Let’s define internal communications to begin with. For the purposes of this article we are speaking of the communications connections within a cabinet. The cable connected between a traffic controller and a conflict monitor that allows the monitor’s error log to be relayed to the controller, or the cable connection between an intelligent sensor like an optical preemption card and the traffic controller or an external device like a laptop. No matter the form of external communications your system makes use of your traffic controller and other intelligent devices very likely require an internal cable to make the connection to a modem/transceiver, which acts as the portal between the internal and external system. External communications then, are the links between the control cabinets and a central system or master controller—whether dial-up, copper or fiber optic cable plant.

In the new NEMA type II standard as well as additions to CALTRAN 170 standard equipment (such as the 2070 controller); controllers, conflict monitors, detectors and other remote sensing devices are tasked with communicating with each other as well as with central control systems and masters. The fact that these devices must communicate to operate with each other and with a central system to function properly make it incumbent for you the traffic signal technician to have an understanding of how they operate. In fact, communication failures, or worse, miscommunications may affect a danger to public safety. Communication failures have wrecked havoc with coordination schemes for years, but the garbled commands sent from a master controller to an intersection controller might very well send an intersection into a totally inappropriate mode of operation. The internal communication link is every bit as vital as the external-remote one. This article is intended for those of you with knowledge of basic electricity and a desire to understand serial communications using the RS232 standard. In this series of articles I intend to briefly describe how RS232 serial communication works, describe some typical connections and provide some trouble shooting suggestions.

Serial and Parallel Communications
Data is commonly transferred between computers and terminals by changes in the current or voltage on a wire. Such transfers are called parallel if a group of bits move over several lines at the same time or serial if the bits move one by one over a single line. Transmission of serial data is called synchronous if the exact sending or receiving time of each bit is determined before it is transmitted or received or asynchronous if the timing of the bits in a character are not determined by the timing of a message.

Serial Communication Devices
Although serial busses are normally slower than their parallel counterparts, they generally support further transmission distances and require fewer signal wires. There are three serial standards commonly found in use today. RS232, RS422 and RS485. RS232 is the oldest and most well known. It supports transmission distances up to 50 feet (although it is routinely pushed in practice to further distances). The distance limitation of RS-232 is overcome with RS-422, which supports transmission lengths up to 3600 feet. Both RS-232 and RS-422 support connection between only two devices on the bus at one time, normally the computer and one device. RS-485 supports similar transmission distances as RS-422, as well as multi-drop operation where up to 32 devices may be connected at one time. RS-422 uses a 4-wire design consisting of transmit+, transmit-, receive+ and receive-. RS-485 is normally a two-wire system with a plus and minus signal line.

Wiring Considerations
Connecting RS-232 devices can be a challenge, especially for the novice user. There are a few basic concepts, which once understood, will make wiring a system much easier. The most commonly used connector in the RS-232 systems...
is a 25 pin sub-D. There are two wiring pin configurations, which are normally used, that of Data Terminal Equipment (DTE) and Data Communication Equipment (DCE). Most computers use the DTE format. DCE devices use a pin-out similar to a DTE except that pins 2 and 3 are reversed. That is, on a DTE device, pin 2 is transmit data and pin 3 is receive data while on a DCE device pin 2 is receive data pin 3 is transmit data. Figure 2 shows the pin-out for a DTE connector. Although up to twenty-three lines may be defined, only 9 lines are normally used. Of the nine lines, three are required for communication (transmit, receive and ground). The other 6 are handshake and modem control lines. When connecting a DTE device to a DCE device a straight pin to pin connection is used as shown in figure three. A cable, which provides this pin to pin connection, is referred to as a modem cable (straight-through cable). When connecting a DTE device to another DTE device, a null modem connection, which crosses the transmit and receive lines, is needed. Connecting the transmit and receive line of one DTE device directly to the transmit and receive line of another DTE device is like trying to carry on a telephone conversation while speaking into the ear piece and listening to the mouth piece. There are no strict guidelines on the implementation of the handshake lines so compatibility problems sometimes arise. One solution is to connect only the transmit, receive and ground lines of the two devices while jumpering across the handshake lines. The devices are then “fooled”: into handshaking with themselves. Manufacturers often use the familiar RS232 DB25 and DB9 for parallel and non-RS232 communications as well. It is a wise practice to check manuals, cut-sheets and/or the manufacture’s representative before attempting to link up unknown equipment. Serious equipment damage could result from an inappropriate linkage. A common example is your PC’s parallel printer connection.

In a later issue: a description of the RS-232 signals and how they are used.