BlueIO832Mini

User Guide

Abstract

We provide a brief overview of the features of BlueIO832Mini and its specifications. Next, we present the steps of setting up BlueIO832Mini as a serial interface bridge between BlueIOTerm mobile application and an arbitrary physical device. Finally, we introduce the users the resources for self-developing their own firmware on the BlueIO832Mini.

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Contents

Revision History

Table 1. Document Revision

Revision no.	Description	Data	Prepared by	Approved by
1.05	5th draft	May 04, 2023	Duy Thinh Tran	

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Limited Warranty

The BlueIO832Mini board is warranted against defects in materials and workmanship for a period of 30 days from the date of purchase from I-SYST or from an authorized dealer.

Disclaimer

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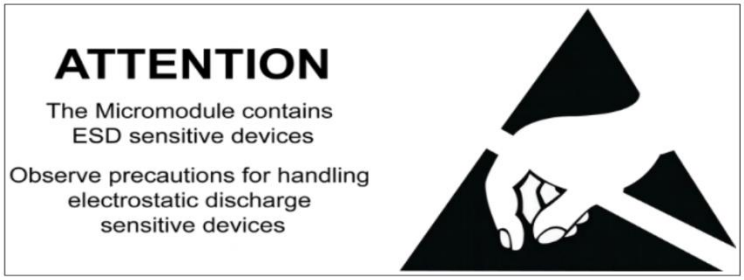
Trademark

ARM® Cortex™ are registered trade mark of ARM
Bluetooth® is a registered trade mark of Bluetooth SIG



I. Overview to BlueIO832Mini

1. Key features of BlueIO832Mini and the BlueIO ecosystem

The BlueIO832Mini and the free BlueIO mobile apps suite constitute to the I-SYST BlueIO ecosystem. This versatile Internet-of-Thing (IoT) framework enables users, from their mobile device such as a smart phone, to wirelessly communicate with an arbitrary physical device - referred to as a *target device* in this document (Fig. 1). BlueIO832Mini and BlueIO mobile app are considered as a data bridge and a data terminal, respectively. After connecting to the target device via a desired serial interface, BlueIO832Mini streams the data on that physical interface to the BlueIO mobile app over Bluetooth® 5 protocol. BlueIO832Mini provides four built-in app-configurable features of data communications with a target device:

- **[1] Serial interface bridge: (i)** Connect BlueIO832Mini to a serial interface (UART, I2C, or SPI) of a target device. **(ii)** Pair BlueIO832Mini with BlueIO mobile app on a mobile device. **(iii)** Configure the serial interface setting in BlueIO mobile app. **(iv)** Use BlueIO mobile app to wirelessly send and receive data on this interface.

- **[2] GPIO functions: (i)** Use BlueIO mobile app to configure pins of BlueIO832Mini as GPIO for sending/receiving signal to/from a target device. **(ii)** Pair BlueIO832Mini with BlueIO mobile app on a mobile device. **(iii)** Use BlueIO mobile app to send/receive signals(s) to/from the GPIO pin(s).

- **[3] Analog-to-Digital Converter (ADC): (i)** Use BlueIO832Mini to convert (up to 3) analog signals to digital signals. **(ii)** Pair BlueIO832Mini with BlueIO mobile app on a mobile device. **(iii)** Use BlueIO mobile app for monitoring the converted digital signals.[1]

- **[4] NFC tag:** BlueIO832Mini can be used as an NFC tag once a Nordic®-compatible NFC antenna is plugged into the NFC connector. [2]

Besides that, BlueIO832Mini can be used as an **IoT embedded development kit** for developing the user's own firmware by using Nordic® SDK. However, we recommend the user to use our open-source library **IOsonata**, which is built upon the Nordic® SDK, for faster and easier developing firmware on BlueIO832Mini and any other Nordic® nRF52x SoC-based embedded system. Here are useful references for the IOsonata SDK and the guides on firmware development with IOsonata:

- IOsonata is available on this Github link.
- The steps of developing firmware with IOsonata SDK are available on this blogpost.
- For debugging the firmware built upon IOsonata in Eclipse® IDE, please refer to this blogpost.

Note 1, 2: *Feature [3] and [4] are not enabled in the current built-in firmware version.*

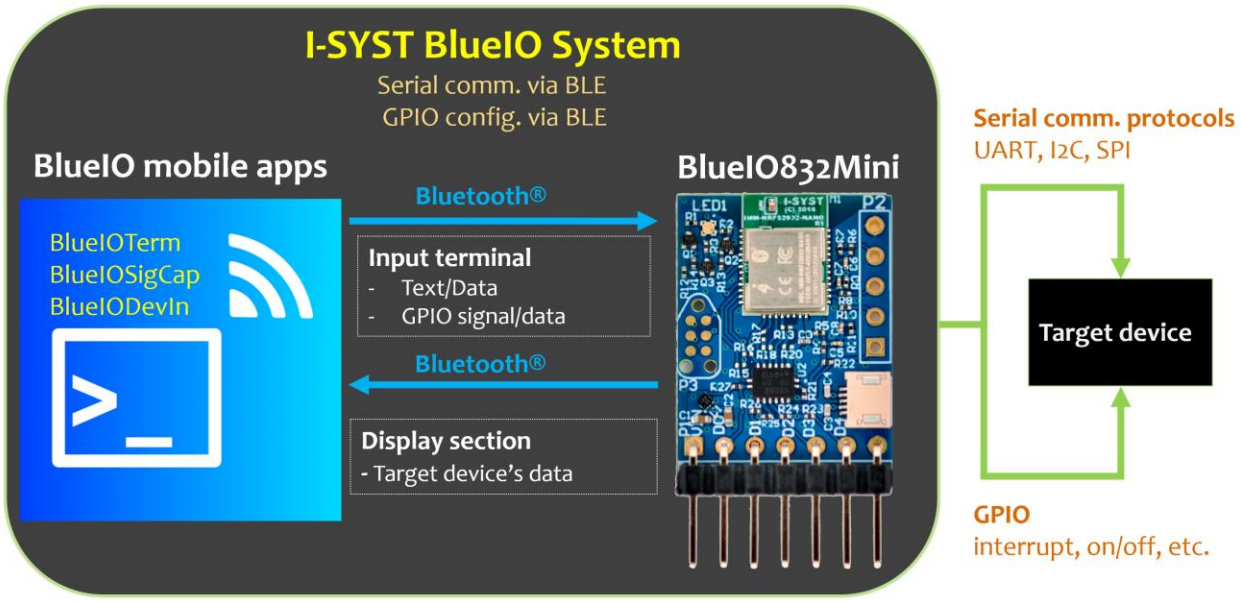


Fig. 1. The I-SYST BlueIO system with BlueIOTerm mobile app and BlueIO832Mini hardware module.

2. Hardware Specification and Pin Layout

The heart of BlueIO832Mini is the **I-SYST BLYST Nano (IMM-NRF52832-NANO)** System-on-Module (SoM) built upon the Nordic® nRF52832 System on Chip (SoC), which is an ultra-low power 2.4 GHz wireless SoC. This Soc is equipped with 64 MHz ARM® Cortex®-M4F processor, 64 KB RAM, 512 KB flash memory. The SoC provides several serial interfaces such as UART, I2C, SPI and especially the Bluetooth® 5 low-energy mode. For more details of the I-SYST BLYST Nano, please refer to this webpage. The detail specifications of Nordic® nRF52832 SoC can be downloaded from the Nordic's website.

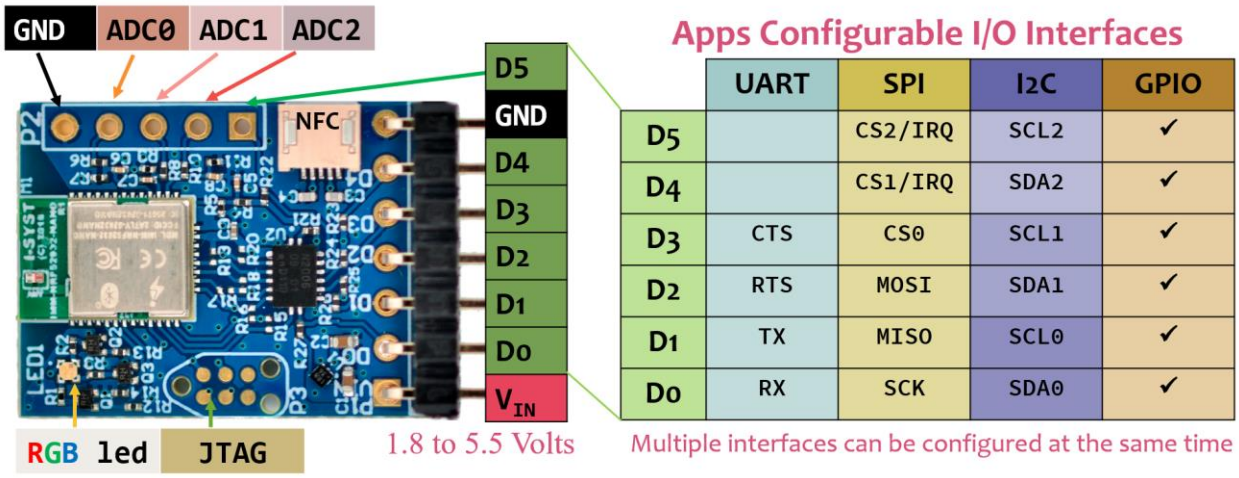
BlueIO832Mini supports:

- Bluetooth® 5 low energy (BLE) mode
- A wide range of supply voltage ranging from 1.8 to 5.5 volts [V_{IN}]
- Internal level shifter supporting GPIO voltage matching the supply voltage
- 6 x pins [D0 – D5] which can be configured (via BlueIOWizard mobile app) as
    - 1 x UART
        - Baud rates up to 1000000 (1M baud)
        - Hardware flow control
        - Bit parity
    - 3 x I2C master
        - 100 kbps, 250 kbps, 400 kbps
    - 3 x SPI master
        - 125 kbps, 250 kbps, 500 kbps
        - 1 Mbps, 2 Mbps, 4 Mbps, 8 Mbps
    - 6 x GPIO with configurable parameters:
        - Direction
        - Drive strength
        - Pull-up/pull-down resistors enabling

    - Pin sensing
- 3 x Configurable ADC channels [ADC0 – ADC2]
    - Max input voltage 1.8V
    - 12-bit resolution
    - 1 differential mode
    - 3 independent channels
- NFC antenna socket
    - Works with any Nordic®-compatible NFC antenna
- JTAG
    - A 6-pin JTAG connector on the front side
    - An ARM® 10-pin CoreSight® JTAG connector on the back side

The pins and connectors layout of BlueIO832Mini are shown in Figs. 2 and 3.

Depending on the use case and the specifications of the user's target device, pins D1-D4 on BlueIO832Mini can be configured for UART, SPI, I2C or GPIO by using BlueIOWizard mobile app. Please follow Figs.2 and 3 for the appropriate pin assignment.



	UART	SPI	I2C	GPIO
D5		CS2/IRQ	SCL2	✓
D4		CS1/IRQ	SDA2	✓
D3	CTS	CS0	SCL1	✓
D2	RTS	MOSI	SDA1	✓
D1	TX	MISO	SCL0	✓
D0	RX	SCK	SDA0	✓

Fig. 2. Pin layout of BlueIO832Mini on the front side

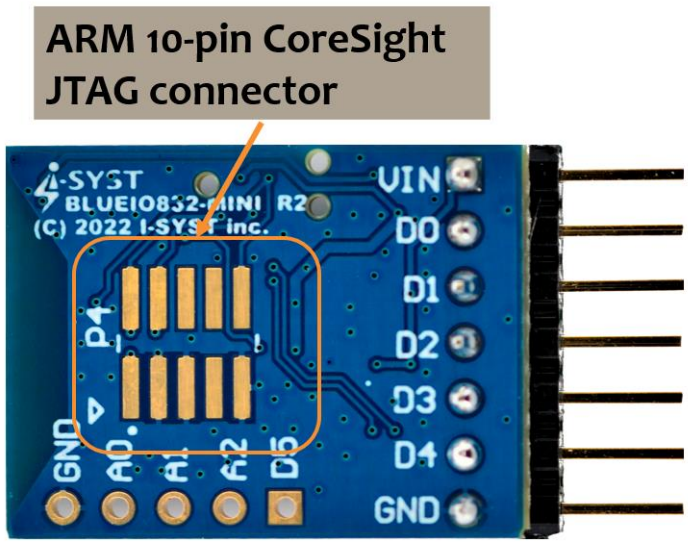


Fig. 3. Pin layout of BlueIO832Mini on the back side

II. BlueIO Mobile Application Suite

In our BlueIO ecosystem, we provide a set of multi-platforms BlueIO mobile apps tailored for different use cases of the BlueIO832Mini. These mobile apps can be installed on smartphones, smartwatches, and tablets. Table I presents the use cases of each mobile app. Table II presents the availability of the mobile apps on different the platforms.

Table 2. BlueIO mobile apps and the use cases

App Name	Use Cases					Pin configurable
	UART	SPI	I2C	GPIO	ADC	
BlueIOTerm	✓					No (*)
BlueIOSpi		✓				No
BlueIOI2c			✓			No
BlueIOAdc					✓	No
BlueIODevin	✓	✓	✓	✓		Yes - App configurable

(*): The pins are pre-configured as in Fig. 2.

Table 3. BlueIO mobile apps and their support platforms

	Smart Phone		Tablet	
App Name	Apple® iOS	Android	Apple® ipadOS	Android
BlueIOTerm	✓	✓	✓	✓
BlueIOSpi				
BlueIOI2c				
BlueIOAdc				
BlueIODevin				

III. Using BlueIOTerm Mobile App with BlueIO832Mini

We present an example using BlueIOTerm and BlueIO832Mini for communicating with a target device over its UART interface. Here, the target device is a serial port app on a computer, which is then connected to BlueIO832Mini via a USB-UART adapter. We present how to send text between the BlueIOTerm mobile app and the serial port app, typically CoolTerm in this example, on a computer (Fig. 4).

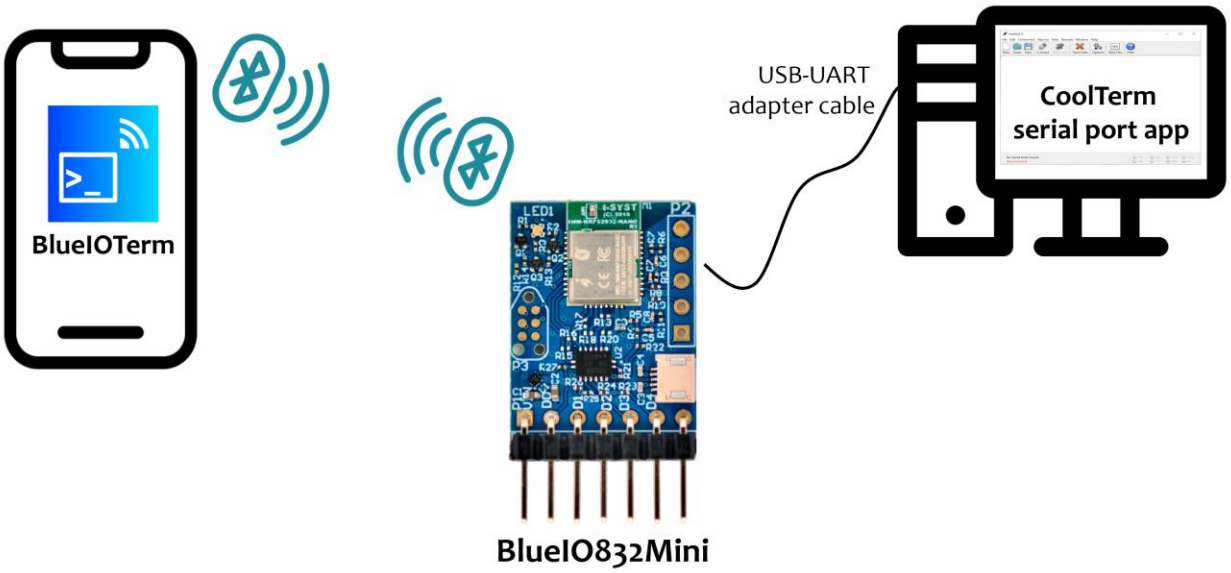


Fig. 4. Example setup

1. Connect BlueIO832Mini to the USB-UART adapter

(i) Identify the pins of the UART port of the USB-UART adapter. In Fig. 5, the adapter consists of four wires. The green and white wires are UART_TX and UART_RX, respectively. The red and black wires are 5V and GND, respectively.

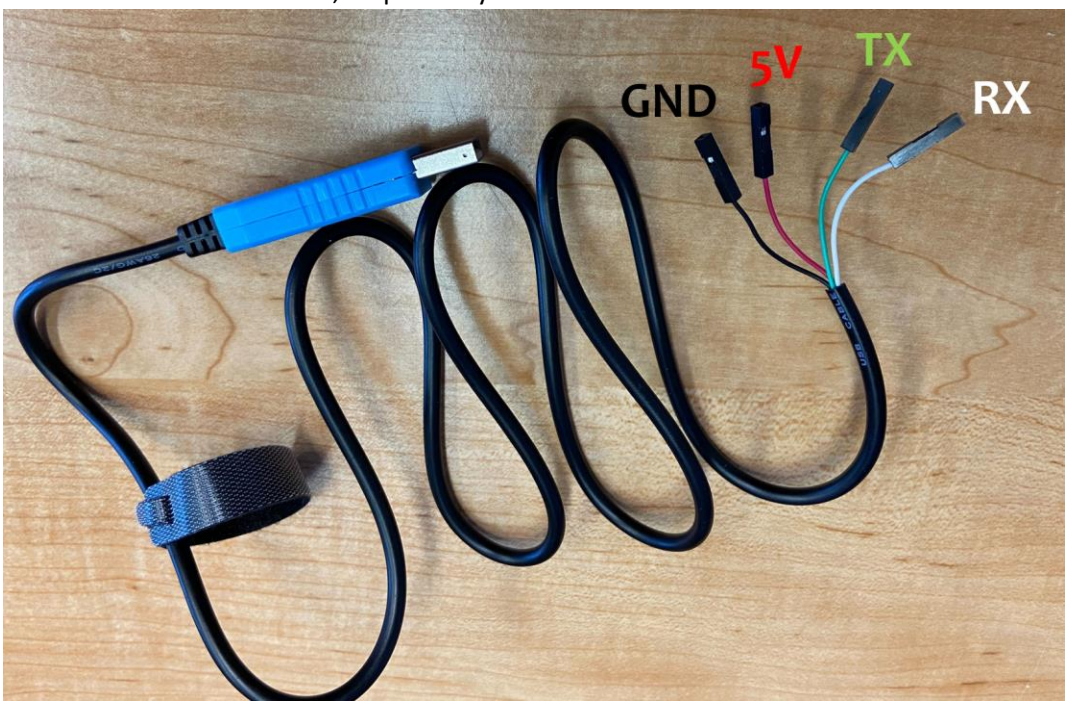
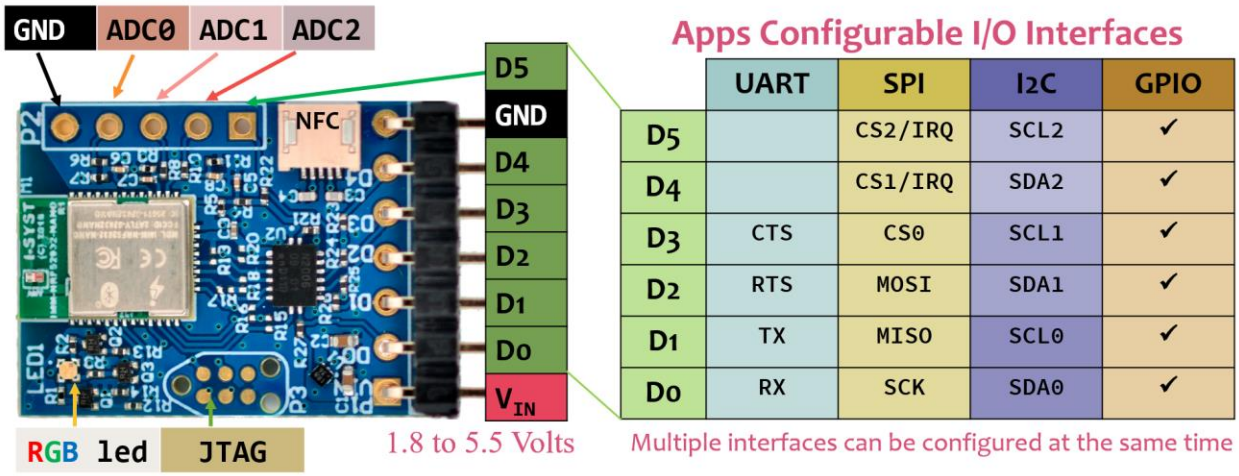


Fig. 5. UART's pins on USB-UART adapter. UART-TX (Green), UART-RX (White), 5V power supply (Red), and Ground (Black)

(ii) Based on the pin assignment table in Fig. 6, connect the BlueIO832Mini pins D0 and D1 to the green and white wires of the USB-UART adapter (Fig. 7).



	UART	SPI	I2C	GPIO
D5		CS2/IRQ	SCL2	✓
D4		CS1/IRQ	SDA2	✓
D3	CTS	CS0	SCL1	✓
D2	RTS	MOSI	SDA1	✓
D1	TX	MISO	SCL0	✓
D0	RX	SCK	SDA0	✓

Fig. 6. BlueIO832 pin assignment

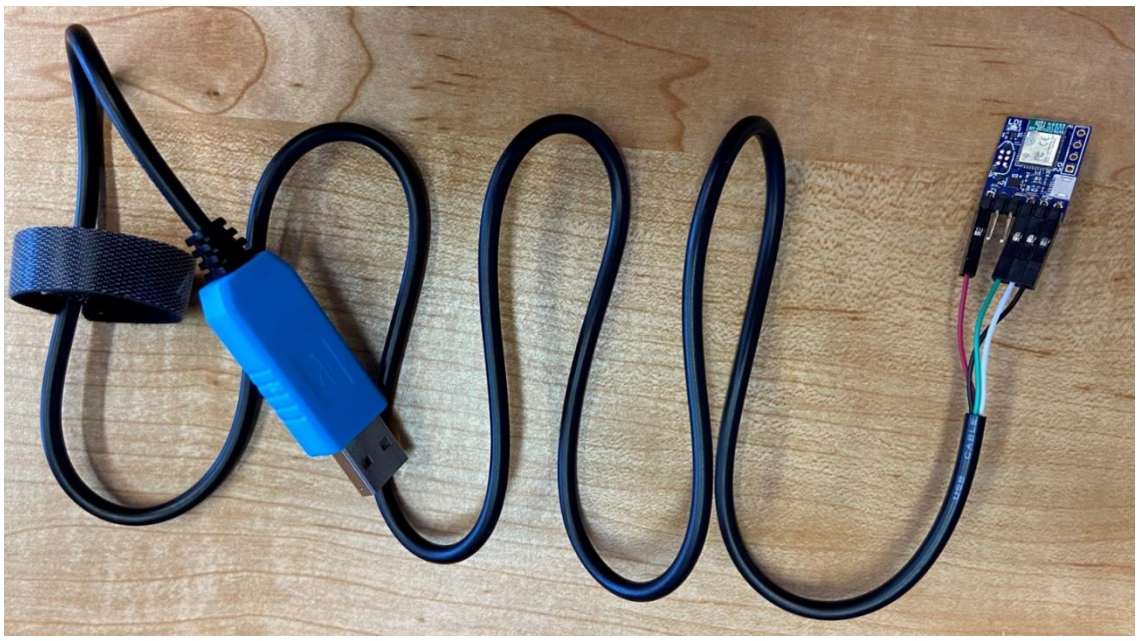


Fig. 7. Connect BlueIO832Mini with a USB-UART adapter. The 5V and GND wires can be used for powering BlueIO832Mini thanks to its internal level shifter.

(iii) Plug the USB port of the USB-UART adapter to the user's computer. Install and open CoolTerm serial port app. In the CoolTerm Options menu → Serial Port Options, select the COM port number assigned for the USB-UART adapter, apply the UART parameters including baudrate, parity, stop bits, flow control to Serial Port Options, and then click OK (Fig. 8). Note that the value of Data Bits is always 8. In this demo, the baud rate is 115200, no flow control, and no bit parity, 8-bit data frame.

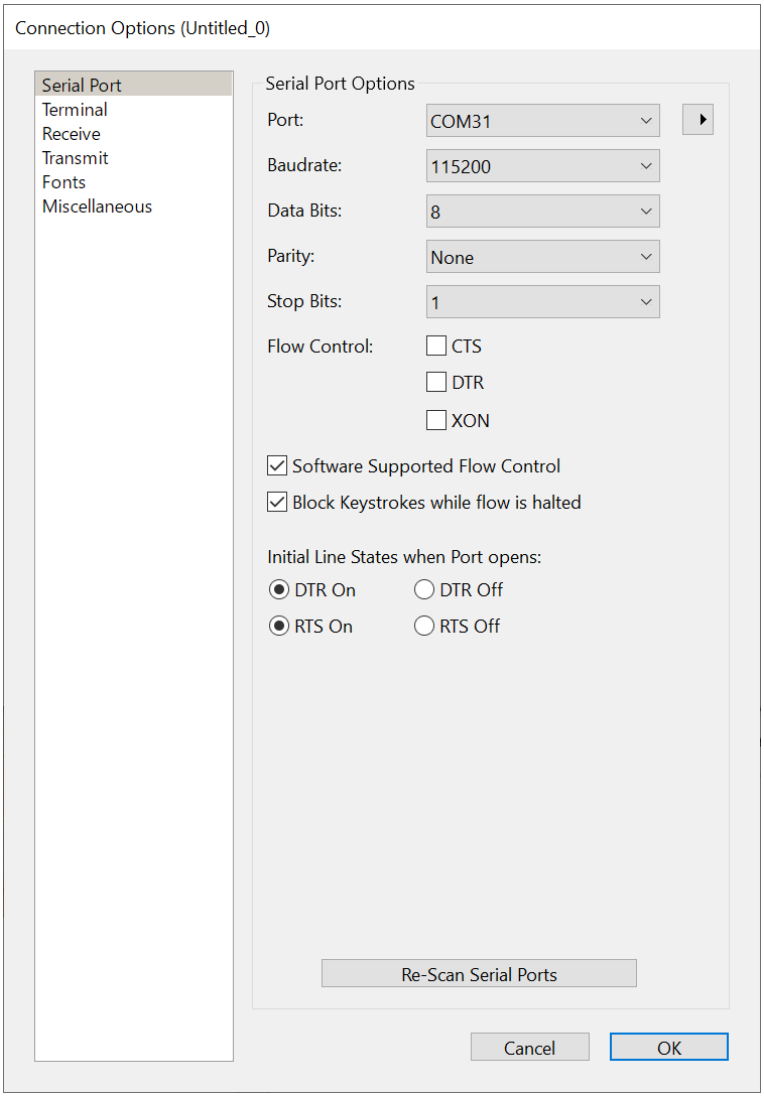


Fig. 8. Setting UART's parameters in CoolTerm.

2. Download and install the BlueIOTerm on mobile device

1. Install the BlueIOTerm on the user's mobile device. User can scan the following QR codes for directly downloading and installing BlueIOTerm on Apple® AppStore and Google® Play app store.

BlueIOTerm app on Apple Store

BlueIOTerm app on Google Play

2. The CoolTerm serial port app can be downloaded from https://freeware.the-meiers.org/

3. Using BlueIOTerm with BlueIO832Mini

(i) Turn on the Bluetooth® feature in the user's mobile device.

(ii) Open the BlueIOTerm mobile app. The main user interface is shown in Fig. 9.

(iii) Fig. 9 shows the three steps for connecting the app with a BlueIO832Mini device.

1. Tap "SCAN" button to search for any existing BlueIO832Mini device. If a BlueIO832Mini device is found, the app displays "BlueIO832Mini" onto the Select Device section.
2. Tap the "Select device" window for selecting other BlueIO832Mini device.
3. Tap "Connect" for connecting the app with the chosen BlueIO832Mini device.

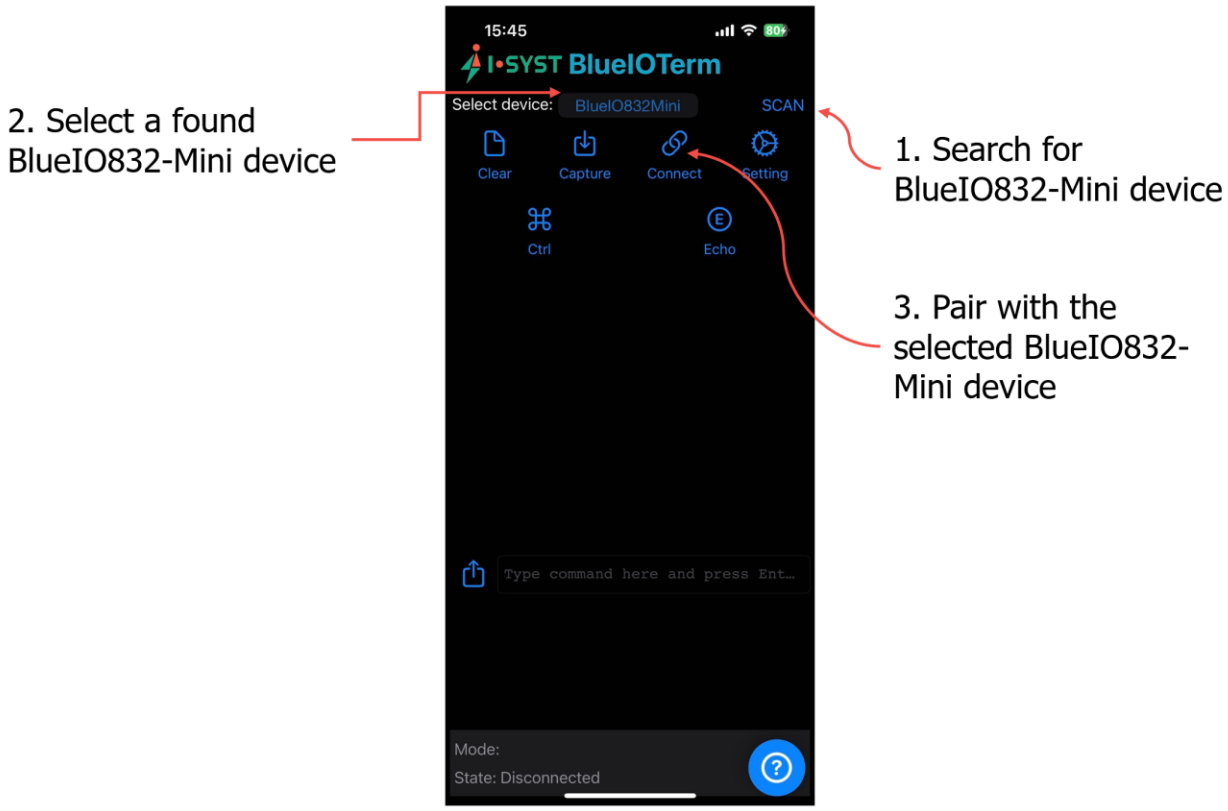


Fig. 9. Main user interface of BlueIOTerm. Search for and connect to a BlueIO832Mini with BlueIOTerm.

(iv) After connecting BlueIOTerm with the selected BlueIO832Mini, the user can send and receive data between the app and the target device (CoolTerm app in this example). BlueIO832Mini plays as a Bluetooth-UART bridge between BlueIOTerm and the target device.

(v) Fig. 10 illustrates the explanation of other buttons in the BlueIOTerm app. From now, the user can send/receive data to/from the target device.

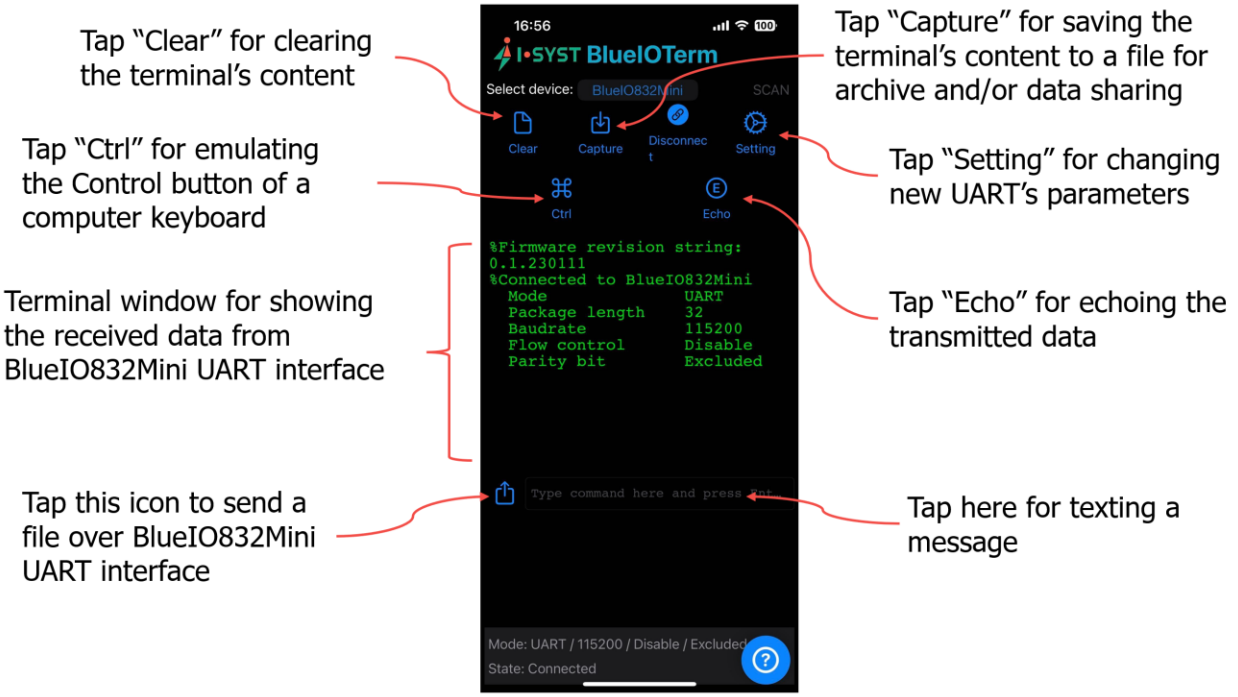


Fig. 10. Explanation of BlueIOTerm buttons

(vi) To change the UART parameters, tap "Setting" to go to the UART configuration setting menu. The UART parameters shown in the menu are the current settings (Fig. 11).

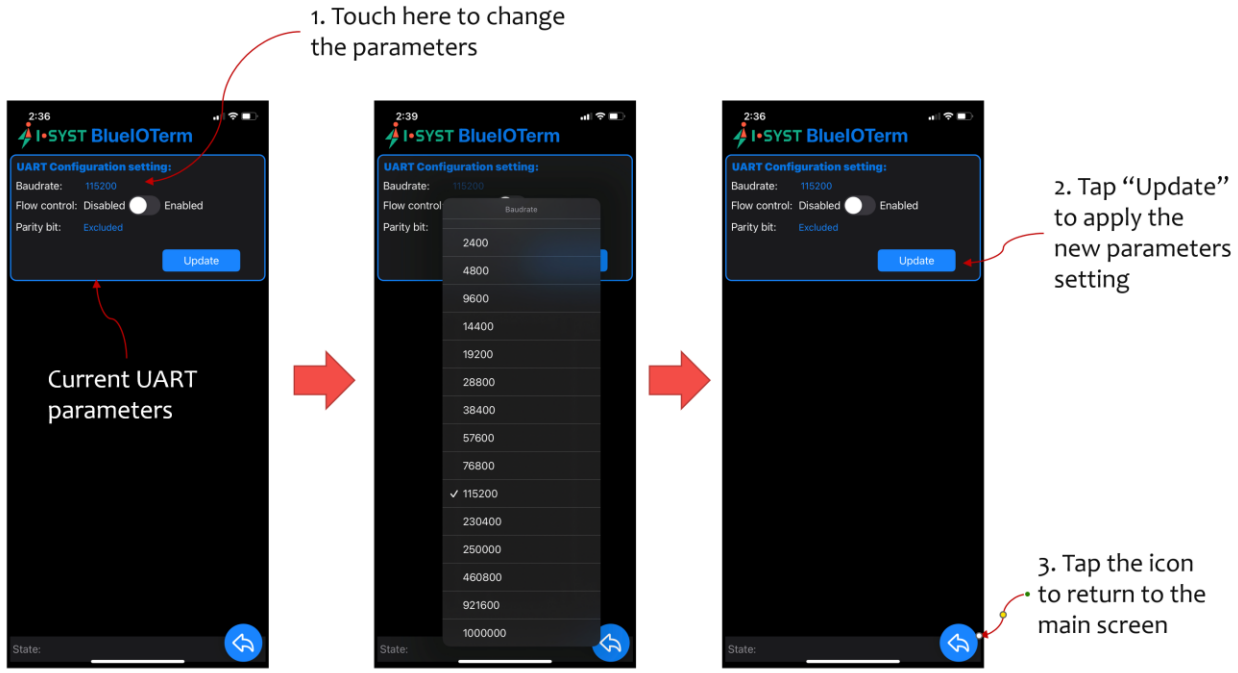


Fig. 11. Change UART parameters in BlueIOTerm.

IV. Using BlueIOSigCap Mobile App with BlueIO832Mini

BlueIO832Mini in accompanied with BlueIOSigCap mobile app can capture analog and digital signals and display them on user's smartphone. The steps are presented in the followings.

1. Feed Analog and Digital Signals to BlueIO832Mini

First, user needs to connect the analog and digital signals with the BlueIO832Mini, as shown in Fig. 12.

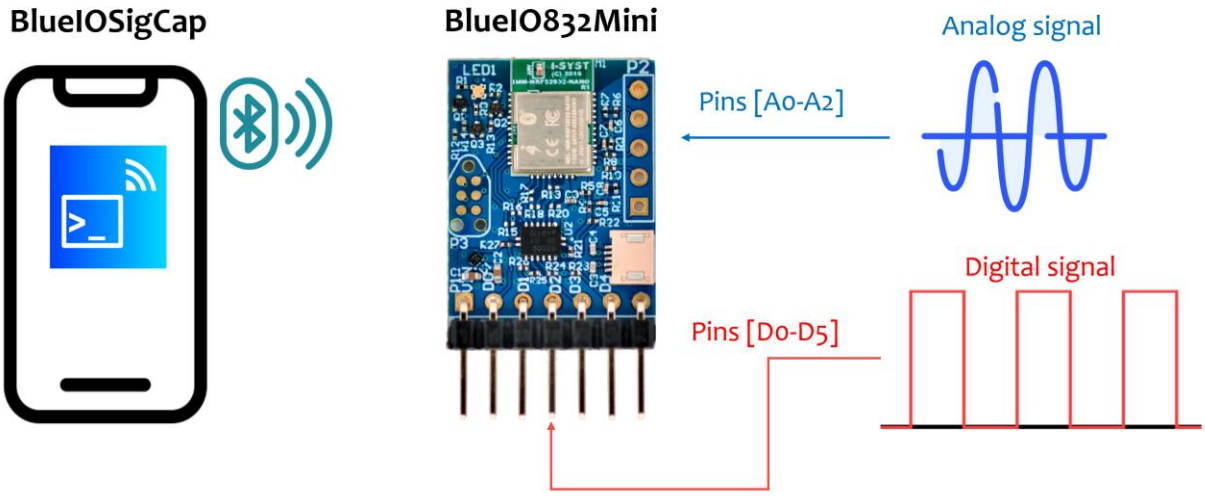


Fig. 12. Analog signals are fed to pins A0 - A2 and digital signals are fed to pins D0 – D5 of BlueIO832Mini

2. Download and Install BlueIOSigCap App on Mobile Phone

User can scan the following QR codes for directly downloading and installing BlueIOSigCap on Apple® AppStore and Google® Play app store.

3. Using BlueIOSigCap with BlueIO832Mini

(i) Turn on the Bluetooth® feature in the user's mobile device.

(ii) Open BlueIOSigCap on the user's smartphone. The main user interface is shown in Fig. 13. There are three main steps for connecting with a BlueIO832Mini device:

1. Tap "SCAN" for searching for BlueIO832Mini.
2. If there exists multiple BlueIO832Mini(s), user can tap the "Select device" scroll list for choosing the preferred one.
3. Tap "Connect" for pairing the app with the selected BlueIO832Mini.

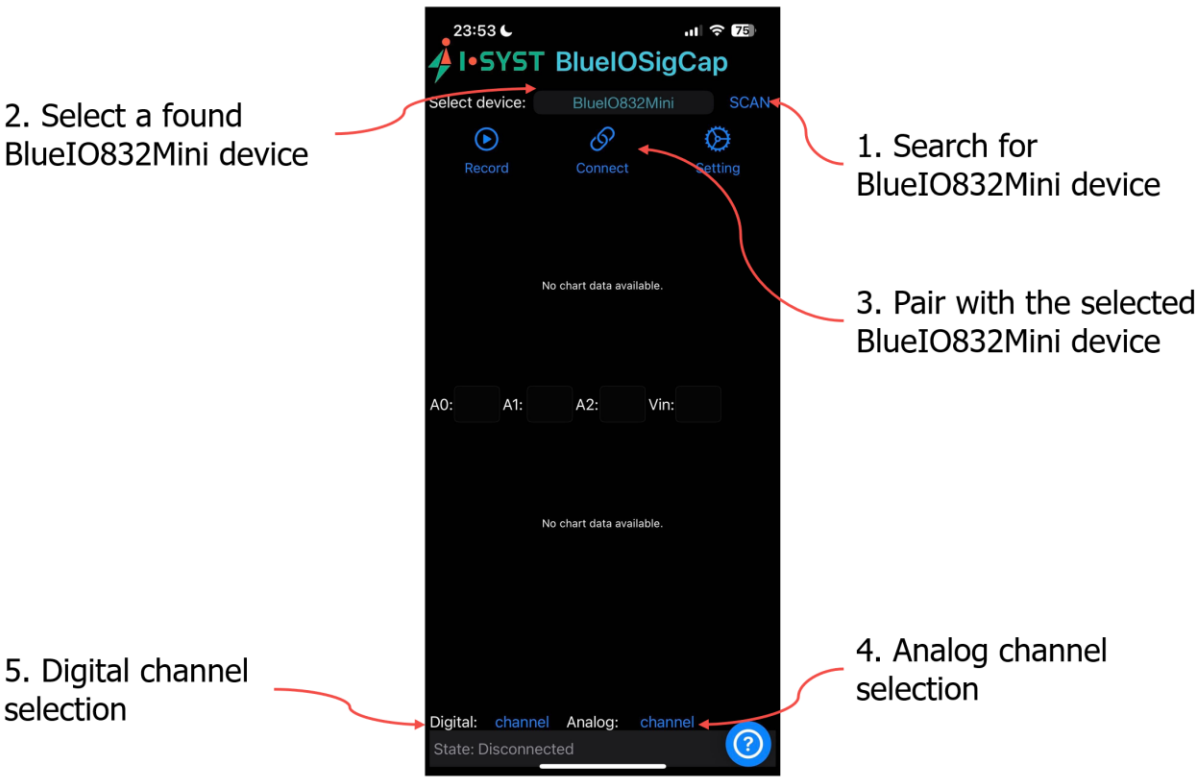


Fig. 13. Main user interface of BlueIOSigCap

(iii) After pairing, the user taps the "Digital" and "Analog" drop-list for selecting the digital and analogs channels for displaying captured data on the app as shown in Fig. 14.

(iv) After selecting preferred channels, the captured data is displayed on the app as shown in Fig. 15.

(v) The user can save the captured data on the phone and/or share it to other people by tapping "Record".

(vi) To stop the data capture, the user un-checks all the selected channel in the "Digital" and "Analog" drop-list.

(vii) Note that, before unpairing the app and BlueIO832Mini, the user must un-check all the selected analog and digital channel before tapping "Disconnect" button.

(viii) To configure the new sample rate and analog configuration, the user taps "Setting" as shown in Fig. 16.

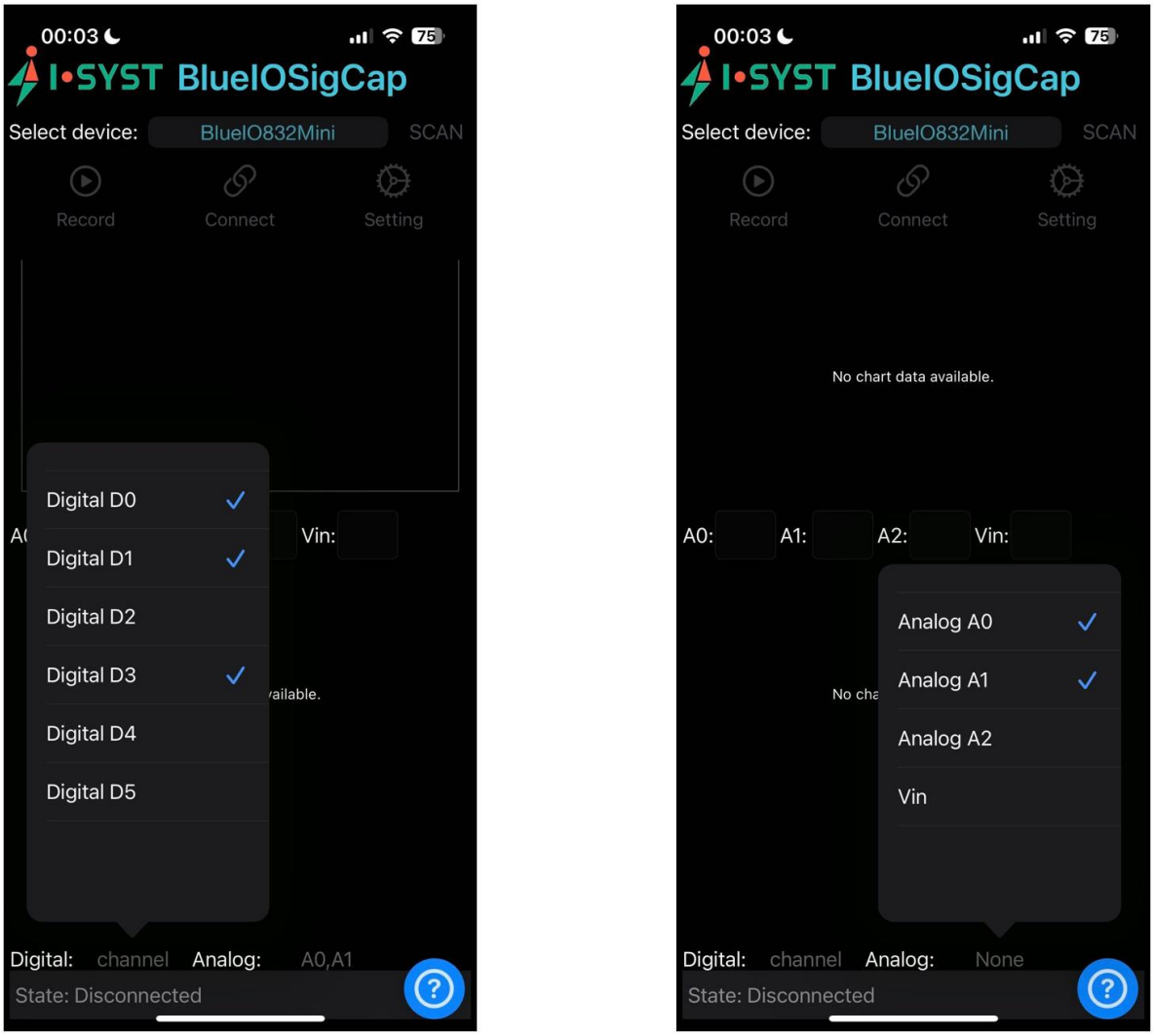


Fig. 14. Digital channel selection (left) and Analog channel selection (right)

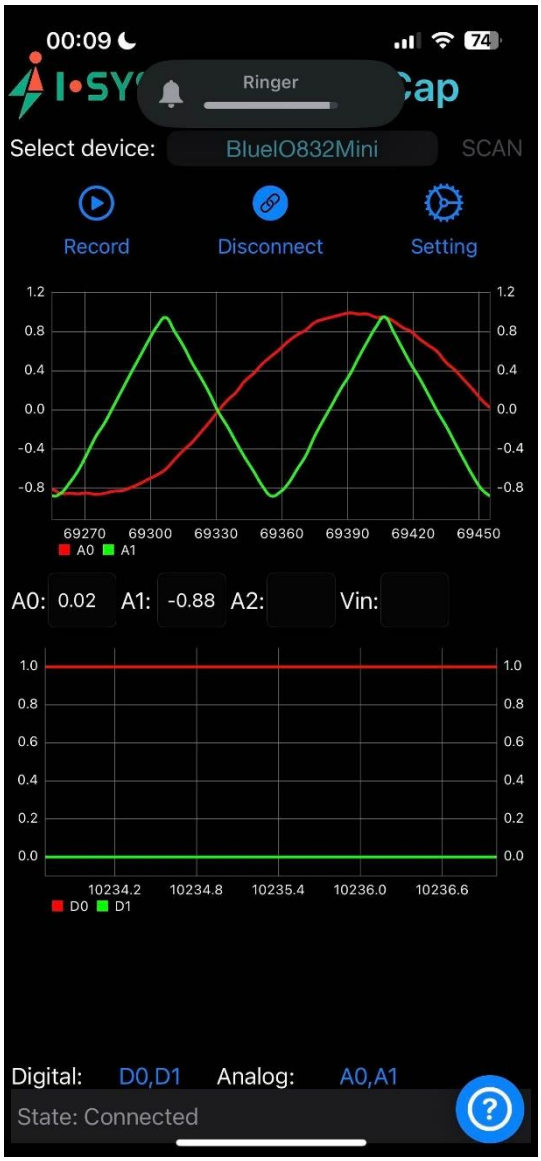


Fig. 15. Captured data displayed on BlueIOSigCap

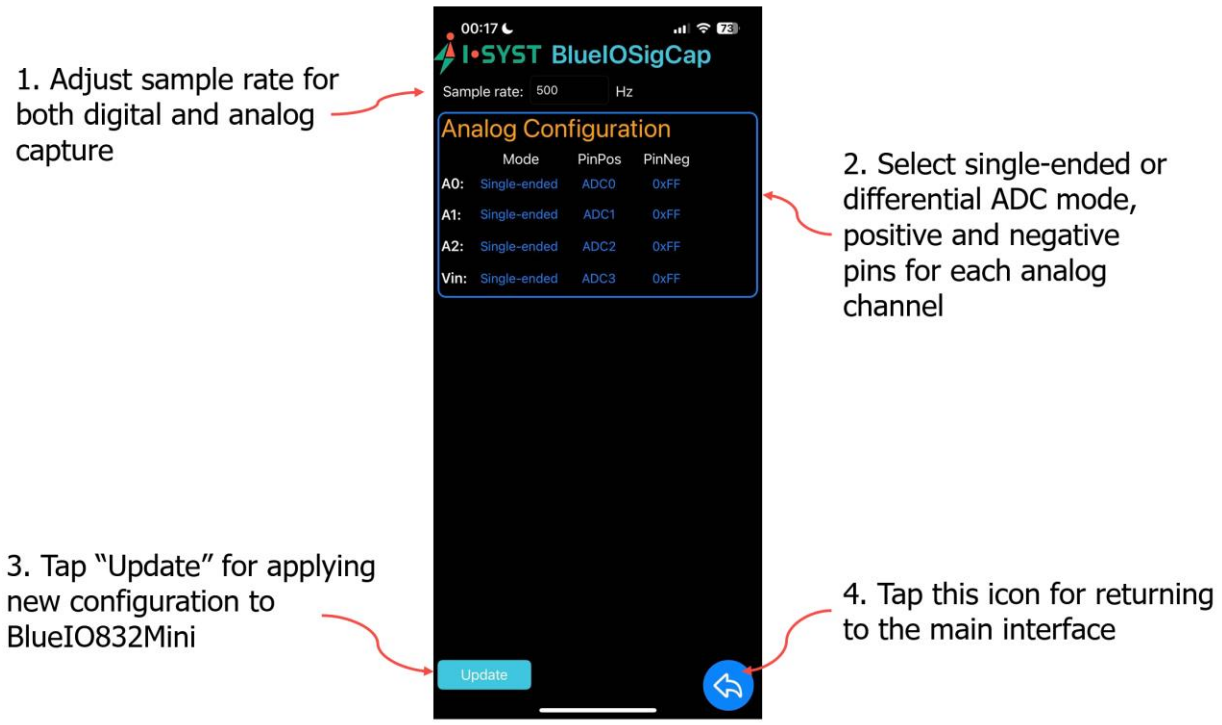


Fig. 16. Setting menu for sample rate and analog configuration

V. User-Own Firmware Development on BlueIO832Mini

BlueIO832Mini can be used as an **IoT embedded development kit** for developing the user's own firmware. We recommend the user to use our open-source library **IOsonata** for quickly developing the firmware. Here are references for the IOsonata SDK and the guides on firmware development with IOsonata:

- IOsonata is available on this Github link.
- The steps of developing firmware with IOsonata SDK are available on this blogpost.
- For debugging the firmware built upon IOsonata in Eclipse IDE, please refer to this blogpost.

References

[1] BlueIO832Mini Product Page:

https://www.i-syst.com/products/blueIO832

[2] BlueIO832Mini User Guide:

https://www.i-syst.com/sites/default/files/2022-08/BlueIO832Mini_UserGuide.pdf

[3] BlueIOTerm on Apple® AppStore

https://apps.apple.com/app/blueioterm/id1618808817?platform=iphone

[4] BlueIOTerm on Google® Play

https://play.google.com/store/apps/details?id=com.i_syst.blueioterm

[3] IOsonata Github

https://github.com/IOsonata/IOsonata

[4] Developing firmware for Nordic® nRF52xxx SoC with IOsonata

https://www.i-syst.com/article/eclipse-ide-firmware-development-iosonata

[5] Debugging firmware built upon IOsonata in Eclipse® IDE

https://www.i-syst.com/article/firmware-debugging-eclipse

[6] I-SYST BLYST NANO (IMM-NRF52832-NANO) SoM

https://www.i-syst.com/products/blyst-nano