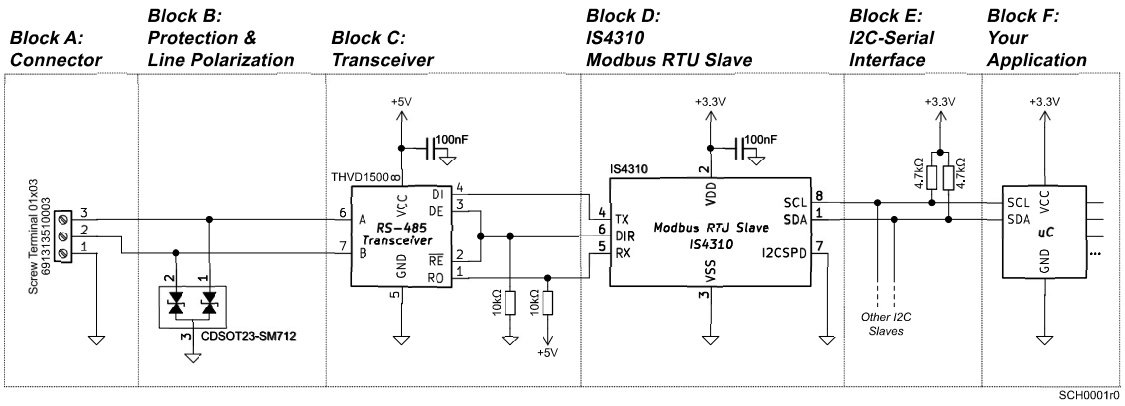
6. Hardware Implementation Guide

The following chapter represents an application design example for explanation proposals and is not part of the product standard. The customer must design his own solution, choose its most appropriate components and validate the final product according to the legislation and the Modbus specifications.

6.1. RS485 Design Example

This example shows the design of a Modbus over Serial Line working in RS485.

More examples can be found on the website.



Block A: Connector

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.

The recommended connector is RJ45, but in the schematic, a screw terminal is used for simplicity. When selecting a connector, always choose the shielded version if available. RJ45 and DB9 connectors typically come with shielded options, while terminal blocks usually do not.

On the cable-side connector, 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.

In the example, the connector has three positions: A, B, and Common. A and B are the differential lines for the transceiver, while Common serves as the reference point for the A and B signals. Common must be connected to the GND of your circuit.

Optionally, power can be supplied to your system through the Modbus connector. In this case, a four-position connector would be used for A, B, Common, and Power. In that case, the Common serves as the reference for A and B signals as well as the return path for Power. The voltage should be within the 5V to 24V range.

Block B: Protection & Line Polarization

Protection

The protection stage is influenced by several factors, including the intrinsic robustness and protection features of the transceiver, the potential harshness of the fieldbus environment, the product's budget, and its required reliability, among other considerations. Refer to your transceiver's documentation to determine the appropriate protection requirements.

In the schematic, a bidirectional 400-W transient suppressor diodes are used to protect against surge transients.

Line Polarization

Line Polarization is the process of biasing the RS485 bus to a known state by pulling signal A down and pulling signal B to 5V using resistors in the range of 450 to 650Ω. This ensures that the bus has a defined idle state.

When there is no data activity on an RS-485 balanced pair, the lines are not actively driven and are therefore susceptible to external noise or interference. To ensure that the transceiver remains in a stable state when no data signal is present,

some transceivers require a biasing circuit. However, not all transceivers need this.

When selecting your transceiver, confirm in the datasheet whether line polarization is necessary or not. If it is necessary, you must document it in the product guide.

If polarization is needed, it should ONLY be implemented at one location on the bus, typically at the master device.

Bus polarization is a good technic to increase the resistance of the bus to external noise or interferences. However, it has the drawback of significantly reducing the number of devices that can support the bus.

Block C: Transceiver

Modbus over Serial Line typically employs the RS485 electrical interface, which uses a transceiver to adapt RS485 fieldbus voltage levels to TTL voltage levels for the IS4310. Other electrical interfaces such as RS422 or RS232 can also be utilized.

A pull-down resistor on DE and RE will keep the transceiver in 'receiver' state by default, ensuring it does not disturb the fieldbus. Pull-up resistor on RO will keep the RX line clear.

Using a 5V transceiver is a good technic to increase the resistance of the bus to external noise or interferences. 5V transceivers can be used with the IS4310 since TX, RX and DIR pins are 5V tolerant.

Block D: IS4310 Modbus RTU Slave

The IS4310 is very simple to integrate into your design.

A decoupling capacitor should be placed on the power pins (VDD and VSS). It is recommended to use a 100nF, 10-25V low-ESR ceramic capacitor.

The I2CSPD pin defines the I2C speed. Connect this pin to GND for a speed of 100kHz. For 400kHz, it should be pulled to 1.65V, which is half of 3.3V. This can be achieved with a simple resistor voltage divider using 3.3V and GND. For 1MHz, the pin must be connected to 3.3V. This pin is not 5V tolerant.

Block E: I2C-Serial Interface

For proper operation of the I2C Serial Interface, pull-up resistors to 3.3V or 5V are necessary. Typical resistor values are 4.7kΩ for Standard Mode (100kHz) and 2.2kΩ for both Fast Mode (400kHz) and Fast Mode Plus (1MHz).

Block F: Your Application

Here is the rest of your product design. Typically, a microcontroller interfaces with the IS4310, but a microprocessor or a single-board computer, such as a Raspberry Pi, can also be used as long as they are equipped with an I2C Serial Interface.