

# SERIAL DATA TRANSMISSION

**RS422, RS485, & 4-20 mA CURRENT LOOP**

## RS422

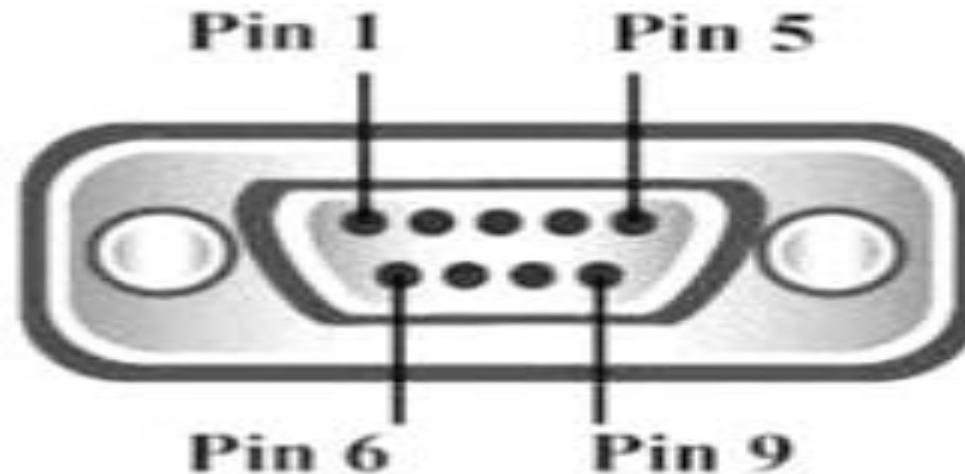
- RS422 was introduced to enable higher data rates to be transferred over serial data lines than was not possible with RS232.
- RS422 is able to provide data rates of up to 10 mbps at distances up to 50 feet.
- It is able to transmit data over distances of 4000 feet (~1220 metres) with data rate of 100 kbps at this distance.
- It is able to achieve these improvements results from the use of differential or balanced transmission techniques.
- It uses both differential transmitters and receivers which means that it is much more resilient to common mode interference, a key issue with long lines.
- To enable the differential driver to be used, it uses a four conductor cable.
- Additionally up to ten receivers can be placed on a single cable, providing a multi-point network or bus.

## RSS 422 PIN OUT

# RS422

<b>Pin 1</b>	TXD-
<b>Pin 2</b>	TXD+
<b>Pin 3</b>	RTS-
<b>Pin 4</b>	RTS+
<b>Pin 5</b>	GND
<b>Pin 6</b>	RXD-
<b>Pin 7</b>	RXD+
<b>Pin 8</b>	CTS
<b>Pin 9</b>	CTS+

**RS422**



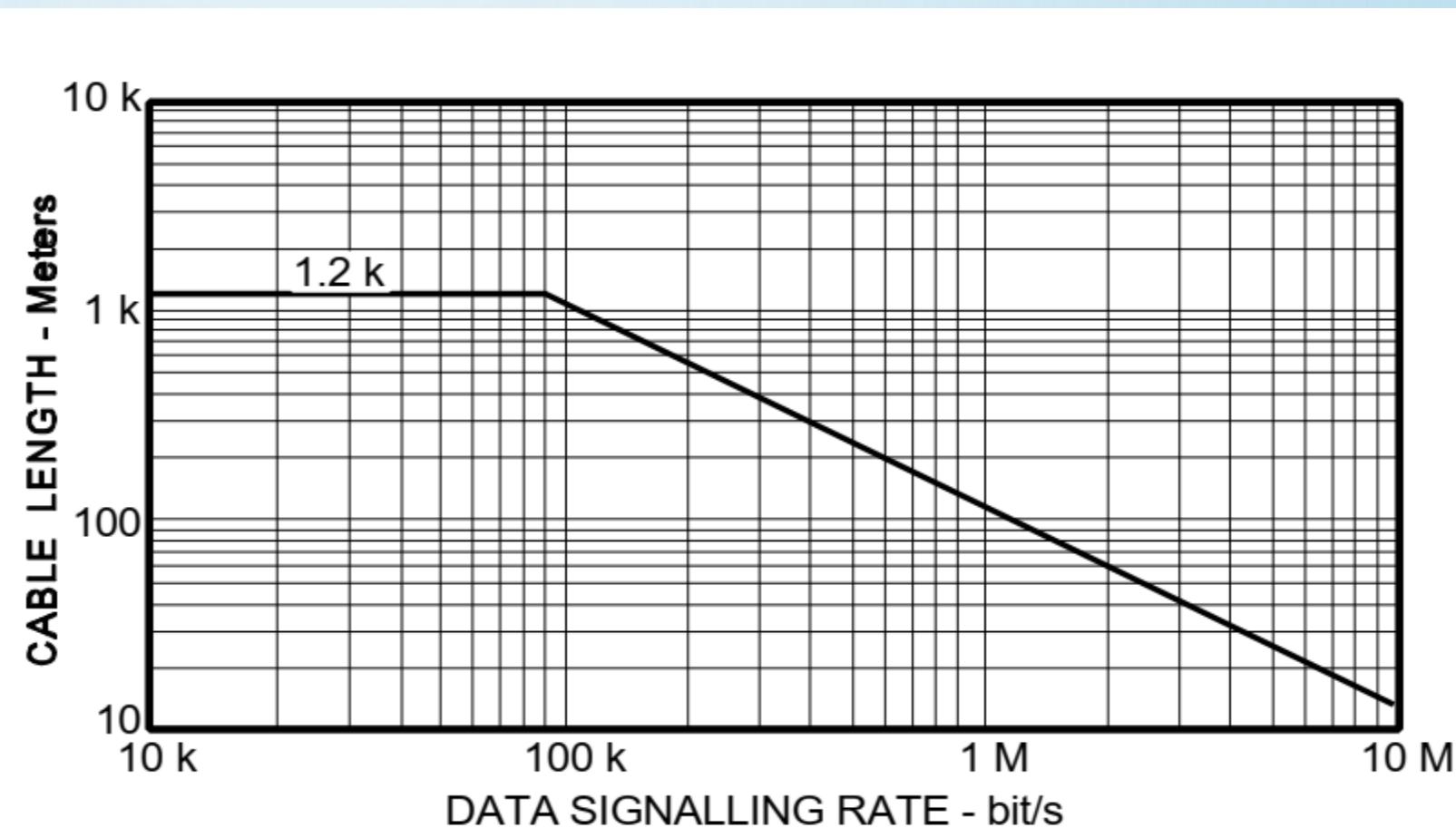
RTS-Request to send signal

## CONTD..

- **RS-422**, also known as TIA/EIA (ELECTRONIC INDUSTRIES ALLIANCE )-422, is a technical standard originated by the electronic industries alliance that specifies electrical characteristics of a digital signaling circuit.
- RS-422 specifies differential signaling, with every data line paired with a dedicated return line.
- It is the voltage difference between these two lines that define the Mark and Space, rather than, as in RS-232, the difference in voltage between a data line and a local ground.
- As the ground voltage can differ at either end of the cable, this required R-232 to use large +5 and -5 voltages.
- Moving to dedicated return lines and always defining ground in reference to the sender allowed RS-422 to use 0.4 v, allowing it to run at much higher speeds.

# CHARACTERISTICS

- QUASI multi drop networks are constructed using RS 422 devices
- These networks are used in half duplex mode in which one master sends command to several slave devices on a network.
- One node is addressed by host computer and response is received from that device.
- 4 wire half duplex system is used to avoid data collisions.



# BALANCED LINE INTERFACE

- IN RS422 each signal is sent separately over two different lines/wires known as balanced line interface.
- Differential signals are produced by the drivers and translated back to single ended signals by receivers.
- Higher transmission rate is possible because differential lines are terminated by resistors so they act transmission lines.
- A common mode electrical noise induced is rejected by transmission line receiver.

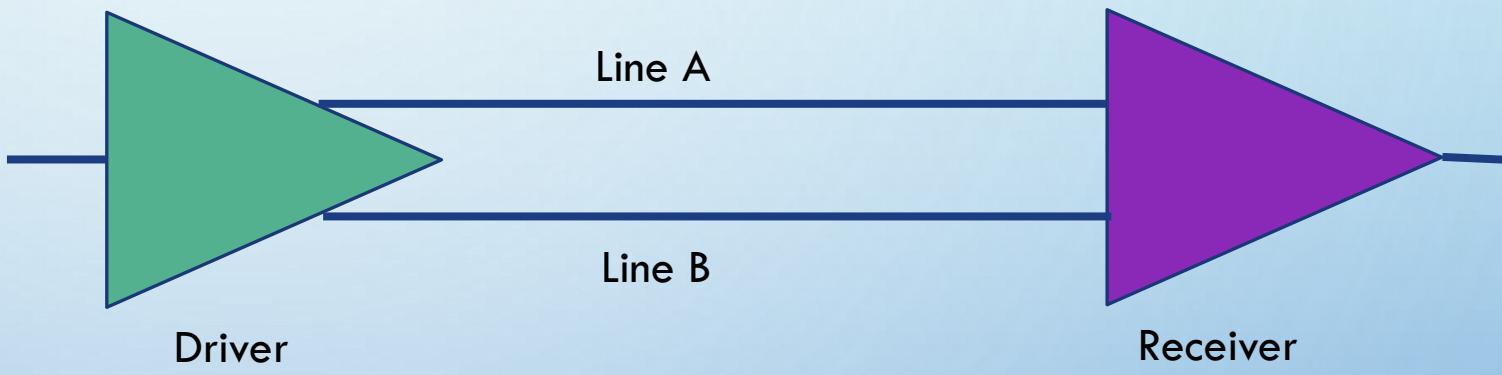


Figure: RS422 transmission in balanced mode

## CONTD..

- A logic 0 is indicated by B signal line is more positive than A signal line.
- A logic 1 is indicated by A signal line being more positive than B signal line.
- So voltage difference between the two lines must be grater than 0.4 V but less than 12 V.

$$V_A - V_B < -0.2V = \text{Logic 0}$$

$$V_A - V_B > +0.2V = \text{Logic 1}$$

- If both lines A and B are closed together then both are affected equally by the noise .
- If lines are twisted together then none of the line is close to noise source than other.
- So twisted pair is very effective in reducing the noise from signal
- Generally the line B is more positive than line A when no communication is taking place.

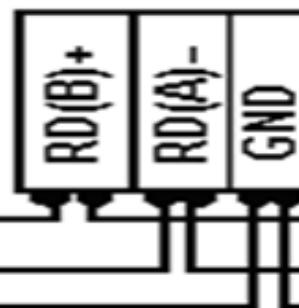
# COUPLING OF MULTIPLE DEVICES

**RS-422 Master**

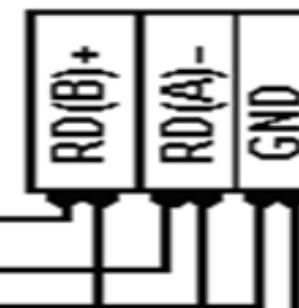
Name
TD(B)+
TD(A)-
RD(B)+
RD(A)-
GND

TD(B) to RD(B)  
TD(A) to RD(A)

**422 Device 1**

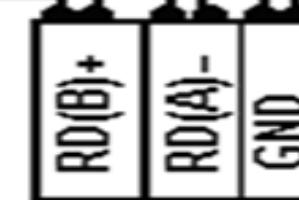


**422 Device 2**



to Remaining  
RS-422 Devices

**422 Device 3**



**422 Device Pinouts Vary**

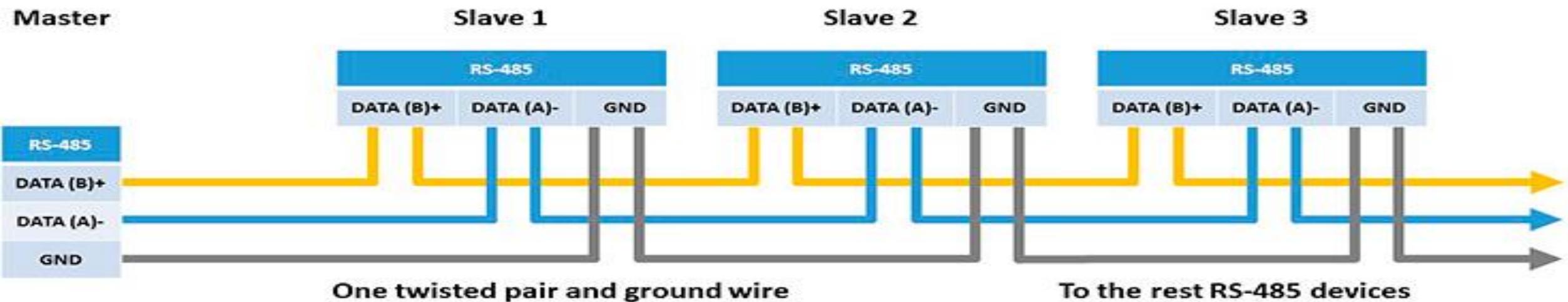
# RS485



- RS485 was developed to provide high speed data.
- This standard is defined by industry telecommunications bodies and may be referred to most commonly as RS485, but references to EI485 or TIA-485 may also be seen.
- RS485 is able to provide a headline data rate of 10 mbps at distances up to 50 feet, but distances can be extended to 4000 feet with a lower speed of 100 kbps.
- Although RS485 was never intended for domestic use, it found many applications where remote data acquisition was required.

# FEATURES OF RS-485

- Suitable for data acquisition world
- RS-485 provides balanced transmission line which also can be shared in multidrop mode.
- It allows high data rates communications over long distances in real world environments.
- RS-485 was designed for greater distance and higher baud rates than rs-232.
- According to the standard, 100kbit/s is the maximum speed and distance up to 4000 feet (1200 meters) can be achieved.



## RS485 HIGHLIGHT SPECIFICATIONS

ATTRIBUTE	SPECIFICATION
Cabling	Multi-drop
Number of devices	32 transmitters 32 receivers
Communications modes	half duplex
Maximum distance	4000 feet @ 100 kbps
Maximum data rate	10 Mbps @ 50 feet
Signalling	Balanced
Mark (data = 1) condition	1.5 V to 5 V (B greater than A)
Space (data = 0) condition	1.5 V to 5 V (A greater than B)
Driver output current capability	250 mA

## KEY CHARACTERISTICS OF THE RS-232 AND RS-485 SERIAL INTERFACES

Parameter	RS-232	RS-485
Line configuration	Single-ended	Differential
Mode of operation	Simplex or full duplex	Simplex or half duplex
Maximum cable length	50 feet	4000 feet
Maximum data rate*	20 kbits/s	10 Mbits/s
Typical logic levels	$\pm 5$ to $\pm 15$ V	$\pm 1.5$ to $\pm 6$ V
Minimum receiver input impedance	3 to 7 k $\Omega$	12 k $\Omega$
Receiver sensitivity	$\pm 3$ V	$\pm 200$ mV

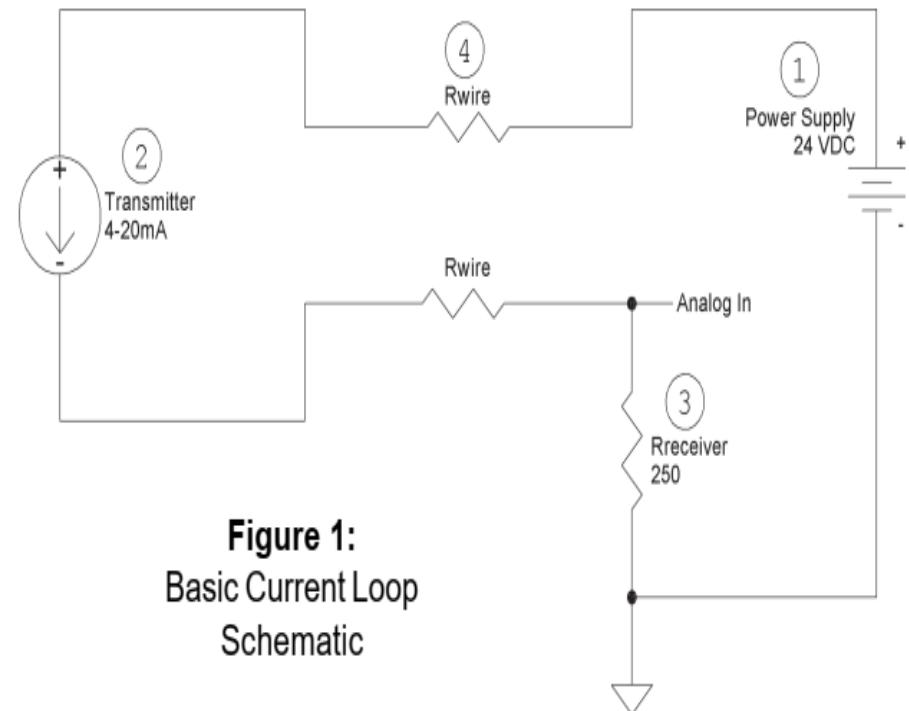
\* Maximum rate at maximum cable length

# 4-20 mA CURRENT LOOP

- The 4-20 mA current loop is a very robust sensor signaling standard.
- Current loops are ideal for data transmission because of their inherent insensitivity to electrical noise.
- In a 4-20 mA current loop, all the signaling current flows through all components; the same current flows even if the wire terminations are less than perfect.
- All the components in the loop drop voltage due to the signaling current flowing through them.
- The signaling current is not affected by these voltage drops as long as the power supply voltage is greater than the sum of the voltage drops around the loop at the maximum signaling current of 20 mA.

# COMPONENTS

- THERE ARE FOUR COMPONENTS:
  1. A DC POWER SUPPLY;
  2. A 2-WIRE TRANSMITTER;
  3. A RECEIVER RESISTOR THAT CONVERTS THE CURRENT SIGNAL TO A VOLTAGE;
  4. THE WIRE THAT INTERCONNECTS IT ALL.
- Current supplied from the power supply flows through the wire to the transmitter and the transmitter regulates the current flow within the loop.
- The current allowed by the transmitter is called the loop current and it is proportional to the parameter that is being measured.
- The loop current flows back to the controller through the wire, and then flows through the receiver resistor to ground and returns to the power supply.
- The current flowing through receiver produces a voltage that is easily measured by an analog input of a controller.
- For a 250 watt resistor, the voltage will be  $1 \text{ v}_{dc}$  at 4 mA and  $5 \text{ v}_{dc}$  at 20 mA.



**Figure 1:**  
Basic Current Loop  
Schematic

Table 1 Copper Wire Resistance @ 20°C (68°F)	
American Wire Gauge	Ohms per 1000 feet
14	2.525
16	4.016
18	6.385
20	10.15
22	16.14
24	25.67

## REFERENCES

- MATHIVANAN, N., *MICROPROCESSOR PC HARDWARE AND INTERFACING*, PRENTICE HALL OF INDIA PRIVATE LIMITED (2007).
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- MURTHY, D.V.S., *TRANSDUCERS AND INSTRUMENTATION*, PRENTICE HALL OF INDIA PRIVATE LIMITED (2006).