The Advantages of RS-485 Data Direction Control

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The Nature and Limitations of RS-485 Communications

RS-485 is a good choice for long distance serial communication since using differential transmission cancels out the vast majority of the electromagnetic disturbances picked up by the RS-485 signal. A simple RS-485 network consists of one master and up to 32 slave devices. Since RS-485 uses half-duplex communication—that is, the same two wires (D+ and D-, as shown below) are used for both transmission and reception—some means of controlling which side of the connection can transmit must be built into the system. In this article, we discuss the ADDC (Automatic Data Direction Control) concept and explain how it works.

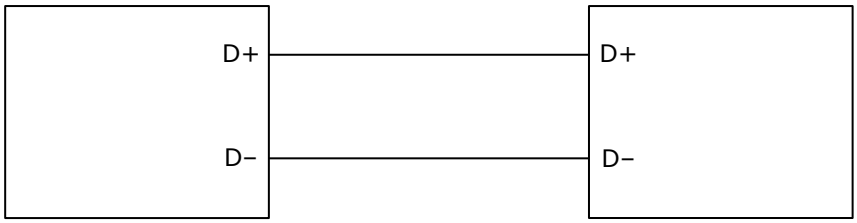

Fig. 1: RS-485 half-duplex communication

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About Moxa

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The most common way of controlling the transmit (Tx) and receive (Rx) direction is to use an RTS (ready to send) signal between the UART and the RS-485 half-duplex wiring. By adding a simple logic circuit (see Fig. 2), you can turn RTS on or off to switch the direction between Tx and Rx. That is, to transmit data you turn RTS on, and then you turn it off when the transmission is finished. Although the overall concept is easy to describe and understand, devising a precise enough timing mechanism can be quite a challenge.

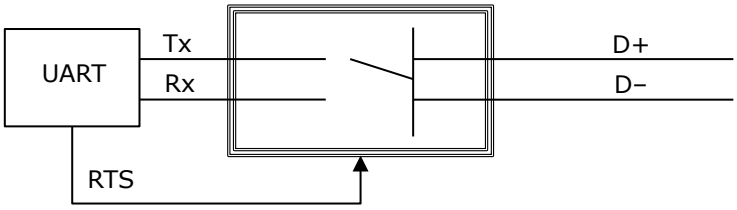

Fig. 2: Using RTS to Control Data Direction

Potential Problems of RS-485 Communications

In most cases, the RS-485 bus uses a master-slave architecture, which requires that each device on the RS-485 bus has a unique ID. The master will send a command with an ID and ask each slave to respond one by one. The default RTS state is off, which means that all devices are in the Rx state and are waiting to receive data (either a command or a response to a command) from one of the other devices. A typical scenario is as follows:

(1) The master switches to the Tx state, transmits a command to query a device, and then switches back to the Rx state and waits for a response.

(2) The slave whose ID matches the ID queried by the master switches to the Tx state, transmits its response, and then switches back to the Rx state.

If the master switches back to the Rx state too slowly, it will not receive the entire response. If the master switches back too quickly, the command will not be sent correctly. To control the timing properly, you need to know when the data was transmitted.

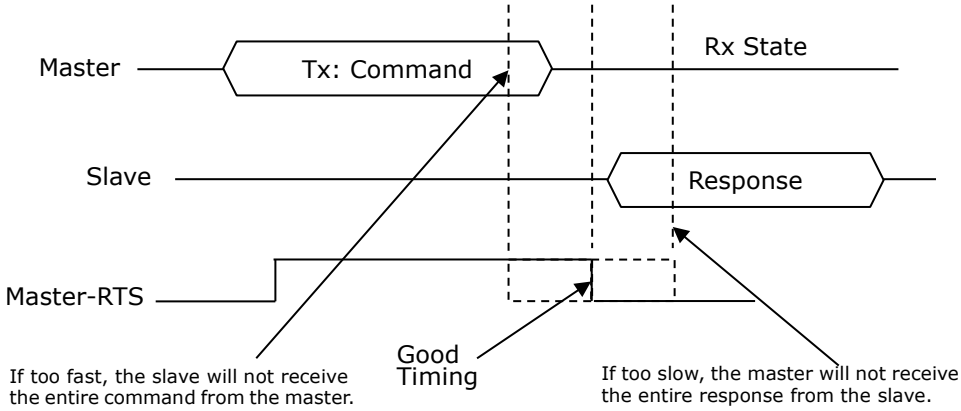

Fig. 3: Using RTS to control data direction

The Solutions

At first, users try to control RTS with software (driver or application), which can cause several problems. As mentioned in Fig. 3, the RTS might switch back too fast and cut off the last bits of the transmitted command, or switch back too late and lose the first bits of the received response, and so on. Many hardware vendors solve this problem by controlling the direction automatically to switch the signal precisely.

This means that the RS-485 hardware can switch the Tx/Rx direction automatically, such as is done with Moxa's ADDC© (Automatic Data Direction Control) function. ADDC is compatible with existing software; if you want to transmit commands over the RS-485 bus, you can just send, instead of worrying about controlling the RTS signal. The hardware will detect the action and switch to the Tx state automatically.

A comparison of the advantages and disadvantages of the different data direction control methods is shown in the table below.

	By RTS	Moxa's ADDC	Other Companys' Auto Solutions
Technology	Software (control the RTS to switch direction)	Hardware (auto)	Hardware (auto)
Reaction Time*	Slow	Fast	Fast
Board Application	Yes	Yes	Yes
Works with Converter	Yes	Yes	No

*The time interval that the RS-485 device needs to switch on or off to transmit data. A longer time makes data collisions more likely. A shorter time makes data collisions less likely.

Note If your converter requires configuring the baudrate first, please check the user's manual of your product for detailed information.

A comparison between Moxa's ADDC technologies and other companies' auto solutions shows Moxa's media converters can automatically detect the serial baudrate. This is an extremely convenient feature. Even if a device's baudrate is changed, the signal will still be transmitted through the media converter without any data loss.

A good way to simplify RS-485 implementation is to choose a product that supports ADDC. With ADDC you do not need to waste time modifying your programming to match the timing. You can keep your existing programming as is, and rest assured that it works with ADDC. Controlling the RTS on/off process will be ignored by ADDC, and all you need to do is to connect the wiring properly.

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