http://www.the-control-freak.com

RS-232-C

Serial Communications

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12/8/2010

RS-232-C Serial Communications is one of the simplest and least expensive means of communicating between a PC and an external piece of equipment. This whitepaper is a simplified mini-tutorial on how to implement it.

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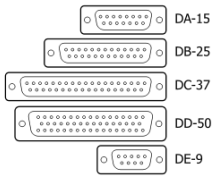
C:\Documents And Settings\Cass\My Documents\RS232\RS-232.Doc

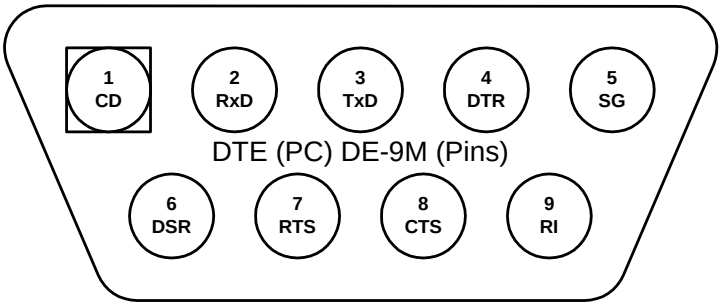
The RS-232 Standard

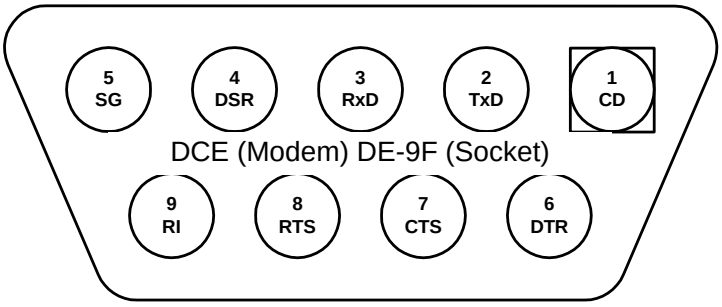
The RS-232 standard (Recommended Standard 232) was originally developed in 1962 to specify the connection mechanism between teletypes (Data Terminal Equipment or DTE) and modems (Data Communication Equipment or DCE)[1]. The RS-232-C version was introduced in 1969 and is considered to be the standard for serial communication. The current version of this standard is the *"TIA/EIA-232-F Interface Between DTE and DCE Employing Serial Binary Data Interchange"*[2].

Nearly all PCs and most laptops contain RS-232 Serial Ports. For PCs, these are usually known as the COM1: and COM2: ports and can usually transfer serial data at 115.2 kBaud or better. RS-232-C Serial Communications is usually considered to be the cheapest and easiest interface between two computers or between a computer and an external device. It can be implemented with as little as 2 wires or as many as 25. Because most PCs use 9 pin ports, it is probably the best known and most used implementation.

The 9 pin com ports are implemented using D-subminiature[3] (or D-sub) connectors, most correctly called DE-9M (male) and DE-9F (female) connectors although they are also commonly called DB-9P (plug) and DB-9S (socket) connectors. The com ports on a PC are always male – i.e. they always have pins rather than sockets.







[1] http://en.wikipedia.org/wiki/RS-232
[2] http://www.techstreet.com/standards/TIA/232?product_id=1525984
[3] http://en.wikipedia.org/wiki/D-subminiature

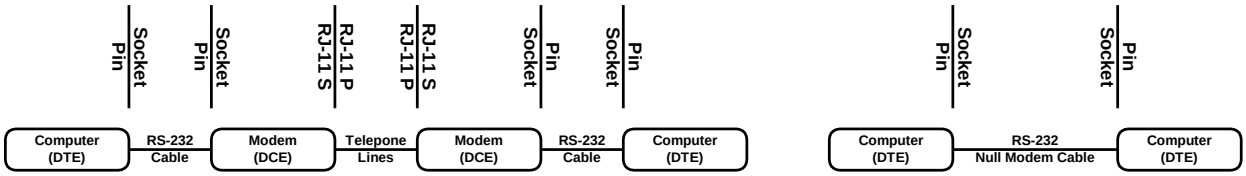


Figure 1 - Point to Point Connections

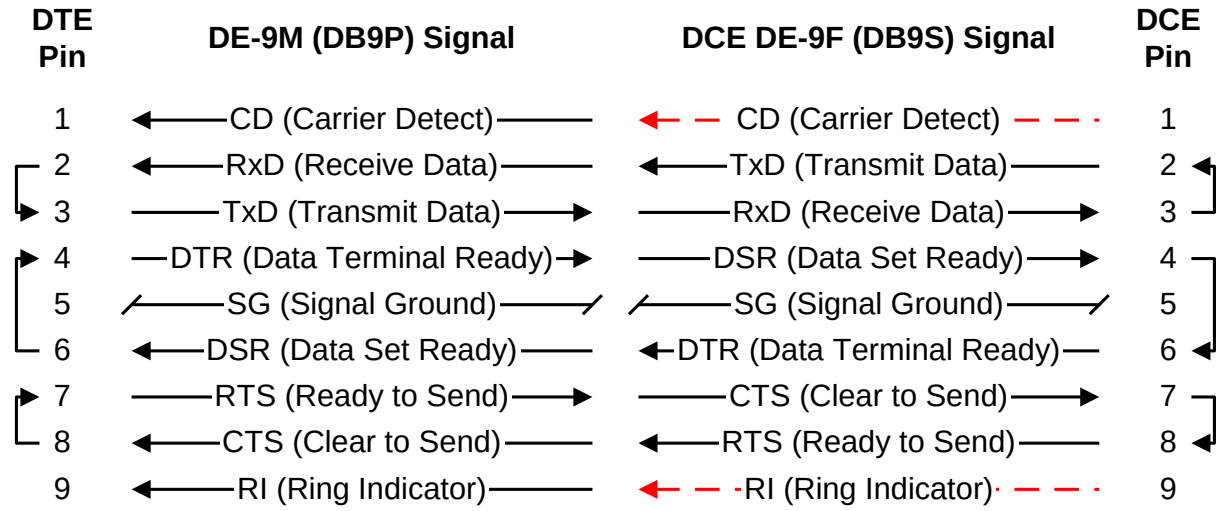


Figure 2 - 9 Pin RS-232 Signal Lines

9 Pin RS-232 Signal Lines

Figure 2 above shows the signals as seen by both the DTE and the DCE. These signals are as follows:

Signal	Description
CD	Carrier Detect – Tells the DTE that a connection has been established and is present in the DCE. This signal is de-asserted if the call is dropped.
RxD	Receive Data – This line is the incoming message stream.
TxD	Transmit Data – This is the outgoing message stream.
DTR	Data Terminal Ready – The computer asserts this line to make a call and sends the dialing commands to the modem. It de-asserts this line for at least 2 seconds to force the modem to hang up.
SG	Signal Ground – The signal voltages are referenced to the signal ground. A -3v to -25v signal is considered logic '1' (mark). A +3v to -25v signal is considered logic '0' (space). Voltages between -3v and +3v are considered to be transitional voltages[4].
DSR	Data Set Ready – The DSR line is used to indicate that the modem has made a connection and that it is ready for an RS-232 conversation to proceed.
RTS	Ready to Send – The RTS line signals a request to send data to the DCE. When the DCE is ready to accept data, it asserts Clear to send (CTS).

[4] http://www.camiresearch.com/Data_Com_Basics/RS232_standard.html

CTS	Clear to Send – The DCE uses this line to indicate that it is ready to accept data from the DTE.
RI	Ring Indicator – The RI echoes the ringing during a modem call. It matches the ringing that you would hear during a voice call.

RTS/CTS Hardware Handshake

The equipment (either the DTE or the DCE) asserts its readiness to receive data by asserting its RTS line. This asserts the CTS signal on the other side. You can throttle receipt of data by toggling your RTS line. When you drop your RTS line, the other side must cease transmission ASAP. Likewise, you can send data as long as the CTS is asserted and must stop if CTS is dropped. Remember that, if a transmission is already in progress, it may continue for a short period of time. Drop CTS early as your incoming buffer starts to fill up so that it can complete transmissions that are already in progress.

The NULL Modem Cable

Sometimes you want to communicate between to PCs (DTEs) directly. You can accomplish this by use of a "NULL Modem" Cable as shown to the right. Note the pairing of TxD with RxD, DTR with DSR and RTS with CTS. Also note that RTS is fed to the CD signal.

This gives you all of the signals that you would normally expect to see when communicating with a modem instead of directly with a PC.

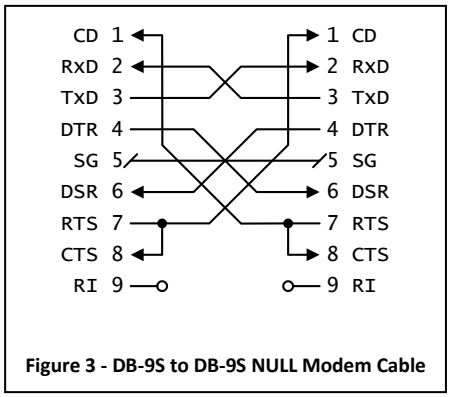


Figure 3 - DB-9S to DB-9S NULL Modem Cable