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TALLER DE MICROCONTROLADORES CON DSPIC33FJ32MC202

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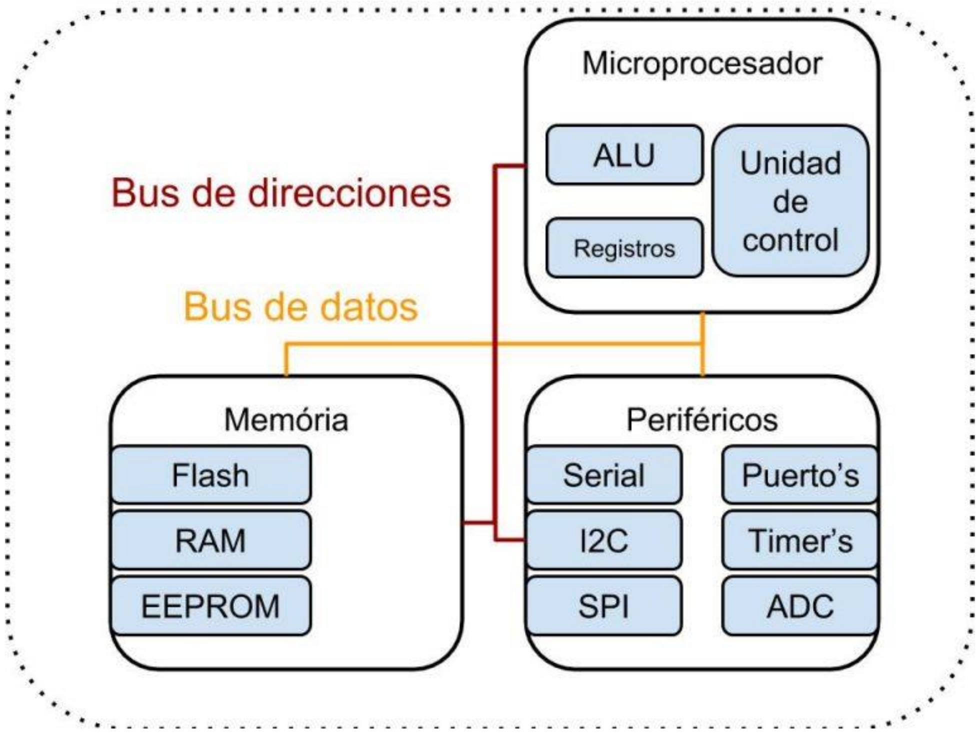
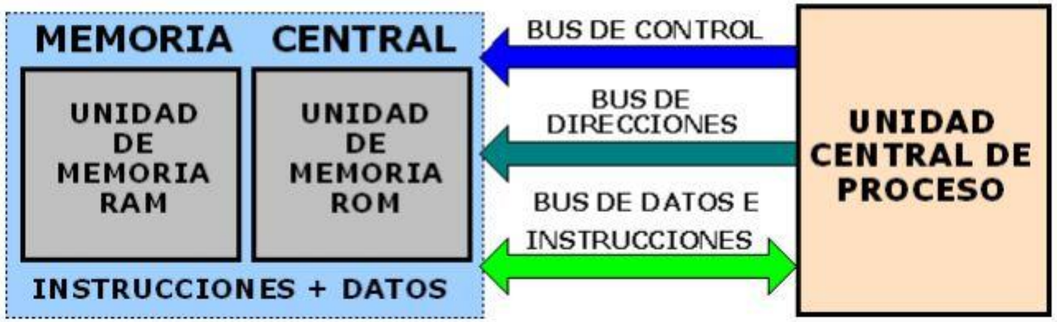
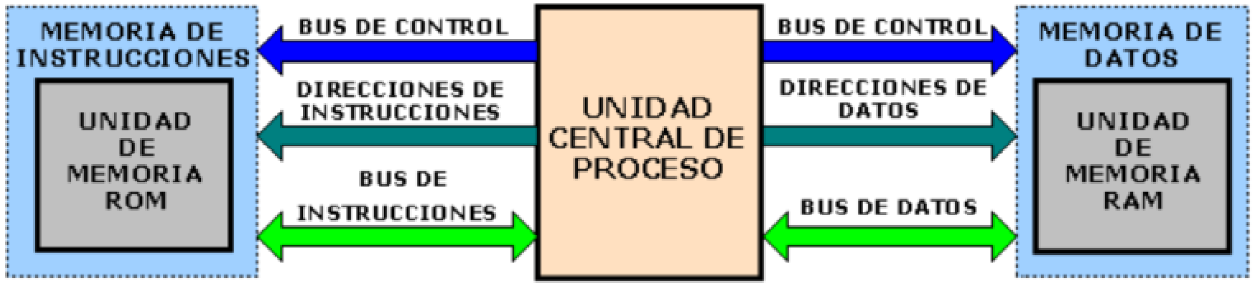
Un microcontrolador es un circuito integrado que en su interior contiene una unidad central de procesamiento (CPU), unidades de memoria (RAM y ROM), puertos de entrada y salida y periféricos.
Se puede decir con toda propiedad que un microcontrolador es una microcomputadora completa encapsulada en un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



ARQUITECTURA VON NEUMANN



ARQUITECTURA HARVARD



dsPIC® MICROCHIP

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.

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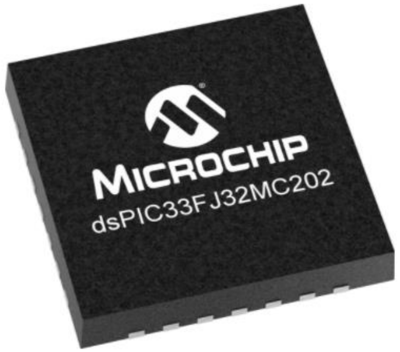
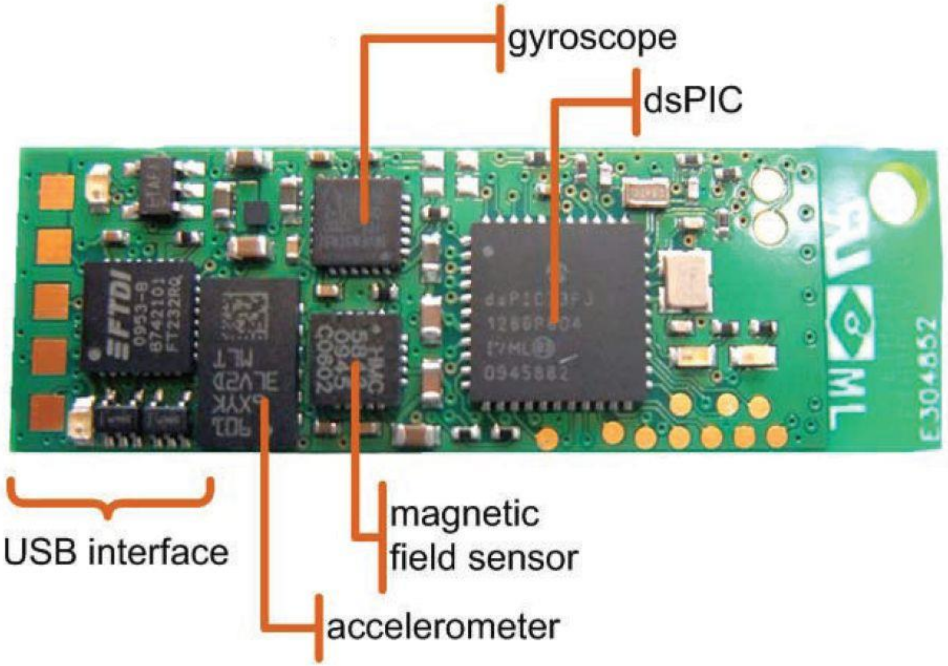
SPDIP

SSOP

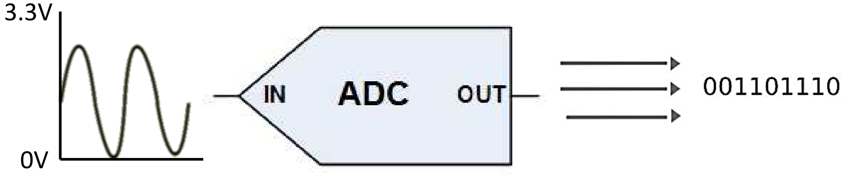


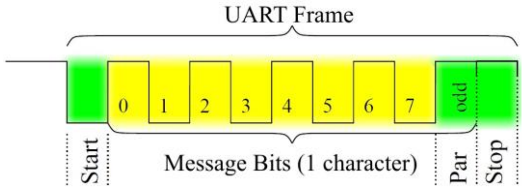
QFN

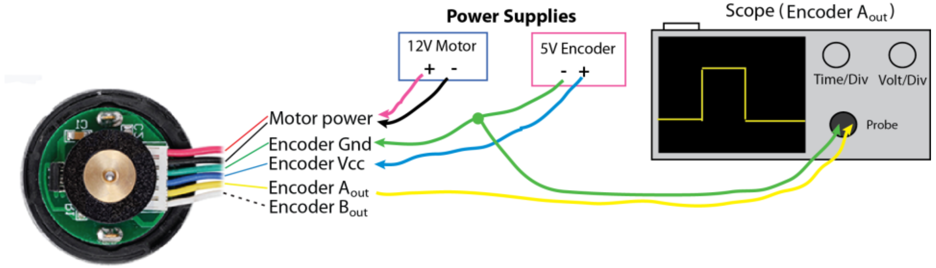


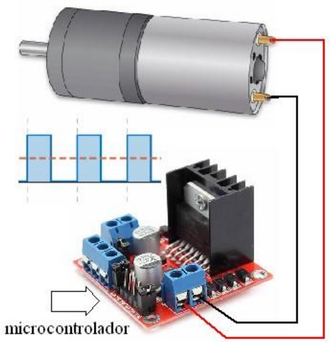
Parametrics

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









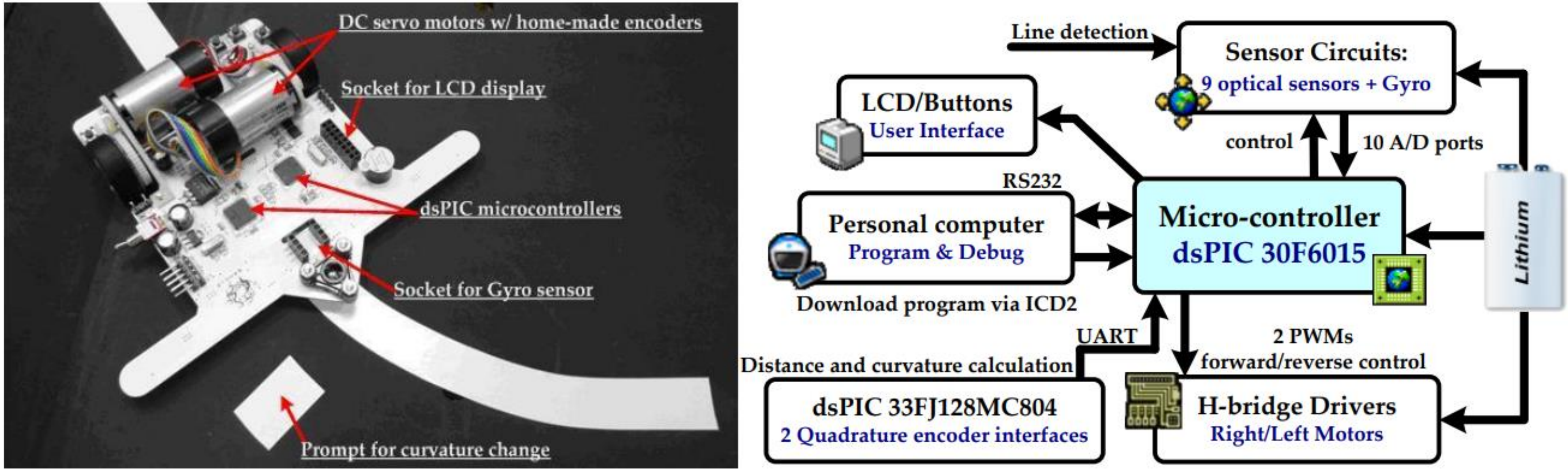


Figure 1: The proposed line-following robot and its corresponding block diagram.

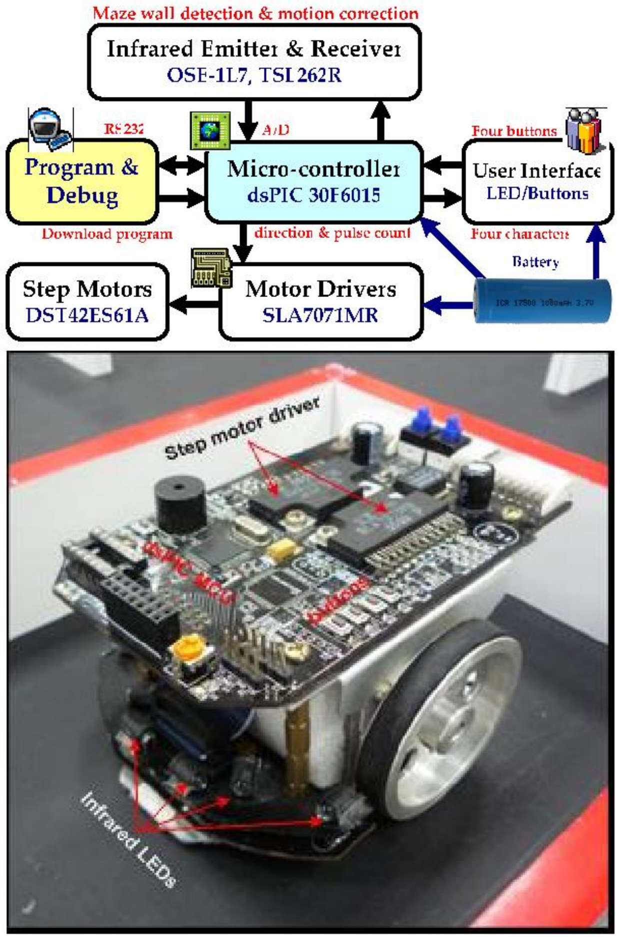


Fig. 1 The low cost micromouse kit designed for teaching

Table 1 Position and orientation calculations for step motor micromouse

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

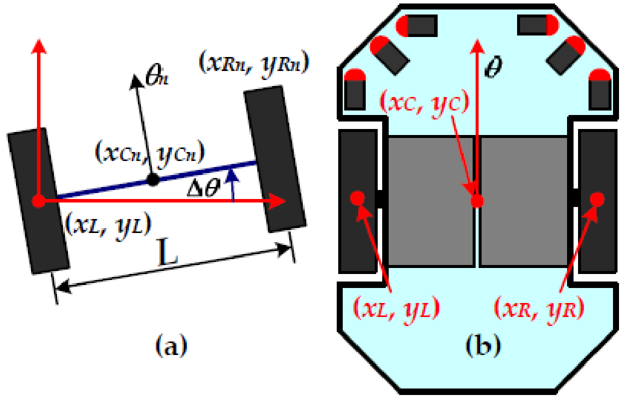


Fig. 6 Position calculation of the micromouse when right or left step motor moves one step

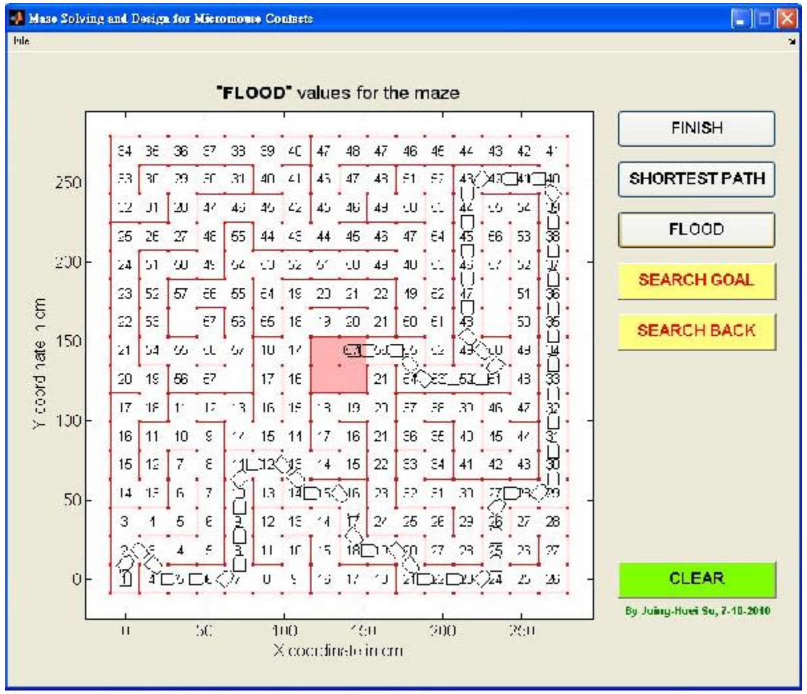


Fig. 2 A MATLAB program for learning maze solving algorithms

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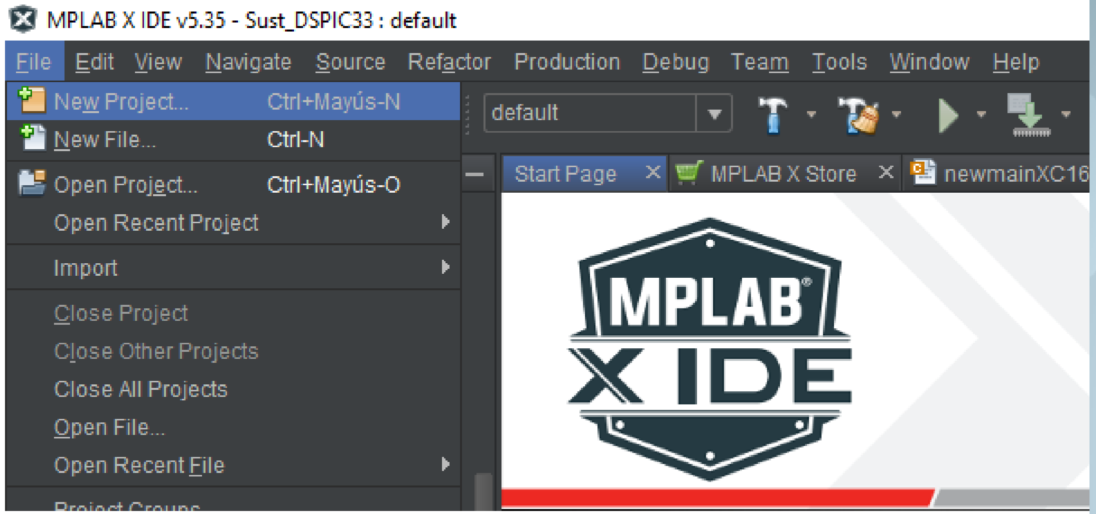
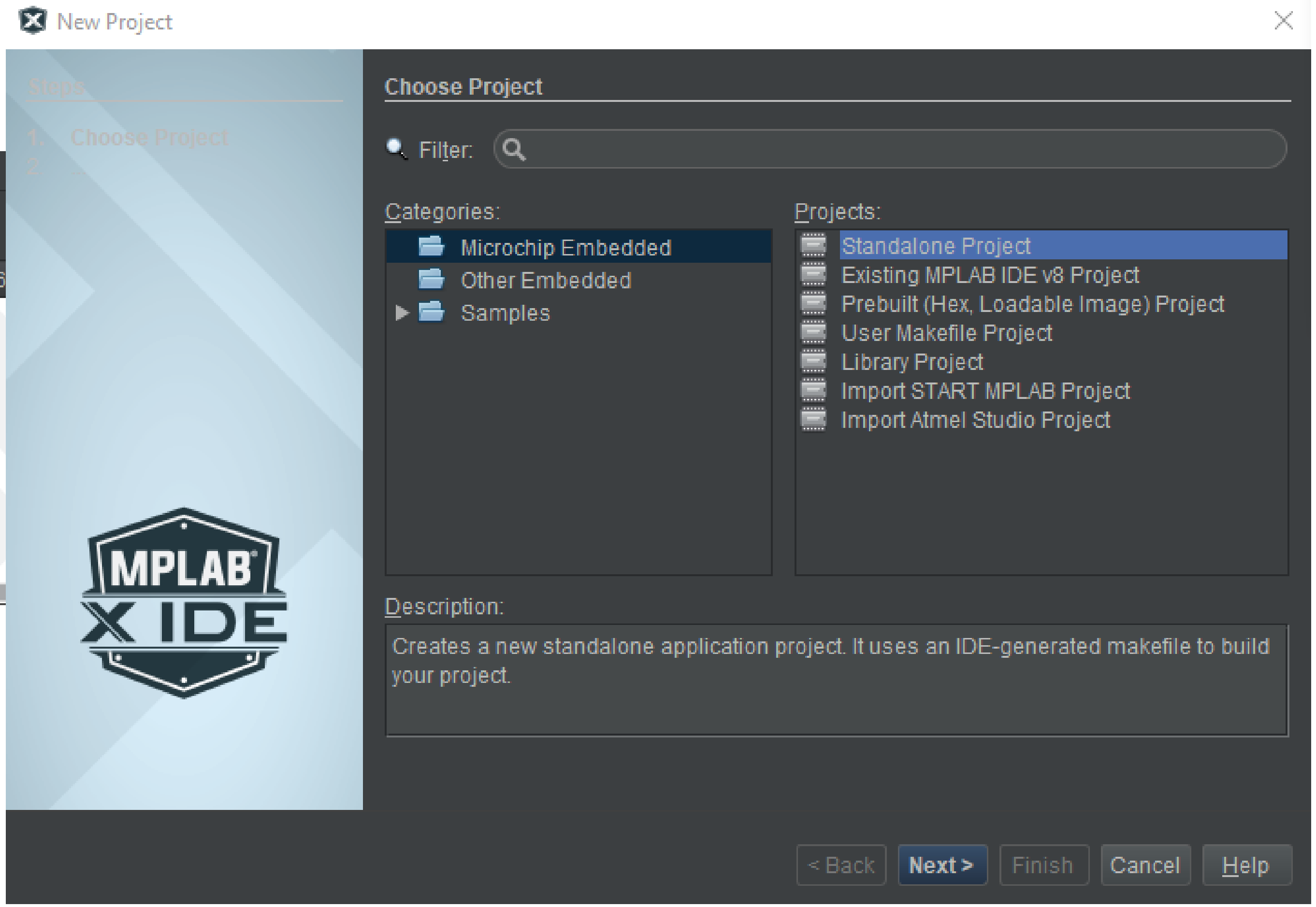
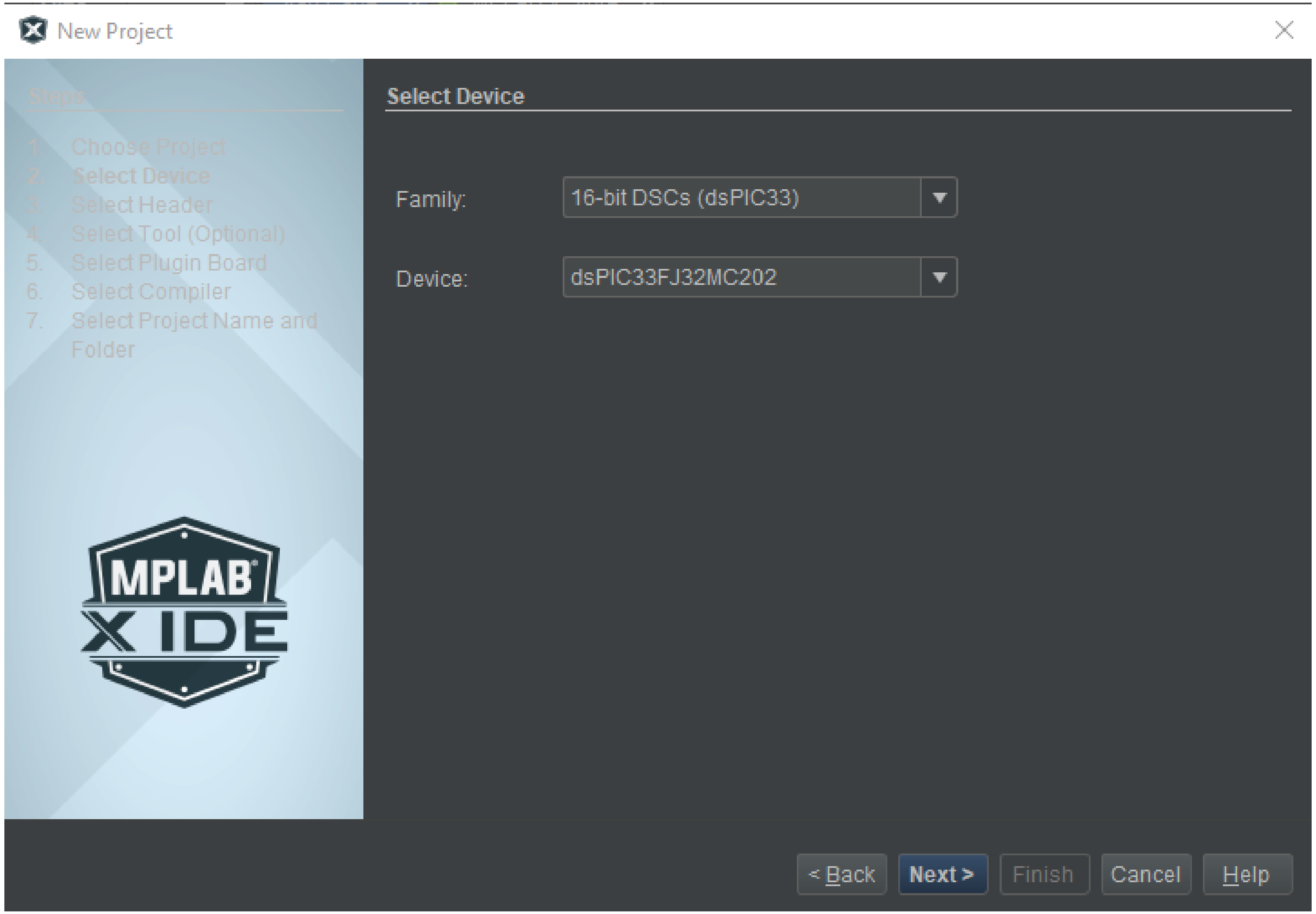
MICROCHIP

EMPECEMOS

CREACION DE PROYECTO







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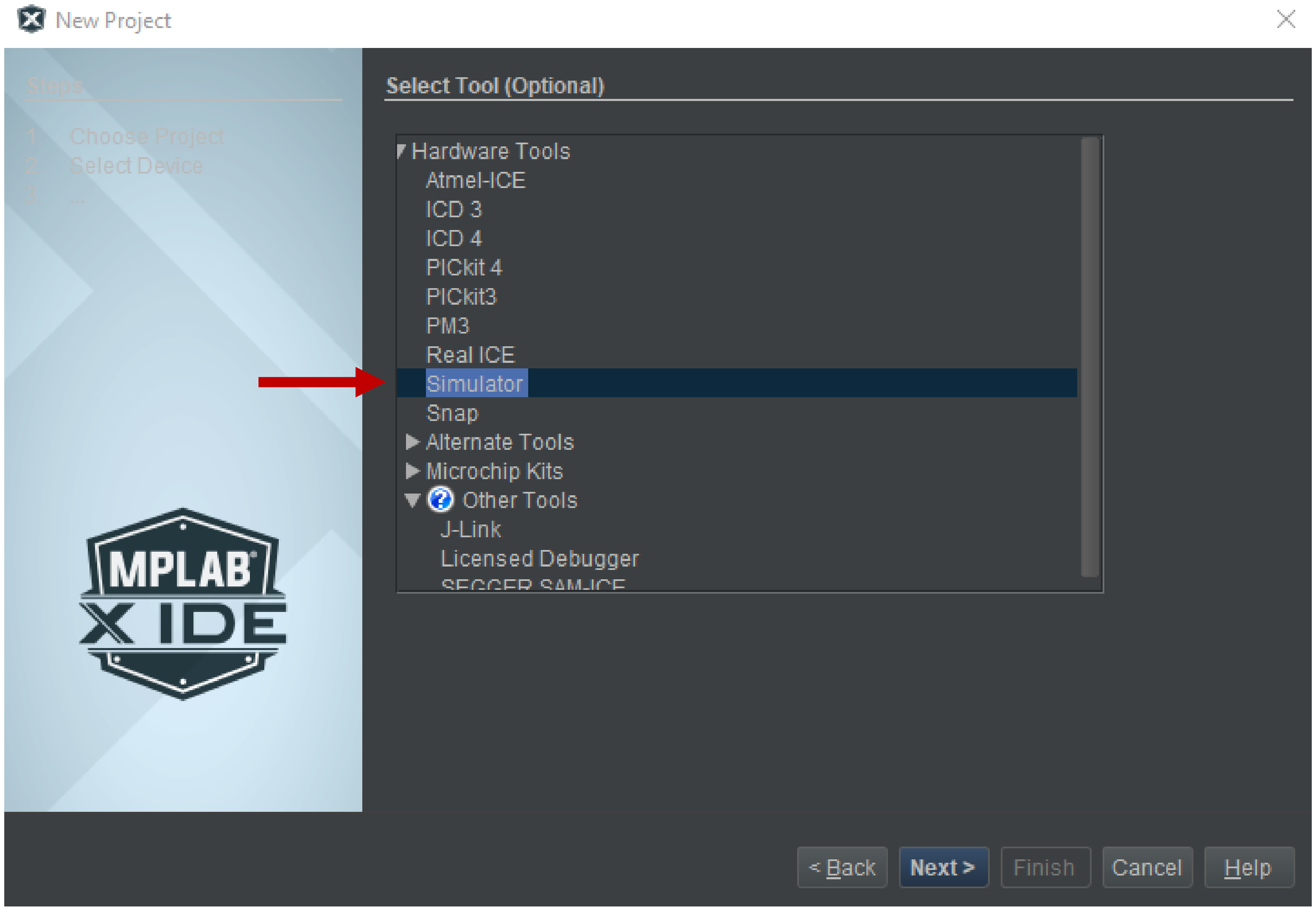
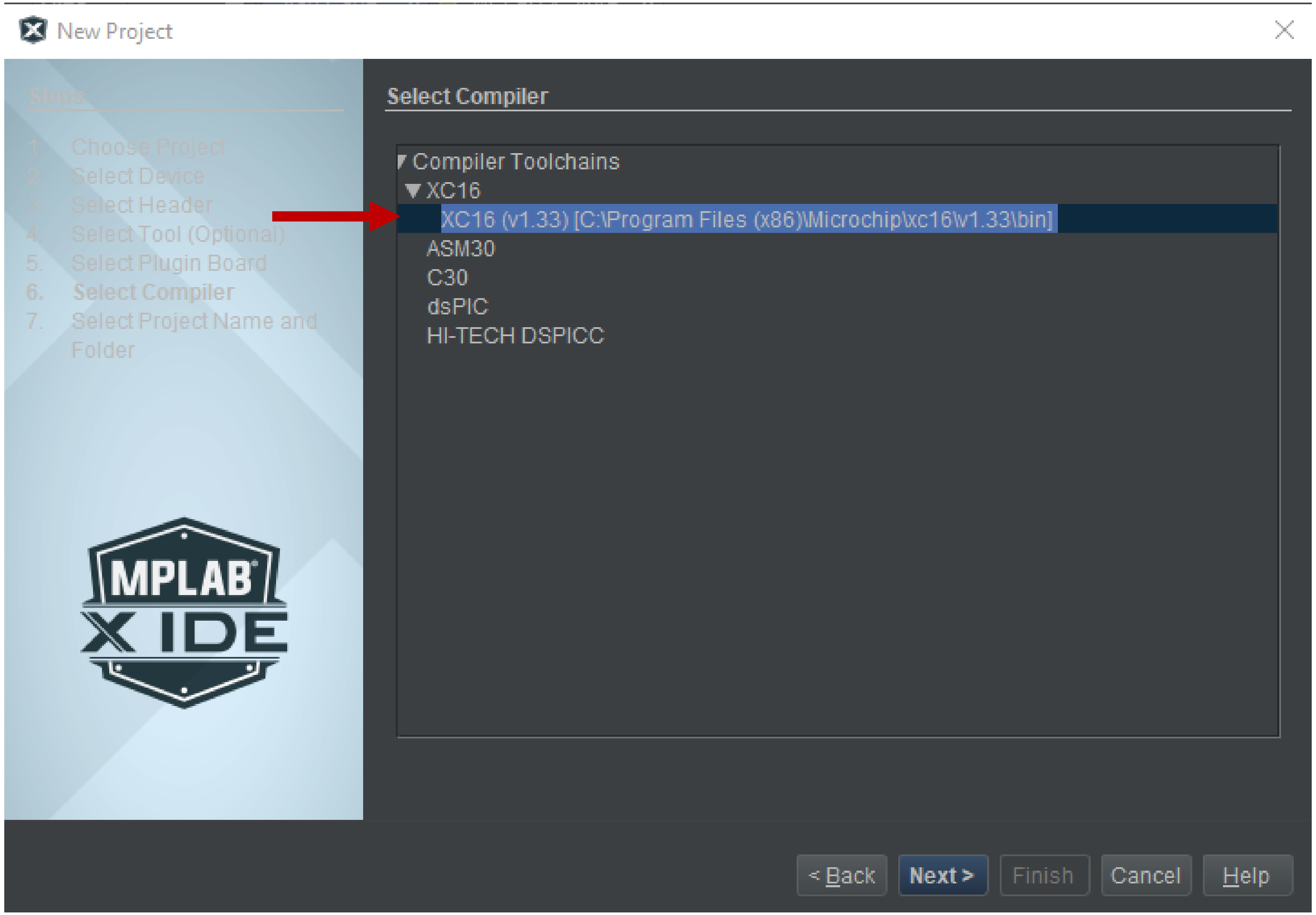

New Project
Select Tool (Optional)
Hardware Tools
Atmel-ICE
ICD 3
ICD 4
PICkit 4
PICkit3
PM3
Real ICE
Simulator
Snap
Alternate Tools
Microchip Kits
Other Tools
J-Link
Licensed Debugger
MPLAB X IDE
< Back
Next >
Finish
Cancel
Help


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
MPLAB X IDE
Select Compiler
Compiler Toolchains
XC16
XC16 (v1.33) [C:\Program Files (x86)\Microchip\xc16\v1.33\bin]
ASM30
C30
dsPIC
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Finish
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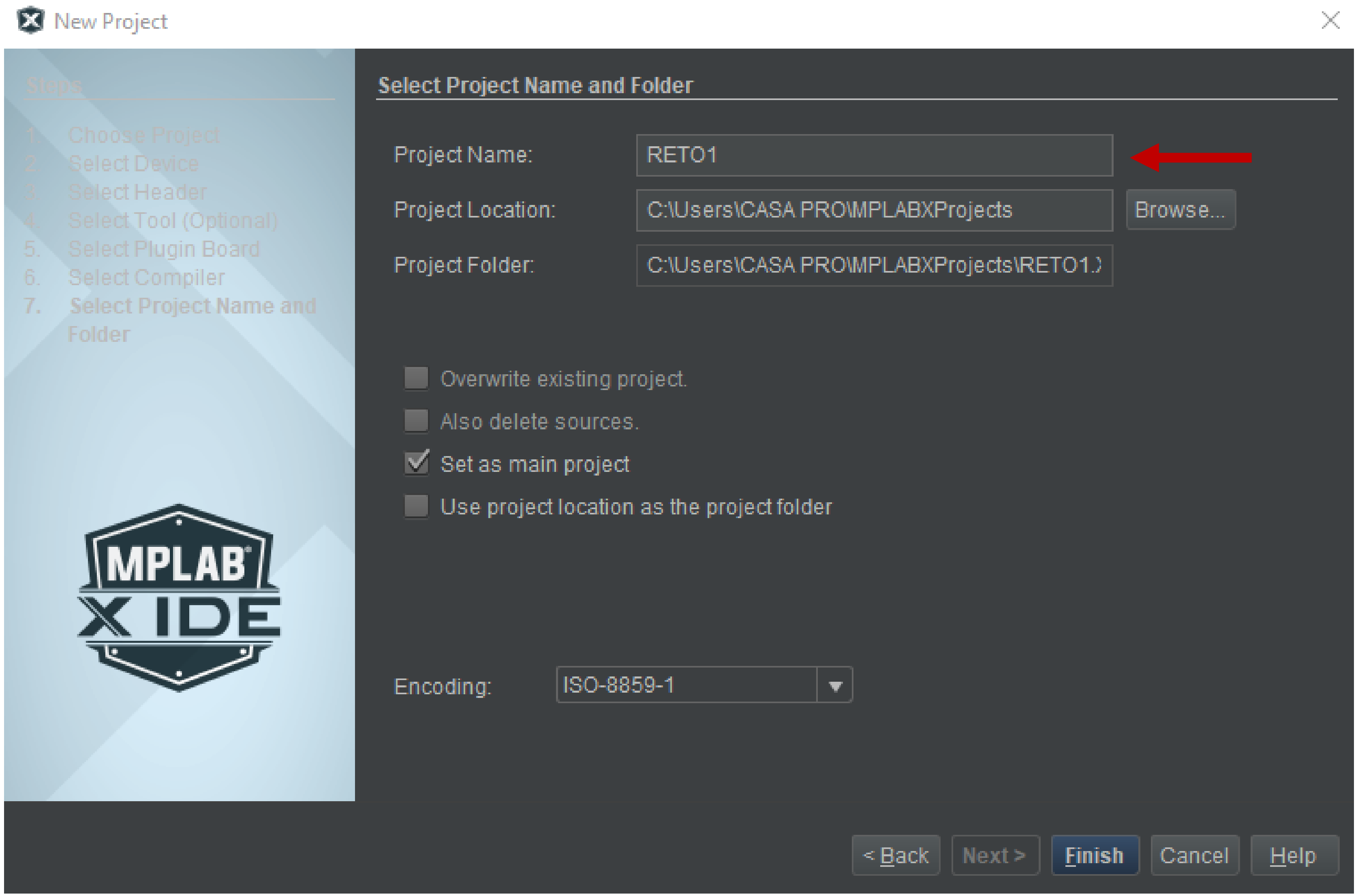


CONFIGURACION INICIAL

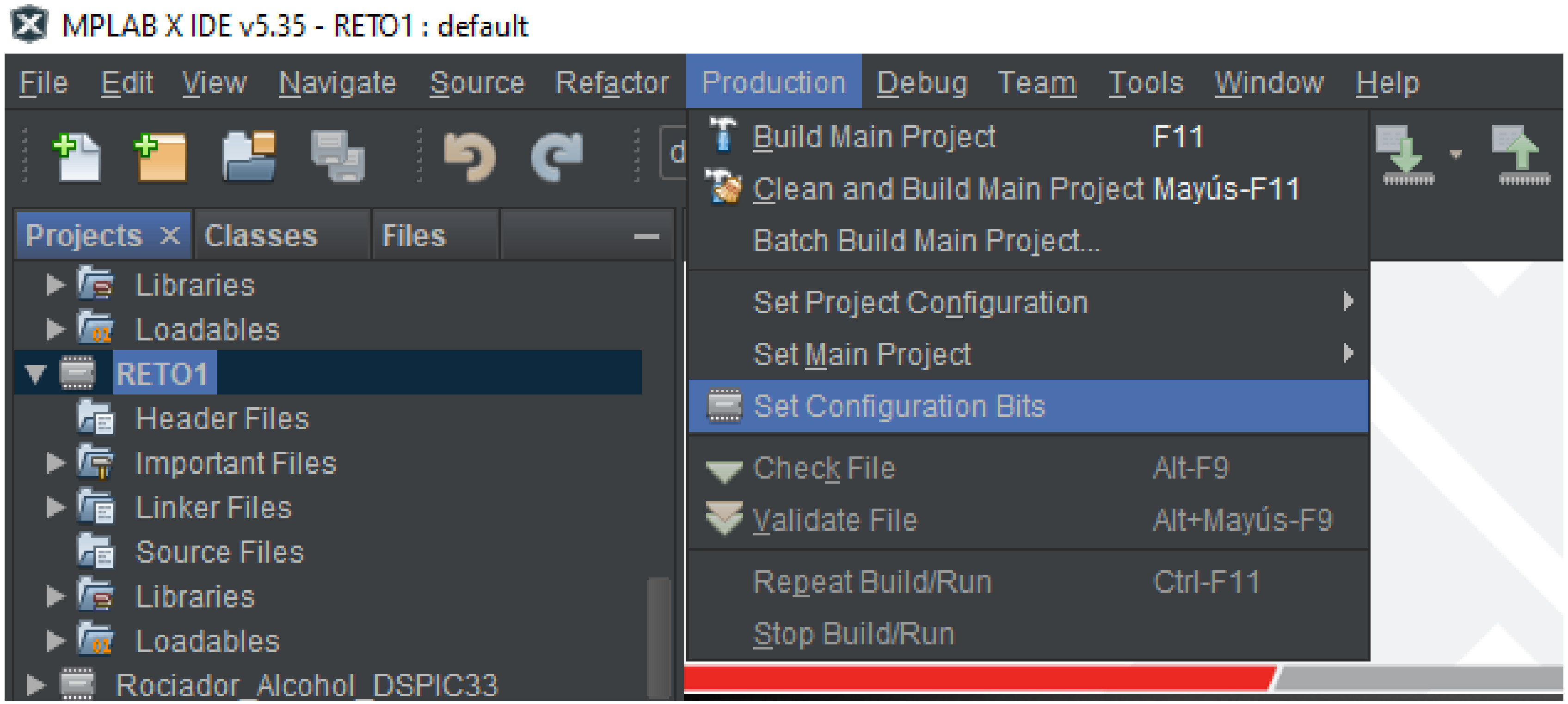
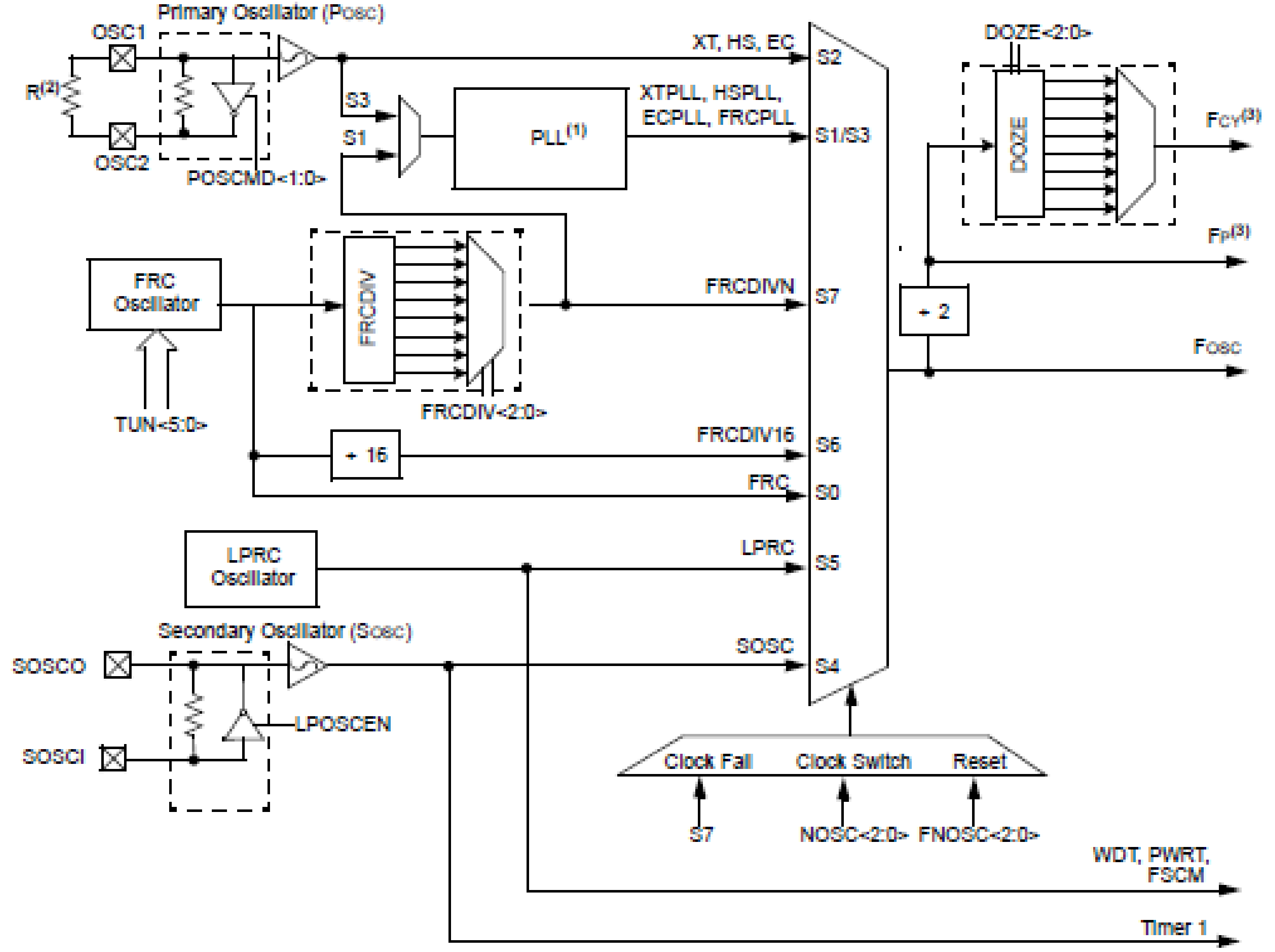


FIGURE 8-1: dsPIC33FJ32MC202/204 and dsPIC33FJ16MC304 OSCILLATOR SYSTEM DIAGRAM



Note 1: See Figure 8-2 for PLL details.

2: If the Oscillator is used with XT or HS modes, an external parallel resistor with the value of 1 MΩ must be connected.

3: The term F_P refers to the clock source for all of the peripherals, while F_{CY} refers to the clock source for the CPU. Throughout this document, F_{CY} and F_P are used interchangeably, except in the case of DOZE mode. F_P and F_{CY} will be different when DOZE mode is used with any ratio other than 1:1 which is the default.

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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.

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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	FO		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	FOS		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	WDTPOST	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
			ALTI2C	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 PGC1/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

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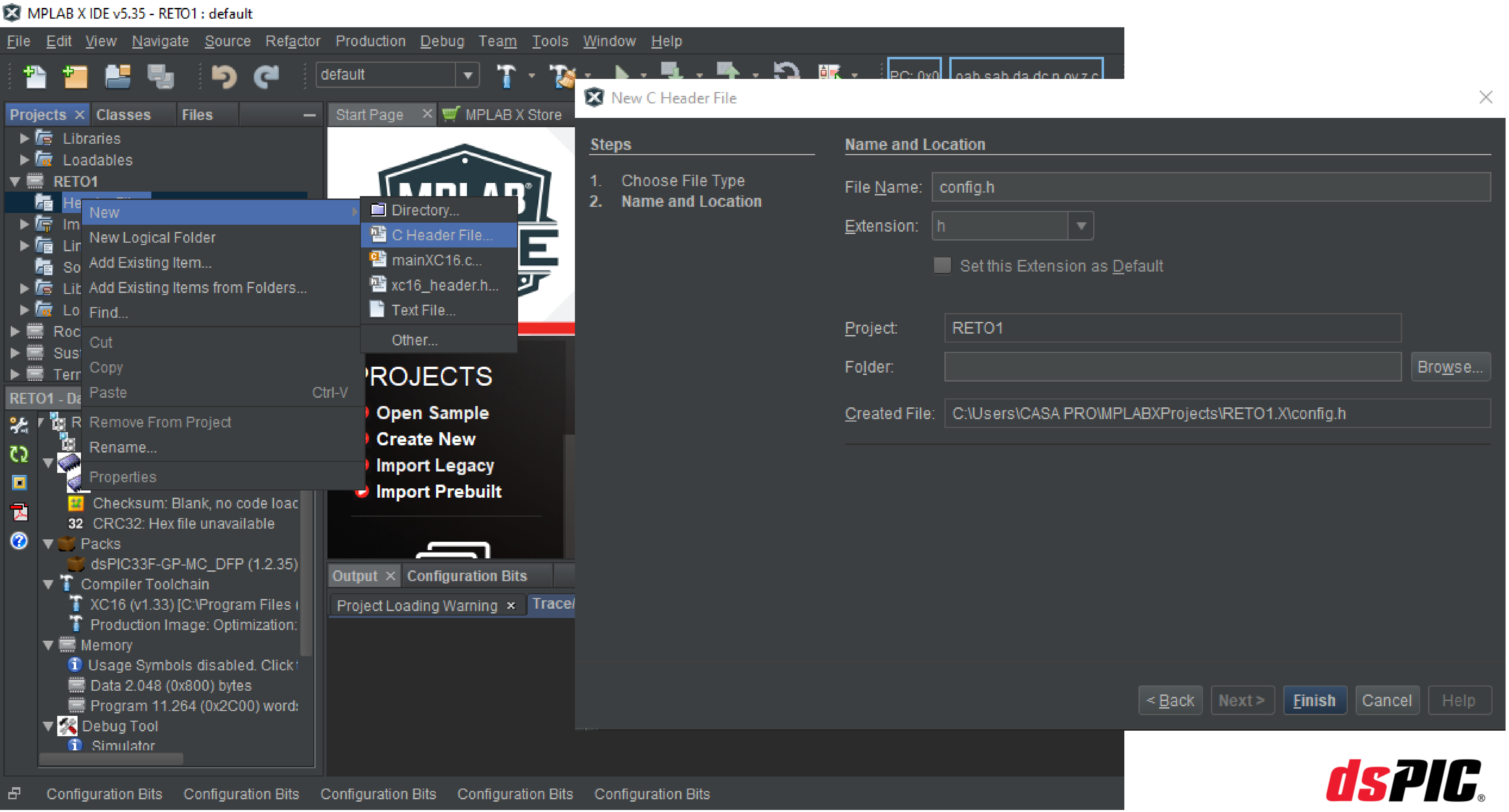

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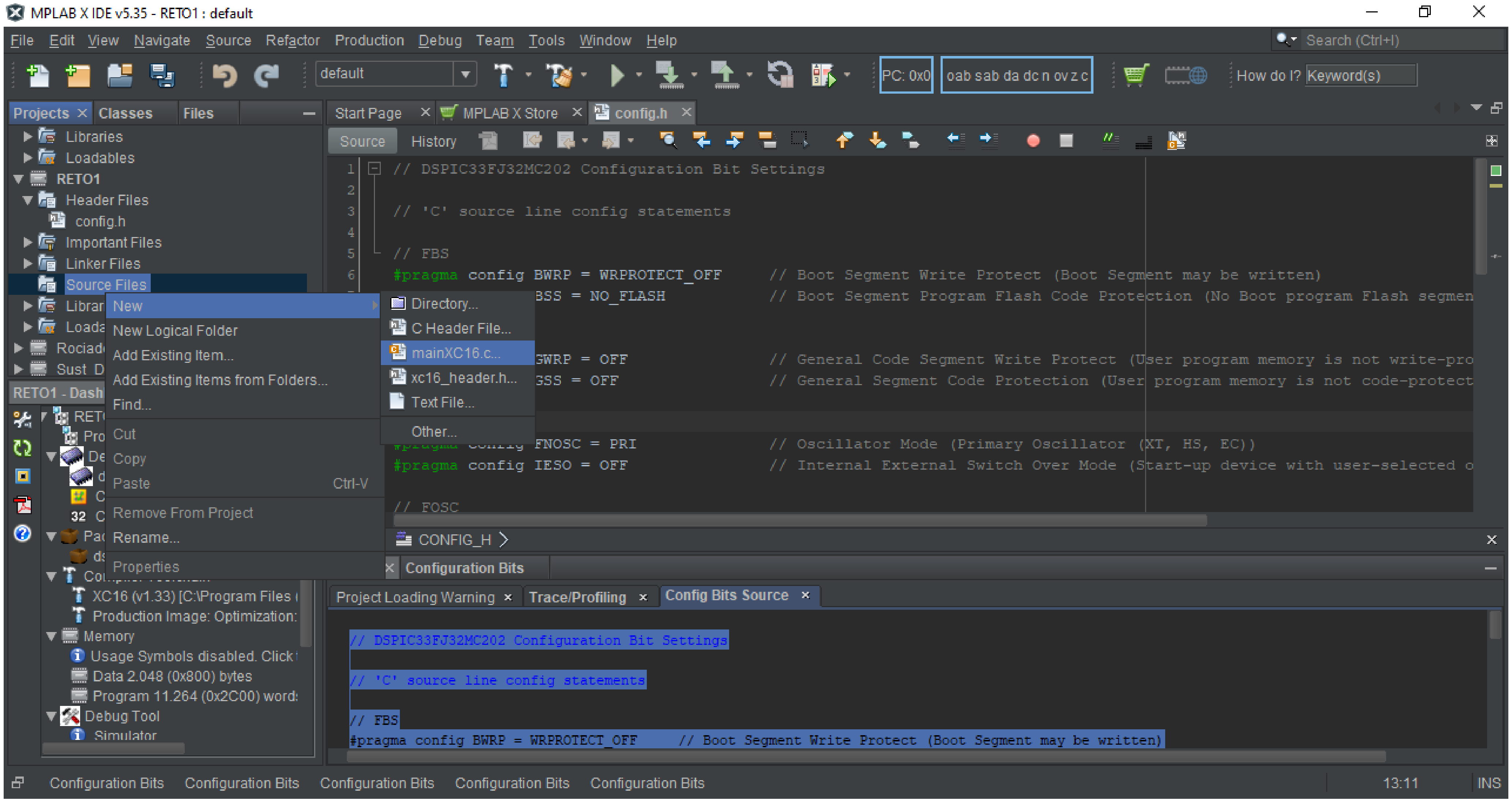

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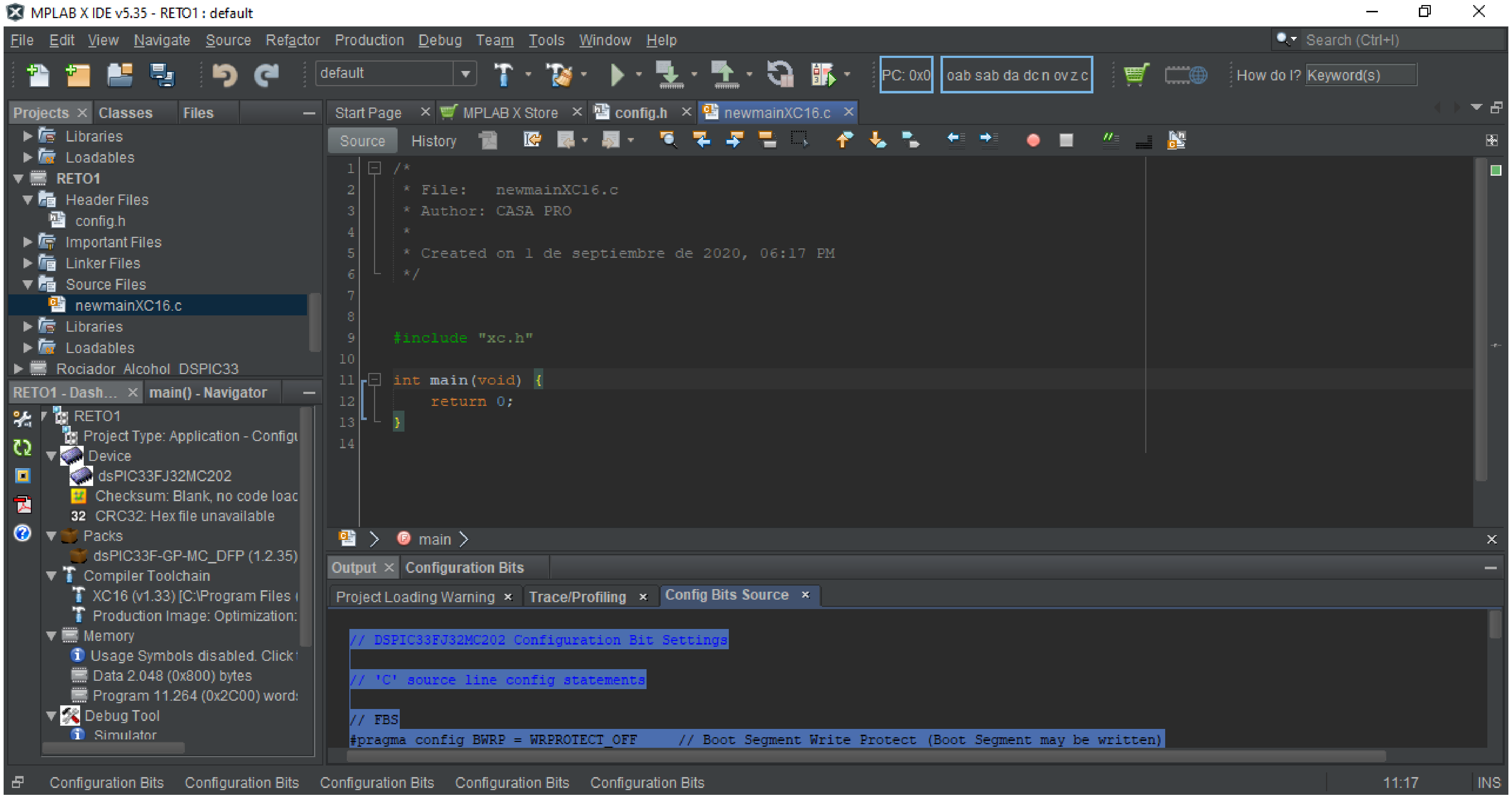
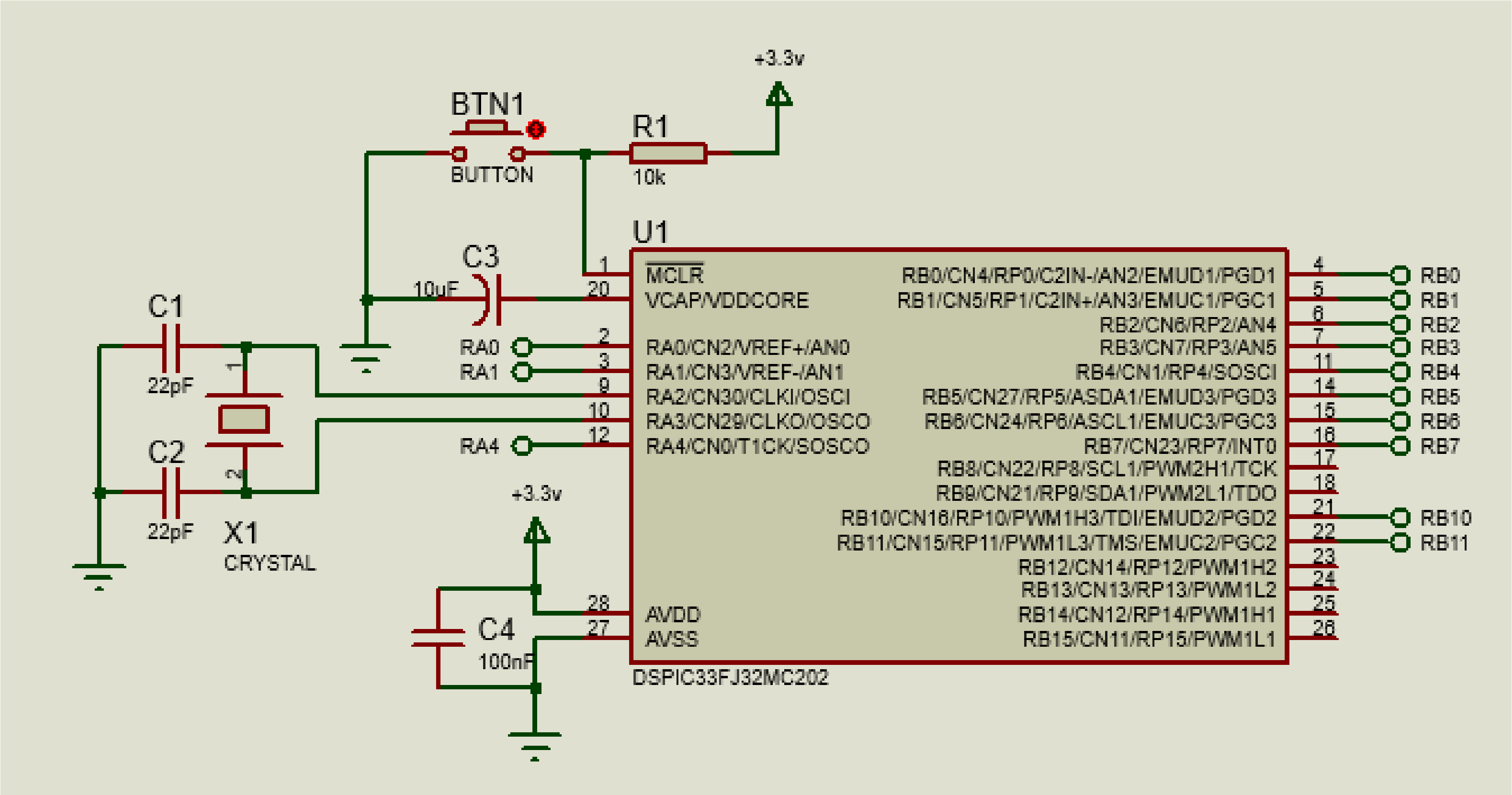
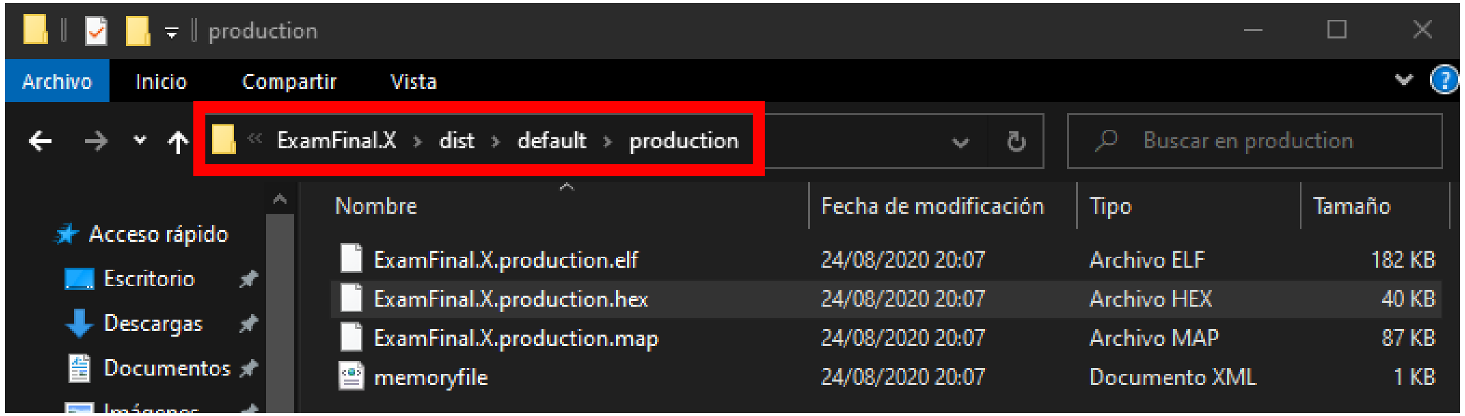


LISTO PARA PROGRAMAR!!!

IMPLEMENTACION EN PROTEUS

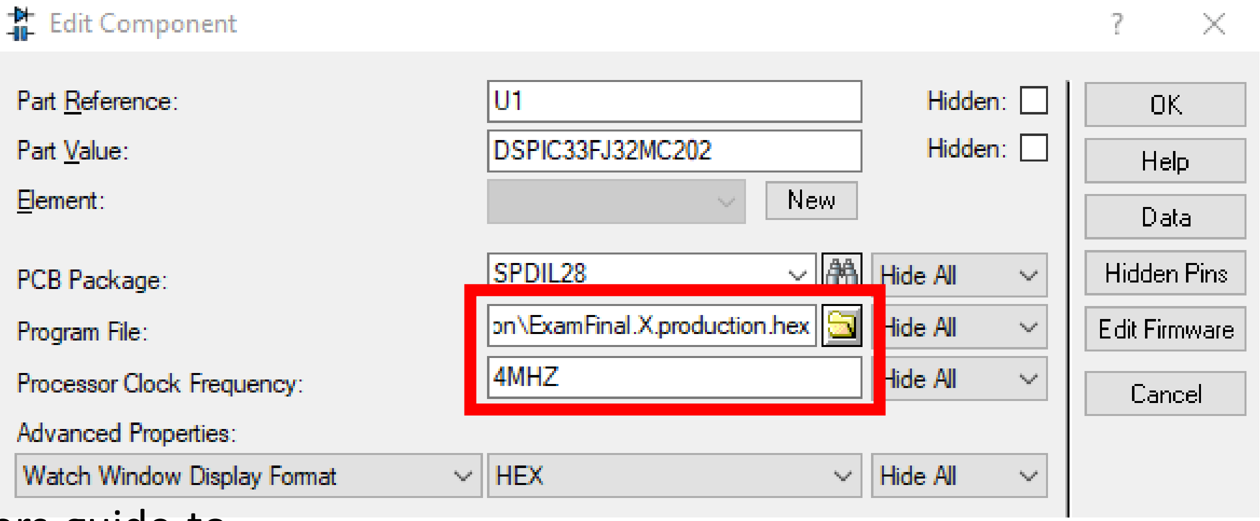




Ruta donde se genera el archivo HEX , dentro de la carpeta “MPLABXProjects”

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

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