RS-485

RS-485

RS-485 is an industrial specification that defines the electrical interface and physical layer for point-to-point communication of electrical devices. The RS-485 standard allows for long cabling distances in **electrically noisy environments** and can support **multiple devices** on the same bus.

In short, RS485 is a standard defining the electrical characteristics of serial lines for use in serial communications systems. It is essentially a form of serial communication.

To start, let's define **serial communication**:
Serial communication is a way to send data. It is like the Universal Serial Bus (USB) or ethernet that we can find in many of our modern computers. Manufacturing facilities use serial communication to link their devices together. As mentioned, an example of serial communication is RS485.

RS485 is used more industrially where many devices need to be interconnected together for a system. However, Arduino and Raspberry Pi hobbyists also use it for some of their projects when multiple peripherals need to be linked to the board.

For projects with multiple peripherals e.g nanosatellites, this makes RS-485 the ideal choice.

WHY USE RS-485

1. Has noise immunity
2. Can be used for long cabling distances
3. Has high speeds
4. Allows for multiple devices on the same bus.

APPLICATIONS OF RS-485

RS485 is used in many computer and automation systems. Some of the examples are robotics, base stations, motor drives, video surveillance, and also home appliances. In computer systems, RS485 is used for data transmission between the controller and a disk drive. Commercial aircraft cabins also use RS485 for low-speed data communications. This is due to the minimal wiring required due to the wiring configuration requirements of RS485.

RS485 is however most popularly used in programmable logic controllers and factory floors where there is a lot of electrical noise

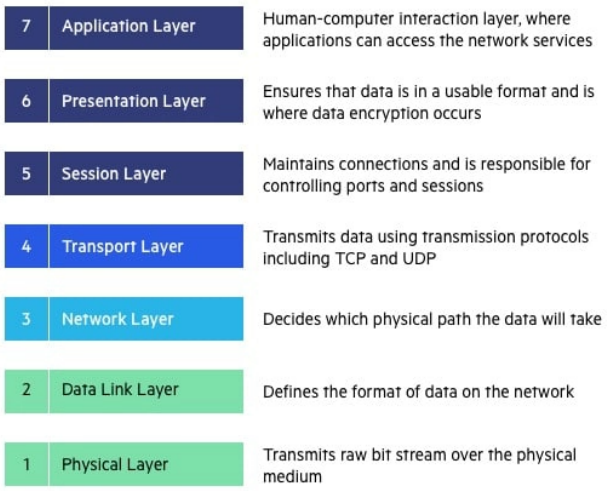
SOME STATS

All this allows sending data over long distances at relatively high speeds, which can reach 100 kbits/s at 4000 feet.
4000 feet or about 1200 meters is the maximum cable length in RS-485 communications. A general guideline, however, is that the product of line length (in meters) and the data rate (in bits per second) should not be more than 108. For instance, a 20-meter cable allows a maximum data rate of 5 Mbits/s.

OSI Model

Before beginning the RS-485 standard, it is important to define the OSI model.
The OSI(Open Systems Interconnections) Model attempts to characterize the various layers of a communication system from the final application, down through the electrical layers, and lastly, onto the physical layer

Figure of OSI Model



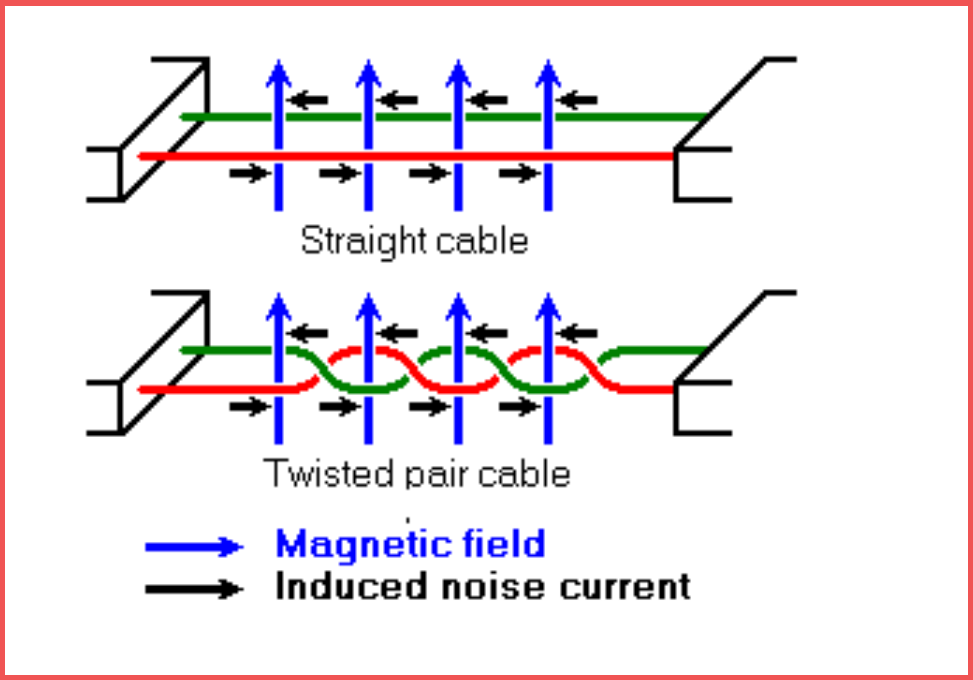
Physical Layer:

The physical layer of the OSI model is responsible for the transfer of raw data between a device and a physical transmission medium. It handles the conversion of electrical signals into digital data while defining voltages, timing, data rates, etc.
The physical layer is responsible for the physical cable or wireless connection between network nodes. It defines the connector, the electrical cable, or wireless technology connecting the devices, and is responsible for the transmission of the raw data, which is simply a series of 0s and 1s while taking care of bit rate control.
This layer is where RS485 is based.

RS-485 Standard

Communication network built on the RS-485 interface consists of transceivers connected by a twisted pair (two twisted wires). The basic principle of the RS-485 interface is differential (balanced) data transmission. That means one signal is transported over two wires. With that, one wire of the pair transmits the original signal and the other one transports its inverse copy.

As a result of differential signal transmission there is always a potential difference between the wires. This ensures high resistance to common mode interference. In addition, the twisted pair may be shielded, which ensures the protection of transmitted data.



RS485 at its core with 2 wires allows **half-duplex** data transmission. This means data can be transmitted in both directions to and fro devices one direction at a time. By adding another 2 wires, making it a 4 wires system, it allows data transmission in both directions to and fro devices at the same time, also known as **full-duplex**. However, in a full-duplex setup, they are limited to a master and slave communication where slaves cannot communicate with each other.

When the RS485 communication line is ready for operation at the physical level, it's time to think about the data transfer protocol - an agreement between the system's devices on the format of the data packets transmission.

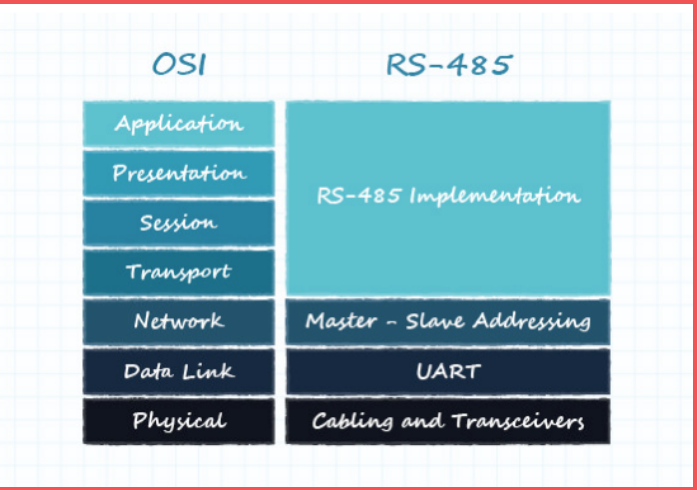
By the nature of the RS-485 interface, RS-485 devices cannot transmit and receive data at the same time, as it leads to a conflict of transmitters. Therefore, deterministic behavior is mandatory to avoid collisions of data packets.

In RS485 communication protocol, the commands are sent by the node which is defined as a master. All other nodes connected to the master receive the data over RS485 ports. Depending on the information sent, zero or more nodes on the line respond to the master.

Full RS-485 model

The OSI model is not a set of rules but more of a model that helps engineers characterize systems. RS-485 is well-contained within the first three layers of the OSI model with the actual implementation of the bus being characterized within the application layer. This layer covers the addresses or command sets used by the devices as well as the interpretation of the data. It also includes how much data a designer could expect to get back, and the control of the bus itself.

Figure



MODBUS PROTOCOL

One of the main features that differ RS485 communication from any other serial communication is the format of data exchanged. While RS232 devices connect over text (ASCII) protocols, most RS485 devices use Modbus.

Modbus is a serial communications protocol that is widely used by industrial electronic devices. In Modbus, the connection is established between a master (host) and slaves (COM-based devices)*. Modbus helps access the configuration of the devices and read the measures.

RS232 vs RS485

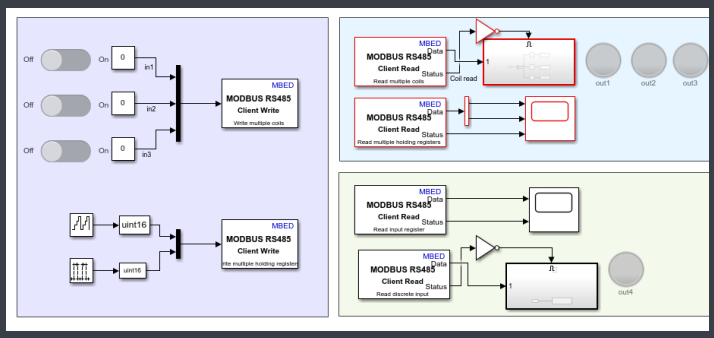
Protocol	RS232	RS485
Protocol type	Duplex	Half-duplex
Signal type	Unbalanced	Balanced
Number of devices	1 transmitter and 1 receiver	Up to 32 transmitters and 43 receivers
Maximum data transfer	19.2Kbps for 15 meters	10Mbps for 15 meters
Maximum cable length	Approximately 15.25 meters at 19.2Kbps	Approximately 1220 meters at 100 Kbps
Output current	500mA	250mA
Minimum input voltage	+/- 3V	0.2V differential

STM32 with RS485

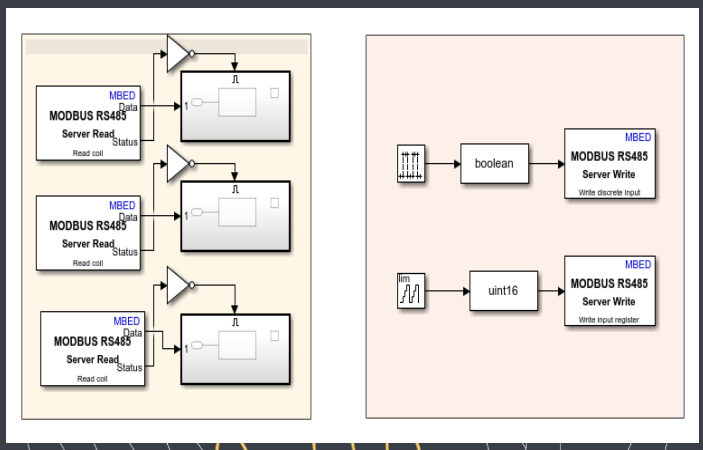
MODBUS

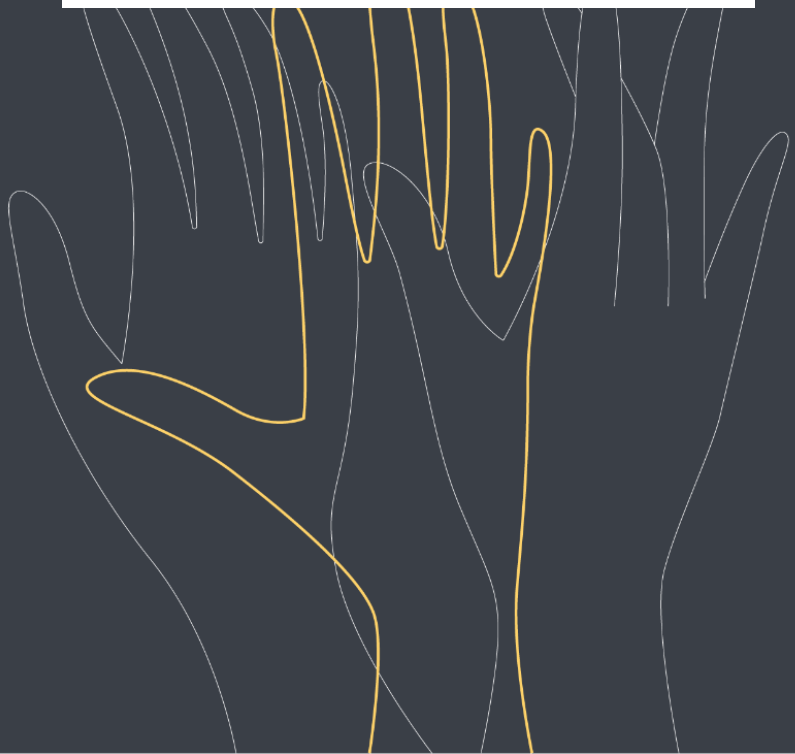
This is the protocol used to interface STM32 with RS-485
Resources and tutorials are available online on how to interface Free-RTOS, Modbus and STM32(Specifically the cortex M7)

MODBUS Client



Modbus Server





CONTACT

tafiti-org.github.io
tafitiorg@gmail.com