RL78/G23

Motor Shield Rev3 Sample sketch (Arduino™ sketch)

Introduction

This application note describes how to use the RL78/G23-64p Fast Prototyping Board (FPB) library for Arduino to control a motor on the serial monitor of the Arduino™ IDE.

Target Device

Evaluation Board : RL78/G23-64p Fast Prototyping Board

Shield : Arduino Motor Shield Rev3

Trademarks

Arduino is a trademark of Arduino SA.

Contents

1. System overview

This system is composed of the RL78/G23-64p Fast Prototyping Board (RL78/G23-64p FPB) and the Arduino Motor Shield Rev3 with the DC motor and battery or AC adapter. Arduino™ IDE is used for creating a program and writing a program to RL78/G23. Also, confirm that the motor can be controlled by sending commands from the serial monitor.

The block configuration of the sample code used in this system is shown below.

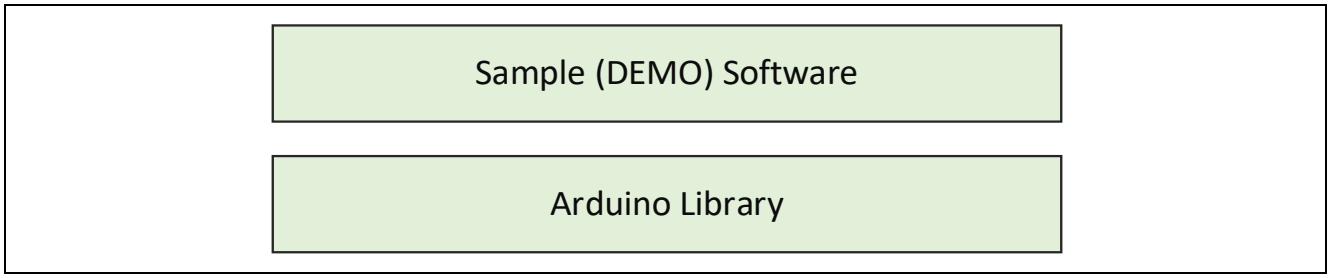


Figure 1-1 Block configuration of software

The simple diagram of this system configuration is shown below.

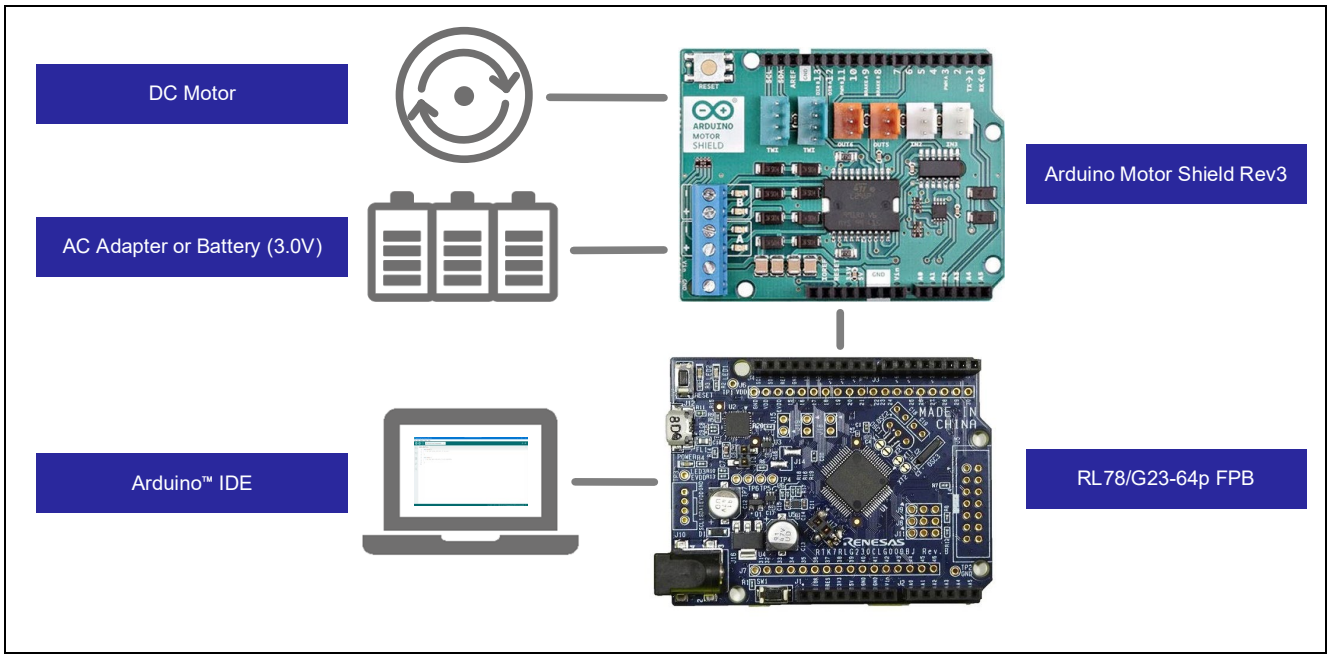


Figure 1-2 System configuration

1.1 Arduino Motor Shield

It is a shield equipped with a motor control circuit (dual full bridge driver L298P) necessary for controlling a DC motor. This shield allows you to set the motor speed, brake, and direction of rotation.

Two motors can be connected. In this application note only channel A is used and channel B is not used. The Arduino pins used for motor control are shown below.

Table 1-1 Pins used for motor control

	Channel A	Channel B
Direction	D12	D13
PWM (work duty)	D3	D11
Brake	D9	D8

The three operations controlled by this shield and the API functions used are listed below.

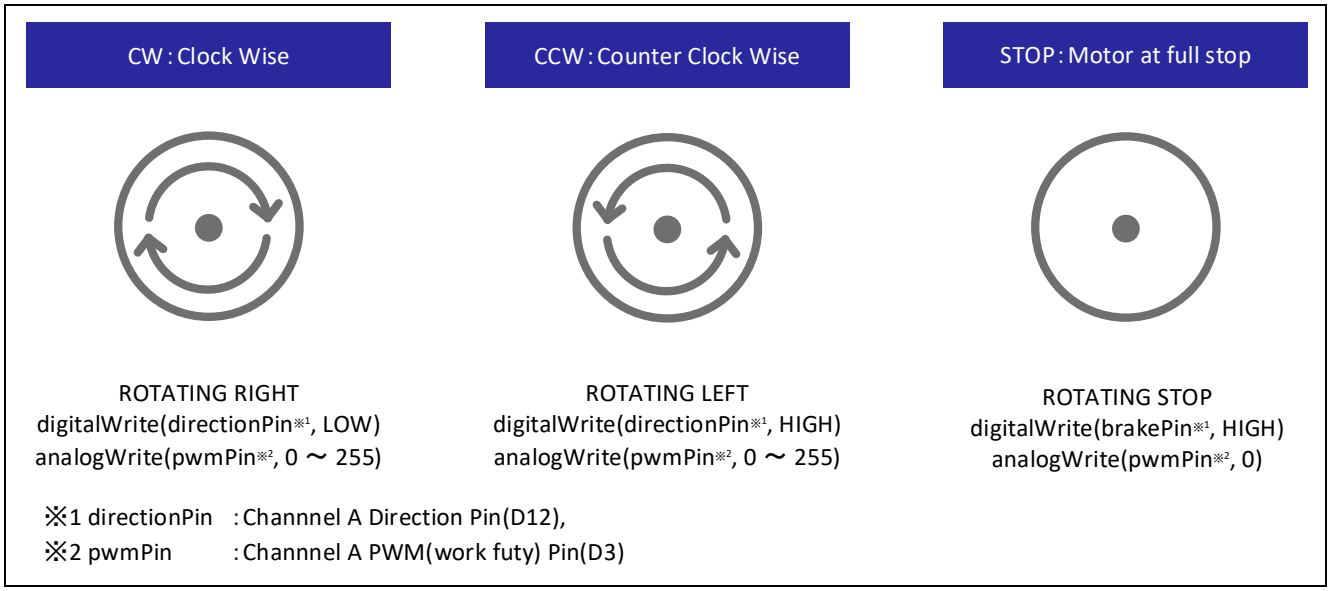


Figure 1-3 Motor shield control operation

2. Operation confirmation environment

The operation of the sample code provided by this application note has been tested under the following conditions.

Table 2-1 Operation confirmation environments (Hardware)

Item	Description
Evaluation board	RL78/G23-64p Fast Prototyping Board – RTK7RLG230CLG000BJ
Shield	Arduino Motor Shield Rev3
DC motor	RE-280RA
Operating voltage	5V
Motor voltage	3V (2 AA alkaline batteries) (Battery box: OHM KIT-UM32SK)

Table 2-2 Operation confirmation environments (Software)

Item	Description	Version
OS	Windows 10	-
Integrated development environment (IDE)	Arduino™ IDE	2.1.0
Library	RL78/G23-64p FPB library for Arduino	2.1.0

3. Build development environment

How to connect boards and how to set up the Arduino™ IDE are explained.

The Arduino™ IDE 2.1.0 is used in this system. Installation of the Arduino™ IDE 2.1.0 or later is necessary if it is not installed.

https://www.arduino.cc/en/software

3.1 Board connection

The PC and the RL78/G23-64p FPB are connected via USB as shown in Figure 3-1. The RL78/G23-64p FPB and the shield with the connector on the shield. The shield, the DC motor (Channel A), and power supply are connected via jumper wires.

USB is used for power supply to the RL78/G23-64p FPB in this system. For the power supply, check the circuit of the RL78/G23-64p FPB by referring to the manual, and set jumpers if required.

In this system, jumpers of the RL78/G23-64p FPB are set as shown in Table 3-1.

Table 3-1 Jumper pins setting of RL78/G23-64p FPB

Jumper pin	Setting	Function
J8	1-2 short-circuit	COM port debugging
J9		
J11		
J13	Open-circuit	
J17	1-2 short-circuit	5V power supply to MCU

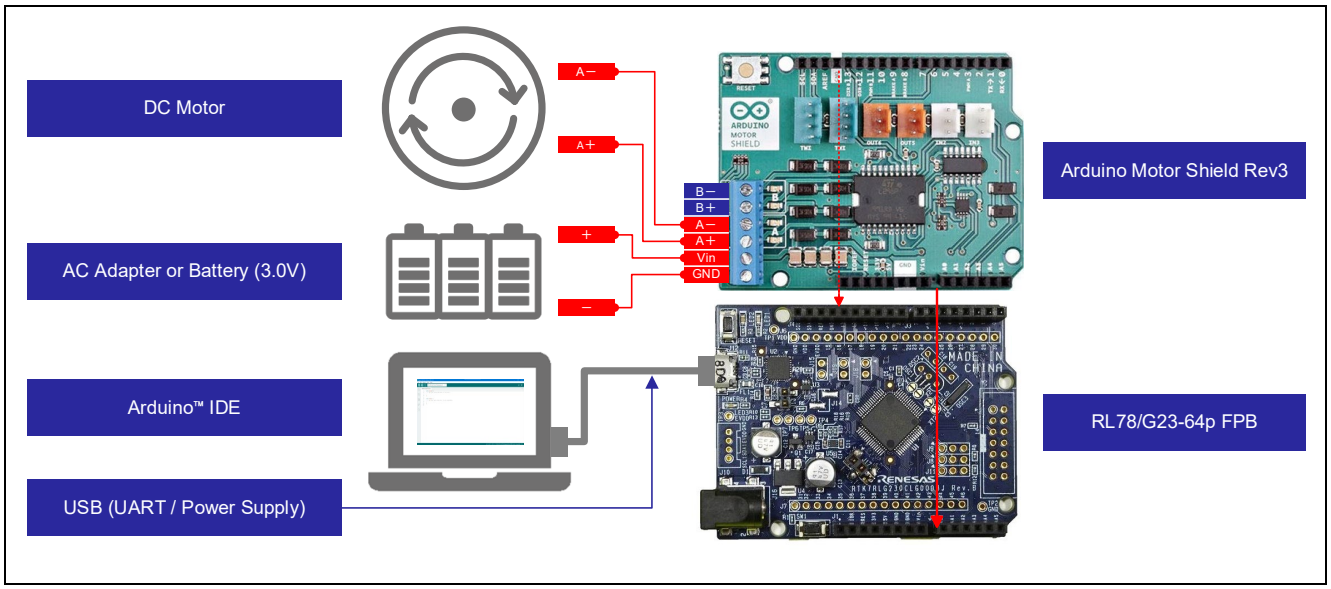


Figure 3-1 Connection of boards

3.2 List of pins used

The pins used in this system are shown below.

Table 3-2 Pins used

Item		Arduino™ signal name	Pin number of MCU	Pin
Motor control				
	Direction	IO12	33	P50
	PWM (work duty)	IO3	3	P42
	Brake	IO9	30	P06
I2C		SDA	18	P61
		SCL	17	P60
VDD		5V	-	-
GND		GND	14	-

For detailed pin descriptions of each board, refer to the following manuals.

RL78/G23-64p Fast Prototyping Board User's Manual (R20UT4814)
Arduino Motor Shield Rev3
https://store-usa.arduino.cc/products/arduino-motor-shield-rev3
Controlling a DC Motor with Motor Shield Rev3
https://docs.arduino.cc/tutorials/motor-shield-rev3/msr3-controlling-dc-motor

3.3 Setup of Arduino™ IDE

The setup procedure of Arduino™ IDE is explained.

Remark. The setup procedure is almost the same as the procedure explained on the Quick Start Guide : renesas/Arduino Wiki · GitHub. The sample sketch to flash LED is described on the above site. Refer to it if required.

1. Start the Arduino™ IDE.
2. Click the [Tools] - [Board] - [Boards Manager…] menu.

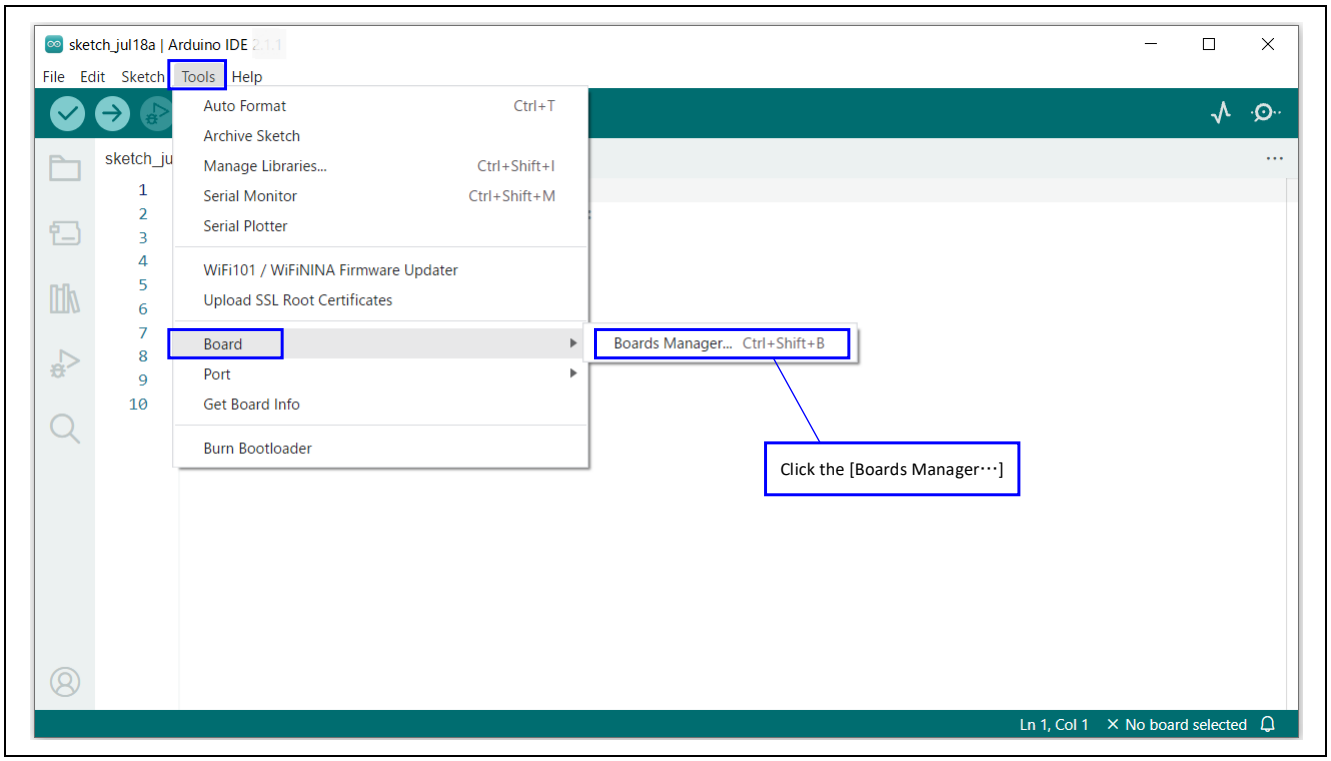


Figure 3-2 Selection of [Boards Manager…]

3. Select “All” at the [Type] and input “RL78/G23” in the textbox. Then, “RL78/G23-64p Fast Prototyping Board” is displayed. Next, click the [INSTALL].

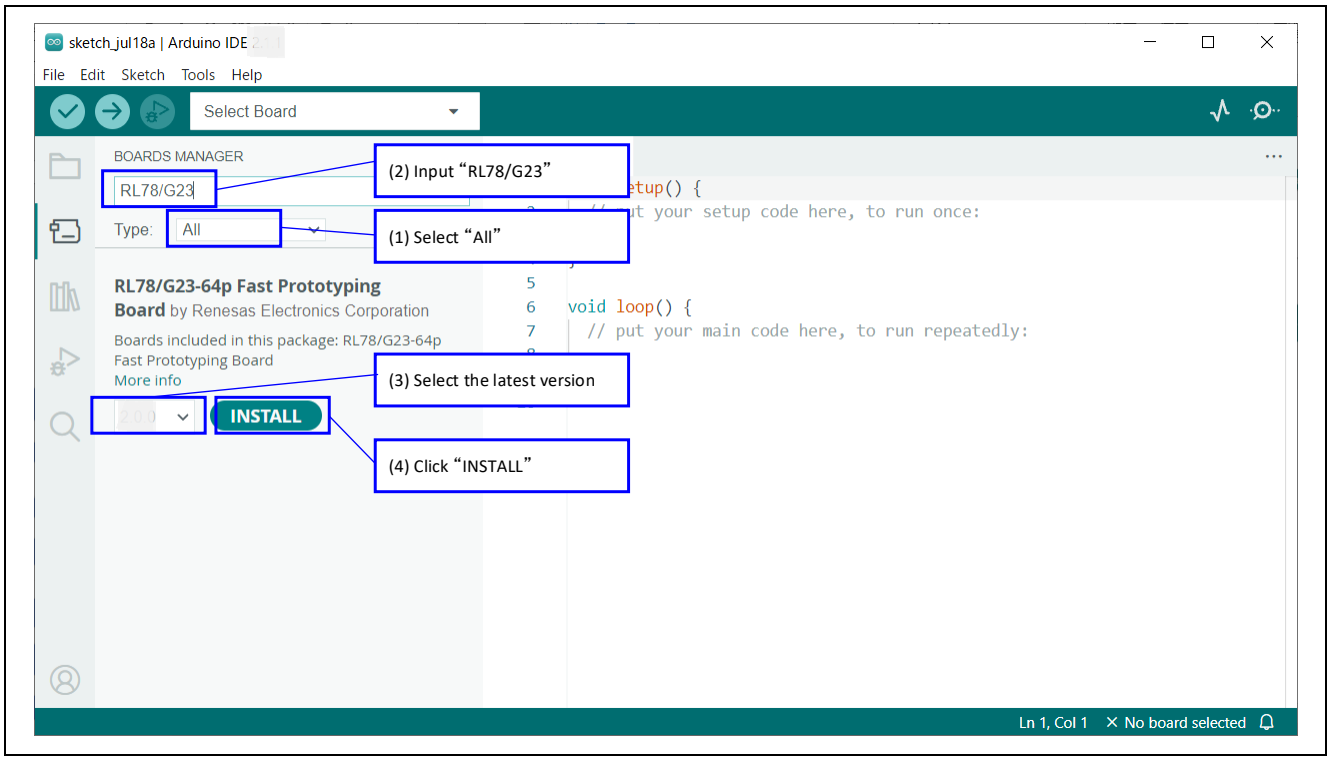


Figure 3-3 Installation of Board Manager

4. Select the serial port assigned to the RL78/G23-64p FPB from the [Tools] - [Port] menu.
   COM port number can be checked at the Device Manager of Windows.

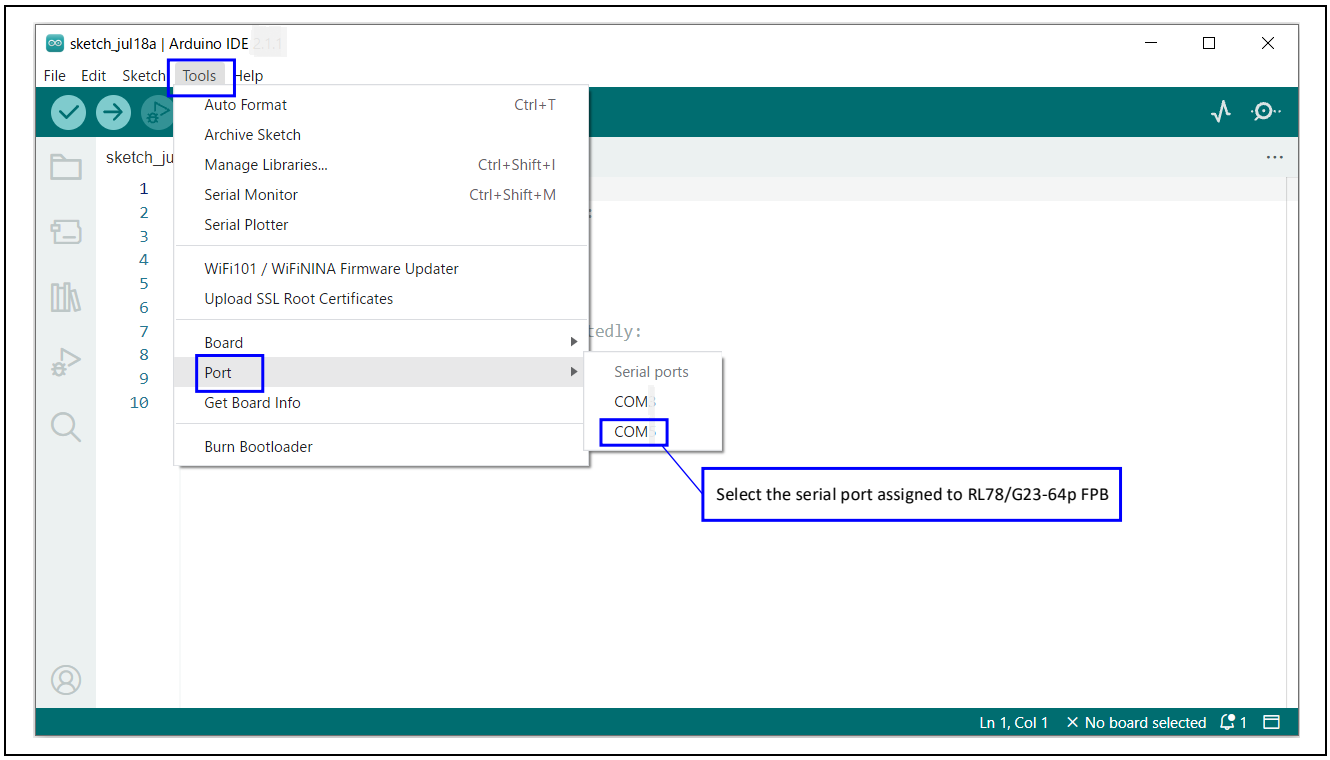


Figure 3-4 Selection of serial port

5. Select the [Tools] - [Board] - [RL78/G23-64p Fast Prototyping Board] - [RL78/G23-64p Fast Prototyping Board] menu.

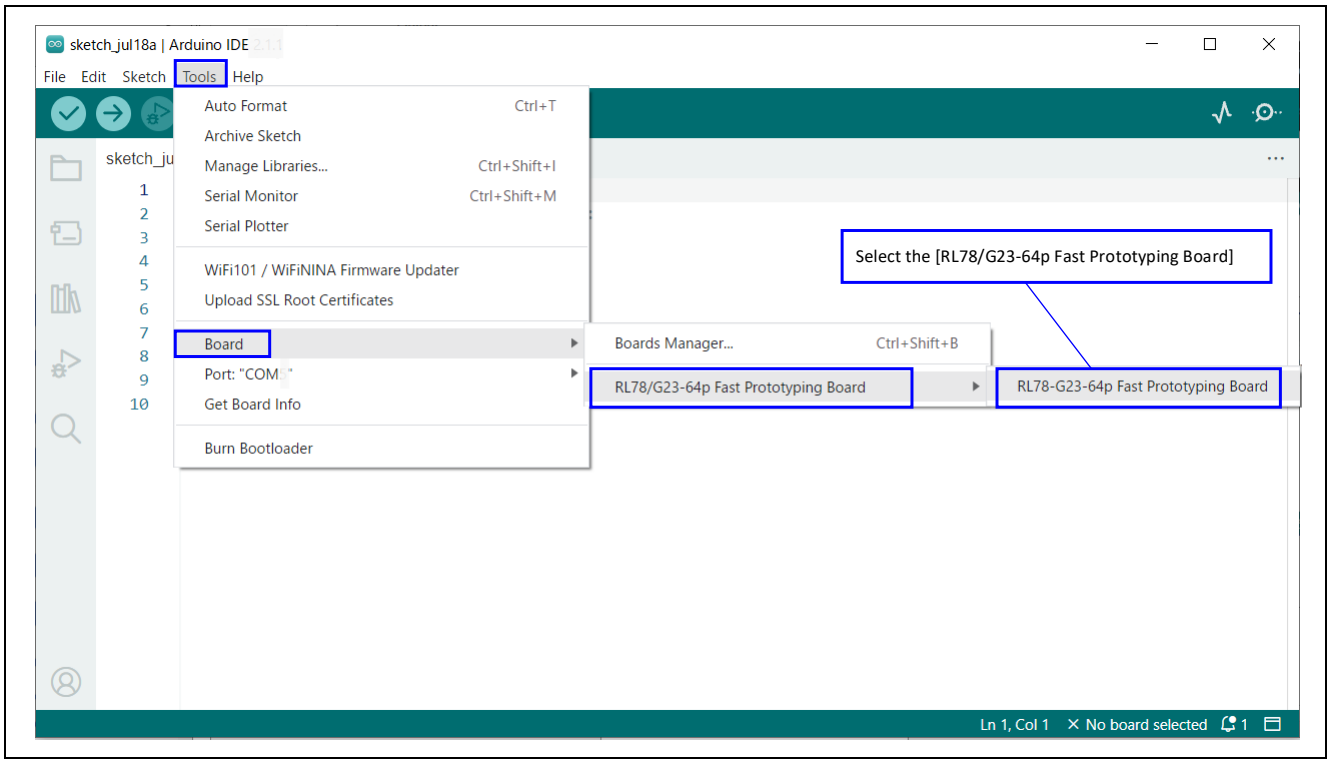


Figure 3-5 Selection of board

4. Software

4.1 Overview of sample code

This sample code uses the Motor Shield and control the motor by input form serial monitor. This sample code is composed of the sample sketch for the Arduino™ IDE. The file structure is shown below.

For details of API functions, refer to “4.2 API functions”, for details of the sample sketch, “4.3 Operating procedure of sample sketch”.

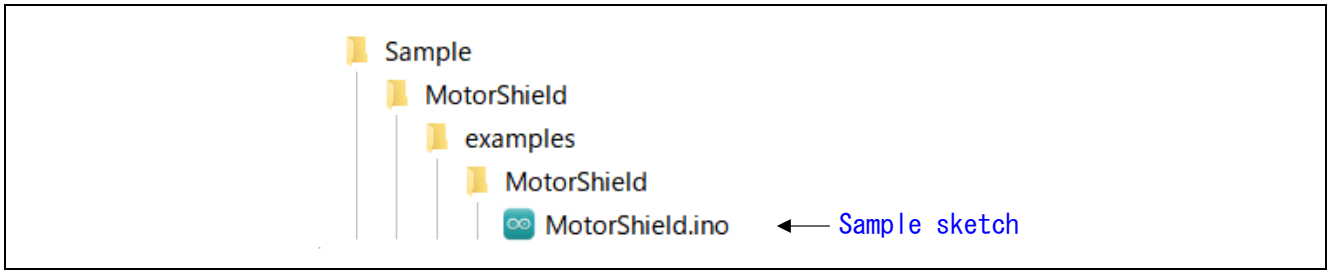


Figure 4-1 File structure of sample code

Table 4-1 Number keys and functions used for motor control

Number key	Command name	Function
1	STOP	Stop rotating
2	CW	Rotate clockwise
3	CCW	Rotate counterclockwise
4	UP	Speed up (+25)
5	DOWN	Slow down (-25)

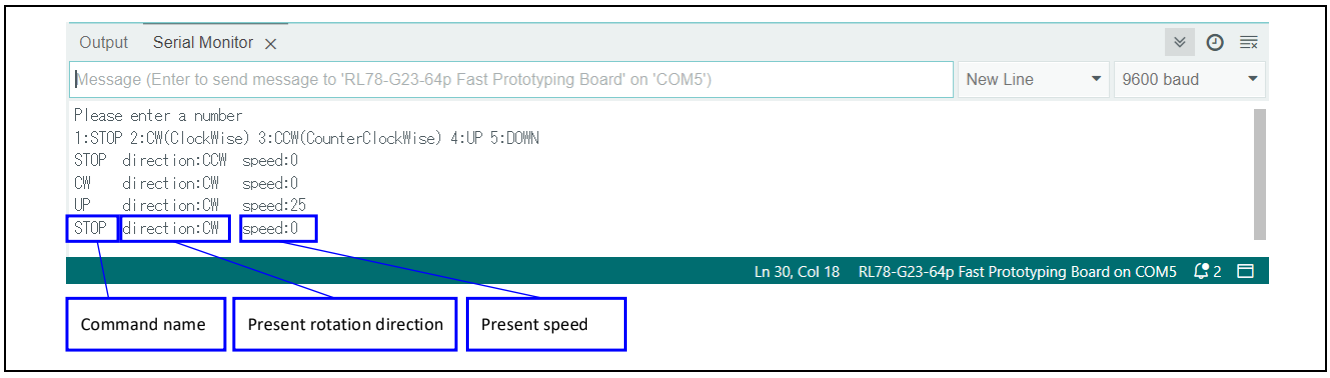


Figure 4-2 Contents to be output on serial monitor

4.2 API functions

This sample code uses “degitalWrite” function, “analogWrite” function, and “HardwareSerial(Serial)” library. The API functions of each library are shown below.

Table 4-2 List of APIs

API function	Function
digitalWrite(pin,value)	Output HIGH/LOW from the digital pin
analogWrite(pin,value)	Output analog value (PWM wave)
Serial.begin(speed)	Specify data transfer rate of serial communication (bps)
Serial.available()	Get the number of bytes (characters) that can be read from the serial port
Serial.readStringUntil(terminator)	Read characters from the serial port until the specific string is received
Serial.print(data, format)	Data output to the serial port
Serial.println(data, format)	Line feed for each data and output to the serial port

For API function specifications of each library, refer to the website of Arduino™ and the other.

API List · renesas/Arduino Wiki · GitHub

digitalWrite() - Arduino Reference

analogWrite() - Arduino Reference

Serial - Arduino Reference

4.2.1 API functions for motor control

The following shows the settings when using channel A. For details of used pins, refer to “Table 1-1 Pins used for motor control”

(1) Brake setting

Outline		Set HIGH or LOW to value for enabling or disabling the brake.			
API function		digitalWrite(pin,value)			
	pin	9			
	value	HIGH	enable	LOW	disable
Usage example		digitalWrite(9, HIGH)	Enable the brake		

(2) Rotation direction setting

Outline		Set HIGH or LOW to value for setting the rotation direction.			
API function		digitalWrite(pin,value)			
	pin	12			
	value	HIGH	CCW(CounterClockWise)	LOW	CW(ClockWise)
Usage example		digitalWrite(12, HIGH)	Set rotation direction to CCW		

(3) Speed setting

Outline		Set value in the range from 0 to 255 for setting the speed (Duty ratio). * Since the current value required for initial operation differs depending on the motor specifications and load conditions, the duty ratio at which rotation starts differs depending on the usage environment.			
API function		analogWrite(pin,value)			
	pin	3			
	value	MIN	0	MAX	255
Usage example		analogWrite(3, 30)	Set the speed to 30		

4.3 Operating procedure of sample sketch

The operation procedure of this sample sketch is shown below. Before the steps below, setup the Arduino™ IDE in the “3.3 Setup of Arduino™ IDE”.

1. Select the [File] - [Open…] menu to open the sample sketch “MotorShield.ino”.

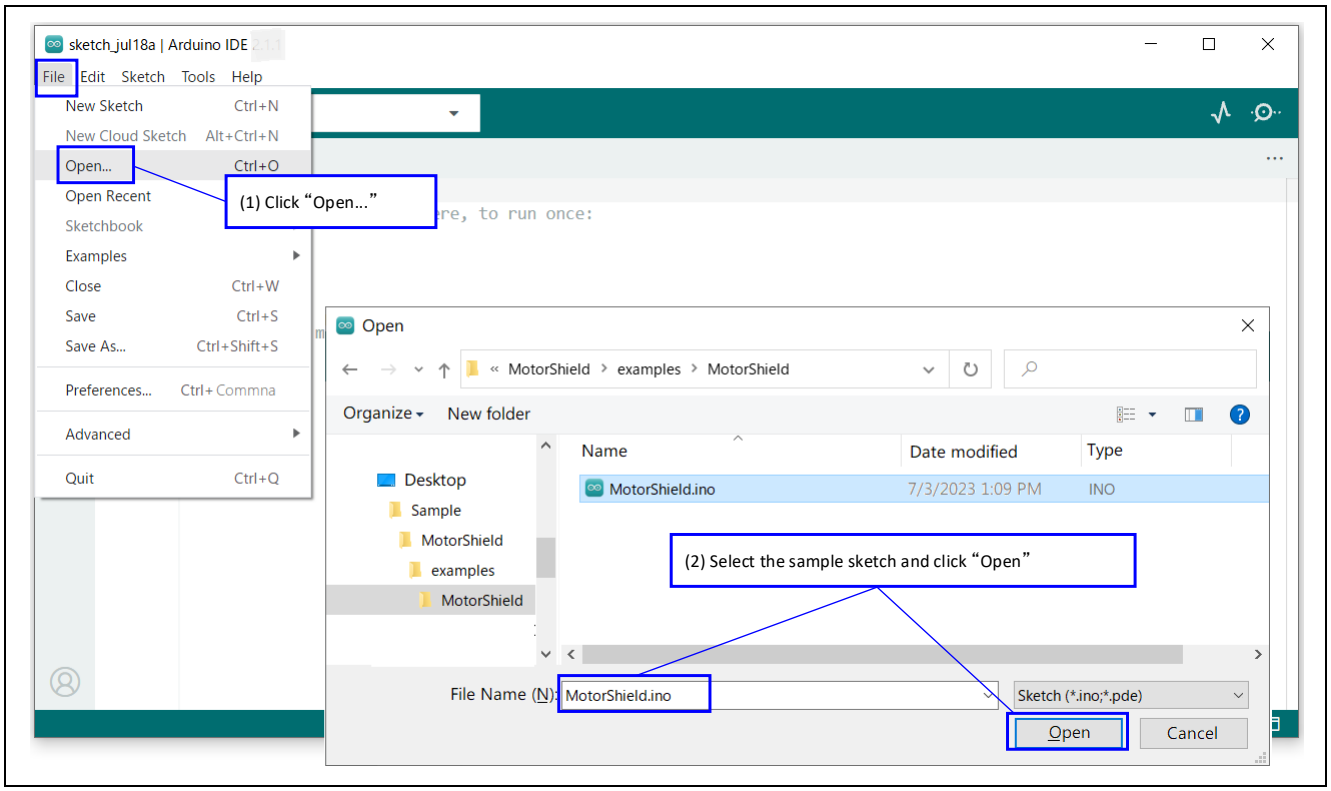


Figure 4-3 Select sample sketch

2. Click the [Verify] icon to start compiling the sketch.

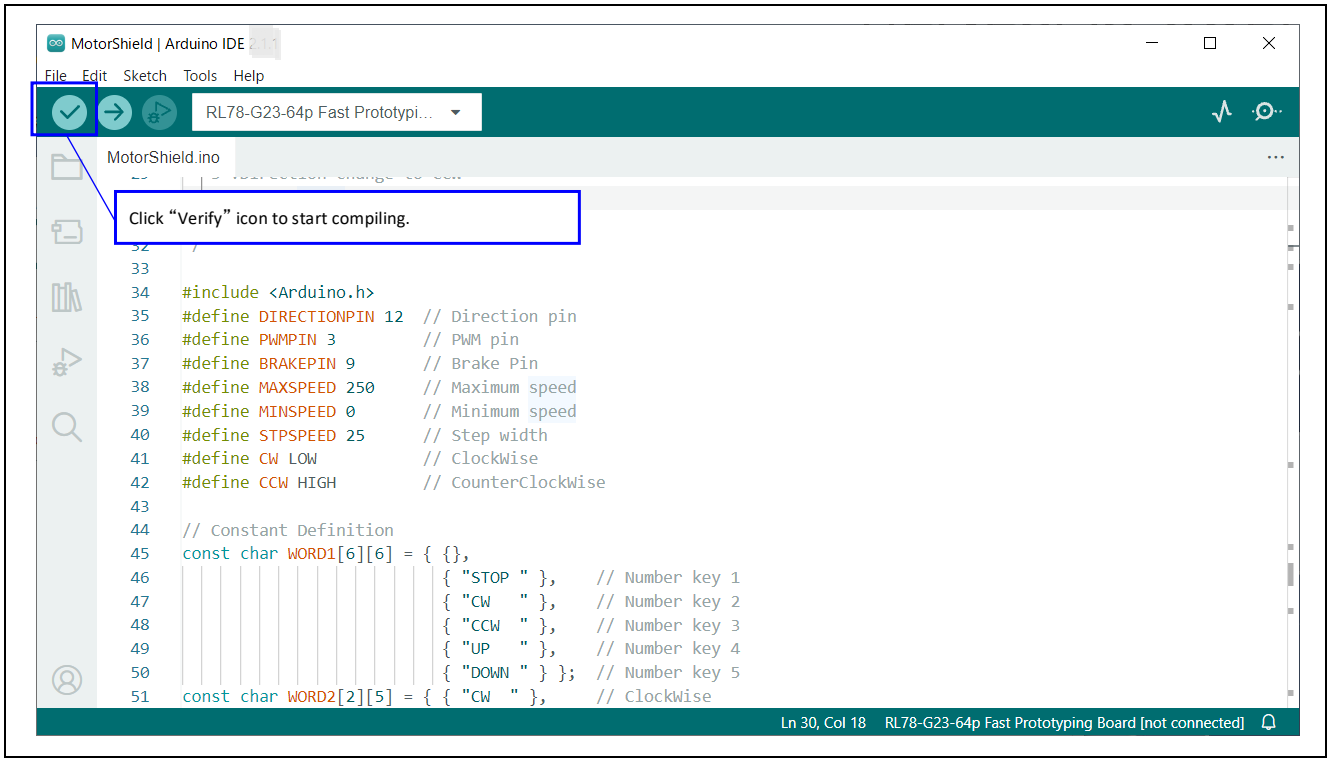


Figure 4-4 Compile sketch

3. After compiling is finished, click the [Upload] icon to write the program to the device.

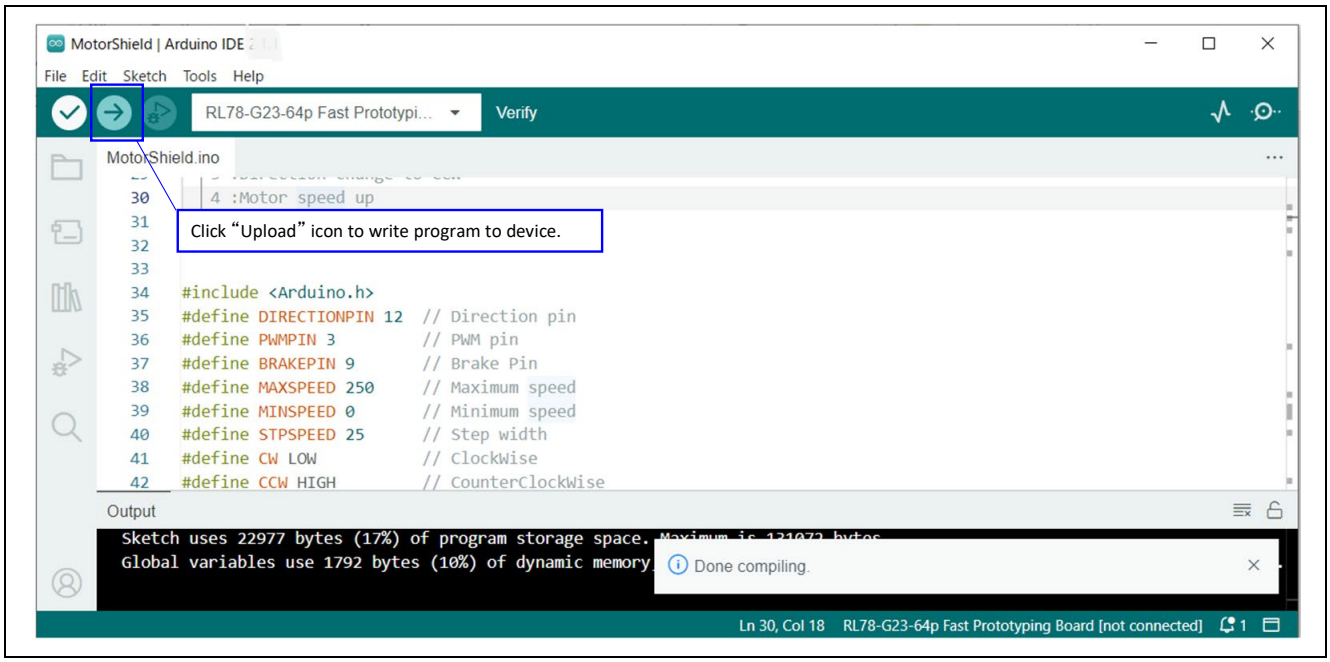


Figure 4-5 Write sketch

4. After writing is finished, click the [Serial Monitor] icon to open the serial monitor. The motor can be controlled by entering 1 to 5 from the serial monitor.

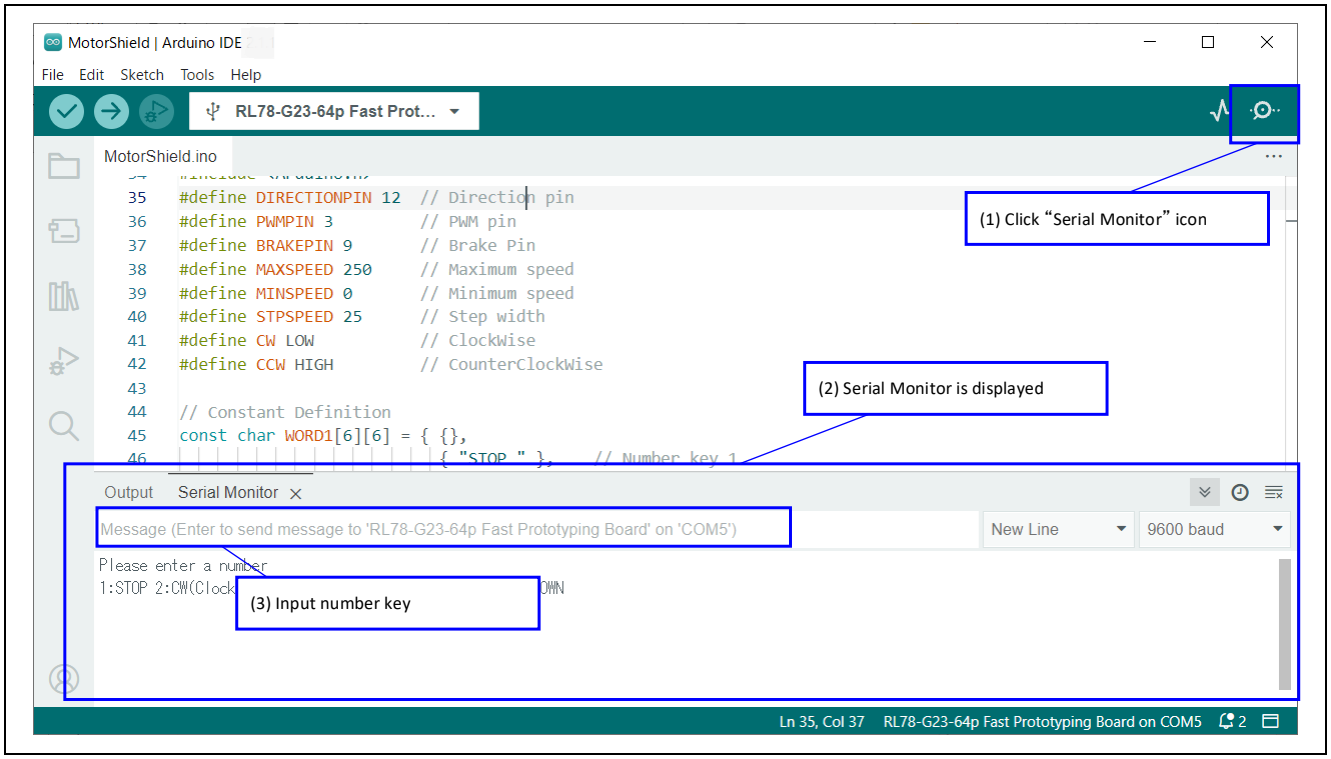
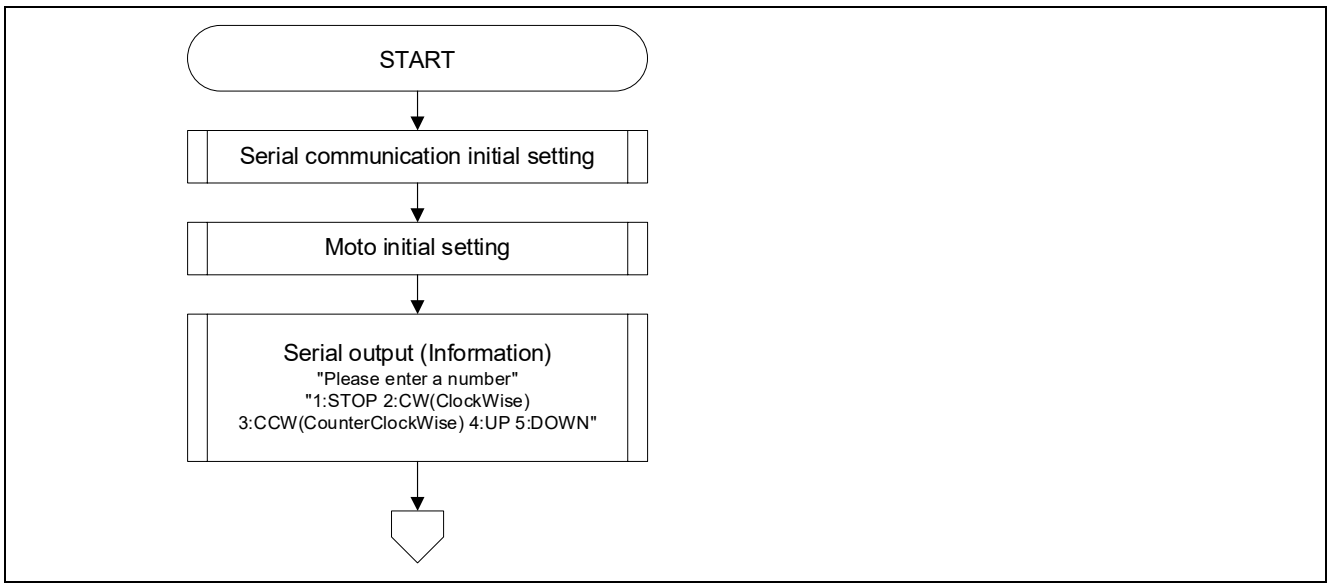


Figure 4-6 Serial monitor of Arduino™ IDE

4.4 Flowchart

4.4.1 main processing

The flow of the sample sketch is shown below.



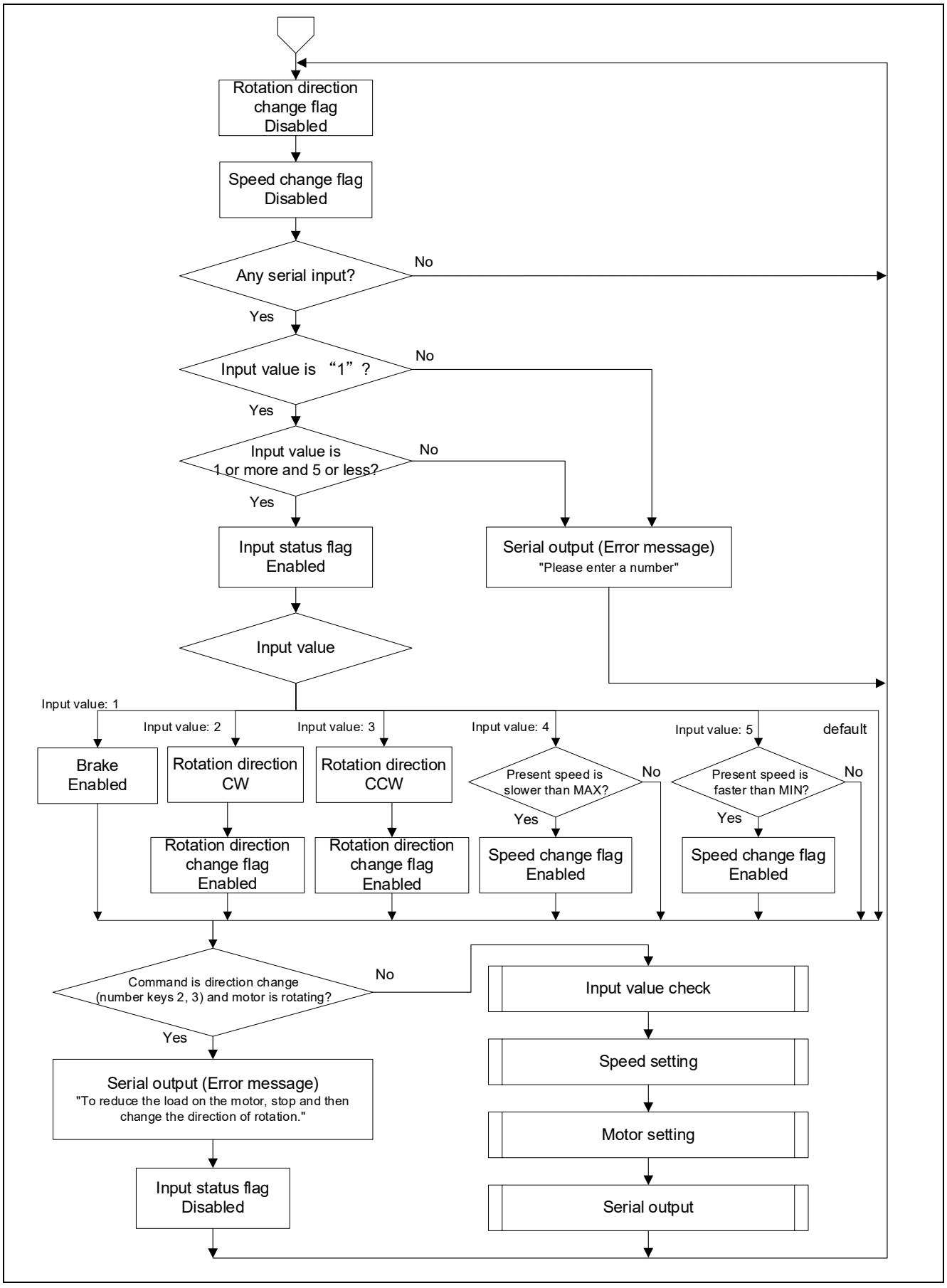


Figure 4-7 Flowchart of main processing

4.4.2 Sub routine

The flow of processing of functions called from the loop function is shown below.

(1) inputCheck: Input value check

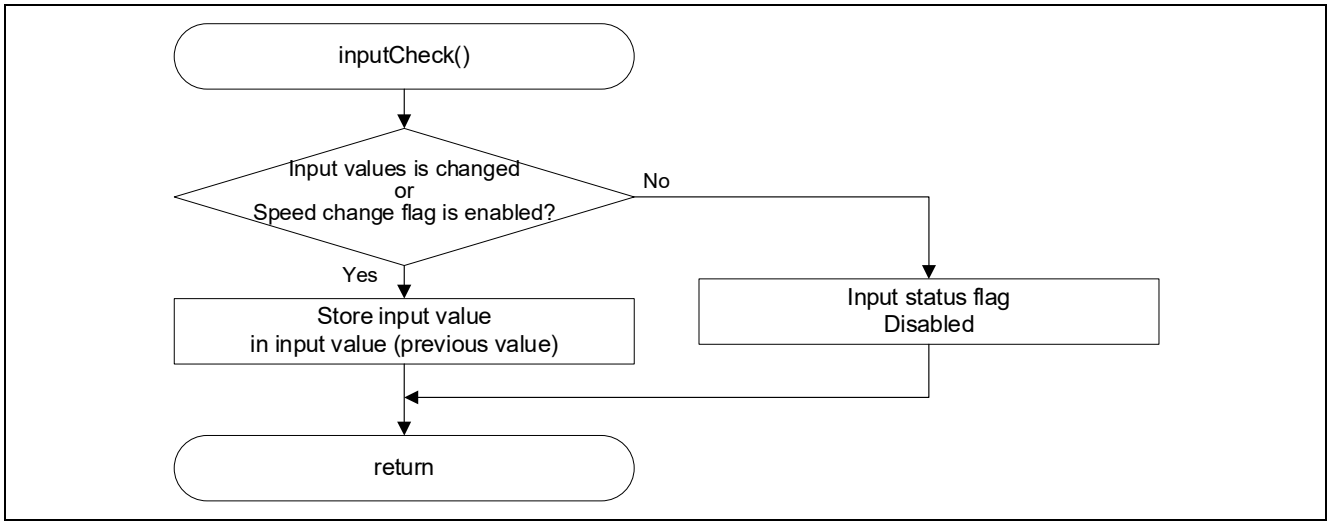


Figure 4-8 Flowchart of inputCheck

(2) speedChange: Speed setting

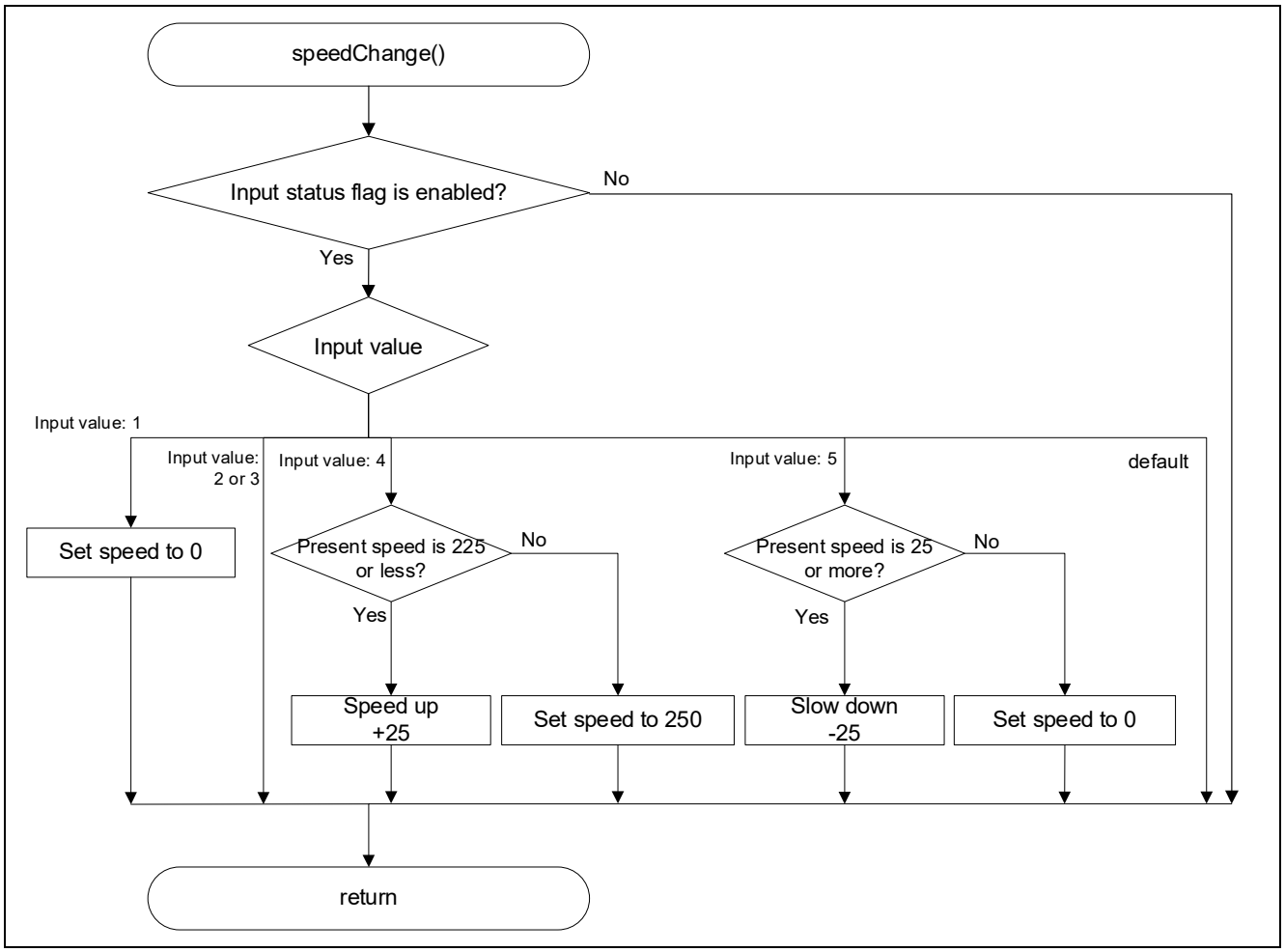


Figure 4-9 Flowchart of speedChange

(3) motorChange: Motor setting

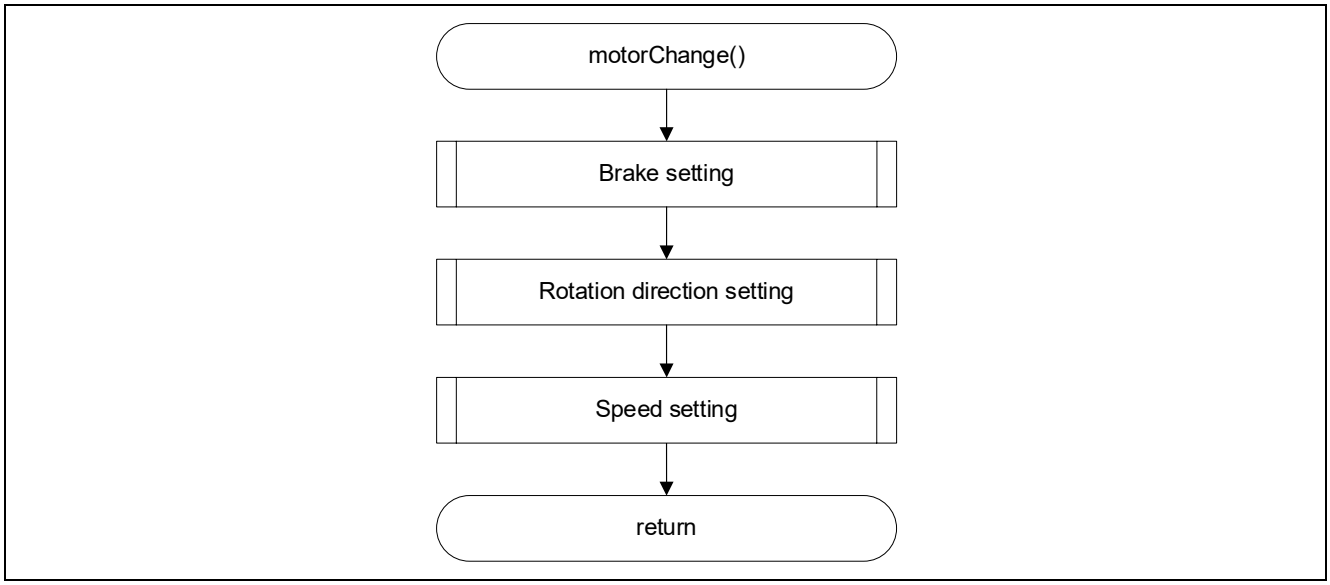
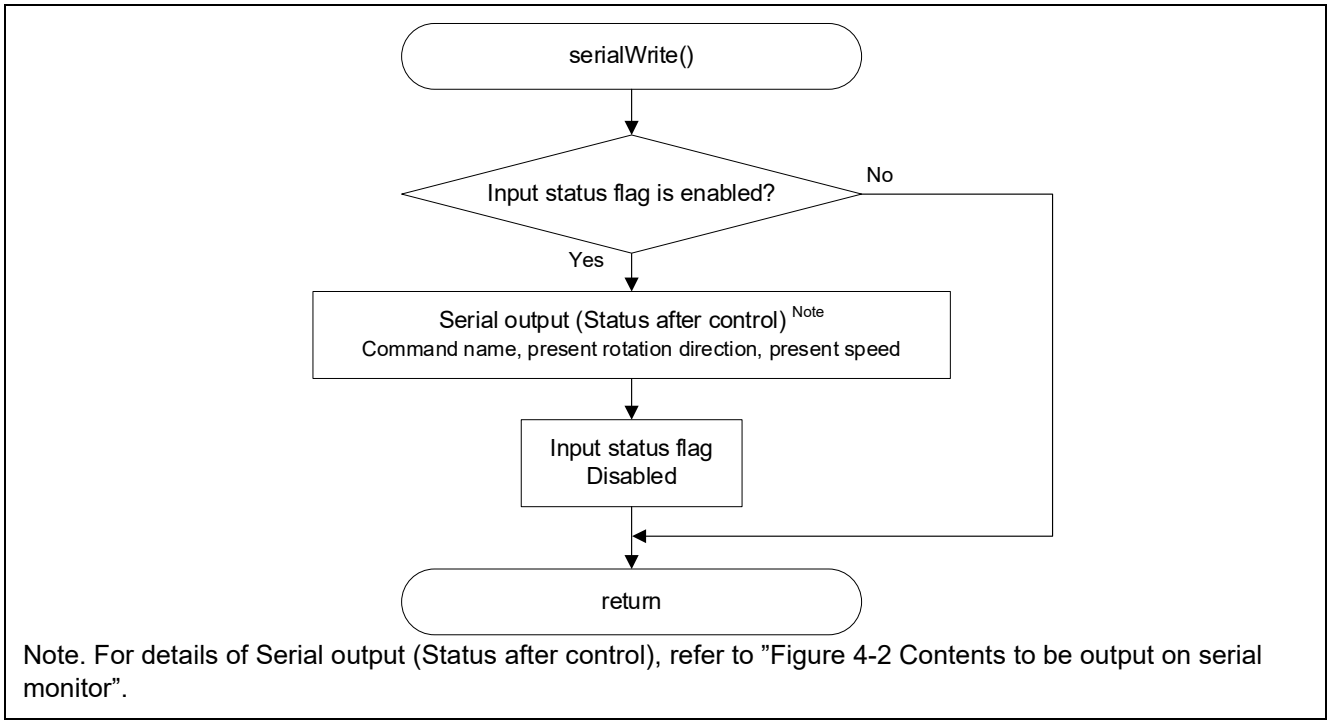


Figure 4-10 Flowchart of motorChange

(4) serialWrite: Serial output



Note. For details of Serial output (Status after control), refer to ”Figure 4-2 Contents to be output on serial monitor”.

Figure 4-11 Flowchart of serialWrite

4.4.3 Specification of functions

The details of the sub routine are as follows.

void inputCheck(int write,bool flgspeed)		
Outline	Input value check of serial monitor	
Argument	1st	Input value
	Data type	int
	2nd	Flag of speed change
	Data type	bool
Return value	None	

void speedChange(int speedno)		
Outline	Set speed of Motor	
Argument	1st	Speed number assigned to number key
	Data type	int
Return value	None	

void motorChange(int brakepin, int setdirection)		
Outline	Set brake (ON/OFF) and rotation direction of motor	
Argument	1st	ON/OFF for brake
	Data type	int
	2nd	rotation direction
	Data type	int
Return value	None	

void serialWrite(int write, int setdirection)		
Outline	Output to serial monitor	
Argument	1st	Input value
	Data type	int
	2nd	rotation direction
	Data type	int
Return value	None	

4.5 Application example

By combining two motors and a sensor, it is possible to create a self-propelled simple robot that does not collide with walls.

Figure 4-12 shows a block diagram that realizes straight ahead, stop, speed, and turning control with the left and right motors, wall distance detection with the Time of Flight (ToF) sensor, and motor current measurement.

Also, refer to "1.1 Arduino Motor Shield1" in this application note for control methods related to straight forward, stop, reverse, and speed for one motor, and refer to "Figure 4-13 Motor control" for the turning method when two motors are combined.

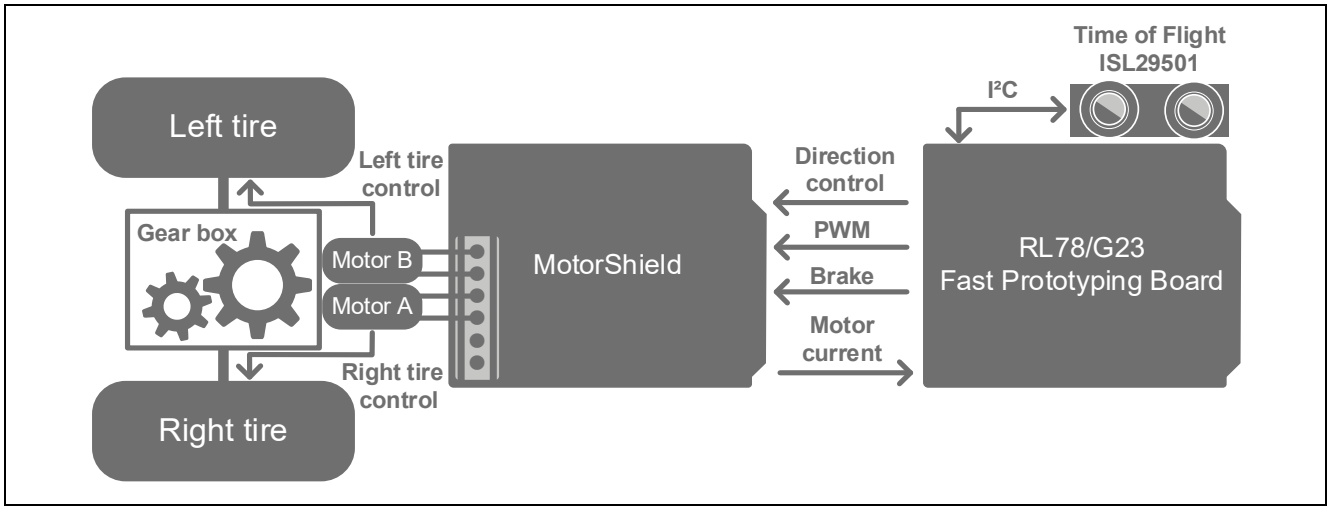


Figure 4-12 Block diagram of application example of self-propelled robot using ToF sensor

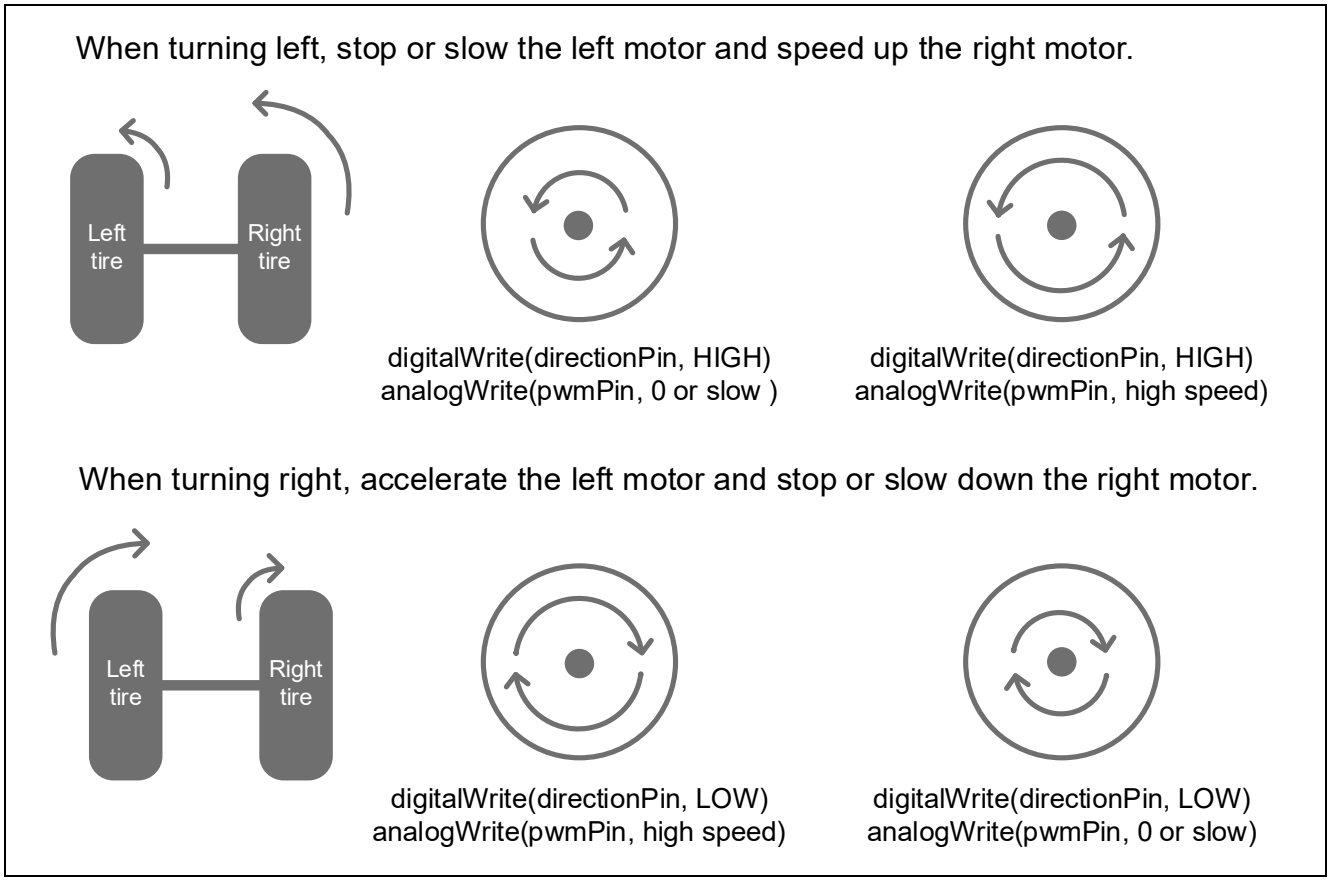


Figure 4-13 Motor control

5. Notes

5.1 COM port is not displayed on the Windows Device Manager

When connecting the PC and the evaluation board (RL78/G23-64p FPB) for the first time, the PC may not recognize the port and the COM port may not be displayed in Windows Device Manager.

If the COM port is not displayed, install the driver of the USB-to-serial convertor (FT232RQ) from FTDI on the RL78/G23-64p FPB by the following procedure.

1. Download the latest driver installer for the target OS from FTDI's website and install it.

   https://ftdichip.com/drivers/vcp-drivers/

2. After installation, “USB Serial Port (COMx)” is displayed under the “Ports (COM & LPT)” on the Device Manager. In the following figure, COM5 is the target COM port.

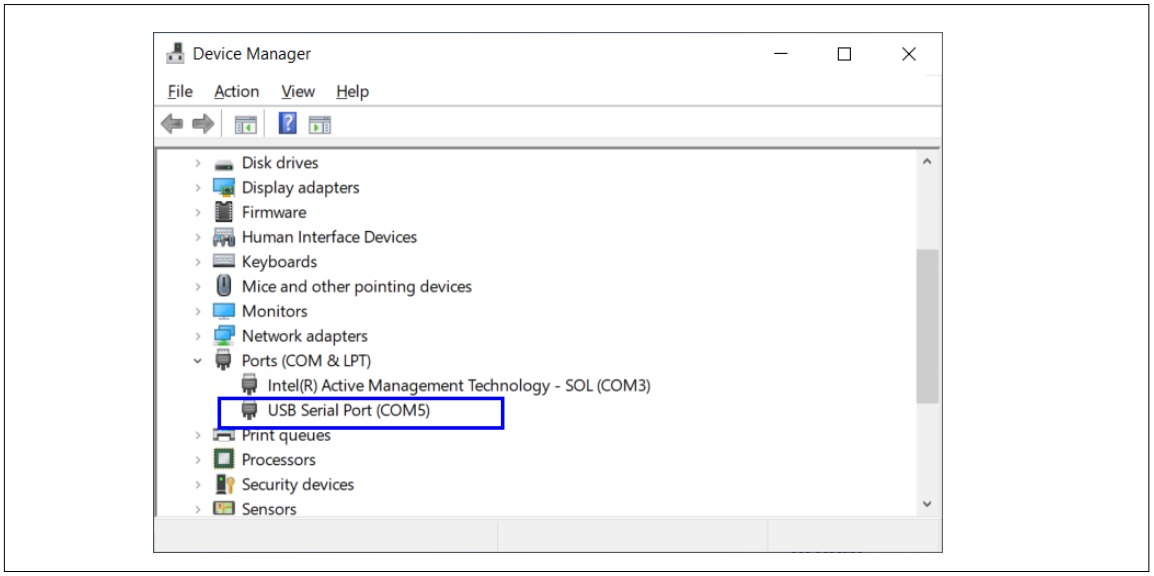


Figure 5-1 Windows Device Manager after installation of device driver

For details of USB-to-serial convector and COM port, refer to “5.11 USB-to-Serial Converter” and “5.12 USB-to-Serial Converter Reset Header” in RL78/G23-64p Fast Prototyping Board User’s manual.

5.2 Program is not written correctly to RL78/G23-64p Fast Prototyping Board

It may not be connected correctly the PC and the RL78/G23-64p FPB even if “USB Serial Port (COMx)” is displayed. Because the RL78/G23-64p FPB is not recognized correctly.

If the program is not written correctly, double-click the target COM port on Windows Device Manager and clear the checkbox of [Serial Emulator].

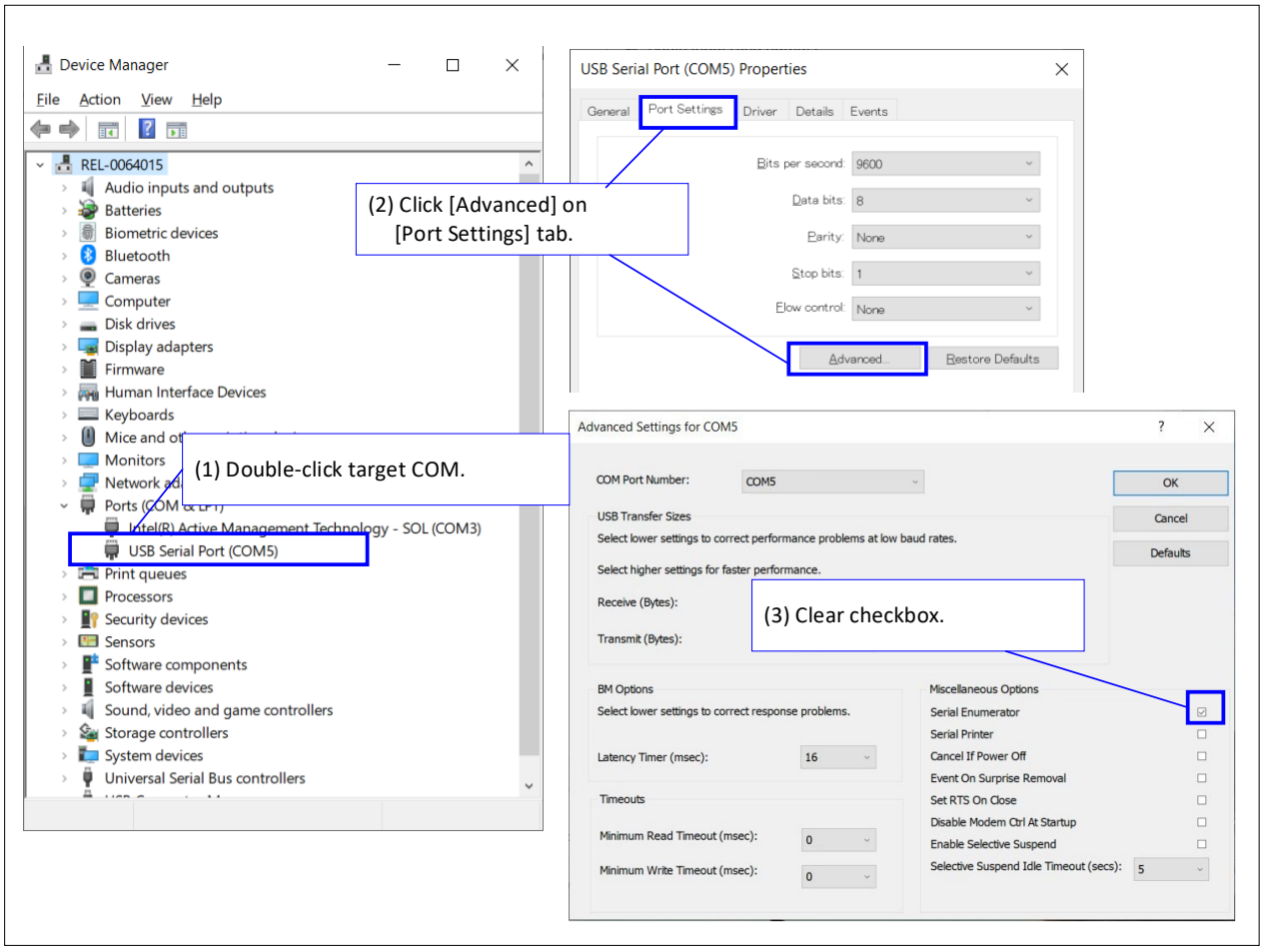


Figure 5-2 Setting example of target COM

6. Sample Code

There is the sample code for this application note.

Sample code can be downloaded from the Renesas Electronics website.

7. Reference Documents

RL78/G23 User's Manual: Hardware (R01UH0896)

RL78/G23-64p Fast Prototyping Board User's Manual (R20UT4814)

The latest versions can be downloaded from the Renesas Electronics website.

Technical update

The latest versions can be downloaded from the Renesas Electronics website.

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Revision History

Rev.	Date	Description	
		Page	Summary
1.00	Jul.20.23	-	First edition

General Precautions in the Handling of Microprocessing Unit and Microcontroller Unit Products

The following usage notes are applicable to all Microprocessing unit and Microcontroller unit products from Renesas. For detailed usage notes on the products covered by this document, refer to the relevant sections of the document as well as any technical updates that have been issued for the products.

1. Precaution against Electrostatic Discharge (ESD)

   A strong electrical field, when exposed to a CMOS device, can cause destruction of the gate oxide and ultimately degrade the device operation. Steps must be taken to stop the generation of static electricity as much as possible, and quickly dissipate it when it occurs. Environmental control must be adequate. When it is dry, a humidifier should be used. This is recommended to avoid using insulators that can easily build up static electricity. Semiconductor devices must be stored and transported in an anti-static container, static shielding bag or conductive material. All test and measurement tools including work benches and floors must be grounded. The operator must also be grounded using a wrist strap. Semiconductor devices must not be touched with bare hands. Similar precautions must be taken for printed circuit boards with mounted semiconductor devices.
2. Processing at power-on

   The state of the product is undefined at the time when power is supplied. The states of internal circuits in the LSI are indeterminate and the states of register settings and pins are undefined at the time when power is supplied. In a finished product where the reset signal is applied to the external reset pin, the states of pins are not guaranteed from the time when power is supplied until the reset process is completed. In a similar way, the states of pins in a product that is reset by an on-chip power-on reset function are not guaranteed from the time when power is supplied until the power reaches the level at which resetting is specified.
3. Input of signal during power-off state

   Do not input signals or an I/O pull-up power supply while the device is powered off. The current injection that results from input of such a signal or I/O pull-up power supply may cause malfunction and the abnormal current that passes in the device at this time may cause degradation of internal elements. Follow the guideline for input signal during power-off state as described in your product documentation.
4. Handling of unused pins

   Handle unused pins in accordance with the directions given under handling of unused pins in the manual. The input pins of CMOS products are generally in the high-impedance state. In operation with an unused pin in the open-circuit state, extra electromagnetic noise is induced in the vicinity of the LSI, an associated shoot-through current flows internally, and malfunctions occur due to the false recognition of the pin state as an input signal become possible.
5. Clock signals

   After applying a reset, only release the reset line after the operating clock signal becomes stable. When switching the clock signal during program execution, wait until the target clock signal is stabilized. When the clock signal is generated with an external resonator or from an external oscillator during a reset, ensure that the reset line is only released after full stabilization of the clock signal. Additionally, when switching to a clock signal produced with an external resonator or by an external oscillator while program execution is in progress, wait until the target clock signal is stable.
6. Voltage application waveform at input pin

   Waveform distortion due to input noise or a reflected wave may cause malfunction. If the input of the CMOS device stays in the area between V_{IL} (Max.) and V_{IH} (Min.) due to noise, for example, the device may malfunction. Take care to prevent chattering noise from entering the device when the input level is fixed, and also in the transition period when the input level passes through the area between V_{IL} (Max.) and V_{IH} (Min.).
7. Prohibition of access to reserved addresses

   Access to reserved addresses is prohibited. The reserved addresses are provided for possible future expansion of functions. Do not access these addresses as the correct operation of the LSI is not guaranteed.
8. Differences between products

   Before changing from one product to another, for example to a product with a different part number, confirm that the change will not lead to problems. The characteristics of a microprocessing unit or microcontroller unit products in the same group but having a different part number might differ in terms of internal memory capacity, layout pattern, and other factors, which can affect the ranges of electrical characteristics, such as characteristic values, operating margins, immunity to noise, and amount of radiated noise. When changing to a product with a different part number, implement a system-evaluation test for the given product.

Notice

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(Rev.5.0-1 October 2020)

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