

LevelPRO™

Single Tank Level Processor

Installation and Operations Manual

Models:

- 5251-11-x
- 5251-21-x
- 5251-31-x



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- (A) August, 1996 – Beta Site Release
- (B) March, 1997 – Production Release
- (C) March, 1998 - (734) Area Code, Modbus Response

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KING-GAGE LevelPRO Single Tank Level Processor

LevelPRO Processors provide continuous measurement of liquid inventory in storage or processing tanks. They calculate level on the basis of hydrostatic pressure created by liquid depth in the tank. This pressure is the result of both depth and density (specific gravity).

The LevelPRO Tank Processor expresses output directly in engineering units. The processor references a capacity profile to correlate transmitter output to actual tank geometry. The processor then formats the resulting value directly as the total weight or volume of liquid in the tank. Unlike digital panel meters, there are no user conversion factors involved or scaling points to enter. All application details have been factory programmed into SRAM.

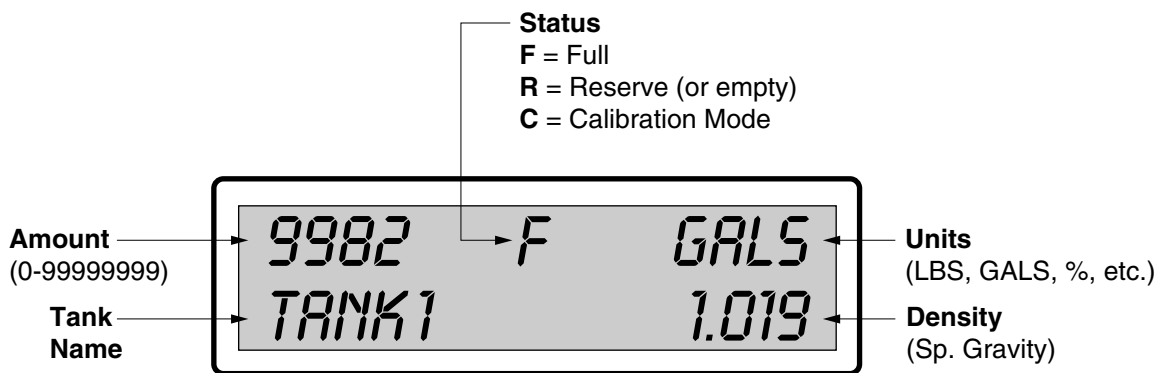
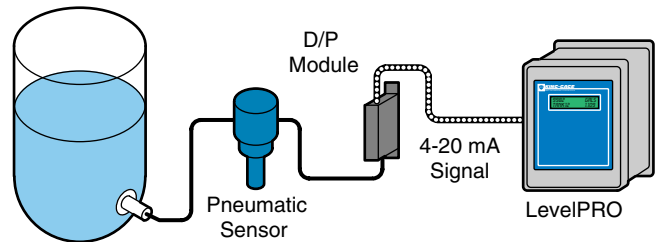
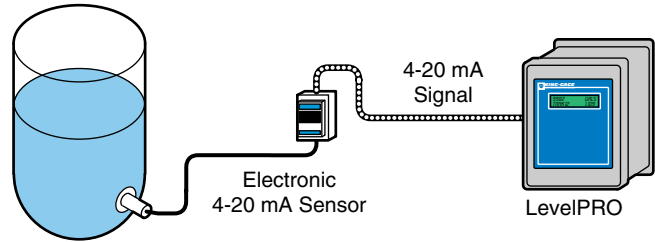
Tank Level Status Display

A two line alphanumeric LCD readout provides tank level indication including the unit of measurement (gals, lbs, ltrs, kgs). The second status line identifies the tank by name up to 10 characters/spaces in length. Level can be represented by up to an 8-digit value to allow direct weight indication for even extremely large tanks.

R (Reserve) - This status designation refers to the corresponding reserve capacity of the tank below the level detectable by the sensor.

Input Requirements

LevelPRO Tank Level Processor accepts standard proportional 4-20 mA output from the liquid level transmitter. The sensor used to detect hydrostatic pressure (created by liquid depth) can be either electronic or pneumatic. With the latter, an electronic pressure transmitter is used to convert the sensor's pneumatic signal into a 4-20 mA output. This can be done with a KING-GAGE® D/P Module or D/P Transmitter.



Detail - Tank Level Status Display

Specifications and Dimensions Model 5251-11-x

Power Requirements

115 Vac, 50/60 Hz. 0.5 Amp, source grounded. Power consumption 40 watts max.

Signal Input

4-20 milliamperes (mA_{dc})

Memory

SRAM, 8k x 8, 100ns

Input Impedance (Resistance)

120 ohm nominal (2.4 Vdc drop @ 20 mA_{dc})

Power Output

24 Vdc excitation available at + Signal Terminal, 0.5 Amp max.

Readout

Alphanumeric 0.3173 in. (8 mm) 16- character x 2-line LCD; numeric 8-digit (0-99999990 maximum), optional backlighting

Resolution

0.024% FS (±0.004 mA)

Accuracy

±0.048% FS (±0.024% FS, typical)

Temperature Range

30°F to 120°F/-1°C to 49°C (operating temperature)

Communications

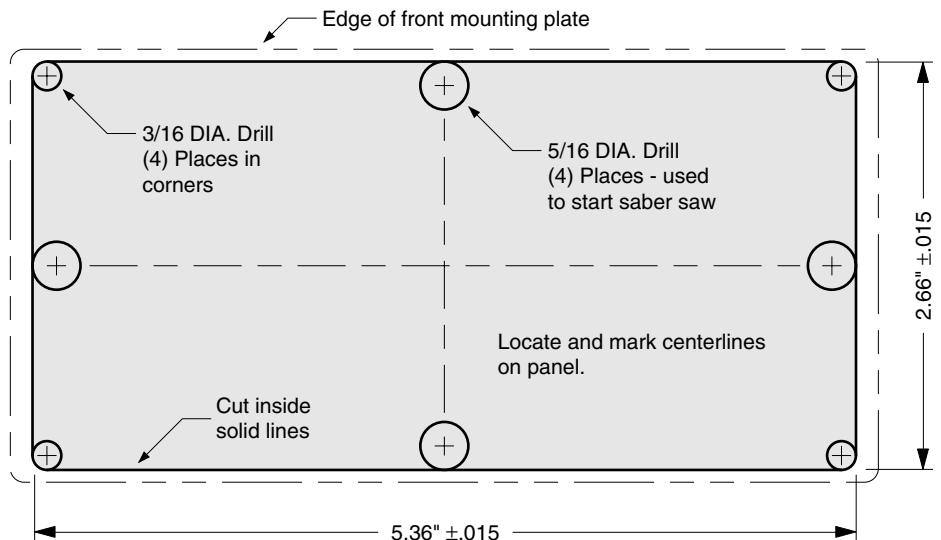
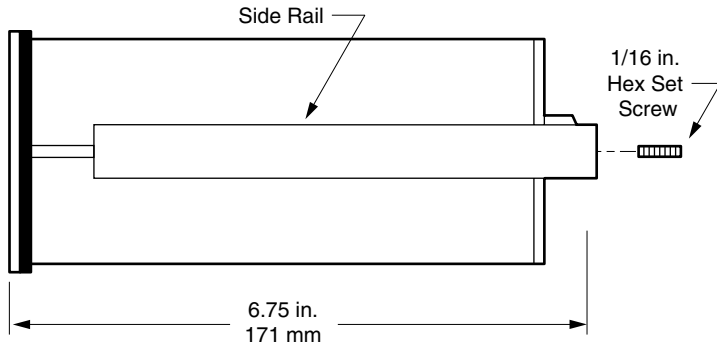
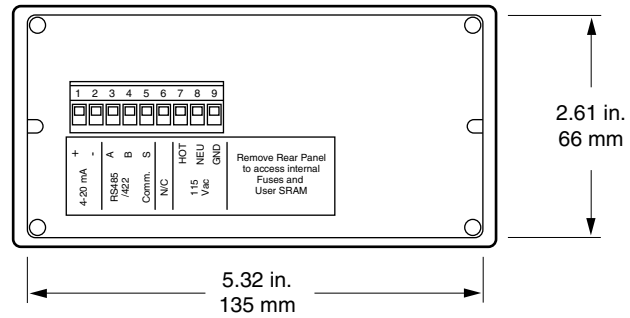
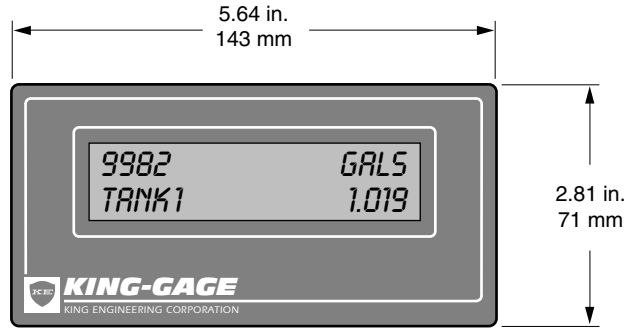
RS-485; multi-drop, two-wire, half-duplex communication
RS-422; point-to-point, two-wire, half-duplex communication

Model 5252-11-x Housing

Extruded aluminum construction. Lexan front panel with gasket seal intended to meet NEMA 4. Flush mount configuration secures to panel opening using side rails.

Mounting

Panel opening for flush mount installation should conform to dimensions noted. **Do not oversize** the opening!! Dimensional tolerance is ± 0.015" (0.04 mm). We suggest using a 5/16" drill bit to establish centerline starting point for saw. Use a 3/16" drill bit to generate corner radius.



Specifications & Dimensions
Model 5251-21-x

Power Requirements

115 Vac, 50/60 Hz. 0.5 Amp, source grounded. Power consumption 40 watts max.

Signal Input

4-20 mAdc

Memory

SRAM, 8k x 8, 100ns

Input Impedance (Resistance)

120 ohm nominal (2.4 Vdc drop @ 20 mAdc)

Power Output

24 Vdc excitation available at + Signal Terminal, 0.5 Amp max.

Digital Readout

Alphanumeric 0.3173 in. (8 mm) 16- character x 2-line LCD; numeric 8-digit (0-99999990 maximum), optional backlight

Resolution

0.024% FS (± 0.004 mA)

Accuracy

$\pm 0.048\%$ FS ($\pm 0.024\%$ FS, typical)

Temperature Range

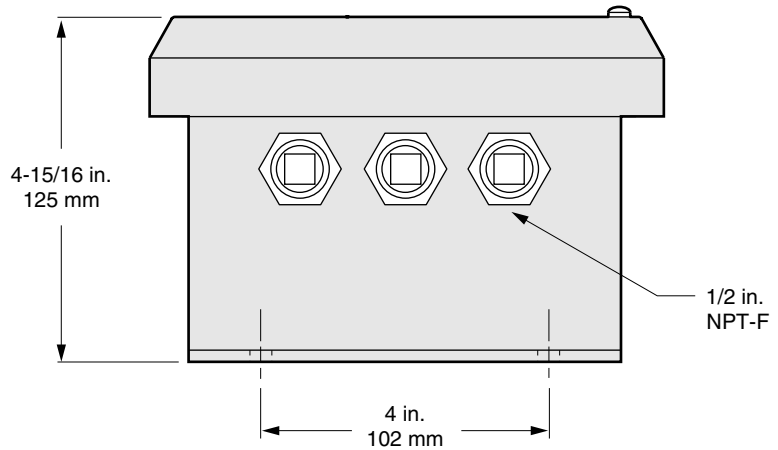
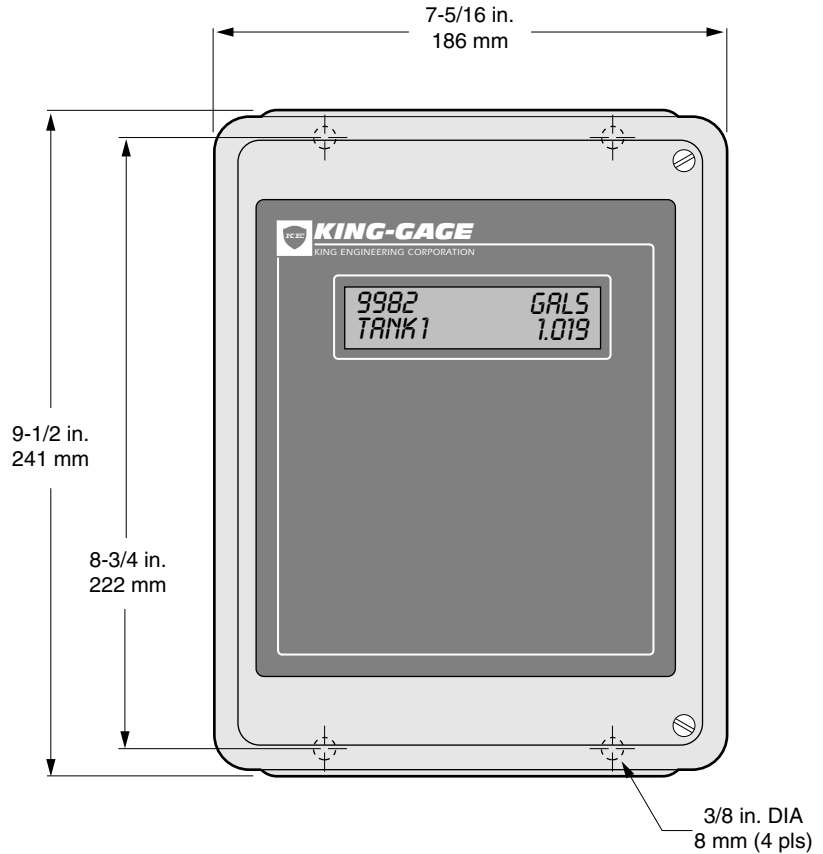
30°F to 120°F/-1°C to 49°C (operating temperature)

Communications

RS-485; multi-drop, two-wire, half-duplex communication
RS-422; point-to-point, two-wire, half-duplex communication

Model 5251-21-x Housing

Fiberglass-reinforced polyester (FRP) enclosure; U.L. listed (U.L. 508) types 3, 3R, 3S, 4, 4X and 12. Hinged cover with dual latching screws.



Specifications & Dimensions Model 5251-31-x

Power Requirements

115 Vac, 50/60 Hz. 0.5 Amp, source grounded. Power consumption 40 watts max.

Signal Input

4-20 mAdc

Memory

SRAM, 8k x 8, 100ns

Input Impedance (Resistance)

120 ohm nominal (2.4 Vdc drop @ 20 mAdc)

Power Output

24 Vdc excitation available at + Signal Terminal, 0.5 Amp max.

Digital Readout

Alphanumeric 0.3173 in. (8 mm)
16-character x 2-line LCD; numeric 8-digit (0-99999990 maximum), optional backlight

Resolution

0.024% FS (± 0.004 mA)

Accuracy

$\pm 0.048\%$ FS ($\pm 0.024\%$ FS, typical)

Temperature Range

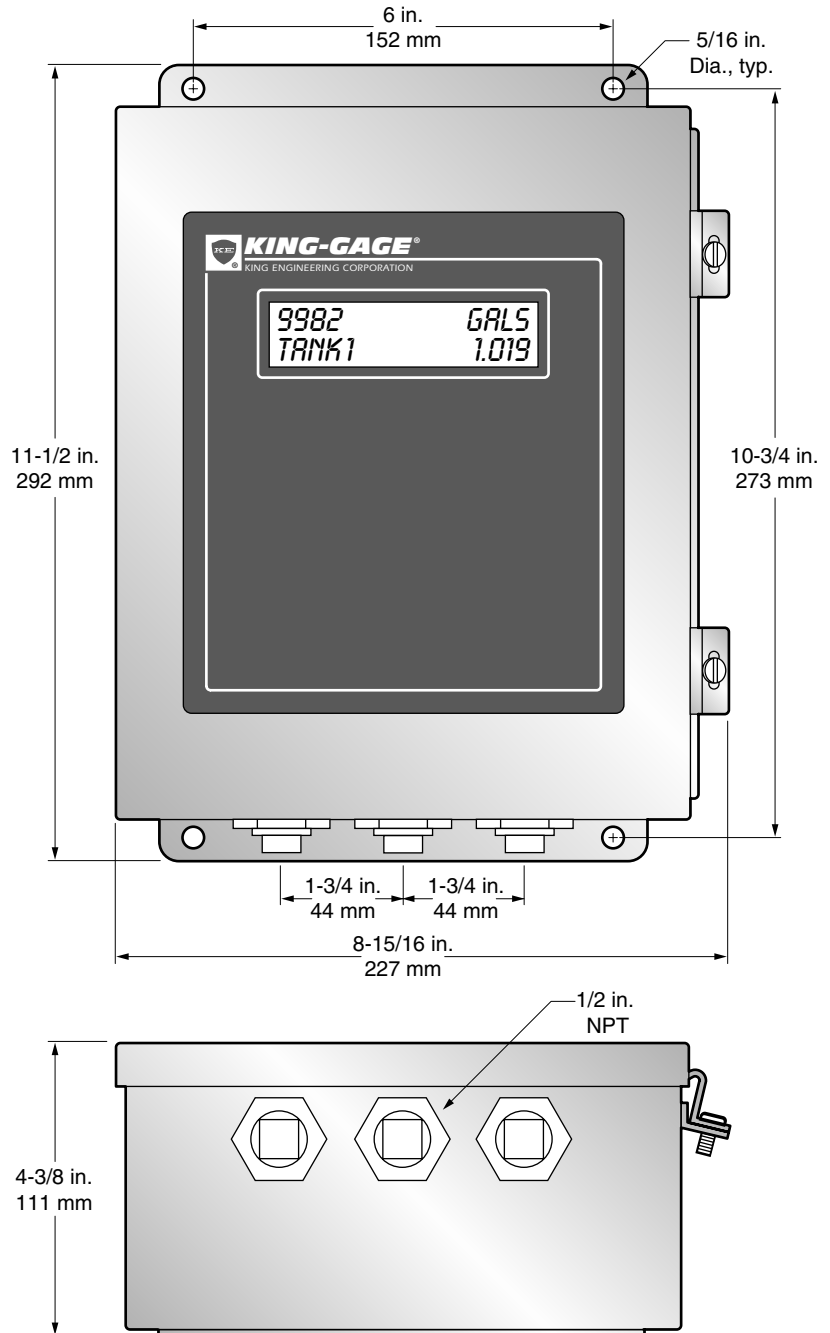
30°F to 120°F/-1°C to 49°C (operating temperature)

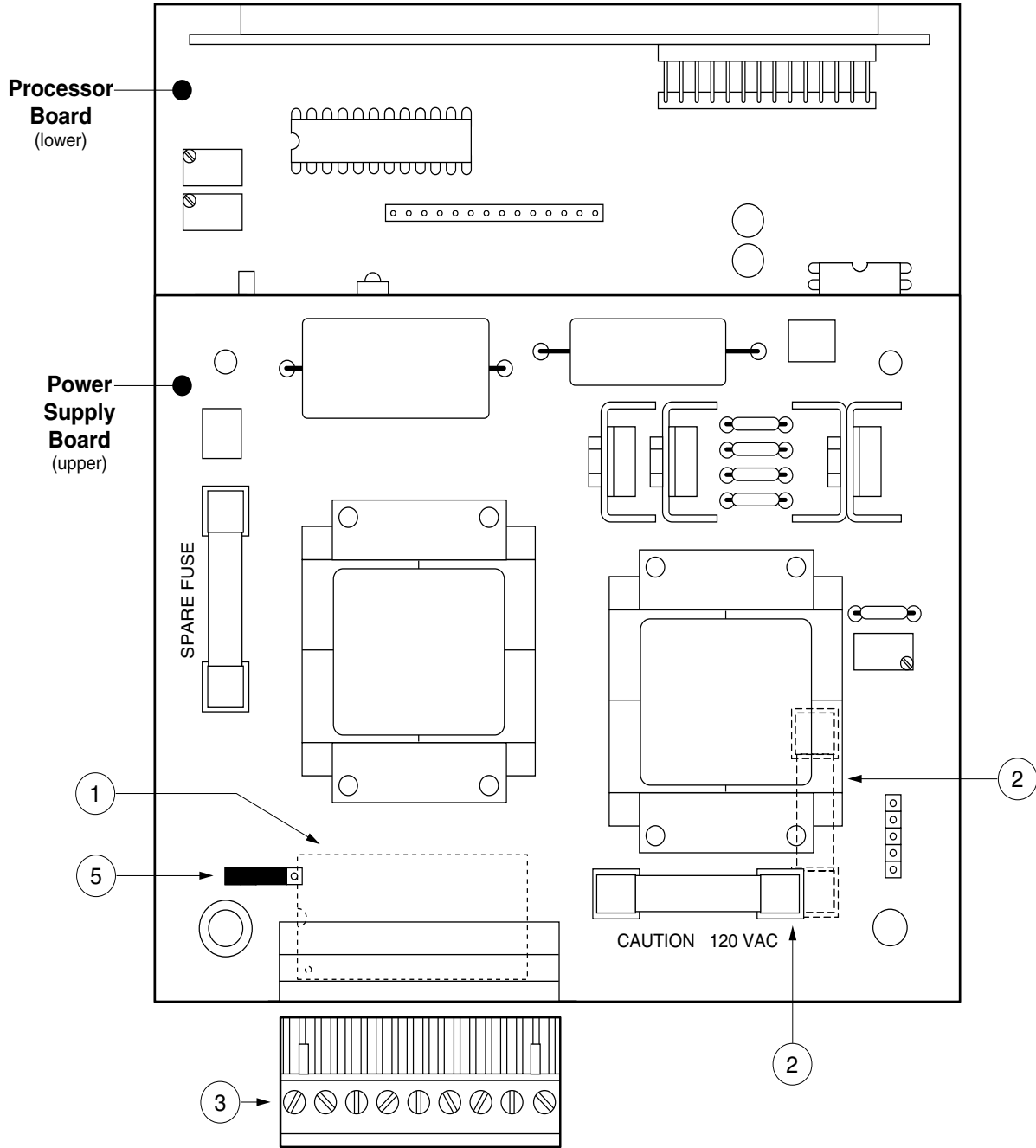
Communications

RS-485; multi-drop, two-wire, half-duplex communication
RS-422; point-to-point, two-wire, half-duplex communication

Model 5251-31-x Housing

304 stainless steel enclosure (14 gauge); U.L. listed (U.L. 50) types 4, 4X, 12 and 13. Hinged cover with dual clamps and latching screws



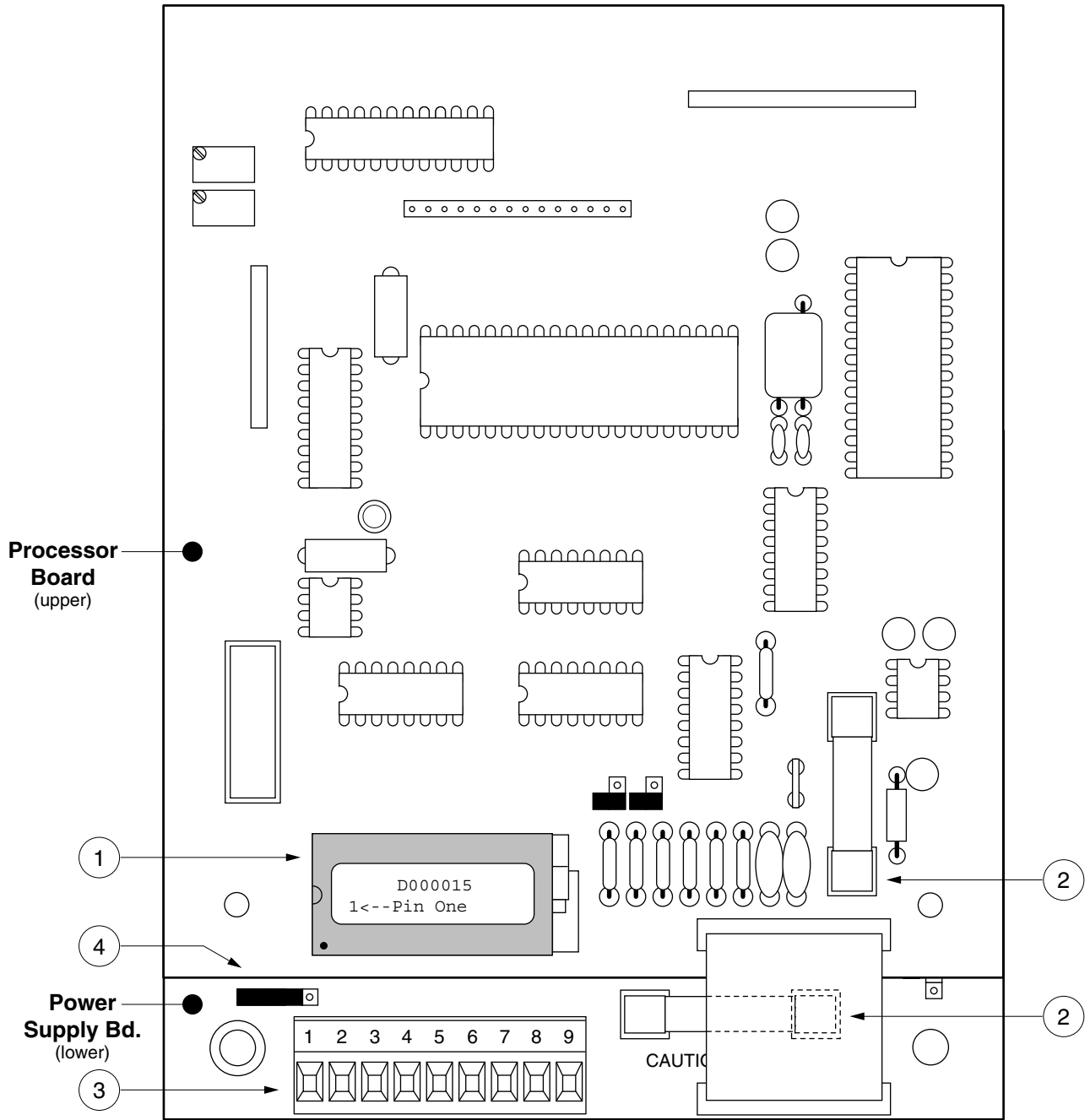


Service Parts List - Model 5251-11-x

| Item | Description | Part No. |
|------|--|-----------|
| 1 | Application Datapack (SRAM) | Note 1 |
| 2 | 1/2 Amp Fuse - 120/250 Volt Fast-Blo (5-pack) | 7469-21-0 |
| 3 | Socket Conn., 9-term. (Note 2) | 5858-9 |
| 4 | Side Rail - (see right side view, page 1) • Set Screw | 5921-1 |
| | (6-32 x 3/8 Hex Socket Cup Point) | |
| 5 | Signal Jumper - Enable/Disable 24 Vdc (reference only) | |

Notes:

- (1) SRAM (part no. 5192) datapack is factory configured with application-specific values. Please reference serial number when ordering replacement or upgrade.
- (2) Screw clamp terminals on connectors will accept the following wire sizes, per the respective standards organization: #22-14 Awg (UL); #26-12 Awg (CSA).



Service Parts List - Model 5251-21-x & 5251-31-x

| Item | Description | Part No. |
|------|--|-----------|
| 1 | Application Datapack (SRAM) | Note 1 |
| 2 | 1/2 Amp Fuse - 120/250 Volt Fast-Blo (5-pack) | 7469-21-0 |
| 3 | Socket Conn., 9-term. (Note 2) | 5858-9 |
| 4 | Signal Jumper - Enable/Disable 24 Vdc (reference only) | |

Notes:

- (1) SRAM (part no. 5192) datapack is factory configured with application-specific values. Please reference serial number when ordering replacement or upgrade.
- (2) Screw clamp terminals on connectors will accept the following wire sizes, per the respective standards organization: #22-14 Awg (UL); #26-12 Awg (CSA).

Installation Requirements

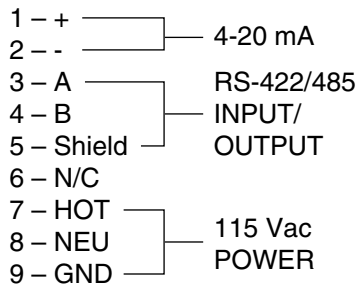
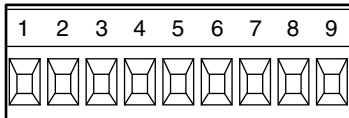
Mounting -

The LevelPRO Processor may be mounted at the tank, or up to several thousand feet away. It is important to find a mounting location that affords some degree of protection for the unit. Do not locate where subfreezing temperatures may be encountered.

Enclosure should be mounted in an upright position to a wall or other structural member. Cabling access ports are 1/2" NPT and intended for conduit or watertight cable connectors. Keep unused connections sealed to maintain enclosure integrity. When locating enclosure, maintain adequate clearance for access to bottom connections.

Signal Input and Electrical Connections

We recommend completing the transmitter input signal (4-20 mA) connections prior to AC power, when practical. Use approved 3-conductor, source grounded power cable for 115 Vac connections.



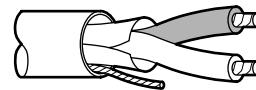
Power/ Communications Terminal

Transmitter Signal Loop

Typical transmitter provides a 4-20 mA output over a dc-powered two wire current loop circuit. This normally requires at least a 24 Vdc power source to provide excitation voltage to the transmitter. The power requirements should be calculated to accommodate the total resistive load residing on the circuit (e.g., cabling impedance, input impedance of receivers, etc.). Refer to the specific load capacity specifications for the sensor or transmitter being used.

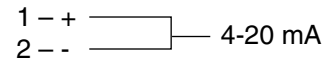
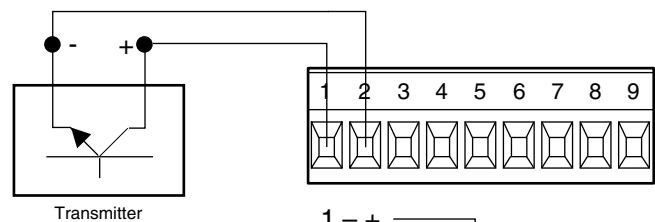
Recommended Signal Cabling

Shielded twisted pair (two conductor) cable should be used for routing the output signal from the transmitter to the LevelPRO Tank Level Processor. Avoid cable placement along multi-phase power lines or equipment that generates strong EMI/RFI fields.



(Two Conductor) Shielded Cable

Recommended: 20 AWG shielded cable (Belden 9320 or equivalent)

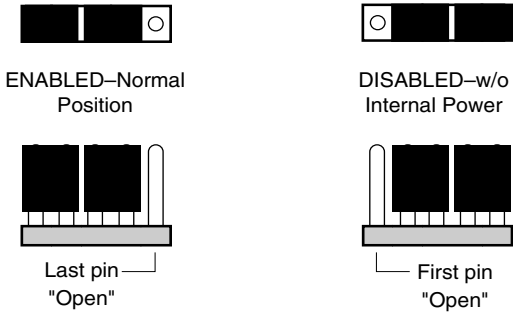


Detail - Onboard 24 Vdc Output

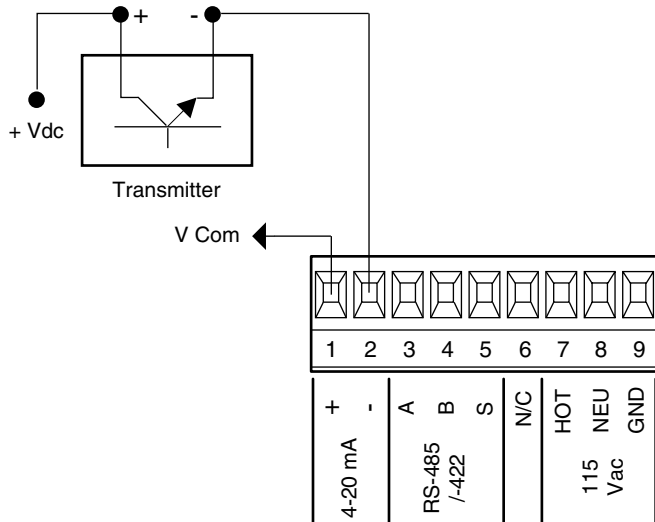
DC Power Output

The LevelPRO tank processor incorporates an internal 24 Vdc supply that can be used to power the signal loop. You can also bypass the power supply when necessary (or when used as a slave indicator). If the circuit load requires a power supply greater than 24 Vdc, an external power supply is required. In addition, the power output from the tank processor must be disabled.

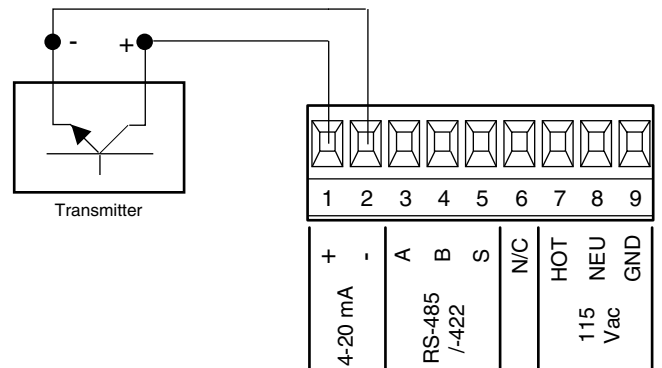
Enable/Disable 24 Vdc - A signal jumper is used to enable/disable voltage across the signal input terminals. The unit is shipped from the factory with the jumper installed in the **ENABLED** position to provide 24 Vdc across signal input terminals #1 and #2. If you are using an external power supply, move the jumper to the **DISABLED** position. Refer to pages 8 & 9 for the location of the jumper on the internal board.



Detail - Signal Jumpers



Transmitter Signal Loop
Detail - External Vdc Power Supply



Transmitter Signal Loop
Detail - Onboard 24 Vdc Output Enabled

Application Programming (Datapack)

The LevelPRO Tank Processor expresses output directly in engineering units. The processor references a capacity profile to correlate transmitter output to actual tank geometry. The processor then displays the resulting value directly as the total weight or volume of liquid in the tank. All application details are factory programmed into SRAM.

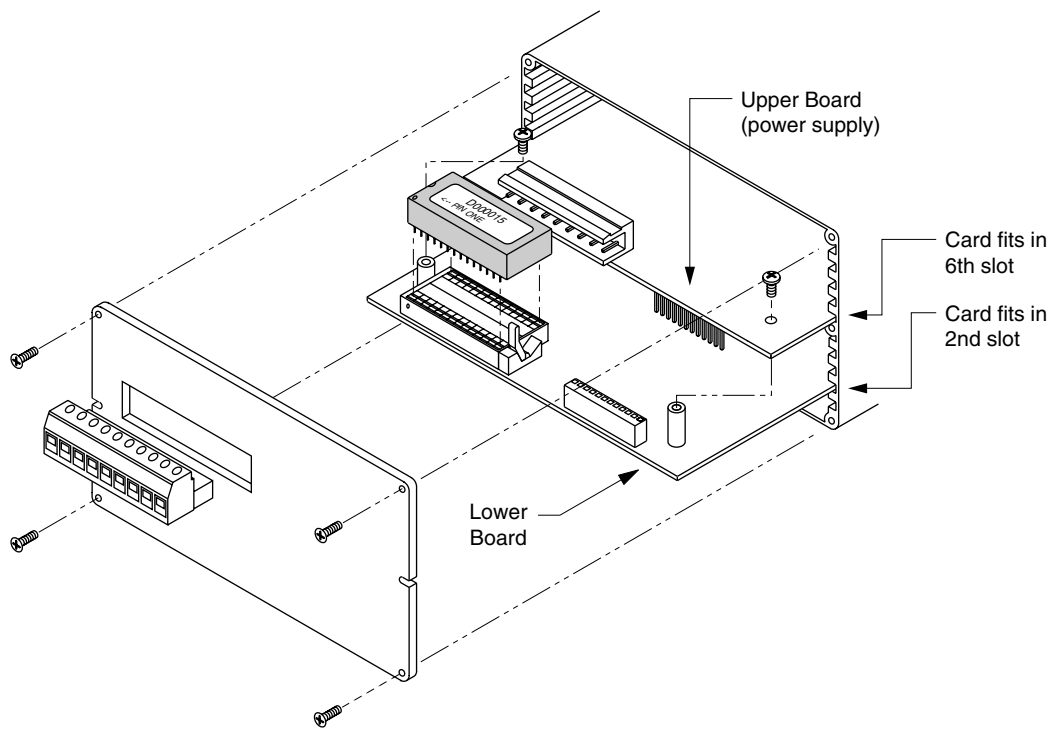
Referred to as the Application Datapack, this nonvolatile memory contains a default liquid density value, readout units factor and tank name. Critical data such as the capacity profile are not user-addressable to prevent any possible corruption of the original factory programming.

Editing Specific Gravity Value: Using the external communications link and ASCII command protocol (see Addendum), the specific gravity value used by the processor can be changed from a remote terminal or PLC. This avoids the need to re-range the level transmitter when the tank is used for more than one liquid product density.

Installing Updated SRAM

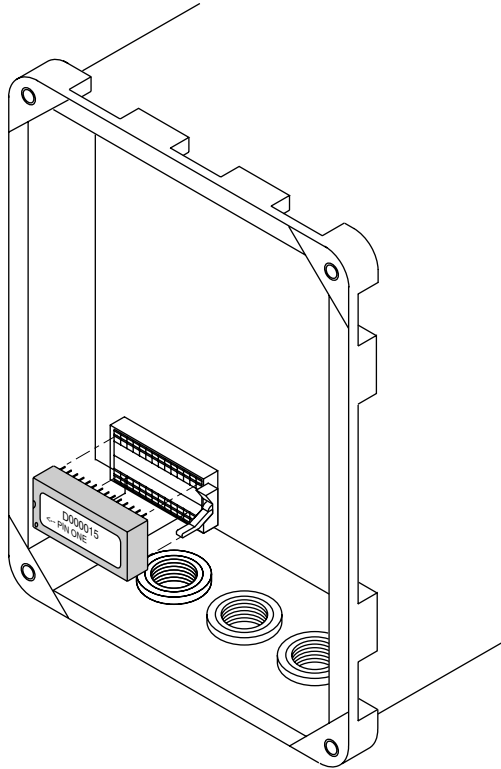
Non-addressable application parameters (i.e., tank name, network polling address, tank capacity profile) require updated SRAM programmed at the factory. Use caution when accessing the SRAM — internal circuitry and electrical connections should not be exposed to moisture. Turn off power to unit prior to handling internal components.

Model 5251-11-* Panel Mount: Disconnect plug-in terminal connector and remove rear panel of housing. Unit has an internal subassembly consisting of two (2) circuit cards. Slide the board subassembly out from the housing. To access the datapack (SRAM) on the lower circuit card, remove the four (4) screws that attach the top circuit card. See detail below.



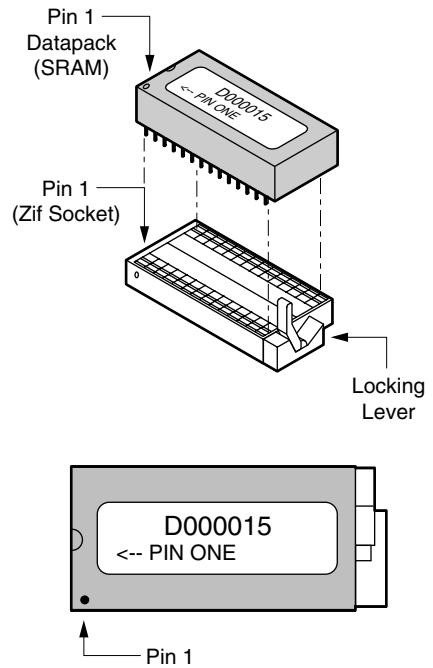
Detail - Model 5251-11-x

Model 5251-21-x or 5251-31-x Enclosure: Turn off power or open the enclosure and disconnect the plug-in terminal connector. Datapack (SRAM) is readily accessible at the lower left hand corner of the lower circuit card.



Detail - Model 5251-21-x

- A. To remove datapack, lift up on locking lever (see illustration) on zero insertion force (ZIF) socket. Remove datapack.
- B. To install datapack, insert datapack carefully into socket. Push locking lever down and forward to lock datapack within socket.



Important! Datapack (SRAM) must be oriented so that PIN 1 lines up with socket. The <-- symbol on label designates PIN 1 side. Refer to illustration above.

Troubleshooting Checklist

Certain problems experienced during initial system installation and start-up may result from incomplete connections. Optimum performance will occur when power and cabling recommendations are followed. A preliminary step should be to reset the processor by turning power off and then back on. If condition remains, refer to the following troubleshooting list.

No Display

Unit does not appear to be functioning and nothing appears on the LCD panel.

- Make certain that Tank Processor is connected to 115 Vac power source.
- Check internal fuse(s) on internal board set of Tank Processor and replace if necessary.

Partial Display (Some Blank Fields)

Unit displays a value including a "C" designation while other areas of the readout are shown blank.

- Tank processor reverts to default code mode if Datapack has been removed.

Low Reading

Level value being displayed is inaccurately low, or does not rise when level increases.

- Check sensor/transmitter output (if necessary, check zero and span settings).
- Signal connections are reversed at the tank processor input terminals or were reversed at the transmitter terminals.
- Resistive load on signal loop exceeds capacity of transmitter at the supplied 24 Vdc excitation from the Tank Processor.

High Reading

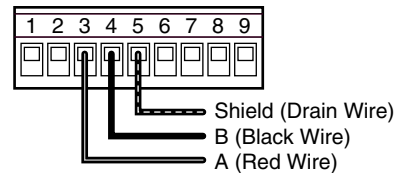
Level value being displayed is inaccurately high.

- Check sensor/transmitter output (if necessary, check zero and span settings).
- Check that tank vent is open. (Rapid fill rate may sometimes exceed venting capacity creating internal pressure in the tank.)
- Specific gravity of liquid in tank may be greater than that programmed into tank processor Datapack (SRAM).

Communications Interface - Network Systems

Network Communications (RS-485)

LevelPRO tank processors can provide direct ASCII communications via a two wire multi-drop network interface. Recommended communications cable is Belden 9501 (24 AWG twisted pair stranded conductors, copper drain wire, overall shielding).



Connections are provided on the plug in terminal for A, B and SH (shield). Refer to the RS-485 diagram for proper cabling connections. Up to 32 individual LevelPRO devices can be installed on a multi-drop network.

Preliminary Network Communications Troubleshooting

These are only a few possible causes of communications problems. Also, consult available reference materials for the host or receiver (i.e., PLC or PC) that is being used to communicate with the LevelPRO devices.

No Communications

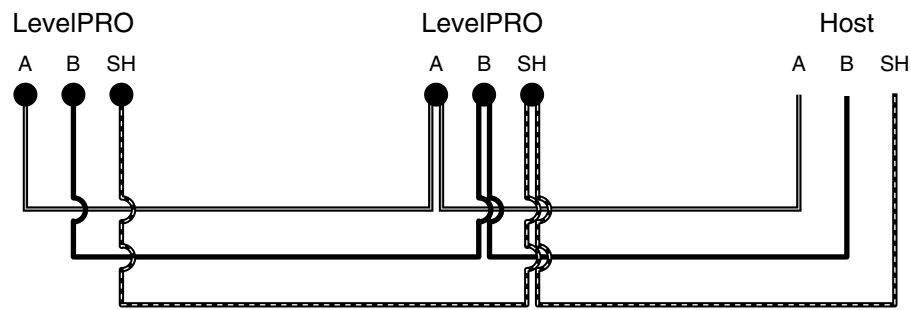
Loss of communications to all devices in the network.

- Check connections at RS-485 terminals at each device. If one processor has been disconnected from the network, make certain that cabling has continuity.
- Check that power is being supplied to the LevelPRO processors. There will be no communications if individual devices suffer loss of power.

No Communications Response (Individual)

Failure of queried polling address device to respond with communications.

- Check that power is supplied to the LevelPRO processor. Additionally, check internal power supply fuse, replace if necessary.
- Check communications connections at RS-485 terminals. If cable conductors have been reversed, unit will not be able to communicate. Make certain that A, B, SH (shield) continuity has been maintained.
- Possible incorrect polling address. 3-digit ASCII address value must correspond to polling address programmed in datapack (SRAM) of LevelPRO.
- Host device may reference A as B or B as A. Swap wires at the host if no communication.



Detail - RS-485 diagram

King Bus ASCII Communications

Communications Technical Specifications:

- Two wire half-duplex with isolated ground
- Automatic signal level shifting for point-to-point (RS-422) and multi-drop (RS-485).
- ASCII character transmission formatted as (0) start bit, (8) data bits and (1) stop bit.
- Standard baud rate up to 19.2 kbps.

Host Polling Protocol

The host device must query LevelPRO processors to receive level data and/or to change specific gravity values. The query should be configured using the following ASCII code formats.

Request Level Data:

#NNN*

- # = Beginning character, first character sent (\$23 Hex)
- NNN** = 3 character ASCII polling address, 001-256
- * = Terminating character, last character sent (\$2A Hex)

Change Specific Gravity:

#NNN_S.SSS*

- # = Beginning character, first character sent (\$23 Hex)
- NNN** = 3 character ASCII polling address, 001-256
- _ = Space character (\$20 Hex)
- S.SSS** = 5 character specific gravity includes decimal (\$2E Hex) character
- * = Terminating character, last character sent (\$2A Hex)

The King Bus ASCII protocol is used by LevelPRO processors having the KINGCODE.HEX microcontroller code. These units are designated by serial numbers beginning with the letter D.

For LevelPRO processors that employ MODBUS compatible communications, refer to EX-1803-2 protocol manual. Units designated by serial numbers beginning with the letter M have the KINGMBUS microcontroller code.

LevelPRO Response Format

Communications output from individual processor in response to query by host.

31 Character Response:

NNN_S.SSS_XLLLLLLL_UUUU_CCCC<CR><LF>

NNN = 3 character ASCII polling address, 001-256

_ = Space character (\$20 Hex)

S.SSS = 5 character specific gravity includes decimal (\$2E Hex) character

_ = Space character (\$20 Hex)

X = Status code; B (blank), F (full), R (reserve/empty), C (calibration mode)

LLLLLLL = 8 character level value, leading zeros required if applicable

_ = Space character (\$20 Hex)

UUUU = 4 character units abbreviation/code in the form, GALS

_ = Space character (\$20 Hex)

CCCC = Check sum in ASCII representation of a 2-byte number in the form, 0FE5

<CR> = Carriage return (\$0D Hex)

<LF> = Line feed (\$0A Hex)

Sample Response:

001_1.032_B00023900_GALS_04DC<CR><LF>

Checksum does not include the last space character (\$20), carriage return (\$0D), line feed (\$0A) or the checksum value itself.

The actual hex data transmission:

\$30 \$30 \$31 \$20 \$31 \$2E \$30 \$33 \$32 \$20 \$42 \$30
\$30 \$30 \$32 \$33 \$39 \$30 \$30 \$20 \$47 \$41 \$4C \$53
\$20 \$30 \$35 \$34 \$33 \$0D \$0A

(Underlined values are not added to the preceding bytes to create the checksum.)



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