

# **KING-GAGE®**

## **Tank Liquid Level ■ Inventory Monitoring**

### ***LP3 System***



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The information contained in this manual was accurate at the time of release. Specifications are subject to change without notice.

**Warranty** - All King Engineering products are guaranteed to be free from defects in material and workmanship for one year from the date of purchase. Any product or part found to be defective under normal use within one year of purchase will be repaired or replaced at no charge if returned to the company at Ann Arbor, Michigan within ten days of discovery of the defect. No other warranties, whether expressed, implied, or statutory, including the warranties of fitness for a particular purpose or merchantability, are given by this agreement.

The exclusive remedy for nonconformity of these goods shall be repair and/or replacement of the nonconforming goods or parts.

Seller will not be liable for consequential damages resulting from breach of this agreement. The term "consequential damages" shall include but shall not be limited to damage to all machines, equipment and goods other than the goods sold hereby, interruption of production, loss of profits, delays of any kind, administrative expense and overhead.

#### Revisions:

- (A) April, 2006 – Original Release
- (B) July, 2006 – Serial port, Ethernet and flash card text, photograph of inside.
- (C) March, 2007 – updated screen photographs and text.

#### LP3 Specifications

##### HMI Display Panel

Color 10.4-in. LCD, active matrix (TFT), 640 x 480 VGA (256 colors), resistive analog touch screen

##### External Memory

CompactFlash Type II slot

##### Network Drivers

Ethernet/IP  
Allen-Bradley DF1 over TCP  
Allen-Bradley DF1 / DH485  
Modbus TCP/IP  
Kingbus ASCII

##### Serial Ports

Ethernet 10 Base-T/100 Base-TX (RJ45)  
RS485 (RJ12)  
RS232 (RJ12)  
USB 1.1 (Type B)

##### External Power Requirements

110-120 VAC, 50/60 Hz, 2.8 Amperes  
(internally fused at 6.3 A)

##### Signal Inputs

4-20 mA, two wire (w/ 24 VDC excitation option);  
8-32 input channels

##### Operating Temperature Range

0°C to 50°C (32°F to 125°F)

##### Enclosure

Type 4X (UL50), IP 66, 304 stainless steel, hinged latching cover

##### Standard System

##### Configurations

8-tank system; 16-tank system; 24-tank system; 32-tank system (includes HMI, analog inputs, power supply)

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# ***KING-GAGE LP3***

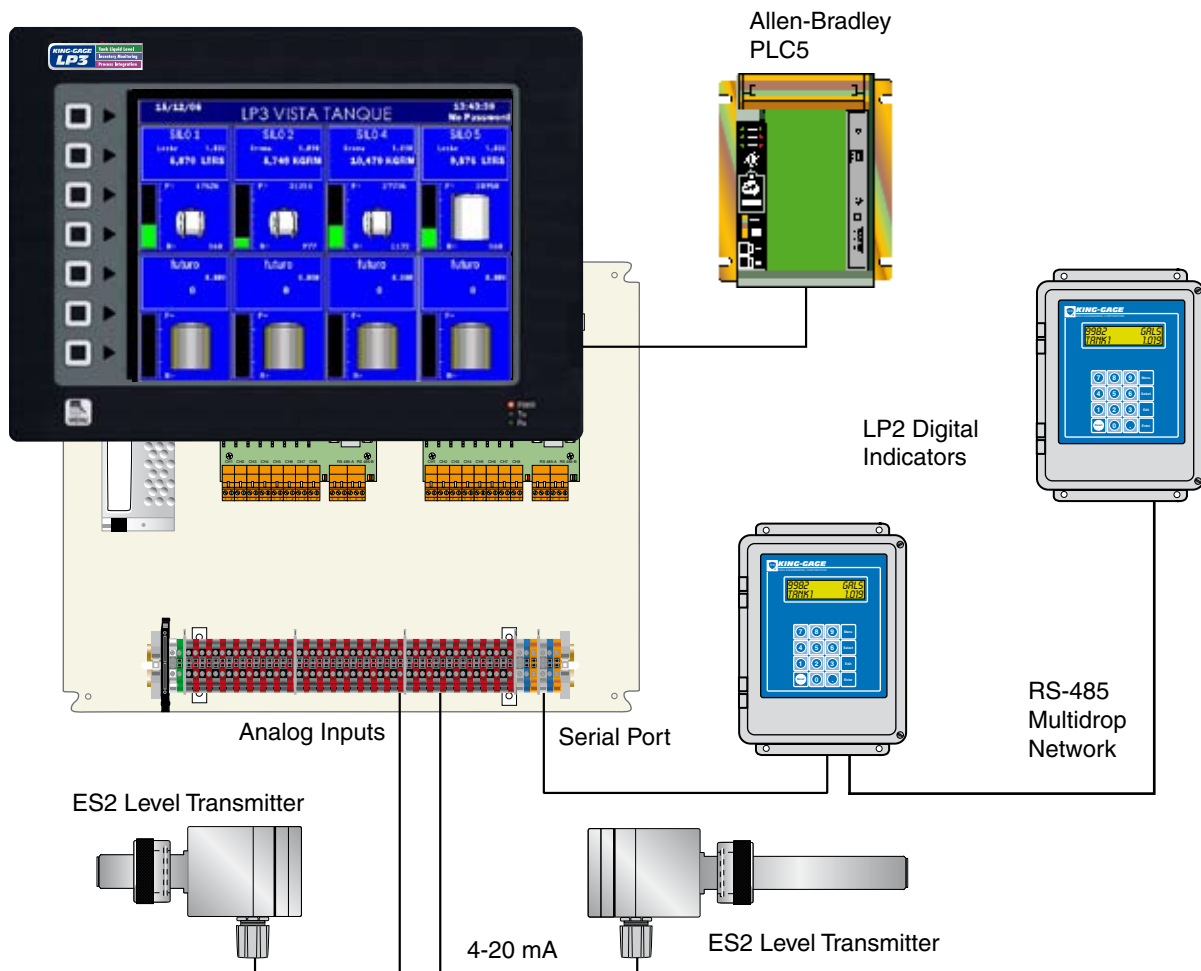
## **Tank Level Monitoring System**

LP3 system provides a complete tank gauging solution with an HMI touchscreen display and networking/process integration. A built in web server permits remote display of tank levels on any PC over an Ethernet LAN using standard web browser software.

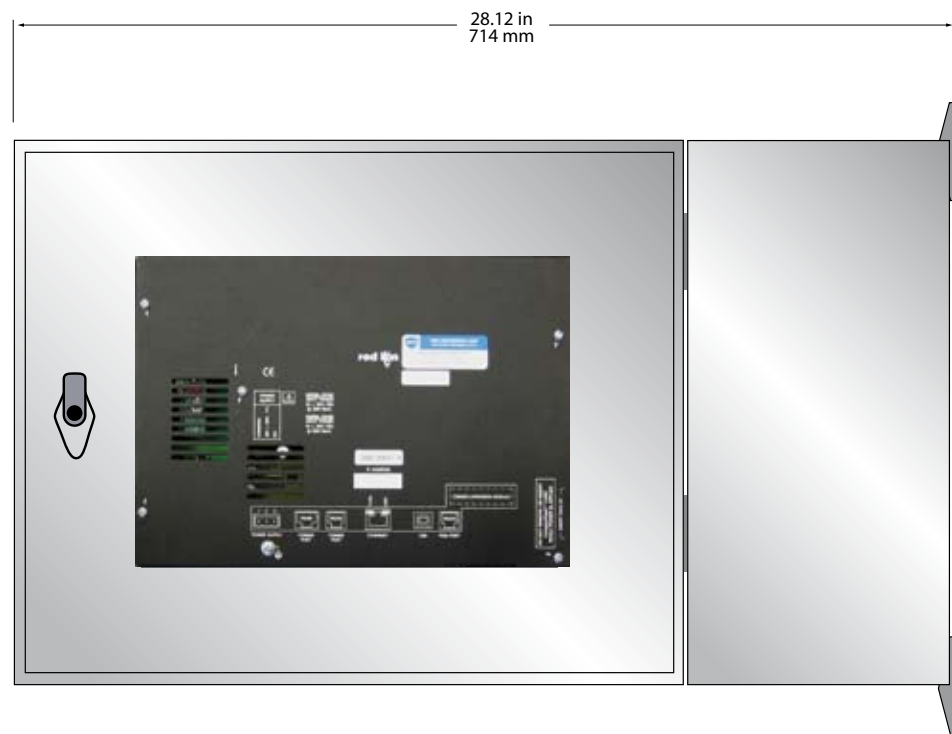
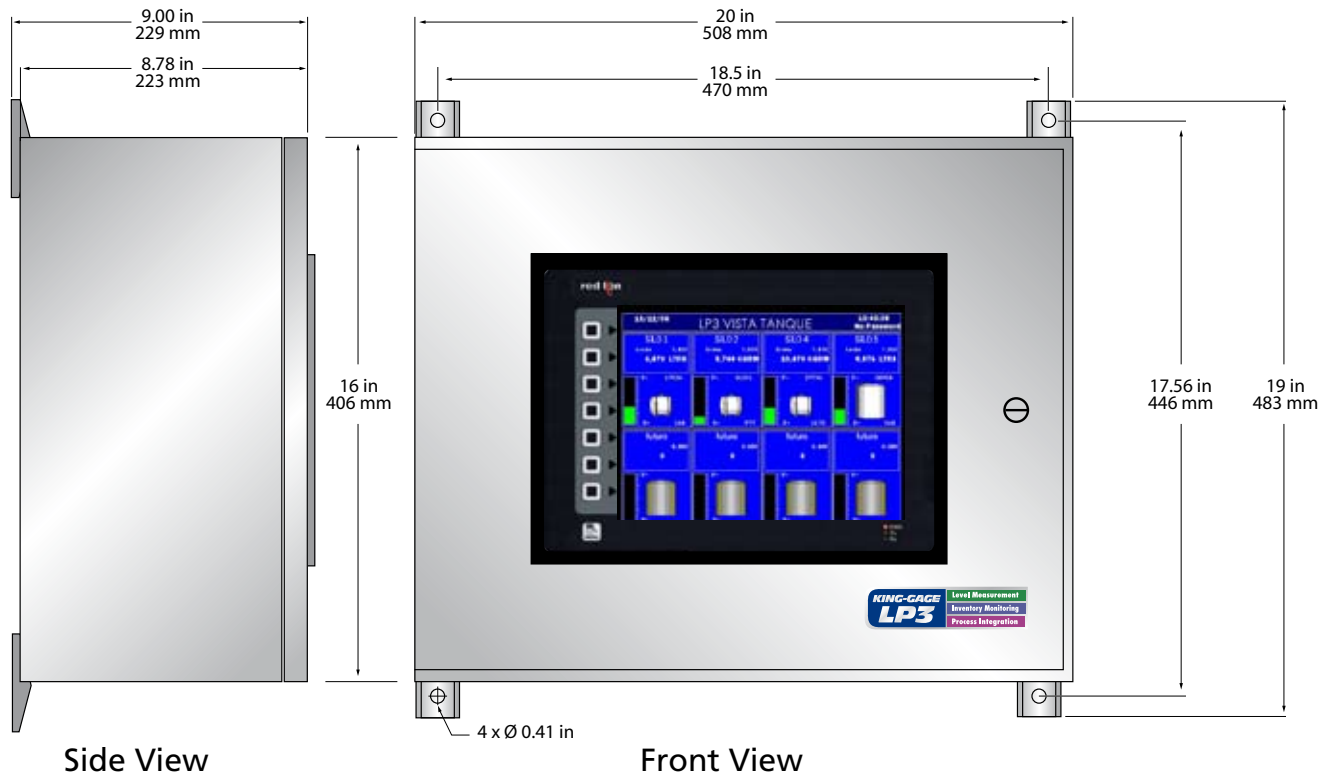
Complete hardware package includes:

1. Analog input modules(s) for signal processing and data acquisition using typical two wire transmitters. These input modules compensate for the specific tank geometry (via a capacity table) to scale the transmitter signal and calculate a volumetric (gallons, liters, etc.) or mass (pounds, kilograms, etc.) measurement of tank contents.
2. Power supply for internal components and external excitation (+24 Vdc) of transmitters through the signal loops.
3. HMI touchscreen display with web server and network connections (Ethernet, serial ports)

A simplified system overview is depicted below.



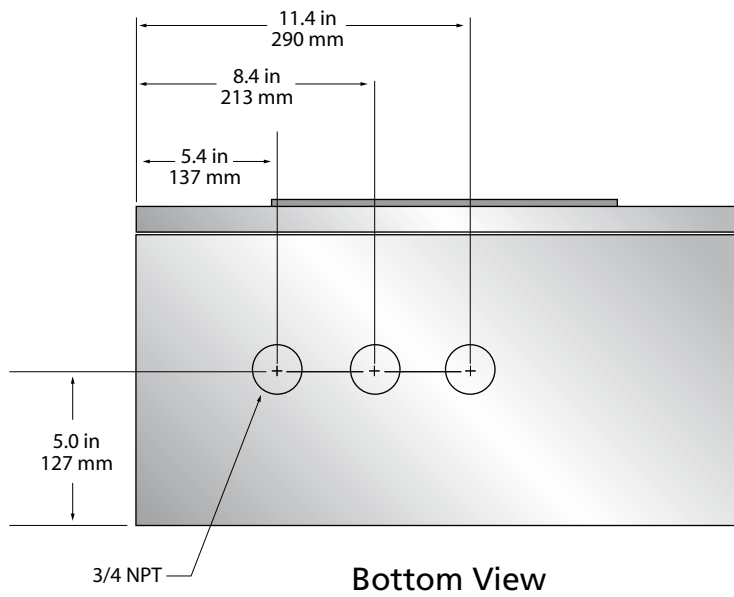
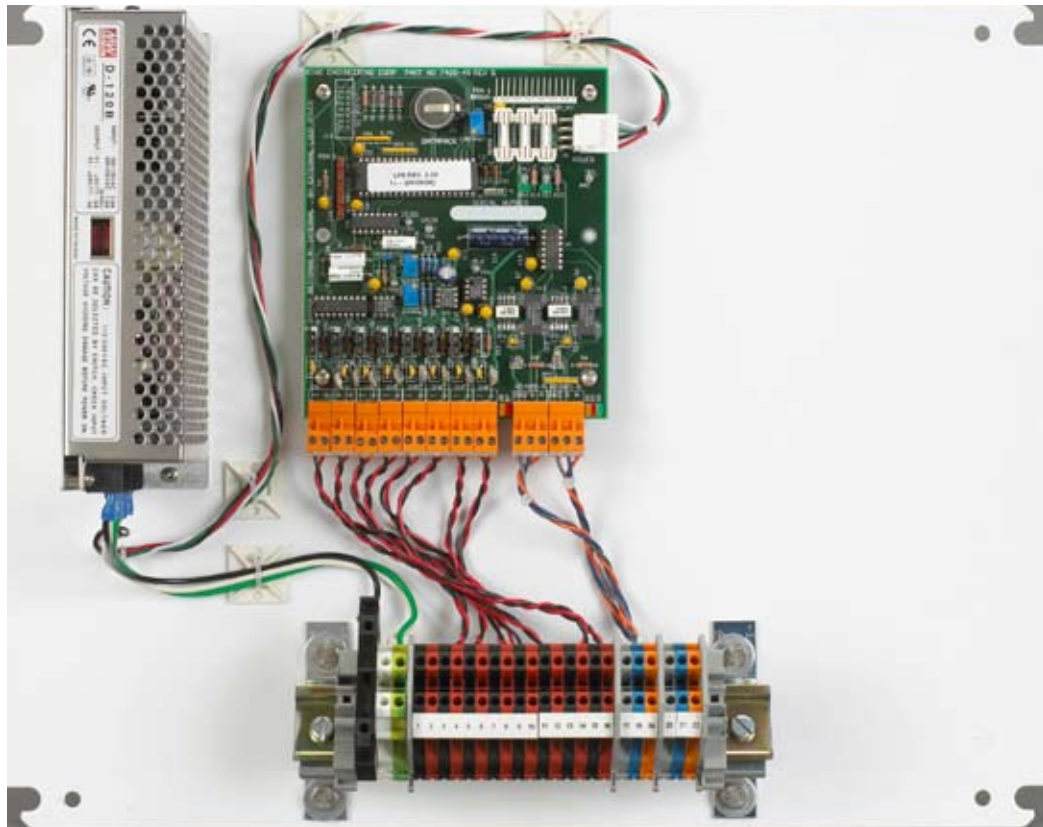
# Dimensions



Side View with Door Open

**LP3 back plane assembly-8 tank configuration**

Power supply, analog input module and user wiring terminal rail (see Page 7 for numbered terminal assignments key)



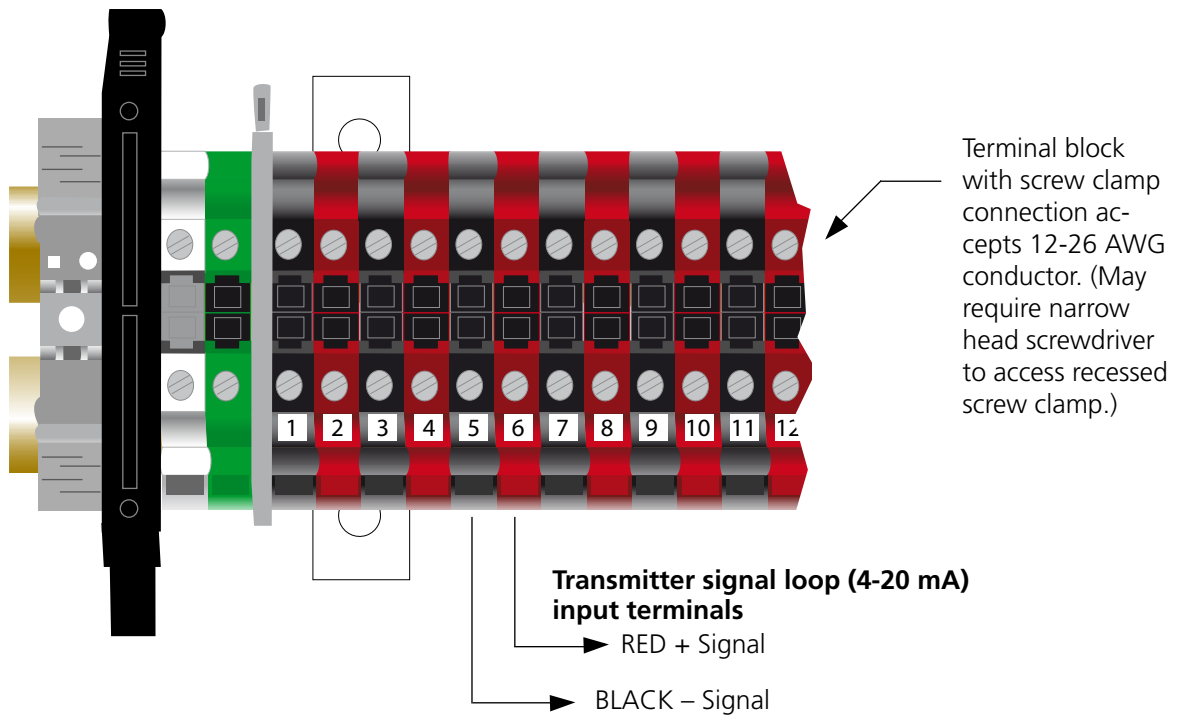
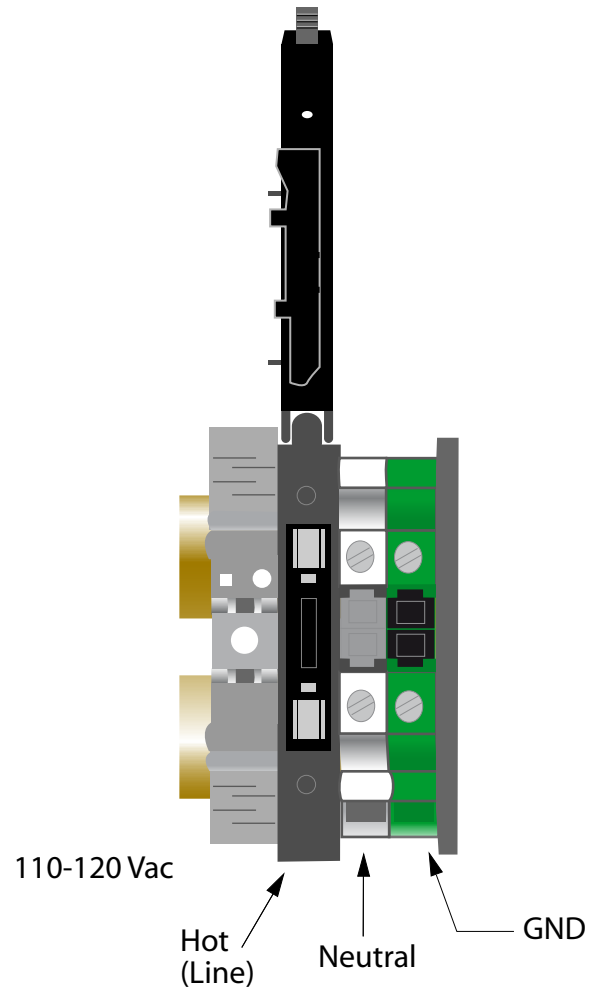
### Installation Requirements

Enclosure should be mounted in an upright position and secured to a wall or other structural member. Cable entry ports are 3/4" NPT and intended for conduit or water-tight cable connectors. Keep unused entry ports sealed to maintain enclosure integrity.

1. Allow adequate clearance below enclosure for access to lower entry ports.
2. Requires 110-120 Vac, 50/60 Hz. single phase power via 3-conductor, source grounded cable.

AC power input fused at 6.3 Amps.  
 Replacement fuse: GDC-6.3A (250V) or equivalent  
 5mm x 20mm, time delay.

NOTE — Complete input single (transmitter loop) connections prior to introducing AC power, when practical.

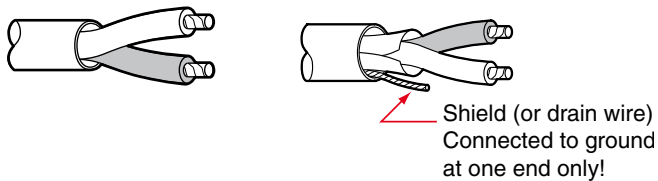


## Transmitter Signal Loop

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.

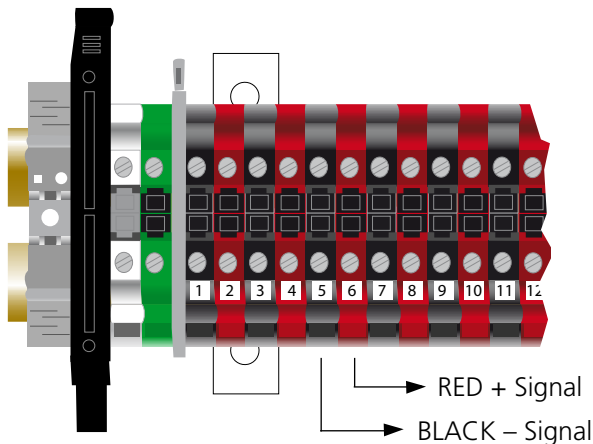
## Signal Cabling

The 4-20 mA signal loop needs to be run using twisted pair (two conductor) cable. "Noise" or EMI (electromagnetic interference) does not generally create a problem since it is common to both wires in the pair and essentially cancels itself out. In most applications, non-shielded twisted pair instrumentation cable (20-22 AWG) will be suitable for the signal loop between the LP3 and sensor/transmitter.

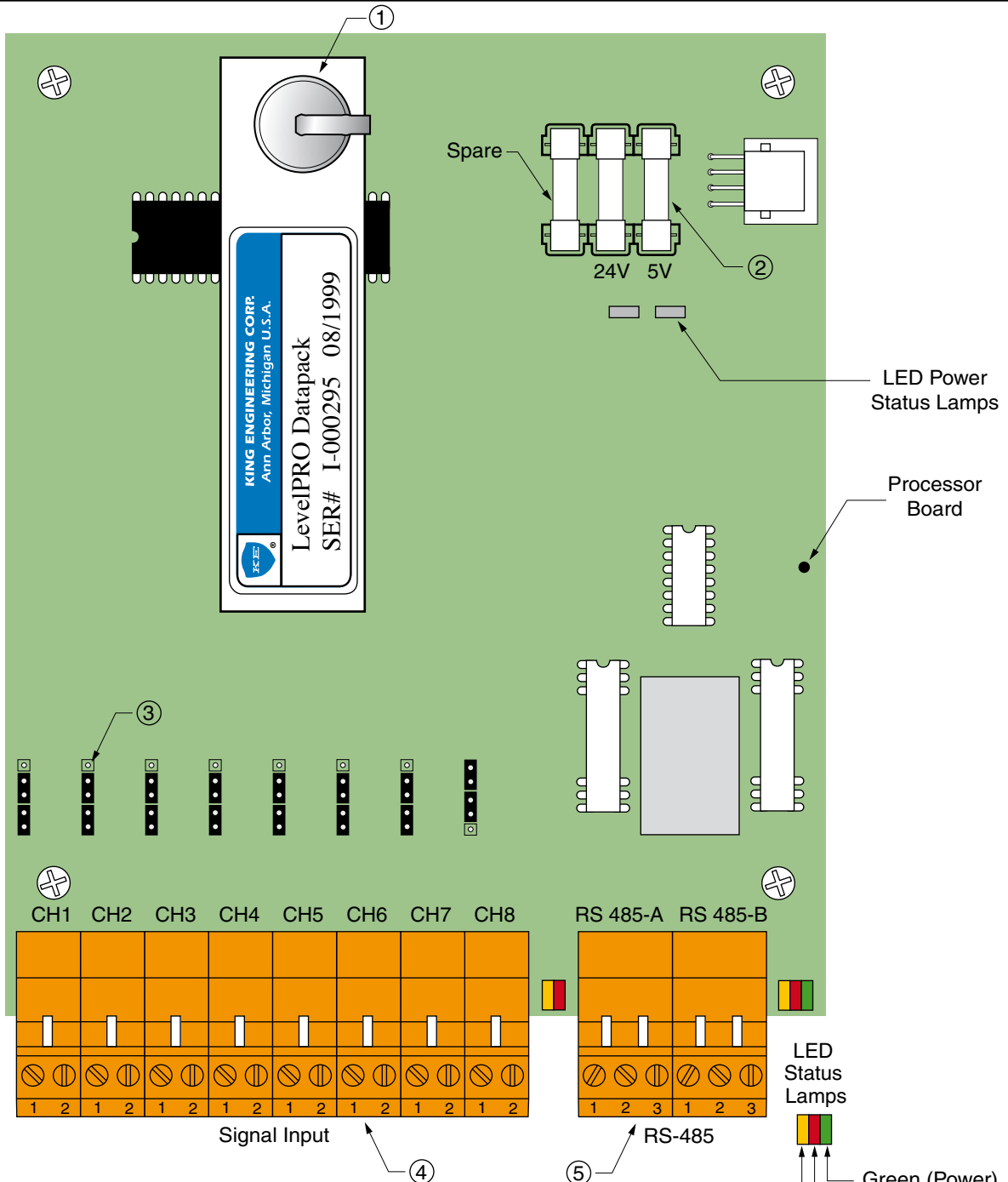


**Recommended Signal Cable:** 20 or 22 AWG twisted pair.

**NOTE:** Shielded twisted pair cable may be used for extremely noisy environments where strong EMI/RFI fields exist. It is critical that shielded cabling be properly earth grounded on one end only. This will guard against the shield from becoming a conductor if improper electrical wiring exists elsewhere in the system or facility. The shield should be grounded to the GND terminal of the earth grounded Vac power connection. (Power supplied to the LP3 processor must be 3-line source with earth ground.)



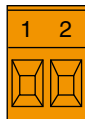




**LP3 Input Module:**

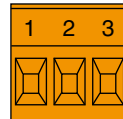
1. Datapack iButton
2. 1/2 Amp Fuse - 120/250 Volt Fast-Blo Order No. 7469-24-0 (5-pack)
3. Shunt /Jumper ; used in pairs to activate or bypass 24Vdc excitation.
4. Terminal, Signal Input
5. Serial EIA RS485 communication ports(2).

**Input Signal Connector**



- 1 – Signal –
- 2 – Signal + (4-20 mA)

**RS – 485 Connector**



- 1 – GND
  - 2 – B
  - 3 – A
- } Data

## LP3 SERIAL PORTS

Ethernet – network connection is provided via RJ45 jack wired as a NIC (network interface card). When wired to another NIC, such as directly to a desktop PC, you must use a crossover cable.

RS232 – network connection is provided via RJ12 jack. Two ports are supplied as COMMS and PGM (programming Port).

RS485 – network connection is provided via RJ45 jack that can be configured as either RS422 (4-wire) or RS485 (2-wire).

## Ethernet Status LEDs

Ethernet communications can be established at either 10 BASE-T or 100 BASE-TX. (Gigabit Ethernet is not supported.) Connection status is indicated by a yellow LED and Bi-color (green/amber) LED – refer to status codes below:

YELLOW – solid Link established.

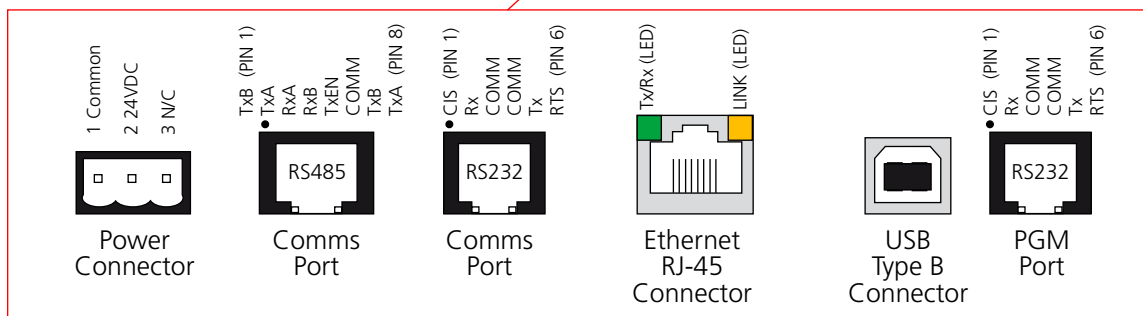
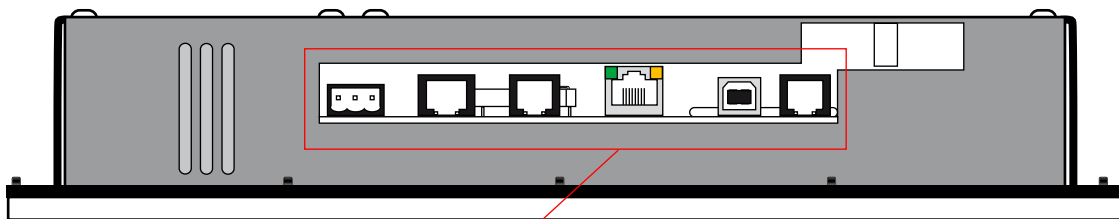
YELLOW – flashing Data transfer

GREEN – solid 10 BASE-T (10 Mbps)

AMBER – solid 100 BASE-TX (100 Mbps – Fast Ethernet)

### WARNING!

DO NOT use standard DH485 cable to connect this port to Allen Bradley equipment.



- No Password
- Operator Access
- Admin Access

### Tank View

The system will start up and display the LP3 Tank View screen. Up to eight (8) tanks will be displayed showing Tank Name, designated contents, specific gravity, inventory display value (in selected engineering unit), tank icon, bar graph of current level with full and empty reserve values.

You may change screens or view tank details using a combination of physical navigation keys and the touch screen panel.



**Next Page** – pressing this navigation key scrolls forward to the next page within the display mode currently selected (i.e., Tank View, List View or Tank Setup).

**Previous Page** – pressing this navigation key scrolls backward to the next page within the display mode currently selected (i.e., Tank View, List View or Tank Setup).

**MENU** – pressing this key on the front panel will bring up the menu of navigation commands. These selections allow the user to go directly to different displays or setup screens.



## Enter Password

There are three (3) levels of password access incorporated into the LP3 system. These are designed to protect system integrity from unauthorized editing of data or changing the installed configuration file.

Operator Access – Enables selection of engineering units (lbs, gal, %) and direct entry or editing of text and/or specific gravity on product selection menu. This password code can be changed via the password menu. (Valid numeric passwords can range from 1-10 digits in length.)

Upload/Download – Required for loading configuration files or saving to Compact Flash (CF) card. Factory preset numeric password cannot be changed via the password menu.

Admin Access – Full administrative access to all configuration settings (allows direct entry or editing of text and/or numeric values). Factory preset numeric password cannot be changed via the password menu.

The Password entry is accessed via the MENU button and launches a new window that displays "Password: \*\*\*\* ". To gain password level access, press the "\*\*\*\*\*" text to launch the numeric keypad.



**Factory default codes**  
 (User can change the Operator Access code via the Password keypad)

Operator Access	1111 (user defined)
Admin Access	XXXX (contact factory)

**Key to Password levels** and what is accessible under each.

	No Password	Operator Access	Admin Access
Tank View	✓	✓	✓
List View	✓	✓	✓
Tank Setup	✓	✓	✓
Change/Define Product (select)	✓	✓	✓
Change/Define Product (edit/erase)			✓
Units (select)		✓	✓
Display Tank Mapping			✓
Screen Title (edit)		✓	✓
Setpoint Hysteresis		✓	✓
Save/Load Config (CF)			✓
IP Address (edit)			✓

No Password  
 Operator Access  
 Admin Access

### List View

An alternate display of tank levels is presented by the List View or “Process Overview” screen. This tabular format displays tank name, current amount (inventory value), units of measurement, product designation, density (specific gravity) and set point status (if applicable).

The list of tanks entries is noted as to the display page on the Tank View screen. Pressing the touch screen within the grouping will take the user directly to that Tank View page. (Note that you cannot select an individual tank directly from the List View screen.)

No.	Tank	Amount	Units	Product	Density
01	TANK-1	3,937	GALS	Brine	1.049
02	TANK-2	3,949	LBS	Light Blend	0.983
03	SIL0-4	1,378	GALS	Base	1.088
04	T3 PLC	716	LBS	Sucrose	1.298
05	T1 Res3	3,821	LBS	Water	1.000
06	T2 Res3	807	LBS	Soya	0.924
07	TANK-7	856	LBS	Base	1.088
08	TANK-8	108,320	GALS	Water	1.000
09					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					

No Password  
 Operator Access  
 Admin Access

### Tank Setup

Using either the MENU button or pressing the touch screen while in TANK VIEW mode, the user can view the Tank Setup (or “Tank Scrn #”) display. This screen provides details on the current settings for the tank, including tank name, sensor range (psi), full and empty reserve capacity of the tank. This information can be viewed from within any access level (i.e., no password, Operator access, or Admin access password).

No Password – Users can simply view data or select a different tank product from the menu list; no editing of data is allowed

Operator Access – Users may change engineering units (e.g., lbs, gallons, %), select a different tank product selection (from menu listing) and edit product description or specific gravity values.

Admin Access – Users may change engineering units (e.g., lbs, gallons, %) or change product selection (from menu listing). Additionally, admin users can directly enter new full and empty reserve values, define new product entries into the menu listing or edit any specific gravity value associated with the product entries. Set point function (if applicable) can be made active or disabled via the Tank Setup screen as well for admin users.

Users may scroll through the multiple tank setup screens by using the Next Page or Previous Page physical navigation keys (see page 11).

03/21/07 **Tank Setup** 11:34:48  
 No Password

Tank Selected: 02 **Layout**

Tank Name: TANK-2

Data Source: MODBUS1: 002

Sensor Range: 0-5 PSI

LevelPro #: NONE

Enabled 

Con Err

Setpoint

Light Blend  
 SFG: 0.983

	Units	Reserve	Full
<input checked="" type="checkbox"/>	LBS	625	37,000
<input type="checkbox"/>	GALS	75	4,500
<input type="checkbox"/>	%	1.00	100.00

**Tank View** **List View**

**ENABLED Button** - This is an Admin Access level function that is used to show (ENABLED) or hide (DISABLED) the tank display on the main Tank View screen(s). Pressing this button will toggle between showing and hiding that specific tank input channel on the main screens (Tank View or List View). When the button appears highlighted in blue and labeled “Enabled”, the tank display status is active on the main screen. If the button is not highlighted (grayed out) it will be labeled “Disabled” and the tank is not displayed.

## Tank Setup—Continued

**Operator Access**  
**Admin Access**

**CHANGE/DEFINE PRODUCT Button** - You can change the current tank product by pressing this button. This will access the Product Menu that indicates available product designations by name and density (showing specific gravity value). The current selection is highlighted by a blue indicator button.

To change the current selection, simply touch the left hand indicator button. A small “updating” window will open while the system accepts the selection.



Operator or Admin Access – if you are password entered into this access level, you can edit the product name or add a new product designation to the list (and enter a specific gravity value). Simply touch the existing text or touch an unused position to launch the on screen entry keypad.





## Reserve & Full Value Table Admin Access

The LP3 system incorporates a tank capacity database programmed into nonvolatile memory (i.e., iButton Data-pack). Additional configuration data is supplied via the CF memory card and displayed on the screen, including the tank reserve (capacity below the sensor that cannot be directly measured) and full tank capacity. If it is necessary to change the reserve or full values, this data table can be edited, even though it will not effect a change in the tank capacity database.

**Admin Access** – Changing the tank reserve and full value requires the “admin access” password to enable the edit function for this data table.

Press the reserve or full value displayed to open the numeric keypad window.

FixedResv1\_Float = Reserve value keypad entry

FixedFull1\_Float = Full value keypad entry

Tank reserve and full values must be entered separately for each unit in the data table. Changes made in one units field does not update the other units fields.



Operator Access

Admin Access

## System Setup

The main System Setup screen is accessed via the MENU button. This is where the date and time settings for the system can be found. Some functions on this screen are restricted based on access level (i.e., operator access or admin access password).



**Time/Date** – Press the time or date display on the touch screen to launch the edit keypad window, then press ENTER for hour to either raise (increment up) or lower (increment down). Press NEXT to edit minutes (or again to edit seconds). When complete, press ENTER to close the window. Similar sequence is used to edit the date by month, day, year.



**Tank Screen Titles** – (Operator or Admin access password required) Press the Tank Screen title text to launch the edit keypad window. Simply enter the text (numbers and symbols are accessed by pressing the SYMBOL key on the keypad). To edit additional screen page titles, press NEXT. When finished, press ENTER.

**Set point Hysteresis** – (Applies only to system with set point function; Operator or Admin access password required). Press the Hysteresis text or value displayed to launch the edit keypad window.





## Configuration File on CF Card

**Admin Access**

The LP3 system can be configured via a direct USB interface or by reading the configuration file from a Compact Flash (CF) memory card. Reading from the CF card or saving the current file is initiated from the System Setup screen. These selection buttons are not highlighted unless user has entered the Upload/Download access password code.

Save (Current) Configuration - Press the Save Config on the touch screen to save the current settings. This will launch the "Save Status" window on the screen.

The file settings will be saved for each tank sequentially. Pressing the "Abort" will interrupt the save function. (Note that any data written to the CF card prior to pressing abort will overwrite that portion of existing entries in the Configuration File stored on the memory card.) Press "Done" when the "Operation Successful" message appears.

Load Configuration (from CF card) - Press the Load Config on the touch screen to copy the configuration file on the CF card into the system memory. This will launch the "Load Status" window on the screen.

The file settings will be saved for each tank sequentially. Pressing the "Abort" will interrupt the file copying function. (Note that any data copied into system memory prior to pressing abort will overwrite that portion of existing entries stored in system memory.) Press "Done" when the "Operation Successful" message appears.

**NOTE** - If no memory card is inserted into the Compact Flash slot, launching either the Save or Load function will display "Operation Failed!" in the status window.

**WARNING!**  
TURN OFF POWER before installing or removing the CF card from the slot.



## Remote Web Access

The LP3 system display can be remotely viewed on any desktop computer using standard browser software (Internet Explorer, Netscape, Opera, Firefox, Mozilla, etc.) when connected to an Ethernet LAN. Begin by entering the IP address of the LP3 system, such as <http://192.168.1.110> or <http://192.168.0.110> in the address window of the browser.

If your browser successfully connects to the LP3 system, it will display an initial screen entitled "G3 Web Server." Simply click on the link identified as [Remote View](#) to access the LP3 display.



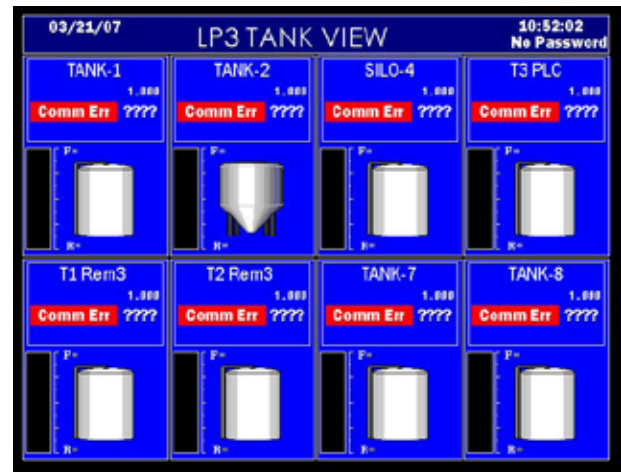
## Error Messages

The LP3 system can report error status for individual tanks related to sensor input signal or loss of communications with the signal input module (or external KING-GAGE LP2 digital tank level indicators). This error status is displayed on the main tank view screen, tabular listing view screen or the individual tank setup page. The three possible error status messages are:

**Over Range** – indicates that the input signal has exceeded 20.35 mA. Check span and zero settings of the external transmitter; high output may suggest possible failure of the transmitter.

**No Sensor** – notes that there is no detected input signal (or less than 3.35 mA) for that channel. Check that transmitter signal connections have been completed at the input terminals; check for continuity of the signal loop wiring.

**Comm Err** – loss of communications between the input module (or external LP2 device, if applicable). Check that the RJ12 plug connector is properly seated in the socket on the underside of the Operator Interface panel (see Page 10). If RS485 communications are used for an external KING-GAGE LP2 digital indicator, check the physical wiring connections at the user input terminals. Turn off power to the LP3 and then power up/restart to see if communication error is still indicated.



## IP Address Setting

**Admin Access**

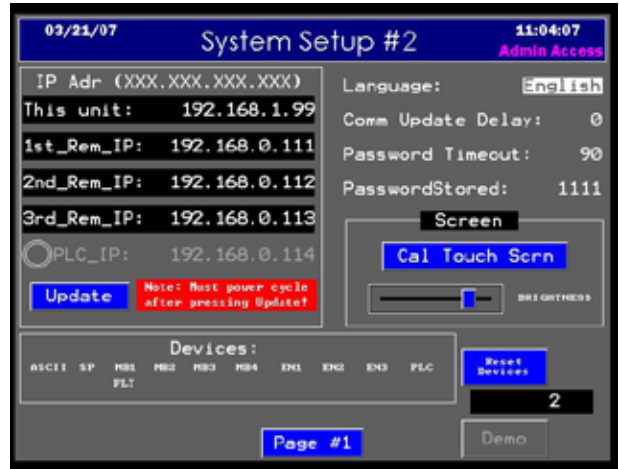
To view the LP3 display remotely over an Ethernet LAN, the internal IP address must be compatible with the existing network address range and subnet mask values. It is possible to change the internal IP address of the LP3. (There is no provision for changing the subnet mask setting of the LP3.)

**Admin Access** – Changing the IP address requires the “admin access” password to enable the edit function for this setting.

The LP3 is provided with a fixed IP address (typically 192.168.0.110) based on a subnet mask setting of 255.255.255.0 as the factory default. These settings are generally compatible with DSL/Cable routers that incorporate an internal DHCP server although various manufacturers of these routers have slight differences in their IP address range. Please consult your network administrator if an existing network server (UNIX, Windows Server, etc.) is employed in your environment.

To edit the numerical address, touch the address field to call up the edit keypad. Press the SYMBOL key on the screen keypad to access the number keys. Begin by entering the first digit of the address to make the cursor active on the address window. You may use the PREV or NEXT to advance through the address or continue to enter each digit. When the numerical address is complete, press ENTER to save the changes.

Press the Update button to load changes. YOU MUST POWER DOWN and RESTART the LP3 System for the new IP address to be active!



## Display Page Tank Mapping Admin Access

Under the Admin Access level, users may rearrange placement and arrangement of individual tanks on the Tank View page.

It is possible to display the same tank on multiple screens. The layout or tank mapping function is accessed from the Tank Setup page by pressing the Layout button on the screen.

The map graphically depicts two rows of four positions as they will be displayed on the Tank View page from left to right. The tank map shows the current positions assigned and indicates the active tank selection. You can only change the active selection via this screen (i.e., if Tank Selected: 07 is displayed, then you may only change the setting for the position currently assigned to 7).

Pressing the position assignment will toggle it between 0 (none assigned) and the Tank Selected. You cannot select another position for the Tank Selected unless that position currently indicates 0 (none assigned).

In practice, to move a tank to a different display position you will first have to clear the assignment (unless it was an unused position). To clear an assignment, go to the Tank Setup screen corresponding to its existing Tank Selection and press the position button to clear the assignment (changing the indication to 0). Next, go to the Tank Setup screen corresponding to the Tank Selection you wish to place in the previously cleared position. Now simply press the position button to display your Tank Selection.

### NOTES:

1. Make certain that all active tanks have a current position assignment.
2. The display page tank mapping function does not affect the List View screen.
3. You must manually select Screen 2 thru Screen 4 on the tank map display using the rotary selector switch (pressing the rotary icon will advance to the next Tank View screen). This is especially true when selecting the Layout button from the Tank Setup screen for tanks 9-32.



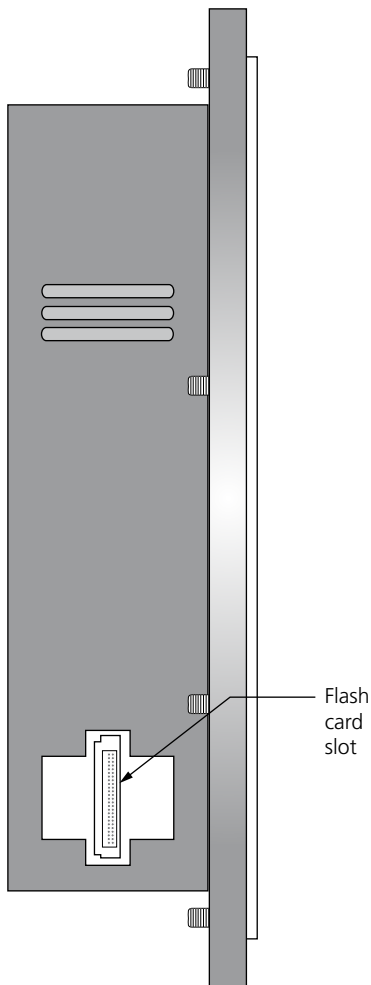
## CompactFlash (CF) Card Admin Access

**WARNING!**

TURN OFF POWER before installing or removing the CF card from the slot.

This unit is equipped with a Type II slot for CompactFlash (CF) memory cards. (Slot is compatible with Type I or Type II cards.) KING-GAGE® LP3 system backup and configuration files are stored on CF card. Note that the non-volatile system memory normally retains system configuration even with power turned off. When changes are entered via the user menus, you may save the updated configuration to the CF card (this overwrites the existing backup file).

Admin Access – To load the backup configuration file or to save current configuration to CF card, you must enter a password to enable this function. (See Page 12)



Side View of Display Panel



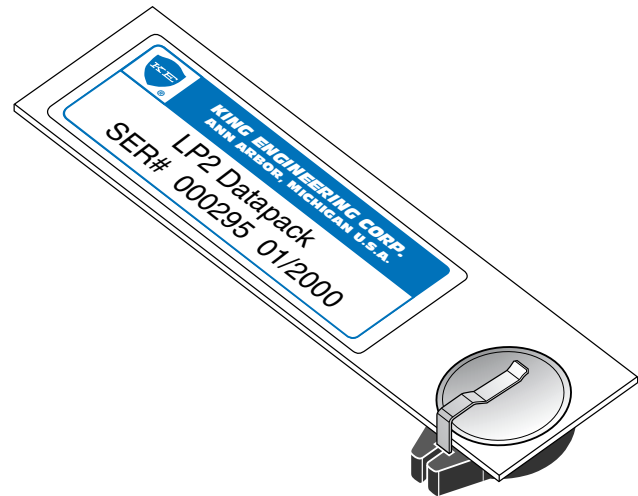
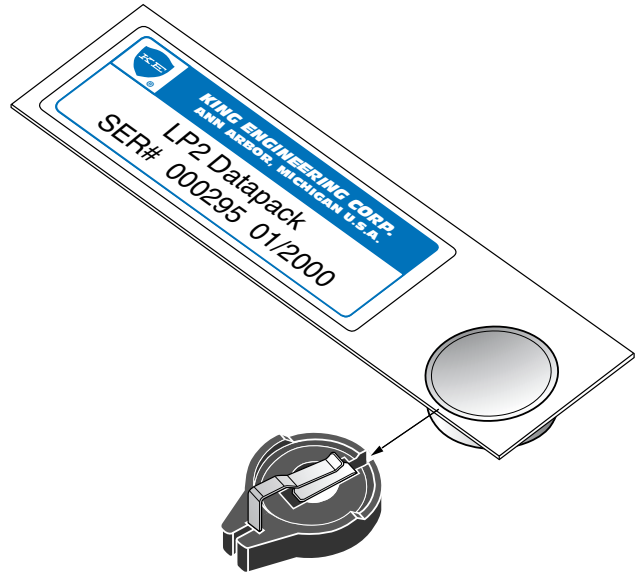
Back of Display Panel

## Application Programming (Datapack)

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

Turn off power or open the enclosure and disconnect the plug-in terminal connector. Datapack (iButton) is readily accessible at the upper portion of the circuit card.

- A. To remove datapack, lift up and slide Datapack outward (see illustration) to free it from the clip socket.
- B. To install datapack, slide datapack under clip. Make certain Datapack iButton is fully seated in socket.





## Front Panel LEDs

In addition to the PWR (power) red LED on the front panel, there are also yellow (CompactFlash status) and green LED indicators. (If no CompactFlash card is present, the yellow LED will not be lit.)

RED – solid	Power on, normal operation
RED – flashing	No valid configuration is loaded
YELLOW – off	CompactFlash (CF card) slot is empty
YELLOW – solid	CompactFlash (CF card) installed
YELLOW – flashing	System is checking CompactFlash (CF card)
YELLOW – flickering	Saving data to CompactFlash (CF card)
GREEN – solid	Valid configuration loaded, normal operation





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