RL78/G23

HS300x Sample sketch (Arduino™ sketch)

Introduction

This application note describes how to use the RL78/G23-64p Fast Prototyping Board (FPB) library for Arduino to display data from the HS3001 sensor on the serial monitor of the Arduino™ IDE.

Target Device

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

Sensor evaluation board : US082-HS3001EVZ

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 US082-HS3001EVZ with the humidity and temperature HS3001. Arduino™ IDE is used for creating a program and writing a program to RL78/G23. The data from the HS3001 is displayed on the serial monitor.

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

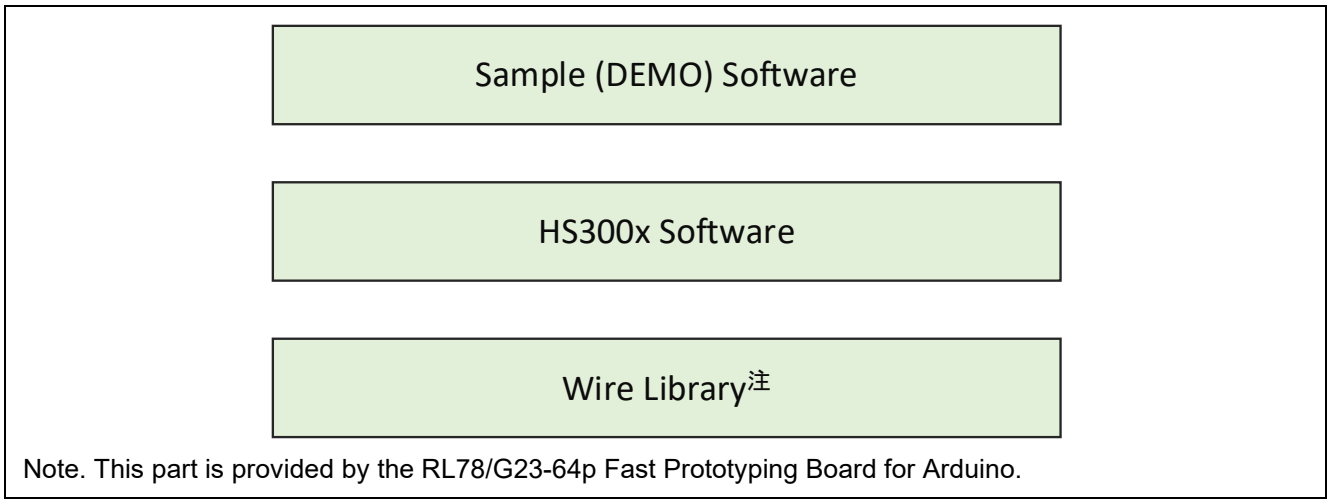

Figure 1-1 Block configuration of software

The simple diagram of this system configuration is shown below.

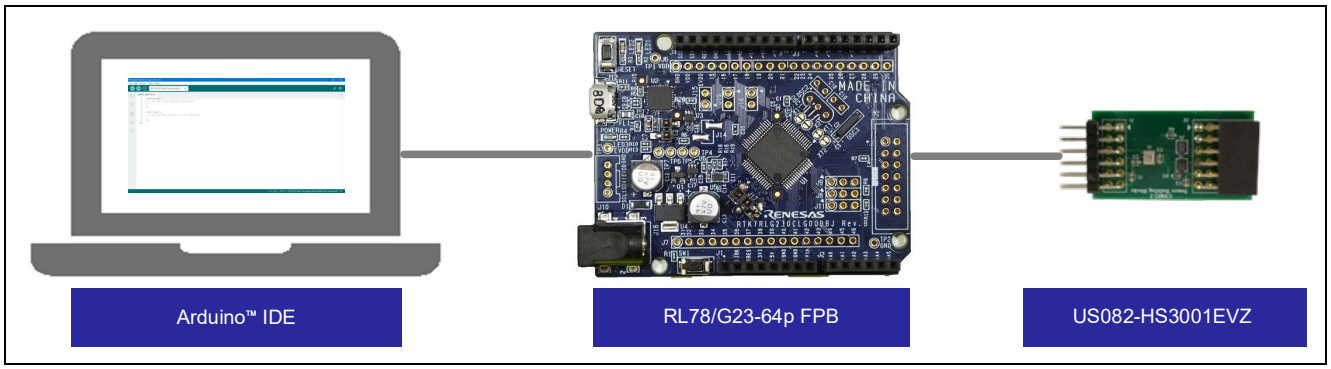

Figure 1-2 System configuration

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
Sensor evaluation board	US082-HS3001EVZ
Operating Voltage	5V

Table 2-2 Operation confirmation environments (Software)

Item	Description	Version
OS	Windows 10	-
Integrated development environment	Arduino™ IDE	2.0.4
Library	RL78/G23-64p FPB library for Arduino	2.0.0

3. Build development environment

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

The Arduino™ IDE 2.0.4 is used in this system. Installation of the Arduino™ IDE 2.0.4 or later is necessary if it is not installed.

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 US082-HS3001EVZ 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	5-V power supply

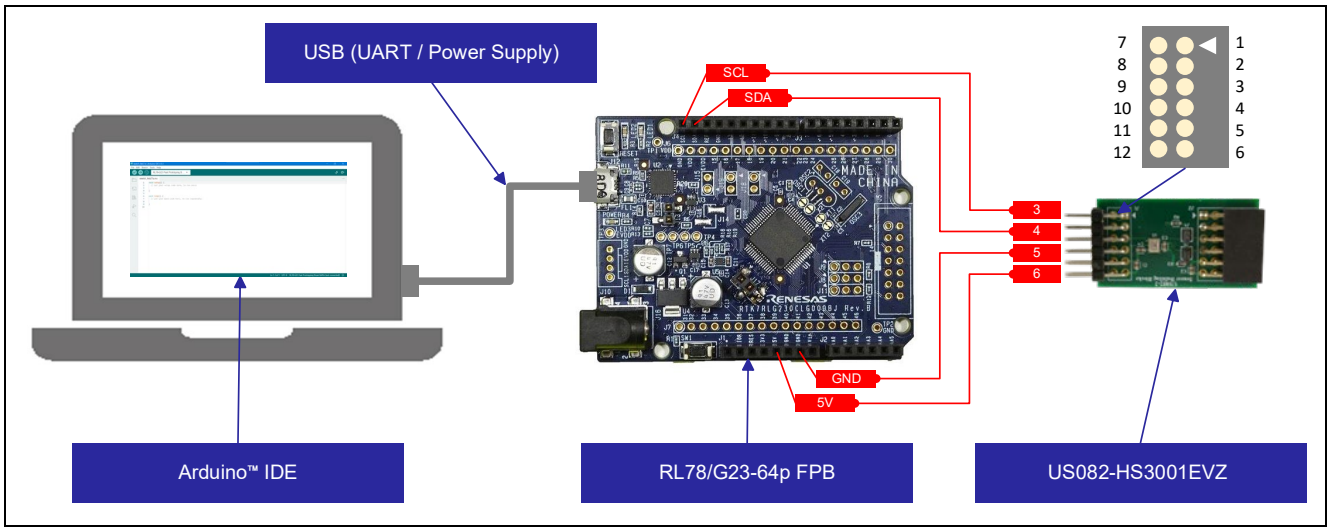

Figure 3-1 Connection of boards

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
I2C	SDA	18	SDAA0/P61
	SCL	17	SCLA0/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)
- US082-HS3001EVZ Evaluation Board Manual (R36UZ0004)

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.

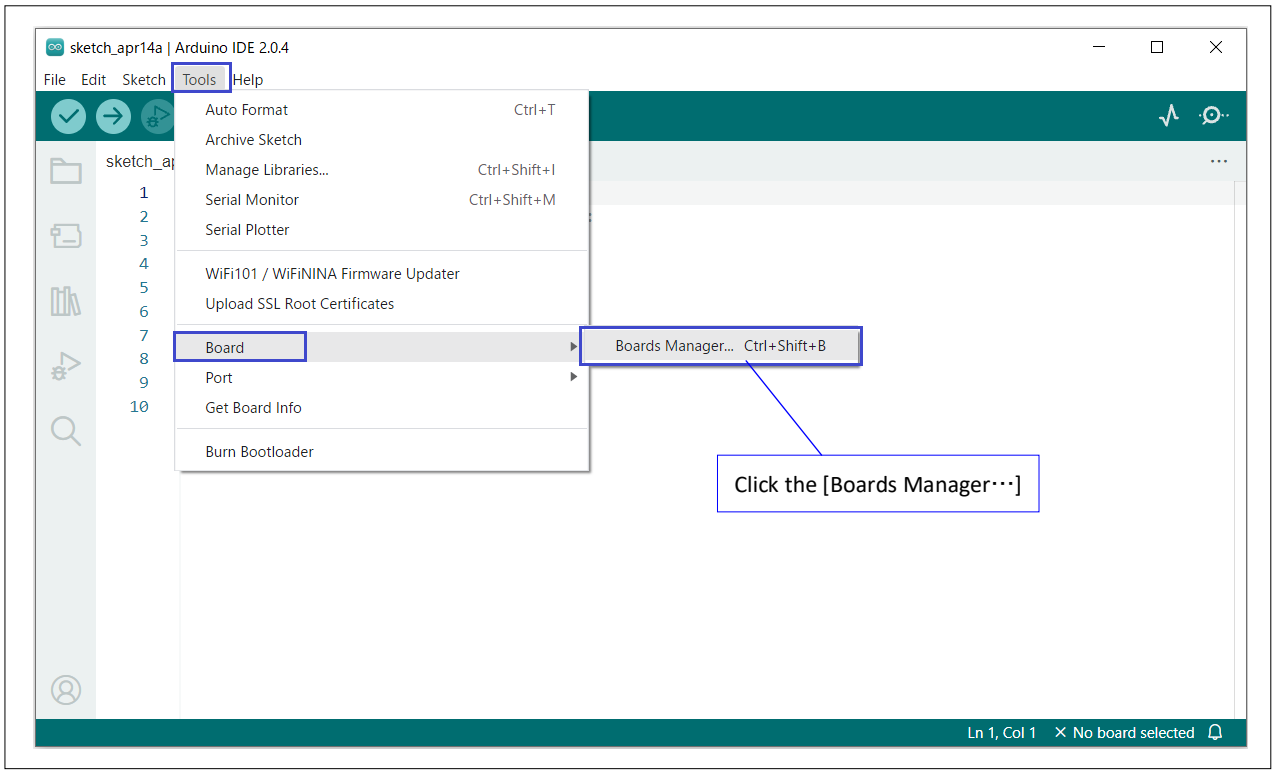

Figure 3-2 Selection of [Boards Manager…]

3. Specify “All” at the [Type] and input “RL78” in the textbox. Then, “RL78/G23-64p Fast Prototyping Board” is displayed. Next, click the [INSTALL]. Version 2.0.0 is used in this sample code.

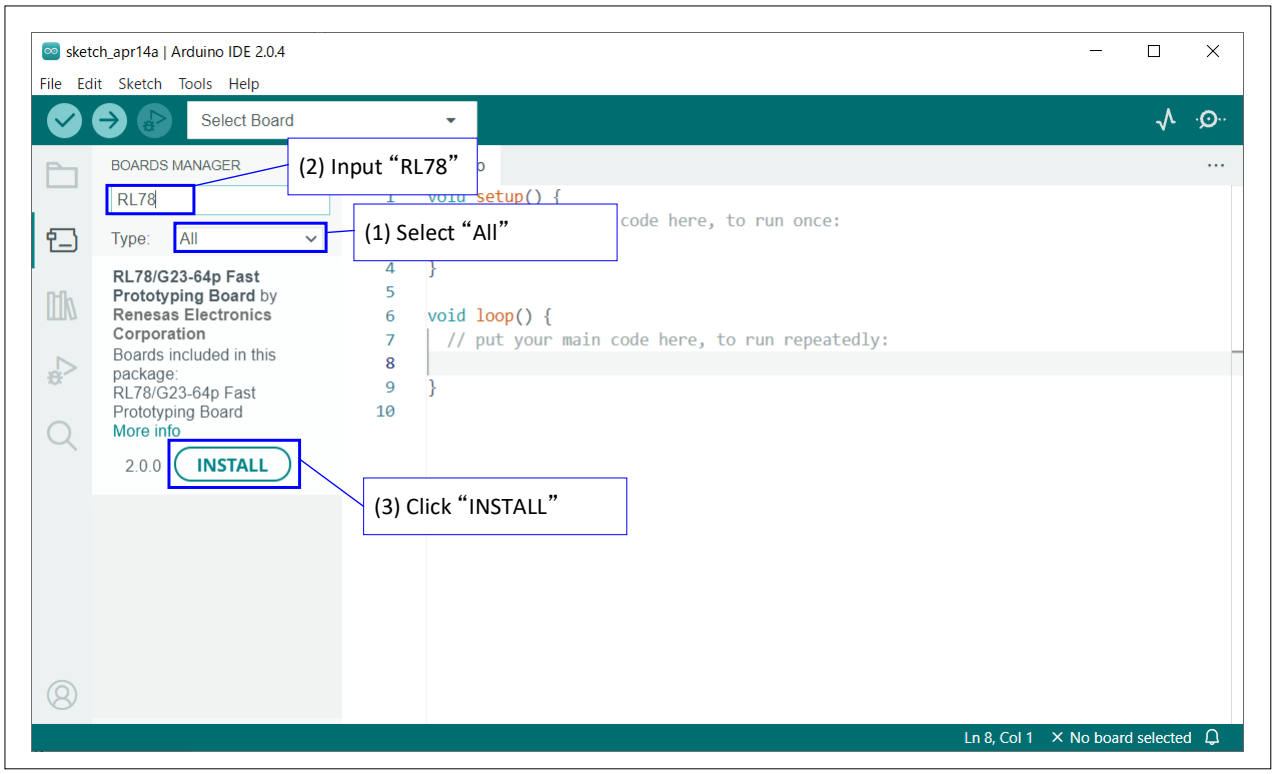

Figure 3-3 Installation of Board Manager

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.

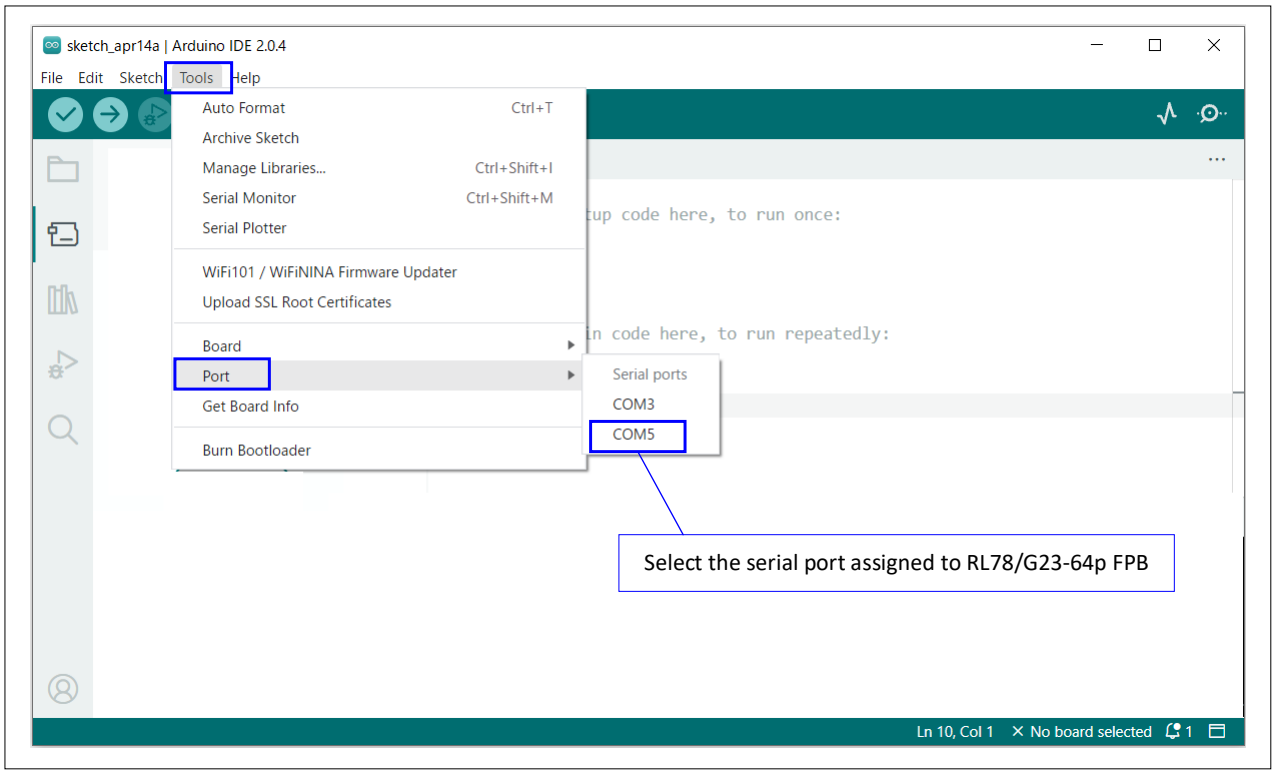

Figure 3-4 Selection of serial port

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

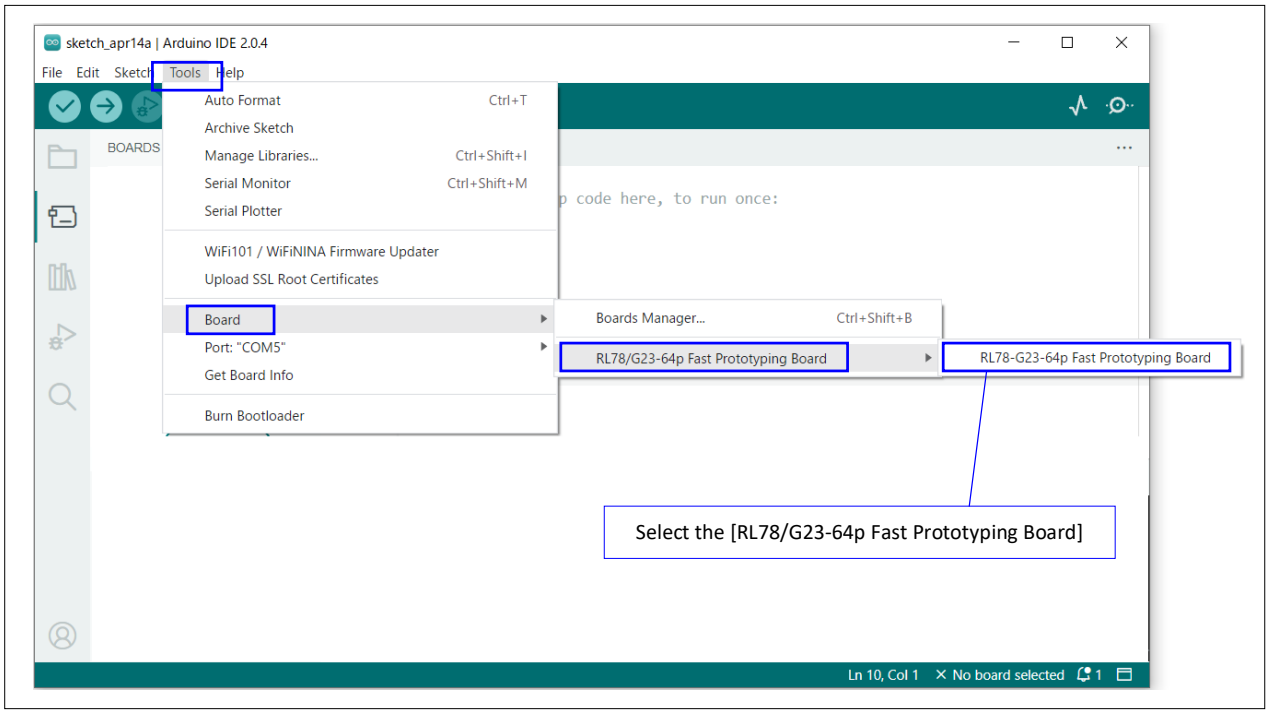

Figure 3-5 Selection of board

4. Software

4.1 Overview of sample code

This sample code gets the data from the HS300x and calculate them to change to the value of temperature and humidity.

This sample code is composed of the sample sketch for the Arduino™ IDE and the HS300x module (API for Arduino). The file structure is shown below.

For details of the HS300x module, refer to the “4.2.1 HS300x module”, for details of the sample sketch, refer to the “4.3 Operating procedure of sample sketch”.

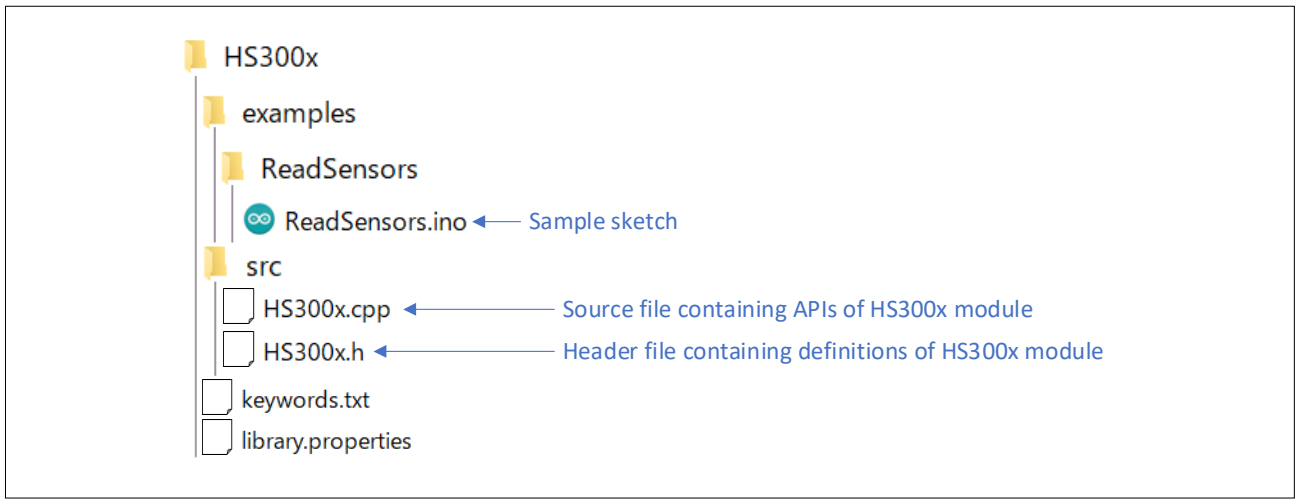

Figure 4-1 File structure of sample code

4.2 API functions

4.2.1 HS300x module

The list of APIs contained in the HS300x module is shown below.

Table 4-1 API list of HS300x module

API function name	Function
int begin()	Measurement preparation • Call the initialization function of Wire channel. • Call the _measurementReq function.
float readTemperature()	Return the value of temperature.
float readHumidity()	Return the value of humidity.
uint8_t _readSensor()	Get the data from HS300x sensor.
int8_t _measurementReq()	Request for measurement • Prepare for IIC transition. • Call the _readSensor function.

The specification of HS300x module's API functions is shown below.

int begin()		
Outline	Call the function of the Wire library to initialize the Wire channel and call the _measurementReq function of the HS300x module in preparation for the measurement.	
Argument	None	
Return value	Description	Readout result from sensor
	Return value	0x01: Normal end (success) 0x00: Failed of read 0xFF: The read data is an abnormal value.
	Data type	uint8_t

float readTemperature()		
Outline	Return the value of the temperature if the retune value of the _measurementReq function is the normal end. Return the "NAN" except the normal end.	
Argument	None	
Return value	Description	The value of temperature or the "NAN" indicating except the normal end
	Retune value	The value of temperature NAN
	Data type	float

float readHumidity()		
Outline	Return the value of the humidity if the retune value of the _measurementReq function is the normal end. Return the "NAN" except the normal end.	
Argument	None	
Return value	Description	The value of humidity or the "NAN" indicating except the normal end
	Retune value	The data of humidity NAN
	Data type	float

Remark. NAN：NaN（Not a Number）

uint8_t _readSensor()		
Outline	Get the data from HS300x sensor and calculate the value of temperature and humidity from the raw data.	
Argument	None	
Return value	Description	Readout result from sensor
	Return value	0x01: Normal end (success) 0x00: Failed of read 0xFF: The read data is an abnormal value.
	Data type	uint8_t

int8_t _measurementReq()		
Outline	To request for the measurement, call the beginTransmission function, the write function, the endTransmission function of the Wire library and the _readSensor function of the HS300x module.	
Argument	None	
Return value	Description	Readout result from sensor
	Return value	0x01: Normal end (success) 0x00: Failed of read 0xFF: The read data is an abnormal value.
	Data type	uint8_t

4.2.2 Other APIs

This sample code uses the Wire library for I2C communication and the HardwareSerial (Serial) library in addition to the HS300x module.

Table 4-2 List of APIs other than HS300x module

API function	Function
Wire.begin(address)	Initialize the Wire library. In this sample code, connect to the I2C bus as the master.
Wire.beginTransmission(address)	Prepare for sending to the communication partner.
Wire.endTransmission()	Send the sequence to the communication partner to start the I2C communication.
Wire.requestFrom(address, count)	Send the sequence to the communication partner to read the data.
Wire.write(value)	Append the data to the end of the transmit buffer.
Wire.read()	Get 1-byte data from the receive buffer.
Serial.begin(speed)	Specify the data transfer speed (bps) of serial communication.
Serial.print(data, format)	Output the data 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

Wire - Arduino Reference

Serial - Arduino Reference

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. Click the [Sketch] - [Include Library] - [Add .ZIP Library…] menu of the Arduino™ IDE. Then, specify the sample code zip file (HS300x.zip) and click the [Open].

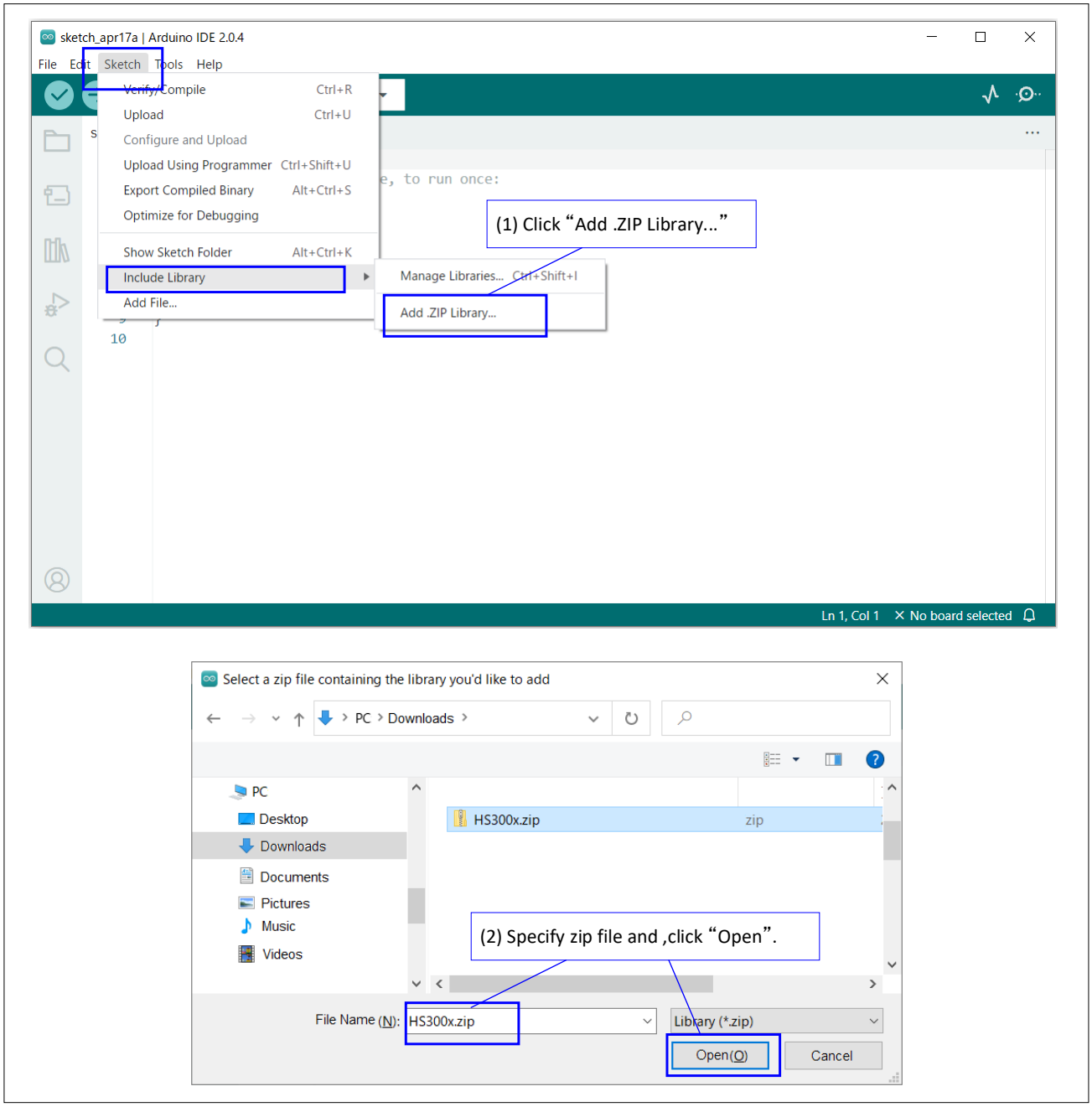

Figure 4-2 Include HS300x module

2. Select the [File] - [Examples] - [HS300x] - [ReadSensors] menu to open the sample sketch “ReadSenesors.ino”.

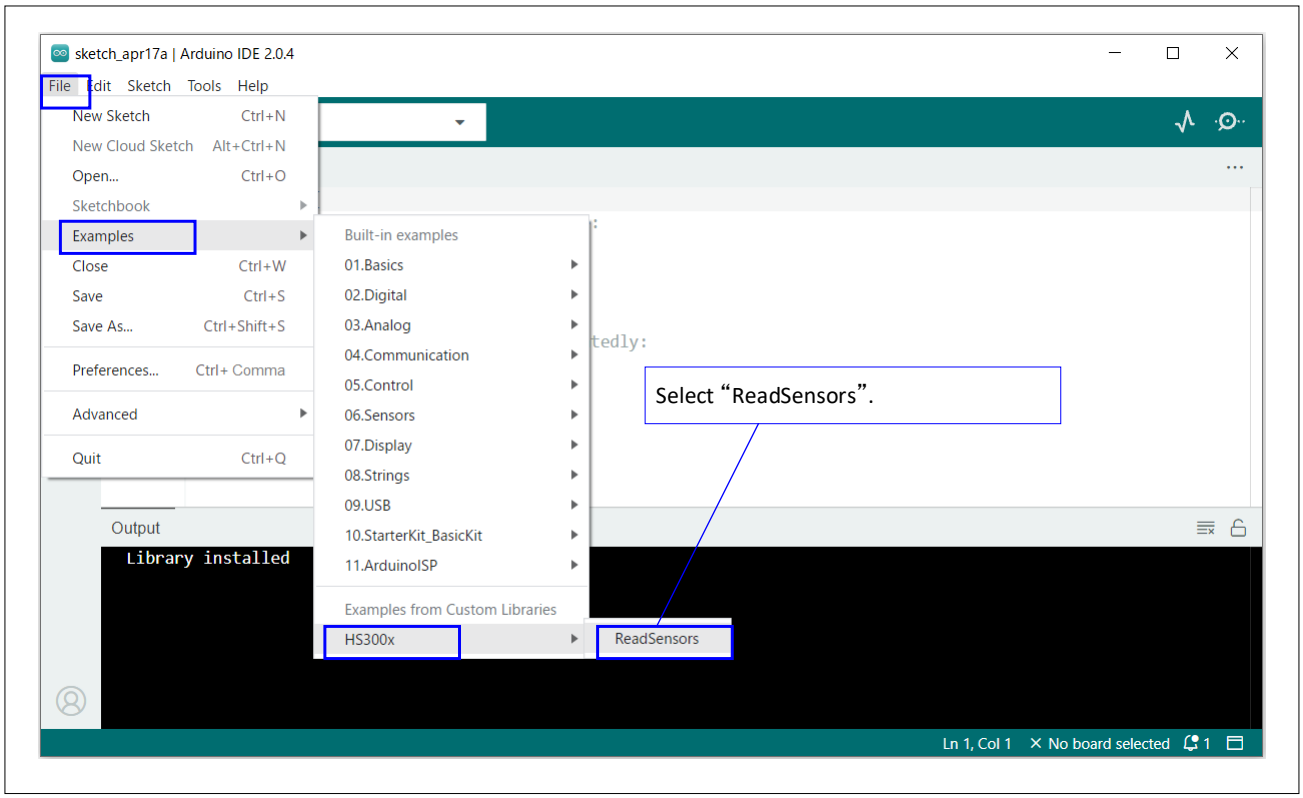

Figure 4-3 Select sample sketch

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

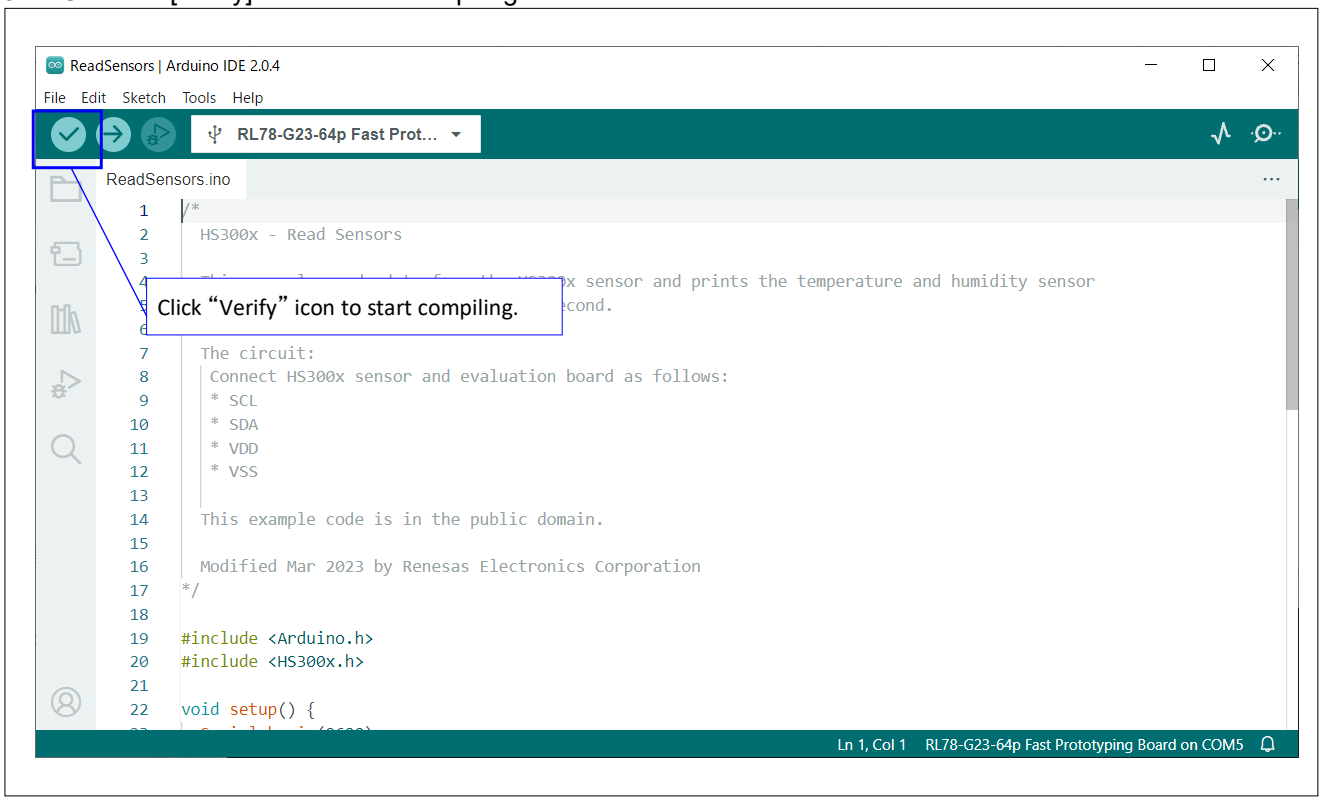

Figure 4-4 Compile sketch

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

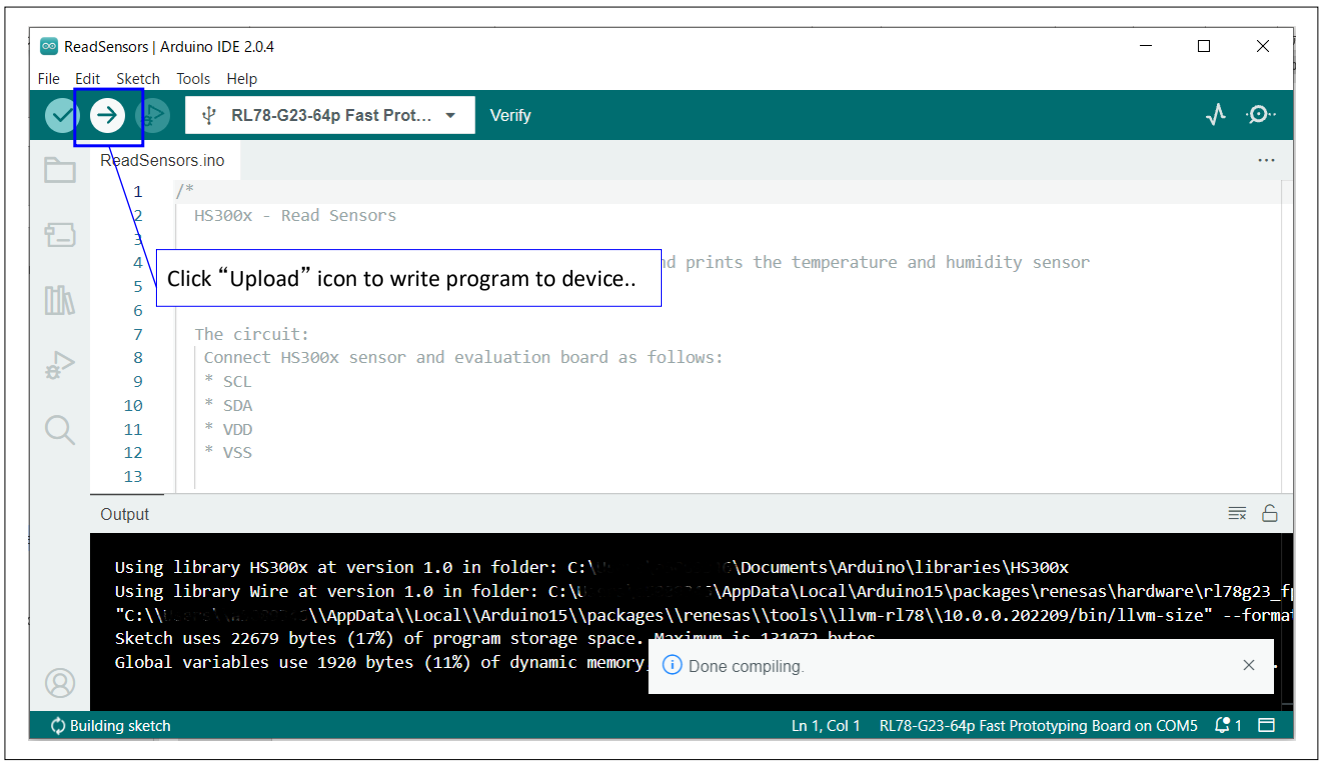

Figure 4-5 Write sketch

5. After writing, click the [Serial Monitor] icon to open the serial monitor. Temperature and Humidity are displayed on the serial monitor every second.

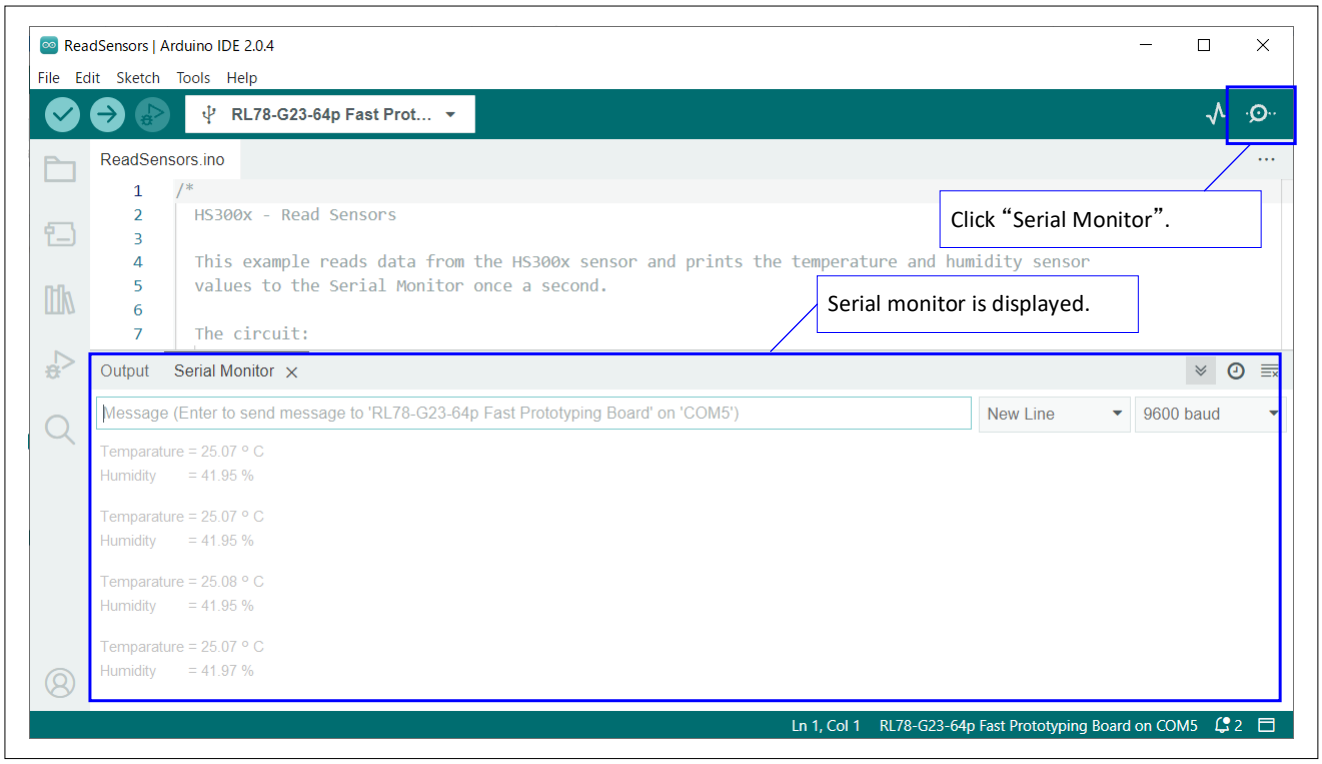

Figure 4-6 Serial monitor of Arduino™ IDE

4.4 Flowchart

The flow of the sample sketch is shown below.

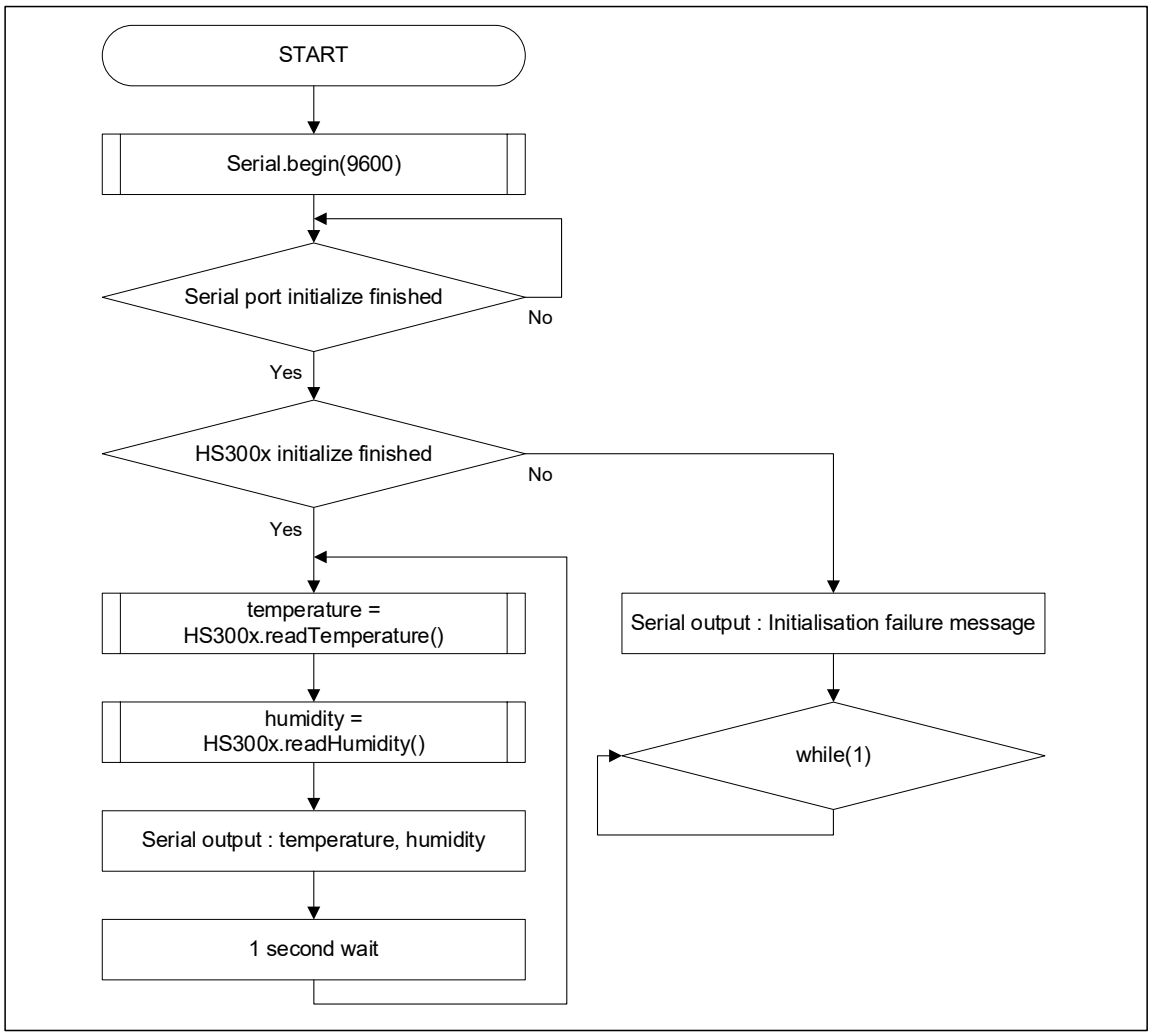

Figure 4-7 Flowchart of sample sketch

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.

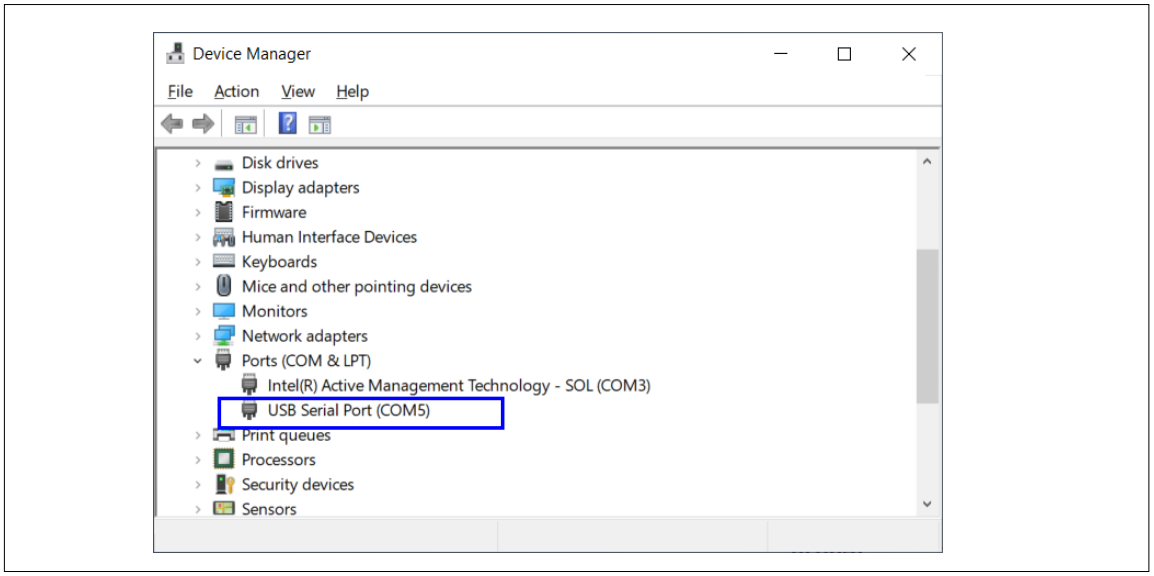

Figure 5-1 Windows Device Manager after installation of device driver

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].

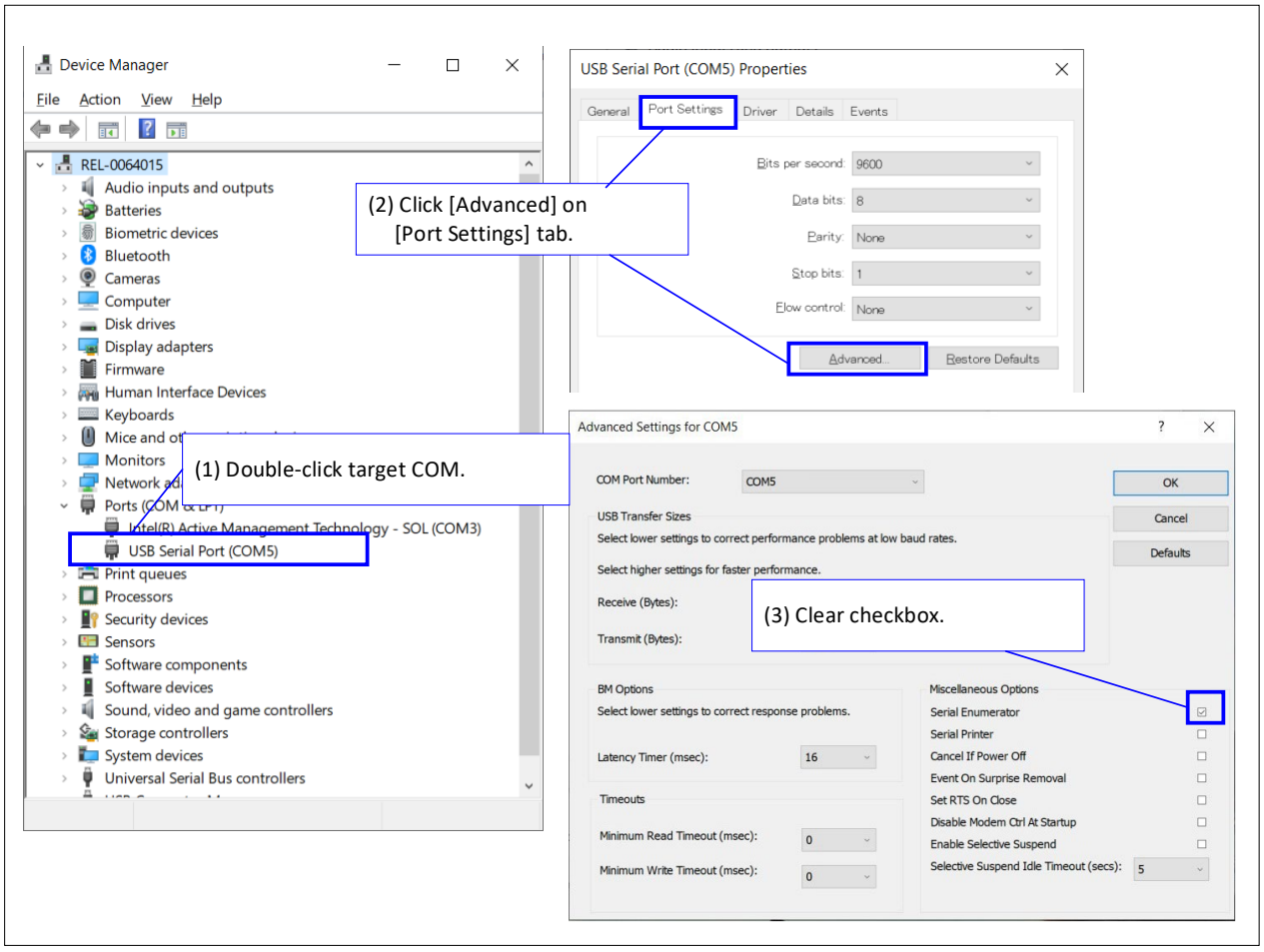

Figure 5-2 Setting example of target COM

6. Sample Code

There is the sample code for this application note.

Sample code can be downloaded from the Renesas Electronics website.

7. Reference Documnets

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

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

HS300x Datasheet (R36DS0010)

US082-HS3001EVZ Evaluation Board Manual (R36UZ0004)

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

Technical update

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

Revision History

Rev.	Date	Description	
		Page	Summary
1.00	April. 21, 2023	-	First Edition

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

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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.

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(Rev.5.0-1 October 2020)

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