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Connect GPS Equipment through the Serial Port

– Randy R. Price, Assistant Professor and Engineer, Precision Agricultural Technology

Most precision farming equipment comes with its own global positioning system (GPS), but some equipment requires the operator to make connections with other units, such as a guidance system or stand-alone GPS unit. These connections typically send data through a nine-pin RS-232 serial port (Figure 1). This connection type continues to be common in agriculture because it does not require a software driver (such as a USB). This publication tells how to create a working connection with RS-232 serial ports and other serial text connections, such as rate controllers.

The Nine-Pin Serial Port

The nine-pin RS-232 serial port is commonly used to connect GPS sensors and guidance systems to other pieces of equipment for coordinate and speed inputs. The port allows for easy transfer of text-type data from one device to another without additional software or hardware drivers. This port is sometimes easier to connect than a USB and has been in use for the last 25 years.

Connection Basics

The RS-232 serial connection and transmission are made in a three-step process:

- Set up the correct cable (null modem or straight through).
- Establish the correct baud rate.
- Establish a sentence structure so each piece of equipment knows what it is sending and going to receive.

Figure 1: Nine-pin RS-232 connector.

Cabling

For most GPS connections, only three pins are needed to cable the RS-232 port for a transmission connection: pin 5 for a ground, and pins 2 and 3 to transmit and receive. The numbers are stamped on the back of the serial port and always match, regardless of gender type. Numbers should be visible with a magnifying glass.

Depending on the port type and equipment, pins 2 and 3 may be switched for sending or receiving, leading to two cabling schemes: a straight-through cable (where pins 2 and 3 match on each end and complete a circuit) or a null-modem cable (where pins 2 and 3 are switched). Knowing which cable to use can be tricky, but can be simplified by carrying a straight-through cable with a null modem adapter and several gender changes to configure either cable type. Cables and adapters are usually available from computer or electronics retailers.

Especially in agricultural equipment, power may be run in one or more of the unused pins, which should be checked for shorting between the two pieces of equipment and the ground. Breaking off all pins except for 2, 3, and 5 on the serial cable or null modem adapter will help alleviate this problem. Pins 6, 7, or 8 may be needed with some equipment for "clear" and "send" operations, but those are not typical in simple GPS serial transmissions.

Securing screws in connectors and cables can help prevent connection problems. A loose connection might jiggle out of place while in use. Worn or loose connectors can be checked by wiggling or applying constant, clamping pressure. Diagnosing this type of problem can be difficult because the loose connection may not allow proper synchronization, and there are no open cable areas to connect diagnostic equipment.

Baud Rate

Once a cable connection has been established, the equipment must be set to send and receive at the same baud rate. This process involves specifying a baud rate, which consists of speed (typically 4,800 to 115,000); bits per word (7 or 8); and parity (even or odd). Some equipment may check automatically, but that is not typical. The most common baud rate for 1 Hertz GPS units and older guidance systems is 4,800. Newer units use 9,600 and 19,200; and 8, N, 1. Very new units may use speeds between 38,400 and 115,000 baud rates, but less-common older equipment may use 7-bit transmission with no parity check. The operator's manual should provide correct rates. It is possible, but time-consuming, to configure different rates manually by trial and error. When cables are extremely long, or connections are loose or worn, the baud rate may have to be reduced to accurately transmit data.

Sentence Structure

Serial transmissions consist of sending words and letters — just as one person talks to another. The next protocol ensures that the appropriate sentence (such as the $GPGLL sentence) is being sent to receiving equipment. GPS sentence structure is typically defined by the National Marine Electronics Association (versions 1.0 through 3.3 or higher), but other companies may have their own formats. Typically sentences start with an identifier, such as "$GPRMC," which stands for "Global Position Recommended Minimum Specific GPS/TRANSIT Data" or "$GPGLL," which stands for "Global Position Geographical Latitude/Longitude." The computer identifies several characters in that sentence and locks onto it. Then, using published sentence structures, the computer knows what piece of information should come next (location, speed, time, heading, etc.) and the units (meters, MPH, degrees, etc.). Consult manufacturers' manuals for the exact sentences needed by each piece of equipment. GPS units typically can output any of the code sentences defined by NMEA.

Potential Problems and Troubleshooting

Problems with the port and connection are not easy to diagnose because connectors are shielded, and other problems — baud rate or sentence structure issues — can cause information not to flow. In addition, most pieces of equipment do not have good diagnostic routines and will not tell you exactly what is wrong. Common problems are incorrect baud rates, incorrect sentence structures being sent, bad or loose connectors, and software unable to lock onto signal. Accidental shorting of pins can occur, but usually turning equipment off and back on solves that problem. If problems persist, the following checks should be considered:

- Both pieces of equipment must be set to the same baud rate.
- Correct sentence structure must be sent. (Multiple sentences are available.)
- Connections must be firm and can be tested by jiggling or pushing the connector slightly. Securing screws must be tight. A new connector or cable might be needed.
- Cycle power to equipment.

It might be necessary to send equipment back to the manufacturer to be checked. Serial transmissions are not instantaneous, so users must allow at least several seconds to see if a connection is made.

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