

# SKIPPER

## Multi Repeater

CD401MR-SB

### Operation and Installation Manual



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## CD401MR-SB Operation and Installation Manual

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# OVERVIEW.

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## 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 Multi Repeater display

The Compact Multi Repeater 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 Multi Repeater display in this configuration

## Appendix 3 - 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.

## Appendix 4 - Current

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.

## Appendix 5 - Sending the system for repair

In the unfortunate case of a failure that requires a factory repair, the described return sequence should be followed.

# TERMINOLOGY. Terms used in this manual

## UNITS

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

Depth	Meters
Speed	Nautical miles per hour (knots)
Distance	Nautical miles (nm)
Heading	Degrees (0 – 359.9°)
Rotation	Degrees per minute (°/min)
Pitch and roll	Degrees (0 – 359.9°)
Wind	Nautical miles per hour (knots)
	Meter per seconds (m/s)
	Beaufort (Bft)
Temperature	Degrees Celcius (°C)
Speed revolutions	Revolutions per minute (rev/min)
Rudder angle	Degrees (0 – 359.9°)
Propeller pitch	Percentage of maximum (0 -100 %)
Clock /UTC	hh:mm (00:00 – 23:59)

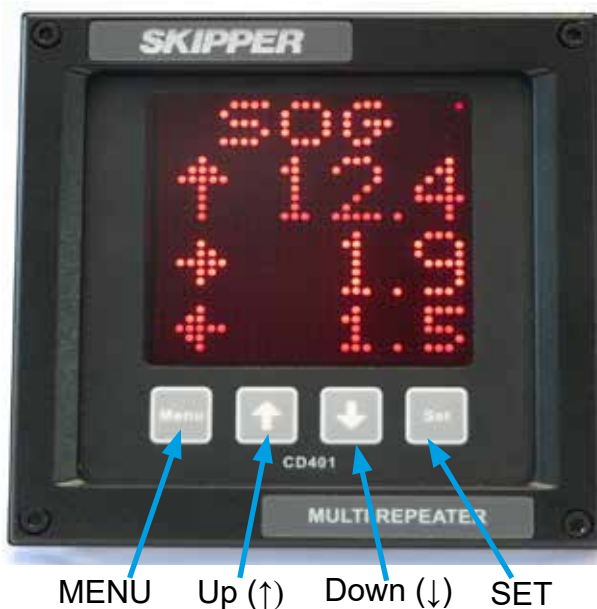
## ABBREVIATIONS

In addition the following symbols are used on the runtime screens:

T <sub>p</sub>	Daily trip (in nm)
T <sub>L</sub>	Total measured distance travelled (in nm)
°	Degrees
%	Percentage
←↑→↓	Direction

## INTRODUCTION. The Multi Repeater

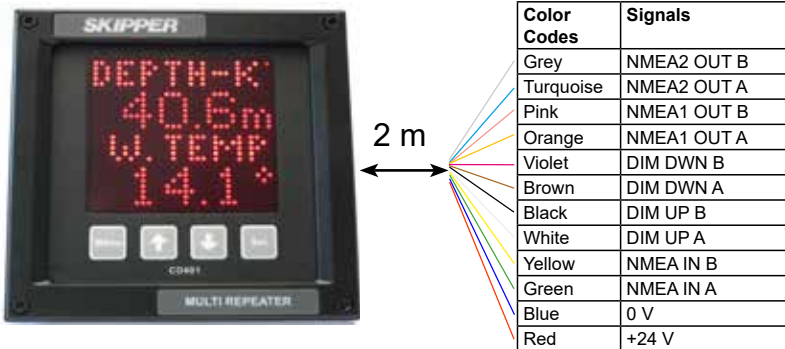
The SKIPPER Multi Repeater allow important values from a variety of systems to be displayed anywhere on the vessel. The CD401 Compact display is unique in its simple and flexible way to display vital data in almost all conditions, from no light to bright sunlight. In addition, it is classed to IP 56 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.

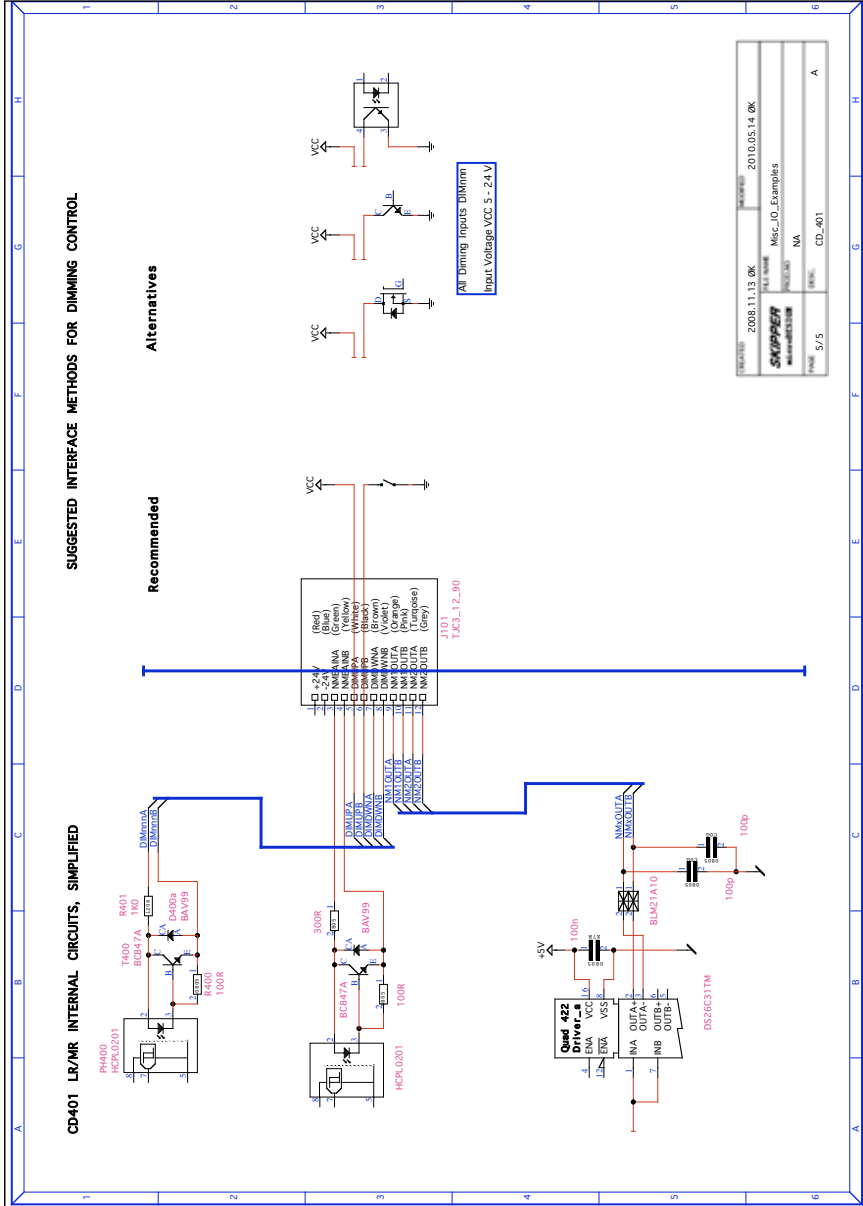
**Note:** Mounting drawing is available in [Appendix 1](#).





# 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 Multi Repeater Display

---

### PRINCIPLES

The Compact Multi Repeater 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. The Compact has three user definable alphanumeric displays, each allowing up to 4 lines to be displayed.

### 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 and DOWN, and SET button to select. To move back and 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](#).

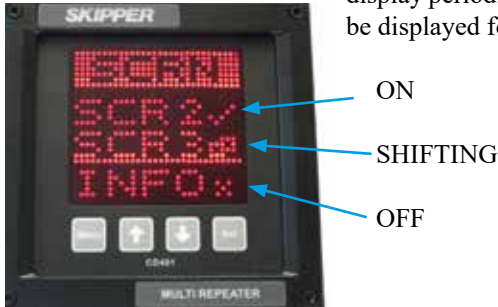
Press both MENU and SET buttons to activate the menus. Press and hold MENU to return to runtime screen.

### SHIFTING SCREENS

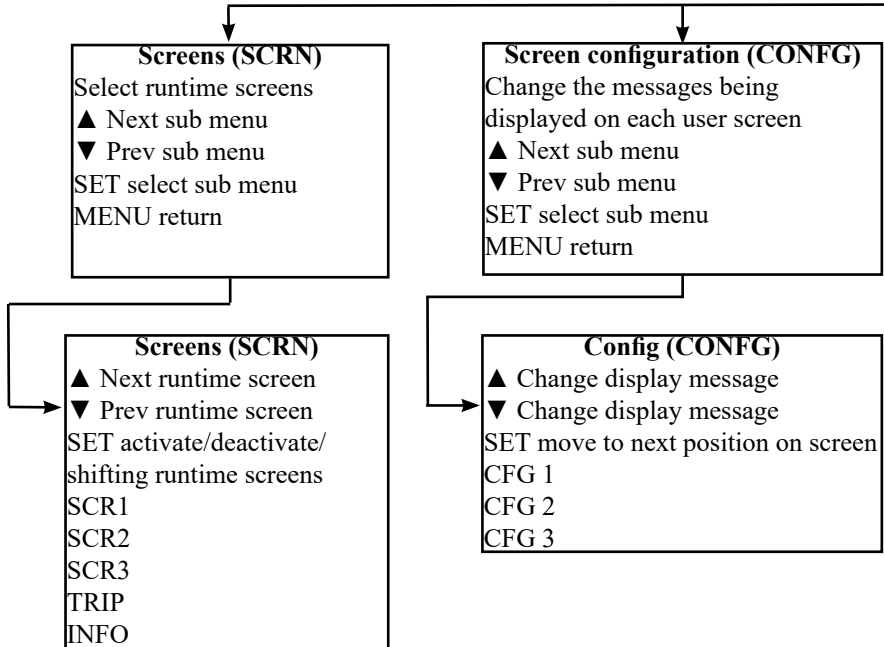
The system can be made to shift, with a five second period, between the activated screens. Pressing MENU will pause this function, and holding MENU will reactivate it.

## 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.

**MENU DIAGRAM**

**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

**NMEA output**  
 Select NMEA outputs  
 ▲ Move to next message  
 ▼ Move to previous message  
 SET turn on/off current message  
 IIVDR  
 PSKPVDR

**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, 3 = 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. No setup is required.

## SETUP OF OUTPUTS

Two outputs are available from the system, TRIP reset is always available, VDR is activated when a current display is selected.

## 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. Three modes are available.

- **Mode 1** is a dynamic demo mode taking the present values 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.
- **Mode 3** is a **fixed speed** longitudinal 5 kn, transversal 1 kn.

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. The Set button is used to reset the Trip counter if Trip Screen is displayed and the Multi Repeater is connected to a SKIPPER EML 224 system or a DL850 270 kHz system.



INFO Screen



TRIP Screen

### 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:

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

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 advise 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 screen menus, select CONFIG and then select wanted screen menu (CFG1, CFG2 or CFG3) to start to configure wanted screen menu. 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 screen menus can be set up using the Config (CONFIG) menu. This submenu allows the user to select one of the three screen menus, and on entering the Config screen menu, the user can change the data type to be displayed in each of the 4 screen menu's positions. UP (↑) and DOWN (↓) will change the data type, SET will move to the next screen menu position.



Placing text (TXT) in the bottom 4<sup>th</sup> line or 3<sup>rd</sup> and 4<sup>th</sup> 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 two text (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 is able to distinguish between both transducer location and channel number. The transducer location is indicated by an arrow in the text line. The channel number is selected by parameter PDPT1, PDPT2 or PDPT3 and is written in the text line as DPT1, DPT2 or DPT3 respectively for each channel. The parameter name PDPT will ignore channel number and is written in the text line as DEPTH.

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.

**Config.  
screen:**



**Runtime  
screen:**



## 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 either one or two decimals depending of the configured parameter to display. STW2L, STW2T, SOG2L and SOG2T will always display speed below 10 knots with two decimals and speed from 10 knots and above with one decimal. All other speed parameters are displayed with one decimal (see the detailed description of the parameters in [Appendix 2](#)). Maximum speed value to be displayed is +/- 99.9 knots.

**Config. screen:**



**Runtime screen:**



The Multi Repeater will accept the NMEA sentence VMXDR to change the direction of the speed through water. Receiving the following NMEA sentence will change the direction of the STW:

```
$VMXDR,A,180,D,SPDD*hh<CR><LF>
```

An arrow symbol is added in front of the STW text to indicate that the speed direction is reversed. Receiving the following NMEA sentence will change the direction of the STW back to normal:

```
$VMXDR,A,0,D,SPDD*hh<CR><LF>
```

The VMXDR sentence must be valid together with the VBW sentence.

The Compact Multi Repeater Backwards (CD MB) will display the arrow symbol in both directions if VMXDR with speed direction information is received. Note that the Compact Multi Repeater Backwards already displays the STW speed in opposite direction, so receiving information about reverse speed will again turn the speed direction with 180 degrees.

Screen with arrow symbol in reverse direction:



## 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:

1. Gyro, north seeking (HE).
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:**



Graphical representation

**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 degrees 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 % are displayed with two decimals and values above 10 % 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.

**Config.  
screen:**



**Runtime  
screen:**



Local time is  
UTC – (1h 30 min).

Expected Time of  
Arrival is UTC +  
(20h 45 min).

## 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).

## Auxillary

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:

\$PSKPPCCPNMEA, <Auxiliary number>, <Header>, <Data Field number.>, <Type>, < Status field number >, < Status valid character >, <Text>\*hh<CR><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 Multi Repeater to accept these parameters:

```
$PSKPPCCPNMEA,1,PPPRP,0,8,,ROLL<CR><LF>
$PSKPPCCPNMEA,2,PPPRP,1,8,,PITCH<CR><LF>
$PSKPPCCPNMEA,3,SGRSA,0,8,1,A,SRUD<CR><LF>
$PSKPPCCPNMEA,4,SGRSA,2,8,3,A,PRUD<CR><LF>
```

Select the AUX1 in the meny to display the roll parameter, select the AUX2 in the meny 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:

CD E1	Compact display EML 1 Axis.
CD E2	Compact display EML 2 Axis.
CD EB	Compact display EML 2 Axis backwards.
CD LR	Compact display Log Repeater.
CD MR	Compact display Multi Repeater.
CD MB	Compact display Multi Repeater backwards.

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 [Appendix 3](#) 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

Power Supply	DC: 19 - 36 V/25 Watt.
Display	28 x 30 pixel, Alphanumeric LED (red). With dimming.
Languages	English.
Accessories	Dimming control.
Classification	IMO MED B.
Service	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.

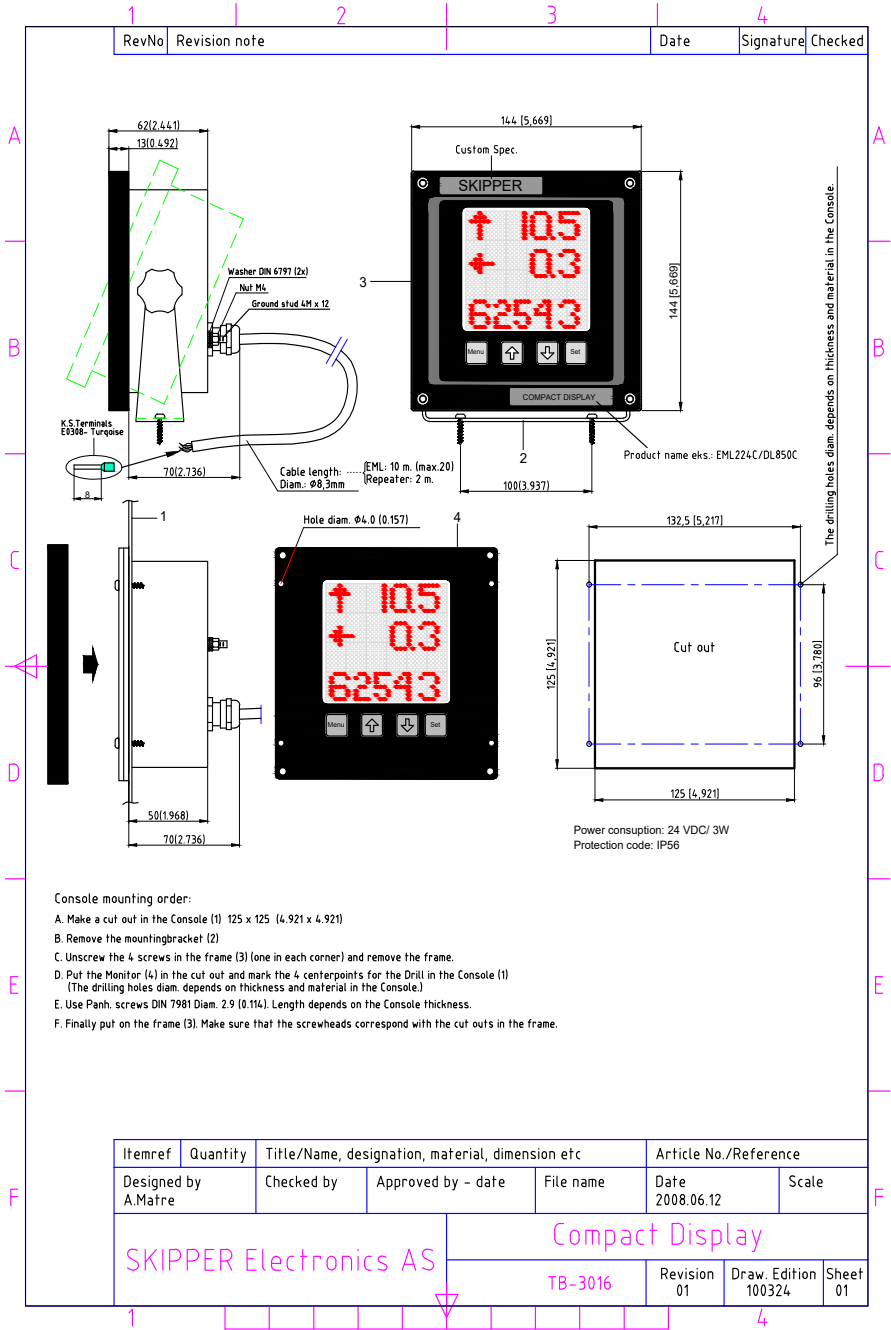
### DISPLAY

Weight (display)	1.3 kg.
Cable length	2 m (can be extended).
Compass safe distance (min)	30 cm.
User adjustable screens	3
Parameters per screen	2 with text, 3 with single text line.

### INPUTS/OUTPUTS

Outputs	2 x NMEA (IEC61162-1) (2007).
Inputs	1 x NMEA (IEC61162-1) (2007).
	External dimming (up and down pulses).

# MECHANICAL DIMENTIONS





## APPENDIX 2.

### ACCEPTED NMEA 0183 SENTENCES SUMMARY

	<b>NMEA Sentence</b>	<b>Description</b>	<b>Parameter Name</b>	<b>Screen name</b>	
<b>Depth</b>	DPT	Water Depth in meters	DPT	DEPTH-K DEPTH-T DEPTH-S	
	DBK	Water Depth below Keel in meters	DBK	DEPTH-K	
	DBT	Water Depth below Transducer in meters	DBT	DEPTH-T	
	DBS	Water Depth below Surface in meters	DBS	DEPTH-S	
	PSKPDPT	SKIPPER proprietary depth sentence		PDPT	DEPTH-K DEPTH-T DEPTH-S
		SKIPPER proprietary depth sentence for channel 1		PDPT1	DPT1-K DPT1-T DPT1-S
		SKIPPER proprietary depth sentence for channel 2		PDPT2	DPT2-K DPT2-T DPT2-S
SKIPPER proprietary depth sentence for channel 3			PDPT3	DPT3-K DPT3-T DPT3-S	

	NMEA Sentence	Description	Parameter Name	Screen name
<b>Speed</b>	VBW	Longitudinal Water Speed STWWL will have one decimal for all speed values STW2L always display speed below 10 knots with two decimals and speed from 10 knots and above with one decimal.	STWWL STW2L	STW
		Transverse Water Speed STWWT will have one decimal for all speed values STW2T always display speed below 10 knots with two decimals and speed from 10 knots and above with one decimal.	STWWT STW2T	STW
		Transverse Water Speed, Aft	STWWA	STW
		Longitudinal Ground Speed SOGBL will have one decimal for all speed values SOG2L always display speed below 10 knots with two decimals and speed from 10 knots and above with one decimal.	SOGBL SOG2L	SOG
		Transverse Ground Speed SOGBT will have one decimal for all speed values SOG2T always display speed below 10 knots with two decimals and speed from 10 knots and above with one decimal.	SOGBT SOG2T	SOG
		Transverse Ground Speed, Aft	SOGBA	SOG
	VHW	Speed Through Water in knots, relative	STW-R	STW-R
	VTG	Speed over Ground in knots, relative	SOG-R	SOG-R
	XDR	Water Speed direction, displayed as arrow on screen	-	-
	<b>Distance</b>	VLW	Water-track Distance since reset	TRIPW
Water-track Total distance			TOTLW	TOTLW
Bottom-track Distance since reset			TRIPB	TRIPB
Bottom-track Total distance			TOTLB	TOTLB
<b>Heading</b>	VHW	Heading, degrees, true	HDW-T	HDG.T
		Heading, degrees, magnetic	HDW-M	HDG.M
	VTG	Heading (Course Over Ground), degrees, true	COG-T	COG.T
		Heading (Course Over Ground), degrees, magnetic	COG-M	COG.M
	THS	Heading, degrees, true	THS	HDG.T
	HDT	Heading, degrees, true	HDT	HDG.T
	HDM	Heading, degrees, magnetic	HDM	HDG.M
	HDG	Heading, degrees, magnetic	HDG	HDG.M
<b>Rotation</b>	ROT	Rate of Turn in degrees/minute	ROT	ROT
<b>Pitch and roll</b>	XDR	Pitch	PITCH	PITCH
		Roll	ROLL	ROLL

	<b>NMEA Sentence</b>	<b>Description</b>	<b>Parameter Name</b>	<b>Screen name</b>
<b>Wind</b>	MWV	Wind angle, Theoretical (True)	MWVAT	WIND-T
		Wind angle, Relative	MWVAR	WIND-R
		Wind speed in knots	MWVNT	WIND-T
		Wind speed in m/s	MWVMT	WIND-T
		Wind speed in Beaufort	MWVBT	WIND-T
		Wind speed in knots	MWVNR	WIND-R
		Wind speed in m/s	MWVMR	WIND-R
		Wind speed in Beaufort	MWVBR	WIND-R
	VWR	Wind angle, Relative	VWR-A	WIND-R
		Wind speed in knots	VWR-N	WIND-R
	VWT	Wind angle, True	VWT-A	WIND-T
		Wind speed in knots	VWT-N	WIND-T
	MWD	Wind angle, True	MWD-T	WIND-T
		Wind angle, Magnetic	MWD-M	WIND.M
Wind speed in knots		MWD-N	WIND	
<b>Temp.</b>	MTA, MDA	Air Temperature in degree Celsius	ATEMP	AIRTEMP
	MTW	Water Temperature in degree Celsius	WTEMP	W.TEMP
<b>Drive</b>	RPM	Revolutions / min	RPM	RPM
		Propeller Pitch (% of maximum)	PPTCH	P.PITCH
	RSA	Rudder Sensor Angle	RSA	RUDDER
<b>Clock/ UTC</b>	ZTG, ZDA, GGA, RMC	UTC (hh:mm)	UTC	UTC
	ZDA	Local Time (hh:mm)	LOC	LOC
	ZTG	Expected Time of Arrival (UTC) (hh:mm)	ETA	ETA
<b>Display dimming</b>	DDC	Display Dimming Control		
<b>Auxillary</b>	Defined by proprietary NMEA sentence	User defined message 1 (Auxillary 1)	AUX1	Defined by proprietary NMEA sentence
		User defined message 2 (Auxillary 2)	AUX2	
		User defined message 3 (Auxillary 3)	AUX3	
		User defined message 4 (Auxillary 4)	AUX4	

## OUTPUT NMEA 0183 SENTENCES SUMMARY

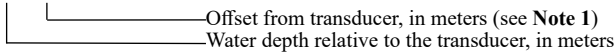
	<b>NMEA Sentence</b>	<b>Description</b>
<b>Trip reset</b>	PSKPRSTT	Reset Trip counter on EML and Doppler systems
<b>Current</b>	SIIVDR	Current set and drift

# DETAILED DESCRIPTION

## Depth:

### Depth

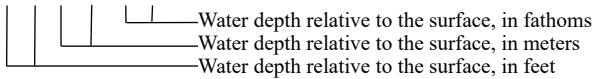
\$--DPT, x.x, x.x\*hh<CR><LF>



**Parameter name**  
DPT

### Depth Below Surface

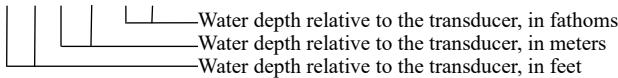
\$--DBS, x.x, f, x.x, M, x.x, F\*hh<CR><LF>



DBS

### Depth Below Transducer

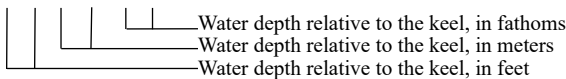
\$--DBT, x.x, f, x.x, M, x.x, F\*hh<CR><LF>



DBT

### Depth Below Keel

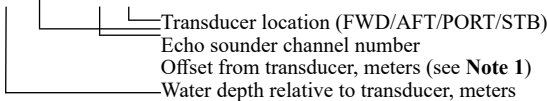
\$--DBK, x.x, f, x.x, M, x.x, F\*hh<CR><LF>



DBK

### SKIPPER Proprietary sentence

\$--PSKPDPT,x.x,x,x,, x.x,c-c\*hh<CR><LF>



PDPT  
PDPT1  
PDPT2  
PDPT3

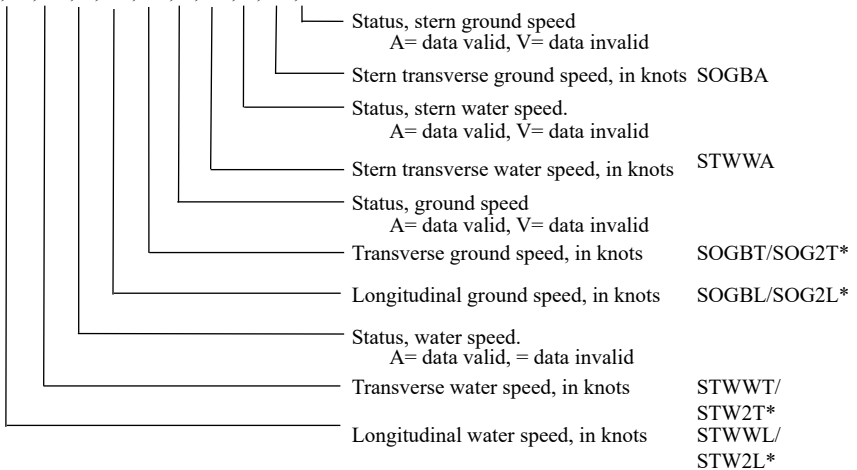
**Note 1:** Positive value indicates distance from transducer to water line.  
Negative value indicates distance from transducer to keel.

**Speed:**

**Parameter name**

**Dual Ground/Water Speed**

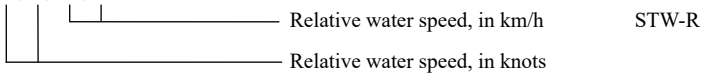
\$--VBW,x.x, x.x, A, x.x, x.x, A, x.x, A, x.x, A\*hh<CR><LF>



\* Speed parameters STW2L, STW2T, SOG2L and SOG2T are always displayed with 2 decimals for speed values below 10 knots and with 1 decimal for speed values from 10 knots and above.

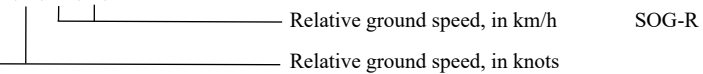
**Water Speed and Heading**

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



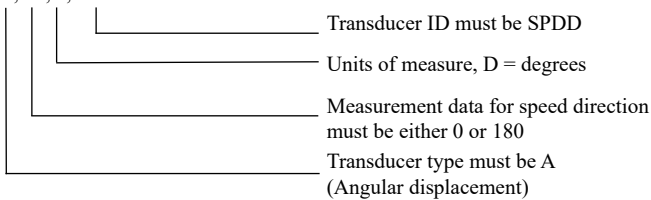
**Course Over Ground and Ground Speed**

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



**Speed direction**

\$VMXDR,A,x.x,D,SPDD\*hh<CR><LF>

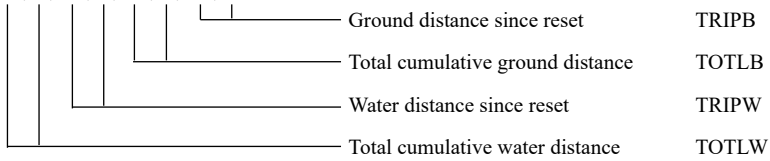


**Distance:**

**Parameter name**

**Dual Ground/Water Speed**

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



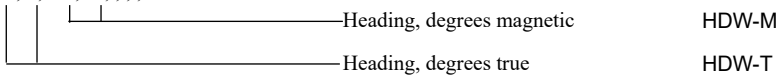
**Note:** All distance values must be specified in nautical miles.

**Heading:**

**Parameter name**

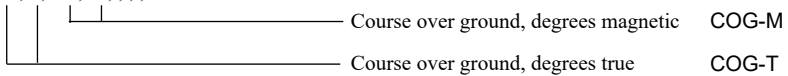
**Water Speed and Heading**

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



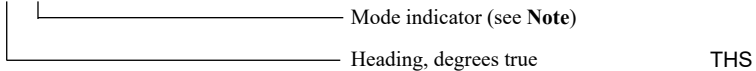
**Course Over Ground and Ground Speed**

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



**True Heading and Status**

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



**Note:** The Mode indicator is ignored

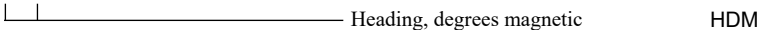
**Heading True**

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



**Heading Magnetic**

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



**Heading, Deviation and Variation**

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

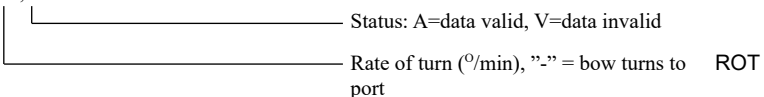


**Rotation:**

**Parameter name**

**Rate Of Turn**

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

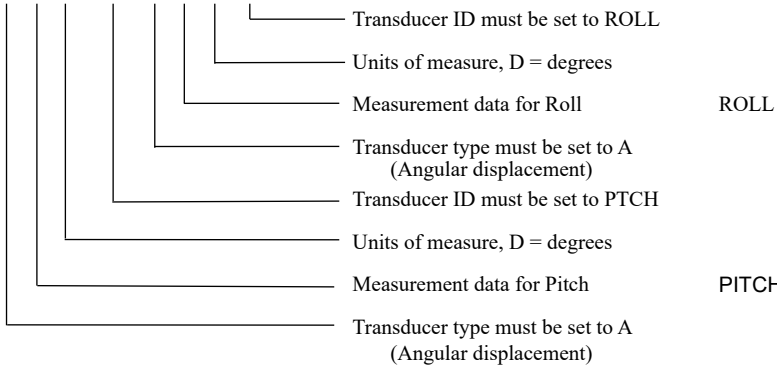


**Pitch and Roll**

Parameter name

**Transducer Measurements**

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

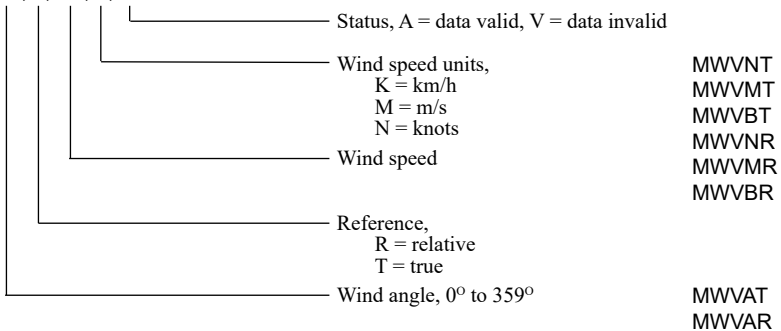


**Wind:**

Parameter name

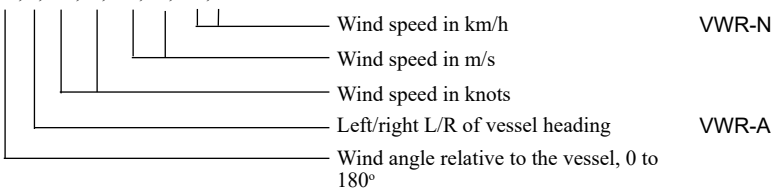
**Wind Speed and Angle**

\$--MWV, x.x, a, x.x, a, A\*hh<CR><LF>



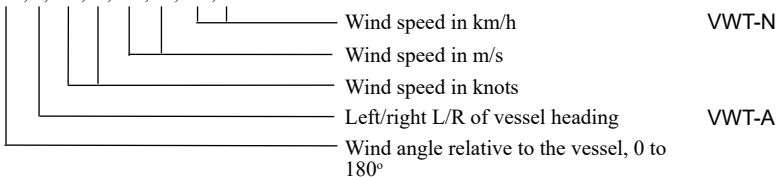
**Relative Wind Speed and Angle**

\$--VWR, x.x, a, x.x, N, x.x, M, x.x, K\*hh<CR><LF>



**True Wind and Speed Angle**

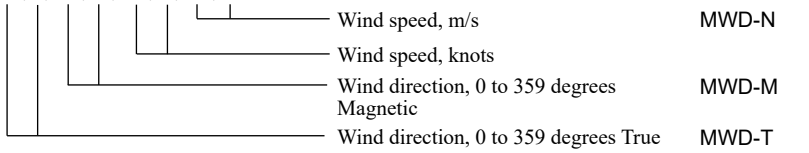
\$--VWT, x.x, a, x.x, N, x.x, M, x.x, K\*hh<CR><LF>



**Wind:**

**Wind Direction and Speed**

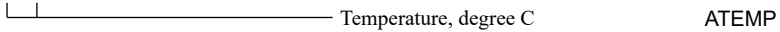
\$--MWD, x.x, T, x.x, M, x.x, N, x.x, M\*hh<CR><LF>



**Temperature:**

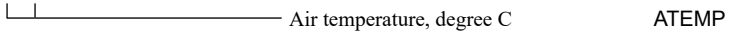
**Air Temperature**

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



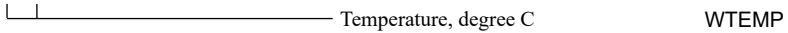
**Meteorological Composite**

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



**Water Temperature**

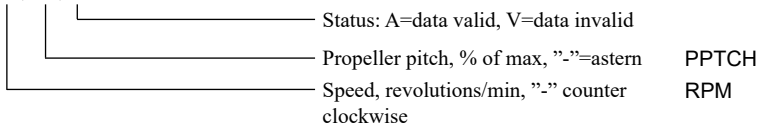
\$--MTW, x.x, C\*hh<CR><LF>



**Drive:**

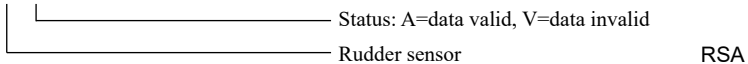
**Revolutions**

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



**Rudder Sensor Angle**

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





**Clock / UTC**

**Parameter name**

**UTC & Time to Destination Waypoint**

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

Time-to-go (max 24 h)  
UTC of observation

ETA  
UTC

**Time & Date**

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

Local zone minutes, 00 to +59  
Local zone hours, 00 to +/- 13  
UTC of observation

LOC  
UTC  
UTC

**Global Positioning System Fix Data**

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

UTC of position

UTC

**Recommended Minimum Specific GNSS Data**

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

UTC of position

UTC

**Display Dimming:**

**Display Dimming Control**

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

Brighthness Percentage:  
00 (min) to 99 (max)  
Display Dimming Preset:  
D = Day time setting (max)  
K = Dusk setting  
N = Nighth time setting  
O = Backlight off setting (min)

**Trip Reset:**

**Trip Reset counter**

\$SPSKPRSTT,\*hh<CR><LF>

**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:  <ul style="list-style-type: none"><li>0: Unsigned value</li><li>1: Signed value</li><li>2: Depth in meters</li><li>3: Speed without arrow and postfix</li><li>4: Longitudinal speed with arrow</li><li>5: Transverse speed with arrow</li><li>6: Speed with knots as postfix</li><li>7: Heading with arrow to indicate the direction the bow turns</li><li>8: Heading / Direction without arrow</li><li>9: Rotation</li><li>10: Temperature</li><li>11: Percentage</li></ul> 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 staus 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:

Data Type No.	Data Type name	Legal Data Type Range		Screen output				Format / Comments
				Out of range (screen)		Within Range		
		Min.	Max.	Below	Above	Pre-fix	Post-fix	
0	Unsigned value	0	99999.99	'.....'	'.....'	None	None	Values between 0 and 9.99 are displayed with 2 decimals. Values between 10 and 99.9 are displayed with one decimal.
1	Signed value	- 9999.99	9999.99	'.....'	'.....'	None or '-'	None	Values above 100 are displayed without decimals.
2	Depth in meters	0	9999.99	'.....'	'9999'	None	' m '	
3	Speed without arrow and postfix	- 99.9	99.9	'99.9'	'99.9'	None	None	All speed values in knots with one decimal. Negative values are displayed without minus sign.
4	Longitudinal speed with arrow	- 99.9	99.9	'99.9'	'99.9'	'↑' or '↓'	None	All speed values in knots with one decimal. Negative values indicates astern direction.
5	Transverse speed with arrow	- 99.9	99.9	'99.9'	'99.9'	'→' or '←'	None	All speed values in knots with one decimal. Negative values indicates port direction.
6	Speed with knots as postfix	- 99.9	99.9	'99.9'	'99.9'	None	' kn '	All speed values in knots with one decimal. Negative values are displayed without minus sign.
7	Heading with arrow to indicate the direction the bow turns	0	360	'.....'	'.....'	None	' ° '	All values are displayed with one decimal. An arrow ('←' or '→') is added in the text line to indicate direction the bow turns. The <Text> field must therefore be limited to 3 characters for this type. The direction of turn is calculated based on previous heading value.
8	Heading / Direction without arrow	0	360	'.....'	'.....'	None	' ° '	All values are displayed with one decimal.
9	Rotation	- 999	999	'.....'	'.....'	None	' °/m '	Values below 99.9 are displayed with one decimal. Values above 100 are displayed with no decimals. An arrow ('←' or '→') is added in the text line to indicate which direction the bow turns. The <Text> field must therefore be limited to 3 characters for this type. A negative value indicates port direction.
10	Temperature	- 99.99	99.9	'-99.9'	'99.9'	None or '-'	' ° '	Values between 0 and 9.99 are displayed with 2 decimals. Values between 10 and 99.9 are displayed with one decimal.
11	Percentage	-100	100	'.....'	'.....'	None or '-'	' % '	Values between 0 and 9.99 are displayed with 2 decimals. Values between 10 and 99.9 are displayed with one decimal.

## APPENDIX 3.

### OTHER OPTIONS WITH THE MULTI REPEATER

#### COMPACT OPTIONS

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

LR	Speed Repeater	
E1 (EML124 Compact)	Single Axis EML	With Electronic unit (JB60CD), sensor and cables
E2 (EML224 Compact)	Dual Axis EML	With Electronic unit (JB60CD), sensor and cables
EB (EML224 Compact)	Dual Axis EML Backwards	With Electronic unit (JB60CD), sensor and cables
MR	Multi Repeater	
MB	Multi Repeater Backwards	

- **Speed Repeater:** A simple repeater for speed in single and dual 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](http://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.



DIAG menu



CODE page

# APPENDIX 4.

## Current

Surface Current speed and direction are calculated by using available information from Speed Through Water and Speed Over Ground. Surface Current is the difference between Speed Through Water and Speed Over Ground indicated by an absolute speed value and a direction towards the current-flow. The direction could be either relative or true.

Speed Through Water is always fetched from the “Longitudinal water speed in knots” and “Transverse water speed in knots” from the VBW NMEA sentence. Speed Over Ground is fetched from “Longitudinal ground speed in knots” and “Transverse ground speed in knots” from the VBW NMEA sentence. If speed over ground is not available from VBW, the speed over ground is fetched from the “Course Over Ground, degree true” and “Relative speed in knots” from the VTG NMEA sentence. Information about True Heading is fetched from either the NMEA sentence THS or HDT prioritized after the following rules:

1. HETHS: THS from Gyro
2. HEHDT: HDT from Gyro
3. GPTHs: THS from Global Position System (GPS)
4. GPHDT: HDT from Global Position System (GPS)
5. HCTHS: THS from Magnetic Compass
6. HCHDT: HDT from Magnetic Compass
7. xxTHS: THS from another Talker
8. xxHDT: HDT from another Talker

Parameter	Parameter name	Description
<b>CUR-S</b>	Current Speed in knots	Absolute Current Surface speed
<b>CURAR</b>	Direction towards Current flow, relative	Speed Through Water from VBW. Speed Over Ground from VTG if VBW not valid. Heading information necessary if Speed Over Ground from VBW not available.
<b>CURAT</b>	Direction towards Current flow, true	Speed Through Water from VBW Speed Over Ground from VTG if VBW not valid.
<b>CURBR</b>	Direction towards Current flow, relative	Both Speed Through Water and Speed Over Ground from VBW.
<b>CURBT</b>	Direction towards Current flow, true	Both Speed Through Water and Speed Over Ground from VBW. Heading information necessary.



A graphical representation of the surface current speed and direction is displayed if the following parameters are selected:

- TXT must be selected for the first two parameters.
- Current speed or direction must be selected for next parameter.
- Current speed or direction must be selected (opposite last choice) for last parameter.

The current direction is represented by an arrow on the screen.



### WHEN THE BOTTOM TRACK IS NOT AVAILABLE

In cases where bottom track is not available and GPS (VTG) and HDT/THS signal is applied, the system will use the GPS as speed over ground compensation. If bottom track is used, the symbol  is displayed in the text line. If GPS is used, the symbol  is displayed. The system will always use bottom track, if available.

### GETTING THE MOST OUT OF YOUR SYSTEM

The SKIPPER DL850, Doppler speed log can be connected to a CD401MR-SB Compact Multi Repeater, to display:

- The current relative to the Vessel, in Direction and Speed
- The current relative to North, if a Compass or Gyro is connected\*

To achieve these parameters, the compact must have an input from the following parameters:

- Speed Through Water (STW), Longitudinal and Transversal (from a Doppler or EML speed log) and either
- Speed Over Ground (SOG), longitudinal or Transversal (From a Doppler system) or
- Speed Over Ground, Course over ground, from an approved (D) GPS system and heading from a gyro/compass.\*

\*For parameters requiring more information than just the Doppler log (true values or GPS compensation), a NMEA multiplexer must be provided to enable inputs from GYRO, GPS and Speed log to be input to the single input of the CD401.

To have all these options available a multiplexer may be fitted to the NMEA input. Inputs should be made available from the log, a gyro, and a GPS.

The system will work best when both SOG and STW come from the same source, i.e. the Doppler system, this because the readings are taken at the same time. If the system is used with data from two different sources, i.e. Doppler and GPS, then there will be slight time differences which will affect the instantaneous accuracy.

The system will therefore always prioritise data from the bottom track over the GPS.

## **CALIBRATION OF THE DL850 OR EML**

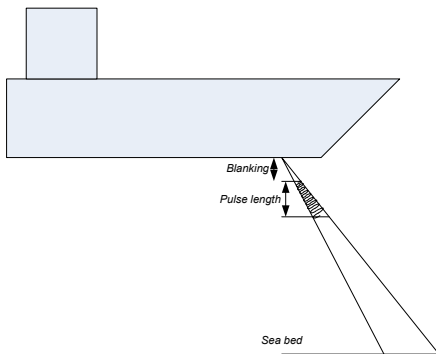
The current display is much more sensitive to wrong calibration of the speed log. Any failure in calibration will show itself as a current that follows the vessel (particularly at higher speeds) whichever direction the vessel sails.

This can be corrected by adding more calibration points at different speeds.

## **MOVING THE SAMPLING CELL**

The vessel will always drag some water with it. The Doppler can sample away from the vessel. This can be adjusted by adding more blanking time to the system. This will sample deeper however, there is always a threat of a layer, typically at 15-20 m where the current can change direction. Moving the sample area out may cause errors due to mixing of current directions.

To move the sample cell, the user must go into the scope screen and hold the hidden button for 2 beeps. The blanking parameter can then be changed (for each depth range) on menu 3.



## **JUMPING VALUES AT LOW SPEEDS**

At very low current speed values, or very low vessel speed values, a small change of speed may result in a large direction change.

A filter has been added to allow a maximum changed direction per second.

## **AVERAGING (GPS MODE)**

When the current measurement is using GPS corrections for the vessel speed, the system may show a wrong, (usually larger) current particularly during a course change. To reduce this effect, the averaging on the Doppler and the averaging on the GPS can be adjusted to synchronize.



## LOGGING OUTPUT

The CD401MR can be set up to produce 2 NMEA outputs:

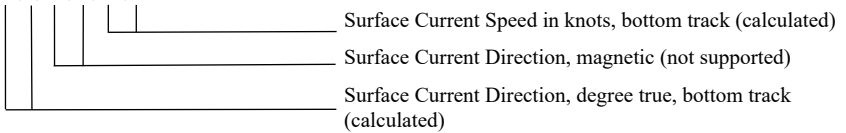
- **IIVDR** is a set and drift parameter to give the current displayed output, in resultant and direction.
- **PSKPVDR** is a proprietary NMEA sentence, containing both the current direction with both bottom track and GPS correction and also the speed log, GPS and heading information.

It is recommended that if you require help from SKIPPER, that this message is logged and sent together with the enquiry.

Detailed description of the NMEA output sentences:

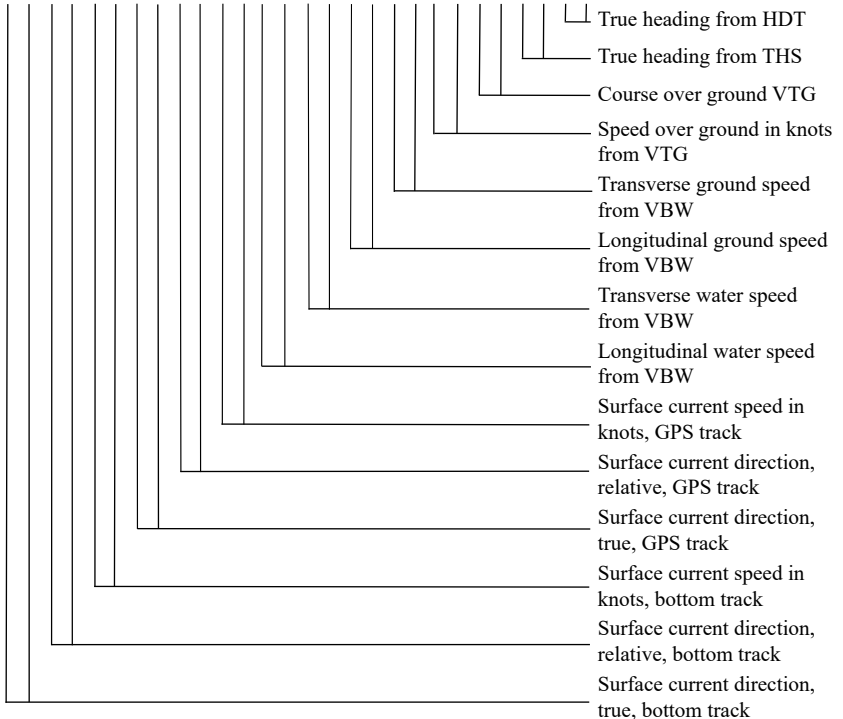
### Speed direction

\$IIVDR,x,x,T,x,x,M,x,x,N\*hh<CR><LF>



### Speed direction (Proprietary)

\$PSKPVDR,x,x,A,x,x,A,x,x,A,x,x,A,x,x,A,x,x,A,x,x,A,x,x,A,x,x,A,x,x,A,x,x,A,x,x,A,x,x,A,x,x,A \*hh<CR><LF> (see NOTE)



NOTE: A = data valid, V = data invalid

## APPENDIX 5.

### SENDING THE SYSTEM FOR REPAIR

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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](http://www.skipper.no)).

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

For normal service/support, please contact SKIPPER Electronics AS on mail [support@skipper.no](mailto:support@skipper.no) or our local dealer (list available on [www.skipper.no](http://www.skipper.no)).

**NOTES:**

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# SKIPPER

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