



SEELEVEL II™ Tank Monitor

**For Recreational Vehicles
Model 713-FT Manual**

IMPORTANT OPERATOR INFORMATION

DATE INSTALLED: _____

	Signal Power	Tank Height
Black Water Tank		
Gray Water Tank		
Fresh Water Tank		



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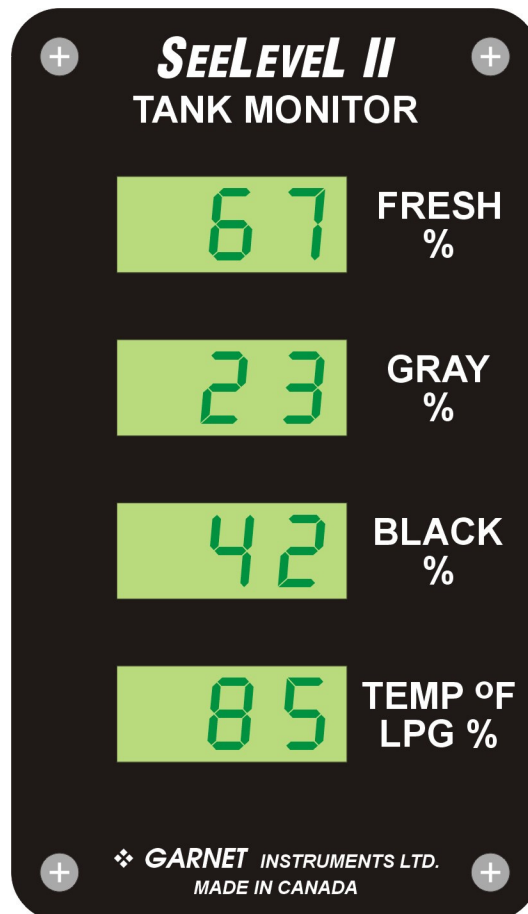
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CHAPTER 1 OVERVIEW

The SeeLevel II Tank Monitor represents a massive leap forward in level measurement technology for the Recreational Vehicle industry. The SeeLevel has a combination of features, accuracy, reliability, and diagnostic capability that have never been available before.

The SeeLevel II will monitor the fresh water holding tank level, gray and black sewer tank levels, LPG level, and the outside temperature. The information is displayed continuously on four separate 3 digit alpha-numeric LED displays. In addition, during servicing the system can display the operating characteristics of each of the tank sending units, giving it unsurpassed diagnostic capability.



CHAPTER 2

SYSTEM DESCRIPTION

The SeeLevel II consists of a display unit that mounts inside the RV, sender panels that adhere to the sides of the holding tanks, and an external temperature sensor mounted to the exterior of the RV. Two conductor wiring is used to connect each sender panel/sensor to the display.

The Sender: 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. The sender scans the water level through the tank wall using advanced digital techniques programmed into the sender microprocessor. When the sender transmits the water or sewer level information to the display, it sends a digital code that has built in error detection, making it highly unlikely for the display to read an incorrect level, even if the wiring is marginal. 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 (the tank will always read empty), so by monitoring the signal power the tank can be cleaned before the buildup gets excessive. If the tank is more than 16 inches tall, two senders can be stacked to allow measurement of levels up to 32 inches.

The Display: The display continuously shows the levels for the fresh, gray, and black tanks, and either the outside temperature or the LP level. The display automatically obtains the level or temperature information every 5 seconds and updates the display accordingly. Since two displays can be connected to the same sender, each display will check for activity from the other display before attempting an update, this way there are no issues with different displays trying to access the same sender at the same time.

The display receives the information from the three sender panels via two wire cables. If the wiring is disconnected or cut, or if the sender panel is damaged, then the display will indicate the appropriate fault condition.

The outside temperature is measured with a digital temperature sensor mounted on the outside of the coach. The temperature can be programmed to read in °C or °F and is accurate to within 3 °F (1.5 °C).

To measure LP level, a remote module is used which converts the signal from the existing resistive sender on the LP tank to a digital signal recognized by the display. Pressing the button to the right of the bottom display toggles the readout between temperature and LP level.

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.

User operation of the display is described in the next chapter.

CHAPTER 3

OPERATING INSTRUCTIONS

The display is the only system component that is accessed by the user. Operation of the display is as follows:

To read a tank level:

The levels in percent are continuously shown on the LED displays, and are updated every 5 seconds.

To read the outside temperature or the LP level:

The bottom LED display can be switched between reading temperature or LP level. To change to the other reading, press the button to the right of the LED digits. The display will stay reading the new parameter until the button is pressed again. When the LP level is being shown, the display will have an "L" for the left digit, whereas the temperature will just have the number in degrees. The reading is updated every 5 seconds. The temperature can be programmed to be in either °C or °F. Refer to the programming section to obtain instructions on how to set this.

CHAPTER 4 DISPLAY CALIBRATION

To calibrate the temperature readouts to °F or °C:

1. Turn off the 12V RV power to the display. Hold down the button under the TEMP label (to the right of the temperature LED display) and turn on the 12V power to the display.
2. The display will turn on and the temperature display will show “F-C” to indicate the choice between Fahrenheit and Celsius. When this occurs release the button.
3. The display will now show “ °C” or “ °F”, based on what is currently programmed into the display.
4. To alternate between Fahrenheit and Celsius, press the button, each time the button is pressed the display will switch to the other temperature.
5. When the display shows the correct temperature mode, turn off the 12V power, the calibration is complete.

To calibrate the number of senders for each tank:

1. This should only be done at the time of installation, there is no reason to change this afterward. Turn off the 12V RV power to the display. Hold down the button under the applicable tank label (FRESH, GRAY, or BLACK to the right of the tank LED display) and turn on the 12V power to the display.
2. The display will turn on and applicable tank display will show “FrS” if doing the number of senders for the fresh tank, “GrS” if doing the gray tank, or “bLS” if doing the black tank. When this occurs release the button.
3. The display will now show “1SE” or “2SE”, based on 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.
4. To change the number of senders, press the tank button, each time the button is pressed the display will switch to the other number.
5. When the display shows the correct number of senders, turn off the 12V power, the calibration is complete for that tank. Each tank will need to be calibrated individually using this procedure.

To program the LED brightness:

1. If the display is to be used inside the coach, the LED brightness should be low. If it is to be used in the service bay area where sunlight can reach it, the LED brightness should be high.
2. Turn off the 12V RV power to the display. Hold down the FRESH and GRAY buttons under the tank labels (to the right of the tank LED display) and turn on the 12V power to the display.
3. The display will turn on and all the displays will show “bri” to indicate that this is the brightness programming mode. When this occurs release the buttons.
4. The displays will now indicate the brightness that is currently programmed by showing “b-1”, “b-2”, “b-3”, or “b-4”, where “b-1” is the minimum brightness and “b-4” is the maximum brightness.
5. Press the FRESH tank button to increase brightness, or the GRAY tank button to decrease brightness.
6. When the display shows the correct brightness, turn off the 12V power, the programming is complete.

To calibrate the LP reading:

1. This should normally only be done at the time of installation, there is no reason to change this afterward. Make sure that the LP module is installed and that the LP sender in the tank is at 100%. Contact Garnet if you are unsure about this.
2. With the 12V RV power to the display turned on, press the button under the TEMP label as required to put the display into temperature mode. Then press the button again to put the display into LP mode, but continue to hold the button down.
3. After about 5 seconds, the display will show “L00” (100%), when this occurs release the button, calibration is complete. Note: since this is an analog reading, it may fluctuate slightly, showing “L01” or “L99” instead of “L00”, this is no cause for concern.

CHAPTER 5

INSTALLATION GUIDE (NEW OEM INSTALLATIONS ONLY)

1. The installation consists of mounting the display inside the RV, cutting and fastening the senders to the sides of the holding tanks, connecting wiring, and programming the display.
2. Mount the display by cutting a hole in the wall 2 1/4" wide by 3 3/8" high and bringing the wiring out through the hole to connect to the display panel connector.
3. Connect the wiring according to the following table. It is easier to connect the wiring to the display connector first, and then plug the connector into the display panel. One pair of wires is required to connect each of the senders. The senders need to be grounded to a single ground wire from the display.

Wire Color	Function
Red 18 gauge	+12V power input to monitor
Black 18 gauge	Ground
Purple 22 gauge	Digital Output (for 744AIM)
Blue 22 gauge	Fresh water tank sender
Gray 22 gauge	Gray water tank sender
Brown 22 gauge	Black water tank sender
White w/Blue 22 gauge	External temperature sensor and LP sensor module

4. Determine where to mount the senders on the tanks. They will need to have a flat area on the side of the tank large enough so the whole width of the sender is in contact with the side of the tank, all the way from the top to the bottom of the tank. Make sure that any metal is at least an inch away from the sender. Clean the area well so that there is no dust, grease, oil, water, etc., that would prevent the adhesive on the sender from sticking.
5. Measure the height of the tank to determine how long the senders should be. For tanks less than 17" tall, follow step 6. For tanks greater than 17" tall, follow step 7.
6. For tanks less than 17" tall, a single sender is used. The sender ends should be 1/4" to 3/4" away from the top and bottom of the tank, to allow for the thickness of the tank top and bottom and any bows in them (see the diagrams). The senders are calibrated to account for this distance from the bottom of the tank. The sender is cut to the nearest even inch in length, for example, a system with a tank height of 11.75 inches, cut the sender to be 11 inches long, this allows 3/8" at each end when the sender

is centered vertically on the tank. **IMPORTANT: Do not cut the sender shorter than 6 inches! The sender will not work if it is cut less than 6 inches.**

7. For tanks greater than 17" tall, two stacked senders are used. The sender ends should be 1/4" to 3/4" away from the top and bottom of the tank, to allow for the thickness of the tank top and bottom and any bows in them (see the diagrams). The senders are calibrated to account for this distance from the bottom of the tank. In addition, there needs to be a gap of 1/8" to 1/4" between the two senders. Therefore total length of both senders will be: $\text{tank height} - 1/4" - 1/4" - 1/8"$ then rounded down to the nearest whole inch. The top and bottom senders should be approximately the same length for best results. For example, if the tank height is 22", then $22" - 1/4" - 1/4" - 1/8" = 21 \text{ } 3/8"$, so the total length of both senders will be 21 inches. Make one sender 10" long and the other 11" long.
8. To make the senders the right length (assuming they are too long) they will need to cut off with a pair of scissors. The end to be cut is the bottom end, which is the opposite end from the top where the wires come out (see the diagrams). DO NOT cut the sides, and DO NOT cut the sender shorter than 6 inches. The cut must be in between the sensor pads, and the cut must be made parallel to the existing bottom end. Double check your measurements, if the sender is cut too short, it cannot be lengthened.
9. For two stacked sender systems, the senders need to be programmed so they know that they are being used as top or bottom senders. As shown in the diagrams, punch a hole or snip a bit of the sender away to cut the line on the sender corresponding to its position. For the bottom sender, cut the line next to the text "CUT FOR BOTTOM", and for the top sender, cut the line next to the text "CUT FOR TOP". DO NOT cut any lines for single sender systems!

No holes punched for single sender

TOP OF SENDER

Punch hole here for top sender

6" minimum

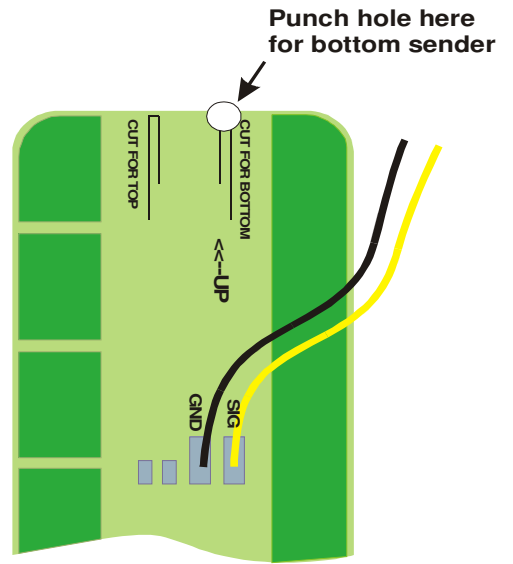
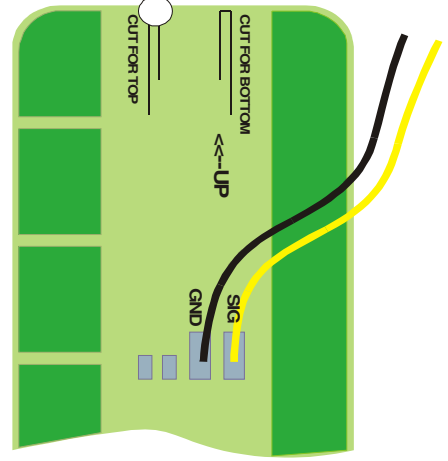
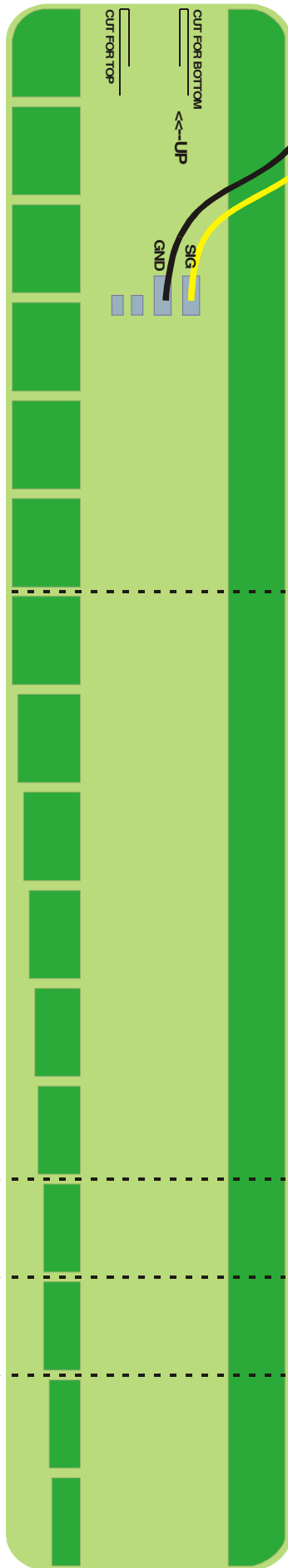
Minimum sender length is 6 inches

Route wires to the right, away from the sender.

Punch hole here for bottom sender

Only cut between pads when cutting the sender to length

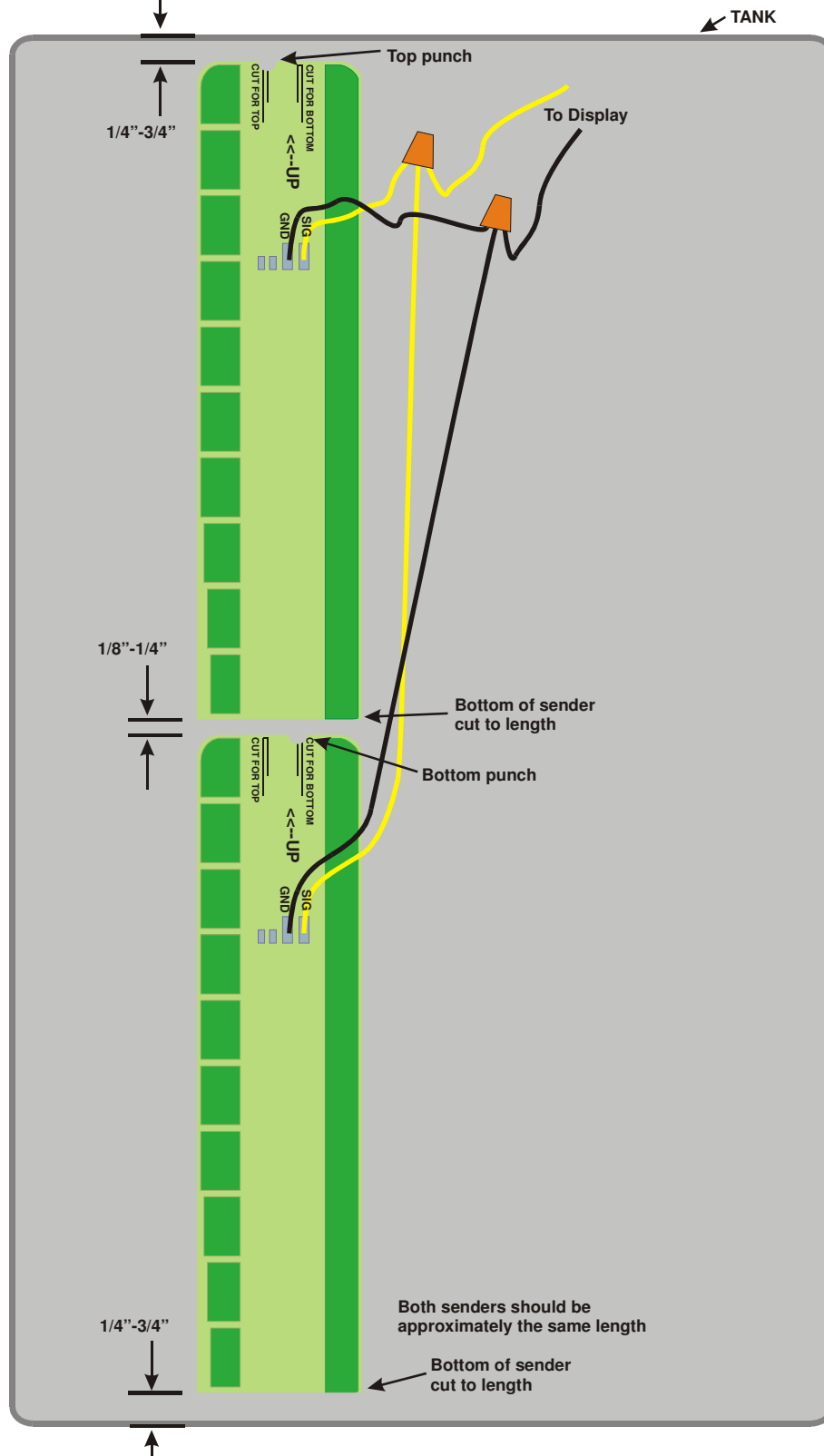
BOTTOM OF SENDER



10. Once the sender is cut to length, carefully peel the backing paper off the adhesive. Do this slowly to prevent the adhesive from being ripped off the sender, and to prevent the backing paper from ripping. Be careful not to bend the sender sharply in the process. Position the sender over the side of the tank and carefully stick it down. **MAKE SURE THAT THE END WITH WIRES IS POINTING UP!!** Position the bottom of the sender at least 1/4" above the bottom of the tank, and more if required to equalize the space at the top and bottom of the tank. Make sure that the sender is square with the tank. You only have one shot at this, if you try to peel it off the tank once it is stuck the sender may be damaged by the sharp bending. Carefully press the sender down to the tank so that all of the adhesive is contacting the tank wall.
11. Connect the yellow wire to the wire from the display corresponding to that tank. For two stacked sender systems, connect the two yellow wires together, then connect these to the display (see the diagrams). Connect the black wire from each sender to ground. Use Marrette or crimp connectors to fasten the wires together. Make sure that the wires from the sender are routed away from the sender, if they drape over the sender they could affect the reading. Secure the wires with tie wraps or something similar so that the wires do not rattle or press against the sender, this may result in sender damage or wires breaking over time.
12. Do steps 4 to 12 for the other two holding tanks.
13. Mount the temperature sensor at the desired location. Connect the black wire to ground and the yellow wire to the white / blue wire from the display.
14. Mount the LP sensor module at a convenient location, preferably close to the LP tank. Connect the black wire to ground, the yellow wire to the white / blue wire from the display, and the green wire to the LP tank sender.
15. All that remains now is calibration and testing. The tank senders will self calibrate to whatever length they are cut, so they will always read from 0 to 100%. The display needs to be set to a 1 or 2 sender system for each tank, follow the directions under the display programming section. Make sure you do it for each tank. For the initial test, have the tank at least 1/4 full of water or sewage, and verify that the percent level reading looks correct (see the section ***To read a tank level***) and that the signal power is at least 12% (see the section ***To review the sender diagnostics***). If the signal power is too low, make sure that the sender is well stuck to the side of the tank and that the tank is reasonably clean inside, as a large buildup will reduce signal strength. The gauge will work with maximum signal strengths as low as 5%, but it is good to have at least 12% at installation so that there is some margin available for buildup in the tank. Note that the system "learns" about the characteristics of the tank with use, so the

readings may be inaccurate when the tank is empty or almost empty when the system is first tested. Once the tank has been filled at least 1/4 full the system will be properly “taught” and should read correctly after that.

16. Program the LED brightness.



Typical Two Stacked Sender Installation

CHAPTER 6

TROUBLESHOOTING GUIDE

Display trouble codes:

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

1. If a sender is unresponsive or there is an open circuit in the wiring so that the sender is not connected, the display will indicate an open circuit by showing “OPn” on the LED display.
2. If a sender is shorted or there is a short circuit in the wiring, the display will indicate a short circuit by showing “Sht” on the LED display.
3. If a sender is sending bad data, there is damaged wiring, or if there is electrical interference, the display will indicate a data error by showing “Err” on the LED display.
4. If the display has been programmed for a single sender, and the sender has been programmed as a bottom sender, the display will show “bot”. If the sender has been programmed as a top sender, the display will show “toP”.
5. If the display has been programmed for 2 stacked senders for tall tanks, and only the bottom sender is working and the top one is not, then the display will show “ntP” indicating that no top sender is being received. If the top is working but no bottom sender is being received, then the display will show “nbo”. If neither sender is working, then the display will show “OPn”. If a sender has not been programmed for top or bottom operation, the display will show “sin” indicating that a single sender is connected.
6. The temperature sensor and LP module share the same data line, so an error on one can affect the other. In temperature mode, if the display shows “OPn”, it indicates either an open temperature sensor/wiring, or an open LP module/wiring and an error from the temperature sensor. If the temperature sensor, the LP module, or the wiring is shorted, the display will show “Sht”. If the display shows “Err” it does indicate an error in the data received from the temperature sensor.
7. In LP mode, the display showing “L--” indicates an open circuit between the LP module and the LP tank sender, or an LP level reading of greater than 109%. Readings from 100% to 109% will show as “L00” to “L09”, whereas a normal reading of 0% would show as “L 0”. The display showing “LOP” indicates an open circuit between the display and the LP module/temperature sensor combination. If the display shows “LEr”, it

indicates either an error or open circuit from the LP module. If the display shows “LSh”, it indicates that either the LP module or the temperature sensor is shorted, or there is a short in the wiring.

To review the sender diagnostics:

1. 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. Note that there are no diagnostics for the temperature.
2. There are three diagnostics for the senders: the signal power, the interference level, and the sender height.
 - a. The 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. 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. The minimum signal power for proper operation is 5%.
 - b. The interference level indicates the amount of signal received from the part of the sender that is above the water level. The tank must be no more than 80% full for this number to be valid. Normal interference levels should be in the 0% to 2% range. If the interference level is high, incorrect readings may occur. Check for water or mud buildup right on the sender, or large a large buildup of debris on the inside of the tank.
 - c. The sender height is simply the length of the sender(s) in inches. The senders 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.
3. To check the diagnostics, press the button under the tank label (to the right of the LED display) for the tank to be checked.
4. While the button is held down, the display will show “dIA”. When the button is released the display will change to showing the signal power diagnostic. This is indicated by a “P” showing on the left digit, for example "P26" indicates a 26% signal power.
5. Press the button again; the display will change to showing the interference level. This is indicated by a small “i” showing on the left digit, for example “i 2” indicates that the interference level is 2%.

6. Press the button again; the display will change to showing the sender height. This is indicated by a small “h” showing on the left digit, for example “h23” indicates that the senders are 23 inches high.
7. Press the button again to revert to the normal level display. If at any time a button is not pressed then the display will automatically revert to the normal level display after 5 seconds.

To check the battery voltage:

Press the buttons under the FRESH and GRAY labels (to the right of the LED displays) at the same time, the temperature display will change to show the battery voltage for as long as the buttons are pressed.

CHAPTER 7

744 ANALOG INTERFACE MODULE

The SeeLevelL 744 Analog Interface Module is a microprocessor based module which converts the digital signals from a SeeLevelL RV Tank Monitor display into individual 0 to 5 volt analog outputs. The display must have a digital interface output in order to send the signal to the Analog Interface Module. The module cannot communicate directly with the senders.

The 744-AIM is compatible with the Aladdin Systems on Monaco and Holiday Rambler coaches, but is not compatible with the Aladdin Junior.

A tank level reading 0% on the display corresponds to 0 volts at the analog output, and 100% on the display corresponds to 5 volts at the analog output. All other percentages are a linear portion of 5 volts, for example, a tank level reading of 43% would give $0.43 * 5 = 2.15$ volts at the analog output.

The temperature output is scaled so that 0 volts is -48°C (-54.4°F) and 5 volts is $+80^{\circ}\text{C}$ (176°F). This gives a scale of 39.06mV per $^{\circ}\text{C}$, or 21.7mV per $^{\circ}\text{F}$. The following table gives some common temperatures and their corresponding analog voltages.

Temperature ($^{\circ}\text{C}$)	Temperature ($^{\circ}\text{F}$)	Voltage
-48	-54.4	0.00
-40	-40	0.31
-18	0	1.17
0	32	1.88
10	50	2.27
20	68	2.66
40	104	3.44
80	176	5.00

The internal resistance of each analog output is 1000 ohms, which provides electrical protection for the module if an output is momentarily shorted to ground or 12 volts. If the load resistance of the receiving system is less than 100,000 ohms, then the system will have to compensate for the drop in voltage due to loading. If the digital signal to the module is lost, all the analog outputs will revert to 0 volts within about 10 seconds. If any of the tanks or temperature shows an error on the display, then the corresponding analog output will go to 0 volts. The tank monitor display automatically checks tank

levels and temperature every 5 seconds and sends the information to the module, so the analog outputs are updated every 5 seconds as well.

The module is potted into a small enclosure measuring approximately 1-1/2" by 1-3/8" by 3/4", and connects to the RV wiring via a 9 pin connector. To mount the module, use an adhesive or double sided tape to fasten the module to a solid surface at a convenient location. Do not let the module hang by the wires. There are 6 analog outputs available, which may not all be used in any given application. Insulate any unused outputs to prevent short circuits which can damage the module. 12 volt power from the RV is required for operation, and current drain is less than 10mA. The following table shows the pigtail wire colors and their function:

Wire Color	Function
Red 18 gauge	+12V power input to module
Black 18 gauge	Ground
Purple	Digital input
Blue	Fresh water analog output
Gray	Gray water analog output
Brown	Black water analog output
White	Temperature analog output
Green	LPG analog output
Orange	Fourth water tank analog output

CHAPTER 8

SERVICE AND WARRANTY INFORMATION

The warranty will apply only if the warranty card shipped with the equipment has been returned to Garnet Technologies Inc.

Garnet Technologies Inc. warrants equipment manufactured by Garnet to be free from defects in material and workmanship under normal use and service for a period of one year from the date of sale from Garnet or an Authorized Dealer. The warranty period will start from the date of purchase or installation as indicated on the warranty card. Under these warranties, Garnet shall be responsible only for actual loss or damage suffered and then only to the extent of Garnet's invoiced price of the product. Garnet shall not be liable in any case for labor charges for indirect, special, or consequential damages. Garnet shall not be liable in any case for the removal and/or reinstallation of defective Garnet equipment. These warranties shall not apply to any defects or other damages to any Garnet equipment that has been altered or tampered with by anyone other than Garnet factory representatives. In all cases, Garnet will warrant only Garnet products which are being used for applications acceptable to Garnet and within the technical specifications of the particular product. In addition, Garnet will warrant only those products which have been installed and maintained according to Garnet factory specifications.

LIMITATION ON WARRANTIES

These warranties are the only warranties, expressed or implied, upon which products are sold by Garnet and Garnet makes no warranty of merchantability or fitness for any particular purpose in respect to the products sold. Garnet products or parts thereof assumed to be defective by the purchaser within the stipulated warranty period should be returned to the seller, local distributor, or directly to Garnet for evaluation and service. Whenever direct factory evaluation, service or replacement is necessary, the customer must first, by either letter or phone, obtain a Returned Material Authorization (RMA) from Garnet Technologies directly. No material may be returned to Garnet without an RMA number assigned to it or without proper factory authorization. Any returns must be returned freight prepaid to: Garnet Technologies Inc., Suite 8, 125 M&M Ranch Road, Granbury, Texas, 76049. Returned warranted items will be repaired or replaced at the discretion of Garnet Instruments. Any Garnet items under the Garnet Warranty Policy that are deemed irreparable by Garnet Technologies will be replaced at no charge or a credit will be issued for that item subject to the customer's request.

If you do have a warranty claim or if the equipment needs to be serviced, contact the installation dealer. If you do need to contact Garnet, we can be reached as follows:

Garnet Technologies Inc.
Suite 8, 125 M&M Ranch Road
Granbury, Texas, 76049
Email: sales@rvgauge.com

CHAPTER 9 SPECIFICATIONS

Resolution:	1/4 inch (6 mm)
Accuracy:	+/- 5% or better, limited by resolution and tank shape
Operating temperature range:	+32°F to +140°F (0°C to + 60°C)
Sender materials:	0.008" thick glass epoxy circuit board with conformal coating for circuit protection. Laminated on the back with 3M 300LSE Bonding Adhesive.
Display mounting panel:	Black panel, approximately 2 3/4" wide by 4 3/4" high by 1" thick (70mm wide X 120mm high X 25mm deep). Panel screws to wall. Required cutout size is 2 1/4" wide by 3 3/8" high.
System power requirements:	Display requires 12 volts from the RV battery; the system will function from 11 volts to 16 volts. Current drain is less than 250mA.
Wiring:	Two wire conductor required from the display to each sender and external temperature sensor. 12 V power and ground required for display.
Temperature sensors:	Semiconductor sensors with integral A/D converters. Accuracy +/- 3 °F (+/- 1.5 °C).