Multi Repeater

CD401MR-SB
Operation and Installation Manual
CD401MR-SB
Operation and Installation Manual
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OVERVIEW.

Terminology
Terms, units and abbreviations used in this manual.

Introduction
This part introduces you to the elements of the Multi Repeater (MR) system.

Chapter 1 – Physical installation
Correct installation of the system will ensure problem free service for many years. This section explains the main steps to get your system working.

Chapter 2 – Setting up and using the Compact Display
The Compact display is a flexible intuitive display allowing data to be displayed in a user friendly way. It is also a primary system and can be integrated into the navigation system as regulation stipulate. This chapter explains how to set up the unit.

Chapter 3 – Operation
Once the system is installed and operational, the user can change the screen to show the data of interest at any time. This section explains the operation of the system.

Chapter 4 – Maintenance
It is a good idea to verify your systems performance from time to time. This chapter describes how to check interfaces and other issues. In the event of malfunction, this is a good place to start for trouble shooting.

Appendix 1 – Specifications and drawings
Here you will find more details of how the system works and which factors are important to know when using it.

Appendix 2 – Accepted NMEA sentences
This section describes the inputs accepted by the compact display in this configuration

Appendix 3 - Sending the system for repair
In the unfortunate case of a failure that requires a factory repair, the described return sequence should be followed.

Appendix 4 - Other options with the Multi Repeater
The Compact can be used in a number of different system both as a repeater and a speed log. This section explains what is available and how to activate the options.
TERMINOLOGY. Terms used in this manual

UNITS
Unless otherwise stated, all values shown on the display are as follows:

<table>
<thead>
<tr>
<th>Term</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth</td>
<td>Meters</td>
</tr>
<tr>
<td>Speed</td>
<td>Nautical Miles per hour (knots)</td>
</tr>
<tr>
<td>Distance</td>
<td>Nautical Miles (nm)</td>
</tr>
<tr>
<td>Heading</td>
<td>Degrees (0 – 359.9°)</td>
</tr>
<tr>
<td>Rotation</td>
<td>Degrees per minute (%/min)</td>
</tr>
<tr>
<td>Pitch and Roll</td>
<td>Degrees (0 – 359.9°)</td>
</tr>
<tr>
<td>Wind</td>
<td>Nautical Miles per hour (knots)</td>
</tr>
<tr>
<td></td>
<td>Meter per seconds (m/s)</td>
</tr>
<tr>
<td></td>
<td>Beaufort (Bft)</td>
</tr>
<tr>
<td>Temperature</td>
<td>Degrees Celcius (°C)</td>
</tr>
<tr>
<td>Speed Revolutions</td>
<td>Revolutions per minute (rev/min)</td>
</tr>
<tr>
<td>Rudder Angle</td>
<td>Degrees (0 – 359.9°)</td>
</tr>
<tr>
<td>Propeller Pitch</td>
<td>Percentage of maximum (0 -100 %)</td>
</tr>
<tr>
<td>Clock /UTC</td>
<td>hh:mm (00:00 – 23:59)</td>
</tr>
</tbody>
</table>

ABBREVIATIONS
In addition the following symbols are used on the Runtime screens:

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>$T_p$</td>
<td>Daily trip (in nm)</td>
</tr>
<tr>
<td>$T_L$</td>
<td>Total measured distance travelled (in nm)</td>
</tr>
<tr>
<td>°</td>
<td>Degrees</td>
</tr>
<tr>
<td>%</td>
<td>Percentage</td>
</tr>
<tr>
<td>←↑→↓</td>
<td>Direction</td>
</tr>
</tbody>
</table>
INTRODUCTION. The Multi Repeater

The SKIPPER Multi Repeater allow important values from a variety of systems to be displayed anywhere on the vessel. The Compact is unique in its simple and flexible way to display vital data in almost all conditions, from no light to bright sunlight. In addition, it is classed to IP 56 allowing it to be mounted outside and used in any conditions. The unit is a standard 144 mm format allowing it to be mounted in tight spaces or overhead.
CHAPTER 1. Physical installation

The Multi Repeater CD401MR is a stand alone unit and does not require additional circuitry. It should be supplied by a 24 V (19 V-36 V) 25 W DC supply and the cabling of the system is as per diagram below. The unit is supplied with 2 m of cable (12 core). This can be extended without problem. Only the wires in use need extending.

Note: Mounting drawing is available in Appendix 1.

<table>
<thead>
<tr>
<th>Colour Codes</th>
<th>Pin no.</th>
<th>Signals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grey</td>
<td>12</td>
<td>NMEA2 OUT B</td>
</tr>
<tr>
<td>Turquoise</td>
<td>11</td>
<td>NMEA2 OUT A</td>
</tr>
<tr>
<td>Pink</td>
<td>10</td>
<td>NMEA1 OUT B</td>
</tr>
<tr>
<td>Orange</td>
<td>9</td>
<td>NMEA1 OUT A</td>
</tr>
<tr>
<td>Violet</td>
<td>8</td>
<td>DIM DWN B</td>
</tr>
<tr>
<td>Brown</td>
<td>7</td>
<td>DIM DWN A</td>
</tr>
<tr>
<td>Black</td>
<td>6</td>
<td>DIM UP B</td>
</tr>
<tr>
<td>White</td>
<td>5</td>
<td>DIM UP A</td>
</tr>
<tr>
<td>Yellow</td>
<td>4</td>
<td>NMEA IN B</td>
</tr>
<tr>
<td>Green</td>
<td>3</td>
<td>NMEA IN A</td>
</tr>
<tr>
<td>Blue</td>
<td>2</td>
<td>0 V</td>
</tr>
<tr>
<td>Red</td>
<td>1</td>
<td>+24 V</td>
</tr>
</tbody>
</table>
**THE DIMMING INPUTS**

Pulses of at least 60 ms on the dimming up and dimming down cables will cause the dimming to change by one level. The inputs are optocoupled and therefore require an external voltage to operate, (5 Volt -24 Volt (Typically 5/12/24 Volt)).
CHAPTER 2. Setting up and using the Compact Display

PRINCIPLES
The Compact Display is a flexible dot matrix LED display designed to display navigation data. The Multi repeater can be user programmed to show most kinds of numerical data from NMEA messages. It can also be used as a primary sensor display for speed logs showing the speed values produced by the sensor. The Compact with its JB60CD box meets all the requirements of a primary device both functionally and electrically. On its own it meets the requirements as a repeater. The Compact has three user definable alphanumeric displays, each allowing up to 4 lines to be displayed. When the device is used as a primary device, some of these screens will be fixed.

RUNTIME SCREENS
The Compact Display starts up in runtime mode. By pressing the MENU button, the preset runtime screens can be selected. The unit can be dimmed in any of the runtime screens using the UP and DOWN buttons.

MENU SCREENS
To change the setup of the Multi Repeater, the user must simultaneously press MENU and SET buttons. This will give access to a menu system allowing the user to scroll up and down the sub menus and functions using UP, DOWN and SET buttons to select. To move back up a menu, the MENU button must be pressed. The middle underlined line is the selected line. The other lines are dimmed.

The menu structure is shown in the MENU DIAGRAM. The menus are product dependant, only the relevant menus are accessible. Some menus are available in all setups.

Press both MENU and SET buttons to activate the menus. Press and hold MENU to return to runtime screen

SHifting SCREENS
The system can be made to shift, with a five second period, between the activated screens. Pressing MENU will pause this function, and holding MENU will reactivate it.
ACTIVATING THE RUNTIME SCREENS
The system has three user preset runtime screens (SCR1, SCR2, SCR3). The Screen Menu allows the user to configure and choose which runtime screens to be included in normal operation. UP and DOWN buttons will scroll to the available screens. By using the SET button, the user can control each individual screen to ON, OFF or SHIFTING. Screens set to ON are available to be displayed by pressing the MENU button. Screens set to OFF will not be displayed. Screens set to SHIFTING will be shown on the display periodically. Each shifting runtime screen will be displayed for 5 seconds.

If any screens are configured to SHIFTING, these selected screens will automatically start displaying periodically. The shifting of these preset runtime screens are stopped if the MENU button is pressed in runtime mode. By holding down the MENU button longer, the shifting will be started again.
### Screens (SCRN)
Select runtime screens
- ▲ Next sub menu
- ▼ Prev sub menu
SET select sub menu
MENU return

### Screen Configuration (CONFG)
Change the messages being displayed on each user screen
- ▲ Next sub menu
- ▼ Prev sub menu
SET select sub menu
MENU return

### Config (CONFG)
- ▲ Change display message
- ▼ Change display message
SET move to next position on screen
CFG 1
CFG 2
CFG 3
Menus, scrollable menu system
Accessed with SET and MENU pressed simultaneously
▲ Next sub menu
▼ Prev sub menu
SET select sub menu
MENU return

System Setup (SETUP)
Setup the system parameters
▲ Next sub menu
▼ Prev sub menu
SET select sub menu
MENU return

Diagnostics Advanced Setup (DIAG)
Diagnose and adjust less used parameters
▲ Next sub menu
▼ Prev sub menu
SET select sub menu
MENU return

Baud Settings (NMEA)
▲ Higher value
▼ Lower value

Code option activation (CODE)
Shows serial no
Code number with active digit underlined
▲ Increment underlined digit
▼ Move to next digit
SET activates the displayed code

Upgrade mode (UPGRD)
Allow the system to upgrade from cable

Demo (DEMO)
▲ Increment mode
▼ Decrement mode
MENU accept mode
Mode 1 = dynamic
Mode 2 = static
Off

Splash screen (INFO)
▲ Dimming up
▼ Dimming down
Option info
Software version

Self Tests (TEST)
▲ Next test
▼ Previous test
SET starts selected test
**Setup of Inputs**
The system will allow many NMEA formats to be displayed. The system will automatically update recognized formats.

**Changing of the Baud Rate**
The NMEA (IEC61162-1) standard is 4800 baud. Some vessels run with higher baud rates. 4800, 9600, 19200, 38400, 57600 and 115200 baud rates can be selected in the baud screen of the setup menu.

**Demo Mode**
A demo mode is available, and can be activated with MENU button in the diagnostics menu. Two modes are available.

- **Mode 1** is a dynamic demo mode taking the present value as the start point and slowly varying all the available values.
- **Mode 2** is a static mode taking the present values and keeping them active.

When the demo mode is active, alarms will be disabled, and the screen will indicate the demo state with a blinking S in the upper right corner. The user can turn off the demo mode from the demo screen, or by recycling the power. The demo mode will turn off automatically after 10 hours.

**Master Reset (Factory Default Settings)**
The factory default settings can be restored by performing the following operations:
1. Select CODE in diagnostic (DIAG) menu.
2. Press the SET button (Note: Do not change code value).

The unit will now restart with factory default settings.
CHAPTER 3. Configuring the screens

RUNTIME SCREENS
The unit starts up in runtime mode. By pressing the MENU button, the preset runtime screens (SCR1, SCR2, SCR3) can be selected. The unit can be dimmed in any of the runtime screens using the UP and DOWN buttons. If Trip/Total are selected as a displayed parameter, they can be toggled using the SET button. If wind speed is selected as a displayed parameter, the unit can be toggled between knots, m/s, or Beaufort using the SET button.

ACCEPTED NMEA SENTENCES
When using the Compact Display as a Multi Repeater, the display could be user programmed to show the most commonly used NMEA 0183 (IEC61162) messages for:

<table>
<thead>
<tr>
<th>Message</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth</td>
<td>Below surface, keel and transducer</td>
</tr>
<tr>
<td>Speed</td>
<td>Over ground and through water (longitudinal, transverse, aft and relative)</td>
</tr>
<tr>
<td>Distance</td>
<td>Total/trip for both ground and water</td>
</tr>
<tr>
<td>Heading</td>
<td>True, magnetic and relative</td>
</tr>
<tr>
<td>Rotation</td>
<td>Rate of turn and direction</td>
</tr>
<tr>
<td>Pitch and roll</td>
<td>In degrees</td>
</tr>
<tr>
<td>Wind</td>
<td>Speed and direction (true, magnetic and relative)</td>
</tr>
<tr>
<td>Temperature</td>
<td>Water and air</td>
</tr>
<tr>
<td>Drive</td>
<td>RPM (Revolutions Per Minute), propeller pitch and rudder position</td>
</tr>
<tr>
<td>Clock</td>
<td>UTC (Universal Time Coordinated), local time and Expected Time of Arrival (ETA)</td>
</tr>
<tr>
<td>Dimming</td>
<td>Display dimming</td>
</tr>
<tr>
<td>Auxillary</td>
<td>User defined NMEA messages</td>
</tr>
</tbody>
</table>

A summary of supported NMEA sentences is listed in Appendix 2.
**Configuration and Operational Screen**

The programming of parameters to show on the screen is very flexible. It is advised to add leading text before the parameters and not mixing too many different messages. A typical configuration is to show two related parameters on the screen simultaneously with leading text. Arrows are added to some parameters for better readability. Press MENU and SET button simultaneously to enter the main menu screen, select CONFIG and then select wanted screen (CFG1, CFG2 or CFG3) to start configure wanted screen. See chapter 2 "Setting up and using the Compact Display" on how to program the display to show wanted information on the screen.

**Configuring of Screens**

The 3 user programmable screens can be set up using the Config (CONFG) menu. This submenu allows the user to select one of the three screens, and on entering the Config screen, the user can change the data type to be displayed in each of the 4 screen positions. UP and DOWN will change the data type, SET will move to the next screen position.

Placing TXT in the bottom 4th line or 3rd and 4th line will cause the data to spread out showing fewer data points. The system will not allow you to mix speed data from different sources on the same screen. Having 2 TXT lines after each other will also rearrange the positioning. (See examples on next page).

The non-active parameters will continue showing the dimmed present data, when not selected. Some combinations of data are not allowed, as they may cause confusion. These will be automatically corrected. Note that the leading text is identical for some data, and information about talkers are ignored. Regulations require the user to be able to identify which data they are looking at. This can be achieved by using the TXT function or a sticker on the unit.
**Depth**

The NMEA sentences DPT, DBS, DBT, DBK and PSKPDPT are all supported for receiving information about the depth. The use of the DPT sentence is recommended when available. Depth values in feet and fathoms (from DBK, DBT and DBS) are converted to meters. The screen will display either DEPTH-S (depth below surface), DEPTH-T (depth below Transducer) or DEPTH-K (depth below keel) depending of the received sentences (DBS, DBT or DBK) or the offset value in DPT. The proprietary sentence PSKPDPT will also indicate the transducer location with an arrow in the text line.

The depth is always displayed in meters. Depth values below 10 meters are displayed with 2 decimals, depth values between 10 and 100 meters are displayed with 1 decimal and depth above 100 meters are displayed without decimals.

Maximum depth value to be displayed is 9999 meters.
**Speed**

The NMEA sentence VBW is supported for receiving information about the speed through water and speed over ground (bottom) for longitudinal, transverse and transverse aft. The NMEA sentences VHW and VTG are supported for receiving information about relative speed.

- An arrow, indicating the direction, is added in front of the value for speed values from the NMEA sentences VBW.
- The relative speed through water is fetched from the NMEA sentence VHW.
- The relative speed over ground is fetched from the NMEA sentence VTG.
- Speed value in km/h is converted to knots if speed value in knots is not available.
- Relative speed is displayed without arrows.
- All speed values are displayed in knots with one decimal. Maximum speed value to be displayed is +/- 99.9 knots.

Config. screen:

Runtime screen:
**Distance**

The NMEA sentence VLW are supported for receiving information about distances. The Trip/Total parameters for either water distance or ground distance can be toggled using the SET button.

The distance values are always displayed in nautical miles and the value will wrap around after reaching the maximum value of 99999. Total/trip values below 10 are displayed with two decimals, values between 10 and 1000 with one decimal and values above 1000 are displayed with no decimals.

**Configuration screen:**

**Runtime screen:**
**Heading**

The NMEA sentences VHW, VTG, THS, HDT, HDM and HDG are all supported for receiving information about the heading. It is recommended to use THS instead of HDT and HDG instead of HDM when available. The deviation and variation parameters in HDT are ignored.

If the same heading parameter is received from different talkers, the heading parameter will be prioritized as shown below:

2. GPS (GP).
3. Compass, magnetic (HC).
4. Others.

An arrow is added on the text line to indicate which direction the bow turns. If no change in heading from previous value, no arrow is displayed.

The heading value is always displayed with one decimal. Legal range for the heading to be displayed, are values in the range from 0 to 359.9°.

**Config. screen:**

**Runtime screen:**

Direction of turn is to port.

Direction of turn is to starboard.

No change in heading since last message.
Rotation
The NMEA sentence ROT is supported for receiving information about the rotation. A steady arrow is added on the text line to indicate which direction the bow turns.

- A positive received value indicates that bow turns to starboard and an arrow to the right is displayed.
- A negative received value indicates that bow turns to port and an arrow to the left is displayed.
- A value of zero indicates no rotation and no arrow is displayed.

Values below 99.9 are displayed with one decimal. Values above 100 are displayed with no decimals. Maximum value to display is +/- 999°/min.

Configuration screen:

Runtime screen:
**Pitch and Roll**
The NMEA sentence XDR, version B is supported for receiving information about the Pitch and Roll.

- A positive received value for Pitch indicates that the bow is up and negative if bow is down.
- A positive received value for Roll indicates that port is up and starboard is down, a negative value indicates that starboard is up and port is down.

Values below 10 degrees are displayed with two decimals and values above 10 degrees with one decimal. Maximum value to be displayed is +/- 359.9°.

**Configuration screen:**

**Runtime screen:**
Wind
The NMEA sentences MWV, VWR, VWT and MWD are all supported for receiving information about the wind speed and direction. MWV is recommended instead of VWR and VWT, when available. All wind speed units are accepted (knots (N), m/s (M) and km/h (K)) and converted to wanted speed units to display on the screen. Speed units on the display may be toggled between kn (knots), m/s and Bft (Beaufort) by pressing the SET-button.

A graphical representation of the wind angle is displayed if the following parameters are selected:

- TXT must be selected for the first two parameters.
- One wind angle must be selected.
- Corresponding wind speed from the same NMEA sentence could be selected. Otherwise TXT must be selected.
- The wind angle is represented by an arrow on the screen.

See chapter 2 ”Setting up and using the Compact Display” for details how to set up the screen.

The range of values to be displayed, are:

- Speed: 0 - 99.9 knots.
- Heading: 0 – 359.9°.
Wind, (continued from previous page):

**Config. screen:**

**Runtime screen:**

SET button has been pressed for toggling the speed units to m/s.

**Configuration screen:**

**Runtime screen:**

SET button has been pressed for changing between knots, m/s and Beaufort units.
Temperature

The NMEA sentences MTA, MTW and MDA are supported for receiving information about the air (MTA or MDA) and water (MTW) temperatures. Air temperature from MDA is used if data from MTA is not available.

Temperatures are displayed in degree Celsius. Values below 10 degrees are displayed with two decimals and values above 10 degrees with one decimal. The maximum/minimum temperatures to be displayed are +/- 99.9 °C.

Configuration screen:

Runtime screen:
Drive

- The NMEA sentence RPM is supported for receiving information about the speed revolutions (rev/min) and propeller pitch (% of maximum).
- The NMEA sentence RSA is supported for receiving information about the rudder angle.

The speed revolution values below 999.9 is displayed with one decimal and values above 1000 is displayed without decimals. Propeller pitch values below 10 degrees are displayed with two decimals and values above 10 degrees with one decimal.

- Max./min. value to be displayed for speed revolution is +/- 9999 rev/min.
- Max./min. value to be displayed for propeller pitch is +/- 100 %.
- Max./min. value to be displayed for rudder angle is +/- 359.9 °.

Configuration screen:

Runtime screen:
**Clock/UTC**

The UTC is fetched from either of the NMEA sentences ZTG, ZDA, GGA or RMC, prioritized in the same order. The NMEA sentences ZDA is used for receiving information about the local time. The NMEA sentences ZTG is used for receiving information about expected time of arrival. Maximum offset for displayed time of "Expected Time of Arrival" is 24 hours. All time values are displayed with the format hh:mm, where hh are hours and mm are minutes.

**Display Dimming Control**

The brightness of the display can be controlled by the NMEA sentence DDC. Note that the brightness also can be controlled by buttons on the display and remote dimmer control (IR30DIM). Both the Brightness Percentage and Display Dimming Preset are supported in the NMEA sentence DDC. (See Appendix 2).
**Auxiliary**

A proprietary NMEA sentence is supported which allow the user to define up to 4 additional parameters to be displayed from any specified NMEA sentence(s). This proprietary NMEA sentence has the following format:

\[
\text{SPSKPCCPNMEA}, <\text{Auxillary number}>,<\text{Header}>,<\text{Data Field number}>,<\text{Type}>, <\text{Status field number}>,<\text{Status valid character}>,<\text{Text}>*\text{hh}<\text{CR}><\text{LF}>
\]

**Example:** Fetch a proprietary NMEA sentence for roll & pitch and display the values: $PPPRP,<a>,<b><CR><LF>$ where $<a>$ is roll data parameter and $<b>$ is pitch data parameter.

Fetch also the parameters for both port and starboard rudder angle from the following NMEA message: $SGRSA,<a>,A,<b>,A<CR><LF>$ where $<a>$ is starboard rudder sensor and $<b>$ is port rudder sensor and 'A' is status for each corresponding data field parameter. The following NMEA sentences must be sent to the Compact display to accept these parameters:

\[
\begin{align*}
\text{SPSKPCCPNMEA},1,\text{PPPRP},0,8,,R\text{OLL}<\text{CR}><\text{LF}> \\
\text{SPSKPCCPNMEA},1,\text{PPPRP},0,8,,P\text{ITCH}<\text{CR}><\text{LF}> \\
\text{SPSKPCCPNMEA},3,\text{SGRSA},0,8,1,A,S\text{RUD}<\text{CR}><\text{LF}> \\
\text{SPSKPCCPNMEA},4,\text{SGRSA},2,8,3,A,P\text{RUD}<\text{CR}><\text{LF}>
\end{align*}
\]

Select the AUX1 in the menu to display the roll parameter, select the AUX2 in the menu to display the pitch parameter, select AUX3 in the menu to display the starboard rudder angle and AUX4 in the menu to display the port rudder angle.

**Configuration screen:**

**Runtime screen:**

**Received NMEA sentence:**

$PPPRP,12.31,1.22$  $SGRSA,3,4,A,0.2,A$
**Error Handling**

All parameters within each NMEA sentences are checked for checksum, legal range, validity and timeout.

**Bad checksum ( - - - - -)**

If the Checksum Field (*hh) is present, the value is checked. The screen will indicate bad checksum by displaying minus signs instead of the value (- - - - -). If no Checksum Field is present, no checking is performed.

**Illegal range and validity (. . . . .)**

Some values must be within a range. If a value is out of range, the following exception is performed:

- **Wrap around**: The displayed value will start from zero again after reaching the maximum/minimum value (Trip values, only).
- **Limited value**: The maximum or minimum value will be displayed (Speed and temperature values).
- **Illegal value**: The value has no meaning (ex. heading values above 360°). The screen will indicate illegal value by displaying dots instead of the value (. . . .).

A Null field is a field in the NMEA sentence without any character between two delimiter characters. A Null field indicates that the value is unreliable or not available. The screen will indicate a Null field by displaying dots instead of the value (. . . . . ) if no value is received within the timeout timeframe.

Some parameters has a status parameters associated with them (A = data valid, V = data invalid). The screen will indicate an invalid parameter by displaying dots instead of the value (. . . . . ) if no new valid value is received within the timeout timeframe.

**Timeout (ERROR)**

The timeout value for each parameter within each NMEA sentence is 10 seconds. The screen will indicate timeout by displaying an error message (ERROR) if no new value is received within the timeout timeframe.
CHAPTER 4. Maintenance

ROUTINE MAINTENANCE
No maintenance is required. The screen can be cleaned with a soft cloth.

CHECKING YOUR VERSION
If the Info screen is activated on the run screens, the system type and firmware version can be read from there. Otherwise the same screen can be obtained in the diagnostics menu. The system type will be one of the following:

<table>
<thead>
<tr>
<th>System Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CD E1</td>
<td>Compact display EML 1 Axis.</td>
</tr>
<tr>
<td>CD E2</td>
<td>Compact display EML 2 Axis.</td>
</tr>
<tr>
<td>CD EB</td>
<td>Compact display EML 2 Axis backwards.</td>
</tr>
<tr>
<td>CD LR</td>
<td>Compact display Log Repeater.</td>
</tr>
<tr>
<td>CD MR</td>
<td>Compact display Multi Repeater.</td>
</tr>
<tr>
<td>CD MB</td>
<td>Compact display Multi Repeater backwards.</td>
</tr>
</tbody>
</table>

The system will be locked to one of these setups, but can be changed to one of the other systems (with an additional cost) using a code (see Appendix 4).

FIRMWARE UPGRADE
The system is undergoing continuously improvements, and periodically new firmware will be released. A chip can be supplied (with an additional cost) with the new software. This is changed by removing the backplate of the Compact display.

MOUNTING THE MULTI REPEATER FACING AFT.
The Compact Display could also be set up to operate in ”Multi Repeater, Backwards” mode. In this mode all speeds are in opposite direction. See the section ”MAINTENANCE” on how to change the system setup. The parameters in ”Multi Repeater, Backwards” mode will be replaced according to the following:

- \( STWWL = - STWWL \)
- \( SOGBL = - SOGBL \)
- \( STWWT = - STWWA \)
- \( SOGBT = - SOGBA \)
- \( STWWA = - STWWT \)
- \( SOGBA = - SOGBT \)
## APPENDIX 1. Specifications and mechanical drawing

### SYSTEM SPECIFICATION

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Display</td>
<td>28 x 30 pixel, Alphanumeric LED (red). With dimming.</td>
</tr>
<tr>
<td>Languages</td>
<td>English.</td>
</tr>
<tr>
<td>Accessories</td>
<td>Dimming control.</td>
</tr>
<tr>
<td>Classification</td>
<td>IMO MED B.</td>
</tr>
<tr>
<td>Service</td>
<td>Available in most major harbours, world-wide through extensive dealer network. See <a href="http://www.skipper.no">www.skipper.no</a> for further information.</td>
</tr>
</tbody>
</table>

### DISPLAY

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight (display)</td>
<td>1.3 kg.</td>
</tr>
<tr>
<td>Cable length</td>
<td>2 m (can be extended).</td>
</tr>
<tr>
<td>Compass safe distance (min)</td>
<td>30 cm.</td>
</tr>
<tr>
<td>User adjustable screens</td>
<td>3</td>
</tr>
<tr>
<td>Parameters per screen</td>
<td>2 with text, 3 with single text line.</td>
</tr>
</tbody>
</table>

### INPUTS/OUTPUTS

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outputs</td>
<td>2 x NMEA (IEC61162-1) (2007).</td>
</tr>
<tr>
<td>Inputs</td>
<td>1 x NMEA (IEC61162-1) (2007).</td>
</tr>
<tr>
<td></td>
<td>External Dimming (up and down pulses).</td>
</tr>
</tbody>
</table>
MECHANICAL DIMENSIONS

Console mounting order:
A. Make a cut out in the Console (1) 125 x 125 (4.921 x 4.921)
B. Remove the mounting bracket (2)
C. Unscrew the 4 screws in the frame (3) (one in each corner) and remove the frame.
D. Put the Monitor (4) in the cut out and mark the 4 counterpoints for the drill in the Console (1).
The drilling holes diam. depends on thickness and material in the Console.
E. Use Panh. screws DIN 7981 Diam. 2.5 (0.126). Length depends on the console thickness.
F. Finally put on the frame (3). Make sure that the screwheads correspond with the cut outs in the frame.
## APPENDIX 2. Accepted NMEA 0183 Sentences

### SUMMARY

<table>
<thead>
<tr>
<th>NMEA Sentence</th>
<th>Description</th>
<th>Parameter Name</th>
<th>Screen name</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Depth</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DPT</td>
<td>Water Depth in meters</td>
<td>DPT</td>
<td>DEPTH-K</td>
</tr>
<tr>
<td>DBK</td>
<td>Water Depth below Keel in meters</td>
<td>DBK</td>
<td>DEPTH-K</td>
</tr>
<tr>
<td>DBT</td>
<td>Water Depth below Transducer in meters</td>
<td>DBT</td>
<td>DEPTH-T</td>
</tr>
<tr>
<td>DBS</td>
<td>Water Depth below Surface in meters</td>
<td>DBS</td>
<td>DEPTH-S</td>
</tr>
<tr>
<td>PSKPDPT</td>
<td>SKIPPER proprietary depth sentence</td>
<td>PDPT</td>
<td>DEPTH-K</td>
</tr>
<tr>
<td><strong>Speed</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VBW</td>
<td>Longitudinal Water Speed</td>
<td>STWWL</td>
<td>STW</td>
</tr>
<tr>
<td></td>
<td>Transverse Water Speed</td>
<td>STWWT</td>
<td>STW</td>
</tr>
<tr>
<td></td>
<td>Transverse Water Speed, Aft</td>
<td>STWWA</td>
<td>STW</td>
</tr>
<tr>
<td></td>
<td>Longitudinal Ground Speed</td>
<td>SOGBL</td>
<td>SOG</td>
</tr>
<tr>
<td></td>
<td>Transverse Ground Speed</td>
<td>SOGBT</td>
<td>SOG</td>
</tr>
<tr>
<td></td>
<td>Transverse Ground Speed, Aft</td>
<td>SOGBA</td>
<td>SOG</td>
</tr>
<tr>
<td>VHW</td>
<td>Speed Through Water in knots, relative</td>
<td>STW-R</td>
<td>STW-R</td>
</tr>
<tr>
<td>VTG</td>
<td>Speed over Ground in knots, relative</td>
<td>SOG-R</td>
<td>SOG-R</td>
</tr>
<tr>
<td><strong>Distance</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VLW</td>
<td>Water-track Distance since reset</td>
<td>TRIPW</td>
<td>TRIPW</td>
</tr>
<tr>
<td></td>
<td>Water-track Total distance</td>
<td>TOTLW</td>
<td>TOTLW</td>
</tr>
<tr>
<td></td>
<td>Bottom-track Distance since reset</td>
<td>TRIPB</td>
<td>TRIPB</td>
</tr>
<tr>
<td></td>
<td>Bottom-track Total distance</td>
<td>TOTLB</td>
<td>TOTLB</td>
</tr>
<tr>
<td><strong>Heading</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VHW</td>
<td>Heading, degrees, true</td>
<td>HDW-T</td>
<td>HDG.T</td>
</tr>
<tr>
<td></td>
<td>Heading, degrees, magnetic</td>
<td>HDW-M</td>
<td>HDG.M</td>
</tr>
<tr>
<td>VTG</td>
<td>Heading (Course Over Ground), degrees, true</td>
<td>COG-T</td>
<td>COG.T</td>
</tr>
<tr>
<td></td>
<td>Heading (Course Over Ground), degrees, magnetic</td>
<td>COG-M</td>
<td>COG.M</td>
</tr>
<tr>
<td>THS</td>
<td>Heading, degrees, true</td>
<td>THS</td>
<td>HDG.T</td>
</tr>
<tr>
<td>HDT</td>
<td>Heading, degrees, true</td>
<td>HDT</td>
<td>HDG.T</td>
</tr>
<tr>
<td>HDM</td>
<td>Heading, degrees, magnetic</td>
<td>HDM</td>
<td>HDG.M</td>
</tr>
<tr>
<td>HDG</td>
<td>Heading, degrees, magnetic</td>
<td>HDG</td>
<td>HDG.M</td>
</tr>
<tr>
<td><strong>Rotation</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ROT</td>
<td>Rate of Turn in degrees/minute</td>
<td>ROT</td>
<td>ROT</td>
</tr>
<tr>
<td>NMEA Sentence</td>
<td>Description</td>
<td>Parameter Name</td>
<td>Screen name</td>
</tr>
<tr>
<td>---------------</td>
<td>-------------</td>
<td>----------------</td>
<td>-------------</td>
</tr>
<tr>
<td>Pitch and roll</td>
<td>Pitch</td>
<td>PITCH</td>
<td>PITCH</td>
</tr>
<tr>
<td></td>
<td>Roll</td>
<td>ROLL</td>
<td>ROLL</td>
</tr>
<tr>
<td>Wind</td>
<td>MWV</td>
<td>Wind angle, Theoretical (True)</td>
<td>MWVAT</td>
</tr>
<tr>
<td></td>
<td>Wind angle, Relative</td>
<td>MWVAR</td>
<td>WIND-R</td>
</tr>
<tr>
<td></td>
<td>Wind Speed in knots</td>
<td>MWVNT</td>
<td>WIND-T</td>
</tr>
<tr>
<td></td>
<td>Wind speed in m/s</td>
<td>MWVMT</td>
<td>WIND-T</td>
</tr>
<tr>
<td></td>
<td>Wind speed in Beaufort</td>
<td>MWVBT</td>
<td>WIND-T</td>
</tr>
<tr>
<td></td>
<td>Wind Speed in knots</td>
<td>MWVNR</td>
<td>WIND-R</td>
</tr>
<tr>
<td></td>
<td>Wind speed in m/s</td>
<td>MWVMR</td>
<td>WIND-R</td>
</tr>
<tr>
<td></td>
<td>Wind speed in Beaufort</td>
<td>MWVBR</td>
<td>WIND-R</td>
</tr>
<tr>
<td></td>
<td>VWR</td>
<td>Wind angle, Relative</td>
<td>VWR-A</td>
</tr>
<tr>
<td></td>
<td>Wind Speed in knots</td>
<td>VWR-N</td>
<td>WIND-R</td>
</tr>
<tr>
<td></td>
<td>VWT</td>
<td>Wind angle, True</td>
<td>VWT-A</td>
</tr>
<tr>
<td></td>
<td>Wind Speed in knots</td>
<td>VWT-N</td>
<td>WIND-T</td>
</tr>
<tr>
<td></td>
<td>MWD</td>
<td>Wind angle, True</td>
<td>MWD-T</td>
</tr>
<tr>
<td></td>
<td>Wind angle, Magnetic</td>
<td>MWD-M</td>
<td>WIND.M</td>
</tr>
<tr>
<td></td>
<td>Wind Speed in knots</td>
<td>MWD-N</td>
<td>WIND</td>
</tr>
<tr>
<td>Temp.</td>
<td>MTA, MDA</td>
<td>Air Temperature in degree Celcius</td>
<td>ATEMP</td>
</tr>
<tr>
<td></td>
<td>MTW</td>
<td>Water Temperature in degree Celcius</td>
<td>WTEMP</td>
</tr>
<tr>
<td>Drive</td>
<td>RPM</td>
<td>Revolutions / min</td>
<td>RPM</td>
</tr>
<tr>
<td></td>
<td>Propeller Pitch (% of maximum)</td>
<td>PPTCH</td>
<td>P.PITCH</td>
</tr>
<tr>
<td></td>
<td>RSA</td>
<td>Rudder Sensor Angle</td>
<td>RSA</td>
</tr>
<tr>
<td>Clock/UTC</td>
<td>ZTG, ZDA, GGA, RMC</td>
<td>UTC (hh:mm)</td>
<td>UTC</td>
</tr>
<tr>
<td></td>
<td>ZDA</td>
<td>Local Time (hh:mm)</td>
<td>LOC</td>
</tr>
<tr>
<td></td>
<td>ZTG</td>
<td>Expected Time of Arrival (UTC) (hh:mm)</td>
<td>ETA</td>
</tr>
<tr>
<td>Display dimming</td>
<td>DDC</td>
<td>Display Dimming Control</td>
<td></td>
</tr>
<tr>
<td>Auxillary</td>
<td>Defined by proprietary NMEA sentence</td>
<td>User defined message 1 (Auxillary 1)</td>
<td>AUX1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>User defined message 2 (Auxillary 2)</td>
<td>AUX2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>User defined message 3 (Auxillary 3)</td>
<td>AUX3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>User defined message 4 (Auxillary 4)</td>
<td>AUX4</td>
</tr>
</tbody>
</table>
**Detailed Description**

**Depth:**

Depth

$--DPT, x.x, x.x*hh<CR><LF>

- Offset from transducer, in meters (see **Note 1**)
  - Water depth relative to the transducer, in meters

Depth Below Surface

$--DBS, x.x, f, x.x, M, x.x, F*hh<CR><LF>

- Water depth relative to the surface, in fathoms
- Water depth relative to the surface, in meters
- Water depth relative to the surface, in feet

Depth Below Transducer

$--DBT, x.x, f, x.x, M, x.x, F*hh<CR><LF>

- Water depth relative to the transducer, in fathoms
- Water depth relative to the transducer, in meters
- Water depth relative to the transducer, in feet

Depth Below Keel

$--DBK, x.x, f, x.x, M, x.x, F*hh<CR><LF>

- Water depth relative to the keel, in fathoms
- Water depth relative to the keel, in meters
- Water depth relative to the keel, in feet

**Note 1:** Positive value indicates distance from transducer to water line.
Negative value indicates distance from transducer to keel.
### Speed:

#### Dual Ground/Water Speed

$--VBW,x.x, x.x, A, x.x, x.x, A, x.x, A, x.x, A*hh<CR><LF>

- Status, stern ground speed
  - A= data valid, V= data invalid
- Stern transverse ground speed, in knots SOGBA
- Status, stern water speed.
  - A= data valid, V= data invalid
- Stern transverse water speed, in knots STWAA
- Status, ground speed
  - A= data valid, V= data invalid
- Transverse ground speed, in knots SOGBT
- Longitudinal ground speed, in knots SOGBL
- Status, water speed.
  - A= data valid, V= data invalid
- Transverse water speed, in knots STWWT
- Longitudinal water speed, in knots STWWL

#### Water Speed and Heading

$--VHW, , , , , x.x, N, x.x, K*hh<CR><LF>

- Relative water speed, in km/h STW-R
- Relative water speed, in knots

#### Course Over Ground and Ground Speed

$--VTG, , , , , x.x, N, x.x, K*hh<CR><LF>

- Relative ground speed, in km/h SOG-R
- Relative ground speed, in knots

### Distance:

#### Dual Ground/Water Speed

$--VLW, x.x, N, x.x, N, x.x, N, x.x, N*hh<CR><LF>

- Ground distance since reset TRIPB
- Total cumulative ground distance TOTLB
- Water distance since reset TRIPW
- Total cumulative water distance TOTLW

**Note:** All distance values must be specified in nautical miles.
### Heading:

**Water Speed and Heading**

\[ \$--VHW, x.x, T, x.x, M, , , ,*hh<CR><LF> \]

- Heading, degrees magnetic: HDW-M
- Heading, degrees true: HDW-T

**Course Over Ground and Ground Speed**

\[ \$--VTG, x.x, T, x.x, M, , , ,*hh<CR><LF> \]

- Course over ground, degrees magnetic: COG-M
- Course over ground, degrees true: COG-T

**True Heading and Status**

\[ \$--THS, x.x, a*hh<CR><LF> \]

- Mode indicator (see **Note**)
- Heading, degrees true: THS

**Note**: The Mode indicator is ignored

**Heading True**

\[ \$--HDT, x.x, T*hh<CR><LF> \]

- Heading, degrees true: HDT

**Heading Magnetic**

\[ \$--HDM, x.x, M*hh<CR><LF> \]

- Heading, degrees magnetic: HDM

**Heading, Deviation and Variation**

\[ \$--HDG, x.x, , , ,*hh<CR><LF> \]

- Magnetic sensor heading, degrees: HDG

### Rotation:

**Rate Of Turn**

\[ \$--ROT, x.x, A*hh<CR><LF> \]

- Status: A=data valid, V=data invalid
- Rate of turn (°/min), ”-” = bow turns to port: ROT
Pitch and Roll

Transducer Measurements
$--XDR, a, x.x, D, PTCH, a, x.x, D, ROLL*hh<CR><LF>

- Transducer ID must be set to ROLL
- Units of measure, D = degrees
- Measurement data for Roll
- Transducer type must be set to A
  (Angular displacement)
- Transducer ID must be set to PTCH
- Units of measure, D = degrees
- Measurement data for Pitch
- Transducer type must be set to A
  (Angular displacement)

Wind:

Wind Speed and Angle
$--MWV, x.x, a, x.x, a, A*hh<CR><LF>

- Status, A = data valid, V = data invalid
- Wind speed units,
  K = km/h
  M = m/s
  N = knots
- Wind speed
- Reference,
  R = relative
  T = true
- Wind angle, 0° to 359°

Relative Wind Speed and Angle
$--VWR, x.x, a, x.x, N, x.x, M, x.x, K*hh<CR><LF>

- Wind speed in km/h
- Wind speed in m/s
- Wind speed in knots
- Left/right L/R of vessel heading
- Wind angle relative to the vessel, 0 to 180°

True Wind and Speed Angle
$--VWT, x.x, a, x.x, N, x.x, M, x.x, K*hh<CR><LF>

- Wind speed in km/h
- Wind speed in m/s
- Wind speed in knots
- Left/right L/R of vessel heading
- Wind angle relative to the vessel, 0 to 180°
### Wind:

**Wind Direction and Speed**

$\text{--MWD, x.x, T, x.x, M, x.x, N, x.x, M*hh<CR><LF>}$

- Wind speed, m/s $\text{MWD-N}$
- Wind speed, knots
- Wind direction, 0 to 359 degrees Magnetic $\text{MWD-M}$
- Wind direction, 0 to 359 degrees True $\text{MWD-T}$

### Temperature:

**Air Temperature**

$\text{--MTA, x.x, C*hh<CR><LF>}$

- Temperature, degree C $\text{ATEMP}$

**Meteorological Composite**

$\text{--MDA, , , , , , x.x, C, , , , , , , , , , , , , , *hh<CR><LF>}$

- Air temperature, degree C $\text{ATEMP}$

**Water Temperature**

$\text{--MTW, x.x, C*hh<CR><LF>}$

- Temperature, degree C $\text{WTEMP}$

### Drive:

**Revolutions**

$\text{--RPM, , x.x, x.x, A*hh<CR><LF>}$

- Status: $A=\text{data valid}, V=\text{data invalid}$
- Propeller pitch, % of max, ",-"=astern $\text{PPTCH}$
- Speed, revolutions/min, ",-" counter clockwise $\text{RPM}$

**Rudder Sensor Angle**

$\text{--RSA, x.x, A, , hh<CR><LF>}$

- Status: $A=\text{data valid}, V=\text{data invalid}$
- Rudder sensor $\text{RSA}$
## Clock / UTC

### UTC & Time to Destination Waypoint

$--ZTG, hhmmss.ss, hhmmss.ss,*hh<CR><LF>

<table>
<thead>
<tr>
<th>Parameter name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time-to-go (max 24 h)</td>
<td>ETA</td>
</tr>
<tr>
<td>UTC of observation</td>
<td>UTC</td>
</tr>
</tbody>
</table>

### Time & Date

$--ZDA, hhmmss.ss, , , x.x, x.x*hh<CR><LF>

<table>
<thead>
<tr>
<th>Parameter name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local zone minutes, 00 to +59</td>
<td>LOC</td>
</tr>
<tr>
<td>Local zone hours, 00 to +/- 13</td>
<td></td>
</tr>
<tr>
<td>UTC of observation</td>
<td>UTC</td>
</tr>
</tbody>
</table>

### Global Positioning System Fix Data

$--GGA, hhmmss.ss, , , , , , , , , , , , ,*hh<CR><LF>

<table>
<thead>
<tr>
<th>Parameter name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>UTC of position</td>
<td>UTC</td>
</tr>
</tbody>
</table>

### Recommended Minimum Specific GNSS Data

$--RMC, hhmmss.ss, , , , , , , , , , , , ,*hh<CR><LF>

<table>
<thead>
<tr>
<th>Parameter name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>UTC of position</td>
<td>UTC</td>
</tr>
</tbody>
</table>

## Display Dimming:

### Display Dimming Control

$--DDC, a, xx,*hh<CR><LF>

<table>
<thead>
<tr>
<th>Parameter name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brightness Percentage:</td>
<td>00 (min) to 99 (max)</td>
</tr>
<tr>
<td>Display Dimming Preset:</td>
<td>D = Day time setting (max)</td>
</tr>
<tr>
<td></td>
<td>K = Dusk setting</td>
</tr>
<tr>
<td></td>
<td>N = Night time setting</td>
</tr>
<tr>
<td></td>
<td>O = Backlight off setting (min)</td>
</tr>
</tbody>
</table>
**Auxillary:**

SKIPPER proprietary

$PSKPPCCPNMEA, <Auxillary number>,<Header>,<Data Field number.>,<Type>,
< Status field number >,< Status valid character >,<Text>*hh<CR><LF>

- **<Auxillary number>**
  The auxillary number for the wanted user defined parameter. Each additional parameter must be defined with an unique auxillary number.
  Legal values are 1, 2, 3 or 4.

- **<Header>**
  This character string follows the ’$’-sign in the specified NMEA sentence. Up to 15 characters could be defined here.

- **<Data field number>**
  Field number for the data to receive within the specified NMEA sentence, starting with 0 after the first field delimiter. Legal values will be limited by the maximum number of characters in a NMEA sentence.

- **<Type>**
  Data type of the parameter. The following data types are defined:

  - 0: Unsigned value
  - 1: Signed value
  - 2: Depth in meters
  - 3: Speed without arrow and postfix
  - 4: Longitudinal speed with arrow
  - 5: Transverse speed with arrow
  - 6: Speed with knots as postfix
  - 7: Heading with arrow to indicate the direction the bow turns
  - 8: Heading / Direction without arrow
  - 9: Rotation
  - 10: Temperature
  - 11: Percentage

  See table of summary of supported data types for user defined messages

- **<Status field number.>**
  Field number for status within the specified NMEA sentence, starting with 0 after the first field delimiter. Legal values will be limited by the maximum number of characters in a NMEA sentence.

- **<Status valid character>**
  The valid character for the status field is defined here. The data in the data field will only be valid if the status field contains this specified character. A Null field indicates that the status field is not used and the recieved parameter data is always valid.

- **<Text>**
  Character string to be displayed if text (TXT) is selected. Only large english characters are accepted. The string can be up to 5 characters long, but limited to 3 characters for some types, see the description <Type> for limitations.

  The text is truncated if more characters are defined. A Null field is interpreted as blank text.
Summary of supported Data Types for User defined messages:

<table>
<thead>
<tr>
<th>Data Type No.</th>
<th>Data Type name</th>
<th>Legal Data Type Range</th>
<th>Screen output</th>
<th>Format / Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Min.</td>
<td>Max.</td>
<td>Out of range (screen)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Below</td>
<td>Above</td>
<td>Pre-fix</td>
</tr>
<tr>
<td>0</td>
<td>Unsigned value</td>
<td>-99999.99</td>
<td>99999.99</td>
<td>‘.....’</td>
</tr>
<tr>
<td>1</td>
<td>Signed value</td>
<td>-99999.99</td>
<td>99999.99</td>
<td>‘.....’</td>
</tr>
<tr>
<td>2</td>
<td>Depth in meters</td>
<td>0</td>
<td>99999.99</td>
<td>‘.....’</td>
</tr>
<tr>
<td>3</td>
<td>Speed without arrow and postfix</td>
<td>-99.9</td>
<td>99.9</td>
<td>‘99.9’</td>
</tr>
<tr>
<td>4</td>
<td>Longitudinal speed with arrow</td>
<td>-99.9</td>
<td>99.9</td>
<td>‘99.9’</td>
</tr>
<tr>
<td>5</td>
<td>Transverse speed with arrow</td>
<td>-99.9</td>
<td>99.9</td>
<td>‘99.9’</td>
</tr>
<tr>
<td>6</td>
<td>Speed with knots as postfix</td>
<td>-99.9</td>
<td>99.9</td>
<td>‘99.9’</td>
</tr>
<tr>
<td>7</td>
<td>Heading with arrow to indicate the direction the bow turns</td>
<td>0</td>
<td>360</td>
<td>‘.....’</td>
</tr>
<tr>
<td>8</td>
<td>Heading / Direction without arrow</td>
<td>0</td>
<td>360</td>
<td>‘.....’</td>
</tr>
<tr>
<td>9</td>
<td>Rotation</td>
<td>-999</td>
<td>999</td>
<td>‘.....’</td>
</tr>
<tr>
<td>10</td>
<td>Temperature</td>
<td>-99.99</td>
<td>99.9</td>
<td>‘-99.9’</td>
</tr>
<tr>
<td>11</td>
<td>Percentage</td>
<td>-100</td>
<td>100</td>
<td>‘.....’</td>
</tr>
</tbody>
</table>
APPENDIX 3. Sending the system for repair

In case of failure, it may be necessary to send a part of the system back for repair. Make contact with your local dealer for warranty case (list available on www.skipper.no).

On contact with SKIPPER the case will be given a SKIPPER id number. This number should be quoted on all correspondance, and marked clearly on all parts returned.

For normal service/support, please contact SKIPPER Electronics AS on mail support@skipper.no or our local dealer (list available on www.skipper.no).
APPENDIX 4. Other options with the Multi Repeater

COMPACT OPTIONS

The Compact Display can be set up for one of the following systems:

<table>
<thead>
<tr>
<th>LR</th>
<th>Speed Repeater</th>
</tr>
</thead>
<tbody>
<tr>
<td>E1 (EML124 Compact)</td>
<td>Single Axis EML With Electronic unit (JB60CD), sensor and cables</td>
</tr>
<tr>
<td>E2 (EML224 Compact)</td>
<td>Dual Axis EML With Electronic unit (JB60CD), sensor and cables</td>
</tr>
<tr>
<td>EB (EML224 Compact)</td>
<td>Dual Axis EML Backwards With Electronic unit (JB60CD), sensor and cables</td>
</tr>
<tr>
<td>MR</td>
<td>Multi Repeater</td>
</tr>
<tr>
<td>MB</td>
<td>Multi Repeater Backwards</td>
</tr>
</tbody>
</table>

- **Speed Repeater**: A simple repeater for speed in 1 and 2 axis and trip. Limited functionality.
- **Single Axis EML**: As above plus primary display for speed logs showing longitudinal speed values produced by the sensor.
- **Dual Axis EML**: As above, but showing both longitudinal and transverse speed values produced by the sensor.
- **Dual Axis EML Backwards**: As above, but can be connected to an external switch for showing the speeds in opposite direction.
- **Multi Repeater**: A comprehensive repeater for many of the most common used NMEA messages. Functions also for user defined messages.
- **Multi Repeater Backwards**: As above, but the speeds are shown in opposite direction.

The software for all these systems is stored in the flash memory and the system configuration can be changed using a security code. This code can be obtained from www.skipper.no. By sending an order to SKIPPER together with the systems serial number. (Obtained by opening the code screen in diagnostics). On entering the supplied code number, the system options will be set. Please note that the cabling is different for repeaters and speed logs, so these are not compatible without replacing the back plate.
**CHANGING THE SYSTEM/ADDING OPTIONS**

The Compact display unit is being developed as a low cost display alternative to full graphics displays already available. Most extra features are available for the Compact and these can be activated using the CODE page in the DIAG menu. On this menu, the systems unique ID is displayed, and the new options can be purchased from the SKIPPER retailer to add extra functions. You will receive a code to be entered into the CODE page by using the arrow buttons.

**NOTE:** It is important to note that pay option codes are unique for each individual unit and will not work on other units.