PIC32CX-BZ2 MCHPRT3 User Guide

PIC32CX-BZ2

Product Page Links

Introduction

This user guide provides detailed information about using the Microchip Radio Test 3 tool (MCHPRT3) with the Microchip PIC32CX-BZ2. The MCHPRT3 enables the user to evaluate and demonstrate the RF performance, calibration and functionalities of the PIC32CX-BZ2.

Note: In this user guide, the MCHPRT3 tool with the PIC32 WBZ451 Curiosity Board is only shown as an example.

The MCHPRT3 is intended for development purposes. Any production test must use either a third-party production tool or users must develop their own production tool based on the DLL release.

Features

- DLL Version – DLL Information and Firmware Support Version
- COM PORT – COM Port Information and Configuration
- Baud Rate – 115200 (default value)
- RF Bluetooth® – Bluetooth Low Energy RF Parameter Configuration and Information
- RF ZB – Zigbee® RF Parameter Configuration and Information
- MAC Address Information and Configuration
- IB File – Read or Save Information Block (IB) File
- Calibration Information and Configuration
- GPIO Information and Configuration

For more details, refer to Getting Started.

Table of Contents

1. Quick References

1.1. Hardware Prerequisites

- WBZ451 Curiosity Board (PIC32CX-BZ2 programmed with HUT firmware)
- USB-A to Micro USB cable
- Bluetooth Low Energy and Zigbee Tester (IQxel)

1.2. Software Prerequisites

Download the latest MCHPRT3 installer package, PIC32CX-BZ2 HUT X.X firmware and the corresponding tools from the Microchip website at www.microchip.com/MCHPRT.

- Windows® OS (version to be confirmed)
- MCHPRT3 installer package (`MCHPRT3_Setup_v1.0.0.XXXX.exe`)
- MPLAB® X IDE v5.45 or above

1.3. Acronyms and Abbreviations

Table 1-1. Acronyms and Abbreviations

Acronyms and Abbreviations	Description
CLI	Command Line Interface
DLL	Dynamic Link Library
DUT	Device Under Test
GPIO	General-Purpose Input/Output
GUI	Graphical User Interface
HUT	Hardware Under Test
IB	Information Block
MCHPRT3 tool	Microchip Radio Test 3 tool
OTP	One-Time Programmable
RSSI	Received Signal Strength Indicator

2. Overview

This section provides an overview of the MCHPRT3 tool setup and the components. Install the `MCHPRT3_setup_v1.0.0.XXXX.exe` tool available in the `C:\Microchip\` folder.

The following table provides the MCHPRT3 tool package files:

Table 2-1. MCHPRT3 Tool Package Files

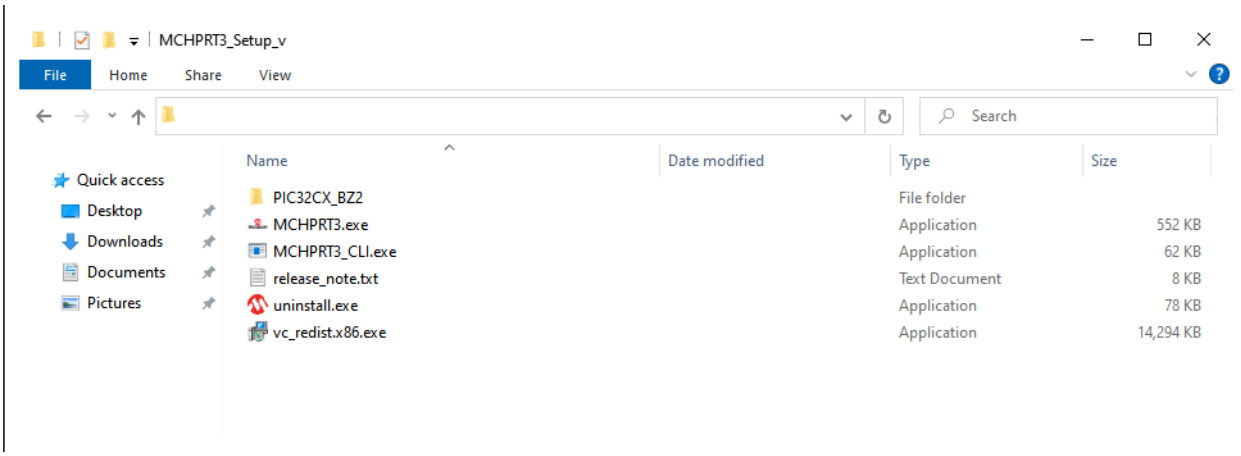
File Name	Description
`MCHPRT3.exe` file	MCHPRT3 executable file
`MCHPRT3_CLI.exe` file	MCHPRT3 CLI executable file
`Release_note.txt`	Tool release note file
`uninstall.exe` file	Uninstall the MCHPRT3 tool
`vc_redist.x86.exe` file	Microsoft® Visual C++ Redistributable (x86) executable file

The following table provides the PIC32CX-BZ2 package files:

Table 2-2. PIC32CX-BZ2 Package Files

File Name	Description
HEX file (`.hex` file)	Hardware Under Test (HUT) firmware version file
`PIC32CX_BZ2.chm`	PIC32CX-BZ2 complied HTML help file
`PIC32CX_BZ2.dll` file	PIC32CX-BZ2 dynamic link library file
`PIC32CX_BZ2_CDECL.dll` file	Default calling convention file for C and C++ programs
`PIC32CX_BZ2_CLI.dll` file	PIC32CX-BZ2 command line dynamic link library file
`PIC32CX_BZ2_GUI.dll` file	PIC32CX-BZ2 graphical user interface dynamic link library file

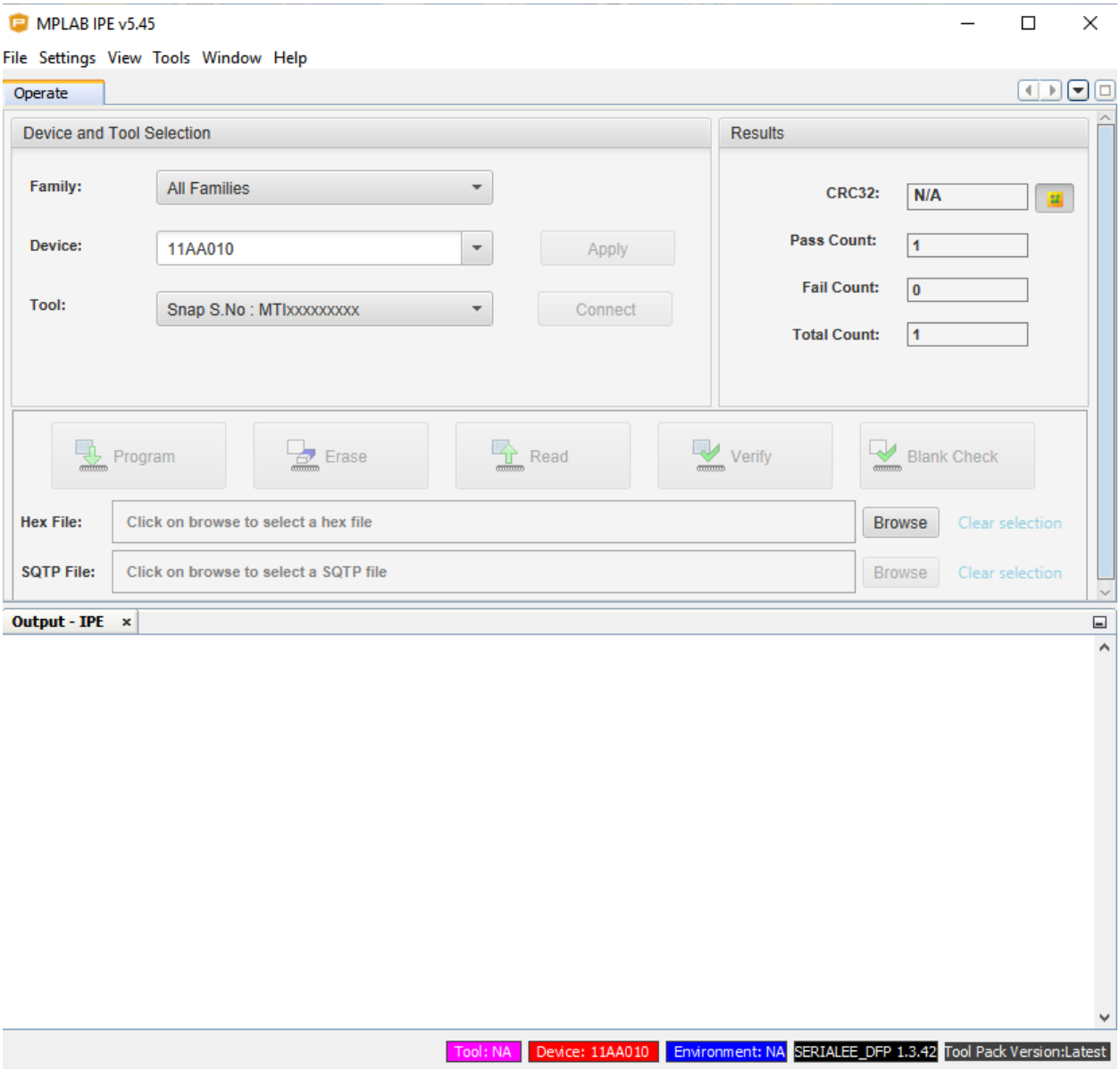
Figure 2-1. MCHPRT3 Package Contents



3. MPLAB X IDE HUT Code Programming Process

In this demonstration, the user can program the HUT firmware to the PIC32CX-BZ2 device using a PC with the installed MPLAB Integrated Programming Environment (IPE).

Figure 3-1. MPLAB X IPE

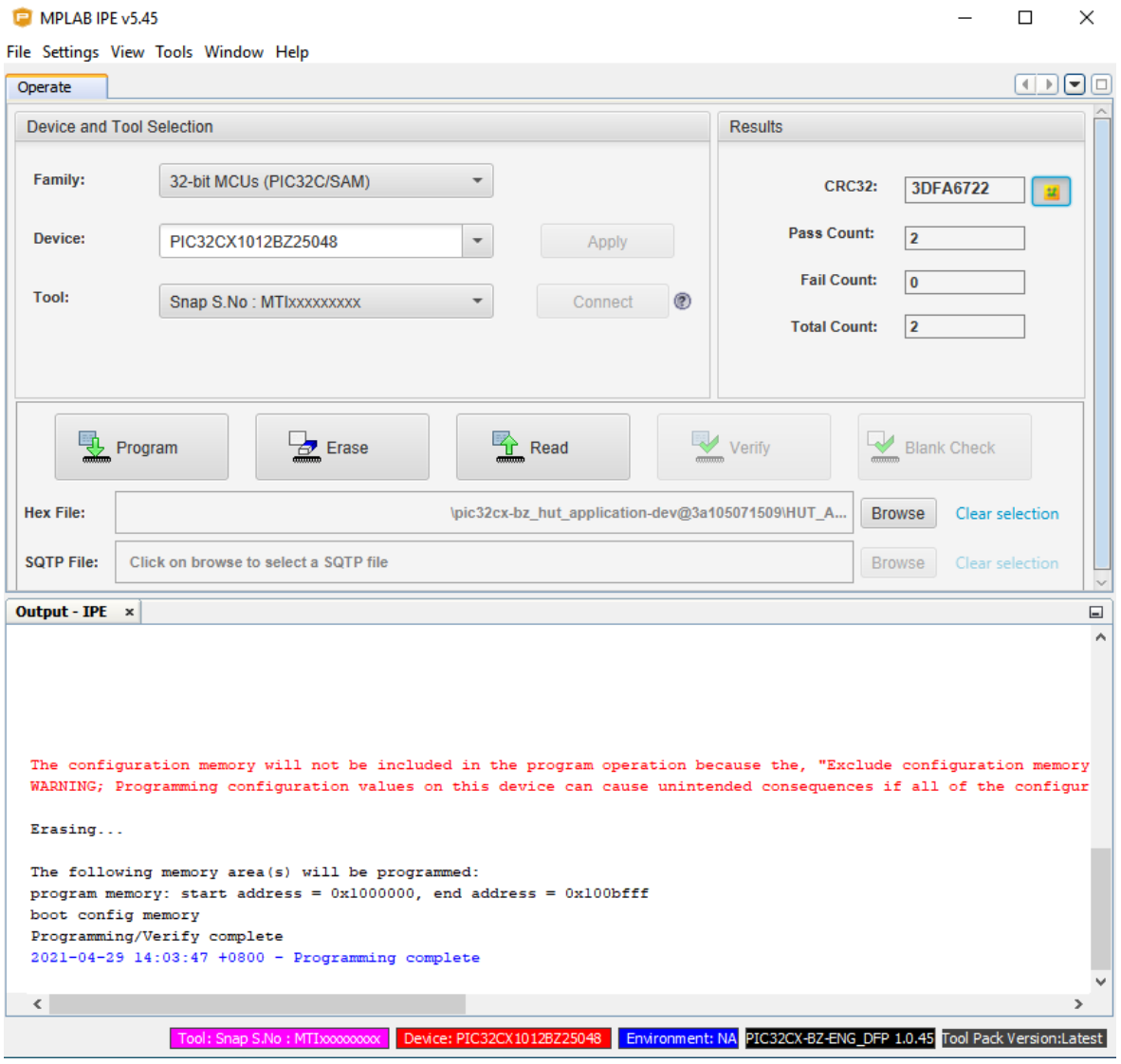


Perform the following steps for HUT firmware programming:

1. Set up the connection between the WBZ451 Curiosity Board and PC. Refer to Getting Started with MCHPRT3.
   a. Start “MPLAB X IPE”, then check for *PIC32CX1012BC5048* in the “Device” text box. If it is not there, check the USB connection (step 1).
   b. Click **Apply**.
   c. Click **Browse** to load the `HUT.Application.X.production.hex`, which is the PIC32CX-BZ2 HUT X.X firmware.

d. Click **Program**, then wait one minute for the programming to complete.

Figure 3-2. MPLAB X IPE (Programming Complete)



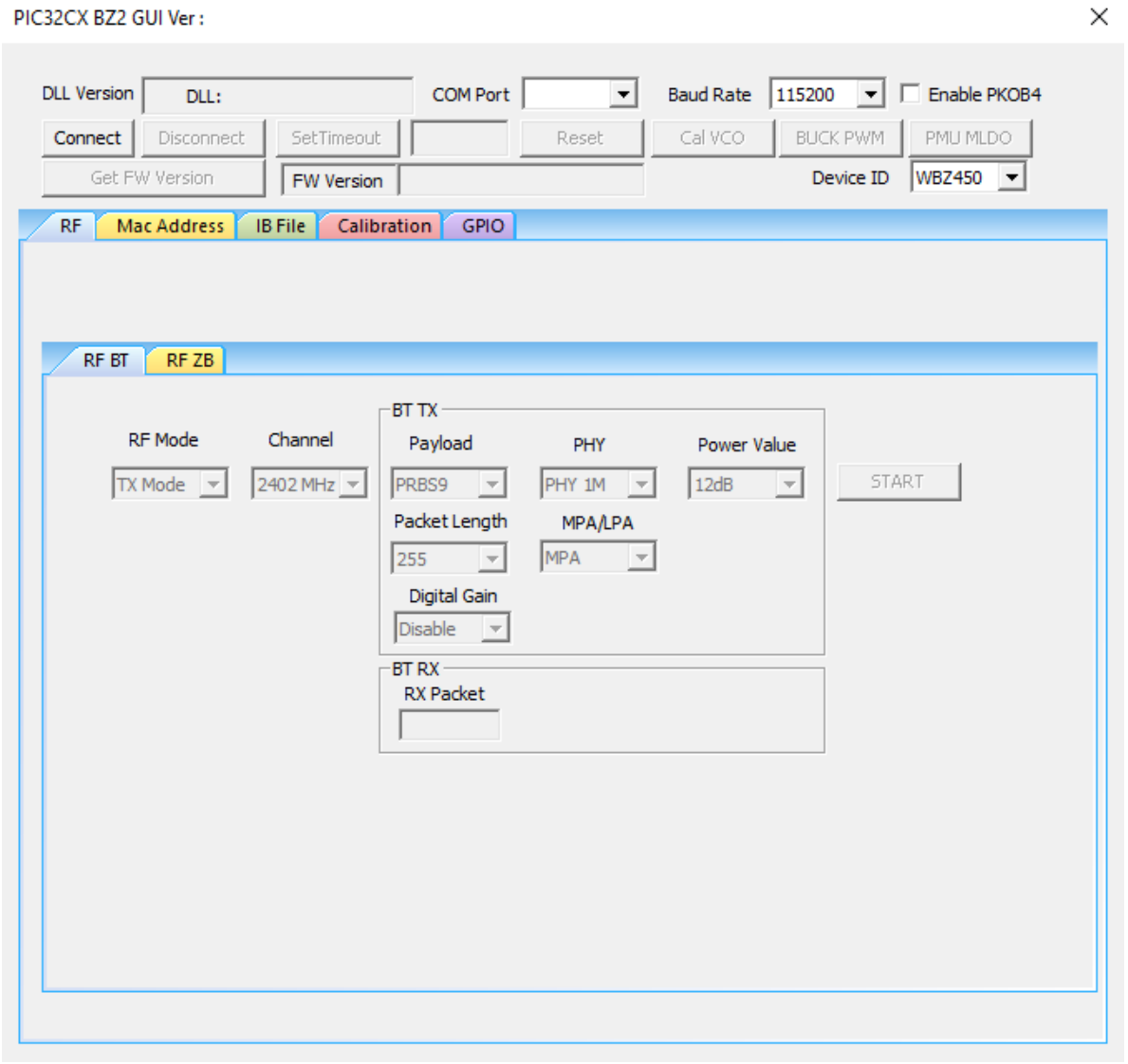
2. The PIC32CX-BZ2 is programmed with the HUT X.X firmware and ready for the test using the PIC32CX-BZ2 MCHPRT3 tool.

4. Getting Started

This section describes how to use the MCHPRT3 GUI to test or calibrate the PIC32CX-BZ2 with the Bluetooth Low Energy and Zigbee tester.

The following figure illustrates the MCHPRT3 for PIC32CX-BZ2 GUI with the following components:

Figure 4-1. PIC32CX-BZ2 GUI



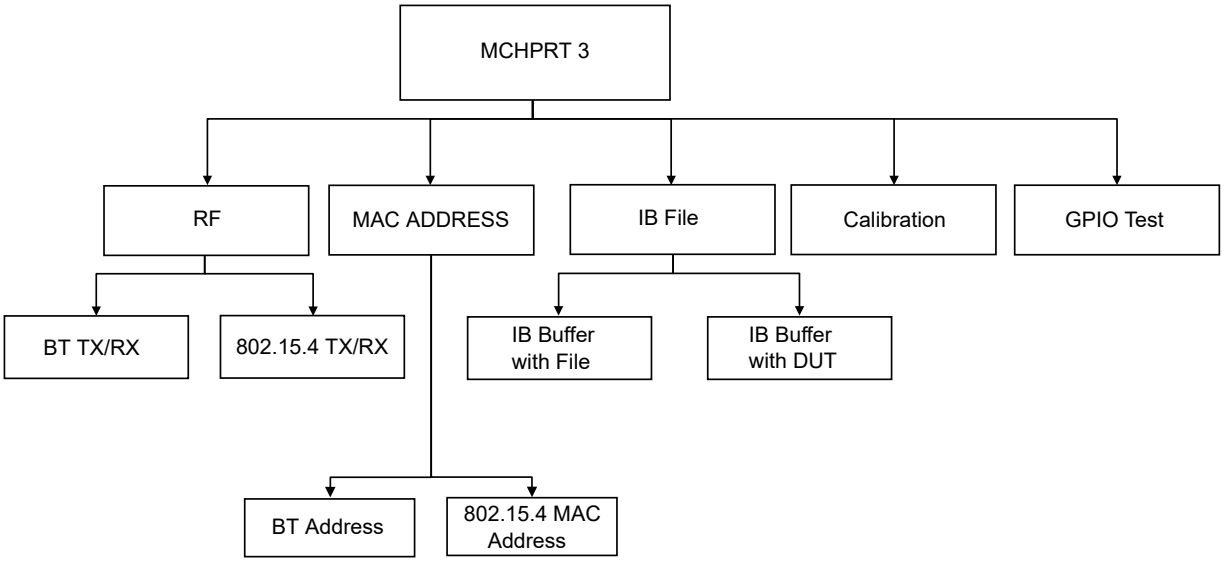
4.1. Getting Started with MCHPRT3

MCHPRT3 Package Features

- RF – RF Test for Bluetooth and Zigbee TX/RX
- Calibration – TX Calibration and RX Calibration
- MAC Address – Read/Write Bluetooth Address and Zigbee MAC Address
- Information Block (IB) File – Read/Save IB File to/from Buffer and Read/Commit IB Buffer to/from DUT

- GPIO – GPIO Test Command

Figure 4-2. MCHPRT3 Block Diagram



The following are the steps to launch the MCHPRT3 tool:

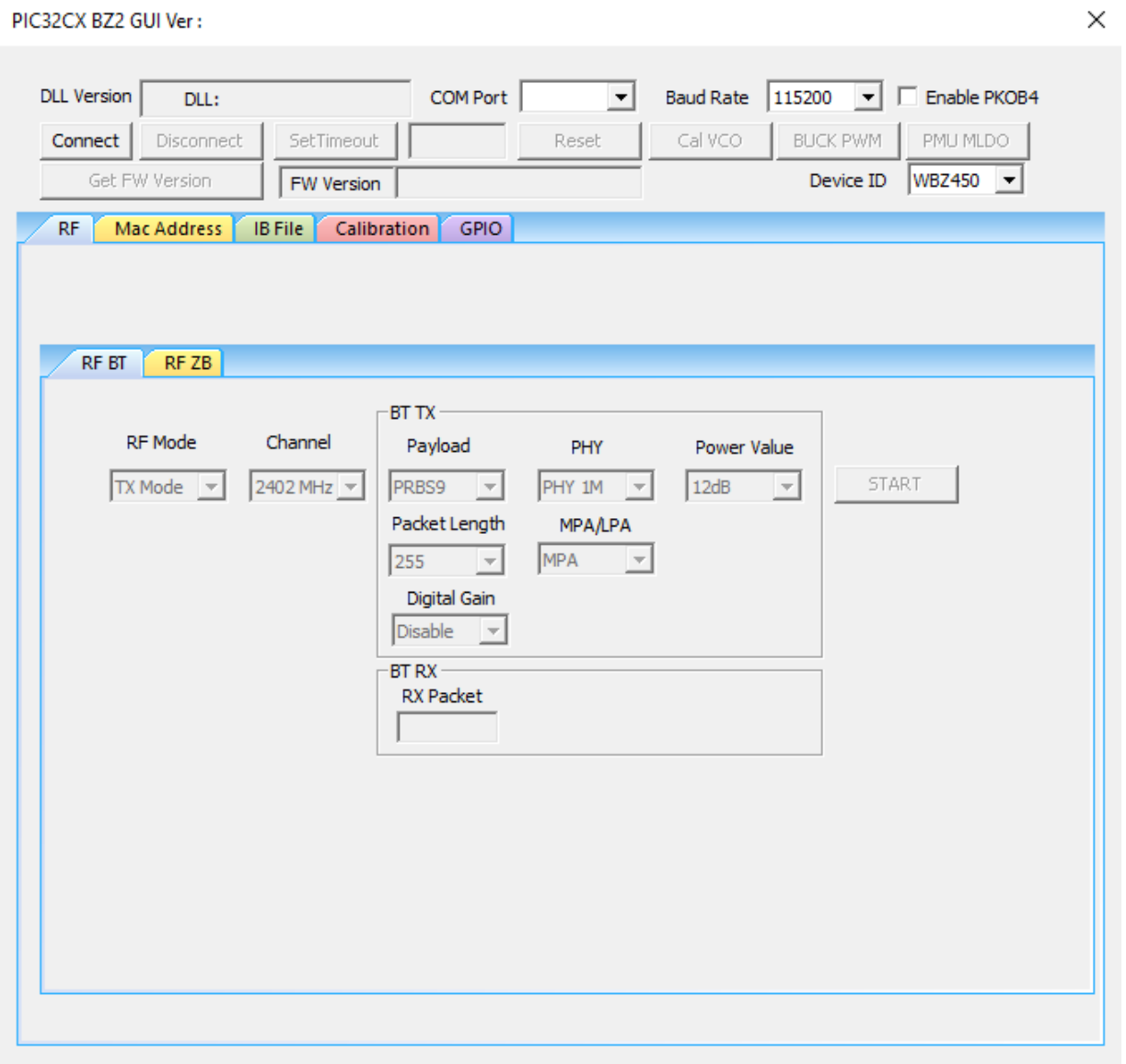
1. Double click `MCHPRT3.exe` under direction `C:\Microchip\MCHPRT3_Setup_v1.0.0.XXXX`; the following screen appears.

   Figure 4-3. Start-Up Window of the MCHPRT3 Tool

2. From the “Select GUI” drop-down list, select PIC32CX-BZ2.
3. Click **Open** to launch the PIC32CX-BZ2 window (see the following figure).

Figure 4-4. PIC32CX-BZ2 GUI



Description of each component:

- Buttons on the top
  - **Connect/Disconnect** – Connects or disconnects the PIC32CX-BZ2
  - **Reset** – Reset the PIC32CX-BZ2
  - **Cal. VCO** – VCO calibration
  - **BUCK PWM** – Switch the power mode into DC-DC (Buck) mode
  - **PMU MLDO** – Switch the power mode into MLDO mode
  - **Get FW Version** – Obtain the firmware version from the sample
  - **Device ID** – Select the appropriate part number that is connecting to the tool
    - For connecting the WBZ451 module/PIC32CX1012BZ25048, select WBZ451
    - For connecting the WBZ450 module/PIC32CX1012BZ25032, select WBZ450

  - **Enable PKOB4** – Only needed to check if the user is using the WBZ450 Curiosity Board
- **RF for Bluetooth and Zigbee** – Settings of RF mode, channel and TX parameter for RF test
  - **BT** – TX setting of payload, PHY (data rate), MPA/LPA (PA setting), packet length and MPA/LPA power step (power level). RX – number of RX packet.
  - **Zigbee** – TX settings of packet type, MPA/LPA (PA setting), power level, delay time between each packet and packet number. RX – setting of RX data rate and number of RX packet.
- **Calibration** – Complete TX and RX calibration flow. The user can save calibration info to file or commit to NVM type Flash or OTP.
  - **TX Calibration** – Perform TX calibration flow to adjust transmitted power and output frequency to target.
  - **RX Calibration** – Perform RX calibration flow to obtain IRR, RSSI to corresponding received power and so on.
- **MAC Address** – Read/write address
  - BT address and Zigbee MAC address
- **Information Block (IB) File**
  - Read IB file to IB buffer/save IB buffer to IB file
  - Read DUT to IB buffer/commit IB buffer to DUT
- **GPIO** – Test GPIO for selected port, pin, in/out and level
  - **Start GPIO** – Initialize GPIO for test
  - **GPIO Command** – Execute GPIO test command for selected port, pin, in/out and level
  - **Stop GPIO** – Stop GPIO test

4.2. Getting Started with MCHPRT3 PIC32CX-BZ2 GUI

Program the sample before use of the MCHPRT3 tool. For more details on the HUT code programming process, refer to MPLAB X IDE HUT Code Programming Process .

To run an RF test on the PIC32 WBZ451 Curiosity Board, perform the following procedure:

1. Connect the Micro USB in the Curiosity Board to the PC.
2. Check whether the jumper for the current measurement was inserted or not.
3. Run `MCHPRT3.exe`.
4. From the “Select GUI” drop-down list, select *PIC32CX-BZ2*.
5. Click **Open** to launch the PIC32CX-BZ2 window.
6. Select the respective “COM PORT” (check device manager in PC). A different USB-to-UART serial converter requires the corresponding driver; install accordingly.
7. Baud Rate - 115200 (default value)
8. Click **Connect**.
9. Click **Reset** to reset the device. The PIC32 WBZ451 Curiosity Board is ready for RF Test, Calibration and MAC Address Programming.

Figure 4-5. PIC32 WBZ451 Curiosity Board USB Connection

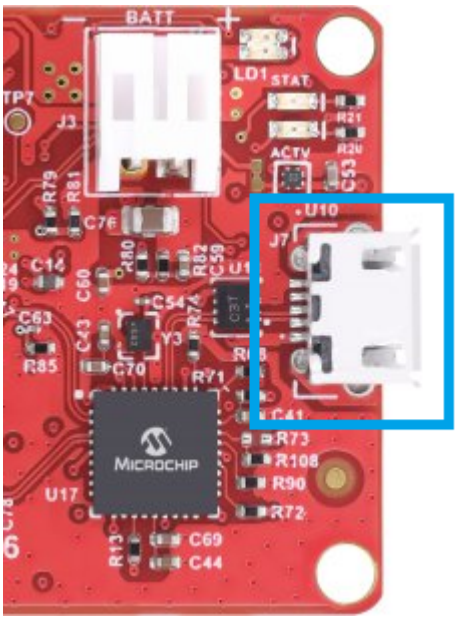
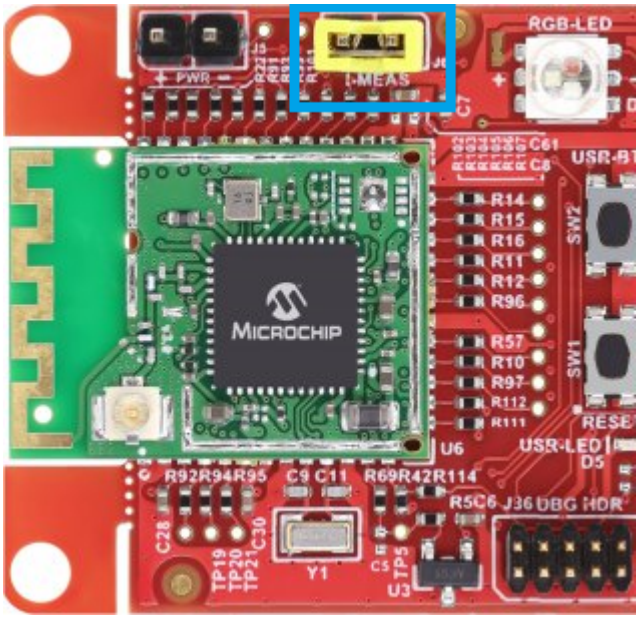


Figure 4-6. Current Measurement Jumper on PIC32 WBZ451 Curiosity Board



4.3. MCHPRT3 PIC32CX-BZ2 GUI Demonstration

4.3.1. Bluetooth RF Test Demonstration

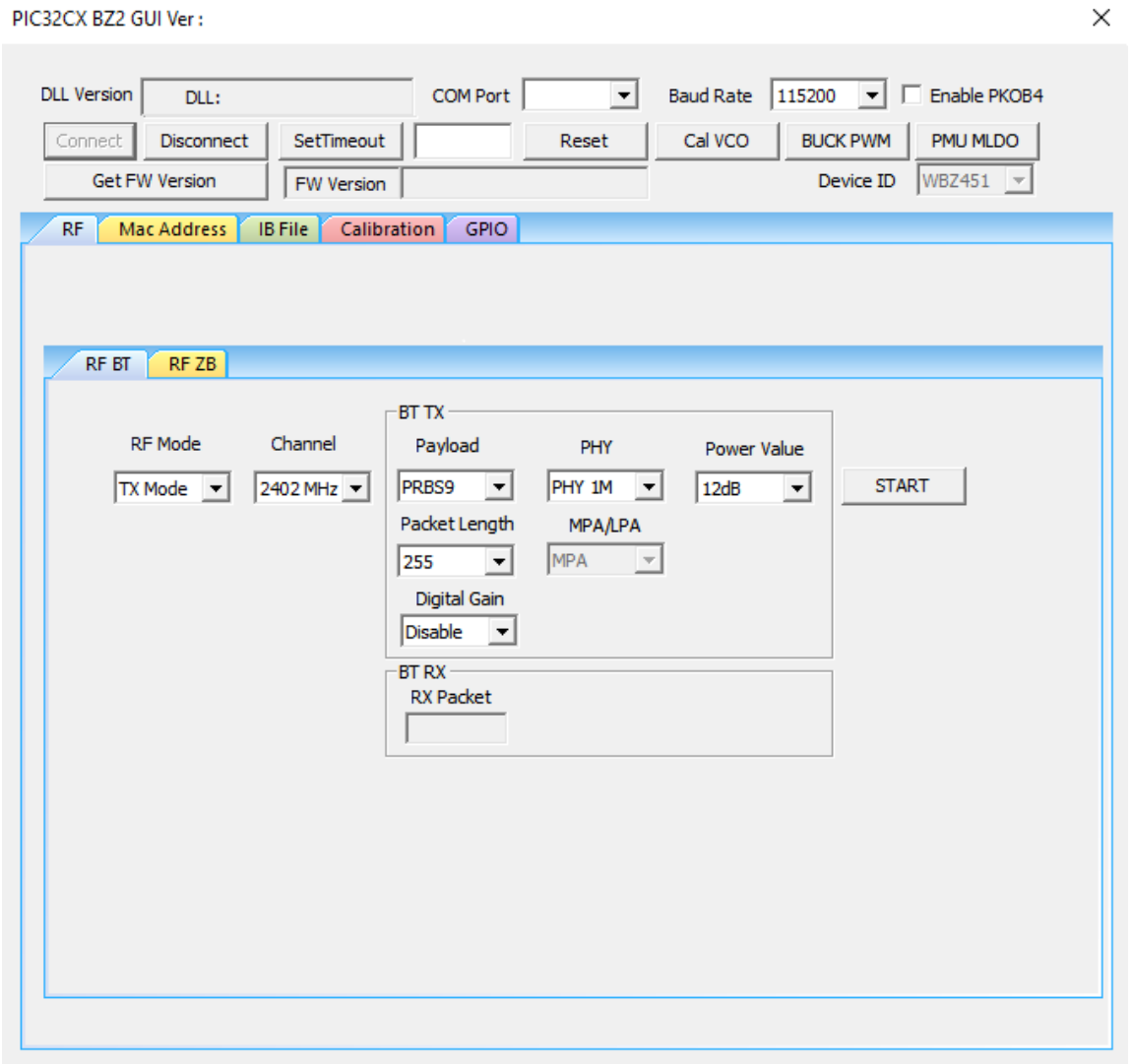
In this demonstration, the user can transmit Bluetooth Low Energy packets, enter RX mode and Test mode with the PIC32CX-BZ2 by using the MCHPRT3.

Perform the following steps for the demonstration of the Bluetooth RF TX modulation test:

1. Set up the connection between the PIC32 WBZ451 Curiosity Board and PC. For more details, refer to the Getting Started with MCHPRT3.

2. In the **RF BT** tab, perform the following steps:
   a. From the “RF Modes” drop-down list, select *TX Mode*.
   b. From the “Channel” drop-down list, select *2402 MHz* for channel 37.
   c. From the “Payload” drop-down list, select *PRBS9* (default value).
   d. From the “PHY” drop-down list, select the *Data Rate* (1M, 2M, S = 2 and S = 8), for example, select *PHY 1M*.
   e. From the “Power Value” drop-down list, select the *Output Power*, for example, select *12 dB*.
   f. From the “Packet Length” drop-down list, select the *Packet Length (0-255)*, for example, *255* (default value).
   g. To enable the selection of *MPA/LPA*, *Disable on Power* must be selected. *Power* is recommended to use for setting the output power level. *MPA/LPA* is disabled by default.
   h. From the “MPA/LPA” drop-down list, select *MPA or LPA*, for example, select *MPA*.
   i. From the “Digital Gain” drop-down list, select *Disable* (default value).
3. Click **START** to transmit the Bluetooth Low Energy packet.

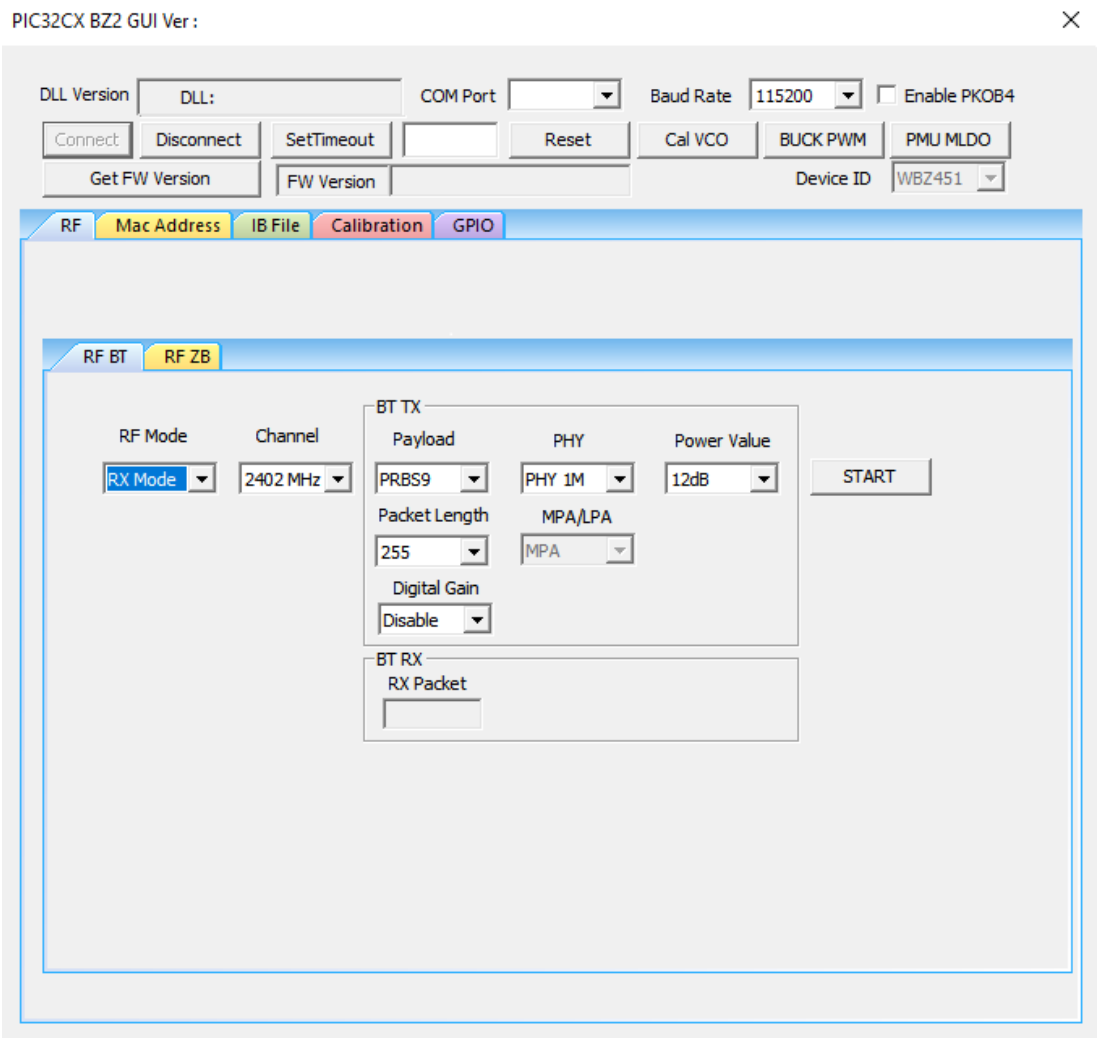
Figure 4-7. MCHPRT3 PIC32CX-BZ2 GUI for Bluetooth RF TX Modulation Test Demonstration



Perform the following steps for the demonstration of the Bluetooth RF RX mode:

1. Set up the connection between the PIC32 WBZ451 Curiosity Board and PC. For more details, refer to Getting Started with MCHPRT3.
2. In the **RF BT** tab, perform the following steps:
   a. From the “RF mode” drop-down list, select *RX Mode*.
   b. From the “Channel” drop-down list, select *2402 MHz* for channel 37.
3. Click **START** to receive the Bluetooth Low Energy packet. The number of received packets is shown in the drop-down list, “RX Packet”.

Figure 4-8. MCHPRT3 PIC32CX-BZ2 GUI for Bluetooth RF RX Mode Demonstration

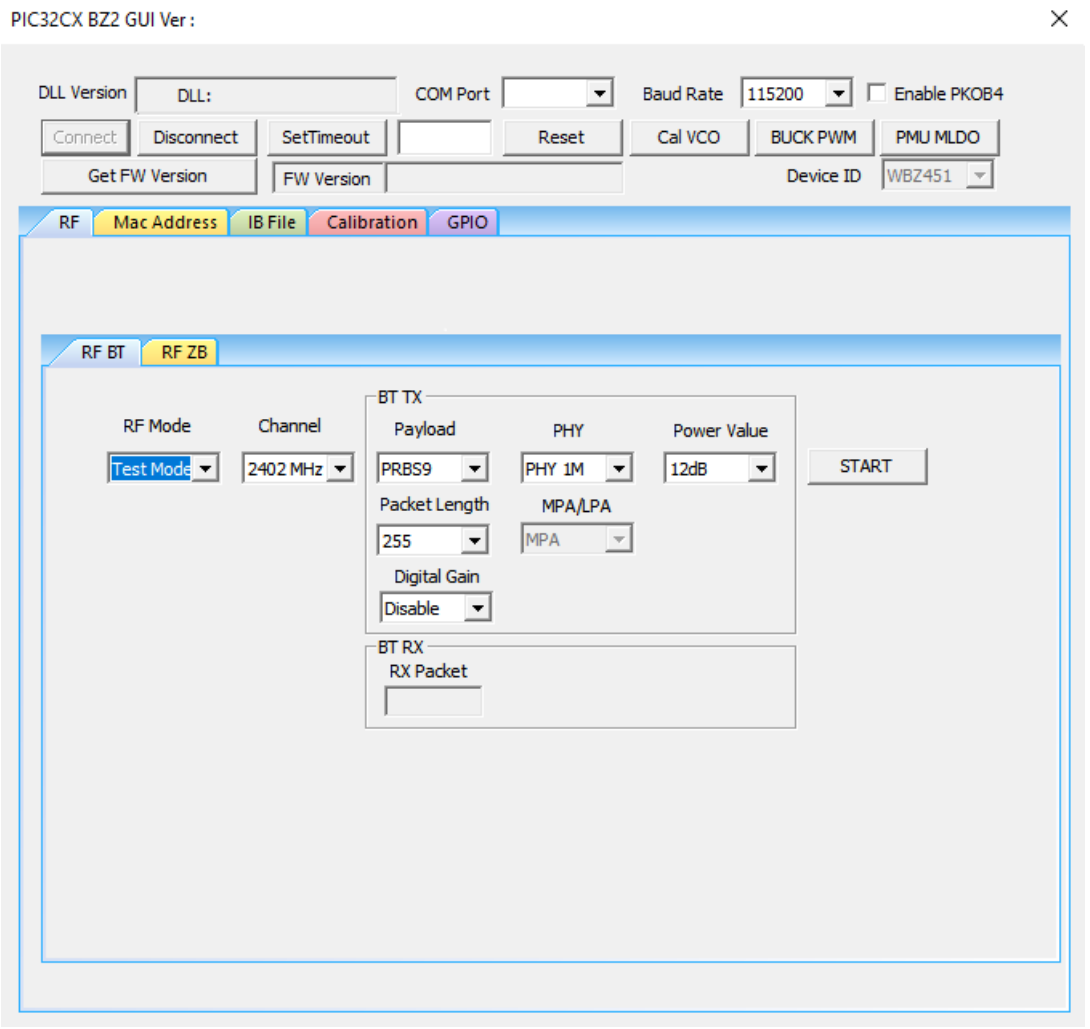


Perform the following steps for the demonstration of the Bluetooth Low Energy Test mode:

1. For the Bluetooth Low Energy Test mode, the sample must contain the following connection:
   - HCI_TXD (PA5 from the module)
   - HCI_RXD (PA6 from the module)
   - VDD (connect with external power supply)
   - Ground

2. Use the USB-to-UART serial converter to make the connection between the sample and PC by connecting the HCI_TXD, HCI_RXD and ground with the converter.
3. Power the sample with 3.3V supply.
4. Select the respective **COM PORT** (the COM port with the converter) in MCHPRT3.
5. In the **RF BT** tab, perform the following steps:
   a. From the “RF mode” drop-down list, select *Test Mode*.
6. Click **START** to enter the Bluetooth test mode, and click **Disconnect** in the GUI. Disconnect the UART interface from the DUT while keeping the power supply, and connect it with the Bluetooth tester.

Figure 4-9. MCHPRT3 PIC32CX-BZ2 GUI for Bluetooth Test Mode Connecting with Bluetooth Tester Demonstration



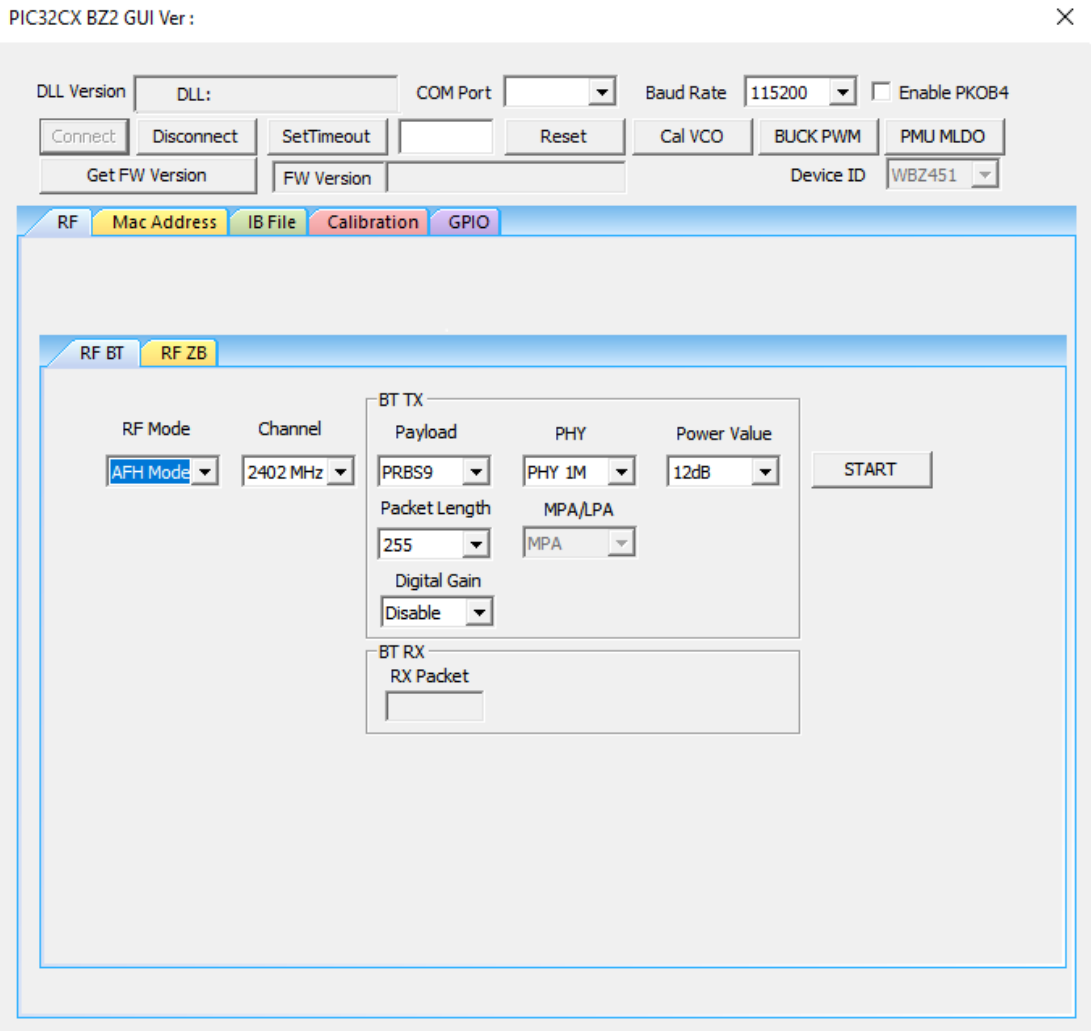
Perform the following steps for the demonstration of the Bluetooth Low Energy Adaptivity Frequency Hopping (AFH) packet transmission:

3. Set up the connection between the PIC32 WBZ451 Curiosity Board and PC. For more details, refer to Getting Started with MCHPRT3.
4. In the **RF BT** tab, perform the following steps:
   a. From the “RF mode” drop-down list, select *AFH Mode*.

b. From the “Payload” drop-down list, select *PRBS9* (default value).
c. From the “PHY” drop-down list, select the *Data Rate* (1M, 2M, S = 2 and S = 8), for example, select *PHY 1M*.
d. From the “RF mode” drop-down list, select the *Output Power*, for example, select *12 dB*.
e. From the “Packet Length” drop-down list, select the *Packet Length (0-255)*, for example, *255* (default value).
f. To enable the selection of *MPA/LPA*, *Disable on Power* must be selected. *Power* is recommended to use for setting the output power level. *MPA/LPA* is disabled by default.
g. From the “MPA/LPA” drop-down list, select *MPA or LPA*, for example, select *MPA*.
h. From the “Digital Gain” drop-down list, select *Disable* (default value).

3. Click **START** to transmit the Bluetooth Low Energy packet with adaptivity frequency hopping.

Figure 4-10. MCHPRT3 PIC32CX-BZ2 GUI for Bluetooth Adaptivity Frequency Hopping (AFH) TX Test Demonstration



4.3.2. Zigbee RF Test Demonstration

In this demonstration, the user can transmit Zigbee packets, enter RX mode and CW mode with the PIC32CX-BZ2 by using the MCHPRT3.

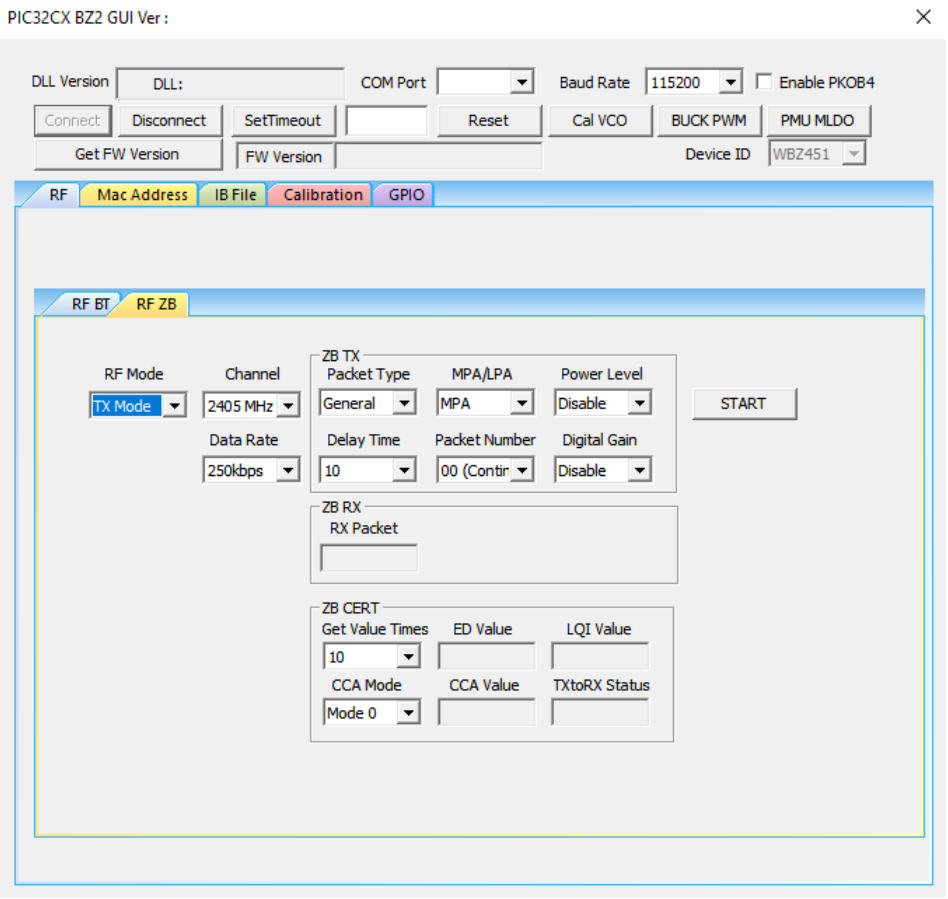
Perform the following steps for the demonstration of Zigbee packet transmission:

1. Set up the connection between the PIC32 WBZ451 Curiosity Board and PC. For more details, refer to Getting Started with MCHPRT3.
2. In the **RF ZB** tab, perform the following steps:
   a. From the “RF Modes” drop-down list, select *TX Mode*.
   b. From the “Channel” drop-down list, select *2405 MHz* for channel 11.
   c. From the “Packet Type” drop-down list, select *Packet Type* as *General* (default value) or *Smallest*.
   d. From the “MPA/LPA” drop-down list, select *MPA or LPA*, for example, select *MPA*.
   e. From the “Power Level” drop-down list, select *Disable* (the maximum power level is the default value).
   f. From the “Delay Time” drop-down list, select the *Packet Delay Time (00-250)* (the default value is *10*).
   g. From the “Packet Number” drop-down list, select the *Number of Transmitting Packet (00-250)* (the default value is *00, Continuous Packet Transmission*).
   h. From the “Digital Gain” drop-down list, select *Disable* (default value).

3. Click **START** to transmit the Zigbee packet.

Note: The "Data Rate" is fixed at 250 Kbps, and the "Delay Time" is 10.

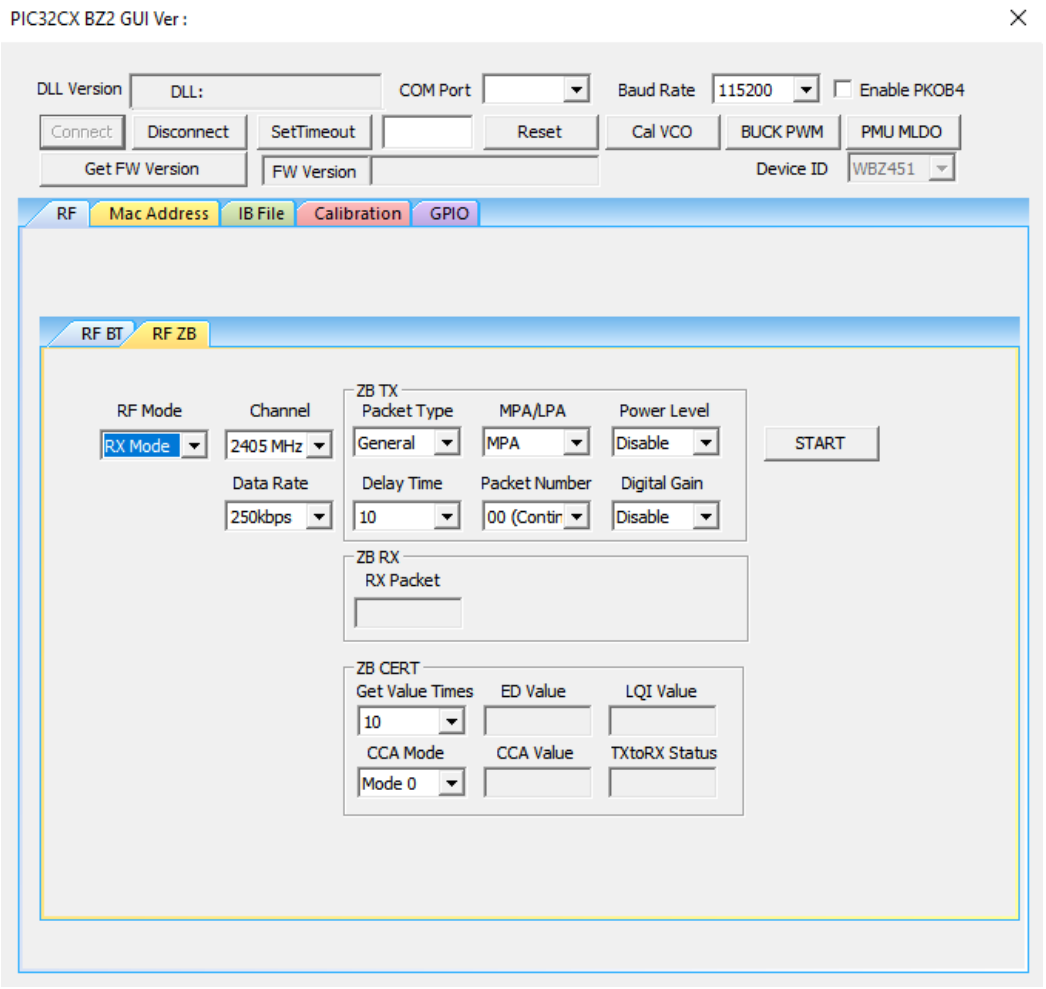
Figure 4-11. MCHPRT3 PIC32CX-BZ2 GUI for Zigbee RF TX Modulation Test Demonstration



Perform the following steps for the demonstration of the Zigbee RX mode:

1. Set up the connection between the PIC32 WBZ451 Curiosity Board and PC. For more details, refer to Getting Started with MCHPRT3.
2. In the **RF ZB** tab, perform the following steps:
   a. From the “RF Modes” drop-down list, select *RX Mode*.
   b. From the “Channel” drop-down list, select *2405 MHz* for channel 11.
   c. From the “RX Data Rate” drop-down list, select *Data Rate* (250K, 500K, 1M and 2M), for example, select *250K*.
3. Click **START** to receive the Zigbee packet. The total number of received packets are available under the “RX Packet” drop-down list.

Figure 4-12. MCHPRT3 PIC32CX-BZ2 GUI for Zigbee RF RX Mode Demonstration



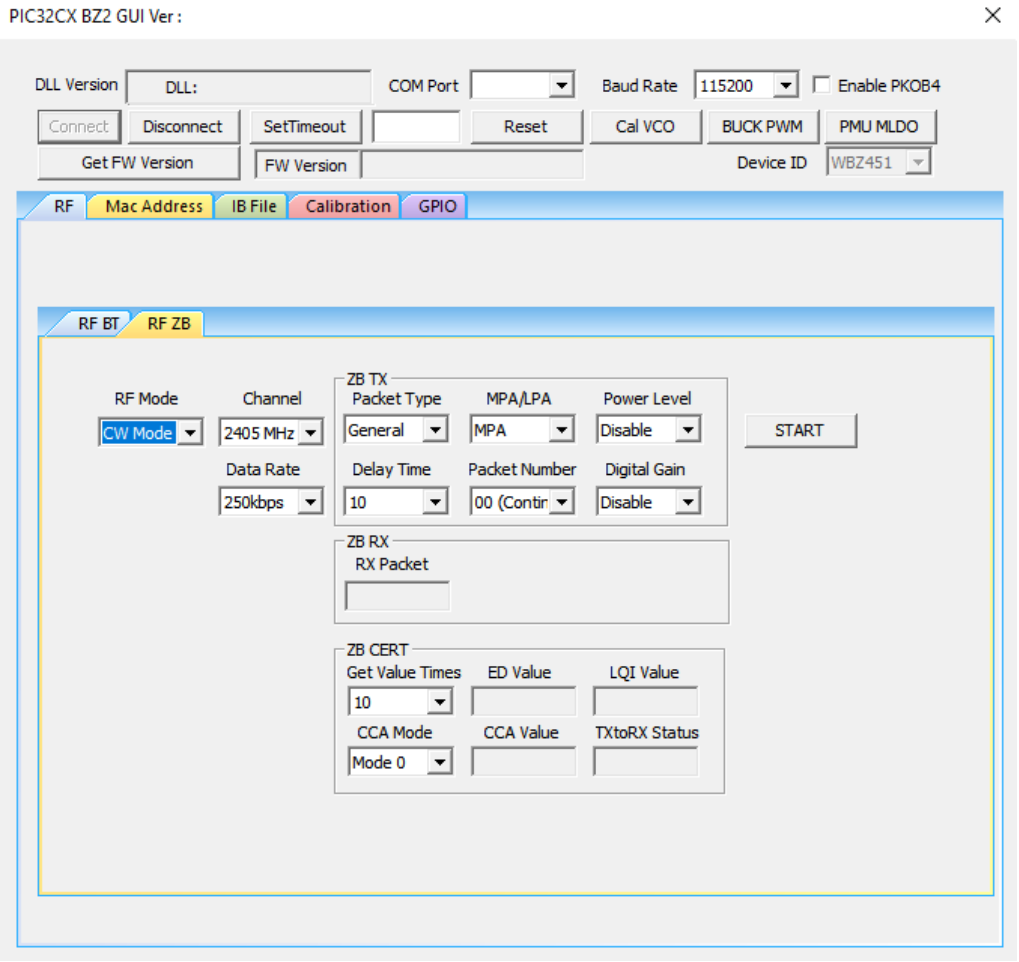
Perform the following steps for the demonstration of the Zigbee CW mode to transmit CW tone:

1. Set up the connection between the PIC32 WBZ451 Curiosity Board and PC. For more details, refer to Getting Started with MCHPRT3.
2. In the **RF ZB** tab, perform the following steps:
   a. From the “RF mode” drop-down list, select *CW Mode*.
   b. From the “Channel” drop-down list, select *2405 MHz* for channel 11.
   c. From the “MPA/LPA” drop-down list, select *MPA or LPA*, for example, select *MPA*.

d. From the “Power Level” drop-down list, select *Disable* (the maximum power level is the default value).

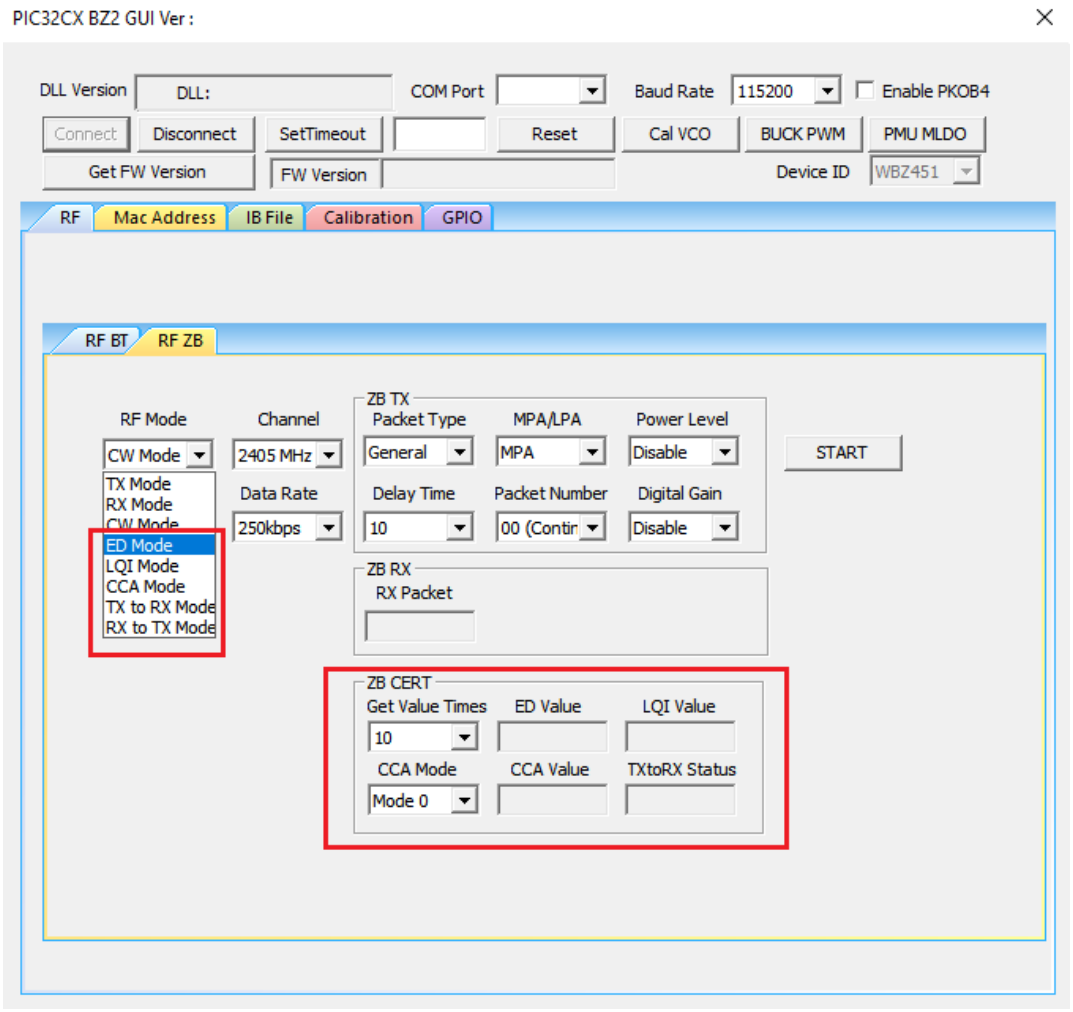
3. Click **START** to transmit the CW tone.

Figure 4-13. MCHPRT3 PIC32CX-BZ2 GUI for Zigbee CW Mode Demonstration



ED Mode, LQI Mode, CCA Mode, TX to RX mode and RX to TX mode as well as the area of ZB CERT are used in Zigbee PHY certification.

Figure 4-14. MCHPRT3 PIC32CX-BZ2 GUI for Zigbee PHY Test



4.3.3. Calibration Flow Demonstration

In this demonstration, the user can calibrate TX parameters and RX parameters of the PIC32CX-BZ2 using a PC with the installed MCHPRT3 tool.

Perform the following steps for the demonstration of the calibration flow (see the following figure):

1. Set up the connection between the PIC32 WBZ451 Curiosity Board and PC. For more details, refer to Getting Started with MCHPRT3.
2. Connect the U.FL connecter on the PIC32CX-BZ2 to Bluetooth/Zigbee tester (IQxel or others) to measure the RF power from the PIC32CX-BZ2.
3. Check the cable loss between the PIC32CX-BZ2 U.FL connecter to the Bluetooth/Zigbee tester.
4. MLDO is the preferred mode of calibration. Click **PMU MLDO** to use the MLDO mode to perform calibration.
5. Enter **Cable loss**, and select *Save IB type* (Flash/OTP) and *DUT Mode* (MPA+LPA/LPA only).

> **CAUTION** OTP is limited in memory of 4k, and it can only be calibrated for 10 to 15 times.

6. Click **Start Cal.** to start the new calibration.
7. Click **Freq. Start** in Cal. step 1. Freq., the DUT transmits the Bluetooth Low Energy packet at 2440 MHz.
8. Check the carrier frequency at the tester and click **Freq. decrease** or **Freq. increase** to change the carrier frequency.
9. Once the carrier frequency is close to 2440 MHz, click **Freq. Done.**
10. Click **MPA Start** in Cal. step 2. RF Power; read the power level in the tester, then enter it in the tool.
11. Click **MPA Power Tune** in Cal. step 2. RF Power; repeat steps 10 and 11 until the power level reaches the target power, 8 dBm ±0.5 dB.
12. Click **LPA Start** in Cal. step 2. RF Power; read the power level in the tester, then enter it in the tool.
13. Click **LPA Power Tune** in Cal. step 2. RF Power; repeat steps 12 and 13 until the power level reaches the target power, 4 dBm ±0.5 dB.
14. If it is **LPA only** in the **DUT Mode**, the LPA target power would be 5.5 dBm ±0.5 dB.
15. Click **LOFT/TXIQ/FLT Calibration** in Cal. step 3. LOFT/TXIQ/FLT, then wait for **done**.
16. Click **Save Cal. Data** in Cal. step 4. Save data to save the calibration data into the file and the DUT.

Figure 4-15. MCHPRT3 PIC32CX-BZ2 GUI for Calibration Flow Demonstration

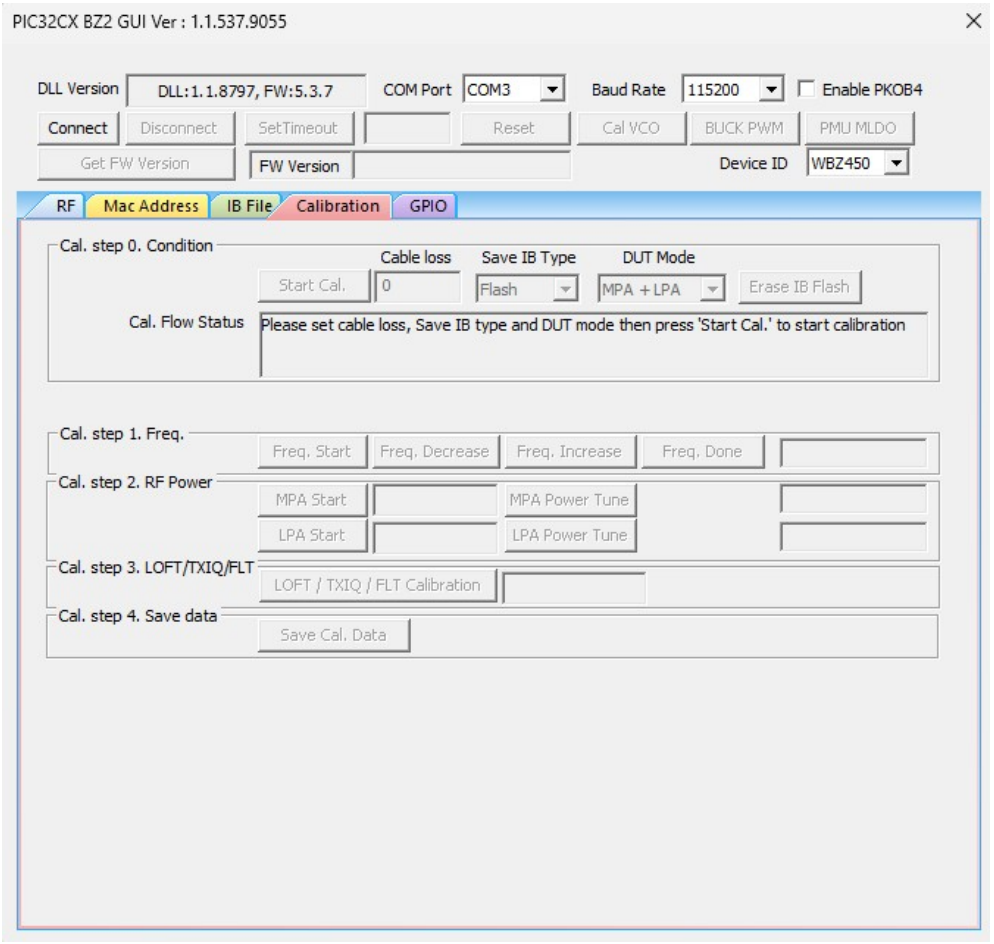
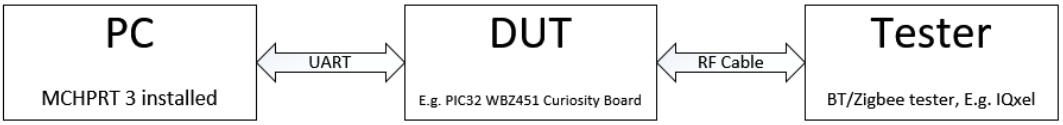
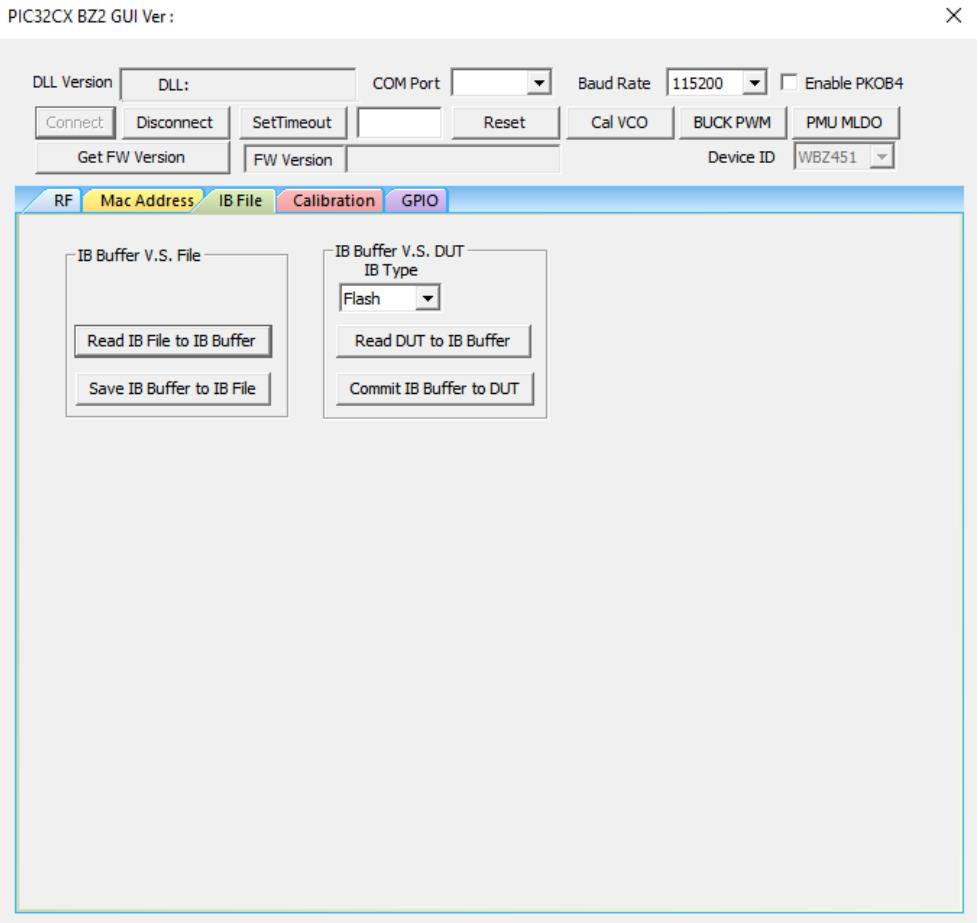


Figure 4-16. Calibration Setup



4.3.4. Operation on Information Block (IB) File

Figure 4-17. MCHPRT3 PIC32CX-BZ2 GUI for Information Block (IB) File Operation



The user can perform the following in the **IB File** tab:

- Read the IB(1) File to IB Buffer(2).
- Save IB Buffer into the IB File.
- From the “IB Type” drop-down list, select *Flash* (default value).
- Read the IB from DUT into the IB Buffer.
- Commit the IB Buffer into DUT – the IB is stored in the Flash.

Note:

1. Use the Information Block (IB) to store various types of calibration and system configuration information.
2. The IB Buffer is a temporary PC location for the Information Block (IB).

4.3.5. MAC Address Programming

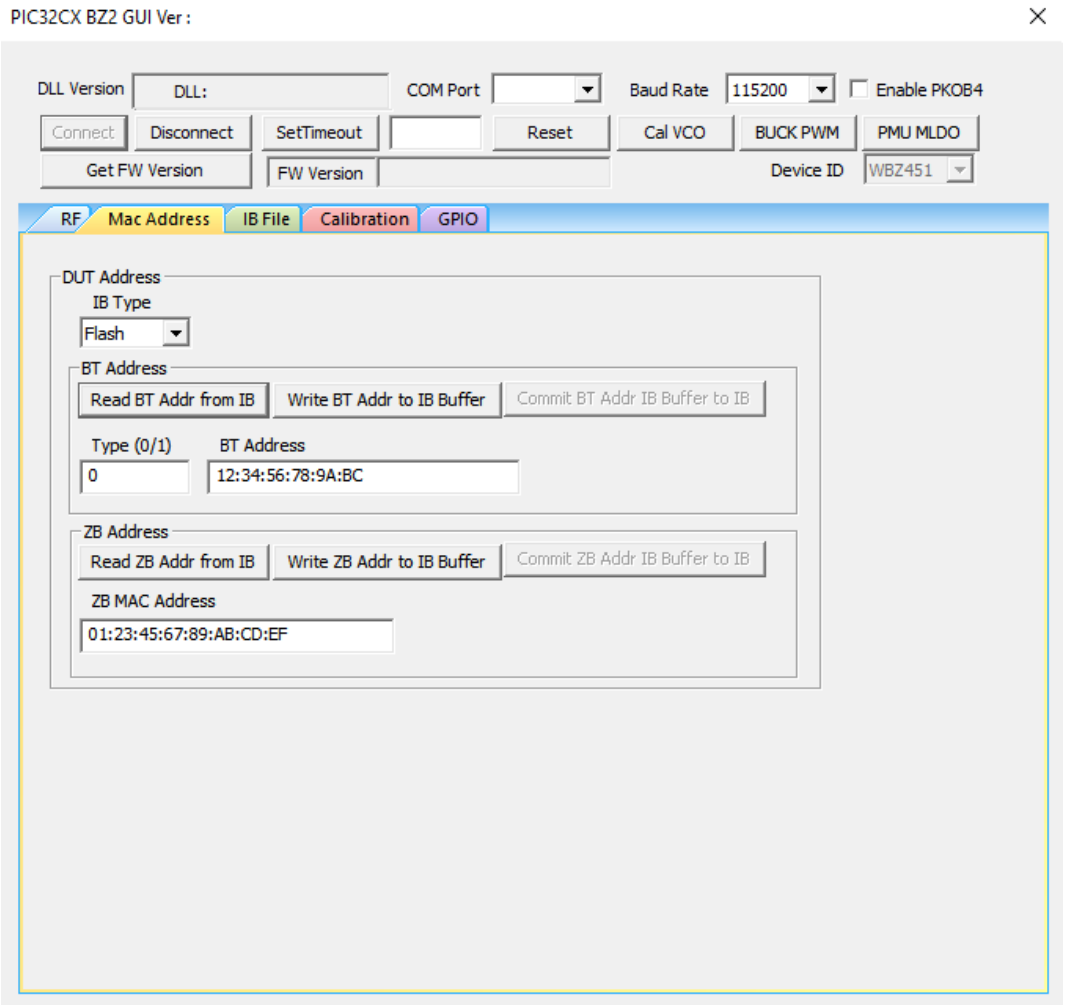
In this demonstration, the user can set the Bluetooth Address and Zigbee MAC Address of the PIC32CX-BZ2 using a PC with the MCHPRT3 tool installed.

In the **MAC Address** tab, perform the following steps for MAC Address programming:

1. From the “IB Type” drop-down list, select *Flash* (default value).

2. To read the Bluetooth address from the IB, click **Read BT Addr** from **IB**.
3. To write the Bluetooth address:
   a. Click **Write BT Addr to IB Buffer**.
   b. Click **Commit BT Addr IB Buffer to IB**.
4. To read Zigbee MAC address from IB, click **Read ZB Addr from IB**.
5. To write Zigbee MC address:
   a. Click **Write ZB Addr to IB Buffer**.
   b. Click **Commit ZB Addr IB Buffer to IB**.

Figure 4-18. MCHPRT3 PIC32CX-BZ2 GUI for MAC Address Programming



4.3.6. GPIO Demonstration

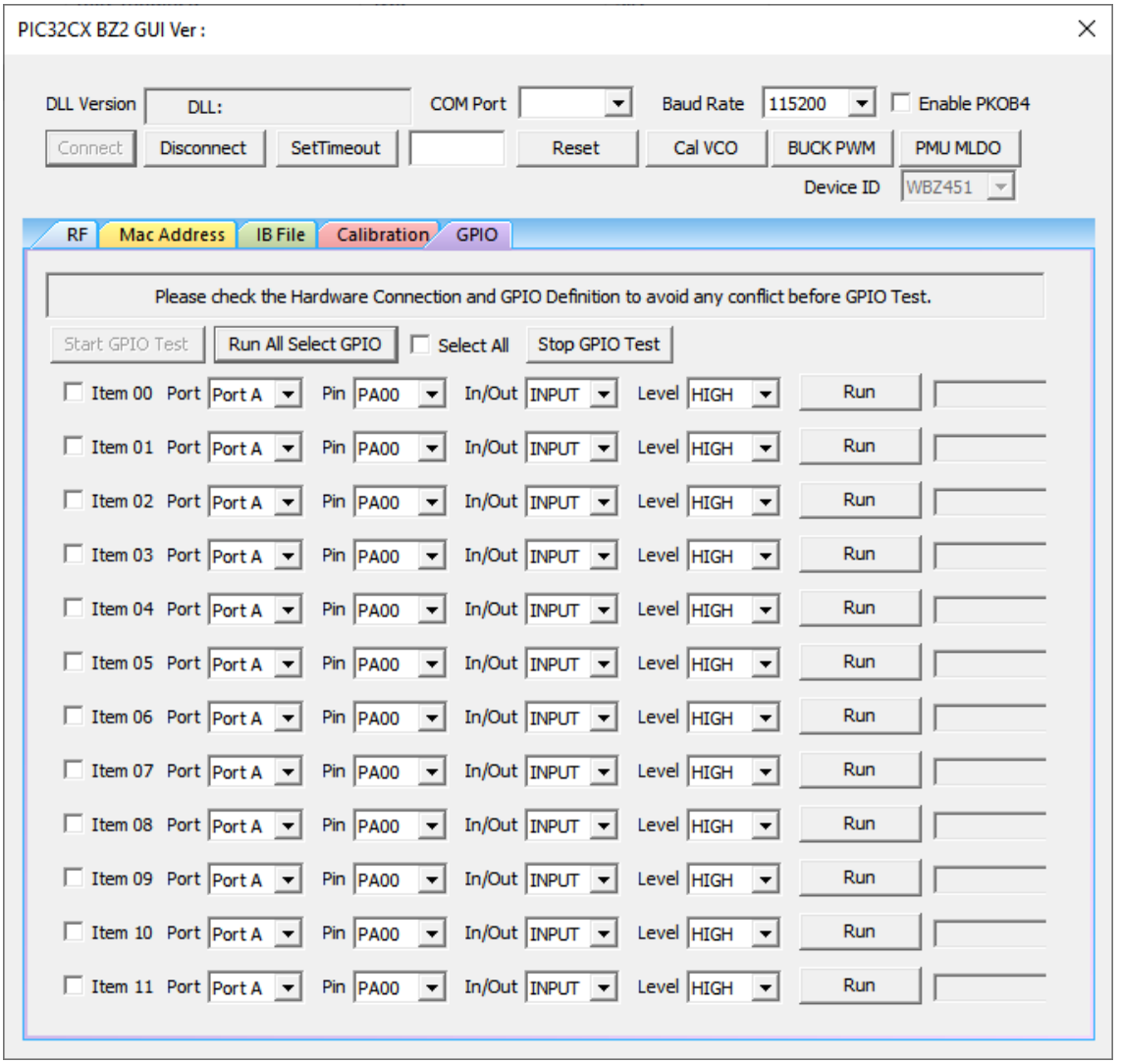
In this demonstration, the user can configure or test the GPIO of the PIC32CX-BZ2 using a PC with the installed MCHPRT3 tool.

In the **GPIO** tab, perform the following steps for GPIO Demonstration (see the following figure):

1. Click **Start GPIO Test** to initiate the GPIO settings for configuration or test.
2. Select *Port, Pin, In/Out* and *Level* to configure or test the GPIO pins.

3. Click **Run** to apply the GPIO configuration.
4. Repeat step 2 and 3 to perform a new GPIO configuration or test.
5. Click **Stop GPIO Test** to stop the GPIO settings for configuration or test.
6. Check the checkbox on each item to perform multiple GPIO configurations. Click **Run All Select GPIO** to apply all the selected GPIO configuration.

Figure 4-19. MCHPRT3 PIC32CX-BZ2 GUI GPIO Demonstration



5. Document Revision History

Revision	Date	Section	Description
B	06/2026	Calibration Flow Demonstration	• Updated the content based on the latest UI changes. • Updated Figure 4-15.
A	08/2022	Document	Initial revision

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