



B&G

Tank Level Sensing Processor & Sensors

Installation and Calibration manual

Tank Level Sensing Processor and Sensors

Certification



Warnings and Precautions

Warning:

This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference, the user is encouraged to try to correct the interference by relocating the equipment or connecting the equipment to a different circuit. Consult an authorised dealer or other qualified technician for additional help if these remedies do not correct the problem.

This device meets requirements for CFR47 Part 15 of the FCC limits for Class B equipment.

The Tank Level Sensing Processor and Sensors meet the standards set out in European Standard EN 60945: 1997 IEC 945: 1996 for maritime navigation and radiocommunication equipment and systems.

The Tank Level Sensing Processor and Sensors contain no user-serviceable parts. Only an authorised service centre should be used to make repairs. Unauthorised repairs or modifications will void your warranty.

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Tank Level Sensing Processor and Sensors

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1 Introduction

Congratulations on your purchase of the Tank Level Sensing Processor and Sensors from B&G. The system is designed to supply the user with reliable data on tank levels and volumes, making for accurate monitoring of on-board fluids, essential for precision trimming to achieve optimum performance when it counts.

Before you begin using the Tank Level Sensing Processor and Sensors, please take the time to read this manual to help you achieve the full potential of your system.

2 Features

- Reliable and accurate measurement of fluid levels in tanks.
- Measures both level and volume*.
- Monitoring of up to 12 tanks.
- Tank sensor material and operation is safe for use with potable water, diesel fuel and 'grey water' tanks.

* Volume measurement requires calibration with the PC setup utility (supplied).

3 Compatibility

The Tank Monitoring system requires integration with one of the following systems:

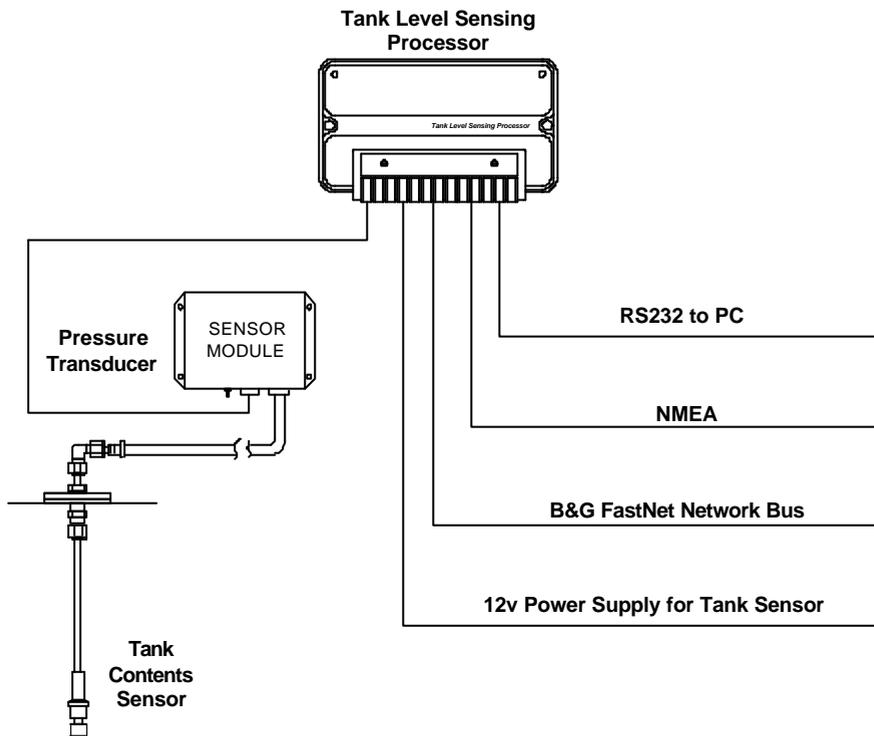
- B&G Hydra.
- B&G Hercules.

Tank Level Sensing Processor and Sensors

4 Description

The Tank Level Sensing Processor and Sensors from B&G offers a choice of 5-bolt tank insert fittings in either brass, stainless steel or marine-grade aluminium, and can be mounted in a tank-top position or on the tank side if space is limited. Using SWAGELOK fittings the tank unit is connected to a Sensor Module by 7.5mm (¼ inch) diameter tubing. A length of 7.5mm (¼ inch) diameter Nylon tube extends inside the tank from the tank fitting to the bottom of the tank and is kept immersed by a stainless steel weight attached to its lower end.

The Sensor Module is connected through a Tank Level Sensing Processor and is connected to the boat's Hydra/Hercules Full Function Displays via the Fastnet databus cable.



5 Operation

The system calculates the contents of the tank by measuring the pressure at the bottom of the tank as the fluid level changes.

A small air compressor, built into the sensor module, is automatically activated for approximately 8 seconds every 10 minutes. This purges the air in the hose between the sensor module and the bottom of the tank.

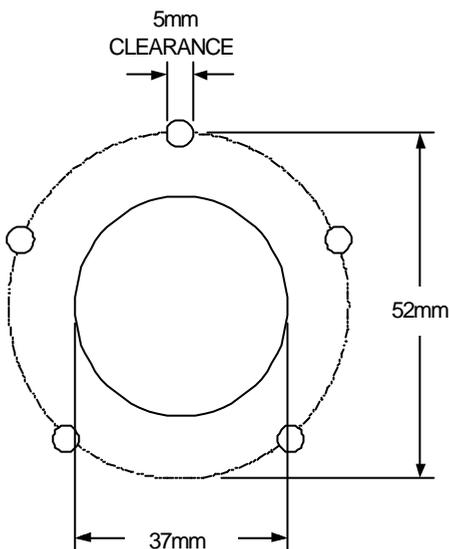
A pressure transducer inside the sensor module senses the pressure and converts it to an electrical signal, which is transmitted to the B&G Tank Level Sensing Processor (TLSP), read by the software and displayed to the user via the FFD.

6 Installation

6.1 Installation of 5-Bolt Flange Fittings

Note: Minimum required distance is 55mm (2") above tank surface to clear elbow fittings/pipes.

Select a suitable position for the tank fitting(s), cut the required holes in accordance with the following diagram



WARNING: THIS DIAGRAM IS NOT DRAWN TO SCALE.

Install the flange fitting as follows:

1. Determine the depth of the tank including the depth of any pump pick-up tubes (refer to the diagram on Page 4 of this manual).
2. Cut the 7.5mm (¼ inch) diameter Nylon tube so that its cut end will be suspended approximately 50mm (2 inches) above the tank pick-up tube.

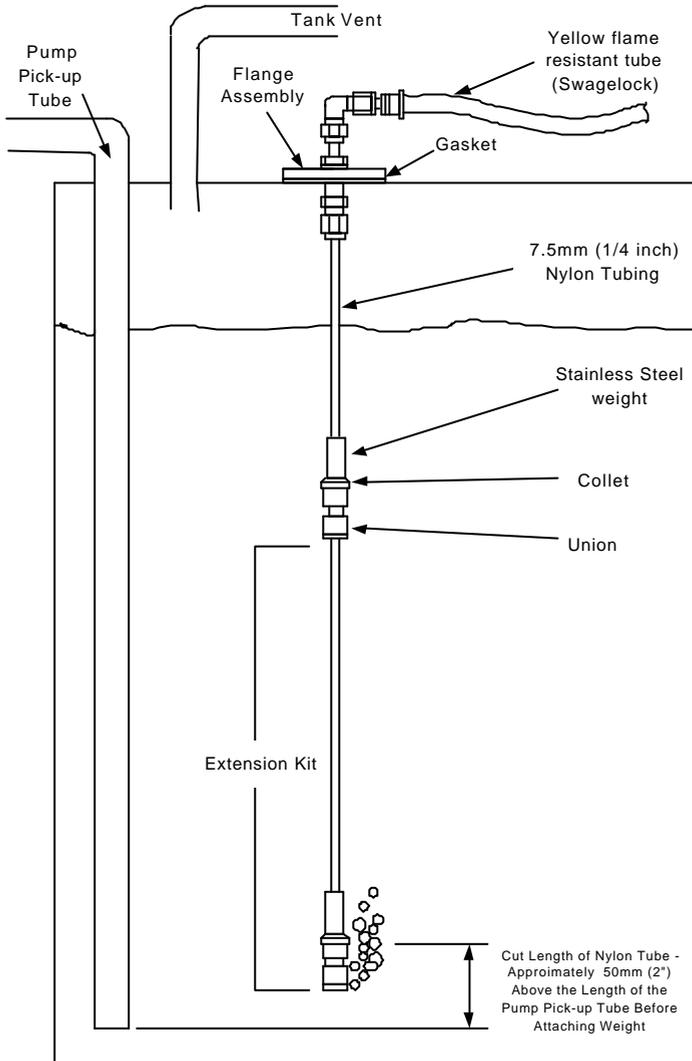
Note: For tanks deeper than 0.9m (3 feet), the extension kit (supplied) will be required (refer to the diagram on Page 4 of this manual).

3. Slide the weight over the cut-end of the Nylon tube then slide the collet cover under the weight. Press the end of the Nylon tube into the union fitting. Snap the collet cover into place to prevent the weight from detaching when immersed in the tank.
4. Place the gasket over the tank opening, between the flange and the tank, align the asymmetrical bolt holes and attach the flange to the tank using the bolts supplied.
5. Connect the Swagelock tubing to the elbow on the flange fitting and tighten.

Note: For each side-tank installation an additional 90° elbow will be required (refer to the diagram on Page 5 of this manual).

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6.2 Deep Top Tank Installation

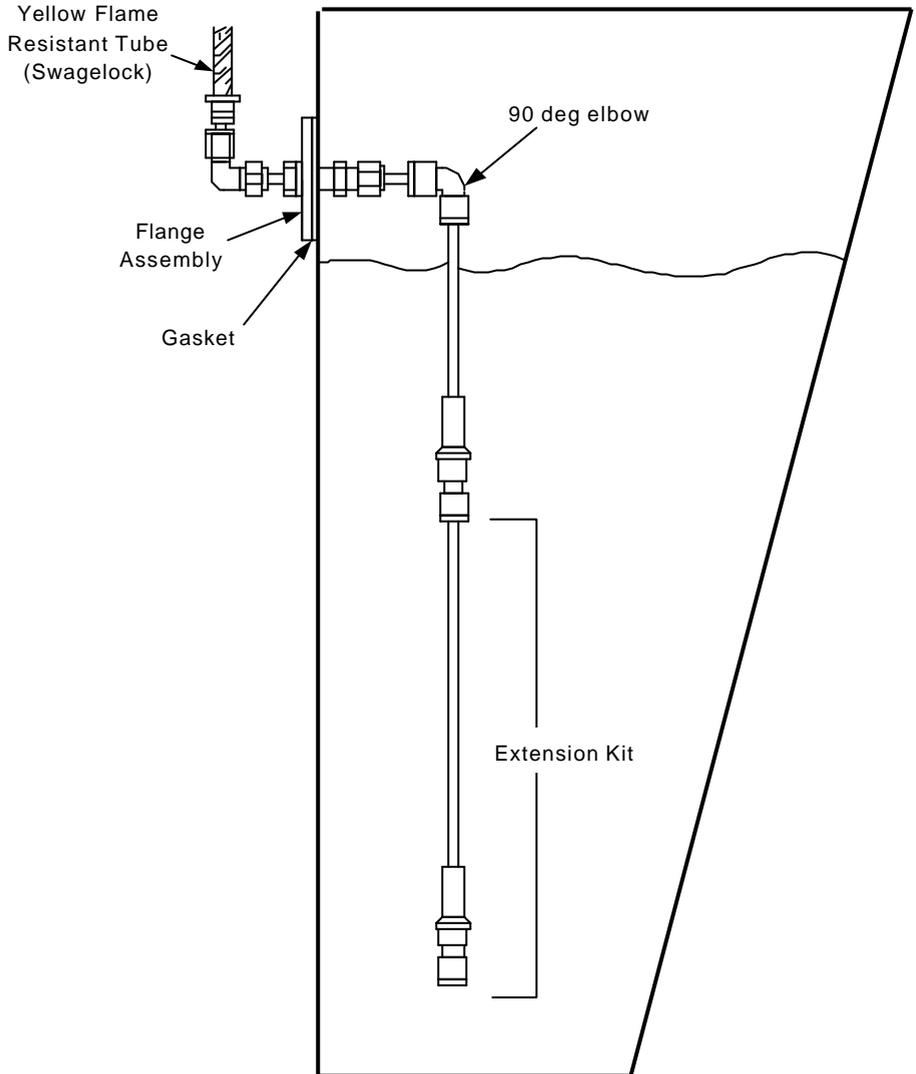


Notes: The end of the nylon tube must be installed above the pick-up tube for any installed tank, otherwise your system may display fluid that you cannot access.

To use the Extension Kit, simply push the second piece of nylon tubing into the bottom of the union fitting and cut the tube to the correct length and fit the weight as previously described.

The maximum length of the nylon tube must not exceed 2.7m (9 feet); the minimum length is 228mm (9 inches).

6.3 Side Tank Installation



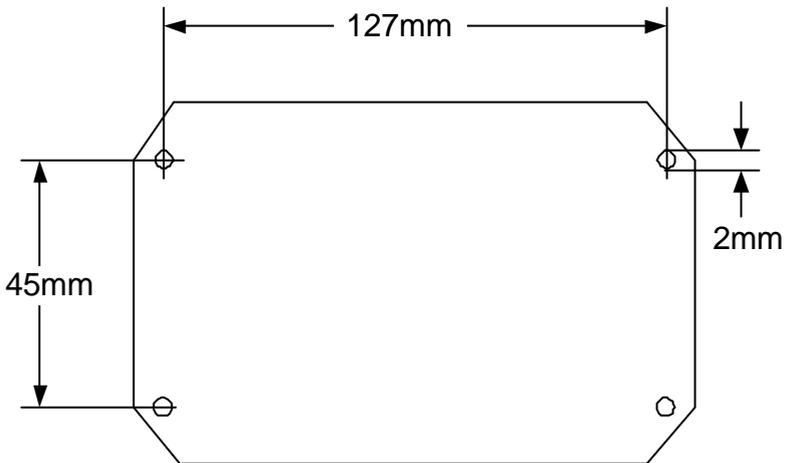
Tank Level Sensing Processor and Sensors

6.4 Installation of the Sensor Module

1. Select a dry location above the tank height and, using the dimensions from the template below to ensure adequate clearance from other equipment or structures, drill the mounting holes for the unit. Using the self-tapping screws supplied secure the Sensor Module.

Note: The Sensor Module must not be submerged. Install the module with the tubing and cable entries facing downward to prevent dust and debris from blocking the filter.

2. Secure the tubing so that no kinks occur and firmly push the free end of the Swagelock tubing to the quick connect fitting on the sensor module.
3. The tank sensor module must be mounted within 3m of the tank insert.

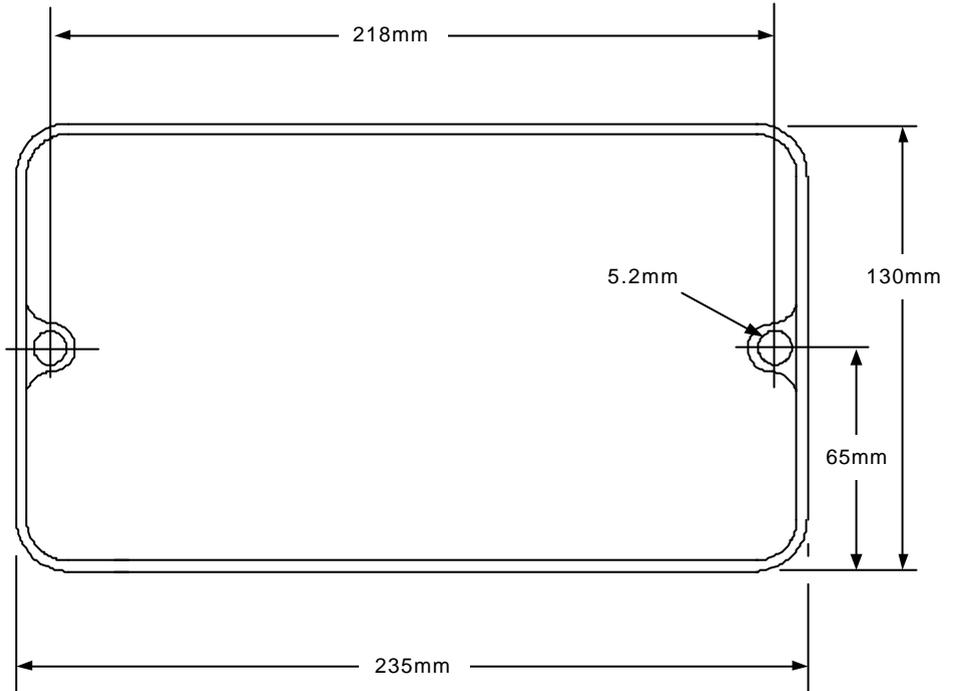


WARNING: THIS DIAGRAM IS NOT DRAWN TO SCALE.

Tank Level Sensing Processor and Sensors

6.5 Installation of the Tank Level Sensing Processor

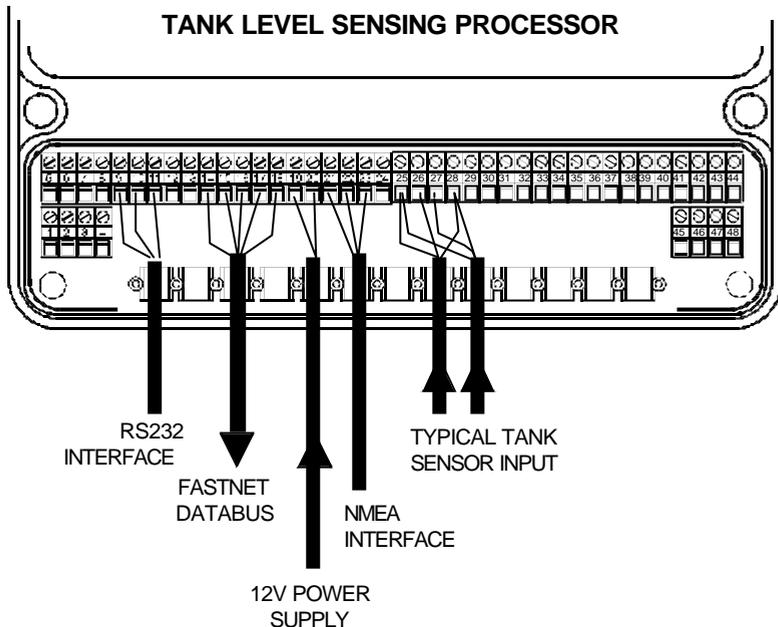
Select a suitable dry location and, using the dimensions from the template diagram below, secure the processor unit with the screws supplied.



WARNING: THIS DIAGRAM IS NOT DRAWN TO SCALE

Tank Level Sensing Processor and Sensors

6.6 Tank Level Sensing Processor Electrical Connections



- Notes:**
1. All screened wires must have their screen attached to the clamp bar across the front case.
 2. Tank sensor inputs to the processor should be wired in pairs with the two sensors sharing common power and ground connections.

Terminal	Function	Wire Colour	Cable
1	0 VDC to Tank Sensors	Black	TBA 3 cores
2	Port Forward Ballast	White	
3	Port Middle Ballast	White	
4	8 VDC to Tank Sensor	Red	
5	0 VDC to Tank Sensor	Black	
6	Port Aft Ballast	White	
7	Stbd Forward Ballast	White	
8	8 VDC to Tank Sensor	Red	
9	RS232 (RX)	Red	135-0A-160 9 way D-Type Socket
10	RS232 (TX)	Blue	
11	RS 232 Ground	Black	

Tank Level Sensing Processor and Sensors

Terminal	Function	Wire Colour	Cable
14	Network Data -	Green	135-0A-130 4 cores/screen
15	Network Data +	White	
16	Network Screen	N/C	
17	Supply Ground	Black	
18	Supply +ve (12V nom.)	Red	
19	0 VDC Tank Supply		
20	12 VDC Tank Supply		
21	NMEA Output -	Blue	135-0B-098 2 cores/screen
22	NMEA Output +	Red	
23	NMEA Ground		
25	0 VDC to Tank Sensor	Black	TBA 3 cores
26	Stbd Middle Ballast	White	
27	Stbd Aft Ballast	White	
28	8 VDC to Tank Sensor	Red	
29	0 VDC to Tank Sensor	Black	
30	Water	White	
31	Port Water	White	
32	8 VDC to Tank Sensor	Red	
33	0 VDC to Tank Sensor	Black	
34	Stbd Water	White	
35	Fuel	White	
36	8 VDC to Tank Sensor	Red	
37	0 VDC to Tank Sensor	Black	
38	Port Fuel	White	
39	Stbd Fuel	White	
40	8 VDC to Tank Sensor	Red	

Tank Level Sensing Processor and Sensors

7 Setup

7.1 Configuration

7.1.1 Sensor Inputs

The TLSP has the ability to accept inputs from up to 12 sensors. In the majority of cases not all 12 will be used so the TLSP will require configuration in order that it should know which tank input controls which tank function.

- Scroll to the **'TANKS'** menu on the FFD, press **ENTER**.
- Scroll to **'CONFIG'**, press **ENTER**.
- Scroll to **'CALIBRATE'** on the opposite side of the display.
- Select the number of tanks and inputs to be made available. For example, if 4 tank sensors are fitted set this value to 4. This will *enable* the inputs 1-4 on the TLSP.

Only select the number of sensors actually fitted.

7.1.2 FFD Text

The text assigned to a tank may be selected from a range of pre-set text, or using a PC attached to the TLSP, custom text may be assigned. When a sensor input has been configured a default text legend will be applied to it as follows:

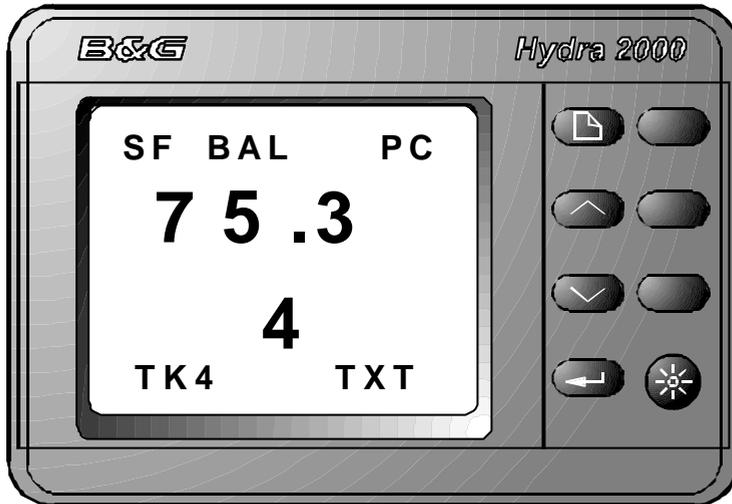
Sensor Input	FFD Text legend
1	P F BAL
2	P M BAL
3	P A BAL
4	S F BAL
5	S M BAL
6	S A BAL
7	WATER
8	P WATER
9	S WATER
10	FUEL
11	P FUEL
12	S FUEL

To change the text for a sensor input:

- Scroll through the menu system to the desired tank.
- Scroll to **'CALIBRATE'**, on the opposite side of the display.
- Press **ENTER**, Scroll to **'CAL VAL 4'**.
- Press **ENTER**, a number corresponding to the text (see table above) is shown.
- To change the text press **ENTER**, alter the display to your desired text, press **ENTER** again to confirm.

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An example is shown, setting tank 4 input.



To avoid confusion, it is not possible to assign the same text to 2 different sensor inputs. If the text is changed, the sensor input associated with that text will change to display **TANK xx**, until it's **CAL VAL 4** is also changed.

If **CAL VAL 4** is set to 0, **TANK xx** will be displayed.

Using a PC attached to the TLSP, it is possible to assign custom labels up to 8 characters in length to the tank sensor inputs. When custom text has been assigned to a tank input, requesting **CAL VAL 4** will result in the text **CuSt** being displayed. The PC will be the only method of changing the text.

7.1.3 Units

The information from the tank sensor is viewed via the FFD under the menu heading of **TANKS**. Although up to 12 tanks can be measured, the actual number of sensors connected may be selected and the associated text assigned to each.

The information relating to the various tanks may be displayed in the following units:

Percentage	PC	1% increments - (0% to 100%)
Litres	Lt	1L increments - (0L to 999L)
US Gallons	UG	1/2G increments - (0G to 999.5G)
Imperial Gallons	IG	1/2G increments - (0G to 999.5G)

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To change the displayed units for each sensor:

- Scroll to the **'TANKS'** menu on the FFD, press **ENTER**.
- Scroll to highlight the tank to be changed, press **ENTER**.
- Scroll to **'CALIBRATE'** on the opposite side of the display.
- Press **ENTER** so that **'CAL VAL1'** is flashing.
- Press **ENTER**, the current setting for the units is shown.
- To change the units press **ENTER**, change the value, press **ENTER** again to confirm.

The units may be changed to any one of the following values:

Percentage	0 (Default)
Litres	1
US Gallons	2
Imperial Gallons	3

If an un-calibrated sensor is selected, it will display **CAL** until the Max/Min levels have been set.

The displayed units may also be changed with the use of the Advanced Calibration software package as described on Pages 12 to 14 of this manual.

8 Calibration

There are two ways in which tanks may be calibrated:

1. **Basic**, this method is used when the tank is a regular shape i.e. square or rectangular.
2. **Advanced**, this method is used when the tank is an irregular shape.

8.1 Basic Calibration

The basic method of calibrating tank sensors is to instruct the TLSP when the tank is empty and what the volume is when full.

Ensure the relevant tank is empty, or temporarily remove the yellow flame resistant tube from the Sensor Module for that tank. This will replicate the 'EMPTY' tank situation.

Note: Before setting both 'FULL' and 'EMPTY' calibrations, the pressure transducer must be purged. Press the small button on the underside of the Sensor Module for a minimum of 8 seconds. Ensure the measurement units you wish to use are set up before beginning your calibration (refer to Page 9 of this manual).

To Calibrate 'EMPTY'

- Scroll through the menu system to the desired tank.
- With the desired tank shown on the display, scroll to **'CALBRATE'** on the opposite side of the display.
- Press **ENTER**, scroll to **'CAL VAL 2'** (Set Zero).
- Press **ENTER**, "1" is displayed.
- To set the minimum (zero) level, press **ENTER**, change the "1" to "0".
- Press **ENTER** to confirm, the minimum point is now set.

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To Calibrate 'FULL'

- Ensure that the tank is full and all connections are secure; check that the yellow flame resistant tubing is connected to the Sensor Module, (refer to the Note on Page 12 of this manual).
- Scroll to '**CAL VAL 3**' (Full Vol).
- Press **ENTER**, the default maximum value is displayed.
- To set the maximum level, press **ENTER** and scroll up to set the value, which is the maximum tank capacity (e.g. if the tank is 90 US Gallons and the units are set in US Gallons then enter 90).

In the case of the units being calibrated in per cent (%), the maximum will always be recorded as 100.

8.1.1 Locking Calibration

This facility is used to stop accidental erasure of the calibrations by either a system reset or by accidental changing via the FFD.

To lock or unlock calibrations:

- Scroll through the menu system to '**TANKS ? CONFIG**'.
- Select '**CALIBRATE**' on the opposite side of the display.
- Press **ENTER**, Scroll to '**CAL VAL 2**'.
- Press **ENTER**, and scroll to '**1**' to lock calibrations or '**0**' to unlock.
- Press **ENTER**, to confirm your selection.

8.2 Advanced Calibration – PC Software Configuration

The Tank Monitoring System is supplied with a PC software configuration utility to enable advanced calibration of the system. The PC utility enables you to calibrate regular and irregular shaped tanks for volume.

8.2.1 System requirements

- PC with a PENTIUM class processor.
- Microsoft WINDOWS 95, 98, 2000 or NT4.
- 16Mb of RAM and 4 Mb of free disk space.
- Minimum VGA graphics (640*480).
- Serial (COM) port.

8.2.2 PC Communications

The TLSP has a RS232 port to allow 2-way communications to a PC for calibrating or monitoring levels on the tanks. Below is a list of the messages and replies that are used. All absolute volumes are in litres, the PC software will convert litres to gallons if required.

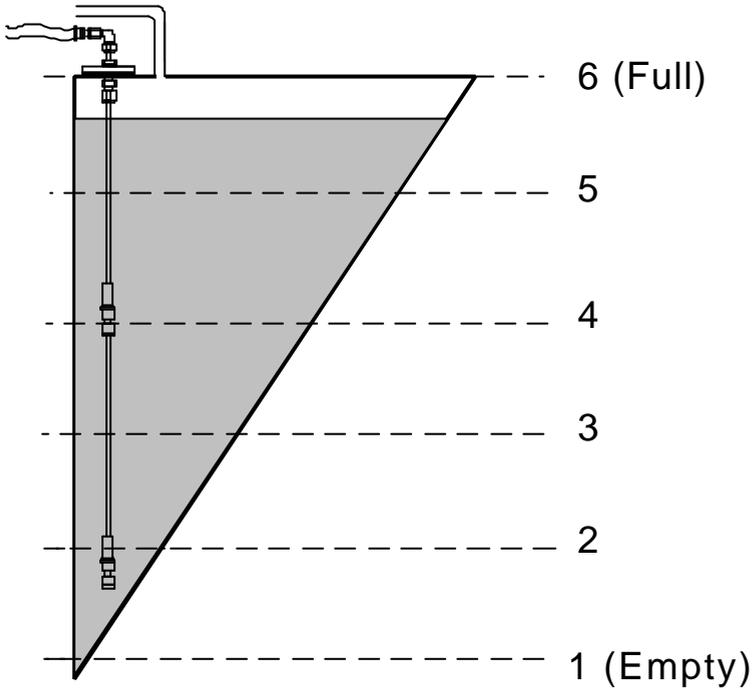
Baud Rate:	9600
Data Bits:	8
Stop Bits:	1
Parity:	None

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8.2.3 Overview

The software will support up to 10 incremental steps for calibrating the volume of your tank, however for the examples below, six stages have been chosen: Empty, Full and four intermediate levels. The readings from the sensor are then interpolated between these known values to give an accurate representation of the quantities of liquid in the tanks at any given point.

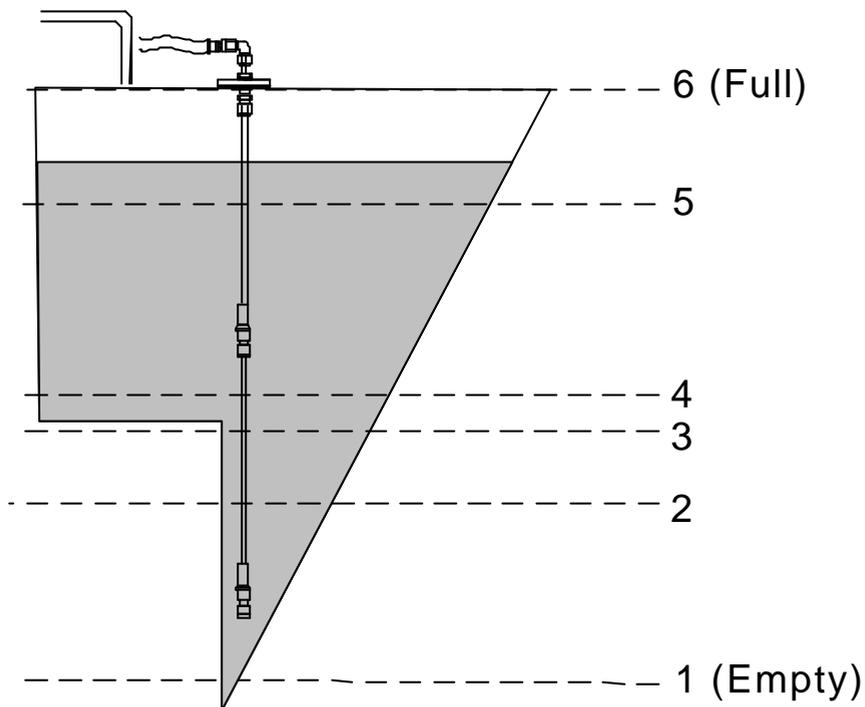
For example a tank which is triangular in section, may be calibrated as follows:



Triangular Tank
Section

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In the case of a very irregular tank it would be sensible to bias the calibration points in the area around the irregularity, as detailed in the example below:



Irregular Shaped Tank Section

The readings obtained from the tank may be 'damped' to reduce any oscillation in values as the water moves in the tank. The duration of the damping can be changed via the system displays. (Refer to Para 10).

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8.3 Calibration Procedure

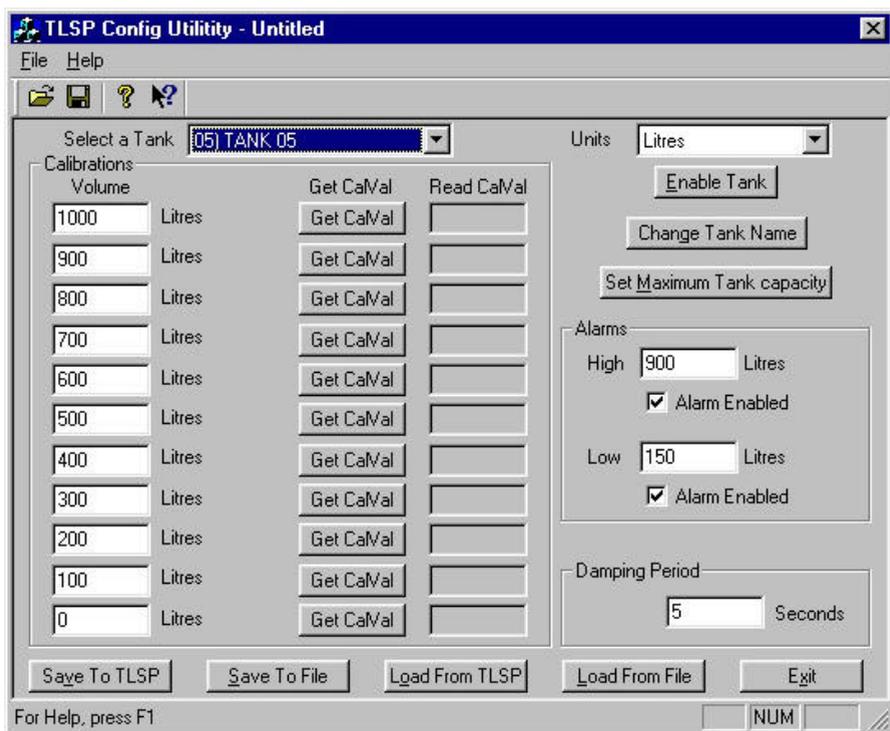
To start the PC utility:

- Ensure that the Tank Monitoring Processor is connected to one of the PC's COM ports (COM port numbers over 8 are not recognised by the software)
- Ensure that the B&G system power is switched on.
- Start the B&G Tank Monitoring System PC Utility on the PC.
- The software will identify the COM port and establish communication with the Tank Monitoring System. [If the software is unable to detect the Tank Monitoring System the software will ask that you check the connections and power to the system].

Once the software has started and communications are established, the software will display the current settings from your processor. If this is the initial calibration then the data displayed will be the factory defaults.

8.3.1 To configure a tank :

- Select the desired tank using the “**Select a Tank**” drop down box. The screen is updated with the current configuration of the tank selected:



An example of a typical Tank Configuration screen shot

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- If the tank is Disabled then it can be Enabled by clicking the “**Enable Tank**” button. Note that you can only enable tanks in sequence (enabling tanks 1,2,3 and 4 is accepted. Enabling tanks 3,4,8,11 is not for example).
- To change the name of a tank click the “**Change Tank Name**” button and enter the new tank name. Press **OK** to accept or **Cancel** to discard.
- To set the units displayed select the appropriate option from the “**Units**” drop down box.
- If the selected units are not “**per cent**”, then click on the “**Set Maximum Tank capacity**” button and enter the maximum volume of the tank. The configuration table will then be filled with a range of “suggested” calibration values.

8.3.2 To calibrate the tank:

- When calibrating a tank, it should be filled using a flow meter or other method of accurate measurement to ensure a satisfactory result.
- The procedure must be started with the tank empty.
- Set the maximum tank capacity with the exact value, if known.
- If the exact value is not known, an estimate may be used, however this value must be corrected to the measured maximum capacity value before pressing ‘**Get Cal Val**’ for the maximum value.
- The setting of the maximum tank capacity serves to evenly distribute the periods at which a calibration value is obtained. These may be adjusted to a measured value until ‘**Get Cal Val**’ is pressed for that volume. For example, if you wish to calibrate at 132 Litres and end up with a capacity of 137 Litres, before pressing ‘**Get Cal Val**’, you may change 132 to 137, rather than attempting to remove contents from the tank.
- You may use up to 11 steps to calibrate your tank. If you wish to use fewer calibration steps, i.e. 5 points including FULL and EMPTY. Enter **0** in the bottom line of the ‘**Calibrations**’ box, and your selected values on the lines above. All volume boxes above your maximum value must be left blank.
- Calibrate as per the instructions given previously, ensuring that ‘**Get Cal Val**’ is not pressed for any of the blank values.

8.3.3 Sending and Saving configuration data

After calibration figures have been calculated and configurations set the data should be uploaded to the system by clicking the “**Save to TLSP**” button.

It is recommended that you backup your calibration data by using the ‘**Save to File**’ button, and saving to your PC for future use if required.

To close the Configuration utility press the “**Exit**” button.

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9 Alarms

Once the system has been correctly calibrated the system will display the levels of the tanks in the units desired. The system allows the user to set alarms and alter the damping value.

Each enabled tank sensor may have a **minimum** and **maximum** alarm threshold set to it. When setting the alarm, the threshold level is in the same units as the displayed reading; i.e. if Tank 1 is in gallons then the alarm value will also be in gallons. When a tank goes into alarm a system wide alarm signal will be transmitted. All FFD's will flash until the alarm is acknowledged.

9.1 To set an alarm

- Select the relevant tank data on the upper line of an FFD.
- Scroll Down to **ALARMS** on the lower line of the FFD.
- Press **ENTER**.
- Select the relevant alarm (minimum or maximum).
- Press **ENTER**, the current value/alarm status will be displayed.
- Press **ENTER**, the data will flash.
- Enter the desired value using the scroll keys.
- Press **ENTER** to confirm.

After setting the alarm, pressing the **PAGE** key will return you to normal operation.

9.2 To set an alarm using the PC Utility:

- Enter relevant values in the maximum and/or minimum alarm boxes for the desired tank.
- Check the "**Alarm Enabled**" button.
- To disable the alarm uncheck the "**Alarm Enabled**" button.

10 Damping

The damping of a function is the time taken to average the readings - the higher the damping value the longer the averaging time which leads to less responsive readings. Due to the slow changing nature of most tanks the damping level is set at ten seconds as a default, this can be changed if required.

10.1 To adjust the damping:

- Select the relevant tank data on the upper line of an FFD.
- Scroll Down to **DAMPING** on the lower line of the FFD.
- Press **ENTER**, the current damping value will be displayed.
- Press **ENTER**, the data will flash.
- Enter the desired value using the scroll keys.
- Press **ENTER** to confirm.

After setting the damping value, pressing the **PAGE** key will return you to normal operation.

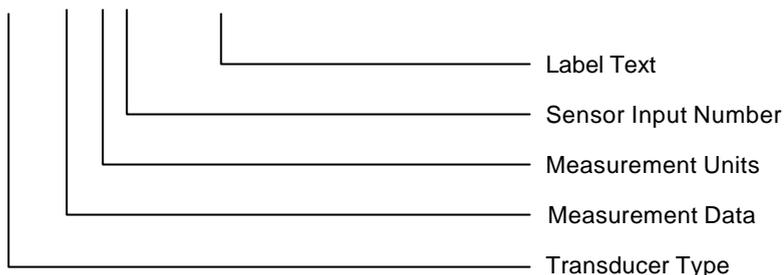
Note: While the sensors modules are purging the air from the tubes the reading is unstable. The TLSP will monitor the system and hold the readings while the purging is being performed. After purging, normal readings will resume. The maximum damping value set by the FFD is 99 seconds.

11 NMEA Output

To allow other equipment to interface with the TLSP, a NMEA sentence is transmitted showing the levels in the tanks. The messages are transmitted using the XDR sentence. Each tank output will have a separate NMEA message.

The format for the XDR message is below:

\$YXXDR,V,0.095,M,1 P F BAL *HH<CR><LF>



From the NMEA specification, the Talker ID is **YX** (Transducer). Transducer type is **V**, (volume). The measurement data is **M**, in cubic meters (1000L = 1M³). The label text is a mixture of the sensor input number and the text displayed on the FFD. The above sentence, decoded reads a volume of **0.095M³** (95L) from sensor input number **1**, which has the FFD text of **'P F BAL'**

The output frequency of the messages is once per second. If the tank system has been setup for percentage only, the output will be 0-100 litres (0-0.1 M³).

12 RS232 Interfacing

12.1 Input messages

Current tank levels are available through the RS232 port by sending the following message:

#OS,s<CR><LF>

s = 0 to stop automatic output.

s = 1 to start automatic output of all enabled sensor inputs.

12.2 Automatic Message Output

S,n,vol,c..c,a<CR><LF>

n = sensor number

vol = volume in tank

c..c = FFD text

a = alarm condition (A=Alarm, N=No Alarm)

In the case of OFF or Err being shown on the FFD the vol field will null.

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