



## Application Note

**App. Note Number:** 1003

**Title:** RS-232 Communications.

**Description:** Terminology and basic concepts of RS-232 communications, along with basic cable configurations.

**Product:** General  
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## **RS-232 Communication Basics**

RS-232 is an Electronics Industries Association (EIA) standard designed to aid in connecting equipment together for serial communications. The standard specifies connector types, pin assignments, voltage levels etc. Even though the specification exists, it was not specific enough, and allowed manufactures options for its implementation. This means that if two devices are connected together, they still may not communicate. The main problem exists in the wiring of cable between the two devices, but in order to see what type of cable is needed we need to first see what type of devices are being connected together, and what handshaking signals are needed for each device.

### **Device Types**

There are two types of RS-232 devices, Data Terminal Equipment, (DTE); and Data Communication Equipment, (DCE). One main difference between the two types of equipment is how the connectors are wired. Personal computers with a serial port are almost always configured as a DTE type of device. A modem is always configured as a DCE type of device. The H-350, the H-500 and the H-370-L are configured as DTE types of devices. Even though the H-350 and the H-500 are configured for DTE operation they use a female connector.

The connector for the DTE device has output pins that match up with input pins on the DCE device. This means that a straight through cable will normally work when connecting a DTE device to a DCE device. Notice in the two tables that follow that the output pins of one type of device match the inputs of the other type of device. On the other hand if two devices of the same type are to be connected together, then a special cable is needed. Contact Design Analysis Associates for any cabling questions or needs.

## DTE Pinouts

The normal connector used for an RS-232 DTE device is a 9 pin male D connector. Older devices used a 25 pin male D connector. Yet other implementations may have used some completely different type of connector. Standard 9 pin to 25 pin adapters are available to convert from the old type connector to the new or vice versa. The following table shows the pin out for the 9 pin DTE connector.

<b>DTE PIN OUT FOR A 9 PIN D CONNECTOR</b>		
<b>PIN</b>	<b>DIRECTION</b>	<b>DESCRIPTION</b>
1	Input	Carrier Detect (CD)
2	Input	Receive Data (RXD)
3	Output	Transmit Data (TXD)
4	Output	Data Terminal Ready (DTR)
5	N/A	Ground (GND)
6	Input	Data Set Ready (DSR)
7	Output	Request To Send (RTS)
8	Input	Clear To Send (CTS)
9	Input	Ring Indicator (RI)

## DCE Pinouts

The normal connector used for an RS-232 DCE device is a 9 pin female D connector. The following table shows the pin out for the 9 pin DCE connector.

<b>DCE PIN OUT FOR A 9 PIN D CONNECTOR</b>		
<b>PIN</b>	<b>DIRECTION</b>	<b>DESCRIPTION</b>
1	Output	Carrier Detect (CD)
2	Output	Receive Data (RXD)
3	Input	Transmit Data (TXD)
4	Input	Data Terminal Ready (DTR)
5	N/A	Ground (GND)
6	Output	Data Set Ready (DSR)
7	Input	Request To Send (RTS)
8	Output	Clear To Send (CTS)
9	Output	Ring Indicator (RI)

Note that pin 1 on the DTE device will drive pin 1 on the DCE device, likewise for pin 2. Pin 3 of the DTE device is driven by the same pin on the DCE device. This correlation continues on for all the pins. This makes connecting a DTE device to a DCE device simple using a straight through cable. If connecting two DTE devices or DCE devices to each other then the cable must be wired in order to prevent two outputs from driving each other, and two inputs connected together without any driving signal.

## Signal Descriptions

There are three signal types, data signals, handshaking signals and a ground. The data signals and ground are always needed, but the handshaking signals may or may not be required.

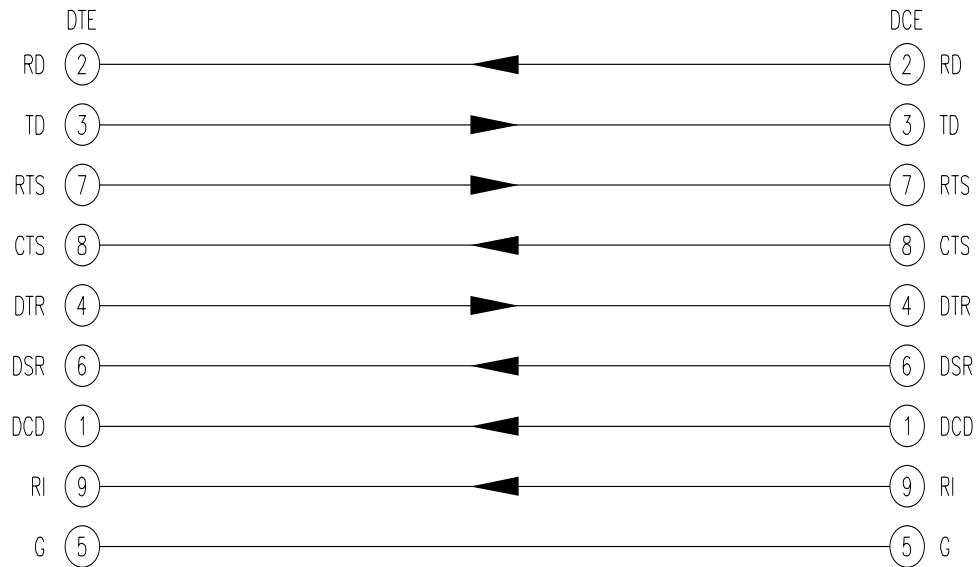
- TXD: The TXD (Transmit Data) signal is the data signal from the DTE device to the DCE device, a PC to a modem for example.
- RXD: The RXD (Receive Data) signal is the data input signal to the DTE device, a PC receives data from a modem on this signal.
- DTR: Data Terminal Ready is activated by the DTE device when it is ready for communications. A PC normally activates this line when some type of terminal program like Procomm is run. When the program is terminated the DTR signal goes inactive. This signal is the complement of the DSR signal.
- DSR: Data Set Ready is driven by the modem and goes active when the modem is powered and ready to receive data. This line is the complement of the DTR signal.
- RTS: Request To Send is activated by the DTE device when it is ready to receive data. This line is the complement of the CTS signal.
- CTS: Clear To Send is activated by the DCE device when it is ready to receive data. This line is the complement of the RTS signal. A PC and modem using hardware flow control will handshake with these two lines to prevent internal data buffers from overflowing.
- RI: Ring Indicator will go active as a modem is receiving a phone call. The modem sends this signal to the DTE device, which may or may not use it. A PC running a terminal emulation program may detect this signal and print a "RING" message to the screen.
- CD: Carrier Detect will go active when one modem is receiving a signal from another modem over the phone line. When 2 modems establish a communication link, a carrier signal is transmitted between the 2 modems. As long as this carrier signal is present the CD signal will be active.
- GND: A ground connection is always required. It is used as the reference for both the data lines and the handshaking lines.

## Basic Cable Configurations

The following sections show and describe some of the most common cable wiring diagrams. Normally one of these cables will work for most all applications. Some of these cables are also available at local computer stores or at Radio Shack stores. Note that the pin numbers are for the 9 pin D connector.

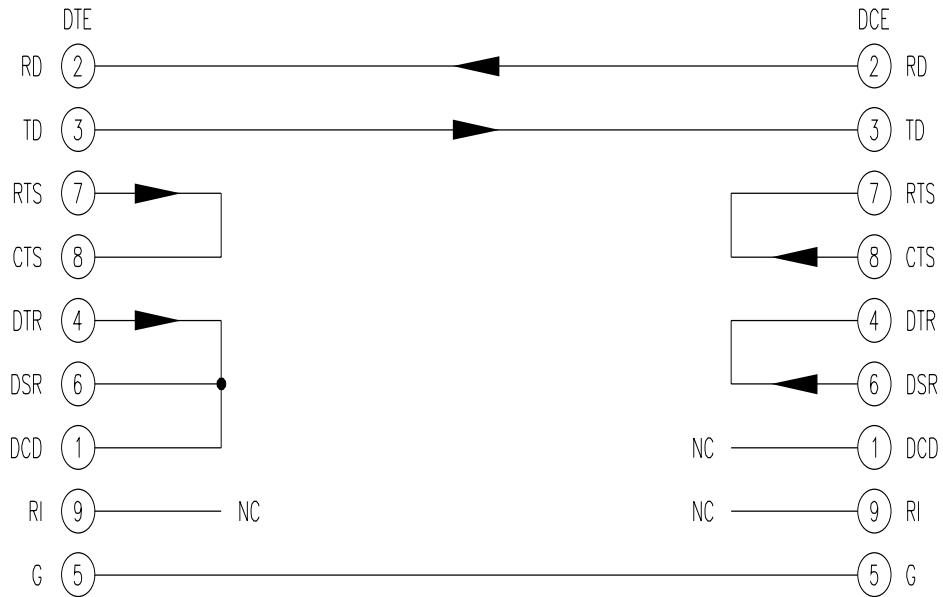
### Standard DTE to DCE Cable

This is a straight through cable and is readily available from most computer stores. This cable allows for all data and handshaking for a DTE device connected to a DCE device. This is the most common cable when using a PC (DTE) and a modem (DCE).



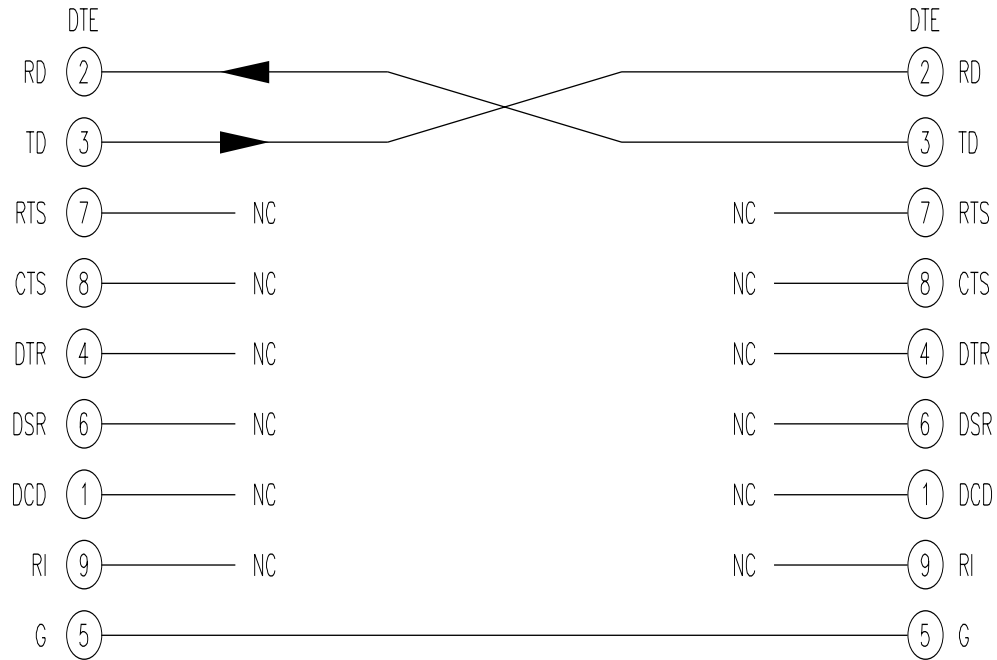
## DTE to DCE cable with Looped Handshaking

This cable provides for data to be transferred from one device to the other but the handshaking lines are looped back in such a way that the device will act as if the handshaking is operating normally. For example as the DTE device enables DTR normally to signal the modem it is ready, it actually signals it's self that the modem is ready. The modem may not be ready or may not even be connected but the DTE device thinks it is ready. The same process works for the other signals also.



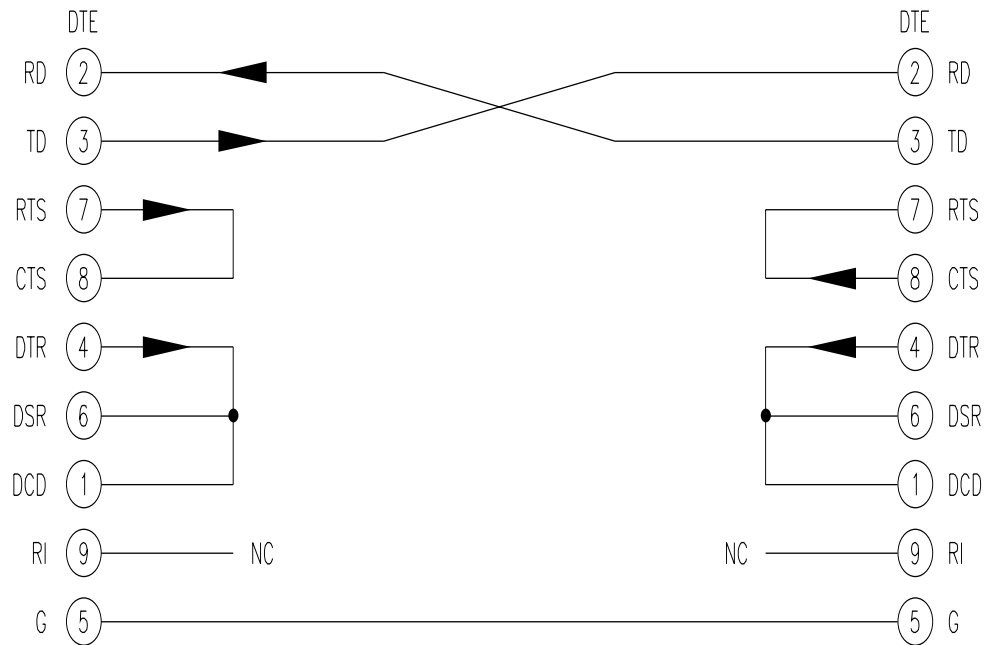
### DTE to DTE Basic Three Wire Cable

Notice here that the transmit and receive lines have been swapped. This is what allows two DTE devices to be connected together. This cable does not take care of any of the handshaking signals. In some cases this is fine as the device in use may not be using them.



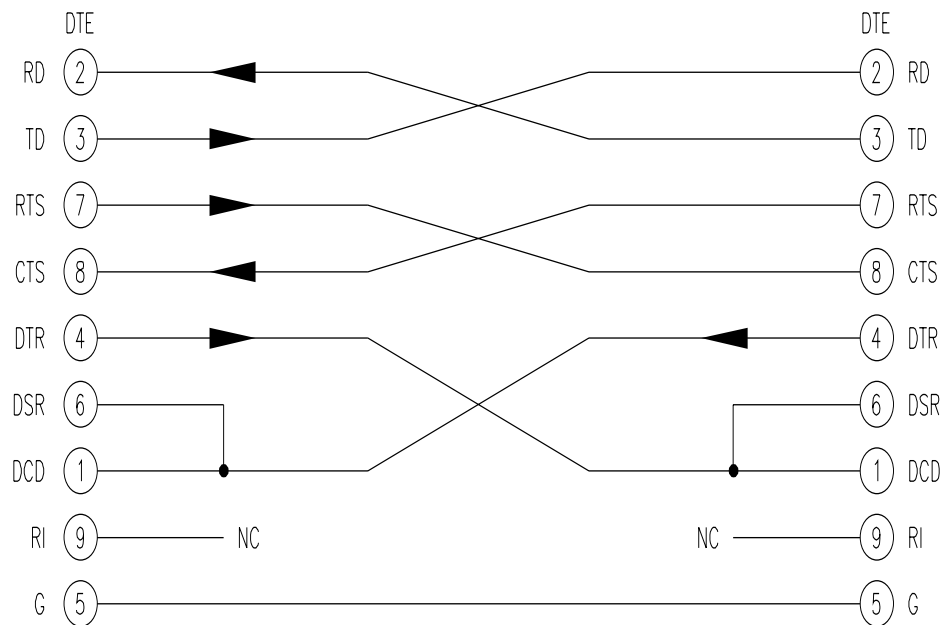
## DTE to DTE with looped handshaking

This diagram shows the basic three wire cable with the addition of looping the handshake lines. This is a very common cable used in many applications, and is often called a "NULL Modem" cable. This type of cable makes a DTE device look like a DCE device.



## DTE to DTE with Handshaking

This diagram shows the basic three wire cable with the addition of the handshake lines also crossed so they can still be used. This cable is also common and is another variation of the "NULL Modem" cable.



## 9 Pin To 25 Pin Conversion

<b>9 PIN D CONNECTOR TO 25 PIN D CONNECTOR CONVERSION</b>		
9 PIN	25 PIN	DESCRIPTION
1	8	Carrier Detect (CD)
2	3	Receive Data (RXD)
3	2	Transmit Data (TXD)
4	20	Data Terminal Ready (DTR)
5	7	Ground (GND)
6	6	Data Set Ready (DSR)
7	4	Request To Send (RTS)
8	5	Clear To Send (CTS)
9	22	Ring Indicator (RI)