PIC32CX-BZ2 and WBZ451

PIC32CX-BZ25 and WBZ451 Curiosity Board User's Guide

Introduction

The WBZ451 Curiosity Board is an efficient and modular development platform that supports rapid prototyping and demonstrates the features, capabilities and interfaces of Microchip's BLE+Zigbee RF Module WBZ451. This board offers integrated programming/debugging features using PICkit™ On-Board (PKOB4) debugger, and requires only a micro-USB cable to power-up and program the board. Users can expand its functionality through MikroElectronika mikroBUS™ Click™ adapter boards and do rapid prototyping utilizing the BLE+Zigbee enabled RF Module.

The WBZ451 Curiosity Board supports a variety of applications such as wireless lightning, home automation/Internet of Things (IoT), industrial automation and other BLE or Zigbee related applications.

Features

- WBZ451 BLE+Zigbee RF Module
- USB or Battery Powered
- On-board Programmer/Debug Circuit using PKoB4 based on Microchip SAME70 MCU
- Microchip MCP73871 Li-Ion/LiPo Battery Charger with Power Path Management
- On-board USB to UART Serial Converter with HW Flow Control based on Microchip MCP2200
- mikroBUS™ Socket to Expand Functionality using MikroElectronika Click™ Adapter Boards
- RGB Lighting LED connected to PWM
- Reset Switch
- One User Configurable Switch
- One User LED
- 32.768 kHz Crystal
- Microchip SST26VF064B, 64 Mbit External QSPI Flash
- Microchip MCP9700A, Low Power Analog Voltage Temperature Sensor
- 10 pin ARM SWD Header for External Programmer/Debugger

For more details, refer to the 3. Hardware.

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1. Quick References

1.1 Design Documentation

The WBZ451 Curiosity Board design documentation has the following packages:

- Schematics
- BOM
- Assembly drawings
- Layer plots

Note: Please contact Microchip Sales Representative for more information.

1.2 Reference Documentation

1. *PIC32CX1012BZ25048/WBZ451* Data Sheet.

1.3 Hardware Prerequisites

- WBZ451 Curiosity Board kit

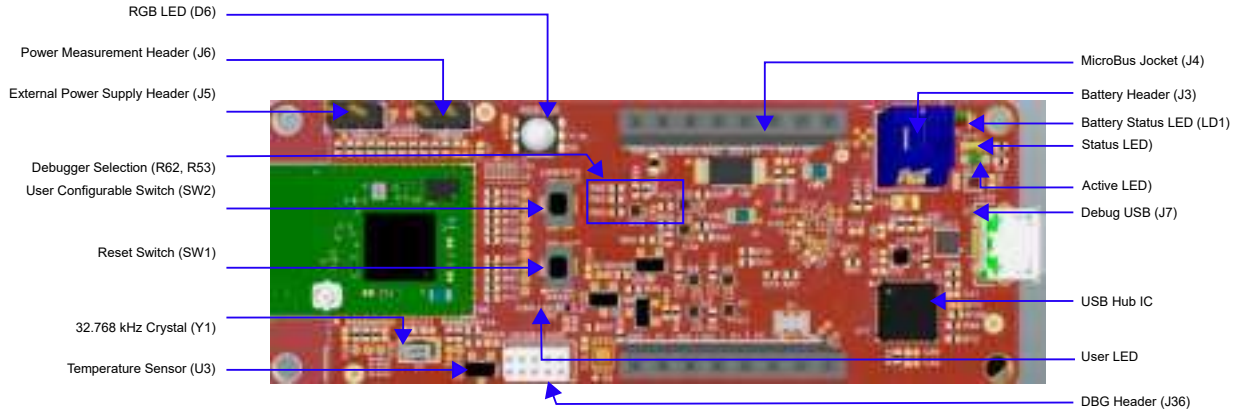
1.4 Software Prerequisites

- MPLABx IDE v5.45 and above (www.microchip.com/mplab/mplab-x-ide)
- MPLABx XC32 Compiler v1.40 and above (www.microchip.com/mplab/compilers)
- Harmony 3 Configurator: Installed as plugin in MPLABX
- Device Pack - Microchip.PIC32CX-BZ_DFP-1.0.54 and above

2. Kit Overview

The WBZ451 Curiosity Board contains a WBZ451 module. All the signals from the WBZ451 RF module are connected to on-board features on curiosity board for flexibility and rapid prototyping.

Figure 2-1. WBZ451 Curiosity Board



2.1 Kit Contents

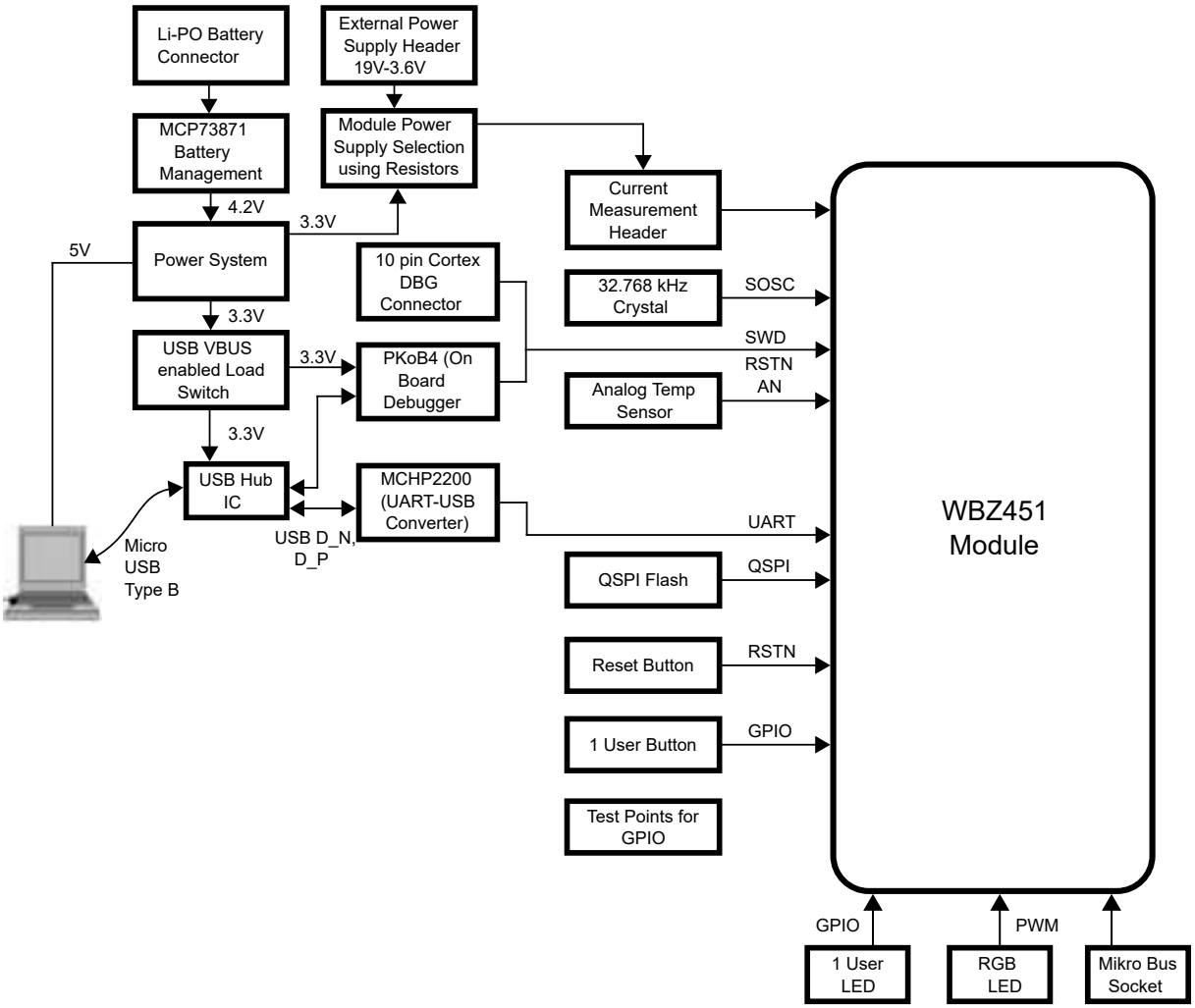
The WBZ451 Curiosity Board kit contains the following:

- WBZ451 Curiosity Board

3. Hardware

This chapter describes the hardware features of the WBZ451 Curiosity Board.

Figure 3-1. Block Diagram



3.1 Power Supply

The WBZ451 Curiosity Board can be powered using any of the following sources:

1. USB power supply using Type-A male to micro-B USB cable.
2. 4.2V Li-ion/Li-Po Battery Kit as follows:
   - Connected to J3, JST PH, 2 pin, 2 mm pitch, right angle male battery header.
   - Crimp style connector, battery polarity according to +/- marking on curiosity board.
   - Battery is not part of the kit.
   - Minimum recommended battery capacity is 400 mAh with a battery charge voltage of 4.2V.
   - For example, refer to the www.adafruit.com/product/258.

Battery management circuit automatically handles selection between USB power supply and battery supply.

On-board MCP1727 voltage regulator generates +3.3V power supply. WBZ451 module and associated circuit default powered by +3.3V.

WBZ451 module can also be powered from:

- External power supply header (J5) using external power supply (1.9V-3.6V) for testing at different voltage levels apart from the default supply of 3.3V from on-board regulator. To use the external power supply header, disconnect the on-board +3.3V supply according to the following table:

Table 3-1. Resistor Option to select WBZ451 Module Power Supply

On-board 3.3V Regulator	External Power Supply
Mount R26	Do not mount R26
Do not mount R32	Mount R32

Figure 3-2. Resistor Position to select WBZ451 Module Power Supply

3.2 Li-Po Battery Charger

A 4.2V, Li-Po Battery connected to the 2 pin, 2 mm pitch right angle male battery header. JST PH connector can be charged using Battery Management IC MCP73871-2CC from the USB power supply at 100 mA fast charge current.

Table 3-2. LD1 Battery Charger Status LED

LED Color	Function
Red (charging)	The battery is being charged by the USB when USB is plugged in.
Red (discharging)	The battery voltage is low. Triggers, if the voltage is under 3.1V.
Green	Charge complete

3.3 Debugger/Programmer Selection

By default, the on-board debugger (PKOB4) is connected to the programming pins (SWDIO and SWDCLK) of the WBZ451 module.

The WBZ451 Curiosity Board has an on-board debugger (PKOB4) based on the ATSAME70 USB MCU. The on-board debugger enables the user to power, program and debug through the micro-B USB connector (J7) from the Host PC. The voltage level translators are provided on signals between PKoB4 and WBZ451 module for supporting target voltage from 1.9V-3.6V.

In addition, the curiosity board supports external debuggers, such as MPLAB ICD4, MPLAB PICKIT4, MPLAB SNAP by connecting to the DBG header (J36).

To use external debugger on the SWD connector, remove resistors R53 and R62 to disconnect the on-board debugger from driving the programming pins.

Table 3-3. Resistor Position for Debugger Selection

On-Board PKOB4	External Debugger
R53 mounted	R53 not mounted
R62 mounted	R62 not mounted

DBG Header (J36) follows the standard ARM SWD 10 pinout shown in the following figure. MPLAB ICD4, MPLAB PICKIT4 MPLAB SNAP can be connected to DBG header using debugger adapter board (AC102015). For more details, refer to the www.microchip.com/DevelopmentTools/ProductDetails/AC102015.

Table 3-4. SWD DBG Header Details

Pin Number of DBG Header	Pin Name	Description
1	VCC	RF module power supply
2	SWDIO	PB9, SWD programming data
3	GND	Ground
4	SWCLK	PB8, SWD programming clock
5	GND	Ground
6	SWO	PB7, optional trace output
7	NC	No connection
8	NC	No connection
9	GND	Ground
10	RESET	RF module reset NMCLR pin

3.4 USB-UART Virtual COM Port

The WBZ451 Curiosity Board has on-board MCP2200 acts as USB to UART converter with hardware flow control support and enables the user through the micro-B USB connector (J7) from the Host PC. MCP2200 supports UART baud rates from 300-1000 kbps. Voltage level translators are provided on signals between MCP2200 and WBZ451 module for supporting target voltage from 1.9V-3.6V when powered externally.

Table 3-5. USB Serial Converter Pin Assignment

Pin on MCP2200	Pin on WBZ451 Module	Description
Tx	PA6, SERCOM0_PAD1	UART Rx pin of WBZ451 module
Rx	PA5, SERCOM0_PAD0	UART Tx pin of WBZ451 module
RTS	PA4, SERCOM0_PAD3	UART CTS pin of WBZ451 module
CTS	PA3, SERCOM0_PAD2	UART RTS pin of WBZ451 module

3.5 mikroBUS Socket

A mikroBUS socket (J4) expands the functionality of the WBZ451 Curiosity Board using the MikroElectronika click adapter boards. The mikroBUS connector consists of two 1 x 8 female headers with Serial Peripheral Interface (SPI), Inter-Integrated Circuit (I^2C), Reset Pin (RST), Pulse Width Modulation (PWM), analog and interrupt lines, as well as 3.3V, 5V and ground power lines. A complete listing of click boards can be found at www.mikroe.com/click.

The GPIO pins for the mikroBUS sockets is assigned to route I^2C, and SPI peripherals and other GPIO pins as follows.

Table 3-6. mikroBUS Socket Pinout Details

Pin Number	Pin Name	Pin on WBZ451 Module	Description
1	AN	PB1, AN5	ADC analog input
2	$\overline{RST}$	PB2	General purpose I/O pin
3	$\overline{CS}$	PA9, SERCOM1_PAD2	Slave select pin for SPI/ General purpose I/O pin
4	SCK	PA8, SERCOM1_PAD1	SPI clock
5	MISO	PA10, SERCOM1_PAD3	SPI master input slave output
6	MOSI	PA7, SERCOM1_PAD0	SPI master output slave input
7	+3.3V	+3.3V	3.3V power
8	GND	GND	Ground
9	GND	GND	Ground
10	+5V	+5V	5V power
11	SDA	PA13, SERCOM2_PAD0	I2C data
12	SCL	PA14, SERCOM2_PAD1	I2C clock
13	TX	-	-
14	RX	-	-
15	INT	PA2	Interrupt pin/General purpose I/O pin. Shared with PWM pin
16	PWM	PA2	PWM pin/General purpose I/O pin. Shared with INT pin

Note: In the mikroBUS socket, both INT and PWM are connected to PA2, click board use both of them simultaneously are not supported (for example, refer to the www.mikroe.com/stepper-2-click).

3.6 Switches

The following switches are available on the WBZ451 Curiosity Board:

- Reset switch (SW1)

- User configurable switch (SW2)

In the Idle state, the level of the reset switch is pulled high using external pull up resistor and, when the switch is pressed, it drives the level of the switch to low.

User configurable switch is also pulled high using external pull up resistor and when the switch is pressed it drives pin low.

Table 3-7. Switches Description

Switch Name	Pin on WBZ451 Module	Description
Reset	NMCLR	Reset switch (SW1) connected to NMCLR pin
USR-BTN	PB4	User configurable switch (SW2)

3.7 LEDs

One user-programmable blue indicator LED (D5) is available on the WBZ451 Curiosity Board and this LED can be turned ON or OFF using the connected GPIO pin PB7. Drive the pin to high level to turn OFF the LED and drive the pin to low level to turn ON the LED.

Important: PB7 is also SWO pin on the WBZ451 module. During a programming/debug session with MPLABx IDE this pin is always driven low from the WBZ451 module, thus making the user LED turned ON entire DEBUG session. When DEBUG session is exited, this pin operates normally.

3.8 Temperature Sensor

Analog output from the temperature sensor (2.3V-5.5V Microchip MCP9700A, U3) is connected to one of the analog pins (PB6, AN2) of the module's ADC channel.

3.9 QSPI Serial Flash

The WBZ451 Curiosity Board has an on-board 64-Mb, 2.3-3.6V Serial Quad I/O (SQI) Flash (SST26VF064B, U6) memory for storage of data. SST26VF064B default at power-up is with WP# and HOLD pins enabled and SIO2 and SIO3 pins disabled allowing for SPI protocol operations without register configuration. Register configuration is required to switch to Quad I/O operation with QSPI.

Table 3-8. QSPI Flash Pin Description

QSPI Flash	Pin on WBZ451 Module	Description
CE	PB10, QSPI_CS	QSPI chip select
SO/SIO1	PB13, QSPI_DATA1	QSPI data channel 1
WP/SIO2	PA0, QSPI_DATA2	QSPI data channel 2
VSS	GND	Ground
SI/SIO0	PB12, QSPI_DATA0	QSPI data channel 0
SCK	PB11, QSPI_SCK	QSPI clock
Hold/SIO3	PA1, QSPI_DATA3	QSPI data channel 3

.....continued		
QSPI Flash	**Pin on WBZ451 Module**	**Description**
VDD	VDD	VDD

3.10 RGB Lighting LED

Three PWM signals from the WBZ451 module are connected to RGB Lighting LED (D6) on the WBZ451 Curiosity Board.

Table 3-9. RGB Lighting LED Pin Description

Color	Pin on WBZ451
Red	PB0
Green	PB3
Blue	PB5

3.11 Power Measurement Header

To measure the power going to the WBZ451 module, 1x2, 2.54 mm male pin header with shunt connector (I-MEAS, J6) is provided.

3.12 32.768 kHz Crystal

The 32.768 kHz crystal connected to SOSC pins (PA11 and PA12) of WBZ451 module.

4. Getting Started

4.1 Introduction

The BLE sensor application is an excellent demonstration of one of the many real-world Bluetooth Low Energy (BLE) applications involving monitor and control of sensor, lights and so on, wirelessly. This application brings BLE concepts like advertisements and connection establishment to practice. The demo consists of the WBZ451 Curiosity Board with accompanying BLE firmware, the Microchip Bluetooth Data (MBD) smartphone application. The MBD application has the capability to scan for BLE advertisements from WBZ451 module and to establish a connection.

Scan operation monitors temperature sensor and status of RGB LED (ON or OFF). Establishing a BLE connection with WBZ451 module enables users to control the RGB status (ON or OFF) as well as intensity and color of the RGB LED using slide controls.

4.2 BLE Sensor Application Demo

1. Installing the MBD smartphone application as follows:
   1.1. iOS users can search for **Microchip Bluetooth Data** application in App Store and install.
   1.2. Android users can directly install the `xxx.apk` file available as part of early adopter package.
   1.3. Enable Bluetooth on the smartphone.
2. Launch the application.
3. Supplying power to WBZ451 Curiosity Board as follows:
   3.1. Connect a USB cable to the kit or a 4.2V Li-ion/Li-Po Battery. For more details, refer to the 3.1 Power Supply.
   3.2. The user programmable blue LED starts blinking on Curiosity Board when the board is in advertisement mode.
4. Monitoring RGB LED state and temperature as follows:
   4.1. WBZ451 Curiosity Board starts in advertisement mode to advertise its presence to a smartphone and to allow access to RGB LED ON or OFF state and temperature sensor data.
   4.2. Navigate through the smartphone application as shown in the following figure to access the advertisement information.

Figure 4-1. MBD Smartphone Application

5. Controlling RGB LED state ON or OFF as well as intensity and color as follows:
   5.1. Click the device that shows up after initiating a scan to establish a connection with WBZ451 module.

5.2.  - Controls the RGB LED state ON or OFF.

5.3.  - Controls the color of RGB LED when LED is ON.

5.4.  - Controls the intensity of RGB LED when LED is ON.

5.5.  - Additional information.

5.6. Press the (SW2) button on curiosity board to toggle the state of RGB LED, the status of RGB LED is relayed to the smartphone application.

Figure 4-2. Status of Smartphone Application

6. Disconnecting the WBZ451 module from the MBD application as follows:
   6.1. Press the reset button on WBZ451 Curiosity Board.
   6.2. Disable Bluetooth on smartphone.

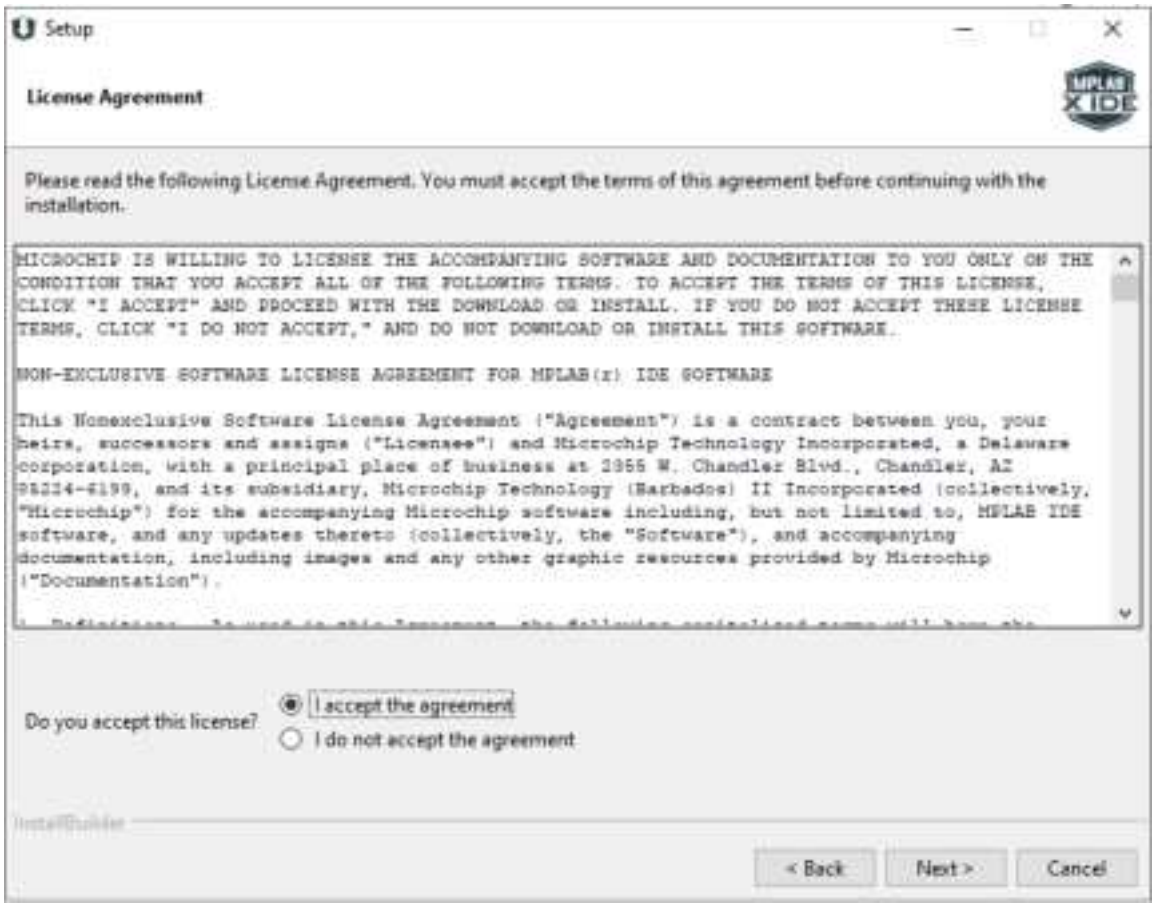
Upon successful disconnection, the WBZ451 module starts in advertisement mode.

4.3 Tools Setup

4.3.1 Installing MPLABx IDE and IPE

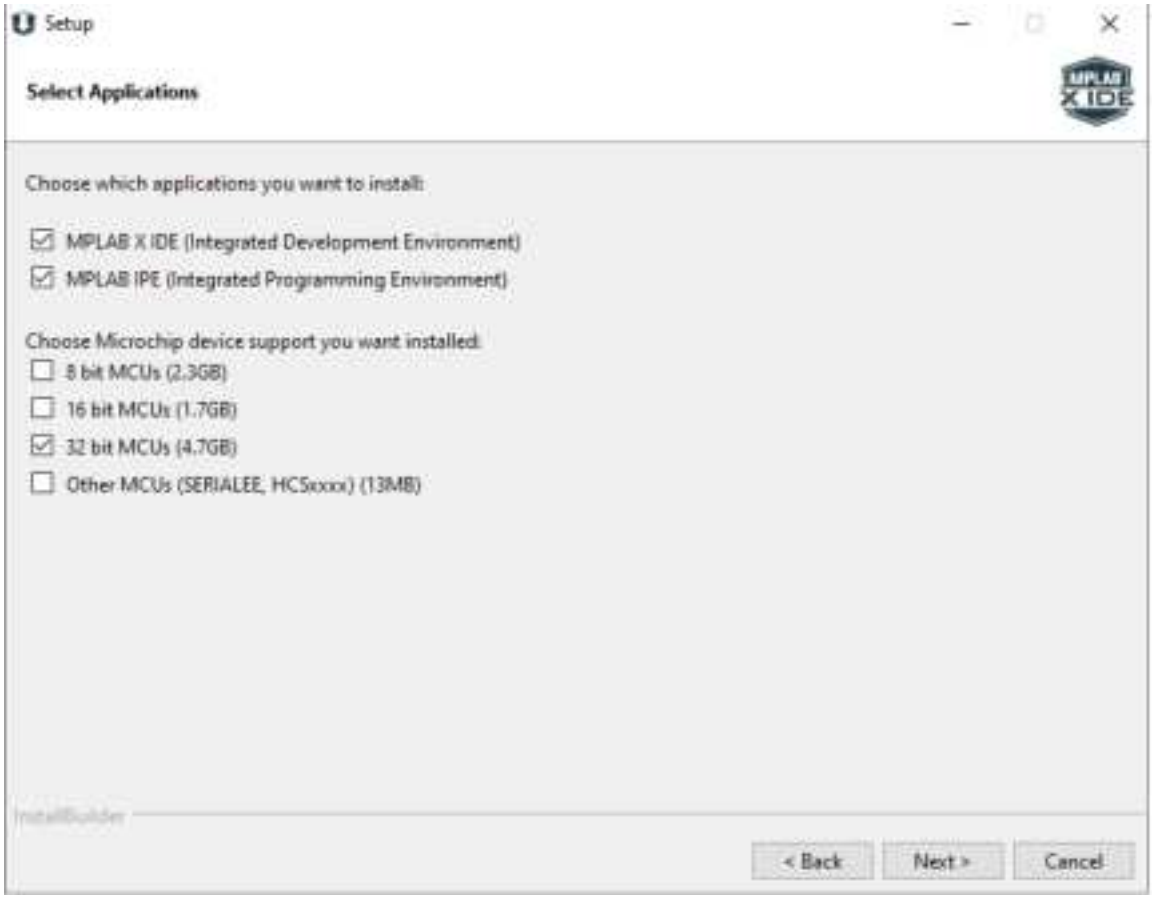
1. Refer to the 1.4 Software Prerequisites to download required version of MPLABx IDE.
2. Execute the installer to begin installation of MPLABx IDE.

Figure 4-3. License Agreement



3. Choose both **MPLABx IDE** and **MPLABx IPE** and click **Next**.

Figure 4-4. Select Applications for Installation



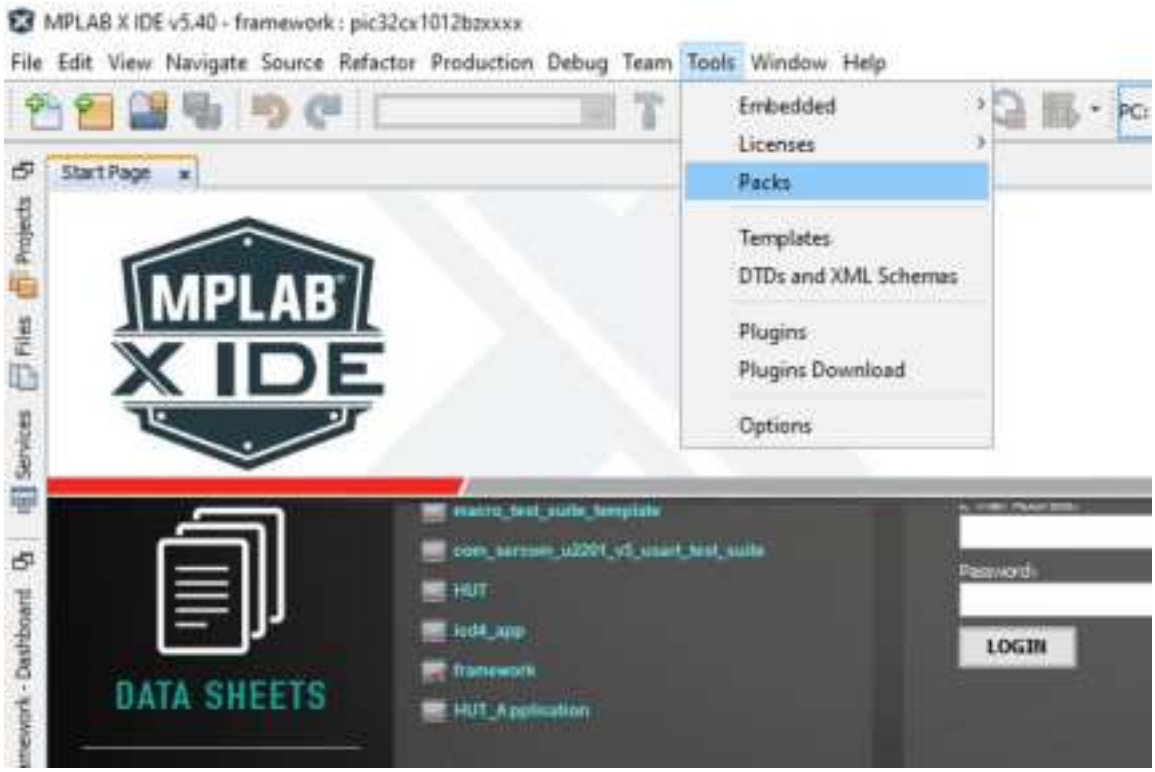
4. Click **Next** on upcoming windows to complete the installation.
5. For more details, refer to the *MPLABx IDE Userguide* (docs.microchip.com/ContentDelivery/web/pub.xql?c=t&action=home&pub=MPLAB_X_IDE_User_Guide&lang=en-US).

4.3.2 Installing Part Pack for PIC32CX1012BZ25048

Required version of device part pack may come preinstalled with MPLABx IDE. If newer or different part packs are needed, follow these instructions:

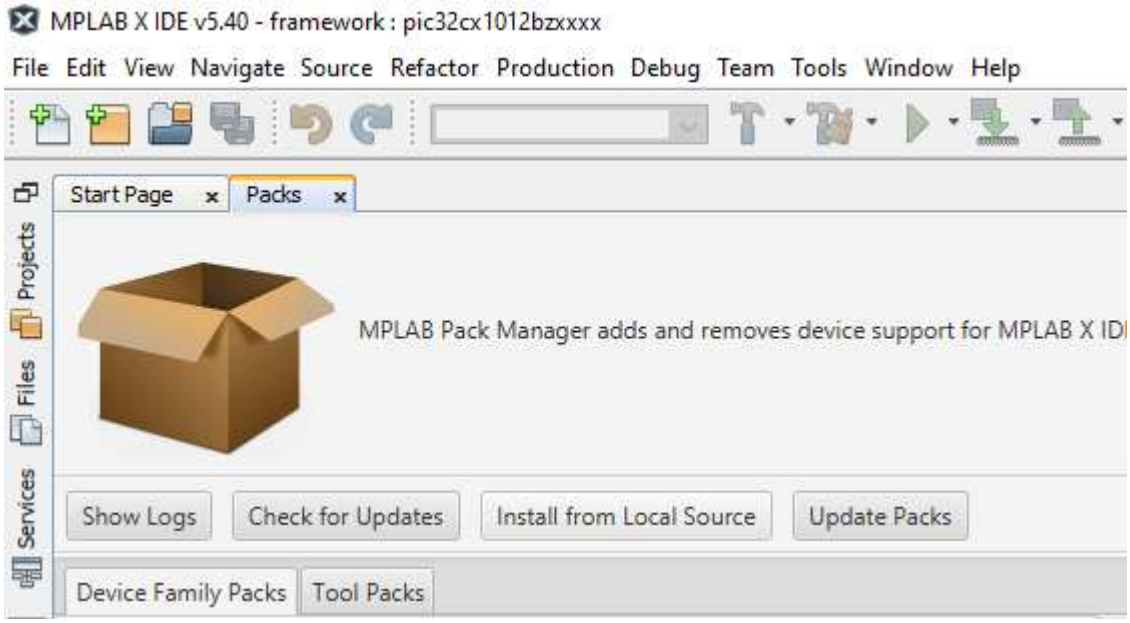
1. Open **MPLABx IDE**.
2. Go to Tools > Packs.

Figure 4-5. Packs Installation



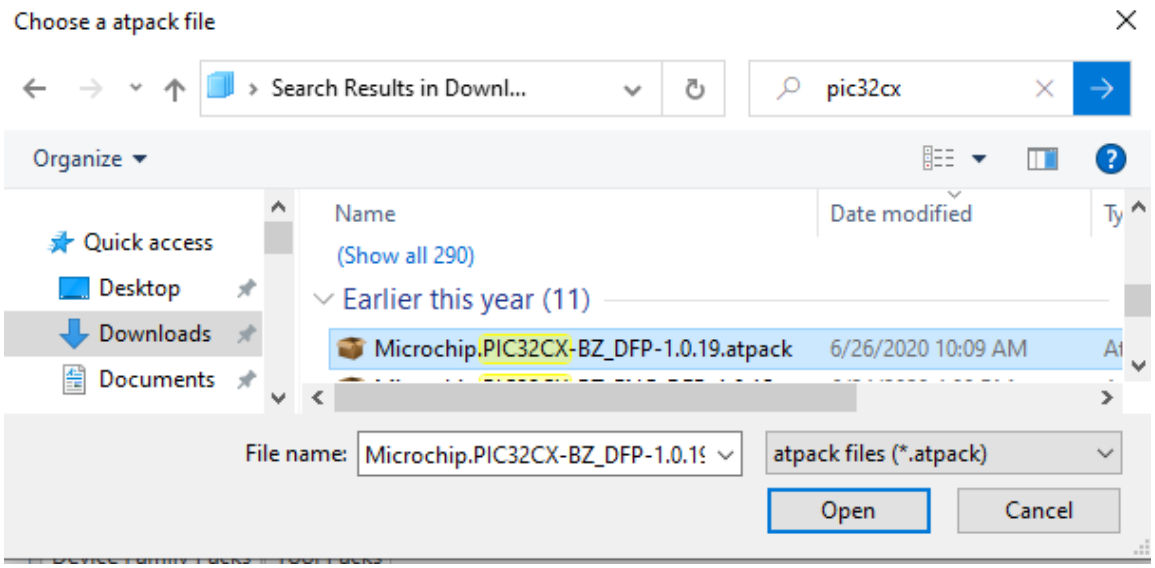
3. Click **Install from Local Source**.

Figure 4-6. Installing from Local Source



4. Browse to the location, where part pack is located and click **Open**.

Figure 4-7. Selecting Pack File

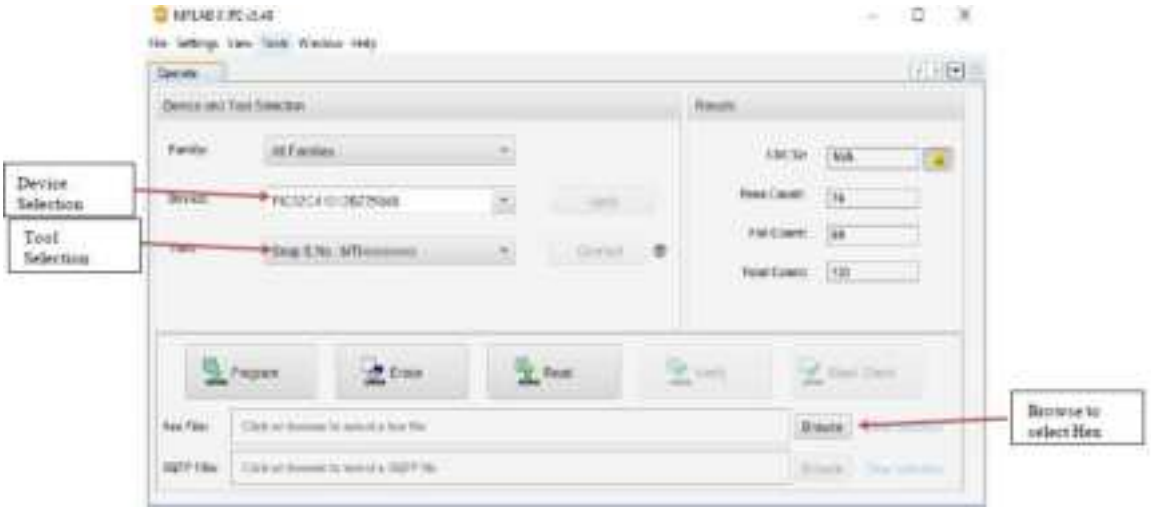


5. Wait for the installation to complete.

4.4 Programming via MPLABX IPE

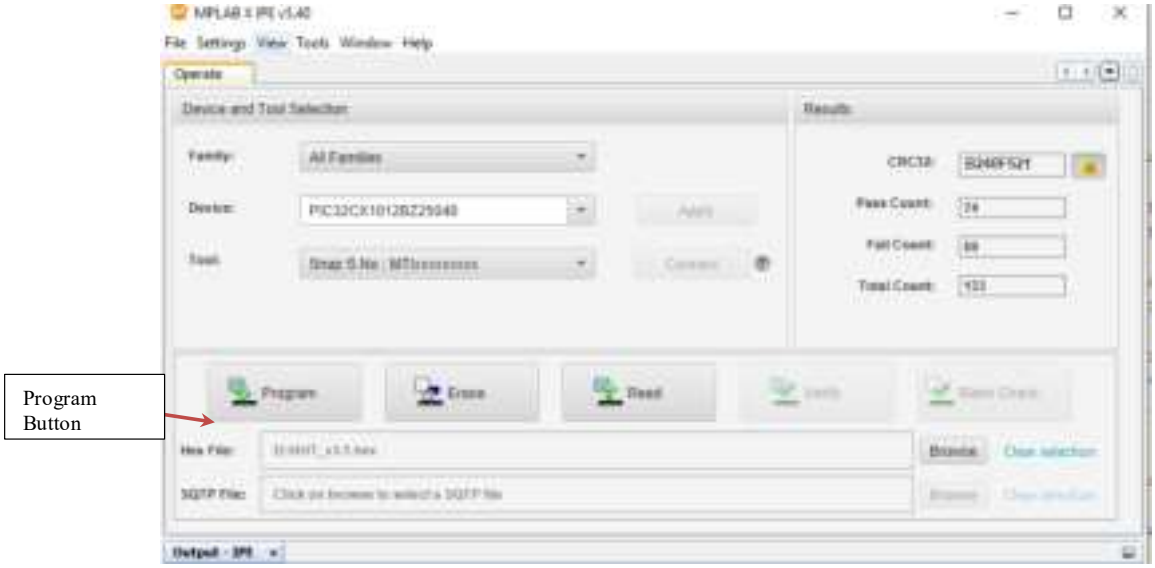
1. Connect the WBZ451 Curiosity Board to PC using a USB cable, from MPLABx IPE tool, select **Device "PIC32CX1012BZ25048"** and the **Tool Connected**.
2. Check the Device Manager.
3. Browse and point to the location where the Hex to be programmed is saved.

Figure 4-8. Programming via MPLABX IPE



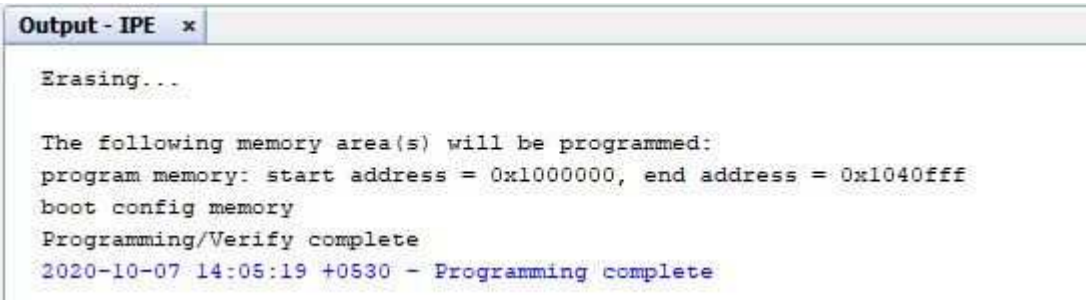
4. Click **Program** button to program the device with the selected Hex file.

Figure 4-9. Programming the Device with Hex File



5. Successful programming output in IPE is as follows.

Figure 4-10. Programming Output



5. Document Revision History

Revision	Date	Section	Description
A	10/2020	Document	Initial revision

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