TD_232 Transceiver Modules' Application Guide 2022

1. RS232 basic knowledge

1.1. RS232 basic characteristics

RS-232 is serial data communication interface standard developed by the American Electronic Industry Alliance (EIA), and the full name of original number is EIA-RS-232 (abbr. 232, RS232). It's widely used in computer serial interface peripheral connections.

In the RS-232 standard, the characters are transmitted by way of one by one's serial bit string. The advantages are less transmission lines, simple wiring, and long transmission distance. The most commonly used encoding format is asynchronous start-stop format, which uses a start bit followed by 7 or 8 data bits, then followed by an optional parity bit, and finally one or two stop bits. So sending a character needs at least 10 bits, which brings a good effect to make all transmission rate and the rate of sending the signal to be divided in 10.

At present, RS-232 is the most widely used serial interface in PC and communication industry. RS-232 is defined as a single-ended standard that increases the communication distance in low-rate serial communication. RS-232 takes unbalanced transmission, so-called single-ended communication. The typical RS-232 signal oscillates between positive and negative levels. When transmitting data, the transmitter output positive level ranges +5 ~ + 15V, the negative level does -5 ~ -15V. When there is no data transmission, the line comes from TTL level to RS-232 level and then return to TTL level from the beginning to the end of the transmission. The receiver's typical operating level can be in the +3 ~ +12 V and -3 ~ -12V. Since the difference between the transmission level and the reception level is only about 2V to 3V, the common mode rejection capability is poor. And the distributed capacitance on the twisted pair results in a maximum transmission distance of about 15 meters and a maximum rate of 120 kb / S. RS-232 is designed for point-to-point (ie, only a pair devices of receiver and transmitter), with a driver load of 3 to 7kΩ. So RS-232 is suitable for communication between local devices. Relevant electrical parameters are as follows:

(1) Working mode: Single-ended communication

(2) Number of nodes: 1 transmitting and 1 receiving

(3) Maximum transmission cable length: 50 feet (about 15 meters) / 9600bps

(4) Maximum transfer rate: 120Kb / s

(5) Maximum driving output voltage: ± 25V

(6) Driver's output signal level (minimum load): ±5V～±15V;

(7) Driver's output signal level(maximum of no load): ±25V;

(8) Driver load impedance: 3KΩ～7KΩ;

(9) Slew rate (max): 30V/uS;

(10) Receiver input voltage range: ±15V;

(11) Receiver input threshold: ±3V;

(12) Receiver input resistance: 3KΩ～7KΩ;

(13) The driver's allowing capacitive loads: 2500pF;

1.2. RS232 transmission distance

The driver allows a capacitive load of 2500pF and the communication distance will be limited by this capacitance. For example, when using 150pF / m communication cable, the maximum communication distance is 15m. If the distribution capacitance per meter cable decreases, the communication distance can be increased appropriately. At the same time, ground noise and that it can't suppress common mode interference or other issues, as RS232 is a single-ended signal transmission, also limit the transmission distance.

But in practical applications, the actual transmission distance can't reach the theoretical value due to cable quality, cable diameter, electrical environment and other factors.

1.3. RS232 connection mode

The RS232 industry standard requires single-ended communication and does not support multipoint communication.

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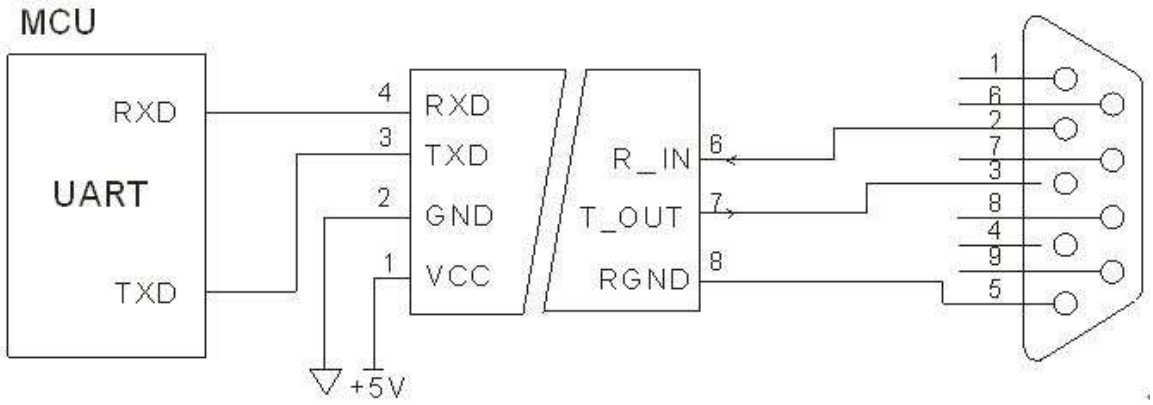

Figure 1-1: Daisy-chain connection

Note: This connection is suitable for DB9 male / needle type. if for DB9 female / hole type, it needs to connect the TD_232 isolation transceiver module's pin 6 with the DB9 female's pin 3, and connect the TD_232 isolation transceiver module's pin 7 with the DB9 female's pin 2.

1.4. Factors affecting communication quality in practical wiring

(1) The shorter the communication distance, the better the communication quality.

(2) The lower the baud rate, the better the communication quality. In cases where application requirements are met, select the lower communication baud rate as much as possible. It is recommended to select between 1200~9600bps.

(3) The smaller the distributed capacitance of the communication cable, the smaller the impact on the communication.

2. Precautions for hardware interface design

2.1 RXD, TXD interface's default level

Asynchronous communication data is transmitted in bytes. Every byte has to pass through a low start bit to achieve a handshake first before transmitted. In order to prevent the interference signal from wrongly triggering the RXD (receiver output) to generate a negative transition, it is recommended to connect a 10kΩ pull-up resistor to RXD in case the receiver's MCU entering into communication reception waiting state.

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2.2. Pull-up resistor design of RS232

TD_232 series module have built-in 4.7KΩ pull-up resistor to ensure RS232 level is the logic 1 in idle state.

2.3. Lighting protection design of RS232 bus port

RS232 communication is generally applied to the port circuit, so whether the RS232 port need add the necessary protection is what the designer should consider. The common lightning protection design circuit is shown in Figure 2-1. Refer to the TD_232 series products' datasheet for the relevant parameters of the device. TD_232 series module comes with built-in internal ESD protection function, so generally users no longer need external ESD protection device.

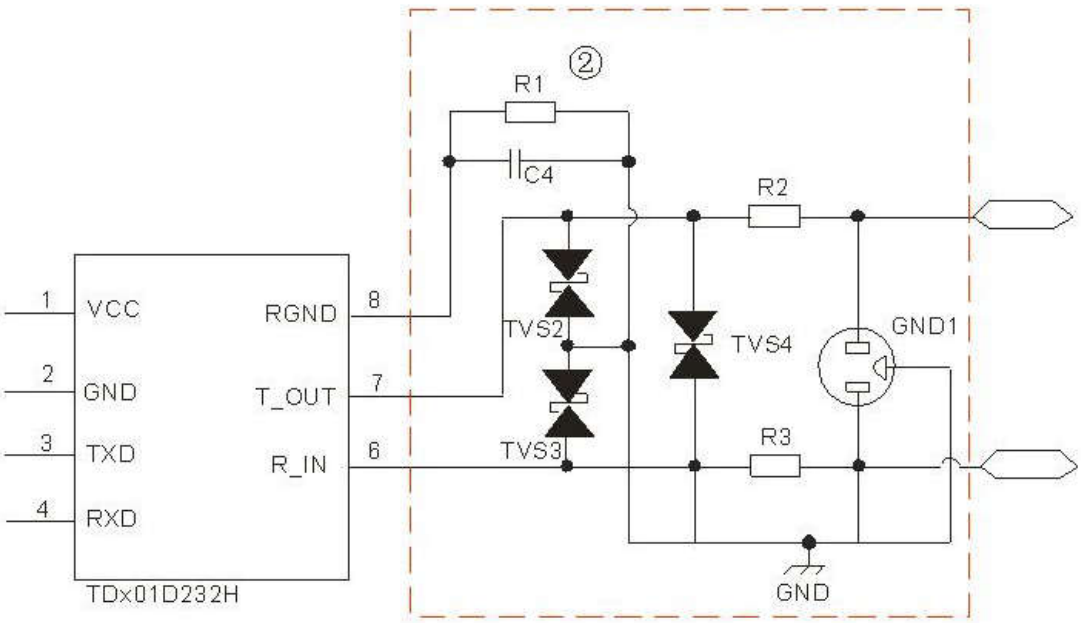

Figure 2-1 Lightning Recommended Circuit

3. Connection of RS232 port reference ground

RS232 uses single-ended communication transmission signal and the data signal that it receives and transmits is relative to the ground signal. RS232 has poor suppression capacity on ground noise and common mode interference, so RS232's grounding has become a problem designer must seriously consider. Using isolation technology can effectively solve the problem of common mode noise. So TD_232 isolation transceiver in hardware port can isolate the

ground loop between the two points and reduce the ground loop current, thereby reducing the common mode interference. But for the serious interference and harsh electrical environment, it recommends designers to use shielded twisted pair through the shield layer of the communication nodes on the bus reference ground, to reduce the common mode and radiation interference and to improve system's communication reliability (as shown in Figure 3-1).

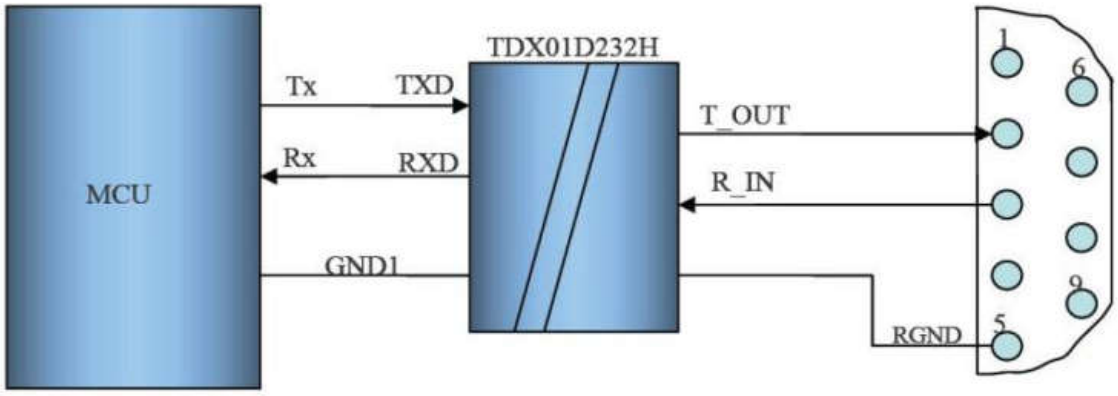

Figure 3-1 RS232 port reference ground connection

Note: This connection is suitable for DB9 male / needle type. If for DB9 female / hole type, it needs to connect the TD_232 isolation transceiver module's pin 6 with the DB9 female's pin 3, and connect the TD_232 isolation transceiver module's pin 7 with the DB9 female's pin 2.

4. FAQs and solutions

Table 4-1 FAQs and solutions

Failure phenomenon	Probable causes	Solutions
Unable to communicate	Reverse connection of the pins TXD and RXD of the TTL/COMS port	Exchange the polarity of TXD and RXD of the TTL/COMS port
	Reverse connection of the pins T_OUT and R_IN of the 232 port	Exchange the polarity of T_OUT and R_IN of the 232 port
	In consistent baud rate of the transmitter and receiver	adjust the frequency to make them become consistent
Communication error rate	Inaccurate baud rate timer clock	Use the suitable frequency crystal oscillator
	Unexpected high communication baud rate	Reduce communication baud rate

	Long communication distance and strong interference	Use a better shielded wire

5. Recommendation of TD_232 series product selection

Table 5-1 Product Selection

Type	Part No.	Input range	Transmission rate	Isolation voltage	Package
2-channel high-speed isolated transceiver module	TD302D232H	3.15-3.45VDC	0-115.2Kbps	2500VDC	DIP12
	TD502D232H	4.75-5.25VDC	0-115.2Kbps	2500VDC	DIP12
1-channel high-speed isolated transceiver module	TD301D232H	3.15-3.45VDC	0-115.2Kbps	2500VDC	DIP8
	TD501D232H	4.75-5.25VDC	0-115.2Kbps	2500VDC	DIP8
1-channel high-speed isolated transceiver module	TD331S232H	3.15-3.45VDC	0-115.2Kbps	2500VDC	SMD12
	TD531S232H	4.75-5.25VDC	0-115.2Kbps	2500VDC	SMD12
Chip-level	TD041S232H	2.375-5.5VDC	0-120Kbps	3750VAC	DFN16
	TD541S232H	4.5-5.5VDC	0-120Kbps	3000VDC	DFN16
	TDH541S232H	4.5-5.5VDC	0-120Kbps	5000VDC	DFN16