PicoJig, PicoJig-WL Manual

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1 Please be sure to read

When using PicoJig or PicoJig-WL, be sure to check the terms of use on the Shiomachi Software website.
<Terms of Use URL >
https://sites.google.com/view/shiomachisoft/english-home/terms-of-use

Please note that Shiomachi Software (creator of PicoJig/PicoJig-WL) is not responsible for any trouble, loss, or damage that may occur as a result of using PicoJig/PicoJigWL or following the contents of this document.

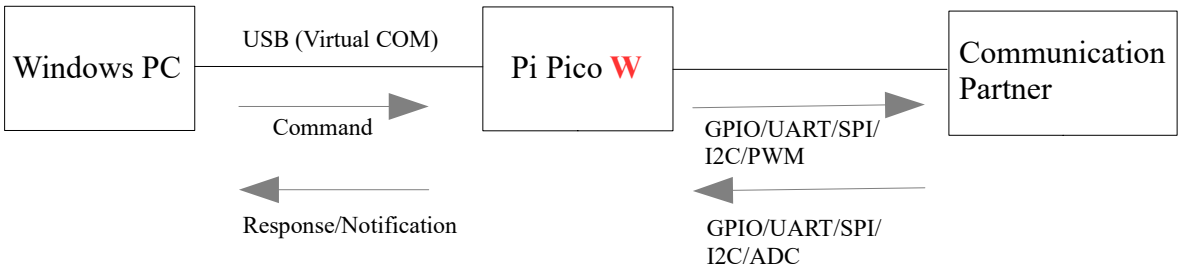
2 Overview

This book is a manual for PicoJig and PicoJig-WL.
An overview of PicoJig and PicoJig-WL is as follows.

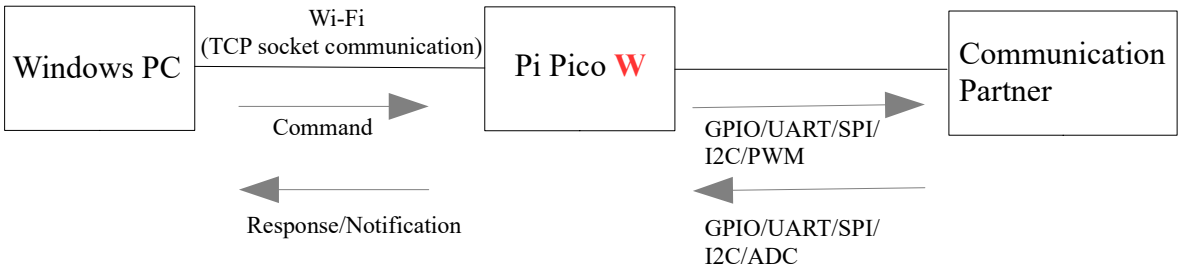
2.1 *Overview of PicoJig-WL*

PicoJig-WL is a firmware and PC app that controls the GPIO/UART/SPI/I2C/ADC/PWM of the Raspberry Pi Pico W via USB (virtual COM) or Wi-Fi (TCP socket communication).
There are two modes: USB mode and Wi-Fi mode.
- The microcontroller board uses Raspberry Pi Pico W.
- In Wi-Fi mode, Pi Pico W becomes the TCP server. The PC becomes the TCP client.
- In Wi-Fi mode, a wireless LAN router that supports the 2.4GHz Wi-Fi standard "IEEE 802.11b/g/n" is required.
- Pi Pico W's SPI and I2C are masters.

<System configuration>
USB mode:



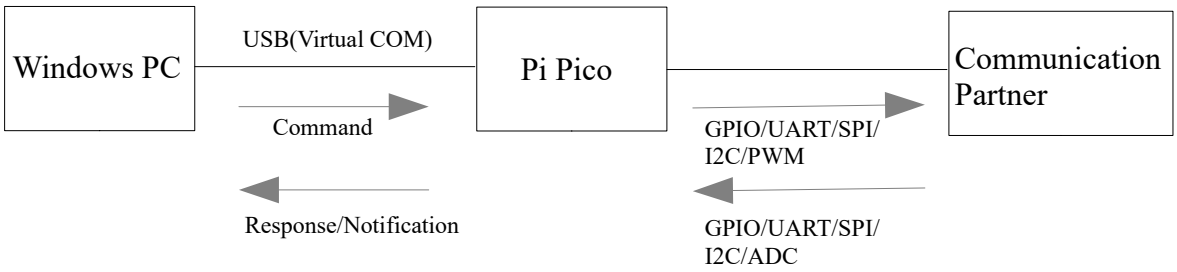
Wi-Fi mode:



2.2 *Overview of PicoJig*

PicoJig is a firmware and PC application that controls Raspberry Pi Pico's GPIO/UART/SPI/I2C/ADC/PWM via USB (virtual COM).
- Raspberry Pi Pico is used as the microcontroller board.
- Pi Pico's SPI and I2C are the master.

<System configuration>
USB mode:



3 Contents

3.1 Firmware (FW)

(1) PicoJig_*XXXXXXXX*.uf2

XXXXXXXX is the version date.

This is firmware for PicoJig and is written to Pi Pico.

(2) PicoJig_WL_*XXXXXXXX*.uf2

XXXXXXXX is the version date.

This is firmware for PicoJig-WL and will be written to Pi Pico W.

3.2 PC Application

(1) PicoJigApp_*XXXXX* *Folder*

XXXX is the version.

This folder contains the binaries for PicoJigApp (the app that runs on a Windows PC).

PicoJigApp is compatible with both PicoJig and PicoJig-WL.

Copy the PicoJigApp_XXXXX folder to a suitable location on your PC (such as the desktop).

For Windows, .NET Framework 4.x.x must be enabled, with .NET Framework 4.6.2 or higher.
Not compatible with .NET 5 and higher.

Enabling the .NET Framework is at your own risk.

4 Setup

4.1 Write FW to Pi Pico or Pi Pico W

Below are the steps to write FW to Pi Pico or Pi Pico W.

<Note>
If you use PicoJig, write PicoJig_XXXXXXXX.uf2 to Pi Pico.
If you use PicoJig-WL, write PicoJig_WL_XXXXXXXX.uf2 to Pi Pico W.

(1) While pressing the white button on the Pi Pico (Pi Pico W), connect the PC and Pi Pico (Pi Pico W) with a USB cable. The RPI-RP2 drive will then be recognized.

(2) Drag PicoJig_XXXXXXXX.uf2 (PicoJig_WL_XXXXXXXX.uf2) into the RPI-RP2.

This completes the firmware writing process.
The firmware will start up when the Pi Pico (Pi Pico W) is turned on.

4.2 PC setup

(1) Copy the PicoJigApp_XXXXX folder to a suitable location on your PC (such as the desktop).
Note that PicoJigApp can be used for both PicoJig and PicoJig-WL.

For Windows, .NET Framework 4.x.x must be enabled, with .NET Framework 4.6.2 or higher.
Not compatible with .NET 5 and higher.
Enabling the .NET Framework is at your own risk.

5 LED

5.1 PicoJig LED lighting

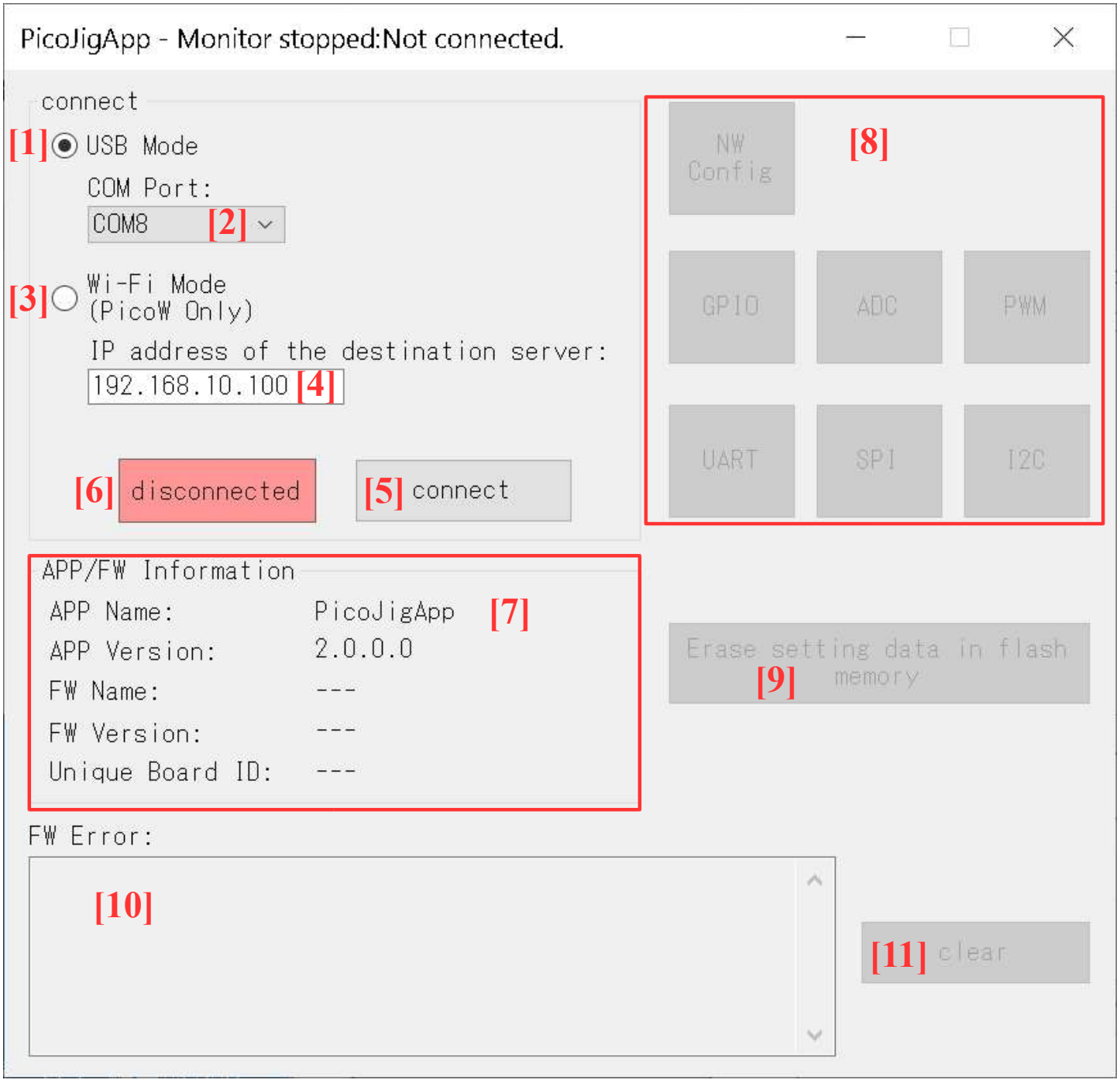
- If the FW does not detect any errors, the LED will flash at 500ms intervals.
- If the FW detects an error, the LED will flash at 100ms intervals.

5.2 PicoJig-WL LED lighting

- If the FW has not detected an error and the device is not connected to the wireless LAN router, the LED will flash at 500 ms intervals.
- If the FW does not detect any errors and the connection to the wireless LAN router is established, the LED will light up.
- If the FW detects an error, the LED will flash at 100ms intervals.

6 Main screen and startup

6.1 Main screen



6.2 Start in USB mode

USB mode is available on both PicoJig and PicoJig-WL.

(1) After connecting Pi Pico with the USB cable, wait about 10 seconds, then double-click PicoJigApp.exe in the PicoJigApp_XXXXX folder. *The reason for waiting about 10 seconds is because it takes time for Windows to recognize Pi Pico's virtual COM.

Double-clicking PicoJigApp.exe will display the main screen in the <Main Screen> chapter.

(2) Turn on [1] on the <Main screen> to select USB mode.

(3) After selecting the Pi Pico COM number in [2] on the <Main screen>, press the [5] button.
If the display of [6] on the <Main screen> changes to “connected”, then the connection to Pico is successful in USB mode.

If an error message box appears, try the following.
- If there are multiple COM numbers in the list [2], change the selected COM number in [2] and then press [5].
- Check the USB cable connection to Pi Pico, wait 10 seconds, and then restart PicoJigApp.exe.

When [6] on the <Main screen> changes to “connected”, buttons [8][9][11] on the <Main screen> will be enabled. FW information will also be displayed on [7].

6.3 Start in Wi-Fi mode

*Wi-Fi mode can only be used with PicoJig-WL.

(1) First, follow the steps in the <Starting in USB Mode> chapter.

*You must start in USB mode at first to save the wireless LAN settings to the Pi Pico W flash memory.

(2) Click the [NW Config] button in [8] on the <Main Screen> to display the <NW Config Screen> and configure the wireless LAN.

*The wireless LAN settings are saved in the Pi Pico W flash memory, so there is no need to configure them every time.

*For instructions on how to configure the wireless LAN settings, refer to the <NW Config Screen> chapter.

(3) Make sure that the LED on the Pi Pico W is lit and not flashing.

Once the Wireless LAN settings have been completed, Pi Pico W will try to connect to the Wireless LAN router. If it's successful in connecting to the Wireless LAN router, the LED will stop flashing and stay lit.
*If the LED continues to flash and does not light up, please do the following.
- Check that there are no devices near Pi Pico W that may cause radio interference.
- Check that there are no errors in the Wireless LAN settings.

(4) Close the virtual COM of Pi Pico W.
Make sure that the button [5] on the <Main screen> displays disconnect, then press the [5] button.
Then make sure that [6] on the <Main screen> displays "disconnected".

Connect to Pi Pico W via TCP using steps (5) to (8) below.

(5) Make sure that the LED on Pi Pico W is lit and not flashing (= connected to the wireless LAN router).

(6) Press [3] on the <Main screen> to select Wi-Fi mode.

(7) Specify the IP address of the Pi Pico W you want to connect to via TCP in [4] on the <Main screen>.
*Note that the network part of the IP address of the PC and Pi Pico W must be the same.

(8) To connect to Pi Pico W via TCP, make sure that the button [5] displays connect, then press the [5] button.
If [6] displays connected, the TCP connection to Pi Pico W has been successful.
(Pi Pico W is connected in Wi-Fi mode.)

When [6] on the <Main screen> changes to "connected," buttons [8], [9], and [11] on the <Main screen> become enabled.
FW information is also displayed in [7].

6.4 Checking for FW errors

Errors recognized by the FW are displayed in [10] on the <Main screen>.
If you want to clear an error recognized by the FW, press [11] on the <Main screen>.

Examples of errors recognized by the FW include the following.
<Example>
- UART: Framing error
- UART: Parity error
- UART: Break error
- UART: Overrun error
- I2C: address not acknowledged, or, no device present.
- I2C communication timeout

6.5 Erasing the configuration data in the Flash memory

The following configuration data is saved at the back of the Pi Pico (Pi Pico W) Flash memory.

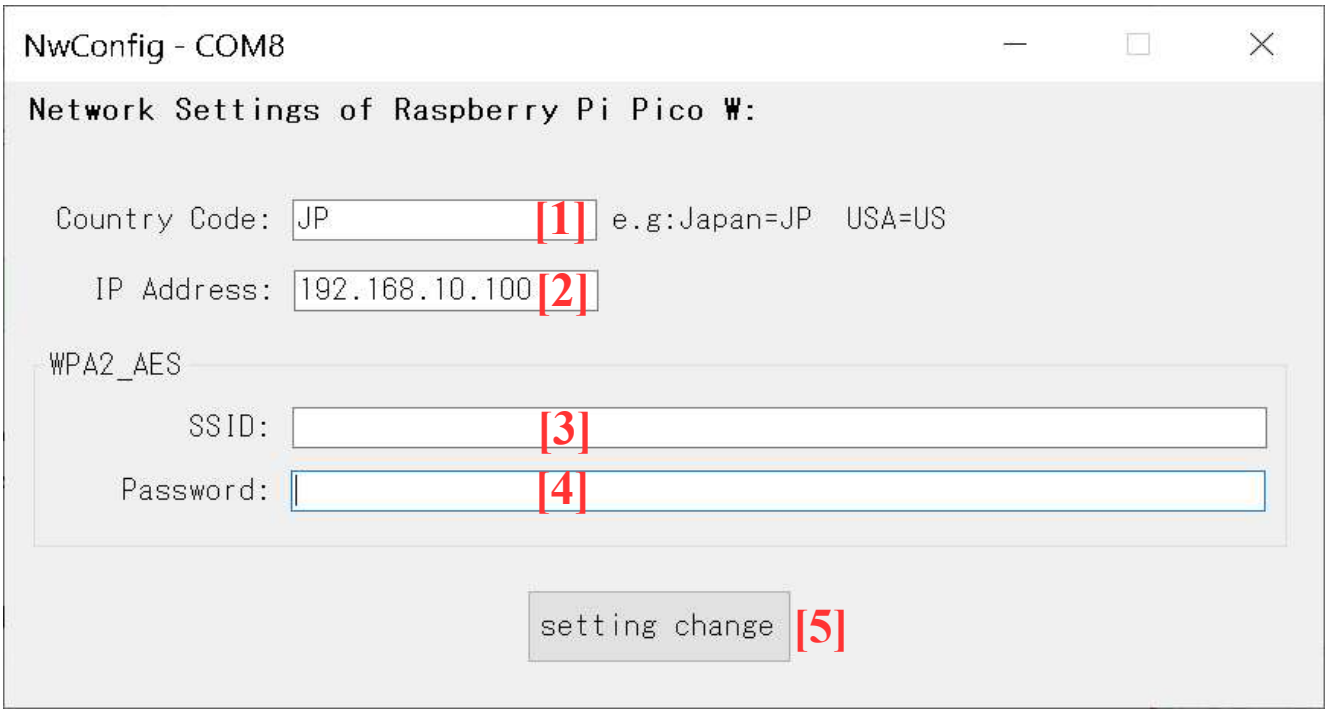
-Wireless LAN settings
-GPIO settings
-UART settings
-SPI settings
-I2C settings

***If you are no longer using PicoJig (PicoJig-WL), we recommend that you erase the configuration data saved at the end of the Flash memory using the [9] button on the <Main screen>.**

7 Wireless LAN Settings

7.1 Wireless LAN setting screen

The wireless LAN setting screen is displayed when you press the [NW Config] button in [8] on the <Main screen>.



(1) Enter the country code in the box [1].
<Example>
Japan: JP
USA: US

(2) In the box [2], enter the IP address you want for Pi Pico W.
<Example>
If you want the IP address of Pi Pico W to be 192.168.10.100:
192.168.10.100

(3) Enter the SSID of your wireless LAN router in the box [3].
*Conditions for the SSID of a wireless LAN router that can be specified:

- It must support the IEEE 802.11b/g/n Wi-Fi standard that uses the 2.4 GHz band.
  Be careful not to accidentally specify an SSID in the 5 GHz frequency band.
- The encryption method must be WPA2 (AES).

(4) Enter the password of your wireless LAN router in the box [4].

(5) When you press the button [5], the setting data will be saved to the end of the Pi Pico W's Flash memory.

(The wireless LAN settings will be configured.)

*If you are no longer using PicoJig-WL, we recommend that you erase the setting data saved to the end of the Flash memory using the button [9] on the <Main screen>.

(6) Check that the LED on Pi Pico W is lit and not flashing.

Once the wireless LAN settings are complete, Pi Pico W will attempt to connect to the wireless LAN router.
If it is able to connect to the wireless LAN router, the LED will light up and not flash.
* If the LED continues to flash and does not light up, please do the following.
- Check that there are no devices near Pi Pico W that may cause radio interference.
- Check that there are no errors in the wireless LAN settings.

8 GPIO

8.1 GPIO pins

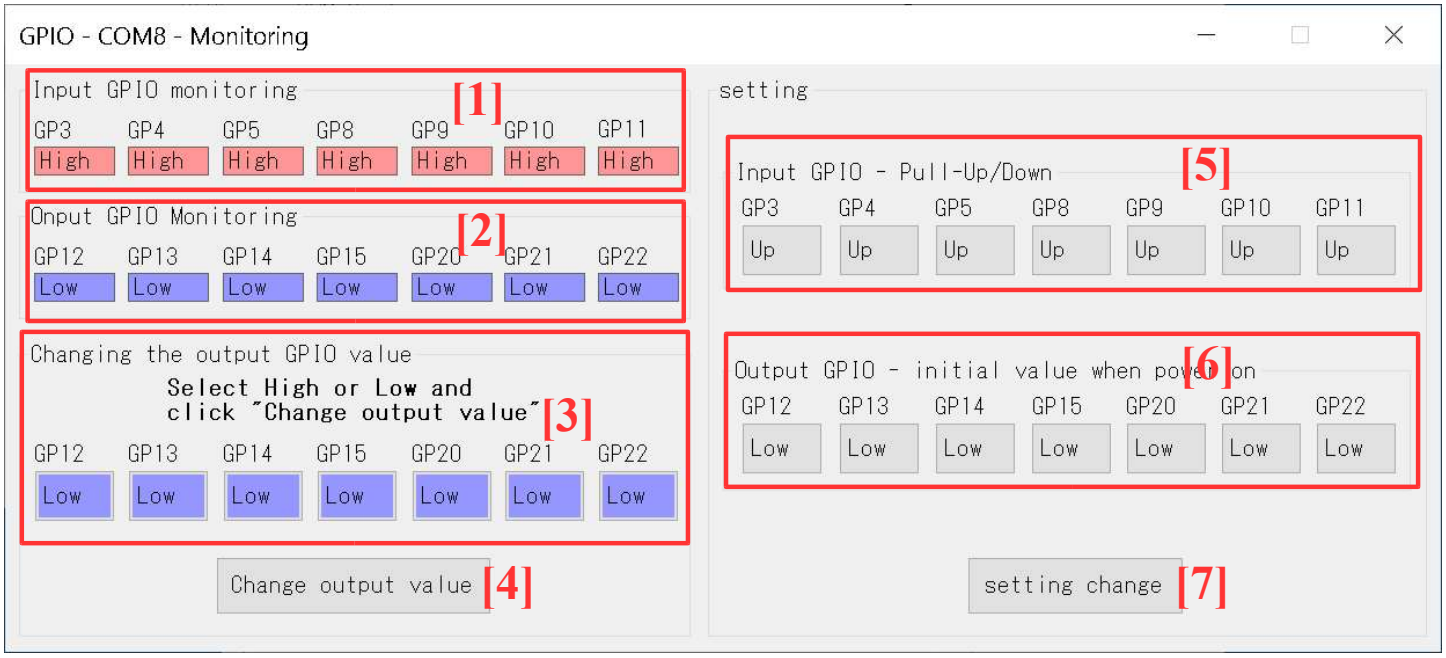
The pins used for GPIO are as follows.

GPIO input:
- GP3=pin 5
- GP4=pin 6
- GP5=pin 7
- GP8=pin 11
- GP9=pin 12
- GP10=pin 14
- GP11=pin 15

GPIO output:
- GP12 = pin 16
- GP13 = pin 17
- GP14 = pin 19
- GP15 = pin 20
- GP20 = pin 26
- GP21 = pin 27
- GP22 = pin 29

8.2 GPIO screen

The GPIO screen is displayed when you press the [GPIO] button in [8] on the <Main screen>.



(1) [1] displays the current High/Low GPIO input.

(2) [2] displays the current High/Low GPIO output.

(3) You can change the High/Low GPIO output using the following procedure.
  (a) Select High/Low for GP12 to GP22 in [3].
  (b) Press the [4] button.

(4) You can change the GPIO settings using the following procedure.
  (a) Select Pull-Up/Pull-Down for the input GPIO in [5].
  (b) Select the power-on default value for the output GPIO in [6].
  (C) Press the [7] button.

When you press the [7] button, the settings data will be saved to the end of the Pico's Flash memory.

***If you are no longer using PicoJig, we recommend that you erase the configuration data stored in the end of the Flash memory using the [9] button on the <Main screen>.**

9 ADC

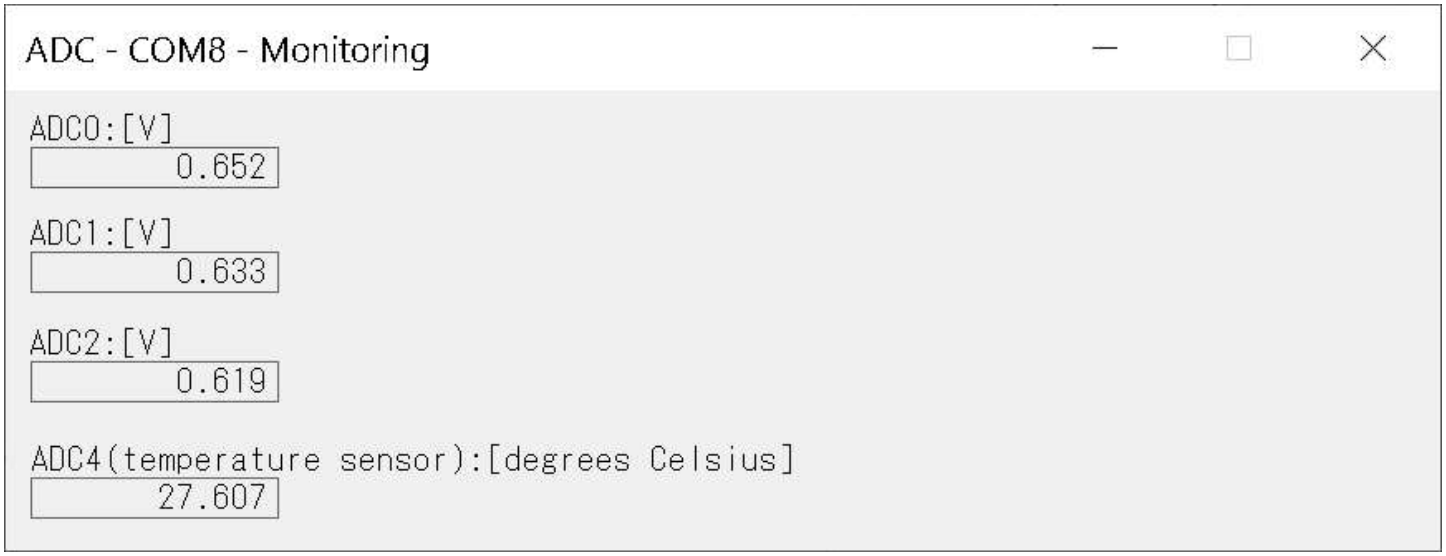
9.1 Pins used by the ADC

The pins used by the ADC are as follows:
- ADC0=GP26=Pin 31
- ADC1=GP27=Pin 32
- ADC2=GP28=Pin 34

ADC4 is a temperature sensor

9.2 ADC screen

The ADC screen is displayed when you press the [ADC] button in [8] on the <Main screen>.



The voltage values [V] of ADC0 to ADC2 and the temperature sensor value [degrees Celsius] of ADC4 are displayed.

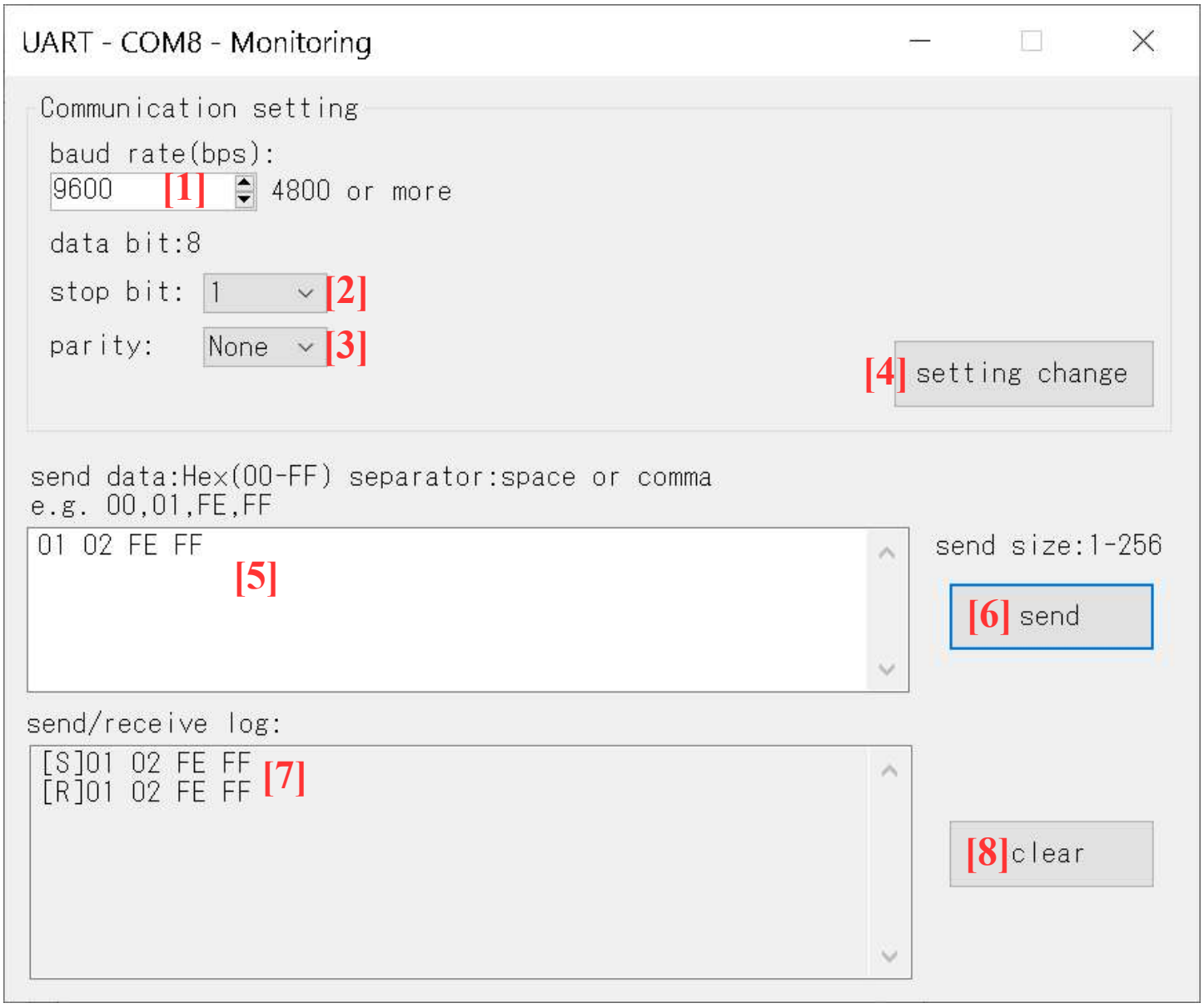
10 UART

10.1 Pins used by UART

The pins used for UART are as follows:
-UART0 TX=GP0=pin 1
-UART0 RX=GP1=pin 2

10.2 UART screen

The UART screen is displayed when you press the [UART] button in [8] on the <Main screen>.



(1) You can change the UART settings using the following steps.
(a) Select the baud rate with [1].
(b) Select the stop bit with [2].
(c) Select the parity with [3].
＊The data bit is fixed at 8.
(d) Press the [4] button.
When you press the [4] button, the settings data will be saved to the end of the Pi Pico's Flash memory.

*If you are no longer using PicoJig, we recommend that you erase the configuration data stored in the end of the Flash memory using the [9] button on the <Main screen>.

(2) You can perform UART transmission using the following steps.

(a) Enter the data to be transmitted in two hexadecimal digits in [5], with a space or comma as the separator.

*The transmit data size must be between 1 and 256 bytes.

(b) Press [6].

(3) A log of transmitted and received data is displayed in [7].

(4) Pressing [8] will clear the log of transmitted and received data.

11 SPI

11.1 Pins used in SPI

The pins used for SPI are as follows:
-SPI0 RX=GP16=pin 21
-SPI0 CSn=GP17=pin 22
-SPI0 SCK=GP18=pin 24
-SPI0 TX=GP19=pin 25

11.2 SPI Considerations

(1) PicoJig is an SPI master.
(2) About CS:
(a) CS is low while PicoJig is sending the SPI clock. Otherwise (when idle) CS is high.
(b) CS goes low 5us earlier than the time to send the SPI clock.
(c) CS goes high 5us after the SPI clock transmission is complete.
(d) CS is controlled by GPIO without using the SPI CSn function.
<reason>
When using the SPI CSn function with the Raspberry Pi Pico microcontroller RP2040 as the SPI master, in modes 0 and 2, the uncommon specification is to set CS to low/high for each byte, as shown in the diagram below, and we want to avoid this type of CS behavior.
For this reason, in PicoJig, to keep CS low while transmitting the SPI clock, CS is controlled by GPIO without using the SPI CSn function, and is output as shown above in (a) to (c).

Figure 91. Motorola SPI frame format, single transfer, with SPO=0 and SPH=0

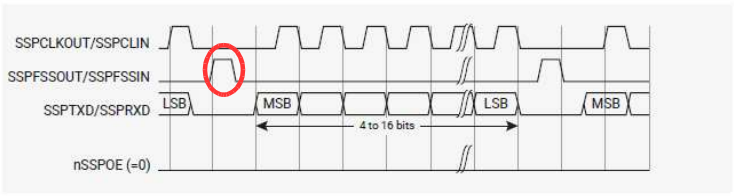
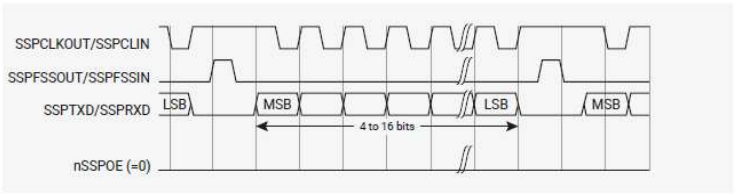


Figure 94. Motorola SPI frame format, continuous transfer, with SPO=1 and SPH=0



(e) When the communication partner SPI slave is a Raspberry Pi Pico:
- In this case, use mode 1 or mode 3.
<reason>
When the RP2040 is an SPI slave, in modes 0 and 2, the master side needs to output an uncommon CS signal like (d).

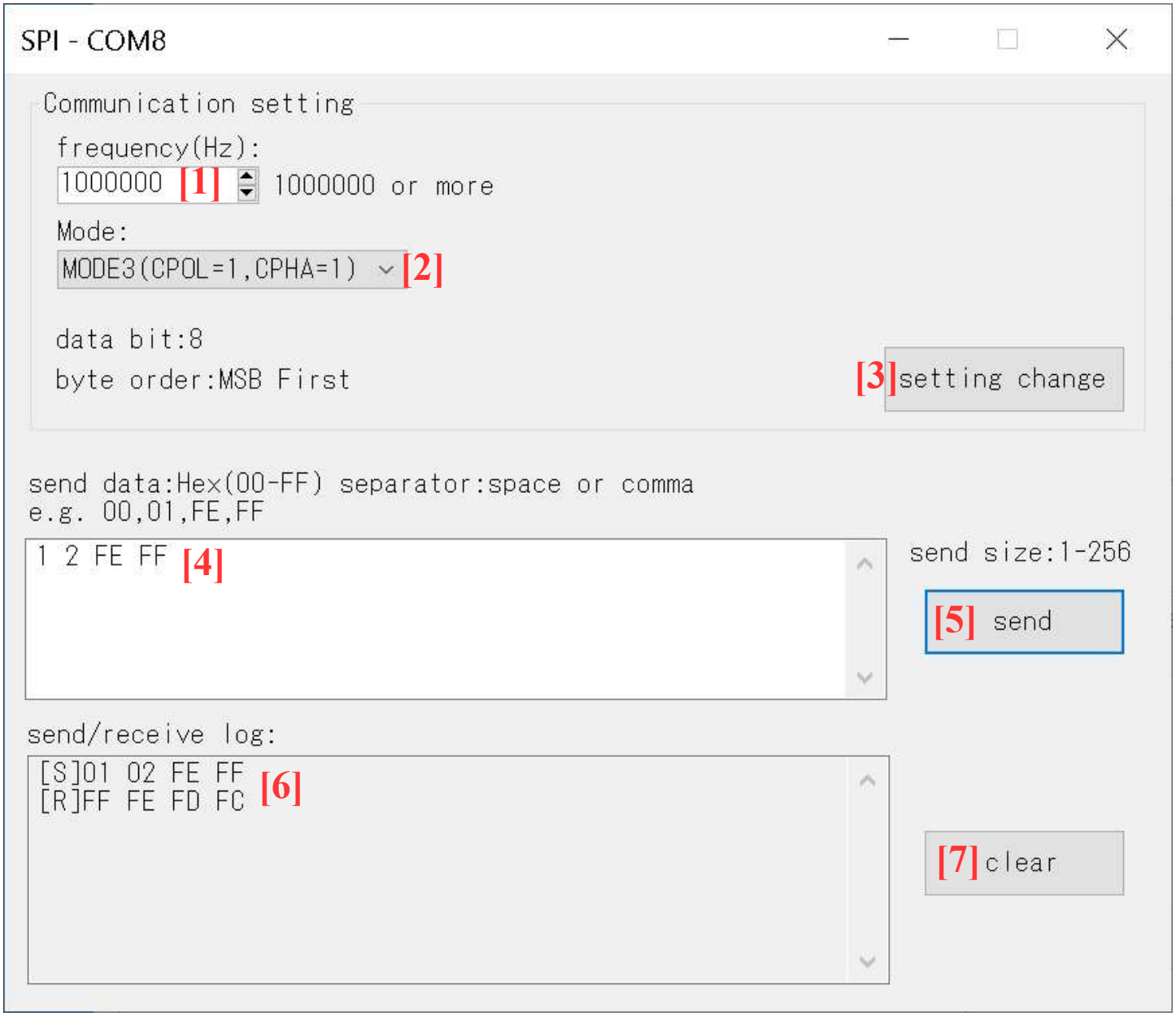
- When Shiomachi Software (the creators of PicoJig) tested this case, the Raspberry Pi Pico on the SPI slave side used DREQ to link SPI and DMA.
(The slave side did not use any CPU-intensive functions such as spi_write_read_blocking() from pico-sdk.)

This was because there was concern that the slave side might experience processing delays compared to the master's SPI clock.

(f) If the lead wires connected to SPI-related pins are long, data may become garbled, so it may be better to use short lead wires connected to SPI-related pins. (Cause not yet investigated)

11.3 SPI screen

The SPI screen is displayed by pressing the [SPI] button in [8] on the <Main screen>.



(1) You can change the SPI settings using the following steps.

(a) Enter the frequency (Hz) in [1].

(b) Select the SPI mode in [2].

* Data bits = fixed at 8, byte order = fixed as MSB first.

(c) Press the [3] button.

When you press the [3] button, the settings data will be saved to the end of the Pi Pico's Flash memory.

***If you are no longer using PicoJig, we recommend that you erase the configuration data stored in the end of the Flash memory using the [9] button on the <Main screen>.**

(2) SPI transmission can be performed using the following steps.

(a) Enter the data to be sent in two hexadecimal digits in [4], with a space or comma as the separator.

*The size of the data to be sent must be between 1 and 256 bytes.

(b) Press [5]. Since this is an SPI transmission from the master, it is received at the same time as it is sent.

(3) A log of the sent and received data is displayed in [6].

(4) Pressing [7] will clear the log of sent and received data.

12 I2C

12.1 Pins used by I2C

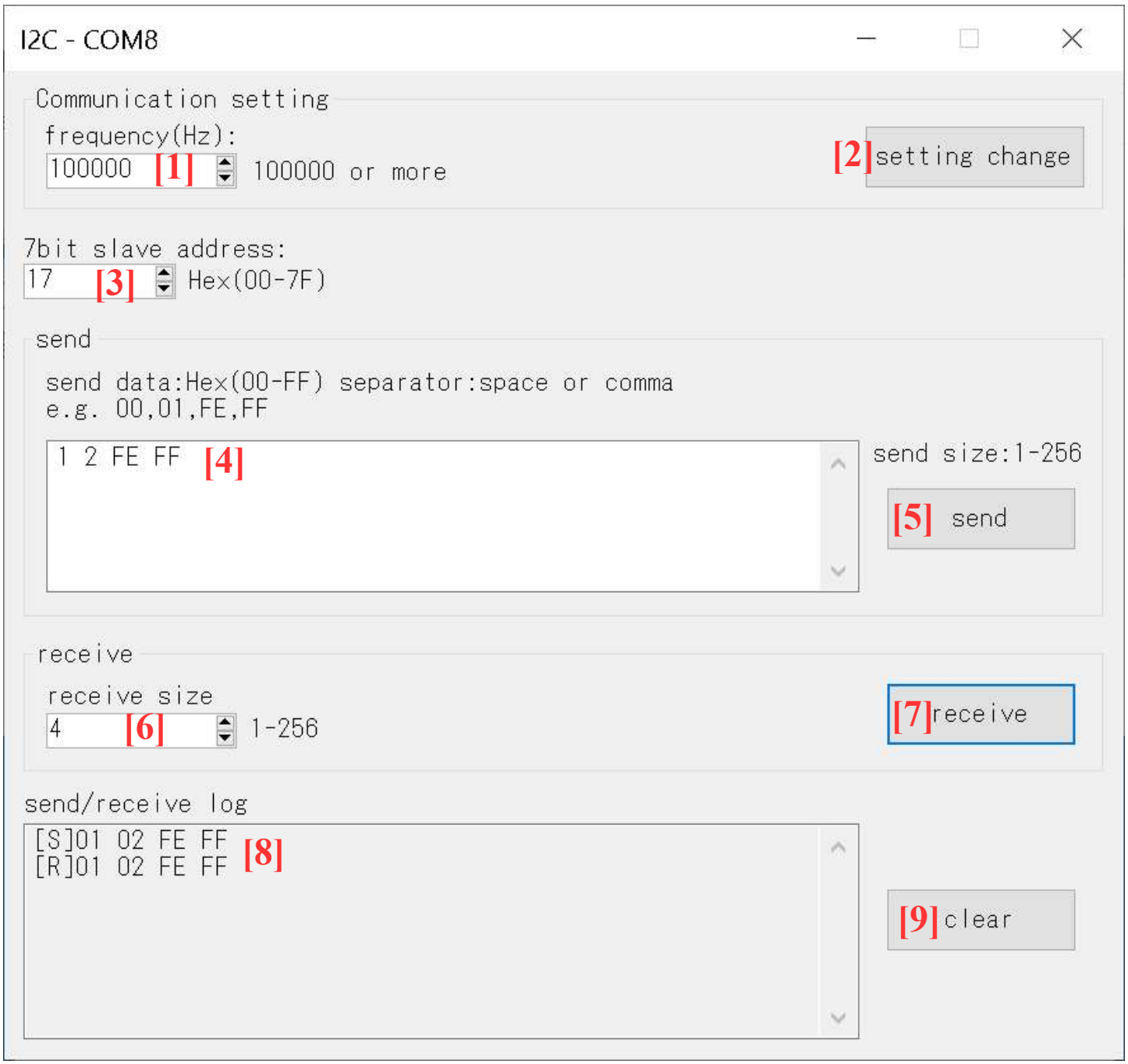
The pins used for I2C are as follows:
-I2C1 SDA=GP6=pin 9
-I2C1 SCL=GP7=pin 10

12.2 I2C Notes

(1) PicoJig is the I2C master.

12.3 I2C screen

The I2C screen is displayed when you press the [I2C] button in [8] on the <Main screen>.



(1) You can change the I2C settings using the following procedure.
(a) Enter the frequency (Hz) with [1].
(b) Press button [2].
When you press button [2], the settings data will be saved to the back of the Pico's Flash memory.
***If you are no longer using PicoJig, we recommend that you erase the configuration data stored in the end of the Flash memory using the [9] button on the <Main screen>.**

(2) You can transmit via I2C using the following steps.
(a) Enter the 7-bit slave address (hexadecimal) in [3].
(b) Enter the data to transmit in [4] as a two-digit hexadecimal number, with a space or comma as the separator.
*The transmit data size must be between 1 and 256 bytes.
(c) Press [5].

(3) You can receive I2C signals using the following steps.
(a) Enter the 7-bit slave address (hexadecimal) in [3].
(b) Enter the receive data size in [6]. *The receive data size should be between 1 and 256 bytes.
(c) Press [7].

(4) [8] displays the log of sent and received data.

(5) Press [9] to clear the log of sent and received data.

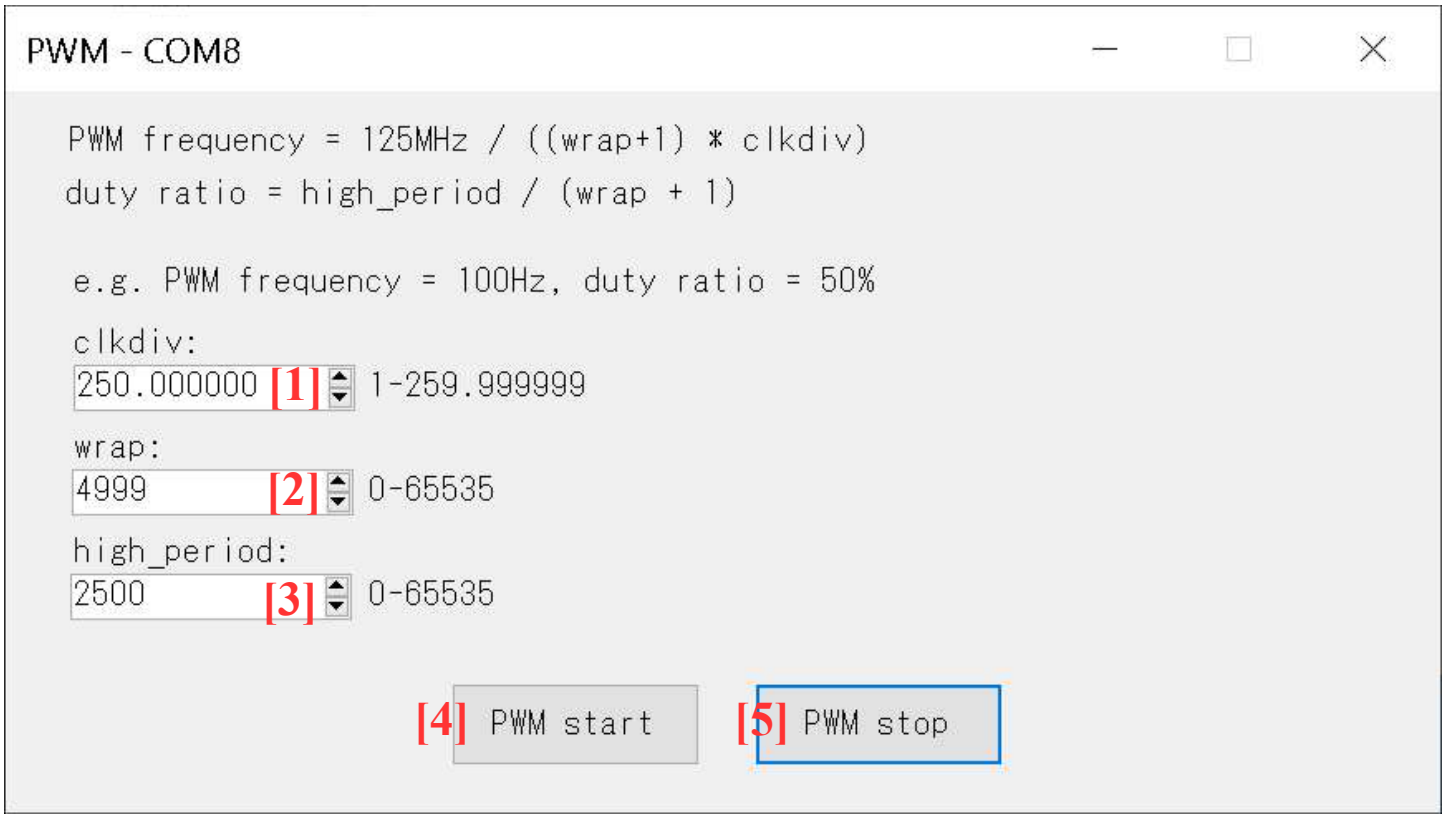
13 PWM

13.1 Pins used by PWM

The pins used for PWM are as follows:
- GP2 = Pin 4

13.2 PWM screen

The PWM screen is displayed by pressing the [PWM] button in [8] on the <Main screen>.



(1) You can output PWM using the following procedure.

(a) Enter the clock divider in [1].

(b) Enter the resolution in [2].

(c) Enter the high period in [3].

PWM frequency = 125MHz / ((resolution + 1) * clock division)
Duty ratio = high period / (resolution + 1)

(d) Press [4].

(2) Press [5] to stop PWM output.