

Kappa4310Rasp

IS4310 Hat for Raspberry Pi

Presentation

The **Kappa4310Rasp** 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 pushbutton to simulate an actuator and a sensor.

Designed as a hat with the **Raspberry Pi form factor**, the Kappa4310Rasp benefits from its widespread popularity, ensuring compatibility with various single board computer (SBC) boards.

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).







Hat 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	
Board Voltage	3.3 V
I2C Compatible Voltage Levels	3.3 V and 5 V

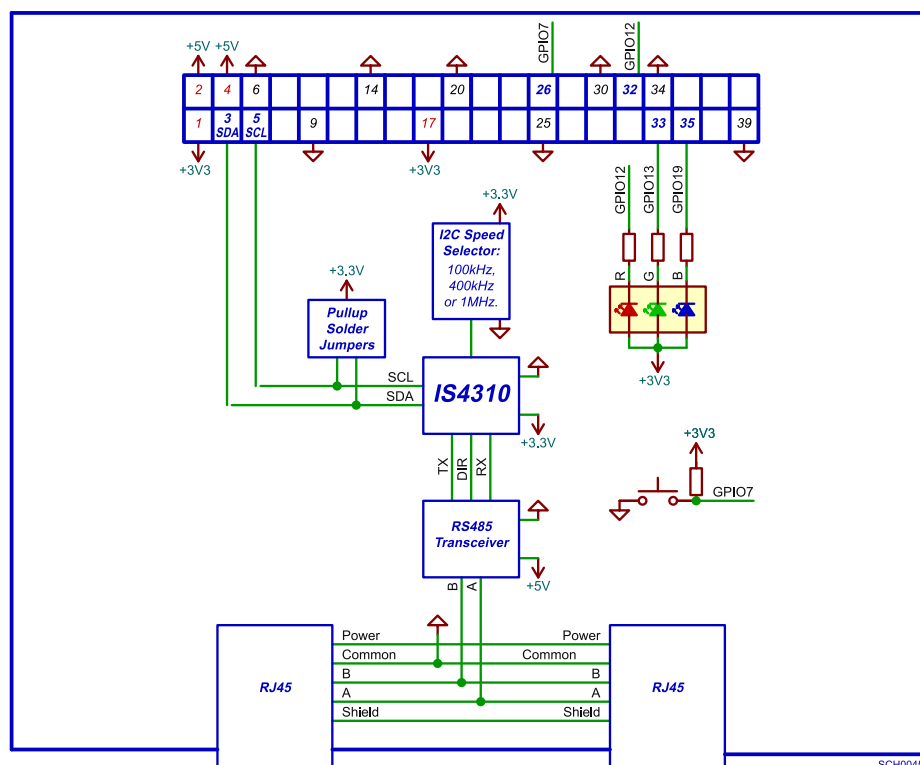


Product Selection Guide

	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 Kappa4310Rasp Modbus Hat is the IS4310 I2C Modbus RTU Slave stack 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 hat. The hat includes a solder-jumper for the SCL and SDA lines that allows the activation of the I2C pull-up voltage (3.3 V). If not soldered, the I2C lines will stay floating. The Floating option is useful when the pull-up resistors are located outside the Kappa4310Rasp.

It is crucial to ensure that pull-up resistors are present either on the hat 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.

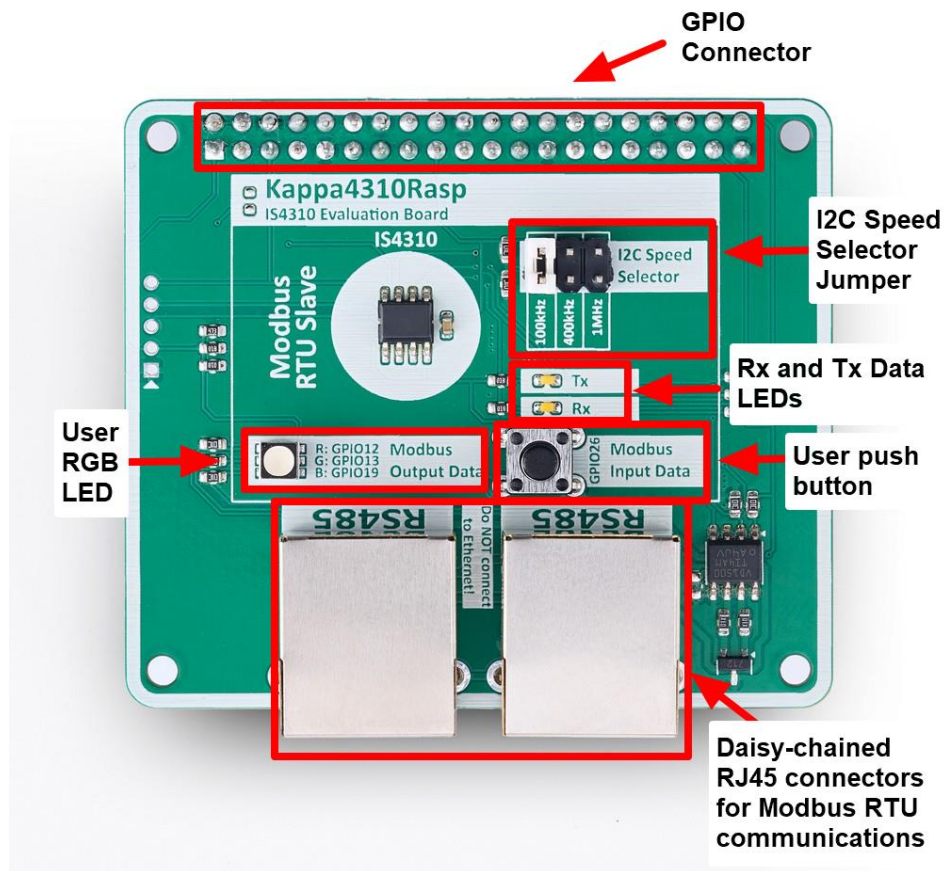
The Hat has 3 LEDs. The Rx yellow LED will blink on received data, and Tx yellow LED will blink on the IS4310 answer. The Power green LED will indicate that the board has detected power. Please note that the board requires both 3.3V and 5V to operate.

A push button is placed on the board to provide an easy way to simulate a sensor. By reading its state and storing it in a Holding Register, you can monitor changes in real time from the Modbus Master as you press the button. The push button is pulled up by default, and pressing it brings the line to a low state. It is connected to GPIO7 (pin 26).

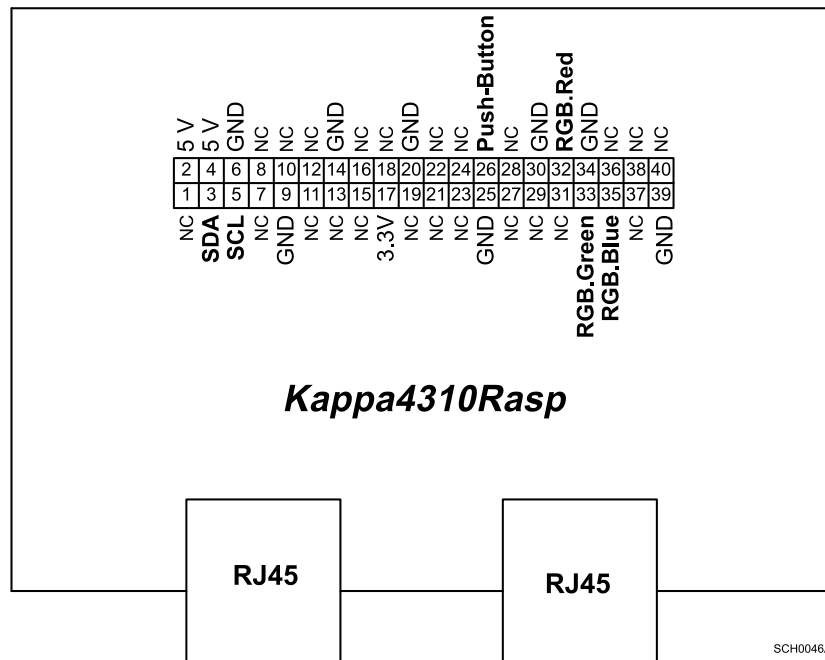
To simulate an actuator, an RGB LED is placed on the board to reflect the state of Modbus Holding Registers.


For example, you can create a traffic light simulation by writing a program that reads values from three Holding Registers and adjusts the PWM of each LED accordingly.

The RGB LED is connected to GPIOs 12 (pin 32), 13 (pin 33), and 19 (pin 35), respectively. These GPIOs support PWM, allowing the display of analog values.



1.2. Module Pinout



Name (Pin Number)	Type	Description
NC	Not Connected	These pins have no electrical connection. They can be used by other hats or by your own proposal.
3.3V	3.3V Power In	The hat needs 3.3V to operate.
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.
Push-Button (26)	Analog	User push-button for prototyping proposals. Default state is high.
SCL (5) SDA (4)	Open Drain	<p>SCL and SDA pins of the IS4310 I2C-Serial Interface. Ensure the pull-up solder jumpers are properly configured:</p>  <ul style="list-style-type: none"> Placing solder on the SDA and SCL jumpers sets the SCL and SDA pull-up voltage to 3.3V. Removing the solder from the solder jumpers leaves SCL and SDA floating. This option is useful when pull-up resistors are located elsewhere in the circuit. <p>Note 1: Both solder jumpers must either have solder or not have solder. You cannot leave one with solder and the other without.</p> <p>Note 2: Solder can be easily removed with solder wick and flux.</p>
RGB.Red (32)	Red LED	User RGB LED for prototyping proposals.
RGB.Green (33)	Green LED	
RGB.Blue (35)	Blue LED	

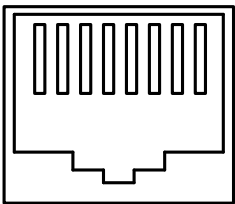
1.3. RJ45 Connectors

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 its shield and make sure to connect the cable shield to the connector shield to ensure proper electrical continuity across all cable shield 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.

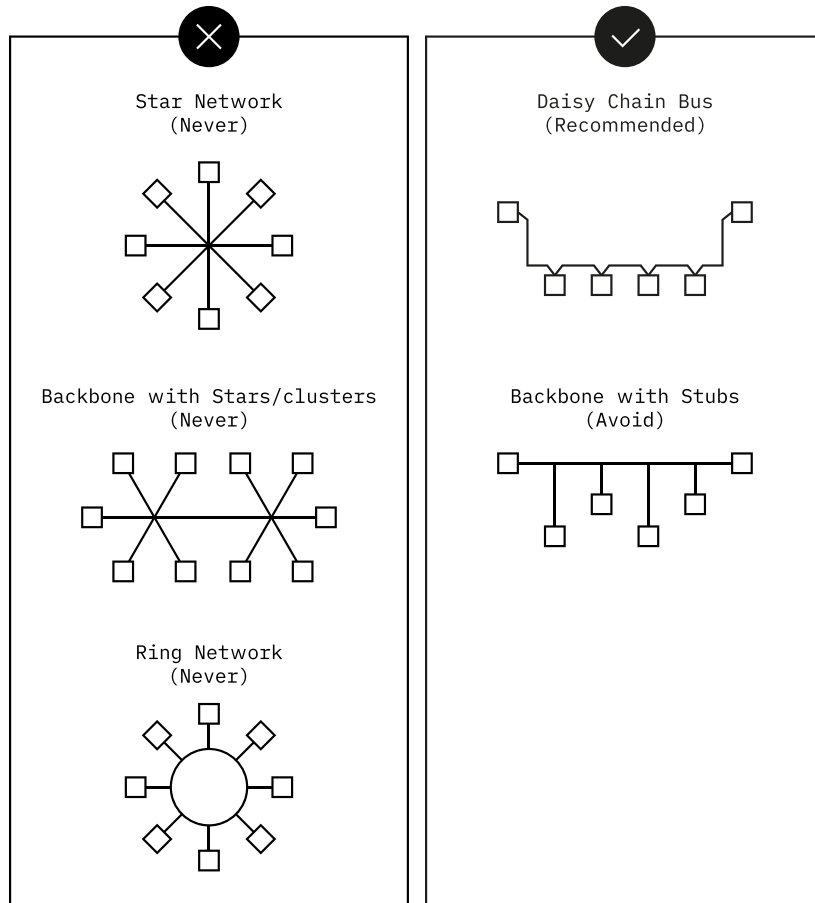
Optionally, power can be supplied to your system through the pin 7 of the RJ45 connector.

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
Hat: 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.	

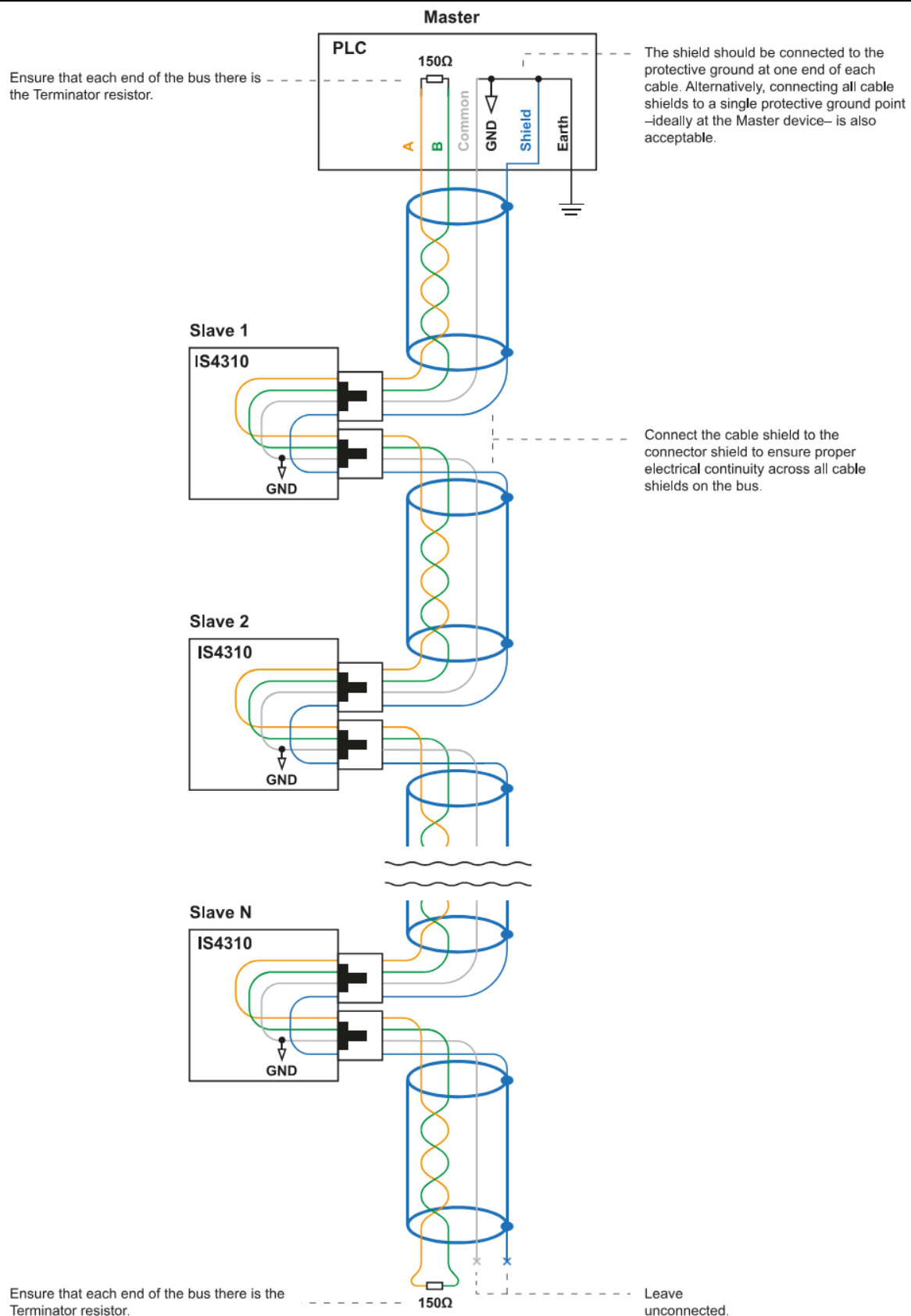
2. Bus Recommendations

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. Raspberry Pi Example

```
# IS4310 Modbus Code Example for Raspberry Pi
# -----
# This Python script communicates with the IS4310 Modbus RTU chip via I2C using a Raspberry
# Pi.
# It demonstrates how to read a push button (simulating a sensor) and store its value in
# Holding Register 0.
# It also controls an RGB LED (simulating an actuator) using PWM pins 12, 13, and 19, based on
# the values in Holding Registers 1, 2, and 3.
# A value of 0 turns off the LEDs, and a value of 100 sets them to maximum brightness.
#
# You can test this code using the **Kappa4310Rasp Evaluation Board**.
# Buy it at: [www.inacks.com/kappa4310rasp] (https://www.inacks.com/kappa4310rasp)
# Download the IS4310 datasheet at: www.inacks.com/is4310

from smbus2 import SMBus, i2c_msg
import RPi.GPIO as GPIO
import time

I2C_BUS = 1 # I2C bus number on Raspberry Pi (usually 1)
DEVICE_ADDRESS = 0x11 # 7-bit I2C address of the IS4310 Modbus RTU chip
GPIO.setmode(GPIO.BCM) # Use BCM pin numbering scheme

# Define GPIO pins for three LEDs and push button
led_pin1 = 12
led_pin2 = 13
led_pin3 = 19
push_button_pin = 26

# Setup push button pin as input with internal pull-down resistor enabled
GPIO.setup(push_button_pin, GPIO.IN, pull_up_down=GPIO.PUD_DOWN)

# Setup LED pins as outputs
GPIO.setup(led_pin1, GPIO.OUT)
GPIO.setup(led_pin2, GPIO.OUT)
GPIO.setup(led_pin3, GPIO.OUT)

# Initialize PWM on LED pins at 1 kHz frequency
pwm1 = GPIO.PWM(led_pin1, 1000)
pwm2 = GPIO.PWM(led_pin2, 1000)
pwm3 = GPIO.PWM(led_pin3, 1000)

# Start PWM with 0% duty cycle (LEDs off initially)
pwm1.start(0)
pwm2.start(0)
pwm3.start(0)

def write_register(register, data):
    """
    Write a 16-bit data value to a 16-bit register address on the I2C device.

    :param register: 16-bit register address (split into high and low bytes)
    :param data: 16-bit data to write (split into high and low bytes)
    """
    high_addr = (register >> 8) & 0xFF # Extract high byte of register address
    low_addr = register & 0xFF # Extract low byte of register address
    data_high = (data >> 8) & 0xFF # Extract high byte of data
    data_low = data & 0xFF # Extract low byte of data

    # Open I2C bus, send write message: [register high, register low, data high, data low]
    with SMBus(I2C_BUS) as bus:
        msg = i2c_msg.write(DEVICE_ADDRESS, [high_addr, low_addr, data_high, data_low])
        bus.i2c_rdwr(msg)

def read_register(start_register):
    """
    Read a 16-bit value from a 16-bit register address on the I2C device.

    :param start_register: 16-bit register address to read from
    :return: 16-bit integer value read (big-endian)
    """
    high_addr = (start_register >> 8) & 0xFF # High byte of register address
    low_addr = start_register & 0xFF # Low byte of register address
```

```
with SMBus(I2C_BUS) as bus:
    # Write register address first to set internal pointer
    write_msg = i2c_msg.write(DEVICE_ADDRESS, [high_addr, low_addr])
    # Prepare to read 2 bytes from the device
    read_msg = i2c_msg.read(DEVICE_ADDRESS, 2)
    bus.i2c_rdwr(write_msg, read_msg)

    data = list(read_msg) # Read bytes as list of ints
    # Combine high and low bytes into 16-bit integer (big-endian)
    value = (data[0] << 8) | data[1]
    return value

try:
    while True:
        # Read push button state (0 or 1)
        button_value = GPIO.input(push_button_pin)

        # Write button state to register 0 of the device
        write_register(0, button_value)

        # Read PWM values from registers 1, 2, and 3
        pwm_val1 = read_register(1)
        pwm_val2 = read_register(2)
        pwm_val3 = read_register(3)

        # Cap PWM values at max 100 to avoid invalid duty cycles
        if pwm_val1 > 100:
            pwm_val1 = 100
        if pwm_val2 > 100:
            pwm_val2 = 100
        if pwm_val3 > 100:
            pwm_val3 = 100

        # Calculate duty cycles by inverting the PWM value (100 - value)
        # abs() used to ensure positive duty cycle, just in case
        duty1 = abs(pwm_val1 - 100)
        duty2 = abs(pwm_val2 - 100)
        duty3 = abs(pwm_val3 - 100)

        # Print duty cycle values for debugging (tab-separated)
        print(f"{duty1}\t{duty2}\t{duty3}")

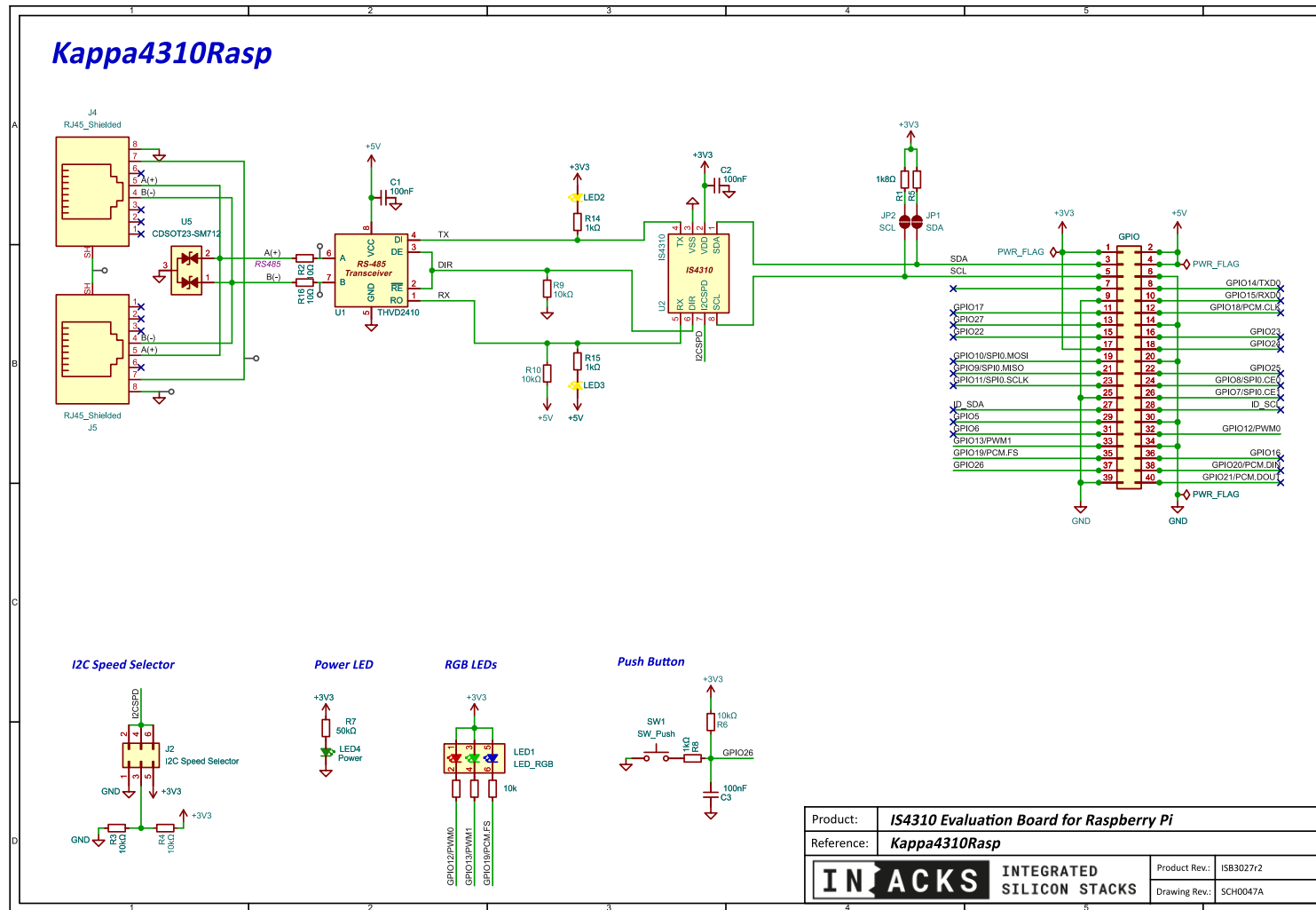
        # Update PWM duty cycles to control LED brightness
        pwm1.ChangeDutyCycle(duty1)
        pwm2.ChangeDutyCycle(duty2)
        pwm3.ChangeDutyCycle(duty3)

        # Small delay to avoid excessive CPU load
        time.sleep(0.05)

except KeyboardInterrupt:
    # Gracefully handle Ctrl+C exit
    print("Exiting...")

finally:
    # Stop all PWM signals and cleanup GPIO pins on exit
    pwm1.stop()
    pwm2.stop()
    pwm3.stop()
    GPIO.cleanup()
```

4. Schematic



Content

Presentation.....	1	3. Schematic.....	11
Product Selection Guide	2	Content.....	12
1. Description	3	Appendix	13
1.1. General Description	3	Revision History	13
1.2. Module Pinout.....	5	Documentation Feedback	13
1.3. RJ45 Connectors	6	Sales Contact.....	13
2. Bus Recommendations	7	Customization	13
2.1. Bus Topology.....	7	Independence and Trademarks Notice	13
2.2. Cable Wiring	8	Disclaimer	14

Appendix

Revision History

Document Revision

Date	Revision Code	Description
June 2025	ISDOC131B	Added Python example for Raspberry Pi
June 2025	ISDOC131A	Initial Release

Hat Revision

Date	Revision Code	Description
June 2025	ISB3027r2	Initial Release

Documentation Feedback

Feedback and error reporting on this document are very much appreciated.

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