

# SEELEVEL II™

## HOLDING TANK MONITORS



## DISPLAY INSTALLATION GUIDE & USER MANUAL FOR 709 SERIES

709-2P | 709 | 709-P3 | 709-P3W | 709-HP3W  
709-BTP3 | 709-RVC | 709-RVC PM | 709-RVC NLP  
709-N2K NLP | 709-4 | 709-4P

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**CANADA**  
Garnet Instruments Ltd.  
286 Kaska Road  
Sherwood Park, AB T8A 4G7

**USA**  
Garnet US Inc.  
5360 Old Granbury Road  
Granbury, TX 76049

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## INTRODUCTION

Through decades of experience and development the SeeLevel II™ tank monitor series has established itself as the gold standard in level measurement technology for the recreational vehicle industry.

The SeeLevel II™ offers an exceptional combination of features, accuracy, and reliability, ensuring an excellent user experience. Depending on the model chosen, it provides comprehensive monitoring of vital parameters, including percentage of full readouts for FRESH, GREY, GALLEY, BLACK water tank levels, LPG, battery voltage, pump switch, and water heater switches.

For certain models, it also offers Bluetooth connectivity, allowing users to conveniently access all tank levels and battery voltage through the SeeLevel RV 2.0 App on their mobile devices. This app offers customizable alarms, ensuring users receive timely notifications when tank levels are too high or too low, enhancing overall control and convenience. In addition, the system can display the operating characteristics of each of the tank sending units, giving it unsurpassed diagnostic capability.

Document the following information for future reference. See page 4 for more information.

Model Number: \_\_\_\_\_

Serial Number: \_\_\_\_\_

Date of purchase: \_\_\_\_\_

709 Series Manual\_v1.1 - 25-Oct-2023

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## SAFETY INFORMATION

Read these instructions carefully and look at the equipment to become familiar with the device before trying to install, operate, service, or maintain it. The following special messages may appear throughout this manual or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure. "Notes", "Cautions", and "Warnings" have been used to bring special matters to the immediate attention of the reader.

### Safety Symbols


 **NOTE:** expands on information for any procedures.

 **CAUTION:** explains safety information that could cause damage to the product, including data loss.

 **WARNING:** explains dangers that might result in personal injury or death.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

### Pump and Heater Switch Safety Precaution

 **WARNING:** All power circuits must be fused. If a fuse is not provided with the system then it is the installer's responsibility to install a fuse with the maximum rating your model requires. **A relay may be required for models with a pump or heater switch. For information about the requirements for your model please refer to the Specifications document located on our website.**

**For more detailed information please refer to the chapter entitled TROUBLESHOOTING GUIDE", section "How to avoid damaging the display or pump switch due to excessive current".**

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### The Senders

Each sender panel is a flexible self-adhesive printed circuit board which is adhered to the side of the holding tank. The sender panel can be cut to length to match the height of the tank, and it auto calibrates itself so that it can read from Empty to Full regardless of the height of the tank.

In addition to the level, the sender also transmits diagnostic information about its operation. This information can be used to determine if there is buildup of sludge on the inside of the tank, or to determine if the sender is damaged or delaminating from the side of the tank. If sludge buildup in the tank becomes extreme the gauge will cease to operate properly, so by monitoring the signal power the tank can be cleaned before the buildup gets excessive.

Multiple senders are available with the ability to double stack the senders to provide accurate level measurement for tank heights ranging from 4" to 25". **(See Sender Installation guide for available sender options-link on page 4)**

### The Display

The display receives the information from sender panels via a single 2 conductor wire and shows the level information in percent of full on a 3-digit LED display, from 0% to 100%. When the button for a particular tank is pressed, the display shows the level for that tank.

### Battery Voltage

The system also shows the RV battery voltage by measuring the voltage which powers the display. The voltage is shown with a resolution of 0.1 volt.

### Diagnostics

If a sender is operating properly and connected to the display with good wiring, then the display will show the level normally. If the wiring is disconnected, shorted, cut, or if the sender panel is defective, then the display will indicate an error code. The various error codes are shown in the section entitled "TROUBLESHOOTING GUIDE".

With these diagnostic features and the digital nature of the tank level sensing technology, it is almost impossible for the system to indicate an incorrect water level, and in the very unlikely event it does occur, servicing is greatly aided with the diagnostic information.

### LPG (if equipped)

The display can use an existing LPG electrical sender to show the LPG level. It can be automatically calibrated to any sender and shows the level information in percent of full on a 3-digit LED display, from 0% to 100%.

### Bluetooth® (if equipped)

The display has *Bluetooth*® wireless technology, which allows you to check your tank levels, battery voltage, and LPG tank levels on any compatible smartphone or tablet device with a free downloadable app available on both iTunes and Google Play. This model include one alarm output which can be used to signal a high or low water or sewer level as required.

**(See separate manual for app installation and operation-link on page 4)**

### RV-C (if equipped)

Models equipped with RV-C are compatible with RV's that have an RV-C network system. These models include one alarm output which can be used to signal a high or low water or sewer level as required.

### Different Display Types (If equipped)

Displays with RV-C, Bluetooth, or Alarms operate differently from displays without these features. In order to keep the tank level and alarm information current, these displays regularly scan the senders every 10 to 15 seconds. When a tank button is pressed, the information displayed is recalled from the most recent scan. A tank on hold is scanned more frequently. Systems with two displays are configured so that the primary display initiates the scanning and the secondary display passively listens to the sender information, this way both displays stay updated without interfering with each other.

### Alarm Output (If equipped)

The single common alarm output can be programmed to indicate a high or low sewage level, a high or low water level, or a high or low LPG level. More than one alarm can be assigned to the alarm output. This output can be connected to an indicator light and used to show a high sewer level and/or a low water level, alerting the user that attention is required. Another example is the alarm could be used on the black tank to prevent toilet use when the tank is full.

### NMEA 2000 Network (If equipped)

Model 709-N2K NLP is NMEA 2000 Network compatible, the tank levels and capacity are available on the NMEA Bus.

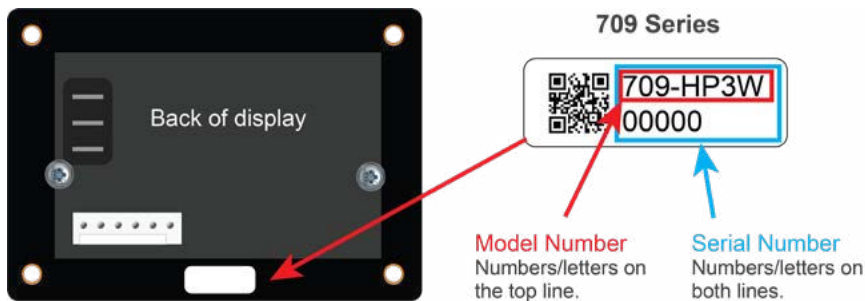
## Series Model Features Table

	No. Tanks	Pump Switch 7.5 amp	Pump Switch 10 amp	Heater Switch 10 amp	LPG	BATT	RV-C	Bluetooth
709-2P	2	✓				✓		
709	3				✓	✓		
709-P3	3	✓				✓		
709-P3W	3		✓		✓	✓		
709-HP3W	3		✓	✓	✓	✓		
709-BTP3	3	✓			✓	✓		✓
709-RVC	3				✓	✓	✓	
709-RVC PM	3	✓			✓	✓	✓	
709-RVC NLP	3	✓				✓	✓	
709-N2K NLP						✓		
709-4	4					✓		
709-4P	4	✓				✓		

**CAUTION:** If a pump or heater requires more amperage than the switch allows, a relay is required.

## Model and Serial Number Info

Before installing your system, look for the model and serial number on the back of the display, as shown below. Write these numbers on the inside cover of this handbook for future reference.



## INSTALLATION INFORMATION

The installation for the complete system consists of mounting the display inside the RV, programming, cutting, and mounting the senders to the sides of the tanks, connecting the wiring, and programming the display.

This manual provides information for all 709 series models. It is important to read carefully for specific instructions about your model. See Series Model Feature table to find out the features on each model.

### Installation Documentation Downloads

Other documentation will be required to complete installation for your specific model. Get them from our website Resource Library either by selecting the link below or scan the QR code and search for your model.

[garnetinstruments.com/holding-tanks-resource-library/](http://garnetinstruments.com/holding-tanks-resource-library/)

- Sender Installation Manual
- Wiring diagrams
- 709-BTP3 Bluetooth App manual (if equipped)
- Specifications - download link at [RVgauge.com](http://RVgauge.com)



RESOURCE  
LIBRARY

### Tools and Equipment to Install Display

- screwdriver or power driver
- wire cutters/stripper
- wire crimper
- electrical tape
- butt connectors
- saw to cut a hole for display (if required)

Optional items available to purchase if required. Go to our website for more information:

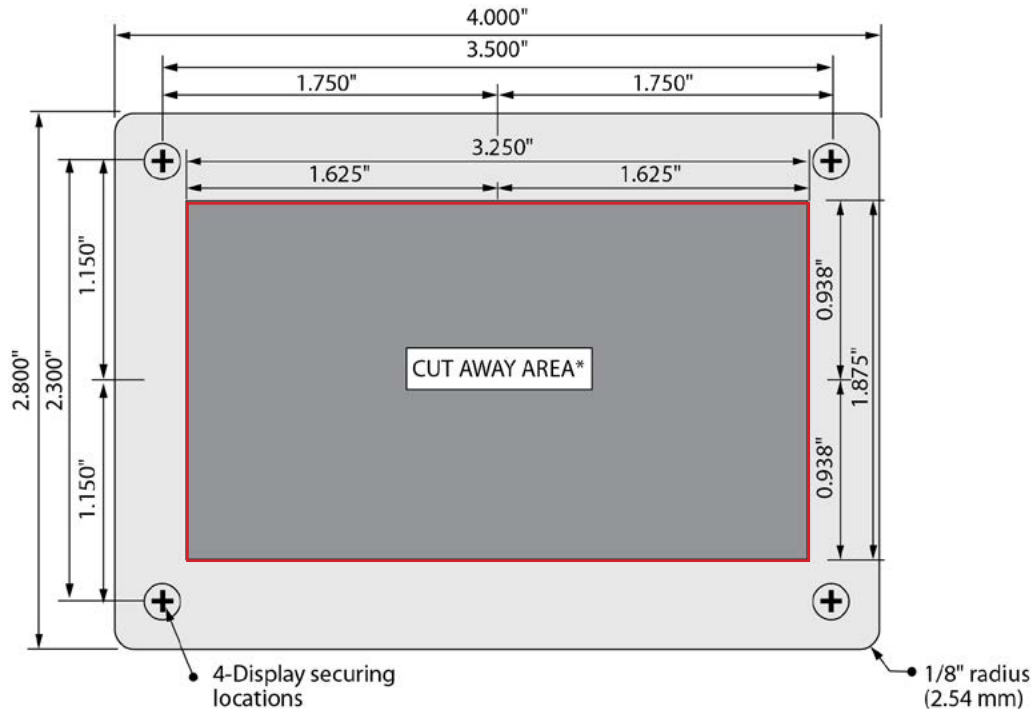
- Filler Panel to fit previous display hole that is too large.
- Gasket to prevent the display monitor from shorting if mounting to a metal surface.

## DISPLAY INSTALLATION

The installation consists of mounting the display inside the RV, programming, cutting and fastening the senders to the sides of the holding tanks, connecting the wiring, and programming the display. When wiring DO NOT use spade connectors to join wires, only use crimp-on butt connectors or solder the wires together.

### Display Panel Mounting Template

Mount the display by cutting a hole in the wall with the given dimensions plus four screw holes. The thickness of the RV wall needs to be thick enough to retain the screws. The panel will be mounted onto the wall using the four included #4 screws, or different screws as required. The cutout diagram below is actual size and can be used as a template. The depth of each model varies 1" - 1 3/8" (25 - 35 mm), model dependent.

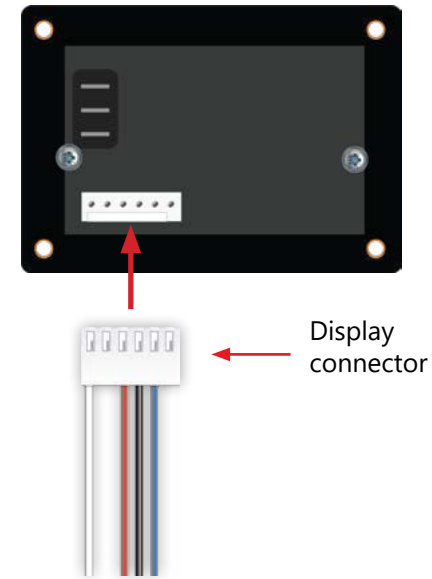


**⚠ CAUTION:** If mounting the display in a metal panel or wall there is a risk the display can short circuit causing permanent damage. Non-conductive mounting spacers are available to purchase to help prevent damaging the display. Contact Garnet or go to our website for further details. More installation tips are available in the "Troubleshooting and Installation Tips" section.

### Connect Wiring to the Display

It is easier to connect the wiring to the display connector first, and then plug the connector into the display panel. **Refer to the wiring diagram for your model from our Resource Library using the link or QR code on page 4.**

The senders need to be grounded to a single ground wire from the display. **Make sure that the system ground is connected to the breaker panel ground.**



**⚠ WARNING:** All power circuits must be fused. If a fuse is not provided with the system then it is the installer's responsibility to install a fuse with the maximum rating your model requires.

**A relay may be required for models with a pump or heater switch.**

**For information about the requirements for your model please refer to the specifications page and wiring diagram.**

## OPERATION GUIDE

The display is the only system component that is accessed by the user. All user input to the display is done using the buttons along the bottom of the display. Operation of the display is as follows:



**NOTE:** The model shown is a 709-P3W. Some models may have different button and switch options.

### To Read a Water or Sewer Tank Level

1. Press and release button for the corresponding tank.



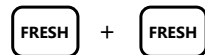
2. LED display shows the level in percent. Display shuts off after about 5 seconds.



3. To read another tank level, battery voltage or LPG level press that corresponding button before the 5 seconds is up. The 5 second time-out is restarted every time a button is pressed.



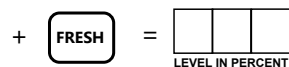
4. To continuously display reading, press and release the desired button twice.



5. Continuous display mode is indicated by a decimal point on the right hand side. The level is updated once per second. User can watch the level change while the tank is being filled or drained.



6. Continuous display mode shuts off after 5 minutes. To end the hold mode sooner, press any tank button and display will shut off.



### To Read the Battery Voltage

1. Press and release the **BATT** button to display the battery voltage. LED display shows the battery level in volts.



2. The display shuts off after about 5 seconds.



3. Hold the **BATT** button and the display will continuously re-check voltage and show updated value.



4. The reading may flicker back and forth between two values, for example, 12.6 and 12.7 volts. This is normal behavior for a digital voltage display.



5. To read a tank level press the corresponding button before the 5 seconds is up. The 5 second time-out is restarted every time a button is pressed.



### To Read the LPG Tank Level (if equipped)

1. Press and release the **LPG** button. Display shuts off after about 5 seconds.



2. Press and release the **LPG** again, to display a new reading. The 5 second timer will be restarted.



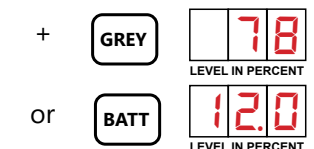
3. Hold the **LPG** button and reading will remain displayed.



4. The display will shut off 5 seconds after the button is released.



5. To read another tank level or battery voltage press that corresponding button before the 5 second time is up for the **LPG**. The 5 second time-out is restarted every time a button is pressed.





## RV-C Bus Communication (if equipped)

RV-C is a communications protocol based on CAN that is used for control, coordination, and diagnostics. CAN bus interface allows continuous communication with RV-C compatible systems.

**NOTE:** Anyone that intends on connecting to the RV-C bus should have a knowledge of the RV-C specification. For more information on RV-C protocol go to: [www.rv-c.com](http://www.rv-c.com)

The senders use a default source address of 72 and SPN-ISB instances are 0 for fresh, 1 for black, 2 for grey and 18 for galley (depending how the display is equipped). The LPG sensor uses a default source address of 73 and a SPN-ISB instance of 3.

1. By disabling the LPG or changing the FRESH/GREY/BLACK to zero senders, you are disabling that sender's updates over the RV-C bus as well.
2. The RV-C has a 4-pin connector as shown in the yellow box in the image below. The connector pins conform to the RV-C standard.
3. All RV-C displays will have a wired connection for the RV-C Bus in addition to the 4-pin connector as shown in the green box in the image below. Refer to the wiring diagrams for each specific model for pin out details.



**RV-C Connector**

Pin	Signal Description
1	Open
2	CAN-Hi
3	CAN-Lo
4	Ground

## NMEA 2000 Network (if equipped)

NMEA 2000 is a marine communications protocol that is used for control, coordination, and diagnostics. The 709-N2K is NMEA 2000 network compatible, the tank levels and capacity are available on the NMEA bus for the fresh, grey, and black tanks.

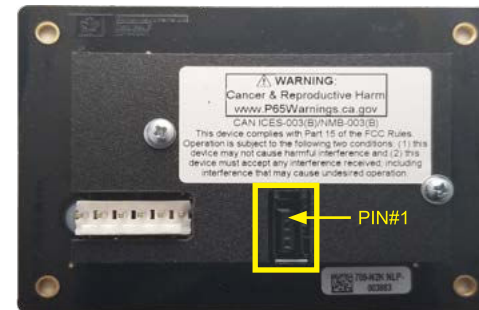
**NOTE:** Anyone that intends to connect to the NMEA 2000 bus should have a knowledge of the NMEA 2000 specification. For more information on NMEA 2000 protocol go to: [www.nmea.org](http://www.nmea.org).

The 709-N2K reports as NMEA device class 75 (sensor communication interface) with an NMEA function code of 150 (fluid level). Garnet Instrument's manufacturer code is 873, and the 709-N2K product code is 15197. The 709-N2K adheres to NMEA database version 2.200. By changing the FRESH/GREY/BLACK to zero senders, you are disabling that sender's updates over the NMEA bus as well.

The display has a 4-pin connector as shown in the yellow box in the image below. Refer to the wiring diagram for pin out details.

The pin closest to the tab on the connector is pin 1.

You can purchase the connector required to connect to our display on the [Digi-Key website](http://Digi-Key website). Digikey part #3M155844-ND.



**NMEA Connector Pinout**

Pin	Signal Description
1	+Voltage
2	CAN-Hi
3	CAN-Lo
4	-Voltage

## CONFIGURATION GUIDE

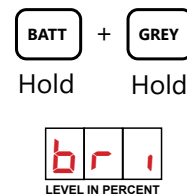
### Set the LED Brightness

The LED brightness can be adjusted to suit the user and the operational circumstances. If it is to be used in the service bay area where sunlight can reach it, the LED brightness should be high.

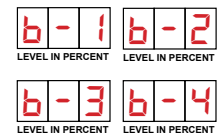
1. To program the LED brightness, the display needs to enter the brightness programming mode. To do this, press and hold down the **BATT** button, the display will show the battery voltage.



2. Continue to hold down the **BATT** button, press and hold the **GREY** button (use the **BLACK** button for 709-2P). Continue to hold down both buttons for about 5 seconds until the display shows **b r 1** indicating brightness programming mode. Then release both buttons.



3. The current brightness level is displayed. **b-1** is the minimum brightness and **b-4** is the maximum brightness.



4. Press the **GREY** tank button (use the **BLACK** button for 709-2P) to increase brightness, or the **FRESH** tank button to decrease brightness.



5. When the display shows the correct brightness, press the **BATT** button to exit the programming mode.



### Program the Number of Senders

To program the number of senders for each tank, the display needs to enter the sender programming mode. By default each tank is set for single sender application. This should only be done at the time of installation; there is no reason to change the number of senders afterward. Make sure that the number of senders programmed into the display matches with the number of senders connected; otherwise the display will show an error.

1. Press and hold down the button for the tank to be programmed, the display may show a level or an error message for that tank.



2. Continue to hold down the button for the tank, and hold down the **BATT** button. The display will show **d i R** (diagnostics). Continue to hold down both buttons until the display enters the programming mode, this should take about 5 seconds (RV-C, BTP3, and N2K models take about 10 seconds).



3. When the programming mode is entered, the display will show **F r 5** if entering the number of senders for the fresh tank, **G r 5** if entering the Grey tank, or **b L 5** if entering the black tank. When this occurs release both buttons.



4. The display will show **1SE** (one sender) or **2SE** (two senders). This is what is currently programmed into the display. These are the only two options; the display will not work with more than two senders per tank.



**Note:** For classic versions, 1 or 2 senders are the only options, but for RV-C and BTP3 the options are 0, 1, or 2 senders. 0 senders removes that tank from the RVC or bluetooth data.

5. To change the number of senders, press the tank button, each time the button is pressed the display will toggle between **1SE** and **2SE**.



6. When the display shows the correct number of senders, press the **BATT** button to save any changes to exit the programming mode. Each tank will need to be calibrated individually using this procedure.



**CAUTION:** For displays that have a GALLEY button the GREY and GALLEY tanks can only have one sender per tank and cannot be stacked.



## Calibrate the LPG Sender (if equipped)

The LPG tank must be full when the sender is calibrated, otherwise the calibration will be invalid. Fill the LPG tank by using an alternate measurement method, such as weight, a spit valve, or a mechanical gauge on the tank.

1. To calibrate, press and hold the **LPG** button, the display will show some LPG level.



2. Continue to hold down the **LPG** button, press and hold down the **BATT** button. Continue to hold down both buttons for about 5 seconds until the display shows **LPG**.



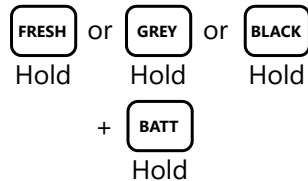
3. When **LPG** displays release both buttons, the display will show **CAL** for a second and then shut off, completing the calibration procedure.



4. The LPG can be re-calibrated as many times as desired, although recalibration should not be needed unless the LPG tank sender or the display has been replaced.

## Set tank capacity (709-N2K NLP only)

1. Press and hold down the tank button to be programmed, then press and hold the **BATT** button. After 15 seconds, the tank capacity edit mode is displayed.



2. The display will show either **FcA** if entering the tank capacity for the fresh tank, **GcA** for the Grey tank, or **bcA** for the black tank.



3. The unit will display the tank capacity in US gallons. Press the **GREY** tank button to increase, or the **FRESH** tank button to decrease.



4. When the display shows the correct tank capacity, press the **BATT** button to save changes and exit programming mode.



## Calibrate the Battery Voltage

**⚠ WARNING:** This should not normally ever need to be done, it is a factory calibration. In the unlikely event that the battery voltage is very inaccurate, this procedure can be tried to correct the error.

In order to properly recalibrate the battery voltage, supply 13.0 Vdc to the display. The display will recalibrate to 13.0 volts, supplying voltage greater or less than 13.0 volts will cause the displayed voltage to be inaccurate.

1. Remove power from the display.

2. Press and hold the **BATT** button. Continue to hold the **BATT** button for the remainder of the steps.



3. Apply 13.0 Vdc to the display.



4. Continue to hold the **BATT** button until the voltage appears. When this occurs release the **BATT** button.








## CONFIGURATION GUIDE (BLUETOOTH MODEL ONLY)


### Program Alarm Set Points for Each Tank









To program the alarm point for each tank, the display needs to enter the alarm programming mode.





- To enter the alarm programming mode, press and hold down the button for the tank to be programmed, the display may show a level or an error message for that tank.
 


	or		or	
Hold		Hold		Hold
- While continuing to hold down the button for the tank, press and hold down the **BATT** button. The display will immediately show "d iR" (diagnostics), continue to hold down both buttons until the display enters the alarm test menu, this should take about 5 seconds. The LPG tank does not show "d iR".
 

+		
	Hold	LEVEL IN PERCENT
- When the alarm test menu is entered, the display will show "ALr" for about 5 seconds. Release the buttons.
 



LEVEL IN PERCENT
- Depending on which tank is selected and the status of the alarm, the display will show a simulated low fluid level below the alarm set point (FL0, GL0, bL0, lL0) or a high level above the alarm point (FH i, GH i, bH i, LH i). The alarm test menu allows the alarms to be manually activated to test. The same tank button toggles the simulated fluid level between low and high.
 

	
LEVEL IN PERCENT	LEVEL IN PERCENT
	
LEVEL IN PERCENT	LEVEL IN PERCENT
	
LEVEL IN PERCENT	LEVEL IN PERCENT
	
LEVEL IN PERCENT	LEVEL IN PERCENT
- To set the alarm point, press and hold the same tank button, after about 3 more seconds, the display will show "FR5" (Fresh Alarm Set), "GR5", or "bR5", "LR5", depending on which tank is selected. Release the button.
 

	
LEVEL IN PERCENT	LEVEL IN PERCENT
	
LEVEL IN PERCENT	LEVEL IN PERCENT
- To set the alarm point, the **GREY** button increases the value.
 



	↑
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The **FRESH** button decreases the value.



	↓
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If the **FRESH** or **GREY** buttons are held down, after 1 second the numbers will change quickly. The alarm point can be from 0% to 99%.


The **BLACK** button cycles through the trip polarity and the inclusion in the common alarm output.

	or	
---	----	---

The **LPG** button toggles the failure polarity.

	↻
	↕

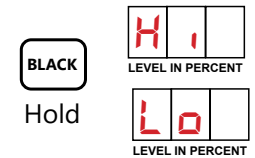
The **BATT** button saves and returns to the previous menu.

	←
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### Trip Polarity

- While the **BLACK** button is held down, the display shows "H i" on the left for a high level alarm or "Lo" for a low level alarm.



- After the button is released, the left digit shows "H" for a high level alarm which means the alarm turns on (closes) when the fluid level is equal to or higher than the set point, and the alarm is off (open) when the fluid level is below the set point.

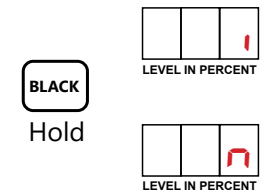



- An "L" shows a low level alarm which means the alarm turns on (closes) when the fluid level is below the set point, and the alarm is off (open) when the fluid level is equal to or above the set point.



### Inclusion in the Common Alarm Output

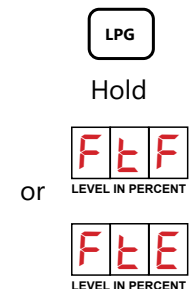
While the **BLACK** button is held down, the display shows an "i" on the right if the alarm is included and an "n" if not included. After the button is released the decimal on the right indicates that the alarm is included in the common alarm output. If any of the included alarms are on, then the common alarm is on. All of the included alarms must be off for the common alarm to be off.





 (Alarm included in common output)

### Failure Polarity (if equipped with LPG)

While the **LPG** button is held down the display shows "FEF" for fail to full, or "FEE" for fail to empty. After the button is released, the left decimal on shows fail to full which means that if the sender fails the alarm acts as though the tank is full. The left decimal off shows fail to empty which means that if the sender fails the alarm acts as though the tank is empty.


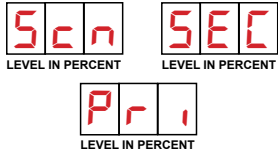
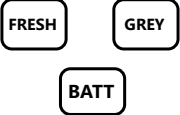


 (Low level alarm at 20%, not included in the common alarm and fail to empty.)


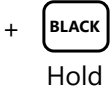
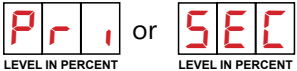
 (Hi level alarm at 90%, included in the common alarm and fail to full.)

## Program the Display as Primary or Secondary

*This setting should normally only need to be done when installing the gauge.* An optional second display can be added to the system. This allows for a display in the service bay and one inside the coach. To avoid reading errors when using dual displays, one display needs to be set to secondary mode. A display in secondary mode monitors the primary displays sender requests and will only scan the tank levels at a much slower rate if the primary display is disconnected. The alarms are inactive on the secondary display. All RVC displays are primary by default. To program a display to be either primary or secondary display:

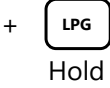

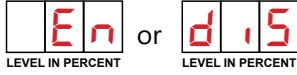


1. With power removed, press and hold the **BATT** and **FRESH** buttons and then power the display.
 
2. The display will show "Scn" for 5 seconds, then change to "SEC" or "Pr i" depending on current programming.
 
3. The **FRESH** button sets the mode to PRIMARY the **GREY** button to SECONDARY the **BATT** button saves and exits.
 

## Check the Primary/Secondary Mode

1. Press and hold down the **BATT** button, the display will show the battery voltage.
 
2. While continuing to hold down the **BATT** button, press and hold down the **BLACK** button.
 
3. Continue to hold down both buttons for about 5 seconds until the display shows "Pr i" for primary mode or "SEC" for secondary mode. When viewing is complete, release both buttons to return to normal operation.
 




## Enable/Disable the LPG Sender (if equipped with LPG)

The LPG sender can only be disabled from the primary display of RVC and Bluetooth models. If these steps are used on the secondary display, no change will result.

1. Press and hold down the **LPG** button.
 
2. While continuing to hold down the **LPG** button, press and hold down the **BATT** button. Continue to hold down both buttons for about 10 seconds until the display shows "Rbl".
 
3. When this occurs release both buttons, the display will show "En" for enabled or "d iS" for disabled.
 
4. Press the **LPG** button to switch between enabled and disabled.
 
5. Press the **BATT** button to save and exit the menu.
 

## Check Hardware/Software Revision









Hardware and software updates may be periodically released to add features. To check the hardware and software version of the display, use the following procedure.

1. Press and hold down the **BATT** button, the display will show the battery voltage.
 
2. While continuing to hold down the **BATT** button, press and hold down the **FRESH** button.
 
3. Continue to hold down both buttons for about 5 seconds until the display shows a number such as "4.10", the first number is the hardware version and the last two numbers are the software version. When viewing is complete, release both buttons to return to normal operation.
 

## TROUBLESHOOTING GUIDE

### Error Codes

If a sender or its wiring is not operating properly, the following codes are shown on the display:

DISPLAY CODE	POSSIBLE CAUSE	SOLUTION
<b>Open circuit</b>  <small>LEVEL IN PERCENT</small>	1. If a sender is unresponsive. 2. There is an open circuit in the wiring so the sender is not connected.	See <b>Wiring Diagnostics</b> flowchart on page 14.
<b>Short circuit</b>  <small>LEVEL IN PERCENT</small>	Blue communication wire from senders to display is shorted to ground.	
<b>Error</b>  <small>LEVEL IN PERCENT</small>	Indicates signal corruption between the sender and display due to bad wiring, bad senders, or multiple senders programmed the same.	Check all the senders to make sure they are programmed correctly. If they are, replace the sender that is creating the error.
<b>Stacked senders</b>  <small>LEVEL IN PERCENT</small>	The display has been programmed for a single sender where double-stacked senders have been connected. The display has not been set to look for two senders	Change the senders or reprogram the display as required.
<b>No top sender</b>  <small>LEVEL IN PERCENT</small> <b>No bottom sender</b>  <small>LEVEL IN PERCENT</small>	The display has been programmed for double-stacked senders and one of these error codes are showing: <ul style="list-style-type: none"> <li>• nTP - only the bottom sender is reporting</li> <li>• nbo - only the top sender is reporting</li> </ul>	Correct the programming on the sender.
<b>Calibration failure</b>  <small>LEVEL IN PERCENT</small>	The memory used to store programming for battery voltage calibration value and tank sender signal values has failed.	Replace the display.
<b>For LPG only</b>  <small>LEVEL IN PERCENT</small>	The only LPG diagnostic code is the open circuit. If the wiring to the LPG sender is shorted then the LPG will always show "0".	

**NOTE:** There are no diagnostics for battery voltage.

### Sender Diagnostics

These diagnostics can be used to check the senders:

### Reviewing Sender Diagnostics

The sender diagnostics can be reviewed periodically to check for any degradation of the tank senders. If a sender appears to be malfunctioning, reviewing the diagnostics should be the first step in the troubleshooting process. There are two diagnostics for the senders:

**Sender signal power** is an indication of how much signal is being transmitted through the tank wall and picked up by the receive part of the sender. **Sender height** is the number of receive segments present in the sender.

SIGNAL POWER PROBLEM	POSSIBLE CAUSE	RESULT
If the signal power is too low.	It can indicate a sender which is detached from the tank, excessive buildup on the inside of the tank, bad wiring to the sender, low battery voltage, or a defective sender.	Typical signal power should be 50% to 60%. The minimum signal power for proper operation is 20%. PGG is 100%

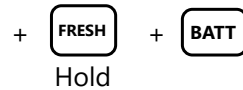
SENDER HEIGHT PROBLEM	RESULT
The number of segments reporting is less than the amount of segments on the sender.	One or more segments are not reporting. Either cut sender to a shorter length or replace the sender.
The senders always auto calibrate to the length that they are cut, so this diagnostic allows the user to confirm the length and to make sure that the auto calibration is working properly.	

## Check Signal Power Diagnostics

1. Press and hold the button for the tank to be checked, the display will show the level for that tank.



2. While continuing to hold down the button for the tank, press the **BATT** button.



3. When the display shows "d 1A", release the buttons, the display will then change to showing the signal power diagnostic.



4. This is indicated by a "P" showing on the left digit, for example "P26" indicates a 26% signal power. "P00" is 100%.



5. The signal power will show for 5 seconds. The display will then change to showing the sender height.

This is indicated by a small "h" showing on the left digit, for example "h 6" indicates that the sender has 6 receive segments.



6. After 5 seconds of showing the height, the display will shut off.



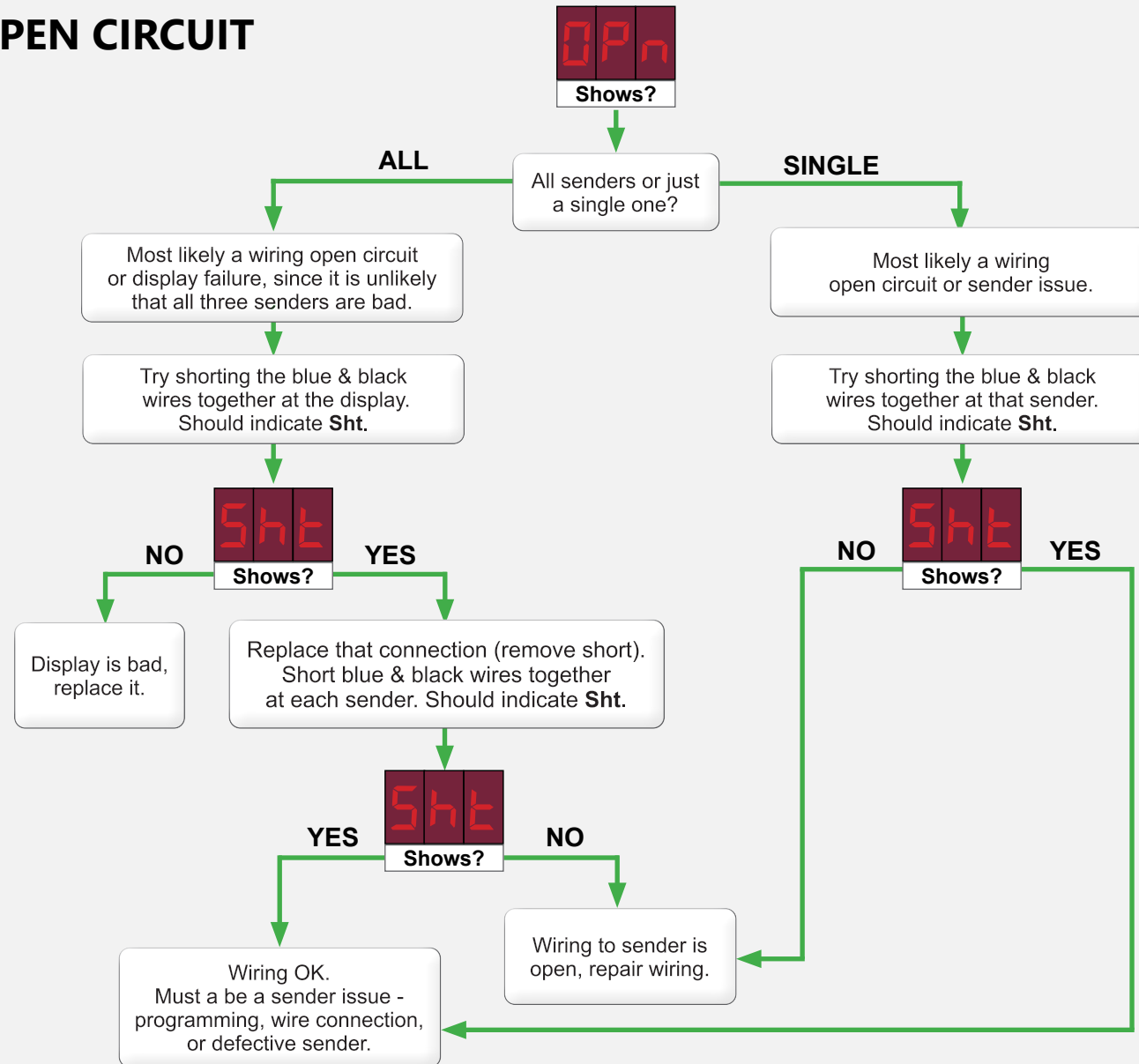
## RV-C Diagnostics (if equipped)

Here is a list of the messages broadcast over the RV-C bus:

FMI (Failure Mode Identifier) Table		
1	Datum value before normal range	DIS or OFF
2	Datum value erratic or invalid	ERR, BOT, TOP, NTP, NBP, or SIN
5	Open circuit, or output current below normal	OPN
6	Grounded circuit, or output current above normal	SHT

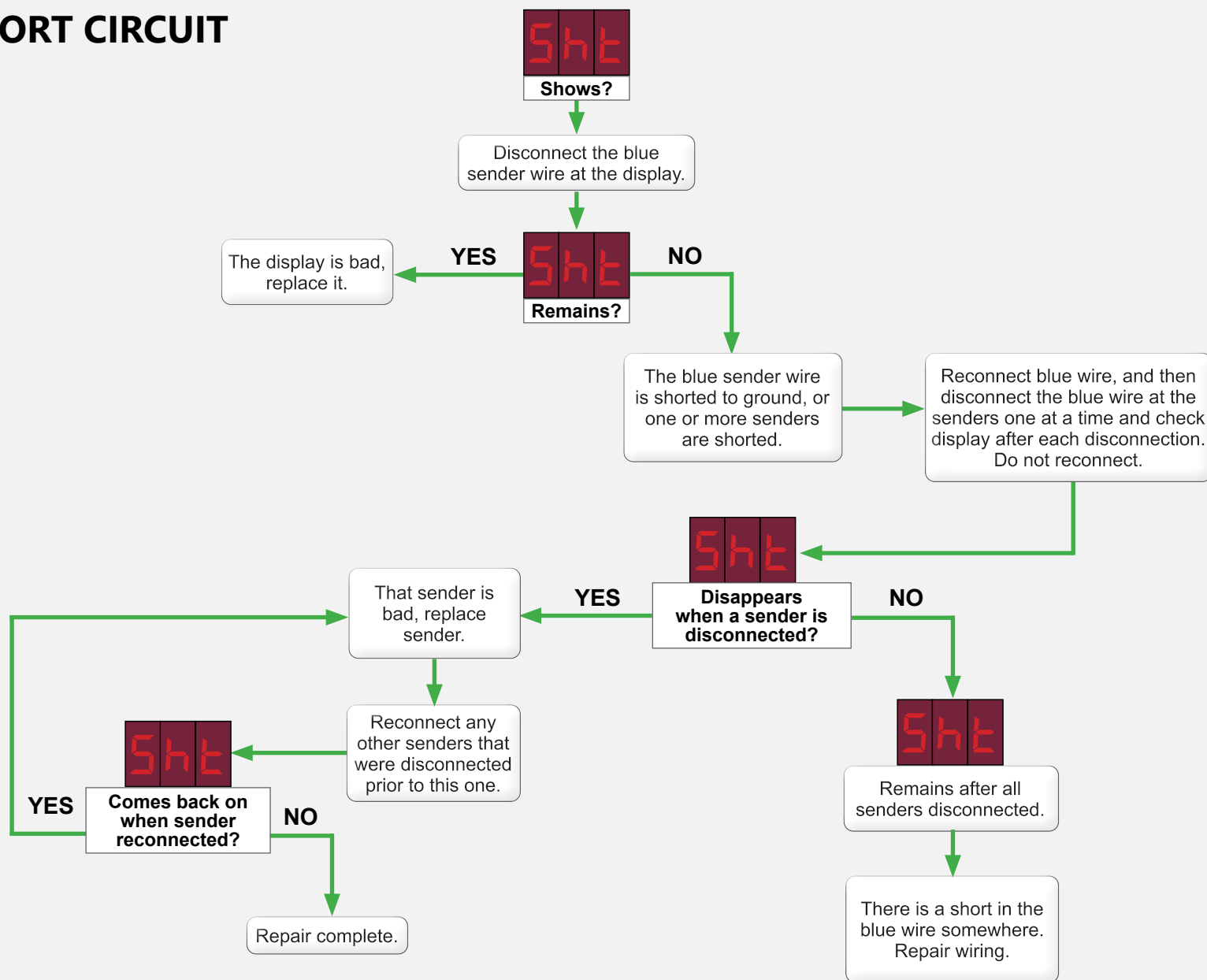
# Wiring Diagnostics

## OPEN CIRCUIT





# SHORT CIRCUIT



## Troubleshooting & Installation Tips

### What to do if the system freezes or is unresponsive

If the display is unresponsive, it may be “hung” due to a static discharge or electrical noise. Try rebooting it by shutting off the 12V power to it for a few seconds, then turning it back on.

### What to do if operation becomes erratic or stops completely

Make sure all wiring connections are solid. Do not use spade connectors to join wiring as they will degrade over time. Use insulated crimp-on butt connectors or solder and insulate the wire connections.

### What to do in dual console systems if the two displays do not read the same

For dual display console applications, if the consoles disagree the most likely reason is a bad console ground. Both console grounds, and the sender grounds, must be connected together with ground wiring. Do not depend on metal chassis components. See item 2 in the following section for further details.

### What to do if readings jump or are inaccurate

1. We have had a few instances where 120VAC interference has caused the readings to stall and create a gap; readings would skip from 50% to 70% and then begin to function again. The cause was wiring between consoles and senders being tied too close to entrance boxes for shore power or bundled with other high AC voltage lines or junction boxes.
2. Always ground the senders and the console to the same ground circuit. This is very important; RV's can have several ground circuits with resistance between them. We have had instances where two consoles are installed with a different ground for the service bay console and interior console. If you see different levels from each console on the same tank, then the ground circuit is not common. Connect both consoles to the same ground back to the breaker panel ground point.

### What to do if the system indicates a residual or non-zero water level even though the tank is drained completely

1. This can be due to a convex tank bottom or a sloped tank bottom. In the case of the convex bottom tank a ring of water may remain after draining. In the case of the sloped bottom (to the drain valve side) a very small amount of water left in the tank will result in a non-zero level indication. In both of these cases, temporary installation of the sender using duct tape or masking tape will allow the installer to check the tank level before committing to a final sender position. After cutting the sender to length and connecting the wires, be sure to tape down both sides of the sender to eliminate air gaps between the sender and tank surface which can cause low signal strength and unpredictable performance. The ends of the sender must be at least ¼” to ½” away from the tank bottom and top to allow for wall thickness. The exterior bottom & top of the tank are not the same as the interior bottom & top; depending on the tank wall thickness the inside height is ½” to 1” shorter than the outside height. Knowing the wall thickness of your tank will allow you to find the optimal sender position; placing the sender where it can “see” the water will ensure proper level calculation and sender operation.

2. The signal strength should be in the 50% range for best performance. If the signal strength is in the 20% range it is indicative of a high resistance in a connector, a bad ground, or improper bonding of the sender to the tank (a possible air gap on one or both sides of the sender).
3. With the console installed you can check the level on each tank, if you get an indicated level of 10% to 20% and you know this is too high, reposition the sensor board as follows:

**▲ NOTE: In the case of a convex tank bottom, usually found on large flat tanks, raising the sender is the best solution to accomplish a zero reading when the tank is empty. This may result in having to shorten the sender by an additional segment.**

**On sloped tanks, which are used to promote complete draining, one alternative is to measure the end of the tank opposite from the drain valve. It may be necessary to extend the wire harness to be able to measure on the optimal side. On the drain valve side, the best choice is to elevate the sender to avoid reading a puddle at the drain valve.**

4. The close proximity of metal to the sender can be misinterpreted as water, since they have similar electrical characteristics. Any metal such as steel, aluminum, copper, or brass can affect the sender reading if it is closer than about 2” from the face of the sender. If there are metal frame pieces, brackets, straps, pipes, ducts, etc. close to the sender you may have to move the sender away from them. Again, trial positioning using tape is necessary until the problem disappears. Flexible pieces of metal can be held away from the sender with rubber wedged between the sender and the metal. If the metal is off to the side of the sender, or just butting to the edge then it is usually not a problem, particularly on the right hand side of the sender.
5. Make sure that metal doors or covers are far enough away from the sender as well, once everything is closed up the positioning may change. The symptoms of exposure to large metal components are usually a non-zero reading when the tank is empty, or the level appearing to jump suddenly as the tank is drained or filled.
6. On fresh tanks there is sometimes a potential to not be able to use all the water in the tank, we suggest you elevate the fresh sender 1” off the tank bottom and position the top of the sender to allow for vent position (if the vent is on the side of the tank). This way you should see ‘0’ before the pump starts to suck air. Some tanks have a sump style draw system, in this case there is no concern with unusable water, just allow for the wall thickness when positioning the sender board (usually ½” to 1” margin from the outer shell). If the sender is positioned above the vent then the maximum reading may be less than 100%.
7. There may be a buildup on the inside walls of black and grey tanks. We get calls occasionally about older coaches that have not been in service for a few years in which the black tank will now indicate a level even though it is empty. The likely cause is that the tank has a significant build-up, probably exceeding ¼” to ½” thick! Redex is not an acceptable chemical to promote clean tank walls; it is far too slow to get the breakdown action started. Use an RV type of liquid chemical, we suggest Tissue Digester, Sensor Cleaner, or the latest we have used called Happy Campers Holding Tank Extreme Cleaner available at [www.happycampersworld.com](http://www.happycampersworld.com). The next time you take a trip, leave with

a high concentration of the chemical in the tank and approximately 30% full of fresh water. Hopefully you can drive for 2-3 days allowing the tank levels to rise through normal use. We recommend that you exceed the level that you see the system report when the tank is empty. After the sloshing and the soaking hopefully the build-up will be flushed away when the tank is drained and flushed. If you still have symptoms the treatment may required a few more times. The waste did not build up on the tank wall in one day, so it may not dissolve in one treatment! The build-up looks like water to the system since it holds a significant volume of water in the build-up area. It takes much more than a film or piece of tissue to cause the error.

#### **What to do if the system reads a zero water level at all times, or does not reach 100%**

1. This may be due to excessive tank wall thickness. We have tested the sender on an actual tank with 3/8" wall thickness to ensure proper operation. If you encounter an excessively thick tank wall the symptom will be a zero reading regardless of the actual tank level. The cross check would be to test the sender on another tank by taping it in place temporarily, if it now works the tank wall thickness is well over 3/8". You can also use a 1 gallon jug or a 5 gallon pail as a test tank to crosscheck operation of the sender.
2. A symptom we have seen is the sender will not indicate 100% when the tank is full. If the sender is positioned too high on the tank, then water cannot reach high enough on the sender for it to read 100%. The top of the sender must be at least 1/4" to 1/2" away from the top of the tank to allow for wall thickness.
3. Another possibility is a tank wall thickness issue that may occur at the corners or edges of the tank. This has not been a common issue, and the only correction you can make is to move the board slightly lower, away from the thick area.

#### **What to do if sender delamination occurs**

1. We have had reports of the senders literally falling off the tanks or showing serious delamination. This is likely caused by a lack of tank surface preparation. Surface prep is very simple, wipe the area to be adhered to with products like Pro Bond, alcohol, or acetone. Do not use thinners because they leave residues which attack the adhesive. Ambient temperatures of less than 60°F or 15°C prevent the bonding agents in the adhesive from working properly; use a heat gun to warm the tank surface if necessary. Also be sure the surface is dry, again a heat gun is the best way to dry the bonding area. Finally, the surface of the tank must be smooth. The adhesive works much better on smooth surfaces, if necessary use an orbital sander with fine grit paper (220 grit) to quickly accomplish the desired smoothness.
2. Another possibility is the wiring harness pulling on the sender. Make sure the wiring to the tank sender is well supported so that it does not put a load on the sender. Be sure to support all connecting harnesses; do not let the board support the harness, this will in time cause delamination of the board from the tank. One simple way to do this is to use Gorilla tape across the top of the sender at a 90 degree angle to the sender orientation, with the wiring held in place by the tape. The wires from the sender must be routed straight up or to the right for reliable operation.

#### **How to protect the sender from road spray and debris**

3. On installations where the holding tank is exposed to under chassis road spray and flying rocks etc. we recommend the use of an auto body undercoat, which is easily purchased in auto parts stores. This tar based material clings well to the senders and protects from water and debris.
4. One material in particular is 3M Professional Grade Rubberized Undercoating, product code 03584. Another product that works well is a Dominion Sure Seal rubberized undercoating such as Gravel Guard Rocker Guard Coating.
5. After the system is completed and tested apply the undercoat over the complete board using two coats. Do not use lacquer, enamel paint, or plastic paint for auto bumpers as these contain chemicals that will dissolve the conformal coating on the board and cause malfunctions.

#### **How to avoid damaging the display when mounting**

1. If mounting the display in a metal panel or wall there is a risk of permanent damage due to a jagged opening or too small of an opening. The metal panel can short-circuit the display rendering it inoperable and requiring the installer to replace it. Ensure that the edges of the cutout are smooth and that no material is bent outward where it can dig into the display. Make sure that the cutout is large enough so that the display can be easily inserted without having to angle it. There is a 1/2" border all around the display to cover the edge of the hole, so if the hole is a bit larger than the minimum requirement it will still be covered by the display.
2. When fastening the display to the panel, make sure that it is centered in the hole and not resting on one edge.
3. Non-conductive mounting spacers are available to help prevent damaging the display. Contact Garnet for further details.

#### **How to avoid damaging the display or pump switch due to excessive current**

1. Please be aware that the water pump switch circuit has a limitation on current draw of 7.5 amps, some large pumps can draw over 10 amps. These high drain pumps must use a relay or the display console printed circuit will overheat and damage the display permanently.
2. If the 12V supply line from the electrical panel does not have a 7.5 amp fuse rating, please be sure to install the supplied fuse holder with a 7.5 amp automotive style fuse inline on the +12V red wire.

