

TALLER DE MICROCONTROLADORES CON DSPIC33FJ32MC202

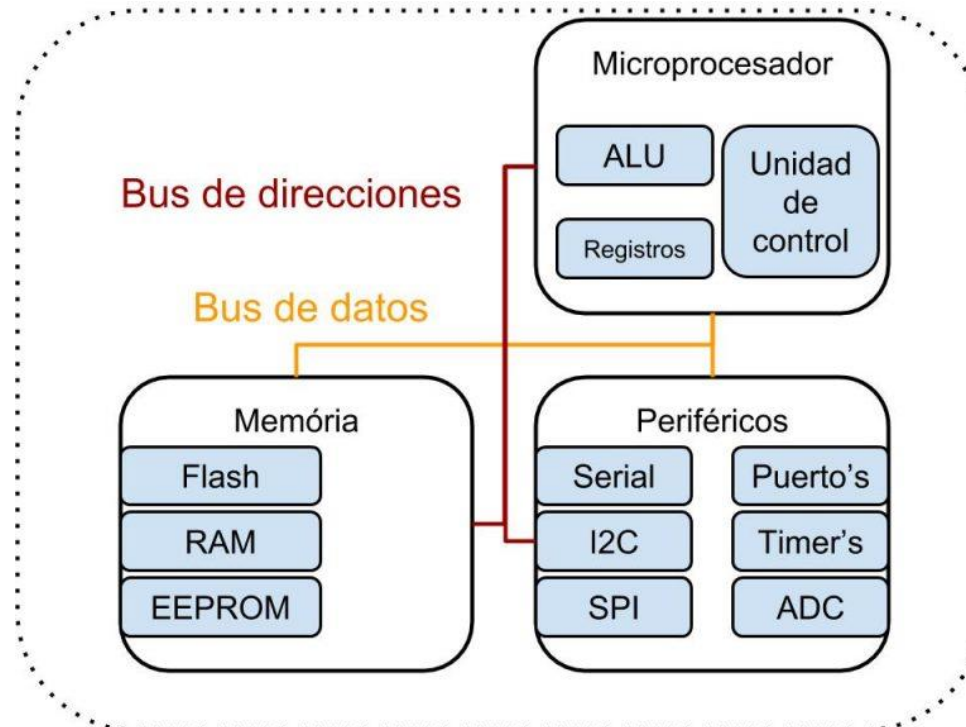
Instructor: Juan David Rosadio Vega

Miembro IEEE RAS UNAC

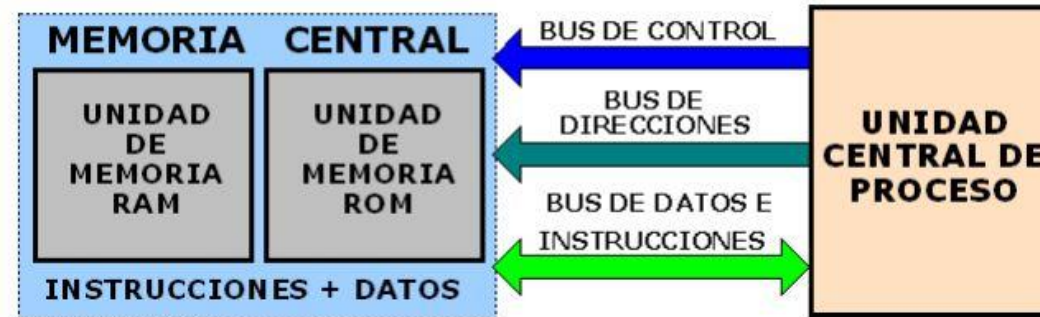
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Un microcontrolador es un circuito integrado que en su interior contiene una unidad central de procesamiento (CPU), unidades de memoria (RAM y ROM), puertos de entrada y salida y periféricos. Se puede decir con toda propiedad que un microcontrolador es una microcomputadora completa encapsulada en un circuito integrado.



ARQUITECTURA VON NEUMANN



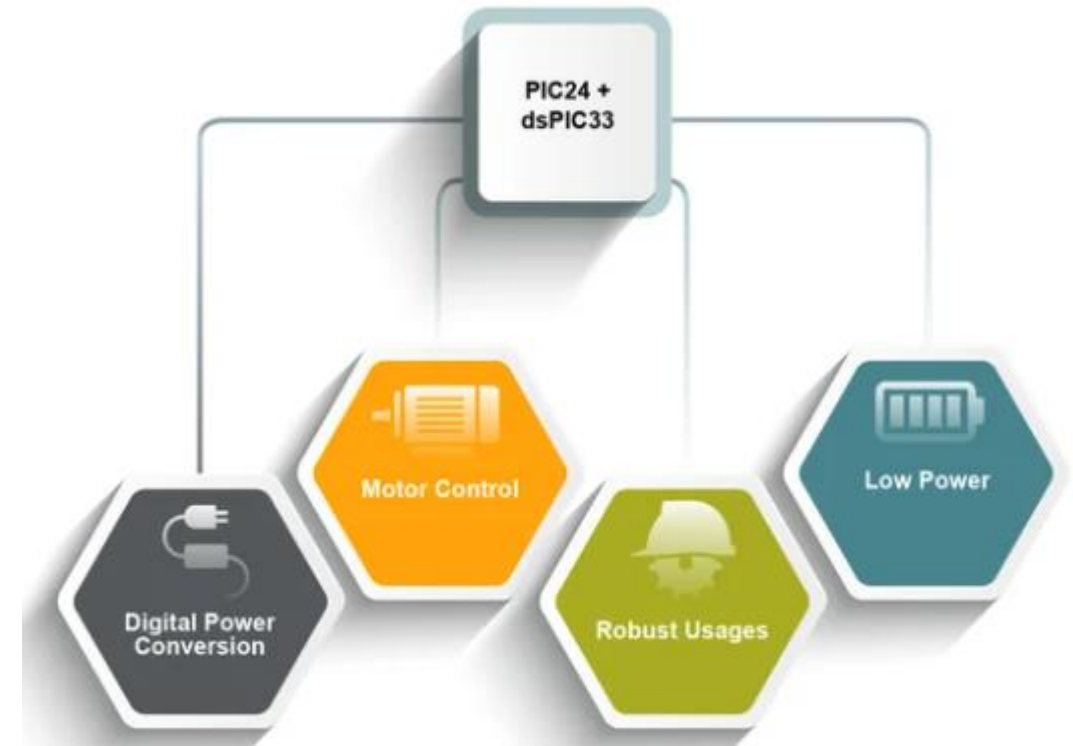
ARQUITECTURA HARVARD



FAMILIA DSPIC33

- Tienen un Procesador de señal digital (DSP) para aplicaciones integradas de alto rendimiento que ejecutan lazos de control de tiempo crítico
- Incluyen periféricos especializados

Todo esto lo hace ideal para control de motores con uso intensivo de matemáticas, conversión de energía digital de alta eficiencia.





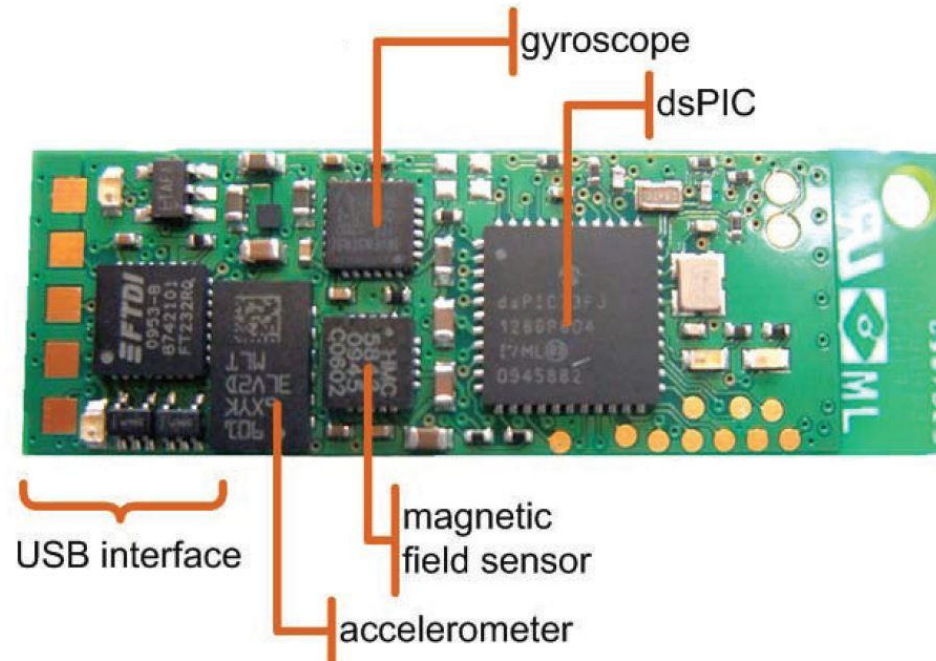
SPDIP



SSOP

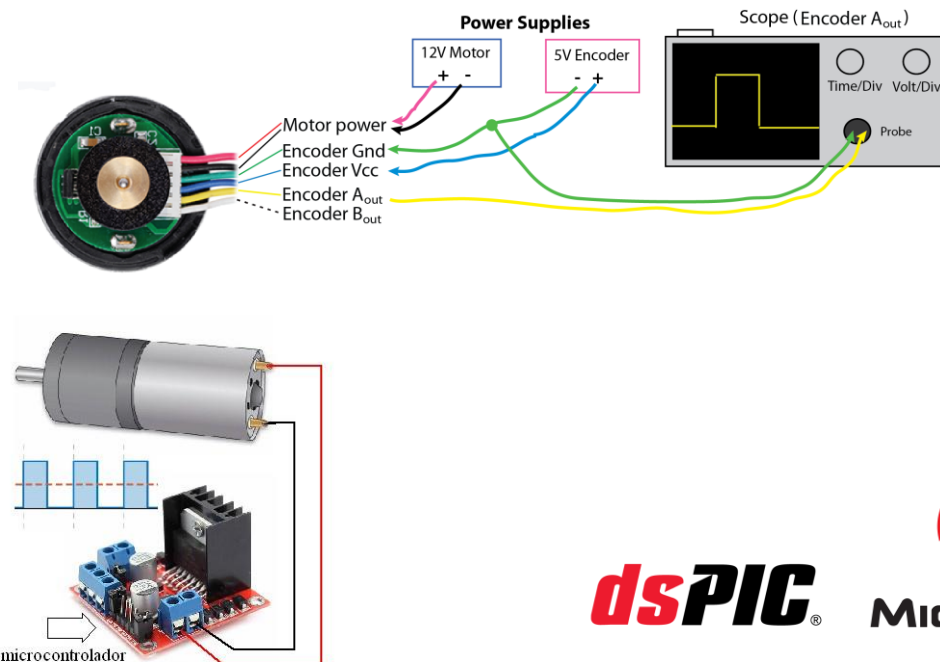
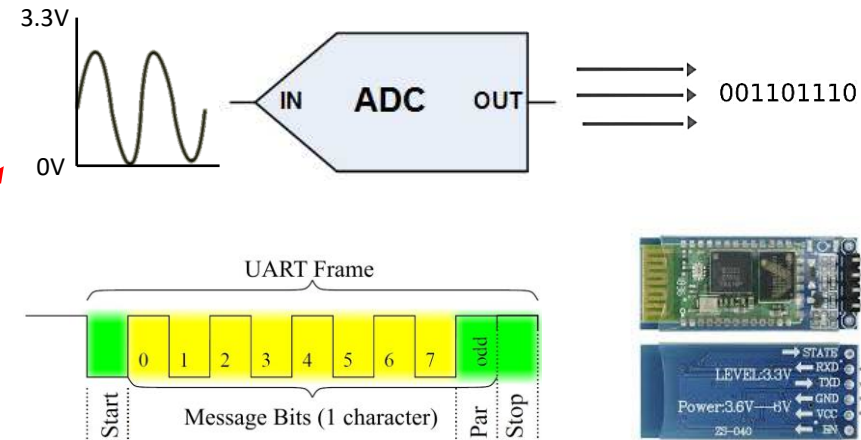


QFN



Parametrics

Name	Value
Architecture	16-bit
Max CPU Speed (MHz)	40
CPU Speed (MIPS/DMIPS)	40
Program Memory Size (KB)	32
SRAM (KB)	2
Temperature Range (C)	-40 to 150
Operating Voltage Range (V)	3 to 3.6
Pin Count	28
Analog Peripherals	1-A/D 6x12-bit @ 1100(ksps)
UART	1
SPI	1
I2C	1
Timers	3 x 16-bit 1 x 32-bit
Motor Control PWM Outputs	8
Input Capture	4
Max PWM outputs (including complementary)	10
Number of PWM Time Bases	3
Output Compare Channels	4
Class B Hardware	Yes
Quadrature Encoder Interface	1
Peripheral Pin Select / Pin Muxing	Yes



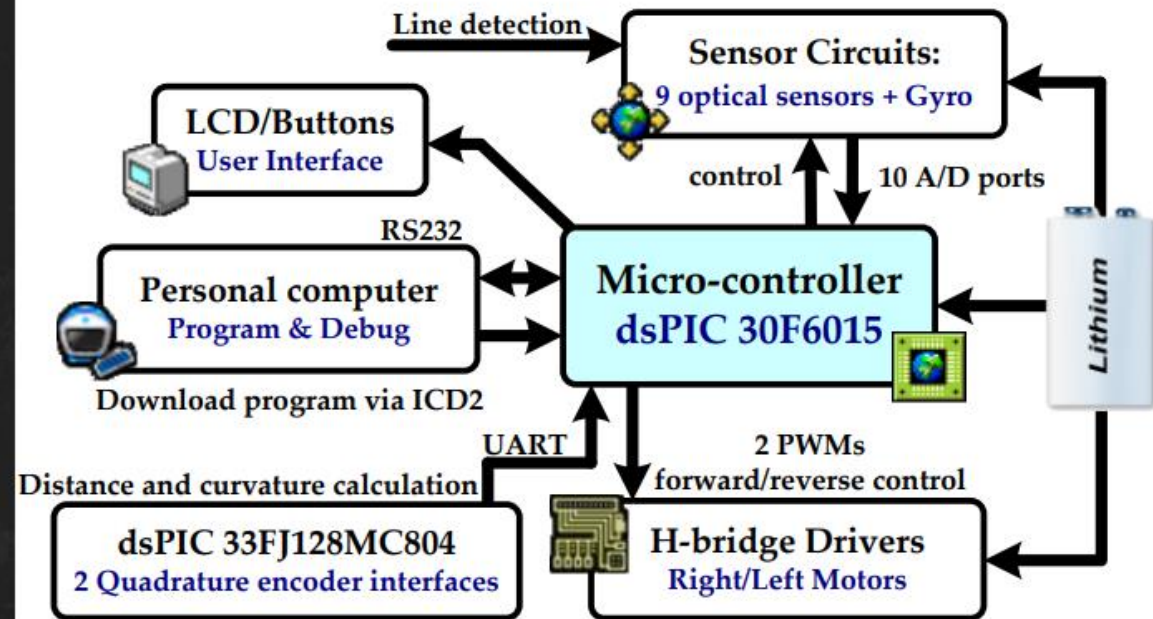
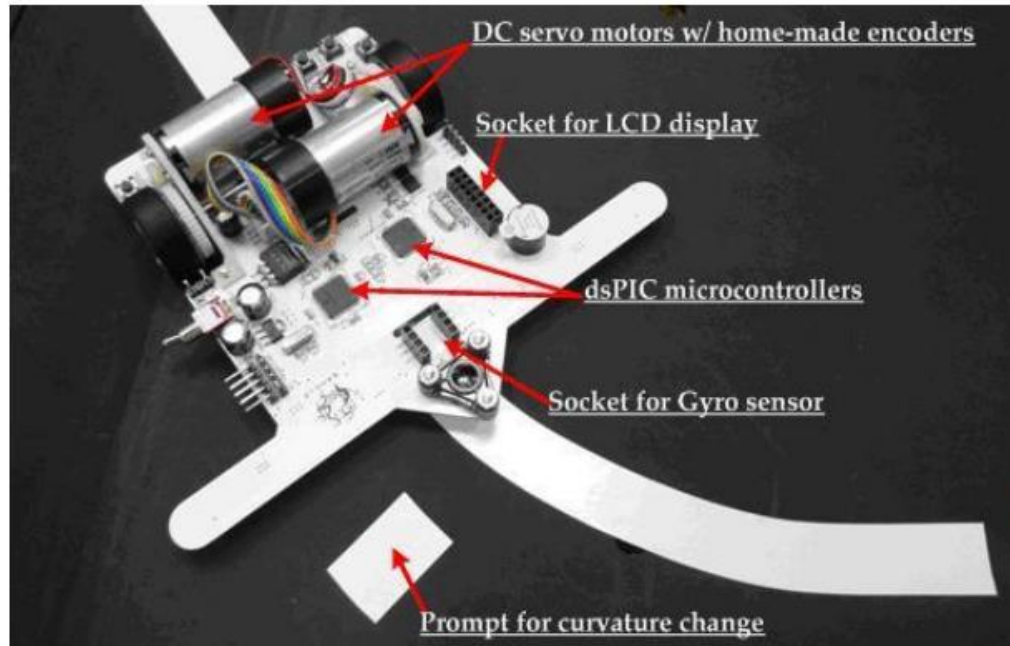


Figure 1: The proposed line-following robot and its corresponding block diagram.

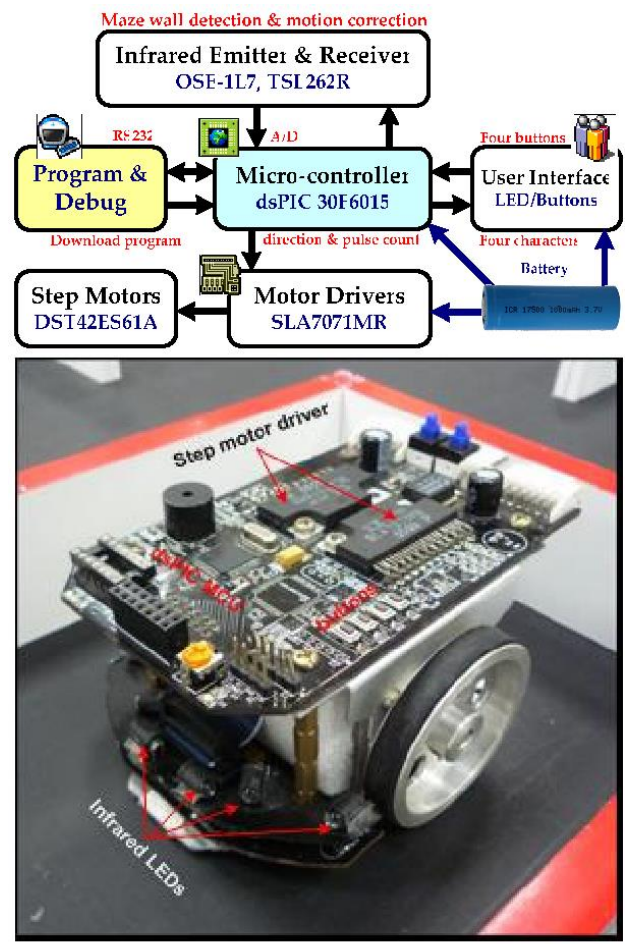


Fig. 1 The low cost micromouse kit designed for teaching

Table 1 Position and orientation calculations for step motor micromouse

Right wheel moves a step
orientation: $\theta_n = \theta + \Delta\theta$
position
$x_{Cn} = \frac{1}{2}(x_{Rn} + x_{Ln}), \quad y_{Cn} = \frac{1}{2}(y_{Rn} + y_{Ln})$
$\begin{bmatrix} x_{Rn} - x_{Ln} \\ y_{Rn} - y_{Ln} \end{bmatrix} = \begin{bmatrix} \cos \Delta\theta & -\sin \Delta\theta \\ \sin \Delta\theta & \cos \Delta\theta \end{bmatrix} \begin{bmatrix} x_R - x_L \\ y_R - y_L \end{bmatrix}$

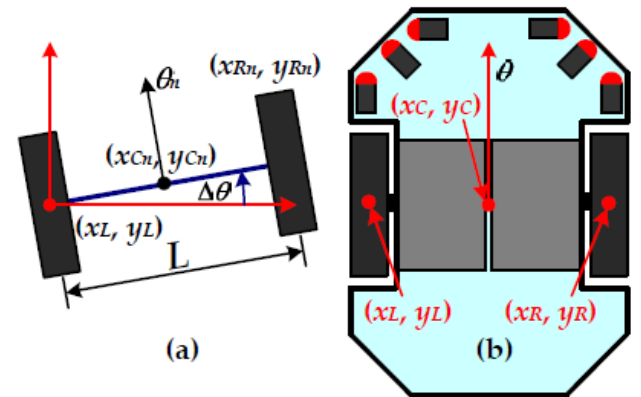


Fig. 6 Position calculation of the micromouse when right or left step motor moves one step

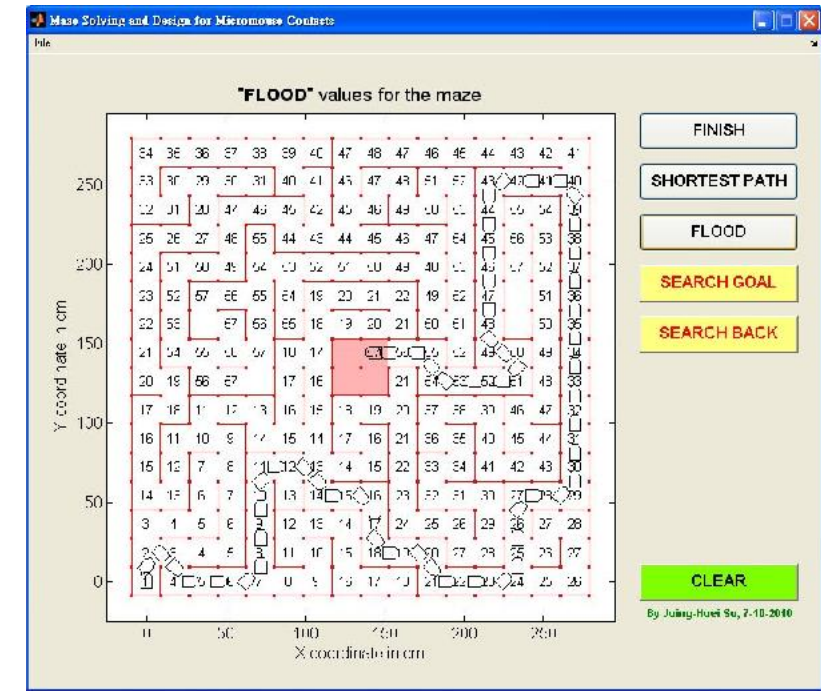


Fig. 2 A MATLAB program for learning maze solving algorithms

EMPECEMOS

Software

MPLABXIDE 5.35

<http://ww1.microchip.com/downloads/en/DeviceDoc/MPLABX-v5.35-windows-installer.exe>

Compilador XC16 V1.33

<http://ww1.microchip.com/downloads/en/DeviceDoc/xc16-v1.33-full-install-windows-installer.exe>

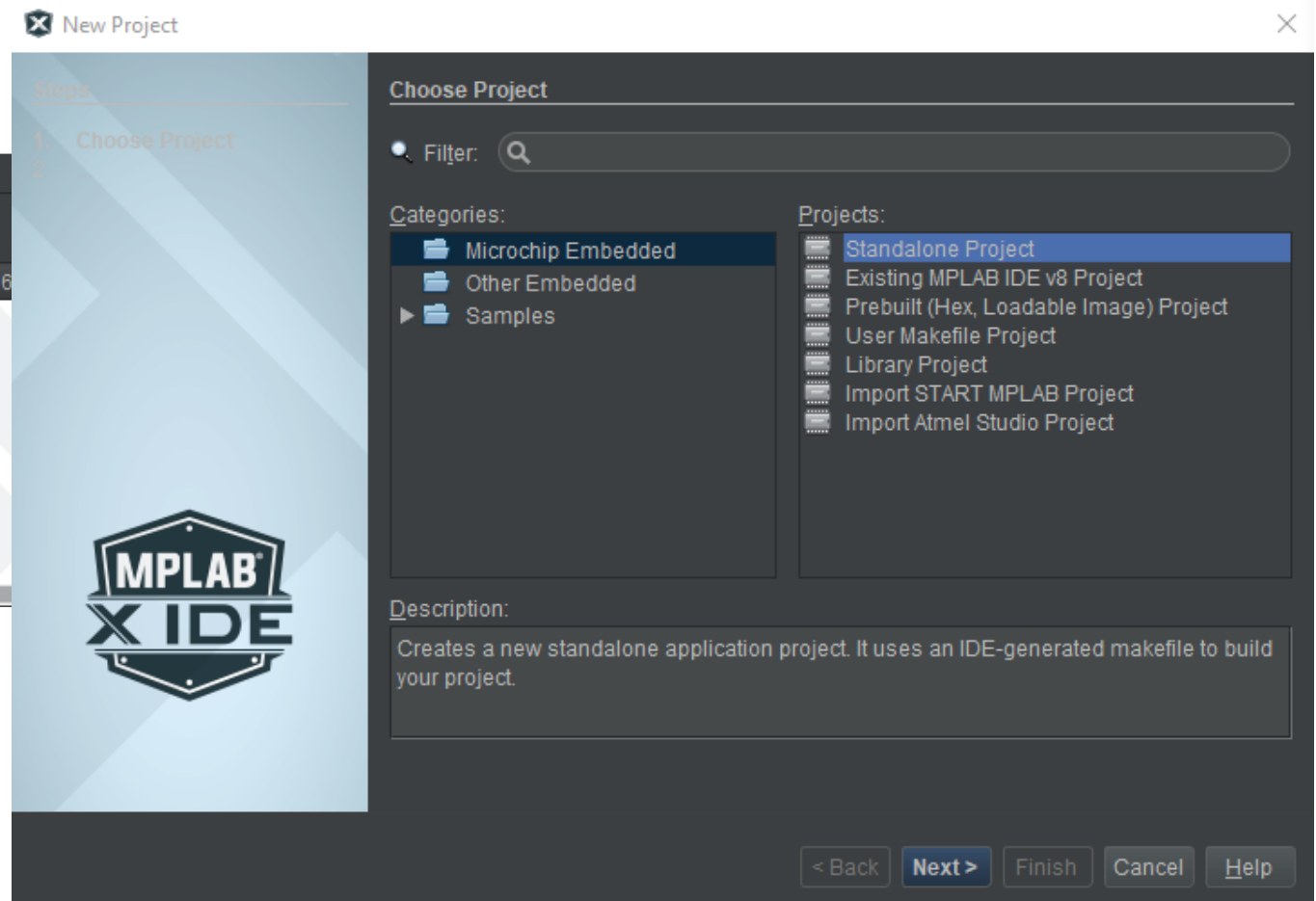
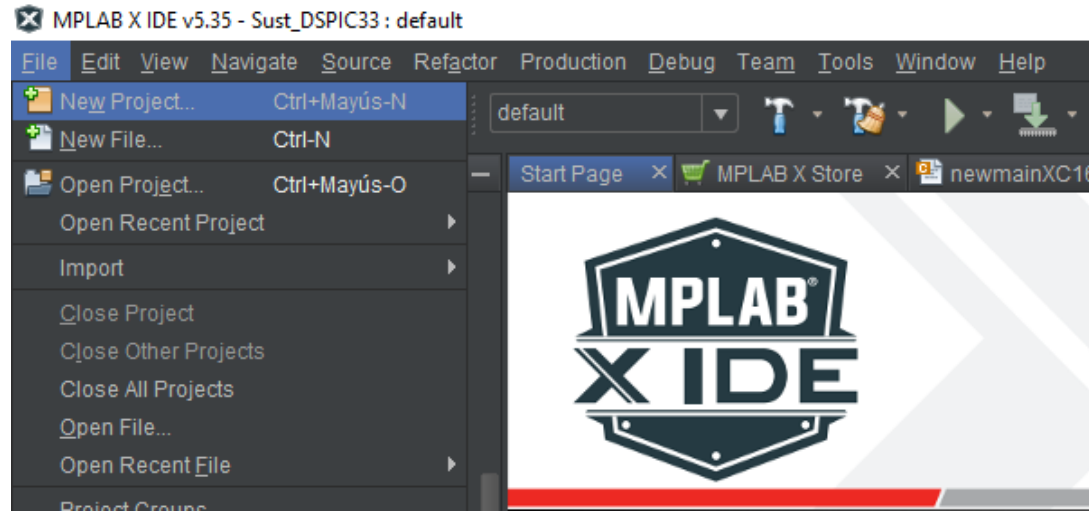
DSPIC33FJ32MC202 Datasheet

<http://ww1.microchip.com/downloads/en/devicedoc/70265b.pdf>

Proteus 8.8

https://www.youtube.com/watch?v=Rru48DApb_o

CREACION DE PROYECTO



New Project

Steps

1. Choose Project

2. Select Device


3. Select Header

4. Select Tool (Optional)

5. Select Plugin Board

6. Select Compiler

7. Select Project Name and Folder



Select Device

Family:

16-bit DSCs (dsPIC33) ▼

Device:

dsPIC33FJ32MC202 ▼

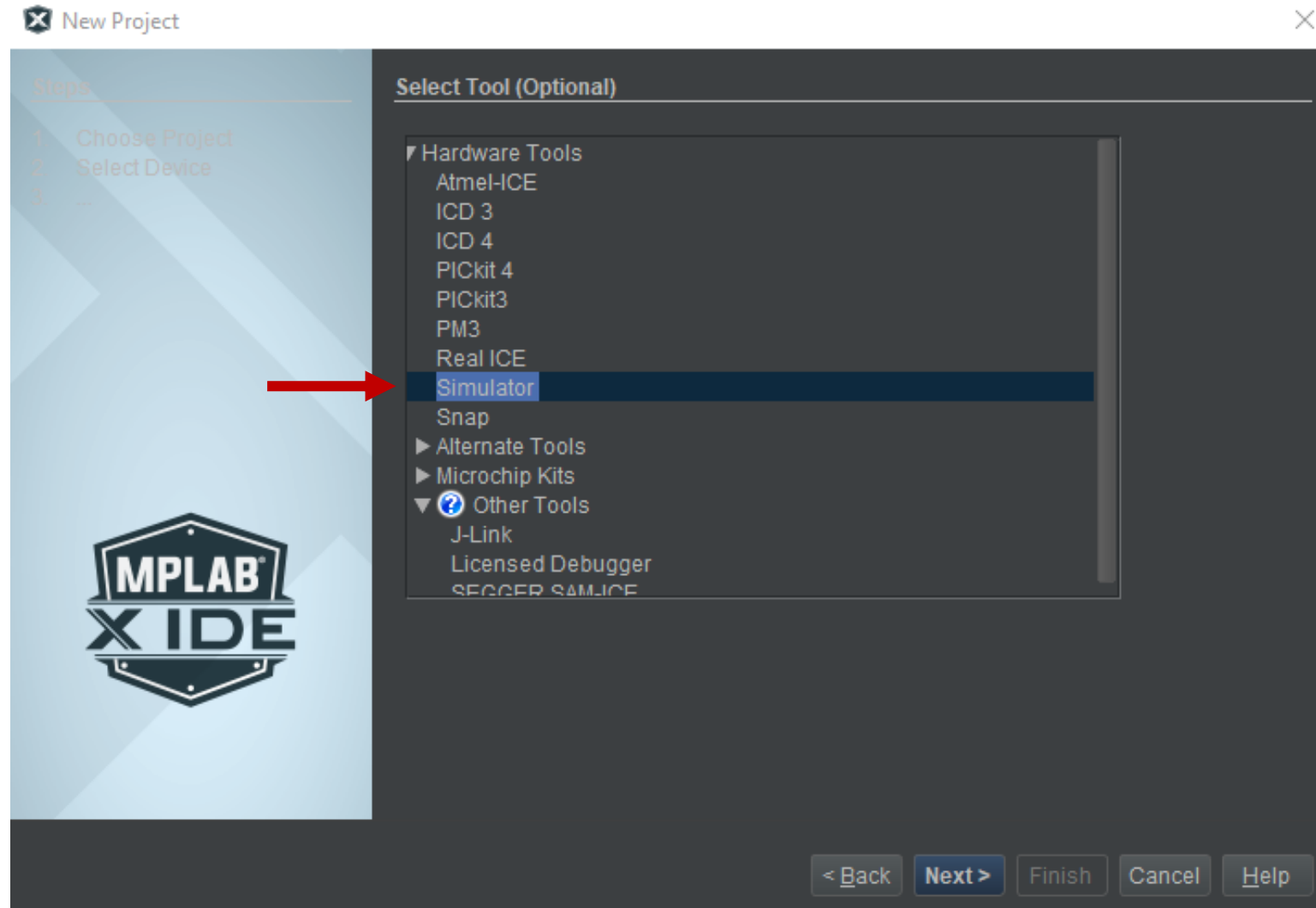
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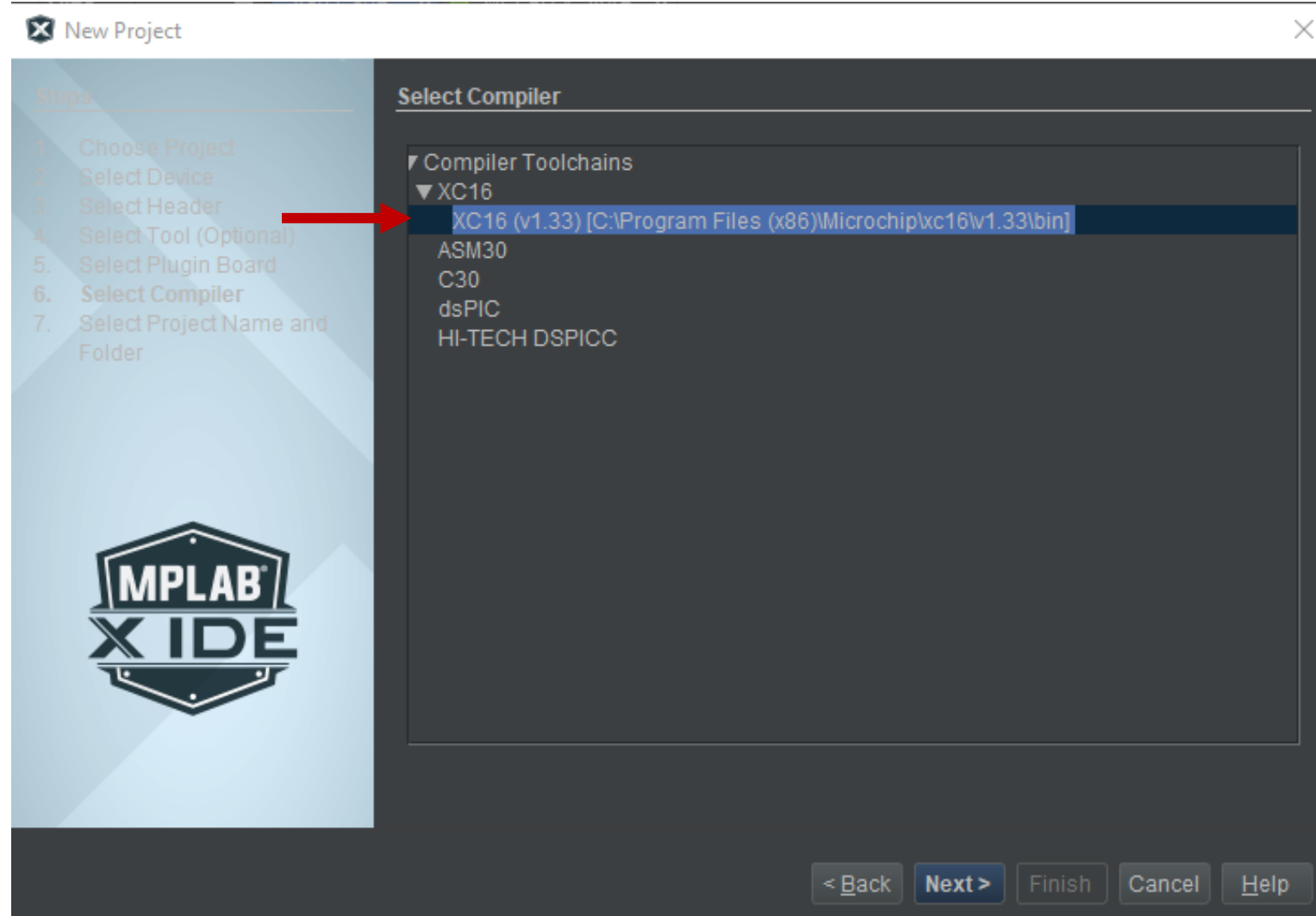
Next >

Finish

Cancel

Help





New Project



Steps

1. Choose Project
2. Select Device
3. Select Header
4. Select Tool (Optional)
5. Select Plugin Board
6. Select Compiler
7. Select Project Name and Folder



Select Project Name and Folder

Project Name:

RETO1

Project Location:

C:\Users\CASA PROMPLABXProjects

Browse...

Project Folder:

C:\Users\CASA PROMPLABXProjects\RETO1\

- ☐ Overwrite existing project.
- ☐ Also delete sources.
- ☒ Set as main project
- ☐ Use project location as the project folder

Encoding:

ISO-8859-1



< Back

Next >

Finish

Cancel

Help

CONFIGURACION INICIAL

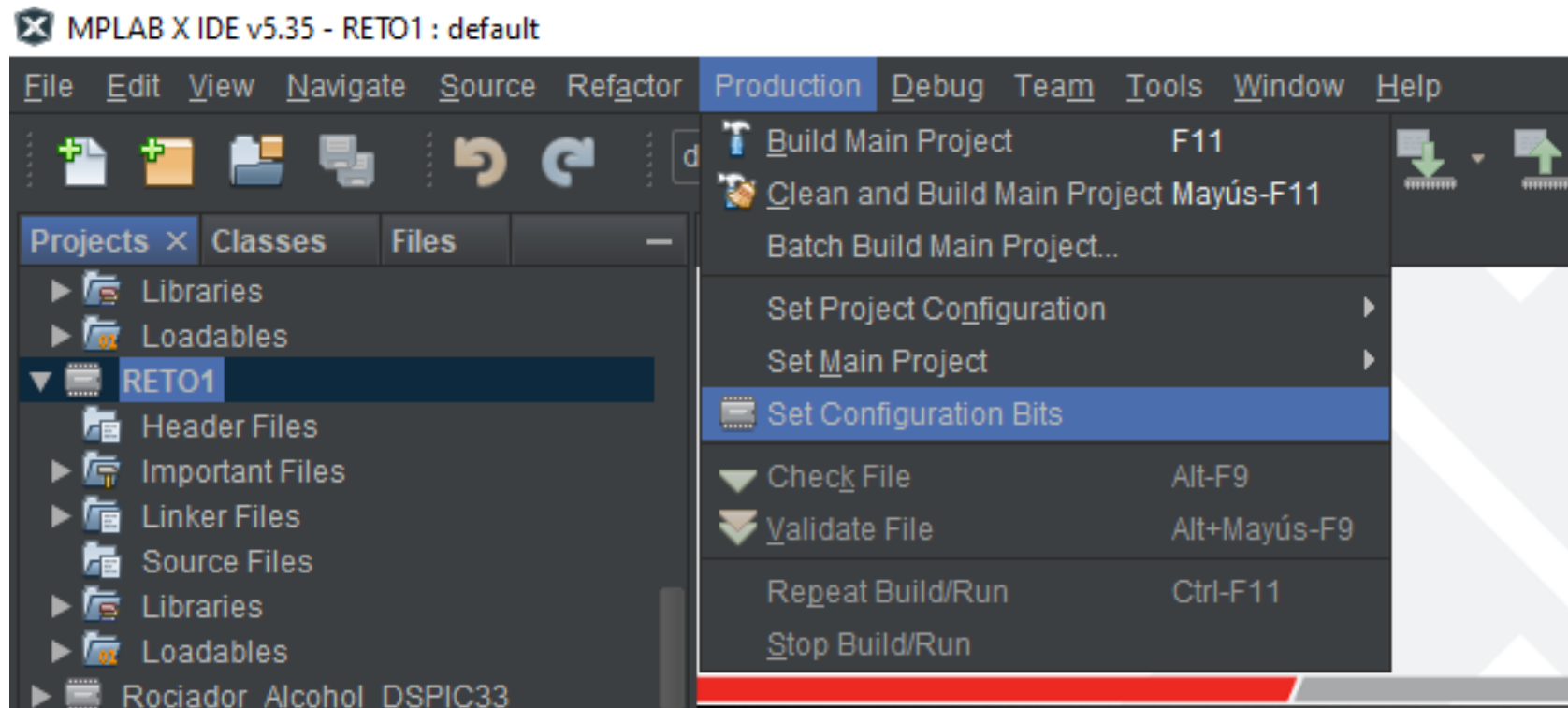
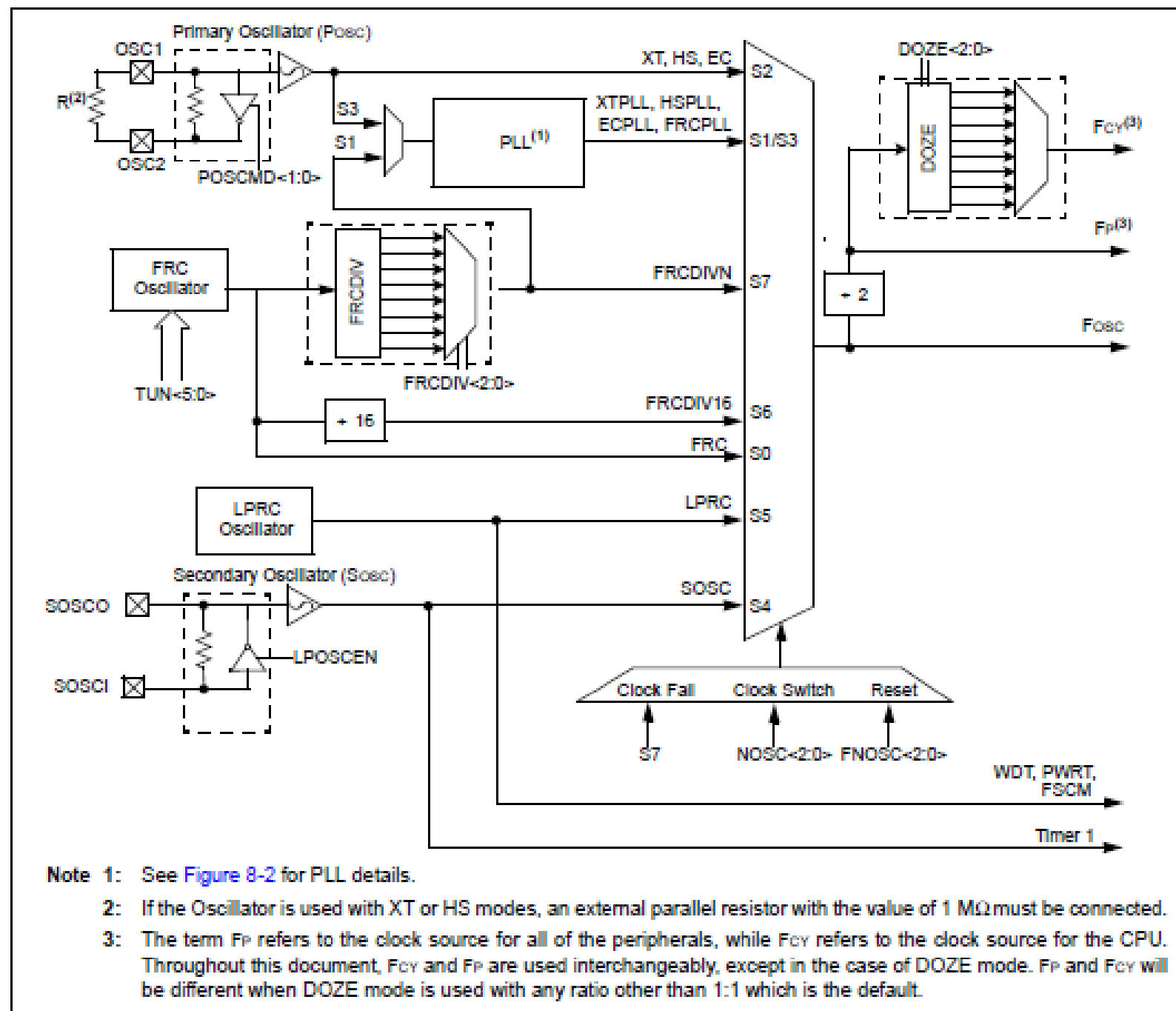


FIGURE 8-1: dsPIC33FJ32MC202/204 and dsPIC33FJ16MC304 OSCILLATOR SYSTEM DIAGRAM



8.1 CPU Clocking System

The dsPIC33FJ32MC202/204 and dsPIC33FJ16MC304 devices provide seven system clock options:

- Fast RC (FRC) Oscillator
- FRC Oscillator with PLL
- Primary (XT, HS or EC) Oscillator ←
- Primary Oscillator with PLL
- Secondary (LP) Oscillator
- Low-Power RC (LPRC) Oscillator
- FRC Oscillator with postscaler

8.1.1.2 Primary

The primary oscillator can use one of the following as its clock source:

- XT (Crystal): Crystals and ceramic resonators in the range of 3 MHz to 10 MHz. The crystal is connected to the OSC1 and OSC2 pins. ←
- HS (High-Speed Crystal): Crystals in the range of 10 MHz to 40 MHz. The crystal is connected to the OSC1 and OSC2 pins.
- EC (External Clock): The external clock signal is directly applied to the OSC1 pin.

EQUATION 8-1: DEVICE OPERATING FREQUENCY

$$F_{CY} = \frac{F_{OSC}}{2}$$

FCY: Frecuencia de ciclo de instrucción-
Fuente de reloj de la CPU.

Configuration Bits

Address	Name	Value	Field	Option	Category	Setting
F80000	FBS	000F	BWRP	WRPROTECT OFF	Boot Segment Write Protect	Boot Segment may be written
			BSS	NO_FLASH	Boot Segment Program Flash Code Protection	No Boot program Flash segment
F80004	FGS	0007	GWRP	OFF	General Code Segment Write Protect	User program memory is not write-protected
			GSS	OFF	General Segment Code Protection	User program memory is not code-protected
F80006	FOSCMD	00	FNOSC	PRI	Oscillator Mode	Primary Oscillator (XT, HS, EC)
			IESO	OFF	Internal External Switch Over Mode	Start-up device with user-selected oscillator source
F80008	FOSCMD	00	POSCMD	XT	Primary Oscillator Source	XT Oscillator Mode
			OSCIOFNC	OFF	OSC2 Pin Function	OSC2 pin has clock out function
			IOL1WAY	ON	Peripheral Pin Select Configuration	Allow Only One Re-configuration
			FCKSM	CSDCMD	Clock Switching and Monitor	Both Clock Switching and Fail-Safe Clock Monitor are disabled
F8000A	FWDT	005F	WDTPRST	PS32768	Watchdog Timer Postscaler	1:32,768
			WDTPRE	PR128	WDT Prescaler	1:128
			WINDIS	OFF	Watchdog Timer Window	Watchdog Timer in Non-Window mode
			FWDTEN	OFF	Watchdog Timer Enable	Watchdog timer enabled/disabled by user software
F8000C	FPOR	00F7	FPWRT	PWR128	POR Timer Value	128ms
			ALT12C	OFF	Alternate I2C pins	I2C mapped to SDA1/SCL1 pins
			LPOL	ON	Motor Control PWM Low Side Polarity bit	PWM module low side output pins have active-high output polarity
			HPOL	ON	Motor Control PWM High Side Polarity bit	PWM module high side output pins have active-high output polarity
			PWMPIN	ON	Motor Control PWM Module Pin Mode bit	PWM module pins controlled by PORT register at device Reset
F8000E	FICD	00C3	ICS	PGD1	Comm Channel Select	Communicate on PGD1/EMUC1 and PGD1/EMUD1
			JTAGEN	OFF	JTAG Port Enable	JTAG is Disabled

Memory Configuration Bits Format Read/Write Generate Source Code to Output

Configuration Bits Configuration Bits Configuration Bits Configuration Bits Output Configuration Bits Configuration Bits Configuration Bits 10:10

MPLAB X IDE v5.35 - RETO1 : default

File Edit View Navigate Source Refactor Production Debug Team Tools Window Help

default

Projects Classes Files Start Page MPLAB X Store

Libraries
Loadables
RETO1

New
New Logical Folder
Add Existing Item...
Add Existing Items from Folders...
Find...
Cut
Copy
Paste
Ctrl-V

Remove From Project
Rename...

Properties
Checksum: Blank, no code load
32 CRC32: Hex file unavailable

Packs
dsPIC33F-GP-MC_DFP (1.2.35)

Compiler Toolchain
XC16 (v1.33) [C:\Program Files\Microchip\MPLABX\bin\XC16\bin\XC16.exe]
Production Image: Optimization:

Memory
Usage Symbols disabled. Click to show details
Data 2.048 (0x800) bytes
Program 11.264 (0x2C00) words

Debug Tool
Simulator

Configuration Bits
Configuration Bits
Configuration Bits
Configuration Bits
Configuration Bits

New C Header File

Steps

1. Choose File Type
2. Name and Location

Name and Location

File Name: config.h

Extension: h

☐ Set this Extension as Default

Project: RETO1

Folder:

Browse...

Created File: C:\Users\CASA.PRO\MPLABXProjects\RETO1.X\config.h

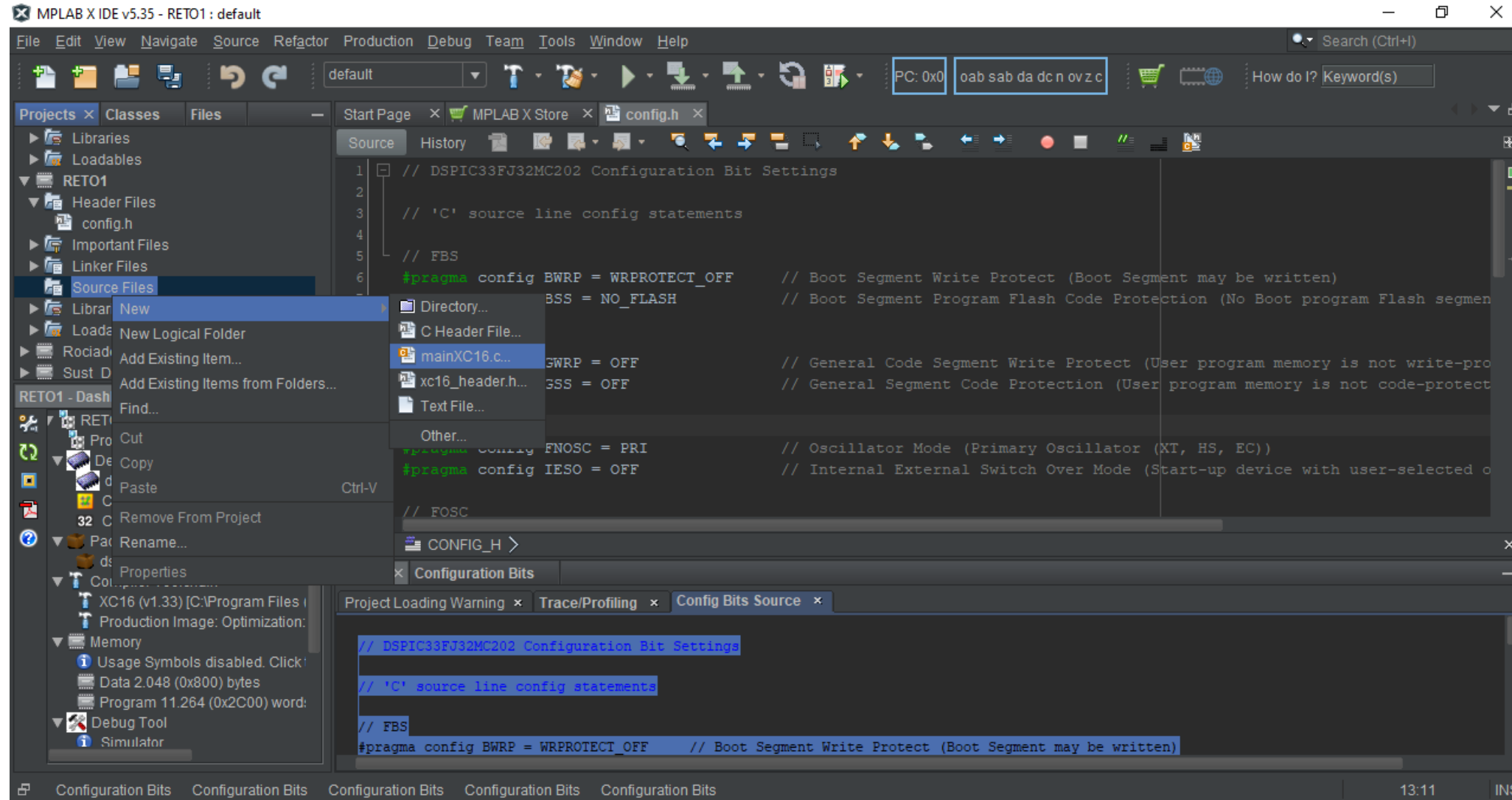
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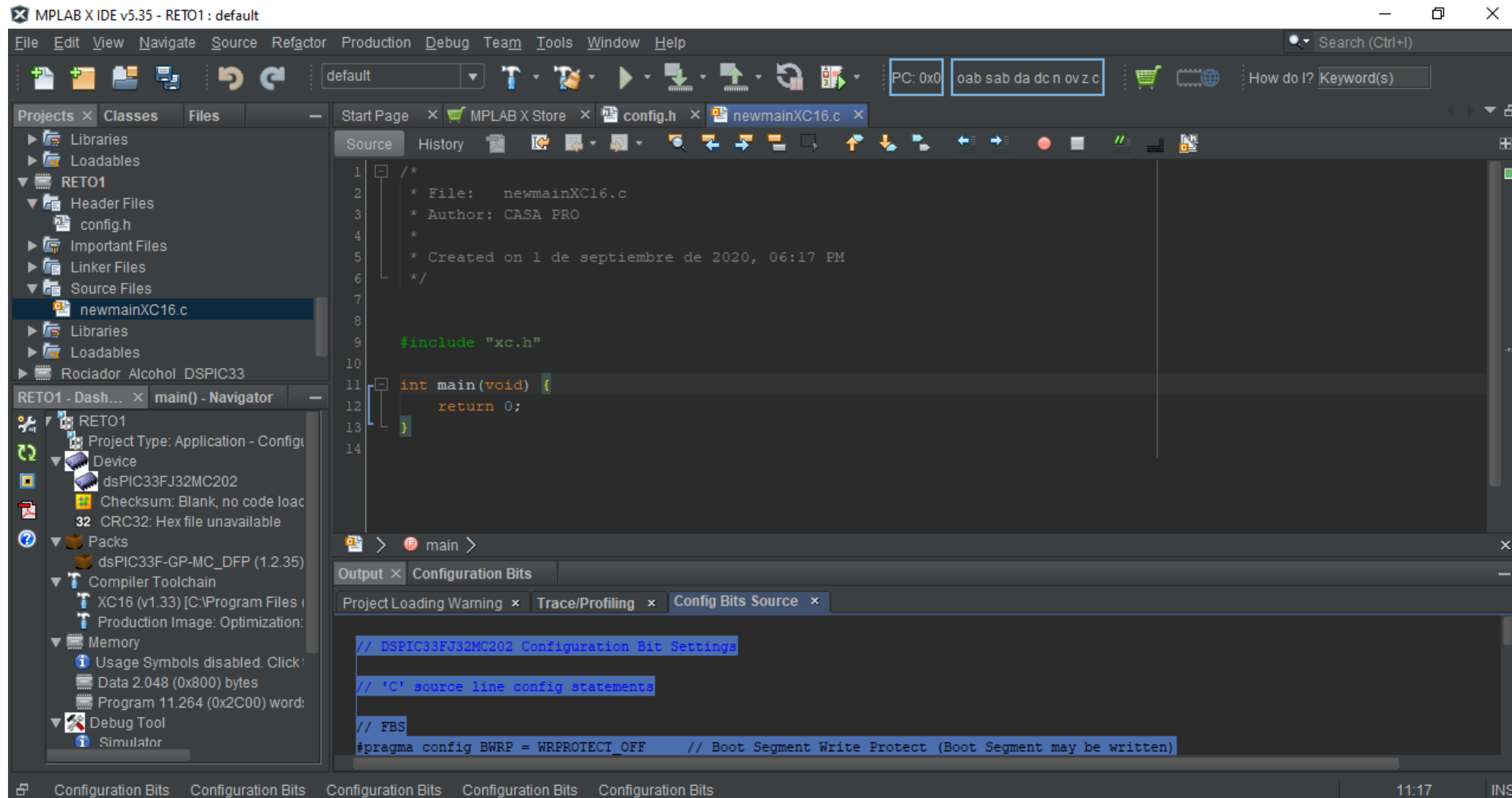
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Finish

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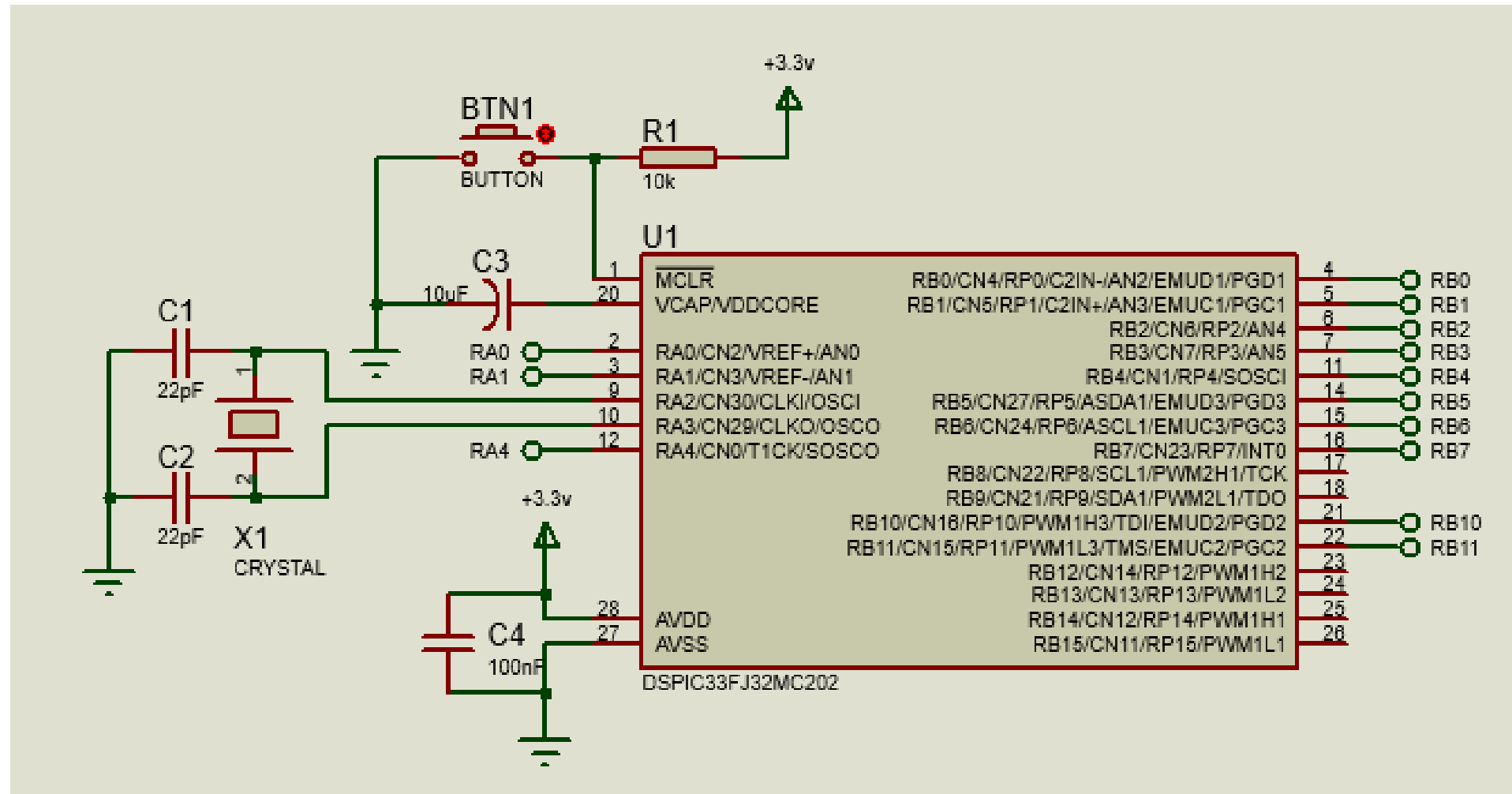
Help

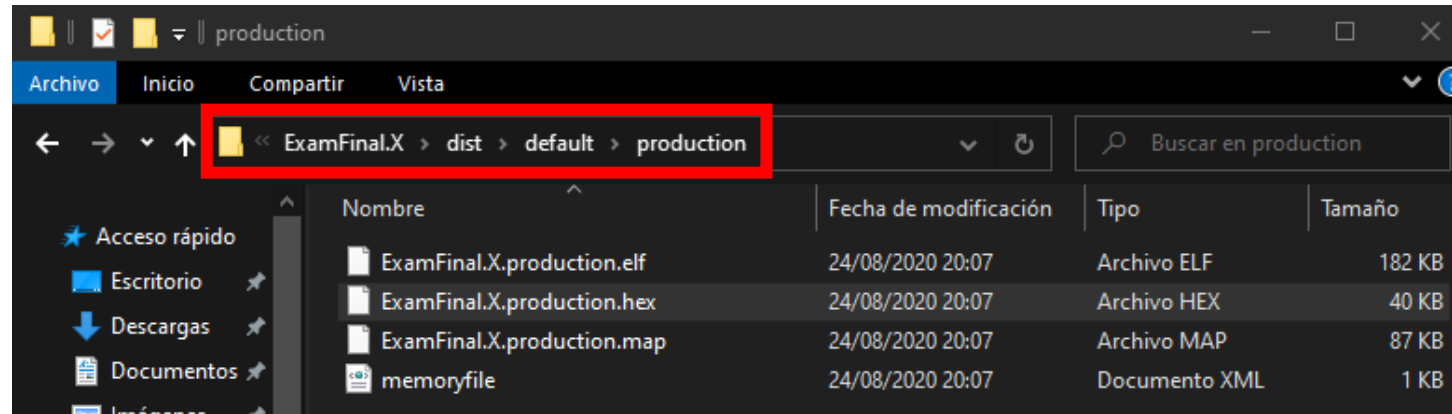




**LISTO PARA
PROGRAMAR!!!**

IMPLEMENTACION EN PROTEUS

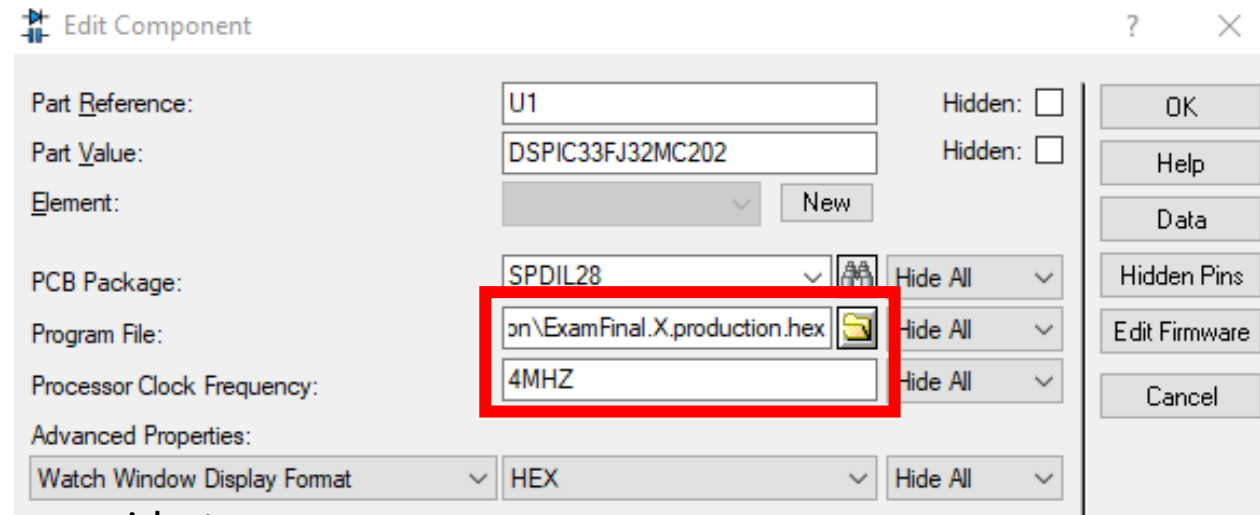




Ruta donde se genera el archivo HEX , dentro de la carpeta “MPLABXProjects”

Propiedades del Dspic:

- Seleccionar ruta del archivo HEX
- Colocar la frecuencia del oscilador externo Fosc



<https://predictabledesigns.com/the-beginners-guide-to-designing-with-the-dspic33-microcontroller/>

BIBLIOGRAFIA

- **Dspic33fj32mc202 Device Overview**

<https://www.microchip.com/wwwproducts/en/dsPIC33FJ32MC202>

- **dsPIC33F Family Data Sheet**

<http://ww1.microchip.com/downloads/en/DeviceDoc/70165d.pdf>

- **16-bit Embedded Control Solutions**

<https://ww1.microchip.com/downloads/en/DeviceDoc/00001032T.pdf>

- **Motor Control and Drive Design Solutions**

<https://ww1.microchip.com/downloads/en/DeviceDoc/00000896P.pdf>