Product Brief for Microbotics SLC22232 Voltage Level Converter

In order to pass information between computers and data terminals when the only transmission medium is a telephone line or RF link, the data are sent one bit at a time, hence the term "serial communications". Since the timing of these data bits must also be sent on the single line, several techniques have been devised for encoding the clocking information within the data stream. The Electronics Industries Association (EIA) has standardized one technique in its Recommended Standard 232 (RS-232). RS-232 has become the default communication standard of the Computer and PC Industries, and, as many devices are interfaced to PCs, RS-232 signals are often incorporated into a wide range of products. While this standard addresses encoding technique, connector pin-outs, and voltage levels, the immediate concern is the voltage levels used.

RS-232 specifies a "Mark" state (equivalent to a logic '1' or "high") be a voltage between –3 and –25 volts. The opposite state, the "Space" state (equivalent to a logic '0' or "low") is specified to be a voltage between +3 and +25 volts, thus a simple communications link could be implemented using only three wires (transmitted data, received data, and a common ground). When the RS-232 specification was originally issued, logic systems usually had ±12-volt or ±15-volt power supplies available, so generating the RS-232 signal did not present a problem. As systems have become more digital-only, the bipolar power supplies are often not available, so the integrated circuits manufacturers developed devices that generate the needed power supplies from the logic rail.

While RS-232 implementation is convenient, the signal levels cause significant system electrical noise problems. Electrical noise occurs whenever a voltage is changed from one level to another (e.g., switching from a Mark to a Space). The amount of noise generated is in direct relation to the speed at which the change is made, and to the square of the voltage transition. Also, RS-232 is a single-ended transmission (the transmitted signal is carried on one wire), and this single-ended mode effectively creates a radiating antenna. On the receiving end, the single-ended mode effectively creates a receiving antenna for noise encountered by the wiring (e.g., electrical motors, RF transmitters, or high-speed electronics). To address this noise issue, the EIA issued another standard that addressed the voltage levels. This standard, RS-422, specifies a differential transmission using a twisted pair of wires to carry the signal. The twisted pair generates very little electrical noise outside the pair. Any external noise develops the same voltage on each wire relative to ground (called "common-mode" voltage), and, as the receiver only measures the voltage between the twisted wires, this common-mode voltage is ignored at the receiver. RS-422 specifies a minimum voltage swing of ±200 millivolts between the pair of wires, allowing the signals to be easily generated from the logic voltage rails (even rails as low a 3.3 volts). RS-422 is used in many noisy industrial applications, or when hard-wired transmission over long distances is required.

Another problem encountered with RS-232 signal levels is these levels are not compatible with standard digital logic. The most common logic levels used are the TTL levels (Transistor-Transistor Logic). This standard specifies a logic '0' to be between +.8 volts and zero, and a logic '1' to be +2 volts to +5 volts. While the RS-232 levels cannot be used with standard logic, most RS-422 drivers (even those operating on 3.3-volt rails) output TTL-compatible levels. RS-422 systems can receive TTL levels if the negative signal is biased between .8 volts and 2 volts.

With both RS-232 and RS-422 devices being used, or the with the need to use RS-232 with a PC but needing to send data through a high noise environment, RS-232 to/from RS-422 voltage converting devices are required. The Microbotics SLC22232 Voltage Level Converter is such a device. While other devices are on the market, the SLC22232 offers several distinct advantages over the competing units. While most units provide full-duplex (i.e., both transmit and receive) voltage level conversion for a single channel, the SLC22232 provides two full-duplex channels. The SLC22232 is extremely small (1.2" x .5"), having been designed to be incorporated directly into the user's wiring harness. Unlike many competing units that have been designed to uses modular wall-mount power supplies ("brick" power converters), the SLC2223 uses whatever voltage rail is available, being specified for operation between 4 volts to 40 volts. The SLC22232 has a built-in 1.5-volt reference signal for terminating the negative line of the RS-422 receivers, thus inherently making the SLC22232 an RS-232 to/from TTL voltage level converter.