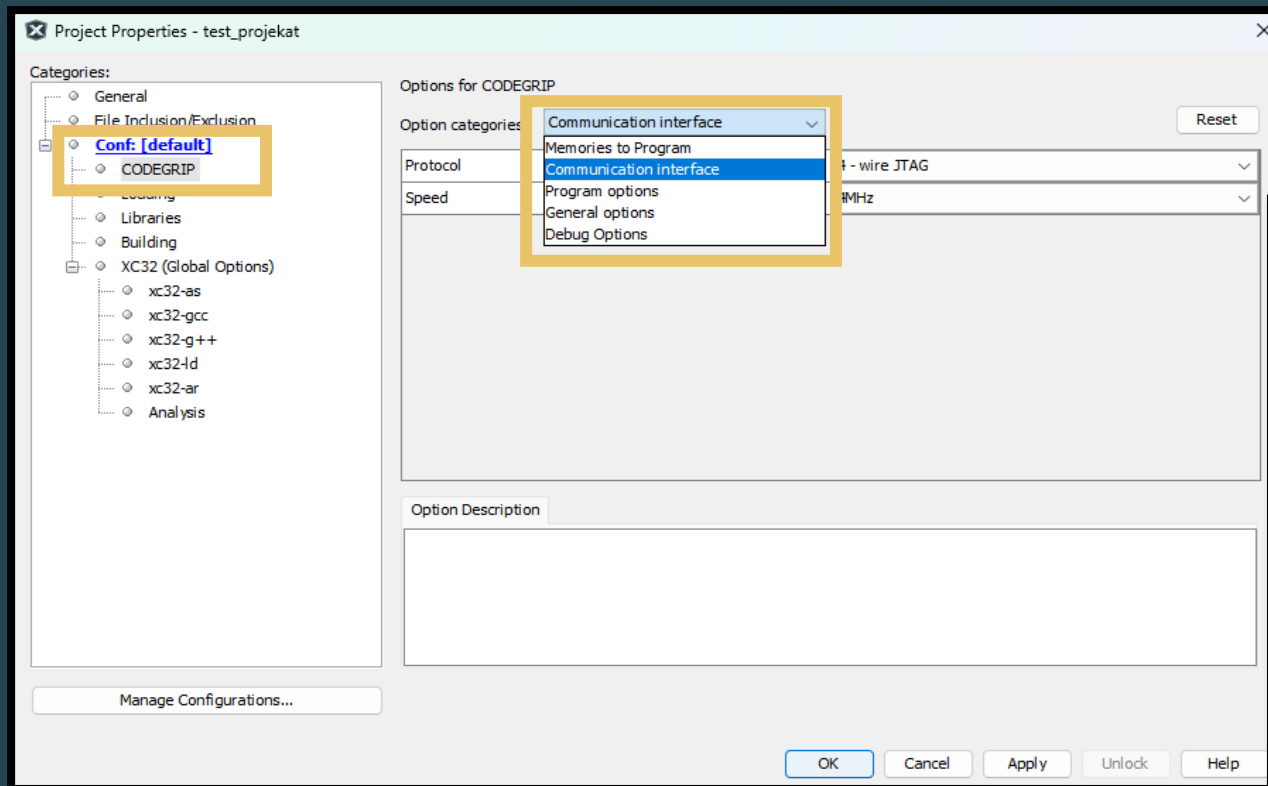


# MPLAB – podešavanje programatora





# MPLAB – podešavanje programatora



# Zadatak 1 – Detekcija pritiska tastera upotrebom spoljašnjeg prekida + LED zavesa



- U odnosu na taster koji je pritisnut na džojstiku (pinovi RA4, RA5, RA6, RA7) neophodno je realizovati blinkanje dioda porta B tako da se postigne efekat LED zavesa:
  - RA4 – pomeranje na gore
  - RA5 – pomeranje na dole
  - RA6 – pomeranje u levo
  - RA7 – pomeranje u desno
- \*Neophodno je primeniti pull-up otpornike na pinove RA4, RA5, RA6 i RA7
- Problem detekcije silazne ivice na pinovima rešiti upotrebom spoljašnjih prekida na pinovima RA4, RA5, RA6 i RA7

# Zadatak 1 – Detekcija pritiska tastera upotrebom spoljašnjeg prekida + LED zavesa



## □ Tasteri:

- **Problem nedefinisanog stanja (floating state)**
  - Usled velike ulazne impedanse pina
  - Rešenje – primena pull-up (definiše stanje logičke 1 kada je taster otpušten) ili pull-down (definiše stanje logičke 0 kada je taster otpušten) otpornika
- **Problem treperenja kontakta**
  - Usled mehaničke prirode kontakta javlja se šum prilikom pritiska tastera
  - Rešenje – hardversko (NF filter) ili softversko (metoda vremenske zadržke, metoda pomeranja bita)
- **Detekcija silazne/uzlazne ivice**
  - Upotreba flag promenljive za čuvanje prethodnog stanja na pinu ili upotreba spoljašnjih prekida



# Zadatak 1 – Detekcija pritiska tastera upotrebom spoljašnjeg prekida + LED zavesa



□ Konfiguracija pinova RA4, RA5, RA6 i RA7 u MPLAB Harmony 3 Configurator-u:

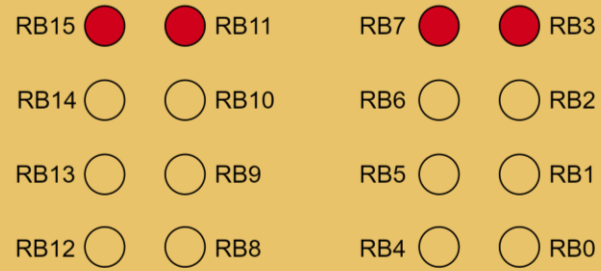
- GPIO input
- Kako bi upotreba spoljašnjih prekida na datim pinovima bila omogućena neophodno je označiti *Change Notification* polje

Pin Settings

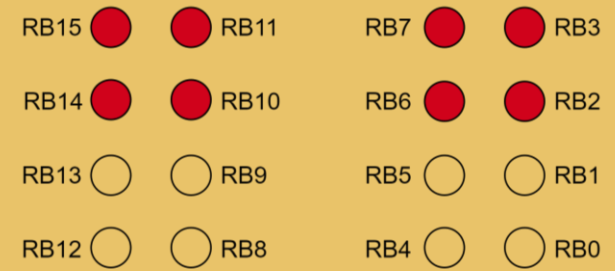
Order: Ports

Pin Number	Pin ID	Voltage Tolerance	Custom Name	Function	Direction (TRIS)	Latch (LAT)	Open Drain (ODC)	Mode (ANSEL)	Change Notification (CN)	Pull Up (CNPU)	Pull Down (CNPD)	Slew Rate
22	RA0			Available	In	n/a	<input type="checkbox"/>	Analog	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Fastest Edge Rate
56	RA1			Available	In	n/a	<input type="checkbox"/>	Analog	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Fastest Edge Rate
85	RA2	5V		Available	In	n/a	<input type="checkbox"/>	Digital	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Fastest Edge Rate
86	RA3	5V		Available	In	n/a	<input type="checkbox"/>	Digital	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Fastest Edge Rate
87	RA4	5V	GPIO_RA4	GPIO	In	Low	<input type="checkbox"/>	Digital	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Fastest Edge Rate
2	RA5		GPIO_RA5	GPIO	In	Low	<input type="checkbox"/>	Digital	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Fastest Edge Rate
129	RA6	5V	GPIO_RA6	GPIO	In	Low	<input type="checkbox"/>	Digital	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Fastest Edge Rate
130	RA7	5V	GPIO_RA7	GPIO	In	Low	<input type="checkbox"/>	Digital	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Fastest Edge Rate
39	RA9			Available	In	n/a	<input type="checkbox"/>	Analog	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Fastest Edge Rate
40	RA10			Available	In	n/a	<input type="checkbox"/>	Analog	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Fastest Edge Rate
95	RA14	5V		Available	In	n/a	<input type="checkbox"/>	Digital	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Fastest Edge Rate
96	RA15	5V		Available	In	n/a	<input type="checkbox"/>	Digital	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Fastest Edge Rate

# ❑ LED zavesa na dole:



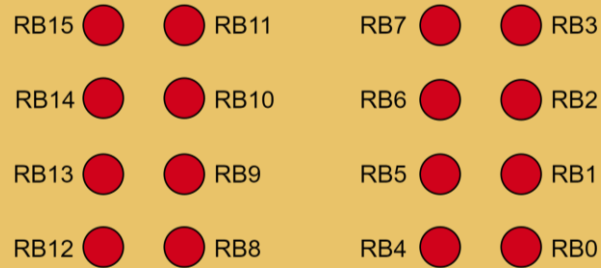
$$0xCCCC = 0x8888 | 0x8888 \gg 1$$



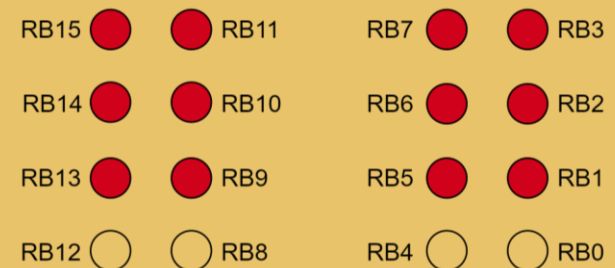
RB15 RB14 RB13 RB12 RB11 RB10 RB9 RB8 RB7 RB6 RB5 RB4 RB3 RB2 RB1 RB0  
 1 0 0 0 1 0 0 0 1 0 0 0 1 0 0 0  
 0x8888

RB15 RB14 RB13 RB12 RB11 RB10 RB9 RB8 RB7 RB6 RB5 RB4 RB3 RB2 RB1 RB0  
 1 1 0 0 1 1 0 0 1 1 0 0 1 1 0 0  
 0xCCCC

$$0xEEEE = 0xCCCC | 0x8888 \gg 2$$



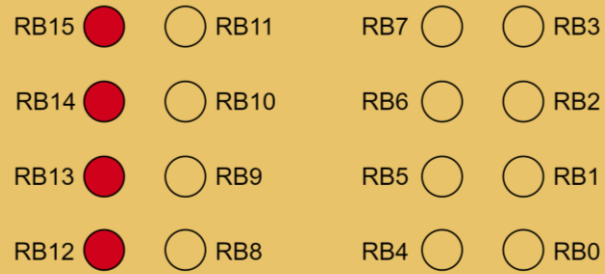
$$0xFFFF = 0xEEEE | 0x8888 \gg 3$$



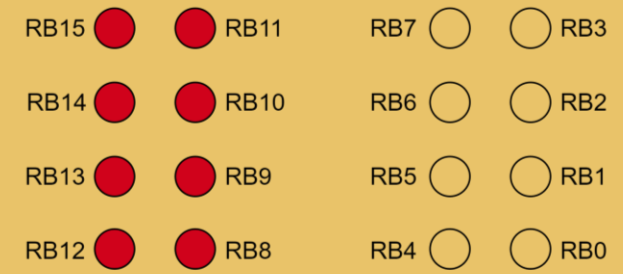
RB15 RB14 RB13 RB12 RB11 RB10 RB9 RB8 RB7 RB6 RB5 RB4 RB3 RB2 RB1 RB0  
 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1  
 0xFFFF

RB15 RB14 RB13 RB12 RB11 RB10 RB9 RB8 RB7 RB6 RB5 RB4 RB3 RB2 RB1 RB0  
 1 1 1 0 1 1 1 0 1 1 1 0 1 1 1 0  
 0xEEEE

## ❑ LED zavesa u desno:



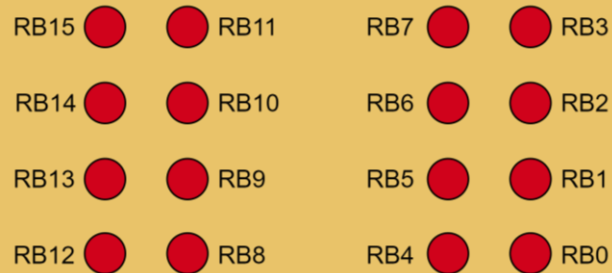
$$0xFF00 = 0xF000 | 0xF000 \gg 4$$



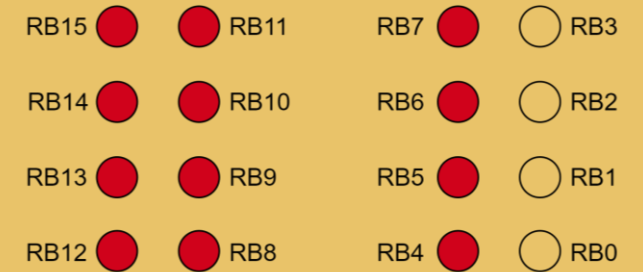
RB15 RB14 RB13 RB12 RB11 RB10 RB9 RB8 RB7 RB6 RB5 RB4 RB3 RB2 RB1 RB0  
 1 1 1 1 0 0 0 0 0 0 0 0 0 0 0 0  
 0xF000

RB15 RB14 RB13 RB12 RB11 RB10 RB9 RB8 RB7 RB6 RB5 RB4 RB3 RB2 RB1 RB0  
 1 1 1 1 1 1 1 1 0 0 0 0 0 0 0 0  
 0xFF00

$$0xFFFF = 0xFF00 | 0xF000 \gg 8$$



$$0xFFFF = 0xFF00 | 0xF000 \gg 12$$



RB15 RB14 RB13 RB12 RB11 RB10 RB9 RB8 RB7 RB6 RB5 RB4 RB3 RB2 RB1 RB0  
 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1  
 0xFFFF

RB15 RB14 RB13 RB12 RB11 RB10 RB9 RB8 RB7 RB6 RB5 RB4 RB3 RB2 RB1 RB0  
 1 1 1 1 1 1 1 1 1 1 1 1 0 0 0 0  
 0xFFFF0