Testing PIC32MZ2051W1 SoC with MCHPRT3 Tool

PIC32MZ2051W1

Introduction

This user guide provides complete information about using the Microchip Radio Test 3 tool (MCHPRT3 tool) with the Microchip PIC32MZ2051W1 based Wi-Fi® design. The MCHPRT3 tool enables the user to evaluate and demonstrate the Radio Frequency (RF) performance and functionalities of the PIC32MZ2051W1 SoC-based Wi-Fi design.

Note: In this user guide, the MCHPRT3 tool with the PIC32 WFI32 2.0 Curiosity Board is only shown as an example.

Table of Contents

1. Quick References

1.1 Reference Documentation

For further details, refer to the following:

- *PIC32MZ-W1 Regulatory Certification and Gain Table Application Note* (DS00004235)
  Note: This document is released as part of the PIC32MZ2051W104132 Reference Design Package. Refer to the PIC32MZ2051W104132 product package to download it.
- *PIC32 WFI32E Curiosity Board User's Guide* (DS50003028)
- *PIC32MZ W1 MCU and WFI32 Module with Wi-Fi® and Hardware-Based Security Accelerator Data Sheet* (DS70005425)

1.2 Hardware Requirements

- PIC32 WFI32 2.0 Curiosity Board (EV12F11A)
- MCP2200 Breakout Module (ADM00393)
- USB-A to micro-USB cable

1.3 Software Requirements

- Windows 10
- Microchip Radio Test 3 tool installer package (MCHPRT3)

1.4 Test Equiptment

- Wi-Fi Tester (Litepoint IQxel)

1.5 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
GUI	Graphical User Interface
GND	Ground
HUT	Hardware Under Test
ICSP™	In-Circuit Serial Programming™
MCHPRT3 tool	Microchip Radio Test 3 tool
OTP	One-Time-Programmable
RSSI	Received Signal Strength Indicator

2. MCHPRT3 Tool Overview

This section provides an overview of the MCHPRT3 tool setup and its components. Install the MCHPRT3 tool. By default, the MCHPRT3 tool installs the PIC32MZ2051W1 package in the `C:\Microchip\` folder.

Note: Microchip recommends the Windows 10 operating system for the use of the MCHPRT3 tool.

The following table lists 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
`uninstall.exe` file	Uninstalls the MCHPRT3 tool
`vc_redist.x86.exe` file	Microsoft Visual C++ Redistributable (x86) executable file

The following table lists the PIC32MZ2051W1 package files:

Table 2-2. PIC32MZ2051W1 Package Files

File Name		Description
examples>python3 folder	*dll_wrapper* folder	Contains conversion files between python3 and the PIC32MZ2051W1 `.dll` files
	docs folder	Contains python3 example complied HTML help file
	gui_wrapper folder	Contains individual python3 Graphical User Interface (GUI) files
	`engine.py` file	Python3 example programming manager file
	`PIC32MZ2051W1_GUI.py` file	Python3 example file for the PIC32MZ2051W1 GUI
	`version.py` file	Version information
HEX file (`.hex` file)		Hardware Under Test (HUT) firmware file
`PIC32MZ2051W1.chm`		PIC32MZ2051W1 complied HTML help file
`PIC32MZ2051W1.dll` file		PIC32MZ2051W1 dynamic link library file
`PIC32MZ2051W1_CDECL.dll` file		Default calling convention file for C and C++ programs
`PIC32MZ2051W1_CLI.dll` file		PIC32MZ2051W1 CLI dynamic link library file
`PIC32MZ2051W1_GUI.dll` file		PIC32MZ2051W1 GUI dynamic link library file
`release_note.txt` file		Release History

Note: The MCHPRT3 tool works efficiently only with the HUT firmware version packaged with the PIC32MZ2051W1, which is included in the MCHPRT3 tool package.

3. Testing and Calibration of PIC32MZ2051W1 with Wi-Fi Tester using MCHPRT3 Tool

This chapter provides details about using the MCHPRT3 tool to test or calibrate the PIC32MZ2051W1 with the Wi-Fi Tester. This chapter also demonstrates the process of updating the parameters using the MCHPRT3 tool. For more details, refer to the *PIC32MZ-W1 Regulatory Certification and Gain Table Application Note* (DS00004235).

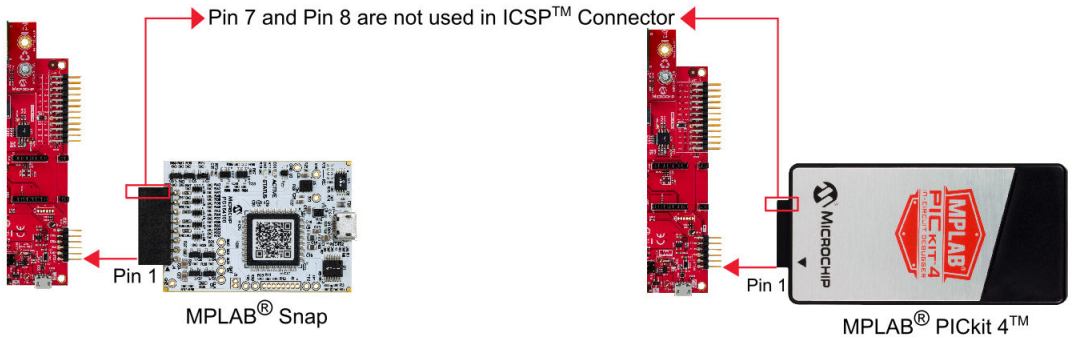
3.1 MPLAB® X IPE HUT Code Programming Process with In-Circuit Serial Programming™ Header

In this demonstration, the user must program the PIC32MZ2051W1 with the HUT firmware using a PC with the MPLAB X IPE.

Note: The user must perform the HUT firmware programming before proceeding with the rest of the operation with the MCHPRT3 tool.

The In-Circuit Serial Programming (ICSP) header (J206) is a standard six-pin staggered header. The J206 allows in-circuit emulation, debugging using Microchip's in-circuit emulator tools and, also, allows direct programming of the WFI32E03 module. The ICSP header supports external debuggers, such as the MPLAB PICkit™ 4 and MPLAB Snap. Use the standard ICSP header to connect an MPLAB programmer or debugger to the PIC32 WFI32 2.0 Curiosity Board. The following figure illustrates the connection between the ICSP header, external debuggers and the PIC32 WFI32 2.0 Curiosity Board.

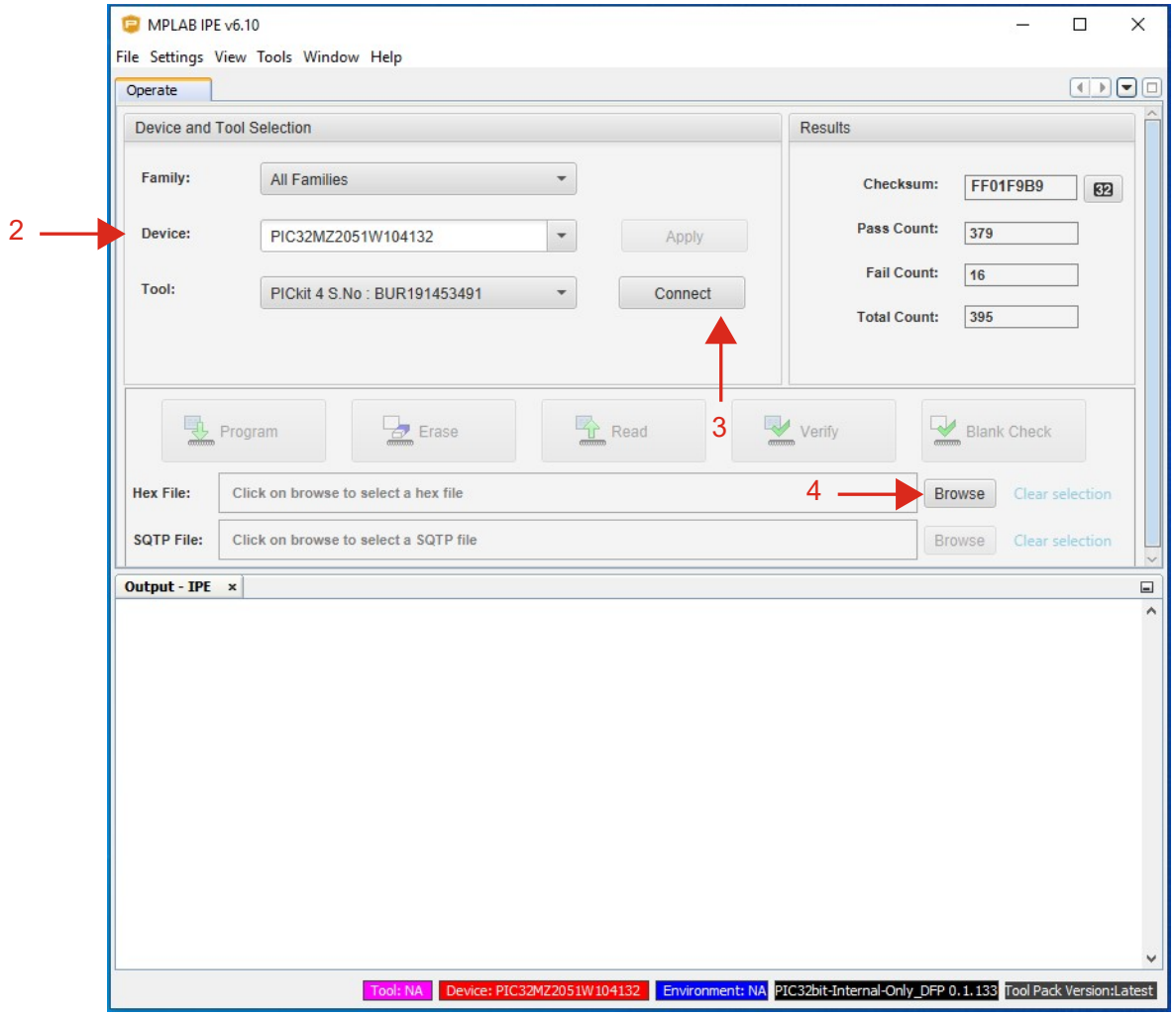
Figure 3-1. Connection Diagram of ICSP Connection for HUT Code Programming



The following figure illustrates the start-up window of the MPLAB X IPE tool. Perform the following steps to set up the HUT firmware programming:

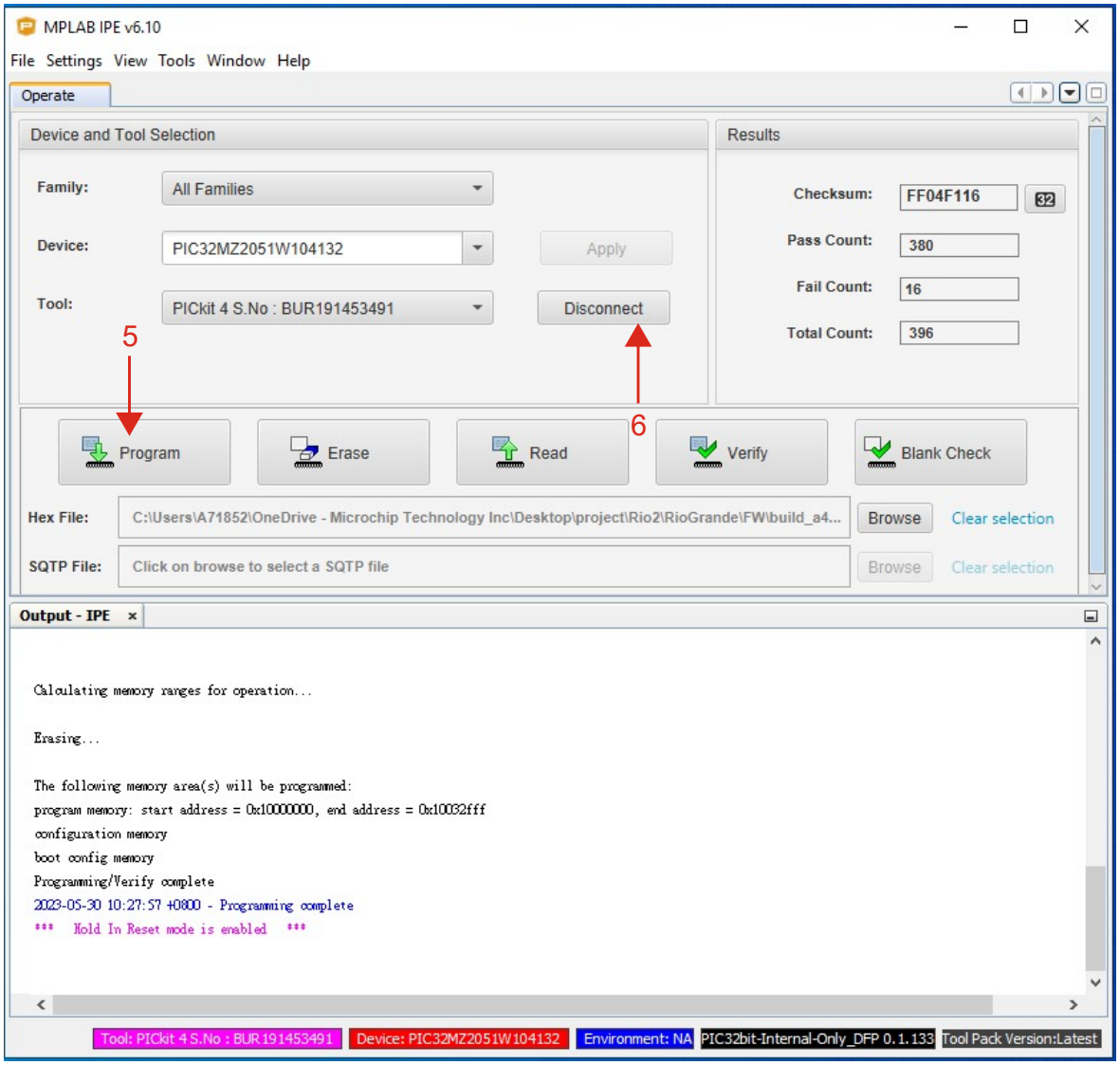
1. Set up the connection between the PIC32 WFI32 2.0 Curiosity Board and PC. For more details, refer to 3.2. Getting Started with MCHPRT3 Tool GUI for PIC32MZ2051W1.
2. Start the MPLAB X IPE tool, and select *PIC32MZ2051W104132* from the "Device" field.
3. Click **Connect** to connect the PIC32 WFI32 2.0 Curiosity Board to the MPLAB X IPE tool for the HUT firmware programming. If the device name is not available, check the USB connection (step 1).
4. Click **Browse** to load the HUT firmware HEX file (see Table 2-2).

Figure 3-2. Start-Up Window of the MPLAB X IPE Tool



5. Click **Program**.
6. After the completion of the HUT firmware programming, click **Disconnect** to disconnect the PIC32 WFI32 2.0 Curiosity Board and MPLAB X IPE tool (see the following figure).

Figure 3-3. MPLAB X IPE – Programming Complete

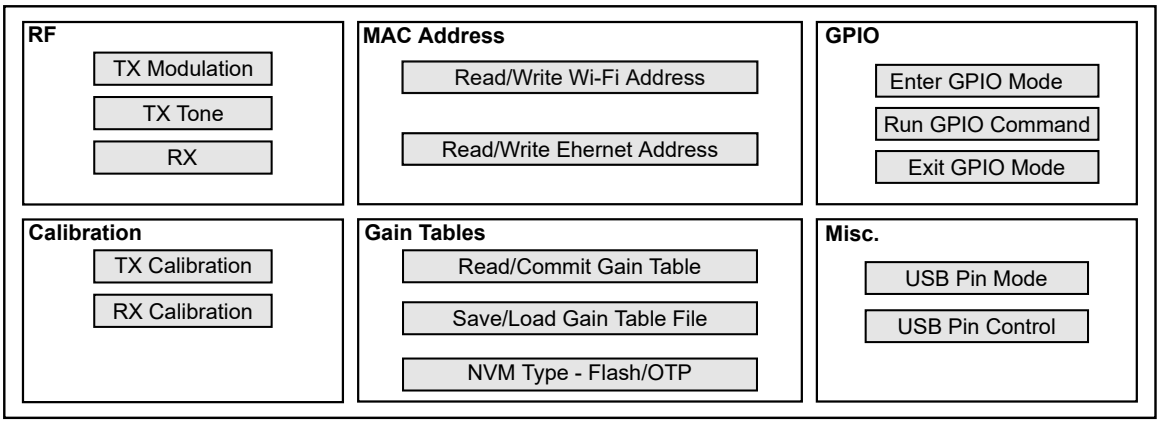


Disconnect the external debuggers (MPLAB PICkit 4 or MPLAB Snap) and Reset PIC32 WFI32 2.0 Curiosity Board for the RF test using the MCHPRT3 tool.

3.2 Getting Started with MCHPRT3 Tool GUI for PIC32MZ2051W1

The following block diagram illustrates the basic structure of the MCHPRT3 tool.

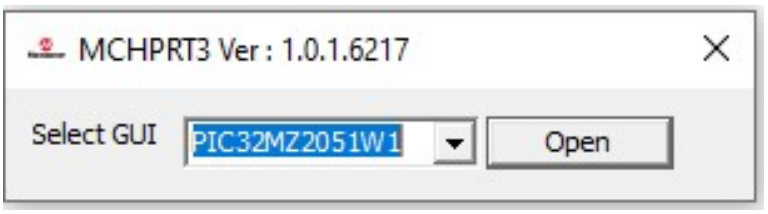
Figure 3-4. MCHPRT3 Tool Block Diagram



The following are the steps to launch the MCHPRT3 tool:

1. Double click the `MCHPRT3.exe` file to launch the MCHPRT3 tool.
2. From the "Select GUI" drop-down list, select **PIC32MZ2051W1**.
3. Click **Open** to launch the PIC32MZ2051W1 window (see the following figure).

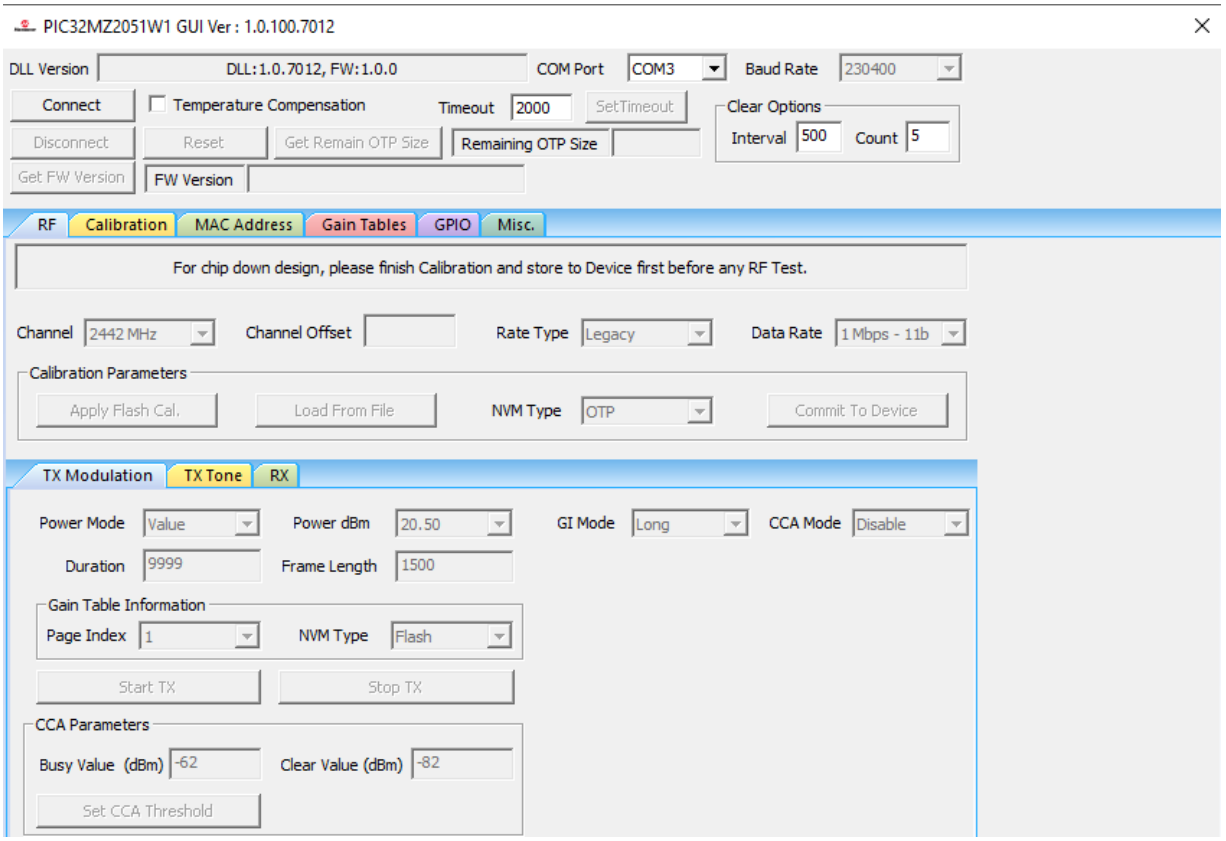
Figure 3-5. Start-Up Window of the MCHPRT3 Tool



4. The PIC32MZ2051W1 window is divided into the following elements (see the following figure):
   - "DLL Version" – Dynamic Link Library (DLL) information and HUT firmware version supported by the MCHPRT3 tool
   - "COM Port" – Lists the available COM ports for the configuration
   - "Baud Rate" – By default, the MCHPRT3 tool configures the supported baud rate of the specific HUT firmware
     Note: User cannot change the baud rate.
   - **Get FW Version** – Current firmware version is read from Device Under Test (DUT)
   - **Get Remaining OTP Size** – Remaining OTP size read from DUT
   - **RF** tab – Provides settings to perform the RF TX Modulation test (see Figure 3-14)
     - **TX Modulation** tab – Provides settings to perform the TX modulation test (see Figure 3-14)
     - **TX Tone** tab – Provides settings to perform the TX tone test (see Figure 3-16)
     - **RX** tab – Provides settings to perform the RX test (see Figure 3-17)
   - **Calibration** tab – Provides settings to perform TX and RX Calibration flow. User can save Calibration Info to a file or commit to NVM Type to Flash or OTP (see Figure 3-19).
     - TX Calibration – Provides settings to perform TX Calibration flow to adjust the transmitted power to the target

    - RX Calibration – Provides settings to perform RX Calibration flow to obtain the Received Signal Strength Indicator (RSSI) to its corresponding received power
- **MAC Address** tab – Read/Write MAC address (see Figure 3-20)
    - Read Wi-Fi address
    - Write Wi-Fi address
    - Read Ethernet address
    - Write Ethernet address
- **Gain Tables** tab – Provides settings of Page Index, NVM Type and RF Version (see Figure 3-23)
    - Read Gain Table – Reads the gain table from selected Page Index and NVM Type
    - Commit Gain Table – Commits the gain table to selected Page Index and NVM Type
    - Apply Gain Table – Apply gain table from selected Page Index and NVM Type so that the transmission uses this for default gain values after the power cycle
    - Save Gain Table To File – Saves the gain table in a file and modifies the file, if necessary
    - Load Gain Table From File – Loads the gain table from a file and commits or applies the gain table, if necessary
- **GPIO** tab – Provides settings to test GPIO for selected Port with a specified Pin, In/Out and Level (see Figure 3-24)
    - Enter GPIO Mode – Initializes the GPIO for test
    - Run GPIO Command – Executes the GPIO test command for a selected Port with a specified Pin, In/Out and Level
    - Exit GPIO Mode – Stops the GPIO test and quit
- **Misc.** tab – Provides settings to test the USB Pin (see Figure 3-25 and Figure 3-26)
    - USB Pin Mode – Provides settings for Mode0 or Mode1
    - USB Pin Control – Executes USB Pin Mode

Figure 3-6. Start-Up Window of the PIC32MZ2051W1 GUI Tool



3.3 Performing RF Test on the PIC32 WFI32 2.0 Curiosity Board with MCHPRT3 Tool

The following are the steps to run the RF test on the PIC32 WFI32 2.0 Curiosity Board:

1. Flash the HUT firmware to the PIC32MZ2051W1. For more details, refer to 3.1. MPLAB X IPE HUT Code Programming Process with In-Circuit Serial Programming Header.
2. Connect the PIC32 WFI32 2.0 Curiosity Board UART to the PC with the MCHPRT3 tool (see the following figure).
3. Perform the following steps to set up a connection between the MCP2200 Breakout module and the PIC32 WFI32 2.0 Curiosity Board (see the following figure):
   a. Connect pin1 to RX.
   b. Connect pin3 to ground (GND).
   c. Connect pin6 to TX.

   Notes:
   - User can choose their own USB-to-UART serial converter.
   - The MCP2200 Breakout module part number is ADM00393.

Figure 3-7. PIC32 WFI32 2.0 Curiosity Board U1TX, U1RX and GND Connection

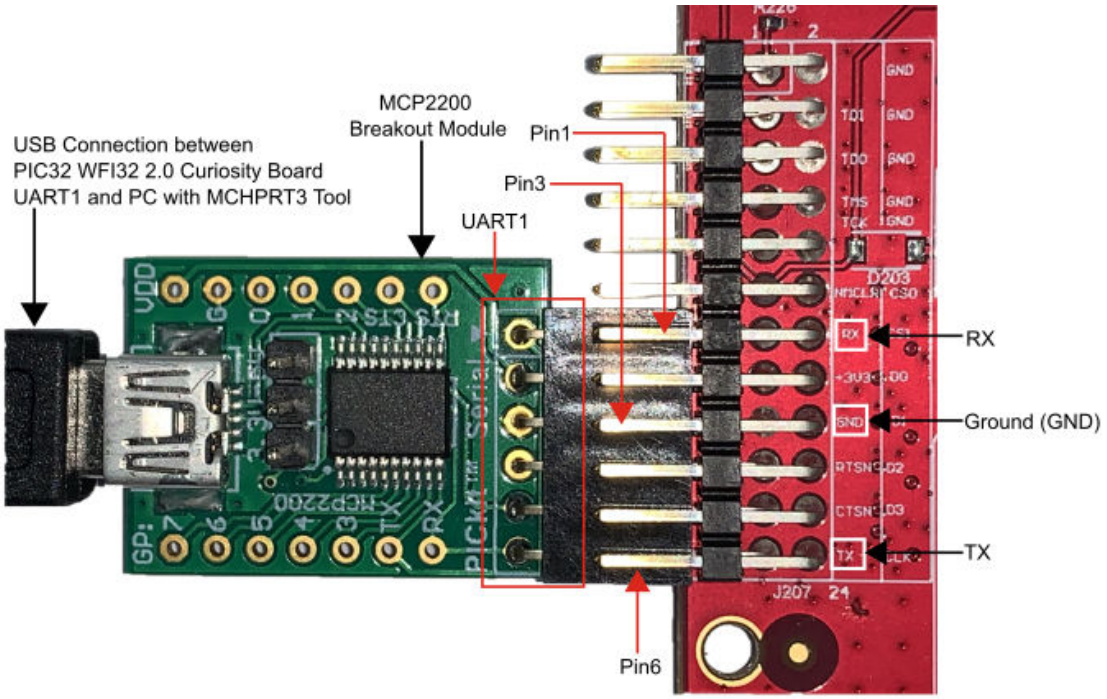
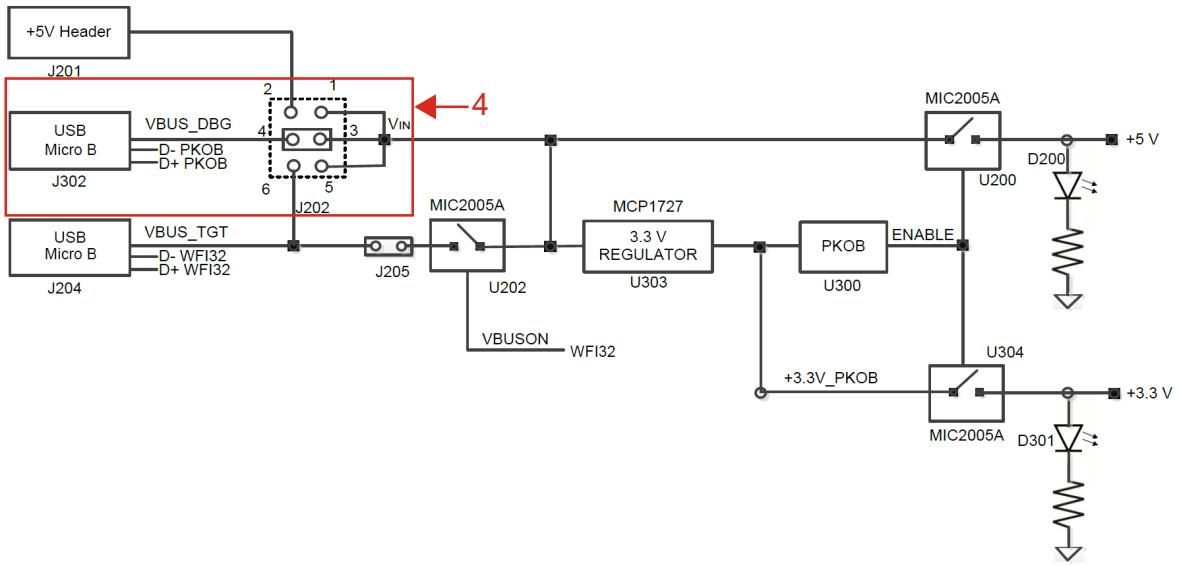


Table 3-1. PIC32 WFI32 2.0 Curiosity Board U1TX, U1RX and GND Connection

MCP2200 Breakout Module J5 Pin Name	MCP2200 Breakout Module J5 Pin Number	PIC32 WFI32 2.0 Curiosity Board J207 Pin Number	PIC32 WFI32 2.0 Curiosity Board J207 Pin Name
TX	1	13	U1RX
VDD	2	15	+3V3
GND	3	17	GND
CTS	4	19	RTS
RTS	5	21	CTS
RX	6	23	U1TX

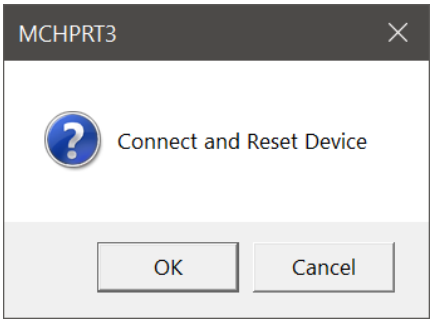
4. Configure J202 at the PKOB position with the jumper, and connect the USB power to J302 USB Micro B DEBUG on the PIC32 WFI32 2.0 Curiosity Board. This enables the WFI32E W1 module to work in the Debug/Test mode (see the following figure). For more details, refer to the *PIC32 WFI32E Curiosity Board User's Guide* (DS50003028).

Figure 3-8. Power Tree Diagram



5. Perform the following steps for the demonstration of the RF test on the PIC32 WFI32 2.0 Curiosity Board with MCHPRT3 tool (see Figure 3-12):
   a. To run the MCHPRT3 tool, double click the `MCHPRT3.exe` file.
   b. From the "Select GUI" drop-down list, select *PIC32MZ2051W1* (see Figure 3-5).
   c. Choose the respective "COM port" from the drop-down list.
      Note: Install the corresponding driver for the respective USB-to-UART serial converter.
   d. Set the "Baud Rate" value to its default value.
   e. Enter the "Timeout" value as *3000* (default value), then click **SetTimeout**.
      Note: This value must be greater than 3000 milliseconds.
   f. In the Clear Options area, enter the "Interval" value as *500* (default value) and "Count" as *5* (default value) for the UART command buffer time and retry.
   g. Check the *Temperature Compensation* field if the test temperature is not at room temperature. By default, the *Temperature Compensation* is disabled.
   h. Click **Connect** to connect the UART of the PIC32MZ2051W1 to the MCHPRT3 tool for the RF test (see the following figure).

Figure 3-9. Connect Device

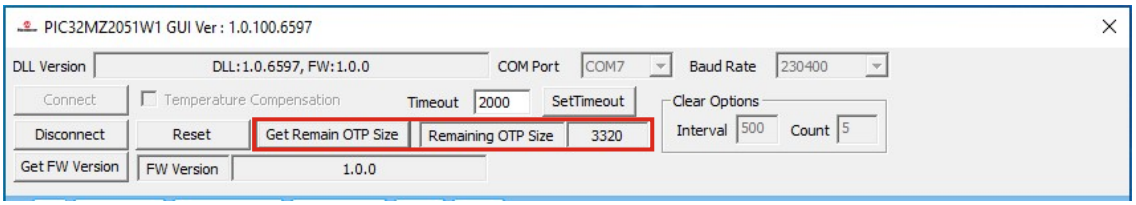


   i. Click **Get FW Version** and click **OK** in the pop-up window to reset the PIC32MZ2051W1 device. The firmware version appears instantly (see the following figure).

Figure 3-10. Reset PIC32MZ2051W1 Device

j. Click **Get Remain OTP Size** to get the remaining OTP size in the device (see the following figure).

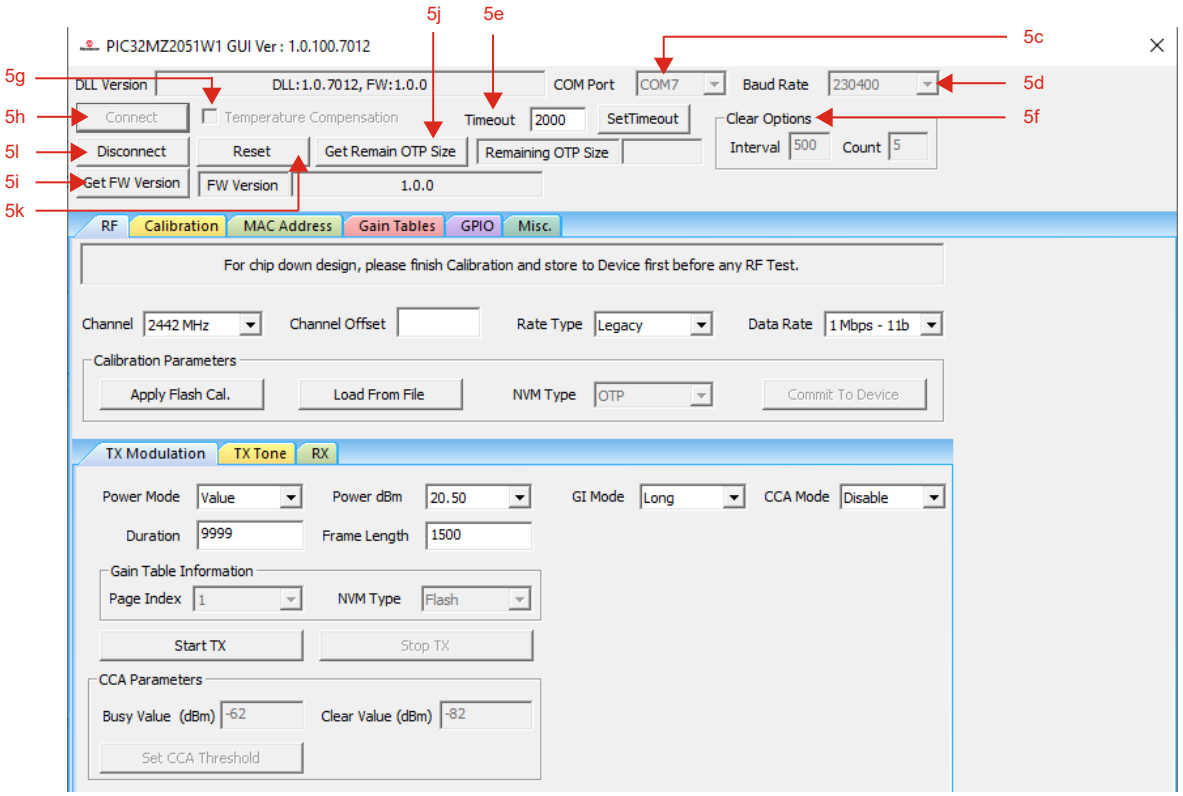
Figure 3-11. Get Remain OTP Size



k. Click **Reset** to reset the device. The PIC32 WFI32 2.0 Curiosity Board is ready for RF Test, Calibration, MAC Address Programming, Gain Tables Editing and GPIO Test.

l. Click **Disconnect** to quit the MCHPRT3 tool.

Figure 3-12. RF Test on PIC32 WFI32 2.0 Curiosity Board with MCHPRT3 Tool



3.4 MCHPRT3 Tool with PIC32MZ2051W1 GUI Demonstration

3.4.1 RF TX Modulation Test Demonstration

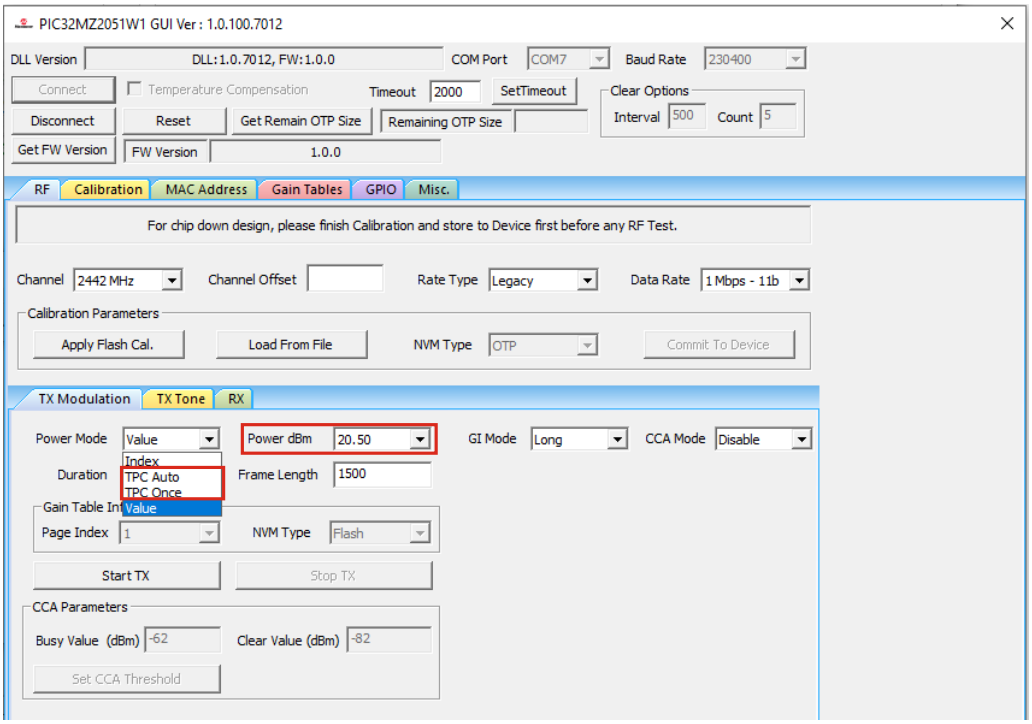
In this demonstration, the user can transmit Wi-Fi standard packets with the PIC32MZ2051W1.

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

1. Set up the connection between the PIC32 WFI32 2.0 Curiosity Board and PC. For more details, refer to 3.2. Getting Started with MCHPRT3 Tool GUI for PIC32MZ2051W1.
2. In the **RF** tab, perform the following steps (see Figure 3-14):
   a. From the “Channel” drop-down list, select *2442 MHz* for channel 7.
   b. By default, the “Channel Offset” value is left blank but the channel offset uses the value from the WFI32E03 module. Enter a value ranging from -20 to 20 in the “Channel Offset” field. For example, enter *1* to add one gain step of 0.25 dB for the testing channel.
   Note: If the “Channel Offset” value is left blank, it means the value can be zero and non-zero depending on the testing channel.
   c. From the “Rate Type” drop-down list, select *Legacy* for 11b and 11g mode or *MCS* for 11n mode.
   d. From the “Data Rate” drop-down list, select *1 Mbps – 11b* for 11b mode and 1 Mbps.
   e. **Click Load From File** – To load the Calibration file (`.cfg` file), select NVM Type, then click **Commit To Device**, if necessary.
   f. If the Calibration file is loaded and committed to Flash, click **Apply Flash Cal.** to apply the Calibration parameters in Flash but not OTP.
3. In the **TX Modulation** tab, perform the following steps (see Figure 3-14):

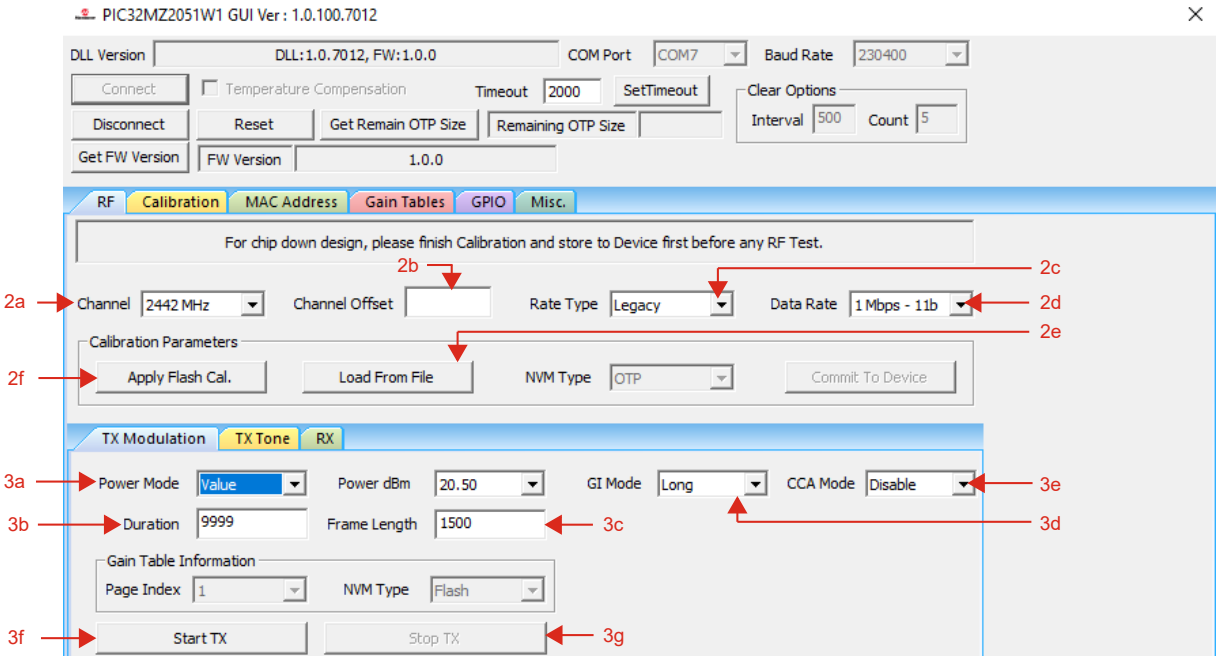
a. On the “Power Mode” drop-down list, there are four options available:
   - *Value* – To configure the TX power manually in dBm scale. TX Power range is 10-25 dBm with 0.25 dB per step. The default value is 20.5 dBm. It is recommended to use this option for validation, which does not require TPC.
   - *Index* – This option is similar to *Value* power mode, but values are configured in the index scale of 0-255.
   - *TPC Once* – This option reads gain values from the gain table from the selected NVM Type, and the TPC (Transmit Power Control) algorithm reads the operating voltage and the temperature and adjusts the TX power level settings once to compensate before the transmission.
     Note: Any further change in the operating voltage/temperature will not be read by the TPC algorithm, so the TX power level will not vary with respect to operating voltage and temperature changes.
   - *TPC Auto* – This option reads gain values from the gain table from the selected NVM Type and applies the TPC algorithm which maintains the stable TX power across temperature and operating voltage. The TPC algorithm will be active throughout the operation, so any changes in the operating voltage/temperature will read and compensate for the TX power level settings.
   - From the “Power Mode” drop-down list, select *TPC Once* or *TPC Auto* to read values from the gain table for the transmission (see Figure 3-23).
     – Read voltage and temperature and changing TX settings.
       - *TPC Once* – One time before transmission
       - *TPC Auto* – Active throughout the operation
     – By default, “NVM Type” is *Flash*, and “Page Index” is *1*.
     – To change Gain Table information, in the **Gain Table** tab, click **Read Gain Table** or **Commit Gain Table** (see Figure 3-23).

Figure 3-13. Power Mode Selection



b. Retain the “Duration” as *9999* (default value).
c. Retain the “Frame Length” as *1500* (default value).
d. From the “GI Mode” drop-down list, select *Long* for long GI and *Short* for short GI.
e. Retain the “CCA Mode” as *Disable* (default value). If the “CCA Mode” is set as Enable, perform the following steps:
   - Enter the “Busy Value (dBm)”. Default value is -62.
   - Enter the “Clear Value (dBm)”. Default value is -82.
   - Click **Set CCA Threshold** to change the CCA threshold value, if required.
f. Click **Start TX** to transmit Wi-Fi packets as configured in step 2 and step 3. Use the Wi-Fi tester to verify the transmitting packets.
g. Click **Stop TX** to stop the transmission.

Figure 3-14. MCHPRT3 PIC32MZ2051W1 GUI for RF TX Modulation Test Demonstration



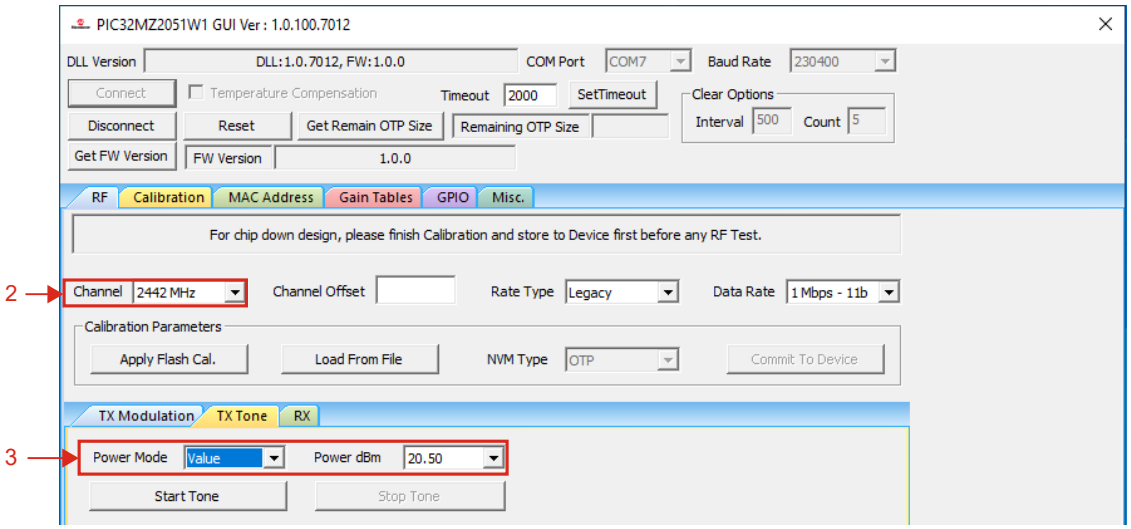
3.4.2 RF TX Tone Test Demonstration

In this demonstration, the user can transmit a single tone on the PIC32MZ2051W1.

Perform the following steps for the demonstration of the transmission:

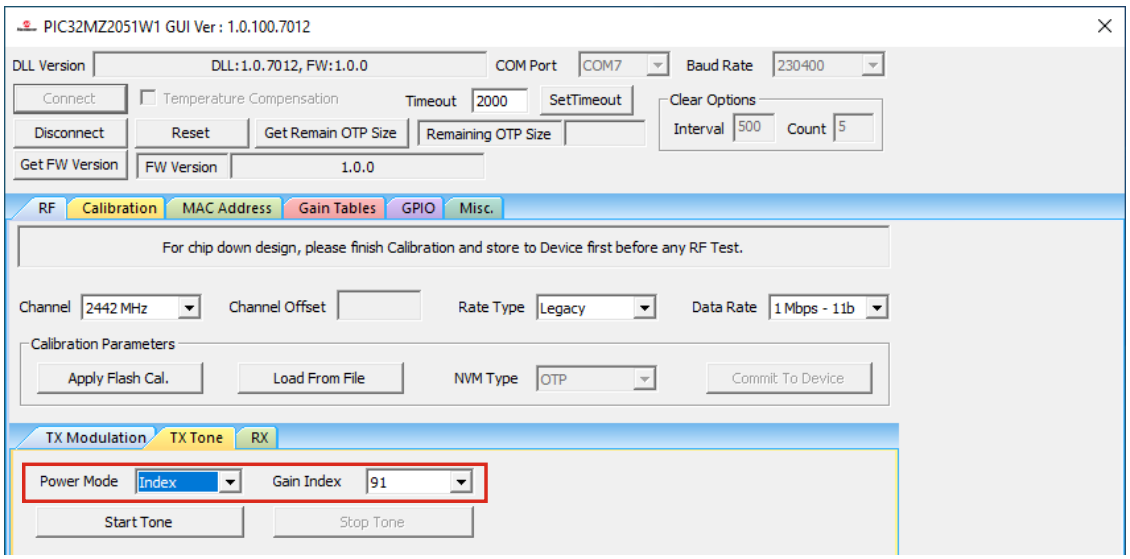
1. Set up the connection between the PIC32 WFI32 2.0 Curiosity Board and PC. For more details, refer to 3.2. Getting Started with MCHPRT3 Tool GUI for PIC32MZ2051W1.
2. In the **RF** tab, from the “Channel” drop-down list, select *2442 MHz* for channel 7 (see the following figure).
3. In the **TX Tone** tab, perform the following steps:
   - From the “Power Mode” drop-down list (see the following figure).
     - Select *Value* for output power in dBm
     - Select *Index* for manual input gain index
   - Enter the “Power dBm” value from 10-25 dBm, each step equals 0.25 dB. 20.5 dBm is the default value.

Figure 3-15. TX Tone Power Mode Value



– Enter the “Gain Index” value from 0-255, 0.25 dB per step (see the following figure).

Figure 3-16. TX Tone Power Mode Gain Index



– Click **Start Tone** to transmit a single tone as configured in step 2 and step 3. Use Spectrum Analyzer to verify the transmitting single tone.
– Click **Stop Tone** to stop the transmission.

3.4.3 RF RX Test Demonstration

In this demonstration, the user can receive Wi-Fi packets on the PIC32MZ2051W1.

Perform the following steps for the receiving demonstration.

1. Set up the connection between the PIC32 WFI32 2.0 Curiosity Board and PC. For more details, refer to 3.2. Getting Started with MCHPRT3 Tool GUI for PIC32MZ2051W1.
2. In the **RF** tab, perform the following steps (see the following figure):
   a. From the “Channel” drop-down list, select *2442 MHz* for channel 7.

b. From the “Rate Type” drop-down list, select *Legacy* for 11b and 11g mode, *MCS* for 11n mode or *ALL – RX Only* for all data rates.

c. From the “Data Rate” drop-down list, select *1 Mbps – 11b* for 11b mode and 1 Mbps.

3. In the **RX** tab, perform the following steps (see the following figure):

a. Click **Start RX** to receive Wi-Fi packets as configured in step 2. Use the IQxel Wi-Fi tester or other tools to send the Wi-Fi packets to the PIC32 WFI32 2.0 Curiosity Board.

b. Click **Stop RX** to stop receiving the Wi-Fi packets.

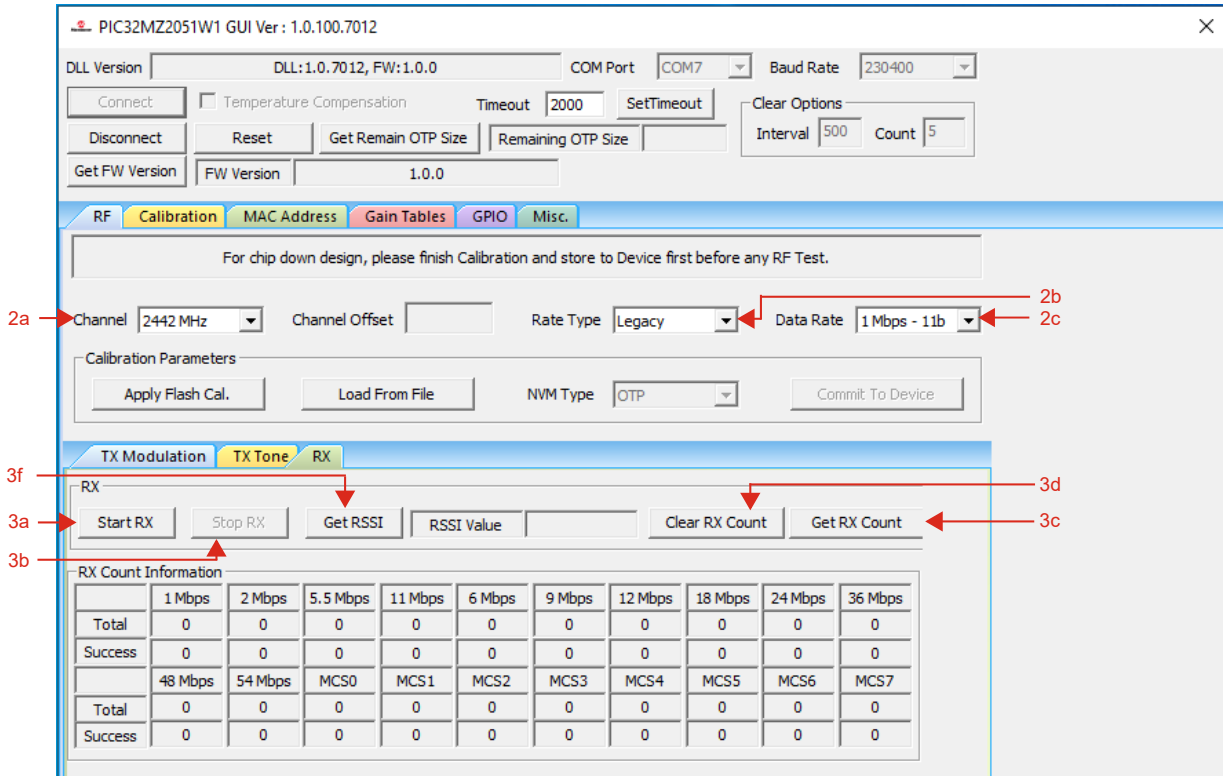
c. Click **Get RX Count**. The “RX Count Information” table shows the received Wi-Fi packets.

d. Click **Clear RX Count** to Reset RX Count Information.

e. Repeat the above steps for a new RX test.

f. Click **Get RSSI** to read the RSSI value.

Figure 3-17. MCHPRT3 PIC32MZ2051W1 GUI for RF RX Test Demonstration



3.4.4 Calibration Flow Demonstration

In this demonstration, the user can Calibrate TX parameters and RX parameters of the PIC32MZ2051W1.

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

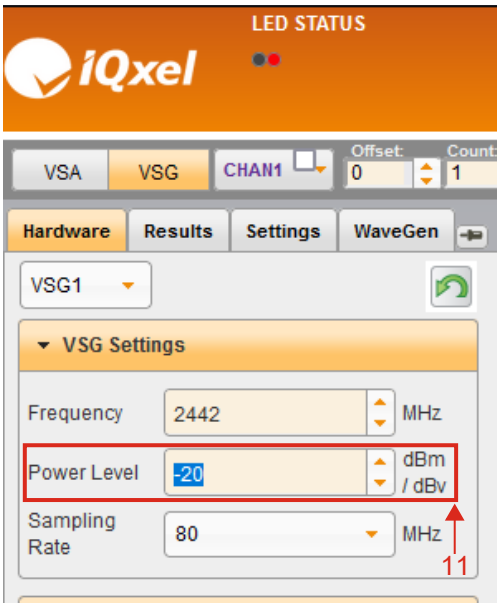
1. Set up the connection between the PIC32 WFI32 2.0 Curiosity Board and PC. For more details, refer to 3.2. Getting Started with MCHPRT3 Tool GUI for PIC32MZ2051W1.
2. Connect the U.FL connecter on the PIC32MZ2051W1 to the Wi-Fi tester (IQxel or other) to measure the RF power from the PIC32MZ2051W1

.

Note: For calibration, the conducted test setup is recommended.

3. Check the cable loss between the PIC32MZ2051W1 U.FL connecter and the Wi-Fi tester. Enter the cable loss or RF power offset into the Wi-Fi tester.
4. Set the Wi-Fi tester to receive the Wi-Fi packets that are transmitted from the PIC32MZ2051W1.
5. In the **Calibration** tab, perform the following steps (see the following figure):
   a. Click **Start TX Calibration** to start the new TX calibration.
   b. Read the RF Power on the Wi-Fi tester. Enter the measured RF Power from the Wi-Fi tester in "1.1.1 Input Power".
   c. If the power does not reach the target power (17.5 dBm +/- 0.25 dB), click **1.1.2 Coarse Tune**.
   d. Read the RF Power on the Wi-Fi tester. Enter the measured RF Power from the Wi-Fi tester in "1.2.1 Input Power".
   e. If the power does not reach the target power (17.5 dBm +/- 0.25 dB), click **1.2.2 First Fine Tune**.
   f. Read the RF Power on the Wi-Fi tester. Enter the measured RF Power from the Wi-Fi tester in "1.3.1 Input Power".
   g. If the power does not reach the target power (17.5 dBm +/- 0.25 dB), click **1.3.2 Second Fine Tune**.
   h. Read the RF Power on the Wi-Fi tester. Enter the measured RF Power from the Wi-Fi tester in "1.4.1 Input Power".
   i. If the power reaches the target power (17.5 dBm +/- 0.25 dB), click **1.4.2 Stop TX Calibration**. **Note:** There is a possibility of three iterations on the TX Calibration. In any iteration, if the rule of 17.5+/-0.125 dB output power limit is satisfied, there is no need for further tuning. The user can skip the other iterations and go to **Stop TX Calibration** to finish the TX Calibration process.
6. Click **2.0 Start RX Calibration** to start the new RX calibration.
7. Check the cable loss between the PIC32MZ2051W1 U.FL connecter and the Wi-Fi tester. Enter the cable loss or the RF power offset into the Wi-Fi tester.
8. Set the Wi-Fi tester to transmit Wi-Fi MCS7 packets at 2442 MHz and -45 dBm power level that will be received by PIC32MZ2051W1.
9. Click **2.1 Init Gain Flag**.
10. Click **2.2 Get Gain Flag (-45 dBm)**.
11. Set -20 dBm power level on the IQxel Wi-Fi tester (see the following figure).

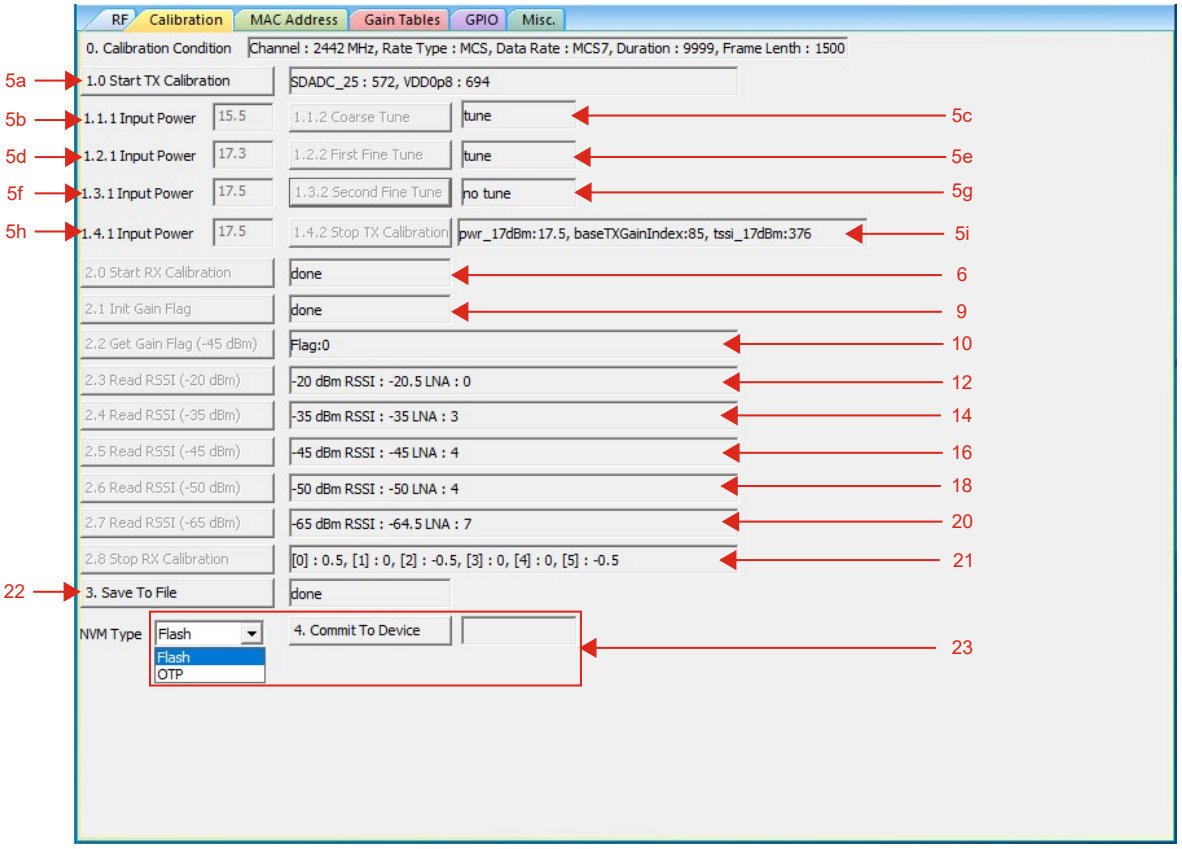
Figure 3-18. IQxel -20 dBm



Note: The user can choose their own Wi-Fi tester tool. In this case, the IQxel Wi-Fi tester tool is shown only as an example. Change the "Power Level" setting for different scenarios in the following steps using the same IQxel Wi-Fi tester tool.

12. Click **2.3 Read RSSI (-20 dBm)**.
13. Set -35 dBm power level in the Wi-Fi tester.
14. Click **2.4 Read RSSI (-35 dBm)**.
15. Set -45 dBm power level in the Wi-Fi tester.
16. Click **2.5 Read RSSI (-45 dBm)**.
17. Set -50 dBm power level in the Wi-Fi tester.
18. Click **2.6 Read RSSI (-50 dBm)**.
19. Set -65 dBm power level in the Wi-Fi tester.
20. Click **2.7 Read RSSI (-65 dBm)**.
21. Click **2.8 Stop RX Calibration** to finish the RX Calibration.
22. Click **3. Save To File** to save the calibration parameters to file.
23. Click **4. Commit To Device** to write the calibration parameters to the device with respect to **NVM Type** Flash or OTP.

Figure 3-19. MCHPRT3 PIC32MZ2051W1 GUI for Calibration Flow Demonstration



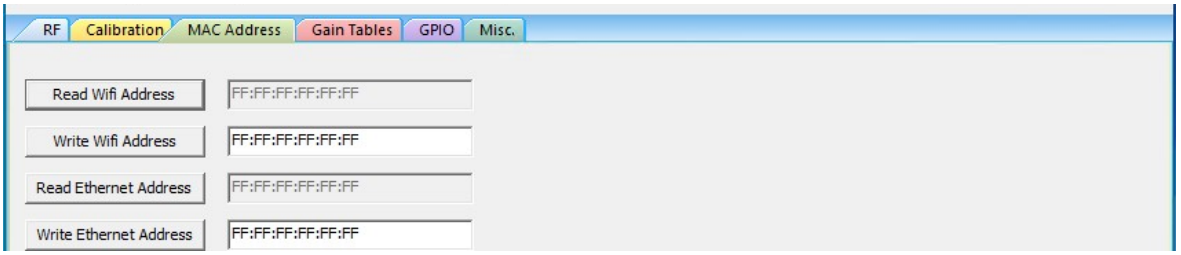
3.4.5 MAC Address Programming

In this demonstration, the user can set the MAC address of the Wi-Fi and Ethernet interfaces of the PIC32MZ2051W1.

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

1. Set up the connection between the PIC32 WFI32 2.0 Curiosity Board and PC. For more details, refer to 3.2. Getting Started with MCHPRT3 Tool GUI for PIC32MZ2051W1.
2. In the **MAC Address** tab, perform the following steps (see the following figure):
   - Click **Read Wifi Address** to read the Wi-Fi address.
   - Click **Write Wifi Address**, then enter the Wi-Fi address, for example, *12:34:56:78:9A:BC*.
   - Click **Read Ethernet Address** to read the Ethernet address.
   - Click **Write Ethernet Address**, then enter the Ethernet address, for example, *12:34:56:78:9A:BC*.

Figure 3-20. MCHPRT3 PIC32MZ2051W1 GUI for MAC Address Programming



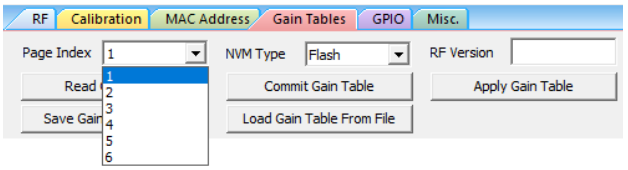
3.4.6 Gain Tables Demonstration

In this demonstration, the user can edit the gain tables of the PIC32MZ2051W1. The gain tables are the power settings stored in “NVM Type” of the PIC32MZ2051W1, which is either *Flash* or *OTP* type to control the TX power in application firmware (see Figure 3-22). The “Page Index” value ranges from *1-6*, and the user can store the gain tables information in the “Page Index” for the respective “NVM Type” either in the form of *Flash* or *OTP* type (see the following figure).

Perform the following steps for Gain Tables demonstration.

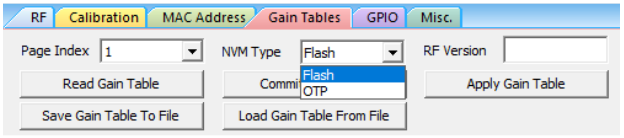
1. Set up the connection between the PIC32 WFI32 2.0 Curiosity Board and PC. For more details, refer to 3.2. Getting Started with MCHPRT3 Tool GUI for PIC32MZ2051W1.
2. In the **Gain Tables** tab, perform the following steps (see Figure 3-23):
   a. From the “Page Index” drop-down list, select the value ranging from *1-6* to read or write for the gain table (see the following figure).

Figure 3-21. Gain Table Page Index



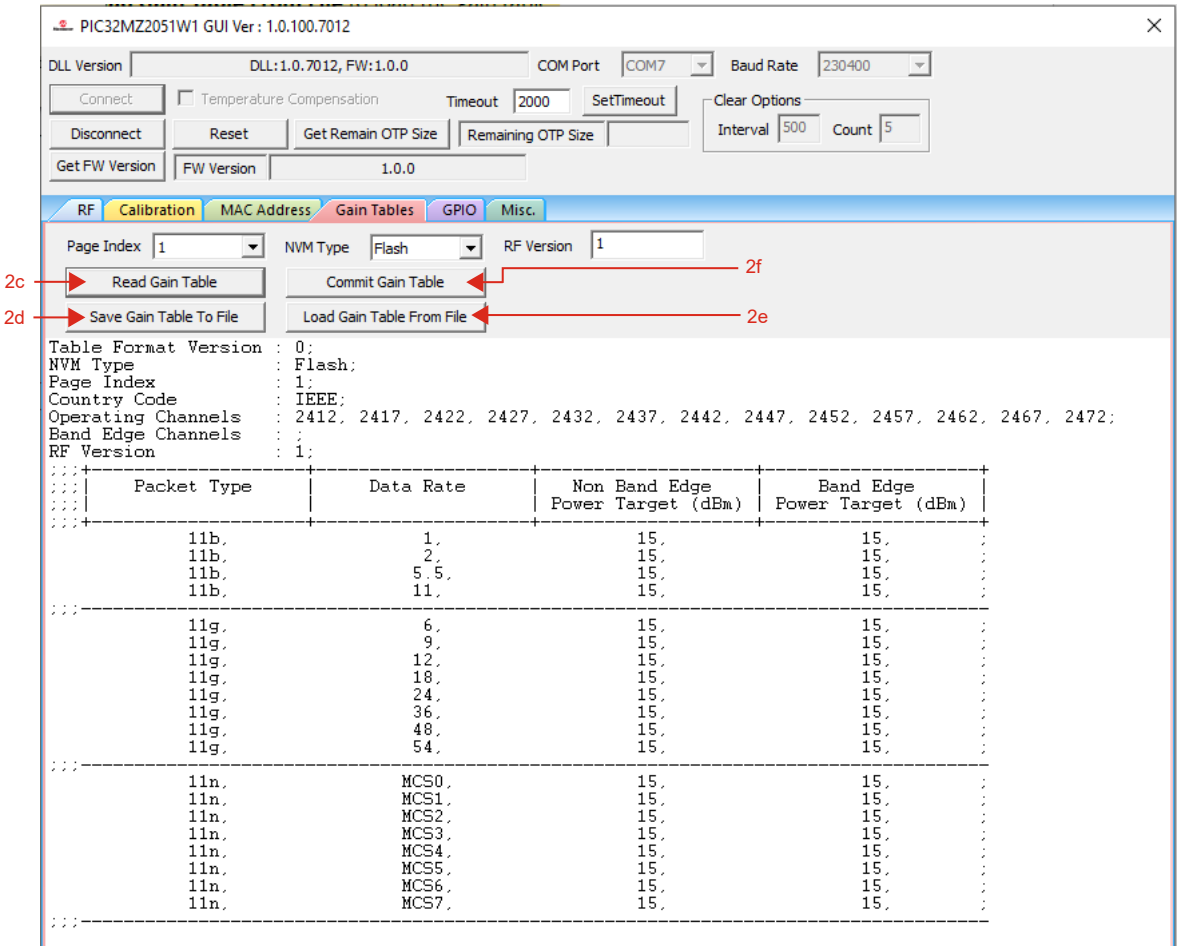
   b. From the “NVM Type” drop-down list, select either the *Flash* or *OTP* Type to read or write for the gain table (see the following figure).

Figure 3-22. Gain Table NVM Type



   c. Click **Read Gain Table** to read the gain table. This will change the default Gain Table Information in the **RF** tab (see Figure 3-13).
   d. Click **Save Gain Table To File** to save the gain table for backup and editing. The user can edit the saved gain table text file if the user needs to modify the gain settings.
   e. Click **Load Gain Table From File** to load the gain table into "MCHPRT3" tool.
   f. Enter a value for “RF Version”, then click **Commit Gain Table** to commit and write the gain table into the device. This will change the default Gain Table Information in the **RF** tab (see Figure 3-13).
   g. Click **OK** in the pop-up window to write the gain table.

Figure 3-23. MCHPRT3 PIC32MZ2051W1 GUI for Gain Tables Demonstration



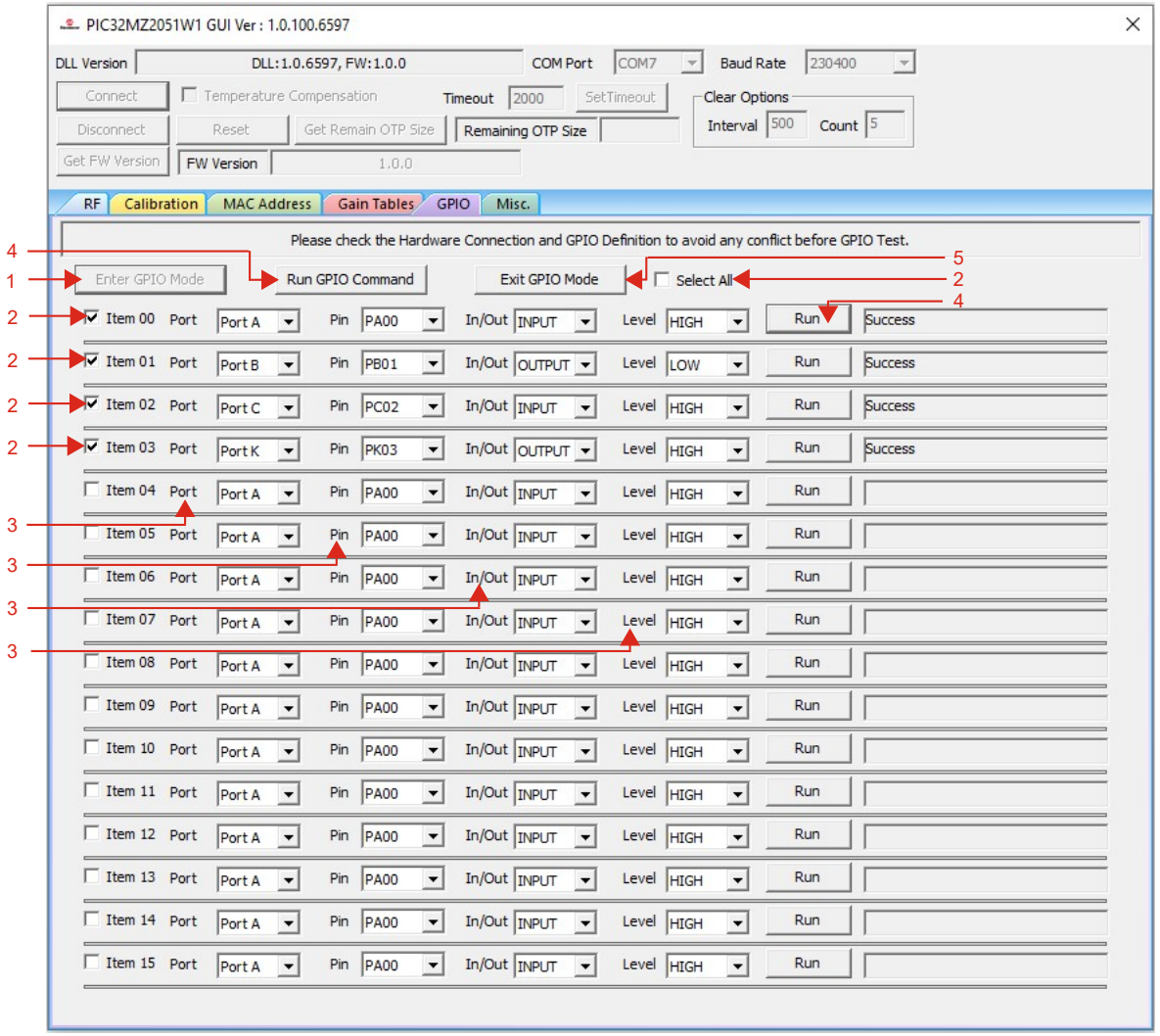
3.4.7 GPIO Demonstration

In this demonstration, the user can configure or test the GPIO of the PIC32MZ2051W1.

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

1. Click **Enter GPIO Mode** to initiate the GPIO settings for configuration or test.
2. Check “Item” for individual GPIO or “Select All” for multiple GPIOs.
   - “Item” – “Item 00”, “Item 01”, “Item 02” and more
3. Select “Port”, “Pin”, “In/Out” and “Level” to configure or test the GPIO pins.
   - “Port” – *Port A*, *Port B* and *Port C*
   - “Pin” – *PA00*, *PB01*, *PC02* and more
   - “In/Out” – *INPUT* and *OUTPUT*
   - “Level” – *HIGH* and *LOW*
4. Click **Run** for individual GPIO, or click **Run GPIO Command** for multiple GPIOs.
5. Click **Exit GPIO Mode** to stop the GPIO settings.

Figure 3-24. MCHPRT3 PIC32MZ2051W1 GUI GPIO Demonstration



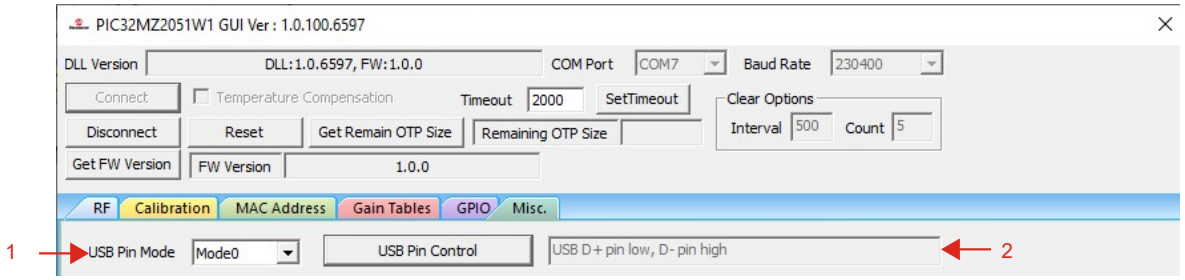
3.4.8 Misc. – USB Pin Control Demonstration

In this demonstration, the user can configure or test the USB pin of the PIC32MZ2051W1.

In the **Misc.** tab, perform the following steps for the USB Pin Control Demonstration (see the following figure):

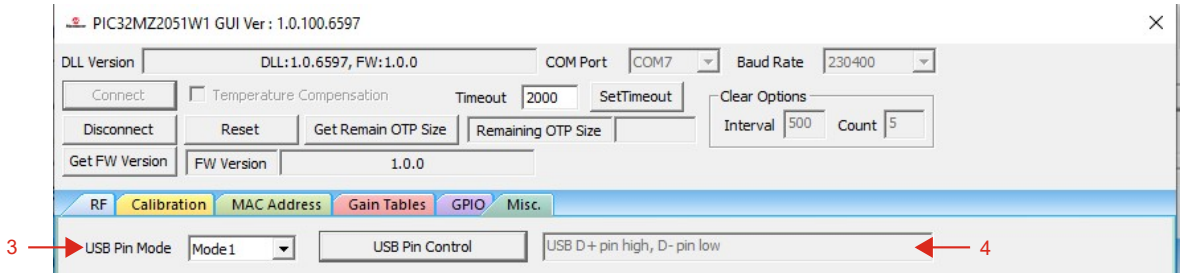
1. From the “USB Pin Mode” drop-down list, select *Mode0*.
2. Click **USB Pin Control** to set *USB D+ pin* as logic low and *USB D- pin* as logic high.

Figure 3-25. Mode0 USB Pin Control



3. From the “USB Pin Mode” drop-down list, select *Mode1*.
4. Click **USB Pin Control** to set *USB D+ pin* as logic high and *USB D- pin* as logic low.

Figure 3-26. Mode1 USB Pin Control



3.5 PIC32MZ2051W1 Dynamic Link Library (DLL) Gain Table Information

This section describes the PIC32MZ2051W1 gain table information and explains how to modify the gain table.

3.5.1 Gain Table Example

The PIC32MZ2051W1 gain table is a text-based file that the user can open or edit using any text editor. The following are the rules for a gain table file:

- “`;;;`” means comment entire line.
- If the first character is “`;`”, this row is for file information.
  Note: The user must not modify this row.
- If the first character is blank, it means this row has the Gain Table information. The user can modify the power target values but not other information and format.
  - Gain table information power target values ranges from 10-25 dBm, each step equals 0.25 dB.

Note: If any of the information in the gain table is not available, this group of information is invalid.

Figure 3-27. PIC32MZ2051W1 Gain Table

Default - Notepad

File Edit Format View Help

```
;;;=============================================================================================
;;; PIC32MZ2051W1 DLL Gain Tables Information;
;Save File Date      : 2023/04/19 14:26:49
;Save DLL Version    : 1.0.6544, Support HUT Version : 1.0.0
;File Format Version : 0
;;;=============================================================================================
;;;;
;;;*********************************************************************************************
Table Format Version : 0;
NVM Type             : Flash;
Page Index           : 1;
Country Code         : IEEE;
Operating Channels   : 2412, 2417, 2422, 2427, 2432, 2437, 2442, 2447, 2452, 2457, 2462, 2467, 2472;
Band Edge Channels   : ;
RF Version           : 1;
;;;+--------------------+--------------------+--------------------+--------------------+
;;;|    Packet Type     |     Data Rate      |   Non Band Edge    |     Band Edge      |
;;;|                    |                    | Power Target (dBm) | Power Target (dBm) |
;;;+--------------------+--------------------+--------------------+--------------------+
            11b,                 1,                 20.5,                20.5,       ;
            11b,                 2,                 20.5,                20.5,       ;
            11b,               5.5,                 20.5,                20.5,       ;
            11b,                11,                 20.5,                20.5,       ;
;;;---------------------------------------------------------------------------------------------
            11g,                 6,                 19.5,                19.5,       ;
            11g,                 9,                 19.5,                19.5,       ;
            11g,                12,                 19.5,                19.5,       ;
            11g,                18,                 19.5,                19.5,       ;
            11g,                24,                 19.5,                19.5,       ;
            11g,                36,                 19.5,                19.5,       ;
            11g,                48,                 19.5,                19.5,       ;
            11g,                54,                 18.5,                18.5,       ;
;;;---------------------------------------------------------------------------------------------
            11n,               MCS0,                18.5,                18.5,       ;
            11n,               MCS1,                18.5,                18.5,       ;
            11n,               MCS2,                18.5,                18.5,       ;
            11n,               MCS3,                18.5,                18.5,       ;
            11n,               MCS4,                18.5,                18.5,       ;
            11n,               MCS5,                18.5,                18.5,       ;
            11n,               MCS6,                 18,                  18,        ;
            11n,               MCS7,                 17,                  17,        ;
;;;---------------------------------------------------------------------------------------------
```

3.6 PIC32MZ2051W1 Command Line Interface (CLI) Information

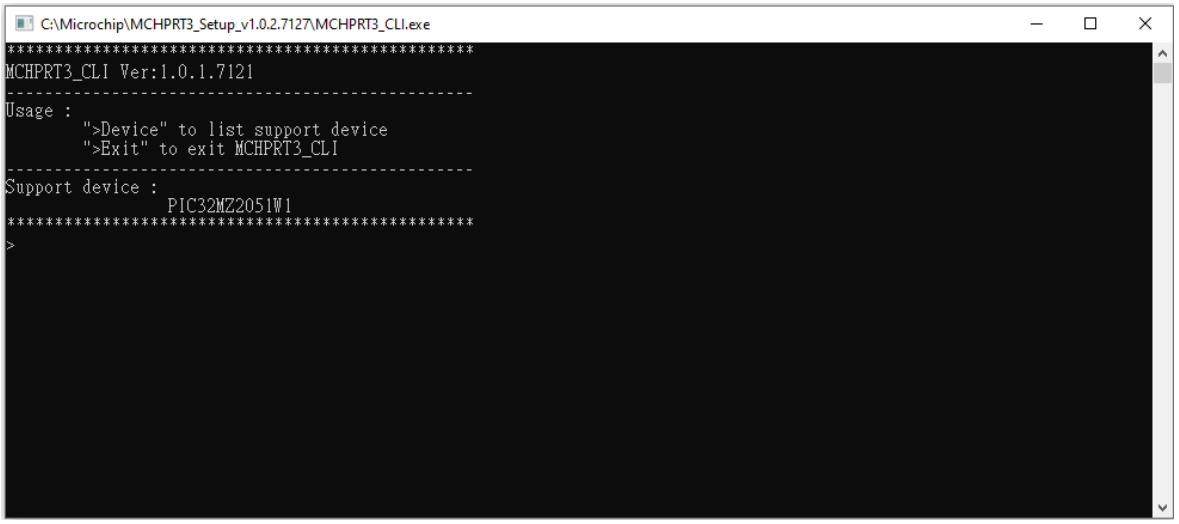
The section describes the Command Line Interface (CLI) information of the PIC32MZ2051W1.

3.6.1 PIC32MZ2051W1 CLI Example

The PIC32MZ2051W1 CLI is a part of the MCHPRT3 tool installer.

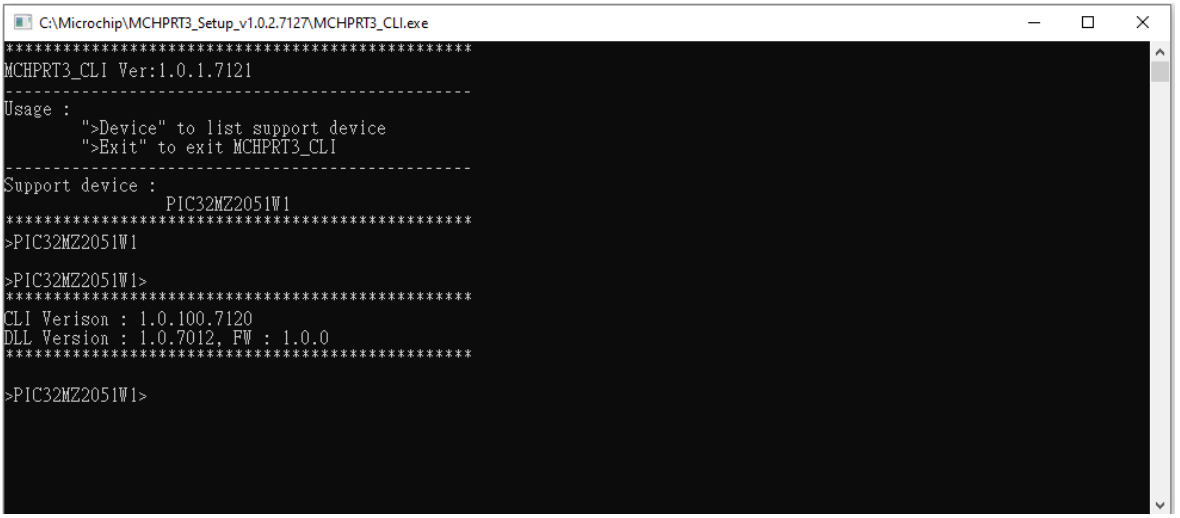
1. Double click `MCHPRT3_CLI.exe` to run the CLI.

Figure 3-28. `MCHPRT3_CLI.exe`



2. To test the PIC32MZ2051W1, enter `PIC32MZ2051W1`.

Figure 3-29. Device Testing – `PIC32MZ2051W1`

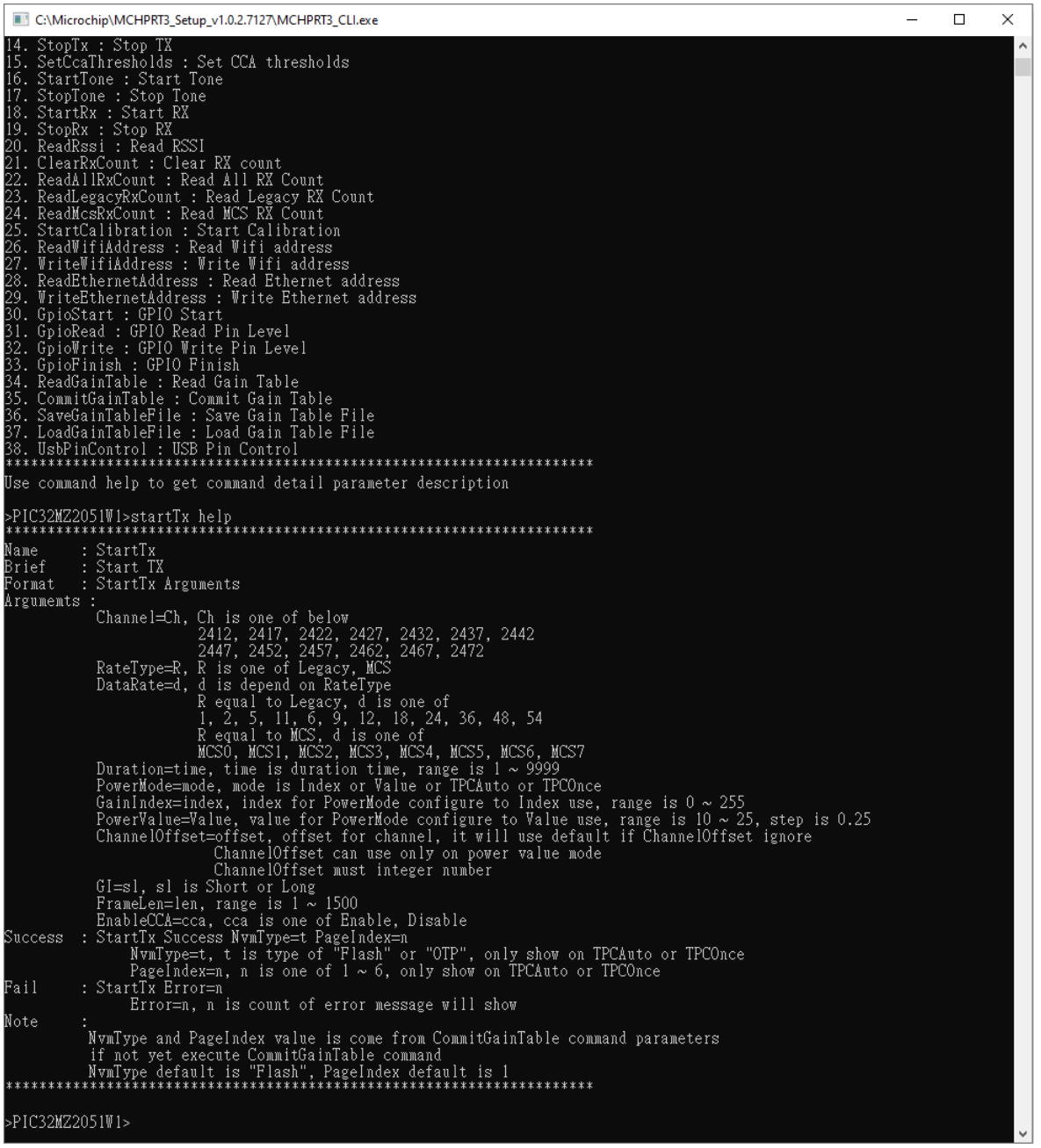


3. Enter `help` to browse CLI help manual.

Figure 3-30. CLI `help` Manual

4. Enter `startTx help` to browse the CLI startTx help manual.

Figure 3-31. `startTx help` Manual



3.7 PIC32MZ2051W1 Python 3 Information

This section describes the Python 3 example information of the PIC32MZ2051W1. For more details, refer to the `Python3_Example.chm`.

The user can refer to the example code in the PIC32MZ2051W1 package example folder, which provides details on how to use the `PIC32MZ2051W1.dll` file with the Python language to control the PIC32MZ2051W1. For more details, refer to 3.7.2. How to Run Python 3.6 Environment.

3.7.1 Python 3.6 Environment

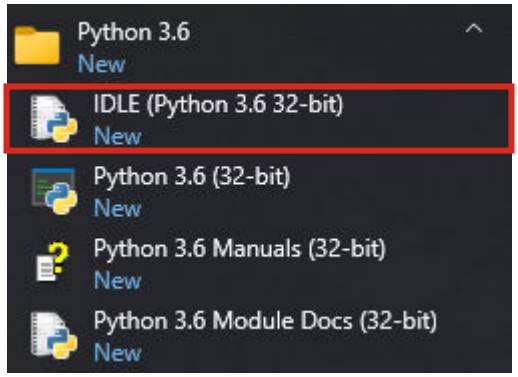
Python 3.6 (v3.6.2:5fd33b5, Jul 8 2017, 04:14:34) [MSC v.1900 32 bit (Intel)] on win32

3.7.2 How to Run Python 3.6 Environment

The following are the steps to run the Python 3.6 environment:

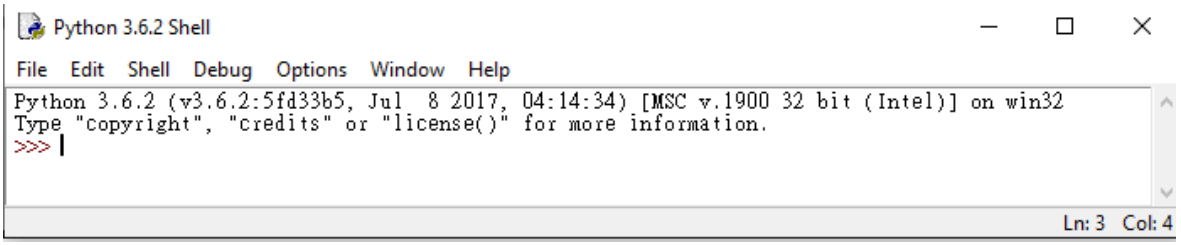
1. Open **IDLE (Python 3.6 32-bit)** in the Python 3.6 folder from the Start menu.

Figure 3-32. Python 3.6 Package



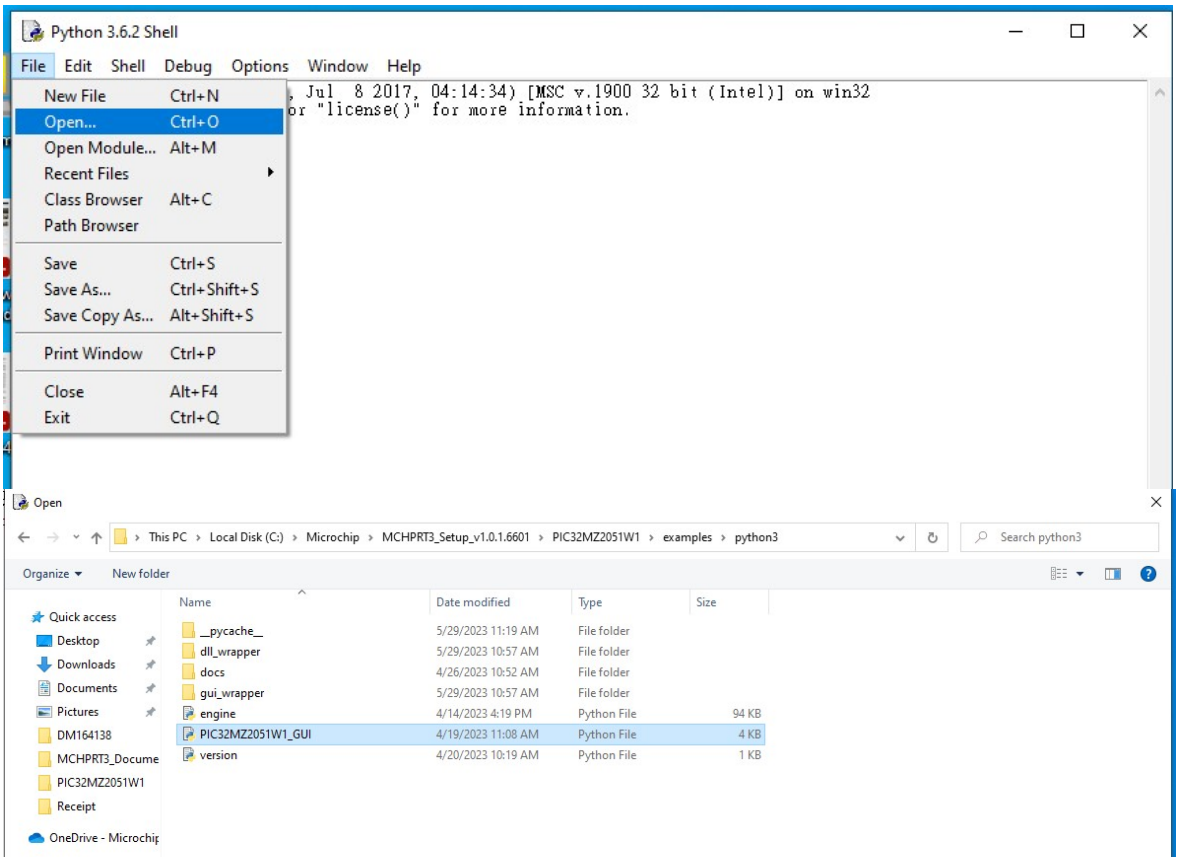
2. The following figure illustrates the IDLE window of Python 3.6.

Figure 3-33. Opening Window of IDLE



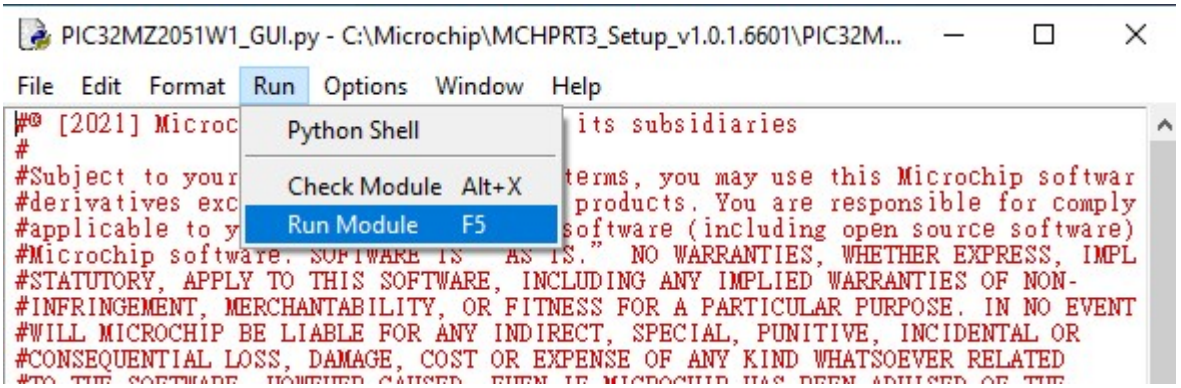
3. Go to *File*>*Open* and choose the `PIC32MZ2051W1_GUI.py` file (see the following figure).

Figure 3-34. Opening `PIC32MZ2051W1_GUI.py` File



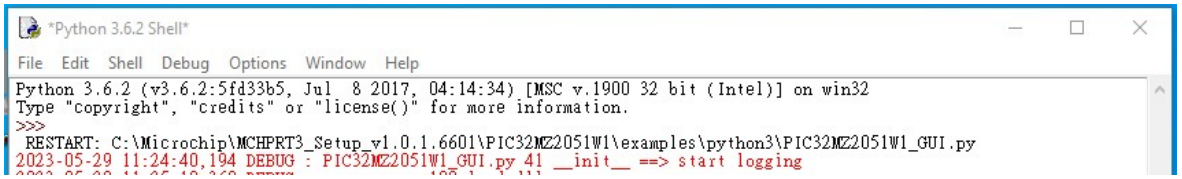
4. Go to *Run*>*Run Module* to execute the `PIC32MZ2051W1_GUI.py` file.

Figure 3-35. Run Module



5. The Python 3.6 shell window displays the following message:

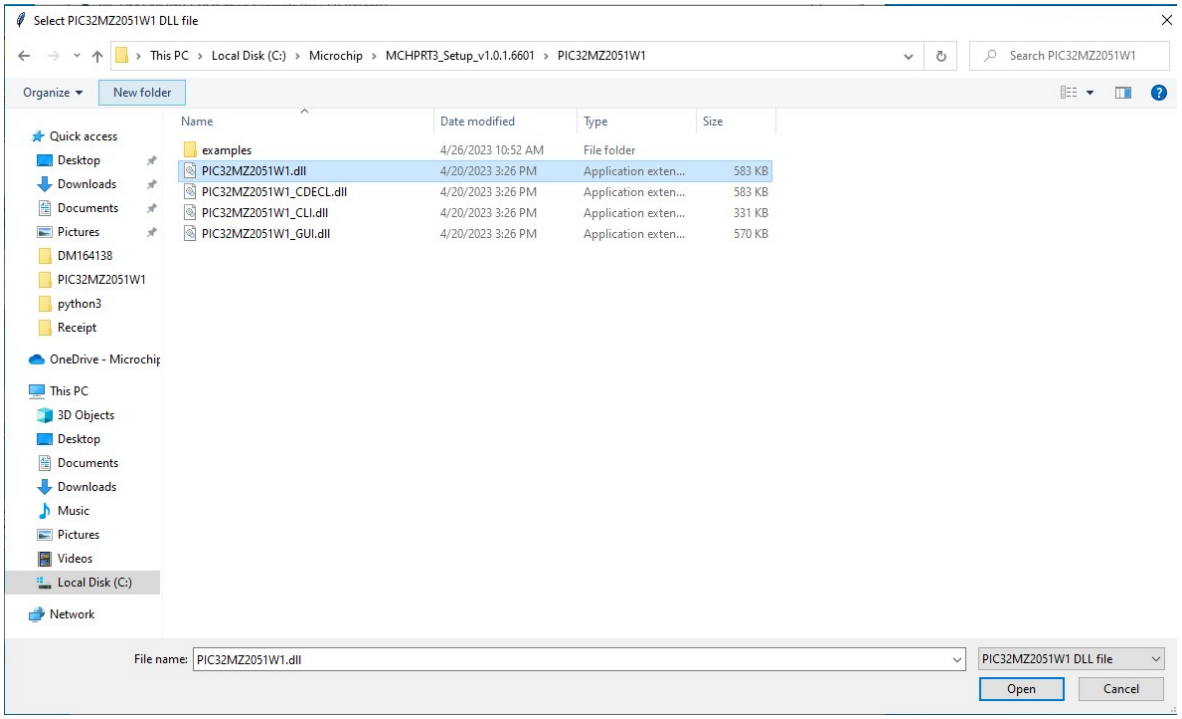
Figure 3-36. Python Shell Window Message



Note: If the shell window displays an error message, check if the source code is from the original `MCHPRT3_Setup.exe` installation folder.

6. Select the `PIC32MZ2051W1.dll` file to load the library and run example code.

Figure 3-37. Opening `PIC32MZ2051W1.dll`

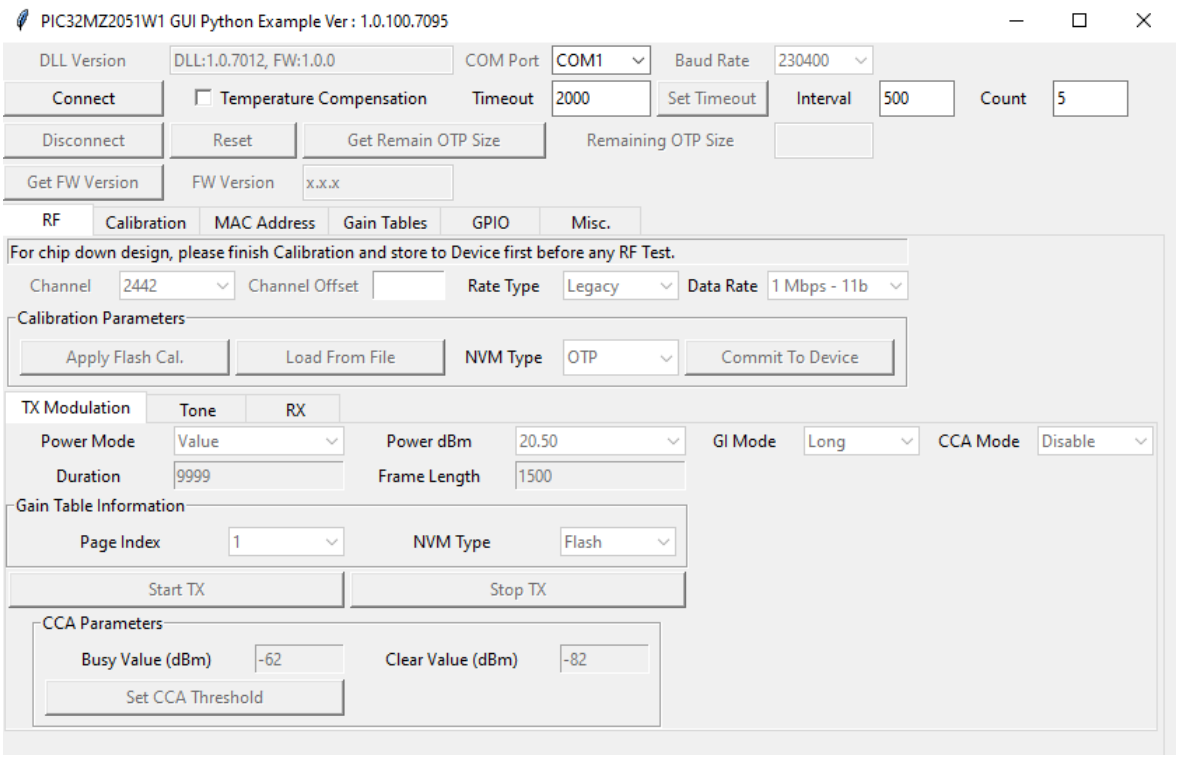


7. The following figure illustrates the Python shell window. After successfully loading the `PIC32MZ2051W1.dll` file, the Python shell window displays the `.dll` file version. In the Python shell window, the user can refer to the GUI running process to design a tool for themselves.

Figure 3-38. `.dll` File Version of PIC32MZ2051W1

8. The following figure illustrates the PIC32MZ2051W1 GUI Python example.
Note: Check if the version matches the device HUT code firmware version.
9. Select the device “COM Port”, *COM**X***, and click **Connect** to connect the PIC32MZ2051W1 device.
Note: *COM**X*** – “**X**” stands for the port number of the PC that the device is connected to.

Figure 3-39. PIC32MZ2051W1 GUI Python Example

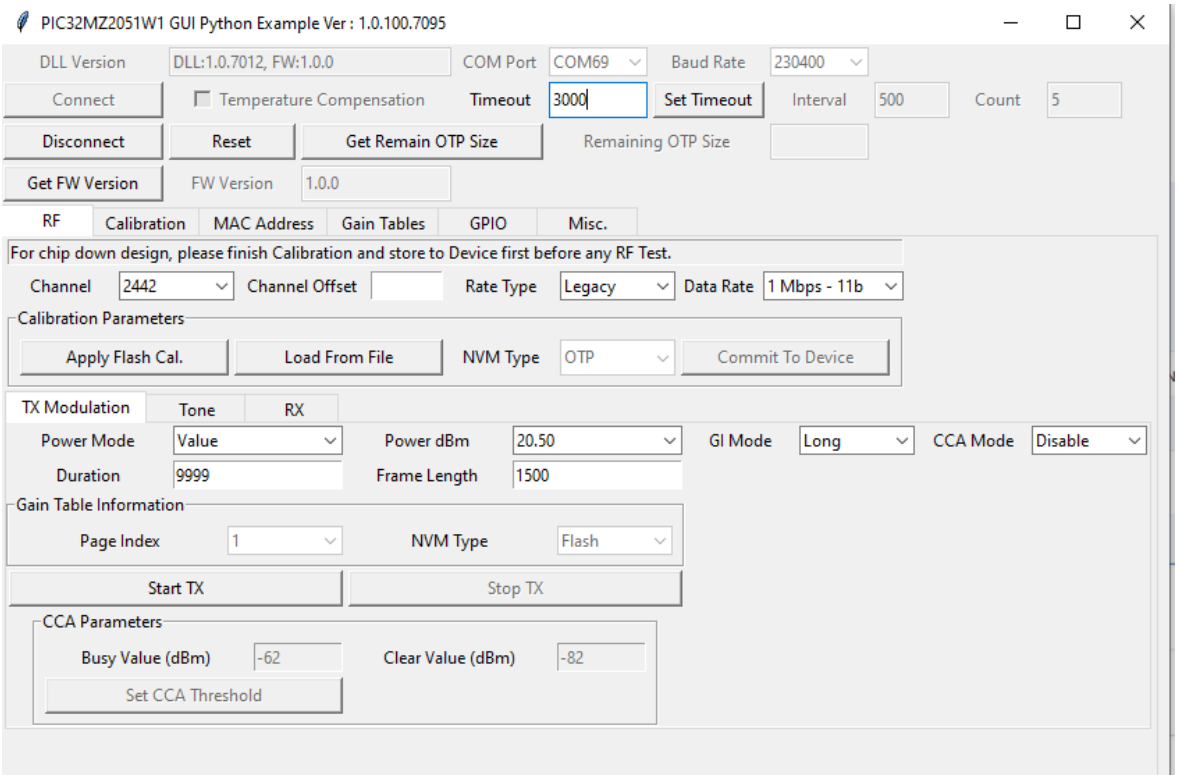


10. The following warning pop-up window appears after connecting the PIC32MZ2051W1 device. Click **Yes** to Reset the PIC32MZ2051W1 device.

Figure 3-40. Reset PIC32MZ2051W1 Device Warning Message

11. After successful connection, the following PIC32MZ2051W1 GUI Python example window appears.

Figure 3-41. Successful Connection of PIC32MZ2051W1 GUI Python Example Window



4. Document Revision History

Revision	Date	Section	Description
A	10/2023	Document	Initial Revision

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