EML224 Compact

CD401 124/224 Speed Log
Operation and Installation Manual

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EML 124/224 SPEED LOG
COMPACT VERSION

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 Electro Magnetic Speed Log (EML) 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 the compact display

The Compact Display is a flexible, yet 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 required by the regulations. This chapter explains how to set up the unit.

Chapter 3 – Calibration

Each new installation is unique and the system must be matched to the vessel. Calibration is required to ensure mounting errors and that hydrodynamics of the vessel are compensated for. This chapter explains the procedure in a step by step guide.

Chapter 4 – Routine operation

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

Chapter 5 – checking your system

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 mailfunction, this is a good place to start for trouble shooting.

Chapter 6 – Maintenance

To keep your EML 224 Compact system in order, regular maintenance is important. To take advantages of new features and performance enhancements, you may need to update software. This section shows how.

Appendix 1 – Background information

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

Appendix 2 – Mechanical drawings

A picture is worth more than 1000 words! In addition to the text describing installation, the mechanical drawings are included to allow correct installation.

Appendix 3 – Output Formats

The system uses primarily NMEA 0183 standard. This section describes the format of the messages used. It also describes the other digital signals in use.

Appendix 4 - other options with the compact display

The EML Compact can be used in a number of different systems both as a repeater and a speed log. This section explains what is available and how to activate the options. The EML Compact also contains a diagnostics port, from which the user can obtain diagnostic information using hyperterm. This is described here.

Appendix 5 - Support software

The Compact display is alphanumeric and as such, is restricted in the amount of information it can display. SKIPPER Electronics AS is continuously developing support tools to ease use of its products. The Compact system allows for the user to extract additional information about the systems condition. This appendix describes the software tools available that will aid this process.

Appendix 6 - Sending the system for repair

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

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TERMINOLOGY. Terms used in this manual

UNITS

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

Distance	Nautical miles (nm)
Speed	Nautical miles per hour (kn)
Pulse indication	Pulses per nautical mile (p/nm)
Temperature	Degrees Celsius (°C)

ABBREVIATIONS

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

Tp	Daily trip (in nm)
TL	Total measured distance travelled
°	Degrees centigrade
STW	Speed through water
TRIP	Text for trip/total
SOG	Speed over ground
TEMP°	Text for TEMPerature

In menu / setup screens, the following abbreviations are used:

STWWL	Speed through water – water track – longitudinal value
STWWT	Speed through water – water track – transversal value
SOGBL	Speed over ground – bottom track – longitudinal value
SOGBT	Speed over ground – bottom track – transversal value
SOGBA	Speed over ground – bottom track – aft value
SPDHI	High speed alarm
SPDLO	Low speed alarm
SENSR	System/sensor alarm
PULSE	Pulse settings
OFS °	Angular offset in degrees (°)
R	Real resultant speed at a specific point (kn)
M	Measured resultant speed at a specific point (kn)
C_{rs}	Calibrated resultant speed
M_{rs}	Instantaneous uncalibrated resultant speed
DIAG	Diagnostics menu

Outgoing NMEA messages follows:

VMVLW	$VMVLW,….,Trip and total
VMMTW	$VMMTW,…,Water temperature
VMVHW	$VMVHW,…,Relative speed through water
VMVBW	$VMVBW,....,Multiple speed
VMXDR	$VMXDR,....,Speed direction

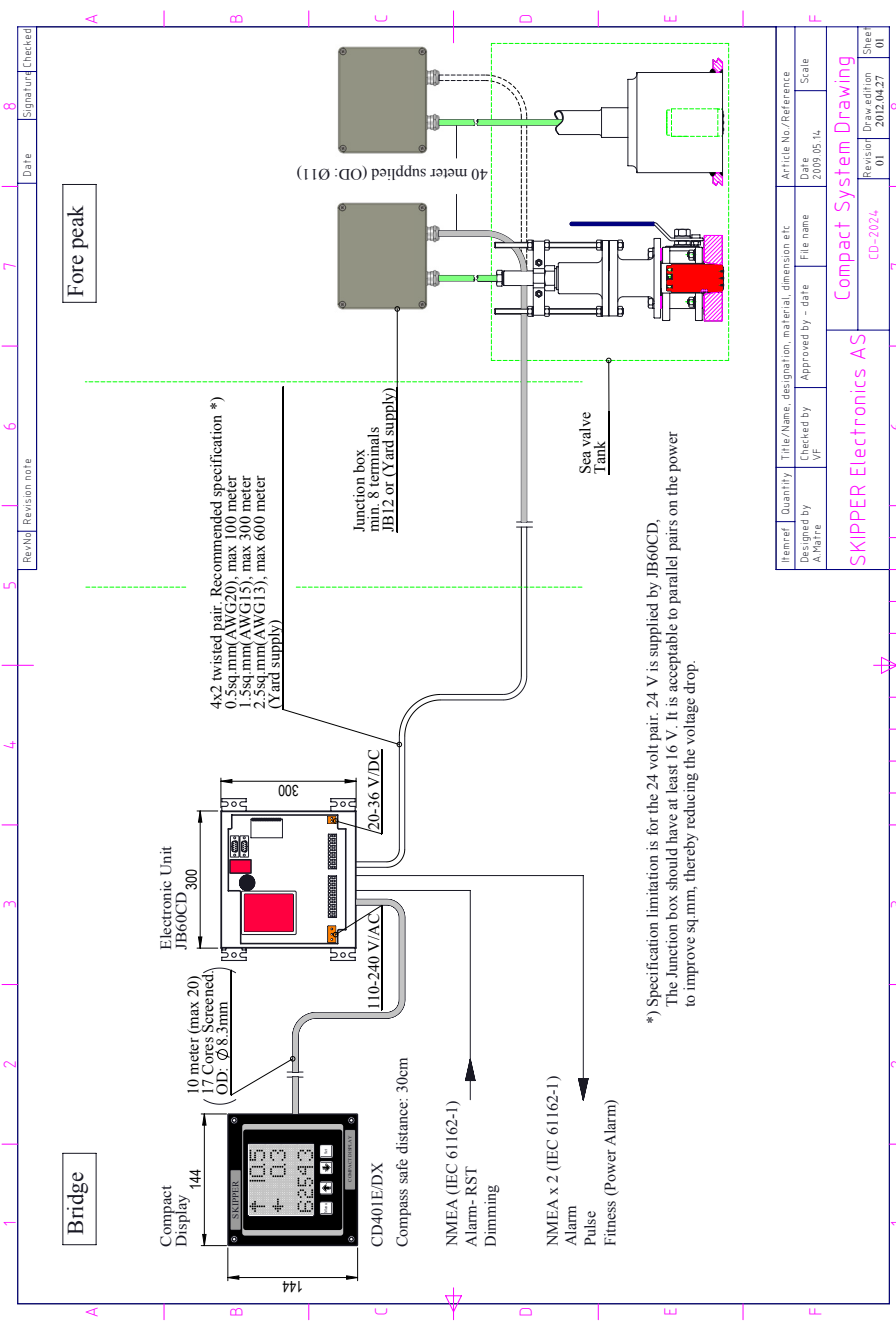
INTRODUCTION. The EML 224 Compact speed log

The SKIPPER EML 224 Compact is a device that uses the effects of magnetism in moving water to measure the speed of a vessel in one or two axis. This effect is well understood and provides reliable data of the speed of the vessel through the water. This information is normally not available from any other sensor on board, and gives the navigator valuable information as to how currents are effecting the motion of the vessel. The EML system comprises of four main parts:

1. ***The mounting***; Either a sea valve, or tank. Welded to the bottom of the hull.
2. ***The sensor***; A speed sensor device designed to fit into the mountings.
3. ***The Electronic unit (JB60CD)***; The JB60CD allowing the EML 224 Compact to be powered and interfaced to the other navigation systems using digital standards.
4. ***The EML 224 Compact display***; An alphanumeric display unit allowing the bridge staff to view the data.

The EML 224 Compact is unique in its simple, yet flexible way to display vital data in almost all conditions.
See drawing on page 12.

INTERCONNECTION DIAGRAM



CHAPTER 1. Physical installation

Installation usually takes place in two/three phases:

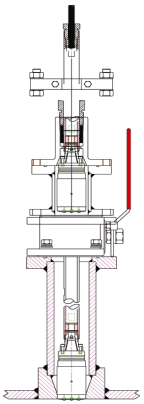
1. Mounting of the hull metalwork
2. Cabling and mounting of the electronics and sensor
3. Initialisation and calibration of the system

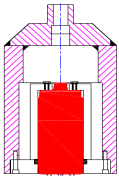
MOUNTING THE HULL METALWORK

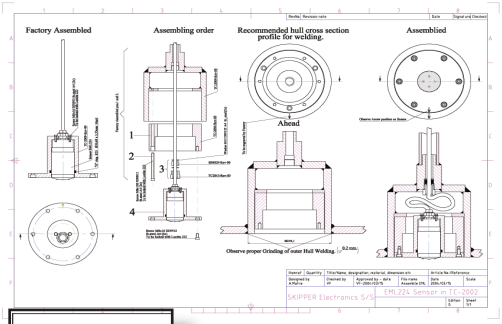
This must happen in dock and care should be taken to mount the valve/tank such that the sensor will be flush with nothing to cause turbulence near the sensor. The sensor should be mounted forward in the vessel, preferably just behind the bulb.

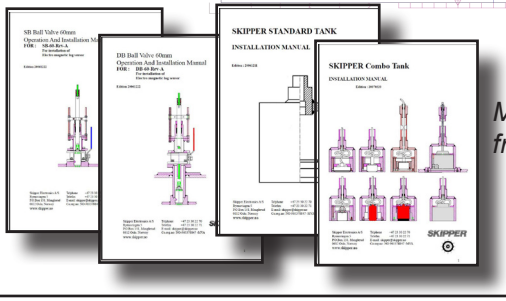
Important: Tank mountings have an orientation (an arrow that must point forward).

The sensor, is fully water tight and can be mounted in wet areas such as ballast tanks. Please see the separate mounting user guide for more details.









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MOUNTING THE SENSOR

Sensor location.
For proper operation, the sensor should be installed close to the bulb or the stem of the ship, avoiding areas where it may be damaged by the anchor chain. It is, of course, necessary to select a part of the hull that is submerged under all load and speed conditions.

The JB60CD unit has to be installed in a dry place on the bridge.

The sea valve with sensor can be installed in a water tank, but it is not recommended. It is necessary to position the sensor on a flat, horizontal hull section which is large enough to ensure a laminar water flow for all angles of drift. If such a flat section is not available, the shipyard must construct a suitable bed. If the vessel is designed with a box keel, this can be used for installation of the sensor. In this case, a double bottom sea valve solution may be used.

Before hull fitting installation procedure is initiated, always check that the hull fitting valve can be properly operated and that the sensor can be removed in the location selected. See installation manual for the valve solution for more information.

PART POSITIONING AND WELDING

Please see the installation manual for the valve. Installation may differ between the different valve solutions available.

RECOMMENDED ELECTRODES

Steel hull:	Type SAF 24, 12 or equivalent
Aluminium hull:	Filler metal = AG4 or AG4 MC

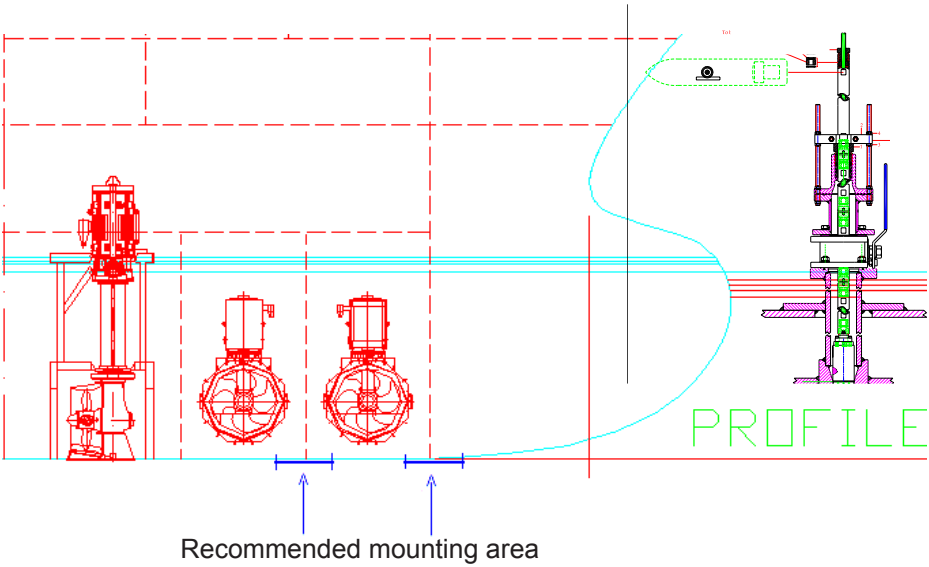
WELDING PRECAUTIONS

Separate the bottom flange from the remaining hull fitting assembly before welding. Use a board to ensure that the bottom flange is flush with the external surface of the hull. Before welding, remove the O-rings. Remember to apply grease when refitting them. After welding, check that the outer weld filling has been properly ground down. Paint the hull fitting as well as the hull itself with a suitable anti-corrosion/anti-fouling product, but **do not paint** the protruding part of the sensor and electrodes.

TRANSDUCER INSTALLATION

Please see the installation manual for the valve. Installation may differ between the different valve solutions available.

The sensor can be mounted and powered in air and water. Briskly rubbing the pins of the sensor will show changes in values in the speed. It is very important that the sensor is mounted in the correct orientation, (especially single axis units). In a tank, the arrows should point forward. On a ball valve, the flat area should point port.



Tip: Placing a large flat straight pole on the flat area will allow accurate adjustment. Alternatively a laser level can be used to get accurate orientation on a remote bulkhead.

Small errors in angle can be calibrated in the 2 axis verson, but care should be taken to get this as accurate as possible. Each time the sensor is lifted or repositioned, the angular offset should be checked.

CABLING

System elements should be placed as in ”Interconnection Diagram” on page 12. The EML sensor is supplied with 40 m of cable. This should be guided to a dry area where a junction box (Yard supply or SKIPPER part nr. ZZL-01020) should be used to extend the cable to the bridge. The EML sensor is a smart sensor and outputs propriety NMEA messages. This standard is based on RS-422, so cable lengths should not be a problem. However, power is

sent down the cable and the sensor should have at least 16 V at the sensor junctions box to function normally. If the voltage (under use) is less than 16 V, the Yellow/Orange pair (J200 pin 7-8) can be removed/disconnected in the junction box and Electronic Unit, and the pair used to double up the power (J200 pin 1-2). The cable should be as follows:

Up to 40 m	Use supplied cable
Up to 100 m	4 twisted pairs min 0.5 mm^2
Up to 300 m	4 twisted screen pairs 1.5 mm^2
Up to 600 m	4 twisted screen pairs 2.5 mm^2
Over 600 m	Local 24 V supply to sensor at junction box is recommended

Although the signals on the cable are digital, it is recommended to avoid electrically noisy areas such as pneumatics and generators.

The JB60CD Electronic unit is mounted on the bridge. The EML 224 Compact display is supplied with 10 m of cable which can be extended to max. 20 m. This cable is connected to the JB60CD box connector J300. The sensor cable is connected to the JB60CD box connector J200. External inputs and outputs are connected to the connectors J301 and J400 as shown in diagram on next page .

POWER

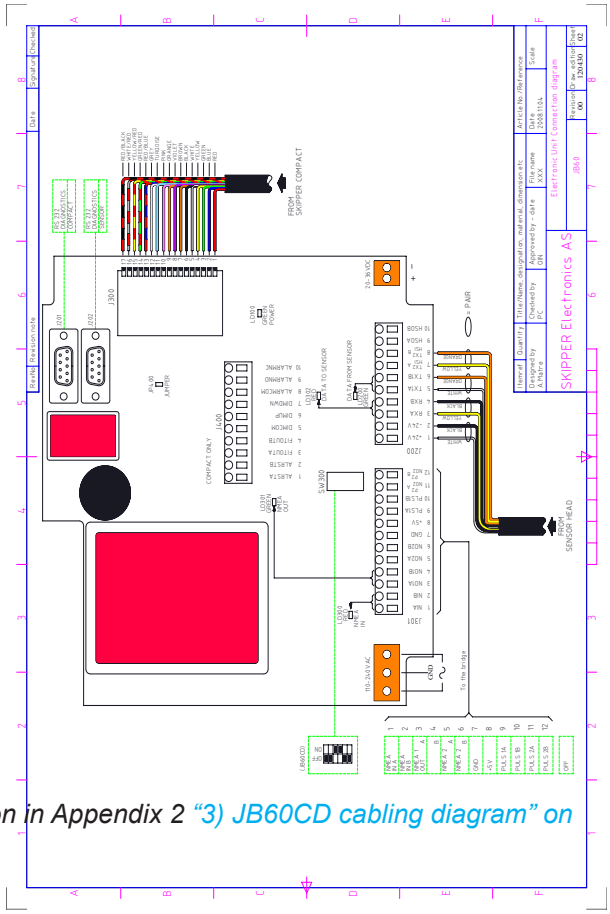
Power to the Electronic Unit (JB60CD) supplies power to the whole system. The user has the option to use either or both AC 110-240 V, or DC 20-36 V supplies. Both can be connected at the same time. The JB60CD has automatic fuses which, if tripped, will reset when the fault is removed.

THE DIGITAL INPUTS AND OUTPUTS

(ALARM, PULSE, DIMMING)

The digital inputs and outputs of the system meet the standard requirements for IEC 61162-1. Inputs and pulse outputs are optoisolated as shown on page 19. To make these work, it is necessary to apply a voltage and a resistance in series to the (XXXXX)A pin, as shown. The nature of this type of connection is such that the installation requires an external voltage (4-30 V) to function. A positive voltage is required on pin marked (XXXXX)A. GND or negative on pin (XXXXX)B. Alarm output uses a standard relay are COM (8), NO (9), NC (10), on J400.

JB60CD Interconnection Diagram



Large version in Appendix 2 "3) JB60CD cabling diagram" on page 48

THE PULSE OUTPUT

A single pulse output is available. This pulses at a rate proportional to the longitudinal speed. (This is the required output for RADAR systems). The pulse is active high, and the pulse length is 60 ms. This output is located on pin 9 and 10 on connector J301 and is attached to an optocoupler. To get a signal from this port, a voltage must be applied to pin (XXXXX)A (4-30 V). (The same as fit-out).

THE DIMMING INPUTS

Pulses of at least 60 ms on the dimming up and dimming down inputs (J400 pins 5, 6, 7) will cause the dimming to change by one level. The inputs are optocoupled and therefore require an external voltage to operate, (4 Volt -30 Volt (typically 12/24 Volt)).

Note: If the system is set up as CD401EB (backwards), the dimming input (DIMUP/COM) are used for changing the speed direction and remote dimming is not possible.

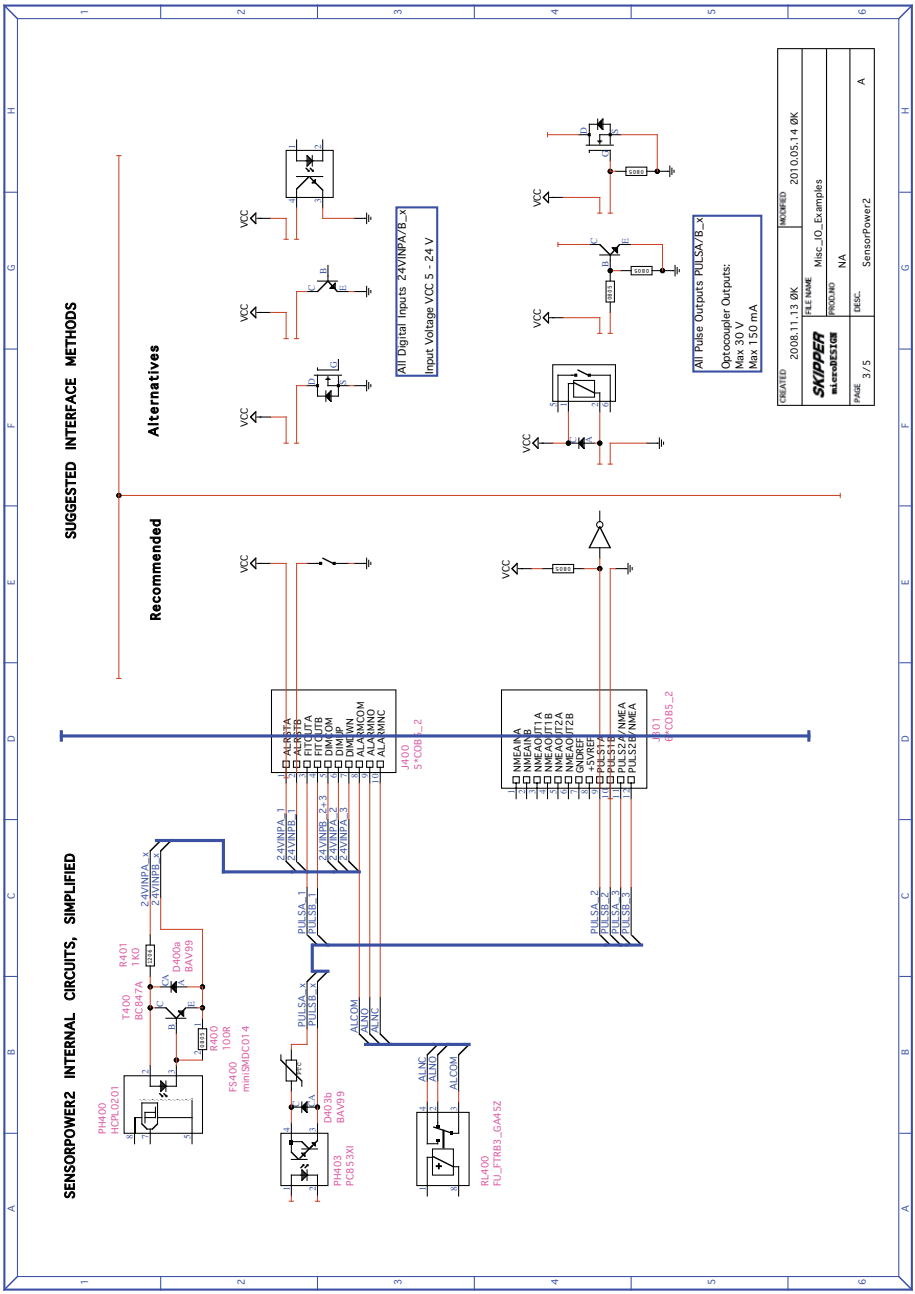
SPEED DIRECTION (CD401EB only)

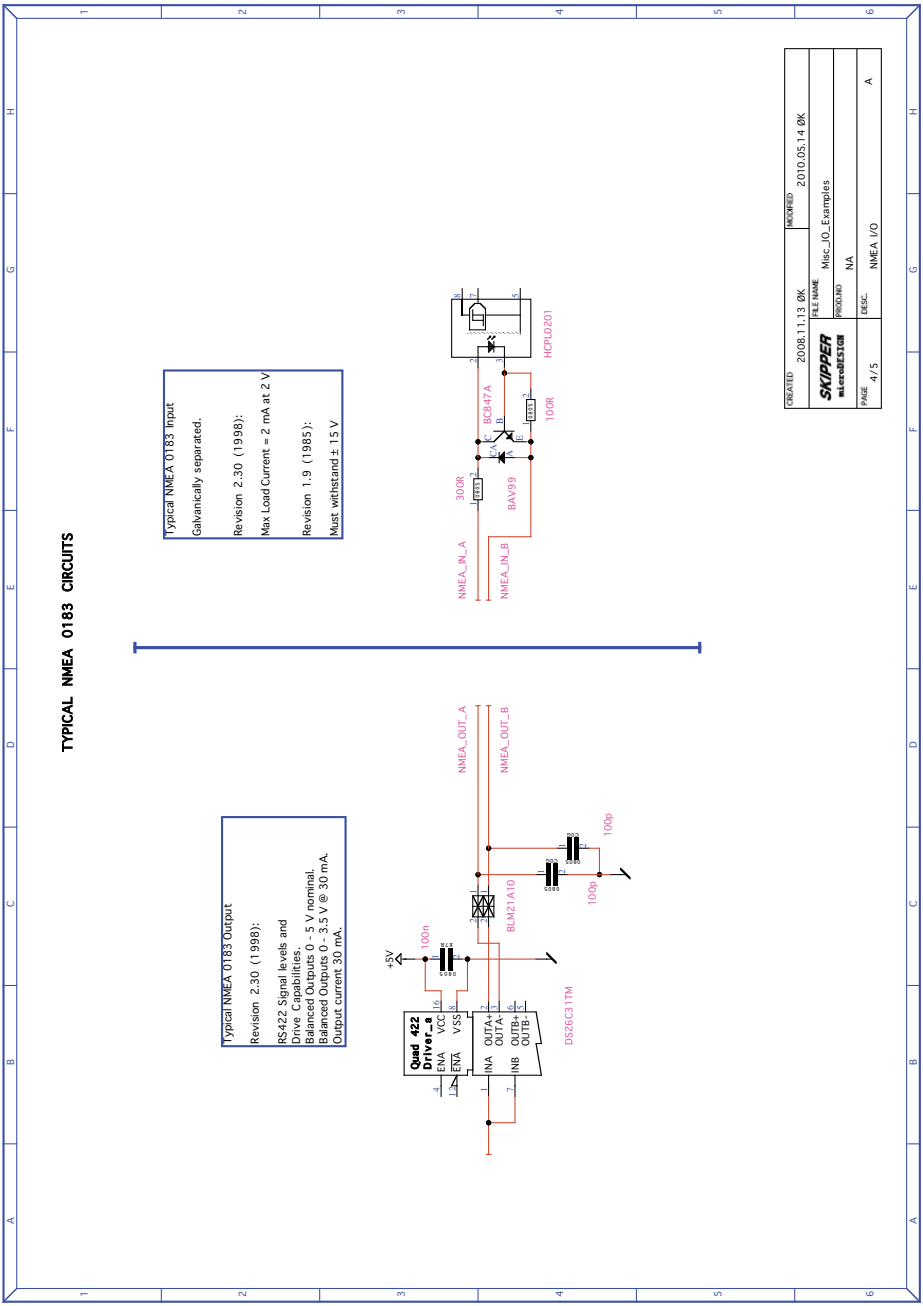
If the system is CD401EB, the NMEA signal is reversable, (the wanted speed direction can be switched by connecting the DIMUP-input to VCC and connect a switch between the DIMCOM-input and Ground). The screen will show the same direction but NMEA VBW will change polarity. The NMEA output sentence VMXDR is used to indicate the speed direction for the Compact EML224 Backward system. The VMXDR NMEA output sentence is sent if the VMVBW NMEA sentence output is enabled.

Note: Only Multi repeater should be used in this mode. These read the XDR message and rotate the axis when required.

If DIMCOM is left open the VMXDR output will be (backward direction):
$VMXDR,A,180,D,SPDD*hh<CR><LF>
If DIMCOM is grounded the VMXDR output will be (forward direction):
$VMXDR,A,0,D,SPDD*hh<CR><LF>

A small arrow symbol is used in front of the STW text on the screen to indicate the configured vessel direction.


SUGGESTED INTERFACE METHODS
Alternatives
Recommended
SENSORPOWER2 INTERNAL CIRCUITS, SIMPLIFIED
All Digital Inputs 24VINPA/B_x
Input Voltage VCC 5 - 24 V
All Pulse Outputs PULSA/B_x
Optocoupler Outputs:
Max 30 V
Max 150 mA
VCC
J400
5*CO8_2
J401
6*CO85_2
PH400
HCPL0201
T400
BC847A
R401
1K0
D400a
BAV99
R400
100R
FS400
miniSMDC014
PH403
PC853XI
D403b
BAV99
RL400
FU_FTR83_GA4SZ
ALNC
ALNO
ALCOM
PULSA_1
PULSB_1
PULSA_2
PULSB_2
PULSA_3
PULSB_3
24VINPA_1
24VINPB_1
24VINPA_2+3
24VINPB_2+3
24VINPA_4
24VINPB_4
CREATED
2008.11.13 ØK
MODIFIED
2010.05.14 ØK
SKIPPER
microDESIGN
FILE NAME
Misc_IO_Examples
PROD.NO
NA
DESC.
SensorPower2
PAGE
3/5
A


TYPICAL NMEA 0183 CIRCUITS
Typical NMEA 0183 Input
Galvanically separated.
Revision 2.30 (1998):
Max Load Current = 2 mA at 2 V
Revision 1.9 (1985):
Must withstand ± 15 V
Typical NMEA 0183 Output
Revision 2.30 (1998):
RS422 Signal levels and
Drive Capabilities
Balanced Outputs 0 - 5 V nominal.
Balanced Outputs 0 - 3.5 V @ 30 mA.
Output current 30 mA.
NMEA_IN_A
NMEA_IN_B
300R
BAV99
BC847A
100R
HCPL0201
NMEA_OUT_A
NMEA_OUT_B
+5V
100n
BLM21A10
100p
100p
Quad 422 Driver_a
ENA
ENA
VCC
VSS
INA
INB
OUTA+
OUTA-
OUTB+
OUTB-
DS26C31TM
CREATED 2008.11.13 ØK
MODIFIED 2010.05.14 ØK
SKIPPER
FILE NAME Misc_IO_Examples
PROD.NO NA
PAGE 4/5
DESC. NMEA I/O
A

CHAPTER 2. Setting up the Compact Display

PRINCIPLES

The EML 224 Compact display is a flexible dot matrix LED display designed to display navigation data. The display can be user programmed to show most kinds of numerical data, from NMEA messages or self generated messages. It can also be used as a primary sensor display for speed logs showing the speed values produced by the sensor, or as a simple repeater. The EML 224 Compact with its electronic unit (JB60CD) meets all the requirements of a primary device, both functionally and electrically. On its own, it meets the requirements as a repeater.

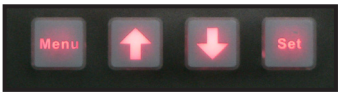
The EML 224 Compact has three user definable alphanumeric displays, each allowing up to 4 parameters to be displayed. When the device is used as a primary device, some of these screens will be fixed.

RUN SCREENS

The unit starts up in run mode. By pressing MENU button, the preset user screens can be selected. Some of the menu screens (i.e alarms) are also available in the run mode. The unit can be dimmed in any of the run screens using the up (↑) and down (↓) buttons. If Trip/Total are selected as a displayed parameter, they can be toggled using the SET button.

SETUP SCREENS

To change the setup of the EML 224 Compact, the user must simultaneously press MENU and SET. 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 to select. To move to the previous 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 diagrams ”Menu Diagram” on page 26. The menus are product dependant, only the relevant menus are accessible. However, some menus are always available.

ACTIVATING THE RUNTIME SCREENS

The system has two user definable screens. In addition, the user can make the most common setup screens available. 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 or OFF. Screens set to ON are available to be displayed by pressing the MENU button. Screens set to OFF will not be displayed.

CONFIGURING OF DATA SCREENS

The three user programmable screens can be set up using the configuration (CONFG) menu. This submenu allows the user to select one of the three displays. On entering the CONFG 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. The screen layout will depend on the selected data type. Up to 4 lines of text and data can be displayed on each screen. 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.

Note: The EML 224 Compact needs one screen which indicates just the primary data. This screen is fixed and cannot be adjusted.

The non-active parameters will continue showing the dimmed title data, when not selected.

Example:

=

=

ConfigurationScreen Runtime Screen ConfigurationScreen Runtime Screen

SETUP OF INPUTS AND OUTPUTS

The system will allow many NMEA formats to be displayed:

VMVBW	Speed long, trans, forward water speed
VMMTW	Temperature (water)
VMVLW	Trip/Total (distance sailed)
VMVHW	Speed through water (resultant)
DIAG	Diagnostic output (all others deactivited)
VMXDR	Vessel (sensor) direction (CD401EB only)

The system will automatically update recognised formats. If the user wishes to output NMEA, the user can select the NMEA sub menu in the SETUP menu and move to the different formats using the up (↑) and down (↓) buttons. Each format can be activated/ deactivated using the SET button.

AVERAGING

Each speed log type has some filters to ensure stable and correct data. The averaging filter takes a number of measurement pulses and makes a rolling average of these values. The longer the averaging, the more stable the data, however the slower the system will respond to changes. The EML 224 Compact has a minimum value of 15 pulses, which equates to 10 seconds. If the system seems unstable at times, increasing the average time will reduce the fluctuations. However, the filtering is time based and as it increases, the response time of the system will decrease.

CHANGING THE BAUD RATE

The NMEA 0183 (IEC61162-1) standard is 4800 baud. Some vessels run with higher baud rates. 4800, 9600, 19200, 38400, 57600, 115200 baud rates can be selected in the baud page of the setup menu. This page contains two sub menus, one for the sensor and one for the NMEA port. It is recommended that the sensor is kept to 4800, as this speed is robust with longer cables. To switch between sub pages, the SET button is used. The baud rates become active as you leave the baud page.

DEMO MODE

A demo mode is available, and can be activated 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 demo 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, the EML sensor signal is ignored, and the screen will indicate the demo state with a blinking S in the upper right corner of the screen. The user can turn off the demo mode from the demo screen, by pressing down button until OFF is shown in the screen, or the demo mode will turn off automatically after 10 hours.

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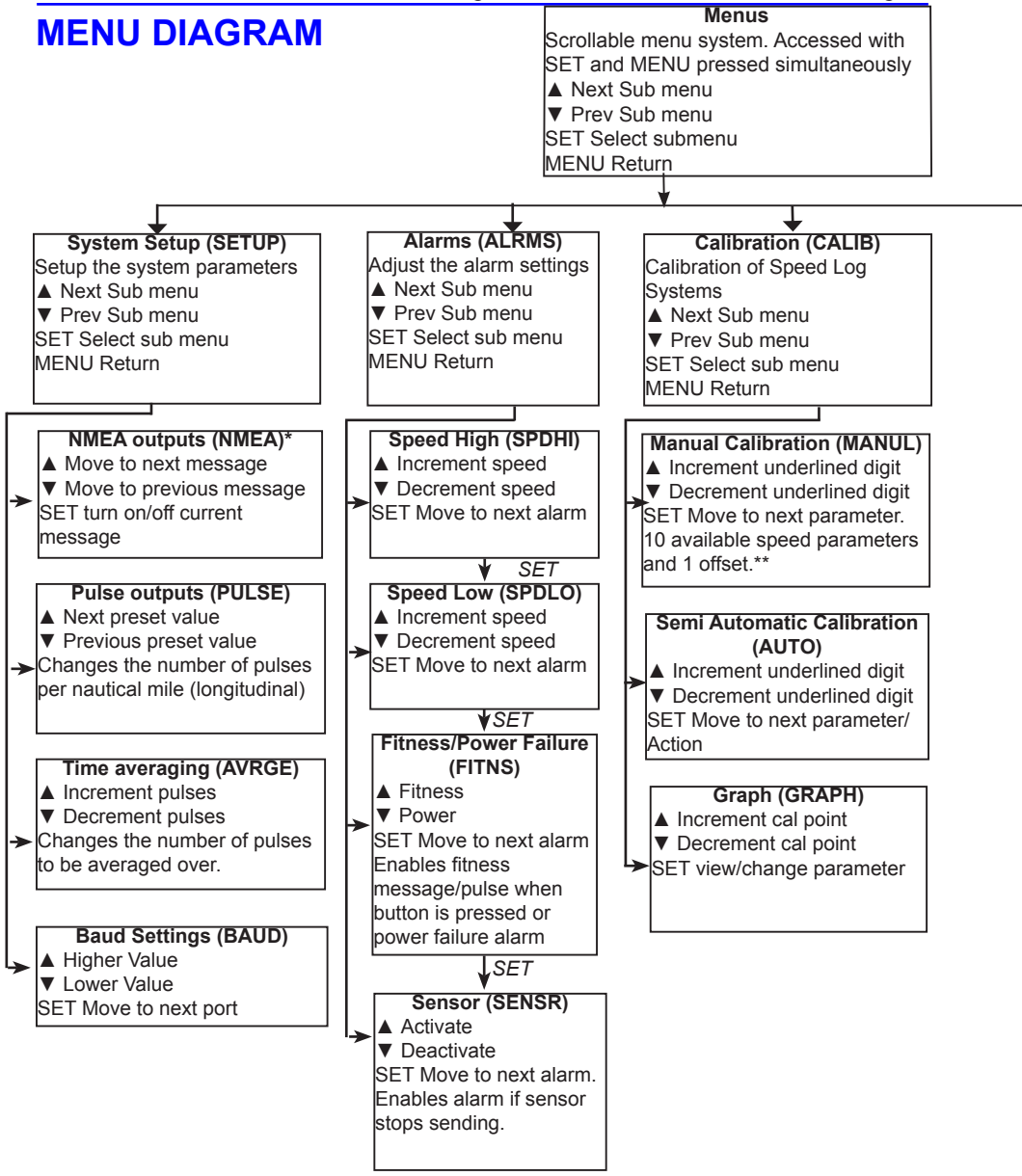
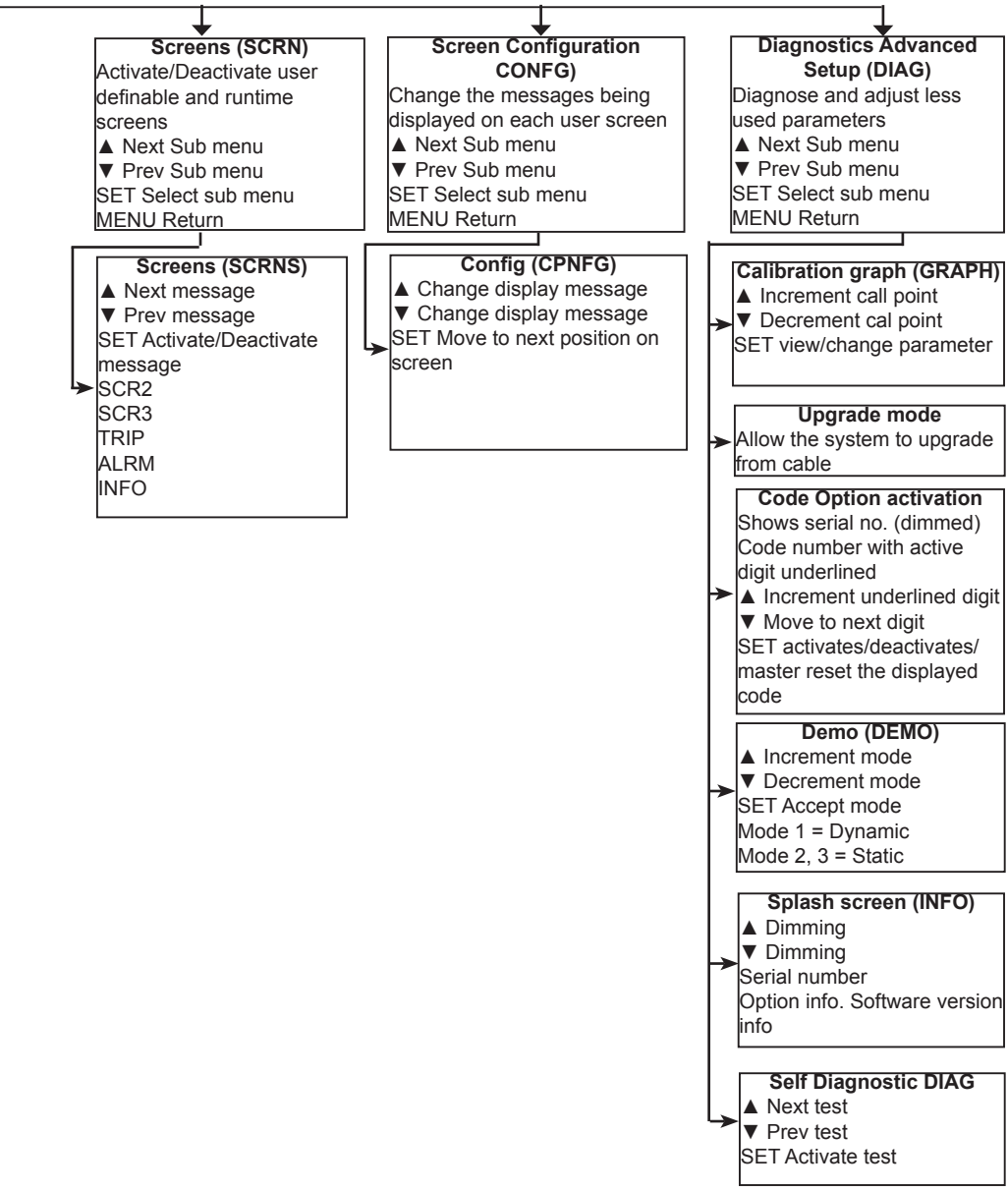
MENU DIAGRAM



* One option in the NMEA settings is DIAG. This turns on some of the diagnostics outputs. These are proprietry messages that occur if an error occurs or if requested. Setting this to 'ON' will stop all other messages.

** Offset calibration not available in single axis system.

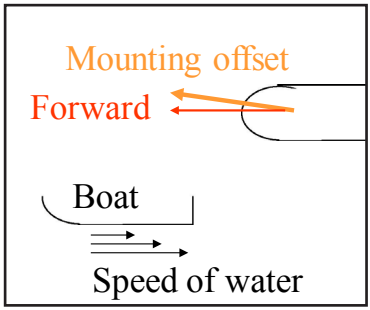

Screens (SCRN)
Activate/Deactivate user definable and runtime screens
▲ Next Sub menu
▼ Prev Sub menu
SET Select sub menu
MENU Return
Screen Configuration CONFG)
Change the messages being displayed on each user screen
▲ Next Sub menu
▼ Prev Sub menu
SET Select sub menu
MENU Return
Diagnostics Advanced Setup (DIAG)
Diagnose and adjust less used parameters
▲ Next Sub menu
▼ Prev Sub menu
SET Select sub menu
MENU Return
Screens (SCRNS)
▲ Next message
▼ Prev message
SET Activate/Deactivate message
SCR2
SCR3
TRIP
ALRM
INFO
Config (CPNFG)
▲ Change display message
▼ Change display message
SET Move to next position on screen
Calibration graph (GRAPH)
▲ Increment call point
▼ Decrement cal point
SET view/change parameter
Upgrade mode
Allow the system to upgrade from cable
Code Option activation
Shows serial no. (dimmed)
Code number with active digit underlined
▲ Increment underlined digit
▼ Move to next digit
SET activates/deactivates/ master reset the displayed code
Demo (DEMO)
▲ Increment mode
▼ Decrement mode
SET Accept mode
Mode 1 = Dynamic
Mode 2, 3 = Static
Splash screen (INFO)
▲ Dimming
▼ Dimming
Serial number
Option info. Software version info
Self Diagnostic DIAG
▲ Next test
▼ Prev test
SET Activate test

CHAPTER 3. Calibration

THE PRINCIPLES

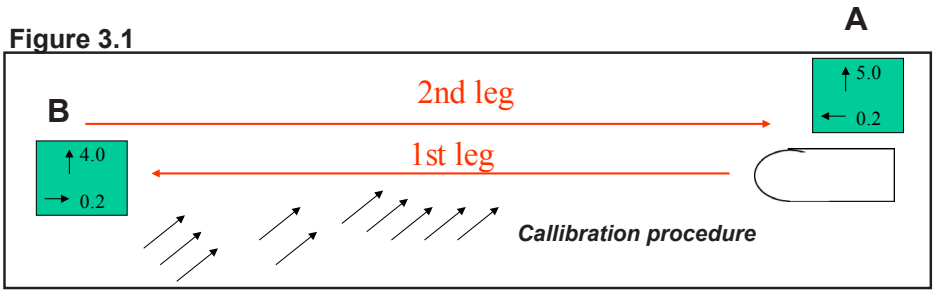
Calibration of a speed log involves finding the mounting angle of the sensor (mounting offset) and the speed error, at various speeds. If the vessel has a laminar water flow near the sensor, a single calibration point will be sufficient. If the flow changes with speed, (due to the friction of the hull, or nearby constructions) then extra calibration points will be required. The sensor is mounted on a pole that can be turned to adjust the angle. This may result in a small angular error. This can be calibrated away in the 2 axis version. This should be done before the main calibration procedure is performed.

Callibration parameters



Full calibration is designed to ignore water current effects. The procedure requires the vessel to sail a fixed length track, at a constant speed. To remove the current and wind effects, the same track should then be sailed in the opposite direction. The average of these tracks will be used to calculate the speed difference between the real speed (measured using the actual distance and the time it took), and the measured speed (using distance from the sensor and the time it took). This procedure must be performed at least once, and then other speeds checked with the GPS.

Figure 3.1



If necessary, the procedure should be repeated at different speeds. SKIPPER recommend that calibration is performed at a low speed and a high speed. If the user is not able to turn the vessel and is sure there is no current, the calibration procedure can be stopped after the first leg and saved as a calibration point. This will give values that are correct for that particular condition. (If current is present, the speed through water will contain an error).

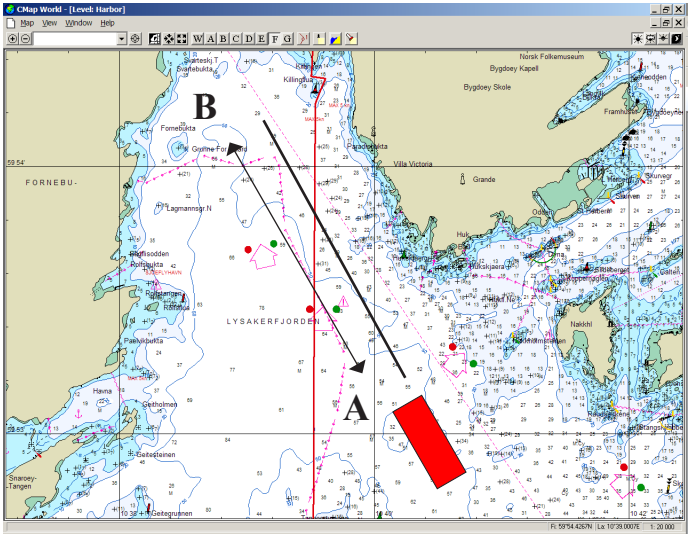


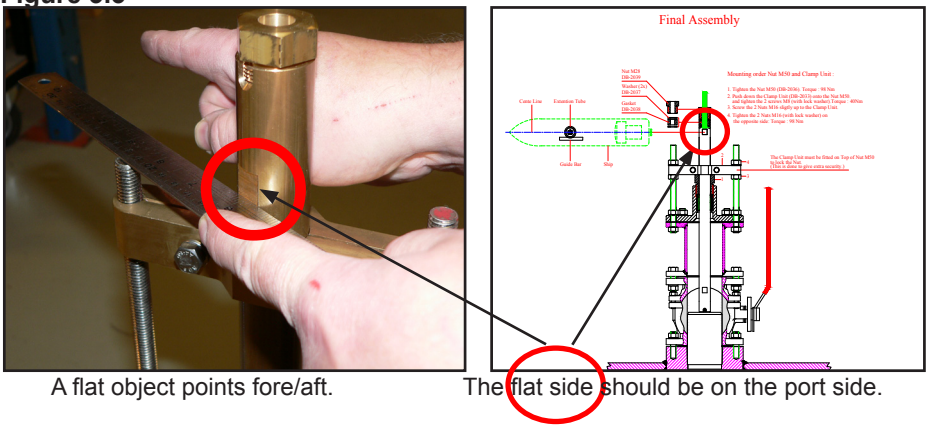
Figure 3.2 shows plotting a calibration path on the chart.

The leg should take at least 5 minutes to sail (distance can be shorter when sailing slowly).

Reducing Heading errors. New generation sea valves can be manually adjusted to ensure the sensor is correctly aligned. Alignment and heading offset are directly connected. To minimize the offset, the sensor should be mounted pointing ahead.

- **Tank mountings** have ahead marks on both the tank and the sensor insert.
- **Sea valves** have either a mark on the top flange or a flat mark on the port side of the pole which when a flat object is placed against this, will point fore/aft (Figure 3.3).

Figure 3.3



A flat object points fore/aft. The flat side should be on the port side.

CALIBRATION MODES

The EML 224 Compact has two modes of calibration:

1. Manual
2. Semi-automatic.

Manual mode

The calibration – (MANUL) menu will allow the user to adjust the heading offset (*see note below), and the speed calibrations individually. Up (↑) and down (↓) adjust the highlighted parameter. SET moves to the next parameter. The data showing the result of the change will be displayed dimmed on the same screen (offset or speed). On the 3rd press, the lower value will change from Measured or Raw resultant value (Mrs) to Calibrated resultant (Crs) to allow the user to check the result of the change.

Procedure

When entering the manual mode, you will be presented with the offset value. This is the mounting angle of the sensor. The bottom line shows the measured offset at this moment. Adjust the midlle value until the bottom value is near zero. Note the bottom value has a long average, and you may have to wait for up to a minute for the value to stabilise.

Note: This function is only available in dual axis systems. *

Hint: Pressing down (↓) and SET together will change the current selected value to the resultant value, or to zero, saving time when adjusting.

Pressing SET moves you to the next speed calibration. Enter the real (R) speed and measured (M) speed, (the measured speed can be seen on the bottom line). The calibrated value can be checked by pressing SET one more time. Repeat this process at as many different speeds as necessary.

Semi-automatic mode

The calibration – AUTO menu will take the user step by step through the calibration menu. The user may follow the steps presented on screen. First drawing a line on the chart system, as shown in figure 3.1 and 3.2.

- The line should be sailed at constant stable speed and the line should represent at least 5 minutes of sailing at the current speed.
- **Leg length setting.** Adjust the length to match the line drawn on the chart.
- **Start first leg**. The vessel crosses point A at the calibration speed, towards point B.
- **Stop first leg**. The vessel reaches point B on the chart and turns to sail the line in the other direction.
- **Save first leg**. If the presented speeds look correct, save the leg and continue.
- **Second leg option**. If you do not have the possibility to turn the vessel, you can use the first leg data directly. If the first leg data is of poor quality you may not be given the option to continue.
- **Start second leg**. The vessel crosses point B sailing towards point A, sailing at the same speed as leg 1.
- **Stop second leg**. Press as the vessel passes point B.
- **Calibration result and save option.** The user can decide to accept or reject this calibration, and in which memory position to save it.

Note: The user should press the start and stop based on position on the chart, and not sailed distance on the unit.

The user may decide which of the 10 calibration points the calibration will be saved in. The screen will display the first available position on the table, or overwrite from zero upwards.

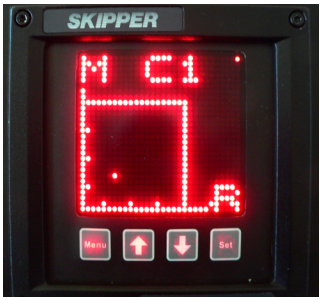
***Note:** The single axis version (CD401E1) of this product does not have the transversal axis available and will not require offset calibration. However, it is highly important that the unit is mounted pointing forward. If mounted in a valve, the pole can be rotated whilst moving the vessel against any current to maximize the longitudinal speed. This should be ahead.

CHECKING THE CALIBRATION

To check that the calibration points are not too far from the ideal linearity, the Calibration – GRAPH menu will plot the calibration points on the screen. The user may use up (↑) and down (↓) to select a calibration point and then adjust that value by pressing SET on the relevant point. The MENU button will return you to the GRAPH menu again.

Calibration should occur or be checked whenever the sensor is moved, or a new sensor is mounted. If there is growth on the sensor over time, the speed may be reduced slightly. The system should then be re-calibrated.

Note: ***If a new sensor is mounted, the calibration in the EML 224 Compact may be useable. However, it should be checked.***



CHAPTER 4. Runtime operation

RUNTIME SCREENS

The EML 224 Compact starts up in run mode. By pressing the MENU button, the preset user screens can be selected. (See diagram on page 35). Some of the menu screens (i.e alarms) are also available in the run mode.

The EML 224 Compact can be dimmed in any of the run screens using the up (↑) and down (↓) buttons.

If Trip/Total are selected as a displayed parameter, they can be toggled using the SET button.

ALARMS

The EML 224 Compact system contains one software alarm output and one reset alarm input.

- **Speed high** and **Speed low** alert the user when the vessel exceeds the speed limits.
- **Sensor alarm** is a system error alarm that activates if a serious system error occurs.
- **Fitness alarm** is a digital output, which if activated, sends a pulse each time a button is pressed on the display.
- **Power failure alarm.** If fitness alarm is deactivated, the output becomes a **power failure alarm** which indicates a power failure in the system. The output will show a high voltage at all times unless if there is a power failure.

SETUP OF ALARMS

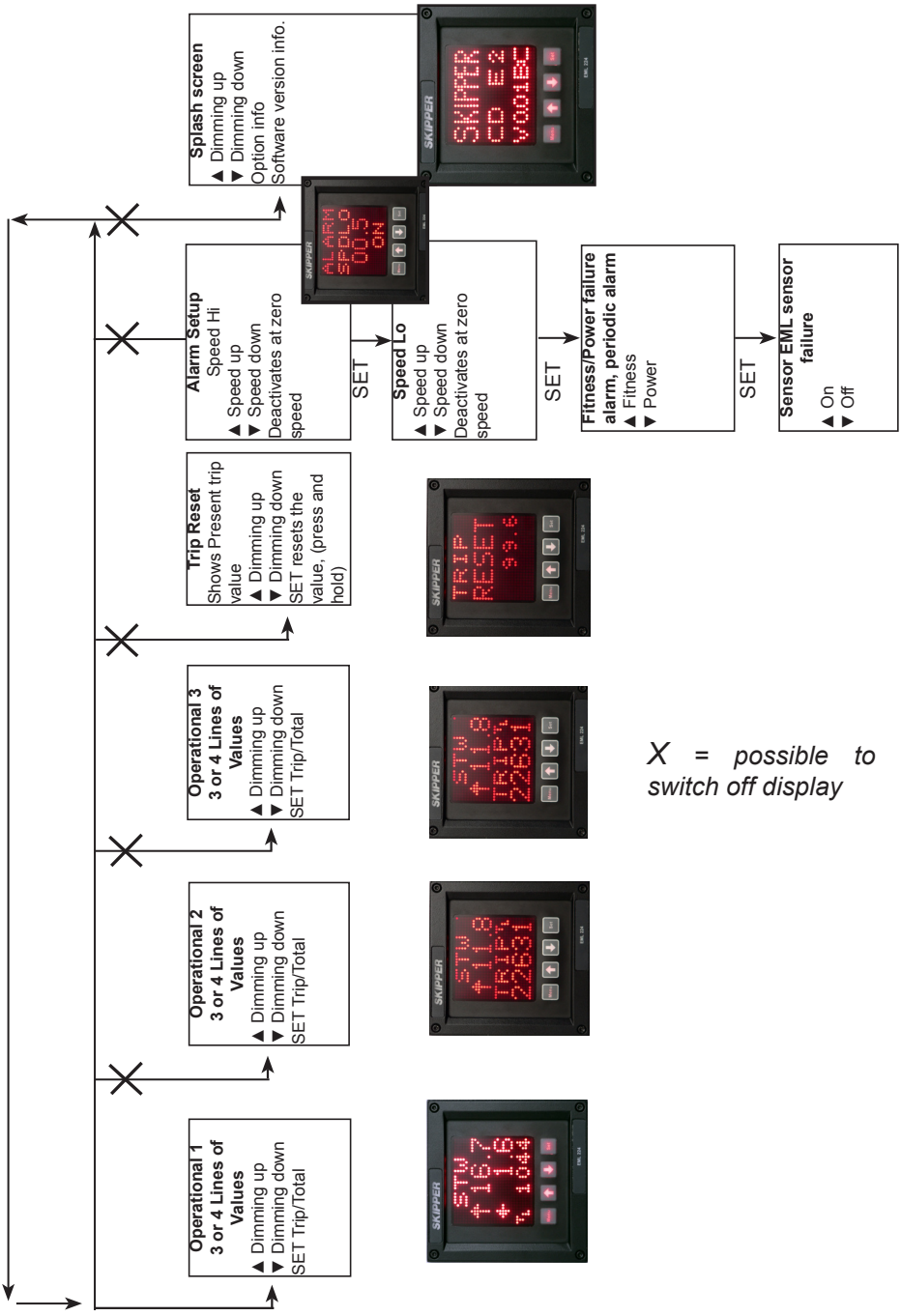
When operating as a primary source, the EML 224 Compact can be made to give an alarm in some conditions. These can be adjusted in the alarms menu page. Values are changed with up (↑) and down (↓). The different alarm types can be selected by selecting from the menu, or by pressing SET to move to the next alarm.

When an alarm is activated, the alarm type will flash on the screen, and a signal will be sent to the external alarm system. The EML 224 Compact does not contain an internal alarm beeper. If required, an external alarm beeper can be wired to the alarm relay. Alarm protocol follows the IMO (International Maritime Organization) regulations and OSV (Offshore Vessel) requirements and can be silenced remotely. To remove the alarm warning from the screen, a button must be pushed on the EML 224 Compact. According to newer regulations, the

system should keep an alarm indication at all times if the system is measuring an alarm state.

If the vessel is sailing faster than the preset high speed, the message ‘SPDHI’ will flash until the external alarm reset is set. It will then show a constant inverted text SPDHI until the alarm is acknowledged on the EML 224 Compact display. If the vessel is still sailing fast, (over the alarm limit) the EML 224 Compact display will have a large square in the top right corner. This will only disappear when the vessel sails slower than the alarm speed again.

RUNTIME DIAGRAM



CHAPTER 5. Checking out your system

If you suspect something may be wrong with your EML system, the system has possibilities to perform self diagnostics. This is available in the diagnostics DIAG menu.

SELF DIAGNOSTICS

The EML 224 Compact contains some diagnostic features to enable the user to decide which part of the system is failing. The last 20 errors are stored in the system and can be downloaded using the diagnostics port. If the error is serious, the system will cause a general alarm (if activated), and restart itself. Error numbers can be found in Appendix 4.

Test No.	What it does	What is wrong?
0	All LEDs dimming SET = on/off	Check for LEDs not working. Check normal screens for rows or LEDs sticking
1	Check internal memory.	If fail, the system is not able to communicate with the internal flash memory.
2	Send out a command to sensor and wait for response or same message back.	If fail, either the output or the input to the sensor is not working or the sensor is failing.
3	Write out 80 characters to NMEA, ask user to press if ok, or read back.	Manually check the output. If fail, try to restart.
4	Write out 80 characters to SENSOR, ask user to press if ok, or read back.	Manually check the output. If fail, try to restart.
5 - loop	Turn on alarm - wait for reset or loopback.	The user or loopback should reply to the alarm by pressing the alarm reset, (works only in test configuration).
6 - loop	Pulse out sends a pulse. If looped back to dimming up, this test will pass.	Fail implies the pulse out or dimming up is not working. Try individually, (works only in test configuration).

Test No.	What it does	What is wrong?
7 - loop	Fitness out sends a pulse, if looped to dimming down this test will pass.	Fail implies the fitness out or dimming up is not working. Try individually, (works only in test configuration).
8 - loop	Test NMEA Baud 4800, 38400, 115200 (only passes if looped to the input).	Fail implies one of the speeds is not working correctly, (works only in test configuration).
9 - loop	Test Sensor Baud 4800, 38400, 115200 (only passes if looped to the input).	Fail implies one of the speeds is not working correctly.

Tests 5 - 9 are designed to be smart by sending and recieving information at the same time. They require loopback or the user to enter the expected reply. These tests are primarily for factory use.

TEST POINTS WITHIN THE SYSTEM

In addition to the internal system testing, it is also possible to connect a PC with a COM port to the 9 pin RS-232 ”COMPACT” DSUB in the JB60CD unit box. By using hyperterminal, many additional features can be checked.

It is also possible to see what is happening within the system by observing the LEDs inside the JB60CD unit box. (See diagram on ”3) JB60CD cabling diagram” on page 48).

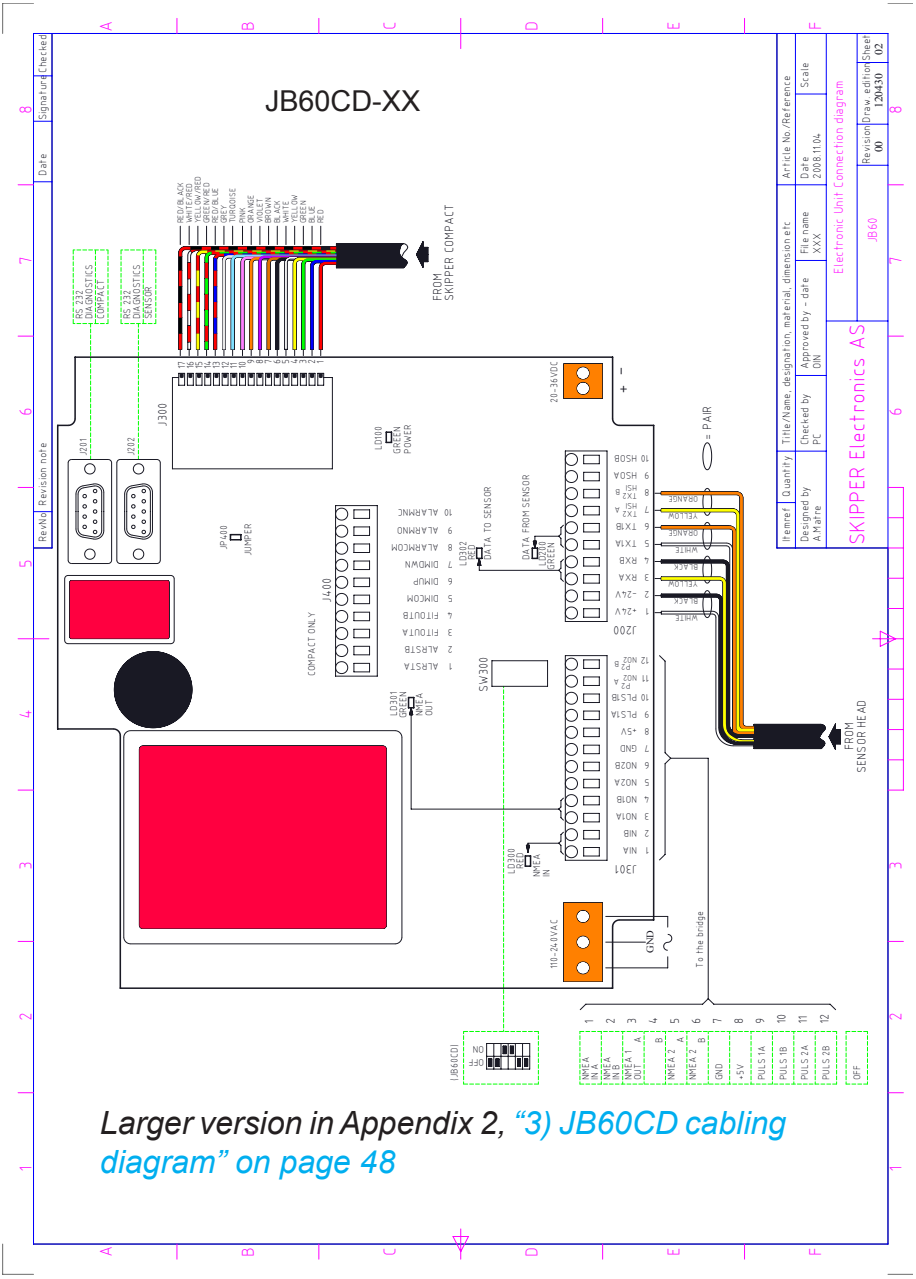
Here you can check if the sensor is operational.

LED	Colour	Description
LD 100	Green	Flickers with each measurement.
LD 200	Green	Flickers with data coming from the EML sensor.
LD 300	Red	Flashes with data arriving from the navigation systems.
LD 301	Green	Flashes with each NMEA out transmission to navigation system.
LD 302	Red	Flickers with data being sent to the sensor (not so common).

NOTE: The LEDs will work even if the NMEA inputs are connected with the wrong polarity. In the correct configuration, they are typically on and flicker off.

LOGGING DATA

No internal data logging is available, however, a diagnostics NMEA can be logged on the standard NMEA port, or on the COMPACT plug J201 in the Electronic unit (JB60CD).



Larger version in Appendix 2, "3) JB60CD cabling diagram" on page 48

CHAPTER 6. Maintenance

ROUTINE MAINTENANCE

If the sensor begins to underestimate the vessels speed, there may be growth forming on the pins. These pins are made of a resistant, anti-rust metal. If the unit is powered off, or the vessel is stationary for longer periods of time (particularly in warm water), the growth may occur. This can be carefully removed by lifting the sensor if a valve is installed, or by divers or in dock. The pins must have electrical contact with the sea water, and **MUST NOT** be painted. The system may be unstable for up to 6 hours after the pins have been cleaned while a new oxide coat forms.

CHECKING YOUR VERSION

If the info screen is activated on the run screens, the system type and software 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:

CD401 E1	EML 124 compact display 1 Axis
CD401 E2	EML 224 compact display 2 Axis
CD401 EB	EML 124/224 compact display ”Reversible” mode
CD401 LR	Log repeater compact display
CD401 MR	Multi repeater compact display
CD401 MB	Multi repeater compact display ”Backwards” mode

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).

SOFTWARE UPGRADE

The system is undergoing continuously improvement, and periodically new software will be released. These can be found at the download area of the SKIPPER website (www.skipper.no) and may be downloaded and the system upgraded using a PC connected to the ’Compact’ COM port in the Electronic unit (JB60CD). Alternatively a chip can be supplied (with an additional cost) with the new software. This is changed by removing the backplate of the display unit.

To upgrade the software, select which com port is to be used (for JB60CD Electronic unit ’Compact’ DSUB use ’COMPACT’ port, and select SENSR for upgrade). Ensure the line is clear by removing power from the EML sensor.

Press set and restart the system. The unit will wait for new firmware for two minutes. After that it will start with the existing code.

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, just press the SET button.)

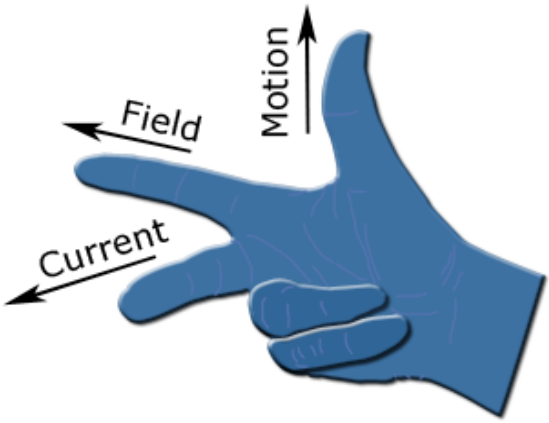
The unit will now restart with factory default settings.

Note. On EML systems, this will also **reset** the stored calibration values.

APPENDIX 1.

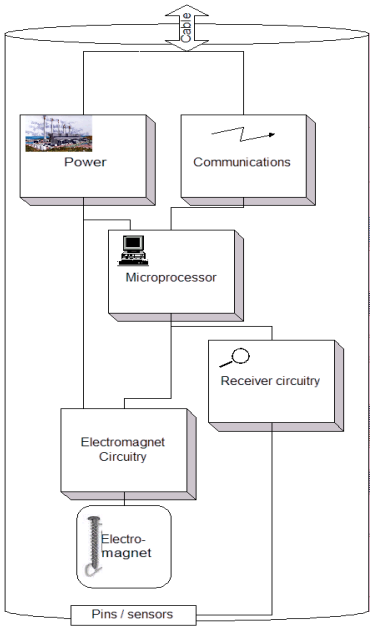
Background information

The EML 224 Compact system works using Kirchoffs right hand rule (based upon Faradays law of generators) which states that a conductor (sea water) moving through a magnetic field (generated in sensor) will produce a current orthogonal to both field and movement. So movement of the vessel through sea water with at least 5 ppt salinity will produce a current across the pins orthogonal to the ships motion.



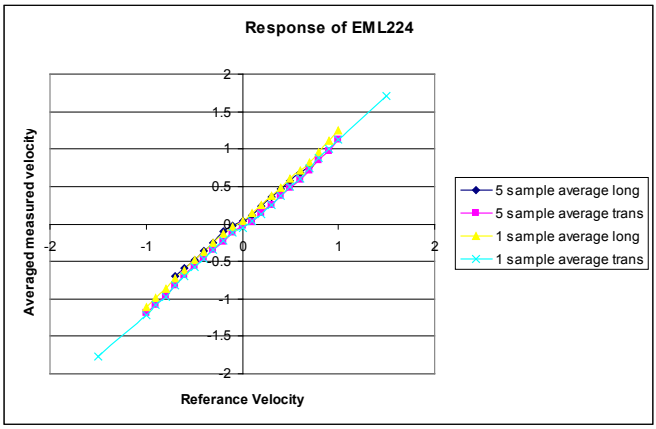
This minute current is measured and converted to a speed. This is formated into proprietry NMEA VBW format and sent to the EML 224 Compact display which applies an angular correction for both transversal and longitudinal speed, and then a scaling factor is applied for the resultant speed.

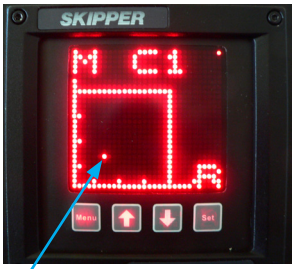
Inside the EML224 smart sensor.



Calibration is piecewise linear, i.e. a linear line is plotted from calibration point to calibration point (sorted by size) and this linearity is applied to the incoming values. This can be seen on the graph screen.

Callibration graph





Callibration point

APPENDIX 2.

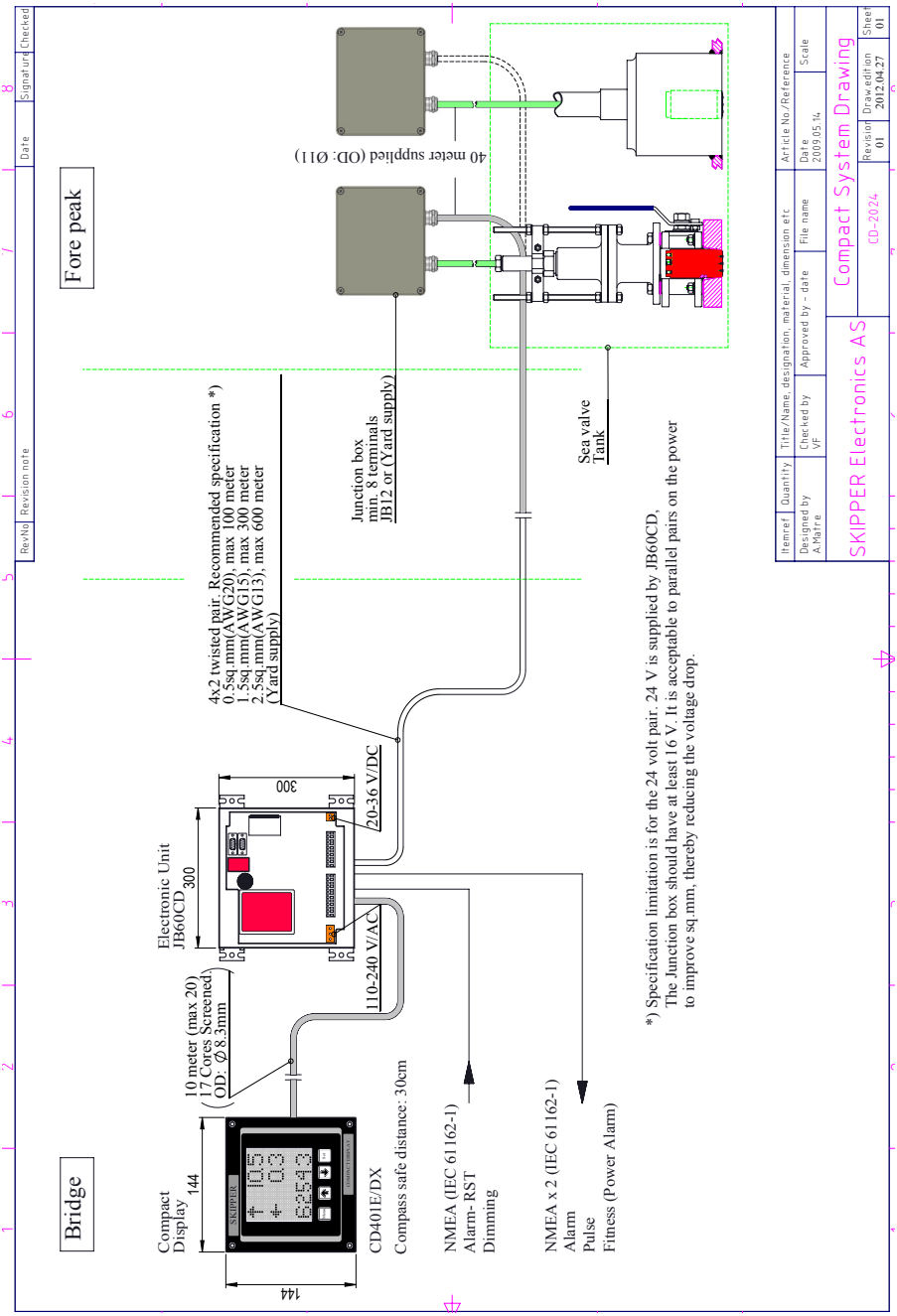
MECHANICAL DRAWINGS

To help planning and installation, the following diagrams are supplied.

1. SYSTEM OVERVIEW DIAGRAM
2. SYSTEM SPECIFICATIONS
3. JB60CD CABLING DIAGRAM
4. JB60CD MOUNTING DIAGRAM
5. EML 224 COMPACT MOUNTING DIAGRAM
6. EML 224 COMPACT CONNECTION DIAGRAM

In addition, further guides for mounting of your particular hull mounting can be found at www.skipper.no.

1) SYSTEM OVERVIEW DIAGRAM



2) SYSTEM SPECIFICATIONS

	SY-EML124C. Single axis	SY-EML224C. Dual axis
Log		
Number of axis	1	2
Speed range long (knots)	±40	±40
Speed range trans (knots)	na	±40
Water track (from) (meters)	0	0
Accuracy (better than) (knots)	0.2	0.2
Temperature accuracy (°C)	< 1	< 1

Mounting

	SY-EML124C. Single axis	SY-EML224C. Dual axis
Sea Valve		
Single bottom	Yes	Yes
Double bottom	Yes	Yes
Tank		
Steel	Yes	Yes
Aluminium	Yes	Yes

Display

	SY-EML124C. Single axis	SY-EML224C. Dual axis
Weight (display)	1.3 kg	1.3 kg
Cable length display to JB60CD	10 m	10 m
(Max)	20 m	20 m
Compass safe distance (min)	30 cm	30 cm

Alarms

Speed alarms	High and low speed limits
System alarms	System error alarm
Other alarms	Fitness (deadman) out or power failure
On screen indication of lost/ corrupt data	

User defines inputs/outputs

Outputs	2 x NMEA (IEC61162-1)
	1 x contact closure (pulse)
Inputs	1 NMEA (opto isolated)
	External dimming (pulse)

Accepted NMEA (IEC61162-1) formats

Outputs	
Speed	VBW, VHW*, XDR**
Distance	VLW
Others	MTW (temp)

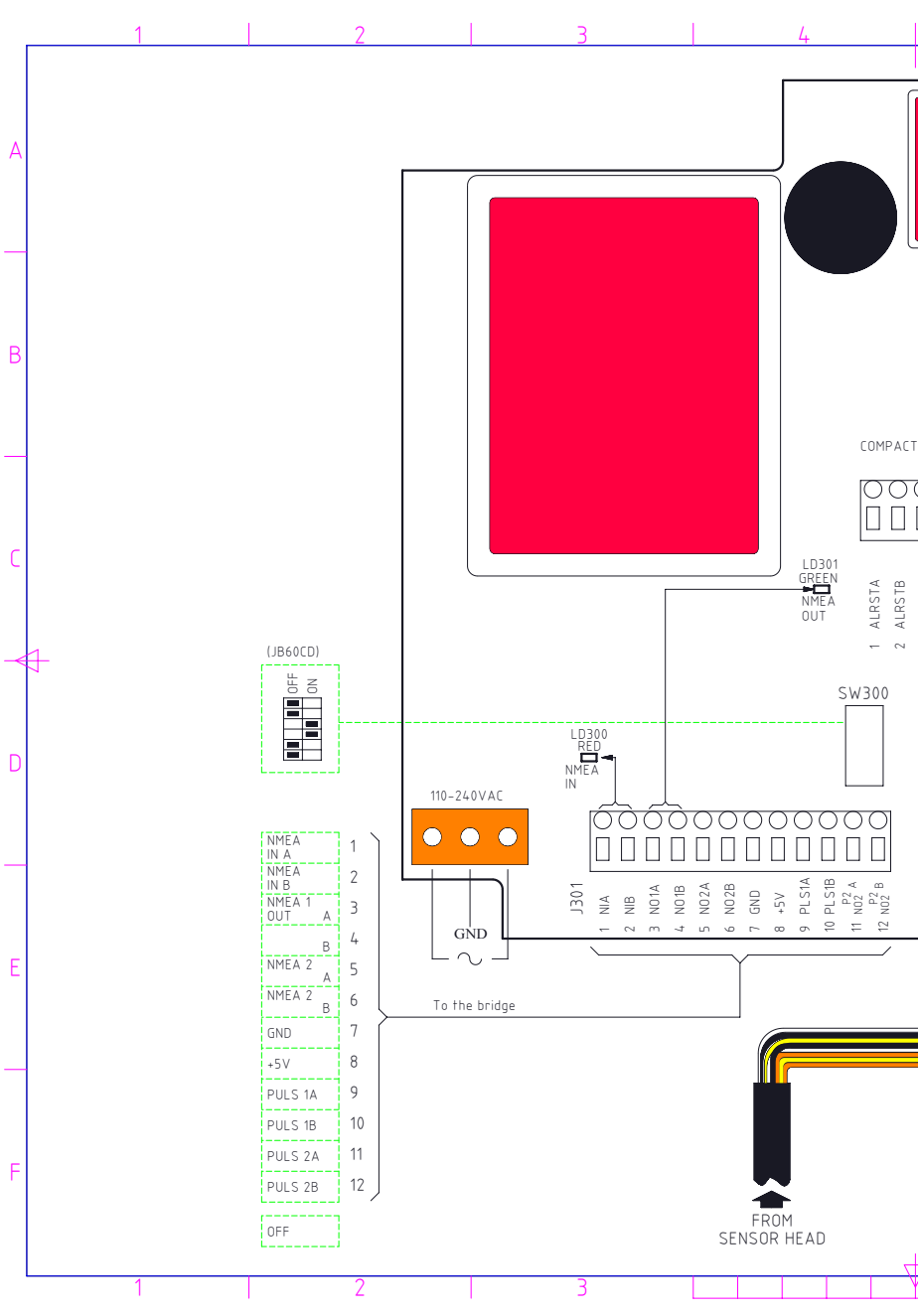
Functional informations

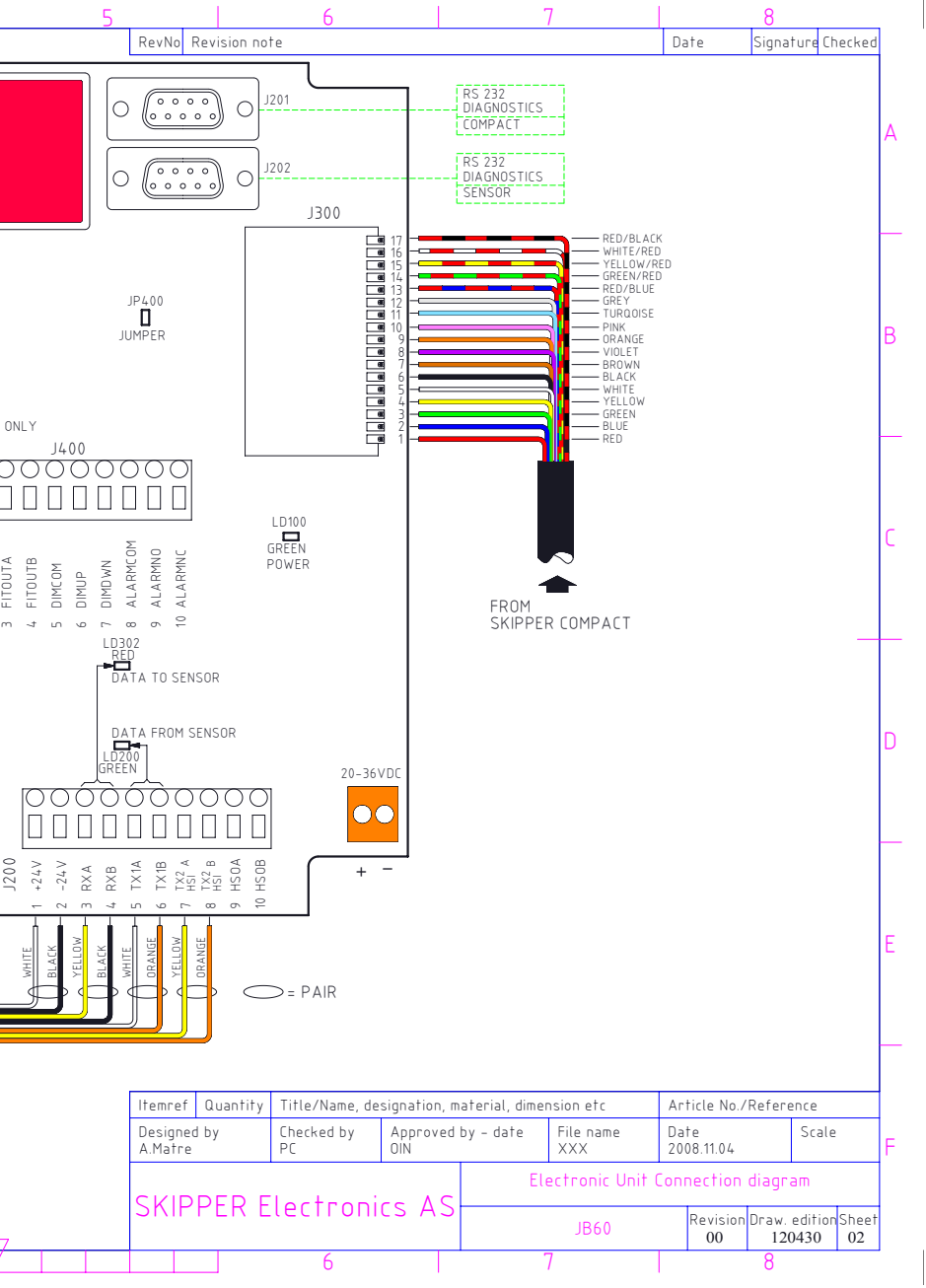
Power Supply	AC: 110 to 240 V 50/60 Hz. (Automatic detect) DC: 20-36 V
Power Consumption	Max. 35 W
Display	28 x 30 pixel alphanumeric LEDs (red) with dimming.
Languages	English.
Accessories	IR300 Speed, CD401LR, CD401MR
	Dimming control
Classification	IMO MED D, MED B,
	Also meets OSV requirements
Service	Available in most major harbours world-wide through extensive dealer network.

*The Compact EML124, has only longitudinal output and will therefore only give that information within the NMEA outputs.

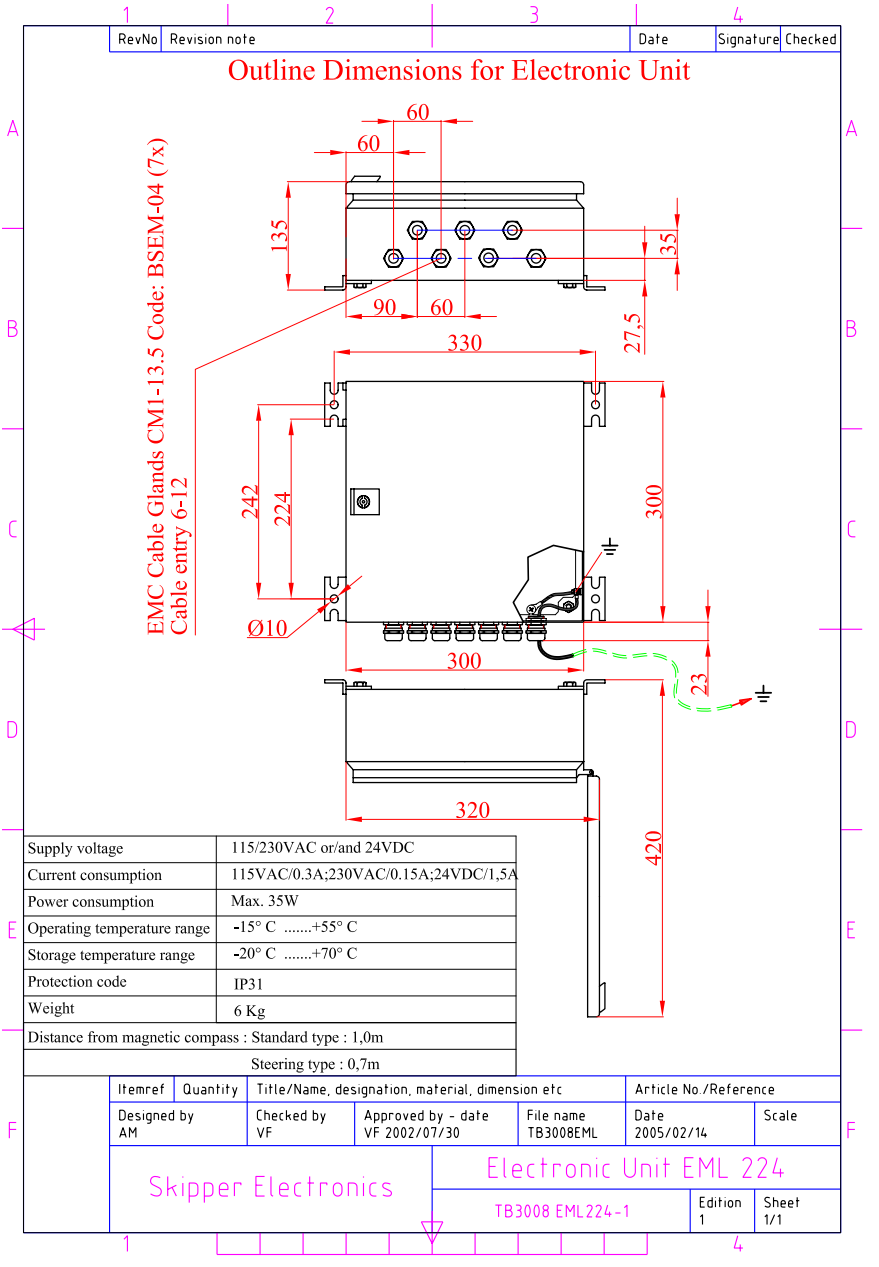
**The Compact EML224 Backwards uses a XDR sentence with an angular displacement of either 0 or 180 degrees for transducer no. 1 to indicate the direction. The transducer ID is SPDD.

3) JB60CD CABLING DIAGRAM



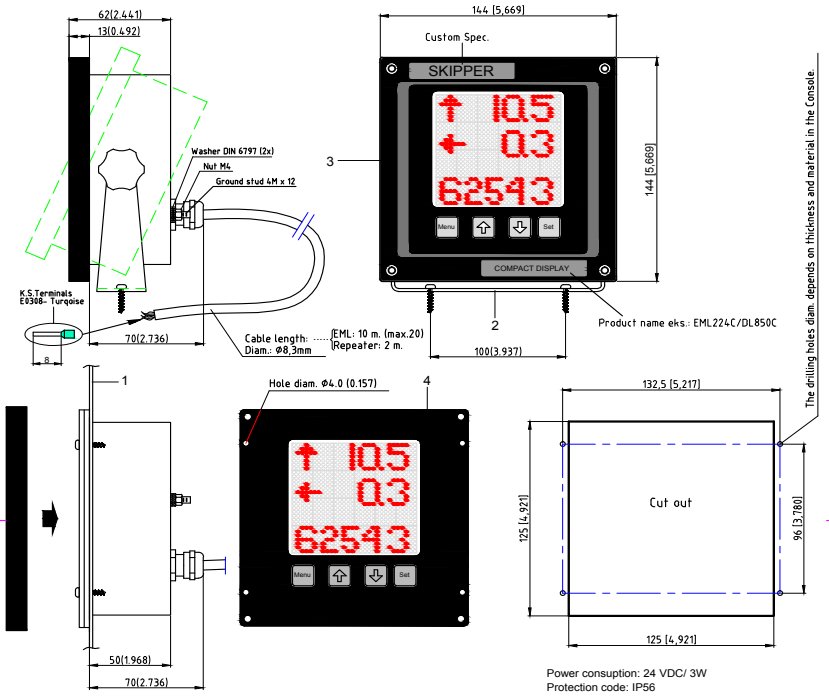

RevNo
Revision note
Date
Signature
Checked
J201
RS 232
DIAGNOSTICS
COMPACT
J202
RS 232
DIAGNOSTICS
SENSOR
J300
17 RED/BLACK
16 WHITE/RED
15 YELLOW/RED
14 GREEN/RED
13 RED/BLUE
12 GREY
11 TURQOISE
10 PINK
9 ORANGE
8 VIOLET
7 BROWN
6 BLACK
5 WHITE
4 YELLOW
3 GREEN
2 BLUE
1 RED
JP400
JUMPER
ONLY
J400
3 FITOUTA
4 FITOUTB
5 DIMCOM
6 DIMUP
7 DIMDWN
8 ALARMCOM
9 ALARMNO
10 ALARMNC
LD100
GREEN
POWER
FROM
SKIPPER COMPACT
LD302
RED
DATA TO SENSOR
DATA FROM SENSOR
LD200
GREEN
20-36VDC
+
−
J200
1 +24V
2 -24V
3 RXA
4 RXB
5 TX1A
6 TX1B
7 TX2 A
HS1 A
8 TX2 B
HS1 B
9 HSOA
10 HSOB
WHITE
BLACK
YELLOW
BLACK
WHITE
ORANGE
YELLOW
ORANGE
= PAIR
Itemref
Quantity
Title/Name, designation, material, dimension etc
Article No./Reference
Designed by
A.Matre
Checked by
PC
Approved by - date
OIN
File name
XXX
Date
2008.11.04
Scale
SKIPPER Electronics AS
Electronic Unit Connection diagram
JB60
Revision
00
Draw. edition
120430
Sheet
02

4) JB60CD MOUNTING DIAGRAM



5) EML 224 COMPACT MOUNTING DIAGRAM

RevNo	Revision note	Date	Signature	Checked



Console mounting order:

A. Make a cut out in the Console (1) 125 x 125 (4.921 x 4.921)

B. Remove the mountingbracket (2)

C. Unscrew the 4 screws in the frame (3) (one in each corner) and remove the frame.

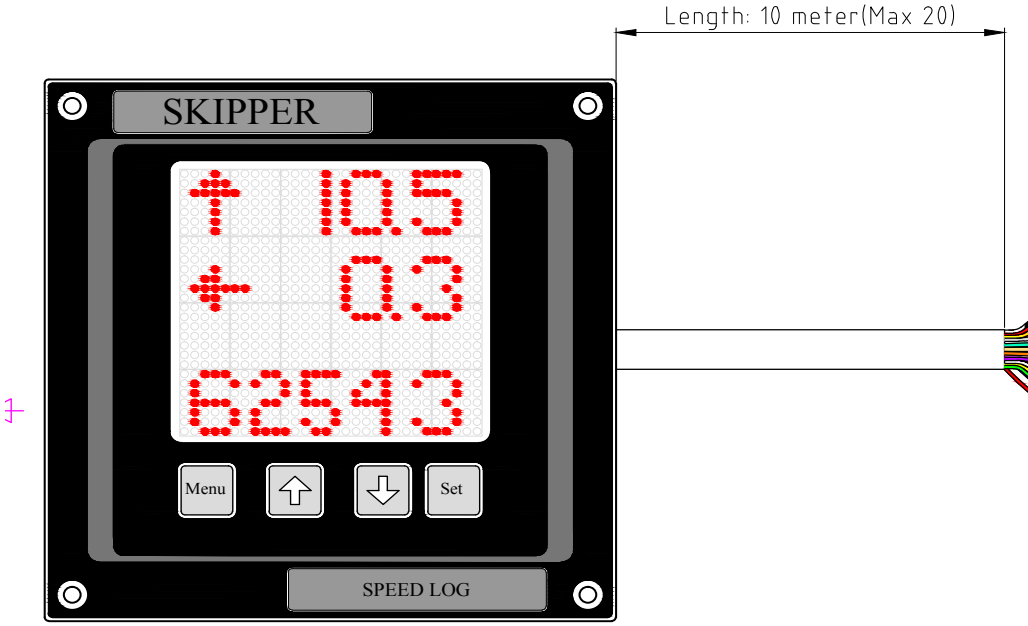
D. Put the Monitor (4) in the cut out and mark the 4 centerpoints for the Drill in the Console (1)
(The drilling holes diam. depends on thickness and material in the Console.)

E. Use Panh. screws DIN 7981 Diam. 2.9 (0.114). Length depends on the Console thickness.

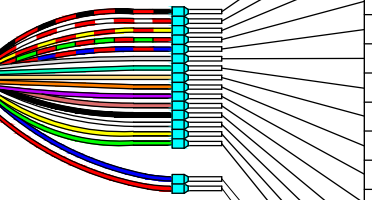
F. Finally put on the frame (3). Make sure that the screwheads correspond with the cut outs in the frame.

Itemref	Quantity	Title/Name, designation, material, dimension etc			Article No./Reference	
Designed by A.Matre		Checked by	Approved by - date	File name	Date 2008.06.12	Scale
SKIPPER Electronics AS		Compact Display				
		TB-3016			Revision 01	Draw. Edition 100324	Sheet 01

6) EML 224 COMPACT CONNECTION DIAGRAM



Pin no. correspond with J300
on PCB__JB60N2



Color Codes	Pin no.	Signals
Red/Black	17	GND
White/Red	16	HSOUT
Yellow/Red	15	HSIN
Green/Red	14	GND
Red/Blue	13	HEADOUT
Grey	12	HEADIN
Turqoise	11	ALARM
Pink	10	REMDIM
Orange	9	REMBR
Violet	8	FITOUT
Brown	7	ALRSTIN
Black	6	PULSOUT
White	5	NMOUTTL
Yellow	4	NMINTTL
Green	3	GND
Blue	2	0V
Red	1	+24V

Itemref	Quantity	Title/Name, designation, material, dimension etc			Article No./Reference	
Designed by A.Matre		Checked by XXX	Approved by - date XXX - 00/00/00	File name XXX	Date 2008.11.12	Scale
SKIPPER Electronics AS		Log Connection Diagram				
		CD401Ex			Revision 01	Draw. Edition 100908	Sheet 01

APPENDIX 3.

OUTPUT FORMATS

PULSE OUTPUTS

There is one output channel with possibility for two galvanically separated output drivers. It is possible to set number of pulses per nautical mile (p/nm) for the optocoupled outputs.

- Number of pulses per nautical mile: 10, 100, 200 or 400.

NMEA OUTPUT

EML 224 Compact Transmitted (Originated) NMEA 0183 (IEC61162-1) Messages

VBW	Multiple Speed Commands	$VMVBW,x.x,y.y,A,x.x,y.y, V,z.z,V,z.z,V*hh<CR><LF>	Where x.x is Longitudinal speed in knots, y.y is transversal speed in knots, y.y aft transversal speeds are also accepted
VLW	Distance Travelled through the Water	$VMVLW,x.x,N,y.y,N *hh<CR><LF>	x.x is Daily Trip, y.y is total trip in NM
MTW	Temperature	$VMMTW,x.x,C, *hh<CR><LF>	x.x is temperature in Celsius. All data fields are free format. Values will be presented with sign as needed (e.g “-“ = Astern, Port)
VHW	Water speed and heading, relative	$VMVHW,,,,x.x.N,x.x,K *hh<CR><lf>	Resultant speed in knots and km/h.
XDR	Speed direction	$VMXDR,A,x.x,D,SPDD *hh<CR><LF>	The angular displacement (x.x) is set to 0 in forward direction and 180 in reverse direction.

*hh = Checksum

In addition some proprietary diagnostic sentences are available. These can be obtained by turning on DIAG. (This disables all other NMEA outputs).

APPENDIX 4.

OTHER OPTIONS WITH THE COMPACT DISPLAY

EML 224 COMPACT OPTIONS

The EML 224 Compact display can be used in the following modes:

Log repeater compact	CD401LR	A simple repeater for speed in 1 or 2 axis and trip. Limited functionality.
Multi repeater compact	CD401MR	A comprehensive repeater for many of the common NMEA messages. Also functions for user defined messages.
Multi repeater backwards	CD401MB	Same as CD401MR but all speeds are in opposite direction.
Single axis EML 124 compact	CD401E1	With Electronic unit (JB60CD), sensor and cable.
Dual axis EML 224 compact	CD401E2	With Electronic unit (JB60CD), sensor and cable.
EML224 compact backwards	CD401EB	With Electronic unit (JB60CD), sensor and cables.

The software for all these options are stored in the system and the options can be changed using a security code. This code can be obtained from sales@skipper.no or 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. However, please note that the cabling is different for the repeaters and the main EML 224 Compact systems, so these are not compatible without replacing the back plate.

CHANGING THE SYSTEM/ ADDING OPTIONS

The EML 224 Compact is being developed as a low cost display alternative to full graphics displays already available. Most extra features are available for the EML 224 Compact and these can be activated using the CODE page in the setup menu. On this page, the systems unique ID is displayed. The new options can be purchased from SKIPPER. You will receive an activation code and, if necessary, a software upgrade.

Entering the code on the CODE page will activate/deactivate the option.

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

INTERFACING WITH YOUR DISPLAY

It is possible to retrieve configuration and diagnostic data from the Compact. This can be performed by conncecting to the Electronic unit (JB60CD) 'compact' port, or directly through the NMEA port. In this way, error messages can be retrieved when required.

The following messages exists:

- $PSKPVMPCGTER,x if x = 0 = Last error, other = whole table.
- $PSKPVMPCDEMO,mm,lw.ll,tw,ta,lb,tb,ab,tmp,trip,total.

where:

- mm=0, auto.
- mm=1, uses the following values: (see table).
- mm =2, turn off.

Table showing mm = 1 values	
lw	longitudinal water value <xx.xx>
tw	transversal water value <xx.xx>
ta	aft transversal water value <xx.xx>
lb	longitudinal bottom value <xx.xx>
tb	transversal bottom value <xx.xx>
ab	aft transversal bottom value <xx.xx>
tmp	temperature <xx.xx>
trip	trip distance value <xxxx>
total	total distance value <xx.xx>

It may be necessary to remove other inputs on the same line (i.e remove power from the EML sensor).

ERROR MESSAGES

Symptom: Screen shows error instead of data.
Reason: If no data is received from the sensor, the screen will show 'ERROR'.
Fix: Check the LEDs are flashing in the Electronic unit. LD 100, LD 200.

- Connect a PC to the RS-232 Diagnostics Sensor/'HEAD' connector in the electronic unit. If the system is sending $PSKP.....ERRBOR or similar, the voltage to the sensor is too low.
- Check if the Voltage on J200 p1 p2 is 23-25 V.
- Check if the voltage in junction box is >21 V, if not, twin pairs to get higher voltage. (Yellow/orange pair is not required and can be disconnected, and used to parallel the power).
- If no, or garbled data, check that the pairs are connected correctly (A/B).

If you suspect you have a problem within the CD401 unit, an error message table can be retrieved from the unit by sending the message $PSKPCPPCERROR <CR><LF> from the 'compact' connector of the JB60CD or the NMEA input on repeater. The returned format is in the form: ID, number of errors, last error, first 18 errors.

$ PSKPERRORTABLE,19,32,100,<Error18>,…,<Error1>
< Identifier >,<Number of errors(19)>,<Last Error after 18 errors(32)>,<first 18 error>,

This format shows a table of 20 numbers, where position 1 shows the number of errors stored. The errors are stored on the flash memory and will be retained. If you suspect an error, download the messages, then reset the error messages and try to perform the same error condition again. If successful, download the errors again and then check the list below. In addition, the self test values 0-4 can be used to check the main peripherals of the unit.

Error codes	Failure message	What it means	What to do
1	Can not open SPI.	The internal communications are not giving the expected response.	Restart.
100	Can not open com 0 (NMEA).	Com port is having problems initialising.	Restart. Disconnect the inputs and restart, check baudrates.
101	Com 0 NMEA failure.	The port is busy.	Restart. Disconnect the inputs and restart, check baudrates.
103	Com message too long.	Check the input strings are correct.	Restart.
150-158	Self diagnostic errors.	Self tests not working.	Run through the individual self tests and find out which part is not working.
2	Sensor com failure.	Com port is busy.	Restart. Disconnect the inputs and restart, check baudrates.
200	Can not open com 1 (sensor).	Com port is having problems initialising.	Restart. Disconnect the inputs and restart, check baudrates.
201	USART initialise failure com 1.	The port is busy, restart.	Disconnect the inputs and restart, check baudrates.
211	Can not transmit on Com 1.	Com port is having problems initialising.	
212, 252	Can not transmit on com 1.		
3	Security can not save	Problem with security settings / options.	

Error codes	Failure message	What it means	What to do
31	Security save failed.	Could not save the new security settings.	
32	Error table confirmation failed – port not replying.	Can not save the error log. Flash memory failure.	Check soldering on components on rear of the processor board in the CD401 unit.
4	Config retrieve failed.	Could not read the last config settings, defaults will be used.	Cal will be wrong.
40	SSC lost coms.	The communication between the screen/ keyboard and processor is not performing correctly.	Buttons may not work, and the screen may not update. Check activity dot. Reboot. Check cables and circuit boards in CD401 unit.
41	DMA write overflow.	Data coming too fast?	
42	Config confirmation failed.	Could not write the new config – probably flash memory problem.	Try diagnostics test nr 1. Check soldering of flash chip on rear of processor board of CD401 unit.
5	Boot retrieve failed.	Could not find the boot information – probably a memory failure.	Restart.
52	Boot config confirmation failed.		

Error codes	Failure message	What it means	What to do
6	Reply failure – no contact with EML.	The EML is not responding.	Check the connection is correct. Restart, check the options are correct.
61	Bad communication with EML sensor.	The CD401 has failed in an attempt to get a response from the EML224S sensor.	Check connections to the sensor, check the baudrates are the same.
All other messages	Some other codes exist, however will not assist in diagnostics.	If you have a problem – contact SKIPPER development (development@skipper.no)	

APPENDIX 5.

SUPPORT SOFTWARE

USING WINDOWS (TM) HYPERTERMINAL

Diagnostics can also be retrieved manually using hyperterm.

Sending commands in the diagnostics port, or along the NMEA input lines will result in an answer with the desired parameters. If other data is being sent on the line, it may be necessary to stop the other data, to allow the commands through uninterrupted.

INSTALLATION/COMMISIONING OF THE EML224 COMPACT

Boat/Build Name		Date:				Bridge Manufacturer:		
Equipment Summary:								
Display:	CD401 -	E1	E2	LR	MR	EB	MB	Serial No:
Electronic Unit	JB60 -	CD		N2		Serial No.:		
Cable type:		Length:						
Sensor:	EML224 -	Sea valve		Tank		Serial No.:		
Bottom part:	Tank	Valve				Serial No.:		
Equipment Details:								
Bottom part:	Bolts checked	Alignment correct				Sensor fully inserted		
Electronic unit:	Mounted where?			NMEA out going to?				
	PULSE connected to?			NMEA IN connected to?				
	Power connected	24 V		115 V		230 V		
Alarms	System alarm to?	NO		NC		Power Fitness alarm to?		
Display	Cable length?			NMEA Outputs		VBW	VLW	VHW MTW
Calibration Data:								
Heading offset (CD401 E2 only)								
Point ____(low speed)		Real:				Measured:		
Point ___(high speed)		Real:				Measured:		
Point_____		Real:				Measured:		
Commisioned by:				Company:				Email:

APPENDIX 6.

Sending the system for repair

In the unlikely chance that a system fails, it may be necessary to send a part of the system back for repair. Make contact with your local dealer or SKIPPER for Returns Materials Authorisation number (RMA). (A list of service centres is available on www.skipper.no)

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

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