

RS-232 Communications Using BobCAD-CAM

RS-232 Introduction

Rs-232 is a method used for transferring programs to and from the CNC machine controller using a serial cable. BobCAD-CAM includes software for both sending and receiving and running DNC or a drip feed if the CNC machine is capable.

The basics of machine tool communication are sending or receiving an NC program to or from a computer and a machine. This is done from the com port (RS-232) of the computer and the com port (RS-232) of the machine.

A cable is used to connect the com port of the computer to the com port of the machine. The cable has a connector at each end. The connector will be 9 or 25 pin depending on the connector port configuration.

Each of the pins in a connector port has a different function. The pins are numbered to distinguish one from the other. For example one pin is used for transmission, another is used to receive data, and another is used for a ground. These are the three pins that are needed for machine tool communications.

A pin-out description is usually supplied for each machine. This pin-out description will determine the function for each pin. Fortunately the pin-out for most controls is standard for all controls. Typically there will be a 9 pin connector on a computer and a 25 pin connector on a machine's control.

DEFINITIONS

RS-232 -

Recommended Standard 232 (RS-232) is a standard for serial communications connecting between a PC and a CNC controller.

Port-

Serial communications port on PC. A 'port' serves as an interface between the computer and the CNC controller.

Baud -

A unit used to measure the speed of signaling or data transfer, equal to the number of pulses or bits per second: baud rate.

Parity-

The condition of the number of items in a set, particularly the number of bits per byte or word, being either even or odd: used as a means for detecting certain errors.

Data-

The Data rate is the number of bits that are conveyed or processed per unit of time.

Stop-

The "stop bit" is actually a "stop period" in the transmission of information to the CNC controller.

Flow-

In computer networking, flow control is the process of managing the rate of data transmission between two nodes to prevent a fast sender from overrunning a slow receiver.

Hardware flow control (RTS / CTS)

Flow control can be done either by control lines in a data communication interface RTS (Request To Send)/CTS (Clear To Send) and DSR (Data Set Ready)/DTR (Data Terminal Ready), which is usually referred to as "hardware flow control".

Software flow control (XON / XOFF)

Or by reserving in-band control characters to signal flow start and stop (such as the ASCII codes for XON/XOFF). Common RS 232 control lines are XON/XOFF is usually referred to as "software flow control".

Timeout-

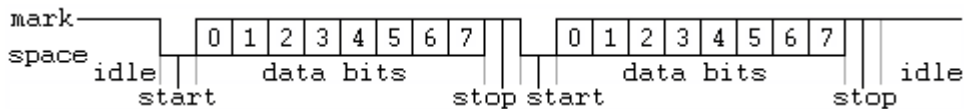
A period of time after which an error condition is raised if data has not been sent or received. If the software does not acknowledge the message within the preset timeout period, a error is assumed to have occurred.

DNC -

Direct Numerical Control, also known as Distributed Numerical Control, (both DNC) is a common manufacturing term for networking CNC machine tools. On some CNC machine controllers, the available memory is too small to contain the machining program (for example machining complex surfaces), so in this case the program is stored in a separate computer and sent Direct to the machine, one block at a time. While BobCAD-CAM has the software capability to use DNC the hardware being used must be of the best quality and capabilities.

UNDERSTANDING HOW RS-232 COMMUNICATIONS WORK

Serial (RS-232) communication describes a serial transmission protocol in which a start signal is sent prior to each byte, character or code word and a stop signal is sent after each code word. The start signal serves to prepare the receiving mechanism for the reception and registration of a symbol and the stop bit serves to bring the receiving mechanism to rest in preparation for the reception of the next symbol.



In the diagram, a start bit is sent, followed by eight data bits, no parity bit and one "stop bit", for a 10-bit character frame. The number of data and formatting bits, the order of data bits, and the transmission speed must be pre-agreed by the communicating parties.

The "stop bit" is actually a "stop period"; the stop period of the transmitter may be an arbitrary length. It cannot be shorter than a specified amount, usually 1 to 2 bit times. The receiver requires a shorter stop period than the transmitter. At the end of each character, the receiver stops briefly to wait for the next start bit. It is this difference which keeps the transmitter and receiver in synchronism.

STEPS TO SET UP RS-232 COMMUNICATIONS WITH BOBCAD-CAM

1. Install the BobCAD-CAM and / or the Predator CNC Editor.
2. Connect a properly configured cable to the PC serial port and then to the CNC machine.
3. Determine first that the Code being sent to the machine is readable , has no errors and bears the correct file extension .
4. Check the Communication settings in the machine the Baud , the Parity and so on.
5. Match the settings in the machine to the settings in the editor.
6. Set the machine to receive.
7. Send the file.

** If there is a failure continue on through the trouble shooting section of this guide.

SEE THE GETTING STARTED GUIDE THAT CAME WITH YOUR BOBCAD-CAM FOR A MORE DETAILED EXPLANATION OF HOW TO SEND A PROGRAM USING BOBCAD-CAM THIS GUIDE IS A REFERENCE FOR UNDERSTANDING AND DEBUGGING COMMUNICATION ISSUES ONLY.

RS-232 Troubleshooting

Making Your Own Cable

Pre-wired cables are relatively inexpensive can be ordered though BobCAD-CAM if a custom cable is to be made the following steps should help.

Making your own cables are not advised or recommended call your machine dealer or contact BobCAD-CAM to order Pre-wired cables.

- 1) Determine the connector plugs needed for the machine side and the computer side (9 or 25).
- 2) Use a pin-out chart to determine which pins need to be connected in the connector plug.
- 3) Determine the proper jumpers required in each connector plug.
- 4) The cable being made is called a “Null Modem”. It is null because the transmit pin from one end is being connected to the receive pin on the other side. And the ground pin from one side is being connected to the ground on the other side.
- 5) Check for continuity after soldering the wires and jumpers in the plug.
- 6) Null Modem adapters can be purchased with the appropriate pin-out from local electronic stores. If these are purchased, “straight cable” needs to be purchased to complete the cable from the computer to the machine tool.

Cable notes:

- 1) Keep the cable as short as possible. The longer the cable the possibility of data corruption is higher. This is because the resistance in the wire increases with the length of the cable and the voltage reduces in this length. The voltage should be between 9 and 12 volts AC between the ground pin and the transmission pin.
- 2) The voltage in the wire affects the baud rate and data corruption. The higher the voltage the higher the baud rate can be. Data transmission can be corrupted when the baud rate is too high for the amount of voltage in the line. Use low baud rates when the voltage is low.
- 3) Do not wrap the cable in a coil. This will cause RF (radio frequency) noise which will cause data corruption.
- 4) Do not attach the cable alone electrical conduit. This will cause RF (radio frequency) noise which will cause data corruption.
- 5) Do not lay the cable over florescent lights. This will cause RF (radio frequency) noise which will cause data corruption.
- 6) Confirm that the machine is grounded properly with a single not spliced wire from the machines buss bar to the buildings buss bar in the sub panel. If not done properly, this will cause RF (radio frequency) noise which will cause data corruption.
- 7) Data corruption can stop transmission, or it can change the data being sent. This is the most dangerous type of data corruption. The position values can change from what was needed.

Com Ports

While USB to serial adapters can sometimes work, they are not recommended.

- 1) The transmit circuit is separate from the receive circuit. One or both might be functioning. This result in being able to send to the machine but not receive from the machine.
- 2) The voltmeter test can be used to determine which device is functioning or not. Place the voltmeter in 0 to 20 volts AC, and put the black lead on the ground pin, and the red lead on the transmit pin. Transmit a file from the device being tested and the reading should be between 9 and 12 volts. If it is lower than 9 volts, this can cause data corruption. One of the ways for a computer builder to save money is to put a 3 volt com port in the computer. Most computer builders are not thinking about machine tool communications when they build the computer.
- 3) If the voltage is lower than 9 volts and higher quality com port should be installed in the computer. Digi International (www.digi.com) is an example of a com port board manufacturer that can be installed into a computer to get higher voltage in the com line.
- 4) If the transmit circuit is tested to function on both the computer and machine side, and the cable is good, the receive circuit on either the computer or machine side can be non functional. This would prevent receiving a file.

Communication Parameters

- 1) The communication parameters in both the machine and the computer need to be matched.
- 2) Usually the parameters can be changed on both sides. They just need to be the same. Do Record the original settings before changing them.
- 3) The parameters are the baud rate, data bits, parity, and stop bits. The information for communication parameters can be found in the user's or operator's manual of the machine tool. Change or set the communication parameters in BobCad to match the requirements of the machine tool.
- 4) Sometimes a delay is needed during transmission. This is usually needed when the computer's clock rate is much higher than the machine's clock rate. This usually happens when the computer is of a much newer vintage than the machine.
- 5) The handshake parameter between a machine and a computer is usually Xon/Xoff. The other handshake options would be used for other devices that require a specialized communications protocol.
- 6) Beginning and End codes are needed in the program to denote the beginning and end of NC program data. The correct beginning and end code information is given in the user's or operator's manual of the machine tool. For example, commonly the % code is used as the beginning and end code.
(Beginning of Program)
%
N1 O1 (PN 1234)
N2 G90 G0 G40

(End of Program)
N100 M30
%
- 7) Some controls have an End of Block (EOB) requirement. This is the block of code that represents the end of each line of program coding. Commonly these would be a carriage return + line feed. These would be an ASCII 10 and 13 codes. Sometimes the code that is displayed on the machines screen is a ";" or nothing. The carriage return and the line feed are non displayable codes. The correct EOB information is given in the user's or operator's manual of the machine tool.

Ready to transmit

Always get the receiving device ready to receive first. For example, set the machine in the receive mode first, then go to the PC and Send.

Ready to receive

Always get the receiving device ready to receive first. For example, set the PC to receive first then go to the machine and use the send function.

RS-232 Communications Using BobCAD-CAM

The following covers all of the most common RS-232 problems.

1. Check the RS-232 settings. They must agree with what the machine is set to. Make very sure that the correct port is selected.
2. Check for pending errors on the control. Occasionally, incorrect or un-recognized g-code can cause a failure in the transmission of the program.
3. If these are all correct, check the wiring on the cable. The wiring must match the desired flow control also called handshaking.
4. If everything above is checked and found correct, check the length of the cable. If the cable is more than 50 feet in length, reduce the baud rate on both BobCAD and the control. Occasionally a custom cable that can exceed this length and still get a fast transfer speed. 300 feet is the absolute maximum length that a RS-232 cable can be without a powered signal booster.
5. Check to see if the control in question has a 'terminal' mode. If it does, and it is set to use it for communications . It must be set for file transfer, ASCII mode.
6. RS-232 testing, check the transmit pin (pin 2 on 25-pin connectors, pin 3 on 9-pin connectors) for intermittent voltage when sending. The light on the tester should blink slightly when it is being used. Check the transmit pins on the other end of the cable when it is attached to the computer, and check the pins in the same manner on the control. The pin numbers should agree with the pin out diagram for the CNC machine.
7. Make sure that cable is connecting to a serial port, not a parallel port. All 9-pin ports on the back of the computer are serial. If the port is 25-pin male, it may be serial also. If the port is 25-pin female, it is the parallel port and communication through it should not be attempted, as it cannot be used for transferal of CNC programs.
8. If the machine states in its manual to connect it to a 25-pin parallel port, BobCAD cannot be used for file transfer. It will require special communication software from the control manufacturer.

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9. Occasionally, having the FIFO buffers active or turned on can be the root of the communications issue to disable them follow the instructions below.

Disabling the FIFO Buffer Settings and setting Communication Parameters

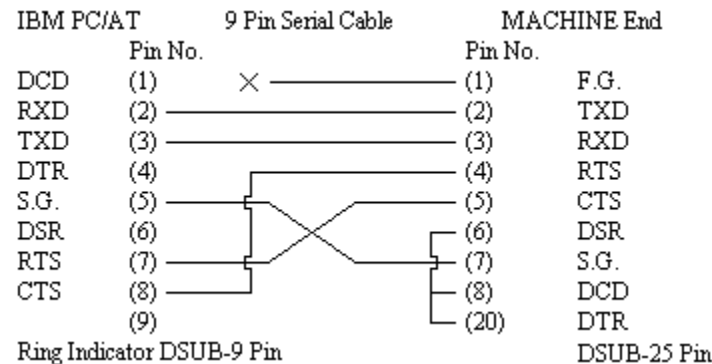
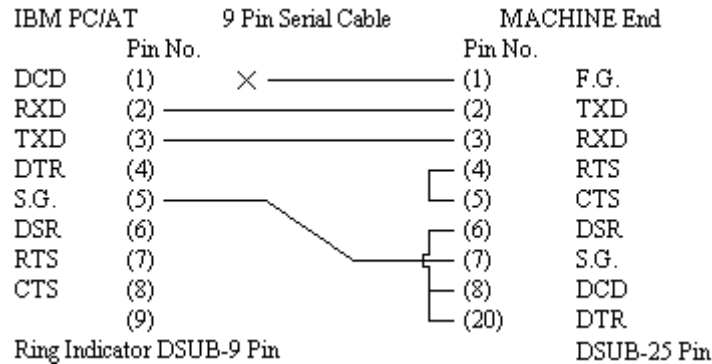
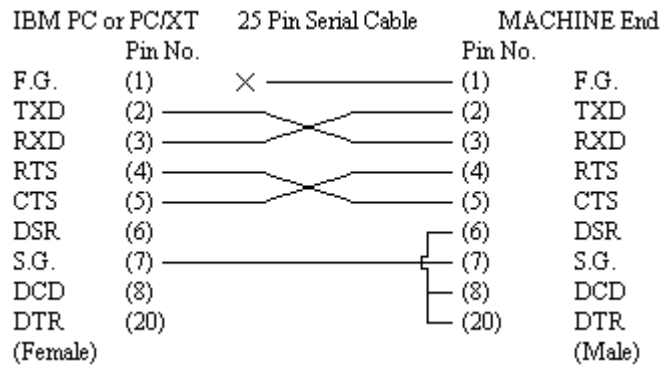
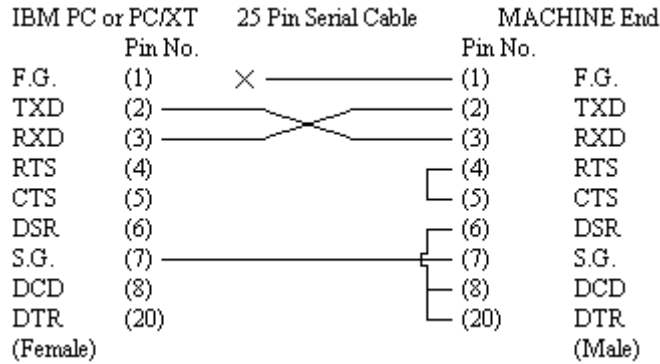
Go to the Device Manager

Click on START / CONTROL PANEL, then double-click on SYSTEM then HARDWARE, and then DEVICE MANAGER.

Look for the PORTS (COM & LPT) section and click the plus sign, “ + ” to expand the section. Double-click on the communications port entry you are using to bring up the Port Properties Window. You will see some tabs along the top of the window. Select the PORT SETTINGS tab.

10. Select the Port Settings Tab. Here you can set the Baud rate, Parity, Data bits, Stop bits, and Flow control. These settings should be the same as your machine settings.
11. Toward the bottom of the PORT SETTINGS window, select the ADVANCED button. You'll be presented with check boxes that can be unchecked to disable the FIFO buffers. Once disabled, try your transfer again.

Common Pin Out Diagrams CNC Controls



DNC Solutions

Direct Numerical Control (DNC)

Direct Numerical Control is a form of machine tool communication not supported in BobCad. DNC is used when the length of the program exceeds the memory capacity of the machine. Another term for DNC is “Drip Feed”. DNC requires the best communication system consisting of all the subjects discussed above. This is because data integrity is paramount during a DNC session. Any corrupt data can cause the machine to move in a path not expected by the programmer. Specialized software is required for DNC transmission. This software should be able to accomplish mid-program starts. Additionally, this software should be able to insure data integrity by using X-modem or other similar style communications protocol. X-modem style protocol uses a check-sum to insure data transmission.

Call BobCad Technical Support for help with DNC solutions.

Simple Solutions:

CNC Hardware Bundle.

These packages include, the Predator CNC editor, 25 feet of custom cable, an RS-232 card for a desktop or a PCMIA card for a laptop computer.

Advanced solutions:

Bobcad offers advanced DNC solutions. Discuss your DNC needs with your BobCad Service Technician and we will provide your company with a custom quote.

Other Solutions:

Job Traveler system, Program Verification System, Remote Machine Monitoring, Paperless shop, and Shop organization are some of the things we offer.

Use the Behind the Tape Reader board to replace tape reader devices on older machines.