Atmosic RF Test Tool

User Guide

SUMMARY: The document provides instructions on how to install and operate the Atmosic RF Test Tool to test Tx and Rx RF performance, and Tx output power of the ATM2/ATM3, ATM33/e, or ATM34/e Wireless SoC Series. The RF Test Tool can also be used for Rx sensitivity measurements, FCC/CE pretest, and certification.

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Acronyms and Abbreviations

Acronyms	Definition
ATM2	ATM2201 ATM2202 ATM2221 ATM2231 ATM2251
ATM3	ATM3201 ATM3202 ATM3221 ATM3231
ATM33/e	ATM3325 ATM3330 ATM3330e
ATM34/e	ATM3405 ATM3430e
Bluetooth LE	Bluetooth Low Energy
EVB	Evaluation Board
EVK	Evaluation Kit
SDK	Software Development Kit
SoC	System on Chip

1. Overview

This document provides instructions on how to install and operate the Atmosic RF Test Tool to test the following functions:

- Tx and Rx RF performance
- Tx output power

The RF Test Tool can also be used for Rx sensitivity measurements, FCC/CE pretest, and certification.

2. Hardware and Software Requirements

The RF tool supports the following devices:

- ATM2/ATM3 series
- ATM33/e series
- ATM34/e series

2.1 Supported EVK

There are multiple versions of the ATM2, ATM3, ATM33/e, and ATM34/e EVKs based on the specific device and package configuration. See the Tables below.

EVK	SoC Package	SoC Part Number	Kit Part Number
Evaluation Kit for ATM2202	40-pin 5x5 mm QFN	ATM2202SR	ATMEVK-M2202-02
Evaluation Kit for ATM2221	64-pin 6x6 mm QFN	ATM2221SR	ATMEVK-M2221-02
Evaluation Kit for ATM2251	37L WLCSP	ATM2251SR	ATMEVK-M2251-01
Evaluation Kit for ATM3201	40-pin 5x5 mm QFN	ATM3201SR	ATMEVK-M3201-02
Evaluation Kit for ATM3202	40-pin 5x5 mm QFN	ATM3202SR	ATMEVK-M3202-02
Evaluation Kit for ATM3221	64-pin 6x6 mm DR_QFN	ATM3221SR	ATMEVK-M3221-02

Table 1 - Supported ATM2/ATM3 SoCs and EVKs

EVK	SoC	SoC Part Number	Kit Part Number
Evaluation Kit for ATM3325	40-pin 5x5 mm QFN	ATM3325-5DCAQK	ATMEVK-3325-QK
Evaluation Kit for ATM3325 with extended storage	40-pin 5x5 mm QFN	ATM3325-5LCAQK	ATMEVK-3325-LQK
Evaluation Kit for ATM3325 WLCSP	49L WLCSP	ATM3325-5DCACM	ATMEVK-3325-CM
Evaluation Kit for ATM3330	56-pin 7x7 mm QFN	ATM3330-5DCAQN	ATMEVK-3330-QN
Evaluation Kit for ATM3330e	56-pin 7x7 mm QFN	ATM3330E-5DCAQN	ATMEVK-3330e-QN

Table 2 - Supported ATM33/e SoCs and EVKs

EVK	SoC	SoC Part Number	Kit Part Number
Evaluation Kit for ATM3405	93-ball 4x4 mm BGA	ATM3405-5YCABV	ATMEVK-3405-YBV-5
Evaluation Kit for ATM3430e	56-pin 7x7 mm QFN	ATM3430E-5YxAQN	ATMEVK-3430e-YQN-5

Table 3 - Supported ATM34/e SoCs and EVKs

2.2 Supported OS

The RF Test Tool can be used with Windows 10 or Windows 11.

2. Environment Setup

A complete set of the test suite includes:

- PC (Windows 10, 11)
- ATM2/ATM3 EVK (includes Atmosic Interface Board) or
- ATM33/e EVK or
- ATM34/e EVK
- Type A to Micro USB cable

See the References section for additional information.

Figure 1 shows the connection setup between the PC, the Interface board, and the EVK for the ATM2/ATM3.

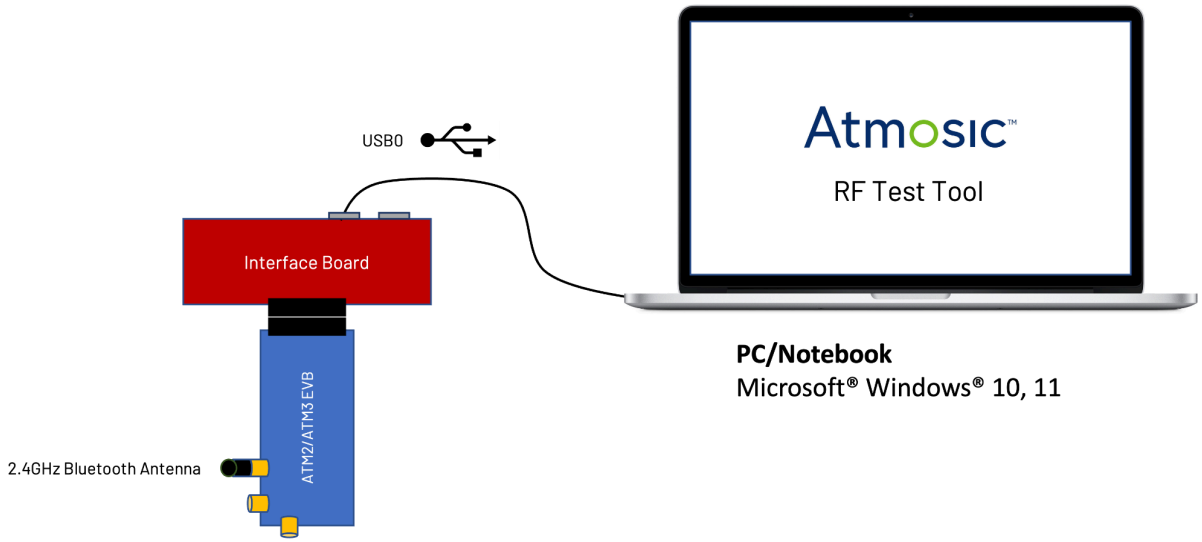

Figure 1 - RF Test Tool Hardware Environment for the ATM2/ATM3

Figure 2 shows the connection setup between the PC and the ATM33/e, ATM34/e Evaluation Board (EVB).

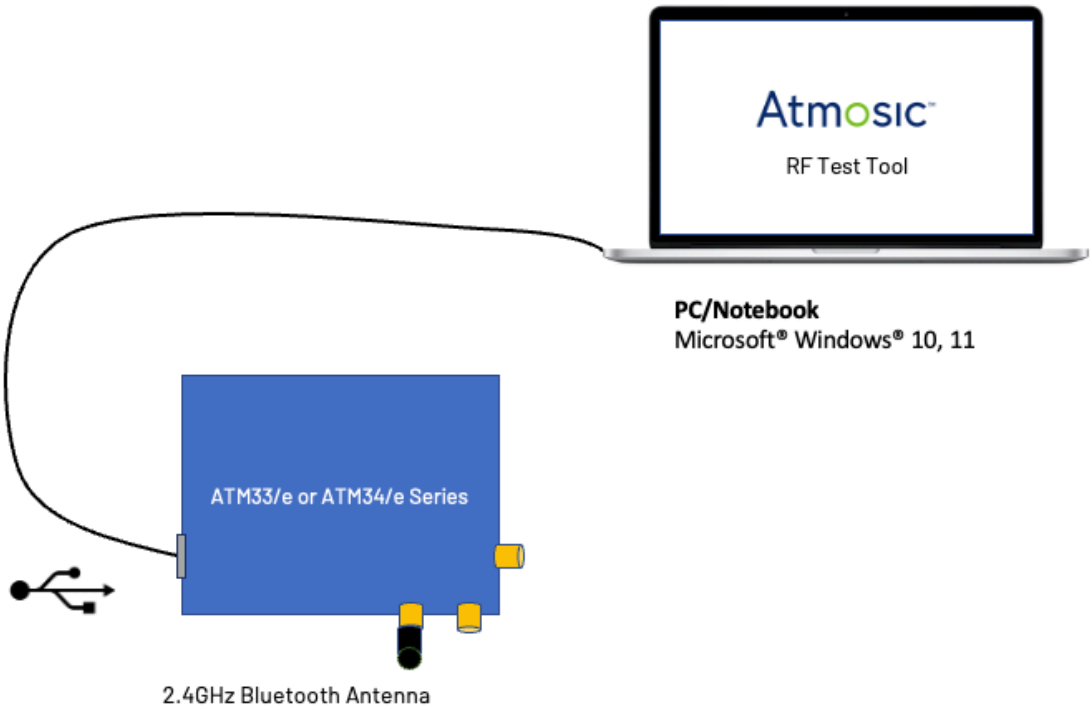

Figure 2 - RF Test Tool Hardware Environment for the ATM33/e or ATM34/e

2.1 Setup Software

- The tool is available at the Atmosic website at https://atmosic.com/software-apps/.
    - Tools -> RF Test Tools

2.1.1 Install WinUSB Driver Using Zadig

This Zadig tool is used to check and install the correct WinUSB driver needed for the Atmosic EVKs. This step is not required if the system has already been installed with the Atmosic SDK and RDI driver.

Windows Administrator privileges are required for replacing a driver. Zadig can be obtained from:

https://github.com/pbatard/libwdi/releases

At the time of this writing, the latest version -- 2.9 -- can be obtained using the following direct link: https://github.com/pbatard/libwdi/releases/download/v1.5.1/zadig-2.9.exe

To replace the driver:

1) From the `Options` menu of Zadig, click `List all devices`.
2) From the drop-down menu, find the `BULK interface or Atmosic RDI USB` corresponding to the Atmosic EVB. It should show `jlink (v...) or FTDIBUS (v ...)` as the current driver on the left.
3) Select `WinUSB (v...)` as the replacement on the right.
4) Click `Replace Driver`.

Refer to Figure 3 and Figure 4.

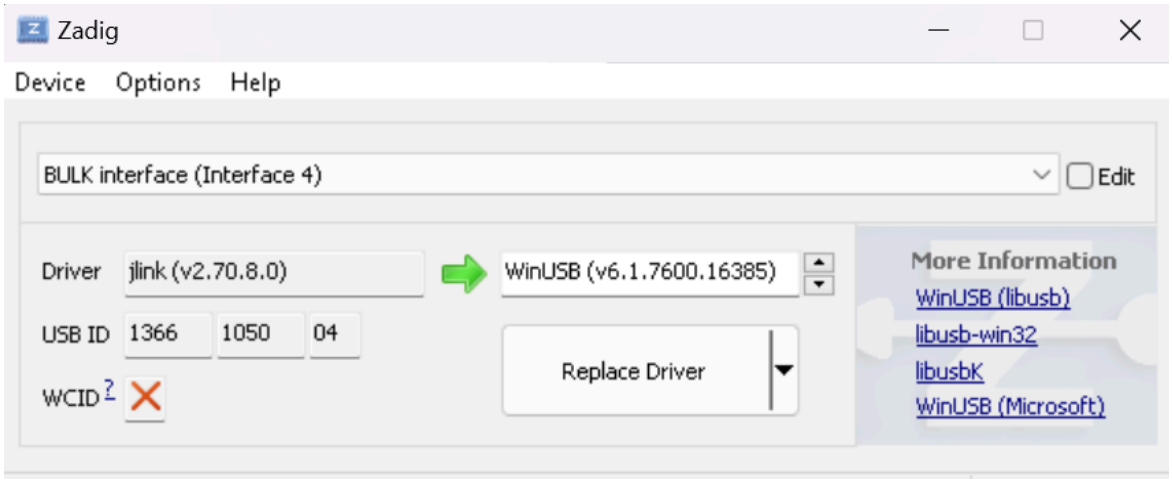

Figure 3 - Replace Driver for ATM33/e or ATM34/e Using Zadig

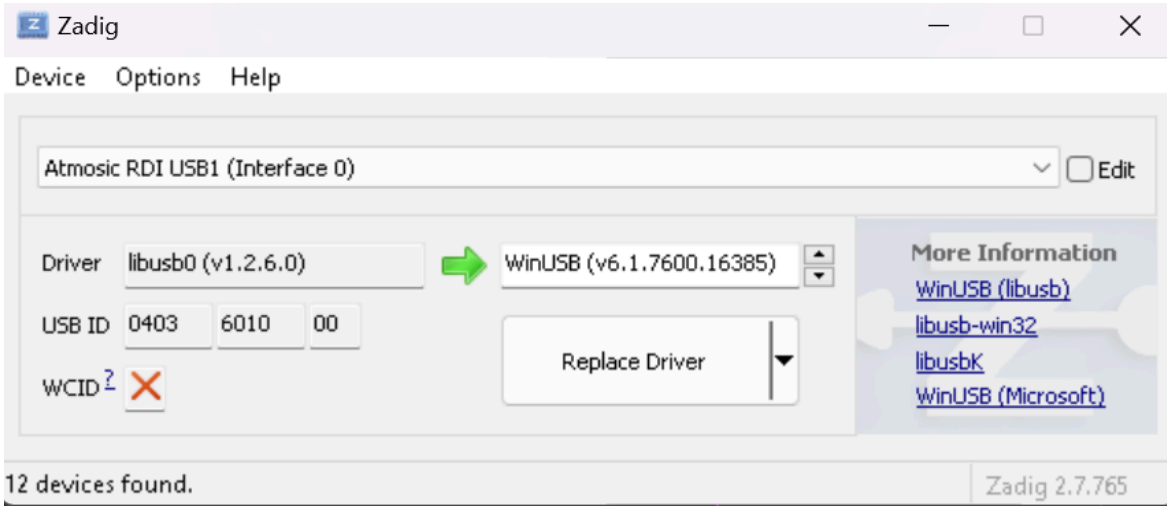

Figure 4 - Replace Driver for ATM2 or ATM3 Using Zadig

Verify the successful installation of WinUSB by accessing the Windows Device Manager and confirming it is the `BULK interface` driver rather than the `J-Link driver`. (In Device Manager, expand the category `Universal Serial Bus devices` and look for the `BULK interface`.)

2.1.2 Program Firmware

For all devices, double-click on the `program_by_openocd.bat` file in the RF Tool folder to execute, then follow the menu to select the platform to program the FW as shown in Figure 5.

The console will guide you through the selection of the right firmware images for the different boards. See Figure 6.

```
.....................................................
Select [0-2] to program flash code, or 3 to exit
.....................................................
.
0 - ATMx2xx-x1x
1 - ATM33xx-5
2 - ATM34xx-5
3 - exit
.
Type 0, 1, 2, 3 then press ENTER:
```

Figure 5 - Run the `program_by_openocd.bat` File in the RF Test Tool Folder to select the platform

```
.....................................................
Select [0-6] to program HCI_vendor flash code, or 7 to exit
.....................................................
.
0 - ATMEVK_3325_LQK
1 - ATMEVK_3325_QK
2 - ATMEVK_3325_TAG
3 - ATMEVK_3325_CM
4 - ATMEVK_3330_QN
5 - ATMEVK_3330e_QN
6 - ATMEVK_3330e_QN_7
.
Type 0, 1, 2, 3, 4, 5, 6, 7 then press ENTER:
```

Figure 6 - Run the program_by_openocd.bat File in the RF Test Tool Folder for programming the firmware for the selected board under the previously selected platform.

2.1.3 Launch RF Test Tool

Double-click on the `runui.bat` file in the RF Test Tool folder to execute after the DUT is powered on properly, as Figure 7.

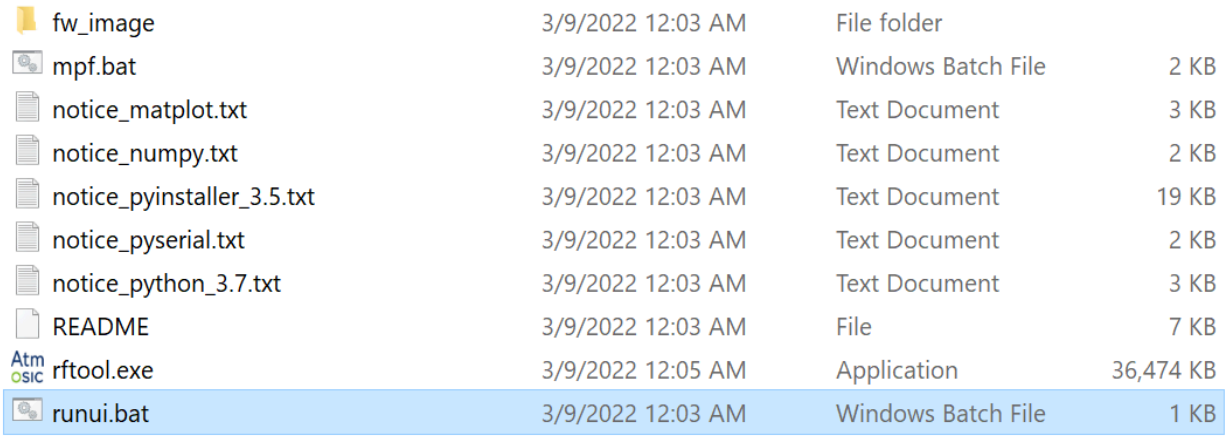

Figure 7 - `runui.bat` File in the RF Test Tool Folder

2.2 UART Ports

For the ATM2/ATM3, connect the EVB to the interface board:

- Plug the USB cable into USB0 (port J6) of the interface board (part of the Evaluation Kit) as shown below. Do not plug a second USB cable into USB1 (port J5) of the interface board.
- Plug the other end of the USB cable into the Windows computer, Windows will install the FTDI USB-to-serial driver automatically. After the driver is installed, the device shows as a COM port in the Windows Device Manager. See Figure 8.

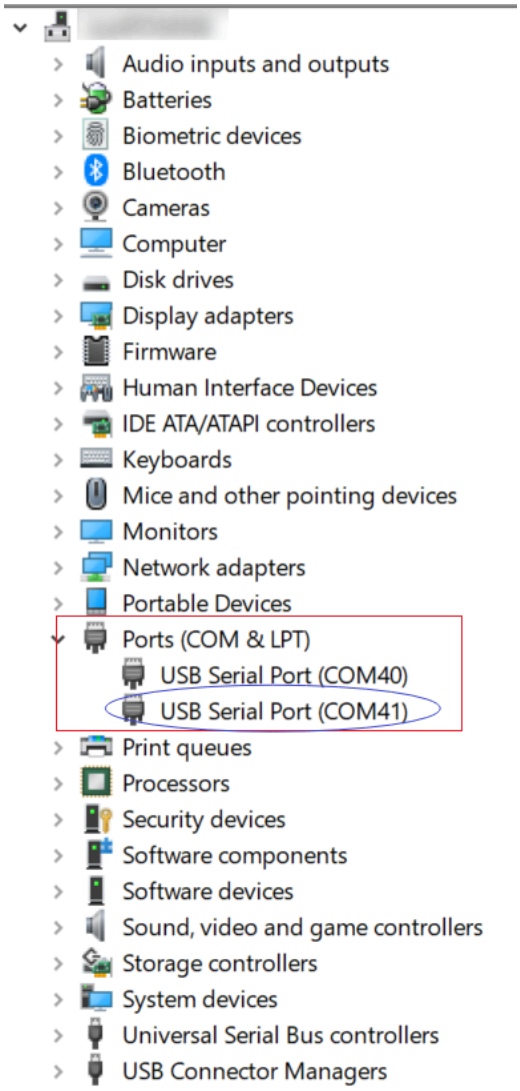

Figure 8 - New COM Ports from the Interface Board of ATM2/ATM3 EVK

For the ATM33/e or ATM34/e, after connecting the USB connector to the Windows laptop, there are two USB ports from JLink CDC UART ports as shown in Figure 9.

One is the console output, and the other is the HCI interface port working with the RF Test Tool.

The HCI interface port uses a 460800 baud rate for ATM2/ATM3 and ATM33, and 2000000 for ATM34.

RF Test Tool will have the interface to select `COM<N>`, where <N> is the COM port sequence number, depending on the Windows OS.

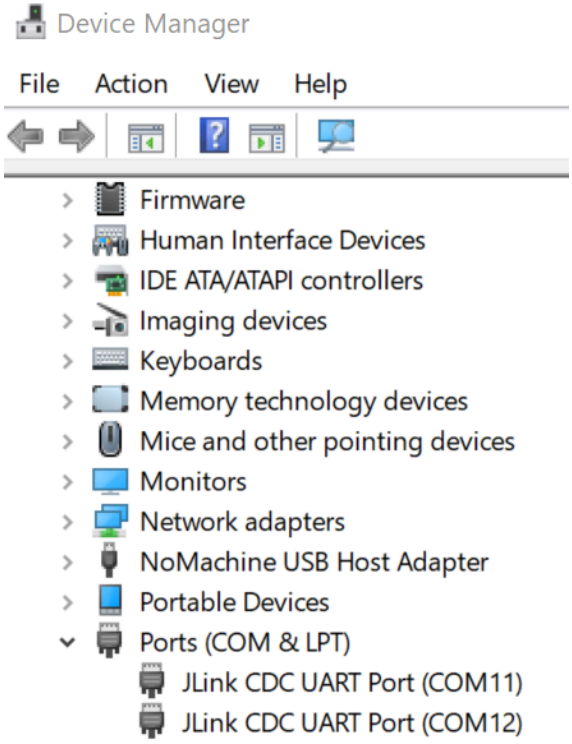

Figure 9 - New COM Ports from the ATM33/e and ATM34/e EVK

2.3 Running the RF Test Tool

Connect the ATM2/ATM3, ATM33/e, or ATM34/e EVK to a Windows laptop and execute `runui.bat`.

Command window pops up:

```
C:\RFtool\rftool_v1_6_16_2>rftool --gui
Main Thread 14712
[Warn]2025-05-19  not find .ini(AtmosicRFTool.ini) file
[Trace]2025-05-19 call enum_comport
[Trace]2025-05-19 Device-COM5, description-JLink CDC UART Port (COM5)
[Trace]2025-05-19 Device-COM6, description-JLink CDC UART Port (COM6)
```

Select the correct platform. Select the correct baud rate for the COM port. The default baud rate is configured as `460800/2000000` bps for the prebuilt HCI_vendor firmware image. Select a different baud rate if you have a different setting on a customized image. Click `Open COM` of RF Test Tool GUI to connect to the DUT. Then click the `Radio Test` item to enter the parameter setting windows as shown in Figure 10.

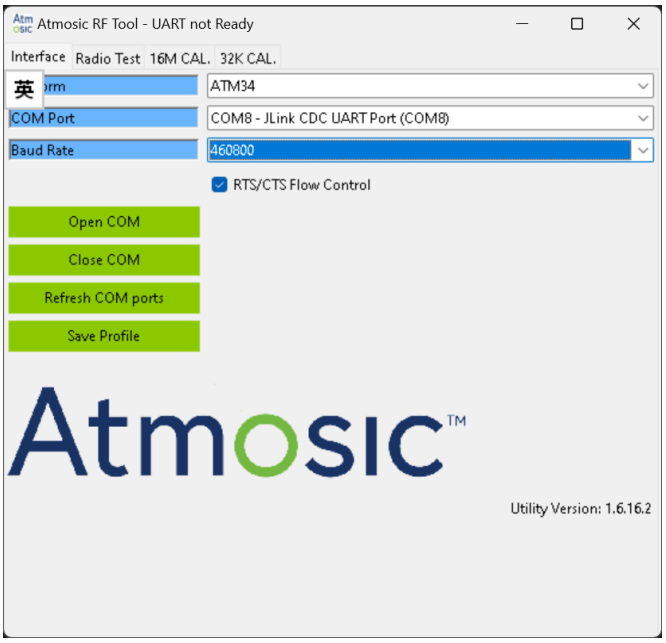

Figure 10 - RF Test Tool Interface Setting

Switch to the Radio Test Tab and click the Reset button on the RF Test Tool GUI.

If the command window shows that the `Reset` command was successful, you can control the EVK via the Atmosic RF Test Tool as shown in Figure 11.

If the command window does not show the successful message, close the RF Test Tool and re-open it to try another UART COM port.

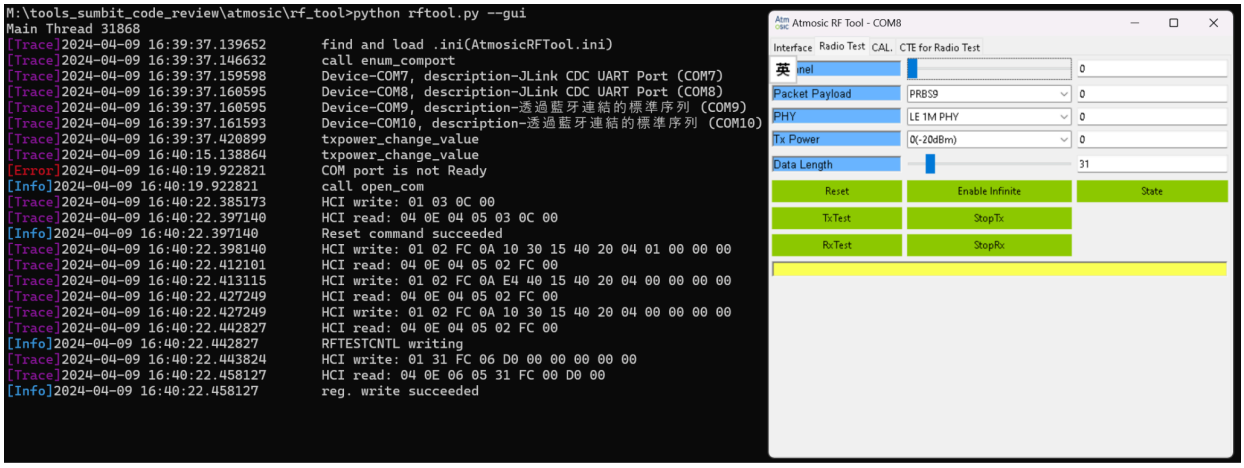

Figure 11 - Reset the EVK

3. RF Test Functions

The RF Test Tool can control the ATM2/ATM3, ATM33/e, or ATM34/e devices to enter Tx test mode or Rx test mode.

The Tx test includes three modes:

- Burst Tx mode
- Infinite Tx mode
- Single tone mode

Rx test mode supports counting the number of packets received through appropriate settings.

Figure 12 shows the RF Test Tool user interface and test items. Detailed descriptions of the test items are in Table 1.

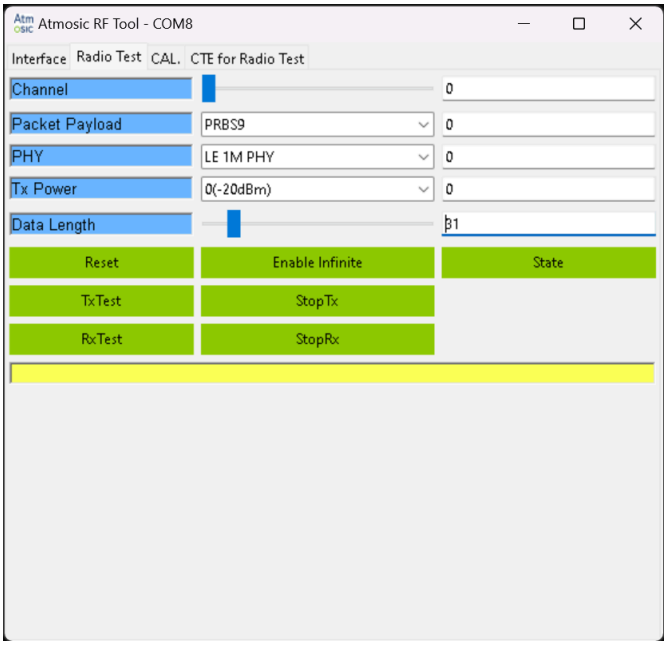

Figure 12 - RF Test Tool User Interface and Test Items

Name	Description	Notes
Channel	Bluetooth LE RF channel	There are 40 channels from CH0 (2402 MHz) to CH39 (2480 MHz). It can be adjusted by typing or by using the slider.
Packet Payload	Bluetooth LE standard packet payload format	Packet Payload includes: PRBS9/ 11110000 /10101010/ PRBS15/ 11111111/00000000/00001111/01010101
PHY	RF PHY	RF PHY includes: LE 1M PHY/ LE 2M PHY/ LE Coded PHY(S=2)/ LE Coded PHY(S=8) / Single Tone
Tx Power	Tx output power setting	The Tx output power level includes: 10 dBm/ 8 dBm/ 6 dBm/ 4 dBm/ 2 dBm/ 0 dBm/ -2 dBm/ -4 dBm/ -6 dBm / -8 dBm/ -10 dBm/ -20 dBm
Data Length	Payload length	The payload length range is from 1 to 255. It can be adjusted by typing or by using the slider
Reset	HCI reset command	HCI reset command: 0x01030C00
Enable Infinite (Disable Infinite)	Enable/Disable Infinite Tx mode	Enable or disable Infinite Tx mode. With this button, all the PHY settings can be defined as the “Infinite Tx mode” or” Burst Tx mode”.
State	Burst Tx mode or Infinite Tx mode	Display the infinite state in the command window. Infinite Tx mode, show “ infinite is 1”

Name	Description	Notes
		Burst Tx mode, show “ infinite is 0”
TxTest	Turn on the Tx function	Start transmitting the RF signal
StopTx	Turn off the Tx function	Stop transmitting the RF signal
RxTest	Turn on the Rx function	Start receiving the RF signal
StopRx	Turn off the Rx function	Stop receiving the RF signal

Table 1 - Radio Test Descriptions

3.1 Tx Test

Three modes are supported in the Tx Test:

- Burst Tx mode
- Infinite Tx mode
- Single tone mode

Figure 13 and Figure 14 show the ATM2/ATM3 EVK and ATM33/e or ATM34/e EVK Tx test environment, respectively.

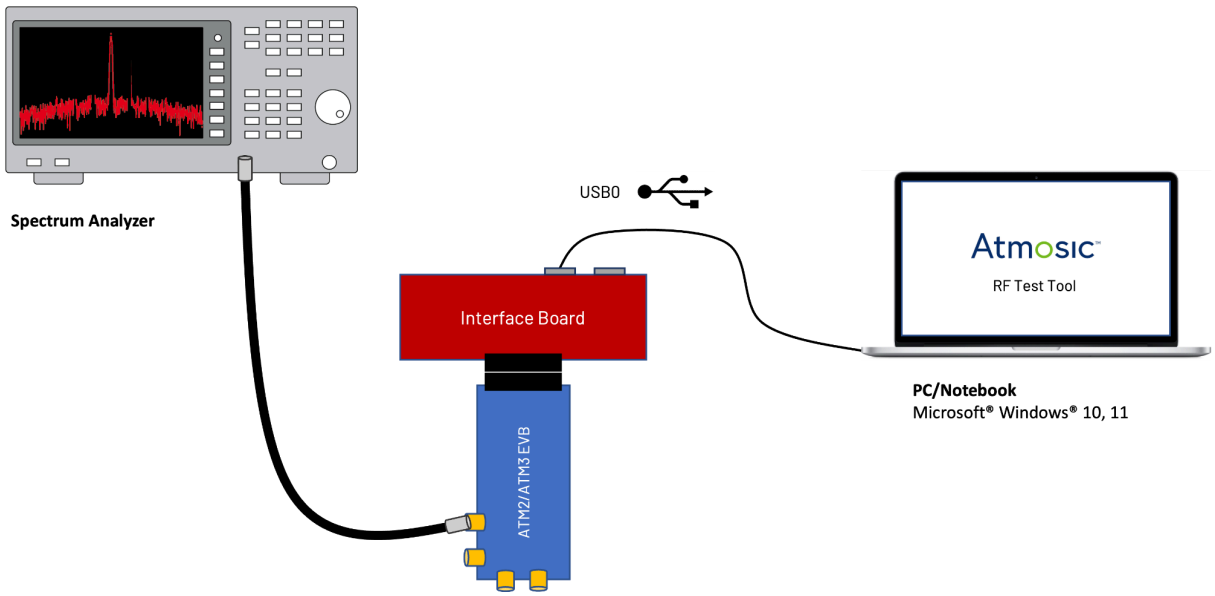

Figure 13 - ATM2/ATM3 EVK Tx Test Environment Setting

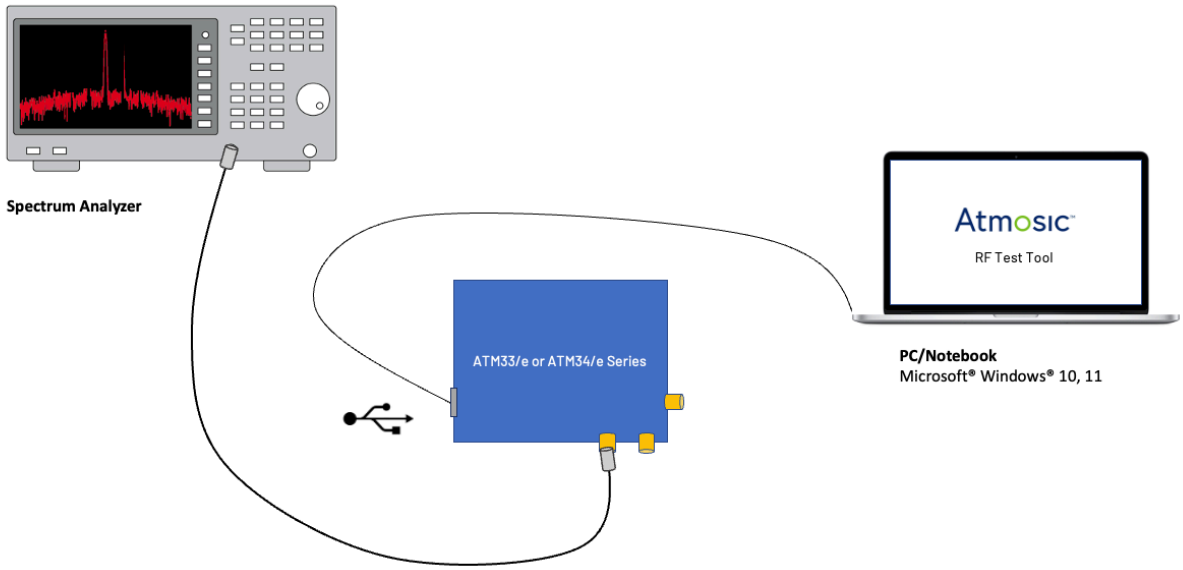

Figure 14 - ATM33/e or ATM34/e EVK Tx Test Environment Setting

3.1.1 Burst Tx Mode

In the default setting, when TxTest is selected, the burst-type modulation signal (duty cycle) will be sent to the RF port. Select an RF channel, RF PHY, Tx power level, and data length before pressing the TxTest button.

To change the transmission settings, first press StopTx to stop the RF signal transmission, then select a new transmission setting.

3.1.2 Infinite Tx Mode

- Select `Enable Infinite` to enable the Infinite Tx mode. When TxTest is selected, the continuous modulation signal (endless packet) will be sent to the RF port.
- Select an RF channel, RF PHY, Tx power level, and data length before pressing the TxTest button.
- To change the transmission settings, first press StopTx to stop the RF signal transmission, then select a new transmission setting.

3.1.3 Single-Tone Transmission

- Select the PHY setting and choose `Single Tone`. When TxTest is selected, the continuous single tone without modulation signal will be sent to the RF port.
- Select an RF channel and Tx power level before pressing the `TxTest` button.
- To change the transmission settings, first press StopTx to stop the RF signal transmission, then select a new transmission setting.

3.2 Rx Test

3.2.1 Rx Mode

- Select RxTest to enable the Rx mode.
- Select an RF channel, RF PHY before pressing the RxTest button.
- To change the Rx settings, first press StopRx to disable the Rx mode, then select new Rx settings.

4. Check the DUT RF Function Using the RF Test Tool

To check the Device Under Test (DUT) RF function without a Bluetooth LE tester, prepare a reference unit such as the ATM3330e EVK and a DUT.

Open two instances of RF Test Tool on the same PC, then control the reference unit and the DUT on separate instances.

Figure 15 and Figure 16 illustrate the test environments for the ATM2/ATM3, ATM33/e, and ATM34/e, respectively.

Set the reference unit into Burst Tx mode to verify the DUT in Rx mode. Then, swap the test to set the reference unit into Rx mode to verify the DUT in Burst Tx mode.

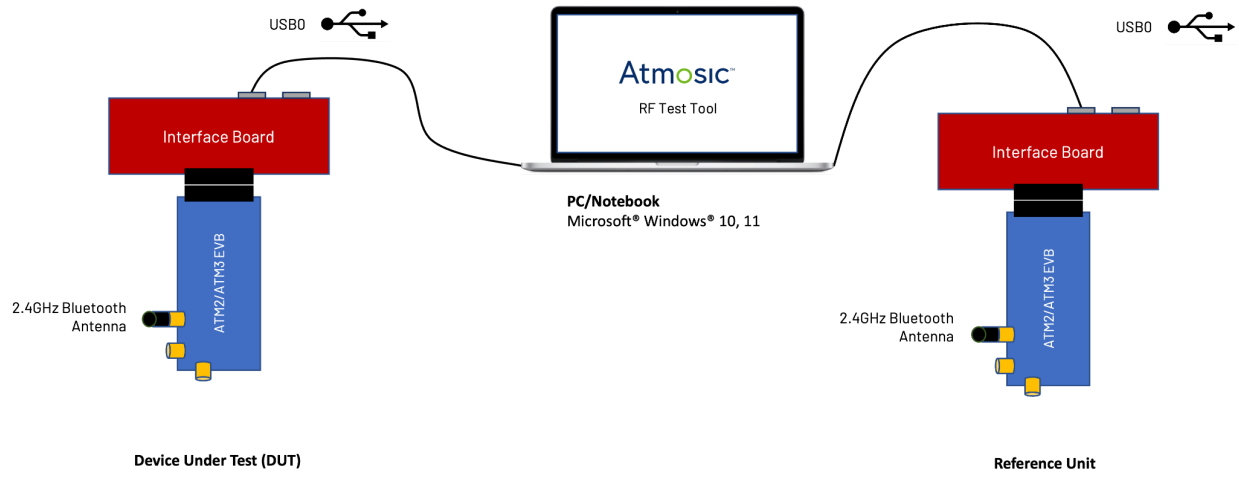

Figure 15 - Test Environment to Check DUT RF Function Using RF Test Tool for the ATM2/ATM3

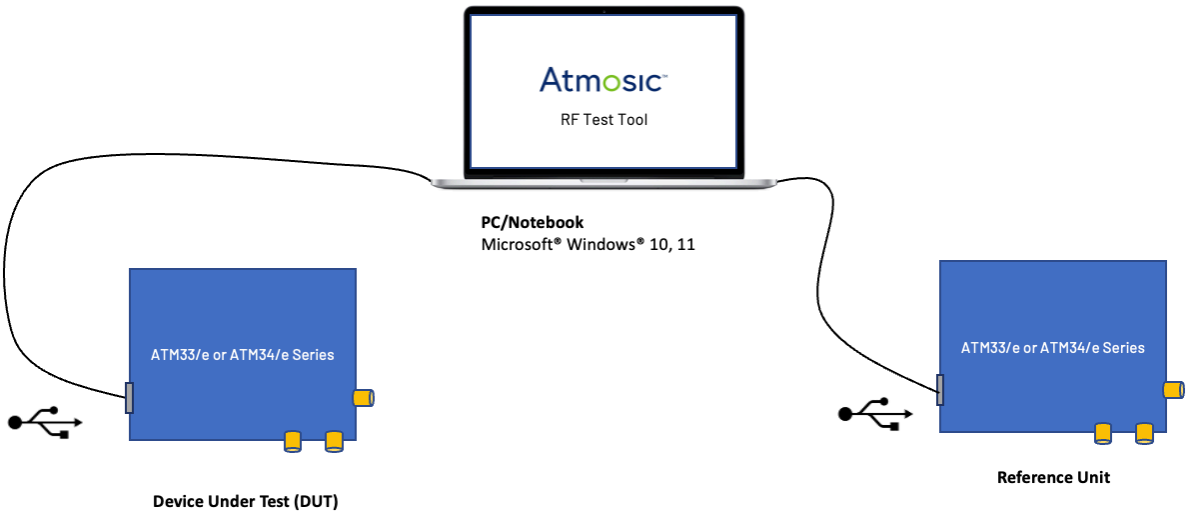

Figure 16 - Test Environment to Check DUT RF Function Using RF Test Tool for the ATM33/e or ATM34/e

5. 16 MHz Crystal Calibration Using RF Test Tool

The 16 MHz crystal is used in Bluetooth LE devices. Bluetooth devices use a crystal oscillator to generate a stable reference frequency for the system clock. The crystal's frequency needs to be accurately calibrated to ensure that the Bluetooth device's radio signals are transmitted and received at the correct frequency.

This tool also provides a feature to aid the calibration flow. The setup is the same environment as the Tx Test section. Enter the CAL. page in the tool, input the channel you would like to calibrate, and the tool will pop up a window to guide you through the process. You may need to input the frequency bias you observe from the spectrum analyzer in several iterations. See Figure 17.

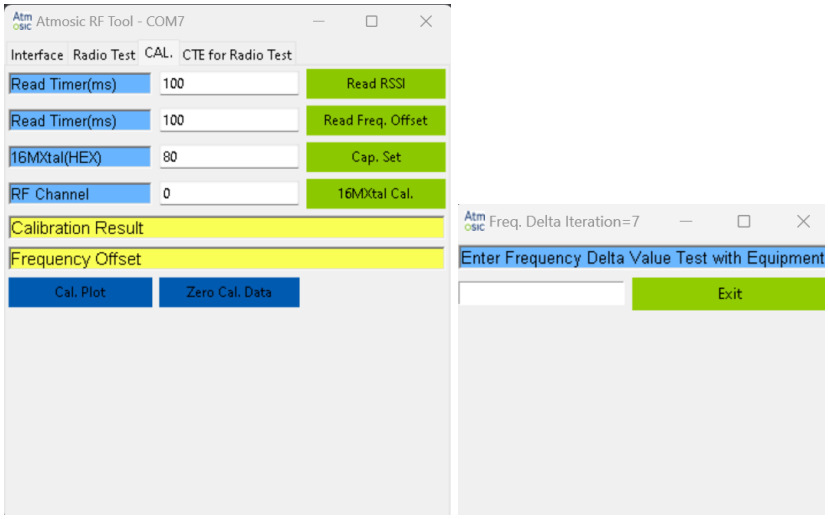

Figure 17 - Calibration iterations in RF Tool

Once the iterations are done, if you are satisfied with the calibration result, you can write back the calibration adjustment parameter the tool suggests by inputting the value and clicking Cap. Set. See Figure 18.

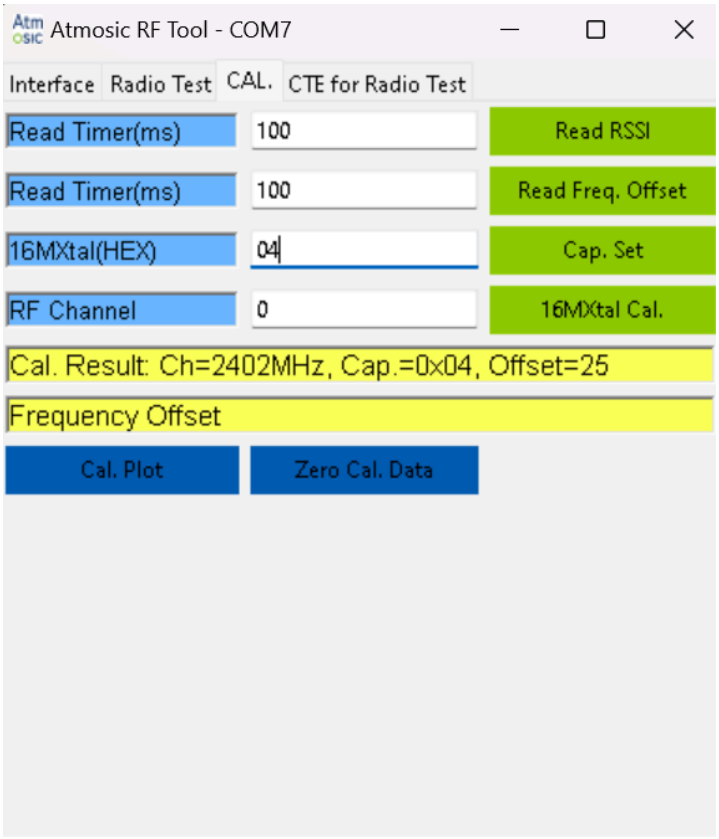

Figure 18 - Calibration result in RF Tool

6. ATM33/ATM34 32 kHz Crystal Calibration

This tool also provides a feature to aid the 32.768 kHz crystal calibration flow. The signal can be observed from a spectrum analyzer by measuring the 32.768 kHz clock signal from the pin defined in the PIN Sel assignment setting. Click the `Pin Out Set` button after selecting the available target pin, which may vary depending on the design. The calibration value ranges from 0x00 to 0x1F (default is 0x1B). Click the Cap. Set the button after entering the value up/down during the calibration until the signal seen at the spectrum analyzer is centered correctly at 32.768 KHz.

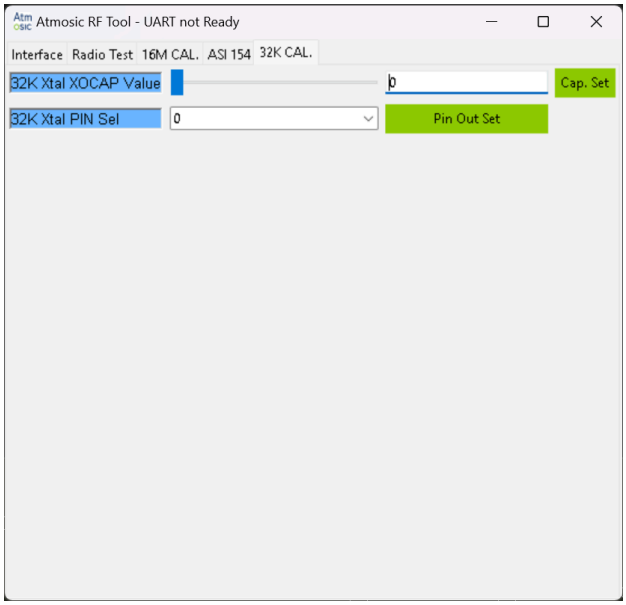

Figure 19 - 32 kHz calibration

7. Change UART0 Pins

The UART0 pins are configurable. If your board design is different from the default settings, follow the instructions below to change it for different SDK environments.

7.1 Change UART0 Pins for Atmosic Bare Metal SDK

Modify the UART0 configuration in the makefile under the hci_vendor folder to change the default setting.

```
CFLAGS += -DPIN_UART0_TX=19 \
        -DPIN_UART0_RX=28 \
        -DPIN_UART0_RTS=17 \
        -DPIN_UART0_CTS=16 \
        -DHCI_UART_BAUD=115200 \
```

7.2 Change UART0 Pins for Zephyr

Modify the UART0 configuration in BOARD.dts under the boards folder to change the default setting.

```
&uart0 {
        rx-pin = <30>;
        tx-pin = <15>;
        rts-pin = <13>;
        cts-pin = <12>;
};
```

References

Title	Document Number
EVK User's Guide for ATMx301/ATMx202	ATMx201-UG
EVK User's Guide for ATMx221	ATMx221-UG
ATM33/e Series Evaluation Kit User Guide	ATM33_e-UGEVK
ATM34/e Series Evaluation Kit User Guide	6441-xxxx-xxxx
	Link
Zadig Driver	Version 2.4

Revision History

Date	Version	Description
May 22, 2025	0.63	Update for RF Tool version 1.6.16.3 Add 32 KHz Crystal calibration for ATM33/34
April 22, 2024	0.62	Update for RF Tool version 1.6.16.1. Remove plotting Rx NOP statistics and support ATM34/e 802.15.4 RF Test.
March 17, 2023	0.60	Updated for RF Tool version 1.6.5. Updated Table 2 - Supported ATM33/e SoCs and EVKs, Setup Software, Install WinUSB Driver Using Zadig, Program Firmware, UART Ports, Burst Tx Mode, Infinite Tx Mode, added 16 MHz Crystal Calibration Using RF Test Tool sections.
March 21, 2022	0.54	Updated for RF Tool version 1.6.0. throughout this document.
August 23, 2021	0.53	Updated baud rate in Figure 10 - RF Test Tool Interface Setting.
April 14, 2021	0.52	Updated format, no content change.
December 2, 2020	0.51	Corrected typos.
June 15, 2020	0.50	Initial version created.

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