SAL NAVIGATION

Manual

SAL R100

STW Speed Log

Table of Contents

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Speed Log
Section 1
General

Doc ID 703821D6

Revision:

Date	Version	Author	Comment
2005-04-20	B0	NE	Created.
2005-05-16	B1	HW	New dimension drawings for ELC and LDU.
2005-05-31	B2	HW	Pictures added. Bottom valve installations.
2005-09-02	B3	HW	Text corrected 6.2.5 TRU inspection.
2005-10-07	B4	HW	Sec. B and C changed to separate documents.
2007-05-16	B5	HW	LPU added as optional distribution device.
2009-09-14	B6	OM	No of displays connected.
2009-10-27	B7	HW	LPU2, NMEA 1to4 Buffer, NMEA N2P Converter added and LPU and LDU removed as optional distribution device.
2013-11-20	B8	STE/SGu	Editorials, SDP removed, 1N4B replacing 1N4.
2014-06-19	C0	JL/SGU/STE	Adapted to WTU – Assembly (rev F and later).
2015-10-06	D0	OM	Updated bottom parts to MSSBSV L.
2016-06-27	D1	STE	Corrected ELC IP protection.
2017-01-23	D2	OM	Added SAL Easy Tank.
2019-10-30	D3	AF	Risk Assessment. Header.
2020-08-20	D4	MS	Company ID.
2021-05-25	D5	HB	Added TRU cable specifications.
2023-02-01	D6	HB	Updated ELC power consumption.

TABLE OF CONTENTS

Section A: GENERAL

1 INTRODUCTION

This General section A of the manual is grouped in the following manner:

- the **Table of Contents**
- this **Introduction** including general **Warnings** to be followed while working with the speed log.
- general **Shipping and Storing** recommendations which are conditions of warranty.
- the speed log **Technical Specification** to be used as a fact and reference chapter and
- the **Basic System Information** which we highly recommend reading before starting any work with the speed log

1.1 Risk Assessment

We, as a manufacturer, evaluate that applicable standards cover all reasonably foreseeable risks.

1.2 Warnings

Lethal Warning!

Voltages within this equipment are sufficiently high to endanger life.

Covers are *not* to be removed, except by persons qualified and authorized to do so, and these persons should always take extreme care once the covers have been removed.

First Aid in Case of Electric Shock

1. Lay victim on his back.
2. Clear victim's mouth and throat
3. Tilt victim's head back as far as possible and raise his head

4. Pinch victim's nostrils.
5. Take a deep breath.
6. Cover the victim's mouth with yours and blow, watching his chest rise.

Note: Blow forcefully into adults, but gently into children.

7. Move your face away to allow victim to breathe out, watching his chest fall.
8. Repeat first five to ten breaths at rapid rate; thereafter, take one breath every three to five seconds.
9. Keep victim's head back as far as possible at all times.

Have someone else send for a doctor. Keep patient warm and loosen his clothing.

Do not give liquids until the patient is conscious.

1.3 Handling

1.3.1 Shipping

Following general rules apply:

- Inspection for damage during transport
- When the unit(s) arrives at destination, inspection should be performed immediately to register any damage that may have occurred during transfer
- The customer is normally responsible for insurance during the transportation. If any damage is found, both the insurance company and the shipping agent must be informed immediately.
- The content of the goods shall also be compared with the Packing List. Complaints regarding the shipped content must be sent to SAL Navigation AB within seven days from goods arrival to the addressee.

1.3.2 Storage

After the material, contained in the boxes, has been inspected in the presence of customer and it has been verified that no damage has occurred, the unit shall be stored in its original packing until the time of installation. The storage premises must be dry and well protected.
If the electronic units must be kept in storage for more than one month, it is advisable to insert hygroscope substances, such as silicone gel salts, in the crates.

1.3.3 Handling

The electrical part should be kept in their packing as long as possible and shall be unpacked at the place of installation.

The bottom unit shall be unpacked and mounted at the place of installation. It should not be transported assembled.

The TRU and the TRU cable must be handled with care. Except for when necessary for mounting the cable, the protecting cover over the TRU and TRU cable termination end must not be taken off until just before installation. **Under any circumstances, do not cut or alter the length of cable!**

2 TECHNICAL SPECIFICATIONS

System performance data

Working principle:	Acoustic correlation
Operating frequencies:	Jumping frequencies in the range 3.8 MHz – 4.2 MHz
Measuring distance:	130 mm from the surface of the transducer.
Speed Range:	+/- 50 knots sensed speed
Speed Accuracy:	Better than 1% or 0.1 knots relative to sensed water flow whichever is the greatest
Distance Accuracy:	Better than 1%

2.1 Basic System

2.1.1 Electronics Cabinet (ELC)

Water Track Unit (WTU)

Mechanical specification

Enclosure material:	Painted Steel plate
Height:	360 mm (reserve space for cable entry at bottom)
Width:	360 mm
Depth:	170 mm
Weight:	10.0 kg
Colour:	RAL 7035

Electrical specification:

Input voltage:	110–115 VAC / 220–230 VAC +/-10% 50-60 Hz
Power consumption:	25W nominal with one SD4, add 1.5W for each additional SD4. Inrush current 4.7A, 4ms.
SD4-display power output:	24 VDC to power up to 4 SD-displays (load < 1.2A)
Main Speed output:	IEC 61162-1 / NMEA0183. Serial driver RS 422/485; max load 100 ohm (10 SD4-displays)
Analogue Speed output:	0.1 V/knot (load max 5 mA)
Relay outputs:	2 x 200 p/NM contact closure, (30V/30mA or 15V/100mA recommended max load)
Alarm relay outputs:	Switching relay, default setting: power failure (30V/2A recommended max load)
Serial input:	IEC 61162-1 / NMEA0183 (used for remote user interface)
Service connection:	9-pole female D-sub serial data connector (RS 232, for additional PC based user interface and software upgrade)

Environmental specification

Enclosure protection:	IP44
Environmental:	IEC 60945, protected class
Heat dissipation (max)	= Power consumption
Recommended operating temperature:	0°C to +40° C
Extreme operating humidity:	Less than 93 % RH (non-condensing) at 40°C

2.1.2 SD4-3, One axis STW and distance serial display

Mechanical specification

Height:	144 mm
Width:	144mm
Depth:	16 mm
Weight:	0.6 kg

Electrical specification

Input voltage:	12 or 24 VDC nominal (10-32VDC)
Current:	Maximum 200 mA at 15VDC (3 W)
Serial input:	IEC 61162-1 / NMEA0183
Remote inputs:	3 inputs with internal pull-up to +5V, activated by grounding to 0 V
Serial output:	IEC 61162-1 / NMEA0183. Serial driver RS 422/485; max load 100 ohm (10 SD4-displays)
SW controlled DC (pulse) output	+5 V with 35 mA current capacity

Environmental specification

Enclosure material:	House/frame: aluminium, front: polyester foil, backside: stainless steel
Enclosure protection: (front)	IP66 in SD4-BMB box or panel mounted on a flat surface
Environmental:	IEC 60945, exposed class
Heat dissipation (max)	= Power consumption
Colour:	House, black Front, background: Satin black (NCS 9000-N)
Operating temperature:	-25°C to +55° C
Operating humidity:	Less than 93 % RH (non-condensing) at 40°C

2.1.3 TRU R1, Transducer

Mechanical specification

Height (excl. cable):	160 mm
Diameter:	31.75 mm
Material:	Polyurethane and bronze
Acoustic frequency:	~ 4 MHz
Cable length standard:	30 m, optional 40 m
Cable max free hanging length	25m

Environmental specification

Environmental:	IEC 60945, submerged class

2.2 Mounting Set Single Bottom Sea Valve Low (MSSBSV L)

Mechanical specification

Height:	~ 335 mm
Weight:	~ 26 kg
Diameter, hull bottom flange:	168 mm
Minimum headroom to change TRU:	650 mm

Environmental specification Sea-valve

Material	Cast Bronze (CuSn5Zn5Pb5)
Hydrostatically test pressure	24 bar

Environmental specification Flange

Material Bottom flange	SS 2142/2172 (alternative S355JR, St52.3N)

2.3 Alternative bottom parts

2.3.1 Mounting Set Double Bottom Sea Valve Low (MSDBSV L)

Mechanical specification

Height:	Depending on installation pending, please refer to drawings in section 3 Installation
Weight:	~ 30 Kg (not including the connecting tube)
Diameter, hull bottom flange:	168 mm
Minimum headroom to change TRU:	Depending on double hull distance and installation, please refer to drawings in section 3 Installation

Environmental specification Sea-valve

Material	Cast Bronze (CuSn5Zn5Pb5)
Hydrostatically test pressure	24 bar (class PN16)

Environmental specification Flange

Material Bottom flange	SS 2142/2172 (alternative S355JR, St52.3N)

2.3.2 SAL Easy Tank

Mechanical specification installed

Height:	~ 85 mm (+ cable)
Weight:	~ 12 Kg including steel flange ~ 7.5 Kg including aluminium flange
Diameter:	168 mm
Hydrostatically test pressure	24 bar

Material

Top cover on TRU	SS5204 (Gun metal)
Bottom flange Steel	SS 2142/2172 (S355JR, St52.3N)
Bottom Flange ALU	EN-AW 5083

2.4 Optional Accessories

For detailed information see Section 4.

LPU2, Log Processing Unit 2nd generation
The manual for the LPU2, document 704531, is available on request.

1N4B, 1-to-4 NMEA Buffer

SD4-4, General Display

SIA-3-8, Speed Indicator Analogue

SD4 BMB, Bulkhead Mounting Box

SD4EB, Extension Board

SD4ED, External Dimmer

3 BASIC SYSTEM INFORMATION

The system is an electronic Speed and Distance Measuring Equipment/SDME, i.e. a Speed Log, designed for measuring longitudinal speed and distance through water on ships of all kinds and sizes. The system is designed without moving parts and the sensor is flush mounted without extending below the hull. The Speed Log works in principle like two small, synchronized echo sounders built together, comparing echoes from water particles close to the hull. The measuring is based on the so-called Correlation Principle, which entails that it is very dependable and reliable in all kinds of waters.

3.1 Parts

The speed log includes following parts:

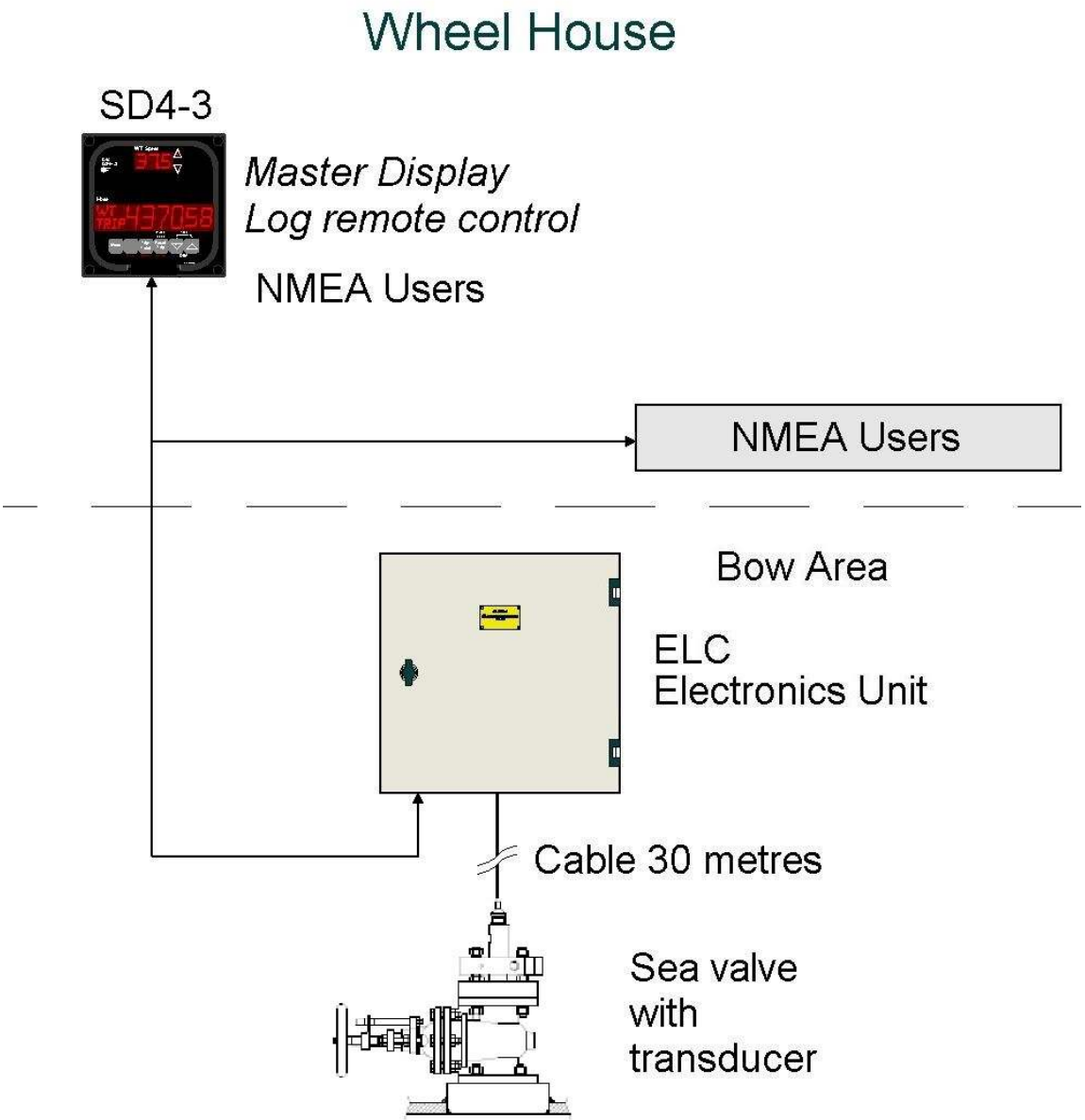
1. Bottom Part comprising the Mounting Set Single Bottom Sea Valve Low (MSSBSV L) and the Transducer Unit (TRU).
   The MSSBSV L is a watertight holder for the TRU through the ship's hull, which also makes it possible to inspect and change the TRU without dry-docking.
   The Transducer Unit (TRU) contains the two transmitting/receiving elements (crystals) and is connected to the Electronic unit (ELC) by a cable of fixed length of 30 metres.
2. Electronic Cabinet (ELC)
   The ELC contains the electronic calculating board, also called the Water Track Unit Assembly (WTU – Assy.) and the Power Supply Unit (PSU). The ELC is normally placed close to (less than 30 or 10 cable metres) from the Bottom Part. Up to 10 speed data receivers can be connected directly to the ELC.
3. SD4- display
   One STW (WT speed) and distance display (Speed Log Master Display) of SD4-3 type is normally placed on the ship's bridge. Besides digital displaying of speed and distance through water the SD4-3 is also used as a remote interface unit to the WTU in the ELC.

Following optional units to the speed log are obtainable:

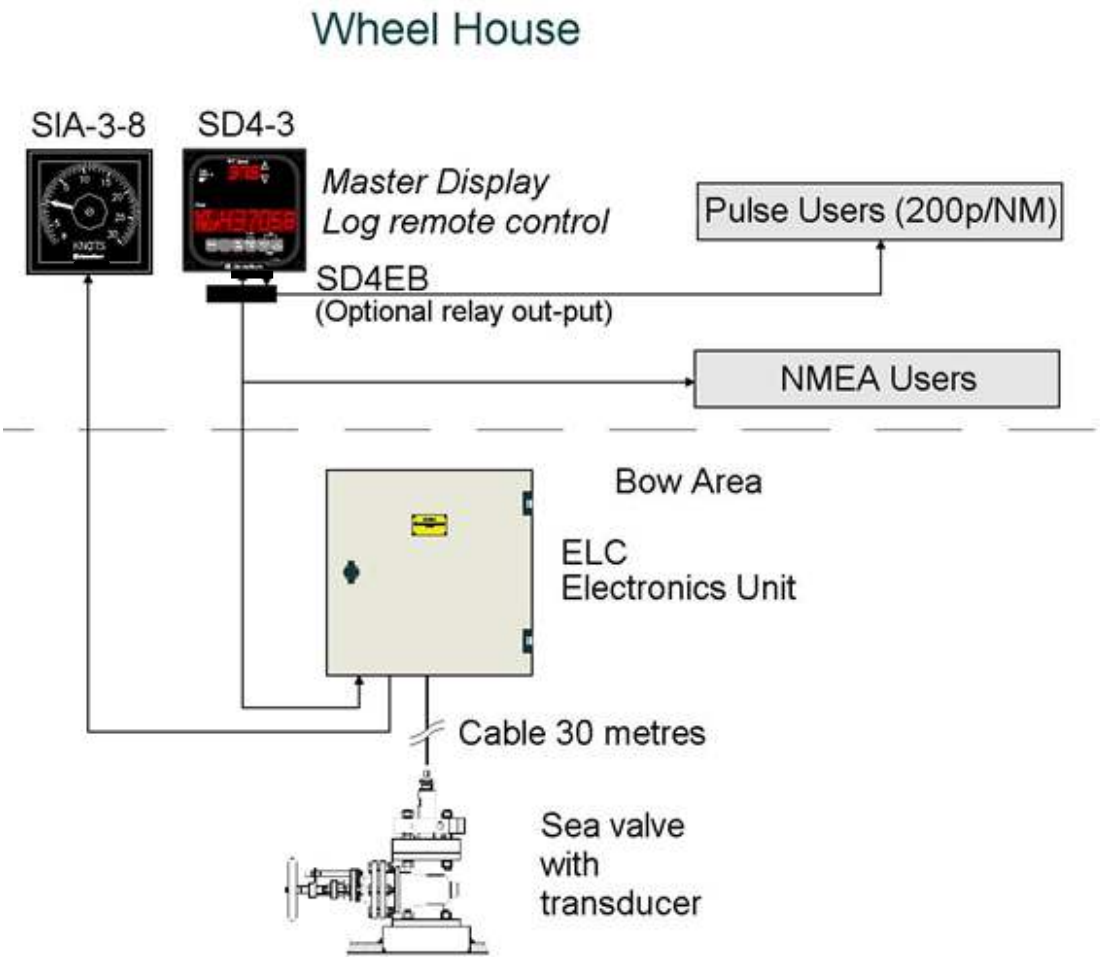
1. Alternative Bottom Parts:
   For ships where the bottom part must be installed through a double bottom a Mounting Set Double Bottom Sea Valve Low (MSDBSV L) an option.
2. For smaller ships or for very space limited installations the SAL Easy Tank is an alternative.
   Note: Dry-docking needed when change or inspection of the TRU.
3. Alternative Transducer cable length:
   TRU with 30 and 40 metres fixed length. SAL Easy Tank TRU with 10m and 40m fixed length. **Never cut or alter the cable!**
4. Repeater displays:
   Additional SD4 displays can be installed on the bridge, bridge wings, engine control room, as appropriate.
   Analogue speed indicator SIA-3-8. A pointer on a circular scale presents the speed.

Extension/distribution options:

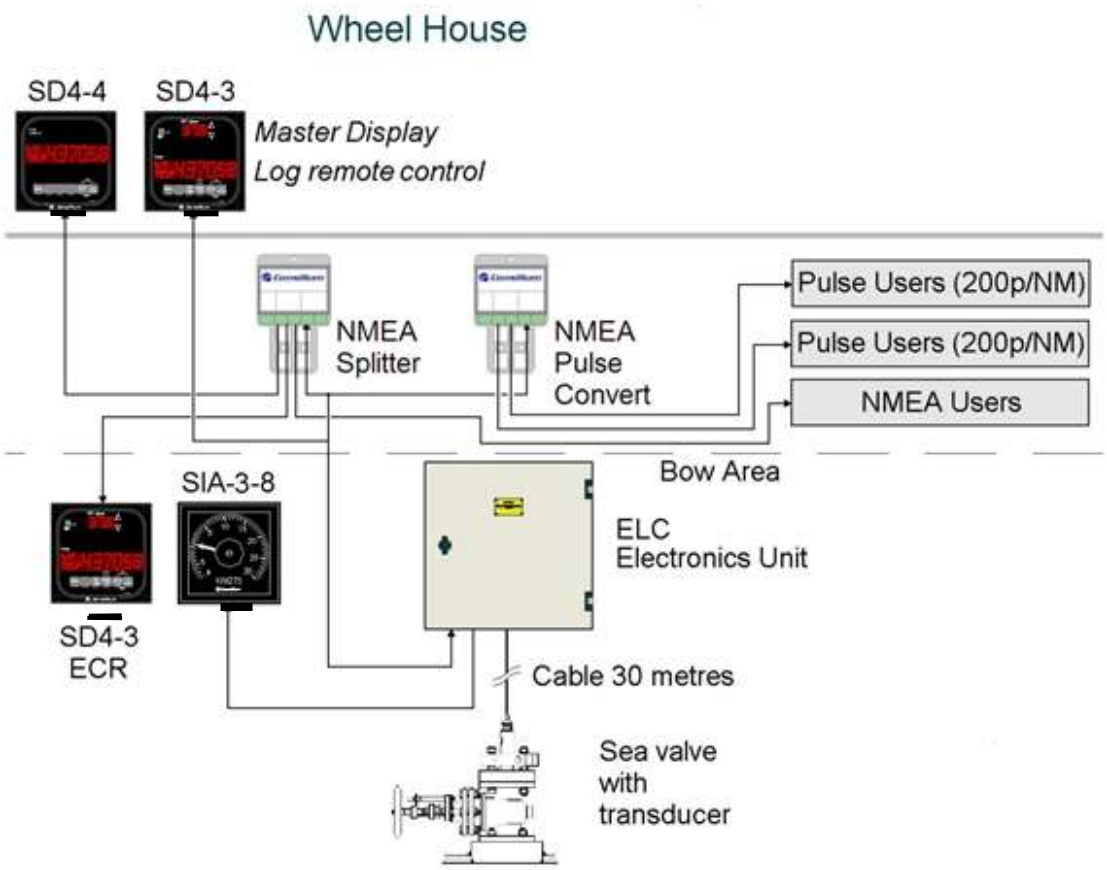
- When the ELC is installed far away from the bridge, e.g. the forepeak, and/or when a large number of repeaters and other speed data receivers are needed, it is recommended to install a NMEA 1N4B Buffer. Those can be located on or near to the bridge. Only one cable is then needed from ELC to the NMEA Units.
- Alternatively an LPU2 unit can be installed. See Technical Specification and NMEA Units Installation Guide for further information.



Typical installation basic design



Typical installation – extended design



Typical installations – extended design with NMEA 1N4B Buffer, NMEA. (Optionally an LPU2 Log Processing Unit can be used as distribution device.)

3.2 Operation, boundary layer effect, calibration and adverse conditions

This part is found in the section 4, Technical description and menu system.

3.3 Data transmission / reception

Speed and distance data are sent from the Water Track Unit (WTU) as serial IEC 61162-1 (NMEA) messages. Up to 10 NMEA receiving units, e.g. SD4-3, radars, gyros etc., can be connected. Four (4) SD4- displays can be powered directly from the ELC.

Speed information is also presented as 200 p/NM (two contact closure relays) and one 0.1 VDC/knot analogue output.

The speed log is equipped with one power failure alarm relay output.

Speed Log
Section 2
User Manual

Doc ID 703822C3

Revision:

Date	Version	Author	Comment
2005-10-07	A0	HW	Created, extracted from 703821B3
2006-11-17	A1	OM	Update to fit software D3, corrections in DIP switches
2007-06-07	A2	HW	LPU added as optional distribution device, V-menus added
2009-02-05	A3	RB	Menus corresponds to SW 700210E1 + editorial
2009-09-14	A4	OM	Change WTL to WT
2010-01-04	A5	HW/OM	LPU2, NMEA 1to4 Buffer, NMEA N2P Converter added and LPU and LDU removed as optional distribution device. Corrections made.
2010-04-16	A6	OM	Corrected timeout to 180sec
2011-05-12	A7	OM	Added alert info, added menu V6-V7 and alert codes to correspond to SW 700210E4
2013-11-28	A8	SGu	Various editorial updates and instruction text changes. Jumper P8 added. Set-Up Guide moved to Section C. Re-arranged Revisions/Contents.
2014-06-12	B0	JL/STE	Adapted to WTU Assembly (rev F and later) Corrections added by SGu 2014-07-04.
2015-10-06	C0	OM	Updated to MSSBSV L
2017-01-23	C1	OM	Updated Alert handling corresponds to s/w 5400130A03/A04, added TP16088B as ref for Alert diagnostics
2019-10-30	C2	AF	Company ID. Diagnostics.
2020-08-20	C3	MS	Company ID

TABLE OF CONTENTS

SECTION 2: USER MANUAL

1 USER GUIDE

1.1 General

The speed log is normally operated from the SD4-3 display on the bridge. If more than one SD4-3 is installed, one of them shall be designated as the Speed Log Master Display, which means that it is the remote display for the WTU menu in the speed log.
This SD4-3 is to be labelled “Master”. Same SD4-3 display or another SD4-3 display can also remotely control other slave SD4 displays e.g. dimming function (See Basic System Information in Section 1 General).

The Main Unit - ELC (Electronics Cabinet), which due to the TRU-cable length is mounted in the vicinity of the Bottom Parts, has fuses and indicating LEDs, which can be checked if a system failure occurs. (See TROUBLE-SHOOTING GUIDE)

Serial Digital Display SD4-3 for STW indication

1.2 Daily use

The SD4-3 display is configured especially for the water tracking speed log. The display has an upper window showing the longitudinal Speed Through the Water, STW, ahead or astern. The upward pointing arrow LED is lit when the speed is ahead and the downward pointing arrow LED is lit when the speed is astern.

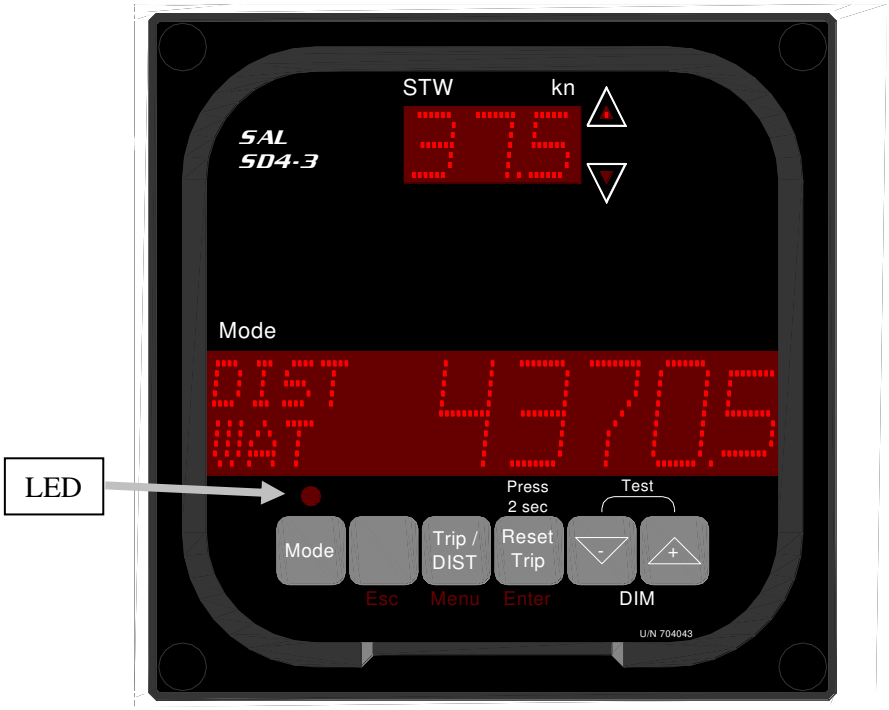
The lower Mode window shows as default the distance the ship has sailed, in nautical miles, either total indicated as DIST WAT or since latest reset of the trip counter indicated as TRIP WAT. **Note:** Only ahead motion is added to these distance counters. Use the Trip/DIST button to toggle the Mode window between showing trip distance TRIP WAT and total distance DIST WAT.

Use the Reset Trip button to zero the trip counter by pressing longer than 2 seconds. To adjust/DIM the display brightness, use plus (+) button to increase and minus (-) button to decrease. Both buttons pressed simultaneously presents a complete display lamp/LED test.

1.3 Diagnostic messages

The Diagnostic mode is intended for service purpose and trouble shooting of the speed log system. A list of diagnostic codes can be found in the Trouble Shooting Guide in this manual.

The Diagnostic mode is disabled as default, but may be enabled in menu LP2.21. In this mode, proprietary $PSALW NMEA messages will be translated and displayed in the mode window, and the LED above the Mode button will lit.



The code is displayed in the Mode window with the following field descriptors:

```
DIAG  XXX     YYY
TEXT
```

XXX: Diagnostic code.
YYY: Input in LPU2 (only seen on systems with LPU2).
TEXT: 16 characters description text.

The Mode window will automatically switch to Diagnostics mode and display the code. Example of STW simulation Diagnostic code from the STW Speed log:

```
DIAG 301 LPUIN5
STW SIMULATION
```

The text “LPUIN5” is indicating that the code is received on the LPU2 input No. 5 and will only appear when the SD4 is connected to an LPU2. The indication for STW simulation without LPU2 is:

```
DIAG 301
STW SIMULATION
```

If more than one diagnostic code is sent to the SD4 Display, the codes are stored in a list in the sequence order they were received.
To view next code press the Mode button.
The SD4 has a capacity of storing a maximum of 10 codes.
If more than 10 different codes are received, code nr 11 and further the Mode window shows:

```
DIAG 999 ------
--- OVERFLOW ---
```

The display of a diagnostic code will time out after one minute if no new code messages arrives.

When there is no diagnostic code the Diagnostic mode on the Mode window will show:

```
DIAG ---
```

1.4 Menu mode

The Mode window of the SD4-3 Display can also be set to Menu mode. The Menu mode is used for internal settings of the display and when SD4-3 is used as a remote display for other units e.g. the WTU menu structure or for remotely dimming of other SD-displays.

The Menu mode is activated by pressing the Mode button for minimum 5 seconds. The Mode window will switch to show the text “PRESS ENTER FOR MENU”. Then press the Enter button (Reset Trip) within 5 seconds.
The Mode window will now show the current menu and the upper window will maintain the speed presentation sent out from the WTU.

Three buttons under the Mode window have now changed to alternative functions. These are lit in red text below relevant button. From left to right the buttons now have the following functions:

Mode: Will inform which remote device that is connected.

Esc: “Blank”. When in “Remote Device menu” Esc is used to leave the “Remote Device menu” (i.e. the WTU menu). When not in “Remote Device menu” Esc has the same function as Menu and Enter pressed simultaneously (see Menu-button below).

Menu: "Trip/DIST". Is used alone, or together with Arrow down (-), or together with Enter, to move/navigate in the menus as described below.
Menu alone, will display next menu, i.e. step forward on same menu level.
Menu and Arrow down (-) pressed simultaneously will display previous menu, i.e. step backwards on same menu level.
Menu and Enter pressed simultaneously will move up one menu level, except when leaving the "Remote Device menu". For this instead use Esc.

Enter: "Reset Trip" is used to save changed values/settings or to move to sub-menus.

▽ △ "Arrow down" and "Arrow up" are used to change status, e.g. Write Access OFF/ON, and /or to change set values.

Note: When being in the Menu System and no button is pressed for 3 minutes, the Mode window will return to previous information displayed before the Menu System was entered.

1.5 SD4-3 in Menu mode

The Menu mode has three "Local Menus" and one "Remote Device menu" on the first set-up level:

- SD4-3 LOCAL. This is the start menu when entering the Menu mode. If one or more other displays are remotely dimmed from the display, this menu shows a second text line and can easily be used to turn the remote dimming function ON/OFF.
- LP0 PROPERTIES. This menu contains sub-menus for local setting-up of the display.
  NB! Do not change to Write Access ON without special training.
- LS0 REMOTE SETUP. This menu contains sub-menus for setting-up when the display is used as a Speed Log Master Display.
  NB! Do not change to Write Access ON without special training.
- R0 REMOTE DEV. On a designated Speed Log Master Display this menu provides access to a Remote Device, e.g. WTU menu structure.
  NB! Verify the setting in menu LS7, normally ON is default.

1.6 Write and read only access

Default for sub-menus when entering the menu system is read only access, i.e. the Mode window shows WRITE ACCESS OFF.

When changing to Write Access ON ("+" and confirmed by Enter) then sub-menus are accessible for changes. Be careful to change intended parameters only. When leaving sub-menus the write access is automatically set to OFF.

1.7 Menu functions

A list for fast indexing of the Menu System, available for the daily user, is included in Section 3 Installation, SD4-3 DISPLAY INSTALLATION under headline "Menu function summary" for SD4 displays and in Section 4; Technical Description under headline "Menu function summary" for WTU-Assy menus.

A Menu Structure chart for the SD4-3/WTU-Assy is found under Section 5 Appendix.

Parameters which can be changed during the operation of the speed log are described below. Special menus for testing can be found under TROUBLE-SHOOTING GUIDE.

1.8 Serial Remote Dimming functions

When serial remote dimming function is installed and initiated, each SD4 display can be dimmed individually, but it is also possible to dim four different displays remotely from one display. This remote dimming function can be turned on/off in the first menu when entering the Menu mode.

```
SD4-3     LOCAL
REMOTE DIM [OFF]
```

Set-up Remote Dimming menu functions are described in the Installation Manual, SD4-3 DISPLAY INSTALLATION, Menu function summary.

If separate external dimming buttons have been connected they are working in parallel with those of the display they are connected to.

1.9 Calibration

This part describes the calibration procedure. How to enter calibration values using the menu system is described in Section 4.

The speed log has two major methods for calibrating the speed which refers to ship's hull boundary layer affecting the water flow near the hull and past the transducer sensor surface.

- Draught dependent calibration – ***single point*** calibration factors compensating differences in indicated speed, due to load and trim of the ship. Three different preset draught conditions can be programmed. They are named: FULL LOAD, BALLAST 1 and BALLAST 2 and should be determined under long term observations.
- Speed dependent calibration - ***multiple point*** calibration factors compensating differences in indicated speed over the whole speed range. Factors can be preset for up to ten different speed levels. Speeds between the calibrated points are interpolated automatically.

Note: The minimum necessary calibrations to be set are the TRU TC-calibration plus at least one of the draught calibrations. If so, after setting the TRU TC-calibration (see below), choose e.g. FULL LOAD and determine and set a compensating calibration factor for the normal cruising speed used at normal load conditions (see below).

Draught dependent calibration and Speed dependent calibration should normally not be used at the same time.

The system also has a function for compensating small differences in characteristics of individual transducers. This TRU calibration is a fixed compensation factor, TC. The TC factor is marked on the transducer body and on the transducer cable termination end.

This factor has to be set at commissioning and before any other calibration method is initiated.
When replacing the transducer the new TC factor has to be entered according to the TC factor marked on the new transducer.

1.9.1 TRU Calibration

Each transducer has been individually calibrated in factory and its compensation factor must be entered into the speed log it is connected to. The factor is engraved on the transducer housing as TC±XXX. It is also labelled at the termination end of the TRU-cable core No.1. Example: TC+123 means calibration actually indicate a factor +1.23% and TC-101 consequently –1.01%.
Note: The TC value shall be set before any other calibration is performed.

Procedure to set TC calibration:
(Refer to paragraph ***1.4 Menu mode*** above how to move in the Menu System)

Go to the Menu mode;
Step to R0 REMOTE DEV and then down to WTU sub-menu C0.
Choose WRITE ACCESS ON (+ and Enter) and proceed to menu C4.

```
C4 TRU CALIBRAT.
MARKING:  TC±000
```

Change the value by using +/- buttons and then press Enter to save.
To leave this menu, press Menu and Enter simultaneously two times.

Leave the WTU Normal Operation menu and the SD4 Menu mode and return to the normal Trip/Total display mode by pressing Esc three times.

1.9.2 Draught dependent calibration – (Single point calibration)

This type of calibration is meant for merchant vessels where the water flow around the hull is changing due to varying draught and trim. Three calibrations can be performed for cruising speeds relevant to each of three decided draught/load conditions (FULL LOAD or BALLAST 1 or BALLAST 2). These calibrations are compensating with the same calibration percentage, respectively, over the whole speed range. Determining these calibrations will need to be done under long term observations/records when underway using various draught and/or trim.
It can be both time consuming and difficult to achieve proper results under a shipyard sea trial. Still the below procedure refers to common a common sea trial procedure.

Changing between the three draught/load calibration conditions can then be done in sub-menu C1 by pressing plus (+) or minus (-) provided WRITE ACCESS ON is granted in menu C0. The altered choice must then be saved by pressing Enter.

Before initial calibration runs, make sure:

- that correct TRU TC factor is set in menu C4 (see above);
- that all three draught condition factors are set to 0% (Menus C1 /C1.1)Menu C2);
- the Multi-Point Calibration is DISABLED (Menu C3, default is ENABLED) if any points have entered values or just assure that all ten points are set to 0%;

The system is calibrated by sailing a true, known distance in calm waters. To eliminate variations caused by tide, current and wind, the ship should run the same route in both directions. For each separate run, carefully observe and record beginning and end of the true sailed distance and corresponding measured distance on speed log display.
Then calculate the deviation according to following equation and examples:
(*CF* = *C*alibration *F*actor to be set)

CF = [(expected dist.#1 + expected dist.#2 : (measured dist.#1 + measured dist.#2)] x100 - 100

The *expected* (true) distance may be based on optical observations (fixed mile posts/land marks), but generally reference systems like DGPS or similar are commonly used.
The *measured* (indicated) distance is obtained from the accumulated value indicated on the speed log display Trip distance counter (or Total distance counter).
If the calibration factor is based on a very long (several hours or days) comparison with GPS observations, be aware and consider the records being likely affected by wind and sea current.

Use the menu system to enter the calibration factor in menu C1.1. C2.
Note that the calibration factor shall be expressed in percentage as obtained from the above equation, e.g. examples as follows:
CF = (1 + 1 : (0.95 + 0.98) x 100 – 100 = + 3.63%
i.e. the speed log is measuring too low speed/short distance, thus needs to **increase** CF;
CF = (1 + 1) : (1.06 + 1.09) x 100 – 100 = - 6.98%
i.e. the speed log is measuring too high speed/long distance, thus needs to **decrease** CF;

With the above procedure it is now possible to change between defined calibration factors in menu C1 DRAUGHT COND for three draught conditions as evaluated and specified by the user for the individual ship.

1.9.3 Speed dependent calibration – (Multiple point calibration)

This type of calibration is intended for vessels where it has been determined during speed trial runs at various speeds that the CF is not linear throughout the speed range, thus different CFs need to be entered at defined *expected* (true) speed levels as calculated.
Up to ten different speed points can be calibrated for, spread to speeds both ahead and astern. Speeds between the calibration points are interpolated automatically, except the area nearest zero, which uses its nearest calibration factor down (up) to speed zero.

The Multiple Point Calibration can be ENABLED and DISABLED in menu C3. The change must be stored by pressing the ENTER button.

The calibration Trial runs and calculations shall be done and defined for ***each*** speed point in the same way as described under Single Point Calibration above.
To be able to enter the *expected* (true) speed value in the C3 menu it is also necessary to define/calculate the actual true speed from the reference (DGPS) system for ***each*** speed trial run.
Do not enter any values in menu C3 until all speed trials are completed and calculated.

Before initial calibration runs, make sure:

- that correct TRU TC factor is set in menu C4 (see above);

- the MULTI-P CAL is DISABLED (Menu C3, default is ENABLED) if any points have entered values or just assure that all ten points are set to 0%;

Due to the interpolation between the calibration factors the MULTI-P CAL should be DISABLED during all calibration runs, also when making a later run for an extra speed calibration point.
The MULTI-P CAL can be ENABLED and DISABLED in menu C3.

1.10 Averaging Speed Constants

Refer to paragraph ***1.4 Menu mode*** above how to move in the Menu System.

If the speed output is fluctuating in an improper manner it may be possible to level it out with a filtering time constant. Two different constants can be set, one for a lower speed range – menu S1 –, for faster reaction of speed changes, and one for a higher speed range – menu S3 – normally needing more equalized speeds. The threshold between low and high averaging speed constants can also be set in menu S2 as desired for the instant use.

1.11 Software revisions

The SD4 display software revision can be found in menu LP9 in the SD4 Menu System.

The WTU software revisions can be found in menu M6 in the WTU Menu System.

The optional LPU2 software revision can be found in LPU2 menu system Menu M10.

2 SETTING UP GUIDE

The Setting Up Procedure includes all steps after the Mechanical and Electrical Installations have been performed and up to the calibration of the speed log. (For calibration see User Guide.) The Setting Up Guide is limited to short instructions and we therefore recommend to using it as a check list. For errors or disruptions during the setting up procedure, please refer to Trouble-Shooting Guide.

Each electrical installation is instructed to be completed by the Pre Set up Procedure. We recommend to double check these points before supplying power to the unit:

- Remove any possible particles from the cabinet(s)
- Carry out a visual inspection of the installed components and cables referring to the layouts of the unit and to the interconnection drawings
- Check that cable terminations have a firm grip of the cable wires
- Check that cable glands have a firm grip around the cables
- Check that the Transducer cable shield is firmly grounded in the cable gland of the ELC.
- Check for proper cable bends to assure a proper amount of slack
- Check that ground connections are duly tightened.
- Carefully check the main power voltage and the integrity of the fuses.

Also check that the transducer is correctly installed down in working position and longitudinally aligned.

Set the speed log to power, follow the procedure below and act accordingly. If a fault occurs or is detected, use the Trouble-Shooting Guide to analyse and eliminate the reason.

- Check that the default settings, (LED 2) on the WTU-Assy board is turned on.
- Check that the red Alert LED on the WTU-Assy board is turned off.
- Use the Speed Log Master Display, SD4-3 to communicate with the WTU-Assy by going into the R0 REMOTE DEV menu.
- Go to Menu T0
- Change to WRITE ACCESS ON
- Move down to T1 and use default speed 8 knots or use speed as desired

NOTE: Now the speed log will stop measuring ship's speed and instead it is showing the simulated speed on all users connected.

- Check that all connected users show the same speed.
- Change to and check at least two more speeds within the ship's speed range, including one speed astern (minus).
- Enable menu T2 – noise test, using sub menu T2.1 and read the two values. Both displayed values shall preferably be below 700 over time (values will vary). Higher values may degrade the measuring performance of the log.
- Enable menu T3 – signal balance, using sub menu T3.1 and read the value. The readings shall be in the interval 50% – 200% and state OK, but if the ship is not moving the values may vary a lot over time and be outside the allowed interval during short periods. Check the reading for a couple of minutes before any conclusions are drawn. A faulty TRU will seldom hit the correct interval.
- Enable menu T4 – loop test, using sub menu T4.1 and read the three values. First and last value shall be below 2, middle value in the interval 40 to 120.
- Move to T6 menu and simulate Log Failure Alarm.
- Check that connected alarm is activated (if any).
- Leave the T menu by pressing Menu and Enter simultaneously two times.
- Check that simulated speed has been replaced by actual speed.
- Check that TC factor (in Menu C4) is set according to calibration factor as marked on TRU cable core No.1. (See User Guide).
- Leave the WTU Menu and the SD4-3 Menu Mode by pressing Esc three times.

3 TROUBLE-SHOOTING

The first part of the Trouble-Shooting Guide explains the Diagnostic codes.

The second part is built-up around possible and likely faults and disruptions acquired from experience. It also includes practical suggestions and actions to solve the listed problems.

The third part consists of test methods, referred to in the second part, as help at fault finding.

However, actions for analysing and fault finding incorporate knowledge and experience of the speed log working principles and how to communicate with and navigate in the WTU menu (see Section 4).

3.1 Diagnostic Codes

Menu A0 Diagnostics in the WTU menu system is for service purposes and trouble-shooting.

Following is a list of diagnostic codes 300 to 399 that may occur on the system.

Code	Display text	Note
301	STW simulation	Warning will rise if simulation mode is activated from the WTU Menu T.
302	FORCE VALID ZERO	Warning will rise when valid zero speed is forcedly transmitted. To avoid various NMEA listeners giving repeatable alarms, when travelling under unfavourable measuring conditions, the speed log can be forced to output valid zero speed when measurement isn't possible. This is controlled via the WTU Menu S13 FORCE VALID ZERO (which is default set to DISABLED and shall only be ENABLED with great caution). First implemented in WTU-Assy software 5400130A05.
320	STW AGC balance	Code is active if average signal balance, i.e., the difference between channels, is too large. Indicates problem with transducer or transducer connection or receiver. In normal conditions when vessel makes speed through the water it takes more than 8 minutes for the code to activate or clear. However, the code may not activate when vessel is at stand-still, even though the system is faulty. Action • First check TRU connections. Test new TRU in a small bucket of water. Connect laptop with SD4Com software and enter main menu. Connect new TRU. If both AGC values (lower right in SD4Com main menu) increases when new TRU is lowered into the bucket water, the old TRU needs to be replaced. If none or only one value increases, the WTU board needs to be replaced.
330	STW TX balance	Code is active if average transmitter balance is too large. Indicates that the transmitter does not work properly. It takes about 8 minutes for the code to activate or clear. This code is independent of vessel's speed. Action: Replace WTU board.
340	STW TRU level	Code is active if measured average signal is too low. Indicates problem with transducer or transducer connection or receiver. The code will only activate at low or no speed through the water. It takes more than 2 minutes for the code to activate. The code will only clear by power cycling of ELC. Action • First check TRU connections. Test new TRU in a small bucket of water. Connect laptop with SD4Com software and enter main menu. Connect new TRU. If both AGC values (lower right in SD4com main menu) increases when new TRU is lowered into water, the old TRU needs to be replaced. If not, the WTU board needs to be replaced.

Code	Display text	Note
350	STW Noise level	Code is active if background noise level is too high. Indicates problem with transducer connection or wiring. It will take more than 1 minute for the code to activate. Action • Verify TRU connections and reconnect if faulty. • Verify that TRU cable is not clamped to or parallel with high power cables. Release if necessary.
351	STW PCB Fail	Code is active if internal PCB loop test fails. It will take more than 1 minute for the code to activate. (*EasyTank transducers S/N: 0071 – S/N: 0110 cause code 351 to trigger. Problem solved in WTU-Assy software 5400130 revision A06*). Action • Replace WTU-Assy board. • If not solved: replace ELC.
352	STW CHECK TRU	Code is active if transducer seems broken. Indicates problem with transducer or transducer connection. It will take more than 1 minute for the code to activate. Action • Verify TRU connections and reconnect if faulty. • Replace TRU.
353	STW CONNECT TRU	Code is active if transducer seems to be missing. Indicates problem with transducer or transducer connection. It will take more than 1 minute for the code to activate. Action • Verify TRU connections and reconnect if faulty. • Replace TRU.
354	STW Signal Balance	Code is active if signal balance, i.e. the difference in received signal strength between the two channels in the transducer, is too large. Indicates problem with transducer, marine growth or transducer connection. It will take more than 1 minute for the code to activate. Action • Verify TRU connections and reconnect if faulty. • Remove any marine growth from transducer surface. • Verify TRU sea valve mounting. • If not solved: Replace TRU.
355	STW Mute or HW	Code is active if there is no internal transducer data on the CPU-board (data from FPGA to CPU). Indicates possible faulty hardware or constant MUTE from SOG log. Action • Disable possible MUTE inputs. Reboot. • If not solved: Replace PCB.

3.2 Possible faults and actions

1. Speed log indicates wrong speed

Reason	Action
The TRU is not aligned longitudinal	Check the TRU according to TRU Mounting Inspection described below
The log is set to wrong speed calibration (WTU-menu C1, C3).	Change calibration alternative. See User Guide ***1.9 Calibration***
The log is set to wrong TRU calibration (WTU-menu C4).	Check TRU calibration. See User Guide ***1.9 Calibration***
The speed calibration is not relevant to present conditions.	Make a new log calibration. See User Guide ***1.9 Calibration***
The TRU signal is disturbed by turbulent and/or aerated water.	Check TRU location.

2. Speed log has locked on constant speed

Reason	Action
The WTU is in test mode.	Enter the WTU T-menu and leave that mode by pressing Menu and Enter simultaneously two times and then ESC two Esc three times.

3. Speed log indicates a delayed speed at accelerations and retardation

Reason	Action
Too high averaging time constant or wrong speed limit between constants.	Change averaging time constant or speed limit between constants. See User Guide ***1.10 Averaging Speed Constants***

4. Speed log indicates an oscillating speed around correct value

Reason	Action
Too low averaging time constant or wrong speed limit between constants.	Change averaging time constant or speed limit between constants. See User Guide ***1.10 Averaging Speed Constants***

5. Some of connected displays/users indicate wrong speed or no speed at all

Reason	Action
At any of reasons below in this table.	Change to simulated speed as described below.
Bad contact between ELC / NMEA Unit(s) (LPU2) and display / user.	Check terminations in ELC / NMEA Unit(s) (LPU2) and display / user. Check cables.
Only serial (NMEA) displays not working. Serial output not working in ELC / NMEA Unit(s) (LPU2).	Measure serial (NMEA) signal in ELC / NMEA Unit(s) (LPU2) as described below.

6. **Speed log indicates speed only intermittently and between that, three dashes (- - -) in SD4-3 Speed Window**
   Note! The speed log is primarily a longitudinal speed measuring system, thus this behaviour may be normal due to e.g. sharp/hard turning manoeuvring.

Reason	Action
The TRU is not aligned longitudinal or not in working position.	Check the TRU according to TRU Mounting Inspection described below.
TRU cable shield not connected in Speed log cabinet gland may cause disturbances.	Check that the TRU cable shield is firmly connected in the ELC cable gland.
The TRU sensor surface is covered by algae/marine growth.	Check the TRU according to TRU Sensor Surface Inspection described below.

7. **The speed log indicates continuously no speed and only three lines (- - -) in SD4-3 Speed Window**

Reason	Action
The TRU is not aligned longitudinal or not in working position.	Check the TRU according to TRU Mounting Inspection described below.
The TRU sensor surface is covered by algae/marine growth.	Check the TRU according to TRU Sensor Surface Inspection described below.

8. **The speed log indicates no speed at all and the SD4-3 shows NO NMEA in Mode Window and *Err* in the Speed Window**

Reason	Action
The speed log ELC has lost power.	Check that ELC is in operation.
The log distribution unit has lost power.	Check that NMEA Unit(s) (LPU2) is in operation.
The serial connection is broken.	Check cables and terminal connections.

3.3 Test methods

1. **Simulated Speed (refer to: *2 Setting Up Guide*)**

- Go to WTU test menu and simulate different speeds, e.g. +8 knots and –2 knots.
- Check that all connected displays/users show the simulated speed.
- Leave the test mode by pressing Menu and Enter simultaneously two times and then Esc three times.
- Check that simulated speed is replaced by actual speed (if operational).

2. **Reading NMEA messages.**

- Use an RS422 to RS232 converter and connect the RS422 side to terminals 50 & 51.
- Any terminal emulating program can be used with settings 4800 Baud, 8 Data bits, no parity, one start bit, Parity None, Stop bits 1.
- The Microsoft Windows® usually has the HyperTerminal program for serial communication. Consult your computer manual for further information.
- The received messages will be sentences starting with “$VDVBW” and “$VDVLW” if connection is successful.
- The interpretation of received messages is described in technical document 700164 in section 4.

3. Measuring relay contact Pulse outputs

- Set the speed log into speed simulation mode of 8 knots.
- Connect a DMM set to resistance measurement to:
  1) the speed log terminals 8-9/Relay1.
  2) the speed log terminals 10-11/Relay2.

  For both relays the measured value shall toggle between a low/near zero and infinite resistance, i.e. closed and open contact.

4. Measuring Analogue speed output

- Set the speed log into speed simulation mode of 8 knots.
- Connect a DMM set to VDC measurement to:
  the speed log terminals 18 (+/- 0.1 VDC/kn) and 19 (Signal ground 0 VDC).
  DMM shall indicate close to 0.8 VDC.

5. Built-in diagnosis tests (refer to: ***2 Setting Up Guide***).

- Run WTU test menus T2 – T4.
- Verify that results are within limits.
- Leave the test mode by pressing Menu and Enter simultaneously two times and then Esc three times to go back to normal SD4-3 presentation.

6. TRU Mounting Inspection

To verify that the TRU is in correct downward/flush seated/aligned position.
Note!
Below description below valid for SAL MSSBSV L and SAL MSDBSV L,
not for SAL Easy Tank that is a closed end installation without Sea-valve.

- Make a reference mark on the Connecting Tube close to where it enters the Valve top cover.
- Loosen and take of the two nuts and spring washers holding the bracket assembly down. Be aware of outside sea water pressure, i.e. firmly handhold the Tube bracket/Connecting Tube!
- Raise the Tube Bracket/Connecting tube out from the threaded rods and turn 90 degrees and then push firmly downwards again to firm stop. A slight splash of sea water will temporarily occur when the slots are passing the water seals in the Valve top cover.
- The brackets shall not rest on the bolt heads; there shall be a gap of approx. 3mm when the TRU is in the lowest position – stopped by the Guide ring and the stop shall have the same height as the mark to be in the same position/level as before. If not, re-adjustment will be needed. Refer to Installation Manual.
- Return the Connecting Tube/Tube Bracket to its normal position considering possible adjustments as above.
- Verify that the alignment/flat mark (SB) on the Connecting Tube is facing towards starboard and aligned parallel with ship's keel/longitudinal line. If not, readjustment will be needed. Refer to Installation Manual.
- After necessary checks/adjustments assure that the Tube Bracket clamping screws and top nuts are tightened in proper position.

7. TRU Sensor Surface Inspection
(**Note:** Only for installations with a Sea Valve)

- Also here recommend making a reference mark on the Connecting Tube close to where it enters the Valve top cover.
- Loosen and take of the two nuts and spring washers holding the bracket assembly down. Be aware of outside sea water pressure, i.e. firmly handhold the Tube bracket/Connecting Tube!
- Raise the Connecting Tube/Tube Brackets 150 mm, the plastic part of the TRU is then ~ 40mm over the Valve cover top. **Do not lift higher before the Sea Valve is closed!** A slight splash of sea water will temporarily occur when the slots are passing the water seals in the Valve top cover.
- Close the Sea Valve (assuring the retracted position of the TRU as above!), approximately 14 full turns of the hand wheel from fully open to fully closed valve. Observe the position indicator pin and feel the resistance when the valve gate comes to closed position.
- Carefully lift out the TRU assembly from the Sea Valve assuring that sea water is not severely pouring out from the Sea Valve. If so, again insert the TRU tip as a plug and try to close the valve more rigidly and/or yank the valve gate back and forth a few times in the closing position to try improve tightness.
- Verify as needed by lifting out the TRU and continue as intended.
- Carefully inspect and clean the TRU sensor surface from overgrown algae/marine growth. Do **NOT** use any sharp/metallic tool that may damage to the TRU sensor surface. Plastic or wooden scraper or cloth rag is normally enough for rubbing off and cleaning.
- Check that the TRU sensor surface is undamaged, i.e. no scratches or indents.
- Provided actions are completed, or TRU has been exchanged, re-install the TRU assembly in the Sea Valve carefully considering above retraction/dismounting precautions avoiding touching/reaching the valve gate.
- Fully open the Sea Valve (14 full turns to fully opened position) while holding the TRU Connecting Tube against water pressure.
- Push the TRU firmly downwards engaging the Tube Bracket in the Fork, to its operating position.
- Check that the alignment mark on the Connecting Tube is facing towards starboard and aligned parallel with ship's longitudinal/keel line.
- After necessary checks/adjustments assure that the Tube Bracket clamping screws and top nuts are tightened in proper position.
- At the speed log ELC check that the TRU cable screen braid is firmly connected in the cabinet cable gland and that the yellow-green ground core is connected to the ground bar and the four signal cores are properly connected.

8. Electrical test of TRU

- Turn off the ELC Mains power.
- Disconnect the TRU cable from the terminals in (note the terminal numbers) Where applicable, disconnect the TRU ring cable shoe from the ground bar. Using a normal DMM measure resistance across cable pins 1-2 and across cable pins 4-5. Both values shall be within the range 2.0-4.0 ohms. Values drastically out of these values might indicate improper TRU due short-circuit or bad connection internally. Re-confirm measurements prior to final conclusion.

- ***For a TRU with a ring cable shoe (yellow-green ground cable):***
  Measure insulation between cable pin 1- ring cable shoe and cable pin 4- ring cable shoe and cable pins 1-4. All three values shall be infinite or close to infinite. (O.L. on common DMMs). A value below 20 Mohms indicates unacceptable insulation. The TRU has to be replaced.
- Reconnect the TRU cables to the terminals/grounding bar, in the ELC if the TRU passes the test as well as if TRU has been replaced.
  If the TRU is equipped with a cable pin marked 3 (older TRUs), connect this pin to the grounding bar at the bottom of the cabinet (leave terminal 3 open, this may suppress external disturbances).
- Turn on ELC Mains Power and verify normal start-up and functions.

9. ELC transceiver test; Oscilloscope-checks

- Measure with an oscilloscope across the TRU cable connection terminals 1-3, 2-3, 4-3 and 5-3, where terminal 3 is virtual ground.
- Normal voltage for above is approx. 20 Vpp
- Normal frequency altering approx. 3875 +/-75 kHz on terminals 1-3 and 2-3
- Normal frequency altering approx. 4125 +/-75 kHz on terminals 4-3 and 5-3

3.4 Jumper settings

The jumper settings shall be checked when the ELC is installed. Names refer to Pcb screen print. The jumpers shall be kept in default positions for normal operation. Default positions are shown in ***bold***:

Jumper	**Position**	**Function**
RESET	***CONNECTED***	Normal operation
	OPEN	CPU will reset until jumper is restored
FACTORY	***CONNECTED***	Normal operation
	OPEN	If open during restart all settable menu parameters will be restored to default
PROGRAM	***CONNECTED***	Normal operation
	OPEN	Not to be used
TEST	***CONNECTED***	Normal operation
	OPEN	Not to be used without special test equipment

Before setting the ELC to power, check that also other units powered and controlled from the ELC are properly connected.

Speed Log
Section 3
Installation Manual

Doc ID 703824C4

Revisions:

Date	Version	Author	Comment
2005-10-07	A0	HW	Created, extracted from doc 703821B3
2007-05-16	A1	HW	LPU added as optional distribution device
2009-02-09	A2	RB	Corrosion protection during transport and storage, editorial, new SD4 diode
2009-09-14	A3	OM	Added standby STW. Menu functions revised
2010-01-04	A4	OM	LPU2, NMEA 1to4 Buffer, NMEA N2P Converter added and LPU and LDU removed as optional distribution device. Changed SD4 fronts to STW type
2011-03-29	A5	OM	Added SD4 menu LP2.21 Alert, clarified terminal 3, not to be used.
2013-11-29	A6	SGu	Editorial changes, corrections and clarifications. Re-arranged Revisions/Contents
2014-07-04	B0	SGu	Added WTU-Assy Pcb front plate, etc..
2015-06-02	C0	OM/JE	Updated with MSSBVS L / MSDBSV L
2016-07-28	C1	OM	MSSB deleted
2019-10-30	C2	AF	Company ID. Diagnostics menu.
2020-08-20	C3	MS	Company ID.
2024-06-25	C4	STE	Clarifications, removed MSDBSV and LPU2, installation location

TABLE OF CONTENTS

Section 3: INSTALLATION MANUAL

1 TRANSDUCER LOCATING PRINCIPLES

An optimized transducer unit (TRU) installation is of primary importance to achieve proper performance of the speed log system (See Basic System Information).

Selecting correct TRU location shall be done in co-operation with the manufacturer. It is recommended to send General Arrangement (GA) drawings, showing suggested TRU installation, for review and comments. The comments given only refer to the hydro-dynamical requirement and not the inside design, such as installation height, access to closing valve or any inside obstacles that might occur and jeopardise the function or maintenance.
Following rules must then be considered:

- The TRU should, preferably, be installed in the foremost area of the vessel, in a perpendicular position in a flat, horizontal part of the bottom hull plating close to the keel line and not behind 1/3 of LOW (Length On Water-line).
- The TRU could be installed in a forepeak, or in a double bottom forepeak tank, or in the lower section of the bulb. It must be a dry space (cofferdam) accessible for maintenance and service also when the ship is afloat.
- The TRU shall not be installed in a water filled tank, e.g. a water ballast tank. (The sea valve arrangement and TRU cable are not intended for permanent submerged mounting). If no other alternative is available a separate watertight compartment must be arranged housing the sea valve/TRU assembly. The compartment may be sealed by a manhole or hatch but it must be accessible for service and maintenance. The cable must be run in a watertight pipe conduit, connecting directly from the watertight compartment to free/dry space above sea water level at maximum draught of the vessel where also the Main Unit - ELC is normally installed.
- The TRU transmitting surface must always remain under water, even in heavy seas, in order to provide speed measurements.
- The outer shape of the vessel, especially in the forward vicinity of the TRU installation position, must be free from sudden projections, steps and sharp edges, welding seams etc., which can cause turbulence in the water flow passing the TRU.
- The TRU shall be installed at least 2 m forward of water inlets and outlets.
- The TRU shall be installed at least 2 m from any echo sounder transmitters and similar acoustic devices.
- On tankers, the TRU shall not be installed within the Ex-area.
- Sufficient headroom must be available at the TRU position to allow for its fitting and removal (see relevant chapter for appropriate bottom parts).

Note: The TRU cable shall run directly to the ELC and **must never be cut off, shortened, extended or by any other mean pass a junction box.** The cable must be laid free and accessible for dismounting if exchange of TRU will be necessary.

2 BOTTOM PARTS / TRU INSTALLATION

Note! Numbers in parenthesis () refer to position in 2.3.7 Figure complete MSSBSV L to identify items.

2.1 General mounting recommendation

Use universal thread locking liquid e.g. Loctite® 243 or equal, when mounting Studs PS M12x40 (part no.71-21535-00) into flange (not grease).

Apply grease on rest of the screw threads, preferably MoS2.

Use Vaseline, Silicone grease or similar to lubricate the *Lip Seals*.

Recommended torque:
M10 approx. 35Nm
M12 approx. 55Nm

2.2 Maintenance of Bottom Parts

Each bottom part assembly incorporates a Zinc Ring that acts as a sacrificial anode to prevent corrosion of the Transducer and Bottom Parts. The Zinc Ring should be checked, and changed if deteriorated, each time that the ship is dry-docked.
When maintaining the Bottom Parts it is also recommended to check and tighten the Tube Bracket clamping arrangement (13, 14, 15, 17).
The Guide Ring (2), Zinc Ring (3) or the TRU (4) shall never be painted!

Overhaul and condition check-out of the Sea Valve (6) should also be part of dry-docking routines, this to assure that the intended use of the Sea Valve arrangement for service/maintenance is safely provided also when the ship is afloat.

Longer periods of slow steaming at low speed and/or extended periods of idling/berthing/anchoring (weeks/months), specifically in tropical waters, tend to result in rapid build-up of marine growth in the TRU vicinity as well as on the sensor surface, thus the TRU should be retracted for inspection/cleaning and/or diver assisted under hull cleaning.

Generally, also under normal sea-going operations, it is recommended to retract the TRU (4) for inspection and cleaning as necessary each 3 to 6 months in order to prevent marine growth which may affect the speed log functionality and accuracy/reliability.
Also this routine serves as condition checks and maintenance of the Sea Valve arrangement.

2.3 Installation of MSSBSV L (Mounting Set Single Bottom Sea Valve Low)

The *Mounting Set Single Bottom Sea Valve Low* is a successor to the former MSSBSV. The additional “L” in the name stands for Low since it is lower in height, minimum headroom for installation is only 650mm (before 820 mm).
The MSSBSV L assembly is suitable for all ships where a mounting location can be found directly in the hull bottom plating. The sea valve provides retraction of the TRU without dry-docking or diver assistance.

This section describes how to assemble the kit and mount it into the ship's hull.

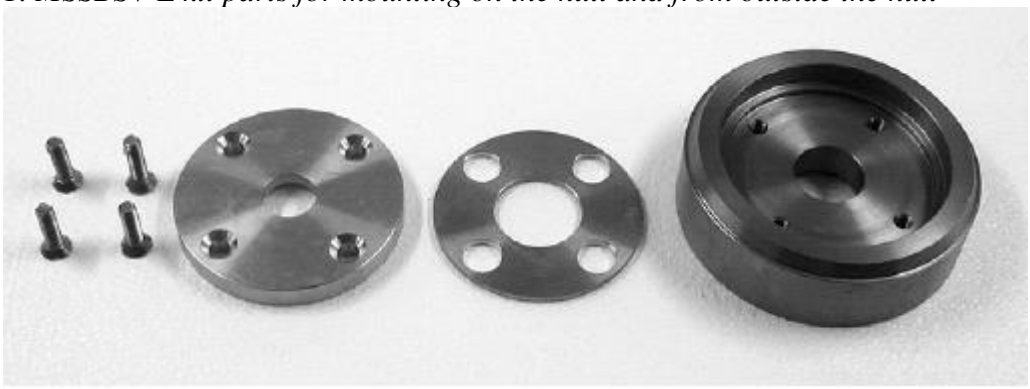
2.3.1 Unpacking of Bottom Flange

The bottom flange (1) which shall be welded into the ship's hull is made of construction steel. Humidity makes the surfaces of the flange corrode if not protected. The flange is therefore protected from corrosion during transport and storage by a special corrosion inhibitor bag. This bag should remain sealed during storage for the corrosion protection to have full effect. The bag shall be opened just before the flange is to be welded into the ship's hull.
Slight normal corrosion on the flange surface will not affect the function, lifetime or quality.
After completed welding work it is recommended to slightly oil/grease the flange surfaces in order to prevent further corrosion until installation is completed.
Do not paint the outboard interior of the Bottom Flange nor the inboard flange gasket area or threaded stud bolt holes!

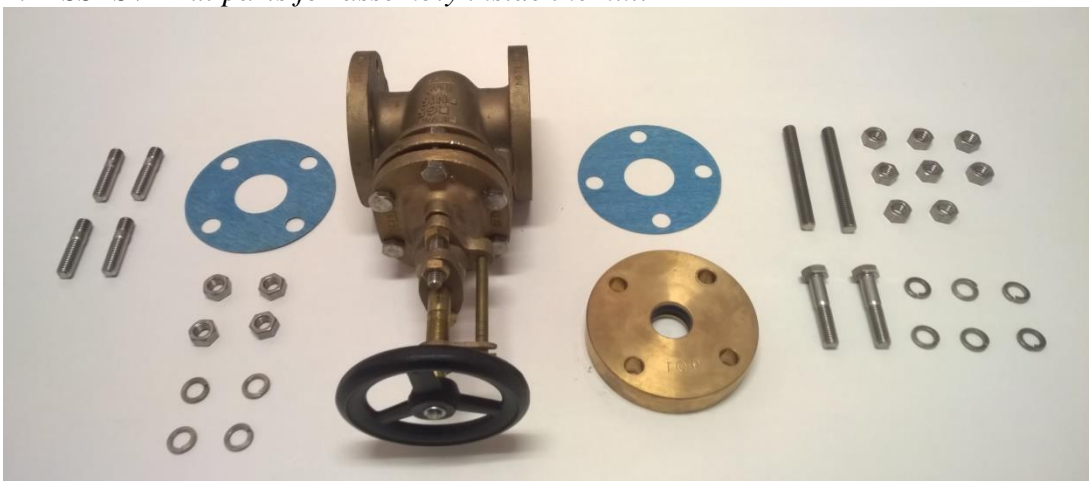
2.3.2 Parts

The components of the MSSBSV L assembly are supplied in kit form for mounting in the ship. Before starting the work check the contents of the kit against the packing list. The contents can be divided into four groups as shown in figures below.

1. MSSBSV L kit parts for mounting on the hull and from outside the hull

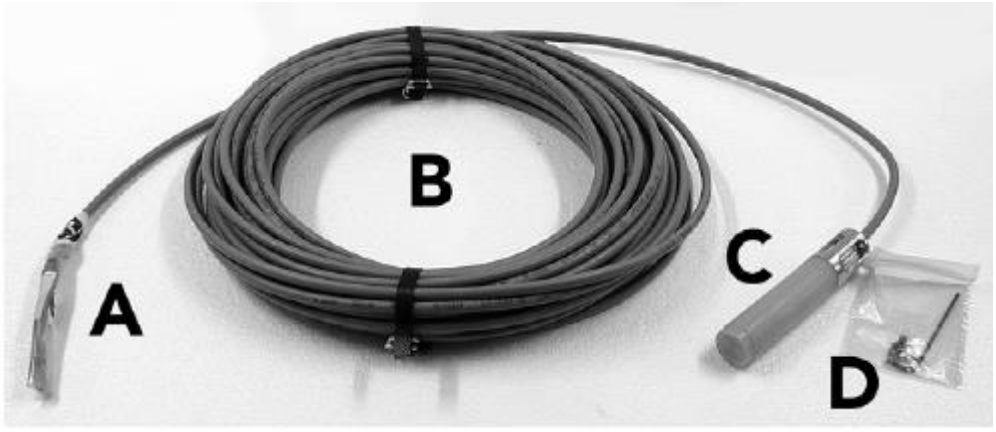


2. MSSBSV L kit parts for assembly inside the hull



3. MSSBSV L TRU-mounting units with connecting tube

TRU with cable

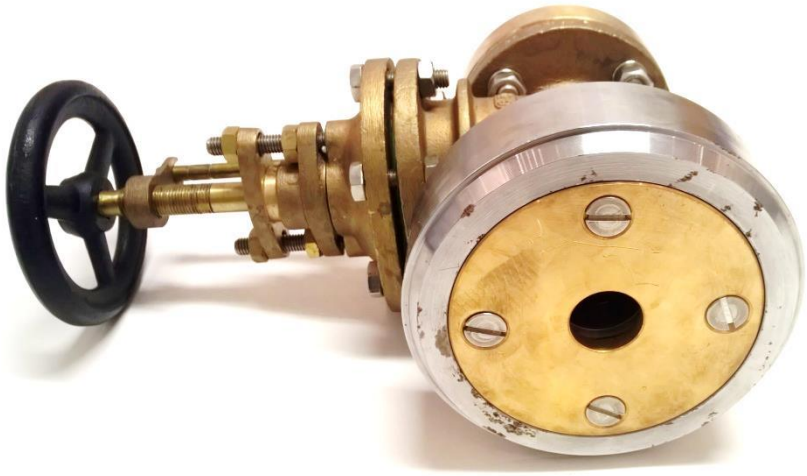


The TRU assembly has four distinctive parts.

A. Pre-fabricated cable terminations, transport protected in a plastic bag.
B. Fixed length cable, 30 or 40 metres. The cable must not to be damaged, cut or spliced under any circumstances. The full length shall be maintained with excess length to be neatly coiled and strapped close to the ELC.
C. TRU body.
D. Screw kit consisting of four M4x10 Allen screws and one Allen key.

MSSBSV L assembly, side view (without TRU)

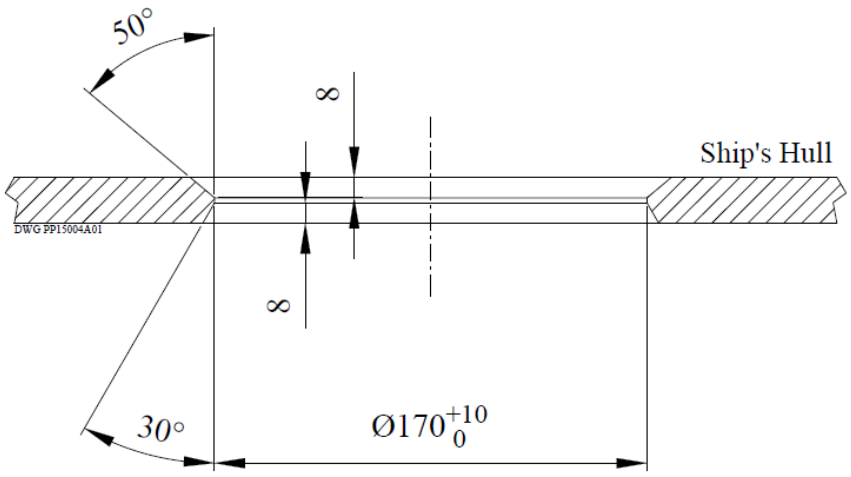
MSSBSV L assembly, bottom view (without TRU)



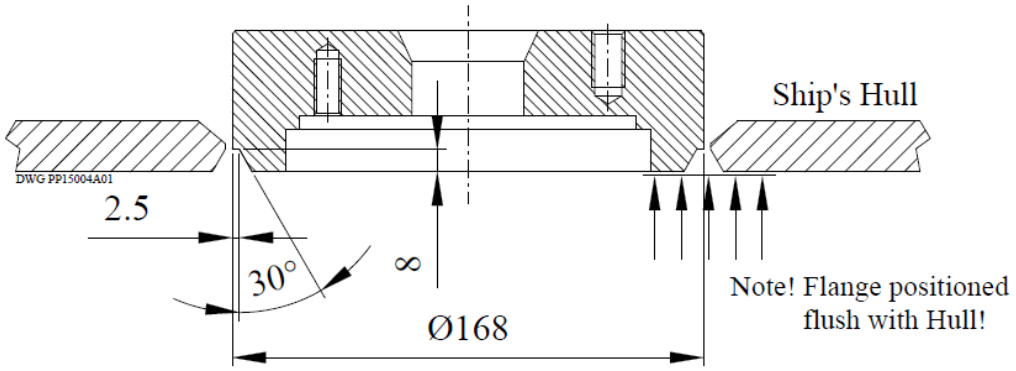
2.3.3 Flange Mounting

The bottom flange must first be welded into a hole cut in the ship's bottom.

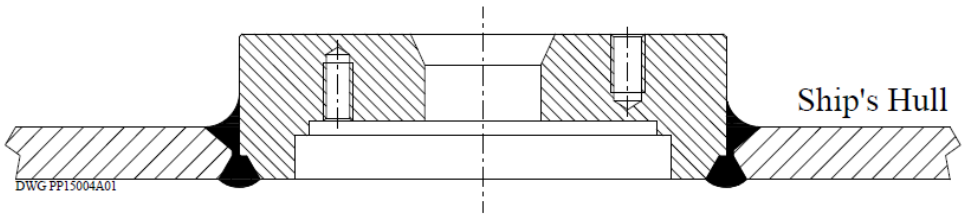
1. Cut a circular hole according to picture below at the selected TRU position.



2. It is important that the outer (bottom) surface of the flange is flush with the hull´s outer surface. The welded joint must be smooth and flush with the hull. There must be no sharp edges that can cause turbulence in the water flow passing the TRU.

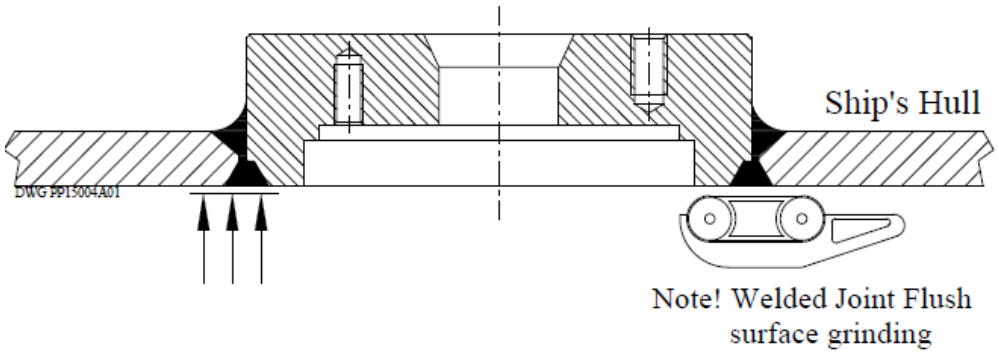


3. Weld the bottom flange (1) into the hole and ensure that it is positioned so that the sea valve may be fitted without obstruction.

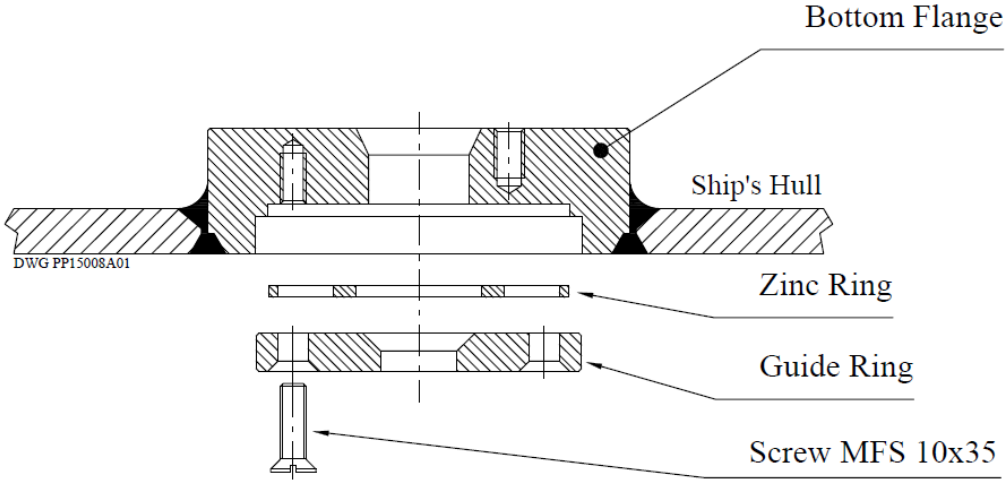


Note! The Bottom part forms a part of the ship's hull. Therefore a licensed welder, approved by the appropriate classification society, shall carry out the welding work.

4. Grind the weld area on the outside of the hull.



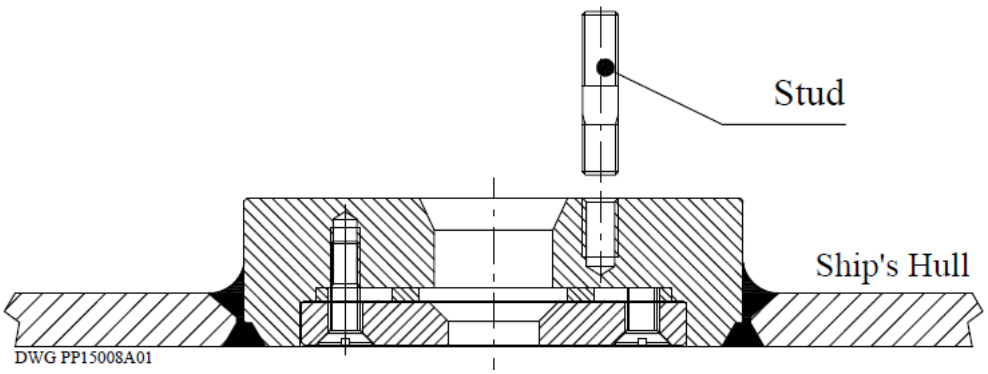
5. Fit the zinc ring (3) and guide ring (2) into the base of the bottom flange. Secure with the four MFS 10 x 35 screws (5).



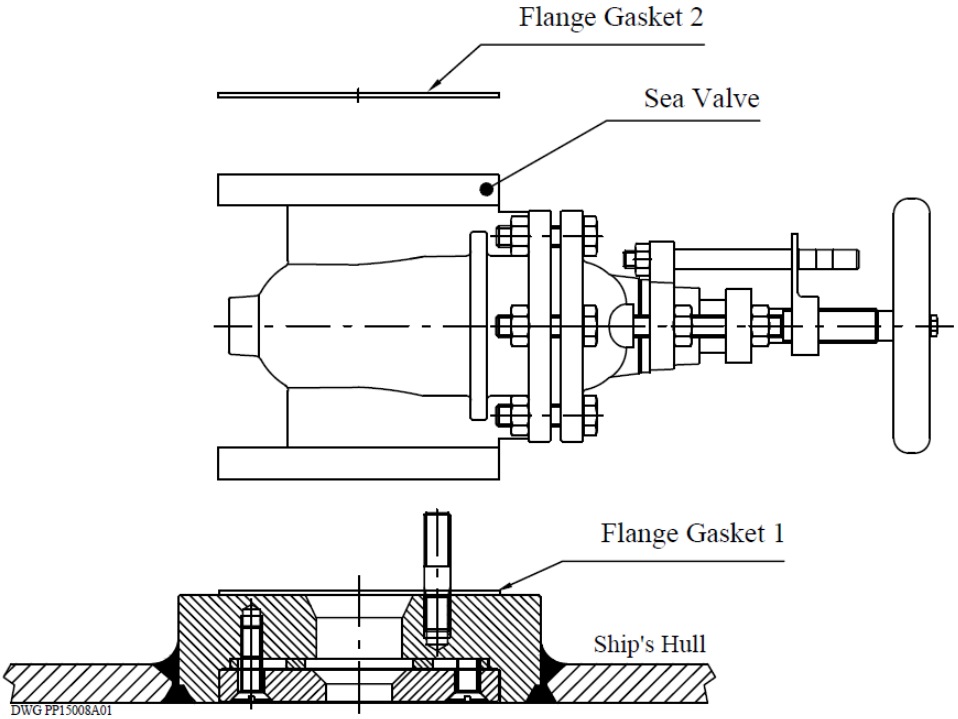
2.3.4 MSSBSV L mounting inside hull

1. Screw the *short* threaded end of the four PS12 x 40 (total length 55mm) studs (9) into the top of the flange.

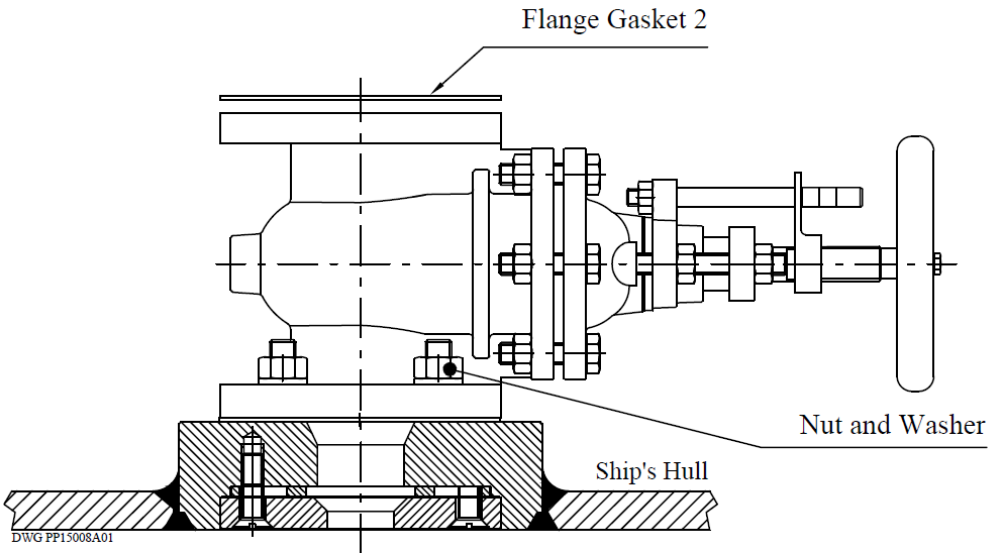
Note!
The thread on the short end of the stud bolts (going into the flange) is designed to generate a high friction when screwing the stud bolts into the flange. This higher friction will help to keep the stud bolts secured over time and make it easier to remove the nuts when dismounting the sea valve from the hull flange.
The use of a medium strength threadlocker, e.g. Loctite® 243 or equal will lubricate the thread during the mounting. It will lock and secure the thread to prevent loosening due to shock or vibration and it will also seal the thread to prevent corrosion.
Loctite® 243 is proven to be tolerant of minor contamination due to industrial oils, e.g., motor oils, corrosion prevention oils and cutting fluid.
It is recommended to only mount the stud bolts to the flange once since the high friction function of the thread will be lost if the stud bolts are removed and remounted.



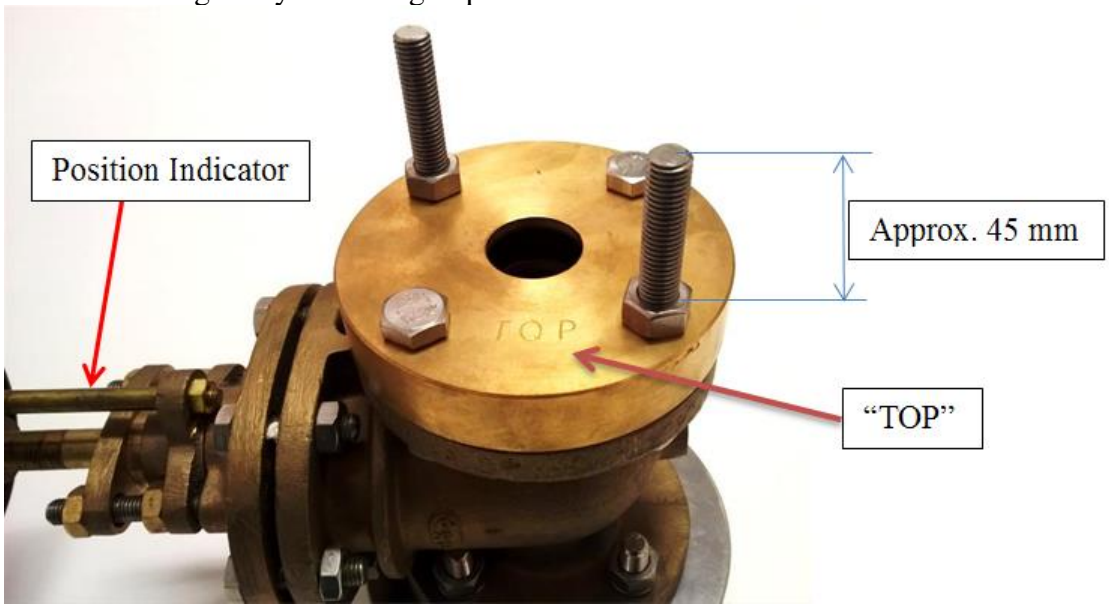
2. Place Flange gasket 1 (10) on the cleaned flange surface. Fit the sea valve (6) over the studs in any of the four possible positions, with the position indicator upwards.



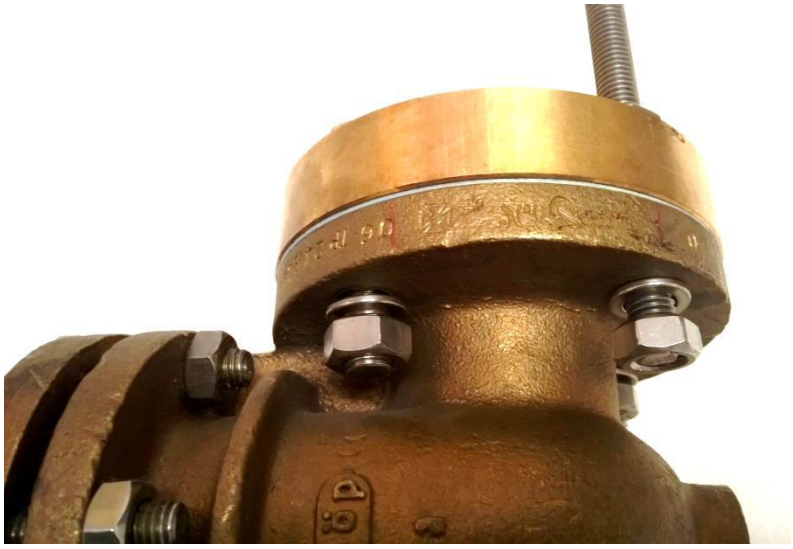
3. Lift the valve to be able to put the 4 pcs spring washers (7) and 4 pcs M6M M12 nuts (8) onto the studs and tighten crosswise the nuts.



4. Place Flange gasket 2 (10) on top of the cleaned sea valve flange.
5. Fit the valve cover (12) (the two *Lip seals* are pre-mounted inside the valve cover), marking "TOP" face upwards and mount the two threaded rods (17) and two screws diagonally according to picture below.



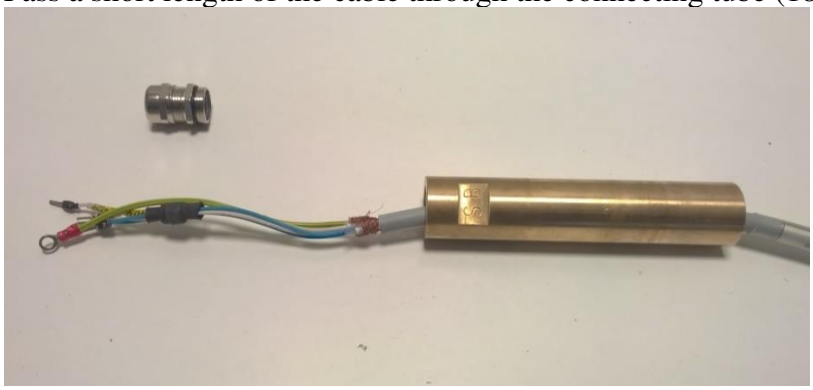
Spring washers below valve flange.



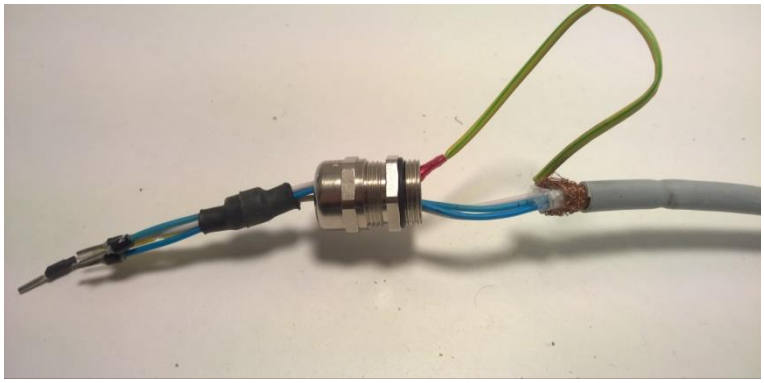
6. Tighten crosswise the 4 pcs M6 M12 nuts on the underside of the valve flange.

2.3.5 Transducer unit (TRU) Assembly

1. Temporarily remove the protective plastic bag from the cable terminations. **Assure that the cable ends are not damaged during the following steps. Never cut/alter the cable or the cable terminations!**
2. Pass a short length of the cable through the connecting tube (18).



3. Pass the cable end through the cable gland (19), it is easier to pass the ground cable separately. The cable gland cap may be loosened to ease passing of cable ends.

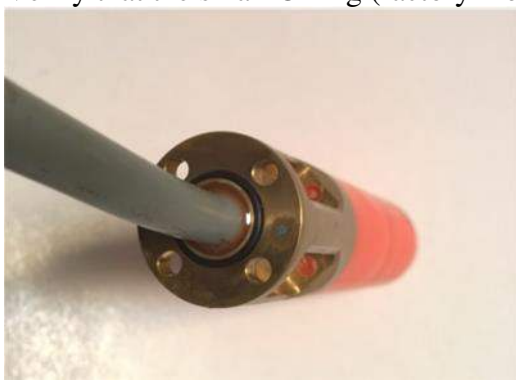


4. Replace the plastic bag to protect the cable terminations.

5. Mount the cable gland (19) on the connecting tube (18) and tighten the gland base to the tube. Mount the cable gland cap part back if dismounted but do not tighten the cable gland cap at this stage.

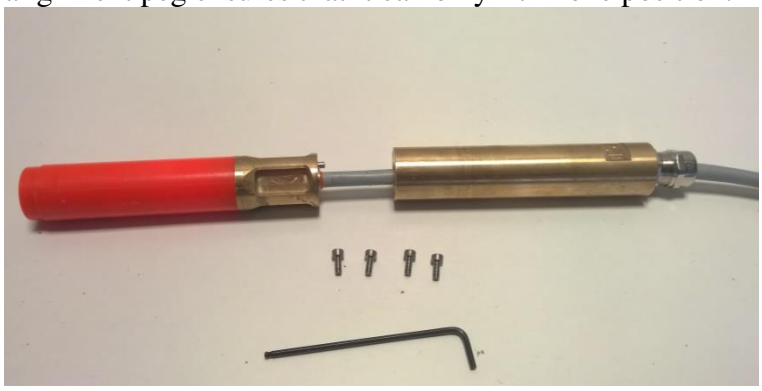
6. Pass the complete length of the cable through the connecting tube and gland. Unpack the transducer (4).

7. Verify that the small O-ring (factory mounted) is fitted on the TRU.



Be careful when handling the transducer / tube assembly.

8. Attach the TRU to the connecting tube using the four M4x10 Allen screws. The alignment peg ensures that it can only fit in one position.



9. Tighten the cable gland cap.

10. Pre-mount the tube bracket assembly (16) onto the connecting tube (18). Slightly tighten the bracket screws (15) approx. 50 mm from the top end of the tube.

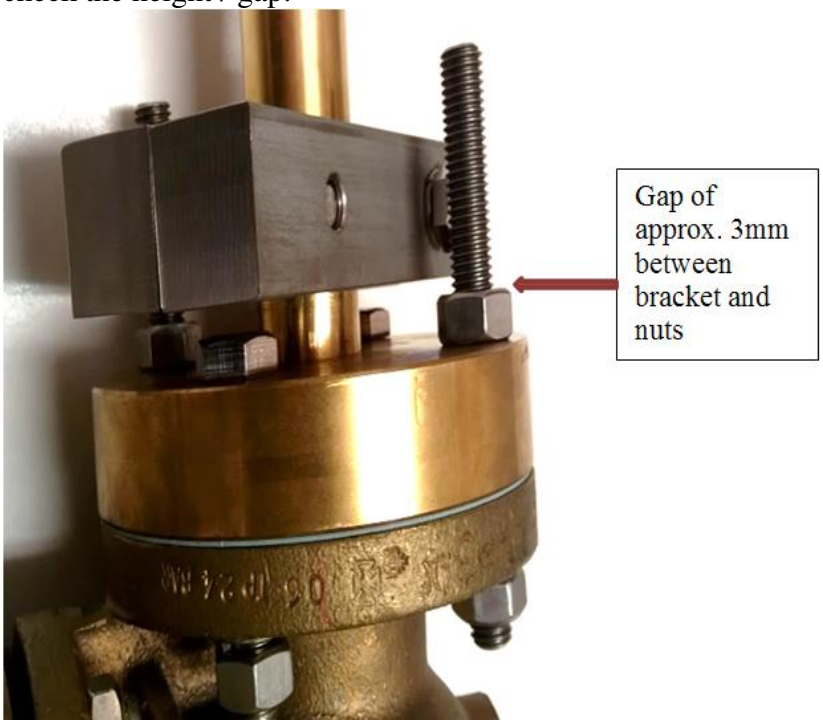
MSSBSV L Transducer unit (TRU) assembly

2.3.6 Transducer assembly Installation

1. It is recommended to lubricate the *Lip Seals* with e.g. Vaseline before inserting the TRU assembly. Make sure that Sea-Valve is fully open then carefully insert the TRU assembly into the sea valve assembly.
   Do not use excessive force; this could easily damage the transmitter/receiver components at the sensor surface of the TRU.

2. Insert the TRU until it reaches a definite firm stop in the guide ring.

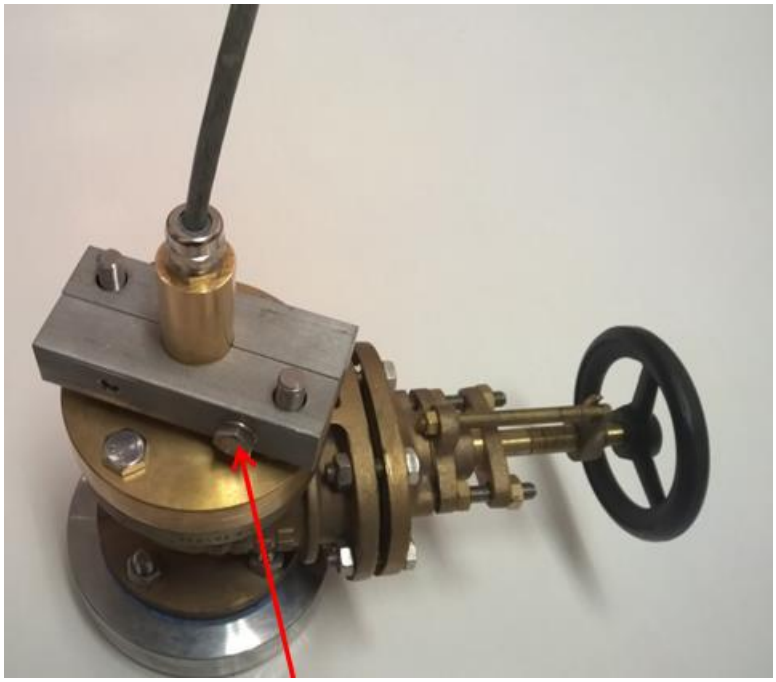
3. Verify by lifting and push the TRU assembly between the rods that the TRU is stopped by and seated flush with the guide ring and not the screws / nuts – check the height / gap.



4. Ensure that it is flush with the guide ring by checking from outside the hull.

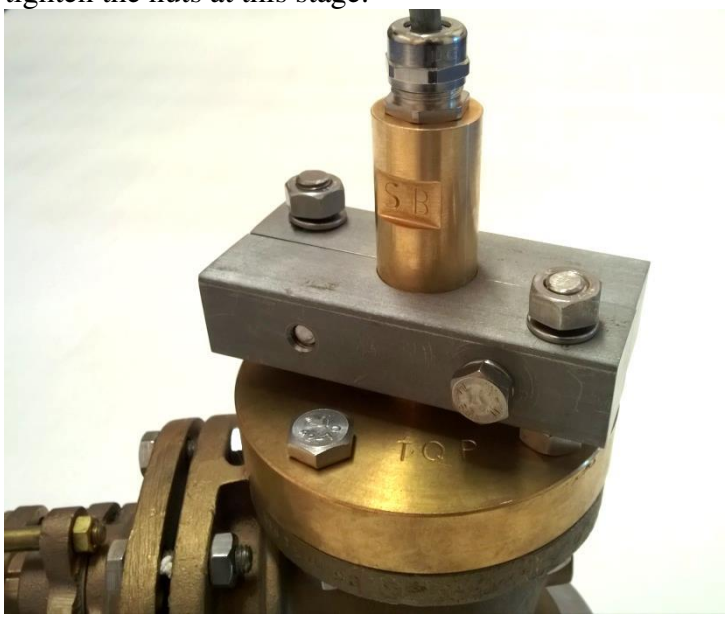
MSSBSV L flush with the hull and TRU properly seated in the guide ring

5. Lift and put the tube bracket (16) onto the rods (18). Loosen the tube bracket screws (15) while pressing down on the connecting tube and ensure that the TRU stays fully down. Slide the tube bracket assembly down (approx. 3mm) until the it stops against the nuts – no gap.



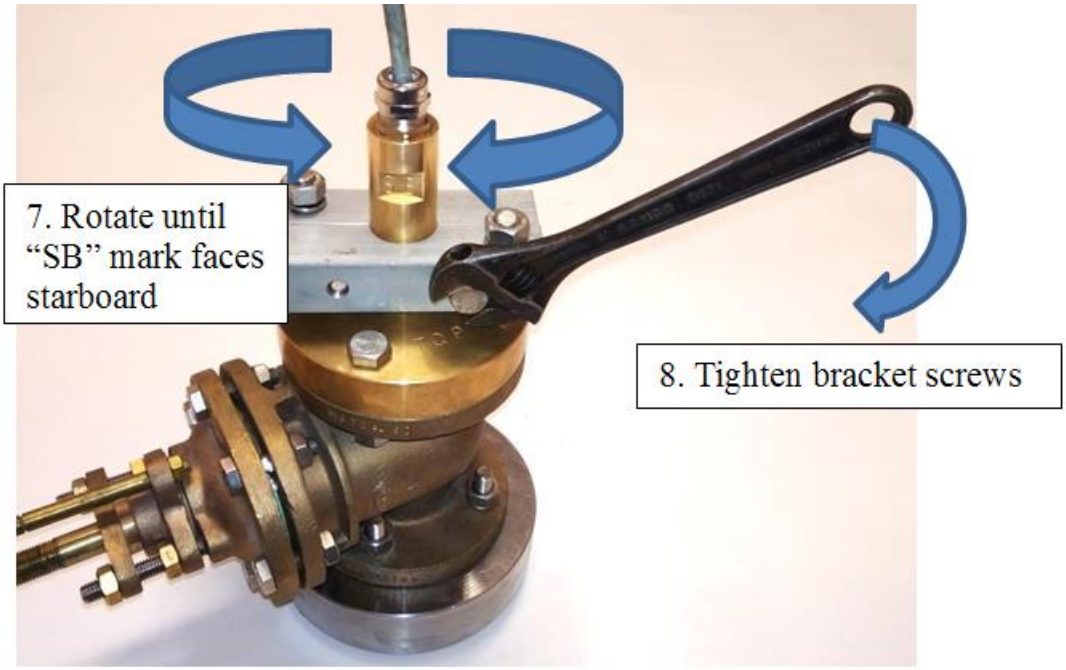
Tube Bracket screws, 2 pcs

6. Mount the spring washers and nuts on the threaded rods (17) but do not fully tighten the nuts at this stage.



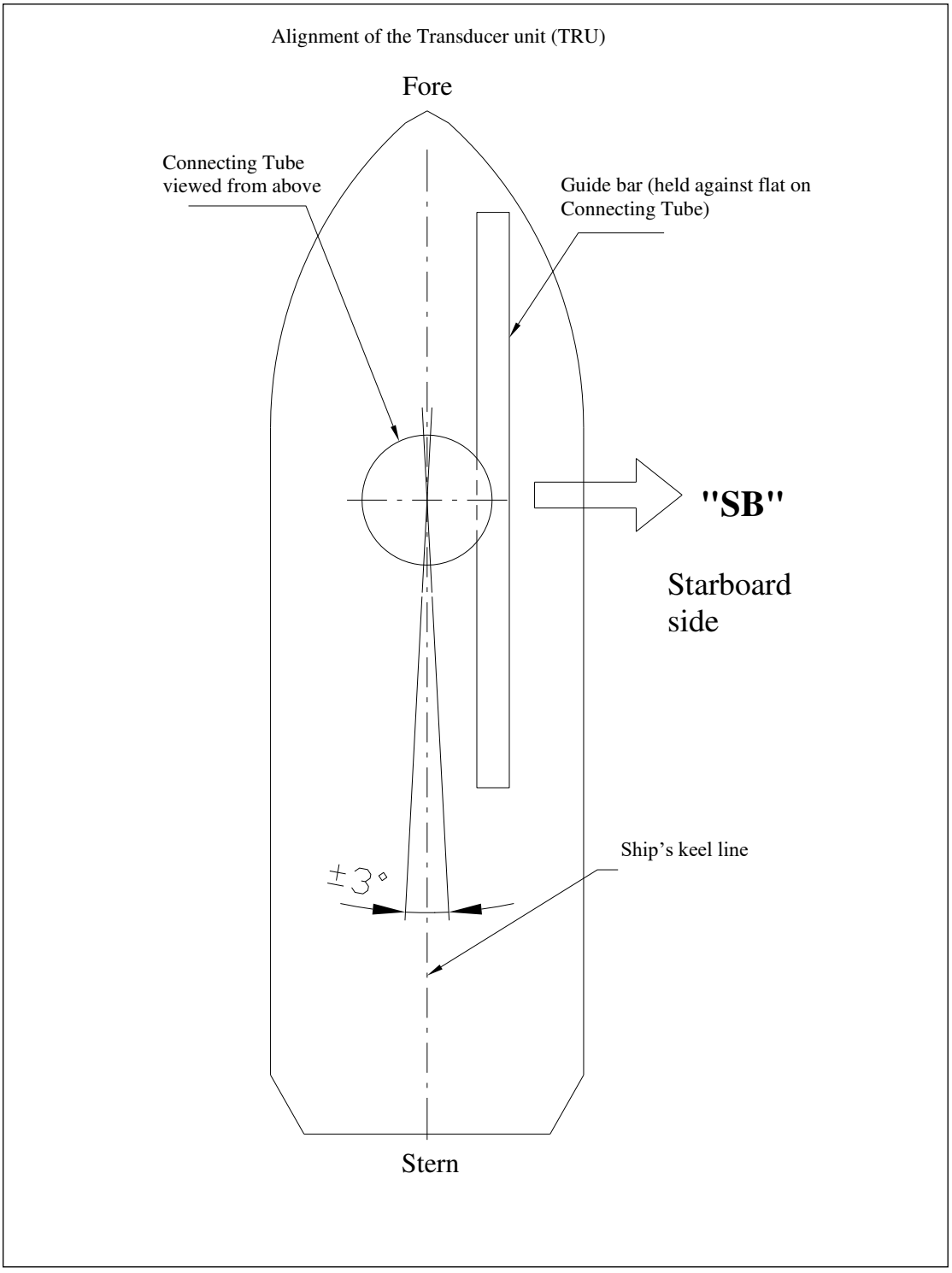
7. Rotate the TRU connecting tube (18) so the flat mark, SB, faces strictly to starboard. Use a suitable straight guide bar held against the flat mark to align the TRU by eye aiming in parallel with the keel line as accurately as possible (see figure *Alignment of the Transducer unit* below).

8. Tighten the tube bracket screws while pressing down on the connecting tube to ensure that the TRU stays fully down / and the tube bracket rests on the nuts.



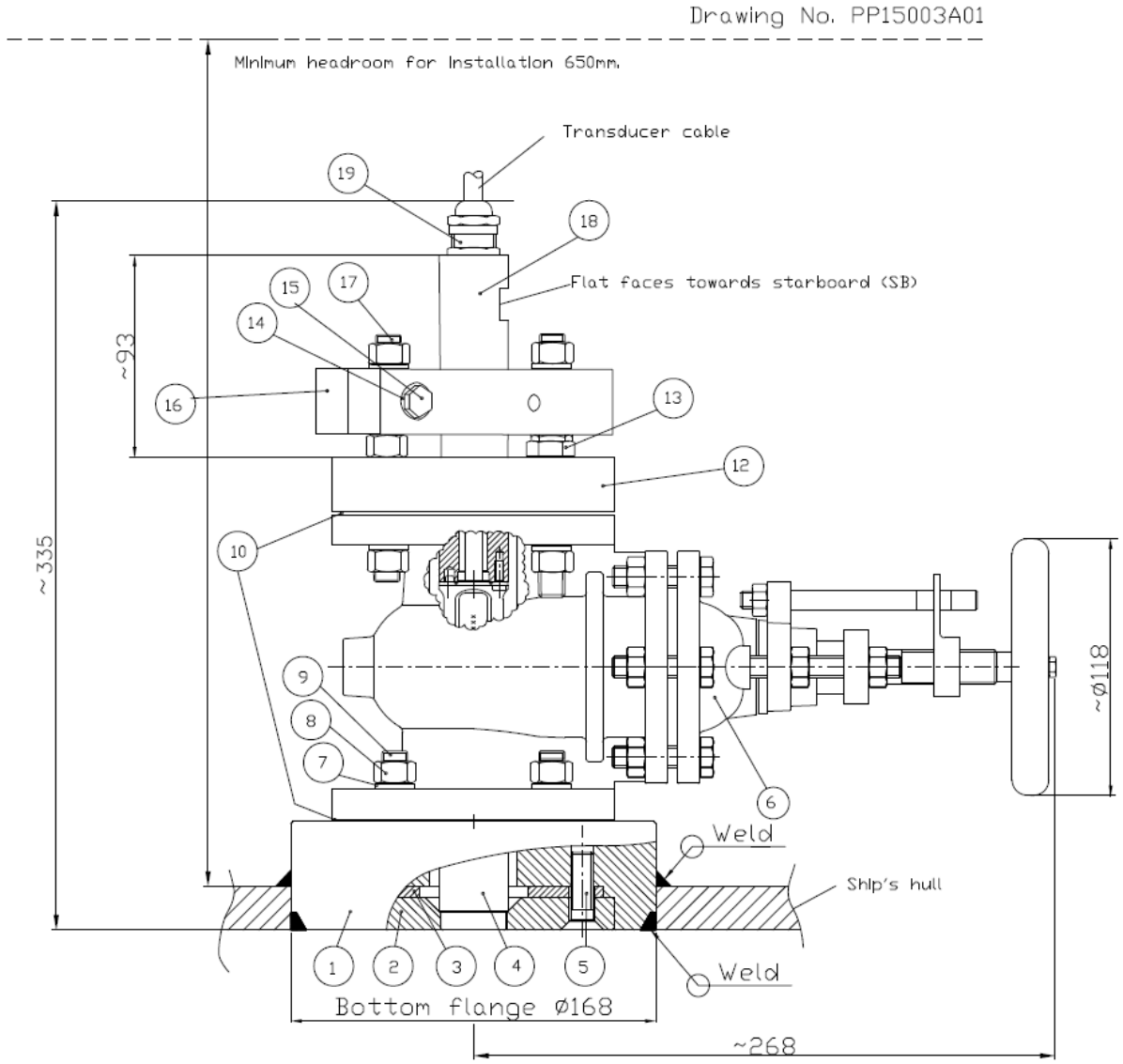
9. Check that the tube bracket (16) is still resting on the nuts. Finally tighten the two nuts on the threaded rods (17).

Ensure once more the alignment and that the TRU (4) is flush with the guide ring (2) by checking from outside the hull.

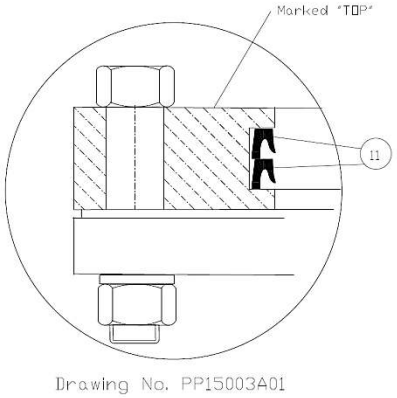

Alignment of the Transducer unit (TRU)
Fore
Connecting Tube
viewed from above
Guide bar (held against flat on
Connecting Tube)
"SB"
Starboard
side
Ship's keel line
+3°
Stern

2.3.7 Figure complete MSSBSV L

Complete MSSBSV L, with position numbers according to table.



Position 12, *Valve cover L Assy.* with pre-mounted Position 11, *Lip seals (2 pcs)*



Pos.	Quantity	Name	Part Number
19	1	Cable Gland Assy.	71-21533-00
18	1	SAL R1 Connecting Tube 150mm	5414105
17	2	Threaded Rod MHGS M12 x 115	5493316
16	2	SAL R1 Tube Bracket	5414101
15	2	Screw M6S 10 x 60	5493312
14	2	Spring Washer FBB 10.2	5493313
13	2	Screw M6S 12 x 60	5493317
12	1	SAL R1 Valve Cover L Assy. (including 2 pcs Lip Seal)	5493318
11	2	SAL R1 Lip Seal (pre-mounted)	00-00500-19
10	2	SAL R1 Flange Gasket	71-21538-00
9	4	Stud PS M12 x 40 (tot length 55mm)	71-21535-00
8	12	Nut M6M M12	5493314
7	10	Spring Washer FBB 12.2	5493315
6	1	SAL R1 Sea Valve	71-21544-00
5	4	Screw MFS 10x35	71-21536-00
4	1	SAL R1 Transducer with cable 30/40m *Note! Not included in Part No 5493350*	705050/ 705051
3	1	SAL R1 Zinc Ring	71-21504-00
2	1	SAL R1 Guide Ring	71-21543-00
1	1	SAL R1 Single Bottom Hull Flange	5414200

2.3.8 Running the Transducer unit (TRU) cable

After the TRU has been mechanically mounted, the cable should be securely fastened to the bulkhead all the way to the mounting place for the ELC. Leave a coil of sufficient length of TRU cable close to the TRU, to allow for retraction. The cable coil must be strapped and may not hang down and swing freely.

The TRU cable must not be run through water filled tank or other permanently or temporarily water filled compartment without protection by a watertight conduit.

Do not remove the plastic bag covering the TRU cable terminations until time for connection in the ELC.

The TRU is delivered with a 30 metres (or 40 metres) factory mounted cable. It is a four-core cable with common screen braid. This cable connects the TRU to the ELC.

Note: The TRU cable shall run directly to the ELC and may not be cut off, shortened, extended or by any other mean pass a junction box.

To make sure that the speed log performance is not affected the cable shall not be laid close to other high voltage cables (440 VAC or more) or other high power or high frequency cables (e.g. sonar, echo sounder, etc.).
Any excess cable length shall be coiled and strapped outside the ELC cabinet.
Do not store any excess cable length inside the ELC.
Any excess cable length inside will act as an antenna and may affect the electronics.

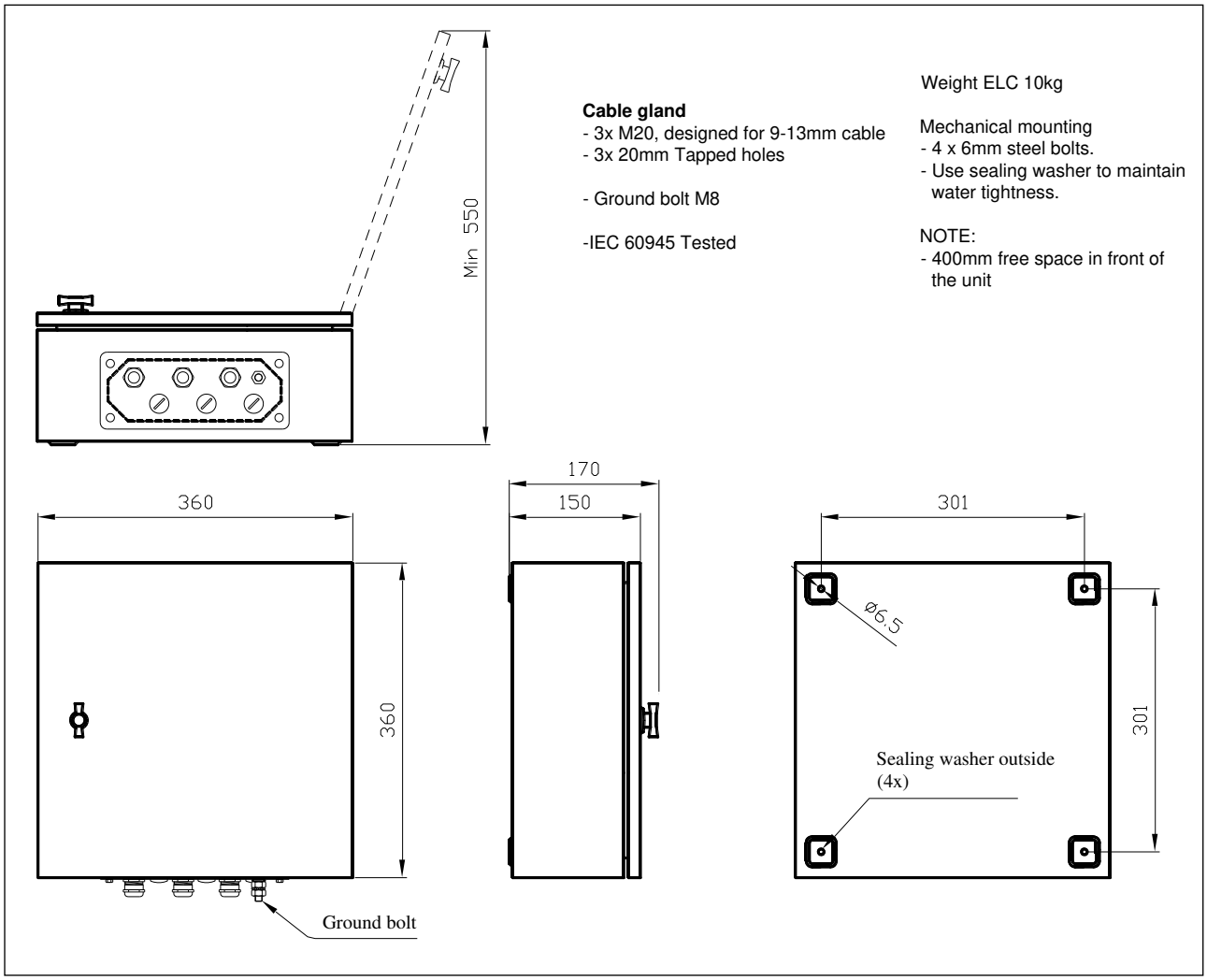
3 ELC, ELECTRONICS UNIT INSTALLATION

3.1 Mechanical installation

Selecting location

- The ELC should be located within restricted access area to minimise the risk of tampering.
- It must be possible to lay the 30 m (alt. 40 m) cable from the TRU in such a way that it can be dismounted in case of a TRU replacement.
  Note: *The cable must not be cut or extended.*
- The location shall be easily accessible for installation and service. There must be minimum 350 mm free space in front of the unit for opening the door to access the electronics inside and there must be proper space for cables below the cabinet.
- The location shall be protected from weather and should offer a stable temperature not outside the range -15 to +55°C.
- The location shall not expose the ELC for excessive vibration levels.
- The location shall not be permanently exposed to water.
- The location shall not be under open floor plates (gratings) or grating ladders.
- The location shall be far from electrical installations giving excessive electric and/or magnetic fields, such as powerful electrical motors for ventilation, bow thrusters etc.
- There must be a flat surface for mounting and to hold the four mounting screws/bolts.

The overall dimensions and mounting details for the ELC are given in the figure below. Dimensions:



4 pcs 6 mm steel screws shall be used for mounting. Use plastic sealing washers supplied to maintain water tightness.

3.2 Electrical Installation

Consider the ship's specific wiring diagram, depending on which units are included in the order that may be delivered with this manual.

Wiring principles:

- The ELC shall be firmly grounded to the ship's metal hull structure.
- All wires shall be electrically shielded and all signal wiring shall be twisted pairs. The mains supply will require a separate cable.
- For transmission of IEC 61162-1 Ed. 4/NMEA 0183 Ver. 4.00, analogue or pulse signals, a cross-section of 0.5 mm² or more is required
- **All connections to the ELC shall be made with screened cables!**
- At least five connections shall always be used:
  1. A solid connection shall be made between the ship's metal hull structure and the ground bolt at the bottom of the ELC cabinet. The cable area of this connection shall be at least 10 mm², preferably using copper braid.

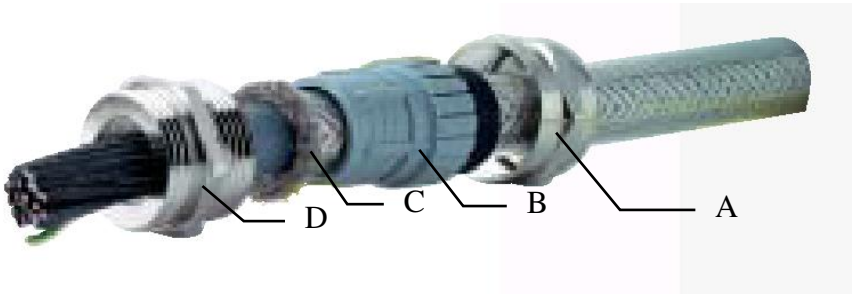
2. The AC power intake cable shall be brought to the 230 VAC terminals. Connect to L1, L2 and GND. If the ELC power supply is set for 115 VAC the same terminals may also be used for this voltage, see Mains Power options below.
3. The TRU cable cores with terminal pins marked 1-2 and 4-5 shall be connected to terminal 1-2, 4-5.
   Note! Leave the terminal number 3 open/not connected on the ELC. Connect the ring cable shoe on the yellow-green ground core to the grounding bar at the bottom of the cabinet.
4. Connect the TRU cable screen braid to the ELC cable gland as described below.
   Note! *Do not cut or alter the cable properties. If the cable is cut or violated the warranty will not be valid.*
5. The NMEA output cable and any other signal outputs should be brought through appropriate cable glands to other users. NMEA output is found on terminals 50 (A) and 51 (B). NMEA input is found on terminals 40 (A) and 41 (B). If an extension or distribution device is used in the installation, the cable shields should be connected firmly there and not in the ELC. If cables are brought directly to users, displays, etc., grounding shall be done firmly in the ELC.

- All supplied cable glands are designed to terminate the cable screen braid directly to the ELC cabinet through the cable gland. This is a precaution to maintain proper EMC protection. If more cable glands than those supplied are needed, other EMC types maybe used.

Terminal	Signal name	Function
1	TRU ch1	Transducer connection
2	TRU ch1	Transducer connection
3	TRU gnd	Not to be connected
4	TRU ch2	Transducer connection
5	TRU ch2	Transducer connection
7	0VDC	Signal ground
8-9	200 p/NM relay1	Speed information (200 contact closures / NM)
10-11	200 p/NM relay2	Speed information (200 contact closures / NM)
18	Analog out	Speed information (0.1V / knots)
19	0VDC	Signal ground (for analog out)
24-25-26	LFA (NO-C-NC)	Log Fail Alarm
40	NMEA A in	NMEA in for Speed Log Master Display
41	NMEA B in	NMEA in for Speed Log Master Display
50	NMEA A out	NMEA out
51	NMEA B out	NMEA out
52	+ VDC for SD indicators	Power for SD4
53	0 VDC for SD indicators	Power for SD4
54	+12VDC in (optional supply)	Not to be connected
55	0VDC in (optional supply)	Not to be connected
L1	230/115VAC	Mains Power supply
L2	230/115VAC	Mains Power supply
GND	PE	Protective Earth/Ground

Table 2 Connections for the speed log

Correct mounting of EMC-type cable gland on TRU cable and on other cables:



1. Remove the protecting cover/strap on the cable, to expose and free the prepared screen braid for proper ground termination.

2. Push the parts “A” and “B” (with rubber packing) over the cable outer insulation sheath in the order shown.

3. “Push/Fold” down the screen braid “C” over the top of part “B”.

4. Push cable with “B” part firmly into the fixed part “D” of the cable gland ensuring that the screen braid makes contact inside “D”.

5. Firmly tighten cap nut “A”.

Display units

Different display units can be connected to the Electronics unit, e.g.:

- **Speed Log Master Display SD4-3,** i.e. used to access the WTU menu system for calibration, system checks, etc.
- Serial Speed and Distance Display SD4-3 as slave display(s).
- Analogue Speed Indicator SIA-2-8.
- General display SD4-4 as slave display(s)

The SD4 display(s) are described in separate sections.
A maximum of 10 SD4 displays can be connected in parallel to the NMEA output.
A maximum of 4 SD4 displays are also possible to power directly from the ELC VDC output.

Mains Power options

At delivery the ELC is adapted to a nominal voltage of 230VAC. It is however possible to change the nominal voltage to 115VAC. When this is done precaution must be taken to prevent the ELC from being connected to 230VAC, as this would damage the unit.

To change to a nominal voltage of 115VAC, cut out the lower right corner of the front panel using a side cutter and move the transformer connector from position P8 to P9.

P9 (Behind front panel): 115VAC-transformer connector position

P8: 230VAC-transformer connector position

4 SET-UP GUIDE

The Set-Up procedure includes all steps after the mechanical and electrical installations have been performed and up to the calibration of the speed log.
(For calibration details refer to User Guide.)
The Set-Up Guide is limited to short instructions and it is therefore recommended to use it as a check list. For errors or disruptions during the Set-Up procedure, please refer to Trouble-Shooting Guide and/or re-check installation details.

4.1 Pre-Set-Up procedure

This paragraph provides information concerning the preparative checks and procedures to be done as a completion of the electrical installation **before** supplying the ELC unit with power and **before** performing the system Set-Up procedure:

Note: Powering the Speed Log System is not included in the Pre-Set-Up procedure.

Each electrical installation needs to be completed by below Pre-Set-up procedure. Therefore it is recommended to double check the below points before connecting power to the unit:

- Clean out and remove any possible foreign particles and installation work residues from the cabinet(s).
- Carry out a visual inspection of the installed components and cables referring to the layout of the unit and to the interconnection drawings.
- Check that the connection terminals have a firm grip on the cable wires.
- Check that cable glands have a firm grip and tightened around the cables.
- Check that the Transducer/TRU cable screen braid is firmly grounded inside the cable gland of the Electronics unit/ELC.
- Check that the TRU cable is connected to intended terminals and that the yellow-green ground wire is connected to the ground bar.
- Any excess length of the TRU cable shall be neatly coiled and strapped near the ELC. NEVER CUT THE CABLE or alter/violate its properties!
- At the Sea Valve/TRU site the cable shall have a sling/coil allowing retraction of TRU for service/maintenance.
- Check for proper cable bends to assure not being stress bended.
- Check that ground connections to ship’s hull are duly tightened.
- Before power-up carefully verify the Mains power voltage and the integrity of the fuses.
- Also verify that the transducer is correctly installed fully down in working position/seated and longitudinally aligned. Refer to TRU mounting procedures.

4.2 Set-up and testing

See section 2, Setting-up guide.

5 SD4-3 DISPLAY INSTALLATION

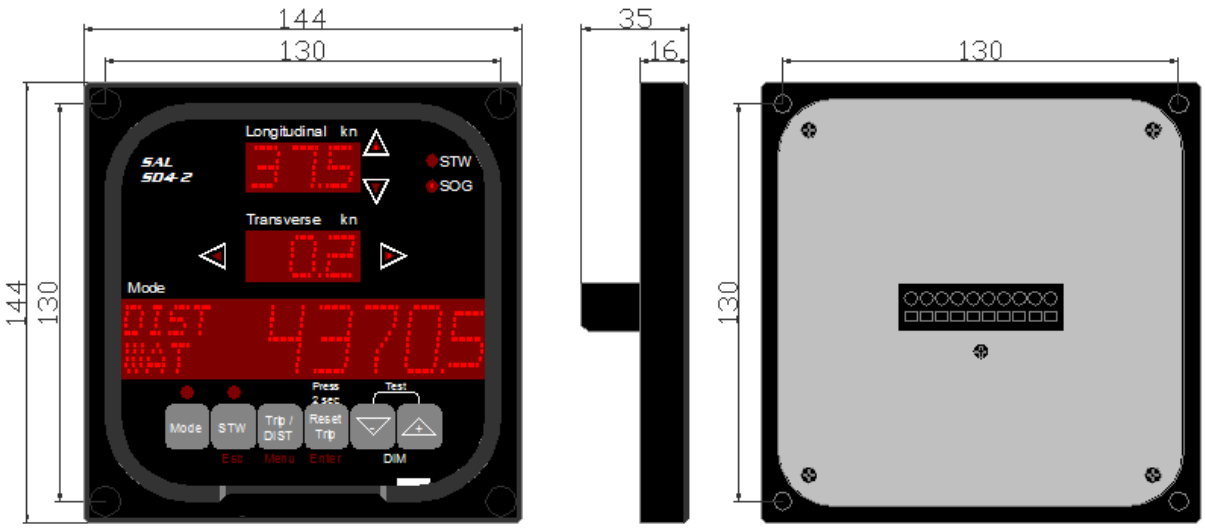
5.1 Mechanical installation

The display can be mounted on any flat panel or surface. The four mounting holes enable mounting of the display with four supplied M5 screws from the front using supplied M5 nuts on the backside or alternatively M5 threaded holes in the panel. A panel cut-out, shown below, must be made for the 10-pole cable connector.

The SD4 unit itself is watertight when mounted into and sealed with the supplied gasket, and the Teflon washers for the screw caps, against a flat panel/console with dry internal atmosphere.

Alternative mounting accessories:
- SD4 BMB Bulkhead Mounting Box for bulkhead surface installation.

The overall dimensions and mounting details for the SD4 display are given in the figure below:



The picture shows an SD4-2, but the dimensions for the SD4-3 are the same.

5.2 Electrical Installation

Consider the ship's specific wiring diagram, depending on which units are included in the complete scope of supply.

List of connections

The list of terminal Nos. and connections is labelled on backside of the unit.

Term#	
1	NMEA A in
2	NMEA B in
3	NMEA A out
4	NMEA B out
5	Pulse output (Menu setting: LP6)
6	
7	Ext Dim –
8	Ext Dim +
9	0 VDC
10	10 - 32 VDC (12 or 24 VDC nominal)

A ground screw is located below the detachable connector on the backside of the SD4. Connect a grounding wire from this screw to ship's ground.

Before powering the display:

- Carry out a visual inspection of the installed cables referring to the layouts of the unit and to the interconnection drawings.
- Check that cable terminations have a firm grip of the cable wires.

5.3 Speed Log Master Display

To remotely control the Menu system in speed logs and possible other equipment in the speed log system one SD4 display positioned on the bridge is used as a remote control. This SD4 display is named **Speed Log Master Display** and has to be marked in such a way that it is clearly distinguishable from all other displays connected to the log system.

The **Speed Log Master Display** can also be used to remotely control the dimming function in other SD4 displays connected to the system. In installations where more than one SD4 display are connected as **Speed Log Master Display**, those additional displays are primarily connected with remote control functionality to be able to control the dimming function in other SD4 displays but can also be used to control the Menu system in speed logs and other equipment. Those additional remote displays do not have to be labelled but the remote control function shall be clearly indicated in installation drawings and other documentation.

5.3.1 Positioning of the Speed Log Master Display

The **Speed Log Master Display** is preferably positioned on the bridge where it can be accessed without interfering with the normal operation of the ship, for example at the chart table.

5.3.2 Electrical connection

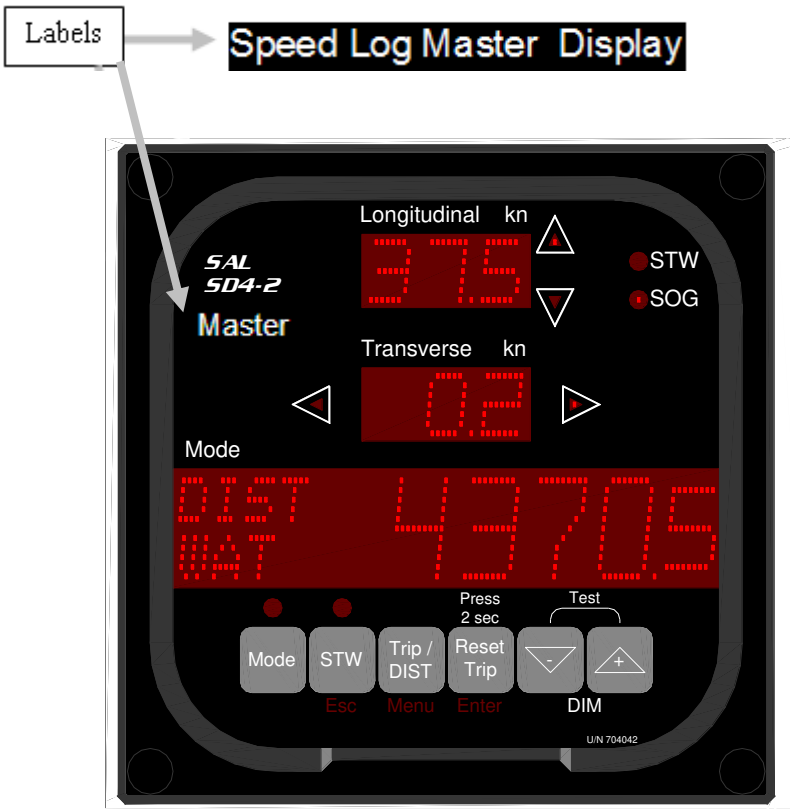
The **Speed Log Master Display** is connected with two-way communication to the Speed Log system. This means that it has to be connected with one pair of wires sending data to the display and one pair of wires sending data back to the Speed Log system. Other displays without remote control functionality only have one pair of wires sending data to the display.

Speed Log Master Display:
4 wires for the serial communication
2 wires for DC power supply
Other slave displays:
2 wires for the serial communication
2 wires for DC power supply

5.3.3 Positioning of the labels

In every shipment of a SAL speed log a set of two labels are included inside the Speed Log Main Unit – ELC. The installation company shall place these labels on and/or adjacent to the dedicated **Speed Log Master Display**.

One label, with the text "**Master**", is intended for placing on the front foil surface of the display.
The other label, with the text "**Speed Log Master Display**", is intended for placing on the bridge console surface adjacent to or on the frame of the display itself.



The picture shows an SD4-2, but labelling should be the same for the SD4-3.

For set-up of desired local properties as well as intended functions, depending on actual optional equipment and/or accessories installed, the below table and “Menu mode” description provide adequate information.

5.4 Menu Mode

The Mode window of the SD4-3 Display can also be set to Menu mode. The Menu mode is used for internal settings of the display and when SD4-3 is used as a remote display for other units e.g. the WTU menu structure or for remotely dimming of other SD-displays.

The Menu mode is reached by pressing the Mode button for minimum 5 sec.
The Mode window will switch to show the text "PRESS ENTER FOR MENU". Then press the Enter button (Reset Trip) within 5 seconds.
The Mode window will now show the current menu and the upper window will maintain the speed presentation sent out from the WTU.

Three buttons under the Mode window have now changed to alternative functions. These are lit in red text below relevant button.
From left to right the buttons now have the following functions:

Mode: Will inform which remote device that is connected.

Esc: "Blank". When in "Remote Device menu" Esc is used to leave the "Remote Device menu" (i.e. the WTU menu). When not in "Remote Device menu" Esc has the same function as Menu and Enter pressed simultaneously (see Menu-button below).

Menu: "Trip/DIST". Is used alone, or together with Arrow down (-), or together with Enter, to move/navigate in the menus as described below.
Menu alone, will display next menu, i.e. step forward on same menu level.
Menu and Arrow down (-) pressed simultaneously will display previous menu, i.e. step backwards on same menu level.
Menu and Enter pressed simultaneously will move up one menu level, except when leaving the "Remote Device menu". For this instead use Esc.

Enter: "Reset Trip" is used to save changed values/settings or to move to sub-menus.

"Arrow down" and "Arrow up" are used to change status, e.g. Write Access OFF/ON, and /or to change set values.

Note: When being in the Menu System and no button is pressed for 3 minutes, the Mode window will return to previous information displayed before the Menu System was entered.

5.5 SD4-3 in Menu Mode

The Menu mode has three "Local Menus" and one "Remote Device menu" on the first set-up level:

- SD4-3 LOCAL. This is the start menu when entering the Menu mode. If one or more other displays are remotely dimmed from the display, this menu shows a second text line and can easily be used to turn the remote dimming function ON/OFF.
- LP0 PROPERTIES. This menu contains sub-menus for local setting-up of the display.
  NB! Do not change to Write Access ON without special training.
- LS0 REMOTE SETUP. This menu contains sub-menus for setting-up when the display is used as a Speed Log Master Display.
  NB! Do not change to Write Access ON without special training.
- R0 REMOTE DEV. On a designated Speed Log Master Display this menu provides access to a Remote Device, e.g. WTU menu structure.
  NB! Verify the setting in menu LS7, normally ON is default.

5.6 Write and read only access

Default for sub-menus when entering the menu system is read only access, i.e. the Mode window shows WRITE ACCESS OFF.

When changing to Write Access ON ("+" and confirmed by Enter) then sub-menus are accessible for changes. Be careful to change intended parameters only. When leaving sub-menus the write access is automatically set to OFF.

5.7 Menu functions

The complete list for fast indexing of the Menu System, available for the daily user, is included below under headline "Menu function summary".

A Menu Structure chart for the SD4-3/WTU is found under Section E Appendix.

Special menus for testing can be found under Trouble-shooting.

5.8 Standby STW

This function can be used to temporarily deactivate the STW speed log. When using the standby function the SD4 has to be connected with two-way NMEA communication to the Speed Log system such as the **Speed Log Master Display**.

Set the local menu LP2.23, STANDBY STW, to ON.
WARNING! The standby mode is not valid/intended for normal operation. The standby mode must only be used for special purposes and under special circumstances to avoid or limit interfering and repeated alarm conditions from user systems disturbing bridge personnel.

Procedure for the user:

Press Mode to toggle the Mode window to show:

```
STW ACTIVE
[-+] FOR STANDBY
```

Press and release both DIM buttons, (- and +) simultaneously to deactivate the STW Speed Log.
When deactivated the Mode window will show:

```
STW DEACTIVATED
ANY KEY TO START
```

To start/activate the STW Speed Log, press **any** key.

If the SD4 Mode window shows:

```
STW UNIT STANDBY
NOT POSSIBLE
```

the SD4 did not establish contact with the STW Speed Log due to older software in the WTU and/or that the SD4 is not connected with two-way NMEA communication to the SAL Speed Log system.

5.9 Menu function summary

Note! Only the most commonly used menus for a speed log are listed below.

Menu no.	Menu name	Default setting		Function
		SD4-3	SD4-4	
BASIC MENU	**SD4- LOCAL**			
LP0	**PROPERTIES**			**Select properties menu**
LP1	SD4 TYPE SD4- [X]	3	4	X = defines type of display, e.g. SD4-1..SD4-4 (factory setting)
LP2	MODE WINDOW			Lists user selected information to be shown in the MODE window ON = shown OFF = not shown
LP2.01	DIST WATER	**ON**	OFF	Total distance counter of STW (resulting)
LP2.04	TRIP WATER	**ON**	OFF	Trip distance counter of STW (resulting)
LP2.09	DIST+TRP WAT	OFF	OFF	DIST WAT and TRIP WAT are displayed simultaneously
LP2.15	SPEED STW-L	OFF	**ON**	STW longitudinal
LP2.21	DIAGNOSTICS	OFF	OFF	Display diagnostic codes (PSALW)
LP2.23	STANDBY STW	OFF	OFF	Deactivates valid STW NMEA to invalid STW NMEA
LP3	STARTUP DIM [50%]	50%	50%	Default brightness after a reset.
LP4	NEG SPD USE [OFF]	OFF	OFF	Longitudinal distance counters and pulse output off at negative/astern speed.
LP5	LP5 EXT INPUT [DIM]	DIM	DIM	Sets functions of external inputs: DIM or SDR2
LP6	LP6 EXT OUTPUT [200 P/NM STW-L]	STW-L	STW-L	200 P/NM STW-L 200 P/NM SOG-L Enables function of external output.
LP7	NMEA GATE THROUGH [OFF]	OFF	OFF	CAUTION! Always OFF when connected back to the Speed Log system. (Only used if more displays are connected in series)
LP8	NMEABAUDRATE [4800]	4800	4800	4800/(38400 not to be used!) CAUTION. Do not change!
LP9	SW REVISION 704021xx			xx = current Software revision.

Menu no.	Menu name	Default setting		Function
LPB	SPEED VALUES 2 DECIMALS [OFF]	OFF	OFF	Displays speed values with two decimals, when enough space
LPD	RESET TOTAL			
LPD.01	RESET TOT CONFIRM [NO]	NO	NO	YES = resets internal total distance counter(s) of the SD4 to zero.
LPE	SET DEFAULT MENU PARAMETERS			
LPE.01	RESET MEN CONFIRM [NO]	NO	NO	YES = resets all menu parameters in the SD4 to default values. (Depending on type of SD4)
LS0	**REMOTE SETUP**			**Select Remote setup menu**
LS1	SD4 ID [4]	4	4	ID number between 0-26. Other SD4 displays that have entered this ID in menu LS3 can remotely DIM this display.
LS2	DIM OFFSET [0 %]	0	0	Offset from remote DIM command
LS3	REMOTE DIM ID			SD4 displays that have corresponding ID numbers will be remotely dimmed from this SD4. Maximum 4 IDs can be entered.
LS3.01	REMOTE DIM ID [ ]			The first SD4 ID to be entered.
LS3.02	REMOTE DIM ID [ ]			The second SD4 ID to be entered.
LS3.03	REMOTE DIM ID [ ]			The third SD4 ID to be entered.
LS3.04	REMOTE DIM ID [ ]			The fourth SD4 ID to be entered.
LS4	HEARTBEAT TIMEOUT [30]S	30	30	Time between heartbeats are sent to the remote device.
LS5	MENU ACKN. TIMEOUT [X]S	2	3	Maximum time for acknowledge signal from the remote device.
LS6	SD2 REMOTE DIM [OFF]	OFF	OFF	On = makes it possible to remotely DIM old SD1/SD2 displays.
LS7	R0 REMOTE ENABLED [ON]	ON	ON	Enables menu R0 to allow remote connection to other device(s). OFF = disables menu R0.

Menu no.	Menu name	Default setting		Function
R0	**REMOTE DEV CONNECT**			Access to menu system in remote device(s)**.** (LS7 defines if this menu shall be enabled)
R1	DEVICE 1 OF X <NAME> (<ID>)			X: number of available remote device(s). NAME: name of the remote device. ID: remote device identity.
R2	DEVICE 2 OF X <NAME> (<ID>)			X: number of available remote device(s). NAME: name of the remote device. ID: remote device identity.
R3	…, etc.			There will be as many R menus as there are remote devices connected and identified.

SAL R1 TRU
Easy Tank
Installation manual

Document No. 5492303A06

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Part number: 5492303 Rev A06

TABLE OF CONTENTS

Revisions:			
Date	Version	Issue by	Description
2016-06-17	A01	STOOM & STOJO	Initial release
2016-10-14	A02	STOOM	Updated to O-Ring (s)
2016-10-26	A03	STOOM & STOJO	Updated pictures and corrections.
2016-11-09	A04	STOOM	Minor corrections
2020-12-11	A05	STE	Manufacturer and name clarifications, removal of options
2021-05-10	A06	HB	Updated cable specifications and image references

1. General

The SAL R1 TRU Easy Tank is very suitable for installation for small ships, which can be easily dry-docked or lifted out of the water, where a mounting location can be found directly in the bottom hull plating. It may also be used for ships where sufficient inboard space is not available for fitting with a seavalve. TRU exchange or maintenance is not recommended with the ship in water or at least not without diver assistance.

A complete SAL R1 TRU Easy Tank is divided in two parts; the SAL R1 TRU Easy Tank with cable and the R1 TRU Easy Tank Flange.
Alternative Flange for aluminium ships is the R1 TRU Easy Tank flange ALU 5083.

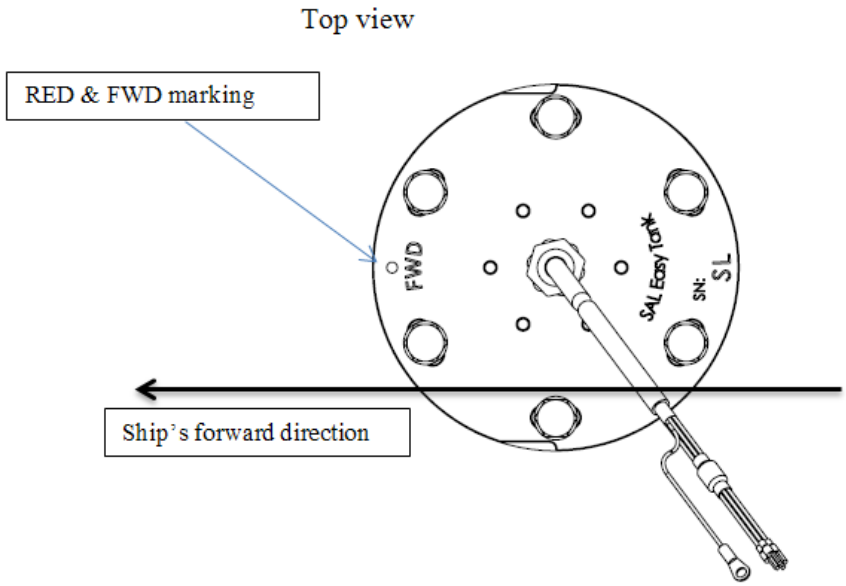
The transducer is designed to be fitted flush with the hull. The transducer measures speed through the water STW (relative speed) approximately 130 mm below the ship's hull.

Note!
The SAL R1 TRU Easy Tank Speed Log transducer is tested with the cable as one unit.
DO NOT CUT OR MODIFY THE TRANSDUCER CABLE.
Because the relative speed measurement operates at a frequency where cable length affects performance and the manufacturer will takes no responsibility if the cable is modified.

The bottom flange is welded into a cut-out in the ship's bottom hull plate.
The bottom flange holds the transducer flush with the underside of the hull.

IMPORTANT!
When welding the bottom flange to the hull the **Red markings** on the flange **must** be assured to point in the **ship's forward direction**.

Red marking indicates forward direction.
The red marking on top of the TRU top must be in line with red markings on the bottom flange.



2. Transducer location requirements

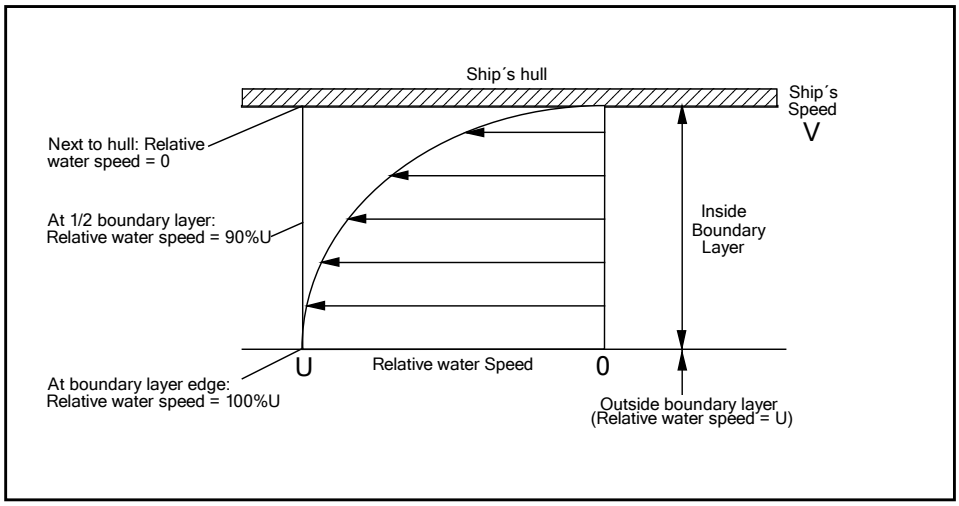
1. To achieve the best performance of the SAL R1 TRU Easy Tank system, special care must be taken to find the best area in respect of water streaming under the transducer.
   The transducer location **SHOULD BE REVIEWED AND COMMENTED BY EQUIPMENT SUPPLIER** in terms of the hydro-dynamical conditions, otherwise the guarantee for the speed log system will not be valid. Early discussions on transducer location with drawings is always recommended. The hydro-dynamical review given only concerns the above requirement and not the inside design, such as installation height, access to the sensor or any inside obstacles that might occur and jeopardise the function or maintenance. For more detailed installation advices please refer to the complete manual.
2. The SAL R1 TRU Easy Tank should be installed in the foremost part of the vessel as close as possible to the keel line.
3. The SAL R1 TRU Easy Tank should always be installed perpendicular to the ship's horizontal plane.
4. The steel version of the SAL R1 TRU Easy Tank and transducer cable can be installed submerged in a water filled tank. The Aluminium version of SAL R1 TRU Easy Tank shall not be installed submerged.
5. The compartment in which the SAL R1 TRU Easy Tank is installed may be sealed by a manhole or hatch but the compartment must be accessible for service.
6. The transducer cable must not be permanently installed in case of service or replacement of a defective transducer. Extra cable length shall be coiled.

   Note!
   Do not cut the Speed log cable! Warranty is void if cable is cut.
7. Sufficient headroom must be available at the SAL R1 TRU Easy Tank position to allow for its fitting and removal/maintenance (see drawing for appropriate bottom part).
8. On tankers the SAL R1 TRU Easy Tank location is not to be within the EX–area. The transducers must never come in contact with cargo oil.
9. The SAL R1 Speed Log transducer cable shall run directly to the electronics cabinet (ELC) and **must never be cut off, shortened, extended or by any other mean passing a junction box!**
10. **The Speed Log Transducer cable (SL) shall run separately from noise sources such as high voltage cables.**
11. In the vicinity of the transducer's location, the outside of the vessel must be free from sudden projections, welding joints, steps and sharp edges. Special care must be taken that no obstacle occurs in the forward vicinity of the transducers. Such conditions will cause water turbulence, which may give unreliable speed readings from the Speed Log.
12. Water inlets and outlets may disturb the water flow. Therefore, the transducers should be located at least 2 m forward of such openings.
13. The transducers (sensor elements) must always remain submerged, even with a minimum draught in heavy seas.

Boundary Layer

A moving ship's hull tends to drag a layer of water with it, causing a boundary region around the hull. The water speed at the hull is almost the same as the ship's speed, so that the relative water speed is almost zero. With successive water layers, the relative water speed increases until, at the boundary edge, the relative water speed becomes equal to the ship's speed. The thickness of this boundary layer is not uniform around the ship, and can range from a few millimetres near the bow to over a metre at the stern on a large ship.

The relative speed of successive water layers is not proportional to distance from the hull, but follows a curve as shown below:



Noise, Cavitation's and Factors Affecting Acoustic Speed Logs

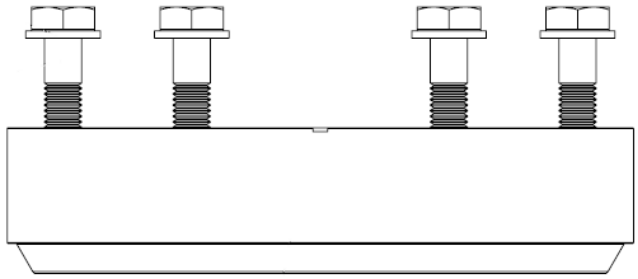
The transducer operates on the acoustic principle and is therefore susceptible to interference from acoustic (noise) sources. In particular, the transducer should be fitted well away from the propeller and other sources of noise, to minimise the effects of noise, vibration and cavitations.

The transducer and electronics unit is designed to respond principally to the acoustic reflections denoting the speed of the ship. In some situations, however, the system may respond to false signals that can arise under adverse conditions. All acoustic logs are affected in a similar way.

3. Parts

The components of the SAL R1 TRU Easy Tank assembly are supplied in kit form for mounting in the ship. Before starting the work, check the contents of the kit against the packing list.
The contents can be divided into two groups as shown in figures below:

1. SAL R1 TRU Easy Tank Flange with Screws and Washers for welding in the hull, steel version.



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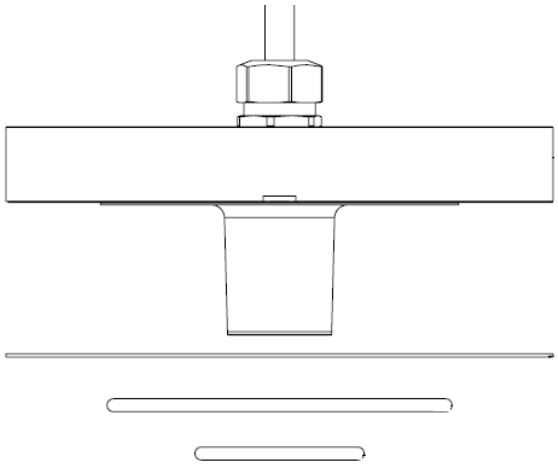
2. SAL R1 TRU Easy Tank (Transducer unit) with cable, O-Ring (s) and Gasket.



Note!
The surfaces of transducer must **never be painted!**

Weight Specifications

SAL R1 TRU Easy Tank 10m WTC	5.1 kg
SAL R1 TRU Easy Tank 40m WTC	8.1 kg
SAL R1 TRU Easy Tank 40m	8.6 kg
SAL R1 TRU Easy Tank Bottom Flange "Steel"	6.2 kg
SAL R1 TRU Easy Tank Bottom Flange ALU 5083	2.1 kg

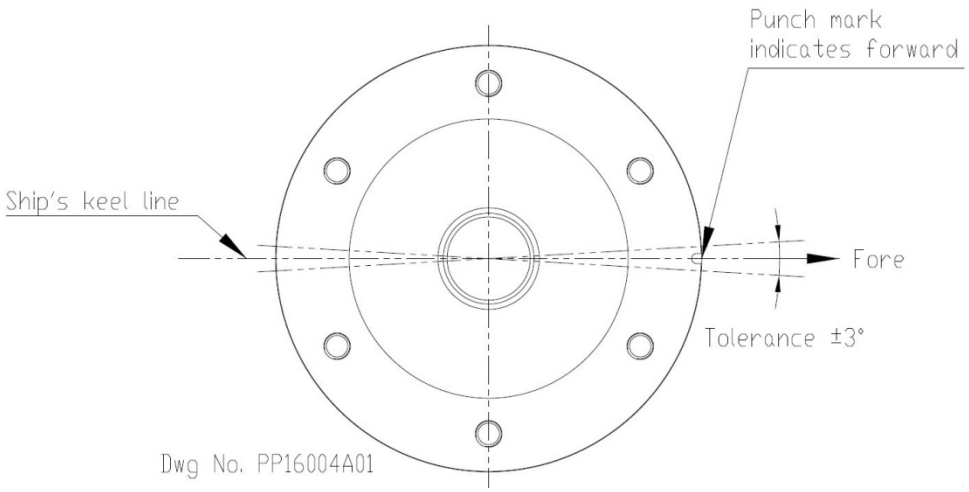
TRU cable specifications

	Diameter (mm)	Min. bend radius (mm)	Max hanging length (m)	Max pressure (bar)
Water tight cable, WTC	9	45	2000	5
Standard cable	10	55	25	-

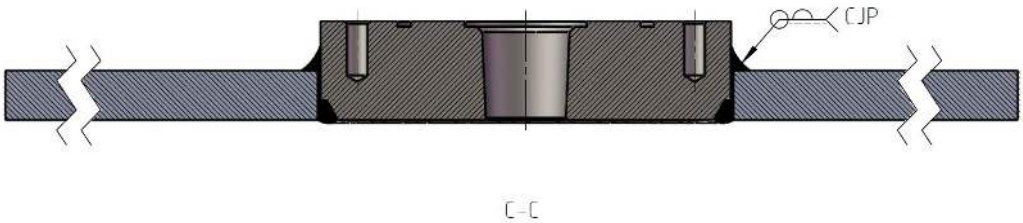
4. Easy Tank mounting procedures

The Easy Tank bottom Flange must first be welded into a hole cut in the ship bottom.
Cut a circular hole, diameter 170 mm (+10 / -0 mm) at the selected Easy Tank transducer position.

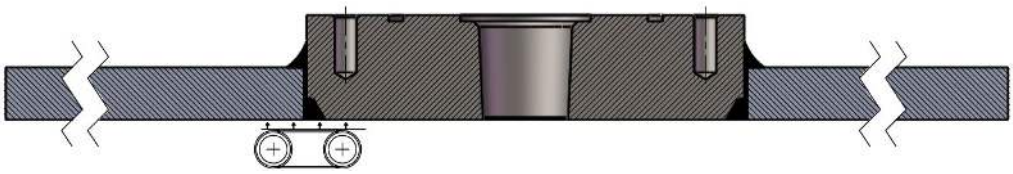
Note!
A licensed welder, approved by the appropriate classification society, should carry out the welding work.



- Red markings aiming strictly (+/-3°) forward.
- Ensure that the bottom flange is **flush** with the outside of the hull.



Welded joint grinding

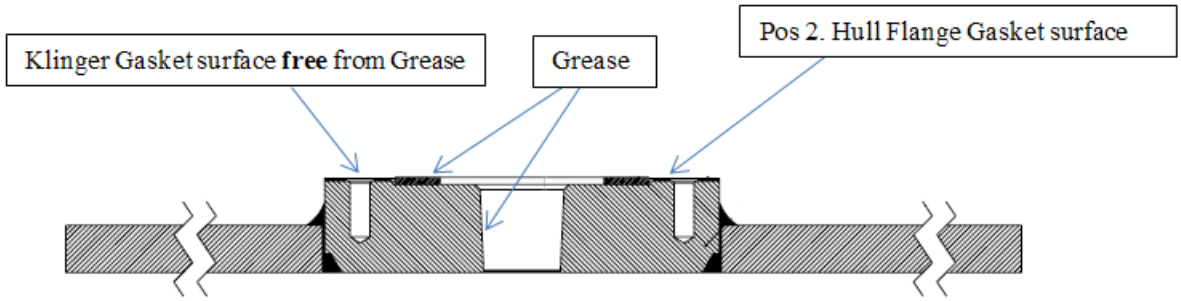


The welded joint must be ground smooth and flush with the hull. There must be no sharp edges that can cause turbulence in the water flow passing the SAL R1 Easy Tank transducer.

Preparation of flange

- Assure that the hull Flange (Position 2) is clean.
- Apply a thin layer of Silicone based grease on the O-Rings and the sufaces inside the outer Klinger Gasket. Keep the outer Klinger Gasket area on the flange free from any grease.

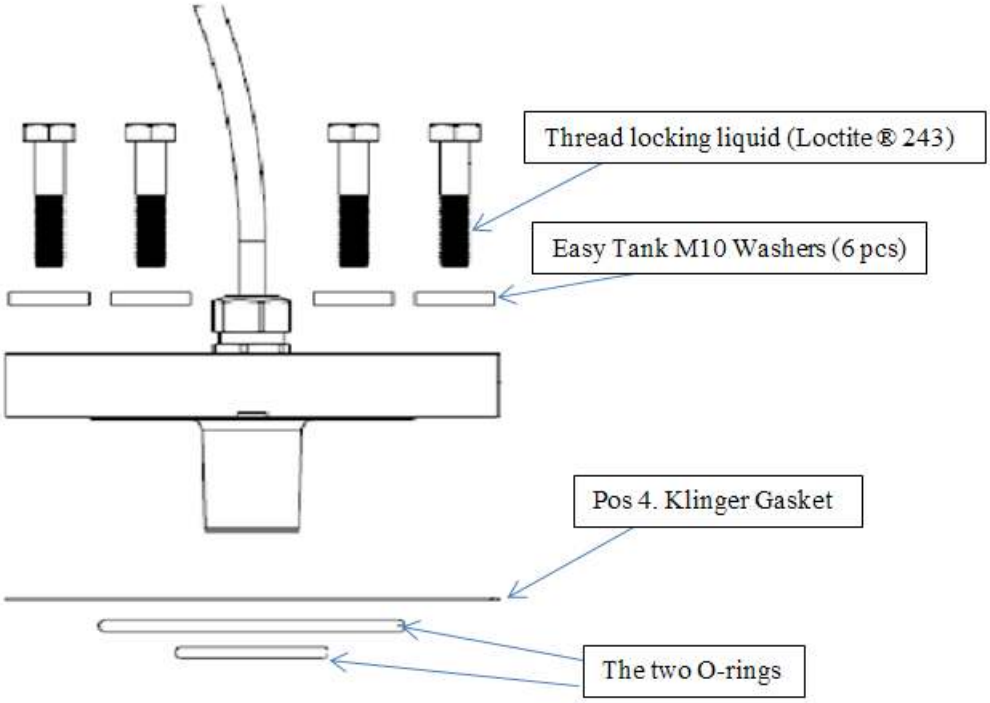
Note! Do not use grease containing any sulphur.



- Place the two O-Rings in the O-Ring slots
- Place the Klinger Gasket (Position 4) on the cleaned Flange surface.

Mounting Easy Tank TRU on Steel flange

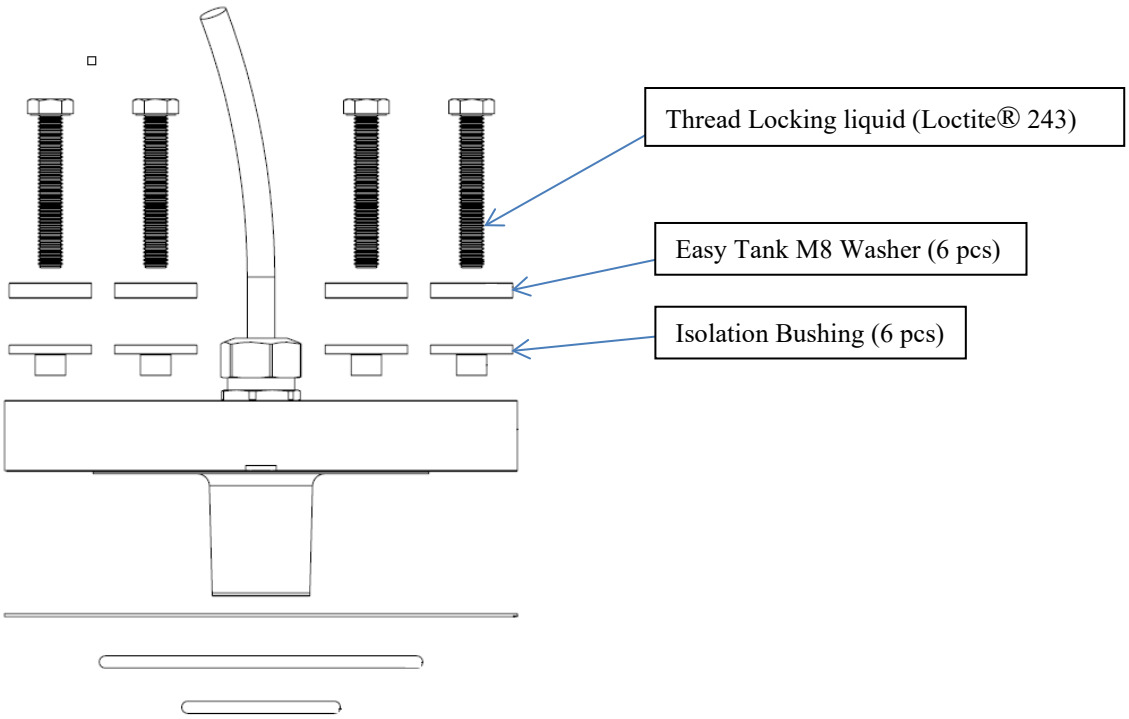
The SAL R1 TRU Easy Tank shall be mounted with the Red and FWD markings pointing in the ship's forward direction in line with Red markings on the bottom flange.



- Place the Washers onto the Screws and use universal thread locking liquid e.g. Loctite® 243 or equal on the Screw treads and mount the Washers and Screws.
- Adjust the angle aiming strictly (+/-3°) forward and tighten the six M10 screws.

Mounting Easy Tank TRU on Aluminium flange

The SAL R1 TRU Easy Tank shall be mounted with the Red and FWD markings pointing in the ship's forward direction in line with Red markings on the bottom flange.



- Place the Washers and Isolation Buchings onto the Screws and use universal thread locking liquid e.g. Loctite® 243 or equal on the Screw treads and mount the Washers and Screws.
- Adjust the angle aiming strictly (+/-3°) forward and tighten the six M8 screws.

General recommendations

Use universal thread locking liquid e.g. Loctite® 243, Loctite 2400® or equal, when mounting the screws into the flange.

Use Silicone grease when mounting the O-rings.

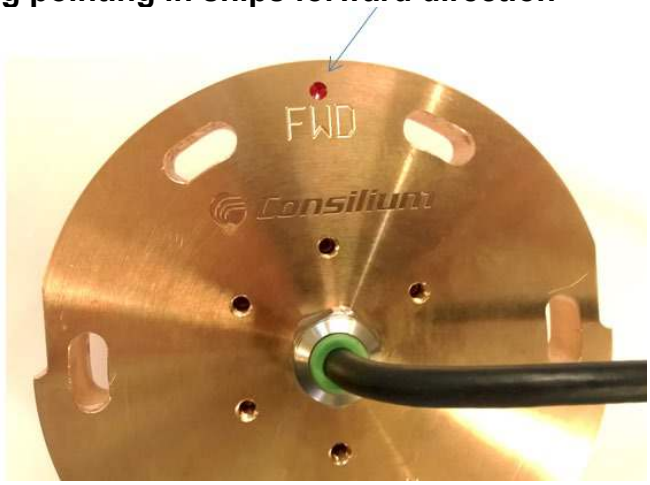
Recommended torque:

For Steel Flange	M10 Screws:	35 Nm.
For Aluminum Flange	M8 Screws:	25 Nm.

Do not overtightening the screws.

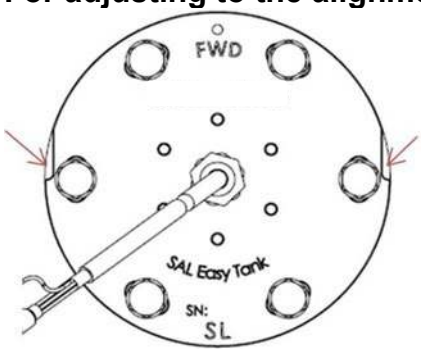
Note!
Bolt should be tightening in a cross-wise sequence.

FWD and RED marking pointing in ships forward direction



To be absolutely sure that the transducers are correctly seated and FLUSH WITH THE HULL, this must be verified from outside the ship. If necessary, this must be readjusted also after the above alignment procedure.

For adjusting to the alignment



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To adjust the angle of the SAL R1 TRU Easy Tank you can use the two gouges ”Red arrows” when the bolts are not tightened.

If the steel version of the SAL R1 TRU Easy Tank is to be installed submerged it is recommended to protect the side part of the flange with corrosion protective treatment, but never paint the top part which is made of bronze.

Note! The aluminium version of Easy Tank shall not be installed submerged.

Running the Transducer unit (TRU) cable

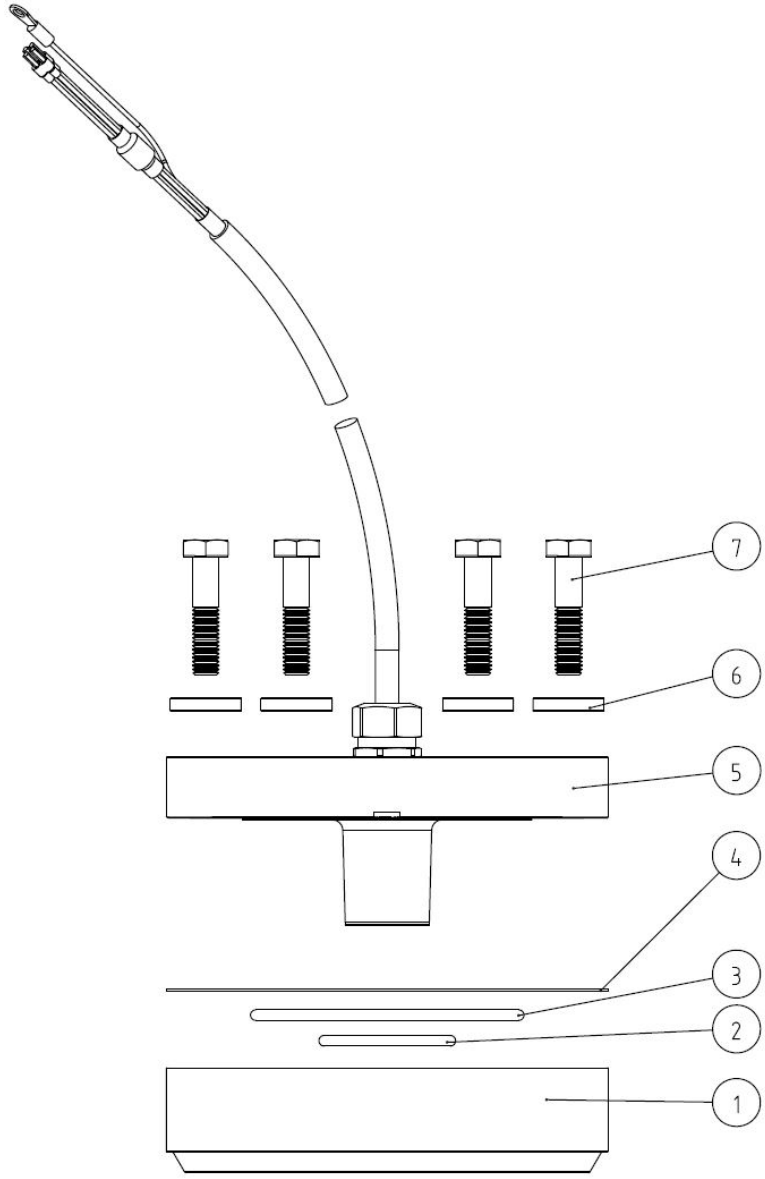
After the TRU has been mechanically mounted, the cable should be securely fastened to the bulkhead all the way to the mounting place for the ELC. Leave a coil of sufficient length of TRU cable close to the TRU, to allow for retraction. The cable coil must be strapped and may not hang down and swing freely.

Note!
The TRU cable shall run directly to the ELC and **shall not be cut off, shortened, extended** or by any other mean pass a junction box. To make sure that the SAL R1 TRU Easy Tank performance is not affected the cable shall not be laid close to other high voltage cables (440 VAC or more) or other high power or high frequency cables (e.g. sonar, echo sounder, etc.).
Any excess cable length shall be coiled and strapped outside the ELC cabinet.
Do not store any excess cable length inside the ELC.
Any excess cable length inside will act as an antenna and may affect the electronics.

Note! The minimum coiling diameter 90 mm ” WTC cable”.

SAL R1 TRU Easy Tank / Part Numbers / Assembly Diagram

Version with Steel Flange



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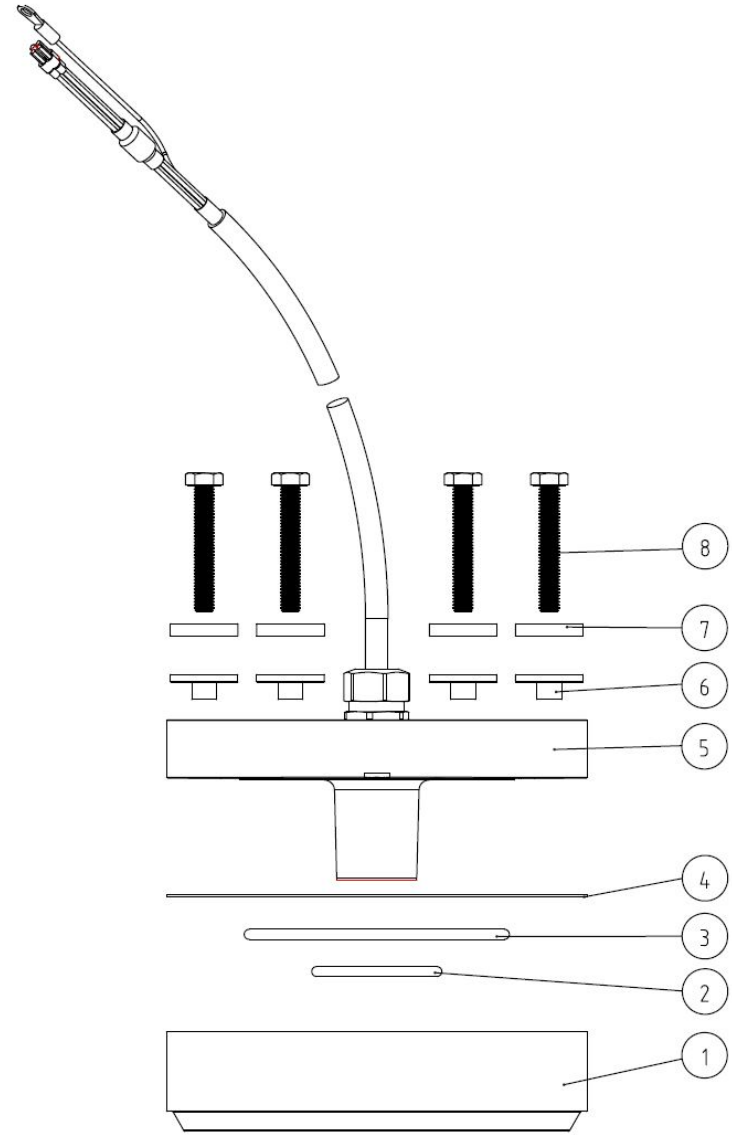
Pos.	Qty.	Part no.	Description
1	1	5493382	R1 TRU Easy Tank bottom Flange “Steel”
6	6	- 5493389	Easy Tank M10 Washer Included in 5493382
7	6	- 5494226	Screw M6S M10x45 SS Included in 5493382
5	1	5492300	SAL R1 TRU Easy Tank 10m WTC
2	1	- 5493387	O-Ring 42x4 Included in 5492300
3	1	- 5493388	O-Ring 96x4 Included in 5492300
4	1	- 5493386	Easy Tank Klinger Gasket Included in 5492300

SAL R1 TRU Easy Tank / Part Numbers / Assembly Diagram

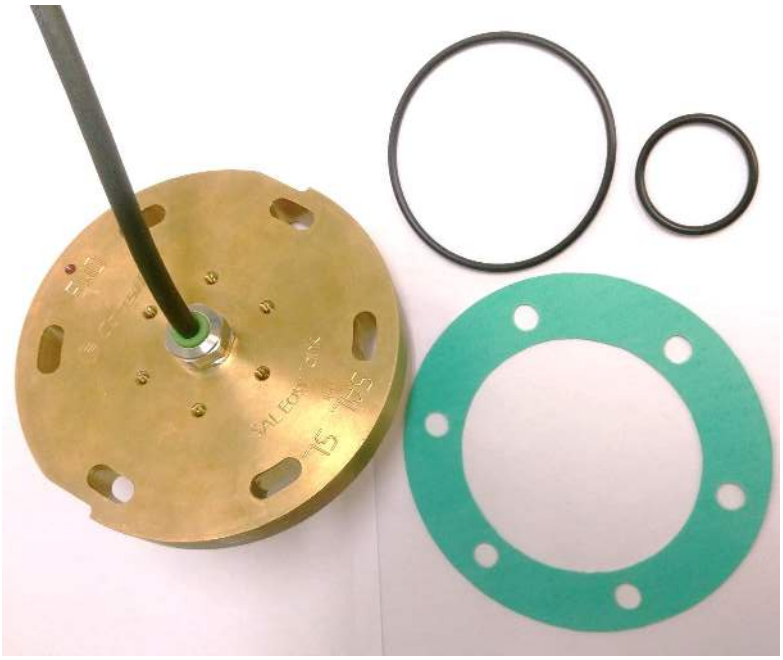
Version with Aluminium alloy Flange



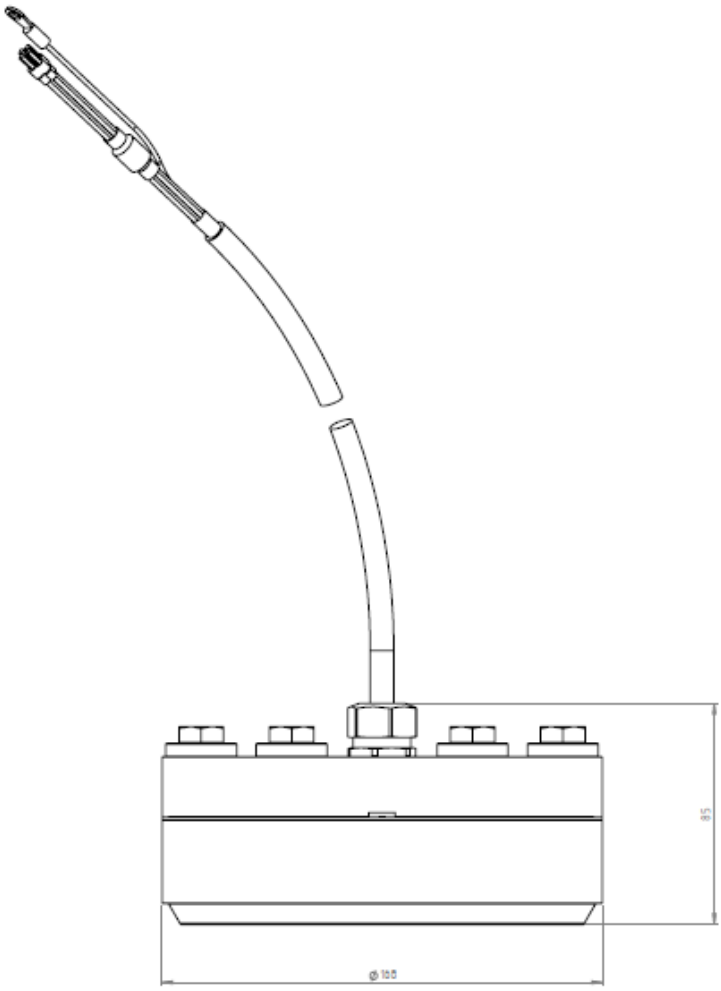
DWG 5414113A01

Pos.	Qty.	Part no.	Description
1	1	5493384	R1 TRU Easy Tank Bottlom Flange ALU 5083
7	6	- 5494221	Easy Tank M8 Washer Included in 5493384
6	6	- 5494227	Aluminium Isolation Bushing Included in 5493384
8	6	- 5494222	Screw M6S M8x50 SS Included in 5493384
5	1	5492300	SAL R1 TRU Easy Tank 10m WTC
2	1	- 5493387	O-Ring 42x4 Included in 5492300
3	1	- 5493388	O-Ring 96x4 Included in 5492300
4	1	- 5493386	Easy Tank Klinger Gasket Included in 5492300

Picture of **5492300 SAL R1 TRU Easy Tank** with included O-Rings and Gasket.



SAL R1 TRU Easy Tank / Main dimensions

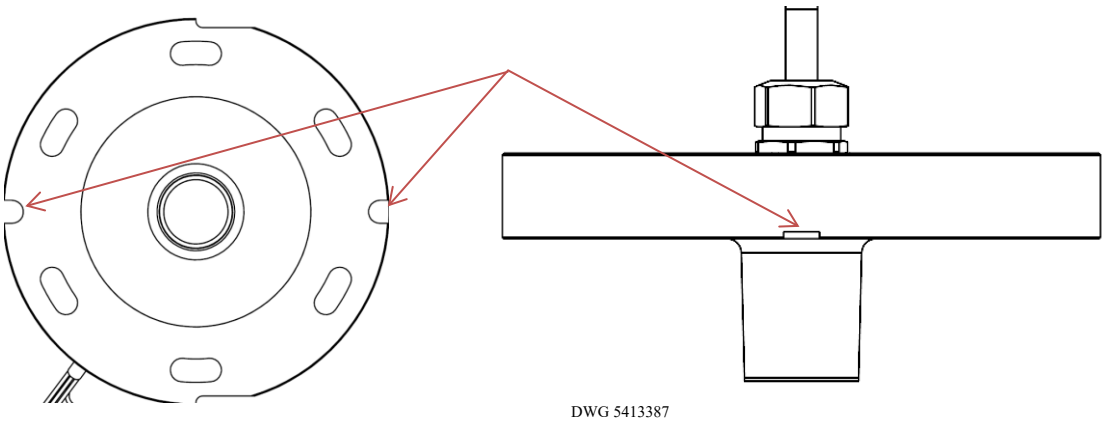


5. Maintenance

Transducer replacement

Parts below are needed whenever a TRU is replaced and/or partly used when maintenance/service work is carried out.

1 pcs	P/No: 5492300	SAL R1 Easy Tank TRU 10m WTC *Including O-rings and Klinger Gasket*
1 pcs	P/No: 5493383	Easy Tank Service kit, *that consist of O-Rings, Gasket and 6 pcs M10 screws/Washers for the steel version of SAL R1 TRU Easy Tank*
	Alternative for Aluminum hull	
1 pcs	P/No: 5494228	Easy Tank Service kit ALU *that consist of O-Rings, Gasket and 6 pcs M8 screws,Washers, Isolation Bushing for the aluminium version of SAL R1 TRU Easy Tank*



DWG 5413387

Note!
The SAL R1 Easy Tank Transducer is made with two gouges on each sides, to make it easier for removal of the transducer.

General dry-docking and maintenance routines

At dry-docking it is recommended to inspect/clean the TRU surface.

Care and caution should be carefully considered in order to protect the TRU sensor surface during outside hull works, e.g. sand blasting, hull grinding, welding work, painting, etc., thus also any temporary protecting cover of the TRU should be properly removed/cleaned off before undocking as well as any marine growth should be carefully removed.

Use no sharp-edged metallic tools!
Wooden/Plastic or cloth/rag based tools are normally enough for marine growth removal. Certain not too aggressive solvents may also be used with care.

Longer periods of slow steaming at low speed and/or extended periods of idling/berthing/anchoring (weeks/months), specifically in tropical waters, tend to result in rapid build-up of marine growth in the TRU vicinity as well as on the sensor surface, thus the TRU should be inspected/cleaning and/or diver assisted under hull cleaning.

Generally, also under normal sea-going operations, it is recommended to inspect the TRU as necessary each 3 to 6 months in order to prevent marine growth which may affect the speed log functionality and accuracy/reliability.

Speed Log
Section 4
Accessories
Technical manuals

Doc ID 703826B4

Revisions:

Date	Version	Author	Comment
2005-10-07	A0	HW	Created, extracted from doc 703821B3
2007-06-05	A1	HW	Para 7 LDU. Optional use of LPU.
2009-10-02	A2	HW	Change SD4 expression from Indicator to Display.
2009-10-27	A3	HW	LPU2, NMEA Units added and LPU and LDU removed as optional distribution device.
2013-11-29	A4	SGu	Editorial changes and clarifications, 1N4B replaces 1N4. SD4ED revised, SDP & SD4SA deleted. Re-arranged Revisions/Contents, etc.
2014-06-19	B0	STE	Added Technical manuals to section
2015-07-30	B1	OM	Minor updates
2016-11-03	B2	OM	Deleted SDR2
2019-10-30	B3	AF	Headers. Deleted SIA2-8.
2020-08-30	B4	MS	Company ID

TABLE OF CONTENTS

1 SD4 BMB, BULKHEAD MOUNTING BOX

Mechanical specification

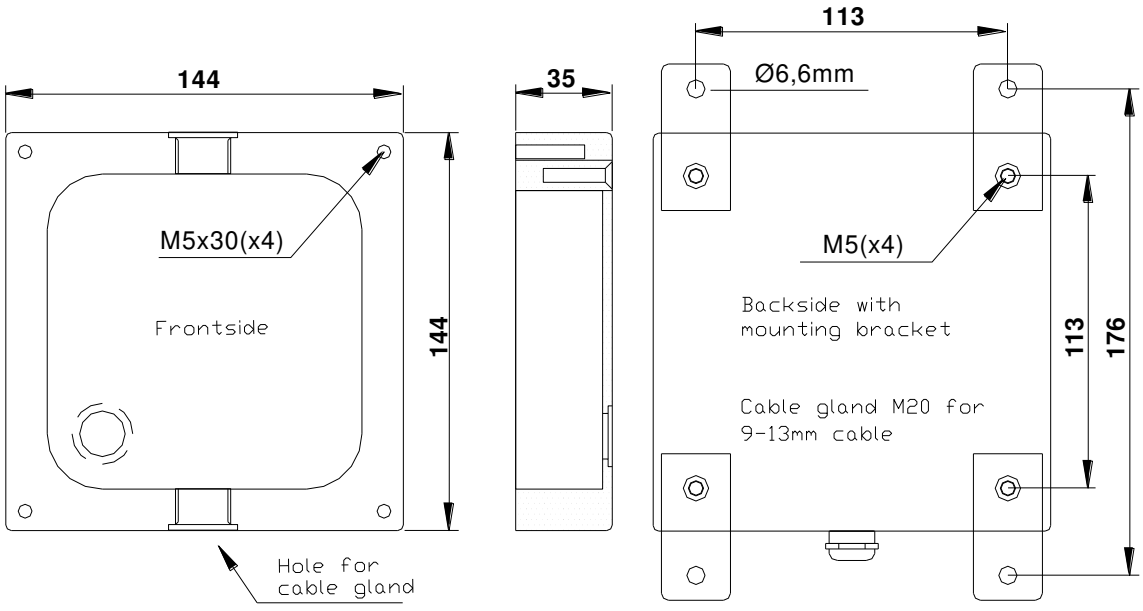
Height:	144 mm
Width:	144 mm
Depth:	54 mm
Weight:	0.9kg

Environmental specification

Enclosure material:	Aluminium
Enclosure protection:	IP66, exposed
Colour:	Black

An SD4 display can be mounted directly on an indoor or outdoor bulkhead by using a BMB (Bulkhead Mounting Box). Using supplied screws, nylon washers and properly tighten the cable gland will make the assembly watertight.

Outline dimensions



2 SD4EB, EXTENSION BOARD

Mechanical specification

Height:	30.5 mm
Width:	66.0 mm
Depth when mounted on SD4:	Adds 14 mm (Total when mounted 49 mm)
Weight:	0.03 kg

Electrical specification

Relay outputs:	2 potential free NO contacts
Max load:	30 V/30 mA or 15 V/100 mA for each output

Environmental specification

Enclosure protection:	IP20, protected (indoor mounting) IP66 when mounted in SD4 BMB
Operating temperature:	0°C to +40° C
Operating humidity:	Less than 93 % RH (non condensing) at 40°C

The SD4EB is equipped with two relays, which can be used to obtain 200 p/NM speed pulses for other users in a specific installation.
Refer to SD4 menu LP6 to verify/initiate desired function of the output, see Section 3 Installation under headlines “Menu Mode” and “Menu function summary” as described for SD4-3.

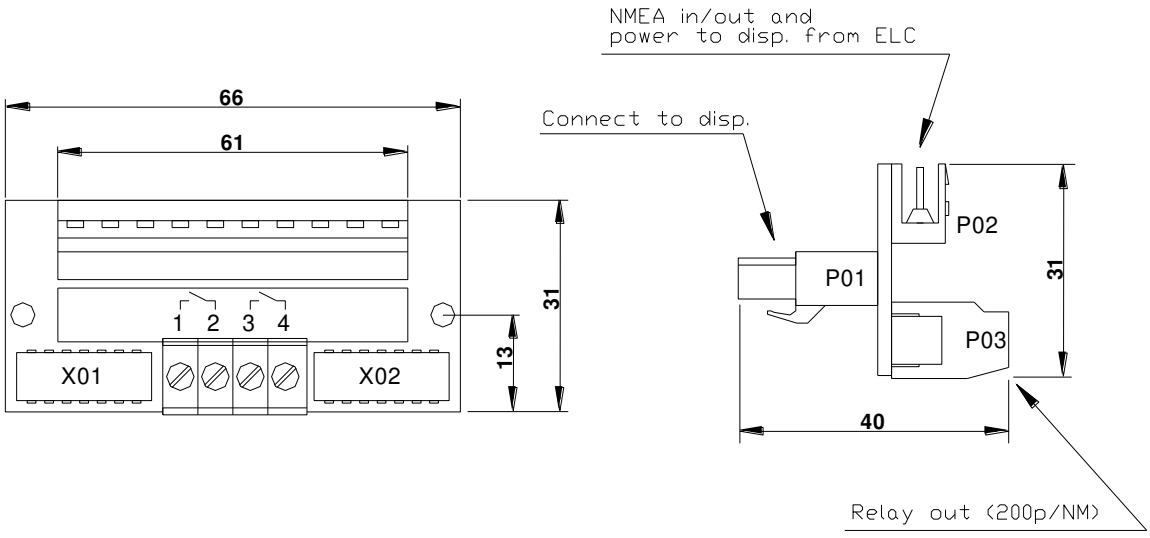
2.1 Installation

The SD4EB is installed directly on the back of the SD4 display. Unplug the 10-pole connector from the SD4, plug in the SD4EB (P01) replacing the 10-pole connector and instead plug in the 10-pole connector in the mating connector on top of the SD4EB. The two relay contacts can now be utilised via terminals #1-4 on the SD4EB.

Connections

SD4EB	Note
Terminal 1	Relay 1 normally open
Terminal 2	
Terminal 3	Relay 2 normally open
Terminal 4	

Outline dimensions



3 SD4ED, EXTERNAL DIMMER SWITCH

Mechanical specification

Height:	144 mm
Width:	48 mm
Depth:	26+28.5 mm
Weight:	0.2 kg
Enclosure material:	Aluminium
Colour:	Black

Electrical specification

Two-way switch	Two-way toggle switch

Environmental specification

Enclosure protection:	IP20, protected (indoor mounting)

The SD4ED is used to DIM an SD4 display from a remote position.

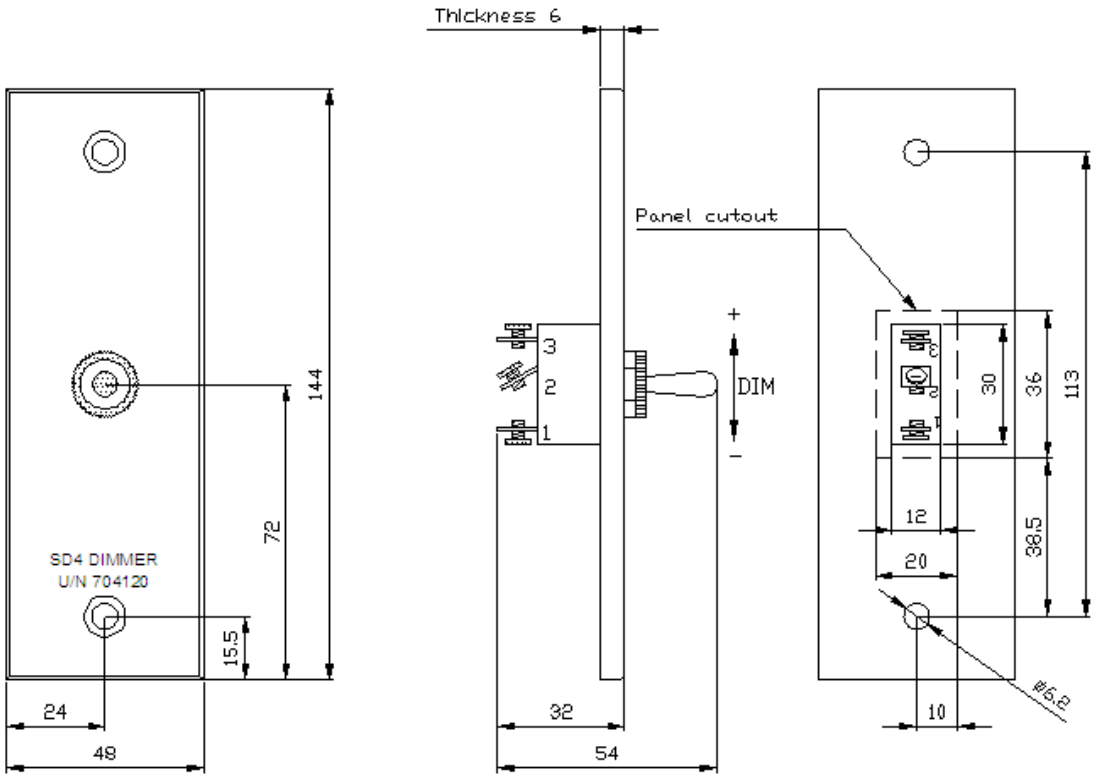
Refer to SD4 menu LP5 to verify/initiate desired function.
See Section 3 Installation under headlines “Menu Mode” and “Menu function summary” as described for SD4-3.
Additional SD4 displays can be connected to the same dimmer switch provided they are powered from the same source. All connected displays will be dimmed but the brightness level on individual displays may not be similar. It is therefore recommended to use serial Remote DIM message when two or more displays shall be dimmed to the same brightness.

3.1 Installation

Connections to SD4 10-pole connector

SD4	SD4ED	Function
Terminal 7	Terminal 3	Dim down
Terminal 8	Terminal 1	Dim up
Terminal 9	Terminal 2	0 VDC

Outline dimensions and panel cut-out



4 NMEA UNIT

4.1 1N4B / 1-to-4 NMEA Buffer

The 1N4B Buffer is intended to interface/split NMEA serial data output where receiver system loads are high or unknown or where a failure in one system must prevent other systems from being affected.
The 1N4B has one opto-isolated input feeding four enhanced ESD-protected separate differential output drivers.

4.1.1 Installation

The unit should be screwed to a flat surface, preferably vertical and with wiring from below.

Wiring termination
On the lower part of the unit an area is provided for securing the cables using wire straps. Connection should be done using shielded cable and making sure the installation will be compliant with the EMC requirements of IEC 60945 it is necessary to make sure that the outer
cable shield is securely connected to the chassis of the unit.

The simplest way to accomplish this is to remove the outer insulation of the cable and to fold down the screen on the outside of the insulation and to secure the cable with the cable ties supplied.

Input connection
When connected to an output, the yellow input LED should lit when the digital input goes active. With a normally working NMEA connection, this LED will flash as data are received and will be unlit between messages.

If the opposite indication is observed, the input terminals “A” and “B” should be reversed.

Output connection
The unit has four RS422/485 based output pairs. Each output will drive several NMEA 0183/IEC 61162-1/-2-compliant inputs. The output drivers are galvanically isolated from the power source, but the NMEA 0183/IEC 61162-1/-2 standard requires all receiver/listener inputs to be opto-isolated.

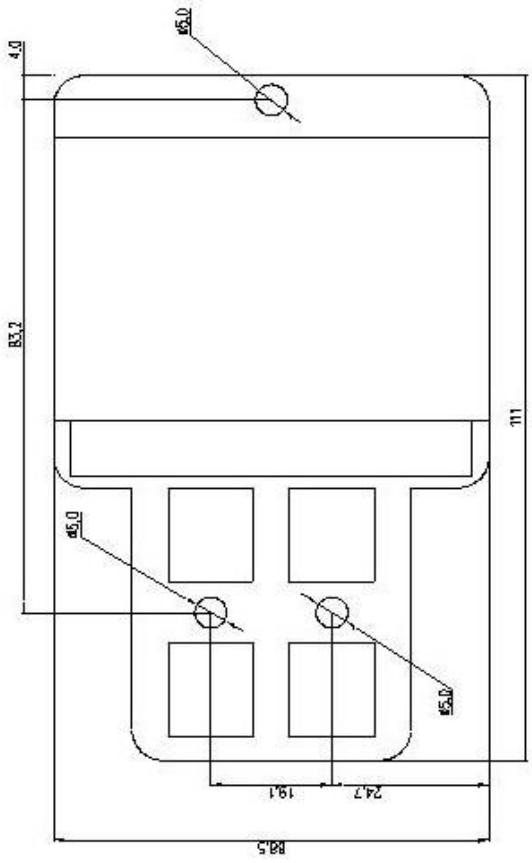
Output terminal “A” should be connected to input terminal “A” of the receiving equipment, which in some cases is marked “+”. “B” connects in the same way to “B” (or “-“).

It is in most cases possible to feed also RS232 inputs if this is required. To avoid feeding signal current into the RS232 signal ground, the NMEA output terminal “A” should be connected to RS232 Rx terminal, while the NMEA output terminal “C” should be connected to signal ground of the RS232 input.

Specifications

Indications	Green LED indicates DC power applied. Yellow LED NMEA input, flashes when messages are received.
Input	Opto-isolated input, compliant with NMEA 0183 and IEC 61162-1, voltage range approx 2 - 12 V.
Output	NMEA0183/IEC 61162-1 compliant using RS422/485-compatible, enhanced ESD-protected differential drivers.
Power requirements	10 – 40 VDC, less than 10 mA at 24 V (typically 6 mA) with open outputs.
Dimensions	Boxed 68.5 x 111 x 22 mm.
Connectors	Phoenix screw terminals, accepting up to 1.5 mm² cable.
Environmental	Meets or exceeds IEC 60945 class “Protected”

Outline dimensions for 1N4B



5 SD4-4, GENERAL INSTRUMENT

Mechanical specification

Height:	144 mm
Width:	144 mm
Depth:	16 mm
Weight:	0.6 kg
Enclosure material:	House/frame: aluminium, front: polyester foil, backside: stainless steel
Colour:	Housing: black Front, background: Satin black (NCS 9000-N)

Electrical specification

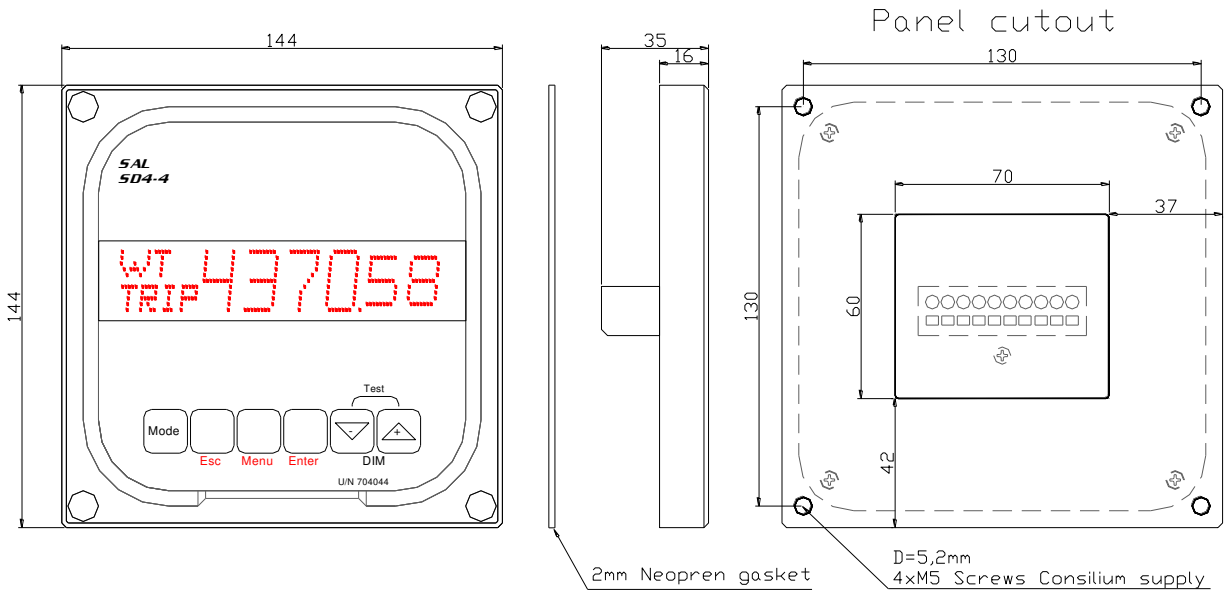
Input voltage:	12 or 24 VDC nominal (10-32VDC)
Current:	Maximum 200 mA at 15VDC
Serial input:	IEC 61162-1 / NMEA0183
Remote inputs:	3 inputs with internal pull-up to +5V, activated by grounding to 0 V
Serial output:	IEC61162-1 / NMEA0183. Serial driver RS 422/485; max load 100 ohm (10 SD-displays)
SW controlled DC (pulse) output	+5 V with 35 mA current capacity

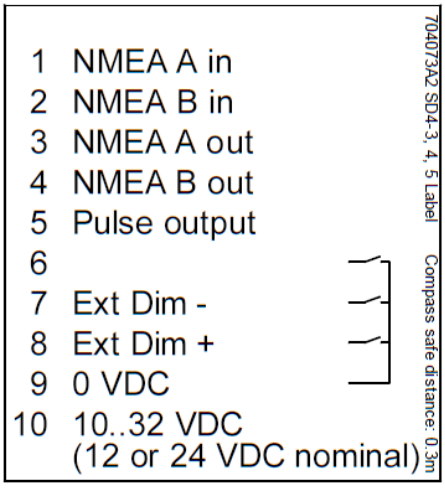
Environmental specification

Enclosure protection: (front)	IP66 in SD4 BMB box or panel mounted on a flat surface
Environmental:	IEC 60945, exposed class
Heat dissipation (max)	= Power consumption
Operating temperature:	-25°C to +55° C
Operating humidity:	Less than 93 % RH (non condensing) at 40°C

The “Mode” window can display selected information, e.g. distance counters, speed, etc., depending on which modes are enabled in the instrument set-up.
Refer to Section 3 Installation under headlines “Menu Mode” and “Menu function summary” as described for SD4-3.

Outline dimensions and panel cut-out





SIA-3-8
Technical Manual
Document No. 701695

Table of Contents

1 Introduction

1.1 General

This document describes the article 701692 SIA-3-8, Speed Indicator Analogue used for the STW / SOG speed logs.
The indicator range is: 8 knots astern (-0.8V DC) to 30 knots ahead (+3.0V DC).
The SIA-3-8 is based on microprocessor-controlled x-coil system and therefore it needs to be connected to an external power supply (DC 12-24V).

Note! Pointer position is random until external power supply is connected.

1.2 Definitions and abbreviations

Abbreviation	Description
SD4	Serial Display 4th generation, e.g. SD4-1, SD4-2, SD4-5
LPU2	Log Processing Unit 2nd generation

1.3 Electrical installation

- Connect external power to terminals 1 (-) and 2 (+). Terminals 1 and 2 are located on the separate two-terminal detachable plug. DC power out for e.g. SD4 on LPU2 or STW Speed Log can be used as source.

  Terminals 3 to 8 are found on the other detachable plug, six-terminal plug.
- Terminal 3 (analogue + in) connects to the analogue out on LPU2 or STW Speed Log and terminal 4 (GND) to analogue out (0V DC) on LPU2 or STW Speed Log
- Terminals 6 (+) and 7 (-) are used for illumination. When dimmable illumination is desired connect a potentiometer to adjust the voltage on terminal 6.

- Terminals 5 and 8 are not used.

2 Technical Specification

Mechanical specification

Panel allocation	148.5 x 148.5 mm
Panel cut out:	138.5 x 138.5 mm
Depth:	96 mm, whereof 90.5 behind panel front
Maximum panel thickness	18 mm
Weight:	0.5 Kg

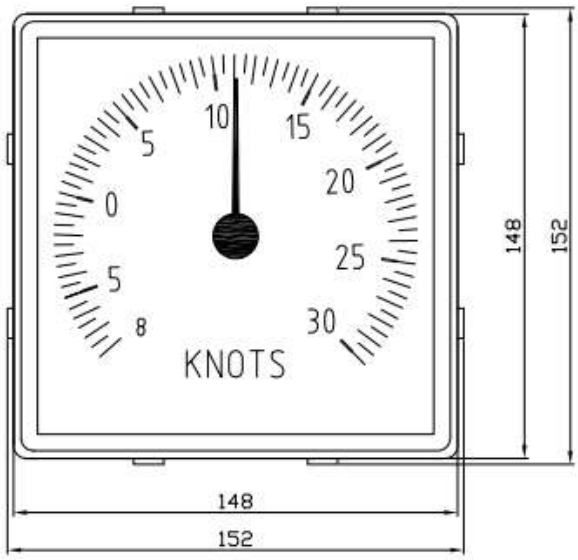
Electrical specification

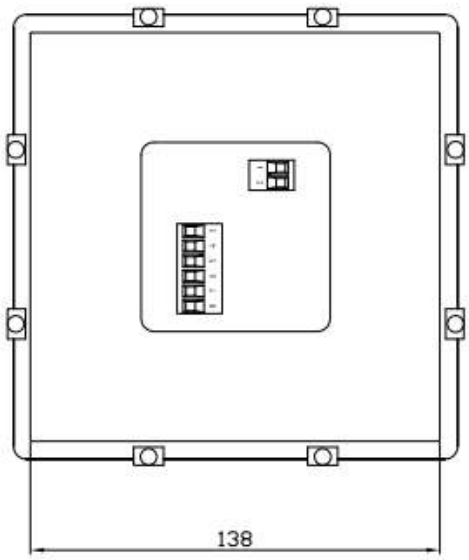
Measuring range	-8 to 30 kn; 0.1 V DC / knot
Power intake:	Nominal 12-24 V DC. (18 – 31.2V DC) Reverse polarity protected. Start-up minimum 9.6V DC
Power consumption:	150mA
Illumination	Dimmer range 7 …30V DC Consumption max 30 mA. Yellow LEDs
Analogue input	4 …20 mA
Accuracy	Class 0.5 Measured at 360 degrees deflection, +/- 1.8 degree error
Terminals	Pluggable screw terminals 0,2 …2,5mm2
Galvanic separation	600V AC: Aux. supply ;Analogue in ;Dimmer
Mounting angle	0…150° horizontal. DIN 16257
Response time	Maximum pointer speed 90 degrees per second, ramped to prevent overshoot.
Pointer	Transparent polycarbonate with white print, illuminated
Scale	Black with white text, numbered each 5 kn and scale design showing each 0.5 kn
Internal error LED	Amber coloured LED in the lower right corner, when lit or flashing the indicator is out of order. Try to power cycle unit. During start-up this LED flashes a few seconds.

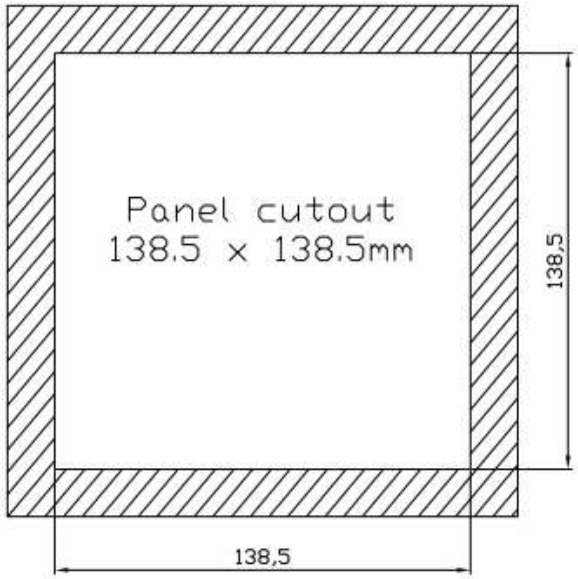
Environmental specification

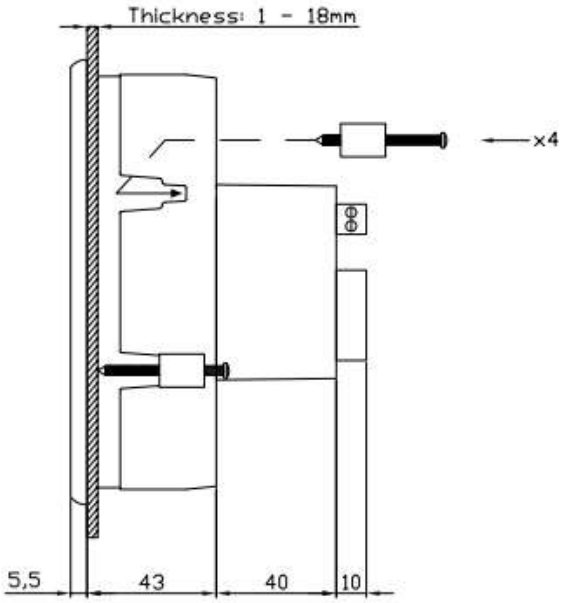
Enclosure material:	Plastic, ASA/PC LURAN-S
Window:	3 mm transparent polycarbonate with UV blocking
EMC and Vibration:	EN 60945
Compass safety distance	Steering compass: 0.60m, emergency: 0.40m
Colour:	Black
Protection	Front IP52 when mounted in panel, rear IP20
Extreme operating temperature:	-25°C…70°C
Extreme operating Humidity:	Class H S E, short term condensing allowed
Safety	300V – CAT.III. Pollution deg 2

2.1 Main Dimensions SIA-3-8

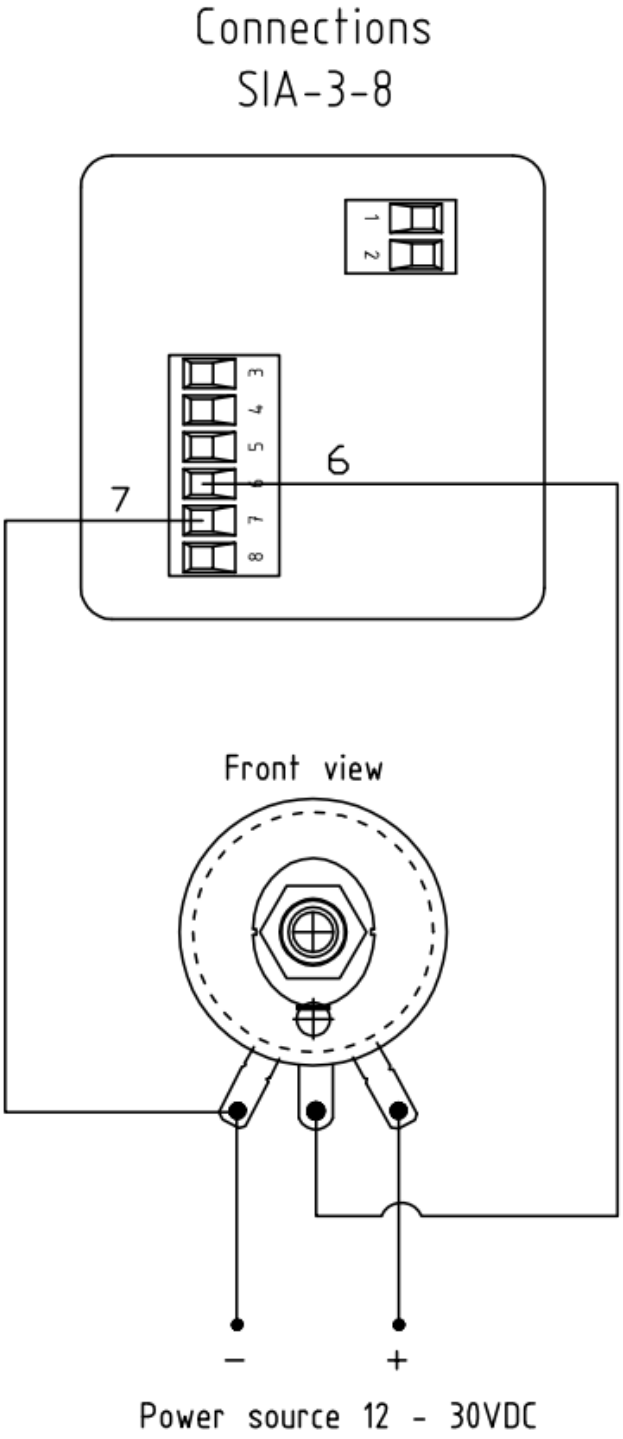








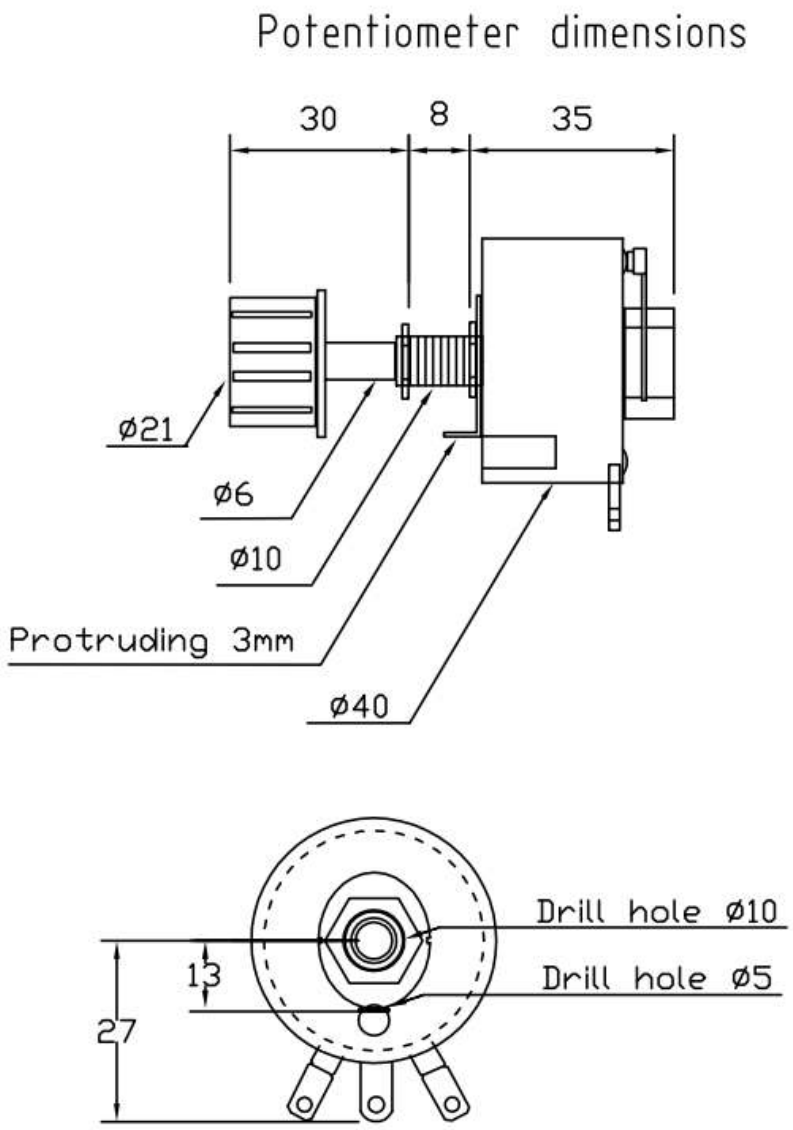
2.2 Dimmer Potentiometer connection



2.3 Dimmer Potentiometer dimension

Article number: 71-71091-00 SIA dimmer

Dimension drawing



Specifications given are subject to changes without prior notice.

WTU-Assy
Technical Manual
including
Menu system
Document No. 702314

Table of Contents

1 Introduction

1.1 Basic Functional Description

WTU – Assy is an electronic Speed and Distance Measuring Equipment board designed to be used in both STW logs and STW/ SOG combo logs. To create a working log the WTU –Assy docks to a motherboard within the logs ELC where the measuring sensor (transducer), speed indicators and optional repeaters are also connected. The signals from the transducer are processed within the WTU – Assy and the result can be read from
IEC 61162/NMEA outputs or as analogue or pulse information (STW logs).

IEC 61162/NMEA telegram syntax and how to connect cables carrying IEC 61162-serial signals are described in **document 700164**.

The speed-log works technically like two small, synchronized echo sounders built together, comparing echoes from water particles close to the hull. The calculation is based on cross-correlation, a mathematical method to estimate the similarity of two waveforms (described below), which entails that it is very dependable and reliable in all kinds of waters. Logs based on WTU – Assy has no moving parts and no parts extending below the hull of the ship.

1.2 Definitions and abbreviations

Abbreviation	**Description**
ELC	Electrical cabinet
NMEA0183	IEC 61162-1 serial interface standard
STW	Speed Through the Water. This is equivalent to Water Track (WT) speed (relative)
SOG	Speed Over the Ground. This is equivalent to Bottom Track (BT) speed (true)
TRU	Transducer

2 Technical Specification

2.1 Performance data

Working principle:	Acoustic correlation
Operating frequencies:	Jumping frequencies in the range 3.8 MHz to 4.2 MHz
Measuring distance:	130 mm from the surface of the transducer.
Speed Range:	+/- 50 knots sensed speed
Speed Accuracy:	Better than 1% or 0.1 knots relative to sensed water flow whichever is the greatest
Distance Accuracy:	Better than 1%

2.2 Electrical specification

Input voltage:	8V – 15V DC (internal supply from log ELC)
Power consumption:	< 30 VA nominal
Main Speed output:	IEC 61162-1 / NMEA0183. Serial driver RS 422; max load 100 ohm (10 SD4-displays)
Analogue Speed output: (STW log)	0.1 V/knots (load max 5 mA)
Relay outputs: (STW log)	2 x 200 p/NM contact closure, (30V/30mA or15V/100mA recommended max load)
Log fail alarm relay output:	Switching relay, default setting: power failure (30V/2A recommended max load)
Serial input:	used for PC interface / software update

2.3 User interfaces

LED (external status):	LED 1 => Normal operation (log fail alarm relay is inactive). LED is turned off if log fail alarm relay activates. LED 2 => Default settings applied, LED is turned off if default settings changed. LED 3 => Signal Quality OK, LED is turned on if measure exceeds a predefined quality threshold. LED 4 => Measuring, LED toggles for each new speed calculation. LED 5 => Application alive, LED toggles each time the watchdog is kicked.
LED (internal status):	LED 6 => ADC OK, LED is turned off if LVDS receiver doesn't lock on incoming data. LED 7 => Data qualified OK, LED is turned off if cycle, transmitter and/or receiver timing don't match (internal SW error). LED 8 => Data write OK,

	LED is turned off if FIFO is full or an internal error occurred. LED 9 => Data read OK, LED is turned off if FIFO overflows.
LED (notification):	ALERT => LED is on if a diagnostic code is active. The diagnostic code will also be transmitted as an NMEA proprietary telegram ($PSALW). MODE => LED is turned on when measuring in normal mode (PARTICLE).
Service connection 1:	9-pole female D-sub serial data connector (RS 232, for additional PC based user interface and software upgrade)
Service connection 2:	RJ45 Ethernet connector for system supervision.

3 Principle of Operation

3.1 Acoustic transmission/reception

3.1.1 Transmitter

The transducer will send two parallel sine waves into the water. During normal operation the forward crystal (TRU cables 1 and 2) will alter between frequencies 3.800 MHz, 3.875 MHz and 3.950 MHz while the astern crystal (TRU cables 4 and 5) will alter between frequencies 4.050 MHz, 4.125 MHz and 4.200 MHz. See ***Figure 1***.

Transmitting amplitude is approximately 40 Vpp into 120 ohms (STW log) resp. 70 ohms (STW/ SOG logs), giving an electrical output of approx. 1.7 W (STW logs) resp. 3 W (STW/ SOG logs),

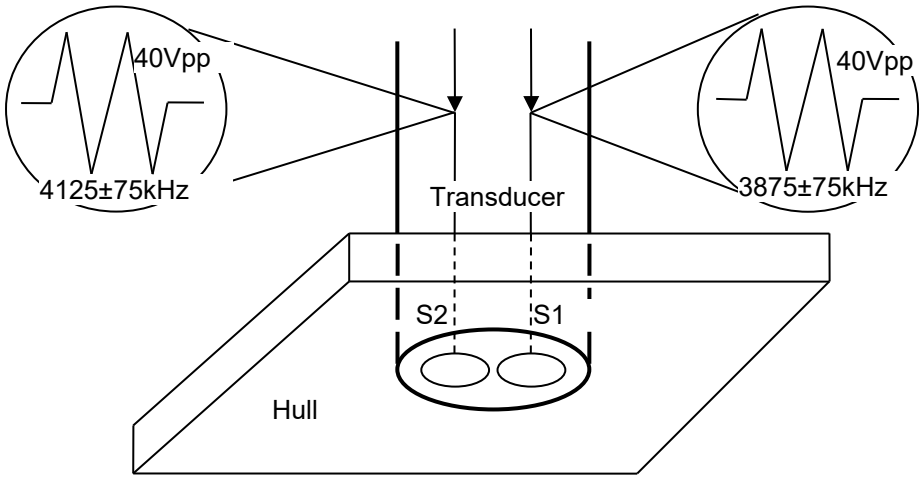


Figure 1 Transmit pulses

The operating frequency, centred on 4 MHz, has been empirically optimised. It is a trade-off between signal decay, lobe function and transducer design.

3.1.2 Receiver

The signals from the transducer move out into the water. A small amount of the signals are reflected by objects in the water and move back to the transducer. The time delay for the signal echo is proportional to the speed of sound in water multiplied with two times the distance to the object. Depending on receiver duration (i.e. how long the receiver is active) a correspondingly sized volume is selected, which may give echo at a given echo delay time. ***Figure 2*** shows the water volume which may give an echo for one specific receiver duration. The WTU–Assy log takes nine samples within each echo volume and stores for later correlation.

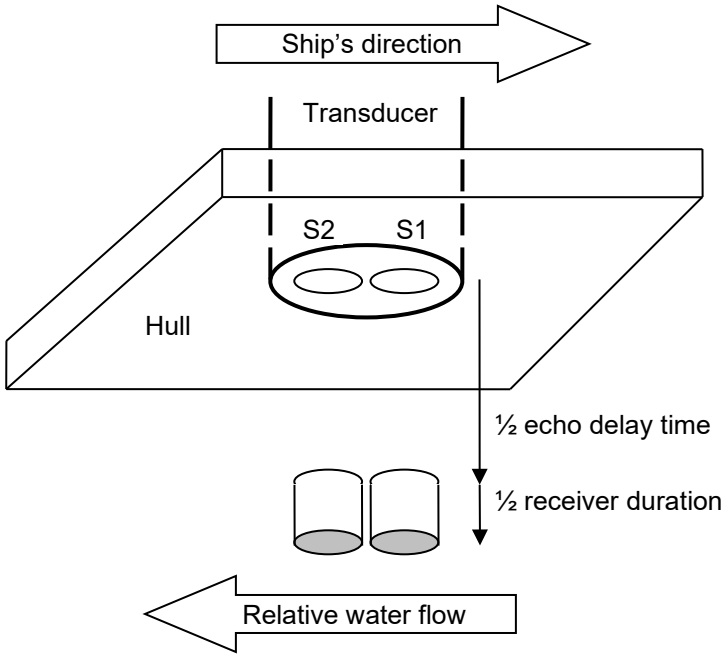


Figure 2 Active echo volumes

The signals received can be regarded as two times nine layers of "snapshots" of the flow of particles under the ship. Using correlation technique it is possible to compare how much the signals differ in time. Knowing the distance between the crystals it is easy to calculate the speed of the particles and hence the speed of the ship through the water.

Depending on ship dimensions and transducer location the measured volume may lie within the boundary layer of the ship and necessitate speed calibration (see ***3.3.1 Boundary layer and calibration***).

3.2 Signal processing

The echo signal measured from the water volume will change in intensity depending on the particles that exist within the measured water volume. This modulation will create a time varying signal pattern. All that is needed to calculate the speed is finding the displacement needed for a pattern to repeat in the other channel.

3.3 Correlation functions

Correlation technique is used to calculate the time delay τ (tau) between signal S1 and S2. The largest value of the correlation function maximises the similarity of the signals.

3.3.1 Boundary layer and calibration

When making speed through the water the ship will push and drag water in the travelling direction. The effect is that water close to the hull moves slower relative to the ship than water further away. The affected layer with lower relative speed is called the boundary layer, see ***Figure 3***.

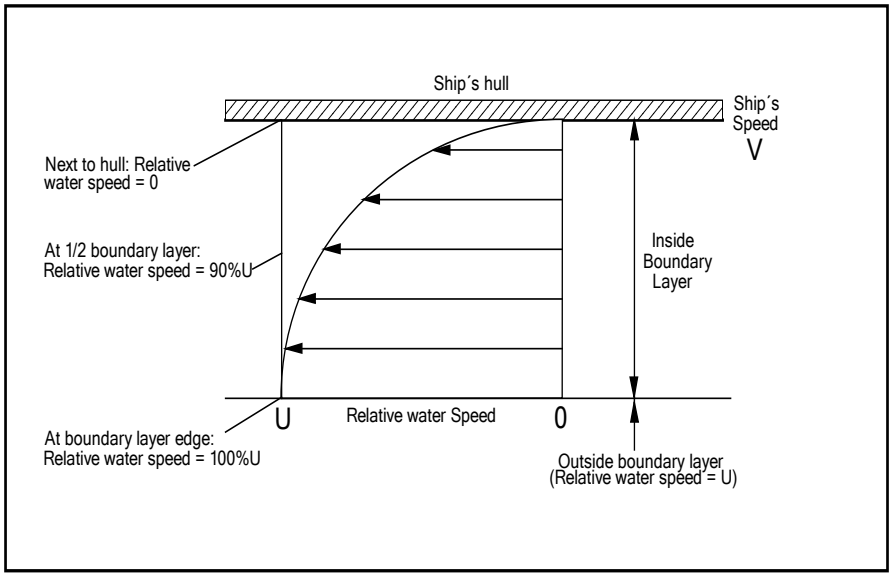


Figure 3 Boundary layer

WTU – Assy measures speed relatively close to the hull, and may thus measure a lower speed. When the ship is in shallow water, the boundary layer may be different from normal. This physical effect will affect all logs measuring relative speed.

The positioning of the TRU is very important. The water flow below the TRU must not be turbulent or affected by skew water flows. Turbulent flow gives no common signal between the two channels.

Calibration is needed to compensate the measured speed if measured within the boundary layer.

The calibration may be set at one speed, called single point calibration, or more than one speed, called multiple point calibration.

3.3.2 Distance calculation

The speed value is integrated into distance. The distance information is sent in separate NMEA telegrams.

3.3.3 Adverse conditions

It is important to remember that what WTU – Assy measures is actually the speed when passing a discrete number of reflectors within a small water volume under the hull. In order to interpret the echoed signal it is anticipated that both transducer sensors are moving over the same water volume. If the transducer has been installed at a non-preference location of the hull the water flow might be turbulent at the site of the transducer. Under these conditions there is no guarantee for the log to work. See section on installation of bottom parts for correct transducer installation.

In the low speed range, the distance travelled per time interval is low yielding limited information to the correlation function. Travelling in water with very high particle content might give “foggy” reflections due to too many particles in the same water volume. Both these conditions influences accuracy and may impose lost speed track conditions.

4 Functional Description

4.1 WTU – Assy user interface

Configuration of log functions may be performed using the built-in menu system in WTU – Assy. The menu system is accessed using the Speed Log Master Display.

For status indication ten green and one red LED are also available on the WTU – Assy board. See ***2.3 User interfaces*** for a closer description of what each LED indicates and ***4.3 Menu system*** for details about the menu system.

4.2 Application Software

The STW-log application software has different working modes as described below.

4.2.1 Power on / software update

At power on the speed log runs a boot loader program that tests if the application software is present and not corrupted. If the software is found and correct, the log starts to execute in normal operation. The boot loader may also be used to download updated log software applications when released. During update the boot loader controls erase of the old application as well as storing of the new updated application.

4.2.2 Normal operation

Two different tasks are cyclically performed during normal operation:

- Ten consecutive speed measurements.
- One self-diagnosis cycle.

This sequence is repeated indefinitely and will only be interrupted if a menu command forcing the log into test mode is externally requested from the SD4-x Speed Log Master Display or elsewhere.

4.2.3 Speed measurement

Speed measurement is the highest prioritised task and will be executed ten times in a row. The measurement can be executed in several different modes depending on previous events and measuring environment.

- Zero mode (4)
- Particle mode (1)
- Dirty mode (10)
- Clear mode (13)
- High speed mode (7)

Zero-mode is used if speed is below 1 knot and High speed mode is used at speeds above 40 knots. Between these two extremes Particle mode is normally used.

Should the echo signal be very strong due to high particle contents in the water, mode is changed to Dirty mode. On the contrary if a very weak signal is returned the mode is changed to Clear mode.

The numbers within parenthesis corresponds to the internal mode number also shown in the mode position in the root menu window, see ***4.4.1 Root Menu***.

4.2.4 Self-Diagnosis

After ten speed measurements the self-diagnosis is performed. The self-diagnosis checks:

- Transmitter
- Receiver
- Internal signal data paths
- ADC (Analogue to Digital Converter)
- High speed (LVDS) interface integrity
- Transducer
- External noise
- Input signal balance

If a detected failure persists for at least 14 diagnosis cycles, a diagnostic code will be sent as an NMEA telegram with the proprietary sentence PSALW. Also the ALERT LED at the WTU – Assy board will be turned on.

4.3 Menu system

The WTU – Assy has an internal menu system that can be accessed via a serial interface connected to a remote display such as the SD4-x Speed log Master Display.

The information is presented as two lines with 16 characters. All WTU – Assy settings, calibration, etc., can be changed through the menu system.

The settings are stored in non-volatile memory and will therefore also be active after a reboot or power shut-down.

4.3.1 Accessing the Menu system

Here follows a short guide to access the menu system in WTU – Assy via an SD4 Speed Log Master Display. (For a detailed description of the SD4 menu system, see **document 704005)**.

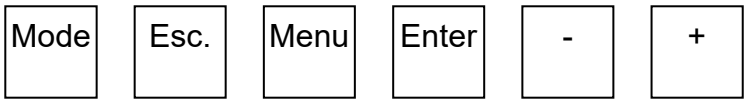
4.3.2 Reaching SD4 Menu Mode

The Mode window of the SD4 Display can be set to Menu Mode, which is used for internal settings of the display and can be used to connect to a remote unit such as WTU – Assy.

The Menu Mode is reached by pressing the Mode button for minimum 5 se. The Mode Window will show the text “PRESS ENTER FOR MENU”. Then press the Enter (4^{th} button from left) within 5 seconds.

The Mode Window will now show the start menu in the SD4. The six buttons under the Mode Window have now got alternative functions. The alternative functions are lit in red text below relevant button.

The buttons now have the following functions:

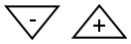


Mode: "1st button from left". Will inform which remote device is connected in remote mode.

Esc: "2nd button from left". The Escape function is used in the "Remote Device menu" to escape from the menu system in a remotely connected unit (E.g. the WTU – Assy. menu system) and step back to the local menu system in the SD4 unit.

Menu: "3rd button from left". Is used alone, or together with the Minus (-) button, or together with the Enter button, to move in the menus as described below.
Menu button alone, will display next menu i.e. step forward on same menu level.
Menu button and Minus (-) buttons pressed simultaneously will display previous menu, i.e. step back on the same menu level.
Menu button and Enter buttons pressed simultaneously will move up one menu level, except when leaving the "Remote Device menu". (See Esc-button)

Enter: "4th button from left" is used to store changed values or to move to sub-menus.



"Minus button" and "Plus button" are used to change values or status (E.g. write access OFF/ON) and /or to change device values.

Note: The Menu System will exit automatically if no button has been pressed for 5 minutes when being in the local SD4 Menu System, when connected to a remote device there is no timeout and the Esc button must be used to exit from a remotely connected device.

To connect to the menu system in the WTU – Assy:

When in SD4 LOCAL (the start menu) step to R0 REMOTE DEV menu by pressing the Menu button three times.

When pressing Enter in the R0 menu the SD4 will establish communication with all connected equipment and display them in a list of menu choices.

Press the Menu button until WTU is displayed and press Enter to start communicating with the WTU – Assy.

Esc is used to step back.

Below follows an example of a menu walk in the R0 REMOTE DEV menu:

```
R0 REMOTE DEV
CONNECT
```

Press Enter to search for remote devices

```
SYNCHRONISING
(counting down from 3)
```

Wait 3 seconds while all available devices are found. Press Menu to see next available remote device in list if more than one device is found.

```
R2 DEVICE 1 OF 2
WTU 1     (R1A)
```

Or press Enter to enter menu system of displayed device

```
R 10.42 C 10.67
C765 J1 Q558 S4
```

The root menu in WTU – Assy will now be displayed in the SD4 Mode window.
To go deeper into WTU – Assy menu system, press Menu.
To exit back to local mode in the SD4, press Esc.
The Esc button will always step out of the remotely controlled menu system.

Press [Esc] to go back to the list of accessible remote devices

```
R2 DEVICE 2 OF 2
LPU 1     (LP1)
```

Press Esc to go back into SD4 local menu system

```
R0 REMOTE DEV
CONNECT
```

4.4 WTU – Assy menus

The function of each menu in the WTU – Assy is defined below.

4.4.1 Root Menu

This is the "default" menu, which is shown when entering the menu system. If left in any other menu, the system will return to this menu after 5 minutes of idling.

```
R nn.nn  C nn.nn
Cnnn Mnn Qnnn Sn
```

or

```
R nn.nn  C nn.nn
Cnnn Jnn Qnnn Sn
```

or

```
R nn.nn  C nn.nn
Cnnn Mnn Dnnn Sn
```

or

```
R nn.nn  C nn.nn
Cnnn Jnn Dnnn Sn
```

R nn.nn:	Last measured Raw Speed nn.nn knots. + = ahead, – =astern
C nn.nn:	Filtered raw speed nn.nn knots. + = ahead, – =astern
Cnnn:	Correlation value nnn from last raw speed measurement, (0 ≤ nnn ≤ 999)
Mnn:	Used mode, Mode nn without cycle jitter (1 ≤ nn ≤ 13)
Jnn:	Used mode, Mode nn with cycle jitter (1 ≤ nn ≤ 13)
Qnnn:	Quality value nnn from last raw speed measurement, (0 ≤ nnn ≤ 999)
Dnnn:	Measuring Depth nnn (in mm) used in last raw speed measurement, (0 ≤ nnn ≤ 999)
Sn:	Confidence estimation of last measured speed, (1 – 4, 1 => unsure, 4 => very sure)

Note that quality value and measuring depth uses the same position in the root menu window, but are alternating when presented on the screen readout.

4.4.2 Menu Access level

The menu system contains two levels, “All User” and “Authorized Expert”. Only “All User” menus are visible in normal operation mode.

“Authorized Expert” menus are only for development purpose. Only instructed personnel are intended to use these menus.

“Authorized Expert” menus are not described in this document but shown for indexing in the *Menu function summary table* in the end of this document.

4.4.3 Menu A, diagnostics

The A-menus are used to view WTU – Assy uptime and diagnostic code history. To be able to make changes to sub-menus write access must be activated (changed to ON) before menu is entered.

```
A0 DIAGNOSTICS
WRITE ACCESS OFF
```

```
A1 TOTAL UPTIME
12D:13H:14M
```

Menu A1 shows WTU – Assy total uptime in days, hours and minutes.

```
A2 DIAG HISTORY
- OR + TO SCROLL
```

Menu A2 shows the 10 latest diagnostic codes within WTU – Assy.
Press Enter to see first entrance in the list.

```
01D:23H:45M  354
STW SIG. BALANCE
```

When entering menu A2.1 the first entrance in the list is shown. This example code 354 occurred 01 days, 23 hours and 45 minutes after system start (viewable in menu A1) and indicates a problem with the signal balance. Use – or + keys to scroll the list.

```
A2.1 DIAG 2/10
```

As soon as + (or –) is pressed the next (or previous) list position is shown for one second.

```
01D:23H:45M  354
STW SIG. BALANCE
```

The corresponding entrance in the list is then automatically shown.

```
A3 ERASE HISTORY
DISABLED
```

Menu A3 erases the history. Use + to enable the menu and then Enter to erase history.

4.4.4 Menu C, Calibration

The calibration menus are used to change calibration parameters for WTU – Assy. To be able to make changes to sub-menus write access must be activated (changed to ON) before menu is entered.

```
C0 CALIBRATION
WRITE ACCESS OFF
```

```
C1 DRAUGHT COND.
FULL LOAD  0.00%
```

Three draught conditions are predefined: FULL LOAD, BALLAST1 and BALLAST2. Menu C1 selects which one of the draught conditions to use. The draught condition adjusts the output speed with the given calibration factor. Scroll between load conditions with – or + keys. Select a condition with Enter which will bring you to the next sub menu level.

```
C1.1 DRAUGHT COND.
FULL LOAD  0.00%
```

Menu C1.1 sets calibration factor for the selected draught condition. Use – or + key to adjust calibration factor and then Enter to save.

```
C3 MULTI-P CAL.
ENABLED
```

Menu C3 is used to store multi point calibration coefficients. Menu must be enabled (change with + if disabled) to set or delete calibration points. Press Enter to go down to enter the first calibration point.

```
C3.1 MULTI-P 1
UNUSED POINT
```

Menu C3.1 shows status for the first calibration point. If not previously used row 2 will state “UNUSED POINT”. Use + key to enable the calibration point.

```
C3.1 MULTI-P 1
ENABLE POINT
```

When point is enabled or previously used, press Enter to step down to next sub-menu level.

```
C3.11 MULTI-P 1
EXPECTED 0.0KN
```

Use – and + to set which speed to be calibrated for (expected) at that point (i.e.

the speed used at the calibration run).
Then press Enter to go to the next level.

```
C3.111 CAL-VALUE
 10.0KN   23.45%
```

Use – and + to set calibration value and Enter to save.

```
C3.2 MULTI-P 2
 15.00KN   34.56%
```

Use – key to delete an existing calibration point.

```
C3.2 MULTI-P 2
DELETE POINT
```

Confirm with Enter to execute.

```
C4 TRU CALIBRAT.
MARKING: TC+123
```

The transducer (TRU) calibration is set with menu C4. Use – or + keys to adjust the TC value to correspond to the engraved marking on the transducer housing or cable #1 and then press Enter to save. Example TC+123 means calibration factor +1.23%, TC–101 means calibration factor –1.01%.

4.4.5 Menu M, Miscellaneous

This menu contains miscellaneous settings and information about the system. To be able to make changes to sub menus write access must be activated (changed to ON) before menu is entered.

```
M0 MISCELLANEOUS
WRITE ACCESS OFF
```

```
M2 RESET CPU
DISABLED
```

Menu M2 restarts the system. Menu system will be closed and must be re-entered.
Use + to enable the menu and then Enter to restart.

```
M4 TOT. DISTANCE
DIST=12345.30 NM
```

Menu M4 can be used to adjust the total distance counter.
Use – and + to change the value and then Enter to save.

NOTE: the distance counter values are sent as $VDVLW messages on the serial output.

```
M5 TRIP DISTANCE
DIST=45.30 NM
```

The trip distance counter is reset with this menu.
Reset value by pressing Enter.
NOTE: the distance counter values are sent as $VDVLW message on the serial output.

```
M6 SW REVISION
5400130 A01
```

Menu M6 shows the revision of the presently running software image.

```
M10 ACCESS LEVEL
ALL USERS
```

Menu M10 sets the menu system access level.
Use + to change to “Authorised expert” and then Enter to set user level.

4.4.6 Menu S, Settings

The setting menus are used to change end user parameters for WTU - Assy. To be able to make changes to sub menus write access must be activated (changed to ON) before menu is entered

```
S0 SETTINGS
WRITE ACCESS OFF
```

```
S1 AVERAGE LOW
TIME= 10 SECONDS
```

Time constant to control output filter when in low speed, i.e. speed is below threshold set in menu S2.
Use – or + to change time constant and then Enter to save.

```
S2 THRES LOW-HI
THRESHOLD= 3.0 KN
```

Menu S2 sets the threshold when filter time constant shall be controlled by menu S1 or S3.
Use – or + to change threshold and then Enter to save.

```
S3 AVERAGE HIGH
TIME= 10 SECONDS
```

Time constant to control output filter when in high speed, i.e. speed is above threshold set in menu S2.
Use – or – to change time constant and then Enter to save.

```
S6 LOCK TIMEOUT
TIME= 20 SECONDS
```

Menu S6 controls maximum lock time, i.e. how long the latest speed value is kept if new measured speed is invalid.
Use –+ or +– to change lock timeout and then Enter to save.

```
S9 VBW FORMAT
EXTENDED
```

Menu S9 controls the $VDVBW telegram format.
EXTENDED (default, newer standard) or
SHORT (the older standard)
Use – or + to select desired alternative and then Enter to save.

```
S10 VHW TELEGRAM
DISABLED
```

Menu S10 enables $VDVHW telegrams.
Use – or + to enable/disable and then Enter to save.

```
S12 ANALOG SPEED
AHEAD + ASTERN
```

Menu S12 controls analogue speed readout. Analogue speed reading may be output in both directions or just ahead.
AHEAD + ASTERN (default) or
AHEAD ONLY
Use – or + to select desired alternative and then Enter to save.

4.4.7 Menu T, Test menus

The test menus are used to force one specific or all built-in self-diagnosis and explicitly show the result in the SD4 Mode window. To be able to make changes to sub menus write access must be activated (changed to ON) before menu is entered.

Note!! Test menus T2 to T5 will force the internal self-diagnosis to be executed much more often (every second speed measurement) than during normal operation.
This might degrade the accuracy of the calculated speed while the test is active.

```
T0 TEST
WRITE ACCESS OFF
```

```
T1 SIMULATION
DISABLED
```

Menu T1 outputs a simulated speed instead of the real speed measured by the log.
Use + to change menu to ENABLED and then Enter to start speed simulation and go to next sub-level where the simulated speed value may be changed.

Note!! The real measured speed to all systems and displays on the ship will be replaced by the simulated speed.

```
T1.1 SIMULATION
SIM.SPD=8.00KN
```

In menu T1.1 the simulated speed may be changed.
Use – or + to change the speed and then Enter to save.

```
T2 NOISE TEST
DISABLED
```

Menu T2 forces the built-in self-diagnosis noise test to be executed and the result is displayed in the SD4 Mode window.
Use + to change menu to ENABLED and then Enter to start the test and go to next sub-level where the test result will be displayed.

```
T2.1 NOISE LEVEL
      654 :: 732
```

Menu T2.1 shows the measured noise level in channel 1 to the left and in channel 2 to the right.
Noise levels from an undisturbed log system shall show values below 700 over time. Low values are better than high.

```
T3 TRU S BALANCE
DISABLED
```

Menu T3 forces the built-in self-diagnosis TRU signal balance test to be executed and the result is displayed in the SD4 Mode window.
Use + to change menu to ENABLED and then Enter to start the test and go to next sub-level where the test result will be displayed.

```
T3.1 SIG BALANCE
Q MAX=  78% OK
```

Menu T3.1 shows the measured signal balance as a quote between the channels. Signal balances in the interval 50% - 200% are accepted as OK100% is the theoretically perfect value.
Note!! If the ship doesn't move the signal balance test might indicate fail even if there is no problem with the signal balance. Under such circumstances use the test with caution.

```
T4 LOOP TEST
DISABLED
```

Menu T4 forces the built-in self-diagnosis loop test to be executed and the result is displayed in the SD4 Mode window.
Use + to change menu to ENABLED and then Enter to start the test and go to next sub-level where the test result will be displayed.

```
T4.1 LOOP TEST
      0 : 82 : 0
```

The loop test generates transmit signals that are looped back to the receiver and then correlated. Menu T4.1 shows the correlation function at three different delays (lags).
The test is passed if the first and last value < 2 and the middle value lie in the interval 40 – 120. The middle value shall be stable during the test. The value depends on transducer load.

```
T5 RUN SELFTESTS
DISABLED
```

Menu T5 forces all built-in self-diagnostic tests to be executed. The A2 DIAG HISTORY list is cleared at start of test. If any self-test fails a diagnostic code will be activated.
Use + to change menu to ENABLED and then Enter to start the test and go to next sub-level where the test result will be displayed.

```
T5.1 NO CODES
      IN LIST
```

Menu T5.1 will continuously show the latest generated diagnostic code. The list will be cleared upon entering this menu. Any new code activated as a result of the forced test (it can take several seconds) will be shown in the order of appearance.

```
T6 LOGFAIL ALARM
DISABLED
```

Menu T6 forces the log fail alarm relay to be set from this menu instead of internal status.
Use + to change menu to ENABLED and then Enter to start the test and go to next sub-level where the relay can be toggled.

```
T6.1 LFA RELAY
NO ALARM POS.
```

Menu T6.1 displays the present log fail alarm relay position. NO ALARM POS. (when log fail relay is not in alarm

position) or ALARM POSITION (when log fail alarm relay is in alarm position).
Use – or + to select desired relay position and then Enter to physically set the relay.

4.4.8 Menu V, View menus

End user and service personnel are intended to use these menus to gather statistics.

Press Enter to go into sub-menus. All menus are read only. To interpret the values please refer to corresponding T menus.

```
V0 VIEW RECORDED
WRITE ACCESS OFF
```

```
V1 SYSTEM UPTIME
01D:23H:45M
```

Menu V1 shows system uptime since last power on.

```
V2 NOISE LEVELS
      654 :: 732
```

Menu V2 shows average noise level since last measuring sequence (~10 sec).

```
V3 TRU S BALANCE
Q MAX=  93% OK
```

Menu V3 shows the most unbalanced TRU signal value during last measuring sequence (~10 sec).

```
V4 LOOP TEST
      0 : 59: 0
```

Menu V4 shows loop test values during the last measuring sequence (~10 sec).

4.5 Menu function summary

The list is included for fast indexing. Menus in **bold font** are main menus.
Menus with access level "Expert" are not visible in "All Users" mode.

"Expert" menus are only for development purpose. Only instructed personnel are intended to use these menus.

No.	Access Level	Name	Default	Function
R0		**Root menu**		**Timeout to root menu after 30 seconds. Presentation according to *4.4.1 Root Menu***
A0	**All Users**	**DIAGNOSTICS**		**Select menu to view log statistics since system start up**
A1	All Users	TOTAL UPTIME		Show the WTU - Assy. system total uptime
A2	All Users	DIAG HISTORY		Press enter to access the history
A2.1	All Users			– or + keys scroll history list
A3	All Users	ERASE HISTORY	DISABLED	Erase history list
C0	**All Users**	**CALIBRATION**		**Select calibration menus**
C1	All Users	DRAUGHT COND	FULL LOAD	Select one of three predefined draught condition
C1.1	All Users			Set calibration factor for selected draught condition
C3	All Users	MULTI-P CAL.	ENABLED	Select Multiple Point Calibration edit/delete
C3.1	All Users		ENABLED	Select first Multiple Point pair to edit/delete
C3.11	All Users			Set speed at first point
C3.111	All Users			Set calibration value for first speed
C3.n	All Users		ENABLED	Select n^{th} Multiple Point pair to edit/delete
C3.n1	All Users			Set speed at n^{th} point
C3.n11	All Users			Set calibration value for n^{th} speed
C4	All Users	TRU CALIBRAT	TC+000	Set engraved transducer calibration factor
C5	*Expert*	CALIBR RESET	DISABLED	Reset calibration values
D0	***Expert***	**DEBUG**		**Select Debug menus**
D1	*Expert*	DATA LOGGING	DISABLED	Put $PSALD in NMEA output stream
D2	*Expert*	SAMPLE TO ETH	239.168.1 .70	Stream binary signal data as UDP through the Ethernet connector
M0	**All Users**	**MISCELLANEOUS**		**Select miscellaneous menus**
M1	*Expert*	SET DEFAULT	DISABLED	Restore default values for all non-volatile settings except calibration factors
M2	All Users	RESET CPU	DISABLED	Reset CPU by disabling watchdog
M4	All Users	TOT. DISTANCE		Show and adjust the total distance counter
M5	All Users	TRIP DISTANCE		Reset trip counter
M6	All Users	SW revision		Display the application software revision 5400130 xxx
M7	*Expert*	APP revision		Display the application revision 6400331 xxx
M8	*Expert*	FW revision		Display the firmware revision 6400341 xxx
M9	*Expert*	HW revision		Display the HW revision 5490240 REV x
M10	All Users	Access level		All Users: Only menus with access level "All Users" are visible Authorised Expert: All menus are visible

No.	Access Level	Name	Default	Function
P0	***Expert***	**PARAMETERS**		**Set Parameters menus**
P1	*Expert*	Measure type	Auto	Set working mode of the log.
P2	*Expert*	Particle mode	Enabled	Enable/disable PARTICLE as one of the toggling modes during TEST mode
P3	*Expert*	Particle mode Depth	130	Desired measuring depth in PARTICLE mode.
P4	*Expert*	Particle mode Max Rx offset	2	Maximum number of simultaneously active transmissions in PARTICLE mode
P5	*Expert*	Particle mode Tx Length	28	Desired transmission length in PARTICLE mode
P6	*Expert*	Speckle mode	Enabled	Enable/disable SPECKLE as one of the toggling modes during TEST
P7	*Expert*	Speckle mode Depth	500	Desired measuring depth in SPECKLE mode.
P8	*Expert*	Speckle mode Max Rx	3	Maximum number of simultaneously active transmissions in SPECKLE mode
P9	*Expert*	Pulse mode	Enabled	Enable/disable PULSE as one of the toggling modes during TEST
P10	*Expert*	Pulse mode Max depth	130	Desired measuring depth in PULSE mode.
P11	*Expert*	Pulse mode Max Rx offset	0	Maximum number of simultaneously active transmissions in PULSE mode
P12	*Expert*	Dirty mode	Enabled	Enable/disable DIRTY as one of the toggling modes during TEST
P13	*Expert*	Dirty mode Depth	Enabled	Desired measuring depth in DIRTY mode.
P14	*Expert*	Dirty mode Max Rx offset	0	Maximum number of simultaneously active transmissions in DIRTY mode
P15	*Expert*	Forced cycle length	0	Force a constant cycle length independent of measuring mode
P16	*Expert*	Median filter length	5	Length of median filter applied to raw speed
P17	*Expert*	Adapt gain factor	1,25	Maximum allowed gain in adaptive gain filter following median filter
P18	*Expert*	Correlation threshold	100	Raw speed invalid if correlation < threshold
P19	*Expert*	Zero speed qual. thres	100	Raw speed invalid if quality < threshold
P20	*Expert*	Zero sp. ACF threshold	250	Zero speed qualifier threshold for ACF
P21	*Expert*	Manual h-spd thresh.disabled	Disabled	Enable manual adjustment of threshold for decision of mode transfer to high speed mode
P21.1	*Expert*		Auto calc.	Set threshold for high speed mode transfer
P22	*Expert*	Layer jitter	40	Set jitter jump length in us

No.	Access Level	Name	Default	Function
S0	**All Users**	**SETTINGS**		**Select Settings menus**
S1	All Users	Average Low	10	Set averaging time constant in seconds for low speed range
S2	All Users	Threshold Low-Hi	3.0	Speed limit between low and high averaging time constant.
S3	All Users	Average High	10	Set averaging time constant in seconds for high speed range
S6	All Users	Lock Timeout	20	Timeout before speed is set invalid after speed loss [sec]
S7	*Expert*	NMEA Interval	1.0	NMEA message interval [sec]
S9	All Users	VBW Telegram	Extended	Control $VDVBW telegram format
S10	All Users	VHW Telegram	Disabled	Add telegram $VDVHW to NMEA stream
S11	*Expert*	LogFail-Alrm	Power-Fail	Set Log Fail Alarm relay function to power fail or invalid speed
S12	All Users	Analog Speed	Ahead + Astern	
T0	**All Users**	**TEST**		**Selects Test menus**
T1	All Users	Simulation	Disabled	Enable simulated speed as $VDVBW in NMEA output stream
T1.1	All Users	Simulation	8.00	Adjust simulated speed if desired
T2	All Users	Noise test	Disabled	Enable forced execution of noise level test
T2.1	All Users	Noise level		View result of forced noise level test
T3	All Users	TRU S balance	Disabled	Enable forced execution of transducer signal balance test
T3.1	All Users	Sig Balance		View result of forced signal balance test
T4	All Users	Loop test	Disabled	Enable forced execution of loop test
T4.1	All Users	Loop test		View result of forced loop test
T5	All Users	Force test	Disabled	Enable forced execution of all self-diagnosis tests
T5.1	All Users	Code		View diagnostic codes resulting from the forced self-diagnosis
T6	All Users	LogFail Alarm	Disabled	Forced switching of the log fail alarm relay
T6.1	All Users	LFA Relay		Activate relay switching
V0	**All Users**	**VIEW**		**Select menu to view log statistics since last power up**
V1	All Users	System Uptime		Read uptime since last power on
V2	All Users	Noise levels		Read highest noise levels, last sequence
V3	All Users	TRU S balance		Read most unbalanced signal last sequence
V4	All Users	Loop test		Read average loop test result last sequence

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SAL R100

Section 5

Appendix

Doc ID 89.16.02

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List of Appendix

Type	Doc ID
Item List	
SAL R100 Item List	89.16.01
Interface	
IEC 61162-1 /NMEA 0183 Interface	700164
Menu structure	
SD4-3/ WTU-assy	703825
Drawings	
SAL System Diagram	5413195
SAL R1 MSSBSV L, Single bottom Assy Drawing. Dimensions and Parts list	5493321
SAL R1 MSDBSV L, Double bottom Assy Drawing. Dimensions and Parts list	5493322

1 List of items, SAL R100

1.1 Standard items for a system

Unit number	Name of unit	Description
80.11.01	SAL R100 ELC	Electronics Cabinet
80.12.03	SAL SD4-3	Speed and Distance Display
705050	SAL R1 TRU 30 m cable	Transducer (30 m cable)
705051	SAL R1 TRU 40 m cable	Transducer (40 m cable)
5493350	SAL R1 MSSBSV L	Mounting Set Single Bottom Sea Valve Low
5493360	SAL R1 MSDBSV L	Mounting Set Double Bottom Sea Valve Low
5492300	SAL R1 TRU Easy Tank 10 m	SAL Easy Tank Transducer 10 m
5493382	SAL R1 Easy Tank Flange	SAL Easy Tank Steel Flange
5493384	SAL R1 Easy Tank Flange ALU	SAL Easy Tank ALU Flange

1.2 Optional items for a system

Unit number	Name of unit	Description
80.11.03	SAL LPU2	Log Processing Unit 2nd generation
80.12.04	SAL SD4-4	General Display
704080	SD4 BMB	Bulkhead Mounting Box
704110	SD4 EB	Extension Board
704120	SD4 ED	External Dimmer
80.19.02	SD4 SDR2	Display remote control
701692	SIA-3-8	Speed Indicator Analogue
704160	1N4B	1-to-4 NMEA Buffer

APPENDIX – IEC 61162-1/ NMEA 0183 Interface

Introduction

The purpose of this document is to define the most common serial sentences that are used by the manufacturer speed logs as well as specify the hardware used for serial communication.

The National Marine Electronics Association (NMEA) has developed a specification that defines the interface between marine electronic equipment called NMEA 0183. This standard is closely aligned with the standard IEC 61162-1 from International Electrotechnical Commission (IEC) which is specified by International Maritime Organization (IMO) to meet the international convention for the Safety of Life at Sea (SOLAS) regulations.

In this document we refer to this standard as IEC 61162-1/NMEA or IEC 61162-2/NMEA for the high-speed version of the same standard.

References: IEC 61162-1 / NMEA 0183 standard, IEC 61162-2 / NMEA 0183 (HS) standard.

Hardware

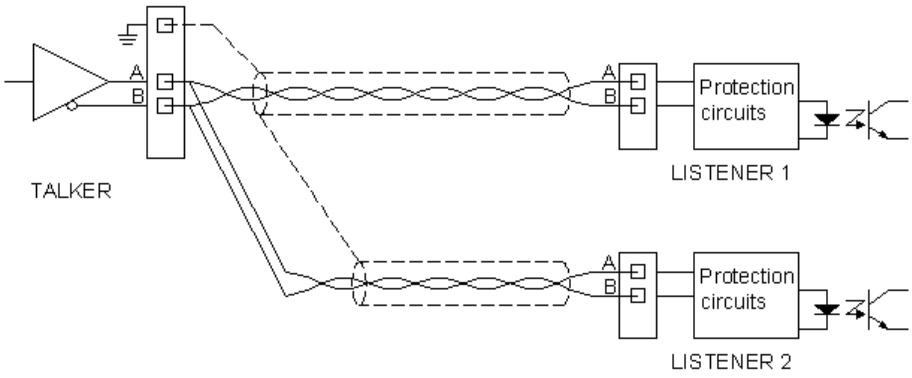
The IEC 61162-1/NMEA and IEC 61162-2/NMEA standard specifies serial data links with one talker and multiple listeners, using for each talker a separate signal pair with all listeners opto-isolated.

The IEC 61162-2/NMEA inputs uses opto-isolated RS485 receivers with a DC power supply which is isolated from case ground as well as from the DC power in the receiving unit.

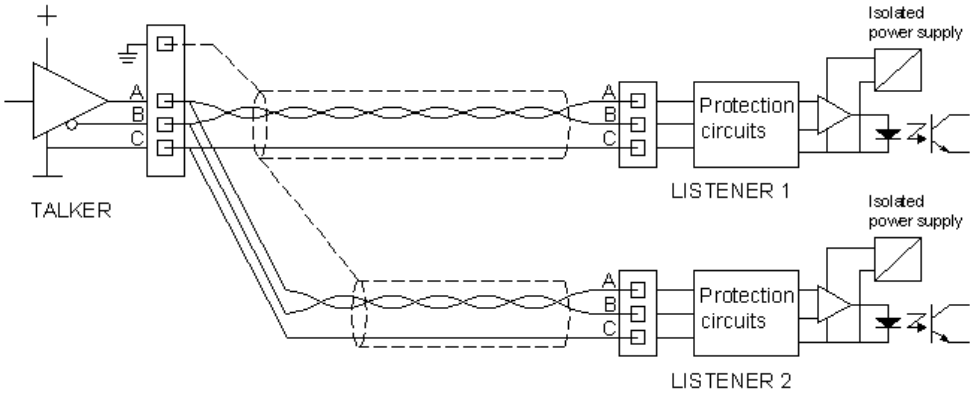
Connection of cables for serial communication

All cables used for serial communication shall be twisted pair and properly shielded. Maximum recommended cable length is 1000 meter with a minimum cross-section area of 0.5 mm2.

IEC 61162-1/NMEA uses two wires in one pair connected as signal "A" and "B" between talker and listener.



IEC 61162-2/NMEA uses three wires, two wires in one pair connected as signal "A" and "B" and a third wire from a separate pair connected as "C" (ground connection between the transmitting unit and the isolated input stage).



Speed log and depth sentences

Depth (--DPT)

```
 1     2   3   4   5
$--DPT,x.x,x.x,x.x*hh<CR><LF>
```

Field	Type	Definition	Note
1	`Name`	Depth	VD = Log, SD = Depth sounder
2	`x.x`	Depth below transducer [m]	Null field indicates out of range

3	x.x	Depth between transducer and keel or water line[m]	This figure is unknown to the log system, so a null field is transmitted here.
4	x.x	Maximum range scale in use	(Fix set to 400 m for bottom track speed log)
5	hh	Checksum	

Example: Data from bottom track speed log (depth measured to 30.0 m):

```
$VDDPT,30.0,,400*
```

Example: Data from echo sounder (depth measured to 30.0 m):

```
$SDDPT,30.0,,400*
```

Dual Doppler Velocities (--VBW)

Water-referenced and ground-referenced speed data.

Note that this sentence has been extended. The speed logs may transmit the shorter version of the sentence with only the first seven fields plus the checksum field for backwards compatibility.

```
 1     2   3   4 5   6   7 8   9 A   B C
$--VBW,x.x,x.x,A,x.x,x.x,A,x.x,A,x.x,A*hh<CR><LF>
```

Field	Type	Definition	Note
1	Name	Water-referenced and ground-referenced speed data	VDVBW
2	x.x	Longitudinal water speed	knots
3	x.x	Transverse water speed	knots
4	A	Status water speed	A = data valid, V = data invalid
5	x.x	Longitudinal ground speed	knots
6	x.x	Transverse ground speed	knots

7	A	Status ground speed	A = data valid, V = data invalid
8	x.x	Stern Transverse water speed	knots
9	A	Status stern transverse water speed	A = data valid, V = data invalid
A	x.x	Stern Transverse ground speed	knots
B	A	Status stern transverse ground speed	A = data valid, V = data invalid
C	hh	Check sum	

Unavailable data are transmitted as empty fields.

Below examples: speed through water 10.05 knots, longitudinal speed over ground 11.02 knots, transverse speed over ground -0,05 knots.

Normal sentence, Water track speed log:

```
$VDVBW,10.05,,A,,,V,,V,,V*
```

Normal sentence, Bottom track speed log:

```
$VDVBW,10.05,,A,11.02,-0.05,A,,V,,V*
```

Short sentence from earlier revision for backwards compatibility, Water track speed log:

```
$VDVBW,10.05,,A,,,V*
```

Distance travelled through the water and over the ground (--VLW)

Note that this sentence was extended. Older systems might still transmit the shorter version of the sentence with only the first five fields plus the checksum field.

```
 1     2   3 4   5 6   7 8   9 A
$--VLW,x.x,T,x.x,T,x.x,T,x.x,T*hh<CR><LF>
```

Field	Type	Definition	Note
1	Name	Distance through water	VDVLW
2	x.x	Total water distance [nautical miles]	minimum range 9999.9

3	T	Type	N = Nautical mile
4	x.x	Trip water distance [nautical miles]	
5	T	Type	N = Nautical mile
6	x.x	Total ground distance [nautical miles]	minimum range 9999.9
7	T	Type	N = Nautical mile
8	x.x	Trip ground distance [nautical miles]	
9	T	Type	N = Nautical mile
A	hh	Checksum	

Example: Data from STW speed log (total distance 100 nautical miles, trip 3.50 nautical miles):

```
$VDVLW,100.00,N,3.50,N,,N,,N*
```

Other sentences

Sentences that may be transmitted or received by speed log and echo sounder under specific conditions.

Rate of turn (--ROT)

The sentence is used by speed log for docking log calculation.

```
 1      2    3 4
$--ROT,x.x,A*hh<CR><LF>
```

Field	Type	Definition	Note
1	Name	Rate of turn	TIROT, HEROT, INROT

2	x.x	Rate of turn [degrees / minute]	"-" is bow turns to port
3	A	Status	A = data valid, V = data invalid
4	Hh	Checksum	

Example: Data from rate of turn gyro (30 degrees / minute clockwise):

```
$TIROT,30.0,*
```

Text Transmission (--TXT)

The sentence is transmitted during initialisation.

```
 1      2  3  4  5    6
$--TXT,xx,xx,xx,c—c*hh<CR><LF>
```

Field	Type	Definition	Note
1	Name	Text transmission	VD = Log, VR = VDR
2	xx	Total number of sentences	
3	xx	Sentence number	
4	xx	Text identifier	
5	c-c	Text message	
6	hh	Check sum	

Proprietary SAL Sentences

The proprietary manufacturer mnemonic code "SAL" has been reserved at NMEA. This means that any sentence starting with "$PSAL..." emanates from our equipment and that any letters following can be chosen by us. However, to comply with standard NMEA

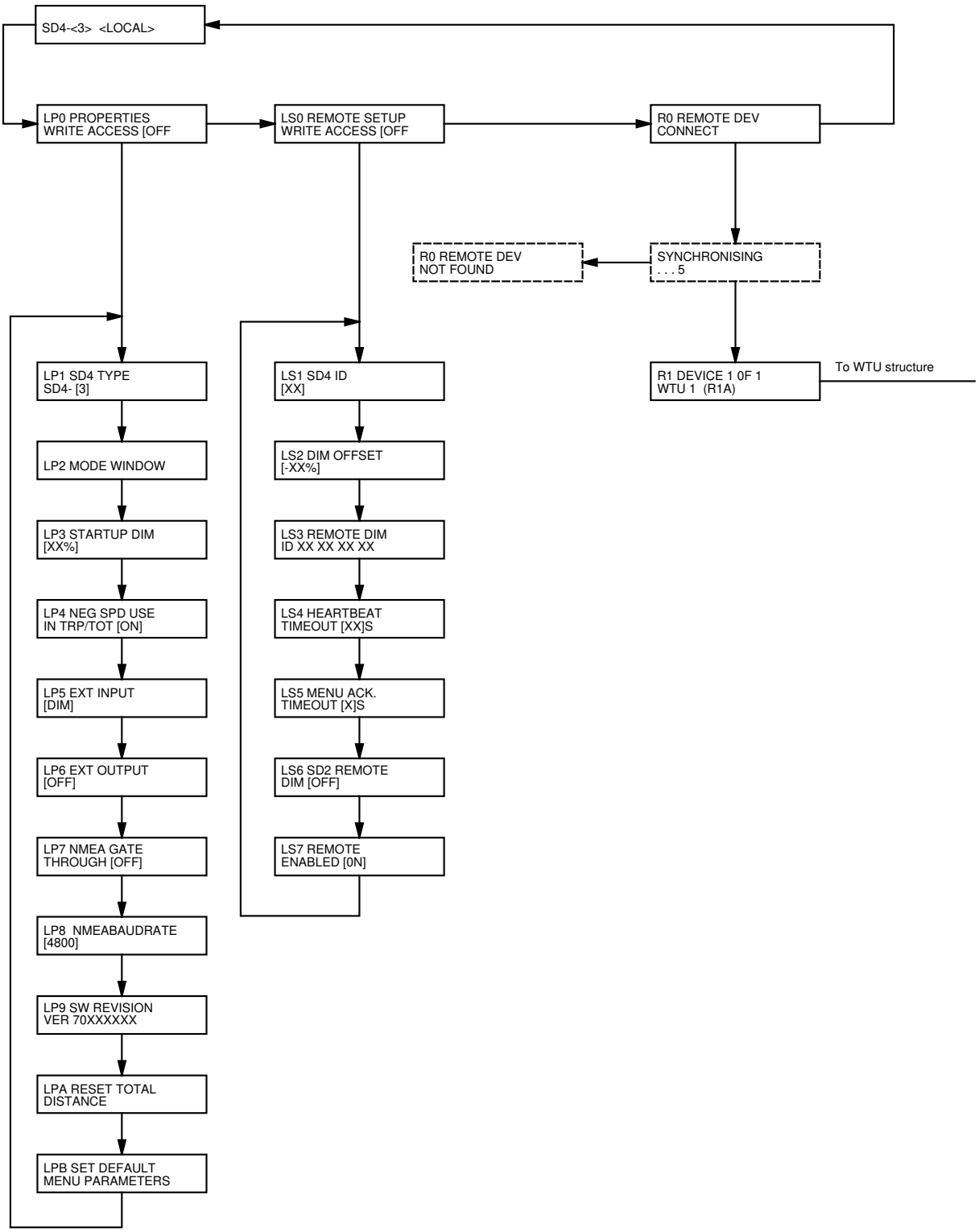
sentences, all these sentences use a five-character combination `$PSAL` before the first delimiter.

These proprietary sentences are mainly used for internal programming, troubleshooting, etc and are only used in normal operation where no good alternatives are available.

These sentences may be changed without notice.

SD4-3 MENU STRUCTURE

* Simplefied structure without any submenus



WTU-Assy MENU STRUCTURE

* Simplified structure without any submenus
* All User level structure

From SD4-3 structure

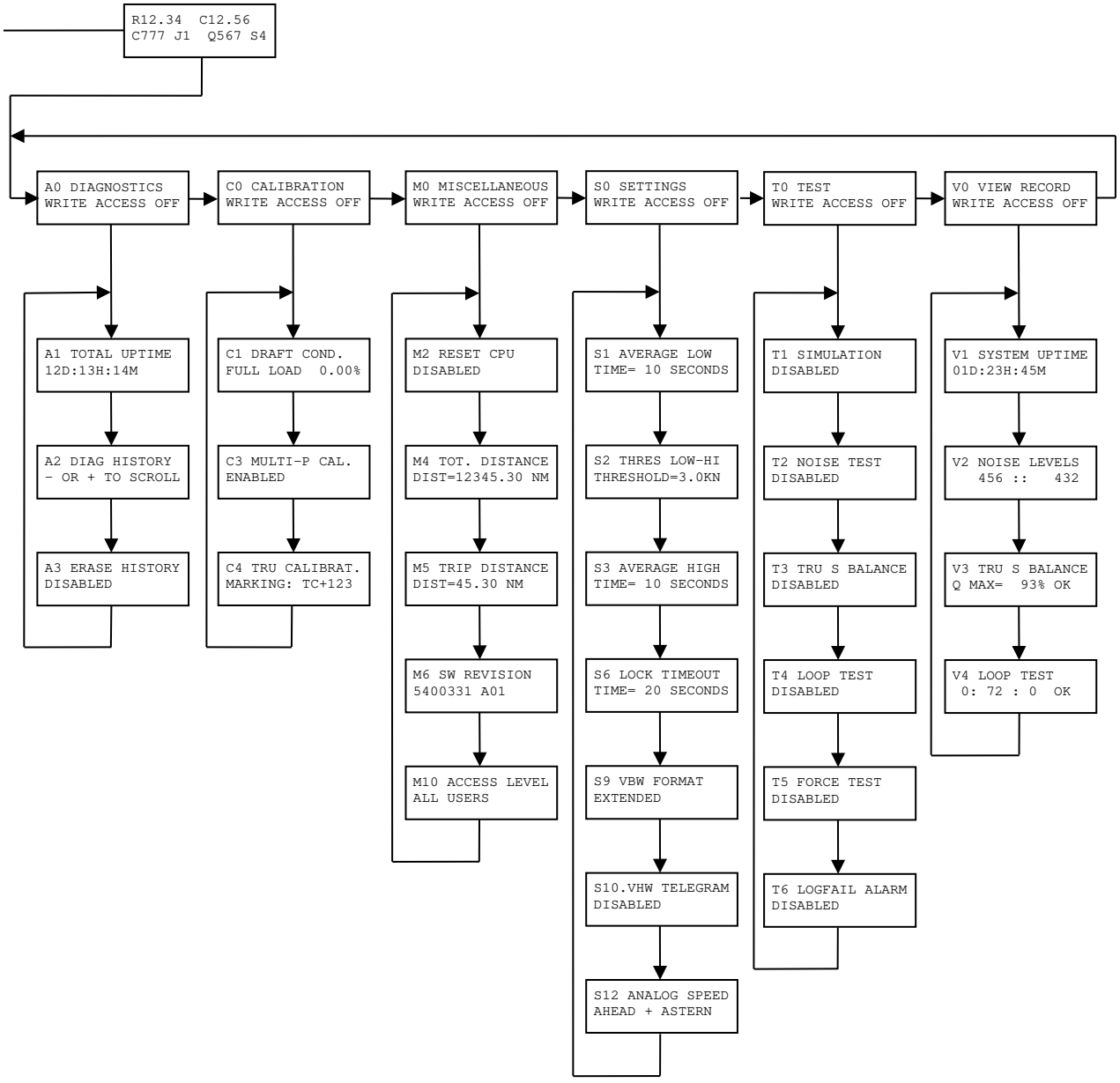


CHART TABLE

SL05
LOG MASTER DISPLAY
SD4-3 SPEED/DISTANCE
LOCATION

NAVIGATION CONSOLE

SL08
EXTERNAL DIMMER
SD4 ED
LOCATION
OPTION

CEILING CONSOLE

SL15
ANALOG SPEED INDICATOR
SIA-3-8
LOCATION
OPTION

NAVIGATION CONSOLE

SL16
SAL SIA
INDICATOR DIMMER
LOCATION
OPTION

YARD
5W/24VDC
ESB (RECOMMENDED)

24 - SL05
2x2x0.5

SL05 - SL08
2x2x0.5

SL15 - SL16
1x2x0.5

SLTB01- SL05
2x2x0.5

BAM
Log Fail Alarm

SLTB01- BAM
1x2x0.5

SLTB01

YARD
TERMINAL BOARD
OPTION

SLTB01- SL15
1x2x0.5

24 - SL16
2x2x0.5

YARD
2.5W/24VDC
ESB (RECOMMENDED)

ECDIS 1

SL14 - EC01
1x2x0.5

RADAR X

SL14 - RA_X
1x2x0.5

GYRO

SL14 - GYRO
1x2x0.5

VDR

SL14 - VD01
1x2x0.5

SL14
NMEA SPLITTER
UPC3002
LOCATION
2IN/6OUT
OPTION

SLTB01- SL14
1x2x0.5

SL01 - SLTB01
4x2x0.5

YARD
2W/24VDC
ESB (RECOMMENDED)

24 - SL14
2x2x0.5

YARD
30VA
220VAC/60Hz
ESB (RECOMMENDED)

220 - SL01
3x1.5

SL01
ELECTRONIC CABINET
ELC
LOCATION

BOW

SL01 - SL03
*[SL03] 30M

BOTTOM BOW

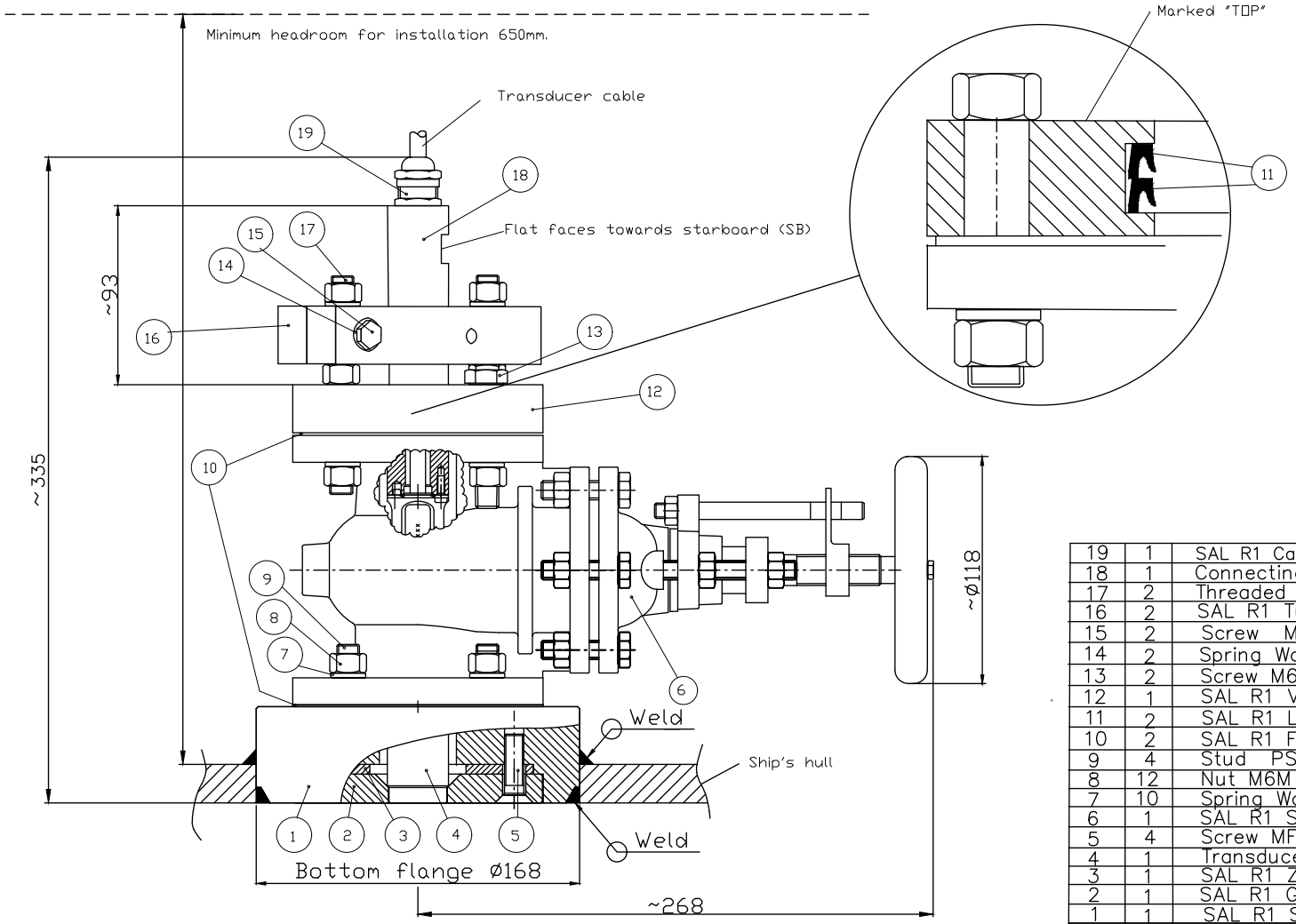
SL03
TRANSDUCER UNIT
SAL R1 TRU
BOTTOM BOW
WITH 30 M CABLE

SL04
SPEED LOG GATE VALVE
SAL R1 MSSBSV L
BOTTOM BOW

Project: Single axix speed log			SPEED LOG SYSTEM
File: 5413195A02	Size A3	Scale N/A	
SAL Navigation AB www.salnavigation.com	Design STOJE	Approved STOOM	SINGLE AXIS SPEED LOG SYSTEM DIAGRAM
	EXAMPLE		Drawing no. SGno-HullNo-SL-L
	Date: 31.08.2020		Rev. A01 / Page 1 / 1

A3 Filename: FILENAME.DWG

Rev.	Change	Date	Sign
A02	Added information and part no. list.	140818	LNY
A03	Added Threaded rod in part list.	140819	LNY
A04	Spelling corrections	140820	LNY
A05	Updated minimum heigth for installation	150527	JEI
A06	Updated Part List	150819	JEI
A07	Updated company name	200831	HB



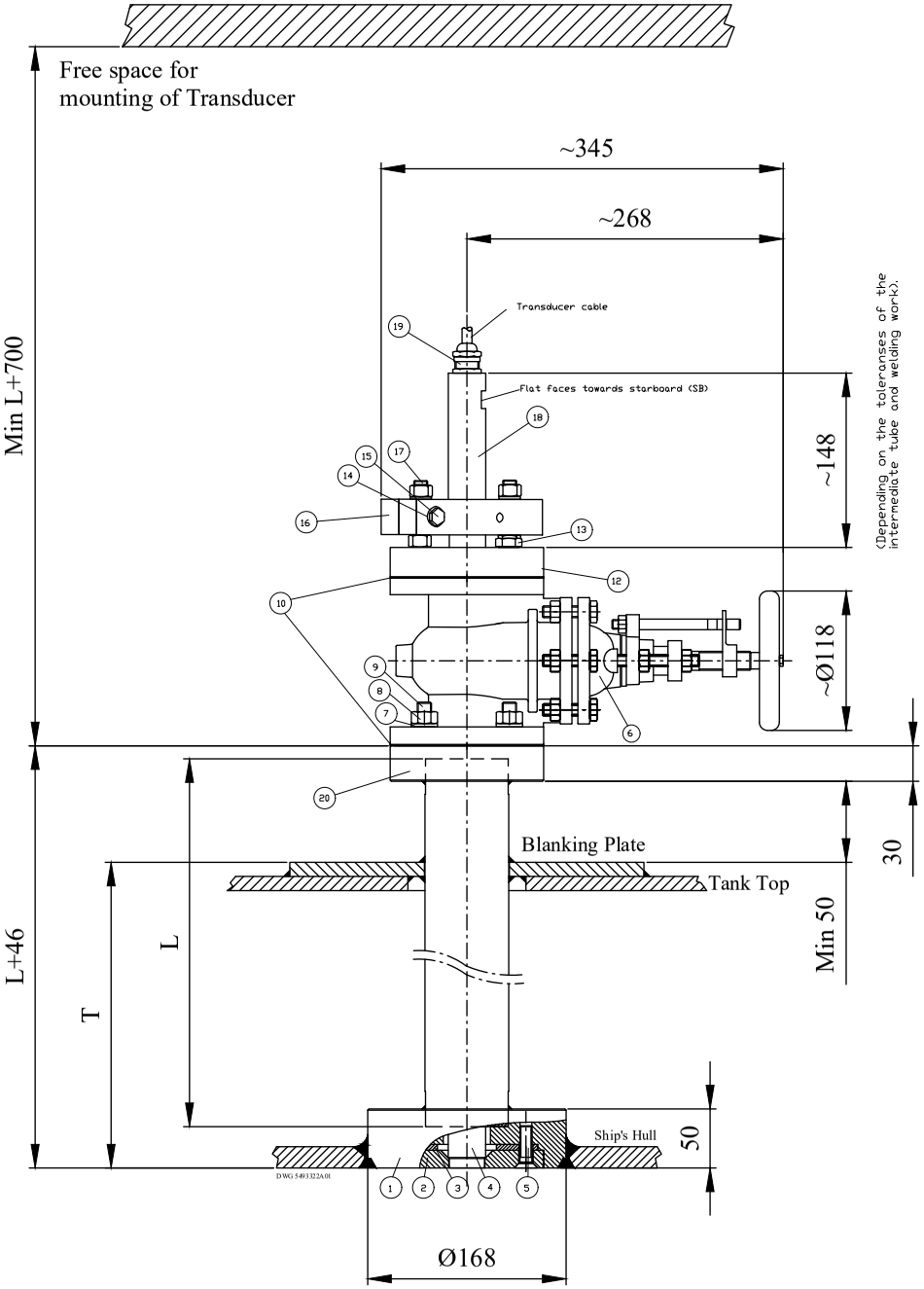
pos.	num.	name	part number
19	1	SAL R1 Cable gland Assy	71-21533-00
18	1	Connecting Tube 150mm	5414105
17	2	Threaded rod MHGS M12x115	5493316
16	2	SAL R1 Tube bracket	5414101
15	2	Screw M6S M10x60	5493312
14	2	Spring Washer FBB 10.2	5493313
13	2	Screw M6S 12x60	5493317
12	1	SAL R1 Valve Cover L	5493318
11	2	SAL R1 Lip Seal / DI 125	00-00500-19
10	2	SAL R1 Flange gasket	71-21538-00
9	4	Stud PS M12x40 (Tot. L=55mm)	71-21535-00
8	12	Nut M6M M12	5493314
7	10	Spring Washer FBB 12.2	5493315
6	1	SAL R1 Sea valve	71-21544-00
5	4	Screw MFS 10x35 A4	71-21536-00
4	1	Transducer with cable 30/40m	705050/51
3	1	SAL R1 Zinc ring	71-21504-00
2	1	SAL R1 Guide ring	71-21543-00
1	1	SAL R1 Single bottom hull flange	5414200

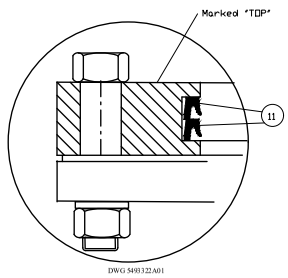
Note! The transducer is not included in part no. 5493350.

TOLERANCES unless otherwise specified	Material	Designed: LNY	Checked: OM
General	Surface treatment	Approved	Scale
Surface	Title: Assembly drawing of part no 5493350 SAL R1 MSSBSV L		
SAL Navigation AB www.salnavigation.com	Page: 1(1)	Date: 20200831	Drawing no.: 5493321 / Rev.: A07

A3 Filename: FILENAME.DWG

Rev.	Change	Date	Sign
A01	Added information and part no. list.	150817	JEI
A02	Updated company name	200831	HB





pos.	num.	name	part number
20	1	SAL R1 Double bottom upper flange	71-21563-00
19	1	SAL R1 Cable gland Assy	71-21533-00
18	1	SAL R1 Connecting Tube	71-21507-XX
17	2	Threaded rod MHGS M12x115	5493316
16	2	SAL R1 Tube bracket	5414101
15	2	Screw M6S M10x60	5493312
14	2	Spring Washer FBB 10.2	5493313
13	2	Screw M6S 12x60	5493317
12	1	SAL R1 Valve Cover L Assy	5493318
11	2	SAL R1 Lip Seal / DI 125	00-00500-19
10	2	SAL R1 Flange gasket	71-21538-00
9	4	Stud PS M12x40 (Tot. L=55mm)	71-21535-00
8	12	Nut M6M M12	5493314
7	10	Spring Washer FBB 12.2	5493315
6	1	SAL R1 Sea valve	71-21544-00
5	4	Screw MFS 10x35 A4	71-21536-00
4	1	Transducer with cable 30/40m	705050/51
3	1	SAL R1 Zinc ring	71-21504-00
2	1	SAL R1 Guide ring	71-21543-00
1	1	SAL R1 Double Bottom hull flange	71-21561-00

Note! The Transducer and the Connecting Tube are not included in part no. 5493360.

TOLERANCES unless otherwise specified	Material	Designed STOJE	Checked OM
General	Surface treatment	Approved	Scale
Surface	Title: Assembly drawing of part no 5493360 SAL R1 MSDBSV L		
SAL Navigation AB www.salnavigation.com	Page 1(1)	Date 20200831	Drawing no. 5493322 Rev. A02