# LevelPRO Communications

## ASCII or ModBus-RTU Digital Communications

The LevelPRO Series of tank level processors offers true digital communications to PLCs or computer based host devices. The communications interface is implemented as a query-response format. Individual channels (corresponding to specific tanks or vessels) are addressable by the host device. This may be either a request to respond with level data or to change the specific gravity variable in use by the processor. The actual form of the response depends upon which communications mode (ASCII or ModBus-RTU) is employed.

## ASCII Mode

The standard communications mode for LevelPRO Tank Level Processors is based on a protocol using ASCII characters in a simple code structure. Any typical DOS or Windows based PC can communicate directly using this mode. With the presence of a BASIC module programmed with a simple communications routine, many PLCs can also interface directly with the LevelPRO processor.

ASCII mode supports a rich data message containing the channel address, 5-character specific gravity value, status indicator (full, empty), 8-character level value, 4-character units abbreviation and 2-byte number checksum. This data output from the LevelPRO is generated whenever the processor receives an query or is downloaded with a specific gravity by the host.

EIA RS-485 Half Duplex
Auto signal level shifting for point-to-point (*RS-422*) or multidrop (*RS-485*)
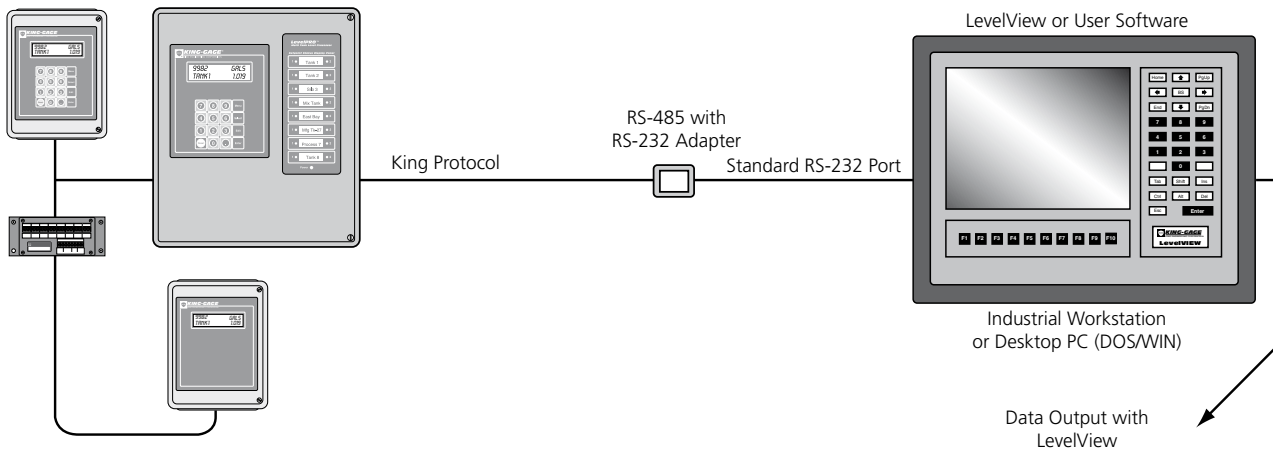19.2k bps Baud Rate
0 start bit
8 data bits
1 stop bit



**Figure 1 - ASCII Mode (RS-485 Interface)**
This communications link is based on the host device (industrial workstation or PC) having an available RS-485 serial port. Requires a simple communications program that will accept standard ASCII characters.

**Figure 2 - ASCII Mode (RS-485 to RS-232 Converter)**
Here the host device (industrial workstation or PC) has a typical RS-232 serial port. Using a commercially
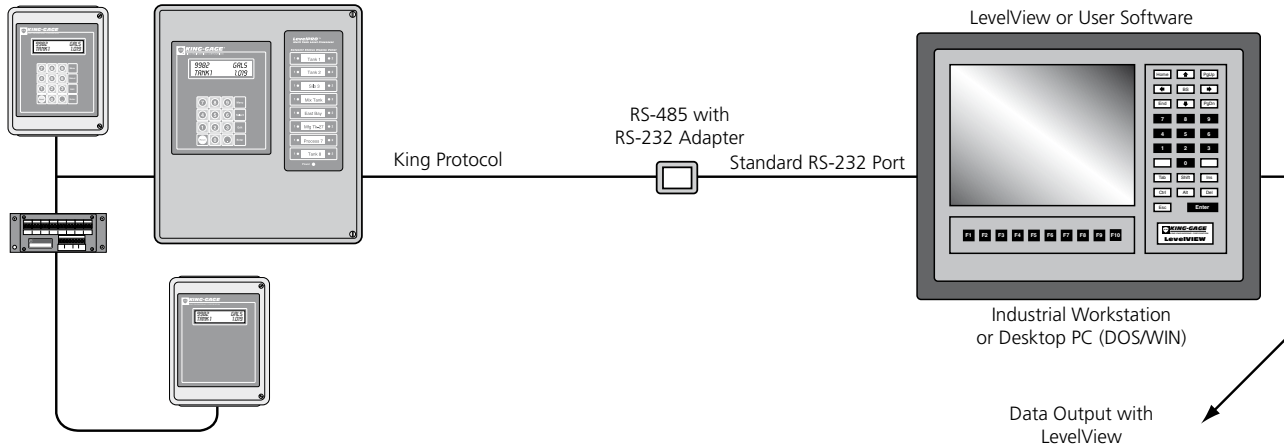
available RS-485 to RS-232 converter, the communications link can be implemented. Also requires a simple communications program that will accept standard ASCII characters.
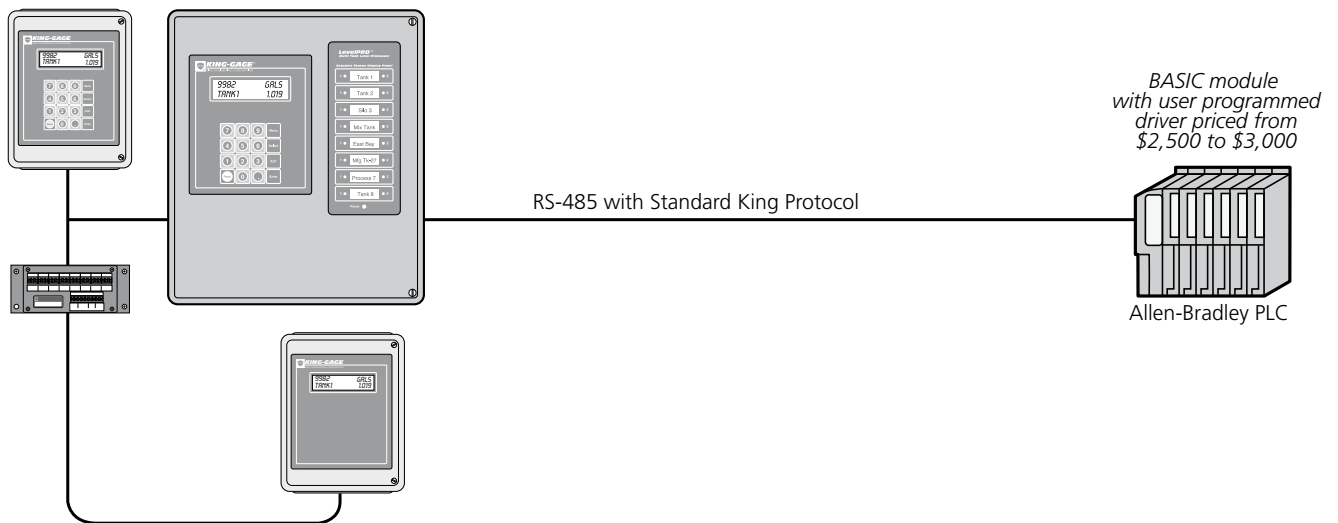


**Figure 3 - ASCII Mode (PLC with BASIC Module)**
With the inclusion of a PLC option module, the user can employ a simple communications driver program. While the cost of a BASIC module is a consideration, the multidrop RS-485 eliminates the need for multiple analog I/O points at the PLC (and the associated cabling costs).

# ModBus Mode

King has developed ModBus communication protocols in order to interface LevelPRO tank level processors directly with Modicon programmable controllers.  Specifications for ModBus were obtained from: *The Modicon ModBus Protocol Reference Guide* (PI-MBUS-300 Rev. H, April 1996).

The optional ModBus communication mode for LevelPRO Tank Level Processors is based on a emulating the remote terminal unit (RTU) code structure.  Modicon programmable controllers equipped with a ModBus port can communicate directly using this mode.  Many other types of PLCs can be enabled for communications through the use of a data converter, including Modicon controllers that only have an active ModBus Plus port.

EIA RS-485 Half Duplex
RTU Mode (with CRC error checking)
19.2k bps Baud Rate
1 start bit
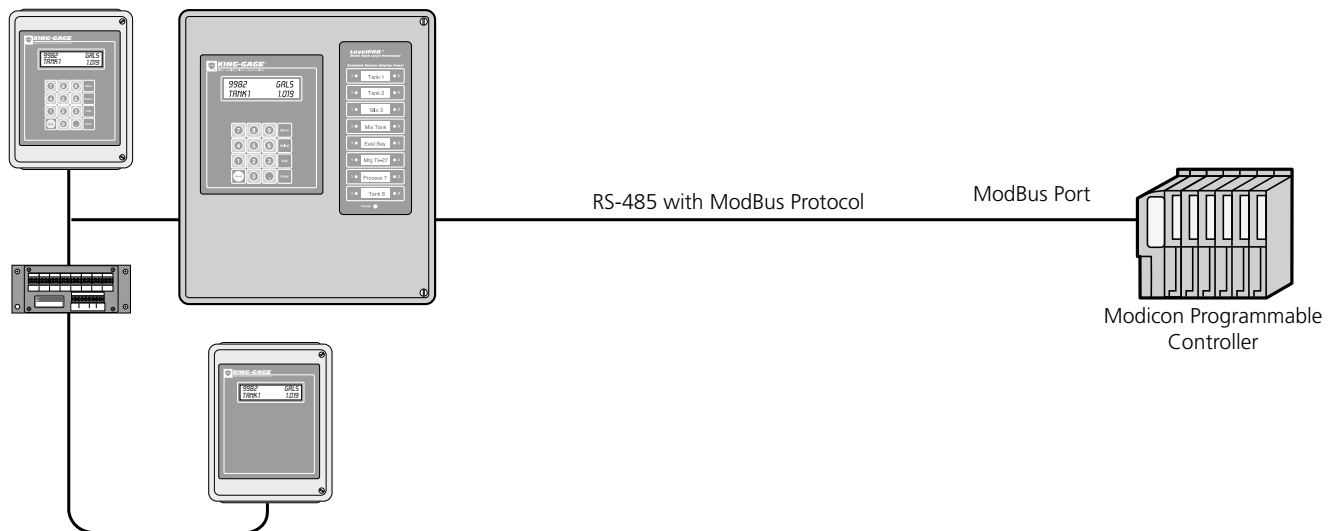8 data bits
2 stop bits
No Parity



RS-485 with ModBus Protocol        ModBus Port

Modicon Programmable
Controller

**Figure 4 - ModBus-RTU Mode (RS-485 Interface)**
Establishing a communications link to a Modicon controller is straightforward when a ModBus port is available.  The ModBus interface is essentially physically the same as RS-485.  However, the LevelPRO processor(s) must be firmware configured for ModBus mode.
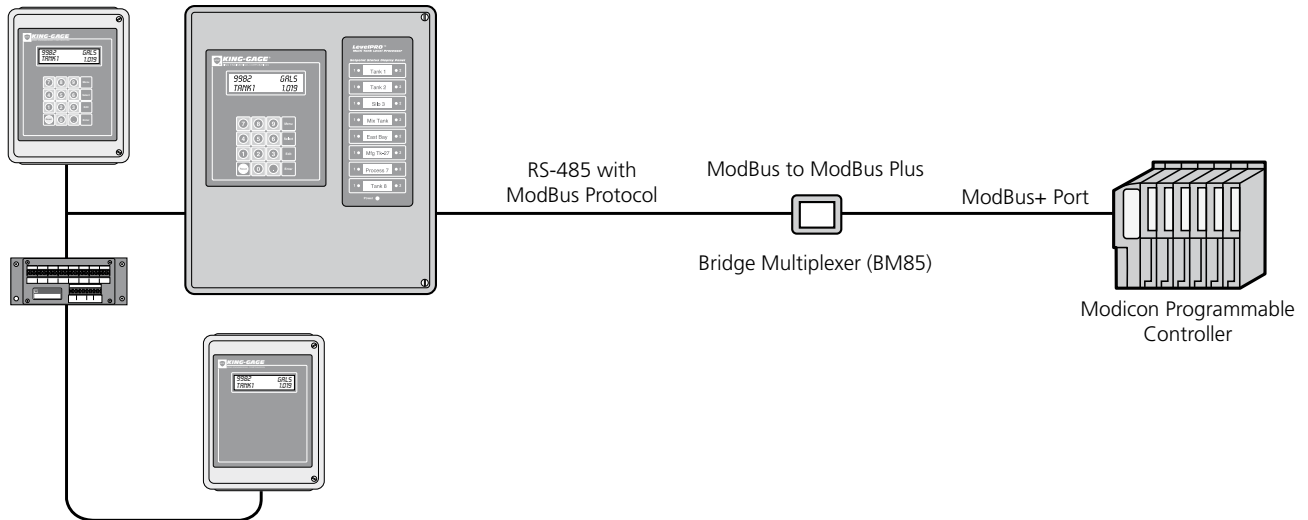
**Figure 5 - ModBus-RTU Mode (RS-485 to ModBus Plus Interface)**
Linking the LevelPRO processor(s) to a Modicon controller with a ModBus Plus port requires the manufacturer's bridge multiplexer (part no. BM85).  One side of the bridge accepts the standard RS-485 (ModBus) interface from the LevelPRO processor that is firmware configured for ModBus mode.
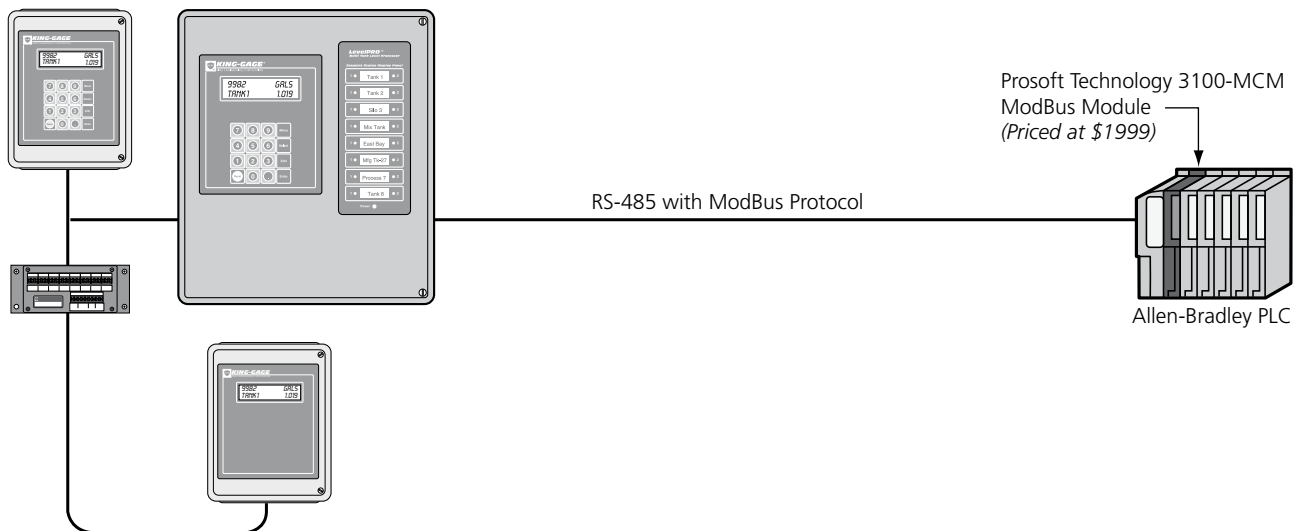


**Figure 6 - ModBus-RTU Mode (RS-485 to ModBus Module)**
ModBus-RTU communications to Allen-Bradley PLCs can be accomplished using a third-party communications module (example:  ProSoft Technology).  This is a single slot module that adds a ModBus port to the PLC and operates over the existing backplane using standard ladder programming.  The LevelPRO processor must be firmware configured for ModBus mode.
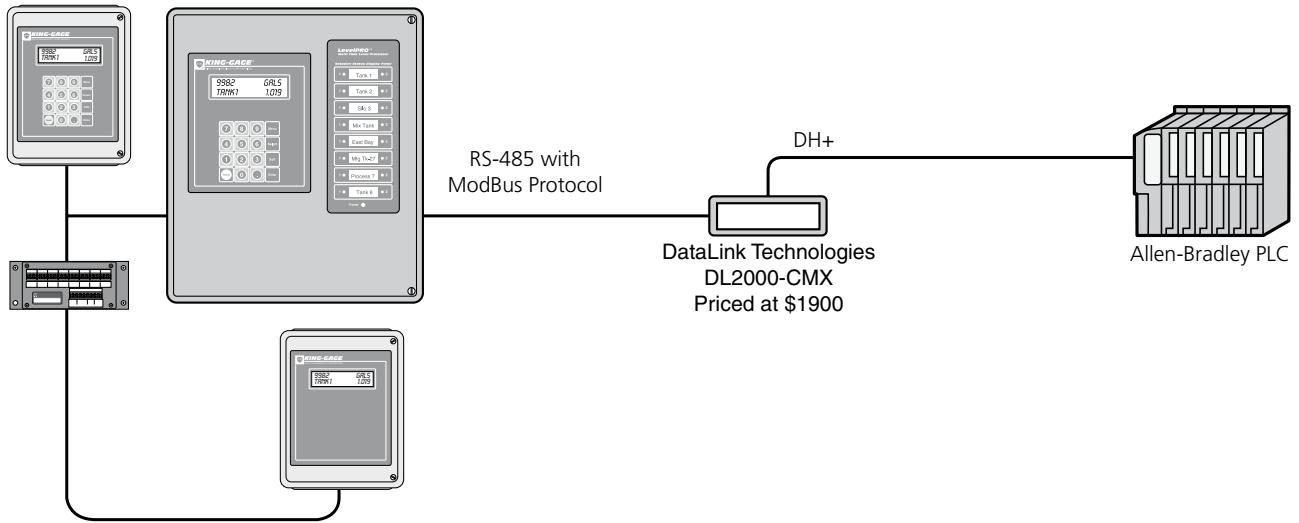
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**Figure 7 - ModBus-RTU Mode (RS-485 to Bus Gateway)**
Using a third-party bus gateway (example: DataLink Technologies), it is possible to link ModBus-RTU communications to high level OEM bus such as A-B's DH+ network. Generally, these gateway devices are "plug and play" and require no user programming.  The LevelPRO processor must be firmware configured for ModBus mode.
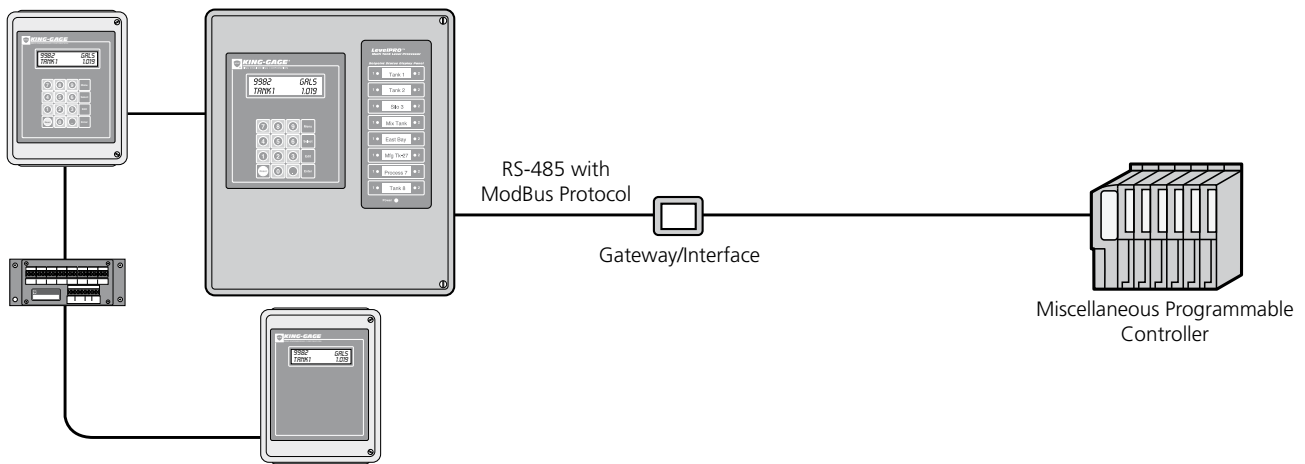


**Figure 8 - ModBus-RTU Mode (FieldBus Gateway)**
Due to the large installed base of ModBus compatible devices, communications between the LevelPRO processor(s) and other higher level buses (Fieldbus, DeviceNet, Interbus, Profibus) will take advantage of readily available third-party gateway solutions.  In many instances, these will take the form of a small dedicated PC using proprietary adapter card and software.

# Terminology & Acronyms

**ASCII**
(American Standard Code for Information Interchange) 7-bit code capable of representing letters, numbers, punctuation marks and control codes.

**BASIC**
Beginners All-purpose Symbolic Instruction Code; a high level programming language.

**BUS**
Hardware lines and communications channels for connecting several devices together.

**CRC**
Cyclical Redundancy Check; error checking method used in ModBus-RTU mode; two bytes containing a 16-bit binary value calculated by the transmitting device.

**DH+**
Data Highway plus is an upper level communications bus developed by Allen-Bradley.

**EIA**
Electronics Industry Association; manufacturer's organization that develops industry standards; see also RS-232, RS-422, RS-485.

**FIELDBUS**
Universal "open" communications bus; developed by an industry consortium of manufacturers and users.

**HALF DUPLEX**
Communications mode in which data can be sent in only one direction at a time (either transmit or receive).

**HART**
Highway Addressable Remote Transducer; hybrid network protocol which imposes a digital signal onto a 4-20 mA analog signal.

**HEX**
Hexadecimal; expression of a number in base-16 using a combination of digits (0-9) and letters (A-F); compact method of representing long binary numbers in 4-bit segments.

**INTERFACE**
The place at which two systems, or a major system and a minor system (such as a computer and a peripheral device) meet and interact; the means by which interaction is effected; also, to connect by means of an interface.

**I/O**
Input/Output; relating to signal input and signal output which may be analog or digital.

**MODBUS**
Communications protocol developed for Modicon controllers; hardware lines are based on RS-485; compare to ModBus Plus.

**MODBUS PLUS**
Upper level communications bus developed for Modicon controllers.

**MULTIDROP**
Communications network or interface between multiple (2 or more) devices; see RS-485.

**PC**
Personal Computer; trademark developed by IBM; now generic terminology for most microprocessor based computer architecture.

**PLC**
Programmable Logic Controller; trademark of Allen-Bradley and also used generically to refer to industrial programmable controllers.

**POINT TO POINT**
Communications channel or interface between two devices only; compare to Multidrop.

**PROFIBUS**
Process Fieldbus; a German national standard now promoted as an "open" industrial network protocol.

**PROTOCOL**
Set of rules governing exchange of information; defined codes, data packets and sequencing to transmit and/or receive data.

**RS-232**
EIA-232; the RS prefix (Reference Standard) was deleted January 1, 1986 in favor of "EIA" though it remains in wide use; point to point binary data interface; a de facto standard developed by the Bell System for data transmission over twisted pair less than 50 feet; standard as adopted by EIA defines pin assignments and signal levels.

**RS-422**

EIA-422; the RS prefix (Reference Standard) was deleted January 1, 1986 in favor of "EIA" though it remains in wide use; serial binary data interface available for point to point or limited multiple receivers; originally implemented by Apple Computers, it uses a differential electrical signal as opposed to unbalanced signals referenced to ground (i.e., EIA/RS-232)

**RS-485**

EIA-485; the RS prefix (Reference Standard) was deleted January 1, 1986 in favor of "EIA" though it remains in wide use; multidrop serial binary data interface supports up to 32 receivers; standard as adopted by EIA defines differential electrical signal with characteristics that ensure adequate signal voltages under maximum load.

**RTU**

Remote Terminal Unit; ModBus RTU mode; defines the bits contents of message fields transmitted serially on ModBus network.

**TWISTED PAIR**

Twisted pair of wires; one conductor +Vdc) runs in parallel with second (common or ground) conductor; used for both analog signals (e.g., 4-20 mAdc) or digital serial communications.