

Kappa4310Ard

IS4310 Arduino Shield

Presentation

The **Kappa4310Ard** is an evaluation board for the **IS4310** Modbus RTU Slave stack chip. It enables engineers to easily evaluate the IS4310 without the need for soldering or developing their own prototype—offering a ready-to-use solution. The board features an RGB LED and a potentiometer to simulate an actuator and a sensor.

Designed as a shield with the **Arduino form factor**, the Kappa4310Ard benefits from its widespread popularity, ensuring compatibility with various microcontroller boards, including **Arduino** and **STM32 Nucleo Boards**, among others.

The board features an **RS485 electrical interface** and includes **two daisy-chained RJ45 connectors** for seamless integration.

The IS4310 is an ideal solution for **ensuring Modbus protocol timing constraints**, reducing CPU load, and eliminating the need for dedicated pins. It includes **500 Holding Registers** for engineers to use and supports Function Codes 3 (0x03), 6 (0x06), and 16 (0x10).







Shield Characteristics

Modbus Characteristics	
Supported Function Codes:	3 (0x03) - Read Holding Registers 6 (0x06) - Write Single Register 16 (0x10) - Write Multiple Registers
Holding Registers:	500
Operating Mode:	RTU
Electrical Interface:	RS485
Default Modbus Configuration:	19200

Electrical Characteristics	
I2C Compatible Voltage Levels	3.3V and 5V

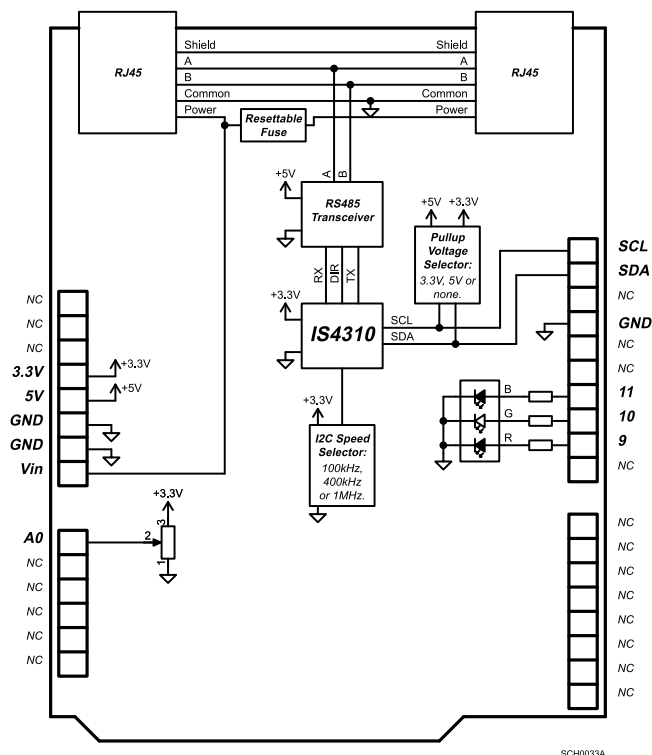


Product Selection Guide

	Part Number	Form Factor	Physical Layer	Stack	Description
Only Stack	IS4310-S8		SO8N	UART 3.3V	Modbus RTU Slave Stack Chip.
				Modbus RTU Server	
Stack with Physical Layer	IS4310-485M2		Castellated Holes Module	RS485	Modbus RTU Server
	IS4310-ISO485M6		Castellated Holes Module	Isolated RS485	Modbus RTU Server
	IS4310-232M4		Castellated Holes Module	RS232	Modbus RTU Server
Evaluation Boards	Kappa4310Rasp		Raspberry Pi Compatible	RS485	Modbus RTU Server
	Kappa4310Ard		Arduino Compatible	RS485	Modbus RTU Server

1. Description

1.1. General Description



The core of the Kappa4310Ard Modbus Shield is the IS4310 I2C Modbus RTU Server chip, which is connected to an RS485 transceiver. This transceiver interfaces with the daisy-chained RJ45 connectors. Since the connectors are daisy-chained, they are functionally identical—connecting the Modbus master to either one makes no difference.

The IS4310 I2C-Serial Interface connects to the I2C pins of the shield. The shield includes a jumper that allows selection of the I2C pull-up voltage: 5V, 3.3V, or Floating. The Floating option is useful when the pull-up resistors are located outside the Kappa4310Ard.

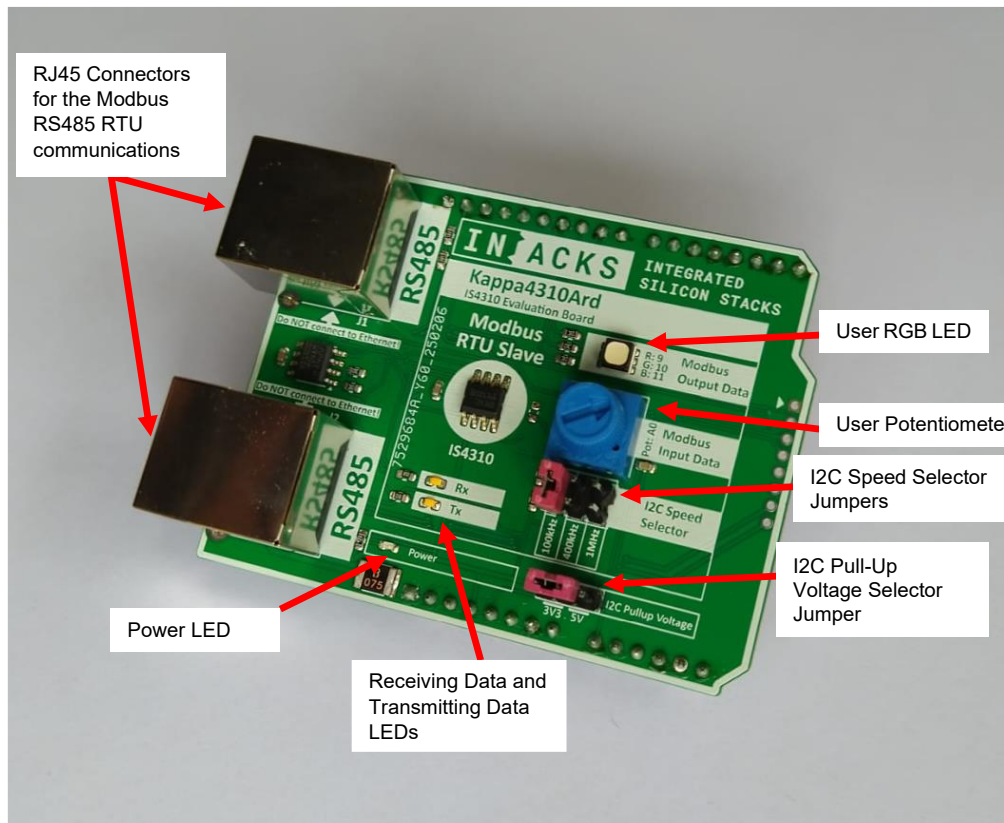
It is crucial to ensure that pull-up resistors are present either on the shield or elsewhere in the circuit. Without pull-up resistors, the I2C-Serial Interface will not function.

Since the IS4310 is 5V tolerant, it can operate with I2C pull-up voltages of 5V and with transceivers powered at 5V. Using 5V transceivers provides better noise immunity and allows for longer bus distances.

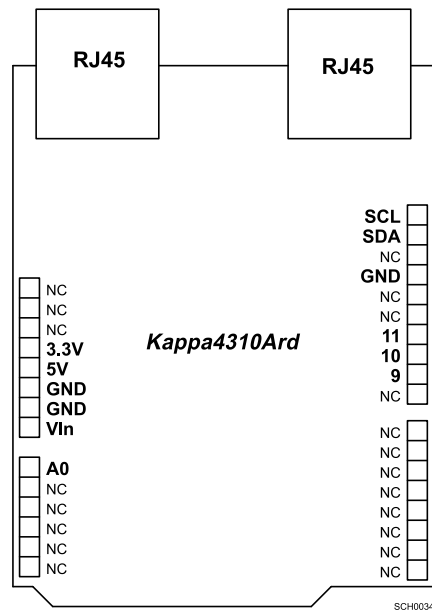
The Shield has 3 LEDs. The Rx yellow LED will blink on received data, and Tx yellow LED will blink on the IS4310 answer. The Power green LED will indicate that the board has detected power. Please note that the board requires both 3.3V and 5V to operate.


A potentiometer is placed on the board to provide a software variable that can be easily adjusted. By reading the analog value of the potentiometer and storing it in a Holding Register, you can continuously monitor the changes on the Modbus Master in real time as you adjust the potentiometer's position. This is a typical application for Modbus sensor development. The output voltage of the potentiometer ranges from 0V to 3.3V.

To develop an actuator, an RGB LED is placed on the board to display the state of Modbus Holding Registers. For example, you can create a traffic light simulation: write a program that reads values from three Holding Registers and adjusts the PWM of each LED accordingly. This is a typical application for Modbus actuator development.



1.2. Module Pinout



Name	Type	Description
NC	Not Connected	These pins have no electrical connection. They can be used by other shields or by your own proposal.
3.3V	3.3V Power In	The shield needs 3.3V and 5V to operate.
5V	5V Power In	
GND	Ground	Ground reference. GND is connected to the "Common" of the RS485 bus. GND is NOT connected to the shield of the RJ45 connector. Refer to section "Bus Topology" for more details.
Vin	Optional (Power In)	This power method is optional and is only for advanced users. Vin pin connects to the pin 7 ("Bus Power Supply") of the RJ45. This allows the Arduino and the Kappa4310Ard to be self-powered from the bus power.
A0	Analog	User potentiometer for prototyping proposals. The output voltage ranges from 0V to 3.3V.
SCL and SDA	Open Drain 5V Tolerant	SCL and SDA pin of the IS4310 I2C-Serial Interface pins. Ensure the proper jumper pull-up configuration on the shield:  <ul style="list-style-type: none"> Placing the jumper on 3V3 sets the SCL and SDA pull-up voltage to 3.3V. Placing the jumper on 5V sets the SCL and SDA pull-up voltage to 5V. Leaving the jumper off leaves SCL and SDA floating. This option is useful when pull-up resistors are located elsewhere in the circuit.
9	Red LED	User RGB LED for prototyping proposals.
10	Green LED	
11	Blue LED	

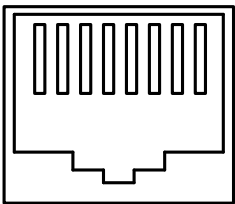
1.3. RJ45 Connectors

Typical Modbus Serial Line connectors include Screw Terminals, RJ45, and D-Sub 9-pin (commonly known as DB9), among others. The device-side connector must be female, while the cable-side connector must be male.

When selecting a RJ45 cable, ensure it has shield and make sure to connect the cable shield to the connector shield to ensure proper electrical continuity across all cable shields on the bus.

Do not connect the shield to the Common. All cable shields should be connected to Common and Protective Ground at a single point for the entire bus, ideally at the master device.

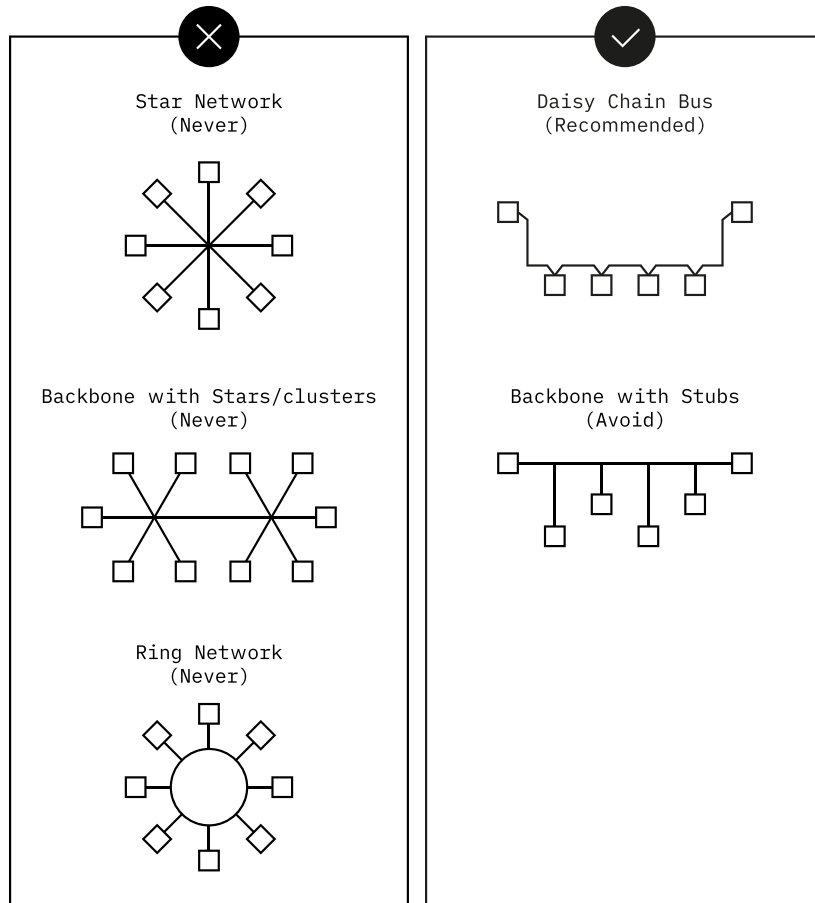
Optionally, power can be supplied to your system through the pin 7 of the RJ45 connector.

RJ45 Connector for RS485 Modbus	
	1: NC
	2: NC
	3: NC
	4: B (D1)
	5: A (D0)
	6: NC
	7: Bus Power Supply (optional)
	8: Common
Shield: Cable Shield	
Attention! The RJ45 connector is intended for the Modbus RS485 bus and must not be connected to an Ethernet network. Connecting it to an Ethernet network may cause damage to Ethernet devices or this device.	

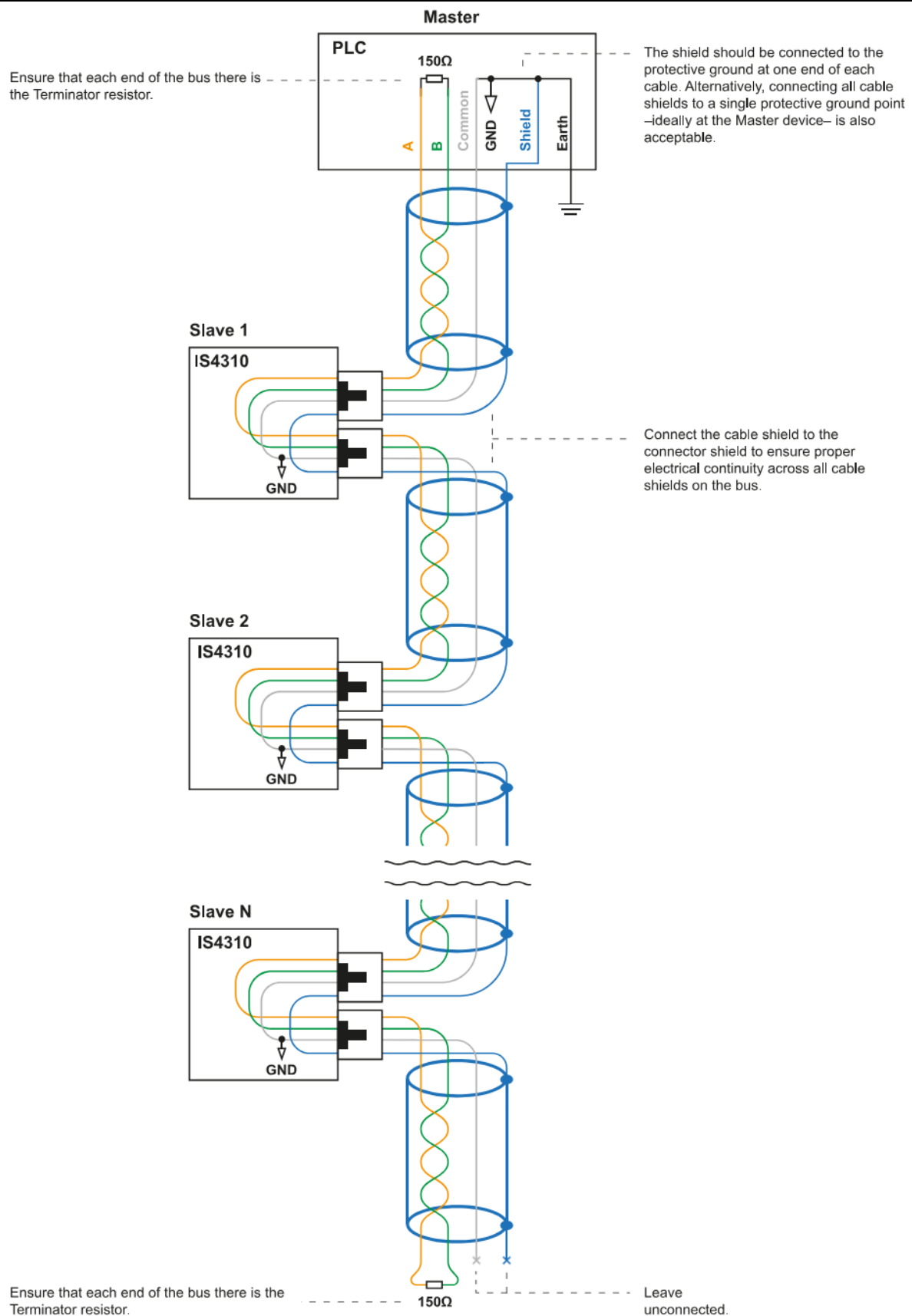
2. Bus Recommendations

2.1. Bus Topology

In an RS485 setup without a repeater, a single trunk cable runs through the system, with devices connected in a daisy-chain manner. Short cables derivations (stubs) are also allowed but not recommended. Keep the derivation distance as short as possible. Other topologies are not allowed.



2.2. Cable Wiring



3. Firmware Implementation Guide

3.1. Arduino Example

```
#include <Wire.h>

void writeHoldingRegister(uint16_t holdingRegisterAddress, uint16_t data) {
    Wire.beginTransmission(0x11); // This is the I2C Chip Address of the IS4310. Never changes.
    // A Holding Register address is 16-bits long, so we need to write 2 bytes to indicate the address.
    Wire.write((holdingRegisterAddress >> 8) & 0xFF); // Send high 8-bits of the Holding Register Address we want to write.
    Wire.write(holdingRegisterAddress & 0xFF); // Send low 8-bits of the Holding Register Address we want to write.
    // A Holding Register data register is 16-bits long. So we need to write 2 bytes to make a full Holding Register Write:
    Wire.write((data >> 8) & 0xFF); // Send high 8-bits of the data we want to write to the Holding Register.
    Wire.write(data & 0xFF); // Send low 8-bits of the data we want to write to the Holding Register.
    Wire.endTransmission();
}

uint16_t readHoldingRegister(uint16_t holdingRegisterAddress) {
    uint16_t result; // This is the variable where the read data will be saved.
    Wire.beginTransmission(0x11); // This is the I2C Chip Address of the IS4310. Never changes.
    // A Holding Register address is 16-bits long, so we need to write 2 bytes to indicate the address.
    Wire.write((holdingRegisterAddress >> 8) & 0xFF); // Send high 8-bits of the Holding Register Address we want to read.
    Wire.write(holdingRegisterAddress & 0xFF); // Send low 8-bits of the Holding Register Address we want to read.
    Wire.endTransmission(false);
    // A Holding Register data register is 16-bits long. So we need to read 2 bytes to make a full Holding Register Read:
    Wire.requestFrom(0x11, 2); // From the IS4310, request 2 bytes (2 bytes make a full Holding Register).
    result = Wire.read(); // Read the first byte.
    result = result << 8; // Make space for the second byte.
    result = result | Wire.read(); // Read the second byte.
```

```
    return result; // Return the read 16-bit register.
}

void setup() {
    uint16_t ModbusSlaveID;

    Wire.begin(); // Initialize the I2C.
    Serial.begin(9600); // Initialize the Serial for the prints.

    // The Modbus Slave ID is stored in the Holding Register Address 500 of the IS4310, let's read it:
    ModbusSlaveID = readHoldingRegister(500);

    // Let's print the read Modbus Slave ID:
    Serial.println("");
    Serial.print("The Modbus Slave Address is: ");
    Serial.println(ModbusSlaveID);
}

void loop() {
    uint16_t humidity = 47; // Let's imagine a humidity sensor that reads a level of 47% RH.

    // Let's write the humidity to the Holding Register Address 0:
    writeHoldingRegister(0, humidity);

    delay(1000);
}
```

3.2. STM32 Example

The following code is an abstraction of the main.c file from the ISXMPL4310ex9 example. All external HAL routines and function calls have been removed for clarity.

You can download the full STM32 project from the [IS4310 product page](#).

This example demonstrates:

1. How to read a potentiometer (simulating a sensor) and store its state in Holding Register 0.
2. How to control an RGB LED (simulating an actuator) using GPIO pins based on values in Holding Registers 1, 2, and 3.

```
uint16_t readHoldingRegister(uint16_t registerAddressToRead) {
    uint8_t IS4310_I2C_Chip_Address; // This variable stores the I2C chip address of the IS4310.
    IS4310_I2C_Chip_Address = 0x11; // The IS4310's I2C address is 0x11.
    // The STM32 HAL I2C library requires the I2C address to be shifted left by one bit.
    // Let's shift the IS4310 I2C address accordingly:
    IS4310_I2C_Chip_Address = IS4310_I2C_Chip_Address << 1;

    // The following array will store the read data.
    // Since each holding register is 16 bits long, reading one register requires reading 2 bytes.
    uint8_t readResultArray[2];

    // This variable will contain the final result:
    uint16_t readResult;

    /*
     * This is the HAL function to read from an I2C memory device. The IS4310 is designed to operate as an I2C memory.
     *
     * HAL_I2C_Mem_Read parameters explained:
     * 1. &hi2c1: This is the name of the I2C that you're using. You set this in the CubeMX. Don't forget the '&'.
     * 2. IS4310_I2C_Chip_Address: The I2C address of the IS4310 (must be left-shifted).
     * 3. registerAddressToRead: The holding register address to read from the IS4310.
     * 4. I2C_MEMADD_SIZE_16BIT: You must indicate the memory addressing size. The IS4310 memory addressing is 16-bits.
     * This keyword is an internal constant of HAL libraries. Just write it.
     * 5. readResultArray: An 8-bit array where the HAL stores the read data.
     * 6. 2: The number of bytes to read. Since one holding register is 16 bits, we need to read 2 bytes.
     * 7. 1000: Timeout in milliseconds. If the HAL fails to read within this time, it will skip the operation
     * to prevent the code from getting stuck.
     */
    HAL_I2C_Mem_Read(&hi2c1, IS4310_I2C_Chip_Address, registerAddressToRead, I2C_MEMADD_SIZE_16BIT, readResultArray, 2, 1000);

    // Combine two bytes into a 16-bit result:
    readResult = readResultArray[0];
    readResult = readResult << 8;
    readResult = readResult | readResultArray[1];
}
```

```
    return readResult;
}

void writeHoldingRegister(uint16_t registerAddressToWrite, uint16_t value) {
    uint8_t IS4310_I2C_Chip_Address; // I2C address of IS4310 chip (7-bit).
    IS4310_I2C_Chip_Address = 0x11; // IS4310 I2C address is 0x11 (7-bit).
    // STM32 HAL expects 8-bit address, so shift left by 1:
    IS4310_I2C_Chip_Address = IS4310_I2C_Chip_Address << 1;

    // The HAL library to write I2C memories needs the data to be in a uint8_t array.
    // So, lets put our uint16_t data into a 2 registers uint8_t array.
    uint8_t writeValuesArray[2];
    writeValuesArray[0] = (uint8_t) (value >> 8);
    writeValuesArray[1] = (uint8_t) value;

    /*
     * This is the HAL function to write to an I2C memory device. To be simple and easy to use, the IS4310 is designed to operate as an I2C
     memory.
     *
     * HAL_I2C_Mem_Write parameters explained:
     * 1. &hi2c1: This is the name of the I2C that you're using. You set this in the CubeMX. Don't forget the '&'.
     * 2. IS4310_I2C_Chip_Address: The I2C address of the IS4310 (must be left-shifted).
     * 3. registerAddressToWrite: The holding register address of the IS4310 we want to write to.
     * 4. I2C_MEMADD_SIZE_16BIT: You must indicate the memory addressing size. The IS4310 memory addressing is 16-bits.
     * This keyword is an internal constant of HAL libraries. Just write it.
     * 5. writeValuesArray: An 8-bit array where we store the data to be written by the HAL function.
     * 6. 2: The number of bytes to write. Since one holding register is 16 bits, we need to write 2 bytes.
     * 7. 1000: Timeout in milliseconds. If the HAL fails to write within this time, it will skip the operation
     * to prevent the code from getting stuck.
     */
    HAL_I2C_Mem_Write(&hi2c1, IS4310_I2C_Chip_Address, registerAddressToWrite, I2C_MEMADD_SIZE_16BIT, writeValuesArray, 2, 1000);
}

while (1) {
    // This will store the potentiometer value:
    uint16_t potentiometerValue;
    // This will store the read value of the Holding Registers 1, 2 and 3:
    uint16_t holdingRegister1;
    uint16_t holdingRegister2;
    uint16_t holdingRegister3;

    // Read Holding Registers 1, 2 and 3:
    holdingRegister1 = readHoldingRegister(1);
    holdingRegister2 = readHoldingRegister(2);
    holdingRegister3 = readHoldingRegister(3);

    // If the value of each read Holding register is different from 0,
    // let's turn on the corresponding LED:
}
```

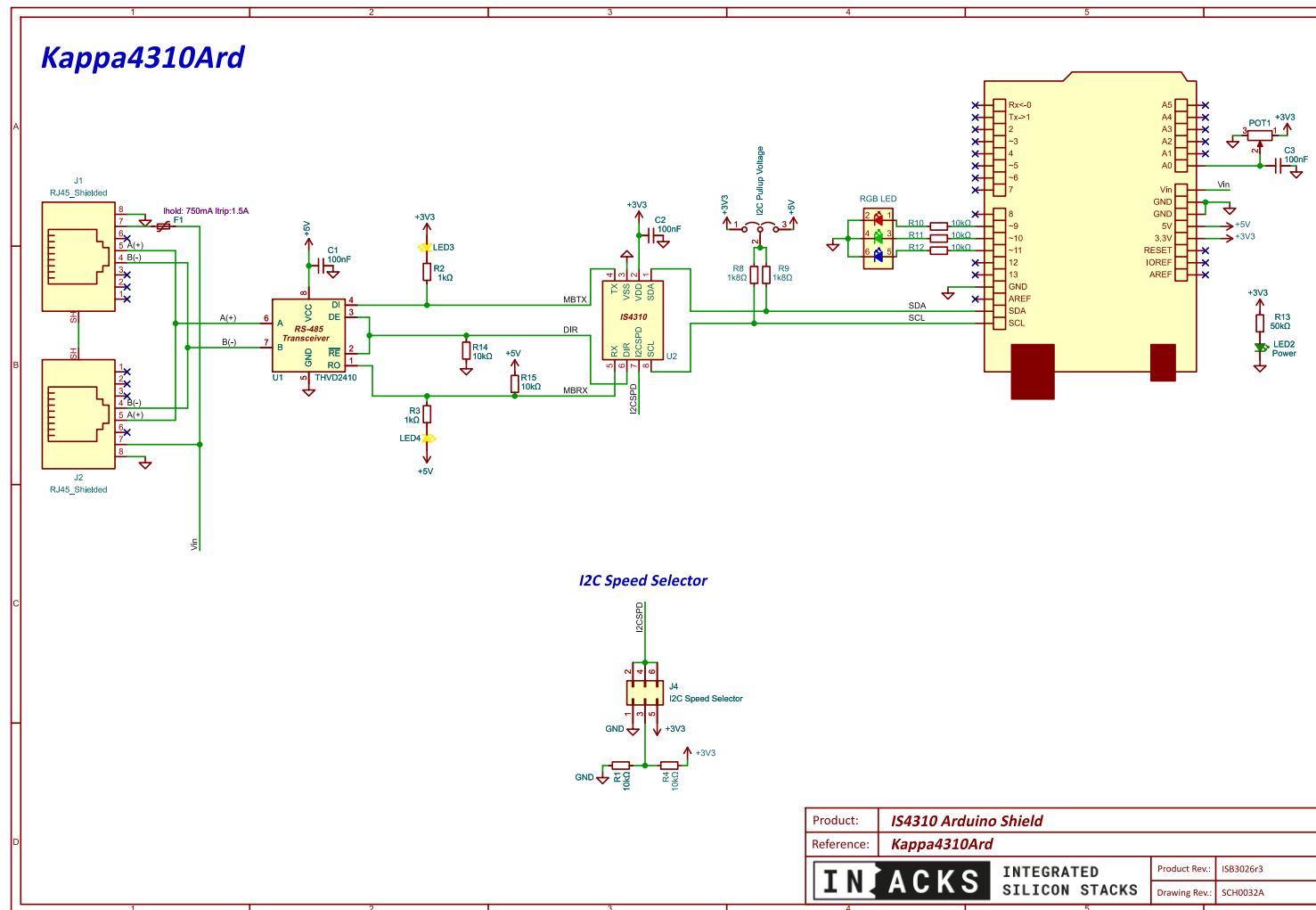
```
if (holdingRegister1 >= 1) {
    HAL_GPIO_WritePin(RGB_Red_GPIO_Port, RGB_Red_Pin, GPIO_PIN_SET);
} else {
    HAL_GPIO_WritePin(RGB_Red_GPIO_Port, RGB_Red_Pin, GPIO_PIN_RESET);
}

if (holdingRegister2 >= 1) {
    HAL_GPIO_WritePin(RGB_Green_GPIO_Port, RGB_Green_Pin, GPIO_PIN_SET);
} else {
    HAL_GPIO_WritePin(RGB_Green_GPIO_Port, RGB_Green_Pin, GPIO_PIN_RESET);
}

if (holdingRegister3 >= 1) {
    HAL_GPIO_WritePin(RGB_Blue_GPIO_Port, RGB_Blue_Pin, GPIO_PIN_SET);
} else {
    HAL_GPIO_WritePin(RGB_Blue_GPIO_Port, RGB_Blue_Pin, GPIO_PIN_RESET);
}

/*
 * Read ADC value from potentiometer (0-4095),
 * and write it to Holding Register 0.
 */
HAL_ADC_Start(&hadc1); // Start the HAL ADC
HAL_ADC_PollForConversion(&hadc1, 400); // Perform an ADC read
// Get the ADC value:
potentiometerValue = HAL_ADC_GetValue(&hadc1);
// Store the ADC value to the Holding Register 0:
writeHoldingRegister(0, potentiometerValue);
// Stop the HAL ADC
HAL_ADC_Stop(&hadc1);
}
```

4. Schematic



Content

Presentation.....	1	3.2. STM32 Example	11
Product Selection Guide	2	4. Schematic.....	14
1. Description	3	Content.....	15
1.1. General Description	3	Appendix	16
1.2. Module Pinout.....	5	Revision History	16
1.3. RJ45 Connectors	6	Documentation Feedback	16
2. Bus Recommendations	7	Sales Contact.....	16
2.1. Bus Topology.....	7	Customization	16
2.2. Cable Wiring	8	Independence and Trademarks Notice	16
3. Firmware Implementation Guide	9	Disclaimer	17
3.1. Arduino Example	9		

Appendix

Revision History

Document Revision

Date	Revision Code	Description
June 2025	ISDOC130B	- Pictures updated - Added firmware examples
March 2025	ISDOC130A	- Initial Release

Shield Revision

Date	Revision Code	Description
February 2025	ISB3026r3	Initial Release

Documentation Feedback

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