Saab TankRadar™

Service Manual

COMBITECH GROUP
Saab Marine Electronics

Third edition

The contents, descriptions and specifications within this manual are subject to change without notice. Saab Marine Electronics AB accepts no responsibility for any errors that may appear in this manual.

As each Saab TankRadar system is specially designed for each delivery, the contents and illustrations in this manual may differ from your system.

Guide to this manual

If there is a problem with you Saab TankRadar system, start by reading the chapter 9 for information on how to find the problem and how to fix it.

If you are not familiar with the Saab TankRadar system, read chapter 1 to get an overview. If you need more information, read the Technical Description, included in the "As-built drawings and user's manual"-binder.

Use the index at the back of the manual to find the page with the information you are looking for.

Complete service information

If your Saab TankRadar G3 is complemented with Saab TankRadar MaC cargo control system including the Substation for handling of control input and output signals, there is an additional Service Manual for these parts.

In this case the service information is divided in two parts:

- Consult this Saab TankRadar G3 Service Manual for information on the Saab TankRadar G3.
- Consult the Service Manual for Saab TankRadar MaC for information related to the control system's **Substation** and **Redundancy Switch Box**.

Information on how to operate the Saab TankRadar system

If you need information about the operation of the Work Station or the Backup Display of the Level Unit, read the Operating Manual included in the "As-built drawings and user's manual"-binder.

Information about technical data of the Saab TankRadar system

If you need to look at the technical specifications of the Saab TankRadar system, please read the Technical Description included in the "As-built drawings and user's manual"-binder.

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Abbreviations and Denominations:

The following abbreviations are used in this manual:

LC	-	Calculation Unit
LCB	-	Backup Display
LCI	-	Interface Board
LCM	-	Processor Memory Board
LCP	-	Calculation Unit Power Supply
LCS	-	Signal Board
LI	-	Transmitter Interface
LIA	-	Analog/Digital/Power Board
LIZ	-	Zener Barrier Board
LP	-	Power Block
LU	-	Level Unit
TX	-	Transmitter
WS	-	Work Station.

1 General Description of Saab TankRadar

Saab TankRadar is made up mainly by the following parts:

- Transmitters
- Level Unit
- Work Station.

These units are shown in figure 1-1 below.

All Saab TankRadar Marine transmitters are intrinsically safe, providing a number of benefits for the operator. There is a high degree of safety built into the system. Since its impossible for electrical faults to cause an igniting spark, the equipment can be serviced at any time, even though the ship is in operation.

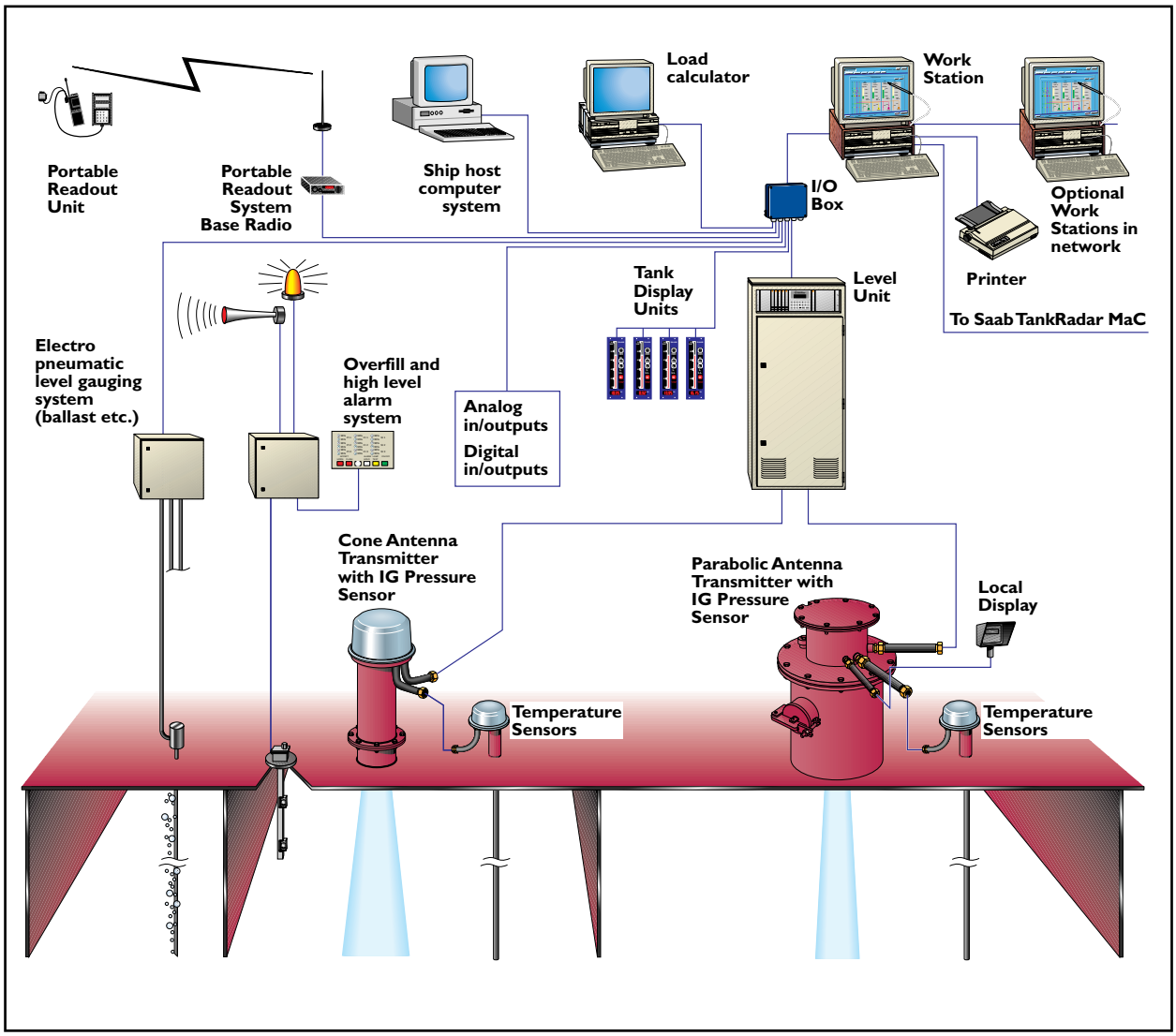

Figure 1-1 shows the TankRadar system with a number of the available options.

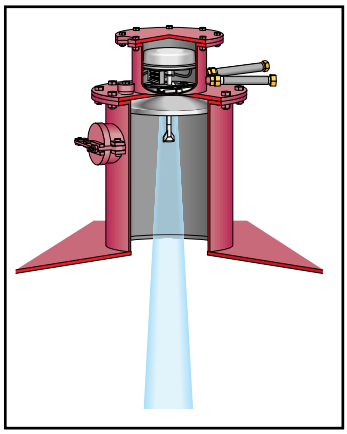

Figure 1-2. Parabolic Antenna

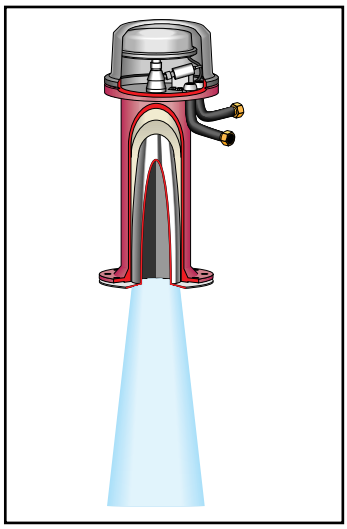

Figure 1-3. Cone Antenna

The Saab TankRadar system is the main part of the Saab Cargo Control system which includes the following optional features:

- Cargo control functions with Saab TankRadar MaC
- Ballast level gauging and draft gauging with the LevelDatic system
- Overfill and high level alarm system with Omicron system
- Load calculation with Kockumation's LoadMaster

The **Work Station** is used by the operator for monitoring of tank ullages, temperatures, inert gas pressures and all the other data that is handled by the Saab TankRadar. The Work Station does the alarm handling of the measured values. The Work Station communicates with other systems, such as load calculators and electro-pneumatic level gauging systems (for ballast etc.) and supervises the Transmitter and Level Unit computers.

The **Level Unit** contains terminals for the intrinsically safe connection of the Transmitters. It contains the electronics used for processing the signals from the Transmitters, for calculating the tank parameters, such as trim/list corrected ullage, and for communicating with the Work Station.

The **Transmitters** measure the distance to the product surface using a continuous radar signal. The Transmitters have an Electronic Box that generates and processes the radar signal.

There are two types of Transmitters, one standard type with a high performance Parabolic Antenna and another with a Cone Antenna.

Optional equipment for each tank, such as temperature sensors, inert gas pressure sensor or the Local Display, is connected to a wire terminal inside the transmitter housing. The inert gas pressure sensor is placed inside the transmitter housing. The Local Display can display ullage, average temperature and inert gas pressure of the tanks.

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1.1 Radar Principle

The radar transmitter on top of the tank emits microwaves directed by an antenna towards the surface of the tank content. The echo from the surface is picked up by the antenna again, and the difference in frequency between the transmitted and the reflected signal is directly proportional to the measured distance, i.e. the ullage indication.

The radar waves are not affected by the atmosphere inside the tank - aggressive chemicals, thick, sticky liquids or any other tank media can be measured without restrictions.

The ideal condition for ullage measurement is a stable cargo surface perpendicular to the radar beam.

Trim or list, foam and waves on the cargo surface and bottom sludge weakens the radar echo. However, the radar echo is usually strong enough for reliable measurements.

But in exceptional cases the radar echo can be lost during turbulent loading/discharging, or with strong trim/list angles, or when measuring close to the tank bottom.

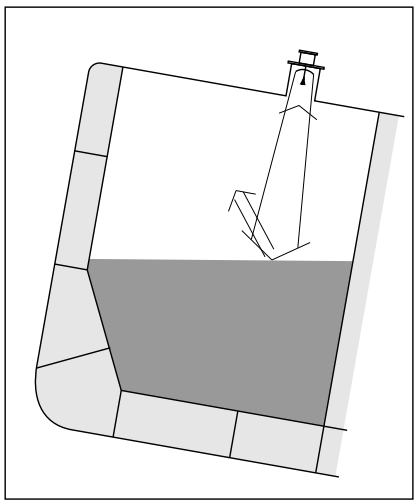


Figure 1-4. An inclined cargo level weakens the radar echo. Trim/list angles of more than + 3° can lead to error in the ullage measurement.

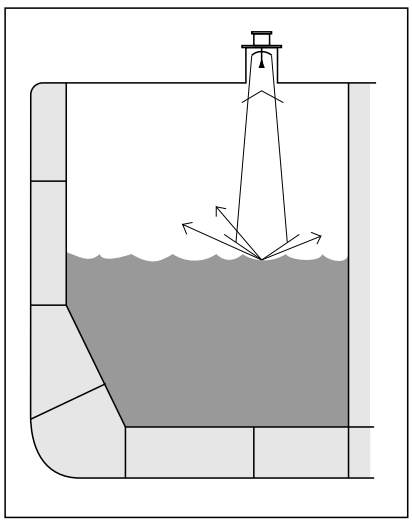


Figure 1-5. Waves on the surface give a scattered and weakened echo signal. Turbulent loading and discharging, especially close to empty tank, can lead to error in the ullage measurement.

2 General Information

Note: *If TankRadar system needs to be switched off, check with officer in charge that it is OK to interrupt the operation of the system.*

2.1 Safety

When connecting equipment in hazardous areas, certain requirements must be fulfilled to provide protection against explosion . There are requirements both for the equipment in the hazardous area on deck and for the associated equipment in non-hazardous area.

The Saab TankRadar system is intrinsically safe and meets the requirements of all the major classification societies. The Transmitters and deck units connected to them, have the following safety approval code:

- EEx ia IIC T4 according to EN50014 and EN 50020 (European Norm)

All other optional equipment such as Portable Readout System, separate high level alarm system, supplied by Saab Marine Electronics, placed in hazardous areas, is also intrinsically safe and meets the requirements of all the major classification societies.

Intrinsic safety is based on the principle of restricting electrical energy available in hazardous-area circuits, so that any sparks or hot surfaces, that may occur as a result of electrical faults in components, are too weak to cause ignition. To accomplish this, zener diodes and current limiting resistors in the Level Unit restrict the maximum voltages and currents into the Transmitters.

Intrinsic safety is the only technique accepted for Zone 0 hazardous areas. It is also safe for the crew or the service personnel and it allows the equipment to be maintained while the ship is in operation.

IMPORTANT!
For trouble shooting and repair work of intrinsically safe equipment or associated equipment, the following rules need to be strictly followed:

- Working permit
- Use only original spare parts from Saab Marine Electronics. Any replacement with non-recognized spare parts will jeopardize the intrinsic safety.

- Use only a certified battery operated multimeter.
- Disconnection of live units in hazardous area is allowed. However, when replacing for example an Electronic Box, it is recommended to disconnect its wiring in the safe area (in the Level Unit).

3 Work Station

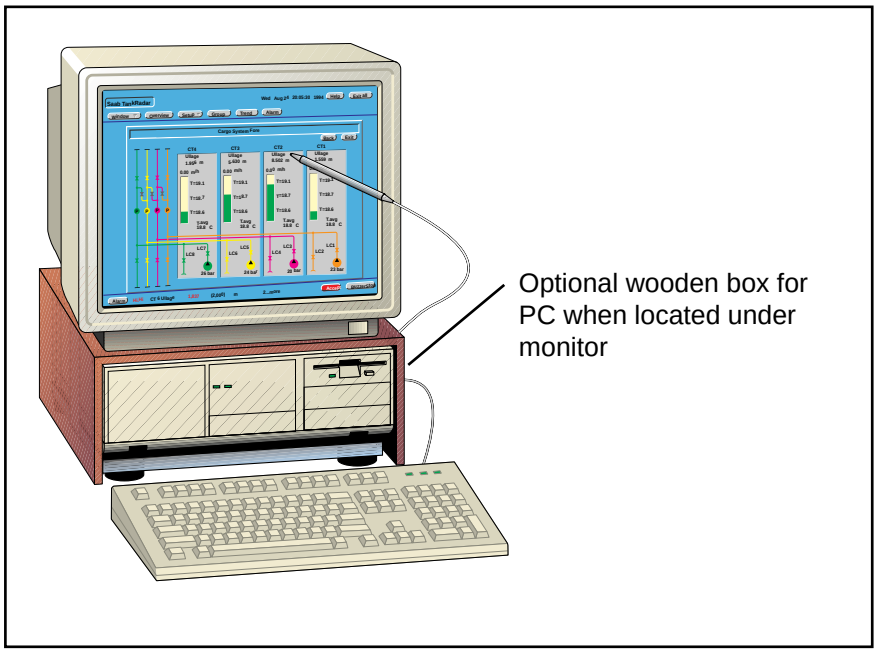


Figure 3-1 shows the Work Station.

The Work Station is operated with a light pen. With the light pen, the operator just points directly on the screen to activate various functions. For input of, for example alarm limits, a keyboard is included.

There is an on-line Help-function, providing direct access to relevant help texts.

As an option, a number of Work Stations can be placed in different locations and connected in a network, sharing data and processing power with each other.

New software can be downloaded from the Work Station to the various units in Saab TankRadar. The Work Station is also used for on board configuration and service of the Transmitters, the Level Unit and the Work Station itself.

The Work Station-software runs under the real-time operating system QNX.

The operation of the Work Station is described in the Operating Manual. However, the Service part of the Work Station software is described in this manual in chapter 3.7.

3.1 Description of the Work Station's Cabinet

Caution: *Always turn the Work Station PC off before removing any cables at the back of the PC.*

Note: *On the inside of the Work Station there are parts that are sensitive to static electricity. Be careful not to expose any of the components inside to static electricity. Always ground yourself by using a grounding wrist band or by touching something that is grounded, before touching any of the components inside the Work Station.*

See maker's manual (Hewlett-Packard) for description of the Work Station PC. This is enclosed in the Saab TankRadar G3 manual binder.

The principle connection of the Work Station is shown on the drawing "Work Station Connection - Principle Diagram" in the "As-built drawings and user's manual"-binder.

3.2 Replacing the Work Station's Hard Disk

See chapters 9.2.1 and 9.2.5 in fault finding section for information on when to change the hard disk of the Work Station.

Remove the Work Station

1. Turn the power off.
2. Disconnect the mains lead.
3. Remove the PC from the ruggedizing kit.
4. See maker's manual (Hewlett-Packard) for detailed information on how to replace the hard disk.

3.3 Replacing a Work Station

Replace the Work Station either with a spare one or by replacing a master Work Station with a slave, if more than one Work Station is included in the system. See fault finding chapters 9.2.1 and 9.2.2 for more information on when it might be necessary to replace the Work Station.

1. Remove all the connectors from both the slave and the master Work Station.
2. On both Work Stations – remove the monitor as well as front and top cover following the instructions in chapter 3.2.1 above.
3. Remove all optional boards (normally the Serial Interface Board and the Network Board) and place them in the new Work Station or Slave Work Station. Make a note of the ethernet address printed on the Network Board.
4. Replace the covers and replace the monitor.

5. Connect all connectors (that were previously connected to the master) to the new master Work Station.
6. Start the new master Work Station.
7. Install program according to the instructions in chapter 3.6. During the installation, select this Work Station as the master.
8. Install database according instructions in chapter 3.32.
9. Restart the Work Station by pressing the Reset-button on the front.

If you have made a slave Work Station become a master, follow the steps below to configure it as a master Work Station.

10. Open the Work Stations-window in the Configure part of the Work Station software. Make a note of the ethernet addresses.
11. Exchange the ethernet addresses between the master and the slave Work Stations. Check that the address corresponds with the note you made in step 3 above.
12. Restart the Work Station by pressing the Reset-button on the front.

3.4 Replacing a Board in the Work Station

There are one or more boards, such as Light Pen Interface Board, Serial Interface Board, Network Board, placed in the Work Station. If you need to replace any of these boards, follow the instructions below.

1. Remove the Work Station from its ruggedizing kit. For opening the Work Station PC, follow the instructions in the maker's manual (Hewlett-Packard) enclosed in the Saab TankRadar G3 manual binder.
2. Remove the faulty board's connectors at the back of the Work Station. Remove the faulty board. In some cases it might be necessary to remove more than one board to reach the faulty board.
3. Replace it with a new board. Connect cables to the boards. If you are replacing a Network Board, make a note of the ethernet address printed on it.
4. Mount cover of the Work Station.
5. Mount the Work Station on its ruggedizing kit and connect monitor and other peripheral units.
6. If you have replaced a Network Board, open the Work Stations-window in the Configure part of the Work Station software.
7. Enter the ethernet address of the new board.
8. Restart the Work Station by pressing the Reset-button on the front.

3.5 Screen Settings of the Work Station Monitor

There are a number of controls below the monitor's screen. Whenever the picture on the screen looks distorted or incorrect, changing the screen settings may produce a better picture.

See maker's manual (Hewlett-Packard) in the Saab TankRadar G3 manual binder for information on the monitor controls.

3.6 Loading Software to a Work Station

Follow the instructions below to install new software onto the hard disk of the Work Station. This needs to be done, for example, if the hard disk has been replaced.

The software consists of three parts: program, database and pictures. This is complemented with your own backup copy of database and pictures.

The program is stored on diskettes that are stored on board. The first diskette is a boot-diskette which means that the PC can be started on that diskette.

If any other diskette is in the drive when powered on, the operator will be notified to remove it.

3.6.1 Install Program on Hard Disk of Work Station

1. Slide the Boot-diskette into the disk drive of the Work Station.
2. Restart the Work Station by pressing the Reset button on the front of the PC. The Work Station will now restart on the Boot-diskette in the disk drive.
3. Follow the instructions on the screen to install the new program.
4. When the installation is finished the Work Station will restart using the new program.

3.6.2 Install Database and Pictures on Hard Disk of Work Station

Database and pictures are stored on a diskette. At the delivery of the TankRadar system, a diskette with files for database and pictures is included. As you make changes to your system you should make backup copies of your database and pictures. See chapter 3.32.

Follow the instructions in chapter 3.32 to install database or pictures onto the hard disk of the Work Station.

3.7 The Service Windows of the Work Station Software

A number of the actions in the fault finding section at the end of this manual suggest operations done on the Work Station.

The Service functions are protected by passwords. The Captain-password is required when:

- installing or backing up database and software in the Service part of the Work Station software,
- downloading or uploading database to Level Unit or Work Station in the Service part of the Work Station software,
- adjusting IG pressure to zero in the Service part of the Work Station software,
- disconnecting a channel,
- changing the Operator-password.

All other functions in the Service part of the Work Station software require the Service-password. Contact Saab Marine Electronics or one of the service agents to receive the Service-password. See list of service agents in chapter 12.

Hit the Window-button at the top of the Work Station screen. Hit the Service-item on the menu to open the Service sub-menu. See figure 3-2.

In the service windows, the dynamic data and database values are in separate boxes. Most of the data in the database boxes can be changed. Where there is data that can be changed (shown as underscored), there are two buttons;

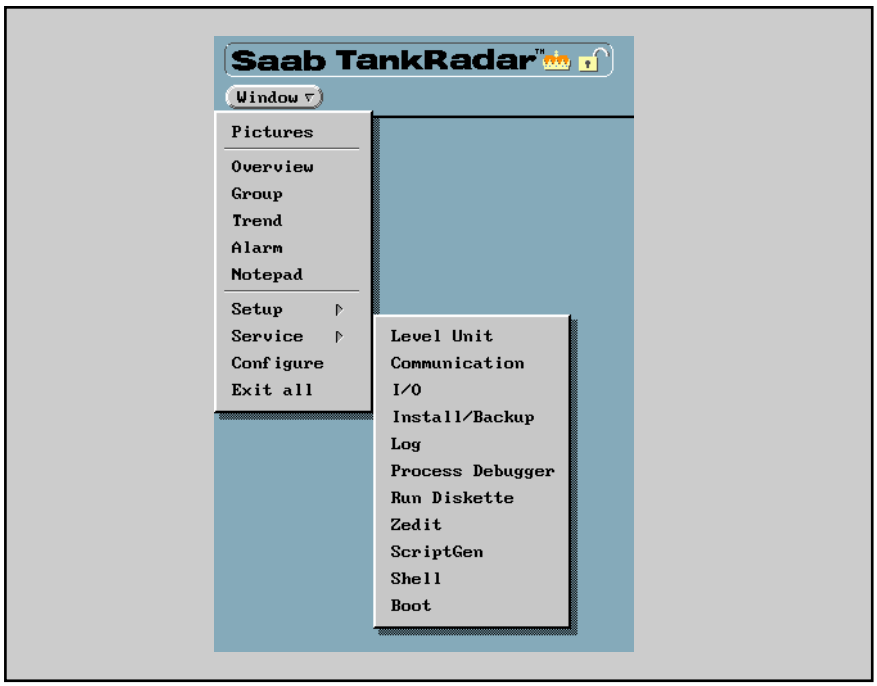


Figure 3-2 shows the Service menu and sub-menu.

Undo and Save. Any data that is changed in these windows is stored according to the settings in the destination part of the Level Unit-window described below. The Undo-button will change an entry, but only if it has not been saved. Once you press the Save-button you cannot undo the entry (unless you enter the previous value and press save again).

3.8 Level Unit – Version Summary and Database Status

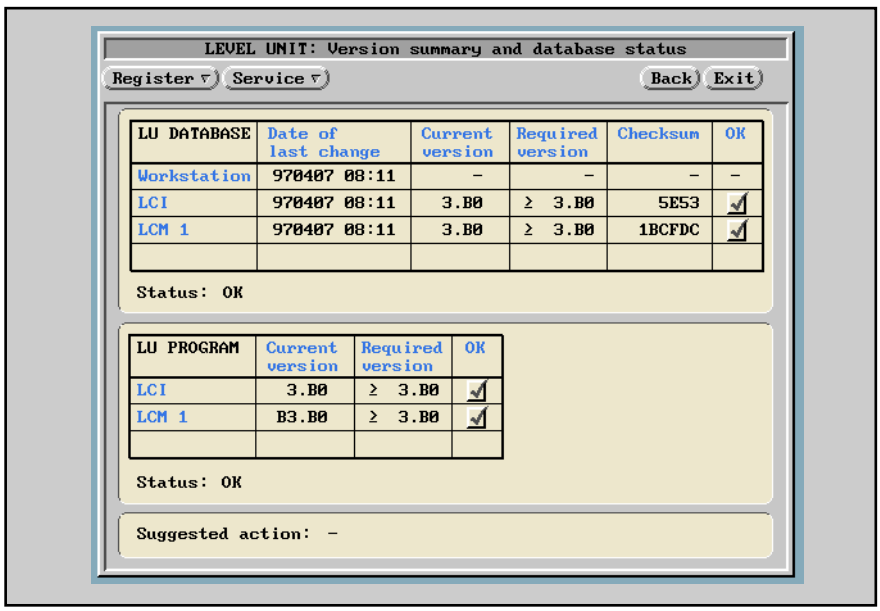
This window shows the version and status of the databases and programs in the LCI and LCMs. You can also see if one or two LCMs are used.

There are status boxes for the different programs as well as the dates for the last changes of the database in the Level Unit.

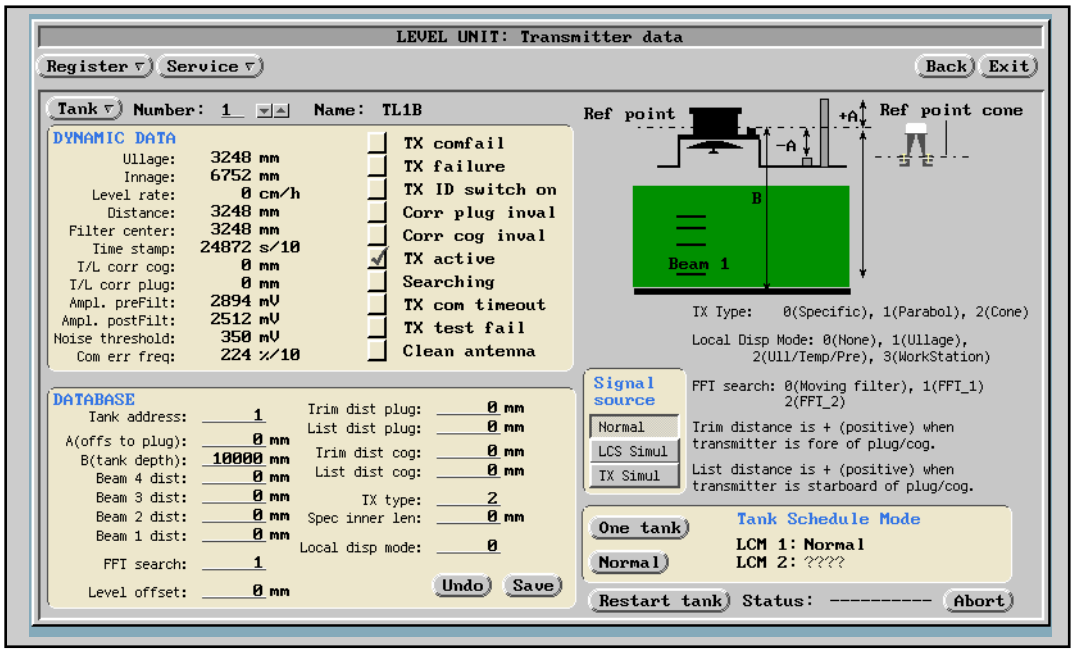
This information can be useful if you need to contact Saab Marine Electronics or one of the service agents.

3.9 Level Unit – Transmitter Data

[Window / Level Unit / Register / Tank Data / Transmitter]



The Transmitter Data-window shows the dynamic data from a Transmitter, as well as the Transmitter's status. The various tank distances stored in the database are displayed in this window. You can change these values in this window. It is also possible to set the Level Unit to a one-tank measurement mode, see chapters 3.25 and 3.14. It is also possible to restart the transmitter by hitting the Restart Tank-button.



Note: When setting the Level Unit into one-tank measurement mode, there is no measurement on the other tanks.

Select a new tank by hitting the Tank-button or by hitting the up or down arrow keys.

The tank number is the internal number in the TankRadar system and is useful when setting the addresses on the optional Tank Display Units, see chapter 8.1. It is also the number that is used when communicating with other systems such as load calculators or ship host computers.

The tank address corresponds to the terminal on the Transmitter Interface to which the Transmitter is connected. Tank addresses 1-15 are connected to LI 1, addresses 16-30 to LI 2, 31-45 to LI 3 and 46-60 to LI 4.

The tank address is usually the same as the tank number. However, they do not need not be the same.

The dynamic data is status or data that is continuously being measured and presented. These values can not be changed by the operator.

- **Ullage** is the distance from the TankRadar reference point down to the surface of the product in the tank. **Innage** is the distance from the bottom up to the surface of the product.
- **Level rate** is the rate at which the surface of the product moves as the tank is loaded or discharged. Positive values indicate that the surface moves upwards.

- **Distance** is the distance from a separate ullage plug, included, to the surface of the product in the tank. It is the ullage plus the A-distance and is T/L-corrected.
- **Filter center** is the location of the center of the measuring filter during the last sweep. This value is normally very close to the ullage value. It can differ when the surface is close to the bottom of the tank or close to a disturbing echo.
- **Time stamp** is a counter that shows that the transmitter is operating.
- **T/L corr cog** shows the correction value used to adjust the ullage value from the TankRadar reference point to a trim and list corrected value at the center of gravity in the tank. The centre of gravity is in this case the center of gravity of the product's surface (COF) when it is at the 98% filling (volume) in the tank.
- **T/L corr plug** is the trim and list corrected ullage at a separate ullage plug (same as A-measure).
- **Ampl prefilt** is the amplitude of the incoming signal from the transmitter before it has passed any filters.
- **Ampl postfilt** is the amplitude of the filtered signal. This is normally the strength of the surface echo. Read the Amplitude postfilt when using the Transmitter Test Cable, see chapter 6.2.
- **Noice threshold**. Any echoes with amplitudes less than the noice threshold do not interfere with the measurement. This value is set to 350 mV as default. A normal echo from an oil surface has an amplitude (Ampl postfilt) of approximately 1500 to 2500 mV.
- **Com err freq**. Shows the frequency of communication errors. Its value should be less than 10 (%/10). A larger value could be an indication of, for example bad wiring. The system should have been running for at least 15 minutes before this value shows a reliable figure. A true indication of the communication performance is available after a few hours operation.

The Transmitter status are shown as check boxes.

- **TX comfail** indicates that the transmitter is not communicating. This produces an alarm on the alarm row.
- **TX failure**. No echo has been found. The transmitter is ordered to wait for a minute, then it starts searching again. The ullage values displayed are the last valid values. The ullage is not updated as long as TX failure is checked.

- **TX ID switch on** is checked when the button on the Service Display is pressed or when positions 4 and 30 on WT500 on the transmitter has been jumpered.
- **Corr plug inval** is checked when the trim and list correction of the ullage cannot be done or when the calculation produces erroneous results. This holds true for the **Corr cog inval** as well. This could be caused by totally incorrect distances from the TankRadar Reference point to the tank's reference point (center of gravity or separate ullage plug).
- **TX active** is checked when the LCM board requests the transmitter to measure. However, this checkbox does not automatically mean that the transmitter is working.
- **Searching.** The transmitter has lost the echo but is searching for it.
- **TX com timeout.** A temporary break in the communication with the transmitter. Does not cause an alarm. The box can be checked for a short while. However if it remains for some time, the **TX sens fail** status will go on resulting in an alarm.
- **TX test fail**. The LCM tests each transmitter regularly. The transmitter sends a known frequency equalling a certain ullage. The LCM calculates the ullage from the test frequency and compares with the expected ullage. If this box is checked there is also an alarm.
  ***Note**: If the TX failure is checked but the TX comfail is not, try exchanging the Electronic Box.*
- **Clean Antenna**. If the strength of the tank signal is slowly weakened over a long period of time, the Clean Antenna box is checked. The effect of both trim and list on the strength of the tank signal are taken into account.
  ***Note**: The Clean Antenna warning may come up if the cargo has extremely low reflectivity, such as certain chemical products.*

A few of the database registers are shown in the window. These registers can be changed and saved.

The tank distances displayed in the database box are explained in the Installation Manual, found in the "As-built drawings and user's manual"-binder. The beam distances can be used when there are disturbing objects in the tank. If required, these distances are set by a service engineer when the TankRadar system is commissioned. These beam distances should normally not be changed once the system has been commissioned.

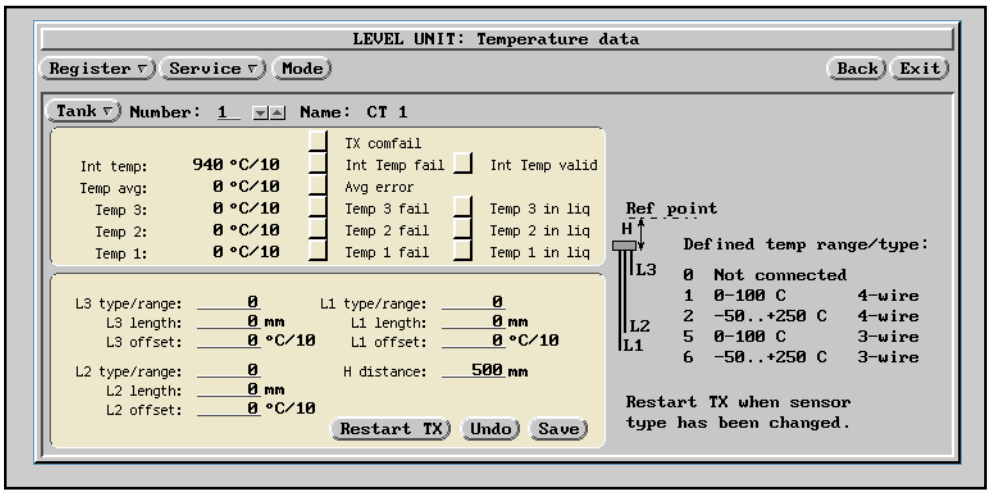
- The **A- and B-distances** are explained in the Installation Manual.
- The **Beam 1-4** distances are used to filter out any disturbing echoes in the tank, where Beam 1 is the lowest in the tank. These values are programmed by a Saab service engineer during the commissioning of the system. They should not be changed.
- **Trim dist plug**, **List dist plug**, **Trim dist cog and List dist cog** are used to define how the correction of the measured ullage should be corrected for trim and list angles. Check if correction is done to a separate ullage plug or to the center of gravity of the tank, in the window "SETUP: Drafts, Trim and List". The trim distance is positive when the TankRadar reference point is fore of the separate ullage plug or the center of gravity. The list distance is positive when the TankRadar reference point is to starboard of the separate ullage plug or the center of gravity.
- **Trim dist plug** is the longitudinal distance from the TankRadar reference point to a separate ullage plug. It is also called the C-distance, see the Installation Manual for more information.
- **List dist plug** is the transversal distance from the TankRadar reference point to a separate ullage plug. It is also called the E-distance, see the Installation Manual for more information.
- **Trim dist cog** is the longitudinal distance from the TankRadar reference point to the center of gravity of the products surface at 98% filling (volume) of the tank (COF). It is also called the C-distance, see the Installation Manual for more information.
- **List dist cog** is the transversal distance from the TankRadar reference point to the center of gravity of the products surface at 98% filling (volume) of the tank (COF). It is also called the E-distance, see the Installation Manual for more information.
- **TX type** describes which type of antenna that is used on the tank.
  - 0 indicates a special antenna,
  - 1 indicates that the Parabolic Antenna is used,
  - 2 indicates that the Cone Antenna is used,
  - XX indicates that the Fast Opening Parabolic Antenna is used.
  - XX indicates that the Draught Antenna is used.
- **Spec inner length** is a theoretical distance correction for the distance from the microwave unit to the TankRadar

reference point. There is no need to enter a value here if **TX type** is selected as 1 or 2.

- The **Local Display Mode** indicates which data the Local Display should show.
  - 0 switches the display off,
  - 1 makes it show ullage continuously.
  - 2 makes it toggle between ullage, average temperature and inert gas pressure.
  - 3 sets the display to show a value sent from the Work Station. This feature is programmed prior to delivery of the system. If no value has been defined, the feature is not working.
  - 4 sets the display to show ullage always in mm
  - 5 sets the Local Display to show the tank address all the time.
- **FFT search.** This indicates the method used to find the echo when it has been lost. The FFT Search method is set by the Saab service engineer when commissioning the system. It should only be changed by a Saab service engineer.

3.10 Level Unit – Temperature Data

The Temperature Data-window shows the dynamic data and the database values for the temperature measurement.



Select a new tank by hitting the Tank-button or by hitting the up or down arrow keys.

The dynamic data box shows:

- **Int temp**. The internal temperature measured by a sensor inside the Transmitter is displayed.
- **Temp avg**. The average temperature calculated as the average of the values from the sensors that are immersed in the liquid.
- **Temp 1, 2 or 3**. The value from each individual sensor is displayed.

The following status are shown:

Note: *Temperature sensor number 1 is the lowest sensor. If only two sensors are used, these will be number 1 and 2, with number 1 as the lowest.*

- **TX comfail** indicates that the transmitter is not communicating. This produces an alarm on the alarm row.
- **Int temp fail**. The internal temperature measurement has failed when the box is checked.
- **Avg error**. This box is checked if it was not possible to calculate any average temperature. For example if there is no temperature sensor in the liquid.
- **Temp 1, 2 or 3 fail.** This temperature sensor does not produce an acceptable value.
- **Int Temp valid**. This box is checked when the internal temperature sensor is producing an acceptable value.

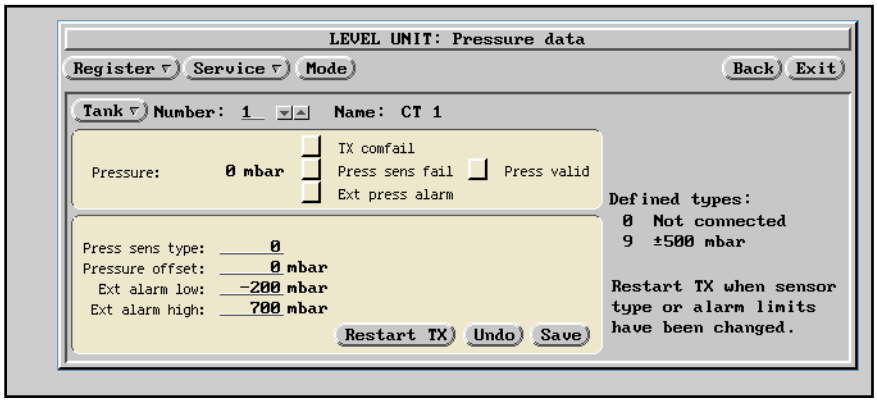
- **Temp 1, 2 or 3 in liq**. This box is checked when this temperature sensor is immersed in the liquid, when it has stabilized and when the ullage value is valid.

The following database data are shown and can be changed:

- **L3, L2 or L1 type/range**. This value shows if it is a three-wire or four-wire type sensor that is used. The temperature range is also defined by this value. The following values can be shown:
  - 0 for no connected temperature sensor.
  - 1 for four-wire sensor with temperature range 0 to +100°C.
  - 2 for four-wire sensor with temperature range -50 to +250°C.
  - 5 for three-wire sensor with temperature range 0 to +100°C.
  - 6 for three-wire sensor with temperature range -50 to +250°C.
- **H distance**. The H distance is explained in the Installation Manual.

Any changes of the database values must be followed by hitting the Save-button as well as restarting the transmitter by hitting the Restart TX-button.

3.11 Level Unit – IG Pressure Data



The IG Pressure Data-window shows the dynamic data and the database values for the IG pressure measurement.

Select a new tank by hitting the Tank-button or by hitting the up or down arrow keys.

The dynamic data box shows:

- **Pressure**. The measured pressure.

The status boxes show:

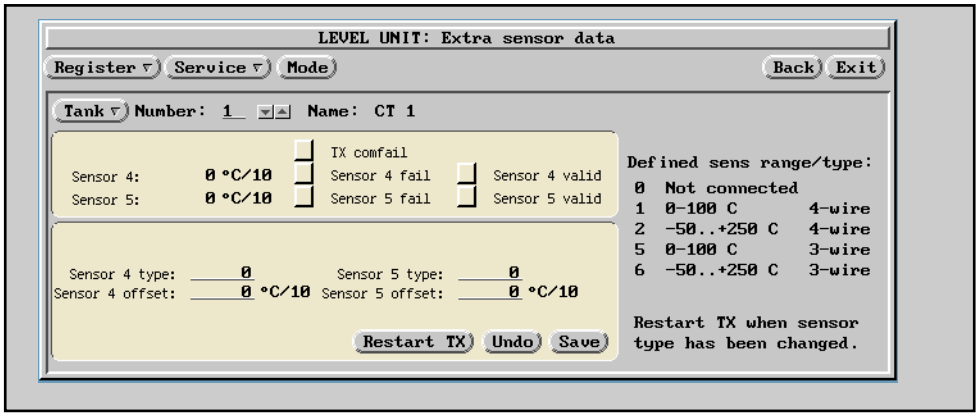
- **TX comfail** indicates that the transmitter is not communicating. This produces an alarm on the alarm row.
- **Press sens fail**. The sensor is faulty. This status will also be shown as an alarm.
- **Press sens valid**. This box is checked when the measurement is working well.
- **Ext. press alarm**. The extreme pressure alarm status is an alarm for rapid detection of changes in the IG pressure. The alarm handling is done in the Transmitter, and the alarm can therefore be displayed to the operator instantly.

The database box shows:

- **Press sens type**. The type of sensor can be set as:
  - 0 for not connected sensor.
  - 9 for ± 500 mbar type sensor.
- **Pressure offset**. The offset correction that has been programmed for the sensor. The pressure offset is programmed by pressing the Service-button in the Level Unit-window, see chapter 3.28 and 6.4.
- **Ext alarm low and Ext alarm high**. Set the high and low alarm limits of the extreme pressure alarm.

Any changes of the database values must be followed by hitting the Save-button as well as restarting the transmitter by hitting the Restart TX-button.

3.12 Level Unit – Extra Sensor Data



The Extra Sensor Data-window shows the dynamic data and the database values for the two extra temperature sensors that can be connected to each transmitter.

Select a new tank by hitting the Tank-button or by hitting the up or down arrow keys.

The dynamic data box shows:

- **Sensor 4 and 5**. The temperature measured by the sensors are displayed in 1/10 of degrees.

The following status are shown:

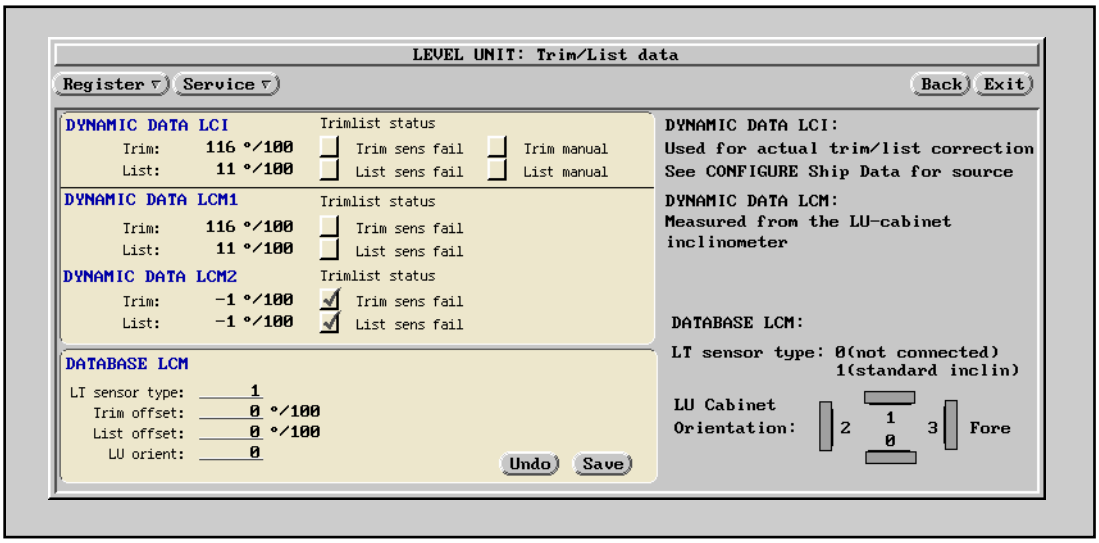
- **TX comfail** indicates that the transmitter is not communicating. This produces an alarm on the alarm row.
- **Sensor 4 or 5 fail**. The temperature sensor has failed when its box is checked. This status will also be shown as an alarm.

The following database data are shown and can be changed:

- **Sensor 4 and 5 type**. This value shows if it is a three-wire or four-wire type sensor that is used. The temperature range is also defined by this value. The following values can be shown:
  - **0**. No connected temperature sensor.
  - **1**. Four-wire sensor. Temperature range 0 to +100°C.
  - **2.** Four-wire sensor. Temperature range -50 to +250°C.
  - **5**. Three-wire sensor. Temperature range 0 to +100°C.
  - **6.** Three-wire sensor. Temperature range -50 to +250°C.
- **Sensor 4 or 5 offset**. An offset can be set for each sensor individually.

Any changes of the database values must be followed by hitting the Save-button as well as restarting the transmitter by hitting the Restart TX-button.

3.13 Level Unit – Trim/List Data



The Trim/List Data-window shows the measured trim and list angles. They are displayed as 1/100 of degrees.

The source of the trim and list values are shown in the Ship measures-window in the Configure-part of the software. Open the Ship measures-window by hitting the Window-key and selecting Configure. Then hit the Picture-button and select Calculation and Ship data.

The dynamic data box is divided into three parts for LCI, LCM 1 and LCM 2. The LCM 1 and 2 read trim and list values produced by the Trim/List Unit mounted in the Level Unit cabinet. The LCI receives its trim and list values from draft sensors, separate inclinometer, from external communication or if it is manually entered.

The status boxes show.

- **Trim or list sens fail**. The sensor in question is faulty.
- **Trim or list manual**. This box is checked if manual values for trim and list have been entered.

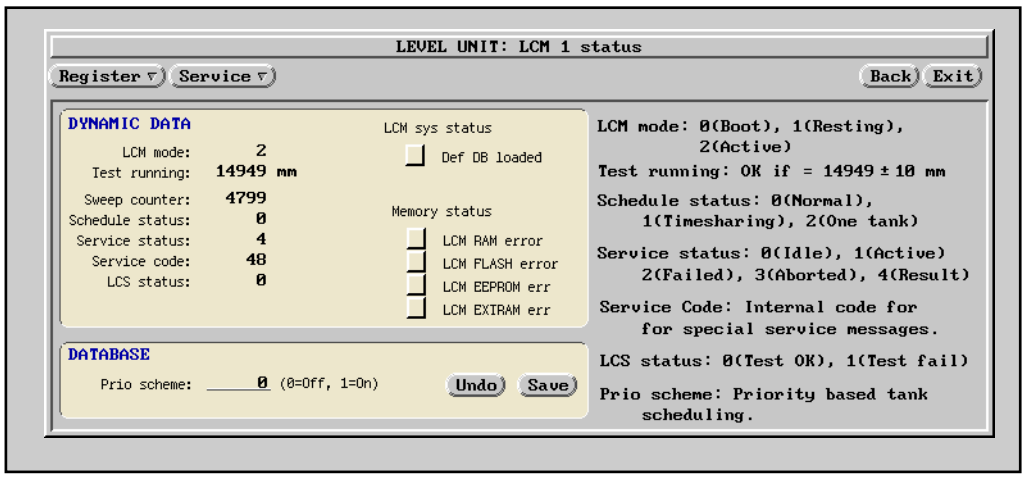
In the database box the following is shown and can be changed:

- **LT sensor type**. Enter 0 if no trim and list sensor is connected. Enter a 1 if the standard Trim/List Unit is used.
- **Trim or list offset**. If you find that the trim/list values displayed by TankRadar are not correct, their offset can be programmed in the database box. The offset is shown in 1/100 degrees angle. For example, enter 5 to set a 0.05° offset.

- LU Orient. This shows in which direction the Level Unit cabinet has been placed on board.
  0 - front of LU faces to port.
  1 - front of LU faces starboard.
  2 - front of LU faces fore
  3 - front of LU faces aft.

Any changes of the database values must be followed by hitting the Save-button.

3.14 Level Unit – LCM 1 and 2 Status



Use these windows to check the status of the Processor Memory Board, LCM. As there can be one or two LCM, there are two windows: LCM 1 Status and LCM 2 Status. To check if there is one or two LCM in the system, see the window LCI, LCM Version, see chapter 3.22.

If there are two LCM in the system, check LCM mode to find out which one is active. The active LCM is also shown in the LCI Status-window described below. See chapter 5.4 for more information on when to use one or two LCM and LCS.

The dynamic data box shows:

- **LCM Mode**. Mode **0** is shown when the board is running the boot software. **1** is shown when it is resting, waiting for the LCI to order it to start measuring. **2** shows that it is running on its flash program.
  Note: If the mode is shown as 0 for a longer period of time, the flash program is probably corrupt in some way. Load new LCM software from the Load Program-window, see chapter 3.23.
  ***Note**: If there is only one LCM and it shows mode 1, there is probably something wrong with the LCI or the communication between LCI and LCM.*

- **Test running**. The LCM asks the LCS for a test signal which is processed and compared with an expected test result. It should show 14949±10 when it is OK. If it is not OK, there will be a LCS failure alarm.
- **Sweep counter**. The sweep counter indicates that the LCM is working. It count ordered sweeps. Check that the sweep counter is counting to see that the board is operating. Check also the Sweep error LCM-status box in the LCI Status-window described below.
- **Schedule status**. Shows the setting in the Transmitter Service window. **0** is the normal mode. A **1** means that every second sweep is done on one of the tanks and the other sweeps are done on the other tanks. **2** means that this is the only transmitter that is measuring. The tank is selected and the schedule mode is set in the Transmitter Service-window. However, in the Transmitter Data it is possible to select mode 0 or 2 for a selected tank.
- **Service status and Service code**. Both of these values can be used by the Saab service engineers. They are of no use to the crew on board the ship.
- **LCS status**. Shows the status of the LCS. **0** means that the LCS is OK, while a **1** indicates that the LCS test failed.

The LCM system and memory status boxes show:

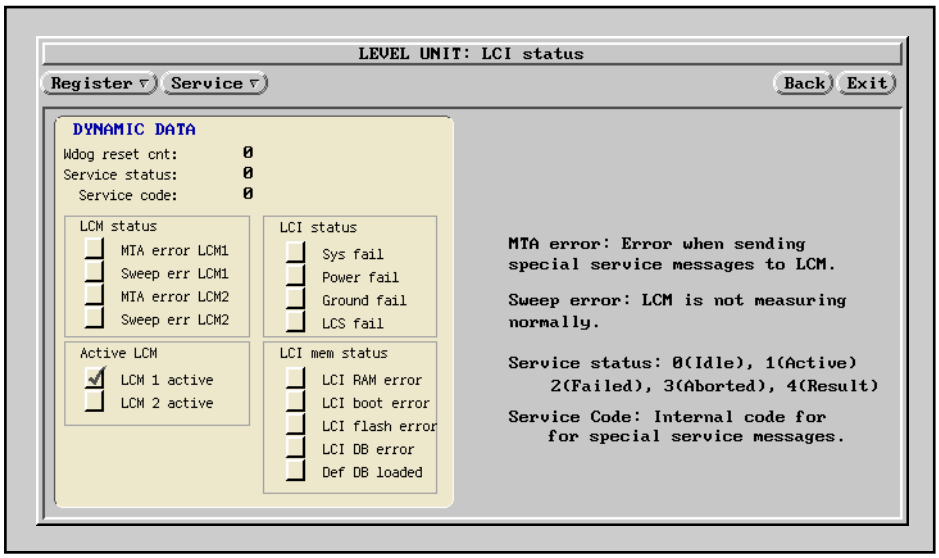
- **Def DB loaded**. The checksum of the database is calculated at startup. If there is some error, the default database is loaded and this box is checked. When this box is checked, a warning appears on the Work Station. See also chapter 9.1.7.
  If this box is checked, download database from Work Station to LCM. The Level Unit restarts automatically when the downloading is finished.
  Restart the Level Unit (see chapter 5.3), to see that default database has been loaded. If the Def DB loaded-box is still checked after restart, the memory on the LCM board is faulty and the board needs to be replaced. See also chapter 9.1.7.
- **LCM RAM error, LCM Flash error, LCM EEPROM error** and **LCM EXTRAM error**. Each time the LCM restarts, the memories are checked. None of these boxes should be checked. If any of these boxes are checked, exchange the LCM.

The database window shows:

- **Prio scheme**. A **0** means that each tank is measured one after the other. However with a **1**, the tanks that have

moving surfaces are measured more often. This function can be useful if there are many tanks, and some of them have large level rates when loading or discharging.

3.15 Level Unit – LCI Status



This window shows the status of the LCI. If you suspect that there is some problem with an LCM, this window provides some good information.

The following information is shown in this window:

- **Wdog reset cnt**. This is a counter that counts the number of times the watchdog has triggered since the last time the Level Unit was powered on. The watchdog is a part of the hardware that triggers a reset if the software gets “stuck”. If it does, the watch dog causes the software to restart. This indication should normally be very low. If there are frequent restarts of the system and this counter shows large values, there may be a problem with the LCI. Try exchanging it.
- **Service status and Service code**. Both of these values can be used by the Saab service engineers. They are of no use to the crew on board the ship.

The **LCM status** box shows the status of the communication between the LCM and LCI:

- **MTA error LCM 1 or 2**. Indication of service message failure between LCI and LCM. If there is an error so that this box becomes checked, the Level Unit will try to restart itself. A message will be displayed “Level Unit restarted”.

- **Sweep err LCM 1 or 2**. This is an indication that the LCM is not measuring normally. The sweep counter on the LCM is supervised. If there is no change in 10 seconds this box becomes checked. See also chapter 3.14. A message will be displayed “Level Unit restarted”.

The **Active LCM** box shows which LCM that is being used. In case there are two LCMs configured in the redundancy mode, this box indicates which of the LCMs that is in use.

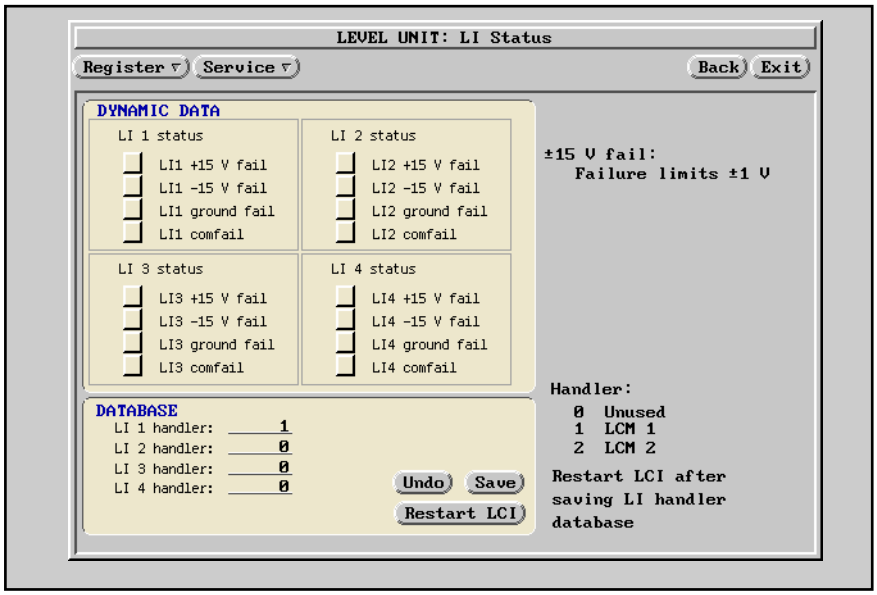
The **LCI status** box shows the status of the LCI:

- **Sys fail**. The Sys fail causes a Level Unit sys fail alarm. It can be caused by:
  - LI power failure,
  - LI communication failure,
  - No active LCM,
  - Error status set in LCM Status-window, see chapter 3.14.

The LCI mem status shows the result of memory checks on the LCI. Both boot and flash memories are continuously supervised.

- **LCI RAM error**. Indicates memory failure of the RAM.
- **LCI boot error**. Indicates memory failure for the boot program.
- **LCI flash error**. Indicates memory failure for the flash program.
- **LCI DB error**. Indicates an error in the database.
- **Default DB loaded**. If the checksum of the database is incorrect at startup, this box is checked. The box will be checked until the next time the LCI (or Level Unit) is restarted or the database is changed.

3.16 Level Unit – LI Status



This window shows the individual status of up to four Transmitter Interfaces (LI).

This window is useful when you are looking for a ground failure. It is easy to detect which Transmitter Interface (LI) that has ground failure. See also chapter 9.1.6 and 9.14.

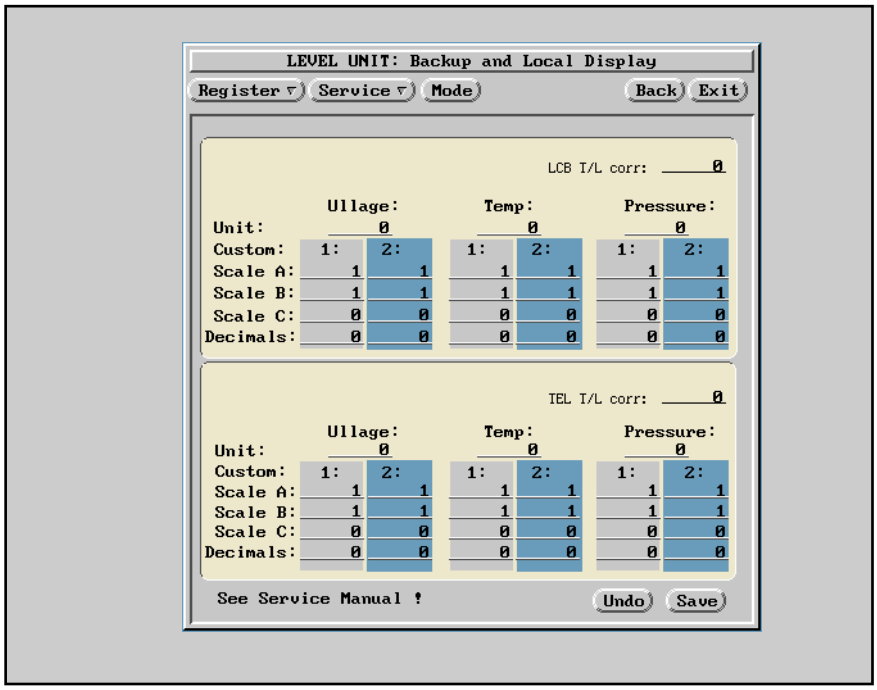
The status boxes show:

- **LI +15V fail** and **LI -15V fail** show if there is any problem with the power supply to the LIs. If any of these are checked, check the Power Block. See chapter 9.1.3.
- **LI ground fail**. This check box indicates which LI that is causing a ground failure alarm.
- **LI comfail**. If there is any problem with the communication to the LI, this is shown in the LI comfail check boxes.

The database shows:

- **LI handler**. The Database box shows which LI that is connected to which LCM. **0** indicates that the LI is not used. **1** indicates the it is connected to LCM 1 and **2** indicates that it is connected to LCM 2.

3.17 Level Unit – Backup and Local Display



This window is used only when special units and special scalings have been programmed into the system at factory before delivery.

A better way to change presentation units and change presentation of trim/list correction is in the Setup-window, opened from the Work Station's base window. See Operating Manual for more information.

However, it is possible to change units and trim/list correction, for the Backup Display and the Local Displays, from the Backup and Local Display-window. You must make the same changes in both windows. At restart of the system, both these databases will be set to the same values anyway.

Set units according to the following:

Ullage:
0 = meter and meter/hour
1 = feet and feet/hour
Temperature:
0 = °C (degrees Celsius)
1 = °F (degrees Fahrenheit)
Pressure:
0 = mbar (millibar)
1 = PSI (pound per square inch)
Trim/list correction:
0 = Uncorrected ullage is displayed

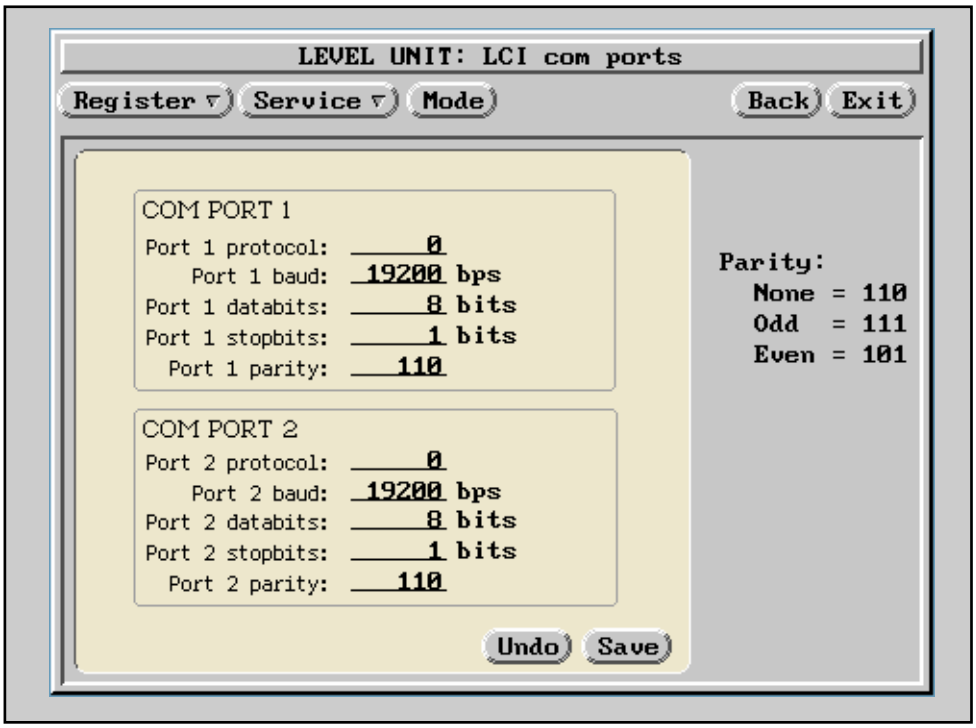
1 = Correction to the tank's reference point (Plug)
2 = Correction to the tank's center of gravity (COG)

It is also possible to use two sets (1 or 2) of customized units for each parameter. These can be scaled from the raw data into the new units using the scale constants A, B and C. The scaling is done according to the formula:

data (in custom units) = (raw data * A) / B + C.

You can also set the number of decimals to be presented on the displays.

3.18 Level Unit – LCI Com Ports



Communication port 1 is usually used for the communication with the Work Station and port 2 is used for a Service PC.

If there is any problem with the communication between the Level Unit and the Work Station, check that the values are:

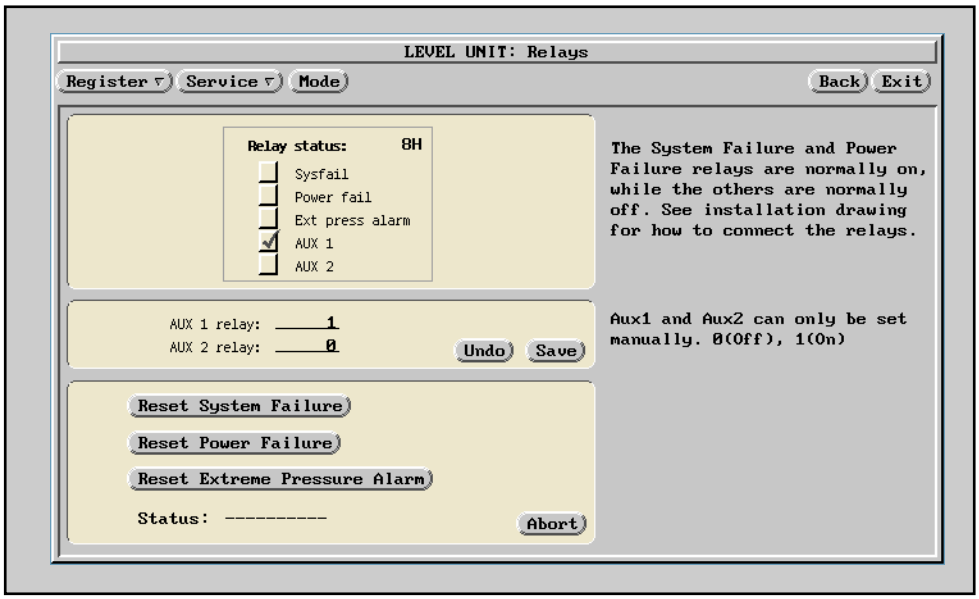
Protocol	=	0
Baud	=	19200 bps
Databits	=	8 bits
Stopbits	=	1 bit
Parity	=	110 (where 110=none, 111=odd and 101=even).

Check also the Serial Communication-window in the configuration part of the Work Station software for communication settings for the Work Station's serial port to the Level Unit.

Note: *The information in this window should normally not be changed. Once the system has been commissioned, the communication parameters have been checked and the communication has been established, there is no need to change this parameters.*

Note: *If there is no contact between the LCI and the Work Station, check the setting of the LCI com ports on the Backup Display on the Level Unit. See the Operating Manual for information about the Backup Display.*

3.19 Level Unit – Relays



In the status box in this window the status of the relays in the Power Block of the Level Unit are shown. These will show the same status as the Sysfail and Power fail in the LCI status window described in chapter 3.15. The External pressure alarm relay will be activated when the this alarm is active. See chapter 3.11 for more information.

***Note**: The Sysfail and Power fail relays are normally on. This means that when the system is working, the relays are activated and consequently off. During a black out, for example, these relays go on.*

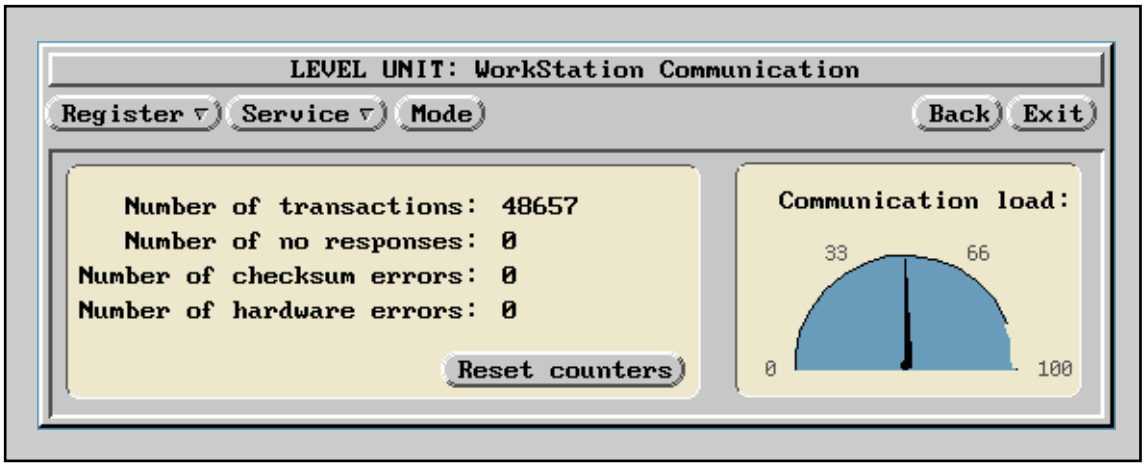
In the TankRadar systems that have a Work Station, the relays in the I/O Box are used instead of the ones in the Level Unit. See also chapter 5.11 and 4.1.4.

In the database box it is possible to manually set the two auxiliary relays in the Power Block. Enter a “1” and hit the Save-button to activate the relay.

If the relays in the Level Unit are used for System Failure, Power Failure and Extreme Pressure Alarm indication, these warnings can be reset by hitting the buttons at the bottom of the window. Use the Abort-button if there would be any problem when hitting the Reset-buttons.

***Note:** It is only the relays that are reset, the alarms may still be active. This is useful for example when you need to quiet a siren that is connected to one of the relays.*

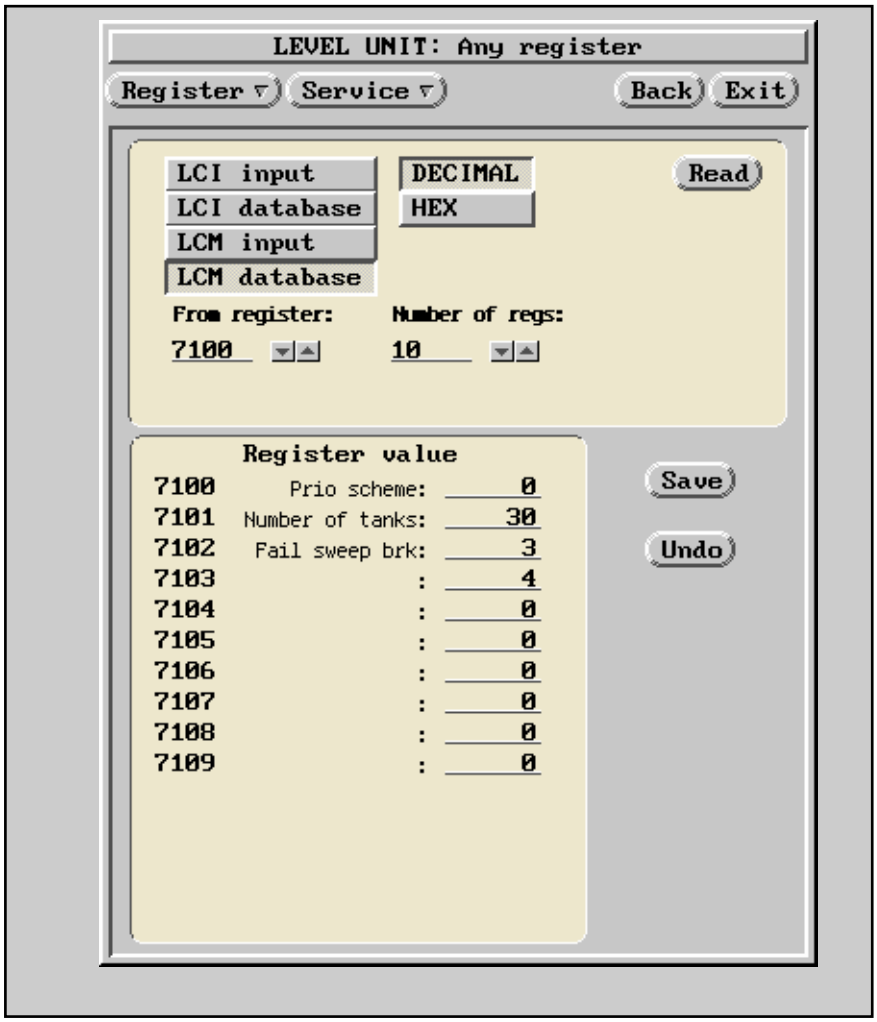
3.20 Level Unit – Work Station Communication



This window shows the load on the communication between the Work Station and the Level Unit. It also shows if the communication is working by counting the number of transactions and responses. You can reset these counters by hitting the Reset counters-button.

Note: *If there is no communication at all the pointer instrument will show 100 % load. The pointer instrument measures the free capacity on the communication. Consequently, if there is no communication, there will be no free capacity.*

3.21 Level Unit – Any Register



In this window you can view any of the registers in the LCMs or the LCI. There are two types of registers, the dynamic registers and the database registers. There are four buttons to select LCI or LCM and to select dynamic or database registers. Hit one of these buttons.

The normally used registers are shown in the windows described in this chapter 3. It is only for extraordinary service actions that you would need to go directly to the register and change data.

You can select if you want to see the registers in hexadecimal or in decimal form. Normally decimal form is best.

Enter at which register you want the displayed list to start at and how many registers you want to see (max 15 at a time). Then hit the Read-button to display the registers you have specified.

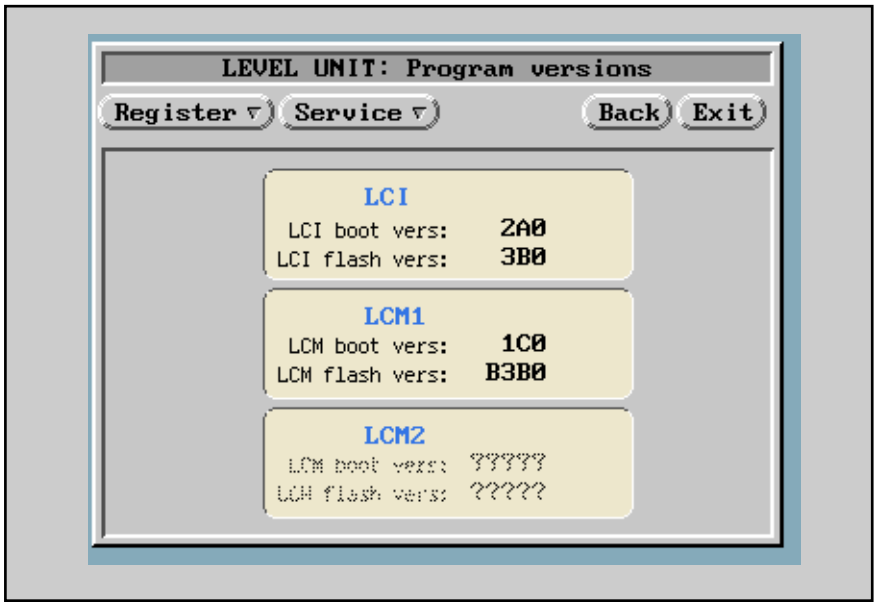
Database registers can be changed. Type in a new value and hit the Save-button.

Note: *You must be sure that you are changing the correct register, as many of the registers lack a descriptor.*

A list of a few of the database registers of the LCI is included below:

Reg no.	Name	Description
00	Port_1_protocol	To Work Station
01	Port_1_baudrate	To Work Station
02	Port_1_databits	To Work Station
03	Port_1_stop bits	To Work Station
04	Port_1_parity	To Work Station
05	Port_2_protocol	To Service PC
06	Port_2_baudrate	To Service PC
07	Port_2_databits	To Service PC
08	Port_2_stop bits	To Service PC
09	Port_2_parity	To Service PC
10	LU_setup	0=fast update, 1= redundance
11	Relay_4_control	0=off, 1=on
12	Relay_5_control	0=off, 1=on
20	LCB_TrimList_corr	0=off, 1=on
21	LCB_ullage_unit	0=m, 1=feet
22	LCB_temp_unit	0=°C, 1=°F
23	LCB_press_unit	0=mbar, 1=PSI
50	LI_1_handler	0=none, 1=LCM1, 2=LCM2
51	LI_2_handler	0=none, 1=LCM1, 2=LCM2
52	LI_3_handler	0=none, 1=LCM1, 2=LCM2
53	LI_4_handler	0=none, 1=LCM1, 2=LCM2
100	Number of tanks	
101	Display shutdown timeout	in seconds

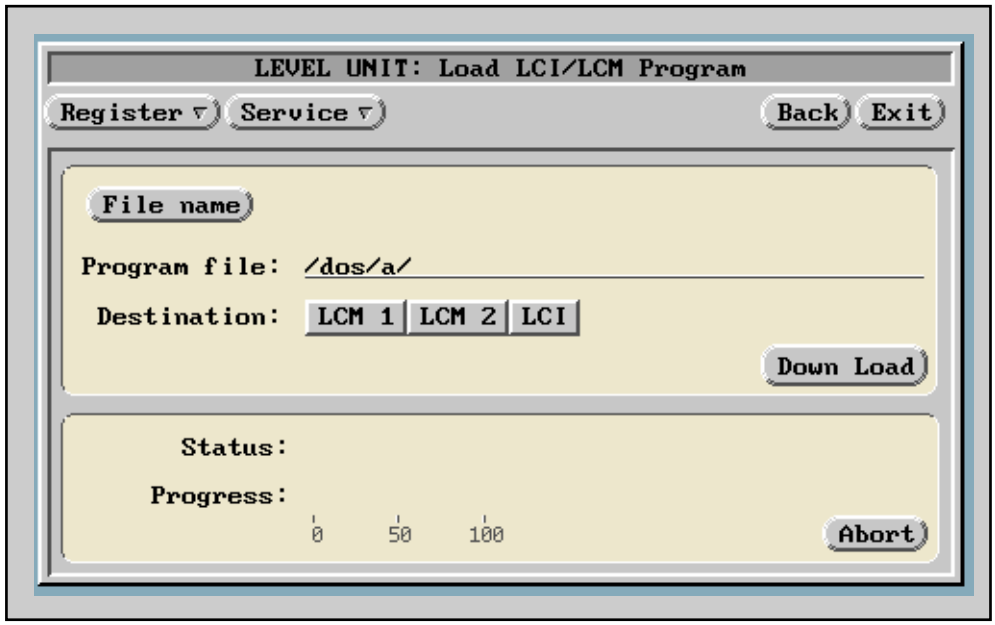
3.22 Level Unit – LCI, LCM Version



In this window you can see the version of the programs in the LCI and LCMs. You can also see if one or two LCMs are used.

This information can be useful if you need to contact Saab Marine Electronics or a service agent.

3.23 Level Unit – Load Program

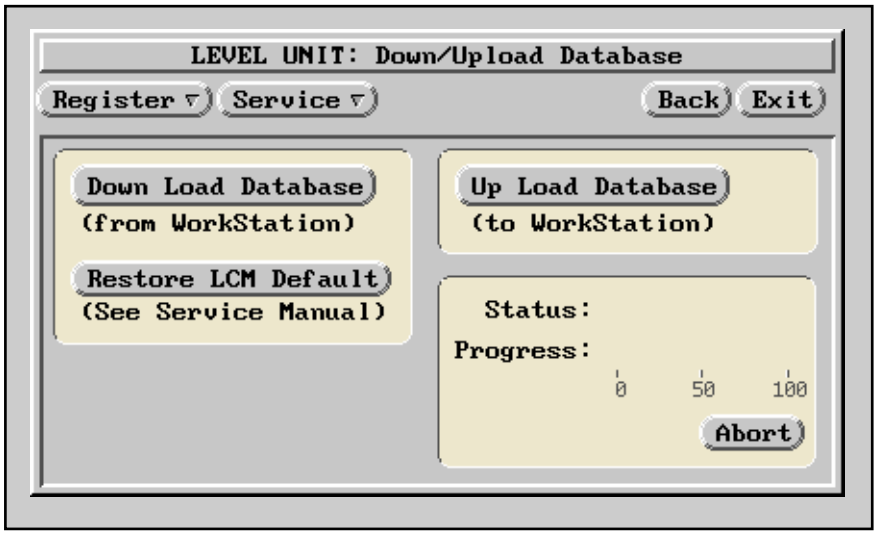


Hit the Service-button to open this window. This window can be used to load new programs into the LCMs and LCI. The new program can be downloaded from a diskette.

Note: *Make sure the new program is compatible with the Work Station software. If unsure, please contact Saab Marine Electronics for advice.*

Insert the diskette with the program into the diskette drive of the Work Station. Hit one of the three buttons to indicate if you want to download a program to LCM 1, LCM 2 or LCI. Hit the Filename-button to find the file containing the program. Hit the Down load-button once you are satisfied with the settings. The progress of the downloading is shown in a bargraph at the bottom of the window. There is an Abort-key. However, once the file has started to download, the original program is lost. Therefore if you abort, you must still down load a new software.

3.24 Level Unit – Up/Download Database

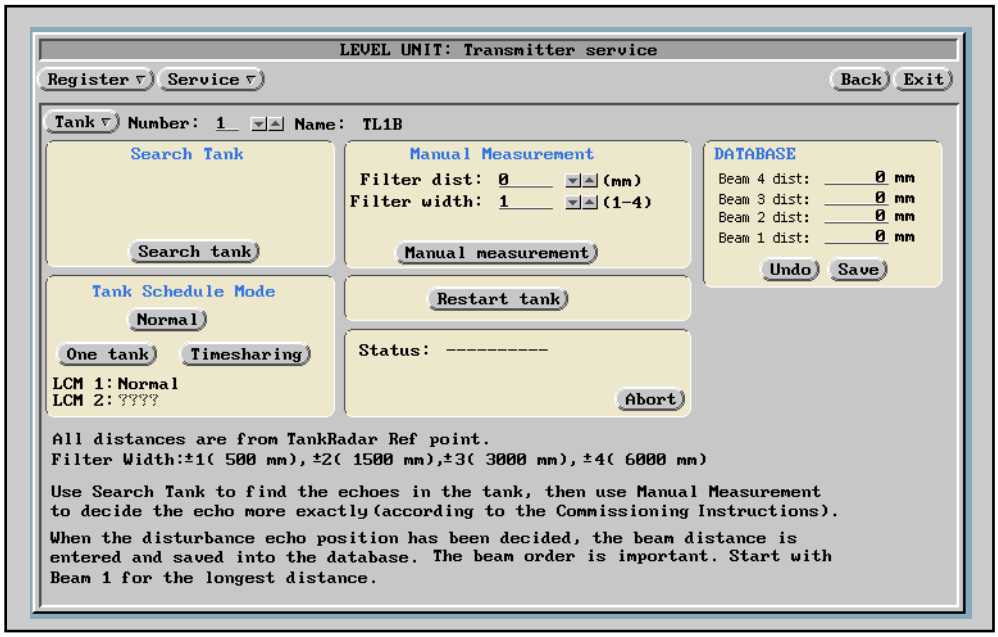


Hit the Service-button to open this window. Use this window to copy database from one memory to another. It is possible to download database from the Work Station to the LCMs and the LCI. It is also possible to upload database from these boards to the Work Station.

This window is useful when you have replaced either an LCM, LCI or a hard disk in the Work Station.

Note: *As the TankRadar system is commissioned, a number of parameters may be changed in the system. These changes are stored in the database. The database will therefore differ from the default database that was installed at delivery of the system.*

3.25 Level Unit – TX Service



The test functions for TX simulation and LCS simulation can be used if a tank has the TX Failure check box marked.

When setting the signal source to TX Simulation, a tank signal will be sent from the Transmitter to the Level Unit. The LCS Simulation generates a signal from within the Level Unit.

The simulation signal represents a “Distance” about half the B-distance if TX Type and Specific Inner Length are set to zero and the Pipe and Vapor Correction are not used. Note that the simulated “Distance” is not precisely defined.

If both TX- and LCS Simulations give a “distance”, but the TX Failure check box is still marked, the reason for fault can be:

- hardware fault in the Transmitter’s Electronic Box,
- dirty, damaged or misaligned antenna,
- the Electronic Box is not correctly mounted on the antenna feeder or
- there are no echoes to find within the defined range.

If only LCS-Simulation produces a “distance”, the reason for fault may be:

- a hardware fault in the Transmitter’s Electronic Box or in a Transmitter Interface (LI) or
- faulty cabling between Transmitter - Transmitter Interface - LCS Board.

If not even LCS Simulation gives a “distance”, the reason for fault is likely to be located on the LCS Board.

3.26 Level Unit – Scan Tank

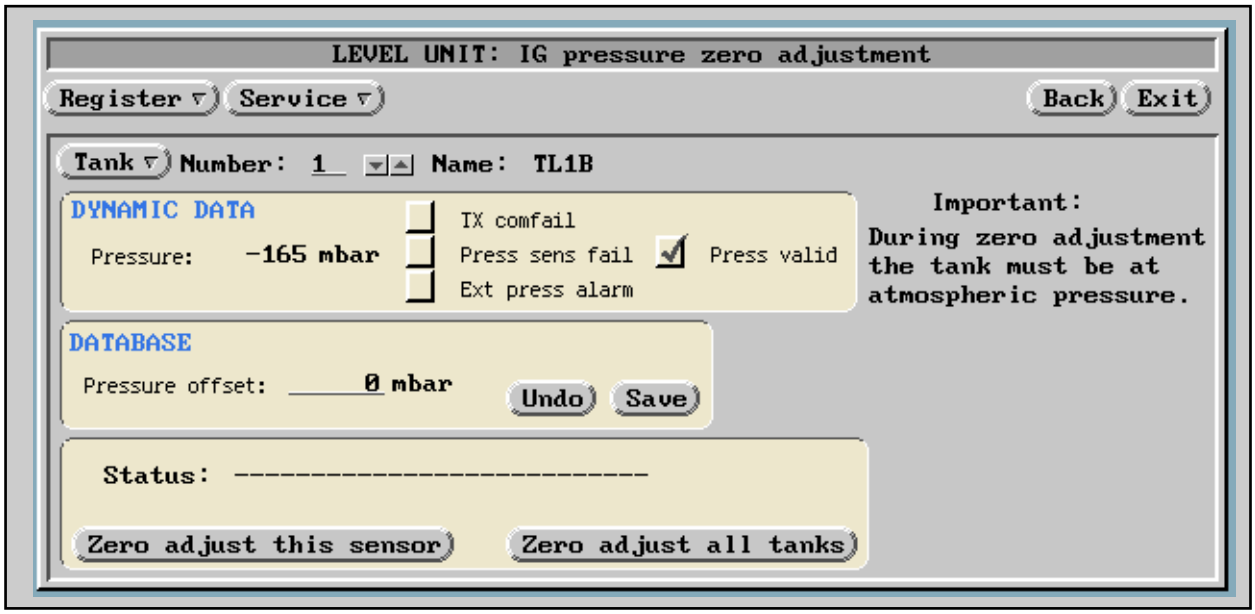
The scan tank function is used when there is a need to view the radar echoes inside the tank. This function is used during the commissioning of the system. A Saab service engineer will use this window to measure and save a curve of the signal strength throughout the tank.

The function of the Scan Tank-window is not described in this manual since it is not used during normal service of the system. The results need to be evaluated by an experienced Saab service engineer.

3.27 Level Unit – Restart LCI, LCM

Use this window to restart the LCI or the LCMs. Restarting the LCI also causes both the LCM and the transmitters to restart. Restarting the LCM also causes the transmitters to restart.

3.28 Level Unit – IG Press Zero Adjust



Select this window when the IG pressure sensors need to be adjusted. Select the tank that needs to be adjusted.

Note: *When the IG pressure sensor is adjusted for zero pressure it is very important that the pressure inside the tank is equal to the pressure outside the tank. The tank must be opened. See also chapter 6.4. Permission from officer in charge must be obtained before the tank is opened.*

Follow the instructions below when calibrating the IG pressure sensor for zero difference in tank pressure and atmospheric pressure.

1. Make sure that the tank or tanks that you intend to calibrate are open and that there is not a strong wind affecting the measurement.
2. Check that none of the check boxes for TX Comfail, Press Sens Fail or Ext Press Alarm are marked for any of the tanks you intend to adjust.
3. Open the IG Press Zero Adjust-window on the Work Station.
4. Select the tank you intend to calibrate.
5. Hit the button “Zero adjust this sensor”.
6. Watch new value in the white database box.
7. Hit the Save-button.
8. Continue with another tank from step 1 above or exit the window.

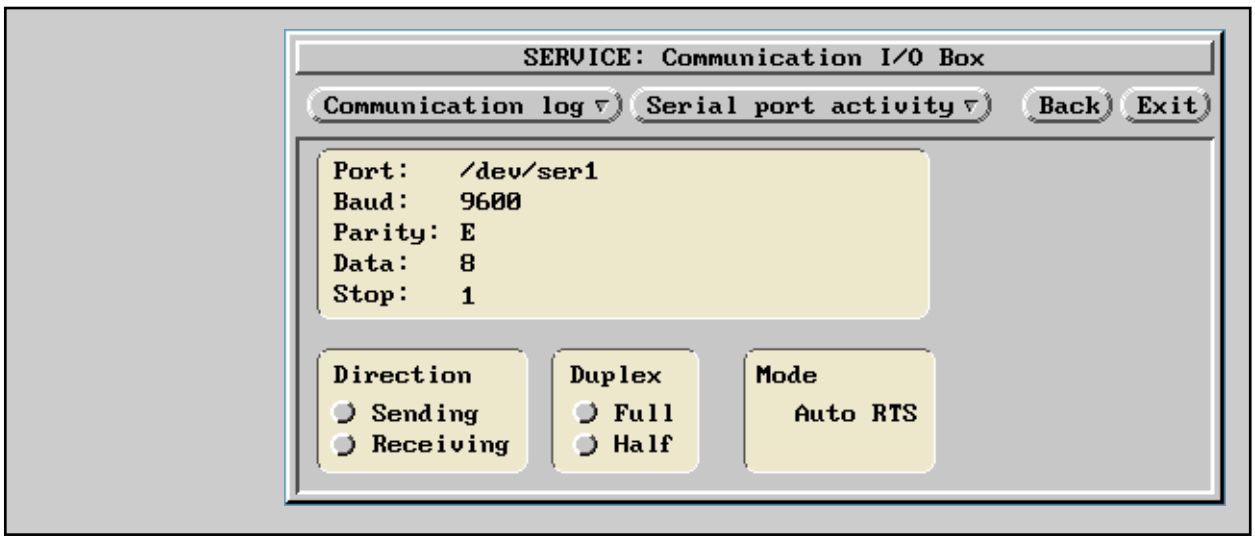
Note: *If you intend to hit the Zero adjust all tanks-button, make sure that ALL tanks have atmospheric pressure inside. Otherwise you might ruin a previously correct calibration on some tanks.*

3.29 Disconnect LU

Use this function when there is a need to change the LU-database in the Work Station when there is no communication with the Level Unit.

When you select Disconnect LU on the Service Menu, the question “Continue without communication with Level Unit? OK or Cancel” will be displayed.

3.30 The Communication-Window



Select Communication from the Service-menu to open the Communication-window. This window shows the communication on the serial ports to the I/O Box.

Select which serial port to view by hitting the Serial port activity-button. A list is displayed with the available ports.

Communication data such as baud rate, parity bits, data bits and stop bit is shown in the white box in the window.

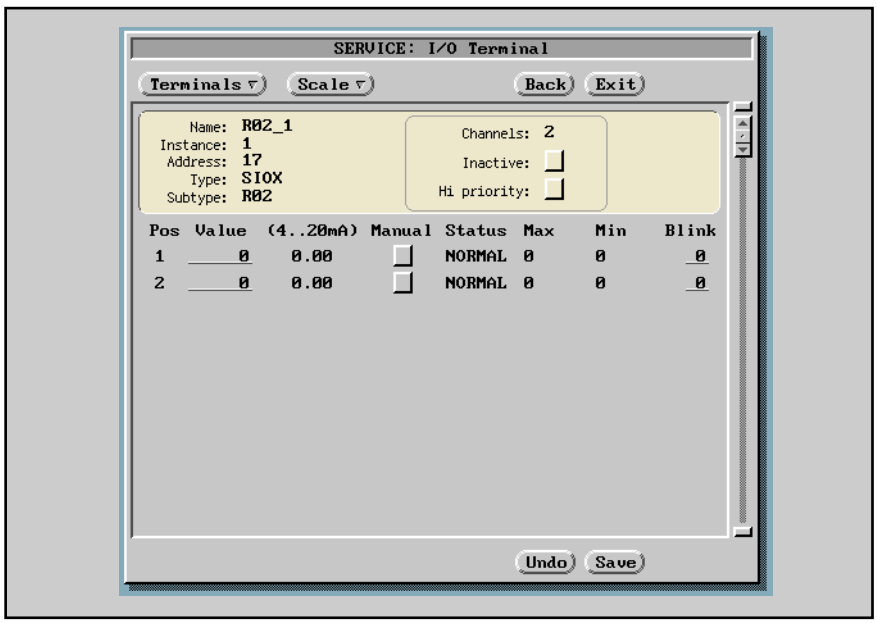
There are also two indicators showing send and receive activity. These are similar to the LEDs on the Interface boards in the I/O Box, see chapter 4. However, in the half-duplex setting, the Send-LED on the Interface boards echoes all the received information. It can therefore be quite difficult to see if the board is really sending anything other than the questions it is receiving. In this window, the Send-indicator does not echo the received signals. Therefore, when the Send-indicator blinks, the interface board is really transmitting data.

The RS-485 Interface Board can be set to half or full duplex, using jumpers. In this window it is easy to check the setting of the jumpers. See chapters 9.4 and 4.3.

Hit the Communication Log-button and select the communication you want to view. The Communication Log-window shows the communication parameters as well as the messages that are communicated.

You can disregard the information in the Mode-box. The information about the Auto RTS is only used by the Saab Marine service engineers or the service agents.

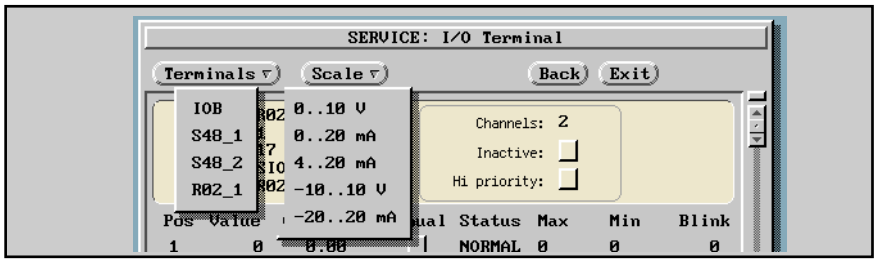
3.31 The I/O-Window



The I/O-window shows the raw values of the signals in and out of the terminals of, for example, the I/O Box and SIOX modules. Hit the Terminals-button to select which terminal you want to look at.

Hit the Terminals-button to show a list of the available terminals. Select one of the shown terminals.

The Scale-button shows the scalings available for showing the raw values as current or voltage.

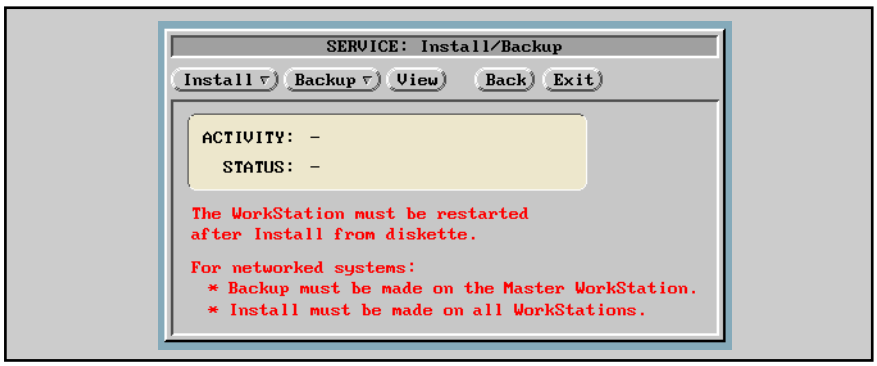


The value for digital inputs or outputs is shown as either 0 or 1. For digital outputs, it is possible to change the value and hit the Save-button to see that the output is working. Sometimes detection of the output is easier if the Blink selection is set to 1. The output (for example relay) will change back and forth between active and inactive.

The value for analog inputs or outputs is shown in unscaled units. The maximum and minimum values for the terminal are shown and cannot be changed. These values could, for example, be the unscaled raw values from a SIOX-system.

The check boxes show if the terminal has been set to be inactive or if it has been given a high priority.

3.32 Install/Backup-Window



Use this window to make a backup copy of pictures and database or to install new software. We recommend that you make two backup copies of database and pictures every six months. Store one copy in a safe place together with program diskettes. Send one copy to Saab Marine Electronics for storage on network servers. In this way the database and pictures of your system will always be up to date. When communicating with Saab Marine, this updated information will be of great help when fault finding, changing pictures or in any other way updating the system.

3.32.1 Backup Copies of the Database and Pictures

Follow the instructions below when making backup copies of the database and pictures:

***Note**: When there is a network of Work Stations, backup must be made from the Master Work Station.*

1. Slide an empty DOS-formatted diskette into the diskette drive.
2. Open the Install/Backup-window.
3. Hit the Backup-button. A menu is opened.

4. Select Backup All. A message is displayed on the screen and the files are copied onto the diskette. Follow any instructions on the screen.

3.32.2 Install Database and Pictures

Follow the instructions below if you need to install new or backup copies of pictures and/or database on the Work Station.

If you are uncertain of which files are stored on the diskette, hit the View-button to view the files on the diskette.

***Note**: When there is a network of Work Stations, install must be made on each Work Station in the network.*

1. Slide the diskette with database and pictures into the diskette drive.
2. Open the Install/Backup-window.
3. Hit the Install-button.
4. Select Install All from the menu.
5. A message is displayed. The files are copied from the diskette onto the hard disk of the Work Station. Follow any instructions on the screen.
6. Restart the Work Station.
7. Open the Up/Download Database-window described in chapter 3.24 and download the database to the LCM or LCMs.

3.32.3 Installing New Program to the Work Station

You may receive a diskette with a new version of the program for the Work Station. In such a case follow the steps below to install the new program:

1. Slide the diskette with the new program into the diskette drive.
2. Open the Install/Backup-window.
3. Hit the Install-button.
4. Select Install All from the menu.
5. A message is displayed. The program is copied from the diskette onto the hard disk of the Work Station.
6. Restart the Work Station.

3.32.4 Saving a Log-file to a Diskette

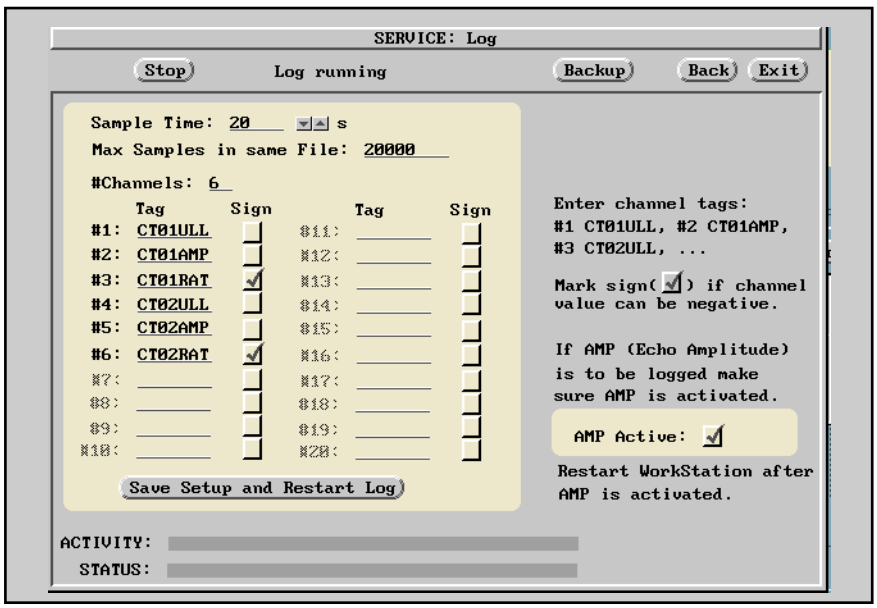
In the Group-window it is possible to log values to a file. These files are possible to copy to a diskette. This could be useful when fault finding the system. Follow the instruction below to copy a log file to a diskette:

1. Insert a DOS formatted diskette into drive A.
2. Hit the Backup-button.

3. Select “Backup one file”.
4. Select the log file you want to save. Its name has an extension “.log”. These are normally placed in the directory acu/tmp.
5. Order the copying to start.

3.33 Service Log-Window

Select Service Log from the Service-menu to open the Service Log-window. It is used when there is a need to store measured data for a later analysis. The log software regularly stores time, channel status and channel value into a log file. The log file is named “dl<mm><dd><hh>.log” where <mm> is the month (01-12), <dd> is the the day (01-31) and <hh> is the hour (00-23). If the log is restarted within the same hour the previous log was started, previous log data is lost. The log file can be copied onto a DOS-diskette, see Backup below.



The Service Log-window is used to setup the logging of the measured values.

Sample time — The time between the logged samples. It can be set to between 10 and 99999 seconds.

Max samples in one file — The maximum number of entries in the log file before a new log file is created (typically 20 000).

 # channels — Number of channels to be logged, between 0 and 20.

Tag — Channel tag with seven characters. For example “CT01ULL” for ullage of first tank or “CT01RAT” for level rate of first tank.

Sign — A √-sign indicates that the channel can have positive and negative values, such as level rate.

AMP Active	A √-sign indicates that the the AMP channel for echo amplitude exists. Check the box to create AMP channels if they are not active, then restart the Work Station.
Log running	Indicates that the log is running.
Log stopped	Indicates that the log is not running.
Start/Stop	Use this button to start or stop the log.
Save Setup and Restart Log	Use this button to save the changes and restart the log.
Backup	The Backup-function saves a compressed archive file (more than 10 times compressed) file with filename (acu.pax) that contains the log files (dl*.log), the software supervisor logfiles (syscon*.log, wdog*.log), and a listing of all the files in the log directory (dlinfo.log). The Backup-function copies the compressed archive to a DOS-diskette. It makes sure that the archive fits onto a diskette. All logs that are a maximum 12 weeks old are copied. However, if they do not fit onto a diskette, only the most recent logs will be copied. For decompression and analysis of a service log, contact the Service Department at Saab Marine Electronics.

3.34 Process Debugger, Interface Editor, PictCopy, Shell

These selections are normally not used on board. They can be used by Saab Marine service engineers or service agents visiting your ship.

4 I/O Box

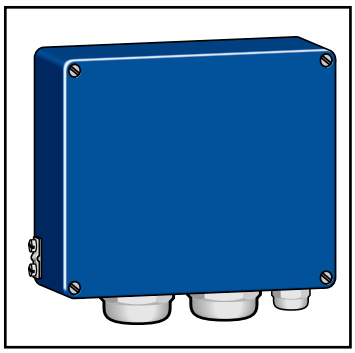


Figure 4-1 shows the I/O Box.

The I/O box is used to interface various equipment to the Work Station including the Level Unit. The I/O Box is made up of a motherboard with power supply, relays and connectors for seven Interface Boards.

The I/O Box is connected either to an 8-channel serial interface board in the Work Station or to the Com 1 and Com 2 ports. One of these channels is used for watch dog and relay output control. The other seven channels are wired to seven connectors on the motherboard. Of these seven channels, one is used for connection of the Level Unit.

The Interface Boards are used for connecting equipment such as host computer, load calculator, ballast level gauging system and Tank Display Units.

Via a SIOX Interface Board, a wide range of analog and digital inputs and outputs can be connected via field bus distributed I/O modules.

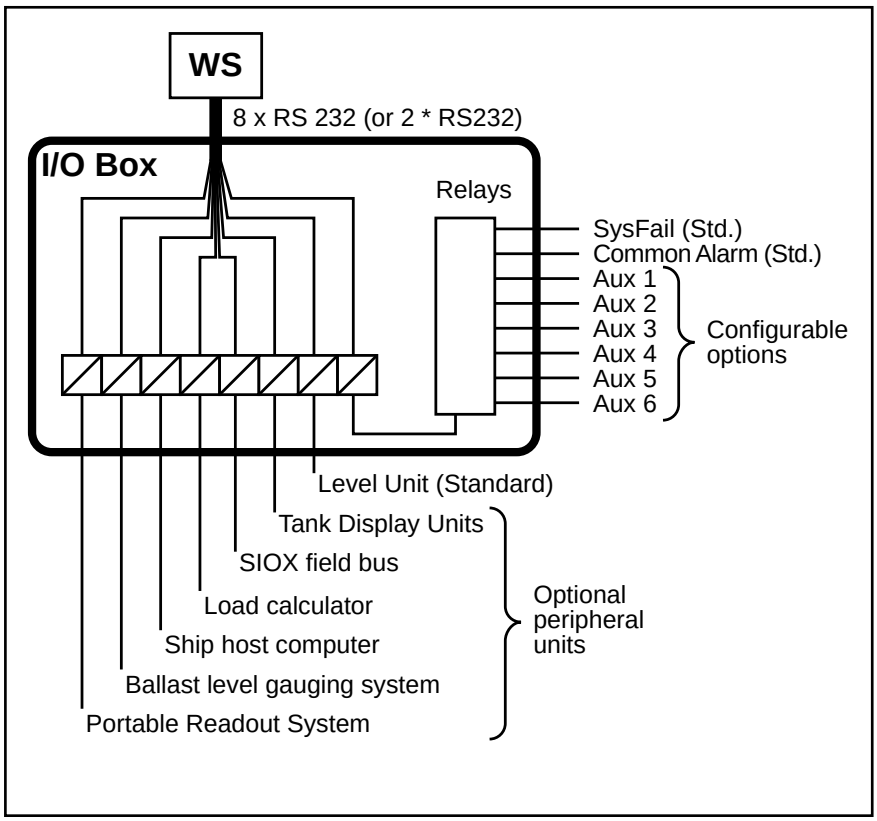


Figure 4-2 shows the I/O Box with various optional equipment connected to it (board locations can differ).

4.1 The Motherboard of the I/O Box

The motherboard in the I/O Box contains a power supply, a communication watch dog with System Failure output, seven relay outputs and seven slots for plug in of various Interface Boards. The seven serial channels are directly wired to the seven connectors for the Interface Boards.

4.1.1 Watch Dog LED

There is a red LED (H4) on the motherboard indicating that there has been an interruption of the communication with the Work Station. The LED remains lit after the watch dog has been triggered. This LED will normally be lit since this watch dog will trigger while the Work Station is starting up

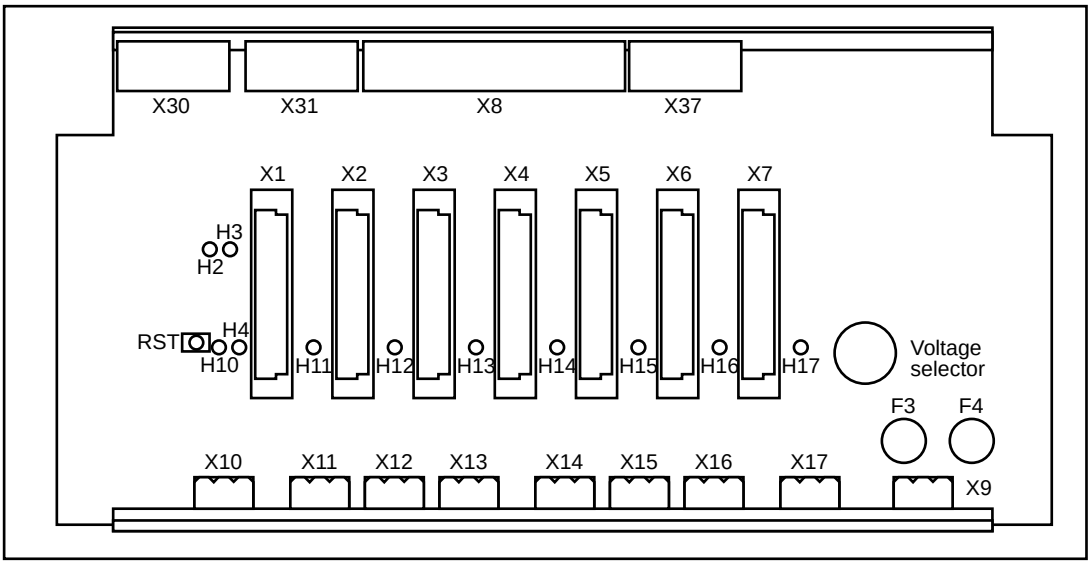


Figure 4-3 shows the motherboard of the I/O Box.

after a black-out or after the Work Station has been switched on. When there is an interruption of the communication to the Work Station, watch dog is triggered and the watch dog LED lights up and remains lit.

Check function of I/O Box by following the steps below.

1. Open cover of I/O Box.
2. Locate the red watch dog LED and a reset switch right next to it on the motherboard of the I/O Box.
3. Beside it there is a reset switch.
4. Make sure the Work Station (if more than one Work Station – the master Work Station) is running.
5. Press the reset switch in the I/O Box.
6. Wait for approximately half a minute. The watch dog LED should not light up.

4.1.2 Communication LEDs

A green LED (H2) indicates received data and a yellow LED (H3) indicates transmitted data. Received data is echoed back to the source.

4.1.3 Power LED

The voltages on the motherboard are monitored and are indicated by a green LED (H1).

4.1.4 Relays

There are eight relays for alarms and general output signals in the I/O Box. One of them is a System Failure relay controlled by the Work Station. The other seven relays can be used for alarms or for general output signals.

There is a similar set of relays in the Power Block of the Level Unit. However, the System Failure relay in the I/O Box is activated by System Failures from both the Level Unit and the Work Station, while the System Failure relay in the Power Block is activated only by System Failures within the Level Unit.

4.1.5 Power Setting

On the motherboard there is a switch for selecting the power as either 230 VAC or as 115 VAC.

4.2 RS-232 Interface Board

The RS-232 Interface Board is used to connect equipment with RS-232 communication to the I/O Box. The Interface Board provides galvanic separation of the signals to the Work Station. No conversion of the RS-232 signals is made.

The Interface Board has a green LED for indication of received signals and a yellow LED for transmitted signals.

4.3 RS 485 Interface Board

The RS 485 Interface Board is used for connecting equipment with RS 485 communication to the I/O Box. The Interface Board converts the signal from RS-232 to RS 485 and back to RS-232, as well as providing galvanic isolation.

The RS 485 Interface Board can be set in two different modes: half duplex or full duplex by setting jumpers on the board. The jumpers also control the 485-bus end termination. The default setting of a spare board is half duplex and end terminated. The jumper settings are:

Half duplex two-wire transmission - S1-S4:1-2.
Full duplex four wire transmission - S1-S4:2-3.

The connection of the Level Unit and LevelDatic system requires half duplex, while the Tank Display Units require full duplex.

***Note**: When trouble shooting you might need to exchange two RS 485 Interface Boards. Remember to check the setting of the jumpers for correct transmission. A 485-bus for a LevelDatic system with more than one module may use an unterminated board depending upon its location.*

The Interface Board has a green LED for indication of received signals and a yellow LED for transmitted signals. All the received signals are transmitted back on the channel and it is therefore quite difficult to use these LEDs to see if any answers are transmitted.

4.4 SIOX Interface Board

The SIOX Interface Board is used to connect the optional SIOX field bus system to the I/O Box. It converts the signal between RS-232 and the SIOX field bus. If an external power supply is used, it also provides galvanic isolation.

The SIOX field bus is a two wire current loop bus which is either powered from the motherboard or from an external power supply. Jumpers S1 and S2 must be set according to the power connection.

The Interface Board has a green LED for data, which is normally lit. A ground failure will blow the fuse (F1) and light the red LED on the board.

Each SIOX module also has two LEDs. The Live Bus-LED indicates that there is communication on the bus. The Answer-LED flashes when the module is sending an answer onto the bus. If the Answer-LED does not flash, the SIOX module might need to be replaced.

4.5 PRS Interface Board

The PRS Interface Board functions as a modem. It transform the digital signals to audio signals. Its transmission speed is 1200 Baud. The PRS Interface Board has a green LED for indication of received signals and a yellow LED for transmitted signals.

5 Level Unit

5.1 Description of the Level Unit

The **Level Unit** contains terminals for the intrinsically safe connection of the Transmitters. It contains the electronics used for processing the signals from the Transmitters, for calculating tank parameters, such as trim/list corrected ullage, and for communicating with the Work Station.

The Level Unit is a cabinet with mainly three different parts.

- At the bottom the Power Block is placed supplying the cabinet and the equipment on deck with intrinsically safe power.
- In the middle of the cabinet the Transmitter Interfaces are placed. This is where the cables from the Transmitters are connected.
- At the top part of the cabinet, the Calculation Unit is placed. It contains the boards for processing and calculating the measured values. It also contains the Backup Display with a keyboard. The Backup Display is used mainly for service purposes.

A Level Unit can connect up to 30 Transmitters. In large systems with more than 30 tanks, a Slave LU cabinet is used. With a Slave LU, up to 30 additional tanks can be connected. The Slave Level Unit does not contain any Calculation Unit since the signals from it are processed in the main Level Unit.

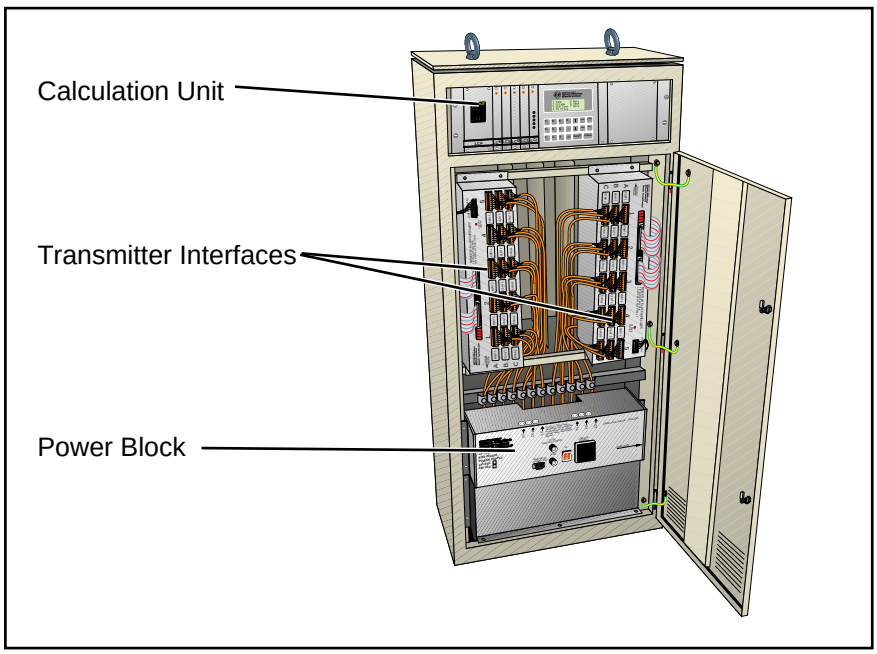


Figure 5-1. Level Unit.

5.2 Information Flow within the Level Unit

The signals from a Transmitter enter the Level Unit into a Transmitter Interface (LI) where they pass the zener barriers and go on to the Signal Board (LCS). The components on the Signal Board amplify and process the signals. The signals are converted to digital form by the Signal Board and are sent to the Processor Memory Board (LCM), where the signals are digitally processed. The Interface Board (LCI) handles the communication between the Level Unit and the Work Station, the Backup Display, the I/O Box and a Service PC if one is connected.

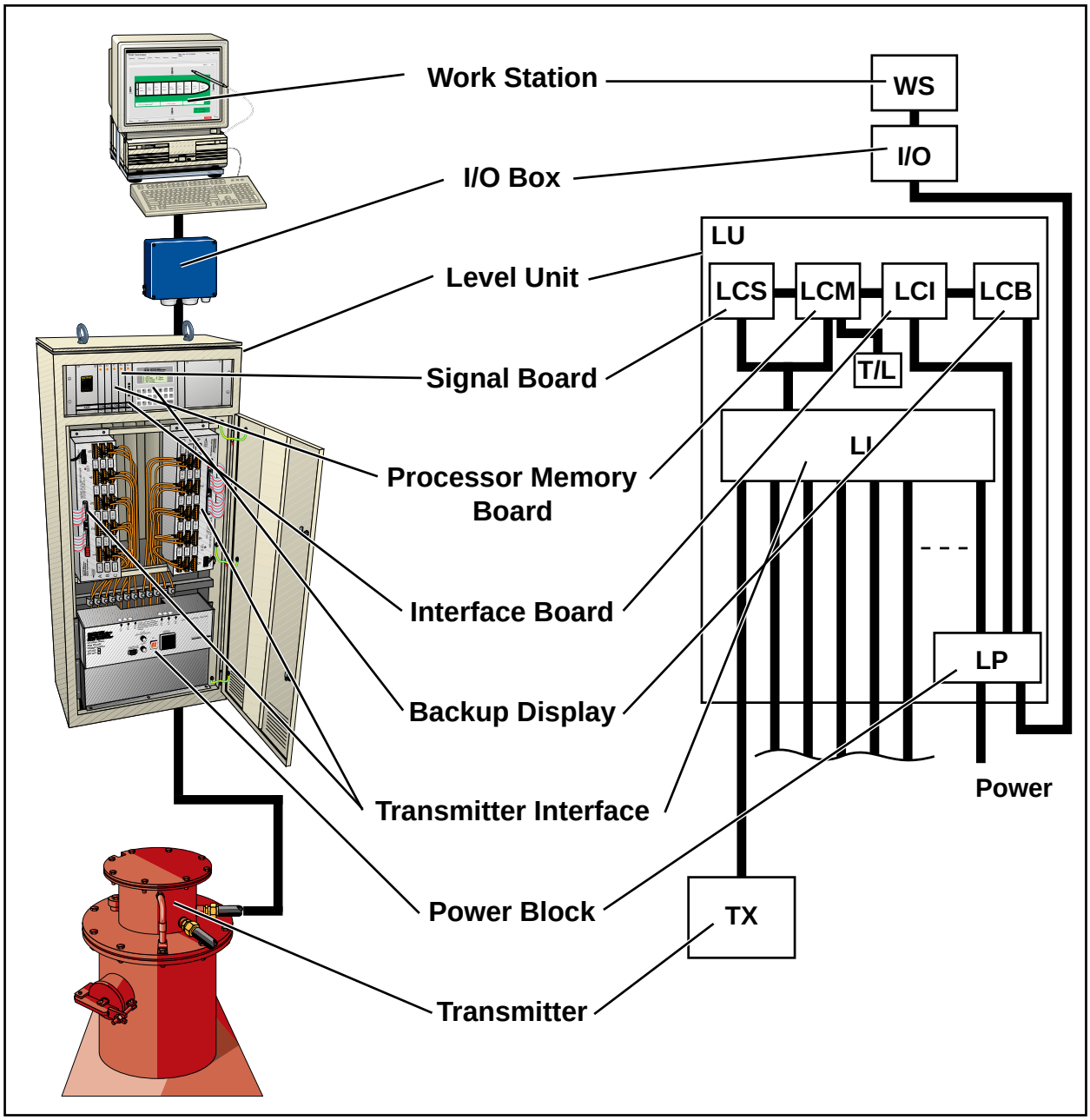


Figure 5-2 shows the information flow in the Saab TankRadar system.

5.3 Restarting the Level Unit

1. Check with officer in charge that it is OK to restart the system. A restart means there may be no information for a few minutes.
2. Open the front door of the Level Unit.
3. Switch the power off by setting the power switch on the Power Block to position 0.
4. Wait until the red LED on the Calculation Unit's power supply goes off.
5. Set the power switch to position 1 and the system will start up again.

5.4 Description of the Calculation Unit

The Calculation Unit at the top part of the Level Unit has the following components,

- one or two LCS
- one or two LCM
- one LCI
- one Backup Display with keyboard
- power supply for the Calculation Unit.

These components are mounted in a board cage. Each one is easy to remove for replacement.

Two sets of LCS and LCM can be used for one of two purposes:

- for redundancy. One of the boards is active, and the other board is standby to start measuring if the first board becomes faulty.
- for increased performance of the system. It is possible to have quicker updates with two sets of the LCM and LCS serving about half of the transmitters each, distributed on two or more LIs.

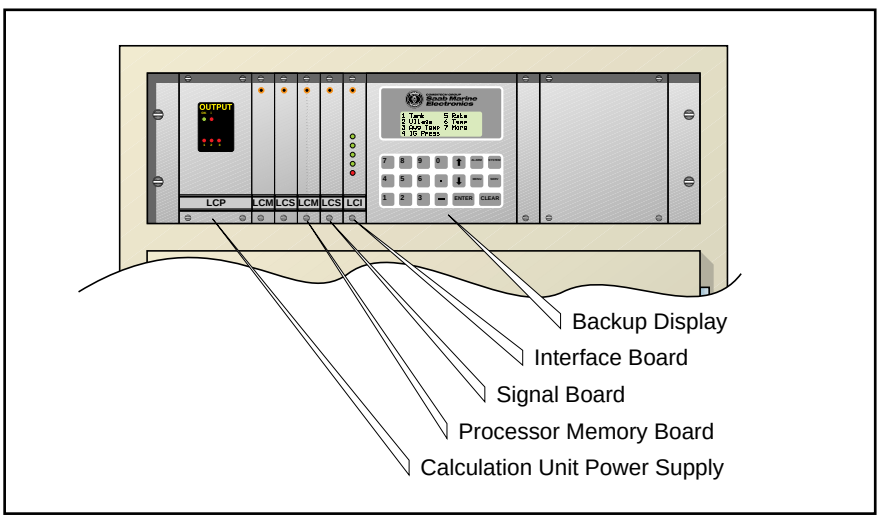


Figure 5-3. The Calculation Unit.

5.5 Signal Board, LCS

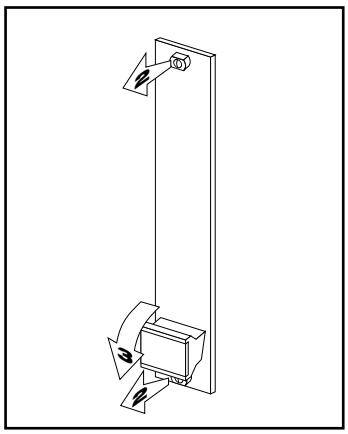


Figure 5-4. Removing a board.

The Signal Board contains analog filters and an A/D converter for the analog signal from the Transmitters.

5.5.1 Replacing a LCS

Note: *In order to avoid ESD-damages (electrostatic discharge), do not touch the components or the pins in the connector at the back of the board.*

1. Switch the power off before starting this operation.
2. Remove the two screws on the front panel of the board.
3. Push the knob down to loosen the connector at the back of the board. See figure 5-4.
4. Enter the new LCS gently into the slots and push it slightly so that it becomes flush with the other boards.
5. Tighten the two screws. Switch system on again.

5.6 Processor Memory Board, LCM

The Processor Memory Board processes the A/D converted signals from the Signal Board and calculates ullages, temperatures and IG pressures for all tanks. The Processor Memory Board contains a processor, flash memory, database memory, etc. It has inputs for ground failure alarm from the Transmitter Interface. Each Processor Memory board can handle up to 60 Transmitters.

5.6.1 Replacing the LCM

Note: *In order to avoid ESD-damages (electrostatic discharge), do not touch the components or the pins in the connector at the back of the board.*

1. Switch the power off before starting this operation.
2. Remove the two screws on the front panel of the board.
3. Push the knob down to loosen the connector at the back of the board. See figure 5-4.
4. Enter the new LCM gently into the slots and push it slightly so that it becomes flush with the other boards.
5. Tighten the two screws. Switch system on again.
6. Check that the correct software version is used on the LCM. If in doubt contact Saab Marine Electronics.
7. Download the database from the Work Station to the new LCM. See chapter 3.24.

5.7 Interface Board, LCI

The Interface Board works as an interface between the Processor Memory Board and the Work Station. It also supports the Backup Display with its keyboard. If a service PC is connected, it communicates via this board.

The Interface Board has five LEDs on the front panel. The first LED from the top indicates the transmitted communication with the Work Station, normally through the RS 485 Interface Board in the I/O Box (position Com 4). The second LED indicates the received signals from the Work Station. In a similar way, the third and fourth LEDs show the communication with a service PC, if one is connected to the spare RS-232 port on the Level Unit. The fifth LED shows if the watch dog has been triggered since the LU was last restarted.

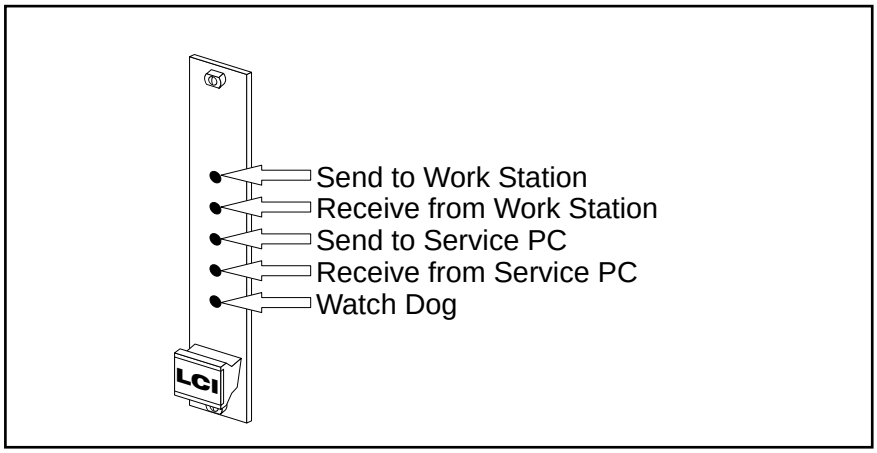


Figure 5-5. LEDs on the Interface Board.

5.7.1 Troubleshooting the LCI

The LEDs are useful when troubleshooting the system. If the top LED (LCI transmit) is flashing the LCI is probably OK.

See fault finding chapter 9.1.1.

If the top LED (LCI transmit) is not flashing while the second LED from top (LCI receive) is flashing or if none of these LEDs are flashing, the LCI may not be functioning. Follow the steps below:

1. Check cables and connectors between LU and I/O Box as well as between I/O Box and Work Station.
2. Check that correct baud rate is used on both Work Station and LCI. See chapter 3.18 for more information.
3. If no fault is found, replace the LCI board. It is included in the Complete Spare Parts set. See instructions in chapter 5.7.2 below.

5.7.2 Replacing the LCI

Note: *In order to avoid ESD-damages (electrostatic discharge), do not touch the components or the pins in the connector at the back of the board.*

1. Switch the power off before starting this operation.
2. Remove the two screws on the front panel of the board. Remove the four screws of the Backup Display.
3. Push the knob down to loosen the connector at the back of the board. See figure 5-4.
4. Pull the both the LCI and the Backup Display out slightly so that you can remove the connectors on the flat cables from the Backup Display.
5. Enter the new LCI gently into the slot.
6. Connect connectors to the Backup Display.
7. Push LCI slightly so that it becomes flush with the other boards.
8. Tighten the screws of LCI and Backup Display. Switch system on again.
9. Download the database from the Work Station to the new LCI. See chapter 3.24.

5.8 Trim/List Unit, LT

A unit with inclinometers for measuring trim and list is integrated in the Level Unit cabinet. These trim and list values are used to support the radar echo detection process that finds the true ullage. These values can also be used for ullage correction if there are no better source of trim and list values available.

The trim an list values are used in the LCM or LCMs to calculate trim/list corrected ullages. The trim and list values are normally measured by the Trim/List Unit in the Level Unit, but they can also be measured and calculated using draft sensors or from communication with another system.

Both the uncorrected and the corrected ullage values are available for presentation on the Work Station, Backup Display or Local Displays. By setting the ullage correction in the Setup-window on the Work Station, the same correction is presented on all displays. The trim/list correction can also be set in the T/L Mode-frame by pressing the System-key on the Backup Display's keyboard. See Operating Manual.

5.8.1 Replacing the Trim/List Unit

The Trim/List Unit is mounted to the back plane inside the Level Unit, below the Calculation Unit.

1. Switch system off
2. Disconnect the connector from the Calculation Unit's backplane.
3. Remove the Trim/List Unit.
4. Replace with new Trim/List Unit. Tighten nuts and connect to backplane.
   Note: *Mechanical adjustment was introduced in October 1995 as a complement to the electronics adjustment. Preset the Trim/List Unit using the adjustment screws on the mounting plate.*
5. Adjust the Trim/List Unit according to the instructions below.

5.8.2 Adjusting the Trim/List Unit

1. Measure the trim and list angles of the ship.

A ship´s trim is the difference between the draft forward and draft aft. The trim-angle is defined as β in the figure.

$$\tan \beta = \frac{D_A - D_F}{L}$$

where:

D_A = draft aft,
D_F = draft fore,
L = Length between scales.

Note: *Aft trim is positive and forward trim is negative.*

The list angle can be established by hand dipping towards the water surface from port and starboard rails. The list angle δ is calculated by:

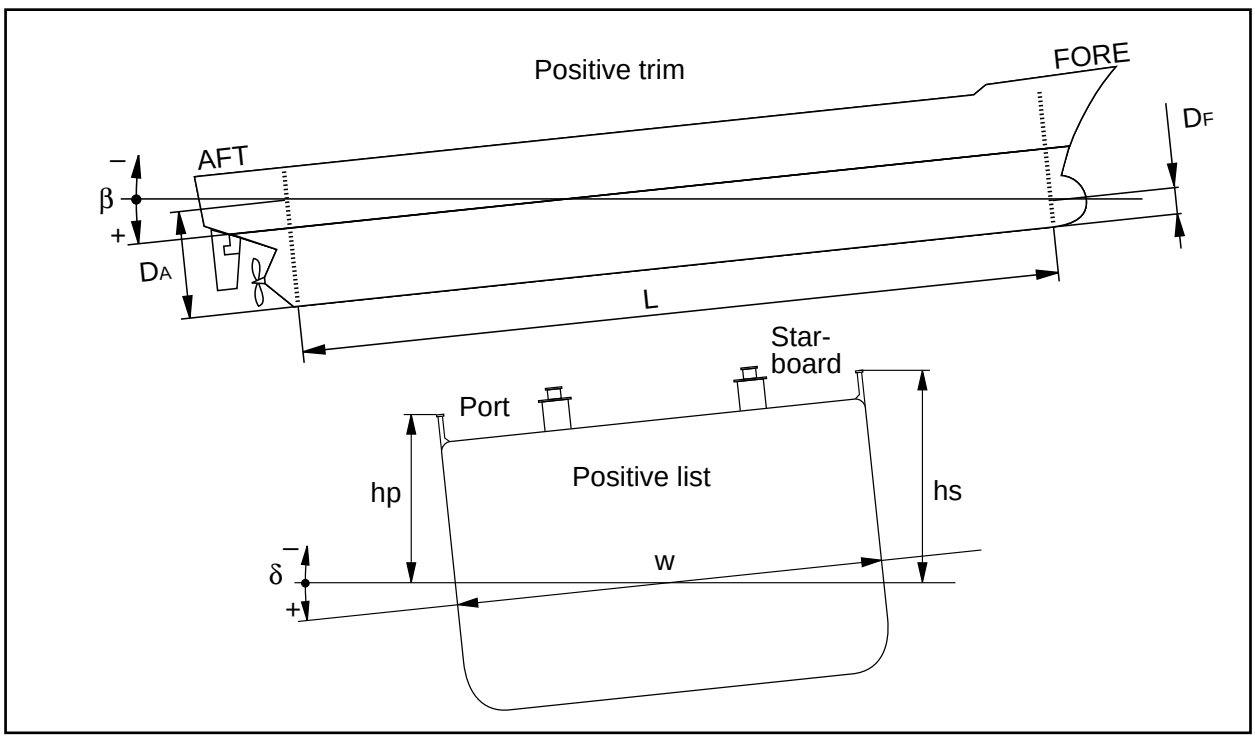
$$\tan \delta = \frac{h_s - h_p}{w}$$

where:

h_p = port dipping distance,
h_s = starboard dipping distance,
w = ship´s width at the dipping point.

Note: *For Saab TankRadar, the list angle is considered positive for port list; conversely, it is negative for starboard list.*

Figure 5-6. Trim and list definitions.



2. Switch the Level Unit on and read the trim and list values on the Backup Display. Press the System-key and select “1 TrimList” to see the values from source selected in Configure/Calculate/Shipdata. Check trim and list values on a Work Station as well.
3. The Trim/List Unit can be adjusted in two different directions. To adjust it sideways, loosen the bottom locking nut and swing it sideways. To adjust it towards the back of the Level Unit or away from it, loosen the locking nut on the bracket and adjust the angle by turning the adjusting nut and/or the locking nut. The displayed value must correspond to the ships trim and list within ±0,2°.
4. When the mechanical adjustment is finished make sure that the adjustment nut touches the bracket and that the locking nut is tightened.
5. On the Work Station, do the fine calibration of the offset of trim and list in the Trim/List Data-window.

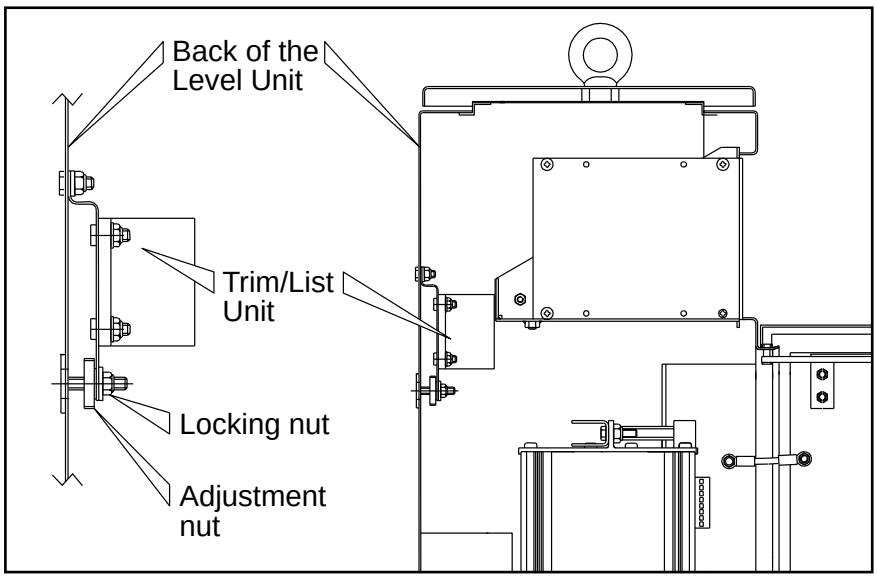


Figure 5-7. Trim/List Unit.

5.9 Backup Display, LCB

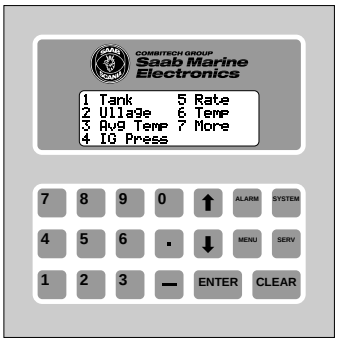


Figure 5-8 shows the Backup Display with its keyboard.

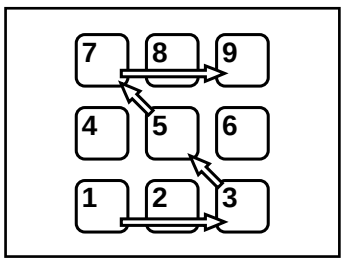


Figure 5-9 shows the key sequence of the service password.

The Backup Display serves only as a backup for the Work Station, for displaying the measured values and contents of the memory registers in the Transmitters, Processor Memory Board and the Interface Board.

The display can show each tank with its tank name and relevant tank values. The display can also show other status in the Level Unit. Except for the extreme pressure alarm, alarms are not shown on the Backup Display.

Most of the operation of the Backup Display is described in the Operating Manual. However, the service part of the display is only described in this Service Manual.

***Note**: If the Backup Display is blank, press any key on the keyboard to light it up. There is a time-out function that switches it off after approximately 20 minutes after last operation.*

5.9.1 Replacing the Backup Display

Follow the instructions in steps 1-4 in chapter 5.7.2 to remove the Backup Display. Connect the new Backup Display and follow steps 7-9 in chapter 5.7.2.

5.9.2 Description of the Service Frames

Press the Serv-key on the keyboard to open the directory to the Service frames. You are required to enter a password to open the Service frames. The password is “13579”. The password protection switches on again automatically after 20 minutes.

5.9.3 Unit Frame

Select the Unit frame to change the units of the system. The measuring units for level, temperature, IG pressure and level can be changed. The units are changed in the Backup Display, Local Display and in the Work Station.

To change a unit, the value of a parameter must be changed. You can select any of the following values:

Level:	0	=	meter
	1	=	feet
Level Rate:	0	=	meter / hour
	1	=	feet / hour

Note: *The level and level rate always based on the same unit. If one of them is changed, the other changes as well.*

Temp:	0	=	degrees Celsius
	1	=	degrees Fahrenheit
Press:	0	=	mbar
	1	=	PSI (pounds per square inch)

5.9.4 Local Display Frame

Select Disp to change the display mode of the Local Display. Each tank can have its own display mode.

Enter a digit from 0 to 3 to change the display mode.

Mode:	0	=	Display is off
	1	=	Ullage
	2	=	Toggle between ullage, temperature and IG pressure.
	3	=	Data directly from the Work Station.

5.9.5 Register Frame

The Register frame is used for viewing and changing data in the registers in the LCI and LCM database. See chapter 3.21 for a list of the registers.

There are two types of registers, the database and dynamic registers. The database registers contain static register that can be changed while the dynamic registers contain dynamic values that are continuously measured or calculated.

The registers are shown in order starting with register 0. New registers can be viewed either by pressing the up or down arrow keys or by entering the register number and pressing the Enter-key. Four registers are shown at a time on the display.

The values are shown as either decimal or hexadecimal values. When the values are hexadecimal, an H is displayed after the value.

You can also use the Enter-key to move the cursor in the frame.

If two LCMs are included in the system, both are updated when database values are changed.

5.9.6 FiltDist Frame

This frame is used for viewing the Filter Distance of the Transmitters. The frame shows three filter distances at a time.

5.9.7 Amplitude Frame

This frame is used for viewing the amplitude of the tank signal. The frame shows three amplitude values at a time.

5.10 Transmitter Interface, LI

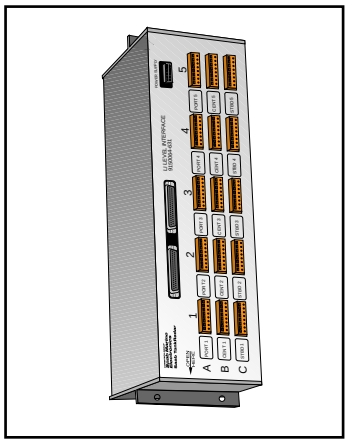


Figure 5-10 shows a Transmitter Interface.

The Transmitter Interfaces provide intrinsically safe power to the Transmitters, temperature sensors, IG pressure measurement and Local Displays on deck.

5.10.1 Cabling

The cables from the Transmitters are connected to the Transmitter Interfaces in the Level Unit. The Transmitters are connected with individual jackable terminals.

5.10.2 Configuration of the Transmitter Interfaces

The Transmitter Interface is made up of two types of printed circuit boards, the Analog/Digital/Power Board (LIA) and the Zener Barrier Board (LIZ).

In each Transmitter Interface there can be one, two or three LIZ boards. Each board can connect up to five Transmitters. Each Transmitter Interface can connect up to 15 Transmitters. There can be one or two Transmitter Interfaces in the Level Unit.

For example, a system with 18 tanks would have one Level Unit with two Transmitter Interfaces. There would be four LIZ boards in these two Transmitter Interfaces together.

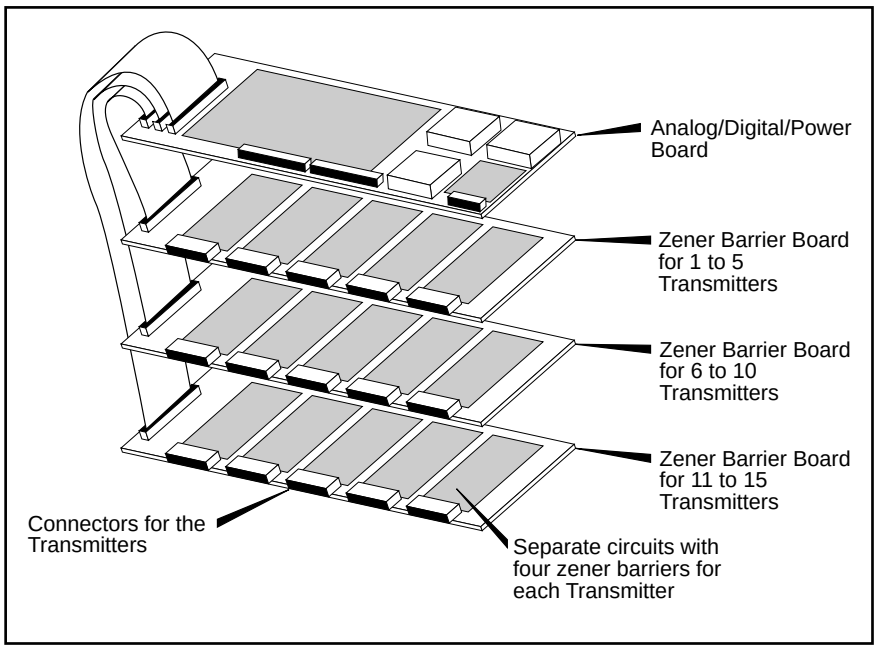


Figure 5-11. The Transmitter Interface boards.

One Transmitter Interface is connected to the Calculation Unit at the top of the Level Unit, while the other Transmitter Interfaces are connected in serial with a flat cable between each one.

5.10.3 Power supply to the Transmitter Interface

The intrinsically safe parts of the Transmitter Interfaces receive power from the Power Block at the bottom of the Level Unit via separate cables. The non-intrinsically safe parts receive their power from the Calculation Unit power supply.

5.10.4 Ground Failure Indication

On the front panel of the Transmitter Interface there is a LED indicating any ground failure on the intrinsically safe equipment connected to it.

5.10.5 Addressing the Transmitter Interface

There is an address switch on side of the Transmitter Interface. When replacing a Transmitter Interface, it is important to set the address switch in the same way as on the one that is replaced.

Switches 1 and 2 are used for setting the address of up to four Transmitter Interfaces in the system. Switches 3 and 4 are used to select the LCM that handles the Transmitter Interface.

Switch 1	**Switch 2**	**LI number**	**Transmitters**
ON	ON	LI no. 1	
OFF	ON	LI no. 2	
ON	OFF	LI no. 3	
OFF	OFF	LI no. 4	
Switch 3	**Switch 4**	**LCM configuration**	
OFF	ON	Only LCM 1	
ON	OFF	Only LCM 2	
OFF	OFF	Both LCM 1 and 2 in redundancy mode	

As default the switch is set to LI no 1 and for only LCM 1 (Switch 1=ON, 2=ON, 3=OFF, 4=ON)

5.10.6 The Analog/Digital/Power Board (LIA)

The Analog/Digital/Power Board;

- relays the analog signal from the Transmitter to the Signal Board,

- relays the digital signals between the Transmitter and the Processor Memory Board and
- stabilizes the intrinsically safe power supply and checks for ground failure.

5.10.7 The Zener Barrier Board (LIZ)

The Zener Barrier Board has five separate circuits for the intrinsically safe connection of up to five Transmitters. Each of the five separate circuits on the Zener Barrier Board contain four zener barriers.

The Zener Barrier Boards are connected to the Analog/Digital/Power Board (LIA) with flat cables. The Transmitters are connected to the Zener Barrier Board with jackable connectors with eight conductors, from four twisted pair cables.

Note: *The fuses on the LIZ must not be changed in the field. If a LIZ has a broken fuse, the whole board must be changed as a complete unit.*

5.10.8 Removing a Transmitter Interface (LI)

1. If they are not marked, mark up all the connectors so that they can be easily replaced in the same positions.
2. Remove all the transmitter connectors.
3. Remove the power supply connector and the flat cable connector (or connectors, if more than one LI is used).
4. Loosen the four nuts and remove the LI.

5.10.9 Replacing a LIZ or a LIA

To open the LI, a TORX-screwdriver is required. This screwdriver can be found in the Complete Spare Part set or it is included together with the spare LIZ or LIA.

1. Remove the LI according to steps 1-4 in chapter 5.10.8 above.
2. Look for an “Open here”-arrow on the front of the LI and remove that end wall.
3. Slide the boards out a little bit so that you can remove the connector to the board you need to replace. Slide it out carefully.
4. Carefully slide the new board into the LI. Mount the end wall.
5. If it was an LIA that was replaced, set the address switches to same positions as on the one you replaced.
6. Mount the LI according to the instructions in chapter 5.10.10.

5.10.10 Replacing a Transmitter Interface (LI)

1. If it is a completely new LI, set address switch on the new LI to same positions as on the replaced LI. See also chapter 5.10.5. Mark up the connectors on the new LI in the same way as the replaced LI.
2. Mount the new LI and tighten the four nuts.
3. Fit connectors for Transmitters, power and flat cable.

5.11 Power Block

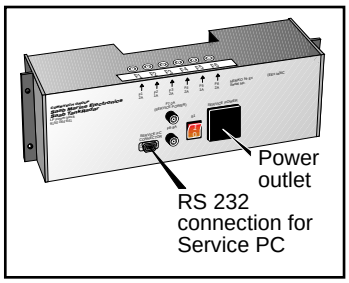


Figure 5-12 shows the Power Block.

The Power Block powers the Level Unit and the intrinsically safe equipment on deck.

The Power Block contains filters for the supply voltage, to ensure that the strictest EMC requirements are met.

The Power Block can be set for supply voltages of either 115 or 230 VAC. The switch is located inside the Transmitter Interface. The setting of the switch is marked on the outside of the Power Block.

There are five relays in the Power Block. Three of these relays are used for cargo tank IG extreme pressure alarm, power loss and System Failure. Two relays can be controlled from the Work Station. If a Work Station is included in the system, there is also an I/O Box with a similar set of relays. These relays will then be used instead of the ones in the Level Unit's Power Block. Only the relay for the IG extreme pressure alarm is unique for the Level Unit.

There is an RS-232 connector and a power outlet located in the Power Block for connecting a service PC to the Level Unit.

5.11.1 Fuses in the Power Block

There are six fuses that protect the two intrinsically safe transformers. To maintain the intrinsic safety, it is very important to use correct fuses when replacing them. See the Spare Parts List at in chapter 10 of this manual.

5.11.2 Replacing the Power Block

If the Power Block is faulty, replace it as a whole unit.

1. Remove the cover plate below the Power Block.
2. Remove the connectors.
3. Remove the four nuts holding the Power Block.
4. Check that setting of the power supply is correct on new Power Block. The setting of the switch is marked

on the label on the front of the Power Block since the switch is located inside it.

5. Mount the new Power Block. Tighten the four nuts.
6. Replace the cable connectors.

6 Transmitters

There are two types of Transmitters with different antennas available with the Saab TankRadar:

- Parabolic Antenna Transmitter
- Cone Antenna Transmitter.

The Transmitters are prepared for inert gas pressure measurement, Local Display, and connection of up to five Pt 100 sensors. Three of these temperature sensors can be placed in a tank mounted thermowell. The remaining two inputs can be used for additional Pt 100 sensors, for example from heaters.

When cargo tank temperature measurement is included the Temperature Connection Box is located on top of the thermowell and connected via a cable to the Transmitter. The Tem-

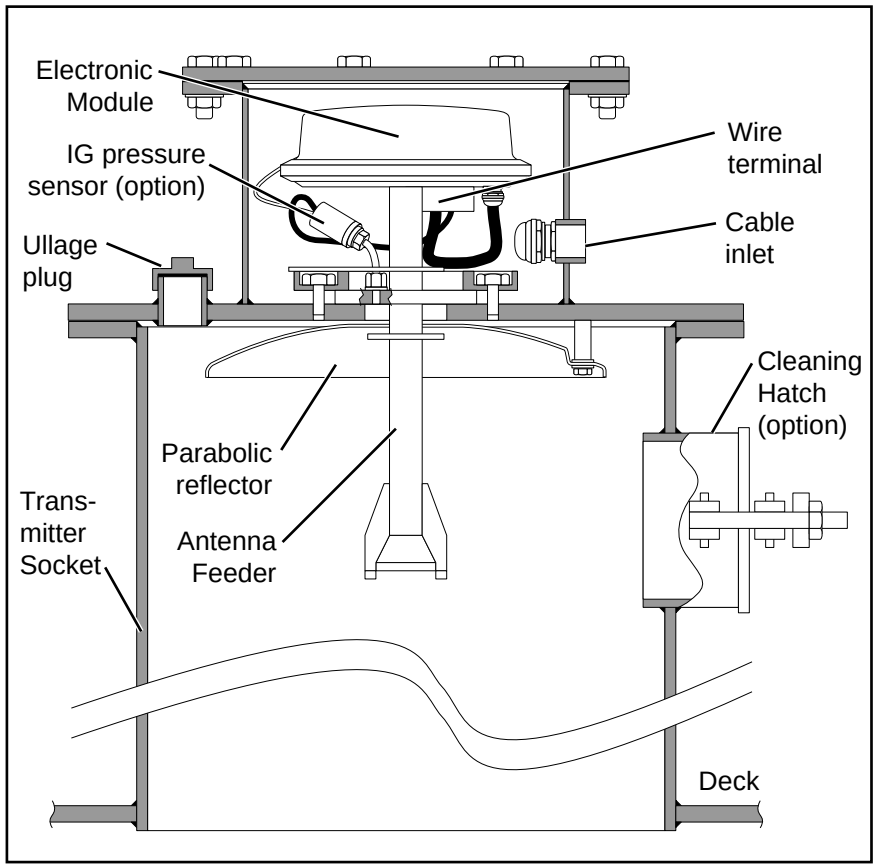


Figure 6-1. Cross-cut of the Parabolic Antenna.

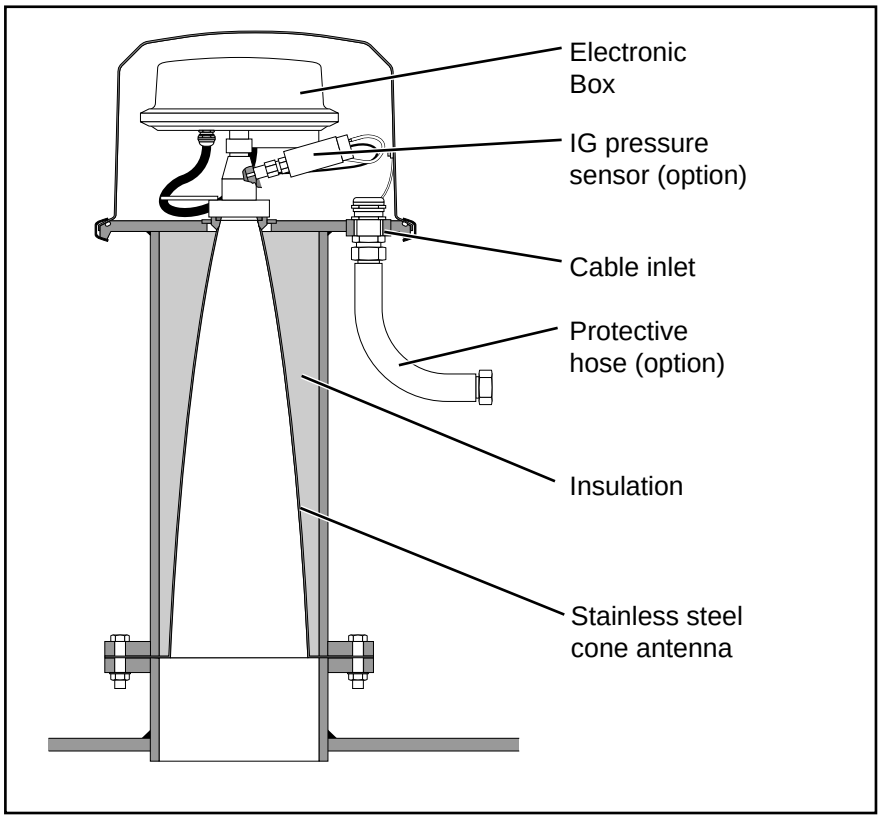


Figure 6-2. Cross-cut of the Cone Antenna.

perature Connection Box may be deck mounted or pump mounted.

There is a wire terminal within the transmitter housing used for connection of the optional sensors, the Local Display and the cables to the Level Unit.

The electronics for the Transmitter are intrinsically safe and are placed in the Electronic Box. The same type of Electronic Box is used for both types of Transmitters. The function of the Transmitter can be tested with the Transmitter Test Cable, see chapter 6.2 below.

6.1 Replacing an Electronic Box

The Electronic Box is placed inside the transmitter housing. See figures 6-1 and 6-2.

The Electronic Box can be replaced while the system is operating. Avoid letting water into the transmitter housing. Handle with care and make sure the wire terminal is clean and dry.

Note: *The Electronic Box is waterproof and must not be opened. Always replace the entire Electronic Box if it is faulty.*

Note: *Make sure the interior of the transmitter housing is completely dry and clean before replacing the cover. Encased water or damp cause corrosion of the terminal block and wire leads causing contact fault. Wipe with a clean and dry cloth if necessary.*

Follow the steps below when removing the Electronic Box:

1. **Parabolic Antenna: Open** the transmitter housing by removing the eight bolts for the cover.
   Cone Antenna: Open the transmitter housing by loosening and removing the large clamp ring around the rim of the cover.
2. Loosen the strap and lift the Electronic Box straight up. Be careful not to touch or damage the top Teflon part of the Antenna Feeder.
3. Place the Electronic Box upside down.
4. If the wires to the wire terminal have not previously been marked, mark them before removing them. Remove the wires from the terminal. If system is switched on, avoid short circuiting the wires.
5. Connect the wires to the new Electronic Box.
6. Mount the Electronic Box. See to it that the pin on the Electronic Box fits into the groove on the antenna feeder.
7. Tighten the strap so the Electronic Box cannot move.
8. **Parabolic Antenna:** Check that the space inside the transmitter housing is clean and dry before replacing it. Make sure the rubber gasket for the transmitter cover is correctly placed and tighten the bolts cross-wise.
   Cone Antenna: Check the O-ring and its groove are clean and dry. Check that the space inside the transmitter housing is clean and dry before replacing it. Tighten the clamp ring.

6.2 Transmitter Test Cable

In the spare parts set on board there is a Transmitter Test Cable. Use this cable to check the function of the Electronic Box of the Transmitter.

There is a distance printed on the Test Cable. It will differ from the ullage shown by TankRadar when the Test Cable is applied on the Transmitter. The distance should be within ±10 % of the distance stated on the Test Cable corrected for the A-distance (the A-distance is shown in the Transmitter Data-window, see chapter 3.9). It can be used to see that the Transmitter is working properly. However, the main function of the Test Cable is to check the amplitude value, see figure 6-3.

1. Remove the Electronic box according to steps 1-3 in chapter 6.1 above.
2. Place the Test Cable into the Electronic Box.
3. The function of the Electronic Box can be checked either from the Backup Display or the Work Station.
4. On the Work Station, check value of amplitude postfilt in the Transmitter Data-window, see chapter 3.9. On the Backup Display, check the Register-frame in the Service part. Check register number 21 (amp_post_filt).

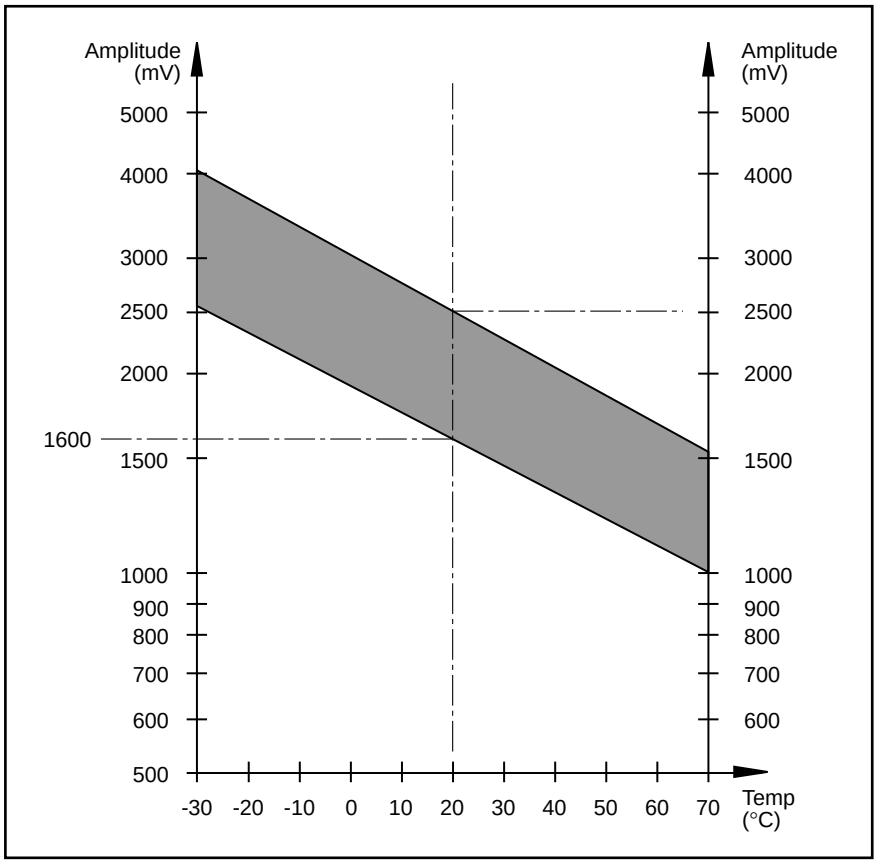


Figure 6-3. The amplitude from the Test Cable varies with ambient temperature and is different for individual Test Cables. The rated amplitude for 20 °C ambient temperature, is printed on a label on each Test Cable. The shaded area in the diagram shows the acceptable amplitude for a Test Cable with a rated amplitude of 2000 mV. When the amplitude printed on the label is other than 2000 mV, the shaded area can be moved up or down so that its centre corresponds to its printed amplitude.

Check that the amplitude is within the shaded area according to figure 6-3. If it is not, exchange with new Electronic Box.

6.3 Cleaning the Antenna

The only regular maintenance required is cleaning of the transmitter antenna. No general intervals can be stated, as cleaning intervals depend on the carried cargo. There is an automatic test function in TankRadar, indicating when antenna cleaning is required. A warning-message, stating which Transmitter that needs cleaning, is displayed on the Work Station.

The warning comes up if the reflected signal from the surface during a period of 5 hours is too weak. Other failure functions override the above indication.

The cleaning of the antennas is carried out differently on the Parabolic Antenna and the Cone Antenna.

6.3.1 Cleaning the Parabolic Antenna

Follow the steps below when cleaning the Parabolic Antenna:

1. First clean the Teflon on the antenna feeder, following the ”Brush cleaning” instructions below.
2. Wait half an hour. If there is still the warning-message, check if the parabolic antenna has any moisture on it. If it has, clean it according to the instructions in “Cleaning by Hand” below. Also check if there is something between the parabolic antenna and the surface of the liquid. If so remove it.
3. If the warning message is still there after another half hour, please contact Saab Marine Electronics Service Department or a service agent for further assistance. See chapter 12 for a complete list of the service agents.

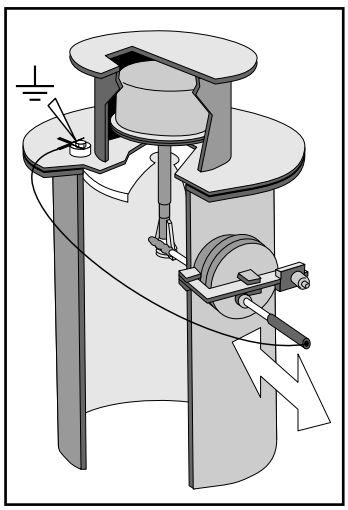


Figure 6-4. Brush cleaning the Parabolic Antenna.

6.3.2 Brush cleaning the Parabolic Antenna

The cleaning with the cleaning brush can take place while the tank is in operation and while it is pressurized with inert gas.

1. Remove the cleaning hole plug on the cleaning hatch on the transmitter socket.
2. Connect the grounding wire of the cleaning brush to the ullage plug or some other suitable place where a good grounding is achieved.
3. Push the Teflon adapter into the plug hole. The check valve on the inside is now opened.
4. Insert the brush to the first mark on the brush shaft.
5. Move the brush between the first and the second marks on the brush holder.

6. Clean both sides of the antenna feeder in the same way.
7. Remove the brush and the Teflon adapter, and replace the cleaning hole plug.

6.3.3 Cleaning by Hand

Before cleaning, the inert gas pressure must be reduced. Also observe local environmental, safety and health regulations.

1. Open the cleaning hatch.
2. Clean the antenna feeder and the parabolic reflector with a rag. If necessary, use a suitable solvent.

6.3.4 Cleaning the Cone Antenna

Before cleaning, the inert gas pressure must be reduced. Also observe local environmental, safety and health regulations.

1. Remove the transmitter cover.
2. Loosen the strap and remove the Electronic Box.
3. Remove the large nut by turning its handle counter clockwise.
4. Carefully lift the Waveguide Cone straight up.
5. Clean the inside of the Cone Antenna through the opening (Ø50 mm).
6. Carefully clean the inside of the Waveguide Cone. Be careful with the Teflon-cone inside the Waveguide Cone.
7. Replace the Waveguide Cone. Be careful not to damage the O-rings on the Waveguide Cone.
8. Replace Electronic Box and the Transmitter Cover.
9. If there is still a clean antenna warning for the Transmitter after half an hour, please contact Saab Marine Electronics Service Department for further assistance.

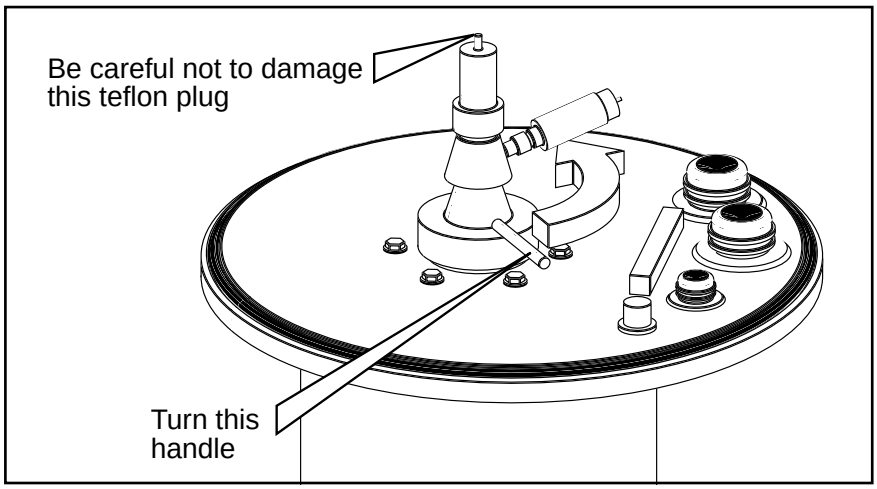


Figure 6-5. Turn handle to remove the Waveguide Cone.

6.4 Inert Gas Pressure Sensor (Option)

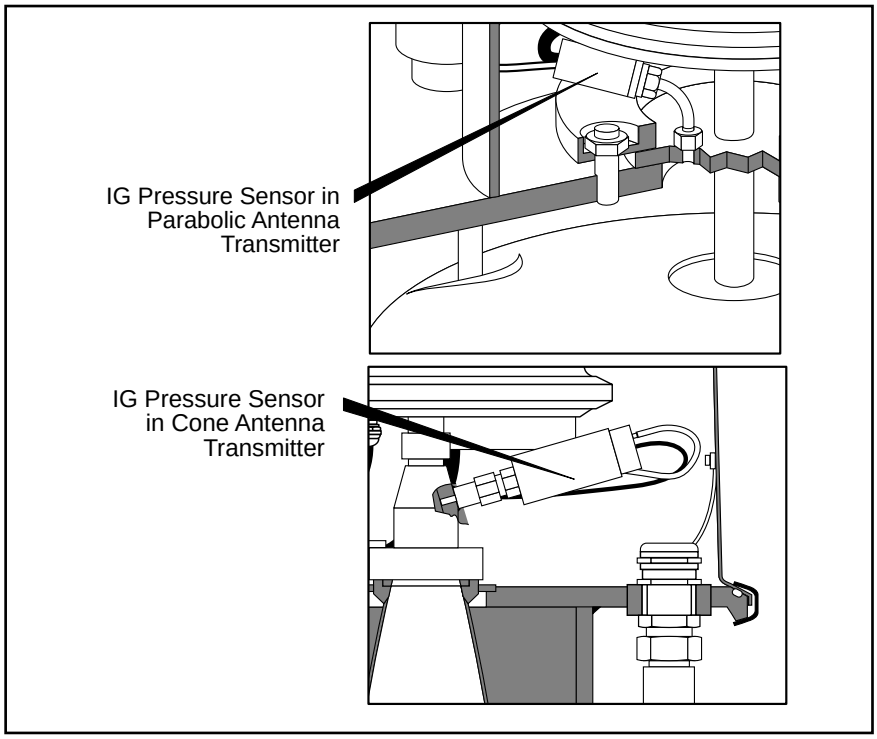


Figure 6-6. The IG pressure sensor in the Parabolic and the Cone Antennas.

WARNING!
Closed tank condition can not be maintained when removing the gas pressure sensor. The tank atmosphere is exposed to deck environment. The IG-pressure sensor must not be removed without permission from officer in charge.

Note: *The inert gas pressure sensor is an optional equipment installed in the Transmitter Unit at the delivery.*

The inert gas pressure sensor is installed in the Transmitter housing. The installation differs slightly between the Parabolic Antenna and the Cone Antenna. See figure 6-6.

The sensor is in contact with the tank atmosphere through the nipple and either through the bottom of the transmitter housing or through the Waveguide Cone. These holes can become clogged and may need to be cleaned.

The IG pressure sensor measures the pressure relative to the atmospheric pressure outside the transmitter housing. There is a small venting hose from the sensor to a nipple in the wall of the transmitter housing for the reference atmospheric pressure.

Note: *The sensor must be fitted to the vent hole by means of a Nylon hose.*

Note: *Make a note of how the leads are connected to the wire terminal on the Electronic Box before you disconnect the leads.*

6.4.1 Cleaning the Inert Gas Pressure Sensor

Follow the steps below when cleaning the IG pressure sensor:

1. Open the cover to the transmitter housing.
2. Disconnect the leads to the IG-sensor and remove the sensor.
3. Remove the sensor and the nipple.
4. Do not attempt to clean the sensor itself as it can easily be damaged. Clean the nipple and the screw in the mounting assembly as well as the opening in the bottom of the Transmitter housing or into the Waveguide Cone.

6.4.2 Replacing the Inert Gas Pressure Sensor

Follow steps 1-3 above (chapter 6.3.1) to remove the sensor. Follow the steps below when replacing the IG pressure sensor:

1. Install the new sensor in the same way as the one you have just removed. Original or new gaskets must be used.
2. **On Parabolic Antenna:** Tighten screw through the banjo nipple to 75 Nm (55 lbsft) torque.
   On Cone Antenna: Tighten cap nut to 55 Nm (40 lbsft) torque.
3. Be sure to connect the electrical leads and the vent hose in the same way as before. The vent hose must not be folded or squeezed.

Note: *A zero pressure calibration of the IG pressure sensor must be done when it has been replaced.*

6.4.3 Zero Pressure Calibration of IG Pressure Sensor

Make sure that the tank is ventilated and that it has atmospheric pressure. Be aware that a strong wind into a tank opening can change the pressure inside the tank quite considerably.

Read chapter 3.28 “IG Pressure Zero Adjust” for a description of how to adjust the IG pressure sensors.

6.5 Dismounting of Antenna Feeder of the Parabolic Antenna

The antenna feeder is mounted in the centre of the trunk and its upper part is engaged in the Electronic Box. Replacement can be carried out when the system is operating.

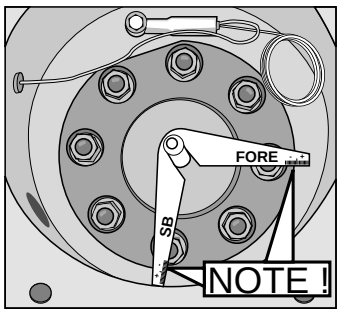


Figure 6-7.

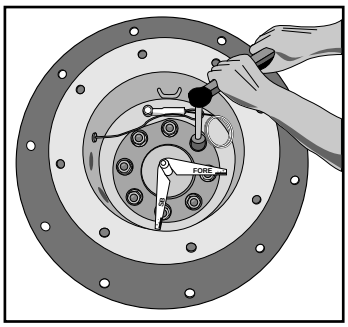


Figure 6-8.

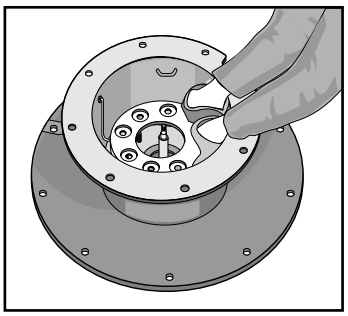


Figure 6-9.

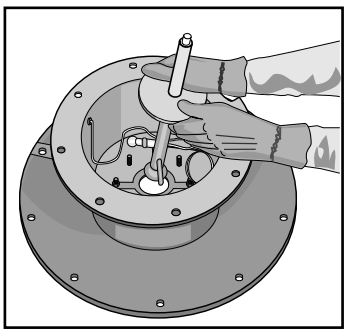


Figure 6-10.

Important!

When removing the antenna feeder the tank must be opened. Permission from officer in charge must be obtained before the service work commences.

6.5.1 Disassembly

1. Begin by removing the Electronic Box according to chapter 6.1.
2. Note the exact position of the adjustment scales. Take a reading of both FORE and SB (starboard) scale positions over the clamp ring edge.
3. Remove the adjustment scales assembly from the antenna feeder.
4. Loosen and remove the eight nuts securing the clamp ring.
5. Remove the clamp ring by lifting it straight up.
6. Lift the antenna feeder straight up and remove it, but leave the gasket in its original place. If the gasket is damaged it must be replaced with a new one.

6.5.2 Reassembly:

1. Insert the antenna feeder in the socket. Make sure the wings of the antenna feeder point to the cleaning hatch plane, thus allowing brush cleaning of the Teflon plug on antenna feeder through the cleaning hatch.
2. Mount the clamp ring. Apply molybdenum sulphide paste on threads. Mount the nuts loosely, but do not tighten.
3. Install the adjustment scales assembly, and adjust the FORE scale pointing forward and the SB scale pointing starboard.
4. Adjust the antenna feeder in its original position using the adjustment scales.
5. The clamp ring nuts are tightened to different torques depending on which type (color) of gasket is used under the clamp ring. Tighten the nuts to the following torque:
   - Brown gylon gasket = 75 Nm
   - Blue gylon gasket = 45 Nm
   - White gylon gasket = 75 Nm

   Tighten the clamp ring nuts in a uniform, crosswise

pattern with a dynamometric wrench. Then check the antenna feeder position once again. Readjust if necessary. The gasket settles down, so tighten the nuts to the torque shown above, again after two hours.

6. Install the Electronic Box.

Note: *Before replacing the transmitter cover, make sure the interior of transmitter housing is completely dry and clean. Encased water or damp cause corrosion of the terminal block and wire leads causing contact fault. Wipe with a clean and dry cloth if necessary.*

7 Temperature Sensors (Option)

The Pt 100 temperature sensors are optional equipment installed separately in a sealed pipe submerged in the tank. Up to three temperature sensors are used to measure the cargo temperature.

The sensors are connected to a wire terminal inside the Temperature Connection Box. From this wire terminal there is a cable to the wire terminal in the transmitter housing.

If there is an ERROR-status on one or more temperature sensors, these may need to be replaced.

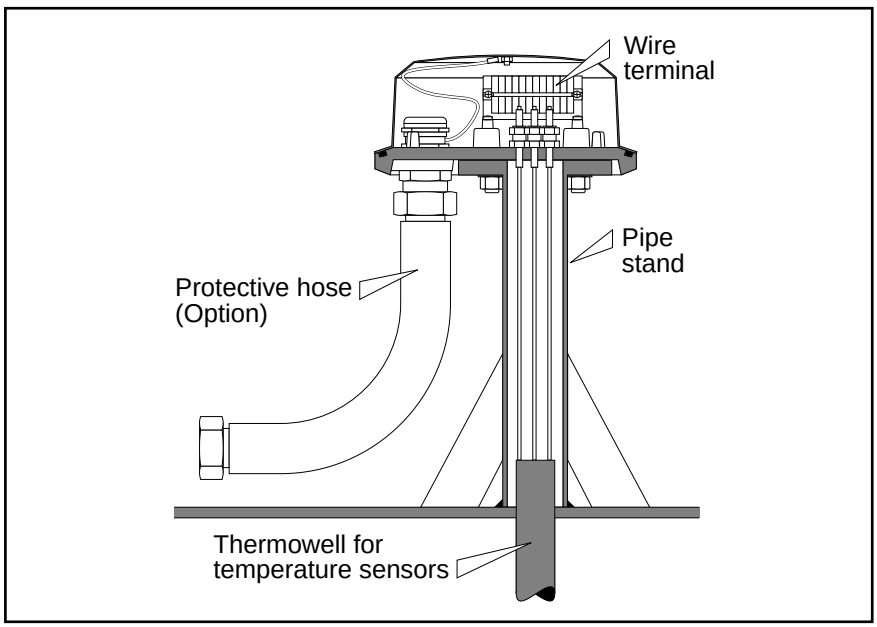


Figure 7-1. Temperature Connection Box.

7.1 Checking a Temperature Sensor

The Pt 100 temperature sensor has a near linear relation between resistance and temperature. 0°C corresponds to 100 Ω and 100°C corresponds to 138,5 Ω. The relation between the temperature and the resistance is shown in figure 7-3.

When checking the resistance of a Pt 100 sensor, observe the additional resistance of the connecting leads, which can be either in a 3-wire or 4-wire configuration.

Note: *For service of temperature sensors, strictly observe the safety regulations for intrinsic safety, see chapter 2.1.*

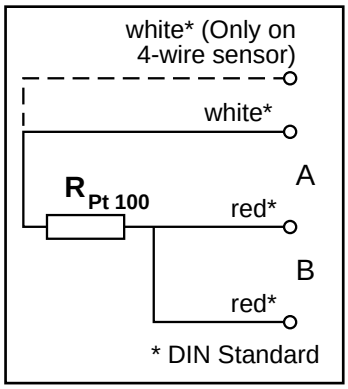


Figure 7-2.

Use a certified battery operated multipurpose instrument to check the resistance of the Pt 100 element. The cable leads are colored according to the DIN Standard - white, (white), red and red.

1. Begin by opening the cover of the Temperature Connection Box and disconnect the leads to the Pt 100 element you want to check.
2. Measure the resistance between two red cable leads to establish the lead resistance (B). Then measure the resistance between white and red leads to get the total resistance (A). The resistance of the Pt 100 elements: $R_{Pt} = A\text{-}B\ \Omega$
   Check corresponding temperature in figure 7-3. If the derived temperature (R_{Pt}) is not equal to the actual temperature, replace the Pt 100 element.
3. Check the insulation to ground. Measure the resistance from each of the leads to the inside of the Temperature Connection Box. If any resistance is below 10 MΩ, replace the Pt 100 element. See also chapter 9.14.

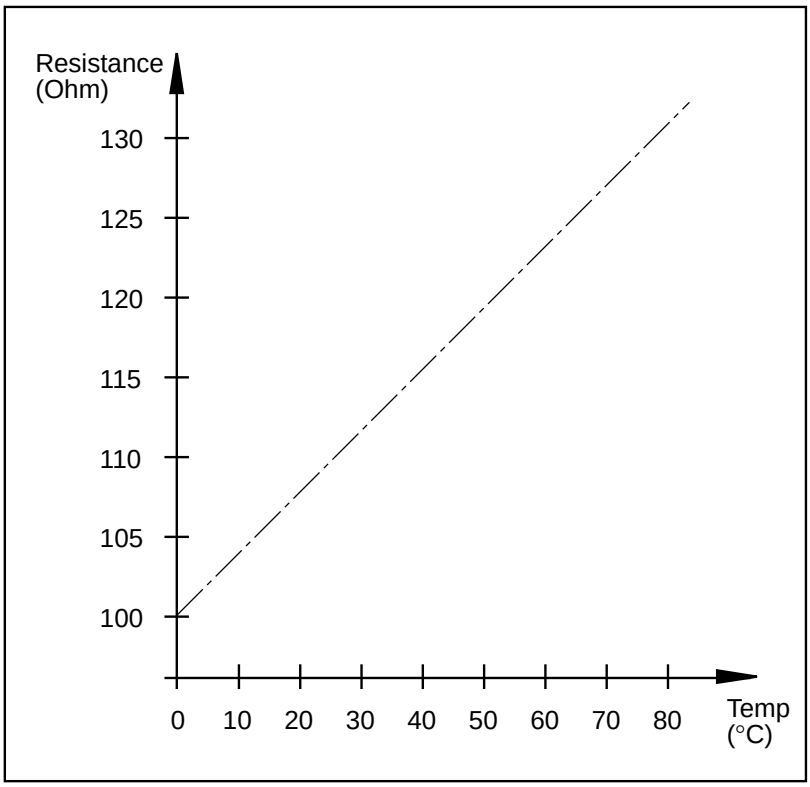


Figure 7-3. Relation between temperature and resistance.

7.2 Replacing a Faulty Temperature Sensor

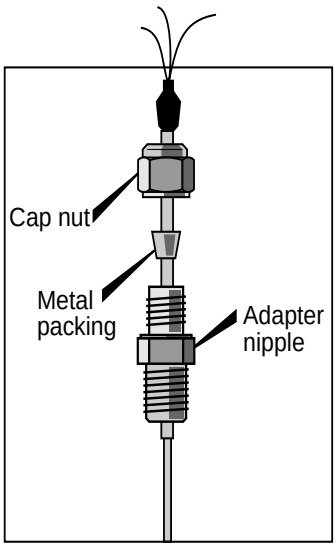


Figure 7-4.

To replace a faulty Pt 100 element, proceed as follows:

1. Remove the cover of the Temperature Connection Box.
2. Loosen the cap nut completely.
3. Loosen the adapter nipple using the box spanner from the spare parts set.
4. Pull out the temperature sensor completely.
5. Insert a new temperature sensor completely. If it is not entered completely the cover will not fit. Tighten the adapter nipple first using the box spanner.
6. Make sure the conical metallic packing is correctly fitted in the cap nut, and then tighten the cap nut securely.

8 Tank Display Unit (Option)

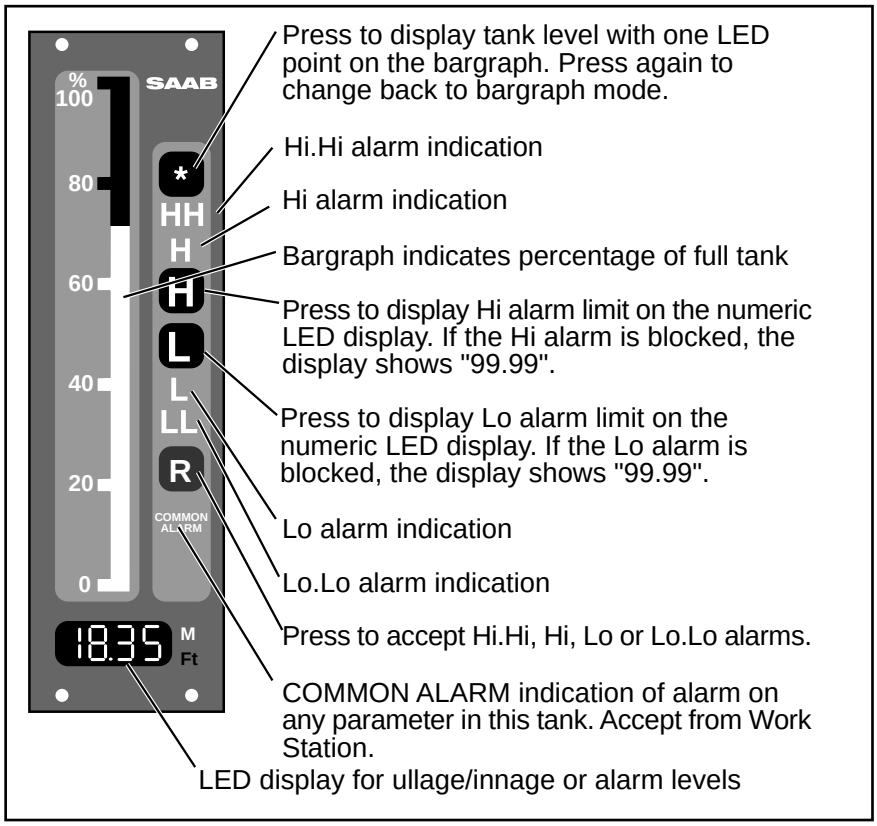


Figure 8-1. Tank Display Unit for ullage indication.

8.1 Replacing a Tank Display Unit

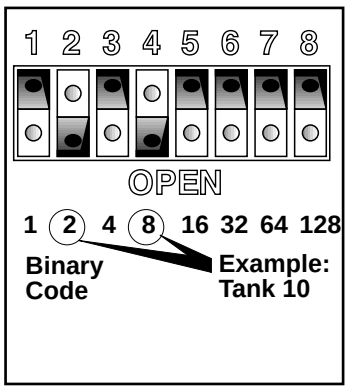


Figure 8-2. In the example the switches have been set to address Transmitter in tank number 10.

1. Begin by loosening the four panel screws and pull the TDU out of its console.
2. Disconnect the wires to the terminal block on the back of the TDU board.
3. Before you install the new TDU you must address the TDU with its unique number. Set the address switch to the same positions as on the TDU you are replacing. The address switches are located in the middle of the TDU board, and accessed through an opening in the black cover plate. The positions of the switches represent a binary ”1” or ”0”.

Note: *Use a slightly blunt object to set the DIL switch. Do not use a lead pencil as some of the lead might come off and damage the switch.*

8.2 Checking the Tank Display Power Supply Unit

The Fl, F2 and F3 fuses (ratings 250 V/4 A) are located on a separate fuse panel.

1. Loosen the four screws to remove the cover.
2. Check if the fuses are intact. Replace if necessary. Also, reset the circuit breaker next to the transductor by pressing the reset button between the side panel of the unit and the interior vertical panel.
3. Replace the cover and tighten the bolts.

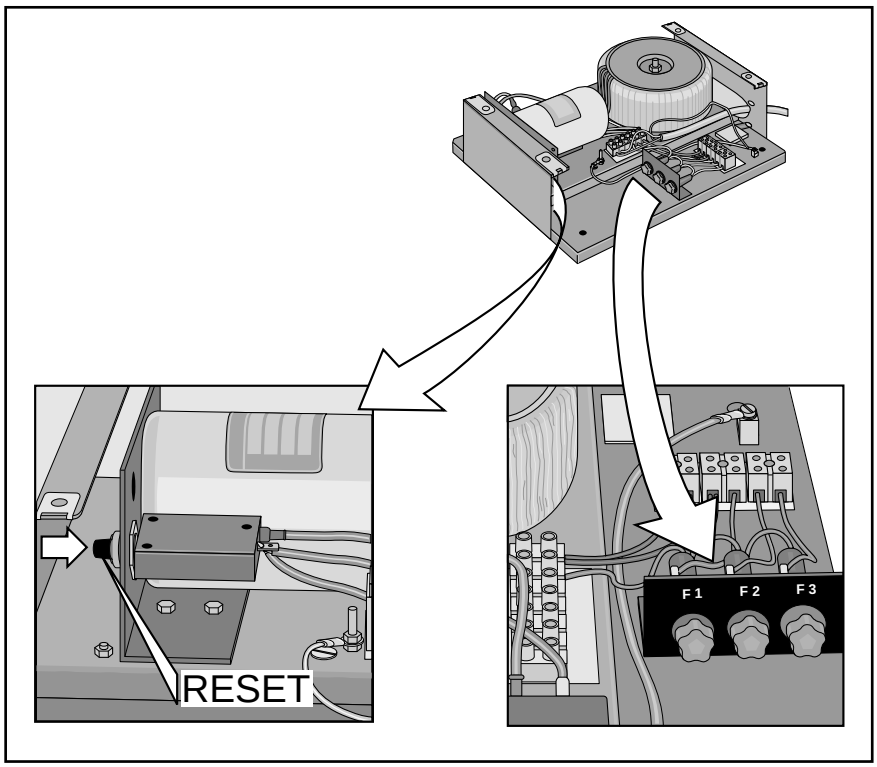


Figure 8-3. Checking the TDU Power Supply Unit.

9 Fault Finding on the Saab TankRadar System

Whenever there are symptoms in the system that may indicate that there is some failure, please start the fault finding by looking at the following pages. Look for a similar symptom as the one your TankRadar system is having, and then look for the cause and the action to take in order to fix the failure.

The symptoms are printed to the far left in bold text. On the line below is one or more descriptions of what is possibly causing the symptoms. Below each cause there are a number of suggested actions preceded by bullets (•). Both causes and actions are listed so that the ones that are most likely to happen or easiest to fix are placed first.

Abbreviations used in the fault finding chart:

LCB	-	Backup Display in Level Unit.
LCI	-	Interface Board in Level Unit.
LCM	-	Processor Memory Board in Level Unit.
LCS	-	Signal Board in Level Unit.
LED	-	Light Emitting Diode.
LI	-	Transmitter Interface in Level Unit.
LP	-	Power Block in Level Unit.
LU	-	Level Unit.
WS	-	Work Station.

9.1 SysFail and Warning Messages Shown on the Work Station

9.1.1 SysFail message: Level Unit SysFail.

Level Unit may not be switched on.

- Press power switch in Level Unit to setting “1”, see chapter 5.3.

Mains power supply to Level Unit may be failing.

- Check power supply, cable and fuses. See chapter 5.11.

Fuses in Power Block of Level Unit might be blown.

- Check cause of blown fuse. Replace burnt fuses, see spare parts list in chapter 10.
- If system is new, check setting of voltage in Power Block in the Level Unit. Voltage setting is marked on the Power Block. See chapter 5.11.

LCM Board faulty.

- See chapter 5.6.

Communication to one or more LIs within the Level Unit has failed.

- See chapter 9.1.3 and 9.1.4 below.

9.1.2 SysFail message: Level Unit Communication Failed.

I/O Box may not be functioning.

- Check mains power supply and power cable to I/O Box. Check setting of voltage in I/O Box. See chapter 4.

Contact fault between Work Station and I/O Box or between I/O Box and Level Unit.

- Check cable and connectors.

Serial port Com 1 or Serial Interface Board in Work Station faulty.

- Check Service window "Communication I/O Box" on Work Station. See chapter 3.30.

The RS 485 Interface Board in location Com 4 in I/O Box faulty.

- Check that LEDs in I/O Box are flashing, see chapter 4.

Interface Board (LCI) in Level Unit faulty.

- See chapter 5.7.

9.1.3 SysFail message: Level Unit Power Failure.

Power failure to LI.

- Check status of LIs in Service window Level Unit: LI Status. See chapter 3.16
- Check fuses in the Power Block (LP), see chapters 5.11 and 10.

9.1.4 SysFail message: Level Unit LI Communication Failed.

Contact fault on cable between Calculation Unit and Transmitter Interface (LI).

- Check status of LIs in Service window Level Unit: LI Status. See chapter 3.16.
- Check cables and connectors inside the Level Unit.
- Check if LCM is functioning, see chapter 9.1.7.
- Check setting of switch for addressing of the LI, see chapter 5.10.5.

Power failure to LI.

- See chapter 9.1.3 above.

LI faulty.

- Replace LI. If the system is equipped with more than one LI, try exchanging the LIs. See chapter 5.10.8 "Replacing a Transmitter Interface". Check result.

9.1.5 SysFail message: I/O Box Communication Failed.

Mains power supply to I/O Box failing.

- Check that I/O Box has power and is running. See chapter 4.

Communication cables faulty.

- Open the cover and watch the LEDs on the main board at the bottom of the box. See chapter 4.1.
- Check communication cables.

Serial Interface Board in Work Station faulty.

- Restart the Work Station (if more than one Work Station – restart the Master Work Station) by pressing the Reset-button. See chapter 3.1.

9.1.6 Warning message: Level Unit Ground Failure.

Ground Failure on one or more LIs.

- Read chapter 9.14 for information on how to find the cause of the ground failure.

9.1.7 Warning message: Level Unit Memory Failure.

LCM Board faulty.

- Restart Level Unit and check Service-window LCM Status on Work Station. If box "DF database loaded" is checked, memory in LCM Board is not working and LCM Board needs to be replaced. See chapter 3.14 and 5.6.1.
- In Service-window LCI Status, check LCM status, see chapter 3.15. If LCM is faulty, replace LCM board.

9.1.8 Warning message: Level Unit Restarted.

This message is shown while the Level Unit is starting up after the power has been switched off and on again or after it has been ordered to restart after downloading software into the LCI or LCM.

- Wait a few minutes until the Level Unit has started up, then accept the warning in the Warning Summary-window.

9.1.9 Warning message: Master Communication Failed.

Communication cables faulty to the master equipment (normally a load calculator) connected to the I/O Box.

- Check cables between master and I/O Box.

Master is not turned on or power supply failing.

- Turn master on or check power supply, cables and fuses.

I/O Box failure.

- See chapter 9.1.5.

RS-232 board for master communication in I/O Box faulty.

- Try exchanging with another RS-232 board, either from the Complete Spare Parts set or if another RS-232 board is used in the I/O Box. See chapter 4.2.

9.1.10 Warning message: LevelDatic Communication Failed.

Communication cables faulty from the I/O Box to the LevelDatic equipment.

- Check cables between LevelDatic and I/O Box.

LevelDatic is not turned on or power supply failing.

- Turn LevelDatic on or check power supply, cables and fuses.

I/O Box failure.

- See chapter 9.1.5.

Duplex setting on the RS-485 board is incorrect

- Check setting of jumpers on board, see chapter 4.3.

RS-485 board for LU communication in I/O Box faulty.

- Try exchanging with another RS-485 board, either from the Complete Spare Parts set or from another serial channel in the I/O Box. However, do not remove the RS-485 Board in location Com 4 as you will loose the communication with the Level Unit. See chapter 4.3.

9.1.11 Warning message: SIOX Communication Failed.

Communication cables faulty from the I/O Box to the SIOX equipment.

- Check cables between SIOX and I/O Box.

Mains power supply failing to SIOX (Mains to box or 24 VDC to each SIOX module).

- Check power supply, cables and fuses.

I/O Box failure.

- See chapter 9.1.5.

Single SIOX module failing

- Check LEDs on each SIOX module. See chapter 4.4.

SIOX Interface Board in I/O Box faulty.

- Try exchanging with another SIOX board from the Complete Spare Parts set. See chapter 4.4.
- Check the fuse for external supply voltage on the SIOX board

9.1.12 Warning message: PRS Communication Failed.

Communication cables faulty from the I/O Box to the PRS equipment.

- Check cables between PRS and I/O Box.

Mains power supply failing to PRS.

- Check power supply, cables and fuses.

I/O Box failure.

- See chapter 9.1.5.

PRS Interface Board in I/O Box faulty.

- Try exchanging with a spare PRS board. See chapter 4.5.
- Check the fuse for external supply voltage on the PRS board

9.2 Other Messages Shown on the Work Station

9.2.1 Message: PROCESS DATABASE NOT RUNNING - Alarm handling is off and pictures are not updated. Please wait until system restart.

If shown on the Master Work Station there is a serious fault in it. If the Work Station keeps trying to start up over and over again try the following:

- Reinstall the Work Station Software, see chapter 3.6.
- If problem persists: Replace hard disk, see chapter 3.2.
- If problem persists: Replace Work Station. See chapter 3.3.

9.2.2 Message: NO CONTACT WITH MASTER WORKSTATION - Network Error or Master Work Station not running. Please wait until connection established.

This message is shown on the Slave Master Work Station in a network system, when the Master Work Station is not communicating.
Master Work Station is not turned on or power supply is failing.

- Turn the Master Work Station on.

The Master Work Station is starting up.

- Wait approximately one minute to allow the Master Work Station to start up.

If there are more Slave Work Stations, check for any messages on these.

- If only one slave Work Station has the message "NO CONTACT WITH MASTER WORK STATION", concentrate your fault finding on this Work Station.
- If all Slave Work Stations have the message displayed, check Master Work Station, the network cables or the Network Board in the Master Work Station.

If Master Work Station is turned on and running without any problems:

- Check cables between the Master and Slave Work Station.
- Check Network Board in both Slave and Master Work Station.

9.3 Channels with status CFAIL, ERROR or INVAL

9.3.1 CFAIL status on one Transmitter

Cables from Level Unit to Transmitter faulty

- Disconnect Transmitter cables at Transmitter Interface (LI) in Level Unit and check cables to Transmitter.
- Interchange connectors of failing Transmitter with one that is OK. Watch these two channels on Work Station. If failing Transmitter becomes OK, find a spare connection on LIZ. Connect the Transmitter and configure to new address using Transmitter Data-window in the service part of the Work Station software.

LIZ board in LI may be faulty

- If there are two LIs in the Level Unit, try exchanging them to find out if it is broken. See chapter 5.10.8 for information on how to change an LI.
- Exchange with LIZ board from the Complete Spare Parts set. See chapter 5.10.9.

Faulty Electronic Box

- Replace Electronic Box, see chapter 6.1.

9.3.2 CFAIL status on five Transmitters

LIZ board in LI may be faulty

- Check if the five Transmitters are connected to the same LIZ board in the LI (that the connectors are placed in a vertical row). If they are, the LIZ board needs to be replaced. See chapter 5.10.9 for information on how to replace it.
- Exchange with LIZ board from the Complete Spare Parts set. See chapter 5.10.9.

9.3.3 ERROR status on one Transmitter, but not CFAIL status

Surface echo is lost. There can be waves, turbulence or foam on the surface of the product. A very large list angle could also cause the echo to be lost.

- Wait while system searches for the surface echo.
- Order an echo search on that tank from the TX Service-window in the Service-part of the Work Station software. See chapter 3.25.

Faulty Electronic Box

- Replace Electronic Box, see chapter 6.1.

9.3.4 Warning "Clean antenna on tank XXX"

If the signal strength is reduced due to a thick layer of cargo or other contamination on the antenna, this warning will be displayed.

- Clean antenna. See chapter 6.3 for cleaning of the antennas.

9.3.5 All warnings associated with one tank shown on Work Station

If warnings about communication failure, error etc. are shown for a single tank, the cabling might be broken.

- Check cabling between faulty Transmitter and Level Unit.

If there is a warning on Level Unit ground failure, there may be water within the Transmitter housing or in any associated cable connection box.

- Check inside of transmitter housing. Clean and dry out if necessary.

9.3.6 ERROR status on one temperature sensor

Faulty cabling between Transmitter and temperature sensor.

- Check cabling and, if necessary, repair.

Temperature sensor faulty.

- Replace temperature sensor. See chapter 7.2.

9.3.7 INVAL status on average temperature

This message normally does not indicate any fault. None of the temperature sensors are below the product surface (immersed in the liquid).

- Check Tank Setup-window for tank in question on the Work Station. Sensors that are immersed in the product are shown with INCL in the Mode column. See Operating Manual.

9.3.8 ERROR status on one IG pressure sensor

Cable to sensor may be faulty

- Check cable between sensor and cable terminal on Transmitter.

Sensor may be supplying a signal that is out of range

- Try to zero adjust the sensor and if that is not possible, replace the sensor. See chapter 6.4.

9.4 Work Station

9.4.1 Work Station screen blank.

Monitor not turned on.

- Check that switch on the front panel below the screen is set to "1". See chapter 3.5.

Incorrect brightness/contrast setting.

- Change setting, see chapter 3.5.

Contact fault between PC and monitor

- Check cables and connectors between PC and monitor.

Power supply to monitor failing

- Check power supply to PC and from PC to monitor, cables and fuses.

Setting of BNC – D-Sub incorrect on front of monitor.

- Switch setting to D-Sub position, see chapter 3.5.

9.4.2 Work Station monitor image located incorrectly, distorted or discolored.

Static field distorting the image.

- Press the degauss-switch, see chapter 3.5.

Image settings incorrect.

- Adjust image settings, see chapter 3.5.

Some object is disturbing the magnetic field controlling the image.

- Check for any large metal object, radio transmitter, magnet or transformer placed close to the monitor.

9.4.3 No new windows can be opened on the Work Station or Work Station cannot be started.

Hard disk failure or software incorrect.

- Install new software, see chapter 3.6. Start the Work Station. If it is still not possible start it, replace the hard disk, see chapter 3.2.

9.4.4 Light Pen is not functioning

The setting of the light intensity of the monitor is too low.

- Increase light intensity, see chapter 3.5.

Cable or Light Pen is faulty or disconnected.

- Check cable and connectors.
- Replace Light Pen. It is included in the Complete Spare Parts set.
- Use arrow-keys on keyboard to move the cursor. Hold an arrow-key down to move the cursor quickly.

Light Pen Interface Board in PC is out of order.

- Replace Light Pen Interface board, see chapter 3.4.

9.5 Level Unit

9.5.1 Backup Display is blank.

The display automatically switches off after approximately 20 minutes after the last key pressing.

- Press any key on the keyboard.

9.5.2 No response when pressing the keys on the Backup Display's keyboard.

Connectors or flat cable between LCI and Backup Display is faulty.

- Check cable with connectors. If necessary, repair or replace cable.

Display or keyboard is broken

- Replace the Backup Display (including keyboard).

LCI board is not functioning

- Check LCI board. If faulty, exchange the board. See chapter 5.7.

9.5.3 Watch Dog LED on LCI board is on (the lowest LED)

LCI Board might be faulty

- Restart Level Unit and then watch the LCI's watch dog LED. Check Work Station for message "Level Unit Communication Failed". If watch dog LED goes on again, replace the LCI board, see chapter 5.7.

9.5.4 Backup Display shows "No flash program"

LCI Software faulty

- Load new software into the LCI. See chapter 3.23.

9.6 Transmitters

9.6.1 Ullage indication not updated close to empty tank.

Too weak radar echo due to inclined bottom or sludge on tank bottom.

- Ullage indication will be resumed when the tank is loaded again.

9.7 Local Display

9.7.1 Local Display blank

Setting of display mode may be incorrect.

- Check setting either on Backup Display in Level Unit, see chapter 5.9.4, or from the Transmitter Data-window in the Service part of the Work Station, see chapter 3.9.

Cabling between Local Display and Transmitter may be faulty.

- Restart Transmitter and Local Display by disconnecting the connector for that Transmitter on the LI, and then connect it again. Check if the Local Display starts working.
- Check cabling, and repair if necessary.

Saab TankRadar system may be starting up.

- Wait approximately 15 min and then check if the Local Display works.

Communication failure to Transmitter.

- Check for CFAIL status on Transmitter. See chapter 9.3.5.

9.8 Temperature Measurement

9.8.1 Incorrect temperature values on one tank

Incorrect setting of temperature range

- Check temperature range in Cargo Tank Sensors-window in Configuration part of Work Station software. If necessary, change to correct range and restart Transmitter by disconnecting and connecting its cable at the LI in the Level Unit.

9.9 Inert Gas Pressure Measurement

9.9.1 Incorrect reading of the IG pressure

IG Pressure sensor not correctly zero adjusted.

- If, or when, conditions allow it, do a zero adjustment of the IG pressure sensor. See chapter 6.4.

Venting hose of the sensor may be clogged or squeezed.

- Check that the venting hose ventilates to the outside of the Transmitter housing. See chapter 6.4.

IG pressure sensor may have been subjected to a too high pressure (more than twice the maximum range).

- Zero adjust sensor. See chapter 6.4.
- If it is not possible to adjust, replace it. See chapter 6.4.

9.9.2 Indicated inert gas pressure always the same

IG pressure sensor's opening to the tank may be clogged.

- Clean the sensor's opening to the tank. See chapter 6.4.

IG pressure sensor faulty.

- Replace sensor, see chapter 6.4.

9.10 Tank Display Unit

9.10.1 Display on TDU not working.

No voltage supply

- Check fuses in TDU-Power Supply. See chapter 8.2.
- Check power cables and DC distribution to TDUs.

Communication failure

- Check communication cables
- Check I/O Box. See chapter 4 and 9.4.

9.11 Portable Readout System:

9.11.1 Indication of communication error (CERR) on PRU.

Low walkie-talkie battery voltage

- Charge battery. This may be necessary even if voice communication works.

Bad radio conditions.

- Move PRU (walkie-talkie) to another position. This may be necessary even if voice communication works.
- Check base radio antenna.

Low volume control on either radio.

- Increase volume control.

Incorrectly adjusted squelch control on either radio.

- Adjust squelch (if any) to low level without noise between transmissions.

9.11.2 No voice communication between walkie-talkie and base radio (PRS).

No power supply.

- Check batteries in walkie-talkie and power supply to base radio.

Unit faulty.

- Replace units one by one: base radio, walkie-talkie, PRU, PRS Interface Board in I/O Box.

Cable faulty.

- Check the cabling between base radio and I/O Box.

9.11.3 No display on PRU.

Low walkie-talkie battery voltage

- Walkie talkie battery needs to be recharged

PRU cable faulty.

- Replace cable.

PRU faulty.

- Replace.

9.12 Draft measurement

9.12.1 Draft measurement incorrect

Failure on LevelDatic equipment

- Check LevelDatic equipment. See separate documentation in "As-built drawings and user's manual"-binder.

Incorrectly configured data for draft measurement.

- Check that configured ship data in Ship measures-window on Work Station correspond to real distances on ship.

Faulty communication with LevelDatic equipment.

- See chapter 9.1.10.

9.13 Load Calculator

9.13.1 Values displayed on TankRadar and load calculator differ.

Ullage values differ due to a delay of information during quick loading or discharging, especially in small tanks.

- When the surface is stable, wait for approximately one minute to see that the values become equal.
- Concentrate on ullage values displayed on TankRadar since they are updated more often than on the load calculator.

Trim/List correction is set to off on Work Station, but the protocol to the load calculator is using trim/list corrected values.

- Check setting of trim/list correction in the Setup-window. See Operating Manual.

Presentation units changed from m to feet or vice versa.

- Check setting of units in the Setup-window. See Operating Manual.

9.14 Finding Cause of Ground Failure Warning

When the warning message "Level Unit Ground Failure" is displayed on the Work Station or when the ground failure LED on a Transmitter Interface in the Level Unit lights up, there is a need to find the cause of the ground failure.

The ground failure could be located in the cables between the Transmitter and Level Unit or between Transmitter and temperature sensors, IG pressure sensors, extra temperature sensors or Local Display (if these options are included). It could also be located within the units themselves or in their wire terminals.

You need a multimeter when searching for a ground failure. Follow the steps below to find the cause of the ground failure:

1. Open the LI Status-window in the Service part of the Work Station Software. In this window the status of the LI's ComFail, GroundFail, +15 V and -15V are shown. Find the LI that is causing the ground failure. Or check ground failure LED on LI to find out which LI is causing the ground failure.

9.14.1 Ground Failure – Transmitter Interface

Note: *Before pulling the connectors out, check that they are marked so that they can be replaced correctly.*

2. On the LI that is causing the ground failure, pull out the connectors to the Transmitters one by one. Check when ground failure LED goes off, to find which transmitter that is causing the ground failure.

9.14.2 Ground Failure – Transmitter Cable

3. Check the cable between Transmitter and Transmitter Interface in the Level Unit following the steps in chapter 9.14.8 below.

9.14.3 Ground Failure – Temperature Sensors

4. Check both temperature sensors and cable to temperature sensor by removing the wires to the temperature sensors from the terminal in the transmitter housing.
5. Hold the wires together so that they are in contact with each other and measure the resistance to ground. If the resistance is larger than 10 MΩ go to step 10 below.
6. Check the cable between the Transmitter and the wire terminal of the temperature sensors following the steps in chapter 9.14.8 below.

7. If there is no ground failure on the cable between the Transmitter and the temperature wire terminal, you need to check each individual temperature sensor.
8. Remove the wires to the temperature sensor from the terminal inside the Temperature Connection Box.
9. Measure the resistance between each wire and ground to find which temperature sensor is causing the ground failure. Replace troubling temperature sensor with a new spare sensor ordered from Saab Marine Electronics or any of the service agents, see list of agents in chapter 12.

9.14.4 Ground Failure – IG Pressure Sensor

10. Remove the wires of the cable to the IG pressure sensor (if included in system) from the wire terminal inside the transmitter housing.
11. Hold all the wires of the sensor cable together so that they are in contact with each other. Measure the resistance to ground, which should be more than 10 MΩ. If it is, go to step 13 below.
12. If the resistance measured in step 12 is less than 10 MΩ, replace the IG pressure sensor with a spare sensor. See chapter 6.4.2.

9.14.5 Ground Failure – Extra Temperature Sensors

13. If there are extra temperature sensors connected (there can be up to two extra sensors except for the one, two or three inside the tank) these can also be the cause of a ground failure. These extra sensors can either be connected to the wire terminal inside the transmitter housing or the temperature housing. Remove one sensor's wires from the terminal and hold them together. Measure resistance, which should be more than 10 MΩ. If it is, go to step 15 below.
14. If the resistance measured in step 13 is less than 10 MΩ replace with new spare sensor.

9.14.6 Ground Failure – Local Display

15. If a Local Display is connected to the Transmitter this could also be causing ground failure. Remove all the wires to the Local Display from the terminal inside the Transmitter Housing.
16. Hold all the wires of the sensor cable together so that they are in contact with each other. Measure the resistance to ground, which should be more than 10 MΩ. If it is, go to step 19 below.

17. If the resistance measured in step 16 is less than 10 MΩ, check the cable between the Transmitter and the Local Display according to the steps in chapter 9.14.8 below.
18. If the Local Display is causing the ground failure, try cleaning and drying the inside of the display. If this does not help replace the Local Display.

9.14.7 Ground Failure – Wire Terminals

19. If you have come this far in your search for the ground failure, check the wire terminals. See chapter 9.14.9.

9.14.8 Checking a Cable for Ground Failure

Note: *If the cables have not previously been marked, mark them before removing them from the wire terminal.*

1. Disconnect all wires in both ends of the cable. Make sure the wires are not in contact with anything.
3. Hold all the wires of the cable together so that they are in contact with each other and measure the resistance between cable and ground (for example, use ground bar inside the transmitter housing). If the resistance is larger than 10 MΩ, the cable is OK.
4. If the resistance measured in step 3 is less than 10 MΩ, measure between each single wire and ground to find which wire that is causing the ground failure. When it has been located, check if there is any spare wire in the cable or lay a new cable.

9.14.9 Checking a Wire Terminal for Ground Failure

1. Remove all wires from the terminal. Measure the resistance between each terminal and ground. If the resistance is larger than 10 MΩ, the terminal is OK.
2. If the resistance is less than 10 MΩ, try to dry the terminal as well as spraying it with CRC666-spray or equivalent de-moisturizing spray.

9.15 Comparing Ullages

The best reference point for ullage measurement is the ullage plug on the flange of the transmitter housing if the Parabolic Antenna is used.

When measuring on the Cone Antenna, the Waveguide Cone has to be removed. See instructions in chapter 6.3.4. Hand dip from the top of the edge of the cone. Reduce the hand dipped measure with 555 mm. The 555 mm includes the length of the cone and the thickness of the gasket (approximately 4 mm).

If separate ullage plugs are used for hand dipping and as reference points, the vertical distances (A-distances) between the two ullage plugs are stored in the database of the Work Station and the Level Unit. The ullage displayed by TankRadar is corrected so that it is equal, at even keel, to the ullage at the separate ullage plug.

Normally TankRadar makes trim/list corrections to the centre of gravity, C.O.G., at 98% filled tank (C and E distances refer to C.O.G.). On some ships TankRadar makes trim and list correction to a separate ullage plug.

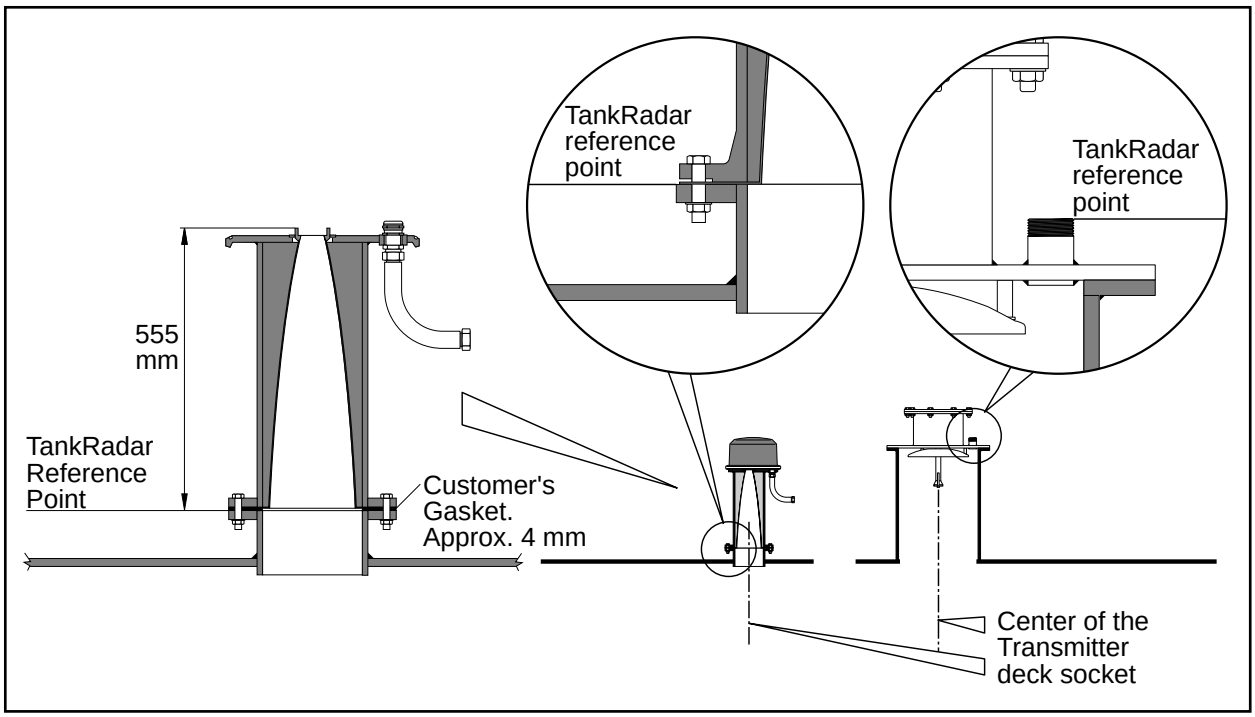


Figure 9-1 shows the TankRadar reference point.

There are three different ways in which the TankRadar can be configured as far as hand dipping and trim/list corrections are concerned. Depending on the configuration please follow the appropriate steps below when comparing ullages. It is important to know which reference point the system uses for correction. See the Setup-window on the Work Station.

If the TankRadar ullage plug is the only reference then proceed as follows to compare ullages:

1. Take a hand dip ullage reading and the TankRadar ullage (not corrected for trim and list. Off-button pressed in the Setup-window on the Work Station).
2. Compare the ullages.

If a separate ullage plug is used as reference and TankRadar is trim/list-corrected to C.O.G. (C and E distances to C.O.G.) then proceed as follows to compare ullages:

1. Take a hand dip ullage reading in the separate ullage plug and use the ship's volume tables to get a volume related to the tank's C.O.G.
2. Take the trim/list corrected TankRadar ullage (with trim/list-correction on). This is equal to the ullage at C.O.G. at even keel. Use this ullage to get the volume.
3. Compare the volumes.

If the separate ullage plug is the reference and the TankRadar ullage is trim/list corrected to the separate ullage plug (C and E distances to the separate ullage plug) then proceed as follows:

1. Take a hand dip ullage reading at the separate ullage plug.
2. Take the trim/list corrected TankRadar ullage (with trim/list-correction on).
3. Compare the ullages.

10 Spare Parts

10.1 Standard Spare Parts Set, 9150065-981

Part no.	Spare Part	Quantity
9150065-615	Transmitter test cable G3	1
9150020-891	Cleaning brush nylon for crude & products CRUDE&PRODUCT	1
9150020-893	Cleaning brush stainless steel for chemicals CHEM	1
9150021-048	Box spanner for temperature sensors (ONLY for systems with TEMP)	1
0980240-002	Fuse 0.125 A slow 5x20 (F3 & F4 in I/O-box)	1
0990117-014	Fuse 2 A 6.3x32 slow (F1,F3,F4,F6,F7 in LP)	2
0990117-011	Fuse 1 A 6.3x32 fast (F2,F5 in LP)	1
0990117-020	Fuse 8 A 6.3x32 slow (F8 in LP)	1
0980240-002	Fuse 0.125 A 5x20 (F1 in SIOX module type R02 & F1 on SIOX board). ONLY for systems with SIOX	3

10.2 Extended Spare Parts Set, 9150065-982

Part no.	Spare Part	Quantity
9150065-981	Standard Spare Parts Set	1
9150064-871	Electronic Box	1
6853489-420	Light Pen Assembly	1

10.3 Complete Spare Parts Set, 9150065-983

Part no.	Spare Part	Quantity
9150065-982	Extended Spare Parts Set	1
9150064-541	Analog/Digital/Power Board, LIA	1
9150064-552	Zener Barrier Board, LIZ	1
9150064-511	Processor Memory Board, LCM	1
9150064-501	Signal Board, LCS	1
9150065-541	Power supply, LCP	1
9150064-531	Interface Board, LCI	1
6853489-388	Torx screw-driver (for LI & LP unit disassembly)	1
9150020-036	Rubber gasket top cover TAP TX, 4x 378 mm TAP ONLY	1
6853488-852	O-ring 54.5 x 3.0 Floursil TAC ONLY	1
6853489-438	O-ring 329.6 x 6.99 Nitrile TAC ONLY	1

Note: *Contents subject to change without prior notice.*

11 Recycling of Saab TankRadar

At a point in time when your TankRadar system has served you well for many years and it is time to scrap the ship, we at Saab Marine Electronics are more than willing to help you with the recycling of the TankRadar system.

At our factory, we are able to sort out the various parts of the system that are possible to recycle. Saab Marine Electronics will see to it that your TankRadar system does not burden our environment when the ship is scrapped.

We would very much appreciate if you would contact us when a decision has been taken to scrap the ship. We will take appropriate measures to be able to remove and transport the TankRadar system to our factory for recycling. We thank you in advance for your kind assistance in helping us care for the environment in the world we live in.

Please contact:

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