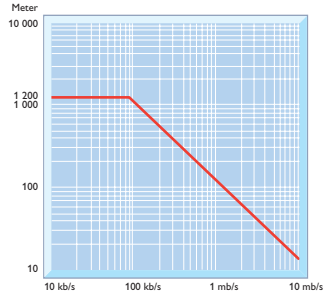
Industrial interfaces

RS-422

RS-422 is an ideal standard for industry as the interface is created to build data buses, typically multidrop, between central computers and a number of substations. The interface is balanced and relatively insensitive to interference. The interface switches polarity on the wire pair depending on whether it is a one or a zero being transferred. The original specification for RS-422 states that communications can take place from one master to 10 slaves, which can only listen to the traffic. We use the drive circuits for RS-485, where the transmitter can communicate with 32 units and can be operated to "tri-state", which means we can design applications with multidrop over both 4-wire and 2-wire connections.

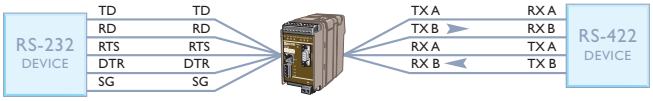
The recommended maximum distance is 1200 m (4000 ft) at a transmission rate of 100 kbit/s. The drive circuits support data rates up to 10 Mbit/s, but the transmission range then drops to 20 m (66 ft). RS-422 can be integrated with RS-485, RS-232/V.24 by using a converter.



RS-485 communication distance

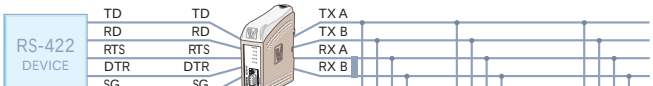
RS-422 on 4-wire

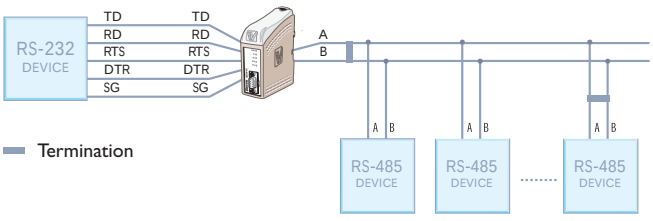
In an RS-422 4-wire system the master transmitter can always be active/switched on, depending on the activity of the slaves. The standard permits simultaneous duplex communications.

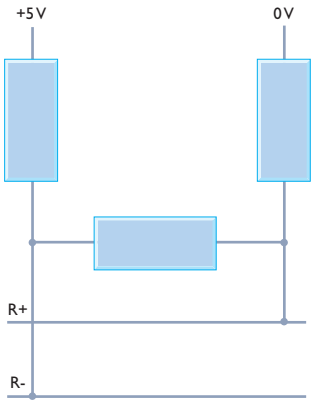


RS-485

RS-485 is a further development of RS-422 and is increasingly used as standard on different equipment. The greatest advantage of RS-485 is that it supports 2-wire communications, i.e. the transmitter and receiver in the equipment can switch the direction of communication. It is designed for data buses of up to 32 devices and is suitable for multidrop networks where a master/slave relation is employed. The recommended maximum range is 1200 m (4000 ft) with a transmission rate of 100 kbit/s. there are many different standard interfaces that use RS-485 as its physical media, for example, PROFIBUS, Interbus-S and Bitbus.





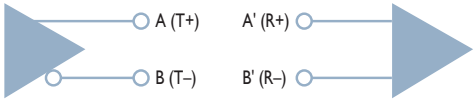


Termination and Fail-Safe

The line should be terminated using a resistor that has the same value as the characteristic impedance for the line. This resistance should be approximately 120 ohm. Termination should be applied as shown in the diagrams on page 29. Termination should be made at each end of the bus. Termination prevents reflections in the cable. "Fail-safe" is a resistance from each wire to the + supply on the one hand, and to the 0V on the other. This means the line is drawn to a predetermined passive level, otherwise the line will fluctuate with the risk of disturbances being detected as data.

Polarity

The interconnection of the transmitter and receiver must be done with the right polarity, in relation to each other. By connecting equipment from different suppliers we know from experience that standards can be interpreted differently. A polarity error in relation to other equipment means that this equipment will interpret the data incorrectly. According to the standard, the transmitter is designated by A and B, these are connected to A´ and B´. We have chosen to clarify these designation with T+, T–, R+ and R- (transmit/receive + and –).



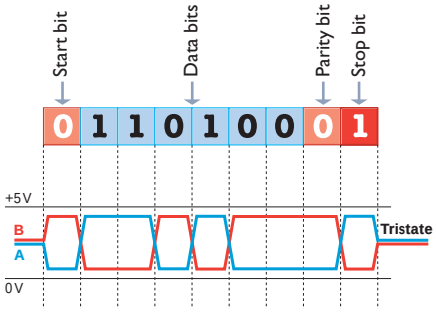
RS-232/V.24 to RS-422/485 converter – RTS support

Systems with RS-422/485 converters in a multidrop network, only permit one transmitter at a time to be active on the bus. Other devices' transmitters must be in "tri-state" mode, i.e. passive. In order to achieve this, it must be possible to control connected equipment by means of a hardware signal. RTS or DTR signals are usually used for this. When a device wishes to transmit on the bus it must first set its RTS or DTR signal high, so that the converter switches its transmitter, it can then send data. When no hardware signal is available, it is possible to use a special converter, which switches on its transmitter as soon as data is sent via RS-232 and switches off as soon as the data stops.

Installation of RS-422 and RS-485

General recommendations for installation

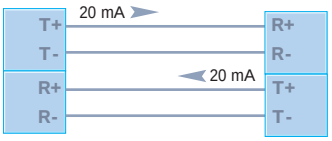
- Twisted pair wire should be used.
- Star networks are not permitted and distance from the bus to the device must be a maximum of 30 cm (1ft).
- Receivers at the end of the bus are to be terminated with a 120 ohm resistor.
- The RS-232/V.24 connection should not be longer than 15 metres (50 ft).
- RS-422/485-supports transmission ranges up to 1200 m (4000 ft) at 100 kbit/s. However, great ranges can be achieved at lower transmission rates.



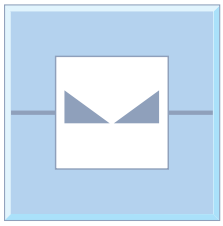
Range and short-haul modems

As mentioned earlier, the RS-232/V.24 standard does not recommend cabling longer than approximately 15 metres (50 ft). Short-haul modems are used to allow longer links to be made. These convert the RS-232/V.24 into defined electrical or optical signals, which are transmitted on e.g. a permanent 4-wire connection or fibre up to a distance of several kilometres. The short-haul modem at the receiver then converts the signal back to RS-232/V.24. The modem must use a common standard and an identical interface for communications over the cable.

20 mA current loop (TTY)



Current Loop is the oldest technique. RS-232/V.24 signals are coded onto a 20 mA current loop as the absence or presence of a current on a wire pair. The transmitter is either connected active and the receiver passive, or vice versa, to feed each wire pair with current. Current Loop provides reliable communications, but is relatively sensitive to interference as the current loop is not balanced (see page 40). In addition, problems can be experienced with the equipment as there is no recognized standard for Current Loop.

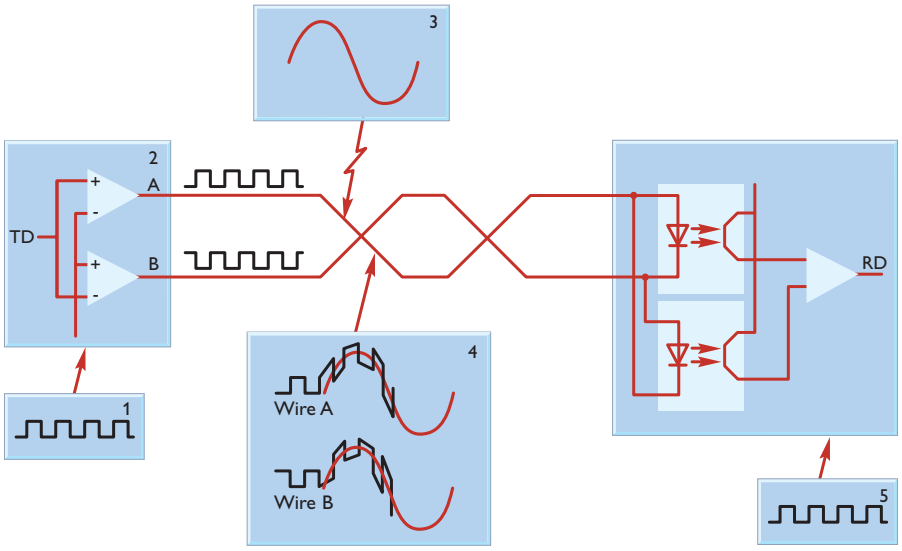


10 mA balanced current loop (W1)

Westermo has developed its own transmission technology for short-haul modems that ensures communications over greater distances and in environments with a high level of interference. The technology is based on converting the signals to a ±10 mA balanced current loop, where the current direction is shifted on the wire pair, depending on whether it is a high or low signal from RS-232/V.24. The line on the transmitter is powered by ±10 mA and an optocoupler is fitted on the receiver to detect the signals. The optocouplers provide complete galvanic isolation between modems. Current is always flowing in one direction even when there is no equipment connected on the RS-232/V.24 side. The exception is when the transmitter is controlled/activated using a handshaking signal. It is a tried and trusted technique that over the years has proven to be very reliable and insensitive to interference and supports data transmission at ranges up to 18 km (11 mi).

Consequently the 10 mA balanced current loop is less sensitive to external sources of interference.

Compared with an unbalanced current loop, a balanced current loop is significantly less sensitive to external disturbance due to the potential differences remaining even when interference is experienced on the line. See the figure below.



1. Data is sent to the transmitter.
2. Data on wire A is inverted compared to the data on wire B.
3. The line is exposed to interference.
4. Transmission data superposed on the interference.
5. Data arriving on the receiving side is unchanged from the data sent by the transmitter (1).